B I D D I N G D O C U M E N T

National Competitive Bidding - NCB
(Two-Envelope Bidding Process with e-Procurement)

Construction of Onshore Facilities at 08 Locations in West Bengal under JMVP-II

BIDDING DOCUMENT

RFB: IN-IWAI-411477-CW-RFB-2-2

Issued on 16th July 2024

Employer: Inland Waterways Authority of India,
Ministry of Shipping, Government of India
A-13, Sector -1, Noida

Country: India

GOVERNMENT OF INDIA PROJECT

INVITATIONS FOR BIDS (IFB)

E-Procurement Notice

(Two-Envelope Bidding Process with e-Procurement)

NATIONAL COMPETITIVE BIDDING FOR SMALL WORKS

Date: 16.07.2024

Bid No.: IN-IWAI-411477-CW-RFB-2-2

1. The Inland Waterways Authority of India, Ministry of Ports, Shipping & Waterways, Government of India has received financing from the International Bank for Reconstruction and Development toward the cost of Capacity Augmentation of National Waterway – 1 (Jal Marg Vikas Project) and intends to apply a part of the funds to cover eligible payments under the contract for construction of works as detailed below:

"Construction of Onshore Facilities at 08 Locations in West Bengal under JMVP-II ".

Bidding is open to all bidders from eligible source countries as defined in the *IBRD Guidelines for Procurement.* **Bidders are advised to note the minimum qualification criteria specified in Clause 3 of the Instructions to Bidders to qualify for the award of the contract.** In addition, please refer to paragraphs 1.6 and 1.7 of the World Bank's Guidelines setting forth the World Bank's policy on conflict of interest.

2. The Inland Waterways Authority of India, Ministry of Ports, Shipping & Waterways, Government of India) invites online bids for the construction of works detailed below in the table. The bidders may submit bids of the works indicated therein.

Package No.	Name of work	Bid Security (Rs.)	Cost of Document (Rs.)	Period of Completion
	Construction of Onshore Facilities at 08 Locations in West Bengal under JMVP-II	14,00,000.00	Rs 5,900.00 including GST	180 days

3. Bidding documents are available online on e-procurement portal, https://eprocure.gov.in/eprocure/app from 16.07.2024 to 20.08.2024, for a non-refundable fee as indicated, in the form of cash or Demand Draft/RTGS/NEFT on any Nationalized/Scheduled bank payable at **Noida** in favour of '**IWAI Fund Jal Marg Vikas'** (Payment documents are to be submitted subsequently as per the procedure described in

paragraph 7 below). Bidders will be required to register on the website, which is free of cost. The bidders would be responsible for ensuring that any addenda available on the website is also downloaded and incorporated. Interested bidders may obtain further information at the address given below during office hours or may request clarifications online through e-procurement portal.

4. For submission of the bid, the bidder is required to have Digital Signature Certificate (DSC) from one of the Certifying Authorities authorized by Government of India for issuing DSC. Aspiring bidders who have not obtained the user ID and password for participating in e-procurement in this Project, may obtain the same from the website https://eprocure.gov.in/cppp/download/disp. A non-refundable fee of **Rs 5,900.00** (inclusive of tax) is required to be paid (to be submitted along with other documents listed in paragraph 7 below) before the bid submission deadline i.e. before 20.08.2024. The mode of payment shall be in the form of DD/RTGS/NEFT drawn in favour of '**IWAI Fund Jal Marg Vikas',** payable at **Noida**, from any Nationalized/Scheduled Bank.

5. Bids must be accompanied by a bid security of the amount specified for the work in the table below, drawn in favour of **Inland Waterways Authority of India, Ministry of Ports, Shipping & Waterways, Government of India**. Bid security will have to be in any one of the forms as specified in the bidding document and shall have to be valid for 45 days beyond the validity of the bid. Bids should be valid for 120 days after the deadline date specified for submission. Procedure for submission of bid security is described in Para 7.

6. Bids, both Technical and Financial Parts, must be submitted online on https://eprocure.gov.in/eprocure/app on or before 1500 hours on 20.08.2024 and the 'Technical Part' of the bids will be publicly opened online on the same day at 1530 hours, in the presence of the bidders who wish to attend. The "Financial Part" shall remain unopened in the e-procurement system until the second public Bid opening for the financial part. Any bid or modifications to bid (including discount) received outside e-procurement system will not be considered. Record of bid opening will be electronically shared with bidders. If the office happens to be closed on the date of opening of the bids as specified, the technical parts of bids will be opened on the next working day at the same time and venue. The electronic bidding system would not allow any late submission of bids.

7. The bidders are required to submit (a) original payment documents towards the cost of bidding document and registration on e-procurement website (if not previously registered); and (b) original bid security in approved form (c) original affidavit regarding correctness of information furnished with bid document (if any) with Vice-Chairman and Project Director, Project Management Unit, Jal Marg Vikas Project, **Inland Waterways Authority of India, A-13, Sector -1, Noida – 201 301 (UP)** before the bid submission deadline, either by registered post/speed post/courier or by hand, failing which the bids will be declared non-responsive and will not be opened.

8. The Employer shall not be held liable for any delays due to system failure beyond its control. Even though the system will attempt to notify the bidders of any bid updates, The Employer shall not be liable for any information not received by the bidder. It is the bidders' responsibility to verify the website for the latest information related to this bid.

9. An on-line pre-bid meeting will be held on 29.07.2024 at 1500 hours at the office of

Vice-Chairman and Project Director, JMVP, Project Management Unit, Jal Marg Vikas Project
Address: A–13, Sector – 1 Noida, Gautam Buddha Nagar, Uttar Pradesh, ZIP Code: 201301
Country: India
to clarify the issues and to answer questions on any matter that may be raised on the bidding document. Bidders are advised to download the bidding document prior to the pre-bid meeting in order for bidders to have a good understanding of the scope of work under this contract for discussion and clarification at the pre-bid meeting. The link of the pre-bid meeting as follows:

https://teams.microsoft.com/l/meetup-join/19%3ameeting_ZmI0NmJkMzItYmRiZS00OTA4LTgzYzYtZTc1NDQ1MTYwMjJj%40thread.v2/0?context=%7b%22Tid%22%3a%22c4d675de-e1da-4ab4-ac52-3299a6812ab9%22%2c%22Oid%22%3a%22823c1ccb-6a8f-4855-9dc6-45316b8dcd88%22%7d

10. Other details can be seen in the bidding documents.

Seal of office
Name & Designation of Officer: Vice-Chairman and Project Director, JMVP
(Official Address: Project Management Unit, Jal Marg Vikas Project, A–13, Sector – A–13, Sector – 1 Noida, Gautam Buddha Nagar, Uttar Pradesh, India- 201301
Email: vc.iwai@nic.in
Telephone: +91 120- 2424544

(Employer)

Instructions to Bidders

SECTION - A

1. Scope of Works (In brief)

The Inland Waterways Authority of India, Ministry of Ports, Shipping & Waterways, Govt of India (Employer/ Client) invites Lumpsum bids for the construction of works as detailed in the below table through central e-procurement portal (https://eprocure.gov.in/eprocure/app).

Brief Description of the Works	Approximate value of Works (Rs.)	Period of Completion
Development of land, terminal building, waiting shed, toilet blocks, parking area, utilities (MEP works, sewerage, water supply etc), landscaping, external & internal finishing works including Mural arts at the external surfaces as approved by IWAI	Rs 6,99,95,739.00	180 days

The successful bidder ("Contractor") is expected to complete the works by the intended completion timeline specified above.

2. Qualification of the bidder: The bidder shall provide qualification information which shall include: -

a) Total monetary value of construction works performed for each year of the last 3 years;

b) Report on his financial standing; and

c) Details of any litigation, current or during the last 3 years in which the bidder is involved, the parties concerned and disputed amount or awards in each case.

3. To qualify for award of the contract, the bidder: -

(a) Should have satisfactorily completed as a prime contractor at least one similar work of value not less than Rs 5.60 crores or two similar works of value not less than Rs. 3.50 Crores or three similar works of value not less than Rs. 2.80 Crores in the last seven years.

Similar works means experience in undertaking construction of buildings/ Industrial sheds/warehouses/ Portable cabins along with ancillary civil, electrical and plumbing works.

(b) should have achieved an average annual financial turnover (in civil Engineering construction works of similar nature only) of value not less than Rs 2.10 crores in the last three financial years (FY 2022-23, FY 2021-22 & FY 2020-21);

(c) Deleted

(d) Deleted

(e) should not have been debarred or suspended on the date of bid opening by the World Bank Group.

(f) No contract should have been suspended or terminated and/or performance security called by an employer(s) for reasons related to Environmental, Social (including sexual exploitation and abuse (SEA) and gender-based violence (GBV)), Health, or Safety (ESHS) requirements or safeguards in the past five years.

(g) availability of liquid assets and/or credit facilities, net of other contractual commitments and exclusive of any advance payments which may be made under the Contract, of not less than Rs 2.80 crores

3.1 Eligibility - Conflict of Interest*

Any Bidder found to have a conflict of interest shall be disqualified. A Bidder may be considered to have a conflict of interest for the purpose of this bidding process, if the Bidder:

i. directly or indirectly controls, is controlled by or is under common control with another Bidder; or

ii. receives or has received any direct or indirect subsidy from another Bidder; or

iii. has the same legal representative as another Bidder; or

iv. has a relationship with another Bidder, directly or through common third parties, that puts it in a position to influence the bid of another Bidder, or influence the decisions of the Employer regarding this bidding process; or

v. any of its affiliates has been hired (or is proposed to be hired) by the Employer or Borrower as Engineer-in-Charge for the Contract implementation.

vi. Has a close business or family relationship with the concerned professional staff of the Borrower or of the project implementing agency.

(* for further details refer to Procurement Guidelines Clauses 1.6 to 1.8)

4. Bid Price

a) The contract shall be for the whole works as described in drawings and technical specifications. Corrections, if any, can be carried out by editing the information before electronic submission on e-procurement portal.

b) All duties, taxes and other levies payable by the Contractor ("successful bidder") under the contract shall be included in the total price.

c) The rates quoted by the bidder shall be fixed for the duration of the contract and shall not be subject to adjustment on any account.

d) The Bidder shall fill in the prices for the Works in conformity with the Bidding Documents, both in figures and words.

5. Submission of Bids

5.1 The bidder is advised to visit the site of works at his own expense and obtain all information that may be necessary for preparing the bid.

5.2 Each bidder shall submit only one bid. Bidders should not contact other competing bidders in matters relating to this bid.

5.3 The set of bidding documents comprise of the following:

i. Layout Drawings of the works;
ii. Indicative Structural Details;
iii. Bill of Quantities;
iv. Technical Specifications;
v. Instructions to Bidders; and
vi. Draft Contract Agreement format which will be used for finalizing the agreement for this Contract.

5.4 The e-procurement system provides for online clarifications. Clarifications requested through any other mode shall not be considered by the Employer. Response of the Employer including a description of the inquiry, but without identifying its source, shall be uploaded on the e-procurement portal for information of all Bidders. It is the bidder's responsibility to check on the e- procurement portal, for any clarifications or amendments to the bidding documents.

5.5 The bid submitted by the bidder shall comprise two parts, namely the Technical Part and the Financial Part. These two Parts shall be submitted simultaneously.

5.5.1 The Technical Part shall contain the following: -

(a) Letter of Bid – Technical Part in the format given in Section B.

(b) Qualification information form given in Section B duly completed.

(c) Bidder's confirmation to comply with (i) the applicable Laws/ Rules/ Regulations for protection of environment, public health and safety; (ii) the regulatory authority conditions (if any) attached to any permits or approvals for the project; and (iii) the Management Strategies and Implementation Plan (MSIP) to manage the Environmental, Social (including sexual exploitation and abuse (SEA) and gender based violence (GBV)), Health and Safety

(ESHS) risks, and ESHS Code of Conduct, that will apply to its employees and all subcontractors.

(d) Bid Security, in original form for the **amount Rs 14.00 lakhs**/- in one of the following forms:

- A e-Bank Guarantee issued by a Nationalized/Scheduled bank located in India in the form given in Section B; or
- Certified cheque or Bank draft payable to Inland Waterways Authority of India, payable at Noida.
- Fixed Deposit/Time Deposit certificates/ E-Bank Guarantees issued by a Nationalized/Scheduled Bank located in India for equivalent or higher values are acceptable provided it is pledged in favour of Inland Waterways Authority of India, Noida, and such pledging has been noted and suitably endorsed by the bank issuing the deposit certificate**.**
- The details of the Bank are as under:
  Name of the Bank: Canara Bank
  Bank Account Number: 87781010014534
  Branch name & address: Morna Noida, B 16/17, Ground Floor, Sector 18, Noida 201301
  IFSC Code: CNRB0018778

5.5.2 The **Financial Part** shall contain the following: -

(a) Letter of Bid – Financial Part in the format given in Section B;

(b) Completed Bill of Quantities.

5.5.3 The Technical Part shall not include any information related to the Bid price. Where material financial information related to the Bid price is contained in the Technical Part, the Bid shall be declared non-responsive.

5.6 (a) The Letter of Bid – Technical Part, Letter of Bid – Financial Part, and all documents listed in Clause 5.5, shall be prepared using the relevant forms. The forms must be completed without any alterations to the text, and no substitutes shall be accepted. All blank spaces shall be filled in with the information requested. For this purpose, the bidders shall fill up online, the forms that are available for online filling on the e-procurement portal. The rest of the forms shall be download by the bidders and filled up.

(b) Bids, both Technical and Financial Parts, shall be simultaneously submitted online on the e-procurement system. Detailed guidelines for viewing bids and submission of online bids are given on the website. Any bidder can logon to this website and view the IFB and details of works for which bids are invited. However, the bidder is required to have enrolment/ registration in the website and should have valid Digital Signature Certificate (DSC) in the form of smart card/e-token obtained from any certifying agency authorised by the Government of India for class of DSC - **CLASS – III/II**. The bidder should register in the website using the relevant option. Then the Digital Signature registration has to be

done with the e-token, after logging into the website. The bidder can then login the website through the secured login by entering the password of the e-token & the user id/ password chosen during registration. After getting the bidding documents, the Bidder should go through them carefully and submit the specified documents along with the respective technical and financial parts of the bid, otherwise the bid will be rejected.

(c) The completed bid, both Technical and Financial Parts, comprising of documents indicated in ITB 5.5, should be uploaded on the e-procurement portal along with scanned copies of requisite certificates and scanned copies of the bid security and demand drafts for cost of bid document and registration on e-procurement website. All the documents are required to be signed digitally by the bidder. After electronic online bid submission, the system generates a unique bid identification number which is time stamped as per server time. This shall be treated as acknowledgement of bid submission.

(d) Any bid or modifications to bid (including discount) received outside e-procurement system will not be considered.

5.7 Bids, both Technical and Financial Parts, must be uploaded online no later than the time and date given in the Invitation for Bids. A bidder may modify his bid any number of times by using the appropriate option for bid modification on the e-procurement portal, before the deadline for submission of bids. No additional payment towards the cost of bid document is required for bid modifications.

5.8 The e-procurement system would not allow any late submission of bids after due date & time as per server time.

5.9 **Submission of Original Documents**: The bidders are required to submit (i) original demand drafts towards the cost of bid document and registration on e-procurement website (if not previously registered) (as per IFB); and (ii) original bid security in approved form, with the office specified in the IFB, before the bid submission deadline, either by registered/speed post/courier or by hand, failing which such bids will be declared non-responsive, and shall be rejected. Hard copy of bids or any other document are not to be submitted.

6. Validity of Bid

Bid shall remain valid for a period not less than 120 days after the deadline date specified for submission. If a Bidder withdraws/modifies/substitutes its bid during the period of bid validity specified by the Bidder on the Letter of Bid - Technical Part and repeated in the Letter of Bid - Financial Part, the Bid Security may be forfeited.

7. Online Public Opening of Technical Parts of Bids

The Technical Part of the Bids will be publicly opened online in the presence of bidders or their representatives who choose to attend on the date and time given in the Invitation for Bids, and at IWAI, Sector-1, Noida, and this could also be viewed by the bidders online. The Financial Part of the bids shall remain unopened in the e-procurement system, until the second online public opening, following the evaluation of Technical Parts of the Bids.

8. Evaluation of Bids – General provisions

8.1 Information relating to evaluation of bids and recommendations for the award of contract shall not be disclosed to bidders or any other persons not officially concerned with the process until the award to the successful bidder is announced.

9. Evaluation of Technical Parts of Bids

9.1 The Employer will evaluate the technical parts of the bids to determine to its satisfaction the Bids that are both substantially responsive to the bidding documents and meet the qualification criteria, i.e. which

(a) conform to the terms and conditions, specifications and drawings without material deviations;

(b) are properly signed; and

(c) meet the qualification criteria specified in clause 3 above.

9.2 If a Bid is not substantially responsive to the requirements of the bidding document and does not meet the qualifying criteria, it shall be rejected, and its Financial Part shall not be opened at the second public opening by the Employer.

10. Online Public Opening of Financial Parts of Bids

10.1 Following the completion of the evaluation of the Technical Parts of the Bids, the Employer shall notify in writing those Bidders whose Bids were considered non-responsive to the bidding document or failed to meet the Qualification Criteria, advising them (a) the grounds on which their Technical Part of Bid failed to meet the requirements of the bidding document; and (b) that their Financial Part of Bid shall not be opened.

10.2 The Employer shall, simultaneously, notify in writing those Bidders whose Technical Part of Bids have been evaluated as substantially responsive to the bidding document and met all Qualifying Criteria, advising them (a) that their Bid has been evaluated as substantially responsive to the bidding document and met the Qualification Criteria; and (b) that their Financial Part of Bid shall be opened at the second online public opening of the Financial Parts.

10.3 The Employer shall notify all bidders the date, time, and place of the second online public opening of the Financial Parts of the Bids. The opening date should allow Bidders sufficient time (normally not less than 7 days) to make arrangements for attending the opening. The Financial Parts of the Bids referred to in Clause 10.2 will be publicly opened online in the presence of bidders or their representatives who choose to attend, and this could also be viewed by the bidders online.

In the event of the specified date of the bid opening of financial parts being declared a holiday for the Employer, the bids will be opened at the appointed time and location on the next working day.

11. Evaluation of Financial Parts of Bids

11.1 Correction of Arithmetical Errors

Bids determined to be substantially responsive shall be checked for any arithmetic errors. Errors shall be corrected as follows:

(a) where there is a discrepancy between the amounts in figures and in words, the amount in words shall govern;

(b) where there is a discrepancy between the unit rate and the line-item total resulting frommultiplying the unit rate by the quantity, unit rate as quoted shall govern; and

(c) the amount stated in the Bid shall be adjusted in accordance with the above procedure for the correction of errors

If the Bidder does not accept the corrected amount, the Bid shall be rejected, and the Bid Security may be forfeited.

11.2 Comparison of Financial Parts

The Employer shall compare the evaluated prices of all substantially responsive bids to determine the lowest evaluated bid.

12. Award of contract

The Employer will award the contract to the bidder whose bid has been determined to be substantially responsive and who has offered the lowest evaluated bid price and who meets the specified qualification criteria.

12.1 Notwithstanding the above, the Employer reserves the right to accept or reject any bids and to cancel the bidding process and reject all bids at any time prior to the award of contract.

12.2 The bidder whose bid is accepted will be notified of the award of contract by the Employer prior to expiration of the bid validity period.

12.3 The Bid security of unsuccessful bidders will be returned as promptly as possible upon the successful Bidder's signing the contract and furnishing the performance security pursuant to ITB 13.

13. Performance Security

Within 15 days of receiving letter of acceptance, the successful bidder shall deliver to the **Inland Waterways Authority of India Ministry of Ports, Shipping & Waterways, Government of India** (Employer) the performance security (either a bank guarantee or a bank draft in favour of the Employer) for an amount equivalent of **5% of the contract price**.The Performance Security shall be valid until a date 28 days after the date of issue of the Certificate of Completion. Failure of the successful Bidder to furnish performance security and sign the agreement within the period stipulated shall constitute sufficient grounds for annulment of award and forfeiture of the Bid Security, in which case the Employer may make the award to the next lowest evaluated bidder or call for new bids.

14. Defects Liability:

The "Defects Liability Period" for the work is 12 months from the date of taking over possession or one full monsoon season whichever occurs later. During this period, the contractor will be responsible for rectifying any defects in construction free of cost to the Employer.

15. Supply of all construction materials including cement and steel as per the specifications (ISI certification marked goods wherever available) shall be the responsibility of the contractor.

16. Corrupt and Fraudulent Practices

The World Bank requires compliance with its policy in regard to corrupt and fraudulent practices as set forth in Section C. In further pursuance of this policy, Bidders shall permit and shall cause their agents (whether declared or not), sub-contractors, sub-consultants, service providers, or suppliers and any personnel thereof, to permit the Bank to inspect all accounts, records and other documents relating to any prequalification process, bid submission, and contract performance (in the case of award), and to have them audited by auditors appointed by the Bank.

SECTION - B

1. **Format for Qualification Information.**
2. **Format for Submission of Bid.**
3. **Format of Letter of Acceptance.**

Appendix to Technical Part

QUALIFICATION INFORMATION

1 For Individual Bidders

1.1 Principal place of business: _____

Power of attorney of signatory of Bid.
[Attach copy]

1.2 Total value of Civil** Engineering 20 2020-21

construction work performed in the last 20___ 2021-22_____
three years (in Rs. Lakhs) 20___ 2022-23_____

1.3 Work performed as prime contractor (in the same name) on works of a similar nature over the last seven years.

Project Name	**Name of Employer**	**Description of work**	**Contract No.**	**Value of contract (Rs. Lakhs)**	**Date of issue of work order**	**Stipulated period of completion**	**Actual date of completion**	**Remarks explaining reasons for delay and work completed**

Existing commitments and on-going works:

Description of Work **(1)**	**Place & State** **(2)**	**Contract No. & Date** **(3)**	**Value of Contract (Rs. Lakh)** **(4)**	**Stipulated period of completion** **(5)**	**Value of works* remaining to be completed (Rs. Lakhs)** **(6)**	**Anticipated date of completion** **(7)**

* Enclose a certificate from concerned officials.
** Modify as appropriate.

1.4 Proposed subcontracts and firms involved.

Sections of the works	**Value of Sub-contract**	**Sub-contractor (name & address)**	**Experience in similar work**

1.5 Evidence of access to financial resources to meet the requirement of working capital: cash in hand, lines of credit, etc. List them below and attach copies of supporting documents.

1.6 Name, address, and telephone, telex, and fax numbers of the Bidders' bankers who may provide references if contacted by the Employer.

1.7 Information on litigation history in which the Bidder is involved.

Other party(ies)	**Employer**	**Cause of dispute**	**Amount involved**	**Remarks showing present status**

1.8 Contract(s) suspended or terminated and/or Performance Security called by an employer(s) for reasons related to Environmental, Social (including sexual exploitation and abuse (SEA) and gender-based violence (GBV)), Health, or Safety (ESHS) performance during the last five years.

Contract(s) suspended or terminated by an Employer(s)			
Year	Contract Identification, Name and address of the Employer, and reasons for suspension or termination	Amount of suspended or terminated portion of contract (Rs)	Total Contract Amount (Rs)
Performance Security called by an employer(s)			
Year	Contract Identification, Name and address of the Employer, and reasons for calling of performance security		Total Contract Amount (Rs)

LETTER OF BID – Technical Part

*

Description of the Works: Construction of Onshore Facilities at 08 Locations in West Bengal under JMVP-II

Date: ……

Invitation for Bid No.: IN-IWAI-411477-CW-

RFB-2

To:

Subject : Construction of Onshore Facilities at 08 Locations in West Bengal under JMVP-II Sir,

**We, the undersigned, hereby submit our bid, in two parts, namely:

(a) the Technical Part, and

(b) the Financial Part

In submitting our Bid, we make the following declarations:

We have no reservations to the Bidding Documents, and offer to execute the Works in conformity with the Bidding Documents in accordance with the Conditions of Contract enclosed therein.

We hereby certify that we have taken steps to ensure that no person acting for us or on our behalf will engage in bribery or collusive arrangements with competitors.

We hereby confirm that this bid is valid for 120 days as required in Clause 6 of the Instructions to Bidders.

We meet the eligibility requirements and have no conflict of interest in accordance with ITB 3.1

We have not been currently debarred or suspended by the World Bank Group.

Yours faithfully,

Authorized Signature : Date: _____

Name & Title of Signatory :_____
Name of Bidder :_____
Address : _____

* To be filled in by the Employer before issue of the bidding documents.
** To be filled in by the Bidder, together with his particulars and date of submission at the bottom of this Form.

LETTER OF BID – Financial Part

Description of the Works: Construction of Onshore Facilities at 08 Locations in West Bengal under JMVP-II
Date: ……

Invitation for Bid No.: IN-IWAI-411477-CW-

RFB-2

To:

Subject: Construction of Onshore Facilities at 08 Locations in West Bengal under JMVP-II
Sir,

We, the undersigned, hereby submit the second part of our Bid and the Bid Price. This accompanies the Letter of Bid - Technical Part. In submitting our Bid, we make the following declarations:

We hereby confirm that this bid is valid for 120 days as required in Clause 6 of the Instructions to Bidders.

We have not been debarred/removed[1] from approved list (dealings suspended) by the Central or any State Government or any Government Undertaking or by the World Bank Group.

We have no reservations to the Bidding Documents, and offer to execute the Works in conformity with the Bidding Documents in accordance with the Conditions of Contract enclosed therein at a total Fixed Contract Price of –

Rs.**_____[in figures]
Rs. _____[in words].

Yours faithfully,

Authorized Signature : Date: _____

Name & Title of Signatory :_____
Name of Bidder :_____
Address : _____

* To be filled in by the Employer before issue of the bidding documents.
** To be filled in by the Bidder, together with his particulars and date of submission at the bottom of this Form.

[1] If debarred/removed, please provide further details.

LETTER OF ACCEPTANCE CUM NOTICE TO PROCEED WITH THE WORK

(LETTERHEAD OF THE EMPLOYER)

Dated: _____

To: _____ [Name and address of the Contractor]
_____
_____
_____
_____

Dear Sirs,

This is to notify you that your Bid dated_____for execution of the _____for the contract price of Rupees_____[amount in words and figures], is hereby accepted by us.

You are hereby requested to furnish performance security for an amount of Rs. _____(Equivalent to 5% of the contract price) within 15 days of the receipt of the letter. The Performance Security in the form of Bank guarantee or a Bank draft in favour of ..... (Employer) shall be valid until a date 28 days after the date of issue of the Certificate of Completion i.e. up to_____. Failure to furnish the Performance Security will entail cancellation of the award of contract.

You are also requested to sign the agreement form and proceed with the work not later than _____ under the instructions of the Engineer-in-Charge , _____and ensure its completion within the contract period.

With the issuance of this acceptance letter and your furnishing the Performance Security, contract for the above said work stands concluded.

Yours faithfully,

Authorized Signature

Name and title of Signatory

Draft Agreement form for Construction through Lump Sum Contract

ARTICLES OF AGREEMENT

1. This deed of agreement is made in the form of agreement on _____ day _____ month _____ 20 ___, between the _____ (Employer) or his authorized representative (hereinafter referred to as the first party) and_____(Name of the Contractor), S/O _____resident of_____[2](hereinafter referred to as the second party), to execute the work of construction of_____(hereinafter referred to as works) on the following terms and conditions.

2. Cost of the Contract

The total cost of the works (hereinafter referred to as the "total cost") is Rs.____ as reflected in Annexure - 1.

3.1 Payments under the contract:

Payments to the second party for the construction work will be released by the first party in the following manner: -

Sl. No	Milestone Schedule for Payment	% of Contract Price on pro-rata basis
01	Advance payment shall be released against the receipt and confirmation of Bank Guarantee as per the attached format for an amount equal to 10% of the total contract price (excluding applicable taxes) after signing of contract agreement. Note: The above advance shall be recovered at the rate of 20% of amounts from each subsequent stage payments (starting SI. No. 02) until the advance is fully recovered. The advance shall be completely recovered prior to the expiry of the original time of completion.	10%
02	Completion of land/ site development and terminal/ substructure of all 08 nos locations in West Bengal (BoQ item no I)	10%
03	Completion of External Development works: Earthwork, GSB, WMM and paver block at Goraipara Ghat, Goraipara Village side, Lalbagh court ghat, Lalbagh Ghat, Taltala Ghat, Berhampur Ghat, Narkelbari Ghat, Maganpara Ghat (08 nos) locations in West Bengal (BoQ item no II)	10%

[2] In case of a firm insert 'complete address of the firm'. In case of an individual contractor insert identification like 'son of and resident of' etc.

Sl No	Milestone Schedule for Payment	% of Contract Price on pro-rata basis
04	Completion of Terminal Building Type - I's superstructure (05 Nos) Goraipara Ghat, Goraipara Village side, Lalbagh court ghat, Lalbagh Ghat, Taltala Ghat, in West Bengal (BOQ item no III), Completion of Terminal Block Type - II's superstructure of Narkelbari Ghat, Maganpara Ghat (02 Nos) in West Bengal and (BOQ item no IV).	20%
05	Completion of Toilet Block's superstructure Goraipara Ghat, Goraipara Village side, Lalbagh court ghat, Lalbagh Ghat, Taltala Ghat, Berhampur Ghat, Narkelbari Ghat, Maganpara Ghat, (08 Nos) in West Bengal. (BOQ item No. V)	10%
06	Completion of Utilities – Mechanical, electrical, plumbing, water supply, sewerage works of Goraipara Ghat, Goraipara Village side, Lalbagh court ghat, Lalbagh Ghat, Taltala Ghat, Berhampur Ghat, Narkelbari Ghat, Maganpara Ghat (08 Nos) in West Bengal as per design and drawing (BoQ item no VII & VIII)	20%
07	Completion of external painting, finishing & mural art on walls as per designs approved by IWAI in all 08 locations of West Bengal (BoQ item no IX)	15%
08	Landscaping works in all 08 locations of West Bengal (BoQ item no VI)	05%
09	Handing over of project - all 08 locations in West Bengal	10%

3.2 Deleted.

3.3 The Employer shall retain (Retention Money) 6% of the amount from each payment due to the Contractor subject to the maximum of 5% of total contract price. Half of the amount retained shall be released upon completion of the works, and other half shall be released on completion of Defects Liability Period (DLP) and the Engineer-in-Charge has certified that all Defects notified to the Contractor before the end of this period have been corrected. On completion of the whole works the Contractor may substitute the balance 50% retention money with an "on demand" Bank guarantee.

3.4 Payments at each stage will be made by the employer as per payment milestones defined in clause no 3.1:

(a) on the second party submitting an invoice for an equivalent amount;

(b) on certification of the invoice (except for the first installment) by the Engineer-in-Charge nominated by the first party with respect to quality of works in the format in Annexure - 2; and

(c) upon proper and justified utilization of at least 50 % of the previous installment and 100 % of any prior installment.

4. Notice by Contractor to Engineer-in-Charge

The Contractor (Successful bidder)/ second party, on the works reaching each stage of construction, shall issue a notice to the Employer/ first party or the Engineer-in-Charge nominated by the first party [who is responsible for supervising the contractor, administering the contract, certifying payments due to the contractor, issuing and valuing variations to the contract, awarding extension of time etc.] to visit the site for certification of stage completion. Within 15 days of the receipt of such notice, the first party or the Engineer-in-Charge nominated by it, will ensure issue of stage completion certificate after due verification.

5. Completion time

The works should be completed in 180 days from the date of this contract Agreement. In exceptional circumstances, the time period stated in this clause may be extended in writing by mutual consent of both the parties.

6. Deleted.

7. Any willful delay on the part of the second party in completing the construction within the stipulated period will render him liable to pay liquidated damages. The liquidated damages shall be **0.5% per week** of the awarded price, which will be deducted from the payments due to the Contractor. The Employer may cancel the contract and take recourse to such other action as deemed appropriate once the total amount of liquidated damages exceeds 5% of the contract amount.

8. Duties and responsibilities of the first party

8.1 The first party shall be responsible for providing regular and frequent supervision and guidance to the second party for carrying out the works as per specifications & drawings. This will include written guidelines and regular site visit of the authorized personnel of the first party, for checking quality of material and construction to ensure that it is as per the norms.

8.2 The first party shall approve the drawings which shall be prepared & submitted by the Second party as per specifications and guidelines for the proposed works.

8.3 Possession of the site will be handed over to the second party within 10 days of signing of the agreement.

8.4 The Engineer-in-Charge or such other person as may be authorized by the first party shall hold meeting once in a month where the second party or his representative at site will submit the latest information including progress report and difficulties if any, in the execution of the work. The whole team may jointly inspect the site on a particular day to take stock of activities.

8.5 The Engineer-in-Charge shall record his observations/instructions at the time of his site visit in a site register maintained by the second party. The second party will carry out the instructions and promptly rectify any deviations pointed out by the Engineer-in-Charge. If the deviations are not rectified, within the time specified in the Engineer-in-Charge 's notice, the first party as well as the Engineer-in-Charge nominated by it, may instruct

stoppage or suspension of the construction. It shall thereupon be open to the first party or the Engineer-in-Charge to have the deviations rectified at the cost of the second party.

8.6 The Engineer-in-Charge shall issue a Certificate of Completion of the Works on the request of the second party, and upon deciding that the whole of the Works is completed.

9. Duties and responsibilities of the second party

9.1 The second party shall:

a) take up the works and arrange for its completion within the time period stipulated in clause 5; prepare the drawings;

b) employ suitable skilled persons to carry out the works;

c) regularly supervise and monitor the progress of work;

d) abide by the technical suggestions/ direction of supervisory personnel including Engineer-in-Charge etc. regarding building construction;

e) be responsible for bringing any discrepancy to the notice of the representative of the first party and seek necessary clarification;

f) ensure that the work is carried out in accordance with specifications, drawings and within the total of the contract amount without any cost escalation;

g) keep the first party informed about the progress of work;

h) correct the notified defects within the length of time specified by the Engineer-in-Charge ;

i) be responsible for all security and watch and ward arrangements at site till handing over of the works to the first party;

j) maintain necessary insurance against loss of materials/cash, etc. or workman disability compensation claims of the personnel deployed on the works as well as third party claims from the start date to the end of defect liability period;

k) pay all duties, taxes and other levies payable by construction agencies as per law under the contract (First party will effect deduction from running bills in respect of such taxes as may be imposed under the law);

l) abide by the regulatory authority conditions (if any) attached to any permits or approvals for the project; and the ESHS Management Strategies and Implementation Plan and ESHS Code of Conduct, as required.;

m) abide by all labour enactments and rules made there under, regulations, notifications and bye laws of the State or Central Government or local authorities;

n) abide by all enactments on environmental protection and rules made there under, regulations, notifications and by-laws of the Sate or Central Government, or local

authorities;

o) Be responsible for the safety of all activities on the Site.

10. Variations / Extra Items

The works shall be executed by the second party in accordance with the approved drawings and specifications. No variation in cost is acceptable. However, if the Engineer-in-Charge issues instructions for execution of extra items, the following procedure shall be followed:

a) The second party shall provide the Engineer-in-Charge with a bid/estimate for carrying out the extra items when requested to do so by the Engineer-in-Charge. The Engineer- in-Charge shall assess the bid, which shall be given within seven days of the requestbefore the extra items are ordered.

b) If the bid given by the second party is unreasonable, the Engineer-in-Charge may order the extra items and make a change to the Contract Price which shall be based on Engineer-in-Charge 's own forecast of the effects of the extra items on the Contractor's costs.

c) The second party shall not be entitled to additional payment for costs.

11. Securities

The Performance Security shall be provided to the Employer no later than the date specified in the Letter of Acceptance and shall be issued in an amount and form and by a bank acceptable to the Employer. The Performance Security shall be valid until a date 28 days from the date of issue of the Certificate of Completion in the case of a Bank Guarantee.

12. Termination

12.1 The Employer may terminate the Contract if the other party causes a fundamental breach of the Contract.

12.2 Fundamental breaches of Contract include, but shall not be limited to the following:

(a) the contractor stops work for 28 days and the stoppage has not been authorized by the Engineer-in-Charge;

(b) the Contractor has become bankrupt or goes into liquidation other than for a reconstruction or amalgamation;

(c) the Engineer-in-Charge gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Engineer-in-Charge;

(d) the Contractor does not maintain a security which is required;

(e) the Contractor has engaged in corrupt, fraudulent, collusive, coercive or obstructive practices, in competing for or in executing the Contract; and

(f) the contractor has delayed the completion of the Works by the number of days for which the maximum amount of liquidated damages can be paid

12.3 Notwithstanding the above, the Employer may terminate the Contract for convenience.

12.4 If the Contract is terminated, the Contractor shall stop work immediately, make the Site safe and secure and leave the Site as soon as reasonably possible.

13. Payment upon Termination

13.1 If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Engineer-in-Charge shall issue a certificate for the value of the work done less advance payments received up to the date of the issue of the certificate, less other recoveries due in terms of the contract, less taxes due to be deducted at source as per applicable law.

13.2 If the Contract is terminated at the Employer's convenience, the Engineer-in-Charge shall issue a certificate for the value of the work done, the reasonable cost of removal of Equipment, repatriation of the Contractor's personnel employed solely on the Works, and the Contractor's costs of protecting and securing the Works and less advance payments received up to the date of the certificate, less other recoveries due in terms of the contract and less taxes due to be deducted at source as per applicable law.

14. Dispute settlement

If over the works, any dispute arises between the two parties, relating to any aspects of this Agreement, the parties shall first attempt to settle the dispute through mutual and amicable consultation.

In the event of agreement not being reached, the matter will be referred for arbitration by a Sole Arbitrator not below the level of retired Chief Engineer-in-Charge / Superintending Engineer-in-Charge , (not connected in part or whole with this Project in his service) to be appointed by the first party. The Arbitration will be conducted in accordance with the Arbitration and Conciliation Act, 1996. The decision of the Arbitrator shall be final and binding on both the parties.

15. Corrupt and Fraudulent Practices

The World Bank requires compliance with its policy in regard to corrupt and fraudulent practices as set forth in Section C. In further pursuance of this policy, the Contractor shall permit and shall cause its sub-contractors, agents, personnel, consultants, service providers, or suppliers, to permit the Bank to inspect all accounts, records and other documents relating to the submission of bids and contract performance, and to have them audited by auditors appointed by the Bank.

Appendix to Financial Part
Annexure I

BILL OF QUANTITIES

The approximate Bill of Quantities is indicated below to give an idea of the work which should be executed in accordance with the approved drawings and specifications to enable the bidder to furnish the lump sum price. Bidders may, however, note that no variations in the lump sum cost is acceptable (except where extra items are ordered by the Engineer-in-Charge separately). The rates quoted by the bidders should include all the factors as per site condition.

BILL OF QUANTITY					
Sl No.	**Location and Item Description**	**Unit of Measurement**	**Quantity**	**Rate**	**Total Amount**
I	**Site Development** as per Annexure-3 (Terms of Reference & Technical Specifications of the tender document)				
	West Bengal	Locations	08		
a	Goraipara Ghat				
b	Goraipara Village side				
c	Lalbagh court ghat				
d	Lalbagh Ghat				
e	Taltala Ghat				
f	Berhampur Ghat				
g	Narkelbari Ghat				
h	Maganpara Ghat				
II	**External Development Works** as per Annexure-3 (Terms of Reference & Technical Specifications of the tender document)				
	West Bengal	Locations	08		
a	Goraipara Ghat				
b	Goraipara Village side				
c	Lalbagh court ghat				
d	Lalbagh Ghat				
e	Taltala Ghat				
f	Berhampur Ghat				
g	Narkelbari Ghat				
h	Maganpara Ghat				
III	**Terminal Building Module I** as per Annexure-3 (Terms of Reference & Technical Specifications of the tender document)				
	West Bengal	Location	05		

		s			
a	Goraipara Ghat				
b	Goraipara Village side				
c	Lalbagh court ghat				
d	Lalbagh Ghat				
e	Taltala Ghat				
IV.	**Terminal Building Module II** as per Annexure-3 (Terms of Reference & Technical Specifications of the tender document)				
	West Bengal	Locations	02		
a	Narkelbari Ghat				
b	Maganpara Ghat				
V	**Toilet Block Civil Works** as per Annexure-3 (Terms ofReference & Technical Specifications of the tender document)				
	West Bengal	Location s	08		
a	Goraipara Ghat				
b	Goraipara Village side				
c	Lalbagh court ghat				
d	Lalbagh Ghat				
e	Taltala Ghat				
f	Berhampur Ghat				
g	Narkelbari Ghat				
h	Maganpara Ghat				
VI	**Landscaping** as per Annexure-3 (Terms of Reference &Technical Specifications of the tender document)				
	West Bengal	Location s	08		
a	Goraipara Ghat				
b	Goraipara Village side				
c	Lalbagh court ghat				
d	Lalbagh Ghat				
e	Taltala Ghat				
f	Berhampur Ghat				
g	Narkelbari Ghat				
h	Maganpara Ghat				

VII	**Electrical Works** as per Annexure-3 (Terms of Reference& Technical Specifications of the tender document)				
	West Bengal	Locations	08		
a	Goraipara Ghat				
b	Goraipara Village side				
c	Lalbagh court ghat				
d	Lalbagh Ghat				
e	Taltala Ghat				
f	Berhampur Ghat				
g	Narkelbari Ghat				
h	Maganpara Ghat				
VIII	**Plumbing Works** as per Annexure-3 (Terms of Reference& Technical Specifications of the tender document)	Locations	08		
	West Bengal				
a	Goraipara Ghat				
b	Goraipara Village side				
c	Lalbagh court ghat				
d	Lalbagh Ghat				
e	Taltala Ghat				
f	Berhampur Ghat				
g	Narkelbari Ghat				
h	Maganpara Ghat				
IX	**External painting, finishing & Mural arts on walls** as per Annexure-3 (Terms of Reference & TechnicalSpecifications of the tender document)				
	West Bengal	Locations	08		
a	Goraipara Ghat				
b	Goraipara Village side				
c	Lalbagh court ghat				
d	Lalbagh Ghat				
e	Taltala Ghat				
f	Berhampur Ghat				
g	Narkelbari Ghat				

h	Maganpara Ghat				

We agree to execute the works in accordance with the approved drawings and technical specifications at a total fixed contract price of Rs.....(Amount in figures) (Rs. .....amount in words).

Signature of Contractor

Annexure - 2

Format of certificate

Certified that the works up to----------level in respect of construction of ..... at ..... have been executed in accordance with the approved drawings and technical specifications.

Signature
Name & Designation
(Official address)

Place:
Date:

Office seal

Annexure-3

Terms of Reference & Technical Specifications

1. Background & Introduction

1.1 Jal Marg Vikas Project (JMVP) for capacity augmentation of navigation on national Waterway -1(NW-1) is being implemented at a cost of Rs. 5369.18 crore with the technical assistance and investment support of the World Bank. The major impact of this project are alternate mode of transport that will be environment friendly and cost effective which will contribute in bringing down the logistics cost of the country, socio economic impetus, huge employment generation and mammoth infrastructure development like multi-modal/inter-modal terminals/Ro-Ro facilities/ferry services/navigation aids etc. This project will lead to direct employment generation to approximately 46,000 and indirect employment to 84,000 which will be generated by the vessel construction industry. The states which covers this project are Uttar Pradesh, Jharkhand, Bihar and West Bengal.

1.2 Inland Waterways Authority of India (IWAI) (hereinafter referred to as "the **Employer**"/ "the Client") is a statutory body of the Ministry of Ports, Shipping & Waterways (MoPSW), Government of India (GoI). The Client was set up in 1986 and is primarily responsible for the regulation and development of inland waterways for purposes of shipping and navigation for Inland Water Transport (IWT). With five (5) National Waterways (NWs) up to 2016 and today, with the enactment of NWs Act, 2016, there are a total of one-hundred eleven (111) waterways that have been declared as NWs.

1.3 The Allahabad-Haldia/Sagar stretch (1620km) of Ganga-Bhagirathi-Hooghly river system was declared as NW-1 in the year 1986 and is a waterway of national significance passing through four (4) states of West Bengal, Jharkhand, Bihar and Uttar Pradesh. It links the gateway ports of Haldia and Kolkata to Bhagalpur, Patna, Ghazipur, Varanasi and Allahabad, their industrial hinterland, and several other industrial hubs located along the Ganga basin.

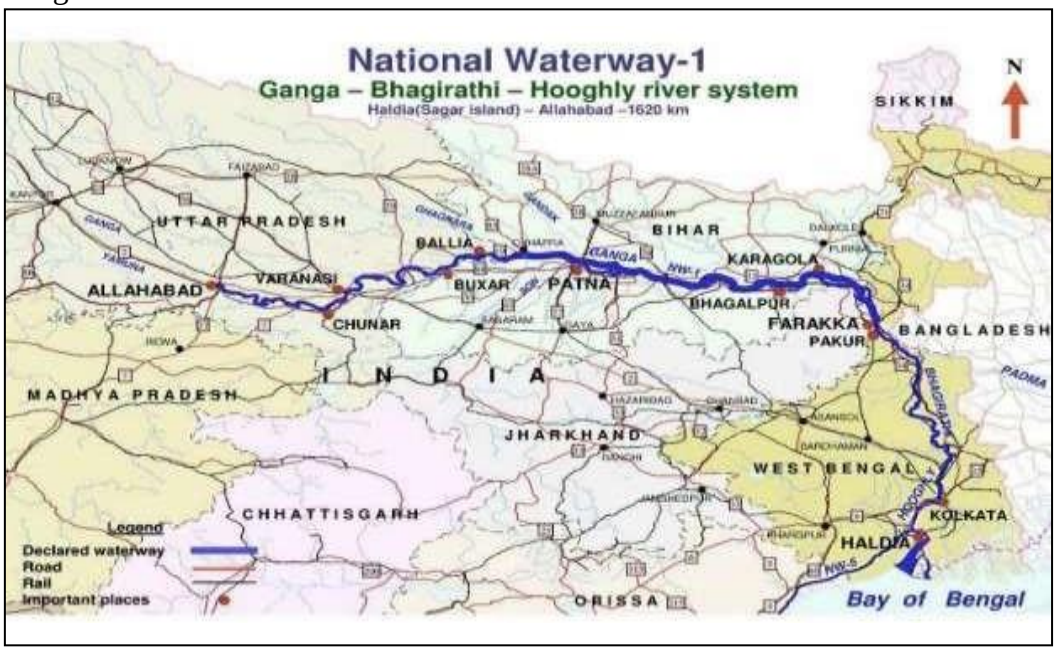


Figure 1: Index Map of NW-1

2. JMVP-II (Arth Ganga) and its alignment with JMVP's objective

2.1 India, with a huge network of rivers and interconnecting canals is ideal for an efficient inland waterways system which has multifarious advantages and is the cheapest mode of transportation. However, this potential could not be tapped to its full extent as development of inland waterways as a means for passenger & cargo transportation, had not been a focus area till recently.

2.2 In India, almost half the population lives around the Ganges river belt. In terms of trade, $1/5^{th}$ of all India's freight originates, and $1/3^{rd}$ terminates in the states around the Ganges belt. Due to the congestion faced by the cities and space constraints, there is hardly any scope for land-based development in the region. Hence, river Ganga can play a pivotal role in generating growth prospects for sustainable economic development of the regions.

2.3 The project was conceptualized with the objective of energizing economic activities in the overall ecosystem along the river Ganga that can lead to inclusive growth and play a key role in improving the livelihoods of the population.

2.4 JMVP-II (Arth Ganga) is being developed on an approach based on principles of sustainable development model that focus on economic activities in & around the hinterland of river Ganga by providing infrastructure to local communities to transport their goods / produce and passenger & tourist movements through waterways and opportunity for skill development and public / private sector capability developments to support the following.

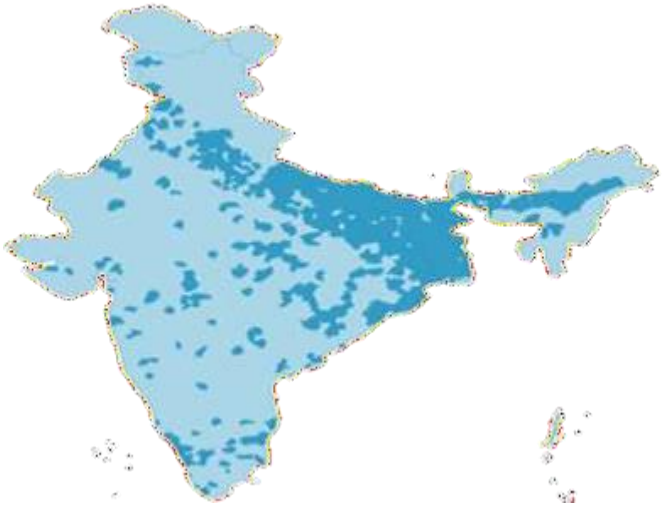


Figure 2: India's population split in half

(a) Economic benefits to the farmers, traders and public living around the Ganga belt;

(b) Growth of small-scale industries;

(c) Employment opportunities;

(d) Easy, cost-effective and environment friendly transportation of cargo; Improved logistics through small jetties; and

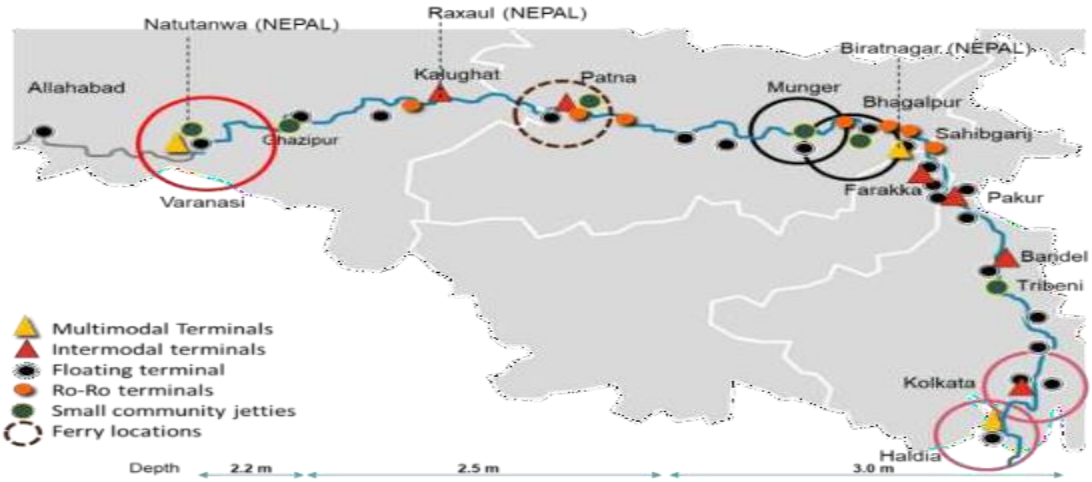
(e) Wider choice of logistics mode for cargo movement

Efficient logistics and transport systems are a critical enabler for sustaining as well as accelerating the economic growth along river Ganga. In this regard, JMVP has the potential

to greatly channelize economic activities along river Ganga, thus also aligning to the objective of JMVP-II (Arth Ganga).

2.5 The development works under JMVP-II (Arth Ganga) will be implemented as part of JMVP through the technical assistance & investment support of the Bank. The following major components have been envisaged under JMVP-II (Arth Ganga):

(i) Fairway development through dredging including bandalling and navigational aids;
(ii) River Training works;
(iii) Construction of Ro-Ro terminals;
(iv) Construction of new community jetties;
(v) Modernization / Rehabilitation of existing jetties;
(vi) Modernization / Rehabilitation of existing Navigational Lock at Farakka;
(vii) River Information System and DGPS;
(viii) Hydrographic equipment, HDP Software, Automatic Gauge Stations etc.; and
(ix) IWT Promotional activities



3. Objective of the Services

3.1 IWAI is currently desirous to undertake the establishment of Onshore terminals at various locations of West Bengal where the existing jetties area available or where IWAI is implementing new jetty (ies) facility. The fulfilment of the onshore terminal works for passengers shall include works such construction of the facilities for passengers like Terminal Building, Toilets, Mechanical, Electrical, water supply & Plumbing works, Bio digester, Walkway, Finishing works, Mural arts, External development works, etc. The locations are as follows

3.2

West Bengal – Terminal Building Locations
1. Goraipara Ghat 2. Goraipara Village side 3. Lalbagh court ghat 4. Lalbagh Ghat 5. Taltala Ghat 6. Narkelbari Ghat 7. Maganpara Ghat 8. Berhampur Ghat

4. Scope of Work

4.1 The Employer's Requirements are that the Contractor shall carryout the Design Engineering, Construction / Installation of all the items listed in this tender document as per the scope, specifications anddrawings outlined in this tender document on lumpsum basis. For this purpose, the Tenderershall conduct all necessary field tests and surveys to satisfy / verify himself regarding the correctness of the data furnished vis-à-vis actual condition. The tenderer may also carry outsuch surveys and investigations even before the submission of tender. No claim whatsoeverwill be entertained for any variation between the actual site condition met with during the execution of the work and those indicated herein.

4.2 The overall responsibility of the Contractor will encompass all the jobs required for carrying out this project from concept to commissioning, adhering to the time schedule, quality parameters and with no time and cost overrun. The Contractor will have to work in close co-ordination with Engineer-in-Charge (EIC) and its deputed team and all major decisions shall be taken in consultation with them. Further, the Contractor shall be responsible for completion of works as stipulated within time & cost parameters. The area mentioned in the BoQ is indicative which may vary as per actual site condition. The contractor shall design all components mentioned in the Scope of Work in consideration of actual area available at site & take the approval from Engineer-in-Charge (EIC). The detailed designs & drawings are to be submitted by the Contractor within 21 days from date of signing of contract.

4.3 The broad scope of work of the Contractor is as below, but not limited to this. In case any associated work is required for successful execution of the project then the same shall also be organized by him. Construction of onshore terminal works at 08 locations in West Bengal under JMVP-II is the scope work and at each locations are the following brief scope of work

a) Procurement of materials, development of land, construction for Terminal Building, Toilet Block, Security cabin and develop the area for parking, develop foot path as shown in the layout drawing etc.
b) Utilities such as water supply, drinking water facility, sewerage system etc. with a provision of electricity by way of solar panel lights (1KW) and assisting in getting the power connection from state electricity board. Main power connection will be provided by IWAI, meanwhile liaison and assisting to get the power connection has to be done bythe successful bidder
c) Construction of footpath from Terminal Building to Jetty.
d) Shall connect the water supply utilities to existing nearby source.
e) Development of land for Terminal building with amenities as shown inthe drawing etc.
f) Landscaping, external & internal finishing works including aesthetic painting at the external surfaces as approved by IWAI.
g) The major structural & MEP designs & drawings along with soil test reports are also attached with the tender documents. The successful bidder is required to execute the works as per the drawings.
h) For finishing works, the successful bidder is required to prepare various options of

external painting & Mural art works reflecting the local aesthetics of the area and obtain the approval of IWAI along with the drawing details before execution of the same.

i) Maintaining all the ESHS (Environment, Social, Health & Safety) parameters at site as per World Bank's guidelines.
j) Deploying key personnel & equipment at site for completion of the work.
k) Any other works associated as directed by IWAI related to the project.

5. General Information

5.1 Background

This call for Lumpsum bid being addressed to potential Contractors for the Construction of Onshore facilities at 08 locations in West Bengal under JMVP-II.

6. Employer's Requirements

6.1 Generals

The Employer's Requirements are that the Contractor shall carryout the Design Engineering, Construction / Installation of all the items listed below, along with associated works as outlined in this tender document. For this purpose, the Tenderer shall conduct all necessary field tests and surveys to satisfy / verify himself regarding the correctness of the data furnished vis-à-vis actual condition. No claim whatsoever will be entertained for any variation between the actual site condition met with during the execution of the work and those indicated herein as per drawing and specifications. Considering the Lumpsum contract any kind of price increase are not allowed. However, in case of any change in scope or increase of areas, the same may be considered subject to approval by IWAI with proper justification. The contractor needs to understand the actual site conditions by visiting sites before bidding & quote their rates including all factors of risks, increase in quantities (if any) etc.

The broad items of works covered are listed below:

- **Terminal Building Module (I & II)**
- **Toilet Block**
- **Paving Work (Terminal Internal Road, Vehicle Parking and Pathway)**
- **Kerb Stone**
- **Water supply system including Overhead Water Tank**
- **Mechanical, Electrical, Water supply, sewerage & Plumbing works.**
- **Finishing works (Internal & External painting, Mural art works on walls).**
- **Landscaping works**
- **Any other works required for successful completion of the project.**

6.2 Site/ Location Details

Project Sign Board shall be installed at every location with contract details, name of client and contractor.

West Bengal

SL. No.	Tentative Location	Land area, Sqm (Approximate)	Co-ordinates
01	Goraipara Ghat	293.8 Sqm	24°48'18.9"N 87°54'21.3"E
02	Goraipara Village side	293.8 Sqm	24°48'18.4"N 87°54'17.7"E
03	Lalbagh court ghat	99.80 Sqm	24°10'13.00"N 88°15'60"E
04	Lalbagh Ghat	99.80 Sqm	24°10'12.9"N 88°16'08.7"E
05	Taltala Ghat	406.80 Sqm	24°48'48.6"N 87°55'01.2"E
06	Berhampur Ghat	167.80 Sqm	24°06'58.0"N 88°14'47.7"E
07	Narkelbari Ghat	438.80 Sqm	23°50'23.3"N 88°12'57.6"E
08	Maganpara Ghat	324.80 Sqm	23°50'10.17"N 88°13'55.65"E

6.3 Site Development

i. The Contractor shall first clear the area assigned for development from any obstructions or old structures and carry out a detailed topographic survey of the whole area. Topographic survey shall be conducted before commencement of construction and site grading and shall be carried out according the design requirements. It shall be the responsibility of bidder to collect the existing details / type of structures with its foundation details and number of trees with girth size.

ii. Clearing grass and removal of the rubbish to the designated disposal area. Pumping or bailing out water and removing slush etc by using pump set including cost of labour, oil, hire charges of pump set, etc complete as required according to the site condition as directed by Engineer-in-Charge.

iii. Supply and installation of fencing with angle iron post placed at 2.4m distance embedded in cement concrete blocks, last but one end post and corner post shall be strutted on both sides and end post on one side only and provided with horizontal lines and two diagonals interwoven with horizontal wires, of barbed wire weighing 9.38 kg per 100 m (minimum), between the two posts fitted and fixed with G.I. staples, turn buckles etc. complete. Payment to be made per metre cost of total length of barbed wire used with G.I. barbed wire

iv. Supplying and fixing at site angle iron post & strut of required size including bottom to be split and bent at right angle in opposite direction for 10 cm length and drilling holes up

to 10 mm dia complete around the boundary of the terminal building/ waiting shed plot (8 locations).

6.4 External Development

i. Earthwork in excavation to the design/ desired level as per the drawing by mechanical or manual means and ramming and levelling the surface for paver works including disposalof the surplus excavated soil to designated disposal area as directed by the Engineer-in- Charge.

ii. Providing and laying of granular sub-base conforming to Grade-I (size range 75 mm to 0.075 mm) having CBR Value-30 and compacting with vibratory power roller to achieve the desired density, complete as per specifications and drawings.

iii. Providing, laying spreading and compacting graded stone aggregate (size range 53 mm to mm) to wet mix macadam (WMM)

iv. Providing and laying factory made chamfered edge Cement Concrete paver blocks over 50mm thick compacted bed of sand, compacting and proper embedding/ laying of interlocking paver blocks into the sand bedding layer through vibratory compaction by using plate vibrator, 80mm thick cement concrete paver block of M-30 grade colour design & pattern

v. Providing and laying 1:2:4 (1 cement: 2 coarse sand (zone-III) derived from natural sources: 4 graded stone aggregate 20 mm nominal size derived from natural sources) for Kerb stone

vi. Providing and laying factory made kerb stone of M-25 grade cement concrete for paver edge protection with cement mortar (Precast C.C. kerb stone shall be approved by Engineer-in-Charge).

vii. Paving Work (Terminal Internal road, Vehicle Parking and Pathway)

viii. The Contractor shall construct paved area for vehicle parking, terminal internal road and Pathway as per drawings, specifications and site survey requirements.

ix. Kerbs

x. This work comprises the construction of concrete kerbs in situ, and installation of precast concrete kerbs on foundation concrete laid on prepared subgrade, sub-base, base-course, asphalt or concrete surface. The Kerbs shall confirm to IS 5758 (1984).

6.5 Toilet Blocks

i. Providing and fixing toilet block as per the drawings and specifications including RCC foundation/ substructure, water proofing shall be provided for required RCC structures, light weight non asbestos fibre reinforced aerated cement sandwiched wall panel (75mm thick) and roofing with zincalume/ galvalume sheets of approved make and shade. Works included are foundation, basement, flooring with anti-skid ceramic tiles-300x300 mm over 100mm thick base PCC 1:4:8 and dadoing with glazed ceramic tiles using adhesives,sandwiched wall partitions, aluminium ventilators and FRP doors, roofing including truss works with tubular MS members with anticorrosive protective

coatings, MS handrail withprotective painting, Water Tank (1000 Litres) and platform, Bio digester system (50 user'scapacity), RCC Sump of 10m3 capacity. complete as per technical specifications, drawings and drawings

6.6 Landscaping

i. Providing and stacking of Hibiscus rosasinensis of height 60-75 cm. with 5-6 branches in plastic bag of size 25 cm as per direction of the Engineer-in-Charge (05 Nos).

ii. Providing and stacking of Nerium oleander (kaner) of height 60-75 cm. with 5-6 branches in poly bags of size 25 cm as per direction of the Engineer-in-Charge (05 Nos).

iii. Providing and stacking of Delonix regia (Gulmohar) of height 150-165 cm.in big poly bags of size 25 cm as per direction of the Engineer-in-Charge (05 Nos).

iv. Bush Rose in different colour 2 to 3 healthy branch 30 cm and above height.well developed with 8 or more flowers / flower buds in 20 cm Earthen pot /Plastic pot as per direction of the Engineer-in-Charge (05 Nos).

v. Providing and stacking of Acacia auriculiformis of ht 150-165 cm in bag size of 25 cm as per direction of the Engineer-in-Charge (05 Nos).

vi. Providing and stacking of Ficus benjamina (green) of height 150-165 cm, bushy with healthy branches and lush green foliage in big size HDPE bags as per direction of the Engineer-in-Charge (05 Nos).

vii. Providing and stacking of Ficus religiosa (Peepal) of height 150-165 cm. in big poly bags of size 30 cm as per direction of the Engineer-in-Charge (05 Nos).

6.7 Water supply system including Overhead Water Tank

i. The Contractor shall do construction and commissioning of the complete water supply distribution system including overhead tank and the supply of potable water to the drinking facility, the source of water supply will be State Govt. water supply of terminal area, where all necessary permissions and connections shall be procured by the successful bidder.

6.8 Electrical Work

i. Contractor shall provide all necessary fitting and electrical equipment's related to terminal and the external space allotted for each location as per the site requirements, drawings and specifications.

ii. Internal and External illumination including lighting fixtures, necessary poles, MCB boxes, accessories and hardware including associated civil works.

iii. The Contractor shall provide complete Electrical works and its fittings for all terminals as required.

iv. All Earthing and Lightning protection works.

v. Outdoor type wall mounted metering panel consist of meter, HRC fuse link with fuse base with sufficient RCCB & MCB as required, and necessary supports to be fabricated out of 16 SWG CRCA sheet with lockable door with sealing facility having glass window for energy meter, sealing facility, weather proof enclosure (IP54) and powder coated finish and as

required. The panel shall be with all accessories as per drawing specification. The Contractor while executing the Works shall follow good industry practice, which however shall meet the Tender Requirements.

Metering Board

i. Supply, installation, testing and commissioning of Outdoor type wall mounted metering board, including supply and fixing of 1ph 230V Bidirectional KWH meter and consisting of 3nos. of 20A HRC fuse link with fuse base 25A DP 30mA RCCB+MCB as required, and necessary supports to be fabricated out of 16 SWG CRCA sheet with lockable door with sealing facility having glass window for energy meter, sealing facility, weather proof enclosure(IP54) and powder coated finish and as per drawings and specifications. The panel shall be with all accessories as per drawing and specification

Cables And Cabling

Supply

i. Supply of following size 1.1 KV grade XLPE insulated, PVC sheathed, armoured aluminium /copper conductor FRLS cable conforming to IS 7098 (Part 1) amended up to date - 2C 4 sqm Cu

ii. Supplying and making end termination with brass compression gland and aluminium lugs for following size of PVC insulated and PVC sheathed / XLPE aluminium conductor cable of 1.1 KV grade as per drawings and specifications - 2C 4 sqm Cu

Laying

i. Laying and fixing of one number PVC insulated and PVC sheathed / XLPE power cable of 1.1 KV grade of following size on wall or surface as per drawings and specifications – up to 35 sq. mm (clamped with 1mm thick saddle)

ii. Laying of one number PVC insulated and PVC sheathed armoured power cable of 1.1kV grade fo the following sizes in ground including excavation ,sand cushioning , providing protective covering and refilling the trench etc. as per drawings and specifications – up to 35 sq mm.

iii. Providing, laying and fixing following dia G.I. pipe (medium class) in ground complete with G.I. fittings including trenching (75 cm deep) and re-filling as per drawings and specifications – 50mm

Wiring And Accessories

i. Wiring for light point/ fan point/ exhaust fan point/ call bell point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable in surface / recessed medium class PVC conduit, with modular switch, modular plate, suitable GI box and earthing the point with 1.5 sqm. FRLS PVC insulated copper conductor single core cable as per drawings and specifications. Group C

ii. Wiring for group controlled (looped) light point/fan point/ exhaust fan point/ call bell point

(without independent switch etc.) with 1.5 sqm FRLS PVC insulated copper conductor single core cable in surface/ recessed PVC conduit and earthing the point with 1.5 sqm FRLS PVC insulated copper conductor single core cable as per drawings and specifications. Group C

iii. Wiring for circuit/ sub main wiring along with earth wire with the following sizes of FRLS PVC insulated copper conductor, single core cable in surface/ recessed medium class PVC conduit as per drawings and specifications.

2 X 1.5 sq. mm + 1 X 1.5 sq. mm earth wire
2 X 2.5 sq. mm + 1 X 2.5 sq. mm earth wire
2 X 4 sq. mm + 1 X 4 sq. mm earth wire

i. Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 3 pin 5/6 amps modular socket outlet and 5/6 amps modular switch, connection as per drawings and specifications. (For light plugs to be used in nonresidential buildings).

ii. Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 6 pin 5/6 & 15/16 amps modular socket outlet and 15/16 amps modular switch, connection as per drawings and specifications.

iii. Supplying and fixing of following sizes of medium class PVC conduit along with accessories in surface/recess including cutting the wall and making good the same in case of recessed conduit as per drawings and specifications.

a. 20 mm
b. 25 mm

iv. Supplying and fixing following modular switch/ socket on the existing modular plate & switch box including connections but excluding modular plate etc. as per drawings and specifications. Bell push

v. Supplying and fixing call bell/ buzzer suitable for single phase, 230 volts, complete as per drawings and specifications

MCBs and MCB Distribution Boards

i. Supplying and fixing following way, single pole and neutral, sheet steel, MCB distribution board, 240 volts, on surface/ recess, complete with tinned copper bus bar, neutral bus bar, earth bar, din bar, interconnections, powder painted including earthing as per drawings and specifications. (But without MCB/RCCB/Isolator)

ii. 16 ways, Double door

iii. Supply and fixing of following rating residual current circuit breaker with MCB having earth leakage and overload protection (RCCB+MCB) as per drawings and specifications.

iv. 2 pole 25 amps. (240 Volts), 30mA sensitivity

v. Supply and fixing of following rating, 10 KA, Miniature Circuit Breakers as per drawings and specifications
6A to 32A, SP, B/C-CURVE

vi. Supplying and fixing single pole blanking plate in the existing MCB DB complete as per

drawings and specifications

vii. Supply and fixing outdoor type START/STOP (2way) push button station (IP65) including all the necessary accessories as required complete with suitable mounting arrangement. (Cat No Hensel-PBS 0201 or equivalent approved make)

viii. S & F Motor starters of the following ratings. Single phase DOL starters for 0.25HP to 3HP motor

ix. Supply, Installation, Testing & Commissioning of 25A DP MCB isolator in weatherproof enclosure complete with connections, testing and commissioning etc. as required.(Enclosure -HENSEL : KV 6103)

Light Fixtures and Fans

i. Supply of indoor decorative surface mounted LED Batten with Polycarbonate diffuser, along with driver, with a maximum system wattage of 20 Watts, lumen output of luminaire greater than 2000, power factor >0.9, rated life of L70 @ 25,000 hours, system efficacy greater than 100lumen/watt and including all the necessary accessories as per drawings and specifications. (Make: Crompton LDL-20-CDL or approved make)

ii. Supply of indoor surface mounted LED Batten with Polycarbonate Diffuser ,along with driver,with a maximum system wattage of 10 (+/-2) Watts,lumen output of luminaire greater than 1000, power factor > 0.9,rated life of L70 @ 25,000 hours, system efficacy greater than 100lumen/watt and including all the necessary accessories as required complete.(Make: Crompton LDL-10-WW or approved make)

iii. Supply of outdoor BULKHEAD luminaire made of polycarbonate housing along with driver, system wattage of 10+/-2 Watts, lumen output of luminaire greater than 700 lumens, power factor > 0.9, rated life of L70 @ 50,000 hours system efficacy greater than 70 lumen/watt, with suitable driver and including all necessary accessories as required complete. (Make: - Cat No: Crompton -LBHP -10-CDL or other approved equivalent makes)

iv. Supply installation, testing and commissioning of Solar LED Street Lighting with luminaire of IP66 protected, pressure die cast aluminium housing body with optimal heat sink, with system wattage of 60 (+/-10) W with system lumens greater than 7200 and system efficiency greater than or equal to 120%. The Light fitting shall be with all required accessories suitable for mounting in (48-60) mm OD pole arm surface mounting on 8m octagonal pole. Solar PV module shall be of 200Wp DC rating along with LiFePO4, 12V/20A capacity ,100Ah battery and suitable charge controller, cables and accessories as per drawings and specifications complete 90.15.3.7

v. Supply installation testing and commissioning of Octagonal Pole made of hot dip galvanised GI sheet 70 mm top diameter, 130 mm bottom diameter thickness 3mm base plate dimensions of 200x200x16 mm suitable for wind speed as per IS 875 Part III single arm bracket 0.5mt including connector foundation bolt 4 nos fixed in existing RCC foundation and junction box complete 8 Meters

vi. Supply of 400 mm size wall mounting oscillating type fan having three speed control, oscillation control at bottom and suitable for operation on single phase 230 volt, 50Hz AC supply complete with continuous duty motor, chrome plated front and rear guards and all accessories as per drawings and specifications complete. (Make Crompton-SDX white or equivalent approved make).

vii. Supply of 250 mm sweep, 900 rpm light duty exhaust fan in plastic body with self opening louvers working on 230 V AC supply complete with all accessories as required. (Make: Crompton Exhaust or equivalent approved make)

ITC Light Fittings and Fans

i. Installation, testing and commissioning of pre-wired, fluorescent fitting / compact fluorescent fitting of all types, complete with all accessories and tube etc. directly on ceiling/ wall, including connection with 1.5 sq. mm FRLS PVC insulated, copper conductor, single core cable and earthing as per drawings and specifications.

ii. Installation of exhaust fan in the existing opening, including making good the damage connection testing, commissioning etc. as required. Upto 450 mm sweep

iii. Numbering of ceiling fan / exhaust fan/ fluorescent fitting.

iv. Installation, testing and commissioning of Wall fan, including all the supports as per drawings and specifications and wiring using 3 runs of 1.5 sqm FR PVC insulated stranded copper conductor complete

v. Installation, testing and commissioning of pre-wired, fluorescent fitting / compact fluorescent fitting of all types, complete with all accessories and tube etc., including supplying and fixing ball and socket arrangement, 2 no. down rods of 20 mm dia X 1.6 mm thick steel conduit upto 30 cm length, painting and wiring the down rods and connection with 1.5 sq. mm FRLS PVC insulated,copper conductor, single core cable and earthing as per drawings and specifications.

Earthing and Safety Equipment

i. Earthing with C.I. earth pipe 3-meter-long, 100 mm dia including accessories, and providing masonry enclosure with heavy duty CI cover plate of having locking arrangement and watering pipe etc. with 64kg charcoal/ coke and 5kg salt as required. (As per IS 3043 amended up to date)

ii. Providing and fixing GI/Cu strip/wire on surface or in recess for connections as per drawings and specifications.
3.15mm Cu (10 SWG)
4mm GI (8 SWG)

iii. Supplying and laying G.I/Copper strip at 0.50 metre below ground as strip earth electrode, including connection/ terminating with G.I. nut, bolt, spring, washer etc. as per drawings and specifications. (Jointing shall be done by overlapping and with 2 sets of G.I. nut bolt & spring washer spaced at 50mm)
3.15mm Cu (10 SWG)
4mm GI (8 SWG)

Lightning Protection

i. Supply and fixing of 8 mm Aluminum Round Conductor as horizontal air terminal for parapet wall/terrace with the required mounting clamps, cross connectors, expansion piece and other accessories required as per IEC 62305-3

ii. Supply and fixing of 8 mm Aluminum Round Conductor as down conductor with the required mounting clamps, cross connectors, expansion piece and other accessories

required as per IEC 62305-3

iii. Providing and Fixing of Test Joint, suitable to fix 8 mm Aluminium conductor to 32 X 6 GI strip

iv. Providing and laying GI tape 32 mm X 6 mm from earth electrode directly in ground as required.

v. Supply and Fixing of following height Air terminals as per IS-IEC -62305 part-3 with 16mm rod tapered to 10 mm aluminium rod with the required accessories like Fang Fix with base, clamps, Stone, anchors etc .as required per IEC 62305-3 1Mtr Air terminal

Solar Works

i. Supply of following size 1.1 KV grade XLPE insulated, PVC sheathed, armoured Aluminium /copper conductor cable conforming to IS 7098 (Part 1) amended up to date.
2C 1.5Sqmm cu

ii. Supplying and making end termination with brass compression gland and aluminium lugs for following size of PVC insulated and PVC sheathed / XLPE aluminium conductor cable of 1.1 KV grade as required.
2C 1.5Sqmm cu

iii. Supplying and termination of UV Resistive MC4 Connectors suitable for terminating 4 Sq. mm copper cables (Male & Female Connectors). Y connector at Inverter end also shall be measured under this item. The item includes all necessary accessories tape etc as per drawings and specifications complete.

iv. Supply fabrication, erection of Mounting structures for solar panels Panel structure (Suitable for Mounting on corrugated roof sheet) 4 panel Structure with 2 nos of 4.75-meter channel, 6 mid clamp,4 End clamp and its SS Spring Nut and Fastner (Non-anodised)

v. Supply and laying of Single core 4 Sq. mm Unarmored Copper Solar cables from Modules to String Combiner / Monitoring Box/inverter. The item includes all necessary accessories clamp, ties complete as per technical specification.

vi. Supply, Installation, Testing and Commissioning of Grid Tied solar string inverter of 1kVA rating, IP 66 rated, outdoor, Single Phase output, true sinewave inverter system, with Maximum Power Point Tracker charge controller. Minimum protection required shall be over voltage/surge, over load, short circuit and anti- islanding protection. Earthing shall be provided as per IEC standards. (earthing and lightning protection quantities /rates are included above under respective headings in this estimate) IGBT based true sine wave output. Unity Power factor(1kVA=1kW). Accuracy of AC voltage control = +/-3%. Accuracy of AC frequency control = +/-1%. Frequency = 50Hz. Intelligent interface with LED/LCD display (Bluetooth/Wifi interface is also acceptable). Total Harmonic Distortion <3%". The inverter should have all specification, protections, operational modes, as detailed in technical specification. The inverter should have in-built Type Surge protection device on AC and DC side. The item includes all necessary accessories like supports, canopy, AC Isolation boxes (with energy meter) Junction boxes, Combiner boxes, DCDBs,

cabling from AC Isolation boxes to inverter, connectors complete as per drawings and specifications

vii. Supply, installation testing and commissioning of MONO PERC half cut solar module photovoltaic panels of total of 450W rating .

6.9 Plumbing Works

Sanitary Installation

i. Providing and fixing white vitreous china pedestal type water closet (European type) with seat and lid, 10litre low level white vitreous china flushing cistern & C.P. flush bend with fittings & C.I. brackets, 40 mm flush bend, overflow arrangement with specials of standard make and mosquito proof coupling of approved municipal design complete, including painting of fittings and brackets, cutting and making good the walls and floors wherever required as directed by the Engineer-in-Charge at all levels.

ii. Providing and fixing wash basin with C.I. brackets, 15 mm C.P. brass pillar taps, 32 mm C.P. brass waste of standard pattern, including painting of fittings and brackets, cutting and making good the walls wherever require: White Vitreous China Wash basin size 630x450 mm with a single 15 mm C.P. brass pillar tap

iii. Providing, fixing and commissioning of CP brass hand spray with lever control (health faucet) of make 1meter long flexible tube and wall hook, CP brass one-way angle valve and all fittings with all accessories complete,15 mm dia 450mm long, testing and commissioning to the satisfaction of Engineer-in-Charge as per direction of Engineer-in-Charge at all levels. (Models: Jaquar catalogue ALD-573 or equivalent)

iv. Providing and fixing brass bib cock of approved quality 15 mm nominal bore

v. Providing and fixing 600x450 mm beveled edge mirror of superior glass (of approved quality) complete with 6 mm thick hard board ground fixed to wooden cleats with C.P. brass screws and washers complete as directed by the Engineer-in-Charge at all levels

vi. Providing and fixing floor trap with cockroach trap (multi trap), SS304 grade floor grating with cup including cost and conveyance of all materials, labour charges, sundries etc complete as directed by the directed by the Engineer-in-Charge at all levels.

vii. Providing and fixing C.P. brass angle valve for basin mixer and geyser points of approved quality conforming to IS:8931 - 15mm nominal bore

viii. Providing and fixing sanitary fixtures for handicapped toilet including one washbasin, one number pillar cock with aerator & all other related fittings like CP brass bottle trap,CP brass angle cock, CP brass waste coupling, etc, one number EWC & Cistern complete with fittings & seat cover, one no. hinged rail & 4 nos. of grab rails 60cm etc, designed for people with special needs comes with as per manufacturers specification including cutting and making good the walls and floors wherever required as directed by Engineer-in-Charge. Hindware Matrix Set/Cera Cruse Set, CeraF1015101/ Hindware F280001CP or equivalent

ix. Providing and fixing rectangular high density polyethylene water storage loft tank with cover, conforming to ISI: 12701, colour of opaque white or as approved by Engineer-in-Charge. The rate includes making necessary holes for inlet, outlet & over flow pipes. The base support i/c fittings & fixtures for tank shall bepaid separately.

External Sanitary Works

i. Supplying, laying, jointing, testing and commissioning to the satisfaction of Engineer-in-Charge of PVC pipes with PVC specials such as tees, bends, door bend, door tee, elbows, unions, etc. with clamps and supports including cutting and making good the walls, testing the lines rectifying any leakages or defects, etc. complete for soil, waste, rain water, drains, vent pipe, etc. concealed or open at all levels including cost and conveyance of all materials, labour charges, sundries etc complete for internal work-exposed on walls as directed by the Engineer-in-Charge– 75 mm dia (6kg/cm2)

ii. Supplying, laying, jointing, testing and commissioning to the satisfaction of Engineer-in-Charge of PVC pipes with PVC specials such as tees, bends, door bend, door tee, elbows, unions, etc. with clamps and supports including cutting and making good the walls, testing the lines rectifying any leakages or defects, etc. complete for soil, waste, rain water, drains, vent pipe, etc. concealed or open at all levels including cost and conveyance of all materials, labour charges, sundries etc complete for concealed work as directed by the Engineer-in-Charge.

110mm OD (6 kg/cm2)
75mm OD(6kg/cm2)
50mm OD (6 kg/cm2)

iii. Supplying, laying, jointing, testing and commissioning to the satisfaction of Engineer-in-Charge of PVC pipes with PVC specials such as tees, bends, door bend, door tee, elbows, unions, etc. with clamps and supports testing the lines rectifying any leakages or defects, etc. complete as directed by the Engineer-in-Charge for soil, waste, rain water, drains, vent pipe, etc.at all levels including cost and conveyance of all materials, labour charges, sundries etc complete for internal work-exposed on walls as directed by the Engineer-in-Charge. - 75 mm dia (6 kg/cm2)

iv. Supplying, laying, jointing, testing and commissioning to the satisfaction of Engineer-in-Charge of hard PVC pipes with PVC specials such as tees, bends, door bends, door tees, elbows, unions, etc. with clamps and supports including earth work, refilling, testing the lines rectifying any leakages or defects, etc., complete as directed by the Engineer-in- Charge for soil, waste, rain water pipe, etc. for underground lines
160mm dia (6 kg/cm2)
110mm dia (6 kg/cm2)
75mm dia (6 kg/cm2)

v. Supplying, fixing, testing and commissioning to the satisfaction of Engineer-in-Charge of PVC gully trap of size 160 x 110mm and CI grating 150mmx150mm size and water tight C.I cover with frames 300mmx300mm size(inside) the weight of cover to be not less than4.5kg and frame to be not less than2.7kg (CI MH cover and frame as per IS:1726) single sealed of size conveying to size the above mentioned items and constructing 30cmx30cm internal size gully trap chamber and depth upto 60cm,115 thk brick wall in CM 1:6 on a foundation of PCC 1:4:8.100mm thick plastering inside with CM 1:3,12mm thk with a neat cement flushing coat and conveying to site, cleaning ,installing and testing approved make PVC gully trap with 160mm outlet(Fabricated),surrounding with CC 1:1.5:3, 150x150mmm,top with CI grating above the PVC gulley trap and light duty CI cover and frame over the chamber including cost of all materials, etc complete as per approved drawing and as directed by Engineer-in-Charge.

vi. Providing and fixing PVC vent cowl to pipe already fixed as directed by Engineer-in-Charge at all levels.
110 mm dia & 75mm dia

vii. Inside size 90x80 cm and 45 cm deep including C.I. cover with frame (light duty) 455x610 mm internal dimensions, total weight of cover and frame to be not less than 38 kg (weight of cover 23 kg and weight of frame 15 kg): With common burnt clay F.P.S. (non modular) bricks of class designation 7.5

Water Supply Works

i. Supplying, fixing, testing and commissioning to satisfaction of Engineer-in-Charge of Chlorinated Polyvinyl Chloride (CPVC- SDR11) pipes, having thermal stability for hot & cold water supply, including all CPVC plain & brass threaded fittings including fixing the pipe with clamps/supports at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and testing of joints complete as per direction of Engineer- in-Charge. Internal work - Exposed on wall

50 mm nominal dia pipes
40 mm nominal dia pipes
32 mm nominal dia pipes
25 mm nominal dia pipes
20 mm nominal dia pipes

ii. Supplying, fixing, testing and commissioning to satisfaction of Engineer-in-Charge of Chlorinated Polyvinyl chloride(CPVC) SDR 11 pipes, having thermal stability for hot and cold water supply including all CPVC plain and brass threaded fittings i/c fixing the pipes with clamps/supports at 1.00 m spacing. This includes jointing of pipes and fittings with one step CPVC solvent cement and the cost of cutting chases and making good the same including testing of joints complete. The rate is including cost and conveyance of all

materials, labour charges, sundries, lead, lift,all taxes etc complete as per the direction of Engineer-in-Charge at all levels.(External Works)
50 mm nominal outer dia pipes

iii. Supplying, fixing, testing and commissioning to satisfaction of Engineer-in-Charge of gun metal gate valve with C.I. Wheel of approved quality (screwed end) including cost and conveyance of all materials, labour charges, sundries etc complete as directed by the Engineer-in-Charge at all levels

50 mm dia nominal bore
40 mm dia nominal bore
32 mm dia nominal bore
25 mm dia nominal bore
20 mm dia nominal bore

iv. Supplying and fixing of CI single flanged wall casting pipe with puddle, 0.6m length including cost and conveyance of all materials, labour charges, making good the walls etc complete as directed by the Engineer-in-Charge. 65mm

v. Supplying and fixing of CI double flanged wall casting pipe with puddle, 0.6m length

including cost and conveyance of all materials, labour charges, making good the walls etc complete as directed by the Engineer-in-Charge. 65mm

vi. Providing and laying non-pressure NP3 class (medium duty) R.C.C. pipes with collars jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement: 2 fine sand) including testing of joints etc. complete
300 mm dia R.C.C. pipe
150 mm dia R.C.C. pipe

vii. Excavating trenches of required width for pipes, cables, etc including excavation for sockets, and dressing of sides, ramming of bottoms, depth upto 1.5 m, including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20 cm in depth, including consolidating each deposited layer by ramming, watering, etc. and disposing of surplus excavated soil as directed, within a lead of 50 m : Pipes, cables etc. exceeding 80 mm dia. but not exceeding 300 mm dia

viii. Providing and fixing gun metal non- return valve of approved quality (screwed end) : 50 mm dia nominal bore

ix. Providing and fixing GM Foot valve of approved quality as per the requirements of the Engineer-in-Charge. 50mm dia

x. Supplying and fixing of centrifugal pump, with CI construction, CI impeller, mechanical seal, complete with motor, base plate, foundation bolts, nuts, pressure gauge and all accessories and working with 415V, 3ph/1ph and 50 Hz frequency including cost and conveyance of all materials, labour, charges etc complete as directed by the Engineer-in-Charge at all levels Capacity 2 -6.9 lps, Head-6-12 meters

6.10 External painting, finishing & Mural arts on walls

i. Installation & Completion of external painting, finishing works & Mural art on walls as per designs approved by IWAI, reflecting the local aesthetics of the area for each location separately.

6.11 Terminal Building-Details of work:

i. Construction of Terminal Building as per drawings and specifications including RCC foundation/ substructure, water proofing shall be provided for required RCC structures, columns, light weight non asbestos fiber reinforced aerated cement sandwiched wall panel (75mm thick) partitions and roofing with zincalume / galvalume sheets (0.55mm thick) of approved make and shade, aluminium windows ventilators and FRP doors, roofing including truss works with tubular MS members with anticorrosive protective coatings, MS handrail with protective painting, finishing works, electrical works including meter boards, distribution boards, wiring, cabling, earthing, light fixtures, street lights with foundation (5nos) complete as per technical specifications, drawings and as directed by Engineer-in-Charge.
ii. Size of Module I is 11.10m length x 5.94 m width x 5.70m height. The waiting area is 7.20m x 4.50m
iii. Size of Module II is 12.87m length x 6.84 m width x 5.9m height. The waiting area is 9.0m x 5.96m

(a) Basement and Foundation

RCC isolated foundations and column pedestals, as per design and drawings, shall be constructed at designated locations after excavation of soil and placing of soling stone layer and base PCC. Grade

beam connecting column pedestals shall be provided and masonry wall (below plinth) shall be constructed upto floor level. Plinth filling shall be considered with good earth in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering. Cutting and filling for levelling the site if required shall be included in the scope of foundation construction. Concrete Solid Block work up to plinth level considered as per drawing.

(b) Superstructure

Providing and fixing in position factory made non asbestos fibre reinforced aerated cement sandwich wall light weight solid core panels made of light weight cement concrete core composed of OPC cement, pulverized flyash, quick lime, cotton pulp & Gypsum in mortar state mixed with aeration agent in a preset mould. The outer face on both sides of the panels will be non-asbestos fibre cement board confirming to IS 14862:2000. These solid wall panels are installed using Galvanized iron steel tracks/C channel of 1mm thick of required sizes as recommended by manufacturer's and fixed to floor and roof soffit in plumb to each other with steel screw/ fasteners. The panel shall be fixed vertically with tongue & groove joint with cement based polymer modified jointing compound. The exposed surface finished with fibre mesh/glass fibre tape with polymer based jointing compound having superior flexibility. Non load bearing panels 75mm thick of required size (minimum 5mm thick fibre cement board).Frame work shall be provided with Anticorrosive protective coated MS tubular sections.

(c) Flooring

25mm thick Kota stone/Natural stone slab flooring over 20 mm (average) thick base laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab, including rubbing and polishing complete with base of cement mortar 1 : 4 (1 cement : 4 coarse sand) for waiting areas.

Providing and laying anti-skid Ceramic floor tiles of size 300x300 mm (thickness to be specified by the manufacturer), of 1st quality conforming to IS: 15622, of approved make, in all colours, shades, laid on 20 mm thick bed of cement mortar 1:4 (1 Cement: 4 Coarse sand), jointing with grey cement slurry @ 3.3 kg/ sq.m including pointing the joints with white cement and matching pigments etc., complete. For toilet areas.

Toilet Wall dadoing : Providing and fixing Ist quality ceramic glazed wall tiles conforming to IS: 15622 (thickness to be specified by the manufacturer), of approved make, in all colours, shades with cement based high polymer modified quick-set tile adhesive (Water based) conforming to IS: 15477 including pointing of matching shade complete.

(d) Granite counter :

It shall be of any colour and size as approved by Engineer-in-Charge. Granite shall be plain machine cut and mirror polished. The stone shall be smooth and of even surface without holes or pits.

Tolerance

Slabs

Length + 2 per cent

Width + 2 per cent

Thickness + 3 per cent

Painting: Providing 2 coat interior/exterior emulsion paint with 2 coat primer of approved colour and 2 coat putty.

(e) Roofing

Providing and fixing polyester coated galvalume profiled sheets 445 -1000mm wide and 28-50 mm

depth rib made out of 0.55mm TCT, cold rolled steel of 300 Mpa (min.) yield strength conforming to ASTM A 368 or AS 1595 with hot dip metallic coating of minimum 150gm/sq.m zinc-aluminium alloy coating mass (55% Aluminium, 43.5% Zinc and 1.5% Silicon) total of both sides as per ASTM A 792 or AS 1397. Sheet should have protective guard film of 25 microns minimum to avoid scratches during transportation and should be supplied in single length upto 12 metre or as desired by Engineer-in-Charge -in-charge.

Truss roof including steel columns shall be constructed with MS tubular sections (round, square or rectangular hollow tubes etc.) including cutting, hoisting, fixing position and applying anticorrosive protective coating with adequate dry film thickness as per tender requirement including welding and bolted with special shaped washers etc. complete-Electric resistance or induction butt welded tubes.

PVC gutter shall be provided with required down pipes.

(f) Joinery

Door

Providing and fixing the FRP flush door of dimensions as mentioned in drawings with including frame, shutter, polyurethane foam (PUF) filling, hinges and fittings etc complete.

Frame: Providing and fixing Fiber Glass Reinforced plastic (FRP) Door Frames of cross- section 90 mm x 45 mm having single rebate of 32 mm x 15 mm to receive shutter of 30 mm thickness. The laminated shall be moulded with fire resistant grade unsaturated polyester resin and chopped mat. Door frame laminate shall be 2 mm thick and shall be filled with suitable wooden block in all the three legs. The frame shall be covered with fiber glass from all sides. M.S. stay shall be provided at the bottom to steady the frame.

Shutter: Providing and fixing to existing door frames 30 mm thick Fiberglass Reinforced Plastic (F.R.P) flush door shutter in different plain and wood finish made with fire retardant grade unsaturated polyester resin, moulded to 3 mm thick FRP laminate all around, with suitable wooden blocks inside at required places for fixing of fittings and polyurethane foam (PUF) / Polystyrene foam to be used all filler material throughout the hollow panel, casted monolithically with testing parameters of F.R.P. laminate conforming to table - 3 of IS : 14856, complete as per direction of Engineer-in-Charge.

(g) Window and Ventilator: Providing and fixing fixed glass window and glass louvered ventilator with aluminium powder coated sections with exhaust fans provision. Shade for window openings provided with cement fibre board and MS tubular sections.

Frame: Providing and fixing aluminium work for windows and ventilators with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminnium snap beading for glazing /paneling, C.P. brass/ stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-Charge: For fixed portion.

(h) Powder coated aluminium (minimum thickness of powder coating 50 micron).

Glass: Providing and fixing glazing in aluminium window shutters and partitions etc. with EPDM rubber / neoprene gasket etc. complete as per the architectural drawings and the directions of Engineer-in-Charge With float glass panes of 5.50 mm thickness. Frosted glass panes 4 mm thick shall be considered for glass louvered ventilators

Aluminium louver: Powder coated aluminium louvers provided as per drawing

Ramps and step access: Ramps for PwD toilet and steps to other toilets and waiting areas shall be provided as per drawing and specifications.

(i) Road and Land development works

For vehicular parking, cement concrete paver blocks of M-30 grade 80 mm thick with GSB/WMM base layers as per applicable standards for light vehicular movement/parking with precast kerb stones on sides.

7. Specification of Civil

7.1 Material

7.1.1 General

The Contractor shall be responsible for furnishing all materials required for execution of theWorks. All materials used in the construction of permanent works required under this Contract shall be of 1st class quality as specified herein and comply with the latest IS Codes or equivalent. The material shall be tested before bringing it to the site.

This specification establishes and defines the requirements of various materials to be used in Civil and Structural works. Whenever any reference to IS Codes is made, the same shall be taken as the latest revision (with all amendments issued thereto) as on the date of submission of the Tender. Apart from the IS Codes mentioned in particular in various clauses of this specification, all other relevant codes related to specific job under consideration regarding quality, tests, testing and/or inspection procedures shall be applicable. Reference to some of the codes invarious clauses of this specification does not limit or restrict the scope of applicability of other referred or relevant codes. In case of any variation/contradiction between the provision of IS Codes and this specification, the provision given in this specification shall be followed, unless the Employeragrees/consents to follow IS codes or other proposal of the Contractor as provided in the Contract. All materials shall be of standard quality and shall be procured from renowned sources/manufacturers. Wherever brand is not mentioned, Contractor can choose a brand complying with the tenderspecifications however mentioning the brand considered in the Bid submission for the approval of the Employer if required.

Quality and acceptability of materials not covered under this specification shall be governedby the relevant IS Codes. In case IS code is not available for the particular material, other codes e.g. B.S. or DIN or API/ASTM etc. shall be considered. The decision of Employer in thisregard shall be final and binding on the Contractor.

The Contractor shall submit manufacturer's test reports on quality and suitability of any material procured from them and their recommendation on storage, application,workmanship etc. for the intended use. Submission of manufacturer's test reports does notrestrict the Employer from asking fresh test results from an approved laboratory of the actual material supplied from an approved manufacturer/source at any stage of execution of work.

All costs relating to or arising out of the tests and submission of test reports and or samples to the Employer for his approval till the date of issuance of Performance Certificate shall be borne by the Contractor.

Materials for approval shall be separately stored and marked, as directed by the Employer and shall not be used in the Works till these are approved. All rejected materials shall be immediately removed from the site by the Contractor at his own cost.

7.1.2 Water

Water used in construction for all civil & structural works shall be clean and free from injurious

amount of oil, acids, alkalies, organic matters or other harmful substances, which may be deleterious to concrete, masonry or steel. Potable water shall be considered satisfactory.

Tests on water samples shall be carried out in accordance with IS: 3025 and they shall fulfil all the guidelines and requirements given in IS: 456.

Water shall be stored in tin barrels, steel tanks or water tight reservoirs made with bricks/stone or reinforced concrete. Brick/stone masonry reservoirs shall have RCC base slab and shall be plastered inside, with 1 part of cement and 4 parts of sand and finished with neat cement punning. These reservoirs shall be of sufficient capacity to meet the water requirements, at any stage of construction.

Water for curing shall be of the same quality as used for concreting and masonry works. Seawater shall not be used for preparation of cement mortar, concrete as well as for curing of plain/reinforced concrete and masonry works. Sea water shall not be used for hydro-testing and checking the leakageof liquid retaining structures also.

7.1.3 Aggregate

(a) General

Coarse and fine aggregates for civil and structural Works shall conform in all respects to IS: 383 (Specification for coarse and fine aggregates from natural sources for concrete). Aggregates shall consist of naturally occurring (crushed or uncrushed) stones, gravel and sand or a combination thereof. These shall be chemically inert, hard, strong, dense durable, clean and free from veins, adherent coatings, injurious amount of alkalies, vegetable matter and other deleterious substances such as iron pyrites, coal, lignite, mica, shale, sea shells etc.

Source and type of aggregates shall be got approved by the Employer prior to procurement.Change in source and type of aggregates, at later stage, shall not be generally permitted; butunder specific circumstances, the Employer subject to the Contract may accept the proposal to change. Contractor shall produce necessary test certificates from approved laboratories regarding the quality and suitability of the proposed aggregates and submit fresh mix designfor approval of the Employer. Aggregates, which may chemically act with alkalies of cement or might cause corrosion of the reinforcement, shall not be used. If so desired by the Employer, the Contractor shall carry out alkali reactivity tests and submit the results to him for approval.

The maximum quantities of deleterious materials in the aggregates as determined in accordance with IS: 2386 – Part II (Methods of Test for aggregates for concrete), shall not exceed the limits defined in IS: 383. No special test is required to prove the absence of such deleterious matters if the aggregates are from a known source with satisfactory prior data on the properties of concrete made with them. In case of newly developed quarry sites, theContractor shall submit necessary test results as per IS: 383 and IS: 2386 to the Employer priorto his acceptance and approval. The method of Sampling shall be in accordance with the requirements given in IS: 2430.

Separate sieve analysis and grading curves shall be prepared by the Contractor for any/all batches of coarse and fine aggregates, and submitted to the Employer, whenever asked for,to ensure conformity with those submitted along with the mix design.

Whenever required by the Employer, the aggregates (coarse/fine) shall be washed and/or sieved by the Contractor before use in the works to obtain clean and graded aggregate at noextra cost to the Employer.

(b) Coarse Aggregates

Coarse aggregates are the aggregates, which are retained on 4.75 mm IS Sieve. It shall havea specific

gravity not less than 2.6 (saturated surface dry basis).

These may be obtained from crushed or uncrushed gravel or stone as above andmay be supplied as single sized or graded. The grading of the aggregates shall be as per IS: 383 or as required by the mix design, to obtain densest possible concrete. For this purpose, the Contractor shall submit to the Employer at least three sets of mix design and test results, each with different grading of coarse aggregates, proposed to be used. The Employer may allow "All-in-aggregates" to be used provided they satisfy the requirements of IS: 383.

(c) Fine Aggregates

Fine aggregates are the aggregates which pass through 4.75 mm IS sieve but not more thanten percent (10%) pass through 150 micron IS sieve. These shall comply with the requirements of grading zones I, II, III and IV of IS: 383. Fine aggregates conforming to gradezone IV shall not be used for reinforced concrete works.

Fine aggregates shall consist of material resulting from natural disintegration of rock and which has been deposited by streams or glacial agencies, or crushed stone sand or gravel sand. Sand from sea shores, creeks or river banks affected by tides, dredged sand shall not be used for filling or concrete works.

(d) Sampling and Testing

Storage of all types of aggregates at site of work shall be at Contractor's expense and risk and shall be stored as specified in IS: 4082. Aggregates shall in no case be stored near to theexcavated earth or directly over ground surface.

Each type and grade of aggregate shall be stored separately on hard, firm surface having adequate slope for drainage of water.

Aggregates delivered at site in wet condition or becoming wet due to rain or any other means, shall not be used for at least 24 hours.

7.1.4 Sand

(a) Sand for Masonry Mortars

The sand shall consist of natural sand, crushed stone sand or crushed gravel sand or a combination of any of these. The sand shall be hard, durable, and clean and free from adherent coatings and organic matter and shall not contain the amount of clay, silt and fine dust more than specified in IS:2116.

The crusher sand / manufactured sand with grading limits satisfying requirements of IS 383shall be considered.

The sand shall not contain any harmful impurities such as iron pyrites, alkalies, salts, coal or other organic impurities, mica, shale or similar laminated materials, soft fragments, sea shells in such form or in such quantities as to affect adversely the hardening, strength or durability of the concrete.

(b) Grading of Sand

The particle size grading of sand shall be within the limits as specified below:Grading of Sand

IS Sieve Designation	Percentage	Method
IS:460 (Part I)	Passing by Mass	
4.75 mm	100	IS:2386 (Part I)
2.36 mm	90 – 100	
1.18 mm	70 – 100	

600 micron	40 – 100	
300 micron	5 to 70	
150 micron	0 to 15	

(c) Sampling and Testing

The method of sampling shall be in accordance with IS: 2430. The amount of material required for each test shall be as specified in relevant parts of IS: 2386. Any test which the Employer may require in connection with this shall be carried out in accordance with the relevant parts of IS: 2386.

If further confirmation as to the satisfactory nature of the material is required, compressivetest on cement mortar cubes (1:6) may be made in accordance with IS:2250 using the supplied material in place of standard sand and the strength value so obtained shall be compared with that of another mortar made with a sand of acceptable and comparable quality.

(d) Sand for Filling

Sand for filling shall meet the requirements of IS: 383 and shall be natural sand, hard, strong, and free from any organic and deleterious materials. Sand obtained from sea shores, creeks or river banks affected by tides shall not be used for filling. Fine aggregates suitable for concreting works shall be suitable for filling also. No sand below grading zone-III as per IS-383 shall be allowed for filling.

7.1.5 Cement

For plain and reinforced concrete works cement shall be of any of the following types:

- 43 Grade OPC Ordinary Portland cement conforming to IS 269
- Portland Pozzolana Cement (Fly ash based) conforming to IS 1489 (Part -1)
- Portland Pozzolana Cement (Calcined based) conforming to IS 1489 (Part -2)

For marine structures, special cement shall be used confirming to IS 4651 Part4.

(a) Chlorides in the concrete

Whenever there is chlorides in concrete there is an increased risk of corrosion of embedded metal. The higher the chloride content or if subsequently exposed to warm moist conditions, the greater the risk of corrosion. All constituents may contain chlorides and concrete may be contaminated by chlorides from the external environment. To minimize the chance of deterioration of concrete from harmful chemical salts, the levels of such harmful salts in concrete materials, that is, cement, aggregates, water and admixtures, as well as by diffusion from the environment should be limited. The total amount of chloride content (as Cl) in the concrete at the time of placing shall be as given below.

Limits of chloride content in concrete

S No.	**Type or use of concrete**	**Maximum Total Acid soluble Chlorid Content Expressed as kg/m3 of Concrete**
1.	Concrete containing metal and steam cured at elevated temperature and pre-stressed concrete	0.4
2.	Reinforced concrete or plain concrete containing embedded metal	0.6

3.	Concrete not containing embedded metal or any material requiring protection form chloride	3.0

The total acid soluble chloride content should be calculated from the mix proportions and the major chloride contents of each of the constituents. Whenever possible the total chloride content of the concrete should be determined as per the approval of the Engineer-in-Charge.

(b) Sulphates in concrete:

Sulphates are present in most cements and in some aggregates; excessive amounts of water –soluble sulphate from these or other mix constituents can cause expansion and disruption of concrete. To prevent this, the total water-soluble sulphate content of the concrete mix, expressed as SO3, should not exceed 4 per cent by mass of the cement in the mix. The sulphate content should be calculated as the total from the various constituents of the mix as per the approval of the Engineer-in-Charge. The 4 percent limit does not applied to concrete made with super sulphated cement complying with IS 6909 or as approved by the Engineer-in-Charge.

(c) Storage at Site

The storage of cement at the site of work shall be at Contractor's expense and risk and shallmeet the requirements of IS: 4082. The cement shall be stored above ground in a suitable weather tight building or godown and in such a manner as to permit easy access for proper inspection and also to prevent determination due to moisture.

All approved cement shall be arranged in batches with type, brand and date of receipt flagged on them. A maximum of eight bags shall be stacked one over the other. Cement bags shall be used in the same order as received from the manufacturer. The Contractor shall maintain a register, on day to day basis, giving the details of the receipt/consumption,source of supply and type of cement etc. The register shall always be accessible to the Employer for verification.

7.2 Plain and Reinforced Concrete Works

(a) General

The section of the specifications includes requirements for furnishing and placing all plain and reinforced cement concrete including form work, reinforcement and incidental works required for the completion of this Contract and herein specified.

This specification establishes the materials, mixing, placing, curing, etc. of all types of cast- in-situ and precast concrete used in jetty, approach trestle, retaining walls, underground structures, floors, buildings, etc.

Apart from this specification, construction of concrete works shall be in accordance with theIndian Standard Code of Practice for "Plain and Reinforced Concrete" IS: 456 and other relevant codes mentioned therein.

(b) Grades of Concrete

Unless otherwise noted, the grades of concrete shall generally be as per Table 1.

Table 1 – Grades of Concrete

Grade Designation	Characteristic Compressive Strengthof 15 cm cu at 28 days (N/mm2)
M 15	15
M20	20
M25	25
M30	30
M35	35

The characteristic strength is defined as the strength of material, below which not more than five (5) percent of the test results are expected to fall.

(c) Type of Concrete Mix

Unless otherwise noted all lean and reinforced concrete shall be nominal mix and design mixtypes respectively.

(d) Nominal Mix Concrete

The Nominal Mix Concrete shall not be used. Only Design Mix concrete shall be used. Hand mixing of cement/sand mortar for use in plastering shall not be allowed. All such mixing shall be done throughmechanical mixer only.

(e) Design Mix Concrete

The mix shall be designed to produce the grade of concrete having the required workability and characteristic strength not less than appropriate values given in Table 1 above.

While designing the mix, the durability requirements as given in IS: 456 shall also be taken into account.

(f) Concrete Mix Proportioning

Proportioning, as used in this specification, shall mean the process of determining the proportions of the various ingredients to be used to produce concrete of the required strength, workability, durability and other properties.

The Employer shall verify the strength of the concrete mix, before giving his sanction of its use. However, this does not absolve the Contractor of his responsibility as regards achieving the prescribed strength of the mix. If during the execution of the work, cube tests show lower strengths than required, the Employer shall order fresh trial mixes to be made by theContractor. Any variation in cement consumption shall be taken into consideration for material reconciliation. Preliminary mix designs shall be established well ahead of start of work. The design mix shall conform to the guidelines of IS: 10262.

(g) Maximum Density

Suitable proportions of sand and the different sizes of coarse aggregates for grade of concrete shall be selected to give as nearly as practicable the maximum density. This shall be determined by mathematical means, laboratory tests, field trials and suitable changes inaggregate gradation. The Contractor shall submit to the Employer at least three sets of mix design and corresponding test results after varying the mix proportions and / or grading of aggregate so as to establish the maximum density of any particular grade of concrete.

(h) Water-Cement Ratio

Once a mix, including its water-cement ratio, has been determined and approved for use by the Employer, that water-cement ratio shall be maintained. The Contractor shall determine the water content of the aggregates frequently as the work progresses, and the amount of mixing water shall

be adjusted so as to maintain the approved water-cement ratio. Maximum water-cement ratio shall never exceed the values given in IS: 456 and IS: 4651 for various exposures and sulphate attack conditions from durability considerations.

(i) Consistency

The concrete shall have a consistency such that it shall be workable in the required position and whenproperly vibrated it flows around reinforcing steel, all embedded fixtures, etc.

(j) Workability

The concrete mix proportion shall be such that the concrete is of adequate workability for the placing condition and can be properly compacted with the means available. Use of plasticiser / super-plasticiser of approved make shall be taken recourse to where required for attaining proper workability as specified in Table 2 below. However, prior written approval of the Employer shall be obtained for any such use of plasticiser / super-plasticiserbefore submitting the proposed design-mix for approval. Where adequate workability is difficult to obtain at maximum permissible water-cement ratio, increased cement content shall also be alternatively considered while designing the mix proportions.

The suggested ranges of values of workability of concrete measured in accordance with IS: 1199 are indicated in Table 2 below. However, the actual values to be followed shall be established depending on aggregate sizing, mix proportions, placing conditions, etc. and shall be got approved by the Employer.

Table 2 - Values of Workability

Placing conditions	**Degree of workability**	**Values of workability**
Concreting of shallow sections with vibration	Very low	20-10 seconds vee-bee time or0.75-0.80 compacting factor
Concreting of lightly reinforcedsection with vibration	Low	10-5 seconds vee-bee time or 0.80-0.85 compacting factor
Heavily reinforced sections with vibration	Medium	5-2 seconds vee-bee time or 0.89-0.92 compacting factor or 25-75mmslump for 20mm aggregate

(k) Durability

For achieving sufficiently durable concrete, strong, dense aggregates, low water-cement ratio and adequate cement content shall always be used. Workability of concrete shall be such that concrete can be completely compacted with the means available. Leak-proof formwork shall be used so as to ensure no loss of cement-slurry during pouring and compaction. Cover to reinforcement shall be uniform and as per standard codes. Concrete mix design shall always take into account the type of cement, minimum cement content irrespective of the type of cement and maximum water-cement ratio conforming to the exposure conditions as given in Table-2A.

Table 2A - Minimum Cement Content and Maximum Water Cement Ratio for Durability

Exposure	Type of Cement	Plain Concrete		Reinforced Concrete	
		MinimumCement Content (Kg./m^3)	MaximumWater-Cement Ratio	Minimum Cement Content (Kg./m^3)	Maximum Water-Cement Rati
Moderate	OPC* PPC* PSC'	250	0.6	350	0.50
Severe	SSC* PSC* SRC'	310	0.45	400	0.45

Note:

1. Severe exposure shall include structures exposed to sea or saline water (e.g. tidal rivers, brackish water, estuaries etc.), alternate wetting and drying, freezing whilst wet and subject to heavy condensation or corrosive environment. This shall also include structures exposed to sulphate and/or chloride attack due to presence of these chemicals in Soil and ground water. Total SO3 content of 0.2% and above in Soil and 300 ppm in ground water shall be considered to constitute severe exposure. Similarly, chloride (as CI) content exceeding 1500 ppm in groundwater or soil shall be considered as severe exposure condition.
2. Structures subjected to aggressive environment below the minimum limits expressed in Note-1 above and/or those in industrial/chemical plants atmosphere shall be considered under moderate exposure. Also, any concrete structure incontact with water or retaining water or any other liquid not usually harmful to concrete shall be considered under moderate exposure.
3. All other environmental conditions not covered under Notes-1&2 shall becategorized under Normal exposure.

OPC - Ordinary low heat Portland cement

PPC - Portland Pozzolana Cement

PSC - Portland Slag Cement

SRC - Sulphate Resistant Cement

SSC - Super Sulphated Cement

(l) Batching

In proportioning concrete, the quantity of both cement and aggregate shall be determined by mass. Where the mass of cement is determined on the basis of mass of cement per bag, a reasonable number of bags shall be weighed periodically to check the net mass. Where the cement is weighed at site and not in bags, it shall be weighed separately from the aggregates. Water shall be either measured by volume in calibrated tanks or weighed. Any solid admixtures that are to be added shall be measured by mass; liquid and paste admixtures shall be measured by volume or mass. Batching plant, where used, shall conform to IS: 4925. All measuring equipment shall be maintained in a clean serviceable condition, and their accuracy periodically checked.

Except where it can be shown to the satisfaction of the Employer that supply of properly graded aggregate of uniform quality can be maintained over the period of work, the grading of aggregate

shall be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions when required, different sizes being stacked in separate stock piles. The grading of coarse and fine aggregates shall be checked frequently, the frequency for a given job being determined by the Employer to ensure that the approved grading is maintained.

The amount of added water shall be adjusted to compensate for any observed variations in the moisture contents in both fine and coarse aggregates. For the determination of moisture content in the aggregates, IS: 2386 (Part-111) may be referred to. To allow for the variation in mass of aggregates due to variation in their moisture content, suitable adjustments in the mass of aggregate shall also be made. In the absence of exact data, only in the case of nominal mixes, the amount of surface water may be estimated from the values given in Table.

Aggregate	**Approximate Quantity of Surface**	
	Percent by mass	**Litre / m^3**
Very wet sand	7.5	120
Moderately wet sand	5.0	80
Moist sand	2.5	40
Moist Gravel or Crushed Rock	1.25-2.5	20-40

No substitutions in materials used on the work or alterations in the established proportions, except as permitted shall be made without additional tests to show that the quality and strength of concrete are satisfactory. In case the Contractor proposes any change in the already approved mix design, fresh mix design with supportive laboratory tests shall be submitted to the Employer and his approval has to be obtained prior to using the revised mix proportion in the works. However, such proposals for revision shall only be entertained in case of successive failure of test cubes to achieve the required strength.

(m) Concrete mixing

Concrete shall be produced in Concrete Batching Plant. The mixing of concrete shall be strictly carried out in an approved type of mechanical concrete mixer. The mixing shall be continued until there is a uniform distribution of the material and the mass is uniform in colour and consistency. If there is segregation, after unloading from the mixer, the concrete shall be remixed.

(n) Mixer

Mixers shall comply with IS: 1791 and shall be maintained in satisfactory operating condition. Mixer drum shall be kept free of hardened concrete and blades shall be replaced when worn down more than ten percent (10%) of their depth. Should any mixer at any time produce unsatisfactory results, leak mortar or cause waste of materials, its use shall be promptly discontinued until it is repaired.

(o) Mixing Time

Mixing time shall be as indicated in the following table. Excessive mixing requiring additionso f water shall not be permitted. Time shall start when all solid materials are poured in the revolving mixer drum, provided that all of the mixing water shall be introduced before one-fourth of the mixing time has elapsed. The Employer may, however, direct a change in the mixing time, if he considers such a change necessary.

Capacity of mixer	Minimum Mixing time
2 m^3 or less	1½ minutes
$3m^3$	2½ minutes
$5m^3$	3 minutes

All records and charts for the batching and mixing operations shall be prepared and maintained by the Contractor as per the instructions of the Employer.

(p) Admixtures

Admixtures in concrete shall be used only with the prior approval of the Employer. Any admixture used for obtaining proper workability or leak-proof-ness of concrete or repair/rendering works of concrete due to non-conformance to the specifications, shall not be measured and paid for.

(q) Placing of Concrete

Placing of concrete shall be carried out by use of pump, conveyor and bucket etc.

(r) Vibrators

Concrete shall be compacted with mechanical vibrating equipment supplemented, if necessary to obtain consolidation, by hand spreading, rodding and tamping. The vibrators shall be of immersion type with operational frequency ranging between 8,000 and 12,000 vibrations per minute. All vibrators shall comply with IS: 2505. Screed board concrete vibrators or concreting vibrating tables or form vibrators conforming to IS: 2506, 2514 and 4656, respectively, shall be used where specifically required.

(s) Transportation

All concrete shall be conveyed from the mixer to the place of final deposit as rapidly as possible, which shall be mortar leak tight. Care shall be taken to prevent the segregation or loss of the ingredients and maintaining the required workability.

(t) Placing and Compaction

Before placing concrete, all surfaces upon which or against which concrete is to be placed shall be well compacted and free from standing water, mud or debris. The surface of absorptive soil (against which concrete is to be placed) shall be moistened thoroughly so that moisture is not drawn from the freshly placed concrete.

Concrete shall not be placed until the formwork, the placement of reinforcing steel, embedded parts, pockets etc. have been inspected and approved by the Employer. Any accumulated water on the surface of the bedding layer shall be removed by suitable means before start of placement. No concrete shall be placed on a water-covered surface.

Concrete shall be discharged by vertical drop only and the drop height shall not normally exceed 1.5m throughout all stages of delivery until the concrete comes to rest in forms. Forcontinuous concreting operation windows of suitable size shall be kept in the formwork or chutes shall be used to avoid segregation of concrete.

The method of placing and compaction employed in any particular section of the work shallbe as per direction of the Employer.

Formation of cold joints shall be avoided.

(u) Items Embedded In Concrete

Concreting shall not be started unless the electrical conduits, pipes, fixtures etc., wherever required, are laid by the concerned agency. The Contractor shall afford all the facilities and maintain co- ordination of work with other agencies engaged in electrical and such other works as directed by theEmployer.

Before concreting, the Contractor shall provide, fabricate and lay in proper position all metal inserts,anchor bolts, pipes etc. (which are required to be embedded in concrete members)

All embedment, inserts etc. shall be fully held and secured in their respective positions by the concerned agencies so as to avoid any dislocation or displacement during the concreting operations. The Contractor shall take all possible care during concreting to maintain these embedment/inserts in their exact locations.

(v) Protection of Freshly Laid Concrete

Newly placed concrete shall be protected, by approved means, from rain, sun and wind.

(w) Curing

Concrete shall be cured by keeping it continuously moist wet for the specified period of time to ensure complete hydration of cement and its hardening. Curing shall be started after 8 hours of placement of concrete, and in hot weather after 4 hours. The water used for curingshall be of the same quality as that used for making of concrete.

Exposed surfaces of concrete shall be maintained continuously in a damp or wet condition for at least the first 7 days after placing of concrete, except that high early strength concreteshall be so maintained for at least the first 3 days.

The Contractor shall have all equipment and materials required for curing on band and readyto use before concrete is placed.

Acceptance Criteria

The acceptance criteria for concrete shall be as per IS456:2000. Concrete shall be assessed daily for compliance.

(x) Finishing of Concrete

On striking the form work, all surface defects such as bulges, ridges and honey-combing etc.observed shall be brought to the notice of the Employer. The Employer may at his discretionallow rectification by necessary chipping and packing or grouting with concrete or cement mortar. However, if honey-combing or sagging are of such extent as being undesirable, the Employer may reject the work totally and his decision shall be binding. No extra payment shall be made for rectifying these defects, demolishing and reconstructing the structure. However, quantity of cement actually used for this purpose may be considered for reconciliation of materials. All burrs and uneven faces shall be rubbed smooth with the helpof carborundum stone.

The surface of non-shuttered faces shall be smoothened with a wooden float to give a finishsimilar to that of the rubbed down shuttered faces. Concealed concrete faces shall be left as from the formwork except that honey-combed surface shall be made good as specified above.

(y) Cement Wash

If instructed by the Employer, the Contractor shall provide one coat of cement wash over the exposed concrete surfaces of foundations, beams, columns, walls, lintels, soffit of slabs etc. which are not plastered and appearance-wise not up to acceptable standard. No extra amount shall be paid to the Contractor on this account.

7.3 Form Work

(a) General

Forms for concrete shall be of plywood conforming to IS: 6461 or steel or as directed by the Employer and shall give smooth and even surface after removal thereof.

Form work and its supports shall maintain their correct position and be to correct shape andprofile so that the final concrete structure is within the limits of dimensional tolerances specified below, unless required otherwise, for functional/aesthetic reasons. The decision of the Employer shall be final and binding in this regard.

Specification for plywood for concrete shuttering work IS: 4990

Specification for ballies for general purposes IS: 3337

(b) Form Requirement

The formwork shall be true, rigid and adequately braced both horizontally as well asdiagonally. The forms shall have smooth and even surface and be sufficiently strong to carry,without deformation, the dead weight of the green concrete working load, wind load and also the side pressure exerted by the green concrete. As far as practicable, clamps shall be used to hold the forms together. Where use of nails is unavoidable minimum number of nailsshall be used. Projected part of nail shall not be bent or twisted for easy withdrawal.

Where through tie rods are required to be put to hold the formwork and maintain accuratedimension, they shall always be inserted through a precast concrete block (of same mix proportion as is to be used for concreting) with a through hole of bigger diameter. The precast block shall tightly fit against in inner faces of formwork. The holes left after the withdrawal of tie rods shall be fully grouted with cement-sand mortar of same proportion as that used for concrete. However, use of such precast block shall in no case impair the desired appearance or durability of the structure. No such tie rods shall be used in any liquidretaining or basement structure.

(c) Reuse of Forms

Before reuse, all forms shall be thoroughly scrapped, cleaned, examined and when necessary, repaired and retreated, before resetting. Formwork shall not be reused, if declared unfit or un-serviceable by the Employer.

(d) Removal of Forms / Stripping time

In the determination of time for removal of forms, consideration shall be given to the location and character of the structures, the weather and other conditions including the setting and curing of the concrete and material used in the mix.

The formwork shall be removed without shock and methods of form removal likely to cause over stressing or damage to the concrete shall not be adopted. Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight

In normal circumstances when average air temperature exceeds 16 degree Celsius during the period under consideration after pouring of concrete and where ordinary Portland cement is used, forms may generally be removed conforming to IS:456.

(e) Staging / Scaffolding

Staging / Scaffolding shall be properly planned and designed by the Contractor. Use of only steel tubes is permitted for staging/scaffolding. The Contractor shall get it reviewed by Employer before commencement of work. While designing and during erection of scaffolding/staging, the following measures shall be considered:

i. Sufficient sills or under pinning in addition to base plates shall be provided particularly where scaffolding are erected on soft grounds.

ii. Adjustable bases to compensate for uneven ground shall be used.

iii. Proper anchoring of the scaffolding/staging at reasonable intervals shall be provided in each direction with the main structure wherever available.

iv. Horizontal braces shall be provided to prevent the scaffolding / staging from rocking.

v. Diagonal braces shall be provided continuously from bottom to top between twoadjacent rows of uprights.

vi. The scaffolding / staging shall be checked at every stage for plumb line.

vii. Wherever the scaffolding / staging is found to be out of plumb line it shall be dismantledand re-erected afresh and effort shall not be made to bring it in line with a physical force.

viii. All nuts and bolts shall be properly tightened and care shall be taken that all clamps/couplings are firmly tightened to avoid slippage

ix. Erection work of a scaffolding/staging under no circumstances shall be left totally to semi-skilled or skilled workmen and shall be carried out under the supervision of a technically qualified civil Engineer of the Contractor.

x. For smaller works or works in remote areas, wooden ballies may be permitted for scaffolding / staging by the Employer at his sole discretion. The Contractor must ensure the safety and suitability of such works as described above.

(f) Exposed Concrete Work

Finishing

Repairing to exposed concrete work shall be avoided. Rendering and plastering shall not be done. Minor repairing, if unavoidable shall be done.

7.4 Reinforcement

Reinforcement Steel

(a) General

Reinforcement bars, if supplies are arranged by contractor unless otherwise specified, shall be either plain round mild steel bars grade I as per IS 432 (Part I) or medium tensile steel bar as per IS 432 (Part I) or hot rolled mild steel and medium tensile steel deformed bars as per IS 1139 or cold twisted steel bars as per IS 1786, as shown and specified on the drawings. Wire mesh or fabric shall be in accordance with IS 1566. Substitution of reinforcement will not be permitted except upon written approval from Engineer-in-Charge

Plain round mild steel bars grade II as per IS 432 (Part I) may be used with prior approval of Engineer-in-Charge in writing and with 10% increase in the reinforcement area but its use shall not be permitted in structures located in earthquake zones subjected to severe damage (as per IS 1895) and for structures subject to dynamic loading (other than wind loading), such as frames supporting rotary or reciprocating machinery, etc.

All reinforcement shall be clean, free from grease, oil, paint, loose mill scale, loose rust, dust, bituminous material or any other substances that will destroy or reduce the bond. All rods shall be thoroughly cleaned before being fabricated. Pitted and defective rods shall not be used.

All concrete in the works shall be of design mix as defined in IS 456, unless it is a nominal mix concrete such as 1:3:6, 1:4:8 or 1:5:10. Whether reinforced or otherwise, all design mix concrete works to be carried out under this specification shall be divided into the following classifications:

Providing, fabricating and placing in position reinforcement steel

The quality of the steel shall be as mentioned in the materials section. The bars shall be fabricated as per the drawings and binding with 16 gauge GI binding wire etc. Laps and splices for reinforcement shall be as shown on the drawings. Splices in adjacent bars shall be approved by Engineer-in-Charge . The bars shall not be lapped unless the length required exceeds the maximum available lengths of bars at site.

(b) Bending

Reinforcing bars supplied bent or in coils, shall be straightened before they are cut to size. Straightening of bars shall be done in cold and without damaging the bars. This is considered as a part of reinforcement binding fabricating work.

All bars shall be accurately bent according to the sizes and shapes shown on the detailed working drawings/bar bending schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and rebent in a manner that will injure the material, bars containing cracks or splits shall be rejected. They shall be bent cold, except bars of over 32 mm in diameter which may be bent hot if specifically approved by Engineer-in-Charge . Bars bent hot shall not be heated beyond cherry red colour (not exceeding 845oC) and after bending shall be allowed to cool slowly without quenching. Bars incorrectly bent shall be used only if the means used for straightening and rebending shall not injure the material. No reinforcement shall be bent when in position in the work without approval whether or not it is partially embedded in hardened concrete. Bars having kind or bends other than those required by design shall not be used.

(c) Fixing

Reinforcement shall be accurately fixed by any approved means and maintained in the correct position shown in the drawings by the use of block, spacers and chairs as per IS 2502 to prevent displacement during placing and compaction of concrete. Bars intended to be in contact at crossing points shall be strongly bound together at all such points with two no. 16 gauge anhealed soft iron wire. The vertical distance required between successive layers of bar in beams or other members shall be maintained by providing of mild steel spacer bars at such intervals that the main bars do not perceptibly sag between adjacent spacer bars.

(d) Cover

Unless indicated otherwise on the drawings, clear concrete cover for reinforcement (exclusive of plaster or other decorative finish) shall be as follows:

i. At each end of reinforcing bar, not less than 25 mm nor less than twice the diameter of the bar whichever is less.
ii. For a longitudinal reinforcing bar in a column, not less than 40 mm, nor less than the

diameter of the bar. In case of columns of minimum dimensions of 20 cm or under, with reinforcing bars of 12 mm and less in diameter, a cover of 25 mm may be used.

iii. For longitudinal reinforcing bars in a beam 25 mm nor less than the diameter of the bar.

iv. For tensile, compressive, shear, or other reinforcement in a slab or wall not less than 12 mm nor less than the diameter of such reinforcement.

v. For any other reinforcement not less than 12 mm nor less than the diameter of such reinforcement.

vi. For footings and other principal structural members in which the concrete is deposited directly against the ground, cover to the bottom reinforcement shall be 75 mm. If concrete is poured on a layer of lean concrete the bottom cover may be reduced to 50 mm.

vii. For concrete surfaces exposed to the weather or the ground after removal of forms, such as retaining walls, footing sides and top, etc., not less than 50 mm for bars larger than 16 mm dia and not less than 40 mm for bars 16 mm dia or smaller.

viii. Increased cover thickness shall be provided, as indicated on the drawings, for surfaces exposed to the action of harmful chemicals (or exposed to earth contaminated by such chemical, acid, alkali, saline atmosphere, sulphurous smoke, etc.

ix. For reinforced concrete members, totally or periodically immersed in sea water or subject to sea water spray, the cover of concrete shall be 50 mm more than those specified in (i) to (v) above.

x. For liquid retaining structures the minimum cover to all steel shall be 40 mm or the diameter of the main bars, whichever is greater. In the presence of sea water and soils and waters of a corrosive character the cover shall be increased by 10 mm.

xi. Protection to reinforcement in case of concrete exposed to harmful surroundings may also be given by providing a dense impermeable concrete with approved protective coatings, as specified by the Engineer-in-Charge .

xii. The correct cover shall be maintained by cement mortar cover blocks. Reinforcement for footings, beams and slabs on sub-grade shall be supported on precast concrete blocks as approved by Engineer-in-Charge . The use of pebbles or stones shall not be permitted.

(e) Inspection

Erected and secured reinforcement shall be inspected, jointly measured and recorded and approved by Engineer-in-Charge prior to placement of concrete.

(f) Grouting

The base plates of all the steel structures shall be grouted to thickness as shown on the relevant structural drawings of Contractor, after the alignment and approval of the Employer. The grout shall consist of either

i. 1:2 (1 Cement: 2 Sand) mortar for operating platforms (not supporting Equipment), pipe supports upto 2.5m in height (above concrete top), cross-over, stair cases and ladders. or

ii. Free flow non shrink Grout (Pre-mix type) of compressive strength not less than 40/mm^2 for all structures other than those covered in (i) above, as per the instructions / recommendations of the manufacturer.

7.5 Admixtures

(a) General

All concrete admixtures shall in general comply with the following Indian standards unlessotherwise stipulated in this specification.

- Specification for integral cement water proofing compounds: IS:2645
- Specification for other admixtures for concrete: IS:9103

Generally, admixtures shall have ISI certification marks. However, even in case of BIScertified admixtures, Employer may require the Contractor to carry out and submit any or all the tests (as specified in relevant IS Codes), from approved laboratories, over and above the manufacturer's test certificate, before giving his final approval.

Bitumen/Bituminous Materials

Bitumen to be used for various types of work shall meet all the requirements of relevant IS Codes as given below:

Specification of Paving Bitumen	IS:73
Specification for bitumen mastic for flooring	IS:1195
Specification for bitumen felts for water proofing and dampproofing	IS:1322
Specification for Bituminous compounds for water proofing andcaulking purposes	IS:1834
Specification for preformed fillers for expansion joint in concretepavements and structures	IS:1838
Specification for bitumen mastic for use in water proofing of roofs	IS:3037
Specification for bitumen primer for use in water proofing anddamp proofing	IS:3384
Specification for Bitumen Mastic for Tanking and Damp proofing	IS:5871
Specification for Glass fibre base coal tar pitch & bitumen felts	IS:7193
Code of practice for damp proofing using bitumen mastic	IS:7198
Specification for bitumen Mastic, Anti Static and electricallyconducting grade	IS:8374

The type and grade shall be as shown on the drawings or as directed by Employer. Tests and acceptable criteria shall be as per relevant IS Codes.

7.6 Bricks

Brick Masonry Works

(a) General

This specification establishes the materials, dressing, laying, joining, curing, workmanship etc. for brick masonry works. Brick masonry shall also comply with all the requirements of IS: 2212.

(b) Cement Mortar

Cement mortar shall meet the requirements of IS: 2250 and shall be prepared by mixing cement and

sand by volume. Proportion of cement and sand shall be 1:6 (1 part of cement and 6 parts of sand), or as directed by the Employer for brick masonry of one brick thicknessor more, while 1:4 cement mortar (1 part of cement and 4 parts of sand) shall be used for brick masonry of half brick thickness. The sand being used for mortar shall be sieved. The mortar shall be used as soon as possible after mixing and before it has begun to set and in any case within initial setting time of cement after water is added to the dry mixture. Mortar unused for more than initial setting time of cement, shall be rejected and removed from the site of work.

(c) Proportioning

The unit of measurement for cement shall be a bag of cement weighing 50 kg and this shall be taken as 0.035 cubic metre. Sand shall be measured in boxes of suitable size on the basisof its dry volume. In case of damp sand, its quantity shall be increased suitably to allow for bulkage.

(d) Mixing

The mixing of mortar shall be done in a mechanical mixer operated by power.

(e) Mixing in Mechanical Mixer

Cement and sand in specified proportions, by volume, shall be thoroughly mixed dry in a mixer. Water shall then be added gradually and wet mixing continued for at least one minute. Care shall be taken not to add more water than that which shall bring the mortar tothe consistency of stiff paste. Wet mix from the mixer shall be unloaded on water-tight masonry platform, made adjacent to the mixer. Platform shall be at least 150 mm above thelevelled ground to avoid contact of surrounding earth with the mix. Size of the platform shallbe such that it shall extend at least 300mm all-round the loaded wet mix area. Wet mix, so prepared, shall be utilised within initial setting time (thirty (30) minutes for ordinary Portlandcement conforming to IS: 269 after addition of water. Mixer shall be cleaned with water eachtime before suspending the work.

(f) Construction Procedure

Soaking of Bricks

Bricks shall be soaked in water before use for a period that is sufficient for the water to justpenetrate the whole depth of bricks as well as to remove dirt, dust and sand. Proper soakingof bricks shall prevent the suction of water from the wet mortar, as otherwise mortar will dry out soon and crumble before attaining any strength. The bricks shall not be too wet at the time of use as they are likely to slip on mortar bed and there will be difficulty in achieving the plumbness of wall as well as proper adhesion of bricks to mortar. The period of soaking shall be determined at site by a field test by immersing the bricks in water for different periods and then breaking the bricks to find the extent of water penetration. The least period that corresponds to complete soaking, will be the one, to be allowed for in the construction work.

The soaked bricks shall be removed from the tank, sufficient early, so that at the time of laying, they are skin dry. The soaked bricks shall be stacked over a clean place, wooden planks or masonry platforms to avoid earth, dirt being smeared on them.

Laying

Brick Work (one or more brick thickness)

Brick work (one or more brick thickness) shall be laid in English Bond unless otherwise specified. Half or cut bricks shall not be used except when needed to complete the bond. Inno case the defective bricks shall be used.

A layer of average thickness of 10mm of cement mortar shall be spread on full width over asuitable

length of lower course or the concrete surface. In order to check and achieve uniformity in masonry, the thickness of bed joints shall be such that four courses and three joints taken consecutively shall measure equal to four times the actual thickness of the brick plus 30mm. Each brick with frog upward, shall be properly bedded and set in position by gently tapping will) handle of trowel or wooden mallet.Its inside faces shall be buttered with mortar before the next brick is laid and pressed against it. Aftercompletion of the course, all vertical joint shall be filled from top with mortar.

All brick courses shall be taken up truly plumb; if battered, the batter is to be truly maintained. All courses shall be laid truly horizontal and vertical joints shall be truly vertical. The level and verticalityof work in walls shall be checked up at every 1 m interval.

Brick Work (half brick thickness)

For brick walls of half brick thickness, all courses shall be laid with stretchers. Wall shall be reinforced with 2 nos. - 6mm diameter mild steel reinforcement bars, placed at every fourth course. The reinforcement bars, shall be straightened and thoroughly cleaned. Half the mortar thickness for the bedding joint shall be laid first and mild steel reinforcement, one on each face of the wall, shall be embedded, keeping a side cover of 12mm mortar. Subsequently, the other half of the mortar thickness shall be laid over the reinforcement covering it fully.

The reinforcement bars shall be carried at least 150mm into the adjoining walls or RCC columns. In case the adjoining wall being of half brick thickness, the length of bars shall be achieved by bending the bars in plan. During casting of reinforced concrete columns, 6mm dia. M.S. reinforcing bar shall be placed at every fourth course of brick masonry. At the junction of two walls, the brick shall, at each alternate course, be carried into each of the respective walls so as to thoroughly unite the work. The brick masonry work shall not be raised more than 14 courses per day.

Brick course under the soffit of beam or slab, shall be laid by restricting the mortar thicknessto 12mm. However, any gap between the finished brickwork and soffit of slab/beam, shall be suitably sealed with the mortar.

Jointing

Joints shall be restricted to a width of 10mm with brickwork of any classification. All bed joints shall be normal to the pressure upon them i.e. horizontal in vertical walls, radial in circular brick masonry and at right angles to the face in the battered retaining walls. The vertical joints in alternate courses shall come directly one over the other and shall be truly vertical. Care shall be taken that all the joints are full of mortar, well flushed up. In case no pointing is to be done, cement mortar shall be neatly struck as the work proceeds. The joints in faces which are to be plastered or pointed shall be squarely raked out to a depth of 12mm while the mortar is still green. The rake joints shall be brushedto remove loose particles. After the day's work, the faces of the brick work shall be cleaned on the same day with wire brush and all mortar droppings removed.

Curing

Green work shall be protected from rain or any other running water or accumulated water from any source, by suitable means. Masonry work, as it progresses, shall be kept thoroughly wet by sprinklingwater at regular intervals, on all faces. Curing shall be done after 24 hoursof completion of day's work and shall be done for atleast 10 days after completion. Proper watering cans with spray nozzles,rubber or PVC pipes shall be used for this purpose.

7.7 Structural Steel Work

(a) General

This section includes requirements of all structural steel work required for the completion of the Works.

All structural steel used by the Contractor for the construction shall conform to relevant IS codes orequivalent and described in this specifications. If deviation or a substitution of material is sought, the Contractor shall submit written request to Employer along with necessary supporting documents including test results, manufacturer's certificate, etc. along with reasonable time for evaluation without disruption of the construction schedule. It shall be the Contractor's responsibility to satisfy the Employer that his proposed deviation or substitution will in no way be detrimental to the quality of the works intended in the Contract. In case of any doubt the Employer may ask for additional information, testing or retesting which the Employer may feel necessary,which the Contractor shall carry out to the Employer approval and with no impact on the construction schedule.

It shall be noted that site fabrication and painting of steel members shall not be allowed. The Contractor has to make his arrangements accordingly.

Structural steel to be used for general structural purposes shall be of grade A conforming toIS: 2062.

Structural steel sections shall conform to following IS specifications.

Steel tubes for structural purposes	IS:1161
Mild Steel Tubes, tubulars and other wrought steel fittings	IS:1239
Hollow steel sections for structural use	IS:4923
Steel Sheet	IS:1730
Structural steel beam, channels, equal and unequal angles	SP: 6(1) 1964

Miscellaneous Steel Materials

Miscellaneous steel materials, if required shall be conforming to the following IS specifications.

Expanded Metal Steel Sheets for General purposes	IS:412
Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement (grade I) (for mild steel barsof anchor bolts, rungs, metal inserts, grating etc.)	IS:432
Hexagonal head bolts, screws & nets of product grade C	IS:1363
Cold formed light gauge structural steel sections	IS:811
Technical supply conditions for threaded steel fasteners	IS:1367
Plain washers	IS:2016
Steel wire ropes for general Engineering purposes	IS:2266
Thimbles for wire ropes	IS:2315
Bulldog grips	IS:2361
Mild Steel Tubes, tubulars and other wrought steel fillings. (For Hand rail tubular sections).	IS:1239
Drop forged sockets for wire ropes for general Engineering purposes	IS:2485
Steel chequered plates	IS:3502

Hexagonal bolts and nuts (M42 to M150)	IS:3138
Electrode for welding shall be used conforming	IS: 814
Hollow tube	IS: 4923

Anchor Bolts

Material for Anchor Bolts such as MS bars, washers, nuts, pipe sleeves and plates etc. shall be as per relevant IS Codes mentioned above.

Storage

The storage of all materials at site of work shall be at the Contractor's expense and risk and shall bedone as per the requirements given in IS: 4082. The Contractor shall maintain the proper records ofreceipt/consumption. The records shall always be accessible to the Employer for verification.

The reinforcement bars, structural steel sections and other miscellaneous steel materials etc., shall be stored in such a way as to avoid and prevent deterioration, corrosion, bending, twisting and wrapping.

Tests after Delivery

Materials procured by the Contractor, shall, after delivery at site and at the discretion of Employer, be subjected to any or all of the tests, required by the relevant IS Codes. The Contractor shall carry out and bear the cost of such tests. The Contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense.

Rejection

The Employer may reject at his direction any material, notwithstanding the manufacturer's certificate, failing to meet the requirements of relevant IS Codes for testing of materials.

(b) Aerated Cement Panels

Providing and fixing in position factory made non asbestos fibre reinforced aerated cement sandwich wall light weight solid core panels made of light weight cement concrete core composed of OPC cement, pulverized flyash, quick lime, cotton pulp & Gypsum in mortar state mixed with aeration agent in a preset mould. The outer face on both sides of the panels will be non asbestos fibre cement board confirming to IS 14862:2000. These solid wall panels are installed using Galvanized iron steel tracks/C channel of 1mm thick of required sizes as recommended by manufacturer's and fixed to floor and roof soffit in plumb to each other with steel screw/ fasteners. The panel shall be fixed vertically with tongue & groove joint with cement based polymer modified jointing compound. The exposed surface finished with fibre mesh/glass fibre tape with polymer based jointing compound having superior flexibility. Non load bearing panels 75mm thick of required size (minimum 5mm thick fibre cement board).Frame work shall be provided with Anticorrosive protective coated MS tubular sections.

7.8 Joinery Works

ALUMINIUM WORK

Sl. No. IS Code Subject

IS 733 : Wrought Aluminium and Aluminium Alloys, Bars, Rods and Sections (For General Engineering Purposes) -Specification

IS 737: Wrought Aluminium and Aluminium alloy sheet and strip for general Engineering

purposes -Specification

IS 1285: Wrought Aluminium and Aluminium Alloy, Extruded Round Tube and Hollow sections (For General Engineering Purposes) -Specification

IS 1868: Anodic coating on Aluminium and its Alloys-Specification

IS 1948: Specification for Aluminium Doors, Windows and Ventilators

IS 3908: Specification for Aluminium equal leg angles

IS 3909: Specification for Aluminium unequal leg angles

IS 3965: Dimensions for wrought Aluminium and Aluminium Alloys bars, rods and sections.

IS 5523: Method of testing anodic coating on aluminium and its alloys.

IS 6012: Measurement of coating thickness by Eddy Current Method

IS 6315: Floor springs (Hydraulically regulated) for heavy doors-Specifications

IS 6477: Dimensions of extruded hollow section and tolerances

IS 12823: Wood products- Pre-laminated particle board – Specifications.

IS 14900: Transparent Float glass- Specifications

7.9 Structural Steel Tube

These shall be of:

Hot finished welded (HFW) type, or

Hot finished seamless (HFS) type, or

Electric resistance or induction butt welded (ERW), YST 310

Conforming to the requirement of IS 4923. These shall be light, medium or heavy as specified depending upon the wall thickness. They shall be free from cracks, surface flaws, laminations and other defects. The ends shall be cut clean and square with axis of tube, unless otherwise specified.

(a) Minimum Thickness of Metals

Wall thickness of tubes used for construction exposed to weather shall be not less than 4 mm and for construction not exposed to weather it shall be not less than 3.2 mm where structures are not readily accessible for maintenance, the minimum thickness shall be 5 mm.

(b) Fabrication

The component parts of the structure shall be assembled in such a manner that they are neither twisted nor otherwise damaged and be so prepared that the specified cambers, if any, are, maintained. The tubular steel work shall be painted with one coat of approved steel primer after fabrication. All fabrication and welding is to be done in an approved workshop. The joint details shall be generally as per S.P-38 of B.I.S publication.

(c) Straightening

All material before being assembled shall be straightened, if necessary, unless required to be of curvilinear form and shall be free from twist.

(d) Bolting

•Washers shall be specially shaped where necessary, or other means, used to give the nuts and the heads of bolts a satisfactory bearing.

•In all cases, where the full area of the bolts is to be developed, the threaded portion of the bolt shall not be within the thickness of the parts bolted together and washers of appropriate thickness shall be provided to allow the nuts to be completely tightened.

(e) Welding

- Where welding is adopted, it shall be as per IS 816.
- Caps and Bases for Columns
- The ends of all the tubes, for columns transmitting loads through the ends, should be true and square to the axis of the tubes and should be provided with a cap or base accurately fitted to the end of the tube and screwed, welded or shrunk on. The cap or base plate should be true and square to the axis of the column.

(f) Sealing of Tubes

•When the end of a tube is not automatically sealed by virtue of its connection be welding to another member the end shall be properly and completely sealed. Before sealing, the inside of the tubes should be dry and free from loose scale.

(g) Flattened Ends

•In tubular construction the ends of tubes may be flattened or otherwise formed to provide for welded. Riveted or bolted connections provide that the methods adopted for such flattening do not injure the material. The change of sections shall be gradual.

(h) Hoisting and Erection

- Tubular trusses shall be hoisted and erected in position carefully, without damage to themselves, other structure, equipment and injury to workman. The method of hoisting and erection proposed to be adopted shall be got approved from the Engineer-in-Charge. The contractor shall however be fully responsible, for the work being carried out in a safe and proper manner without unduly stressing the various members. Proper equipment such as derricks, lifting tackles, winches, ropes etc. shall be used.

(i) Providing and fixing inserts in concrete works

Inserts are required to be fixed/embedded as indicated in construction drawings and/or as directed by Engineer-in-Charge in foundations, columns and other miscellaneous concrete works. These inserts comprise plates, angles, pipe sleeves, anchor bolt assemblies, etc.

The rate quoted by the Tenderer shall hold good for accurately fixing the inserts at the correct levels/alignment and shall include for the cost of any temporary or permanent supports/anchors such as bars including cutting, bending, welding, etc. as required.

Steel templates shall be used by Contractor to locate and very accurately position bolts, group of bolts, inserts, embedded parts, etc. at his cost. Such templates shall be previously approved by the Engineer-in-Charge . Templates shall invariably be supported such that the same is not disturbed due to vibration, movement of labourers, materials, shuttering work, reinforcement, etc. while concreting. The Contractor will have to suitably bend, cut or otherwise adjust the reinforcement in concrete at the locations of inserts as directed by the Engineer-in-Charge at no extra cost to OWNER. If the Engineer-in-Charge so directs, the inserts will have to be welded to reinforcement to keep them in place. Contractor shall be responsible for the accuracy of dimensions, levels, alignments and centre lines of the inserts in accordance with the drawings and for maintenance of

the same until the erection of equipment/structure or final acceptance by Owner.

Contractor shall ensure proper protection of all bolts, inserts, etc. from weather and other damages by greasing or other approved means such as applying white lead putty and wrapping them with gunny bags or canvas or by other means as directed by Engineer-in-Charge to avoid damage due to movement of his labourers, material, equipment, etc. No extra claim from the Contractor on this account shall be entertained. Contractor shall be solely responsible for all the damages caused to bolts, inserts, etc. due to his negligence and in case damages do occur, they shall be rectified to the satisfaction of Engineer-in-Charge at the Contractor's cost.

(j) Steel Work In Built Up Sections (Riveted and Bolted)

The steel work in built up section (Riveted and bolted) such as trusses, framed work etc. is specified in this clause.

(k) Laying Out

A figure of the steel structure to be fabricated shall be drawn on a level platform to full scale. This may be done in full or in parts, as shown on drawings or as directed by the Engineer-in-Charge. Steel tape shall be used for measurements.

(l) Fabrication

Fabrication shall generally be done as specified in IS 800. In major works or where so specified, shop drawings giving complete information for the fabrication of the component parts of the structure including the location, type, size, length and details or rivets, bolts or welds, shall be prepared in advance of the actual fabrication and approved by the Engineer-in-Charge. The drawings shall indicate the shop and field rivets, bolts and welds. The steel members shall be distinctly marked or stenciled with paint with the identification marks as given in the shop drawings.

Great accuracy shall be observed in the fabrication of various members, so that these can be assembled without being unduly packed, strained or forced into position and when built up, shall be true and free from twist, kinks, buckles or open joints. Wooden or metal sheet templates shall be made to correspond to each member, and position of rivet holes shall be marked accurately on them and holes drilled. The templates shall then be laid on the steel members, and holes for riveting and bolting marked on them. The ends of the steel members shall also be marked for cutting as per required dimensions. The base of steel columns and the positions of anchor bolts shall be carefully set out at the required location.

The steel section shall be straight or to be straightened or flattened by pressure unless required to be of curvilinear form and shall free from twists. These shall be cut square either by shearing or sawing to correct length and measured by steel tape. No tow pieces shall be welded or joined to make up for the required length of member.

Making Holes: Holes through more than one thickness of materials for members, such as compound stanchion and girder flanges shall, where possible, be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, provided the holes are punched 3mm less in diameter than the required size and reamed after assembly to the full diameter. The thickness of material punched shall be not greater than 16 mm.

(m) Rivet Holes

The diameter for rivets and black bolts holes shall be taken as the nominal diameter of a rivet/ black bolts plus 1.5 mm for rivets/ bolts of nominal diameter less than or equal to 25mm" and 2.0 mm for rivets of nominal diameter exceeding 25 mm, unless specified otherwise. Holes for turned and fitted bolts shall be drilled or reamed large by 0.2 to 8 mm depending upon the dia. of bolts. Holes shall

have their axis perpendicular to the surface bored through. The drilling or reaming shall be free from burrs, and the holes shall be clean and accurate. Holes for rivets and bolts shall not be formed by gas cutting process.

Holes for counter sunk bolts shall be made in such a manner that their heads sit flush with the surface after fixing.

Assembly : Before making holes in individual members, for fabrication and steel work intended to be riveted or bolted together shall be assembled and clamped properly and tightly so as to ensure close abutting, or lapping of the surfaces of the different members. All stiffeners shall be fixed (or placed) tightly both at top and bottom without being drawn or caulked. The abutting joints shall be cut or dressed true and straight, and fitted close together.

Web plates of girders, which have no cover flange plates, shall have their ends flush with the tops of angles unless otherwise required. The web plate when spliced, shall have clearance of not more than 5mm. The erection clearance of cleated ends of members connecting steel to steel shall preferably be not greater than 1.5 mm. The erection clearance at the ends of beams without web cleats shall not be more than 3 mm at each end but where for practical reasons, greater clearance is necessary, seating designed suitably shall be provided.

Column splices and butt joints of struts and compression members requiring contact for tress transmission shall be accurately, machined and close butted over the whole section. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc. after riveting together shall be accurately machined so that the parts connected, butt against each other over the entire surfaces of contact. Connecting angles or channels shall be fabricated and placed in position with great accuracy so that they are not unduly reduced in thickness by machining. The ends of all bearing stiffeners shall be machined or grounded to fit tightly both at top and bottom.

(n) Riveting: Rivets shall be used, where slip under load has to be avoided.

Preliminaries before Rivetings: - Members to be riveted shall have all parts firmly placed and held together before and during riveting, and special care shall be taken in this respect for all single riveted connections. For multiple riveted connections, a service bolt shall be provided in every third or fourth hole.

Process of Riveting

The riveting shall be carried out by using machines of the steady pressure type. However, where such facilities are not available hand riveting may be permitted by the Engineer-in-Charge. The rivets shall be heated red hot, care being taken to control the temperature of heating so as not to burn the steel. Rivets of diameter less than10mm may be driven cold. Rivets shall be finished neat with heads full and of equal size. The heads shall be central on shanks and shall grip the assembled members firmly. All loose, burnt, or badly formed rivets with eccentric or deficient heads shall be cut out and

replaced. In cutting out rivets, care shall be taken so as not to injure the assembled members. Caulking and recapping shall not be permitted.

For testing rivets, a hammer weighing approx. 0.25 kg shall be used and both heads of the rivet (Specially the machine head) shall be tapped. When so tested, the rivets shall not give a hollow sound and a jar where so specified, other tests shall be carried out to ensure the soundness of rivets. All rivets heads shall be painted with approved steel primer paint within a week of their fixing.

(o) Bolting: The nominal length of the bolt shall be the distance from the underside of the head to the further end of the shank. The nominal diameter of the bolt shall be the diameter at the shank above the screwed threads. Bolts, nuts and washers shall be thoroughly cleaned and dipped in double boiled linseed oil, before use. All bolts heads and nuts shall be hexagonal unless specified otherwise. The screwed threads shall conform to IS 1363 and the threaded surface shall not be tapered. The bolts shall be of such length as to project at least two clear threads beyond the nuts when fixed in position, and these shall fit in the holes without any shake. The nuts shall fit in the threaded ends of bolts properly. Where necessary, washers shall be tapered or otherwise suitably shaped to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project through the nut at least two thread. In all cases where the full bearing area of the bolt is to be developed, the bolt shall be provided with a washer of sufficient thickness under the nuts to avoid any threaded portion of the bolt being within the thickness of the parts bolted together.

Where there is a risk of the nuts being removed or becoming loose due to vibrations or reversal of stresses, these shall be secured from slackening by the use of lock nut, spring washers as directed by the Engineer-in-Charge.

(p) Erection

Steel members shall be hoisted and erected in position carefully, without any damage to itself, other structures and equipment and injury to workmen. The method of hoisting and erection proposed to be adopted by the contractor shall be got approved from the Engineer-in-Charge in advance. The contractor however shall be fully responsible for the work being carried out in a safe and proper manner without unduly stressing the various members and proper equipment such as derricks, lifting tackles, winches, ropes etc. shall be used.

The work of erection may be done in suitable units as may be directed by the Engineer-in-Charge. Fabricated members shall be lifted at such points so as to avoid deformation or excessive stress in members. The structure or part of it placed in position shall be secured against over-turning or collapse by suitable means. During execution, the steel members shall be securely bolted or otherwise fastened when necessary temporarily braced to provide for all loads including those due to erection equipments and its operation to be carried safely by structure during erection. The steel members shall be placed in proper position as per approved drawing, final riveting or permanent bolting shall be done only after proper alignment has been checked and confirmed.

Trusses shall be lifted only at nodes. The trusses above 10 m in span shall not be lifted by slinging at two mid points of rafters, which shall be temporary braced by a wooden member of a suitable section. After the trusses are placed in position, purlins and wind bracings shall be fixed as soon as possible. The end of the truss which faces the prevailing winds shall be fixed with holding down bolts, and the other end kept free to move. In case of trusses of spans upto 10m the free end of the truss shall be laid on lead sheet or steel plate as per design, and the holes for holding down bolts shall be made in the form of oblong slots so as to permit the free movements of the truss end. For larger spans the truss shall be provided with proper bearing as per design.

Columns and stanchions shall be erected truly vertical with the necessary cross bracing etc. and the base shall be properly fixed with the foundation concrete by means of anchor bolts etc. as per drawing.

Anchor bolts to be placed in the concrete foundation should be held in position with a wooden template. At the time of concreting anchor bolt locations shall be provided with suitable timber mould or pipe sleeve to allow for adjustment which shall be removed after initial setting of concrete. The spaces left around anchor bolts shall be linked to a stopping channel in the concrete leading to the side of the pedestal and on the underside of the base plate to allow the spaces being grouted up after the base plate is fixed in the position along with the column footing. Grouting shall be of cement mortar 1:3(1 cement: 3 coarse sand) or as specified.

Bedding of Column, Stanchions etc.:- Bedding shall not be carried out until the steel work has been finally levelled, plumbed and connected together. The stanchion shall be supported on steel wedges and adjusted to make the column plumb. For multistoried buildings, the bedding shall not be done until sufficient number of bottom lengths of stanchions have been properly lined, levelled and plumbed and sufficient floor beams are fixed in position. The base plates shall be wedged clear of the bases by M.S. wedges and adjusted where necessary to plumb the columns. The gaps under the base plate may be made upto 25 mm which shall be pressure grouted with cement grouts. With small columns, if permitted by the Engineer-in-Charge, the column base shall be floated on a thick cement grout on the concrete pedestal. The anchor bolt holes in the base plate may be made about 10 to 15 mm larger than the bolts. In such cases suitable washers shall be provided.

(q) Painting

Before the members of the steel structure are placed in position or taken out of the workshop these shall be painted as specified.

(r) STEEL WORK IN BUILT UP SECTION (WELDED)

The steel work in built up sections (welded) such as in trusses, form work etc. is specified in this clause.

Laying out

It shall be as specified.

Fabrication

Straightening, shaping to form, cutting and assembling, shall be as per 10.3.2 as far as applicable, except that the words “riveted or bolted” shall be read as “welded” and holes shall only be used for the bolts used for temporary fastening as shown in drawings.

Welding: Welding shall generally be done by electric arc process as per IS 816 and IS 823.

The electric arc method is usually adopted and is economical. Where electricity for public is not available generators shall be arranged by the contractor at his own cost unless otherwise specified. Gas welding shall only by resorted to using oxyacetylene flame with specific approval of the Engineer-in-Charge. Gas welding shall not be permitted for structural steel work Gas welding required heating of the members to be welded along with the welding rod and is likely to create

temperature stresses in the welded members. Precautions shall therefore be taken to avoid distortion of the members due to these temperature stresses. The work shall be done as shown in the shop drawings which should clearly indicate various details of the joint to be welded, type of welds, shop and site welds as well as the types of electrodes to be used. Symbol for welding on plans and shops drawings shall be according to IS 813. As far as possible every efforts shall be made to limit the welding that must be done after the structure is erected so as to avoid the improper welding that is likely to be done due to heights and difficult positions on scaffolding etc. apart from the aspect of economy. The maximum dia of electrodes for welding work shall be as per IS 814. Joint surfaces which are to be welded together shall be free from loose mill scale, rust, paint, grease or other foreign matter, which adversely affect the quality of weld and workmanship.

Precautions: All operation connected with welding and cutting equipment shall conform to the safety requirements given in IS 818 for safety requirements and Health provision in Electric and gas welding and cutting operations.

Operation, Workmanship and process of Welding is described in Part 3, Inspection and testing of welds shall be as per IS 822.

Assembly: Before welding is commenced, the members to be welded shall first be brought together and firmly clamped or tack welded to be held in position. This temporary connection has to be strong enough to hold the parts accurately in place without any disturbance. Tack welds located in places where final welds will be made later shall conform to the final weld in quality and shall be cleaned off slag before final weld is made.

Erection: The specification shall be as described except that while erecting a welded structure adequate means shall be employed for temporary fastening the members together and bracing the frame work until the joints are welded. Such means shall consists of applying of erection bolts, tack welding or other positive devices imparting sufficient strength and stiffness to resist all temporary loads and lateral forces including wind. Owing to the small number of bolts ordinarily employed for joints which are to be welded, the temporary support of heavy girders carrying columns shall be specially attended.

Different members which shall be fillet welded, shall be brought into as close contact as possible. The gap due to faulty workmanship or incorrect fit if any shall not exceed. 1.5 mm if gap exceeds 1.5 mm or more occurs locally the size of fillet weld shall be increased at such position by an amount equal to the width of the gap.

Painting: Before the member of the steel structures are placed in position or taken out of the workshop these shall be painted as specified.

Providing & Fixing MS holding down bolts

The MS holding down bolts of specified dia, length and shape shall be provided as per the drawings in line & level. These shall be fixed to RCC work or brick work by grouting it with concrete. The bolt shall be provided with nuts and washers. The grease shall be applied to the threaded portion with the help of templates. If the bolts need some adjustment it shall be provided with a wooden piece 75x75 mm or 50 mm dia GI pipe around bolt shall be provided at the time of concreting and shall be removed after initial set.

(s) MANHOLE COVERS & FRAMES

Manhole Covers

The covers and frames shall conform to IS 1726 for cast Iron and IS 12592 for pre-cast concrete covers and shall be of the following grades and types. Grades Grade Type/shape of cover Designation Light Duty LD - 2.5 Rectangular, Square, Circular Medium Duty MD - 10 Rectangular, Circular and Square (for pre-cast concrete manhole covers) Heavy Duty HD - 20 Circular-Square, Rectangular, (Scrapper Manhole) Extra Heavy Duty EHD - 35 Circular, Square, Rectangular, (Scrapper Manhole)

Cast Iron Manhole Covers and Frames

The covers and frames shall conform to IS 1726 for cast Iron manhole cover.

(i) Manhole covers and frame shall be manufactured from appropriate grade of grey cast iron not inferior than FG150 grade of IS 210.

(ii) They shall be cleanly cast and shall be free from air and sand holes, cold shuts and warping.

(iii) Covers shall have on its operative top a raised chequered design to provide for an adequate no-slip grip. The rise of chequers shall be not less than 4mm.

(iv) Key holes, keys and lifting devices shall be provided in the manhole covered to facilitate their placement in the frames and their operative maintenance.

(v) Manhole covers and frames shall be coated with materials having base with a black bituminous composition. The coating shall be smooth and tenacious. It shall not flow when exposed to temperature of 63°C and shall not be so brittle as to chip off at temperature of 0°C.

(vi) Size and shape and performance requirement of manhole covers and frames shall conform to IS 1726.

(vii) Each manhole covers and frame shall have cast on them the following information:

(a)Manufacturer's name or trade-mark

Grade designation

Date of manufacturer

The words SWD or 'Sewer' to denote 'storm water drain' or 'sewer' respectively

Identification marks as required by Engineer-in-Charge.

(viii) The cover shall be gas tight and water tight.

(ix) The sizes of covers specified shall be taken as the clear internal dimensions of the frame.

(x) The approximate weight of the various type of manhole covers and frames shall be as per IS 1726.

(xi) The cover shall be capable of easy opening and closing and it shall be fitted in the frame in workmanship like manner.

7.10 Flooring

(a) General

This section shall cover all flooring and wall tiling work and specified for different terminal buildings as given below.

S.No.	Building/Shed	Type of Flooring
1.	Terminal	AS per architectural drawing

2 Toilets As per architectural drawing

No work under this section shall be started until specifically allowed by the Employer and until all other major works such as plastering, embedding of conduits and pipes channels, window fixing etc. have been completed. Samples of basic materials and work of adequate size representing the nature of variation including quality, size, texture after finishing to be used in the flooring work shall be prepared for all work and got approved by the Employer sufficiently prior to ordering. The approved samples shall be retained up to the end of the project. The works shall be got done by skilled and specialized workmen experienced in the respective trade of work.

Reference shall be made to the following Indian Standards:

IS: 4971 Recommendations for selection of Industrial floor finishes

IS: 2114 Code of practice for laying in situ terrazzo floor finish.

IS: 1237 Specification for Cement concrete flooring tiles

IS: 777 Specification for glazed earthenware wall tiles

IS: 2571 Code of practice for laying in situ cement concrete flooring

(b) Workmanship

All sanitary ware shall be fixed in a neat workmanlike manner, true to the level and plumb. Manufacturer's instructions shall be followed closely regarding installation and commissioning.

(c) Protection of Fixtures

Fixtures shall be protected throughout the progress of the work from damage. Special care shall be taken to prevent damage and scratching of chromium plated fittings. Tool marks on chromium fixtures etc. shall not be accepted.

The Contractor while executing the Works shall follow good industry practice, which however shall meet the Employer's Requirements. The Contractor shall adhere to and honour the Conditions of the Contract in all respects. The specifications provided in the tender outlines the functional requirements and the operating characteristics which the equipment must fulfil. Alternative technical features other than those specified may be acceptable subject to the approval of the Employer. In any case, the performance of the system / equipment delivered shall be guaranteed in every detail by the Contractor. Overall dimensions (boundary dimensions) and functional requirements as specified shall be strictly adhered to. The scope of work outlined below and quantities indicated are for overall understanding of the Works, and does not absorb the Contractor from successful commissioning and operation of the Works with best available latest technology. Any item/equipment not listed but required for completion of the Works shall be considered as includedin the scope of the Contractor. The Contractor shall be deemed to have examined the site and familiarized himself with all existing site conditions. He shall accept the Site in the existing condition at the time of award of the Contract.

The Contractor shall also have to ensure that with the rise and fall of water level and with the changes of site condition i.e. erosion, de-siltation of the area, there may be a need to extend the jetty / change the orientation & location / shift of the site and the Contractor shall have to change the location accordingly as per the directions of the EIC. Re-construction of the ramp and connecting approach road will be done at other suitable locations if necessary by using fresh material as per variation in water level and site condition.

The Contractor shall make his own arrangements for protecting the works / materials during the course of execution of the work. During the process of work, the Contractor shall provide such precautionary and protective works at his own cost to protect arrangements from the weather conditions and the Contractor shall be solely responsible for any damage, which may occur due to the Contractor not taking necessary protective steps.

The Contractor shall forthwith dispatch, raise and remove any plant (floating or otherwise) belonging to him or any person employed by him which may be sunk in the course of execution and completion of the works or otherwise deal with the same as the EIC or his representative may direct, until the same shall be raised and removed, the Contractor shall display at night, search lights and do all such arrangements for the safe navigation nearby terminal area as may be required by the department. In the event of the Contractor not carrying out the obligations imposed by him under this clause, the EIC shall raise and remove the same (without prejudice to the right of the department to hold the contractor liable) and the Contractor shall pay to the department all costs incurred in connection herewith.

The progress of the work at each stage shall be subject to the approval of the EIC whose decision as to the rate of progress at each stage shall be final and binding on the Contractor. The EIC reserves himself to the right to cancel the contract for unsatisfactory progress in the work at any stage.

The Contractor shall maintain one Inspection Register in duplicate for recording details of materials and to be produced by the Contractor or his agent whenever called upon to do so by the EIC or his representative during their inspection of the work. One copy of the register shall be retained in the office of EIC.

The Contractor shall bear full responsibility for the intimation to the EIC forthwith of any accident and take all necessary action required under relevant Acts and Rules, Marine Rules etc. as the case may be. The Contractor shall also report such accidents to the Competent Authority wherever such reports are required under rules. The EIC or his representative must however, be informed immediately in the event of any marine accident. The Contractor should also bear full responsibility for all accident, damages or injury caused to any of the IWAI's employee, cause of which is established as due to Contractor's carelessness or negligence.

Transportation of men & material and delivery of the materials shall be under the scope of the Contractor. Any delays encountered in the transportation / mobilization of the men and material shall be accounted to the Contractor.

Note: The Bidder may visit the proposed locations for providing the required facility. It is deemed that the Bidder has visited the location and collected the required site

information and details prior to submitting of proposal. No claim what so ever shall be entertained in future on this account.

Applicable codes

1) IS: 1443- Code of practice for laying and finishing of cement concrete flooring tiles.

2) IS:2114 -Code of practice for laying in situ terrazzo floor finish

3) IS: 777 - Glazed earthenware tiles

(d) KOTA STONE FLOORING

(i) Kota Stone Slabs

The slabs shall be of selected quality, hard, sound, dense and homogeneous in texture free from cracks, decay, weathering and flaws. They shall be hand or machine cut to the requisite thickness.

They shall be of the colour indicated in the drawings or as instructed by the Engineer-in-Charge.

The slabs shall have the top (exposed) face polished before being brought to site, unless otherwise specified. The slabs shall conform to the size required. Before starting the work the contractor shall get the samples of slabs approved by the Engineer-in-Charge.

(ii) Dressing

Every slab shall be cut to the required size and shape and fine chisel dressed on the sides to the full depth so that a straight edge laid along the side of the stone shall be in full contact with it. The sides (edges) shall be table rubbed with coarse sand or machine rubbed before paving. All angles and edges of the slabs shall be true, square and free from chippings and the surface shall be true and plane.

The thickness of the slab after it is dressed shall be 20, 25, 30 or 40 mm as specified in the description of the item. Tolerance of ±2 mm shall be allowed for the thickness. In respect of length and breadth of slabs Tolerance of ± 5 mm for hand cut slabs and ± 2 mm for machine cut slabs shall be allowed.

(iii) Preparation of Surface and Laying

Base concrete or the RCC slab on which the slabs are to be laid shall be cleaned, wetted and mopped. The bedding for the slabs shall be with cement mortar 1:4 (1 cement: 4 coarse sand) or as given in the description of the item.

The average thickness of the bedding mortar under the slab shall be 20 mm and the thickness at any place under the slab shall be not less than 12 mm.

The slabs shall be laid in the following manner:

Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness specified in the item. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows. The mortar is allowed to harden a bit and cement slurry of honey like consistency shall be spread over the same at the rate of 4.4 kg of cement per sqm. The edges of the slab already paved shall be buttered with grey or white cement with or without admixture of pigment to match the shade of the marble slabs as given in the description of the item.

The slab to be paved shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slabs with as fine a joint as possible. Subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cement on the surface of the slabs shall be cleaned off. The flooring shall be cured for a minimum period of seven days. The surface of the flooring as laid shall be true to levels, and, slopes as instructed by the Engineer-in-Charge. Joint thickness shall not be more than 1 mm.

Due care shall be taken to match the grains of slabs which shall be selected judiciously having uniform pattern of Veins/streaks or as directed by the Engineer-in-Charge.

The slabs shall be matched as shown in drawings or as instructed by the Engineer-in-Charge.

Slabs which are fixed in the floor adjoining the wall shall enter not less than 12 mm under the plaster skirting or dado. The junction between wall plaster and floor shall be finished neatly and without waviness.

Kota slabs flooring shall also be laid in combination with other stones and/or in simple regular pattern/ design as described in item of work and/or drawing.

The edges of the slabs to be jointed shall be buttered with grey cement, with admixture of pigment to match the shade of the slab. The thickness of the joints should be minimum as possible. In any location, it shall not exceed 1 mm.

(iv) KOTA STONE IN RISERS OF STEPS, SKIRTING AND DADO

Kota Stone Slabs and Dressing shall be as specified above except that the thickness of the slabs shall be 25 mm or as specified in the description of the item. The slabs may be of uniform size if required.

Installation using approved adhesive as per manufactures specification. Curing, Polishing and Finishing shall be as specified above except that first polishing with coarse grade carborundum stone shall not be done.

(v) Pressed Ceramic Tiles

The tiles shall be of approved make and shall generally conform to IS 15622. They shall be flat, and true to shape and free from blisters crazing, chips, welts, crawling or other imperfections detracting from their appearance. The tiles shall be tested as per IS 13630.

Classification and Characteristics of pressed ceramic tiles shall be as per IS 13712.

The tiles shall be square or rectangular of nominal size. Table 1,3,5, and 7 of IS 15622 give the modular preferred sizes and table 2,4,6 and 8 give the most common non modular sizes. Thickness shall be specified by the manufacturer. It includes the profiles on the visible face and on the rear side. Manufacturer/supplier and party shall choose the work size of tiles in order to allow a nominal joint width upto 2mm for unrectified floor tiles and upto 1mm for rectified floor tiles. The joint in case of spacer lug tile shall be as per spacer. The tiles shall conform to table10 of IS 15622 with water absorption 3 to 6% (Group BII).

The top surface of the tiles shall be glazed. Glaze shall be either glossy or matt as specified. The underside of the tiles shall not have glaze on more than 5% of the area in order that the tile may adhere properly to the base. The edges of the tiles shall be preferably free from glaze. However, any glaze if unavoidable, shall be permissible on only upto 50 per cent of the surface area of the edges.

(e) Coloured Tiles

Only the glaze shall be coloured as specified. The sizes and specifications shall be the same as for the white glazed tiles.

(f) Decorative Tiles

The type and size of the decorative tiles shall be as follows :

(g) Decorated white back ground tiles

The size of these tiles shall be as per IS 15622.

(h) Decorated and having coloured back-ground

The sizes of the tiles shall be as per IS 15622.

Base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tile shall be with cement mortar 1:4 (1 cement: 4 coarse sand) or as specified. The average thickness of the bedding shall be 20 mm or as specified while the thickness under any portion of the tiles shall not be less than 10 mm.

Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable the mason to place wooden plank across and squat on it.

Over this mortar bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 3.3 kg of cement per square metre over an area upto one square metre. Tiles shall be soaked in water washed clean and shall be fixed in this grout one after another, each tile gently being tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern.

The surface of the flooring during laying shall be frequently checked with a straight edge about 2 m long, so as to obtain a true surface with the required slope. In bath,

toilet W.C. kitchen and balcony/verandah flooring, suitable tile drop or as shown in drawing will be given in addition to required slope to avoid spread of water. Further tile drop will also be provided near floor trap.

Where full size tiles cannot be fixed these shall be cut (sawn) to the required size, and their edge rubbed smooth to ensure straight and true joints.

Tiles which are fixed in the floor adjoining the wall shall enter not less than 10 mm under the plaster, skirting or dado.

After tiles have been laid surplus cement slurry shall be cleaned off.

(i) Pointing and Finishing

The joints shall be cleaned off the grey cement slurry with wire/coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment if required to match the colour of tiles. Where spacer lug tiles are provided, the half the depth of joint shall be filled with polysulphide or as specified on top with under filling with cement grout without the lugs remaining exposed. The floor shall then be kept wet for 7 days. After curing, the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallet.

(i) FIXING OF TILE FLOORING WITH CEMENT BASED HIGH POLYMER MODIFIED QUICK SET ADHESIVE (WATER BASED)

High polymer modified quick set tile adhesive (conforming to IS 15477) shall be thoroughly mixed with water and a paste of zero slump shall be prepared so that it can be used within 1.5 to 2 hours. It shall be spread over an area not more than one sqm at one time. Average thickness of adhesive shall be 3 mm The adhesive so spreaded shall be combed using suitable trowel. Tiles shall be pressed firmly in to the position with slight twisting action checking it simultaneously to ensure good contact gently being tapped with wooden mallet till it is properly backed with adjoining tiles. The tiles shall be fixed within 20 minutes of application of adhesive. The surplus adhesive from the joints, surface of the tiles shall be immediately cleaned.

The surface of the flooring shall be frequently checked during laying with straight edge of above 2m long so as to attain a true surface with required slope.

Where spacer lugs tiles are provided these shall be filled with grout with lugs remaining exposed.

Where full size tile cannot be fixed these shall be cut (sawn) to the required size and edges rubbed smooth to ensure straight and true joints. Tiles which are fixed in floor adjoining to wall shall enter not less than 10 mm under plaster, skirting or dado.

(j) POLYESTER COLOUR COATED GALVALUME PROFILE ROOFING SHEET

Supplying and fixing on purlins polyester coated galvalume profiled sheets 445 - 1000mm wide and 28-50 mm depth rib made out of 0.55mm TCT, cold rolled steel of 300 Mpa (min.) yield strength conforming to ASTM A 368 or AS 1595 with hot dip metallic coating of minimum 150gm/sq.m zinc-aluminium alloy coating mass(55% Aluminium, 43.5% Zinc and 1.5% Silicon) total of both sides as per ASTM A 792 or AS 1397.The colour shall have a total coating thickness of 35 microns of polyester paint system as per AS/NZS-2728:1997 (Category 3) of approved colour, comprising of 20 microns exterior coat on top surface,5 microns reverse polyester coat on the back surface and 5 microns primer coat on both surfaces. The step profile is to have adequate interlock arrangement to make the sheet water tight. Roofing sheets shall be factory cut and supplied in required lengths (of upto 12 m) to suit site conditions & design drawings. Roofing sheets shall be crest fixed to purlins with hot dip galvanized self drilling fasteners with integral EPDM washers (one fastener on each crest). Also, fasteners are to be provided on side laps. Minimum sheet overlap at end laps shall be 150mm. Penetrations and end laps in sheet shall be sealed by using proper sealant. Profiled HDPE fillers shall be provided wherever required to close voids between capping and troughs of the sheet to provide a weather tight exterior. Rate shall include cost and conveyance of all materials, lead, lift, scaffolding, labour charges, etc. complete at all level and as directed by Engineer-in-Charge.

Scope

The scope of work is to provide profile roofing sheet in areas as shown in the drawings. The work shall include, manufacture, supply, and installation of the roofing system on the roof of buildings as described in the schedule and shown in the drawings, including all fixings, flashings, finishing, gutters, down-spouts etc.

Installation

General

The contractor shall supply and install the roofing, gutters, down-spouts, as specified and as approved by the Engineer-in-Charge with uniform and consistent product quality. All panels shall be factory formed and all materials shall be delivered to site with manufacturer’s name or trade mark, grade of coating, length, thickness and item identification with respect to shop drawings legibly marked on top of each item or shown on a label fixed to each bundle. The material may also be marked with a standard mark where applicable.

Accessories

Cappings, Flashings and Trims: All exposed flashing edges must have a 10mm hem and a 45° drip. All closure flashings shall be hemmed.

Material: In substrate, and finish as external sheeting.

Fixing: Cappings etc. shall be screwed to external sheeting at crests with hex head self drilling stitching fasteners at max. 500mm centers along the length of the capping/flashing. All fasteners must be installed at 90° to the material being fastened.

If this is not done, the screw must be withdrawn and the hole closed with an oversize screw and EPDM washer. All longitudinal joints in cappings and flashings shall be overlapped a minimum of 50mm and sealed with a continuous run of sealant. Backing plates shall be provided in 16G steel wherever required at end conditions for proper support of cappings and closures.

Fixing Accessories

External fasteners

Fasteners for roof sheeting clips and self drilling stitching fasteners for cappings/flashings shall be mechanically zinc-coated/zinc-tin alloy coated/ galvanised carbon steel self drilling self tapping fasteners as per AS3566-2002 with EPDM washers.

Sealants

All laps in flashing and capping shall be sealed with a non-hardening neutral cure silicon sealant.

FLASHING/ RIDGE CAPPING

Technical details same as above item for ridge/ valley capping etc. all complete and in straight lengths.

7.11 Cement Plaster

The cement plaster shall be 12 mm, 15 mm or 20 mm thick as specified in the item.

(a) Scaffolding

For all exposed brick work or tile work double scaffolding independent of the work having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed. For all other work in buildings, single scaffolding shall be permitted. In such cases the inner end of the horizontal scaffolding pole shall rest in a hole provided only in the header course for the purpose. Only one header for each pole shall be left out. Such holes for scaffolding shall, however, not be allowed in pillars/columns less than one metre in width or immediately near the skew backs of arches. The holes left in masonry works for scaffolding purposes shall be filled and made good before plastering.

Note: In case of special type of brick work, scaffolding shall be got approved from Engineer-in-Charge in advance.

(b) Preparation of Surface

The joints shall be raked out properly. Dust and loose mortar shall be brushed out. Efflorescence if any shall be removed by brushing and scrapping. The surface shall then be thoroughly washed with water, cleaned and kept wet before plastering is commenced. In case of concrete surface if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting

dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface.

(c) Mortar

The mortar of the specified mix using the type of sand described in the item shall be used. It shall be as specified. For external work and under coat work, the fine aggregate shall conform to grading IV. For finishing coat work the fine aggregate conforming to grading zone V shall be used.

(d) Application of Plaster

- Ceiling plaster shall be completed before commencement of wall plaster.

- Plastering shall be started from the top and worked down towards the floor. All putlog holes shall be properly filled in advance of the plastering as the scaffolding is being taken down. To ensure even thickness and a true surface, plaster about 15 × 15 cm shall be first applied, horizontally and vertically, at not more than 2 metres intervals over the entire surface to serve as gauges. The surfaces of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall then be laid on the wall, between the gauges with trowel. The mortar shall be applied in a uniform surface slightly more than the specified thickness. This shall be brought to a true surface, by working a wooden straight edge reaching across the gauges, with small upward and sideways movements at a time. Finally the surface shall be finished off true with trowel or wooden float according as a smooth or a sandy granular texture is required. Excessive troweling or over working the float shall be avoided.

- All corners, arises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering corners, arrises, provision of grooves at junctions etc. where required shall be done without any extra payment. Such rounding, chamfering or grooving shall be carried out with proper templates or battens to the sizes required.

- When suspending work at the end of the day, the plaster shall be left, cut clean to line both horizontally and vertically. When recommencing the plastering, the edge of the old work shall be scrapped cleaned and wetted with cement slurry before plaster is applied to the adjacent areas, to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of wall and not nearer than 15 cm to any corners or arrises. It shall not be closed on the body of the features such as plasters, bands and cornices, nor at the corners of arrises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakages. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar. No portion of the surface shall be left out initially to be patched up later on. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar.

- Thickness: Where the thickness required as per description of the item is 20 mm the average thickness of the plaster shall not be less than 20 mm whether the wall treated is of brick or stone. In the case of brick work, the minimum thickness over any portion of the surface shall be not less than 15 mm while in case of stone work the minimum thickness over the bushings shall be not less than 12 mm.

- Curing: Curing shall be started as soon as the plaster has hardened sufficiently not to be damaged when watered. The plaster shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from all damages at the contractor's expense by such means as the Engineer-in-Charge may approve. The dates on which the plastering is done shall be legibly marked on the various sections plastered so that curing for the specified period thereafter can be watched.

- Finish: The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work proceeds with a true straight edge not less than 2.5 m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds.

- Precaution: Any cracks which appear in the surface and all portions which sound hollow when tapped, or are found to be soft or otherwise defective, shall be cut out in rectangular shape and redone as directed by the Engineer-in-Charge.

(i) When ceiling plaster is done, it shall be finished to chamfered edge at an angle at its junction with a suitable tool when plaster is being done. Similarly, when the wall plaster is being done, it shall be kept separate from the ceiling plaster by a thin straight groove not deeper than 6 mm drawn with any suitable method with the wall while the plaster is green.

(ii) To prevent surface cracks appearing between junctions of column/beam and walls, 150 mm wide chicken wire mesh should be fixed with U nails 150 mm centre to centre before plastering the junction. The plastering of walls and beam/column in one vertical plane should be carried out in one go. For providing and fixing chicken wire mesh with U nails payment shall be made separately.

(iii) Cement Plaster with a Floating Coat of Neat Cement

When the plaster has been brought to a true surface with the wooden straight edge it shall be uniformly treated over its entire area with a paste of neat cement and rubbed smooth, so that the whole surface is covered with neat cement coating. The quantity of cement applied for floating coat shall be 1 kg per sqm. Smooth finishing shall be completed with trowel immediately and in no case later than half an hour of adding water to the plaster mix. The rest of the specifications described and shall apply.

(iv) Application

- The plaster shall be applied in two coats i.e. 12 mm under coat and then 6 mm finishing coat and shall have an average total thickness of not less than 18 mm.

- 12 mm Under Coat: This shall be applied as specified except that when the plaster has been brought to a true surface a wooden straight edge and the surface shall be left rough and furrowed 2 mm deep with a scratching tool diagonally both ways, to form key for the finishing coat. The surface shall be kept wet till the finishing coat is applied.

- 6 mm Finishing Coat: The finishing coat shall be applied after the under coat has sufficiently set but not dried and in any case within 48 hours and finished in the manner specified

- Specifications for Curing, Finishing, Precautions, Measurements and Rate shall be as described.

- 6mm Cement Plaster on Cement Concrete and Reinforced Cement

- Concrete Work

- Mortar

- The mix and type of fine aggregate specified in the description of the item shall be used for the respective coats. Generally, the mix of the finishing coat shall not be richer than the under coat unless otherwise described in item. Generally coarse sand shall be used for the under coat and fine sand for the finishing coat, unless otherwise specified for external work and under coat work, the fine aggregate shall conform to grading zone IV. For finishing coat work the fine aggregate conforming to grading zone V shall be used.

- Scaffolding: Stage scaffolding shall be provided for the work. This shall be independent of the walls.

- Preparation of Surface: Projecting burrs of mortar formed due to the gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brushes. In addition, concrete surfaces to be plastered shall be pock marked with a pointed tool, at spacing of not more than 5 cm. Centres, the pock being made not less than 3 mm deep. This is to ensure a proper key for the plaster. The mortar shall be washed off and surface, cleaned off all oil, grease etc. and well wetted before the plaster is applied.

- Application: To ensure even thickness and a true surface, gauges of plaster 15 x 15 cm. shall be first applied at not more than 1.5 m intervals in both directions to serve as guides for the plastering. Surface of these gauged areas shall be truly in the plane of the finished plaster surface. The plaster shall be then applied in a uniform surface to a thickness slightly more than the specified thickness and shall then be brought to true and even surface by working a wooden straight edge reaching across the gauges. Finally, the surface shall be finished true with a trowel or with wooden float to give a smooth or sandy granular texture as required. Excess troweling or over working of the floats shall be avoided. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar. Plastering of ceiling shall not be commenced until the slab above has been finished and centering has been removed. In the case of ceiling of roof slabs, plaster shall not be commenced until the terrace work has been completed. These precautions are necessary in order that the ceiling plaster is not disturbed by the vibrations set up in the above operations.

- Finish: The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work proceeds with a true straight edge not less than 2.5 m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds.

- Thickness: The average thickness of plaster shall not be less than 6 mm. The minimum thickness over any portion of the surface shall not be less than 5 mm.

7.12 Painting

(a) General

All paints shall be of an approved quality and shall be obtained from only those suppliers and makers who have been in the market for a period of not less than 5 years. All paints shall conform to the appropriate Indian Standards for ready mixed paints where applicable. All paints, undercoats, primers and finishing paint shall be supplied in sealed container. The Engineer-in-Charge may, if he so wishes, take samples for analysis at the Contractor's expense.

Wood preservative shall be of chemical type comprising copper-chrome-arsenic composition conforming to IS 401-1967.

All paints shall be stored in cool and dry conditions and clear of other stores to the approval of the Engineer-in-Charge.

(b) Painting

All structural steel work and metals including handrails, brackets & exposed surfaces of steel inserts shall be painted except if otherwise specified.

The operations, workmanship, schedules and equipment for painting shall generally comply with the requirements of IS: 1477 (Parts I & II) "Code of Practice for Painting of Ferrous Metals in Buildings" except in so far as this Specification modifies it.

All surfaces shall be thoroughly cleaned of all foreign matters adhering to the steel surface to Swedish Standard specification Sa 21/2 by means of blasting with sand. Use of scraper wire brush and pig hammer is acceptable wherever blasting with sand is not possible due to lack of access. All painting shall be carried out by brushing. Spray and roller application of paint shall not be allowed without the written permission of the Engineer-in-Charge.

Painting shall generally be done immediately after cleaning. The cleaned surface shall not be allowed to stand overnight before painting. Where galvanised surfaces are to be painted, they shall be cleaned and washed with a solution of copper sulphate before the application of the first coat of primer.

Reference / applicable code & standards:

- Paint manufacturers instruction & safety data sheet
- Technical data sheet for paints / touch –up paints systems
- Surface preparation and coating / painting shall be carried out in accordance with project technical specification
- ISO 12944
- ISO 8501
- ASTM- D- 3359
- SSPC – PA.2

- ISO 850 A
- ISO-8502

(c) Cement Primer Coat

Cement primer coat is used as a base coat on wall finish of cement, lime or lime cement plaster or on non-asbestos cement surfaces before oil emulsion distemper Paints are applied on them. The cement primer is composed of a medium and pigment which are resistant to the alkalies present in the cement, lime or lime cement in wall finish and provides a barrier for the protection of subsequent coats of oil emulsion distemper Paints. Primer coat shall be preferably applied by brushing and not by spraying. Hurried priming shall be avoided particularly on absorbent surfaces. New plaster patches in old work should also be treated with cement primer before applying oil emulsion Paints etc.

(d) Preparation of the Surface

The surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any uneveness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

- Application: The cement primer shall be applied with a brush on the clean dry and smooth surface. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for at least 48 hours, before oil emulsion Paint is applied.

(e) Cement Paint

Material

The cement Paint shall be (conforming to IS 5410) of approved brand and manufacture. The cement Paint shall be brought to the site of work by the contractor in its original containers is sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the Contractor and the Engineer-in-Charge -in-Charge. The empty containers shall not be removed from the site of work till the relevant item of the work has been completed and permission obtained from the Engineer-in-Charge -in-Charge.

Preparation of Surface

For New Work, the surface shall be thoroughly cleaned of all mortar dropping, dirt dust, algae, grease and other foreign matter by brushing and washing. Pitting in plaster shall be made good and a coat of water proof cement Paint shall be applied over patches after wetting them thoroughly.

Preparation of Mix

Cement Paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish. Cement Paint shall be mixed with water in two stages. The first stage shall comprise of 2 parts of cement Paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the cement Paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all cases the manufacturer's instructions shall be followed meticulously. The lids of cement Paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement Paint rapidly becomes air set due to its hygroscopic qualities. In case of cement Paint brought in gunny bags, once the bag is opened, the contents should be consumed in full on the day of its opening. If the same is not likely to be consumed in full, the balance quantity should be transferred and preserved in an airtight container to avoid its exposure to atmosphere.

Application

The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of application of cement Paint shall be as per manufacturer's specification. The completed surface shall be watered after the day's work.

The second coat shall be applied after the first coat has been set for at least 24 hours. Before application of the second or subsequent coats, the surface of the previous coat shall not be wetted.

For new work, the surface shall be treated with three or more coats of water proof cement Paint as found necessary to get a uniform shade.

For old work, the treatment shall be with one or more coats as found necessary to get a uniform shade.

Precaution

Water proof cement Paint shall not be applied on surfaces already treated with white wash, colour wash, distemper dry or oil bound, varnishes, Paints etc. It shall not be applied on gypsums, wood and metal surfaces. If water proofing cement is required to be applied on existing surface, previously treated with white wash, colour wash etc., the surface shall be thoroughly cleaned by scrapping off all the white wash, colour wash etc. completely. Thereafter, a coat of cement primer shall be applied followed by two or more coat of water proof cement.

(f) Material

The paint shall be (Texured exterior paint/Acrylic smooth exterior paint/premium acrylic smooth exterior paint) of approved brand and manufacture. This paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fornight's work. The materials shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty containers

shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge.

Preparation of Surface

For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. The prepared surface shall have received the approval of the Engineer-in-Charge after inspection before painting is commenced.

(g) Application

Base coat of exterior primer

Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its container, when applying also the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform. Dilution ratio of paint with potable water can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer's instructions & directions of the Engineer-in-Charge shall be followed meticulously. The lids of paint drums shall be kept tightly closed when not in use as by exposure to atmosphere the paint may thicken and also be kept safe from dust.

Paint shall be applied with a brush on the cleaned and smooth surface. Horizontal strokes shall be given, First and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks.

7.13 CEMENT BASED PUTTY

(a) Surface Preparation

Remove all loosely adhering material from the wall surface with the help of sand

paper, putty blade or wire brush. The substrate should be clean, free from dust, grease and loose materials.

(b) Mixing

Mixing with 40-45% clean water slowly to make a paste. It is very important that water be added to putty to make a mix and not vice versa. Continue the mixing or 10-15 minutes till a uniform paste is formed. It is very important that the mixing of putty should be done thoroughly. This will help in easy application, obtaining more coverage and smooth uniform shade. Only prepare a quantity which can be used within 2-3 hours of mixing with water.

(c) Application

After thoroughly mixing Putty apply the first coat on the moistened wall surface from bottom to upward direction uniformly with the aid of putty blade. This would ensure minimum wastage and proper finish.

After drying of first coat of putty just rub the surface gently with wet sponge or very gently with the putty blade in order to remove the loose particles.

Allow the surface to dry for at least 3 hours and then apply second coat of putty. Leave the surface to dry completely. After drying of second coat remove any type of marks with the help of moist sponge or rub the surface very gently with putty blade.

Leave the surface to dry, preferably overnight/10-12 hours.

Always prepare a required quantity of putty and use it within 2-3 hours of mixing with water.

The total thickness of the coats should be limited to maximum 1.5 mm.

It is not necessary to rub the surface done with putty. However, if at all there is a need to remove unevenness before applying any kind of paint/distemper, gently level the surface with very fine water proof emery paper of not less than 500 number to get a glossy white surface.

(d) Precautions during application

Mixing of the Putty is very important. Hence extreme care should be taken for proper and thorough mixing. It should be preferably mixed with mechanical stirrer in order to get best results. Mixing is to be continued till a uniform paste is formed. Do not add putty into water.

It is recommended not to rub the surface done with Putty strongly & harshly with rough emery paper. This breaks the film formed over it which decreases the water repellency properties.

In case of fresh concrete/mortar surface it is recommended that two coats of cement wash be done before application of Putty.

(e) Scaffolding

Scaffolding shall be got approved from Engineer-in-Charge in advance. Scaffolding has to be in steel, arranged by the contractor at his own cost for carrying out entire painting jobs at all height and provide all facilities for proper inspection of surface at various stages. Material has to be erected as per safe methods. Ropes and guy wires shall be used for tying etc. The scaffolding shall be of steel and shall not endanger the painter. Scaffolding shall be sufficiently away from the surface to be painted so as to enable the painter to work with ease. The scaffolding shall be removed by the contractor promptly after completion of the work.

(f) Protective Measures

Doors, windows, floors, articles of furniture etc. and such other parts of the building not to be painted, shall be protected from being splashed upon. Splashing and

droppings, if any shall be removed by the contractor at his own cost and the surfaces cleaned. Damages if any to furniture or fittings and fixtures shall be recoverable from the contractor.

7.14 WALL PAINTING WITH PLASTIC EMULSION PAINT

The plastic emulsion Paint is not suitable for application on external, wood and iron surface and surfaces which are liable to heavy condensation. These Paints are to be used on internal surfaces except wooden and steel. Plastic Emulsion Paint as per IS 5411 of approved brand and manufacture and of the required shade shall be used.

Painting on New Surface

The surface shall be thoroughly cleaned and dusted off. All rust, dirt, scales, smoke splashes, mortar droppings and grease shall be thoroughly removed before painting is started. The prepared surface shall have received the approval of the Engineer-in-Charge after inspection, before painting is commenced.

Application: The number of coats shall be as stipulated in the item. The Paint will be applied in the usual manner with brush, spray or roller. The Paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surfaces to 2 to 3 hours on non-absorbent surfaces.The thinning of emulsion is to be done with water and not with turpentine. Thinning with water will be particularly required for the under coat which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer's instructions.

The surface on finishing shall present a flat velvety smooth finish. If necessary more coats will be applied till the surface presents a uniform appearance.

Precautions

(a) Old brushes if they are to be used with emulsion Paints, should be completely dried of turpentine or oil Paints by washing in warm soap water.Brushes should be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the Paint from hardening on the brush.

(b) In the preparation of wall for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.

(c) Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.

(d) Washing of surfaces treated with emulsion Paints shall not be done within 3 to 4 weeks of application.

7.15 PAINTING WITH SYNTHETIC ENAMEL PAINT

Synthetic Enamel Paint (conforming to IS 2933) of approved brand and manufacture and of the required colour shall be used for the top coat and an undercoat of ordinary Paint of shade to match the top coat as recommended by the same manufacturer as far the top coat shall be used.

Painting on New Surface

Wooden Surface: The wood work to be painted shall be dry and free from moisture. The surface shall be thoroughly cleaned. All unevenness shall be rubbed down smooth with sand paper and shall be well dusted. Knots, if any shall be coveredwith preparation of red lead made by grinding red lead in water and mixing with strong glue sized and used hot. Appropriate filler material conforming to IS 345 withsame shade as Paint shall be used where specified. The surface treated for knotting shall be dry before Paint is applied. After obtaining approval of Engineer-in-Charge for wood work, the priming coat shall be applied before the wood work is fixed in position. After the priming coat is applied, the holes and indentation on the surface shall be stopped with glazier's putty or wood putty.

Stopping shall not be done before the priming coat is applied as the wood will absorb the oil in stopping and the latter is therefore liable to crack.

Iron & Steel Surface: All rust and scales shall be removed by scrapping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during rolling which becomes loose by rusting, shall be removed. All dust and dirt shall be thoroughly wiped away from the surface. If the surface is wet, it shall be dried before priming coat is undertaken.

Plastered Surface: The surface shall ordinarily not be painted until it has dried completely.

Trial patches of primer shall be laid at intervals and where drying is satisfactory, painting shall then be taken in hand. Before primer is applied, holes and undulations, shall be filled up with plaster of paris and rubbed smooth.

Application: The number of coats including the undercoat shall be as stipulated in the item.

(a) Under Coat: One coat of the specified ordinary Paint of shade suited to the shade of the top coat, shall be applied and allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure a smooth and even surface, free from brush marks and all loose particles dusted off.

(b) Top Coat: Top coats of synthetic enamel Paint of desired shade shall be applied after the undercoat is thoroughly dry. Additional finishing coats shall be applied if found necessary to ensure properly uniform glossy surface.

Painting on Old Surface

Preparation of Surface: Where the existing Paint is firm and sound it shall be cleaned of grease, smoke etc. and rubbed with sand paper to remove all loose particles dusted off. All patches and cracks shall then be treated with stopping and filler prepared with the specified Paint. The surface shall again be rubbed and made smooth and uniform.

Painting: The number of coats as stipulated in the item shall be applied with synthetic enamel Paint. Each coat shall be allowed to dry and rubbed down smooth with very fine wet abrasive paper, to get an even glossy surface. If however, the surface is not satisfactory additional coats as required shall be applied to get correct finish.

7.16 CEMENT PAINT

(a) Material

The cement Paint shall be (conforming to IS 5410) of approved brand and manufacture. The cement Paint shall be brought to the site of work by the contractor in its original containers is sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the Contractor and the Engineer-in-Charge. The empty containers shall not be removed from the site of work till the relevant item of the work has been completed and permission obtained from the Engineer-in-Charge.

(b) Preparation of Surface

For New Work, the surface shall be thoroughly cleaned of all mortar dropping, dirt dust, algae, grease and other foreign matter by brushing and washing. Pitting in plaster shall be made good and a coat of water proof cement Paint shall be applied over patches after wetting them thoroughly.

(c) Preparation of Mix

Cement Paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish. Cement Paint shall be mixed with water in two stages. The first stage shall comprise of 2 parts of cement Paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the cement Paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all cases the manufacturer's instructions shall be followed meticulously. The lids of cement Paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement Paint rapidly becomes air set due to its hygroscopic qualities. In case of cement Paint brought in gunny bags, once the bag is opened, the contents should be consumed in full on the day of its opening. If the same is not likely to be consumed in full, the balance quantity should be transferred and preserved in an airtight container to avoid its exposure to atmosphere.

(d) Application

The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of application of cement Paint shall be as per manufacturer's specification. The completed surface shall be watered after the day's work.

The second coat shall be applied after the first coat has been set for at least 24 hours. Before application of the second or subsequent coats, the surface of the previous coat shall not be wetted.

For new work, the surface shall be treated with three or more coats of water proof cement Paint as found necessary to get a uniform shade.

For old work, the treatment shall be with one or more coats as found necessary to get a uniform shade.

(e) Precaution

Water proof cement Paint shall not be applied on surfaces already treated with white wash, colour wash, distemper dry or oil bound, varnishes, Paints etc. It shall not be applied on gypsums, wood and metal surfaces. If water proofing cement is required to be applied on existing surface, previously treated with white wash, colour wash etc., the surface shall be thoroughly cleaned by scrapping off all the white wash, colour wash etc. completely. Thereafter, a coat of cement primer shall be applied followed by two or more coat of water proof cement.

7.17 EXTERIOR PAINTING ON WALL

(a) Material

The paint shall be (Textured exterior paint/Acrylic smooth exterior paint/premium acrylic smooth exterior paint) of approved brand and manufacture. This paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty containers shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge.

(b) Preparation of Surface

For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. The prepared surface shall have received the approval of the Engineer-in-Charge in ch after inspection before painting is commenced.

(c) Application

Base coat of water proofing cement paint

Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its container, when applying also the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform. Dilution ratio of paint with potable water can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer's instructions & directions of the Engineer-in-Charge -in-ch shall be followed meticulously. The lids of paint drums shall be kept tightly closed when not in use as by exposure to atmosphere the paint may thicken and also be kept safe from dust.

Paint shall be applied with a brush on the cleaned and smooth surface. Horizontal strokes shall be given, First and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks.

(d) Finishing

Berms and road edges shall be restored and all surplus earth including rubbish etc. disposed off as directed by the Engineer-in-Charge. Nothing extra shall be paid for this.

7.18 Mural Art

The contractor needs to prepare three design options reflecting the local aesthetics which shall be applied on the external walls. Three designs options shall be prepared for each location separately. Based on the design options, IWAI shall approve one option for further execution of the works at site.

General design criteria:

- Mural techniques may include fresco, mosaic, graffiti and marouflage.
- Content should be aesthetically pleasing, will contribute positively to a neighborhood, is original, and does not infringe on the copyright of others including cultural rights, and takes into consideration other nearby public artworks, urban design and community context;
- Content to be non-partisan, non-racial, non-denominational, non-sexist, and non-political, and in keeping with Human Rights Act principles;
- Wall art will not be used or serve as any form of commercial advertising or public information or solicitation of any kind;
- Content is appropriate for child audiences and if deemed sensitive is not permitted; (e.g. content depicting alcohol, drugs, tobacco or violence is not permitted).
- Content does not include logos or organizational brands or identities; and.

- The theme of the mural is respectful of the greater context of the community, including historic and sociocultural contexts.

- The utilization of colour, design, and thematic treatment in mural art should have the capability to bring about an extreme change in the sensation of spatial proportions of the building. The form of artwork to be truly three-dimensional.

- The colour materials on the mural paintings to be derived from the natural materials like terracotta, chalk, red ochre and yellow ochre mixed with animal fat.

7.19 ANTI CORROSIVE PAINTING ON ALL STEEL WORK

(a) Providing and applying anticorrosive protective coating on external steel structures – A high performance passivation enhanced epoxy primer having Minimum of volume solids 75% and DFT (Dry Film Thickness) of 75 microns followed by a two component epoxy High Build intermediate MIO, having 80% volume solids and DFT of 150 microns and thereafter top coated with a two component high solids acrylic Polyurethane having Min 50 % volume solids and DFT of 60 microns. Total thickness of minimum 285 Microns or as per manufacturer recommendation. All steel surfaces shall be abrasive blast cleaned to Sa 2.5 (ISO8501-1:1988) or SSPC- SP10 with suitable abrasive Grid/shot. If oxidation has occurred between blasting and paint application, the surface should re-blasted to the specified visual standard. Any surface defects revealed by the blast cleaning process should be filled/ ground or treated suitably. Before blasting, surfaces shall be washed and cleaned by water jet/ Solvent to remove surface contamination/ grease etc.. The rate Including cost and conveyance of all materials , labour charges, lead, lift etc at all heights complete as directed by Engineer-in-Charge all complete as per manufacturer recommendation.

(b) Surface Preparation:

All steel surfaces shall be abrasive blast cleaned to Sa 2.5 (ISO8501-1:1988) or SSPC-SP10 with suitable abrasive Grid/shot. If oxidation has occurred between blasting and paint application, the surface should re-blasted to the specified visual standard. Any surface defects revealed by the blast cleaning process should be filled/ ground or treated suitably. Before blasting, surfaces shall be washed and cleaned by water jet/ Solvent to remove surface contamination/ grease etc.

(c) PRIMER Coat:-

A high performance passivation enhanced epoxy primer having Minimum of volume solids 75% and DFT (Dry Film Thickness) of minimum 75 microns, works out to TSR (Theoretical Spread Rate) =10 nm2 / litre, touch dry 30 Min, &hard dry 2.5 hrs.at 25 Deg C. This coat shall be applied at shop by airless spray method all complete as per manufacturer recommendation.

(d) INTERMEDIATE Coat:-

A low VOC, high solids – VS 80%, high build, two component epoxy coating to a DFT (Dry Film Thickness) of 150 microns works to TSR (Theoretical Spread Rate) = 5.33 m2/litre, Touch dry 60 Min/Hard dry 5hrs at 25 Deg C.This coat shall be applied at site or shop by airless spray / brush all complete as per manufacturer recommendation.

(e) Finish Coat:-

A two component acrylic polyurethane finish, giving excellent durability and long term recoat ability, having minimum of VS–57%, to a DFT (Dry Film Thickness) of 60 microns, works out to TSR (Theoretical Spread Rate) = 9.50 m2/Litre ,touch dry 1.5 hr/Hard dry 6 hrs at 25 Deg C .This coat shall be applied at site by airless spray / brush all complete as per manufacturer recommendation.

7.20 PVC Pipes

PVC Pipes shall conform to the requirements of IS: 4985.

7.21 Site Grading & External Development

(a) Site Grading

General

The Contractor shall first clear the area assigned for development from any obstructions or old structures and carry out a detailed topographic survey of the whole area. Formation levelshall be such that there shall be no flooding of the site. It is proposed to provide the formation level of MSL for the entire Site, up to the boundary wall of the terminal, parking and road area & locations where land facilities have to be constructed. While carrying out site grading, it is ensured that no existing natural drainage shall be blocked without providing required cross drainage structures or alternative drainage arrangement.

(b) Material

Acceptable Fill Material

Fill material shall be granular, non-cohesive, naturally occurring and shall be free fromorganic and deleterious matter and shall have the following properties:

o Maximum particle size	:	200mm
o Percentage maximum particle size	:	10%
o Percentage passing 63 micron sieves	:	10% maximum
o Liquid limit	:	35% maximum
o Plasticity index	:	6% maximum
o Chloride content (top 150mm only)	:	3.3% maximum
o Sulphate content (top 150mm only)	:	2.0% maximum

(c) Unsuitable Material

Material, which has been deposited in reclamation areas and does not comply with the specification requirements for filling, shall be removed by the Contractor and replaced with suitable fill.

(d) Compaction

General

During the reclamation process the Contractor shall place approved material within the reclamation area to achieve an in-situ density not less than 90% of the Maximum Dry Density(MDD) throughout the full thickness and lateral extent of the fill. The latter is defined in Clauses 3.5 & 3.6 of BS 1377: Part 4: 1990 - Determination of the dry density/moisture content relationship using the 4.5kg rammer.

The uppermost zone of fill shall be placed and treated to ensure that the top 900mm of thefill has an in situ density not less than 95% MDD.

The in situ density shall be measured using the appropriate method described in Clause 2.1 of

BS1377: Part 9: 1990 or similar approved.

7.22 Internal Road Works

(a))General

This section covers the specification of pavement including paver blocks for the construction of internal roads and parking area.

These specifications include the requirements in conformity with the dimensions shown in the drawings and with the lines and grades established by the Contractor at site subject to approval by the Employer.

The pavement shall be graded to allow the cargo handling equipment to operate at their optimum rates and to allow for storm water to the drainage system.

7.23 Interlocking Paver block

Providing and laying factory made chamfered edge Cement Concrete paver blocks In foot path, park & lawns driveway or light & traffic parking etc. of required strength, thickness & size/ shape, made by table vibratory method using PU mould, laid in required colour & pattern over 50mm thick compacted bed of course sand/6mm metal, compacting and proper embedding/laying of inter locking paver blocks into the sand bedding layer through vibratory compaction by using plate vibrator, filling the joints with sand and cutting of paver blocks as per required size and pattern, finishing and sweeping extra sand, all complete as per manufacturer's specifications.

Factory made precast paver block of M-30 or otherwise specified grade to be used. Paver blocks to be of approved brand and manufacturer and of approved quality. Minimum strength as prescribed by manufacturer and as per direction of Engineer-in-Charge for the grade specified to be tested as per method mentioned in specification.

i) Cement

The cement used in the manufacture of precast concrete paving blocks shall be ordinary Portland cement complying with IS: 269. The cement content of the compacted concrete shall be not less than 380 kg/m3

ii) Aggregates

The fine and coarse aggregate shall be natural aggregates complying with IS: 383 and as givenin Specification- Materials. The nominal maximum size of aggregate shall not exceed 20 mm.

iii) Water

Water shall be clean, free from deleterious matter and comply with IS: 3025.

iv) Other Materials

Admixtures: Admixtures shall not be used without the approval of the Employer. TheContractor shall inform the Employer in writing of the admixtures to be used. Admixtures shall conform IS: 9103. Pigments: Any pigments used shall comply with IS: 3493.

v) Finishes

Natural Colour Blocks: A block described as ‘natural colour’ shall not container pigment.

Surface finishes: Surface finishes, including colour, shall be as directed or approved by the Employer. Pigmented blocks: When pigmented blocks are specified, samples shall be submitted to the Employer for approval.

vi) Dimension and TolerancesDimensions:

Nominal sizes and aspect ratios

Standard rectangular blocks shall be manufactured with a work size length of 200 mm and awork size width of 100 mm. The work size thickness shall be 60 and 80 mm.

vi) Wearing Surface Area

A chamfer round the wearing surface (no deeper than 7 mm) shall be permitted, and the work size and width of any chamber shall be declared by the manufacturers. The wearing surface area shall not be less than 70% of the plan area.

Tolerances:
The maximum dimensional deviations from the stated work sizes for paving blocks shall beas given below:

- Length : ± 2mm
- Width : ± 2mm
- Thickness : ± 3mm

Construction of Concrete Block Paving

Concrete block paving shall be laid to comply with IS: 6509 and the requirements as given hereunder:

Subgrade
The preparation of the subgrade shall not commence until all subgrade drainage has been completed and side drains or channels are capable of removing water from the immediate vicinity of the formation.

The subgrade, sub-base and base shall be prepared so that:

i) The surface levels are within the tolerances given in Table C

ii) The longitudinal falls and cross falls are such that no depressions hold water. A minimum longitudinal fall of 1.25% and a minimum cross-fall of 2.5% shall generally be adopted.

iii) The surface is tight and dense enough to prevent laying course material being lost into it during construction and use.

iv) Provision is made to:

a. drain water from the laying course in service (e.g. by installation of drainage when the laying course is on impermeable foundations)

b. prevent migration and loss of laying course material into drainage (e.g, by use of a geotextile)

Trimming and regulation shall then be carried out to bring the formation to the correct leveland grade within the tolerance stated in Table I and finally, the formation shall be re-rolled with a smooth wheeled roller having a load of not less than 2.5 t/m width of roll.

Sub-base

Materials for the sub-base shall comply with the requirements for granular sub-base of the Specification. The sub-base layer shall be laid on the prepared formation and compacted. The thickness of the sub-base shall be as per drawings.

Cement Bound Material (CBM) base

Where shown on the approved drawings or if specified by the Employer, the Contractor shalllay a CBM base for block paving of this specification.

Edge Restraints

Edge restraints shall be formed before compacting adjacent blocks.

Laying Course

The laying course shall consist of 2-10 mm naturally occurring coarse sand or crushed rock fines graded in accordance with IS:2386. The coarse sand or crushed rock fines shall not contain more than 3% by weight of clay, silt and fine dust. The moisture content of the layingcourse should be as uniform as possible and the material should be moist without being saturated.

The Contractor shall construct the laying course so that after compaction, it forms an approximately 30 mm thick layer below the paving blocks. The sand shall be stuck off to such a level that, when blocks have been vibrated, the upper face of the blocks shall be trueto the finished level. Before the blocks are laid, the laying course shall not be subjected to any form of traffic including pedestrian traffic, before, after or during screeding.

Concrete Paving Blocks

Blocks shall be laid in herringbone bond, except where specifically instructed by the Employer. Blocks shall be placed firmly together without disturbance to the laying course and the order of placing the blocks shall ensure this.

At edges or obstructions such as gully grating or manholes, blocks shall generally be cut to fit. Cutting may be carried out with a hydraulic splitter, a hammer and bolster, or by sawing. Immediately adjacent to gullies and manholes the tolerance shall be +3 mm, -0 mm.

The laid blocks shall be compacted to the finished levels by a vibrating plate compactor which transmits an effective force not less than 75 kN/m^2 at a frequency of 75-100 Hz and has a plate area not less than 0.25 m^2. Sufficient passes shall be made to compact the laying course to produce an even surface.

Vibration shall not be carried out within 1 m of an unrestrained edge or laying face.

After initial vibration, sand or crushed rock fines shall be brushed into joints and further passes of the vibrating plate compactor made to fill the joints, more sand being spread over the surface if required.

The tolerances in Table-C apply on straight profiles. Equivalent tolerances shall apply on vertical curves. All profile devices such as pegs, pins, profile boards or guide wires shall be set to the true plan line with a maximum tolerance of +25 mm and to the true level with a maximum tolerance of +3 mm. Spacing of support pints for guide wires shall be less than 10m.

1. Permissible tolerance on center line of pavement construction relative to horizontal alignment: +10 mm.
2. Permissible tolerance on surface levels:

Table-C: Tolerances on Surface Level for Concrete Block Paving

Layer of Pavement	**Maximum permissible in deviation from design level(mm)**
Sub-grade	+ 20
Sub-base	+ 15

Road-base (Surface Course) - Overall	+ 6
- Flatness	0 under a 3 m straight edge 2between adjacent blocks
Adjacent to gullies, surface drainage channels and outlets (see Note)	+6, -0

Note: The permissible deviations for the upper level of drainage inlets and channels should be +0, -0 mm to ensure positive drainage.

7.24 GRANULAR SUB BASE (GSB)

(a) Scope

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer-in-Charge.

(b) Materials

The material to be used for the work shall be natural sand, crushed gravel, and crushed stone, crushed slag or combination thereof depending upon the grading required. Use of materials like brick metal, Kankar and crushed concrete shall be permitted in the lower sub-base. The material shall be free from organic or other deleterious constituents and shall conform to the grading given in Table 16.44 and physical requirement given in Table 16.45 Gradings III and IV shall preferably be used in lower sub-base. Grading V and VI shall be used as a sub-base-cum-drainage layer. The grading to be adopted for a project shall be as specified in the Contract. Where the sub-base is laid in two layers as upper sub-base and lower sub-base, the thickness of each layer shall not be less than 150 mm.

If the water absorption of the aggregate determined as per IS : 2386 (Part 3); if this value is greater than 2 per cent, the aggregate shall be tested for Wet Aggregate Impact Value (AIV) (IS: 5640). Soft aggregates like Kankar, Brick ballast and laterite shall also be tested for Wet AIV (IS: 5640).

TABLE No. 16.44
GRADING FOR GRANULAR SUB-BASE MATERIALS

IS Sieve Designation	Percent by Weight Passing the IS Sieve					
	Grading I	Grading II	Grading III	Grading IV	Grading V	Grading VI
75.0 mm	100	--	--	--	100	--
53.0 mm	80-100	100	100	100	80-100	100
26.5 mm	55-90	70-100	55-75	50-80	55-90	75-100
9.50 mm	35-65	50-80	--	--	35-65	55-75
4.75 mm	25-55	40-65	10-30	15-35	25-50	30-55
2.36 mm	20-40	30-50	--	--	10-20	10-25
0.85 mm	--	--	--	--	2-10	--
0.425 mm	10-15	10-15	--	--	0-5	0-8
0.075 mm	<5	<5	<5	<5	--	0-3

TABLE No. 16.45
PHYSICAL REQUIREMENTS FOR MATERIALS FOR GRANULAR SUB-BASE

Aggregate Impact Value (AIV)	IS:2386 (Part 4) or IS:5640	40 Maximum
Liquid Limit	IS:2720 (Part 5)	Maximum 25
Plasticity Index	IS:2720 (Part 5)	Maximum 6
CBR at 98% dry density (at IS:2720-Part 8)	IS:2720 (Part 5)	Minimum 30 unless otherwise specified in the Contract

(c) Construction Operations

Preparation of Sub-Grade:

The surface of the sub grade to receive the Granular Sub-base shall be prepared to the specified lines and crossfall (Camber) as necessary and made free of dust and other extraneous materials.

Any ruts or soft yielding places shall be corrected in an approved manner and rolled with 80 – 100 kN smooth wheeled roller until firm surface is obtained if necessary by sprinkling water. Weak places shall be strengthened, corrugations removed and depressions and pot holes made good with suitable materials, before spreading the aggregate for GSB.

Where the existing surface over which the sub base of GSB is to be laid is black topped, to ensure effective internal drainage, furrows 50 mm x 50 mm (depth of furrows increased to reach bottom of bituminous layer where necessary) at one metre intervals shall be cut in the existing bituminous surface at 45 degrees to the central line of the carriageway at one metre intervals in the existing road before the GSB is laid.

(d) Spreading and compacting:

The sub-base material of grading specified in the Contract and water shall be mixed mechanically by a suitable mixer equipped with provision for controlled addition of water and mechanical mixing.

So as to ensure homogenous and uniform mix. The required water content shall be determined in accordance with IS:2720 (Part 8). The mix shall be spread on the prepared sub-grade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation, or other means as approved by the Engineer-in-Charge.

Moisture content of the mix shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted so that, at the time of compaction, it is from 1 to 2 per cent below the optimum moisture content (OMC).

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall or on super elevation. For carriageway having crossfall on both sides, rolling shall commence at the edges and progress towards the crown. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS : 2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

7.25 WET MIX MACADAM (WMM) SUB-BASE/BASE

(a) 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. The material shall be laid in one or more layers as necessary to lines, grades and cross-sections shown on the approved drawings or as directed by the Engineer-in-Charge.

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 subbase course may be increased to 200 mm upon approval of the Engineer-in-Charge.

(b) Materials

Aggregates

Physical requirements

Coarse aggregates shall be crushed stone. If crushed gravel/shingle is used, not less than 90 per cent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table **16.46** below.

If the water absorption value of the coarse aggregate is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS:2386(Part-5).

TABLE 16.46
PHYSICAL REQUIRMENTS OF COARSE AGGREGATES FOR SUB-BASE/BASE COURSES

	Test	Test Method	Requirement
1.	Los Angeles Abrasion value or Aggregate impact value	IS:2386 (Part-4) IS:2386 (Part-4) or IS:5640	40 per cent (Max.) 30 per cent (Max.)
2.	Combined Flakiness and Elongation indices (Total)	IS:2386 (Part-1)	35 per cent (Max.)*

To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The value of flakiness index and elongation index so found are added up.

(c) Grading requirements :

The aggregates shall conform to the grading given in Table **16.47 below**.

TABLE 16.47
GRADING REQUIREMENTS OF AGGREGATES FOR WET MIX MACADAM

IS Sieve Designation	Per cent by weight passing the IS sieve
53.00 mm	100
45.00 mm	95-100
26.50 mm	---
22.40 mm	60-80
11.20 mm	40-60
4.75 mm	25-40
2.36 mm	15-30
600.00 micron	8-22
75.00 micron	0-5

Materials finer than 425 micron shall have Plasticity Index (PI) not exceeding 6.

The final gradation approved within these limits shall be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

(d) Construction Operations

Preparation of base :

The surface of the sub grade / sub base / base to receive the Wet Mix Macadam shall be prepared to the specified lines and crossfall (Camber) as necessary and made free of dust and other extraneous materials. Any ruts or soft yielding places shall be corrected in an approved manner and rolled with 80-100 kN smooth wheeled roller until firm surface is obtained if necessary by

sprinkling water. Weak places shall be strengthened, corrugations removed and depressions and pot holes made good with suitable materials, before spreading the aggregate for WMM.

Where the existing surface over which the sub base of WMM is to be laid is black topped, to ensure effective internal drainage, furrows 50 mm x 50 mm (depth of furrows increased to reach bottom of bituminous layer where necessary) at one metre intervals shall be cut in the existing bituminous surface at 45 degrees to the central line of the carriageway at one metre intervals in the existing road before the WMM is laid.

(e) Provision of lateral confinement of aggregates:

While constructing wet mix macadam, arrangement shall be made for the lateral confinement of wet mix. This shall be done by laying materials in adjoining shoulders along with that of wet mix macadam layer.

(f) Preparation of mix:

Wet Mix Macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled, addition of water and forced/positive mixing arrangement like pugmill or pan type mixer of concrete batching plant. For small quantity of wet mix work, the Engineer-in-Charge may permit the mixing to be done in concrete mixers.

Optimum moisture for mixing shall be determined in accordance with IS:2720 (Part-8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size. While adding water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits.

The mixed material should be uniformly wet and no segregation should be permitted.

(g) Spreading of mix :

Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared subgrade/sub- base/base in required quantities. In no case should these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.

The mix may be spread either by a paver finisher.

The paver finisher shall be self-propelled of adequate capacity with the following features:

(i) Loading hoppers and suitable distribution system. So as to provide a smooth uninterrupted material flow for different layer thickness from the tipper to the screed.

(ii) Hydraulically operated telescopic screed for paving width upto 8.5 metre and fixed screed beyond this. The screed shall have tamping and vibrating arrangement for initial compaction of the layer.

(iii) Automatic leveling control system with electronic sensing device to maintain mat thickness and cross slope of mat during laying procedure. In exceptional cases where it is not possible for the paver to be utilized mechanical means like motor grader may be used with the prior approval of the Engineer-in-Charge. The motor grader shall be capable of spreading the material uniformly all over the surface.

The surface of the aggregate shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate may be required. The layer may be tested by depth blocks during construction. No segregation of larger and fine panicles should be allowed. The aggregates as spread should be of uniform gradation with no pockets of fine materials.

The Engineer-in-Charge may permit manual mixing and / or laying of Wet Mix Macadam, where
small quantity of WMM is to be executed. Manual mixing / layhing in inaccessible / remote locations and in situations where use of machinery is not feasible can also be permitted. Were manual mixing / laying is intended to be used, the same shall be done with the approval of the Engineer-in-Charge.

(h) Compaction:

After the mix has seen laid to the required thickness, grade and crossfall/camber the same shall be uniformly compacted, to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100 mm, a smooth wheel roller of 80 to 100 kN weight may be used. For a compacted single layer upto 200 mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 kN with an arrangement for adjusting the frequency and amplitude. An appropriate frequency and amplitude may be selected. The speed of the roller shall not exceed 5 km/h.

In portions having unidirectional cross fall/super elevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the centre line of the road, uniformly over-lapping each preceding track by at least one-

third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop.

In portions in camber, rolling should begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the centre parallel to the centre line of the road uniformly overlapping each of the preceding track by at least one-third width until the entire surface has been rolled.

Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good.

Along forms, kerbs, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added material shall not be permitted.

Rolling should not be done when the subgrade is soft or yielding or when it causes a wave-like motion in the sub-base/base course or subgrade. If irregularities develop during rolling which exceed 12 mm when tested with a 3 metre straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and crossfall. In no case should the use of unmixed material be permitted to make up the depressions.

Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material as determined by the method outlined in IS: 2720 (Part-8)

After completion, the surface of any finished layer shall be well-closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of the layer and recompacted.

Surface Setting and drying: After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours.

Opening to Traffic

No vehicular traffic of any kind should be allowed on the finished wet mix macadam surface till it has dried and the wearing course laid.

Evenness

All work perform shall confirm to the lines, grades, cross sections and dimensions shown on the drawings or as directed by the Engineer-in-Charge, subject to the permitted tolerances described herein after.

Horizontal Alignment

Horizontal alignments shall be reckoned with respect to the centre line of the carriageway as shown on the drawings. The edges of the carriage way as constructed shall be correct within a tolerance of ± 10 mm there from. The corresponding tolerance for edges of the roadway and lower layers of pavement shall be ± 25 mm.

Surface Levels

The levels of the Sub-base / base course as constructed, shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the Engineer-in-Charge beyond the tolerances mentioned as below:

(i) TOLERANCES IN SURFACE LEVELS OF WMM

Sub-base
(a) Flexible pavement ± 10 mm
(b) Concrete pavement ± 06 mm
Base course flexible pavement
(a) Bituminous Base / Binder Course ± 06 mm
(b) Granular
(i) Machine laid ± 10 mm
(ii) Manually laid ± 15 mm

For checking compliance with the above requirement for sub-base / base courses, measurements of the surface levels shall be taken on a grid of points placed at 6.25 m longitudinally and 3.5m transversely.

The longitudinal profile shall be checked with a 3 metre long straight edge / moving straight-edge as desired by the Engineer-in-Charge at the middle of each traffic lane along a line parallel to the centre line of the road.

7.15 KERB STONE (PRECAST)

(a) Laying

Trenches shall first be made along the edge of the wearing course of the road to receive the kerb stones of cement concrete of specified grade. The bed of the trenches shall be compacted manually with steel rammers to a firm and even surface and then the stones shall be set in cement mortar of specified proportion.

The kerb stones with top 20 cm. wide shall be laid with their length running parallel to the road edge, true in line and gradient at a distance of 30 cm. from the road edge to allow for the channel and shall project about 12.5 cm. above the latter. The channel stones with top 30 cm. wide shall be laid in position in chamber with finished road surface and with sufficient slope towards the road gully chamber. The joints of kerb and channel stones shall be staggered and shall be not more than 10 mm. Wherever specified all joints shall be filled with mortar 1:3 (1 cement : 3 coarse sand) and pointed with mortar 1:2 (1 cement: 2 fine sand) which shall be cured for 7 days.

The necessary drainage openings of specified sizes shall be made through the kerb as per drawings or as directed by the Engineer-in-Charge for connecting to storm water drains.

(b) Kerbs

This work comprises the construction of concrete kerbs in situ, and installation of precast concrete kerbs on foundation concrete laid on prepared subgrade, sub-base, base-course, asphalt or concrete surface. Kerbs shall be provided at the locations to the lines, grades, and typical sections as per approved Drawings or established by the Employer.

(c) Materials

Cement shall be ordinary Portland cement to IS: 269.

Aggregates shall conform to the requirements of Specification - Materials. All aggregate shall be o a size appropriate to the sections and method of manufacture of the kerbs. The coarse aggregate to be used, when tested in accordance with IS: 2386 shall not exceed the following limits:

- Aggregate crushing value 30%
- Flakiness Index 35%

The preparation and placing of concrete shall conform to the requirements of the Specification Section 2, Plain and Reinforced Concrete. Reinforcement, where used, shall comply with the Specification Section 2, Plain and Reinforced Concrete.

(d) Equipment

Equipment shall be of the number and type outlined in the Contractor's Programme of Work a approved by the Employer.

(e) In-situ Kerbs

Concrete Class

In situ kerbs shall be constructed of concrete OPC 25/20. Expansion, contraction and construction joints for kerbs Joints shall be constructed at the intervals and places as approved by the Employer All joints shall be of the type and materials and conform to the approved dimensions of the kerb. When constructed in connection with or abutting concrete pavement, the method of constructing the joints in kerbs shall conform to the requirements for joints in the pavement.

When constructed separately from concrete pavement, or in connection with flexible base or surface courses, contraction joints in kerbs may be constructed by sawing through the kerb to a depth of no less than 32 mm below the surface of the gutter. Alternatively contraction joints may be formed by inserting an approved removable metal template in the fresh concrete, or by other methods approved by the Employer.

Sealing of the joints will not be required unless the kerb and is constructed in connection with abutting concrete pavement.

(f) Precast Kerbs

Precast concrete kerbs shall comply with IS: 5758 and be manufactured by hydraulic pressing. Form for precast kerb shall be constructed so that the kerb sections will conform to the approved shape and dimensions.

(g) Construction Requirements Subgrade

Soil below subgrade level to a depth of 200 mm in cut shall be scarified, broken up, adjusted to optimum moisture content and re-compacted to the required density. If Quality Control tests show the required compaction cannot be achieved, the layer shall be replaced with suitable excavated material.

Subgrade in cut shall have a minimum CBR value as per requirement of relevant IS Codes.

When the subgrade is formed on ramps, it shall be to the full width of the top of the ramps. Material placed in the top 300 mm of ramps, shall exclude particle sizes greater than 75 mm and shall have minimum subgrade CBR value as per requirement of relevant IS Codes.

The width to be excavated shall be 300 mm each side of the outside edges of the kerb or gutter. The subgrade shall be of uniform density as approved by the Employer. Rock, shale, or soft and yielding material shall be excavated 15 mm below subgrade elevation and replaced with suitable backfill material. The backfill material shall be compacted to meet the compaction requirements of the specification. All subgrade shall be rolled or compacted to provide a smooth surface and shall be approved by the Employer before placing concrete.

(h) Concrete

Concrete kerb foundation and backing concrete shall be OPC 15/20. The composition, consistency proportioning, batching, mixing and curing of concrete shall conform to the requirements of Section 2.

The area to be covered with the kerb shall, immediately after finishing, be cleaned of all laitance and roughened. The concrete shall be placed and compacted and then shaped with a steel tool conforming to the section. The Concrete shall be compacted with an approved internal vibrator or by hand spudding and tamping. The surface shall be shaped by use of a steel tool to produce the section. The edges shall be rounded by the use of wood moulding or by the use of an edger to form the required radius.

(i) Reinforcement

Reinforcement, if required shall be held in the position by clips, bar chairs, or other approved devices

(j) Precast kerbs

Precast kerb sections shall not be moved (except as required for the removal of forms) or placed until the concrete has attained 75% of the design 28 day strength.

Precast kerb sections shall be set in a sand-cement grout on the concrete kerb foundation. They shall be butted up close together without mortared joints unless otherwise mentioned or instructed by the Employer.

Grouted joints, where indicated, shall consist of the one part Portland cement and three parts of fin aggregate, and one-fifth part of hydrated lime with sufficient water to produce a plastic mix a approved by the Employer. Grouted joints shall be cured by an approved method for a minimum period of four days.

Where kerbs are laid with concrete pavement, joints shall be provided in the kerb, foundation and backing in the same locations as in the pavement, and constructed and sealed to similar details usin the same materials.

For curves of 12 m radius or less, precast kerbs or appropriate radius or length shall be used. Kerb units shall not deviate from line and level by more than 3 mm in 3 m. Standard precast concrete quadrant units shall be used where appropriate.

Finishes

a) In situ kerbs : surface shall be uniform and smooth finish

b) Precast kerb: surface shall be finished to a true and even. Surfaces concealed in the form will require no finishing. All voids and honeycombed areas shall be repaired with sand-cement grout.

Curing

Kerbs shall be cured in accordance with the provisions for Section 3.2, Plain and reinforced concrete.

Backfill

The area adjacent to kerbs shall be backfilled with approved material to the top edges of the kerbs The backfill shall be placed and compacted to a density equal to or greater than the adjacent undisturbed natural ground.

Removal of Surplus Earth

Surplus earth and soil from excavation shall be removed from construction area to the area demarcated by the Employer.

7.16 Storm Water Drainage

General

The intent is to drain the storm water of entire terminal area without any undue pooling and final water to be let into the river.

Scope

Storm drainage consists of furnishing transportation, labour, equipment and materials to construct storm drainage system in accordance with Contractor own Design and Drawings complying India standards. The work includes construction and installation of the following:

a) Masonry work drain system shall be built at site as per site requirements.

b) Masonry work with drain pre-cast cover drain as well as box drains for collection an conveyance of storm water.

c) Storm drains outlets into river including flap gates and related features.

Earthwork

General

This section of the specifications includes requirements for accomplishing all earthworks including filling, anti-termite treatment, riprap and yard grading for this Contract.

Nature of the Ground

The Contractor shall judge for himself the nature of the ground and shall be fully responsible for ascertaining all necessary information concerning permanent water table period of rainfall, floodin of the site and all matters affecting the excavation & foundation work.

Earthwork Method

The Contractor shall not undertake any earthwork; including the operation of any borrow area or quarry, without having obtained the EMPLOYER'S prior approval to the methods which he propose to employ. He shall not thereafter modify such methods without the consent of the Employer.

Correct Widths and Depths of Excavations

In the event of excavation being made larger than the sizes shown on the drawings, the Contractor shall fill in the excavated void to the correct profile with mass concrete as described under

specification for 'Plain and Reinforced Concrete' or other approved compacted material at his own expense.

Method of Excavation

Excavation may be carried out by machine or any other method approved by the Employer. In soil excavations shall be taken to within 150 mm of the formation or foundation level and all subsequent excavation in any section must be carried out by hand not more than 24 hours before th commencement of construction in that section unless agreed otherwise by the Employer.

As soon as possible after inspection by the Employer, the bottom level of the excavation shall b sealed with blinding if specified and the required construction shall commence. No excavation for foundations shall be filled in or covered with concrete until the Contractor has notified the Employe that it is ready for inspection and has received sanction to proceed with the works. The Contractor shall give a minimum of 24 hours' notice of any inspection.

Filling & Backfilling Generally

During compaction the backfill shall have uniform moisture content within 2% of the optimum for the compaction plant employed oras may be directed by the Employer after tests. Where necessary the Contractor shall adjust the moisture content of the backfill material either by drying out or byadding water. After such drying out or adding of water, the backfill shall be thoroughly mixed until the moisture content is uniform. Should the material being placed as filling or as backfilling while acceptable at the time of selection, become unacceptable to the Employer due to exposure to weathe conditions or due to flooding or have become puddled, soft or segregated during the process of the works, the Contractor shall at his own expense remove such damaged, softened or segregated material and replace it with fresh approved material.

When placing the filling or backfilling the Contractor shall make due allowance for any settlement that may occur before the end of the Period of Maintenance remove any excess material or make u any deficiency of backfilling to the specified levels.

Bio digester Septic Tanks

A bio digester tank can be defined as biological waste treatment and management system, where living microorganisms are used to degrade solid and liquid waste and convert it into useful by-products like carbon dioxide, methane and water. Subsequently, the treated effluent can be used for different purposes.

Bio digester tanks are used in bio-toilets and Normal Toilets. Human excreta or faecal waste is treated differently. The decomposition of waste in a bio digester septic tank is carried out by a high-grade bacteria known as Anaerobic Microbial Inoculum (AMI) with high bio-degradation efficiency. This process is carried out in the absence of air, and thus it is known as an anaerobic form of waste treatment.

Working

A bio digester tank consists of three chambers. In the first chamber, the microbial consortium feeds on the organic waste and start the decomposition process as soon as the human excreta or faecal matter coming from the toilet outlet reaches the chamber. Also, the solid and liquid waste is separated in the chamber. Once the first chamber is filled, the water overflows and reaches the second chamber, where further treatment is done, removing close to 90% of waste. In the final chamber, the effluent is estimated to be 98% clean and free of pathogens and harmless by-products, which can be safely used for irrigation.

The outlet pipe for carrying the effluent is placed on the other side. The anaerobic bacterial inoculum is then injected into the bio septic tank. Sewage enters the bio septic tank through the inlet pipe; it then passes over the consortium of anaerobic bacteria which break it down into gas and effluent.

Precautions

Do not feed the bacterial culture directly to the digester.
Feed the bacterial cultures through toilets basin.
First feed all the bacterial culture mix -I through toilet basin and wait for 12 hrs.
Then feed all the bacterial culture mix - II through toilet basin and wait for another 12 hrs.
Finally feed all the bacterial culture mix – III and leave it incubation for 24 hrs.
Start using the toilet after flushing fresh water.
10 % of Harpic i.e., 100g of Harpic in 900 ml water (or) 10 % Domex i.e., 100g of Domex in 900 ml water are cleaning agents used for toilets and do not use other cleaning agents.

LIST OF APPROVED MAKE

1.	Cement	Ultra Tech, Zuari, Ramco, ACC, India Cements, Dalmia, Ambuja, J.P. Rewa, Vikram, Shri Cement, Birla Jute and Cement Corporation of India, JSW Cement, Penna cement etc. or any other approved brand
2.	Steel (TMT)	Tata, Vizag, SAIL, TISCO, IISCO, RINL , Jindal Steel and Power Ltd, JSW Steel Ltd or equivalent as approved
3.	Structural Steel -MS Tubular and Built up sections.	Tata, Vizag, SAIL, Jindal Steel & Power Ltd, Appollo tubes or equivalent as approved

4.	Welding rode	ESAB, Advani, Best Arc, Solar or equivalent as approved
5.	Ceramic Tiles	Kajaria, Regency, Nitco, RAK, Somany, Mirage Ceramics Pvt. Ltd, Naveen, Orient Bell, Swastik Ceracon Ltd. Asian Granito India Ltd, Johnson, simpolo or equivalent as approved
6.	Tile Adhesive /Epoxy Grout	Ardex Endura (India) Pvt. Ltd, MYK Laticrete, Kerakoll India Pvt. Ltd, Eurobuild Construction Chemicals & Coating , Bostik, MAPEI BASF, Pidilite, Sunanda Speciality Coatings Pvt. Ltd, Kunal Conchem Private Ltd. or equivalent as approved
7.	Concrete Paver blocks	Basant Beton, Conwood, Automatic, Amcon, Sirex, Planet green Outdoor Solutions Pvt Ltd or equivalent as approved.
8.	Water proofing compound / Coating /Membrane waterproofing	Fosroc, Sika, Pidilite, Structural Waterproofing Co.Pvt. Ltd, BASF , Eurobuild Construction Chemicals & Coating, Bostik, MAPEI, CICO Technologies Ltd., Sunanda Speciality Coatings Pvt. Ltd, Kunal Conchem Private Ltd., ECMAS, CHRYSO, MYK Schomburg ,Asian paints smart care or equivalent as approved
9.	Aerated cement sandwich wall/roof/floor	Aerocon, RAMCO, Everest Industries or equivalent as approved
10.	Paint & Primer, Distemper	ICI (Akzonobel), Berger, Asian, Jotun ,Indigo ,Nerolac or equivalent as approved
11.	Water Proof Cement paint	Super Snowcem, Supercem or equivalent as approved
12.	Sealers	ICI (Akzonobel), Berger, Asian, Euro Build. Indigo ,Nerolac or equivalent as approved
13.	Wall Putty	Birla White, NCL, Altek, Berger, ICI, Asian or equivalent as approved
14.	Primer	Altek, Berger, Asian, ICI , Jotun, Indigo ,Nerolac or equivalent as approved
15.	Epoxy Paint	ICI (Akzonobel),Asian Paints, Berger, Jotun, Indigo , Nerolac or equivalent as approved
16.	Synthetic textured paint	Spectrum, Renovo or equivalent as approved
17.	Protective Paints	AkzoNobel, Jotun India Private Limited, Berger Paints India Limited, Asian Paints Ltd, Grand Polycoats Co. (P) Ltd, Euro Build, Hempel Paints,

		CIPY Polyurethanes Pvt Ltd, MYK Schomburg or equivalent as approved.	
18.	PVC Water stopper	Fosroc, Sika, Euro Build, BASF, Aarti Cables or equivalent as approved.	
19.	Door hardwares	Dorma, Ozone Overseas Pvt. Ltd., Dorset Kaba Security Systems Pvt. Ltd., ASSA ABLOY India Pvt. Ltd., Hafele, Godrej, Everite Agencies, Dyna, Door king, Hettich India Pvt. Ltd or equivalent as approved	
20.	Mortice locks, locks, latch	Godrej, Dorset Kaba Security Systems Pvt. Ltd., Magnum, Ozone Overseas Pvt. Ltd, Dorma. ASSA ABLOY India Pvt or equivalent as approved	
21.	Galvalume Roofing sheet	Tata Blue Scope, Interarch, LLOYD Insulations, Adithya profiles, JSW or equivalent as approved	
22.	High pressure compact laminate	Greenlam, Merino, FunderMax India Pvt. Ltd, Century, Yemag raised flooring, Alfa ICA India Ltd, or equivalent as approved	
23.	Laminates	Kitply, Formica, Greenlam, National, Century, Decolam, Merino, Archid ply or equivalent as approved	
24.	Plain float glass /lacquered glass & Mirror	Saint Gobain, Asahi, Pilkington ,Modiguard or equivalent as approved	
25.	Marine Plywood	Century, Kitply, Anchor, Green Ply, Apple Ply, Archid ply or equivalent as approved	
26.	Pre Laminated Ply	Greenlam, Merino Industries Ltd, Kitply, Archid ply, Century or equivalent as approved	
27.	Frosted Film	Birla 3M, Lumar, Garware, Ultra Mark or equivalent as approved.	
28.	Veneers	Century, Kitply, Anchor, Green ply, Kenwood , Jacsons, Jac group, Archid ply or equivalent as approved	
29.	Particle board	Associate, Jacksons (Exterior grade), Jac group, Century or equivalent as approved	
30.	Cement fibre board	RAMCO ,Bison panel, PE,NCL, or equivalent	
31.	Adhesive Tape/Double sided tape/ Single sided multipurpose Adhesive	3 m, Scotch Tape, Bow Tape, Norton or equivalent as approved	
32.	Silicon Sealant	Dow corning, GE Silicon, Euro Build, CIPY Polyurethanes Pvt Ltd, MYK Schomburg or	
		equivalent as approved	

33.	Synthetic polyester triangu fiber	Recron 3S or equivalent as approved	
34.	Epoxy chemical for anchoring grout	HILTI India Pvt. Ltd, Fisher, Euro Build, Pidilite, Rawl plug or equivalent as approved	
35.	Chemical /Mechanical Anchor Fasteners	HILTI, Fisher, MKT (Germany), Black and Decker India Ltd., MAPEI, SS Fasteners Pvt. Ltd , Rawl plug or equivalent as approved.	
36.	Polysulphide sealing compou	Fosroc, Roffe, Krishna conchem, Fairmate, Eurobuild Construction Chemicals & Coating, or equivalent as approved	
37.	Plasticisers, Non shrink grou	Fosroc, BASF, Krishna conchem, Fairmate, Eurobuild Construction Chemicals & Coating, MYK Schomburg or equivalent as approved	
38.	Admixtures	FOSROC, Polygon, STP, BASF, CERACHEM, Don Chemicals, Sika, Eurobuild Construction Chemicals & Coating, MAPEI, Bostik, MYK Schomburg, Sunanda Speciality Coatings Pvt. Ltd, Kunal Conchem Private Ltd., The Structural Waterproofing co. Pvt.Ltd. / CHRYSO or equivalent as approved	
39.	High tensile Bolts /Screws	Hilti, Fischer, Unbrako, TVS, Euro Build. Rawl plug or equivalent as approved	
40.	High Performance Glass / Clear Glass/Reflective glass	Saint Gobain, ASAHI India Glass Ltd, Emirates Glass L.L.C or equivalent as approved	
41.	EPDM Gaskets	Osaka Rubber Private Limited, AMEE Rubber Industries Pvt. Ltd or equivalent as approved	
42.	Glass Processing	AIS Glass Solutions Ltd, Gold Plus Group, GSC Toughened Glass Pvt. Ltd., Sejal Architectural Glass Limited, Impact Safety Solutions Ltd, TPRS Enterprises Pvt. Ltd, FUSO Glass India Pvt. Ltd or equivalent as approved	
43.	Aluminum Structural Members	Hindalco Industries Ltd, Jindal Aluminium Ltd, Indalco Alloys or equivalent as approved.	
44.	GI Section for Partitions & False Ceiling	Saint Gobain – Gyproc or equivalent as approved.	
45.	Aluminium louvers:	Hunterdouglas, Euro Build or equivalent as approved	
46.	Office Furnitures	Naran Chirakkal Corporate Pvt.Ltd. – BOSQ, Godrej ,Wipro ,Featherlite, Monarch or equivalent as approved	

47.	FRP Doors	Highness, Real or equivalent as approved
48.	Sanitaryware fixtures	Cera/Hindware /Jaquar or approved equivalent

8. Technical Specification for Water Supply and Sanitary Works

Domestic water supply through Gravity system for making water available at the residual pressure of 2 meter is required for sanitary and plumbing fixtures. Sewage and Sullage collection system is based on IS: 1742 and applicable standards for domestic drainage.

The water requirement for the project is proposed to be based on the provisions of IS: 1172 / NBC and prevalent practice. The estimated requirement of water per day for the building is based on the number of users (approximately 50 users considered for design) and other services.

Plumbing works includes providing concealed, exposed and external lines for the toilets for water supply, sanitary etc. including fixing, testing and commissioning. All Plumbing Fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition.

Water Closet: Providing and fixing white vitreous china pedestal type water closet (European type W.C. pan) with seat and lid, with coupled ceramic cistern, including flush pipe, with manually controlled device (handle lever), conforming to IS : 7231, with all fittings and fixtures complete, including cutting and making good the walls and floors wherever required.

Make -Cera/Hindware /Jaquar or approved equivalent.

Wash Basin: Providing and fixing wash basin with pedestal, C.P. brass pillar taps, C.P. brass waste of standard pattern, including painting of fittings, cutting and making good the walls wherever required.

Make-Cera/Hindware /Jaquar or approved equivalent.

Handicapped Toilet Set: Providing and fixing sanitary fixtures for handicapped toilet including one wash basin, one number pillar cock & all other related fittings like CP brass bottle trap, brass angle valve, CP brass waste coupling, etc, one number EWC & Cistern complete with fittings & seat cover, one no. hinged rails, bars etc, designed for people with special needs including cutting and making good the walls and floors wherever required.

Make-Cera/Hindware /Jaquar or approved equivalent.

Pipes:

Concealed Pipe: Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes or Polyvinyl Chloride (PVC), for water supply or sanitary, including all fittings, including fixing the pipe with clamps at required spacing. This includes jointing of pipes & fittings with one step solvent cement and testing of joints complete as per direction of Engineer-in-Charge.

Make: Astral/Ajay/Ashirvad/Finolex or approved equivalent.

Exposed Pipe: Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes or Polyvinyl Chloride (PVC), for water supply or sanitary, including all fittings, including fixing the pipe with clamps at required spacing. This includes jointing of pipes & fittings with one step solvent cement and the cost of cutting chases and making good the same including testing of joints complete as per direction of Engineer-in-Charge.

Make: Astral/Ajay/Ashirvad/Finolex or approved equivalent.

External Pipe: Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes or Polyvinyl Chloride (PVC), for water supply or sanitary including all fittings This includes jointing of pipes & fittings with one step solvent cement, trenching, refilling & testing of joints complete as per direction of Engineer-in-Charge.

Make: Astral/Ajay/Ashirvad/Finolex or approved equivalent.

All fixtures and pipes shall be tested as per standards/manufactures specification after installation.

Toilet Block consists of:

Gents Toilet including one no water closet and one number wash basin with all required accessories and fittings.

Ladies Toilet including one no water closet and one number wash basin with all required accessories and fittings.

Handicapped Toilet including one no water closet and one number wash basin with all required accessories and fittings

9. Technical Specifications – Electrical works

9.1LT Panel boards and accessories

The switch boards are to be manufactured / assembled as per the latest BIS/IEC specifications IP42 classification for indoor duty, IP54 classification for outdoor duty, including special requirements and the detailed specifications mentioned. The panel shall be floor mounted, free standing type, suitable for indoor installation in dust, vermin proof construction and extensible type. The design shall include all provisions for safety of operation and maintenance personnel. The general construction shall conform to IS/IEC 61439 for factory assembled switch board.

9.2 Cables and Cabling

The scope under this section covers the following:

a) Power cables

b) Control cables

c) Armouring and Serving

All multicore cables liable for mechanical damage shall be armoured.

The armouring for cables above 16 sqmm shall be galvanized steel strips and 16sqmm & below shall be with galvanized steel round wire

Power cables (LV) 1.1kV grade XLPE insulated cable

Power cables for use on 415/230 V system shall be of 1100 volt grade, Aluminium conductor, XLPE insulated, PVC sheathed, armoured and overall PVC sheathed cable, strictly as per relevant IS specification. Unarmoured cable to be used only if specifically mentioned in schedule of requirements. Bi-metallic plate washers should be provided where ever cables, lugs, and switch terminals are of different materials. Cables and cable lugs should be of same material where ever possible and Core identification shall be by colour coding.

Control Cables

Control cables for use on 415 V system shall be 1100 volts grade, copper conductor, PVC/XLPE insulated, PVC sheathed, round wire armoured and overall PVC sheathed, strictly as per IS : 1554 (Part I) – 1976 and IS 7098 part 1. Unarmoured cables to be used only if specifically mentioned in schedule of quantities. Control cable carrying current should be black colour and voltage circuit shall be of grey colour and shall be segregated and Core identification shall be by numerals. The size of these cables shall be as specified in schedule of requirements or as per erection drawing. No cable of size less than 1.5 sq.mm. shall be used and 2.50 sq mm cable shall be used for CT connection.

Cable Glands

Cable glands shall be of heavy duty compression type of brass, chrome plated.

Cable Connectors

Cable connectors, lugs/sockets, shall be of copper/aluminium alloy, suitably tinned, solderless, crimping type.

Cables Tags:

Cable tags shall be made out of 2mm thick aluminum sheets/PVC, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Trays tags are to be tied at all bends

G.I. Pipes for Cables

For laying of cables under floor, ground etc. G.I. class 'B' pipes shall be used. MS. Conduits is not acceptable for this purpose. All accessories of pipes shall be threaded types. Size of pipe shall depend upon the overall outer diameter of cable to be drawn through pipe.

9.3 EARTHING AND SAFETY EQUIPMENTS

All cladding or steel work should be bonded to the earthing system, as should all structural steel work. A main earth bar should be provided, so disposed as to allow of the shortest subsidiary connections to all major equipment, such as Metering board, Distribution board, Solar panels, Street light etc. All earth connections shall be visible for inspection

Electrode materials and dimensions

a) The materials and minimum sizes of earth electrodes shall be as per fault level calculation.
c) When more than one electrode is to be installed the distance between the pipe/rod electrode shall be 5m and that between plates shall be 8m.
d) The strip or conductor electrode shall be buried in trench not less than 0.5m deep.
e) If the conditions necessitate the use of more than one strip or conductor electrode, they shall be laid as widely distributed as possible, in a single straight trench where feasible, or preferably in a number of trenches radiating from one point or as directed by the Engineer-in-Charge.
f) All joints in copper conductor should be tinned properly.

9.4 SOLAR PANEL

A Grid Tied Solar ground mount Photo Voltaic (SPV) power plant consists of SPV array, Module Mounting Structure, Power Conditioning Unit (PCU) consisting of Maximum Power Point Tracker (MPPT), Inverter, and Controls & Protections, interconnect cables and switches. PV Array is mounted on a suitable structure. Grid tied SPV system is without battery and should be designed with necessary features to supplement the grid power during day time. Components and parts used in the SPV power plants including the PV modules, metallic structures, cables, junction box, switches, PCUs etc., should conform to the BIS or IEC or international specifications, wherever such specifications are available and applicable.

Solar PV system shall consist of following equipments/components.

(a) Solar PV system consisting of required number of crystalline PV modules.
(b) Grid interactive Power Conditioning Unit with Remote Monitoring System
(c) Mounting structures
(d) Junction Boxes.
(e) Earthing and lightning protections.
(f) IR/UV protected PVC Cables, pipes and accessories

WIRING AND ACCESSORIES

This chapter covers the detailed requirements of wiring work in conduit system, casing and caping, trunking system etc.

Conduiting

All non- metallic conduit pipe and accessories shall be of suitable material complying with IS 9537 Part 3: 1983 and IS:3419-1989 ,IS: 9537(Part5)2000.

General requirements:

a. All rigid conduit pipes shall be ISI marked
b. No conduit less than 20 mm in diameter shall be used.
c. Flexible conduits will only be permitted for interconnections between ceiling rose/junction box to light fixtures, conduit terminations in wall and interconnection between switchgear, DB's.
d. The conduit wiring system shall be complete in all respects, including their accessories.

WIRING

Wires shall be Flame Retardant Low Smoke Halogen (FRLSH/ FRLS), PVC insulated bright annealed electrolytic grade (99.9% pure) copper stranded for uniformity of resistance, dimension and flexibility and suitable upto 660V grade wires for single phase circuits and 1100 V grade for 3 phase circuits as per IS 694:2010 amended upto date.

Colour coded as below:

Phase – R - Red
Phase – Y - Yellow
Phase – B - Blue
Neutral - Black
Earth – Green.

WIRING IN CONDUIT

The wiring in conduit shall comply the following:
Wire sizes

Copper conductor

Light point / Sub main wiring 1.5 sq.mm
Light Circuit Point 2.5 sq.mm
Power points 4.0 sq.mm

Machinery As per Schedule of requirements jointing of wires is not permissible, however looping may be done from point (same circuit) or using a terminal strip in junction box where site condition warrants, prior permission from Engineer-in-Charge shall be obtained.

9.5 M C B DISTRIBUTION BOARDS (MCB DBS) AND ACCESSORIES

All SPN & TPN DBs shall be suitable for flush mounting with double door and to be provided with inbuilt additional compartment for looping of loose wires/adapter boxes for entry of armoured cables with IP 42/43 category of protection and conform to IS: 8623.

Miniature Circuit Breakers (MCBs)

All MCBs should conform to IS/IEC:60898-1(2002) and rated for 10Ka category of short circuit duty and tested for breaking capacity upto 10 Ka. **C** curve type for inductive loads and **D** curve type for UPS loads. MCBs shall be suitable for use in frequency range 50 Hz to 60 Hz and shall accommodate AC/DC supply according to requirements The MCBs shall be of IP 20 degree of protection. The power loss per pole shall be in accordance with IS/IEC:60898-1(2002) and shall be furnished by the Manufacturer.

Residual Current Circuit Breaker (RCCB)

Residual Current Circuit Breakers shall be provided complete protection against Earth leakage faults. RCCB should conform to IS: 12640-2016, IEC 61008-1. The RCCB shall have threshold sensitivities (non-user adjustable) of 30Ma, 100 Ma & 300 Ma with inbuilt time delay of 200 ms for discrimination with downstream RCCB. The short circuit withstand capacity of the RCCB shall not be less than 6 Ka. It shall be operationally independent of line voltage.

9.6 LIGHT FIXTURES AND FANS

The scope of work includes design, development and supply of LED light fittings complete with all accessories including all mounting arrangement for recessed/surface type arrangements. The luminaire shall be suitable for rugged service under the operational and environmental conditions encountered during service.

(a) All the luminaire shall be finalized based on the performance feedback. The detailed calculation for lux with uniform distribution including the lux distribution curve /graph distribution shall be submitted in support of the dimensions selected and variation thereof.
(b) Suitable reflector / lenses may also be provided to increase the illumination uniformity and distribution.

(c) Design of the thermal management shall be done in such a way that it shall not affect the properties of the diffuser.

(d) Supplier will be solely responsible for the performance of the luminaires after installation and shall also ensure the specified and uniform illumination and comfort level on the work plane.

9.7 SOLAR STREET LIGHT

The scope of the work comprises the Supply Loading Transportation, Unloading, Testing and Handing over of LED Street Lights. Solar LED Street Lighting with luminaire of IP66 protected pressure die cast aluminium housing body with optimal heat sink with designed wattage with system lumens greater than 7000 .The Light fitting shall be with all required accessories suitable for mounting in OD pole arm surface mounting on octagonal pole. Solar PV module shall be of 200Wp DC rating along with appropriate battery capacity and suitable charge controller, cables and accessories as required complete.

9.8 STREET LIGHTING POLE

These general requirements apply to octagonal poles manufactured according to following standards:

Mast sections: BS EN 10025 & IS 2062

For flanges, base plate & foundation bolts: IS 2062

Hot dip galvanization: IS 4759 & IS 2629 or BS EN ISO 1461

Basic wind speed: IS 875

9.9 List of Approved Makes of Equipment and Materials

Sl. No.	Item	Make of Materials/Equipment
1.	Push Buttons	Schneider, Siemens, L&T, BCH, C&S, Teknic
2.	Indicating lamps (LED type)	Teknic, Schneider, Siemens, L&T, BCH, C&S
3.	Indicating meters (Analogue)	AE, MECO, L&T, Rishab
4.	meter	L&T, Schnieder, Secure
5.	1.1 kV grade XLPE insulated PVC sheathed Al./ Cu. Cable	KEI, Polycab, Havells, Gloster, Finolex, Torrent
6.	660/1100 volt grade stranded unsheathed wire with copper conductor	Finolex, RR Kabel, Lapp Kabel, Polycab, V-guard

7.	Cable glands, lugs, End termination kits	Lapp Kabel, Gripwel, HMI, Denson, Multipressings, Yamuna Gasses, Dowels
8.	Thermoplastic Junction Box and enclosures	Clipsal, Hensel, OBO, Spelsberg
9.	Anchor Fastener	Hilti, Fischer
10.	LT Termination	Raychem, 3M
11.	Modular type switches, sockets, bell push, fan regulator etc-Medium range	Honeywell (Blenze), Wipro-North West (Nowa) , Legrand (Myrius), Kolors (krest),Crabtree (Athena)
12.	Metalclad plug/socket.	Legrand, Schneider, L&T
13.	Thermoplastic receptacles	Mennekes, Hensel Walther, Schneider, Scame
14.	MCB, RCCB	Legrand, Siemens, Hager, Schnedier, L&T, ABB
15.	MCB Distribution Boards	Legrand, Siemens, Hager, Schneider, L&T, ABB
16.	Ceiling fans/Wall fans	Usha, Crompton, Orient,,Khaitan
17.	Exhaust fans	Almonard,Crompton, Khaitan
18.	PVC Conduit and accessories/ casing and capping	Precision , Clipsal, Lappkabel, Balco, Konseal, Polycab
19.	Ceiling Rose	Anchor, GM
20.	GI conduit/M S Conduit	Any ISI marked.
21.	LED Light Fixtures.	Philips, Wipro, Crompton Greaves, Trilux, XAL, LT, Zumtobel, Osram, Duralamp Targetti.
22.	External Light	K-lite, Crompton, Philips, Wipro, Keselec, LT, Bajaj
23.	Pole	K-lite, LT, Crompton, Bajaj, Unique Poles, Keselec, Valmont, Utkarsh
24.	Surge Protective Devices	OBO, Dehn, Furse, Phoenix Contact, Erico

10. Supply of 10W Solar Street light

i. Foundation of Street light pole
Earth work in excavation by mechanical means (Hydraulic Excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead up to 50 m and lift up to 1.5 m, as directed by Engineer-in-Charge. All kind of soil

ii. 1:4:8 (1 Cement : 4 coarse sand (zone-III) derived from natural sources : 8 graded stone aggregate 40 mm nominal size derived from natural sources)

iii. Centering and shuttering including strutting, propping etc. and removal of form work for foundations, footings, bases for columns

iv. Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level 1:2:4 (1 cement : 2 coarse sand (zone-III) derived from natural sources : 4 graded stone aggregate 20 mm nominal size derived from natural sources)

Note: Relevant drawings are attached.

Environmental, Social, Health and Safety (ESHS)

Metrics for Progress Reports

Metrics for regular reporting:

a. environmental incidents or non-compliances with contract requirements, including contamination, pollution or damage to ground or water supplies;

b. health and safety incidents, accidents, injuries and all fatalities that require treatment;

c. interactions with regulators: identify agency, dates, subjects, outcomes (report the negative if none);

d. status of all permits and agreements:

   i. work permits: number required, number received, actions taken for those not received;

   ii. status of permits and consents:

   - List areas/facilities with permits required (, asphalt & batch plants), dates of application, dates issued (actions to follow up if not issued), dates submitted to resident Engineer (or equivalent), status of area (waiting for permits, working, abandoned without reclamation, decommissioning plan being implemented, etc.);
   - list areas with landowner agreements required (borrow and spoil areas, camp sites), dates of agreements, dates submitted to resident Engineer (or equivalent);
   - identify major activities undertaken in each area in the reporting period and highlights of environmental and social protection (land clearing, boundary marking, topsoil salvage, traffic management, decommissioning planning, decommissioning implementation);
   - For quarries: status of relocation and compensation (completed, or details of activities and current status in the reporting period).

e. health and safety supervision*:*

   i. safety officer: number days worked, number of full inspections & partial inspections, reports to construction/project management;

   ii. number of workers, work hours, metric of PPE use (percentage of workers with full personal protection equipment (PPE), partial, etc.), worker violations observed (by type of violation, PPE or otherwise), warnings given, repeat warnings given, follow-up actions taken (if any);

f. worker accommodations:

   i. number of expats housed in accommodations, number of locals;

   ii. date of last inspection, and highlights of inspection including status of accommodations' compliance with national and local law and good practice, including sanitation, space, etc.;

   iii. actions taken to recommend/require improved conditions, or to improve conditions.

g. HIV/AIDS: provider of health services, information and/or training, location of clinic, number of non-safety disease or illness treatments and diagnoses (no names to be provided);

h. gender (for expats and locals separately): number of female workers, percentage of workforce, gender issues raised and dealt with (cross-reference grievances or other sections as needed);

i. training:

i. number of new workers, number receiving induction training, dates of induction training;

ii. number and dates of toolbox talks, number of workers receiving Occupational Healthand Safety (OHS), environmental and social training;

iii. number and dates of HIV/AIDS sensitization and/or training, no. workers receiving training (this reporting period and in the past); same questions for gender sensitization, flag person training.

iv. number and date of GBV /SEA sensitization and/or training, number of workers receiving training on code of conduct (in the reporting period and in the past), etc.

j. environmental and social supervision*:*

i. environmentalist: days worked, areas inspected and numbers of inspections of each (road section, work camp, accommodations, quarries, borrow areas, spoil areas, swamps, forest crossings, etc.), highlights of activities/findings (including violations of environmental and/or social best practices, actions taken), reports to environmental and/or social specialist/construction/site management;

ii. sociologist: days worked, number of partial and full site inspections (by area: road section, work camp, accommodations, quarries, borrow areas, spoil areas, clinic, HIV/AIDS center, community centers, etc.), highlights of activities (including violations of environmental and/or social requirements observed, actions taken), reports to environmental and/or social specialist/construction/site management; and

iii. community liaison person(s): days worked (hours community center open), number of people met, highlights of activities (issues raised, etc.), reports to environmental and/or social specialist /construction/site management.

k. *Grievances*: list new grievances (e.g. allegations of GBV / SEA) received in the reporting period and unresolved past grievances by date received, complainant, how received, to whom referred to for action, resolution and date (if completed), data resolution reported to complainant, any required follow-up (Cross-reference other sections as needed):

i. Worker grievances;

ii. Community grievances

l. Traffic and vehicles/equipment:

i. traffic accidents involving project vehicles & equipment: provide date, location, damage, cause, follow-up;

ii. accidents involving non-project vehicles or property (also reported under immediate metrics): provide date, location, damage, cause, follow-up;

iii. overall condition of vehicles/equipment (subjective judgment by environmentalist); non-routine repairs and maintenance needed to improve safety and/or environmental performance (to control smoke, etc.).

m. Environmental mitigations and issues (what has been done):

i. dust: number of working bowsers, number of waterings/day, number of complaints, warnings given by environmentalist, actions taken to resolve; highlights of quarry dust control (covers, sprays, operational status); % of rock/spoil lorries with covers, actions taken for uncovered vehicles;

ii. erosion control: controls implemented by location, status of water crossings, environmentalist inspections and results, actions taken to resolve issues, emergency repairs needed to control erosion/sedimentation;

iii. quarries, borrow areas, spoil areas, asphalt plants, batch plants: identify major activities undertaken in the reporting period at each, and highlights of environmental and social protection: land clearing, boundary marking, topsoil salvage, traffic management, decommissioning planning, decommissioning implementation;

iv. blasting: number of blasts (and locations), status of implementation of blasting plan (including notices, evacuations, etc.), incidents of off-site damage or complaints (cross-reference other sections as needed);

v. spill clean-ups, if any: material spilled, location, amount, actions taken, material disposal (report all spills that result in water or soil contamination;

vi. waste management: types and quantities generated and managed, including amount taken offsite (and by whom) or reused/recycled/disposed on-site;

vii. details of tree plantings and other mitigations required undertaken in the reporting period;

viii. details of water and swamp protection mitigations required undertaken in the reporting period.

n. compliance:

i. compliance status for conditions of all relevant consents/permits, for the Work, including quarries, etc.): statement of compliance or listing of issues and actions taken (or to be taken) to reach compliance;

ii. compliance status of ESMP/C-ESMP/ESIP requirements: statement of compliance or listing of issues and actions taken (or to be taken) to reach compliance

iii. compliance status of GBV/SEA prevention and response action plan: statement of compliance or listing of issues and actions taken (or to be taken) to reach compliance

iv. compliance status of Health and Safety Management Plan re: statement of compliance or listing of issues and actions taken (or to be taken) to reach compliance

v. Other unresolved issues from previous reporting periods related to environmental and social: continued violations, continued failure of equipment, continued lack of vehicle covers, spills not dealt with, continued compensation or blasting issues, etc. Cross-reference other sections as needed.

Special Conditions of Contract	
SCC 01	The documents forming the Contract shall be interpreted in the following order of priority: (a) Agreement, (b) Letter of Acceptance, (c) Particular Conditions of Contract, (d)General Conditions of Contract, including Appendices, (e) Specifications, (f) Drawings, (g) Environmental, Social, Health and Safety – ESHS (i) Management Strategies and Implementation Plans and (ii) Code of Conduct. (h) Contractor's Bid & Priced Bill of Quantities, (i) Joint Venture Agreements (where applicable).
SCC 02	**Key Personnel & Equipment** The Contractor shall employ the key personnel and deploy required equipment, to carry out the Works or other personnel and equipment approved by the EIC. The EIC shall approve any proposed replacement of key personnel and equipment only if their relevant qualifications or characteristics are substantially equal to or better than those proposed in the Bid. The name/s of agreed each Key Personnel agreed by the Employer prior to Contract signature, Schedule of Key Personnel and equipment as proposed by the contractor during bidding stage & construction methodology shall be included.
SCC 03	**Code of Conduct (ESHS)** "The reasons to remove a person include behaviour which breaches the Code of Conduct (ESHS) (e.g. spreading communicable diseases, sexual harassment, gender based violence, illicit activity or crime)."
SCC 04	a) The Performance Security and an Environmental, Social, Safety and Health (ESHS) Security shall be provided to the Employer no later than the date specified in the Letter of Acceptance and shall be issued in an amount specified in the SCC (for Article 7.1.1), and shall be issued by a Nationalized or Scheduled bank in India. The Performance Security and, if applicable, the ESHS Security, shall be valid until a date 28 days from the date of issue of the Certificate of Completion.

	b) The Performance security & ESHS security shall be submitted in two separate Bank Guarantees in the Standard Form of Bank Guarantee of the Employer as detailed here under. (i) The Performance Security amount is 5.0 percent of the Contract Amount. (ii) Environmental, Social, Health and Safety (ESHS) Security amount is 1.5 Percent of Contract Amount. The standard forms of Performance Security and ESHS Security acceptable to the Employer shall be unconditional Bank Guarantees from Scheduled or Nationalized banks in India of the types as presented in Section X of the Bidding Document.
SCC 05	"In addition to the progress report, the Contractor shall also provide a report on the Environmental, Social, Health and Safety (ESHS) metrics set out in Part 3. In addition to Part 3 reports, the Contractor shall also provide immediate notification to the EIC of incidents in the following categories. Full details of such incidents shall be provided to the E I C within t h e timeframe agreed with the EIC. (a) confirmed or likely violation of any law or international agreement; (b) any fatality or serious (lost time) injury; (c) significant adverse effects or damage to private property (e.g. vehicle accident, damage from fly rock, working beyond the boundary) (d) major pollution of drinking areas aquifer or damage or destruction of areas, endangered areas, (including protected areas) or species; or any allegation of sexual harassment or sexual misbehavior, child abuse, defilement, or other violations involving children
SCC 06	**Strategies and Implementation Plans** (i)The ESMP plan is attached as Annexure-A. The Contractor shall not commence any Works, including mobilization and/or pre-construction activities (e.g. limited clearance for haul roads, site accesses and work site establishment, geotechnical investigations or investigations to select ancillary features such as quarries and borrow pits), unless the EIC is satisfied that appropriate measures are in place to address environmental, social, health and safety risks and impacts. At a minimum, the Contractor shall apply the Management Strategies and Implementation Plans and Code of Conduct, submitted as part of the Bid and agreed as part of the Contract. The Contractor shall submit, on a continuing basis, for the EIC's prior approval, such supplementary Management Strategies and Implementation Plans as are necessary to manage the ESHS risks and impacts of ongoing

	works. These Management Strategies and Implementation Plans collectively comprise the Contractor's Environmental and Social Management Plan (C-ESMP) updated based on the ESMP plan attached as Annexure-A. The C-ESMP shall be approved prior to the commencement of construction activities (e.g. Excavation, earth works, quarrying or extraction of materials, concrete batching etc.). The approved C-ESMP/ ESMP shall be reviewed, periodically (but not less than every three (3) months), and updated in a timely manner, as required, by the Contractor to ensure that it contains measures appropriate to the Works activities to be undertaken. The updated C-ESMP shall be subject to prior approval by the EIC." (ii)The Contractor shall be instructed through written site order for commencement of indivisible / item works or part of works. Such work or works shall be completed within 60 days from the date of placement of the written order.
SCC 07	Additional Clause Progress Monitoring and supervision shall be undertaken by the EIC or his nominated representative/authorised representative or any third-party agency appointed by the Employer. The supervision and monitoring shall not relieve the contractor to perform his responsibilities under the Contract. The contractor shall submit regular progress reports at the intervals decided by the EIC or his nominated representative/authorised representative or any third-party agency appointed by the Employer. The progress of the work at each stage (as per the Bill of Quantities) shall be subject to the approval of the EIC whose decision as to the rate of progress at each stage shall be final and binding on the Contractor. The EIC reserves himself to the right to cancel the contract for unsatisfactory progress in the work at any stage
SCC 08	(c) The Contractor shall maintain one Inspection Register in duplicate for recording details of materials and to be produced by the Contractor or his agent whenever called upon to do so by the EIC or his representative during their inspection of the work. One copy of the register shall be retained in the office of EIC. (d) The Contractor shall intimate in writing the placement of materials / arrangement after completion within 2 days to enable EIC for arranging for the inspection of the same. The EIC or his representative shall inspect immediately and file a certificate accordingly.
SCC 09	(d) The Contractor shall bear full responsibility for the intimation to the EIC forthwith of any accident and take all necessary action required under relevant Acts and Rules, Marine Rules etc. as the case may be. The Contractor shall also report such accidents to the Competent Authority wherever such reports are required under rules.

	The EIC or his representative must however, be informed immediately in the event of any marine accident. The Contractor should also bear full responsibility for all accident, damages or injury caused to any of the IWAI's employee, cause of which is established as due to Contractor's carelessness or negligence.
SCC 10	"The Contractor shall also provide information of any ESHS risks and impacts of the Variation."
SCC 11	The Contractor shall also have to ensure that with the rise and fall of water level and with the changes of site condition i.e. erosion, de-siltation of the area, change the location / shift of the site and the Contractor shall have to change the location accordingly as per the directions of the EIC. The Contractor shall make his own arrangements for protecting the works / materials during the course of execution of the work. During the process of work, the Contractor shall provide such precautionary and protective works at his own cost to protect arrangements from the weather conditions and the Contractor shall be solely responsible for any damage, which may occur due to the Contractor not taking necessary protective steps. The Contractor shall forthwith dispatch, raise and remove any plant (floating or otherwise) belonging to him or any person employed by him which may be sunk in the course of execution and completion of the works or otherwise deal with the same as the EIC or his representative may direct, until the same shall be raised and removed, the Contractor shall display at night, search lights and do all such arrangements for the safe navigation nearby terminal area as may be required by the department. In the event of the Contractor not carrying out the obligations imposed by him under this clause, the EIC shall raise and remove the same (without prejudice to the right of the department to hold the contractor liable) and the Contractor shall pay to the department all costs incurred in connection herewith.
SCC 12	The Service Provider / Contractor shall submit an undertaking that they shall pass on the input tax credit in GST, if availed by them, during the course of the contract or afterwards and shall compensate the Employer for any losses suffered on this account by the Employer.
SCC 13	(i)The Contractor shall submit Interim Milestone Stage Payment Bills on the actual work executed by the Contractor. The Contractor shall be paid as per the Milestone Stage Payment Bills submitted after verification & certification by the EIC.
SCC 14	If the Contractor was, or is, failing to perform any ESHS obligations or work under the Contract, the value of this work or obligation, as

	determined by the EIC, may be withheld until the work or obligation has been performed, and/or the cost of rectification or replacement, as determined by the EIC, may be withheld until rectification or replacement has been completed. Failure to perform includes, but is not limited to the following: (i) failure to comply with any ESHS obligations or work described in the Works' Requirements which may include: working outside site boundaries, excessive dust, failure to keep public roads in a safe usable condition, damage to offsite vegetation, pollution of water courses from oils or sedimentation, contamination of land e.g. from oils, human waste, damage to archeology or cultural heritage features, air pollution as a result of unauthorized and/or inefficient combustion; (ii) failure to regularly review ESMP/C-ESMP and/or update it in a timely manner to address emerging ESHS issues, or anticipated risks or impacts; (iii) failure to implement the ESMP/ C-ESMP; (iv) failing to have appropriate consents/permits prior to undertaking Works or related activities; (v) failure to submit ESHS report/s (as described in Part 3), or failure to submit such reports in a timely manner; (vi) failure to implement remediation as instructed by the Engineer-in-Charge within the specified timeframe (e.g. remediation addressing non-compliance/s).
SCC 15	Quality Control The contractor shall prepare and submit for the EIC's approval, not later than fifteen (15) days prior to the commencement of works, his detailed proposals for a quality control system for execution of works. The EIC's written approval of the system shall be obtained prior to commencement of work and the system shall not be altered by the contractor without the written permission of the EIC. The quality control system shall clearly indicate, inter-alia: (a) Contractor's personnel responsible for quality control. (b) Method of monitoring and determining the type of material being used; (c) Method of determining whether the material is suitable for works; and (d) System for obtaining approval from the EIC or his representative for all the works being carried out.

SCC 16 New Clause (Force Majeure)	**1.** "Force Majeure" shall mean any event beyond the reasonable control of the Employer or of the Contractor, as the case may be, in so far as they directly affect the execution of the Services and Works included in this Contract and which is unavoidable notwithstanding the reasonable care of the party affected, and shall include, without limitation, the following: (a) war, hostilities or warlike operations (whether a state of war be declared or not), invasion, act of foreign enemy and civil war; (b) rebellion, revolution, insurrection, mutiny, usurpation of civil or military government, conspiracy, riot, civil commotion and terrorist acts; (c) confiscation, nationalization, mobilization, commandeering, requisition by or under the order of any government or de jure or de facto authority or ruler or any other act or failure to act of any local state or national government authority; (d) strike, sabotage, lockout, embargo, import restriction, port congestion, lack of usual means of public transportation and communication, industrial dispute, shipwreck, shortage or restriction of power supply, epidemics, quarantine and plague; (e) earthquake, landslide, volcanic activity, fire, flood or inundation, tidal wave, typhoon or cyclone, hurricane, storm, lightning, or other inclement weather condition, nuclear and pressure waves or other natural or physical disaster; (f) shortage of labor, materials or utilities where caused by circumstances that are themselves Force Majeure. **2**. If either party is prevented, hindered or delayed from or in performing any of its obligations under the Contract by an event of Force Majeure, then it shall notify the other in writing of the occurrence of such event and the circumstances thereof within fourteen (14) days after the occurrence of such event. **3**. The party who has given such notice shall be excused from the performance or punctual performance of its obligations under the Contract for so long as the relevant event of Force Majeure continues and to the extent that such party's performance is prevented, hindered or delayed. The Time for Completion shall be extended in accordance with GC Clause 12. **4.** The party or parties affected by the event of Force Majeure shall use reasonable efforts to mitigate the effect thereof upon its or their performance of the Contract and to fulfill its or their obligations under the Contract, but without prejudice to either party's right to terminate the Contract under GC Clause 12. 5. No delay or nonperformance by either party hereto caused by the occurrence of any event of Force Majeure shall (a) constitute a default or breach of the Contract; give rise to any claim for damages or additional cost or expense occasioned thereby; if and to the extent that such delay or nonperformance is caused by the occurrence of an event of Force Majeure. **6.** If the performance of the Contract is substantially prevented, hindered or delayed for a single period of more than sixty (60) days or an aggregate period of more than one hundred and twenty (120) days

	on account of one or more events of Force Majeure during the currency of the Contract, the parties will attempt to develop a mutually satisfactory solution, failing which either party may terminate the Contract by giving a notice to the other, but without prejudice to either party's right to terminate the Contract under GC Clause 12. **7.** Notwithstanding GC Clause 12, Force Majeure shall not apply to any obligation of the Employer to make payments to the Contractor herein.
SCC 17 **- New Clause (Variation/ Extra Items)**	**Variations and Extra Items** The works shall be executed by the second party (Contractor) in accordance with the approved drawings and specifications. No variation in cost is acceptable. However, if the Engineer-in-Charge issues instructions for execution of extra items, the following procedure shall be followed: a. The second party (Contractor) shall provide the Engineer-in-Charge with a bid/estimate for carrying out the extra items when requested to do so by the Engineer-in-Charge. The Engineer- in-Charge shall assess the bid, which shall be given within seven days of the requestbefore the extra items are ordered. b. If the bid given by the second party is unreasonable, the Engineer-in-Charge may order the extra items and make a change to the Contract Price which shall be basedon Engineer-in-Charge 's own forecast of the effects of the extra items on the Contractor's costs. c. The second party shall not be entitled to additional payment for costs.

Appendix to Technical Part

Form of Bid Security - Bank Guarantee

[Guarantor letterhead or SWIFT identifier code]

Bid Guarantee No…..... *[insert guarantee reference number]*
Date… .....*[insert date of issue of the guarantee]*

WHEREAS,_____*[name of Bidder]*[3] (hereinafter called "the Bidder") has submitted his Bid dated_____*[date]* or will submit his Bid for the construction of_____*[name of Contract]* (hereinafter called "the Bid") under Request for Bids No……*[insert number]* (hereinafter called "the RFB")

KNOW ALL PEOPLE by these presents that We_____*[name of bank]* of_____*[name of country]* having our registered office at _____ (hereinafter called "the Bank") are bound unto _____*[name of Employer]* (hereinafter called "the Employer") in the sum of_____[4] for which payment well and truly to be made to the said Employer the Bank binds itself, his successors and assigns by these presents.

SEALED with the Common Seal of the said Bank this_____day of_____20___.

THE CONDITIONS of this obligation are:

(1) If after Bid opening the Bidder (a) withdraws his bid during the period of Bid validity specified in the Letters of Bid, or any extension thereto provided by the Bidder; or (b) does not accept the correction of the Bid Price pursuant to ITB 11.1;

or

(2) If the Bidder having been notified of the acceptance of his Bid by the Employer during the period of Bid validity:
   (a) fails or refuses to execute the Form of Agreement in accordance with the Instructions to Bidders, if required; or
   (b) fails or refuses to furnish the Performance Security, in accordance with the Instruction to Bidders.

we undertake to pay to the Employer up to the above amount upon receipt of his first written demand, without the Employer having to substantiate his demand, provided that in his demand the Employer will note that the amount claimed by him is due to him owing to the occurrence of one or any of the four conditions, specifying the occurred condition or conditions.

[3] *Insert name of the Bidder, which in the case of a joint venture shall be (a) the name of the joint venture that submits the bid if the JV has been constituted into a legally enforceable JV, or (b) the names of all future members of the JV as named in the letter of intent to execute the JV Agreement submitted by the bidder alongwith its bid.*
[4] *The Guarantor should insert the amount of the guarantee in words and figures denominated in Indian Rupees. This figure should be the same as shown in Clause 5.5 of the Instructions to Bidders.*

This Guarantee will remain in force up to and including the date_____[5] days after the deadline for submission of Bids as such deadline is stated in the Instructions to Bidders or as it may be extended by the Employer, notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this guarantee should reach the Bank not later than the above date.

DATE_____ SIGNATURE OF THE BANK _____

WITNESS_____ SEAL _____

_____
[signature, name, and address]

Note: All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.

[5] *45 days after the end of the validity period of the Bid.*

PERFORMANCE SECURITY - BANK GUARANTEE

[Guarantor letterhead or SWIFT identifier code]

Performance Guarantee No… .....*[insert guarantee reference number]*
Date… .....*[insert date of issue of the guarantee]*

To: _____*[name of Employer]*
_____*[address of Employer]*

WHEREAS_____*[name and address of Contractor]* (hereinafter called "the Contractor") has undertaken, in pursuance of Contract No._____dated_____to execute _____*[name of Contract and brief description of Works]* (hereinafter called "the Contract");

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with his obligations in accordance with the Contract;

AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee;

NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you, on behalf of the Contractor, up to a total of _____ [6] *[amount of guarantee]* _____ *[in words]*, such sum being payable in the types and proportions of currencies in which the Contract Price is payable, and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of _____ *[amount of guarantee]*[1] as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed thereunder or of any of the Contract documents which may be made between you and the Contractor shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

This guarantee shall be valid until ……. (i.e.) 28 days after the date of issue of the Certificate of Completion, and any demand for payment under it must be received by us at this office on or before that date.

Signature and seal of the guarantor _____
Name of Bank _____
Address _____
Date _____

Note: All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product

[6] An amount shall be inserted by the Guarantor, representing the percentage of the Contract Price specified in the Contract and denominated in Indian Rupees.

BANK GUARANTEE FOR ADVANCE PAYMENT
[Guarantor letterhead or SWIFT identifier code]

Advance Payment Guarantee No….....*[insert guarantee reference number]*
Date… .....*[insert date of issue of the guarantee]*

To: _____*[name of Employer]*
_____*[address of Employer]*
_____*[name of Contract]*

Gentlemen:

In accordance with the provisions of the Conditions of Contract, subclause 3.1 of the above-mentioned Contract,_____*[name and address of Contractor]* (hereinafter called "the Contractor") shall deposit with_____*[name of Employer]* a bank guarantee to guarantee his proper and faithful performance under the said Clause of the Contract in an amount of _____ *[amount of guarantee]* [7] _____*[in words]*.

We, the_____*[bank or financial institution]*, as instructed by the Contractor, agree unconditionally and irrevocably to guarantee as primary obligator and not as Surety merely, the payment to_____*[name of Employer]* on his first demand without whatsoever right of objection on our part and without his first claim to the Contractor, in the amount not exceeding _____ [*amount of guarantee*][1] _____*[in words]*.

We further agree that no change or addition to or other modification of the terms of the Contract or of Works to be performed thereunder or of any of the Contract documents which may be made between_____*[name of Employer]* and the Contractor, shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

This guarantee shall remain valid and in full effect from the date of the advance payment under the Contract until_____*[name of Employer]* receives full repayment of the same amount from the Contractor. Consequently any demand for payment under this guarantee must be received by us at this office on or before that date.

Yours truly,
Signature and seal: _____
Name of Bank: _____
Address:_____
Date: _____

Note: All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.

[7] An amount shall be inserted by the bank representing the amount of the Advance Payment, and denominated in Indian Rupees.

Retention Money Security

Demand Guarantee

[Guarantor letterhead or SWIFT identifier code]

_____*[Bank's name and address of issuing branch or office]*

Beneficiary: _____*[Name and Address of Employer]*

Date: _____

RETENTION MONEY GUARANTEE NO.: _____

We have been informed that _____*[name of contractor]* (hereinafter called "the Contractor") has entered into Contract No. _____*[reference number of the contract]* dated _____ with you, for the execution of _____ *[name of contract and brief description of Works]* (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, when the Taking-Over Certificate has been issued for the Works and the first half of the Retention Money has been certified for payment, payment of _____*[insert* the second half of the Retention Money*]* is to be made against a Retention Money guarantee.

At the request of the contractor, we _____*[name of Bank]* hereby irrevocably undertake to pay you the sum or sums not exceeding in total an amount of _____*[amount in Rupees]* (_____) *[amount in words*[8]*]* upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation under the Contract without cavil or argument.

It is a condition for any claim and payment under this guarantee to be made that the payment of the second half of the Retention Money referred to above must have been received by the Contractor on its account number _____ at _____*[name and address of Bank]*.

This guarantee shall expire, at the latest, 21 days after the date when the Employer has received a copy of the Defects Liability Certificate issued by the Engineer-in-Charge . Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date.

_____

[Signature(s) and seal of the guarantor]

Note: All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.

[8] *The Guarantor shall insert an amount representing the amount of the second half of the Retention Money.*

Section C. World Bank Policy - Corrupt and Fraudulent Practices

(Text in this Appendix shall not be modified)

Guidelines for Procurement of Goods, Works, and Non-Consulting Services under IBRD Loans and IDA Credits & Grants by World Bank Borrowers, dated January 2011 Revised July 2014:

"**Fraud and Corruption:**

1.16 It is the Bank's policy to require that Borrowers (including beneficiaries of Bank loans), bidders, suppliers, contractors and their agents (whether declared or not), sub-contractors, sub-consultants, service providers or suppliers, and any personnel thereof, observe the highest standard of ethics during the procurement and execution of Bank-financed contracts. [9] In pursuance of this policy, the Bank:

(a) defines, for the purposes of this provision, the terms set forth below as follows:

(i) "corrupt practice" is the offering, giving, receiving, or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party;[10];

(ii) "fraudulent practice" is any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation;[11]

(iii) "collusive practice" is an arrangement between two or more parties designed to achieve an improper purpose, including to influence improperly the actions of another party;[12]

(iv) "coercive practice" is impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;[13]

(v) "obstructive practice" is

[9] In this context, any action to influence the procurement process or contract execution for undue advantage is improper.

[10] For the purpose of this sub-paragraph, "*another party*" refers to a public official acting in relation to the procurement process or contract execution. In this context, "*public official*" includes World Bank staff and employees of other organizations taking or reviewing procurement decisions.

[11] For the purpose of this sub-paragraph, "party" refers to a public official; the terms "benefit" and "obligation" relate to the procurement process or contract execution; and the "act or omission" is intended to influence the procurement process or contract execution.

[12] For the purpose of this sub-paragraph, "parties" refers to participants in the procurement process (including public officials) attempting either themselves, or through another person or entity not participating in the procurement or selection process, to simulate competition or to establish bid prices at artificial, non-competitive levels, or are privy to each other's bid prices or other conditions.

[13] For the purpose of this sub-paragraph, "party" refers to a participant in the procurement process or contract execution.

(aa) deliberately destroying, falsifying, altering, or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede a Bank investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation, or

(bb) acts intended to materially impede the exercise of the Bank's inspection and audit rights provided for under paragraph 1.16(e) below.

(b) will reject a proposal for award if it determines that the bidder recommended for award, or any of its personnel, or its agents, or its sub-consultants, sub-contractors, service providers, suppliers and/or their employees, has, directly or indirectly, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices in competing for the contract in question;

(c) will declare misprocurement and cancel the portion of the loan allocated to a contract if it determines at any time that representatives of the Borrower or of a recipient of any part of the proceeds of the loan engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices during the procurement or the implementation of the contract in question, without the Borrower having taken timely and appropriate action satisfactory to the Bank to address such practices when they occur, including by failing to inform the Bank in a timely manner at the time they knew of the practices;

(d) will sanction a firm or individual, at any time, in accordance with the prevailing Bank's sanctions procedures, [14] including by publicly declaring such firm or individual ineligible, either indefinitely or for a stated period of time: (i) to be awarded a Bank-financed contract; and (ii) to be a nominated[15];

(e) will require that a clause be included in bidding documents and in contracts financed by a Bank loan, requiring bidders, suppliers and contractors, and their sub-contractors, agents, personnel, consultants, service providers, or suppliers, to permit the Bank to inspect all accounts, records, and other documents relating to the submission of bids and contract performance, and to have them audited by auditors appointed by the Bank."

[14] A firm or individual may be declared ineligible to be awarded a Bank financed contract upon: (i) completion of the Bank's sanctions proceedings as per its sanctions procedures, including, inter alia, cross-debarment as agreed with other International Financial Institutions, including Multilateral Development Banks, and through the application the World Bank Group corporate administrative procurement sanctions procedures for fraud and corruption; and (ii) as a result of temporary suspension or early temporary suspension in connection with an ongoing sanctions proceeding. See footnote 14 and paragraph 8 of Appendix 1 of these Guidelines.

[15] A nominated sub-contractor, consultant, manufacturer or supplier, or service provider (different names are used depending on the particular bidding document) is one which has either been: (i) included by the bidder in its pre-qualification application or bid because it brings specific and critical experience and know-how that allow the bidder to meet the qualification requirements for the particular bid; or (ii) appointed by the Borrower.

SAMPLE PLAN FOR BIDDERS FOR PREPARATION OF MSIP TO MANAGE ESHS RISKS & ESHS CODE OF CONDUCT

Management Strategies and Implementation Plan (MSIP) to manage the ESHS risks and ESHS Code of Conduct

The policy goal, as a minimum, shall be to integrate environmental protection, occupational and community health and safety, gender, equality, child protection, vulnerable people (including those with disabilities), sexual harassment, gender-based violence (GBV), sexual exploitation and abuse (SEA), HIV/AIDS awareness and prevention in the planning processes, programs, and various activities involved in the execution of the Works.

The Bidder shall accordingly submit a comprehensive and concise Management Strategies and Implementation Plan (MSIP) to manage the Environmental, Social (including sexual exploitation and abuse (SEA) and gender-based violence (GBV)), Health and Safety (ESHS) risks, and ESHS Code of Conduct. The plan shall describe the actions, materials, equipment, management processes etc. that will be implemented by the Contractor, and its subcontractors.

The Plan shall include at the minimum (i) construction traffic management plan to ensure safety of local communities from construction traffic; (ii) water resource protection plan to prevent contamination of drinking water; (iii) boundary marking and protection strategy to prevent depositing on private land and offsite adverse impacts; (iv) gender based violence and sexual exploitation and abuse (GBV/SEA) prevention and response action plan; (v) program to address regulatory authority conditions attached to any permits or approvals for the project; (vi) mobilization strategy; (vii) worker's camp management plan including the process for mitigating construction related impacts on local community etc.

The Bidder shall document and submit the Code of Conduct that will apply to its employees and subcontractors, to mitigate ESHS risks and to ensure compliance with its Environmental, Social, Health and Safety (ESHS) obligations under the contract. In addition, the Bidder shall submit an outline of how this Code of Conduct will be implemented and availability of qualified and trained personnel to supervise and implement the action plan. This will include: how it will be introduced into conditions of employment/engagement, what training will be provided, how it will be monitored and how the Contractor proposes to deal with any breaches.

~~[*Note: (i) delete where ESHS risks are not significant; and (ii) if used, modify to suit the specific requirements of the proposed work*]~~

ANNEXURE A

ENVIRONMENTAL & SOCIAL MANAGEMENT PLAN

1. Introduction

Environmental and social monitoring is the systematic measurement of key environmental indicators over time within project area and its surroundings. It is an integral part of any ESIA. It shows how the project has or is impacting the baseline environmental and social conditions that have been assessed as the part of the ESIA. It identifies the degree and magnitudes of the predicted environmental impacts forthe project are felt on the environment as well as social as a result of project implementation. Thus, it will help in implementing the mitigation measures that are already identified in this report or implementfurther measures if the impacts are identified to be bigger than anticipated.

2. Environmental and Social Management Plan

The ESMP consists of a set of mitigation, monitoring and institutional measures to be taken during the design, construction and operation (post-construction) stages of the project. The ESMP has been designed keeping in view the regulatory and other requirements to ensure the following:

- Minimum disturbance to the native flora and fauna
- Compliance with the air, water, soil and noise quality norms.
- Conservation of water to the extent possible through rain water harvesting, wastewater recycling

Considering all the impacts identified for construction phase of the project, during the ESIA study, mitigation measures are proposed to prevent pollution. Detailed ESMP is given below.

Table 1: Environment & Social Management Plan

Environmental Issue/ Component	Remedial Measure	Reference to laws and Contract Documents	Approximate Location	Time Frame	Indicative / Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
1. Climate							
1. Project is unlikely to cause negative effect on climate. However, project can contribute positively for climate	Prior permission shall be taken for cutting any tree. Compensatory tree planation shall be carried out for any tree cut (asper state forest policy) Addition plantation of local variety of tree (200 no one row of tree onthree side of the terminal land) shall be carried out along boundary of the terminal site	Forest Conservation Act,1980	Access road area and proposed terminal area	During design and Pre-Construction Stage	Compensatory / Additional Plantation(@ Rs 500 per tree)	Contractor	IWAI/SEMU/PMC[9]
2. Natural Hazard							
2. Earthquake-Seismic Zone III i.e., Moderate damage risk zone	Adoption of Relevant IS codes while designing the civil structures to sustain the earthquake of moderate to high magnitude.	Applicable BIS Standards	Project area	During design and Pre-Construction Stage	Part of Project Costs	Contractor	IWAI/SEMU/PMC
3. Site Preparation: Access road, Construction Camp, Construction Site							
3. Improvement of Access road : pavement of the road, Disposal of accumulated Municipal Solid Waste : Loss of Agricultur al land, loss of tree, air and noise pollution	**Improvement of Access Road:** ▪ Access road route and alignment (for unpaved area) shall be finalized and submitted to PMC and IWAI for their concurrence. ▪ Tree shall not be cut. Alignment shall be suitable adjusted to avoid cutting of the tree. If unavoidable, than tree shall be cut with due permission from concerned district/forests authorities.		Juncture of Access road	During design and Pre-Constructio n Stage	Part of Project Costs	Contractor	IWAI/SEMU/PMC

Environmental Issue/ Component	Remedial Measure	Reference to laws and Contract Documents	Approximate Location	Time Frame	Indicative / Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	▪ Trimming of the large tree standing close to the site shall be done as minimum as possible. ▪ Provision shall be made for dust suppression during its use. ▪ Provision shall be made (safety boards, speed control, traffic guards) to prevent accident. ▪ Survival rate of tree shall be regularly monitored. It is shall be minimum 70%.						
	Municipal Solid Waste Management: ▪ Arrangement shall be made for identifying the area for disposal of construction debris and notify to IWAI. The site should be minimum 1000 m distance from the river bank, residential area and sensitive areas like hospitals, school and temples. ▪ Arrangement shall be made for segregation of waste generated from construction site into recyclable, compostable and non-compostable waste. ▪ Resalable/recyclable waste shall be sold off to authorized agencies. Compostable waste will be composted in pits at site and non-compostable waste shall be disposed off to designated landfill site. If designated	Municipal Solid Wastes (Management and Handling) Rules, 2000,					

Environmental Issue/ Component	Remedial Measure	Reference to laws and Contract Documents	Approximate Location	Time Frame	Indicative / Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	landfill site not available, then debris disposal site shall be identified						
4. Setting of Labor Camps : Loss of agricultur e land, contamin ation of land and water resources from municipal waste from Camps, worker‟s health, Pressure on natural resources due to establish ment of labour camps	**Location of Camp:** ▪ Agriculture land should not be used for development of construction labour camps. Barren/waste land should be used ▪ Site identified by contractor should be approved by the engineers of PMC/IWAI ▪ Proper closure, stabilization and rehabilitation of the area should be carried out as soon as the activity is completed ▪ No land should be used for above purpose without consent of land owner. **Sanitation and Worker's Health :** ▪ Camp shall be well ventilated. It should have adequate provision for illumination, kitchen and safe drinking water facility shall be provided at the camp ▪ Adequate bathing and sanitation facilities to be provided at labour camp. Mobile Toilets shall be provided. Soak Pits can be provided only if labour camp is located away from river. ▪ Proper drainage to be maintained around the sites to avoid water logging leading to disease	▪ The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 and ▪ Cess Act of 1996 and ▪ The Water (Prevention & Control of Pollution) Act, 1974 and amendments thereof. ▪ Municipal Solid Wastes (Management and	Labour Camp Locations	During design and Pre-Construction Stage	Approximate ₹ 500,000/-per camp for sanitation and health facilities.	Contractor	IWAI/SEMU/PMC

Environmental Issue/ Component	Remedial Measure	Reference to laws and Contract Documents	Approximate Location	Time Frame	Indicative / Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	▪ Preventive medical care to be provided to workers- six monthly medical check-up should be organized ▪ Waste will be collected & segregated within site into recyclable, compostable and inert waste. Recyclable waste will be sold off to authorized dealers. Compostable waste shall be pit composted and inert waste shall be sent for disposal to landfill or site identified for debris disposal. ▪ Provision shall be made for essential material supply like cooking fuel (only LPG gas should be used, open burning of fuel should not be allowed) ▪ Provision shall be made for day crèche for children	Handling) Rules, 2000					
5. Setting up constructi on Camp: Concert Mix Plant, Hot Mix Plant, Mechanic al Worksho p, Fuel storages, Lubricant storages	▪ All these facilities shall be installed at proposed terminal site itself. In case these are to be set up away from site than these shall be located at minimum distance of 500 m from habitation, water bodies and 1000 m from forest areas. ▪ All maintenance facilities, hot mix plant and concrete missing plant shall be established with prior consent to establish to be obtained from SPCB.	Air (Prevention and Control of Water Pollution) Act, 1981 and Water (Prevention and Control of Water Pollution) Act, 1972	Site construction Camp	During design and Pre-Construction and construction Stage	Approximate ₹ 500,000/ -per camp for sanitation and health facilities.	Contractor	IWAI/SEMU/PMC

Environmental Issue/ Component	Remedial Measure	Reference to laws and Contract Documents	Approximate Location	Time Frame	Indicative / Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	▪ All such equipment/plant shall be fitted with air pollution control system and shall comply with condition of consent to establish. ▪ Periodic monitoring shall be carried as per consent conditions						
4. Site Preparation : Power supply, Water Supply, Drainage and disposal of muck and debris							
6. Power supply and Energy Conserva tion: Air Pollution , energy loss	▪ Power shall be sourced from national/state grid. DG sets shall be used only during power failure. ▪ Back-up power shall be set up with all provisions of containment for fuel leakages, air pollution control (stack height as per regulation), and with acoustic enclosure. ▪ Solar energy shall be used in common lighting area on 1:2 basis. ▪ Buildings designed should have green infrastructure. Measures should be taken to conserve energy as per ECBC norms as applicable.	Energy Conservation Building Code 200733	Construction Sites, Access road, and Labour Camp Locations	During design, Pre-Construction Stage	Part of Project Costs	Contractor	IWAI/SEMU/PMC
7. Water Supply, Drainage and effluent discharge	▪ The project areas are under safe / Semi Critical category as per Central Ground Water Board. However, necessary permission shall be taken from district	Central Ground Water Board, Local regulations.	Construction Sites, and Labour Camp Locations	Pre-Construction and construction Stage	Approx. ₹ 300,000 for construction of grease	Contractor	IWAI/SEMU/PMC

Environmental Issue/ Component	Remedial Measure	Reference to laws and Contract Documents	Approximate Location	Time Frame	Indicative / Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	authorities as applicable before digging the bore well. ▪ Staff and visitors should be made aware about water conservation by displaying posters and signage ▪ Garland storm water temporary drains shall be developed around the site to prevent any direct discharge of contaminated or soiled water to river. It shall be pass through di-siltation chamber and water collection pit. Collected water shall be used for construction purposes. ▪ All washing and maintenance effluent from the workshop area of vehicle maintenance area should darin to separate collection areas fitted with oil and grease trap and de-siltation chamber. The treated water shall be used for dust suppression and green belt development. This water shall not be discharged to river at all.				traps and de-siltation chambers		
8. Disposal of piling earth, muck and debris: uncontrolled disposal may leads to increased	▪ Provision shall be made for collection and draining of water for the piling earth. It shall be used for embankment protection or road construction depending on its suitability.		Jetty area River Bank along the proposed jetty site	Pre-Construction and construction Stage	Part of Project Costs	Contractor	IWAI/SEMU/PMC

Environmental Issue/ Component	Remedial Measure	Reference to laws and Contract Documents	Approximate Location	Time Frame	Indicative / Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
sediment ation of the river	▪ Provision shall be made for geo synthetic Screen for arresting silt flowing down stream.						
5. Embankment Design and Construction, Drainage Pattern and Fishermen's Access to River.							
9. River Bank Erosion Protection: Construct ion of Embankment and construction of jetty: may lead to accumula tion of sediment s on the updrift side and erosion of the downdrift side. Contamination of river water quality and land may happen due to river bed material	▪ Embankment protection measures (stone pitching) shall be made in both upstream and downstream to the extent that erosion is minimized. ▪ Erosion monitoring shall be carried out periodically downstream as well. ▪ River Bed material shall be tested for contaminants before its use or disposal for land fill site. If any level of heavy metal contamination is found than it shall be disposed off in a secure manner.		River Bank along the proposed jetty site	During design, Pre-Construction and construction Stage	Part of Project Costs	Contractor	IWAI/SEMU/PMC
10. Drainage Pattern	▪ Natural Drainage pattern of area around shall be maintained. No waste shall be allowed to dumped.		Construction Sites, Access road, and Labour Camp Locations	Pre-Construction Stage and construction stage	Part of Project Costs	Contractor	IWAI/SEMU/PMC

Environmental Issue/ Component	Remedial Measure	Reference to laws and Contract Documents	Approximate Location	Time Frame	Indicative / Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
11. Access to river : restricted movement of fisherman	▪ Fishing activities are seen in the river close to site. Arrangement shall be made to provide free access to river and undisturbed safe movement of the fishermen.		Terminal site and area around	Construction Stage	Part of Project Costs	Contractor	IWAI/SEMU/PMC
6. Protection of Flora and Fauna							
12. Protectio n of Tortoise : Increased sediment ation downstre am of constructi on site	▪ No movement of Turtles is reported upward to the site. No harm shall be caused to these Turtles in case any Turtle is sited, necessary caution notice shall be displaced and conveyed to all construction workers and officers. ▪ Geo-Textile synthetic sheet curtain shall be placed around pilling and construction area to prevent movement of sediments and construction waste.	Wild Life (Protection) Act, 1972	In and around project Site	During the design and Construction stage	Part of project costs	SEMU through DFO	IWAI/SEMU/PMC
13. Terrestria l Fauna: increase in hunt tendency	▪ Caution sign shall be placed to prevent hunting of wild animal and birds. ▪ Provision shall be made for strict penalty for hunting these animals. ▪ High noise construction work shall not be made in night.	Wild Life (Protection) Act, 1972	In and around project Site	During the design and Construction stage	Part of project costs	Contractor	IWAI/SEMU/PMC
14. Vegetation loss due to site preparation and	▪ Tree shall not be cut as much as possible. Any tree cut shall be compensated with	Forest Conservation Act, 1980	In and around project Site	During the design and Construction stage	Part of project costs	Contractor	IWAI/SEMU/PMC

Environmental Issue/ Component	Remedial Measure	Reference to laws and Contract Documents	Approximate Location	Time Frame	Indicative / Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
construction activities	compensatory tree plantation as per state forest policy. ▪ Tree plantation shall be made as feasible at site and around the site depending on land availability. ▪ Provision of LPG shall be made in construction site camp and labour camp as fuel source to avoid tree cutting. ▪ Proper arrangement of lighting should be made at site and construction labour camp ▪ Open burning of fuel for any purpose should not be allowed at the site						
15. Effect on Aquatic life such as Fish, Plankton	▪ No breeding ground is noticed around the project site. However construction activity shall be restricted during spawning period of June to August. ▪ Sedimentation and siltation shall be prevented/ controlled to maintain productivity of aquatic ecosystem and ensure availability of food for aquatic fauna & flora.		Proposed jetty construction site	During the design and Construction stage	Part of project costs	Contractor	IWAI/SEMU/PMC
7. Air Quality							
16. Fugitive Dust Generation due to construction activities	▪ Transport of loose and fine materials through covered vehicles.	Environmental Protection Act, 1986 and	Construction sites, Loading areas,	During the Construction stage	Part of project Costs	Contractor	IWAI/SEMU/PMC

Environmental Issue/ Component	Remedial Measure	Reference to laws and Contract Documents	Approximate Location	Time Frame	Indicative / Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	▪ Loading and unloading of construction materials in covered area. ▪ Approach roads shall be paved and widened. ▪ Water spraying on earthworks, unpaved haulage roads, other dust prone areas and construction yard. ▪ Make Provision of PPEs like face mask to workers.	amendments thereof; The Air (Prevention and Control of Pollution) Act, 1981 and amendments thereof	storage areas,				
17. Exhaust gas emissions from machinery and vehicular traffic.	▪ Regular maintenance shall be carried out of machinery and equipment. ▪ Periodic Ambient air quality monitoring shall be carried out. ▪ DG sets to be fitted with stacks of adequate height and low sulphur diesel to be used in DG sets as well as in machineries. ▪ Monitoring of air quality for PM_{10}, $PM_{2.5}$, SOx, NOx, and CO shall be carried out quarterly at construction site. Stack monitoring shall be carried out every month at the site.	Environmental Protection Act, 1986 and amendments thereof; The Air (Prevention and Control of Pollution) Act, 1981 and amendments thereof	Construction camps and sites, concrete mixing plant, DG sets locations	During the Construction stage	Part of project Costs	Contractor	IWAI/SEMU/PMC

Environmental Issue/ Component	Remedial Measure	Reference to laws and Contract Documents	Approximate Location	Time Frame	Indicative / Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
18. Emissions at access road : avoidance of traffic Jams	▪ Efforts shall be made to move construction material early morning and late evening period. ▪ Traffic regulators (Guard) shall be posted in habitat area and at key junction areas to avoid congestion	-do-	Access road	During the Construction stage	-do-	Contractor	IWAI/SEMU/PMC
8. Noise and Vibration							
19. Noise from construction vehicle, equipment and machinery.	▪ All equipment to be timely serviced and properly maintained to minimize its operational noise. ▪ Construction equipment and machinery to be fitted with silencers and maintained properly. ▪ Provision of temporary noise barrier near habitat areas during construction phase. ▪ Protection devices (ear plugs or ear muffs) will be provided to the workers operating in the vicinity of high noise generating machines. ▪ Speed control shall be enforced in habitat areas. ▪ The ambient noise level as per CPCB standard is 55 dB(A) and 45 db(A). Current noise level at habitat area meets the standard	Noise Pollution (Regulation and Control) Rules, 2000 and amendments thereof	Construction Site and accesses road.	During the Construction stage	Part of project Costs	Contractor	IWAI/SEMU/PMC

Environmental Issue/ Component	Remedial Measure	Reference to laws and Contract Documents	Approximate Location	Time Frame	Indicative / Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	▪ Noise monitoring day and night at site, labour camp and access road area shall be carried quarterly to ensure the effectiveness of mitigation measures.						
9. Landuse & Landscape							
20. Land use Change and Loss of productive/top soil	▪ Efforts shall be made to improve the aesthetic of the area. No construction waste or other wastes shall be dumped at unidentified areas. Caution board in local language shall be placed at different locations to prevent dumping of waste generated from construction site in the river and nearby areas ▪ Compensatory tree plantation for loss of trees. ▪ Top soil shall be preserved and laid over either on the embankment slope for growing vegetation to protect soil erosion or spread over in the proposed plantation areas. ▪ Land earmarked for dumping of construction waste shall be free from any social and R&R issue and away from settlements.	Design requirement	Around project site area	During the Construction stage	Approximately ₹5000 per board	Contractor	IWAI/SEMU/PMC

Environmental Issue/ Component	Remedial Measure	Reference to laws and Contract Documents	Approximate Location	Time Frame	Indicative / Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
21. Soil erosion due to construction activities, earthwork	▪ Provision of cross drainage structure shall be made in the access road if required to maintain the natural drainage pattern. ▪ Provision of side drain shall be made in access road if required to prevent water logging. ▪ Measures like building of scouring protection structures, protection by geo-textiles matting etc shall be made, if river bank erosion is found around the terminal area. ▪ Bio-turfing of embankments shall be made enhance the slop stabilization.		Access road and river bank	Construction stage	Part of project Costs	Contractor	IWAI/SEMU/PMC
22. Soil erosion at earth stockpiles	▪ The earth stockpiles to be provided with gentle slopes to prevent soil erosion.		At earth stockpiles	Construction stage	Part of project costs	Contractor	IWAI/SEMU/PMC
23. Compaction and contamination of soil due to movement of vehicles and equipment	▪ Fuel and lubricants to be stored at the predefined storage location. ▪ Storage area shall be paved with gentle slope to a corner and connected with a chamber to collect any spills of the oils. ▪ Provision of “oil interceptors” at wash-down and re-fuelling areas. ▪ Oil and grease spill and oil soaked materials are to be collected and stored in labelled containers (Labelled: WASTE		Project site	Pre construction and construction stage.	Part of project costs	Contractor	IWAI/SEMU/PMC

Environmental Issue/ Component	Remedial Measure	Reference to laws and Contract Documents	Approximate Location	Time Frame	Indicative / Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	OIL; and hazardous sign be displayed) and sold off to SPCB/ MoEF authorized vendors. ▪ Movement of construction vehicles, machinery and equipment shall be restricted to the designated haulage route.						
10. Water Resources							
24. Depletion of Groundwater resources due to unregulated abstraction for construction purpose	▪ Preference shall be given to source water from rivers wherever feasible in the project area with due permission from authorities. ▪ Augmentation through incorporating water harvesting structures if technically feasible. ▪ Construction of check dams in consultation with community to reduce burden on ground water resources. ▪ Efforts to restrict water intensive activities during summer period (April, May, June)			During Construction stage	Part of project costs	Contractor	IWAI/SEMU/PMC
25. Increase in water Siltation levels due to construction of terminal and contamination due to disposal of domestic waste	▪ The piling work shall be undertaken during low flow period. ▪ Restoration of changes in the stream, if any, made during construction to its original level. ▪ Precautions shall be made that no nala or canal is clogged.		Project Site	During Construction stage	Part of project costs	Contractor	IWAI/SEMU/PMC

Environmental Issue/ Component	Remedial Measure	Reference to laws and Contract Documents	Approximate Location	Time Frame	Indicative / Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	▪ Substructure construction should be limited to the dry season and cofferdams may be constructed and utilized to lift the spoil directly out of it and carried to the riverbank for land disposal. ▪ Mobile toilets with anaerobic digestion facility shall be fixed at construction site. No domestic waste shall be discharged to river.						
11. Accident and Safety Risks							
26. Accident risk from construction activities	▪ Contractors to adopt and maintain safe working practices. ▪ Usage of fluorescent signage, in local language at the construction sites ▪ Training shall be provided to workers, especially machinery operators, on safety procedures and precautions. ▪ The contractors to appoint a safety officer mandatory. ▪ At every work place, a readily available first aid unit including an adequate supply of dressing materials, a mode of transport (ambulance), nursing staff, and doctor to be provided. ▪ Required PPE shall be provided to workers.	Central Motor and Vehicle Act 1988 EP Act 1986 Noise Rules 2002	Construction sites	Construction period	Part of project costs	Contractor	IWAI/SEMU/PMC

Environmental Issue/ Component	Remedial Measure	Reference to laws and Contract Documents	Approximate Location	Time Frame	Indicative / Mitigation Cost	Institutional Responsibility	
						Implementation	Supervision
	▪ Half yearly medical check-up shall be carried of the workers and summary report shall be submitted to PMC						
12. Shifting of Common Property Resources and other Utilities							
Shifting of community properties and utilities	▪ As per assessment, no such shifting is involved. However if any shifting is involved it shall done at suitable location with the concurrence from local authorities and community.		Project area	During Construction stage	Part of project costs	Contractor	IWAI/SEMU/PMC

3. Specific Activities by Contractor/Concessionaire and Monitoring Consultant

The role of IWAI Kolkata office for West Bengal in the implementation of ESMP involves the following activities:

- Applying for NOC from West Bengal State Pollution Control Board under Air and Water Act by Contractor/Concessionaire
- Permission from Forest / District Administrative Department for felling of trees by Contractor/Concessionaire.
- Supervision of implementations of ESMP through Contractor/Concessionaire and Monitoring Consultant

4. Specific Activities by Concessionaire/Contractor

The activities to be performed by the Concessionaire/contractor to implement the ESMP shall comprise the following:

- Confirm the Tree Cutting Schedule based on the final design and provide the same to IWAI
- Follow up with the respective departments & facilitate IWAI for getting various required NoC.
- Felling of trees after IWAI secures Forest Department's/ District Administrative Department's permissions
- Selection, design and layout of construction areas, hot mix and batching plants, labour camps etc.
- Apply for and obtain all the necessary clearances from the agencies concerned after finalizing the locations of the sites for labour camp.
- Planning traffic diversions and detours including arrangements for temporary land utilization on lease basis
- Plant and maintain of flowering, shade, medicinal, ornamental & fruit bearing trees in suitable area for the entire duration of the contract period
- Planting and maintenance of ornamental, medicinal & flowering plants and shrubs for the entire duration of the contract period

5. Institutional Arrangement

The Contractor shall have an Environmental and social cell that will coordinate with site engineers IWAI/PMC.

5.1 Environmental and Social Management Cell

Apart from having an Environmental and Social Management Plan, it is also necessary to have a permanent organizational set up charged with the task of ensuring its effective implementation of mitigation measures and to conduct environmental monitoring.

The major duties and responsibilities of the Environment and Social Management Cell are:

- To implement the environmental and social management plan
- To assure regulatory compliance with all relevant rules and regulations
- To ensure regular operation and maintenance of pollution control devices
- To minimize environmental and social impacts of operations as by strict adherence to the ESMP
- To initiate environmental monitoring as per the approved schedule
- Review and interpretation of monitoring as per the approved schedule
- Review and interpretation of monitoring results and corrective measures in case

monitored results are above the specified limit

- Maintain documentation of good environmental practices and applicable environmental laws as a ready reference
- and social Maintain environmental and social-related records
- Coordination with regulatory agencies, consultants, monitoring laboratories
- Maintain a log of public complaints and the action taken

The proposed environmental and social management cell should have all basic record keeping facilities such as hardware/software facilities, adequate space, vehicle (transport) and basic furniture and all simple instruments such as GPS, Digital camera, Hand held noise metre etc. The cell should have all basic environmental management data of the project that includes but not limited tothe following:

- Environmental & Social Impact Assessment Report (both well preserved soft and hardcopy)
- All valid and up to date environmental clearance and consent papers
- All latest Environmental legislations, policies, codes and manuals for ready references

6. Environment and Social Monitoring Plan

The objective of environmental monitoring during the construction and operation phases is to compare the monitored data against the baseline condition collected during the study period to assess the effectiveness of the mitigation measures and the protection of the ambient environment based on national standards. The following are the main objectives of the environmental monitoring program:

- Provides information for documentation of monitoring of mitigation measures and impacts
- Tool for the statutory authority of unanticipated adverse impacts or sudden changes in the environmental condition due to the proposed project
- Provides information that could be used for evaluating the effectiveness of implemented mitigation measures
- Provides information that could be used to verify predicted impacts and thus validate impact prediction techniques
- The effectiveness of the mitigation measures being followed during construction and operational phases can be assessed and the measures can be revised, made more stringent and reinforced based on the monitoring results
- Environmental and Social Monitoring can also serve a basic component of a periodic environmental regulatory auditing program for the proposed project

A monitoring schedule has been sketched based on the environmental and social components that maybe affected during the construction phase of the project. Environmental and social monitoring plan for operation phase to be carried out. Environment monitoring indicators identified are listed below:

- Air quality- ambient air quality levels
- Surface Water quality/ Wastewater disposal
- Drinking water quality- for construction labours

- Noise levels- ambient noise level and work zone noise levels
- Soil quality- dredged sand quality and soil quality/ Soil Erosion
- Solid & Hazardous Waste Management
- Re-plantation success / survival rate
- Aquatic ecology– plankton and benthic communities
- Socio- economic parameters

These indicators will have evaluated periodically based on the monitoring results, baseline conditions, predicted impacts and mitigation measures.

Table 2: Environment & Social Monitoring Plan

S. No.	Aspect	Parameters to be monitored	No of sampling locations & frequency	Standard methods for sampling and analysis	Role & Responsibility	
					Implementation	Supervision
Construction Period						
1	Air Quality	PM_{10}, $PM_{2.5}$, SO_2, NO_2, HC and CO	All project site and 1other sites within 2 km from the site Once in a month	Fine Particulate Samplers for $PM_{2.5}$ Respirable Dust Sampler fitted PM_{10} Respirable Dust Sampler fitted with Gaseous sampling arrangements for SO_2 and NO_2, CO analyser / portable CO meter for CO portable HC meter or tubesfor HC; TO- 14A, TO-15, USEPA method for sampling andanalysis of VOCs in ambient air	Contractor	IWAI & PMC
2	Surface Water Quality	Physical, chemical and biological	River Ganga	Grab sampling and analysis by using standard methods	Contractor	IWAI & PMC
3	Drinking water Quality	Physical, chemical and biological	Drinking water from labour camps Once a month	Grab sampling and analysis by using standard methods	Contractor	IWAI & PMC
4	Noise Level	Day time and night time noise level (max, min & Leqlevels)	Construction labour camp, construction site and 2 locations within 2 km of terminal site Once a month	Noise meter	Contractor	IWAI & PMC
5	Soil Quality	Soil texture, type, Electrical conductivity, pH, infiltration, porosity, etc.,	Construction site, labour camps and debris disposal site Once in 6 months	Collection and analysis of samples as per IS 2720	Contractor	IWAI & PMC

S. No.	Aspect	Parameters to be monitored	No of sampling locations & frequency	Standard methods for sampling and analysis	Role & Responsibility	
					Implementation	Supervision
6	Soild & Hazardous Waste Management	Physical & Chemical characteristics	Construction site, labour camps and debris disposal site Daily	MSW Rules, 2000, Hazardous Waste & Management Rules, 2008	Contractor	IWAI & PMC
7	Wastewater Management	Physical, chemical and biological	Construction site & labour camps Once a month	--	Contractor	IWAI & PMC
8	Plantation	Plantation survival rate	At plantation site (terminal site & afforestation site)	Survey, counting, recording & reporting	Contractor	IWAI & PMC
9	Soil Erosion	--	Upstream & downstream of terminal site	Survey & observation; Extent and degree of erosion; Structures for controlling soil erosion	Contractor	IWAI & PMC
10	Aquatic ecology	Phytoplankton, Zooplankton	River Ganga Once a month	Plankton net of diameter of 0.35 m, No.25 mesh size 63 and analysis by using standard methods	Contractor	IWAI & PMC

7. Reporting Requirement

It is required that the contractor will submit a quarterly compliance report to PIU/PMC. Project Management Consultants (PMC) as well as to SEMU (Social and Environmental Management Unit) of IWAI. will analyze the report and notify the corrective action if any is required to contractor under intimation to IWAI.

8. Grievance Redress Mechanism

Concern/grievances from local/affected people may come up related to the inappropriate implementation of various components of EMP. These issues can be easily addressed through acknowledgment, evaluation and corrective action and response approach. To resolve grievances from public or stakeholders concerning the project will be directed to the SPMU/Director concerned. Firstly, it will be assessed if the grievances are genuine or suggestion is acceptable. Accordingly, response will be given within 15-30 days by the SEMU in consultation with PMC and Director concerned. In case the SEMU is unable to resolve the issue, the matter will be forwarded to Project Director at Head Quarter. The corrective action will be started as per the response or action plan indicated to the stakeholder. The outcome shall also form part of quarterly report to World Bank.

RISK ASSESSMENT & HAZARD MANAGEMENT PLAN

National Disaster Management Act, 2005 (DM Act, 2005) is the basic legislation in the purview of Disaster Management (DM). DM Act defines a disaster as "a catastrophe, mishap, calamity or grave occurrence in an area, arising from natural or manmade causes, by incidence or negligence which results in substantial loss of life or human suffering or damage to and destruction of property or damage to, or degradation of the environment of such a nature or magnitude as to be beyond the coping capacity of the affected area". They can be natural, manmade or hybrid based on the cause of their occurrence.

DM Act defines disaster management as a "continuous and integrated process of planning, organizing and coordinating and implementing measure which are necessary or expedient". It can be divided into the following steps:

- **Prevention:** Preventing threat of any disaster which is possible to a great extent inthe case of a manmade disaster.
- **Preparedness:** Contingency planning, stockpiling of equipment and supplies, arrangements for inter-agency coordination, preparation of evacuation plans and public awareness, capacity building and associated training and mock drills.
- **Response:** Prompt response to any threatening disaster situation or disaster including evacuation, rescue and immediate relief.
- **Recovery & Mitigation:** Assessing the severity or magnitude of effects of any disaster. Rehabilitation and Reconstruction and implementing measures for reduction of severity or consequences of a disaster

So, in case of disaster management, the phase wise activities required could be summarized as in
Figure 1.

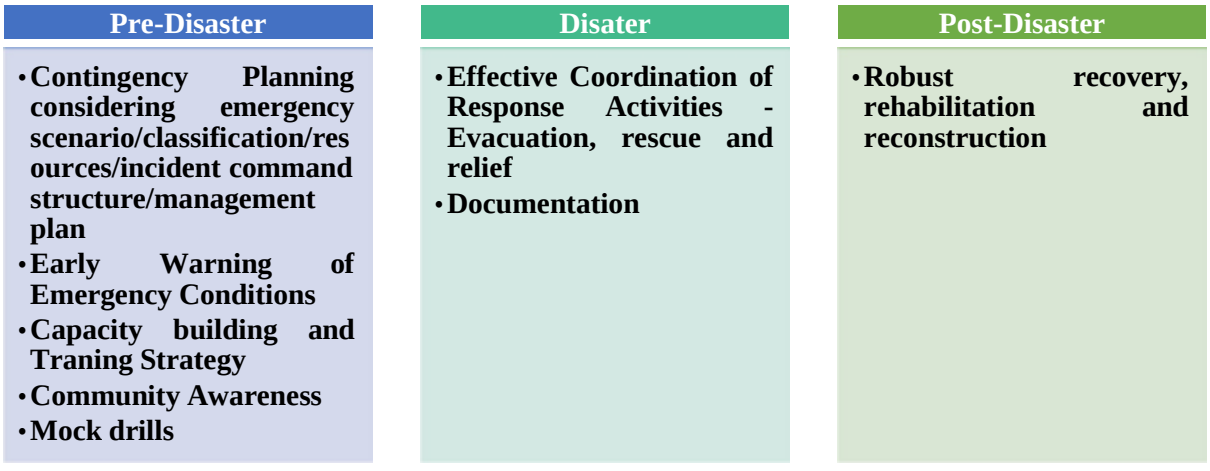


Figure 1: Various Phase of Disasters and Activities Involved – On a Broader Profile

Towards identification of the probable disasters associated with the project, a hazard risk, vulnerability and capacity analysis was carried out as presented below.

1. Hazard, Risk, Vulnerability and Capacity Analysis (HRVCA)

The project component include construction of community jetties, associated ancillary facilities and vessel operation. Hazards due to the project may be natural or manmade which may turn out in to a disaster during operation phase. Towards deriving the disaster management plan, the probable hazards along the project area and activities were identified followed by risk assessment.

A hazard is defined as an agent, which has the potential to cause harm or damage to a vulnerable target

i.e. people, property or environment. Historical analysis has been carried out based on the literature review to understand the hazards associated with IWT operation. The accident data were analyzed to delineate the major hazard as well as the causes of hazard and further the same was analyzed w. r. to their applicability for vessel operation in NW-1 route.

The hazards could be categorized as natural and manmade. Natural hazard include flood, tsunami, earth quake etc., and manmade hazards include chemical disasters, road /vessel accidents etc. The project area vulnerability w.r.to the prominent natural and manmade disasters were primarily assessed which will have impact on operation of various facilities and activities on land and cruise operations. W r to the cruise vessel apart from the natural and disasters, the various risk factors w. r. to vessel operation was analyzed in detail.

An extensive literature review was carried out for the various causes and contributing factors of inland vessel accidents worldwide and probability of the same w.r.to the project region and cruise operation was assessed with specific reference to the local factors which may have an additional influence on the risk profile. The analysis is summarized in **Table 1.**

Table 1: Probable Disasters due to Natural Hazards

Sl.No	Risk Factors	Disaster
1	Bad Weather Condition /Natural Hazard	
2	Storm	Destruction of structures Collision/Contact/grounding of Vessel leading to Capsize
	Flood	
	Earth Quake	
	Cyclone	
	Tsunami	

In case of cruise operation of various facilities the risk factors and resultant probable disasters are presented in **Table 2.**

Table 2: Probable Disasters along the Infrastructure facilities in Operational Phase

Sl.No	Facility	Risk Factor	Disaster
1	Community Jetties at all 08 locations	Overcrowding / slipping while boarding and unboarding from vessel	Structural collapse and accident due to fall into river.

Risk factors w r.to vessel operation include channel related risk as well as vessel related risk and leadingto the probable disasters are as presented in **Table .3**

Table 3: Probable Disasters during Vessel Operation

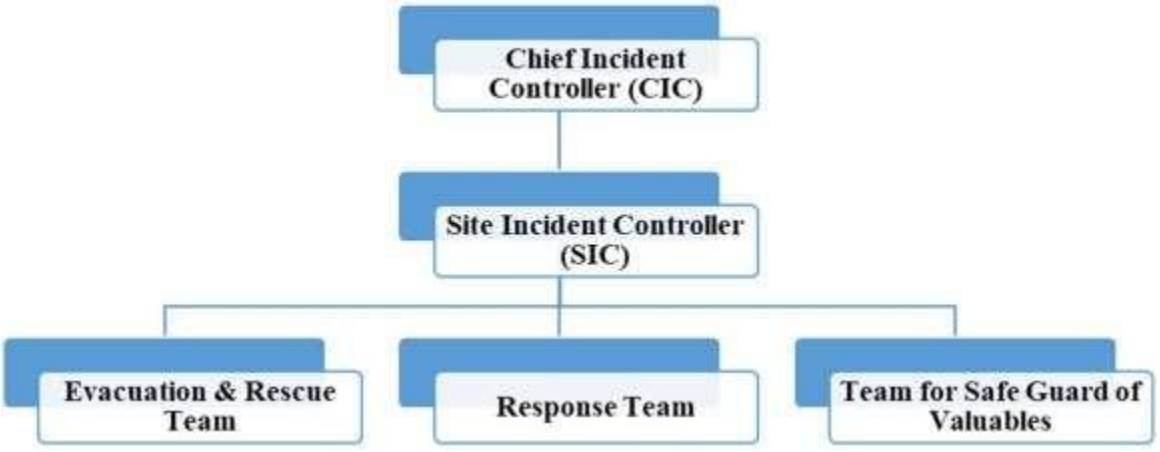
Sl No	Risk Factors	Probable Disaster
1	Careless Vessel Operation	Collision / contact / grounding for vessel leading to vessel Capsize
2	Overloading	Vessel Capsize
3	Loss of Vessel Control	Collision/contact/grounding for vessel leading to vessel Capsize
4	Equipment failure leading to mis navigation	Collision/contact/grounding for vessel leading to vessel Capsize
5	Stability Failure due to unbalanced allotment of people on board	Collision/contact/grounding for vessel leading to vessel Capsize
6	Fire on Vessel due to use of flammable materials	Accident due to human escape to river.
6	River Piracy / Sabotage	Collision/contact/grounding for vessel leading to vessel Capsize

2. Disaster Management Measures

Management Measures to be adopted for the reducing the impact of the expected disasters are discussed in the following section.

- **Constitution of Onsite Disaster/ Emergency Management Cell (EMC)**

An Emergency Management Cell (EMC) will be constituted before the operation phase towards the better coordination and implementation of disaster management measures. The



EMC proposed is as presented in

Figure 2: Emergency Management Cell Proposed for the Facility

The EMC will meet at least once in 3 months to review the working of the contingency plan, the problem faced in recent disasters and amendment modifications to be adopted in future. The Committee will be responsible for overall managing the disaster situation, take administrative decisions as and when required, reviewing the disaster plan and to inform the Government on the situation. An Emergency Response Centre (ERC) should be maintained

and put in action within the facility whichwould co-ordinate with various state departments to ensure planning, response and recovery. The responsibility allocation of each member EMC during a disaster management is presented in **Table 4.**

Table 4: Responsibilities of EMC Members

Sl. No.	Designation	Responsibilities
1		▪ Overall In charge of the Incident.
Sl. No.	Designation	Responsibilities
	Chief Incident Controller	▪ Coordination with Management/ mother Department District Disaster Management Authorities, external agencies, media etc.,
		▪ Appraise the incident and give proper directions to the SIC and his team from time to time.
		▪ Declare emergency as well as issue 'ALL Clear' order after emergency.
2	Site Incident Controller (SIC)	▪ Analyse the onsite emergency response requirement and request for the same to CIC from time to time.
		▪ Deploy the team members and supervise their operations.
		▪ Support CIC for coordination internal and external communication and administration.
3	Response Team headed	▪ Initiate response with equipment and facilities available at site.
		▪ Report regarding the adequacy of existing equipment and provide the requirement for additional facilities.
		▪ Identifying safe route for firefighting, ambulance, medical team etc.,
4	Evacuation & Rescue Team	▪ Alert the occupants about the emergency
		▪ Blow siren
		▪ Show evacuation paths, Assembly points and cite self-protection measures.
		▪ Arrange for rescue and first aid with the help local and occupant volunteers.
		▪ Arrange for sending causalities to hospitals.
5	Team for Safe Guard of Valuables headed	▪ Take appropriate actions for the safe guard of valuables and assets such as important documents, cash chests etc.,
		▪ Take head count (Live/Injury/ Death) after emergency.

- **Emergency Response Centre (ERC) for Disaster Management**

The Emergency Response Centre will be earmarked to function as a Control Room for disaster management. A Control Room will respond immediately during an emergency situation and isequipped with State of the Art communication equipment which enables it to communicate quickly to the affected area and provide immediate support during the Golden Hour of the disaster. This room should also consist of announcing system, fire extinguishers, smoke detectors and sensors.

- **Establishing Local Coordinating Group**

Coordination group at the local level shall be constituted to be mobilize at the time of major disasters.

- **Early Warning System w r to Natural Hazards**

The early warning system is useful to detect, forecast and issue the alert when the disaster occurs. A liasoning with the nodal agencies of Government of UP / India responsible for the natural disaster will be done for getting the warning on the natural hazards.

- **Proper Crowd Management**

Towards ensuring safety and security to crowd coming to the of the proposed tourism circuitfollowing guidelines shall be followed

  - Sufficient CCTV shall be established in terminals to monitor the crowd
  - Entire circuit area shall be provided with proper communication channels (PA system) to send message to crowd shall be implemented.
  - A mini UAV shall be deployed for observing the crowd in case of crowd spared istoo big
  - Sufficient safety measures shall be provided in each cruise to be utilized at the time of disaster. And the detailing of the same shall be provided to the victors before starting of each trip.
  - A detailed narration of the emergency measure provided will be displayed to the commutators before starting of the trip.

- **Development and Display of Evacuation Plan**

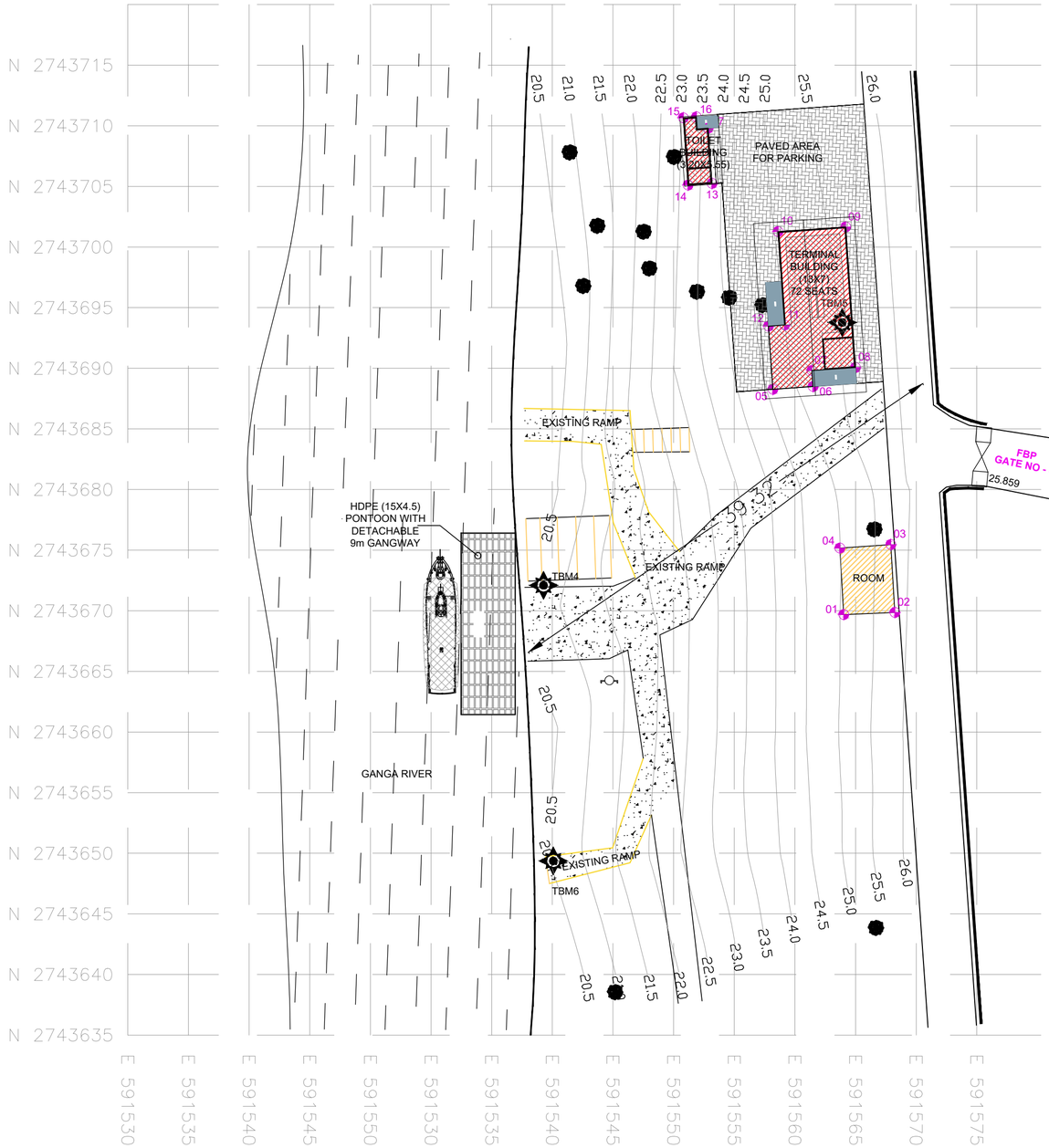
A well-planned assembling point within the route will be detailed so that easy evacuation of the crowd during the disaster can be achieved.

- **Fire Alarms / Other Measures**

Sufficient fire and smoke alarms at common areas shall be provided, so that visitors and all the staff will be are informed in the event of the disaster for initiating appropriate measures forrescue.

- **DO's and Don'ts Pamphlets**

Dos and Don'ts pamphlets for the visitors towards each disaster will be prepared and displayed intourists' places.



T.B.M. POINTS

PONT I.D.	NORTHING	EASTING	ELEVATION
T.B.M. 4	2743672.0970	591539.2730	20.858
T.B.M. 5	2743693.7740	591563.9000	26.604
T.B.M. 6	2743649.3650	591540.0790	20.556

NOTE:

1. EXISTING BUILDING
2. PROPOSED BUILDING
3. PROPOSED RAMP

CO - ORDINATES

COORDPNT	EAST	NORTH
01	591564.0239	2743669.6862
02	591568.2360	2743669.8560
03	591567.9078	2743675.4552
04	591563.7011	2743675.1635
05	591558.1828	2743688.2638
06	591561.4899	2743688.4931
07	591561.3986	2743689.8100
08	591564.9899	2743690.0591
09	591564.1858	2743701.6566
10	591558.6042	2743701.2696
11	591559.1385	2743693.5631
12	591557.8217	2743693.4718
13	591553.1626	2743705.2457
14	591551.1843	2743705.1085
15	591550.7999	2743710.6527
16	591551.8803	2743710.7276
17	591552.8467	2743709.8008

DETAILS	
Location	Goraipara
Plot Size	295 sqm
Building Area	96 sqm
FFL For Terminal (M)	+25.30
Type of Jetty	HDPE
Total Base Year Traffic (Average No of persons per day) in 2022	2200
Total Design Year Traffic (Average No of persons per day) in 2052	5971
Design Peak Hour (10%) in no of passenger	598
Design Trip Max.Capacity in no of passenger	75
Seating Capacity (75%) (No of seats)	56

REVISION

Rev.No.	PARTICULARS	INITIAL	DATE

KITCO Ltd.
the consultants
(Estd. in 1972 by IDBI & Govt. of Kerala)
MM GARDENS, CHURCH LANDING ROAD, KOCHI - 16

CLIENT: INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DEVELOPMENT OF COMMUNITY JETTIES, TO BE DEVELOPED IN WB UNDER JMVP-II

TITLE: -: GORAIPARA :- SITE PLAN

DRG NO:		SHEET NO: 1 OF 1	REV.	SCALE: NTS	A2
DESIGNED:	CHECKED:	DRAWN:	DRG. CHECKED	APPROVED:	
ISSUED FOR: TENDER PURPOSE			UNIT: mm.	DATE: 05.08.2023	

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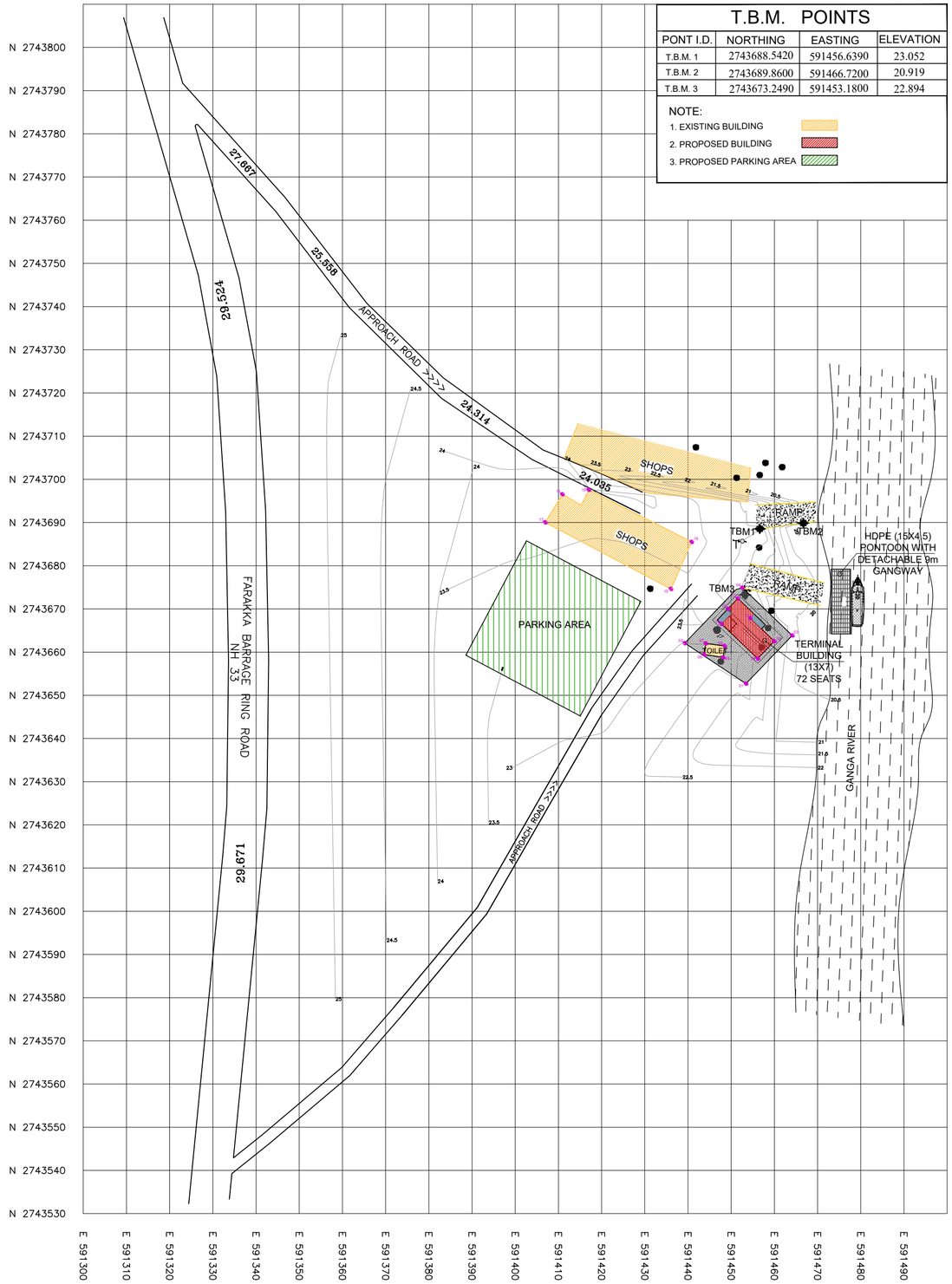

COORDPNT	EAST	NORTH
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06	591443.8010	2743659.4200
07	591444.1493	2743662.0175
08	591448.4958	2743661.4347
09	591456.1254	2743658.4923
10	591459.9916	2743662.5365
11	591454.4078	2743667.8747
12	591451.5464	2743672.4363
13	591449.2557	2743670.0401
14	591447.7222	2743666.5257
15	591436.0445	2743674.6173
16	591440.8630	2743685.5170
17	591406.9639	2743690.0379
18	591410.9153	2743696.5380
19	591417.0380	2743697.5700

DETAILS	
Location	Goraipara Village side
Plot Size	283 sqm
Building Area	96 sqm
FFL For Terminal (M)	+21.30
Type of Jetty	HDPE
Total Base Year Traffic (Average No of persons per day) in 2022	2200
Total Design Year Traffic (Average No of persons per day) in 2052	5218
Design Peak Hour (10%) in no of passenger	598
Design Trip Max.Capacity in no of passenger	75
Seating Capacity (75%) (No of seats)	56

REVISION

Rev.No.	PARTICULARS	INITIAL	DATE

KITCO Ltd.
the consultants
(Estd. in 1972 by IDBI & Govt. of Kerala)
MM GARDENS, CHURCH LANDING ROAD, KOCHI - 16

CLIENT:
INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT:
DEVELOPMENT OF COMMUNITY JETTIES, TO BE DEVELOPED IN WB UNDER JMVP-II

TITLE:
-: GORAIPARA VILLAGE SIDE :-
SITE PLAN

DRG NO:		SHEET NO:	REV.	SCALE:	
		1 OF 1		NTS	A2

DESIGNED:	CHECKED:	DRAWN:	DRG. CHECKED	APPROVED:

ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	05.08.2023

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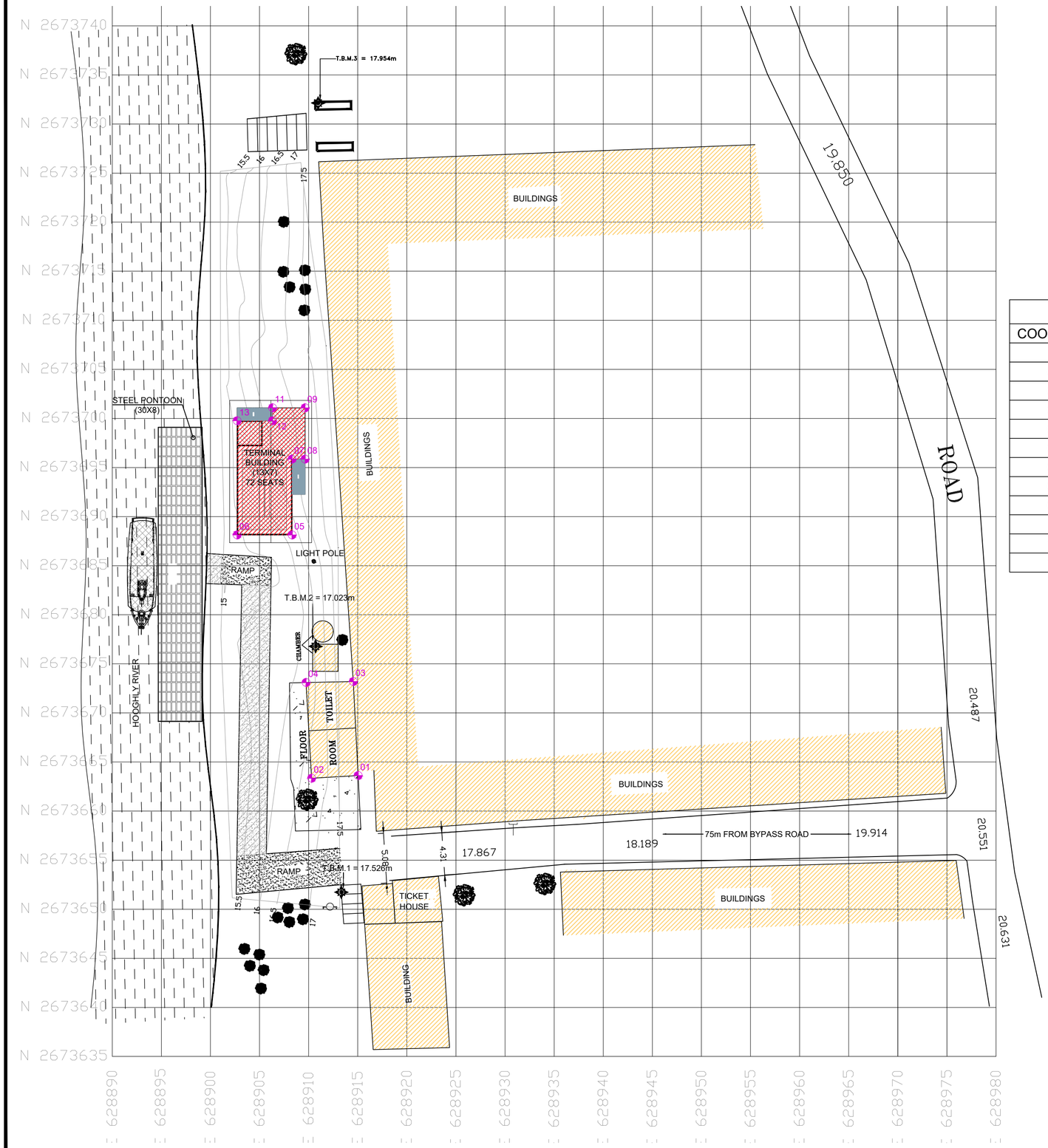

T.B.M. POINTS

SL.NO.	PONT I.D.	NORTHING	EASTING	ELEVATION
1.	T.B.M. 1	2673651.734	628913.329	17.526
2.	T.B.M. 2	2673676.7806	628910.6946	17.023
3.	T.B.M. 3	2673732.1364	628910.9645	17.954

NOTE:

1. EXISTING BUILDING
2. PROPOSED BUILDING
3. PROPOSED RAMP

CO - ORDINATES

COORDPNT	EAST	NORTH
01	628915.0329	2673663.6129
02	628910.3048	2673663.3430
03	628914.5445	2673673.1963
04	628909.7317	2673673.0939
05	628908.3152	2673688.1357
06	628902.7202	2673688.1357
07	628908.3152	2673695.8607
08	628909.6352	2673695.8607
09	628909.6352	2673701.0812
11	628906.3202	2673701.0812
12	628906.3202	2673699.7611
13	628902.7202	2673699.7611

DETAILS	
Location	Lalbagh Ghat
Plot Size	415 sqm
Building Area	96 sqm
FFL For Terminal (M)	+17.30
Type of Jetty	HDPE
Total Base Year Traffic (Average No of persons per day) in 2022	2000
Total Design Year Traffic (Average No of persons per day) in 2052	13017
Design Peak Hour (10%) in no of passenger	1301
Design Trip Max.Capacity in no of passenger	163
Seating Capacity (45%) (No of seats)	72

REVISION

Rev.No.	PARTICULARS	INITIAL	DATE

KITCO Ltd.
(Estd. in 1972 by IDBI & Govt. of Kerala)
MM GARDENS, CHURCH LANDING ROAD, KOCHI - 16
the consultants

CLIENT:
INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT:
DEVELOPMENT OF COMMUNITY JETTIES, TO BE DEVELOPED IN WB UNDER JMVP-II

TITLE:
-: LALBAGH GHAT :-
SITE PLAN

DRG NO:	SHEET NO:	REV.	SCALE:	
	1 OF 1		NTS	A2

DESIGNED:	CHECKED:	DRAWN:	DRG. CHECKED	APPROVED:

ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	05.08.2023

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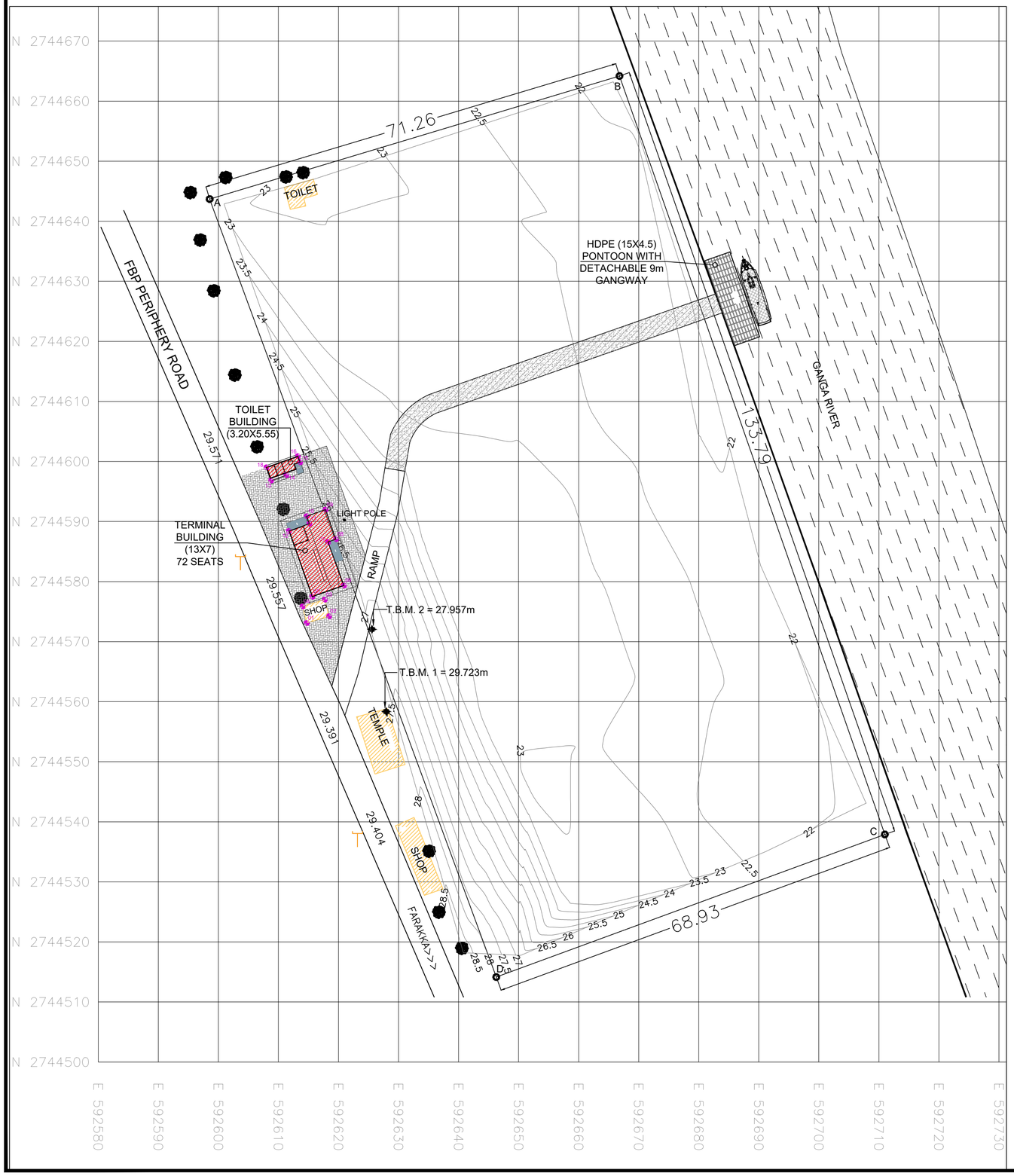

REFFERENCE POINT

SL.NO.	PONT I.D.	NORTHING	EASTING
1.	A	2744643.6985	592598.5561
2.	B	2744664.1845	592666.8043
3.	C	2744537.9019	592710.9904
4.	D	2744514.1425	592646.2805
5.	T.B.M. 1	2744558.3590	592627.9610
6.	T.B.M. 2	2744572.0500	592625.5760

NOTE:

1. EXISTING BUILDING
2. PROPOSED BUILDING
3. PROPOSED RAMP

COORDPNT	NORTH	EAST
01	592614.7210	2744573.0920
02	592618.4300	2744574.2294
03	592617.7079	2744576.9943
04	592614.0142	2744575.8616
05	592615.6310	2744577.4705
06	592620.9060	2744579.3357
07	592618.2601	2744586.5938
08	592619.5753	2744587.0588
09	592617.8350	2744591.9807
10	592614.7096	2744590.8756
11	592615.1497	2744589.6311
12	592611.7556	2744588.4310
13	592608.7856	2744596.8309
14	592611.3071	2744597.7224
15	592613.6085	2744599.8620
16	592613.2475	2744600.8830
18	592608.0079	2744599.0304

DETAILS	
Location	Taltala Ghat
Plot Size	415 sqm
Building Area	96 sqm
FFL For Terminal (M)	+29.80
Type of Jetty	HDPE
Total Base Year Traffic (Average No of persons per day) in 2022	2200
Total Design Year Traffic (Average No of persons per day) in 2052	5218
Design Peak Hour (10%) in no of passenger	598
Design Trip Max.Capacity in no of passenger	75
Seating Capacity (75%) (No of seats)	56

REVISION

Rev.No.	PARTICULARS	INITIAL	DATE

KITCO Ltd.
the consultants
(Estd. in 1972 by IDBI & Govt. of Kerala)
MM GARDENS, CHURCH LANDING ROAD, KOCHI - 16

CLIENT:
INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT:
DEVELOPMENT OF COMMUNITY JETTIES, TO BE DEVELOPED IN WB UNDER JMVP-II

TITLE:
-: TALTHALA :-
SITE PLAN

DRG NO:	SHEET NO:	REV.	SCALE:	
	1 OF 1		NTS	A2

DESIGNED:	CHECKED:	DRAWN:	DRG. CHECKED	APPROVED:

ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	05.08.2023

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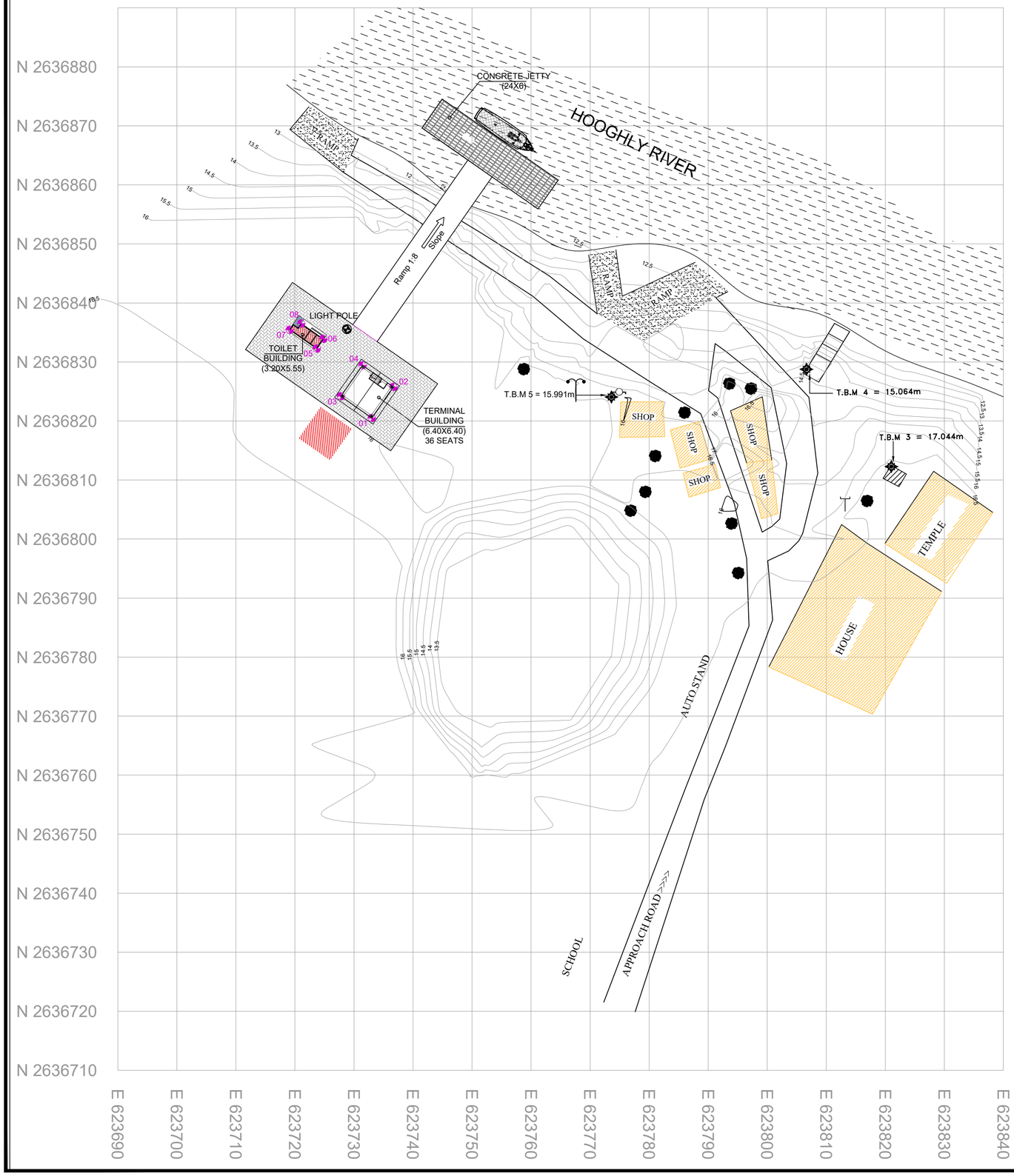
S:\DWGS\1083 IWAI\CIVIL WORKING\SITE PLAN\03_WEST BENGAL\08_ TALTALA GHAT CAD.dwg _ 30.01.2024



T.B.M. POINTS

SL.NO.	PONT I.D.	NORTHING	EASTING	ELEVATION
3.	T.B.M. 3	2636812.2807	623821.0124	17.044
4.	T.B.M. 4	2636828.75808	623806.6591	15.064
5.	T.B.M. 5	2636824.0672	623773.5999	15.991

LEGEND:

1. EXISTING BUILDING
2. PROPOSED BUILDING
3. PROPOSED RAMP

CO - ORDINATES

COORDPNT	EAST	NORTH
01	623733.0169	2636820.5156
03	623727.7746	2636824.1869
02	623736.6882	2636825.7579
04	623731.4459	2636829.4292
05	623723.6705	2636832.2656
06	623724.8060	2636833.9164
07	623719.1142	2636835.4478
08	623721.0625	2636836.5058

DETAILS	
Location	Narkelbari Ghat
Plot Size	415
Building Area	58.22 sqm
FFL For Terminal (M)	+16.30
Type of Jetty	STEEL
Total Base Year Traffic (Average No of persons per day) in 2022	550
Total Design Year Traffic (Average No of persons per day) in 2052	1899
Design Peak Hour (10%) in no of passenger	190
Design Trip Max.Capacity in no of passenger	24
Seating Capacity (75%) (No of seats)	18

REVISION

Rev.No.	PARTICULARS	INITIAL	DATE

KITCO Ltd.
(Estd. in 1972 by IDBI & Govt. of Kerala)
the consultants
MM GARDENS, CHURCH LANDING ROAD, KOCHI - 16

CLIENT: INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DEVELOPMENT OF COMMUNITY JETTIES, TO BE DEVELOPED IN WB UNDER JMVP-II

TITLE: -: NARKELBARI GHAT :- SITE PLAN

DRG NO:	SHEET NO:	REV.	SCALE:	
	1 OF 1		NTS	A2

DESIGNED:	CHECKED:	DRAWN:	DRG. CHECKED	APPROVED:

ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	28.01.2023

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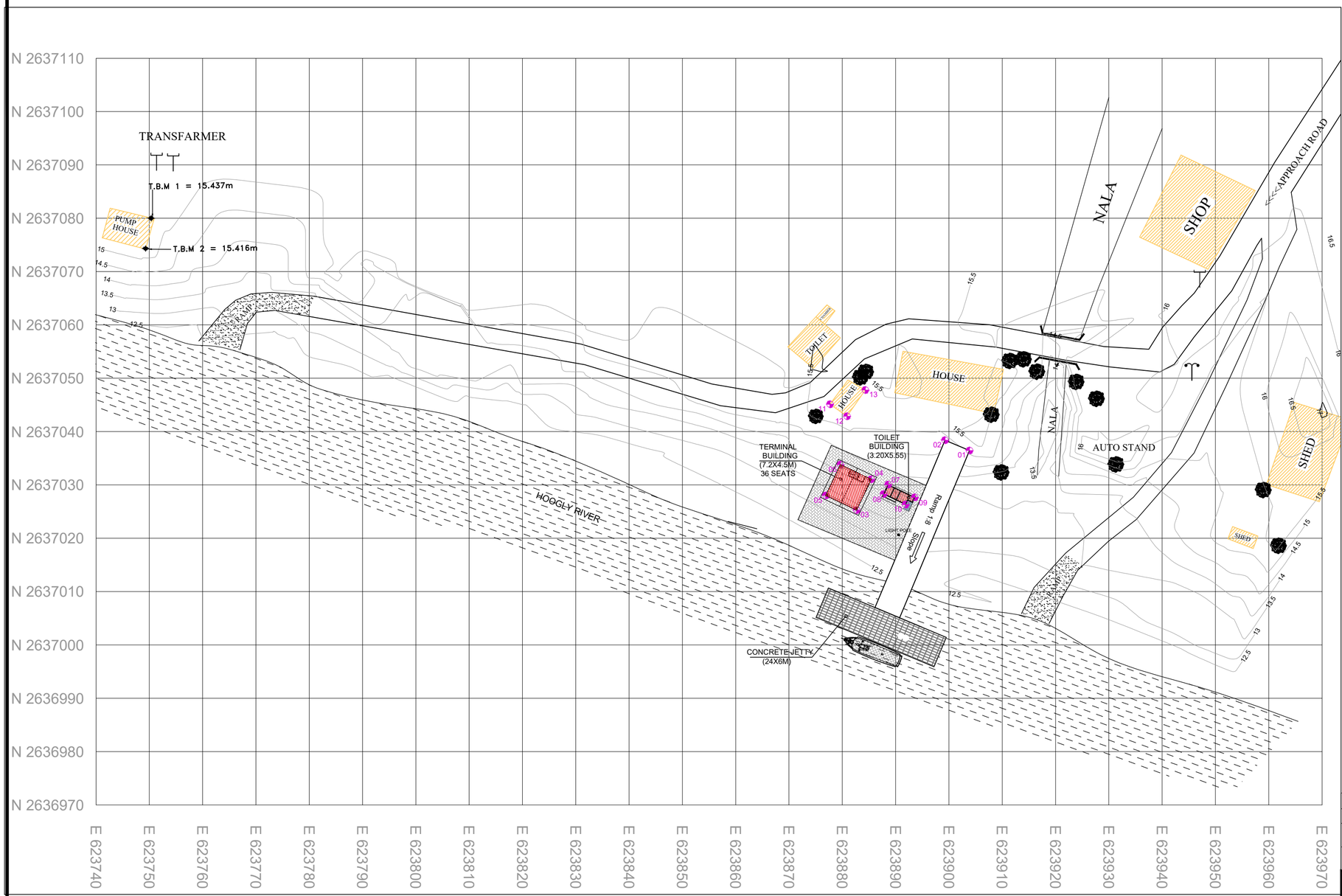

CO-ORDINATES		
COORDPNT	EAST	NORTH
01	623903.8728	2637036.4579
02	623899.2596	2637038.3862
03	623882.6877	2637025.2839
04	623885.4308	2637031.0662
05	623876.9054	2637028.0270
06	623879.6485	2637033.8093
07	623888.5882	2637030.0601
08	623887.7383	2637028.2684
09	623893.6094	2637027.6781
10	623891.8636	2637026.3114
11	623877.6809	2637045.1202
12	623880.8836	2637042.8719
13	623884.3118	2637047.7868

DETAILS	
Location	Maganpara Ghat
Plot Size	296.70 sqm
Building Area	58.22 sqm
FFL For Terminal (M)	+13.80
Type of Jetty	HDPE
Total Base Year Traffic (Average No of persons per day) in 2022	400
Total Design Year Traffic (Average No of persons per day) in 2052	1899
Design Peak Hour (10%) in no of passenger	190
Design Trip Max.Capacity in no of passenger	24
Seating Capacity (75%) (No of seats)	18

T.B.M. POINTS

SL.NO.	PONT I.D.	NORTHING	EASTING	ELEVATION
1.	T.B.M. 1	2637080.0163	623750.3399	17.044
2.	T.B.M. 2	2637074.3192	623749.3079	15.064

1. EXISTING BUILDING
2. PROPOSED BUILDING
3. PROPOSED RAMP

REVISION

Rev.No.	PARTICULARS	INITIAL	DATE

KITCO Ltd.
the consultants
(Estd. in 1972 by IDBI & Govt. of Kerala)
MM GARDENS, CHURCH LANDING ROAD, KOCHI - 16

CLIENT: INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DEVELOPMENT OF COMMUNITY JETTIES, TO BE DEVELOPED IN WB UNDER JMVP-II

TITLE: -: MAGANPARA GHAT :- SITE PLAN

DRG NO:	SHEET NO:	REV.	SCALE:	
	1 OF 1		NTS	A2

DESIGNED:	CHECKED:	DRAWN:	DRG. CHECKED	APPROVED:

ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	28.01.2023

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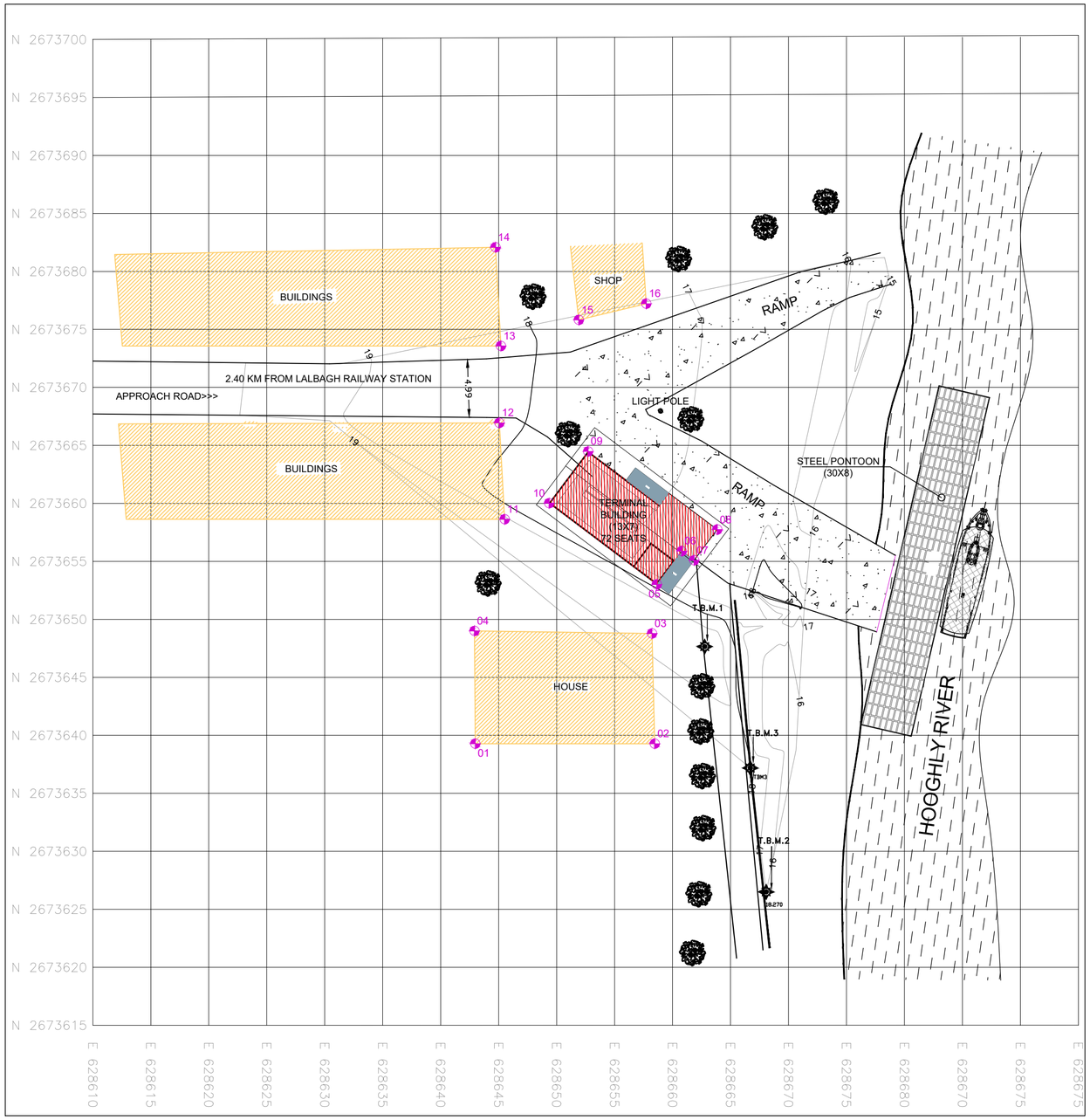

T.B.M. POINTS

SL.NO.	PONT I.D.	NORTHING	EASTING	ELEVATION
1.	T.B.M. 1	2673647.6489	628662.7729	17.420
2.	T.B.M. 2	2673626.4910	628668.0710	18.269
3.	T.B.M. 3	2673637.1927	628666.7007	18.272

NOTE:

1. EXISTING BUILDING
2. PROPOSED BUILDING

CO - ORDINATES

COORDPNT	EAST	NORTH
01	628642.9824	2673639.2788
02	628658.4646	2673639.2788
03	628658.2268	2673648.7797
04	628642.9107	2673649.0026
05	628658.6350	2673653.0142
06	628660.8017	2673655.8892
07	628661.8559	2673655.0947
08	628663.8511	2673657.7420
09	628652.7184	2673664.4793
10	628649.3510	2673660.0111
11	628645.5200	2673658.6295
12	628645.0557	2673666.9424
13	628645.1962	2673673.5735
14	628644.7215	2673682.0755
15	628651.9088	2673675.8181
16	628657.7345	2673677.2161

DETAILS	
Location	Lalbagh Court Ghat
Plot Size	415 sqm
Building Area	96 sqm
FFL For Terminal (M)	+17.30
Type of Jetty	HDPE
Total Base Year Traffic (Average No of persons per day) in 2022	2000
Total Design Year Traffic (Average No of persons per day) in 2052	13017
Design Peak Hour (10%) in no of passenger	1301
Design Trip Max.Capacity in no of passenger	163
Seating Capacity (45%) (No of seats)	72

REVISION

Rev.No.	PARTICULARS	INITIAL	DATE

KITCO Ltd.
(Estd. in 1972 by IDBI & Govt. of Kerala)
MM GARDENS, CHURCH LANDING ROAD, KOCHI - 16
the consultants

CLIENT: INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DEVELOPMENT OF COMMUNITY JETTIES, TO BE DEVELOPED IN WB UNDER JMVP-II

TITLE: -: LALBAGH COURT GHAT :- SITE PLAN

DRG NO:	SHEET NO:	REV.	SCALE:	
	1 OF 1		NTS	A2

DESIGNED:	CHECKED:	DRAWN:	DRG. CHECKED	APPROVED:

ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	05.08.2023

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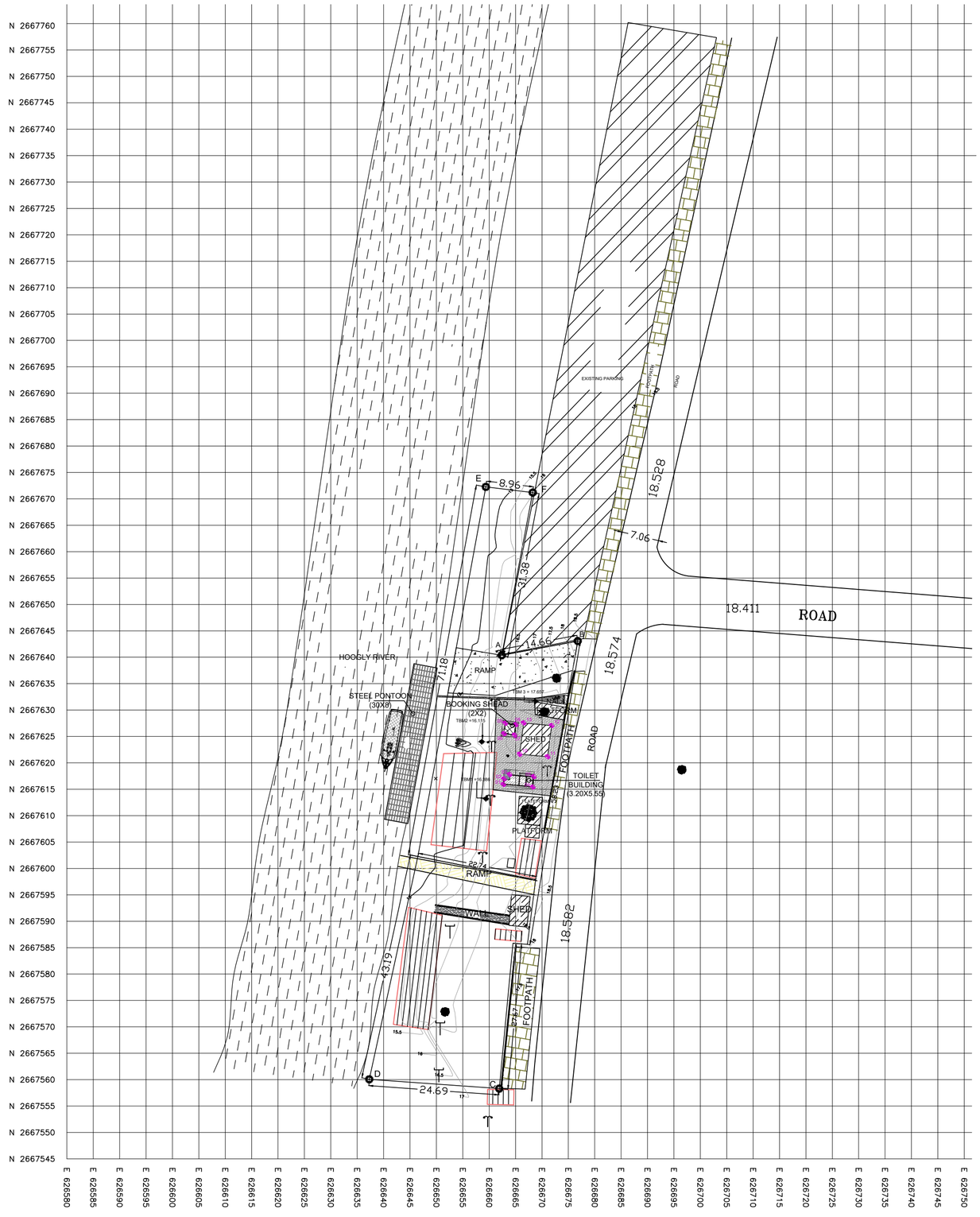

REFFERENCE POINT			
SL.NO.	PONT I.D.	NORTHING	EASTING
1.	A	2667640.3758	626662.3726
2.	B	22667643.0658	626676.7903
3.	C	2667558.3035	626661.9058
4.	D	2667560.0629	626637.2821
5.	E	2667672.2701	626659.3659
6.	F	2667671.1975	626668.2565
7.	T.B.M. 1	2667613.1950	626659.3840
8.	T.B.M. 2	2667624.0020	626658.5860
9.	T.B.M. 3	2667631.6527	626668.7401

CO - ORDINATES		
COORDPNT	EASTING	NORTHING
01	626662.6977	2667615.8963
02	626662.7922	2667616.9751
03	626663.8585	2667617.7852
04	626668.2340	2667615.4113
05	626668.4070	2667617.3867
06	626662.7926	2667625.5209
07	626664.7748	2667625.2548
08	626665.0410	2667627.2370
09	626663.0588	2667627.5031
10	626665.7430	2667621.6350
11	626671.0678	2667621.1686
12	626671.8390	2667627.0600
13	626666.5380	2667627.5560

DETAILS	
Location	Berhampore
Plot Size	197 sqm
Building Area	15 sqm
FFL For Terminal (M)	+17.30
Type of Jetty	HDPE
Total Base Year Traffic (Average No of persons per day) in 2022	1650
Total Design Year Traffic (Average No of persons per day) in 2052	2989
Design Peak Hour (10%) in no of passenger	298
Design Trip Max.Capacity in no of passenger	37
Seating Capacity (75%) (No of seats)	28

REVISION			
Rev.No.	PARTICULARS	INITIAL	DATE

KITCO Ltd.
the consultants
(Estd. in 1972 by IDBI & Govt. of Kerala)
MM GARDENS, CHURCH LANDING ROAD, KOCHI - 16

CLIENT:
INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT:
DEVELOPMENT OF COMMUNITY JETTIES, TO BE DEVELOPED IN WB UNDER JMVP-II

TITLE:
-: BERHAMPORE GHAT :-
SITE PLAN

DRG NO:		SHEET NO:	REV.	SCALE:	
		1 OF 1		NTS	A2

DESIGNED:	CHECKED:	DRAWN:	DRG. CHECKED	APPROVED:

ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	05.08.2023

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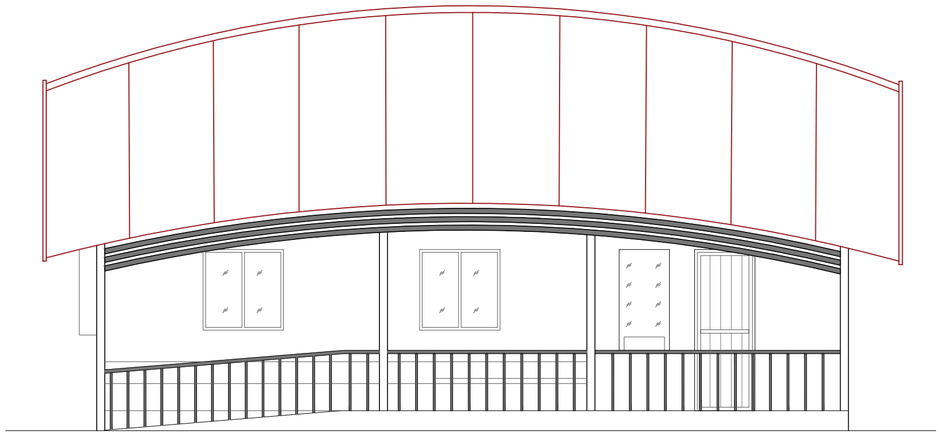
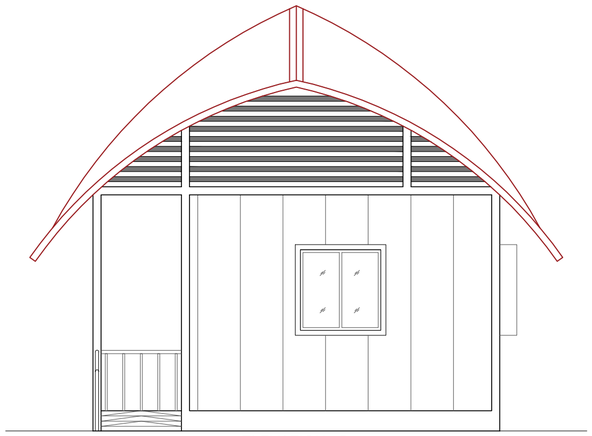


ELEVATION - A

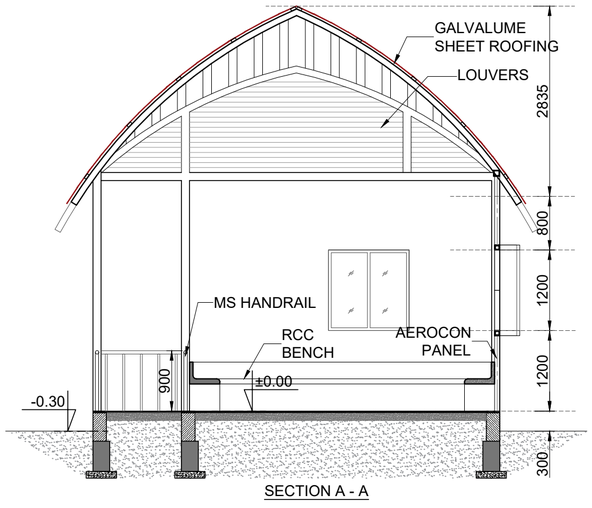


ELEVATION - B

JOINERY SCHEDULE			
NAME	WIDTH	HEIGHT	TYPE OF OPENING
D1	900	2400	FRP DOOR
FG	750	1500	FIXED GLASS
W1	1200	1200	AL. FIXED WINDOW

FINISHING SCHEDULE				
FACILITIES	FLOORING	ROOF	INTERIOR WALLS	EXTERIOR WALLS
WAITING AREA AND TICKET COUNTER	KOTA STONE FLOORING	GALVALUME SHEET ROOFING	AEROCON PANEL WITH EXTERIOR EMULSION PAINT	AEROCON PANEL WITH EXTERIOR GRADE EMULSION PAINT ALONG WITH TEXTURED PAINT AS PER DESIGN
RAMP AND STEP				
TICKET COUNTER	GRANITE			

PLAN



SECTION A - A

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED.
3. ±0.00m LVL. CORRESPONDS TO FINISHED GROUND FLOOR LEVEL
4. HFL TO BE VERIFIED AND CONSIDERED BEFORE COMMENCEMENT OF THE PROJECT, AT EACH OF THE SITE.
5. LIGHTING FIXTURES, PLUMBING FIXTURES, AND OTHER HARDWARE AND AMENITIES SHOULD BE MADE VANDAL RESISTANT/PROOF.
6. THE PROPOSED STRUCTURES HAVE TO COMPLY WITH THE LATEST EDITION OF HARMONISED GUIDELINES AND SPACE STANDARDS 2016 TO MAKE THE FACILITIES DISABLED FRIENDLY.

Rev.No.	PARTICULARS	INITIAL	DATE

REVISION

KITCO Ltd.
the consultants
(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28

CLIENT:
INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT:
DEVELOPMENT OF COMMUNITY JETTIES, TO BE DEVELOPED IN WB UNDER JMVP-II

TITLE:
-: TERMINAL BUILDING MODULE 1:-
(WAITING AREA, TICKETING AND OFFICE)
PLAN,SECTION AND ELEVATION.

DRG NO:	SHEET NO:	REV.	SCALE:	
DP 1083 DRG CL 03 101	1 OF 1		NTS	A3

DESIGNED:	DRAWN:	CHECKED:	VERIFIED:	APPROVED:
Kiran Kumar	Hari Sankar	Kiran Kumar	Sansu sunny	Lipin K

ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	03.12.2022

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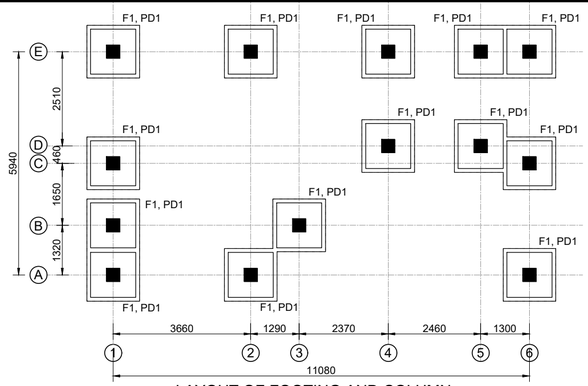
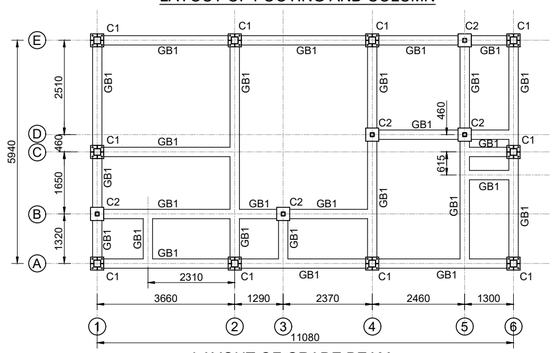
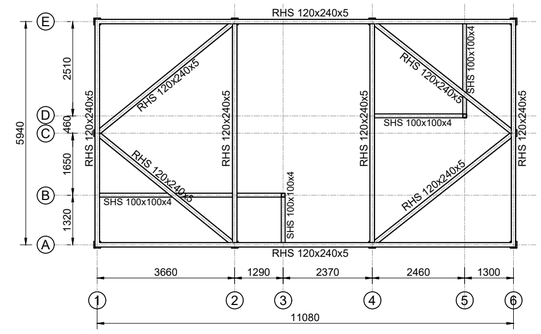


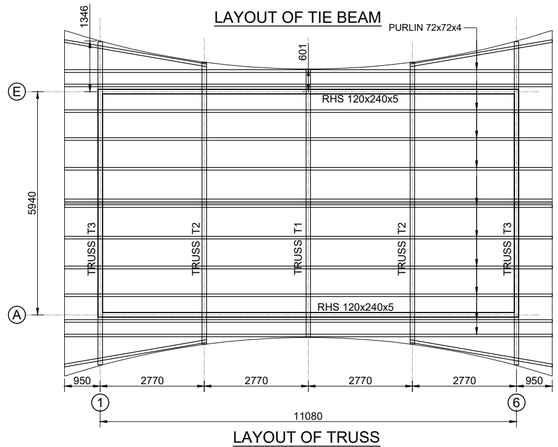
LAYOUT OF FOOTING AND COLUMN



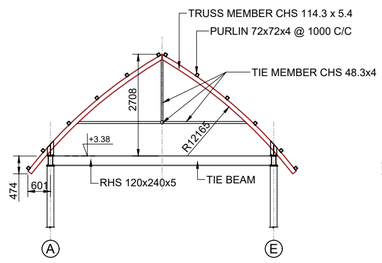
LAYOUT OF GRADE BEAM



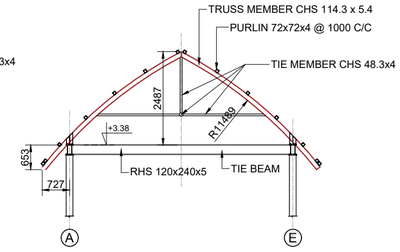
LAYOUT OF TIE BEAM



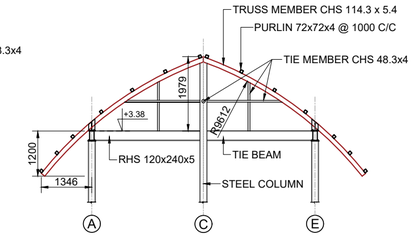
LAYOUT OF TRUSS



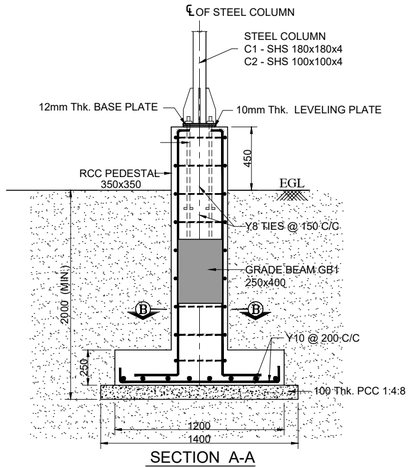
DETAILS OF TRUSS T1



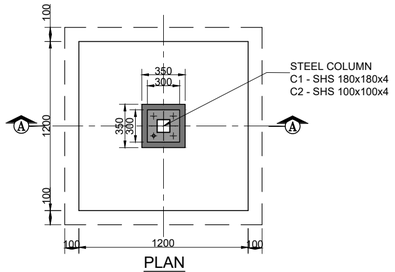
DETAILS OF TRUSS T2



DETAILS OF TRUSS T3
AT GABLE END



SECTION A-A



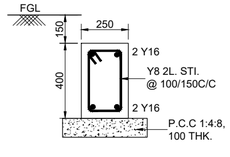
PLAN

COLUMN FOOTING

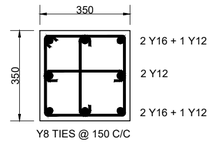
F1 - 1200 x 1200

FOOTING PCC TO BE LAID ON HARD STRATA WHERE SBC IS ASSUMED AS 60kN/ SQ.M. AT 2.0m DEPTH. SOIL INVESTIGATION SHALL BE CARRIED OUT AND SBC SHALL BE ENSURED AT SITE BEFORE EXECUTION. ANY VARIATION IN SBC SHALL BE INTIMATED TO DESIGN OFFICE IMMEDIATELY.

TYPICAL DETAILS OF GRADE BEAM

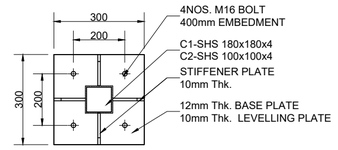


GRADE BEAM-GB1 (250x400)

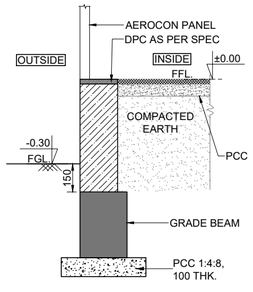


SECTION B-B

TYPICAL REFT. DETAILS
OF PEDESTAL (350 X 350)



TYPICAL DETAILS OF BASE PLATE



TYP. DETAILS OF GRADE
BEAM FOR OUTER WALLS

GENERAL GUIDANCE FOR FABRICATION & ERECTION

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS
2. DIMENSIONS SHALL NOT BE SCALED FROM THE DRAWING AND FOLLOW ONLY WRITTEN DIMENSIONS.
3. STRUCTURAL MEMBERS CONFIRMS TO GRADE Fy 310 FOR HOLLOW SECTIONS AND Fy250 FOR OTHERS .
4. WELDING SHALL BE DONE AS PER IS:816-1969, IS 9595-1996
5. ALL WELDS ARE CONTINUOUS FILLET WELD
6. MINIMUM SIZE OF FILLET WELD SHALL BE EQUAL TO THE LOWEST THICKNESS OF THE CONNECTED MEMBER.
7. THE WELDING TO BE DONE ONLY BY A SKILLED PERSON HAVING RESPECTIVE TRADE CERTIFICATE.
8. ALL GUSSET PLATES ARE 8mm THICK UNLESS SPECIFIED OTHERWISE.
9. STRUCTURAL MEMBERS MUST BE CLEANED OF SLAG AND OTHER DEPOSITS,RUST ETC. USING WIRE BRUSH BEFORE FABRICATION.
10. ALL STEEL MEMBERS ARE TO BE PAINTED WITH ANTI CORROSIVE PAINTING SYSTEM AS PER SPECIFICATION.
11. FABRICATOR SHALL TAKE ACCURATE MEASUREMENTS AT THE SITE AND PREPARE SHOP DRAWINGS BEFORE FABRICATION.
12. ANY MODIFICATION REQUIRED AS PER SITE CONDITION SHALL BE COMMUNICATED TO KITCO DESIGN OFFICE AND GET THE PRIOR APPROVAL FOR EXECUTION.
13. FABRICATION DRAWING PREPARED BY THE CONTRACTOR SHOULD BE SUBMITTED TO DESIGN OFFICE FOR APPROVAL AND GET IT APPROVED BEFORE THE COMMENCEMENT OF FABRICATION (TRUSS LAYOUT 1:100 SCALE AND JOINT DETAILING IN 1:50 & 1:10 SCALE).
14. ANY DISCREPANCY FOUND IN DRAWING WHILE FABRICATING SHALL BE BROUGHT TO THE NOTICE OF CONSULTANTS IMMEDIATELY.
15. A SEQUENCE OF ERECTION SHALL BE PREPARED AND SUBMITTED BY FABRICATOR/ERECTOR FOR APPROVAL BY KITCO DESIGN OFFICE AND GET IT APPROVED BEFORE ACTUAL ERECTION COMMENCES.
16. A FULL SCALE LAYOUT SHALL BE LAID OUT ON THE GROUND BEFORE ACTUAL CUTTING OF THE GUSSET PLATES AND MEMBERS.
17. THE LIFTING PATH SHOULD BE CLEAR OF OBSTRUCTION IF NECESSARY, TAIL OR GUIDE ROPES SHOULD BE USED TO ENSURE THAT THE TRUSS DOES NOT ENCOUNTER OBSTRUCTIONS IN COURSE OF HOISTING.
18. ANY DISPLACEMENT CAUSED DURING THE ERECTION SHOULD BE RECTIFIED BEFORE THE LIFTING EQUIPMENT IS RELEASED.

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED
3. ±0.00 Lvl. CORRESPONDS TO FINISHED GROUND FLOOR LEVEL.
4. CONCRETE SHALL BE CONTROLLED QUALITY AS PER IS:456-2000, MIX. M30.
5. BEND,HOOK,LAP LENGTH ETC., SHOULD BE TAKEN AS PER IS:456-2000.
6. REINFORCEMENT MARKED Y DENOTES HYSD BARS OF GRADE Fe. 500.D
7. CLEAR COVER TO OUTER REFT. : FOOTING - 50mm, COLUMN - 40mm,
8. DEVELOPMENT LENGTH IN TENSION (Ld) = 46 x BAR DIA.
9. MINIMUM LAP LENGTH FOR REFT. BARS SHALL BE 46 x DIA OF BAR.
10. LAP SPLICES SHALL BE STAGGERED. NOT MORE THAN 50% OF BARS SHALL BE LAPPED AT ONE SECTION
11. LAP SPLICES SHALL BE CONSIDERED AS STAGGERED IF CENTER TO CENTER DISTANCE OF SPLICES IS NOT LESS THAN 1.3 TIMES THE LAP LENGTH
12. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ARCHITECTURAL DRAWING REFER DP 1083 DRG CL 03 101 _SHEET 1 OF 2

KITCO the consultants

KITCO Ltd.

(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28

CLIENT:
INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT:
DEVELOPMENT OF COMMUNITY JETTIES TO BE DEVELOPED IN WB UNDER JMVP-II

TITLE:
-:TERMINAL BUILDING MODULE 1:-
LAYOUT AND DETAILS OF WAITING AREA, OFFICE AND TICKET COUNTER

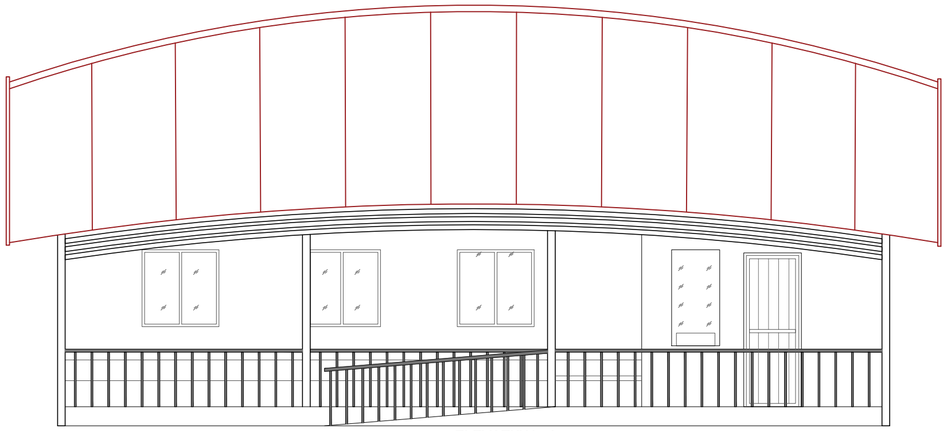
DRG NO:	SHEET NO:	REV.	SCALE:	
DP 1083 DRG CL 03 101	2 OF 2		NTS	A3

DESIGNED:	DRAWN:	CHECKED:	VERIFIED:	APPROVED:
	Hari Sankar			

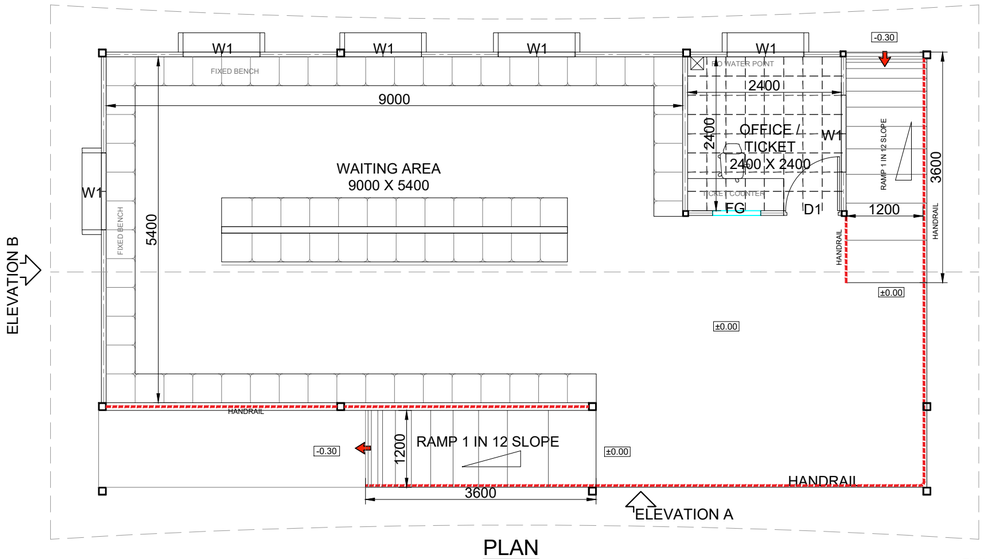
ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	25.01.23

This drawing is the property of KITCO Ltd. and is to be used only for the purpose for which it was lent and must not be in any way detrimental to the interest of the company and is subject to return on demand

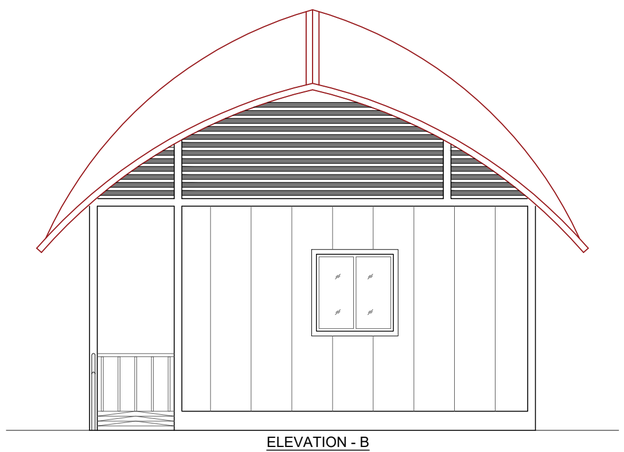
S:\DWGS\1083 IWAI\CIVIL\WORKING\IWAI TERMINAL\03_WEST BENGAL\03_101_STRUC_TERMINAL BUILDING_MOD 1_WB_IWAI.dwg _30.01.2024



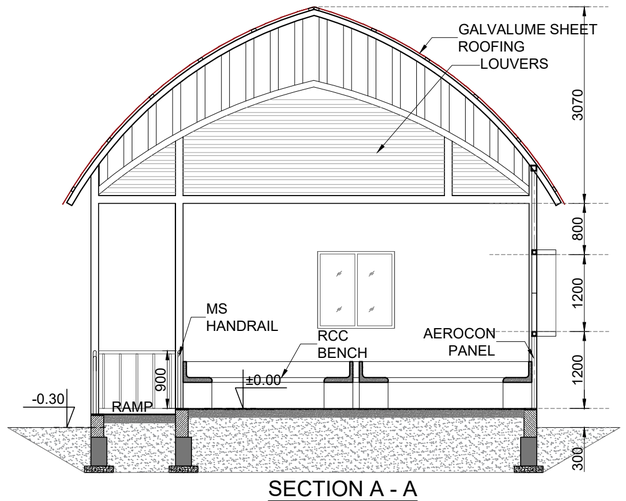
ELEVATION - A



PLAN



ELEVATION - B



SECTION A - A

JOINERY SCHEDULE			
NAME	WIDTH	HEIGHT	TYPE OF OPENING
D1	900	2400	FRP DOOR
FG	750	1500	FIXED GLASS
W1	1200	1200	AL. FIXED WINDOW

FINISHING SCHEDULE				
FACILITIES	FLOORING	ROOF	INTERIOR WALLS	EXTERIOR WALLS
WAITING AREA AND TICKET COUNTER	KOTA STONE FLOORING	GALVALUME SHEET ROOFING	AEROCON PANEL WITH EXTERIOR EMULSION PAINT	AEROCON PANEL WITH EXTERIOR GRADE EMULSION PAINT ALONG WITH TEXTURED PAINT AS PER DESIGN
RAMP AND STEP				
TICKET COUNTER	GRANITE			

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED.
3. ±0.00m LVL. CORRESPONDS TO FINISHED GROUND FLOOR LEVEL
4. HFL TO BE VERIFIED AND CONSIDERED BEFORE COMMENCEMENT OF THE PROJECT, AT EACH OF THE SITE.
5. LIGHTING FIXTURES, PLUMBING FIXTURES, AND OTHER HARDWARE AND AMENITIES SHOULD BE MADE VANDAL RESISTANT/PROOF.
6. THE PROPOSED STRUCTURES HAVE TO COMPLY WITH THE LATEST EDITION OF HARMONISED GUIDELINES AND SPACE STANDARDS 2016 TO MAKE THE FACILITIES DISABLED FRIENDLY.

Rev.No.	PARTICULARS	INITIAL	DATE

REVISION

KITCO Ltd.
(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28
the consultants

CLIENT:
INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT:
DEVELOPMENT OF COMMUNITY JETTIES, TO BE DEVELOPED IN WB UNDER JMVP-II

TITLE:
-: TERMINAL BUILDING MODULE 2:-
(WAITING AREA, TICKETING AND OFFICE)
PLAN,SECTION AND ELEVATION.

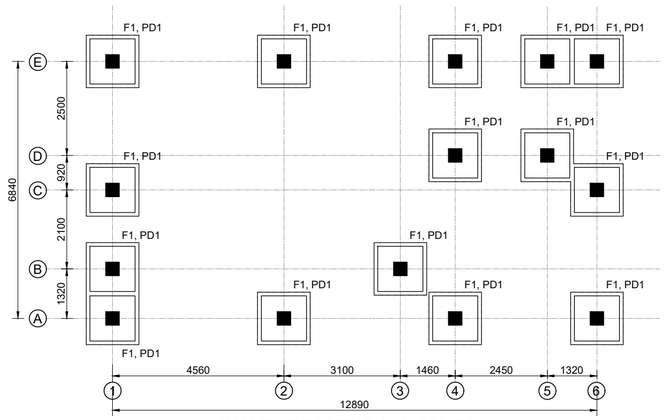
DRG NO:	SHEET NO:	REV.	SCALE:	
DP 1083 DRG CL 03 102	1 OF 1		NTS	A3

DESIGNED:	DRAWN:	CHECKED:	VERIFIED:	APPROVED:
Kiran Kumar	Hari Sankar	Kiran Kumar	Sansu sunny	Lipin K

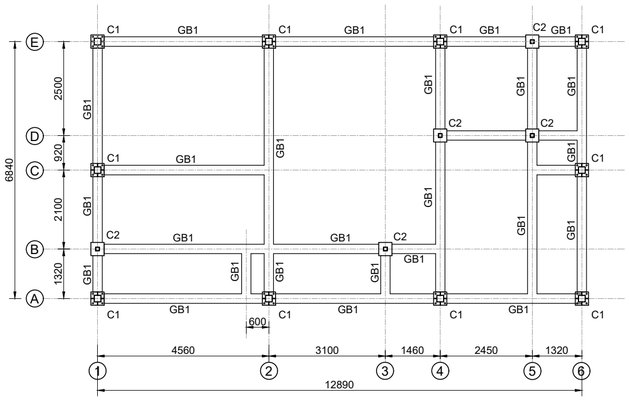
ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	03.12.2022

This drawing is the property of KITCO Ltd. and is to be used only for the purpose for which it was lent and must not be in any way detrimental to the interest of the company and is subject to return on demand

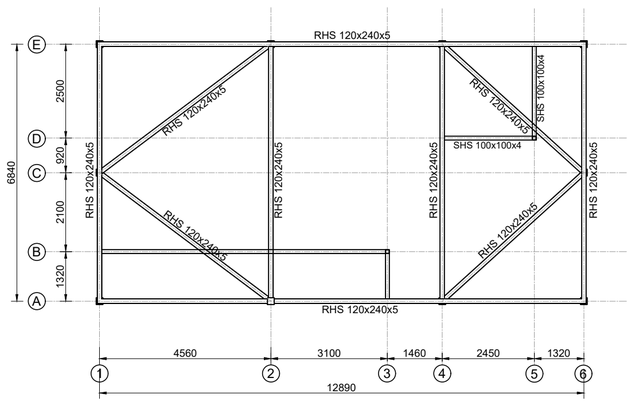
S:\DWGS\1083 IWAI\CIVIL\WORKING\IWAI TERMINAL\03_WEST BENGAL\03_102_ARCH_TERMINAL BUILDING_MOD 2_WB_IWAI.dwg 30.01.2024



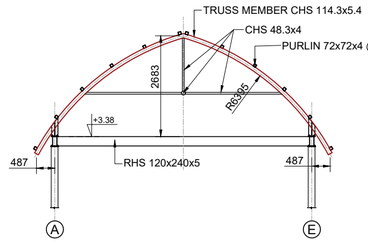
LAYOUT OF FOOTING AND COLUMN



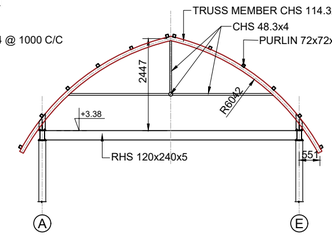
LAYOUT OF GRADE BEAM



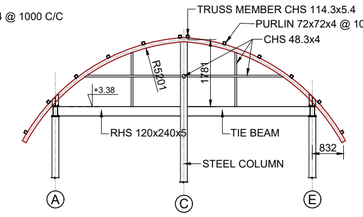
LAYOUT OF TIE BEAM



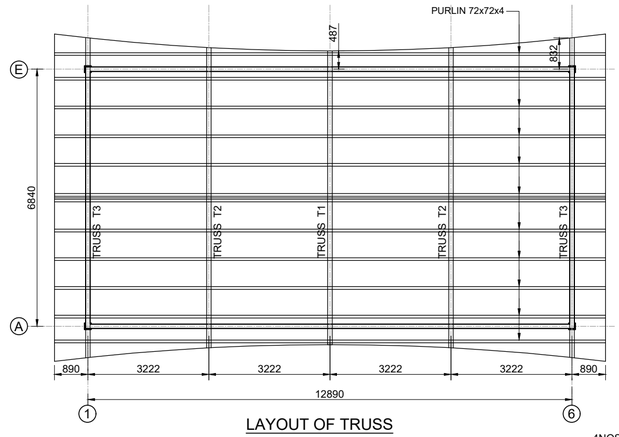
DETAILS OF TRUSS T1



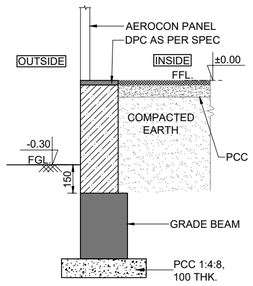
DETAILS OF TRUSS T2



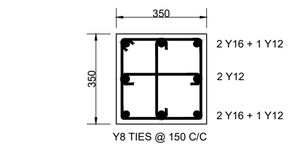
DETAILS OF TRUSS T3
AT GABLE END



LAYOUT OF TRUSS

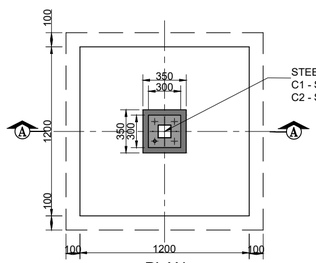


TYP. DETAILS OF GRADE
BEAM FOR OUTER WALLS



SECTION B-B

TYPICAL REFT. DETAILS
OF PEDESTAL (350 X 350)

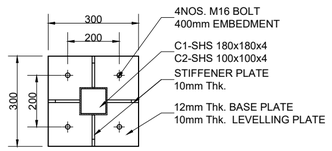


PLAN

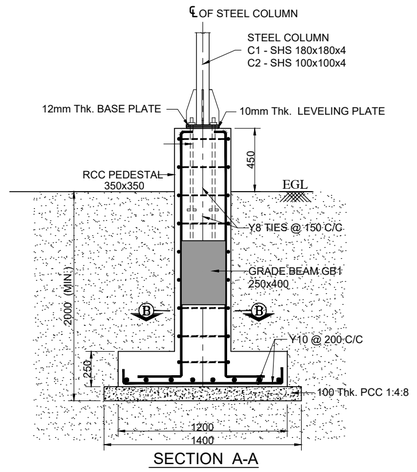
COLUMN FOOTING

F1 - 1200 x 1200

FOOTING PCC TO BE LAID ON HARD STRATA WHERE SBC IS ASSUMED AS 70kN/ SQ.M. AT 2.0m DEPTH. SOIL INVESTIGATION SHALL BE CARRIED OUT AND SBC SHALL BE ENSURED AT SITE BEFORE EXECUTION. ANY VARIATION IN SBC SHALL BE INTIMATED TO DESIGN OFFICE IMMEDIATELY.

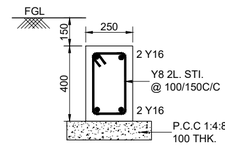


TYPICAL DETAILS OF BASE PLATE



SECTION A-A

TYPICAL DETAILS OF GRADE BEAM



GRADE BEAM-GB1 (250x400)

GENERAL GUIDANCE FOR FABRICATION & ERECTION

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS
2. DIMENSIONS SHALL NOT BE SCALED FROM THE DRAWING AND FOLLOW ONLY WRITTEN DIMENSIONS.
3. STRUCTURAL MEMBERS CONFIRMS TO GRADE Fy 310 FOR HOLLOW SECTIONS AND Fy250 FOR OTHERS .
4. WELDING SHALL BE DONE AS PER IS:816-1969, IS 9595-1996
5. ALL WELDS ARE CONTINUOUS FILLET WELD
6. MINIMUM SIZE OF FILLET WELD SHALL BE EQUAL TO THE LOWEST THICKNESS OF THE CONNECTED MEMBER.
7. THE WELDING TO BE DONE ONLY BY A SKILLED PERSON HAVING RESPECTIVE TRADE CERTIFICATE.
8. ALL GUSSET PLATES ARE 8mm THICK UNLESS SPECIFIED OTHERWISE.
9. STRUCTURAL MEMBERS MUST BE CLEANED OF SLAG AND OTHER DEPOSITS,RUST ETC. USING WIRE BRUSH BEFORE FABRICATION.
10. ALL STEEL MEMBERS ARE TO BE PAINTED WITH ANTI CORROSIVE PAINTING SYSTEM AS PER SPECIFICATION.
11. FABRICATOR SHALL TAKE ACCURATE MEASUREMENTS AT THE SITE AND PREPARE SHOP DRAWINGS BEFORE FABRICATION.
12. ANY MODIFICATION REQUIRED AS PER SITE CONDITION SHALL BE COMMUNICATED TO KITCO DESIGN OFFICE AND GET THE PRIOR APPROVAL FOR EXECUTION.
13. FABRICATION DRAWING PREPARED BY THE CONTRACTOR SHOULD BE SUBMITTED TO DESIGN OFFICE FOR APPROVAL AND GET IT APPROVED BEFORE THE COMMENCEMENT OF FABRICATION (TRUSS LAYOUT 1:100 SCALE AND JOINT DETAILING IN 1:50 & 1:10 SCALE).
14. ANY DISCREPANCY FOUND IN DRAWING WHILE FABRICATING SHALL BE BROUGHT TO THE NOTICE OF CONSULTANTS IMMEDIATELY.
15. A SEQUENCE OF ERECTION SHALL BE PREPARED AND SUBMITTED BY FABRICATOR/ERECTOR FOR APPROVAL BY KITCO DESIGN OFFICE AND GET IT APPROVED BEFORE ACTUAL ERECTION COMMENCES.
16. A FULL SCALE LAYOUT SHALL BE LAID OUT ON THE GROUND BEFORE ACTUAL CUTTING OF THE GUSSET PLATES AND MEMBERS.
17. THE LIFTING PATH SHOULD BE CLEAR OF OBSTRUCTION IF NECESSARY, TAIL OR GUIDE ROPES SHOULD BE USED TO ENSURE THAT THE TRUSS DOES NOT ENCOUNTER OBSTRUCTIONS IN COURSE OF HOISTING.
18. ANY DISPLACEMENT CAUSED DURING THE ERECTION SHOULD BE RECTIFIED BEFORE THE LIFTING EQUIPMENT IS RELEASED.

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED
3. ±0.00 Lvl. CORRESPONDS TO FINISHED GROUND FLOOR LEVEL.
4. CONCRETE SHALL BE CONTROLLED QUALITY AS PER IS:456-2000, MIX. M30.
5. BEND,HOOK,LAP LENGTH ETC., SHOULD BE TAKEN AS PER IS:456-2000.
6. REINFORCEMENT MARKED Y DENOTES HYSD BARS OF GRADE Fe. 500.D
7. CLEAR COVER TO OUTER REFT. : FOOTING - 50mm, COLUMN - 40mm,
8. DEVELOPMENT LENGTH IN TENSION (Ld) = 46 x BAR DIA.
9. MINIMUM LAP LENGTH FOR REFT. BARS SHALL BE 46 x DIA OF BAR.
10. LAP SPLICES SHALL BE STAGGERED. NOT MORE THAN 50% OF BARS SHALL BE LAPPED AT ONE SECTION
11. LAP SPLICES SHALL BE CONSIDERED AS STAGGERED IF CENTER TO CENTER DISTANCE OF SPLICES IS NOT LESS THAN 1.3 TIMES THE LAP LENGTH
12. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ARCHITECTURAL DRAWING REFER DP 1083 DRG CL 03 102 _SHEET 1 OF 2

KITCO Ltd.
the consultants
(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28

CLIENT:
INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT:
DEVELOPMENT OF COMMUNITY JETTIES TO BE DEVELOPED IN WB UNDER JMVP-II

TITLE:
-:TERMINAL BUILDING MODULE 2:-
LAYOUT AND DETAILS OF WAITING AREA, OFFICE AND TICKET COUNTER

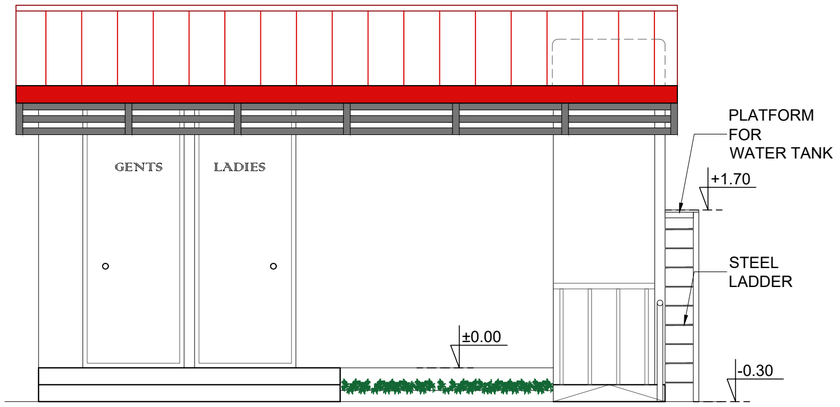
DRG NO:	SHEET NO:	REV.	SCALE:	
DP 1083 DRG CL 03 102	2 OF 2		NTS	A3

DESIGNED:	DRAWN:	CHECKED:	VERIFIED:	APPROVED:
	Hari Sankar			

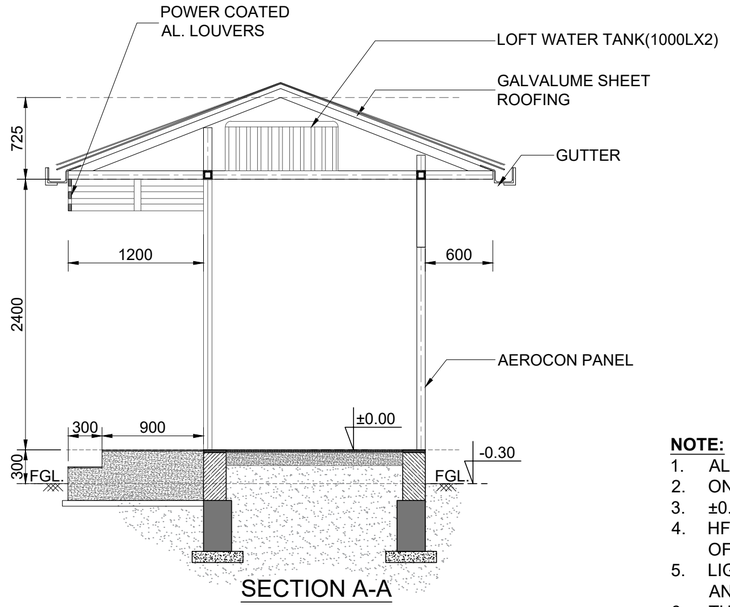
ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	25.01.23

This drawing is the property of KITCO Ltd. and is to be used only for the purpose for which it was lent and must not be in any way detrimental to the interest of the company and is subject to return on demand

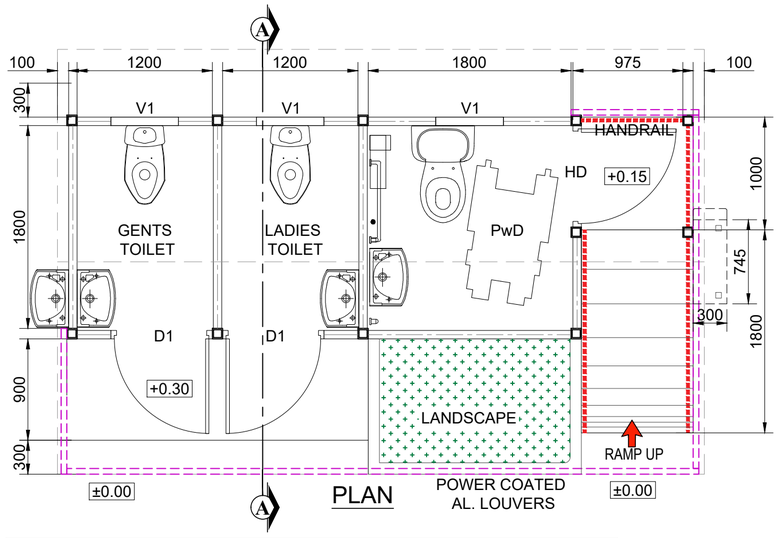
S:\DWGS\1083 IWAI\CIVIL WORKING\IWAI TERMINAL\03_WEST BENGAL\03_102_STRUC_TERMINAL BUILDING_MOD 2_WB_IWAI.dwg _30.01.2024



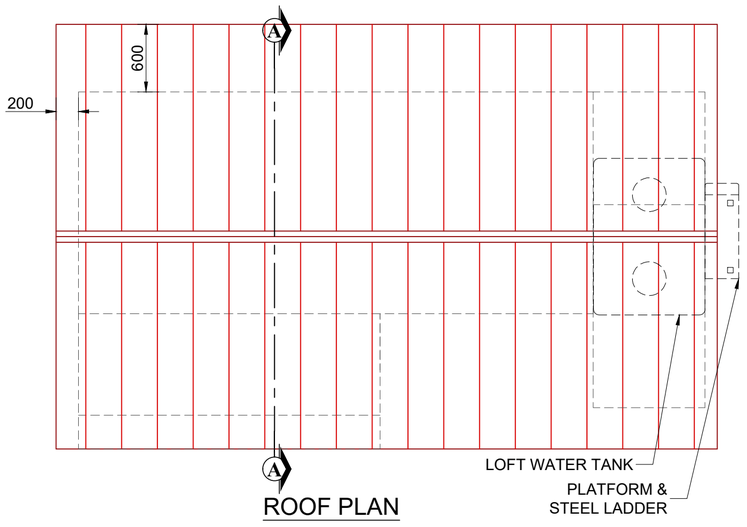
ELEVATION



SECTION A-A



PLAN



ROOF PLAN

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED.
3. ±0.00m LVL. CORRESPONDS TO FINISHED GROUND FLOOR LEVEL
4. HFL TO BE VERIFIED AND CONSIDERED BEFORE COMMENCEMENT OF THE PROJECT, AT EACH OF THE SITE.
5. LIGHTING FIXTURES, PLUMBING FIXTURES, AND OTHER HARDWARE AND AMENITIES SHOULD BE MADE VANDAL RESISTANT/PROOF.
6. THE PROPOSED STRUCTURES HAVE TO COMPLY WITH THE LATEST EDITION OF HARMONISED GUIDELINES AND SPACE STANDARDS 2016 TO MAKE THE FACILITIES DISABLED FRIENDLY..

FINISHING SCHEDULE

FACILITIES	FLOORING	ROOF	INTERIOR WALLS	EXTERIOR WALLS
TOILET AREA	ANTISKID CERAMIC TILE (600 X 600)	GALVALUME SHEET ROOFING	DADOING UPTO 2.4M HT. WITH INTERIOR ACRYLIC PAINT FINISH OVER AEROCON PANEL	AEROCON PANEL WITH EXTERIOR GRADE EMULSION PAINT ALONG WITH TEXTURED PAINT AS PER DESIGN
RAMP AND STEP	KOTA STONE FLOORING			

JOINERY SCHEDULE

NAME	WIDTH	HEIGHT	TYPE OF OPENING
D1	900	2100	FRP DOOR
HD	1000	2100	AL.HANDICAPPED DOOR
V1	600	600	AL.VENTILATOR

Rev.No.	PARTICULARS	INITIAL	DATE

REVISION

KITCO Ltd.
the consultants
(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28

CLIENT:
INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT:
DEVELOPMENT OF COMMUNITY JETTIES, TO BE DEVELOPED IN WB UNDER JMVP-II

TITLE:
-:TOILET BLOCK:-
PLAN, SECTION & ELEVATION

DRG NO:	SHEET NO:	REV.	SCALE:	
DP 1083 DRG CL 03 104	1 OF 1		NTS	A3

DESIGNED:	DRAWN:	CHECKED:	VERIFIED:	APPROVED:
Kiran Kumar	Hari Sankar	Kiran Kumar	Sansu sunny	Lipin K

ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	18.08.2022

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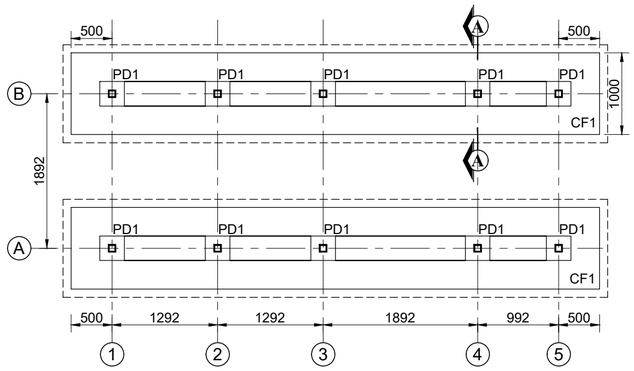
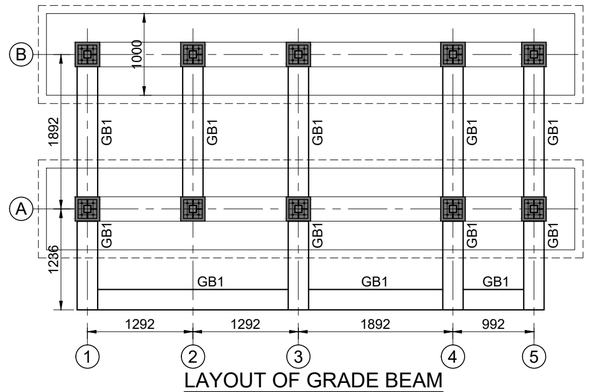
S:\DWGS\1083 IWAI\CIVIL\WORKING\IWAI TERMINAL\03_WEST BENGAL\201_ARCHI_TOILET BLOCK_IWAI.dwg -30.01.2024



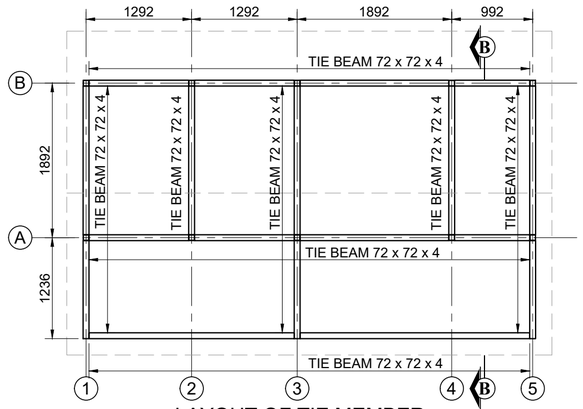
LAYOUT OF FOOTING AND COLUMN



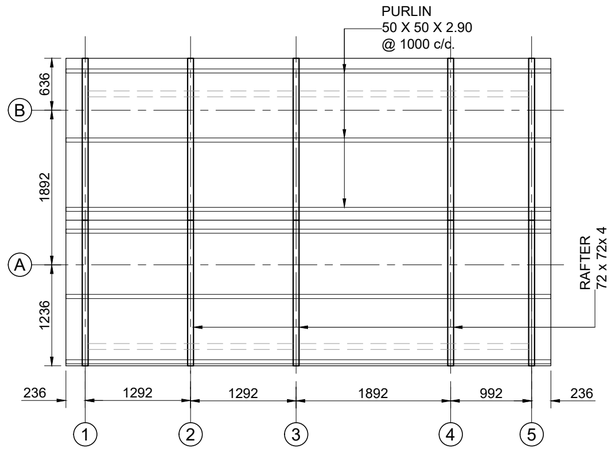
LAYOUT OF GRADE BEAM

NOTES:-

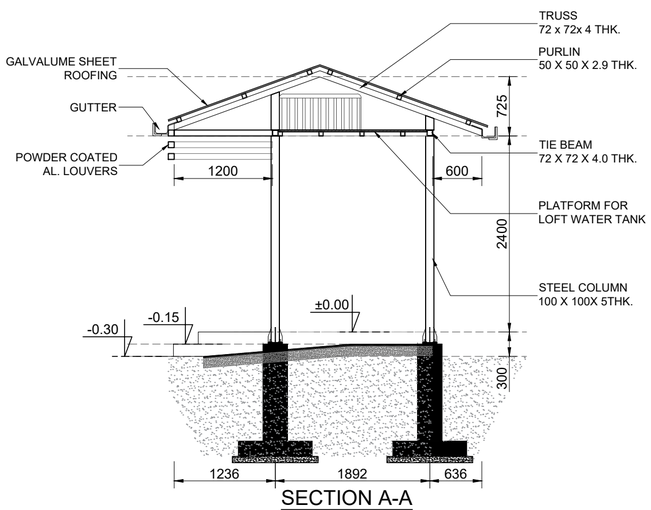
1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES.
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED.
3. ±0.00 LVL. CORRESPONDS TO FINISHED GROUND FLOOR LEVEL.
4. STRUCTURAL MEMBERS CONFIRMS TO GRADE Fy 310
4. CONCRETE SHALL BE CONTROLLED QUALITY AS PER IS:456-2000, MIX. M30.
5. BEND,HOOK,LAP LENGTH ETC., SHOULD BE TAKEN AS PER IS:456-2000.
6. REINFORCEMENT MARKED Y DENOTES HYSD BARS OF GRADE Fe. 500.D
7. CLEAR COVER TO OUTER REFT. : FOOTING - 50mm, COLUMN - 40mm,
8. DEVELOPMENT LENGTH IN TENSION (Ld) = 46 x BAR DIA.
9. MINIMUM LAP LENGTH FOR REFT. BARS SHALL BE 46 x DIA OF BAR.
10. LAP SPLICES SHALL BE STAGGERED. NOT MORE THAN 50% OF BARS SHALL BE LAPPED AT ONE SECTION
11. LAP SPLICES SHALL BE CONSIDERED AS STAGGERED IF CENTER TO CENTER DISTANCE OF SPLICES IS NOT LESS THAN 1.3 TIMES THE LAP LENGTH
12. WELDING SHALL BE DONE AS PER IS:816-1969, IS 9595-1996.
13. ALL SHOP JOINTS ARE WELDED AND FIELD JOINTS ARE BOLTED.
14. ALL MS BOLTS AND NUTS SHALL CONFORM TO IS:1363 & 1367 (Latest)
15. MINIMUM SIZE OF FILLET WELD SHALL BE EQUAL TO THE LOWEST THICKNESS OF THE CONNECTED MEMBER.
16. THE WELDING TO BE DONE ONLY BY A SKILLED PERSON HAVING RESPECTIVE TRADE CERTIFICATE.
17. ALL SPLICE JOINTS MUST BE NON SLIP
18. THE CIVIL CONTRACTOR SHALL MAKE SURE THAT THE INSERT PLATES PLACED ARE IN CORRECT POSITION AND WELDED ALONG THE LENGTH OF MAIN REINFORCEMENT OF COLUMN / BEAM BEFORE POURING CONCRETE AT SITE.
19. STRUCTURAL MEMBERS MUST BE CLEANED OF SLAG AND OTHER DEPOSITS,RUST ETC. USING WIRE BRUSH BEFORE FABRICATION.
20. ALL STEEL MEMBERS ARE TO BE PAINTED WITH 2 COATS OF SYNTHETIC ENAMEL PAINT OVER 2 COATS OF ANTI CORROSIVE YELLOW ZINC CHROMATE PRIMER BEFORE LAYING TILE/ ROOFING SHEET OR AS PER SPEC..
21. FABRICATOR SHALL TAKE ACCURATE MEASUREMENTS AT THE SITE AND PREPARE SHOP DRAWINGS BEFORE FABRICATION.
22. FOR ARCHITECTURAL DETAIL REFER DP 1083 DRG CL 01 201_SHEET 1 OF 1.



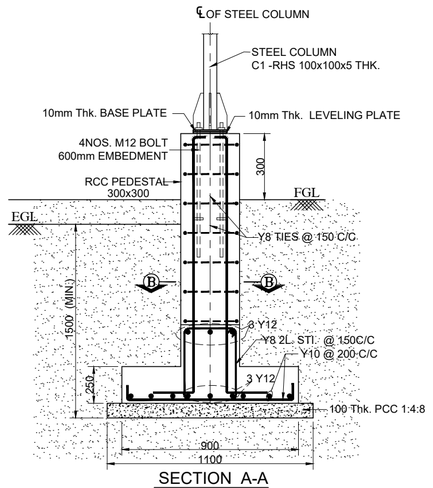
LAYOUT OF TIE MEMBER



LAYOUT OF RAFTER



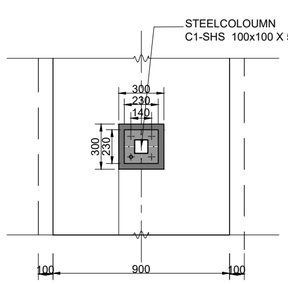
SECTION A-A



SECTION A-A

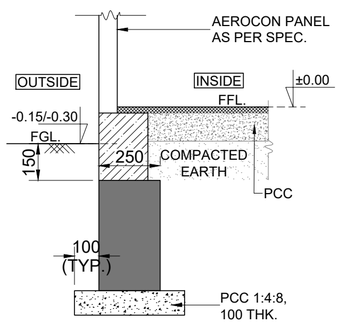
SPECIAL NOTES:

FOOTING PCC TO BE LAID ON STRATA WHERE SBC IS ASSUMED AS 100kN/ SQ.M. AT 1.5m DEPTH FROM EGL. SOIL INVESTIGATION SHALL BE CARRIED OUT AND SBC SHALL BE ENSURED AT SITE BEFORE EXECUTION. ANY VARIATION IN SBC SHALL BE INTIMATED TO DESIGN OFFICE IMMEDIATELY.

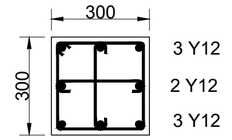


PLAN

COMBINED FOOTING - CF1



TYP. DETAILS OF GRADE BEAM FOR OUTER WALLS

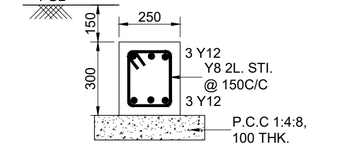


SECTION B-B

TYPICAL REFT. DETAILS OF PEDESTAL-PD1

300 X 300

TYPICAL DETAILS OF GRADE BEAM



GRADE BEAM-GB1 (250 X 300)

Rev.No.	PARTICULARS	INITIAL	DATE

REVISION

KITCO Ltd.
the consultants
(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28

CLIENT:
INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT:
DEVELOPMENT OF COMMUNITY JETTIES 13 NOS, TO BE DEVELOPED IN BIHAR & JHARKHAND UNDER JMVP-II

TITLE:
-:TOILET BLOCK:-
GENERAL STRUCTURAL DETAILS

DRG NO:	SHEET NO:	REV.	SCALE:	
DP 1083 DRG CL 02 106	1 OF 1		NTS	A3

DESIGNED:	DRAWN:	CHECKED:	VERIFIED:	APPROVED:
Cherish	Hari Sankar	Sindhu Anna George	Shamilar M S	Lissy Innocent

ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	18.08.2022

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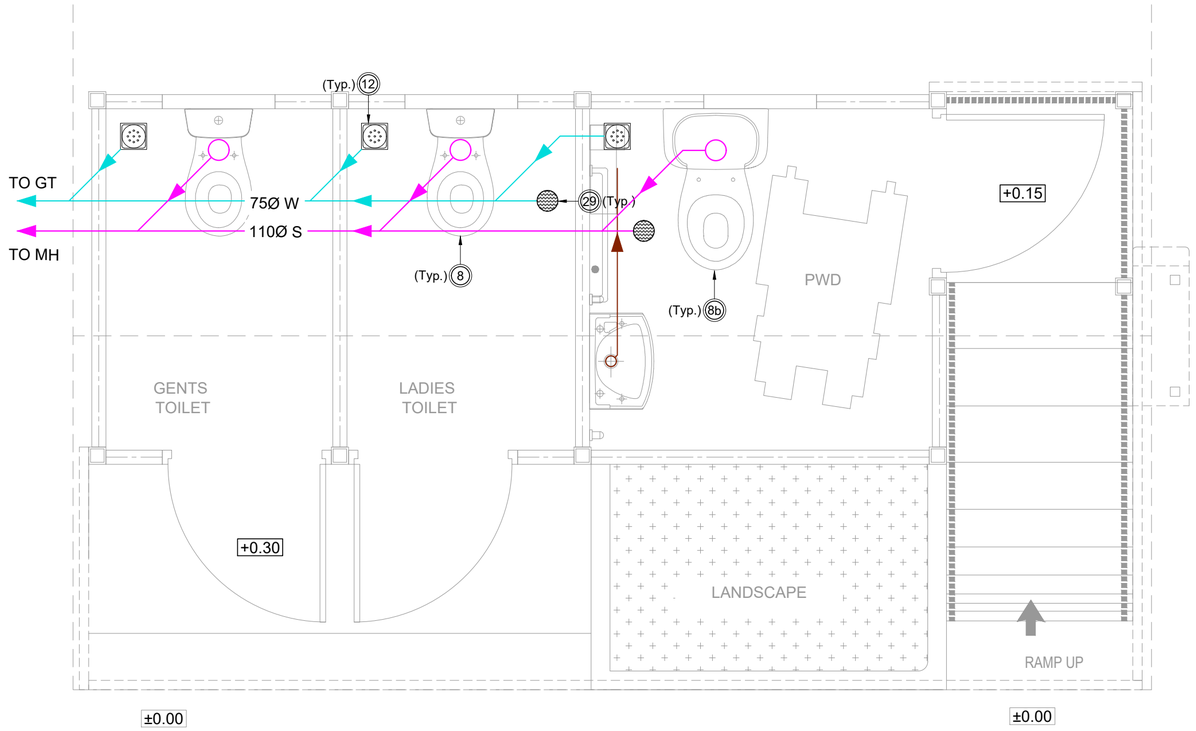
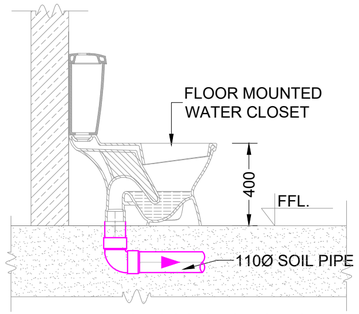


SANITARY LAYOUT



TYP. CROSS SECTION OF WATER CLOSET

TABLE 1 - PIPE SUPPORTS SPACING

NOMINAL PIPE SIZE (mm)	PVC	
	HORIZONTAL (m)	VERTICAL (m)
50	1.20	1.50
75	1.20	1.50
110	1.20	1.50

LEGEND:

	50Ø WASTE WATER PIPE (CONCEALED) PVC 6Kg/cm²
	75Ø WASTE WATER PIPE (CONCEALED) PVC 6Kg/cm²
	110Ø SOIL PIPE (CONCEALED) PVC 6Kg/cm²
S	SOIL PIPE
W	WASTE PIPE
MH	MANHOLE
GT	GULLY TRAP

NOTATION	ITEM
8	FLOOR MOUNTED WATER CLOSET
8b	HANDICAPPED TOILET
12	FLOOR TRAP 110 mm OUTER DIA (MULTI TRAP) INCLUDING CP COCKROACH FREE FLOOR GRATING WITH CUP
29	SS CLEANOUT

NOTE :-

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS
2. ONLY WRITTEN DIMENSIONS TO BE FOLLOWED
3. ±0.00m LVL. CORRESPONDS TO FINISHED GROUND FLOOR LEVEL
4. PROVIDE ACCESS DOOR AT ALL JUNCTIONS AND TURNINGS.
5. A MINIMUM DISTANCE OF 150mm SHOULD BE KEPT BETWEEN WALL & FLOOR TRAP CENTRE.
6. ALL PIPES SHOWN ARE PVC 6 kg/cm² EXCEPT FOR VENT PIPES
7. ALL VENT PIPE SHOWN ARE PVC 4kg/cm².
8. THE DIAMETER OF PIPE LINES GIVEN IN THE DRAWINGS ARE OUTSIDE DIMENSIONS FOR PVC PIPES.
9. THE SEWER PIPE LINES SHALL BE TESTED BY COMPLETELY FILLING THE SEWER PIPE WITH WATER BY PLUGGING LOWEST POINT OF CONNECTION TO THE HIGHEST POINT CONNECTION. THE SEWER PIPE SHALL BE WATER TIGHT AT ALL POINTS.
10. ALL ITEMS/SHADES/ MODELS SHALL BE APPROVED FROM ENGINEER-IN-CHARGE PRIOR TO BULK PROCUREMENT.
11. NO PIPES SHALL BE EXPOSED AND SHALL BE SUITABLY COVERED OR CLADDED.
12. SUPPORTS SHALL BE PROVIDED AT EVERY BRANCH CONNECTION OR CHANGE OF DIRECTION.
13. ALL PIPES SHALL BE PROVIDED WITH NECESSARY SUPPORTS AS GIVEN IN TABLE 1
14. ALL SOIL AND WASTE WATER PIPES RUNS IN 1 IN 100 SLOPE .

Rev.No.	PARTICULARS	INITIAL	DATE

REVISION

KITCO the consultants

KITCO Ltd.
(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28

CLIENT:
INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT:
DEVELOPMENT OF COMMUNITY JETTIES 14 NOS, TO BE DEVELOPED IN UP UNDER JMVP-II

TITLE:
-:TOILET BLOCK:-
LAYOUT & DETAILS OF INTERNAL SANITARY LINES

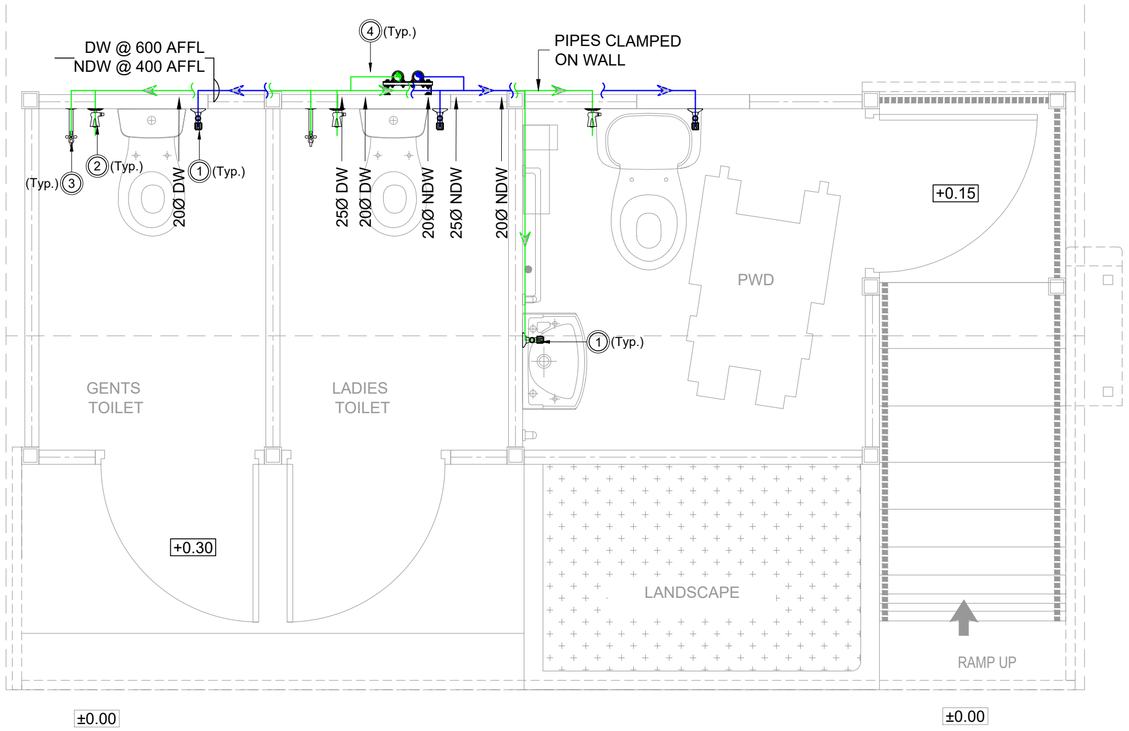
DRG NO:	SHEET NO:	REV.	SCALE:	
DP 1083 DRG PL 01 201	1 OF 1		NTS	A3

DESIGNED:	DRAWN:	CHECKED:	VERIFIED:	APPROVED:
Susan P Rajan	Pravitha V S	Susan P Rajan	_	Ajish Unnithan S

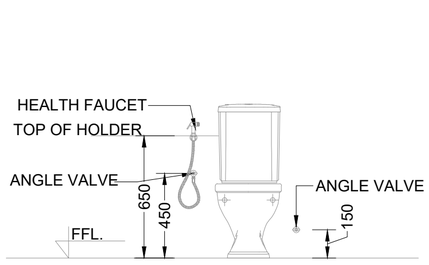
ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	19.08.2022

This drawing is the property of KITCO Ltd. and is to be used only for the purpose for which it was lent and must not be in any way detrimental to the interest of the company and is subject to return on demand

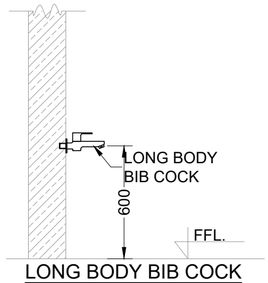
S:\DWGS\1083 IWAI\WATR SPLY & SNTRY\201-202_INTERNAL SANITARY & WATER SUPPLY_IWAI.dwg -30.01.2024



WATER SUPPLY LAYOUT



HEALTH FAUCET & ANGLE VALVE



LONG BODY BIB COCK

LEGEND

- DRINKING WATER [DW] PIPE CPVC SDR11
- NON DRINKING WATER [NDW] PIPE CPVC SDR11
- DRINKING WATER (DW) HEADER CPVC SDR11 (NOMINAL DIA)
- NON DRINKING WATER (NDW) HEADER CPVC SDR11 (NOMINAL DIA)
- AFFL — ABOVE FINISHED FLOOR LEVEL
- GM GATE VALVE

TABLE 2 - PIPE SUPPORTS SPACING		
NOMINAL PIPE SIZE (mm)	CPVC/PVC	
	HORIZONTAL (m)	VERTICAL (m)
25	0.50	1.00
32	0.50	1.00
40	0.80	1.40
50	1.20	1.50

NOTATION	ITEM
1	PILLAR COCK + ANGLE VALVE + BOTTLE TRAP + WASTE COUPLING
2	ANGLE VALVE + HEALTH FAUCET @ 450AFFL
3	LONG BODY BIB COCK
4	ISOLATION VALVE

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS
2. ONLY WRITTEN DIMENSIONS TO BE FOLLOWED.
3. ±0.00m LVL. CORRESPONDS TO FINISHED GROUND FLOOR LEVEL
4. ALL CONCEALED LINES ARE PVC 10kg/cm². AND ALL EXPOSED LINES ARE CPVC PIPES.
5. THE DIAMETER OF PIPE LINES GIVEN IN THE DRAWINGS ARE NOMINAL DIMENSIONS FOR CPVC SDR 11 PIPES AND OUTER DIMENSIONS FOR PVC PIPES.
6. AFTER LAYING & JOINTING, THE PIPE LINES SHALL BE PRESSURE TESTED (TEST PRESSURE - 5 BAR) AS PER CPHEEO MANUAL ON W.S. AND TREATMENT 3RD EDITION.
7. NO PIPES SHALL BE EXPOSED AND SHALL BE SUITABLY COVERED OR CLADDED.
8. SUPPORTS SHALL BE PROVIDED AT EVERY BRANCH CONNECTION OR CHANGE OF DIRECTION.
9. ALL PIPES SHALL BE PROVIDED WITH NECESSARY SUPPORTS AS GIVEN IN TABLE 2
10. ALL ITEMS/SHADES/ MODELS SHALL BE APPROVED FROM ENGINEER-IN-CHARGE PRIOR TO BULK PROCUREMENT.

Rev.No.	PARTICULARS	INITIAL	DATE

REVISION

KITCO the consultants

KITCO Ltd.
(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28

CLIENT:
INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT:
DEVELOPMENT OF COMMUNITY JETTIES 14 NOS, TO BE DEVELOPED IN UP UNDER JMVP-II

TITLE:
-:TOILET BLOCK:-
LAYOUT & DETAILS OF INTERNAL WATER SUPPLY LINES

DRG NO:	SHEET NO:	REV.	SCALE:	
DP 1083 DRG PL 01 202	1 OF 1		NTS	A3

DESIGNED:	DRAWN:	CHECKED:	VERIFIED:	APPROVED:
Susan P Rajan	Pravitha V S	Susan P Rajan	_	Ajish Unnithan S

ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	19.08.2022

This drawing is the property of KITCO Ltd. and is to be used only for the purpose for which it was lent and must not be in any way detrimental to the interest of the company and is subject to return on demand

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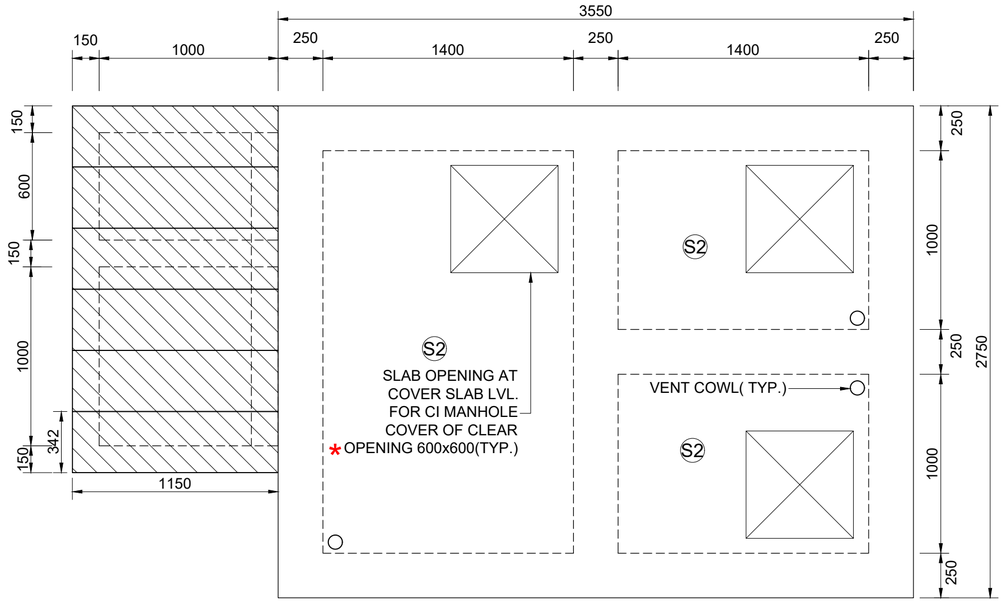
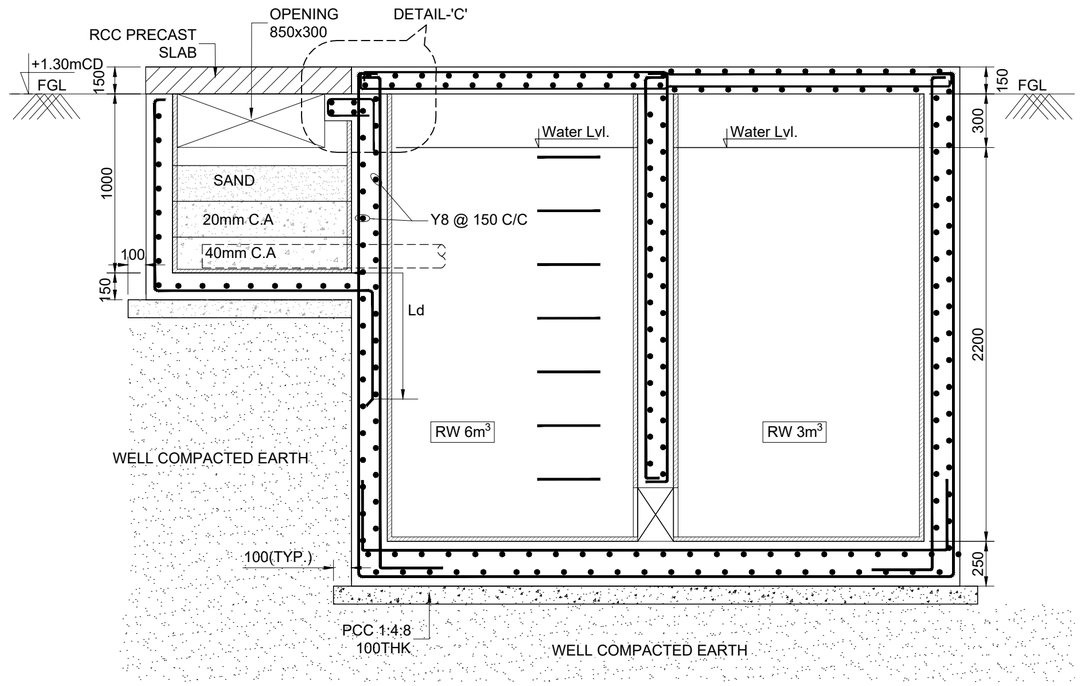
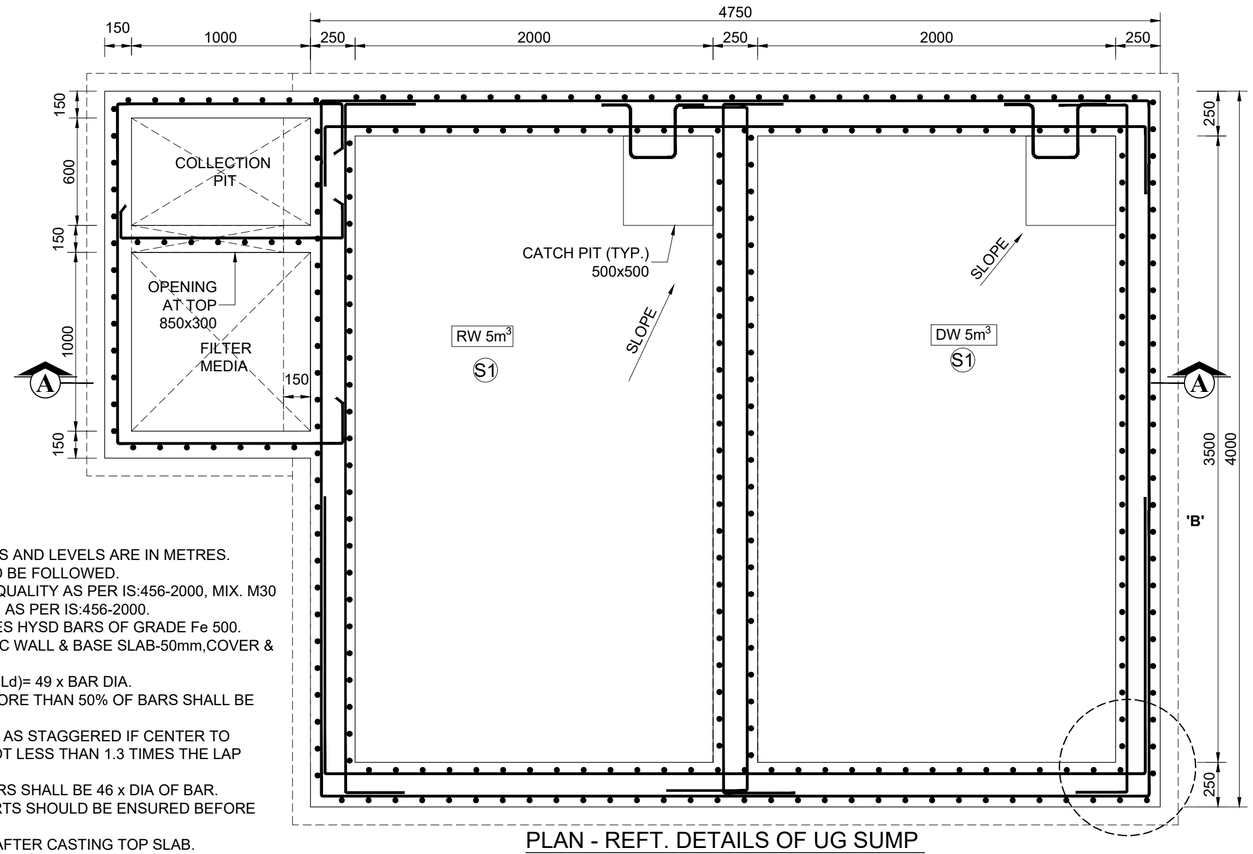


PLAN - LAYOUT OF COVER SLAB



SECTION A-A



PLAN - REFT. DETAILS OF UG SUMP

NOTE:-

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES.
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED.
3. CONCRETE SHALL BE CONTROLLED QUALITY AS PER IS:456-2000, MIX. M30
4. BEND,HOOK,ETC., SHOULD BE TAKEN AS PER IS:456-2000.
5. REINFORCEMENT MARKED Y DENOTES HYSD BARS OF GRADE Fe 500.
6. CLEAR COVER TO OUTER REFT. : RCC WALL & BASE SLAB-50mm,COVER & PRECAST SLAB -30mm.
7. DEVELOPMENT LENGTH IN TENSION (Ld)= 49 x BAR DIA.
6. LAPS SHALL BE STAGGERED. NOT MORE THAN 50% OF BARS SHALL BE LAPPED AT ONE SECTION.
7. LAP SPLICES SHALL BE CONSIDERED AS STAGGERED IF CENTER TO CENTER DISTANCE OF SPLICES IS NOT LESS THAN 1.3 TIMES THE LAP LENGTH.
8. MINIMUM LAP LENGTH FOR REFT. BARS SHALL BE 46 x DIA OF BAR.
9. PROPER POSITIONING OF PIPE INSERTS SHOULD BE ENSURED BEFORE CONCRETING.
10. BACKFILLING SHALL BE DONE ONLY AFTER CASTING TOP SLAB.

Rev.No.	PARTICULARS	INITIAL	DATE

REVISION

KITCO Ltd.
the consultants
(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28

CLIENT:
INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT:
DEVELOPMENT OF COMMUNITY JETTIES, TO BE DEVELOPED IN WB UNDER JMVP-II

TITLE:
LAYOUT AND REFT.DETAIL OF UG SUMP

DRG NO:	SHEET NO:	REV.	SCALE:	
DP 1083 DRG CL 03 106	1 OF 1		NTS	A3

DESIGNED:	DRAWN:	CHECKED:	VERIFIED:	APPROVED:
--	Hari	---	----	-----

ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	14.09.2022

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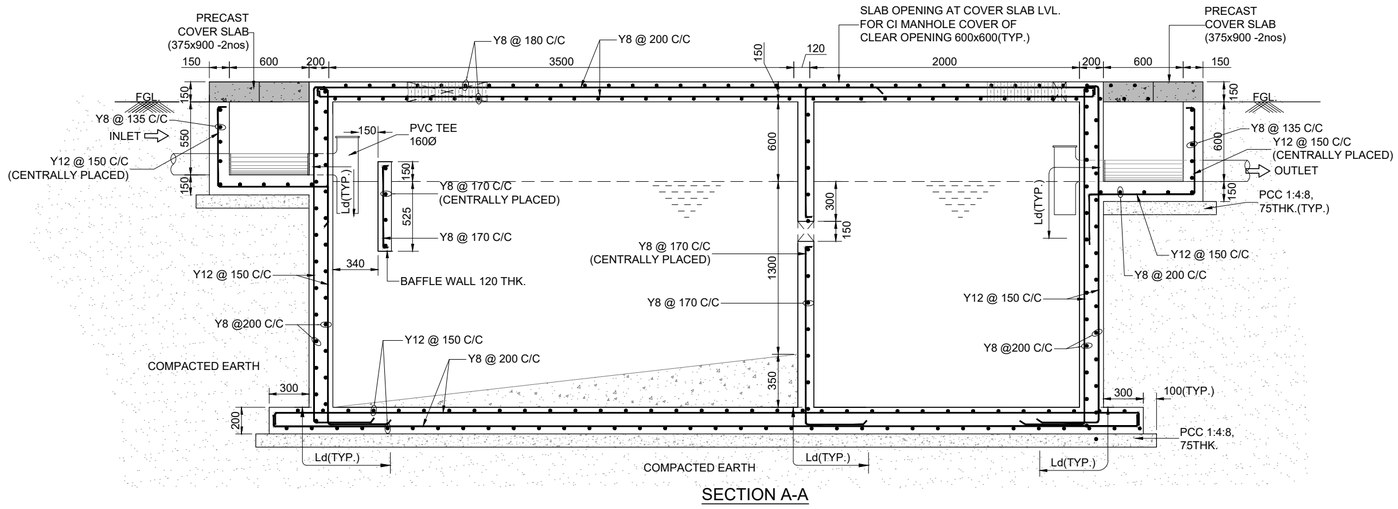
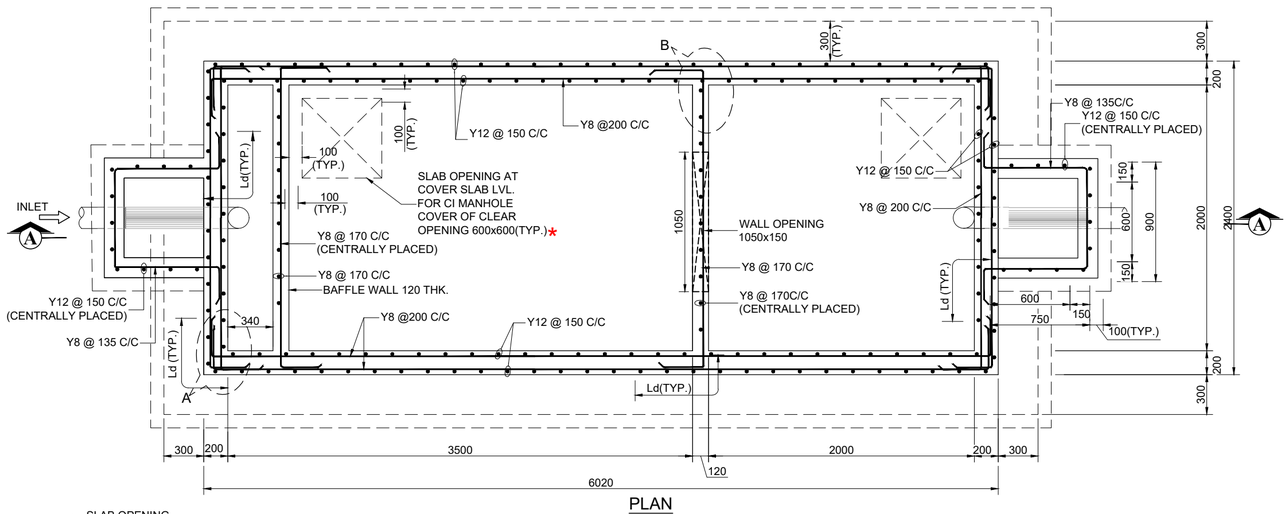
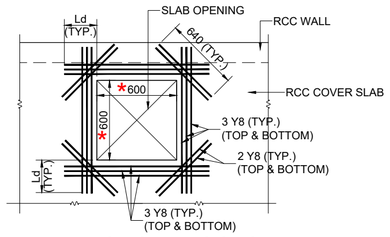


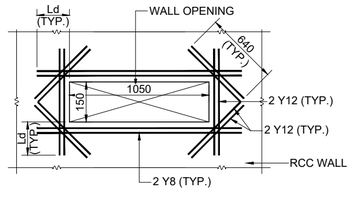
SECTION A-A



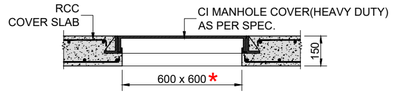
PLAN



DETAIL OF OPENING ON SLAB
(EXTRA REFT: FOR OPENINGS)

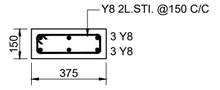


DETAIL OF OPENING ON RCC WALL
(EXTRA REFT: FOR OPENINGS)

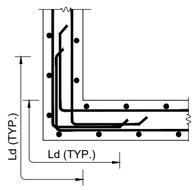


TYP. DETAILS OF MANHOLE COVER
(SLAB OPENING SIZE SHALL BE PROVIDED SUITABLY FOR PROPERLY FIXING CI MANHOLE COVER OF SPECIFIED SIZE)

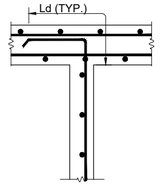
* DIMENSIONS OF CI MANHOLE FRAME AS PER SPEC. TO BE VERIFIED WITH THE PRODUCT AVAILABLE IN THE MARKET



TYP.REFT.DETAILS OF RCC PRECAST SLAB FOR CHAMBER (375x900) - 4NOS.



DETAIL-A



DETAIL-B

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METERS
2. DRAWING IS NOT TO BE SCALED. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED.
3. CONCRETE SHALL BE CONTROLLED QUALITY AS PER IS:456-2000, MIX M30
4. BEND,HOOK,LAP LENGTH ETC., SHOULD BE TAKEN AS PER IS:456-2000
5. REINFORCEMENT MARKED Y DENOTES GRADE Fe. 500D AS PER IS 1786:2008.
6. MINIMUM LAP LENGTH FOR REFT. BARS SHALL BE 46 x DIA. OF BAR.
7. DEVELOPMENT LENGTH IN TENSION (Ldt) - 46 x DIA OF BAR.
8. CLEAR COVER TO OUTER REFT. RCC WALL-50mm & BASE SLAB - 50mm, COVER SLAB & PRECAST SLAB - 30mm
9. VENTILATING PIPE MAY BE CONNECTED AT AVAILABLE DUCTS AS PER SITE CONDITION AND TAKING THE COWL UPTO SUITABLE HEIGHT.
10. PRECAST SLAB TOP SHALL BE MARKED WHILE CASTING AND POSITIONED ACCORDINGLY.
11. **BACK FILLING SHALL BE DONE ONLY AFTER CASTING COVER SLAB**
12. VEHICULAR LOAD IS CONSIDERED IN THE DESIGN
13. FOR LOCATION OF SEPTIC TANK REFER EXTERNAL SANITARY LAYOUT DWG NO: PR 135 DRG PL 02 009

Rev.No.	PARTICULARS	INITIAL	DATE

REVISION

KITCO Ltd.
the consultants
(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28

CLIENT: INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DEVELOPMENT OF COMMUNITY JETTIES, TO BE DEVELOPED IN WB UNDER JMVP-II

TITLE: LAYOUT AND REFT. DETAILS OF SEPTIC TANK

DRG NO:	SHEET NO:	REV.	SCALE:	
DP 1083 DRG CL 03 107	1 OF 1		NTS	A2

DESIGNED:	DRAWN:	CHECKED:	VERIFIED:	APPROVED:

ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	05.08.2023

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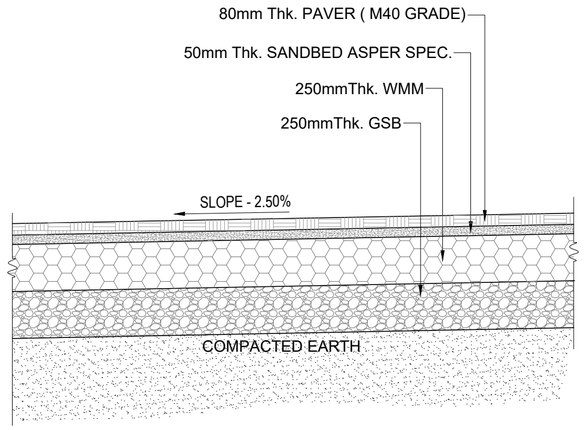
S:\DWGS\1083 IWAI\CIVIL WORKING\IWAI TERMINAL\03_WEST BENGAL\01B_SEPTIC TANK FOR 50 USERS — (600 FREE BOARD)_RO.dwg _ 30.01.2024



TYPICAL CROSS SECTION FOR PAVER AREA

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED

Rev.No.	PARTICULARS	INITIAL	DATE

REVISION

KITCO Ltd.
(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28
the consultants

CLIENT:
INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT:
DEVELOPMENT OF COMMUNITY JETTIES TO BE DEVELOPED IN WB UNDER JMVP-II

TITLE:
TYPICAL CROSS SECTION OF PAVER AREA

DRG NO:	SHEET NO:	REV.	SCALE:	
DP 1083 DRG CL 03 016	1 OF 1		NTS	A3

DESIGNED:	DRAWN:	CHECKED:	VERIFIED:	APPROVED:
##	Hari	###	####	#####

ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	05.09.2022

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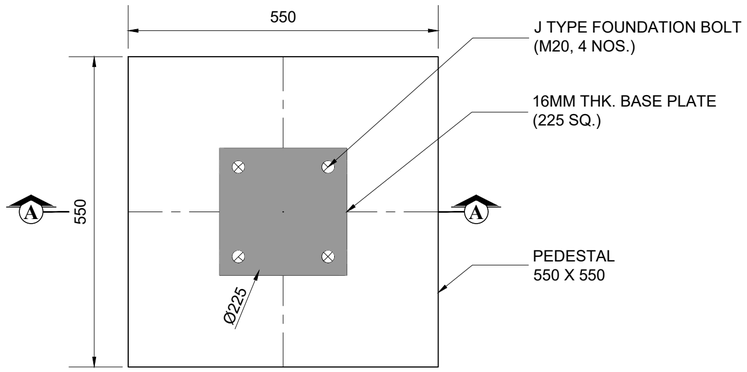
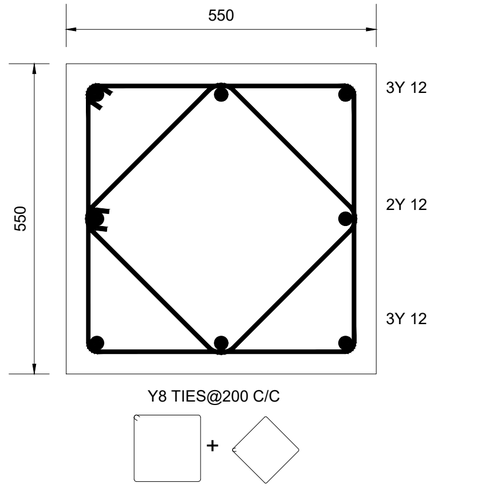
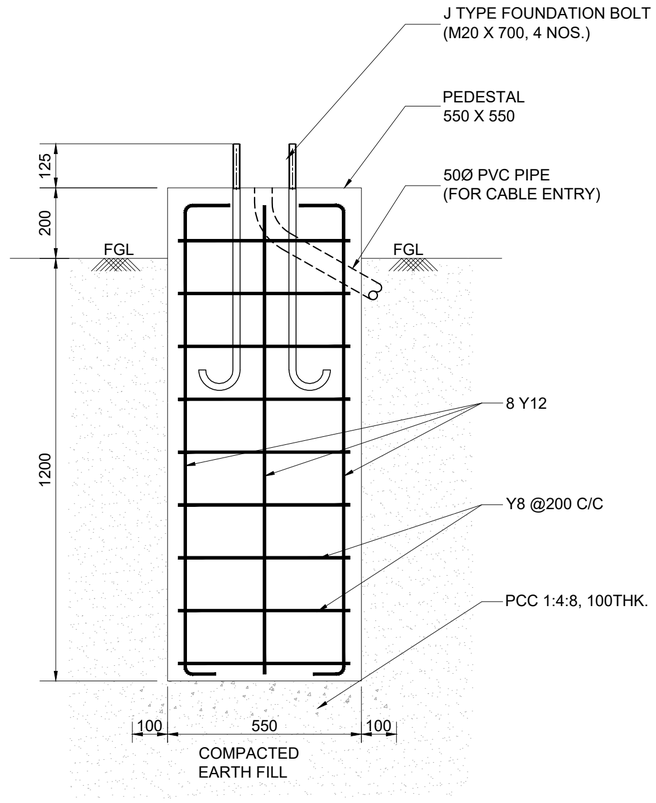


PLAN

LIGHT POLE FOUNDATION



REFT. DETAILS OF PEDESTAL-(550 X 550)



SECTION A - A

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED
3. CONCRETE SHALL BE CONTROLLED QUALITY AS PER IS:456-2000, MIX. M30
4. BEND,HOOK,LAP LENGTH ETC., SHOULD BE TAKEN AS PER IS:456-2000
5. REINFORCEMENT MARKED Y DENOTES HYSD BARS OF GRADE FE 500D, IS 1786-2008
6. CLEAR COVER TO OUTER REFT. : 50mm.
7. BASE PLATE AND ANCHOR BOLT LOCATIONS/ SIZE/NOS etc. SHALL BE CONFIRMED WITH VENDOR DRAWING .

Rev.No.	PARTICULARS	INITIAL	DATE

REVISION

KITCO Ltd.
(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28
the consultants

CLIENT:
INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT:
DEVELOPMENT OF COMMUNITY JETTIES TO BE DEVELOPED IN WB UNDER JMVP-II

TITLE:
TYPICAL LIGHT POLE FOUNDATION DETAILS

DRG NO:	SHEET NO:	REV.	SCALE:	
DP 1083 DRG CL 03 015	1 OF 1		NTS	A3

DESIGNED:	DRAWN:	CHECKED:	VERIFIED:	APPROVED:
--	Hari Sankar	---	----	-----

ISSUED FOR:	UNIT:	DATE:
TENDER PURPOSE	mm.	03.09.2022

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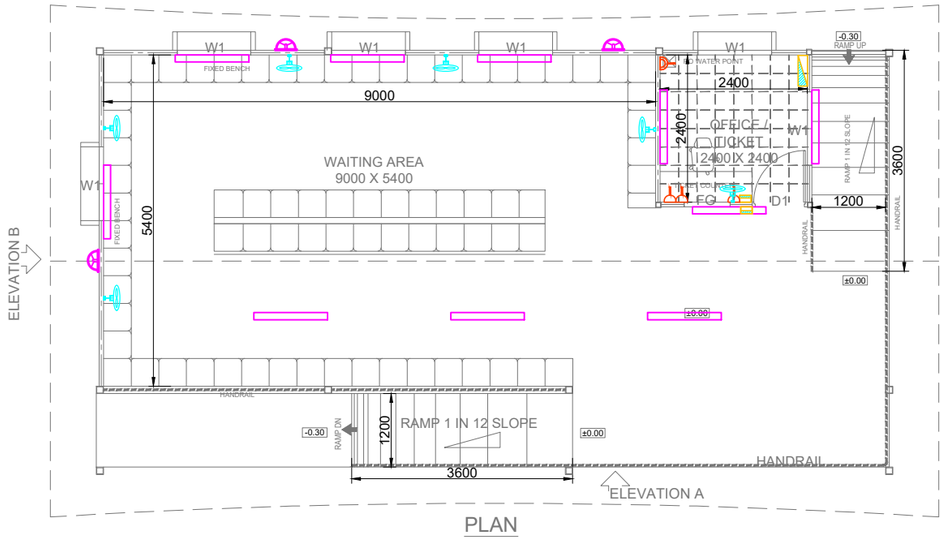
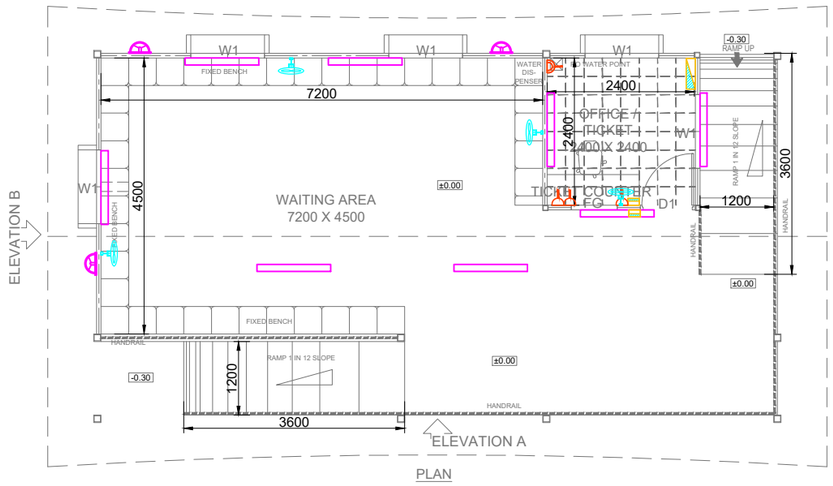
S:\DWGS\1083 IWAI\CIVIL\WORKING\IWAI TERMINAL\03_WEST BENGAL\015_TYP_LIGHTPOLE_FDN_IWAI.dwg 30.01.2024



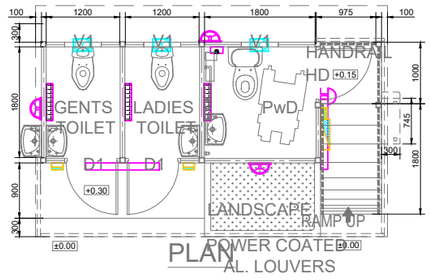
LIGHTING LAYOUT OF TERMINAL BUILDING MODULE 2

LEGEND

SL. NO.	SYMBOL	DESCRIPTION
1		20W LED LIGHT
2		BULK HEAD LIGHT
3		WALL FAN
4		SWITCH BOARD
5		6A SWITCH SOCKET
6		16A SWITCH SOCKET
7		DISTRIBUTION BOARD



LIGHTING LAYOUT OF TERMINAL BUILDING MODULE 1



LIGHTING LAYOUT OF TOILET

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METERS
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED

Rev.No.	PARTICULARS	INITIAL	DATE

REVISION

KITCO Ltd.
the consultants
(Estd. in 1972 by IDBI & Govt. of Kerala)
MM GARDENS, CHURCH LANDING ROAD, KOCHI - 16

CLIENT:
INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT:
DEVELOPMENT OF COMMUNITY JETTIES, TO BE DEVELOPED IN WB UNDER JMVP-II

TITLE:
LIGHTING LAYOUT OF TERMINAL MODULE 1, 2 & TOILET BLOCK

DRG NO:	SHEET NO:	REV.	SCALE:	
DP 1083 DRG EL 03 001	1 OF 1		NTS	A3

DESIGNED:	CHECKED:	DRAWN:	DRG. CHECKED:	APPROVED:
Treesa Archana	Anooj Kamal	Binoy TB	#####	Rajna E

ISSUED FOR:	UNIT:	DATE:
ESTIMATE PURPOSE	mm.	27.01.2023

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Annexure-A

VMT
GEOTECH & MATERIAL TESTING

TC-8969

REPORT NO. – VMT 129 B/2023-2024

GEOTECH INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT NARKALBARI IN WEST BENGAL

Prepared By -

VIVEK MATERIAL TESTING LABORATORY

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(Civil Engineering Projects)
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Semra, Chinhat, Lucknow
Mobile: 08563996516, 06388461573
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visit us at: www.vivekmaterialtesting.com

ACKNOWLEDGEMENT

WE ARE GRATEFUL TO M/s KITCO LTD., KERLA FOR PROVIDING US THE OPPORTUNITY TO CARRY OUT THESE INVESTIGATIONS.

THE CO-OPERATION EXTENDED BY THEIR ENGINEERS DURING FIELD INVESTIGATIONS IS THANKFULLY ACKNOWLEDGED.

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4	Interpretation Of Lab Test Results	
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	B. S.P.T. Values	3-4
	C. Water Table	4
5	Recommendations	5-6
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SUB-SOIL INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL

INTRODUCTION

The work of sub-soil exploration was awarded to us by M/s KITCO LTD., KERLA Order no. – 6777:DP 1083: RG: 2023 dated 21/03/2023. The object of the investigation was to study the geo-technical properties of soil both in field and laboratory and determine safe allowable pressure for the foundation soil.

The fieldwork consisted of 02 bore holes of 10.00 metre depth each. The fieldwork was conducted on 14/04/2023. The location of the bore holes is shown in the Site location.

REFERENCES

1. **IS: 1892-2021** for field work including existent ground water table.
2. **IS: 2132-1986** for sampling in Undisturbed and Disturbed form.
3. **IS: 2131-1981** for Standard Penetration Test.
4. **IS: 2720** for all laboratory tests on soil samples collected.
5. **IS: 6403-1981** for determination of Bearing Capacity.
6. **IS: 8009(Part I)-1976** for calculation of settlement of foundations.
7. **IS: 1904-2021** for permissible maximum settlement, differential settlement and angular distortion.

SCOPE OF WORK

The scope consisted of drilling of boreholes down to maximum depth of 10.00 m in normal soils / rock, Standard Penetration Testing, collection of samples, laboratory testing and preparation and submission of Geotechnical Investigation report.

Summary of the fieldwork					
Sl. No.	**Site**	**Borehole Nos.**	**Coordinates**		**Depth below existing ground level (m)**
			Latitude	**Longitude**	
1.	NARKALBARI	BH-01 (LHS)	23.8398374	88.2166931	10.0
2.		BH-02 (LHS)	23.83998184	88.21707834	10.0

SITE LOCATION

INTERPRETATION OF THE LAB TEST RESULTS

GENERAL NATURE OF SOIL STRATA

The bore hole log charts and lab test results of bore holes 1 and 2 indicate that the strata at the site is found to comprise of both cohesive as well as non-cohesive soil.

The results of classification tests indicate that the natural soil stratum present at the Site is found to comprise of both fine-grained soils comprising of 'CL' and 'CI' group of IS classification (clayey soil) having 79 to 99 percent material finer than 75 micron and coarse-grained soils (sandy soil) comprise of 'ML' and 'SM' group of IS classification having 49 to 61 percent material finer than 75 micron.

The bore hole log charts and lab test results of bore holes 1 indicate that:

first strata, from 0.00 metre to 2.50 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 2.50 metre to 7.00 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity,

third strata, from 7.00 metre to 8.50 metre, consists of a layer of SM group of IS classification which is silty Sand with none plasticity

fourth strata, from 8.50 metre to 10.00 metre, consists of a layer of ML group of IS classification which is inorganic silts with none to low plasticity.

The bore hole log charts and lab test results of bore holes 2 indicate that:

first strata, from 0.00 metre to 4.00 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 4.00 metre to 8.50 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity

third strata, from 8.50 metre to 10.00 metre, consists of a layer of ML group of IS classification which is inorganic silts with none to low plasticity.

S.P.T. VALUES

The S.P.T. values obtained in the respective clayey layer region present as per bore-log charts enclosed are found to range 4 to 8 indicating 'Soft' to 'Medium' consistency.

However, the S.P.T. values obtained in the respective sandy layer region present as per bore-log charts enclosed are found to range from 12 to 14 indicating 'Medium' relative density.

The results of S.P.T. values indicate that the stratum at the Site is 'Loose' to 'Well' compacted.

WATER TABLE

Water Table at the Site was observed at a depth from 3.00 metre to 4.50 metre below ground level on the day of soil investigation during the Third week of April 2023. However, the existing water table may rise by 1.00 metre in the post-monsoon period in general. Therefore, a water table at a depth of 2.00 metre to 3.50 metre below ground level has been adopted for calculation purposes.

RECOMMENDATIONS FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL

NET SAFE BEARING CAPACITY/SAFE ALLOWABLE PRESSURE

Bore Hole Nos.	Type of Structure	Depth of Foundation (metres)	Size of Footing (L x B) (metres)	Net Safe Bearing Capacity (Tonne/sqm.)	Settlement Produced (mm)	Safe Allowable Pressure for Permissible Settlement 50 mm (Tonne/sqm.)
1	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	7.89	28.02	-
		2.00	1.20 x 1.20	8.95	27.18	-
		2.50	1.20 x 1.20	11.70	29.53	-
		1.50	2.00 x 2.00	7.36	38.24	-
		2.00	2.00 x 2.00	8.17	36.75	-
		2.50	2.00 x 2.00	10.39	39.00	-
		1.50	2.50 x 2.50	7.26	44.52	-
		2.00	2.50 x 2.50	7.97	41.03	-
		2.50	2.50 x 2.50	10.03	45.31	-
2	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	11.21	35.03	-
		2.00	1.20 x 1.20	12.74	33.59	-
		2.50	1.20 x 1.20	13.80	31.52	-
		1.50	2.00 x 2.00	10.57	47.18	-
		2.00	2.00 x 2.00	11.64	44.68	-
		2.50	2.00 x 2.00	12.40	41.68	-
		1.50	2.50 x 2.50	10.34	53.73	9.39
		2.00	2.50 x 2.50	11.34	49.84	-
		2.50	2.50 x 2.50	12.05	48.68	-

NOTE: -

The above recommendations are based on the field investigation data results and the laboratory tests results of the samples collected from the test locations and our experience in this regard. If the actual sub-soil conditions during excavation for the

foundations differ from that has been reported, a reference should be made to us for suggestions.

Further, the recommendations are based on the assumptions as mentioned in the Report and the designer of the Structure should take into consideration all the factors required as per codes. The recommendations should be taken as guidelines for the designer.

Er. Akhil Singh
TECHNICAL MANAGER
VIVEK MATERIAL TESTING LABORATORY

Shubham Singh
Dy. TECHNICAL MANAGER/ QUALITY MANAGER
VIVEK MATERIAL TESTING LAORATORY

BEARING CAPACITY CALCULATIONS

Soil when stressed due to loading, tend to deform. The resistance to deformation of the soil depends upon factors like water content, bulk density, angle of internal friction and the manner in which load is applied on the soil. The maximum load per unit area which the soil or rock can carry without yielding or displacement is termed as the bearing capacity of soils. The Safe Bearing Capacity of the proposed STRUCTURE without any distress is determined from the considerations of the following criteria.

[A] SHEAR CRITERIA

The soil beneath the foundation shall be safe from risk of shear failure.

[B] SETTLEMENT CRITERIA

The settlement due to load is caused basically on account of two factors, namely,

(i) the soil below footing gets compressed by certain amount and

(ii) since the foundations cover only a limited area there is a possibility that the concentrated stresses developed are so high as to cause actual rupture (shear failure) and displacement of soil below.

The foundation should not settle or deflect to an extent causing damage to the Structure or impair its usefulness.

The Bearing Capacity Calculations for the Foundation shall be governed as per IS: 6403-1981, IS: 8009(Part-I)-1976 and IS: 1904-2021 on the basis of available information regarding the proposed design.

BEARING CAPACITY ON SHEAR CONSIDERATIONS

ULTIMATE NET BEARING CAPACITY

As per IS: 6403-1981, the Ultimate Net Bearing Capacity 'qd' on shear consideration for a Structure is given by the formula: -

FOR GENERAL SHEAR FAILURE

qd = c.Nc.Sc.dc.ic+q(Nq-1).sq.dq.iq + 1/2 B.r.Nr.Sr.dr.ir.W'.

FOR LOCAL SHEAR FAILURE

q'd = 2/3 c.N'c.Sc.dc.ic+q(N'q-1).Sq.dq.iq + 1/2 B.r.N'r.Sr.dr.ir.W'.

VIVEK MATERIAL TESTING LABORATORY

BEARING CAPACITY CALCULATION

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT								
BOREHOLE 01 (L.H.S.)	Depth of borehole	10.00	metre	Water table below borehole level (m)	3.00		Factor of safety	2.50
				Water table used for calculation (m)	2.00		Assumed post monsoon rise (m)	1.00

VMT
GEOTECH & MATERIAL TESTING

Input Parameters														Shearing Resistance Parameters																Ultimate Net Bearing Capacity			Net Safe Bearing Capacity
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	
					Bulk		Bulk		c	Ø	Ø'	e	q	Nc	Nq	Nγ	Nc'	Nq'	Nγ'	Sc	Sq	Sγ	Dc	Dq	Dγ	Dc'	Dq'	Dγ'	Ic	Iq	Iγ				
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																		kN/m2	kN/m2	kN/m2	kN/m2
1	SQUARE	1.50	1.20	1.20	1.78	17.46	1.78	17.46	0.15	11	7.42	0.699	26.18	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	290.39	160.41	193.55	**77.42**
2	SQUARE	2.00	1.20	1.20	1.78	17.46	1.82	17.85	0.15	11	7.42	0.699	34.91	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.40	1.20	1.20	1.40	1.20	1.20	1.00	1.00	1.00	328.98	181.84	219.36	**87.74**
3	SQUARE	2.50	1.20	1.20	1.78	15.50	1.82	15.89	0.20	10	6.74	0.688	38.74	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.50	1.25	1.25	1.50	1.25	1.25	1.00	1.00	1.00	410.93	231.07	286.83	**114.73**
4	SQUARE	1.50	2.00	2.00	1.78	17.46	1.78	17.46	0.15	11	7.42	0.699	26.18	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.18	1.09	1.09	1.18	1.09	1.09	1.00	1.00	1.00	270.85	149.53	180.47	**72.19**
5	SQUARE	2.00	2.00	2.00	1.78	17.46	1.82	17.85	0.15	11	7.42	0.699	34.91	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	300.43	165.98	200.26	**80.10**
6	SQUARE	2.50	2.00	2.00	1.78	15.50	1.82	15.89	0.20	10	6.74	0.688	38.74	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	365.05	205.22	254.77	**101.91**
7	SQUARE	1.50	2.50	2.50	1.78	17.46	1.78	17.46	0.15	11	7.42	0.699	26.18	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.15	1.07	1.07	1.15	1.07	1.07	1.00	1.00	1.00	267.16	147.45	177.98	**71.19**
8	SQUARE	2.00	2.50	2.50	1.78	17.46	1.82	17.85	0.15	11	7.42	0.699	34.91	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.19	1.10	1.10	1.19	1.10	1.10	1.00	1.00	1.00	293.20	161.94	195.41	**78.16**
9	SQUARE	2.50	2.50	2.50	1.78	15.50	1.82	15.89	0.20	10	6.74	0.688	38.74	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	352.42	198.09	245.93	**98.37**

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	3.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	77.42	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.78	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.82	0.688	0.135	0.00	39.57	29.32	-	-	28.885	-	28.02
3	3	CLAY	3.00	4.00	1.00	1.86	0.690	0.137	0.00	57.17	10.89	-	-	6.137	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	3.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	87.74	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.78	0.000	0.000	0.00	Depth of foundation						27.18
2	2	CLAY	2.00	3.50	1.50	1.82	0.688	0.135	0.00	47.25	33.23	-	-	27.745	-	
3	3	CLAY	3.50	4.50	1.00	1.86	0.690	0.137	0.00	63.80	12.34	-	-	6.224	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	3.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	114.73	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.82	0.000	0.000	0.00	Depth of foundation						29.53
2	2	CLAY	2.50	4.00	1.50	1.86	0.690	0.137	0.00	56.46	43.45	-	-	30.138	-	
3	3	CLAY	4.00	5.00	1.00	1.90	0.669	0.130	0.00	72.72	16.13	-	-	6.778	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	3.00	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	72.19	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.78	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.82	0.688	0.135	0.00	39.57	38.18	-	-	35.191	-	38.24
3	3	CLAY	3.00	4.50	1.50	1.86	0.690	0.137	0.00	59.28	15.99	-	-	12.608	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	3.00	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	80.10	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.78	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	2.00	3.50	1.50	1.82	0.688	0.135	0.00	47.25	42.37	-	-	33.349	-	36.75
3	3	CLAY	3.50	5.00	1.50	1.86	0.690	0.137	0.00	65.91	17.74	-	-	12.586	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	3.00	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	101.91	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.82	0.000	0.000	0.00	Depth of foundation						39.00
2	2	CLAY	2.50	4.00	1.50	1.86	0.690	0.137	0.00	56.46	53.90	-	-	35.393	-	
3	3	CLAY	4.00	5.50	1.50	1.90	0.669	0.130	0.00	74.93	22.57	-	-	13.360	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	3.00	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	71.19	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.78	0.000	0.000	0.00	Depth of foundation						44.52
2	2	CLAY	1.50	3.50	2.00	1.82	0.688	0.135	0.00	42.63	36.32	-	-	42.809	-	
3	3	CLAY	3.50	5.25	1.75	1.86	0.690	0.137	0.00	66.46	15.40	-	-	12.841	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	3.00	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	78.16	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.00	Depth of foundation						41.03
2	2	CLAY	2.00	4.00	2.00	1.86	0.690	0.137	0.00	51.49	39.88	-	-	40.384	-	
3	3	CLAY	4.00	5.50	1.50	1.90	0.669	0.130	0.00	73.90	17.72	-	-	10.909	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	3.00	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	98.37	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.82	0.000	0.000	0.00	Depth of foundation						45.31
2	2	CLAY	2.50	4.50	2.00	1.86	0.690	0.137	0.00	59.59	50.19	-	-	43.018	-	
3	3	CLAY	4.50	6.25	1.75	1.90	0.669	0.130	0.00	82.29	21.28	-	-	13.616	-	

VIVEK MATERIAL TESTING LABORATORY

BEARING CAPACITY CALCULATION

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT								
BOREHOLE 02 (L.H.S.)	Depth of borehole	10.00	metre	Water table below borehole level (m)	4.50		Factor of safety	2.50
				Water table used for calculation (m)	3.50		Assumed post monsoon rise (m)	1.00

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Input Parameters														Shearing Resistance Parameters																Ultimate Net Bearing Capacity			
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors							Inclination Factors			General shear	Local shear	Intermediate	Net Safe Bearing Capacity
					Bulk		Bulk		c	Ø	Ø'	e	q	Nc	Nq	Nγ	Nc'	Nq'	Nγ'	Sc	Sq	Sγ	Dc	Dq	Dγ	Dc'	Dq'	Dγ'	Ic	Iq	Iγ				
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																			kN/m2	kN/m2	kN/m2	kN/m2
1	SQUARE	1.50	1.20	1.20	1.80	17.65	1.80	17.65	0.20	12	8.11	0.686	26.48	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.31	1.15	1.15	1.31	1.15	1.15	1.00	1.00	1.00	398.10	216.83	274.84	**109.94**
2	SQUARE	2.00	1.20	1.20	1.80	17.65	1.88	18.44	0.20	12	8.11	0.686	35.31	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.41	1.21	1.21	1.41	1.21	1.21	1.00	1.00	1.00	452.36	246.47	312.35	**124.94**
3	SQUARE	2.50	1.20	1.20	1.80	17.65	1.88	18.44	0.15	13	8.79	0.660	44.13	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.52	1.26	1.26	1.52	1.26	1.26	1.00	1.00	1.00	455.51	242.40	338.30	**135.32**
4	SQUARE	1.50	2.00	2.00	1.80	17.65	1.80	17.65	0.20	12	8.11	0.686	26.48	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.19	1.09	1.09	1.19	1.09	1.09	1.00	1.00	1.00	375.52	204.28	259.08	**103.63**
5	SQUARE	2.00	2.00	2.00	1.80	17.65	1.88	18.44	0.20	12	8.11	0.686	35.31	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.25	1.12	1.12	1.25	1.12	1.12	1.00	1.00	1.00	413.37	225.03	285.30	**114.12**
6	SQUARE	2.50	2.00	2.00	1.80	17.65	1.88	18.44	0.15	13	8.79	0.660	44.13	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.31	1.16	1.16	1.31	1.16	1.16	1.00	1.00	1.00	409.37	217.64	303.92	**121.57**
7	SQUARE	1.50	2.50	2.50	1.80	17.65	1.80	17.65	0.20	12	8.11	0.686	26.48	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.15	1.07	1.07	1.15	1.07	1.07	1.00	1.00	1.00	367.53	199.86	253.51	**101.40**
8	SQUARE	2.00	2.50	2.50	1.80	17.65	1.88	18.44	0.20	12	8.11	0.686	35.31	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	402.87	219.23	277.99	**111.20**
9	SQUARE	2.50	2.50	2.50	1.80	17.65	1.88	18.44	0.15	13	8.79	0.660	44.13	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.25	1.13	1.13	1.25	1.13	1.13	1.00	1.00	1.00	398.00	211.47	295.41	**118.16**

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	109.94	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.88	0.660	0.130	0.00	40.31	41.63	-	-	36.195	-	35.03
3	3	CLAY	3.00	4.00	1.00	1.91	0.669	0.134	0.00	63.50	15.46	-	-	7.598	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	124.94	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.80	0.000	0.000	0.00	Depth of foundation						33.59
2	2	CLAY	2.00	3.50	1.50	1.88	0.660	0.130	0.00	49.13	47.31	-	-	34.409	-	
3	3	CLAY	3.50	4.50	1.00	1.91	0.669	0.134	0.00	72.33	17.57	-	-	7.583	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	135.32	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.88	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	2.50	4.00	1.50	1.91	0.669	0.134	0.00	60.14	51.25	-	-	32.235	-	31.52
3	3	CLAY	4.00	5.00	1.00	1.90	0.701	0.136	0.00	83.02	19.03	-	-	7.166	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	103.63	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	-	-	-	Depth of foundation						47.18
2	2	CLAY	1.50	3.00	1.50	1.88	0.660	0.130	0.00	40.31	54.81	-	-	43.803	-	
3	3	CLAY	3.00	4.50	1.50	1.91	0.669	0.134	0.00	68.18	22.95	-	-	15.174	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	114.12	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.80	0.000	0.000	0.00	Depth of foundation						44.68
2	2	CLAY	2.00	3.50	1.50	1.88	0.660	0.130	0.00	49.13	60.36	-	-	40.881	-	
3	3	CLAY	3.50	5.00	1.50	1.91	0.669	0.134	0.00	76.27	25.27	-	-	14.968	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	121.57	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.88	0.000	0.000	0.00	Depth of foundation						41.68
2	2	CLAY	2.50	4.00	1.50	1.91	0.669	0.134	0.00	60.14	64.30	-	-	38.032	-	
3	3	CLAY	4.00	5.50	1.50	1.90	0.701	0.136	0.00	86.83	26.92	-	-	14.067	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	101.40	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	0.000	0.000	0.00	Depth of foundation						53.73
2	2	CLAY	1.50	3.50	2.00	1.88	0.660	0.130	0.00	44.92	51.73	-	-	52.126	-	
3	3	CLAY	3.50	5.25	1.75	1.91	0.669	0.134	0.00	78.52	21.94	-	-	15.034	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	92.10	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	1.50	3.50	2.00	1.88	0.660	0.130	0.00	44.92	46.99	-	-	48.702	-	50.00
3	3	CLAY	3.50	5.25	1.75	1.91	0.669	0.134	0.00	78.52	19.92	-	-	13.799	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	111.20	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.88	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	2.00	4.00	2.00	1.91	0.669	0.134	0.00	55.61	56.73	-	-	49.042	-	49.84
3	3	CLAY	4.00	5.50	1.50	1.90	0.701	0.136	0.00	86.97	25.22	-	-	13.260	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

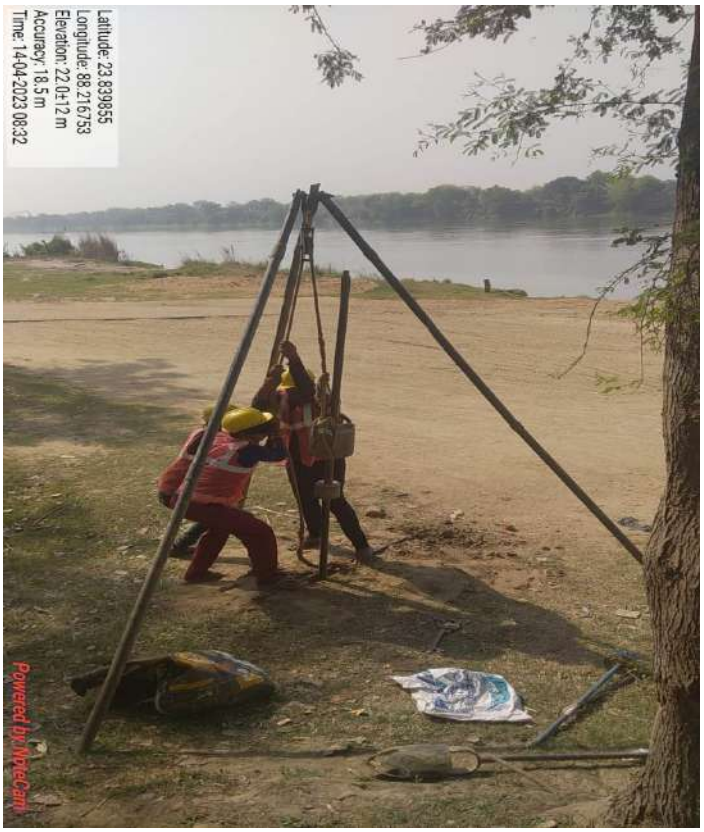
SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	118.16	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.88	0.000	0.000	0.00	Depth of foundation						48.68
2	2	CLAY	2.50	4.50	2.00	1.91	0.669	0.134	0.00	64.82	60.29	-	-	45.853	-	
3	3	CLAY	4.50	6.25	1.75	1.90	0.701	0.136	0.00	91.28	25.56	-	-	15.003	-	

SITE PHOTOS DURING SITE INVESTIGATION



RESULT SHEET

NAME OF THE PROJECT	CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL						
Client Name							
Bore Hole No.	1 (L.H.S.)	Coordinate	Easting		Depth of Water Level	3.00	VIVEK MATERIAL TESTING LABORATORY
Total depth of Bore Hole	10.00		Northing		Commenced on	4/14/2023	
			Elevation	100.000	Completed on	4/14/2023	

Depth of Bore Hole	Reduced Level	Types of Samples	% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characterisitics		Compression Index
			4.750	2.000	0.425	0.075	LL	PL	PI										Cohesion	Angle of Internal Friction	
metre	metre		(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N"	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(Ø)	(Cc)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0.00 - 0.50	100.000 - 99.500	DS	100	100	98	90	34	22	12	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	100	100	99	33	20	13	CL				1.78	16.2	1.53	2.60	0.699	0.15	11°	0.139
1.35 - 1.80	98.650 - 98.200	SPT									4	5.49	5.49								
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	99	36	18	18	CI				1.82	18.4	1.54	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									5	7.19	7.19								
4.00 - 4.35	96.000 - 95.650	UD	100	100	100	98	37	20	17	CI				1.86	20.1	1.55	2.62	0.690	0.20	10°	0.137
4.35 - 4.80	95.650 - 95.200	SPT									5	6.52	6.52								
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	98	39	25	14	CI				1.90	21.2	1.57	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									8	9.63	9.63								
7.00 - 7.35	93.000 - 92.650	UD	100	100	98	49	NON PLASTIC			SM				1.87	22.3	1.53	2.58	0.686	0	29°	-
7.35 - 7.80	92.650 - 92.200	SPT									12	13.57	13.57								
8.50 - 8.85	91.500 - 91.150	UD	100	100	99	61	NON PLASTIC			ML				1.86	20.7	1.54	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									14	14.99	14.99								
9.30 - 10.00	90.700 - 90.000	DS	100	100	99	54	NON PLASTIC			ML					-	-	-	-	-	-	-

RESULT SHEET

NAME OF THE PROJECT	**CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL**																							
Client Name																								
Bore Hole No.	**2 (L.H.S.)**		**Coordinate**		**Easting**				**Depth of Water Level**			4.50		**VIVEK MATERIAL TESTING LABORATORY**										
Total depth of Bore Hole	**10.00**				**Northing**				**Commenced on**			4/14/2023												
					Elevation		**100.000**		**Completed on**			4/14/2023												

Depth of Bore Hole	**Reduced Level**	**Types of Samples**	**% Material Passing IS Sieve**				**Atterberg Limits**			**IS group symbol**	**SPT Value**	**SPT Value corrected due to overburden**	**SPT Value corrected due to dilatancy**	**Wet Bulk Density**	**Original Moisture**	**Dry Bulk Density**	**Specific Gravity**	**Void Ratio**	**Shear Characterisitics**		**Compression Index**
			4.750	**2.000**	**0.425**	**0.075**	**LL**	**PL**	**PI**										**Cohesion**	**Angle of Internal Friction**	
metre	metre		(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N''	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(Ø)	(Cc)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0.00 - 0.50	100.000 - 99.500	DS	100	100	99	79	30	16	14	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	100	100	97	32	22	10	CL				1.80	15.6	1.56	2.63	0.686	0.20	12°	0.138
1.35 - 1.80	98.650 - 98.200	SPT									5	6.84	6.84								
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	99	34	21	13	CL				1.88	18.4	1.59	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									7	8.11	8.11								
4.00 - 4.35	96.000 - 95.650	UD	100	100	100	98	38	22	16	CI				1.91	21.8	1.57	2.62	0.669	0.25	9°	0.134
4.35 - 4.80	95.650 - 95.200	SPT									6	7.71	7.71								
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	99	39	26	13	CI				1.90	23.1	1.54	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									5	5.96	5.96								
7.00 - 7.35	93.000 - 92.650	UD	100	100	100	99	40	20	20	CI				1.99	24.2	1.60	2.65	0.656	0.15	12°	0.132
7.35 - 7.80	92.650 - 92.200	SPT									8	8.89	8.89								
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	60	NON PLASTIC			ML				1.87	23.3	1.52	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									13	13.71	13.71								
9.30 - 10.00	90.700 - 90.000	DS	100	100	100	54	NON PLASTIC			ML					-	-	-	-	-	-	-

BORE-LOG CHART

VMT
GEOTECH & MATERIAL TESTING

VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL

WATER TABLE 3.00 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 01 (L.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES
			GROUP	HATCHING	N1	N2	N3	N2+N3	10 20 30 40 50 60 70 80 90 100
0.00-0.50	SILTY-CLAY	D.	CL						
1.00-1.35	SILTY-CLAY	U.D.	CL						
1.35-1.80		S.P.T.			1	2	2	4	
2.50-2.85	SILTY-CLAY	U.D.	CI						
2.85-3.30		S.P.T.			2	2	3	5	
4.00-4.35	SILTY-CLAY	U.D.	CI						
4.35-4.80		S.P.T.			2	2	3	5	
5.50-5.85	SILTY-CLAY	U.D.	CI						
5.85-6.30		S.P.T.			2	3	5	8	
7.00-7.35	SILTY-SAND	U.D.	SM						
7.35-7.80		S.P.T.			3	5	7	12	
8.50-8.85	SANDY-SILT	U.D.	ML						
8.85-9.30		S.P.T.			5	6	8	14	
9.30-10.00	SANDY-SILT	D.	ML						

BORE-LOG CHART

VMT
GEOTECH & MATERIAL TESTING

VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL

WATER TABLE 4.50 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 02 (L.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES
			GROUP	HATCHING	N1	N2	N3	N2+N3	10 20 30 40 50 60 70 80 90 100
0.00-0.50	SILTY-CLAY	D.	CL						
1.00-1.35	SILTY-CLAY	U.D.	CL						
1.35-1.80		S.P.T.			1	2	3	5	
2.50-2.85	SILTY-CLAY	U.D.	CL						
2.85-3.30		S.P.T.			2	3	4	7	
4.00-4.35	SILTY-CLAY	U.D.	CI						
4.35-4.80		S.P.T.			2	2	4	6	
5.50-5.85	SILTY-CLAY	U.D.	CI						
5.85-6.30		S.P.T.			2	2	3	5	
7.00-7.35	SILTY-CLAY	U.D.	CI						
7.35-7.80		S.P.T.			3	4	4	8	
8.50-8.85	SANDY-SILT	U.D.	ML						
8.85-9.30		S.P.T.			5	6	7	13	
9.30-10.00	SANDY-SILT	D.	ML						

VMT/129B/23-24

VMT
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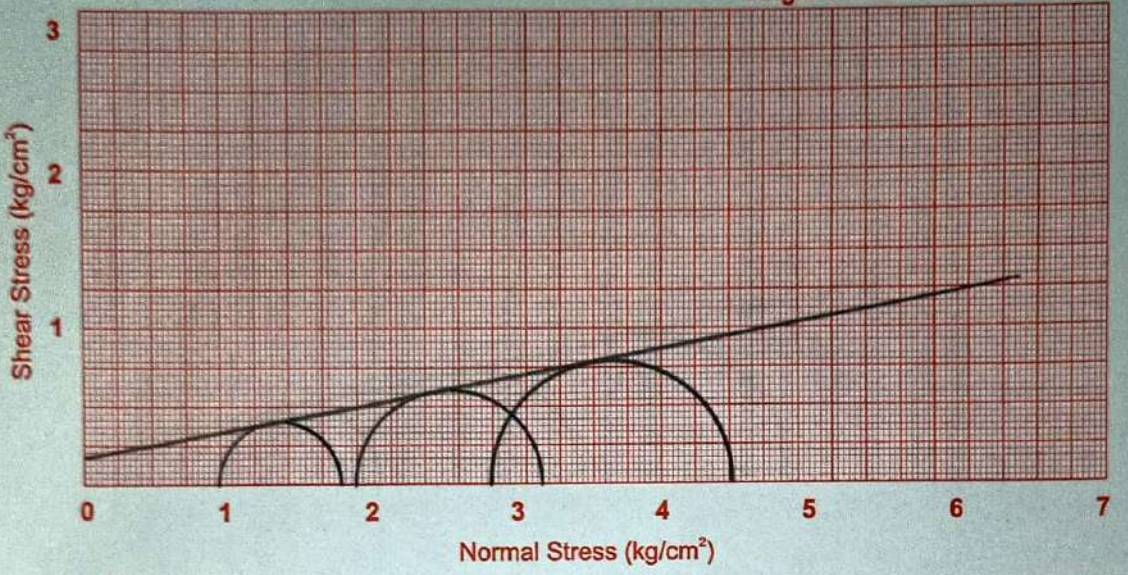
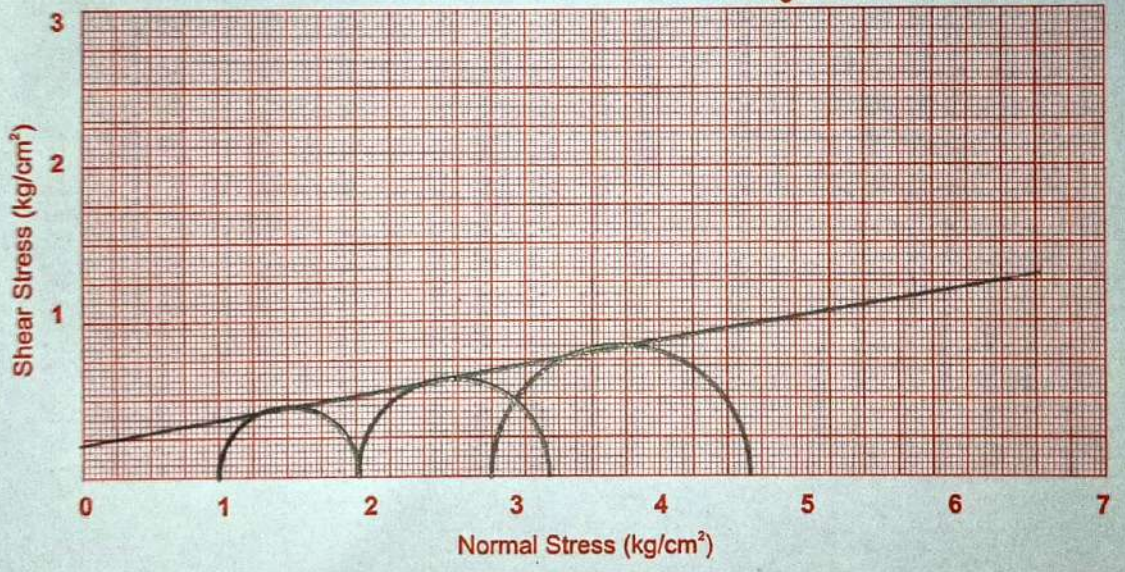
B.H. No. :- 01
Depth -1.00-1.35

Cohesion 'c' 0.15 Kg/cm²
Angle of Internal Friction 11° *



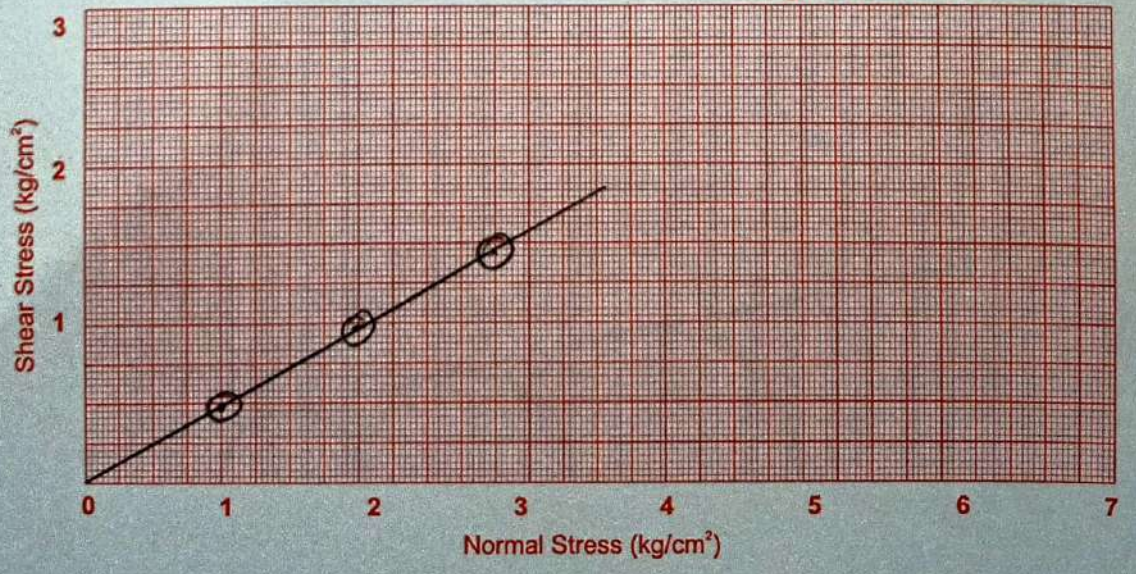
B.H. No. :- 01
Depth :- 4.00-4.35

Cohesion 'c' 0.20 Kg/cm²
Angle of Internal Friction 10° *



B.H. No. :- 01
Depth :- 7.00-7.35

Cohesion 'c' 0 Kg/cm²
Angle of Internal Friction 29° *



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VMT/129B/23-24

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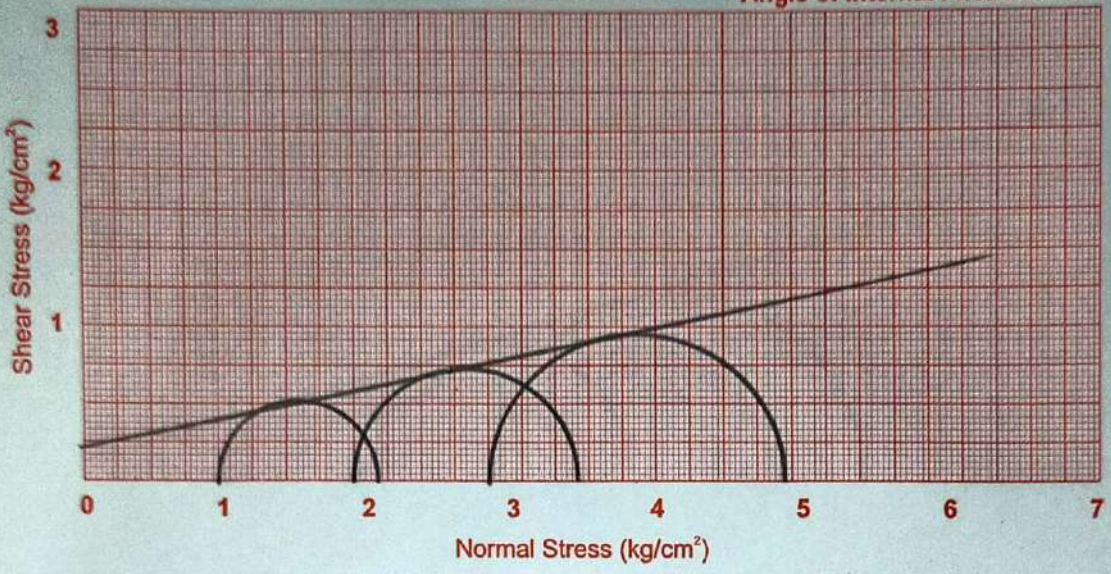
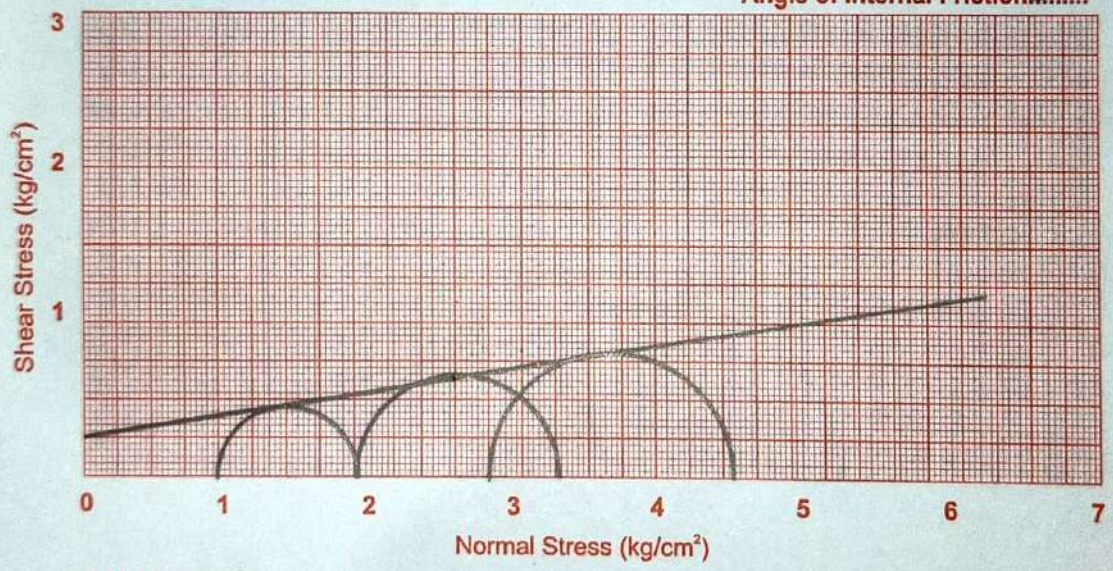
B.H. No. :- 02
Depth - 1.00-1.35

Cohesion 'c' 0.20 Kg/cm²
Angle of Internal Friction 12° *



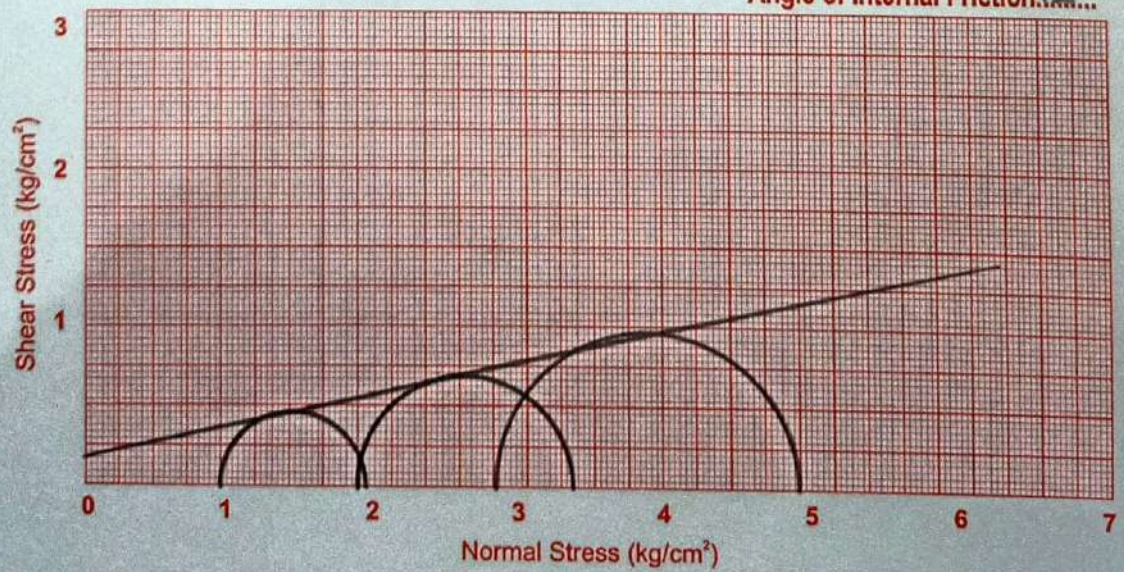
B.H. No. :- 02
Depth :- 4.00-4.35

Cohesion 'c' 0.25 Kg/cm²
Angle of Internal Friction 9° *



B.H. No. :- 02
Depth :- 7.00-7.35

Cohesion 'c' 0.15 Kg/cm²
Angle of Internal Friction 12° *



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TC-8969

REPORT NO. – VMT 129 A/2023-2024

GEOTECH INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT MAGANPARA IN WEST BENGAL

Prepared By -

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THE CO-OPERATION EXTENDED BY THEIR ENGINEERS DURING FIELD INVESTIGATIONS IS THANKFULLY ACKNOWLEDGED.

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SUB-SOIL INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL

INTRODUCTION

The work of sub-soil exploration was awarded to us by M/s KITCO LTD., KERLA Order no. – 6777:DP 1083: RG: 2023 dated 21/03/2023. The object of the investigation was to study the geo-technical properties of soil both in field and laboratory and determine safe allowable pressure for the foundation soil.

The fieldwork consisted of 02 bore holes of 10.00 metre depth each. The fieldwork was conducted on 13/04/2023. The location of the bore holes is shown in the Site location.

REFERENCES

1. **IS: 1892-2021** for field work including existent ground water table.
2. **IS: 2132-1986** for sampling in Undisturbed and Disturbed form.
3. **IS: 2131-1981** for Standard Penetration Test.
4. **IS: 2720** for all laboratory tests on soil samples collected.
5. **IS: 6403-1981** for determination of Bearing Capacity.
6. **IS: 8009(Part I)-1976** for calculation of settlement of foundations.
7. **IS: 1904-2021** for permissible maximum settlement, differential settlement and angular distortion.

SCOPE OF WORK

The scope consisted of drilling of boreholes down to maximum depth of 10.00 m in normal soils / rock, Standard Penetration Testing, collection of samples, laboratory testing and preparation and submission of Geotechnical Investigation report.

Summary of the fieldwork					
Sl. No.	Site	Borehole Nos.	Coordinates		Depth below existing ground level (m)
			Latitude	Longitude	
1.	MAGANPARA	BH-01 (RHS)	23.83807188	88.21512401	10.0
2.		BH-02 (RHS)	23.83845431	88.21508244	10.0

SITE LOCATION

INTERPRETATION OF THE LAB TEST RESULTS

GENERAL NATURE OF SOIL STRATA

The bore hole log charts and lab test results of bore holes 1 and 2 indicate that the strata at the site is found to comprise of both cohesive as well as non-cohesive soil.

The results of classification tests indicate that the natural soil stratum present at the Site is found to comprise of both fine-grained soils comprising of 'CL' group of IS classification (clayey soil) having 95 to 99 percent material finer than 75 micron and coarse-grained soils (sandy soil) comprise of 'SM' group of IS classification having 31 to 49 percent material finer than 75 micron.

The bore hole log charts and lab test results of bore holes 1 indicate that:

first strata, from 0.00 metre to 7.00 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 7.00 metre to 10.00 metre, consists of a layer of SM group of IS classification which is silty Sand with none plasticity.

The bore hole log charts and lab test results of bore holes 2 indicate that:

first strata, from 0.00 metre to 2.50 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 2.50 metre to 10.00 metre, consists of a layer of SM group of IS classification which is silty Sand with none plasticity.

S.P.T. VALUES

The S.P.T. values obtained in the respective clayey layer region present as per bore-log charts enclosed are found to range 5 to 8 indicating 'Medium' consistency.

However, the S.P.T. values obtained in the respective sandy layer region present as per bore-log charts enclosed are found to range from 9 to 19 indicating 'Loose' to 'Medium' relative density.

The results of S.P.T. values indicate that the stratum at the Site is 'Loose' to 'Well' compacted.

WATER TABLE

Water Table at the Site was observed at a depth from 1.30 metre to 5.40 metre below ground level on the day of soil investigation during the Third week of April 2023. However, the existing water table may rise by 1.00 metre in the post-monsoon period in general. Therefore, a water table at a depth of 0.30 metre to 4.40 metre below ground level has been adopted for calculation purposes.

RECOMMENDATIONS FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL

NET SAFE BEARING CAPACITY

Bore Hole Nos.	Type of Structure	Depth of Foundation (metres)	Size of Footing (L x B) (metres)	Net Safe Bearing Capacity (Tonne/sqm.)	Settlement Produced (mm)
1	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	9.95	32.09
		2.00	1.20 x 1.20	11.51	31.10
		2.50	1.20 x 1.20	11.98	27.42
		1.50	2.00 x 2.00	9.47	43.50
		2.00	2.00 x 2.00	10.70	41.75
		2.50	2.00 x 2.00	11.09	37.11
		1.50	2.50 x 2.50	9.44	48.39
		2.00	2.50 x 2.50	10.53	45.63
		2.50	2.50 x 2.50	10.80	42.74
2	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	7.92	12.43
		2.00	1.20 x 1.20	9.07	14.23
		2.50	1.20 x 1.20	8.36	11.36
		1.50	2.00 x 2.00	7.48	19.98
		2.00	2.00 x 2.00	8.38	22.38
		2.50	2.00 x 2.00	8.19	18.92
		1.50	2.50 x 2.50	7.44	20.27
		2.00	2.50 x 2.50	8.26	19.72
		2.50	2.50 x 2.50	8.31	19.58

NOTE: -

The above recommendations are based on the field investigation data results and the laboratory tests results of the samples collected from the test locations and our experience in this regard. If the actual sub-soil conditions during excavation for the

foundations differ from that has been reported, a reference should be made to us for suggestions.

Further, the recommendations are based on the assumptions as mentioned in the Report and the designer of the Structure should take into consideration all the factors required as per codes. The recommendations should be taken as guidelines for the designer.

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TECHNICAL MANAGER
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BEARING CAPACITY CALCULATIONS

Soil when stressed due to loading, tend to deform. The resistance to deformation of the soil depends upon factors like water content, bulk density, angle of internal friction and the manner in which load is applied on the soil. The maximum load per unit area which the soil or rock can carry without yielding or displacement is termed as the bearing capacity of soils. The Safe Bearing Capacity of the proposed STRUCTURE without any distress is determined from the considerations of the following criteria.

[A] SHEAR CRITERIA

The soil beneath the foundation shall be safe from risk of shear failure.

[B] SETTLEMENT CRITERIA

The settlement due to load is caused basically on account of two factors, namely,

(i) the soil below footing gets compressed by certain amount and

(ii) since the foundations cover only a limited area there is a possibility that the concentrated stresses developed are so high as to cause actual rupture (shear failure) and displacement of soil below.

The foundation should not settle or deflect to an extent causing damage to the Structure or impair its usefulness.

The Bearing Capacity Calculations for the Foundation shall be governed as per IS: 6403-1981, IS: 8009(Part-I)-1976 and IS: 1904-2021 on the basis of available information regarding the proposed design.

BEARING CAPACITY ON SHEAR CONSIDERATIONS

ULTIMATE NET BEARING CAPACITY

As per IS: 6403-1981, the Ultimate Net Bearing Capacity 'qd' on shear consideration for a Structure is given by the formula: -

FOR GENERAL SHEAR FAILURE

qd = c.Nc.Sc.dc.ic+q(Nq-1).sq.dq.iq + 1/2 B.r.Nr.Sr.dr.ir.W'.

FOR LOCAL SHEAR FAILURE

q'd = 2/3 c.N'c.Sc.dc.ic+q(N'q-1).Sq.dq.iq + 1/2 B.r.N'r.Sr.dr.ir.W'.

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BEARING CAPACITY CALCULATION

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT								
BOREHOLE 01 (R.H.S.)	Depth of borehole	10.00	metre	Water table below borehole level (m)	5.40		Factor of safety	2.50
				Water table used for calculation (m)	4.40		Assumed post monsoon rise (m)	1.00

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Input Parameters														Shearing Resistance Parameters																Ultimate Net Bearing Capacity			Net Safe Bearing Capacity
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	
					Bulk		Bulk		c	Ø	Ø'	e	q	Nc	Nq	Nγ	Nc'	Nq'	Nγ'	Sc	Sq	Sγ	Dc	Dq	Dγ	Dc'	Dq'	Dγ'	Ic	Iq	Iγ				
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																		kN/m2	kN/m2	kN/m2	kN/m2
1	SQUARE	1.50	1.20	1.20	1.83	17.95	1.83	17.95	0.15	13	8.79	0.679	26.92	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.31	1.16	1.16	1.31	1.16	1.16	1.00	1.00	1.00	349.63	185.84	243.99	**97.60**
2	SQUARE	2.00	1.20	1.20	1.83	17.95	1.85	18.14	0.15	13	8.79	0.679	35.89	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.42	1.21	1.21	1.42	1.21	1.21	1.00	1.00	1.00	404.40	215.07	282.28	**112.91**
3	SQUARE	2.50	1.20	1.20	1.83	17.95	1.85	18.14	0.10	16	10.88	0.712	44.87	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.55	1.28	1.28	1.55	1.28	1.28	1.00	1.00	1.00	494.51	246.64	293.74	**117.50**
4	SQUARE	1.50	2.00	2.00	1.83	17.95	1.83	17.95	0.15	13	8.79	0.679	26.92	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.19	1.09	1.09	1.19	1.09	1.09	1.00	1.00	1.00	333.20	176.74	232.28	**92.91**
5	SQUARE	2.00	2.00	2.00	1.83	17.95	1.85	18.14	0.15	13	8.79	0.679	35.89	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.25	1.13	1.13	1.25	1.13	1.13	1.00	1.00	1.00	376.33	199.75	262.44	**104.98**
6	SQUARE	2.50	2.00	2.00	1.83	17.95	1.85	18.14	0.10	16	10.88	0.712	44.87	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.33	1.17	1.17	1.33	1.17	1.17	1.00	1.00	1.00	458.60	227.97	271.79	**108.72**
7	SQUARE	1.50	2.50	2.50	1.83	17.95	1.83	17.95	0.15	13	8.79	0.679	26.92	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.15	1.08	1.08	1.15	1.08	1.08	1.00	1.00	1.00	332.34	176.06	231.54	**92.62**
8	SQUARE	2.00	2.50	2.50	1.83	17.95	1.85	18.14	0.15	13	8.79	0.679	35.89	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	370.27	196.33	258.08	**103.23**
9	SQUARE	2.50	2.50	2.50	1.83	17.95	1.85	18.14	0.10	16	10.88	0.712	44.87	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.27	1.13	1.13	1.27	1.13	1.13	1.00	1.00	1.00	447.04	221.99	264.75	**105.90**

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	5.40	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	97.60	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.83	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.85	0.712	0.136	0.00	40.53	36.96	-	-	33.542	-	32.09
3	3	CLAY	3.00	4.00	1.00	1.91	0.682	0.130	0.00	63.50	13.73	-	-	6.568	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	5.40	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	112.91	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.83	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	2.00	3.50	1.50	1.85	0.712	0.136	0.00	49.50	42.76	-	-	32.220	-	31.10
3	3	CLAY	3.50	4.50	1.00	1.91	0.682	0.130	0.00	72.47	15.88	-	-	6.649	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	5.40	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	117.50	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.85	0.000	0.000	0.00	Depth of foundation						27.42
2	2	CLAY	2.50	4.00	1.50	1.91	0.682	0.130	0.00	59.41	44.50	-	-	28.148	-	
3	3	CLAY	4.00	5.00	1.00	1.94	0.660	0.129	0.00	82.97	16.52	-	-	6.130	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	5.40	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	92.91	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.83	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.85	0.712	0.136	0.00	40.53	49.14	-	-	41.098	-	43.50
3	3	CLAY	3.00	4.50	1.50	1.91	0.682	0.130	0.00	68.18	20.58	-	-	13.278	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	5.40	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	104.98	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.83	0.000	0.000	0.00	Depth of foundation						41.75
2	2	CLAY	2.00	3.50	1.50	1.85	0.712	0.136	0.00	49.50	55.53	-	-	38.928	-	
3	3	CLAY	3.50	5.00	1.50	1.91	0.682	0.130	0.00	77.16	23.25	-	-	13.261	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	5.40	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	108.72	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.85	0.000	0.000	0.00	Depth of foundation						37.11
2	2	CLAY	2.50	4.00	1.50	1.91	0.682	0.130	0.00	59.41	57.50	-	-	34.087	-	
3	3	CLAY	4.00	5.50	1.50	1.94	0.660	0.129	0.00	87.59	24.08	-	-	12.294	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	5.40	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	92.62	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.85	0.000	0.000	0.00	Depth of foundation						48.39
2	2	CLAY	1.50	3.50	2.00	1.91	0.682	0.130	0.00	45.95	47.26	-	-	47.482	-	
3	3	CLAY	3.50	5.25	1.75	1.94	0.660	0.129	0.00	81.32	20.04	-	-	13.008	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	5.40	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	103.23	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.85	0.000	0.000	0.00	Depth of foundation						45.63
2	2	CLAY	2.00	4.00	2.00	1.91	0.682	0.130	0.00	55.02	52.67	-	-	45.084	-	
3	3	CLAY	4.00	5.50	1.50	1.94	0.660	0.129	0.00	87.88	23.41	-	-	11.954	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	5.40	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	105.90	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.85	0.000	0.000	0.00	Depth of foundation						42.74
2	2	CLAY	2.50	4.50	2.00	1.91	0.682	0.130	0.00	64.09	54.03	-	-	41.047	-	
3	3	CLAY	4.50	6.25	1.75	1.94	0.660	0.129	0.00	98.30	22.91	-	-	12.373	-	

VIVEK MATERIAL TESTING LABORATORY

BEARING CAPACITY CALCULATION

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT								
BOREHOLE 02 (R.H.S.)	Depth of borehole	10.00	metre	Water table below borehole level (m)	1.30		Factor of safety	2.50
				Water table used for calculation (m)	0.30		Assumed post monsoon rise (m)	1.00

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Input Parameters														Shearing Resistance Parameters																	Ultimate Net Bearing Capacity			Net Safe Bearing Capacity
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	
					Bulk		Bulk		c	Ø	Ø'	e	q	Nc	Nq	Nγ	Nc'	Nq'	Nγ'	Sc	Sq	Sγ	Dc	Dq	Dγ	Dc'	Dq'	Dγ'	Ic	Iq	Iγ				
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																		kN/m2	kN/m2	kN/m2	kN/m2
1	SQUARE	1.50	1.20	1.20	1.83	10.10	1.83	10.10	0.10	17	11.58	0.695	15.15	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.34	1.17	1.17	1.34	1.17	1.17	1.00	1.00	1.00	308.63	150.94	194.30	**77.72**
2	SQUARE	2.00	1.20	1.20	1.83	9.61	1.78	9.12	0.10	17	11.58	0.695	19.22	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.45	1.23	1.23	1.45	1.23	1.23	1.00	1.00	1.00	353.09	172.82	222.39	**88.96**
3	SQUARE	2.50	1.20	1.20	1.83	9.32	1.78	8.83	0.00	26	18.10	0.735	23.29	22.25	11.85	12.53	13.19	5.31	4.12	1.30	1.20	0.80	1.67	1.33	1.33	1.67	1.33	1.33	1.00	1.00	1.00	473.15	183.17	204.92	**81.97**
4	SQUARE	1.50	2.00	2.00	1.83	10.10	1.83	10.10	0.10	17	11.58	0.695	15.15	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	291.91	142.29	183.44	**73.38**
5	SQUARE	2.00	2.00	2.00	1.83	9.61	1.78	9.12	0.10	17	11.58	0.695	19.22	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.27	1.14	1.14	1.27	1.14	1.14	1.00	1.00	1.00	326.87	159.50	205.53	**82.21**
6	SQUARE	2.50	2.00	2.00	1.83	9.32	1.78	8.83	0.00	26	18.10	0.735	23.29	22.25	11.85	12.53	13.19	5.31	4.12	1.30	1.20	0.80	1.40	1.20	1.20	1.40	1.20	1.20	1.00	1.00	1.00	468.90	179.08	200.82	**80.33**
7	SQUARE	1.50	2.50	2.50	1.83	10.10	1.83	10.10	0.10	17	11.58	0.695	15.15	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.16	1.08	1.08	1.16	1.08	1.08	1.00	1.00	1.00	290.59	141.36	182.40	**72.96**
8	SQUARE	2.00	2.50	2.50	1.83	9.61	1.78	9.12	0.10	17	11.58	0.695	19.22	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.22	1.11	1.11	1.22	1.11	1.11	1.00	1.00	1.00	322.50	157.08	202.57	**81.03**
9	SQUARE	2.50	2.50	2.50	1.83	9.32	1.78	8.83	0.00	26	18.10	0.735	23.29	22.25	11.85	12.53	13.19	5.31	4.12	1.30	1.20	0.80	1.32	1.16	1.16	1.32	1.16	1.16	1.00	1.00	1.00	478.64	181.45	203.74	**81.50**

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	1.30	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	77.72	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.83	-	-	-	Depth of foundation						
2	2	SAND	1.50	3.00	1.50	1.78	0.000	0.000	12.92	30.70	29.43	0.199	0.500	-	11.727	12.43
3	3	SAND	3.00	4.00	1.00	1.86	0.000	0.000	14.33	40.65	10.93	0.174	0.500	-	3.813	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	1.30	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	88.96	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.83	0.000	0.000	0.00	Depth of foundation						14.23
2	2	SAND	2.00	3.50	1.50	1.78	0.000	0.000	12.92	34.77	33.69	0.199	0.500	-	13.423	
3	3	SAND	3.50	4.50	1.00	1.86	0.000	0.000	14.33	44.72	12.51	0.174	0.500	-	4.364	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	1.30	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	81.97	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	SAND	0.00	2.50	2.50	1.78	0.000	0.000	0.00	Depth of foundation						
2	2	SAND	2.50	4.00	1.50	1.86	0.000	0.000	14.33	38.20	31.04	0.174	0.500	-	10.829	11.36
3	3	SAND	4.00	5.00	1.00	1.89	0.000	0.000	16.54	48.89	11.53	0.146	0.500	-	3.365	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	1.30	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	73.38	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.83	-	-	-	Depth of foundation						
2	2	SAND	1.50	3.00	1.50	1.78	0.000	0.000	12.92	30.70	38.81	0.235	0.500	-	18.271	19.98
3	3	SAND	3.00	4.50	1.50	1.86	0.000	0.000	14.33	42.76	16.25	0.206	0.500	-	6.698	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	1.30	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	82.21	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.83	0.000	0.000	0.00	Depth of foundation						
2	2	SAND	2.00	3.50	1.50	1.78	0.000	0.000	12.92	34.77	43.48	0.235	0.500	-	20.470	22.38
3	3	SAND	3.50	5.00	1.50	1.86	0.000	0.000	14.33	46.83	18.21	0.206	0.500	-	7.504	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	1.30	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	80.33	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	SAND	0.00	2.50	2.50	1.78	0.000	0.000	0.00	Depth of foundation						
2	2	SAND	2.50	4.00	1.50	1.86	0.000	0.000	14.33	38.20	42.49	0.206	0.500	-	17.513	18.92
3	3	SAND	4.00	5.50	1.50	1.89	0.000	0.000	16.54	51.07	17.79	0.172	0.500	-	6.136	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	1.30	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	72.96	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.83	0.000	0.000	0.00	Depth of foundation						
2	2	SAND	1.50	3.50	2.00	1.78	0.000	0.000	12.92	32.61	37.22	0.248	0.500	-	18.475	20.27
3	3	SAND	3.50	5.25	1.75	1.86	0.000	0.000	14.33	47.64	15.78	0.217	0.500	-	6.859	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	1.30	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	81.03	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	SAND	0.00	2.00	2.00	1.78	0.000	0.000	0.00	Depth of foundation						
2	2	SAND	2.00	4.00	2.00	1.86	0.000	0.000	14.33	36.48	41.34	0.217	0.500	-	17.965	19.72
3	3	SAND	4.00	5.50	1.50	1.89	0.000	0.000	16.54	51.46	18.37	0.182	0.500	-	6.681	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	1.30	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	81.50	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	SAND	0.00	2.50	2.50	1.78	0.000	0.000	0.00	Depth of foundation						
2	2	SAND	2.50	4.50	2.00	1.86	0.000	0.000	14.33	40.31	41.58	0.217	0.500	-	18.069	19.58
3	3	SAND	4.50	6.25	1.75	1.89	0.000	0.000	16.54	56.38	17.63	0.182	0.500	-	6.411	

SITE PHOTOS DURING SITE INVESTIGATION

RESULT SHEET

NAME OF THE PROJECT	CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL						
Client Name							
Bore Hole No.	1 (R.H.S.)	Coordinate	Easting		Depth of Water Level	5.40	VIVEK MATERIAL TESTING LABORATORY
Total depth of Bore Hole	10.00		Northing		Commenced on	4/13/2023	
			Elevation	100.000	Completed on	4/13/2023	

Depth of Bore Hole	Reduced Level	Types of Samples	% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characterisitics		Compression Index
			4.750	2.000	0.425	0.075	LL	PL	PI										Cohesion	Angle of Internal Friction	
metre	metre		(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N"	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(Ø)	(Cc)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0.00 - 0.50	100.000 - 99.500	DS	98	98	97	95	29	21	8	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	100	99	98	30	20	10	CL				1.83	17.3	1.56	2.62	0.679	0.15	13°	0.134
1.35 - 1.80	98.650 - 98.200	SPT									6	8.18	8.18								
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	98	32	21	11	CL				1.85	20.8	1.53	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									5	5.80	5.80								
4.00 - 4.35	96.000 - 95.650	UD	100	100	100	99	28	20	8	CL				1.91	21.4	1.57	2.64	0.682	0.20	14°	0.130
4.35 - 4.80	95.650 - 95.200	SPT									7	7.21	7.21								
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	99	31	20	11	CL				1.94	22.3	1.59	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									8	9.51	9.51								
7.00 - 7.35	93.000 - 92.650	UD	100	100	100	33	NON PLASTIC			SM				1.88	23.1	1.53	2.58	0.686	0	28°	-
7.35 - 7.80	92.650 - 92.200	SPT									13	14.52	14.52								
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	31	NON PLASTIC			SM				1.89	21.1	1.56	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									15	15.87	15.44								
9.30 - 10.00	90.700 - 90.000	DS	100	100	99	31	NON PLASTIC			SM					-	-	-	-	-	-	-

RESULT SHEET

NAME OF THE PROJECT	**CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL**																						
Client Name																							
Bore Hole No.	**2 (R.H.S.)**		**Coordinate**		**Easting**				**Depth of Water Level**			1.30		**VIVEK MATERIAL TESTING LABORATORY**									
Total depth of Bore Hole	**10.00**				**Northing**				**Commenced on**			4/13/2023											
					Elevation		**100.000**		**Completed on**			4/13/2023											

Depth of Bore Hole	**Reduced Level**	**Types of Samples**	**% Material Passing IS Sieve**				**Atterberg Limits**			**IS group symbol**	**SPT Value**	**SPT Value corrected due to overburden**	**SPT Value corrected due to dilatancy**	**Wet Bulk Density**	**Original Moisture**	**Dry Bulk Density**	**Specific Gravity**	**Void Ratio**	**Shear Characterisitics**		**Compression Index**
			4.750	**2.000**	**0.425**	**0.075**	**LL**	**PL**	**PI**										**Cohesion**	**Angle of Internal Friction**	
metre	**metre**		**(mm)**	**(mm)**	**(mm)**	**(mm)**	**%**	**%**	**%**		**N**	**N'**	**N"**	**(gms/cc)**	**%**	**(gms/cc)**	**(G)**		**(Kg/sqcm)**	**(Ø)**	**(Cc)**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
0.00 - 0.50	100.000 - 99.500	DS	100	100	100	95	28	18	10	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	100	100	96	31	20	11	CL				1.83	18.6	1.54	2.61	0.695	0.10	17°	0.136
1.35 - 1.80	98.650 - 98.200	SPT									5	8.15	8.15								
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	38	NON PLASTIC			SM				1.78	21.3	1.47	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									9	12.92	12.92								
4.00 - 4.35	96.000 - 95.650	UD	100	100	100	41	NON PLASTIC			SM				1.86	23.2	1.51	2.57	0.702	0	27°	-
4.35 - 4.80	95.650 - 95.200	SPT									11	14.33	14.33								
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	35	NON PLASTIC			SM				1.89	22.1	1.55	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									15	18.07	16.54								
7.00 - 7.35	93.000 - 92.650	UD	100	100	100	49	NON PLASTIC			SM				1.91	20.7	1.58	2.56	0.620	0	30°	-
7.35 - 7.80	92.650 - 92.200	SPT									17	19.18	17.09								
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	44	NON PLASTIC			SM				1.89	18.3	1.60	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									19	20.27	17.64								
9.30 - 10.00	90.700 - 90.000	DS	100	100	99	38	NON PLASTIC			SM					-	-	-	-	-	-	-

BORE-LOG CHART

VMT
GEOTECH & MATERIAL TESTING

VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL

WATER TABLE 5.40 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 01

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES
			GROUP	HATCHING	N1	N2	N3	N2+N3	10 20 30 40 50 60 70 80 90 100
0.00-0.50	SILTY-CLAY	D.	CL						
1.00-1.35	SILTY-CLAY	U.D.	CL						
1.35-1.80		S.P.T.			2	3	3	6	
2.50-2.85	SILTY-CLAY	U.D.	CL						
2.85-3.30		S.P.T.			2	2	3	5	
4.00-4.35	SILTY-CLAY	U.D.	CL						
4.35-4.80		S.P.T.			2	3	4	7	
5.50-5.85	SILTY-CLAY	U.D.	CL						
5.85-6.30		S.P.T.			3	3	5	8	
7.00-7.35	SILTY-SAND	U.D.	SM						
7.35-7.80		S.P.T.			4	6	7	13	
8.50-8.85	SILTY-SAND	U.D.	SM						
8.85-9.30		S.P.T.			5	7	8	15	
9.30-10.00	SILTY-SAND	D.	SM						

BORE-LOG CHART

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NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GARDUARA FERRY GHAT IN WEST BENGAL

WATER TABLE 1.30 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 02 (R.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES
			GROUP	HATCHING	N1	N2	N3	N2+N3	10 20 30 40 50 60 70 80 90 100
0.00-0.50	SILTY-CLAY	D.	CL						
1.00-1.35	SILTY-CLAY	U.D.	CL						
1.35-1.80		S.P.T.			2	2	3	5	
2.50-2.85	SILTY-SAND	U.D.	SM						
2.85-3.30		S.P.T.			3	3	6	9	
4.00-4.35	SILTY-SAND	U.D.	SM						
4.35-4.80		S.P.T.			4	5	6	11	
5.50-5.85	SILTY-SAND	U.D.	SM						
5.85-6.30		S.P.T.			5	7	8	15	
7.00-7.35	SILTY-SAND	U.D.	SM						
7.35-7.80		S.P.T.			6	8	9	17	
8.50-8.85	SILTY-SAND	U.D.	SM						
8.85-9.30		S.P.T.			7	9	10	19	
9.30-10.00	SILTY-SAND	D.	SM						

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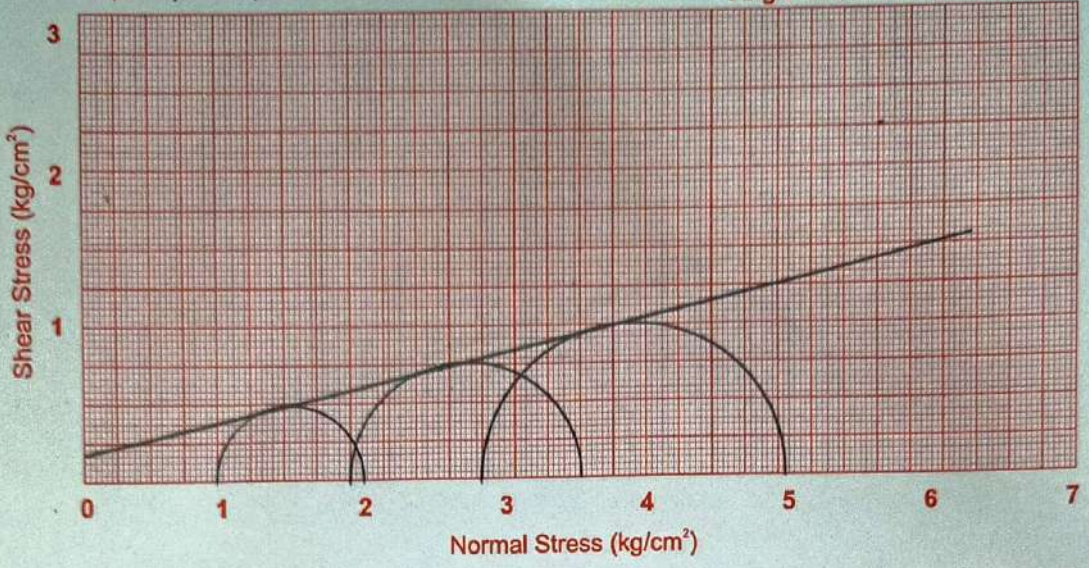
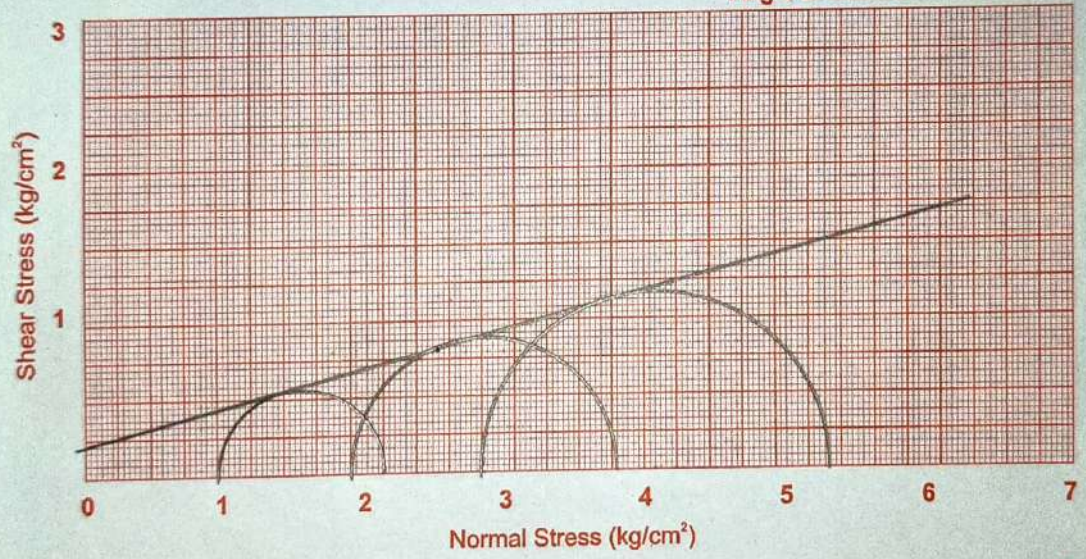
B.H. No. :- 01
Depth - 1.00 - 1.35

Cohesion 'c' 0.15 Kg/cm²
Angle of Internal Friction 13° *



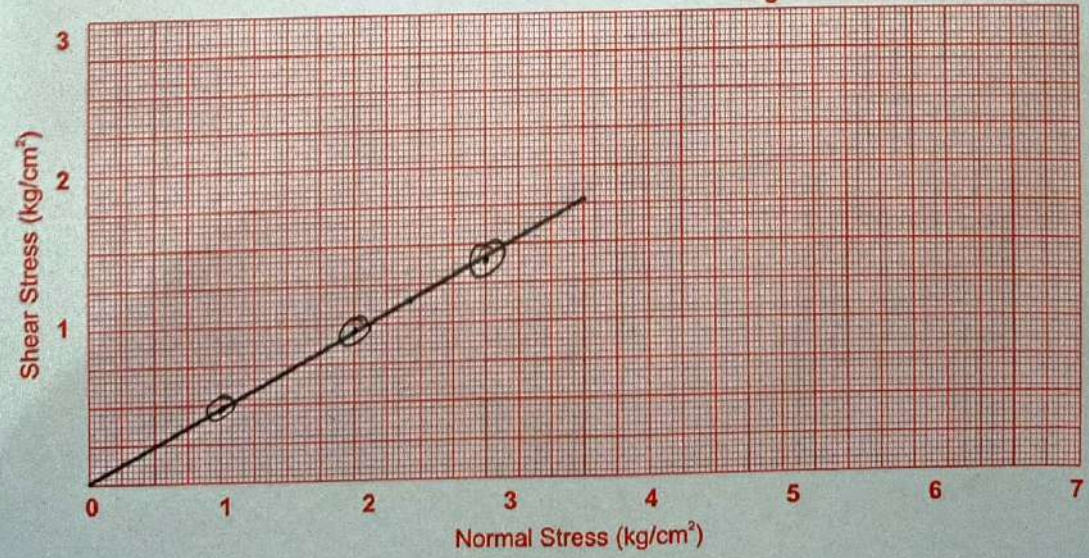
B.H. No. :- 01
Depth :- 4.00 - 4.35

Cohesion 'c' 0.20 Kg/cm²
Angle of Internal Friction 14° *



B.H. No. :- 01
Depth :- 7.00 - 7.35

Cohesion 'c' 0 Kg/cm²
Angle of Internal Friction 28° *



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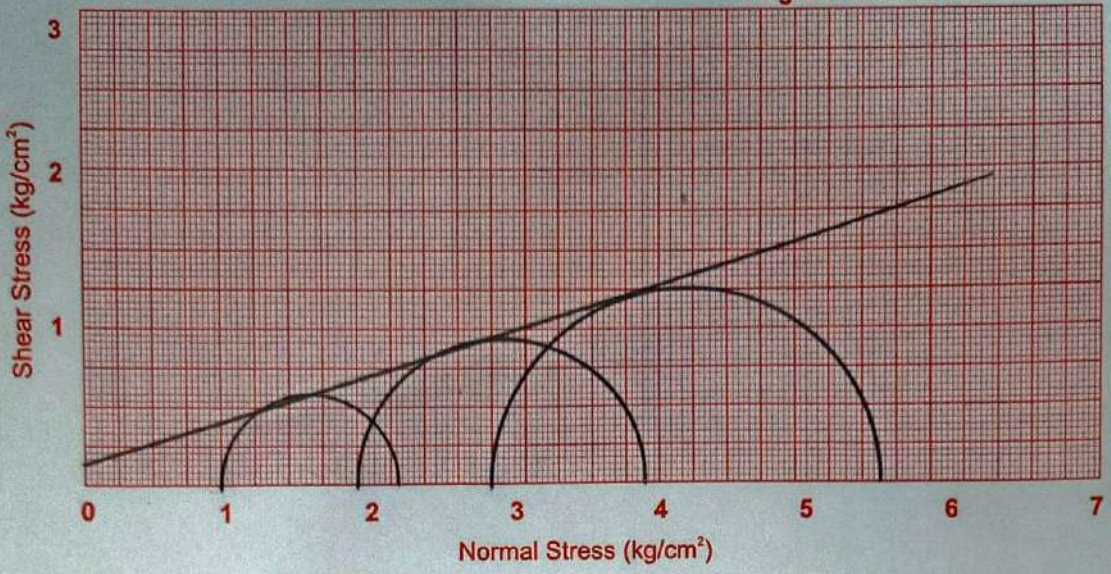
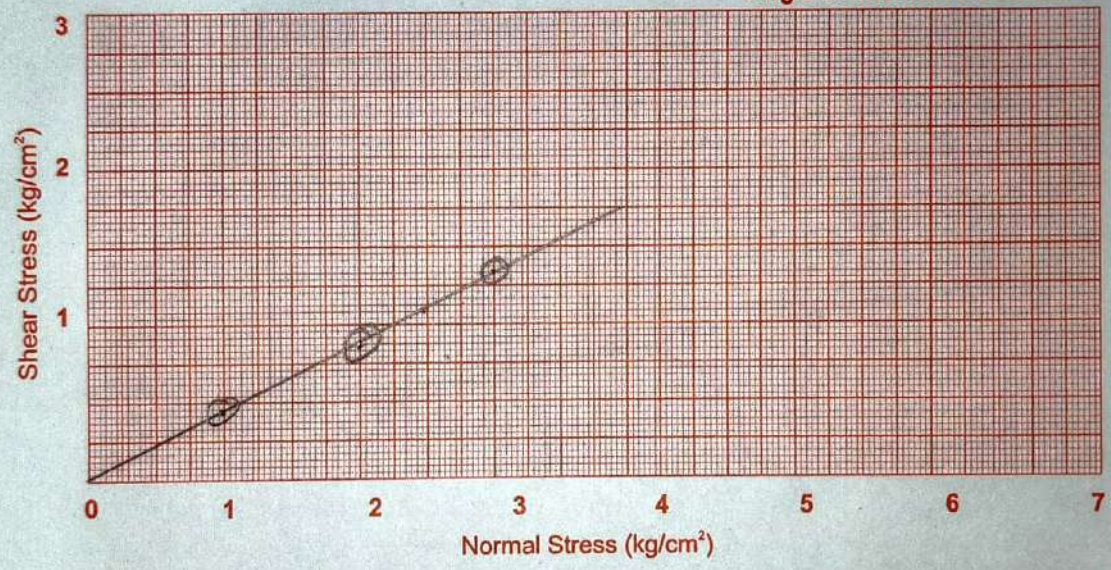
B.H. No. :- 02
Depth - 1.00 - 1.35

Cohesion 'c' 0.10 Kg/cm²
Angle of Internal Friction 17° *



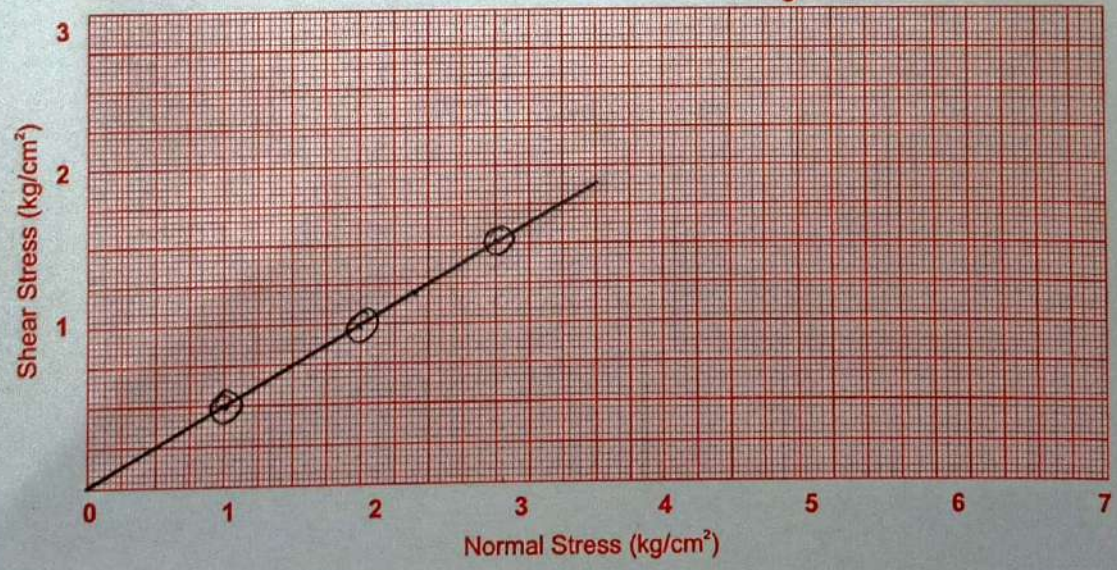
B.H. No. :- 02
Depth :- 4.00 - 4.35

Cohesion 'c' 0 Kg/cm²
Angle of Internal Friction 27° *



B.H. No. :- 02
Depth :- 7.00 - 7.35

Cohesion 'c' 0 Kg/cm²
Angle of Internal Friction 30° *



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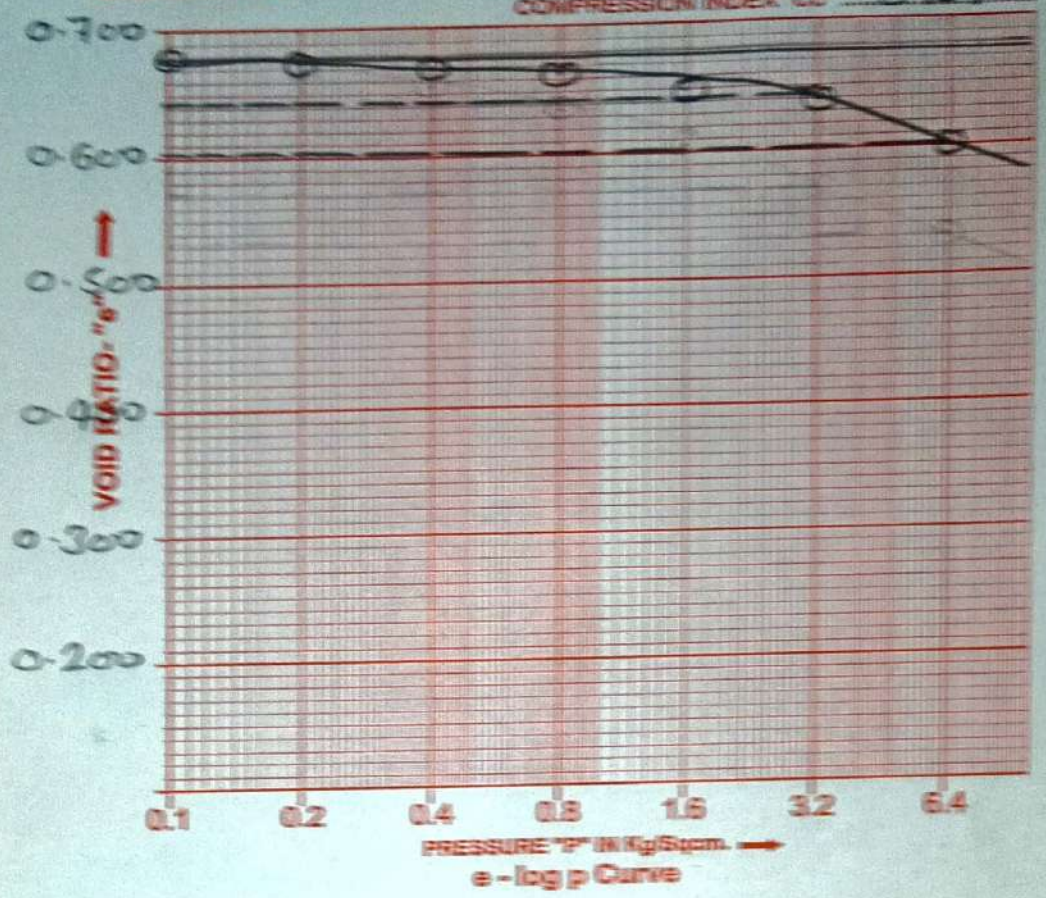
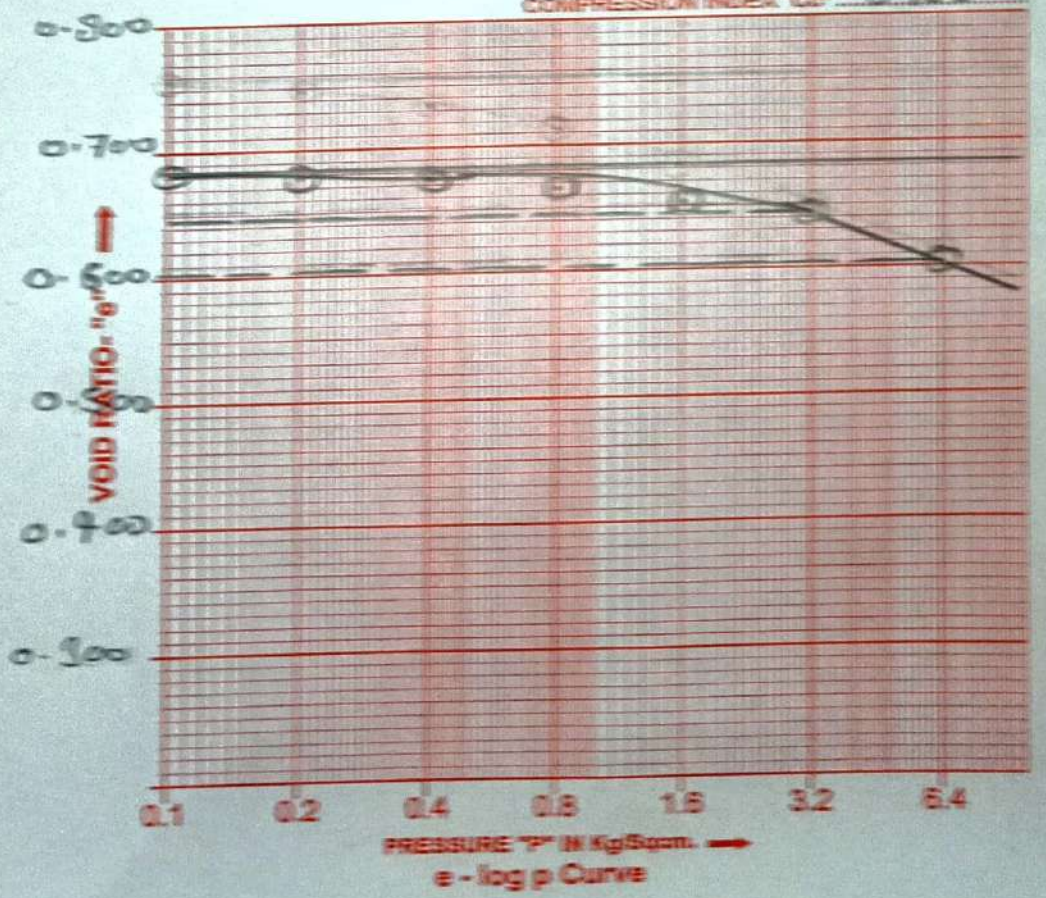
BORE HOLE NO. 01
DEPTH 1.00 - 1.65
COMPRESSION INDEX 'Cc' 0.134



e - log p Curve

BORE HOLE NO. 01
DEPTH 4.00 - 4.35
COMPRESSION INDEX 'Cc' 0.170



e - log p Curve

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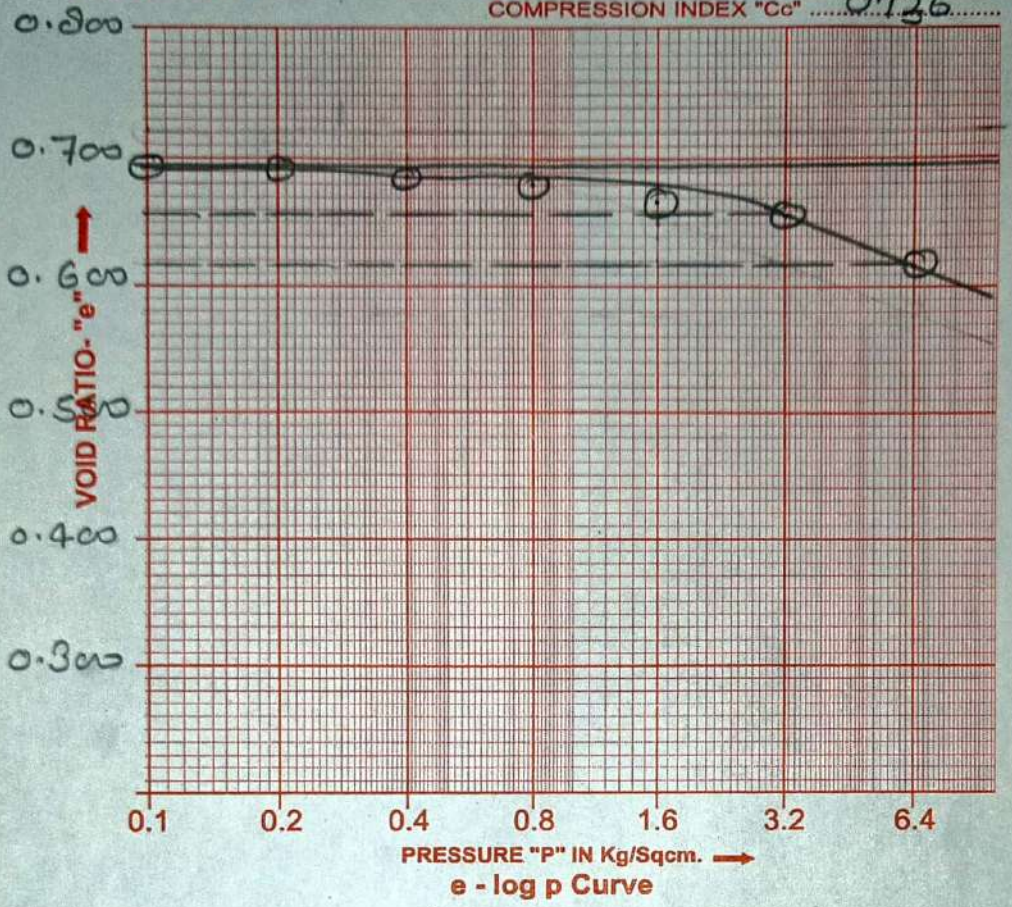
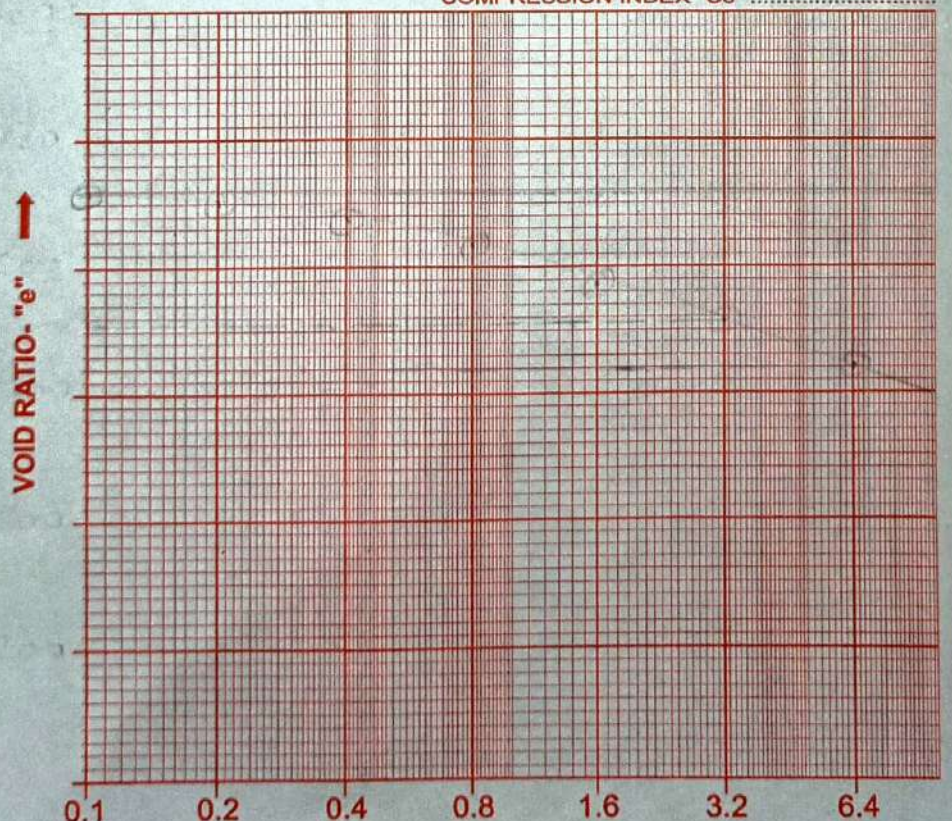
BORE HOLE NO. 9
DEPTH 1.00 - 1.35
COMPRESSION INDEX "Cc" 0.126



e - log p Curve

BORE HOLE NO.
DEPTH
COMPRESSION INDEX "Cc"



e - log p Curve

Scanned with CamScanner

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TC-8969

REPORT NO. – VMT 133 A/2023-2024

GEOTECH INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT VILLAGE SIDE (GORAIPARA OPP.)IN WEST BENGAL

Prepared By -

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ACKNOWLEDGEMENT

WE ARE GRATEFUL TO M/s KITCO LTD., KERLA FOR PROVIDING US THE OPPORTUNITY TO CARRY OUT THESE INVESTIGATIONS.

THE CO-OPERATION EXTENDED BY THEIR ENGINEERS DURING FIELD INVESTIGATIONS IS THANKFULLY ACKNOWLEDGED.

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SUB-SOIL INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT VILLAGE SIDE IN WEST BENGAL

INTRODUCTION

The work of sub-soil exploration was awarded to us by M/s KITCO LTD., KERLA Order no. – 6777:DP 1083: RG: 2023 dated 21/03/2023. The object of the investigation was to study the geo-technical properties of soil both in field and laboratory and determine safe allowable pressure for the foundation soil.

The fieldwork consisted of 02 bore holes of 10.00 metre depth each. The fieldwork was conducted on 18/04/2023. The location of the bore holes is shown in the Site location.

REFERENCES

1. **IS: 1892-2021** for field work including existent ground water table.
2. **IS: 2132-1986** for sampling in Undisturbed and Disturbed form.
3. **IS: 2131-1981** for Standard Penetration Test.
4. **IS: 2720** for all laboratory tests on soil samples collected.
5. **IS: 6403-1981** for determination of Bearing Capacity.
6. **IS: 8009(Part I)-1976** for calculation of settlement of foundations.
7. **IS: 1904-2021** for permissible maximum settlement, differential settlement and angular distortion.

SCOPE OF WORK

The scope consisted of drilling of boreholes down to maximum depth of 10.00 m in normal soils / rock, Standard Penetration Testing, collection of samples, laboratory testing and preparation and submission of Geotechnical Investigation report.

Summary of the fieldwork					
Sl. No.	Site	Borehole Nos.	Coordinates		Depth below existing ground level (m)
			Latitude	Longitude	
1.	GORAIPARA FERRY GHAT VILLAGE SIDE	BH-01 (RHS)	24.8051423	87.9049081	10.0
2.		BH-02 (RHS)	24.80510304	87.90486351	10.0

SITE LOCATION

INTERPRETATION OF THE LAB TEST RESULTS

GENERAL NATURE OF SOIL STRATA

The bore hole log charts and lab test results of bore holes 1 and 2 indicate that the strata at the site is found to comprise of cohesive soil.

The results of classification tests indicate that the natural soil stratum present at the Site is found to comprise of both fine-grained soils comprising of 'CL' and 'CI' group of IS classification (clayey soil) having 95 to 99 percent material finer than 75 micron.

The bore hole log charts and lab test results of bore holes 1 indicate that:

first strata, from 0.00 metre to 4.00 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 4.00 metre to 10.00 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity.

The bore hole log charts and lab test results of bore holes 2 indicate that:

first strata, from 0.00 metre to 4.00 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 4.00 metre to 10.00 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity.

S.P.T. VALUES

The S.P.T. values obtained in the respective clayey layer region present as per bore-log charts enclosed are found to range 4 to 22 indicating 'Soft' to 'Very Stiff' consistency.

The results of S.P.T. values indicate that the stratum at the Site is 'Loose' to 'Well' compacted.

WATER TABLE

Water Table at the Site was observed at a depth from 2.00 metre to 4.50 metre below ground level on the day of soil investigation during the Third week of April 2023. However, the existing water table may rise by 1.00 metre in the post-monsoon period in general. Therefore, a water table at a depth of 1.00 metre to 3.50 metre below ground level has been adopted for calculation purposes.

RECOMMENDATIONS FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT VILLAGE SIDE IN WEST BENGAL

NET SAFE BEARING CAPACITY/SAFE ALLOWABLE PRESSURE

Bore Hole Nos.	Type of Structure	Depth of Foundation (metres)	Size of Footing (L x B) (metres)	Net Safe Bearing Capacity (Tonne/sqm.)	Settlement Produced (mm)	Safe Allowable Pressure for Permissible Settlement 50 mm (Tonne/sqm.)
1	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	10.34	35.44	-
		2.00	1.20 x 1.20	11.24	35.65	-
		2.50	1.20 x 1.20	8.81	26.07	-
		1.50	2.00 x 2.00	9.63	47.78	-
		2.00	2.00 x 2.00	10.17	47.48	-
		2.50	2.00 x 2.00	7.84	34.64	-
		1.50	2.50 x 2.50	9.40	55.58	8.16
		2.00	2.50 x 2.50	9.94	51.83	9.47
		2.50	2.50 x 2.50	7.59	40.46	-
2	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	12.56	37.29	-
		2.00	1.20 x 1.20	14.36	35.95	-
		2.50	1.20 x 1.20	16.19	33.83	-
		1.50	2.00 x 2.00	11.85	49.95	-
		2.00	2.00 x 2.00	13.12	47.53	-
		2.50	2.00 x 2.00	14.35	44.05	-
		1.50	2.50 x 2.50	11.63	57.22	9.68
		2.00	2.50 x 2.50	12.76	51.56	12.24
		2.50	2.50 x 2.50	13.84	51.23	13.40

NOTE: -

The above recommendations are based on the field investigation data results and the laboratory tests results of the samples collected from the test locations and our experience in this regard. If the actual sub-soil conditions during excavation for the

foundations differ from that has been reported, a reference should be made to us for suggestions.

Further, the recommendations are based on the assumptions as mentioned in the Report and the designer of the Structure should take into consideration all the factors required as per codes. The recommendations should be taken as guidelines for the designer.

Er. Akhil Singh
TECHNICAL MANAGER
VIVEK MATERIAL TESTING LABORATORY

Shubham Singh
Dy. TECHNICAL MANAGER/ QUALITY MANAGER
VIVEK MATERIAL TESTING LAORATORY

BEARING CAPACITY CALCULATIONS

Soil when stressed due to loading, tend to deform. The resistance to deformation of the soil depends upon factors like water content, bulk density, angle of internal friction and the manner in which load is applied on the soil. The maximum load per unit area which the soil or rock can carry without yielding or displacement is termed as the bearing capacity of soils. The Safe Bearing Capacity of the proposed STRUCTURE without any distress is determined from the considerations of the following criteria.

[A] SHEAR CRITERIA

The soil beneath the foundation shall be safe from risk of shear failure.

[B] SETTLEMENT CRITERIA

The settlement due to load is caused basically on account of two factors, namely,

(i) the soil below footing gets compressed by certain amount and

(ii) since the foundations cover only a limited area there is a possibility that the concentrated stresses developed are so high as to cause actual rupture (shear failure) and displacement of soil below.

The foundation should not settle or deflect to an extent causing damage to the Structure or impair its usefulness.

The Bearing Capacity Calculations for the Foundation shall be governed as per IS: 6403-1981, IS: 8009(Part-I)-1976 and IS: 1904-2021 on the basis of available information regarding the proposed design.

BEARING CAPACITY ON SHEAR CONSIDERATIONS

ULTIMATE NET BEARING CAPACITY

As per IS: 6403-1981, the Ultimate Net Bearing Capacity 'qd' on shear consideration for a Structure is given by the formula: -

FOR GENERAL SHEAR FAILURE

qd = c.Nc.Sc.dc.ic+q(Nq-1).sq.dq.iq + 1/2 B.r.Nr.Sr.dr.ir.W'.

FOR LOCAL SHEAR FAILURE

q'd = 2/3 c.N'c.Sc.dc.ic+q(N'q-1).Sq.dq.iq + 1/2 B.r.N'r.Sr.dr.ir.W'.

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BEARING CAPACITY CALCULATION

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT								
BOREHOLE 01 (R.H.S.)	Depth of borehole	10.00	metre	Water table below borehole level (m)	2.00		Factor of safety	2.50
				Water table used for calculation (m)	1.00		Assumed post monsoon rise (m)	1.00

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Input Parameters														Shearing Resistance Parameters																Ultimate Net Bearing Capacity			
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors							Inclination Factors			General shear	Local shear	Intermediate	Net Safe Bearing Capacity
					Bulk		Bulk		c	Ø	Ø'	e	q	Nc	Nq	Nγ	Nc'	Nq'	Nγ'	Sc	Sq	Sγ	Dc	Dq	Dγ	Dc'	Dq'	Dγ'	Ic	Iq	Iγ				
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																			kN/m2	kN/m2	kN/m2	kN/m2
1	SQUARE	1.50	1.20	1.20	1.82	14.58	1.82	14.58	0.25	9	6.06	0.690	21.87	7.89	2.25	1.03	6.78	1.72	0.58	1.30	1.20	0.80	1.29	1.00	1.00	1.29	1.00	1.00	1.00	1.00	1.00	361.62	207.22	253.54	**101.42**
2	SQUARE	2.00	1.20	1.20	1.82	12.95	1.86	13.34	0.25	9	6.06	0.690	25.89	7.89	2.25	1.03	6.78	1.72	0.58	1.30	1.20	0.80	1.39	1.00	1.00	1.39	1.00	1.00	1.00	1.00	1.00	392.90	225.16	275.48	**110.19**
3	SQUARE	2.50	1.20	1.20	1.82	11.96	1.86	12.36	0.15	11	7.42	0.712	29.91	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.51	1.25	1.25	1.51	1.25	1.25	1.00	1.00	1.00	338.72	187.18	215.97	**86.39**
4	SQUARE	1.50	2.00	2.00	1.82	14.58	1.82	14.58	0.25	9	6.06	0.690	21.87	7.89	2.25	1.03	6.78	1.72	0.58	1.30	1.20	0.80	1.18	1.00	1.00	1.18	1.00	1.00	1.00	1.00	1.00	336.90	193.03	236.19	**94.48**
5	SQUARE	2.00	2.00	2.00	1.82	12.95	1.86	13.34	0.25	9	6.06	0.690	25.89	7.89	2.25	1.03	6.78	1.72	0.58	1.30	1.20	0.80	1.23	1.00	1.00	1.23	1.00	1.00	1.00	1.00	1.00	355.67	203.80	249.36	**99.74**
6	SQUARE	2.50	2.00	2.00	1.82	11.96	1.86	12.36	0.15	11	7.42	0.712	29.91	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	301.44	166.50	192.14	**76.86**
7	SQUARE	1.50	2.50	2.50	1.82	14.58	1.82	14.58	0.25	9	6.06	0.690	21.87	7.89	2.25	1.03	6.78	1.72	0.58	1.30	1.20	0.80	1.14	1.00	1.00	1.14	1.00	1.00	1.00	1.00	1.00	328.68	188.31	230.42	**92.17**
8	SQUARE	2.00	2.50	2.50	1.82	12.95	1.86	13.34	0.25	9	6.06	0.690	25.89	7.89	2.25	1.03	6.78	1.72	0.58	1.30	1.20	0.80	1.19	1.00	1.00	1.19	1.00	1.00	1.00	1.00	1.00	347.49	199.10	243.62	**97.45**
9	SQUARE	2.50	2.50	2.50	1.82	11.96	1.86	12.36	0.15	11	7.42	0.712	29.91	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	292.13	161.30	186.16	**74.46**

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SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	101.42	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.86	0.712	0.137	0.00	38.00	38.41	-	-	36.412	-	35.44
3	3	CLAY	3.00	4.00	1.00	1.91	0.686	0.130	0.00	53.69	14.26	-	-	7.888	-	

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SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	110.19	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.00	Depth of foundation						35.65
2	2	CLAY	2.00	3.50	1.50	1.86	0.712	0.137	0.00	42.02	41.73	-	-	35.951	-	
3	3	CLAY	3.50	4.50	1.00	1.91	0.686	0.130	0.00	52.81	15.50	-	-	8.616	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	86.39	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.86	0.000	0.000	0.00	Depth of foundation						26.07
2	2	CLAY	2.50	4.00	1.50	1.91	0.686	0.130	0.00	47.39	32.72	-	-	26.366	-	
3	3	CLAY	4.00	5.00	1.00	1.97	0.613	0.123	0.00	58.84	12.15	-	-	6.216	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	94.48	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.86	0.712	0.137	0.00	38.00	49.97	-	-	43.759	-	47.78
3	3	CLAY	3.00	4.50	1.50	1.91	0.686	0.130	0.00	55.92	20.92	-	-	15.964	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	99.74	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.00	Depth of foundation						47.48
2	2	CLAY	2.00	3.50	1.50	1.86	0.712	0.137	0.00	42.02	52.76	-	-	42.399	-	
3	3	CLAY	3.50	5.00	1.50	1.91	0.686	0.130	0.00	55.04	22.09	-	-	16.947	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	76.86	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.86	0.000	0.000	0.00	Depth of foundation						34.64
2	2	CLAY	2.50	4.00	1.50	1.91	0.686	0.130	0.00	47.39	40.65	-	-	31.112	-	
3	3	CLAY	4.00	5.50	1.50	1.97	0.613	0.123	0.00	61.22	17.02	-	-	12.186	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	92.17	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	0.000	0.000	0.00	Depth of foundation						55.58
2	2	CLAY	1.50	3.50	2.00	1.86	0.712	0.137	0.00	40.81	47.03	-	-	53.279	-	
3	3	CLAY	3.50	5.25	1.75	1.91	0.686	0.130	0.00	62.66	19.94	-	-	16.191	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	80.05	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	1.50	3.50	2.00	1.86	0.712	0.137	0.00	40.81	40.84	-	-	48.205	-	50.00
3	3	CLAY	3.50	5.25	1.75	1.91	0.686	0.130	0.00	62.66	17.32	-	-	14.300	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	97.45	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.86	0.000	0.000	0.00	Depth of foundation						51.83
2	2	CLAY	2.00	4.00	2.00	1.91	0.686	0.130	0.00	45.41	49.72	-	-	49.530	-	
3	3	CLAY	4.00	5.50	1.50	1.97	0.613	0.123	0.00	61.47	22.10	-	-	15.257	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	92.87	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.86	0.000	0.000	0.000	Depth of foundation						
2	2	CLAY	2.00	4.00	2.00	1.91	0.686	0.130	0.000	45.41	47.38	-	-	47.864	-	50.00
3	3	CLAY	4.00	5.50	1.50	1.97	0.613	0.123	0.000	61.47	21.06	-	-	14.635	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	74.46	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.86	0.000	0.000	0.00	Depth of foundation						40.46
2	2	CLAY	2.50	4.50	2.00	1.91	0.686	0.130	0.00	49.62	37.99	-	-	38.072	-	
3	3	CLAY	4.50	6.25	1.75	1.97	0.613	0.123	0.00	66.87	16.11	-	-	12.508	-	

VIVEK MATERIAL TESTING LABORATORY

BEARING CAPACITY CALCULATION

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT								
BOREHOLE 02 (R.H.S.)	Depth of borehole	10.00	metre	Water table below borehole level (m)	4.50		Factor of safety	2.50
				Water table used for calculation (m)	3.50		Assumed post monsoon rise (m)	1.00

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Input Parameters														Shearing Resistance Parameters																Ultimate Net Bearing Capacity			Net Safe Bearing Capacity
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	
					Bulk		Bulk		c	Ø	Ø'	e	q	Nc	Nq	Nγ	Nc'	Nq'	Nγ'	Sc	Sq	Sγ	Dc	Dq	Dγ	Dc'	Dq'	Dγ'	Ic	Iq	Iγ				
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																			kN/m2	kN/m2	kN/m2	kN/m2
1	SQUARE	1.50	1.20	1.20	1.80	17.65	1.80	17.65	0.20	13	8.79	0.671	26.48	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.31	1.16	1.16	1.31	1.16	1.16	1.00	1.00	1.00	429.68	228.47	307.95	**123.18**
2	SQUARE	2.00	1.20	1.20	1.80	17.65	1.87	18.34	0.20	13	8.79	0.671	35.31	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.42	1.21	1.21	1.42	1.21	1.21	1.00	1.00	1.00	491.31	261.33	352.17	**140.87**
3	SQUARE	2.50	1.20	1.20	1.80	17.65	1.87	18.34	0.25	10	6.74	0.650	44.13	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.50	1.25	1.25	1.50	1.25	1.25	1.00	1.00	1.00	508.34	285.77	397.06	**158.82**
4	SQUARE	1.50	2.00	2.00	1.80	17.65	1.80	17.65	0.20	13	8.79	0.671	26.48	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.19	1.09	1.09	1.19	1.09	1.09	1.00	1.00	1.00	405.65	215.33	290.51	**116.20**
5	SQUARE	2.00	2.00	2.00	1.80	17.65	1.87	18.34	0.20	13	8.79	0.671	35.31	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.25	1.13	1.13	1.25	1.13	1.13	1.00	1.00	1.00	448.81	238.45	321.54	**128.62**
6	SQUARE	2.50	2.00	2.00	1.80	17.65	1.87	18.34	0.25	10	6.74	0.650	44.13	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	450.53	253.22	351.88	**140.75**
7	SQUARE	1.50	2.50	2.50	1.80	17.65	1.80	17.65	0.20	13	8.79	0.671	26.48	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.15	1.08	1.08	1.15	1.08	1.08	1.00	1.00	1.00	398.43	211.38	285.26	**114.10**
8	SQUARE	2.00	2.50	2.50	1.80	17.65	1.87	18.34	0.20	13	8.79	0.671	35.31	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	436.67	231.88	312.77	**125.11**
9	SQUARE	2.50	2.50	2.50	1.80	17.65	1.87	18.34	0.25	10	6.74	0.650	44.13	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	434.35	244.09	339.22	**135.69**

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	123.18	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.87	0.650	0.127	0.00	40.23	46.65	-	-	38.601	-	37.29
3	3	CLAY	3.00	4.00	1.00	1.93	0.636	0.125	0.00	63.45	17.32	-	-	8.009	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	140.87	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.80	0.000	0.000	0.00	Depth of foundation						35.95
2	2	CLAY	2.00	3.50	1.50	1.87	0.650	0.127	0.00	49.06	53.35	-	-	36.900	-	
3	3	CLAY	3.50	4.50	1.00	1.93	0.636	0.125	0.00	72.28	19.81	-	-	8.038	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	158.82	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						33.83
2	2	CLAY	2.50	4.00	1.50	1.93	0.636	0.125	0.00	60.04	60.14	-	-	34.543	-	
3	3	CLAY	4.00	5.00	1.00	1.99	0.596	0.120	0.00	83.51	22.33	-	-	7.739	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	116.20	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	-	-	-	Depth of foundation						49.95
2	2	CLAY	1.50	3.00	1.50	1.87	0.650	0.127	0.00	40.23	61.46	-	-	46.495	-	
3	3	CLAY	3.00	4.50	1.50	1.93	0.636	0.125	0.00	68.18	25.73	-	-	15.938	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	128.62	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.80	0.000	0.000	0.00	Depth of foundation						47.53
2	2	CLAY	2.00	3.50	1.50	1.87	0.650	0.127	0.00	49.06	68.03	-	-	43.618	-	
3	3	CLAY	3.50	5.00	1.50	1.93	0.636	0.125	0.00	76.27	28.48	-	-	15.794	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	140.75	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						44.05
2	2	CLAY	2.50	4.00	1.50	1.93	0.636	0.125	0.00	60.04	74.45	-	-	40.139	-	
3	3	CLAY	4.00	5.50	1.50	1.99	0.596	0.120	0.00	87.54	31.17	-	-	14.919	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	114.10	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	0.000	0.000	0.00	Depth of foundation						57.22
2	2	CLAY	1.50	3.50	2.00	1.87	0.650	0.127	0.00	44.82	58.21	-	-	55.652	-	
3	3	CLAY	3.50	5.25	1.75	1.93	0.636	0.125	0.00	78.49	24.68	-	-	15.878	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	94.98	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	1.50	3.50	2.00	1.87	0.650	0.127	0.00	44.82	48.46	-	-	49.002	-	50.00
3	3	CLAY	3.50	5.25	1.75	1.93	0.636	0.125	0.00	78.49	20.55	-	-	13.502	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	125.11	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.87	0.000	0.000	0.00	Depth of foundation						51.56
2	2	CLAY	2.00	4.00	2.00	1.93	0.636	0.125	0.00	55.61	63.83	-	-	50.737	-	
3	3	CLAY	4.00	5.50	1.50	1.99	0.596	0.120	0.00	87.83	28.37	-	-	13.710	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	120.04	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.87	0.000	0.000	0.000	Depth of foundation						50.00
2	2	CLAY	2.00	4.00	2.00	1.93	0.636	0.125	0.000	55.61	61.24	-	-	49.284	-	
3	3	CLAY	4.00	5.50	1.50	1.99	0.596	0.120	0.000	87.83	27.22	-	-	13.223	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	135.69	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						51.23
2	2	CLAY	2.50	4.50	2.00	1.93	0.636	0.125	0.00	64.78	69.23	-	-	48.244	-	
3	3	CLAY	4.50	6.25	1.75	1.99	0.596	0.120	0.00	92.20	29.35	-	-	15.795	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

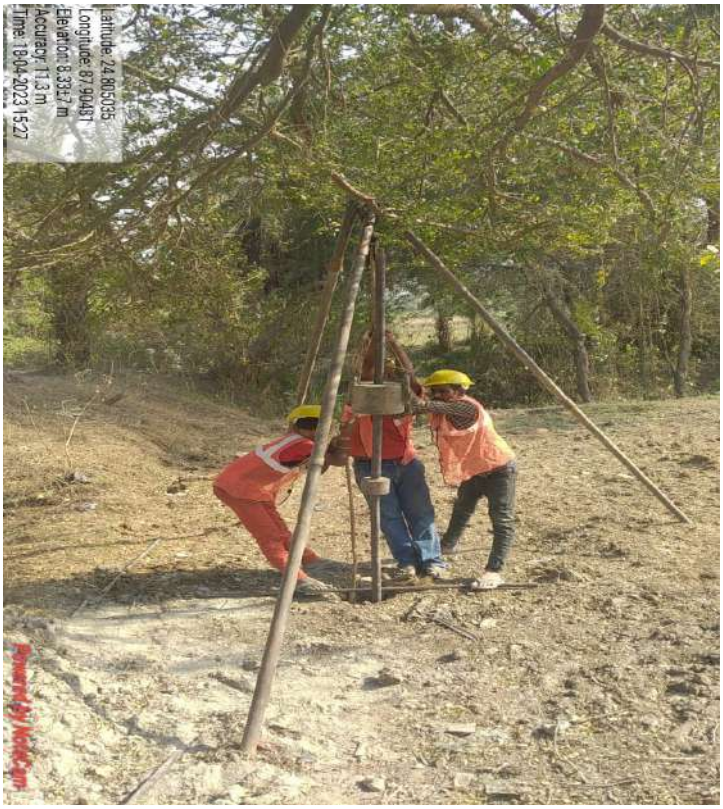
CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	4.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	131.38	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.000	Depth of foundation						
2	2	CLAY	2.50	4.50	2.00	1.93	0.636	0.125	0.000	64.78	67.03	-	-	47.146	-	50.00
3	3	CLAY	4.50	6.25	1.75	1.99	0.596	0.120	0.000	92.20	28.42	-	-	15.355	-	

SITE PHOTOS DURING SITE INVESTIGATION



RESULT SHEET

NAME OF THE PROJECT	**CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT VILLAGE SIDE IN WEST BENGAL**																						
Client Name																							
Bore Hole No.	**1 (R.H.S.)**		**Coordinate**	**Easting**					**Depth of Water Level**			2.00		**VIVEK MATERIAL TESTING LABORATORY**									
Total depth of Bore Hole	**10.00**			**Northing**					**Commenced on**			4/18/2023											
				Elevation	**100.000**				**Completed on**			4/18/2023											

Depth of Bore Hole	**Reduced Level**	**Types of Samples**	**% Material Passing IS Sieve**				**Atterberg Limits**			**IS group symbol**	**SPT Value**	**SPT Value corrected due to overburden**	**SPT Value corrected due to dilatancy**	**Wet Bulk Density**	**Original Moisture**	**Dry Bulk Density**	**Specific Gravity**	**Void Ratio**	**Shear Characterisitics**		**Compression Index**
			4.750	**2.000**	**0.425**	**0.075**	**LL**	**PL**	**PI**										**Cohesion**	**Angle of Internal Friction**	
metre	**metre**		**(mm)**	**(mm)**	**(mm)**	**(mm)**	**%**	**%**	**%**		**N**	**N'**	**N"**	**(gms/cc)**	**%**	**(gms/cc)**	**(G)**		**(Kg/sqcm)**	**(Ø)**	**(Cc)**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
0.00 - 0.50	100.000 - 99.500	DS	100	100	100	99	33	23	10	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	100	99	96	29	18	11	CL				1.82	17.1	1.55	2.62	0.690	0.25	9°	0.135
1.35 - 1.80	98.650 - 98.200	SPT									6	8.20	8.20								
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	99	33	22	11	CL				1.86	21.8	1.53	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									4	5.69	5.69								
4.00 - 4.35	96.000 - 95.650	UD	100	98	97	96	37	26	11	CI				1.91	22.5	1.56	2.63	0.686	0.15	12°	0.130
4.35 - 4.80	95.650 - 95.200	SPT									7	9.01	9.01								
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	99	39	25	14	CI				1.97	20.9	1.63	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									12	14.23	14.23								
7.00 - 7.35	93.000 - 92.650	UD	100	100	100	97	38	26	12	CI				1.96	18.5	1.65	2.62	0.588	0.30	12°	0.123
7.35 - 7.80	92.650 - 92.200	SPT									15	16.64	15.82								
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	99	40	22	18	CI				1.95	16.8	1.67	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									18	18.85	16.93								
9.30 - 10.00	90.700 - 90.000	DS	100	100	100	99	41	21	20	CI					-	-	-	-	-	-	-

RESULT SHEET

NAME OF THE PROJECT	**CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT VILLAGE SIDE IN WEST BENGAL**																						
Client Name																							
Bore Hole No.	**2 (R.H.S.)**		**Coordinate**	**Easting**							**Depth of Water Level**			4.50		**VIVEK MATERIAL TESTING LABORATORY**							
Total depth of Bore Hole	**10.00**			**Northing**							**Commenced on**			4/18/2023									
				Elevation			**100.000**				**Completed on**			4/18/2023									

Depth of Bore Hole	**Reduced Level**	**Types of Samples**	**% Material Passing IS Sieve**				**Atterberg Limits**			**IS group symbol**	**SPT Value**	**SPT Value corrected due to overburden**	**SPT Value corrected due to dilatancy**	**Wet Bulk Density**	**Original Moisture**	**Dry Bulk Density**	**Specific Gravity**	**Void Ratio**	**Shear Characterisitics**		**Compression Index**
			4.750	**2.000**	**0.425**	**0.075**	**LL**	**PL**	**PI**										**Cohesion**	**Angle of Internal Friction**	
metre	metre		(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N"	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(Ø)	(Cc)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0.00 - 0.50	100.000 - 99.500	DS	100	100	100	97	30	21	9	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	98	97	96	29	17	12	CL				1.80	13.7	1.58	2.64	0.671	0.20	13°	0.127
1.35 - 1.80	98.650 - 98.200	SPT									8	10.96	10.96								
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	95	28	15	13	CL				1.87	16.8	1.60	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									10	11.60	11.60								
4.00 - 4.35	96.000 - 95.650	UD	100	100	98	96	39	22	17	CI				1.93	19.3	1.62	2.65	0.636	0.30	13°	0.125
4.35 - 4.80	95.650 - 95.200	SPT									12	15.43	15.22								
5.50 - 5.85	94.500 - 94.150	UD	100	100	99	98	42	22	20	CI				1.99	20.1	1.66	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									15	17.74	16.37								
7.00 - 7.35	93.000 - 92.650	UD	100	100	99	97	40	22	18	CI				1.99	18.6	1.68	2.66	0.583	0.25	14°	0.117
7.35 - 7.80	92.650 - 92.200	SPT									19	20.98	17.99								
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	98	39	23	16	CI				1.98	16.5	1.70	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									22	22.91	18.96								
9.30 - 10.00	90.700 - 90.000	DS	100	100	100	99	38	20	18	CI					-	-	-	-	-	-	-

BORE-LOG CHART

VMT
GEOTECH & MATERIAL TESTING

VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT VILLAGE SIDE IN WEST BENGAL

WATER TABLE 2.00 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 01 (R.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES
			GROUP	HATCHING	N1	N2	N3	N2+N3	10 20 30 40 50 60 70 80 90 100
0.00-0.50	SILTY-CLAY	D.	CL						
1.00-1.35	SILTY-CLAY	U.D.	CL						
1.35-1.80		S.P.T.			2	3	3	6	
2.50-2.85	SILTY-CLAY	U.D.	CL						
2.85-3.30		S.P.T.			1	2	2	4	
4.00-4.35	SILTY-CLAY	U.D.	CI						
4.35-4.80		S.P.T.			3	3	4	7	
5.50-5.85	SILTY-CLAY	U.D.	CI						
5.85-6.30		S.P.T.			4	5	7	12	
7.00-7.35	SILTY-CLAY	U.D.	CI						
7.35-7.80		S.P.T.			5	7	8	15	
8.50-8.85	SILTY-CLAY	U.D.	CI						
8.85-9.30		S.P.T.			6	8	10	18	
9.30-10.00	SILTY-CLAY	D.	CI						

BORE-LOG CHART

VMT
GEOTECH & MATERIAL TESTING

VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT VILLAGE SIDE IN WEST BENGAL

WATER TABLE 4.50 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 02 (R.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES
			GROUP	HATCHING	N1	N2	N3	N2+N3	10 20 30 40 50 60 70 80 90 100
0.00-0.50	SILTY-CLAY	D.	CL						
1.00-1.35	SILTY-CLAY	U.D.	CL						
1.35-1.80		S.P.T.			2	3	5	8	
2.50-2.85	SILTY-CLAY	U.D.	CL						
2.85-3.30		S.P.T.			3	4	6	10	
4.00-4.35	SILTY-CLAY	U.D.	CI						
4.35-4.80		S.P.T.			4	5	7	12	
5.50-5.85	SILTY-CLAY	U.D.	CI						
5.85-6.30		S.P.T.			5	7	8	15	
7.00-7.35	SILTY-CLAY	U.D.	CI						
7.35-7.80		S.P.T.			6	8	11	19	
8.50-8.85	SILTY-CLAY	U.D.	CI						
8.85-9.30		S.P.T.			7	10	12	22	
9.30-10.00	SILTY-CLAY	D.	CI						

VMT/133/23-24 (R.H.S.) W.B.

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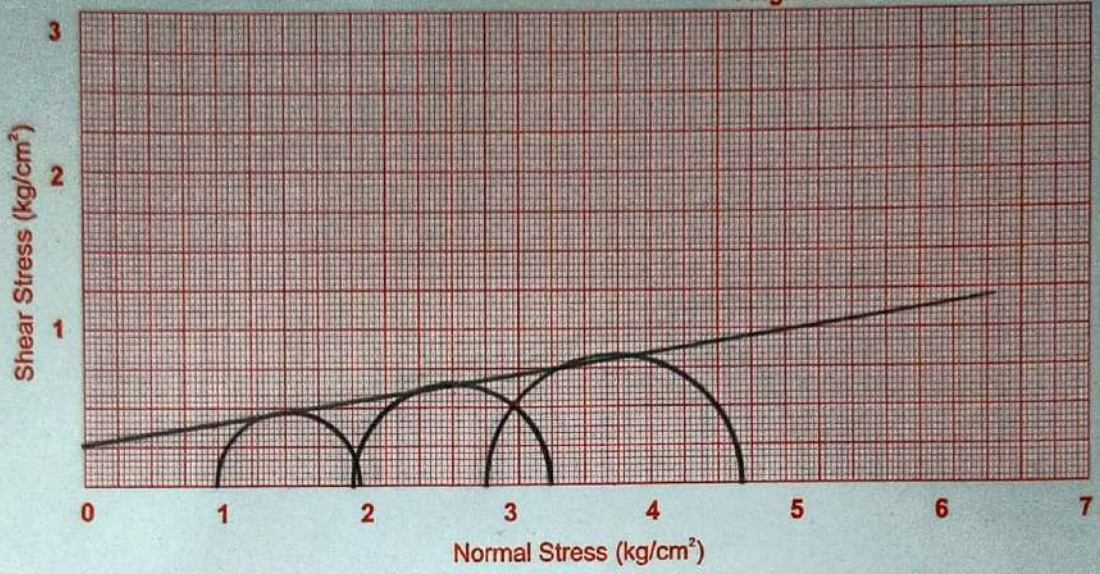
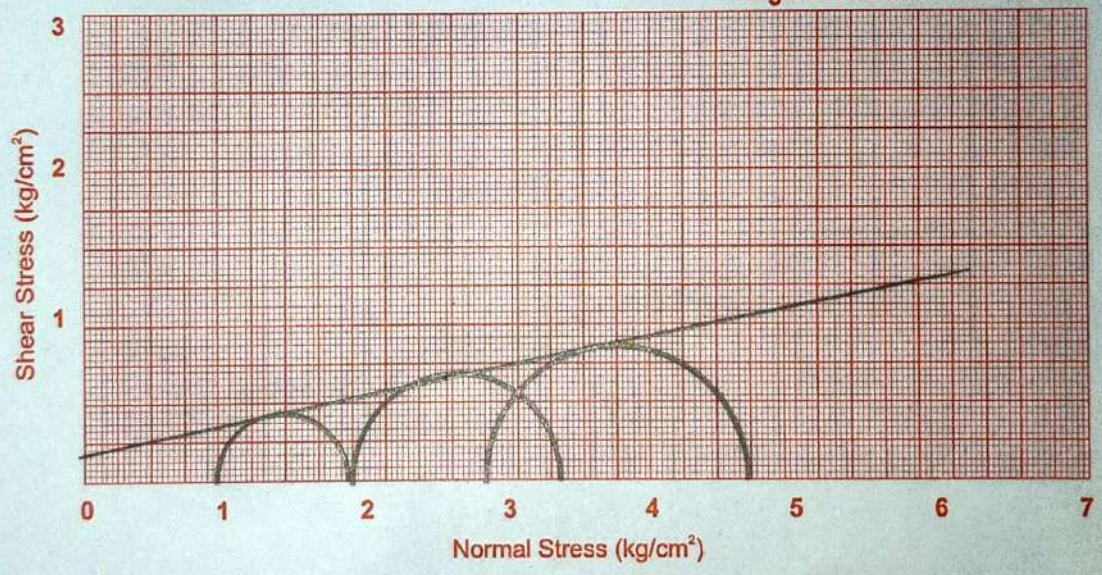
B.H. No. :- 01
Depth - 1.00 - 1.35

Cohesion 'c' 0.25 Kg/cm²
Angle of Internal Friction 9° *



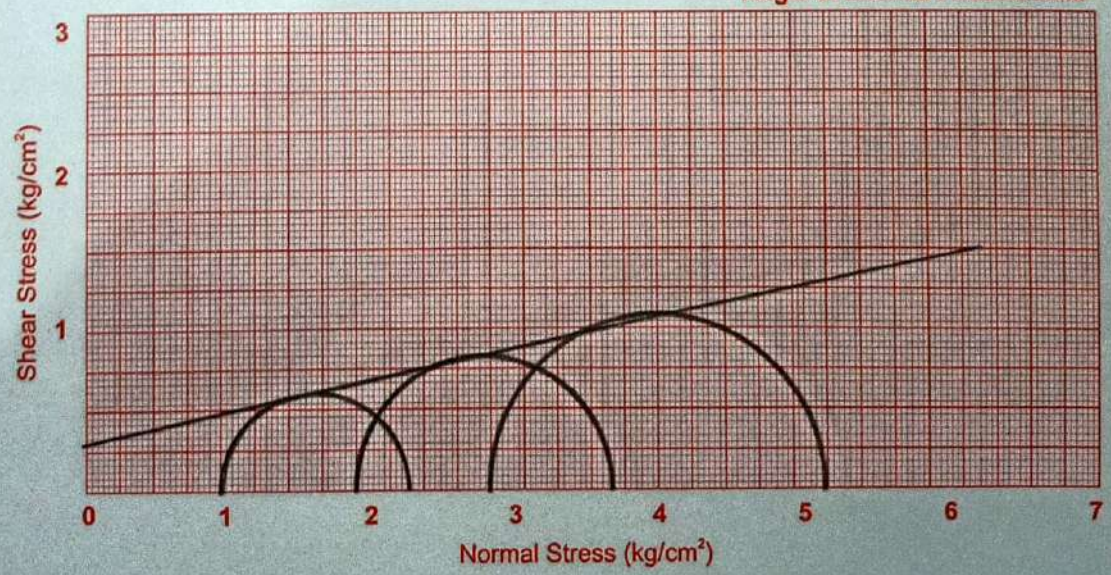
B.H. No. :- 01
Depth :- 4.00 - 4.35

Cohesion 'c' 0.15 Kg/cm²
Angle of Internal Friction 12° *



B.H. No. :- 01
Depth :- 7.00 - 7.35

Cohesion 'c' 0.30 Kg/cm²
Angle of Internal Friction 12° *



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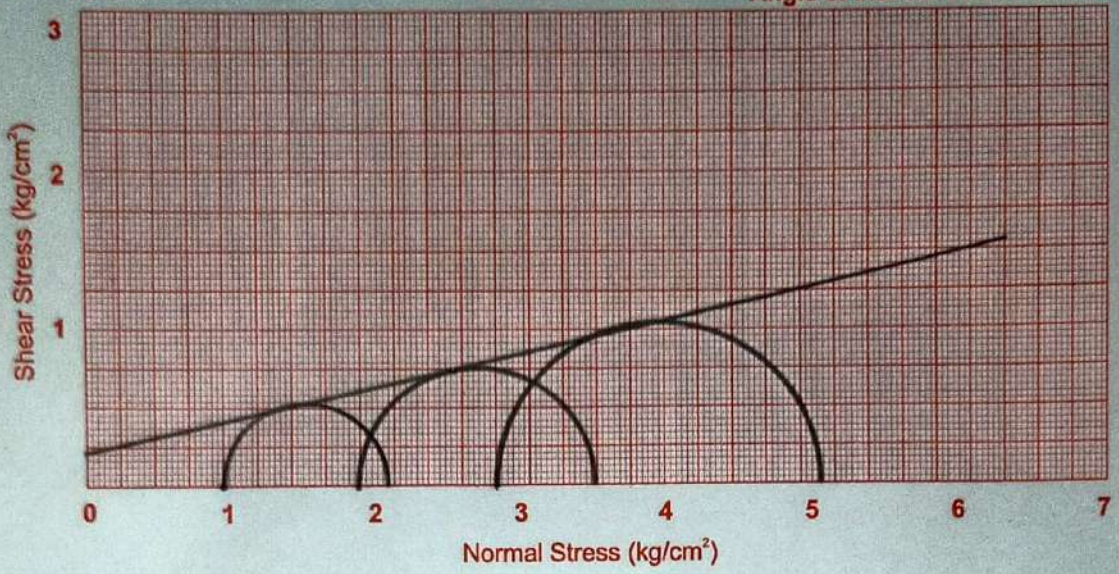
VMT/133/23-24

VMT
GEOTECH & MATERIAL TESTING

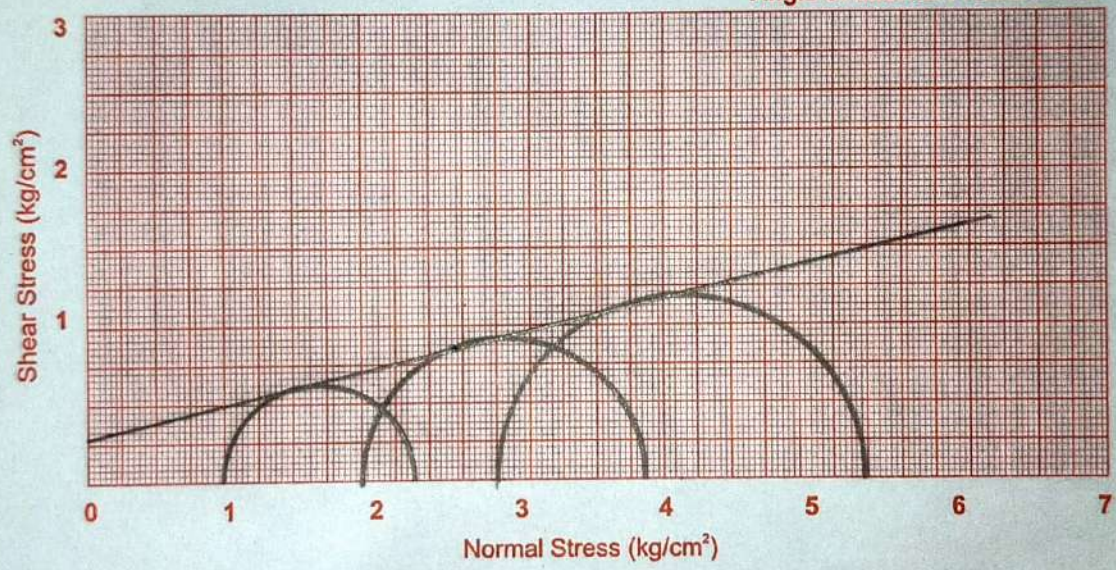
B.H. No. :- 02
Depth - 1.00-1.35

Cohesion 'c' 0.20 Kg/cm²
Angle of Internal Friction 13° *



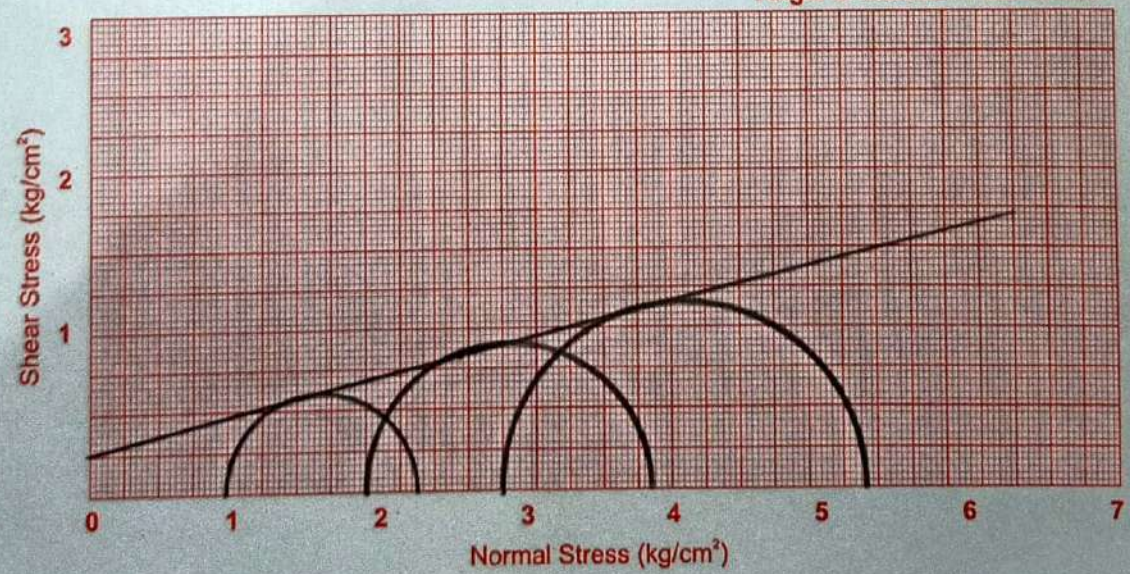
B.H. No. :- 02
Depth :- 4.00-4.35

Cohesion 'c' 0.30 Kg/cm²
Angle of Internal Friction 13° *



B.H. No. :- 02
Depth :- 7.00-7.35

Cohesion 'c' 0.25 Kg/cm²
Angle of Internal Friction 14° *



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TC-8969

REPORT NO. – VMT 133 B/2023-2024

GEOTECH INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT (L.H.S.) IN WEST BENGAL

Prepared By -

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ACKNOWLEDGEMENT

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THE CO-OPERATION EXTENDED BY THEIR ENGINEERS DURING FIELD INVESTIGATIONS IS THANKFULLY ACKNOWLEDGED.

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SUB-SOIL INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT IN WEST BENGAL

INTRODUCTION

The work of sub-soil exploration was awarded to us by M/s KITCO LTD., KERLA Order no. – 6777:DP 1083: RG: 2023 dated 21/03/2023. The object of the investigation was to study the geo-technical properties of soil both in field and laboratory and determine safe allowable pressure for the foundation soil.

The fieldwork consisted of 02 bore holes of 10.00 metre depth each. The fieldwork was conducted on 19/04/2023. The location of the bore holes is shown in the Site location.

REFERENCES

1. **IS: 1892-2021** for field work including existent ground water table.
2. **IS: 2132-1986** for sampling in Undisturbed and Disturbed form.
3. **IS: 2131-1981** for Standard Penetration Test.
4. **IS: 2720** for all laboratory tests on soil samples collected.
5. **IS: 6403-1981** for determination of Bearing Capacity.
6. **IS: 8009(Part I)-1976** for calculation of settlement of foundations.
7. **IS: 1904-2021** for permissible maximum settlement, differential settlement and angular distortion.

SCOPE OF WORK

The scope consisted of drilling of boreholes down to maximum depth of 10.00 m in normal soils / rock, Standard Penetration Testing, collection of samples, laboratory testing and preparation and submission of Geotechnical Investigation report.

Summary of the fieldwork					
Sl. No.	**Site**	**Borehole Nos.**	**Coordinates**		**Depth below existing ground level (m)**
			Latitude	**Longitude**	
1.	GORAIPARA FERRY GHAT	BH-01 (LHS)	24.80523269	87.90574294	10.0
2.		BH-02 (LHS)	24.80546977	87.90557899	10.0

SITE LOCATION

INTERPRETATION OF THE LAB TEST RESULTS

GENERAL NATURE OF SOIL STRATA

The bore hole log charts and lab test results of bore holes 1 and 2 indicate that the strata at the site is found to comprise of cohesive soil.

The results of classification tests indicate that the natural soil stratum present at the Site is found to comprise of both fine-grained soils comprising of 'CL' and 'CI' group of IS classification (clayey soil) having 90 to 99 percent material finer than 75 micron.

The bore hole log charts and lab test results of bore holes 1 indicate that:

first strata, from 0.00 metre to 4.00 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 4.00 metre to 10.00 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity.

The bore hole log charts and lab test results of bore holes 2 indicate that:

first strata, from 0.00 metre to 5.50 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 5.50 metre to 10.00 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity.

S.P.T. VALUES

The S.P.T. values obtained in the respective clayey layer region present as per bore-log charts enclosed are found to range 5 to 15 indicating 'Medium' to 'Stiff' consistency.

The results of S.P.T. values indicate that the stratum at the Site is 'Loose' to 'Well' compacted.

WATER TABLE

Water Table at the Site was observed at a depth from 1.50 metre to 5.00 metre below ground level on the day of soil investigation during the Third week of April 2023. However, the existing water table may rise by 1.00 metre in the post-monsoon period in general. Therefore, a water table at a depth of 0.50 metre to 4.00 metre below ground level has been adopted for calculation purposes.

RECOMMENDATIONS FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT IN WEST BENGAL

NET SAFE BEARING CAPACITY/SAFE ALLOWABLE PRESSURE

Bore Hole Nos.	Type of Structure	Depth of Foundation (metres)	Size of Footing (L x B) (metres)	Net Safe Bearing Capacity (Tonne/sqm.)	Settlement Produced (mm)	Safe Allowable Pressure for Permissible Settlement 50 mm (Tonne/sqm.)
1	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	15.42	43.11	-
		2.00	1.20 x 1.20	17.37	41.20	-
		2.50	1.20 x 1.20	21.45	42.18	-
		1.50	2.00 x 2.00	14.45	57.24	11.88
		2.00	2.00 x 2.00	15.91	54.29	14.14
		2.50	2.00 x 2.00	19.12	55.07	16.67
		1.50	2.50 x 2.50	14.22	65.75	9.73
		2.00	2.50 x 2.50	15.47	60.21	11.98
		2.50	2.50 x 2.50	18.49	63.55	13.34
2	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	8.36	32.81	-
		2.00	1.20 x 1.20	9.57	33.47	-
		2.50	1.20 x 1.20	10.61	31.97	-
		1.50	2.00 x 2.00	7.89	44.92	-
		2.00	2.00 x 2.00	8.86	45.30	-
		2.50	2.00 x 2.00	9.49	42.37	-
		1.50	2.50 x 2.50	7.84	53.10	7.24
		2.00	2.50 x 2.50	8.74	49.93	-
		2.50	2.50 x 2.50	9.21	49.56	-

NOTE: -

The above recommendations are based on the field investigation data results and the laboratory tests results of the samples collected from the test locations and our experience in this regard. If the actual sub-soil conditions during excavation for the

foundations differ from that has been reported, a reference should be made to us for suggestions.

Further, the recommendations are based on the assumptions as mentioned in the Report and the designer of the Structure should take into consideration all the factors required as per codes. The recommendations should be taken as guidelines for the designer.

Er. Akhil Singh
TECHNICAL MANAGER
VIVEK MATERIAL TESTING LABORATORY

Shubham Singh
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VIVEK MATERIAL TESTING LAORATORY

BEARING CAPACITY CALCULATIONS

Soil when stressed due to loading, tend to deform. The resistance to deformation of the soil depends upon factors like water content, bulk density, angle of internal friction and the manner in which load is applied on the soil. The maximum load per unit area which the soil or rock can carry without yielding or displacement is termed as the bearing capacity of soils. The Safe Bearing Capacity of the proposed STRUCTURE without any distress is determined from the considerations of the following criteria.

[A] SHEAR CRITERIA

The soil beneath the foundation shall be safe from risk of shear failure.

[B] SETTLEMENT CRITERIA

The settlement due to load is caused basically on account of two factors, namely,

(i) the soil below footing gets compressed by certain amount and

(ii) since the foundations cover only a limited area there is a possibility that the concentrated stresses developed are so high as to cause actual rupture (shear failure) and displacement of soil below.

The foundation should not settle or deflect to an extent causing damage to the Structure or impair its usefulness.

The Bearing Capacity Calculations for the Foundation shall be governed as per IS: 6403-1981, IS: 8009(Part-I)-1976 and IS: 1904-2021 on the basis of available information regarding the proposed design.

BEARING CAPACITY ON SHEAR CONSIDERATIONS

ULTIMATE NET BEARING CAPACITY

As per IS: 6403-1981, the Ultimate Net Bearing Capacity 'qd' on shear consideration for a Structure is given by the formula: -

FOR GENERAL SHEAR FAILURE

qd = c.Nc.Sc.dc.ic+q(Nq-1).sq.dq.iq + 1/2 B.r.Nr.Sr.dr.ir.W'.

FOR LOCAL SHEAR FAILURE

q'd = 2/3 c.N'c.Sc.dc.ic+q(N'q-1).Sq.dq.iq + 1/2 B.r.N'r.Sr.dr.ir.W'.

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BEARING CAPACITY CALCULATION

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT								
BOREHOLE 01 (L.H.S.)	Depth of borehole	10.00	metre	Water table below borehole level (m)	5.00		Factor of safety	2.50
				Water table used for calculation (m)	4.00		Assumed post monsoon rise (m)	1.00

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Input Parameters														Shearing Resistance Parameters																Ultimate Net Bearing Capacity			Net Safe Bearing Capacity
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	
					Bulk		Bulk		c	Ø	Ø'	e	q	Nc	Nq	Nγ	Nc'	Nq'	Nγ'	Sc	Sq	Sγ	Dc	Dq	Dγ	Dc'	Dq'	Dγ'	Ic	Iq	Iγ				
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																			kN/m2	kN/m2	kN/m2	kN/m2
1	SQUARE	1.50	1.20	1.20	1.80	17.65	1.80	17.65	0.25	12	8.11	0.640	26.48	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.31	1.15	1.15	1.31	1.15	1.15	1.00	1.00	1.00	475.51	259.03	378.09	**151.24**
2	SQUARE	2.00	1.20	1.20	1.80	17.65	1.87	18.34	0.25	12	8.11	0.640	35.31	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.41	1.21	1.21	1.41	1.21	1.21	1.00	1.00	1.00	535.59	291.84	425.90	**170.36**
3	SQUARE	2.50	1.20	1.20	1.80	17.65	1.87	18.34	0.25	13	8.79	0.630	44.13	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.52	1.26	1.26	1.52	1.26	1.26	1.00	1.00	1.00	646.94	344.29	525.88	**210.35**
4	SQUARE	1.50	2.00	2.00	1.80	17.65	1.80	17.65	0.25	12	8.11	0.640	26.48	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.19	1.09	1.09	1.19	1.09	1.09	1.00	1.00	1.00	445.84	242.62	354.39	**141.76**
5	SQUARE	2.00	2.00	2.00	1.80	17.65	1.87	18.34	0.25	12	8.11	0.640	35.31	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.25	1.12	1.12	1.25	1.12	1.12	1.00	1.00	1.00	490.57	267.04	389.98	**155.99**
6	SQUARE	2.50	2.00	2.00	1.80	17.65	1.87	18.34	0.25	13	8.79	0.630	44.13	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.31	1.16	1.16	1.31	1.16	1.16	1.00	1.00	1.00	576.93	306.75	468.86	**187.54**
7	SQUARE	1.50	2.50	2.50	1.80	17.65	1.80	17.65	0.25	12	8.11	0.640	26.48	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.15	1.07	1.07	1.15	1.07	1.07	1.00	1.00	1.00	438.68	238.56	348.63	**139.45**
8	SQUARE	2.00	2.50	2.50	1.80	17.65	1.87	18.34	0.25	12	8.11	0.640	35.31	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	477.04	259.58	379.18	**151.67**
9	SQUARE	2.50	2.50	2.50	1.80	17.65	1.87	18.34	0.25	13	8.79	0.630	44.13	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.25	1.13	1.13	1.25	1.13	1.13	1.00	1.00	1.00	557.95	296.53	453.38	**181.35**

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SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	151.24	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.87	0.630	0.125	0.00	40.23	57.27	-	-	44.224	-	43.11
3	3	CLAY	3.00	4.00	1.00	1.93	0.598	0.123	0.00	63.45	21.27	-	-	9.663	-	

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SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	170.36	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.80	0.000	0.000	0.00	Depth of foundation						41.20
2	2	CLAY	2.00	3.50	1.50	1.87	0.630	0.125	0.00	49.06	64.52	-	-	41.935	-	
3	3	CLAY	3.50	4.50	1.00	1.93	0.598	0.123	0.00	72.28	23.96	-	-	9.570	-	

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SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	210.35	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						42.18
2	2	CLAY	2.50	4.00	1.50	1.93	0.598	0.123	0.00	60.04	79.66	-	-	42.343	-	
3	3	CLAY	4.00	5.00	1.00	1.91	0.648	0.130	0.00	83.60	29.58	-	-	10.378	-	

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SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	141.76	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.87	0.630	0.125	0.00	40.23	74.98	-	-	52.560	-	57.24
3	3	CLAY	3.00	4.50	1.50	1.93	0.598	0.123	0.00	68.18	31.39	-	-	18.990	-	

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SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	116.51	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.87	0.630	0.125	0.00	40.23	61.63	-	-	46.40	-	50.00
3	3	CLAY	3.00	4.50	1.50	1.93	0.598	0.123	0.00	68.18	25.80	-	-	16.09	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	155.99	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.80	0.000	0.000	0.00	Depth of foundation						54.29
2	2	CLAY	2.00	3.50	1.50	1.87	0.630	0.125	0.00	49.06	82.51	-	-	49.282	-	
3	3	CLAY	3.50	5.00	1.50	1.93	0.598	0.123	0.00	77.01	34.54	-	-	18.582	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	138.67	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.80	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	2.00	3.50	1.50	1.87	0.630	0.125	0.00	49.06	73.35	-	-	45.676	-	
3	3	CLAY	3.50	5.00	1.50	1.93	0.598	0.123	0.00	77.01	30.71	-	-	16.827	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	187.54	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						55.07
2	2	CLAY	2.50	4.00	1.50	1.93	0.598	0.123	0.00	60.04	99.19	-	-	48.905	-	
3	3	CLAY	4.00	5.50	1.50	1.91	0.648	0.130	0.00	87.62	41.53	-	-	19.938	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	163.47	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	2.50	4.00	1.50	1.93	0.598	0.123	0.00	60.04	86.46	-	-	44.727	-	50.00
3	3	CLAY	4.00	5.50	1.50	1.91	0.648	0.130	0.00	87.62	36.20	-	-	17.772	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	139.45	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	0.000	0.000	0.00	Depth of foundation						65.75
2	2	CLAY	1.50	3.50	2.00	1.87	0.630	0.125	0.00	44.82	71.15	-	-	63.325	-	
3	3	CLAY	3.50	5.25	1.75	1.93	0.598	0.123	0.00	79.31	30.17	-	-	18.858	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	95.40	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	1.50	3.50	2.00	1.87	0.630	0.125	0.00	44.82	48.67	-	-	48.975	-	
3	3	CLAY	3.50	5.25	1.75	1.93	0.598	0.123	0.00	79.31	20.64	-	-	13.530	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	151.67	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.87	0.000	0.000	0.00	Depth of foundation						60.21
2	2	CLAY	2.00	4.00	2.00	1.93	0.598	0.123	0.00	55.61	77.38	-	-	58.297	-	
3	3	CLAY	4.00	5.50	1.50	1.91	0.648	0.130	0.00	87.91	34.39	-	-	16.967	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	117.48	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.87	0.000	0.000	0.000	Depth of foundation						50.00
2	2	CLAY	2.00	4.00	2.00	1.93	0.598	0.123	0.000	55.61	59.94	-	-	48.897	-	
3	3	CLAY	4.00	5.50	1.50	1.91	0.648	0.130	0.000	87.91	26.64	-	-	13.602	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	181.35	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						63.55
2	2	CLAY	2.50	4.50	2.00	1.93	0.598	0.123	0.00	64.78	92.53	-	-	59.317	-	
3	3	CLAY	4.50	6.25	1.75	1.91	0.648	0.130	0.00	98.38	39.23	-	-	20.121	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	130.80	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.000	Depth of foundation						50.00
2	2	CLAY	2.50	4.50	2.00	1.93	0.598	0.123	0.000	64.78	66.73	-	-	47.345	-	
3	3	CLAY	4.50	6.25	1.75	1.91	0.648	0.130	0.000	98.38	28.30	-	-	15.156	-	

VIVEK MATERIAL TESTING LABORATORY

BEARING CAPACITY CALCULATION

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT								
BOREHOLE 02 (L.H.S.)	Depth of borehole	10.00	metre	Water table below borehole level (m)	1.50		Factor of safety	2.50
				Water table used for calculation (m)	0.50		Assumed post monsoon rise (m)	1.00

VMT
GEOTECH & MATERIAL TESTING

Input Parameters														Shearing Resistance Parameters																	Ultimate Net Bearing Capacity			Net Safe Bearing Capacity
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	
					Bulk		Bulk		c	Ø	Ø'	e	q	Nc	Nq	Nγ	Nc'	Nq'	Nγ'	Sc	Sq	Sγ	Dc	Dq	Dγ	Dc'	Dq'	Dγ'	Ic	Iq	Iγ				
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																		kN/m2	kN/m2	kN/m2	kN/m2
1	SQUARE	1.50	1.20	1.20	1.83	11.41	1.83	11.41	0.10	17	11.58	0.690	17.11	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.34	1.17	1.17	1.34	1.17	1.17	1.00	1.00	1.00	319.01	156.07	204.95	**81.98**
2	SQUARE	2.00	1.20	1.20	1.83	10.59	1.89	11.18	0.10	17	11.58	0.690	21.18	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.45	1.23	1.23	1.45	1.23	1.23	1.00	1.00	1.00	365.12	178.70	234.63	**93.85**
3	SQUARE	2.50	1.20	1.20	1.83	10.10	1.89	10.69	0.15	12	8.11	0.665	25.25	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.51	1.26	1.26	1.51	1.26	1.26	1.00	1.00	1.00	352.38	192.09	260.21	**104.08**
4	SQUARE	1.50	2.00	2.00	1.83	11.41	1.83	11.41	0.10	17	11.58	0.690	17.11	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	301.67	147.10	193.47	**77.39**
5	SQUARE	2.00	2.00	2.00	1.83	10.59	1.89	11.18	0.10	17	11.58	0.690	21.18	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.27	1.14	1.14	1.27	1.14	1.14	1.00	1.00	1.00	338.72	165.27	217.31	**86.92**
6	SQUARE	2.50	2.00	2.00	1.83	10.10	1.89	10.69	0.15	12	8.11	0.665	25.25	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.31	1.15	1.15	1.31	1.15	1.15	1.00	1.00	1.00	315.29	171.74	232.75	**93.10**
7	SQUARE	1.50	2.50	2.50	1.83	11.41	1.83	11.41	0.10	17	11.58	0.690	17.11	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.16	1.08	1.08	1.16	1.08	1.08	1.00	1.00	1.00	300.17	146.09	192.31	**76.92**
8	SQUARE	2.00	2.50	2.50	1.83	10.59	1.89	11.18	0.10	17	11.58	0.690	21.18	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.22	1.11	1.11	1.22	1.11	1.11	1.00	1.00	1.00	334.47	162.89	214.36	**85.74**
9	SQUARE	2.50	2.50	2.50	1.83	10.10	1.89	10.69	0.15	12	8.11	0.665	25.25	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.25	1.12	1.12	1.25	1.12	1.12	1.00	1.00	1.00	306.00	166.59	225.84	**90.34**

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	81.98	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.83	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.89	0.665	0.130	0.00	33.47	31.05	-	-	33.382	-	32.81
3	3	CLAY	3.00	4.00	1.00	1.91	0.667	0.127	0.00	44.47	11.53	-	-	7.626	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	93.85	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.83	0.000	0.000	0.00	Depth of foundation						33.47
2	2	CLAY	2.00	3.50	1.50	1.89	0.665	0.130	0.00	37.54	35.54	-	-	33.886	-	
3	3	CLAY	3.50	4.50	1.00	1.91	0.667	0.127	0.00	48.54	13.20	-	-	7.957	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	104.08	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.89	0.000	0.000	0.00	Depth of foundation						31.97
2	2	CLAY	2.50	4.00	1.50	1.91	0.667	0.127	0.00	43.22	39.41	-	-	32.164	-	
3	3	CLAY	4.00	5.00	1.00	1.94	0.656	0.125	0.00	54.53	14.64	-	-	7.795	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	77.39	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.83	-	-	-	Depth of foundation						44.92
2	2	CLAY	1.50	3.00	1.50	1.89	0.665	0.130	0.00	33.47	40.93	-	-	40.635	-	
3	3	CLAY	3.00	4.50	1.50	1.91	0.667	0.127	0.00	46.71	17.14	-	-	15.513	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	86.92	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.83	0.000	0.000	0.00	Depth of foundation						45.30
2	2	CLAY	2.00	3.50	1.50	1.89	0.665	0.130	0.00	37.54	45.97	-	-	40.674	-	
3	3	CLAY	3.50	5.00	1.50	1.91	0.667	0.127	0.00	50.78	19.25	-	-	15.952	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	93.10	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.89	0.000	0.000	0.00	Depth of foundation						42.37
2	2	CLAY	2.50	4.00	1.50	1.91	0.667	0.127	0.00	43.22	49.24	-	-	37.741	-	
3	3	CLAY	4.00	5.50	1.50	1.94	0.656	0.125	0.00	56.83	20.62	-	-	15.220	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	76.92	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.83	0.000	0.000	0.00	Depth of foundation						53.10
2	2	CLAY	1.50	3.50	2.00	1.89	0.665	0.130	0.00	35.65	39.24	-	-	50.345	-	
3	3	CLAY	3.50	5.25	1.75	1.91	0.667	0.127	0.00	52.19	16.64	-	-	16.026	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	71.02	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.83	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	1.50	3.50	2.00	1.89	0.665	0.130	0.00	35.65	36.23	-	-	47.563	-	50.00
3	3	CLAY	3.50	5.25	1.75	1.91	0.667	0.127	0.00	52.19	15.36	-	-	14.942	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	85.74	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.89	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	2.00	4.00	2.00	1.91	0.667	0.127	0.00	41.09	43.74	-	-	47.971	-	49.93
3	3	CLAY	4.00	5.50	1.50	1.94	0.656	0.125	0.00	56.93	19.44	-	-	14.447	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

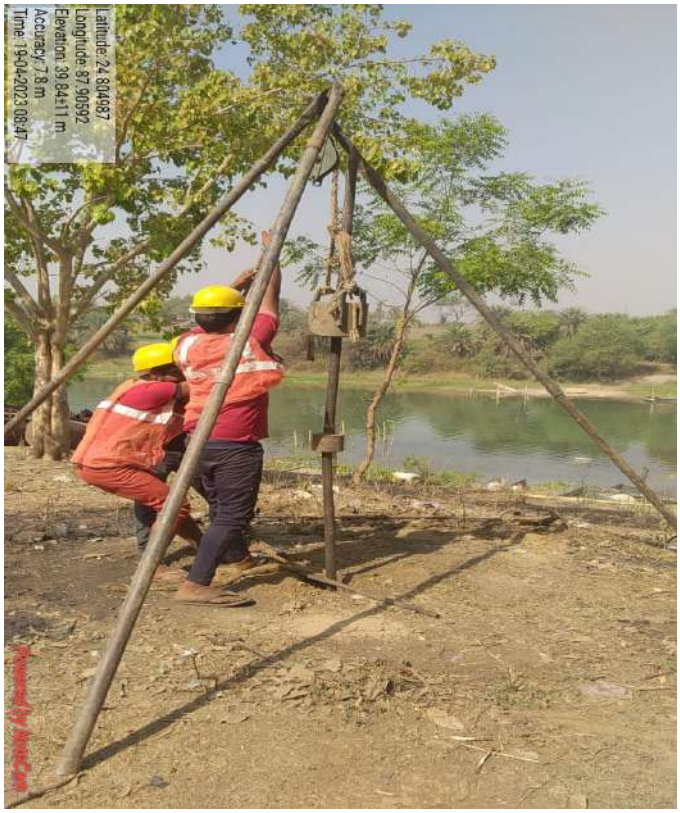
CALCULATION SHEET 6

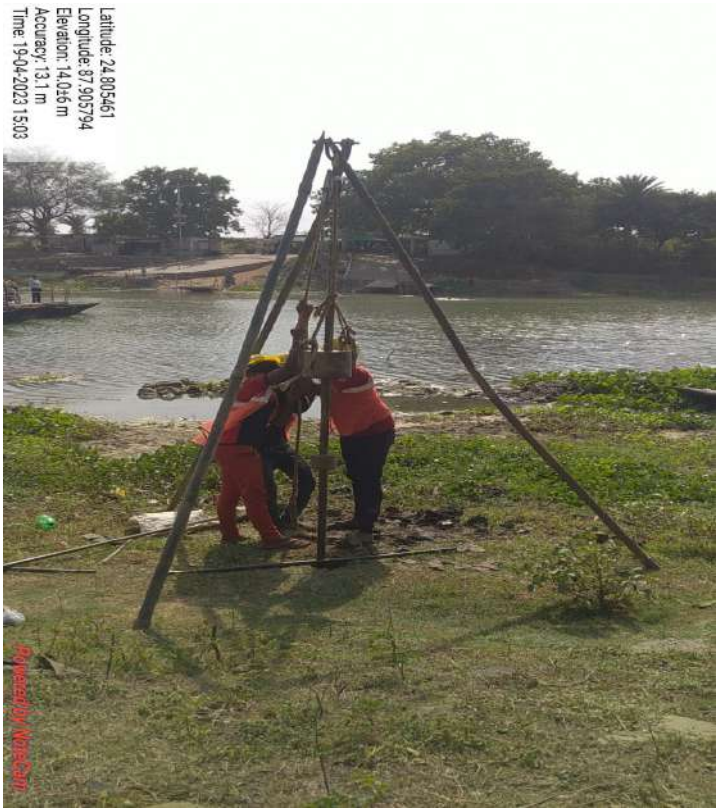
Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	
Length	2.50	metre	Water Table depth for calculation	1.50	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	90.34	kN/m2		Type of foundation	SQUARE	

BOREHOLE 2

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.89	0.000	0.000	0.00	Depth of foundation						49.56
2	2	CLAY	2.50	4.50	2.00	1.91	0.667	0.127	0.00	45.46	46.09	-	-	46.329	-	
3	3	CLAY	4.50	6.25	1.75	1.94	0.656	0.125	0.00	62.45	19.54	-	-	15.621	-	

SITE PHOTOS DURING SITE INVESTIGATION





RESULT SHEET

NAME OF THE PROJECT	CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT IN WEST BENGAL						
Client Name							
Bore Hole No.	1 (L.H.S.)	Coordinate	Easting		Depth of Water Level	5.00	VIVEK MATERIAL TESTING LABORATORY
Total depth of Bore Hole	10.00		Northing		Commenced on	4/19/2023	
			Elevation	100.000	Completed on	4/19/2023	

Depth of Bore Hole	Reduced Level	Types of Samples	% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characterisitics		Compression Index
			4.750	2.000	0.425	0.075	LL	PL	PI										Cohesion	Angle of Internal Friction	
metre	metre		(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N"	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(Ø)	(Cc)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0.00 - 0.50	100.000 - 99.500	DS	100	100	98	93	34	23	11	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	98	95	90	35	21	14	CL				1.80	12.1	1.61	2.64	0.640	0.25	12°	0.127
1.35 - 1.80	98.650 - 98.200	SPT									11	15.05	15.05								
2.50 - 2.85	97.500 - 97.150	UD	100	100	97	94	34	25	9	CL				1.87	15.3	1.62	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									12	13.91	13.91								
4.00 - 4.35	96.000 - 95.650	UD	100	100	100	99	36	18	18	CI				1.93	17.6	1.64	2.62	0.598	0.30	15°	0.123
4.35 - 4.80	95.650 - 95.200	SPT									14	14.40	14.40								
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	98	37	22	15	CI				1.91	20.1	1.59	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									8	9.52	9.52								
7.00 - 7.35	93.000 - 92.650	UD	100	100	100	97	39	23	16	CI				1.94	21.3	1.60	2.63	0.644	0.20	12°	0.130
7.35 - 7.80	92.650 - 92.200	SPT									11	12.25	12.25								
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	98	38	25	13	CI				1.95	18.4	1.65	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									15	15.77	15.39								
9.30 - 10.00	90.700 - 90.000	DS	100	100	100	99	40	21	19	CI					-	-	-	-	-	-	-

RESULT SHEET

NAME OF THE PROJECT	**CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT IN WEST BENGAL**																						
Client Name																							
Bore Hole No.	**2 (L.H.S.)**		**Coordinate**		**Easting**					**Depth of Water Level**			1.50		**VIVEK MATERIAL TESTING LABORATORY**							
Total depth of Bore Hole	**10.00**				**Northing**					**Commenced on**			4/19/2023										
					Elevation		**100.000**			**Completed on**			4/19/2023										

Depth of Bore Hole	**Reduced Level**	**Types of Samples**	**% Material Passing IS Sieve**				**Atterberg Limits**			**IS group symbol**	**SPT Value**	**SPT Value corrected due to overburden**	**SPT Value corrected due to dilatancy**	**Wet Bulk Density**	**Original Moisture**	**Dry Bulk Density**	**Specific Gravity**	**Void Ratio**	**Shear Characterisitics**		**Compression Index**
			4.750	**2.000**	**0.425**	**0.075**	**LL**	**PL**	**PI**										**Cohesion**	**Angle of Internal Friction**	
metre	**metre**		**(mm)**	**(mm)**	**(mm)**	**(mm)**	**%**	**%**	**%**		**N**	**N'**	**N"**	**(gms/cc)**	**%**	**(gms/cc)**	**(G)**		**(Kg/sqcm)**	**(Ø)**	**(Cc)**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
0.00 - 0.50	100.000 - 99.500	DS	100	99	97	95	30	20	10	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	100	100	98	29	17	12	CL				1.83	18.3	1.55	2.62	0.690	0.10	17°	0.135
1.35 - 1.80	98.650 - 98.200	SPT									5	8.13	8.13								
2.50 - 2.85	97.500 - 97.150	UD	100	100	99	97	28	20	8	CL				1.89	19.6	1.58	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									7	9.89	9.89								
4.00 - 4.35	96.000 - 95.650	UD	100	100	98	96	33	21	12	CL				1.91	20.3	1.59	2.65	0.667	0.25	12°	0.127
4.35 - 4.80	95.650 - 95.200	SPT									9	11.53	11.53								
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	99	37	22	15	CI				1.94	21.2	1.60	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									9	10.66	10.66								
7.00 - 7.35	93.000 - 92.650	UD	100	100	100	99	38	24	14	CI				1.95	18.6	1.64	2.62	0.598	0.30	13°	0.123
7.35 - 7.80	92.650 - 92.200	SPT									13	14.42	14.42								
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	98	39	25	14	CI				1.95	17.3	1.66	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									14	14.66	14.66								
9.30 - 10.00	90.700 - 90.000	DS	100	100	100	97	40	20	20	CI					-	-	-	-	-	-	-

BORE-LOG CHART

VMT
GEOTECH & MATERIAL TESTING

VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT IN WEST BENGAL

WATER TABLE 5.00 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 01 (L.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES
			GROUP	HATCHING	N1	N2	N3	N2+N3	10 20 30 40 50 60 70 80 90 100
0.00-0.50	SILTY-CLAY	D.	CL						
1.00-1.35	SILTY-CLAY	U.D.	CL						
1.35-1.80		S.P.T.			3	5	6	11	
2.50-2.85	SILTY-CLAY	U.D.	CL						
2.85-3.30		S.P.T.			4	5	7	12	
4.00-4.35	SILTY-CLAY	U.D.	CI						
4.35-4.80		S.P.T.			4	6	8	14	
5.50-5.85	SILTY-CLAY	U.D.	CI						
5.85-6.30		S.P.T.			3	3	5	8	
7.00-7.35	SILTY-CLAY	U.D.	CI						
7.35-7.80		S.P.T.			4	5	6	11	
8.50-8.85	SILTY-CLAY	U.D.	CI						
8.85-9.30		S.P.T.			5	7	8	15	
9.30-10.00	SILTY-CLAY	D.	CI						

BORE-LOG CHART

VMT
GEOTECH & MATERIAL TESTING

VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GORAIPARA FERRY GHAT IN WEST BENGAL

WATER TABLE 1.50 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 02 (L.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES
			GROUP	HATCHING	N1	N2	N3	N2+N3	10 20 30 40 50 60 70 80 90 100
0.00-0.50	SILTY-CLAY	D.	CL						
1.00-1.35	SILTY-CLAY	U.D.	CL						
1.35-1.80		S.P.T.			2	2	3	5	
2.50-2.85	SILTY-CLAY	U.D.	CL						
2.85-3.30		S.P.T.			2	3	4	7	
4.00-4.35	SILTY-CLAY	U.D.	CL						
4.35-4.80		S.P.T.			3	4	5	9	
5.50-5.85	SILTY-CLAY	U.D.	CI						
5.85-6.30		S.P.T.			4	4	5	9	
7.00-7.35	SILTY-CLAY	U.D.	CI						
7.35-7.80		S.P.T.			5	6	7	13	
8.50-8.85	SILTY-CLAY	U.D.	CI						
8.85-9.30		S.P.T.			4	6	8	14	
9.30-10.00	SILTY-CLAY	D.	CI						

VMT/133/23-24-(L.H.S) W.B

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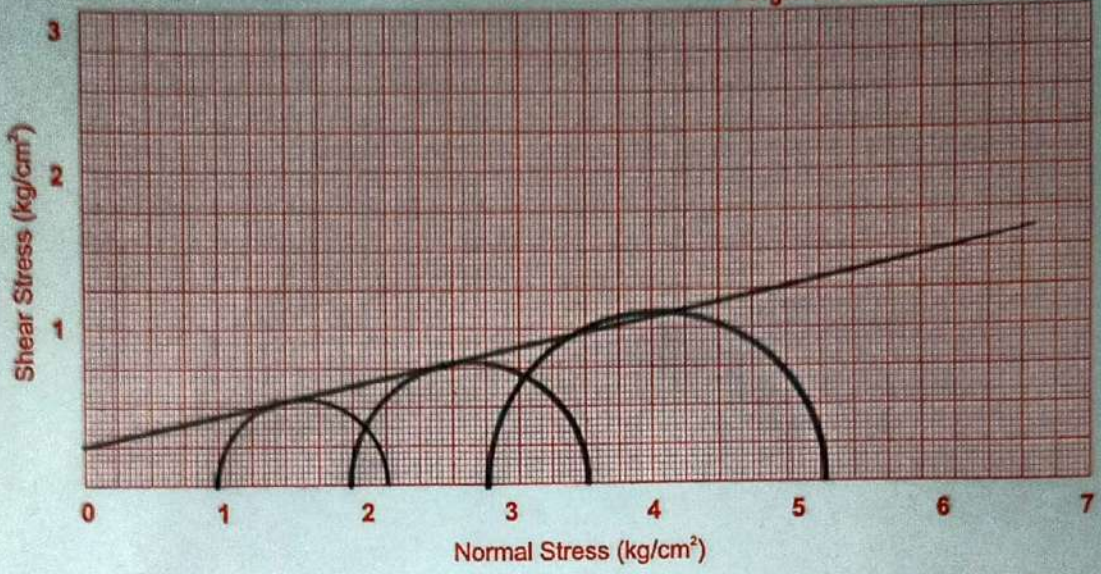
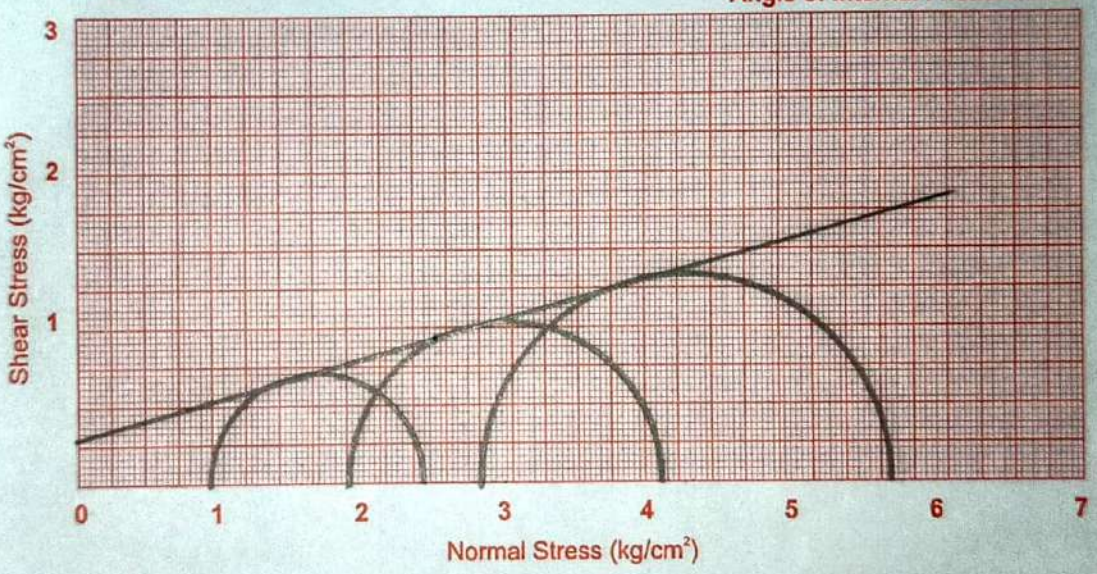
B.H. No. :- 01
Depth - 1.00 - 1.35

Cohesion 'c' 0.25 Kg/cm²
Angle of Internal Friction 12° *



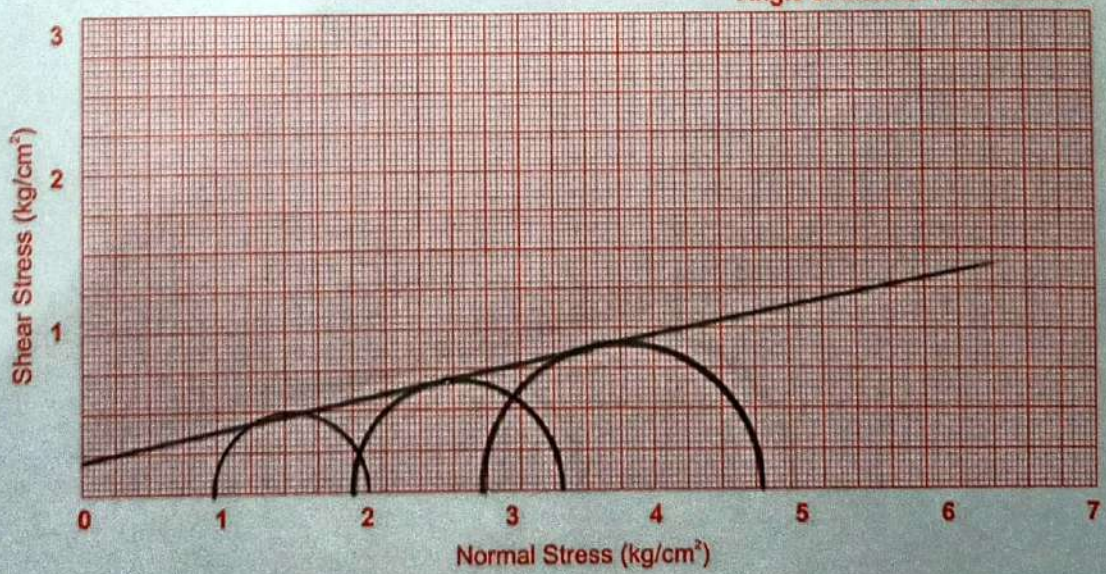
B.H. No. :- 01
Depth :- 4.00 - 4.35

Cohesion 'c' 0.30 Kg/cm²
Angle of Internal Friction 15° *



B.H. No. :- 01
Depth :- 7.00 - 7.35

Cohesion 'c' 0.20 Kg/cm²
Angle of Internal Friction 12° *



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VMT/133/23-24 (L.H.S)

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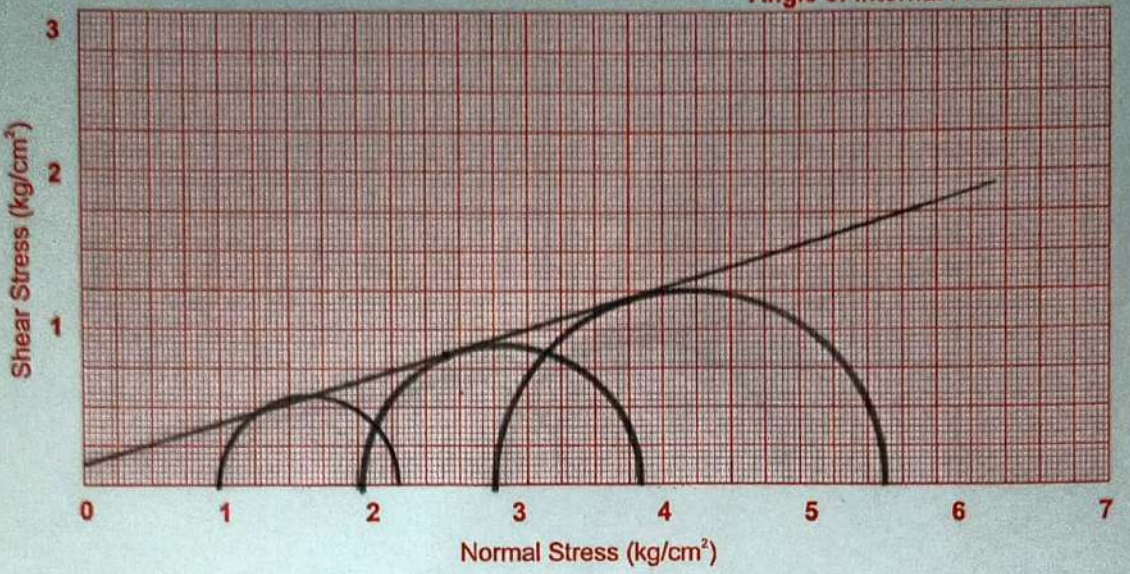
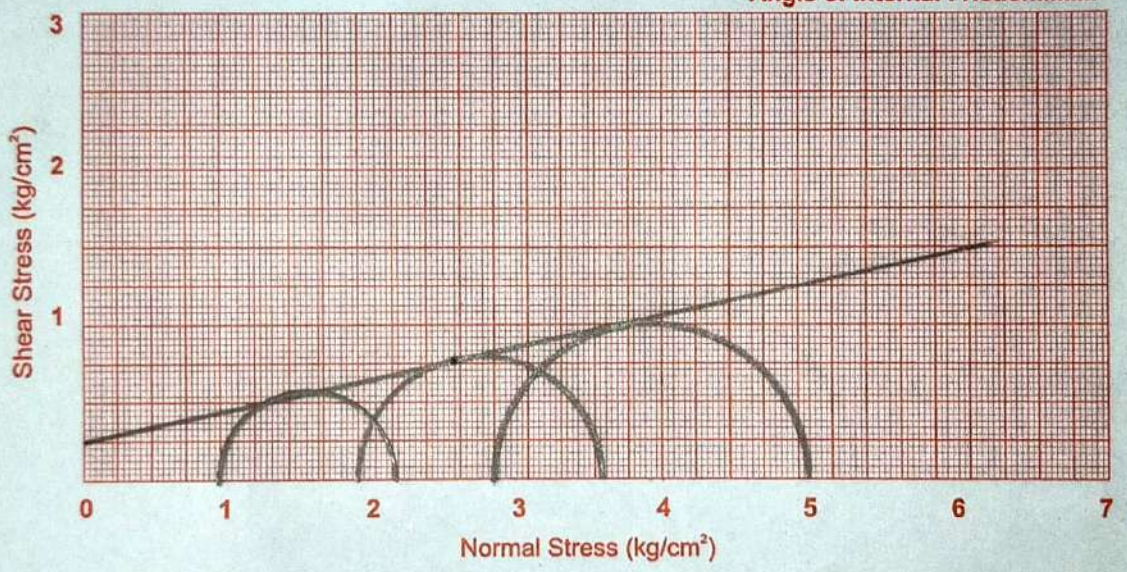
B.H. No. :- 02
Depth - 1.00 - 1.35

Cohesion 'c' 0.10 Kg/cm²
Angle of Internal Friction 17°



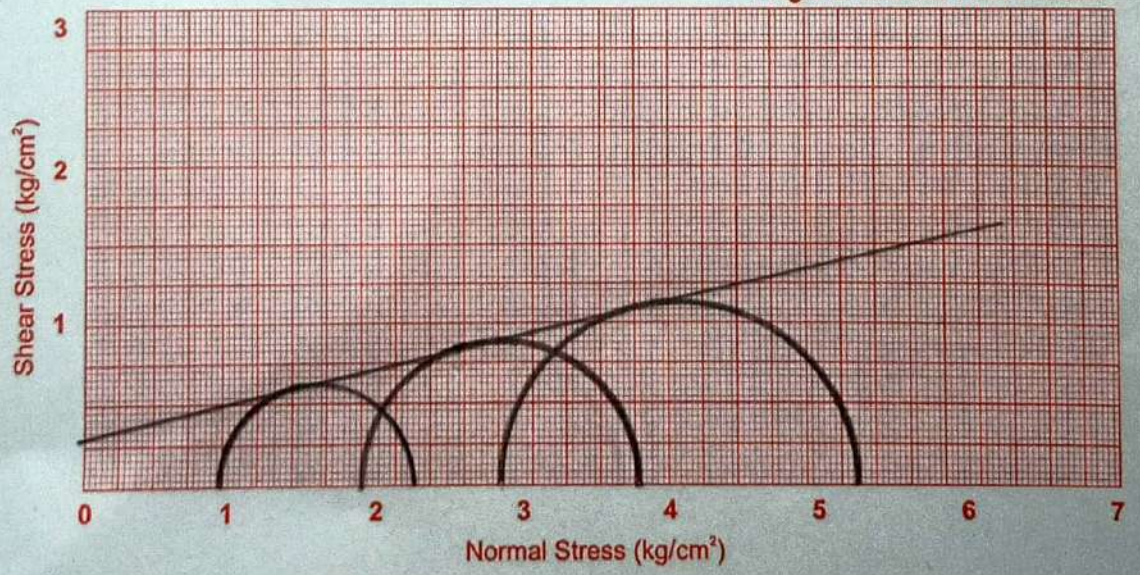
B.H. No. :- 02
Depth :- 4.00 - 4.35

Cohesion 'c' 0.25 Kg/cm²
Angle of Internal Friction 12°



B.H. No. :- 02
Depth :- 7.00 - 7.35

Cohesion 'c' 0.30 Kg/cm²
Angle of Internal Friction 13°



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VMT
GEOTECH & MATERIAL TESTING

TC-8969

REPORT NO. – VMT 132 A/2023-2024

GEOTECH INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT (L.H.S.) IN WEST BENGAL

Prepared By -

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ACKNOWLEDGEMENT

WE ARE GRATEFUL TO M/s KITCO LTD., KERLA FOR PROVIDING US THE OPPORTUNITY TO CARRY OUT THESE INVESTIGATIONS.

THE CO-OPERATION EXTENDED BY THEIR ENGINEERS DURING FIELD INVESTIGATIONS IS THANKFULLY ACKNOWLEDGED.

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SUB-SOIL INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT IN WEST BENGAL

INTRODUCTION

The work of sub-soil exploration was awarded to us by M/s KITCO LTD., KERLA Order no. – 6777:DP 1083: RG: 2023 dated 21/03/2023. The object of the investigation was to study the geo-technical properties of soil both in field and laboratory and determine safe allowable pressure for the foundation soil.

The fieldwork consisted of 02 bore holes of 10.00 metre depth each. The fieldwork was conducted on 16/04/2023. The location of the bore holes is shown in the Site location.

REFERENCES

1. **IS: 1892-2021** for field work including existent ground water table.
2. **IS: 2132-1986** for sampling in Undisturbed and Disturbed form.
3. **IS: 2131-1981** for Standard Penetration Test.
4. **IS: 2720** for all laboratory tests on soil samples collected.
5. **IS: 6403-1981** for determination of Bearing Capacity.
6. **IS: 8009(Part I)-1976** for calculation of settlement of foundations.
7. **IS: 1904-2021** for permissible maximum settlement, differential settlement and angular distortion.

SCOPE OF WORK

The scope consisted of drilling of boreholes down to maximum depth of 10.00 m in normal soils / rock, Standard Penetration Testing, collection of samples, laboratory testing and preparation and submission of Geotechnical Investigation report.

Summary of the fieldwork					
Sl. No.	Site	Borehole Nos.	Coordinates		Depth below existing ground level (m)
			Latitude	Longitude	
1.	LALBAGH FERRY GHAT	BH-01 (LHS)	24.1706269	88.26898679	10.0
2.		BH-02 (LHS)	24.17039443	88.26892644	10.0

SITE LOCATION

INTERPRETATION OF THE LAB TEST RESULTS

GENERAL NATURE OF SOIL STRATA

The bore hole log charts and lab test results of bore holes 1 and 2 indicate that the strata at the site is found to comprise of both cohesive as well as non-cohesive soil.

The results of classification tests indicate that the natural soil stratum present at the Site is found to comprise of both fine-grained soils comprising of 'CL' group of IS classification (clayey soil) having 96 to 99 percent material finer than 75 micron and coarse-grained soils (sandy soil) comprise of 'SM' group of IS classification having 40 to 46 percent material finer than 75 micron.

The bore hole log charts and lab test results of bore holes 1 indicate that:

first strata, from 0.00 metre to 7.00 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 7.00 metre to 10.00 metre, consists of a layer of SM group of IS classification which is silty Sand with none plasticity.

The bore hole log charts and lab test results of bore holes 2 indicate that:

first strata, from 0.00 metre to 7.00 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 7.00 metre to 10.00 metre, consists of a layer of SM group of IS classification which is silty Sand with none plasticity.

S.P.T. VALUES

The S.P.T. values obtained in the respective clayey layer region present as per bore-log charts enclosed are found to range 5 to 11 indicating 'Medium' to 'Stiff' consistency.

However, the S.P.T. values obtained in the respective sandy layer region present as per bore-log charts enclosed are found to range from 13 to 19 indicating 'Medium' relative density.

The results of S.P.T. values indicate that the stratum at the Site is 'Loose' to 'Well' compacted.

WATER TABLE

Water Table at the Site was observed at a depth from 2.15 metre to 2.20 metre below ground level on the day of soil investigation during the Third week of April 2023. However, the existing water table may rise by 1.00 metre in the post-monsoon period in general. Therefore, a water table at a depth of 1.15 metre to 1.10 metre below ground level has been adopted for calculation purposes.

RECOMMENDATIONS FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT IN WEST BENGAL

NET SAFE BEARING CAPACITY/SAFE ALLOWABLE PRESSURE

Bore Hole Nos.	Type of Structure	Depth of Foundation (metres)	Size of Footing (L x B) (metres)	Net Safe Bearing Capacity (Tonne/sqm.)	Settlement Produced (mm)	Safe Allowable Pressure for Permissible Settlement 50 mm (Tonne/sqm.)
1	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	10.02	34.05	-
		2.00	1.20 x 1.20	11.01	31.95	-
		2.50	1.20 x 1.20	14.45	37.53	-
		1.50	2.00 x 2.00	9.29	45.87	-
		2.00	2.00 x 2.00	9.99	42.70	-
		2.50	2.00 x 2.00	12.77	49.21	-
		1.50	2.50 x 2.50	9.14	53.57	8.34
		2.00	2.50 x 2.50	9.71	46.73	-
		2.50	2.50 x 2.50	12.30	57.65	10.17
2	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	9.78	33.44	-
		2.00	1.20 x 1.20	11.15	32.27	-
		2.50	1.20 x 1.20	9.80	27.98	-
		1.50	2.00 x 2.00	9.29	45.92	-
		2.00	2.00 x 2.00	10.34	43.89	-
		2.50	2.00 x 2.00	8.72	37.17	-
		1.50	2.50 x 2.50	9.23	54.03	8.32
		2.00	2.50 x 2.50	10.16	48.79	-
		2.50	2.50 x 2.50	8.45	43.56	-

NOTE: -

The above recommendations are based on the field investigation data results and the laboratory tests results of the samples collected from the test locations and our experience in this regard. If the actual sub-soil conditions during excavation for the

foundations differ from that has been reported, a reference should be made to us for suggestions.

Further, the recommendations are based on the assumptions as mentioned in the Report and the designer of the Structure should take into consideration all the factors required as per codes. The recommendations should be taken as guidelines for the designer.

Er. Akhil Singh
TECHNICAL MANAGER
VIVEK MATERIAL TESTING LABORATORY

Shubham Singh
Dy. TECHNICAL MANAGER/ QUALITY MANAGER
VIVEK MATERIAL TESTING LAORATORY

BEARING CAPACITY CALCULATIONS

Soil when stressed due to loading, tend to deform. The resistance to deformation of the soil depends upon factors like water content, bulk density, angle of internal friction and the manner in which load is applied on the soil. The maximum load per unit area which the soil or rock can carry without yielding or displacement is termed as the bearing capacity of soils. The Safe Bearing Capacity of the proposed STRUCTURE without any distress is determined from the considerations of the following criteria.

[A] SHEAR CRITERIA

The soil beneath the foundation shall be safe from risk of shear failure.

[B] SETTLEMENT CRITERIA

The settlement due to load is caused basically on account of two factors, namely,

(i) the soil below footing gets compressed by certain amount and

(ii) since the foundations cover only a limited area there is a possibility that the concentrated stresses developed are so high as to cause actual rupture (shear failure) and displacement of soil below.

The foundation should not settle or deflect to an extent causing damage to the Structure or impair its usefulness.

The Bearing Capacity Calculations for the Foundation shall be governed as per IS: 6403-1981, IS: 8009(Part-I)-1976 and IS: 1904-2021 on the basis of available information regarding the proposed design.

BEARING CAPACITY ON SHEAR CONSIDERATIONS

ULTIMATE NET BEARING CAPACITY

As per IS: 6403-1981, the Ultimate Net Bearing Capacity 'qd' on shear consideration for a Structure is given by the formula: -

FOR GENERAL SHEAR FAILURE

qd = c.Nc.Sc.dc.ic+q(Nq-1).sq.dq.iq + 1/2 B.r.Nr.Sr.dr.ir.W'.

FOR LOCAL SHEAR FAILURE

q'd = 2/3 c.N'c.Sc.dc.ic+q(N'q-1).Sq.dq.iq + 1/2 B.r.N'r.Sr.dr.ir.W'.

VIVEK MATERIAL TESTING LABORATORY

BEARING CAPACITY CALCULATION

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT								
BOREHOLE 01 (L.H.S.)	Depth of borehole	10.00	metre	Water table below borehole level (m)	2.15		Factor of safety	2.50
				Water table used for calculation (m)	1.15		Assumed post monsoon rise (m)	1.00

VMT
GEOTECH & MATERIAL TESTING

Input Parameters														Shearing Resistance Parameters																Ultimate Net Bearing Capacity			Net Safe Bearing Capacity
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors							Inclination Factors			General shear	Local shear	Intermediate	
					Bulk		Bulk		c	Ø	Ø'	e	q	Nc	Nq	Nγ	Nc'	Nq'	Nγ'	Sc	Sq	Sγ	Dc	Dq	Dγ	Dc'	Dq'	Dγ'	Ic	Iq	Iγ				
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																			kN/m2	kN/m2	kN/m2	kN/m2
1	SQUARE	1.50	1.20	1.20	1.80	15.36	1.80	15.36	0.20	11	7.42	0.686	23.05	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	353.10	195.06	245.63	**98.25**
2	SQUARE	2.00	1.20	1.20	1.80	13.48	1.87	14.17	0.20	11	7.42	0.686	26.97	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.40	1.20	1.20	1.40	1.20	1.20	1.00	1.00	1.00	388.15	214.45	270.03	**108.01**
3	SQUARE	2.50	1.20	1.20	1.80	12.36	1.87	13.04	0.25	10	6.74	0.665	30.89	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.50	1.25	1.25	1.50	1.25	1.25	1.00	1.00	1.00	473.56	266.21	354.33	**141.73**
4	SQUARE	1.50	2.00	2.00	1.80	15.36	1.80	15.36	0.20	11	7.42	0.686	23.05	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.18	1.09	1.09	1.18	1.09	1.09	1.00	1.00	1.00	327.40	180.79	227.71	**91.08**
5	SQUARE	2.00	2.00	2.00	1.80	13.48	1.87	14.17	0.20	11	7.42	0.686	26.97	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	352.05	194.42	244.86	**97.94**
6	SQUARE	2.50	2.00	2.00	1.80	12.36	1.87	13.04	0.25	10	6.74	0.665	30.89	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	418.52	235.23	313.13	**125.25**
7	SQUARE	1.50	2.50	2.50	1.80	15.36	1.80	15.36	0.20	11	7.42	0.686	23.05	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.15	1.07	1.07	1.15	1.07	1.07	1.00	1.00	1.00	322.24	177.89	224.08	**89.63**
8	SQUARE	2.00	2.50	2.50	1.80	13.48	1.87	14.17	0.20	11	7.42	0.686	26.97	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.19	1.10	1.10	1.19	1.10	1.10	1.00	1.00	1.00	342.42	189.05	238.13	**95.25**
9	SQUARE	2.50	2.50	2.50	1.80	12.36	1.87	13.04	0.25	10	6.74	0.665	30.89	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	403.18	226.57	301.63	**120.65**

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	98.25	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.87	0.665	0.131	0.00	38.15	37.21	-	-	34.890	-	34.05
3	3	CLAY	3.00	4.00	1.00	1.90	0.671	0.130	0.00	54.23	13.82	-	-	7.668	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	108.01	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.80	0.000	0.000	0.00	Depth of foundation						31.95
2	2	CLAY	2.00	3.50	1.50	1.87	0.665	0.131	0.00	46.22	40.90	-	-	32.490	-	
3	3	CLAY	3.50	4.50	1.00	1.90	0.671	0.130	0.00	61.55	15.19	-	-	7.452	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	141.73	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						37.53
2	2	CLAY	2.50	4.00	1.50	1.90	0.671	0.130	0.00	49.04	53.67	-	-	37.471	-	
3	3	CLAY	4.00	5.00	1.00	1.96	0.640	0.125	0.00	60.36	19.93	-	-	9.445	-	

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SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	91.08	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	-	-	-	Depth of foundation						45.87
2	2	CLAY	1.50	3.00	1.50	1.87	0.665	0.131	0.00	38.15	48.17	-	-	41.854	-	
3	3	CLAY	3.00	4.50	1.50	1.90	0.671	0.130	0.00	56.44	20.17	-	-	15.486	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	97.94	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.80	0.000	0.000	0.00	Depth of foundation						42.70
2	2	CLAY	2.00	3.50	1.50	1.87	0.665	0.131	0.00	46.22	51.80	-	-	38.531	-	
3	3	CLAY	3.50	5.00	1.50	1.90	0.671	0.130	0.00	63.76	21.69	-	-	14.839	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	125.25	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						49.21
2	2	CLAY	2.50	4.00	1.50	1.90	0.671	0.130	0.00	49.04	66.25	-	-	43.325	-	
3	3	CLAY	4.00	5.50	1.50	1.96	0.640	0.125	0.00	62.72	27.74	-	-	18.184	-	

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SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	89.63	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	0.000	0.000	0.00	Depth of foundation						53.57
2	2	CLAY	1.50	3.50	2.00	1.87	0.665	0.131	0.00	41.04	45.73	-	-	51.170	-	
3	3	CLAY	3.50	5.25	1.75	1.90	0.671	0.130	0.00	63.31	19.39	-	-	15.796	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	81.77	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.80	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	1.50	3.50	2.00	1.87	0.665	0.131	0.00	41.04	41.72	-	-	47.937	-	50.00
3	3	CLAY	3.50	5.25	1.75	1.90	0.671	0.130	0.00	63.31	17.69	-	-	14.568	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	95.25	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.87	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	2.00	4.00	2.00	1.90	0.671	0.130	0.00	50.78	48.60	-	-	45.373	-	46.73
3	3	CLAY	4.00	5.50	1.50	1.96	0.640	0.125	0.00	71.93	21.60	-	-	13.037	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	120.65	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.00	Depth of foundation						57.65
2	2	CLAY	2.50	4.50	2.00	1.90	0.671	0.130	0.00	51.24	61.56	-	-	53.319	-	
3	3	CLAY	4.50	6.25	1.75	1.96	0.640	0.125	0.00	68.31	26.10	-	-	18.746	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	99.72	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.87	0.000	0.000	0.000	Depth of foundation						
2	2	CLAY	2.50	4.50	2.00	1.9	0.671	0.130	0.000	51.24	50.88	-	-	46.598	-	50.00
3	3	CLAY	4.50	6.25	1.75	1.96	0.640	0.125	0.000	68.31	21.57	-	-	15.899	-	

VIVEK MATERIAL TESTING LABORATORY

BEARING CAPACITY CALCULATION

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT								
BOREHOLE 02 (L.H.S.)	Depth of borehole	10.00	metre	Water table below borehole level (m)	2.20		Factor of safety	2.50
				Water table used for calculation (m)	1.20		Assumed post monsoon rise (m)	1.00

VMT
GEOTECH & MATERIAL TESTING

Input Parameters														Shearing Resistance Parameters																Ultimate Net Bearing Capacity			Net Safe Bearing Capacity
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	
					Bulk		Bulk		c	Ø	Ø'	e	q	Nc	Nq	Nγ	Nc'	Nq'	Nγ'	Sc	Sq	Sγ	Dc	Dq	Dγ	Dc'	Dq'	Dγ'	Ic	Iq	Iγ				
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																		kN/m2	kN/m2	kN/m2	kN/m2
1	SQUARE	1.50	1.20	1.20	1.81	15.79	1.81	15.79	0.10	18	12.28	0.695	23.68	13.11	5.26	4.07	9.42	3.05	1.76	1.30	1.20	0.80	1.34	1.17	1.17	1.34	1.17	1.17	1.00	1.00	1.00	385.91	184.23	239.69	**95.88**
2	SQUARE	2.00	1.20	1.20	1.81	13.83	1.86	14.32	0.10	18	12.28	0.695	27.66	13.11	5.26	4.07	9.42	3.05	1.76	1.30	1.20	0.80	1.46	1.23	1.23	1.46	1.23	1.23	1.00	1.00	1.00	439.83	210.05	273.24	**109.30**
3	SQUARE	2.50	1.20	1.20	1.81	12.65	1.86	13.14	0.15	11	7.42	0.684	31.63	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.51	1.25	1.25	1.51	1.25	1.25	1.00	1.00	1.00	343.12	189.62	240.28	**96.11**
4	SQUARE	1.50	2.00	2.00	1.81	15.79	1.81	15.79	0.10	18	12.28	0.695	23.68	13.11	5.26	4.07	9.42	3.05	1.76	1.30	1.20	0.80	1.21	1.10	1.10	1.21	1.10	1.10	1.00	1.00	1.00	367.21	174.71	227.65	**91.06**
5	SQUARE	2.00	2.00	2.00	1.81	13.83	1.86	14.32	0.10	18	12.28	0.695	27.66	13.11	5.26	4.07	9.42	3.05	1.76	1.30	1.20	0.80	1.28	1.14	1.14	1.28	1.14	1.14	1.00	1.00	1.00	408.96	194.68	253.61	**101.44**
6	SQUARE	2.50	2.00	2.00	1.81	12.65	1.86	13.14	0.15	11	7.42	0.684	31.63	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	305.49	168.75	213.87	**85.55**
7	SQUARE	1.50	2.50	2.50	1.81	15.79	1.81	15.79	0.10	18	12.28	0.695	23.68	13.11	5.26	4.07	9.42	3.05	1.76	1.30	1.20	0.80	1.17	1.08	1.08	1.17	1.08	1.08	1.00	1.00	1.00	365.32	173.47	226.23	**90.49**
8	SQUARE	2.00	2.50	2.50	1.81	13.83	1.86	14.32	0.10	18	12.28	0.695	27.66	13.11	5.26	4.07	9.42	3.05	1.76	1.30	1.20	0.80	1.22	1.11	1.11	1.22	1.11	1.11	1.00	1.00	1.00	402.04	191.01	249.04	**99.62**
9	SQUARE	2.50	2.50	2.50	1.81	12.65	1.86	13.14	0.15	11	7.42	0.684	31.63	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	296.07	163.49	207.24	**82.90**

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	95.88	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.81	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.86	0.684	0.133	0.00	38.35	36.31	-	-	34.278	-	33.44
3	3	CLAY	3.00	4.00	1.00	1.89	0.686	0.132	0.00	54.43	13.48	-	-	7.525	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	109.30	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.81	0.000	0.000	0.00	Depth of foundation						32.27
2	2	CLAY	2.00	3.50	1.50	1.86	0.684	0.133	0.00	46.45	41.39	-	-	32.782	-	
3	3	CLAY	3.50	4.50	1.00	1.89	0.686	0.132	0.00	61.76	15.37	-	-	7.556	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	96.11	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.86	0.000	0.000	0.00	Depth of foundation						27.98
2	2	CLAY	2.50	4.00	1.50	1.89	0.686	0.132	0.00	49.21	36.40	-	-	28.240	-	
3	3	CLAY	4.00	5.00	1.00	1.95	0.654	0.127	0.00	60.41	13.52	-	-	6.733	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	91.06	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.81	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.86	0.684	0.133	0.00	38.35	48.16	-	-	41.861	-	45.92
3	3	CLAY	3.00	4.50	1.50	1.89	0.686	0.132	0.00	56.61	20.17	-	-	15.540	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	101.44	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.81	0.000	0.000	0.00	Depth of foundation						43.89
2	2	CLAY	2.00	3.50	1.50	1.86	0.684	0.133	0.00	46.45	53.65	-	-	39.505	-	
3	3	CLAY	3.50	5.00	1.50	1.89	0.686	0.132	0.00	63.95	22.46	-	-	15.355	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	85.55	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.86	0.000	0.000	0.00	Depth of foundation						37.17
2	2	CLAY	2.50	4.00	1.50	1.89	0.686	0.132	0.00	49.21	45.25	-	-	33.259	-	
3	3	CLAY	4.00	5.50	1.50	1.95	0.654	0.127	0.00	62.74	18.95	-	-	13.199	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	90.49	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.81	0.000	0.000	0.00	Depth of foundation						54.03
2	2	CLAY	1.50	3.50	2.00	1.86	0.684	0.133	0.00	41.22	46.17	-	-	51.545	-	
3	3	CLAY	3.50	5.25	1.75	1.89	0.686	0.132	0.00	63.46	19.58	-	-	15.998	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	81.61	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.81	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	1.50	3.50	2.00	1.86	0.684	0.133	0.00	41.22	41.64	-	-	47.893	-	50.00
3	3	CLAY	3.50	5.25	1.75	1.89	0.686	0.132	0.00	63.46	17.65	-	-	14.605	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	99.62	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.86	0.000	0.000	0.00	Depth of foundation						48.79
2	2	CLAY	2.00	4.00	2.00	1.89	0.686	0.132	0.00	50.60	50.83	-	-	47.286	-	
3	3	CLAY	4.00	5.50	1.50	1.95	0.654	0.127	0.00	71.71	22.59	-	-	13.697	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	2.20	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	82.90	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.86	0.000	0.000	0.00	Depth of foundation						43.56
2	2	CLAY	2.50	4.50	2.00	1.89	0.686	0.132	0.00	51.39	42.30	-	-	40.837	-	
3	3	CLAY	4.50	6.25	1.75	1.95	0.654	0.127	0.00	68.27	17.93	-	-	13.612	-	

SITE PHOTOS DURING SITE INVESTIGATION

RESULT SHEET

NAME OF THE PROJECT	**CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT IN WEST BENGAL**																						
Client Name																							
Bore Hole No.	**1 (L.H.S.)**		**Coordinate**		**Easting**					**Depth of Water Level**				2.15		**VIVEK MATERIAL TESTING LABORATORY**							
Total depth of Bore Hole	**10.00**				**Northing**					**Commenced on**			4/16/2023										
					Elevation	**100.000**				**Completed on**			4/16/2023										
Depth of Bore Hole	**Reduced Level**		**Types of Samples**	**% Material Passing IS Sieve**				**Atterberg Limits**			**IS group symbol**	**SPT Value**	**SPT Value corrected due to overburden**	**SPT Value corrected due to dilatancy**	**Wet Bulk Density**	**Original Moisture**	**Dry Bulk Density**	**Specific Gravity**	**Void Ratio**	**Shear Characterisitics**		**Compression Index**
				4.750	**2.000**	**0.425**	**0.075**	**LL**	**PL**	**PI**										**Cohesion**	**Angle of Internal Friction**	
metre	metre			(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N''	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(Ø)	(Cc)
1	**2**		**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
0.00 - 0.50	100.000 - 99.500		DS	100	100	100	98	29	20	9	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650		UD	100	100	99	97	28	19	9	CL				1.80	15.3	1.56	2.63	0.686	0.20	11°	0.133
1.35 - 1.80	98.650 - 98.200		SPT									6	8.21	8.21								
2.50 - 2.85	97.500 - 97.150		UD	100	100	100	99	30	19	11	CL				1.87	18.4	1.58	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700		SPT									7	9.96	9.96								
4.00 - 4.35	96.000 - 95.650		UD	100	100	100	98	32	16	16	CL				1.90	20.2	1.58	2.64	0.671	0.30	7°	0.130
4.35 - 4.80	95.650 - 95.200		SPT									8	10.32	10.32								
5.50 - 5.85	94.500 - 94.150		UD	100	100	100	96	30	16	14	CL				1.96	21.8	1.61	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700		SPT									11	13.07	13.07								
7.00 - 7.35	93.000 - 92.650		UD	100	100	100	41	NON PLASTIC			SM				1.90	23.6	1.54	2.59	0.682	0	29°	-
7.35 - 7.80	92.650 - 92.200		SPT									13	14.50	14.50								
8.50 - 8.85	91.500 - 91.150		UD	100	100	100	40	NON PLASTIC			SM				1.93	22.2	1.58	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700		SPT									17	17.91	16.46								
9.30 - 10.00	90.700 - 90.000		DS	100	100	100	40	NON PLASTIC			SM					-	-	-	-	-	-	-

RESULT SHEET

NAME OF THE PROJECT	**CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT IN WEST BENGAL**																							
Client Name																								
Bore Hole No.	**2 (L.H.S.)**		**Coordinate**		**Easting**					**Depth of Water Level**			2.20		**VIVEK MATERIAL TESTING LABORATORY**								
Total depth of Bore Hole	**10.00**				**Northing**					**Commenced on**			4/16/2023											
					Elevation		**100.000**			**Completed on**			4/16/2023											

Depth of Bore Hole	**Reduced Level**	**Types of Samples**	**% Material Passing IS Sieve**				**Atterberg Limits**			**IS group symbol**	**SPT Value**	**SPT Value corrected due to overburden**	**SPT Value corrected due to dilatancy**	**Wet Bulk Density**	**Original Moisture**	**Dry Bulk Density**	**Specific Gravity**	**Void Ratio**	**Shear Characterisitics**		**Compression Index**
			4.750	**2.000**	**0.425**	**0.075**	**LL**	**PL**	**PI**										**Cohesion**	**Angle of Internal Friction**	
metre	**metre**		**(mm)**	**(mm)**	**(mm)**	**(mm)**	**%**	**%**	**%**		**N**	**N'**	**N''**	**(gms/cc)**	**%**	**(gms/cc)**	**(G)**		**(Kg/sqcm)**	**(Ø)**	**(Cc)**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
0.00 - 0.50	100.000 - 99.500	DS	100	100	100	98	34	22	12	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	100	98	97	31	20	11	CL				1.81	17.4	1.54	2.61	0.695	0.10	18°	0.135
1.35 - 1.80	98.650 - 98.200	SPT									5	6.84	6.84								
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	98	33	19	14	CL				1.86	20.3	1.55	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									6	8.54	8.54								
4.00 - 4.35	96.000 - 95.650	UD	100	100	97	96	34	21	13	CL				1.89	21.4	1.56	2.63	0.686	0.25	11°	0.132
4.35 - 4.80	95.650 - 95.200	SPT									7	9.03	9.03								
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	98	35	21	14	CL				1.95	22.6	1.59	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									10	11.90	11.90								
7.00 - 7.35	93.000 - 92.650	UD	100	100	100	43	NON PLASTIC			SM				1.91	23.1	1.55	2.58	0.665	0	28°	-
7.35 - 7.80	92.650 - 92.200	SPT									14	15.62	15.31								
8.50 - 8.85	91.500 - 91.150	UD	100	100	98	44	NON PLASTIC			SM				1.92	20.2	1.60	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									19	20.04	17.52								
9.30 - 10.00	90.700 - 90.000	DS	100	100	100	46	NON PLASTIC			SM					-	-	-	-	-	-	-

BORE-LOG CHART

VMT
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VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT IN WEST BENGAL

WATER TABLE 2.15 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 01 (L.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES
			GROUP	HATCHING	N1	N2	N3	N2+N3	10 20 30 40 50 60 70 80 90 100
0.00-0.50	SILTY-CLAY	D.	CL						
1.00-1.35	SILTY-CLAY	U.D.	CL						
1.35-1.80		S.P.T.			2	3	3	6	
2.50-2.85	SILTY-CLAY	U.D.	CL						
2.85-3.30		S.P.T.			2	3	4	7	
4.00-4.35	SILTY-CLAY	U.D.	CL						
4.35-4.80		S.P.T.			3	4	4	8	
5.50-5.85	SILTY-CLAY	U.D.	CL						
5.85-6.30		S.P.T.			4	5	6	11	
7.00-7.35	SILTY-SAND	U.D.	SM						
7.35-7.80		S.P.T.			5	6	7	13	
8.50-8.85	SILTY-SAND	U.D.	SM						
8.85-9.30		S.P.T.			6	8	9	17	
9.30-10.00	SILTY-SAND	D.	SM						

BORE-LOG CHART

VMT
GEOTECH & MATERIAL TESTING

VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT IN WEST BENGAL

WATER TABLE 2.20 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 02 (L.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES
			GROUP	HATCHING	N1	N2	N3	N2+N3	10 20 30 40 50 60 70 80 90 100
0.00-0.50	SILTY-CLAY	D.	CL						
1.00-1.35	SILTY-CLAY	U.D.	CL						
1.35-1.80		S.P.T.			2	2	3	5	
2.50-2.85	SILTY-CLAY	U.D.	CL						
2.85-3.30		S.P.T.			2	3	3	6	
4.00-4.35	SILTY-CLAY	U.D.	CL						
4.35-4.80		S.P.T.			2	3	4	7	
5.50-5.85	SILTY-CLAY	U.D.	CL						
5.85-6.30		S.P.T.			4	5	5	10	
7.00-7.35	SILTY-SAND	U.D.	SM						
7.35-7.80		S.P.T.			5	7	7	14	
8.50-8.85	SILTY-SAND	U.D.	SM						
8.85-9.30		S.P.T.			7	9	10	19	
9.30-10.00	SILTY-SAND	D.	SM						

VMT/132/23-24 (LHS) WB

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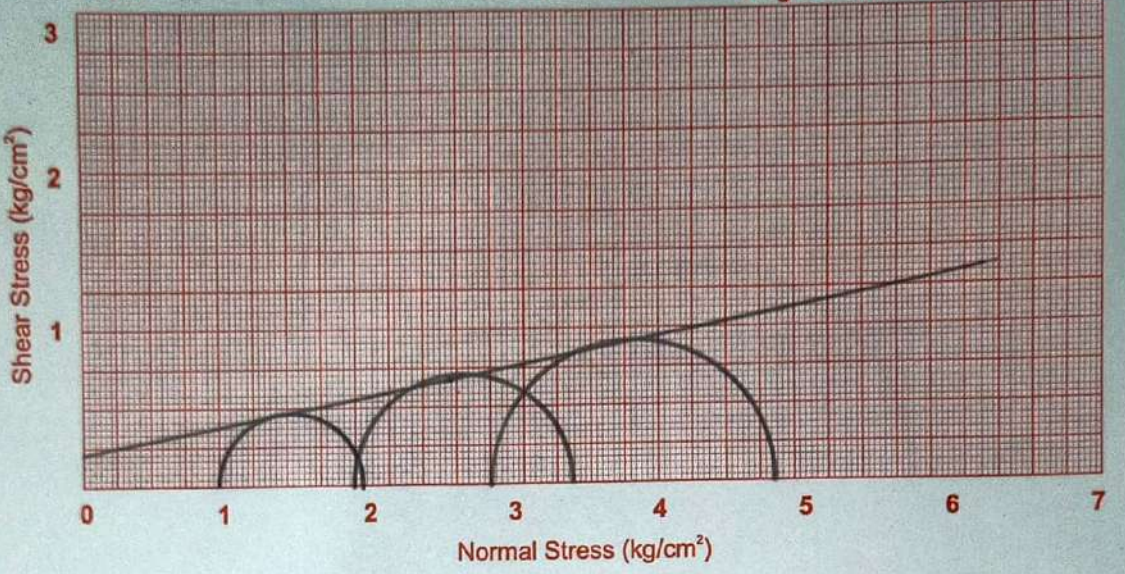
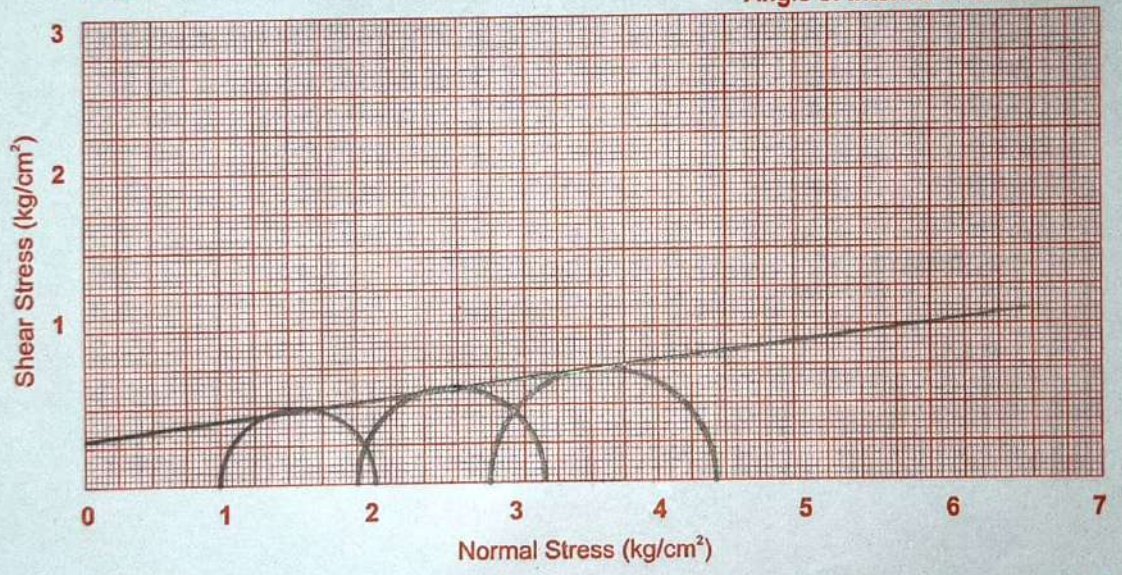
B.H. No. :- 01
Depth - 1.00 - 1.35

Cohesion 'c' 0.20 Kg/cm²
Angle of Internal Friction 11° *



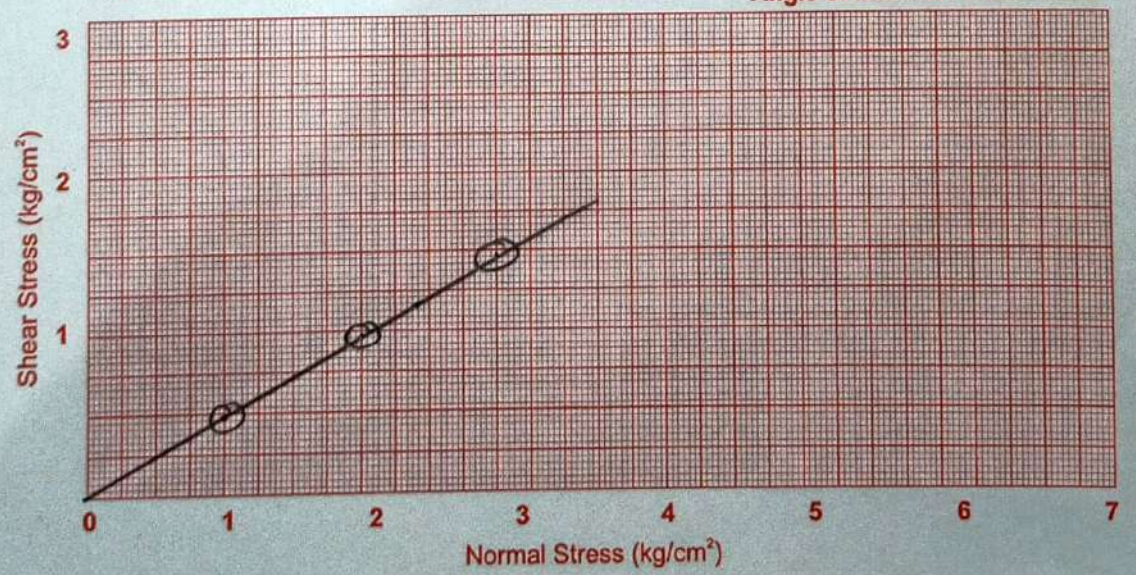
B.H. No. :- 01
Depth :- 4.00 - 4.35

Cohesion 'c' 0.30 Kg/cm²
Angle of Internal Friction 7° *



B.H. No. :- 01
Depth :- 7.00 - 7.35

Cohesion 'c' 0 Kg/cm²
Angle of Internal Friction 29° *



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VMT/132/23-24 (L.H.S) W.B.

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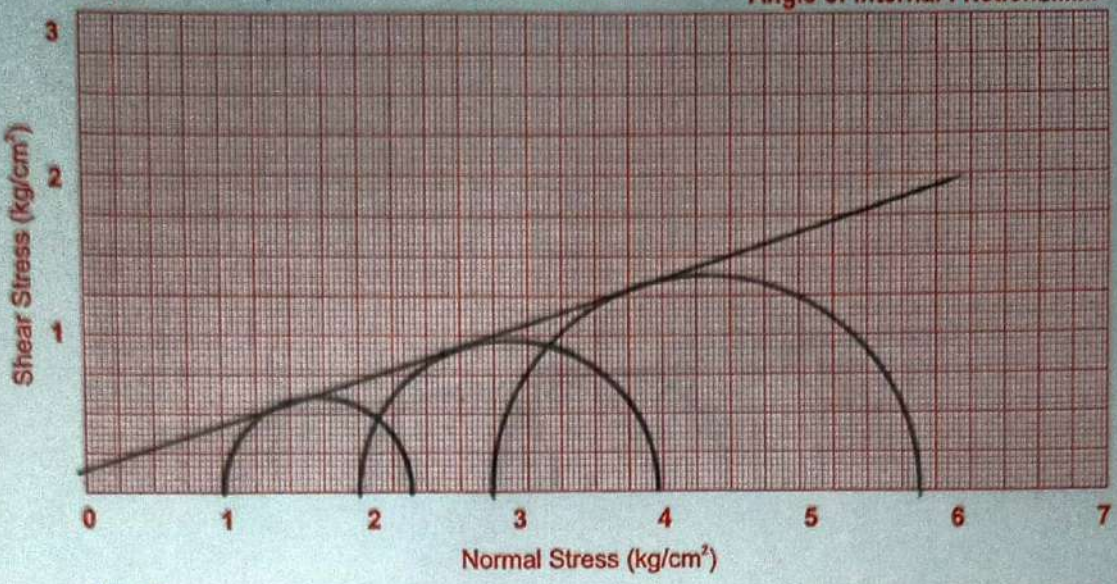
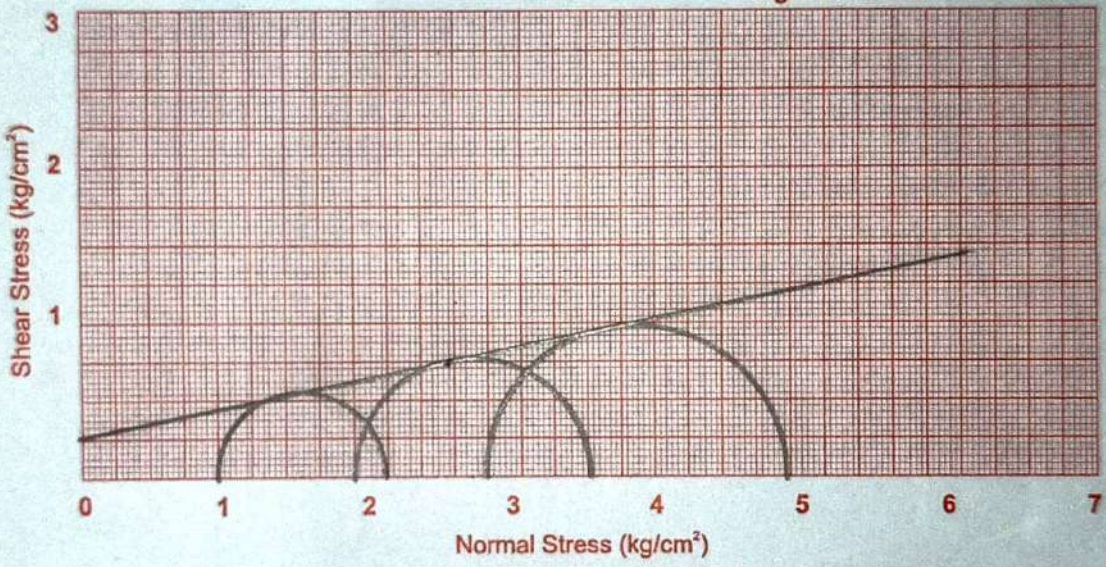
B.H. No. :- 02
Depth - 1.00 - 1.35

Cohesion 'c' 0.10 Kg/cm²
Angle of Internal Friction 18° *



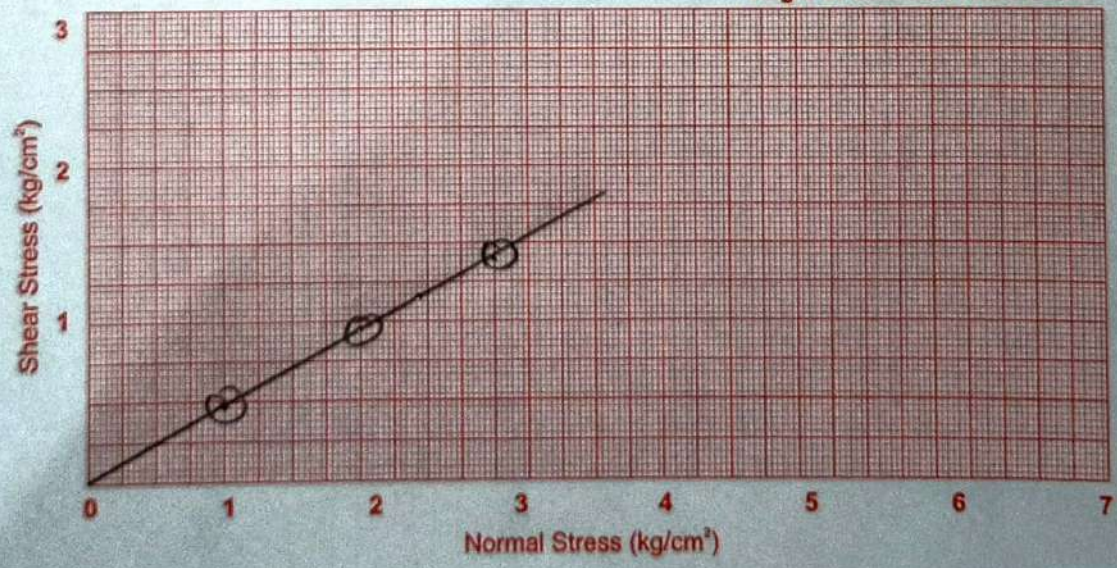
B.H. No. :- 02
Depth :- 4.00 - 4.35

Cohesion 'c' 0.25 Kg/cm²
Angle of Internal Friction 11° *



B.H. No. :- 02
Depth :- 7.00 - 7.35

Cohesion 'c' 0 Kg/cm²
Angle of Internal Friction 28° *



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TC-8969

REPORT NO. – VMT 132 B/2023-2024

GEOTECH INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT OPOOSITE (R.H.S.) IN WEST BENGAL

Prepared By -

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ACKNOWLEDGEMENT

WE ARE GRATEFUL TO M/s KITCO LTD., KERLA FOR PROVIDING US THE OPPORTUNITY TO CARRY OUT THESE INVESTIGATIONS.

THE CO-OPERATION EXTENDED BY THEIR ENGINEERS DURING FIELD INVESTIGATIONS IS THANKFULLY ACKNOWLEDGED.

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SUB-SOIL INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT OPOOSITE IN WEST BENGAL

INTRODUCTION

The work of sub-soil exploration was awarded to us by M/s KITCO LTD., KERLA Order no. – 6777:DP 1083: RG: 2023 dated 21/03/2023. The object of the investigation was to study the geo-technical properties of soil both in field and laboratory and determine safe allowable pressure for the foundation soil.

The fieldwork consisted of 02 bore holes of 10.00 metre depth each. The fieldwork was conducted on 17/04/2023. The location of the bore holes is shown in the Site location.

REFERENCES

1. **IS: 1892-2021** for field work including existent ground water table.
2. **IS: 2132-1986** for sampling in Undisturbed and Disturbed form.
3. **IS: 2131-1981** for Standard Penetration Test.
4. **IS: 2720** for all laboratory tests on soil samples collected.
5. **IS: 6403-1981** for determination of Bearing Capacity.
6. **IS: 8009(Part I)-1976** for calculation of settlement of foundations.
7. **IS: 1904-2021** for permissible maximum settlement, differential settlement and angular distortion.

SCOPE OF WORK

The scope consisted of drilling of boreholes down to maximum depth of 10.00 m in normal soils / rock, Standard Penetration Testing, collection of samples, laboratory testing and preparation and submission of Geotechnical Investigation report.

Summary of the fieldwork					
Sl. No.	Site	Borehole Nos.	Coordinates		Depth below existing ground level (m)
			Latitude	Longitude	
1.	LALBAGH FERRY GHAT OPOOSITE	BH-01 (RHS)	24.17059937	88.26650675	10.0
2.		BH-02 (RHS)	24.17004572	88.26657582	10.0

SITE LOCATION

INTERPRETATION OF THE LAB TEST RESULTS

GENERAL NATURE OF SOIL STRATA

The bore hole log charts and lab test results of bore holes 1 and 2 indicate that the strata at the site is found to comprise of both cohesive as well as non-cohesive soil.

The results of classification tests indicate that the natural soil stratum present at the Site is found to comprise of both fine-grained soils comprising of 'CL' and 'CI' group of IS classification (clayey soil) having 95 to 99 percent material finer than 75 micron and coarse-grained soils (sandy soil) comprise of 'ML' group of IS classification having 71 to 88 percent material finer than 75 micron.

The bore hole log charts and lab test results of bore holes 1 indicate that:

first strata, from 0.00 metre to 7.00 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity,

second strata, from 7.00 metre to 10.00 metre, consists of a layer of ML group of IS classification which is inorganic silts with none to low plasticity.

The bore hole log charts and lab test results of bore holes 2 indicate that:

first strata, from 0.00 metre to 2.50 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 2.50 metre to 7.00 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity,

third strata, from 7.00 metre to 10.00 metre, consists of a layer of ML group of IS classification which is inorganic silts with none to low plasticity.

S.P.T. VALUES

The S.P.T. values obtained in the respective clayey layer region present as per bore-log charts enclosed are found to range 4 to 9 indicating 'Soft' to 'Medium' consistency.

However, the S.P.T. values obtained in the respective sandy layer region present as per bore-log charts enclosed are found to range from 9 to 16 indicating 'Loose' to 'Medium' relative density.

The results of S.P.T. values indicate that the stratum at the Site is 'Loose' to 'Well' compacted.

WATER TABLE

Water Table at the Site was observed at a depth from 2.00 metre to 2.15 metre below ground level on the day of soil investigation during the Third week of April 2023. However, the existing water table may rise by 1.00 metre in the post-monsoon period in general. Therefore, a water table at a depth of 1.00 metre to 1.15 metre below ground level has been adopted for calculation purposes.

RECOMMENDATIONS FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT OPOOSITE IN WEST BENGAL

NET SAFE BEARING CAPACITY/SAFE ALLOWABLE PRESSURE

Bore Hole Nos.	Type of Structure	Depth of Foundation (metres)	Size of Footing (L x B) (metres)	Net Safe Bearing Capacity (Tonne/sqm.)	Settlement Produced (mm)	Safe Allowable Pressure for Permissible Settlement 50 mm (Tonne/sqm.)
1	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	11.06	37.45	-
		2.00	1.20 x 1.20	11.99	37.67	-
		2.50	1.20 x 1.20	9.87	30.28	-
		1.50	2.00 x 2.00	10.23	50.43	10.11
		2.00	2.00 x 2.00	10.84	50.33	10.74
		2.50	2.00 x 2.00	8.75	39.99	-
		1.50	2.50 x 2.50	10.03	58.87	8.06
		2.00	2.50 x 2.50	10.48	57.04	8.78
		2.50	2.50 x 2.50	8.44	46.69	-
2	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	9.07	32.33	-
		2.00	1.20 x 1.20	10.12	30.62	-
		2.50	1.20 x 1.20	12.10	33.15	-
		1.50	2.00 x 2.00	8.48	43.85	-
		2.00	2.00 x 2.00	9.23	41.10	-
		2.50	2.00 x 2.00	10.77	43.86	-
		1.50	2.50 x 2.50	8.35	51.22	8.09
		2.00	2.50 x 2.50	9.00	44.52	-
		2.50	2.50 x 2.50	10.42	51.39	10.05

NOTE: -

The above recommendations are based on the field investigation data results and the laboratory tests results of the samples collected from the test locations and our experience in this regard. If the actual sub-soil conditions during excavation for the

foundations differ from that has been reported, a reference should be made to us for suggestions.

Further, the recommendations are based on the assumptions as mentioned in the Report and the designer of the Structure should take into consideration all the factors required as per codes. The recommendations should be taken as guidelines for the designer.

Er. Akhil Singh
TECHNICAL MANAGER
VIVEK MATERIAL TESTING LABORATORY

Shubham Singh
Dy. TECHNICAL MANAGER/ QUALITY MANAGER
VIVEK MATERIAL TESTING LAORATORY

BEARING CAPACITY CALCULATIONS

Soil when stressed due to loading, tend to deform. The resistance to deformation of the soil depends upon factors like water content, bulk density, angle of internal friction and the manner in which load is applied on the soil. The maximum load per unit area which the soil or rock can carry without yielding or displacement is termed as the bearing capacity of soils. The Safe Bearing Capacity of the proposed STRUCTURE without any distress is determined from the considerations of the following criteria.

[A] SHEAR CRITERIA

The soil beneath the foundation shall be safe from risk of shear failure.

[B] SETTLEMENT CRITERIA

The settlement due to load is caused basically on account of two factors, namely,

(i) the soil below footing gets compressed by certain amount and

(ii) since the foundations cover only a limited area there is a possibility that the concentrated stresses developed are so high as to cause actual rupture (shear failure) and displacement of soil below.

The foundation should not settle or deflect to an extent causing damage to the Structure or impair its usefulness.

The Bearing Capacity Calculations for the Foundation shall be governed as per IS: 6403-1981, IS: 8009(Part-I)-1976 and IS: 1904-2021 on the basis of available information regarding the proposed design.

BEARING CAPACITY ON SHEAR CONSIDERATIONS

ULTIMATE NET BEARING CAPACITY

As per IS: 6403-1981, the Ultimate Net Bearing Capacity 'qd' on shear consideration for a Structure is given by the formula: -

FOR GENERAL SHEAR FAILURE

qd = c.Nc.Sc.dc.ic+q(Nq-1).sq.dq.iq + 1/2 B.r.Nr.Sr.dr.ir.W'.

FOR LOCAL SHEAR FAILURE

q'd = 2/3 c.N'c.Sc.dc.ic+q(N'q-1).Sq.dq.iq + 1/2 B.r.N'r.Sr.dr.ir.W'.

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BEARING CAPACITY CALCULATION

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT								
BOREHOLE 01 (R.H.S.)	Depth of borehole	10.00	metre	Water table below borehole level (m)	2.00		Factor of safety	2.50
				Water table used for calculation (m)	1.00		Assumed post monsoon rise (m)	1.00

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Input Parameters														Shearing Resistance Parameters																Ultimate Net Bearing Capacity			
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors							Inclination Factors			General shear	Local shear	Intermediate	Net Safe Bearing Capacity
					Bulk		Bulk		c	Ø	Ø'	e	q	Nc	Nq	Nγ	Nc'	Nq'	Nγ'	Sc	Sq	Sγ	Dc	Dq	Dγ	Dc'	Dq'	Dγ'	Ic	Iq	Iγ				
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																			kN/m2	kN/m2	kN/m2	kN/m2
1	SQUARE	1.50	1.20	1.20	1.81	14.48	1.81	14.48	0.30	7	4.70	0.690	21.72	7.17	1.88	0.71	6.44	1.53	0.42	1.30	1.20	0.80	1.28	1.00	1.00	1.28	1.00	1.00	1.00	1.00	1.00	376.98	225.79	271.15	**108.46**
2	SQUARE	2.00	1.20	1.20	1.81	12.85	1.82	12.95	0.30	7	4.70	0.690	25.69	7.17	1.88	0.71	6.44	1.53	0.42	1.30	1.20	0.80	1.38	1.00	1.00	1.38	1.00	1.00	1.00	1.00	1.00	408.62	244.75	293.91	**117.56**
3	SQUARE	2.50	1.20	1.20	1.81	11.87	1.82	11.96	0.20	10	6.74	0.724	29.67	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.50	1.25	1.25	1.50	1.25	1.25	1.00	1.00	1.00	390.93	219.77	242.02	**96.81**
4	SQUARE	1.50	2.00	2.00	1.81	14.48	1.81	14.48	0.30	7	4.70	0.690	21.72	7.17	1.88	0.71	6.44	1.53	0.42	1.30	1.20	0.80	1.17	1.00	1.00	1.17	1.00	1.00	1.00	1.00	1.00	348.83	208.92	250.89	**100.36**
5	SQUARE	2.00	2.00	2.00	1.81	12.85	1.82	12.95	0.30	7	4.70	0.690	25.69	7.17	1.88	0.71	6.44	1.53	0.42	1.30	1.20	0.80	1.23	1.00	1.00	1.23	1.00	1.00	1.00	1.00	1.00	369.51	221.32	265.78	**106.31**
6	SQUARE	2.50	2.00	2.00	1.81	11.87	1.82	11.96	0.20	10	6.74	0.724	29.67	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	346.65	194.83	214.57	**85.83**
7	SQUARE	1.50	2.50	2.50	1.81	14.48	1.81	14.48	0.30	7	4.70	0.690	21.72	7.17	1.88	0.71	6.44	1.53	0.42	1.30	1.20	0.80	1.14	1.00	1.00	1.14	1.00	1.00	1.00	1.00	1.00	341.87	204.74	245.88	**98.35**
8	SQUARE	2.00	2.50	2.50	1.81	12.85	1.82	12.95	0.30	7	4.70	0.690	25.69	7.17	1.88	0.71	6.44	1.53	0.42	1.30	1.20	0.80	1.18	1.00	1.00	1.18	1.00	1.00	1.00	1.00	1.00	357.06	213.86	256.82	**102.73**
9	SQUARE	2.50	2.50	2.50	1.81	11.87	1.82	11.96	0.20	10	6.74	0.724	29.67	8.34	2.47	1.22	7.03	1.83	0.67	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	334.50	187.97	207.02	**82.81**

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	108.46	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.81	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.82	0.724	0.136	0.00	37.56	41.07	-	-	37.969	-	37.45
3	3	CLAY	3.00	4.00	1.00	1.87	0.695	0.136	0.00	52.76	15.25	-	-	8.848	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	117.56	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.81	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	2.00	3.50	1.50	1.82	0.724	0.136	0.00	41.53	44.52	-	-	37.436	-	37.67
3	3	CLAY	3.50	4.50	1.00	1.87	0.695	0.136	0.00	51.83	16.53	-	-	9.647	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	96.81	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.82	0.000	0.000	0.00	Depth of foundation						30.28
2	2	CLAY	2.50	4.00	1.50	1.87	0.695	0.136	0.00	46.12	36.66	-	-	30.577	-	
3	3	CLAY	4.00	5.00	1.00	1.92	0.662	0.130	0.00	57.03	13.61	-	-	7.272	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	100.36	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.81	-	-	-	Depth of foundation						50.43
2	2	CLAY	1.50	3.00	1.50	1.82	0.724	0.136	0.00	37.56	53.08	-	-	45.273	-	
3	3	CLAY	3.00	4.50	1.50	1.87	0.695	0.136	0.00	54.89	22.23	-	-	17.768	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	99.15	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.81	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.82	0.724	0.136	0.00	37.56	52.44	-	-	44.91	-	50.00
3	3	CLAY	3.00	4.50	1.50	1.87	0.695	0.136	0.00	54.89	21.96	-	-	17.59	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	106.31	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.81	0.000	0.000	0.00	Depth of foundation						50.33
2	2	CLAY	2.00	3.50	1.50	1.82	0.724	0.136	0.00	41.53	56.23	-	-	43.993	-	
3	3	CLAY	3.50	5.00	1.50	1.87	0.695	0.136	0.00	53.96	23.54	-	-	18.924	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	105.35	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.81	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	2.00	3.50	1.50	1.82	0.724	0.136	0.00	41.53	55.72	-	-	43.725	-	
3	3	CLAY	3.50	5.00	1.50	1.87	0.695	0.136	0.00	53.96	23.33	-	-	18.781	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	85.83	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.82	0.000	0.000	0.00	Depth of foundation						39.99
2	2	CLAY	2.50	4.00	1.50	1.87	0.695	0.136	0.00	46.12	45.40	-	-	35.821	-	
3	3	CLAY	4.00	5.50	1.50	1.92	0.662	0.130	0.00	59.28	19.01	-	-	14.171	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	98.35	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.81	0.000	0.000	0.00	Depth of foundation						58.87
2	2	CLAY	1.50	3.50	2.00	1.82	0.724	0.136	0.00	40.27	50.18	-	-	55.443	-	
3	3	CLAY	3.50	5.25	1.75	1.87	0.695	0.136	0.00	61.38	21.28	-	-	18.148	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	79.00	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.81	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	1.50	3.50	2.00	1.82	0.724	0.136	0.00	40.27	40.31	-	-	47.524	-	50.00
3	3	CLAY	3.50	5.25	1.75	1.87	0.695	0.136	0.00	61.38	17.09	-	-	14.978	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	102.73	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.00	Depth of foundation						57.04
2	2	CLAY	2.00	4.00	2.00	1.87	0.695	0.136	0.00	44.23	52.41	-	-	54.473	-	
3	3	CLAY	4.00	5.50	1.50	1.92	0.662	0.130	0.00	59.53	23.29	-	-	16.828	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	86.06	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.000	Depth of foundation						50.00
2	2	CLAY	2.00	4.00	2.00	1.87	0.695	0.136	0.000	44.23	43.91	-	-	48.053	-	
3	3	CLAY	4.00	5.50	1.50	1.92	0.662	0.130	0.000	59.53	19.51	-	-	14.448	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	2.00	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	82.81	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.82	0.000	0.000	0.00	Depth of foundation						46.69
2	2	CLAY	2.50	4.50	2.00	1.87	0.695	0.136	0.00	48.25	42.25	-	-	43.833	-	
3	3	CLAY	4.50	6.25	1.75	1.92	0.662	0.130	0.00	64.68	17.91	-	-	14.535	-	

VIVEK MATERIAL TESTING LABORATORY

BEARING CAPACITY CALCULATION

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT								
BOREHOLE 02 (R.H.S.)	Depth of borehole	10.00	metre	Water table below borehole level (m)	2.15		Factor of safety	2.50
				Water table used for calculation (m)	1.15		Assumed post monsoon rise (m)	1.00

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Input Parameters														Shearing Resistance Parameters																Ultimate Net Bearing Capacity			Net Safe Bearing Capacity
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	
					Bulk		Bulk		c	Ø	Ø'	e	q	Nc	Nq	Nγ	Nc'	Nq'	Nγ'	Sc	Sq	Sγ	Dc	Dq	Dγ	Dc'	Dq'	Dγ'	Ic	Iq	Iγ				
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																		kN/m2	kN/m2	kN/m2	kN/m2
1	SQUARE	1.50	1.20	1.20	1.82	15.56	1.82	15.56	0.15	13	8.79	0.688	23.34	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.31	1.16	1.16	1.31	1.16	1.16	1.00	1.00	1.00	328.48	174.84	222.47	**88.99**
2	SQUARE	2.00	1.20	1.20	1.82	13.68	1.88	14.27	0.15	13	8.79	0.688	27.36	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.42	1.21	1.21	1.42	1.21	1.21	1.00	1.00	1.00	366.19	194.94	248.03	**99.21**
3	SQUARE	2.50	1.20	1.20	1.82	12.55	1.88	13.14	0.20	12	8.11	0.706	31.38	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.51	1.26	1.26	1.51	1.26	1.26	1.00	1.00	1.00	459.82	250.72	296.72	**118.69**
4	SQUARE	1.50	2.00	2.00	1.82	15.56	1.82	15.56	0.15	13	8.79	0.688	23.34	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.19	1.09	1.09	1.19	1.09	1.09	1.00	1.00	1.00	307.12	163.29	207.88	**83.15**
5	SQUARE	2.00	2.00	2.00	1.82	13.68	1.88	14.27	0.15	13	8.79	0.688	27.36	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.25	1.13	1.13	1.25	1.13	1.13	1.00	1.00	1.00	334.29	177.77	226.29	**90.52**
6	SQUARE	2.50	2.00	2.00	1.82	12.55	1.88	13.14	0.20	12	8.11	0.706	31.38	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.31	1.15	1.15	1.31	1.15	1.15	1.00	1.00	1.00	409.29	223.03	264.01	**105.60**
7	SQUARE	1.50	2.50	2.50	1.82	15.56	1.82	15.56	0.15	13	8.79	0.688	23.34	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.15	1.08	1.08	1.15	1.08	1.08	1.00	1.00	1.00	302.65	160.80	204.77	**81.91**
8	SQUARE	2.00	2.50	2.50	1.82	13.68	1.88	14.27	0.15	13	8.79	0.688	27.36	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	326.27	173.38	220.78	**88.31**
9	SQUARE	2.50	2.50	2.50	1.82	12.55	1.88	13.14	0.20	12	8.11	0.706	31.38	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.25	1.12	1.12	1.25	1.12	1.12	1.00	1.00	1.00	396.00	215.70	255.37	**102.15**

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	88.99	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.88	0.706	0.139	0.00	38.52	33.70	-	-	33.364	-	32.33
3	3	CLAY	3.00	4.00	1.00	1.92	0.686	0.133	0.00	54.77	12.51	-	-	7.050	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	99.21	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	2.00	3.50	1.50	1.88	0.706	0.139	0.00	46.69	37.57	-	-	31.337	-	30.62
3	3	CLAY	3.50	4.50	1.00	1.92	0.686	0.133	0.00	62.19	13.95	-	-	6.934	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	118.69	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.88	0.000	0.000	0.00	Depth of foundation						33.15
2	2	CLAY	2.50	4.00	1.50	1.92	0.686	0.133	0.00	49.43	44.95	-	-	33.237	-	
3	3	CLAY	4.00	5.00	1.00	1.97	0.654	0.129	0.00	60.95	16.69	-	-	8.198	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	83.15	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	-	-	-	Depth of foundation						43.85
2	2	CLAY	1.50	3.00	1.50	1.88	0.706	0.139	0.00	38.52	43.98	-	-	40.427	-	
3	3	CLAY	3.00	4.50	1.50	1.92	0.686	0.133	0.00	57.03	18.41	-	-	14.380	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	90.52	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.00	Depth of foundation						41.10
2	2	CLAY	2.00	3.50	1.50	1.88	0.706	0.139	0.00	46.69	47.88	-	-	37.463	-	
3	3	CLAY	3.50	5.00	1.50	1.92	0.686	0.133	0.00	64.45	20.05	-	-	13.918	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	105.60	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.88	0.000	0.000	0.00	Depth of foundation						43.86
2	2	CLAY	2.50	4.00	1.50	1.92	0.686	0.133	0.00	49.43	55.85	-	-	38.857	-	
3	3	CLAY	4.00	5.50	1.50	1.97	0.654	0.129	0.00	63.33	23.39	-	-	15.968	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	81.91	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	0.000	0.000	0.00	Depth of foundation						51.22
2	2	CLAY	1.50	3.50	2.00	1.88	0.706	0.139	0.00	41.43	41.79	-	-	49.364	-	
3	3	CLAY	3.50	5.25	1.75	1.92	0.686	0.133	0.00	63.98	17.72	-	-	14.658	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	79.36	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	1.50	3.50	2.00	1.88	0.706	0.139	0.00	41.43	40.49	-	-	48.249	-	
3	3	CLAY	3.50	5.25	1.75	1.92	0.686	0.133	0.00	63.98	17.17	-	-	14.252	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00		BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	88.31	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.88	0.000	0.000	0.00	Depth of foundation						44.52
2	2	CLAY	2.00	4.00	2.00	1.92	0.686	0.133	0.00	51.17	45.06	-	-	43.274	-	
3	3	CLAY	4.00	5.50	1.50	1.97	0.654	0.129	0.00	72.60	20.02	-	-	12.377	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	102.15	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.88	0.000	0.000	0.00	Depth of foundation						51.39
2	2	CLAY	2.50	4.50	2.00	1.92	0.686	0.133	0.00	51.68	52.12	-	-	47.781	-	
3	3	CLAY	4.50	6.25	1.75	1.97	0.654	0.129	0.00	69.03	22.10	-	-	16.463	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	2.15	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	98.52	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.88	0.000	0.000	0.000	Depth of foundation						50.00
2	2	CLAY	2.50	4.50	2.00	1.92	0.686	0.133	0.000	51.68	50.27	-	-	46.547	-	
3	3	CLAY	4.50	6.25	1.75	1.97	0.654	0.129	0.000	69.03	21.31	-	-	15.950	-	

SITE PHOTOS DURING SITE INVESTIGATION

RESULT SHEET

NAME OF THE PROJECT	CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT OPOOSITE IN WEST BENGAL																				
Client Name																					
Bore Hole No.	1 (R.H.S.)	Coordinate	Easting				Depth of Water Level							2.00	VIVEK MATERIAL TESTING LABORATORY						
Total depth of Bore Hole	10.00		Northing				Commenced on							4/17/2023							
			Elevation			100.000	Completed on							4/17/2023							
Depth of Bore Hole	Reduced Level	Types of Samples	% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characterisitics		Compression Index
			4.750	2.000	0.425	0.075	LL	PL	PI										Cohesion	Angle of Internal Friction	
metre	metre		(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N"	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(Ø)	(Cc)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0.00 - 0.50	100.000 - 99.500	DS	100	100	98	95	36	21	15	CI					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	100	99	97	38	22	16	CI				1.81	16.5	1.55	2.62	0.690	0.30	7°	0.132
1.35 - 1.80	98.650 - 98.200	SPT									6	8.21	8.21								
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	99	39	24	15	CI				1.82	19.7	1.52	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									4	5.73	5.73								
4.00 - 4.35	96.000 - 95.650	UD	100	100	100	97	40	22	18	CI				1.87	21.4	1.54	2.61	0.695	0.20	12°	0.136
4.35 - 4.80	95.650 - 95.200	SPT									5	6.50	6.50								
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	98	41	25	16	CI				1.92	22.3	1.57	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									7	8.40	8.40								
7.00 - 7.35	93.000 - 92.650	UD	100	100	100	76	NON PLASTIC			ML				1.82	23.8	1.47	2.56	0.741	0	29°	-
7.35 - 7.80	92.650 - 92.200	SPT									9	10.18	10.18								
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	71	NON PLASTIC			ML				1.86	21.7	1.53	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									13	13.92	13.92								
9.30 - 10.00	90.700 - 90.000	DS	100	100	100	73	NON PLASTIC			ML					-	-	-	-	-	-	-

RESULT SHEET

NAME OF THE PROJECT	**CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT OPOOSITE IN WEST BENGAL**																						
Client Name																							
Bore Hole No.	**2 (R.H.S.)**		**Coordinate**		**Easting**					**Depth of Water Level**			2.15		**VIVEK MATERIAL TESTING LABORATORY**							
Total depth of Bore Hole	**10.00**				**Northing**					**Commenced on**			4/17/2023										
					Elevation			**100.000**		**Completed on**			4/17/2023										

Depth of Bore Hole	**Reduced Level**	**Types of Samples**	**% Material Passing IS Sieve**				**Atterberg Limits**			**IS group symbol**	**SPT Value**	**SPT Value corrected due to overburden**	**SPT Value corrected due to dilatancy**	**Wet Bulk Density**	**Original Moisture**	**Dry Bulk Density**	**Specific Gravity**	**Void Ratio**	**Shear Characterisitics**		**Compression Index**
			4.750	**2.000**	**0.425**	**0.075**	**LL**	**PL**	**PI**										**Cohesion**	**Angle of Internal Friction**	
metre	**metre**		**(mm)**	**(mm)**	**(mm)**	**(mm)**	**%**	**%**	**%**		**N**	**N'**	**N"**	**(gms/cc)**	**%**	**(gms/cc)**	**(G)**		**(Kg/sqcm)**	**(Ø)**	**(Cc)**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
0.00 - 0.50	100.000 - 99.500	DS	99	98	98	97	34	23	11	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	99	98	97	35	22	13	CL				1.82	18.2	1.54	2.60	0.688	0.15	13°	0.137
1.35 - 1.80	98.650 - 98.200	SPT									5	6.83	6.83								
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	98	38	24	14	CI				1.88	22.7	1.53	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									4	5.67	5.67								
4.00 - 4.35	96.000 - 95.650	UD	100	100	100	99	36	22	14	CI				1.92	23.1	1.56	2.63	0.686	0.20	12°	0.133
4.35 - 4.80	95.650 - 95.200	SPT									6	7.70	7.70								
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	97	37	23	14	CI				1.97	24.2	1.59	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									9	10.64	10.64								
7.00 - 7.35	93.000 - 92.650	UD	100	100	100	81	NON PLASTIC			ML				1.90	22.8	1.55	2.58	0.665	0	30°	-
7.35 - 7.80	92.650 - 92.200	SPT									14	15.55	15.28								
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	88	NON PLASTIC			ML				1.89	20.3	1.57	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									16	16.84	15.92								
9.30 - 10.00	90.700 - 90.000	DS	100	100	100	78	NON PLASTIC			ML					-	-	-	-	-	-	-

BORE-LOG CHART

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VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT OPOOSITE IN WEST BENGAL

WATER TABLE 2.00 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 01 (R.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES
			GROUP	HATCHING	N1	N2	N3	N2+N3	10 20 30 40 50 60 70 80 90 100
0.00-0.50	SILTY-CLAY	D.	CI						
1.00-1.35	SILTY-CLAY	U.D.	CI						
1.35-1.80		S.P.T.			2	3	3	6	
2.50-2.85	SILTY-CLAY	U.D.	CI						
2.85-3.30		S.P.T.			1	2	2	4	
4.00-4.35	SILTY-CLAY	U.D.	CI						
4.35-4.80		S.P.T.			2	2	3	5	
5.50-5.85	SILTY-CLAY	U.D.	CI						
5.85-6.30		S.P.T.			2	3	4	7	
7.00-7.35	SANDY-SILT	U.D.	ML						
7.35-7.80		S.P.T.			3	4	5	9	
8.50-8.85	SANDY-SILT	U.D.	ML						
8.85-9.30		S.P.T.			4	6	7	13	
9.30-10.00	SANDY-SILT	D.	ML						

BORE-LOG CHART

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NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT LALBAGH FERRY GHAT OPOOSITE IN WEST BENGAL

WATER TABLE 2.15 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 02 (R.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES
			GROUP	HATCHING	N1	N2	N3	N2+N3	10 20 30 40 50 60 70 80 90 100
0.00-0.50	SILTY-CLAY	D.	CL						
1.00-1.35	SILTY-CLAY	U.D.	CL						
1.35-1.80		S.P.T.			2	2	3	5	
2.50-2.85	SILTY-CLAY	U.D.	CI						
2.85-3.30		S.P.T.			2	2	2	4	
4.00-4.35	SILTY-CLAY	U.D.	CI						
4.35-4.80		S.P.T.			2	3	3	6	
5.50-5.85	SILTY-CLAY	U.D.	CI						
5.85-6.30		S.P.T.			3	4	5	9	
7.00-7.35	SANDY-SILT	U.D.	ML						
7.35-7.80		S.P.T.			4	6	8	14	
8.50-8.85	SANDY-SILT	U.D.	ML						
8.85-9.30		S.P.T.			5	7	9	16	
9.30-10.00	SANDY-SILT	D.	ML						

VMT/132/23-24 (R.H.S)

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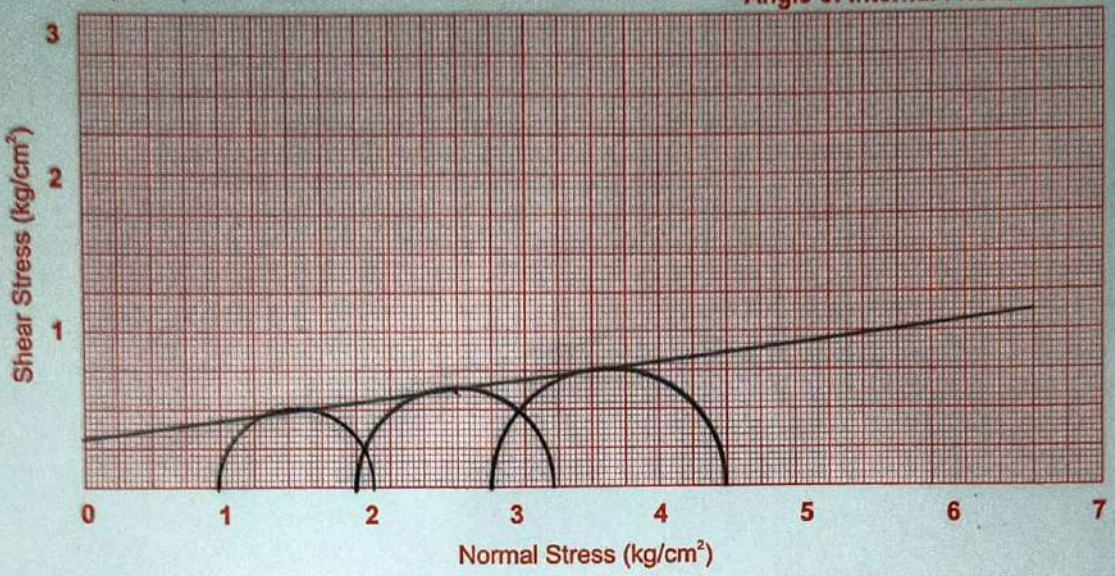
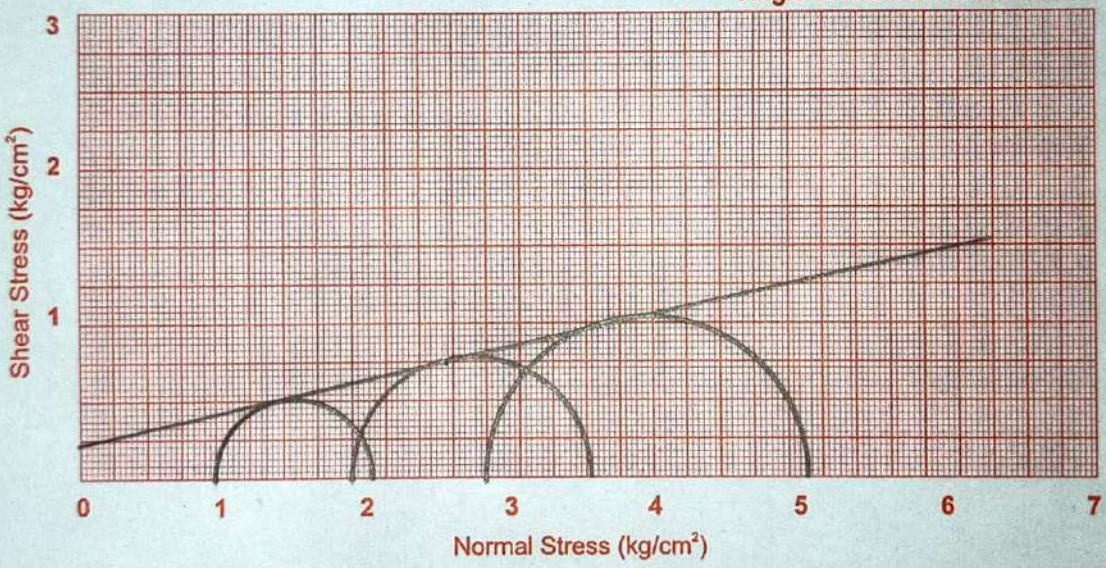
B.H. No. :- 01
Depth - 1.00 - 1.35

Cohesion 'c' 0.30 Kg/cm²
Angle of Internal Friction 7° *



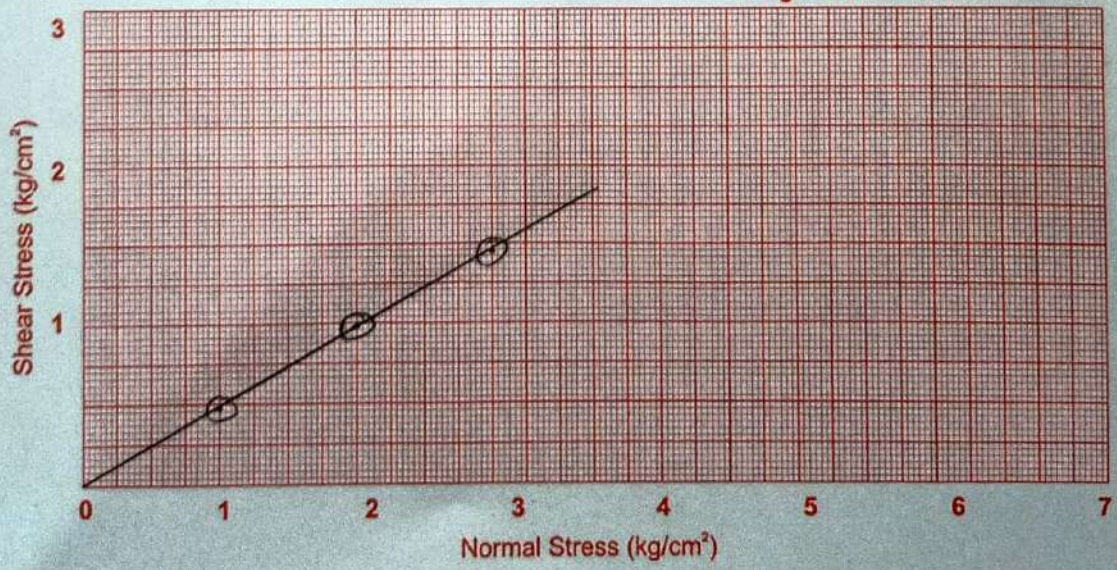
B.H. No. :- 01
Depth :- 4.00 - 4.35

Cohesion 'c' 0.20 Kg/cm²
Angle of Internal Friction 12° *



B.H. No. :- 01
Depth :- 7.00 - 7.35

Cohesion 'c' 0 Kg/cm²
Angle of Internal Friction 29° *



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VMT/132/23-24 (R.H.S.)

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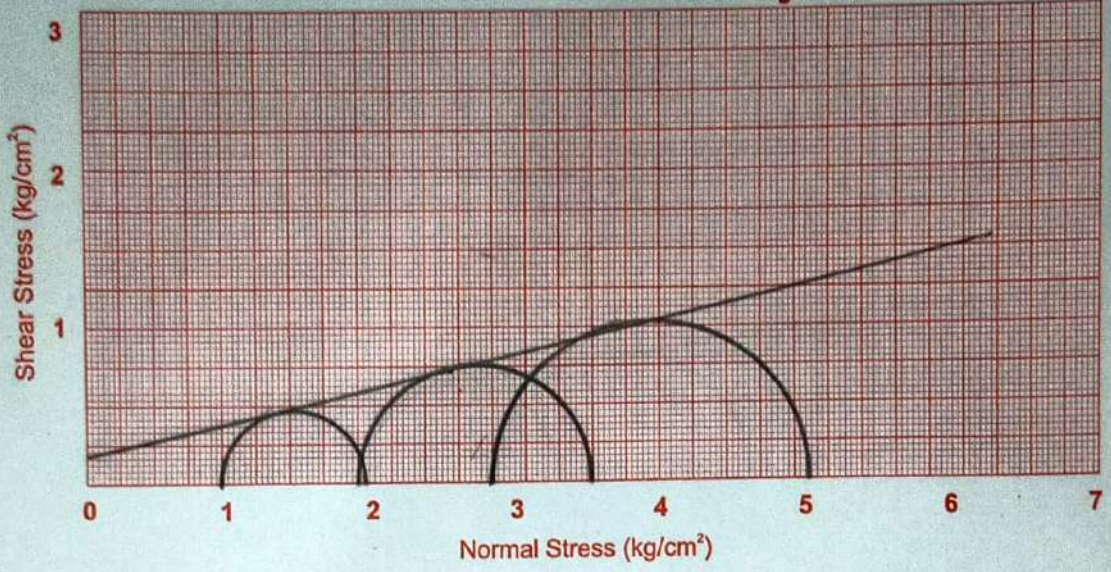
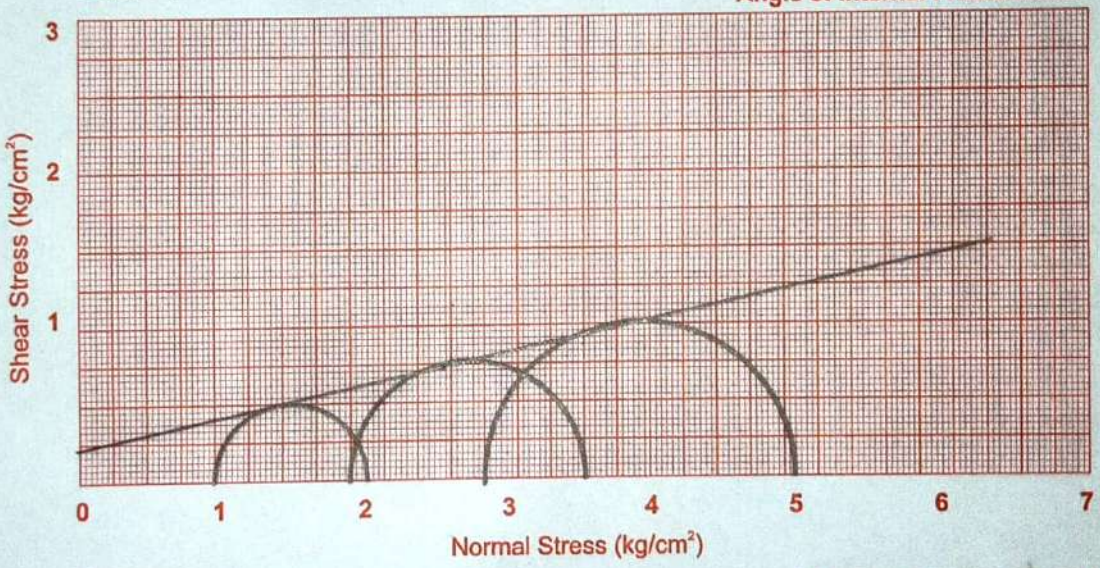
B.H. No. :- 02
Depth - 1.00 - 1.35

Cohesion 'c' 0.15 Kg/cm²
Angle of Internal Friction 13° *



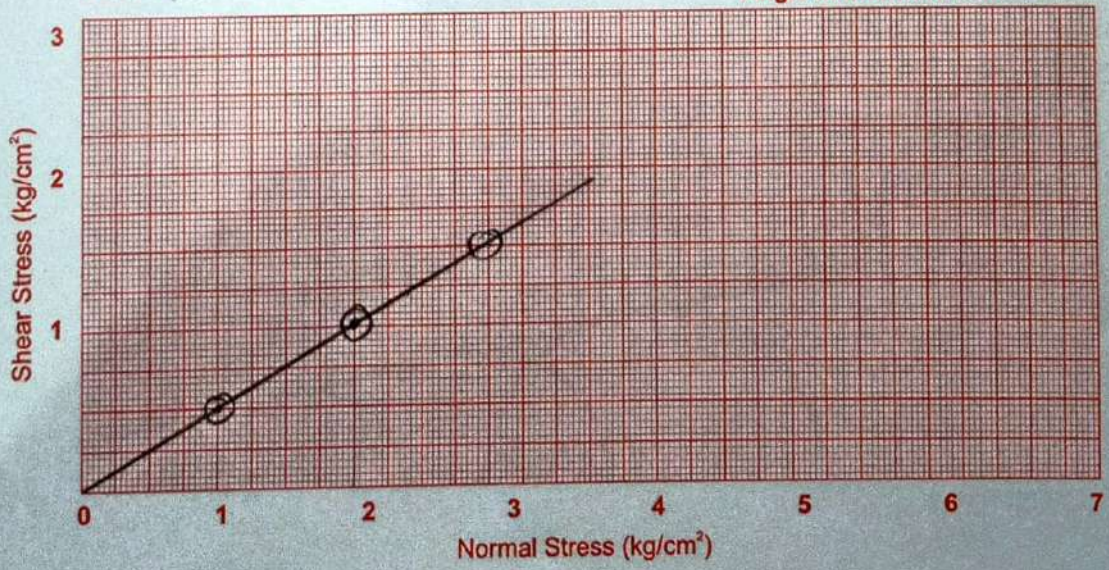
B.H. No. :- 02
Depth :- 4.00 - 4.35

Cohesion 'c' 0.20 Kg/cm²
Angle of Internal Friction 12° *



B.H. No. :- 02
Depth :- 7.00 - 7.35

Cohesion 'c' 0 Kg/cm²
Angle of Internal Friction 30° *



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TC-8969

REPORT NO. – VMT 134/2023-2024

GEOTECH INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT TALTALA GHAT (R.H.S.) IN WEST BENGAL

Prepared By -

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ACKNOWLEDGEMENT

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THE CO-OPERATION EXTENDED BY THEIR ENGINEERS DURING FIELD INVESTIGATIONS IS THANKFULLY ACKNOWLEDGED.

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SUB-SOIL INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT TALTALA GHAT IN WEST BENGAL

INTRODUCTION

The work of sub-soil exploration was awarded to us by M/s KITCO LTD., KERLA Order no. – 6777:DP 1083: RG: 2023 dated 21/03/2023. The object of the investigation was to study the geo-technical properties of soil both in field and laboratory and determine safe allowable pressure for the foundation soil.

The fieldwork consisted of 02 bore holes of 10.00 metre depth each. The fieldwork was conducted on 20/04/2023. The location of the bore holes is shown in the Site location.

REFERENCES

1. **IS: 1892-2021** for field work including existent ground water table.
2. **IS: 2132-1986** for sampling in Undisturbed and Disturbed form.
3. **IS: 2131-1981** for Standard Penetration Test.
4. **IS: 2720** for all laboratory tests on soil samples collected.
5. **IS: 6403-1981** for determination of Bearing Capacity.
6. **IS: 8009(Part I)-1976** for calculation of settlement of foundations.
7. **IS: 1904-2021** for permissible maximum settlement, differential settlement and angular distortion.

SCOPE OF WORK

The scope consisted of drilling of boreholes down to maximum depth of 10.00 m in normal soils / rock, Standard Penetration Testing, collection of samples, laboratory testing and preparation and submission of Geotechnical Investigation report.

Summary of the fieldwork					
Sl. No.	Site	Borehole Nos.	Coordinates		Depth below existing ground level (m)
			Latitude	Longitude	
1.	TALTALA GHAT	BH-01 (RHS)	24.813268	87.91631855	10.0
2.		BH-02 (RHS)	24.81275552	87.91642584	10.0

SITE LOCATION

INTERPRETATION OF THE LAB TEST RESULTS

GENERAL NATURE OF SOIL STRATA

The bore hole log charts and lab test results of bore holes 1 and 2 indicate that the strata at the site is found to comprise of cohesive soil.

The results of classification tests indicate that the natural soil stratum present at the Site is found to comprise of both fine-grained soils comprising of 'CL' and 'ML' group of IS classification (clayey soil) having 87 to 99 percent material finer than 75 micron.

The bore hole log charts and lab test results of bore holes 1 indicate that:

first strata, from 0.00 metre to 2.50 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 2.50 metre to 4.00 metre, consists of a layer of ML group of IS classification which is inorganic silts with none to low plasticity

third strata, from 4.00 metre to 10.00 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity.

The bore hole log charts and lab test results of bore holes 2 indicate that:

first strata, from 0.00 metre to 10.00 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity.

S.P.T. VALUES

The S.P.T. values obtained in the respective clayey layer region present as per bore-log charts enclosed are found to range 5 to 17 indicating 'Medium' to 'Stiff' consistency.

The results of S.P.T. values indicate that the stratum at the Site is 'Loose' to 'Well' compacted.

WATER TABLE

Water Table at the Site was observed at a depth 7.00 metre below ground level on the day of soil investigation during the Third week of April 2023. However, the existing water table may rise by 1.00 metre in the post-monsoon period in general. Therefore, a water table at a depth of 6.00 metre below ground level has been adopted for calculation purposes.

RECOMMENDATIONS FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT TALTALA GHAT IN WEST BENGAL

NET SAFE BEARING CAPACITY/SAFE ALLOWABLE PRESSURE

Bore Hole Nos.	Type of Structure	Depth of Foundation (metres)	Size of Footing (L x B) (metres)	Net Safe Bearing Capacity (Tonne/sqm.)	Settlement Produced (mm)	Safe Allowable Pressure for Permissible Settlement 50 mm (Tonne/sqm.)
1	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	8.53	28.08	-
		2.00	1.20 x 1.20	9.80	27.09	-
		2.50	1.20 x 1.20	13.87	31.60	-
		1.50	2.00 x 2.00	8.10	38.32	-
		2.00	2.00 x 2.00	9.09	36.60	-
		2.50	2.00 x 2.00	12.91	42.70	-
		1.50	2.50 x 2.50	8.03	43.75	-
		2.00	2.50 x 2.50	8.97	41.40	-
		2.50	2.50 x 2.50	12.79	49.85	-
2	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	13.22	39.05	-
		2.00	1.20 x 1.20	15.14	37.75	-
		2.50	1.20 x 1.20	19.33	39.07	-
		1.50	2.00 x 2.00	12.47	52.29	11.70
		2.00	2.00 x 2.00	13.95	50.14	13.90
		2.50	2.00 x 2.00	17.25	50.96	16.80
		1.50	2.50 x 2.50	12.36	60.06	9.62
		2.00	2.50 x 2.50	13.70	55.05	12.02
		2.50	2.50 x 2.50	16.75	58.86	13.45

NOTE: -

The above recommendations are based on the field investigation data results and the laboratory tests results of the samples collected from the test locations and our experience in this regard. If the actual sub-soil conditions during excavation for the

foundations differ from that has been reported, a reference should be made to us for suggestions.

Further, the recommendations are based on the assumptions as mentioned in the Report and the designer of the Structure should take into consideration all the factors required as per codes. The recommendations should be taken as guidelines for the designer.

Er. Akhil Singh
TECHNICAL MANAGER
VIVEK MATERIAL TESTING LABORATORY

Shubham Singh
Dy. TECHNICAL MANAGER/ QUALITY MANAGER
VIVEK MATERIAL TESTING LAORATORY

BEARING CAPACITY CALCULATIONS

Soil when stressed due to loading, tend to deform. The resistance to deformation of the soil depends upon factors like water content, bulk density, angle of internal friction and the manner in which load is applied on the soil. The maximum load per unit area which the soil or rock can carry without yielding or displacement is termed as the bearing capacity of soils. The Safe Bearing Capacity of the proposed STRUCTURE without any distress is determined from the considerations of the following criteria.

[A] SHEAR CRITERIA

The soil beneath the foundation shall be safe from risk of shear failure.

[B] SETTLEMENT CRITERIA

The settlement due to load is caused basically on account of two factors, namely,

(i) the soil below footing gets compressed by certain amount and

(ii) since the foundations cover only a limited area there is a possibility that the concentrated stresses developed are so high as to cause actual rupture (shear failure) and displacement of soil below.

The foundation should not settle or deflect to an extent causing damage to the Structure or impair its usefulness.

The Bearing Capacity Calculations for the Foundation shall be governed as per IS: 6403-1981, IS: 8009(Part-I)-1976 and IS: 1904-2021 on the basis of available information regarding the proposed design.

BEARING CAPACITY ON SHEAR CONSIDERATIONS

ULTIMATE NET BEARING CAPACITY

As per IS: 6403-1981, the Ultimate Net Bearing Capacity 'qd' on shear consideration for a Structure is given by the formula: -

FOR GENERAL SHEAR FAILURE

qd = c.Nc.Sc.dc.ic+q(Nq-1).sq.dq.iq + 1/2 B.r.Nr.Sr.dr.ir.W'.

FOR LOCAL SHEAR FAILURE

q'd = 2/3 c.N'c.Sc.dc.ic+q(N'q-1).Sq.dq.iq + 1/2 B.r.N'r.Sr.dr.ir.W'.

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BEARING CAPACITY CALCULATION

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT								
BOREHOLE 01 (R.H.S.)	Depth of borehole	10.00	metre	Water table below borehole level (m)	7.00		Factor of safety	2.50
				Water table used for calculation (m)	6.00		Assumed post monsoon rise (m)	1.00

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Input Parameters														Shearing Resistance Parameters																Ultimate Net Bearing Capacity			
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors							Inclination Factors			General shear	Local shear	Intermediate	Net Safe Bearing Capacity
					Bulk		Bulk		c	Ø	Ø'	e	q	Nc	Nq	Nγ	Nc'	Nq'	Nγ'	Sc	Sq	Sγ	Dc	Dq	Dγ	Dc'	Dq'	Dγ'	Ic	Iq	Iγ				
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																			kN/m2	kN/m2	kN/m2	kN/m2
1	SQUARE	1.50	1.20	1.20	1.76	17.26	1.76	17.26	0.15	12	8.11	0.701	25.89	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.31	1.15	1.15	1.31	1.15	1.15	1.00	1.00	1.00	318.72	173.57	209.13	**83.65**
2	SQUARE	2.00	1.20	1.20	1.76	17.26	1.82	17.85	0.15	12	8.11	0.701	34.52	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.41	1.21	1.21	1.41	1.21	1.21	1.00	1.00	1.00	366.22	199.52	240.36	**96.14**
3	SQUARE	2.50	1.20	1.20	1.76	17.26	1.82	17.85	0.10	17	11.58	0.692	43.15	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.56	1.28	1.28	1.56	1.28	1.28	1.00	1.00	1.00	533.81	261.00	340.11	**136.04**
4	SQUARE	1.50	2.00	2.00	1.76	17.26	1.76	17.26	0.15	12	8.11	0.701	25.89	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.19	1.09	1.09	1.19	1.09	1.09	1.00	1.00	1.00	303.11	164.82	198.70	**79.48**
5	SQUARE	2.00	2.00	2.00	1.76	17.26	1.82	17.85	0.15	12	8.11	0.701	34.52	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.25	1.12	1.12	1.25	1.12	1.12	1.00	1.00	1.00	340.02	184.98	222.96	**89.18**
6	SQUARE	2.50	2.00	2.00	1.76	17.26	1.82	17.85	0.10	17	11.58	0.692	43.15	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.34	1.17	1.17	1.34	1.17	1.17	1.00	1.00	1.00	498.02	242.50	316.60	**126.64**
7	SQUARE	1.50	2.50	2.50	1.76	17.26	1.76	17.26	0.15	12	8.11	0.701	25.89	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.15	1.07	1.07	1.15	1.07	1.07	1.00	1.00	1.00	300.57	163.29	196.92	**78.77**
8	SQUARE	2.00	2.50	2.50	1.76	17.26	1.82	17.85	0.15	12	8.11	0.701	34.52	9.27	2.97	1.69	7.58	2.08	0.88	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	335.68	182.46	220.00	**88.00**
9	SQUARE	2.50	2.50	2.50	1.76	17.26	1.82	17.85	0.10	17	11.58	0.692	43.15	12.33	4.77	3.53	9.08	2.86	1.58	1.30	1.20	0.80	1.27	1.14	1.14	1.27	1.14	1.14	1.00	1.00	1.00	494.01	239.96	313.63	**125.45**

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SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	83.65	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.76	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.82	0.692	0.128	0.00	39.28	31.68	-	-	29.146	-	28.08
3	3	CLAY	3.00	4.00	1.00	1.89	0.650	0.130	0.00	61.93	11.76	-	-	5.950	-	

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SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	96.14	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.76	0.000	0.000	0.00	Depth of foundation						27.09
2	2	CLAY	2.00	3.50	1.50	1.82	0.692	0.128	0.00	47.91	36.41	-	-	27.859	-	
3	3	CLAY	3.50	4.50	1.00	1.89	0.650	0.130	0.00	70.56	13.52	-	-	5.998	-	

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SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	136.04	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.82	0.000	0.000	0.00	Depth of foundation						31.60
2	2	CLAY	2.50	4.00	1.50	1.89	0.650	0.130	0.00	58.52	51.52	-	-	32.409	-	
3	3	CLAY	4.00	5.00	1.00	1.95	0.630	0.127	0.00	81.99	19.13	-	-	7.097	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	79.48	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.76	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.82	0.692	0.128	0.00	39.28	42.04	-	-	35.862	-	38.32
3	3	CLAY	3.00	4.50	1.50	1.89	0.650	0.130	0.00	66.57	17.60	-	-	12.042	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	89.18	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.76	0.000	0.000	0.00	Depth of foundation						36.60
2	2	CLAY	2.00	3.50	1.50	1.82	0.692	0.128	0.00	47.91	47.17	-	-	33.779	-	
3	3	CLAY	3.50	5.00	1.50	1.89	0.650	0.130	0.00	75.20	19.75	-	-	11.969	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.00	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	126.64	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.82	0.000	0.000	0.00	Depth of foundation						42.70
2	2	CLAY	2.50	4.00	1.50	1.89	0.650	0.130	0.00	58.52	66.98	-	-	39.158	-	
3	3	CLAY	4.00	5.50	1.50	1.95	0.630	0.127	0.00	86.77	28.04	-	-	14.215	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	78.77	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.76	0.000	0.000	0.00	Depth of foundation						43.75
2	2	CLAY	1.50	3.50	2.00	1.82	0.692	0.128	0.00	43.74	40.19	-	-	42.823	-	
3	3	CLAY	3.50	5.25	1.75	1.89	0.650	0.130	0.00	77.81	17.04	-	-	11.859	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	88.00	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.00	Depth of foundation						41.40
2	2	CLAY	2.00	4.00	2.00	1.89	0.650	0.130	0.00	54.23	44.90	-	-	41.276	-	
3	3	CLAY	4.00	5.50	1.50	1.95	0.630	0.127	0.00	87.11	19.95	-	-	10.469	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	125.45	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.82	0.000	0.000	0.00	Depth of foundation						49.85
2	2	CLAY	2.50	4.50	2.00	1.89	0.650	0.130	0.00	63.16	64.01	-	-	47.893	-	
3	3	CLAY	4.50	6.25	1.75	1.95	0.630	0.127	0.00	98.43	27.14	-	-	14.420	-	

VIVEK MATERIAL TESTING LABORATORY

BEARING CAPACITY CALCULATION

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT								
BOREHOLE 02 (R.H.S.)	Depth of borehole	10.00	metre	Water table below borehole level (m)	7.00		Factor of safety	2.50
				Water table used for calculation (m)	6.00		Assumed post monsoon rise (m)	1.00

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Input Parameters														Shearing Resistance Parameters																Ultimate Net Bearing Capacity			
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors							Inclination Factors			General shear	Local shear	Intermediate	Net Safe Bearing Capacity
					Bulk		Bulk		c	Ø	Ø'	e	q	Nc	Nq	Nγ	Nc'	Nq'	Nγ'	Sc	Sq	Sγ	Dc	Dq	Dγ	Dc'	Dq'	Dγ'	Ic	Iq	Iγ				
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																			kN/m2	kN/m2	kN/m2	kN/m2
1	SQUARE	1.50	1.20	1.20	1.78	17.46	1.78	17.46	0.20	13	8.79	0.654	26.18	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.31	1.16	1.16	1.31	1.16	1.16	1.00	1.00	1.00	428.53	227.87	324.19	**129.68**
2	SQUARE	2.00	1.20	1.20	1.78	17.46	1.91	18.73	0.20	13	8.79	0.654	34.91	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.42	1.21	1.21	1.42	1.21	1.21	1.00	1.00	1.00	490.47	260.87	371.08	**148.43**
3	SQUARE	2.50	1.20	1.20	1.78	17.46	1.91	18.73	0.25	11	7.42	0.613	43.64	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.51	1.25	1.25	1.51	1.25	1.25	1.00	1.00	1.00	551.65	304.74	473.87	**189.55**
4	SQUARE	1.50	2.00	2.00	1.78	17.46	1.78	17.46	0.20	13	8.79	0.654	26.18	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.19	1.09	1.09	1.19	1.09	1.09	1.00	1.00	1.00	404.45	214.70	305.78	**122.31**
5	SQUARE	2.00	2.00	2.00	1.78	17.46	1.91	18.73	0.20	13	8.79	0.654	34.91	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.25	1.13	1.13	1.25	1.13	1.13	1.00	1.00	1.00	452.39	240.21	342.06	**136.82**
6	SQUARE	2.50	2.00	2.00	1.78	17.46	1.91	18.73	0.25	11	7.42	0.613	43.64	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	492.42	271.85	422.94	**169.18**
7	SQUARE	1.50	2.50	2.50	1.78	17.46	1.78	17.46	0.20	13	8.79	0.654	26.18	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.15	1.08	1.08	1.15	1.08	1.08	1.00	1.00	1.00	400.91	212.60	302.99	**121.20**
8	SQUARE	2.00	2.50	2.50	1.78	17.46	1.91	18.73	0.20	13	8.79	0.654	34.91	9.79	3.26	1.97	7.82	2.21	0.99	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	444.30	235.68	335.82	**134.33**
9	SQUARE	2.50	2.50	2.50	1.78	17.46	1.91	18.73	0.25	11	7.42	0.613	43.64	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	478.30	263.95	410.78	**164.31**

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	129.68	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.78	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.91	0.613	0.125	0.00	40.23	49.11	-	-	40.275	-	39.05
3	3	CLAY	3.00	4.00	1.00	1.94	0.598	0.125	0.00	63.79	18.24	-	-	8.541	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	148.43	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.78	0.000	0.000	0.00	Depth of foundation						37.75
2	2	CLAY	2.00	3.50	1.50	1.91	0.613	0.125	0.00	48.96	56.21	-	-	38.598	-	
3	3	CLAY	3.50	4.50	1.00	1.94	0.598	0.125	0.00	72.52	20.87	-	-	8.593	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	189.55	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.91	0.000	0.000	0.00	Depth of foundation						39.07
2	2	CLAY	2.50	4.00	1.50	1.94	0.598	0.125	0.00	61.10	71.78	-	-	39.593	-	
3	3	CLAY	4.00	5.00	1.00	1.93	0.669	0.130	0.00	84.83	26.66	-	-	9.243	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	122.31	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.78	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.91	0.613	0.125	0.00	40.23	64.69	-	-	48.392	-	52.29
3	3	CLAY	3.00	4.50	1.50	1.94	0.598	0.125	0.00	68.55	27.09	-	-	16.968	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	114.77	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.78	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.91	0.613	0.125	0.00	40.23	60.70	-	-	46.44	-	50.00
3	3	CLAY	3.00	4.50	1.50	1.94	0.598	0.125	0.00	68.55	25.42	-	-	16.07	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	136.82	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.78	0.000	0.000	0.00	Depth of foundation						50.14
2	2	CLAY	2.00	3.50	1.50	1.91	0.613	0.125	0.00	48.96	72.37	-	-	45.813	-	
3	3	CLAY	3.50	5.00	1.50	1.94	0.598	0.125	0.00	77.28	30.30	-	-	16.857	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	136.30	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.78	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	2.00	3.50	1.50	1.91	0.613	0.125	0.00	48.96	72.09	-	-	45.698	-	
3	3	CLAY	3.50	5.00	1.50	1.94	0.598	0.125	0.00	77.28	30.18	-	-	16.802	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	169.18	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.91	0.000	0.000	0.00	Depth of foundation						50.96
2	2	CLAY	2.50	4.00	1.50	1.94	0.598	0.125	0.00	61.10	89.48	-	-	45.965	-	
3	3	CLAY	4.00	5.50	1.50	1.93	0.669	0.130	0.00	89.56	37.47	-	-	17.733	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.00	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	164.72	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.91	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	2.50	4.00	1.50	1.94	0.598	0.125	0.00	61.10	87.12	-	-	45.161	-	
3	3	CLAY	4.00	5.50	1.50	1.93	0.669	0.130	0.00	89.56	36.48	-	-	17.337	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	121.20	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.78	0.000	0.000	0.00	Depth of foundation						60.06
2	2	CLAY	1.50	3.50	2.00	1.91	0.613	0.125	0.00	44.92	61.84	-	-	58.273	-	
3	3	CLAY	3.50	5.25	1.75	1.94	0.598	0.125	0.00	80.29	26.22	-	-	16.799	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	94.35	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.78	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	1.50	3.50	2.00	1.91	0.613	0.125	0.00	44.92	48.14	-	-	49.029	-	
3	3	CLAY	3.50	5.25	1.75	1.94	0.598	0.125	0.00	80.29	20.41	-	-	13.465	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	134.33	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.91	0.000	0.000	0.00	Depth of foundation						55.05
2	2	CLAY	2.00	4.00	2.00	1.94	0.598	0.125	0.00	56.49	68.54	-	-	53.979	-	
3	3	CLAY	4.00	5.50	1.50	1.93	0.669	0.130	0.00	89.71	30.46	-	-	14.833	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	117.90	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.91	0.000	0.000	0.000	Depth of foundation						
2	2	CLAY	2.00	4.00	2.00	1.94	0.598	0.125	0.000	56.49	60.15	-	-	49.264	-	50.00
3	3	CLAY	4.00	5.50	1.50	1.93	0.669	0.130	0.000	89.71	26.73	-	-	13.235	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	164.31	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.91	0.000	0.000	0.00	Depth of foundation						58.86
2	2	CLAY	2.50	4.50	2.00	1.94	0.598	0.125	0.00	65.85	83.83	-	-	55.788	-	
3	3	CLAY	4.50	6.25	1.75	1.93	0.669	0.130	0.00	101.44	35.55	-	-	17.784	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2	
Length	2.50	metre	Water Table depth for calculation	7.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	131.87	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.91	0.000	0.000	0.000	Depth of foundation						
2	2	CLAY	2.50	4.50	2.00	1.94	0.598	0.125	0.000	65.85	67.28	-	-	47.827	-	50.00
3	3	CLAY	4.50	6.25	1.75	1.93	0.669	0.130	0.000	101.44	28.53	-	-	14.670	-	

SITE PHOTOS DURING SITE INVESTIGATION

RESULT SHEET

NAME OF THE PROJECT	CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT TALTALA GHAT IN WEST BENGAL																				
Client Name																					
Bore Hole No.	1 (R.H.S.)	Coordinate	Easting				Depth of Water Level														
Total depth of Bore Hole	10.00		Northing				Commenced on														
			Elevation				Completed on														
Depth of Bore Hole	Reduced Level	Types of Samples	% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characterisitics		Compression Index
			4.750	2.000	0.425	0.075	LL	PL	PI										Cohesion	Angle of Internal Friction	
metre	metre		(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N"	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(Ø)	(Cc)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0.00 - 0.50	100.000 - 99.500	DS	100	100	98	97	30	21	9	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	100	100	99	27	18	9	CL				1.76	14.2	1.54	2.62	0.701	0.15	12°	0.136
1.35 - 1.80	98.650 - 98.200	SPT									5	6.88	6.88								
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	87	26	22	4	ML				1.82	16.8	1.56	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									7	8.18	8.18								
4.00 - 4.35	96.000 - 95.650	UD	100	100	100	99	33	22	11	CL				1.89	18.3	1.60	2.64	0.650	0.20	14°	0.130
4.35 - 4.80	95.650 - 95.200	SPT									9	9.33	9.33								
5.50 - 5.85	94.500 - 94.150	UD	100	100	99	96	34	20	14	CL				1.95	20.1	1.62	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									10	9.40	9.40								
7.00 - 7.35	93.000 - 92.650	UD	100	100	100	97	35	23	12	CL				1.95	19.7	1.63	2.62	0.607	0.25	13°	0.125
7.35 - 7.80	92.650 - 92.200	SPT									11	12.32	12.32								
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	98	34	21	13	CL				1.96	17.3	1.67	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									17	17.95	16.48								
9.30 - 10.00	90.700 - 90.000	DS	100	100	100	99	29	18	11	CL					-	-	-	-	-	-	-

RESULT SHEET

NAME OF THE PROJECT	**CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT TALTALA GHAT IN WEST BENGAL**																							
Client Name																								
Bore Hole No.	**2 (R.H.S.)**		**Coordinate**		**Easting**						**Depth of Water Level**			7.00		**VIVEK MATERIAL TESTING LABORATORY**							
Total depth of Bore Hole	**10.00**				**Northing**						**Commenced on**			4/20/2023										
					Elevation		**100.000**				**Completed on**			4/20/2023										

Depth of Bore Hole	**Reduced Level**	**Types of Samples**	**% Material Passing IS Sieve**				**Atterberg Limits**			**IS group symbol**	**SPT Value**	**SPT Value corrected due to overburden**	**SPT Value corrected due to dilatancy**	**Wet Bulk Density**	**Original Moisture**	**Dry Bulk Density**	**Specific Gravity**	**Void Ratio**	**Shear Characterisitics**		**Compression Index**
			4.750	**2.000**	**0.425**	**0.075**	**LL**	**PL**	**PI**										**Cohesion**	**Angle of Internal Friction**	
metre	**metre**		**(mm)**	**(mm)**	**(mm)**	**(mm)**	**%**	**%**	**%**		**N**	**N'**	**N"**	**(gms/cc)**	**%**	**(gms/cc)**	**(G)**		**(Kg/sqcm)**	**(Ø)**	**(Cc)**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
0.00 - 0.50	100.000 - 99.500	DS	100	100	100	99	29	20	9	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	100	98	98	28	14	14	CL				1.78	12.1	1.59	2.63	0.654	0.20	13°	0.129
1.35 - 1.80	98.650 - 98.200	SPT									9	12.35	12.35								
2.50 - 2.85	97.500 - 97.150	UD	100	100	97	96	30	22	8	CL				1.91	17.3	1.63	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									11	12.73	12.73								
4.00 - 4.35	96.000 - 95.650	UD	100	100	99	98	32	20	12	CL				1.94	18.1	1.64	2.62	0.598	0.25	12°	0.125
4.35 - 4.80	95.650 - 95.200	SPT									13	13.35	13.35								
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	97	34	21	13	CL				1.93	23.1	1.57	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									7	6.53	6.53								
7.00 - 7.35	93.000 - 92.650	UD	100	100	100	99	33	20	13	CL				1.96	21.2	1.62	2.65	0.636	0.30	10°	0.126
7.35 - 7.80	92.650 - 92.200	SPT									11	12.19	12.19								
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	98	30	16	14	CL				1.99	20.5	1.65	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									15	15.67	15.34								
9.30 - 10.00	90.700 - 90.000	DS	100	100	100	99	31	20	11	CL					-	-	-	-	-	-	-

BORE-LOG CHART

VMT
GEOTECH & MATERIAL TESTING

VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT TALTALA GHAT IN WEST BENGAL

WATER TABLE 7.00 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 01 (R.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES
			GROUP	HATCHING	N1	N2	N3	N2+N3	10 20 30 40 50 60 70 80 90 100
0.00-0.50	SILTY-CLAY	D.	CL						
1.00-1.35	SILTY-CLAY	U.D.	CL						
1.35-1.80		S.P.T.			2	2	3	5	
2.50-2.85	CLAYEY-SILT	U.D.	ML						
2.85-3.30		S.P.T.			2	3	4	7	
4.00-4.35	SILTY-CLAY	U.D.	CL						
4.35-4.80		S.P.T.			3	3	6	9	
5.50-5.85	SILTY-CLAY	U.D.	CL						
5.85-6.30		S.P.T.			4	5	5	10	
7.00-7.35	SILTY-CLAY	U.D.	CL						
7.35-7.80		S.P.T.			5	5	6	11	
8.50-8.85	SILTY-CLAY	U.D.	CL						
8.85-9.30		S.P.T.			6	8	9	17	
9.30-10.00	SILTY-CLAY	D.	CL						

BORE-LOG CHART

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VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT TALTALA GHAT IN WEST BENGAL

WATER TABLE 7.00 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 02 (R.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES
			GROUP	HATCHING	N1	N2	N3	N2+N3	10 20 30 40 50 60 70 80 90 100
0.00-0.50	SILTY-CLAY	D.	CL						
1.00-1.35	SILTY-CLAY	U.D.	CL						
1.35-1.80		S.P.T.			3	4	5	9	
2.50-2.85	SILTY-CLAY	U.D.	CL						
2.85-3.30		S.P.T.			3	4	7	11	
4.00-4.35	SILTY-CLAY	U.D.	CL						
4.35-4.80		S.P.T.			4	5	8	13	
5.50-5.85	SILTY-CLAY	U.D.	CL						
5.85-6.30		S.P.T.			3	3	4	7	
7.00-7.35	SILTY-CLAY	U.D.	CL						
7.35-7.80		S.P.T.			4	5	6	11	
8.50-8.85	SILTY-CLAY	U.D.	CL						
8.85-9.30		S.P.T.			5	7	8	15	
9.30-10.00	SILTY-CLAY	D.	CL						

VMT/134/23-24

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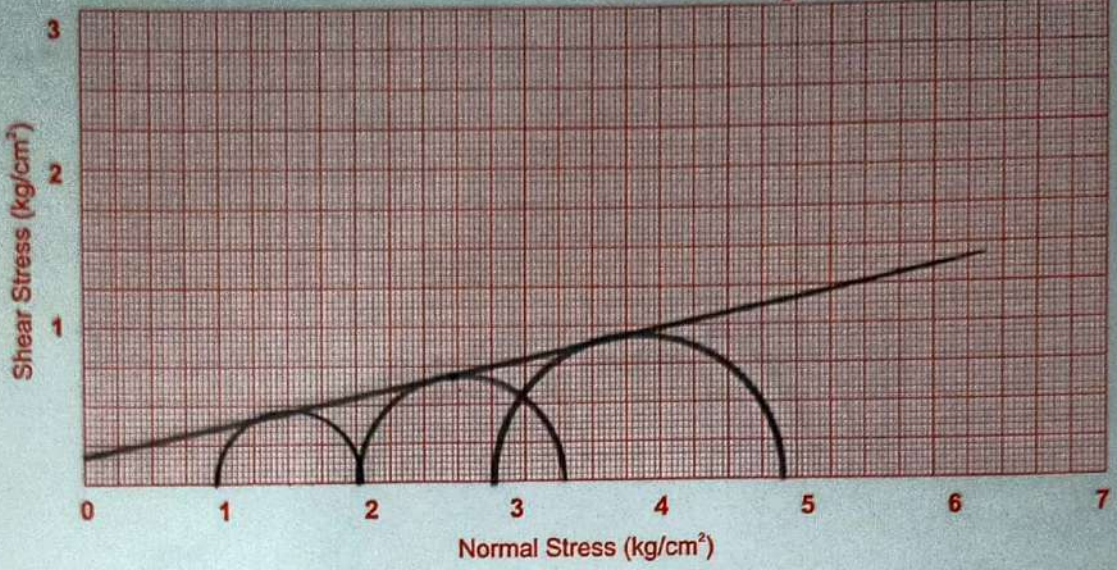
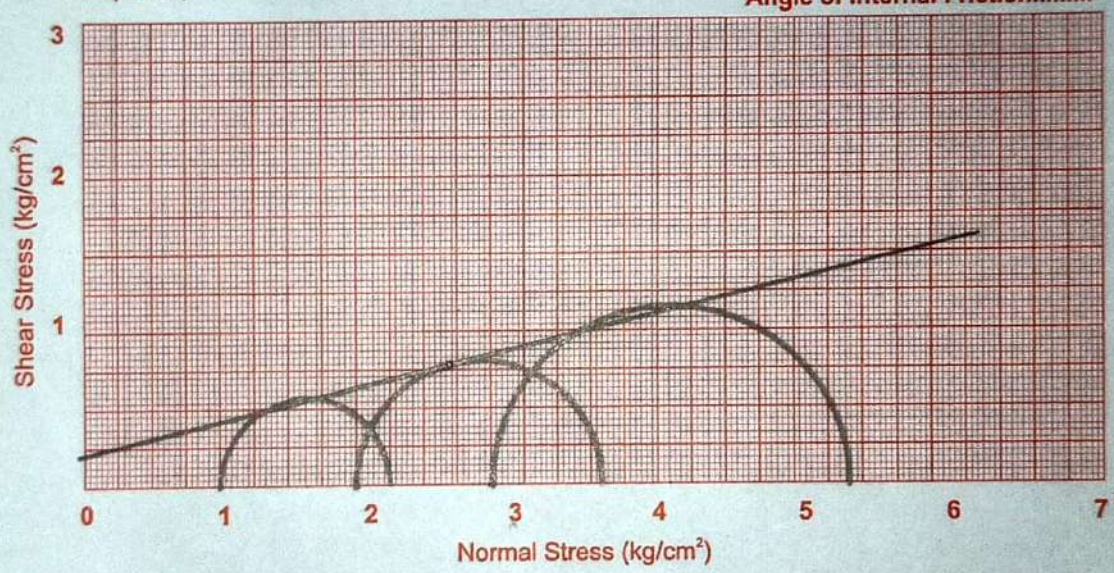
B.H. No. :- 01
Depth - 1.00-1.35

Cohesion 'c' 0.15 Kg/cm²
Angle of Internal Friction 12°



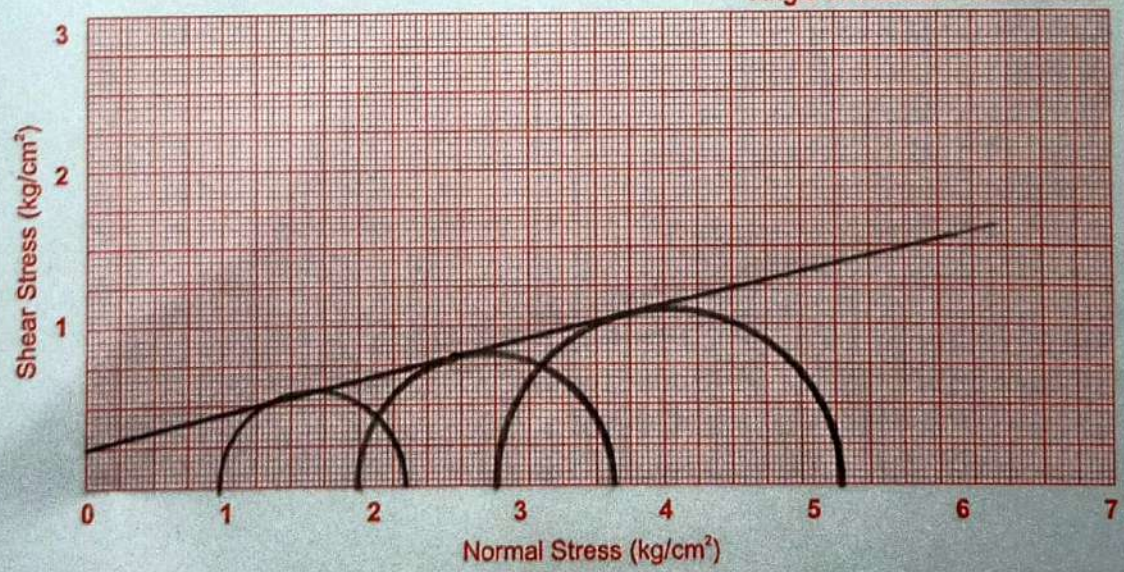
B.H. No. :- 01
Depth :- 4.00-4.35

Cohesion 'c' 0.20 Kg/cm²
Angle of Internal Friction 14°



B.H. No. :- 01
Depth :- 7.00-7.35

Cohesion 'c' 0.25 Kg/cm²
Angle of Internal Friction 13°



Scanned with CamScanner

VMT/134/23-24

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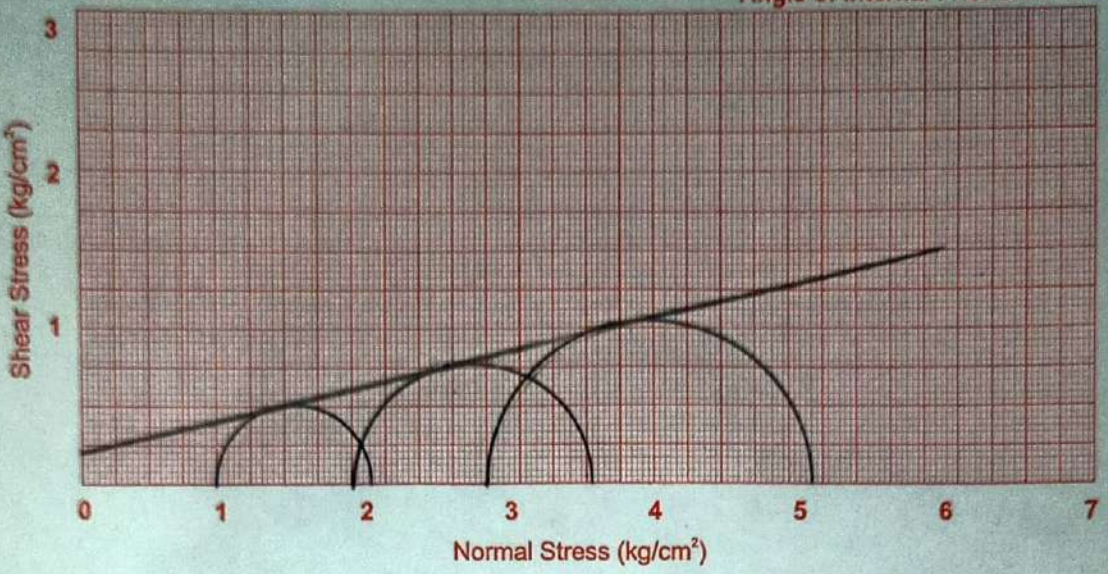
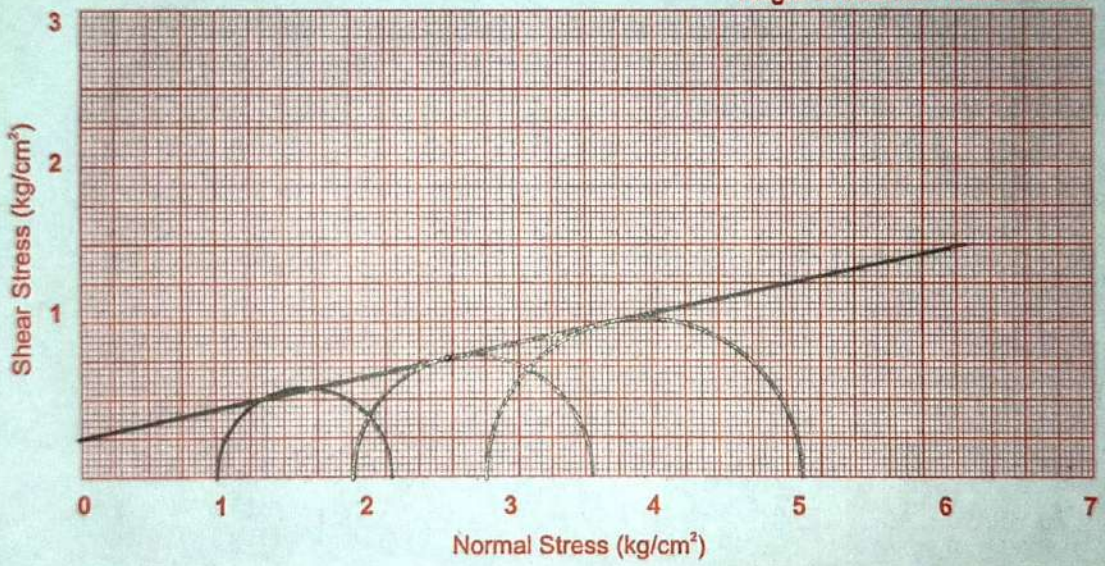
B.H. No. :- 02
Depth - 1.00 - 1.35

Cohesion 'c' 0.20 Kg/cm²
Angle of Internal Friction 13° *



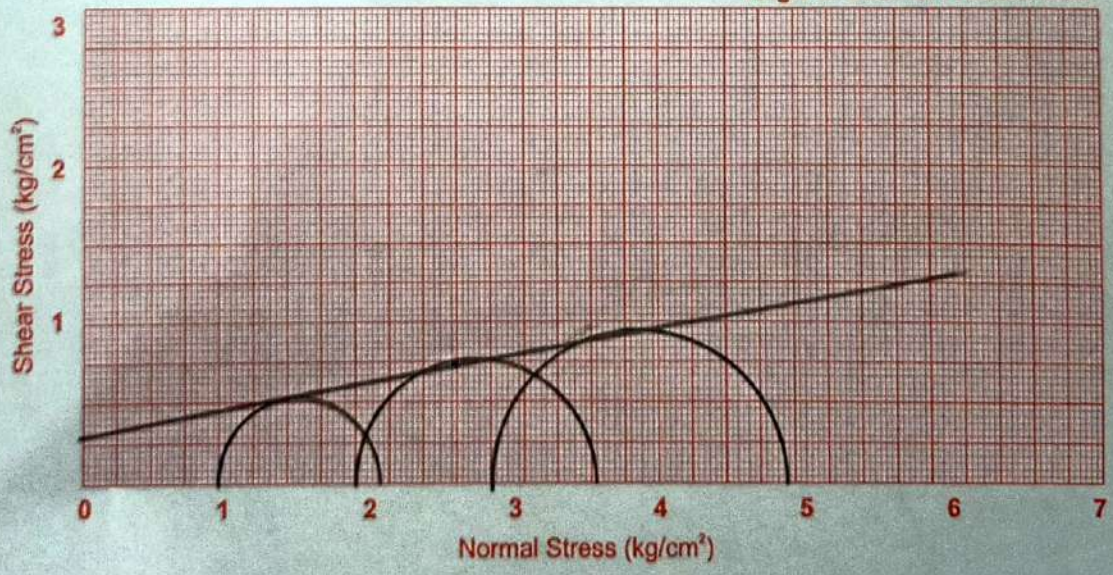
B.H. No. :- 02
Depth :- 4.00 - 4.35

Cohesion 'c' 0.25 Kg/cm²
Angle of Internal Friction 12° *



B.H. No. :- 02
Depth :- 7.00 - 7.35

Cohesion 'c' 0.30 Kg/cm²
Angle of Internal Friction 10° *



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GEOTECH & MATERIAL TESTING

TC-8969

REPORT NO. – VMT 130/2023-2024

GEOTECH INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GOPAL GHAT (L.H.S.) IN WEST BENGAL

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ACKNOWLEDGEMENT

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THE CO-OPERATION EXTENDED BY THEIR ENGINEERS DURING FIELD INVESTIGATIONS IS THANKFULLY ACKNOWLEDGED.

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SUB-SOIL INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GOPAL GHAT IN WEST BENGAL

INTRODUCTION

The work of sub-soil exploration was awarded to us by M/s KITCO LTD., KERLA Order no. – 6777:DP 1083: RG: 2023 dated 21/03/2023. The object of the investigation was to study the geo-technical properties of soil both in field and laboratory and determine safe allowable pressure for the foundation soil.

The fieldwork consisted of 02 bore holes of 10.00 metre depth each. The fieldwork was conducted on 15/04/2023. The location of the bore holes is shown in the Site location.

REFERENCES

1. **IS: 1892-2021** for field work including existent ground water table.
2. **IS: 2132-1986** for sampling in Undisturbed and Disturbed form.
3. **IS: 2131-1981** for Standard Penetration Test.
4. **IS: 2720** for all laboratory tests on soil samples collected.
5. **IS: 6403-1981** for determination of Bearing Capacity.
6. **IS: 8009(Part I)-1976** for calculation of settlement of foundations.
7. **IS: 1904-2021** for permissible maximum settlement, differential settlement and angular distortion.

SCOPE OF WORK

The scope consisted of drilling of boreholes down to maximum depth of 10.00 m in normal soils / rock, Standard Penetration Testing, collection of samples, laboratory testing and preparation and submission of Geotechnical Investigation report.

Summary of the fieldwork					
Sl. No.	Site	Borehole Nos.	Coordinates		Depth below existing ground level (m)
			Latitude	Longitude	
1.	GOPAL GHAT	BH-01 (LHS)	24.11603815	88.24637409	10.0
2.		BH-02 (LHS)	24.11614128	88.24654642	10.0

SITE LOCATION

INTERPRETATION OF THE LAB TEST RESULTS

GENERAL NATURE OF SOIL STRATA

The bore hole log charts and lab test results of bore holes 1 and 2 indicate that the strata at the site is found to comprise of both cohesive as well as non-cohesive soil.

The results of classification tests indicate that the natural soil stratum present at the Site is found to comprise of both fine-grained soils comprising of 'CL' and 'CI' group of IS classification (clayey soil) having 84 to 99 percent material finer than 75 micron and coarse-grained soils (sandy soil) comprise of 'SM' group of IS classification having 14 to 28 percent material finer than 75 micron.

The bore hole log charts and lab test results of bore holes 1 indicate that:

first strata, from 0.00 metre to 2.50 metre, consists of a layer of CL group of IS classification which is inorganic clays of low plasticity,

second strata, from 2.50 metre to 7.00 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity,

third strata, from 7.00 metre to 10.00 metre, consists of a layer of SM group of IS classification which is silty Sand with none plasticity.

The bore hole log charts and lab test results of bore holes 2 indicate that:

first strata, from 0.00 metre to 4.80 metre, consists of a layer of **filled up soil (Brick Pieces + Sand)**,

second strata, from 4.80 metre to 10.00 metre, consists of a layer of CI group of IS classification which is inorganic clays of medium plasticity.

S.P.T. VALUES

The S.P.T. values recorded in the filled up soil zone present up to 4.80 metre depth below ground level in borehole 2 are found to range from 5 to 9.

The S.P.T. values obtained in the respective clayey layer region present as per bore-log charts enclosed are found to range 4 to 9 indicating 'Soft' to 'Medium' consistency.

However, the S.P.T. values obtained in the respective sandy layer region present as per bore-log charts enclosed are found to range from 14 to 15 indicating 'Medium' relative density.

The results of S.P.T. values indicate that the stratum at the Site is 'Loose' to 'Well' compacted.

WATER TABLE

Water Table at the Site was observed at a depth from 1.00 metre to 5.00 metre below ground level on the day of soil investigation during the Third week of April 2023. However, the existing water table may rise by 1.00 metre in the post-monsoon period in general. Therefore, a water table at a depth of 0.00 metre to 4.00 metre below ground level has been adopted for calculation purposes.

RECOMMENDATIONS FOR PROPOSED CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GOPAL GHAT IN WEST BENGAL

NET SAFE BEARING CAPACITY/SAFE ALLOWABLE PRESSURE

Bore Hole Nos.	Type of Structure	Depth of Foundation (metres)	Size of Footing (L x B) (metres)	Net Safe Bearing Capacity (Tonne/sqm.)	Settlement Produced (mm)	Safe Allowable Pressure for Permissible Settlement 50 mm (Tonne/sqm.)
1	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	6.69	31.50	-
		2.00	1.20 x 1.20	7.68	31.82	-
		2.50	1.20 x 1.20	9.27	32.09	-
		1.50	2.00 x 2.00	6.33	43.11	-
		2.00	2.00 x 2.00	7.12	43.03	-
		2.50	2.00 x 2.00	8.23	42.23	-
		1.50	2.50 x 2.50	6.29	50.52	6.20
		2.00	2.50 x 2.50	7.00	47.05	-
		2.50	2.50 x 2.50	7.97	49.05	-
2	ISOLATED RCC SQUARE	1.50	1.20 x 1.20	6.33	28.45	-
		2.00	1.20 x 1.20	7.40	27.76	-
		2.50	1.20 x 1.20	9.68	29.43	-
		1.50	2.00 x 2.00	6.08	39.07	-
		2.00	2.00 x 2.00	6.92	37.66	-
		2.50	2.00 x 2.00	8.78	38.95	-
		1.50	2.50 x 2.50	6.07	45.04	-
		2.00	2.50 x 2.50	6.77	40.92	-
		2.50	2.50 x 2.50	7.52	40.63	-

NOTE: -

The above recommendations are based on the field investigation data results and the laboratory tests results of the samples collected from the test locations and our experience in this regard. If the actual sub-soil conditions during excavation for the

foundations differ from that has been reported, a reference should be made to us for suggestions.

Further, the recommendations are based on the assumptions as mentioned in the Report and the designer of the Structure should take into consideration all the factors required as per codes. The recommendations should be taken as guidelines for the designer.

Er. Akhil Singh
TECHNICAL MANAGER
VIVEK MATERIAL TESTING LABORATORY

Shubham Singh
Dy. TECHNICAL MANAGER/ QUALITY MANAGER
VIVEK MATERIAL TESTING LAORATORY

BEARING CAPACITY CALCULATIONS

Soil when stressed due to loading, tend to deform. The resistance to deformation of the soil depends upon factors like water content, bulk density, angle of internal friction and the manner in which load is applied on the soil. The maximum load per unit area which the soil or rock can carry without yielding or displacement is termed as the bearing capacity of soils. The Safe Bearing Capacity of the proposed STRUCTURE without any distress is determined from the considerations of the following criteria.

[A] SHEAR CRITERIA

The soil beneath the foundation shall be safe from risk of shear failure.

[B] SETTLEMENT CRITERIA

The settlement due to load is caused basically on account of two factors, namely,

(i) the soil below footing gets compressed by certain amount and

(ii) since the foundations cover only a limited area there is a possibility that the concentrated stresses developed are so high as to cause actual rupture (shear failure) and displacement of soil below.

The foundation should not settle or deflect to an extent causing damage to the Structure or impair its usefulness.

The Bearing Capacity Calculations for the Foundation shall be governed as per IS: 6403-1981, IS: 8009(Part-I)-1976 and IS: 1904-2021 on the basis of available information regarding the proposed design.

BEARING CAPACITY ON SHEAR CONSIDERATIONS

ULTIMATE NET BEARING CAPACITY

As per IS: 6403-1981, the Ultimate Net Bearing Capacity 'qd' on shear consideration for a Structure is given by the formula: -

FOR GENERAL SHEAR FAILURE

qd = c.Nc.Sc.dc.ic+q(Nq-1).sq.dq.iq + 1/2 B.r.Nr.Sr.dr.ir.W'.

FOR LOCAL SHEAR FAILURE

q'd = 2/3 c.N'c.Sc.dc.ic+q(N'q-1).Sq.dq.iq + 1/2 B.r.N'r.Sr.dr.ir.W'.

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BEARING CAPACITY CALCULATION

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT								
BOREHOLE 01 (L.H.S.)	Depth of borehole	10.00	metre	Water table below borehole level (m)	1.00		Factor of safety	2.50
				Water table used for calculation (m)	0.00		Assumed post monsoon rise (m)	1.00

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Input Parameters													Shearing Resistance Parameters																		Ultimate Net Bearing Capacity			Net Safe Bearing Capacity
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	
					Bulk		Bulk		c	Ø	Ø'	e	q	Nc	Nq	Nγ	Nc'	Nq'	Nγ'	Sc	Sq	Sγ	Dc	Dq	Dγ	Dc'	Dq'	Dγ'	Ic	Iq	Iγ				
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																		kN/m2	kN/m2	kN/m2	kN/m2
1	SQUARE	1.50	1.20	1.20	1.82	8.04	1.82	8.04	0.10	16	10.88	0.706	12.06	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.33	1.17	1.17	1.33	1.17	1.17	1.00	1.00	1.00	269.44	134.32	164.05	**65.62**
2	SQUARE	2.00	1.20	1.20	1.82	8.04	1.89	8.73	0.10	16	10.88	0.706	16.08	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.44	1.22	1.22	1.44	1.22	1.22	1.00	1.00	1.00	309.13	154.18	188.27	**75.31**
3	SQUARE	2.50	1.20	1.20	1.82	8.04	1.89	8.73	0.15	11	7.42	0.673	20.10	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.51	1.25	1.25	1.51	1.25	1.25	1.00	1.00	1.00	313.69	173.27	227.33	**90.93**
4	SQUARE	1.50	2.00	2.00	1.82	8.04	1.82	8.04	0.10	16	10.88	0.706	12.06	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	255.45	126.97	155.24	**62.10**
5	SQUARE	2.00	2.00	2.00	1.82	8.04	1.89	8.73	0.10	16	10.88	0.706	16.08	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.27	1.13	1.13	1.27	1.13	1.13	1.00	1.00	1.00	287.11	142.79	174.54	**69.82**
6	SQUARE	2.50	2.00	2.00	1.82	8.04	1.89	8.73	0.15	11	7.42	0.673	20.10	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.30	1.15	1.15	1.30	1.15	1.15	1.00	1.00	1.00	278.49	153.75	201.77	**80.71**
7	SQUARE	1.50	2.50	2.50	1.82	8.04	1.82	8.04	0.10	16	10.88	0.706	12.06	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.16	1.08	1.08	1.16	1.08	1.08	1.00	1.00	1.00	254.00	126.02	154.18	**61.67**
8	SQUARE	2.00	2.50	2.50	1.82	8.04	1.89	8.73	0.10	16	10.88	0.706	16.08	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.21	1.11	1.11	1.21	1.11	1.11	1.00	1.00	1.00	282.75	140.38	171.70	**68.68**
9	SQUARE	2.50	2.50	2.50	1.82	8.04	1.89	8.73	0.15	11	7.42	0.673	20.10	8.80	2.71	1.44	7.29	1.95	0.77	1.30	1.20	0.80	1.24	1.12	1.12	1.24	1.12	1.12	1.00	1.00	1.00	269.83	148.91	195.46	**78.18**

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SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	65.62	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.89	0.673	0.132	0.00	28.42	24.85	-	-	32.297	-	31.50
3	3	CLAY	3.00	4.00	1.00	1.92	0.675	0.130	0.00	39.47	9.23	-	-	7.081	-	

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SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	75.31	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.00	Depth of foundation						31.82
2	2	CLAY	2.00	3.50	1.50	1.89	0.673	0.132	0.00	32.44	28.52	-	-	32.426	-	
3	3	CLAY	3.50	4.50	1.00	1.92	0.675	0.130	0.00	43.49	10.59	-	-	7.345	-	

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SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	1.20	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	90.93	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.89	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	2.50	4.00	1.50	1.92	0.675	0.130	0.00	38.39	34.44	-	-	32.369	-	32.09
3	3	CLAY	4.00	5.00	1.00	1.93	0.644	0.128	0.00	49.72	12.79	-	-	7.739	-	

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SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	62.10	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	-	-	-	Depth of foundation						43.11
2	2	CLAY	1.50	3.00	1.50	1.89	0.673	0.132	0.00	28.42	32.85	-	-	39.485	-	
3	3	CLAY	3.00	4.50	1.50	1.92	0.675	0.130	0.00	41.73	13.75	-	-	14.402	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	69.82	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.82	0.000	0.000	0.00	Depth of foundation						43.03
2	2	CLAY	2.00	3.50	1.50	1.89	0.673	0.132	0.00	32.44	36.93	-	-	39.069	-	
3	3	CLAY	3.50	5.00	1.50	1.92	0.675	0.130	0.00	45.75	15.46	-	-	14.721	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.00	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80		
Width	2.00	metre	Applied Pressure at foundation base	80.71	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.89	0.000	0.000	0.00	Depth of foundation						42.23
2	2	CLAY	2.50	4.00	1.50	1.92	0.675	0.130	0.00	38.39	42.69	-	-	37.797	-	
3	3	CLAY	4.00	5.50	1.50	1.93	0.644	0.128	0.00	52.00	17.87	-	-	14.985	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	61.67	kN/m2		Type of foundation	SQUARE		

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	0.000	0.000	0.00	Depth of foundation						50.52
2	2	CLAY	1.50	3.50	2.00	1.89	0.673	0.132	0.00	30.60	31.46	-	-	48.466	-	
3	3	CLAY	3.50	5.25	1.75	1.92	0.675	0.130	0.00	47.22	13.34	-	-	14.678	-	

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1	
Length	2.50	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80		
Width	2.50	metre	Applied Pressure at foundation base	60.84	kN/m2		Type of foundation	SQUARE		

FINAL TRIAL

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.82	0.000	0.000	0.00	Depth of foundation						50.00
2	2	CLAY	1.50	3.50	2.00	1.89	0.673	0.132	0.00	30.60	31.04	-	-	47.997	-	
3	3	CLAY	3.50	5.25	1.75	1.92	0.675	0.130	0.00	47.22	13.16	-	-	14.503	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	68.68	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.89	0.000	0.000	0.00	Depth of foundation						47.05
2	2	CLAY	2.00	4.00	2.00	1.92	0.675	0.130	0.00	36.29	35.04	-	-	45.560	-	
3	3	CLAY	4.00	5.50	1.50	1.93	0.644	0.128	0.00	52.15	15.57	-	-	13.254	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 1
Length	2.50	metre	Water Table depth for calculation	1.00	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	78.18	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.89	0.000	0.000	0.00	Depth of foundation						49.05
2	2	CLAY	2.50	4.50	2.00	1.92	0.675	0.130	0.00	40.65	39.89	-	-	46.092	-	
3	3	CLAY	4.50	6.25	1.75	1.93	0.644	0.128	0.00	57.65	16.91	-	-	15.222	-	

VIVEK MATERIAL TESTING LABORATORY

BEARING CAPACITY CALCULATION

BEARING CAPACITY CALCULATION SHEET AS PER IS: 6403-1981

NAME OF PROJECT								
BOREHOLE 02 (L.H.S.)	Depth of borehole	10.00	metre	Water table below borehole level (m)	5.00		Factor of safety	2.50
				Water table used for calculation (m)	4.00		Assumed post monsoon rise (m)	1.00

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Input Parameters														Shearing Resistance Parameters																Ultimate Net Bearing Capacity			
S. No.	Type of foundation	Depth	Length	Width	Density Above Foundation Level	Density Including water effect	Density Below Foundation Level	Density Including water effect	Cohesion	Angle of Shearing Resistance		Void Ratio	Effective Surcharge	Bearing Capacity Factors						Shape Factors			Depth Factors						Inclination Factors			General shear	Local shear	Intermediate	Net Safe Bearing Capacity
					Bulk		Bulk		c	Ø	Ø'	e	q	Nc	Nq	Nγ	Nc'	Nq'	Nγ'	Sc	Sq	Sγ	Dc	Dq	Dγ	Dc'	Dq'	Dγ'	Ic	Iq	Iγ				
		(m)	(m)	(m)	(gms/cc)	(kN/m3)	(gms/cc)	(kN/m3)	Kg/cm2	°	°		kN/m2																		kN/m2	kN/m2	kN/m2	kN/m2
1	SQUARE	1.50	1.20	1.20	1.40	13.73	1.40	13.73	0.10	15	10.18	0.740	20.59	10.97	3.94	2.65	8.41	2.51	1.26	1.30	1.20	0.80	1.33	1.16	1.16	1.33	1.16	1.16	1.00	1.00	1.00	290.55	147.99	155.12	**62.05**
2	SQUARE	2.00	1.20	1.20	1.40	13.73	1.40	13.73	0.10	15	10.18	0.740	27.46	10.97	3.94	2.65	8.41	2.51	1.26	1.30	1.20	0.80	1.43	1.22	1.22	1.43	1.22	1.22	1.00	1.00	1.00	339.49	173.05	181.37	**72.55**
3	SQUARE	2.50	1.20	1.20	1.40	13.73	1.40	13.73	0.10	16	10.88	0.730	34.32	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.55	1.28	1.28	1.55	1.28	1.28	1.00	1.00	1.00	432.12	215.61	237.26	**94.90**
4	SQUARE	1.50	2.00	2.00	1.40	13.73	1.40	13.73	0.10	15	10.18	0.740	20.59	10.97	3.94	2.65	8.41	2.51	1.26	1.30	1.20	0.80	1.20	1.10	1.10	1.20	1.10	1.10	1.00	1.00	1.00	279.77	142.05	148.94	**59.58**
5	SQUARE	2.00	2.00	2.00	1.40	13.73	1.40	13.73	0.10	15	10.18	0.740	27.46	10.97	3.94	2.65	8.41	2.51	1.26	1.30	1.20	0.80	1.26	1.13	1.13	1.26	1.13	1.13	1.00	1.00	1.00	318.58	161.93	169.76	**67.90**
6	SQUARE	2.50	2.00	2.00	1.40	13.73	1.40	13.73	0.10	16	10.88	0.730	34.32	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.33	1.17	1.17	1.33	1.17	1.17	1.00	1.00	1.00	392.91	195.62	215.35	**86.14**
7	SQUARE	1.50	2.50	2.50	1.40	13.73	1.40	13.73	0.10	15	10.18	0.740	20.59	10.97	3.94	2.65	8.41	2.51	1.26	1.30	1.20	0.80	1.16	1.08	1.08	1.16	1.08	1.08	1.00	1.00	1.00	280.00	141.90	148.81	**59.52**
8	SQUARE	2.00	2.50	2.50	1.40	13.73	1.40	13.73	0.10	15	10.18	0.740	27.46	10.97	3.94	2.65	8.41	2.51	1.26	1.30	1.20	0.80	1.21	1.10	1.10	1.21	1.10	1.10	1.00	1.00	1.00	311.81	158.35	166.02	**66.41**
9	SQUARE	2.50	2.50	2.50	1.40	13.73	1.40	13.73	0.10	16	10.88	0.730	34.32	11.65	4.34	3.06	8.74	2.68	1.41	1.30	1.20	0.80	1.27	1.13	1.13	1.27	1.13	1.13	1.00	1.00	1.00	382.07	190.04	209.24	**83.70**

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	62.05	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.40	-	-	-	Depth of foundation						
2	2	CLAY	1.50	3.00	1.50	1.40	0.730	0.140	0.00	30.89	23.50	-	-	29.822	-	28.45
3	3	CLAY	3.00	4.00	1.00	1.45	0.720	0.137	0.00	48.30	8.73	-	-	5.745	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	72.55	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.40	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	2.00	3.50	1.50	1.40	0.730	0.140	0.00	37.76	27.47	-	-	28.825	-	27.76
3	3	CLAY	3.50	4.50	1.00	1.45	0.720	0.137	0.00	55.16	10.20	-	-	5.870	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	1.20	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80	
Width	1.20	metre	Applied Pressure at foundation base	94.90	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.40	0.000	0.000	0.00	Depth of foundation						29.43
2	2	CLAY	2.50	4.00	1.50	1.45	0.720	0.137	0.00	44.99	35.94	-	-	30.465	-	
3	3	CLAY	4.00	5.00	1.00	1.87	0.686	0.131	0.00	64.82	13.35	-	-	6.317	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 1

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	59.58	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.40	-	-	-	Depth of foundation						39.07
2	2	CLAY	1.50	3.00	1.50	1.40	0.730	0.140	0.00	30.89	31.51	-	-	37.069	-	
3	3	CLAY	3.00	4.50	1.50	1.45	0.720	0.137	0.00	51.85	13.19	-	-	11.763	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 2

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	67.90	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.40	0.000	0.000	0.00	Depth of foundation						37.66
2	2	CLAY	2.00	3.50	1.50	1.40	0.730	0.140	0.00	37.76	35.91	-	-	35.239	-	
3	3	CLAY	3.50	5.00	1.50	1.45	0.720	0.137	0.00	58.72	15.04	-	-	11.830	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 3

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.00	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80	
Width	2.00	metre	Applied Pressure at foundation base	86.14	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.40	0.000	0.000	0.00	Depth of foundation						38.95
2	2	CLAY	2.50	4.00	1.50	1.45	0.720	0.137	0.00	44.99	45.56	-	-	36.295	-	
3	3	CLAY	4.00	5.50	1.50	1.87	0.686	0.131	0.00	68.74	19.08	-	-	12.396	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 4

Depth	1.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	59.52	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	1.50	1.50	1.40	0.000	0.000	0.00	Depth of foundation						45.04
2	2	CLAY	1.50	3.50	2.00	1.40	0.730	0.140	0.00	34.32	30.37	-	-	44.548	-	
3	3	CLAY	3.50	5.25	1.75	1.45	0.720	0.137	0.00	60.09	12.88	-	-	11.754	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 5

Depth	2.00	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	66.41	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.00	2.00	1.40	0.000	0.000	0.00	Depth of foundation						
2	2	CLAY	2.00	4.00	2.00	1.45	0.720	0.137	0.00	41.68	33.88	-	-	41.161	-	40.92
3	3	CLAY	4.00	5.50	1.50	1.87	0.686	0.131	0.00	68.99	15.06	-	-	9.994	-	

VIVEK MATERIAL TESTING LABORATORY

SETTLEMENT CALCULATION

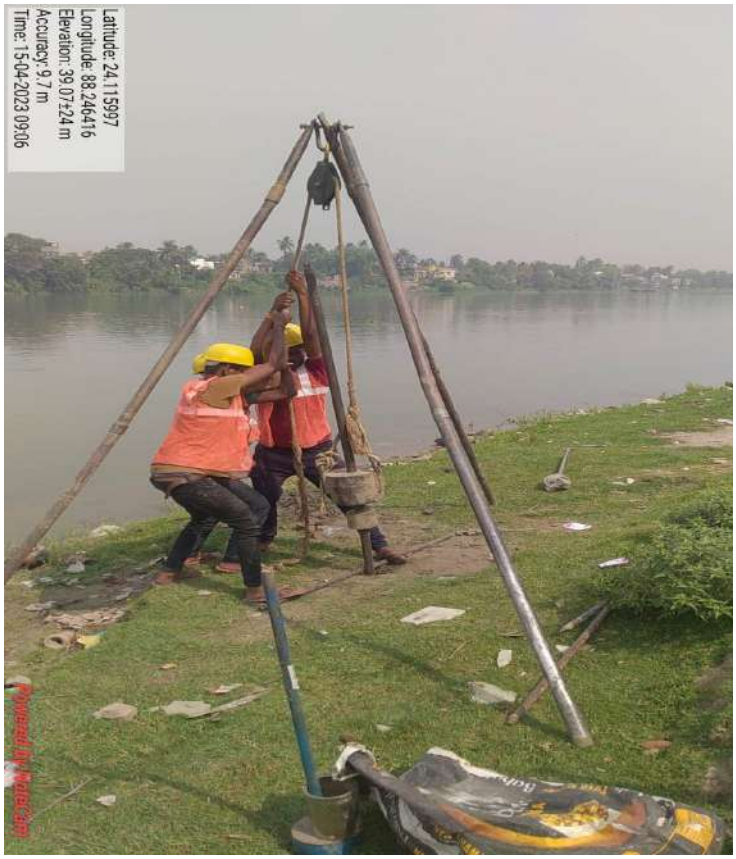
SETTLEMENT CALCULATION AS PER IS 8009 (PART 1) : 1976

CALCULATION SHEET 6

Depth	2.50	metre	Settlement effective zone depth	1.50	X Width		Depth factor	1.00	BOREHOLE 2
Length	2.50	metre	Water Table depth for calculation	5.00	(m) bgl		Rigidity factor	0.80	
Width	2.50	metre	Applied Pressure at foundation base	73.70	kN/m2		Type of foundation	SQUARE	

S. No.	Layer No.	Type of Layer	Layer Start depth	Layer End depth	Layer Thickness	Density	Void Raito	Compression Index	Corrected SPT	Effective stress	Increment stress	Settlement for Unit Pressure	Water Correction factor	Consolidation settlement	Immediate settlement	Total settlement
		CLAY					e	Cc	N''	P_o	ΔP		W'			
		SAND	(m)	(m)	(m)	(gms/cc)				kN/m2	kN/m2	(mm)		(mm)	(mm)	(mm)
1	1	CLAY	0.00	2.50	2.50	1.40	0.000	0.000	0.00	Depth of foundation						40.63
2	2	CLAY	2.50	4.50	2.00	1.45	0.720	0.137	0.00	48.54	37.60	-	-	39.682	-	
3	3	CLAY	4.50	6.25	1.75	1.87	0.686	0.131	0.00	77.10	15.94	-	-	11.100	-	

SITE PHOTOS DURING SITE INVESTIGATION



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RESULT SHEET

NAME OF THE PROJECT	**CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GOPAL GHAT IN WEST BENGAL**
Client Name	

Bore Hole No.	**1 (L.H.S.)**	**Coordinate**	**Easting**		**Depth of Water Level**	1.00	**VIVEK MATERIAL TESTING LABORATORY**
Total depth of Bore Hole	**10.00**		**Northing**		**Commenced on**	4/15/2023	
			Elevation	**100.000**	**Completed on**	4/15/2023	

Depth of Bore Hole	**Reduced Level**	**Types of Samples**	**% Material Passing IS Sieve**				**Atterberg Limits**			**IS group symbol**	**SPT Value**	**SPT Value corrected due to overburden**	**SPT Value corrected due to dilatancy**	**Wet Bulk Density**	**Original Moisture**	**Dry Bulk Density**	**Specific Gravity**	**Void Ratio**	**Shear Characterisitics**		**Compression Index**
			4.750	**2.000**	**0.425**	**0.075**	**LL**	**PL**	**PI**										**Cohesion**	**Angle of Internal Friction**	
metre	metre		(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N''	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(Ø)	(Cc)
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
0.00 - 0.50	100.000 - 99.500	DS	98	95	90	84	33	23	10	CL					-	-	-	-	-	-	-
1.00 - 1.35	99.000 - 98.650	UD	100	100	100	99	32	21	11	CL				1.82	18.7	1.53	2.61	0.706	0.10	16°	0.140
1.35 - 1.80	98.650 - 98.200	SPT									4	6.53	6.53								
2.50 - 2.85	97.500 - 97.150	UD	100	100	100	98	38	19	19	CI				1.89	21.4	1.56	-	-	-	-	-
2.85 - 3.30	97.150 - 96.700	SPT									6	8.49	8.49								
4.00 - 4.35	96.000 - 95.650	UD	100	100	100	99	39	25	14	CI				1.92	22.5	1.57	2.63	0.675	0.20	13°	0.130
4.35 - 4.80	95.650 - 95.200	SPT									7	8.97	8.97								
5.50 - 5.85	94.500 - 94.150	UD	100	100	100	99	41	21	20	CI				1.93	20.7	1.60	-	-	-	-	-
5.85 - 6.30	94.150 - 93.700	SPT									9	10.67	10.67								
7.00 - 7.35	93.000 - 92.650	UD	100	100	99	28	NON PLASTIC			SM				1.88	21.3	1.55	2.59	0.671	0	29°	-
7.35 - 7.80	92.650 - 92.200	SPT									14	15.60	15.30								
8.50 - 8.85	91.500 - 91.150	UD	100	100	99	21	NON PLASTIC			SM				1.88	19.6	1.57	-	-	-	-	-
8.85 - 9.30	91.150 - 90.700	SPT									15	15.85	15.43								
9.30 - 10.00	90.700 - 90.000	DS	100	100	98	14	NON PLASTIC			SM					-	-	-	-	-	-	-

RESULT SHEET

NAME OF THE PROJECT	CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GOPAL GHAT IN WEST BENGAL						
Client Name							
Bore Hole No.	2 (L.H.S.)	Coordinate	Easting		Depth of Water Level	5.00	VIVEK MATERIAL TESTING LABORATORY
Total depth of Bore Hole	10.00		Northing		Commenced on	4/15/2023	
			Elevation	100.000	Completed on	4/15/2023	

Depth of Bore Hole	Reduced Level	Types of Samples	% Material Passing IS Sieve				Atterberg Limits			IS group symbol	SPT Value	SPT Value corrected due to overburden	SPT Value corrected due to dilatancy	Wet Bulk Density	Original Moisture	Dry Bulk Density	Specific Gravity	Void Ratio	Shear Characterisitics		Compression Index
			4.750	2.000	0.425	0.075	LL	PL	PI										Cohesion	Angle of Internal Friction	
metre	metre		(mm)	(mm)	(mm)	(mm)	%	%	%		N	N'	N"	(gms/cc)	%	(gms/cc)	(G)		(Kg/sqcm)	(Ø)	(Cc)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0.00 - 0.50	100.000 - 99.500	DS	FILLED UP SOIL UP TO 4.80 METRE DEPTH BELOW GROUND LEVEL (BRICK PIECES + SAND)																		
1.00 - 1.35	99.000 - 98.650	UD																			
1.35 - 1.80	98.650 - 98.200	SPT																			
2.50 - 2.85	97.500 - 97.150	UD																			
2.85 - 3.30	97.150 - 96.700	SPT																			
4.00 - 4.35	96.000 - 95.650	UD																			
4.35 - 4.80	95.650 - 95.200	SPT																			
5.50 - 5.85	94.500 - 94.150	UD	100	100	98	97	36	20	16	CI				1.87	20.1	1.56	2.63	0.686	0.25	10°	0.131
5.85 - 6.30	94.150 - 93.700	SPT									7	8.34	8.34								
7.00 - 7.35	93.000 - 92.650	UD	100	100	99	98	38	24	14	CI				1.92	21.3	1.58	-	-	-	-	-
7.35 - 7.80	92.650 - 92.200	SPT									8	8.90	8.90								
8.50 - 8.85	91.500 - 91.150	UD	100	100	100	98	37	23	14	CI				1.97	22.2	1.61	2.64	0.640	0.15	14°	0.127
8.85 - 9.30	91.150 - 90.700	SPT									9	9.40	9.40								
9.30 - 10.00	90.700 - 90.000	DS	100	100	100	97	39	25	14	CI					-	-	-	-	-	-	-

BORE-LOG CHART

VMT
GEOTECH & MATERIAL TESTING

VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GOPAL GHAT IN WEST BENGAL

WATER TABLE 1.00 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 01 (L.H.S.)

DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES
			GROUP	HATCHING	N1	N2	N3	N2+N3	10 20 30 40 50 60 70 80 90 100
0.00-0.50	SILTY-CLAY	D.	CL						
1.00-1.35	SILTY-CLAY	U.D.	CL						
1.35-1.80		S.P.T.			1	2	2	4	
2.50-2.85	SILTY-CLAY	U.D.	CI						
2.85-3.30		S.P.T.			2	3	3	6	
4.00-4.35	SILTY-CLAY	U.D.	CI						
4.35-4.80		S.P.T.			2	3	4	7	
5.50-5.85	SILTY-CLAY	U.D.	CI						
5.85-6.30		S.P.T.			3	4	5	9	
7.00-7.35	SILTY-SAND	U.D.	SM						
7.35-7.80		S.P.T.			4	6	8	14	
8.50-8.85	SILTY-SAND	U.D.	SM						
8.85-9.30		S.P.T.			5	7	8	15	
9.30-10.00	SILTY-SAND	D.	SM						

BORE-LOG CHART

VMT
GEOTECH & MATERIAL TESTING

VIVEK MATERIAL TESTING LABORATORY

NAME OF THE PROJECT:- CONSTRUCTION OF BOAT IN THE IDENTIFIED COMMUNITY JETTY AT GOPAL GHAT IN WEST BENGAL

WATER TABLE 5.00 METRE DEPTH BELOW GROUND LEVEL

BORE HOLE NO.:- 02 (L.H.S.)

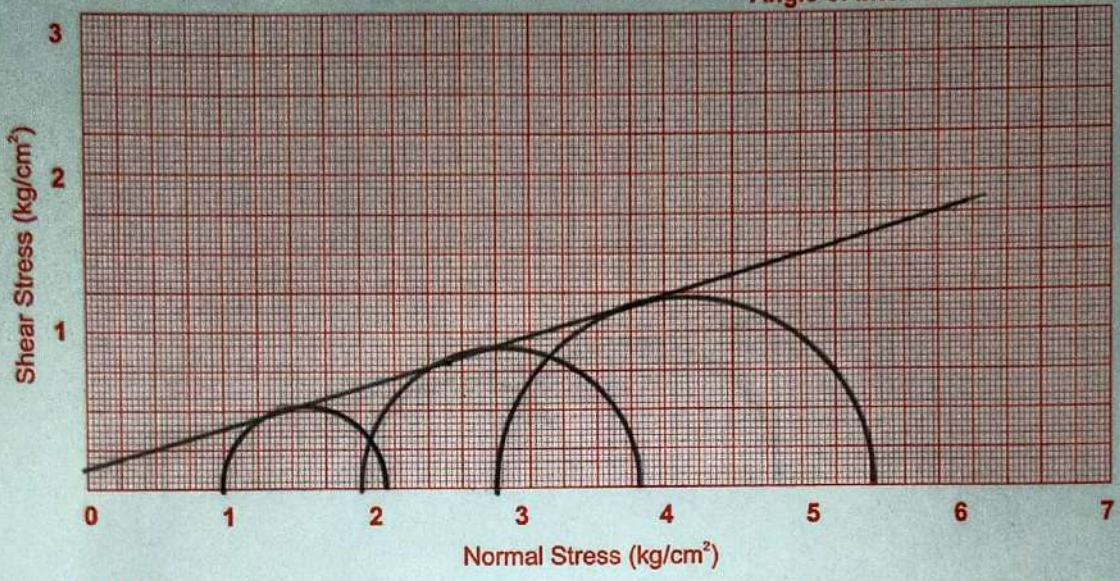
DEPTH IN METRES BELOW GROUND LEVEL	VISUAL FIELD OBSERVATIONS	SAMPLE	I.S.		S.P.T. VALUE				S.P.T. VALUES
			GROUP	HATCHING	N1	N2	N3	N2+N3	10 20 30 40 50 60 70 80 90 100
0.00-0.50		D.		FILLED UP SOIL UP TO 4.80 METRE DEPTH BELOW GROUND LEVEL (BRICK PIECES + SAND)					
1.00-1.35		U.D.							
1.35-1.80		S.P.T.			2	3	4	7	
2.50-2.85		U.D.							
2.85-3.30		S.P.T.			2	2	3	5	
4.00-4.35		U.D.							
4.35-4.80		S.P.T.			3	4	5	9	
5.50-5.85	SILTY-CLAY	U.D.	CI						
5.85-6.30		S.P.T.			2	3	4	7	
7.00-7.35	SILTY-CLAY	U.D.	CI						
7.35-7.80		S.P.T.			2	3	5	8	
8.50-8.85	SILTY-CLAY	U.D.	CI						
8.85-9.30		S.P.T.			3	4	5	9	
9.30-10.00	SILTY-CLAY	D.	CI						

VMT/130/23-24

VMT
GEOTECH & MATERIAL TESTING

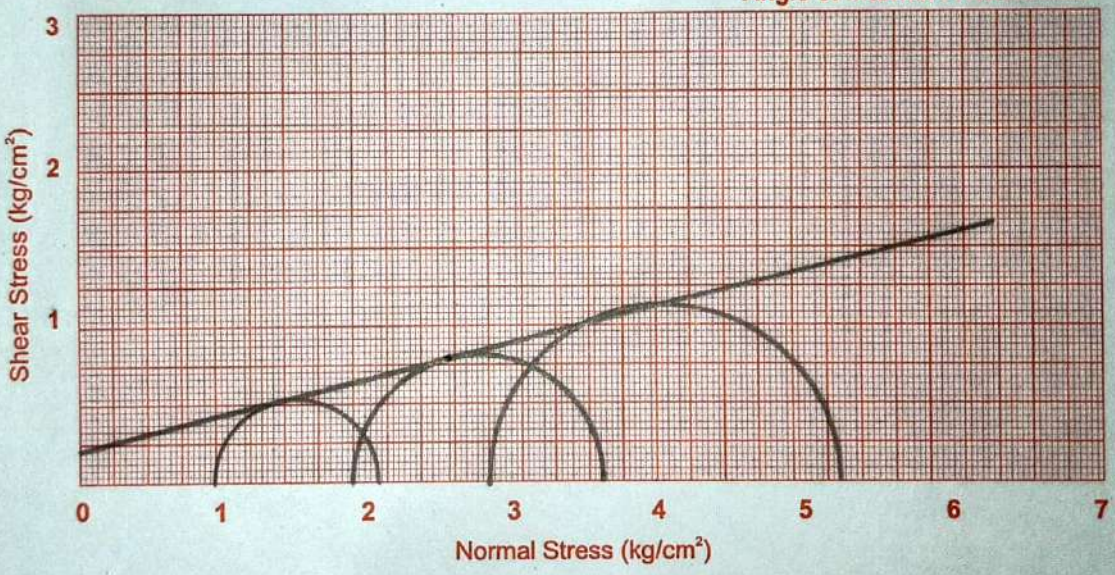
B.H. No. :- 01
Depth - 1.00 - 1.35

Cohesion 'c' 0.10 Kg/cm²
Angle of Internal Friction 16° *



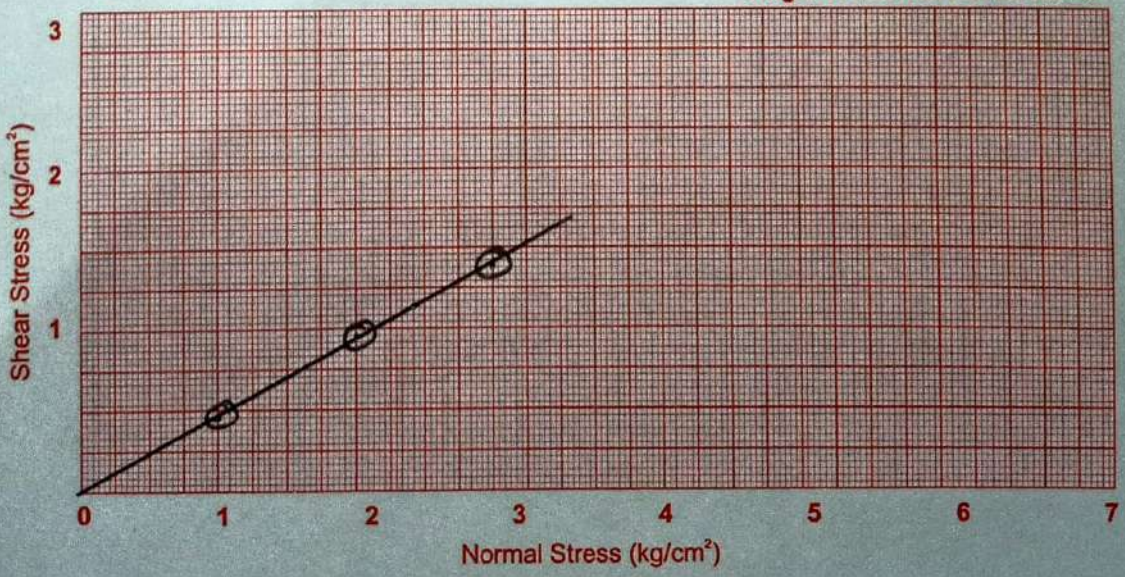
B.H. No. :- 01
Depth :- 4.00 - 4.35

Cohesion 'c' 0.20 Kg/cm²
Angle of Internal Friction 13° *



B.H. No. :- 01
Depth :- 7.00 - 7.35

Cohesion 'c' 0 Kg/cm²
Angle of Internal Friction 29° *



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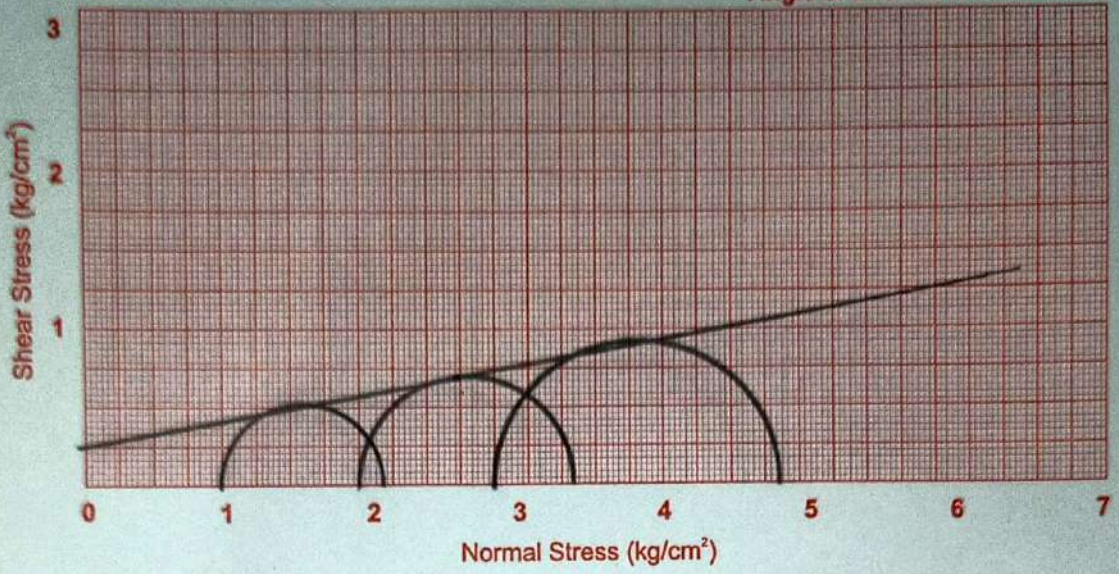
VMT/130/23-24

VMT
GEOTECH & MATERIAL TESTING

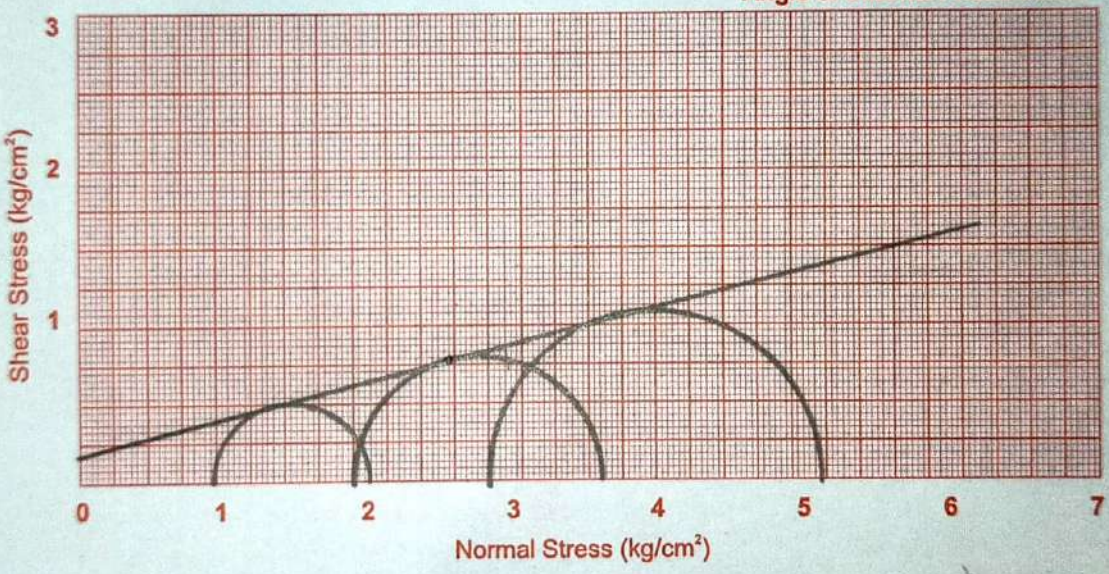
B.H. No. :- 02
Depth - 5.50 - 5.85

Cohesion 'c' 0.25 Kg/cm²
Angle of Internal Friction 10°



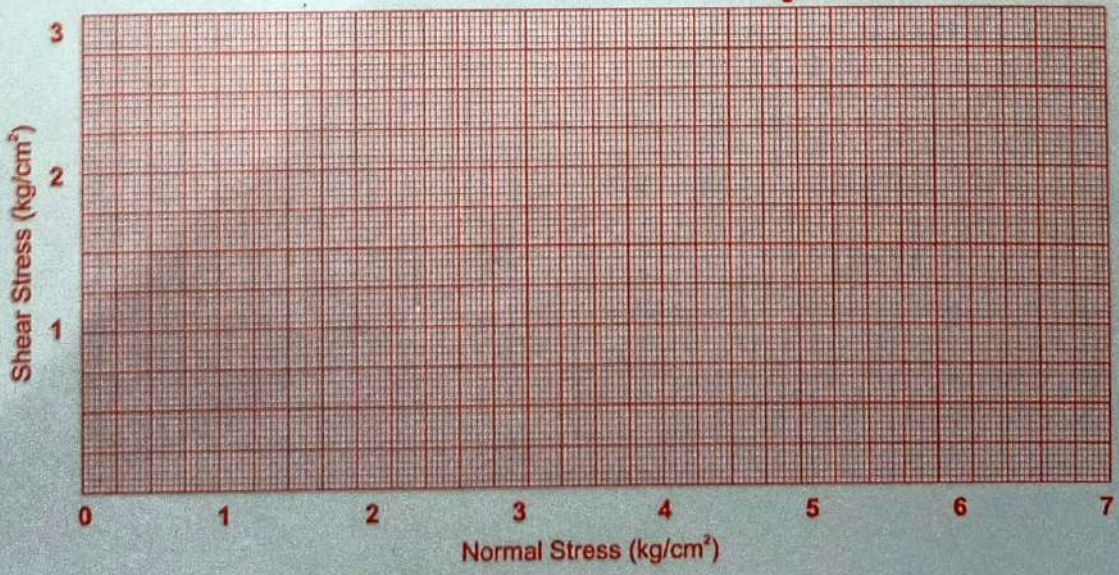
B.H. No. :- 02
Depth :- 8.50 - 8.85

Cohesion 'c' 0.15 Kg/cm²
Angle of Internal Friction 14°



B.H. No. :-
Depth :-

Cohesion 'c' ..... Kg/cm²
Angle of Internal Friction ..... °



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