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HQ Chief Engineer Jabalpur Zone
 Military Engineer Services
 Ridge Road
 Jabalpur Cantt - 482001

752986/A/ 19/ E8

15 Nov 2025

All Bidders,

**PROVN OF SINGLE MEN BARRACKS INCLUDING COOK HOUSE (IN EPC MODE) FOR AGNIVEERS
 AT 1 STC JABALPUR**

Dear Sir(s),

1. Refer Tender documents for the above-mentioned work uploaded on www.defproc.gov.in by this office having tender reference ID: 2025_MES_725970_1 dated 12 Sep 2025 vide this office letter No 752986/A/03/E8 dated 12 Sep 2025, date corrigendum issued vide this office letter No 752986/A/09/E8 dated 10 Oct 2025, 752986/A/14/E8 dated 31 Oct 2025 & 752986/A/17/E8 dated 14 Nov 2025.
2. The following amendment shall be carried out / considered before submission of bid:-

SI No	Page No	Location	Description of changes
1	2	3	4
1.	01	Index sheet (Contents)	The existing Serial Page No 1 is hereby cancelled & shall be replaced with revised Serial Page No 1(R) enclosed herewith.
2.	21-33	Schedule 'A' Notes	The existing Serial Page No 21 to 33 are hereby cancelled & shall be replaced with revised Serial Page No 21 (R) to 33 (R) enclosed herewith.
3.	58-112	BOQ	The existing Serial Page No 58 to 112 is hereby cancelled & shall be replaced with revised Serial Page No 58(R) to 112(R) enclosed herewith. * Tenderers/bidders attention is specifically drawn to the fact that they should submit their offer on revised BOQ only. In case any tenderer/bidder submits offer on pre-revised BOQ in lieu of Revised BOQ, it will be considered as a willful negligence by the tenderer/bidder and quotation shall be considered non-Bonafide.
3.	225-230	Particular Specification	The existing Serial Page No 225 to 230 are hereby cancelled & shall be replaced with revised Serial Page No 225(R) to 230(R) enclosed herewith.
4.	-	Particular Specification	Add Additional Pages 230(A) to 230(O) after page No 230(R) for Design Basis Report of Structural, E/M Portion and Internal water supply.
5.	-	List of drawing	Add additional Pages 230(P) after page No 230(O).
6.	270-384	SBC Report	Add Additional Pages 270 to 384 after page No 269 for Soil Bearing Capacity Report.

3. This letter alongwith its enclosure shall be form part of the tender documents and shall be uploaded duly signed along-with tender.

Encls: As above

Yours faithfully

Signature of Contractor
 Date :

Dy Dir/ AD (Contract)
 For Accepting Officer

Military Engineer Services
Chief Engineer Jabalpur Zone, Ridge Road
Jabalpur Cantt – 482001
Email – dircontcezi2-mes@nic.in

TENDER ID : 2025_MES_725970_1
PROVN OF SINGLE MEN BARRACKS INCLUDING COOK HOUSE (IN EPC MODE) FOR AGNIVEERS
AT 1 STC JABALPUR

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* These documents are not attached with tender documents and can be seen in the office of **CE Jabalpur, CWE Jabalpur and GE (P) No 1 Jabalpur** during working hours.

(Signature of Contractor)

Dy Dir (Contracts)
For Accepting Officer

SCHEDULE 'A' NOTES
LIST OF WORKS AND PRICES
PROVN OF SINGLE MEN BARRACKS INCLUDING COOK HOUSE (IN EPC MODE) FOR AGNIVEERS
AT 1 STC JABALPUR

1. The Notes here-in-below shall be applicable to all parts of Schedule 'A' and BOQ. Wherever Schedule 'A' is mentioned in tender documents, it means the Schedule 'A' as well as BOQ as applicable.
2. The Schedules are divided into various parts as detailed below:-

(i)	Sch 'A' Part-I	Building/Structures (To be quoted by the tenderer)
(ii)	Sch 'A' Part-II	External Electric Supply (Pre Priced on SSR 2020)
(iii)	Sch 'A' Part-III	External Water supply (Pre Priced on SSR 2020)
(iv)	Sch 'A' Part-IV	Road Path Culvert (Pre Priced on SSR 2020)
(v)	Sch 'A' Part-V	Sewage Disposal (Pre Priced on SSR 2020)
(vi)	Sch 'A' Part-VI	Security Fence and gate (Pre Priced on SSR 2020)
(vii)	Sch 'A' Part-VII	Area Drainage (Pre Priced on SSR 2020)
(viii)	Sch 'A' Part-VIII	Summer & cooling Appliances (Pre Priced on SSR 2020)
(ix)	Sch 'A' Part-IX	Arboriculture (Pre Priced on SSR 2020)
(x)	Sch 'A' Part-X	Fire Fighting System (Pre Priced on SSR 2020)
(xi)	Sch 'A' Part-XI	Lightning protection system (Pre Priced on SSR 2020)
(xii)	Sch 'A' Part-XII	Site Clearance (Pre Priced on SSR 2020)
(xiii)	Sch 'A' Part-XIII	(Miscellaneous B&R / E&M items of works (To be quoted by the tenderer))

3. The description of various items of works mentioned in Schedule 'A' and BOQ are in brief and includes for all materials and labour complete unless otherwise mentioned. These shall be read in conjunction with Special Conditions, Particular specifications, Drawings including notes there on, specifications for materials and workmanship contained in SSR Part-I and relevant preambles to various trade sections in SSR Part-II. Words "all as specified and/or shown on drawings and/or as directed" shall be deemed to be included in all items of Schedule 'A' and BOQ whether specifically mentioned in Schedule 'A' and BOQ or not.

4. **VISIT TO SITE:** The bidders shall visit the work site of work by taking prior appointment with GE before quoting. The bidders shall have no claim what-so-ever on this account at a later stage whether he has actually inspected the work site or not. Bidder shall upload a certificate self-certifying about having visited the site of work.

5. **LAYOUT:** Layout of Building/Structures and Works Services indicated in the SITE PLAN are Tentative and no Adjustment in Price shall be done on account of Final Approved Layout.

6. **PERIOD OF COMPLETION:-**

6.1 The entire work under this contract shall be completed in both Phases in **548 (Five Hundred Forty-Eight Days)**, from the date of handing over site as indicated in Work Order No.1. The brief details work to be carried out in each phase are as under:

Phase	Scope covered	Date of commencement	period of completion from the date of commencement	Amount of Phase for calculation of Compensation
I	Topographic survey, Site clearance, Soil investigation, Submission of design & drawing, vetting by IITs/NITs and its approval from employer	As per Work order No. 1	60 Days	40 Lakh
II	All works NOT covered in Phase -I	Next day subsequent to completion of Phase-I	488 Days	CA Amount – (Minus) 40 Lakh

Note: -

- (i) Work order will be placed for both phases simultaneously duly mentioning date of commencement and date of completion of each phase. In case of extension of completion period of Phase-I, the commencement date of phase-II shall be modified accordingly.
- (ii) The whole work shall be deemed to be completed only after completion of Phase-II.
- (iii) Single Final bill shall be submitted by the contractor and paid by the department.
- (iv) Defect liability period of work shall commence from the completion date of the Phase-II.

6.2 **HANDING OVER OF SITE:**

Site for execution of work will be available as soon as the work is awarded. In case it is not possible to make the entire site available on the award of work, the contractor will have to rearrange his working programme accordingly. No claim whatsoever, for not giving the entire site on award of work and for giving site gradually, will be tenable. However Work Order No 1 shall specifically indicate phased handing over of site as proposed in consultation with users.

7. Lump sum amount and Unit rate quoted by the tenderer shall interalia includes for all taxes levied by Central Govt/State Govt/Local bodies viz GST, GST on works contract, workers welfare tax/cess etc. including recovery of income tax, GST on works contract and labour welfare tax which is deductible at source. No claim of whatsoever nature shall be admitted by the Govt on this account.

8. Probable distribution of various Items of Internal/External Services is indicated on site plan/line plan / relevant Drawings, inventory of items and the same are tentative. Bidder will work out his own details/schedule for various services and cost as per bidder's own schedule and the same shall be accounted for in his quoted lump sum. These may be varied as per site requirement, where necessary, at the discretion of the Engineer-in-Charge. The effect of such changes/variations in quantities due to realignment or resitting after approval of contractor's final schedule shall be duly accounted for in working out the deviation as applicable.

9. Cost considered for each item of work covering the scope of work shall be inclusive of all 'Material & Labour' or 'Supply & Fixing' or 'Supply & Laying' including Tools and Plants, Installing, Commissioning and Testing complete as required for entire Completion of Works.

10. All Reinforcement bars shall be TMT Bars (Fe 500D grade) (except Mild Steel Round Bars where specifically shown in approved Drawings/TD drawings) irrespective of whatever shown on approved drawings or specified elsewhere in these tender documents. Wherever Mild Steel Round Bars is intended as reinforcement, the same shall be of size 8mm dia TMT Bar (Fe 500D).

11. In case any royalty is required to be paid by the Contractor for bringing approved earth from outside of the MoD Land, the rate quoted shall be deemed to include for the same and nothing extra shall be paid to the Contractor by the Department.

12. Cost of testing including transportation of Materials and/or Equipments or Items, provision of all facilities for testing in accordance with Specifications and/or IS shall be borne by the Contractor unless otherwise mentioned.

13. **SAFETY MEASURES, PRECAUTIONS, RISKS ETC.**

13.1 The Work shall be carried out with utmost care to ensure that no damage to existing/adjoining work is done failing which the damage, if any done shall be rectified by the contractor to match with the existing/ adjoining work to the entire satisfaction of Engineer-in-Charge under contractor's own arrangement and at his own expenses.

13.2 Suitable tools, plants, equipments, mechanism, etc., as considered necessary shall be adopted during execution of the work. The Contractor shall take all precautions, safety measures, etc., to avoid any damage, mis-happening, accident, etc., to the workmen engaged by him to carryout the work. The lump sum amount quoted by Contractor shall be deemed to have included the element of adopting safety measures, precautions and also the risks, etc. involved in work, except Accepted Risks as covered under the General Conditions of Contract, and nothing EXTRA shall be admissible on this account.

14. **METHOD OF MEASUREMENTS:** The method of measurements to be adopted in the Contract shall be as laid down in MES Standard Schedule Of Rates Part-I & II, **IS-1200 (latest)** and other relevant BIS standard. The General Rules, Special Conditions, preambles and other provisions of these documents shall be deemed to apply to the work under this Contract unless otherwise mentioned in the tender documents.

15. ORDER OF PRECEDENCE

The Specifications must be read in conjunction with the conditions of contract, concept drawings, specifications" and other documents forming the Contract documents. Notwithstanding the subdivision of the specification under different headings, every part of it shall be deemed supplementary to and complementary of every other part. In the event of a discrepancy, difference or conflicting provisions among different parts of the documents on the same issue, the interpretation shall be based on the order of precedence as laid down below :-

- (a) provisions as contained in Notes to Schedule "A" & various schedule A/BOQ.
- (b) provisions as contained in the Scope of Work
- (c) provisions as contained in the Design Basis Report (DBR)
- (d) provisions as contained in the Schedule of Finishes
- (e) provisions as contained in Particular Specifications
- (f) provisions as contained in the MES Standard Schedule of Rates (SSR) (Part –I)
- (g) provisions as contained in the relevant Indian Standard of BIS
- (j) provisions as contained in the TD (Typical Details) drawings
- (k) provisions as contained in the General Conditions of Contract (GCC)

The heading in these specifications shall not be deemed to be part, thereof, or be taken into consideration in the interpretation or construction, thereof, or of the Contract.

16. SCOPE OF WORK

16.1 SITE OF PROJECT

Site for PROVN OF SINGLE MEN BARRACKS INCLUDING COOK HOUSE (IN EPC MODE) FOR AGNIVEERS AT 1 STC JABALPUR is located at Jabalpur. For exact location, the tenderers are advised to visit the office of GE (P) No 01 Jabalpur. Layout Plan/Site Plans enclosed alongwith the tender documents should be referred for access road, electric point, water point, temporary shed, tentative layout of the various buildings and other relevant information.

16.2 Site Context :

16.2.1 New accommodations are to be constructed as catered in Schedule -A part-I.

16.2.2 An inventory of site including the land, buildings, structures, road work, trees, services and any other immovable property on, attached to or lying at the site shall be prepared jointly by the contractor and representative of Employer and such inventory shall form part of the contract agreement.

16.3 Climate

16.3.1 The climate of Jabalpur over most of the year is a pronounced continental in character. It is very hot in summers and markedly cold in winters. May and June can be really hot with the temperature soaring to over 42°C, while in winter it can be as low as 4°C. Jabalpur has a semi-arid as well as tropical climate. Around 70% rainfall is received during the month of Jun to Aug and the remaining rainfall is received during December to February. Jabalpur is the one of the maximum rain-hit area in Madhya Pradesh with average rainfall being 54.6 inches per annum.

16.3.2 Bidders are advised to login to Govt website of Metrological Dept for other details.

16.5 Seismology

16.5.1 Seismically Jabalpur district lies in a region where earthquakes of moderate to high risk of earthquakes have been experienced in the past. A committee of experts under the auspices of Indian Standard institution prepared seismic zoning map of India, where Jabalpur district has been placed in **zone III**

16.6 Soil

16.6.1 The soil is generally black **cotton soil (Vertisol)**. However, project is to be taken up only after proper soil investigation as catered under schedule -A part-I of Scope of Work. Preliminary soil investigation has been done by the deptt but final soil testing for design is to be done by the bidder. Tentative report is attached for guidance only.

17. Brief Scope of Work:**17.1 Objective**

17.1.1 This contract is an EPC Contract wherein the Employer has provided concept drawings, specifications and other documents to establish and make clear the Employer's goals, objectives, requirements and expectations to do Engineering procurement and for PROVN OF SINGLE MEN BARRACKS INCLUDING COOK HOUSE (IN EPC MODE) FOR AG-NIVEERS AT 1 STC JABALPUR as detailed in the contract documents. The Contractor is required to use the concept documents provided by the Employer and then fully develop detailed, final and thorough plans, design, specifications and all other documents (**referred to in the contract document as 'Design Basis Report' or 'Design parameter'**) needed to successfully execute the works. In this regard the Employer is providing the following in concept form:

- (a) Line plan of buildings
- (b) Design Basis Report
- (c) Brief scope of services
- (d) Specifications
- (e) List of T&P, equipment & machinery.

17.1.2 These documents are intended to provide the contractor with sufficient information so as to clearly understand the Employer's intent, goals and objectives in execution of the works. The contractor is not required to strictly conform to concepts provided by the employer, but, on the contrary, is encouraged to improve on concepts with the goal to provide the final solution which best meets the Employer's goals and objectives. The contractor shall use a certain degree of liberty and flexibility in producing solutions which best meet established goals and objectives. The contractor will be required to adopt the general concepts, as provided, and expand and develop the same to produce complete, thorough, comprehensive and high-quality designs, working drawings, and specifications for review and approval by the Employer. While developing the complete and final designs and specifications, the contractor shall review the concept designs and planning for betterments or improvements which may be incorporated to better achieve the Employer's goals and objectives.

These betterments, if any, shall be submitted by the contractor to the employer for review and approval before the final design is completed. A brief summary of the Employer's key goals and objectives in executing works under this EPC Contract are as follows:

- (a) High quality construction
- (b) Pleasant and sustainable architectural appearance/features planned as per terrain and local climatic conditions
- (c) Quality life for residents
- (d) Maximize sustainability concepts.
- (e) Minimize long term facilities maintenance and upkeep costs.
- (f) Employee latest/modern construction technologies and best practices.
- (g) Maximize the natural surroundings and attributes to the extent possible.
- (h) Complete interim project priority milestones and overall schedule objectives on time.
- (k) Complete project within established budget.
- (l) Completion of various stages of the project within laid down time schedule as approved by the Accepting Officer

17.1.3 The specifications contained, herein, shall apply to all works/items of work as are required to be executed under the Contract or otherwise directed.

17.2 Documents to be submitted before commencement of work:

17.2.1 The architectural drawings of the buildings covered under Schedule 'A' Part-1, have been uploaded along with the tender document. Contractor has to submit drawings of building portion duly vetted by IIT within 60(Sixty) calendar days from the date of commencement as per work order No 1.

- (a) The following documents shall be submitted to accepting officer within 60 days of acceptance:-
- (i) Confirmatory Soil Investigation Report.
 - (ii) Design parameters adopted.
 - (iii) Detailed load calculation.
 - (iv) Enumeration of load combination & load factors (Hard & Soft copies).
 - (v) Analytical model (Hard & Soft copies).
 - (vi) Design output of software in hard copies.
 - (vii) Detailed Structural drawings duly vetted by any IIT in 7(Seven) tracing and white sheet, ink signed and certified to be "safe" and design as per standard procedure incorporating relevant codal provisions of loading and detailing.
 - (viii) Detailed bills of quantities with abstract and analysis of items based on market rates as specified hereinafter.
 - (ix) Separate Bill of quantities for internal water supply and internal electric supply to be submitted
- NOTE:** Minimum SBC (Minimum of confirmatory and attached report) to be used for design purpose.
- (b) The design parameters for buildings covered under Schedule 'A' Part-1 and is appended in PS clauses.
- (c) Detailed specifications, are given in particular specification which shall be taken into consideration by the contractor for designing the complete structural components of Schedule 'A' Part-I. In case any deficiency is noticed by the tenderer while carrying out design etc., the same shall also be intimated alongwith design details. The deficient details submitted shall also be deemed considered by the tenderer for arriving the lumpsum quoted for Schedule 'A' Part-I.

REFERENCE STANDARDS

- (a) The work covered by this specification shall comply with the latest editions and revision of SSR Part-I Specifications and as specified elsewhere in the Contract documents.
- (b) The latest editions and revision of SSR Part-I applicable as on bid submission start date shall be adopted. The contractor shall maintain at site a copy of the latest editions of all Indian Standards being followed in the design development, SSR and Codes applicable to the work to be undertaken on site.

17.3 WORK(S) COVERED UNDER SCH 'A' PART-I

17.3.1 Contractor has to carry out confirmatory Soil Bearing capacity test/ Soil Investigation at his cost.

17.3.2 Design Basis report for building, internal water supply & internal electric supply covered in Sch A Part I is given in Particular Specification. Contractor shall be fully responsible for providing fully functional Internal electric Services (internal wiring, electrical points, MCB/MCCB, electrical appliances such as fan, Led Lights, exhaust fan etc) and Internal water services (Pipe connections, bib taps, bathroom/kitchen fittings, geyser, hot water & cold-water pipe etc.). These provisions are for guidance only and the contractor shall be fully responsible for submission of sound, safe aesthetic design in the scope of work of this Contract.

17.3.3 Description of buildings covered in schedule -A part-I, is in brief. These are deemed to be amplified and read in conjunction with Special Conditions, Particular Specifications for materials and workmanship and conditions in relevant trade section of SSR Part-I, Part-II and contract drawings including notes on the drawings.

The scope of work under Sch A Part-I is not exhaustive. However, the contractor is required to execute all the items as per scope of work, Design Basis Reports (DBR) and in compliance with general specifications, particular specifications, drawings etc. to make the PROVN OF SINGLE MEN BARRACKS INCLUDING COOK HOUSE (IN EPC MODE) FOR AGNIVEERS AT 1 STC JABALPUR and its services fit for its purpose i.e. handing over for functional use. The details mentioned in DBR and general as well as particular specification / conceptual drawings / site plan/line plan are indicative in nature. The bidder will ensure to complete the work and make it functional as per relevant codes and Standards. Any other item not covered under scope of work but seems necessary for proper operation of building shall be executed by the contractor within the quoted amount and no extra payment shall be admissible.

17.3.4 The scope also includes Two (02) years of Defects Liability Period (DLP) for all Works and Plants as defined in the General Conditions of Contract (GCC) IAFW-2249. The Defect Liability Period of plants, equipment, machineries etc. shall be as per guarantee/warranty clause hereinafter. Contractor shall deploy required number of technicians, tools, plants and machineries for maintenance/upkeep of buildings and plants/installations during the period of DLP, as per service liability agreement.

17.3.5 The site shall be cleared of rubbish, debris and all waste material by the contractor at his own expense and the site shall be delivered in clean and tidy state to the satisfaction of Engineer –in-Charge.

17.4 THIRD PARTY VETTING

17.4.1 From the date of commencement of work. A period of 60 (sixty) calendar days will be given to the contractor within which drawings and details of Sch `A' part-I, duly vetted and certified by any of the IIT, shall be submitted to the Accepting Officer for approval. Any discrepancy or observation raised by Accepting Officer shall be got modified by the vetting agency within a week's time. The commencement of physical execution of work shall start after approval of vetted design/drawing by the Accepting Officer only. However, during the period of 60 days mentioned above, the contractor can start mobilization on site his preparatory arrangements for the work like making site offices, bringing tools, plants, machineries etc.

17.4.2 . In case Vetting Agency suggests modifications/changes/ alterations/ additions, they will have to be complied with by the contractor in his design and drawings by way of dated revisions. Vetted/certified design & drawings along with correspondence exchanged between contractor & Vetting Agency shall be submitted to Accepting Officer along with 7 (seven) sets of drawings and original tracings who will approve the same & circulate them officially to contractor & executives of the Deptt which shall only be used for execution. In case owing to site/technical reasons, any further clarification/modification in design/drawing is necessitated, the contractor shall approach the vetting agency for revised design/drawing at his own cost and the work shall be executed as per revised design/drawing without any extra cost to the Government The cost effect towards vetting & certification fees payable/paid to Vetting Agency & submission of 7 (seven) sets of design & drawings including original tracings are deemed included in the quoted rate/offer. All the expenditure towards these elements shall be on contractor 's account and nothing extra shall be payable on account of any misunderstanding in respect of this clause.

17.4.3 The vetting of designs and drawings and its report shall be duly signed by the authorized signatory on behalf of the institute and not from a professor/individual of the institute in his personal capacity.

17.4.4 A certificate that all details have been thoroughly checked and are in compliance as per laid down standards, regulations in respect of safety soundness and economy, IS Codes, adherence to NBC norms and sound engineering practices shall be obtained from the vetting agency. The certificate duly signed shall be submitted by the consultant.

17.4.5 The vetting agency shall also be liable and answerable for any design deficiencies detected during design life of the structure/ plant and may be called upon to address such issues, if required.

17.4.6 The consultant/Institute shall facilitate interaction of rep of Accepting Officer with the vetting authority during the vetting/proof checking of the design/drawings and ensure all clarifications/confirmations of design parameters from the vetting authority.

17.4.7 Liability for accuracy of design, drawing and penalty for default shall lie with the contractor.

17.5 PROCESS OF APPROVALS OF DESIGNS, DRAWINGS

17.5.1 GE (P) No 01 Jabalpur is responsible for getting the approval for different types works under the Engineering Phase from the authorities as stipulated below. The contractor shall submit all the requisite documents/ details through the GE and liaise with stipulated authorities for approval within period stipulated as per milestones.

17.5.2 7(Seven) Copies of approved drawings along with soft copies 7(Set) shall be submitted for execution

(a) Soil Investigation Reports & Structural Design of Bldgs - Director (Des)/ E2(Des) section HQ CE Jabalpur Zone

(b) Any Issue related to contract- Director (Contracts)/ E8 section HQ CE Jabalpur Zone

(c) Any issue regard to site - CWE Jabalpur / GE (P) No 01 Jabalpur

(d) Any issue related to Site plan/ Floor Plan/ Arch Drawings- Director (Arch)/ E6 Section HQ CE Jabalpur Zone

- (e) The bill of quantities/costed schedule of **internal water supply** will be checked by Dir(Plg)/ officer nominated by the CE Jabalpur before commencement of work.
- (f) The bill of quantities/costed schedule of **internal electric supply** will be checked by Dir(E4)/ officer nominated by the CE Jabalpur before commencement of work.
- (g) Based on entire set of working drawings so finalised, the contractor shall work out the Bill of Quantities for Married accn with pricing at market rates. The contractor shall work out detailed estimates including services and price it at par market rates and work out Yard Stick for payment in respect Sheds at different stages of progress. The detailed BOQ of Shed and Yardsticks of Training Shed shall be submitted to CWE through GE for the approval. BOQs and Yard sticks approved by CWE shall be the basis for making payments under RARs.

17.6 DESIGN BY CONTRACTOR AND COPYRIGHT

17.6.1 All these design drawings will become the property of MES. The drawing cannot be issued to any other person, firm or authority or used by the contractor for any other project. No copies of any drawing or document shall be issued to anyone except MES and authorized representative of MES.

17.7.2 All drawings/specifications/makes, shop drawings and construction methodology etc. are to be got approved from MES prior to execution/procurement. However, it does not imply that contractor absolves themselves from Codal provisions/ statutory requirements.

17.7.3 If any modification in Architectural/Structural/Service design/drawing or any other change is needed due to deficiency in design/drawings/scheme arising out of inadequate considerations of site conditions/ non-compliance of Codal provisions, the contractor shall do/re-do the design/redevelop the scheme and then execute without any extra cost. The decision of the GE shall be final and binding. No claim whatsoever will be entertained in this regard. However in case of architectural changes in buildings arising out of Client's requirement after preparation/finalization of the drawings leading to change in specifications/finishes/scope of work, the same shall be regularized through deviation order.

17.7.4 The area mentioned in tender document is indicative in nature. The Built-Up area is based on concept drawings/permissible as per scale of Accommodation for Defence Services and other components. In case of any increase in area mentioned in tender document due to Employer/User requirement, the cost on this account is deemed to be included in the quoted by contractor and nothing extra shall be paid on any account.

17.7.5 All structural drawings/ Facade drawings shall be got approved from any of the IITs. Statutory fee shall be borne by the contractor.

17.8 DESIGN LIFE

The class of Structure of the buildings/ structures being provisioned under the subject work is "General Buildings and Structures", as such, the Mean Probable design life of structure in years shall be 50 as stipulated in IS 875: "Code of practice for design loads of building and construction". The contractor shall accordingly select the Materials and construction systems to be consistent with Mean Probable design life of structure.

17.9 SITING OF BUILDINGS:

Siting of buildings shall be as per layout plan generally. However, same may vary wherever necessary as per Employer requirement. The contractor shall not be entitled for any claims on account of any such re-siting of Building(s).

18. SCHEDULE 'A' PART- II to XIII

- (a) The unit rates inserted by MES under column 4 of Schedule 'A' Part-II to Part-XIII have been worked out at par with MES Standard Schedule of Rates 2020 including amendments and errata's thereto as indicated in tender page, or at the rates analogous thereto. The inserted rate are for guidance purpose. The tenderer's attention is invited to Condition 6A(B) of IAFW-2249.
- (b) The contractor is required to quote his unit rates against each item of work given under **BOQ (Schedule 'A') Part-II and Part-XIII**. The rates quoted shall include supply of material and labour and fixing etc complete.

19. UNIT RATES FOR SCHEDULE 'A' PART-I (BUILDING/STRUCTURES WORKS)

19.1 Unit rate quoted by the contractor for building work should include amount for provn of internal water supply and provn of internal electric supply.

19.2 The lump sum considered towards BOQ shall be deemed to include for all items of works complete as specified/referred in Annexures, Particular Specifications and all minor details though not specifically shown on approved drawings/TD drawings or specified in Particular Specifications. STD/TD drawings required for the tender have not been attached. These drawings can be referred in the office of Chief Engineer Jabalpur Zone on any working day during working hours.

19.3 Cutting and forming chases in masonry, concrete work etc. including cutting and or leaving holes/recesses, sinking, etc. where required and as directed by the Engineer-in-Charge shall be done as far as possible while the work is in progress. The cost of materials and labour for cutting and/or forming chases, cutting or leaving holes/recesses, sinking and making good in cement mortar 1:3 for filling up to 20mm and in PCC 1:2:4 (12.5mm graded stone aggregate) for filling more than 20mm shall deemed to be included in the cost considered by the contractor in its lump sum.

19.4 In all the above and other similar cases, the details indicated elsewhere in the drawings as approved or TD drawings that are similar or near similar to the missed out items of work shall be followed. In the absence of any other similar or near similar details, minimum essential requirement for completion of the work from structural and utility point of view shall be deemed to be included in the lump sum /rates quoted by contractor.

19.5 LUMP SUM amount considered by the Contractor for the building/Works under Schedule -A part-I shall be deemed to include for the following whether or not these are covered in the approved drawing :-

- (a) The existing areas/ground where the buildings /structures covered in Schedule -A part-I are to be provided, are assumed not having much undulations. In case large undulations are existing at site and site clearance/development works are required to achieve the modified ground level, the same shall be provided including surface dressing.
- (b) Pre-construction anti-termite treatment shall be carried out to the all the buildings. Pre-construction Anti-Termite Treatment shall be carried out as per IS.
- (c) Contractor has to give the Guarantee for for Anti-Termite Treatment for TEN YEARS.
- (d) Damp Proof Course (DPC) as required and specified.
- (e) Seismic Strengthening measures as per relevant IS.
- (f) Water proofing roof treatment shall be provided to the buildings. Contractor has to give the Guarantee for Water Proofing Treatment over RCC Roof Slabs for TEN YEARS.
- (g) PCC Plinth Protection with PCC Surface Drain as indicated/shown in TD Drawings or approved drawings.
- (j) Builders hardware for doors/windows etc. as essential from functional requirement.
- (k) Crumple joints as per standard engineering practice.
- (l) RCC/HDPE water tank of suitable capacity as per including PVC valve with PVC float of size to suit inlet pipe for each service tank including over flow pipe and wash out pipe CPVC pipe of dia same as inlet pipe).
- (m) Flushing Cistern, WC /EWC shall be as per standard pattern, Urinal, Readymade PVC Connecting Pipes to Wash Hand Basin, etc., Wash Hand Basin with bottle trap including Mirror.
- (n) Nahani trap with stainless steel grating, gully trap with grating, soil, waste and vent pipe, HDPE drain pipe upto and including first manhole and gully trap where bath/WC/toilet are occurring.
- (p) Suitable provision for hanging arrangement for ceiling fan and fixing arrangement for exhaust fan, AC, etc.
- (q) The foundation depth wherever marked on approved drawings shall be taken as depth from natural ground level and in no case any foundation shall be laid on filled earth.
- (r) Suitable provision for required type of RCC shelves / RCC loft / working platform.
- (s) Suitable provision for cup-board for living room
- (t) Provision of required type of "false ceiling" as per functional requirement.
- (u) Provision of required type of "Cable Duct" as per functional requirement.
- (v) Water proofing compound (liquid water proofing compound) of approved make as per

manufacturer instructions whichever is more to be mixed in water used for concrete/mortar.

- (w) All built-in furniture as per Scale of Accommodation
- (x) Sunken floor
- (y) Efflorescence treatment.

19.6 SBC (SAFE BEARING CAPACITY) : The SBC as indicated in report enclosed with the tender documents is indicative and purely for guidance only. While quoting the offer, the tenderer shall consider complete Soil Investigation as part of Scope of Work. The contractor shall ascertain the actual SBC of soil at the locations of respective buildings before designing of buildings. Minimum SBC (Minimum of confirmatory and attached report) to be used for design purpose. However, in case GE observes soil of unusual nature at site during the execution, which may result in lower SBC, he shall get tested the SBC of soil and if actual SBC found at site is at variance with reference to SBC as found out after soil investigation, the case shall be referred to Accepting Officers for approval and the structural design of affected elements shall be redone by the contractor at his own cost.

20.0 ALL SCHEDULES EXCEPT SCH 'A' PART-I

- (a) The quantities of items of work shown in relevant column of BOQ are approximate/provisional and are inserted as a guide only. These shall, however, not be varied beyond the limits laid down in condition 7 of IAFW-2249 (General Conditions of Contract) forming part of this contract.
- (b) Unless otherwise mentioned in the description of items, the unit rates (inserted by the department/as well as by the tenderer) shall be deemed to include for all material and labour complete. The description shall also be deemed to include for fixing, erection, installation, testing etc as required by the Government.
- (c) Layout of buildings indicated on site plan is tentative. No adjustment in price shall be done on account of changes/modifications in the final approved layout within the site plan area.
- (d) Probable distribution of various items of internal/external services are indicated on drawings. These are tentative and likely to be varied where necessary at the discretion of the Engineer-in-Charge. The contractor shall not be entitled for any claim whatsoever on account of such varied alignment.

21.0 MINOR CONSTRUCTION DETAILS

- (a) Rate quoted for a particular item and/or lump sum quoted by tenderer shall be deemed to be included for any minor details/item of work and/or construction which are obviously and fairly intended which may not have been included in these documents but which are essential for the execution and entire completion of the work as per standard Engineering practice. Decision of Accepting Officer as to whether any minor details of work and/or construction is obviously and fairly intended to be included in the contract or not shall be final, conclusive and binding and beyond the scope of arbitration clause.
- (b) Some of the minor details/ items which shall be deemed to be essential for execution and entire completion of work are detailed as under for guidance: -
 - (i) Reinforcement for any RCC member not indicated in the drawings but is structural requirement.
 - (ii) Dwarf wall in situations like verandah, passage etc not indicated in drawings.
 - (iii) Lintel over doors, windows and openings not shown in drawings.
 - (iv) Builders hardware for doors/windows etc though not indicated on drawings but essential for usage.
 - (v) In all the above and similar cases, the details indicated elsewhere in the drawings which are similar or near similar to missed out items of work shall be followed. In the absence of any other similar or near similar details, minimum essential requirement for completion of the work from structural and utility point of view shall be deemed to be included in the lump sum quoted. In the event of any dispute, decision of the Accepting Officer shall be final and binding.
- (c) The unit rates inserted in Sch 'A' Part-II to XII are deemed to be at par with rates contained in MES Schedule Part-II (2020) or at rates analogous thereto. The tenderer shall work out the total lump sum cost against these different parts of Schedule 'A' based on his own calculations/rates and arrive at total lump sum for each part of Schedule 'A' which shall be inserted in the relevant column of BOQ. The contractor shall have no claim whatsoever on account of error or inaccuracies in the unit rates /lump sum price inserted by MES.

22.0 MAKES OF ITEMS

(a) In case Sch "A" items indicate the makes, then same shall be from any one of the makes specified therein at the option of contractor.

(b) If Sch "A" items do not indicate makes, then makes to be incorporated in the work shall be from those listed in List of Makes. Selection shall be at the option of contractor from amongst the list. In case manufacturer of the item makes both ISI and non ISI marked items, then ISI marked item shall only be used. Please note that even if any makes are given in Particular Specifications, they shall stand superseded and only the makes given in Appendix to particular specification shall be applicable for all purposes.

(c) Contractor will intimate in writing to GE the name of make of material along with brand, model No/Cat Part No, etc. which he intends to procure. GE will approve the same within 10 days of receipt of such request after due verification of documents supplied by contractor with his request letter.

23.0 VALUATION OF DEVIATION

The percentage addition/deduction of MES Schedule of Rates for the purpose of Pricing deviation vide Condition 62 of IAFW-2249 shall be as follows:

(a)	For works covered under BOQ/ Schedule 'A' Part-I	(-) 10% on SSR-2020 RATES
(b)	For works covered under BOQ/ Schedule 'A' Part-II to Part-XII	Percentage addition/ deduction as derived from the lump sum amount tendered by comparing with the amount inserted by MES (as per condition 6-A of IAFW-2249) as applicable or stipulated in Condition 62 (B)
(c)	For works covered under BOQ/ Schedule 'A' Part XIII	Condition 62 (F) and (G) as applicable

24.0 In absence of any specification either in tender documents or in the drawing, the specification as given in SSR for relevant items and/or as per BIS Code shall be considered while quoting the tender. Reference to any drawings which is mentioned in the tender documents and or drawings forming part of the tender but not specifically mentioned in the list of drawings shall be deemed to be forming part of the tender. The tenderer shall see such drawings/details in the office of the Accepting Officer/concerned CWE/GE before quoting the tender. No claim whatsoever shall be entertained by the Govt on this account.

25.0 M&L or S&F wherever occurring shall be read as "Material and Labour" or "Supply and Fix" respectively. All items of works included in BOQ shall include supply of all materials (new), labour and fixing etc complete all as specified and shown on drawing except where specifically mentioned otherwise in the description of items/works.

26.0 A list of drawings indicates main drawings under particular heading of building. Certain other connected drawings as referred to in the main drawings but not under particular heading of buildings shall also apply to corresponding items of Schedule 'A'. Details not given in the drawings referred to in the main drawings shall be followed from any other drawings in the list of drawings.

27.0 The contractor shall maintain updated data and progress of work/ records/drawings/CPM etc on computer at site as required by work. One graduate Engineer or one diploma Engineer having adequate knowledge of computer shall be deputed by the contractor for this purpose. The CWE/GE may check these updated details at site on computer.

28.0 The department may exercise the right to call the manufacture for verification of the quality of the items as per his discretion.

29.0 The tenderers are advised to refrain from making any stipulations or conditions in their offer.

30.0 WORKING CONDITIONS:

(a) The subject work lies in **Un-restricted Area**.

(b) Tenderers are advised to visit site of work to familiarize themselves with nature of site, access to site, approaches, existence of shrubs/vegetation, etc. security checks exercised by the authorities in whose control the area lies, availability of labour and local materials, space for keeping their men, material in proximity of site, climatic conditions of the area, to enable them their resource planning for completion of work within the period of completion specified in the tender documents. The tenderer shall be deemed to have noted the site condition before quoting their offer irrespective of the fact whether they have visited the site or not and nothing extra shall be admissible on this account.

(c) Tenderers are advised to quote their rates keeping all these factors in view. Sites will be handed over on as-is-where-is basis. No claim whatsoever shall be entertained at a later date after acceptance of tender. If the tenderer envisages any difficulty existing at site and desires to propose any change, he should do so in writing at least seven days before due date of receipt of tender so that his proposals could be seen, analysed and cognizance of any changes can be made in tender documents by issue of suitable amendments as applicable. Tenderers quoted rates are deemed to have applicable. Tenderers quoted rates are deemed to have taken into consideration all these factors irrespective of whether they visited the site or not.

31.0 BREAK DOWN DETAILS FOR PAYMENT:**32.0 BLANK**

33.0 The tenderer shall submit yard stick for each building / structure mentioned in Schedule 'A' Part-I in duplicate to GE within two months from the date of handing over site as indicated in Work Order No.1, indicating percentage payments to be made for each stage along with supporting details i.e detailed estimate. Yard stick will be technically checked by JE(QS&C)/AGE(Contracts) of GE office and shall further be submitted to the office of CWE for technical check by DCWE(Contracts)/ACWE(Contracts) of CWE office and shall be approved by CWE. The tenderer shall take cognizance of this aspect while quoting the tender. No claim whatsoever arising due to any misinterpretation / misunderstanding on this account shall be admissible. The decision of CWE, in this regard shall be FINAL AND BINDING.

34.0 There may be certain changes in the yard stick percentages as submitted by the contractor while approving the yard stick by CWE due to market rates of various materials and due to policy of the Dept of withholding sufficient amount for later stages of the building. Contractor shall not have any claim on this account and percentage payment made for each stage as per approved yardstick shall be final and binding.

35.0 Payment against lump sum buildings shall be made as per the approved yard stick. Payment against lump sum buildings shall be allowed in III RAR and onwards to Contractor only after yard stick for the buildings is finalized and approved by CWE. Any delay in the payment of III RAR on account of late submission of yard stick by the Contractor to the GE shall be Contractor's responsibility and no claim on this account shall be entertained

33.0 FIXING OF SPECIAL (STAR) RATES

(a) In case of any deviation, mode of pricing shall be decided by Accepting Officer in terms of Condition 62 of IAFW-2249.

(b) In the event of a deviation order involving fixation of Special (Star) Rate, Draft Rate shall be prepared by GE (within a maximum period of 30 days) while initiating the proposal for deviation seeking approval of Accepting Officer and notified to contractor. While notifying the Draft Rate, it will be clearly stipulated that the same is merely an estimated rate and firm rate shall be fixed based on actual and receipt of supporting documents from contractor such as vouchers/literature of product/test certificates etc (as applicable) on completion of the work involving Star Rate. Any objection to the method of fixing Star Rate will be dealt as per Condition 7 of IAFW-2249.

- (c) Draft Star Rate shall be made based on market enquiry through telephonic enquiry/ quotations/ email/rate lists/internet based sources, material & labour constants available in various Civil Engineering books and record available in respect of Star Rates approved in the past for similar items of work etc. Contractor may also assist GES office in preparation of draft Star Rate.
- (d) The Draft Star Rate shall be purely a draft rate and shall not be used for claiming final payment during execution of work. However GE shall allow part payment to the tune of 80% during execution to avoid any financial hardship to contractor.
- (e) After completion of the item of work involving Star Rate, contractor shall submit the vouchers/literature of product/test certificates (as applicable, decision of GE being final in case of any disagreement) for finalisation of Star Rate. The Star Rate shall be technically checked by DCWE (C)/Director(C) depending upon the financial effect & approved by competent authority within a period of one month from submission of the relevant documents by contractor as mentioned above.
- (f) The Star Rate as approved by competent authority after technical check by DCWE (C)/Director(C) depending upon the financial effect shall be referred as "the rate decided by GE" under Para 62(G) of IAFW-2249.

34. SITE ESTABLISHMENT:

The tenderer shall be required to strictly ensure engagement of Engineers and deployment of T&P, Machinery & Transport as specified in subsequent paras. Inadequate engagement of Engineers/ deployment of T&P, Machinery & Transport shall be considered as serious breach of contract condition attracting ban/ removal/ downgrading/ debarment of the firm/company. The requirement of Engineer/ deployment of T&P, Machinery & Transport required to be ensured by the contractor are as mentioned below. However, this is the minimum requirement. The contractor at his own shall work out and deploy additional Engineer, T&P, Machineries & transport, if the execution of work in the given time period demands. No extra payment shall be admissible in case more Engineers, T & P, Machinery etc are deployed at site and all cost shall be deemed to be included in the rate quoted by the contractor.

(A) **ENGINEER ESTABLISHMENT:**

Refer condition-25 of General Conditions of Contract IAFW-2249 for supervision of work at site. Contractor shall employ the following Engineers. This provision shall be applicable irrespective of whether contractor himself is a qualified Engineer or not:-

Sr No	Supervision of Work by	No of Staff	Penalty for non employment in Rs per day per vacyancy
1	Graduate Engineers from recognized Institution/Engineering College with 5 years experience.	02	2000
2	Diploma holder Engineers from recognized Institutions with 5 years experience.	03	1500
3	Lab Technician having graduation with 4 years experience.	01	1000

The G.E shall have full powers, to put the contractor on notice on account of default either for non employment of Engineer(s) from site and levy penalty upto 30 days period. Thereafter GE shall have the option to either suspend the work or employ engineers at contractor cost and recover the amount from contractor dues

LIST OF WORKS AND PRICES (Contd...)**(B) LIST OF T&P, MACHINERY AND TRANSPORT:**

(i) As per requirement

Srl	Description of T&P desired in work	Unit	Qty
a.	Fully automatic concrete batching plant (1 cum)	Each	02
b.	Trucks / Tippers	Each	02
c.	Tower/ Builder's hoist	Each	01
d.	Excavators (JCB, Power shovel, etc)	Each	01
e.	Drilling machine	Each	02
f.	Transit mixer	Each	01
g.	Delivery Pump/Concrete pump (for RMC)	Each	02
h.	Vibratory roller	Each	01
i.	Power roller 8 to 10 tonne	Each	01
j.	DG Sets/ 10 KVA	Each	01
k.	Site Testing lab with full set of testing apparatus	Each	01
l.	Steel aluminum ladders 1.5 m to 8m	Each	02
m.	Chase cutting machine	Each	01
n.	Torque wrench for nuts/bolts /screws	Each	01
o.	Magnetic dial indicator for alignment	Each	01
p.	Conduit die set	Each	01
q.	Pipe vice	Each	01
r.	Bench vice	Each	01
s.	LT meager 500 Volts	Each	02
t.	Hydraulically operated & hand operated crimping machines	Each	02
u.	Portable Drilling Machine	Each	01
v.	Test bench for light fittings	Each	01
w.	Earth tester	Each	02
x.	Multi Meter	Each	02

(ii) Mandatory

a	Vibrator (Needle/ Plate type)	Each	04
b	Steel shuttering with spans, props etc	Sqm	1000
c	Total station	Each	01
d	Cube testing machine (hydraulically operated)	Each	01
e	Auto level with staff	Each	01
f	RMC plant with 15 Cum/ hour capacity	Each	01

Signature of Contractor
Dated:

Dy. Dir (Contracts)
For Accepting Officer

FURNITURE
PARTICULAR SPECIFICATIONS SECTION - I

GENERAL REQUIRMENTS

1. WORK IN ACCORDANCE WITH DRAWINGS AND SPECIFICATIONS

The work under this contract shall be carried out in accordance with schedule 'A', Special condition, particular specifications, General specifications and other provisions in the MES Schedule, relevant latest Indian standards and codes of practice. National building codes and drawings forming part of this contract read in conjunction with each other. The term "General specifications" referred to above as well as in IAFW-1815 (Z) shall mean the specifications contained in relevant IS.

2. SAMPLES OF MATERIALS (ARTICLES AND EQUIPMENTS)

All materials, articles and equipment's to be incorporated in the work shall be brand new and shall be procured from the manufacturer/authorised agents of the manufacturer and these shall be brought at site in the original packing. If any article is manufactured in more than one quality, the material/article of first quality shall be provided. These materials shall be got approved from the GE in writing before placing bulk order for incorporation in the works. Two samples of each article (except heavy equipment/article for which the decision of GE shall be final and binding) shall be produced by the contractor for the approval of GE well in time. The approved sample shall be signed by GE as well as contractors representative and shall be kept in safe custody till the expiry of the defect liability period. The materials articles referred to in Schedule 'A' shall invariably bear ISI certification mark. These materials although conforming to relevant IS will not be accepted if they do not bear ISI certification mark. The materials, articles and equipment not covered above shall bear ISI certification mark. If ISI mark not available, then conforming to relevant IS and if conforming to IS are also not available then these shall be of best quality available in the trade as approved by the GE. The decision of the GE in this regard shall be final, conclusive and binding.

3. PROPRIETARY MATERIALS

The material such as steel & proprietary material like paints, polish and the like which lose their identify and cannot be measured after incorporation in the work shall be recorded in the measurement book and signed by the contractor and Engr-in-Charge as a check to ensure that the required quantity of material has been brought for incorporation in the work. Proprietary materials brought to site shall be stored as directed by Engineer-in-Charge and those already recorded in measurement book shall be suitably marked for identification.

FURNITURE
PARTICULAR SPECIFICATIONS SECTION-II

1. GENERAL

1.1. The furniture shall be manufactured in accordance with the drawings in conjunction with specification (Sec-I & II) as indicated.

2. WORKMANSHIP

2.1 Workmanship shall be of good standard. The GE shall be the sole judge as to whether or not the workmanship is of the required standard.

3. TIMBER

3.1 All timber shall be of teak wood and shall be best quality available in the market and will be equivalent to the sample kept in GE office in all respects. Knots upto 3/4 inch in dia will be accepted if :-

- (a) These are not likely to become loose or dead.
- (b) These are not in cluster or groups.
- (c) These do not occur at edges of joints or on underside of members in tension.
- (d) These do not disfigure and or predominantly show out in finished articles.
- (e) General tolerance of wood should be ± 3 mm in thickness and ± 5 mm on length.

No timber with bigger knots, dead knots, loose knots, cracks, worm holes and sap will be accepted. However timber with sap wood upto 8 %(eight percent) will be acceptable at the discretion of GE. All timber shall be seasoned. The minimum permissible moisture content for timber for various purposes shall be as laid down in IS-287 and contractor shall submit the test certificate for the same without any extra cost to the Govt. Boards, planks and scantling etc shall be straight, square, sawn and planed/wrought true to the entire satisfaction of the GE to the dimensions shown on drawings.

Unless otherwise stated in the Key specifications (Section-III), plank used for larger surfaces shall generally be in widths, not less than 9 inches. Where the total width of planks does not permit use of all plank more than 8 inch wide, the GE may allow to use planks of lesser width but of equal widths or to use one plank only of lesser width (but not less than 4 inch) out of total number of plank to make up the total width. The GEs decision in this matter shall be final and binding.

4. JOINTS IN WOOD WORK

4.1 All wooden parts to be jointed with tongue & Groove method by providing a coat of wood primer and proper grinding with emery paper to smoothen the surface and then covering the surface with spirit coat or varnish.

5. NAILS, PINS AND SCREWS

5.1 Use of nails shall not be permitted unless absolutely necessary and permitted by the GE in writing. Pin for joints shall be of solid bamboo. Screws shall be driven with screw driver and not hammered in.

5.2 Unless otherwise specified screws shall be of M/S Brite Metal fold or other equivalent steel screws and shall be required lengths and gauge. Brass screws shall be provided wherever below visible surface. Surface and cavity shall be filled in with mixture of wood powder and glue and well set before applying polish.

6. CANE WORK FOR CHAIR ETC

6.1 All cane shall be of plastic strips of uniform width and Type-I (HDPE) as per sample kept in GE office, shall conform to IS-5378 and shall be manufactured by M/s Arihant/Arya/Shah. Weave of caning will be carried out as shown in drawing and width and thickness of plastic strips shall be 2.00 mm & 0.4mm respectively. Weight shall not be less than 0.250 Kg per 100 metre. The cane work shall consist of four strands in each hole so as to produce 2 horizontal, 2 vertical and 2 single diagonals. The perimeter of cane work shall be finished with plastic strips beading not less than 3.5 mm wide on exposed side only.

7. PREPARATORY WORK FOR POLISHING

7.1 Remove plane marks with a wood scraper and make surface smooth with sand paper from grades 2 to 0.5. File and stop bore hole with ready made fillers or a paste filler, prepared from plaster of Paris dissolved in water, mixed with colouring pigment to match colour of wood work. In applying the filler it should be rubbed across the grain. When the surface has dried up, wipe off superfluous filling and allow the surface to harden for a period of 24 hours. Rub surface with sand paper grade 'D' until it is thoroughly smooth and cleaned off dirt.

8. FRENCH POLISH

8.1 French polish for wood shall conform to IS-348 Specification of french polish (Second Revision). All unevenness of timber surface shall be rubbed down to smooth with sand paper and surface shall be well dusted. The pores in the wood shall be filled up with filler made of paste of plaster of Paris in water or methylated spirit.

8.2 A pad woolen cloth covered by a fine cloth shall be used to apply the polish. The pad shall be saturated with polish and rubbed hard on the surface in series of overlapping circles applying the polish sparingly but uniformly over the entire area to give an even surface. A trace of linseed oil in the face of pad facilitates this operation. The surface shall be allowed to dry and the remaining coats applied on the same day. To finish off, the pad shall be covered with a fresh piece of clean fine cloth slightly dampened with methylated spirit and rubbed lightly & quickly with circular motion. The finished surface shall have a uniform texture and high gloss.

9. LINSEED OIL AND BEE'S WAX MIXTURE FOR WOOD WORK

9.1 Linseed oil shall conform to IS-75: specification for linseed oil, Raw or Refined (First Revision). Bee's wax shall be free from stearin or other adulterants and shall be of specific gravity 0.965 to 0.969 and of melting point 63 degree centigrade. Turpentine shall conform to IS-633: Specification for gum spirit or turpentine (Oil of turpentine). The polish shall be prepared by mixing 500 gms of bee's wax and 2.5 liters of linseed oil, heated together till the wax is completely melted and added to the mixture of wax and oil. 0.40 litre of turpentine and stirred well (this quantity of polish should cover about 80 sq meters). The surface of wood shall be sand papered and cleaned off and the mixture as above shall be applied freely and evenly until no more of it is absorbed by wood. The article so treated shall be left over night to allow the mixture to soak into pores of wood. The superfluous mixture shall be wiped off and finished by rubbing with soft flannel cloth till a uniform gloss is obtained to the satisfaction of GE. Final surface with an eggshell gloss should result after continued rubbing.

10. HARD PVC RING

10.1 Unless otherwise specified on drawings, 20 mm dia standard hard PVC rings shall be fixed with steel screw in the bottom of legs all as specified and shown on drawings.

11. CLARIFICATION ON DRAWINGS

11.1 Details of material quantities except for fitting/ fixtures shown there in are meant for the guidance of the MES staff only and contractor shall have no claim whatsoever on this account.

12. STEEL AND IRON WORK

12.1 Structural steel for MS Square pipes shall be of standard quality and conforming to IS-4923-1997.

12.2 The steel shall also conform IS-1732 for general engineering purpose. Contractor shall use steel sections of equivalent metric sizes wherever dimensions in FPS system are shown in drawings without any extra cost to Govt.

12.3 All forging and framings shall be conforming to the dimensions given on drawings. Rivet holes shall be accurately marked and drilled unless ordered to be punched. Drilling, punching, forging, riveting etc shall be done in a sound and workmanship like manner.

12.4 Rivets shall be truly shaped and hammered red hot so as to give tight fit and shall have round head.

12.5 The contractor shall produce manufacturer test certificate in original alongwith test sheet giving the results of each machined test as applicable and chemical composition of steel duly signed.

12.6 WELDING

12.6.1 Welding shall be gas or metallic at the option of the contractor as per IS-1323 or IS- 828 respectively. The size of the weld and its position shall be as shown on drgs and as approved by GE.

12.7 FINISH

12.7.1 All steel members shall be pre-treated with epoxy polyester powder coating (Black) 70 microns by 7 tank process and oven dried with the following specification.

- (i) Dry film thickness more than 45 microns.
- (ii) Salt spray test to with-stand more than 1000 hours.
- (iii) Adhesion as per DIN 53152 standards.
- (iv) Pencil scratch hardness more than 2H.

12.8 GAUGE

12.8.1 All steel members to be of 18 gauges unless otherwise specified.

1. BLACK JAPAN PAINT

1.1 The black Japan paint shall be conforming to IS No. 341 and dried with a brilliant gloss.

2. PAINT

14.1 Superior quality(1st quality) paints shall be used in all painting work.The exact tint shall be decided by the GE.

14.2 The contractor shall inform GE within four weeks of the acceptance of the tender, the names of manufacturers and the brands of paints which he will use in the work and submit samples thereof and obtain prior written approval of the GE before their use in the work. The contractor shall, when so required by the GE, produce certificate from the manufacturers or their representatives to establish that the brands of paint purchased by the contractor from them satisfy the requirement of the relevant IS specifications or are superior to the quality specified in the relevant IS specifications.

14.3 Articles to be painted/polished shall be passed by the Engineer-in-Charge and marked as such before commencement of painting/polish work. Each coat of paint/polish shall be passed by Engineer-in-Charge before application of next coat.

15 PAINTING TO WOODEN SURFACE

15.1 The surface shall be sand papered smooth along the lines of grain and dusted clean. Knots shall receive two thin coats of knotting and brushed in. The surface shall then be given a coat of primer and allowed to dry. Over primed surface, one under coating and one finishing coat shall be applied after each coat is completely dry. Where two coats work is specified in the Key Specifications, one finishing coat & one under coat shall be applied over primer. The paint shall be of makes as mentioned in Appendix B.

15.2 The paint used in priming coat and finishing coat shall be of the same make/manufacturer.

16. PAINTING TO IRON AND STEEL WORK

16.1 The surface shall be thoroughly cleaned from oil , grease, dirt and other foreign matters and surface cleaned with wire brush, , steel wood scraper and surface rubbed with sand paper to remove small scale and rust so as to obtain a clean surface to the satisfaction of the GE. The surface shall then be given one coat of primer, one under coat and one finishing coat after each coat is completely dry. Paint shall be of approved manufacturer and of quality as specified in Para 14 here-in-before.

17. CUSHION AND TAPESTRY CLOTH

Foam for cushion shall be of high density i.e 2.0 or above and shall be obtained from approved manufacture and thickness shall be as shown on drg. The tapestry cloth shall not be less than Rs 350.00 per RM. The colour and texture of tapestry cloth shall be got approved from GE before procurement.

18. PLY WOOD

Ply wood shall be BWR grade AA class & ISI marked. Thickness of ply wood shall be as shown on drawings/specified in Key specifications. The plywood shall be of uniform thickness and free from warp and cracks. The ply wood shall be of makes as mention in Appendix B.

19. DECORATIVE LAMINATED SHEET

19.1 1.5mm thick decorative laminated sheet (Shade and texture natural teak) shall be provided all as per drawing and shall conform to IS-2046 and shall be fixed with Fevicol (Pidilite) or equivalent conforming to IS-4835. The make of the decorative laminated sheet shall be of makes as mention in Appendix B

20. MEDIUM DENSITY FIBRE BOARD

20.1 MDF Board, BWR grade shall be as per IS-12406 veneered both side commercial/teak face and thickness as specified in key specifications in section-III. The MDF board shall be ISI marked and from one of the makes as mentioned in Appendix B. MDF board shall be Grade I, type I, Designation PLMDF-11. It shall be OSL/ BSL as specified in key specifications.

21. PRELAMINATED PARTICLE BOARD

21.1 Wherever prelaminated particle board are specified in the key specification here-in-after, it shall be exterior grade (conforming to relevant IS), BWR grade bonded with phenol formaldehyde synthetic resin of one side decorative pre-laminated and other side commercial. The shade of pre-laminated particle board shall be of makes as mention in Appendix B.

22. GI PIPE/IRON PIPE

22.1 Pipe shall be conforming to relevant ISI marked.GI pipe shall be of make as specified in Appx 'B'.

23. GI FITTINGS

23.1 GI fitting shall be of medium grade, ISI marked (IS-1239). GI fittings shall be of make as specified in Appx 'B'.

24 COTTON NIWAR (WHITE)

24.1 Cotton niwar 60 mm to 65 mm wide shall be of best quality. Niwar shall be closely woven on both sides of charpoys all as shown on drawing. Quantity of niwar to be used for each charpoy shall not less than 2.50 Kg.

25. NYLON NIWAR

25.1 Nylon niwar 50 to 55 mm wide shall be new white /light coloured (not made out of recycled nylon) and of best quality. Niwar shall be closely woven on both sides of charpoys all as shown on drawing. Quantity of nylon niwar to be used for each charpoy shall not be less than 1.5 kg.

26. MS SQUARE / RECTANGULAR TUBE

MS Square or rectangular tube shall be used all as shown on drawing and shall be as per IS- 1239. MS Square or rectangular tube shall be ISI marked, conforming to relevant IS and make shall be as specified in Appx 'B'. Fittings shall be of medium grade, ISI marked (IS- 1239). Fittings shall be of make as specified in Appx 'B'.

27. CREOSOTING

27.1 Where specified in key specifications after the surfaces have been cleared of all dirt and dust, apply two coats of creosote solution conforming to IS-218 shall be applied.

28. VARNISHING

The varnishing used in the work is to be stain proof against hot and cold drinks, alcohol drinks etc and applied strictly in accordance with manufacturer's instructions. M/S Shalimar paint colour and varnish Co. Ltd products are described below but other equal approved products manufactured by other recognized firms may also be used with the approval of the GE

- (a) Transparent liquid wood fillers.
- (b) Under coating varnish.
- (c) Superior varnish finishing exterior synthetic.

The drying time for each of the above should be 24 hours approximately. After the wood surface has been sand papered smooth and cleaned, the liquid wood filler shall be applied. On drying out, it shall be rubbed down lightly with sand paper cleaned and treated with an application of the under coating varnish and left to harden. This film shall be lightly rubbed with sand paper before the final coat of superior varnish is applied.

29. TEAK WOOD EDGING

Teak wood edging to all exposed edges of particle board/pre-laminated particle board shall be provided, whether shown on drg or not. Thickness of edging shall be as shown on drawings. Where edging is not shown or thickness of edging is not indicated, it shall be 4 mm thick teak wood edging fixed with adhesive and headless nails. Wherever standard PVC edging indicated in drawing, 4 mm thick teak wood edging shall be provided in lieu thereof.

30. FINISH WHEREIN CONTACT WITH FLOOR

All surfaces of timber of the articles of furniture shall be wrought where surfaces in contact with floor shall not be given any finish, like polish, varnish / and paint etc.

PARTICULAR SPECIFICATIONS
DESIGN BASIS REPORT

Project : Provn of Single Men Bk incl Cook House for Agniveer at At 1STC Jabalpur.
SBC Report : SBC Report Attached
Basic Wind Speed : 2.8 m/s
Seismic Zone : Zone III

1. **STRUCTURAL SYSTEM:** The main consideration for the design of structure shall be as under:-
 - 1.1 Structural safety and stability
 - 1.2 To meet the demand of aesthetics as conceived in the architectural drawing
 - 1.3. Availability of material, equipment and expertise
 - 1.4. Constructability and ease of maintenance
 - 1.5. Durability and design shall be based on Indian Standard and Codes as specified in the bid documents.
2. Structural elements for buildings under the subject project as mentioned above is as under:--

Structural Item	Description
Foundation	Cast in Situ RCC foundation / pile Foundation as per design
Stilt floor	Combinations of precast RCC shear walls and solid RCC precast portals as per design(M-40).
Load Bearing superstructure	Precast shear walls as per design 150 to 200 mm or any other thickness as per structural requirement (M 40).
Floor slabs	Precast pre-stressed hollow cover slab with concrete topping min 60 mm over slabs, thickness and standards as per design (M 50).
Partition Walls	Precast RCC walls (Non load bearing wall) Min100mm thick (M 40).
Wet floors(Only washrooms/ toilets / bathrooms)	Precast solid core slab as per design requirements with water proofing treatment (M 50)
Balconies	Precast solid slabs / hollow core slab as per location and structural requirement (M 40)
Staircase	Precast stair flights and precast mid landing slab(M40)

All the structures shall be designed in accordance with the relevant latest Indian code of practice for civil works.

BUILDINGS– Cast in Situ with conventional RCC framed structure technology.

3. **Important Note:**

3.1. The minimum dimension of column in structural drawings shall be as per latest Indian Standard Codes. The minimum thickness of special shear walls, if any, shall not be less than as per Clause 10 of IS : 13920-2016 and IS : 456 – 2000. The minimum thickness provided must conform to the fire resistance requirements based on occupancy as laid down in IS : 456.

3.2. As per the Clause 7.1.1 of IS : 456, the minimum dimension of a column shall not be less than higher of the following:-

(a) 20 times the diameter of the largest diameter longitudinal reinforcement bar in the beam passing through or anchoring into the column /wall at the junction.

(b) 300mm.

3.3. As per Clause 6.3.4 of IS:13920-2016: In the calculation of Design Shear Force capacity of RC beams, contributions of the Bent up Bars, Inclined Links and concrete in RC Section shall not be considered.

4. SOIL INVESTIGATION / SOIL EXPLORATION:

4.1. Soil investigation report is attached along with this design basis report. The contractor shall ascertain the actual bearing capacity of the soil at the locations of respective buildings/structures using soil investigation/soil exploration. The bidder desire for soil testing before submission of bid, may contact for necessary assistance. The lower of the two SBC will be used for the design of the foundation for the structure. The soil investigation Report shall be submitted by the contractor to CEJZ and the same shall be got approved prior to preparation of foundation and other structure design from the CEJZ.

5. FOUNDATION AND SOIL REPORT:

Suitable foundation as per soil investigation report shall be designed and provided. The foundation system shall comply with relevant IS codes. The foundation shall be designed using suitable software. The Soil Investigation Report is enclosed with tender document. In case of mass concrete for Raft foundation the rmo couple shall be used to monitor temp gradients.

In case the Soil Investigation Report recommends pile foundation, all the aspects in relevant IS Codes (IS 2911) must be kept in mind. Certain key points are as under:

- (a) Grade of concrete for Piles, Pile Caps, Tie Beam, basement Slab and RCC retaining/Pit wall shall be M-30 design mix unless noted otherwise.
- (b) Design safe load capacity of Pile has been taken as mentioned under schedule of Pile. Initial test as per IS:2911(Part54) shall be carried out for load twice of safe load capacity of Pile. In the event of any variation at site, matter shall be referred to accepting officer by GE.
- (c) Routine load test on working Piles shall be carried out as per S:2911(Part4).
- (d) Concrete of Pile shall be done by Tromie Method only. Max size of aggregate shall be 20 MM.
- (e) The piling and Pile cap work shall conform to provisions in IS:2911(Part-1).
- (f) Column/Shear wall main bars shall embedded into the Pile cap for full development length.
- (g) Piling work shall commence only after carrying out initial load test as per IS:2911- 1985(Part-4) and written approval by GE.
- (h) Socketing zone of Pile is said to be started when Pile penetration ratio (PPR) Is more than $112.05 \text{ TM/M}^2/\text{CM}$ (Calculated) as per CL No 10, IRC-78 and same shall be confirmed by engineering charge.
- (j). The vertical reinforcement of Piles and column shall be taken into the Pile Cap for full development length.
- (k) The minimum cement content shall be 400KG/Cumfort piling work.
- (l). Bored cast-in-situ concrete Pile(AsperIS-2911(Part-1/Sec-2)is considered in design based on soil investigation report.

5. PILE FOUNDATION

6.1. Earthwork: - Pile foundation boring shall be carried out all as per clause 3.25 of MES Schedule Part 1 (2009)

6.2. Concreting: -Pile foundation concreting shall be carried out all as per under clause4.26of MES Schedule Part 1 (2009) Pile foundation shall meet requirement of ISCode2911-(Part-I:Sec2)-1979: Code of Practice for design & construction of pile foundation, Section 2 bored cast in situ pile & IS

6.3. Code 2911-Part 4-1985: Code of Practice for design a Part 4 Load test on piles. & construction of pile foundation:

6.4. The rates/lump sum quoted by the contractor shall also deemed to be inclusive of costs towards testing of piles as per IS.

7. DESIGN BASIS:
BASIC REQUIREMENT OF PRECAST PLANT FACILITY.

- 7.1. The precast facility should be as close to the site preferably to avoid major transportation of precast elements.
- 7.2. Precast factory should have experience of manufacturing precast Structural elements including precast shear walls, precast columns and beams, pre-Tensioned hollow core/solid slabs etc.
- 7.3. The machinery and plant should be of standard quality and to be of major manufactures like Ebawe, Elimatic, Spancrete or equivalent to produce the quality product.
- 7.4. Proper storage with overhead cranes should be available for controlled shifting and transporting of finished goods.
- 7.5. The Plant should have in-house quality assurance and testing lab facility with qualified Engineers. The facility should be strictly following NGT Norms.
- 7.6. The precast elements should have embossing of CA No on all manufactured elements.
- 7.7. The testing of raw material to be used in the manufacture of precast members to be carried out at factory as per laid down norms, conditions and frequency as mentioned in the CA. Test certificates to be provided by the contractor. Non destructive tests i.e Schmidt hammer pulse ultrasonic velocity test by NABL approved lab be done before incorporation in the work.
- 7.8. Contractor to submit test certificates of all the tests carried out as per frequency and Provision in relevant IS code.
- 7.9. Third party testing at factory site to be done and cost borne by the contractor.

8. PRECAST PANEL FACILITY

The following specific requirements/qualification criteria in the precast wall plan must for this time bound work.

- 8.1. Precast elements will be manufactured in controlled factory environment as per IS:456. latest edition, with approved methodology including moulds (Pallet system, Tilts form, table moulds, vertical moulds, beam moulds, column moulds, staircase moulds etc.
- 8.2. Facility should have exclusive automated mixing batching plant attached to the plant to have minimum human intervention.
- 8.3. It should have moving bucket transportation & placement of concrete system along with vibratory tables to ensure quality and speed.
- 8.4. The plant facility should be completely covered with no dust coming inside the working area.
- 8.5. For shifting the material & finished elements, proper EOT cranes should be installed to ensure no damage to elements.

9. WORK EXPERIENCE OF FACILITY

9.1 Besides the machinery, the team at the facility should be experienced enough to produce large quantity of precast elements with quality and speed and should include Engineers. Technical Supervisors, plant equipment operator with experience to monitor precast works. Therefore following criteria must be fulfilled by facility should be in running condition for at least 03 (Three) years and should not be a fresh setup which will delay this time bound project. The plant should be well established in all respect.

10. MOU

10.1. A MOU will be signed between contractor and pre-Cast elements manufactures during up-loading of tender for this work.

11. DESIGN CONSIDERATIONS AND REQUIREMENTS STRUCTURAL DESIGN APPROACH

The overall behavior of a precast structure is dependent on the behavior of the connections which must provide: -

- (a) Resistance to all design forces
- (b) Ductility in case of excessive deformation
- (c) Resistance to volume changes and related forces.
- (d) Adequate durability
- (e) Required fire resistance
- (f) Feasible production consideration
- (g) Feasible construction considerations.

12. DESIGN LOADS - LOADS ON THE STRUCTURE

12.1. All loads as per BIS specifications are to be considered on the building. For analysis and design of the structure, the vertical dead loads, live loads, lateral wind loads and seismic loads as per the relevant Indian Standard codes will be considered. In addition erection loads shall also be considered

13. VERTICAL AND LATERAL LOAD PATH

13.1. The precast system for the project can be classified as a full factory prefabrication system. The system is based on the use of large precast panels. RCC precast walls are considered to be shear walls and part of the lateral load resisting system and are adequately connected to the floor diaphragm. The precast flooring in this system is consisting of precast pre-stressed hollow core slabs with PCC topping.

13.2 The precast structure has to be analysed and designed as to resist the horizontal loadings by shear walls. The shear walls are placed in two directions at right angles, Adequate buttressing of the external wall panels has to be achieved by connecting the internal wall panels to the external wall panels by shear key connections. All load bearing elements at the corners of building have to be stiffened by connecting structural elements perpendicular to it.

14. STRUCTURAL ANALYSIS

14.1. The foundation shall be made as RCC cast in situ and shall be designed as per the specific site conditions and safe bearing capacity of the soil, Preliminary soil investigation has been done by the depth but final soil testing for design is to be done by the bidder

14.2. After preliminary sizing of various structural members, a computer model of the structure of the building is to be generated for carrying out computer analysis for the effects of vertical and lateral loads that are likely to be imposed on the structure

14.3. Geometrical dimensions, member properties and member-node connectivity are to be model led in FEM computer program STAAD-Pro. Dead loads, live loads, wind loads and seismic loads are to be applied for structural analysis. Wind load and seismic loads will not act simultaneously

14.4. For the design of the structural elements the limit state method will be followed as per relevant Indian standard codes using software RCDC/RCDC FE/STAAD Foundation Advanced

15. JOINT DESIGN

- 15.1. The horizontal joints between the precast wall panels have to be designed as reinforced concrete sections. Minimum eccentricity accordingly to IS codes has to be considered in the calculation in combination with the high strength grout of M60 grade. In the structure analysis model the horizontal joints have to be taken as fully continuous reinforced sections
- 15.2 The vertical joints have to be modeled as open joints without any transfer of shear forces between the precast wall panels.

16. SAFETY AGAINST PROGRESSIVE COLLAPSE

16.1. The precast building has to be designed with proper structural integrity to avoid situations. Where damage to small areas of the structure or failure of single elements may lead to collapse of major parts of the structure. This has to be achieved by taking the following precautions:-

- (a) The building should be capable to safely resist the minimum horizontal load of 1.5 percent of characteristic dead load applied at each floor and roof level simultaneously.
- (b) The complete structure shall be provided with effective horizontal ties.
- (c) Peripheral reinforcement ties inside the RCC topping precast slabs are provided.
- (d) Internal reinforcement ties inside the RCC topping precast slabs are provided.
- (e) Adequate horizontal reinforcement ties coming out of the precast wall panels and being connected inside RCC topping which shall be filled with cast in situ concrete.

16.2. Vertical reinforcement ties inside the precast wall panels and running continuously from foundation to roof level are to be provided. These tie reinforcement bars will be lapped with lap length inside the oversized (2.5 times dia) corrugated steel dowel tubes which are filled with high strength non shrink grout.

17 PRE CAST CONCRETE WORK

17.1. **GENERAL**:- Precast construction technology (PCT) is a system of casting concrete in a reusable mould or form which is then treated in a controlled environment conveyed to the construction site and lifted to the place. Precast construction Technology consists of various precast elements such as walls, beams, slabs, columns, staircase, landing and some customized elements that are standardized and designed for stability, durability, and structure integrity of the building. Precast building construction involves design, strategic yard planning lifting, handling and transportation of precast elements.

17.2. **PRECAST SHEAR WALL LOAD BEARING SYSTEM** All load bearing walls shall be RCC shear walls made in factory using precast technology. All wall panels shall be finished both side fully finished while green concrete and no plastering shall be required. The precast wall panels should be load bearing members and shall be capable of carrying the vertical and lateral loads. The minimum reinforcement ratio in each direction in shear walls design code. The reinforcement shall be distributed uniformly across the cross section of the shall be followed as per wall. The reinforcement is to be lapped through dowel rebars which are placed inside the corrugated steel dowel tubes and filled with non shrink grout. As regards size of walls panels, it is desired to make the possible. However based on the operational feasibility of heavy tower cranes (preferably 12 MT) the maximum weight of the precast elements should be in a range of 6 to 7 tons for a precast wall panels as large as radius of 30 mtrs.

18. **PRECAST PRE STRESSED FLOOR SYSTEM** Pre-stressed hollow core slabs are pre-stressed floor slabs with longitudinal voids made on a special bed having width of 1.2mtrs and length of 120 to 150 mtr. Hollow core slab shall be made using special machine using either extrusion or slip forming technique for make longitudinal circular cores in a self-vibratory mechanism using zero slump concrete. The presence of the voids results in weight savings preferred in seismic zone 4. 7.3.2 in the present project with hollow core slabs large spans maximum upto 6m shall be used while erection, no temporary propping shall be used. Hollow core slabs will only have longitudinal pre-stressed reinforcement and no other reinforcement until and unless required as per design.

18.1. Solid slabs will be preferably used only in case of wet areas ie toilets and bathrooms.

18.2. Diaphragm action will be achieved using RCC topping over slabs has to be added (min 60mm) thick M30 concrete with reinforcement to join the slabs and achieve proper diaphragm action through special joint design.

19. IMPORTANT NOTES FOR HOLLOW CORE SLAB CASTING: -

19.1. Standard width of the slabs is 1200mm Floor slab layout has to be designed on a multiple grid of 1200mm.

19.2. Slabs can be cut in longitudinal direction if required to achieve different size of slab. However longitudinal cutting should be avoided as much as possible.

19.3. Minimum slab thickness for this project can be 120mm and maximum 200mm.

19.4 Maximum span allow able in project is 4 mtr.

19.5. No propping should be used to support the slabs during the erection.

19.6. Camber and deflection should be kept at minimum and uniform duly checked in design and detailing. It should be kept in view whiling design and detailing.

19.7. Minimum 60mm RCC copping is recommended for diaphragm action and prevention of progressive collapse for multi-storeyed buildings.

19.8. Due to RCC topping the top surface of the solid has to be roughened during precasting at factory.

19.9. MEP services in solid slabs to be placed either below duly covered with false ceiling (in case of wet area) or above the slab within the top screed over slabs.

19.10. Connection of the hollow core slabs to the shear walls has to be properly designed and detailed for transfer of vertical and lateral loading.

19.11 All we are as of kitchen and bathrooms shall be provided with pre-cast solid slabs.

20. PRE CAST BALCONIES

20.1. Balconies are to be designed as precast solid slabs resting on precast wall/beams. Top and bottom reinforcement of the solid slab comes out at the backside of the slab and goes inside the RCC topping which provides the structural connection to achieve the cantilever action

21. PRE CAST STAIR CASE

21.1. Stair case flights are also to be made completely of precast stairs which rest at the precast mid landing and solid slab at one side and at the precast plank slab at other side. Mid landing and staircase is connected through steel dowels coming out of mid landing slab and going inside Staircase flight and grouted. Stair case and floor slab is connected through reinforcement coming out of stair case flight and going inside the RCC topping. The mid landing solid slab rests on steel angles welded to wall panels, at both the ends. Structural designer to follow these norms.

22. RAW MATERIALS REFERENCES OF THE PRECAST SYSTEM

Following list of standards & codes used in assessment shall be used for design of the project. These are for ready reference only

S R	Parameter to be Inspected	Requirements pacified	IS for material / Test	Frequency
RAW MATERIAL				
1	Cement	OPC53Grade	IS269: 2015	Manufacturer will provide test certificate. Independent testing from CTL/NABL to be done
2	Fine aggregate	Should pass test as Per code	1838320168IS 2386:1963	15cum
3	Coarse aggregate	Should pass test as Per code	1838320168IS 2386:1963	15cum
4	Fly Ash	Fly ash shall confirm to IS 3812:2013	IS 1727:1967	Manufacturer will Provide test certificate
5	Admixtures	Pre Cast based	IS9103:1999	Manufacturer will provide test certificate
6	Reinforcement Steel	Physical test and Chemical Test as per IS 1786:2008	IS1786:2008	Manufacturer will provide test certificate Manufacturer will provide test certificate. Independent testing from CTL/NABL to be done
7	Water	pH 6.5-8.5 As per code	IS456:2000	As per source
8	Anchors	Swift lift anchor shall have two anchors in each wall panel and four anchors in each floor panel. Spacing of anchors shall be according to cut-outs provision respective panel in	IS1608	Manufacturer will provide test certificate
9	Anchors bolt		IS1363:2022	Manufacturer will Provide test certificate
10	Non Shrink Grout	Cement based flow able shall have compressive strength and flexural strength has grout per relevant Code at 28 days	As per ASTM C1107 or equivalent	Manufacturer will provide test certificate
11	PU Sealant		As per ASTM C920Class-35	Manufacturer will provide test certificate

23. **PRECAST ELEMENTS**

23.1. Two main types of precast concrete elements, namely pre-cast reinforced concrete elements and precast pre-stressed concrete elements shall be used as per the details given below :-

23.2. Precast reinforcement concrete elements shall consist of reinforcement bars and/or welded wire meshes within the elements to provide the structural strength as per requirement of the component such as facade walls, beams, columns, slabs, staircases and parapet wall.

23.3. Precast pre-stressed concrete elements shall consist of pre-stress in tendons within the elements to provide a predetermined force needed to resist external loadings and cracks such as hollow core slabs, beams and planks.

23.4. Moulds for precast elements shall be of steel and comerate various elements, special importance should be given in easy de-moulding and assembly of the various parts. At the same time rigidity, strength and water tightness of the mould are also important taking into consideration forces due to vibration. For design of the moulds for in pouring of green concrete.

24. TESTS

24.1. Testing to determine placement of steel, honey combine to be done, NDT testing of precast members by rebound hammer and pulse ultrasonic velocity test fromfrom NABL approved lab.

24.2. PRODUCTION OF PRECAST WALLS

The production of precast concrete parts on stationarying tables allows the shuttering vertical removal angle of up to 80. The tiling tables are set up individually from each other. The size of the tilting tables shall be preferably 4mtr x 12mtr. Steel magnets(atleast50%) for shall be fixed to the table through magnets. The precast elements shall be produced with smooth finished surfaces. Proposed embedded parts in the precast elements shall be as follows: lentssthatplacethe shuttering at a tiling

- *Protruding reinforcement for connections
- *Lifting anchors
- *Inserts for temporary popping
- *Corrugated Steel dowel tubes
- *Shear key loops in the side of the wall panels
- *Services like electricity conduits, electricity boxes, fan points
- *Provision for plumbing pipes to be made for fixing later at site under the tiles.

25. CASTING PROCEDURE STEPS ARE GIVEN AS UNDER:-

25.1. Pre cast concrete elements shall be produced on horizontal, flat steel surfaced tilting tables. Steel side shuttering shall be fixed in position to form the precast elements on the table. The shuttering shall be fixed to the table through magnets. Apply mould released agents to sides and bottom.

25.2. Steel reinforcement shall be kept in position using adequate spacers to ensure correct position and concrete cover. Prior to casting, electrical conduits, plumbing grooves and sleeves and other required accessories like lifting anchors, loop boxes and dowel tube shall be fixed in position. The high quality concrete shall be transported from batching plant to the precast bay moulds, through concrete distribution system of flying bucket distribution bucket and EOT cranes. discharge chutes,

25.3. During casting, table vibrators (as& when required) shall be used to achieve compaction. Top surface shall be finished with hand operated trowel which smooth finish. Care should be taken on embedded items while concreting. Care should be taken on embedded items while concreting. After casting all exposed surfaces shall be covered with at arpaulin (as required) to avoid vaporization. Casted elements shall be de-Moulded on the strength meets the design requirements and the units are then shifted to the stockyard. Thereafter curing shall be carried out for minimum 5 days.

25.4. The curing of the prefabricated elements may be done by the normal methods of curing by sprinkling water and keeping the elements moist for a period of min 14 days.

26. WATER PROOFING

26.1. External Joints shall be sealed with baker rods and sealants after filling the joints with out to avoid the leakage. Additional waterproofing treatment shall be provided at external jointsand-wetareastoensurewatertightnessthemethodologyandproductforwater proofing of external joints, Internal joints in walls and ceiling and roof shall be got approved from the GE. Minimum ten (10) years guarantee shall be given by the contractor for the same.

REFERENCE:IS CODES PART 5 LIST OF STANDARDS & CODES USED IN ASSESSMENT
REFERENCE: IS CODES

PART 5 LIST OF STANDARDS & CODES USED IN ASSESSMENT

IS: 875 (Part-1)-1987 (Reaffirmed 2008)		Code of practice for Design Loads (other for buildings and Earthquake ights of than Structures-Unit buildings Material sand Stored Materials.
IS: 875 (Part-2)-1987 (Reaffirmed 2008)		Code of practice for Design Loads (other Earthquake) for buildings and than Structures-Imposed loads.
IS: 875 (Part-3)-1987 (Reaffirmed 2008)		Code of practice for Design Loads (other buildings and than Earthquake) Structures-Wind Loads.
IS: 875 (Part-5)-1987 (Reaffirmed 2008)		Code of practice for Design Loads (other than Earthquake) for buildings and Structures-Special Loads and combinations.
IS:456-2000(Reaffirmed2005)		Code of practice for plain and reinforced concrete
IS:13920-1993(Reaffirmed2008)		Ductile Detailing of reinforcement Concrete structures subjected to seismic forces-code of practice.
IS 15916:2010		Code of practice for. Design and erection using prefabricated concrete
IS:9103:1999(Reaffirmed2008)		Specification for concrete Admixtures
IS:2062:2011		Specification for Hot Rolled Medium and High Tensile Structural steel
IS 11447:1985		Code of practice for construction with large Panel prefabricates
IS10262:2009		Guidelines for concrete in proportioning

PRECASTCONSTRUCTIONTECHNOLOGY

Srl No	CHECK	ISCODE
1	Structural Stability	IS11477:1985 IS15916:2010
2	Durability	IS516:1969
3	Compressive strength	IS516:1969
4	Flexural strength	IS2095(Part-):1996
5	Axial Compression	
6	Thermal resistance	IS3346:1980
7	Acoustic resistance	IS9901:1981
8	Fire resistance	IS456:2000
9	Earthquake esistance	IS1893:2002
10	Wind resistance	IS875:1987

LIST OF INDIAN STANDARDS / CODES

Sr. No.	Code	Year	Description
1.	IS:16700	2017	Criteria for Structural Safety of Tall Concrete Buildings
2.	IS:1893(Part1)	2016	Criteria for Earthquake Resistant Design of Structures: General Provisions and Buildings.
3.	IS:13920	2016	Ductile Design and Detailing of Reinforced Concrete Structures subjected to Seismic Forces-Code of Practice
5.	NBC	2016	National Building Code of India
6.	IS:875(Part3)	2015	Design Loads (Other than Earthquake) for Buildings and Structures- Code of Practice – Part 3 WindLoads
7.	IS:800	2007	General Construction in Steel-Code of Practice
8.	IS:456	2000	Plain and Reinforced Concrete-Code of Practice
9.	IS:3370(Parts1&2)	2009	Concrete Structures for Storage of Liquids-Code of Practice.
10.	IS:3370(Part4)	1967	Concrete Structures for Storage of Liquids–Code of Practice.
11.	IS:875(Part1)	1987	Code of Practice for Design Loads(Other than Earthquake) for Buildings and Structures -Part1 – Dead Loads-Unit weight of materials and stored materials
12.	IS:875(Part2)	1987	Code of Practice for Design Loads(Other than Earthquake)for Buildings and Structures -Part2- Imposed Loads
13.	IS:875(Part5)	1987	Code of Practice for Design Loads(Other than Earthquake) For Buildings and Structures–Part5–SpecialLoads&Load Combinations
14.	IS:1080	1985	Code of Practice for Design & Construction of Shallow Foundations in Soils.
15.	IS:4326	2013	Code for design of earthquake resistant design of structure.
16.	SP:16		Design aids for Reinforced concrete structure.
17.	SP:34		Hand book on concrete Reinforcement and detailing.
18.	IS:1786		Specification for High strength deformed steel bars and wires for concrete reinforcement
19.	IS:1904		Code and Practice for design and construction of foundations in soils.
20.	IS:2905		Code and practice for design and construction of raft foundations
21.	IS:2911		Code of practice for design and construction of pile foundation
22.	IRC58-2015		Design of rigid pavements
23.	IRC58-2011		Construction of concrete roads
24.	IRC58-2011		Precast concrete blocks for paving-specification.

27. STRUCTURAL SYSTEM

The structural system adopted in the work will be of RCC frame work using Col and or Shear wall, Beam and Slab. Reinforced Concrete of strength Minimum M-30 grade and above with appropriate lateral load Resisting system with following desired requirements: -

- 27.1. Minimal column projections in main rooms of all floors.
- 27.2. Core are as accommodating lifts, stair cases, and other services which can be used for locating lateral load resisting elements like Shear Walls.
- 27.3. Total floor height and clear height requirements.
- 27.4. Partition wall locations.
- 27.5. Type of external facade.
- 27.6. Construction Materials.
- 27.7. Speed of Construction
- 27.8. New and Innovative construction technology such as (system Aluminium shuttering and precast infill walls etc.)

28 DESIGN PARAMETERS:

DESIGN LIFE- The design life be considered for the structure a period of 50 years. Following loads be considered for the design:-

- 28.1. Dead Load
- 28.2. Live Load
- 28.3. Seismic Effect
- 28.4. Wind Load
- 28.5. Fire load

29. **DEAD LOAD** It includes self-weight of various structural and non-structural members and super- imposed dead loads on floors of the building as per IS 875:1987-Part I.

DEAD LOADS (IS875:1987-PART1)

Sr. No.	Structural Units	Unit weight(KN/m ³)
1.	Reinforced Concrete	25
2.	Plain Concrete	24
3.	Floor finish	1.5
4.	Plaster(Internal12mm)	20
5.	Partition Walls (AACBlock)	10
6.	Soil Fill	18
7.	Water Proofing	20
8.	Water(for water tank)	10
9.	Light Weight Fill	10
10.	Steel	78.5
11.	Saturated Soil	20
12.	Glass	26
13.	Aluminum	27

30. **LIVE LOAD** Live load on the entire floor shall comprise all loads other than dead loads. The minimum live loads on different occupancies shall be considered as per IS 875 (Part2). Live load shall be considered in design as per Table 1 of IS: 875 (Part 2) as follows:

LIVE LOADS (IS875:1987-PART2)

Sr.No.	Area	Loading (U.D.L) KN/m ²	Concentrated Load (KN)
1.	Living Areas	2.0	1.8
2.	Passages, Stairways & Lobbies	3.0	4.5
3.	Balconies	3.0	1.5 per meter run concentrated at outer edge
4.	Terrace(inaccessible)	1.5	1.4
5.	Terrace(accessible)	3	2.7
6.	Parking Area (Single Car Parking)	2.5	9
7.	Drive Way	4	-
8.	Toilets and Bathrooms	2	-

31. **CRITERIA** Minimum percentage, max. & min. Spacing of reinforcement in Structural members: The design shall be as per IS 456-2000 and detailing as per IS 13920:2016. Crack width in water retaining structures: Water retaining structures has water tanks or underground /semi underground sumps shall be designed as as per IS 3370:2021.

Punching- shear checks in flat plates and Raft foundation: It shall be as per clause 31.6 of IS 456:2000. Slab depth requirements shall be confirming to the clause of 23.2 of IS:456. **Sensitivity Analysis** shall be as per clause 8.1.3.2 of IS 16700:2017. Back stay effect shall be as per clause 8.1.3.2 of IS 16700:2017.

32. **DEFORMATION CAPABILITY**

Gravity columns in structural wall buildings shall be designed as per requirements of deformation compatibility on non-seismic member given IS 1893 (Part1)

33. **OVER TURNING AND SLIDING**

A factor of safety of 1.5 shall be provided against overturning and sliding as under: Un factored design wind and gravity loads. 2.5 times design earth quake load and unfactored gravity loads

34. **Building movement**

Deflection: deflection shall be limited as per clause 23.2 of IS 456: 2000.

BLANK

DRIFT

The storey drifts due to earthquake load shall be limited as per clause 7.11 of IS 1893 (Part I) 2016. **Lateral Sway** : Under transient wind load the lateral sway at the top shall not exceed H/500, where H is the total height of the building.

DESIGN BASIS REPORT FOR INTERNAL ELECTRICAL SUPPLY INCLUDING PVC CONDUIT:

- 1 Design, engineering, supply, install, testing & commissioning of internal electrification system for 400 single men barracks including cook house, dining hall, all common areas, staircases, lift machine rooms of Bldgs., Firefighting cum fresh water pump house. consisting of copper wiring, LED lights, BLDC ceiling fans 5 star rated, exhaust fans, 5 Amps, 15 Amps sockets, switches, distribution boards, suitable size submain wiring, MCBs, MCCBs, RCBOs, earthings and all necessary items for the proposed buildings as per following specifications/requirements: -
- (i) All the buildings to be fitted with zero halogen, fire retardant wiring in PVC insulated copper cables of suitable sizes as per latest standard code of practice IS 694 and to be illuminated with suitable luminaires of LED type fittings as authorised in **SOA Chapter 60 relevant table**. All wiring, cabling, conduiting shall be concealed in walls, ceiling, floors etc. DBs inside Building shall be recessed in the wall.
 - (ii) Wiring shall be copper conductor cable drawn through non-metallic PVC rigid concealed conduit of suitable sizes all as per SSR Part-I and standard code of practice.
 - (iii) Lighting system shall be designed in accordance with Scales of Accn 2022 **SOA Chapter 60 relevant table**, National lighting code-2010 and ECBC-2017 with latest amendments/ revisions if any. Desired average illumination level as per SOA 2022 Chapter 60, relevant table to be maintained in all rooms including basements, common areas and other premises of Bldgs.
 - (iv) Electric sockets single phase 5A, 15A, 5/15A are to be provided as per Scales of Accn 2022 Ch 60 relevant Table for single Living in Barrack. For other areas/premises such as cook house, Dining area, corridor for any specific requirement of additional socket be provided as per inventory of equipment/user requirement.
 - (v) All switches, sockets, switch boards shall be modular type with suitable GI boxes concealed in wall. Each point (Light, Fan) shall be control by one switch.
 - (vi) In stair case two-way point wiring will be provided and one light point controlled by two Nos 2-way switch.
 - (vii) All internal electrification fittings, fixtures, and etc shall be energy efficient.
 - (viii) All ceiling fan should be 5 stars rated BLDC remote control operated. Size of ceiling fan as required on site. Desired ventilation level as per SOA 2022 Chapter 64, Table 64.I to be maintained in all rooms including basements, common areas and other premises of Bldgs.
 - (ix) Exhaust fan shall be provided in Kitchen, fresh/dry / meat store, all toilets, kitchen/cook room and pane wash area. All exhaust fan should be energy efficient and design based on 4 air changes per hour for toilet and 20 Air changes cook house and 10 air changes for dining area as mentioned in SOA Ch 64 Table 64.I Sl. No 4.s.
 - (x) Power sockets 20 A with necessary point wiring in sheet metal encloser with control by MCB SP 20 A are to be provided for Geyser and AC (catered in Pre price schedule) as directed by Engineer -in-Charge
 - (xi) Power sockets 20 A with necessary point wiring in sheet metal encloser with control by MCB SP 20 A In cook house for Electric chimney (catered in Pre price schedule) necessary point wiring to be provided as directed by Engineer -in-Charge. Exhaust fan also be provided in addition to electric chimney.
 - (xii) Power socket 15A with necessary point wiring are to be provided for Deep freezer, refrigerator, water cooler, and water dispenser (catered in pre price sch) as directed by Engineer -in-Charge.
 - (xiii) Power sockets 32 A with necessary point wiring in sheet metal encloser with control by MCB SP 32A are to be provided for Solar water heating system back up (catered in Pre price schedule) as directed by Engineer -in-Charge.
 - (xiv) Sufficient power socket 5/15/20 Amp with wiring of suitable rating to be provided for modernisation kitchen equipment's (such as roti maker, Mixer grinder, Oven etc) in Cook house/dining area as directed by Engineer -in-Charge.
 - (xv) Incoming control shall be provided with suitable size RCBO in each floor of barrack. For the purpose of internal electrification design and planning the connected load shall be taken into account with 80% diversity factor.(Transformers, LT/HT switch gears outside bldg. premises will be measured and paid under relevant Schedule items).

- (xvi) LED lights shall be with minimum lumen efficiency 100 lumens/watt, CRI>80%, THD <30%, Driver efficiency >85%, PF>0.9. The of LED fitting shall be recessed mounted in case of false ceiling and in other case it should be surface mounted.
- (xvii) Internal Electrification system shall be designed as per GRIHA norms.
- (xviii) Bldg. security LED lights of IP-66 fitting including bracket with 40mm dia GI light grade pipe of suitable length and fixing arrangement with proper illumination level to be provided.
- (xix) Design, supply & install separate indoor type electric distribution panels, IP-43 rated, with suitable rated MCCBs/MCBs, Floor wise VTPN DBs with suitable rated MCCBs as incomer / MCBs, as outgoing circuit, on Each DB with MCCBs/MCB complete with suitable size copper control cables inclusive of rigid PVC conduits/GI cable trays etc complete. Separate VTPN DB shall be provided for Standby supply incoming cable for Lift.
- (xx) Separate DB distribution system with indoor panel & DBs shall be designed, supplied and installed with complete wiring for standby/emergency supply including common areas/parking areas/staircases complete.
- (xxi) Adequate number of BLDC ceiling fans, exhaust fans and LED lights in the living spaces, toilets and all other premises shall be as per requirement of Defence Scale of Accn 2022, Ch 64 Table 64.I.
- (xxii) The contractor shall submit the distribution circuit drawings of internal electrification along with inventory List of items and specification and shall get it approved by concern section of **HQ Chief Engineer Zone** before executing the work.
- (xxiii) The capacity of power sockets has been finalised based on the equipment load, hence the capacity and size of the cables shall be suitable to carry the load of specified capacity of sockets.
- (xxiv) All relevant IS, BS, S o A 2022, E-in-C standards/policies and ECBC code provision shall be followed in terms of design, size, capacity and specification items and practices.
- (xxv) All circuit wire from DB to Control switch boards shall be 2.5 Sq mm for Light/Fan. The nominal cross-sectional area of copper conductors shall not be less from switch board to Light/Fan 1.5 Sq mm, for power socket up to 1000w - 2.50 Sq.mm, for ac /geysers up to 3 KW- 4 Sq mm for L-N an E wire.
- (xxvi) The nominal cross-sectional area of copper conductors in submain wiring shall not be less than 2 time to full load current for L-N an E wire.
- (xxvii) Design, Supply, install, testing and commissioning of concealed rigid non-metallic PVC conduit of suitable size inclusive of boxes (junction/ terminal), of all tees, bends, elbows, reducers, bell mouth tube ends and fixing accessories such as couplers, lock nuts, saddles, pipe hooks etc including GI metal flush boxes, TV co-axial socket, connecting jack internet/telephone modular socket, GI wire for wiring of TV/telephone cable complete from roof top to each Single Men barrack completely concealed in wall or clamped on wall all as specified and directed all as per latest modern engineering practice & NBC-16. ELV duct will be made along with ELV control panel cubicle on each floor for connecting & laying of TV/data/telephone cables also. The TV/telephone & data cabling system from cubicle will be done by other agency.

DESIGN BASIS REPORT FOR INTERNAL WATER SUPPLY

1.	Design, Engineering, Supply, install, testing & commissioning of Internal Water supply system consisting of necessary pipes, control valves, pressure release valves & bib taps etc for uninterrupted water supply to bathrooms, toilets, kitchen etc from tanks.	01	LS
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Notes:

1. Complete design parameters, pipe network, drawings, layout etc shall be prepared by contractor and shall be got approved from CWE before execution
2. All internal pipes shall be of CPVC type of required dia as per design parameters with respect to maintenance of required pressure and safety criteria.
3. All external pipes shall be of GI medium grade type of required dia as per design parameters with respect to maintenance of required pressure and safety criteria.
4. All PVC water of three-layer, white colour with threaded lid with float valve shall be provided.
5. Air vent pipe to be provided near water tank.
6. All fitting fixture (Bib cock, Stop cock, etc) shall be provided as per SSR Pt-I clause/PS clause.
7. Capacity of water tank shall be design/ provided as per SOA 2022 Appx'C" water consumption considering water supplied morning and evening two times.

Particular Specifications
List of Drawings

(a) All drawings (Str Drgs, Arch Drgs, Line Plan, site plan, SoF, TDs, Level sheet etc) mentioned in List of Drawing given below shall be **deemed to form an integral and binding part of this Contract Agreement**, notwithstanding that such drawings may not have been enclosed or uploaded with the tender documents.

(b) The Tenderers shall be **deemed to have inspected and fully acquainted themselves** with all the list of drawings in the office of the **GE/CWE/CE**, as applicable, **prior to submission of the tender**.

(c) The Contractor shall **not be entitled to any claim, compensation, or extension of time** on account of non-receipt, non-uploading, omission, misinterpretation, wrong interpretation, applicability, or deviation of any nature whatsoever in respect of the aforesaid drawings.

(d) The decision of the **Accepting Officer** regarding the **interpretation, scope, and applicability** of the aforesaid drawings to the works under this contract shall be **final, conclusive, and binding** on the Contractor.

(e) The Contractor shall be **fully bound by all details, notes, and instructions** appearing on the said drawings, whether or not specifically referred to in the Particular specifications.

SL No	Description	Ref Drawing No	Sht No	Date of Drg	Revision up-to
1	2	3	4	5	6
1.	List Of drawing	CEJZ/LIST/EPC/231	1/1	04.11.2025	-

Notes :

1. All drawings (Str Drgs, Arch Drgs, Line Plan, site plan, SoF, TDs, Level sheet etc) mentioned in List of Drawing at Sr No 1 above shall be **deemed to form an integral and binding part of this Contract Agreement**,
2. Contractor to check and verify all dimensions before execution of the work.
3. Figured dimensions shall be followed.
4. All dimensions are given in MM.
5. For all general Notes and Architecture Norms refer CEJZ/TD/884/03 Sheet No: 1/1.
6. For respective details refer TD drawings.
7. KOTA Stone Cill shall be provided below all Windows/Vents/Jalies.
8. DDR (Decorative Drapery Rod) type 'D' shall be provided in all doors and windows except toilet and store even if the same is not marked in main plan.
9. Details/Sections shown for one side of symmetrical type of building/portion shall also be applicable for other side with details/sections as mirror image of the same.
10. The details shown in any drawings shall be deemed to be included in the scope of work, even in the same/connected/related details are not marked in other related drawings.
11. 01 No TPH shall be provided with each EWC whether shown or not in drawings.

Signature of Contractor

Date :

Dy Dir/AD (Contract)

For Accepting Officer



**Shiva Testing & Research Laboratory
Private Limited**

Geo-Technical Investigation Report

Name of the Work

**REPORT ON SOIL INVESTIGATION WORK AT
DIFFERENT LOCATIONS AT JABALPUR
(PROJECT-3)**

Location

Jabalpur, Madhya Pradesh

Client

GE (P), Jabalpur (MP)

Report Number

SR-2508010001-C

Report Date:

September,2025

Test Conducted By:

**M/s Shiva Testing and Research Laboratory Pvt. Ltd,
849/1, Baddi Shitalpur, Baddi Industrial Area, Solan
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**(AN ISO-9001:2008 CERTIFIED & NABL
ACCREDITED LAB)**



Shiva Testing & Research Laboratory Pvt. Ltd.

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1.0 INTRODUCTION

There is a proposal for **Soil Investigation work at different location at Jabalpur, Madhya Pradesh**. Geotechnical investigation is required to know the type of substrata and its safe bearing capacity at the proposed site of structures for design of foundation system.

The job for boring bore holes, in situ testing, soil sampling, determination of safe bearing capacity (SBC) and report preparation was awarded by under **GE (Project) No. 1, Jabalpur, Madhya Pradesh**.

2.0 SCOPE OF WORK

1. Drilling of boreholes of dia 150mm as directed and specified- 10 no.
2. Conducting Standard Penetration Test as per IS 2131 at every 1.5 M depth or any change of strata upto 10 m.
3. Collection disturbed and undisturbed samples of soil.
4. Recording of Ground Water Table up to the depth of investigation.
5. Conducting a trial pit of size (1.2mtr x 1.2mtr x 3.00mtr) including collection and testing of samples- 10 no's
6. Conducting various laboratory tests on soil samples collected from boreholes.
7. Preparation and submission of this technical report stating safe bearing capacity of soil sub strata.

3.0 OBJECTIVE OF SITE INVESTIGATION

The Object of the current geotechnical investigation was to explore and determine the existing sub-strata conditions such as stratification, Denseness or hardness of the strata, position of ground water table at Bore Holes etc. and to evaluate approximate range of safe bearing capacity for the proposed structure using empirical formulas provided in the relevant IS codes. The goal of our investigation was to identify the key geotechnical issues that could potentially impact the proposed project and to develop geotechnical recommendations for design and construction of the project.

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4.0 INVESTIGATIONS CONDUCTED

This report contains details of field investigations, Laboratory tests and the recommendations based upon them.

The various results have been presented under two heads, i.e.

- (i) The field tests
- (ii) The laboratory tests

4.1 The field tests include:

- (a) Boring, borehole of 150 mm diameter at the site for the purpose of knowing the type of soil and thickness of every stratum encountered by the boring tools.
- (b) Standard Penetration tests (SPT) are meant for measuring the penetration resistance of the soil, which is measure of its bearing capacity in-situ. This test is particularly best suited to cohesionless soils which are difficult and expensive to be sampled in the undisturbed state.
- (c) Sampling, depending upon the type of soil, both disturbed & undisturbed soil samples are collected. They are needed for various tests to be conducted in the laboratory for confirmation of soil properties.

4.2 The laboratory tests include:

- (a) Bulk density, Dry Density and Moisture Content, of the soil samples at various depths for the estimation of overburden pressure required for overburden correction in the observed penetration resistance values of the soil and for bearing capacity computation from shear failure consideration.
- (b) Grain Size analysis (sieve analysis and hydrometer analysis) of the soil samples for the purpose of soil classification and preparation of log of the borehole.
- (c) Atterberg limits, i.e. the liquid limit, plastic limit tests and plasticity index of fine grained soils passing through 425 micron IS sieve. They give an idea about the type of soil and its consistency, i.e., the degree of firmness of a soil to bear external loads imposed on it.

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- (d) Shear strength parameters: i.e. the soil cohesion (c) and its angle of internal friction (ϕ). These are needed for the estimation of bearing capacity (B.C.) from shear consideration. They are determined by Triaxial/Direct shear Tests.
- (e) Consolidation Properties: The consolidation parameters are required for knowing the ultimate settlements of clayey strata.
- (f) Specific Gravity Tests

5.0 FIELD TESTS

The purpose of various field tests required during sub-surface explorations for the foundation of a structure has already been discussed; a brief discussion of these tests is given below:

5.1 BORING AND SAMPLING

Boring was done for fifteen boreholes for the **Soil Investigation work at different location at Jabalpur, Madhya Pradesh**. These boreholes have been designated as BH-25, BH-26, BH-27, BH-28, BH-29, BH-30, BH-31, BH-32, BH-33, BH-34.

Representative undisturbed soil samples were collected in a Shelby tube (a thin tube sampler) of 100 mm dia and 450 mm long by inserting it in the soil with hydraulic pressure to minimize disturbance. These samples were collected in accordance with the procedure laid down in IS: 1892-2021 "Code of Practice for Subsurface Investigation for Foundations". Also, disturbed soil samples were collected from these two boreholes. Disturbed soil samples were collected from SPT sampler and may be used for classification of soil where undisturbed soil could not be obtained. Depending upon the type of soil strata that exists in the borehole, a number of undisturbed & disturbed soil samples were collected, numbered and packed. The undisturbed soil samples were sealed by wax on both sides to avoid any moisture loss. All the soil samples collected were transported to the laboratory for further testing.

5.2 STANDARD PENETRATION TEST

The boreholes were supplemented by standard penetration tests (S.P.T.) at 1.5 m vertical depth interval from top of existing ground to drilled depth in all the ten boreholes. These tests were conducted in accordance with the procedure laid down in IS:2131-1981 "Method of Standard Penetration Tests for soils" and N-Values (Soil Penetration resistance) were obtained by driving a

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split spoon sampler 30cm into the ground after giving 15 cm of initial seating drive at respective intervals or at change of strata. N value is the number of blows required to penetrate the SPT sampler 30 cm in the sub strata when it is subjected to an impact load given by a 63.5 kg hammer when it falls freely from 75 cm height.

6.0 LABORATORY TESTS

To know about the type of soil and to confirm & supplement the information obtained from field tests about the nature of soils strata, laboratory tests as given below were conducted on the soil samples collected from the boreholes at the time of drilling.

6.1 BULK DENSITY TEST

Bulk density determinations were carried out on undisturbed soil samples collected from the boreholes. The results of dry density are calculated from bulk density.

The results of average bulk density, in-situ moisture content and dry density tests of the undisturbed soil sample collected from these boreholes is tabulated in Log of Boreholes of each borehole.

6.2 MOISTURE CONTENT

In situ Moisture Content of undisturbed soil samples was determined by oven drying method. It is used to find out in-situ Dry Density of soil and also helpful in knowing present condition of wetness of strata.

6.3 PARTICLE SIZE ANALYSIS

This test was done as per Indian Standard IS: 2720 (Part-IV) – 1985. Samples collected from the boreholes were subjected to mechanical analysis for particle size distribution and classification of the soil at proposed site and depth. The analysis was done by wet sieving for particles bigger than 75 micron and by hydrometer analysis for particles finer than 75 micron.

The results of Particle Size analysis of the soil samples collected from the boreholes are tabulated in Log of Boreholes of each borehole. Grain size distribution curves of all the soil samples were plotted and are given in figures next to tables. The description of various soil strata encountered in these boreholes is shown in Log of boreholes of each borehole. The I.S. Classification for various soils is also shown in this table.

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6.4 ATTERBERG LIMITS

For fine-grained cohesive soils, the soil consistency was determined to check their firmness. This was done by determining the liquid limit, plastic limit and plasticity index of such soil samples according to the procedure laid down in IS :2720 Part-V – 1985, “Determination of Liquid and Plastic Limits”.

The results of liquid Limit (L.L.), Plastic Limit (P.L.) tests and Plasticity Index (P.I.) for various fine-grained soil samples collected from these two boreholes is tabulated in log of boreholes.

6.5 SHEAR STRENGTH PARAMETERS

The Shear strength Parameters are determined by Direct Shear tests and Triaxial tests. Triaxial tests are conducted on cohesive (Clayey soil) while Direct Shear tests are conducted on cohesionless soils (Sandy/silty) by packing them at insitu density in a remoulded state and at saturated conditions. These shear parameters are important from the point of view to check the bearing capacity of the soil of proposed site against shear failure and for the design of foundation.

For this project direct shear tests and triaxial shear tests were performed on some selected soil samples in saturated conditions from each borehole. The samples having some clays were tested by triaxial test and others by direct shear test. The results of these shear tests on soil samples collected from various depths are given in Log of Boreholes of each borehole. The results of specific gravity tests are also given in this table.

6.6 SPECIFIC GRAVITY TEST

Specific Gravity of all the undisturbed soil samples was determined by specific gravity bottles.

7.0 TESTS RESULTS

From the field and laboratory tests description of (BH-25 to BH-34 from different locations) at the site of **Soil Investigation work at different location at Jabalpur, Madhya Pradesh** refer Summary of Findings clause 9.0

The exact soil strata, results of field tests while doing sub-surface explorations by means of borehole at the site of the proposed site are given in log of borehole. The results obtained from laboratory investigations/tests carried out on soil samples collected from the boreholes at the proposed site are given in Log of Boreholes.

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7.1 WATER TABLE

The water table is given below in table that was met at respectively depth in the boreholes at the site **Soil Investigation work at different location at Jabalpur, Madhya Pradesh**, during investigation period in the month of August 2025. Actual Water table may rise if investigation conducted during monsoon.

Sr. No.	Bore Hole Number	Drilling Depth in Meter	Ground Water Table in Meter
1	25	15	1.90
2	26	15	0.90
3	27	15	1.70
4	28	15	1.00
5	29	15	1.70
6	30	15	4.50
7	31	15	5.60
8	32	15	6.00
9	33	15	5.90
10	34	15	6.30

7.2 STANDARD PENETRATION TEST

The result of these tests for all boreholes are calculated penetration resistance curves for observed penetration resistance (N-Values) as well as corrected penetration resistance (N'-Values). These results are given in Log of Boreholes and plots are given in Fig.2 of each borehole.

The observed values of 'N' have been corrected for overburden pressure by the following formula.

$$N' = (0.77 \log_{10} 20/p) N \dots\dots\dots (1)$$

where N = observed value for penetration resistance in no. of blows per 30cm penetration of sampler.

N' = Value of penetration resistance corrected for overburden pressure

p = Overburden pressure in Kg/cm²

The observed N values have also been corrected for dilatancy wherever applicable.

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8. COMPUTATION OF BEARING CAPACITY

A properly designed foundation must satisfy the following basic requirements:

- (i) Foundation must be safe against the shear failure of the supporting soil.
- (ii) The settlement of foundation must be within permissible limit.

The bearing capacities have been determined separately to satisfy both the above-mentioned requirements and the smaller of the two values has been recommended as the allowable bearing capacity.

8.1 BEARING CAPACITY FROM SHEAR CONSIDERATIONS

In shear, a foundation can fail in any of the three different ways viz.

- (i) Local shear failure
- (ii) General shear failure
- (iii) In between the above two

The local Shear Failure is assumed to occur for ϕ less than 28.5° & general shear failure for $\phi > 36^\circ$ & between these limiting values of ϕ , interpolated values for local & general shear failure can be determined. In this case bearing capacity for shear failure consideration has been determined.

Adopting a continuous foundation of width 2.0m and taking the depths from 1.50 m to 4.50m below O.G.L. and using Eq.2 below as per code IS 6403 – 1981: “Code of practice for determination of bearing capacity of shallow foundations” and also using codes IS 8009 (Part I) - 1978: Code of practice for calculation of settlements of foundations and IS: 1904-1978 “Structural Safety for Buildings: Shallow Foundation” SBC has been determined.

$$q_a = \frac{1}{F} \left[\frac{2}{3} C N_c s_c d_c i_c + \gamma D_f (N_q - 1) s_q d_q i_q + 0.5 \gamma B N_\gamma s_\gamma d_\gamma i_\gamma W' \right] + \gamma D_f \tag{2}$$

- where
- q_a = Allowable Safe Bearing Capacity
 - F = Factor of safety taken as 2.5
 - C_m = Modified cohesive strength
 - γ = Unit Weight of Soil

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D_f	=	Depth of foundation
B	=	Width of foundation
N_c, N_q, N_γ	=	Modified bearing capacity factors
S_c, S_q, S_γ	=	Shape factors
d_c, d_q, d_γ	=	Depth factors
i_c, i_q, i_γ	=	Inclination factor

8.2 BEARING CAPACITY FROM SETTLEMENT CRITERIA

The net allowable Bearing Capacity based on the maximum settlement of foundation to 50 mm has been computed as per IS: 8009.

The foundation should not settle or deflect to an extent causing damage to structure or impair its usefulness. The bearing capacity calculation for foundation shall be governed by IS 1904-1986, IS 6403-1981, and I.S. 8009-1981 (part-I & II) - 1976 on the basis of available information regarding the proposed design have been done.

9.0 SUMMARY OF FINDINGS

The safe bearing capacities have been calculated from above two criteria i.e. from settlement criteria and shear failure criteria. The lower of these two values have been recommended for adoption as SBC.

Location-SM Barrack & Cook House for 1 STC, Jabalpur

- Stratum of borehole, **BH-25**, consists of clay with low compressibility (of CL Group) from GL to 4.95 m depth, consists of clayey sand (of SC Group) from depth 5.25 m to 13.50 m depth, consists of poorly graded gravel (of GP Group) from depth 13.50 m to 15.45 m depth. The water Table met at 1.90 m depth from GL.
- Stratum of borehole, **BH-26**, consists of clay with low compressibility (of CL Group) from GL to 4.50 m depth, consists of clayey sand (of SC Group) from depth 4.50 m to 12.00 m depth, consists of poorly graded gravel (of GP Group) from depth 12.00 m to 15.20 m depth. The water Table met at 0.90 m depth from GL.

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- c. Stratum of borehole, **BH-27**, consists of clayey sand (of SC Group) from GL to 12.28 m depth, consists of poorly graded gravel (of GP Group) from depth 13.50 m to 15.14 m depth. The water Table met at 1.70 m depth from GL.
- d. Stratum of borehole, **BH-28**, consists of clayey sand (of SC Group) from GL to 12.28 m depth, consists of poorly graded gravel (of GP Group) from depth 13.50 m to 15.14 m depth. The water Table met at 1.00 m depth from GL.
- e. Stratum of borehole, **BH-29**, consists of clayey sand (of SC Group) from GL to 12.28 m depth, consists of poorly graded gravel (of GP Group) from depth 13.50 m to 15.14 m depth. The water Table met at 1.70 m depth from GL.

Location-SM Barrack for Agniveers at JAK RIF Regimental Centre, Jabalpur

- f. Stratum of borehole, **BH-30**, consists of clayey sand (of SC Group) from GL to 4.95 m depth, consists of poorly Silty sand (of SM Group) from depth 5.25 m to 13.75 m depth, consists of poorly graded gravel (of GP Group) from depth 15.00 m to 15.14 m depth. The water Table met at 4.50 m depth from GL.
- g. Stratum of borehole, **BH-31**, consists of clayey sand (of SC Group) from GL to 4.95 m depth, consists of poorly Silty sand (of SM Group) from depth 5.25 m to 13.50 m depth, consists of poorly graded gravel (of GP Group) from depth 13.75 m to 15.14 m depth. The water Table met at 5.60 m depth from GL.
- h. Stratum of borehole, **BH-32**, consists of clayey sand (of SC Group) from GL to 4.95 m depth, consists of poorly Silty sand (of SM Group) from depth 5.25 m to 13.50 m depth, consists of poorly graded gravel (of GP Group) from depth 13.50 m to 15.14 m depth. The water Table met at 6.00 m depth from GL.
- i. Stratum of borehole, **BH-33**, consists of clayey sand (of SC Group) from GL to 4.95 m depth, consists of poorly Silty sand (of SM Group) from depth 5.25 m to 13.50 m depth, consists of poorly graded gravel (of GP Group) from depth 13.50 m to 15.14 m depth. The water Table met at 5.90 m depth from GL.
- j. Stratum of borehole, **BH-34**, consists of clayey sand (of SC Group) from GL to 4.95 m depth, consists of poorly Silty sand (of SM Group) from depth 5.25 m to 13.50 m depth, consists of poorly graded gravel (of GP Group) from depth 13.50 m to 15.14 m depth. The water Table met at 6.30 m depth from GL.

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- k. From penetration tests it can be concluded that the stratum has medium bearing capacity throughout the depth so the recommended type of foundation is open Isolated footing. And raft foundation.
- l. Factor of Safety is taken equal to 2.5
- a. For calculation purpose, water table assumed at Ground level, as it may rise in heavy monsoon season.

10.0 RECOMMENDATIONS

10.1 RECOMMENDATIONS FOR SM BARRACK FOR 1 STC

ISOLATED SQUARE FOOTING:-

Net Safe Bearing Capacity for Isolated footing in T/m ²				
BH	Foundation Type and Size	Embedment Depth of Footing (D _f)		
		D _f =1.0m	D _f =2.0m	D _f =3.0m
25	2m x 2m Square footing	4.5	7	11.17
	3m x 3m Square footing	2.89	4.44	7.22
26	2m x 2m Square footing	4.75	8	10.48
	3m x 3m Square footing	3.11	5.33	9.67
27	2m x 2m Square footing	5.24	5.24	13.97
	3m x 3m Square footing	4.3	4.3	12.78
28	2m x 2m Square footing	12.29	12.29	32.01
	3m x 3m Square footing	10.97	10.97	28.8
29	2m x 2m Square footing	10.25	10.25	16.62
	3m x 3m Square footing	8.89	8.89	15.51

RAFT FOUNDATION:-

Net Safe Bearing Capacity for Raft in T/m ²				
BH	Foundation Type and Size	Embedment Depth of Footing (D _f)		
		D _f =1.0m	D _f =2.0m	D _f =3.0m
25	10m x 10m Square Raft	2.9	4.7	8.4
	15m x 15m Square Raft	2.58	4.09	7.38
26	10m x 10m Square Raft	3.6	6.5	8.54
	15m x 15m Square Raft	3.16	5.78	8.38
27	10m x 10m Square Raft	5.99	5.99	17.28
	15m x 15m Square Raft	5.99	5.99	17.28
28	10m x 10m Square Raft	15.23	15.23	32.73
	15m x 15m Square Raft	15.23	15.23	35.75
29	10m x 10m Square Raft	12.61	12.61	20.49
	15m x 15m Square Raft	12.61	12.61	20.49

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10.2 RECOMMENDATIONS FOR SM BARRACK AT JAK RIF REGIMENTAL CENTRE

ISOLATED SQUARE FOOTING:-

Net Safe Bearing Capacity for Isolated footing in T/m ²				
BH	Foundation Type and Size	Embedment Depth of Footing (D _f)		
		D _f =1.0m	D _f =2.0m	D _f =3.0m
30	2m x 2m Square footing	18.54	25.64	27.38
	3m x 3m Square footing	18.53	24.69	24.3
31	2m x 2m Square footing	15.27	21.5	28.35
	3m x 3m Square footing	15.35	20.82	26.7
32	2m x 2m Square footing	11.33	11.33	33.1
	3m x 3m Square footing	9.97	9.97	30.23
33	2m x 2m Square footing	17.78	17.86	31.83
	3m x 3m Square footing	16.67	16.67	23.9
34	2m x 2m Square footing	10.25	10.25	17.86
	3m x 3m Square footing	8.89	8.89	16.67

RAFT FOUNDATION:-

Net Safe Bearing Capacity for Raft in T/m ²				
BH	Foundation Type and Size	Embedment Depth of Footing (D _f)		
		D _f =1.0m	D _f =2.0m	D _f =3.0m
30	10m x 10m Square Raft	22.37	27.23	32.22
	15m x 15m Square Raft	25.67	30.34	32.69
31	10m x 10m Square Raft	18.96	23.37	27.9
	15m x 15m Square Raft	21.98	26.24	30.58
32	10m x 10m Square Raft	14	14	32.13
	15m x 15m Square Raft	14	14	35.1
33	10m x 10m Square Raft	21.34	22.06	30.65
	15m x 15m Square Raft	22.06	22.06	33.35
34	10m x 10m Square Raft	12.61	12.61	22.06
	15m x 15m Square Raft	12.61	12.61	22.06

- In cases where the subsurface layers contain embedded boulders and intact sampling is not feasible, the bearing capacity has been conservatively estimated using the strength parameters of the underlying or overlying soils encountered at adjacent depths.

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- It is advised that any significant deviations in soil profile or ground conditions observed during construction activities be promptly communicated so that necessary reassessments can be undertaken to ensure foundation stability.
- The groundwater table has been conservatively assumed at ground surface level to account for potential flooding conditions, which may occur during monsoon or other high-inflow scenarios. This assumption ensures a safe and robust foundation design under adverse conditions. Necessary measures—such as improved site drainage, use of durable construction materials, protective coatings, and concrete mix modification should be considered to enhance the long-term durability and structural integrity of the substructure.
- Due to the practical limitations and difficulties in obtaining undisturbed soil samples at all depths, the SBC values were conservatively estimated by correlating with similar strata encountered at shallower depths, and their tested engineering properties were adopted for analysis. Additionally, consolidation settlement has been duly considered, as the borelog data indicates the presence of significant clay layers at depth.
- The zone of influence has been conservatively taken as 2 times the width of the foundation, in accordance with established geotechnical practice, considering the overall dimensions of the structure. This ensures that the deeper compressible strata contributing to settlement are adequately captured in the analysis.
- If clay layers fall within the zone of influence or are close enough to affect settlement behavior, the consolidation settlement is computed based on the properties of the clay.
- For clayey layers, column loads (unfactored) have been used for consolidation settlement analysis. These column loads corresponding to settlement less than permissible limits of 50mm for isolated footings and 75mm for raft were used, and its corresponding pressure reported for the SBC based on the settlement criteria. However, in the case of sandy layers, factoring of loads is not typically required, and the immediate settlement is calculated directly based on in-situ SPT N-values as per IS 8009 guidelines.

For Shiva Testing & Research Laboratory Pvt. Ltd.

Akshya Sharm Director

Authorized Signatory
STR Labs



Geotech. Expert
STR Labs

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11.0 ABBREVIATION USED

UDS = Undisturbed Soil Sample
DS= Disturbed Sample
SPT= Standard Penetration Test
DIR = Direct Shear Test
Tx = Triaxial Shear Test
C = Cohesion
 ϕ = Angle of Shearing Resistance

12.0 CLOSURE

We appreciate the opportunity given to M/s Shiva Testing and Research Laboratory Pvt. Ltd. Baddi (Himachal Pradesh) to conduct the soil investigation (lab and analysis) and to submit this technical report. This presented report is based on observations made in field and tests conducted on samples collected from Ten boreholes and as briefed by driller-in-charge. In case of any deviation in soil strata from reported one or abnormal/abrupt change in soil sub strata is noticed during actual excavation, kindly contact us before proceeding with further construction to take remedial measure, if any, required for safety of structure. This Geotechnical Report is specifically applicable to the locations where the site investigation was conducted. The findings and recommendations presented herein may not be representative or valid for areas beyond the explored locations. Any changes to the area of exploration or site conditions may necessitate additional investigation and reevaluation.

For, Shiva Testing & Research Laboratory Pvt. Ltd.

Akshya Sharm Director

For M/s STR Labs,
Baddi (Himachal Pradesh)

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13.0 REFERENCES

1. IS 6403 – 1981: Code of practice for determination of bearing capacity of shallow foundations.
 2. IS 8009 (Part I) - 1978: Code of practice for calculation of settlements of foundations.
 3. IS: 1904-1978 “Structural Safety for Buildings: Shallow Foundation”.
 4. Foundation design manual, N. V. Nayak, 4th edition, 1996.
 5. Foundation analysis and design, Joseph E. bowels.
 6. IS-1498, IS-2131, IS-1892 and various parts of IS-2720
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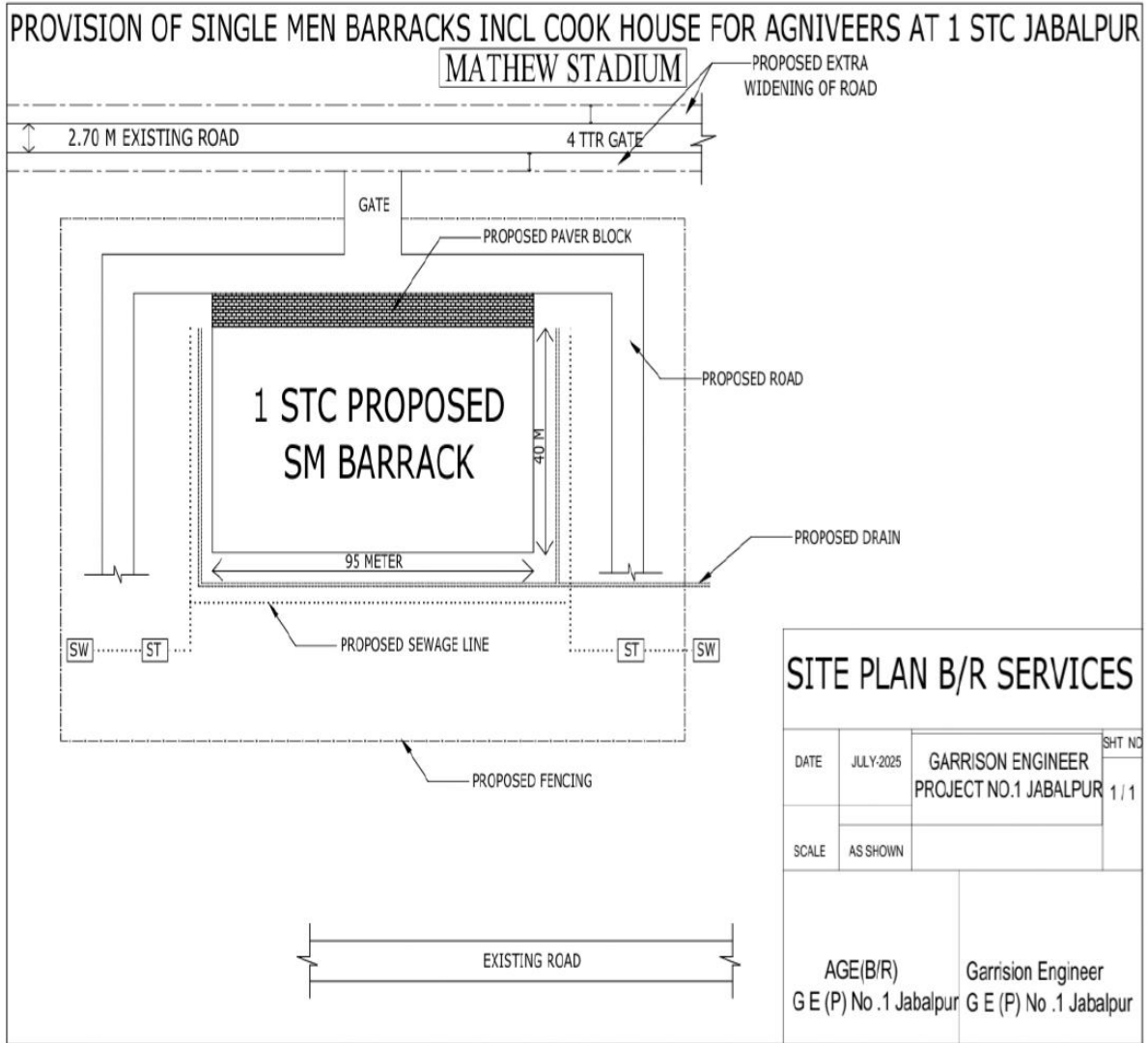


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14.0 SITE LAYOUT PLAN



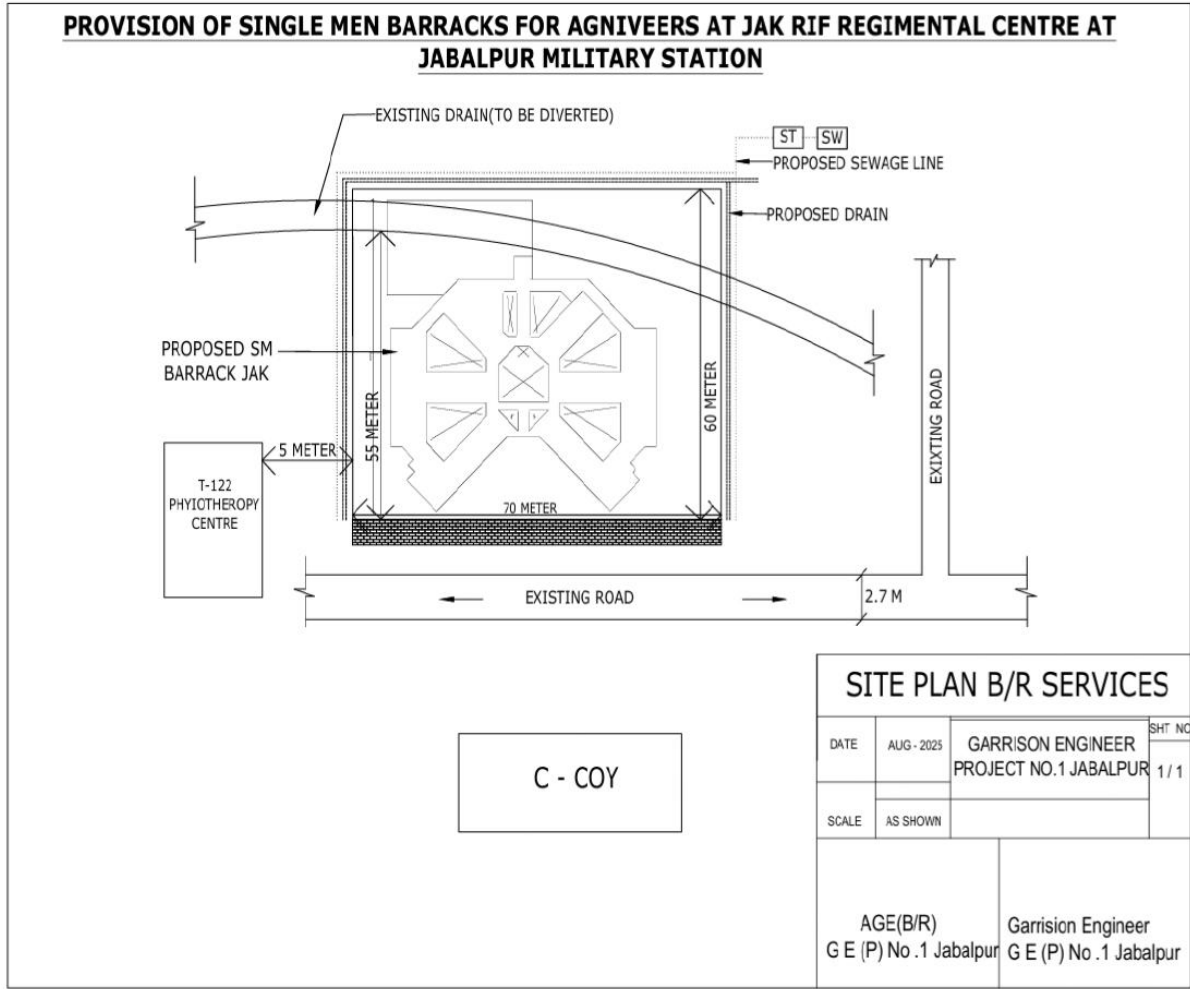
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COORDINATES OF BOREHOLES

Sr. no.	BOREHOLES	CO-ORDINATES
1	25	23°07'56"N 79°57'24"E
2	26	23°07'55"N 79°57'24"E
3	27	23°07'56"N 79°57'25"E
4	28	23°07'56"N 79°57'25"E
5	29	23°07'56"N 79°57'26"E
6	30	23°08'16"N 79°56'39"E
7	31	23°08'16"N 79°56'38"E
8	32	23°08'14"N 79°56'38"E
9	33	23°08'15"N 79°56'38"E
10	34	23°08'14"N 79°56'39"E

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WORK-2

**PROVN OF SINGLE MEN BARRACK INCLUDING COOK
HOUSE FOR 1 STC, JABALPUR**

(BH-25 TO BH-29)

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15.1 LOG OF BOREHOLE, BH-25

BOREHOLE NO.		25		DATE OF DRILLING		TERMINAL DEPTH (M)		WATER TABLE (M)	
Location		BH-1 [1STC, 1MTR] 23°07'56"N 79°57'24"E		05.08.2025		15.00		1.90	
DEPTH M	OBSERVED N VALUE	CORRECTED N VALUE	SAMPLE TYPE	SAMPLE DEPTH IN M	DESCRIPTION OF STRATA	LOG	IS SOIL CLASSIFICATION	STANDARD PENETRATION RESISTANCE CURVE	
								Observed N Value	Corrected N Value
0.00	-	-	-	-	CLAY WITH LOW COMPRESSIBILITY		CL	0.0	0
1.50	18	18	SPT-1	1.50-1.95				1.5	15
2.25			UDS-1	2.25-2.70				2.25	25
3.00	42	42	SPT-2	3.00-3.45				3.0	30
4.50	28	28	SPT-3	4.50-4.95	CLAYEY SAND		SC	4.5	28
5.25			UDS-2	5.25-5.70				5.25	35
6.00	47	36	SPT-4	6.00-6.45				6.0	36
7.50	36	28	SPT-5	7.50-7.95				7.5	28
9.00	49	35	SPT-6	9.00-9.45				9.0	35
10.50	48	33	SPT-7	10.50-10.95				10.5	33
12.00	54	35	SPT-8	12.00-12.45				12.0	35
13.50	58	57	SPT-9	13.50-13.95	POORLY GRADED GRAVEL		GP	13.5	57
15.00	63	62	SPT-10	15.00-15.45				15.0	62

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LOG OF BOREHOLE, BH-26

BOREHOLE NO.		26	DATE OF DRILLING		07.08.2025	TERMINAL DEPTH (M)		15.00	WATER TABLE (M)		0.90			
Location		BH-2 [1STC, 1MTR] 23°07'55"N 79°57'24"E												
DEPTH	OBSERVED N VALUE	CORRECTED N VALUE	SAMPLE TYPE	SAMPLE DEPTH IN M	DESCRIPTION OF STRATA	LOG	IS SOIL CLASSIFICATION	STANDARD PENETRATION RESISTANCE CURVE						
M														
0.00	-	-	-	-	CLAY WITH LOW COMPRESSIBILITY		CL							
1.50	12	12	SPT-1	1.50-1.95										
2.25			UDS-1	2.25-2.70										
3.00	64	64	SPT-2	3.00-3.45	CLAYEY SAND		SC							
4.50	62	51	SPT-3	4.50-4.95										
5.25			UDS-2	5.25-5.70										
6.00	50 REF	38	SPT-4	6.00-6.45										
7.50	61	43	SPT-5	7.50-7.95										
9.00	50 REF	36	SPT-6	9.00-9.25										
10.50	50 REF	35	SPT-7	10.50-10.70								POORLY GRADED GRAVEL		GP
12.00	50 REF	51	SPT-8	12.00-12.30										
13.50	50 REF	50	SPT-9	13.50-13.68										
15.00	50 REF	49	SPT-10	15.00-15.20										

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LOG OF BOREHOLE, BH-27

BOREHOLE NO.		27		DATE OF DRILLING		09.08.2025		TERMINAL DEPTH (M)		15.00		WATER TABLE (M)		1.70			
Location		BH-3 [1STC, 1MTR] 23°07'56"N 79°57'25"E															
DEPTH	M	OBSERVED N VALUE	CORRECTED N VALUE	SAMPLE TYPE	SAMPLE DEPTH IN M	DESCRIPTION OF STRATA	LOG	IS SOIL CLASSIFICATION	STANDARD PENETRATION RESISTANCE CURVE								
0.00		-	-	-	-												
1.50		8	14	SPT-1	1.50-1.95	CLAYEY SAND		SC									
2.25				UDS-1	2.25-2.70												
3.00		16	20	SPT-2	3.00-3.45												
4.50		18	20	SPT-3	4.50-4.95												
5.25				UDS-2	5.25-5.70												
6.00		45	35	SPT-4	6.00-6.45												
7.50		37	29	SPT-5	7.50-7.95												
9.00		50 REF	36	SPT-6	9.00-9.45												
10.50		62	41	SPT-7	10.50-10.95												
12.00		50 REF	51	SPT-8	12.00-12.28												
13.50		50 REF	50	SPT-9	13.50-13.75												
15.00		50 REF	49	SPT-10	15.00-15.14												

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LOG OF BOREHOLE, BH-28

BOREHOLE NO.		28		DATE OF DRILLING		11.08.2025		TERMINAL DEPTH (M)		15.00		WATER TABLE (M)		1.00	
Location		BH-4 [1STC, 1MTR] 23°07'56"N 79°57'25"E													
DEPTH	OBSERVED N VALUE	CORRECTED N VALUE	SAMPLE TYPE	SAMPLE DEPTH IN M	DESCRIPTION OF STRATA	LOG	IS SOIL CLASSIFICATION	STANDARD PENETRATION RESISTANCE CURVE							
M															
0.00	-	-	-	-	CLAYEY SAND		SC								
1.50	14	14	SPT-1	1.50-1.95											
2.25			UDS-1	2.25-2.70											
3.00	31	20	SPT-2	3.00-3.45											
4.50	50	20	SPT-3	4.50-4.95											
5.25			UDS-2	5.25-5.70											
6.00	45	35	SPT-4	6.00-6.45											
7.50	61	29	SPT-5	7.50-7.95											
9.00	50 REF	36	SPT-6	9.00-9.45											
10.50	62	41	SPT-7	10.50-10.95											
12.00	50 REF	51	SPT-8	12.00-12.28											
13.50	50 REF	50	SPT-9	13.50-13.75											
15.00	50 REF	49	SPT-10	15.00-15.14											

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LOG OF BOREHOLE, BH-29

BOREHOLE NO.		29		DATE OF DRILLING		11.08.2025		TERMINAL DEPTH (M)		15.00		WATER TABLE (M)		1.70	
Location		BH-5 [1STC, 1MTR] 23°07'56"N 79°57'26"E													
DEPTH	M	OBSERVED N VALUE	CORRECTED N VALUE	SAMPLE TYPE	SAMPLE DEPTH IN M	DESCRIPTION OF STRATA	LOG	IS SOIL CLASSIFICATION	STANDARD PENETRATION RESISTANCE CURVE						
0.00		-	-	-	-	CLAYEY SAND		SC							
1.50		12	18	SPT-1	1.50-1.95										
2.25				UDS-1	2.25-2.70										
3.00		19	22	SPT-2	3.00-3.45										
4.50		43	38	SPT-3	4.50-4.95										
5.25				UDS-2	5.25-5.70										
6.00		64	46	SPT-4	6.00-6.45										
7.50		50 REF	37	SPT-5	7.50-7.95										
9.00		50 REF	36	SPT-6	9.00-9.45										
10.50		50 REF	35	SPT-7	10.50-10.95										
12.00		50 REF	51	SPT-8	12.00-12.28										
13.50		50 REF	50	SPT-9	13.50-13.75										
15.00		50 REF	49	SPT-10	15.00-15.14										

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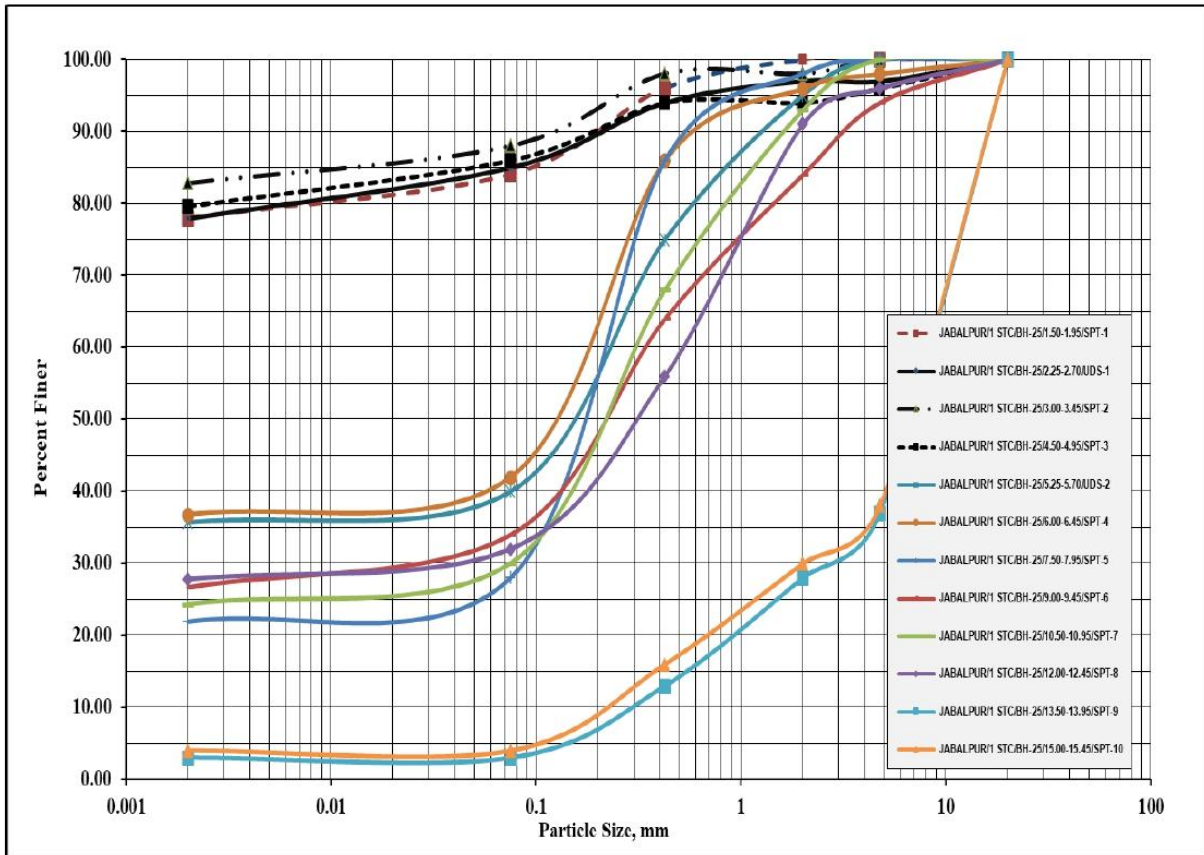
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16.1 LABORATORY TEST RESULTS

TEST ON SOIL SAMPLES																				
BH-25			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT					SHEAR PARAMETERS			
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL	CLAY	SILT	fine SAND	med SAND	coarse SAND	GRAVEL	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²	ANGLE OF INTERNAL FRICTION, in Degree	FREE SWELL INDEX
			<0.002 mm	0.002-0.075	0.075-0.425	0.425-2.00	2.00-4.75	>4.75 mm	%	%	%	gm/cc	%	gm/cc	G	e	c	φ	%	
1.50-1.95	SPT-1	CL	77.95	6.05	12.00	4.00	0.00	0.00	34.17	18.04	16.13	-	20	-	2.63	-	-	-	-	-
2.25-2.70	UDS-1	CL	77.90	7.10	9.00	3.00	0.00	3.00	34.30	17.00	17.30	1.72	20	1.433	2.64	0.84	TX	0.48	12.14	6
3.00-3.45	SPT-2	CL	82.80	5.20	10.00	0.00	2.00	0.00	33.54	17.62	15.92	-	23	-	2.63	-	-	-	-	-
4.50-4.95	SPT-3	CL	79.60	6.40	8.00	0.00	2.00	4.00	33.03	17.08	15.95	-	22	-	2.60	-	-	-	-	-
5.25-5.70	UDS-2	SC	35.70	4.30	35.00	20.00	5.00	0.00	28.47	16.02	12.45	1.77	14	1.553	2.63	0.69	TX	0.20	32.21	5
6.00-6.45	SPT-4	SC	36.80	5.20	44.00	10.00	2.00	2.00	29.84	16.28	13.56	-	11	-	2.61	-	-	-	-	-
7.50-7.95	SPT-5	SC	21.90	6.10	58.00	12.00	2.00	0.00	32.34	17.22	15.12	-	11	-	2.60	-	-	-	-	-
9.00-9.45	SPT-6	SC	26.70	7.30	30.00	20.00	10.00	6.00	29.65	15.85	13.80	-	17	-	2.63	-	-	-	-	-
10.50-10.95	SPT-7	SC	24.30	5.70	38.00	25.00	7.00	0.00	28.98	16.03	12.95	-	12	-	2.64	-	-	-	-	-
12.00-12.45	SPT-8	SC	27.80	4.20	24.00	35.00	5.00	4.00	28.47	16.78	11.69	-	12	-	2.60	-	-	-	-	-
13.50-13.95	SPT-9	GP	3.00		10.00	15.00	9.00	63.00	NP	NL	NIL	-	5	-	2.64	-	-	-	-	-
15.00-15.45	SPT-10	GP	4.00		12.00	14.00	8.00	62.00	NP	NL	NIL	-	3	-	2.63	-	-	-	-	-

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



GRAIN SIZE DISTRIBUTION CURVE, BH-25

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR,
MADHYA PRADESH



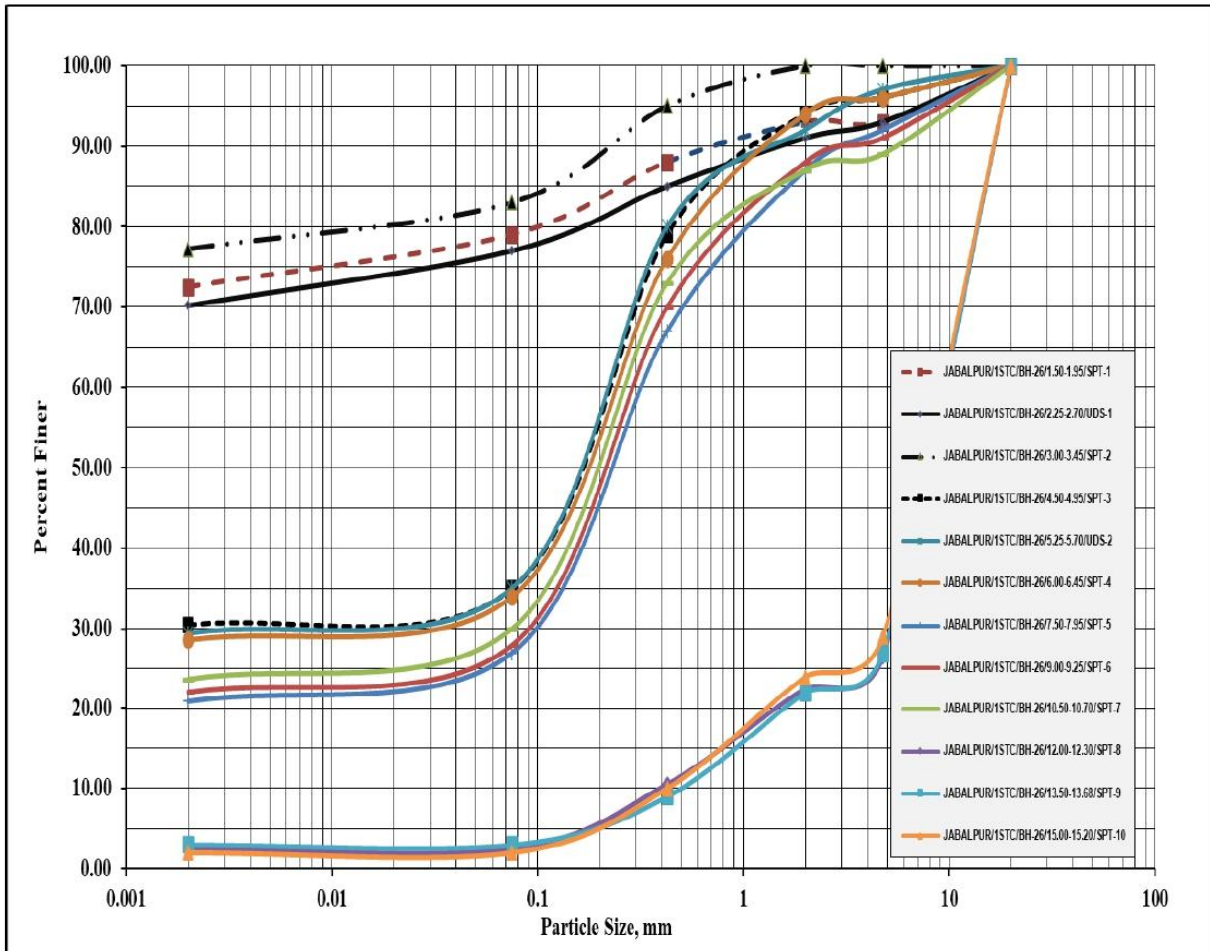
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TEST ON SOIL SAMPLES																				
BH-26			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT					SHEAR PARAMETERS			FREE SWELL INDEX
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL	CLAY	SILT	fine SAND	med SAND	coarse SAND	GRAVEL	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²	ANGLE OF INTERNAL FRICTION, in Degree	
			<0.002 mm	0.002-0.075	0.075-0.425	0.425-2.00	2.00-4.75	>4.75 mm				gm/cc	%	gm/cc	G	e				
			%	%	%	%	%	%	%	%	%	gm/cc	%	gm/cc	G	e		c	φ	
1.50-1.95	SPT-1	CL	72.50	6.50	9.00	5.00	0.00	7.00	34.50	18.47	16.03	-	28	-	2.63	-	-	-	-	
2.25-2.70	UDS-1	CL	70.20	6.80	8.00	6.00	2.00	7.00	33.35	18.50	14.85	1.77	22	1.451	2.63	0.81	TX	0.45	10.72	8
3.00-3.45	SPT-2	CL	77.20	5.80	12.00	5.00	0.00	0.00	34.07	18.36	15.71	-	25	-	2.62	-	-	-	-	
4.50-4.95	SPT-3	SC	30.50	4.50	44.00	15.00	2.00	4.00	30.74	19.22	11.52	-	17	-	2.60	-	-	-	-	
5.25-5.70	UDS-2	SC	29.40	5.60	45.00	12.00	5.00	3.00	30.17	18.12	12.05	1.88	16	1.621	2.63	0.62	TX	0.19	36.53	5
6.00-6.45	SPT-4	SC	28.60	5.40	42.00	18.00	2.00	4.00	31.23	19.03	12.20	-	19	-	2.64	-	-	-	-	
7.50-7.95	SPT-5	SC	20.90	6.10	40.00	20.00	5.00	8.00	31.02	19.41	11.61	-	20	-	2.63	-	-	-	-	
9.00-9.25	SPT-6	SC	22.10	5.90	42.00	18.00	3.00	9.00	30.47	19.35	11.12	-	21	-	2.62	-	-	-	-	
10.50-10.70	SPT-7	SC	23.70	6.30	43.00	14.00	2.00	11.00	31.62	18.41	13.21	-	17	-	2.64	-	-	-	-	
12.00-12.30	SPT-8	GP	2.50		8.00	12.00	4.00	73.50	NL	NP	NIL	-	4	-	2.63	-	-	-	-	
13.50-13.68	SPT-9	GP	3.00		6.00	13.00	5.00	73.00	NL	NP	NIL	-	5	-	2.64	-	-	-	-	
15.00-15.20	SPT-10	GP	2.00		8.00	14.00	5.00	71.00	NL	NP	NIL	-	3	-	2.64	-	-	-	-	

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



GRAIN SIZE DISTRIBUTION CURVE, BH-26

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



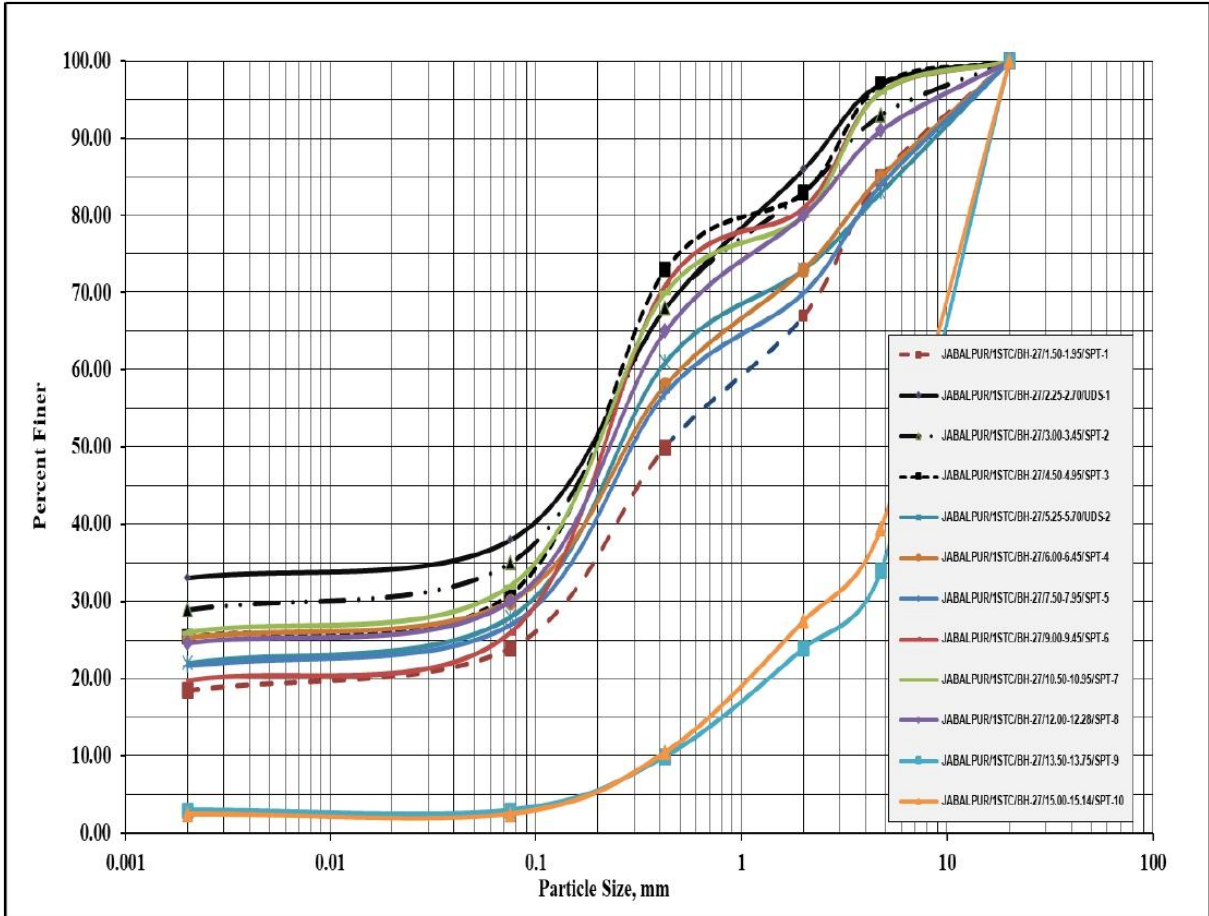
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TEST ON SOIL SAMPLES																				
BH-27			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT					SHEAR PARAMETERS		FREE SWELL INDEX	
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL	CLAY	SILT	fine SAND	med SAND	coarse SAND	GRAVEL	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²		ANGLE OF INTERNAL FRICTION, in Degree
			<0.002 mm	0.002-0.075	0.075-0.425	0.425-2.00	2.00-4.75	>4.75 mm	%	%	%	%	%	gm/cc	%	gm/cc	G	e		c
1.50-1.95	SPT-1	SC	18.50	5.50	26.00	17.00	18.00	15.00	34.78	15.45	19.33	-	17	-	2.61	-	-	-	-	
2.25-2.70	UDS-1	SC	33.10	4.90	30.00	18.00	11.00	3.00	31.24	16.57	14.67	1.70	15	1.478	2.63	0.78	TX	0.22	26.24	8
3.00-3.45	SPT-2	SC	28.90	6.10	33.00	15.00	10.00	7.00	30.63	16.36	14.27	-	11	-	2.60	-	-	-	-	
4.50-4.95	SPT-3	SC	25.40	5.60	42.00	10.00	14.00	3.00	33.30	15.84	17.46	-	20	-	2.62	-	-	-	-	
5.25-5.70	UDS-2	SC	22.00	6.00	33.00	12.00	10.00	17.00	28.41	16.30	12.11	1.84	18	1.559	2.64	0.69	TX	0.20	32.67	7
6.00-6.45	SPT-4	SC	25.30	4.70	28.00	15.00	12.00	15.00	29.63	18.47	11.16	-	11	-	2.60	-	-	-	-	
7.50-7.95	SPT-5	SC	21.70	5.30	30.00	13.00	14.00	16.00	30.84	16.81	14.03	-	11	-	2.62	-	-	-	-	
9.00-9.45	SPT-6	SC	19.80	6.20	45.00	10.00	15.00	4.00	26.45	17.77	8.68	-	9	-	2.63	-	-	-	-	
10.50-10.95	SPT-7	SC	26.00	6.00	38.00	10.00	16.00	4.00	29.81	18.33	11.48	-	14	-	2.61	-	-	-	-	
12.00-12.28	SPT-8	SC	24.60	5.40	35.00	15.00	11.00	9.00	28.41	18.47	9.94	-	15	-	2.60	-	-	-	-	
13.50-13.75	SPT-9	GP	3.00		7.00	14.00	10.00	66.00	NL	NP	NIL	-	4	-	2.64	-	-	-	-	
15.00-15.14	SPT-10	GP	2.50		8.00	17.00	12.00	60.50	NL	NP	NIL	-	5	-	2.63	-	-	-	-	

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



GRAIN SIZE DISTRIBUTION CURVE, BH-27

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR,
MADHYA PRADESH



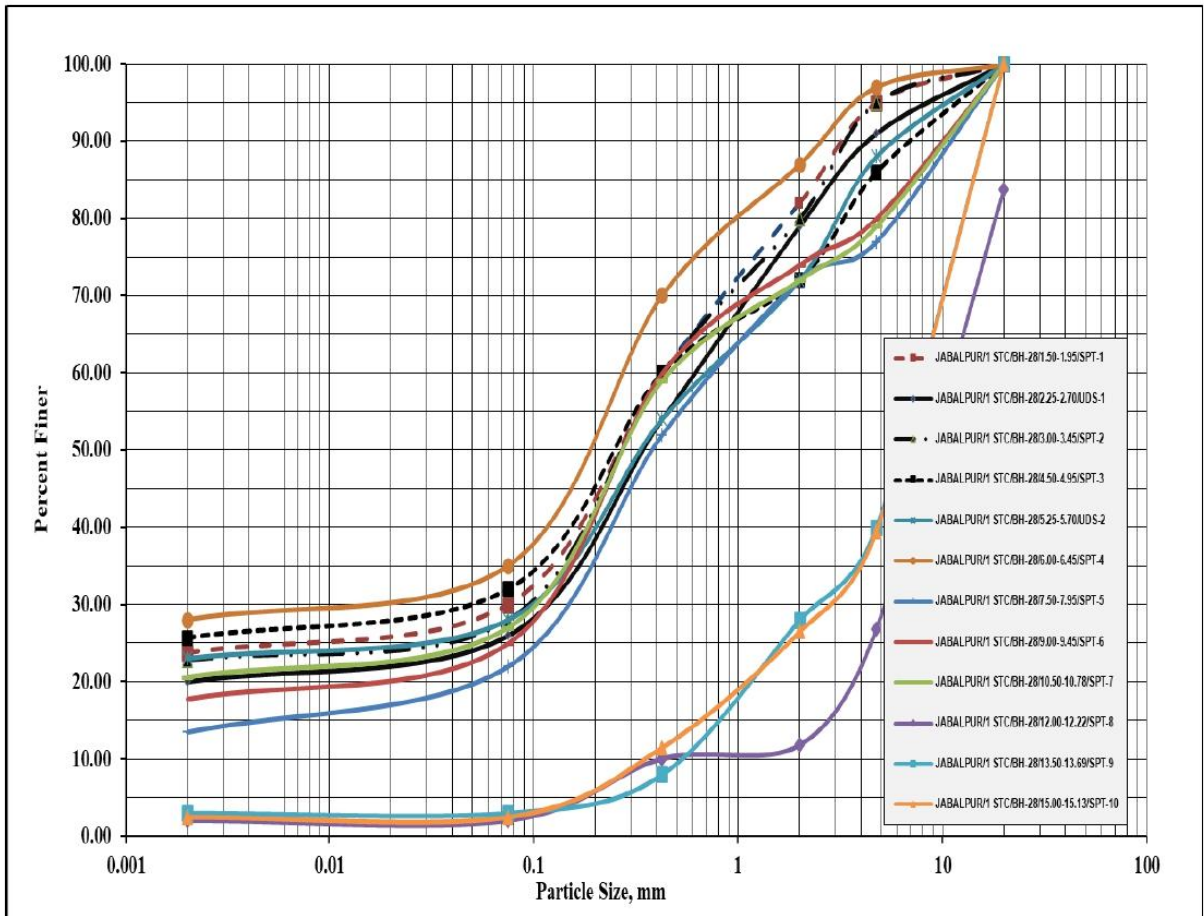
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TEST ON SOIL SAMPLES																				
BH-28			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT					SHEAR PARAMETERS			
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL	CLAY	SILT	fine SAND	med SAND	coarse SAND	GRAVEL	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²	ANGLE OF INTERNAL FRICTION, in Degree	FREE SWELL INDEX
			<0.002 mm	0.002-0.075	0.075-0.425	0.425-2.00	2.00-4.75	>4.75 mm	%	%	%	%	%	gm/cc	%	gm/cc	G	e		c
1.50-1.95	SPT-1	SC	23.70	6.30	30.00	22.00	13.00	5.00	29.67	15.62	14.05	-	19	-	2.63	-	-	-	-	-
2.25-2.70	UDS-1	SC	20.00	6.00	28.00	25.00	12.00	9.00	28.60	15.32	13.28	1.77	22	1.451	2.62	0.81	TX	0.21	27.74	6
3.00-3.45	SPT-2	SC	22.80	5.20	32.00	20.00	15.00	5.00	33.84	14.10	19.74	-	21	-	2.61	-	-	-	-	-
4.50-4.95	SPT-3	SC	25.70	6.30	28.00	12.00	14.00	14.00	27.70	16.59	11.11	-	13	-	2.60	-	-	-	-	-
5.25-5.70	UDS-2	SC	23.00	5.00	26.00	18.00	16.00	12.00	28.47	16.11	12.36	1.89	21	1.562	2.63	0.68	TX	0.24	36.00	7
6.00-6.45	SPT-4	SC	28.00	7.00	35.00	17.00	10.00	3.00	28.08	16.74	11.34	-	14	-	2.64	-	-	-	-	-
7.50-7.95	SPT-5	SC	13.50	8.50	30.00	20.00	5.00	23.00	28.33	16.20	12.13	-	17	-	2.63	-	-	-	-	-
9.00-9.45	SPT-6	SC	17.80	7.20	35.00	14.00	6.00	20.00	28.80	15.33	13.47	-	16	-	2.62	-	-	-	-	-
10.50-10.78	SPT-7	SC	20.60	6.40	32.00	13.00	7.00	21.00	29.31	17.50	11.81	-	18	-	2.64	-	-	-	-	-
12.00-12.22	SPT-8	GP	2.00		8.00	1.77	15.00	57.00	NL	NP	NIL	-	4	-	2.62	-	-	-	-	-
13.50-13.69	SPT-9	GP	3.00		5.00	20.00	12.00	60.00	NL	NP	NIL	-	5	-	2.64	-	-	-	-	-
15.00-15.13	SPT-10	GP	2.50		9.00	15.00	13.00	60.50	NL	NP	NIL	-	5	-	2.61	-	-	-	-	-

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



GRAIN SIZE DISTRIBUTION CURVE, BH-28

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR,
MADHYA PRADESH



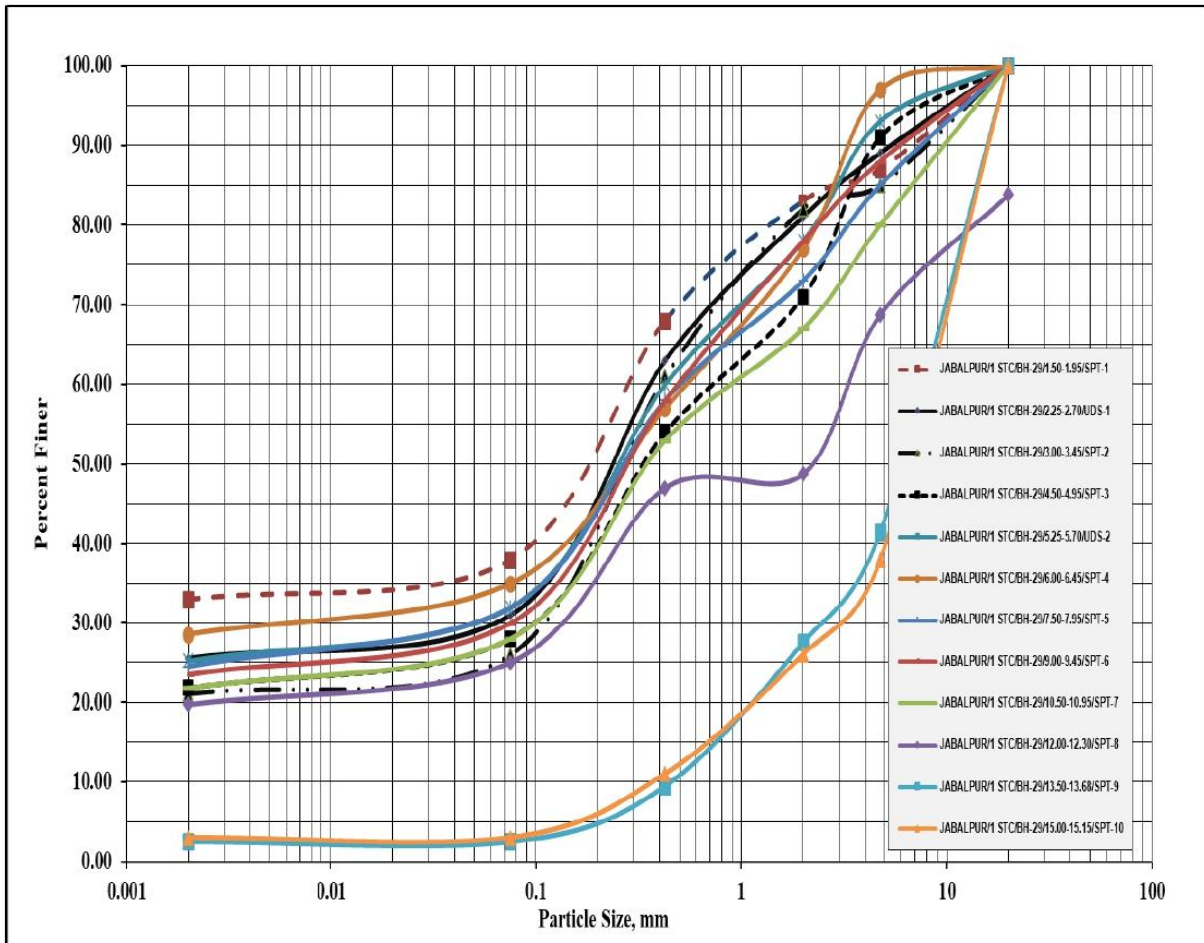
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TEST ON SOIL SAMPLES																				
BH-29			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT					SHEAR PARAMETERS			
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL	CLAY	SILT	fine SAND	med SAND	coarse SAND	GRAVEL	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²	ANGLE OF INTERNAL FRICTION, in Degree	FREE SWELL INDEX
			<0.002 mm	0.002-0.075	0.075-0.425	0.425-2.00	2.00-4.75	>4.75 mm												
1.50-1.95	SPT-1	SC	33.00	5.00	30.00	15.00	4.00	13.00	30.41	15.14	15.27	-	11	-	2.62	-	-	-	-	-
2.25-2.70	UDS-1	SC	25.50	5.50	32.00	18.00	8.00	11.00	29.54	16.12	13.42	1.74	13	1.540	2.63	0.71	TX	0.22	28.30	7
3.00-3.45	SPT-2	SC	21.10	4.90	35.00	21.00	3.00	15.00	28.15	16.02	12.13	-	15	-	2.61	-	-	-	-	-
4.50-4.95	SPT-3	SC	21.80	6.20	26.00	17.00	20.00	9.00	29.35	15.46	13.89	-	18	-	2.60	-	-	-	-	-
5.25-5.70	UDS-2	SC	25.20	6.80	28.00	18.00	15.00	7.00	28.93	16.47	12.46	1.87	15	1.630	2.63	0.62	TX	0.25	36.00	7
6.00-6.45	SPT-4	SC	28.50	6.50	22.00	20.00	20.00	3.00	30.47	16.33	14.14	-	17	-	2.64	-	-	-	-	-
7.50-7.95	SPT-5	SC	24.50	7.50	26.00	15.00	12.00	15.00	28.63	16.27	12.36	-	16	-	2.63	-	-	-	-	-
9.00-9.45	SPT-6	SC	23.50	6.50	28.00	20.00	10.00	12.00	29.57	17.50	12.07	-	17	-	2.62	-	-	-	-	-
10.50-10.95	SPT-7	SC	21.80	6.20	25.00	14.00	13.00	20.00	28.00	16.24	11.76	-	12	-	2.64	-	-	-	-	-
12.00-12.30	SPT-8	SC	19.70	5.30	22.00	1.77	20.00	15.00	29.74	17.30	12.44	-	14	-	2.62	-	-	-	-	-
13.50-13.68	SPT-9	GP	2.50		7.00	18.00	14.00	58.50	NL	NP	NIL	-	16	-	2.64	-	-	-	-	-
15.00-15.15	SPT-10	GP	3.00		8.00	15.00	12.00	62.00	NL	NP	NIL	-	15	-	2.63	-	-	-	-	-

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



GRAIN SIZE DISTRIBUTION CURVE, BH-29

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



17.1 DESIGN OF SHALLOW FOUNDATION
17.1.1 ISOLATED SQUARE FOOTING
SIZE OF FOUNDATION- 2M X 2M

Safe Bearing Capacity (SBC) Calculation for 2m x 2m Square Foundation – Jabalpur Site (BH-25)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
Parameters	Unit	Denotation	1	2	3
Bore Hole Number		BH	25	25	25
SPT N Value at end of compressible zone		N	47	47	47
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	2	2	2
Width of Foundation	m	B	2	2	2
Saturated density of soil	kg/cm ³	γ _{sat}	0.00172	0.00172	0.00172
Submerged density of soil	kg/cm ³	γ'	0.00072	0.00072	0.00072
Overburden Pressure	kg/cm ²	γ x Df	0.172	0.344	0.516
	kg/cm ²	B x γ	0.144	0.144	0.144
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.48	0.48	0.48
Angle of Internal Friction for General Shear	Degrees	φ	0	0	0
Angle of Internal Friction for Local Shear	Degrees	φ'	0.00	0.00	0.00
Initial void ratio		e ₀	0.84	0.84	0.84
Column load coming on to footing (Unfactored Load)	Tons	Load	18.00	28.00	47.00
Depth of Clay layer from ground level	m	H _{clay}	5.25	5.25	5.25
Depth of clay layer from base of footing	m	H	4.25	3.25	2.25
Bearing Capacity factors for local shear failure		N _c '	5.140	5.140	5.140
		N _q '	1.000	1.000	1.000
		N _γ '	0.000	0.000	0.000
		S _c	1.3	1.3	1.3
Shape Factors		S _q	1.2	1.2	1.2
		S _γ	0.8	0.8	0.8
		D _c	1.100	1.200	1.300
Depth Factors		D _q	1.000	1.000	1.000
		D _γ	1.000	1.000	1.000
		D _γ	1.000	1.000	1.000
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67 * C * N_c' * S_c * D_c + q (N_q' - 1) * S_q * D_q + 0.5 * B * N_γ' * S_γ * D_γ * W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Q_d'	2.364	2.579	2.794
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Q_d/FOS)	9.460	10.310	11.170
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
Consolidation Settlement for Clayey Soil Layers					
Height of compressible zone from influence zone	m	H	4.25	3.25	2.25
Compression Index C _c =0.3*(e ₀ -0.27)		C _c	0.171	0.171	0.171
Initial Pressure at the centre of influence zone	T/m ²	P ₀	2.250	2.610	2.970
Additional pressure intensity 2:1 method at mid of clay layer	T/m ²	ΔP	1.058	2.131	4.813
Consolidation Settlement	mm	s _c	66.104	78.292	87.485
Settlement criteria for for Sandy Soil Layers					
Pressure intensity 2:1 method at end of clay layer	T/m ²	ΔP _c	0.46	1.02	2.6
Settlement from Fig 9 of IS8009, for 1Kg/cm ² or 10 T/m ²	mm	S _u	5.13	5.13	5.13
Corrected Settlement due to Water Table for 1Kg/cm ² or 10 T/m ²	mm	S _u '=S _u /W'	10.26	10.26	10.26
Settlement for the granular layer due to pressure intensity at end of clay layer	mm	S _g =S _u '*ΔP _c /10	0.47196	1.04652	2.6676
Corrected Settlement Total					
If clay layer is resting on cohesionless soil layer then value of λ should be taken as 0.85		λ	0.85	0.85	0.85
Correction factor for depth		Def	0.85	0.73	0.63
Correction factor for rigidity		Rf	1	1	1
Total Settlement after correction (Consolidation Settlement+ Settlement for the granular layer)	mm	S _c =s _c *λ*Def*Rf + S _g	48.230	49.627	49.520
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	S _a	50	50	50
Check whether observed settlement is within permissible limits			OK	OK	OK
Net Safe Bearing Capacity (Settlement Criteria)	T/m ²	SBC=Load/BL	4.50	7	11.75
Safe Bearing Pressure (Without risk of Shear failure or excessive settlement)	T/m ²	SBP	4.500	7.000	11.170

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



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Safe Bearing Capacity (SBC) Calculation for 2m x 2m Square Foundation – Jabalpur Site (BH-26)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
Parameters	Unit	Denotation	1	2	3
Bore Hole Number		BH	26	26	26
SPT N Value at end of compressible zone		N	50	50	50
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	2	2	2
Width of Foundation	m	B	2	2	2
Saturated density of soil	kg/cm ³	γ _{sat}	0.00177	0.00177	0.00177
Submerged density of soil	kg/cm ³	γ'	0.00077	0.00077	0.00077
Overburden Pressure	kg/cm ²	γ x Df	0.177	0.354	0.531
	kg/cm ²	B x γ	0.154	0.154	0.154
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.45	0.45	0.45
Angle of Internal Friction for General Shear	Degrees	φ	0	0	0
Angle of Internal Friction for Local Shear	Degrees	φ'	0.00	0.00	0.00
Initial void ratio		e ₀	0.81	0.81	0.81
Column load coming on to footing (Unfactored Load)	Tons	Load	19.00	32.00	68.00
Depth of Clay layer from ground level	m	H _{clay}	4.50	4.50	4.50
Depth of clay layer from base of footing	m	H	3.50	2.50	1.50
Bearing Capacity factors for local shear failure		N _c '	1.000	1.000	1.000
		N _q '	5.140	5.140	5.140
		N _γ '	1.000	1.000	1.000
Shape Factors		S _c	0.000	0.000	0.000
		S _q	1.3	1.3	1.3
		S _γ	1.2	1.2	1.2
Depth Factors		D _c	0.8	0.8	0.8
		D _q	1.100	1.200	1.300
		D _γ	1.000	1.000	1.000
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67 * C * N_c' * S_c * D_c + q(N_q' - 1) * S_q * D_q + 0.5 * B * N_γ' * S_γ * D_γ * W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Q_d'	2.216	2.418	2.619
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Q_d/FOS)	8.860	9.670	10.480
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
Consolidation Settlement for Clayey Soil Layers					
Height of compressible zone from influence zone	m	H	3.50	2.50	1.50
Compression Index C _c =0.3*(e ₀ -0.27)		C _c	0.162	0.162	0.162
Initial Pressure at the centre of influence zone	T/m ²	P ₀	2.118	2.503	2.888
Additional pressure intensity 2:1 method at mid of clay layer	T/m ²	ΔP	1.351	3.030	8.992
Consolidation Settlement	mm	s _c	67.142	77.088	82.468
Settlement criteria for for Sandy Soil Layers					
Pressure intensity 2:1 method at end of clay layer	T/m ²	ΔP _c	0.63	1.58	5.55
Settlement from Fig 9 of IS8009, for 1Kg/cm ² or 10 T/m ²	mm	S _u	4.76	4.76	4.76
Corrected Settlement due to Water Table for 1Kg/cm ² or 10 T/m ²	mm	S _u '=S _u /W'	9.52	9.52	9.52
Settlement for the granular layer due to pressure intensity at end of clay layer	mm	S _g =S _u '*ΔP _c /10	0.59976	1.50416	5.2836
Corrected Settlement Total					
If clay layer is resting on cohesionless soil layer then value of λ should be taken as 0.85		λ	0.85	0.85	0.85
Correction factor for depth		Def	0.85	0.73	0.63
Correction factor for rigidity		Rf	1	1	1
Total Settlement after correction (Consolidation Settlement+ Settlement for the granular layer)	mm	S _c =s _c *λ*Def*Rf + S _g	49.110	49.337	49.450
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	S _a	50	50	50
Check whether observed settlement is within permissible limits			OK	OK	OK
Net Safe Bearing Capacity (Settlement Criteria)	T/m ²	SBC=Load/BL	4.75	8	17
Safe Bearing Pressure (Without risk of Shear failure or excessive settlement)	T/m ²	SBP	4.750	8.000	10.480

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Safe Bearing Capacity (SBC) Calculation for 2m x 2m Square Foundation – Jabalpur Site (BH-27)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotation	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	27	27	27
SPT N Value		N	8	8	16
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	2	2	2
Width of Foundation	m	B	2	2	2
Saturated density of soil	kg/cm ³	γ_{sat}	0.0017	0.0017	0.0017
Submerged density of soil	kg/cm ³	γ'	0.0017	0.0017	0.0017
Overburden Pressure	kg/cm ²	$\gamma \times Df$	0.17	0.34	0.51
	kg/cm ²	$B \times \gamma$	0.34	0.34	0.34
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.22	0.22	0.22
Angle of Internal Friction for General Shear	Degrees	ϕ	26.24	26.24	26.24
Angle of Internal Friction for Local Shear	Degrees	ϕ'	18.27	18.27	18.27
$N\phi$			2.585	2.585	2.585
Bearing Capacity factors for local shear failure		Nc'	13.464	13.464	13.464
		Nq'	5.547	5.547	5.547
		$N\gamma'$	4.440	4.440	4.440
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		$S\gamma$	0.8	0.8	0.8
Depth Factors		Dc	1.161	1.322	1.482
		Dq	1.080	1.161	1.241
		$D\gamma$	1.080	1.161	1.241
Net Ultimate Bearing Capacity (Local Shear Criteria) = $0.67 \times C \times Nc' \times Sc \times Dc + q(Nq'-1) \times Sq \times Dq + 0.5 \times B \times N\gamma' \times S\gamma \times D\gamma \times W'$ [Used for ϕ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	4.323	5.914	7.653
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	$NSBC=(Qd'/FOS)$	17.290	23.650	30.610
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
<i>SBC based on settlement criteria for for Sandy Soil Layers</i>					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	47.73	47.73	17.9
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	$Su'=Su/W'$	95.46	95.46	35.8
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	50	50	50
Net Safe Bearing Capacity (Settlement Criteria)	kg/cm ²	Sa/Su'	0.524	0.524	1.397
Safe Bearing Pressure for 50mm Settlement (Settlement Criteria)	T/m ²	$(Sa/Su') \times 10$	5.238	5.238	13.966
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	5.240	5.240	13.970

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Safe Bearing Capacity (SBC) Calculation for 2m x 2m Square Foundation – Jabalpur Site (BH-28)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
Parameters	Unit	Denotion	1	2	3
			Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	28	28	28
SPT N Value		N	14	14	31
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	2	2	2
Width of Foundation	m	B	2	2	2
Saturated density of soil	kg/cm ³	γ _{sat}	0.00177	0.00177	0.00177
Submerged density of soil	kg/cm ³	γ'	0.00177	0.00177	0.00177
Overburden Pressure	kg/cm ²	γ x Df	0.177	0.354	0.531
	kg/cm ²	B x γ	0.354	0.354	0.354
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.21	0.21	0.21
Angle of Internal Friction for General Shear	Degrees	φ	27.74	27.74	27.74
Angle of Internal Friction for Local Shear	Degrees	φ'	19.40	19.40	19.40
Nφ			2.742	2.742	2.742
Bearing Capacity factors for local shear failure		Nc'	14.357	14.357	14.357
		Nq'	6.105	6.105	6.105
		Nγ'	5.061	5.061	5.061
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sγ	0.8	0.8	0.8
Depth Factors		Dc	1.166	1.331	1.497
		Dq	1.083	1.166	1.248
		Dγ	1.083	1.166	1.248
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Nγ' * Sγ *Dγ*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	4.623	6.441	8.438
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	18.490	25.760	33.750
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
<i>SBC based on settlement criteria for for Sandy Soil Layers</i>					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	20.34	20.34	7.81
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	40.68	40.68	15.62
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	50	50	50
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	1.229	1.229	3.201
Safe Bearing Pressure for 50mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	12.291	12.291	32.010
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	12.290	12.290	32.010

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Safe Bearing Capacity (SBC) Calculation for 2m x 2m Square Foundation – Jabalpur Site (BH-29)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	29	29	29
SPT N Value		N	12	12	19
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	2	2	2
Width of Foundation	m	B	2	2	2
Saturated density of soil	kg/cm ³	γ _{sat}	0.00174	0.00174	0.00174
Submerged density of soil	kg/cm ³	γ'	0.00174	0.00174	0.00174
Overburden Pressure	kg/cm ²	γ x Df	0.174	0.348	0.522
	kg/cm ²	B x γ	0.348	0.348	0.348
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.22	0.22	0.22
Angle of Internal Friction for General Shear	Degrees	φ	28.3	28.3	28.3
Angle of Internal Friction for Local Shear	Degrees	φ'	19.83	19.83	19.83
Nφ			2.803	2.803	2.803
Bearing Capacity factors for local shear failure		Nc'	14.693	14.693	14.693
		Nq'	6.315	6.315	6.315
		Nγ'	5.295	5.295	5.295
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sγ	0.8	0.8	0.8
Depth Factors		Dc	1.167	1.335	1.502
		Dq	1.084	1.167	1.251
		Dγ	1.084	1.167	1.251
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Nγ' * Sγ *Dγ*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	4.889	6.779	8.856
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	19.560	27.120	35.420
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
<i>SBC based on settlement criteria for for Sandy Soil Layers</i>					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	24.38	24.38	15.04
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	48.76	48.76	30.08
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	50	50	50
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	1.025	1.025	1.662
Safe Bearing Pressure for 50mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	10.254	10.254	16.622
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	10.250	10.250	16.620

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SIZE OF FOUNDATION- 3M X 3M

Safe Bearing Capacity (SBC) Calculation for 3m x 3m Square Foundation – Jabalpur Site (BH-25)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
Parameters	Unit	Denotation	1	2	3
Bore Hole Number		BH	25	25	25
SPT N Value at end of compressible zone		N	47	47	47
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	3	3	3
Width of Foundation	m	B	3	3	3
Saturated density of soil	kg/cm ³	γ _{sat}	0.00172	0.00172	0.00172
Submerged density of soil	kg/cm ³	γ'	0.00072	0.00072	0.00072
Overburden Pressure	kg/cm ²	γ x Df	0.172	0.344	0.516
	kg/cm ²	B x γ	0.216	0.216	0.216
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.48	0.48	0.48
Angle of Internal Friction for General Shear	Degrees	φ	0	0	0
Angle of Internal Friction for Local Shear	Degrees	φ'	0.00	0.00	0.00
Initial void ratio		e ₀	0.84	0.84	0.84
Column load coming on to footing (Unfactored Load)	Tons	Load	26.00	40.00	65.00
Depth of Clay layer from ground level	m	H _{clay}	5.25	5.25	5.25
Depth of clay layer from base of footing	m	H	4.25	3.25	2.25
Nφ			1.000	1.000	1.000
		N _c '	5.140	5.140	5.140
		N _q '	1.000	1.000	1.000
Bearing Capacity factors for local shear failure		N _y '	0.000	0.000	0.000
		S _c	1.3	1.3	1.3
		S _q	1.2	1.2	1.2
Shape Factors		S _γ	0.8	0.8	0.8
		D _c	1.067	1.133	1.200
		D _q	1.000	1.000	1.000
Depth Factors		D _γ	1.000	1.000	1.000
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67 * C * N _c ' * S _c * D _c + q * (N _q ' - 1) * S _q * D _q + 0.5 * B * N _y ' * S _γ * D _γ * W'	kg/cm ²	Q _d '	2.292	2.435	2.579
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Q _d /FOS)	9.170	9.740	10.310
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
Consolidation Settlement for Clayey Soil Layers					
Height of compressible zone from influence zone	m	H	4.25	3.25	2.25
Compression Index C _c =0.3*(e ₀ -0.27)		C _c	0.171	0.171	0.171
Initial Pressure at the centre of influence zone	T/m ²	P ₀	2.250	2.610	2.970
Additional pressure intensity 2:1 method at mid of clay layer	T/m ²	ΔP	0.990	1.870	3.820
Consolidation Settlement	mm	s _c	62.543	70.869	75.092
Settlement criteria for for Sandy Soil Layers					
Pressure intensity 2:1 method at end of clay layer	T/m ²	ΔP _c	0.49	1.02	2.36
Settlement from Fig 9 of IS8009, for 1Kg/cm ² or 10 T/m ²	mm	S _u	5.58	5.58	5.58
Corrected Settlement due to Water Table for 1Kg/cm ² or 10 T/m ²	mm	S _u '=S _u /W'	11.16	11.16	11.16
Settlement for the granular layer due to pressure intensity at end of clay layer	mm	S _g =S _u '*ΔP _c /10	0.54684	1.13832	2.63376
Corrected Settlement Total					
If clay layer is resting on cohesionless soil layer then value of λ should be taken as 0.85		λ	0.85	0.85	0.85
Correction factor for depth		Def	0.91	0.8	0.73
Correction factor for rigidity		Rf	1	1	1
Total Settlement after correction (Consolidation Settlement+ Settlement for the granular layer)	mm	S _c =s _c *λ*Def*Rf + S _g	48.920	49.329	49.230
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	S _a	50	50	50
Check whether observed settlement is within permissible limits			OK	OK	OK
Net Safe Bearing Capacity (Settlement Criteria)	T/m ²	SBC=Load/BL	2.89	4.44	7.22
Safe Bearing Pressure (Without risk of Shear failure or excessive settlement)	T/m²	SBP	2.890	4.440	7.220

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STEP 1 : SBC BASED ON SHEAR CRITERIA					
Parameters	Unit	Denotation	1	2	3
Bore Hole Number		BH	26	26	26
SPT N Value at end of compressible zone		N	50	50	50
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	3	3	3
Width of Foundation	m	B	3	3	3
Saturated density of soil	kg/cm ³	γ _{sat}	0.00177	0.00177	0.00177
Submerged density of soil	kg/cm ³	γ'	0.00077	0.00077	0.00077
Overburden Pressure	kg/cm ²	γ x Df	0.177	0.354	0.531
	kg/cm ²	B x γ	0.231	0.231	0.231
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.45	0.45	0.45
Angle of Internal Friction for General Shear	Degrees	φ	0	0	0
Angle of Internal Friction for Local Shear	Degrees	φ'	0.00	0.00	0.00
Initial void ratio		e ₀	0.81	0.81	0.81
Column load coming on to footing (Unfactored Load)	Tons	Load	28.00	48.00	99.00
Depth of Clay layer from ground level	m	H _{clay}	4.50	4.50	4.50
Depth of clay layer from base of footing	m	H	3.50	2.50	1.50
Bearing Capacity factors for local shear failure		N _c '	1.000	1.000	1.000
		N _q '	5.140	5.140	5.140
		N _γ '	1.000	1.000	1.000
Shape Factors		S _c	0.000	0.000	0.000
		S _q	1.3	1.3	1.3
		S _γ	1.2	1.2	1.2
Depth Factors		D _c	0.8	0.8	0.8
		D _q	1.067	1.133	1.200
		D _γ	1.000	1.000	1.000
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67 * C * N_c' * S_c * D_c + q (N_q' - 1) * S_q * D_q + 0.5 * B * N_γ' * S_γ * D_γ * W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Q_d'	2.149	2.283	2.418
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Q_d/FOS)	8.600	9.130	9.670
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
Consolidation Settlement for Clayey Soil Layers					
Height of compressible zone from influence zone	m	H	3.50	2.50	1.50
Compression Index C _c =0.3*(e ₀ -0.27)		C _c	0.162	0.162	0.162
Initial Pressure at the centre of influence zone	T/m ²	P ₀	2.118	2.503	2.888
Additional pressure intensity 2:1 method at mid of clay layer	T/m ²	ΔP	1.241	2.657	7.040
Consolidation Settlement	mm	s _c	62.753	70.320	72.003
Settlement criteria for for Sandy Soil Layers					
Pressure intensity 2:1 method at end of clay layer	T/m ²	ΔP _c	0.66	1.59	4.89
Settlement from Fig 9 of IS8009, for 1Kg/cm ² or 10 T/m ²	mm	S _u	5.14	5.14	5.14
Corrected Settlement due to Water Table for 1Kg/cm ² or 10 T/m ²	mm	S _u '=S _u /W'	10.28	10.28	10.28
Settlement for the granular layer due to pressure intensity at end of clay layer	mm	S _g =S _u '*ΔP _c /10	0.67848	1.63452	5.02692
Corrected Settlement Total					
If clay layer is resting on cohesionless soil layer then value of λ should be taken as 0.85		λ	0.85	0.85	0.85
Correction factor for depth		Def	0.91	0.8	0.73
Correction factor for rigidity		Rf	1	1	1
Total Settlement after correction (Consolidation Settlement+ Settlement for the granular layer)	mm	S _c =s _c *λ*Def*Rf + S _g	49.220	49.452	49.700
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	S _a	50	50	50
Check whether observed settlement is within permissible limits			OK	OK	OK
Net Safe Bearing Capacity (Settlement Criteria)	T/m ²	SBC=Load/BL	3.11	5.33	11
Safe Bearing Pressure (Without risk of Shear failure or excessive settlement)	T/m ²	SBP	3.110	5.330	9.670

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STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	27	27	27
SPT N Value		N	8	8	16
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	3	3	3
Width of Foundation	m	B	3	3	3
Saturated density of soil	kg/cm ³	γ _{sat}	0.0017	0.0017	0.0017
Submerged density of soil	kg/cm ³	γ'	0.0017	0.0017	0.0017
Overburden Pressure	kg/cm ²	γ x Df	0.17	0.34	0.51
	kg/cm ²	B x γ	0.51	0.51	0.51
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.22	0.22	0.22
Angle of Internal Friction for General Shear	Degrees	φ	26.24	26.24	26.24
Angle of Internal Friction for Local Shear	Degrees	φ'	18.27	18.27	18.27
Nφ			2.585	2.585	2.585
Bearing Capacity factors for local shear failure		Nc'	13.464	13.464	13.464
		Nq'	5.547	5.547	5.547
		Nγ'	4.440	4.440	4.440
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sγ	0.8	0.8	0.8
Depth Factors		Dc	1.107	1.214	1.322
		Dq	1.054	1.107	1.161
		Dγ	1.054	1.107	1.161
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Nγ' * Sy *Dγ*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	4.311	5.689	7.166
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	17.240	22.750	28.660
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
<i>SBC based on settlement criteria for for Sandy Soil Layers</i>					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	58.2	58.2	19.56
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	116.4	116.4	39.12
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	50	50	50
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	0.430	0.430	1.278
Safe Bearing Pressure for 50mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	4.296	4.296	12.781
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	4.300	4.300	12.780

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Safe Bearing Capacity (SBC) Calculation for 3m x 3m Square Foundation – Jabalpur Site (BH-28)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	28	28	28
SPT N Value		N	14	14	31
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	3	3	3
Width of Foundation	m	B	3	3	3
Saturated density of soil	kg/cm ³	γ _{sat}	0.00177	0.00177	0.00177
Submerged density of soil	kg/cm ³	γ'	0.00177	0.00177	0.00177
Overburden Pressure	kg/cm ²	γ x Df	0.177	0.354	0.531
	kg/cm ²	B x γ	0.531	0.531	0.531
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.21	0.21	0.21
Angle of Internal Friction for General Shear	Degrees	φ	27.74	27.74	27.74
Angle of Internal Friction for Local Shear	Degrees	φ'	19.40	19.40	19.40
Nφ			2.742	2.742	2.742
Bearing Capacity factors for local shear failure		Nc'	14.357	14.357	14.357
		Nq'	6.105	6.105	6.105
		Ny'	5.061	5.061	5.061
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sy	0.8	0.8	0.8
Depth Factors		Dc	1.110	1.221	1.331
		Dq	1.055	1.110	1.166
		Dy	1.055	1.110	1.166
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Ny' * Sy *Dy*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	4.627	6.210	7.913
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	18.510	24.840	31.650
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
SBC based on settlement criteria for for Sandy Soil Layers					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	22.78	22.78	8.68
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	45.56	45.56	17.36
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	50	50	50
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	1.097	1.097	2.880
Safe Bearing Pressure for 50mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	10.975	10.975	28.802
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	10.970	10.970	28.800

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Safe Bearing Capacity (SBC) Calculation for 3m x 3m Square Foundation – Jabalpur Site (BH-29)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	29	29	29
SPT N Value		N	12	12	19
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	3	3	3
Width of Foundation	m	B	3	3	3
Saturated density of soil	kg/cm ³	γ _{sat}	0.00174	0.00174	0.00174
Submerged density of soil	kg/cm ³	γ'	0.00174	0.00174	0.00174
Overburden Pressure	kg/cm ²	γ x Df	0.174	0.348	0.522
	kg/cm ²	B x γ	0.522	0.522	0.522
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.22	0.22	0.22
Angle of Internal Friction for General Shear	Degrees	φ	28.3	28.3	28.3
Angle of Internal Friction for Local Shear	Degrees	φ'	19.83	19.83	19.83
Nφ			2.803	2.803	2.803
Bearing Capacity factors for local shear failure		Nc'	14.693	14.693	14.693
		Nq'	6.315	6.315	6.315
		Nγ'	5.295	5.295	5.295
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sγ	0.8	0.8	0.8
Depth Factors		Dc	1.112	1.223	1.335
		Dq	1.056	1.112	1.167
		Dγ	1.056	1.112	1.167
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Nγ' * Sγ *Dγ*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	4.885	6.526	8.290
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	19.540	26.100	33.160
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
SBC based on settlement criteria for for Sandy Soil Layers					
Settlement from Fig 9 of IS8009, for 1Kg/cm2	mm	Su	28.11	28.11	16.12
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	56.22	56.22	32.24
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	50	50	50
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	0.889	0.889	1.551
Safe Bearing Pressure for 50mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	8.894	8.894	15.509
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	8.890	8.890	15.510

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**17.1.2 RAFT FOUNDATION
SIZE OF FOUNDATION- 10M X 10M**

Safe Bearing Capacity (SBC) Calculation for 10m x 10m Square Raft – Jabalpur Site (BH-25)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
Parameters	Unit	Denotion	1 Calculation 1	2 Calculation 2	3 Calculation 3
Bore Hole Number		BH	25	25	25
SPT N Value at end of compressible zone		N	47	47	47
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	10	10	10
Width of Foundation	m	B	10	10	10
Saturated density of soil	kg/cm ³	γ _{sat}	0.00172	0.00172	0.00172
Submerged density of soil	kg/cm ³	γ'	0.00072	0.00072	0.00072
Overburden Pressure	kg/cm ²	γ x Df	0.172	0.344	0.516
	kg/cm ²	B x γ	0.72	0.72	0.72
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.48	0.48	0.48
Angle of Internal Friction for General Shear	Degrees	φ	0	0	0
Angle of Internal Friction for Local Shear	Degrees	φ'	0.00	0.00	0.00
Initial void ratio		e ₀	0.84	0.84	0.84
Column load coming on to footing (Unfactored Load)	Tons	Load	290.00	470.00	840.00
Depth of Clay layer from ground level	m	H _{clay}	5.25	5.25	5.25
Depth of clay layer from base of footing	m	H	4.25	3.25	2.25
N ₆₀			1.000	1.000	1.000
Bearing Capacity factors for local shear failure		N _c '	5.140	5.140	5.140
		N _q '	1.000	1.000	1.000
		N _γ '	0.000	0.000	0.000
Shape Factors		S _c	1.3	1.3	1.3
		S _q	1.2	1.2	1.2
		S _γ	0.8	0.8	0.8
Depth Factors		D _c	1.020	1.040	1.060
		D _q	1.000	1.000	1.000
		D _γ	1.000	1.000	1.000
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67 * C * N _c ' * S _c * D _c + q (N _q ' - 1) * S _q * D _q + 0.5 * B * N _γ ' * S _γ * D _γ * W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Q _d '	2.192	2.235	2.278
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Q _d /FOS)	8.770	8.940	9.110
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
Consolidation Settlement for Clayey Soil Layers					
Height of compressible zone from influence zone	m	H	4.25	3.25	2.25
Compression Index C _c =0.3*(e ₀ -0.27)		C _c	0.171	0.171	0.171
Initial Pressure at the centre of influence zone	T/m ²	P ₀	2.250	2.610	2.970
Additional pressure intensity 2:1 method at mid of clay layer	T/m ²	ΔP	1.973	3.478	6.787
Consolidation Settlement	mm	sc	107.984	111.097	108.015
Settlement criteria for for Sandy Soil Layers					
Pressure intensity 2:1 method at end of clay layer	T/m ²	ΔP _c	1.43	2.68	5.6
Settlement from Fig 9 of IS8009, for 1Kg/cm ² or 10 T/m ²	mm	S _u	6.01	6.01	6.01
Corrected Settlement due to Water Table for 1Kg/cm ² or 10 T/m ²	mm	S _u '=S _u /W'	12.02	12.02	12.02
Settlement for the granular layer due to pressure intensity at end of clay layer	mm	S _g =S _u '*ΔP _c /10	1.71886	3.22136	6.7312
Corrected Settlement Total					
If clay layer is resting on cohesionless soil layer then value of λ should be taken as 0.85		λ	0.85	0.85	0.85
Correction factor for depth		Def	0.98	0.95	0.92
Correction factor for rigidity		Rf	0.8	0.8	0.8
Total Settlement after correction (Consolidation Settlement+ Settlement for the granular layer)	mm	S _c =sc*λ*Def*Rf + S _g	73.680	74.990	74.310
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	S _a	75	75	75
Check whether observed settlement is within permissible limits			OK	OK	OK
Net Safe Bearing Capacity (Settlement Criteria)	T/m ²	SBC=Load/BL	2.90	4.7	8.4
Safe Bearing Pressure (Without risk of Shear failure or excessive settlement)	T/m ²	SBP	2.900	4.700	8.400

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Safe Bearing Capacity (SBC) Calculation for 10m × 10m Square Raft – Jabalpur Site (BH-26)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
Parameters	Unit	Denotation	1	2	3
Bore Hole Number		BH	26	26	26
SPT N Value at end of compressible zone		N	50	50	50
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	10	10	10
Width of Foundation	m	B	10	10	10
Saturated density of soil	kg/cm ³	γ _{sat}	0.00177	0.00177	0.00177
Submerged density of soil	kg/cm ³	γ'	0.00077	0.00077	0.00077
Overburden Pressure	kg/cm ²	γ x Df	0.177	0.354	0.531
	kg/cm ²	B x γ	0.77	0.77	0.77
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.45	0.45	0.45
Angle of Internal Friction for General Shear	Degrees	φ	0	0	0
Angle of Internal Friction for Local Shear	Degrees	φ'	0.00	0.00	0.00
Initial void ratio		e ₀	0.81	0.81	0.81
Column load coming on to footing (Unfactored Load)	Tons	Load	360.00	650.00	1500.00
Depth of Clay layer from ground level	m	H _{clay}	4.50	4.50	4.50
Depth of clay layer from base of footing	m	H	3.50	2.50	1.50
N _φ			1.000	1.000	1.000
Bearing Capacity factors for local shear failure		N _c '	5.140	5.140	5.140
		N _q '	1.000	1.000	1.000
		N _γ '	0.000	0.000	0.000
Shape Factors		S _c	1.3	1.3	1.3
		S _q	1.2	1.2	1.2
		S _γ	0.8	0.8	0.8
Depth Factors		D _c	1.020	1.040	1.060
		D _q	1.000	1.000	1.000
		D _γ	1.000	1.000	1.000
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67 * C * N_c' * S_c * D_c + q (N_q' - 1) * S_q * D_q + 0.5 * B * N_γ' * S_γ * D_γ * W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Q_d'	2.055	2.095	2.136
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Q_d/FOS)	8.220	8.380	8.540
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
Consolidation Settlement for Clayey Soil Layers					
Height of compressible zone from influence zone	m	H	3.50	2.50	1.50
Compression Index C _c =0.3*(e ₀ -0.27)		C _c	0.162	0.162	0.162
Initial Pressure at the centre of influence zone	T/m ²	P ₀	2.118	2.503	2.888
Additional pressure intensity 2:1 method at mid of clay layer	T/m ²	ΔP	2.608	5.136	12.980
Consolidation Settlement	mm	sc	109.196	108.438	99.346
Settlement criteria for for Sandy Soil Layers					
Pressure intensity 2:1 method at end of clay layer	T/m ²	ΔP _c	1.98	4.16	11.34
Settlement from Fig 9 of IS8009, for 1Kg/cm ² or 10 T/m ²	mm	S _u	5.59	5.59	5.59
Corrected Settlement due to Water Table for 1Kg/cm ² or 10 T/m ²	mm	S _u '=S _u /W'	11.18	11.18	11.18
Settlement for the granular layer due to pressure intensity at end of clay layer	mm	S _g =S _u '*ΔP _c /10	2.21364	4.65088	12.67812
Corrected Settlement Total					
If clay layer is resting on cohesionless soil layer then value of λ should be taken as 0.85		λ	0.85	0.85	0.85
Correction factor for depth		D _{ef}	0.98	0.95	0.92
Correction factor for rigidity		R _f	0.8	0.8	0.8
Total Settlement after correction (Consolidation Settlement+ Settlement for the granular layer)	mm	S _c =s _c *λ*D _{ef} *R _f + S _g	74.980	74.702	74.830
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	S _a	75	75	75
Check whether observed settlement is within permissible limits			OK	OK	OK
Net Safe Bearing Capacity (Settlement Criteria)	T/m ²	SBC=Load/BL	3.60	6.5	15
Safe Bearing Pressure (Without risk of Shear failure or excessive settlement)	T/m ²	SBP	3.600	6.500	8.540

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Safe Bearing Capacity (SBC) Calculation for 10m x 10m Square Raft – Jabalpur Site (BH-27)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
Parameters	Unit	Denotion	1	2	3
Bore Hole Number		BH	27	27	27
SPT N Value		N	8	8	16
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	10	10	10
Width of Foundation	m	B	10	10	10
Saturated density of soil	kg/cm ³	γ _{sat}	0.0017	0.0017	0.0017
Submerged density of soil	kg/cm ³	γ'	0.0017	0.0017	0.0017
Overburden Pressure	kg/cm ²	γ x Df	0.17	0.34	0.51
	kg/cm ²	B x γ	1.7	1.7	1.7
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.22	0.22	0.22
Angle of Internal Friction for General Shear	Degrees	φ	26.24	26.24	26.24
Angle of Internal Friction for Local Shear	Degrees	φ'	18.27	18.27	18.27
Nφ			2.585	2.585	2.585
Bearing Capacity factors for local shear failure		Nc'	13.464	13.464	13.464
		Nq'	5.547	5.547	5.547
		Ny'	4.440	4.440	4.440
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sy	0.8	0.8	0.8
Depth Factors		Dc	1.032	1.064	1.096
		Dq	1.016	1.032	1.048
		Dy	1.016	1.032	1.048
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Ny'*Sy*Dy*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	5.139	6.219	7.328
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	20.560	24.880	29.310
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
<i>SBC based on settlement criteria for for Sandy Soil Layers</i>					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	62.63	62.63	21.7
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	125.26	125.26	43.4
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	75	75	75
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	0.599	0.599	1.728
Safe Bearing Pressure for 75mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	5.988	5.988	17.281
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	5.990	5.990	17.280

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Safe Bearing Capacity (SBC) Calculation for 10m x 10m Square Raft – Jabalpur Site (BH-28)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	28	28	28
SPT N Value		N	14	14	31
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	10	10	10
Width of Foundation	m	B	10	10	10
Saturated density of soil	kg/cm ³	γ _{sat}	0.00177	0.00177	0.00177
Submerged density of soil	kg/cm ³	γ'	0.00177	0.00177	0.00177
Overburden Pressure	kg/cm ²	γ x Df	0.177	0.354	0.531
	kg/cm ²	B x γ	1.77	1.77	1.77
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.21	0.21	0.21
Angle of Internal Friction for General Shear	Degrees	φ	27.74	27.74	27.74
Angle of Internal Friction for Local Shear	Degrees	φ'	19.40	19.40	19.40
Nφ			2.742	2.742	2.742
Bearing Capacity factors for local shear failure		Nc'	14.357	14.357	14.357
		Nq'	6.105	6.105	6.105
		Nγ'	5.061	5.061	5.061
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sγ	0.8	0.8	0.8
Depth Factors		Dc	1.033	1.066	1.099
		Dq	1.017	1.033	1.050
		Dγ	1.017	1.033	1.050
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Nγ' * Sγ *Dγ*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	5.636	6.891	8.182
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	22.550	27.560	32.730
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
<i>SBC based on settlement criteria for for Sandy Soil Layers</i>					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	24.62	24.62	9.8
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	49.24	49.24	19.6
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	75	75	75
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	1.523	1.523	3.827
Safe Bearing Pressure for 75mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	15.232	15.232	38.265
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	15.230	15.230	32.730

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Safe Bearing Capacity (SBC) Calculation for 10m x 10m Square Raft – Jabalpur Site (BH-29)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
Parameters	Unit	Denotion	1	2	3
			Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	29	29	29
SPT N Value		N	12	12	19
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	10	10	10
Width of Foundation	m	B	10	10	10
Saturated density of soil	kg/cm ³	γ _{sat}	0.00174	0.00174	0.00174
Submerged density of soil	kg/cm ³	γ'	0.00174	0.00174	0.00174
Overburden Pressure	kg/cm ²	γ x Df	0.174	0.348	0.522
	kg/cm ²	B x γ	1.74	1.74	1.74
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.22	0.22	0.22
Angle of Internal Friction for General Shear	Degrees	φ	28.3	28.3	28.3
Angle of Internal Friction for Local Shear	Degrees	φ'	19.83	19.83	19.83
Nφ			2.803	2.803	2.803
Bearing Capacity factors for local shear failure		Nc'	14.693	14.693	14.693
		Nq'	6.315	6.315	6.315
		Ny'	5.295	5.295	5.295
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sy	0.8	0.8	0.8
Depth Factors		Dc	1.033	1.067	1.100
		Dq	1.017	1.033	1.050
		Dy	1.017	1.033	1.050
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Ny' * Sy *Dy*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	5.911	7.202	8.530
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd/FOS)	23.650	28.810	34.120
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
SBC based on settlement criteria for for Sandy Soil Layers					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	29.74	29.74	18.3
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	59.48	59.48	36.6
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	75	75	75
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	1.261	1.261	2.049
Safe Bearing Pressure for 75mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	12.609	12.609	20.492
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	12.610	12.610	20.490

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SIZE OF FOUNDATION- 15M X 15M

Safe Bearing Capacity (SBC) Calculation for 15m x 15m Square Raft – Jabalpur Site (BH-25)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
Parameters	Unit	Denotion	1	2	3
			Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	25	25	25
SPT N Value at end of compressible zone		N	47	47	47
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	15	15	15
Width of Foundation	m	B	15	15	15
Saturated density of soil	kg/cm ³	γ _{sat}	0.00172	0.00172	0.00172
Submerged density of soil	kg/cm ³	γ'	0.00072	0.00072	0.00072
Overburden Pressure	kg/cm ²	γ x Df	0.172	0.344	0.516
	kg/cm ²	B x γ	1.08	1.08	1.08
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.48	0.48	0.48
Angle of Internal Friction for General Shear	Degrees	φ	0	0	0
Angle of Internal Friction for Local Shear	Degrees	φ'	0.00	0.00	0.00
Initial void ratio		e ₀	0.84	0.84	0.84
Column load coming on to footing (Unfactored Load)	Tons	Load	580.00	920.00	1660.00
Depth of Clay layer from ground level	m	H _{clay}	5.25	5.25	5.25
Depth of clay layer from base of footing	m	H	4.25	3.25	2.25
N _φ			1.000	1.000	1.000
Bearing Capacity factors for local shear failure		N _c '	5.140	5.140	5.140
		N _q '	1.000	1.000	1.000
		N _γ '	0.000	0.000	0.000
Shape Factors		S _c	1.3	1.3	1.3
		S _q	1.2	1.2	1.2
		S _γ	0.8	0.8	0.8
Depth Factors		D _c	1.013	1.027	1.040
		D _q	1.000	1.000	1.000
		D _γ	1.000	1.000	1.000
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67 * C * N_c' * S_c * D_c + q (N_q' - 1) * S_q * D_q + 0.5 * B * N_γ' * S_γ * D_γ * W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Q _d '	2.178	2.206	2.235
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Q _d /FOS)	8.710	8.820	8.940
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
Consolidation Settlement for Clayey Soil Layers					
Height of compressible zone from influence zone	m	H	4.25	3.25	2.25
Compression Index C _c =0.3*(e ₀ -0.27)		C _c	0.171	0.171	0.171
Initial Pressure at the centre of influence zone	T/m ²	P ₀	2.250	2.610	2.970
Additional pressure intensity 2:1 method at mid of clay layer	T/m ²	ΔP	1.978	3.329	6.384
Consolidation Settlement	mm	s _c	108.193	107.841	104.186
Settlement criteria for for Sandy Soil Layers					
Pressure intensity 2:1 method at end of clay layer	T/m ²	ΔP _c	1.57	2.76	5.58
Settlement from Fig 9 of IS8009, for 1Kg/cm ² or 10 T/m ²	mm	S _u	6.01	6.01	6.01
Corrected Settlement due to Water Table for 1Kg/cm ² or 10 T/m ²	mm	S _u '=S _u /W'	12.02	12.02	12.02
Settlement for the granular layer due to pressure intensity at end of clay layer	mm	S _g =S _u '*ΔP _c /10	1.88714	3.31752	6.70716
Corrected Settlement Total					
If clay layer is resting on cohesionless soil layer then value of λ should be taken as 0.85		λ	0.85	0.85	0.85
Correction factor for depth		Def	0.99	0.97	0.95
Correction factor for rigidity		Rf	0.8	0.8	0.8
Total Settlement after correction (Consolidation Settlement+ Settlement for the granular layer)	mm	S _c =s _c *λ*Def*Rf + S _g	74.720	74.449	74.010
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	S _a	75	75	75
Check whether observed settlement is within permissible limits			OK	OK	OK
Net Safe Bearing Capacity (Settlement Criteria)	T/m ²	SBC=Load/BL	2.58	4.09	7.38
Safe Bearing Pressure (Without risk of Shear failure or excessive settlement)	T/m ²	SBP	2.580	4.090	7.380

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Safe Bearing Capacity (SBC) Calculation for 15m x 15m Square Raft – Jabalpur Site (BH-26)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
Parameters	Unit	Denotation	1	2	3
Bore Hole Number		BH	26	26	26
SPT N Value at end of compressible zone		N	50	50	50
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	15	15	15
Width of Foundation	m	B	15	15	15
Saturated density of soil	kg/cm ³	γ _{sat}	0.00177	0.00177	0.00177
Submerged density of soil	kg/cm ³	γ'	0.00077	0.00077	0.00077
Overburden Pressure	kg/cm ²	γ x Df	0.177	0.354	0.531
	kg/cm ²	B x γ	1.155	1.155	1.155
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.45	0.45	0.45
Angle of Internal Friction for General Shear	Degrees	φ	0	0	0
Angle of Internal Friction for Local Shear	Degrees	φ'	0.00	0.00	0.00
Initial void ratio		e ₀	0.81	0.81	0.81
Column load coming on to footing (Unfactored Load)	Tons	Load	710.00	1300.00	3000.00
Depth of Clay layer from ground level	m	H _{clay}	4.50	4.50	4.50
Depth of clay layer from base of footing	m	H	3.50	2.50	1.50
Bearing Capacity factors for local shear failure		N _c '	1.000	1.000	1.000
		N _q '	5.140	5.140	5.140
		N _γ '	1.000	1.000	1.000
Shape Factors		S _c	1.3	1.3	1.3
		S _q	1.2	1.2	1.2
		S _γ	0.8	0.8	0.8
Depth Factors		D _c	1.013	1.027	1.040
		D _q	1.000	1.000	1.000
		D _γ	1.000	1.000	1.000
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67 * C * N_c' * S_c * D_c + q (N_q' - 1) * S_q * D_q + 0.5 * B * N_γ' * S_γ * D_γ * W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Q_d'	2.041	2.068	2.095
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Q_d/FOS)	8.170	8.270	8.380
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
Consolidation Settlement for Clayey Soil Layers					
Height of compressible zone from influence zone	m	H	3.50	2.50	1.50
Compression Index C _c =0.3*(e ₀ -0.27)		C _c	0.162	0.162	0.162
Initial Pressure at the centre of influence zone	T/m ²	P ₀	2.118	2.503	2.888
Additional pressure intensity 2:1 method at mid of clay layer	T/m ²	ΔP	2.531	4.923	12.094
Consolidation Settlement	mm	s _c	106.964	105.693	95.995
Settlement criteria for for Sandy Soil Layers					
Pressure intensity 2:1 method at end of clay layer	T/m ²	ΔP _c	2.07	4.24	11.02
Settlement from Fig 9 of IS8009, for 1Kg/cm ² or 10 T/m ²	mm	S _u	5.59	5.59	5.59
Corrected Settlement due to Water Table for 1Kg/cm ² or 10 T/m ²	mm	S _u '=S _u /W'	11.18	11.18	11.18
Settlement for the granular layer due to pressure intensity at end of clay layer	mm	S _g =S _u '*ΔP _c /10	2.31426	4.74032	12.32036
Corrected Settlement Total					
If clay layer is resting on cohesionless soil layer then value of λ should be taken as 0.85		λ	0.85	0.85	0.85
Correction factor for depth		Def	0.99	0.97	0.95
Correction factor for rigidity		Rf	0.8	0.8	0.8
Total Settlement after correction (Consolidation Settlement+ Settlement for the granular layer)	mm	S _c =s _c *λ*Def*Rf + S _g	74.320	74.455	74.330
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	S _a	75	75	75
Check whether observed settlement is within permissible limits			OK	OK	OK
Net Safe Bearing Capacity (Settlement Criteria)	T/m ²	SBC=Load/BL	3.16	5.78	13.33
Safe Bearing Pressure (Without risk of Shear failure or excessive settlement)	T/m ²	SBP	3.160	5.780	8.380

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Safe Bearing Capacity (SBC) Calculation for 15m x 15m Square Raft – Jabalpur Site (BH-27)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotation	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	27	27	27
SPT N Value		N	8	8	16
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	15	15	15
Width of Foundation	m	B	15	15	15
Saturated density of soil	kg/cm ³	γ _{sat}	0.0017	0.0017	0.0017
Submerged density of soil	kg/cm ³	γ'	0.0017	0.0017	0.0017
Overburden Pressure	kg/cm ²	γ x Df	0.17	0.34	0.51
	kg/cm ²	B x γ	2.55	2.55	2.55
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.22	0.22	0.22
Angle of Internal Friction for General Shear	Degrees	φ	26.24	26.24	26.24
Angle of Internal Friction for Local Shear	Degrees	φ'	18.27	18.27	18.27
Nφ			2.585	2.585	2.585
Bearing Capacity factors for local shear failure		Nc'	13.464	13.464	13.464
		Nq'	5.547	5.547	5.547
		Nγ'	4.440	4.440	4.440
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sγ	0.8	0.8	0.8
Depth Factors		Dc	1.021	1.043	1.064
		Dq	1.011	1.021	1.032
		Dγ	1.011	1.021	1.032
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Nγ' * Sγ *Dγ*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	5.862	6.899	7.955
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	23.450	27.590	31.820
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
<i>SBC based on settlement criteria for for Sandy Soil Layers</i>					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	62.63	62.63	21.7
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	125.26	125.26	43.4
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	75	75	75
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	0.599	0.599	1.728
Safe Bearing Pressure for 75mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	5.988	5.988	17.281
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	5.990	5.990	17.280

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Safe Bearing Capacity (SBC) Calculation for 15m x 15m Square Raft – Jabalpur Site (BH-28)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	28	28	28
SPT N Value		N	14	14	31
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	15	15	15
Width of Foundation	m	B	15	15	15
Saturated density of soil	kg/cm ³	γ _{sat}	0.00177	0.00177	0.00177
Submerged density of soil	kg/cm ³	γ'	0.00177	0.00177	0.00177
Overburden Pressure	kg/cm ²	γ x Df	0.177	0.354	0.531
	kg/cm ²	B x γ	2.655	2.655	2.655
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.21	0.21	0.21
Angle of Internal Friction for General Shear	Degrees	φ	27.74	27.74	27.74
Angle of Internal Friction for Local Shear	Degrees	φ'	19.40	19.40	19.40
Nφ			2.742	2.742	2.742
Bearing Capacity factors for local shear failure		Nc'	14.357	14.357	14.357
		Nq'	6.105	6.105	6.105
		Nγ'	5.061	5.061	5.061
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sγ	0.8	0.8	0.8
Depth Factors		Dc	1.022	1.044	1.066
		Dq	1.011	1.022	1.033
		Dγ	1.011	1.022	1.033
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Nγ' * Sγ *Dγ*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	6.497	7.705	8.937
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	25.990	30.820	35.750
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
<i>SBC based on settlement criteria for for Sandy Soil Layers</i>					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	24.62	24.62	9.8
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	49.24	49.24	19.6
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	75	75	75
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	1.523	1.523	3.827
Safe Bearing Pressure for 75mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	15.232	15.232	38.265
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	15.230	15.230	35.750

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Safe Bearing Capacity (SBC) Calculation for 15m x 15m Square Raft – Jabalpur Site (BH-29)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	29	29	29
SPT N Value		N	12	12	19
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	15	15	15
Width of Foundation	m	B	15	15	15
Saturated density of soil	kg/cm ³	γ _{sat}	0.00174	0.00174	0.00174
Submerged density of soil	kg/cm ³	γ'	0.00174	0.00174	0.00174
Overburden Pressure	kg/cm ²	γ x Df	0.174	0.348	0.522
	kg/cm ²	B x γ	2.61	2.61	2.61
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.22	0.22	0.22
Angle of Internal Friction for General Shear	Degrees	φ	28.3	28.3	28.3
Angle of Internal Friction for Local Shear	Degrees	φ'	19.83	19.83	19.83
Nφ			2.803	2.803	2.803
Bearing Capacity factors for local shear failure		Nc'	14.693	14.693	14.693
		Nq'	6.315	6.315	6.315
		Nγ'	5.295	5.295	5.295
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sγ	0.8	0.8	0.8
Depth Factors		Dc	1.022	1.045	1.067
		Dq	1.011	1.022	1.033
		Dγ	1.011	1.022	1.033
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Nγ' * Sγ *Dγ*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	6.795	8.036	9.301
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	27.180	32.140	37.200
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
<i>SBC based on settlement criteria for for Sandy Soil Layers</i>					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	29.74	29.74	18.3
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	59.48	59.48	36.6
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	75	75	75
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	1.261	1.261	2.049
Safe Bearing Pressure for 75mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	12.609	12.609	20.492
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	12.610	12.610	20.490

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



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WORK-7

**PROVN OF SINGLE MEN BARRACK FOR AGNIVEERS AT JAK
RIF REGIMENTAL CENTRE, JABALPUR**

(BH-30 TO BH-34)

**SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR,
MADHYA PRADESH**



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15.2 LOG OF BOREHOLE, BH-30

BOREHOLE NO.		30		DATE OF DRILLING		11.08.2025		TERMINAL DEPTH (M)		15.00		WATER TABLE (M)		4.50	
Location		BH-01 [JAK RIF] 23°08'16"N 79°56'39"E													
DEPTH	M	OBSERVED N VALUE	CORRECTED N VALUE	SAMPLE TYPE	SAMPLE DEPTH IN M	DESCRIPTION OF STRATA	LOG	IS SOIL CLASSIFICATION	STANDARD PENETRATION RESISTANCE CURVE						
									Observed N Value	Corrected N Value					
0.00		-	-	-	-	CLAYEY SAND		SC	0.0	0	0	0			
1.50		33	36	SPT-1	1.50-1.95				1.0	20	25	20			
2.25				UDS-1	2.25-2.70				2.0	30	35	30			
3.00		28	29	SPT-2	3.00-3.45				3.0	35	40	35			
4.50		21	22	SPT-3	4.50-4.95	SILTY SAND		SM	4.0	45	50	45			
5.25				UDS-2	5.25-5.70				5.0	50	55	50			
6.00		28	24	SPT-4	6.00-6.45				6.0	60	65	60			
7.50		42	32	SPT-5	7.50-7.95				8.0	70	75	70			
9.00		62	42	SPT-6	9.00-9.45				9.0	80	85	80			
10.50		50 REF	35	SPT-7	10.50-10.95				10.0	90	95	90			
12.00		50 REF	33	SPT-8	12.00-12.28				11.0	100	105	100			
13.50		50 REF	32	SPT-9	13.50-13.75				12.0	110	115	110			
15.00		50 REF	49	SPT-10	15.00-15.14	POORLY GRADED GRAVEL		GP	14.0	120	125	120			
									15.0	130	135	130			

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



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LOG OF BOREHOLE, BH-31

BOREHOLE NO.		31		DATE OF DRILLING		15.08.2025		TERMINAL DEPTH (M)		15.00		WATER TABLE (M)		5.60	
Location		BH-02 [JAK RIF] 23°08'16"N 79°56'38"E													
DEPTH M	OBSERVED N VALUE	CORRECTED N VALUE	SAMPLE TYPE	SAMPLE DEPTH IN M	DESCRIPTION OF STRATA	LOG	IS SOIL CLASSIFICATION	STANDARD PENETRATION RESISTANCE CURVE							
								Observed N Value	Corrected N Value						
0.00	-	-	-	-	CLAYEY SAND		SC								
1.50	22	27	SPT-1	1.50-1.95											
2.25			UDS-1	2.25-2.70											
3.00	33	33	SPT-2	3.00-3.45											
4.50	50 REF	43	SPT-3	4.50-4.95											
5.25			UDS-2	5.25-5.70	SILTY SAND	SM									
6.00	50 REF	38	SPT-4	6.00-6.45											
7.50	50 REF	37	SPT-5	7.50-7.95											
9.00	50 REF	36	SPT-6	9.00-9.45											
10.50	50 REF	35	SPT-7	10.50-10.95											
12.00	50 REF	33	SPT-8	12.00-12.28											
13.50	50 REF	50	SPT-9	13.50-13.75	POORLY GRADED GRAVEL	GP									
15.00	50 REF	49	SPT-10	15.00-15.14											

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



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LOG OF BOREHOLE, BH-32

BOREHOLE NO.		32		DATE OF DRILLING		16.08.2025		TERMINAL DEPTH (M)		15.00		WATER TABLE (M)		6.00	
Location		BH-03 [JAK RIF] 23°08'14"N 79°56'38"E													
DEPTH	M	OBSERVED N VALUE	CORRECTED N VALUE	SAMPLE TYPE	SAMPLE DEPTH IN M	DESCRIPTION OF STRATA	LOG	IS SOIL CLASSIFICATION	STANDARD PENETRATION RESISTANCE CURVE						
									Observed N Value	Corrected N Value					
0.00		-	-	-	-	CLAYEY SAND		SC							
1.50		13	19	SPT-1	1.50-1.95										
2.25				UDS-1	2.25-2.70										
3.00		32	33	SPT-2	3.00-3.45										
4.50		17	19	SPT-3	4.50-4.95										
5.25				UDS-2	5.25-5.70	SILTY SAND		SM							
6.00		32	27	SPT-4	6.00-6.45										
7.50		50 REF	37	SPT-5	7.50-7.95										
9.00		50 REF	36	SPT-6	9.00-9.45										
10.50		50 REF	35	SPT-7	10.50-10.95										
12.00		50 REF	33	SPT-8	12.00-12.28										
13.50		50 REF	50	SPT-9	13.50-13.75	POORLY GRADED GRAVEL		GP							
15.00		50 REF	49	SPT-10	15.00-15.14										

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



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LOG OF BOREHOLE, BH-33

BOREHOLE NO.		33		DATE OF DRILLING		17.08.2025		TERMINAL DEPTH (M)		15.00		WATER TABLE (M)		5.90	
Location		BH-04 [JAK RIF] 23°08'15"N 79°56'38"E													
DEPTH M	OBSERVED N VALUE	CORRECTED N VALUE	SAMPLE TYPE	SAMPLE DEPTH IN M	DESCRIPTION OF STRATA	LOG	IS SOIL CLASSIFICATION	STANDARD PENETRATION RESISTANCE CURVE							
0.00	-	-	-	-											
1.50	20	25	SPT-1	1.50-1.95	CLAYEY SAND		SC								
2.25			UDS-1	2.25-2.70											
3.00	21	24	SPT-2	3.00-3.45											
4.50	17	19	SPT-3	4.50-4.95											
5.25			UDS-2	5.25-5.70	SILTY SAND		SM								
6.00	70	50	SPT-4	6.00-6.45											
7.50	69	48	SPT-5	7.50-7.95											
9.00	73	48	SPT-6	9.00-9.45											
10.50	50 REF	35	SPT-7	10.50-10.95											
12.00	50 REF	33	SPT-8	12.00-12.28											
13.50	50 REF	50	SPT-9	13.50-13.75	POORLY GRADED GRAVEL		GP								
15.00	50 REF	49	SPT-10	15.00-15.14											

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



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LOG OF BOREHOLE, BH-34

BOREHOLE NO.		34		DATE OF DRILLING		18.08.2025		TERMINAL DEPTH (M)		15.00		WATER TABLE (M)		6.30	
Location		BH-05 [JAK RIF] 23°08'14"N 79°56'39"E													
DEPTH	M	OBSERVED N VALUE	CORRECTED N VALUE	SAMPLE TYPE	SAMPLE DEPTH IN M	DESCRIPTION OF STRATA	LOG	IS SOIL CLASSIFICATION	STANDARD PENETRATION RESISTANCE CURVE						
									Observed N Value	Corrected N Value					
0.00		-	-	-	-			SC							
1.50		12	18	SPT-1	1.50-1.95	CLAYEY SAND	SC								
2.25				UDS-1	2.25-2.70										
3.00		20	23	SPT-2	3.00-3.45										
4.50		30	29	SPT-3	4.50-4.95	SILTY SAND	SM								
5.25				UDS-2	5.25-5.70										
6.00		50 REF	38	SPT-4	6.00-6.45										
7.50		50 REF	37	SPT-5	7.50-7.95										
9.00		50 REF	36	SPT-6	9.00-9.45										
10.50		50 REF	35	SPT-7	10.50-10.95										
12.00		50 REF	33	SPT-8	12.00-12.28	POORLY GRADED GRAVEL	GP								
13.50		50 REF	50	SPT-9	13.50-13.75										
15.00		50 REF	49	SPT-10	15.00-15.14										

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



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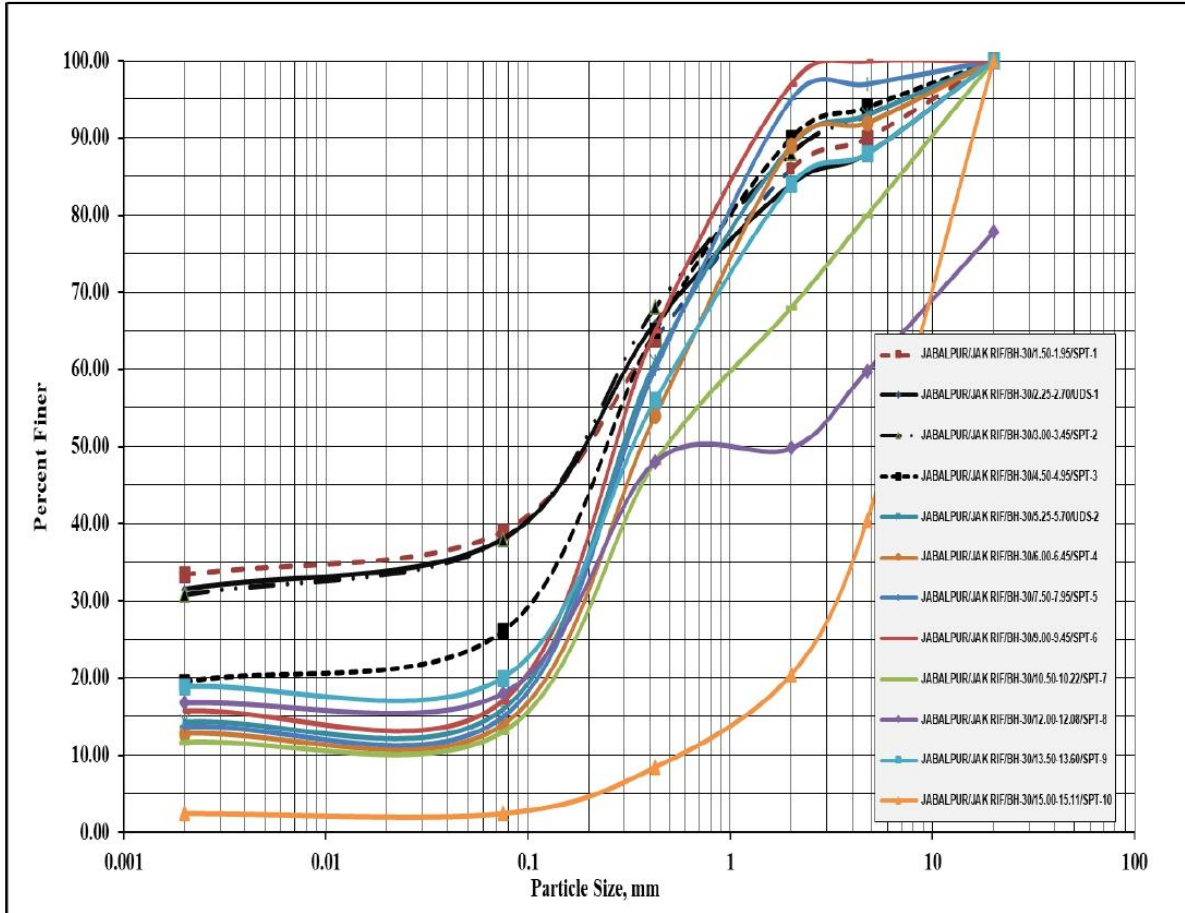
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16.2 LABORATORY TEST RESULTS

TEST ON SOIL SAMPLES																				
BH-30			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT					SHEAR PARAMETERS		FREE SWELL INDEX	
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL	CLAY	SILT	fine SAND	med SAND	coarse SAND	GRAVEL	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²		ANGLE OF INTERNAL FRICTION, in Degree
			<0.002 mm	0.002-0.075	0.075-0.425	0.425-2.00	2.00-4.75	>4.75 mm				gm/cc	%	gm/cc	G	e	c	φ		%
1.50-1.95	SPT-1	SC	33.40	5.60	25.00	22.00	4.00	10.00	32.59	15.88	16.71	-	13	-	2.63	-	-	-	-	-
2.25-2.70	UDS-1	SC	31.50	6.50	28.00	18.00	4.00	12.00	31.18	15.42	15.76	1.78	12	1.590	2.64	0.66	TX	0.22	27.20	6
3.00-3.45	SPT-2	SC	30.80	7.20	30.00	20.00	5.00	7.00	30.10	15.36	14.74	-	10	-	2.63	-	-	-	-	-
4.50-4.95	SPT-3	SC	19.50	6.50	39.00	25.00	4.00	6.00	29.45	14.81	14.64	-	13	-	2.62	-	-	-	-	-
5.25-5.70	UDS-2	SM	14.40	1.60	45.00	28.00	4.00	7.00	21.03	NP	NIL	1.84	10	1.670	2.64	0.58	DIR	0.00	37.11	0
6.00-6.45	SPT-4	SM	12.90	1.10	40.00	35.00	3.00	8.00	20.18	NP	NIL	-	12	-	2.60	-	-	-	-	-
7.50-7.95	SPT-5	SM	13.80	1.20	45.00	35.00	2.00	3.00	22.00	NP	NIL	-	14	-	2.61	-	-	-	-	-
9.00-9.45	SPT-6	SM	15.75	1.25	48.00	32.00	3.00	0.00	20.68	NP	NIL	-	12	-	2.63	-	-	-	-	-
10.50-10.22	SPT-7	SM	11.70	1.30	35.00	20.00	12.00	20.00	21.18	NP	NIL	-	8	-	2.62	-	-	-	-	-
12.00-12.08	SPT-8	SM	16.80	1.20	30.00	1.77	10.00	18.00	23.36	NP	NIL	-	10	-	2.63	-	-	-	-	-
13.50-13.60	SPT-9	SM	18.90	1.10	36.00	28.00	4.00	12.00	22.50	NP	NIL	-	11	-	2.64	-	-	-	-	-
15.00-15.11	SPT-10	GP	2.50	6.00	12.00	20.00	59.50	NL	NP	NIL	-	4	-	-	2.62	-	-	-	-	-

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



GRAIN SIZE DISTRIBUTION CURVE, BH-30

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR,
MADHYA PRADESH



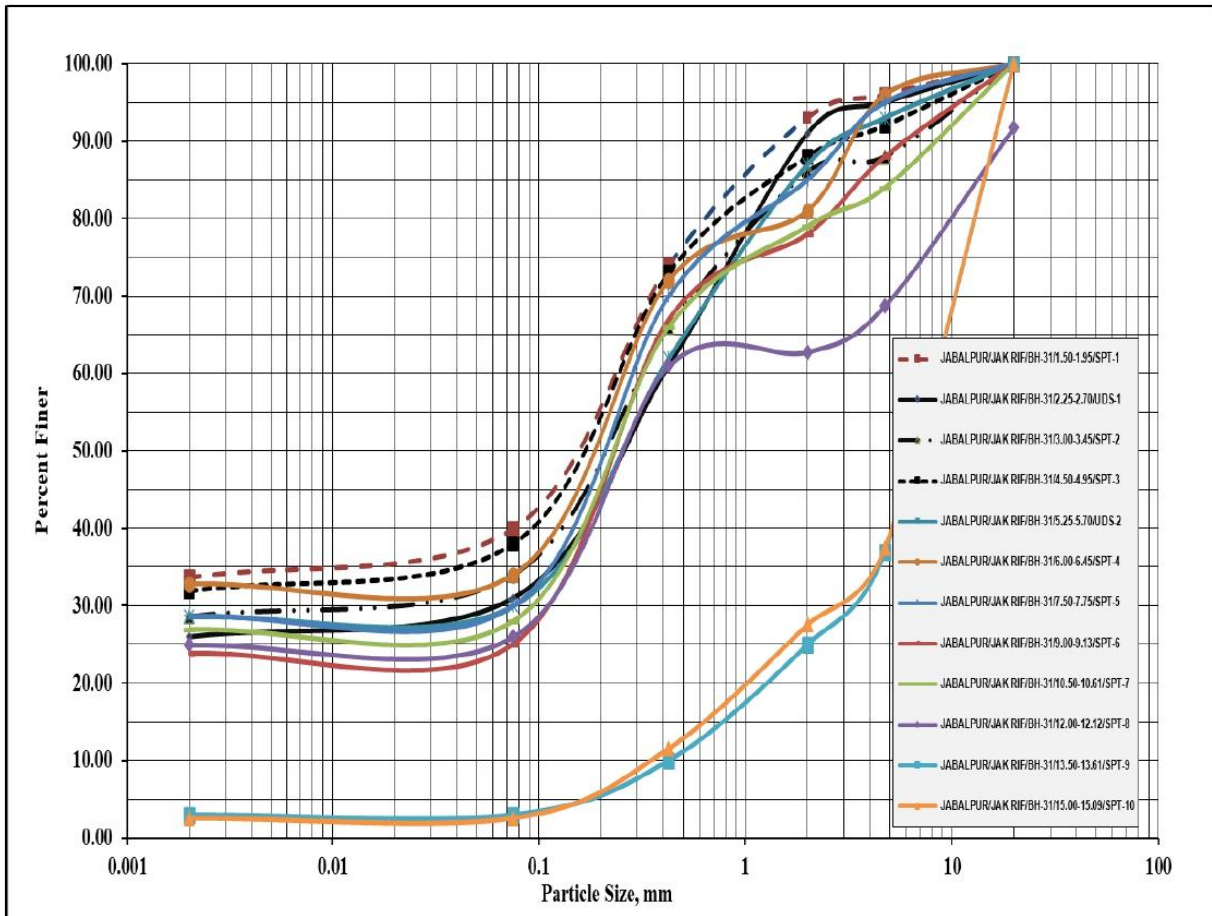
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TEST ON SOIL SAMPLES																				
BH-31			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT					SHEAR PARAMETERS		FREE SWELL INDEX	
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL	CLAY	SILT	fine SAND	med SAND	coarse SAND	GRAVEL	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²		ANGLE OF INTERNAL FRICTION, in Degree
			<0.002 mm	0.002-0.075	0.075-0.425	0.425-2.00	2.00-4.75	>4.75 mm												
1.50-1.95	SPT-1	SC	33.70	6.30	34.00	19.00	3.00	4.00	33.79	15.41	18.38	-	14	-	2.63	-	-	-	-	
2.25-2.70	UDS-1	SC	26.00	5.00	30.00	30.00	4.00	5.00	32.74	15.63	17.11	1.78	10	1.620	2.64	0.63	TX	0.18	26.14	8
3.00-3.45	SPT-2	SC	28.60	5.40	32.00	20.00	2.00	12.00	37.02	14.62	22.40	-	13	-	2.64	-	-	-	-	
4.50-4.95	SPT-3	SC	31.90	6.10	35.00	15.00	4.00	8.00	29.71	17.30	12.41	-	9	-	2.63	-	-	-	-	
5.25-5.70	UDS-2	SM	28.60	1.40	32.00	25.00	6.00	7.00	23.17	NP	NIL	1.95	10	1.770	2.63	0.48	DIR	0.00	39.42	0
6.00-6.45	SPT-4	SM	32.80	1.20	38.00	9.00	15.00	4.00	20.21	NP	NIL	-	13	-	2.60	-	-	-	-	
7.50-7.75	SPT-5	SM	28.70	1.30	40.00	15.00	10.00	5.00	22.32	NP	NIL	-	8	-	2.62	-	-	-	-	
9.00-9.13	SPT-6	SM	23.80	1.20	42.00	11.00	10.00	12.00	21.08	NP	NIL	-	7	-	2.61	-	-	-	-	
10.50-10.61	SPT-7	SM	26.90	1.10	38.00	13.00	5.00	16.00	23.24	NP	NIL	-	6	-	2.63	-	-	-	-	
12.00-12.12	SPT-8	SM	24.95	1.05	35.00	1.77	6.00	23.00	22.18	NP	NIL	-	8	-	2.60	-	-	-	-	
13.50-13.61	SPT-9	GP	3.00		7.00	15.00	12.00	63.00	NL	NP	NIL	-	8	-	2.62	-	-	-	-	
15.00-15.09	SPT-10	GP	2.50		9.00	16.00	10.00	62.50	NL	NP	NIL	-	7	-	2.61	-	-	-	-	

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



GRAIN SIZE DISTRIBUTION CURVE, BH-31

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR,
MADHYA PRADESH



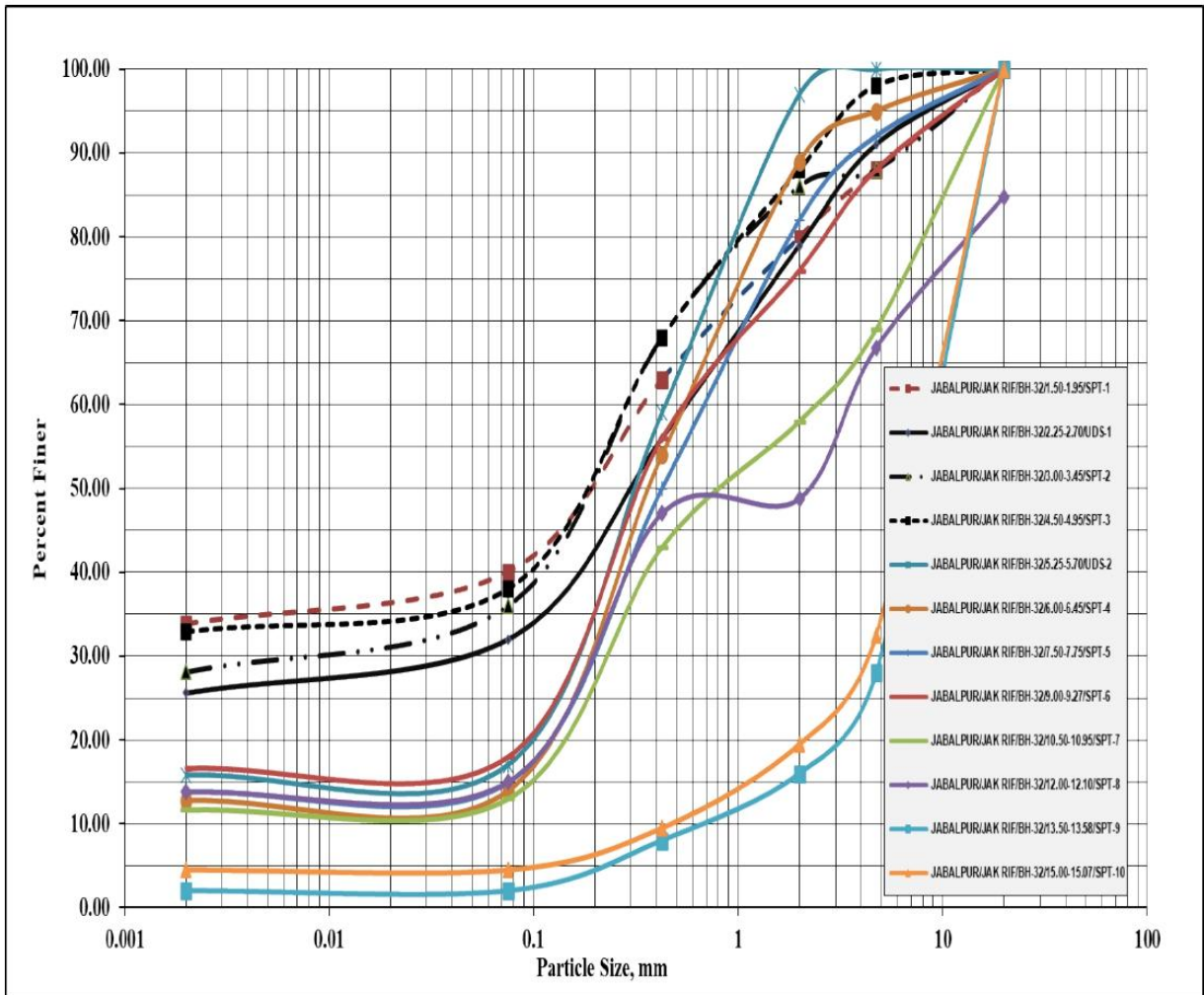
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TEST ON SOIL SAMPLES																				
BH-32			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT					SHEAR PARAMETERS			FREE SWELL INDEX
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL	CLAY	SILT	fine SAND	med SAND	coarse SAND	GRAVEL	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²	ANGLE OF INTERNAL FRICTION, in Degree	
			<0.002 mm	0.002-0.075	0.075-0.425	0.425-2.00	2.00-4.75	>4.75 mm												
1.50-1.95	SPT-1	SC	33.80	6.20	23.00	17.00	8.00	12.00	32.07	16.90	15.17	-	15	-	2.64	-	-	-	-	-
2.25-2.70	UDS-1	SC	25.60	6.40	24.00	23.00	12.00	9.00	33.17	15.08	18.09	1.80	11	1.620	2.63	0.62	TX	0.21	27.30	9
3.00-3.45	SPT-2	SC	28.10	7.90	32.00	18.00	2.00	12.00	33.57	16.30	17.27	-	12	-	2.60	-	-	-	-	-
4.50-4.95	SPT-3	SC	32.90	5.10	30.00	20.00	10.00	2.00	34.32	16.20	18.12	-	16	-	2.61	-	-	-	-	-
5.25-5.70	UDS-2	SM	15.80	1.20	42.00	38.00	3.00	0.00	22.18	NP	NIL	1.86	10	1.690	2.64	0.56	DIR	0.00	36.23	0
6.00-6.45	SPT-4	SM	12.85	1.15	40.00	35.00	6.00	5.00	23.21	NP	NIL	-	12	-	2.63	-	-	-	-	-
7.50-7.75	SPT-5	SM	13.90	1.10	35.00	32.00	10.00	8.00	24.12	NP	NIL	-	10	-	2.62	-	-	-	-	-
9.00-9.27	SPT-6	SM	16.65	1.35	38.00	20.00	12.00	12.00	22.30	NP	NIL	-	8	-	2.63	-	-	-	-	-
10.50-10.95	SPT-7	SM	11.70	1.30	30.00	15.00	11.00	31.00	22.47	NP	NIL	-	6	-	2.62	-	-	-	-	-
12.00-12.10	SPT-8	SM	13.80	1.20	32.00	1.77	18.00	18.00	23.57	NP	NIL	-	9	-	2.60	-	-	-	-	-
13.50-13.58	SPT-9	GP	2.00	6.00	8.00	12.00	72.00	NL	NP	NIL	-	4	-	2.63	-	-	-	-	-	-
15.00-15.07	SPT-10	GP	4.50	5.00	10.00	13.00	67.50	NL	NP	NIL	-	7	-	2.64	-	-	-	-	-	-

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



GRAIN SIZE DISTRIBUTION CURVE, BH-32

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR,
MADHYA PRADESH



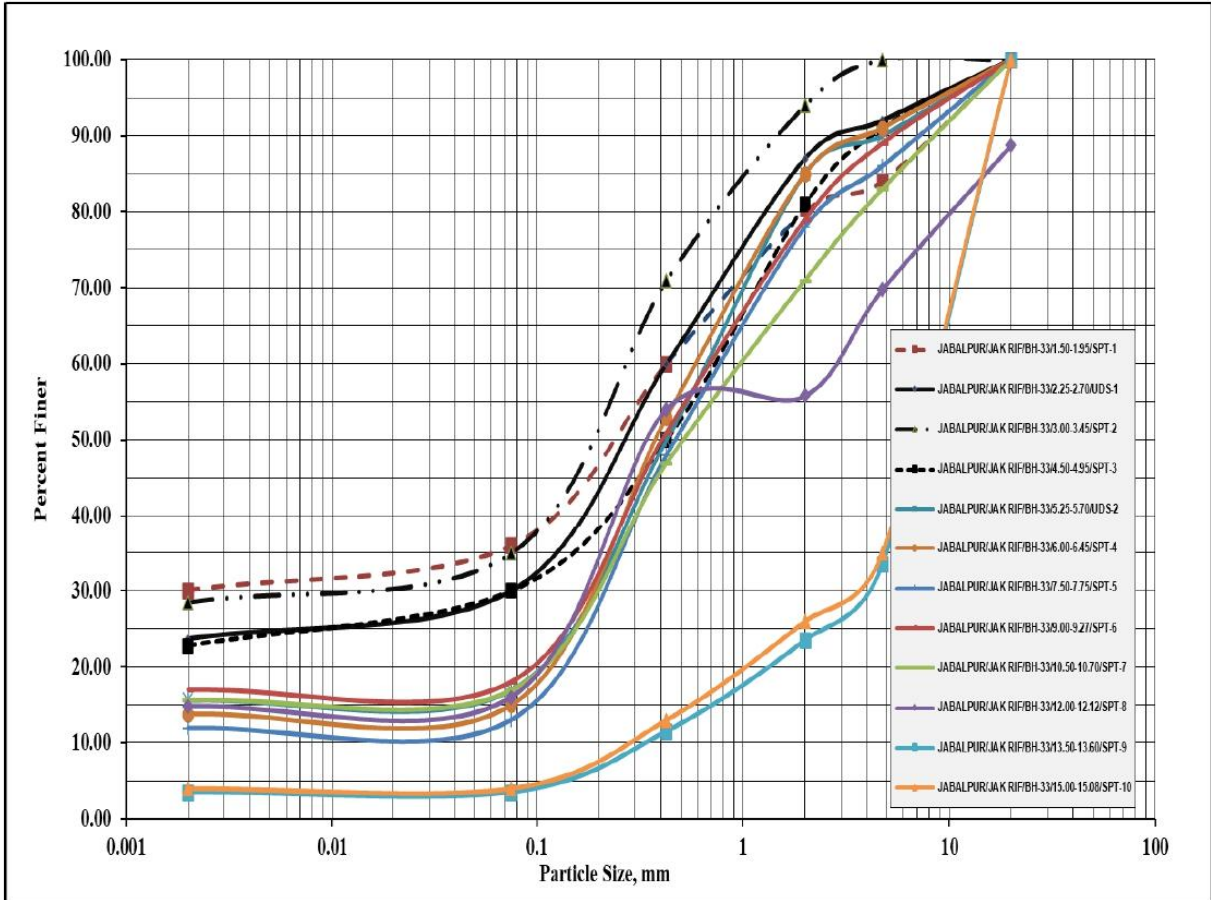
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TEST ON SOIL SAMPLES																				
BH-33			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT					SHEAR PARAMETERS			
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL	CLAY	SILT	fine SAND	med SAND	coarse SAND	GRAVEL	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²	ANGLE OF INTERNAL FRICTION, in Degree	
			<0.002 mm	0.002-0.075	0.075-0.425	0.425-2.00	2.00-4.75	>4.75 mm												%
1.50-1.95	SPT-1	SC	30.10	5.90	24.00	20.00	4.00	16.00	39.50	16.69	22.81	-	5	-	2.63	-	-	-	-	
2.25-2.70	UDS-1	SC	23.70	6.30	30.00	27.00	5.00	8.00	32.41	16.30	16.11	1.78	7	1.660	2.64	0.59	TX	0.22	26.47	7
3.00-3.45	SPT-2	SC	28.50	6.50	36.00	23.00	6.00	0.00	35.34	16.84	18.50	-	9	-	2.62	-	-	-	-	
4.50-4.95	SPT-3	SC	22.80	7.20	20.00	31.00	10.00	9.00	36.21	16.58	19.63	-	10	-	2.60	-	-	-	-	
5.25-5.70	UDS-2	SM	15.65	1.35	33.00	35.00	5.00	10.00	24.60	NP	NIL	1.84	11	1.660	2.62	0.58	DIR	0.00	36.14	0
6.00-6.45	SPT-4	SM	13.80	1.20	38.00	32.00	6.00	9.00	23.34	NP	NIL	-	8	-	2.61	-	-	-	-	
7.50-7.75	SPT-5	SM	11.90	1.10	35.00	30.00	8.00	14.00	22.02	NP	NIL	-	12	-	2.63	-	-	-	-	
9.00-9.27	SPT-6	SM	16.95	1.05	33.00	28.00	10.00	11.00	21.65	NP	NIL	-	10	-	2.62	-	-	-	-	
10.50-10.70	SPT-7	SM	15.70	1.30	30.00	24.00	12.00	17.00	22.47	NP	NIL	-	8	-	2.63	-	-	-	-	
12.00-12.12	SPT-8	SM	14.75	1.25	38.00	1.77	14.00	19.00	22.31	NP	NIL	-	6	-	2.64	-	-	-	-	
13.50-13.60	SPT-9	GP	3.50		8.00	12.00	10.00	66.50	NL	NP	NIL	-	6	-	2.63	-	-	-	-	
15.00-15.08	SPT-10	GP	4.00		9.00	13.00	9.00	65.00	NL	NP	NIL	-	5	-	2.64	-	-	-	-	

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



GRAIN SIZE DISTRIBUTION CURVE, BH-33

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



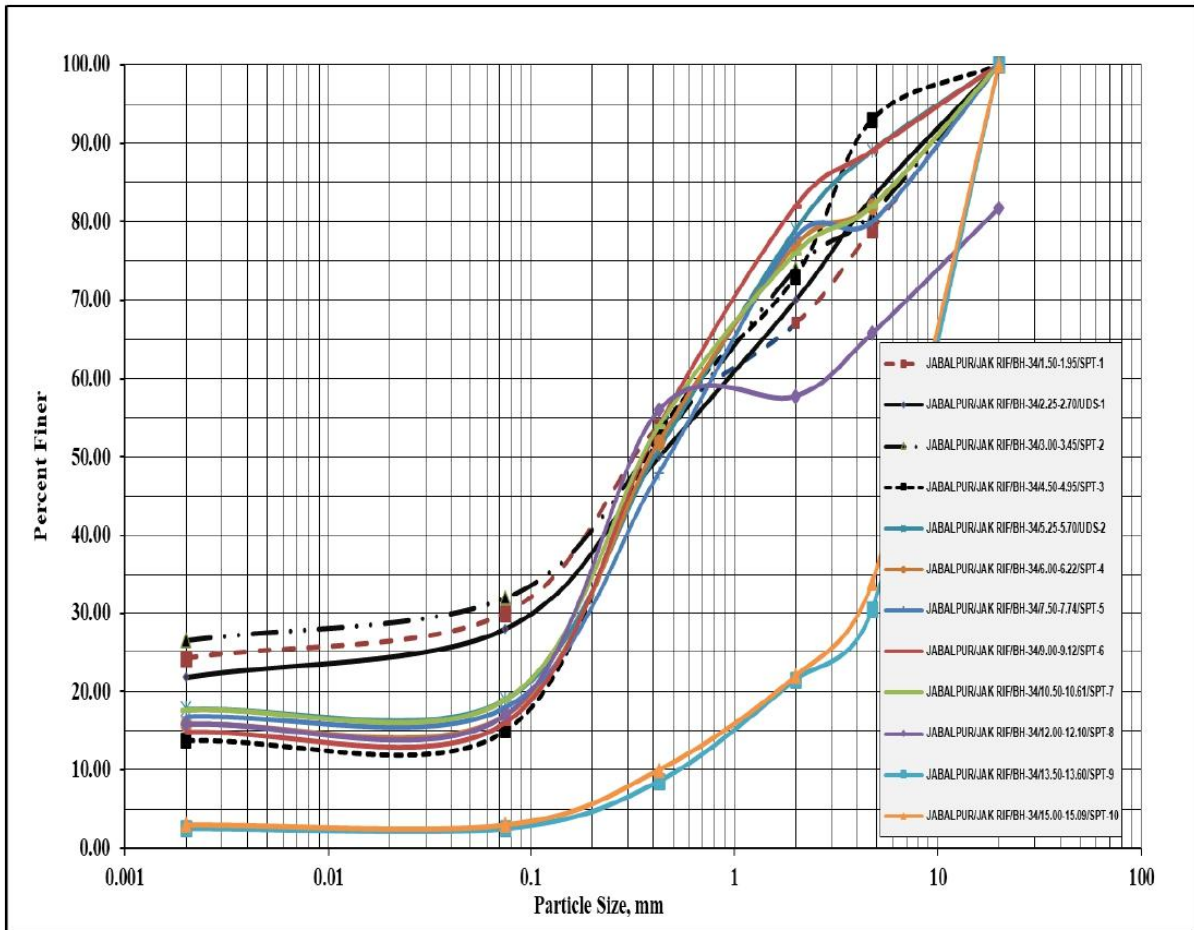
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TEST ON SOIL SAMPLES																				
BH-34			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT					SHEAR PARAMETERS			
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL	CLAY	SILT	fine SAND	med SAND	coarse SAND	GRAVEL	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²	ANGLE OF INTERNAL FRICTION, in Degree	FREE SWELL INDEX
			<0.002 mm	0.002-0.075	0.075-0.425	0.425-2.00	2.00-4.75	>4.75 mm				gm/cc	%	gm/cc	G					
1.50-1.95	SPT-1	SC	24.20	5.80	24.00	13.00	12.00	21.00	33.61	16.77	16.84	-	12	-	2.63	-	-	-	-	-
2.25-2.70	UDS-1	SC	21.80	6.20	22.00	20.00	13.00	17.00	31.54	16.44	15.10	1.78	14	1.560	2.64	0.69	TX	0.24	27.62	8
3.00-3.45	SPT-2	SC	26.50	5.50	20.00	22.00	7.00	19.00	32.17	16.30	15.87	-	12	-	2.62	-	-	-	-	-
4.50-4.95	SPT-3	SM	13.70	1.30	38.00	20.00	20.00	7.00	22.15	NP	NIL	-	11	-	2.64	-	-	-	-	-
5.25-5.70	UDS-2	SM	17.75	1.25	32.00	28.00	10.00	11.00	21.30	NP	NIL	1.85	10	1.680	2.62	0.56	DIR	0.00	38.32	0
6.00-6.22	SPT-4	SM	15.85	1.15	35.00	25.00	5.00	18.00	23.06	NP	NIL	-	12	-	2.63	-	-	-	-	-
7.50-7.74	SPT-5	SM	16.80	1.20	30.00	30.00	2.00	20.00	23.14	NP	NIL	-	13	-	2.62	-	-	-	-	-
9.00-9.12	SPT-6	SM	14.75	1.25	38.00	28.00	7.00	11.00	22.52	NP	NIL	-	11	-	2.61	-	-	-	-	-
10.50-10.61	SPT-7	SM	17.70	1.30	35.00	22.00	6.00	18.00	22.35	NP	NIL	-	10	-	2.60	-	-	-	-	-
12.00-12.10	SPT-8	SM	15.85	1.15	39.00	1.77	8.00	16.00	23.75	NP	NIL	-	12	-	2.63	-	-	-	-	-
13.50-13.60	SPT-9	GP	2.50		6.00	13.00	9.00	69.50	NL	NP	NIL	-	8	-	2.64	-	-	-	-	-
15.00-15.09	SPT-10	GP	3.00		7.00	12.00	12.00	66.00	NL	NP	NIL	-	7	-	2.62	-	-	-	-	-

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



GRAIN SIZE DISTRIBUTION CURVE, BH-34

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR,
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**17.2 DESIGN OF SHALLOW FOUNDATION
17.2.1 ISOLATED SQUARE FOOTING
SIZE OF FOUNDATION- 2M X 2M**

Safe Bearing Capacity (SBC) Calculation for 2m x 2m Square Foundation – Jabalpur Site (BH-30)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	30	30	30
SPT N Value		N	33	33	28
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	2	2	2
Width of Foundation	m	B	2	2	2
Saturated density of soil	kg/cm ³	γ _{sat}	0.00178	0.00178	0.00178
Submerged density of soil	kg/cm ³	γ'	0.00178	0.00178	0.00178
Overburden Pressure	kg/cm ²	γ x Df	0.178	0.356	0.534
	kg/cm ²	B x γ	0.356	0.356	0.356
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.22	0.22	0.22
Angle of Internal Friction for General Shear	Degrees	φ	27.2	27.2	27.2
Angle of Internal Friction for Local Shear	Degrees	φ'	18.99	18.99	18.99
Nφ			2.684	2.684	2.684
Bearing Capacity factors for local shear failure		Nc'	14.034	14.034	14.034
		Nq'	5.903	5.903	5.903
		Nγ'	4.836	4.836	4.836
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sγ	0.8	0.8	0.8
Depth Factors		Dc	1.164	1.328	1.491
		Dq	1.082	1.164	1.246
		Dγ	1.082	1.164	1.246
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Nγ' * Sγ *Dγ*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	4.635	6.409	8.354
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	18.540	25.640	33.420
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
SBC based on settlement criteria for for Sandy Soil Layers					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	7.11	7.11	9.13
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	14.22	14.22	18.26
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	50	50	50
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	3.516	3.516	2.738
Safe Bearing Pressure for 50mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	35.162	35.162	27.382
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	18.540	25.640	27.380

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Safe Bearing Capacity (SBC) Calculation for 2m x 2m Square Foundation – Jabalpur Site (BH-31)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	31	31	31
SPT N Value		N	22	22	33
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	2	2	2
Width of Foundation	m	B	2	2	2
Saturated density of soil	kg/cm ³	γ _{sat}	0.00178	0.00178	0.00178
Submerged density of soil	kg/cm ³	γ'	0.00178	0.00178	0.00178
Overburden Pressure	kg/cm ²	γ x Df	0.178	0.356	0.534
	kg/cm ²	B x γ	0.356	0.356	0.356
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.18	0.18	0.18
Angle of Internal Friction for General Shear	Degrees	φ	26.14	26.14	26.14
Angle of Internal Friction for Local Shear	Degrees	φ'	18.19	18.19	18.19
Nφ			2.575	2.575	2.575
Bearing Capacity factors for local shear failure		Nc'	13.405	13.405	13.405
		Nq'	5.510	5.510	5.510
		Nγ'	4.399	4.399	4.399
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sy	0.8	0.8	0.8
Depth Factors		Dc	1.160	1.321	1.481
		Dq	1.080	1.160	1.241
		Dγ	1.080	1.160	1.241
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Nγ' * Sy *Dγ*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	3.818	5.376	7.088
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	15.270	21.500	28.350
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
SBC based on settlement criteria for for Sandy Soil Layers					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	8.02	8.02	7.11
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	16.04	16.04	14.22
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	50	50	50
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	3.117	3.117	3.516
Safe Bearing Pressure for 50mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	31.172	31.172	35.162
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	15.270	21.500	28.350

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Safe Bearing Capacity (SBC) Calculation for 2m x 2m Square Foundation – Jabalpur Site (BH-32)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	32	32	32
SPT N Value		N	13	13	32
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	2	2	2
Width of Foundation	m	B	2	2	2
Saturated density of soil	kg/cm ³	γ _{sat}	0.0018	0.0018	0.0018
Submerged density of soil	kg/cm ³	γ'	0.0018	0.0018	0.0018
Overburden Pressure	kg/cm ²	γ x Df	0.18	0.36	0.54
	kg/cm ²	B x γ	0.36	0.36	0.36
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.21	0.21	0.21
Angle of Internal Friction for General Shear	Degrees	φ	27.3	27.3	27.3
Angle of Internal Friction for Local Shear	Degrees	φ'	19.07	19.07	19.07
Nφ			2.694	2.694	2.694
Bearing Capacity factors for local shear failure		Nc'	14.094	14.094	14.094
		Nq'	5.940	5.940	5.940
		Ny'	4.878	4.878	4.878
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sy	0.8	0.8	0.8
Depth Factors		Dc	1.164	1.328	1.492
		Dq	1.082	1.164	1.246
		Dy	1.082	1.164	1.246
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Ny' * Sy *Dy*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	4.536	6.318	8.275
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	18.140	25.270	33.100
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
SBC based on settlement criteria for for Sandy Soil Layers					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	22.07	22.07	7.44
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	44.14	44.14	14.88
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	50	50	50
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	1.133	1.133	3.360
Safe Bearing Pressure for 50mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	11.328	11.328	33.602
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	11.330	11.330	33.100

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Safe Bearing Capacity (SBC) Calculation for 2m x 2m Square Foundation – Jabalpur Site (BH-33)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	33	33	33
SPT N Value		N	20	20	21
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	2	2	2
Width of Foundation	m	B	2	2	2
Saturated density of soil	kg/cm ³	γ _{sat}	0.00178	0.00178	0.00178
Submerged density of soil	kg/cm ³	γ'	0.00178	0.00178	0.00178
Overburden Pressure	kg/cm ²	γ x Df	0.178	0.356	0.534
	kg/cm ²	B x γ	0.356	0.356	0.356
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.22	0.22	0.22
Angle of Internal Friction for General Shear	Degrees	φ	26.47	26.47	26.47
Angle of Internal Friction for Local Shear	Degrees	φ'	18.44	18.44	18.44
Nφ			2.608	2.608	2.608
Bearing Capacity factors for local shear failure		Nc'	13.600	13.600	13.600
		Nq'	5.632	5.632	5.632
		Ny'	4.535	4.535	4.535
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sy	0.8	0.8	0.8
Depth Factors		Dc	1.162	1.323	1.485
		Dq	1.081	1.162	1.242
		Dy	1.081	1.162	1.242
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Ny' * Sy *Dy*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	4.445	6.121	7.957
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	17.780	24.490	31.830
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
<i>SBC based on settlement criteria for for Sandy Soil Layers</i>					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	14	14	6.58
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	28	28	13.16
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	50	50	50
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	1.786	1.786	3.799
Safe Bearing Pressure for 50mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	17.857	17.857	37.994
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	17.780	17.860	31.830

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Safe Bearing Capacity (SBC) Calculation for 2m x 2m Square Foundation – Jabalpur Site (BH-34)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	34	34	34
SPT N Value		N	12	12	20
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	2	2	2
Width of Foundation	m	B	2	2	2
Saturated density of soil	kg/cm ³	γ _{sat}	0.00178	0.00178	0.00178
Submerged density of soil	kg/cm ³	γ'	0.00178	0.00178	0.00178
Overburden Pressure	kg/cm ²	γ x Df	0.178	0.356	0.534
	kg/cm ²	B x γ	0.356	0.356	0.356
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.24	0.24	0.24
Angle of Internal Friction for General Shear	Degrees	φ	27.62	27.62	27.62
Angle of Internal Friction for Local Shear	Degrees	φ'	19.31	19.31	19.31
Nφ			2.729	2.729	2.729
Bearing Capacity factors for local shear failure		Nc'	14.285	14.285	14.285
		Nq'	6.060	6.060	6.060
		Ny'	5.011	5.011	5.011
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sy	0.8	0.8	0.8
Depth Factors		Dc	1.165	1.330	1.496
		Dq	1.083	1.165	1.248
		Dy	1.083	1.165	1.248
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Ny' * Sy *Dy*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	5.036	6.907	8.957
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	20.140	27.630	35.830
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
<i>SBC based on settlement criteria for for Sandy Soil Layers</i>					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	24.38	24.38	14
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	48.76	48.76	28
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	50	50	50
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	1.025	1.025	1.786
Safe Bearing Pressure for 50mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	10.254	10.254	17.857
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	10.250	10.250	17.860

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SIZE OF FOUNDATION- 3M X 3M

Safe Bearing Capacity (SBC) Calculation for 3m x 3m Square Foundation – Jabalpur Site (BH-30)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
Parameters	Unit	Denotion	1	2	3
Bore Hole Number		BH	30	30	30
SPT N Value		N	33	33	28
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	3	3	3
Width of Foundation	m	B	3	3	3
Saturated density of soil	kg/cm ³	γ _{sat}	0.00178	0.00178	0.00178
Submerged density of soil	kg/cm ³	γ'	0.00178	0.00178	0.00178
Overburden Pressure	kg/cm ²	γ x Df	0.178	0.356	0.534
	kg/cm ²	B x γ	0.534	0.534	0.534
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.22	0.22	0.22
Angle of Internal Friction for General Shear	Degrees	φ	27.2	27.2	27.2
Angle of Internal Friction for Local Shear	Degrees	φ'	18.99	18.99	18.99
Nφ			2.684	2.684	2.684
Bearing Capacity factors for local shear failure		Nc'	14.034	14.034	14.034
		Nq'	5.903	5.903	5.903
		Nγ'	4.836	4.836	4.836
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sγ	0.8	0.8	0.8
Depth Factors		Dc	1.109	1.218	1.328
		Dq	1.055	1.109	1.164
		Dγ	1.055	1.109	1.164
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Nγ' * Sγ *Dγ*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	4.632	6.173	7.828
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	18.530	24.690	31.310
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
SBC based on settlement criteria for for Sandy Soil Layers					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	7.91	7.91	10.29
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	15.82	15.82	20.58
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	50	50	50
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	3.161	3.161	2.430
Safe Bearing Pressure for 50mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	31.606	31.606	24.295
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	18.530	24.690	24.300

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Safe Bearing Capacity (SBC) Calculation for 3m x 3m Square Foundation – Jabalpur Site (BH-31)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	31	31	31
SPT N Value		N	22	22	33
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	3	3	3
Width of Foundation	m	B	3	3	3
Saturated density of soil	kg/cm ³	γ _{sat}	0.00178	0.00178	0.00178
Submerged density of soil	kg/cm ³	γ'	0.00178	0.00178	0.00178
Overburden Pressure	kg/cm ²	γ x Df	0.178	0.356	0.534
	kg/cm ²	B x γ	0.534	0.534	0.534
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.18	0.18	0.18
Angle of Internal Friction for General Shear	Degrees	φ	26.14	26.14	26.14
Angle of Internal Friction for Local Shear	Degrees	φ'	18.19	18.19	18.19
Nφ			2.575	2.575	2.575
Bearing Capacity factors for local shear failure		Nc'	13.405	13.405	13.405
		Nq'	5.510	5.510	5.510
		Nγ'	4.399	4.399	4.399
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sγ	0.8	0.8	0.8
Depth Factors		Dc	1.107	1.214	1.321
		Dq	1.053	1.107	1.160
		Dγ	1.053	1.107	1.160
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67 * C * Nc' * Sc * Dc + q (Nq'-1) * Sq * Dq + 0.5 * B * Nγ' * Sγ * Dγ * W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	3.836	5.204	6.675
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	15.350	20.820	26.700
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
<i>SBC based on settlement criteria for for Sandy Soil Layers</i>					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	11.55	11.55	7.91
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	23.1	23.1	15.82
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	50	50	50
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	2.165	2.165	3.161
Safe Bearing Pressure for 50mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	21.645	21.645	31.606
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	15.350	20.820	26.700

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Safe Bearing Capacity (SBC) Calculation for 3m x 3m Square Foundation – Jabalpur Site (BH-32)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	32	32	32
SPT N Value		N	13	13	32
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	3	3	3
Width of Foundation	m	B	3	3	3
Saturated density of soil	kg/cm ³	γ _{sat}	0.0018	0.0018	0.0018
Submerged density of soil	kg/cm ³	γ'	0.0018	0.0018	0.0018
Overburden Pressure	kg/cm ²	γ x Df	0.18	0.36	0.54
	kg/cm ²	B x γ	0.54	0.54	0.54
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.21	0.21	0.21
Angle of Internal Friction for General Shear	Degrees	φ	27.3	27.3	27.3
Angle of Internal Friction for Local Shear	Degrees	φ'	19.07	19.07	19.07
Nφ			2.694	2.694	2.694
Bearing Capacity factors for local shear failure		Nc'	14.094	14.094	14.094
		Nq'	5.940	5.940	5.940
		Nγ'	4.878	4.878	4.878
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sy	0.8	0.8	0.8
Depth Factors		Dc	1.109	1.219	1.328
		Dq	1.055	1.109	1.164
		Dγ	1.055	1.109	1.164
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Nγ' * Sy *Dγ*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	4.541	6.094	7.764
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	18.160	24.380	31.060
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
SBC based on settlement criteria for for Sandy Soil Layers					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	25.07	25.07	8.27
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	50.14	50.14	16.54
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	50	50	50
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	0.997	0.997	3.023
Safe Bearing Pressure for 50mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	9.972	9.972	30.230
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	9.970	9.970	30.230

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Safe Bearing Capacity (SBC) Calculation for 3m x 3m Square Foundation – Jabalpur Site (BH-33)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
Parameters	Unit	Denotion	1	2	3
Bore Hole Number		BH	33	33	33
SPT N Value		N	20	20	21
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	3	3	3
Width of Foundation	m	B	3	3	3
Saturated density of soil	kg/cm ³	γ _{sat}	0.00178	0.00178	0.00178
Submerged density of soil	kg/cm ³	γ'	0.00178	0.00178	0.00178
Overburden Pressure	kg/cm ²	γ x Df	0.178	0.356	0.534
	kg/cm ²	B x γ	0.534	0.534	0.534
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.22	0.22	0.22
Angle of Internal Friction for General Shear	Degrees	φ	26.47	26.47	26.47
Angle of Internal Friction for Local Shear	Degrees	φ'	18.44	18.44	18.44
Nφ			2.608	2.608	2.608
Bearing Capacity factors for local shear failure		Nc'	13.600	13.600	13.600
		Nq'	5.632	5.632	5.632
		Ny'	4.535	4.535	4.535
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sy	0.8	0.8	0.8
Depth Factors		Dc	1.108	1.215	1.323
		Dq	1.054	1.108	1.162
		Dy	1.054	1.108	1.162
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Ny' * Sy *Dy*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	4.440	5.896	7.458
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	17.760	23.580	29.830
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
SBC based on settlement criteria for for Sandy Soil Layers					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	15	15	10.46
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	30	30	20.92
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	50	50	50
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	1.667	1.667	2.390
Safe Bearing Pressure for 50mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	16.667	16.667	23.901
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	16.670	16.670	23.900

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Safe Bearing Capacity (SBC) Calculation for 3m x 3m Square Foundation – Jabalpur Site (BH-34)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	34	34	34
SPT N Value		N	12	12	20
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	3	3	3
Width of Foundation	m	B	3	3	3
Saturated density of soil	kg/cm ³	γ _{sat}	0.00178	0.00178	0.00178
Submerged density of soil	kg/cm ³	γ'	0.00178	0.00178	0.00178
Overburden Pressure	kg/cm ²	γ x Df	0.178	0.356	0.534
	kg/cm ²	B x γ	0.534	0.534	0.534
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.24	0.24	0.24
Angle of Internal Friction for General Shear	Degrees	φ	27.62	27.62	27.62
Angle of Internal Friction for Local Shear	Degrees	φ'	19.31	19.31	19.31
Nφ			2.729	2.729	2.729
Bearing Capacity factors for local shear failure		Nc'	14.285	14.285	14.285
		Nq'	6.060	6.060	6.060
		Nγ'	5.011	5.011	5.011
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sγ	0.8	0.8	0.8
Depth Factors		Dc	1.110	1.220	1.330
		Dq	1.055	1.110	1.165
		Dγ	1.055	1.110	1.165
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67 * C * Nc' * Sc * Dc + q(Nq'-1) * Sq * Dq + 0.5 * B * Nγ' * Sγ * Dγ * W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	5.020	6.637	8.374
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd/FOS)	20.080	26.550	33.500
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
SBC based on settlement criteria for for Sandy Soil Layers					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	28.11	28.11	15
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	56.22	56.22	30
Permissible settlement =50mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	50	50	50
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	0.889	0.889	1.667
Safe Bearing Pressure for 50mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	8.894	8.894	16.667
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	8.890	8.890	16.670

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**17.2.2 RAFT FOUNDATION
SIZE OF FOUNDATION- 10M X 10M**

Safe Bearing Capacity (SBC) Calculation for 10m x 10m Square Foundation – Jabalpur Site (BH-30)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	30	30	30
SPT N Value		N	33	33	28
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	10	10	10
Width of Foundation	m	B	10	10	10
Saturated density of soil	kg/cm ³	γ _{sat}	0.00178	0.00178	0.00178
Submerged density of soil	kg/cm ³	γ'	0.00178	0.00178	0.00178
Overburden Pressure	kg/cm ²	γ x Df	0.178	0.356	0.534
	kg/cm ²	B x γ	1.78	1.78	1.78
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.22	0.22	0.22
Angle of Internal Friction for General Shear	Degrees	φ	27.2	27.2	27.2
Angle of Internal Friction for Local Shear	Degrees	φ'	18.99	18.99	18.99
Nφ			2.684	2.684	2.684
Bearing Capacity factors for local shear failure		Nc'	14.034	14.034	14.034
		Nq'	5.903	5.903	5.903
		Ny'	4.836	4.836	4.836
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sy	0.8	0.8	0.8
Depth Factors		Dc	1.033	1.066	1.098
		Dq	1.016	1.033	1.049
		Dy	1.016	1.033	1.049
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Ny' * Sy *Dy*W'	kg/cm ²	Qd'	5.592	6.807	8.056
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	22.370	27.230	32.220
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
<i>SBC based on settlement criteria for for Sandy Soil Layers</i>					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	8.9	8.9	11.47
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W ⁱ	17.8	17.8	22.94
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	75	75	75
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	4.213	4.213	3.269
Safe Bearing Pressure for 75mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	42.135	42.135	32.694
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	22.370	27.230	32.220

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Safe Bearing Capacity (SBC) Calculation for 10m x 10m Square Foundation – Jabalpur Site (BH-31)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
Parameters	Unit	Denotion	1	2	3
Bore Hole Number		BH	31	31	31
SPT N Value		N	22	22	33
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	10	10	10
Width of Foundation	m	B	10	10	10
Saturated density of soil	kg/cm ³	γ _{sat}	0.00178	0.00178	0.00178
Submerged density of soil	kg/cm ³	γ'	0.00178	0.00178	0.00178
Overburden Pressure	kg/cm ²	γ x Df	0.178	0.356	0.534
	kg/cm ²	B x γ	1.78	1.78	1.78
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.18	0.18	0.18
Angle of Internal Friction for General Shear	Degrees	φ	26.14	26.14	26.14
Angle of Internal Friction for Local Shear	Degrees	φ'	18.19	18.19	18.19
Nφ			2.575	2.575	2.575
		Nc'	13.405	13.405	13.405
	Bearing Capacity factors for local shear failure		Nq'	5.510	5.510
		Nγ'	4.399	4.399	4.399
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sγ	0.8	0.8	0.8
Depth Factors		Dc	1.032	1.064	1.096
		Dq	1.016	1.032	1.048
		Dγ	1.016	1.032	1.048
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc' ¹ *Sc*Dc + q(Nq' ¹)*Sq*Dq + 0.5*B*Nγ' * Sy *Dγ*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	4.739	5.841	6.975
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd/FOS)	18.960	23.370	27.900
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
SBC based on settlement criteria for for Sandy Soil Layers					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	11.97	11.97	8.9
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	23.94	23.94	17.8
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	75	75	75
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	3.133	3.133	4.213
Safe Bearing Pressure for 75mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	31.328	31.328	42.135
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	18.960	23.370	27.900

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Safe Bearing Capacity (SBC) Calculation for 10m x 10m Square Raft – Jabalpur Site (BH-32)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	32	32	32
SPT N Value		N	13	13	32
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	10	10	10
Width of Foundation	m	B	10	10	10
Saturated density of soil	kg/cm ³	γ _{sat}	0.0018	0.0018	0.0018
Submerged density of soil	kg/cm ³	γ'	0.0018	0.0018	0.0018
Overburden Pressure	kg/cm ²	γ x Df	0.18	0.36	0.54
	kg/cm ²	B x γ	1.8	1.8	1.8
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.21	0.21	0.21
Angle of Internal Friction for General Shear	Degrees	φ	27.3	27.3	27.3
Angle of Internal Friction for Local Shear	Degrees	φ'	19.07	19.07	19.07
Nφ			2.694	2.694	2.694
		Nc'	14.094	14.094	14.094
		Nq'	5.940	5.940	5.940
Bearing Capacity factors for local shear failure		Nγ'	4.878	4.878	4.878
		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
Shape Factors		Sγ	0.8	0.8	0.8
		Dc	1.033	1.066	1.098
		Dq	1.016	1.033	1.049
Depth Factors		Dγ	1.016	1.033	1.049
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc ¹ *Sc*Dc + q(Nq ¹ -1)*Sq*Dq + 0.5*B*Nγ' * Sγ *Dγ*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	5.532	6.765	8.033
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd/FOS)	22.130	27.060	32.130
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
SBC based on settlement criteria for for Sandy Soil Layers					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	26.78	26.78	9.32
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	53.56	53.56	18.64
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	75	75	75
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	1.400	1.400	4.024
Safe Bearing Pressure for 75mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	14.003	14.003	40.236
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	14.000	14.000	32.130

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Safe Bearing Capacity (SBC) Calculation for 10m x 10m Square Raft – Jabalpur Site (BH-33)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	33	33	33
SPT N Value		N	20	20	21
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	10	10	10
Width of Foundation	m	B	10	10	10
Saturated density of soil	kg/cm ³	γ _{sat}	0.00178	0.00178	0.00178
Submerged density of soil	kg/cm ³	γ'	0.00178	0.00178	0.00178
Overburden Pressure	kg/cm ²	γ x Df	0.178	0.356	0.534
	kg/cm ²	B x γ	1.78	1.78	1.78
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.22	0.22	0.22
Angle of Internal Friction for General Shear	Degrees	φ	26.47	26.47	26.47
Angle of Internal Friction for Local Shear	Degrees	φ'	18.44	18.44	18.44
Nφ			2.608	2.608	2.608
Bearing Capacity factors for local shear failure		Nc'	13.600	13.600	13.600
		Nq'	5.632	5.632	5.632
		Nγ'	4.535	4.535	4.535
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sγ	0.8	0.8	0.8
Depth Factors		Dc	1.032	1.065	1.097
		Dq	1.016	1.032	1.048
		Dγ	1.016	1.032	1.048
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Nγ' * Sγ *Dγ*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	5.336	6.484	7.663
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	21.340	25.930	30.650
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
SBC based on settlement criteria for for Sandy Soil Layers					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	17	17	10.76
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	34	34	21.52
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	75	75	75
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	2.206	2.206	3.485
Safe Bearing Pressure for 75mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	22.059	22.059	34.851
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	21.340	22.060	30.650

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Safe Bearing Capacity (SBC) Calculation for 10m x 10m Square Raft – Jabalpur Site (BH-34)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	34	34	34
SPT N Value		N	12	12	20
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	10	10	10
Width of Foundation	m	B	10	10	10
Saturated density of soil	kg/cm ³	γ _{sat}	0.00178	0.00178	0.00178
Submerged density of soil	kg/cm ³	γ'	0.00178	0.00178	0.00178
Overburden Pressure	kg/cm ²	γ x Df	0.178	0.356	0.534
	kg/cm ²	B x γ	1.78	1.78	1.78
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.24	0.24	0.24
Angle of Internal Friction for General Shear	Degrees	φ	27.62	27.62	27.62
Angle of Internal Friction for Local Shear	Degrees	φ'	19.31	19.31	19.31
Nφ			2.729	2.729	2.729
Bearing Capacity factors for local shear failure		Nc'	14.285	14.285	14.285
		Nq'	6.060	6.060	6.060
		Ny'	5.011	5.011	5.011
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sy	0.8	0.8	0.8
Depth Factors		Dc	1.033	1.066	1.099
		Dq	1.017	1.033	1.050
		Dy	1.017	1.033	1.050
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Ny' * Sy *Dy*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	5.997	7.259	8.557
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	23.990	29.040	34.230
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
<i>SBC based on settlement criteria for for Sandy Soil Layers</i>					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	29.74	29.74	17
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	59.48	59.48	34
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	75	75	75
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	1.261	1.261	2.206
Safe Bearing Pressure for 75mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	12.609	12.609	22.059
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	12.610	12.610	22.060

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SIZE OF FOUNDATION- 10M X 10M

Safe Bearing Capacity (SBC) Calculation for 15m x 15m Square Foundation – Jabalpur Site (BH-30)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	30	30	30
SPT N Value		N	33	33	28
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	15	15	15
Width of Foundation	m	B	15	15	15
Saturated density of soil	kg/cm ³	γ _{sat}	0.00178	0.00178	0.00178
Submerged density of soil	kg/cm ³	γ'	0.00178	0.00178	0.00178
Overburden Pressure	kg/cm ²	γ x Df	0.178	0.356	0.534
	kg/cm ²	B x γ	2.67	2.67	2.67
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.22	0.22	0.22
Angle of Internal Friction for General Shear	Degrees	φ	27.2	27.2	27.2
Angle of Internal Friction for Local Shear	Degrees	φ'	18.99	18.99	18.99
Nφ			2.684	2.684	2.684
		Nc'	14.034	14.034	14.034
		Nq'	5.903	5.903	5.903
Bearing Capacity factors for local shear failure		Ny'	4.836	4.836	4.836
		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
Shape Factors		Sy	0.8	0.8	0.8
		Dc	1.022	1.044	1.066
		Dq	1.011	1.022	1.033
Depth Factors		Dy	1.011	1.022	1.033
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67 * C * Nc' * Sc * Dc + q(Nq'-1) * Sq * Dq + 0.5 * B * Ny' * Sy * Dy * W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	6.418	7.586	8.778
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	25.670	30.340	35.110
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
<i>SBC based on settlement criteria for for Sandy Soil Layers</i>					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	8.9	8.9	11.47
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	17.8	17.8	22.94
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	75	75	75
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	4.213	4.213	3.269
Safe Bearing Pressure for 75mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	42.135	42.135	32.694
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	25.670	30.340	32.690

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Safe Bearing Capacity (SBC) Calculation for 15m x 15m Square Foundation – Jabalpur Site (BH-31)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
Parameters	Unit	Denotion	1	2	3
			Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	31	31	31
SPT N Value		N	22	22	33
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	15	15	15
Width of Foundation	m	B	15	15	15
Saturated density of soil	kg/cm ³	γ _{sat}	0.00178	0.00178	0.00178
Submerged density of soil	kg/cm ³	γ'	0.00178	0.00178	0.00178
Overburden Pressure	kg/cm ²	γ x Df	0.178	0.356	0.534
	kg/cm ²	B x γ	2.67	2.67	2.67
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.18	0.18	0.18
Angle of Internal Friction for General Shear	Degrees	φ	26.14	26.14	26.14
Angle of Internal Friction for Local Shear	Degrees	φ'	18.19	18.19	18.19
Nφ			2.575	2.575	2.575
Bearing Capacity factors for local shear failure		Nc'	13.405	13.405	13.405
		Nq'	5.510	5.510	5.510
		Ny'	4.399	4.399	4.399
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sy	0.8	0.8	0.8
Depth Factors		Dc	1.021	1.043	1.064
		Dq	1.011	1.021	1.032
		Dy	1.011	1.021	1.032
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Ny' * Sy *Dy*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	5.494	6.559	7.644
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	21.980	26.240	30.580
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
SBC based on settlement criteria for for Sandy Soil Layers					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	11.97	11.97	8.9
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	23.94	23.94	17.8
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	75	75	75
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	3.133	3.133	4.213
Safe Bearing Pressure for 75mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	31.328	31.328	42.135
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	21.980	26.240	30.580

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Safe Bearing Capacity (SBC) Calculation for 15m x 15m Square Raft – Jabalpur Site (BH-32)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
Parameters	Unit	Denotation	1	2	3
			Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	32	32	32
SPT N Value		N	13	13	32
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	15	15	15
Width of Foundation	m	B	15	15	15
Saturated density of soil	kg/cm ³	γ _{sat}	0.0018	0.0018	0.0018
Submerged density of soil	kg/cm ³	γ'	0.0018	0.0018	0.0018
Overburden Pressure	kg/cm ²	γ x Df	0.18	0.36	0.54
	kg/cm ²	B x γ	2.7	2.7	2.7
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.21	0.21	0.21
Angle of Internal Friction for General Shear	Degrees	φ	27.3	27.3	27.3
Angle of Internal Friction for Local Shear	Degrees	φ'	19.07	19.07	19.07
Nφ			2.694	2.694	2.694
Bearing Capacity factors for local shear failure		Nc'	14.094	14.094	14.094
		Nq'	5.940	5.940	5.940
		Ny'	4.878	4.878	4.878
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sy	0.8	0.8	0.8
Depth Factors		Dc	1.022	1.044	1.066
		Dq	1.011	1.022	1.033
		Dy	1.011	1.022	1.033
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Ny' * Sy *Dy*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	6.376	7.563	8.774
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	25.500	30.250	35.100
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
<i>SBC based on settlement criteria for for Sandy Soil Layers</i>					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	26.78	26.78	9.32
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	53.56	53.56	18.64
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	75	75	75
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	1.400	1.400	4.024
Safe Bearing Pressure for 75mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	14.003	14.003	40.236
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	14.000	14.000	35.100

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Safe Bearing Capacity (SBC) Calculation for 15m x 15m Square Raft – Jabalpur Site (BH-33)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	33	33	33
SPT N Value		N	20	20	21
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	15	15	15
Width of Foundation	m	B	15	15	15
Saturated density of soil	kg/cm ³	γ _{sat}	0.00178	0.00178	0.00178
Submerged density of soil	kg/cm ³	γ'	0.00178	0.00178	0.00178
Overburden Pressure	kg/cm ²	γ x Df	0.178	0.356	0.534
	kg/cm ²	B x γ	2.67	2.67	2.67
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.22	0.22	0.22
Angle of Internal Friction for General Shear	Degrees	φ	26.47	26.47	26.47
Angle of Internal Friction for Local Shear	Degrees	φ'	18.44	18.44	18.44
Nφ			2.608	2.608	2.608
Bearing Capacity factors for local shear failure		Nc'	13.600	13.600	13.600
		Nq'	5.632	5.632	5.632
		Nγ'	4.535	4.535	4.535
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sγ	0.8	0.8	0.8
Depth Factors		Dc	1.022	1.043	1.065
		Dq	1.011	1.022	1.032
		Dγ	1.011	1.022	1.032
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Nγ' * Sγ *Dγ*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	6.110	7.213	8.338
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd'/FOS)	24.440	28.850	33.350
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
<i>SBC based on settlement criteria for for Sandy Soil Layers</i>					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	17	17	10.76
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	34	34	21.52
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	75	75	75
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	2.206	2.206	3.485
Safe Bearing Pressure for 75mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	22.059	22.059	34.851
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	22.060	22.060	33.350

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Safe Bearing Capacity (SBC) Calculation for 15m x 15m Square Raft – Jabalpur Site (BH-34)					
STEP 1 : SBC BASED ON SHEAR CRITERIA					
			1	2	3
Parameters	Unit	Denotion	Calculation 1	Calculation 2	Calculation 3
Bore Hole Number		BH	34	34	34
SPT N Value		N	12	12	20
Depth of embedment	m	Df	1	2	3
Factor of Safety		FOS	2.5	2.5	2.5
Length of foundation	m	L	15	15	15
Width of Foundation	m	B	15	15	15
Saturated density of soil	kg/cm ³	γ _{sat}	0.00178	0.00178	0.00178
Submerged density of soil	kg/cm ³	γ'	0.00178	0.00178	0.00178
Overburden Pressure	kg/cm ²	γ x Df	0.178	0.356	0.534
	kg/cm ²	B x γ	2.67	2.67	2.67
Shape of foundation base			Square	Square	Square
Effect of Water Table		Worst Case	0.5	0.5	0.5
Cohesion	kg/cm ²	C	0.24	0.24	0.24
Angle of Internal Friction for General Shear	Degrees	φ	27.62	27.62	27.62
Angle of Internal Friction for Local Shear	Degrees	φ'	19.31	19.31	19.31
Nφ			2.729	2.729	2.729
Bearing Capacity factors for local shear failure		Nc'	14.285	14.285	14.285
		Nq'	6.060	6.060	6.060
		Nγ'	5.011	5.011	5.011
Shape Factors		Sc	1.3	1.3	1.3
		Sq	1.2	1.2	1.2
		Sy	0.8	0.8	0.8
Depth Factors		Dc	1.022	1.044	1.066
		Dq	1.011	1.022	1.033
		Dγ	1.011	1.022	1.033
Net Ultimate Bearing Capacity (Local Shear Criteria) = 0.67*C*Nc'*Sc*Dc + q(Nq'-1)*Sq*Dq + 0.5*B*Nγ' * Sy *Dγ*W' [Used for φ less than 29 degrees as per IS 6403-1981]	kg/cm ²	Qd'	6.850	8.062	9.297
Net Safe Bearing Capacity (Local Shear Criteria)	T/m ²	NSBC=(Qd/FOS)	27.400	32.250	37.190
STEP 2 : CALCULATION OF SBC BASED ON SETTLEMENT CRITERIA					
<i>SBC based on settlement criteria for for Sandy Soil Layers</i>					
Settlement from Fig 9 of IS8009, for 1Kg/cm ²	mm	Su	29.74	29.74	17
Corrected Settlement due to Water Table for 1Kg/cm ²	mm	Su'=Su/W'	59.48	59.48	34
Permissible settlement =75mm (For RC structures and Water tanks IS1904:1986)	mm	Sa	75	75	75
Net Safe Bearing Capacity (Settlement Criteria)	Kg/cm ²	Sa/Su'	1.261	1.261	2.206
Safe Bearing Pressure for 75mm Settlement (Settlement Criteria)	T/m ²	(Sa/Su')*10	12.609	12.609	22.059
Safe Bearing Pressure (Minimum of shear criteria and settlement criteria)	T/m ²	SBP	12.610	12.610	22.060

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH

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18.0 TRIAL-PITS

A trial pit (or test pit) is an excavation of ground to study or sample the composition and structure of the subsurface, usually dug during a site investigation, a soil survey or a geological survey. Trial pits are dug before the construction. They are dug to determine the geology and the water table of that site.

Trial pits are usually between 1 and 4 metres deep and are dug either by hand or using a mechanical digger. Building and construction regulations clearly state that any trial pits that concedes deeper than 1.2 metres should be secured against structural collapse.

As per the client's requirement field investigation as well as the laboratory test are conducted to complies with the client requirement.

Field Observation: -

- 10 no of the Trial Pit of size 1.2 mtr x 1.2 mtr x 3.0 mtr have been executed at the location near BH-25 identifies the site engineer and in the presence of the concern engineer.
- During excavation it was found that clayey soil of low compressibility up to the depth to 3.45 meter and whole layers is well compacted.

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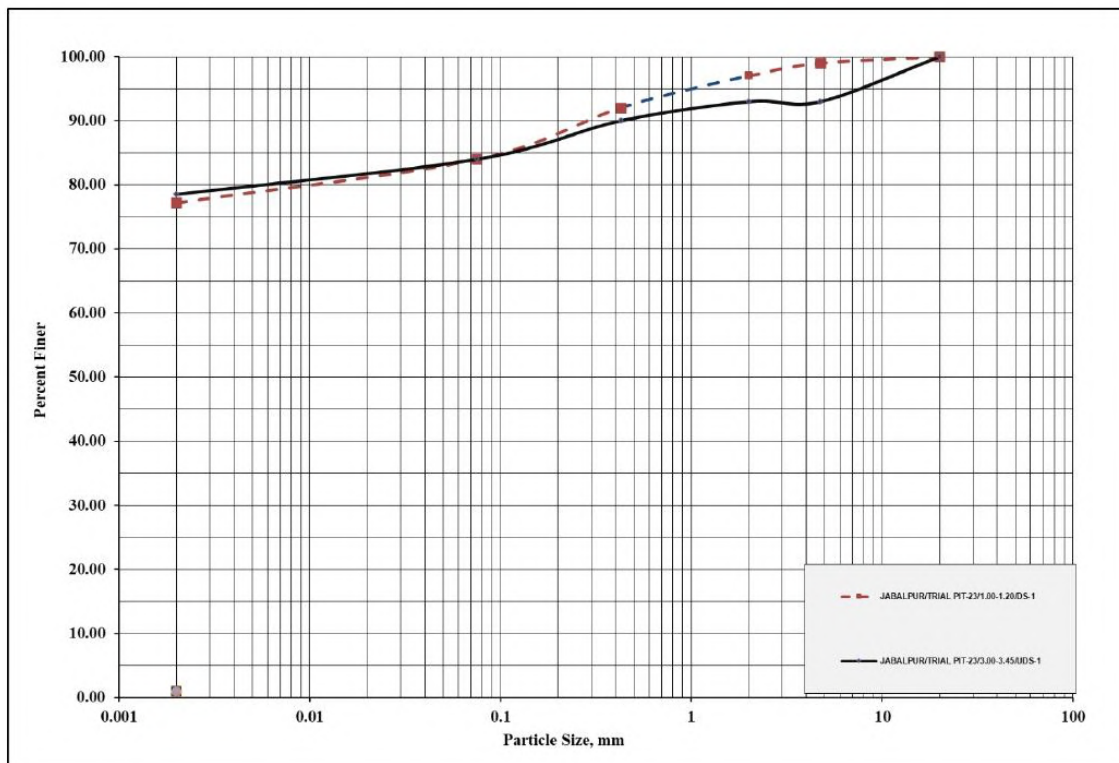


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TEST ON SOIL SAMPLES																				
TRIAL PIT-23		GRAIN SIZE ANALYSIS							ATTEBERG LIMITS			DENSITY & MOISTURE CONTENT					SHEAR PARAMETERS			
Location:	Near BH-25 (BH-1 [1STC, 1MTR])	CLAY	SILT	fine SAND	med SAND	coarse SAND	GRAVEL	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²	ANGLE OF INTERNAL FRICTION, in Degree	FREE SWELL INDEX	
SAMPLE DEPTH IN M	SAMPLE NO.																			IS CLASSIFICATION OF SOIL
1.00-1.20	DS-1	CL	77.20	6.80	8.00	5.00	2.00	1.00	32.52	18.85	13.67	-	20	-	2.60	-	-	-	-	
3.00-3.45	UDS-1	CL	78.50	5.50	6.00	3.00	0.00	7.00	33.64	18.47	15.17	1.74	18	1.47	2.63	0.78	TX	0.44	20.54	7



GRAIN-SIZE DISTRIBUTION CURVE, TP-23

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH

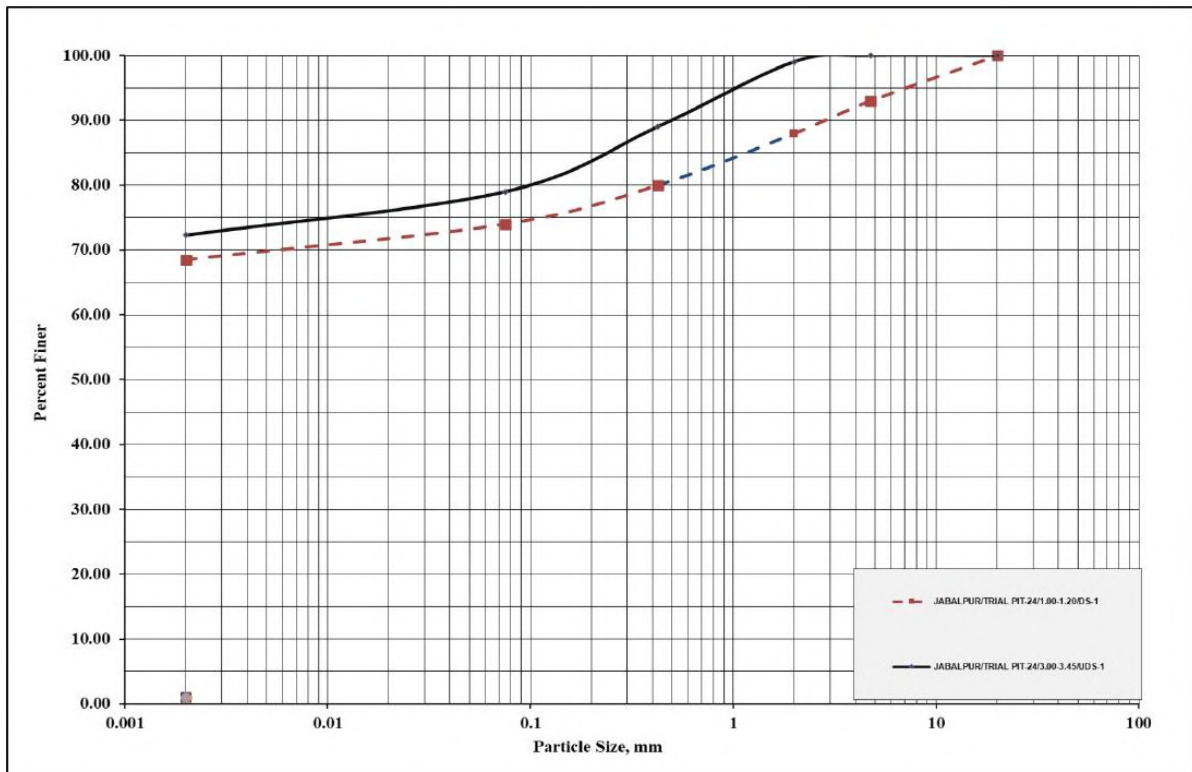


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TEST ON SOIL SAMPLES																				
TRIAL PIT-24			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT				SHEAR PARAMETERS				
Location:	Near BH-26 (BH-2 [1STC, 1MTR])																			
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL	CLAY	SILT	fine SAND	med SAND	coarse SAND	GRAVEL	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²	ANGLE OF INTERNAL FRICTION, in Degree	FREE SWELL INDEX
			<0.002 mm	0.002-0.075	0.075-0.425	0.425-2.00	2.00-4.75	>4.75 mm	%	%	%	%	%	%	%	%	%	%	%	%
			%	%	%	%	%	%	%	%	gm/cc	%	gm/cc	G	e		c	φ	%	
1.00-1.20	DS-1	CL	68.50	5.50	6.00	8.00	5.00	7.00	32.02	18.60	13.42	-	21	-	2.64	-	-	-	-	
3.00-3.45	UDS-1	CL	72.30	6.70	10.00	10.00	1.00	0.00	32.51	19.57	12.94	1.85	25	1.48	2.62	0.77	TX	0.40	21.85	10



GRAIN-SIZE DISTRIBUTION CURVE, TP-24

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH

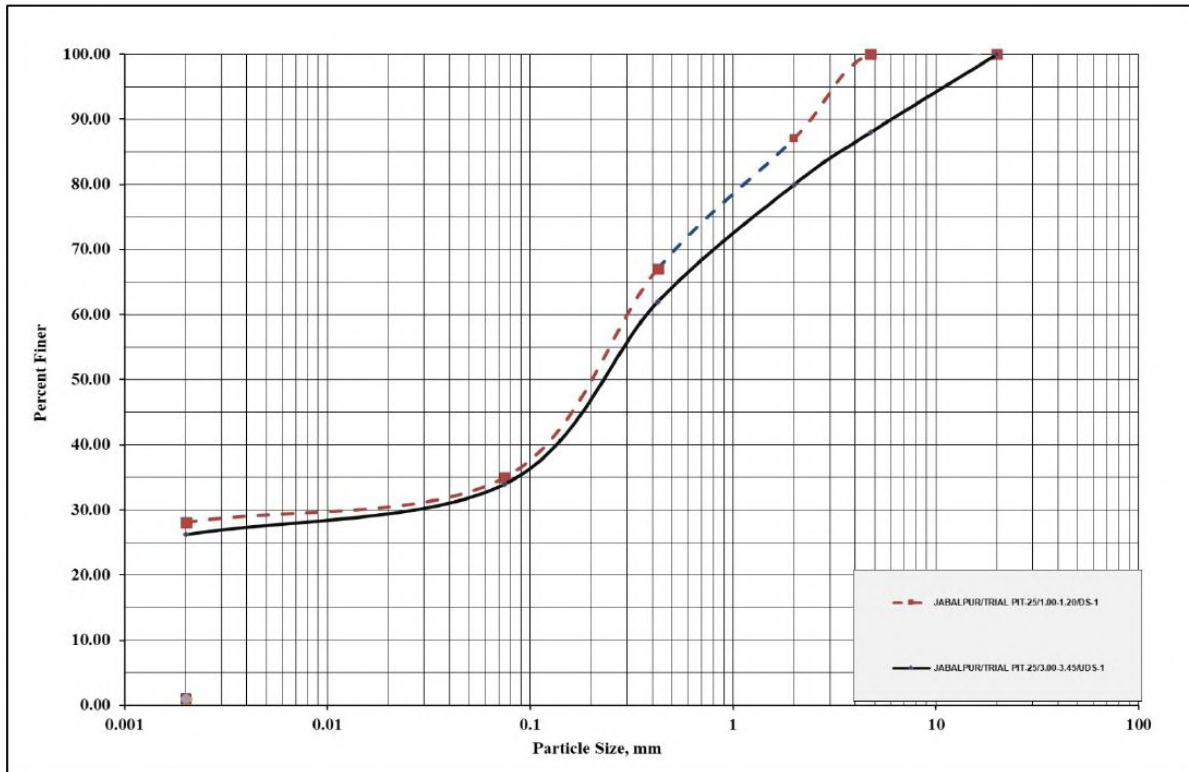


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TEST ON SOIL SAMPLES																				
TRIAL PIT-25			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT				SHEAR PARAMETERS				
Location:	Near BH-27 (BH-3 [1STC, 1MTR])																			
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL	CLAY	SILT	fine SAND	med SAND	coarse SAND	GRAVEL	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²	ANGLE OF INTERNAL FRICTION, in Degree	FREE SWELL INDEX
			<0.002 mm	0.002-0.075	0.075-0.425	0.425-2.00	2.00-4.75	>4.75 mm	%	%	%	gm/cc	%	gm/cc	G	e		c	φ	%
1.00-1.20	DS-1	SC	28.10	6.90	32.00	20.00	13.00	0.00	32.30	18.90	13.40	-	10	-	2.61	-	-	-	-	
3.00-3.45	UDS-1	SC	26.20	7.80	28.00	18.00	8.00	12.00	33.17	19.84	13.33	1.78	13	1.58	2.63	0.67	TX	0.28	23.42	8



GRAIN-SIZE DISTRIBUTION CURVE, TP-25

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH

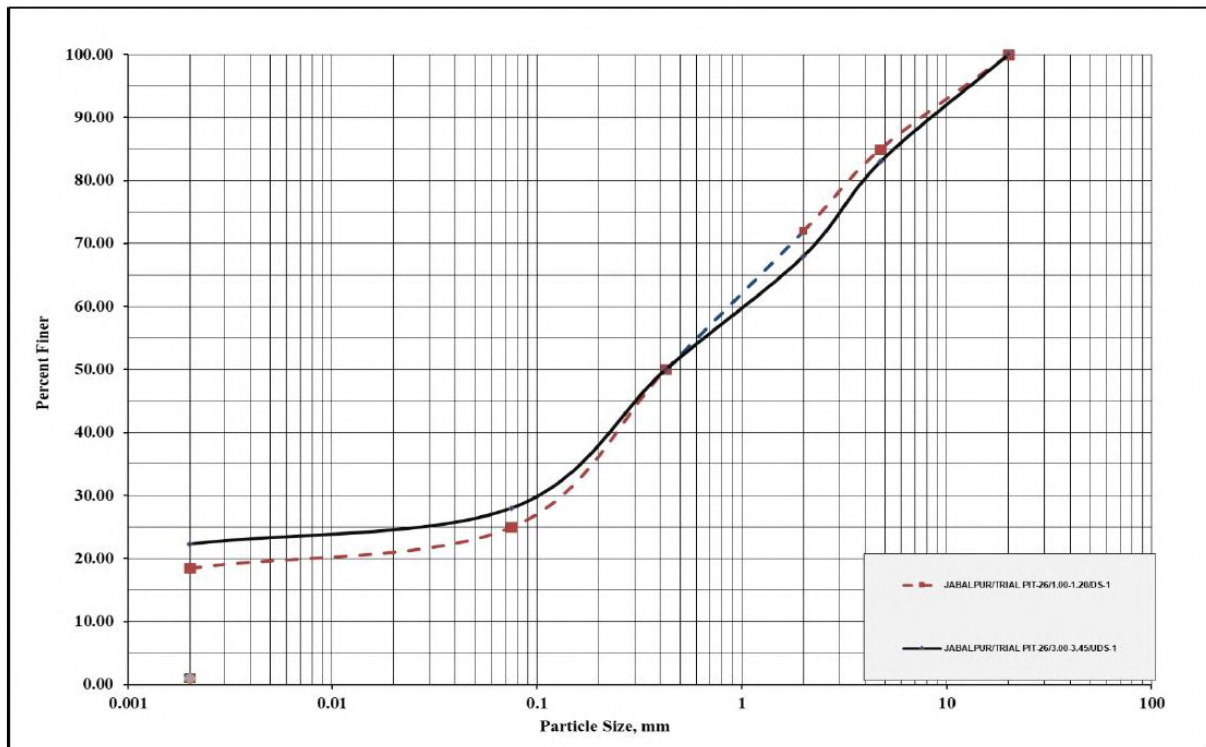


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TEST ON SOIL SAMPLES																				
TRIAL PIT-26			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT				SHEAR PARAMETERS				
Location:	Near BH-28 (BH-4 [1STC, 1MTR])																			
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL	CLAY	SILT	fine SAND	med SAND	coarse SAND	GRAVEL	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²	ANGLE OF INTERNAL FRICTION, in Degree	FREE SWELL INDEX
			<0.002 mm	0.002-0.075	0.075-0.425	0.425-2.00	2.00-4.75	>4.75 mm												
1.00-1.20	DS-1	SC	18.50	6.50	25.00	22.00	13.00	15.00	28.50	18.79	9.71	-	10	-	2.61	-	-	-	-	-
3.00-3.45	UDS-1	SC	22.30	5.70	22.00	18.00	15.00	17.00	30.67	19.25	11.42	1.84	13	1.63	2.62	0.61	TX	0.23	26.17	11



GRAIN-SIZE DISTRIBUTION CURVE, TP-26

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH

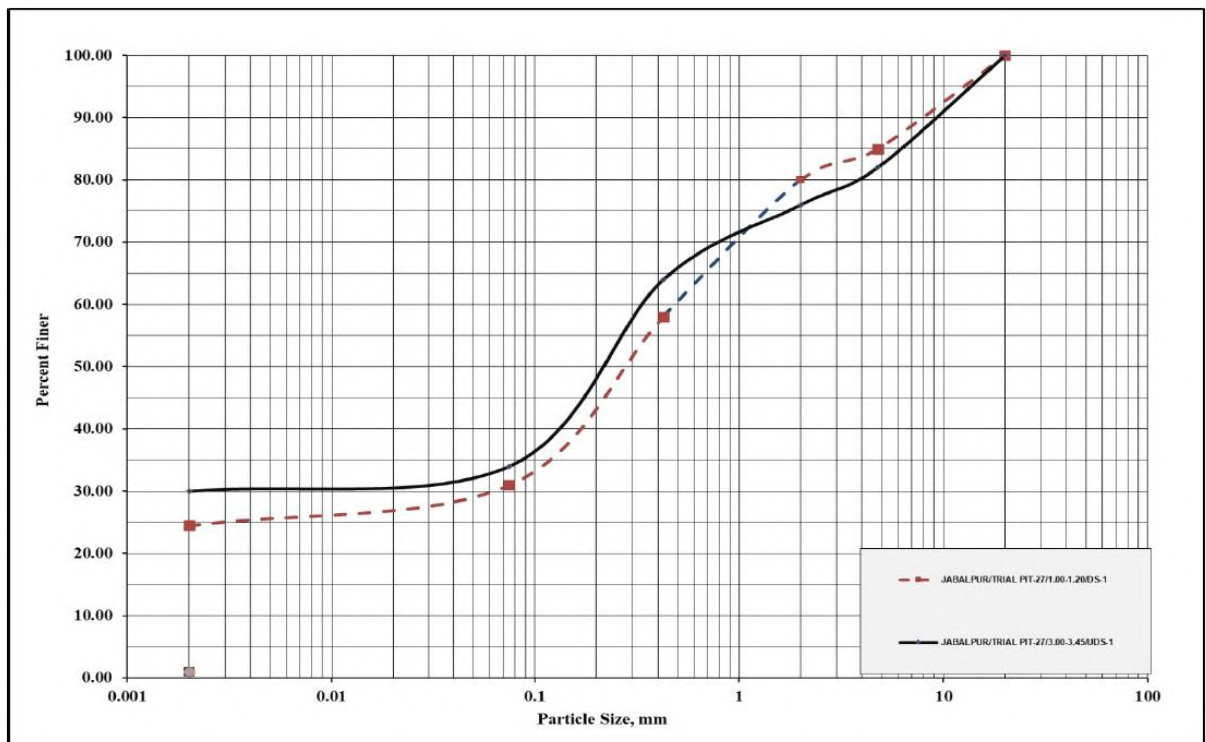


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TEST ON SOIL SAMPLES																				
TRIAL PIT-27			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT				SHEAR PARAMETERS				
Location:	Near BH-29 (BH-5 [1STC, 1MTR])		GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT				SHEAR PARAMETERS				
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL	CLAY	SILT	fine SAND	med SAND	coarse SAND	GRAVEL	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²	ANGLE OF INTERNAL FRICTION, in Degree	FREE SWELL INDEX
			<0.002 mm	0.002-0.075	0.075-0.425	0.425-2.00	2.00-4.75	>4.75 mm	%	%	%	%	%	g/cm ³	%	g/cm ³	G	e		c
1.00-1.20	DS-1	SC	24.50	6.50	27.00	22.00	5.00	15.00	30.02	19.83	10.19	-	10	-	2.61	-	-	-	-	-
3.00-3.45	UDS-1	SC	30.00	4.00	30.00	12.00	6.00	18.00	30.48	20.18	10.30	1.79	12	1.60	2.63	0.65	TX	0.25	26.74	6



GRAIN-SIZE DISTRIBUTION CURVE, TP-27

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH

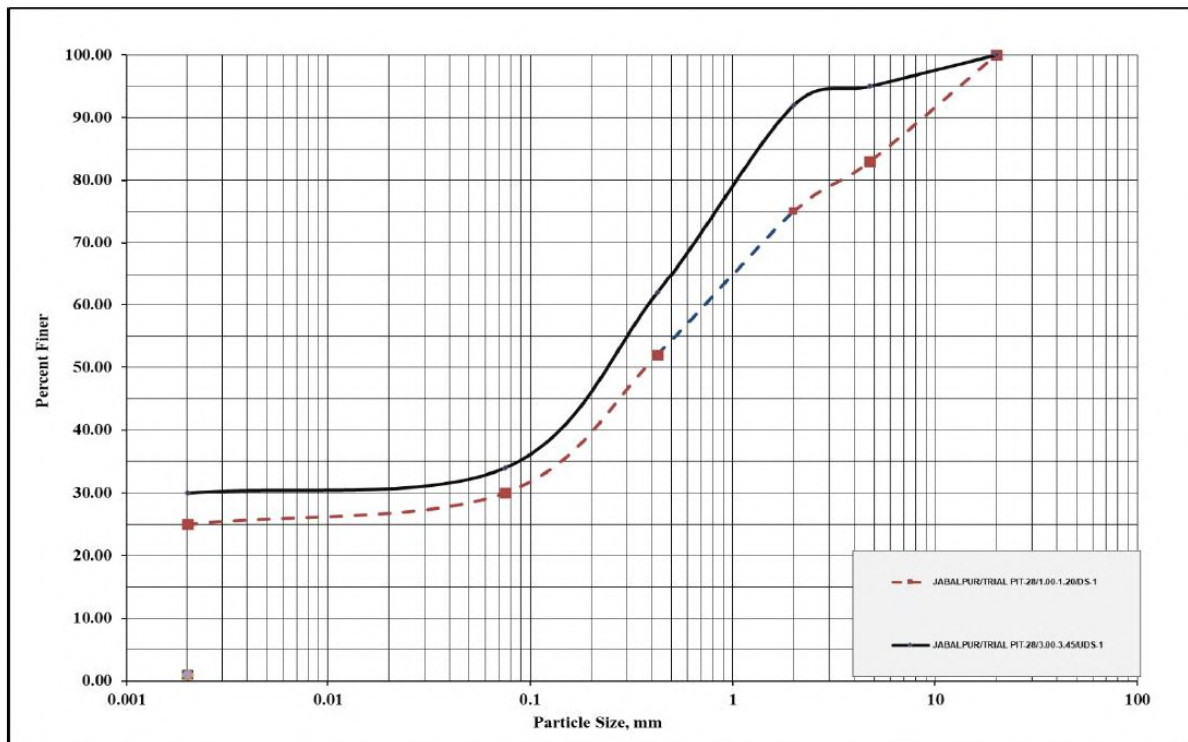


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TEST ON SOIL SAMPLES																				
TRIAL PIT-28			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT				SHEAR PARAMETERS		FREE SWELL INDEX		
Location:	Near BH-30 (BH-01 [JAK RIF])		CLAY <0.002 mm %	SILT 0.002-0.075 %	fine SAND 0.075-0.425 %	med SAND 0.425-2.00 %	coarse SAND 2.00-4.75 %	GRAVEL >4.75 mm %	LIQUID LIMIT %	PLASTIC LIMIT %	PLASTICITY INDEX %	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE		COHESION, in kg/cm ²	ANGLE OF INTERNAL FRICTION, in Degree
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL										gm/cc	%	gm/cc	G	e		c	φ	%
1.00-1.20	DS-1	SC	25.00	5.00	22.00	23.00	8.00	17.00	30.26	18.94	11.32	-	13	-	2.64	-	-	-	-	-
3.00-3.45	UDS-1	SC	30.00	4.00	28.00	30.00	3.00	5.00	31.39	19.25	12.14	1.83	10	1.66	2.63	0.58	TX	0.23	26.74	11



GRAIN-SIZE DISTRIBUTION CURVE, TP-28

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH

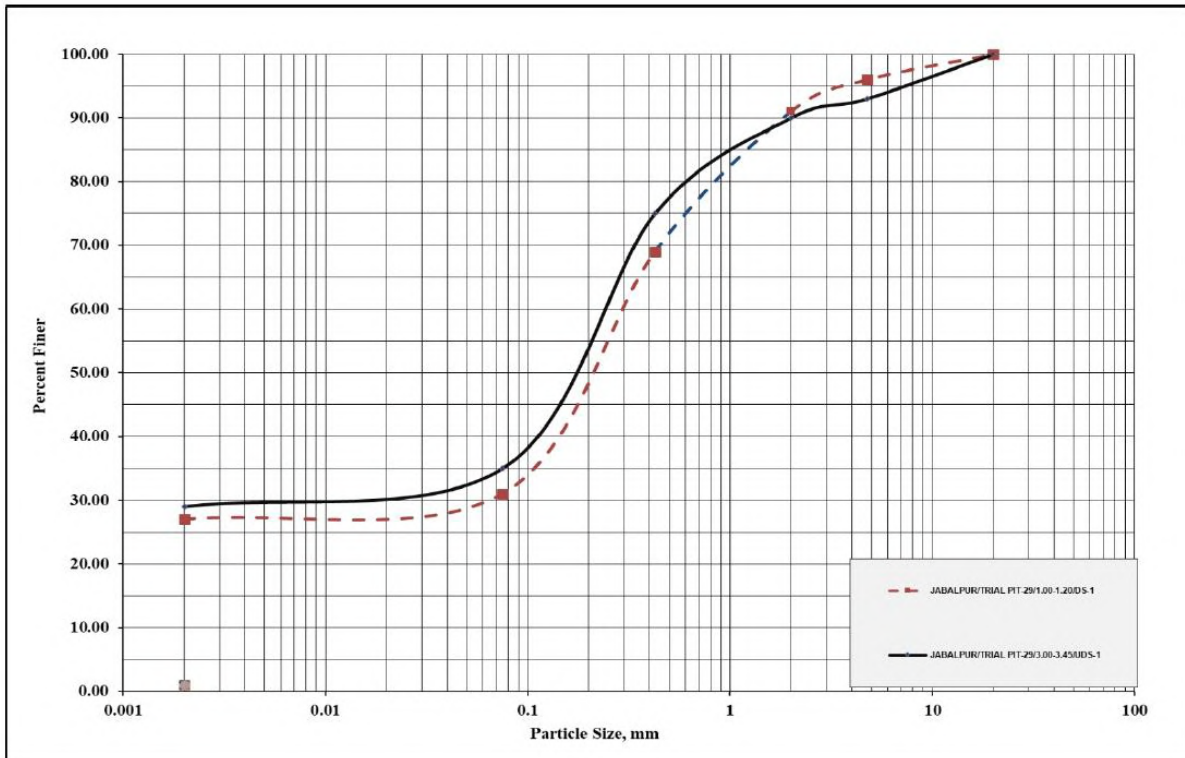


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TEST ON SOIL SAMPLES																				
TRIAL PIT-29			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT				SHEAR PARAMETERS			FREE SWELL INDEX	
Location:	Near BH-31 (BH-02 [JAK RIF])		CLAY <0.002 mm	SILT 0.002-0.075	fine SAND 0.075-0.425	med SAND 0.425-2.00	coarse SAND 2.00-4.75	GRAVEL >4.75 mm	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²		ANGLE OF INTERNAL FRICTION, in Degree
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL																		
1.00-1.20	DS-1	SC	27.00	4.00	38.00	22.00	5.00	4.00	30.18	19.74	10.44	-	12	-	2.63	-	-	-	-	
3.00-3.45	UDS-1	SC	29.00	6.00	40.00	15.00	3.00	7.00	31.41	19.63	11.78	1.83	13	1.62	2.64	0.63	TX	0.24	25.61	10



GRAIN-SIZE DISTRIBUTION CURVE, TP-29

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH

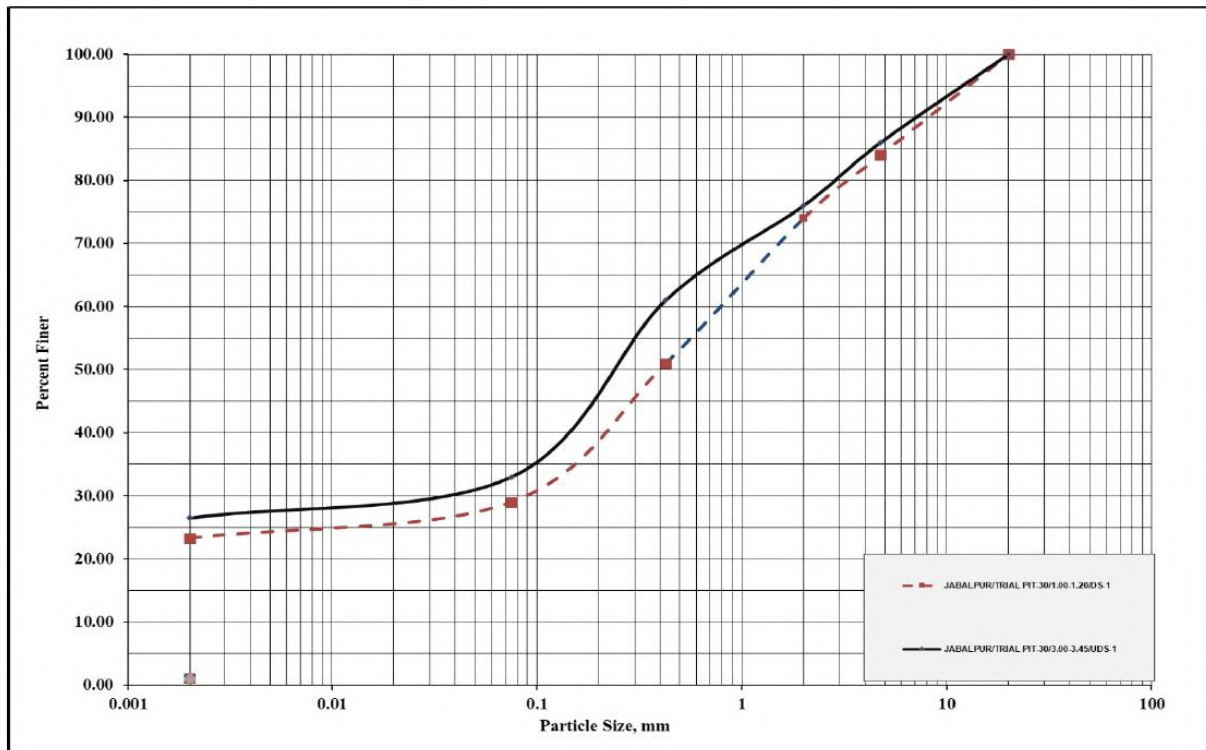


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TEST ON SOIL SAMPLES																			
TRIAL PIT-30			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT				SHEAR PARAMETERS			
Location:	Near BH-32 (BH-03 [JAK RIF])																		
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL	CLAY	SILT	fine SAND	med SAND	coarse SAND	GRAVEL	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²	ANGLE OF INTERNAL FRICTION, in Degrees
			<0.002 mm	0.002-0.075	0.075-0.425	0.425-2.00	2.00-4.75	>4.75 mm	%	%	%	%	%	gm/cc	%	gm/cc	G	e	
1.00-1.20	DS-1	SC	23.30	5.70	22.00	23.00	10.00	16.00	30.02	18.78	11.24	-	12	-	2.63	-	-	-	-
3.00-3.45	UDS-1	SC	26.50	6.50	28.00	15.00	10.00	14.00	30.39	18.62	11.77	1.88	10	1.71	2.64	0.54	TX	0.23	26.47



GRAIN-SIZE DISTRIBUTION CURVE, TP-30

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH

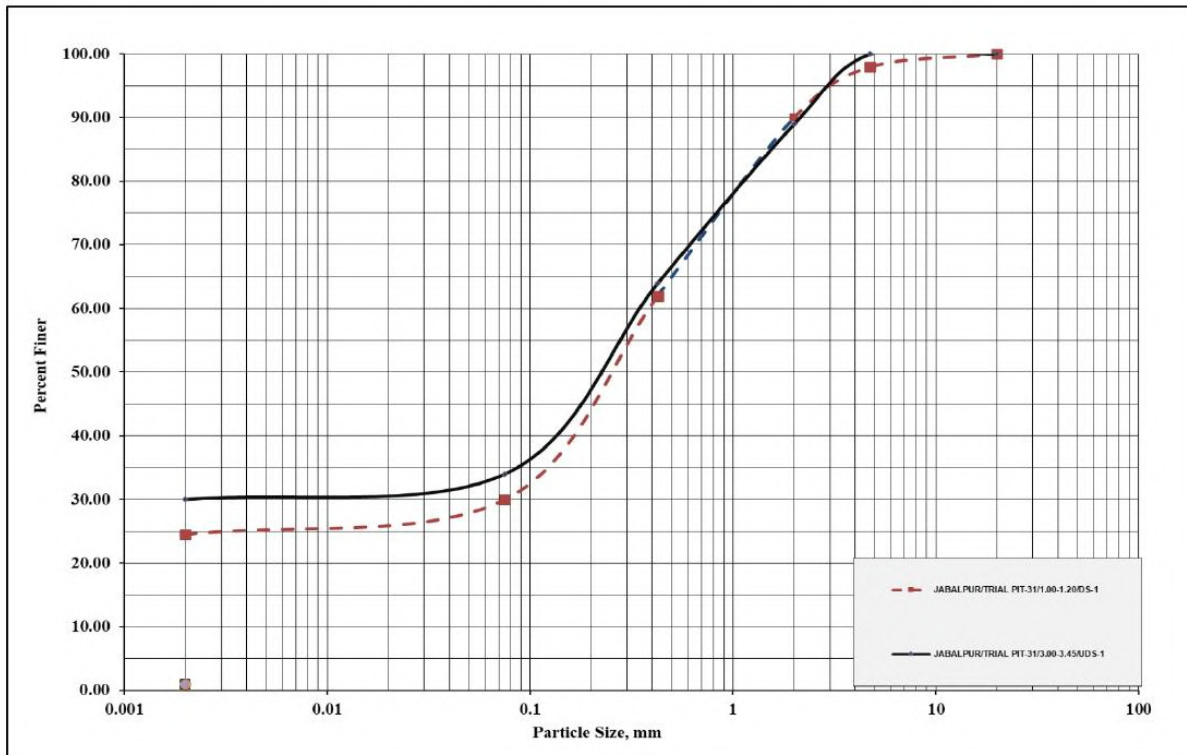


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TEST ON SOIL SAMPLES																				
TRIAL PIT-31			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT				SHEAR PARAMETERS				
Location:	Near BH-33 (BH-04 [JAK RIF])		GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT				SHEAR PARAMETERS				
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL	CLAY	SILT	fine SAND	med SAND	coarse SAND	GRAVEL	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²	ANGLE OF INTERNAL FRICTION, in Degree	FREE SWELL INDEX
			<0.002 mm	0.002-0.075	0.075-0.425	0.425-2.00	2.00-4.75	>4.75 mm	%	%	%	%	%	gm/cc	%	gm/cc	G	e	c	φ
1.00-1.20	DS-1	SC	24.50	5.50	32.00	28.00	8.00	2.00	31.78	18.81	12.97	-	8	-	2.61	-	-	-	-	-
3.00-3.45	UDS-1	SC	30.00	4.00	30.00	25.00	11.00	0.00	33.49	18.48	15.01	1.81	10	1.65	2.63	0.60	TX	0.18	28.74	6



GRAIN-SIZE DISTRIBUTION CURVE, TP-31

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH

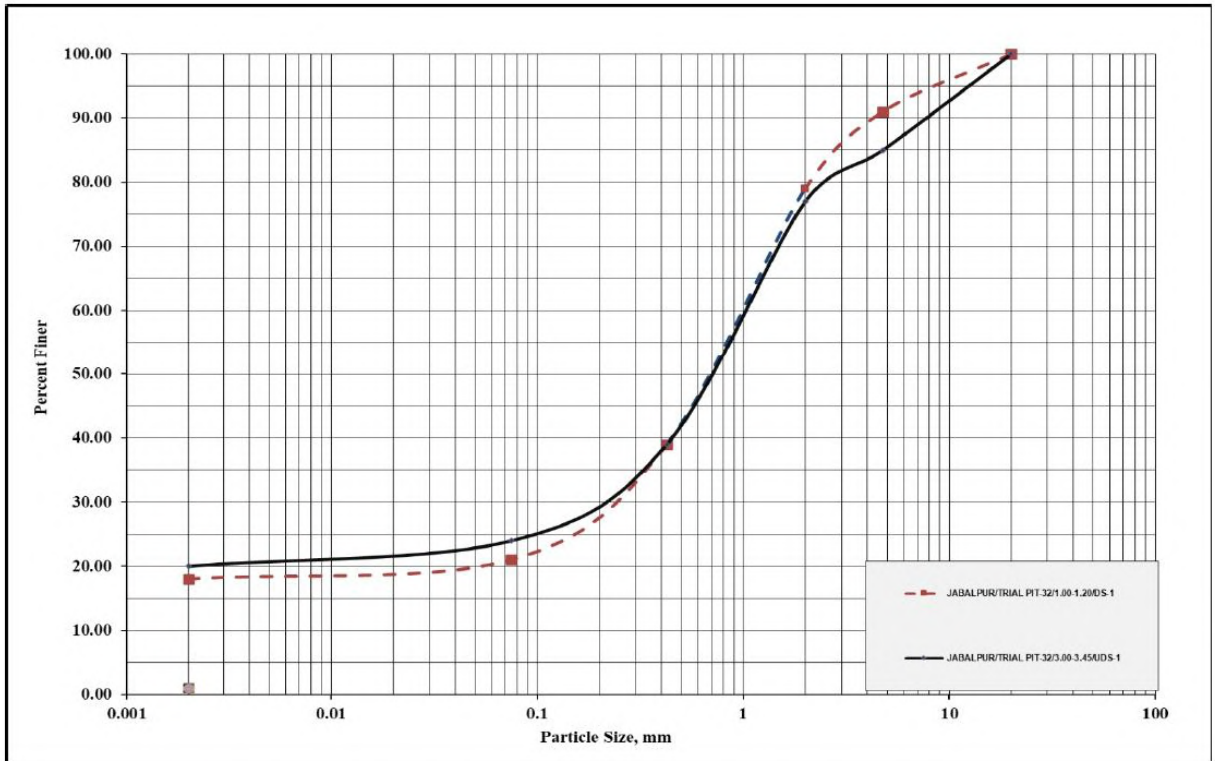


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TEST ON SOIL SAMPLES																				
TRIAL PIT-32			GRAIN SIZE ANALYSIS						ATTERBERG LIMITS			DENSITY & MOISTURE CONTENT					SHEAR PARAMETERS			
Location:	Near BH-34 (BH-05 [JAK RIF])		CLAY <0.002 mm	SILT 0.002-0.075	fine SAND 0.075-0.425	med SAND 0.425-2.00	coarse SAND 2.00-4.75	GRAVEL >4.75 mm	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	BULK DENSITY	MOISTURE CONTENT	DRY DENSITY	SPECIFIC GRAVITY	VOID RATIO	TEST TYPE	COHESION, in kg/cm ²	ANGLE OF INTERNAL FRICTION, in Degree	FREE SWELL INDEX
SAMPLE DEPTH IN M	SAMPLE NO.	IS CLASSIFICATION OF SOIL																		
			%	%	%	%	%	%	%	%	gm/cc	%	gm/cc	G	e		c	φ	%	
1.00-1.20	DS-1	SC	18.00	3.00	18.00	40.00	12.00	9.00	29.75	19.84	9.91	-	8	-	2.63	-	-	-	-	
3.00-3.45	UDS-1	SC	20.00	4.00	15.00	38.00	8.00	15.00	30.49	18.73	11.76	1.75	12	1.56	2.64	0.69	TX	0.19	28.84	6



GRAIN-SIZE DISTRIBUTION CURVE, TP-32

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



19.0 SITE PHOTOGRAPHS



SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



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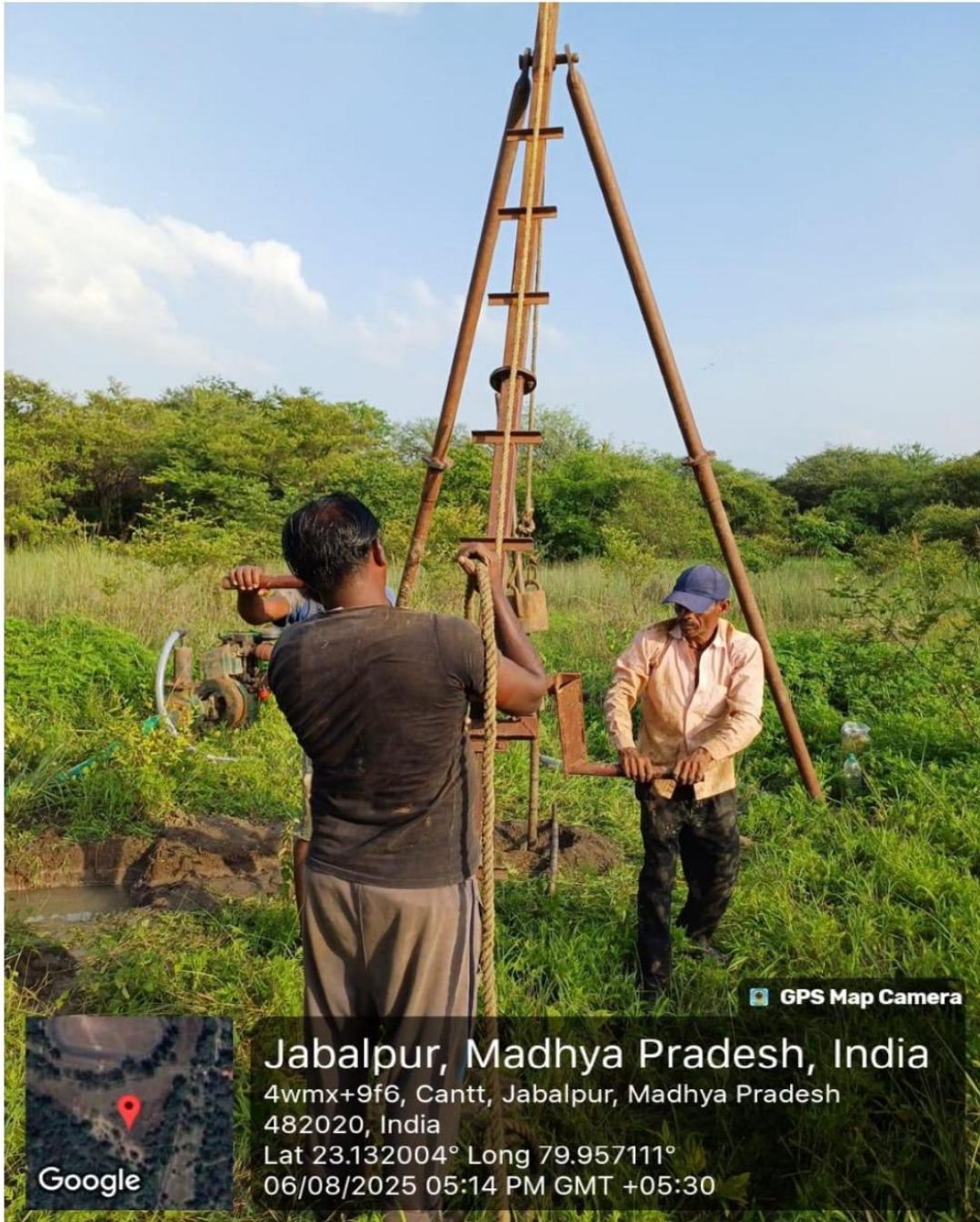
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GPS Map Camera



Jabalpur, Madhya Pradesh, India
4xp4+4f4 War Memorial, Bilhari, Jabalpur, Madhya Pradesh
482001, India
Lat 23.135495° Long 79.955468°
11/08/2025 12:13 PM GMT +05:30

**SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR,
MADHYA PRADESH**



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Jabalpur, Madhya Pradesh, India
4wqr+x7c, Cantt, Jabalpur, Madhya Pradesh 482001, India
Lat 23.139385° Long 79.94148°
15/08/2025 09:29 AM GMT +05:30

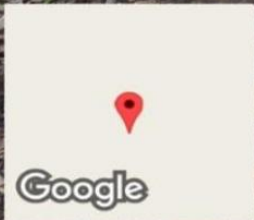
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Jabalpur, Madhya Pradesh, India
4wqv+h72, Cantt, Jabalpur, Madhya Pradesh 482001,
India
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17/08/2025 12:29 PM GMT +05:30

GPS Map Camera

SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR, MADHYA PRADESH



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Jabalpur, Madhya Pradesh, India
4wqr+x7c, Cantt, Jabalpur, Madhya Pradesh 482001, India
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18/08/2025 10:18 AM GMT +05:30

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******END OF REPORT******

For. Shiva Testing & Research Laboratory Pvt. Ltd.

Akshya Sharm Director

Authorized Signatory
STR Labs



Geotech. Expert
STR Labs

**SOIL INVESTIGATION WORK AT DIFFERENT LOCATION AT JABALPUR,
MADHYA PRADESH**

REFERENCE TO DRAWINGS						
S. NO	DESCRIPTION	DRG. NO.	SHT. NO.	DATE	REV. DATE	REMARKS
1	LIST OF DRAWINGS AND NOTES	CEJZLIST/EPC/231	0101	01 NOV 2025		
SITE PLAN						
1	EXTERNAL SITE PLAN SHOWING BR SERVICES	CEJZSP/BR-020	0101	31 OCT 2025		
2	EXTERNAL SITE PLAN SHOWING EM SERVICES	CEJZSP/IE-020	0101	31 OCT 2025		
ARCHITECTURAL DRAWINGS						
A. SINGLE MEN ACCN (270 ORs & 30 VAs)						
1	GROUND FLOOR PLAN & SIDE ELEVATIONS	CEJZJAE/PC/081	14	04 NOV 2025		
2	TYPICAL FLOOR PLAN (FIRST FLOOR TO 3RD FLOOR LVL) ROOF PLAN FRONT ELEVATION	CEJZJAE/PC/081	24	04 NOV 2025		
3	REAR ELEVATION & 3D VIEW	CEJZJAE/PC/081	34	04 NOV 2025		
4	1200s (TYPICAL UNIT) DETAIL DRAWING SECTION & MISCELLANEOUS DETAILS	CEJZJAE/PC/081	44	04 NOV 2025		
SCHEDULE OF FINISHES						
1	SCHEDULE OF FINISHES	CEJZJAE/PC/081/01	1/1	04 NOV 2025		

- CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS BEFORE EXECUTION OF THE WORK
- FIGURED DIMENSIONS SHALL BE FOLLOWED
- ALL DIMENSIONS ARE GIVEN IN MM UNLESS OTHERWISE SPECIFIED
- ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH EACH OTHER
- EXECUTIVE AUTHORITY SHALL CHECK THE DRAWINGS BEFORE TAKING THE EXECUTION IN HAND
- GROUND LEVEL SHOWN IN THIS DRAWING IS THE FINISHED GROUND LEVEL TO WHICH NATURAL GROUND LEVEL SHALL BE CUT/FILLED AS DIRECTED BY THE ENGINEER - IN - CHARGE AND AS PER SPECIFICATIONS IN TENDER
- DETAILS BELOW FF.L AT GROUND FLOOR LEVEL SHALL BE FOLLOWED AS PER STRUCTURAL DRAWINGS
- DPC SHALL NOT BE PROVIDED TO ALL WALLS BELOW FLOOR LEVEL AS APPLICABLE
- DETAILS NOT SHOWN IN MAIN DRAWINGS SHALL BE PROVIDED AS SHOWN IN RELEVANT TYPICAL DETAILS DRAWINGS INCLUDED IN REFERENCE LIST OF DRAWINGS
- ANY DETAILS SHOWN IN ONE VIEW (PLAN/ELEVATION/SECTION) WILL BE APPLICABLE TO OTHER VIEWS (PLAN/ELEVATION/SECTION) EVEN IF IT IS NOT SHOWN IN ANY ONE OF THE VIEWS
- DETAILS OF ONE BLOCK/OTR TO BE FOLLOWED FOR OTHER BLOCK/OTR UNLESS SPECIFIED. SINGLE UNIT/OTR SHALL BE FOLLOWED FOR OTHER UNITS QTRs IN CASE OF SINGLE ACCN & MD ACCN
- IN CASE OF DISCREPANCY IN SIZE OF ROOM ONLY EXTERNAL DIMENSIONS SHALL BE CONSIDERED IRRESPECTIVE OF WHAT EVER SHOWN INSIDE ROOM
- IN CASE OF ANY MISSING DETAILS, STANDARD ENGINEERING PRACTICE SHALL BE FOLLOWED.
- LO - LIFT OPENING 900 X 2100 OR AS PER MANUFACTURER'S SPECIFICATIONS SHALL BE PROVIDED IN ALL LIFTS.
- GRANITE CLADDING SHALL BE PROVIDED ON LIFTS FACADE AS PER DETAILS/SPECIFICATIONS
- 150 Ø UPVC PIPE OF 450MM LONG SPOUT SHALL BE CONNECTED TO NEAREST 150 Ø RAMP TO DRAIN OUT WATER FROM BALCONIES, PASSAGES/VERANDHAS
- DOORS AND WINDOWS MAY BE REFERRED EITHER FROM MAIN PLAN OR FROM DETAILED PLAN WHENEVER APPLICABLE
- IN CASE OF NON AVAILABILITY OF WINDOW WIDTH AS PER THE MARKING IN THE PLAN ACTUAL WIDTH OF WINDOW AS AVAILABLE AT THE LOCATION OF WINDOW SHALL BE FOLLOWED FROM TD DRG OF WINDOW EXCEPT FOR THE SIZE OF WINDOW IN TD.
- ELEVATION OF WINDOWS AND DOORS SHALL BE AS PER DETAILS / TO DRAWING IRRESPECTIVE OF WHAT EVER SHOWN IN ELEVATIONS
- SIZES OF ALL ROOMS AND OTHER DETAILS INCLUDING THE DOORS, WINDOWS, VENTILATOR SHALL BE FOLLOWED AS PER ARCHITECTURAL DRAWINGS, IRRESPECTIVE OF WHAT EVER SHOWN IN SCHEDULE OF FINISHES AND ELECTRIFICATION PLAN.
- DOORS AND WINDOWS SHALL BE PROVIDED AS PER THE MAIN PLAN OR FROM THE DETAILED PLAN WHATEVER APPLICABLE. MAXIMUM LIGHTING & VENTILATION SHALL BE TAKEN INTO CONSIDERATION WHILE PROVIDING THE DOORS & WINDOWS
- ALL DOORS AND WINDOWS SHALL BE PROVIDED WITH ALL NECESSARY FITTINGS AND FIXTURES WITH LOCKING ARRANGEMENTS.
- ALL WINDOWS / VENTS SHALL BE PROVIDED WITH MS GRILLS/ GUARDS BARS, FOR GRILLS/ BARS, REFER STANDARDS AND CODES
- IN CASE OF ANY MISSING DETAILS, STANDARD ENGINEERING PRACTICE SHALL BE FOLLOWED.
- 900 WIDE PLINTH PROTECTION WITH SAUCER DRAIN SHALL BE PROVIDED ALL AROUND THE BUILDING EXCEPT FOR RAMP & STEPS.
- MINIMUM 900 WIDE CHAJJA SHALL BE PROVIDED TO ALL EXTERNAL DOORS / WINDOWS / VENTILATORS UNLESS SPECIFIED IN THE DRAWINGS
- DRIP COURSE SHALL BE PROVIDED AROUND TO ALL RCC PROJECTIONS
- SKIRTING / DADO SHALL BE EXTENDED ON JAMBS AND CILL WHEREVER APPLICABLE
- ALL DUCTS/SHAFTS SHALL BE PROPERLY SEALED AND FIRE STOPPED AT ALL FLOOR LEVELS BY STEEL PLATES WITH REQUIRED FIRE RATINGS AS PER NBC 2016
- DR. DENOTES DRAPERY ROD AND IT SHALL BE OF 25MM Ø IRRESPECTIVE OF WHAT EVER SHOWN IN DRGS UNLESS OTHERWISE SPECIFIED AND DR SHALL BE PROVIDED IN ALL DOORS AND WINDOWS INTERNALLY IRRESPECTIVE OF WHAT EVER MARKED IN DRAWINGS. NECESSARY STD SPECS SHALL BE FOLLOWED FOR THE MATERIALS OF THE DRAPERY ROD.
- THE FOLLOWING PROVISIONS SHALL BE CATERED IN TOILETS:
 - ALROUND DADO SHALL BE PROVIDED TO ALL INTERNAL WALLS OF TOILET MIN UP TO UNTEL LEVEL OR AS PER SCHEDULE OF FINISHES
 - STAINLESS STEEL TOWEL RAIL (MIN 600MM LENGTH) SHALL BE PROVIDED IN ALL TOILETS INCLUDING BATH & WC.
 - 2 NOS OF SOAP DISH TO BE PROVIDED IN EACH TOILET INCLUDING BATH & WC.
 - 1 COMMON BIB TAP TO BE PROVIDED IN EACH TOILET
 - NECESSARY SLOPE SHALL BE MAINTAINED ON FLOORS TOWARDS THE FLOOR TRAPS TO DRAIN OUT THE WATER.
 - READYMADE WPC TOILET CABINET OF SIZE 300X450X150 AS SPECIFIED/AS PER STANDARD MANUFACTURER'S DETAILS SHALL BE PROVIDED IN ALL TOILETS.
 - STANDARD PEG SET OF SIX SHALL BE PROVIDED TO THE BACK SIDE OF DOOR OF EACH WC/ BWC UNLESS SPECIFIED
 - ALL PIPE LINES SHALL BE CONCEALED
 - EWIC - EUROPEAN WATER CLOSET WITH LOW HIGH FLUSHING CISTERN, EACH EWIC SHALL BE PROVIDED WITH No. TAP & 1 No. NTF UNLESS OTHERWISE SPECIFIED
 - WPC CUPBOARDS SHALL BE PROVIDED BELOW WASH BASIN AREA AS PER STANDARD MANUFACTURER'S DETAILS AND INSTRUCTIONS
 - BOTTLE TRAP SHALL BE PROVIDED WITH ALL WBS AND SINKS
 - LOCAL SUNK SHALL BE MIN 300X300X150 AND FOR OTHER DETAILS REFER TD.
- LOCATION OF WP, SP, VP, GT, MA IS TENTATIVE. ACTUAL LOCATION WILL BE DECIDED BY ENGINEER - IN - CHARGE AS PER SITE CONDITIONS DURING EXECUTION
- THE FLOOR SLOPE SHALL BE PROVIDED IN VERANDHAS / BATHS/ WCs/ TOILETS TOWARDS RWP/NTFT.
- ALL RWP SHALL BE 150 DIA UPVC AS SPECIFIED/STANDARD MANUFACTURER DETAILS/STD SHALL BE REFERRED FOR FIXING RWPs.
- ALL PLASTER EDGES SHALL BE ROUNDED OFF.
- LADDER TO ACCESS WATER TANK / TERRACE OF MUMPTY / LIFT MACHINE ROOM SHALL BE PROVIDED AS SHOWN IN DRAWINGS OR AS DIRECTED BY THE ENGINEER - IN - CHARGE.
- LOFTS ALONG WITH SHUTTER SHALL BE PROVIDED WITH ALL NECESSARY FITTINGS IN RESPECTIVE ROOMS. WARDROBE (WRDB) AS SHOWN IN MAIN PLAN OR AS PER DIRECTION OF ENGR - IN - CHARGE.
- ALL BALCONIES / VERANDHAS SHALL BE PROVIDED WITH WIRE ROPE FOR DRYING CLOTHES IN SINGLE ACCN. ENGINEER - IN - CHARGE SHALL ENSURE THIS DURING EXECUTION
- LAYOUT OF VEHICLES/ FURNITURE SHOWN IN DRGS ARE SCHEMATIC AND FOR REFERENCE ONLY
- STEEL DOOR - 80" DOOR SHALL BE FIRE RESISTANT AND SHALL BE AS PER SPECIFICATIONS RECOMMENDED BY CEES UNDER THE CONTROL OF MAINTENANCE PERSON. CHECKERED PLATES SHALL BE PROVIDED AT ALL FLOOR/ROOF SLAB LVLS IN ALL SHAFTS.
- 18-20 mm PREPOUSHED GRANITE CILL WITH ROUNDED EDGE SHALL BE PROVIDED TO ALL CILL OF WINDOWS AND VENTILATORS INCLUDING RCC PROJECTION AT WINDOWS/WHENEVER SHOWN
 - CILL BEARING SHALL BE 50 mm ON EITHER SIDE IN ADDITION TO THE OPENING OF WINDOWS & VENTS

- DOOR, WINDOW AND C.B. - ALL JOINERY INCLUDING WINDOWS, DOORS, KITCHEN CABINET, CUPBOARDS AND BUILT - IN FURNITURE SHOULD BE COMPOSITE AND SYSTEM MADE STRUCTURE AND FACTORY MADE FOR ZERO INGRESS OF WATER. MAKES SHALL BE AS PER SPECIFICATIONS. NO LOCAL ASSEMBLY SHALL BE ALLOWED. HANDLES, FITTINGS & LOCKING ARRANGEMENTS OF DOORS, WINDOWS, CABINETS & ALMIRAH/ CUPBOARDS & KITCHEN CABINETS AVAILABLE IN MARKET & APPROVED BY ENGINEER - IN - CHARGE WITHOUT CHANGE IN COST.
 - ALL PARAPET WALLS SHALL BE PROVIDED WITH COPING TO PROTECT IT FROM WEATHERING EFFECTS. NECESSARY WEATHERING ELEMENTS SHALL BE PROVIDED TO ARREST THE FLOW OF RAIN WATER THROUGH PARAPET WALLS. 1200MM HIGH PARAPET/ RAILING SHALL BE PROVIDED IN MULTI - STOREY BUILDING LONG BEING A MANDATORY SAFETY NORMS AS PER NBC 2016. NECESSARY RWP SHALL BE PROVIDED TO DRAIN OUT WATER FROM THE ROOF
 - KITCHEN COUNTERS, WINDOW CILL AND STAIR TREADS/RISERS - ALL COUNTER TOP SLABS IN BATHROOMS & KITCHEN SHALL BE PROCURED READYMADE IN SINGLE PIECE WITH FACTORY MADE NOISING, OFFSETS & ROUNDED. SINGLE PIECE FACTORY FABRICATED TILE/STONE DULY CUT AND POLISHED WITH PROPER NOISING AND TO BE PROVIDED IN STAIRCASE WITH DARK COLOURED TREADS AND LIGHT COLOURED RISERS.
 - THE LOCATION, ITEMS AND QUANTITIES OF ENM FITTINGS, FIXTURES AND ROUTING OF PIPES, CABLE AND DUCTS ETC MARKED ARE TENTATIVE AND FOR GUIDANCE ONLY. THE SAME MUST BE APPROVED BY THE ENGINEER - IN - CHARGE DURING THE EXECUTION OF WORK AS PER THE REQUIREMENT/1 SCHEDULE.
 - ALL STRUCTURAL MEMBERS (COL, PL, LB, RB ETC) AND ALL OTHER STR DETAILS SHALL BE PROVIDED AS PER STRUCTURAL DRAWINGS. IRRESPECTIVE OF WHAT EVER SHOWN IN ARCHITECTURAL DRAWINGS, IN CONSIDERATION WITH THE ARCHITECTURAL ASPECTS OF BUILDING. IN CASE OF ANY DISCREPANCY ENGINEER-IN-CHARGE SHALL CONTACT DIRECTOR (ARCH) OF THIS HEAD QUARTER BEFORE STARTING THE EXECUTION AT GROUND.
- FIRE FIGHTING**
- PREFIGHTING NORMS SHALL BE FOLLOWED AS PER GOO DEEDS/LETTERS/INSTRUCTIONS PERTAINING TO THIS PROJECT WORK
 - ANALOUCE PERTAINING TO THIS WORK SHALL BE CONSIDERED FOR DETERMINING THE FIRE AND LIFE SAFETY OF THE PROPOSED BUILDING. EXECUTIVES & ENGINEER-IN-CHARGE SHALL ADVISE THE FIRE AND LIFE SAFETY NORMS AS PER CEES RECOMMENDATION AND NBC
 - RESERVE SPACE: A MINIMUM OPEN SPACE OF 6 METERS WITH MINIMUM ABILITY TO WITHSTAND A PRESSURE OF 0.05 MPa SHALL BE PROVIDED AT THE POINT OF ENTRY OF THE BUILDING TO FACILITATE FREE MOVEMENT OF FIREFIGHTING RESOURCES APPLICABLE IN THE CASE OF EMERGENCY OPEN SPACE ESSENTIALLY SHALL NOT BE USED AS PARKING SPACE UNDER ANY CIRCUMSTANCES.
 - TO PREVENT EVAPORATION OF WATER IN THE TANK (BIB) ARRANGEMENT MAY BE MADE TO PREVENT THE WATER IN THE TANK (BIB) AND THEN OVERFLOW TO THE BIFURCATED PORTION OF THE SAME TANK MEANT FOR DOMESTIC USE (REFER NBC PART IV)
 - CONSTRUCTION OF INTERNAL WALLS OR THE TANK CASE SHALL BE OF BRICK/BLOCK OR REINFORCED CONCRETE WITH A MINIMUM TWO-HOUR FIRE RATING. SERVICE DUCTS SHALL BE PROTECTED BY WALLS OF TWO HOURS AND DOORS OF ONE HOUR FIRE RATING. ALL SUCH DUCTS/SHAFTS SHALL BE PROPERLY SEALED AND FIRE STOPPED AT ALL FLOOR LEVELS
 - THE TANK CASE SHALL BE CONSTRUCTED AS PER GUIDELINES MENTIONED AT PARAGRAPH 4.4.2.2 OF NATIONAL BUILDING CODE 2016
 - THE WATER TANK (BIB) OF REQUIRED CAPACITY SHALL BE PROVIDED AT TERRACE LEVEL TO PREVENT EVAPORATION OF WATER IN THE TANK (BIB) ARRANGEMENT MAY BE MADE TO PREVENT THE WATER IN THE TANK (BIB) AND THEN OVERFLOW TO THE BIFURCATED PORTION OF THE SAME TANK MEANT FOR DOMESTIC USE (REFER NBC - PART IV)
- SPECIAL NOTES FOR GRHA NORMS (WHENEVER APPLICABLE)**
- UPVC WINDOW WITH 6MM THK LAMINATED GLASS TO BE PROVIDED
 - GRASS PAVERS BLOCK -
 - GRASS PAVERS BLOCK OF SIZE: 400X600(80/100)125 AS APPLICABLE) SHALL BE PROVIDED
 - THE BASE FOR CONCRETE GRASS PAVER DEPENDS UPON THE USE OF PAVEMENT IN TERMS OF MOVEMENT OVER IT AND FREQUENCY OF MOVEMENT.
 - FOR PEDESTRIAN MOVEMENT GRASS PAVERS OF THICKNESS 60MM, SUB BASE SHOULD BE 100MM GSB AND 15MM WBM.
 - FOR LIGHT VEHICULAR MOVEMENT 80MM THICK GRASS PAVER, SUB BASE 200MM THK GSB AND 10MM WBM IN TWO LAYER ARE REQUIRED TO BE DONE
 - FOR HEAVY DUTY VEHICULAR MOVEMENT (80/100)125 MM GRASS PAVER) 300MM THK GSB & 150MM WBM IN TWO LAYER SHOULD BE DONE OR GENERALLY FOR THE HEAVY VEHICULAR MOVEMENT SUB BASE IS SAME AS BASE MADE FOR BITUMINOUS ROAD.
 - GRASS PAVERS SHALL BE LAID ON WPM ON SAND BEDDING OF MAXIMUM 50MM. GRASS PAVERS SHALL BE LAID KEEPING UNIFORM DISTANCE IN LINE AND LEVEL. GRASS POCKETS SHALL BE FILLED WITH SOIL TO THE TOP OF THE PAVING UNIT AND THEN GRASS IS PLANTED ON THE SOIL POCKETS.
 - PROPER SLOPE TO DRAIN OUT THE RAIN WATER SHOULD BE PROVIDED IN GRASS PAVER AREA
 - EDGE SHOULD BE FILLED WITH CUT PIECES WHEN HALF PIECE OR BIGGER CAN BE ACCOMMODATED IN THE SPACE OTHERWISE THE EDGES SHOULD BE LOCKED WITH EITHER CONCRETE OR EDGE RESTRAINTS
 - ONCE THE GRASS GROWS IN THE POCKETS OF GRASS PAVERS BY MINIMUM 25MM THEN IT IS RECOMMENDED TO USE THE GRASS PAVER.

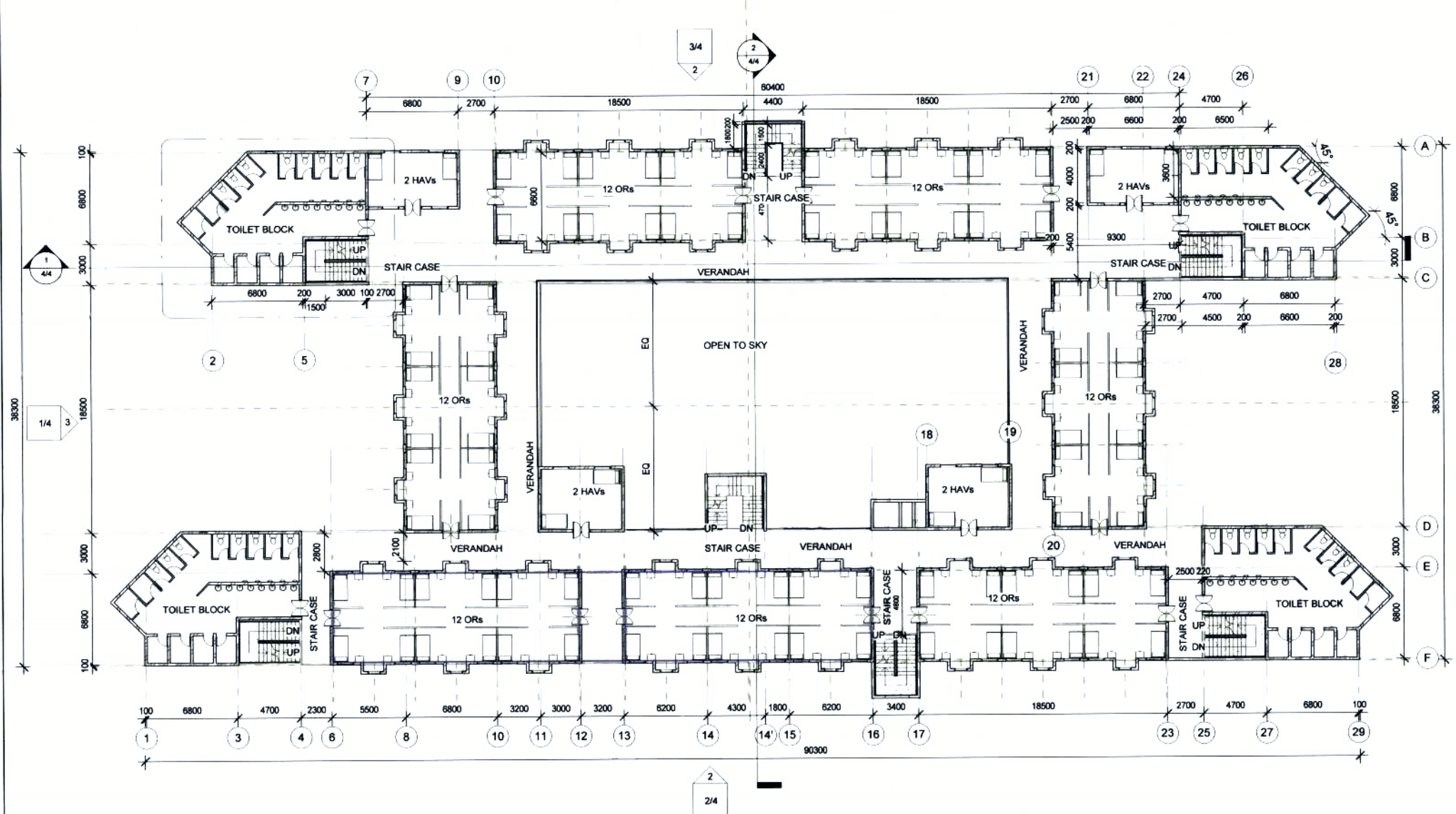
Sl No.	DATE	DESCRIPTION	SIGN
1		GENERAL NOTES ARE ADDED IN THIS SHEET SHALL BE READ IN CONJUNCTION WITH TENDER CONDITIONS AND THE PARTICULAR SPECIFICATIONS. ALL MISSING DETAILS OF WORKING DRGS SHALL BE REFERRED IN CONJUNCTION WITH THESE NOTES PERTAINING TO THIS WORK	
2		ADDITIONAL GENERAL NOTES FOR EPC CONTRACT FOR PREPARATION DRGS:	
(i)		THE PLANS, ELEVATIONS, 3D VIEWS AND SECTIONS ATTACHED WITH THIS SET OF DRAWINGS ARE IN THE PRELIMINARY STAGE. WORKING DRAWINGS SHALL BE DEVELOPED BY THE CONTRACTOR AND SHALL BE APPROVED BY THE CHIEF ENGINEER, JABALPUR ZONE WITHIN THE SPECIFIED TIME.	
(ii)		TYPE OF CONSTRUCTION AND WALL THICKNESS SHALL BE AS PER TENDER SPECIFICATIONS. IF ANY CHANGE IN WALL THICKNESS FROM THIS SET OF DRAWINGS, THE EXTERNAL DIMENSIONS SHALL BE CONSIDERED WHILE DESIGNING THE DETAILED DRAWINGS. NO CHANGE IN AREA IS PERMITTED. CONSULTANT ARCHITECT SHALL TAKE CARE THIS FACTOR WHILE PREPARING THE DETAILED WORKING DRAWINGS OF THIS PROJECT.	
(iii)		DETAILED WORKING DRAWINGS SHALL BE PREPARED BY THE CONSULTANT ARCHITECT APPOINTED BY THE CONTRACTOR. THE DRAWINGS SHALL BE ADHERED WITH INDUSTRY STANDARDS AND SHALL BE GOOD FOR CONSTRUCTION. ALL ARCHITECTURAL DETAILED DRAWINGS SHALL BE PREPARED BY THE CONSULTANT ARCHITECT AND IT SHALL BE APPROVED BY THE DIRECTOR (ARCH) BEFORE EXECUTION STARTS ON THE GROUND. THE APPROVAL OF DRAWINGS AT VARIOUS STAGES SHALL BE DONE AS PER THE STIPULATED TIME FRAME. THE CONSULTANT ARCHITECT SHALL BE REGISTERED WITH COUNCIL OF ARCHITECTURE. HE/SHE SHALL BE MET WITH MINIMUM CRITERIA AS PER THE CLASS OF CONSULTANCY SPECIFIED.	
(iv)		ALL BUILDING COMPONENTS SHALL BE INCORPORATED IN THE DETAILED WORKING DRAWINGS. ALL WEATHER PROTECTION ELEMENTS LIKE CHAJJA, FIN, ROOF PROJECTION, PLINTH PROTECTION, PARAPET WITH COPING SHALL BE DETAILED OUT. DOORS, WINDOWS, BOOK SHELVES, CUP BOARDS, ALMIRAH, WRITING TABLES ETC SHALL BE PROVIDED IN THE WORKING DRAWINGS. NECESSARY STANDARDS AND SPECIFICATIONS SHALL BE FOLLOWED.	
(v)		A NON DISCREPANCY CERTIFICATE REGARDING ARCHITECTURAL & STRUCTURAL DRAWINGS SHALL BE GIVEN BY THE CONTRACTOR, STRUCTURAL ENGINEER AND ARCHITECT APPOINTED BY THE CONTRACTOR.	
(vi)		ALL DRAWINGS SHALL BE SUBMITTED IN A SHEET NOT LESS THAN A1 SIZE SHEET WITH MINIMUM THREE SETS OF DRAWINGS IN WHITE PAPER FOR APPROVAL.	
(vii)		THE FOLLOWING CODES AND STANDARDS SHALL BE TAKEN INTO CONSIDERATION WHILE DEVELOPING THE WORKING DRAWINGS: <ol style="list-style-type: none"> NATIONAL BUILDING CODE 2016 SCALES OF ACCOMMODATION FOR DEFENCE SERVICES 2022 SCALES OF FURNITURE SPECIFICATIONS PERTAINING TO THIS WORK GRHA NORMS REVISED PLINTH AREA NORMS AND THE PUBLISHED FROM E-IN-C'S BARRACKS ZONAL SPECIFICATIONS LOCAL BUILDING EYE LAWS GUIDELINES OF COUNCIL OF ARCHITECTURE FOR PROFESSIONAL PRACTICE FIRE & LIFE SAFETY NORMS FOR BUILDING AND EXTERNAL SERVICES AT SITE 	
SL NO.	DATE	DESCRIPTION	SIGN
REVISIONS			
PROVN OF SINGLE MEN BARRACKS INCLUDING COOK HOUSE FOR AGNIVEER AT 1 STC JABALPUR			
LIST OF DRAWINGS AND NOTES			
DATE	04/11/2025	CHIEF ENGINEER	SHT NO.
DRN	SUBHASH	JABALPUR	1/1
TCD	-	ZONE	
CKD	-		
SCALE	As indicated	Ref Drg No: CEJZLIST/EPC/231	
ARCHITECT J. DIRECTOR (ARCH)		Sr ARCHITECT DIRECTOR (ARCH) FOR CHIEF ENGINEER	

CEJZLIST/EPC/231
SHT No. 1
04/11/2025

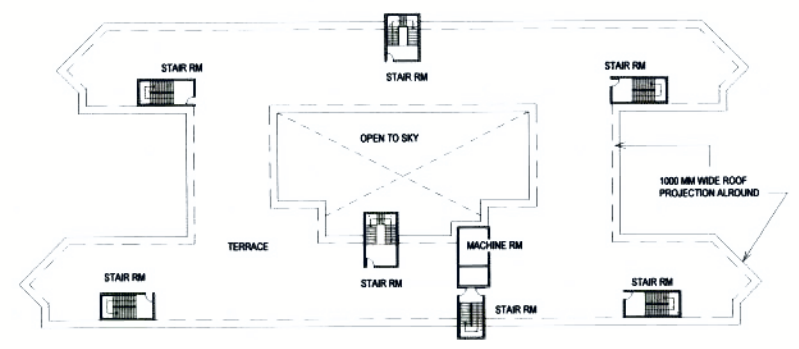
- TENDER DRGS
- NOTES:-
1. CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS BEFORE EXECUTION OF WORKS
 2. FIGURED DIMENSIONS SHALL BE FOLLOWED.
 3. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED
 4. ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH EACH OTHER. ANY DISCREPANCIES SHALL BE BROUGHT TO THE NOTICE OF DIRECTOR (ARCH) OF HQ CE JABALPUR BEFORE STRATING THE EXECUTION AT SITE.
 5. THESE SET OF DRAWINGS ARE FORMULATED FOR EPC CONCEPT. ALL JOINERIES INCLUDING DOORS, WINDOWS, VENTILATORS ETC SHALL BE INCORPORATED IN ALL ROOMS EVEN IF IT IS MISSED OUT IN ANY DRAWINGS OF THIS SET.
 6. DETAILED ARCHITECTURAL DRAWINGS AND STRUCTURAL DRAWINGS WITH RESPECT TO THIS SET OF DRAWINGS SHALL BE PREPARED BY THE CONSULTANT ARCHITECT AND STRUCTURAL ENGINEER APPOINTED BY THE CONTRACTOR BEFORE STARTING THE WORK AT GROUND
 7. STRUCTURAL DRAWINGS SHALL BE DONE IN CONSULTATION WITH E2 DESIGN SECTION OF HQ CE JABALPUR ZONE OR AS SPECIFIED IN TENDER
 8. INCORPORATION OF STRUCTURAL ELEMENTS SHALL BE DONE WITHOUT COMPROMISING THE ARCHITECTURAL ASPECTS OF THE BUILDING. GENERAL CONDITIONS OF STRUCTURAL DESIGN AND DRAWINGS SHALL BE REFERRED FROM THE CONTRACT DOCUMENTS
 9. FOR ALL OTHER GENERAL NOTES REFER TDs, LIST OF DRAWINGS & NOTES AND TENDER SPECIFICATIONS.



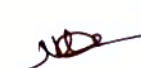
2 FRONT ELEVATION
1 : 200



1 TYPICAL FLOOR PLAN
1ST FLOOR
1 : 200

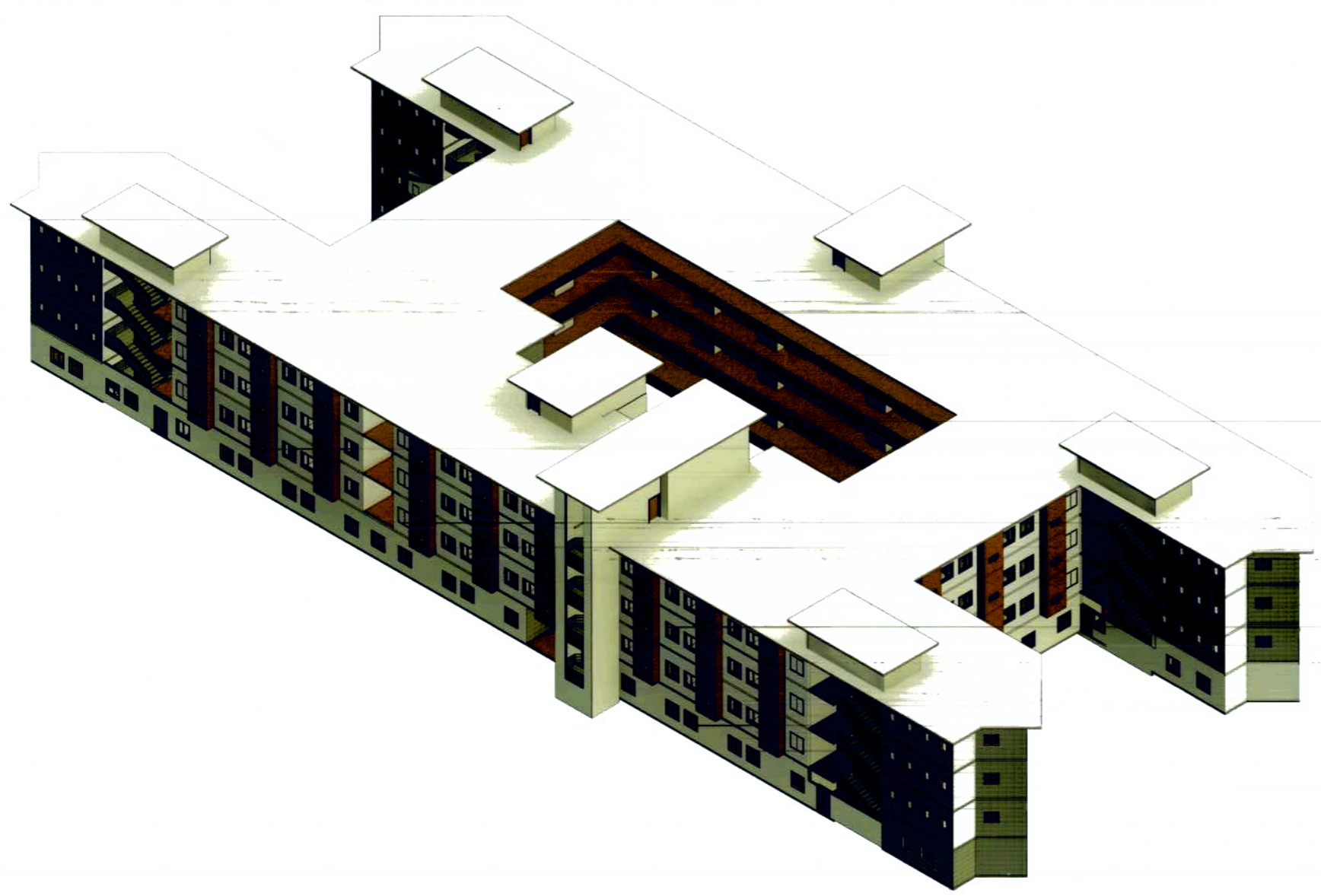


3 ROOF PLAN
1 : 500

SL NO	DATE	DESCRIPTION	SIGN
REVISIONS			
PROVN OF SINGLE MEN BARRACKS INCLUDING COOK HOUSE FOR AGNIVEERS AT 1 STC JABALPUR			
TYPICAL FLOOR PLAN, ROOF PLAN & FRONT ELEVATION			
DATE	04.11.2025	CHIEF ENGINEER JABALPUR ZONE	SHT NO
DRN	NISHA		2/4
TCD	-		
CKD	-		
SCALE	As indicated	Ref Drg No: CEJZ/JA/EPC/861	
ARCHITECT Jt. DIRECTOR (ARCH)		 Sr ARCHITECT DIRECTOR (ARCH) FOR CHIEF ENGINEER	

CEJZ/JA/EPC/861


- NOTES:-
1. CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS BEFORE EXECUTION OF WORKS.
 2. FIGURED DIMENSIONS SHALL BE FOLLOWED.
 3. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
 4. ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH EACH OTHER, ANY DISCREPANCIES SHALL BE BROUGHT TO THE NOTICE OF DIRECTOR (ARCH) OF HQ CE JABALPUR BEFORE STRATING THE EXECUTION AT SITE.
 5. THESE SET OF DRAWINGS ARE FORMULATED FOR EPC CONCEPT ALL JOINERIES INCLUDING DOORS, WINDOWS, VENTILATORS ETC SHALL BE INCORPORATED IN ALL ROOMS EVEN IF IT IS MISSED OUT IN ANY DRAWINGS OF THIS SET
 6. DETAILED ARCHITECTURAL DRAWINGS AND STRUCTURAL DRAWINGS WITH RESPECT TO THIS SET OF DRAWINGS SHALL BE PREPARED BY THE CONSULTANT ARCHITECT AND STRUCTURAL ENGINEER APPOINTED BY THE CONTRACTOR BEFORE STARTING THE WORK AT GROUND.
 7. STRUCTURAL DRAWINGS SHALL BE DONE IN CONSULTATION WITH E2 DESIGN SECTION OF HQ CE JABALPUR ZONE OR AS SPECIFIED IN TENDER.
 8. INCORPORATION OF STRUCTURAL ELEMENTS SHALL BE DONE WITHOUT COMPROMISING THE ARCHITECTURAL ASPECTS OF THE BUILDING GENERAL CONDITIONS OF STRUCTURAL DESIGN AND DRAWINGS SHALL BE REFERRED FROM THE CONTRACT DOCUMENTS .
 9. FOR ALL OTHER GENERAL NOTES REFER TDs, LIST OF DRAWINGS & NOTES AND TENDER SPECIFICATIONS .



1 3 D VIEW

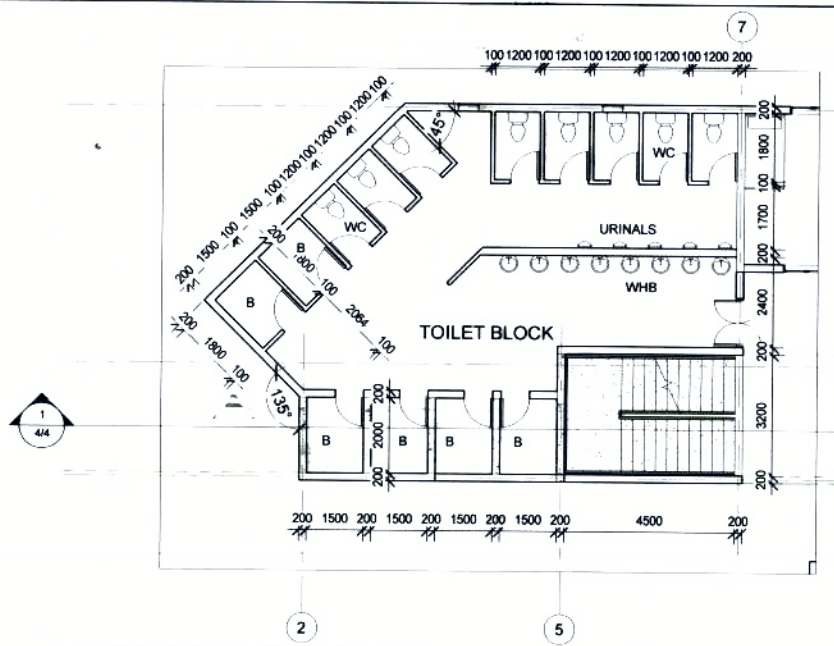


2 REAR ELEVATION
1 : 200

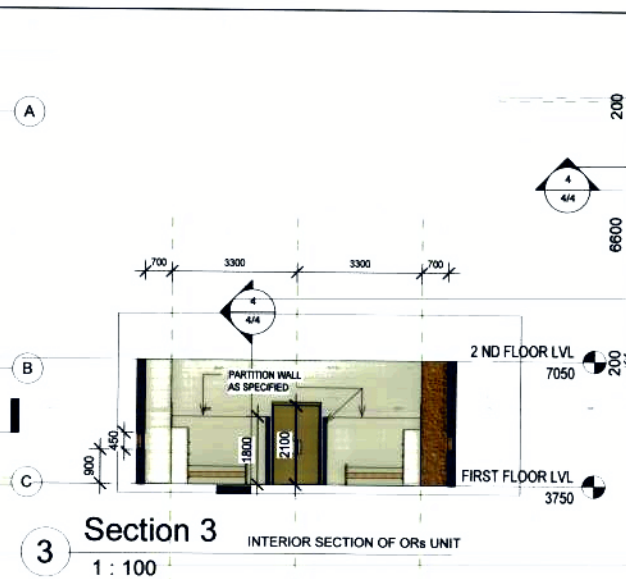
SL NO	DATE	DESCRIPTION	SIGN
REVISIONS			
PROVN OF SINGLE MEN BARRACKS INCLUDING COOK HOUSE FOR AGNIVEERS AT 1 STC JABALPUR			
REAR ELEVATION & 3D VIEW			
DATE	04.11.2025	CHIEF ENGINEER JABALPUR ZONE	SHT NO
DRN	NISHA		3/4
TCD	-		AN ISO -9001-2000 ORGANISATION
CKD	-		Ref Drg No: CEJZ/JA/EPC/861
SCALE	1 : 200		
ARCHITECT J. DIRECTOR (ARCH)		 Sr ARCHITECT DIRECTOR (ARCH) FOR CHIEF ENGINEER	

CEJZ/JA/EPC/861

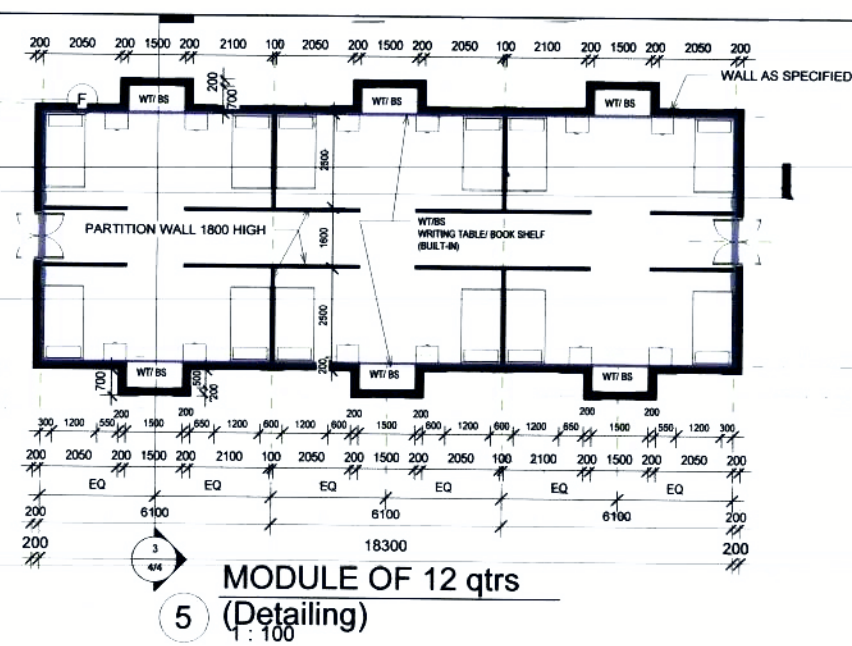
- NOTES:-
1. CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS BEFORE EXECUTION OF WORKS
 2. FIGURED DIMENSIONS SHALL BE FOLLOWED
 3. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
 4. ALL DRAWINGS SHALL BE READ IN CONJUNCTION WITH EACH OTHER. ANY DISCREPANCIES SHALL BE BROUGHT TO THE NOTICE OF DIRECTOR (ARCH) OF HQ CE JABALPUR BEFORE STRATING THE EXECUTION AT SITE
 5. THESE SET OF DRAWINGS ARE FORMULATED FOR EPC CONCEPT. ALL JOINERIES INCLUDING DOORS, WINDOWS, VENTILATORS ETC SHALL BE INCORPORATED IN ALL ROOMS EVEN IF IT IS MISSED OUT IN ANY DRAWINGS OF THIS SET.
 6. DETAILED ARCHITECTURAL DRAWINGS AND STRUCTURAL DRAWINGS WITH RESPECT TO THIS SET OF DRAWINGS SHALL BE PREPARED BY THE CONSULTANT ARCHITECT AND STRUCTURAL ENGINEER APPOINTED BY THE CONTRACTOR BEFORE STARTING THE WORK AT GROUND.
 7. STRUCTURAL DRAWINGS SHALL BE DONE IN CONSULTATION WITH E2 DESIGN SECTION OF HQ CE JABALPUR ZONE OR AS SPECIFIED IN TENDER.
 8. INCORPORATION OF STRUCTURAL ELEMENTS SHALL BE DONE WITHOUT COMPROMISING THE ARCHITECTURAL ASPECTS OF THE BUILDING. GENERAL CONDITIONS OF STRUCTURAL DESIGN AND DRAWINGS SHALL BE REFERRED FROM THE CONTRACT DOCUMENTS.
 9. FOR ALL OTHER GENERAL NOTES REFER TDs, LIST OF DRAWINGS & NOTES AND TENDER SPECIFICATIONS.



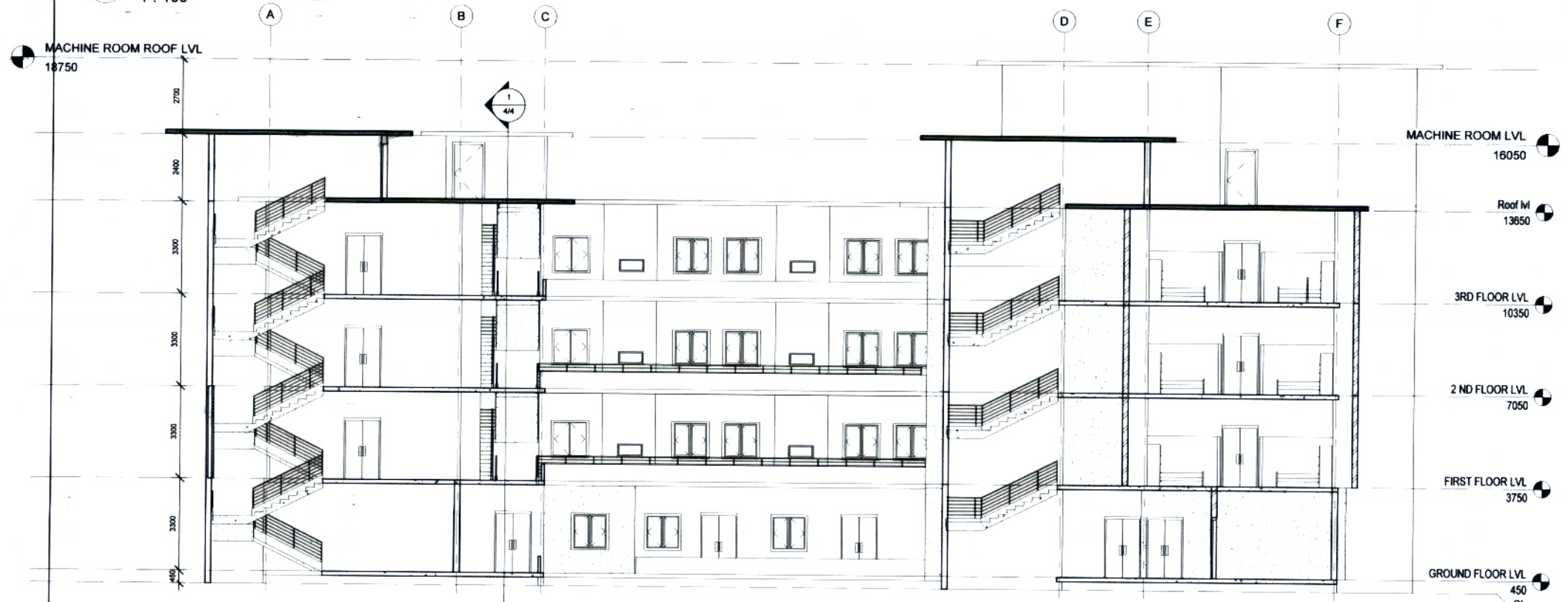
6 TYPICAL FLOOR PLAN
1ST FLOOR - Callout 1
1:100



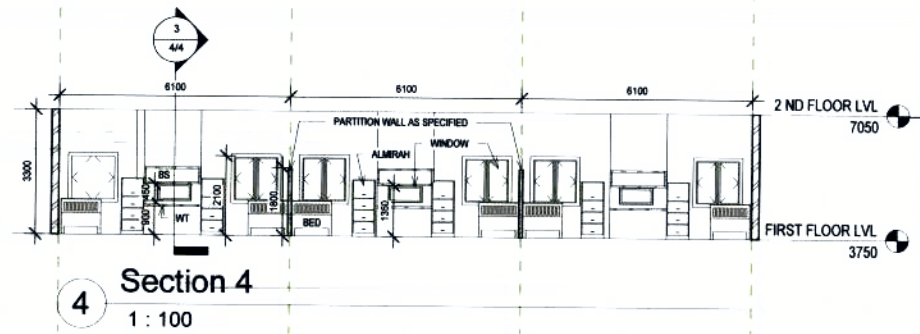
3 Section 3
1:100
INTERIOR SECTION OF ORs UNIT



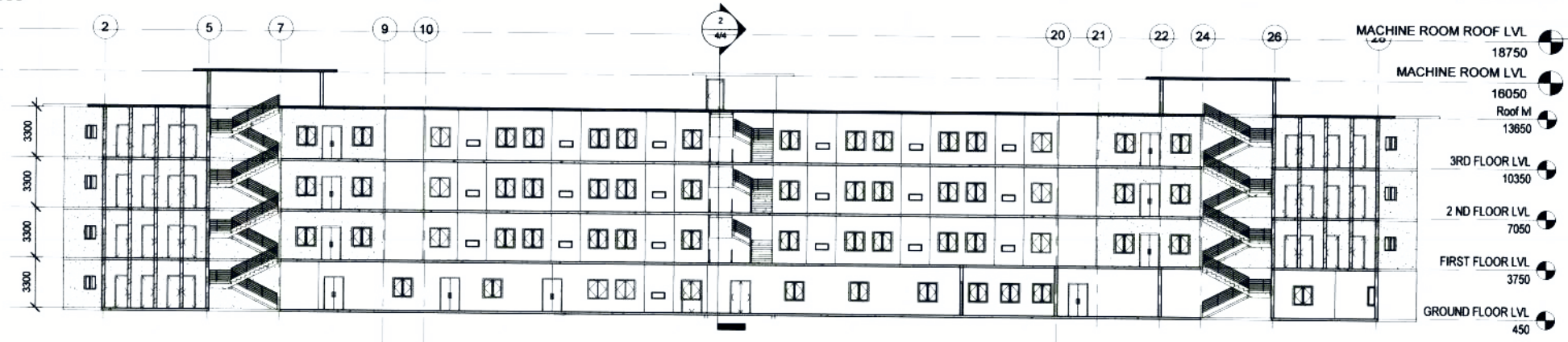
5 MODULE OF 12 qtrs
(Detailing)
1:100



2 Section 2
1:100



4 Section 4
1:100




1 Section 1
1:200


SL NO	DATE	DESCRIPTION	SIGN
REVISIONS			
PROVN OF SINGLE MEN BARRACKS INCLUDING COOK HOUSE FOR AGNIVEERS AT 1 STC JABALPUR			
12 ORs (TYPICAL UNIT) DETAIL DRAWING, SECTIONS & MISCELLANEOUS DETAILS			
DATE	04.11.2025	CHIEF ENGINEER JABALPUR ZONE	SHT NO.
DRN	NISHA		4/4
TCD	-		
CKD	-		
SCALE	As indicated	Ref Drg No: CEJZ/JA/EPC/861	
ARCHITECT JL DIRECTOR (ARCH)		Sr ARCHITECT DIRECTOR (ARCH) FOR CHIEF ENGINEER	

SCHEDULE OF FINISHES

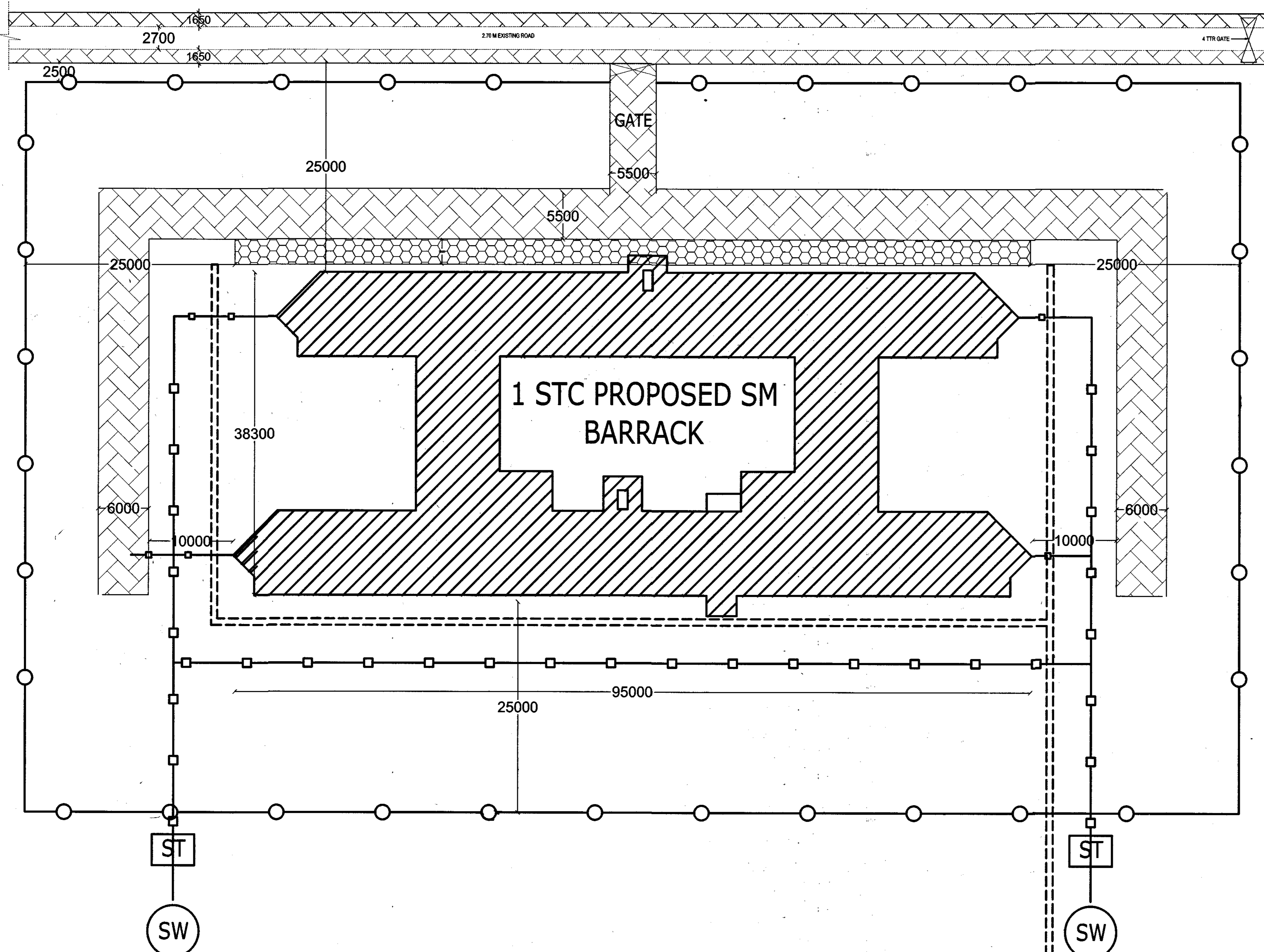
SERIAL NO.	DESCRIPTIONS	FLOORING										CEILING	ROOF	SKIRTING		DADO	WALL		SURFACE FINISHES					SL NO.	TREATMENT	DESCRIPTIONS	
		1	2	3	4	5	6	7	8	9	10			INT	EXT	1	2	3	4	5	6						
1	18-20 MM THICK GRANITE STONE SLAB (LAPPATO FINISH ON TREAD) OVER 20 MM THICK SCREED BED IN CM 1:4 OVER RCC SLAB																							1.	X	INDICATED MATERIAL TO BE USED.	
2	PCC TYPE B-1 1:2:4 FINISHED EVEN & SMOOTH WITH USING EXTRA CEMENT AND MARKING OF EXPANDED METAL OVER SUB BASE PCC TYPE D-2 1:4:8 100 MM THICK OVER COMPACTED FILLED EARTH.																							2.	T-1	THREE COATS WHITE WASH (LIME).	
3	PARKING TILE (ENDUR) NOT EXC 0.38 SOM. 10-12 MM THICK LAID OVER 25 MM THICK PCC TYPE B-0 1:2:4 OVER SUB BASE PCC TYPE D-2 1:4:8 100 MM THICK OVER COMPACTED EARTH (FOR GF OVER SUBE & FOR GF OVER RCC SLAB)																							3.	T-2	TWO COATS OF PREMIUM LOW VOC ACRYLIC WASHABLE, ALKALI RESISTANT EMULSION PAINT, OVER ONE COAT OF PRIMER, OVER LAYERS OF ACRYLIC PUTTY COMPLETE AS PER GRIHA STAR RATING-III NORMS.	
4	POLISHED GLAZED VITRIFIED TILES (PGVT), DOUBLE CHARGED OF SIZE 600 X 1200X10MM THICK LAID OVER 20MM THICK SCREED IN CM 1:4 OVER RCC SLAB COMPLETE.																							4.	T-3	TWO COATS OF CEMENT BASE PAINT OVER ONE COAT OF PRIMER WITH WHITE CEMENT.	
5	POLISHED GLAZED VITRIFIED TILES (PGVT), DOUBLE CHARGED OF SIZE 600X1200X10MM THICK LAID OVER 20 MM THICK SCREED IN CM 1:4 OVER 25 MM THICK PCC TYPE B-0 OVER 100 MM THICK PCC 1:4:8 SUB BASE TYPE D-2 OVER COMPACTED APPROVED EARTH FILLING.																							5.	T-4	TWO COATS SYNTHETIC ENAMEL LEAD FREE PAINT OVER A COAT OF WHITE/PINK PRIMER OVER PREPARED SURFACE OF WOOD, AS PER GRIHA STAR RATING-III NORMS COMPLETE.	
6	20-22 MM THICK POLISH KOTA STONE FLOORING, SET IN NEAT CEMENT SLURRY MIXED WITH COLOUR OVER 20 mm TH. CEMENT SCREED IN CM 1:4. OVER PCC 1:4:8 100 MM THICK TYPE D-2. OVER COMPACTED APPROVED EARTH FILLING. THE SIZE OF STONE, SHALL BE OF 550X 550 mm (MINIMUM) WITH WHITE MARBLE BORDER.																							6.	T-5	TWO COATS SYNTHETIC ENAMEL LEAD FREE PAINT OVER A COAT OF RED OXIDE PRIMER OVER PREPARED SURFACES OF STEEL, AS PER GRIHA STAR RATING-III NORMS COMPLETE.	
7	20-22 mm TH. POLISH KOTA STONE FLOORING, SET IN NEAT CEMENT SLURRY MIXED WITH COLOUR OVER 20 mm TH. CEMENT SCREED IN CM 1:4. OVER RCC SLAB. THE SIZE OF STONE, SHALL BE OF 550X 550 mm (MINIMUM) WITH WHITE MARBLE BORDER.																							7.	T-6	TWO COATS PREMIUM WEATHER PROOF LOW VOC PAINT (MECHANISED APPLICATION) OVER ONE COAT OF PRIMER OVER LAYER OF WALL CARE PUTTY, AS PER GRIHA STAR RATING - III NORMS COMPLETE.	
8	MIL MATT FINISH NON SKID CERAMIC TILES 7-8 mm TH. AREA OF EACH TILE EXC. 0.18 SOM BUT N. EXC. 0.38 SOM LAID OVER 15 mm TH. 1:4 CM SCREED OVER 20 mm TH. CEMENT CONCRETE TYPE B-0 OVER SUB BASE 100 mm TH. PCC 1:4:8 TYPE D-2 OVER COMPACTED APPROVED EARTH FILLING.																							8.	T-7	GRIT FINISH.	
9	MATT FINISH NON SKID CERAMIC TILES 7-8 mm TH AREA OF EACH TILE EXC. 0.11 SOM BUT N. EXC 0.38 SOM. LAID OVER 15 mm TH. 1.4 CM SCREED OVER RCC SLAB.																								NOTES 1. ALL EXPOSED SURFACES OF WOOD SHALL BE TREATED WITH T-4. 2. ALL EXPOSED SURFACES OF STEEL SHALL BE TREATED WITH T-5. 3. ALL EXTERNAL SURFACES SIDES OF CHAJJA, SHALL BE TREATED WITH T-6. 4. ALL CEILING SURFACES INCL SIDES AND SOFITS OF BEAMS SHALL BE PLASTERED WITH 5MM THICK IN 1:4 CM & TREATED WITH T-2. 5. WOODEN MEMBERS COMING IN CONTACT WITH MASONARY/RCC SHALL BE TREATED WITH COALTAR. 6. C/I BRACKETS OF FLUSHING CISTERN, FAN HOOKS AND THE LIKE ARTICLES SHALL BE TREATED WITH T-5. 7. WATER PROOFING TREATMENT TO ALL ROOF SLABS SHALL BE PROVIDED AS SPECIFIED IRRESPECTIVE OF WHERE EVER SPECIFIED MARKED IN THE DRAWING OR NOT. 8. ALL EXTERNAL SURFACES OF WALL SHALL BE PLASTERED WITH 15 MM THK CM (1:4) IN TWO COATS ON BRICK/STONE MASONARY/ CONCRETE SURFACES. FIRST COAT 10 MM THK (THICKNESS OF PLASTER IS EXCLUDING THE DUBBING COAT) AND 5 MM FINAL COAT. BOTH COATS MIXED WITH WATER PROOFING COMPOUND AS PER PARTICULAR SPECIFICATION. 9. ALL INTERNAL SURFACES OF WALL ABOVE DADO / SKIRTING SHALL BE PLASTERED WITH 10 MM THICK IN CM (1:4) ON BRICK MASONARY /CONCRETE SURFACES (THE THICKNESS OF PLASTER IS EXCLUDING THE DUBBING COAT FOR UNEVEN SURFACE) FINISHED EVEN AND SMOOTH WITHOUT USING EXTRA CEMENT. 10. ALL EXPOSED SURFACE OF RCC COL AND BEAMS AND SIDES OF SAFFIT & CHAJJA AWAY FROM BLDGS SHALL BE PLASTERED WITH 5 MM THICK IN CM 1:4 AND TREATED WITH T-3. 11. DADO HEIGHT SHALL BE - (a) TOILET BLOCK EXCEPT WC & JC - LINTEL HEIGHT (b) WC - LINTEL HEIGHT (c) BATH /CTWHB - LINTEL HEIGHT (d) JC - LINTEL HEIGHT (e) Parity - 1.50 HEIGHT 12. ALL EXTERNAL SURFACES OF WALLS SHALL BE PLASTERED 15 MM THICK IN TWO LAYERS. FIRST LAYER 10 MM THICK IN CM (1:4) AND SECOND LAYER 5 MM THICK IN CM 1:4 MIXED WITH WPC FINISHED EVEN AND SMOOTH. 13. ALL BRICK STEPS (TREAD & RISERS BOTH), LANDING, TREAD & RISERS OF RCC STAIR SHALL BE FINISHED WITH 22-25 MM THICK GRANITE STONE OVER 20 MM THICK CM 1:6 FRONT EDGE OF STONE SHALL BE BULL NOSED SIZE OF STONE SHALL BE 600X600 MM FOR LANDING. HOWEVER FOR TREAD & RISER STONE SHALL BE PROVIDED IN SINGLE PIECE. 14. APPROVED EARTH SHALL BE NON EXPANSIVE SOIL HAVING PLASTICITY INDEX AND LIQUID LIMIT BELOW 6 AND 20 RESPECTIVELY. 15. IN PLINTH PROTECTION COARSE RIVER SAND OF CONSOLIDATED THICKNESS 200 MM SHALL BE PROVIDED BELOW HARDCORE OF PLINTH PROTECTION. 16. 18-20MM THICK GRANITE FOR KITCHEN PLATFORM. 17. 60 CM HIGH DADO ABOVE KITCHEN PLATFORM GLAZED TILE BELOW PLATFORM COMPLETE. 18. OTHER THAN BATHROOM, TOILET AND KITCHEN MATT FINISH TILES OF SIZE 600 MM X 600MM X 7.8 MM THICK FLOOR TILES SHALL BE PROVIDED. 19. SINGLE PIECE POLISHED KOTA STONE SHALL BE PROVIDED IN STAIR/STEPS.		
10	19-20 MM THICK GRANITE STONE SLAB (LAPPATO FINISH ON TREAD) OVER 20 MM THICK SCREED BED IN CM 1:4 OVER RCC SLAB																							9.			
11	PCC TYPE B-1 1:2:4 FINISHED EVEN & SMOOTH WITH USING EXTRA CEMENT AND MARKING OF EXPANDED METAL OVER SUB BASE PCC TYPE D-2 1:4:8 100 MM THICK OVER COMPACTED FILLED EARTH.																							10.			
12	PARKING TILE (ENDUR) NOT EXC 0.38 SOM. 10-12 MM THICK LAID OVER 25 MM THICK PCC TYPE B-0 1:2:4 OVER SUB BASE PCC TYPE D-2 1:4:8 100 MM THICK OVER COMPACTED EARTH (FOR GF OVER SUBE & FOR GF OVER RCC SLAB)																							11.			
13	POLISHED GLAZED VITRIFIED TILES (PGVT), DOUBLE CHARGED OF SIZE 600 X 1200X10MM THICK LAID OVER 20MM THICK SCREED IN CM 1:4 OVER RCC SLAB COMPLETE.																							12.			
14	POLISHED GLAZED VITRIFIED TILES (PGVT), DOUBLE CHARGED OF SIZE 600X1200X10MM THICK LAID OVER 20 MM THICK SCREED IN CM 1:4 OVER 25 MM THICK PCC TYPE B-0 OVER 100 MM THICK PCC 1:4:8 SUB BASE TYPE D-2 OVER COMPACTED APPROVED EARTH FILLING.																							13.			
15	20-22 MM THICK POLISH KOTA STONE FLOORING, SET IN NEAT CEMENT SLURRY MIXED WITH COLOUR OVER 20 mm TH. CEMENT SCREED IN CM 1:4. OVER PCC 1:4:8 100 MM THICK TYPE D-2. OVER COMPACTED APPROVED EARTH FILLING. THE SIZE OF STONE, SHALL BE OF 550X 550 mm (MINIMUM) WITH WHITE MARBLE BORDER.																							14.			
16	20-22 mm TH. POLISH KOTA STONE FLOORING, SET IN NEAT CEMENT SLURRY MIXED WITH COLOUR OVER 20 mm TH. CEMENT SCREED IN CM 1:4. OVER RCC SLAB. THE SIZE OF STONE, SHALL BE OF 550X 550 mm (MINIMUM) WITH WHITE MARBLE BORDER.																							15.			
17	MIL MATT FINISH NON SKID CERAMIC TILES 7-8 mm TH. AREA OF EACH TILE EXC. 0.18 SOM BUT N. EXC. 0.38 SOM LAID OVER 15 mm TH. 1:4 CM SCREED OVER 20 mm TH. CEMENT CONCRETE TYPE B-0 OVER SUB BASE 100 mm TH. PCC 1:4:8 TYPE D-2 OVER COMPACTED APPROVED EARTH FILLING.																							16.			
18	MATT FINISH NON SKID CERAMIC TILES 7-8 mm TH AREA OF EACH TILE EXC. 0.11 SOM BUT N. EXC 0.38 SOM. LAID OVER 15 mm TH. 1.4 CM SCREED OVER RCC SLAB.																							17.			
19	5 MM THK RENDERING IN CM 1:4. (REFER NOTE NO.- 4)																							18.			
20	5 MM THK RENDERING IN CM 1:3.																							19.			
21	WATER PROOFING TREATMENT ALL AS SPECIFIED. (REFER NOTE NO.- 7)																							20.			
22	HEAT RESISTANT TERRACE TILE OVER SCREED BED 1:4 20MM THICK OVER WATER PROOFING TREATMENT AS SPECIFIED(SIZE OF TILE NOT EXC 0.18 SOM)																							21.			
23	POLISHED GLAZED (PGVT) VITRIFIED TILES DOUBLE CHARGED LIGHT SHADE 600 X 1200 MM, 10MM THICK OVER 10MM THICK CEMENT SCREED IN CM 1:4 (100MM HIGH).																							22.			
24	7 TO 8 MM THICK CERAMIC TILES 100 MM HIGH OVER 10 MM THICK RENDERING IN CM 1:4 MATCHING WITH FLOOR TILES (100 MM HIGH).																							23.			
25	18-20 MM THICK POLISH KOTA STONE OVER 15 MM THICK CEMENT SCREED IN CM 1:4 (100MM HIGH),MATCHING WITH FLOOR FINISH.																							24.			
26	15-18 MM THICK POLISH GRANITE STONE OVER 15 MM THICK CEMENT SCREED IN CM 1:4 (100MM HIGH), MATCHING WITH FLOOR FINISH.																							25.			
27	GLAZED CERAMIC TILES IN VERTICAL SURFACE 600X300X8-10 MM THICK SET AND JOINTED IN NEAT CEMENT SLURRY AND POINTED WITH COLOURED CEMENT TO MATCH OVER 10 MM THICK SCREED IN CM 1:3.																							26.			
28	5-7 mm TH. GLAZED CERAMIC TILES OVER 10 mm TH. SCREED IN CM 1:3 (REFER NOTE NO.-11)																							27.			
29	(REF NOTE NO.- 9)																							28.			
30	(REF NOTE NO.- 12)																							29.			
31	ALL CEILING SURFACE INCLUDING UNDER SIDE OF CHAJJA AND LINTEL																							30.			
32	ALL INTERNAL WALL SURFACES AND ABOVE SKIRTING AND DADO.																							31.			
33	ALL EXTERNAL WALL /COL																							32.			
34	ALL EXPOSED STEEL SURFACE EXCEPT WIRE MESH AND IRON MONGERY UNLESS OTHERWISE SPECIFIED. (REF NOTE NO.- 2)																							33.			
35	ALL EXPOSED WOODEN SURFACES UNLESS OTHERWISE SPECIFIED. (REF NOTE NO.- 1)																							34.			
36	REMARKS																							35.			

SL NO	DATE	DESCRIPTION	INITIAL
REVISIONS			
PROJECT :-			
PROVN OF SINGLE MEN BARRACKS INCLUDING COOK HOUSE FOR AGNIVEERS AT 1STC, JABALPUR			
BUILDING :-			
270 ORs' & 30 HAVs ACCN WITH DH & CH (G+3 BUILDING)			
TITLE :-			
SCHEDULE OF FINISHES			
DATE	04-11-2025	SHT. NO.	
DRN.	SUBHASH	CHIEF ENGINEER JABALPUR ZONE	1
TCD			
CKD		AN ISO-9001-2000 ORGANISATION	
SCALE	NTS	DRG. NO.	CEJZJA/EPC/SOF/861


AAD (PLG)


DIRECTOR (PLG)
FOR CHIEF ENGINEER

EXISTING MATHEW STADIUM



LEGEND :-

1	PROPOSED BUILDING	
2	PROPOSED ROAD	
3	PROPOSED EXTRA WIDENING	
4	PROPOSED INTER LOCKING TILE (HARD STANDING)	
5	PROPOSED DRAIN	
6	PROPOSED SEAWAGE LINE	
7	PROPOSED FENCING	

SL.NO	DATE	DESCRIPTION	INITIAL
REVISIONS			

PROJECT :-
PROVN OF SINGLE MEN BARRACKS INCL COOK HOUSE FOR AGNIVEERS AT 1 STC JABALPUR

BUILDING :- 270 ORS & 30 HAVS ACCN WITH DT & CH (G+3 BUILDING)

TITLE :- SITE PLAN SHOWING EXTERNAL B/R SERVICES

DATE	31-10-2025	CHIEF ENGINEER JABALPUR ZONE AN ISO-9001-2000 ORGANIZATION	SHT.NO.
DRN	HAV ROOM SINGH		1
TCD			1
CKD			
SCALE	AS SHOWN	DRG NO - CEJZ/SP/B-R/240	

[Signature]
AAD (PLG)

[Signature]
DIRECTOR (PLG)
FOR CHIEF ENGINEER

EXTERNAL SITE PLAN OF B/R SERVICE
SCALE 1:250