PACKAGE- 4C

REQUEST FOR PROPOSALS (RFP) FROM ELIGIBLE PSUs/GOVT AGENCIES/DEPARTMENTS ARE INVITED BY NALANDA UNIVERSITY, RAJGIR

FOR

ENGAGEMENT OF THE EXECUTING AGENCY FOR SETTING UP 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM INCLUDING DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING UNDER EPCC MODE AT PERMANENT CAMPUS (PHASE I)

NOTICE INVITING RFP

RFP No: NU/ENGG/62/4C/NIT/2020-21/ Vol-II/Govt-PSU/03 Dated 05.11.2020

NALANDA UNIVERSITY, RAJGIR, BIHAR.

Every care has been taken while preparing this document to cover all necessary information, matters, specifications, general conditions, special conditions & provisions for smooth and complete execution of works. However, in case of any omission in the RFP/ contract document, the most recent version of correction slips (as on August 2020) of General Conditions of Contract (GCC) for CPWD Works, 2014 shall be the reference manual.

DISCLAIMER

The information contained in this Request for Proposal (RFP) UNDER ENGINEERING PROCUREMENT AND COMMISSIONING (EPCC) MODE has been prepared solely to assist prospective agencies/PSUs in making their decision of whether or not to submit their financial bid. Nalanda University does not purport this information to be all-inclusive or to contain all the information that a prospective agency/PSU may need to consider in order to submit the proposal. The designs, drawings, technical data and any other information provided in this RFP UNDER EPCC MODE is indicative and neither Nalanda University nor its employees, officers nor its consultants will make or will be deemed to have made any current or future representation, promise or warranty, express or implied as to the accuracy, reliability or completeness of the information contained herein or in any document or information, whether written or oral, made available to a interested/participating Govt agencies/PSUs, whether or not the aforesaid parties know or should have known of any errors or omissions or were responsible for its inclusion in or omission from this RFP document.

Neither Nalanda University nor its employees or consultants make any claim or give any assurance as to the accuracy or completeness of the information provided in this RFP. Interested parties are advised to carry out their own investigations and analysis of any information contained or referred to herein or made available at any stage in the RFP process in relation to Project.

This ON-GRID PV Power Project is recognised and registered under CPSU (Tranche-II) Phase-II Scheme being run by the "**Solar Energy Corporation of India Limited under Ministry of New and Renewable Energy, Govt of India**", and hence the Govt Agencies/PSUs has to mandatorily comply the technical requirement published under the CPCU scheme. In addition, to the mandate of the CPCU scheme and SECI requirement, the published technical specification herewith by the university shall be followed as per the design confirmation after issuance of the contract award. The successful Govt Agencies/PSUs will be bound to support the stage confirmations, information required to the SECI in future (if any) related to the project without any delay.

This RFP is provided for information purposes only and upon the understanding that such parties will use it only for the purpose set forth above. It does not purport to be all-inclusive or contain all the information about the Project in relation to which it is being issued.

The information and statements made in this RFP UNDER EPCC MODE have been made in good faith. Interested parties should rely on their own judgments in participating in the said Project. Any liability is accordingly expressly disclaimed even if any loss or damage is caused by any act or omission on part of the aforesaid, whether negligent or otherwise.

Nalanda University makes no representation or warranty and shall incur no liability under any law, statute, rules or regulations as to the accuracy, reliability or completeness of this document.

Nalanda University reserves the right to modify, suspend, change or supplement this RFP. Any change to the RFP UNDER EPCC MODE will be notified to all the prospective parties. No part of this RFP DOCUMENTS UNDER EPCC MODE and no part of any subsequent correspondence by Nalanda University, its employees, officers or its consultants shall be taken neither as providing legal, financial or other advice nor as establishing a contract or contractual obligation. Contractual obligations would arise only if and when definitive agreements have been approved and executed by the appropriate parties having the University to enter into and approve such agreements. Nalanda University reserves the right to reject all or any of the proposal submitted in response to this RFP document at any stage without assigning any reasons whatsoever.

All prospective & Interested agencies are responsible for all costs incurred by them when evaluating and responding to this document and any negotiation costs incurred by the recipient thereafter. Nalanda University may in its sole discretion proceed in the manner it deems appropriate which may include deviation from its expected evaluation process, the waiver of any requirements, and the request for additional information. Unsuccessful Govt Agencies/PSUs will have no claim whatsoever against Nalanda University nor its employees, officers nor its consultants.

Though adequate care has been taken while preparing the RfS document, the prospective govt agencies /PSUs shall satisfy themselves that the document is complete in all respect. Intimation regarding any discrepancy shall be given by the prospective Govt Agencies/PSUs to the office of Nalanda University immediately. If no intimation is received from any prospective govt agencies within 7 (Seven) days from the date of issuance of RfS documents, it shall be considered that the document is complete in all respect and has been received/ acknowledged by the Govt Agencies/PSUs(s). Nalanda University reserves the right to modify, amend or supplement this document.

This RfS document has been prepared in good faith, and on best endeavour basis. Neither Nalanda University nor their employees or advisors make any representation or warranty, express or implied, or accept any responsibility or liability, whatsoever, in respect of any statements or omissions herein, or the accuracy, completeness or reliability of information, and shall incur no liability under any law, statute, rules or regulations as to the accuracy, reliability or completeness of this document, even if any loss or damage is caused by any act or omission on their part.

NALANDA UNIVERSITY

RFP

Nalanda University invites RFP from the govt agencies/PSUs of repute for the following work:

RFP No: NU/ENGG/62/4C/NIT/2020-21/ Vol-II/Govt-PSU/03 Dated 05.11.2020

NAME OF WORK: RFP for engaging EPC executing PSU/Govt agency for ONGRID PV Solar setup with all required hardware, software, co-ordination with the DISCOM/BERC/CERC/SBPDCL/NISE/SECI for setting up of 5000 KW AC Capacity grid connected ground mounted solar PV system including DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING at the permanent campus of Nalanda University (NU), Nalanda, Rajgir, Bihar.

Estimated Cost: Rs. 24.25 Crores,

Earnest Money: 34.25 Lacs,

Tender Processing fee ; Rs 5,000/- Rupees Five Thousand Only in Favour of Nalanda University, payable at Rajgir.

Period of Completion: 12 Months,

Last time and date of submission: 27.11.2020, Time – Please refer to CPPP.

Summary of Scope of work

This RFP is invited for engaging the govt agencies/PSUs for setting up 5000 KW AC Capacity grid connected ground mounted solar PV system including DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING at the permanent campus of Nalanda University (NU), Nalanda, Rajgir, Bihar, comprising of the following:

1. Designing of the complete solar plant with all accessories, mounting structure, inverters, DC Cables, Communication cables, Earthing, LA, Panels, SCADA system, Metering system, UPS etc… for proper functioning and monitoring of the system, including all hardware & software. Vetting of design through Third Party(s). The clearances from the SECI, MNRE, CERC, SBPDCL/DISCOM, & BERC.
2. Comprehensive Operation and Maintenance of the entire installation for 5 years.

Site is located along the Patna - Rajgir Highway and is well connected with the city of Rajgir, Bihar. Total area of the site is approximately 455 acres ("Site") out of which 20 acres area has been allotted and marked for the Ground Mounted Solar PV System and associated job.

The proposed campus of Nalanda University is planned to be developed on a mostly flat terrain in the foot hill of Nalanda Hills. The site is located in Gangatic plains area of Southern Bihar.

The RFP is for engaging contractor for setting up 5000 KW AC, ILR1.3 OR 6.5MW-DC Capacity grid connected ground mounted solar PV system including DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING at the permanent campus of Nalanda University (NU), Nalanda, Rajgir, Bihar.

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SECTION 1

TECHNICAL PART

INFORMATION &INSTRUCTIONS TO GOVT AGENCIES/PSUS FOR e-RFPING

The Registrar, Nalanda University on Behalf of the Vice Chancellor, Nalanda University invites online percentage rate bids from the PSUs/Govt Agencies in two bid system for the following work:

NAME OF WORK: RFP for engaging govt agencies/ PSUs for setting up 5000 KW AC Capacity grid connected ground mounted solar PV system including DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING at the permanent campus of Nalanda University (NU), Nalanda, Rajgir, Bihar.

Estimated Cost	Rs. 24.25 Crores
Performance Guarantee	5% of tendered Value.
Security Deposit	2.5% of tendered Value
EMD	**Earnest Money: Rs** 34.25 Lacs,
Tender Processing fee	Rs 5000/- Rupees Five Thousand Only in Favour of "Nalanda University" Payable at Rajgir.
Execution Time Allowed	12 Months
Pre-bid Meeting	17.11.2020 at 11.30 AM at NU Rajgir. (Project Site at Permanent Campus)
Last Date of Submission of Tender Date & Time	27.11.2020, time as per portal In order to avoid the last hours rush and any technical glitches, please ensure bid submission prior to the set timeline.
Date & Time of Opening of Technical Tender (Eligibility) Documents	28.11.2020 at 4.00 PM as per CPPP NOTIFICATION

General Information:

1) Pre-bid meeting (discussions before submission of the offer for better understanding) shall be held with the prospective Govt agencies/ PSUs in the office of Nalanda University, at Rajgir, on 17.11.2020 at 11.30 AM. The detailed address of the venue is as follows:

Nalanda University,
Rajgir, District Nalanda,
Bihar - 803116, India.

The Program of Pre-Bid Meeting is as follows.

a) Welcome of the Prospective Govt agencies/ PSUs by Nalanda University.

b) Introduction Session.

c) Presentation and Discussions of Queries raised by the Govt agencies/ PSUs.

2)Govt agencies/ PSUs should send all their queries by email, at least Two days before pre -tender meeting, to project manager on phase1.tender@nalandauniv.edu.in The Govt agencies/ PSUs' authorised representatives are advised to attend the pre-tender meeting. In response to the queries and clarifications sought by the Govt agencies/ PSUs during the pre-tender meeting, certain modifications/clarification may be issued to all Govt agencies/ PSUs by the project manager, as may be deemed necessary through an Addendum and not through the minutes of the pre-tender meeting and will be uploaded on website hosting the tender document. No separate communication in this regard shall be sent to the individual Govt agencies/ PSUs. Govt agencies/ PSUs are advised to periodically check the website hosting the tender for any addendum until 2 days before the date of submission of the tender.

NOTICE INVITING RFP

1. The Govt agencies/Public Sector Under Taking involved in the execution or manufacturing or business of the SOLAR PV System in last seven years are welcome to submit the percentage rate offer over the given estimations read with the terms and conditions laid down in this RFP.

2. Percentage rate tenders (in e-tendering mode) are invited by the Nalanda University from the eligible Govt agencies/ PSUs in two-tender system for the Setting up of Solar Plant at its permanent campus at the Site i.e. Rajgir, Bihar.

3. **Name of the Work: S**etting up 5000 KW AC Capacity grid connected ground mounted solar PV system including DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING at the permanent campus of Nalanda University (NU), Nalanda, Rajgir, Bihar.

TECHNICAL ELLIGIBILITY SECTION

Intending Govt Agencies/ PSUs are eligible to submit the offer provided they have definite proof from the appropriate authority, which shall be to the satisfaction of the

competent authority, of having satisfactorily completed similar works of magnitude specified below: -

1. **Three similar** works of ON-GRID Solar plant setup each of size not less than 2MWac **OR**

Completed **two similar** works of ON-GRID Solar plant setup size each of size not less than 3 MWac **OR**

Completed **one similar** works of ON-GRID Solar plant setup of size not less than 4 MWac

For the purpose of this clause, "similar work" shall mean **"Designing / Engineering, Procurement, Installation, Testing, commissioning, Operation and maintenance of Solar Farm with all necessary components for generation and evacuation of Electricity in a single order, in last seven years in India".**

OR

The Solar PV Panel Manufacturing PSUs/Govt Agency or Authorized PSU/Govt agency of panel manufacturer who has done similar work of Designing, Engineering, Procurement, Installation, Testing, commissioning, Operation and maintenance of Solar Farm with all necessary components for generation and evacuation of Electricity.

The value of executed works shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion to the previous day of the last day of submission of the Tender.

2. The Govt agencies/ PSUs should have had **average annual financial turnover (gross)**of **Rs. 12.12 Crore (Rupees Twelve Crore Twelve Lakh only)** of Similar works during the immediate last five consecutive financial years balance sheets, ending 31st March 2019, duly audited by Charted Accountant. Year in which no turnover is shown would also be considered for working out the average. The Govt Departments are exempted for this average turnover criteria.

5. The PSUs/Govt Agencies shall have sufficient number of technical and administrative employees for proper execution of the Contract. The PSUs/Govt Agencies **shall have to submit** a list of these employees stating clearly how these would be involved in this work within 15 **days of award of work**.

6. Intending PSUs/Govt Agencies are advised to ensure that they meet the minimum eligibility criteria as per the detailed terms and evaluation parameters enumerated in this document before they submit their tender document.
7. Earnest Money Deposit (EMD) **INR 34.25 Lakhs** shall be accepted only in the form of BG/FDR/TDR/Deposit at Call receipt/Demand Draft drawn in favour of "Nalanda University", payable at Rajgir, Bihar from any scheduled bank guaranteed by the Reserve Bank of India. The intending bidder has to scan and upload all the details such as Banker's name, Demand Draft/ Bank Guarantee number, amount and date to the e-Tendering website within the period of tender submission and original should be deposited at project office of Nalanda University.
8. Interested bidders who wish to participate in the tender shall pay Rs. 5,000/ (Rupees Fifteen Thousand only) as e-Tender Processing Fee of Nalanda University, Rajgir, Bihar in the form of Demand Draft of any scheduled bank, a copy of which shall have to be scanned and uploaded to the e-Tendering website before tender submission.

9. While submitting the offer the list of the similar job (Solar PV system Installation) to be submitted in the FORM **C.**

DETAILS OF SIMILAR WORKS COMPLETED DURING THE LAST SEVEN YEARS ENDING PREVIOUS DAY OF LAST DATE OF SUBMISSION OF RFP

A	B	C	D	E	F	G	H	I	J
Sr. No	Name of work/project and location	Owner or sponsoring organization	Cost of work in Crores of Rupees	Date of commencement as per contract	Stipulated date of completion	Actual date of completion	Litigation / arbitration cases pending / in progress with details*	Name and address / telephone number of officer to whom reference may be made	Whether the work was done on back to back basis Yes/No
1									

2									
3									

*Indicate gross amount claimed and amount awarded by the Arbitrator.

SIGNATURE OF GOVT AGENCIES/PSUS (S)

FORM D (On letterhead of respective owners of the Work)

PERFORMANCE REPORT OF WORKS REFERRED TO IN 'FORM C'

1	Name of work/ Project & Location	
2	Agreement No.	
3	Estimated Cost and/or Size in MW	
4	RFP/Tendered Cost	
5	Date of Start	
6	Date of completion	
	(i) Stipulated Date of Completion	
	(ii) Actual Date of Completion	
7	(i) Whether case of levy of compensation for delay has been decided or not. (ii) If decide, amount of compensation levied for delayed completion, if any	Yes/No
8	Performance Report	
	1) Quality of Work	Outstanding/Very Good/Good/Poor
	2) Financial Soundness	Outstanding/Very Good/Good/Poor
	3) Technical Proficiency	Outstanding/Very Good/Good/Poor
	4) Resourcefulness	Outstanding/Very Good/Good/Poor
	5) General Behaviour	Outstanding/Very Good/Good/Poor
Dated: Stamp:		Signed by Ex. Engineer or equivalent and attested by first class judicial magistrate or equivalent or Group A Gazetted officer of Central or any State Government or equivalent.

Certified that the above information is complete and that the information furnished above is true, correct and not misleading to my/our knowledge and belief.

FORM E

STRUCTURE & ORGANIZATION

1	Name & Address of the Govt Agencies/PSUs		
2	Telephone No./Telex No./Fax No./e-mail address		
3	Legal status of the Govt Agencies/PSUs (attach copies of original document defining the legal status).		
	a)	Type of the Organizations and details: PSUs or Department State PSUs or Central PSUs	
	b)	Administrative Ministry	
	c)	Nature of Business	
4	Particulars of registration with various Government bodies (attach attested photo-copy). (Company Registration, PAN no., CST and VAT Registration, Service Tax Registration, GST Registration, PF Registration, ESI Registration, Registration as a Contractor with CPWD/MES/State PWD etc. ant information about others)		
	ORGANIZATION/PLACE OF REGISTRATION		REGISTRATION No.
	1		
	2		
5	Names and Titles of Directors& Officers with designation to be deputed for the Works		

6	Designation of individuals authorized to act for the organization.	
7	Has the Govt Agencies/PSUs ever been convicted by a court of law? If so, give details.	
8	Any other information considered necessary but not included above.	

Certified that the information mentioned above is complete and no information has been left undisclosed and that the information furnished above is true, correct and not misleading to my/our knowledge and belief.

SIGNATURE OF GOVT AGENCIES/PSUS (S)

GENERAL INFORMATION

1. An agreement shall be executed by and between the NU and the successful Govt agency / PSUs for the **"Setting up 5000 KW AC Capacity grid connected ground mounted solar PV system including DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING at the permanent campus of Nalanda University (NU), Nalanda, Rajgir, Bihar."** in the given format as per the terms and conditions stipulated in the tender documents. The percentage rates shall be quoted by the Govt agencies/ PSUs as per various terms and conditions of this document, which shall form part of the agreement.
2. The time allowed for carrying out the Work shall be 12 months from the date of initiation as defined in Schedule – F or from the first date of handing over of the Site, whichever is later.
3. The Site shall be handed over to the successful Govt agencies/ PSUs at the time of award of contract on "as is where is" basis.
4. The tender documents consisting of drawings, specifications, schedule of quantities of the various classes of work to be done and the set of terms & conditions of contract to be complied with and other necessary documents can be seen on the website of NU at http://www.nalandauniv.edu.in and also at http://www.eprocure.gov.in/eprocure/app
5. Intending Govt agencies/ PSUs are advised to obtain valid class-II (or appropriate class) digital signature to participate in tendering.
6. The interested Govt agencies/ PSUs shall upload their e-tenders in http://www.eprocure.gov.in/eprocure/app and also physically submit the hard copies of tenders at Reception of Nalanda University's Rajgir office both within the stipulated time and date as indicated above. The detailed address of the Nalanda University's Rajgir Office is as follows:

Nalanda University,
Rajgir, District Nalanda,
Bihar - 803116, India.

7. Earnest Money Deposit (EMD) INR 34.25 Lakhs shall be accepted only in the form of BG/FDR/TDR/Deposit at Call receipt/Demand Draft drawn in favour of "Nalanda University", payable at Rajgir, Bihar from any scheduled bank guaranteed by the Reserve Bank of India. The intending bidder has to scan and upload all the details such as Banker's name, Demand Draft/ Bank Guarantee

number, amount and date to the e-Tendering website within the period of tender submission and original should be deposited at project office of Nalanda University.

Bank Details of Nalanda university is as follows, if required for the EMD Instrument:

1. Name of Bank: HDFC BANK LTD
2. Name & Address of Branch: DHARAMSHALA ROAD, DIST NALANDA, City: RAJGIR 803116, State: BIHAR
3. Branch Code: 2059
4. IFSC Code of respective branch: HDFC0002059

8. Interested bidders who wish to participate in the tender shall pay Rs. 5,000/ (Rupees Fifteen Thousand only) as e-Tender Processing Fee of Nalanda University, Rajgir, Bihar in the form of Demand Draft of any scheduled bank, a copy of which shall have to be scanned and uploaded to the e-Tendering website before tender submission.

9. While submitting the revised offer, Govt Agencies/ PSUs can revise the percentage rate offered one or more item(s) any number of times but before last time and date of submission of tender as notified.

10. **The offer shall be accompanied with the following documents:**

a) Deposit at Call receipt/Demand Draft and/or Bank Guarantee against the EMD and Demand Draft for the-Tender Processing Fee shall be placed in a sealed Envelope 1 super scribed as "**Earnest Money and Cost of e-Tender Processing Fee"** with name of Work and due date of opening of the tender also mentioned thereon.

b) Copies of certificates of work experience and other prequalifying documents as specified in the RFP shall be deposited in a sealed Envelope 2A super scribed as **"Eligibility Documents".**

c) All the RFP documents (RFP, Schedule of Quantities, BOQ, Technical Specifications and Tender drawings) uploaded by the University shall be duly signed on each page by the authorized signatory of the Govt agencies/ PSUs, stamped and placed in a sealed Envelope 2B super scribed as "**Signed Tender Documents".** The documents in this envelop 2B is not required to be uploaded

in the e-tendering website (http://www.eprocure.gov.in/eprocure/app). However, a declaration must be uploaded under the relevant packet stating on oath that the signed tender documents will be submitted physically on or before 03:00 PM on 04.12.2020 at Nalanda University, Rajgir Office.

d) Both the envelops, Envelop 2A & 2B shall be put in to a large envelop super scribed as **"Envelop 2 Technical offer".**

e) Bill of quantities duly filled in and compiled with rates offered as percentage below/above/ at par with the rates entered in the Schedule of quantities, total amounts, offered (in duplicate) and other relevant commercial information (tender) signed by authorized signatory shall be uploaded on the CPPP.

f) All the three envelopes shall be placed in large sealed envelope marked as **"Offer for engaging contractor for setting up 5000 KW AC Capacity grid connected ground mounted solar PV system including DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING at the permanent campus of Nalanda University (NU), Nalanda, Rajgir, Bihar."** with due mention of Name of work, date and time of opening of RFP. The large sealed envelope containing Technical Bids shall be submitted in the Rajgir office of Nalanda University up to 03:30 PM, 3rd December 2020. The Technical tender documents submitted shall be opened at 04:00 PM on 28.11.2020 in presence of intending Govt agencies/ PSUs who chose to remain present. The large sealed envelope shall be addressed to the Registrar, Nalanda University, Rajgir, Bihar.

g) Opening of e-Tender shall be in the following sequence:

i) Eligibility documents of which hard copies are placed in Envelope 1;
ii) Financial offer of which hard copies are placed in Envelope 2, to be opened only for the Govt agencies/ PSUs fulfilling necessary eligibility criteria per this offered document and accepted by NU. The date of opening of financial tender shall be intimated separately to each successful/eligible Govt agencies/ PSUs evaluated on the basis of eligibility criteria.

11. The tender submitted shall become invalid if:
i) The bidders are found ineligible; or
ii) The bidders fail to upload all the documents (Including GST Registration) as stipulated in this tender document.
iii) If any discrepancy is noticed between the documents as uploaded at the time of submission of e-Tender and hard copies as submitted physically in the office of the tender opening authority.
iv) If the PSU/Govt agency does not upload the scan copy of the EMD on CPPP, followed by its physical copy submission in original along with Technical Bid as per the set time. and the lowest bidder EMD within a week of opening of bid.

v) If a Govt Agency/PSU quotes nil rates against each item in item rate tender or does not quote any percentage above/below on the total amount of the tender of any section/sub head in percentage rate tender, the tender shall be treated as invalid and will not be considered as lowest tenderer.

4. The govt agency/PSUs whose bid is accepted will be required to furnish performance guarantee of 5% (Five Percent) of the RFP amount within the period specified in Schedule F. This guarantee shall be in the form of Deposit at Call receipt of any scheduled bank/Banker's cheque of any scheduled bank/Demand Draft of any scheduled bank or Government Securities or Fixed Deposit Receipts or Guarantee Bonds of any Scheduled Bank or the State Bank of India in accordance with the prescribed form. In case the Govt agencies/PSUs fails to deposit the said performance guarantee within the period as indicated in Schedule 'F', including the extended period if any.
5. Intending Govt Agencies/PSUs must inspect and examine the Site and its surroundings and satisfy themselves before submitting their RFPs as to the nature of the ground and sub-soil (so far as is practicable), form and nature of the Site, the means of access to the Site, the accommodation as may be required and in general, shall obtain all necessary information as to the risks involved, contingencies and other circumstances which may have a bearing or influence or affect the decision of submission of RFP. A Govt Agencies/PSUs shall be deemed to have full knowledge of the Site whether or not an inspection has been undertaken by the Govt Agencies/PSUs or not and no extra charge consequent on any misunderstanding or otherwise shall be allowed in the amount quoted in the RFP. The Govt Agencies/PSUs shall be responsible for arranging and maintaining cost of all materials, tools & plants, water, electricity, access, facilities for workers and all other services required for executing the Work unless otherwise specifically provided for in this document and/or the agreement and/or any other letter, circular, notification issued or document released by **NU (NALANDA UNIVERSITY)**. Submission of an RFP by a Govt Agencies/PSUs implies that he has read this notice and all other contract documents and has made himself aware of the scope and specifications of the Work to be executed and of conditions and local conditions and other factors having a bearing on the execution of the Work. **The Departments/Govt Agencies/PSUs submitting RFP shall be presumed that they are well acquainted with the site and accepting all the actual site conditions.**

6. Owner is not bound to accept the lowest or any other RFP and reserves to itself the right to reject any or all the RFPs received without assigning any reason thereof. Owner also reserves the right to restrict the list of qualified contractors to any number deemed suitable by it, if too many RFPs are received satisfying the laid down criteria. All RFPs in which any of the prescribed conditions are not fulfilled or any condition including that of conditional rebate is put forth by the Govt Agencies/PSUs shall be rejected summarily. RFPs subject to any conditions

proposed by the Govt Agencies/PSUs shall not be accepted and shall be liable to be rejected.

7. Canvassing either directly or indirectly, in connection with RFP is strictly prohibited and the RFPs submitted by the Govt Agencies/PSUs who resort to canvassing shall be liable to be rejected.

8. Owner reserves the right of accepting the whole or any part of the RFP and the Govt Agencies/PSUs shall be bound to perform the same at the quoted rate.

9. The Govt Agencies/PSUs shall intimate the names of persons who are or were working in any capacity with the Govt Agencies/PSUs or are subsequently employed by the Govt Agencies/PSUs and who are or have been an officer in **NU.**

10. The contractor shall not be permitted to render for this work if near relative of its officer/employee is employed by Nalanda University in any capacity. He shall also intimate the names of persons who are working with him in any capacity or are subsequently employed by him and who are near relatives to any officer in Nalanda University or in the Ministry of External Affairs. Any breach of this condition by the Govt Agencies/PSUs would render liable to be debarred from participating in RFP process.

11. The receipt of the proposal from the govt agency will be presumed that the Govt Agencies/PSUs has accepted all the terms and condition of this RFP read with the corrigendum/addendum issued by the University. This notice-inviting RFP shall form a part of the agreement and shall be read and construed accordingly. The successful Govt Agencies/PSUs, on acceptance of its RFP by the Owner, shall within 15 days from the stipulated date of initiation of the Work, execute an agreement consisting of: -

    The Notice Inviting RFP, general conditions, all the documents including additional conditions, specifications, drawings and minutes of pre-RFP meeting, addendums and corrigendum, if any, forming the RFP as issued at the time of invitation of RFP and acceptance thereof together with any correspondence leading thereto.

Note: Integrity Agreement will be signed and sealed by the Authorised Representative of Govt Agencies/PSUs as per the format of RFP on Govt Agencies/PSUs' letter head initial ly. Formal agreement on stamp paper shall be signed between NU and the successful Govt Agencies/PSUs only, at the time of Signing of agreement for the work.

Note : Integrity Agreement will be signed and sealed by the Authorised Representative of Govt agencies/ PSUs as per the format of RFP on Govt agencies/ PSUs' letter head initially. Formal agreement on stamp paper shall be signed between NU and the successful Govt agencies/ PSUs only, at the time of Signing of agreement for the work.

INTEGRITY AGREEMENT

On account of the e-tendering process adopted by NU, the Govt agencies/ PSUs does not sign any document physically and entire tender document is submitted online through digital signature. However, the Govt agencies/ PSUs shall be required to physically submit a set of documents in the office of Registrar, NU. In order to maintain transparency and integrity in the process of awarding contract, it is essential for NU and Govt agencies/ PSUs to agree and abide by certain principles and policies. NU and Govt agencies/ PSUs agree to following:

i) NU shall remain committed to follow the principles of transparency, equity and competitiveness in public procurement;

ii) The Notice Inviting Tender (RFP) is an invitation to offer made on the condition that the Govt agencies/ PSUs shall sign the Integrity Agreement, which is an integral part of tender/tender documents, failing which the Govt agencies/ PSUs will stand disqualified from the tendering process and the tender of the Govt agencies/ PSUs shall be liable to be rejected summarily.

iii) The Govt agencies/ PSUs agree and acknowledge that the RFP is an invitation to offer made on the condition that the Govt agencies/ PSUs shall sign an Integrity Agreement in the format as provided for in this document. Such Integrity Agreement shall form an integral part of the tender documents. Any failure on the part of any Govt agencies/ PSUs to execute the Integrity Agreement shall render such Govt agencies/ PSUs disqualified from the tendering process. The Govt agencies/ PSUs agree and acknowledge that bidding for the Work as envisaged in this document shall be regarded as an unconditional and absolute acceptance of the condition of executing the Integrity Agreement.

iv) The Govt agencies/ PSUs acknowledge, agree and confirm acceptance and compliance with the Integrity Agreement in letter and spirit and further agree that execution of the Integrity Agreement shall be separate and distinct from the main agreement, which shall come into existence once tender is finally accepted by NU. The Govt agencies/ PSUs acknowledge and accept the tenure of the Integrity Agreement, which shall be in the line with Article 1 of the format of Integrity Agreement as prescribed herein.

The Govt agencies/ PSUs acknowledge that in the event of failure to sign and accept the Integrity Agreement, while submitting the tender/tender documents, NU shall have unqualified, absolute and unfettered right to disqualify the Govt agencies/ PSUs and reject the tender in accordance with terms and conditions of the tender. In addition to other components of tender document, the Integrity Pact shall also be signed between The Registrar, NU and successful Govt agencies/ PSUs after acceptance of tender.

To,

THE REGISTRAR,

……..,

Sub: Notice Inviting Tender for engaging contractor for setting up 5000 KW AC Capacity grid connected ground mounted solar PV system including DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING at the permanent campus of Nalanda University (NU), Nalanda, Rajgir, Bihar.

Dear Sir,

It is here by declared that the Nalanda University is committed to follow the principle of transparency, equity and competitiveness in public procurement.

The subject Notice Inviting Tender (RFP) is an invitation to offer made on the condition that the Govt agencies/ PSUs will sign the integrity Agreement, which is an integral part of tender/tender documents, failing which the Govt agencies/ PSUs will stand disqualified from the tendering process and the tender of the Govt agencies/ PSUs would be summarily rejected.

This declaration shall form part and parcel of the Integrity Agreement and signing of the same shall be deemed as acceptance and signing of the Integrity Agreement on behalf of the NU.

Yours faithfully

Registrar, NU

(TO BE SUBMITTED ON GOVT AGENCIES/PSUs/DEPARTMENT LETTER HEAD during bidding process)

INTEGRITY PACT

To,

THE REGISTRAR,

……..,

Sub: Notice Inviting RFP for engaging contractor for setting up 5000 KW AC Capacity grid connected ground mounted solar PV system including DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING at the permanent campus of Nalanda University (NU), Nalanda, Rajgir, Bihar.

Dear Sir,

It is here by declared that the Nalanda University is committed to follow the principle of transparency, equity and competitiveness in public procurement.

The subject Notice Inviting RFP (RFP) is an invitation to offer made on the condition that the Govt Agencies/PSUs will sign the integrity Agreement, which is an integral part of RFP/RFP documents, failing which the Govt Agencies/PSUs will stand disqualified from the RFP process and the RFP of the Govt Agencies/PSUs would be summarily rejected.

This declaration shall form part and parcel of the Integrity Agreement and signing of the same shall be deemed as acceptance and signing of the Integrity Agreement on behalf of the NU.

Yours faithfully

Registrar, NU

INTEGRITY AGREEMENT

(To be signed by the Govt agencies/ PSUs and the Registrar, NU)

THIS INTEGRITY AGREEMENT is made at ..... on this..... Day of 2020

BETWEEN

The Vice Chancellor, Nalanda University represented through the Registrar, Nalanda University (hereinafter referred as "NU" or "Owner" which expression shall unless repugnant to the context or meaning thereof is deemed to include its successors & permitted assigns) of the FIRST PART:

AND

..... (Name and Address of the Individual/firm/Company) through..... (Hereinafter referred to as the (Details of duly authorized signatory) "Govt agencies/ PSUs/Contractor" and which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns) of the SECOND PART

Each of the NU/Owner and Govt agencies/ PSUs/Contractor individually referred to as the "Party" and collectively referred to as the "Parties".

Preamble

WHEREAS the Owner floated a tender for **engaging contractor for setting up 5000 KW AC Capacity grid connected ground mounted solar PV system including DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING at the permanent campus of Nalanda University (NU), Nalanda, Rajgir, Bihar**. ("Tender") and intends to award, under laid down organizational procedure, contract for ……. (Name of Work) hereinafter referred to "Contract".

AND WHEREAS the Owner values full compliance with all applicable laws of the land, rules, regulations, economic use of resources and of fairness/transparency in its relation with its Govt agencies/ PSUs(s) and contractor(s).

AND WHEREAS to meet the purpose aforesaid, the Parties have agreed to enter into this Integrity Agreement (hereinafter referred to as "Integrity Pact" or "Pact"), the terms and conditions of which shall also be read as integral part and parcel of the tender documents and Contract between the Parties.

NOW, THEREFORE, in consideration of mutual covenants contained in this Pact, the Parties hereby agree as follows and this Pact witnesses as under:

Article 1: Commitment of the Owner

1) The Owner commits itself to take all measures necessary to prevent corruption and to observe the following principles:

(a) No employee of the Owner, personally or through any of his/her family members, will in connection with the Tender, or the execution of the Contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.

(b) The Owner will, during the tender process, treat all Govt agencies/ PSUs(s) with equity and reason. The Owner will, in particular, before and during the tender process, provide to all Govt agencies/ PSUs(s) the same information and will not provide to any Govt agencies/ PSUs(s) confidential/additional information through which the Govt agencies/ PSUs(s) could obtain an advantage in relation to the tender process or the Contract execution.

(c) The Owner shall endeavour to exclude from the tender process any person, whose conduct in the past has involved any bias of any nature.

2) If the Owner obtains information on the conduct of any of its employees which is a criminal offence under the Indian Penal Code (IPC) or Prevention of Corruption Act, 1988 or is in violation of the principles herein mentioned or if there be a substantive suspicion in this regard, the Owner will be at liberty to take appropriate disciplinary action or initiate disciplinary proceedings as per its internal policies and procedures.

Article 2: Commitment of the Govt agencies/ PSUs(s)/Contractor(s)

1) Each Govt agencies/ PSUs/Contractor shall be required to (including their respective officers, employees and agents) adhere to the highest ethical standards and shall report to the Owner of any suspected acts of fraud or corruption or coercion or collusion of which it has knowledge or becomes aware, during the tendering process and throughout the negotiation and award of the Contract.

2) The Govt agencies/ PSUs(s)/Contractor(s) commits themselves to take all measures essential to prevent any act of corruption. The Govt agencies/ PSUs/Contractors commit themselves to observe the following principles during their participation in the Tender process and during the execution of the Contract:

a) The Govt agencies/ PSUs(s)/Contractor(s) will not, directly or through any other person or firm, offer, promise or give to any of the owner's employees involved in the Tender process or execution of the Contract, or to any third person any material or other benefit which such person is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the Tender Process or during the execution of the Contract.

b) The Govt agencies/ PSUs(s)/Contractor(s) shall not enter with other Govt agencies/ PSUs(s) in to any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of tenders or any other actions to restrict competitiveness or to cartelize in the tendering process.

c) The Govt agencies/ PSUs(s)/Contractor(s) will not commit any offence under the relevant Indian Penal Code (IPC)/PC Act. Further the Govt agencies/ PSUs(s)/Contractor(s) will not use improperly, (for the purpose of competition or personal gain), or pass on to others, any information or documents provided by the Owner as part of the business relationship regarding plans, technical proposals and business details, including information contained or transmitted electronically or otherwise.

d) The Govt agencies/ PSUs(s)/Contractor(s) of foreign origin shall disclose the names and addresses of agents/representatives in India, if any. Similarly, Govt agencies/ PSUs(s)/Contractor(s) of Indian nationality shall disclose names and addresses of foreign agents/representatives, if any. Either the Indian agent on behalf of the foreign principal or the foreign principal directly can submit tender in the process of tender, but not both. In cases where an agent participates in the tender on behalf of one Govt agencies/ PSUs, such agent shall not be permitted to quote on behalf of any another Govt agencies/ PSUs along with the first manufacturer in a subsequent/parallel tender for the same item.

e) The Govt agencies/ PSUs(s)/Contractor(s) will, when presenting tender, disclose any and all payments made, is committed to make or intends to make to agents, brokers or any other intermediaries in connection with the award of the Contract.

3) The Govt agencies/ PSUs(s)/Contractor(s) will not instigate any third person to commit offences mentioned above or be an accessory to such offences.

4) The Govt agencies/ PSUs(s)/Contractor(s) will not, directly or through any other person or firm indulge in fraudulent practice means wilful misrepresentation or omission of facts or submission of fake/forged documents in order to induce public official to act in reliance thereof, with the purpose of obtaining unjust advantage by or causing damage to justified interest of others and/or to influence the procurement process to the detriment of the interest of the Owner.

5) The Govt agencies/ PSUs(s)/Contractor(s) will not, directly or through any other person or firm use coercive practices (means the act of obtaining something, compelling an action or influencing a decision through intimidation, threat or the use of force directly or indirectly, where potential or actual injury may befall upon a person, his/ her reputation or property to influence their participation in the tendering process).

Article 3: Consequences of Breach

Without prejudice to any rights that may be available to the Owner under law or the Contract or the Contract or its established policies and laid down procedures, the Owner shall have the following rights in case of breach of this Integrity Pact by the Govt agencies/ PSUs(s)/Contractor(s) and the Govt agencies/ PSUs/ Contractor accepts and undertakes to respect and uphold the Owner's absolute right:

1) If the Govt agencies/ PSUs(s)/Contractor(s), either before award or during execution of Contract has committed a transgression through a violation of Article 2 above or in any other form, such as to put his reliability or credibility in question, the Owner after giving 14 days' notice to the Govt agencies/ PSUs/Contractor shall have the powers to disqualify the Govt agencies/ PSUs(s)/Contractor(s) from the process of Tender or terminate/determine the Contract, if already executed or exclude the Govt agencies/ PSUs/Contractor from future contract award processes. The imposition and duration of the exclusion will be determined by the severity of transgression and determined by the Owner. Such exclusion may be forever or for a limited period as decided by the Owner.

2) **Forfeiture of EMD/Performance Guarantee/Security Deposit:** If the Owner has disqualified the Govt agencies/ PSUs(s) from the Tender process prior to the award of the Contract or terminated/determined the Contract or has accrued the right to terminate/determine the Contract according to Article 3(1), the Owner apart from exercising any legal rights that may have accrued to the Owner, may in its considered opinion forfeit the entire amount of Earnest Money Deposit, Performance Guarantee and Security Deposit rendered by the Govt agencies/ PSUs/Contractor.

3) **Criminal Liability:** If the Owner obtains knowledge of conduct of a Govt agencies/ PSUs or Contractor, or of an employee or a representative or an associate of a Govt agencies/ PSUs or Contractor which constitutes corruption within the meaning of the Indian Penal Code (IPC) Act or if the Owner has substantive suspicion in this regard, the Owner will forthwith inform the same to any law enforcing agencies for further investigation.

Article 4: Previous Transgression

1) The Govt agencies/ PSUs/Contractor declares that no previous transgressions occurred in the last five (5) years with any other company in any country confirming to the anti-corruption approach or with the Central Government or State Government or any other Central/State Public Sector Enterprises in India that could justify its exclusion from the process of Tender.

2) If the Govt agencies/ PSUs makes incorrect statement on this subject, he can be disqualified from the process of Tender or action can be taken for banning of business dealings/holiday listing of the Govt agencies/ PSUs/Contractor as deemed fit by the Owner.

3) If the Govt agencies/ PSUs/Contractor can prove that he has resorted / recouped the damage caused by him and has installed a suitable corruption

prevention system the Owner may, at its sole discretion, revoke the exclusion prematurely.

Article 5: Equal Treatment of all Govt agencies/ PSUs/Contractors/Subcontractors

1) The Govt agencies/ PSUs(s)/Contractor(s) undertake(s) to demand from all sub-contractors a commitment in conformity with this Integrity Pact. The Govt agencies/ PSUs/Contractor shall be responsible for any violation(s) of this Integrity Pact by any of its subcontractors/sub-vendors.

2) The Owner will enter into such agreements or pacts on identical terms as this Integrity Pact with all Govt agencies/ PSUs and Contractors.

3) The Owner will disqualify Govt agencies/ PSUs, who do not submit the duly signed Integrity Pact between the owner and the Govt agencies/ PSUs, along with the Tender or violate its provisions at any stage of the Tender process, from the Tender process.

Article 6- Duration of the Pact

This Pact begins when both parties (the Owner and the Govt agencies/ PSUs/Contractor) have legally signed it. It expires for the Contractor/Vendor twelve (12) months after the completion of work under the contract or till the continuation of defect liability period, whichever is more and for all other Govt agencies/ PSUs, till the Contract has been awarded

If any claim is made/lodged during the time, the same shall be binding and continue to be valid despite the lapse of this Pact as specified above, unless it is discharged/determined by the Owner.

Article 7- Other Provisions

1) This Integrity Pact is subject to Indian laws and the place of performance and jurisdiction is the place of office of the Owner/NU who has floated the Tender.

2) Any change, amendment, modification or supplement or addendum to the Integrity Pact can only be brought into effect by way of mutual written agreement between the parties to the Integrity Pact.

3) If the Contractor is a partnership or a consortium, this Pact shall be signed by all the partners or by one or more partners holding power of attorney signed by all partners and consortium members. In case the contractor is a company, the Pact must be signed by a representative duly authorized by board resolution of such company. In case of Consortium, the Lead partner shall have to meet all the eligibility criteria(s) that has been laid down in the RFP to qualify to bid for the work."

4) Should one or several provisions of this Integrity Pact turn out to be invalid, the remainder of the Integrity Pact remains valid. In this case, the Parties will strive to come to an agreement to their original intensions.

5) It is agreed term and conditions that any dispute or difference arising between the Parties with regard to the terms of this Integrity Agreement/ Pact, any action taken by the Owner in accordance with this Integrity Agreement / Pact or interpretation thereof shall not be subject to arbitration.

Article 8- LEGAL AND PRIOR RIGHTS

All rights and remedies of the Parties hereto shall be in addition to all the other legal rights and remedies belonging to such Parties under the contract and/or law and the same shall be deemed to be cumulative and not alternative to such legal rights and remedies aforesaid. For the sake of brevity, both the Parties agree that this Integrity Pact shall have precedence over the Tender/Contact documents with regard to any of the provisions covered under this Integrity Pact.

IN WITNESS WHEREOF the Parties have signed and executed this Integrity Pact at the place and date first above mentioned in the presence of following witnesses

:.....

(For and on behalf of Owner)

.....

(For and on behalf of Govt agencies/ PSUs/Contractor)

WITNESSES (Signature, name and address)

1 .....

2 .....

Place:

Dated:

(To be signed by the Govt Agencies/PSUs and the Registrar, NU)

FORM OF BANK GUARANTEE FOR EARNEST MONEY

WHEREAS, contractor..... (Name of contractor) (Hereinafter called "the Contractor") has submitted his tender dated..... (Date) for Work of..... (Name of work) (Hereinafter called "the Tender")

KNOW ALL PEOPLE by these presents that We, _____ (name of bank) having our registered office at..... (Hereinafter called "the Bank") are bound unto The Registrar, Nalanda University, Rajgir (hereinafter called "the Owner") in the sum of Rs..... (Rs. in words .....) for which payment well and truly to be made to the said Owner, the Bank binds itself, his successors and assigns by these presents.

SEALED with the Common Seal of the said Bank this .....day of..... 20....

The conditions of this obligation are:

1) If after opening of the Tender, the Contractor withdraws the Tender during the period of validity of Tender (including extended validity of the Tender) specified in the Form of Tender;

2) If the Contractor having been notified of the acceptance of his Tender by the Owner:

a. fails or refuses to execute the Form of Agreement in accordance with the instructions to contractor, if required;

or

b. fails or refuses to furnish the Performance Guarantee, in accordance with the provisions of the Notice Inviting Tender and instructions given to the Contractor;

or

c. If the contractor withdraws his tender before the expiry of the validity period, or before the issue of letter of acceptance, whichever is earlier, or makes any modification in the terms and conditions of the tender, which are not acceptable to the NU.

We undertake to pay to the Owner, without any protest or demur, an amount equal to the amount specified in this Bank Guarantee or part thereof upon receipt of the first written demand received from the Owner, without the Owner having to substantiate his demand, provided that in his demand the Owner will clearly note that the amount claimed by him is due to him owing to occurrence of one or any of the above conditions, specifying the occurred condition or conditions entitling the Owner to claim the amount under the present Bank Guarantee.

This Guarantee will remain in force up to and including the date ----------(validity period of **120 Days** from the last date of receipt of the Tender) after the deadline for submission of tender as such deadline is stated in the Instructions to contractor or as it may be extended by the Owner, notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this Guarantee should reach the Bank not later than the above date.

DATE: …… SIGNATURE OF THE BANK:

.
SEAL:
WITNESS: ……
(SIGNATURE, NAME AND ADDRESS)

(To be executed by and between the Owner and the successful Govt Agencies/PSUs)

FORMAT OF AGREEMENT

This agreement is executed at _____ (place of execution) on the _____ day of _____, 20__
BETWEEN

_____
_____, which expression shall mean and include its successors and assigns (name and address of the Owner) ("Owner") of the FIRST PART
AND
_____
_____
_____
_____,
(name and address of the successful Govt Agencies/PSUs) ("Contractor") of the SECOND PART

The Owner and the Contractor shall be individually referred to as the "Party" and collectively referred to as the "Parties"

Whereas the Owner is desirous of **Engaging contractor for setting up 5000 KW AC Capacity grid connected ground mounted solar PV system including DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING at the permanent campus of Nalanda University (NU), Nalanda, Rajgir, Bihar** and had invited RFPs by issuing Notice Inviting RFP ("RFP") for selection of a contractor for constructing the said campus. The Contractor has submitted its RFP pursuant to the issuing of the RFP by the Owner. WHEREAS the details of the work proposed to be executed by the Contractor is more particularly specified in the **RFP for engaging contractor for setting up 5000 KW AC Capacity grid connected ground mounted solar PV system including DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING at the permanent campus of Nalanda University (NU), Nalanda, Rajgir, Bihar**, (name and identification number of Contract) ("Works") and the Owner has accepted the RFP submitted by the Contractor for the execution and completion of the Works and the remedying of any defects therein, at a contract price of Rs..... ..... (Rupees _____(*in words*))

WHEREAS the Owner is now desirous of laying down the terms and conditions governing the execution of the Works and has therefore, requested the Contractor to execute the present Agreement.
NOW THIS AGREEMENT WITNESSETH as under:

1. In this Agreement, words and expressions shall carry the same meanings as are ascribed to them in the Conditions of Contract as more particularly mentioned in the RFP. The Parties agree that the RFP shall form an integral part of this Agreement and shall be read and construed accordingly.

2. In consideration of the payments to be made by the Owner to the Contractor as the consideration for execution of the Works ("Consideration"), the Contractor hereby covenants with the Owner to execute and complete the Works and remedy the defects therein in conformity in all aspects with the provisions of the RFP and this Agreement.

3. The Owner hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and in the remedying the defects wherein the Contract Price or such other sum as may become payable under the provisions of the RFP and this Agreement at the times and in the manner prescribed under the RFP.

4. The following documents shall be deemed to form and be read and construed as part of this Agreement:

i) Letter of Acceptance;
ii) Notice to proceed with the Works;
iii) Contractor's RFP;
iv) Contract Data;
v) Conditions of Contract (including Special Conditions of Contract);
vi) Specifications;
vii) Drawings;
viii) Bill of Quantities; and
ix) Any other documents listed in the Contract Data as forming part of the Contract.

In witness whereof the Parties have caused this Agreement to be executed on the day and year first written above.

The Common Seal of _____
_____
_____
_____
was hereunto affixed in the presence of:

Signed Sealed and Delivered by the said _____
_____
_____
_____
_____

Binding Signature of Owner _____

Binding Signature of Contractor _____

in the presence of _____

Format of Performance Security (Guarantee)Bank Guarantee Bond

In consideration of the Nalanda University (hereinafter called "the Owner") having offered to accept the terms and conditions of the proposed agreement between The Registrar, Nalanda University and ……(hereinafter called "the said Contractor(s)") for the work…… (herein after called "the said agreement") having agreed to production of an irrevocable Bank Guarantee for Rs. ……(Rupees …… only) as a security/guarantee from the contractor(s) for compliance of his obligations in accordance with the terms and conditions in the said agreement.

1. We, ……. (hereinafter referred to as "the Bank") hereby undertake to pay to the Owner an amount not exceeding Rs. …….. (Rupees……. Only) on demand by the Owner.

2. We, …….(indicate the name of the Bank) do hereby undertake to pay the amounts due and payable under this guarantee without any demure, merely on a demand from the Owner stating that the amount claimed as required to meet the recoveries due or likely to be due from the said contractor(s). Any such demand made on the bank shall be conclusive as regards the amount due and payable by the bank under this Guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. …….. (Rupees …….only)

3. We, the said bank further undertake to pay to the Owner any money so demanded notwithstanding any dispute or disputes raised by the contractor(s) in any suit or proceeding pending before any court or Tribunal relating thereto, our liability under this present being absolute and unequivocal. The payment so made by us under this bond shall be a valid discharge of our liability for payment thereunder and the Contractor(s) shall have no claim against us for making such payment.

4. We, ……. (indicate the name of the Bank) further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said agreement and that it shall continue to be enforceable till all the dues of the Owner under or by virtue of the said agreement have been fully paid and its claims satisfied or discharged or till Engineer-in-Charge on behalf of the Owner certified that the terms and conditions of the said agreement have been fully and properly carried out by the said Contractor(s) and accordingly discharges this guarantee.

5. We, ……. (indicate the name of the Bank) further agree with the Owner that the owner shall have the fullest liberty without our consent and without affecting in any manner our obligation hereunder to vary any of the terms and conditions of the said agreement or to extend time of performance by the said Contractor(s) from time to time or to postpone for any time or from time to time any of the powers exercisable by the Owner against the said contractor(s) and to forbear or enforce any of the terms and conditions relating to the said agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Contractor(s) or for any forbearance, act of omission on the part of the Owner or any indulgence by the Owner to the said Contractor(s) or

by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.

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

7. We, ……. (Indicate the name of the Bank) lastly undertake not to revoke this guarantee except with the previous consent of the Owner in writing.

8. This guarantee shall be valid up to ……unless extended on demand by the Owner. Notwithstanding anything mentioned above, our liability against this guarantee is restricted to Rs.

…… (Rupees ……..) and unless a claim in writing is lodged with us within six months of the date of expiry or the extended date of expiry of this guarantee all our liabilities under this guarantee shall stand discharged.

Dated the ……..day of ……for…….(indicate the name of the Bank)

Brief Particulars of the Work

Nalanda University was established in November 2010. It came into being by an Act of the Indian Parliament – a testimony to the important status that Nalanda University occupies in the Indian intellectual landscape. Nalanda is a standalone international university unlike any other established in the country. Located in the town of Rajgir, in the northern Indian State of Bihar, Nalanda University is mandated to be "an international institution for the pursuit of intellectual, philosophical, historical and spiritual studies". This new university contains within it a memory of the ancient Nalanda University and is premised on the shared desire of Member States of the East Asia Summit countries to re-discover and strengthen "educational co-operation by tapping the East Asia Regions centres of excellence in education ... [and] to improve understanding and the appreciation of one another's heritage and history"

The proposed site for the University is located in the Nalanda district of Bihar and fronts the State Highway 71. The site for the University is on the South West outskirts of Rajgir town at a distance of 3.5 kms from the current urban edge of the town. Rajgir also happens to be the administrative sub division of Nalanda district.

The whole campus is planned to be constructed in two phases. The first phase will be of approximately 1,40,200 Sqm of Built up area.

This RFP document is for engaging contractor for setting up 5000 KW AC Capacity grid connected ground mounted solar PV system including DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING at the permanent campus of Nalanda University (NU), Nalanda, Rajgir, Bihar.

GENERAL GUIDELINES FOR GOVT AGENCIES/PSUs

1. GENERAL:

Any information furnished by the Govt Agencies/PSUs found to be incorrect either immediately or at a later date, shall render such Govt Agencies/PSUs liable to be debarred from RFP/taking up of the Work.

2. DEFINITIONS:

1.1 The **Contract** means the documents forming the RFP and acceptance thereof and the formal agreement executed between the competent authority on behalf of the President of India and the Contractor, together with the documents referred to therein including these conditions, the specifications, designs, drawings and instructions issued from time to time by the Engineer-in- Charge and all these documents taken together, shall be deemed to form one contract and shall be complementary to one another.

In this document the following words and expressions shall carry the meaning hereby assigned to them:

2.1 "Owner/Purchaser/Employer/NU" shall mean and refer to the Nalanda University, Rajgir, Bihar

2.2 "Vice Chancellor" shall mean and refer to the Vice Chancellor of NU

2.3 "Registrar" shall mean and refer to Registrar of NU

2.4 "Project Manager" shall mean and refer to the person/Project Management Consultants (PMC) nominated as Project Manager by NU and shall report to Engineer in Charge.

2.5 "Architect Consultants" shall mean and refer to the Consultants appointed by NU as Architect Consultants.

2.6 "MEP Consultant" shall mean and refer to the Consultants appointed by "Architect Consultants" as MEP Consultants.

2.7 "Engineer in Charge" shall mean and refer to an authorized Engineer Officer appointed by NU who shall supervise and be In-Charge of the work.

2.8 "Govt Agencies/PSUs" shall mean and refer to Govt department, Public Sector Companies (public), joint venture or corporation but shall not include a special purpose vehicle.

2.9 "Year" means financial year unless stated otherwise.

2.10 "Market Rate" shall be the rate as decided by the Engineer-in-Charge on the basis of the prevailing cost of materials and labour at the site (where the work is being executed) involved in executing that item plus the percentage mentioned in Schedule 'F' to cover, all overheads and profits, provided that no extra overheads and profits shall be payable on the part(s) of work assigned to other agency(s) by the contractor as per terms of contract.

3. METHOD OF APPLICATION:

3.1 If the Govt Agencies/PSUs is a limited company or a corporation or department , the application for submitting RFP shall be signed by a duly authorized person holding power of attorney for signing the application accompanied by a copy of the power of attorney. The Govt Agencies/PSUs shall also furnish a notarized copy of the Memorandum and Articles of Association of the company.

4. FINAL DECISION-MAKING AUTHORITY

The NU reserves the right to accept or reject any RFP and to annul the process and reject all RFPs at any time without assigning any reason thereof or incurring any liability to the Govt Agencies/PSUs.

5. Particulars of the work given in Brief are to be considered Provisional. They are liable to change and must be considered only as advance information to assist the Govt Agencies/PSUs.

6. SITE VISIT

The Govt Agencies/PSUs shall visit the Site of Work, at their own cost, and examine the Site and its surroundings to satisfy himself and collect all information that may be considered necessary for proper assessment of the scope of Work enumerated in this RFP document. Contact Person at Nalanda University for Coordination of Site Visit.

Junior Engineer Electrical, Nalanda University, Rajgir.
Email: skrishna@nalandauniv.edu.in
Mobile @ +91-9102011241

SECTION 2

PROFORMA & SCHEDULES:

SCHEDULE F (GENERAL RULES & DIRECTIONS)

1. **Authority Inviting RFP. - Registrar, Nalanda University, Rajgir, Bihar.**

2. **Maximum percentage for quantity of items of work to be executed beyond which rates are to be determined in accordance with Clauses "Deviation, Extra items and pricing & Deviation submitted items and pricing" Please refer below**

Definitions:

Sr. No	DESCRIPTION	DETAILS
1	**Owner**	Vice Chancellor, Nalanda University, Rajgir, Bihar
2	**RFP Accepting Authority**	Registrar, Nalanda University, Rajgir, Bihar.
3	**Engineer In charge**	Authorized Engineer Officer appointed by Nalanda University Rajgir, Bihar
4	**Project Manager**	Nominated Person/PMC by NU
5	**Architect Consultants**	Consultants, if any appointed by NU as Architect Consultants.
6	**Percentage on cost of materials and Labour to cover all overheads and profits for Extra Items**	15% For all Civil, Electrical Works.
7	**Rates considered for Estimate**	Market rate

CLAUSE 1: Performance Guarantee

1	**Time allowed for submission of Performance Guarantee Programme Chart (Time and Progress) and applicable labour Licenses, Registration with EPFO, ESIC, and BOCW Welfare board or proof of applying therefrom the date of issue of letter of acceptance**	15 (Fifteen) Days
2	**Maximum allowable extension beyond the period provided in 1 above**	7 (Seven) Days with late fee @ 0.1% per day of the Performance Guarantee amount.

CLAUSE 2 and Clause 2 A: Compensation for Delay and Incentive for early completion

1	**Authority for fixing compensation under its clause**	Vice Chancellor, Nalanda University, Rajgir, Bihar

CLAUSE 3 & 4 as per CPWD GCC.

CLAUSE 5: Time and Extension for Delay

1	**Number of days from the date of issue of letter of acceptance for reckoning date of start.**	22 (Twenty Two) days.

Milestone(s) as per table given below:-

Though the overall time of completion is 12 months the contractor shall complete all the work in scope so that the system is ready for commissioning and charging with GRID in all respects, strictly conforming to the CEA, BERC, SECI , MNRE, SBPDCL guidelines and time limit specified for such items. Any delay in achieving specified

timeline given in the Milestones (as mentioned below) of these building shall invite withholding of payments as indicated against each and every Milestone:

Project Milestone Schedule:			
Sr. No.	Description of Milestone (Physical)	Time allowed in Months (from date of start/LOA)	Amount to be with-held in case of non-achievement of milestone
Milestone of Works (Time duration 18 Months)			
1	Submission of Engineering Design for the Solar plant for approval from Client along with Vetting report from NISE / SECI / MNRE	60 Days	0.5% of RFP/tendered/offered value.
2	Approval of technical data sheet for all the equipment's as per the vetted & approved design including GA drawings for Panels Etc.	90 Days	0.5% of RFP/tendered/offered value
3	Supply of all the mounting structure, solar panels and other equipment's to site	150 Days	0.5% of RFP/tendered/offered value
4	Supply of all electrical & others panels, cables and related accessories for completion of the work	180 Days	0.25% of RFP/tendered/offered value
5	Completion of SITC work for the complete scope Completion of SITC work for the complete scope including 3rd Party inspection Pre and Post of solar power plant design, drawing and vetting of documents.	A. Minimum 1 MW in 240 Days B. 2 MW in 300 Days C. Remaining all in 345 Days	A. 0.25% of RFP/tendered/offered value B. 0.25% of RFP/tendered/offered value C. 0.25% of RFP/tendered/offered value
6	Final Handing over including approval/Co-ordination Liasioning with SBPDCL/ BERC & Statuary / Government clearances(if required) of the entire	365 Days	0.5% of RFP/tendered/offered amount

	setup as per design intent along with details of the local service and central service centre. The contractor shall introduce in writing about the services support, do's & don'ts, Operation, Maintenance and Services procedures and guidelines. The contractor has to submit the AS Built Drawing and maintenance manuals of all the items.		

Note:

a. **Withheld amount shall be released if and when subsequent milestone is achieved.**
b. **The Milestone may be rescheduled within the timeline as per the University's requirement.**

1	**Total Time allowed for execution of work**	12 (Twelve) Months thereafter DFL, O&M
2	**Authority to decide Extension of Time**	Vice Chancellor, Nalanda University, Rajgir, Bihar
3	**Rescheduling of Milestones**	Engineer In Charge, and the Rescheduling is to be approved by Vice Chancellor, Nalanda University (NU)

1	**Total Time allowed for execution of work**	12 (Twelve) Months thereafter DFL, O&M
2	**Authority to decide Extension of Time**	Vice Chancellor, Nalanda University, Rajgir, Bihar
3	**Rescheduling of Milestones**	Engineer In Charge, and the Rescheduling is to be approved by Vice Chancellor, Nalanda University (NU)

Clause 5
Schedule of handing over of site

Part	Portion of site	Description	Time Period for handing over reckoned from date of issue of letter of intent.
1	Site dedicated for solar plant	Handing over of all spaces	Within 15 days of work order.

Schedule of issue of Designs

Part	Portion of Design	Description	Time Period for issue of design reckoned from date of receipt of tenders
Part A	Portion already included in RFP	Tender Drawings	Included in Tender Set
Part B	Portions of Designs to be issued	NA	NA

Clause 5.4
Schedule of rate of recovery for delay in submission of the modified program in terms of delay days

I.	More than Rs. 20 Crore.	Rs. 5000

CLAUSE 7 : Payment on Intermediate Certificate to be regarded as Advances

1	**Gross work to be done together with net payment / adjustment of advances for material collected, if any, since the last such payment for being eligible to interim payment.**	Minimum Value shall be Rs. 2.0 Crores per Running Bill. (this limit of Rs. 2.0 crore will not apply to the first running bill and last running bill preceding the final bill).

Clause 7A

1	**Whether Clause 7 A shall be applicable**	yes

List of Testing Equipment.

1	**List of Testing equipment to be provided by the contractor at site laboratory.**	As required to complete the work in given time and for testing as per technical specifications.

CLAUSE 10B (i) & 10B (ii) : Secured Advance & Mobilization Advance.

1	**Secured advance on Non-perishable materials & Mobilization Advance.**	Applicable as per detailed clause.

CLAUSE 10CA : Payment due to variation in prices of materials after receipt of tender

NOT APPLICABLE

Clause 10CC : Payment due to Increase/Decrease in Prices/Wages (excluding materials covered under clause 10CA) after Receipt of Tender for Works

NOT APPLICABLE

CLAUSE 11 : Work to be executed in accordance with Specifications, Drawings, and Orders etc.

1	**Specifications**	Detailed Specifications and related IS/IEC and other mentioned codes For Civil and Electrical works

CLAUSE 12 : Deviations/Variations/ Extent and Pricing

1	**Deviation limit beyond clause 4.23 shall apply for all building work (Above plinth level).**	30 % (Thirty per cent).
2	**Deviation Limit beyond clauses 4.23 for work up to plinth level**	100% (One Hundred per cent)

CLAUSE 16 : Action in casework not done as per Specifications

1	**Competent Authority for deciding reduced rates.**	Engineer in Charge

CLAUSE.17 : Contractor Liable for Damages/ Defects during defects liability period

4	**Defects Liability Period**	24 months from completion of the project as a whole.

CLAUSE 4.38: Settlement of Disputes

1	**Settlement of Disputes**	Committee appointed by NU

Employment of Technical Staff and employees

Requirement of Technical Representative(s) in progressive manner in satisfaction of Project Manager & Engineer-In-Charge with its recovery Rate.

S. No.	Minimum Qualification of Technical Representative	Discipline	Minimum Experience	Number	Rate at which recovery shall be made from the contractor in the event of not fulfilling provision of clause Figures	
1	Project Manager Graduate Engineer	Electrical	Twenty Years	One	Rs. 60,000/- p.m.	.
2.	Project Engineer Graduate Engineer	Electrical	Twelve Years	Two	Rs. 40,000/ p.m.	.
3.	Site Engineer Graduate Engineer or Diploma Engineer	Electrical	Five years Ten Years	Two Two	Rs. 25,000/ p.m. Rs. 25,000/ p.m.	
4.	Site Supervisor Graduate Engineer or Diploma Engineer	Electrical	Five years Eight Years	Two Two	Rs. 15,000/ p.m. Rs. 15,000/ p.m.	
5	Billing Engineer Graduate Engineer	Electrical	Six Years	One	Rs. 20,000/- p.m.	

SECTION 3

GENERAL CONDITIONS OF CONTRACT

Definitions:
The **Contract** means the documents forming the RFP and acceptance thereof and the formal agreement executed between the Competent Authority, Nalanda University and the Contractor, together with the documents referred to therein including these conditions, the specifications, designs, drawings and instructions issued from time to time by the Engineer-In-Charge/the Competent Authority at NU and all these documents taken together, shall be deemed to form one contract and shall be complementary to one another. In the contract, the following expressions shall, unless the context otherwise requires, have the meanings, hereby respectively assigned to them: -

Work:

The expression work or works shall, mean unless there be something either in the subject or context repugnant to such construction the context otherwise requires be construed and taken to mean the works by or by virtue of the contract contracted to be executed whether temporary or permanent, and whether original, altered, substituted or additional.

Site:
The Site shall mean the land/or other places on, into or through which work is to be executed under the contract or any adjacent land, path or street through which work is to be executed under the contract or any adjacent land, path or street which may be allotted or used for the purpose of carrying out the contract.

Contractor:
The Contractor shall mean the individual, firm or company, whether incorporated or not, undertaking the works and shall include the legal personal representative of such individual or the persons composing such firm or company, or the successors of such firm or company and the permitted assignees of such individual, firm or company.

Owner:
Owner shall mean the Nalanda University, Rajgir, BIHAR.

Project Manager:

Means the authorized Engineer Officer nominated by the Project Management Consultant appointed by Nalanda University. He will report to the Engineer-In-Charge and will be responsible for day to day supervision of project execution and will assist Engineer-in-Charge in Planning, Quality Assurance and Control, Execution and monitoring the Progress of work.

Architect Consultants:

Architect Consultants shall mean the Architect Consultant appointed by NU including its associate architects and their authorized consultants and Engineers to design and assist the Engineer In Charge in monitoring the Architectural, Structural, Electrical, Plumbing, Acoustic, HVAC, Landscape and Infrastructure works and also to check

quality, project scheduling, cost control, installation of systems and equipment in the Works and ensure that the same is done as per the drawings approved.

Engineer-in-Charge:
Engineer-in-Charge (EIC) shall mean the authorized Engineer Officer appointed by NU, who shall supervise and be in charge of the work. Engineer-in-Charge will administer the contract with the assistance of his authorized subordinate Engineers.

Accepting Authority:
Accepting Authority shall mean the authority mentioned in **Schedule 'F'**.

Excepted Risk:
Excepted Risk are risk due to riots (other than those on account of Contractor's employees), war (whether declared or not) invasion, act of foreign enemies, hostilities, civil war, rebellion revolution, insurrection, military or usurped power, any acts of Owner damage from aircraft, acts of God, such as earthquake, lightening and unprecedented floods and other causes over which the Contractor has no control and accepted as such by the Accepting Authority (i.e. either the Owner or an Agency appointed by the Owner) or causes solely due to use or occupation by Owner of the part of the Work in respect of which a certificate of completion has been issued or a cause solely due to Owner's faulty design of works..

Market Rate:
Market rate shall be the rate as decided by the Engineer-in-Charge in consultation with Architect Consultants and Project Management Consultant (PMC) on the basis of the cost of materials and labour at the site where the Work is to be executed plus the percentage mentioned in **Schedule 'F'** to cover all overheads and profits of the Contractor and approved by the NU, provided that no extra overheads and profits shall be payable on the part(s) of work assigned to other agency(s) by the contractor as per terms of contract. Schedule(s) referred to in these conditions shall mean the relevant schedule(s) annexed to the RFP documents or the standard Schedule of Rates of the government mentioned in Schedule 'F' hereunder, with the amendments thereto issued upto the date of receipt of the RFP.

Tendered /offered value:

Tendered value / Contract value means the value of the entire Work as stipulated in the letter of award.

Date of commencement of work:

The Date of commencement of work shall be the date when contract comes into existence i.e. the date the Letter of Acceptance by NU is awarded or the first date of handing over of the site, whichever is later, in accordance with the phasing if any, as indicted in the RFP document.

Scope & Performance

Where the context so requires, words imparting the singular only also include the plural and vice versa. Any reference to masculine gender shall whenever required include feminine gender and vice versa.

The contractor shall be furnished, free of cost one certified copy of the contract documents including specifications, Schedule of Rates and such other printed and published documents, together with all drawings as may be forming part of the RFP papers. None of these documents shall be used for any purpose other than that of this contract.

Works to be carried out

The Work to be carried out under the Contract shall, except as otherwise provided in these conditions shall include all labour, materials, tools and plants, equipment and transport to be provided at the cost and expense of the Contractor which may be required in preparation of and for and in the full and entire execution and completion of the Works. The descriptions given in the Schedule of Quantities (Schedule A) shall unless otherwise stated, be held to include wastage on materials, carriage and cartage, carrying and return of empties, hoisting, setting, fitting and fixing in position and all other labours necessary in and for the full and entire execution and completion of the Works as aforesaid in accordance with good practice and recognized principles.

Sufficiency of RFP:

The Contractor shall be deemed to have satisfied himself before RFP as to the correctness and sufficiency of his RFP for the works and of the rates and prices quoted in the Schedule of Quantities and RFP Documents, which rates and prices shall, except as otherwise provided, cover all its obligations under the contract and all matters and things necessary for the proper completion and maintenance of the works.

Discrepancies and Adjustment of Errors:

The several documents forming the Contact are to be taken as mutually explanatory of one another, detailed drawings being followed in preference to small scale drawing and figured dimensions in preference to scale and special conditions in preference to General Conditions.

In the case of discrepancy between the schedule of Quantities, the Specifications and / or the Drawings, the following order of preference shall be observed: -

I) Description of Schedule of Quantities.

ii) Particular Specifications

iii) Special Conditions.

iv) Additional Conditions

v) General Conditions

vi) Drawings.

vii) CPWD standard specifications for Civil, Plumbing, Mechanical and Electrical works.

viii) Indian Standard specifications for Solar PV , Structures , ELV works and related equipment's and accessories.

ix) Indian Standard Specifications of BIS.

x) Accepted good Engineering Practice based on experience of Foreign Countries'' Codes.

xi) Relevant IS or any other international code in case IS code is not available.

If there are varying or conflicting provisions made in any one document forming part of the contract, the Accepting Authority shall be the deciding authority with regard to the intention of the document and his decision shall be final and binding on the contractor.

Any error in description, quantity or rate in Schedule of Quantities or any Omission there from shall not vitiate the Contract or release the Contractor from the execution of the whole or any part of the works comprised therein according to drawings and specifications or from any of his obligations under the contract.

Signing of Contract: The successful Govt Agencies/PSUs, on acceptance of his RFP by the Accepting Authority, shall, within 15 days from the stipulated date of start of the work, sign the contract consisting of:

i. The notice inviting RFP, all the documents including drawings, if any, forming the RFP as issued at the time of invitation of RFP and acceptance thereof together with any correspondence leading thereto.
ii. Standard CPWD Form as mentioned in Schedule 'F' consisting of:
    a. Various standard clauses with corrections up to the date stipulated in Schedule 'F' along with annexures thereto.
    b. CPWD Safety Code
    c. Model Rules for the protection of health, safety arrangements for workers employed by CPWD or its contractors.
    d. CPWD Contractor's Labour Regulations.
    e. List of Acts and omissions for which fines can be imposed.
iii. No payment for the work done will be made unless contract is signed by the contractor

CLAUSES OF CONTRACT

CLAUSE.1 Performance Guarantee

(i)The Contractor shall submit an irrevocable Performance Guarantee of 5% (Five percent) of the tendered/offered amount in addition to other deposits mentioned elsewhere in the contract for his proper performance of the contract agreement, (not withstanding and/or without prejudice to any other provisions in the contract) within period specified in Schedule 'F' from the date of issue of letter of acceptance. This period can be further extended by the Engineer-in-Charge up to a maximum period as specified in schedule 'F' on written request of the contractor stating the reason for delays in procuring the Performance Guarantee, to the satisfaction of the Engineer-in-Charge. This guarantee shall be in the form of Deposit at Call receipt of any scheduled bank/Bankers Cheque of any scheduled bank/Demand Draft of any scheduled bank or Government Securities or Fixed Deposit Receipts or Guarantee Bonds of any Scheduled Bank or the State Bank of India in accordance with the form annexed hereto. In case a fixed deposit receipt of any Bank is furnished by the contractor to the Nalanda University as part of the performance guarantee and the Bank is unable to make payment against the said fixed deposit receipt, the loss caused thereby shall fall on the contractor and the contractor shall forthwith on demand furnish additional security to the Nalanda University to make good the deficit.

(ii)The Performance Guarantee shall be initial ly valid up to the stipulated date of completion plus 60 days beyond that. In case the time for completion of work gets enlarged, the contractor shall get the validity of Performance Guarantee extended to cover such enlarged time for completion of work. After recording of the completion certificate for the work by the Engineer In charge, the performance guarantee shall be returned to the contractor, without any interest.

iii) The Engineer-in-Charge shall not make a claim under the performance guarantee except for amounts to which the Nalanda University is entitled under the contract (not withstanding and/or without prejudice to any other provisions in the contract agreement) in the event of:

(a) Failure by the Contractor to extend the validity of the Performance Guarantee as described herein above, in which event the Engineer-in-Charge may claim the full amount of the Performance Guarantee.

(b) Failure by the Contractor to pay Nalanda University any amount due, either as agreed by the contractor or determined under any of the Clauses/Conditions of the agreement, within 30 days of the service of notice to this effect by Engineer-in-Charge.

(iv) In the event of the contract being determined or rescinded under provision of any of the Clause/Condition of the agreement, the performance guarantee shall stand forfeited in full and shall be absolutely at the disposal of the Nalanda University.

(v) On substantial completion of any work which has been completed to such an extent that the intended purpose of the work is met and ready to use, then a provisional completion certificate shall be recorded by the Engineer-In-Charge. The provisional certificate shall have appended with a list of outstanding balance item of work that need to be completed in accordance with the provisions of the contract.

This provisional completion certificate shall be recorded by the concerned Engineer-In-Charge with the approval of Project manager/ chief Project manager/ Superintending Engineer. After recording of the provisional completion certificate for the work by the competent authority, the 80% of performance guarantee shall be returned to the contractor, without any interest.

However, in case of contracts involving Maintenance of building and services. Any other work after construction of same building and services/ other work, then 40% of performance guarantee shall be returned to the contractor without any interest after recording the provisional completion certificate.

The contractor needs to submit an additional performance guarantee of 10% of the Comprehensive O&M amount for the DLP & O&M period of total 5 years before the release of the final bill. The Final bill for DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING shall be released only after submission of PG of 10% which shall be valid till the completion of the DLP and AMC period combined."

CLAUSE. 1A. Recovery of Security Deposit

The person/persons whose RFP(s) may be accepted (hereinafter called the contractor) shall permit Nalanda University, at the time of making any payment to him for work done under the contract to deduct a sum at the rate 2.5% (two decimal five per cent) of the gross amount of each running and final bill, till the sum deducted will amount to security deposit of 2.5 % (two decimal five per cent) of the RFP/tendered/offered value of the work. Such deductions will be made and held by Nalanda University by way of Security Deposit unless he/they has/have deposited the amount of Security at the rate mentioned above in the form of Government Securities or fixed deposit receipt. In case a fixed deposit receipt of any Bank is furnished by the contractor to the Nalanda University as part of the security deposit and the Bank is unable to make payment against the said fixed deposit receipt, the loss caused thereby shall fall on the contractor and the contractor shall forthwith on demand furnish additional security to the Nalanda University to make good the deficit.

All compensations or the other sums of money payable by the contractor under the terms of this contract may be deducted from, or paid by the sale of a sufficient part of his security deposit or from the interest arising there from, or from any sums which may be due to or may become due to the contractor by Owner on any account whatsoever and in the event of his Security Deposit being reduced by reason of any such deductions or sale as aforesaid, the contractor shall within 10 days make good in fixed deposit receipt RFP/tendered/offered by the State Bank of India or by

Scheduled Banks or Government Securities (if deposited for more than 12 months) endorsed in favour of the Nalanda University, any sum or sums which may have been deducted from, or raised by sale of his security deposit or any part thereof. The security deposit shall be collected from the running bills and the final bill of the contractor at the rates mentioned above.

No interest shall be paid on the amount retained as Security Deposit by NU.

Security deposit shall be released as follows:

Security deposit shall be released after the completion of the Defects Liability period.

CLAUSE. 2. Compensation for Delay

If the contractor fails to maintain the required progress in terms of clause 5 (Time and Extension for delay) or to complete the work and clear the site on or before the contract or justified extended date of completion as per clause 5 (excluding any extension under Clause 5.5) as well as any extension granted under clauses 12 and 15, he shall, without prejudice to any other right or remedy available under the law to the Owner on account of such breach, pay as agreed compensation the amount calculated at the rates stipulated below as the authority specified in schedule-F (whose decision in writing shall be final and binding) may decide on the amount of RFP/tendered/offered value of the work for every completed day/month (as determined) that the progress remains below that specified in Clause 5 (Time and Extension for delay) or that the work remains incomplete.

This will also apply to items or group of items for which a separate period of completion has been specified.

Compensation for delay of work with maximum rate @ 1 % (one percent) per month of delay to be computed on per day basis based on the quantum of damage suffered due to stated delay on the part of Contractor.

Provided always that the total amount of compensation for delay to be paid under this Condition shall not exceed 10% (Ten per cent) of the accepted RFP/tendered/offered Value of work or of the accepted RFP/tendered/offered Value of the Sectional part of work as mentioned in Schedule 'F' for which a separate period of completion is originally given.

In case no compensation has been decided by the authority in Schedule 'F' during the progress of work, this shall be no waiver of right to levy compensation by the said authority if the work remains incomplete on final justified extended date of completion. If the Engineer In Charge decides to give further extension of time allowing performance of work beyond the justified extended date, the contractor shall be liable to pay compensation for such extended period. If any variation in amount of contract takes place during such expired period beyond justified extended date and the contractor becomes entitled to additional time under clause 12, the net period for such variation shall be accounted for while deciding the period for levy of compensation. However, during such further extended period beyond the

justified extended period, if any delay occurs by events under sub clause 5.2, the contractor shall be liable to pay compensation for such delay.

Provided that compensation during the progress of work before the justified extended date of completion for delay under this clause shall be for non-achievement of sectional completion or part handing over of work on stipulated/justified extended date for such part work or if delay affects any other works/ services. This is without prejudice to right of action by the Engineer In Charge under clause 3 for delay in performance and claim for compensation under that clause.

In case action under clause 2 has not been finalized and the work has been determined under clause 3, the right of action under this clause shall remain post determination of contract but levy of compensation shall be for days the progress is behind the schedule on date of determination, as assessed by the authority in Schedule 'F', after due consideration of justified extension. The compensation for delay, if not decided before the determination of contract, shall be decided after determination of contract.

The amount of compensation may be adjusted or set-off against any sum payable to the Contractor under this or any other contract with the Nalanda University. In case, the contractor does not achieve a particular milestone mentioned in schedule F, or the re-scheduled milestone(s) in terms of Clause 5 (Time and Extension for delay), the amount shown against that milestone shall be withheld, to be adjusted against the compensation levied as above. Withholding of this amount on failure to achieve a milestone shall be automatic without any notice to the contractor. However, if the contractor catches up with the progress of work on the subsequent milestone(s), the withheld amount shall be released. In case the contractor fails to make up for the delay in subsequent milestone(s), amount mentioned against each milestone missed subsequently also shall be withheld. However, no interest, whatsoever, shall be payable on such withheld amount.

CLAUSE. 3. When Contract can be Determined

Subject to other provisions contained in this clause, the Engineer – in charge may without prejudice to any other rights or remedy against the Contractor in respect of any delay, inferior workmanship or any claims for damages and/or any other provisions of this contract or otherwise, whether or not the date of completion has or has not elapsed, by notice in writing, absolutely determine the contract in any of the following cases:

(i) If the contractor having been given, the Engineer-in-Charge a notice in writing to rectify, reconstruct or replace any defective work or that the work is being performed in an inefficient or otherwise improper or un-workman like manner or shall omit to comply with the requirement of such notice for a period of seven days thereafter.

(ii) If the Contractor has, without reasonable cause suspended the progress of the Work or has failed to proceed with the work with due diligence and continues to do so after a notice in writing of seven days from the Engineer-in-Charge.

(iii) If the contractor fails to complete the work or **section of work with individual date of completion on or before** the stipulated date or **justified extended date, on or before such date of completion; and the Engineer-in-Charge without any prejudice to any other right or remedy under any other provision in the contract has given further reasonable time in a notice given in writing in that behalf as either mutually agreed or in absence of such mutual agreement by his own assessment making such time essence of contract and in the opinion of Engineer-in-charge the contractor will be unable to complete the same or does not complete the same within the period specified.**

(iv) If the contractor persistently neglects to carry out his obligations under the contract and/ or commits default in complying with any of the terms and conditions of the contract and does not remedy it or take effective steps to remedy it within 7 days after a notice in writing is given to him in that behalf by the Engineer-in-Charge.

(v) If the contractor shall offer or give or agree to give to any person in service of Nalanda university or consultants or to any other person on his behalf any gift or consideration of any kind as an inducement or reward for doing or forbearing to do or for having done or forborne to do any act in relation to the obtaining or execution of this or any other contract for Nalanda University.

(vi) If the contractor shall enter into a contract with Owner in connection with which commission has been paid or agreed to be paid by him or to his knowledge, unless the particulars of any such commission and the terms of payment thereof have been previously disclosed in writing to the Engineer-in-Charge

(vii) If the contractor had secured the contract with Owner as a result of wrong tendering or other non-bonafide methods in this RFP competition or commits breach of integrity agreement.

(viii) If the contractor being a PSU, any partner thereof shall at any time be adjudged insolvent or have a receiving order or order for administration of his estate made against him or shall take any proceedings for liquidation or composition (other than a voluntary liquidation for the purpose of amalgamation or reconstruction) under any Insolvency Act for the time being in force or make any conveyance or assignment of his effects or composition or arrangement for the benefit of his creditors or purport to do so, or if any application be made under any Insolvency Act for the time being in force for the sequestration of his estate or if a trust deed be executed by him for benefit of his creditors.

(ix) If the Contractor being a company shall pass a resolution or the court shall make an order that the company shall be wound up or if a receiver, or a manager on behalf of a creditor shall be appointed, or if circumstances shall arise which

entitle the court or the creditor to appoint a receiver or a manager, or which entitle the court to make a winding up order.

(x) If the contractor shall suffer an execution being levied on his goods and allow it to be continued for a period of 21 days.

(xi) If the contractor assigns **(excluding part(s) of work assigned to other agency(s) by the contractor as per terms of contract)**, transfers, sublets (engagement of labour on a piece-work basis or of labour with materials not to be incorporated in the work, shall not be deemed to be subletting) or otherwise parts with or attempts to assign, transfer, sublet or otherwise parts with the entire works or any portion thereof without the prior written approval of the Engineer -in-Charge.

When the Contractor has made himself liable for action under any of the cases aforesaid, the Engineer-in-Charge on behalf of the Nalanda University shall have powers:

(a) To determine the contract as aforesaid **so far as performance of work by the contractor is concerned** (of which **determination** notice in writing to the contractor under the hand of the Engineer-in-Charge shall be conclusive evidence).

(b) After giving notice to the contractor to measure up the work of the contractor and to take such whole, or the balance or part thereof, as shall be un-executed out of his hands and to give it to another contractor to complete the work. The contractor, whose contract is determined as above, shall not be allowed to participate in the RFP process for the balance work.

In the event of anyone or more of the above course(s) of action(s) being adopted by the Engineer-in-Charge the Contractor shall have no right to claim compensation for any loss sustained by him by reason of his having purchased or procured any materials or entered into any engagement or made any advances on account or with a view to the execution of the Work or the performance of the contract And In case action is taken under any of the provisions aforesaid, the Contractor shall not be entitled to recover or be paid any sum for any work thereof actually performed under this contract unless and until the Engineer-in-Charge has certified in writing the performance of such Work and the value payable in respect thereof and the Contractor shall only be entitled to be paid the value so certified.

CLAUSE 3A.Work cannot be Started Due to Reasons not within the Control of the Contractor.

In case, the work cannot be started due to reasons not within the control of the contractor within 1/8th of the stipulated time for completion of work or one month whichever is more, either party may close the contract **by giving notice to the other party stating the reasons**. In such eventuality, the Performance Guarantee of the contractor shall be refunded within 30 days.

Neither party shall claim any compensation for such eventuality. This clause is not applicable for any breach of the contract by either party.

CLAUSE. 4 Contractor Liable to Pay Compensation even if Action not taken as Clause 3 (When Contract can be determined)

In any case in which any of the powers conferred upon the Engineer-in-Charge by Clause 3 (when contract can be determined) thereof, shall have become exercisable and the same are not exercised, the non-exercise thereof shall not constitute a waiver of any of the conditions hereof and such powers shall notwithstanding be exercisable in the event of any future case of default by the contractor and the liability of the contractor for compensation shall remain unaffected. In the event of the Engineer-in-Charge putting in force all or any of the powers vested in him under the preceding clause he may, if he so desires after giving a notice in writing to the contractor, take possession of (or at the sole discretion of the Engineer-in-Charge which shall be final and binding on the contractor) use as on hire (the amount of the hire money being also in the final determination of the Engineer-in-Charge) all or any tools, plant, materials and stores, in or upon the works, or the site thereof belonging to the contractor, or procured by the contractor and intended to be used for the execution of the work/or any part thereof, paying or allowing for the same in account at the contract rates, or, in the case of these not being applicable, at current market rates to be certified by the Engineer-in-Charge, whose certificate thereof shall be final, and binding on the contractor, clerk of the works, foreman or other authorized agent to remove such tools, plant, materials, or stores from the premises (within a time to be specified in such notice) in the event of the contractor failing to comply with any such requisition, the Engineer-in-Charge may remove them at the contractor's expense or sell them by auction or private sale on account of the contractor and his risk in all respects and the certificate of the Engineer-in-Charge as to the expenses of any such removal and the amount of the proceeds and expenses of any such sale shall be final and conclusive against the contractor.

CLAUSE. 5 Time and Extension for Delay

The time allowed for execution of the Works as specified in Schedule F or the extended time in accordance with these conditions shall be the essence of the contract. The execution of the works shall commence from such time period as mentioned in Schedule F or from the date of handing over of the site, **notified by the Engineer-in-Charge,** whichever is later. **However, the handing over of site by the Engineer in Charge, in full or in part (if so provided in contract), shall be completed within two months for issue of acceptance letter.** If the Contractor commits default in commencing the execution of the work as aforesaid,

the performance guarantee shall be forfeited by the Engineer In charge and shall be absolutely at disposal of the Owner without prejudice to any other right or remedy available in law.

5.1 The contractor shall submit within Fifteen days of award of work as in consideration of

a) Schedule of handing over of site as specified in the Schedule 'F"
b) Schedule of issue of designs as specified in the schedule 'F'

(i) The contractor shall submit a programme Chart (Time and Progress) for each mile stone. The Engineer in Charge may within 30 days thereafter, if required modify, and communicate the program approved to the contractor failing which the program submitted by the contractor shall be deemed to be approved by the Engineer-in-Charge. The work programme shall include all details of balance drawings and decisions required to complete the contract with specific dates by which these details are required by the contractor without causing any delay in execution of the work. The Chart shall be prepared in direct relation to the time stated in the Contract documents for completion of items of the works. It shall indicate the forecast of the dates of commencement and completion of various trades of sections of the work and may be amended as necessary by agreement between the Owner and the Contractor within the limitations of time imposed in the Contract documents, and further to ensure good progress during the execution of the work, the contractor shall in all cases in which the time allowed for any work, exceeds one month (save for special jobs for which a separate program has been agreed upon) complete the work as per mile stones given in Schedule F.

(ii) In case of non-submission of construction programme by the contractor the program approved by the Engineer-in-charge shall be deemed to be final.

(iii) The approval by the Engineer-in-charge of such programme shall not relieve the contractor of any of the obligations under the contract.

(iv) The contractor shall submit the Time and progress chart and progress report using mutually agreed software or in other format decided by Engineer-in-Charge for the work done during previous month to the Engineer-in-charge on or before 5th day of each month failing which a recovery Rs. 5000/- shall be made on per week or part basis in case of delay in submission of the monthly progress report.

5.2 If the work(s) were delayed by: -

(i) Force majeure, or

(ii) Abnormally bad weather, or

(iii) Serious loss or damage by fire, or

(iv) Civil commotion, local commotion of workmen, strike or lockout, affecting any of the trades employed on the work, or

(v) Delay on the part of other contractors or tradesmen engaged by Engineer-in-Charge in executing work not forming part of the Contract, or

(vi) Any other cause like above which, in the **reasoned opinion** of the Engineer-in-Charge is beyond the Contractor's control.

Then upon the happening of any such event causing delay, the Contractor shall immediately give notice thereof in writing to the **Engineer In Charge for entry in the hindrance register (physical or web-based as prescribed in Schedule F)** but shall nevertheless use constantly his best endeavours to prevent the delay in overall completion of the work or make good the delay and shall do all that may be reasonably required to the satisfaction of the Engineer-in-Charge to proceed with the works. **The contractor shall have no claim of damages for extension of time granted or rescheduling of milestone/s for evens listed in sub clause 5.2.**

5.3 In case the work is hindered by any reason, in the opinion of the contractor, by the owner or for someone for whose action the owner is responsible, the contractor may immediately give notice thereof in writing to the Engineer in Charge in the same manner as prescribed under sub clause 5.2 seeking extension of time or reschedule of milestone/s. The authority as indicated in schedule 'F' shall, if justified, give a fair and reasonable extension of time and reschedule the milestones for completion of work after due consideration of the same within 30 days of receipt of such request. In event of non-application by the contractor for extension of time Engineer in Charge after affording opportunity to the contractor may give, supported with a programme, a fair and reasonable extension within a reasonable period of occurrence of the event. Such extension of time or rescheduling of milestone/s shall be without prejudice to any other right or remedy of the parties in contract or in lay; provided further that for concurrent delays under this sub clause and sub clause 5.2 to the extent the delay is coveted under sub clause 5.2 the contractor shall be entitled to only extension of time and no damages.

5.3 Request for rescheduling of Mile stones **or** extension of time, to be eligible for consideration, shall be made by the Contractor in writing with supporting documents within fourteen days of the happening of the event causing delay on the prescribed form **i.e. Form of application by the contractor for seeking reschedule of milestones (Appendix-XVI) or form of application by the contractor for seeking extension of time (Appendix- XVII) respectively** to the authority as indicated in Schedule-F. **The contractor shall indicate in such a request the period by which rescheduling of milestone/s or extension of time is desired. With every request for rescheduling of milestones, or if at any time the actual progress of work falls behind the approved program by more than 10% of the stipulated period of completion of contract, the contractor shall produce a revised program which shall include all details of pending drawings and decisions required to complete the contract and also the target dates by which these details should be available without causing any delay in execution of the work. A recovery as specified in Schedule 'F' shall**

be made on per day basis in case of delay in submission of the revised program.

5.4 **In any such case the authority as indicated in Schedule 'F' may give a fair and reasonable extension of time for completion of work or reschedule the mile stones. Such extension or rescheduling of the milestones shall be communicated to the Contractor by the authority as indicated in Schedule 'F' in writing, within 30 days of the date of receipt of such request from the Contractor in prescribed form. In event of non-application by the contractor for extension of time E-in-C after affording opportunity to the contractor, may give, supported with a program (as specified under 5.4 above), a fair and reasonable extension within a reasonable period of occurrence of the event.**

5.5 In case the work is delayed by any reasons, in the opinion of the Engineer-in-Charge, by the contractor for reasons beyond the events mentioned in clause 5.2 or clause 5.3 or clause 5.4 and beyond the justified extended date; without prejudice to right to take action under Clause 3, the Engineer-in-Charge may grant extension of time required for completion of work without rescheduling of milestones. The contractor shall be liable for levy of compensation for delay for such extension of time.

CLAUSE. 6. Measurement of Work Done

Engineer-in-Charge shall, except as otherwise provided, ascertain and determine by measurement the value in accordance with the contract of Work done.

All measurement of all items having financial value shall be entered in Measurement Book and/or level field-books complete record is obtained of all works performed under the contract.

All measurements and levels shall be taken jointly by the Engineer-in-Charge or his authorized representative and by the Contractor or his authorized representative from time to time during the progress of the Work and such measurements shall be signed and dated by the Engineer-in-Charge or their authorized representative and the Contractor or their authorized representatives in token of their acceptance. If the Contractor objects to any of the measurements recorded, a note shall be made to that effect along with reasons and signed by both the parties.

If for any reason the Contractor or his authorized representative is not available and the Work of recording measurements is suspended by the Engineer-in-Charge/PMC or his authorized representative, the Engineer-in-Charge and the Owner shall not entertain any claim from the Contractor for any loss or damages on this account. If the Contractor or his authorized representative does not remain present at the time of such measurements after the Contractor or his authorized representative has been given a notice in writing three (3) days in advance or fails to countersign or to record objection within a week from the date of the measurement, then such measurements recorded in his absence by the Engineer-in-Charge or his representative shall be deemed to be accepted by the Contractor.

The Contractor shall, without any extra charge, provide all assistance with every appliance, labour and other things necessary for measurements and recording levels.

Except where any general or detailed description of the Work expressly shows to the contrary, measurements shall be taken in accordance with the procedure set forth in the specifications notwithstanding any provision in the relevant Standard Method of measurement or any general or local custom. In the case of items, which are not covered by specifications, measurements shall be taken in accordance with the relevant standard method of measurement issued by the Bureau of Indian Standards and if for any item no such standard is available then a mutually agreed method shall be followed.

The Contractor shall give not less than seven days' notice to the Engineer-in-Charge or his authorized representative in-charge of the Work before covering up or otherwise placing beyond the reach of measurement any Work in order that the same may be measured and correct dimensions thereof may be taken before the same is so covered up or placed beyond the reach of measurement and shall not cover up or placed beyond the reach of measurement any Work without the consent in writing of the Engineer-in-Charge or his authorized representative in charge of the Work who shall within the aforesaid period of 7 days inspect the work, and 'if any Work shall be covered up or be placed beyond the reach of measurement without such notice having been given or Engineer- in - charge's consent being obtained in writing, the same shall be uncovered at Contractor's expense or in default thereof no payment or allowance shall be made for such Work or of the material with which the same was executed.

Engineer-in-Charge or his authorized representative may cause either themselves or through another officer of the Authority to check the measurements recorded jointly or otherwise as aforesaid and all provisions stipulated herein above shall be applicable to such checking of measurements or levels.

It is also a term of this contract that recording of measurements of any item of Work in the measurement book and/or its payment in the interim bill, on account bill or final bill shall not be considered as conclusive evidence as to the sufficiency of any Work or material to which it relates nor shall it relieve the Contractor from liabilities from any over measurement or defects noticed till completion of the defects liability period.

CLAUSE. 6A. Computerized Measurement Book

Engineer-in-Charge shall, except as otherwise provided, ascertain and determine by measurement the value of work done in accordance with the contract.

All measurements of all items having financial value shall be entered by the contractor and compiled in the shape of the Computerized Measurement Book having pages of A-4 size as per the format suggested by the Engineer–in-charge so that a complete record is obtained of all the items of works performed under the contract.

All such measurements and levels recorded by the contractor or his authorized representative from time to time, during the progress of the work, shall be got checked by the contractor from the Engineer-in-Charge or his authorized representative as per interval or program fixed in consultation with Engineer-in-Charge or his authorized representative. After the necessary corrections are made by the Engineer-in-Charge, the measurement sheets shall be returned to the contractor for incorporating the corrections and for resubmission to the Engineer-in- Charge for the dated signatures by the Engineer-in- Charge and the contractor or their representatives in token of their acceptance.

Whenever bill is due for payment, the contractor would initial ly submit draft computerized measurement sheets and these measurements would be got checked/test checked from the Engineer-in-Charge and/or his authorized representative. The contractor will, thereafter, incorporate such changes, as may be done during these checks/test checks in his draft computerized measurements, and submit to the Engineer in Charge computerized measurement book, duly bound, and with its pages machine numbered. The Engineer-in- Charge and/or his authorized representative would thereafter check this MB, and record the necessary certificates for their checks/test checks.

The final, fair, computerized measurement book given by the contractor, duly bound, with its pages machine numbered, should be 100% correct, and no cutting or over-writing in the measurements would thereafter be allowed. If at all any error is noticed, the contractor shall have to submit a fresh computerized MB with its pages duly machine numbered and bound, after getting the earlier MB cancelled by the Engineer in charge.

The contractor shall also submit to the Engineer in charge separately his computerized Abstract of Cost and the bill based on these measurements, duly bound, and its pages machine numbered along with two spare copies of the "bill. Thereafter, this bill will be processed by the Engineer-in-Charge and allotted a number as per the computerized record in the same way as done for the measurement book meant for measurements.

The contractor shall, without extra charge, provide all assistance with every appliance, labour and other things necessary for checking of measurements/levels by the Engineer-in- Charge or his representative.

Except where any general or detailed description of the work expressly shows to the contrary, measurements shall be taken in accordance with the procedure set forth in the specifications notwithstanding any provision in the relevant Standard Method of measurement or any general or local custom. In the case of items, which are not covered by specifications, measurements shall be taken in accordance with the relevant standard method of measurement issued by the Bureau of Indian Standards and if for any item no such standard is available then a mutually agreed method shall be followed.

The contractor shall give not less than seven days' notice to the Engineer-in-Charge or his authorized representative in charge of the work before covering up or

otherwise placing beyond the reach of checking and/or test checking the measurement of any work in order that the same may be checked and/or test checked and correct dimensions thereof be taken before the same is covered up or placed beyond the reach of checking and/or test checking measurement and shall not cover up and place beyond reach of measurement any work without consent in writing of the Engineer-in-Charge or his authorized representative in charge of the work who shall within the aforesaid period of seven days inspect the work, and if any work shall be covered up or placed beyond the reach of checking and/or test checking measurements without such notice having been given or the Engineer-in-Charge's consent being obtained in writing the same shall be uncovered at the Contractor's expense, or in default thereof no payment or allowance shall be made for such work or the materials with which the same was executed.

Engineer-in-Charge or his authorized representative may cause either themselves or through another officer of the Authority to check the measurements recorded by contractor and all provisions stipulated herein above shall be applicable to such checking of measurements or levels.

It is also a term of this contract that checking and/or test checking the measurements of any item of work in the measurement book and/or its payment in the interim, on account of final bill shall not be considered as conclusive evidence as to the sufficiency of any work or material to which it relates nor shall it relieve the contractor from liabilities from any over measurement or defects noticed till completion of the defects liability period.

CLAUSE. 7. Payment on intermediate Certificate to be regarded as Advances

No payment shall be made for work, estimated to cost Rs. One Lakh or less till after the whole of the work shall have been completed and certificate of completion given. For works estimated to cost over Rs. One Lakh, the interim or running account bills shall be submitted by the contractor for the work executed on the basis of such recorded measurements on the format of the Engineer in charge in triplicate on or before the date of every month or as fixed for the same by the Engineer–in-charge. The contractor shall not be entitled to be paid any such interim payment if the gross work done together with net payment/ adjustment of advances for material collected, if any, since the last such payment is less than the amount specified in Schedule-F, in which case the interim bill shall be prepared on the appointed date of the month after the requisite progress is achieved. Engineer-in-Charge shall arrange to have the bill verified by taking or causing to be taken, where necessary, the requisite measurements of the work. In the event of the failure of the contractor to submit the bills, Engineer-in-Charge shall prepare or cause to be prepared such bills in which event no claims whatsoever due to delays on payment including that of interest shall be payable to the contractor. Payment on account of amount admissible shall be made by the Engineer-in- Charge certifying the sum to which the contractor is considered entitled by way of interim payment at such rates as decided by the Engineer-in-Charge. The amount

admissible shall be paid by 15th working day after the day of presentation of the bill by the Contractor to the Engineer-in-Charge or his Asst. Engineer together with the account of the material issued by the Owner, or dismantled materials, if any.

All such interim payments shall be regarded as payment by way of advances against final payment only and shall not preclude the requiring of bad, unsound and imperfect or unskilled work to be rejected, removed, taken away and reconstructed or re-erected. Any certificate given by the Engineer-in-Charge relating to the work done or materials delivered forming part of such payment, may be modified or corrected by any subsequent such certificate(s) or by the final certificate and shall not by itself be conclusive evidence that any work or materials to which it relates is/are in accordance with the contract and specifications. Any such interim payment, or any part thereof shall not in any respect conclude, determine or affect in any way powers of the Engineer-in-Charge under the contract or any of such payments be treated as final settlement and adjustment of accounts or in any way vary or affect the contract.

Pending consideration of extension of date of completion, interim payments shall continue to be made as herein provided without prejudice to the right of the Owner to take action under the terms of this contract for delay in the completion of work, if the extension of date of completion is not granted by the competent authority.

The Owner in his sole discretion on the basis of a certificate from the Engineer in Charge to the effect that the work has been completed up to the level in question make interim advance payments without detailed measurements against work done up to 75% of the assessed value. The advance payments so allowed shall be adjusted in the subsequent interim bill by checking the detailed measurement sheets to be submitted by the contractor within 10 days of the interim payment. In case of delay in submission of bill by the contractor a simple interest @ 10% per annum shall be paid to the Government from the date of expiry of prescribed time limit which will be compounded on yearly basis.

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No running account bill shall be paid for the work till the applicable labour licenses, registration with EPFO, ESIC and BOCW Welfare board, whatever applicable are submitted by the contractor to the engineer-in-Charge.

CLAUSE. 8 Completion Certificate and completion plans

Within ten days of the completion of the work, the contractor shall give notice of such completion to the Engineer-in-Charge and within thirty days of the receipt of such notice, the Engineer-in-Charge shall inspect the work and if there is no defect in the work, shall furnish the contractor with a final certificate of completion, otherwise a provisional certificate of physical completion indicating defects (a) to be rectified by the contractor and/or (b) for which payment will be made at reduced rates, shall be issued. But no final certificate of completion shall be issued, nor shall the work be considered to be complete until the contractor shall have removed from the premises on which the work shall be executed all scaffolding, surplus materials,

rubbish and all huts and sanitary arrangements required for his/their work people on the site in connection with the execution of the works as shall have been erected or constructed by the contractor(s) and cleaned off the dirt from all wood work, doors, windows, walls, floor or other parts of the building, in, upon, or about which the work is to be executed or of which he may have had possession for the purpose of the execution; thereof, and not until the work shall have been measured by the Engineer-in-Charge. If the contractor shall fail to comply with the requirements of this Clause as to removal of scaffolding, surplus materials and rubbish and all huts and sanitary arrangements as aforesaid and cleaning off dirt on or before the date fixed for the completion of work, the Engineer-in-Charge may at the expense of the contractor remove such scaffolding, surplus materials and rubbish etc., and dispose of the same as he thinks fit and clean off such dirt as aforesaid, and the contractor shall have no claim in respect of scaffolding or surplus materials as aforesaid except for any sum actually realized by the sale thereof.

CLAUSE. 8A Contractor to keep site clean

When any repair or maintenance of works are carried out, the splashes and droppings from white washing, colour washing, painting etc., on walls, floor, windows, etc. shall be removed and the surface cleaned simultaneously with the completion of these items of work in the individual rooms, quarters or premises etc. where the work is done: without waiting for the actual completion of all the other items of work in the contract. In case the contractor fails to comply with the requirements of this clause, the Engineer-in-Charge shall have the right to get this work done at the cost of the contractor or through any other agency. Before taking such action, the Engineer-in-Charge shall give ten days' notice in writing to the contractor.

CLAUSE 8B Completion plans to be submitted by the contractor

The contractor shall submit completion plan as required for all the ELV works as applicable within thirty days of the completion of the work.

In case, the contractor fails to submit the completion plan as aforesaid, he shall be liable to pay a sum equivalent to 0.1% of RFP/tendered/offered Value subject to a ceiling of Rs.15, 000 (Rs. Fifteen thousand only) or as may be fixed by the Engineer/PMC concerned and in this respect the decision of the Superintending Engineer shall be final and binding on the contractor.

The contractor shall submit completion plan for all the Solar works done under this contract within Thirty days of the completion of the work, provided that the services plans have been issued for execution by the Engineer-in-Charge, unless the contractor, by virtue of any other provision in the contract, is required to prepare such plans.

In case, the contractor fails to submit the completion plan as aforesaid, the department will get it done through other agency at his cost and actual expenses incurred plus Rs. 15,000/- For the same shall be recovered from the contractor.

CLAUSE.9 Payment of final bill

The final bill shall be submitted by the contractor in the same manner as specified in interim bills within three months of physical completion of the work or within one month of the date of the final certificate of completion furnished by the Engineer-in-Charge whichever is earlier. No further claims shall be made by the contractor after submission of the final bill and these shall be deemed to have been waived and extinguished. Payments of those items of the bill in respect of which there is no dispute and of items in dispute, for quantities and rates as approved by Engineer-in-Charge, will, as far as possible be made within the period of 6 (six) months, the period being reckoned from the date of receipt of the bill by the Engineer-in-Charge or his authorized representative, complete with account of materials issued by the Owner and the dismantled materials.

" The Payment of final bill shall be done only after submission of Performance guarantee of 10% of the comprehensive O&M amount, valid upto entire DLP and O&M period."

In case of delay in payment of final bills after prescribed time limit, a simple interest @ 10% per annum shall be paid to the contractor from the date of expiry of prescribed time limit which will be compounded on yearly basis, provided the final bill submitted by the contractor found to be in order.

CLAUSE. 9A Payment of Contractor's Bills to Banks

Payments due to the contractor may, if so desired by him, be made to his bank, registered financial, co-operative or thrift societies or recognized financial institutions instead of direct to him provided that the contractor furnishes to the Engineer-in-Charge (1) an authorization in the form of a legally valid document such as a power of attorney conferring authority on the bank; registered financial, co-operative or thrift societies or recognized financial institutions to receive payments and (2) his own acceptance of the correctness of the amount made out as being due to him by the Owner or his signature on the bill or other claim preferred against the Owner before settlement by the Engineer-in-Charge of the account or claim by payment to the bank, registered financial, co-operative or thrift societies or recognized financial institutions. While the receipt given by such banks; registered financial, co-operative or thrift societies or recognized financial institutions shall constitute a full and sufficient discharge for the payment, the contractor shall whenever possible present his bills duly receipted and discharged through his bank, registered financial, co-operative or thrift societies or recognized financial institutions.

Nothing herein contained shall operate to create in favour of the bank; registered financial, co-operative or thrift societies or recognized financial institutions any rights or equities visa-vis the Owner.

CLAUSE. 10. Materials supplied by the Owner

No material is planned to be procured by the Owner for supply to the contractor however in case of any subsequent mutual understanding entered into between the Owner and the Contractor, it is decided that certain materials are to be supplied by the Owner to the Contractor in to the best interest of the Project, the modalities for such Owner supplied material shall be as per mutual understanding between the Owner and the Contractor.

CLAUSE. 10A Materials to be provided by the Contractor

The contractor shall, at his own expense, provide all materials, required for the works other than those, which are stipulated, to be supplied by the Owner.

The contractor shall, at his own expense and without delay, submit to the Engineer-in- Charge samples of materials to be used on the work and shall get these approved in advance from PMC & Architect Consultants. All such materials to be provided by the Contractor shall be in conformity with the specifications laid down or referred to in the contract. The contractor shall, if requested by the Engineer-in-Charge furnish proof, to the satisfaction of the Engineer-in-Charge/ that the materials so comply. The Engineer-in-Charge shall within thirty days of submission of samples or within such further period as he may require intimate to the Contractor in writing whether samples are approved by him or not. If samples are not approved, the Contractor shall forthwith arrange to supply to the Engineer-in-Charge for his approval, fresh samples complying with the specifications laid down in the contract. When materials are required to be tested in accordance with specifications, approval of the Engineer-in-Charge shall be issued after the test results are received.

The Contractor shall at his risk and cost submit the samples of materials to be tested or analysed and shall not make use of or incorporate in the work any materials represented by the samples until the required tests or analysis have been made and materials finally accepted by the Engineer-in-Charge. The Contractor shall not be eligible for any claim or compensation either arising out of any delay in the work or due to any corrective measures required to be taken on account of and as a result of testing of materials.

The contractor shall, at his risk and cost, make all arrangements and shall provide all facilities as the Engineer-in-Charge may require for collecting, and preparing the required number of samples for such tests at such time and to such place or places as may be directed by the Engineer-in-Charge and bear all charges and cost of testing unless specifically provided for otherwise elsewhere in the contract or specifications. The Engineer in- Charge or his authorized representative shall at all times have access to the works and to all workshops and places where work is being prepared or from where materials, manufactured articles or machinery are being obtained for the works and the contractor shall afford every facility and every assistance in obtaining the right to such access.

The Engineer-in-Charge shall have full powers to require the removal from the premises of all materials which in his opinion are not in accordance with the specifications and in case of default, the Engineer-in-Charge shall be at liberty to employ at the expense of the contractor, other persons to remove the same without being answerable or accountable for any loss or damage that may happen or arise to such materials. The Engineer-in-Charge shall also have full powers to require other proper materials to be substituted thereof and in case of default, the Engineer-in-Charge may cause the same to be supplied and all costs which may attend such removal and substitution shall be borne by the Contractor.

The contractor shall at his own expense, provide a material-testing lab at the site for conducting routine field tests. The lab shall be equipped at least with the testing equipment as specified.

CLAUSE. 10BSecured Advance on Non-perishable Materials

(i) The contractor, on signing an indenture in the form to be specified by the Engineer-in- Charge, shall be entitled to be paid during the progress of the execution of the work up to 75% (Seventy Five per cent)of the assessed value of any materials which are in the opinion of the Engineer in- Charge non-perishable, non-fragile and non-combustible and are in accordance with the contract and which have been brought on the site in connection therewith and are adequately stored and/or protected against damage by weather or other causes but which have not at the time of advance been incorporated in the works. When materials on account of which an advance has been made under this sub-clause are incorporated in the work, the amount of such advance shall be recovered/deducted from the next payment made under any of the clause or clauses of this contract.
Such secured advance shall also be payable on other items of perishable nature, fragile and combustible with the approval of the Engineer-in-Charge provided the contractor provides a comprehensive insurance cover for the full cost of such materials. The decision of the Engineer- in-Charge shall be final and binding on the contractor in this matter. No secured advance, shall however, be paid on high-risk materials such as ordinary glass, sand, petrol, diesel etc.

Mobilization Advance (Contractor request and project necessity, if required)

(ii) Mobilization advance not exceeding 10% (Ten per cent) of the RFP/tendered/offered value may be given, if requested by the contractor in writing within 1[One] month of the order to commence the work. Such advance shall be in two or more instalments to be determined by the Engineer-in-Charge at his sole discretion. The first instalment of such advance shall be released by the Owner/Engineer-in-charge to the contractor on a request made by the contractor to the Owner/Engineer- in-Charge in this behalf. The second and subsequent instalments shall be released by the Owner /Engineer- in- Charge only after the contractor

furnishes a proof of the satisfactory utilization of the earlier instalment to the entire satisfaction of the Engineer-in-Charge.

Before any instalment of advance is released, the contractor shall execute a Bank guarantee Bond not more than 6 in number (As per the draft given below) from scheduled Bank for the amount equal to 110% of advance & valid for the period till recovery of advance. This (Bank Guarantee from Schedule Bank for the amount equal to 110%of the balance amount of advance) shall be kept renewed from time to time to cover the balance amount and likely period of complete recovery, together with interest.

(iii) An advance for plant, machinery & shuttering material required for the work and brought to site by the Contractor may be given if requested by the contractor in writing within one month of bringing such plant and machinery to site. Such advance shall be given on such plant and machinery which in the opinion of the Engineer-in-charge will add to the expeditious execution of work and improve the quality of work. The amount of advance shall be restricted to 5% percent of the RFP value. In the case of new plant and equipment to be purchased for the work, the advance shall be restricted to 90% of the price of such new plant and equipment paid by the contractor for which the contractor shall produce evidence satisfactory to the Engineer-in-Charge. In the case of second hand and used plants and equipment, the amount of such advance shall be limited to 50% of the depreciated value of plant and equipment as may be decided by the engineer in-Charge. The contractor shall, if so required by the Engineer-in-Charge, submit the statement of value of such old plant and equipment duly approved by a Registered Value recognized by the Central Board of Direct Taxes under the Income- Tax Act, 1961. No such advance shall be paid on any plant and equipment of perishable nature and on any plant and equipment of a value less than Rs. 50,000/- Seventy five per cent of such amount of advance shall be paid after the plant & equipment is brought to site and balance twenty five percent on successfully commissioning the same.

Leasing of equipment shall be considered at par with purchase of equipment and shall be covered by tripartite agreement with the following:

☐ Leasing company which gives certificate of agreeing to lease equipment to the contractor.

☐ Engineer in Charge, and

☐ The contractor.

This advance shall further be subject to the condition that such plant and equipment (a) are considered by the Engineer-in-Charge to be necessary for the works; (b) and are in working order and are maintained in working order; (c) hypothecated to the Government as specified by the Engineer-in-Charge before the payment of advance is released. The contractor shall not be permitted to remove from the site such hypothecated plant and equipment without the prior written permission of the engineer in- Charge. The contractor shall be responsible for maintaining such plant and equipment in good working order during the entire period of hypothecation failing which such advance shall be entirely recovered in lump sum. For this purpose, steel scaffolding and form work shall be treated as plant and equipment. The contractor shall insure the Plant and Machinery for which mobilization advance is Sought and given, for a sum sufficient to provide

for their replacement at site. Any amounts not recovered from the insurer will be borne by the contractor.

(iv) The mobilization advance and plant and machinery advance in (ii) & (iii) above bear simple interest at the rate of 10% per annum and shall be calculated from the date of payment to the date of recovery, both days inclusive, on the outstanding amount of advance. Recovery of such sums advanced shall be made by the deduction from the contractors bills commencing after first ten per cent of the gross value of the work is executed and paid, on pro-rata percentage basis to the gross value of the work billed beyond 10% in such a way that the entire advance is recovered by the time eighty per cent of the gross value of the contract is executed and paid, together with interest due on the entire outstanding amount up to the date of recovery of the instalment.

(v) If the circumstances are considered reasonable by the Engineer-in-Charge, the period mentioned in (ii) and (iii) for request by the contractor in writing for grant of mobilization advance and plant and equipment advance may be extended in the discretion of the Engineer-in-Charge.

(VI) Draft format of Bank Guarantee for Mobilization Advance

In consideration of the Vice Chancellor, Nalanda University, Rajgir, Bihar (hereinafter called "The NU") having offered to accept the terms and conditions of the agreement No._____ dated_____ between Nalanda University, Rajgir, Bihar and M/s. _____ (hereinafter called "the said Contractor(s)") for Construction and Development works of Housing Parcel of Permanent Campus (PHASE I) for Nalanda University at Rajgir, Bihar,(hereinafter called "the said Agreement") having agreed to production of an irrevocable Bank Guarantee for Rs.…… (Rupees……..only) as a guarantee from the contractor(s) for compliance of his obligations in accordance with the terms and conditions in the said agreement, in connection with the said Contractor's request for Mobilization Advance of Rs._____ for utilizing it for the purpose of the said Agreement.

We, (hereinafter referred to as "the Bank") hereby undertake to pay to the NU an amount not exceeding Rs. (Rupees. Only) on demand by the NU.

We, ……(indicate the name of the Bank) do hereby undertake to pay the amounts due and payable under this guarantee without any demure, merely on a demand from The NU stating that the amount claimed as required to meet the recoveries due of likely to be due from the said contractor(s). Any such demand made on the bank shall be conclusive as regards the amount due and payable by the bank under this Guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. (Rupees. Only)

We, the said bank further undertake to pay The NU any money so demanded notwithstanding any dispute or disputes raised by the contractor(s) in any suit or proceeding pending before any court or Tribunal relating thereto, our liability under this present being absolute and unequivocal.

The payment so made by us under this bond shall be a valid discharge of our liability for payment there under and the Contractor(s) shall have no claim against us for making such payment.

We, (indicate the name of the Bank) further agree that the guarantee herein contained shall remain in full force and effect during the period that

would be taken for the performance of the said agreement and that it shall continue to be enforceable till all the dues of The NU under or by virtue of the said agreement have been fully paid and its claims satisfied of discharged or till Engineer-in-charge on behalf of The NU certified that the terms and conditions the said agreement have been fully and properly carried out by the said Contractor(s) and accordingly discharges this guarantee.

We, ……..(Indicate the name of the Bank) further agree with The NU that the NU shall have the fullest liberty without our consent and without affecting in any manner our obligation hereunder to vary any of the terms and conditions of the said agreement or to extend time of performance by the said Contractor(s) from time to time of to postpone for any time or from time to time any of powers exercisable by The NU against the said Contractors(s) and to forbear or enforce any of the terms and conditions relating to the said agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Contractor(s) or for any forbearance, act of omission on the part of The NU or any indulgence by The NU to the said Contractor(s) of by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.

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

We…….. (Indicate the name of the Bank) Agree that in case of encashment of this bank Guarantee, the requisite amount shall be drawn in favour of "Nalanda University, Rajgir, Bihar, Or Any other authority as demanded by Him and shall be payable by Demand Draft at location specified by him at such time.

We, (indicate the name of the Bank) lastly undertake not to revoke this guarantee except with the previous consent of The NU in writing.

This guarantee shall be valid up to ……..Unless extended on demand by the NU. Notwithstanding anything mentioned above, our liability against this guarantee is restricted to Rs. (Rupees……) and unless a claim in writing is lodged with us within six months of the date of expiry or the extended date of expiry of this guarantee all our liabilities under this guarantee shall stand discharged.

Date the ……day of ……for …… (Indicate the name of the Bank)

CLAUSE. 10C. Payment on Account of Increase in Price/Wages due to statutory Order(s)

Not applicable

CLAUSE. 10CAPayment due to variation in prices of materials after receipt of RFP

Not Applicable

CLAUSE. 10CC.Payment due to Increase/Decrease in Prices/Wages (excluding materials covered under clause 10CA after Receipt of RFP for Works)

Not applicable

CLAUSE.10D Dismantled Material Owner's Property

The contractor shall treat all materials obtained during dismantling of a structure, excavation of the site for a work, etc. as Owner's property and such materials shall be disposed of to the best advantage of Owner according to the instructions in writing issued by the Engineer-in-Charge.

CLAUSE. 11 Work to be executed in Accordance with Specifications, Drawings, and Orders etc.

The contractor shall execute the whole and every part of the work in the most substantial and workmanlike manner both as regards materials and otherwise in every respect in strict accordance with the specifications. The contractor shall also conform exactly, fully and faithfully to the design, drawings and instructions in writing in respect of the work signed by Engineer-In-Charge and the contractor shall be furnished free of charge one copy of the contract documents together with specifications, designs, drawings and instructions as are not included in the standard specifications of Central Public Works Department specified in Schedule 'F' or in any Bureau of Indian Standard or any other, published standard or code or, Schedule of Rates or any other printed publication referred to elsewhere in the contract.

The contractor shall comply with the provisions of the contract and with the care and diligence execute and maintain the works and provide all labour and materials, tools and plants including for measurements and supervision of all works, structural plans and other things of temporary or permanent nature required for such execution and maintenance in so far as the necessity for providing these, is specified or is reasonably inferred from the contract. The Contractor shall take full responsibility for adequacy, suitability and safety of all the works and methods of construction.

CLAUSE. 12Deviations / Variations Extent and Pricing

The Owner shall have power

(I) To make alteration in, omissions from, additions to or substitutions for the original specifications, drawings, designs and instructions that may appear to him to be necessary or advisable during the progress of the Work, and

(II) To omit a part of the Work(s) in case of non-availability of a portion of the site or for any reasons, and Contractor shall be bound to carry out the Works in accordance with any instructions given to him in writing signed by the Engineer-in-Charge and such alterations omissions, additions or substitutions shall form part of the contract as if originally provided therein and any altered, additional or substituted Work which the Contractor may be directed to do in the manner specified above as part of the Works, shall be carried out by the Contractor on the same conditions in all respects including price on which he agreed to do the main Work except as hereafter provided.

12.1. The time for completion of the Works shall in the event of any deviations resulting in additional cost over the RFP/tendered/offered Value sum being ordered, be extended, if requested by the Contractor, as follows:

(I) in the proportion which the additional cost of the altered, additional or substituted Work, bears to the original RFP/tendered/offered Value plus

(II) 25% of the time calculated in (i) above or such further additional time as may be considered reasonable by the Engineer-in-Charge.

(III) Any Further deviation beyond this limit up to 1.5 times of the RFP/tendered/offered amount shall be approved by Chief Engineer with recorded reason and in exceptional case, ADG shall have full power to approved the deviation beyond 1.5 times of RFP/tendered/offered amount with recorded reason and take suitable corrective action.

12.2Deviation, Extra items and Pricing

In the case of extra items (items that are completely new, and are in addition to the items contained in the contract) the contractor may within fifteen days of receipt of order or occurrence of the item(s) claim rates, supported by proper analysis **which shall include invoices, vouchers etc. and Manufacturer's specifications**, for the work **failing which the rate approved later by the Engineer-in-Charge shall be binding** and the engineer-in-charge shall within prescribed time limit of one month of the receipt of the claims supported by analysis, after giving consideration to the analysis of the rates submitted by the contractor, determine the rates on the basis of the market rates and the contractor shall be paid in accordance with the rates so determined, **failing which it will be deemed to have been approved.**

Deviation, substituted items, Pricing

In the case of substituted items (items that are taken up with partial substitution or in lieu of items of work in the contract), the rate for the agreement item (to be substituted) and substituted item shall also be determined in the manner as mentioned in the following para.

(a) If the market rate for the substituted item so determined is more than the market rate of the agreement item (to be substituted), the rate payable to the contractor for the substituted item shall be the rate for the agreement item (to be

substituted) so increased to the extent of the difference between the market rates of substituted item and the agreement item (to be substituted).

(b) If the market rate for the substituted item so determined is less than the market rate of the agreement item (to be substituted), the rate payable to the contractor for the substituted item shall be the rate for the agreement item (to be substituted) so decreased to the extent of the difference between the market rates of substituted item and the agreement item (to be substituted).

Deviation, Deviated Quantities, Pricing

In the case of contract items, substituted items, contract cum substituted items, which exceed the limits laid down in Schedule-F, the contractor may within fifteen days of receipt of order or occurrence of the excess, claim revision of the rates, supported by proper analysis for the work in excess of the above mentioned limits, provided that if the rates so claimed are in excess of the rates specified in the schedule of quantities, the Engineer-in-Charge shall within prescribed time limit of receipt of the claims supported by analysis, after giving consideration to the analysis of the rates submitted by the contractor, determine the rates on the basis of the market rates and the contractor shall be paid in accordance with the rates so determined.

12.3 The provisions of the preceding paragraph shall also apply to the decrease in the rates of items for the work in excess of the limits laid down in Schedule-F, and the Engineer in-Charge shall after giving notice to the contractor within one month of occurrence of the excess and after taking into consideration any reply received from him within fifteen days of the receipt of the notice, revise the rates for the work in question within one month of the expiry of the said period of fifteen days having regard to the market rates.

12.4. The contractor shall send to the Engineer-in-Charge once every three months, an up to date account giving complete details of all claims for additional payments to which the contractor may consider himself entitled and of all additional work ordered by the Engineer-in-Charge which he has executed during the preceding quarter failing which the contractor shall be deemed to have waived his right. However, the Owner may authorize consideration of such claims on merits.

12.5 For the purpose of operation of Schedule-F the following works shall be treated as works relating to work up to plinth level.

(i) For buildings and basements: All works up to respective plinth level or up tofloor1level.
(ii) For abutments, piers and well staining: all works up to1.2m above the bed level:
(iii) For retaining wall, wing walls, compound walls, chimneys, overhead reservoirs/ tanks and other elevated structures: All works up to1.2meter above the formation ground level
(iv) For reservoirs/tanks (other than overhead reservoirs/tanks): All works up to1.2meters above the formation ground level:

v) For basement: All works up to 1.2 m above ground level or up to floor 1 level whichever is lower.

(vi) For Roads, all items of Excavation and filling including treatment of Sub base.

12.6 Any operation incidental to or necessarily has to be in contemplation of Govt Agencies/PSUs while filling RFP, or necessary for proper execution of the item included in the Schedule of quantities or in the schedule of rates mentioned above, whether or not, specifically indicated in the description of the item and the relevant specifications, shall be deemed to be included in the rates quoted by the Govt Agencies/PSUs or the rate given in the said schedule of rates, as the case may be. Nothing extra shall be admissible for such operations.

CLAUSE.13. Foreclosure of Contract due to Abandonment or Reduction in Scope of Work(s).

If at any time after acceptance of the **RFP or during the progress of work, the purpose or object for which the work is being done changes due to any supervening cause and as a result of which the work has to be abandoned or reduced in scope**, the Registrar /Engineer in-Charge /PMC shall give notice in writing to that effect to the Contractor **stating the decision as well as the cause for such decision** and the Contractor shall act accordingly in the matter. The Contractor shall have no claim to any payment of compensation or otherwise whatsoever on account of any profit or advantage which he might have derived from the execution of the Works in full but which he did not derive in consequence of the foreclosure of the whole or part of the Works.

The Contractor shall be paid at contract rates for the full amount for Work(s) executed at site and, in addition, a reasonable amount as certified by the Engineer-in-Charge for the items hereunder mentioned which could not be utilized on the Work to the full extent in view of the foreclosures:

i) Any expenditure incurred on preliminary site work, e.g. temporary access roads, temporary labour huts, staff quarters and site office; storage accommodation and water storage tanks.

ii) The Owner shall have the option to take over Contractor's materials or any part thereof either brought to site or of which the Contractor is legally bound to accept delivery from suppliers (for incorporation in or incidental to the work) provided, however, the Owner shall be bound to take over the materials or such portions thereof as the Contractor does not desire to retain. For materials taken over or to be taken over by the Owner, the cost of such materials as detailed by Engineer-in-Charge shall be paid. The cost shall, however, take into account purchase price, cost of transportation and deterioration or damage which may have been caused to materials whilst in the custody of the Contractor.

ii) If any materials supplied by Owner are rendered surplus, the same except normal wastage shall be returned by the contractor to Owner at rates not exceeding those at which these were originally issued, less allowance for any deterioration or damage which may have been caused whilst the materials

were in the custody of the contractor. In addition, cost of transporting such materials from site to Owner stores, if so required by Owner, shall be paid.

Reasonable compensation for transfer of T & P from site to contractor's permanent stores or to his other works, whichever is less. If T & P are not transported to either of the said places, no cost of transportation shall be payable.

i) Reasonable compensation for repatriation of contractor's site staff and imported labour to the extent necessary.

The contractor shall, if required by the Engineer- in-Charge, furnish to him, books of account, wage books, time sheets and other relevant documents and evidence as may be necessary to enable him to certify the reasonable amount payable under this condition.

The reasonable amount of items on (i), (ii) and (iii) above shall not be in excess of 2% of the cost of the work remaining incomplete on the date of closure, i.e. total stipulated cost of the work as per accepted RFP less the cost of work actually executed under the contract and less the cost of contractor's materials at site taken over by the Government as per item (ii) above. Provided always that against any payments due to the contractor on this account or otherwise, the Engineer-in-Charge shall be entitled to recover or be credited with any outstanding balances due from the contractor for advance paid in respect of any tool, plants and materials and any other sums which at the date of termination were recoverable by the Government from the contractor under the terms of the contract.

A compensation for such eventuality, on account of damages etc. shall be payable @ 0.5% of cost of work remaining incomplete on date of closure i.e. total stipulated cost of the work less the cost of work actually executed under the contract shall be payable.

In the event of action being taken under Clause 13 to reduce the scope of work, the contractor may furnish fresh Performance Guarantee on the same conditions, in the same manner and at the same rate for the balance RFP/tendered/offered amount and initial ly valid up to the extended date of completion or stipulated date of completion if no extension has been granted plus 60 days beyond that. Wherever such a fresh Performance Guarantee is furnished by the contractor the Engineer-in-Charge may return the previous Performance Guarantee.

CLAUSE14. Carrying out part work at risk & cost of contractor.

If Contractor

- At any time makes default during currency of the Work or does not execute any part of the Work with the due diligence and continues to do so after a notice in writing of 7 days from the Owner/Engineer-in-Charge; or

- Commits default in complying with any of the terms and conditions of the contract and does not remedy it or takes effective steps to remedy it or take effective steps to remedy it within 7 days even after a notice in writing is given in that behalf by the Owner/Engineer-in-Charge; or
- Fails to complete the Work(s) or items of Work, with individual dates of completion, on or before the date(s) so determined and does not complete them within the period specified in the notice given in writing in that behalf by the Engineer-in-Charge.

The Engineer- in-Charge without invoking action under clause 3 (when Contract can be determined) may, without prejudice to any other right or remedy against the contractor which have either accrued or accrue thereafter to Owner, by a notice in writing to take the part work / part incomplete work of any item(s) out of his hands and shall have powers to:

a) Take possession of the site and any materials, constructional plant, implements, stores, etc. thereon; and/or

b) Carry out the part work/ part incomplete Work of any item(s) by any means at the risk and cost of the Contractor.

The Engineer-in-Charge shall determine the amount, if any, is recoverable from the contractor for completion of the part work/ part incomplete work of any item(s) taken out of his hands and execute at the risk and cost of the contractor, the liability of contractor on account of loss or damage suffered by Owner because of action under this clause shall not exceed 10% (Ten per cent) of the RFP/tendered/offered value of the work.

In determining the amount, credit shall be given to the contractor with the value of work done in all respect in the same manner and at the same rate as if it had been carried out by the original contractor under the terms of his contract, the value of contractor's materials taken over and incorporated in the work and use of plant and machinery belonging to the contractor. The certificate of the Engineer-in-Charge as to the value of work done shall be final and conclusive against the contractor provided always that action under this clause shall only be taken after giving notice in writing to the contractor. Provided also that if the expenses incurred by the Authority are less than the amount payable to the contractor at his agreement rates, the difference shall not be payable to the contractor.

Any excess expenditure incurred or to be incurred by Owner in completing the part work/ part incomplete work of any item(s) or the excess loss of damages suffered or may be suffered by Owner as aforesaid after allowing such credit shall without prejudice to any other right or legal remedy available to Owner as per agreement be recovered from any money due to the contractor on any account, and if such money is insufficient, the contractor shall be called upon in writing and shall be liable to pay the same within 30 days.

If the contractor fails to pay the required sum within the aforesaid period of 30 days, the Engineer-in-Charge shall have the right to sell any or all of the contractors'

unused materials, constructional plant, implements, temporary building at site etc. and adjust the proceeds of sale thereof towards the dues recoverable from the contractor under the contract and if thereafter there remains any balance outstanding, it shall be recovered in accordance with the provisions of the contract.

In the event of above course being adopted by the Engineer-in-Charge, the contractor shall have no claim to compensation for any loss sustained by him by reason of his having purchased or procured any materials or entered into any engagements or made any advance on any account or with a view to the execution of the work or the performance of the contract.

CLAUSE.15. Suspension of Work

(i)The Contractor shall, on receipt of the order in writing of the Engineer-in-Charge (whose decision shall be final and binding on the Contractor) suspend the progress of the Works or any part thereof for such time and in such manner as the Engineer-in-Charge may consider necessary so as not to cause any damage, or injury to the Work already completed or endanger the safety thereof for any of the following reason:

- On account of any default on the part of the Contractor or;
- For proper execution of the Works or part thereof for reasons other than the default of the Contractor; or
- For safety of the Works or part thereof.

  The Contractor shall, during such suspension, properly protect and secure the Work(s) to the extent necessary and carry out the instructions given in that behalf by the Engineer-in-Charge.

(ii) If the suspension is ordered for reasons as per (b) and (c) of para (i) above;

- The Contractor shall be entitled to an extension of time equal to the period of every such suspension plus 25% for completion of the item or group of items of Work for which a separate period of completion is specified in the contract and of which the suspended Work forms a part, and;
- If the total period of all such suspensions in respect of an item or group of items or Work for- which a separate period of completion is specified in the contract exceeds thirty days, the Contractor shall, in addition to the compensation payable under the Contract be entitled to such compensation as the Engineer-in-Charge may consider reasonable in respect of salaries and/or wages paid by the Contractor to his employees and labour at site, remaining idle during the period of suspension by adding thereto 2% (to such compensation payable) to cover indirect expenses of the Contractor; provided the Contractor submits his claim supported by details to the Engineer-in-Charge within fifteen days of the expiry of the period of 30 days.
- If the Works or part thereof is suspended on the orders of the Engineer-in-Charge for more than three months at a time, except when suspension is ordered for reason as per para (i) (a) above, the Contractor may after receipt of such order

serve a written notice on the Engineer-in-Charge requiring permission within fifteen days from receipt by the Engineer-in-Charge of the said notice, to proceed with the Work or part thereof in regard to which progress has been suspended and if such permission is not granted within that time, the Contractor, if he intends to treat the suspension, where it affects only a part of the Works as an omission of such part by the Owner or where it affects whole of the Works, as an abandonment of the Works by the Owner, shall within ten days of expiry of such period of 15 days give notice in writing of his intention to the Engineer-in-Charge. In the event of the Contractor treating the suspension as an abandonment of the contract by the Owner, he shall have no claim to payment of any compensation on account of any profit or advantage which he might have derived from the execution of Work in full, but which he could not derive in consequence of the abandonment. He shall, however, be entitled to such compensation, as the Engineer-in-charge may consider reasonable in respect of salaries and/or wages paid to his employees and labour at site remaining idle in consequence adding to the total thereof 2% to cover indirect expenses of the Contractor provided the Contractor submits his claim supported by details to the Engineer-in-Charge within 15 days of the expiry of the period of 3 months.

CLAUSE.16. Action in case work not done as per Specifications

All Works under or in course of execution or executed in pursuance of the Contract shall at all times be open and accessible to the inspection and supervision of the Engineer-in-charge, his authorized subordinates in charge of the Work and all superior officers, officer of Quality assurance plan of the Owner or any organization engaged by the Owner for quality assurance and of the Chief Technical Examiner's Office, and the Contractor shall, at all times during the usual working hours and at all other times at which reasonable notice of the visit of such officers has been given to the Contractor either himself be present to receive orders and instructions or have a responsible agent duly accredited in writing, present for that purpose. Orders given to the Contractor's agent shall be considered to have the same force as if they had been given to the Contractor himself.

If it shall appear to the Engineer-In-Charge or his authorized subordinates in charge of the Work or to the Chief Engineer in charge of Quality Assurance or his subordinate officers or the officers of the organization engaged by the Owner for quality assurance or to the Chief Technical Examiner or his subordinate officers, that any Work has been executed with unsound, imperfect, or unskilful workmanship, or with materials or articles provided by him for the execution of the work which are unsound or of a quality inferior to that contracted or otherwise not in accordance with the Contract, the Contractor shall, on demand in writing, which shall be made within twelve months of the completion of the Work from the Engineer-in-Charge specifying the work, materials or articles complained of, notwithstanding that the same may have been passed, certified and paid for forthwith rectify, or remove and reconstruct the Work so specified in whole or in part, as the case may require or as the case may be, remove the materials or articles so specified and provide other proper and suitable materials or articles at

his own charge and cost. In the event of failing to do so within a period specified by the Engineer-in- charge in his demand aforesaid, then the Contractor shall be liable to pay compensation at the same rate as under clause 2 of the Contract (for non-completion of the work in time) for this default.

In such case the Engineer-in-Charge may not accept the item of Work at the rates applicable under the contract, but may accept such items at reduced rates as the Authority specified in Schedule F may consider reasonable during the preparation of on account bills or final bill, if the item is so acceptable without detriment to the safety and utility of the item and the structure or he may reject the work outright without any payment and/or get it and other connected and incidental items rectified, or remove and re-executed at the risk and cost of the contractor. Decision of the Engineer-in-Charge to be conveyed in writing in respect of the same will be final and binding on the contractor.

CLAUSE. 17. Contractor Liable for Damages/ Defects during defects liability period

If the Contractor or his working people or servants shall break, deface injure or destroy any part of building/ installation/ equipment in which they may be working, or any building road, road curb, fence, enclosure, water pipe, cables, drains, electric or telephone post or wires, trees, grass or grassland, or cultivated ground contiguous to the premises on which the Work or any part is being executed, or if any damage shall happen to the Work while in progress, from any cause whatsoever, or if any defect, shrinkage or other faults appear in the Work within 12 (Twelve) months after a certificate final or otherwise of its completion shall have been given by the Engineer-in-charge as aforesaid arising out of defect or improper materials or workmanship, the Contractor shall upon receipt of a notice in writing on that behalf by the Engineer-in-Charge make the same good at his own expense or In default of the Contractor to make such payments, the Engineer-in Charge shall cause the same to be made good by other workmen and deduct the expense incurred from any sums that may be due or at any time thereafter may become due to the Contractor or from his security deposit or the proceeds of sale thereof or of a sufficient portion thereof. The security deposit of the contractor shall not be refunded before the expiry of twelve months after the issue of the certificate final or otherwise, of completion of work, or till the final bill has been prepared and passed whichever is later. Provided that in the case of road work, if in the opinion of the Engineer-in-Charge, half of the security deposit is sufficient, to meet all liabilities of the contractor under this contract, half of the security deposit will be refundable after six months and the remaining half after twelve months of the issue of the said certificate of completion or till the final bill has been prepared and passed whichever is later.

In case of Maintenance and Operation works of E&M services, the security deposit deducted from contractors shall be refunded within one month from the date of final payment or within one month from the date of completion of the maintenance contract whichever is earlier.

CLAUSE.18. Contractor to provide tools & plants etc.

The contractor shall provide at his own cost all materials (except such special materials, if any, as may in accordance with the contract be supplied from the Owner's store), machinery, tools & plants as specified in Schedule-F. In addition to this, appliances, implements, other plants, ladders, cordage, tackle, scaffolding and temporary works required for the proper execution of the work, whether original, altered or substituted and whether included in the specifications or other documents forming part of the contract or referred to in these conditions or not, or which may be necessary for the purpose of satisfying or complying with the requirements of the Engineer-in-Charge as to any matter as to which under these conditions he is entitled to be satisfied, or which he is entitled to require together with carriage therefore to and from the work. The contractor shall also supply without charge the requisite number of persons with the means and materials, necessary for the purpose of setting out works, and counting, weighing and assisting the measurement for examination at any time and from time to time of the work or materials.

Failing his so doing, the same may be provided by the Engineer-in-Charge at the expense of the contractor and the expenses may be deducted, from any money due to the contractor, under this contract or otherwise and/or from his security deposit or the proceeds of sale thereof, or of a sufficient portion thereof.

CLAUSE. 18A.Recovery of Compensation paid to Workmen

In every case in which by virtue of the provisions sub-section (1) of Section 12, of the Workmen's Compensation Act, 1923, Owner is obliged to pay compensation to workman employed by the contractor, in execution of the works, Owner will recover from the contractor, the amount of the compensation so paid; and, without prejudice to the rights of the Owner under sub-section (2) of Section 12, of the said Act, Owner shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due by Owner to the contractor whether under this contract or otherwise. Owner shall not be bound to contest any claim made against it under sub-section (1) of Section 12, of the said Act, except on the written request of the contractor and upon his giving to Owner full security for all costs for which Owner might become liable in consequence of contesting such claim.

CLAUSE. 18B.Ensuring Payment and Amenities to Workers if Contractor fails

ln every case in which by virtue of the provisions of the Contract Labour (Regulation and Abolition) Act, 1970, and of the Contract Labour (Regulation and Abolition) Central Rules, 1971, Owner is obliged to pay any amounts of wages to a workman employed by the contractor in execution of the works, or to incur any expenditure in providing welfare and health amenities required to be provided under the above said Act and the rules under Clause 19H or under the C.P.W.D. Contractor's Labour

Regulations, or under the Rules framed by Government from time to time for the protection of health and sanitary arrangements for workers employed by C.P.W.D. Contractors, Owner will recover from the contractor, the amount of wages so paid or the amount of expenditure so incurred; and without prejudice to the rights of the Owner under sub-section(2) of Section 20, and sub-section (4) of Section 21, of the Contract Labour (Regulation and Abolition) Act, 1970, Owner shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due by Owner to the contractor whether under this contract or otherwise. Owner shall not be bound to contest any claim made against it under sub-section (1) of Section 20, sub-section (4) of Section 21, of the said Act, except on the written request of the contractor and upon his giving to the Owner full security for all costs for which Owner might become liable in contesting such claim.

CLAUSE.19. Labour Laws to be complied with, by the Contractor

The contractor shall obtain a valid license under the Contract Labour (Regulation & Abolition) Act, 1970, and the Contract Labour (Regulation and Abolition) Central Rules, 1971, before the commencement of the work, and continue to have a valid license until the completion of the work. The contractor shall also comply with provision of the interstate migrant workmen (Regulation of employment & condition of services) Act 1979. The contractor shall also abide by the provisions of the Child Labour (Prohibition and Regulation) Act, 1986.

The contractor shall also comply with the provisions of the building and other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996 and the building and other Construction Workers Welfare Cess Act, 1996.

Any failure to fulfil these requirements shall attract the penal provisions of this contract arising out of the resultant non-execution of the work.

CLAUSE 19A Child Labour:

No labour below the age of fourteen years shall be employed on the work.

CLAUSE 19B Payment of wages:

(i) The contractor shall pay to labour employed by him either directly or through subcontractors, wages not less than fair wages as defined in the CPWD. Contractor's Labour Regulations or as per the provisions of the Contract Labour (Regulation and Abolition) Act, 1970 and the contract Labour (Regulation and Abolition) Central Rules, 1971, wherever applicable.

(ii) The contractor shall, notwithstanding the provisions of any contract to the contrary, cause to be paid fair wage to labour indirectly engaged on the work, including any labour engaged by his sub-contractors in connection with the said work, as if the labour had been immediately employed by him.

(iii) In respect of all labour directly or indirectly employed in the works for performance of the contractor's part of this contract, the contractor shall comply

with or cause to be complied with the Central Public Works Department contractor's Labour Regulations made by Government from time to time in regard to payment of wages, wage period, deductions from wages recovery of wages not paid and deductions unauthorized made, maintenance of wage books or wage slips, publication of scale of wages and other terms of employment, inspection and submission of periodical returns and all other matters of the like nature or as per the provisions of the Contract Labour (Regulation and Abolition) Act, 1970, and the Contract Labour (Regulation and Abolition) Central Rules, 1971, wherever applicable.

(iv) (a) The Engineer-in-Charge concerned shall have the right to deduct from the moneys due to the contractor any sum required or estimated to be required for making good the loss suffered by a worker or workers by reason of non-fulfilment of the conditions of the contract for the benefit of the workers, non-payment of wages or of deductions made from his or their wages which are not justified by their terms of the contract or non-observance of the Regulations.

(b) Under the provision of Minimum Wages (Central) Rules, 1950, the contractor is bound to allow to the labours directly or indirectly employed in the works one-day rest for 6 days continuous work and pay wages at the same rate as for duty. In the event of default, the Engineer-in-Charge shall have the right to deduct the sum or sums not paid on account of wages for weekly holidays to any labours and pay the same to the persons entitled thereto from any money due to the contractor by the Engineer-in-Charge concerned.

(v) The contractor shall comply with all the Central, State Laws & other statutory and regulatory provisions and Rules including but not limited to the provisions of the Payment of Wages Act, 1936, Minimum Wages Act 1948, Minimum Wages (Central) Rules, 1950, Employees Liability Act, 1938, Workmen's Compensation Act, 1923, Industrial Disputes Act, 1947, Maternity Benefits Act, 1961, Child Labour (Prohibition and Regulation) Act, 1986 and the Contractor's Labour (Regulation and Abolition) Act 1970, or the modifications thereof or any other laws relating thereto and the rules made there under from time to time.

(vi) The contractor shall indemnify and keep indemnified Owner against payments to be made under and for the observance of the laws aforesaid and the C.P.W.D. Contractor's Labour Regulations without prejudice to his right to claim indemnity from his sub-contractors.

(vii) The laws aforesaid shall be deemed to be a part of this contract and any breach thereof shall be deemed to be a breach of this contract.

(viii) Whatever is the minimum wage for the time being, or if the wage payable is higher than such wage, such wage shall be paid by the contractor to the workmen directly without the intervention of Jamadar (head of the labour Gang) and that Jamadar shall not be entitled to deduct or recover any amount from the minimum wage payable to the workmen as and by way of commission or otherwise.

(ix) The contractor shall ensure that no amount by way of commission or otherwise is deducted or recovered by the Jamadar from the wage of workmen.

Clause 19C

In respect of all labour directly or indirectly employed in the work for the performance of the contractor's part of this contract, the contractor shall at his own expense arrange for the safety provisions as per CPWD. Safety Code framed from time to time and shall at his own expense provide for all facilities in connection therewith. In case the contractor fails to make arrangement and provide necessary facilities as aforesaid, he shall be liable to pay a penalty of Rs.200/- for each default and in addition, the Engineer-in- Charge shall be at liberty to make arrangement and provide facilities as aforesaid and recover the costs incurred in that behalf from the contractor.

CLAUSE 19D

The contractor shall submit by 4th and 19th of every month, to the Engineer-in-Charge, a true statement showing in respect of the second half of the preceding month and the first half of the current month respectively: -

1) The number of labourers employed by him on the work,
2) Their working hours,
3) The wages paid to them,
4) The accidents that occurred during the said fortnight showing the circumstances under which they happened and the extent of damage and injury caused by them, and
5) The number of female workers who have been allowed maternity benefit according to **"Leave and pay during leave Clause19F"** and the amount paid to them.

Failing which the contractor shall be liable to pay to Owner, a sum not exceeding Rs.200/- for each default or materially incorrect statement. The decision of the Engineer in Charge shall be final in deducting from any bill due to the contractor; the amount levied as fine and is binding on the contractor.

CLAUSE 19E

In respect of all labour directly or indirectly employed in the works for the performance of the contractor's part of this contract, the contractor shall comply with or cause to be complied with all the rules framed by Government from time to time for the protection of health and sanitary arrangements for workers employed by the Owner and its contractors.

CLAUSE 19F Leave and pay during leave:

Leave and pay during leave shall be regulated as follows:

1. Leave:

(i) in the case of delivery – maternity leave not exceeding 8 weeks, 4 weeks up to and including the day of delivery and 4 weeks following that day,

(ii) in the case of miscarriage – up to 3 weeks from the date of miscarriage.

2. Pay:

(i) in the case of delivery - leave pay during maternity leave will be at the rate of the women's average daily earnings, calculated on total wages earned on the days when full time work was done during a period of three months immediately preceding the date on which she gives notice that she expects to be confined or at the rate of Rupee one only a day whichever is greater.

(ii) in the case of miscarriage - leave pay at the rate of average daily earning calculated on the total wages earned on the days when full time work was done during a period of three months immediately preceding the date of such miscarriage.

3. Conditions for the grant of Maternity Leave:

No maternity leave benefit shall be admissible to a woman unless she has been employed for a total period of not less than six months immediately preceding the date on which she proceeds on leave.

4. The contractor shall maintain a register of Maternity (Benefit) in the Prescribed Form as shown in appendix -I and II, and the same shall be kept at the place of work.

CLAUSE 19G

In the event of the contractor(s) committing a default or breach of any of the provisions of the Central Public Works Department, Contractor's Labour Regulations and Model Rules for the protection of health and sanitary arrangements for the workers as amended from time to time or furnishing any information or submitting or filing any statement under the provisions of the above Regulations and' Rules which is materially incorrect, he/they shall, without prejudice to any other liability, pay to the Owner a sum not exceeding Rs.200/- for every default, breach or furnishing, making, submitting, filing such materially incorrect statements and in the event of the contractor(s) defaulting continuously in this respect, the penalty may be enhanced to Rs.200/- per day for each day of default subject to a maximum of 5 per cent of the estimated cost of the work put to RFP. The decision of the Engineer-in-Charge shall be final and binding on the parties.

Should it appear to the Engineer-in-Charge that the contractor(s) is/are not properly observing and complying with the provisions of the CPWD. Contractor's Labour Regulations and Model Rules and the provisions of the Contract Labour (Regulation and Abolition) Act 1970, and the Contract Labour (R& A) Central Rules 1971, for the protection of health and sanitary arrangements for work-people employed by the contractor(s) (hereinafter referred as "the said Rules") the Engineer-in-Charge shall have power to give notice in writing to the contractor(s) requiring that the said Rules be complied with and the amenities prescribed therein be provided to the work-people within a reasonable time to be specified in the notice. If the contractor(s) shall fail within the period specified in the notice to comply with

and/observe the said Rules and to provide the amenities to the work-people as aforesaid, the Engineer-in-Charge shall have the power to provide the amenities hereinbefore mentioned at the cost of the contractor(s). The contractor(s) shall erect, make and maintain at his/their own expense and to approved standards all necessary huts and sanitary arrangements required for his/their work-people on the site in connection with the execution of the works, and if the same shall not have been erected or constructed, according to approved standards, the Engineer-in-Charge shall have power to give notice in writing to the contractor(s) requiring that the said huts and sanitary arrangements be remodelled and/or reconstructed according to approved standards, and if the contractor(s) shall fail to remodel or reconstruct such huts and sanitary arrangements according to approved standards within the period specified in the notice, the Engineer-in-Charge shall have the power to remodel or reconstruct such huts and sanitary arrangements according to approved standards at the cost of the contractor(s).

CLAUSE 19 H

The contractor(s) shall at his/their own cost provide his/their labour with a sufficient number of huts (hereinafter referred to as the camp) of the following specifications on a suitable plot of land to be approved by the Engineer-in-Charge.

(i) (a) The minimum height of each hut at the eaves level shall be 2.10m (7 ft.) and the floor area to be provided will be at the rate of 2.7 sqm. (30 sq. ft.) For each member of the worker's family staying with the labourer.

(b) The contractor(s) shall in addition construct suitable cooking places having a minimum area of 1.80m x 1.50m (6'x5') adjacent to the hut for each family.

(c) The contractor(s) shall also construct temporary latrines and urinals for the use of the labourers each on the scale of not less than four per each one hundred of the total strength, separate latrines and urinals being provided for women.

(d) The contractor(s) shall construct sufficient number of bathing and washing places, one unit for every 25 persons residing in the camp. These bathing and washing places shall be suitably screened.

(ii) (a) all the huts shall have walls of sun-dried or burnt-bricks laid in mud mortar or other suitable local materials as may be approved by the Engineer-in-Charge. In case of sun-dried bricks, the walls should be plastered with mud gobri on both sides. The floor may be kutcha but plastered with mud gobri and shall be at least 15 cm (6") above the surrounding ground. The roofs shall be laid with thatch or any other materials as may be approved by the Engineer-in-Charge and the contractor shall ensure that throughout the period of their occupation, the roofs remain watertight.

(b) The contractor(s) shall provide each hut with proper ventilation.

(c) All doors, windows, and ventilators shall be provided with suitable leaves for security purposes.

(d) There shall be kept an open space of at least 7.2m (8 yards) between the rows of huts which may be reduced to 6m (20 ft.) according to the availability of site with the approval of the Engineer-in-Charge. Back to back construction will be allowed.

(iii)Water Supply - The contractor(s) shall provide adequate supply of water for the use of labourers. The provisions shall not be less than two gallons of pure and wholesome water per head per day for drinking purposes and three gallons of clean water per head per day for bathing and washing purposes. Where piped water supply is available, supply shall be at stand posts and where the supply is from wells or river, tanks that may be of metal or masonry, shall be provided. The contractor(s) shall also at his/ their own cost make arrangements for laying pipe lines for water supply to his/ their labour camp from the existing mains wherever available, and shall pay all fees and charges therefore.

(iv) The site selected for the camp shall be high ground, removed from jungle.

(v)Disposal of Excreta - The contractor(s) shall make necessary arrangements for the disposal of excreta from the latrines by trenching or incineration, which shall be according to the requirements lay down by the Local Health Authorities. If trenching or incineration is not allowed, the contractor(s) shall make arrangements for the removal of the excreta through the Municipal Committee/authority and inform it about the number of labourers employed so that arrangements may be made by such Committee/authority for the removal of the excreta. All charges on this account shall be borne by the contractor and paid direct by him to the Municipality/authority. The contractor shall provide one sweeper for every eight seats in case of dry system.

(**vi) Drainage -** The contractor(s) shall provide efficient arrangements for draining away sullage water so as to keep the camp neat and tidy. The contractor may provide package type STP plant of required capacity approved by engineer in change for treating the sewage water and supply to the Owner free of cost for the use of gardening. The contractor will carry out maintenance of STP at his own cost. Contractor will keep the camp neat and tidy.

(vii) The contractor(s) shall make necessary arrangements for keeping the camp area sufficiently lighted to avoid accidents to the workers.

(Viii) Sanitation - The contractor(s) shall make arrangements for conservancy and Sanitation in the labour camps according to the rules of the Local Public Health and Medical Authorities.

CLAUSE 19I

The Engineer-in-Charge may require the contractor to dismiss or remove from the site of the work any person or persons in the contractors' employ upon the work who may be incompetent or misconduct himself and the contractor shall forthwith comply with such requirements. In respect of maintenance/repair or renovation works etc. where the labour have an easy access to the individual houses, the contractor shall issue identity cards to the labourers, whether temporary or

permanent and he shall be responsible for any untoward action on the part of such labour. Engineer-in-charge will display a list of contractors working in the colony/Blocks on the notice board in the colony and also at the service center, to apprise the residents about the same.

CLAUSE 19J Occupation of Buildings by Unauthorized persons

It shall be the responsibility of the contractor to see that the building under construction is not occupied by anybody unauthorized during construction, and is handed over to the Engineer-in-Charge with vacant possession of complete building. If such building though completed is occupied illegally, then the Engineer-in-Charge shall have the option to refuse to accept the said building/buildings in that position. Any delay in acceptance on this account will be treated as the delay in completion and for such delay, a levy up to 5% of RFP/tendered/offered value of work may be imposed by the Engineer-in-charge whose decision shall be final both with regard to the justification and quantum and be binding on the contractor.

However, the Engineer in charge through a notice may require the contractor to remove the illegal occupation any time on or before construction and delivery.

CLAUSE 19K Employment of skilled/semi-skilled workers

The contractor shall, at all stages of work, deploy skilled/semi-skilled tradesmen who are qualified and possess certificate in particular trade from CPWD Training Institute/Industrial Training Institute/National Institute of construction Management and Research (NICMAR)/ National Academy of Construction, CIDC or any similar reputed and recognized Institute managed/ certified by State/Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled/semi-skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, it's scheduling and the list of qualified tradesmen along with requisite certificate from recognized Institute to Engineer in charge for approval. Notwithstanding such approval, if the tradesmen are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesmen within two days of written notice from Engineer in-Charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesmen will attract a compensation to be paid by contractor at the rate of Rs. 100 per such tradesman per day. Decision of Engineer-in-Charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding.

If required then contractor shall arrange on site training as per National Skill development Corporation (NSDC) norms for at least 10% of the unskilled worker engaged in the project in co-ordination with the NU and National Skill Development Corporation (NSDC) for certification at the level of skilled/ semi-skilled tradesmen.

CLAUSE 19 L Contribution of EPF and ESI

The ESI and EPF contributions on the part of employer in respect of this contract shall be paid by the contractor. These contributions on the part of employer paid by the contractor shall be reimbursed by the Engineer-in-charge to the contractor on actual basis. The applicable and eligible amount of EPF & ESI shall be reimbursed preferably within 7 days but not later than 30 days of submission of documentary proof of payment provided same are in order.

CLAUSE. 20. Minimum Wages Act to be complied with

The contractor shall comply with all the provisions of the Minimum Wages Act, 1948, and Contract Labour (Regulation and Abolition) Act, 1970, amended from time to time and rules framed there under and other labour laws affecting contract labour that may be brought into force from time to time.

CLAUSE. 21. Work not to be sublet. Action in case of insolvency

The contract shall not be assigned or sublet without the written approval of the Engineer-in-Charge. And if the contractor shall assign or sublet his contract, or attempt to do so, or become insolvent or commence any insolvency proceedings or make any composition with his creditors or attempt to do so, or if any bribe, gratuity, gift, loan, perquisite, reward or advantage pecuniary or otherwise, shall either directly or indirectly, be given, promised or offered by the contractor, or any of his servants or agent to any officer or person in the employ of Owner or any of its formally appointed consultants in any way relating to their office or employment, or if any such officer or person shall become in any way directly or indirectly interested in the contract, the Engineer-in-Charge on behalf of the Owner (Nalanda University shall have power to adopt the course specified in Clause 3 (when contract can be determined) hereof in the interest of Owner and in the event of such course being adopted, the consequences specified in the said Clause 3 shall ensue.

CLAUSE. 22. Compensation

All sums payable by way of compensation under any of these conditions shall be considered as reasonable compensation to be applied to the use of Owner without reference to the actual loss or damage sustained and whether or not any damage shall have been sustained.

CLAUSE. 23. Changes in firm's Constitution to be intimated

Where the contractor is a partnership firm, the previous approval in writing of the Engineer-in-Charge shall be obtained before any change is made in the constitution of the firm. Where the contractor is an individual or a Hindu undivided family business concern, such approval as aforesaid shall likewise be obtained before the contractor enters into any partnership agreement where under the partnership firm would have the right to carry out the works hereby undertaken by the contractor.

If previous approval as aforesaid is not obtained, the contract shall be deemed to have been assigned in contravention of Clause 21 (Work not be sublet Action in case of insolvency) hereof and the same action may be taken, and the same consequences shall ensue as provided in the said Clause 21 (Work not be sublet. Action in case of insolvency)

CLAUSE. 24. Works to be executed under the Contract

All works to be executed under the contract shall be executed under the direction and subject to the approval in all respects of the Engineer-in-Charge who shall be entitled to direct at what point or points and in what manner they are to be commenced, and from time to time carried on.

CLAUSE.25. Settlement of disputes & Arbitration

Except where otherwise provided in the contract, all questions and disputes relating to the meaning of the specifications, design, drawings and instructions herein before mentioned and as to the quality of workmanship or materials used on the Work or as to any other question, claim, right, matter or thing whatsoever in any way arising out of or in relation to the contract, design, drawings, specification, estimates, instructions, orders or these conditions or otherwise concerning the Work or the execution or failure to execute the same whether arising during the progress of the Work or after the cancellation, termination, completion or abandonment thereof shall be dealt with as mentioned hereinafter

(a) If the Contractor considers any Work demanded of him to be outside the requirements of the Contract, or disputes any drawings, record or decision given in writing by the Engineer-in-Charge or **if the Engineer in Charge considers any act or decision of the contract** on any matter in connection with or arising out of the contract or carrying out of the Work to be unacceptable he shall promptly within 15 days request the Owner in writing for written instruction or decision on such matters. Thereupon, the Owner shall give his written instructions or decisions within a period of one month from the receipt of the Contractor's letter.

If the Owner fails to give his instructions or decision in writing within the aforesaid period or if the Contractor is dissatisfied with the instructions or decision of the Owner, the Contractor may, within 15 days of the receipt of the Owner's decision, give notice to the Owner to appoint an Arbitrator failing which the said decision shall be final, binding and conclusive and not referable to adjudication by the Arbitrator. It is a term of contract that each party invoking arbitration must exhaust the aforesaid mechanism of settlement of claims/disputes prior to invoking arbitration.

(b) Disputes or difference shall be referred for adjudication through arbitration by a Tribunal having sole arbitrator where RFP/tendered/offered amount is Rs. 100 Crore or less. Where RFP/tendered/offered Value is more than Rs. 100 Crore, Tribunal shall consist of three Arbitrators as above. The requirements of the Arbitration

and Conciliation Act, 1996 (26 of 1996) and any further statutory modifications or re-enactment thereof and the rules made there under and for the time being in force shall be applicable.

It is a term of this Contract that the party invoking Arbitration shall give a list of disputes with amounts claimed, **if any,** in respect of each such dispute along with the notice for appointment of Arbitrator and giving reference to the rejection by the Owner of the appeal.

It is also a term of this contract that any member of the Arbitration Tribunal shall be a Graduate Engineer with experience in handling public works engineering contracts at a level not lower than Chief Engineer (Joint Secretary level of Government of India). This shall be treated as a mandatory qualification to be appointed as arbitrator.

Parties, before or at the time of appointment of Arbitral Tribunal may agree in writing for fast track arbitration as per the Arbitration and Conciliation Act, 1996 (26 of 1996) as amended in 2015.
Subject to provision in the Arbitration and Conciliation Act, 1996 (26 of 1996) as amended in 2015 whereby the counter claims if any can be directly filed before the arbitrator without any requirement of reference by the appointing authority, the arbitrator shall adjudicate on only such disputes as are referred to him by the appointing authority and give separate award against each dispute and claim referred to him and in all cases where the total amount of the claims by any party exceeds Rs. 1,00,000/-, the arbitrator shall give reasons for the award.

It is also a term of the contract that if any fees and other expenses are payable to the Arbitrator, these shall be paid **as per the act**.

The place of arbitration shall be as mentioned in Schedule F. In case there is no mention of place of arbitration, the arbitral tribunal shall determine the place of arbitration. The venue of the arbitration shall be such place as may be fixed by the Arbitral Tribunal in consultation with both the parties. Failing any such agreement, then the Arbitral Tribunal shall decide the venue.

CLAUSE. 26. Contractor to indemnify Owner against Patent Rights

The contractor shall fully indemnify and keep indemnified the Owner against any action, claim or proceeding relating to infringement or use of any patent or design or any alleged patent or design rights and shall pay any royalties which may be payable in respect of any article or part thereof included in the contract. In the event of any claims made under or action brought against Owner in respect of any such matters as aforesaid, the contractor shall be immediately notified thereof and the contractor shall be at liberty, at his own expense, to settle any dispute or to conduct any litigation that may arise there from, provided that the contractor shall not be liable to indemnify the Owner if the infringement of the patent or design or any alleged patent or design right is the direct result of an order passed by the Engineer-in-Charge in this behalf.

CLAUSE 27 Lump sum provision in RFP.

Whenever any claim or claims for payment of a sum of money arises out of or under the contract or against the contractor, the Engineer-in-Charge or the Government/NU shall be entitled to withhold and also have a lien to retain such sum or sums in whole or in part from the security, if any deposited by the contractor and for the purpose aforesaid, the Engineer-in-Charge or the Government shall be entitled to withhold the security deposit, if any, furnished as the case may be and also have a lien over the same pending finalization or adjudication of any such claim. In the event of the security being insufficient to cover the claimed amount or amounts or if no security has been taken from the contractor, the Engineer-in-Charge or the Government shall be entitled to withhold and have a lien to retain to the extent of such claimed amount or amounts referred to above, from any sum or sums found payable or which may at any time thereafter become payable to the contractor under the same contract or any other contract with the Engineer-in-Charge of the Government or any contracting person through the Engineer-in-Charge pending finalization of adjudication of any such claim. It is an agreed term of the contract that the sum of money or moneys so withheld or retained under the lien referred to above by the Engineer-in-Charge or Government will be kept withheld or retained as such by the Engineer-in-Charge or Government till the claim arising out of or under the contract is determined by the arbitrator(if the contract is governed by the arbitration clause) by the competent court, as the case may be and that the contractor will have no claim for interest or damages whatsoever on any account in respect of such withholding or retention under the lien referred to above and duly notified as such to the contractor. For the purpose of this clause, where the contractor is a partnership firm or a limited company, the Engineer-in-Charge or the Government shall be entitled to withhold and also have a lien to retain towards such claimed amount or amounts in whole or in part from any sum found payable to any partner/limited company as the case may be, whether in his individual capacity or otherwise.

(i) Nalanda University shall have the right to cause an audit and technical examination of the works and the final bills of the contractor including all supporting vouchers, abstract, etc., to be made after payment of the final bill and if as a result of such audit and technical examination any sum is found to have been overpaid in respect of any work done by the contractor under the contract or any work claimed to have been done by him under the contract and found not to have been executed, the contractor shall be liable to refund the amount of over-payment and it shall be lawful for Government to recover the same from him in the manner prescribed in sub-clause (i) of this clause or in any other manner legally permissible; and if it is found that the contractor was paid less than what was due to him under the contract in respect of any work executed by him under it, the amount of such under payment shall be duly paid by Government to the contractor, without any interest thereon whatsoever. Provided that the Government shall not be entitled to recover any sum overpaid, nor the contractor shall be entitled to payment of any sum paid short where such payment has been agreed upon between the Registrar/ EIC/PMC or Executive Engineer on the one hand and the contractor on the other under any term of the contract permitting payment for work after assessment by the representative of Registrar/ Engineer or the PMC.

CLAUSE.28 .Action where no Specifications are specified

In the case of any class of work for which there is no such specifications as referred to in Clause 11, such work shall be carried out in accordance with the Bureau of Indian Standards Specifications. In case there are no such specifications in Bureau of Indian Standards, the work shall be carried out as per manufacturers' specifications, if not available then as per District Specifications. In case there are no such specifications as required above, the work shall be carried out in all respects in accordance with the instructions and requirements of the Engineer-in-Charge.

CLAUSE. 29. Withholding and lien in respect of sum due from contractor

(i) Whenever any claim or claims for payment of a sum of money arises out of or under the contract or against the contractor, the Engineer-in-Charge or the Owner shall be entitled to withhold and also have a lien to retain such sum or sums in whole or in part from the security, if any deposited by the contractor and for the purpose aforesaid, the Engineer-in-Charge or the Owner shall be entitled to withhold the security deposit, if any, furnished as the case may be and also have a lien over the same pending finalization or adjudication of any such claim. In the event of the security being insufficient to cover the claimed amount or amounts or if no security has been taken from the contractor, the Engineer-in-Charge or the Owner shall be entitled to withhold and have a lien to retain to the extent of such claimed amount or amounts referred to above, from any sum or sums found payable or which may

at any time thereafter become payable to the contractor under the same contract or any other contract with the Engineer-in-Charge of the Owner or any contracting person through the Engineer-in-Charge pending finalization of adjudication of any such claim.

It is an agreed term of the contract that the sum of money or moneys so withheld or retained under the lien referred to above by the Engineer-in-Charge or the Owner will be kept withheld or retained as such by the Engineer-in-Charge or Owner till the claim arising out of or under the contract is determined by the arbitrator by the competent court, as the case may be and that the contractor will have no claim for interest or damages whatsoever on any account in respect of such withholding or retention under the lien referred to above and duly notified as such to the contractor. For the purpose of this clause, where the contractor is a partnership firm or a limited company, the Engineer-in-Charge or the Owner shall be entitled to withhold and also have a lien to retain towards such claimed amount or amounts in whole or in part from any sum found payable to any partner/limited company as the case may be, whether in his individual capacity or otherwise.

(ii) Owner shall have the right to cause an audit and technical examination of the works and the final bills of the contractor including all supporting vouchers, abstract, etc., to be made after payment of the final bill and if as a result of such audit and technical examination any sum is found to have been overpaid in respect of any work done by the contractor under the contract or any work claimed to have been done by him under the contract and found not to have been executed, the contractor shall be liable to refund the amount of over-payment and it shall be lawful for Owner to recover the same from him in the manner prescribed in sub-clause (i) of this clause or in any other manner legally permissible; and if it is found that the contractor was paid less than what was due to him under the contract in respect of any work executed by him under it, the amount of such under payment shall be duly paid by Owner to the contractor, without any interest thereon whatsoever.

Provided that the Owner shall not be entitled to recover any sum overpaid, nor the contractor shall be entitled to payment of any sum paid short where such payment has been agreed upon between the Engineer-in-Charge on the one hand and the contractor on the other under any term of the contract permitting payment for work after assessment by the Engineer-in-Charge.

CLAUSE. 29A.Lien in respect of claims in other Contracts

Any sum of money due and payable to the contractor (including the security deposit returnable to him) under the contract may be withheld or retained by way of lien by the Engineer-in-Charge or the Owner or any other contracting person or persons through Engineer-in-Charge against any claim of the Engineer-in-Charge or the Owner or such other person or persons in respect of payment of a sum of money arising out of or under any other contract made by the contractor with the Engineer-in-Charge or the Owner or with such other person or persons.

It is an agreed term of the contract that the sum of money so withheld or retained under this clause by the Engineer-in-Charge or the Owner will be kept withheld or retained as such by the Engineer-in-Charge or the Owner or till his claim arising out of the same contract or any other contract is either mutually settled or determined by the arbitration clause or by the competent court, as the case may be and that the contractor shall have no claim for interest or damages whatsoever on this account or on any other ground in respect of any sum of money withheld or retained under this clause and duly notified as such to the Contractor.

CLAUSE 30. Employment of Coal Mining or Controlled area labour not permissible.

This clause may not be relevant to this work and hence to be read as deleted.

CLAUSE. 31. Unfiltered Water Supply

The Contractor(s) shall make his/their own arrangements for water required for the work and nothing extra will be paid for the same. This will be subject to the following conditions:

(i) That the water used by the contractor(s) shall be fit for construction purposes to the satisfaction of the Engineer-in-Charge.

(ii) The Engineer-in-Charge shall make alternative arrangements for supply of water at the risk and cost of contractor(s) if the arrangements made by the contractor(s) for procurement of water are in the opinion of the Engineer-in-Charge, unsatisfactory.

CLAUSE 31A Departmental Water supply if available.

Water if available may be supplied to the contractor by the Owner subject to the following conditions.

i) The water charges @ 1 % shall be recovered on gross amount of the work done.

ii) The contractor shall make his own arrangement of water connection and laying of pipelines from existing main of source of supply.

iii) The Owner do not guarantee to maintain uninterrupted supply of water and it will be incumbent on the contractor to make alternative arrangements for water at his own cost in the event of any temporary break down in the Government water main so that the progress of his/their work is not held up for want of water. No claim of damage or refund of water charges will be entertained on account of such break down.

CLAUSE 32. Alternate water arrangements

Deleted

CLAUSE. 33. Return of Surplus materials

Notwithstanding anything contained to the contrary in this contract, where any materials for the execution of the contract are procured with the assistance of Owner either by issue from the Owner's stocks or purchase made under orders or permits or licenses issued by Owner, the contractor shall hold the said materials economically and solely for the purpose of the contract and not dispose of them without the written permission of the Owner and return, if required by the Engineer-in-Charge, all surplus or unserviceable materials that may be left with him after the completion of the contract or at its termination for any reason whatsoever on being paid or credited such price as the Engineer-in-Charge shall determine having due regard to the condition of the materials. The price allowed to the contractor however shall not exceed the amount charged to him excluding the element of storage charges. The decision of the Engineer-in-Charge in this regard shall be final and conclusive. In the event of breach of the aforesaid condition, the contractor shall in addition to throwing himself open to action for contravention of the terms of the license or permit and/or for criminal breach of trust, be liable to Owner for all moneys, advantages or profits resulting or which in the usual course would have resulted to him by reason of such breach.

CLAUSE. 34 Hire of Plant & Machinery

This clause is deleted as the Owner cannot supply any Plant and Machinery.

Clause 35. Conditions relating to use of asphaltic materials.

This clause is deleted as the Owner cannot supply any Plant and Machinery.

CLAUSE 36. Employment of technical Staff and employees

Contractors Superintendence, Supervision, Technical Staff & Employees

(i) The contractor shall provide all necessary superintendence during execution of the work and all along thereafter as may be necessary for proper fulfilling of the obligations under the contract.

The contractor shall immediately after receiving letter of acceptance of the RFP and before commencement of the work, intimate in writing to the Engineer-in-Charge, the name(s), qualifications, experience, age, address(s) and other particulars along with certificates, of the principal technical representative to be in charge of the work and other technical representative(s) who will be supervising the work. Minimum requirement of such technical representative(s) and their qualifications and experience shall not be lower than specified in Schedule-F. The Engineer-in-Charge shall within 3 days of receipt of such communication intimate in writing his approval or otherwise of such a representative(s) to the contractor. Any such approval may at any time be withdrawn and in case of such withdrawal, the contractor shall appoint another such representative(s) according to the provisions of this clause. Decision of

the RFP Accepting Authority shall be final and binding on the contractor in this respect. Such a principal technical representative and other technical representative(s) shall be appointed by the contractor soon after receipt of the approval from Engineer-in-charge and shall be available at site before start of work.

All the provisions applicable to the principal technical representative under the Clause will also be applicable to other technical representative(s) The principal technical representative and other technical representative(s) shall be present at the site of work for supervision at all times when any construction activity is in progress and also present himself/themselves, as required, to the Engineer-in-Charge and or his designated representative to take instructions. Instructions given to the principal technical representative or other technical representative(s) shall be deemed to have the same force as if these have been given to the contractor. The principal technical representative and other technical representative(s) shall be actually available at site fully during all stages of execution of work, during recording/checking/test checking of measurements of works and whenever so required by the Engineer-in-Charge and shall also note down instructions conveyed by the Engineer-in-Charge or his designated representative(s) in the site order book and shall affix his/their signature in token of noting down the instructions and in token of acceptance of measurements/checked measurements/test checked measurements. The representative(s) shall not look after any other work other than this project. Substitutes, duly approved by Engineer-in-Charge of the work in similar manner as aforesaid shall be provided in event of absence of any of the representative(s) by more than two days.

If the Engineer-in-Charge, whose decision in this respect is final and binding on the contractor, is convinced that no such technical representative(s) is/are effectively appointed or is/are effectively attending or fulfilling the provision of this clause, a recovery (non-refundable) shall be effected from the contractor as specified in Schedule 'F' and decision of the Engineer-in-Charge as recorded in the site order book and measurement recorded checked/test checked in Measurement Books shall be final and binding on the contractor. . Further if the contractor fails to appoint suitable technical Principal technical representative and/or other technical representative(s) and if such appointed persons are not effectively present or are absent by more than two days without duly approved substitute or do not discharge their responsibilities satisfactorily, the Engineer-in-Charge shall have full powers to suspend the execution of the work until such date as suitable other technical representative(s) is/are appointed and the contractor shall be held responsible for the delay so caused to the work. The contractor shall submit a certificate of employment of the technical representative(s) (in the form of copy of Form-16 or CPF deduction issued to the Engineers employed by him) along with every on account bill/final bill and shall produce evidence if at any time so required by the Engineer-in-Charge.

(ii) The contractor shall provide and employ on the site only such technical assistants as are skilled and experienced in their respective fields and such foremen and supervisory staff as are competent to give proper supervision to the work.

The contractor shall provide and employ skilled, semiskilled and unskilled labour as is necessary for proper and timely execution of the work.

The Engineer-in-Charge shall be at liberty to object to and require the contractor to remove from the works any person who in his opinion misconducts himself, or is incompetent or negligent in the performance of his duties or whose employment is otherwise considered by the Engineer-in-Charge to be undesirable. Such person shall not be employed again at works site without the written permission of the Engineer-in-Charge and the persons so removed shall be replaced as soon as possible by competent substitutes.

CLAUSE. 37. Levy/Taxes payable by Contractor

(i) **GST**, Building and other Construction Workers Welfare Cess or any other tax, levy or Cess in respect of input for or output by this contract shall be payable by the contractor and Owner shall not entertain any claim whatsoever in this respect except as provided under Clause 38.
(ii) The contractor shall deposit royalty and obtain necessary permit for supply of the of the red bajri, stone, kankar etc. required for the project from local authorities.

If pursuant to or under any law, notification or order any royalty, cess or the like becomes payable by the Government of India and does not any time become payable by the contractor to the State Government, Local authorities in respect of any material used by the contractor in the works, then in such a case, it shall be lawful to the Owner and it will have the right and be entitled to recover the amount paid in the circumstances as aforesaid from dues of the contractor.

CLAUSE 38 Conditions for Reimbursement of levy/taxes if levied after receipt of RFPs.

a) GST, labour cess and other statutory deductions etc shall be made at source as per prevalent law. The deductions of security deposit, income tax etc shall be done after calculation of due payments and net payment shall be reduced accordingly. Copy of GST registration shall be submitted with the RFP document during its submission. All RFP/tendered/offered rates under the contract shall be inclusive of any tax, levy or cess application on last stipulated date of receipt of RFP including extension if any. No adjustment i.e. increase or decrease shall be made of any variation in the rate of GST, Building or other Construction Workers Welfare cess or any tax, levy or cess applicable on Inputs. However, effect of variation in rates of GST of Building and Other Construction Workers Welfare Cess or imposition or repeal of any other tax, levy or cess applicable on output of the works contract shall be adjusted on either side, increase or decrease. Provided further that for Buildings and Other Construction Workers Welfare Cess or any tax (other than GST), levy or cess varied or imposed after the last date of receipt of RFP including extension if any, any increase shall be reimbursed to the contractor only if the contractor necessarily and properly pays such increased amount of taxes/levies/cess. Provided further that such adjustment including GST shall not be made in the extended period of contract for

which the contractor alone is responsible for delay as determined by authority for extension of time under Clause 5 of Schedule F.

b) The Contractor shall keep necessary books of accounts and other documents for the purpose of this condition as may be necessary and required, and shall allow inspection of the same by a duly authorized representative of the Owner and/or Engineer-in-Charge and shall also furnish such other information/document as the Engineer-in-Charge may require from time to time.

c) The Contractor shall, within a period of 30 days of the imposition of any such further tax or levy or cess, give a written notice thereof to the Engineer-in-Charge that the same is given pursuant to this condition, together with all necessary information relating thereto.

CLAUSE. 39. Termination of Contract on death of contractor

This clause is deleted as the Owner cannot supply any Plant and Machinery.

CLAUSE 40. If relative working in Nalanda University then the contractor not allowed to RFP:

The contractor shall not be permitted to RFP for the work in Nalanda University where his near relative is posted as an officer in any capacity. He shall also intimate the names of persons who are working with him in any capacity or are subsequently employed by him and who are near relatives to any Officer in the Nalanda University or in the Ministry of External Affairs. Any breach of this condition by the contractor would render him liable to be rejected from participating in this or any other subsequent RFP(s).

NOTE: By the term "near relatives" is meant wife, husband, parents and grandparents, children and grandchildren, brothers and sisters, uncles, aunts and cousins and their corresponding in-laws.

CLAUSE 41. No Gazzeted Engineer to work as contractor within one year of Retirement.

No engineer of gazetted rank or other gazetted officer employed in engineering or administrative duties in an engineering department of the Government of India shall work as a contractor or employee of a contractor for a period of one year after his retirement from government service without the previous permission of Government of India in writing. This contract is liable to be cancelled if either the contractor or any of his employees is found at any time to be such a person who had not obtained the permission of Government of India as aforesaid, before submission of the RFP or engagement in the contractor's service, as the case may be.

CLAUSE 42. Return of material & recovery for excess material issued.

This Clause is deleted as the Owner is not going to supply any materials.

CLAUSE. 43. Compensation during warlike situations

The work (whether fully constructed or not) and all materials, machines, tools and plants, scaffolding, temporary buildings and other things connected therewith shall be at the risk of the contractor until the work has been delivered to the Engineer-in-Charge and a certificate from him to that effect obtained. In the event of the work or any materials properly brought to the site for incorporation in the work being damaged or destroyed in consequence of hostilities or warlike operation, the contractor shall when ordered (in writing) by the Engineer-in-Charge to remove any debris from the site, collect and properly stack or remove in store all serviceable materials salvaged from the damaged work and shall be paid at the contract rates in accordance with the provision of this agreement for the work of clearing the site of debris, stacking or removal of serviceable material and for reconstruction of all works ordered by the Engineer-in-Charge, such payments being in addition to compensation up to the value of the work originally executed before being damaged or destroyed and not paid for. In case of works damaged or destroyed but not already measured and paid for, the compensation shall be assessed by the Engineer in Charge. The contractor shall be paid for the damages/destruction suffered and for restoring the material at the rate based on analysis of rates RFP/tendered/offered for in accordance with the provision of the contract. The certificate of the Engineer-in-Charge regarding the quality and quantity of materials and the purpose for which they were collected shall be final and binding on all parties to this contract.

Provided always that no compensation shall be payable for any loss in consequence of hostilities or warlike operations (a) unless the contractor had taken all such precautions against air raid as are deemed necessary by the Engineer-in-Charge (b) for any material etc. not on the site of the work or for any tools, plant, machinery, scaffolding, temporary building and other things not intended for the work.

In the event of the contractor having to carry out reconstruction as aforesaid, he shall be allowed such extension of time for its completion as is considered reasonable by the Engineer in Charge.

CLAUSE. 44. Apprentices Act provisions to be complied with

The contractor shall comply with the provisions of the Apprentices Act, 1961 and the rules and orders issued thereunder from time to time. If he fails to do so, his failure will be a breach of the contract and the Engineer-in-Charge may, in his discretion, cancel the contract. The contractor shall also be liable for any pecuniary liability arising on account of any violation by him of the provisions of the said Act.

CLAUSE. 45. Release of Security Deposit after labour clearance

Release of Security Deposit of the work shall not be refunded till the contractor produces a clearance deposit after labour certificate from the Labour Officer. As soon as the work is virtually complete the contractor shall apply for the clearance certificate to the Labour Officer under intimation to the Engineer-in-Charge. The Engineer-in-Charge, on receipt of the said communication, shall write to the Labour Officer to intimate if any complaint is pending against the contractor in respect of the work. If no complaint is pending, on record till after 3 months after completion of the work and/or no communication is received from the Labour Officer to this effect till six months after the date of completion, it will be deemed to have received the clearance certificate and the Security Deposit will be released if otherwise due.

SECTION 5

SPECIAL CONDITIONS OF CONTRACT

General instructions:

The RFP shall be written in English language. All other information such as documents and drawings supplied by the Govt Agencies/PSUs shall also be in English language only. Drawings and design shall be dimensioned according to the metric system of measurements. RFP shall be forwarded under cover or a letter typewritten on the Govt Agencies/PSUs's letterhead and duly signed by the Govt Agencies/PSUs. Signature must be in long hand, executed in ink by a duly authorized principal/representative of the Govt Agencies/PSUs. No oral, telegraphic or telephonic RFPs or subsequent modifications there to shall be entertained. If a RFP is submitted on behalf of the firm, then all the partners shall sign the RFP or the RFP may be signed by one of the partners in whose favour all the remaining partners have given such signing partner a valid General Power of Attorney. In case of RFP submitted by a company, the person who has been authorized by the Board of Directors of the company through a resolution shall sign the RFP. Copy of power of attorney/resolution as the case may be, and the authority letter in favour of the person signing must accompany the RFP.

The Govt Agencies/PSUs shall quote the percentage above/below the total estimated cost given in Schedule of Quantities. Incomplete offer under the RFP shall be liable for rejection. Quantities shown in the Schedule of Quantities are approximate and can increase or decrease. No claim shall be entertained for any item of work due to variation in the quantities.

The RFP shall be typed or written in indelible ink and shall be signed by the Govt Agencies/PSUs or a person(s) duly authorized to sign under a valid Power of Attorney/Board Resolution on behalf of the Govt Agencies/PSUs. The person or persons signing the RFP shall initial at all pages of the RFP document and an initial shall be affixed at all such places where any insertions, corrections or amendments are made by hand.

The Govt Agencies/PSUs shall sign at the bottom right hand corner of every page of the RFP documents in token of acceptance of RFP conditions and for the purpose of identification.

The Contractor shall give his address for communication along with telephone/e-mail address and all communication made by **NU** to the said address by registered post acknowledgement due, speed post, courier or any other mode of service shall be deemed to have been effected provided that communication made by mobile, telephone or e-mail shall be followed by a written communication through courier/post. All correspondence addressed to **NU** shall be in the name of **Registrar, Nalanda University, Rajgir, Bihar.**

Submission of a RFP by a Govt Agencies/PSUs implies that he has read all the terms and conditions contained in this document and all other contract documents and has acquainted himself of the nature, scope and specifications of the Works to be executed. The Contractor shall also be deemed to have acquainted himself of the

local conditions and other factors, which might have a bearing on the execution of the Works. **NU** shall in no event be held liable for any loss/damage/harm for costs or otherwise caused to the Contractor due to such non-acquaintance.

Against the loss/damage/harm caused, **NU** shall not be liable for any act or omission of the act of the Contractor in so far as any violation of any of the aforementioned act.

Govt Agencies/PSUs have to compulsorily submit the entire RFP Contract Documents. Every Govt Agencies/PSUs shall submit all documents issued to him for the purpose of this RFP after duly filling the same in all respects. RFP Contracts, which are found to be vague, irrelevant and incomplete, shall be summarily rejected.

Unless otherwise stated, the contract shall be for the whole Work as described in the "Schedule of items of Works" and under the drawings. The Contractor shall be bound to complete the whole Work within such stipulated time as set out in the schedule of items of Works and the drawings, including such additional items as may be necessary, if any, as per drawings and instructions. On the Completion of work, inspect the work and certify The Architect Consultant shall The issuance of certificate of completion, as issued by the Engineer-in-Charge on or by the Competent Authority at Nalanda University shall be mandatory for indicating the successful completion of work and such certificate of completion will be conclusive proof of completion of Work. Such certificate shall be issued only after the inspection of work by Architects Consultants and obtaining certificate from him that work is executed as per approved design and specifications

The work to be carried out under the contract shall, except as otherwise provided in these conditions shall include all labour, materials, tools, plants, equipment, transport and royalties, taxes, labour cess etc., which may be required in preparation of the full and entire execution and completion of the Works. The descriptions given in the Schedule of Quantities shall, unless otherwise stated be held to include wastage of materials, carrying and all other labour necessary for the full and entire execution and completion of the Work as aforesaid in accordance with the specifications, good practice and recognized principles.

The Contractor shall be deemed to have satisfied itself before submission of the RFP as to the correctness and sufficiency of the RFP for the Works and of the rates and prices quoted in the Schedule of Quantities, which rates and prices shall, except as otherwise provided, cover all his obligations under the Contract and all matters and things necessary for the proper completion and maintenance of the Works. Under no circumstances shall the Contractor withdraw from the Contract once the RFP is accepted.

No cost payable for preparing RFP: The Govt Agencies/PSUs shall not be entitled to claim any costs, charges, expenses in connection with preparation and submission and subsequent clarification of its RFP in the event of withdrawal of the invitation of RFPs by **NU**.

The Contractor shall comply with the provisions of the Apprentices Act, 1961, Minimum Wages Act, 1948, Workmen's Compensation Act, 1923, Contract Labour (Regulation and Abolition) Act, 1970, Payment of Wages Act, 1936, Owner's Liability Act, 1938, Maternity Benefits Act, 1961, and the Industrial Disputes Act, 1947 as may be applicable and the rules and regulations issued there under from time to time. The list of the statutes mentioned above is an indicative list and all enactments applicable for workmen shall be complied with by the Govt Agencies/PSUs. Any failure to comply with such statutes shall amount to breach of the Contract and the Engineer-in-Charge may, at his discretion, terminate the Contract without any prior notice being furnished to the Contractor. The Contractor shall also be liable for any pecuniary liability arising on account of violation of any of the said statutes and shall indemnify and keep the NU indemnified for any loss or damage arising on account of the same.

The provisions in the RFP documents shall prevail over the contents of the above paragraphs if there is any contradiction or variation in the conditions mentioned hereinabove and those contained in the Contract Documents.

Additional Definitions

Nominated Sub-Contractor:

Nominated Sub-Contractor shall mean any person or agency appointed by NU for the execution of any particular Work or providing any services under the Contract.

Samples:

Samples are physical samples, which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

Shop drawings:

Shop drawings means those drawings or other documents which are specifically prepared by or on behalf of the Contractor to illustrate details of construction for the purpose of fabrication or installation or any other construction related works mentioned in the RFP which required by the Architect Consultants and are submitted to the Engineer In charge for the approval/suggestion/verification from Architect Consultants as the Contractor's intended method of achieving the end result required by the Contract Drawings and Specifications.

Submittals:

Submittals includes progress schedules, setting out drawings, shop drawings, testing and inspection reports, and other information required by the Contract Documents to be submitted by the Contractor for information or approval by the Engineer in Charge.

Virtual Completion:

Virtual Completion shall mean completion of the Works as per drawings and specifications to the entire satisfaction of Engineer in Charge/ Architect Consultants/ NU whose decision shall be final and binding on the parties in this regard and particularly the act of securing by the Contractor to get the virtual completion certificate from the Engineer in charge and submission of the same to the NU to start the Defect liability period of the contract.

Final Completion:

Final Completion shall mean the completion of the Works and any necessary rectification directed to be carried out during the Defects Liability Period and any extension thereof by the Contractor and securing of such final completion certificate from the Engineer in Charge/ Architect Consultants/ NU, and also obtaining the final handing over of the Works to the NU, and the acceptance of the same.

Jurisdiction of Courts: The Court at Bihar Sharif/High Court at Patna in the state of Bihar shall have the Jurisdiction to decide any dispute arising out of or in respect of the contract for this work.

CLAUSE.5.1: Sub-Contractors

Where and when the appointment of Sub-Contractors for specialized job (in the opinion of Engineer In Charge) is indicated, such Sub-Contractors shall be appointed only with the prior written approval of the Owner upon recommendation of Engineer-in-Charge/PMC/Architect Consultants on the following conditions:

a) The Contractor shall enter into written agreements with Sub-Contractors and ensure that the Sub-Contractors perform their Work in accordance with and subject to the terms and conditions of these Contract Documents. A copy of each such Agreement shall be furnished to the Engineer-in-Charge and the Owner.
b) The Contractor shall remain fully responsible to the Owner for the performance and workmanship and all actions of all sub-Contractors and persons directly or indirectly employed by them.
c) The Contractor shall supply and permit all Sub-Contractors to avail of site facilities and services to enable them to complete their Work safely and without hindrance or delay and conducive to produce the highest quality of Work required.
d) The Contractor shall upon receipt of instruction from the Engineer-in-Charge, terminate and remove from site forthwith such Sub-Contractor or their person who's Work may be considered unsatisfactory.
e) The Contractor shall make regular and prompt payment to each Sub-Contractor not later than one week after receipt of payment from Owner for their measured Works certified by the Engineer-in-Charge. If the Contractor fails to make payments to Sub-Contractors as aforesaid, the Owner may, without any obligation or prejudice to its rights and with prior intimation to the Contractor may make direct payments to Sub-Contractors for and on behalf and from the account of the Contractor and recover such sums from the account of the Contractor out of the amounts due and payable under the bills raised by the Contractor. Such direct

payments to Sub-Contractors shall be on behalf of the Contractor and shall in no way relieve the Contractor of his responsibilities or create a contractual relationship between the Owner and Sub-Contractor.

f) Any Subcontractor that has been approved by the Owner shall neither be removed nor replaced without the prior written consent of the Owner.

CLAUSE.5.2: Site office

The Contractor shall at his cost provide a watertight, air-conditioned, lockable site office Approximately 100 Smt. with necessary communication facilities at a suitable location as approved by the Engineer-in-charge for the purpose daily supervision, and supervision purpose. The site-office shall be reasonably well furnished and to the preference and tastes of the Owner along with electricity and a telephone connection, Internet Connections at no extra cost payable to the Contractor by the Owner in this regard.

CLAUSE.5.3: Reinforcement steel and structural steel

Use of Indian standard reinforcement steel and structural steel manufactured by Primary steel manufacturers only will be allowed for the work under this contract. For Non-standard steel sections, the steel manufactured by the producers other than Primary steel manufacturers shall be allowed after prior approval of Engineer – in – Charge in writing.

CLAUSE. 5.4: Electricity

The Owner shall not provide electrical power. Contractor has to arrange with necessary permission from relevant authority if any at his own cost electrical power for construction or for general lighting and other usage

The Contractor shall, at his own cost, provide approved temporary electrical connections, cables, distribution boards and related equipment for construction, as required by the Engineer-in-Charge.

The Contractor shall permit and enable all sub-Contractors to use his power & distribution facilities. The Sub-Contractor shall pay such amount for the use of power & distribution facilities as may be determined between the Contractors.

The Contractor shall, at his own cost and in order to prevent interruption of the Work(s) due to power failures, provide for stand-by diesel generators of sufficient capacity as per the requirements to supply adequate electricity for the Works and for other uses.

Disruptions in power supply, whether due to power failures, load shedding, generator breakdowns, non-availability of Electric Supply or any other reason, shall not be accepted as a valid reason for delays and deficiencies in the Work or for claims for additional payments.

The Contractor shall, at his own cost supply the required electrical power supplies to the Site offices of the Owner as directed by the Engineer-In-Charge.

CLAUSE.5.5: Fossils:

All fossils, coins, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the Site shall, as between the Owner and the Contractor, be deemed to be the absolute property of the Owner. The Contractor shall take reasonable precautions to prevent his workmen or any other persons from removing or damaging any such article or thing and shall, immediately upon discovery thereof and before removal, acquaint the Engineer of such discovery and carry out the Engineer's instructions for dealing with the same. If, by reason of such instructions, the Contractor suffers delay and/or incurs costs then the Engineer shall, after due consultation with the Owner and the Contractor, determine:

CLAUSE.5.6: Insurance

The Contractor shall at his own expense arrange for all insurance policies, including workmen compensation policy and Contractor's All Risk policy (CAR Policy) in the amount of the Contract effective from the date of commencement of Work(s) and until final completion of the Work(s) also taking into consideration the defects liability period, against all of the following risks.

a) Injuries and damage of persons, property, machinery, equipment, vehicles, animals or things, within or outside the site, arising out of his operations or of any sub-Contractors, nominated or otherwise, or out of any actions of his employees, agents or representatives, limited to Rs. 20,00,000 (Rupees Twenty Lakhs) per accident

b) Injuries to his or any Sub-Contractor's employees.

c) Damage to or loss of the property, equipment, and materials at site, of the Owner, Contractor and all Sub-Contractors, as a result of natural causes such as lightning, storm, flood, rain, fire, earthquake, explosion, landslide, etc.

d) Damage and injuries to persons, property and materials arising out of riot and civil commotion, theft, sabotage malicious acts, terrorist activities, flood, water logging etc.

The insurance policy or policies to cover risks of every nature shall be in the joint names of the Owner and Contractor, and the original of such policy/ policies shall be lodged with the Engineer-in-Charge. The Contractor shall also lodge the premium receipts with the Engineer-in-Charge, such standing jointly in the names of the Owner and the Contractor.

If the Contractor fails to arrange the requisite insurance or fails to renew the policies, the Owner shall arrange for obtaining the requisite insurance policies and or renew them and recover the cost of all premiums from the Contractor and/or subsequently deduct such amount from the payments due and payable by the Owner to the Contractor from the bills raised by the Contractor in respect of the Work(s) executed.

No certificate of payment shall be issued by the Engineer-in-Charge whether for an interim or of the final bill raised by the Contractor if the Contractor fails to arrange for total insurance cover.

The Contractor shall reinstate in a manner approved by the Engineer-in-Charge all damage of every sort caused entirely at his cost so as to deliver up to the Owner the whole of the Work(s) complete and perfect in all respects, and so certified by the Engineer-in-Charge and also make good or otherwise satisfy all claims for damage to property of third parties.

The Contractor shall be responsible for anything within his control and for all risks and consequences, which are not included in the purview of the insurance policies.

The insurance cover shall stand extended until final completion of the Works and the contract and shall also cover the defects liability period.

The Contractor undertakes not to cancel any insurance policy nor reduce its scope without the written consent of the Engineer-in-Charge.

The Contractor undertakes to file necessary insurance claims jointly with the Owner and also to join the Owner in filing any claim the Owner chooses to.

Payments against all insurance claims shall be received in the name of the Owner and commensurate adjustments shall be made in accounts with the Contractor.

The aforesaid insurance policy/policies shall not be cancelled till the Engineer-in-Charge has agreed to their cancellation.

The Contractor shall prove to the Engineer-in-Charge from time to time that it has taken out all insurance policies referred to above and has paid the necessary premium for keeping the policies alive till the end of the defects liability period.

The Contractor shall ensure that similar insurance policies are taken out by his Sub-Contractor (if any) and shall be responsible for any claims of losses to the Owner resulting from their failure to obtain adequate insurance protections in connection thereof. The Contractor shall also obtain the originals of the policies and the premium receipts from the Sub-Contractor and shall lodge the same with the Engineer-in-Charge.

CLAUSE.5.7: Good for Construction Drawings, Details and Clearance to Construct.

After the acceptance of the Letter of Intent, issued by the Owner – Nalanda University, the contractor will be issued "Good for construction" drawings for works. The contractor will arrange to mobilize his resources in very positive and judicious manner to start work on maximum possible fronts. This Execution Plan will be discussed with Project Management Consultants, Architect Consultants and NU in detail and will be finalized subject to changes, if any, and will be agreed to by all the stake holders. If the contractor fails to show reasonable progress for the works for which the drawings and details are already available, Then the Owner Nalanda University, through the Engineer In Charge, will take suitable punitive action like withholding the payments due to contractor, which is equivalent to the amount to be withheld for completion of nearest mile stone as per this Notice Inviting RFP. The withheld amount will be released as soon as the corrective action is taken by the Contractor, for making up the time lost due to delay.

CLAUSE.5.8: Protection of Persons, Works and Property

Accident or Injury to Workmen

The Owner shall not be liable for or in respect of any damages or compensation payable to any workman or other person in the employment of the Contractor or any Subcontractor, other than death or injury resulting from any act or default of the Owner, his agents or servants.

Accident Prevention:

a) General:

In performing this contract, the Contractor shall provide for protecting the lives and health of employees and other persons preventing damage to or theft or loss of property, materials, supplies, and equipment; and avoiding Work interruptions. For these purposes, the Contractor shall- Provide appropriate safety barricades, signs, and signal lights.

Comply with the standards issued by any statutory bodies having jurisdiction over occupational health and safety and Ensure that any additional measures as required by the Engineer-in-Charge for this purpose.

b) Records.

The Contractor shall maintain an accurate record of exposure data on all accidents taken place incidental to performance of Work(s) under this contract resulting in death, traumatic injury, occupational disease, or damage to or theft / loss of property, materials, supplies, or equipment. The Contractor shall report this data in the manner prescribed by the Engineer-in-Charge.

c) Sub-Contractors:

The Sub-Contractors shall be bound to comply with the clause in the same manner as complied with by the Contractor. In the event of non-compliance by the Sub-Contractor of such clause, the Contractor shall be responsible for compliance of the Sub-Contractor.

d) Written program:

Before commencing the Work, the Contractor shall submit to the Engineer-in-Charge a written proposal for implementing this clause,

Hazardous Material Identification.

a) Notification:

The Contractor shall notify the Engineer-in-Charge in writing of all hazardous material 5 days before delivery of the material. This obligation applies to all materials delivered under this contract, which will involve exposure to hazardous materials or items containing these materials.

b) Responsibility of Contractor:

Neither the requirement of this clause nor any act or failure to act by the Owner shall relieve the Contractor of any responsibility or liability for the safety of Owner, Contractor, or Sub-Contractor's personnel or property.

c) Compliance with laws:

The Contractor shall comply with applicable laws, including the Public Liability Insurance Act 1991, Fatal Accident Act 1855, codes, ordinances, and regulations (Including the obtaining of licenses and permits) in connection with hazardous materials. Contractor shall pay fees and other expenses for obtaining such permission or licenses.

d) Sub-Contractors:

The Contractor shall insert these above clauses, relating to hazardous material, with appropriate changes on entering into contracts or agreements with Sub-Contractors and the sub-contractors shall be bound and be liable to comply with the same, and in the event of non-compliance of the same, the Contractor shall be held liable for damages or otherwise on the acts of the Sub-Contractor in this regard.

Protection of Property

a) Vegetation, structures and equipment:

The Contractor shall preserve and protect all structures, equipment, and vegetation on or adjacent to the Work site, and which do not unreasonably interfere with the Work required under this contract and shall not be removed by the Contractor. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place.

b) Utilities and improvements:

The Contractor shall protect from damage and have all existing improvements and utilities at or near the Work site and on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall be liable to repair any damage caused to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the Work. If the Contractor fails or refuses to repair the damage promptly, the Engineer-in-Charge may have the necessary Work performed and charge the cost to the Contractor or reduce such amounts from the bills of the Contractor due and payable by the Owner.

c) Contractor shall be required to work within specified areas and they shall be allowed to use only those areas around the works under their scope, for storage of their materials, construction of site offices, erection of batching plant etc. at predetermined locations as shown on the plans. The area so demarcated, shall be barricaded in such a way that the construction activities or the moving vehicular traffic involved in carriage of construction materials/ construction waste etc. do not create interference with any other areas within the premises or activities of the Institute or the activities of other contractor/s working within the premises.

d) The contractor shall provide suitable barricading approximately 2.0 m high, with suitably painted with three rows of G.I. Sheets about 2'-6" to 3'- 0" wide (75 cms to 90 cms.) nailed or bolted with wooden poles spaced 2 to 3 meter apart and each pole 1.6 m to 2 m long 8 cm. to 10 cm. dia. The poles will be embedded in mobile iron pedestal rings suitably framed for giving stable support as per direction of the Engineer-in-charge. All management (including watch and ward) of barricades shall be the full responsibility of the contractor. The barricades shall be removed only after completion of the work or part of the work. The contractor's rate shall include all above items of work and nothing extra shall be paid to the contractor over and above his quoted rates.

e) The positioning of barricading will be reviewed from time to time and necessary shifting barricading as directed by Engineer - in – charges shall be done forthwith by the contractor.

f) Contractor will make his own arrangements for making temporary roads and approaches to various locations of work under their scope and up to disposal sites marked on the drawing. These internal approaches and temporary roads shall be made in such a way that they do not affect construction activities of permanent roads within the premises at any time.

Watchmen and Security

The Contractor shall provide sufficient personnel and materials to provide adequate protection to the property and personnel at the site, in transit and stored goods/materials including but not limited to measures specifically required by and under the Contract Documents and any security requirements under this contract.

Corrective Action

a) Authority to Stop Work:

The Engineer-in-Charge shall notify the Contractor of any non-compliance with the safety and property protection measures as required under this contract of which the Engineer-in-Charge becomes aware and of the corrective action required. This notice, when delivered to the Contractor or the Contractor's authorized representative at the site of the Work shall be deemed sufficient notice of non-compliance and corrective action required. After receiving the notice, the Contractor shall immediately take necessary steps to correct the action. If the Contractor fails or refuses to take corrective action promptly, the Engineer-in-Charge shall at his discretion after due consultation with the Owner may issue an order stopping all or part of the Work(s) until satisfactory corrective action has been taken. The Contractor shall not base any claim or request for equitable adjustment for additional time or money on any stop Work order issued under these circumstances.

b) Rectification:

The Contractor shall be solely responsible to make good at his cost any damage to the Works, property of the Owner and/or any adjacent property, to the satisfaction of the Engineer-in-Charge. In case the contractor fails to do so within a reasonable time the Engineer-in-Charge shall get the same executed at the risk & cost of the contractor & deduct the same from his due payments.

CLAUSE.5.9: Site Security:

The Contractor shall be deemed to be in possession of the Works site and shall be responsible for its total security, and shall ensure that all materials, sheds, equipment, plant, tools, etc.; whether his own or belonging to any Sub-Contractor, are well protected.

a) The Contractor shall at his own cost install and maintain sufficient security fences and gates and employ full time round-the-clock security personnel to prevent the Works site from and against the intrusion of the public or any other unauthorized persons or vehicles.

b) Total security of the site, property, and materials shall be the sole responsibility of the Contractor. The presence of his consultants representatives, or the NU 's security personnel shall in no way relieve or absolve the Contractor of his responsibilities in ensuring the security and protection of the site and everything stored or lying thereon

CLAUSE.5.10: Warranty/Guarantee and Defect Liability period

Warranty/Guarantee: As per the SECI/MNRE Guideline read with this RFP whichever will be maximum.

The Contractor shall be responsible for the proper performance of the Work(s), including installations and systems, as specified under the Contract Documents.

Subject to Clause the Contractor shall, at his own cost and in the shortest possible time, repair and remove any defect or deficiency in the Works, which may appear prior to or during the defect liability period, to the satisfaction of the Engineer-in-Charge.

A guarantee will be given by the Contractor for the complete installation of the Works including its functioning, replacement of parts etc. as specified under the Contract Documents.

Defect Liability period

The defect liability period will be 24 months for the project from taking over of the system by the University. However, beyond the Defect Liability Period(i.e. after completion of 24 months), if the manufacturer provides the warranty of the appliances for more than two years, in that case, the warranty/guaranty of the system will be valid as per the OEM practice and warranty of the equipment and system as mentioned in this RFP.

All the Guarantees referred above shall commence from the date of Completion Certificate.

CLAUSE.5.11: Contractor's Responsibilities and Work Control

The Contractor shall have complete control of the Works and shall effectively and diligently control, direct and supervise his employees, supervisors, subordinates and Sub-Contractor(s) so as to ensure timely completion of the Works in order and in conformity with the Contract Documents. It shall be the sole responsibility of the Contractor for construction means, methods, techniques, sequences and procedures, and for coordinating the various parts of the Work, whether carried out by the Contractor or any Sub-Contractor.

The Contractor shall provide adequate, qualified and experienced personnel for the proper superintendence and execution of the Works until completion. The category and strength of such personnel shall be determined by the Engineer-in-Charge, and such approved site organization strength shall be maintained by the Contractor at all times until completion of Work(s), and also during defects liability period and as may be decided by the Engineer-in-Charge.

The Contractor shall be responsible for the design, erection, operation, maintenance and removal of temporary structures and other facilities at his own cost during completion of the Works. Any approval sought, given or implied, regarding sufficiency, stability and safety of temporary staging and facilities, shall in any way not relieve the Contractor of his responsibility.

a) The Contractor shall study all Contract Documents and promptly report to the Engineer-in-Charge any non-conformity, discrepancy, inconsistency or omission he may discover in the same. In the event of such discovery, the Contractor shall not proceed with the affected Works until he has received due corrections and clearances from the Engineer-in-Charge.

b) The Contractor shall be deemed to have thoroughly studied and satisfied himself regarding Contract Documents and particularly all drawings before commencement of the Work(s). Should any discrepancy or error be discovered during execution of parts of the Work(s) necessitating demolition, repairs or reconstruction, all such remedial measures shall be carried out only with the approval of the Engineer-in-Charge and entirely at the cost of the Contractor. In such an event the Contractor shall neither claim any extra payment nor any extension of time for any delay caused by virtue of such demolition, repairs and reconstruction.

Any instructions given to the Contractor's supervisory staff by the Engineer-in-Charge shall be deemed to have been given to the Contractor. Instructions that involve any variations in design or specifications and which may have a bearing on time and cost shall be through a written Change Order by the Engineer-in-Charge and at rates agreed in writing prior to implementation

The Contractor shall at his own cost, obtain any permits or authorizations necessary for the execution of the Work and obtaining any permits or approvals for the works executed by him, from all concerned statutory and Owner

Authorities/Authority's, including but not limited to Municipal bodies, Electrical Authority, Fire Service Authorities etc.,

The Contractor shall not be entitled to claim additional sums on account of having to work overtime in order to complete an operation that cannot be interrupted, for working in extended shifts / night shifts /holidays.

In the event the Contractor chooses to work overtime, in extended night shifts as and by way of overtime either by working extended/night shifts or morning or holidays in order to complete the Work(s) within the specified period or on holidays, he shall do so by obtaining prior written approval from the Engineer-in-Charge at least twenty-four hours in advance. The Contractor moreover shall ensure that in any of the above circumstances he maintains the full-agreed strength of his supervisory staff.

The Contractor shall take all necessary precautions to protect the site and Works, materials, plant and equipment, whether his own or belonging to the Owner or any Sub-Contractors, against hazards of fire, rains, floods, landslides, underground water, accidents, etc.

The Contractor shall not be permitted to replace nor remove his Project Manager/Project Engineer / Site Engineer etc. from the site without the prior written approval of the Engineer-in-Charge.

Submittals

a) "Shop drawings" means those drawings or other documents, which are specifically prepared by or on behalf of the Contractor to illustrate details of construction for the purpose of fabrication or installation and are submitted to the Owner to indicate the Contractor's intended method of achieving the end result required by the Contract Drawings and Specifications.

b) "Project data" includes standard drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by the Contractor to explain in detail specific portions of the Work required by the. Contract.

c) "Samples" are physical examples, which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

d) "Other submittals" includes progress schedules, setting drawings, testing and inspection reports, and other information required by the Contract Documents to be submitted by the Contractor for information or approval by the Owner.

Schedules of Submittals

Promptly after contract award the Contractor shall submit to the Engineer-in-Charge the submittal schedule showing when shop drawings, product data or samples and other submittals required by and under the RFP Documents would be submitted for the approval of the Engineer-in-Charge.

Review and approval of submittals by Contractor

The Contractor shall co-ordinate and compiles all submittals required by and under the Contract Documents, and thoroughly check them for accuracy, completeness, and compliance in accordance with contract requirements and shall indicate his approval thereon in the form required by the Contract Documents as evidence of such co-ordination and checking. Submittals to the Engineer-in-Charge without the approval of the Contractor shall be returned by the Engineer-in-Charge for resubmission. Submission of shop drawings, product data or samples shall constitute a representation that the Contractor has agreed to, asserted and guaranteed that the assemblies, products or materials indicated therein will be available in a timely manner and in the quantities required for the project as set out under the Contract Documents.

Submission

All submittals shall be in English language, and any system of dimensions (i.e.; English or metric) shown shall be consistent with that used in the Contract Documents. The Contractor shall submit all Submittals in the form and number required by the Contract Documents within required time limits and sufficiently in advance of construction requirements to permit adequate review by the Owner for correction, approval and resubmission if required. No extension of time shall be allowed on account of any delay by the Owner in approving such submittals, if the Contractor has failed to act promptly and responsively in making his submissions. Each submittal shall be identified as required by the Contract Documents.

Action on Submittals

The Engineer-in-Charge will indicate an approval or disapproval of the Submittals for and on behalf of the Owner requiring approval by the Owner and if not approved as

submitted shall indicate the Owner's reasons thereof. Approval by the Engineer-in-Charge shall not relieve the Contractor from responsibility for any errors or omissions in his submittals, nor from responsibility for complying with the requirements of this contract, except with respect to variations described by the Contractor and approved in accordance with "Variations in Submittals" Clause. The approval of the Engineer-in-Charge on the submittals will be for general compliance with the intent of the Contract Documents and with the information given therein, and shall not be construed

a) As permitting any departure from the contract requirements

b) As relieving the Contractor of responsibilities for any error including details, dimensions, materials, etc. and

c) As approving departures from details appearing on Contract 'Drawings and Specifications.

Where approval of Submittals is required, the Contractor shall perform the Work in accordance with such approved Submittals. Any Work performed by the Contractor prior to such approval by the Engineer-in-Charge shall be at the sole risk and liability of the Contractor.

Variation in Submittals

If Submittals contain any variations from the contract requirements, other than those requested on previous submittals, the Contractor shall specifically describe such variations in writing and the reasons thereof to the Engineer-in-Charge. If the approval of any such variation affects the Contract Price or the Completion time of the Contract, the Engineer-in-Charge shall issue an appropriate Contract modification. Otherwise, the variation may be approved by the Engineer-in-Charge, only by specific reference thereto in writing. The Contractor shall not be entitled to rely on general approval of a submittal as an approval of variations of requirements of the Contractor. If the Contractor fails to describe such variations and shall not be relieved from the responsibilities of executing the Work in accordance with the contract, notwithstanding a general approval of such submittals. Nothing contained herein shall relieve the Contractor of the responsibility of notifying the Engineer-in-Charge of any part of the Contract Drawings or Specifications, which the Contractor

knows or reasonably should have known which could result in defects under construction.

Use of submittals

The Owner may duplicate, use, and disclose in any manner and for any purpose shop drawings, product data and other submittals delivered under this contract.

Placement of Orders

The Contractor shall place orders for items requiring a sample or product data submittal promptly after receiving the written approval of the submittal by the Engineer-in-Charge. No such materials or products shall be ordered or used in the Work until such written approval by the Engineer-in-Charge has been given. In the event such materials or products pre ordered or used in the Works without the written approval of the Engineer-in-Charge, the same shall be at the risks, consequences, liability and costs of the Contractor.

Use and testing of samples

a) Use:

Approved samples not destroyed in testing will be sent to Engineer-in-Charge. Those samples, which are in good condition, will be marked for identification and may be used in the Works. Materials and equipment incorporated in the Work shall match the approved samples within any specified tolerances. Other samples not destroyed in testing nor approved will be returned to the Contractor at the expense of the Contractor if so requested at the time of submission.

b) Failure of samples to pass specified tests:

Failure of any material to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make of that material or equipment which previously has proved unsatisfactory in service.

c) Taking and testing of samples:

Samples of various materials or equipment delivered on the site or in place may be taken by the Engineer-in-Charge for additional testing by the Owner outside of those found not to have met contract requirements, unless the Engineer-in-Charge determines it to be in the Owner's interest to accept the non-conforming materials or equipment with an appropriate adjustment of the Contract Price/Value as determined by the Engineer-in-Charge.

d) Cost of additional testing:

Unless otherwise specified, when additional tests are made, only one test of each set of sample proposed for use will be made at the expense of the Contractor. Samples, which do not meet contract requirements, will be rejected. Further testing of additional samples, if required, will be made at the expense and costs of the Contractor.

CLAUSE.5.12: Co-operation with other contractors/specialized agencies/sub-contractors

1) The Contractor shall take all necessary precautions to prevent any nuisance or inconvenience to the owners, tenants or occupants of the adjacent properties and to the public in general .The Contractor shall take all care, as not to damage any other adjacent property or other services running adjacent to the plot. If any damage is done, the same shall be made good by the Contractor at his own cost and to the entire satisfaction of the Engineer-in-Charge. The Contractor shall use such methodology and equipment for execution of the work, so as to cause minimum environmental pollution of any kind during execution, to have minimum execution time and minimum inconvenience to road users and to the occupants of the buildings on the adjacent plot and public in general, etc. He shall make good at his own cost and to the entire satisfaction of the Engineer in Charge any damage to roads, paths, cross drainage works or public or private property whatsoever caused, due to the execution of the work or by traffic brought thereon, by the Contractor. Further, the Contractor shall take all precautions to attendee by the environmental related restrictions imposed by Govt. of Bihar as well as prevent any pollution of streams, ravines, river bed and waterways. All waste or superfluous materials shall be transported by the Contractor, entirely to the satisfaction of the Engineer-in-Charge. Utmost care shall be taken to keep the noise level to the barest minimum so that no disturbance as far as possible is caused to the occupants / users of adjoining

buildings. No claim what so ever on account of site constraints mentioned above or any other site constraints, inadequate availability of skilled, semi-skilled or unskilled workers in the near vicinity, non-availability of machinery spare parts and any other constraints not specifically stated here, shall be entertained from the Contractor. Therefore, the Govt Agencies/PSUs are advised to visit site and get first-hand information of site constraints. Accordingly, they should quote their RFPs. Nothing extra shall be payable on this account.

2) The Contractor shall cooperate with and provide the facilities to the sub-Contractors and other agencies working at site for smooth execution of the work. The contractor shall indemnify the Owner against any claim(s) arising out of such disputes. The Contractor shall:

3) Allow use of scaffolding, toilets, sheds etc.

4) Properly co-ordinate their work with the work of other Contractors.

5) Provide control lines and benchmarks to his Sub-Contractors and the other Contractors.

6) Provide electricity and water at mutually agreed rates.

7) Provide hoist and crane facilities for lifting material at mutually agreed rates.

8) Co-ordinate with other Contractors for leaving inserts, making chases, alignment of services etc. at site.

9) Adjust work schedule and site activities in consultation with the Engineer-in-Charge and other Contractors to suit the overall schedule completion.

10) Resolve the disputes with other Contractors/ sub-contractors amicably and the Engineer-in-Charge shall not be made intermediary or arbitrator.

11) The work should be planned in a systematic manner so as to ensure proper co-ordination of various disciplines & water supply, drainage, rain water harvesting, electrical, and firefighting, information technology, communication & electronics and any other services.

12) Other agencies will also simultaneously execute and install the works of sub-station / generating sets, air-conditioning, lifts, etc. for the work and the contractor shall afford necessary facilities for the same. The contractor shall leave such recesses, holes, openings trenches etc. as may be required for such related works (for which inserts, sleeves, brackets, conduits, base plates, clamps etc. shall be

supplied free of cost by the Owner unless otherwise specifically mentioned) and the contractor shall fix the same at time of casting of concrete, stone work and brick work, if required, and nothing extra shall be payable on this account.

13) The contractor shall conduct his work, so as not to interfere with or hinder the progress or completion of the work being performed by other contractor(s) or by the Engineer-In-Charge and shall as far as possible arrange his work and shall place and dispose of the materials being used or removed so as not to interfere with the operations of other contractor or he shall arrange his work with that of the others in an acceptable and in a proper co -ordination manner and shall perform it in proper sequence to the complete satisfaction of others.

CLAUSE.5.13 : Percentage Rates

(A) The percentage rates quoted by the Contractor are deemed to be inclusive of site clearance, setting out work, profile, setting lay out on ground, establishment of reference bench mark(s), installing various signage, taking spot levels, survey with total station, construction of all safety and protection devices, compulsory use of helmet and safety shoes, and other appropriate safety gadgets by workers, imparting continuous training for all the workers, barriers, preparatory works, construction of clean, hygienic and well ventilated workers housings in sufficient numbers as per drawing supplied by Engineer in charge, working during monsoon or odd season, working beyond normal hours, working at all depths, height, lead, lift, levels and location etc. and any other unforeseen but essential incidental works required to complete this work. Nothing extra shall be payable on this account and no extension of time for completion of work shall be granted on these accounts.

(B) The rates quoted by the Govt Agencies/PSUs, shall be firm and inclusive of all taxes and levies as applicable (including works contract tax and GST as per Clause 38). Labour cess applicable as per relevant Central/State laws will be deducted from every bill of the contractor and deposited to respective Government department. TDS for Income-tax and Works Contract tax as applicable will be deducted from contractors' bills and deposited to respective Government department. The ESI and EPF contributions on the part of employer in respect of this contract shall be paid by the contractor. These contributions on the part of the employer paid by the contractor shall be reimbursed by the Engineer-in-charge to the contractor on actual basis. Effect of any tax due to new legislation shall be

adjusted accordingly as per actual on production of documentary proofs of payment of such tax to concerned Government departments.

(C) No foreign exchange shall be made available by the Owner for importing (purchase) of equipment, plants, machinery, materials of any kind or any other items required to be carried out during execution of the work. No delay and no claim of any kind shall be entertained from the Contractor, on account of variation in the foreign exchange rate.

(D) All ancillary and incidental facilities required for execution of work like labour camp, stores, fabrication yard, offices for Contractor, watch and ward, temporary ramp required to be made for working at the basement level, temporary structure for plants and machineries, water storage tanks, installation and consumption charges of temporary electricity, telephone, water etc. required for execution of the work, liaison and pursuing for obtaining various No Objection Certificates, completion certificates from local bodies etc., protection works, testing facilities / laboratory at site of work, facilities for all field tests and for taking samples etc. during execution or any other activity which is necessary (for execution of work and as directed by Engineer-in-Charge), shall be deemed to be included in rates quoted by the Contractor, for various items in the schedule of quantities. Nothing extra shall be payable on these accounts. Before start of the work, the Contractor shall submit to the Engineer-in-Charge, a site / construction yard layout, specifying areas for construction, site office, positioning of machinery, material yard, cement and other storage, steel fabrication yard, site laboratory, water tank, etc.

(E) For completing the work in time, the Contractor might be required to work in two or more shifts (including night shifts). No claim whatsoever shall be entertained on this account, not with-standing the fact that the Contractor may have to pay extra amounts for any reason, to the laborers and other staff engaged directly or indirectly on the work according to the provisions of the labour and other statutory bodies regulations and the agreement entered upon by the Contractor with them.

(F) All material shall only be brought at site as per program finalized with the Engineer-in-Charge. Any pre-delivery of the material not required for immediate consumption shall not be accepted and thus not paid for.

(G) Rate shall including of Liaison work required, if any, in this regard with the local bodies. Nothing extra shall be payable on this account. Statutory charges, fees etc. required to be paid to the local bodies in this connection shall only be

payable by the Owner or shall be reimbursable to the contractor on production of proof of actual payment made by him.

(H) It is clarified that the contractor shall be responsible for obtaining all No-objection certificate (NOCs) and relevant licenses for services like lift installation, electrical installation, fire installation and like. Nothing extra shall be payable on this account.

CLAUSE.5.15 : Inspection and rectification of Works

Access:

The Owner and their authorized agents and representatives shall at all times have access to the site and other locations where parts of the Work are under preparation.

Contractor tests:

The Contractor shall notify the Engineer-in-Charge well in advance, of tests and inspections to be carried out, and shall obtain his written approval wherever so stipulated before proceeding with the Works.

Inspections:

The Contractor shall maintain an adequate inspection system and perform such inspections from time to time as will ensure that the Work called for by this contract conforms to contract requirements and does not result in any deviation. The Contractor shall maintain complete inspection records and make them available to the Owner. All Work shall be conducted under the general direction of the Contractor and is subject to Owner's inspection and test at all places and at all reasonable times before final completion and acceptance with a view to ensure strict compliance with the terms and conditions of the contract.

Owner's inspections and tests:

Inspections and tests conducted by or on behalf of the Owner are for the sole benefit of the Owner and do not: -

(A) Relieve the Contractor of responsibility for providing adequate quality control measures,

(B) Relieve the Contractor of responsibility for damage to or loss of the material before final completion and acceptance of the Work;

(C) Constitute or imply acceptance. Or.

(D) Affect the continuing rights of the Owner after acceptance of completed Work.

Owner inspectors:

The presence or absence of an Owner's inspector does not relieve the Contractor from any of the obligations under the contract nor is the inspector authorized to change any term or condition of the contract.

Performance of inspections and tests:

The Contractor shall promptly furnish, without an additional charge all facilities, labour, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by the Engineer-in-Charge as per the terms of the Contract. The Owner may charge to the Contractor any additional cost of inspection or testing when work is not ready at the time specified by the Contractor for inspection or testing, when prior rejection makes re inspection or retesting necessary. The Owner shall perform all its inspections and tests in a manner that will not unnecessarily delay the work. Special, full size, and performance tests shall be performed as described in the Contract Documents.

The Contractor shall be solely responsible for the protection of all finished surfaces and Works so as to avoid any repairs and shall deliver to the Owner upon final completion the Works free of any blemish, defect or damage.

(E) In addition to the provisions of relevant clauses of the contract, the work shall also be open to inspection by the other agency as and when required by NU in addition of the Engineer-in-charge and his authorized representative. The contractor shall at times during the usual working hours and at all times at which reasonable notices of the intention of the Engineer-in-charge to visit the works shall have been given to the contractor, either himself be present to receive the orders and instructions or have a responsible representative duly accredited in writing, to be present for that purpose.

(F) Inspection of the work by Architect Consultants appointed by the NU.

(i)The Architect Consultants appointed by NU shall be inspecting the works frequently to ensure that the works are in general being executed according to the design, drawings and specifications laid down in the contract.

(ii)The Architect Consultants appointed by NU shall certify on completion of particular building that it has been constructed according to the approved drawings design and specifications.

CLAUSE.5.15 : Rejected Work

The Architect Consultants and/or Engineer-in-Charge/or Owner/PMC shall be authorized to reject any Work, which in their/his opinion is not in conformity to the specifications set out in the Contract Documents. The decision of the Architect Consultants /Engineer-in-Charge in this regard shall be final and binding on the Contractor.

Defective Work whether caused due to poor workmanship, use of sub-standard materials, or on account of damage or for any other reason whatsoever, whether caused by the Contractor and/or the Sub-Contractor may be rejected by the Architect Consultants/Engineer-in-Charge and shall be demolished by the Contractor and removed promptly from the site and replaced or re-executed expeditiously by the Contractor at his own cost. The Owner, Architect Consultants and the Engineer-in-Charge shall in no event be responsible to bear any costs/liability arising on account of such defective workmanship.

If in the opinion of the Engineer-in-Charge/ Architect Consultants, it is not expedient nor feasible to correct the defective Work, the Owner shall be entitled to deduct from monies due to the Contractor, the difference in value between the executed Work and that required under the Contract, such amount of which shall be determined by the Engineer-in-Charge in due consultation with the Owner.

Clause.5.16 : On Account Payment of Interim Bills

The following percentage of contract rates for the various items included in the contract shall be payable against the stage of work shown herein.

SR N	Stage of Work	PV panels & Equipment	All other Items
1)	Approval of design, Technical datasheet, GA & others drawings. This including vetting from the Consultants and/or SECI/NISE any others as per the direction of the Engineer In Charge.	2.5 %	2.5 %
2)	After initial inspection (Wherever specified) & delivery at site in good condition on pro rata basis	72.5 %	72.5 %

3)	On completion of Pro-rata Installation	10%	15%
4)	On commissioning and completion (Pro-rata completion may also be considered if owner intend as pe the site requirement.	10%	5%
5)	On completion of Successful running of 3 months for the beneficial use of the system.	5%	5%

The Owner shall release 75% of the value of the interim bill submitted by the contractor immediately on adhoc basis on preliminary scrutiny of the bill by Engineer-in-charge. Such adhoc payment shall be regarded as the advance payments against the submitted bill. The balance amount shall be released within 15 (Fifteen) working days after the verification in detail by the Engineer-in-charge and getting certification for the quality of the Work(s) from the **Architect Consultants** and **Project Management Consultants (PMC)** or as per the approved SOPs for which the Contractor shall provide assistance to the Engineer-in-charge in accordance with their direction. All payment will be subject to statutory or permissible deductions to be made by the Owner prior to the release of the amount to the Contractor.

Each bill shall be accompanied by the following documents.

Measurements and quantities of items of Work done since last bill.

Physical Progress Report along with relevant Photographs.

Copies of quality control tests in specified format covering the Work done since last bill.

Copies of Material Bills for equipment's and items procured at site after initial inspecting and approval from Engineer In Charge.

Copies of instructions recorded in the site instruction book containing the instructions and compliance made thereof, covering the Work done since last bill.

Clause.5.17: Payment of Final Bill

On the intimation to the Engineer-in-charge by the contractor for the completion of the work, the Engineer-in-charge shall arrange for the inspection of works by his representative, PMC and the Architect Consultants. Upon the inspection of works Engineer-in-charge will hand over a list showing the defects in works, if there are any, to the contractor. The final Bill shall not be paid till all such defects are not rectified to the entire satisfaction of the Engineer-in-charge.

The final bill shall be accompanied by:

All-technical documents on the basis of which the Work was carried out.

1. As-built drawings. Three sets of construction and installation drawings for all Works, and Site development, showing therein modifications, corrections and additions signed and confirmed by the Engineer-in-Charge to be "as built" drawings. The entire documentation shall be submitted in Compact Discs (CD), using latest version of AUTOCAD software.

2. Completion certificates for embedded and covered-up Works issued by the Engineer-in-Charge.

3. Certificates for tests carried out for various items of Work.

4. Manufacture's operating and maintenance manuals as well as guarantee/warrantee papers, commissioning and handing over reports for whatever equipment/Materials installed.

5. Security Deposit of 2.5% (Two Decimal Five per cent) of the Contract Value in the form of bank guarantee valid for a Defect liability period from the date of certificate.

6. Performance Guarantee of 10 % (Ten percent) of the Contract Value of comprehensive O&M amount in the form of Deposit at Call receipt of any scheduled bank/Bankers Cheque of any scheduled bank/Demand Draft of any scheduled bank or Government Securities or Fixed Deposit Receipts or Guarantee Bonds of any Scheduled Bank or Nationalised Bank of India under RBI, valid up to entire DLP & O&M period."

CLAUSE.5.18 : Limit of price Adjustment

Provided that, in determining all such price adjustment in accordance with the aforesaid sub-clauses:

(a) No account will be taken of any amount by which any cost incurred by the contractor has been increased by default or negligence of the contractor.

(b) If the contractor fails to complete the work within time for completion, increase or decrease of cost of specified materials shall be made using either the indices or prices relating to prescribed time for completion, or the current indices or prices, relating to prescribed time for completion, or the current indices or prices, whichever is more favourable to the Owner, provided that if an extension of time is granted, the above position shall apply to the adjustment made after expiry of such extension of time.

(c) On completion of the works and before final payment the contractor shall give a certificate that he has made full and complete disclosure to the Engineer-in-Charge of every increase or decrease in price obtained by him on materials affected by this clause.

CLAUSE.5.19 : Exemption from price Adjustment

The following items shall not be included in the price adjustment calculation:

(A) Liquidated damages:

(B) Retention withheld and released:

(C) Advance payments in the form of loans and their repayments:

(D) The value of any additional or varied work valued at current prices:

CLAUSE.5.20: Specifications

This ON-GRID PV Power Project is recognised and registered under CPSU (Tranche-II) Phase-II Scheme being run by the "Solar Energy Corporation of India Limited under Ministry of New and Renewable Energy, Govt of India", and hence the Govt Agencies/PSUs has to mandatorily comply the technical requirement published under the CPCU scheme. In addition, to the mandate of the CPCU scheme and SECI requirement, the published technical specification herewith by the university shall be followed as per the design confirmation after issuance of the contract award. The successful Govt Agencies/PSUs will be bound to support the stage confirmations, information required to the SECI in future (if any) related to the project with any delay. The minimum technical requirement of the SECI guidelines must be fulfilled, however, in addition of the CPCU scheme, the Technical requirement published with this RFP under Technical requirement read with SLD, Drawings and BOQ to be followed.

In the case of any class of work for which there is no such specifications as referred to in detailed specification, such work shall be carried out in accordance with the Bureau of Indian Standards Specifications. In case there are no such specifications in Bureau of Indian Standards, the work shall be carried out as per manufacturers' specifications, if not available then as per C.P.W.D. /District/ state P.W.D. / Specifications. In case there are no such specifications as required above, the work shall be carried out in all respects in accordance with the instructions and requirements of the Engineer-in-Charge. Specifications for a type of work are not covered by the detailed specifications/State P.W.D. specifications/I.S.I specifications or particular specifications, the same shall be decided by the engineer-in-charge and shall be binding on the contractor.

The engineer-in-charge shall have the power to insist upon the contractor to purchase and use such materials of particular approved make which may in this opinion be necessary for proper and reasonable compliance with the specifications and execution of work.

In the event of any variation/discrepancy in the drawings, specification and RFP documents, the decision of the Engineer In charge shall be final, binding and conclusive on the contractor.

(A) As required by the Engineer-in-charge, the contractor shall provide all facilities at site or at manufactures work or an approved laboratory for testing of materials and/or workmanship, all the expenditure in respect of this shall be borne by the contractor unless specified otherwise in the contract. The contractor shall when required to do so by the engineer-in-charge submit that the materials have been tested in accordance with requirements of the specifications.

(B) Neither the confirmation by the engineer-in-charge not to test the materials nor the production of manufacturer(s) certificate etc. as aforesaid shall affect the right of the engineer-in-charge to reject, after delivery; the materials found not in accordance with the specifications.

CLAUSE.5.21: Contractor shall submit fabrication/ shop drawings for obtaining approval

The contractor shall submit fabrication drawing based on GA drawings and design parameters given by the Architect Consultants, in triplicate for obtaining preliminary approval of the Engineer-in-Charge for all design drawing. One copy of this drawing duly corrected and signed wherever necessary by Architect Consultants will be returned to the contractor for preparing and resubmitting drawing after incorporating the said corrections again in triplicate for final approval. Along with the completion and approval of each drawing the contractor shall also submit the materials list for checking and approval to the Engineer-in-charge. No drawing shall be approved finally without material list. Once the drawing, if finally approved no request for any alternative section will be entertained. The contractor shall submit to Engineer in Charge 6 copies of all approved drawings out of which 3 copies will be issued back to the contractor for the execution of work. The contractor shall also submit copies

of design calculations. Approval of shop drawings however will not absolve the contractor of his responsibility for the safety and correctness of the fabrication.

CLAUSE.5.23: Quality Assurance

(A) The proposed project is a prestigious project and quality of work is of paramount importance. Contractor shall have to engage well-experienced skilled labour and deploy modern T & P and other equipment to execute the work.

(B) The contractor shall ensure quality construction in a planned and time bound manner. Any sub-standard material / work beyond set out tolerance limit shall be summarily rejected by the Engineer-in-charge & contractor shall be bound to replace / remove such sub-standard / defective work immediately. If any material, even though approved by Engineer-In-Charge is found defective or not conforming to specifications shall be replaced / removed by the contractor at his own risk & cost.

In addition to the supervision of work by project management consultants, the Architect Consultants appointed by the NU shall also be carrying out regular and periodic inspection of the on-going activities in the work and deficiencies, shortcomings, inferior workmanship pointed out by them shall be communicated by engineer in charge to the contractor. Upon receipt of instructions from Engineer in Charge these are also to be made good by necessary improvement, rectification, replacement up to his complete satisfaction. Special attention shall be paid towards line and level of internal and external finishing, water tight pipe linings, etc. to achieve an Institution of International standards and up keeping of quality assurance shall be of paramount importance, as such.

(C) The Contractor shall submit, within 20 days after the date of award of work, a detailed and complete method statement for the execution, testing and Quality Assurance, of such items of works, as directed by the Engineer-in-Charge. All the materials to be used in the work, to give the finished work complete in all respects, shall comply with the requirements of the Specifications and shall pass all the tests required as per specifications as applicable or such specifications / standards as directed by the Engineer-in-Charge. However, keeping the Quality Assurance in mind, the Contractor shall submit, on request from the Engineer-in-Charge, his own Quality Assurance procedures for basic materials and such items, to be followed during the execution of the work, for approval of the Engineer-in-Charge.

(D) The Contractor shall procure and provide all the materials from the manufacturers / suppliers as per the list attached with the RFP documents, as per the item description and particular specifications for the work. The equivalent brand for any item shall be permitted to be used in the work, only when the specified make is not available. This is, however, subject to documentary evidence produced by the contactor for non-availability of the brand specified and also subject to independent verification by the Engineer-in-Charge. In exceptional cases, where such approval is required, the decision of Engineer-in-Charge as regards equivalent make of the material shall be final and binding on the Contractor. No claim, whatsoever, of any kind shall be entertained from the Contractor on this account. Nothing extra shall be payable on this account. Also, the material shall be procured only after written approval of the Engineer-in-Charge. All materials shall be got checked by the Engineer-in-Charge or his authorized supervisory staff on receipt of the same at site before use.

(E) The tests, as necessary, shall be conducted in the laboratory approved by the Engineer–in- Charge. The samples shall be taken for carrying out all or any of the tests stipulated in the particular specifications and as directed by the Engineer-in-Charge or his authorized representative.

(F) The Contractor shall at his own risk and cost make all arrangements and shall provide all such facilities including material and labour, the Engineer-in-Charge may require for collecting, preparing, forwarding the required number of samples for testing as per the frequency of test stipulated in the contract specifications or as considered necessary by the engineer-in-Charge, at such time and to such places, as directed by the Engineer-in- Charge. Nothing extra shall be payable for the above.

(G) The Contractor or his authorized representative shall associate in collection, preparation, forwarding and testing of such samples. In case he or his authorized representative is not present or does not associate him, the result of such tests and consequences thereon shall be binding on the Contractor. The Contractor or his authorized representative shall remain in contact with the Engineer-in–Charge or his authorized representative associated for all such operations. No claim of payment or claim of any other kind, whatsoever, shall be entertained from the Contractor.

(H) The contractor shall give performance test of the entire installation(s) as per the standing specifications before the work is finally accepted and nothing extra whatsoever shall be payable to the contractor for the test.

(I) The Contractor shall maintain all the work in good condition till the completion of entire work. The Contractor shall be responsible for and shall make good, all damages and repairs, rendered necessary due to fire, rain, traffic, floods or any other causes. The Engineer-in- Charge shall not be responsible for any claims for injuries to person/workmen or for structural damage to property happening from any neglect, default, want of proper care or misconduct on the part of the Contractor or of any other of his representatives, in his employment during the execution of the work. The compensation, if any, shall be paid directly to the Department / authority / persons concerned, by the Contractor at his own cost.

CLAUSE.5.24: Special Conditions – SOLAR FARM.

1. GENERAL

1.1. Special Conditions of Contract shall be read in Conjunction with the General conditions of Contract, specification of work, Drawings and any other documents forming part of this Contract wherever the context so requires.

1.2. Notwithstanding the sub-division of the documents into these separate sections and volumes, every part of each shall be deemed to be supplementary to and complementary of every other part and shall be read with and into the Contract so far as it may be practicable to do so.

1.3. Where any portion of the General Condition of Contract is repugnant to or at variance with any provisions of the Special Conditions of Contract, unless a different intention appears, the provisions of the special Conditions of Contract shall be deemed to over-ride the provisions of the General Conditions of Contract and shall to the extent of such repugnancy, or variations, prevail.

1.4. Wherever it is mentioned in the specifications that the Contractor shall perform certain work or provide certain facilities, it is understood that the Contractor shall do so at his cost and the value of contract shall be deemed to have included cost of such performance and provisions, so mentioned.

1.5. The materials, design, and workmanship shall satisfy the relevant Indian Standards, SECI-CPCU scheme under, MNRE, NISE, IEC, all standard mentioned in technical sections and CPWD specifications, the Job Specifications contained herein and Codes referred to. Where the job specification stipulate requirements in addition to those contained in the standard codes and specifications, these additional requirements shall also be satisfied.

1.6. It will be the Contractor's responsibility to bring to the notice of Engineer-in-Charge any irreconcilable conflict in the contract documents before starting the work (s) or making the supply with reference which the conflict exists.

1.7. In the absence of any Specifications covering any material, design of work (s) the same shall be performed / supplies / executed in accordance with Standard Engineering Practice as per the instructions / directions of the Engineer-in-Charge, which will be binding on the Contractor.

1.8. Drawings:
The Drawings, which may be issued with RFPs, are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. The architectural/interiors drawings and details shall be examined for exact location of equipment's and cutouts.
The contractor shall follow the GFC drawings in preparation of his shop drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed. Maximum headroom and space conditions shall be maintained at all points. Where headroom appears inadequate, the contractor shall notify the Architect/Consultant/Owner's site representative before proceeding with the installation. In case installation is carried out without notifying, the work shall be rejected and contractor shall rectify the same at his own cost.

The contractor shall examine all architectural, structural, plumbing, HVAC and other services drawings and check the as-built works before starting the work and report to the Owner's site representative any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Architect/Consultant/Owner's site representative without additional cost to the Owner.

1.9. Samples and Catalogues:
Before ordering/procurement of the material necessary for these installations, the contractor shall submit to the Engineer In charge/Consultants for approval of catalogues with their dimensional details. All equipment cut sheets along with required technical data shall be submitted for approval.

1.10. The installation shall be in conformity with the Byelaws, Regulations and Standards of the local authorities concerned, in so far as these become applicable to the installation. But if these Specifications and Drawings call for a higher standard of materials and / or workmanship than those required by any of the above regulations and standards, then these Specifications and Drawings shall take precedence over the said regulations and standards. However, if the Drawings and specifications

require something, which violates the Bye-laws and Regulations, then the Byelaws and Regulations shall govern the requirement of this installation.

1.11. Equipment Receipt Checklists:
On arrival of any Equipment's on site, Contractor has to inform Engineer In charge well in time and has to submit a material Inspection report stating the physical inspection and technical data. The report should be signed and documented as a part of project documents.

1.12. All works will have to be done in close co-ordination with all other disciplines like Civil, Plumbing, HVAC & Electrical service to avoid infringement with any of the MEP associated works.

1.13. Tools, Tackles, Equipment's & Scaffolding:
All tools, tackles & equipment necessary for installation and testing shall be provided by the contractor. The quoted rates shall take into account for providing any such equipment, which may not form part of the installation, but are necessary for the execution of the job. Contractor shall be responsible to make his own arrangement to provide scaffolding / supports etc., necessary for his work.

1.14. Manufacturers:
Where manufacturers have furnished specific instructions relating to the materials used in this job, covering points not specifically mentioned in these documents, these instructions should be followed in all cases.
Where manufacturer's names and/or catalogue numbers are given, this is an indication of the quality, standards and performance required.
For items not covered under the List of Approved Makes', contractor shall offer items of first class quality, standards and performance and obtain the approval of Engineer In charge/Consultants before procuring them.
Where interfacing occurs, equipment shall be mutually compatible in all respects.

1.15. Rating:
Rating of all items shall be appropriate for the conditions on the particular site on which the item will be used. All the equipment shall be fit for continuous work under the most severe weather conditions of site.

1.16. Codes and Standards
Any other codes or standards which are required but not mentioned in the technical specs should be considered as per the latest Indian standards & international standard.

1.17. Technical Data
All technical data to be filled by the Govt Agencies/PSUs in Technical specs shall be accepted in metric system or after the approval from Consultant/ Engineer In charge only. Any Govt Agencies/PSUs submitting the technical data in any other unit would render his bid liable for rejection. The technical data should be typed in capitals only.

1.18. Bye-laws and Regulations

The installation shall be in conformity with the Bye Laws, regulation and standards of the local authorities concerned in so far as these become applicable to the installation. But if these specifications and drawings call for a higher standard of materials and /or workmanship than those required by any of the above regulations and standards, than these specifications and drawings shall take precedence over the said regulation and standards. However, if the drawings and specifications require something which violates the Bye-laws and regulations, then the bye laws and regulations shall govern the requirements of this installation.

2. SCOPE OF WORK

The general character and the scope of work to be carried out under this contract is illustrated in the RFP document. Being a DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING contract, the contractor has to design the complete system and submit for approval and once the design is approved, further procurement and execution work can be done by the contractor. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Owner's site representative. The contractor shall furnish all labour, materials and equipment (except those to be supplied by the owner) as as required for the work to complete the scope as listed in this document. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract. The system shall be designed by various methodology mentioned under this RFP read with TS for its efficiency and performances parameters and the most efficient mythology will be adopted/approved.

3. NET MINIMUM GUARANTEED GENERATION (NMGG)

3.1 Provided, in case of grid outage or inability of NALANDA UNIVERISTY to evacuate power shall be excluded from NMGG. The evacuation loss during such instance shall be based on the average generation of the previous week, calculated for each hour on pro-rata basis.

3.2 The Govt Agencies/PSUs shall submit detailed solar PV analysis for the proposed location, indicating achievement of NMGG.

3.3 The Successful Govt Agencies/PSUs shall submit a DPR having following details / index heads for approval from client & NISE team.

1. Disclaimer
2. ABBREVIATIONS
3. Scope of work

3.1 Other Requirements:

3.2 Special Conditions of Contract (SCC) as per the RFP

3.3 Payment terms: As per the RFP.

3.4 Payment schedule to the contractor: As per the RFP.

3.5 Time of Completion: Confirming to the RFP

3.6 Price Reduction Schedule (PRS) : Confirming to the RFP

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16.4 Potential of REC in India up to 2020

16.5 Business Models under the REC Mechanism

16.6 Risk Factors of REC

17. Graphs and pictures/tables

3.4 The Govt Agencies/PSUs shall quote after considering proposed configuration and all local conditions, solar insolation, wind speed and direction, air temperature & relative humidity, barometric pressure, rainfall, sunshine duration, grid availability and grid related all other factors and losses due to near shading, incidence angle modifier, irradiance level, temperature loss array loss, Module quality loss, Module array mismatch loss, and various inverter losses etc. To assess/ verify feasibility of quoted NMGG, Govt Agencies/PSUs are required to provide computation documents along with considered factors base on which NMGG has been computed.

3.5 Govt Agencies/PSUs are expected to make their own study of solar profile and other related parameters of the proposed site and make sound commercial judgment about energy generated. The site information and solar data provided in this bid document are only for information purpose.

No claim or compensation shall be entertained on account of this information. It shall be the responsibility of the Govt Agencies/PSUs to access the corresponding solar insolation values and related factors of solar plant along with expected grid availability. The Govt Agencies/PSUs should access all related factors about the selected site for the project and then quote the NMGG for the proposed project.

3.6 The contractor has to maintain the Solar Plant equipment's including its repair, replacement etc. at his own cost, so as to achieve the agreed NMGG.

3.7 There will be no relaxation in NMGG. However, the Govt Agencies/PSUs will be allowed to relocate the solar modules and install at different places within the site area at their own cost ensuring guaranteed net minimum generation. The entire cost including dismantling and re-erection, etc., will be borne by the Govt Agencies/PSUs. The contractor may also go for manual or automatic tracking modules to meet the NMGG. To ensure NMGG, the Govt Agencies/PSUs will be allowed to erect additional number of solar modules or increase capacity of the modules without extra cost to NALANDA UNIVERISTY.

4. GUARANTEE AND WARRANTEE

4.1 The mechanical structures, electrical works including power conditioners/ inverters/ charge controllers/ maximum power point tracker RFPs/distribution boards/digital meters/ switchgear/ storage batteries, etc. and overall workmanship of the SPV power plants/ systems must be warranted against any manufacturing/ design/ installation defects for a minimum period of 2 years. Further, PV modules used in solar power plants/ systems must be warranted for their output peak watt capacity, which should not be less than 90% at the end of 10 years and 80% at the end of 25 years.

4.2☐ PV modules used in Grid (including Mini & Micro Grid) Connected solar power plants must be warranted for peak output wattage, which should not be less than 90% at the end of 10 years and 80% at the end of 25 years.

4.3☐ The modules shall be warranted for at least 10 years for failures due to material defects/ any hot spots and workmanship.

4.4☐ The mechanical structures, electrical works and overall workmanship of the grid solar power plants must be warranted for a minimum of 5 years.

4.5☐ The Inverters/ PCUs installed in the solar power plant must have a warranty for 5 years.

4.6 The Govt Agencies/PSUs may also provide additional information about the system and conditions of guarantee as necessary.

4.7 Govt Agencies/PSUs shall without prejudice to any other clauses of the order repair / restore the defective parts and restore the system to satisfactory working / performance within seven (7) days of intimation of fault without any additional cost to NALANDA UNIVERISTY within the period of warrantee.

4.8 In case the supplier fails to rectify / replace the defective / damage equipment including transit damages, shortage within seven (7) days from the date of intimation of such shortage / damages, they shall have to pay penalty to the beneficiary as the deficit in NMGG.

5. Maintenance and Service

5.1 NALANDA UNIVERISTY attaches great importance to Maintenance of the systems. It may be carefully noted that Maintenance of SPV Systems includes maintenance of all items including all accessories. In case of defects during guarantee / warranty period, the contractor shall be responsible for repairs / replacement of defective part/ module free of cost and to ensure that SPV modules perform satisfactorily for the warranted period.

5.2 The maintenance service provided shall ensure proper functioning of the system as a whole. All preventive / routine maintenance and breakdown / corrective maintenance required for ensuring maximum uptime shall have to be provided by the Govt Agencies/PSUs. Accordingly, this shall have two distinct components as described below:

i) Preventive / Routine Maintenance

This shall be done by the company at least once in three (3) months and shall include activities such as, cleaning and checking the health of the SPV system, cleaning of module surface, tightening of all electrical connections, changing of tilt angle of the module mounting structure, and any other activity that may be required for proper functioning of SPV system as a whole.

ii) Breakdown / Corrective Maintenance

Whenever a complaint is lodged by the user, the same shall be attended within 24 hours in case of minor complaint. Major complaints have to be rectified within the period of seven (7) days. The system breakdown shall be corrected within a period of not exceeding seven (7) days from the date of complaint. If more than seven (7) days are taken after registration of the complaint, then Successful Govt Agencies/PSUs has pay to NALANDA UNIVERISTY penalty not less than 120% of the cost towards lost average energy during that period at CERC approved rate.

6. Delivery, Packing, Storage and Insurance

6.1 Obligation of delivering required material at the site shall be responsibility of the Selected Govt Agencies/PSUs.

6.2 In case of failure to deliver in full the required supplies on order, NALANDA UNIVERISTY shall have the right to make risk purchase at the cost of supplier or/and cancel the contract and claim reasonable compensation / damages. The contract of the supply shall be repudiated if the supplies are not made within the prescribed period and the satisfaction of the purchasing officer.

6.3 The Supplier shall provide such packing of the Goods as is required to prevent their damage or deterioration during transit to their final destination should and conform to the relevant ISS for transportation direct to destination. All crates shall be marked with proper signs indicating up and down sides of the packing and also unpacking instructions considered necessary by the suppliers. During transit, the packing shall be sufficient to withstand, without limitation, rough handling and exposure to extreme temperatures, salt and precipitation, and open storage. Packing case size and weights shall take into consideration, where appropriate, the remoteness of the final destination of the Goods and the absence of heavy handling facilities at all points in transit. NALANDA UNIVERISTY shall not be responsible in any manner for any loss or damage caused to the Goods during Transit. The quoted price shall be deemed to include the cost of packing.

6.4 Material received at site should be stored in premises and contractor shall be responsible for safety of material stored which shall be adequately insured. Insurance charges shall be borne by the Contractor.

6.5 The Goods supplied under the Contract shall be fully insured by the Supplier against loss or damage incidental to manufacture or acquisition, transportation, storage, and delivery.

7. Confidentiality

7.1 Information relating to the examination, evaluation, comparison and recommendation of contract award, shall not be disclosed to Govt Agencies/PSUs or any other persons not officially concerned with such process. Any attempt by a Govt Agencies/PSUs to influence NALANDA UNIVERISTY in the examination, evaluation, comparison, and post qualification of the Bids or Contract award decisions may result in the rejection of its Bid.

8. Inspections and Tests

8.1 The Supplier shall at its own expense and at no cost to NALANDA UNIVERISTY carry out all such tests and/or inspections of to ensure that the Goods and Related Services are complying with the functional parameters, codes and standards specified in the RFP Documents, to the satisfaction of NALANDA UNIVERISTY.

8.2 The inspections and tests may be conducted on the premises of NALANDA UNIVERISTY. In case test facility is available only at Supplier premises, the same shall be carried out at the Supplier end in presence of the representative of NALANDA UNIVERISTY.

8.3 Whenever the Supplier is ready to carry out any such test and inspection, it shall give a reasonable advance notice, including the place and time, to NALANDA UNIVERISTY.

8.4 NALANDA UNIVERISTY may require the Supplier to carry out any test and/or inspection to verify that the characteristics and performance of the

Goods or Related Services comply with the technical specifications, codes and standards under the Contract.

8.5 The Supplier shall provide NALANDA UNIVERISTY with a report of the results of any such test and/or inspection.

8.6 NALANDA UNIVERISTY may reject any Goods / Related Services or any part thereof that fail to pass any test and/or inspection or do not conform to the specifications. The Supplier shall either rectify or replace such rejected Goods/ Related Services or parts thereof or make alterations necessary to meet the specifications at no cost to NALANDA UNIVERISTY, and shall repeat the test and/or inspection, at no cost to NALANDA UNIVERISTY, upon giving a notice.

8.7 The Supplier agrees that neither the execution of a test and/or inspection of the Goods / Related Services or any part thereof, nor the attendance by NALANDA UNIVERISTY or its representative, nor the issue of any report, shall release the Supplier from any warranties or other obligations under the Contract.

GUARANTEED TECHNICAL PARTICULARS

Technical Specification

Sr. No.	Component with all hard ware and software for 5MW AC & 6.5MW DC	Technical details after award of the LOA
1	Solar PV Cell	
2	Solar PV Module	
3	Inverter	
4	Foundations	
5	String Monitoring Box	
6	Weather Module with SCADA & Monitoring Stations	
7		

9. ASSOCIATED CIVIL WORKS

All the civil works like foundation, grouting and fixing, and associated with the solar works are included in the Contractor's scope of work, like wall chasing by wall chaser, making holes etc. for installation of piping/ducting and making good. These shall be executed in accordance with approved shop drawings of the contractor. The minor civil works & structure support for cable trays etc shall be inclusive in the scope till Main LT.

No extra payment / claim shall be made on this account.

10. CO-ORDINATION WITH OTHER WORKS

The Contractor during the execution of the Works shall co-ordinate with other Works, and other Agencies associated with the Project and shall

work in harmony with them without causing any hindrance or obstruction or impeding the progress of their work in any way. Shafts/cut-outs (sizes) confirmation that specified can be accommodated within the available size of shafts etc.

In respect of the work of other Services and Agencies, where the commencement or progress of such work of any other Service, or Agency is dependent upon the completion of particular portions of the Contractor's Works or generally upon the Contractor maintaining progress in accordance with the approved co-ordinate construction programmed, it shall be the responsibility of the Contractor to complete such portions and maintain such progress.

Should any differences arise between the Contractor and the other Works, and Agencies, these shall immediately be brought to the attention of the Construction Manager/Consultants who after reviewing the matters causing the differences will give his decision which shall be final and binding on the Contractor.

11. CO-ORDINATION WITH MEP ELECTRICAL, & PHE WORKS

To co-ordinate all relevant information regarding power and exact location of panels.

12. PROJECT EXECUTION AND MANAGEMENT

The Contractor shall ensure that senior planning and erection personnel from his organization are assigned exclusively for this project. The Contractor shall appoint one Project Manager holding senior management position in the organization. He shall be assisted on full time basis by a minimum of two mechanical & electrical engineer & three senior supervisors. The entire staff shall be posted at site on full time basis. Separate ID card to be given by the Contractor to each worker working on site.

The project management shall be through modern technique. The Contractor’s office at site shall be fully equipped with fax, computers & plotter and shall prepare proper bar chart and completion schedules to be submitted & ensure timely completion. Erection engineer and supervisors shall be provided with mobile communication system so that they can always be reached.

For quality control & monitoring of workmanship, contractor shall assign at least one full-time engineer who would be exclusively responsible for ensuring strict quality control, adherence to specifications and ensuring top class workmanship for the CHP and related installation. Contractor

shall furnish details of licenses of supervisors/workmen to be employed at site.

13. COMPLETION (AS BUILT) DRAWINGS

Upon completion of the work and before issuance of certificate of virtual completion the contractor shall submit to the Owner's site representative four sets of layout drawings in progressive manner for individual systems drawn at approved scale indicating the complete system as installed. Drawings shall be prepared on AUTO-CAD (latest version). Along with the hard copies, the contractor shall submit copies of all drawings on CD and one set of all drawings on Rich Text Format shall also be submitted. These drawings must provide:

a) Any equipment related details like foundation, accessory, Project specific typical details and general details.
b) Complete layout for the total installation with location of all the accessories and equipment's installed.
c) Layouts for Panel Rooms, Control rooms,
d) Schematics for all Electrical and ELV services including SCADA.
e) Instruction, maintenance and operation manuals including maintenance schedule for all equipment. Testing & commissioning reports of CHP system.

14. POWER & WATER FOR CONSTRUCTION AND OTHER PURPOSES

Contractor has to make his own arrangement for water and power required during construction at his own cost.
Contractor will arrange for Power back up through DG set in case power from electricity board is not available / supplied. All expenses pertaining to operating and running of DG Set will be borne by the contractor.

15. SCAFFOLDING:

The contractor shall make his own arrangement for provisions of necessary scaffolding for the work and include the same in the rates quoted by them. No additional cost shall be payable other than specified in the specified RFP schedule.

16. INSPECTION, TESTING, AND COMMISSIONING:

1 SCOPE

This chapter covers RFP inspection and testing of all equipment's at manufacturer's works, RFP inspection of other equipment's/materials on receipt at site, final inspection testing & commissioning of all equipment at site & description of testing requirements & procedure.

2 INSPECTION AT MANUFACTURER'S WORKS

2.1 All equipment's Salient features such as model, capacity control, , Current, Voltage, Power (Rating) etc.

i) Manufacturer 's internal test certificates shall be scrutinised to check compliance with the requirements as specified in the contract.
ii) Salient features such as model, capacity, size etc...
iii) Manufacturer 's internal test certificates shall be scrutinised to check compliance with the requirements as specified in the order.

3 INSPECTION AT SITE

3.1 All equipment's received at site shall be checked for conformity to technical specifications and approval of the Data sheet by the design consultant. Any equipment or material violating the above requirement shall be out rightly rejected and shall be removed immediately from the site.

17. SAFETY:

The safety conditions shall not be regarded as exhaustive. These have been issued for the guidance of the Contractor and will not in any way absolve the Contractor from any such obligations or liabilities he might incur or transfer such obligations or liabilities to the Owner.

a) The Contractor shall obtain a Work Permit from the Engineer in Charge before starting any work on site. The work permit is issued to prevent contractors working in unauthorized areas and will be valid for specific area for a limited period as mentioned on the permit. Contractor shall duly return the work permit after the completion of the job or on expiry of the permit.
b) Extra care need to be taken for jobs being carried out after normal working hours with due revalidated work permit.
c) Head and eye protection and safety equipment are to be worn at all times as per job requirements.
d) The Contractor shall remove all the waste material and rubbish from and around the work site and leave the job thoroughly cleaned up, ready for use. No combustible material is to be stored on or near any source of heat, and before leaving the work place contractors employees should ensure that nothing is left which could start a fire. Contractor shall indemnify Owner from any and all claims, damages or penalties and will remain liable for the losses caused to Owner as result of Contractors non-compliance of the said requirements.
e) All precautions necessary for not only for the safe working of the contractors workmen at site shall be taken by the contractor, but he shall also deploy all precautions to safeguard existing structures, equipment and persons of other agencies in and around the job site

18. TEST CERTIFICATES

The contractor shall submit test certificates for all the equipment and system installed Type tests shall be carried out as per relevant standards mentioned in technical specifications. For other items, such test certificates issued by Government recognized inspection office certifying that all equipment, materials, construction and functions are in compliance

with the requirements of these specifications and accepted standards of BIS/International standards.

19. PERFORMANCE GUARANTEE

The contractor shall carry out the work in accordance with the Drawings, Specifications, Schedule of Quantities and other documents forming part of the Contract.

The contractor shall be fully responsible for the performance of the selected equipment (installed by him) at the specified parameters and for the efficiency of the installation to deliver the required end result. The replacement warrantee of different items is as mentioned in specification.

The contractor shall guarantee that the CHP system as installed shall perform to complete satisfaction of the owner.

Complete set of architectural drawings is available in the Architect/ Consultant's office and reference may be made to same for any details or information. The contractor shall also guarantee that the performance of various equipment individually, shall not be less than the quoted capacity; also actual power consumption shall not exceed the quoted rating, during testing and commissioning, taking over and guarantee period.

At the close of the work and before issue of final certificate of virtual completion, the contractor shall furnish written performance guarantee of 5% of contract value against defective materials and workman-ship for a period of Seven years from date of testing, commissioning and taking over.

The Contractor shall hold himself fully responsible for reinstallation or replacement, free of cost to Owner the following:

a. Any defective work or material supplied by the Contractor.

b. Any material or equipment damaged or destroyed as a result of defective workmanship by the Contractor.

20. UPTIME GUARANTEE

The contractor shall guarantee for the installed system an uptime of 99%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period, the contract for Operation and Maintenance shall get extended by a month for every month having the shortfall and no reimbursement shall be made for the extended period.

The Contractor shall provide log in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all temperatures, pressures, humidity, power generation. Starting and stopping times for various equipment, daily services rendered for the system alarms, maintenance and record of unusual observations etc. Contractor shall also submit preventive maintenance schedule.

21. QUIET OPERATION AND VIBRATION ISOLATION

All equipment shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the owner's site representative. In case of rotating machinery sound or vibration noticeable outside the room in which is installed. Or annoyingly noticeable inside its own room, shall be considered objectionable. Such conditions shall be corrected by the contractor at his own expense. The contractor shall guarantee that the equipment installed shall maintain the specified db/NC levels.

22. COMPREHESIVE ANNUAL MAINTENANCE , OPERATION, SITE SUPPORT WITH UTMOST TECHNICAL SUPPORT AND MINIMUM MANPOWER AS PER SLA DURING DEFECTS LIABILITY PERIOD AND ANOTHER 3 YEARS

Contractor is responsible to provide a comprehensive Operation and maintenance for the system installed and commissioned by him for a minimum of **Two (2) years** is covered under this defect liability period FOLLOWED by further three years (total five years of Comprehensive O&M). The defect liability period and compressive O&M shall start from the **Date of Taking over** of the system by the University. Contractor shall take actions as described below but not limited to:

1. Complaints

The Contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 2 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist. Corrective actions to problem experienced, if takes longer time, shall be complied 100% by during next business hours.

2. Repairs

All equipment that requires repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the Owner.

3. Log Book

The contractor shall provide four (4) copies of bound printed comprehensive log book containing tables for daily record of all temperature pressures, humidity, power consumption, starting and stopping times for various equipment, and record of unusual observations. This log book shall contain pages for one year's records of above observations.

5. Operation of equipment

i) During Sunny hours for power generation.
ii) All stand-by equipment to be operated as per mutually agreed program.
iii) Proper entry and upkeep of relevant log books.
iv) Maintain complaints register. Submit weekly report.
v) Proper housekeeping of all areas under the contract.
vi) Prepare daily Generation report and summary of operation.

23. INSTRUCTION, OPERATION AND MAINTENANCE MANUAL

The Contractor shall prepare and produce instruction, operation and maintenance manuals in English for the use, operation and the maintenance of the supplied equipment and installations, and submit to the Engineer In charge/ Consultants in three (3) copies at the time of taking over. In addition, one set with editable version will be given on compact disc. The manual shall generally consist of the following:

a) Description of the project.
b) Operating instructions.
c) Maintenance instructions including procedures for preventive maintenance.
d) Manufacturers catalog.
e) Spare parts list.
f) Trouble shooting charts.
g) Drawings.
h) Type and routine test certificates of major items.

24. TRAINING

The concerning vendor shall be liable to impart training to the field personnel or Engineer appointed by Owner responsible for daily operations and maintenance. Such trainings shall consist of but not limited to following:

a) Providing classroom training as well as field training. The duration of classroom training shall be minimum of 0**3** hours and that of field training shall be **05** hours and shall be repeated for all buildings or systems.
b) The concerning vendor shall provide such training for each building and systems.
c) Training syllabus shall be submitted and approved in prior by "The Consultant/Engineer In charge".
d) Providing video recording of every such training and shall submit 4 copies of training videos in CD/DVD/Pen drive to "The Client".
e) Wherever required representatives of respective OEM shall be present at the time of imparting training and ensuring all necessary information shall be imparted to the owner's representative.
f) The concerning vendor shall be liable to arrange required representatives of respective OEM during training.

25. OPERATING INSTRUCTIONS

The contractor shall submit a draft copy of comprehensive operating instructions and maintenance schedule for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the contractor shall submit four (4) complete bound sets of typewritten operating instructions, maintenance schedules, and log books.
The manual shall be carefully indexed and shall include sections on:

a) General description of equipment's & systems.
b) Handbooks operation & maintenance instructions of manufacturers.
c) Drive List
d) Technical Particulars of Equipment's

e) Start-up& stopping procedure.
f) Procedure & setting of Controls
g) List drawings
h) Schedule of spare parts essential & others.
i) Test results & certificates.
j) Log Book format.

26. COMPLETION CERTIFICATE

On completion of the installation a certificate shall be furnished by the contractor countersigned by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local statutory authority. The contractor shall be responsible for getting the installation inspected and approved by the local concerned authorities and for obtaining the necessary clearance certificates from the authorities.

27. COMPREHENSIVE ANNUAL MAINTENANCE & OPERATION SERVICE

Contractor shall be required to carry out the operation and Maintenance of the Solar PV System systems installed by him for the defects liability period confirming to the efficiency and SLA satisfactory as required to the university**.** However, during the operation, a snag list may be issued to contractor for further modification without any cost implication.

a) Operation contract
   i) Sunny hours operation and preventive maintenance.
   ii) All stand-by equipment to be operated as per mutually agreed program.
   iii) Proper entry and upkeep of relevant log books.
   iv) Maintain complaints register. Submit weekly report.
   v) Proper housekeeping of all areas under the contract.

b) All Inclusive Maintenance Contract
   i) Scope.
   The Comprehensive AMC shall cover all the items installed by the contractor

   ii) Routine Preventive Maintenance Schedule to be submitted
   - Schedule to cover manufacturer's recommendation and/or common engineering practice (for all equipment's and related accessories, cables, wires, panels etc under contract).
   - Equipment's history card giving full details of equipment and frequency of checks and overhaul.
   - Monthly status report.

c) Uptime during maintenance contract
   i) 99% uptime of all systems under contract.
   ii) Up time shall be assessed every month and in case of shortfall during any month the contract shall be extended by a month.
   iii) There shall be no reimbursement for the extended period.
   iv) Break-downs shall be attended to within ten hours of reporting.

d) Manpower
   i) Adequate number of persons to the satisfaction of the Owner's site representative shall be provided including relievers.
   ii) Statutory requirements of EPF, ESIC and other applicable labour legislations to be complied with; and monthly certification to that effect to be submitted.
   iii) Duty allocation and Roaster control shall be contractor's responsibility.
   iv) No overtime shall be payable by Owner for any reason whatsoever.

e) Shut Downs
   i) Routine shut downs shall be permitted only as allowed by the Chief Engineer.
   ii) Contractor shall be at liberty to carry out routine maintenance as and when required but with prior permission of the Owner.

f) Security Deposit and Performance Guarantee

The Contractor shall provide Security deposit and Performance Guarantee in the form of Bank Guarantee amounting to 5 % of the total AMC and O&M contract value on start of the AMC and O&M period post DLP period.

28. DISPUTE IN MODE OF MEASUREMENT

Where Works have to be measured for any purpose whatsoever, it shall be in accordance with item specifications as per relevant Indian Standards unless otherwise specifically indicated in the Contract Specifications. All measurements will be recorded in metric units or as per the MNRE guidelines only. In case of absence of mode of measurement of any item not covered by both the methods mentioned above, the Engineer-in-Charge's decision shall be final and binding. The required number of bills, measurement sheets, registers, bill forms, level/field books, materials/ account registers, testing registers, site order books and any other stationary item pertaining to this contract shall be printed and provided for by the contractor, at his own cost in the format prescribed and approved by the Engineer-in-Charge in writing.

29. TIME FOR COMPLETION

Time for completion for all the works shall be as per the Project Time Line Matrix from the date of issue of Letter of Intent (LOI).

The work shall be executed strictly as per the Time Schedule, working drawings and specification of the items included into the schedule of items. The period of work given includes the time required for mobilization and completion in all respects to the entire satisfaction of the Engineer-in-Charge.

a) Weekly programs of work will be drawn up by the Contractor to be approved by the Engineer-in- Charge. The Contractor shall scrupulously adhere to these schedules by deploying adequate personnel and construction tools and tackles. In all matters concerning the extent of targets set out for weekly programs and degree of achievements, the decision of Engineer-in-Charge shall be final and binding.
b) The time for completion mentioned above shall be inclusive of any monsoon following within the aforesaid time for completion. Delay/ held up of work on account of monsoon/ rain will not be considered for granting of additional time to complete the work.

30. WARRANTIES AND GUARANTEES

All manufacturers' warranties & guaranties for the equipment supplied by the contractor shall be passed on to the owner.

31. MEASUREMENTS

The Engineer-in-Charge shall, except as otherwise stated ascertain and determine by measurement the value of Work done, in accordance with the Contract and as per actual Work done. The Engineer-in-Charge shall, when he requires any part or parts of the Works to be measured, give notices to the Contractor's authorized agent or representative who shall forthwith attend or send a qualified agent to assist the Engineer-in-Charge in making such measurement and shall furnish all particulars required by either of them. Should the Contractor not attend or neglect or omit to send such representative then the measurement made by the Engineer- in-Charge shall be taken to be the correct measurement of the Work. For all measurements, figured dimensions given in the drawings shall be followed. Measurement of all hidden items shall be carried out by the Engineer-in-Charge. The Contractor or his representative who attends may at the time of measurement take such notes and measurements as he may desire.

Where Works have to be measured for any purpose whatsoever, it shall be in accordance with item specifications as per relevant Indian Standards unless otherwise specifically indicated in the Contract Specifications. All measurements will be recorded in metric units only. In case of absence of mode of measurement of any item not covered by both the methods mentioned above, the Engineer-in- Charge's decision shall be final and binding. The required number of bills, registers, bill forms, level/field books, materials/ account registers, testing registers, site order books and any other stationary item pertaining to this contract shall be printed and provided for by the contractor, at his own cost in the format prescribed and approved by the Engineer-in-Charge in writing.

32. CONTRACTOR PERSONNEL AT SITE:

List of persons employed by Contractor for the subject work mentioning their residential address shall be submitted to Nalanda University. In case of any revision, the same shall be informed to NU from time-to-time.
The Contractor shall be directly responsible for any/all disputes arising between him and his personnel and keep indemnified NU against all losses, damage and claims arising thereof.

Within the Nalanda University premises, the Contractor's personnel shall not do any private work other than their normal duties.

The contractor may also be required to provide photo passes to the personnel required by him, for security and safety reasons and furnish the details of the same when asked for.

Contractor shall be fully responsible for theft, burglary, fire or any mischievous deeds by his staff and any loss to Nalanda University shall be recovered from the immediate bill of the Contractor.

Contractor shall provide all necessary tools and tackles, equipment's, safety belt, wheel burrow, scaffolding, ladders, drilling m/c & safety equipment etc. required to carry out job at his cost and material used by Contractor shall be of standard make and approval of Engineer-In-Charge shall be taken for the same.

Engineer In-charge also reserves the right to ask the Contractor to remove particular person(s) from site with immediate effect if his behavior/ performance is not up to the mark and/or found indulging in unlawful activities, Contractor shall immediately comply with such instructions.
It will be the responsibility of contractor's engineer to ensure that their personnel behave in a proper manner and behavior and not to undergo the argument with the employees. It will be the responsibility of the Contractor's Engineer to deal with such complaints or co- ordinate with the University Engineer.

33. Compliance of various rules and regulations during execution of works in line with Green Building norms as per GRIHA.

All measures will need to be complied with by the CONTRACTOR and supervised by the PMC in order to assure that the right information is obtained on the required manners and time. This information will have to be sent to the Owner/Architect, on a forth night basis. The PMC will supervise the collated information and records to asses any discrepancy or improvement required in order to prepare the submittal to GRIHA for Green Building Certification.
A photographic and paper record as required will have to be provided of all below mentioned measures to the Architects/Sustainability Consultant.

CLAUSE.5.26: Store:

The site store of the Contractor shall be verified at the end of every month by the concerned University's officials certifying the level of minimum inventory, as

specified. The Contractor is required to replace the defective equipment within 12 hours of its failure. A monthly breakdown report shall be submitted to the owner.

CLAUSE 5.27: Inspection:

Govt Agencies/PSUs/manufacturer shall indicate the various specified sources of the items being procured. Type of checks, quantum of checks and acceptance norms shall be intimated and random test and check results should be made available for inspection whenever so desired.

CLAUSE 5.28: Pre Dispatch Inspection:

The contractor will intimate to owner well in advance or with sufficient notice period for readiness of material at manufactures' works. The Employer/his representative may carry out stage inspection of the plant/equipment during manufacturing/ assembling stage. The Employer shall have absolute right to reject the raw material/ component/ sub-assemblies or complete equipment not found to be conforming to the specification or being of poor quality/ workmanship. The stage inspection will particularly include tests specified for any particular plant or equipment in the technical specification, general routine tests and physical measurements to be conducted during manufacturing stages as per manufacturer's standard practice.

The Govt Agencies/PSUs/manufacturer shall give fifteen (15) days advance notice to enable the Employer to arrange for inspection. Inspection and testing shall be conducted at the place of manufacture. Inspection and testing of any material under this specification by the Employer shall not relieve the Govt Agencies/PSUs/manufacturer of his obligation to supply the plant/equipment in accordance with the specification and shall not prevent subsequent rejection if it is found to be defective.

The Govt Agencies/PSUs/manufacturer shall afford the Employer's representative all reasonable facilities, without charge, to satisfy him that the plant/ equipment is being manufactured in accordance with the specifications. The Govt Agencies/PSUs/manufacturer must have adequate set of instruments for conducting tests as per IS specification. Instruments for testing shall be duly calibrated and calibration certificate should not be older than one year on the date of inspection. Calibration shall be done by NABL accredited laboratories. A comprehensive list of testing equipment/ instruments indicating make, Sr. No, type, class of accuracy, calibrating agency, calibration date etc. should be furnished, as and when desired. Calibrated instruments shall be duly sealed by calibrating agency to avoid any tampering with calibration and the details thereof shall be clearly mentioned in the calibration certificate(s).

CLAUSE 5.29 : Material Supply Lot :

Only Type tested material shall be supplied in compliance of relevant IS. The Type Test should be issued by NABL or NABL accredited laboratory and it should not be older than 3 years.

CLAUSE 5.30 : Fake Inspection Call :

In case of fake inspection call announced by the inspecting officer or University's authority, a penalty of Rs. 25000/- against Contractor shall be imposed and such amount shall be deducted from the running bill of the contractor.

CLAUSE.5.31: Special Conditions for Directives of Hon'ble National Green Tribunal 04.12.2014 & 10.04.2015 And EIA Guidance Manual

1. The contractor shall not store/dump construction material or debris on metalled road.

2. The contractor shall get prior approval from Engineer-in-Charge for the area where the construction material or debris can be stored beyond the metalled road. This area shall not cause any obstruction to the free flow of traffic/inconvenience to the pedestrians. It should be ensured by the contractor that no accidents occur on account of such permissible storage.

3. The contractor shall take appropriate protection measures like raising wind breakers of appropriate height on all sides of the plot/area using CGI sheets or plastic and /or other similar material to ensure that no construction material dust fly outside the plot area.

4. The contractor shall ensure that all the trucks or vehicles of any kind which are used for construction purposes/or are carrying construction material like cement, sand and other allied material are fully covered. The contractor shall take every necessary precaution that the vehicles are properly cleaned and dust free to ensure that en-route their destination, the dust, sand or any other particles are not released in air/contaminate air.

5. The contractor shall provide mask to every worker working on the construction site and involved in loading, unloading and carriage of construction material and construction debris to prevent inhalation of dust particles.

6. The contractor shall provide all medical help, investigation and treatment to the workers involved in the construction of building and carry of construction material and debris relatable to dust emission.

7. The contractor shall ensure that C&D waste is transported to the C & D Waste site only and due record shall be maintained by the contractor.

8. The contractor shall compulsory use of wet jet in grinding and stone cutting.

9. The contractor shall comply all the preventive and protective environmental steps as stated in the MoEF guidelines, 2010.

10. The contractor shall carry out on-Road- Inspection for black smoke generating machinery. The contractor shall use cleaner fuel.

11. The contractor shall ensure that all DG sets comply emission norms notified by MoEF.

12. The contractor shall use vehicles having pollution under control certificate. The emissions can be reduced by a large extent by reducing the speed of a vehicle to 20 kmph. Speed bumps shall be used to ensure speed reduction. In cases where speed reduction cannot effectively reduce fugitive dust, the contractor shall divert traffic to nearby paved areas.

13. The contractor shall ensure that the construction material is covered by tarpaulin. The contractor shall take all other precaution to ensure that no dust particles are permitted to pollute air quality as a result of such storage.

14. The paving of the path for plying of vehicles carrying construction material is more permanent solution to dust control and suitable for longer duration projects. The RFP approving authority shall carry out cost benefit ratio analysis of the same.

SLA (Service Level Agreement) during AMC period:

The SLA is being defined to get the quick/prompt response and effective Defect Liability Period and O&M Period. Therefore, the AMC with onsite support is being given together with the Defect liability period to avoid any kind of the allegations, delay and excuses from the contractor. The SLA will be signed after execution of the Design, Supply, Installation, Testing and Commissioning of all the works as per the RFP. The SLA shall be executed after successful completion and handing over/taking over formality. The effective start date of AMC period shall be declared jointly after taking over formalities. The main works shall be closed after successful completion of the execution period of main the work and a supplementary agreement shall be signed. The Format of the agreement will be as provided in the CPWD works manual. The date of the agreement shall be reckoned from the date of handing/taking over formalities. The period of the AMC agreement will be initial ly for the defect liability period after DLP the AMC and onsite manpower support may be extended on mutually agreed upon.

SLA Objectives

The contractor is required to provide utmost service satisfaction and minimum 99 % overall uptime. Contractor shall ensure Operation and Maintenance and provide support on-site in terms of Comprehensive AMC along with warranty and operation support services.

SCOPE OF SLA:

The Defect liability period of the all the equipment is 24 months after completion of execution of SITC job and final taking over by the University and the comprehensive AMC with team deployment at site for the period of 60 Months.

Difference between DLP & Guaranty/warranty:

(a) DLP- Replacement - In case of any fault in the system including local, Civil, Mechanical and entire system Job
(b) Guaranty/warranty: Replacement/Restoration as the case may be.

The contractor has to provide at least **One** Engineer (BE Electrical or Equivalent) and **Two** certified Technician (Diploma Holders) for Two Shifts (Eight Hour Each). However the requirement shall be in two shifts and one helper in general shift. The same Technician shall not be deployed in all three shift other than emergency case.

The deployed technician on behalf of the agency/contractor shall maintain a logbook of the all the installed equipment's for ELV and register all the faults & incidents, if occurred. The contractor will draft the logbook format for its approval before the Engineer in-Charge in accordance of the manufacturer guidelines.

The contractor has to attend all the faults during operation period/services. In case of any defect shall be attended and replacement of the equipment shall be performed during the Defect Liability Period. No any extra cost shall be bear by the University during the DLP for the replacement of the equipment.

The safety measures shall be taken care by the contractor to ensure the safety of human and equipment.

The contractor has to make payment as per the minimum wage rule as per the applicable category and area on monthly basis, and he proof shall be submitted along with the bill invoice.

The contractor will submit the details with a copy of the qualifications, Experience proof, identity proof and police verification report to the University. In case of any changes in the deployment of the manpower staff at site minimum one week of common period shall be maintained by the contractor under intimation of the reporting officer of the University. The engineer must be experienced and well conversant of the operating and maintenance procedure.

The University reserve right to expel or recommend to the contractor to remove the particular or all deployed staff on the observation of any malpractice, illegal involvement. Unsatisfactory works, unsatisfactory and miss-behaviours, delay in response and unethical practise. The contractor shall be bounded to replace the staff in such cases.

The University will not be responsible for any case or illegal involvement, compliance of the labour court/University's, accidental support/claim or any. The contractor will be solely responsible for all the affairs related to the deployed manpower at the site. If any technician or helper will be absent during the concerned shift, then INR 1000/- per shift per Technician and INR 800/ per shift per helper shall be recovered.

If any recovery amount (either due to deduction in manpower and its compliance or due to defect liability of material) exceed than the AMC amount, then same amount shall be recovered from the security deposited with the University. The maximum allowable time for the replacement of the appliances will be 48 Hours. However, meanwhile the makeshift arrangement shall be made by the contractor and no any extra payment shall be made.

In the compelling circumstances, if required then the University may also replace the damaged material and recovery shall be made from the AMC and if required then from the Security deposited with NU and even after this the expenditure exceeds then contractor has deposited the balance amount. In case of non-responsive event from the contractor, the University may debarred or blacklist to the contractor. During the handing over of the system, the address of the local and central service & repair centre shall be provided by the contractor.

Security Deposit and Performance Guarantee:

The Contractor shall provide Security deposit and Performance Guarantee in the form of Bank Guarantee amounting to 5% of the total AMC and O&M contract value on start of the AMC and O&M period post DLP period.

SLA Duration
Timings : 24x7

Period: Seven years (from the date of successful commissioning and Acceptance of equipment's)

SLA Manpower Requirements and working requirements

- Contractor shall deploy suitably qualified and experienced sufficient manpower in shifts to meet out the SLA. Minimum personnel's required to be deployed are as under.
    - For plant: Minimum Three - One in each shift for two shifts. One engineer should be available for 2 shifts. 2 technicians shall also be employed for each shift.
- Contractor shall appoint as many team members, over and above the manpower specified, as deemed fit by them, to meet out the time Schedule and SLA requirements. NU would not be liable to pay any additional cost for this.
- Contractor shall always maintain above minimum manpower on-site throughout the period of the contract.
- Warranty/AMC involves comprehensive maintenance and repairs of all hardware and/or software for the said systems, including free of cost replacement of parts, consumables if any, modules, sub-modules, assemblies, sub-assemblies, spares, checking of instrument health, etc to keep the system operational.
- Govt Agencies/PSUs should ensure 99.0 % availability of the all the systems. This will include all kind of breakdown, corrective & preventive maintenance
- Downtime shall be calculated on monthly basis. Downtime will be based on the report of representative of NU, based on system logs, equipment logs, downtime and rectification reporting etc. In case the availability for each of the system under Warranty/AMC/ O&M is less than 99 % the non-performance deduction from payments for the system under Warranty/AMC/ O&M shall be as per the following calculation:

Calculation for downtime of Service:

Working Hours: 8:00 am to 4:00 p.m = 480 minutes

As only 1 % downtime i.e. 4.8 minutes (1% of 480 minutes) daily is allowed as acceptable downtime as per the Supplier's conditions for maintenance and service. In case the system of the service provider remains un-operational during the whole day, 9 hrs straight will be considered as downtime. In case of partial closure of the system, the duration for which it remains un-operational will be considered as downtime. At the end of the month, all such un-operational time duration will be summed up to arrive at the total downtime. The downtime monthly can be calculated as follows

Downtime (in %age) =

((Summed up downtime in min) / (Working Days in month * 480)) * 100

Calculation of Penalty

Let us consider the following example:

The Total service provider SI's Monthly O & M Service charges Bill is for Rs 2,00,000/-

Downtime Calculation:

e.g. Assuming Total working days:= 24 days (24 * 480= 11520 minutes)

Acceptable downtime = 1 % (i.e. 11520*0.01= 115.20 minutes)

Suppose the total downtime after one month (24 working days) is 500 minutes.

As the acceptable downtime is 1% (115.20 minutes), the total of 384.80 minutes (500 minutes- 115.20 minutes) is liable for imposing penalty.

Hence, the total downtime in % liable for imposing penalty will be:

= (384.80 / 11520)* 100

= 3.34%

Hence, penalty applicable for the concerned month will be (3.34/100)*200000 = Rs 6680.00/-

- The agency will submit the healthiness certificate of all the equipment regular basis at least once in a two month. The Resident Engineer any other staff shall be stationed at Rajgir and before leaving the Rajgir permission of the official concerned from Nalanda University will be required.

- Replacement Approval: Before replacement, if required, of the appliances/system/parts thereof, the AMC service provider will take approval from the in-charge.

- Experienced and Suitable Resident Engineer: Before deployment of the Resident Engineer, the AMC service provider shall submit the CV in details followed by an interview and seek approval for the deployment of the personnel. Experience of the resident Engineer should not be less than 5 years for the graduate engineer and 7 years in case of diploma engineer. However, the university decision in this regard will be final to approve for the deployment of any suitable number of experience year as deemed fit for the University. The AMC service provider will deploy one qualified resident Engineer. Who will handle the hardware and allied software issues and will handle the Networking system.

- The AMC service provider should have back to back tie-up with the OEM and its authorized service provider.

- The AMC service provider may replace the hardware with the same make, at least same configuration to ensure the genuineness.

- Before replacement of the material/spare parts, the service provider will take approval of the IT in charge from Nalanda University.

- Spare Parts in stock: The Service provider will prepare a list duly verified by the IT In-Charge, and sufficient stock shall be maintained to avoid the last hour rush. Makeshift arrangement: In case of replacement or anticipated delay, the service provider will ensure the makeshift arrangement of the spares and personnel.

- The agency will submit the healthiness certificate of all the equipment regular basis at least once in a two month. The Resident Engineer and any other staff shall be stationed at Rajgir and before leaving the Rajgir permission of the official concerned from Nalanda University will be required. Replacement Approval: Before replacement, if required, of the appliances/system/parts thereof, the Contractor will take approval from the in-charge. Experienced and Suitable Resident Engineer: Before deployment of the Resident Engineer, the Contractor shall submit the CV in details followed by an interview and seek approval for the deployment of the personnel. Experience of the resident Engineer should not be less than 5 years for the graduate engineer and 7 years in case of diploma engineer. However, the university decision in this regard will be final to approve for the deployment of any suitable number of experience year as deemed fit for the University. The Contractor will deploy one qualified resident Engineer Who will handle the hardware and allied software issues and handle the Networking system. This is as per the volume and nature of the work required to maintain the various campuses and system. The Contractor should

have back to back tie-up with the OEM and its authorized service provider. The Contractor may replace the hardware with the same make, at least same configuration to ensure the genuineness. Before replacement of the material/spare parts, the service provider will take approval of the IT in charge from Nalanda University. Spare Parts in stock: The Service provider will prepare a list duly verified by the IT In-Charge, and sufficient stock shall be maintained to avoid the last hour rush. Makeshift arrangement: In case of replacement or anticipated delay, the service provider will ensure the makeshift arrangement of the spares and personnel.

Tie up with OEM/ Manufacture

The Contractor should have back-to-back arrangements with OEM/Manufacturer for warranty support for a period of Two years and AMC period of Five Years

It is the responsibility of the Contractor to provide certification of OEM/Manufacture for complete support for the period of Twenty Five years for the PV and others as per the life period in case of product upgrades or discontinue of product and has sufficient provision for spares.

SERVICE LEVEL AGREEMENT FORMAT

THIS AGREEMENT is made on **[Month, day, year]**

BETWEEN

1. **Nalanda University** to be called (the "Buyer"); and
2. **[_____]** of (the "Service Provider"),

collectively referred to as the "Parties". **RECITALS**

The Buyer wishes to be provided with the Services (defined below) by the Service Provider and the Service Provider agrees to provide the Services to the Buyer on the terms and conditions of this Agreement.

1. **Key Terms**

1.1 Services

The Service Provider shall provide the following services ("Services") to the Buyer in accordance with the terms and conditions of this Agreement:

Contractor shall be required to carry out the operation and maintenance of the Solar farm system for the defects liability period of 24 months and for further period of 60 months for operation and maintenance**.** However, during the operation, a snag list may be issued to contractor for further modification without any cost implication.

a) Operation contract
   i) During Sunny Hours, year round during for full load
   ii) All stand-by equipment to be operated as per mutually agreed program.
   iii) Proper entry and upkeep of relevant log books.
   iv) Maintain complaints register. Submit weekly report.
   v) Proper housekeeping of all areas under the contract.

b) All Inclusive Maintenance Contract
   iii) Scope.
   The AMC shall cover all the items installed by the contractor including but not limited to replacement of all equipment's, racks, Patch panels, Cables, etc.

   iv) Routine Preventive Maintenance Schedule to be submitted
   - Schedule to cover manufacturer's recommendation and/or common engineering practice (for all plant and machinery under contract).
   - Plant and machinery history card giving full details of equipment and frequency of checks and overhaul.
   - Monthly status report.

c) Uptime during maintenance contract
   v) 99% uptime of all systems under contract.
   vi) Up time shall be assessed every month and in case of shortfall during any month the contract shall be extended by a month.
   vii) There shall be no reimbursement for the extended period.
   viii) Break-downs shall be attended to within ten hours of reporting.

d) Manpower
   v) Adequate number of persons to the satisfaction of the Owner's site representative shall be provided including relievers.
   vi) Statutory requirements of EPF, ESIC and other applicable labour legislations to be complied with; and monthly certification to that effect to be submitted.
   vii) Duty allocation and Roaster control shall be contractor's responsibility.
   viii) No overtime shall be payable by Owner for any reason whatsoever.

e) Shut Downs

iii) Routine shut downs shall be permitted only as allowed by the Chief Engineer.
iv) Contractor shall be at liberty to carry out routine maintenance as and when required but with prior permission of the Owner.

1.2 Delivery of the Services

a. **Start date:** The Service Provider shall commence the provision of the Services from the **date of taking over of the installation by the University.**
b. **Completion date:** The Service Provider shall complete/cease to provide the Services **by the end of Seven years from the date of taking over of the installation by the University** including Defect Liability Period.

1.3 Site

The Service Provider shall provide the Services at the following site(s): Outreach center

1.4 Price

a. As consideration for the provision of the Services by the Service Provider, the price for the provision of the Services for the defect liability period is included in the RFP cost.

b. The Buyer shall not pay for any of the Service Provider's out-of-pocket expenses as it shall be all considered in the above mentioned price. The price shall be inclusive of all taxes, duties, GST, approval costs etc required by the Govt Agencies/PSUs to render the services effectively for the contract.

1.5 Payment

a. The method of payment of the Price by the Buyer to the Service Provider shall be as per the University/govt procedure.
b. Any charges payable under this Agreement are inclusive of any applicable taxes, tariff surcharges or other like amounts assessed by any governmental entity arising as a result of the provision of the Services by the Service Provider to the Buyer under this Agreement and such shall be payable by the Buyer to the Service Provider in addition to all other charges payable hereunder.

2. **General terms**

2.1 Intellectual Property Rights

The Service Provider agrees to grant to the Buyer a non-exclusive, irrevocable, royalty free license to use, copy and modify any elements of the Material not specifically created for the Buyer as part of the Services. In respect of the Material specifically created for the Buyer as part of the Services, the Service Provider assigns the full title guarantee to the Buyer and any all of the copyright, other intellectual property rights and any other data or material used or subsisting in the Material whether finished or unfinished. If any third party intellectual property rights are used in the Material the Service Provider shall ensure that it has secured all necessary consents and approvals to use such third party intellectual property rights for the Service Provider and the Buyer. For the purposes of this Clause 2.1, "Material" shall mean the materials, in whatever form, used by the Service Provider to provide the Services and the products, systems, programs or processes, in whatever form, produced by the Service Provider pursuant to this Agreement.

2.2 Warranty

a. The Service Provider represents and warrants that:
    i. it will perform the Services with reasonable care and skill; and
    ii. the Services and the Materials provided by the Service Provider to the Buyer under this Agreement will not infringe or violate any intellectual property rights or other right of any third party.

2.3 Limitation of liability

a. Subject to the Buyer's obligation to pay the Price to the Service Provider, either party's liability in contract, tort or otherwise (including negligence) arising directly out of or in connection with this Agreement or the performance or observance of its obligations under this Agreement and every applicable part of it shall be limited in aggregate to the Price.
b. Nothing in this Clause 2.3 will serve to limit or exclude either Party's liability for death or personal injury arising from its own negligence.

2.4 Term and Termination

a. This Agreement shall be effective on the date hereof and shall continue, unless terminated sooner in accordance with Clause 2.4(b), until the Completion Date.
b. Either Party may terminate this Agreement upon notice in writing if:
    i. the other is in breach of any material obligation contained in this Agreement, which is not remedied (if the same is capable of being remedied) within 30 days of written notice from the other Party so to do; or
    ii. a voluntary arrangement is approved, a bankruptcy or an administration order is made or a receiver or administrative receiver is appointed over any of the other Party's assets or an undertaking or a resolution or petition to wind up the other Party is passed or presented (other than for the purposes of amalgamation or reconstruction) or any analogous procedure in the country of incorporation of either party or if any circumstances arise which entitle the Court or a creditor to

appoint a receiver, administrative receiver or administrator or to present a winding-up petition or make a winding-up order in respect of the other Party.

c. Any termination of this Agreement (howsoever occasioned) shall not affect any accrued rights or liabilities of either Party nor shall it affect the coming into force or the continuance in force of any provision hereof which is expressly or by implication intended to come into or continue in force on or after such termination.

2.5 Relationship of the Parties

"The Parties acknowledge and agree that the Services performed by the Service Provider, its employees, agents or sub-contractors shall be as an independent contractor and that nothing in this Agreement shall be deemed to constitute a partnership, agency relationship or otherwise between the parties." Joint Venture Shall not be Allowed.

2.6 Confidentiality

Neither Party will use, copy, adapt, alter or part with possession of any information of the other which is disclosed or otherwise comes into its possession under or in relation to this Agreement and which is of a confidential nature. This obligation will not apply to information which the recipient can prove was in its possession at the date it was received or obtained or which the recipient obtains from some other person with good legal title to it or which is in or comes into the public domain otherwise than through the default or negligence of the recipient or which is independently developed by or for the recipient.

2.7 Notices

Any notice which may be given by a Party under this Agreement shall be deemed to have been duly delivered if delivered by hand, registered post, facsimile transmission or electronic mail to the address of the other Party as specified in this Agreement or any other address notified in writing to the other Party. Subject to any applicable local law provisions to the contrary, any such communication shall be deemed to have been made to the other Party, if delivered by:

a. Registered Post, 2 days from the date of posting;
b. hand or by facsimile transmission, on the date of such delivery or transmission; and
c. electronic mail, when the Party sending such communication receives confirmation of such delivery by electronic mail.

2.8 Miscellaneous

a. The failure of either party to enforce its rights under this Agreement at any time for any period shall not be construed as a waiver of such rights.
b. If any part, term or provision of this Agreement is held to be illegal or unenforceable neither the validity or enforceability of the remainder of this Agreement shall be affected.

c. Neither Party shall assign or transfer all or any part of its rights under this Agreement without the consent of the other Party.
d. This Agreement may not be amended for any other reason without the prior written agreement of both Parties.
e. This Agreement constitutes the entire understanding between the Parties relating to the subject matter hereof unless any representation or warranty made about this Agreement was made fraudulently and, save as may be expressly referred to or referenced herein, supersedes all prior representations, writings, negotiations or understandings with respect hereto.
f. Neither Party shall be liable for failure to perform or delay in performing any obligation under this Agreement if the failure or delay is caused by any circumstances beyond its reasonable control, including but not limited to acts of god, war, civil commotion or industrial dispute. If such delay or failure continues for at least 7 days, the Party not affected by such delay or failure shall be entitled to terminate this Agreement by notice in writing to the other.
g. This Clause 2.8(g) and Clauses 2.3, 2.5, 2.6, 2.7 and 2.8 of this Agreement shall survive any termination or expiration.
h. This Agreement shall be governed by the laws of the jurisdiction in which the Buyer is located (or if the Buyer is based in more than one country, the country in which its headquarters are located) (the "Territory") and the parties agree to submit disputes arising out of or in connection with this Agreement to the non-exclusive of the courts in the Territory.

Additional clauses

AS WITNESS the hands of the Parties hereto or their duly authorized representatives the day and year first above written.

SIGNED by)

for and on behalf of)

[the Buyer])

SIGNED by)

for and on behalf of)

[the Service Provider])

SECTION 6

ADDITIONAL CONDITIONS FOR GREEN BUILDING PRACTICES

6.1 The campus is proposed to be registered for obtaining GRIHA LD Rating from GRIHA Secretariat under MNRE scheme. The contractor is required to execute the work in a befitting manner to obtain the targeted GRIHA rating by Owner.

6.2 Special conditions for GRIHA rating: -

6.2.1 The contractor shall prepare scheme for the approval of Engineer-in-charge for obtaining GRIHA rating in the criteria relevant to the execution of work.

6.2.2 The contractor shall plan and execute the work in a manner to preserve and protect the landscape during construction and shall arrange the materials/equipment and follow the procedure as per criterion 2 of the GRIHA rating as applicable.

6.2.3 The contractor shall appoint/engage consultant/ consultancies to provide technical guidance and supervise the work, pertaining to the criterion related to the execution of work, so that it finally achieves the targeted GRIHA rating.

The contractor shall preserve the topsoil layer for supporting vegetative growth as per the guidelines given in chapter 4, Section 1, Part 10, NBC 2005.

The contractor shall comply with NBC norms on construction safety, health and sanitation as per criterion.

The construction activity shall be done in a befitting manner and the contractor shall adopt measures to prevent air pollution at site in compliance with criterion 9 of GRIHA rating as applicable.

The contractor shall comply with all the instructions and schemes for execution of green building.

Nothing shall be paid extra for fulfilment of all these conditions except for the items existing in the schedule of quantities. For such items work done shall be paid on the basis of the agreement rates.

6.3 Pre- construction stage

Construction Vehicles, Equipment and Machinery

All vehicles, equipment and machinery to be procured for construction shall conform to the relevant Bureau of India Standard (BIS) norms.

Emission from the vehicles must conform to environmental norms.

Dust produced from the vehicular movement and other site activities is to be mitigated by sprinkling of water. Noise limits for construction equipment shall not exceed 75 dB(A), measured at one meter from the edge of the equipment in free area, as specified in the Environment Protection Act,1986, schedule VI part E, as amended on 9th May,1993. The maximum noise levels near the construction site should be limited to 65 dB (A) Leq (5 min) in project area. Contractor has to make a confined boundary to restrict construction activities within it. Contractor is required

to prepare the Construction waste management plan for segregation, storage and safe disposal of construction waste for the approval of engineer in charge.

6.4 Construction Stage

6.4.1 Construction Wastes Disposal

The pre-identified dump locations will be a part of solid waste management plan OR construction waste management plan or safe handling, storage and recycling of construction waste to be prepared by the Contractor in consultation with Engineer-in-charge. Contractor needs to designate the area for construction waste storage. Inert and hazardous waste should be collected and stored separately on site.

The other construction waste should be either reused on site or safely dispose them off to designed agencies for recycling. The procedure of waste disposal either on-site reuse or selling for recycling purpose should be documented by photographs / log books / receipt copies and evidences needs to be submitted to the Engineer In charge. Contractor shall get approved the location of disposal site prior to commencement of the excavation on any section of the project location.

Contractor shall ensure that any spoils of material will not be disposed of in any municipality solid waste collection bins.

6.4.2 Procurement of Construction Materials

All vehicles delivering construction materials to the site shall be covered to avoid spillage of materials and maintain cleanliness of the roads.

Wheel Tires of all vehicles used by of the contractor, or any of his sub-contractor or materials supplies shall be cleaned and washed clear of all dust/mud before leaving the project premises. This shall be done by routing the vehicles through tire washing tracks.

Contractor shall arrange for regular water sprinkling at least twice a day (i.e. morning and evening) for dust suppression of the construction sites and unpaved roads used by his construction vehicles.

6.4.3 Water Pollution

The Contractor shall take all precautionary measures to prevent the wastewater during construction to accumulate anywhere. The wastewater arising from the project is to be disposed of in the manner that is acceptable to the Engineer-in-charge.

6.4.4 Air and Noise Pollution

Contractor shall use dust screens and sprinkle water around the construction site to arrest spreading of dust in the air and surrounding areas.

Contractor shall ensure that all vehicles, equipment and machinery used for construction are regularly maintained and confirm that emission levels comply with environmental emission standards/norms.

For controlling the noise from Vehicles, Plants and Equipment, the Contractor shall confirm the following:

All vehicles and equipment used in construction will be fitted with exhaust silencers.

Servicing of all construction vehicles and machinery will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced.

Noise emission from compactors (rollers) front loaders, concrete mixers, cranes (movable), vibrators and saws should be less than 75 dB(A).

As per the standards/guidelines for control of Noise Pollution from Stationary Diesel Generator (DG) sets, noise emission in dB(A) from DG Set (15-500 KVA) should be less than 94+10 log 10 (KVA). The standards also suggest construction of acoustic enclosure around the DG Set and provision of proper exhaust muffler with insertion loss of minimum 25 dB (A) as mandatory.

6.4.5 Personal Safety Measures for Labour

Contractor will provide the following items for safety of workers employed by contractor and associate agencies:
Protective footwear and gloves to all workers employed for the work on mixing, cement, lime mortars, concrete etc. and openings in water pipeline/sewer line.
Welders' protective eye-shields for all workers who are engaged in welding works.
Safety helmet and Safety harness/ belt.

6.5 The following provisions shall be maintained by the contractor at site:

6.5.1 Provide adequate precaution/safety facilities for construction workers to ensure the health and safety of the workers during construction, with effective provisions for the basic facilities such as satisfaction, drinking water and safety equipment or machinery.

All the workers should be wearing helmet and shoes all the time on site.

Masks and gloves should be worn whenever and wherever required.

Adequate drinking water facility should be provided at site, adequate number of decentralized latrines and urinals to be provided for construction workers.

Full time workers residing on site should be provided with clean and adequate temporary hutment. Crèche/Day-care facility should be provided to young children of laborers residing on site. Child labour should be banned on site.

First aid facility should also be provided.

Overhead lifting of heavy materials should be avoided. Barrow wheel and hand-lift boxes should be used to transport materials onsite.

Tobacco and cigarette smoking should be prohibited onsite.

All dangerous parts of machinery are well guarded and all precautions for working on machinery are taken.

Maintain hoists and lifts, lifting machines, chains, ropes and other lifting tackles in good condition.

Use of durable and reusable formwork systems to replace timber formwork and ensure that formwork where used is properly maintained.

Ensure that walking surfaces or boards at height are of sound construction and are provided with safety rails and belts. Provide protective equipment such as helmets.

Provide measure to prevent fire. Fire extinguisher and buckets of sand to be provided in fire-prone area and elsewhere.

Provide sufficient and suitable light for working during night.

Ensure that measures to protect workers from materials of construction, transportation, storage and other dangers and health hazards are taken.

Ensure that the construction firm/division/company have sound safety policies.

Comply with the safety procedure, norms and guidelines (as applicable) as outlined in NBC 2005 (BIS 2005c).

Adopt additional best particles and prescribed norms as in NBC 2005 (BIS 2005).

6.5.2 Identify roads on-site that would be used for vehicular traffic. Update vehicular roads (if these are unpaved) by increasing the surface strength by improving particle size, shape and mineral type that make up the surface base. Add surface gravel to reduce source of dust emission. Limit amount of fine particles (smaller than 0.075mm) to 10-20%. Limit vehicular speed on site 10km/h.

6.5.3 All material storages should be adequately covered and contained so that they are not exposed to situations where winds on site could lead to dust/particulate emissions.

6.5.4 Spills of dirt or dusty materials shall be cleaned up promptly so the spilled material does not become a source of fugitive dust and also to prevent of seepage of pollutant laden water into the ground aquifers. When cleaning up the spill, ensure that the clean-up process does not generate additional dust. Similarly, spilled concrete slurries or liquid wastes should be contained/cleaned up immediately before they can infiltrate into the soil/ground or runoff in nearby areas.

6.5.5 Ensure that water spraying is carried out by wetting the surface by spraying water on:

Any dusty material.

Areas where demolition works is carried out.

Any unpaved main-haul road and.

Areas where excavation or earth moving activities is to be carried out.

6.6 The contractor shall ensure the following:

Cover and enclose the site by providing dust screen, sheeting or netting to scaffold along the perimeter of a building.

Covering stockpiles of dusty material with impervious sheeting.

Covering dusty load on vehicles by impervious sheeting before they leave the site.

Transferring, handling/storing dry loose materials like bulk cement and dry pulverized fly ash inside a totally enclosed system.

Spills of dirt or dusty materials shall be cleaned up promptly so that the spilled material does not become a source of fugitive dust and also to prevent seepage of pollutant-laden water into the ground aquifers. When cleaning up the spill, ensure that the clean-up process does not generate additional dust. Similarly, spilled concrete slurries or liquid wastes should be contained/cleaned up immediately before they can infiltrate into the soil/ground or runoff in nearby areas.

Clear vegetation only from areas where work will start right away.

Vegetate/mulch areas where vehicles do not ply.

Apply gravel/landscaping rock to the areas where mulching/paving is impractical.

6.6.1 Adopt measures to prevent air pollution in the vicinity of the site due to construction activities. There is no standard reference for this. The best practices should be followed (as adopted from international best practice documents and codes).

6.6.2 Provide hoardings of not less than 3m height along the site boundary, next to a road or other public area.

6.6.3 The contractor shall provide experienced personnel with suitable training to ensure that these methods are implemented. Prior to the commencement of any work, the method of working, plant equipment and air pollution control system to be used on-site should be made available for the inspection and approval of the Engineer-in-Charge to ensure that these are suitable for the project.

6.6.4 Employ measures to segregate the waste on-site into inert, chemical or hazardous wastes. Recycle the unused chemical/hazardous wastes such as oil, paint, batteries and asbestos. The inert waste is to be disposed of to Municipal Corporation/local bodies dump yard and landfill sites.

6.7 Preserve and protect landscape during construction

6.7.1 Following provisions shall be made at site by the contractor to preserve and protect landscape. Nothing shall be paid on this account unless specifically provided for in the schedule of quantities.

6.7.2 To preserve the existing landscape and protect it from degradation during the process of construction. Select proper timing for construction activity to minimize the disturbance such as soil pollution due to spilling of the construction material and its mixing with rainwater. The construction management plan including soil erosion control management plan shall be prepared accordingly for each month. The application of erosion control measures includes construction of gravel pits and tyre washing bays of approved size and specification for all vehicular site entry/ exits, protection of steep slopes. Sedimentation Collection System and run-off diversion systems shall be in place before the commencement of construction activity. Preserve

and protect the existing vegetation by not disturbing or damaging to specified site areas during construction. The trees that are identified to be retained on site are protected during the construction period using the following measures:

The damage to roots is prevented during trenching, placing backfill, driving or parking heavy equipment. The dumping of trash, oil, paint and other material is detrimental to plant health. These activities should be restricted to the areas outside of the canopy of the trees.

The trees are not used for support; their trunks should not be damaged by cutting and carving by nailing posters and advertisements or in any other way.

The lighting of fires or carrying out heat or gas emitting construction activity within the ground covered by canopy of the trees is not permitted.

The young trees of saplings identified for preservation within the construction site must be protected using tree guards of approved specification.

The grades of soil should be maintained around existing vegetation. Lowering or raising the levels around the vegetation should not be allowed unless specifically directed by the Engineer –in – Charge.

Maintenance activities should be performed, as and when needed, to ensure that vegetation remain healthy.

6.8 Staging is dividing a construction area into two or more sections to minimize the area of soil that will be exposed at any given time. Staging should be done to separate undisturbed land from land disturbed by construction activity and material storage. A vector drawing plan to be submitted identifying the areas of sites, which shall be disturbed for the construction activity and apart from these other areas on site should not be disturbed. Measures should be followed for collecting drainage water run-off from construction areas and material storage sites and diverting water flow away from such polluted areas. Temporary drainage channels and perimeter dike/swale should be constructed to carry the pollutant-laden water directly to the treatment device or facility (municipal sewer line). The plan should indicate how the above was accomplished on site well in advance of the commencement of the construction activity.

6.8.1 The Contractor should follow the construction plan as proposed by the Architect Consultants/landscape consultant to minimize the site disturbance such as soil pollution due to spilling. Use staging and spill prevention and control plan to restrict the spilling of the contaminating material on site. Protect top soil from erosion by collection storage and reapplication of top soil, constructing sediment basin, contour trenching, mulching etc.

6.8.2 Spill prevention and control plans should clearly state measures to stop the source of the spill. Measures to contain the spill and measures to dispose the contaminated material and hazardous wastes. It should also state the designation of personnel trained to prevent and control spills. Hazardous wastes include pesticides, paints, cleaners and petroleum products.

6.9 Contour trenching is to be provided which an earth embankment or ridge-and-channel arrangement constructed parallel to the contours, along the face of the slope, at regular intervals on the lengths and steep slopes. They are used for reducing run-off velocity, increasing the distance of overland run-off flow. They are also used to hold moisture and minimize sediment loading of surface run-off.

6.10 Prepare the list of trees to be felled with reference to the tree survey, Compensate the loss of vegetation (trees) due to the construction activity by compensatory plantation. Replant same native and/or non-invasive species, which existed on the site before elimination, in the proportion of 1:3 (as per the suggestion of the landscape consultant).

6.11 The contractor shall prepare and submit 'Spill prevention and control plans' before the start of construction, clearly stating measures to stop the source of the spill, to contain the spill, to dispose the contaminated material and hazardous wastes, and stating designation of personnel trained to prevent and control spills. Hazardous wastes include pesticides, paints, cleaners, and petroleum products.

6.12 The contractor shall ensure that no construction leaches (Ex: cement slurry) is allowed to percolate into the ground. Adequate precautions are to be taken to safeguard against this including reduction of wasteful curing processes, collection, basic filtering and reuse. The contractor shall follow requisite measures for collecting drainage water run-off from construction areas and material storage sites and diverting water flow away from such polluted areas. Temporary drainage channels, perimeter dike/swale, etc. shall be constructed to carry the pollutant-laden water directly to the treatment device or facility (municipal sewer line).

6.13 All lighting installed by the contractor around the site and at the labour quarters during construction shall be CFL bulbs of the appropriate illumination levels. This condition is a must, unless specifically prescribed.

6.14 All paints, adhesives and sealants should comply with the VOC limits prescribed by GRIHA, as follows:

6.15 All the building materials and systems used on site must be as per the specifications and approved makes by the consultants.

6.16 All required certificates explaining the properties of the building material/system needs to be obtained from the manufacturer/vendor as required by the green building rating authority.

The final certificates would be produced after the approval of green building consultant with necessary due diligence.

The purchase orders of all the materials made with the manufacturers/authorized vendors should be maintained and shall be provided for the process with due diligence upon request.

6.17 Water saving measures as suggested by the consultants need to be followed on site.

6.18 The contractor / subcontractor shall prepare and submit a Site Management Plan (SMP) within 10 days of start, for approval by the Engineer-in-charge. This SMP shall indicate the locations of godown, stockpiles, barricading, waste storage, offices, vehicular movement routes etc. In short this SMP would comprehensively represent how the site activities shall be managed conforming to GRIHA guidelines.

6.19 Any other site management measures suggested by the Engineer-in-charge / green building consultant shall be followed on site.

6.20 The contractor shall submit to the Engineer-in-Charge after construction of the buildings, a detailed as built quantification of the following:

Total materials used,

Total top soil stacked and total reused,

Total earth excavated,

Total waste generated,

Total waste reused,

Total water used,

Total electricity consumed, and

Total diesel consumed.

6.21 The contractor shall submit to the engineer-in-charge, before the start of construction, a site plan along with a narrative to demarcate areas on site from which top soil has to be gathered, designate area where it will be stored, measures adopted for top soil preservation and indicate areas where it will be reapplied after construction is complete.

6.22 Evidence for the implementation of the all the above required measures shall be provided to the green building consultant in the form of photographs and templates (as provided), which is required for the submission to the green building rating authority (GRIHA).

6.23 Nothing extra shall be payable for above provisions unless otherwise specified in Schedule of Quantities.

6.24 SPECIAL CONDITIONS FOR CLERANCES & ENVIRONMENT MANAGEMET PLAN

A. The contractor shall obtain approval for laying electrical lines from the concerned SE of BERC/BSPHCL/SBPDCL and comply with the provisions as per Terms and condition for determination of Tariff Regulation, 2007 of for construction purpose as well as for final connection.

B. The contractor shall ensure taking necessary steps on urgent basis to improve the living conditions of the labour at site and provide necessary facility to the labour.

C. Contractor has to construct housing colony for labour within the site with all necessary infrastructure and facilities such as health facility, sanitation facility, and fuel for cooking, along with safe drinking water, medical camps, and toilets for

women, crèche for infants. The housing may be in the form of temporary structures to be removed after the completion of the project. Details of provisions should be submitted to Engineer In charge for them to submit it to Bihar State Pollution Control Board at the time of obtaining Consent to Establish.

D. During construction period mobile STP of capacity 60 & 20 KLD shall be provided by the contractor for the labour colony. The drains should be of adequate capacity and be lined till the final disposal points. Provision for disinfection of wastewater after treatment and before reuse to be ensured by the contractor.

E. All required standard and hygienic measures shall be in place before starting construction activities. The safe disposal of wastewater and solid waste generated during the Construction phase shall be ensured.

F. All the laborers engaged for construction shall be screened for health and adequately treated before engaging them to work at the site.

G. All the topsoil excavated during the construction shall be stored for use in horticulture/landscape development within the project site.

H. Disposal of muck during construction phase shall not create any adverse effect on the neighbouring communities and be disposed taking the necessary precautions for general safety and health aspects of people only in approved sites with approve competent authority.

I. The contractor to ascertain that, there is no threat to the ground water quality by leaching of heavy metals and other toxic contaminants during construction will test soil and ground water samples.

J. Construction spoils, including bituminous material and other hazardous materials must not be allowed to contaminate water courses and the dump sites for such material must be secured so that they do not leach into the ground water.

K. The diesel generator sets to be used during construction phase shall be of low-sulphur- diesel type and shall conform to Environment (Protection) Rules for air and noise emission standards.

L. Vehicles hired for bringing construction material and laborers to the site shall be in good conditions and shall conform to applicable air and noise emission standards and shall be operated during non-peak/approved hours.

M. Ambient noise levels shall conform to residential standards both during day and night. Incremental pollution loads on the ambient air and noise quality shall be closely monitoring during construction phase.

N. NOC shall be obtained from National State Disaster Management Authority, · wherever applicable.

O. Water demand during construction shall be reduced by the use of pre-mixed concrete, curing agents and other best practices.

P. Total domestic water requirement shall not exceed 94 KLD during construction stage.

Q. Adequate measures shall be taken to reduce air and noise pollution during construction as per CPCB norms.

R. A First Aid Room should be provided at the project site during construction phase of the project.

S. Any hazardous waste generated during construction phase shall be disposed of as per applicable rules and norms with necessary authorization of the BSPCB.

T. Regular supervision of the above and other measures for monitoring shall be done by Engineer In charge throughout the construction phase, so as to avoid nuisance to the surroundings.

SECTION 7

SAFETY related others codes and rules - as per the C.P.W.D guidelines.

orm H CHECK LIST FOR GOVT AGENCIES/ PSUS			
Sr. No.	**Check Item**	**Yes/No**	**No of Pages**
	Received and studied the following documents		
	Main Tender Document including the RFP, General Conditions of Contract, Special Conditions of Contract, Technical Specifications and Tender Forms & Formats in the soft copy .pdf form containing a total number of ----- pages excluding the cover page		
	Bill of Quantities in the..		
	Total number of tender drawings received and studied are -----		
	Cover letter is complete on the company letterhead and signed by the authorized signatory and stamped with company seal.		
	The tender being filled is in total compliance with the terms specified and there is no assumption of any special condition in addition to what has been specified in the tender documents by the owners		
Envelope 1: Technical Tender			
	Envelope 1 : Pre-Qualifying Documents **EMD and Tender Fee**		
	Envelope 2 : Technical Eligibility Documents		
	Documents certified by a chartered accountant in support of Average Annual Financial Turnover during the last 3 years, ending 31st March of the previous financial year has been submitted and the average annual financial turnover is more than or equal to 50% of the estimated cost		

	Balance sheet duly audited and Certified by a Chartered Accountant showing that the Govt agencies/ PSUs has not incurred any loss (profit after tax should be positive) in more than two (2) years during the available last five consecutive financial years, ending 31st March 2019.		
	Documents in support of having successfully completed similar works during last 7 years as mentioned below		
	Form A to E completed, signed, stamped and put together along with all the relevant documentary proof solicited in the Form A to H shall be put in envelope 1		
	Envelope marked as Envelope 1 on Top and titled as "Technical eligibility documents"		
	Envelop 1 is sealed and signed		
	Scanned copy of the Technical eligibility documents uploaded on the e-tendering portal		
	Envelope 2 : Signed Tender Documents		
	Signed and stamped all the pages of tender documents as uploaded by the University (Notice Inviting Tender, summary Schedule of Quantities, SOQ, technical specifications and all the tender drawings)		
	All these documents put together in an envelope and Envelope marked as Envelope 2B on Top and titled as "Signed Tender Documents"		
	Envelope for Technical Tender is sealed, signed and stamped		
ENVELOPE 3 FOR FINANCIAL TENDER – Only online			
	Bill of Quantities duly filled in and compiled with rates quoted as percentage below/above/at par with the rates entered in the Schedule of quantities,		
	Envelop is sealed, signed and stamped		

	All the two envelopes shall be placed in a large sealed envelope marked as **"Tender for engaging contractor for setting up 5000 KW AC Capacity grid connected ground mounted solar PV system including DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING at the permanent campus of Nalanda University (NU), Nalanda, Rajgir, Bihar** **"**		

PACKAGE- 4C

ENGAGING DESIGN, PROCUREMENT, INSTALLATION, COMMISSIONING & TESTING CONTRACTOR FOR SETTING UP 5 MW AC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM AT PERMANENT CAMPUS OF NALANDA UNIVERSITY, RAJGIR, BIHAR.

AT

NALANDA UNIVERSITY, AT RAJGIR, BIHAR.

DESIGN, PROCUREMENT, INSTALLATION & COMMISSIONING & TESTING TENDER DOCUENT

Technical Part

(5 MW AC CAPACITY SOLAR FARM)

DISCLAIMER

These tender documents are not an agreement or offer by NALANDA UNIVERISTY to the prospective Bidders or any other party. The purpose of these tender documents is to provide interested parties with information to assist the formulation of their Bid. The tender documents are based on material and information available in public domain and specific surveyed carried out by NALANDA UNIVERISTY for the purpose of the assignment.

The tender documents, along with the Formats, are not transferable. The tender documents and the information contained therein, has to be used only by the person to whom it is issued through e-tendering platform. It shall not be copied or distributed by the recipient to third parties. In the event that the recipient does not continue with its involvement in the bidding process these tender documents must be kept confidential.

While the tender documents have been prepared in good faith, neither NALANDA UNIVERISTY nor its employees or advisors/consultants make any representation or warranty express or implied as to the accuracy, reliability or completeness of the information contained in the tender documents.

Neither NALANDA UNIVERISTY, its employees nor its advisors / consultants will have any liability to any Bidder or any other person under the law of contract, tort, the principles of restitution or unjust enrichment or otherwise for any loss, expense or damage which may arise from or be incurred or suffered in connection with anything contained in the tender documents, any matter deemed to form part of the tender documents, the information supplied by or on behalf of NALANDA UNIVERISTY or its employees, any advisors/ consultants or otherwise arising in any way from the selection process.

This ON-GRID PV Power Project is recognized and registered under CPSU (Tranche-II) Phase-II Scheme being run by the **"Solar Energy Corporation of India Limited under Ministry of New and Renewable Energy, Govt of India",** and hence the bidder has to mandatorily comply the technical requirement published under the CPCU scheme. In addition, to the mandate of the CPCU scheme and SECI requirement, the published technical specification herewith by the university shall be followed as per the design confirmation after issuance of the contract award. The successful bidder will be bound to support the stage confirmations, information required to the SECI in future (if any) related to the project without any delay.

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1. Introduction and Background

Nalanda University is an Educational Campus proposed at Rajgir, BIHAR, The site is located along the Patna - Rajgir Highway and is well connected with the city of Rajgir, Bihar. Total area of the site is approximately 455 acres ("Site").

The proposed campus of Nalanda University is planned to be developed on a mostly flat terrain in the foot hill of Nalanda Hills. The site is located in Gangatic plains area of Southern Bihar.

Entire campus is planned to be constructed in two phases. The first phase will be of approximately 140,200 Smt. of built up area.

This tender is for setting up of Solar farm of 5 MW Capacity under including all related works in Civil, Electrical and plumbing work and power evacuation as per the campus requirement.

2. Scope of Work and Technical Specifications

2.1 Scope of Work

2.1.1 The scope of work shall include overall design, engineering, approval from client & SECI/NISE and third-party team, quality surveillance, testing, technical & documentation for liaising, packing, supply, erection, & testing and commissioning and performance testing of grid interactive solar photovoltaic system of 5000 KW to be installed at PERMENANT CAMPUS OF NALANDA UNIVERSITY - RAJGIR, BIHAR. It shall be responsibility of the Bidder to ensure that all the works as per scope of the specification are completed in totality for safe and efficient working of the system.

This includes co-ordination and approval from the SECI, BERC, DISCOM and third party vetting as well.

After completion of the SITC in EPCC mode, the comprehensive Operation and Maintenance will be performed confirming to the SLA.

Formula for performance testing is given in this document as annexure – P for perusal.

The scope is defined for the design, and specification read with CPWD manuals supply, Installation, Testing and Commissioning of ongrid Solar Photovoltaic Power Plant conforming to MNRE specifications as amended, consisting of Mono/Poly Crystalline silicon solar cells, net metering facility, necessary protections, earthing, mounted on Aluminium/GI structure of suitable strength with following components complete as required:- a) Solar Photovoltaic Module of capacity 330 Wp or above, manufactured in India, conforming to IS 14286/IEC 61215, IS/IEC 61730-Part-1, IS/IEC 61730-Part-2. Solar Photovoltaic Module conversion efficiency shall not be less than 16.5%. PV modules used in solar power plants/ systems must be warranted for their output peak watt capacity, which should not be less than 90% at the end of 10 years and 80% at the end of 25 years. b) Power Conditioning Unit (PCU) of 350-800 V DC Input voltage range and 400 V AC, three phase, 4 wire, 50Hz +/- 2.5 Hz, output voltage suitable to generate AC Power with efficiency not less than 97%, total harmonic distortion less than 3% and suitable for ambient temperature from 0 to 50 degree C. The PCU shall adjust the voltage and frequency level to suit the Grid Voltage Frequency. c) Data Monitoring System complete with accessories. d) Fixing of Array junction box & Main junction box with IP 65

protection and termination arrangement for incoming and outgoing cable along with glands, lugs and other accessories etc. as required. e) Lightning and surge voltage protection. (f) Connections & Interconnections by supplying & fixing required size XLPE insulated copper conductor 1.1 kV grade armoured power and control cables between solar modules, main power cable to grid supply PCU unit along with supplying & fixing of necessary channel/conduit lugs and other accessories etc. as required. The Plant size 5 MWac with ILR 1.3 which equals to 6.5 MWdc.

The CUF to be maintain minimum 19% or as per the third party approval. The 415V /11KV steup Transformer with its Main LT Panel, HT Panels and Cable at the 11KV line/feeder will be executed by the University through other contractor.

2.1.2 These systems shall be complete with PV modules, inverter, metering, junction boxes, AC, DC distribution boards and cables, communication interface, and any other equipment necessary for safe and efficient operation of the grid connected Ground Mounted Solar PV systems.

2.1.3 The scope of supply shall also include comprehensive insurance, storage and transportation, necessary fabrication works for installation of complete system etc. No civil construction work including foundation, roads & paved streets will be provided by client, everything shall be under scope of solar vendor as per requirement & approved design. This includes all other civil activity like cleaning & surface of ground, required trench / pipe network laying, related excavation backfilling, etc shall be part of this scope of work & solar vendor has to do the same as per standard practise & requirement of site in-charge.

2.1.4 The proposal submitted by the bidder should be inclusive of comprehensive O&M charges for 5 (five) years from the date of successful commissioning of grid connected Ground Mounted solar PV project.

2.1.5 The contractor should maintain all necessary spares for breakdown to maintain zero breakdown time.

2.1.6 The equipment offered shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in commercial operation up to Bidder's guarantee in a manner acceptable to the purchaser, who will interpret the meaning of drawings, specification and shall have the power to reject any work or materials, which is his judgment are not in full accordance therewith.

2.1.7 It shall be responsibility of the Bidder to obtain all necessary statutory & other clearances in well advance from the competent authorities.

2.1.8 All the necessary co-ordination with regard to Sub-Contracted items shall be carried out by the Bidder. The purchaser/Engineer will communicate only with the Bidder for all matter pertaining to this contract.

2.1.9 The total price for this contract shall be on lump sum all-inclusive Basis and shall cover all items and service necessary for successful completion of the contract. Even if all components of a system included in this specification are not explicitly identified and /or listed herein, these shall be supplied under this contract to ensure completion of the system and facilitate proper operation and easy maintenance of plant.

2.1.10 Considering the reliability of the grid, no electrical storage batteries shall be required as excess electricity generated by the solar panels which are not required by the equipment/ devices in the building premises shall be exported to grid.

2.1.11 All the fittings and accessories that might not have been mentioned specifically in the Specification but are necessary for the plant, shall be deemed to be included in the specification and shall be supplied and furnished by the Contractor without any extra charge.

2.1.12 This scope also includes to design, supply, installation, testing, commissioning, operating & maintaining a complete day night CCTV Surveillance system for the solar farm covering all key areas from surveillance point of view. The system shall include high quality day/night vision outdoor rated IP base cameras with required mounting arrangement, IP rated termination boxes, cables, hoods, etc along with a centralised DVR system which shall be capable to have last 180 days 24X7 Data Storage of CCTV footage in it. Remote base operation facility shall be provided for the system. All the components of the system shall be in line with latest IEC codes & relevant standards.

2.1.13 This scope also includes to design, supply, installation, testing, commissioning, operating & maintaining LED based area lighting for the solar farm covering all key areas for O&M purpose. Fixture shall be minimum IP 66 rated along with minimum IP 65 rated control gear, luminance efficacy of the fixture shall be more than 70%, colour temperature shall be 3000~4000 K to match the peripheral area lighting of the campus. GI / PU Painted poles as per IS guideline, shall be used made of B class pipes with preferable integral junction box & sufficient protection per pole. This shall includes all necessary electrical cabling, earthing Timer based control panel etc as required to complete the system. Average 30 Lux to be maintained through the solar farm when all the lights are on.

2.1.14 Client will provide Power, Water Supply & One Internet Connection at one predefined point to the solar farm, from that point onwards, everything shall be in the scope of Solar Contractor. Power will be measured through a sub meter which shall be arranged by the contractor as per given specification in this document. Charges for the power & internet to be reimbursed to the main campus organisation, while provision for water meter to be kept in the system at present for water part of this.

2.1.15 Any kind of coordination, liaison, authority supervision / approval etc & preparation of related documents etc shall be in the scope of solar contractor. All kind of required approvals shall be taken by the contractor on behalf of client. No extra charges to be paid to contractor for these.

2.1.16 This scope shall include design, approval, supply, installation, testing & commissioning of Complete SCADA System as per requirement provided in this document & as required for such setup.

2.1.17 This scope shall also include providing competent manpower for dealing with SLDC requirements to generate & provide adequate data to State Load Dispatch Centre on behalf of client as per requirement.

2.1.18 All Electrical High Side Equipments starting from Bus-duct, Transformer of 415 V to 11 KV, its related earthing, UPS for 11 KV System, Safety Equipments for 11 S/S, 11 KV Panels etc will be provided by client at desired location.

2.1.19 All Indoor electrification for client provided constructed areas like 11 KV Sub-station Panel Rooms, Utility Room, Supervision Rooms etc will be provided by client as per requirement. All other construction

for LT panel rooms, O&M staff, UPS & Battery rooms, Local Scada Centre, external lighting within solar farms & near vicinity to solar farms to be designed & provided by solar vendor.

2.1.20 The contractor has to ensure cleaning/washing as per the approved schedule. The contractor will submit the cleaning schedule on a monthly basis in advance, and a monthly certification shall be submitted for the compliance of the approved program. CCTV,Pump & pipes, manual & robotics cleaning shall be within the schedule of O&M requirements. The minimum 3 Nos skilled manpower requirement at the site to be deployed by the contractor. Minimum once in 15 Days cleaning shall be performed by the contractor.

2.1.21 e Contractor has to design, supply, installation & testing of required complete Plumbing system for cleaning of solar modules etc as may be required. Sufficient /adequate quantity of raw water will be provided at one point of the solar farm & all further scope will be of vendor. Automatic type water cleaning system shall be provided for solar modules.

2.1.22 The Contractor has to design & provide all the safety measures related systems & equipments including & not limited to Fire Detection System / Fire Fighting System etc as per standards requirements.

2.1.23 The contractor has to arrange complete visit & give a call for Pre Dispatch Inspection in prior (at least 15 days). All related cost for PDI to be bared by the contractor

2.1.24 The contractor has to submit all final data & as built drawings & details in 5 sets of hard copy including soft copy in pdf & AutoCAD at the time of completion.

2.1.25 All necessary support as on required shall be extended by the contractor for subsidy to the client for the project.

2.1.26 A licensed PV System Software shall be provided by the contractor for plant analysis and its performances verifications.

2.1.27 The scope of design supply & installation of all metal structure shall be in the scope of contractor. The design requirement for bearing capacity against the wind speed/load impact / forces need to be indicated in DPR. The maximum wind speed experienced during the last 50 years date to be consider. It shall be designed for minimum wind speed of 140KM/hrs. and above in general, but this must be in consultation through a structural specialist by the vendor.

2.1.28 The contractor shall submit the detail design and dimension & other requirements of all the civil structures in well advance for approval by the University before execution.

2.2 Codes and Standards

The PV modules used in the grid connected solar power projects must qualify to the latest edition of Mono / Poly Crystalline Silicon Solar Cell Modules as per IEC 61215 or equivalent BIS standards. In addition, PV modules must qualify to IEC 61730 for safety qualification testing at 4100 V DC or higher. the modules must conform to IEC 61730 Part-1 - requirements for construction & Part 2 – requirements for testing, for safety qualification or equivalent IS.

2.2.1 For the PV modules to be used in a highly corrosive atmosphere throughout their lifetime, they must qualify to IEC 61701. The bidder needs to provide relevant certifications for the same.

2.2.2 The PV modules must be tested and approved by one of the IEC authorized test centres. In addition, a PV module qualification test certificate as per IEC standard, issued by ETDC, Bangalore or Solar Energy Centre MNRE, New Delhi will also be valid. The bidder needs to provide relevant certifications for the same.

Other subsystem / components used in SPV power plant (Cables, Connectors, Junction Boxes, Surge Protection Devices, etc.) must also confirm to the relevant international / national Standards for Electrical Safety besides that for Quality required for ensuring Expected Service Life and Weather Resistance.

2.3 Warranty

2.3.1 The mechanical structures, electrical works and overall workmanship of the grid solar power plants must be warranted for a minimum of 15 years. PV modules used in grid connected solar power plants must be warranted for output wattage, which should not be less than 90% at the end of 10 years and 80% at the end of 25 years. Contractor shall install the performance evaluation system, and the contractor or the contractor through manufacturer will submit the performance certificate on a yearly basis. The suggestions and remedial for better performances shall be submitted by the contractor and/Or manufacturer. A Back to back tripartite agreement to be signed between the client, contractor, and Manufacturer.

2.4 Identification and Traceability

Each PV module used in any solar power project must use a RF identification tag. The following information must be mentioned in the RFID used on each module (This can be inside or outside the laminate but must be able to withstand harsh environmental conditions.)

a. Name of the manufacturer of PV Module
b. Name of the Manufacturer of Solar cells
c. Month and year of the manufacture (separately for solar cells and module)
d. Country of origin (separately for solar cells and module)
e. I-V curve for the module
f. Wattage, Im, Vm and FF for the module
g. Unique Serial No and Model No of the module
h. Date and year of obtaining IEC PV module qualification certificate
i. Name of the test lab issuing IEC certificate
j. Other relevant information on traceability of solar cells and module as per ISO 9000/9001 and ISO 14001

2.5 General Requirements

Design, Equipments & System shall be as per the SBPDCL/BERC guidelines for

ON-GRID Connection Solar PV system.

2.5.1 Solar PV system shall consist of following equipment:

i) Solar PV modules consisting of required number of PV cells.

ii) Power Conditioning Units/ Inverters with SCADA

iii) Mounting structures (metal part & construction part) including grouting by contractor.

iv) Cables and hardware including but not limited to required size & strength of Nut Bolts. (A detail fabrication drawing to be provided by the contractor for approval showing all the fabrication arrangements for approval)

v) Junction box and distribution boxes

vi) Earthing system

vii) Lighting arrestors

viii) PVC pipes and accessories

ix) Tool Kit

x) 2.1 m meter high Chain-link fencing with minimum 6.5 m wide gate, and a Watchman cabin, around the Solar Power Plant.

xi) Minimum 4.0 m. wide internal road with Cement Concrete surface and min. 1.5 m wide Footpaths/pathways from Gate to all the parts of Solar PV Farm required for Smooth operation and Maintenance of the entire Solar PV Farm.

xii) The Bidder will have to Prepare the master plan for the Entire Solar PV farm including Location of Solar PV Panels, Control rooms, Transformer Yard, Location of Grid Connection, Internal Roads & Pathways, gates etc. along with their Bid.

xiii) A complete SCADA setup shall be made available which shall connect all the modules via optimizers, all the PCU / inverters, Power Panel Switchgear & Meters & all other misc components like UPS etc & a final gateway to be provided to communicate & handover control (when & if required) to the master SCADA of the campus. All required hardware, software setups & license, training etc shall be included in this scope.

2.5.2 Installation shall be done by the licensed engineer who has adequate experience with installation of the PV system. The installer must verify that the system has been installed according to the manufacturer's procedures. A checkout procedure should be developed to ensure an efficient and complete installation.

2.5.3 Modules with output of 330 Wp or above shall be used. Photo / electrical conversion efficiency of SPV module shall be greater than 16.5%. (mono/multi crystalline)

2.5.4 All grid solar PV power plants must install necessary equipment to continuously measure solar radiation, ambient temperature, wind speed and other weather parameters and simultaneously measure the generation of DC power as well as AC power generated from the plant. They will be required to submit this data to the Ministry on line and/ or through a report on regular basis for the entire duration of Agreement if required.

2.6 PV Arrays

a) Supplier shall follow the latest engineering practice to ensure long-term compatibility requirement and continuity of equipment supply and the safety of the operating staff.

b) The PV project developers are required to optimize generation of electricity in term of kWh generated per kWp of PV capacity installed vis-à-vis available solar radiation at the site (may be obtained through use of efficient electronics, lower cable losses, maximization of power transfer form PV modules to electronics and the grid, maximization of power generation by enhancing incident radiation by optional methods like seasonally changing tilt angles (but not the trackers) etc.)

c) The PV system shall support remote monitoring of important parameters. The system shall be designed such that personal without any background knowledge in Microprocessor-based technology are able to operate the system. The operator interface shall be intuitive such that operating personal shall be able to operate the system easily after having received some basic training.

d) The manufacturer shall arrange certification on qualification of PV modules.

e) Stabilized net output of the Solar PV Array for the Solar System should not be less than the Normal design level for the system under Standard Test Condition

f) Fill factor of the module shall not be less than 0.75.

g) The bidder shall provide the sample solar PV module electrical characteristics including current-voltage (I-V) performance curves and temperature coefficients of power, voltage and current. However, the tabulated document with all the relevant data like voltage, current, power output for all the modules also to be provided.

h) The PV modules shall be suitable for continues outdoor use.

i) The PV modules shall be made of high quality laminated in ultra violet stabilized polymer material such as Ethyl Vinyl Accelerate (EVA). High transmission glass is on the top and Tedlar sheet at bottom side of the module should be provided. The size of single crystalline silicon PV cells shall be so chosen so as to maximize energy density and align with economics of scale. The Cells are encapsulated under vacuum to make the PV module weather proof. The electrical output connections are taken through a weather proof (IP65 rated) junction box.

j) PV module shall be provided with frame of anodized channel for size and simplicity in installation offered as a single module or series parallel combination of modules. The PV module shall be provided with screen- less frame with Solar cable and connector.

a. Cells are encapsulated under high-transmission toughened glass.

b. Laminate edges are sealed by sealant.

c. Framed using weather resistant RTV silicon sealant.

k) The PV module shall be equipped with bypass diode to minimize power drop caused by shade. It should have waterproof terminal box with provision for mounting bypass diodes.

l) The PV modules shall be made of light weight cells, resistant to abrasion, hail impact, rain water and environmental pollution. The PV modules shall be provided with antireflection coating and back surface field (BSF) structure to increase conversion efficiency.

m) The PV modules shall use lead wire weatherproof connector for output terminal.

n) All materials used shall have a proven history of reliable and stable operation in external applications. Whole system shall perform satisfactorily in relative humidity up to 85% with temperatures between -10ºC to +85ºC and withstand gust up to 140 km/h and above on the surface of panel

2.6.1 The SPV Module must be provided with acceptable Test & Certified documents. The PV shall provide a copy of the type test certificate(s)/ reports(s) with the bid and routine type reports before the dispatch of the equipment.

2.7 Power Conditioner Unit

For Power Conditioners/Inverters[1] following certificates shall be submitted by the bidder

- Efficiency Measurements- IEC 61683
- Environmental Testing- IEC 60068-2 (6,21,27,30,75,78)
- Electromagnetic Compatibility (EMC) IEC 61000 series – relevant parts
- Electrical Safety IEC 62109-1&2
- Protection against islanding of Grid IEEE 1547/UL 1741 / equivalent
- Other sub-system components BIS standards

The DC power produced is fed to inverter for conversion into AC. In a grid interactive system AC power shall be fed to the grid at three phase 11 KV AC bus. Power generated from the solar system during the daytime is utilized fully by powering the loads and feeding excess power to the grid as long as grid is available. In cases, where solar power is not sufficient due to more demand or cloud cover etc. the building loads shall be served by drawing required energy from the grid. The inverter should always give preference to the Solar Power and will use Grid power only when the Solar Power is insufficient to meet the load requirement as per the third party confirmation for its optimization as per the campus need. Each PCU should be rated minimum 50 KW & maximum 200 KW - voltage can be 800, 1000 OR 1500 V but as per SLD eventually it should be at 415V when it connects to client side.'

a) The inverter shall be a true sine way inverter for a grid interactive PV system. The output of the inverter must synchronize automatically its AC output to the exact AC voltage and frequency of the grid.

b) Inverter shall continuously monitor the condition of the grid and in the event of grid failure; the inverter automatically switches to off-grid supply within 20-50 milliseconds. The solar system is resynchronized with two minutes after the restoration of grid.

[1] Must additionally conform to the relevant national/international Electrical Safety Standards.

c) Grid voltage shall be continuously monitored and in the event of voltage going below a preset value and above a preset value, the solar system shall be disconnected from the grid within the set time. Both over voltage and under voltage relays shall have adjustment voltage (50% to 130%) and time settings (0 to 5 Seconds).

d) Metal Oxide Varistors (MOVs) shall be provided on DC and AC side of the inverter.

e) The inverter control unit shall be so designed so as to operate the PV system near its maximum Power Point (MPP), the operating point where the combined values of the current and voltage of the solar modules result in a maximum power output.

f) The degree of protection of the outdoor inverter panel shall be at least IP- 55.

g) Typical technical features of the inverter shall be as follows:

Purpose	The power conditioner unit shall convert DC produced by SPV array and adjust the voltage & frequency levels to suit the Grid.
Grid supervision	All three phases shall be supervised with respect to rise / fall in programmable threshold values of frequency & the power section of the plant. The plant shall get disconnected / connected from the grid in case of a grid fault / after normal grid conditions have resumed.
Type & technology	IGBT based and should utilize a circuit topology and components suitable for meeting the specifications.
Output voltage on AC side	415 +10%, - 15% V AC at 50 Hz A dedicated isolation transformer housed in the PCU enclosure shall be supplied to match the PCU output voltage to the utility grid voltage. If necessary, PCU/ Solar Inverter voltage range should be reconfigured as per site requirements.
DC system voltage	The electrical safety of the array installation is of the utmost importance. Array electrical configuration shall be in such a way that, the MPPT shall operate with maximum efficiency, between the low and high temperature of the site.
Maximal Current ripple	3%
Power Factor	0.95 inductive to 0.95 capacitive
No load losses	< 1% of rated power
Ambient room temperature	5 to 55 ºC

Housing Cabinet	a) PCU is housed in suitable switch cabinet, with min IP 21 degree of Ingress Protection. b) Weatherproof, rodents & insect proof c) Components and circuit boards mounted inside the enclosures clearly identified with appropriate permanent designations, which shall also serve to identify the items on the supplied drawings. d) All doors, covers, panels and cable exists shall be gasketed or otherwise designed to limit the entry of dust and moisture. All doors shall be equipped with locks. All openings shall be provided with grills or screens with openings no larger than 0.95 cm (about 3x8 inch).
Display	Liquid crystal display shall at least be provided on the inverters front panel or on Separate data logging/display device to display following • DC Input Voltage • DC Input current • AC Power output(kW) • Current time and date • Time active • Time disabled • Time Idle • Temperatures (c) • Converter status

h) Other important features

Electrical safety Protections a)General	i) The PCU shall include appropriate self-protective and self-diagnostic feature to protect itself and the PV array from damage in the event of PCU component failure or from parameters beyond the PCU's safe operating range due to internal or external causes. The self-protective features shall not allow signals from the PCU front panel to cause the PCU to be operated in a manner which may be unsafe or damaging. Faults due to malfunctioning within the PCU, including commutation failure, shall be cleared by the PCU protective devices and not by the existing site utility grid service circuit
b) Over/under voltage	• Mains (Grid) over-under voltage and frequency protection. • Over voltage protection against atmospheric lightning. • Protection against voltage fluctuations in the grid itself and internal faults in the power conditioner, operational errors and switching transients.
c) Islanding	• Protection against islanding
d) Accidental	Full protection against accidental open circuit and reverse polarity

open circuit	at the input.
e) Internal Faults	Inbuilt protection for internal faults including excess temperature, commutation failure, overload and cooling fan failure is obligatory
f) Galvanic Isolation	Galvanic isolation is provided to avoid any DC component being injected into the grid and the potential for AC components appearing at the array. - Galvanic isolation shall be provided between the inverter/ PCU and grid to avoid any DC component being injected into the grid and the potential for AC components appearing at the array. - The specification of the isolation transformer shall be as follows: • Capacity: 125% of capacity of the PV modules (i.e., a 12.5 kVA transformer shall be used for a 10 kW PV system, and so on) • System: 3-phase, 4-wire • Input voltage range: 320-480 V AC • Output voltage range: 380-435 V AC • Output voltage for single phase: 220-240 V AC • Tap change: Manual, V+/-20%, V+/-10%, V+/-0% • Operating frequency: 48-52 Hz • Efficiency:>98.5% • Impedance: 4-10% • Output waveform: Zero distortion • Insulation class: Class F • Leakage current: <20 mA • Cooling: AN • Enclosure: IP 21 (if indoors) • IP 54 (if outdoors) • Normal Operating Temperature: 0-60°C • Cable entry: Separate input/ output enclosed cable entry • Standard: IS 2026 - Further, it is also observed at various locations throughout the distribution grid that the grid voltage would consistently be greater or less than the acceptable voltage window of many inverters and PCUs. Moreover, this variation may be only for particular days of a week, seasonal, or for a limited time. - In such a case, the Contractor shall study/ measure the point of interconnection of the PV system consistently for at least one

	week to identify the voltage range experienced at the interconnection point of the distribution grid. Consequently, the Contractor shall adjust the input/ output of the isolation transformer to appropriate tap settings so that the voltage on the inverter side of the transformer is always within the acceptable voltage window of the inverter. The appropriate tap setting shall be conveyed to NALANDA UNIVERISTY by the contractor.
g) Earth Fault Supervision	An integrated earth fault detection device is provided to detect eventual earth fault on DC side and shall send message to the supervisory system
h) Disconnection & Islanding	a) Disconnection of the PV generator in the event of loss of the main grid supply is achieved by in built protection within the power conditioner. This may be achieved through rate of change of current, phase angle, unbalanced voltages, or reactive load variants. b) Operation outside the limits of power quality as described in technical data sheet shall cause the power conditioner to disconnect the grid. Additional parameters requiring automatic disconnection are: • Neutral voltage displacement • Over current • Earth fault & • Reverse power In each of the above cases, tripping time shall be less than 0.5 seconds. Response time in case of grid failure due to switch off or failure based shutdown should be well within 60 seconds.
i) Automatic reconnection after the Grid restoration	PCU has facility to reconnect the Inverter automatically to the grid following restoration of grid, subsequent to grid failure condition.
Array Ground fault	Provided
Operator interface	LCD and keypad operator interface, Menu driven.
Fault conditions	Automatic fault conditions reset for all parameters like voltage, frequency and /or black out.
Control Logic Failure detection	Using watch dog timers.

Parameter access	All parameters accessible through an industry standard communication link.
DC-AC conversion efficiency	• 93% for output ranging from 20% to full load • Idling current at no load shall not exceed 2% of the full load current.
DC isolation	Provided at the output by means of a suitable isolating transformer
Parallel operation with Grid	Provided & capable of interrupting line-to-line fault currents and line to ground fault currents.
Unbalanced output load	PCU is able to withstand an unbalanced output load to the extent of 30%.
PCU generated harmonics	Shall not exceed a total harmonic current distortion of 5%, a single frequency current distortion of 3%, and single frequency current distortion of 1%, when the first through the fiftieth integer harmonics of 50Hz are considered.
Circuit separation	High voltage & power circuits separated from low voltage & control circuits.
Internal wiring	Standard Cu wiring, with flame resistant insulation.
Cabling practice	a) Cables :PVC Cu cables as per relevant international Standards) b) Cable connections : suitable terminations c) PVC channel with covers to house the cables.
High voltage test	PCU with stand high voltage test of 2000 Vrms between either the input or the output terminals and the cabinet (chassis).
EMI (Electromagnetic interface)	PCU shall not produce EMI which cause malfunctioning of electronic & electrical instruments including communication equipments which are located within the facility in which the PCU is housed.
Display on front panel & indicators	a) instantaneous PCU ac power output and the DC voltage current and power input b) Accuracy of display : 3% of full scale factor or better c) Display visible from outside the PCU enclosure. d) Operational status of the PCU, alarms, trouble indicators and AC and DC disconnect switch positions shall also be communicated by appropriate messages or indicator lights on the front cover of the PCU enclosure.

Emergency OFF	Emergency OFF button is located at an appropriate position on the unit
Grounding	PCU includes ground lugs for equipment and PV array groundings. The DC circuit ground is a solid single point ground connection.
Exposed surfaces	Exposed surfaces of ferrous parts are thoroughly cleaned, primed, and painted and suitably protected to survive a nominal 30 years design life of the unit.
Factory Testing	• Tested to demonstrate operation of its control system and the ability to be automatically synchronized and connected in parallel with a utility service, prior to its shipment. • Operation of all controls, protective and instrumentation circuits demonstrated by direct test if feasible or by simulation operation conditions for all parameters that cannot be directly tested. • Demonstration of utility service interface protection circuits and functions, including calibration and functional trip tests of faults and isolation protection equipment. • Operation of startup, disconnect and shutdown controls also to be tested and demonstrated, stable operation of the PCU and response to control signals shall also be tested and demonstrated. • Factory testing include measurement of phase currents, efficiencies, harmonic content and power factor. All tests shall be performed 25, 50, 75 and 100% of the rated nominal power. • Factory test report (FTR): Should be supplied with the unit after all tests. The FTR shall include. • Detailed description of all parameters tested qualified and warranted.
MPPT	Maximum power point tracker is integrated in the power conditioner unit to maximize energy drawn from the array. The MPPT shall be microprocessor based to minimize power losses. The MPPT shall have provision (manual setting) for constant voltage operation. The MPPT unit shall confirm to IEC 62093 for design qualification.
Operating Modes	a) Night or sleep mode : where the Inverter is almost completely turned off, with just the timer and control system still in operation, losses < 2 W per 5 kW b) Standby mode: where the control system continuously monitors the output of the solar generator until pre-set value is exceeded (typically 10 W).

	Operational of MPP tracking mode: the control system continuously adjust the voltage of the generator to optimize the power available. The power conditioner shall automatically re-enter standby mode input power reduces below the standby mode threshold. Front panel display providing the status of the PCU, including AC power output & DC current voltage and power input, and unit fault indication. Shut down / standby mode with its contact open under the following conditions before attempting an automatic restart after an appropriate time delay; in sufficient solar power output. ***a) Insufficient solar power input :*** When the power available from the PV array is insufficient to supply the losses of the PCU, the PCU shall go to a standby/ shutdown mode. The PCU control shall prevent excessive cycling during rightly shut down or extended periods of insufficient solar radiation. ***b) Utility -Grid over or under voltage :*** The PCU shall restart after an over or under voltage shutdown when the utility grid voltage has returned to within limits for a minimum of two minutes. ***c) Utility-Grid over or under frequency*** *:* The PCU shall restart after an over or under frequency shutdown when the utility grid voltage has returned to the within limits for minimum of two minutes.
Inverter / Array Size Ratio	The ratio of the Inverter continuous power rating and the array peak power rating shall be between 80 to 90%. This is because better overall annual yield can be obtained by allowing the Inverter to operate for longer periods closer to optimal efficiency.
Data Logging System	All major parameters available on the digital bus and logging facility for energy auditing through the internal microprocessor and can be read on the digital front panel at any time the current values, previous values for up to a month and the average values. The following parameters shall be accessible via the operating interface display : • AC voltage • AC output current • Output power • DC input voltage

	• DC input current • Time active • Time disabled • Time Idle • temperatures (C) • Converter status Protective function limits viz., AC over voltage, AC under voltage, Over frequency, under frequency, ground fault, PV starting voltage, PV stopping voltage, over voltage delay, under voltage delay over frequency, ground fault delay, PV starting delay, PV stopping delay.
Remote Monitoring System	• A remote monitoring system shall be included with each photovoltaic system. • Usually such monitoring systems are connected and synchronized with the inverters. • Such monitoring services are provided by many leading inverter manufacturers and also third party service providers. • The monitoring system should transmit the following data in real-time to a central server and store it: ✓ DC currents, voltages and power. ✓ AC currents, voltages and power. ✓ Irradiation, ambient temperature, module temperature and wind speed. ✓ Error logs. • This data may be transmitted either using the available LAN or GSM/ GPRS, or any other mode of connectivity available at the site. SIM card for the same to be provided by Vendor. • The contractor shall be responsible for data connectivity for monitoring up to the warranty/ O&M period of the PV system, after which, the Contractor shall transfer all ownership rights, account information, instructions, etc. to NALANDA UNIVERISTY. • The stored data should be represented through hourly, daily, monthly, etc. graphs and easily downloadable in .csv or .xls format.

2.8 Protections and Control

2.8.1 PV system software and control system shall be equipped with islanding protection as descried above. In addition to disconnection from the grid (islanding protection i.e. on no supply), under and over voltage conditions, PV systems shall be provided with adequate rating fuses, fuses on inverter input side (DC) as well as output side (AC) side for overload and short circuit protection and disconnecting switches to isolate the DC and AC system for maintenances are needed. Fuses of

adequate rating shall also be provided in each solar array module to protect them against short circuit.

2.8.2 A manual disconnect switch beside automatic disconnection to grid would have to be provided at utility end to isolate the grid connection by the utility personal to carry out any maintenance. This switch shall be locked by the utility personal.

2.8.3 In case grid failure resulting into islanding operation appropriate provisions should be made to utilize the available solar power to continuously supply the connected load.

2.9 Integration of PV Power With Grid

2.9.1 Solar PV systems shall be provided with synchronizing at PCU level having two input for comparison i.e. grid supply vs. solar output, so as to connect the SPV systems in synchronism with grid.

2.9.2 The output power from SPV would be fed to the inverter which converts DC produced by SPV array to AC and feeds it into the main electricity grid after synchronization. In case of grid failure, or low or high voltage, solar PV system shall be out of synchronization and shall be disconnected from the grid.

2.9.3 The solar power would be used for local consumption. The excess power from inverter would be fed at the panel of NALANDA UNIVERISTY.

2.10 Metering Scheme

i) Metering is required to measure the Solar Gross Generation on continuous basis and register cumulative energy based on 15 minute interval basis, daily, monthly and yearly energy generation.

ii) The average voltage and power factor based on 15 minute interval must also be recorded.

iii) Meter must also display on demand, instantaneous, AC system voltages and currents, frequency, reactive power with sign, Total harmonics current and voltage distortion etc.

iv) Meter shall comply with the requirements of CEA “Installation and Operation of meters” Regulations 2006 as amended from time to time. The Meter shall be provided as per the requirement of Local Power Supply Company (Local Grid) & has to be inspected & sealed mutually with the local supply company as per their guidelines.

v) All the required liaising work shall be included in the contractor’s scope weather it is for local power supply company correspondence & or approval or for electrical inspector visit & approval etc.

vi) An integrating pyranometer (class II or better) to be provided, with the sensor mounted in the plane of the array. Readout shall be integrated with data logging.

vii) Meter data and reports should be available online with login and password facility.

viii) In addition to above, a separate LT Multi Function KWH sub meter is also required to measure the auxiliary supply made available to the Solar Farm from the main campus. This shall be class 0.5 & of suitable capacity, & shall provided with suitable IP rated lockable meter box. Single point 3 Phase / 1 Phase supply (as per requirement provided) will be made available to the solar farm implementer.

2.11 Power Quality Requirements

i) DC Injection into the grid:

The injection of DC power into the grid shall be avoided by using an isolation transformer at the output of the inverter. It is proposed to limit DC injection within 1% of the rated current of the inverter as per IEC 61727.

ii) Harmonics on AC side

Harmonic distortion is caused principally by non-linear load such as rectifiers and arc furnaces and can affect the operation of a supply system and can cause overloading of equipments such as capacitors, or even resonance with the system leading to overstressing (excessive voltage & current). Other effects are interference with telephone circuits and broadcasting, metering errors, overheating of rotating machines due to increased iron losses (eddy current effects), overheating of delta connected winding of transformer due to excessive third harmonics or excessive exciting current.

The limits for harmonics shall be as stipulated in the CEA Regulations on grid connectivity which are as follows:

- Total Voltage harmonic Distortion = 5%
- Individual Voltage harmonics Distortion = 5%
- Total Current harmonic Distortion = 8%

OR as per the SECI/ CPWD specification which ever will be better for the system.

iii) **Voltage Unbalance** – The Voltage Unbalance in the grid shall not exceed 3.0%.

iv) Voltage Fluctuations

- The permissible limit of voltage fluctuation for step changes which may occur repetitively is 1.5%
- For occasional fluctuations other than step changes the maximum permissible limits is 3%
- The limits prescribed in (i) and (ii) above shall come into force not later than five years from the date of publication of these regulations in the Official Gazette.

2.12 Communication Interface

i) The project envisages a communication interface which shall be able to support.

- Real time data logging
- Event logging
- Operational modes
- Set point editing

ii) The following parameters shall also be measured and displayed continuously.

- Solar system temperature
- Ambient temperature
- Solar irradiation / isolation DC current and Voltages
- DC injection into the grid (one time measurement at the time of installation)
- Efficiency of the inverter

- Solar system efficiency
- Display of I-V curve of the solar system
- Any other parameter considered necessary by supplier of the solar PV system bases on prudent practice.

iii) Data logger must record these parameters for study of effect of various environmental & grid parameters on energy generated by the solar system and various analysis would be required to be provided through bar charts, curves, tables, which shall be finalized during approval of drawings.

iv) The communication interface shall be an integral part of inverter and shall be suitable to be connected to SCADA system and also remotely via the Web using either a standard modem or a GSM / WIFI mode.

2.13 Mounting Structures:

Solar Photovoltaic Module is the key element in PV systems which converts the solar irradiation/energy in to DC electrical Power. SPV Module comprises of series combination of many crystalline silicon solar cells. Solar cells are stacked in between two layers of ethylene vinyl acetate (EVA); High transmission glass is on the top and Tedlar sheet at bottom side of the module. The Cells are encapsulated under vacuum to make the PV module weather proof. The electrical output connections are taken through a weather proof (IP65 rated) junction box. Each PV module junction box contains 3 nos. bypass diodes.

Salient features:

- Cells are encapsulated under high-transmission toughened glass.
- Laminate edges are sealed by sealant.
- Framed using weather resistant RTV silicon sealant.
- Employ anodized aluminum frame for resistance to shock and corrosion.
- Have waterproof terminal box with provision for mounting bypass diodes.

2.13.1 Technical Detail for the PV modules

The PV modules are to be mounted on the mounting structure for optimizing the energy generation. Typically, each structure is capable of supporting at least 10 Nos. of PV modules arranged in multiple rows and columns. As each series string is of 20 modules, two adjacent structures are connected in series to form a series string.

The structure shall support SPV modules at a given orientation at required inclination, absorb and transfer the mechanical loads to the ground properly. These structures will be with anti-corrosive surface protection. The frames and legs of structure assemblies shall be made of MS hot dip galvanization sections with minimum thickness of galvanization of 80 microns. PV module mounting rafters used shall be of Aluminum alloy and all the fasteners except foundation bolts shall be of stainless steel - SS304. The mounting structures shall be mounted on RCC pedestals through properly grouted J bolts. The structure will be designed to withstand the maximum wind speed prevailing at the place and confirming to IS - 875.

i) Hot dip galvanized iron mounting structures may be used for mounting the modules / panels / arrays. These mounting structures must be suitable to mount the SPV modules / panels / arrays on the ground, on the ground or on the poles / masts.

ii) The frame structure should have provision to adjust its angle of inclination to the horizontal between 0 and 45 degrees, so that it can be installed at the specified tilt angle i.e. inclined at 25 degree to horizontal facing due south.

iii) All hardware, nuts, bolts should be cadmium passivated.

iv) The Mounting structure shall be so designed to withstand the speed for the wind zone of the location where a PV system is proposed to be installed. It may be ensured that the design has been certified by a recognized Lab / Institution in this regard.

v) The mounting structure steel shall be as per latest IS 2062: 1992 and galvanization of the mounting structure shall be in compliance of latest IS 4759. The bidder needs to provide relevant certifications for the same.

2.14 String Monitoring Box

Each PV string has to be equipped with a blocking diode which avoids the circulating currents to flow from the healthy strings to unhealthy strings. To place these string blocking diodes along with their heat sinks, Array Junction Boxes are being used, in which additionally protective fuses with fuse blown indicators, Surge Protective Devices (SPDs) are also provided. The earth cable from the SPD is connected to structure to ensure earthing. These AJBs are mounted on an ISMC channel bolted between two leg members of a structure. As these AJBs are rated with IP 65, these can sustain against harsh weather conditions and thus these are outdoor mounted.

Generally, all the positive outputs of series strings are taken into AJBs through 6 sq. mm cabling and MC4 quick connectors are used for connecting these 6 sq. mm cables with quick connectors of PV modules. Other end of the 6 sq. mm cables are properly lugged and also equipped with heat shrinkable sleeves to terminate into the terminal blocks of AJBs. The strings from AJB are taken to a String Monitoring Unit where each string current and voltage is monitored and logged.

As the name indicates, SMB monitors string currents and sends those data signals to SCADA connected to it.

2.15 Power Optimizers

A power optimizer shall be combination of both a string and micro inverter. This module-level power electronic (MLPE) device shall be used to increases the solar panel system's energy output by constantly measuring the maximum power point tracking (MPPT) of each individual solar string and adjusts DC characteristics to maximize energy output. The panel optimizers relay performance characteristics via a monitoring system to facilitate operations and any necessary solar panel maintenance.

Built-in safety features like rapid-shutdown response etc shall be considered for this product. Efficiency shall not be less than 98%, standby voltage shall not go beyond 1.5 V for safety, optimizer shall be capable to Mitigates all types of module mismatch losses, from manufacturing tolerance to partial shading, provide module / string level monitoring, etc.

2.16 Lightning Arrestor

The Lightning Arrestor (LA) will be Early Streamer Emission (ESE) type. This lightning rod is made of stainless steel and epoxy resin. The specific function of this lightning rod is producing an upward stream of ionized particles pointed towards the clouds that will channel the electrical discharge produced at the time of lightning.

To properly ground the lightning surges, earthing is provided to each lightning arrestor by providing two earth pits which are connected to lightning arrestor with suitable Cu size cable/ Cu Strip.

The source of over voltage can be lightning or other atmospheric disturbances. Main aim of over voltage protection is to reduce the over voltage to a tolerable level before it reaches the PV or other sub-system components. The bidder needs to provide relevant certifications for the same.

Necessary concrete foundation for holding the lightning conductor in position to be made after giving due consideration to shadow on PV array, maximum wind speed and maintenance requirement at site in future.

The lightning conductor shall be earthed through flats and connected to the earth mats as per applicable Indian Standards with earth pits. Each lightning conductor shall be fitted with individual earth pit as per required Standards including accessories, and providing masonry enclosure with cast iron cover plate having locking arrangement, watering pipe using charcoal or coke and salt as required as per provisions of IS.

If necessary more numbers of lightning conductors may be provided.

The Successful bidder shall submit the drawings and detailed specifications of the PV array lightning protection equipment.

2.17 Remote Monitoring System

SCADA:

These systems should encompass the transfer of data between a SCADA central host computer and a number of Remote Terminal Units (RTUs) and/or Programmable Logic Controllers (PLCs), and the central host and the operator terminals. A SCADA system gathers information (such as where a fault has occurred), transfers the information back to a central site, then alerts the home station that a

fault has occurred, carrying out necessary analysis and control, such as determining if the fault is critical, and displaying the information in a logical and organized fashion.

SCADA systems should consist of:

• One or more field data interface devices, usually RTUs, or PLCs, which interface to

field sensing devices and local control switchboxes and valve actuators

• A communications system used to transfer data between field data interface devices and control units and the computers in the SCADA central host. Communication protocol between solar SCADA & central SCADA through interfacing equipment & comply to IEC-60870-104/ IEC-61850/ Modbus.

• A central host computer server or servers (sometimes called a SCADA Center, master station, or Master Terminal Unit (MTU)

• A collection of standard and/or custom software [sometimes called Human Machine Interface (HMI) software or Man Machine Interface (MMI) software] systems used to provide the SCADA central host and operator terminal application, support the

communications system, and monitor and control remotely located field data interface devices

RMS of PCU shall clearly depict the single line diagram of the plant on the monitor. Mimics shall be provided with radio buttons to show the following parameters:

- Solar radiation (W/m2)
- PV module back surface temp
- Ambient temp
- Inverter output power (3 phase)
- Line and phase currents
- Cumulative energy exported

RMS system shall perform following control operations:

- Mimic control through PC key board operation

RMS shall also conform to following features:

RMS system shall incorporate integrated system control and data acquisition facilities. The use of a local operator interface and latest technology features shall be incorporated to enable viewing of instantaneous parameter metering, changing of operator modes and review of system logged events. Further, with PC based latest software technology, solar plant shall be monitored remotely via satellite link. The major RMS features incorporated in to the control system are listed below.

Operator interface of latest technology: Instantaneous grid, array, inverter, AC, and metering of all parameters.

Integrated AC, DC data point logging: Instantaneous logging of all parameters. Including AC parameters, generator run hours and energy details.

Fault and system diagnostics with time stamped event logging.

Selectable event logging resolution for enhanced diagnostics.

Remote SCADA features with specific needs of station monitoring and remote communication are to be incorporated. Remote system access software, secured transmission of data and central PC facility provided.

RTU (REMOTE TERMINAL UNIT)

a. The RTU must be non-PLC based industrial grade and present an open, expandable and future-proof system, by taking into account latest standards, such as e.g. modular system concept, etc.
b. RTU should be having power supply and central processor. The central processor is responsible to communicate all IEDs / meters on RJ45/RS485 connectivity. The central processor should have the capability to integrate IEC 61850, IEC104 and Modbus RTU Master or Open Type as Pre approved. Central Processor will be connected to LAN Switch for communication with HMI. These are responsible for communication between the RTU with Central control centre. The protocol for two way communication between RTU & Central control centre should be IEC 104/IEC 61850 or Open Type as Pre approved.
c. The RTU shall have standardized, parameter-settable acquisition, processing and output functions of the process periphery signals, taking into account the methods and procedures according to IEC 60870-5-104 Open Type as Pre approved for:
   i. Single-Point Information
   ii. Double-Point Information
   iii. Integrated Totals via Count Pulses
   iv. Currents
   v. Pulse commands
   vi. Binary Information Output
   vii. Setpoint Values by means of Currents and Voltages
d. The RTU shall support IEC-103, IEC-104, MODBUS-RTU and many other IEC protocols for substation and tele control level communication.
e. Digital Inputs: All Inputs should be suitable for 48V or 220 VDC. They will be connected to potential free contact from field.
f. Digital Outputs: All Outputs should be suitable for 48V or 220 VDC. They will be connected to potential free contact in field. The control of ACBs shall be through DOs of the RTU.
g. Analog Inputs: Analog signals are to be configurable as 4-20mA as required.
h. Control Voltage: Voltage converter to be provided by bidder for converting control DC voltage to required DC in the RTU Panel in case the control voltage is different from station supply.
i. RTU will read all the signals coming from IEDs & MFMs as Soft signals on standard protocols.
j. Numerical relays in 33 kV and 11 kV HT Switchboard should be IEC 61850 compatible. The relays should have redundant communication port on Fibre Optic medium. All the hardware required to extend the relay signals to the RTU shall be supplied along with the switchboards. All

hardware or protocol converters required for compatibility with SCADA shall be in bidder's scope.

k. Programming tool with IEC 61131-3 compliant programming environment for logic programming of functions. These functions shall be supported by offered RTU. All software and configuration tools required for configuration of RTU and Network should be included in scope of supply.

l. The RTU shall be suitable for operation in Substation or High Electromagnetic Interference environment.

m. Sizing & Scalability: The system shall be scalable and shall be able to add more bays in future.

n. Each RTU shall be provided with minimum one AI/ AO/ DI & DO cards. Al each RTU, minimum 30 % spare ports shall be considered for each type of card. Calculation shall be furnished during detailed engineering.

o. RTU shall have redundancy in power supply, communication and processor such that failure of any single component should not result in loss of communication.

P. REDUNDANT WORK STATION:

Processor and RAM shall be selected in such a manner that during normal operation not more than 30% capacity of processing and memory are used. Supplier shall demonstrate these features.
The capacity of hard disk shall be selected such that the following requirement should occupy less than 50% of disk space:

1. Storage of all analogue data (at 2 Minutes interval) and digital data including alarm, event and trend data for thirty (30) days.

2. Storage of all necessary software,

3. 100GB space for OWNER'S use.

Latest Windows OS with full license version shall be made available with adequate RAM & other hardware configurations. Supplier shall demonstrate that the capacity of hard disk & other items is sufficient to meet the above requirement otherwise he shall provide items which are to the satisfaction of client. For Workstation minimum 32" LED screens to be provided in full HD configurations.

2.18 Power and Control Cables:

i) The Use of aluminium cable from Inverter to AJB/Panel & AJB/Panel to LT Panel may be issued to give opportunity to all prospective bidders to consider the same and submit its offer accordingly.

ii) Power Cables of adequate rating shall be required for interconnection of:

- Modules / panels within array
- Array & Charge Controller
- Charge Controller & Battery
- Charge controller & Loads including Inverter (if used) & between load & inverter.

iii) The cable shall be 1.1 KV grade, heavy duty, stranded copper conductor, XLPE insulated. An insulated, galvanized steel wire / strip armored, extruded PVC type ST-2 outer sheathed FRLS Type. The cables shall, in general conform to IS-7098-Part-I & other relevant standards. All cables laid up to load should be without any joint.

iv) The control cable shall be 1.1 KV grades, heavy duty, stranded copper conductor, PVC type. An insulated, galvanized steel wire / strip armoured, flame retardant (FR) extruded PVC type ST-1 outer sheathed. The cables shall, in general conform to IS-1554 P+1 & other relevant standards. Minimum 10% spare to be provided.

v) The permissible voltage drop from the SPV Generator to the Charge controller shall not be more than 2% of peak power voltage of the SPV power source (generating system). In the light of this fact the cross-sectional area of the cable chosen is such that the voltage drop introduced by it shall be within 2% of the system voltage at peak power.

vi) All connections should be properly terminated, soldered and / or sealed from outdoor and indoor elements. Relevant codes and operating manuals must be followed. Extensive wiring and terminations (connection points) for all PV components is needed along with electrical connection to lighting loads.

vii) For Cables & Accessories following certificates are mandatory: (Copy to be provided with tender.)

- General Test and Measuring Methods PVC/XLPE insulated: IEC 60189
- Cables for working Voltages up to and including 1100 : IS 694/ IS 1554
- UV resistant for outdoor installation: IS/IEC 69947

viii) All cables shall be new without any kind or visible damage. The manufacturers name, insulating material, conductor size and voltage class shall be marked on the surface of the cable at every 600 mm centers.

ix) The core insulation shall be with PVC compound applied over the conductor by extrusion and shall confirm to the requirement of IS-5831.

x) Core identification shall be provided with prominent and indelible Arabic numerals on the outer surface of the insulation colour as under.

Single core	-	Red, Black, Yellow or blue.
Two core	-	Red and Black.
Three core	-	Red, Yellow, and blue.
Four core	-	Red, Yellow, Blue and Black.
3.5 core	-	Red, yellow, Blue and Black. (Reduced neutral)

Five core - Red, Yellow, Blue, Black and Light Grey.

xi) In case of cables having more than 5 cores two adjacent (counting and directional) in each layer shall be coloured Blue and yellow respectively and the remaining cores shall be light grey.

xii) The inner sheath shall be applied over the laid up cores by extrusion and shall be of extruded XLPE compound.

xiii) Armouring shall be applied over the inner sheath. Armour shall be of galvanized round steel wires up to the cable diameter of 13 mm and above 13 mm galvanized flat steel wires shall be provided. Requirement and methods of tests for armoured material and uniformity of galvanism shall be as per IS-3975 and IS -2633.

xiv) The outer sheath for the cables shall be applied by extrusion and shall be of PVC compound confirming to the requirement of compound of IS-5831 for protection of the cable against atmospheric effect. Pollution rodent and termite attack suitable chemical shall be added in PVC compound. Colour shall be black.

xv) All the cables shall be tested and examined at the manufacturer work. All the materials employed in the manufacturing of cable shall be subject to examination and testing after manufacture of cable.

xvi) All routine and acceptance tests in accordance with the relevant standard shall be conducted on each size of cables and shall be submitted to client at the time of hand over.

xvii) Cables shall be dispatched in wooden drums of suitable barrel diameter, securely battened with the take off end fully protected against mechanical damage. The wood used for construction of the drum shall be properly seasoned. Sound and free from defect. Wood preventative shall be applied to the entire drum.

xviii) On flange of the drum, necessary information such as manufacturers name, type, size, voltage grade of cable, length of cable in meters, drum no., cable code, ISI certification mark gross weight etc. shall be printed. An arrow shall be printed on the drum with suitable instructions to show direction of rotation of the drum. Cable shall be supplied in drum length as follows.

xix) Cable terminations shall be made with copper/Aluminium Heavy duty long nack copper crimping lugs only crimped type solderless lugs for all aluminium cables and stud type terminals. For copper cables copper crimped solderless lugs shall be used.

xx) Crimping shall be done with the help of hydraulically operated crimping tool. All cable lugs should be long neck type only.

xxi) Cable glands shall be of heavy duty brass single compression type as specified. Generally single compression type cable glands shall be used for indoor protected locations and double compression type shall be used for outdoor locations. Glands for classified hazardous areas shall be CMRS approved.

xxii) Ferrules shall be of self sticking type and shall be employed to designate the various cores of the control cable by the terminal numbers to which the cores are connected, for ease in identification and maintenance.

xxiii) Kit type joint shall be done and filled with insulating compound. The joint should be for 1.1 KV grade insulation.

2.19 Earthing

i) Earthing is essential for the protection of the equipment & manpower. Two main grounds used equipments are:

- System earth: System earth is earth which is used to ground one leg of the circuit. For example in AC circuits the Neutral is earthed while in DC supply +ve is earthed.
- Equipment earth: In case of equipment earthing all non-current carrying metal parts should be bonded together and connected to earth to prevent shock to the man power and also the protection of the equipment in case of any accidental contact.

ii) To prevent the damage due to lightning the one terminal of the lightning protection arrangement is also earthed. The provision for lightning & surge protection of the SPV power source is required to be made.

iii) In case the SPV Array cannot be installed close to the equipment to be powered and a separate earthing has to be provided for SPV System, it shall be ensured that all the earths are bonded together to prevent the development of potential difference between any two earths.

iv) Earth resistance shall not be more than 1 ohms. It shall be ensured that all the earths are bonded together to make them at the same potential.

v) The earthing conductor shall be rated for the maximum short circuit current & shall be 1.56 times the short circuit current. The area of cross – section shall not be less than 1.6 sq mm in any case.

vi) The array structure of the PV modules shall be grounded properly using adequate numbers of earthing pits. All metal casing / shielding of the plant shall be thoroughly grounded to ensure safety of the power plant.

2.19.1 **Surge Protection Device (SPD):** Internal surge protection shall consist of three MOV type arrestors connected from +ve and –ve terminals to earth (via Y arrangement) for higher withstand of the continuous PV-DC voltage during earth fault condition. SPD shall have safe disconnection and short circuit interruption arrangements through integrated DC in-built bypass fuse (parallel) which should get tripped during failure mode of MOV, extinguishing DC arc safely in order to protect the installation against fire hazards. Nominal discharge current (Imin) at 8/20 micro seconds shall be minimum 10 kA with maximum discharge current (Imax) at 8/20 micro seconds minimum 20 kA with visual indication (through mechanical flag) in modules to monitor the life of SPD.

2.19.2 Earthing for PV Array

- The photovoltaic modules and other components of power plant requires adequate earthing for protecting against any serious faults as guided by IEC 60364. The bidder needs to provide relevant certifications for the same.
- The earthing system shall be provided according to the IS 3043 supported with design calculations.
- Necessary provision shall be made for bolted isolating joints of each earthing pit for periodic checking of earth resistance.
- Each string/ array and MMS of the plant shall be grounded properly. The array structures are to be connected to earth pits as per IS standards. Necessary provision shall be made for bolted isolating joints of each earthing pit for periodic checking of earth resistance.
- The complete earthing system shall be mechanically & electrically connected to provide independent return to earth.
- For each earth pit, a necessary test point shall be provided.
- In compliance to Rule 11 and 61 of Indian Electricity Rules, 1956 (as amended up to date), all non-current carrying metal parts shall be earthed with two separate and distinct earth continuity conductors to an efficient earth electrode.
- The Bidder shall submit the detailed specifications of the array earthing.

2.20 Junctions/ Combiner Boxes & Other Electrical Components

Dust, water and vermin proof junction boxes of adequate rating and adequate terminal facility made of fire resistant Plastic (FRP) shall be provided for wiring. Each solar shall be provided with fuses of adequate rating to protect the solar arrays from accidental short circuit. Junction Box shall have protection class of IP-65.

2.20.1 Protection Features

- The injection of DC power into the grid is avoided by using an isolation transformer at the output.
- Over-voltage protection is provided by using varistors at the output of the inverter.
- Another set of varistors at the input of the inverter provides lightning protection.

2.21 Control & Instrumentation System

The instrumentation and control system for the solar PV power plant will be Distributed Control System (DCS) with electronic instruments. Monitor / Keyboard based Operator Work Stations shall be used for monitoring and control of the power plant from the control room.

2.22 Solar Island

The controls for the PV modules, transformers and switchgears, cabinets, housing, system optimization, control, SCADA, security system, cabling, etc shall be through main plant DCS. In security system each corner and vital locations shall be provided with CCTV camera which shall be given display at security room.

2.23 Other Electrical Equipments:

1.1 LT Panel

1.1 Scope :

The scope covers supply, installation, testing and commissioning of power panels, incorporating circuit breakers, fuse units, busbars, interconnections, earthing etc., meeting the requirements shown in equipment schedule and the drawings.

1.2 Standards :

AS PER SCHEDULE OF INDIAN STANDARD; ATTACHED WITH THE DOCUMENT.

The PCCs & MCCs shall comply with the latest edition of relevant Indian standards and Indian Electricity rules and regulations. The following Indian Standards shall be complied with:

IS : 4237 : General requirements for switch gear and control gear for voltage not exceeding 4100 v.

IS : 375 : Switchgear bus-bars, main connection and auxiliary wiring, marking and arrangement.

IS : 2147 : Degree of protection provided by enclosures for low voltage switch gear and control gear.

IS : 8197 : Terminal marking for electrical measuring instrument and their accessories.

IS : 2557 : Danger notice plates.

IS : 2516 : Specification for AC circuit breaker.

IS : 1818 : Specification for AC isolator and earthing switch.

IS : 3072 : Code of practice for installation and maintenance of switchgear.

IS : 8623 : Specification for factory built as symbolize of switch gear and control gear for voltage up to and including 4100v. A.C.& 1200 v. D.C.

IS : 8828 : Miniature Circuit Breaker.

IS : 4064 : Fuse switch and switch fuse unit.

IS : 9224 : HRC fuse unit.

IS : 2705 : Current transformer.

IS : 3155 : Voltage transformer.

IS : 3231 : Electrical relay for protection.

IS : 1248	:	indicating instrument.
IS : 722	:	Integrating instrument.
IS : 6875	:	Control switches & push buttons.
IS : 2959	:	Auxiliary contactor.
IS : 1822	:	AC motor starters of voltage not exceeding 4100V.
IS : 13947	:	Switch Board General Requirement

1.3 TYPE OF M.V. SWITCH GEAR :

1.3.1 All the PCC's / PDB's / MCC's shall be metal clad, totally enclosed, rigid, floor / wall mounted, air - insulation, cubical type suitable for operation on three phase / single phase, 415 / 230 volts, 50 Hz. neutral effectively / Non effectively grounded at transformer and short circuit level not less than 30 MVA at 415 volts.

1.3.2 The PCC's / MCC's shall be designed the withstand and heaviest condition at site, with minimum expected ambient temperature of 55 degree celsius, 90 percent humidity and dusty weather.

1.3.3 Should confirm to Indian Electricity Act and rules. (as amended up to ate) & approval of FIA. of India.

1.4 STRUCTURE :

1.4.1 The PCCs, MCCs & PDBs shall be metal clad enclosed and be fabricated out of high quality CRCA sheet, suitable for indoor installation having dead front operated and floor mounting type.

1.4.2 All CRCA sheet steel used in the construction of PCCs / MCCs / PDBs shall be 2 mm thick and shall be folded and braced as necessary to provided a rigid support for all components. Joints of any kind in sheet shall be seam welded, all welding slag grounded off and welding pits wiped smooth with plumber metal.

1.4.3 The PCCs / MCCs / PDBs shall be totally enclosed, completely dust and vermin proof and degree of protection being not less than IP-51 to IS 2147. Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. All doors and covers shall be fully gasket with foam rubber and / or rubber strips and shall be lockable.

1.4.4 All panels and covers shall be properly fitted and secured with the frame, and holes in the panel correctly positioned. Fixing screw shall enter into holes taped into an adequate thickness of metal or provided with bolts and nuts. Self threading screws shall not be used in the construction of PCCs / MCCs / PDBs.

1.4.5 A base channel of 75 mm x 75 mm x 5 mm thick shall be provided at the bottom.

1.4.6 PCCs / MCCs /PDBs shall arranged in multi-tier formation. The PCCs / MCCs / PDBs shall be of adequate size with a provision of 20 percent spare space to accommodate possible future additional switch gear. The size of the PCCs / MCCs / PDBs shall be designed in such a way that the internal space is

sufficient for hot air movement, and the electrical component does not attain temperature more than 45 degree celsius. If necessary openings shall provided for natural ventilation, but the said openings shall be screened with fine weld mesh.

1.4.7 Knockout holes of appropriate size and number shall be provided in the PCCs / MCCs/ PDBs in conformity with number, and size of incoming and outgoing conduits / cables.

1.4.8 Alternatively the PCCs / MCCs / PDBs shall provided with removable sheet plates at top and bottom to drill holes for cable / conduit entry at site.

1.4.9 The PCCs / MCCs / PDBs shall be designed to facilitate easy inspection, maintenance and repair.

1.4.10 The PCCs / MCCs / PDBs shall be sufficiently rugged in design and shall support the equipment without distortion under normal and short circuit condition, they shall be suitable braced for short circuit duty.

1.5 PAINTING :

All sheet steel work shall undergo a process of decreasing pickling in acid, cold rinsing, phosphating, pesivating and then sprayed with a high corrosion resistant primer. The primer shall be backed in an oven. The finishing treatment shall be by application. Three coats of synthetic enamel paint of approved colour shall be applied by spray and stoves in dust free atmosphere or the panel shall be powder coated.

1.6 CIRCUIT COMPARTMENT :

1.6.1 Each circuit breaker and switch fuse units shall be housed in separate compartments and shall be enclosed an all sides. Sheet steel hinged lockable door shall be duly inter locked with the breaker / switch fuse units in ON and OFF position. Safety interlocks shall be from being drawn out when the breaker is in ON position.

1.6.2 The door shall not form as integral part of the drawout position of the circuit breaker. All instruments and indicating lamp shall be mounted on the compartment door. Sheet steel barriers shall be provided between the tires in a vertical section.

1.7 INSTRUMENT COMPARTMENT

Separate and adequate compartment shall provided for accommodating instruments, indicating lamp, control contactors, relays and control fuses etc. These components shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, switch fuse units, busbars and connections.

1.8 BUSBARS

1.8.1 The busbar shall be air insulated and made high quality, high conductivity, high strength copper and as per relevant IS code. The busbar shall of three phases and neutral system with separate neutral and earth bar. the busbar and interconnection between busbar and various components shall be of high conductivity, hard drawn, electrolytic copper. the busbar shall be of rectangular cross section designed to withstand full load current for phase busbar and full rated current for neutral busbar and shall be extensible type on either side. The busbar shall be rated for the frame size of the main incoming breaker but in any case not less than 200 amp capacity. The busbar shall have uniform cross section through out the length.

1.8.2 The busbar and interconnection shall be insulated with heat shrinkable PVC sleeves and be colour coded in red, Yellow, Blue and Black to identify the three phases and neutral of the system. The busbar shall be supported on unbreakable, non hygroscopic DMC insulated supports at sufficientevely close interval to prevent busbar sag and shall effectively withstand electromagnetic stresses in the event of short circuit capacity of 50 KA RMS symmetrical for one second and a peak short circuit withstand of 105 KA minimum.

1.8.3 The busbar shall be housed in a separate compartment. The busbar shall be isolated with 3 mm thick bakalite sheet to avoid any accidental contact. The busbar shall be arranged such that minimum clearance between the busbar are maintained as per below.

Between phases	:	27 mm min.
Between phases and neutral	:	25 mm min.
Between phases and earth	:	25 mm min.
Between neutral and earth	:	23 mm min.

1.8.4 All busbar connection shall be done by drilling holes in busbars and connecting by chromium plated brass bolt and nuts. Additional cross section of busbar shall be provided in all PCCs / MCCs / PDBs to cover-up the holes drilled in the busbars. Spring and flat washers shall be used for tightening the bolts.

1.8.5 All connection between busbar and circuit breaker / switches and between circuit breaker/ switches and cable terminals shall be through solid copper strips of proper size to carry full rated current. These strips shall be insulated with insulating strips.

1.9 ELECTRICAL POWER & CONTROL WIRING CONNECTION

a) Terminal for both incoming and outgoing cable shall be suitable for 1100 volts grade, aluminum/copper conductor PVC insulated and sheathed, armoured cable and shall be suitable for connections of solder less sockets for the cable size as indicated on the appended drawing for the PCCs, MCCs, PDBs.

b) Both control and power wiring shall be brought out in cable alley for ease of external connections, operation and maintenance.

c) Both control and power terminals shall properly be shrouded.

d) 10% spare terminal shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block so that not more than one outgoing wire connected per terminal.

e) Terminal strip for power and control shall preferably be separated from each other by suitable barriers of enclosures.

f) Wiring inside the module for power, control protection and instrument etc. shall be done with use of 660/1100 confirming to IS 694 and IS 8130. Power wiring inside the starter module shall be rated for full current rating of contactor, but not less than 4 sq mm cross section area. For current transformer circuits, 2.5 sq mm copper conductor wire shall be used. Other control wiring shall be done with 2.5 sq mm copper conductor wires. Wires for connections to the door shall be flexible. All conductors shall be crimped with solder less sockets at the ends before connections are made to the terminals.

i) Control power for the motor starter module shall be taken from the respective module switchgear outgoing from R phase and Neutral. Control wiring shall have control fuse (HRC type).

j) Particular care shall be taken to ensure that the layout of wiring neat and orderly.
Identification ferrules shall be filled to all the wire termination for ease of identification and to facilitate and testing.

Suitable washers shall be used for all copper and aluminium connections.

k) Final wiring diagram of the PCC, MCC, PDB power and control circuit with ferrules number shall be submitted along with the PCC/MCC/PDB as one of the documents.

1.10 TERMINALS

The outgoing terminals and neural link shall be brought out to a cable alley suitably located and accessible from the panel front. The current transformer for instrument metering shall mounted on the disconnecting type terminal blocks. No direct connection of incoming and outgoing cables to internal components connection of the distribution board is permitted, only one conductor may be connected in one terminal.

1.11 WIREWAYS

A horizontal PVC wire way with screwed covers shall provided at the top to take interconnecting control wiring between different vertical sections.

1.12 CABLE COMPARTMENT

Cable compartment of adequate size shall be provided in the PCCs, MCCs, PDBS for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate support shall be provided in the cable compartment shall be brought out to terminal blocks in the cable compartment.

1.13 EARTHING

a) Copper earth busbar of 25 mm x 3 mm shall be provided in the PCCs, MCCs, PDBS for the entire length of panel. The frame work of the PCCs, MCCs, PDBs shall be connected to this earth busbar.

Provisions shall be made for connection from earth busbar to the main earthing bar coming from the earth pit on both side of the PCCs, MCCs, PDBs.

b) The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with earthing clamp and the clamp shall be ultimately bounded with the earth bar.

1.14 LABELS

Engraved PVC labels shall be provided on all incoming and outgoing feeders. Single line circuit diagram showing the arrangements of circuit inside the distribution board shall be pasted on inside of the panel door and covered with transparent laminated plastic sheet.

1.15 NAME PLATE

a) A name plate with panel designation in bold letter shall be fixed at top of the central in panel. A separate name plate giving feeder giving feeder details shall be provided for each feeder module door.

b) Inside the feeder compartment, the electrical component, equipments, accessories like switchgear, contactor, lamp, relays etc. shall suitably be identified by providing stickers.

c) Engraved name plates shall preferably be of 3 ply, (red-white-red or black-white-black) lamicold sheet. However black engraved perplex sheet name plates shall also be applicable. Engraving shall be done with square groove cutters.

d) Name plate shall be fastened by counter sunk screws and not by adhesives.

1.16 DANGER NOTICE PLATE

a) The danger plate shall be affixed in a permanent manner on operating side of the panel.

b) The danger notice plate shall indicate danger notice both in Hindi and English and with a sign of skull and bones.

c) The danger notice plate in general shall meet to requirements of local inspecting authorities.

d) Overall dimension of the danger notice plate shall be 200 mm wide and 150 mm high. The danger notice plate shall be made from minimum 1.6 mm thick mild steel sheet and after due pre-treatment to the plate, the same shall be painted white with vitreous enamel paint on both front and rear surface of the plate.

e) The letter, the figure, the conventional skull and bones shall etc. shall be positioned on the plate as per recommendations of IS : 2551-1982.

f) The said letter, the figure and the sign of skull and bones be painted in single red colour as per IS : 5-1978.

g) The danger plate shall have rounded corners. Locations of fixing holes for the plate shall be decided to suit design of the panel.

h) The danger notice plate, if possible, be of ISI certification mark.

1.17 INTERNAL COMPONENTS

a) The PCC / MCC / PDB shall be equipped complete with all type of required number of air circuit breakers, switch fuse unit, contactor, relays, fuses, meters, instruments, indicating lamps, push buttons, equipment, fittings, busbar, cable boxes, cable glands etc. and all the necessary internal connections /wiring as required and as indicated on relevant drawings. Components necessary for proper complete functioning of the PCC / MCC / PDB but not indicated on the drawings shall be supplied and installed on the PCC / MCC / PDB.

b) All part of the PCC / MCC/ PDB carrying current including the components, connections, joints and instruments shall be capable of carrying their specified rated current continuously, without temperature rise exceeding the acceptable values of the relevant specifications at any part of the PCC / MCC / PDB.

c) All units of the same rating and specifications shall be fully interchangeable.

1.18 INSPECTIONS

Each equipment should inspect and witness by client & consultant.

a) The PCC / MCC / PDB shall be inspected and checked as per inspection manual of the PCC / MCC / PDB manufacturer.

b) Various electrical components and accessories of the PCC / MCC / PDB shall be checked as per drawing for the respective PCC / MCC / PDB.

c) The PCC / MCC / PDB shall be checked for rigid mounting, earthing connections, proper rating and size of components, internal wiring, etc.

d) All mechanical fasteners and electrical connections shall be checked and tightened before installation.

e) Type test certificates for all ACB for similar rating shall be submitted.

f) Test :

a) Prior to dispatch of the PCC / MCC / PDB following tests shall be carried out.

b) Mechanical endurance test shall carried out by closing and opening of all the ACB's, MCB's switches etc.

c) Over voltage and Insulation resistance test shall be carried out between phases and between phase to earth bus, keeping the isolating switch in ON position. Similar test shall be carried out keeping the isolating switch in closed position.

d) All the interlocks, controls and tripping mechanism of the switch gears shall be tested for their proper functioning.

1.19 COMPONENTS :

GENERAL

a) The type, size, and rating of the components shall be as indicated on the relevant drawings.

b) While selection od the capacity of the components resulting from the prevailing conditions like room temperature shall be allowed for the Thermal and magnetic trip rating shall be compensated for the ambient temperature.

c) The rating indicated on the drawings are rating anticipated at prevailing site condition.

A) Air Circuit Breaker

- The Circuit Breakers shall be 3/4 pole as specified, Microprocessor based with LCD display, air break drawout type having electrical closing arrangements as defined in the SLD.ACB shall be provided with built in over load, short circuit and earth fault protection. Circuit Breaker carriage shall be mounted on guides to ensure correct alignment. Isolating contacts shall be of the self alignment type. Breakers shall have three distinct and separate operation positions. Circuit Breaker shall be provided with spring assisted operating mechanism. Circuit breaker Shall be suitable for minimum fault level 50kA for 1 second (Ics = Icu =Icw= 50kA) & Making capacity 2.1 times breaking capacity.

The circuit breaker ratings shall be as follows:

a)	Rated Voltage	:	415V ± 10%
b)	RMS symmetrical breaking capacity at rated voltage	:	50 KA (minimum)
c)	Rated short time current	:	Not less than 50KA for 1 sec.
d)	Rated operating duty (P2)	:	0-3sec-CO-3min-CO

The circuit breaker shall be provided with the following.

a) 6 NO & 6 NC spare auxiliary contacts wired to terminal blocks.
b) 24V DC Shunt Trip Coil for Breakers
c) One mechanical position indicator.
d) indicating lamps to show ‘ON-OFF’, and Auto-Trip conditions.
e) Mechanical emergency trip push button.

f) Easily removable arc chutes for effective arc quenching.
g) Mechanical trip button, integral with the breaker shall be provided at the front.
h) Padlocking facility in 'OFF' position.
i) Operating handle interlocked with the front cover for safety.
j) All breakers to have thermal, magnetic and under voltage releases.
k) Triple pole, ambient temperature compensated, adjustable, direct acting thermal release.
l) Triple pole, direct acting, adjustable upto 12 times rated current short-circuit trips with time delay upto 0.3 seconds for discrimination obtained through rugged and non-aging mechanical means. The timing device shall be independent of power supply.
m) Under voltage releases to have inherent delay to prevent tripping on transient voltage dips

Following safety interlocks shall be provided on the circuit breakers:

a) The operation of the circuit breaker shall not be possible unless it is in :

i. Service Position
ii. Withdrawn to test position.
iii. Fully drawn-out.
iv. Bus coupler interlocking with two incomers (when two incomers are on, bus coupler shall not be possible to close in service position)

Further it shall not be possible to close the circuit breaker without completing the auxiliary circuits between the fixed and moving portion. All interlocks shall be effective in Service Position.

a) The withdrawal or racking in of the circuit breaker without completing the auxiliary circuit between the fixed and moving portion.
b) The door of the circuit breaker portion, if any, shall open only if the circuit breaker is in the open position.
c) Safety shutters operated automatically by the movement of the circuit breaker shall ensure that the live parts are fully shrouded when the circuit breaker is withdrawn.
d) The circuit breaker carriage shall be earthed before the main contacts are plugged in.

Potential free contact for on/off/trip status monitoring to be provided for completely compatible interface with centralized building automation.

Auto self starting required after power failure.

B) MINIATURE CIRCUIT BREAKER

Miniature circuit breakers shall be quick make and break and break type conform with British standard BS : 3871 (Part-I) 1965, IEC 898-1995 and IS :8828 (1996). The housing of MCBs shall be heat resistant and having a high impact strength. The fault current of MCBs shall not be less than 9000 amps, at 230 volts. The MCBs shall be flush mounted and shall be provided with trip free manual operating mechanism with mechanical "ON" and "OFF" indications.

The circuit breaker dollies shall be of trip free pattern to prevent closing the breaker on a faculty current. Tightening torque at terminals shall be not less than 2.5 Nm. Power losses should not be more than as specified in IEC 898-1995.

The MCB contact shall be silver nickel and silver graphite alloy and tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCB's shall be provided with magnetic fluid plunger relay 3 as for over current and short circuit protection. The over load or short circuit devices shall have a common trip bar in the case of DP and TPN miniature circuit breakers. All the MCB's shall be tested and certified as per Indian Standard, prior to Installation.

For protection of electric circuits with equipment that does not cause surge current (i.e. lighting and socket outlet circuits)'B' curve MCB to be used in which magnetic releases operates between 3 and 5 In.

For protection of electric circuits with equipment that cause surge current (i.e. inductive and motor circuits) 'C' curve MCB to be used in which magnetic releases operates between 5 and 10 In.

For protection of electric circuits with equipment that cause surge current (i.e. transformer, heavy start motors circuits) 'D' curve MCB to be used in which magnetic releases operates between 10 and 15 In.

Auto self starting required after power failure.

C) FUSE

Fuses shall be of high rupturing capacity (HRC) fuse links and shall be in accordance with IS : 2000-1962 and having rupturing capacity of not less than 35 MVA at 415 Volts. The backup fuse rating for each motor / equipment. HRC fuses shall be of English Electric make or approved equal.

D) MOULDED CASE CIRCUIT BREAKER

Moulded case circuit breakers shall be conforming with IEC 60947-2 and IS 13947 -2. The MCCB shall be air break type and having quick make quick break with trip free operating mechanism. Housing of the MCCB shall be of heat resistant and flame-retardant insulating material. All the MCCB should be provided with adjustable thermal and magnetic release and with rotary handles.

Operating handle of the MCCB shall be in front and clearly indicate ON / OFF / TRIP positions. The electrical contact of the circuit breaker shall be of high conducting non-deteriorating silver alloy contacts. Shall be equal to system short circuit level i.e. 50 kA/65 kA (Minimum) (Ics =Icu).(Ics) = Service Short circuit breaking capacity (Icu) =Rated ultimate short circuit breaking capacity. Icw as per manufacturer's design for higher ratings, if applicable, shall be 50 kA for 1 sec.

The MCCB shall be provided with thermal / magnetic type bi-metal over load release and electro-magnetic short circuit protection device. All the releases shall operate on common trip busbar so

that in case of operation of any one of the releases in any of the three phases, it will cut off all the three phases and thereby single phasing of the system is avoided.

The MCCB whenever called for in the appendix drawings shall be provided with an earth fault relay. The MCCB shall provide two sets of extra auxiliary contacts with connections for additional controls at future date.

The electrical parameters of the MCCB shall be as per the descriptions given in the appended drawings.

E) CONTACTORS :

The contactor shall meet with the requirements of IS : 2959 and BS : 775.

The contactors shall have minimum making and breaking capacity in accordance with utilization category AC 3 and shall be suitable for minimum class II intermittent duty.

If the contactor forms part of a distribution board then a separate enclosure is not required, but the installation of the contactor shall be such that it is not possible to make an accidental contact with live parts.

F) METER

The meter should meet the following requirement unless and otherwise specified in the bill of material or drawings.

Ameter : The Ameter should be digital type 96 x 96 mm size having facility to read current parameters.

Voltmeter : The Voltmeter should be digital type 96 x 96 mm size having facility to read voltage parameters.

KWH METER : Digital KWH meter 96 x 96 x 80 mm size Acc Class 1.0 suitable for true RMS reading having reverse LED. Optically isolated pulse output having pulse with 500 ms and pulse amplitude 12 volts. It should be with RS 485 port with open protocol.

LOAD MANAGER:

The load manager should meet the following requirement unless and otherwise specified in the bill of material or drawings.

Load Manager (For Incoming Feeders) : The load manager should having facility to read voltage current harmonics power parameters. It should contain real time clock. The meter should be field programmable and to generate high / low profile for all power parameters with date & time, also able to store previous period integrated data. The meter should have RS 485 port with open protocol for networking purpose. All the programming should be pass word protected.

Load Manager (For other Feeders) : Load manager facility to measure A, V, PF, kW, kWH with RS 485 port with open protocol for networking. The meter should be totaly field programmable and having a password protection. Size should be 96 x 96 mm.

G) CURRENT TRANSFORMER

Where ammeter are called for, CT's shall provided for current measuring. Each phase shall be provided with separate CT of class 1 accuracy and suitable VA burden for operation of associated metering and controls. Current transformer shall be in accordance with IS : 2705-19 64 as amended up to date.

H) PUSH BUTTON :

The push button unit shall comprise of the contact element, a fixing holder , and push button actuator. The push button shall be momentary contact type. The contacts shall be of silver alloy and rated at 10 Amps. continuous current rating. The actuator shall be of stranded type and colour as per its usage for ON, OFF and Trip.

J) INDICATING LAMP :

Indicating Lamp shall be transformer operated low voltage rated and shall supplied complete with translucent covers to diffuse the lamp light.

Colour shade for the indicating lamps shall be as below :

ON indicating lamp	:	Red
OFF indicating lamp	:	Green
TRIP indicating lamp	:	Amber
PHASE indicating lamp	:	Red, Yellow, Blue.

1.21 SPECIAL REQUIREMNTS.

a. Bottom most feeder shall be minimum 300 mm above the bottom of panel base frame.

b. Necessary floor stand to be provided whenever required along with the panels

1.22 Testing & Co-ordination :

Testing and setting the relay set – point and co-ordination between relay on LT/HT fuses, breaker, setting shall be done by contractor. The down stream of the setting should be provided.

1. The following drawings shall be submitted before procurement for approval from the client.

    1. General arrangement and Fabrication details.
    2. Power wiring diagram of the panel.
    3. Control wiring diagram of panel.

4. C.T. ratios with connection.

5. Material list with make, catalogue nos and

2. Testing and setting the relay set – point and co-ordination between relay on LT/HT fuses, breaker, setting shall be done by contractor. The down stream of the setting should be provided.

3. The relay should be tested by reputed agencies and test report of the relay should be submitted by the contractor.

Note: Panels shall also equipped with Transient Voltage Surge Suppressor (TVSS) for protection against transient voltage surges. Digital Ammeter & Digital Voltmeter with their inbuilt selector switches and Digital Load manager which performs as a multifunction meter are provided on the front side of the cubicle. LTPDB is also provided with a Breaker Control Switch (TNC) for electrically operating the ACB. NO & NC contacts for ACB are provided to communicate the On, OFF and Trip status & control to/by SCADA.

2.23.1 Other Accessories

To carry the DC power generated from Solar PV modules to PCUs located in the control room, DC cables of 1100 V rated are used, as the system voltage is around 700 V DC cables of appropriate sizes depending on the current ratings will be used as per the IS.

After inversion of power from DC to AC at PCU, appropriate rating AC cables/bus ducts will be used for exporting the power through various panels as listed. All the PVC/XLPE cables used will be confirming to the relevant IS codes.

All terminations of the cables will be done with proper routing, through HDPE Conduits /cable trenches where ever applicable, with appropriate lugs and accessories as per the standards ensuring minimum stress.

PV array yard Earthing will be basically done to ensure safety of the personnel and equipment in the case of high voltages and lightning. In solar PV plant, earthing is provided for array yard, control room and switch yard equipment. For this efficient super earth kits and chemical earthing kits will be used.

Solar lights needs to be installed in area of the solar PV project. The developer needs to carryout survey and propose appropriate number of solar lights for this purpose.

All meters installed for solar power generators should have automatic meter reading facilities. Further, the monitoring of various parameters of solar plant such as module wise and total energy generation, tripping, logs, etc. should be available on website with username and password facilities.

Accommodation of staff, labor etc. shall be arranged by vendor.

UPS:

Separate dual redundant (n+1) UPS with 2hour backup (with Degradation till 5 Years, Bidder have to furnish Calculation) shall be installed at server room. Control rooms for feeding power to SCADA system equipments & all other emergency equipment loads & systems like CCTV etc. The UPS shall be connected to SCADA for necessary monitoring & controls. A bypass switch shall be provided for maintenance purpose.

2.24 CCTV Surveillance System

IP based CCTV system shall be deployed, minimum resolution shall be 1MP 720p HD for dome & 2MP 1080p HD for Bullet cameras, IR based night vision cameras to be used for security purpose. Vendor has to provide complete solution by using fix + PTZ cameras as required to cover the total solar farm area. Sufficient capacity of NVR with minimum 30days back up to be provided with cloud-based backup with necessary licensing etc. All the misc accessories like connecting wires, POE switches, IP66 junction boxes, pole / other mounting arrangements, etc shall be provided as per requirement. Realtime screening via cloud / internet to be made available with access parameters to the client as required.

2.25 Civil Works

The civil work to be carried out by the contract shall include but not limited to following.

- Cutting and clearing of trees / plantation to remove the shadow.
- Providing civil works for Embedment of structures & providing & installation of all metal fabrication & structure suitable for mounding PV modules.
- Laying of earthing equipments / structures and connecting to the main ground mat as per the statutory requirements.
- Construction of cable trenches etc. wherever necessary.
- Constructing LT Panel Rooms & other utility area complete with required internal utilities, UPS room , Scada room, maintenance & training area etc.

Water supply works for cleaning of Solar PV panels: The Contractor shall estimate the water requirements for cleaning the photovoltaic modules at least once a month in order to operate the plant at its guaranteed plant performance. The Contractor shall have to plan, design, provide and lay water supply system for cleaning of Solar PV panels in the entire plant area. The GI piping network is to be designed with considering pressure to provide appropriate head at outlet point i.e. Garden Hydrant. Before execution, the detailed specification and drawing prepared by the Contactor is to be submitted to get necessary approvals from the Client and Consultant.

1 MMS Specification

1.1 Design Parameters

The Ground mounting structure system which constitute a photovoltaic array(s) shall be designed to withstand the extreme fair wind (positive pressure) and adverse wind (negative pressure) on design tilt angle of solar photovoltaic array(s).

The design calculations shall be supplemented with neat sketch and reference to various clauses of Technical specification and Indian standards. For MMS design analysis and determination of forces, where computer program (preferably STAAD) is used, the contractor shall submit a write-up on computer program used and its input and output data for review and approval of Engineer-in-Charge
An increase in allowable stresses of structural materials should not be considered during design analysis.

Wind pressure for following loads shall be considered as follows:

- Dead Load of steel with all members, fittings & panels.
- Load due to fair wind direction on design tilt angles of solar mounting structural members.
- Load due to adverse wind direction on design tilt angles of solar mounting structural members.
- Load on side face of mounting structural members.

Wind pressure coefficient, load and load combination, load test/factor of safety shall be as per Indian standards (latest revision) such as IS: 875, IS: 800, IS: 801, etc. The relevant load combination shall be as per IS codes.

Design analysis and determination of forces (Compressive force, uplift force, shear and moment) from MMS shall be provided for design of foundation system. Limiting deflection shall be as per relevant IS code.

1.2 Foundation System

Top of concrete/ height of collar for MMS foundation shall be minimum250 mm above FGL. The minimum plan area of MMS foundation collar shall be 700 sq.cm. The proposed foundation system for MMS shall be based on findings/results of the approved geo technical investigation. Following kind of foundation may be provided:

- Short pile RCC foundation (Min. 300mm dia.)
- Rock anchor with concrete collar
- Isolated, strip or raft foundation

Yard fencing

Supply and fixing of chain link fencing with angle iron posts 50x50x6mm placed at every 3 Mtr. apart 30cm in ground embedded in cement concrete 1:3:6 (30x30x45cm) corner and every tenth post to be strutted with (50 x 50 x 6cm) angle iron provided, fixed and fitted with posts including earth work in excavation etc. complete in all respect with chain link of sizes 50 mm x 50 mm x 3.15 mm. Providing and erecting Min 6.5 m wide M.S. Gate of approved design.

Sign Boards: The sign board containing brief description of various components of the power plant as well as the complete power plant in general shall be installed at appropriate locations of the power plant.

The Signboard shall be made of steel plate of not less than 3 mm. Letters on the board shall be with appropriate illumination arrangements.

The Contractor shall provide to the Company, detailed specifications of the sign boards.

2.26 Maintenance Requirement

- Easy access shall be provided for all components in the SPV plant and grid connecting equipments. Maintenance platform shall be provided for easy inspection of all the equipments.

- If special tools are required for installation and maintenance, the bidder shall indicate the same and to be supplied free of cost.
- The Bidder shall furnish operating and maintenance instruction manual to enable the purchaser to carry out maintenance of equipment effectively and safely.
- Washing / cleaning of SPV panels would be carried out as per the prudent practice of the supplier.

2.27 Test and Test Reports

- Type test certificates for all the tests specified for the factory built solar PV modules, and the component parts shall be submitted by the successful bidder in well advance along with GTP / GA submissions of the parts / equipment's for approval from client, after design is approved.'
- The Supplier shall carryout all routine tests as specified in relevant standards on all major components in presence of the purchaser's representative (or third party nominated by NALANDA UNIVERISTY for this purpose) at manufacturer's premises before dispatch of the material and furnish copies of test reports for purchaser's approval. If required, stage wise inspection will be carried out by the purchaser.
- Supplier shall carryout all routine and functional tests as specified in the relevant standards on the assemble SPV Plant with all accessories of the equipment in the presence of the purchaser's representative before dispatch and furnish copies of the test reports for approval before dispatch.
- Equipment shall not be dispatched unless the test certificates are duly approved by the purchaser.
- Two sets of copies of the complied and approved test certificates shall be submitted to the purchaser.

2.28 Rating and Name Plate

- Each main and auxiliary item of plant shall have permanently attached to it a rating name plate in a conspicuous position, This shall be of a non- corrodible material preferably chromium plated steel to stand the prevalent atmosphere condition as indicated. The inscription shall be engraved in black on the plate or as plate or as otherwise specified in section C/D.
- The size of the rating and name palate shall depend upon space availability but an inscription shall be approved by the Engineer. The plates shall be should be reasonably sized of clarity and clear inscription.
- In case of indoor equipment, the plate shall be of transparent plastic material with black lettering engraved on the back.
- The name plates shall be screwed to the body of the equipment.

2.29 Layout Requirements

2.29.1 The Overall dimensions of the SPV plant shall suit provided for the layout requirement. The arrangement to suit this space is to be intimated at the time of approving the general arrangement drawing of the equipments.

2.30 System Documentation

2.30.1 It is essential that the owner have complete documentation on the system. System documentation should include an owner's manual and copies of relevant drawings for whatever system maintenance might be required in the future.

2.31 Drawings

The contractor shall furnish the following drawings

- General arrangement and dimensioned layout
- Schematic Drawing showing the requirement of SV panel, power condition unit(s), junction Boxes. AC and DC Distribution Boards, meters etc.
- Power Flow Schematic
- Earthing & Lightning arrestor Layout
- Structural drawing along with foundation details.
- Itemized bill of material for complete SV plant covering all the components and associated accessories
- Overall layout showing SV Plant in the allocated space of the campus
- Detail architectural, Civil & Structural plan for the buildings to be constructed
- Format for reports and charts for analysis various parameters

2.32 Instruction and O&M Manuals

2.32.1 Two sets of installation manual / user manual shall be supplied along with each power plant. The manual shall include complete system details such as array lay out, schematic of the system, inverter details, working principle etc. Step by step maintenance and troubleshooting procedures shall be given in the manuals. The manual shall also include,

- Detailed instructions and procedures for the installation operation and maintenance.
- Pre-commissioning tests.
- About solar PV system – its components and expected performance.
- Clear instructions about mounting of PV module (s)
- About electronics
- Do's and DON'T's
- Principal of Operation of various equipments
- Safety and reliability aspects
- Metering scheme
- About power conditioning units software and controls
- Clear instruction on regular maintenance and trouble shooting of solar power plant.
- Name and address of the person or service center to be contacted in case of failure or complaint.
- Outline dimension showing relevant cross sectional views, earthling details
- and constructional features.

- Rated voltages, current and all other technical information which may be
- necessary for correct operation of the SV Plant.
- Catalogue number of all the components which are liable to be replaced during life of the SV plant and all the component parts.
- Trouble shooting and diagnostic procedure

2.33 Training

The Successful bidder shall provide necessary training at factor for mutually agreed duration and number of persons to enable the purchaser to maintain the system.

The bidder needs to submit the proposal completed in all aspects and clearly mentioning layout of the modules, actual requirement of the material in line with the price bid, work schedule/ PERT chart along with the implementation schedule etc. NALANDA UNIVERISTY may at its discretion ask for additional material or decrease the material requirements at the price quoted in the price bid.

2.34 Operation & Maintenance

The Successful contractor has to operate & maintain the plant for next 5 years from date of successful handover of the project to client once. During the same all the required maintenance, operational costs, replacements, repairs shall be done by the contractor on behalf of client as per system requirement. A preventive maintenance shall be done by the contractor on specified schedule as per proven practice, such schedule shall be submitted & got approved from client, by the contractor.

3. Make List

Equipment	Make
Modules	Shall be Domestic Manufactured Only: Waaree/Vikram/PV Powertech/REC/LG/VS / Adani /BHEL/CEL/TATA POWER Sola OR any other PSU, GoI fulfilling the technical requirement and approved supplier for CPSU (Tranche-II) Phase-II Scheme being run by the SECI and recognised by the MNRE.
Inverter	Schneider/Delta/ABB/SMA/Huwai/Solar Edge/Hitachi / Siemens OR any other PSU, GoI fulfilling the technical requirement and approved supplier for CPSU (Tranche-II) Phase-II Scheme being run by the SECI and recognised by the MNRE.
Optimizer	Optimizer - Solar edge / Tigo Energy /Enphase- equivalent OR any other PSU, GoI fulfilling the technical requirement and approved supplier for CPSU (Tranche-II) Phase-II Scheme being run by the SECI and recognised by the MNRE.
Mounting Structure	Tata Steel/ Jindal Steel / TISCO / RINL / Asian OR any other PSU, GoI fulfilling the technical requirement and approved supplier for CPSU (Tranche-II) Phase-II Scheme being run by the SECI and recognised by the MNRE.
String Monitoring Boxes	Trinity Touch/Hensel/VNT/Fairwood/Spillsberg/Eaton Salaris / Statcon /Machine Pulse OR any other PSU, GoI fulfilling the technical requirement and approved supplier for CPSU (Tranche-II) Phase-II Scheme being run by the SECI and recognised by the MNRE.
TTA LT Panels including switchgears	ABB / Schneider / Siemens / L&T OR any other PSU, GoI fulfilling the technical requirement and approved supplier for CPSU (Tranche-II) Phase-II Scheme being run by the SECI and recognised by the MNRE.
Control Relay	ABB/Siemens/Schneider/L&T OR any other PSU, GoI fulfilling the technical requirement and approved supplier for CPSU (Tranche-II) Phase-II Scheme being run by the SECI and recognised by the MNRE.
SCADA	Schneider/ ABB/ GE/ L&T / Ecolibrium/ Neo Silica/ Trinity / Touch/JPION/ICAM/MACH Pulse OR any other PSU, GoI fulfilling the technical requirement and approved supplier for CPSU (Tranche-II) Phase-II Scheme being run by the SECI and recognised by the MNRE. (Shall be on open protocol)
Meter	Secure / Schneider / L&T / HPL

	OR any other PSU, GoI fulfilling the technical requirement and approved supplier for CPSU (Tranche-II) Phase-II Scheme being run by the SECI and recognised by the MNRE.
Cables	DC Cable: Polycab/KEI/Ravin/Lapp/ Apar / Havells AC Cable: Polycab/KEI/Ravin/Lapp/Havells / RR Kables
Plant Lightening Arrestor	Erico /LPI/ Cape /OBO / DEHN
SPD	DEHN / Cape / OBO / Socomech
Connector	Multi contact/Amphenol/Koyo/Bizlink / Elcon / Stsubli
Weather monitoring system	Dynalab / Zonner / Metone / Trinity / KIPP / Webdesign (Shall be With minimum features of wind monitoring, system, temperature system, rain monitoring system, weather forecasting system and pyrometer)
IP Base CCTV	Honeywell/Bosch / Sony OR any other PSU, GoI fulfilling the technical requirement and approved supplier for CPSU (Tranche-II) Phase-II Scheme being run by the SECI and recognised by the MNRE.

Note: The contractor has to submit the Type approval certificates & type test reports of the Inverts, cables, PV Panels, etc issued by the NABL & NABL accredited laboratories. The PV Panels and others shall be randomly selected for its type testing as per the MNRE/IEC/NISE guidelines.

Location Data:

Courtesy: Google Earth

Proposed Site & Space allocated (Approx 20 acre)

Coordinates:

25°00'54.2"N 85°22'26.7"E, 25.015061, 85.374075

4. Site Particulars:

System particulars

a. Nominal system voltage – 415V & Tolerance as per IS
b. Frequency - 50Hz ± 3%
c. No. of phases – Three Phase & Neutral.
d. System neutral - Solidly earthed

Tropical conditions

a. Ambient temperature: 50 degree Celsius
b. Relative humidity (avg.) : 60
c. Isokeraunic level: 33
d. Seismic Zone: Zone-4
e. Climate type: hot and humid

The climatic conditions are prone to wide variations in ambient conditions and hence the equipment shall be of suitable design to work satisfactorily under these conditions.

5. List of Abbreviations:

°C : Degrees Centigrade (or Celsius)

µc-Si : Micro-crystalline Silicon

A : Ampere,

AC : Alternating Current ,

AD : Accelerated Depreciation,

APPC : Average Power Purchase Cost, w

BoS : Balance of System,

CCI : Clinton Climate Initiative,

CDM: Clean Development Mechanism,

CdTe : Cadmium Telluride,

CEA : Central Electricity Authority,

CERC : Central Electricity Regulatory Commission,

c-Si : Crystalline Silicon,

CUF : Capacity Utilization Factor,

DC : Direct Current

DHI : Diffused Horizontal Irradiance

DisCom : Distribution Company

DNI : Direct Normal Irradiance

DPR : Detailed Project Report

DSCR : Debt-Service Coverage Ratio

EBV : Evaluated Bid Value

EIA : Environment Impact Assessment

ESCOM : Electricity Supply Company

EVA : Ethyl Vinyl Acetate

FiT : Feed-In Tariff

GBI : Generation-Based Incentive

GHI : Global Horizontal Irradiance.

BERC-Bihar Electricity Regulatory Commission,

SBPDCL-South Bihar Power Distribution Company Limited.

Hz : Hertz

IAM : Incidence Angle Modifier

IEC : International Electro technical Commission

IEX : Indian Energy Exchange

IMD : Indian Meteorological Department

IMP : Current at Maximum Power Point

IREDA : Indian Renewable Energy Development Agency

IRR : Internal Rate of Return

IS : Indian Standards

ISC : Short-Circuit Current

JNNSM : Jawaharlal Nehru National Solar Mission

KPCB : Kerala Pollution Control Board

kV : Kilo-Volt

kW : Kilowatt

kWh : Kilowatt- hour

LCOE : Levelized Cost of Electricity

MMS : Module Mounting Structure

MNRE : Ministry of New and Renewable Energy, Government of India

MOEF : Ministry of Environment and Forest, Government of India

MPPT : Maximum Power Point Tracking

MW : Megawatt

MWh : Megawatt-hour (i.e. 103 kWh)

NAPCC : National Action Plan on Climate Change

NASA : National Aeronautics and Space Administration

NH : National Highway

NOC : No Objection Certificate

NPV : Net Present Value

O&M : Operation and Maintenance

OEM : Original Equipment Manufacturer

PFC : Power Finance Corporation

PMAX : Maximum Power

PPA : Power Purchase Agreement,

PR : Performance-Ratio

REC : Renewable Energy Certificate

RPO : Renewable Purchase Obligation

SCADA : Supervisory Control And Data Acquisition

SERC : State Electricity Regulatory Commission

SNA : State Nodal Agency

STC : Standard Testing Condition

STU: State Transmission Utility

T&D : Transmission and Distribution

THD : Total Harmonic Distortion

VAT : Value-Added Tax

VMP : Voltage at Maximum Power Point

VOC : Open-Circuit Voltage

W : Watt

6. Annexure – P

Performance Ratio Test

1 INTRODUCTION

This document lays down the procedures and requirements for conducting Functional Guarantee tests including scope of the tests, procedures for the tests, reporting formats and process for determining test results in accordance with the Tender Specifications, applicable standards and industry best practices.

2 FUNCTIONAL GUARANTEE TESTS FOR SOLAR PV PLANT

Functional Guarantee for Solar PV Plant shall comprise of following Guarantees: (1) Performance Ratio Guarantee test for operational acceptance.

(2) Annual Generation Guarantee up to a period of 5 years (O&M Period), starting from the date of

Operational Acceptance.

2.1 PERFORMANCE RATIO GUARANTEE TEST

A Performance Ratio Guarantee test shall be commenced within 60 days of the commissioning of Plant Facilities to demonstrate that the plant has achieved the Guaranteed Performance Ratio in line with requirements under section VII of the bidding document. This will be one of the pre-conditions for the Plant Operational Acceptance. Performance Ratio (PR) test period would be continuous measurement of 30 consecutive days. The test shall be conducted in accordance with the IEC-61724 as per the methodology described in Technical Specifications under section VII of the bidding document. The procedure of PR test is described further in Section 2.4. The report shall contain all the measured energy and Met data values, calculations, results and conclusions.

2.1.1 Performance Ratio

The Performance Ratio (PR) of the PV Plant is calculated as follows (according to IEC 61724 Ed.2).

$$PR = \frac{E_{out}}{\sum_k \left(\frac{(C_k \times P_o) \times (G_{i,k} \times \tau_k)}{G_{i,ref}} \right)}$$

where

PR Temperature Corrected Performance Ratio

Eout Cumulative AC energy measured at the plant end ABT meter over the duration of reporting period (kWh)

τ_k Duration of the kth recording interval, i.e. (1/60) hour

$\sum k$ Summation over all recording intervals in the reporting period, (1/4) hour

Ck Power rating temperature adjustment factor and can be calculated as below

Ck = 1 + γ x (Tavg_mod,k – Tref)

γ Temperature coefficient of power with negative sign ($°C^{-1}$)

Tavg_mod,k Average PV Module temperature measured at the commencement of time interval 'τ_k' (°C) Tref PV Module temperature at which Po is determined, i.e. 25°C

P_o Installed nominal peak power of PV modules, i.e. Nameplate rating at STC (kW_p)

$G_{i,k}$: Average irradiance measured at the Plane of Array (POA) at the commencement of time interval τ_k (kW/m^2)

$G_{i,ref}$ Irradiance value at which P_o is determined, i.e. 1 kW/m^2

2.1.2 General Requirement

- The Functional Guarantee shall comprise of a set of visual/mechanical/Electrical checks followed by a Performance Ratio (PR) test of the Plant Facilities.

- The PR test shall be carried out for a period of 30 consecutive days at site by the Contractor in presence of the Employer/ Employer's Representative/ Owner's Engineer.

- These tests shall be binding on both the parties to the contract to determine compliance of the equipment with the guaranteed performance parameters.

- The test will consist of guaranteeing the correct operation of the Plant Facilities, by way of the performance ratio based on the reading of the energy produced and delivered to the grid at the plant end ABT meter and the Plane of Array incident solar radiation.

- PR is calculated as per the formula given in Clause no. 2.1 and recorded as per the format provided at ***Annexure 1***.

- All the end of each day, the filled-in format shall be signed by both the parties (Contractor and SECI) and each party will keep one copy for record. **The same will continue for 30 consecutive days.**

- The Functional Guarantee condition for the purpose of Provisional Acceptance of Part 1 of the Plant Facilities shall be considered to have been met if the guaranteed Performance Ratio (PR) is achieved on a daily basis for 30 consecutive days.

- During this PR test, equipment failure/interruption of any kind, except for SCADA communication failures, will not be accountable. In case of a breakdown, the test may be resumed once the complete system is rectified and working properly.

2.1.3 Pre-PR Test

2.1.3.1 The Contractor shall perform start-up tests after successful completion of visual inspection and functional testing. Such testing shall be conducted under the SECI's / Owner's Engineers supervision. The test results shall be recorded as part of a signed-off commissioning record.

2.1.3.2 Preliminary Test Check

The preliminary checks include all the warranty certificates for the major equipment, pre – commissioning test reports, field quality checklists verified through the FQP documents of all equipment and works along with the calibration reports of all the instruments and sensors, wherever applicable.

2.1.3.3 Visual /Mechanical Test

Visual checks shall be done on all the components that form part of the plant including the grid connection equipment in compliance with the field quality plans. The following critical elements as a minimum shall be subjected to visual inspection:

- Module mounting structure and foundations.
- PV module and DC installation.
- Inverters.
- Transformers.
- Switchgear.
- Lightning protection systems.
- Earthing protection systems.
- Electrical protection systems, junction boxes and cabling.
- Grid connection compliance protection and disconnection systems.
- Monitoring systems (including meteorological sensors).

2.1.3.4 Electrical Tests

Subsequent to mechanical completion and visual testing of the plants, following functional electrical tests shall be performed. These tests also referred as start-ups tests shall be the first step for PG guarantee of the plant. These tests shall essentially include:

2.1.3.5 Open circuit voltage (VOC) test.

This test verifies that strings are properly connected (module and string polarity) and that all modules are producing the expected voltage according to the module data sheet. To measure Voc, the following procedure shall be used:

(a) DC string combiner box is opened; fuses leading to the sub main junction box are removed.

(b) The voltage is measured with a calibrated, industry accepted instrument from the negative bus bar to the string positive lead.

2.1.3.6 Functional Guarantee Test shall commence immediately after all issues arising from the functional/

start-up test have been rectified. Note:

(a) All measurement(s) procedure should be carried out taking proper safety precaution.

(b) Also it should be ensured that to avoid any loose connection at the terminal points for which measurement procedure is conducted.

(c) Ensure proper functioning (e.g. Mustimeters shall be calibrated) of all measuring instruments before conducting above measurement procedure.

(d) The above test procedure shall be conducted in presence of site in-charge.

2.1.4 PR Test Procedure

The date of commencement of the PR Test shall be communicated in advance and agreed upon by both parties i.e. SECI and Contractor. Any consecutive 30 days period (excluding interruptions that last entire day on account of grid outage or as per hindrance record maintained at site only) for the purpose of conducting PR test shall be mutually discussed and agreed between SECI and Contractor. It shall comprise of the following procedures.

2.1.4.1 Pre-test Procedure

(1) Before the commencement of Performance Ratio (PR) test, the plant shall have achieved visual/mechanical/Electrical completion as per Clause 2.3 above and SCADA system and WMS shall be fully commissioned and functional.

(2) Trial Run: The PG Test for Plant Facilities shall commence with a trial run for 7 consecutive days.

The Contractor shall provide the data in requisite formats (specified elsewhere in the document) to SECI. SECI shall vet the data for any discrepancies and systemic errors and revert within 3 working days. Post the trial run period, the 30 days PR test will commence after communication from SECI in this regard.

(3) Pyranometer Tilt Angle & Cleanness: The pyranometers & Tilt Angle shall be verified before the test commences and **then visually inspected at regular intervals for cleanliness during the tests**.

(4) The average of all the Pyranometers (GTI) shall be considered for the calculation of PR. The average of module temperatures recorded by all the temperature sensors shall be used for calculation of PR. The Pyranometers and Temperature sensors used for the purpose of the PR Test shall have valid calibration certificates.

2.1.4.2 Following the completion of the pre-test procedures, Performance Ratio Test of plant shall commence in accordance with the procedures, conditions and requirements provided in the next section.

2.1.4.3 General Procedure for the PR Test

The PR Test Procedure shall include the following components:

- Data Collection: PV Power Plant test related parameters are collected in one-minute and 15 intervals for the 30 (Thirty) days (consecutive) reference period. The data shall consist of the following at a minimum:
- Irradiance at Collector's (i.e. PV Module) POA; (Source: SCADA, Temporal Resolution: 1 minute)
- Other Met Data received from installed WMS; (Source: SCADA, Temporal Resolution: 1 minute)
- Energy generated at Plant (kWh) (Source: Plant MFM Meter from SCADA, Temporal Resolution: 1 minute)

- Energy injected into grid (kWh) (Source: Plant ABT Meter at GSS/injection point, Temporal Resolution: 15 minute)
- PV Module Temperature recorded from the temperature Sensors (oC) (Source: SCADA, Temporal Resolution: 1 minute)

(2) **Data Filtering:** The data shall be filtered so that the data set is free of nuisance data points and bad data that exhibit a high degree of error (such as errors caused by faulty instrumentation). The Contractor shall document the data which is to be eliminated along with reasons. The following criteria shall be excluded from the dataset used for this test:

- Nuisance or bad data – Nuisance data points or bad data that clearly exhibit a high degree of error including required meteorological measurement equipment that is identified as being out of calibration or requiring adjustment. A 15-minute time-block shall be explicitly flagged through a flag parameter on account of this factor after recording reasons thereof (Note: no filtration shall be done at site level). The same shall be corroborated/verified by SECI.
- Time blocks with insufficient (less than equal to 10) 1-minute records.

- Grid Interruptions – Time periods (in 15-minute time blocks) of the grid interruptions at the utility substation, recorded manually jointly by Contractor and SECI representatives shall be eliminated. Grid outage period, if any, shall be verified from SCADA.
- Any Force majeure conditions
- Radiation Criteria – Radiation on Plane of Array (POA) less than 200 W/m2
- Shutdown explicitly demanded by the Owner/DISCOM/STU.
- As per the hindrance record maintained at site.

Note: Minimum 24 Nos of 15-minute time blocks shall be considered to account the day for PR measurement. Otherwise the PR test shall be extended to another day.

2.1.5 Determination of PR Test

Daily PR shall be calculated as the average of the PR calculated for valid 15-minute time blocks (Refer Clause 0) for the 30-day duration. If the Contractor is not able to demonstrate guaranteed PR during this period, the two more chances shall be given to demonstrate the same after incorporation of suitable corrective measures. In case the contractor fails to achieve guaranteed PR even after the two more chances, further action shall be taken as per the provisions of contract.

The test shall be repeated for 30 days in case of any outage of following equipment for more than 7 days.

- Power Transformer
- Power Conditioning Unit
- HT Switchgear Panel
- SCADA and data logger combined
- Tilted pyranometer
- Other WMS sensors.

2.1.6 **Raw Data** Formats **and Reports**

The Contractor shall submit to SECI the raw data from the Plant SCADA on daily basis in the following format.

TEMPORAL RESOLUTION: 1 MINUTE

Date & dd/mm/yyyy hh:mm:ss format	Wind Speed (m/s)	Module Temp. (°C)	Ambient Temp. (°C)	Horizontal Irradiance (W/m²)	POA Irradiance (W/m²)	POA Radiation (kWh/m²)	Humidity (%)	Wind Direction (°)	Generation (kWh) (Source: TVM)

TEMPORAL RESOLUTION: 15 MINUTE (EVERY 15TH MIN RECORD FROM THE 1 MIN DATA)

Date & Time dd/mm/yyyy hh:mm:ss format	Wind Speed (m/s)	Module Temp. (°C)	Ambient Temp. (°C)	Horizontal Irradiance (W/m²)	POA Irradiance (W/m²)	POA Radiation (kWh/m²)	Humidity (%)	Wind Direction (°)	Generation (kWh) (Source: TVM)	Explicit Removal Flag* (0 or1)	Remarks

***** Explicit Removal Flag: 0 indicates time block considered; 1 indicates time block not considered.

PR Test Report shall be generated from the Raw Data (Sample Report provided in the Annexure) after data filtering as per criteria laid out in 0. The Report shall contain the signature of both representatives (SECI/Employer & Contractor).

2.2 CAPACITY UTILIZATION FACTOR

Capacity Utilization Factor for Solar Plant shall be calculated as per the following formula.

$$\mathbf{CUF} = \frac{E_{ac}}{8760 \times P_{ac} \times (1 - DF \times N)}$$

where,

Eac is the number of units recorded in the plant end ABT meter, kWh

8760 refers to the number of hours in non-leap year. It shall be replaced by 8784 hours during leap year

Pac is the plant AC capacity, kW

DF is module degradation factor, 0.7% per year

N is the number of years of operation after operational acceptance of the plant

CUF shall be calculated on annual basis from the date of operational acceptance of the plant till the end of O&M period.

It is the responsibility of the Contractor to build-in the expected variation of irradiance in their design by installing additional DC capacity to meet the committed CUF. Irradiance variation will not be considered for the calculation of CUF. The contractor has to consider minimum 30% additional capacity or higher as required on compete DC side.

Grid outage hours shall be subtracted from total number of hours in a year. The Contractor shall submit grid outage certification from component authority of STU/DISCOM.

ReportsSample Report for PR Test

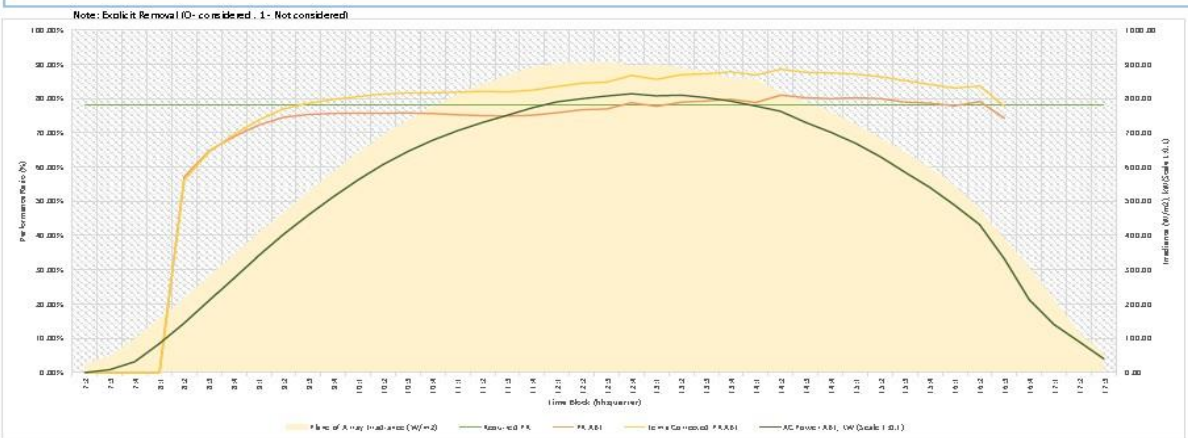
PR Guarantee Test Report

Day	20-Nov-2016	Criteria	>200	*Average POA Irradiance in a time block in W/m2*
No. of Timeblocks considered	36 /42	Tot Gen	53694 *kWh*	*Source: ABT Meter at GSS*
Plant PR for the day ABT	80.66%			*Average PR (temp corrected) of 15 min time blocks where POA irradiance is greater than 200W/m2 and not explicitly removed*

(Guarantee d PR: 78%)

Time Block (hh:Qtr)	Wind Speed (m/s)	Module Temp. (°C)	Ambient Temp. (°C)	POA Radiation (kWh/m2)	Plane of Array Irradiance (W/m2)	GHI (W/m²)	Humidity (%)	Wind Direction (°)	Generation ABT GSS (KWh)	AC Power ABT, kW (Scale 1:01)	PR ABT	Temp Corrected PR ABT	Explicit Removal
7:2	1.62	13.91	15.10	2.17	25.25	27.00	45.92	88.10	0.00	0.00	0.00%	0.00%	0
7:3	1.41	14.47	15.25	12.34	47.92	50.47	45.53	38.35	21.00	8.40	14.73%	14.10%	0
7:4	0.57	15.84	15.73	25.08	98.48	92.93	44.41	0.00	79.00	31.60	27.27%	26.24%	0
8:1	0.26	17.73	16.01	39.51	156.11	143.67	44.55	0.00	212.00	84.80	46.45%	45.07%	0
8:2	0.66	20.64	17.01	54.73	216.78	193.67	42.19	0.00	361.00	144.40	57.10%	56.08%	0
8:3	0.43	24.09	17.94	70.40	279.62	245.80	40.17	0.00	526.00	210.40	64.69%	64.45%	0
8:4	0.71	27.22	18.85	86.46	343.62	291.80	38.39	0.00	688.00	275.20	68.90%	69.52%	0
9:1	0.71	29.93	19.74	102.34	407.36	348.47	36.74	0.00	854.00	341.60	72.25%	73.71%	0
9:2	0.71	32.98	20.73	117.25	466.99	398.00	35.17	0.00	1009.00	403.60	74.51%	76.95%	0
9:3	0.80	35.60	21.52	132.29	527.14	445.27	33.94	0.00	1151.00	460.40	75.33%	78.61%	0
9:4	0.74	38.17	22.31	146.86	585.56	486.27	32.98	0.00	1283.00	513.20	75.64%	79.72%	0
10:1	0.87	40.55	23.23	160.77	641.34	516.87	31.86	0.00	1406.00	562.40	75.72%	80.54%	0
10:2	0.93	42.99	24.08	173.62	692.91	540.33	31.13	0.00	1518.00	607.20	75.70%	81.28%	0
10:3	0.99	43.78	24.78	184.38	736.02	559.67	30.67	0.00	1613.00	645.20	75.74%	81.57%	0
10:4	1.18	44.44	25.53	194.12	775.43	576.53	29.87	12.76	1695.00	678.00	75.60%	81.63%	0
11:1	1.05	46.52	26.17	203.12	811.43	593.60	28.97	0.00	1765.00	706.00	75.23%	81.87%	0
11:2	0.89	48.11	26.74	210.57	841.02	609.07	28.28	0.00	1824.00	729.60	75.00%	82.10%	0
11:3	1.51	47.95	27.61	217.05	867.66	624.60	26.97	0.00	1877.00	750.80	74.87%	81.92%	0
11:4	2.03	48.74	28.04	222.77	890.54	642.47	25.69	76.95	1932.00	772.80	75.09%	82.40%	0
12:1	1.61	49.61	28.91	225.54	902.04	656.13	24.24	0.00	1975.00	790.00	75.82%	83.47%	0
12:2	2.03	49.58	29.45	225.55	902.30	664.40	22.97	129.40	1998.00	799.20	76.69%	84.42%	0
12:3	2.34	49.79	29.73	227.09	907.75	672.60	21.62	131.02	2018.00	807.20	76.94%	84.75%	0
12:4	2.48	49.66	29.92	223.65	895.29	671.87	20.71	96.20	2034.00	813.60	78.74%	86.70%	0
13:1	2.10	49.70	30.20	224.96	899.51	670.93	18.75	0.00	2019.00	807.60	77.71%	85.57%	0
13:2	2.32	49.80	30.31	222.11	889.25	665.80	18.11	22.42	2024.00	809.60	78.90%	86.92%	0
13:3	2.59	49.39	30.42	219.07	877.23	649.13	17.75	219.19	2005.00	802.00	79.24%	87.17%	0
13:4	2.22	49.55	30.70	215.00	859.72	630.67	17.39	0.00	1980.00	792.00	79.73%	87.76%	0
14:1	1.87	49.88	30.98	213.62	855.38	620.80	16.27	0.00	1944.00	777.60	78.79%	86.83%	0
14:2	2.27	47.80	31.28	203.86	816.52	584.27	16.13	19.15	1906.00	762.40	80.95%	88.51%	0
14:3	2.30	47.34	30.99	196.95	788.89	548.20	16.46	38.30	1825.00	730.00	80.23%	87.58%	0
14:4	2.05	47.88	31.01	189.95	760.16	520.20	16.53	7.33	1754.00	701.60	79.95%	87.45%	0
15:1	1.75	45.99	31.44	180.73	724.65	484.80	15.75	0.00	1674.00	669.60	80.19%	87.10%	0
15:2	2.30	44.51	31.33	170.69	684.26	442.27	15.51	95.39	1576.00	630.40	79.94%	86.34%	0
15:3	2.10	44.35	31.19	160.33	642.47	402.40	15.57	28.93	1462.00	584.80	78.95%	85.21%	0
15:4	2.33	41.86	31.19	148.67	596.65	358.47	15.41	45.73	1350.00	540.00	78.62%	84.06%	0
16:1	1.91	41.25	31.19	135.70	544.70	311.80	15.33	90.91	1220.00	488.00	77.84%	83.02%	0
16:2	2.37	38.99	31.12	118.23	475.45	255.73	14.96	5.47	1080.00	432.00	79.09%	83.62%	0
16:3	2.57	36.66	30.95	96.68	389.67	195.27	15.01	86.82	829.00	331.60	74.24%	77.79%	0
16:4	1.60	34.83	30.62	70.86	306.83	143.86	15.44	76.91	531.00	212.40	64.88%	67.50%	0
17:1	1.56	32.61	30.19	52.45	212.88	92.47	15.59	63.97	350.00	140.00	57.78%	59.58%	0
17:2	1.75	29.57	29.68	26.61	117.56	48.14	15.94	103.66	226.00	90.40	73.53%	74.91%	0
17:3	0.84	27.22	28.80	4.19	52.66	21.40	16.82	0.00	100.00	40.00	206.71%	208.59%	0

Note: Explicit Removal (0- considered , 1- Not considered)



7. ANNEXURE B

BILL OF MATERIAL 5 MW GROUND MOUNTED SOLAR FARM - DESIGN, PROCUREMENT, INSTALLATION, COMMISSIONING & TESTING JOB			
Sr. No.	**Description**	**Unit**	**Quantity**
1	Solar Modules: - Solar Modules Of 325 Wp Capacity Manufactured On Automated Production Lines With 18.3 % Cell Efficiency.	Nos.	20020
2	Module Mounting Structure:- 2.5mm Thickness Minimum 120 micron Minimum HDGI	Ton	2600
3	Power Conditioning Unit (Inverters) :- String Inverter Above 98.2 % Efficiency Inverter. Max 10% Overloading. Min 50 KW to Max 200 KW ONLY	Nos.	66 to 132
4	Whether Monitoring System with Minimum features of wind monitoring system, weather forecasting system, pyrometer, Irradiation, Mod Temp and Amb Temp	Nos.	1 + 1 standby
5	DC cables - 1C x 4 or 6 sq mm Tin Copper Solar Cable 1.1kV (Array to Inverter)	M	320000
6	Earthing Cable (Green) - 1C x 6 Sq.mm Cu conductor, PVC 1.1kV	M	6500
7	Interconnecting cables - Communication Cable - RS485 (2 Pair)	M	4000
8	Earthing Kit Complete (600x600*3.15 cu plate Earthing at 2.25 mtr)	Nos.	125
9	Lightning Arrester confirm to latest IS	System	1
10	Cu strip 20x3 for earthing	M	4200
11	Accessories & All The Necessary Equipment MC4 connector, cable Tie, Cable Lugs, Gland, SPDs, SMBs Etc.	LS	1
12	HDPE Pipe 50mm	M	2250
13	Optimizer	Nos.	5005
14	Armoured XLPE Copper & Aluminium AC Cables as required from Inverter to AJB / Panel & AJB/Panel to Panel including laying, termination etc. Consider se of aluminium cable from Inverter to AJB/Panel & AJB/Panel to LT Panel may be issued to give opportunity to all prospective bidders to consider the same and submit its offer accordingly.	LS	1
15	LT PANELs as required from Inverter to Main LT Panel	Nos.	14 to 28

16	Main LT Panel	Nos.	1
17	Auxiliary supply panel as required	Nos.	1
18	Data Logger: Daily Power Generation and Consumption made available through ethernet. Monthly Report of Generation Will Be Forwarded On Selected Email Id's	Nos.	10
19	Complete SCADA System with Pc and License Software etc	Set	1
20	DISCOM Approved Metering System - Solar Generation & Net Meter	Set	1
21	UPS in n+1 formation with 2 hours Battery Backup	Nos.	2
22	External Lighting & Security Lighting with cabling, panel etc	LS	1
23	Module Cleaning Arrangement	Set	1
24	Comprehensive Operation & maintenance contract Beyond the Guarantee Period For Equipment Supplied.	Year	5

Note:

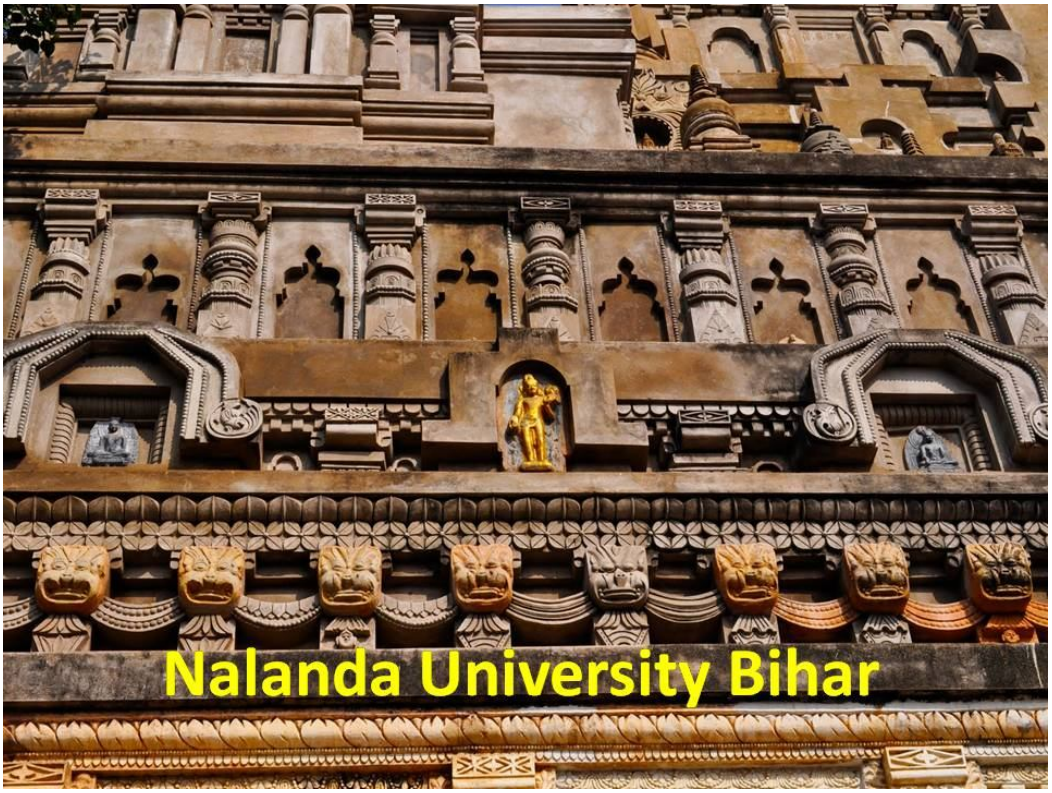
1.) **Above BOQ is provided for ready reference only, contractor has to consider additional items, quantity, scope, costs as may be required to complete the project as defined intent in tender document & as required to complete the system in all manner.**

2.) **Intent of this BOQ is to describe the system component requirements in brief & hence contractor may us enhance products keeping minimum technical criteria given in above line items.**

3.) **Contractor to provide a complete detail line item BOQ for the system designed by their team for review & approval.**

NALANDA UNIVERSITY

PROJECT: - SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE, RAJGIR, NALANDA, BIHAR.



SUBMISSION: -
GEOTECHNICAL INVESTIGATION REPORT

TO

CONSULTANT
(ADMINISTARTINON)
ON BEHALF OF VICE CHANCELLOR,
NALANDA UNIVERSITY
1ST FLOOR , INDIAN CONGRESS BUILDING
SEC-6,RKPURAM , NEW DELHI-110022

SUBMITTED BY
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2012

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PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.

1.0 INTRODUCTION

The Consultant (Administration) **Nalanda University** has proposed to construct New University building at Rajgir , Dist. Nalanda, Bihar . To design an appropriate, efficient and cost effective buildings , the generation of data of general geotechnical parameters viz sub soil profile consisting of physical characteristics such as atterbergs limits, Grain Size analysis, field moisture contents, Bulk and Dry unit weight, specific gravity, CBR Values , Chemical Properties and safe bearing capacity, for the preparation of Bore logs and other information along with ground water table from Existing Ground Level Considered essential.

In view to the above The Consultant (Administration) Nalanda University proposed to conduct a detailed geotechnical investigations (Field and Laboratory test) for the proposed development of entire area and entrusted the work of geotechnical investigations to **M/S Allied Engineers, Space No 77, LSC LU Block Pitam Pura DELHI - 110034**.

The Report presented here in deals with the field and laboratory investigation carried out to assess the nature of sub-soil strata and to evaluate such soil parameters as may be required for the development of the proposed site. The work of soil investigation was entrusted to M/s ALLIED ENGINEERS, New Delhi, by the Consultant (Administration) Nalanda University vides his office order No:-NU/39/12-13 Dated 18th September 2012.The soil investigation work was taken up during September – October 2012.

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1.1:-LOCATION OF SITE :-

The site was investigated for the purpose of overall development of university (i.e. Construction of buildings, roads etc) and to revive historical heritage of original Nalanda University at Rajgir , District Nalnda, Bihar. The "SITE" is Situated at a close distance from the Rajgir Town . The project site is located in a region comprising of alluvial soil deposits within shallow depth . At present the ground appeared to be a fairly leveled.

1.2 GEOLOGY OF THE REGION IN BRIEF

Nalnda-Rajgir metasedimentary belt is situated in parts of Munger, Nalanda and Gaya districts of Bihar. The mega-fold structure of the Rajgir belt and occurrence of several hot springs in the vicinity has attracted geologists from the time when geological mapping of the Indian subcontinent was still in its nascent stages. However, in the latest Geological map of India published by the Geological Survey of India (1998, 7th Edn.), the Munger-Rajgir metasediments have been depicted as probable time equivalent with the lower Vindhyans. These have experienced mild metamorphism and overall lithology and structure do not exactly conform to the nature of the Vindhyan sequence. The sequence is situated in the northwest of the Rajgir fold belt near Bathani village of Gaya district. Occurrence of such volcano-sedimentary sequence was hitherto not reported from the Munger Rajgir metasedimentary belt and provides a new perspective to the understanding of the litho-stratigraphic set-up of the area. Geological Setting. The most prominent geological feature in the study area is the NE-SW-trending Rajgir fold belt comprising alternate quartzite and phyllite unit. According to Srivastava and Sen Gupta (1967) this fold belt comprises two distinct quartzite bands interbedded with phyllites, whereas Thiagarajan and Banerjee (1967) and Sarkar and Basu Mallick (1979) contend that the Rajgir fold belt comprises a quartzite unit bounded by upper and lower phyllite units. These metasedimentary units have been intruded in the northern part by granite and basic rocks at places (Sarkar and Basu Mallick, 1979).The quartzite unit displays very -preserved primary sedimentary structures such as stratification, cross-bedding,ripple marks, mud cracks and convolute-bedding.

The phyllite unit is gradational as as in sharp contact with quartzite. The phyllite is essentially thinly laminated and shows variegated colour and of ferruginous nature. The alternate quartzite and phyllite units of the Rajgir fold belt have preserved clear evidences of two phases of deformation. The first phase of folding (F1) has given rise to the regional fold structure with closure at Giriak in NE and the dominant NE-SW-trending bedding parallel schistosity. The litho-units of volcano-sedimentary sequence of the study area have been classified into three divisions: (i) mafic volcanics, comprising pillow basalt and mafic pyroclasts (ii) acid volcanics,comprising rhyolite and (iii) volcanosedimentary sequence comprising tuff, banded chert and banded iron formation (BIF).

1.3 OBJECT OF INVESTIGATION:

In order to establish the infrastructural development in the entire university campus , the following data would be required: The soil profile down to probable depth of the proposed Structures indicating thicknesses of various soil strata. Classification of soils and physical characteristics of the sub-soil strata. Engineering properties of sub-soil at various depths. Location of ground water table depth below the ground surface. Quality of ground water vis-à-vis the standard norms. To obtain and evaluate the above information and parameters, both, field investigation as well as laboratory tests on soil and water samples have been analyzed to provide preliminary recommendations for the selection of sites for the proposed construction of Structures .

2.0 SCOPE OF INVESTIGATION:-

The Scope of the present soil investigation at the proposed site for the construction of Structures was decided by the Engineer – in charge to achieve the afore said objectives of the present investigation progarmme . The scope of the study included the following:-

Advancing 100/150 mm dia bore holes up to specified depths below the ground level at locations decided by Engineer-in-Charge.

Obtaining disturbed (D/S) undisturbed (UDS) soil samples at appropriate interval as per BIS specifications up to 6.0 m to 9.0 m depth .

Observing water table depth in all the bore holes after 24 hours of their completion.

Collecting water sample from the boreholes and to perform necessary chemical tests on them to assess the quality of ground water .

Conducting Grain-Size analysis on soil samples to determine co-efficient of uniformity and co-efficient of curvature of soil sample and to plot the resulting Grain Size distribution curves.

Performing the laboratory permeability test on undisturbed samples obtained from boreholes to find out the coefficient of permeability of the sub-soil strata at various levels.

Performing plate load test at 20 Nos location on 30.0 cm X 30.0 cm plate at 1.5 m depth or above water table which ever encounters earlier.

Performing laboratory CBR test at 20 Nos location as decided by Engineer in charge.

Performing Liquefaction analysis based sub soil parameter obtained from the bore holes.

Finally, the scope included preparation and submission of technical report containing the analysis and results of the characteristics and properties of the sub-soil strata of the proposed Structures site in 3-copies.

3.0 FIELD INVESTIGATION:-

3.1 DRILING BOREHOLES:-

Drilling of borehole is generally achieved by using auger. Helical auger is generally found more efficient in advancing boreholes. However, the augers can be used where the bore is dry and the soil has strength to stand of its own. It has been experienced that boreholes to be drilled in sandy stratum under submerged conditions generally cave-in / collapse. The alternative method in the above said site conditions is to advance the borehole by lowering casing pipe and using bailer to excavate and remove the soil from the borehole. Casing pipe when penetrates to greater depths below the water level in a sandy stratum, a phenomena named as "boiling of sand" comes into play. To over come this, water level within the casing pipe has to be maintained to be level slightly above the ground water table level. Yet another method to a stabilizing boreholes by using bentonite mud solution is implied too frequently. However, the present investigation programme did not allow the use of bentonite mud as the scope of work included to collect undisturbed samples for determining its co-efficient of permeability. The down ward movement of bailer gives upward moment of soil due to which the soil in the bottom of the borehole is filled up in the bailer. The bailer is then taken out and soil is again excavated and collected with the similar process and the borehole is advanced or cleaned.

3.2 SOIL SAMPLING:-

The undisturbed soil samples (UDS) were collected from the boreholes at every 3 m. vertical interval in all the boreholes as shown in the soil profile sheets (Bore log sheet 1 to 10). The UDS were collected by attaching thin-walled Shelby tubes having an area ratio of 8% to 'A' rods and driving it into the natural soil for 45 cm. depth. This method of collecting UDS was found workable for retrieving samples from shallow depths. However, sampling failed at greater depths below the water table by way of slippage of samples from the Shelby tubes . In this situation , thin walled piston sampler is used to collect the undisturbed soil samples .The sampling was achieved by using 100 mm dia samplers. The soil samples were then extruded from the samplers and were lab tested for determining various characteristics and engineering properties of soil as per the scope of the work.

3.3 DEPTH OF WATER TABLE:

The water table below the general ground level is measured in all the boreholes. The water table in any borehole is measured after 24 hours of its completion. The ground water table level equilibrates and stabilizes itself in the said intervening period. The observations from the boreholes at **"SITE"** indicated the presence of water table at an average depth of about 2.0 mtrs to 2.75 m below the existing general ground level. However the ground water level was measured at existing ground during monsoon season after heavy rainfall and certain part of site was waterlogged for very long period.

4.0 LABORATORY TESTS:-

4.1Grain Size Analysis.

An analysis of this kind express quantitatively the proportions by mass of the sizes of particles present in the soil. In a soil mass , the gravel, sand , silt and clay fraction are recognized as containing particles of decreasing magnitude. The analysis is covered under Indian standard : 2720 (part-4) – 1985, method of test for soils, "Grain Size Analysis". The results of grain size analysis may also be represented graphically in the form of a grain size distribution curve in which the cumulative percentages finer than known equivalent grain size plotted against these sizes, the latter being on a logarithmic scale. The results of grain size analysis are widely used in soil classification. The data obtained from grain size distribution curves is used to deal with a wide range of civil engineering problems.

Two methods are used for finding the distribution of grain sizes larger than 75-micron IS Sieve; the first method, wet sieving, shall be applicable to all soils and the second, dry sieving, shall be applicable only to soils which do not have an appreciable amount of clay. For the determination of distribution of grain sizes smaller than 75-miron, the pipette method or the hydrometer method is used.

4.1.1SIEVE ANALYSIS OF SOIL PASSING 4.75 mm IS SIEVE AND RETAINED ON 75-MICRON IS SIEVE.

Analysis by wet sieving – the portion of soil passing 4.75 mm IS sieve shall be oven-dried at 105 to 110^0C. the oven-dried material shall then be riffled so that a fraction of convenient mass is obtained. This shall be about 200 g if a substantial proportion of the material only, just passes the 4.75 mm IS sieve or less if the largest size is smaller. The fraction shall be weighed to 0.1 percent of its total mass and the mass recorded. The riffled and fraction shall be spread out in the large tray or bucket and covered with water.

Two grams sodium hexametaphosphate or one gram of sodium hydroxide and one gram of sodium carbonate per liter of water used should then be added to the soil. the mix should be thoroughly stirred and left for soaking. The soil soaking specimen should be washed thoroughly over the nest of sieves specimens nested in order of their fineness with the finest sieve (75 micron IS Sieve) at the bottom. Washing shall be continued until the water passing each sieve is substantially clean. Care shall be taken to see that the sieves are not overloaded in the process. The fraction retained on each sieves should be emptied carefully without any loss of material in separate trays. Oven dried at 105 to 110^0C. and each fraction weighed separately and the masses recorded.

Alternatively, the soaked soil specimen may be washed on the 75-micron IS sieve until the water passing the sieve is substantially clean. The fraction retained on the sieve should be tipped without loss of material in a tray, dried in the oven and sieved through the nest of sieves specified either by hand or by using mechanical sieve shaker. The fraction retained on each sieve should be weighed separately and masses recorded.

Calculation:- The cumulative mass of soil fraction retain on each sieve shall be calculated. The percentage of soil fraction retained on each sieve shall be calculated on the basis of the mass of the sample passing 4.75 mm IS sieve taken for the initial analysis. The combined gradation on the basis of the total soil sample taken for analysis shall then be calculated.

4.1.2 GRAIN SIZE ANALYSIS OF THE FRACTION PASSING 75-MICRON IS SIEVE OUT OF THE PORTION PASSING 4.75 mm IS SIEVE.

Hydrometer method

(A) **Calibration of Hydrometer** :-

The volume of the hydrometer bulb (Vh) shall be determined in one of the following ways :

a) Approximately 800 ml of water shall be poured in the 1000 ml measuring cylinder. The reading of the water level shall be observed and recorded . The hydrometer shall be immersed in the water and level shall be again be observed and recorded . The difference between the two readings shall be recorded as the volume of the hydrometer bulb in milliliters plus the volume of that part of the stem that is submerged . Fro practical purposes, the error de to the inclusion of this stem volume may be neglected.

b)

(b) **From the mass of the hydrometer**:-

The hydrometer shall be weighed to the nearest 0.1 g . The mass in grams shall be recorded as the volume of the hydrometer in millimeters. This includes the volume of bulb plus , the volume of the stem below the 1000 graduation mark . For practical purposes , error due to the inclusion of this stem may be neglected.

Calibration :

The sectional area of the 1000 ml measuring cylinder in which the hydrometer is to be used shall be determined by measuring the distance between two graduations. The sectional area (A) is equal to the volume included between the two graduations divided by the measured distance in centimeters between them. The distance from the lowest calibration mark on the stem of the hydrometer to each of the other major calibration marks (Rh) shall be measured and recorded . The distance from the neck of the bulb to the nearest H corresponding to a reading Rh is the sum of the distances measured as above . The distance from the neck of the bulb to the nearest calibration mark shall be measured and recorded . The distance (H) corresponding to a reading Rh is the sum of the distance measured as above .The distance h from the neck to the bottom of the bulb shall be measured and recorded as the height of the bulb . The distance h/2 locates the centre of volume of asymmetrical bulb .If any asymmetrical bulb is used , the centre of volume can be with sufficient accuracy by projecting the shape of the bulb on to a sheet of paper and locating the centre of gravity of the projected area . The effecting depth (Hr) corresponding to each of the major calibration marks (Rh) shall be calculated from the following formula :

$$H_R = H1 + 1/2[h - Vh/A]$$

Where

Hr= effective depth ;

H1 = length from neck of bulb , to graduation Rh, in cm;

H= twice the length from neck of the bulb to its centre of volume in cm

Vh= Volume of Hydrometer bulb in ml and

A= Area of measuring cylinder in cm2 .

The Factor (Vh/A) in the above equation shall not be applied to hydrometer reading taken after periods of sedimentation of half , one , two and four minutes . The relationships between Hr & Rh may be plotted as a smooth curve which may be used for finding the effective depth (Hr) corresponding to hydrometer reading (Rh) Obtained during test .

Meniscus Correction:-

The hydrometer shall be inserted in a 1000 ml measuring cylinder containing about 700 ml water .By replacing the eye slightly below the plane of the surface of the liquid and then raising it slowly until the surface seen as an ellipse becomes a straight line , the point where the plane intersects the hydrometer scale shall be determined . By placing the eye slightly above the plane of surface of the liquid , the point where the upper limit of the meniscus intersects the hydrometer scale shall be determined . The difference between the two readings shall be recorded as the meniscus correction Cm. This is a constant for a given hydrometer.

Procedure and Pre- treatment of soil :-

The percentage of soluble salts shall be determined. In case it is more than one percent, the soil shall be washed with water before further treatment, taking care to see the soil particles are not lost. Two samples each of mass 50 to 100 g approximately shall be obtained by riffling from the air dried sample passing the 4.75 mm IS Sieve. The actual amount of soil required will vary according to the type of soil, 50 g with a clay and 100 g with a sand soil. The moisture content (w) of one sample shall be determined by the method given in IS: 2720 (part-2) 1973. The other sample shall be accurately weighed (**W**a) to the nearest 0.01 g and placed in the wide mouth conical flask 150 ml of Hydrogen peroxide shall then be added and the mixture stirred gently with a glass rod for a few minutes after which it shall be covered with a cover glass and left to stand over night . The mixture in the conical flask shall be gently heated. Care shall be taken to avoid frothing over and the contents of the dish shall be periodically stirred. As soon as vigorous frothing has subsided, the volume shall be reduced to about 50 ml by boiling. With organic soils, additional peroxide may be required to complete the oxidation.

In the case of soil containing calcium compounds the mixture shall be allowed to cool and about 50 ml of hydrochloric acid added. The solution shall be stirred with a glass rod for a few minutes and allowed to stand for one hour or for longer periods, if necessary. If the soil contains a considerable amount of calcium salts, more acid may be required. When the treatment is complete, the solution shall have an acid reaction litmus. In the case of soils containing no calcium compounds of soluble salts and having a low organic content (less than 2 per cent), the pretreatment prescribed may be omitted and the dispersing agent shall be added direct to the soil taken for analysis.

The mixture shall than be filtered and washed with warm water until the filtrate shows no acid reaction to litmus. The damp soil on the filter paper and funnel shall be transferred without any loss what so ever to the evaporating dish (weighed to 0.01 g) using a jet of distilled water. Only the minimum quantity of distilled water shall be used. The dish and contents shall be placed in an oven and dried at 110° C. The dish and contents shall than be weighed to 0.01 g. and allowed to cool. They shall than be weighed to 0.01 g. and the mass of soil remaining after pre-treatment shall be recorded (**W**b).

Dispersion of soil:

To the soil in the evaporating dish, 100 ml of sodium hexametaphosphate solution shall be added and the mixture shall then be warmed gently for about 10 minutes and then transferred to the cup of the mechanical mixer using a jet of distilled water to wash all traces of soil out of the evaporation dish. The amount of water used may be about 150 ml. The soil Suspension shall then be stirred for 15 minutes. The suspension shall then be transferred to the 75 micron IS Sieve placed on a receiver and the soil shall be washed on this sieve using a jet of distilled water from a wash bottle. Particular care shall be taken to wash off all traces of suspension adhering to the dispersion cup. The amount of distilled water during this operation may be about 500 ml. The suspension that has passed through the sieve shall be transferred to the 1000 ml measuring cylinder and made up to exactly 1000 ml with distilled water. This suspension shall then be used for the sedimentation analysis. The material retained on the 75 micron IS Sieve may be over dried and analyzed and the cumulative percentages of the soil fraction retained on each sieve shall be calculated.

Sedimentation:

(a) A rubber bung shall be inserted in the mouth of the measuring cylinder which shall then be shaken vigorously and mouth of the measuring cylinder which shall then be shaken vigorously and finally be inverted end over end. Immediately the shaking has ceased, the measuring cylinder shall be allowed to stand and the stop watch started. The hydrometer shall be immersed to a depth slightly below its floating position and then allowed to float freely. Hydrometer readings shall be taken after periods of half, one, two and four minutes.

(b) The hydrometer shall then be removed slowly, rinsed in distilled water and kept in a cylinder of distilled water at the same temperature as the soil suspension.

(c) The hydrometer shall be re-inserted in the suspension and readings taken after periods of 8, 15 and 30 minutes, one, two and four hours after shaking. The hydrometer shall be removed, rinsed and placed in the distilled water after each reading. After 4 hours, hydrometer readings shall be taken once or twice within 24 hours, the exact periods of sedimentation being noted. Finally a reading may be taken at the end of 24 hours. In taking all reading, insertion and withdrawal of the hydrometer before and after taking a reading shall be done carefully to avoid disturbing the suspension unnecessarily. Ten seconds shall be allowed for each operation. Vibration of the sample shall be avoided. Other suitable time intervals may be used, provided they give nearly equally spaced points on the grain size distribution curve.

(d) The temperature of the suspension shall be observed and recorded once during the first 15 minutes and then after every subsequent reading. The temperature shall be read with an accuracy of least $\pm$0.5 C. Hydrometer readings shall also be taken in pure distilled water at the corresponding temperatures and the temperature correction (**M**t) calculated as the difference between this reading and the reading corresponding to the density of water at the calibration temperatures. A chart of such corrections for all temperatures may also be prepared for ready use. The temperature of the suspension over the period of the test should not differ from the mean temperature by more than $\pm$ 20°C in order not to cause an error in the particle size of more than 2 percent. This requirement will generally be fulfilled if the maximum difference in room temperature is not greater than about 8°C. If the variation in temperature is likely to be greater than this, the constant temperature bath should be used.

(e) The correction (x) to be applied for the dispersing agent shall be ascertained by placing exactly 50 ml of the sodium hexametaphosphate solution in a previously weighed glass weighing bottle and after evaporating the water by drying at 105 to 110° C in an oven, the mass of dispersing agent (Wd) shall be calculated.

The dispersing agent correction (X) shall then be calculated from the formula:

$$X = 2\ Wd$$

This correction is independent of the temperature. Alternatively, the correction may be obtained directly by making up a 1000 ml cylinder full of distilled water containing the same

proportion of dispersing agent and at the same temperature, and placing the hydrometer in this solution. The corrected zero reading may then be read directly, this correction shall be corrected for temperature.

Calculations

Loss in mass in pre-treatment. The loss in mass in pre-treatment of the soil shall be calculated using the formula as given below:

$$P = 100 - \frac{Wb\,(100+W)}{Wa}$$

Sieving –

The percent of soil sample passing each of the sieves used in the analysis shall be calculated using the mass of the pre-treated soil and as percentage of the total soil sample taken for analysis.

<u>Sedimentation</u>

(a) Diameter of the Particles :- The Diameter of the particle in suspension at any sampling time "t" shall be calculated from the formula :

$$D = (30\mu/(980X(G-G1)))^{1/2} \times (Hr/t)^{1/2}$$

Where

D= Diameter of Particle in suspension , in mm:

M = Coefficient of viscosity of water at the temperature of the suspension at the time of taking the hydrometer reading , in poises;

G=Specific gravity of the soil fraction used in the sedimentation analysis ;

G1 = Specific gravity of water;

H r = Effective depth corresponding to Rh as explained earlier .

t= time elapsed between the beginning of sedimentation and taking of hydrometer reading in minutes.

<u>(b) meniscus correction :-</u>

The hydrometer reading corrected for meniscus (Rh) shall be calculated from the following formula :

$$Rh=R'h+Cm$$

Where

Rh = hydrometer reading corrected for meniscus

R'h = hydrometer at the upper rim of the meniscus, and

Cm= Meniscus correction

(c) Percentage finer than D

The Percentage by mass (W) of particles smaller than corresponding equivalent particles diameter shall be calculated from the formula:

$$W = 100\ G / Wb\ (G-1) * (Rh+Mt-X)$$

Where

G = specific gravity of soil particles

Wb, = Weight of Soil after pre- treatment ;

Rh = hydrometer reading corrected for meniscus

Mt = temperature correction , and

X = dispersion agent correction

The values shall be calculated for all the values of D obtained and shall be expressed as percentage of finer than the corresponding value of D . These percentage shall than be expressed as combined percentages of the total soil sample taken for analysis.

4.2 DETERMINATION OF PERMEABILTY:

The knowledge of the permeability is essential in the solution of many engineering problems involving flow of water through soils such as:

(a) De watering and drainage of Excavations, back fills & sub grades ;

(b) Determining yield of water bearing strata ;

(c) Assessing seepage through the body of earth dams; and

(d) Computing losses from canals.

The constant head and falling head tests are used for most of the soil for determination of their permeability in the laboratory and covered under Indian Standard : 2720 (Part-17) 1986- Methods of test for Soils , " Laboratory Determination of permeability ". The tests are recommended for soils with coefficient of permeability in the range 10^{-3} to 10^{-7} cm/sec and maximum particle size of 9.5 mm.

4.2.1 PREPARATION OF TEST SPECIMEN:-

Undisturbed Soil Sample :

For testing undisturbed soils, undisturbed specimen shall be trimmed in the form a cylinder not larger than about 85 mm in diameter and having a height equal to that of the mould . The specimen shall be placed centrally over the porous disc of the drainage base fixed to the mould. The annular space between the mould and the specimen shall be filled with an impervious materials such as cement slurry, or a mixture of 10 percent dry powdered bentonite and 90 percent fine sand by weight to provide sealing between the soil specimen and the mould against leakage from the sides. When using the cement slurry, the mould shall be kept on a flat surface other than the porous disc .The mixture shall be compacted using a small tamping rod. The drainage cap shall then be fixed over the top of the mould.

Saturation:

In the case of soils of medium to high permeability, the specimen shall be subjected to sufficient head , flow or immersion so as to obtain full saturation . Soils of low permeability require flow under a high head for periods ranging from a day to a week depending upon the permeability and the head . Alternatively, in the case of soils of low permeability , the specimen shall be subjected to a gradually increasing vacuum with bottom outlet closed so as to remove to form the soils voids. The vacuum shall be increased to at least 70 cm of mercury which shall be maintained for 15 minutes or more depending upon the soil type . The evacuation shall be followed by a very slow saturation of the specimen with de-aired water from the bottom upwards under full vacuum. When the specimen is saturated, both the top and bottom outlets shall be closed.

4.2.2 CONSTANT HEAD TEST :-

For a constant head arrangement, the specimen shall be connected through the top inlet to the constant head water reservoir. The Bottom outlet shall be opened and when the steady state of flow has been established, the quantity of flow for a convenient time interval shall be collected and weighed or measured . Alternatively , the inlet may be at the bottom and water may be collected from the outlet at the top . The collection of the quantity of flow for the same time interval shall be repeated thrice.

The Linearity (of Darcy's Law) between the hydraulic gradient and the average velocity of flow for the soil under test should be established by performing the test over a range of hydraulic gradient. The hydraulic gradients in the permeability test should preferably include the hydraulic gradients likely to occur in the field and deviation from linearity observed should be noted .

Record of Observation:

The inside diameter and the height of the permeability are measured and recorded as diameter D and length L of the specimen . The heights H1 and H2 are measured to determine the head loss H . The temperature of water T is also measured and recorded

During the test , observations are made of volume of water , Q collected in a graduated jar in time t and are recorded . For the propose of getting a quantitative description of the state of the sample , after the test, the weight of wet soil specimen Wt is measured and recorded . Its dry weight Ws is measured after drying for 24 hours The water content, w is computed and noted . From the knowledge of the specific gravity Gs of specimen and water content W , void ratio e0 and degree of saturation S are determined.

Calculations

The permeability Kr at temperature T is calculated as:

Kr =Q/(Ait)

K27= KrX (ήr)/y*i*r

In which

K27 = permeability at 27^0 C ,

ήr = coefficient of viscosity at T^0 C

ή27 = coefficient of viscosity at 27 C

Q=Quantity in cm3

A = area of specimen in cm 2

I = hydraulic gradient , and

T= time in seconds

4.2.3.FALLING HEAD TEST

For a falling head test arrangement, the specimen shall be connected through the top inlet to selected stand-pipe . The bottom outlet shall be opened and the time interval required for the water level to fall from a known initial head to a known final head as measured above the centre of out let shall be recorded. The Stand pipe shall be refilled with water and the repeated till three successive observations give nearly same time interval; the time intervals being recorded for the drop in head from the same initial to final values, as in the first determination. Alternatively, after selecting the suitable initial and final heads h1 and h2 respectively, the time intervals shall be noted for the head to fall from h1 to (h1- h2)1/2 and similarly form (h1- h2)1/2 to h2. The time intervals should be the same; otherwise the observations shall be repeated after refilling the stand – pipe.

Record of observation

The dimensions of specimen, length L and diameter D, are measured and recorded. Area a of stand pipe is recorded. The temperature T, of water is also measured and recorded . during the test, observation are made of initial time t1 final time t2 , initial head h1 , final head h2 In stand pipe and are recorded . h1/h2 and log 10 (h1./ h2) are calculated .

At the end of the test , the weight of soil specimen Wt is measured and recorded . Its dry weight Ws is measured after drying for 24 hours . The water content , w is computed and noted . From the knowledge of the specific gravity Gs of specimen and water content w , void ratio e and degree of saturation S are determined

Calculations :

At temperature T water, the permeability Kt is calculated as :

Kt = 2.303[a L/A{tf-t i }] Log 10 (h1/h2)

And the permeability at 27 0 C is given by K27 = Kt ($\gamma t/\gamma 27$)

4.3LIQUID LIMIT, PLASTIC LIMIT & PLASTICITY INDEX

4.3.1 CONCEPT:

The behavior of all the soils and specially clays considerable differs with the presence of water. A clayey soil depending upon its water content may be almost like a liquid, or it may be quite hard too. The liquid and plastic limits of soils are dependent on the amount and type of clay in a soil. This also makes the basis for the soil classification system for cohesive soil.

Liquid Limit is the water content at which the soil has such a small shear strength that it flows to close a groove of standard width when jarred in a specified manner.

Plastic Limit is the water content at which the soil begins to crumble when rolled into threads of specified size. Liquid limit is the boundary between liquid and plastic states of soil.

Plasticity Index is the amount of water, which must be added to change a soil from its plasticity of the soil. The plasticity is measured by the 'plasticity index', which is equal to the liquid limit minus the plastic limit.

TEST PROCEDURE:

4.3.2 Liquid Limit

The test is conduct following the procedure as laid down in I.S: 2720 (part-5)-1985. About 100g of soil specimen passing through 425-micron sieve is mixed thoroughly with distilled water in the evaporating dish to form a homogeneous and uniform paste. A portion of the paste is placed in the cup of the liquid limit device. Fill the mix so as to have a maximum depth of 1 cm. draw the grooving tool through the sample along the symmetrical axis of the cup. Now, rotate the handle at the rate of about 2 revolutions per second and the numbers of bellows are counted till the two halves of the soil sample come into contact at the bottom of the grooves for a length of about 12 mm. Taking about 10 gm of soil from near the closed groove determine its water content by oven dying method. By evaporating and scarifying reduce the water content of the soil then repeat the foregoing operation and obtain at least 5 reading in the rage of 20-35 blows. The liquid limit is determined by plotting the graph on the semi-logarithmic graph between the number of blows as abscissa on a logarithmic scale and the corresponding water content as ordinate on simple linear scale. Generally these points lie in a straight line. The water content corresponding to 25 blows is taken as the value of liquid limit of the soil.

4.3.3 Plastic limit

About 15 gm of oven dried soil specimen passing through 425 micron sieve is taken and mixed thoroughly with distilled water until the soil mass becomes plastic enough to be easily moulded

into a ball with fingers. Take a portion of the ball and roll it on a glass palm of the hand to form the soil mass into a thread of uniform diameter throughout its length. Take care that diameter should be around 3 mm. when a diameter of 3 mm is reached, the soil is remoulded again into a. ball. This process of rolling and remoulding is repeated until the thread starts just crumbling at a diameter of 3 mm. The crumbling threads are kept for water content determination. Repeat the test with 2 more samples. The plastic limit is then taken as the average of the three water content values.

3.3.5 Plasticity Index

The plasticity index may be calculated as the difference of liquid and plastic limit. Thus, plasticity index (Ip)

$$Ip = WL - WP$$

4.40 LABORATIRY CBR TEST:

4.4.1 CONCEPT:

The CBR test is an adhoc penetration test development by the California state Highway Department of U.S.A. for the evaluations of sub-grade strengths for roads and pavements. One of the chief advantages of CBR method is the simplicity of the test procedure. Based on extensive CBR test data collected on pavements, which behaved satisfactorily, and those, which failed, an empirical design chart was developed correlating the CBR value and the pavement thickness. The basis of the design chart is that a material with a given CBR requires a certain thickness of pavement layer as a cover. A higher load needs a thicker pavement layer to protect the sub-grade. Design curves correlating the CBR value with total pavement thickness cover were developed by the California State Highway Department for wheel loads of 3175 kg, 4080 kg and 5450 kg representing light, medium and heavy traffic respectively. The CBR test can be performed in the laboratory as well as in the field. Since it is difficult to control the field variables precisely and also that the field testing requires heavy equipment and considerable time in creating worst moisture content conditions and penetration testing, it is generally recommended to opt for a laboratory CBR test. The laboratory CBR test can be performed either on undisturbed soil specimens obtained from the field or on the remoulded soil compacted in the laboratory either statically or dynamically. In static method of compaction there is a possibility of the actual density varying with the depth though the mean density may be the one desired. It is extremely difficult to obtain an undisturbed specimen of sandy or cohesionless soil deposit. Remoulded specimen, however, are used for almost all types of soils ranging from clay to gravel. Firstly the dry density of the remoulded sample shall be determined. It can either be field density or the maximum dry density determined by compaction test. The test can be conducted at any other density also if CBR is to be determined at a particular density. The water content used for compaction should be the optimum water content or the field moisture content as the case may be. The standards as laid down in I.S: 2720 (Part-16)-1979 are followed for laboratory of CBR-value.

4.4.2 TEST PROCEDURE:

Dynamic Compaction (for Remoulded Specimen) Weight the mould with base plate and collar. Keep the spacer disc on the base plate and a filter paper over the disc. Fix the mould to the base plate, with the disc inside the mould. Compact the wet soil in the mould using either light or heavy compaction.

For heavy compaction, compact the soil in 5 layers by giving 56 blows by 4.9 kg rammer to each layer. Remove the collar and trim off the excess soil in level with the top of the mould. Detach the base plate and remove spacer disc also. Determine the dry density of sample. Place the filter paper on the perforated base plate. Fix the mould upside down to the base plate so that surface of the specimen which was downwards in content with spacer disc during compaction is now turned upwards on which the penetration test is to be performed. The specimen is now ready for soaking or penetration test. Soaking of specimen may then be started by weighing the mould with base plate and the specimen. Keep the filter paper on the specimen and place the perforated top plate with adjustable stem over the specimen. Keep the mould in the tank in which water will be filled for soaking. Apply a surcharge in multiples of 2.5 kg (each 2.5 kg mass is equivalent to 70 mm of construction) equivalent to the expected pavement thickness over the material of which CBR is being determined. The minimum surcharge should be 5 kg. Now fill the water in the tank to immerse the mould, test specimen and surcharge masses, allowing free access of water to top and bottom of specimen. At the end of soaking, take out the mould and allow it to drain downwards for minutes. Remove the surcharge masses, the perforated top plate and the filter paper. Weigh the specimen to know the mass of water absorbed.

The mould containing the test specimen and the surcharge masses, sufficient to produce an intensity of loading equal to the weight of the base material and pavement (in the field) is placed on the lower plate of the testing machine. To prevent upheaval of soil into the hole of the surcharge weights, a 2.5 kg annular mass is placed on the soil surface prior is seating the penetration plunger after which the reminder of kept under a load of about 4 kg so that full contact is ensured. The stress and strain dial gauges are set to initial zero reading. Load is applied to the penetration plunger at the rate of 1.25 mm per minute. The load is recorded at penetration 0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 6.0, 7.0, 8.0, 9.0 & 10.0 mm. About 50-100 g of soil is taken immediately below the plunger for water content determination after the plunger is released.

The load penetration curve is generally convex upwards, although the initial portion of the curve may be concave upwards due to surface irregularities. A correction shall then be applied by drawing a tangent to the upper curve at the point of contra flexure. The corrected curve shall be taken to be this tangent plus the convex portion of the original curve with the original curve with the origin of strains shifted to the point where the tangent cuts the horizontal strain axis. Thus the penetration of plunger shall be read from this shifted zero point instead of original zero. Accordingly the corrected load shall be read corresponding to this penetration value.

AEs

Corrected load value shall be taken from the load penetration curve corresponding to the penetration value at which CBR is desired. The CBR is then determined as follows. CBR is reported to the nearest one percent.

$$CBR = (Pt / Ps) \times 100$$

Where, Pt = Corrected test load corresponding to the chosen penetration from the load penetration curve, and

Ps = Standard load for the same depth of penetration.

5.0TEST RESULTS AND INTERPRETATIONS

The general description about " SITE" for proposed Structures has been presented in bore hole lay out plan . In all, 20 Nos boreholes each of 100-150 mm dia up to 6.0 m to 9.0 m depth were drilled as per the instruction of Engineer In-charge. These were designated as BH-1 to BH-20. Undisturbed Soil samples were collected at a regular vertical interval of 3 m from each boreholes. Although some of the samples were lost due to slippage as the sampling in sands under submerged condition is difficult. Water samples from bore hole were also colleted from different depths . The depth of water table in each boreholes was also measured upon their completion. Standard Penetration Test has also been conducted at 1.5 m interval as per IS 2131-1981 up to 9.0 m depth for assessment of safe /allowable bearing capacity.

5.1 LOCATION AND DEPTH OF BOREHOLE:

A Total of 20 boreholes (BH 1 to BH- 20) were excavated as per location and pattern shown in the bore hole lay out plan of the report. The bore holes 1 to 20 were drilled to different termination depth of 6.0 m to 9.0 m as per the exploration programs and directions of the Engineer-in – Charge .

5.2 RESULT OF GRAIN SIZE ANALYSIS :

In order to determine various sizes of particles and their respective proportions present in the soil samples obtained from the field bore holes, wet sieves analysis were performed .As the fractions finer than 75 µ were found in large quantity , the hydrometer analysis was required . The results of the grain size analysis have been presented in Grain Size Distribution curves .The results on the sieve analysis in the from of proportions of Gravels , Sand , Silts, Clays and also their gradation i.e Coefficient of Uniformity and Coefficient of Curvature have been worked out from the curves and presented in soil profile sheets .

5.3 **SOIL CLASSIFICATION:** The sub soil strata in the bore holes mainly consists of silty clay of low to intermediate plasticity (classified as CL/CI). There is poorly graded silty sandy soil (classified as SP-SM) in certain bore holes at 3.5m-4.0 m to 6.0m-8.0m depth .The sub soil is well graded within 4.0 m depth in almost all the bore holes .The strata beyond 4.0 m depth is also well graded in most of the bore holes but there is thin layers of poorly graded sandy strata in certain bore holes.

5.4 **RESULT OF STANDARD PENETRATION TEST:** The SPT N values in top layers are very poor. The N values ranges from 5 to 7 within 3.0 m depth. However it enhances up to 14 to 25 at 3.0 m to 9.0 m depth. The sub soil is termed as loose strata in top layers where as it is medium dense in deeper strata.

5.5 **GROUND WATER TABLE:-** The ground water table in the bore hole is observed at 2.0 m to 3.0 m depth below EGL. This ground water table will definitely rise up to existing ground level during heavy rains in the monsoon season. During our field investigation , the site was partly waterlogged for considerable period in the month of September & October 2012.

5.6 **LIQUEFACTION ANALYSIS :-**

In view of well graded sub soil system up to 3.0 m-4.0 m depth and poorly graded fine sandy strata (classified as SP-SM) under submerged condition beyond 3.0 m-4.0 m depth , it is observed that vibrations caused by earthquake may cause liquefaction or excessive total and differential settlements. as per IS 1893-2000. Under these circumstances , it is appropriate to adopt pile foundation instead of shallow footing .

The liquefaction analysis based on co-relations presented by I.M. Idriss and R.W.Boulangar (Department of civil & Environment Engg) University of California Davis CA95616-5924 has also been carried out using SPT N values and particle sizes within the influence zone of foundation. It is found that the sub soil strata is not liquefiable for earthquake moment magnitude of 7.0 and ground acceleration of 0.12g. However if higher values of earthquake moment magnitude and ground acceleration is considered , the strata becomes liquefiable in spite of well graded silty clayey soil .

6.0 PLATE LOAD TEST

Plate Load Test:-

The Plate load test is performed as per IS-1888 –1982. The test has been conducted at natural sub soil at a depth of 1.5 m below EGL.using 30.0cmX30.0cm plate as per scope of work .

The scope of work was limited to mobilize necessary equipment and personnel at the site. Conducting 20 Nos plate load test on 30.0 cm square plate at specified depth below existing ground level (i.e. at footing level) at the location decided by Engineer- in- Charge.

6.2FIELD INVESTIGATION:-

The plate load test was performed as per IS 1888-1982 and co- relation suggested as per clause 0.1to 5.3. The plate size used are 30.0 cm square and test pit of 5 times of the plate size at the foundation level (i.e. Pit size 1.50m X1.50m) The final settlement of the plate is recorded as per clause 4.7.

6.3SUB SOIL CONDITION:-

The sub soil at the foundation level is semi saturated silty clayey strata at PLT -1 to PLT 20 .

6.4 ASSUMPTIONS :-

The settlement at the footing depth has been observed from the test results as per relevant co-relation using depth correction factor . The probable settlement of actual footing size of 1.0 m to 2.0 m for shallow footing has been deduced using clause 5.3 of the code . It is assumed that the sub soil condition within influence zone of plate is same as at test level The permissible settlement of 50.0 mm is considered for shallow footing .

6.5 Limitations:-

The plate bearing test does not incorporates consolidation settlement because of its short duration. However the sub soil condition at site is compressible There is large difference between influence zone of plate size and actual foundation hence extrapolation of plate results requires larger safety factors. Ground Water table effect on settlement of plate during the test is also ignored . .

6.6TEST RESULT:-

The plate load results are plotted on graphical form as pressure intensity vs settlement of plate load test. The failure point is read by plotting the load settlement values on LOG- LOG scale as per IS 1888-1962. In indefinable cases the failure is assumed at an settlement of 10% of the plate size as suggested by some author. Although LOG- LOG plot of load settlement curves gives a clear demarcation of elastic and plastic zone. In our case the settlement of sub soil fro actual footing is deduced by extrapolating the plate settlement. The ultimate bearing capacity of actual footing is considered as bearing pressure corresponding to 50.0 mm settlement. The factor of Safety in ultimate and safe load capacity is assumed as 3.0.

CHAPTER 7

RECOMMENDATIONS

Based on field investigation, laboratory test results, and analysis presented above, net bearing pressure values for shallow footing and raft foundation is analyzed and presented below. In view of very high water table and loose sub soil in top layers, the under reamed pile foundation for the proposed structures is also analyzed and recommended .

However shallow footing (i.e. isolated square footing/continuous strip footing / raft foundation) may be laid at the depth of 1.5 m below EGL with size ranging 1.0 m to 3.0 m (shallow footing) and 10.0 m to 20.0 m (raft foundation) for light weight structure depending upon static load coming at footing level.

In view of very large site , the entire area is sub divided in to 5 groups . The Safe /allowable bearing capacity is analyzed for each group separately and submitted as per following .

7.1 ALLOWABLE BEARING CAPACITY :-

The allowable bearing capacity shall be lower of the values as obtained from above two consideration (i.e. shear failure criteria or settlement consideration) as per following table.

PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.			
ALLOWABLE BEARING PRESSURE(LOWEROF THETWO CONSIDERATION)			
DEPTH OF FOOTING Below EGL (m)	SIZE OF FOOTING (m)	ALLOWABLE BEARING PRESSURE (T/M2)	
BH-1,2,3		(CONTINUOUS STRIP FOOTING) (T/M2)	(ISOLATED SQUARE FOOTING) (T/M2)
1.50	1.00	6.30	6.30
1.50	2.00	5.58	5.58
1.50	3.00	4.81	4.81
BH-4,5,6,15,16,17			
1.50	1.00	5.25	5.25
1.50	2.00	5.83	5.83
1.50	3.00	5.20	5.20
BH-7,8,13,14			
1.50	1.00	6.13	6.13
1.50	2.00	5.43	5.43
1.50	3.00	4.72	4.72
BH-9,10,11,12			
1.50	1.00	5.88	5.88
1.50	2.00	5.53	5.53

1.50	3.00	4.78	4.78
BH-18,19,20			
1.50	1.00	5.25	5.25
1.50	2.00	5.43	5.43
1.50	3.00	4.71	4.71
		RAFT FOUNDATION (T/M2)	
1.50	10.0 M x20.0M	6.99	
1.50	15.0 M x30.0M	6.79	
1.50	20.0 M x40.0M	6.72	

7.2:-SINGLE UNDER REAMED PILE FOUNDATIONS.:-

The Load carrying Capacity of under reamed pile has been worked out as per IS 2911(Part III)-1980 Appendix B Clauses 5.2.3.3 & 5.2.5, B.1.1 to B.1.7 Table -1 considering submerged condition of sub soil strata and SPT N values ranging as 2 or more for clayey soil .

The effective length of pile has been considered below the cut – off – level. The cutt of level of pile has been considered at 1.0 m below existing G.L. considering pile cap, grade beam etc.

Single under reamed pile foundation having stem dia. equal to 30.0cm to 50.0 cm of lengths 3.5 m to 12.0 m has been analyzed. The value of safe load carrying capacities of pile based on soil properties in compression & uplift as per IS 2911 (Part III)1980 has been tabulated below.

Load Carrying Capacity of Single Under Reamed Pile Foundation . (PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.)

Stem dia (cm.)	Bulb diaOf pile (cm)	Cutt of Level Of Pile below GL(m.)	Length of pile Below Cutt of Level(m.)	Safe load carrying capacity of single Under reamed pile		
				In compression (T)	In uplift (T)	Lateral Thrust (T.)
30.0	75.0	1.0	3.5	9.0	4.5	2.0
37.5	93.8	1.0	3.5	13.5	6.8	3.0
40.0	100.0	1.0	3.5	15.8	7.9	3.4
45.0	112.5	1.0	3.5	19.7	9.8	4.0
50.0	125.0	1.0	3.5	23.6	11.8	4.5
30.0	75.0	1.0	5.0	12.9	7.5	2.0
37.5	93.8	1.0	5.0	18.6	10.5	3.0
40.0	100.0	1.0	5.0	21.1	12.0	3.4
45.0	112.5	1.0	5.0	25.7	14.3	4.0
50.0	125.0	1.0	5.0	30.4	16.9	4.5

30.0	75.0	1.0	6.0	15.6	9.4	2.0
37.5	93.8	1.0	6.0	21.9	13.1	3.0
40.0	100.0	1.0	6.0	24.7	14.7	3.4
45.0	112.5	1.0	6.0	29.8	17.3	4.0
50.0	125.0	1.0	6.0	34.9	20.3	4.5
30.0	75.0	1.0	7.0	18.2	11.4	2.0
37.5	93.8	1.0	7.0	25.3	15.6	3.0
40.0	100.0	1.0	7.0	28.2	17.4	3.4
45.0	112.5	1.0	7.0	33.8	20.3	4.0
50.0	125.0	1.0	7.0	39.4	23.6	4.5
30.0	75.0	1.0	8.0	20.8	13.4	2.0
37.5	93.8	1.0	8.0	28.7	18.1	3.0
40.0	100.0	1.0	8.0	31.8	20.1	3.4
45.0	112.5	1.0	8.0	37.8	23.3	4.0
50.0	125.0	1.0	8.0	43.9	27.0	4.5
30.0	75.0	1.0	9.0	23.4	15.3	2.0
37.5	93.8	1.0	9.0	32.1	20.7	3.0
40.0	100.0	1.0	9.0	35.3	22.8	3.4
45.0	112.5	1.0	9.0	41.9	26.3	4.0
50.0	125.0	1.0	9.0	48.4	30.4	4.5
30.0	75.0	1.0	10.0	26.1	17.3	2.0
37.5	93.8	1.0	10.0	35.4	23.2	3.0
40.0	100.0	1.0	10.0	38.9	25.5	3.4
45.0	112.5	1.0	10.0	45.9	29.3	4.0
50.0	125.0	1.0	10.0	52.9	33.8	4.5
30.0	75.0	1.0	11.0	28.7	19.3	2.0
37.5	93.8	1.0	11.0	38.8	25.7	3.0
40.0	100.0	1.0	11.0	42.5	28.3	3.4
45.0	112.5	1.0	11.0	49.9	32.3	4.0
50.0	125.0	1.0	11.0	57.4	37.1	4.5
30.0	75.0	1.0	12.0	31.3	21.2	2.0
37.5	93.8	1.0	12.0	42.2	28.3	3.0
40.0	100.0	1.0	12.0	46.0	31.0	3.4
45.0	112.5	1.0	12.0	54.0	35.3	4.0
50.0	125.0	1.0	12.0	61.9	40.5	4.5

SUGGESSTIONS :-

Note :-1.0 The safe load carrying capacity of piles have been worked out on the basis of IS: 2911 part – III – 1980 as per the assumptions and specification. The safe loads obtained above are only an assessment based on soil characteristics obtained from the test locations. Accordingly,as per IS specification & as per clause 5.3.1.2. of IS 2911(Part III) - 1980 for the final design / construction of foundations, the safe / allowable load carrying capacity of these piles should be taken by conducting actual initial load tests on these piles casted in representative area.

2.0 The piles should have necessary structural strength to transmit / sustain the design loads.

3.0 The safe load capacity of piles in up lift will be limited to the structural capacity of the piles in tension due to uplift if the same is lower .

4.0 In view of High water table (Available at Existing ground) , strict quality control has to be ensured during casting of pile under water.

7.3:- MODULUS OF SUBGRADE REACTION :-

Based on field investigation and correction as per I.S 1888-1892 and 9214-1979 clause 5.1.1to 5.1.4 , the value of modulus of sub grade reaction of plate **('K'=0.60 Kg/cm3)** may be considered as design values .The modulus of sub grade reaction has been deduced from the plate load test results conducted at various locations inside the vast campus .The required observation and calculation sheet is enclosed .

7.4 CHEMICAL ANALYSIS OF SOIL & WATER:-

20 number water and soil samples has been collected from the bore holes at different depths and examined for chemical content . The test results are tabulated as per following. The analysis of sub soil & water sample shows that there is no aggressive chemical present in the sub soil system .

The water sample taken for chemical testing consists of shallow aquifer . During actual execution of work , the water sample may be drawn from the different aquifer (i.e. from very deep level) . Such water sample may be re-examined for chemical content and decision regarding use of water may be taken as per the actual test results .

CHEMICAL ANALYSIS OF WATER SAMPLE,
PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.

SL NO	LOCATION (BH No)	DEPTH (M)	ACCEPTING CRITERIA AS PE IS 456-2000.	pH VALUES	ALKALINITY TO NEUTRALISE 100 ML OF WATER	ACIDITY TO NEUTRALISE 100 ML OF WATER	TOTAL SOLIDS IN MG/L	Chloride MG/L	SULPHATE MG/L	TOTAL ORGANIC MATTER IN MG/L
				>6	0-25 ML OF 0.02N H2SO4	0-5 ML OF 0.02 N NaOH	3000 MG/L	500 MG/L	400 MG/L	200 MG/L
1.0	BH-1	4.50		7.37	32.3	1.70	500.00	9.00	102.00	151.00
2.0	BH-2	6.00		7.30	31.6	1.82	520.00	9.12	106.00	158.00
3.0	BH-3	4.50		7.31	31.5	1.78	525.00	9.06	110.00	162.00
4.0	BH-4	3.00		8.05	32.1	1.75	541.00	9.14	112.00	160.00
5.0	BH-5	1.50		7.89	33.6	1.76	539.00	9.23	116.00	159.00
6.0	BH-6	3.00		7.64	32.8	1.81	537.00	9.20	119.00	172.00
7.0	BH-7	4.50		7.82	32.7	1.86	530.00	9.40	108.00	155.00
8.0	BH-8	6.00		7.96	31.9	1.89	535.00	9.52	113.00	179.00
9.0	BH-9	3.00		7.66	32.4	1.77	529.00	9.48	117.00	176.00
10.0	BH-10	1.50		7.92	33.6	1.72	524.00	9.16	108.00	182.00
11.0	BH-11	6.00		8.02	33.5	1.83	528.00	9.23	112.00	189.00
12.0	BH-12	3.00		8.63	32.7	1.74	515.00	9.41	104.00	164.00
13.0	BH-13	4.50		8.79	32.5	1.79	519.00	9.53	113.00	173.00
14.0	BH-14	1.50		8.14	32.4	1.73	523.00	9.49	107.00	170.00
15.0	BH-15	3.00		8.33	31.8	1.76	516.00	9.27	110.00	179.00
16.0	BH-16	6.00		7.94	32.4	1.79	517.00	9.33	104.00	182.00
17.0	BH-17	3.00		7.63	32.6	1.84	531.00	9.18	106.00	175.00
18.0	BH -18	4.50		8.34	33.4	1.85	527.00	9.34	102.00	181.00
19.0	BH -19	3.00		8.19	33.6	1.88	522.00	9.36	107.00	169.00
20.0	BH -20	6.00		7.95	33.5	1.83	534.00	9.27	112.00	174.00

SOIL CHEMICAL TEST RESULT , PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.					
SL NO	**LOCATIONS BH NO**	**Depth of Sample Below EGL(m)**	**PERMISSIBLE LIMIT**		
			Chloride as CL % by Mass (Volhards Method)	**Sulphate as SO4% by Mass (Gravimetric)**	**pH as Per IS 2720Pt 26**
			<0.05%	<0.04%	>6.0
1.0	BH-1	1.50	0.020	0.014	7.20
2.0	BH-2	3.00	0.023	0.019	7.40
3.0	BH-3	4.50	0.029	0.021	7.80
4.0	BH-4	6.00	0.031	0.012	7.49
5.0	BH-5	1.50	0.038	0.015	7.50
6.0	BH-6	3.00	0.042	0.018	7.82
7.0	BH-7	1.50	0.029	0.020	7.65
8.0	BH-8	7.50	0.034	0.022	8.12
9.0	BH-9	6.00	0.039	0.024	7.82
10.0	BH-10	3.00	0.022	0.026	7.24
11.0	BH-11	4.50	0.032	0.025	8.25
12.0	BH-12	1.50	0.039	0.017	7.39
13.0	BH-13	3.00	0.035	0.016	7.41
14.0	BH-14	4.50	0.036	0.027	8.45
15.0	BH-15	6.00	0.041	0.023	8.25
16.0	BH-16	7.50	0.042	0.026	7.95
17.0	BH-17	6.00	0.045	0.023	7.55
18.0	BH-18	3.00	0.043	0.022	7.65
19.0	BH-19	4.50	0.045	0.021	7.42
20.0	BH-20	6.00	0.040	0.027	7.25

7.5 CBR TEST RESULTS:-

Based on laboratory investigation on the samples procured from site, and analysis on various test results, the detailed results are summarized as per following .

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR .				
SUMMARY OF CBR TEST RESULTS				
S. NO/ LOCATION NO	**DRY DENSITY (MDD) GM/CM^3**	**NATURAL MOISTURE CONTENT (NMC) %**	**OPTIMUM MOISTURE CONTENT (OMC) %**	**CALIFORNIA BEARING RATIO (CBR) %**
1	1.895	18.97	24.32	5.56
2	1.856	19.01	23.04	5.27
3	1.850	19.06	23.11	5.32
4	1.842	18.62	23.10	4.93
5	1.849	19.23	23.14	5.22
6	1.862	19.21	24.33	5.37
7	1.819	18.65	24.33	5.17
8	1.816	18.75	24.02	5.28
9	1.826	19.68	24.36	5.46
10	1.811	19.36	24.66	4.93
11	1.820	20.01	23.58	5.08
12	1.836	19.76	23.65	5.41
13	1.842	18.44	23.01	5.22
14	1.864	18.61	23.85	5.33
15	1.822	18.42	22.64	5.17
16	1.878	18.99	24.06	5.51
17	1.821	19.12	24.16	4.93
18	1.833	19.24	24.05	5.33
19	1.823	19.43	24.22	5.12
20	1.864	19.20	23.16	5.51

7.6 PERMEABILITY TEST RESULTS:-

The permeability test has been carried out on selected UDS samples obtained from the bore holes and the detailed results are summarized as per following .

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR					
S. No	**BORE HOLE NO**	**Permeability Test Result (Depth Below EGL)**			
		2.0 m	**4.0 m**	**6.0 m**	**8.0 m**
1	1.0	2.55×10^{-8} cm/sec	3.18×10^{-8} cm/sec	3.28×10^{-4} cm/sec	-
2	6.0	2.43×10^{-8} cm/sec	3.16×10^{-8} cm/sec	3.45×10^{-8} cm/sec	3.23×10^{-8} cm/sec
3	10.0	2.39×10^{-8} cm/sec	3.17×10^{-8} cm/sec	3.41×10^{-8} cm/sec	3.51×10^{-8} cm/sec
4	12.0	2.25×10^{-8} cm/sec	3.24×10^{-8} cm/sec	3.48×10^{-8} cm/sec	3.56×10^{-8} cm/sec
5	19.0	2.47×10^{-8} cm/sec	3.15×10^{-8} cm/sec	4.32×10^{-4} cm/sec	-

7.7 EXPANSIVENESS OF THE SUB SOIL SYSTEM: - The sub soil strata contains liquid limit and plastic limit ranging from 32 to 36 and 20 to 22 respectively. The plasticity index ranges from 12 to 15.The free swell index ranges from 32 to 42.

As per IS 1498-1970 Table-8, the liquid limit less that 50, plasticity index less than 12 and free swell less than 50 , the degree of expansiveness is low and non critical. Therefore it is concluded that the sub soil strata does not contains high proportion of montmorillonite minerals beyond the permissible limit.

The above recommendations are based on the field data collected from the various limited test locations and result of laboratory test carried out on the soil sample recovered from test bore holes. In case the proposed structure are located away from the tests location and/ or the actual subsoil conditions varied during the excavation for various foundation and found to be different from what has been reported above, the consultants are to be referred for further advice prior to taking up to actual construction work at site.

Consulting Engineer

(R.S. Kesharwani)

M.Tech. (Soil)

ALLIED ENGINEERS ***JOB NO. M-11/2012-13/1598*** SOIL PROFILE	CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR	SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR	WATER TABLE 2.00 (M)	LOCATION BH-1	SHEET NO 1

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROM ANALY: SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMET UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (Ø)	CONSOLIDATION PARAMETER: VOID RATIO	COMPRESSION INDEX
GL																								
SPT	1.50		Brownish colour Inorganic Silty Clay Highly Plasticity (CL)	8	11	1	3	4	7	85	34.20	20.40	13.80											
																					0.03	28.0	DST	
UDS	**2.00**					1	3	6	9	81	34.26	20.49	13.77		1.89	1.58	19.57	2.68	32.5		0.65	8.0	0.70	0.143
SPT	3.00			13	16	1	2	5	7	85	34.22	20.45	13.75											
SPT	4.50			28	25	1	3	4	63	29														
																						DST		
UDS	**5.00**					1	2	3	62	32	**REMOULDED UDS**				1.76	1.58	11.26	2.65			0.00	30.50	0.68	
SPT	6.00		Light Grayish Colour Inorganic Silty Sand (SM)	29	25	1	3	4	65	28														
	6.50																							

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS ***JOB NO. M-11/2012-13/1598*** SOIL PROFILE	**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**	**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR**	WATER TABLE **2.25 (M)**	LOCATION **BH-2**	**SHEET NO 2**

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROM ANALY: SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMETER UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (Ø)	CONSOLIDATION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
GL																									
SPT	1.50		Highly Plasticity Inorganic Silty Clay (CL)	6	8	1	2	5	8	84	33.40	20.60	12.80												
UDS	**2.00**					0	2	5	8	85	33.89	20.69	13.20		1.90	1.54	23.01	2.67	38.5		0.05 0.74	29.5 9.5	DST 0.73	0.140	
SPT	3.00			12	15	1	2	4	9	86	32.45	20.10	12.35												
SPT	4.50			25	23	2	1	1	63	35															
UDS	**5.00**					1	2	2	67	28	REMOULDED UDS				1.79	1.61	10.98	2.65			0.00	DST 31.0	0.64		
SPT	6.00		Mix with graval Inorganic Silty Sand (SM)	30	26	3	2	1	65	29															
	6.50																								

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS

JOB NO. M-11/2012-13/1598

SOIL PROFILE

CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR

SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR -NALANDA BIHAR

WATER TABLE **2.00 (M)**

LOCATION **BH-3**

SHEET NO 3

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROM ANALY: SILTY+CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm/cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMET UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (Ø)	CONSOLIDATION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
GL																									
SPT	1.50			6	8	1	3	4	8	84	33.00	20.60	12.40												
																					0.03	27.5	DST		
UDS	**2.00**					1	2	4	9	84	34.02	20.69	13.33		1.91	1.58	21.01	2.67	35.5		1.18	8.50	0.69	0.132	
SPT	3.00		Drak brownish Colour Highly Plasticity Inorganic Silty Clay (CL)	9	12	1	3	5	7	84	34.20	20.50	13.70												
SPT	4.50			13	16	1	2	4	9	86	31.25	20.40	10.85												
UDS	**5.00**					0	1	6	10	83	34.19	20.04	14.15		1.95	1.58	23.05	2.68			1.24	8.00	0.69	0.096	
SPT	6.00			16	17	1	3	5	8	83	34.20	20.00	14.20												
SPT	7.50		Inorganic Silty Sand (SM)	21	20	2	2	3	63	30															
																						DST			
UDS	**8.00**					0	2	2	62	34	**REMOULDED UDS**				1.80	1.60	12.62	2.65			0.00	32.50	0.66		
SPT	9.00		Brownish Colour Highly Plasticity Inorganic Silty Clay (CL)	25	22	1	3	5	8	83	34.00	20.35	13.65												
	9.50																								

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS ***JOB NO. M-11/2012-13/1598*** SOIL PROFILE	CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR	SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR	WATER TABLE **2.00 (M)**	LOCATION **BH-4**	**SHEET NO 4**

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROM ANALY: SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMET UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (Ø)	CONSOLIDA TION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
GL																									
SPT	1.50			5	7	1	2	5	8	82	35.00	20.00	15.00												
																					0.04	28.0	DST		
UDS	**2.00**					1	1	5	8	85	35.01	20.04	14.97		1.88	1.57	19.86	2.68	40.0		0.80	9.00	0.71	0.124	
SPT	3.00			7	9	4	3	3	4	86	34.00	20.20	13.80												
SPT	4.50			10	12	1	3	5	8	84	34.20	21.00	13.20												
UDS	**5.00**		Highly Plasticity Inorganic Silty Clay (CL)			0	2	8	7	83	31.16	20.12	13.04		1.97	1.62	21.66	2.67			1.29	8.50	0.65	0.094	
SPT	6.00			13	15	1	2	7	7	83	33.20	20.80	12.40												
SPT	7.50			17	17	1	2	5	8	84	32.00	20.90	11.10												
UDS	**8.00**					1	1	6	9	83	31.76	21.03	11.73		1.99	1.62	23.02	2.68			1.34	6.00	0.66	0.075	
SPT	9.00			23	20	1	3	7	9	80	31.70	21.50	10.20												
	9.50																								

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS

JOB NO. M-11/2012-13/1598 SOIL PROFILE

CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR

SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR -NALANDA BIHAR

WATER TABLE **2.50 (M)**

LOCATION **BH-5**

SHEET NO 5

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROM ANALY SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMET UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (Ø)	CONSOLIDATION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
CL																									
SPT	1.50			6	8	1	2	4	8	85	34.80	20.40	14.40												
																					0.04	29.0	DST		
UDS	**2.00**					0	2	4	11	83	34.86	20.47	14.39		1.91	1.59	20.44	2.67	37.5		1.22	8.50	0.68	0.110	
SPT	3.00		Highly Plasticity Inorganic Silty Clay (CL)	10	13	1	3	7	7	82	35.70	20.30	15.40												
SPT	4.50			13	16	1	2	6	9	83	31.00	20.00	11.00												
UDS	**5.00**					0	1	3	10	86	33.95	20.84	13.11		1.98	1.60	23.59	2.68			1.31	7.00	0.67	0.092	
SPT	6.00			14	16	1	2	5	8	84	33.00	20.80	12.20												
	6.50																								

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS

JOB NO. M-11/2012-13/1598

SOIL PROFILE

CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR

SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR

WATER TABLE **3.00 (M)**

LOCATION **BH-6**

SHEET NO 6

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROM ANALY: SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMET UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (Ø)	CONSOLIDATION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
GL																									
SPT	1.50		Dark Brownish Colour Highly Plasticity Inorganic Silty Clay (CL)	6	8	1	3	5	6	85	35.00	20.00	15.00								0.04	27.5	DST		
UDS	**2.00**					0	1	4	9	86	35.09	20.66	14.43		1.93	1.60	20.86	2.67	36.0		1.20	9.50	0.67	0.145	
SPT	3.00			10	13	1	2	4	7	86	34.50	20.60	13.90												
SPT	4.50			14	16	3	3	3	2	89	34.40	20.50	13.90												
UDS	**5.00**					0	2	5	8	85	34.96	20.14	14.82		1.98	1.61	22.76	2.68			1.33	7.00	0.66	0.110	
SPT	6.00			18	18	1	3	7	8	81	34.50	20.50	14.00												
SPT	7.50			21	20	1	3	4	7	85	31.00	20.10	10.90												
UDS	**8.00**					1	1	3	12	83	34.77	20.01	14.76		2.02	1.63	24.12	2.68			1.42	6.00	0.65	0.072	
SPT	9.00			24	21	1	3	5	8	82	34.70	20.40	14.30												
	9.50																								

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS ***JOB NO. M-11/2012-13/1598*** SOIL PROFILE	CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR	SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR -NALANDA BIHAR	WATER TABLE 3.00 (M)	LOCATION BH-7	SHEET NO 7

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROM ANALY: SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMET UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (Ø)	CONSOLIDA TION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
GL																									
SPT	1.50			5	7	1	2	5	8	84	34.30	20.10	14.20												
																					0.05	29.5	DST		
UDS	**2.00**					1	2	3	10	84	34.37	20.17	14.20		1.89	1.55	21.55	2.67	42.0		1.28	8.00	0.72	0.123	
SPT	3.00			8	10	1	3	5	7	84	34.20	20.15	14.05												
SPT	4.50		Brownish colour Highly Plasticity Inorganic Silty Clay (CL)	12	15	1	2	6	8	83	31.00	21.50	9.50												
UDS	**5.00**					0	1	4	12	83	33.84	20.32	13.52		1.97	1.59	23.67	2.68			1.35	6.50	0.68	0.097	
SPT	6.00			15	16	1	3	4	9	83	32.80	20.30	12.50												
	6.50																								

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS

JOB NO. M-11/2012-13/1598

SOIL PROFILE

CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR

SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR

WATER TABLE **3.50 (M)**

LOCATION **BH-8**

SHEET NO 8

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROM ANALY: SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMET UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (Ø)	CONSOLIDA TION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
GL																									
SPT	1.50			6	8	0	2	5	8	85	35.50	20.50	15.00												
																					0.03	27.5	DST		
UDS	**2.00**		Highly Plasticity Inorganic Silty Clay (CL)			1	2	4	9	84	35.01	20.01	15.00		1.91	1.57	21.36	2.68	30.5		1.19	8.50	0.70	0.133	
SPT	3.00			10	13	1	3	6	7	83	34.00	21.50	12.50												
SPT	4.50			13	16	3	3	3	2	89	33.12	20.90	12.22												
UDS	**5.00**					0	2	5	10	83	35.10	20.04	15.06		1.96	1.60	22.78	2.68			1.34	6.50	0.68	0.090	
SPT	6.00			16	17	1	1	2	61	35															
SPT	7.50		Inorganic Silty Sand (SM)	20	19	2	3	3	62	30															
																						DST			
UDS	**8.00**					1	2	3	62	32	**REMOULDED UDS**				1.82	1.60	14.02	2.65			0.00	33.50	0.66		
SPT	9.00		Inorganic Silty Clay (CL)	22	20	1	3	4	8	84	35.90	20.70	15.20												
	9.50																								

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS ***JOB NO. M-11/2012-13/1598*** SOIL PROFILE	**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**	**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR -NALANDA BIHAR**	WATER TABLE **2.50 (M)**	LOCATION **BH-9**	**SHEET NO 9**

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROM ANALY: SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMET UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (Ø)	CONSOLIDATION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
GL																									
SPT	1.50			6	8	1	2	5	9	83	33.80	20.10	13.70												
UDS	**2.00**		Drak Brownish colour Inorganic Silty Clay (CL)			0	1	7	8	84	34.88	20.19	14.69		1.94	1.59	21.94	2.68	38.0		0.04 1.22	28.5 9.50	DST 0.69	0.145	
SPT	3.00			11	14	1	3	4	8	84	34.70	21.50	13.20												
SPT	4.50			14	16	1	2	7	7	83	34.00	21.90	12.10												
UDS	**5.00**					0	2	6	9	83	32.69	20.03	12.66		2.01	1.63	22.96	2.68			1.38	7.50	0.64	0.096	
SPT	6.00		Inorganic Silty Sand (SM)	19	19	2	2	1	65	30															
	6.50																								

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS

JOB NO. M-11/2012-13/1598

SOIL PROFILE

CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR

SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR

WATER TABLE **3.00 (M)**

LOCATION **BH-10**

SHEET NO 10

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROM ANALY: SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMET UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (Ø)	CONSOLIDATION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
GL																									
SPT	1.50			7	10	1	3	5	8	84	34.50	20.10	14.40												
UDS	**2.00**					0	1	7	6	86	34.53	20.18	14.35		1.83	1.53	19.77	2.68	35.0		0.03 1.27	28.0 10.00	DST 0.75	0.126	
SPT	3.00			12	15	1	3	4	7	85	32.50	20.50	12.00												
SPT	4.50			16	18	1	2	5	8	84	32.80	20.80	12.00												
UDS	**5.00**		Brownish Colour Highly Plasticity Inorganic Silty Clay (CL)			1	2	9	7	81	32.00	20.51	11.49		1.84	1.49	23.11	2.68			1.31	8.00	0.79	0.110	
SPT	6.00			19	19	1	3	6	8	82	32.15	20.15	12.00												
SPT	7.50			23	21	1	2	7	7	83	31.18	21.50	9.68												
UDS	**8.00**					0	1	6	9	84	33.86	20.31	13.55		1.89	1.51	24.86	2.68			1.42	6.50	0.77	0.092	
SPT	9.00			25	22	1	3	5	8	83	33.80	20.30	13.50												
	9.50																								

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS

JOB NO. M-11/2012-13/1598 SOIL PROFILE

CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR

SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR

WATER TABLE **3.50 (M)**

LOCATION **BH-11**

SHEET NO 11

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROM ANALY: SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMET UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (Ø)	CONSOLIDATION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
GL																									
SPT	1.50			6	8	1	2	4	8	85	34.60	20.00	14.60												
																					0.03	27.5	DST		
UDS	**2.00**					0	1	5	9	85	34.68	20.09	14.59		1.93	1.61	20.14	2.67	33.0		1.19	7.50	0.66	0.142	
SPT	3.00			9	11	1	3	6	7	83	33.50	21.50	12.00												
SPT	4.50		Brownish Colour Highly Plasticity Inorganic Silty Clay (CL)	13	15	1	2	4	9	84	33.40	22.60	10.80												
UDS	**5.00**					1	2	6	8	83	35.16	20.04	15.12		1.96	1.59	22.89	2.68			1.26	6.50	0.68	0.110	
SPT	6.00			17	17	1	2	7	8	82	35.00	20.00	15.00												
	6.50																								

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS *JOB NO. M-11/2012-13/1598* SOIL PROFILE	CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR	SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDABIHAR	WATER TABLE 3.00 (M)	LOCATION BH-12	SHEET NO 12

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROM ANALY SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMET UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (Ø)	CONSOLIDA TION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
GL																									
SPT	1.50			7	9	1	3	5	9	82	33.00	20.00	13.00												
UDS	**2.00**					1	2	7	9	81	33.94	20.19	13.75		1.93	1.58	21.87	2.67	34.5		0.04 1.17	29.0 9.50	DST 0.69	0.132	
SPT	3.00			11	14	1	2	4	7	86	33.90	20.10	13.80												
SPT	4.50			14	16	1	3	6	8	82	33.80	20.50	13.30												
UDS	**5.00**		Brownish Colour Highly Plasticity Mix With Kankars Inorganic Silty Clay (CL)			0	3	6	7	84	34.86	20.01	14.85		1.97	1.60	22.98	2.68			1.25	8.00	0.67	0.100	
SPT	6.00			17	18	1	3	4	8	84	34.80	21.50	13.30												
SPT	7.50			20	19	1	2	7	7	83	34.50	21.80	12.70												
UDS	**8.00**					0	2	5	9	84	34.69	20.11	14.58		2.02	1.62	24.53	2.68			1.32	6.50	0.65	0.089	
SPT	9.00			24	21	1	2	5	9	83	34.60	20.10	14.50												
	9.50																								

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS

JOB NO. M-11/2012-13/1598 SOIL PROFILE

CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR

SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR -NALANDA BIHAR

WATER TABLE **3.00 (M)**

LOCATION **BH-13**

SHEET NO 13

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROM ANALY: SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMET UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (ϕ)	CONSOLIDATION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
GL																									
SPT	1.50			6	8	1	2	4	7	86	34.40	20.00	14.40												
																					0.03	27.5	DST		
UDS	**2.00**					1	1	4	9	85	35.48	20.07	14.41		1.91	1.57	21.75	2.67	37.0		1.16	8.00	0.70	0.141	
SPT	3.00			9	12	1	3	5	8	83	35.45	20.50	14.95												
SPT	4.50		Brownish Colour Highly Plasticity Inorganic Silty Clay (CL)	13	16	1	3	7	7	82	34.40	21.22	13.80												
UDS	**5.00**					1	2	5	8	84	34.69	14.50	14.50		1.94	1.58	22.67	2.68			1.28	7.50	0.69	0.102	
SPT	6.00			18	18	1	2	8	9	80	34.60	14.30	20.30												
	6.50																								

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS ***JOB NO. M-11/2012-13/1598*** SOIL PROFILE	**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**	**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR -NALANDA BIHAR**	WATER TABLE **2.80 (M)**	LOCATION **BH-14**	**SHEET NO 14**

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROM ANALY: SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMET UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (Ø)	CONSOLIDA TION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
GL																									
SPT	1.50			8	11	1	2	4	8	85	33.60	20.00	13.60												
																					0.05	29.5	DST		
UDS	**2.00**					1	1	6	7	85	33.69	20.07	13.62		1.89	1.57	20.74	2.67	40.5		1.19	9.00	0.71	0.144	
SPT	3.00			12	15	1	2	5	8	84	31.50	21.50	10.00												
SPT	4.50		Brownish Colour Inorganic Silty Clay (CL)	16	17	1	3	7	7	82	31.80	21.80	10.00												
UDS	**5.00**					0	2	8	9	81	32.45	20.09	12.36		1.94	1.59	22.39	2.68			1.24	7.50	0.69	0.130	
SPT	6.00			19	19	1	3	4	9	83	32.44	20.00	12.44												
SPT	7.50			22	20	1	2	5	8	84	31.40	21.60	9.80												
UDS	**8.00**					1	1	6	8	84	35.01	20.04	14.97		1.99	1.59	24.86	2.68			1.29	6.00	0.68	0.100	
SPT	9.00			25	22	1	2	4	7	86	35.00	21.05	13.95												
	9.50																								

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS

JOB NO. M-11/2012-13/1598 SOIL PROFILE

CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR

SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDABIHAR

WATER TABLE **2.50 (M)**

LOCATION **BH-15**

SHEET NO 15

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROM ANALY: SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMET UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (Ø)	CONSOLIDATION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
GL																									
SPT	1.50			7	10	1	3	7	7	82	34.95	20.80	14.15												
																					0.04	28.5	DST		
UDS	**2.00**					1	3	5	10	81	34.97	20.84	14.13		1.88	1.56	20.64	2.68	34.0		1.16	9.00	0.72	0.135	
SPT	3.00		Dark Brownish Colour Highly Plasticity Inorganic Silty Clay (CL)	11	14	1	3	5	8	83	34.80	20.60	14.20												
SPT	4.50			14	16	1	2	4	9	84	32.20	21.50	10.70												
UDS	**5.00**					0	2	6	9	83	34.55	20.44	14.11		1.95	1.57	23.97	2.68			1.26	8.50	0.70	0.90	
SPT	6.00			18	18	1	3	7	9	80	34.50	20.30	14.20												
	6.50																								

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS

JOB NO. M-11/2012-13/1598

SOIL PROFILE

CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR

SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR

WATER TABLE **3.00 (M)**

LOCATION **BH-16**

SHEET NO 16

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROM ANALY: SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMET UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (Ø)	CONSOLIDA TION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
GL																									
SPT	1.50		Brownish Colour Highly Plasticity Inorganic Silty Clay (CL)	6	8	1	2	4	7	86	35.10	20.10	15.00								0.03	28.0	DST		
UDS	**2.00**					1	1	6	8	84	35.14	20.19	14.95		1.91	1.59	20.38	2.68	36.5		1.23	8.50	0.69	0.140	
SPT	3.00			10	13	1	3	5	9	82	34.90	21.00	13.90												
SPT	4.50			14	16	1	2	7	7	83	34.50	20.50	14.00												
UDS	**5.00**					0	2	1	67	30	**REMOULDED UDS**				1.74	1.55	12.46	2.65			0.00	DST 33.00	0.71		
SPT	6.00		Inorganic Silty Sand (SM)	18	18	2	2	1	65	30															
SPT	7.50			22	19	1	2	3	62	32															
UDS	**8.00**					1	1	2	62	34	**REMOULDED UDS**				1.77	1.54	14.57	2.65			0.00	DST 34.00	0.72		
SPT	9.00		Highly Plasticity Inorganic Silty Clay (CL)	25	22	1	3	5	9	82	31.00	22.25	8.75												
	9.50																								

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS ***JOB NO. M-11/2012-13/1598*** SOIL PROFILE	**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**	**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDABIHAR**	WATER TABLE **2.25 (M)**	LOCATION **BH-17**	**SHEET NO 17**

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROM ANALY: SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMET UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (ø)	CONSOLIDATION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
GL																									
SPT	1.50			5	7	1	2	4	7	86	34.80	20.00	14.80												
																					0.03	27.5	DST		
UDS	**2.00**					0	1	6	9	84	34.86	20.91	13.95		1.93	1.61	19.68	2.67	31.5		1.17	9.50	0.59	0.145	
SPT	3.00			9	12	1	3	5	8	83	34.70	20.50	14.20												
SPT	4.50		Highly Plasticity Inorganic Silty Clay (CL)	12	15	1	2	6	8	83	32.20	21.40	10.80												
UDS	**5.00**					1	1	5	8	85	35.12	21.01	14.11		1.98	1.63	21.36	2.68			1.29	7.50	0.64	0.092	
SPT	6.00			15	16	1	3	7	9	80	35.10	21.50	13.60												
	6.50																								

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS

JOB NO. M-11/2012-13/1598

SOIL PROFILE

CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR

SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDABIHAR

WATER TABLE **2.00 (M)**

LOCATION **BH-18**

SHEET NO 18

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROMETER ANALY: SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELLINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMETER UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (ϕ)	CONSOLIDATION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
GL																									
SPT	1.50		Brownish Colour Highly Plasticity Inorganic Silty Clay (CL)	6	8	1	3	7	9	80	34.00	20.00	14.00								0.04	29.0	DST		
UDS	**2.00**					1	1	3	10	85	34.39	20.08	14.31		1.92	1.59	20.55	2.68	38.5		1.22	9.00	0.68	0.132	
SPT	3.00			9	12	1	2	5	8	84	32.45	21.25	11.20												
SPT	4.50			12	15	1	3	6	9	81	32.25	21.00	11.25												
UDS	**5.00**					0	2	2	64	32	**REMOULDED UDS**				1.72	1.53	12.78	2.65			0.00	31.00	0.74		
SPT	6.00			16	17	2	2	1	65	30															
SPT	7.50		Light Grayish Colours Inorganic Silty Sand (SM)	20	19	1	3	2	62	32															
UDS	**8.00**					0	1	2	68	29	**REMOULDED UDS**				1.74	1.53	13.89	2.65			0.00	DST 32.50	0.73		
SPT	9.00			23	20	2	1	3	63	31															
	9.50																								

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS

JOB NO. M-11/2012-13/1598 SOIL PROFILE

CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR

SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR

WATER TABLE **2.00 (M)**

LOCATION **BH-19**

SHEET NO 19

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROM ANALY: SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMET UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (Ø)	CONSOLIDA TION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
GL																									
SPT	1.50		Drak Brownish colour Highly Plasticity Inorganic Silty Clay (CL)	5	7	1	2	5	8	84	35.19	20.35	14.84												
UDS	2.00					1	2	6	9	82	35.22	20.43	14.79		1.90	1.56	21.69	2.68	41.5		0.05 1.19	29.5 8.50	DST 0.72	0.140	
SPT	3.00			10	12	1	3	6	9	81	34.30	21.44	12.86												
SPT	4.50			10	12	1	3	4	7	84	34.20	21.80	14.84												
UDS	5.00					1	2	2	67	28	REMOULDED UDS				1.75	1.54	13.76	2.65			0.00	DST 32.00	0.72		
SPT	6.00		Light Grayish Colours Inorganic Silty Sand (SM)	19	16	2	2	1	65	30															
	6.50																								

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

ALLIED ENGINEERS

JOB NO. M-11/2012-13/1598

SOIL PROFILE

CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR

SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR

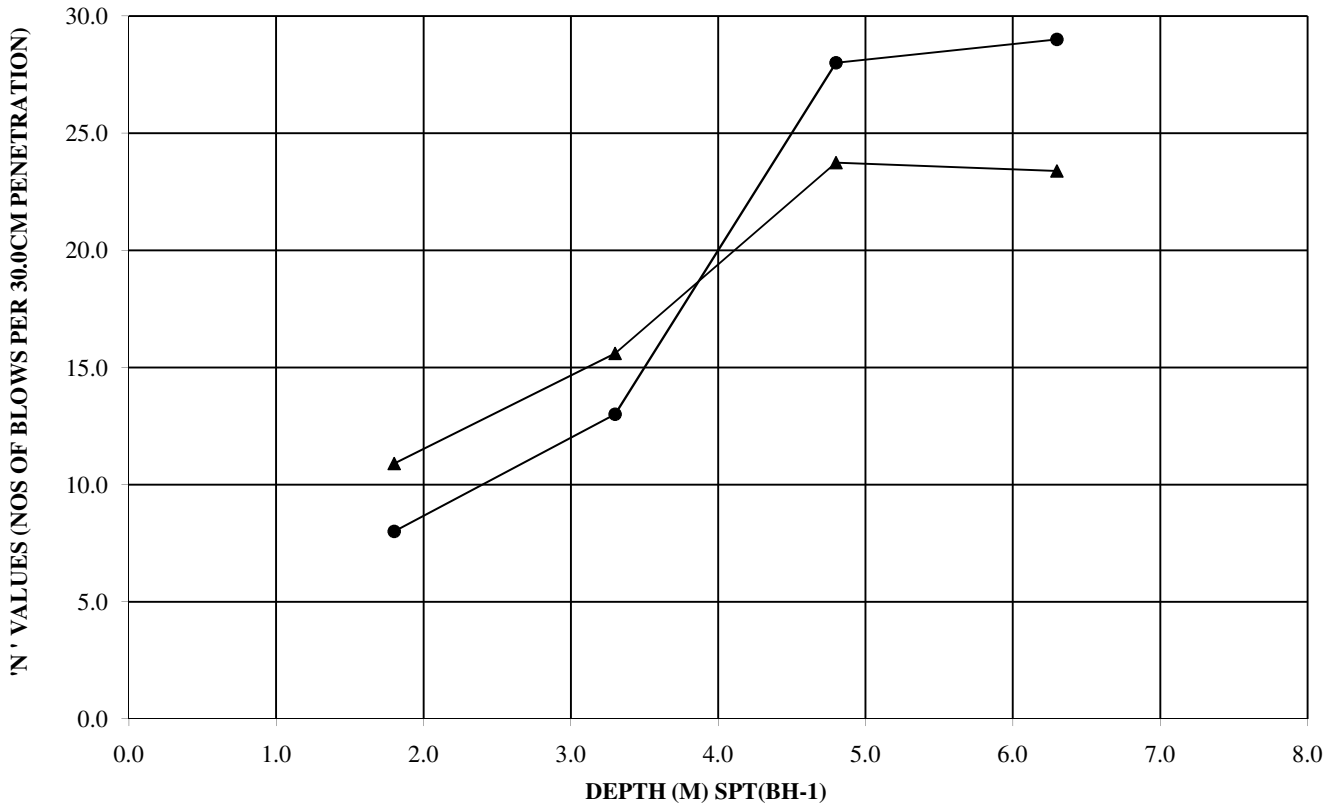
WATER TABLE **2.00 (M)**

LOCATION **BH-20**

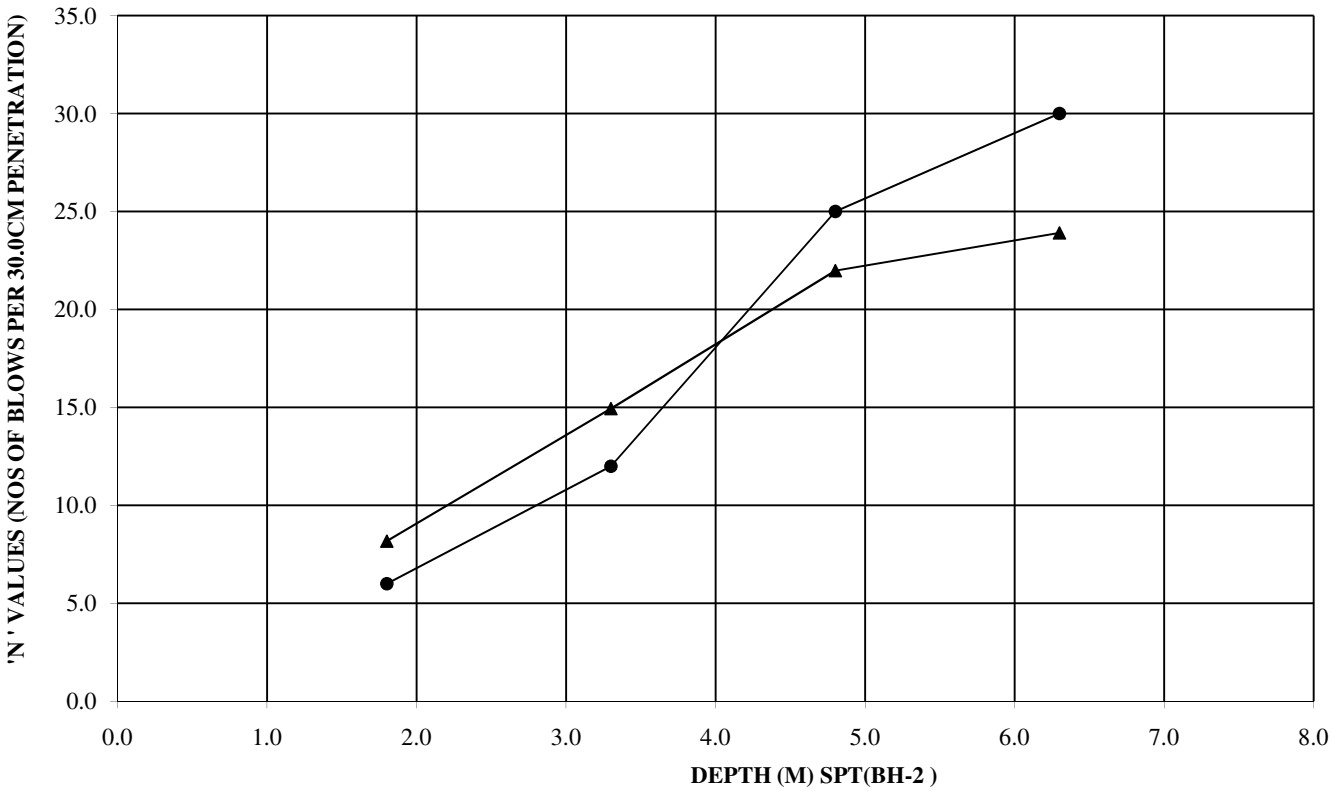
SHEET NO 20

TYPE OF SAMPLE	DEPTH (m)	SUB SOIL PROFILE	SOIL DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Measured)	SPT 'N' VALUES(Corrected)	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS: GRAVEL	COARSE	MEDIUM	FINE	HYDROMETER ANALY: SILTY+ CLAY %	ATTERBERGS' LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	DENSITY gm / cm³: BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTENT (%)	SPECIFIC GRAVITY	FREE SWELLINDEX (%)/ SWELL PRESSURE	RELATIVE DENSITY	SHEARPARAMETER UCC,TXL: COHESION (C) (KG/CM²)	FRICTION ANGLE (ø)	CONSOLIDATION PARAMETER: VOID RATIO	COMPRESSION INDEX	STD. PROCTOR TEST MDD GM/CC/OMC %
CL																									
SPT	1.50			5	15	1	2	5	9	83	35.10	20.50	14.60												
UDS	2.00		Brownish Colour Highly Plasticity Inorganic Silty Clay (CL)			0	2	6	8	84	35.12	20.67	14.45		1.91	1.56	22.48	2.68	31.0		0.03 1.25	27.5 9.50	DST 0.72	0.135	
SPT	3.00			9	16	1	3	7	9	80	35.00	20.00	15.00												
SPT	4.50			12	17	1	2	4	7	86	31.50	21.50	10.00												
UDS	5.00					0	1	2	65	32	REMOULDED UDS				1.76	1.56	12.63	2.65			0.00	31.50	0.70		
SPT	6.00			15	18	2	1	1	61	35															
SPT	7.50		Inorganic Silty Sand (SM)	21	17	1	2	2	63	32															
UDS	8.00					1	1	2	69	27	REMOULDED UDS				1.79	1.57	13.97	2.65			0.00	DST 32.50	0.69		
SPT	9.00		Highly Plasticity Inorganic Silty Clay (CL)	25	19	1	3	5	8	83	32.25	21.45	10.80												
	9.50																								

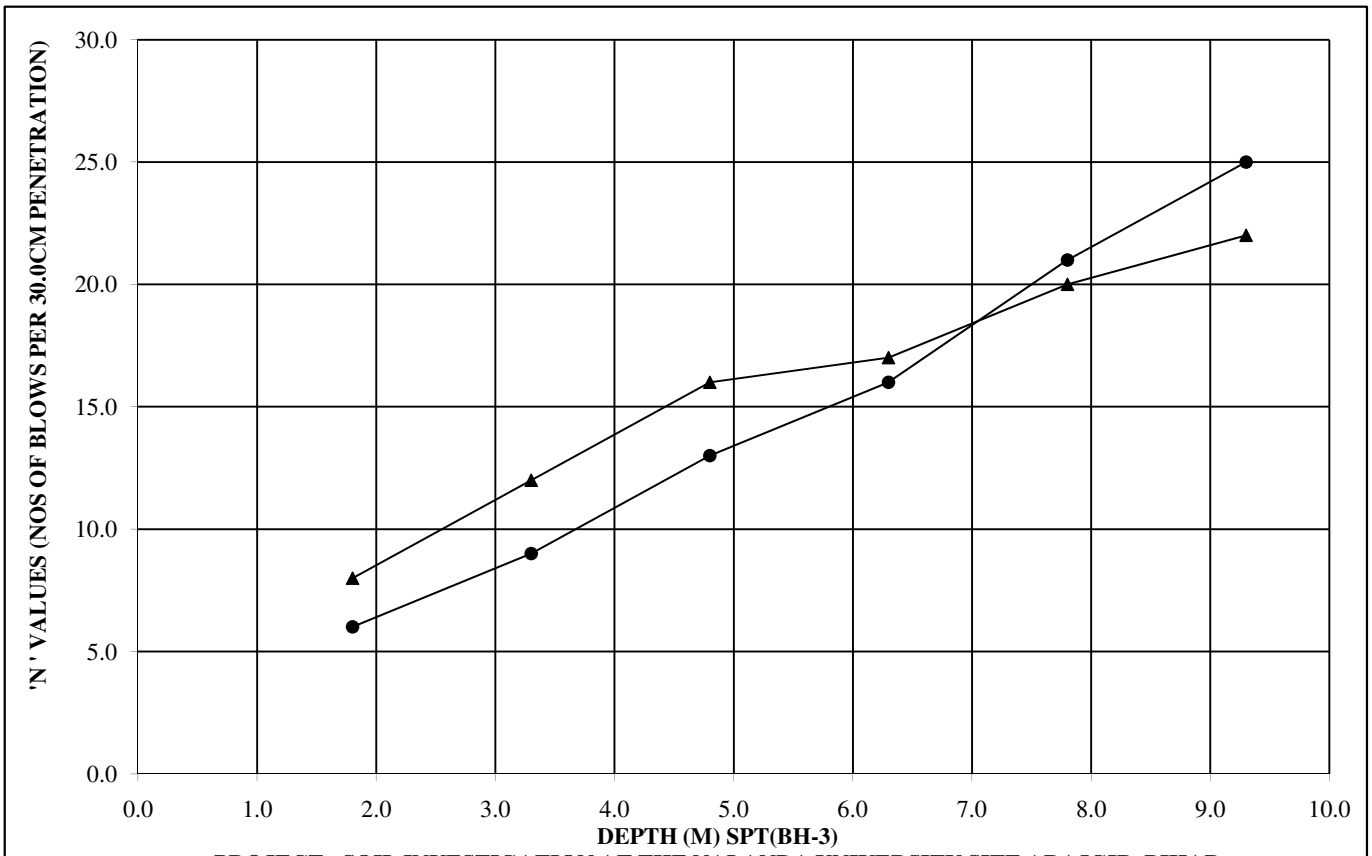
*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.



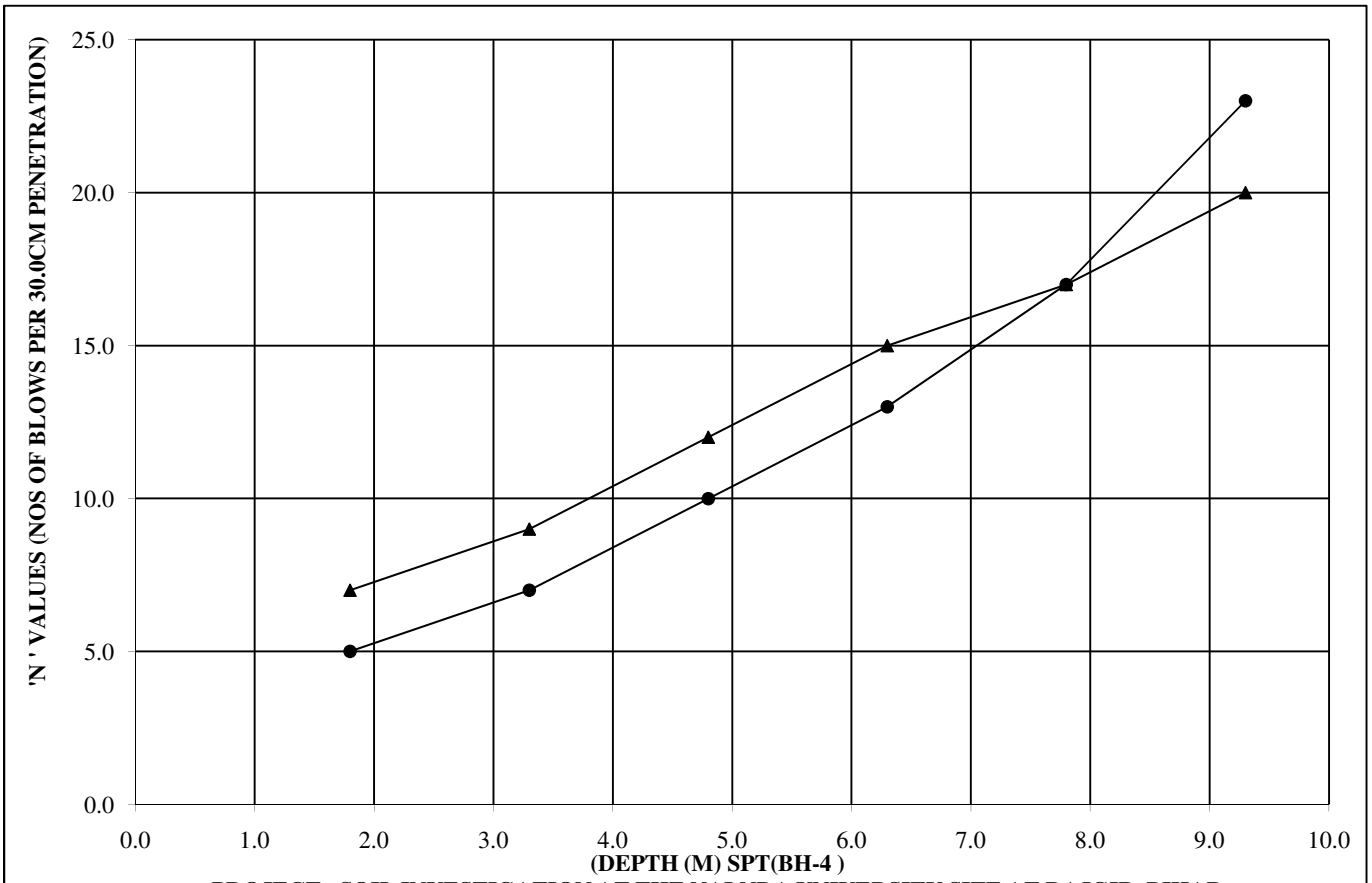
PROJECT=SOIL IVESTIGATION AT THE NA;ANDA UNVERSITY SITE AT RAJGIR BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)



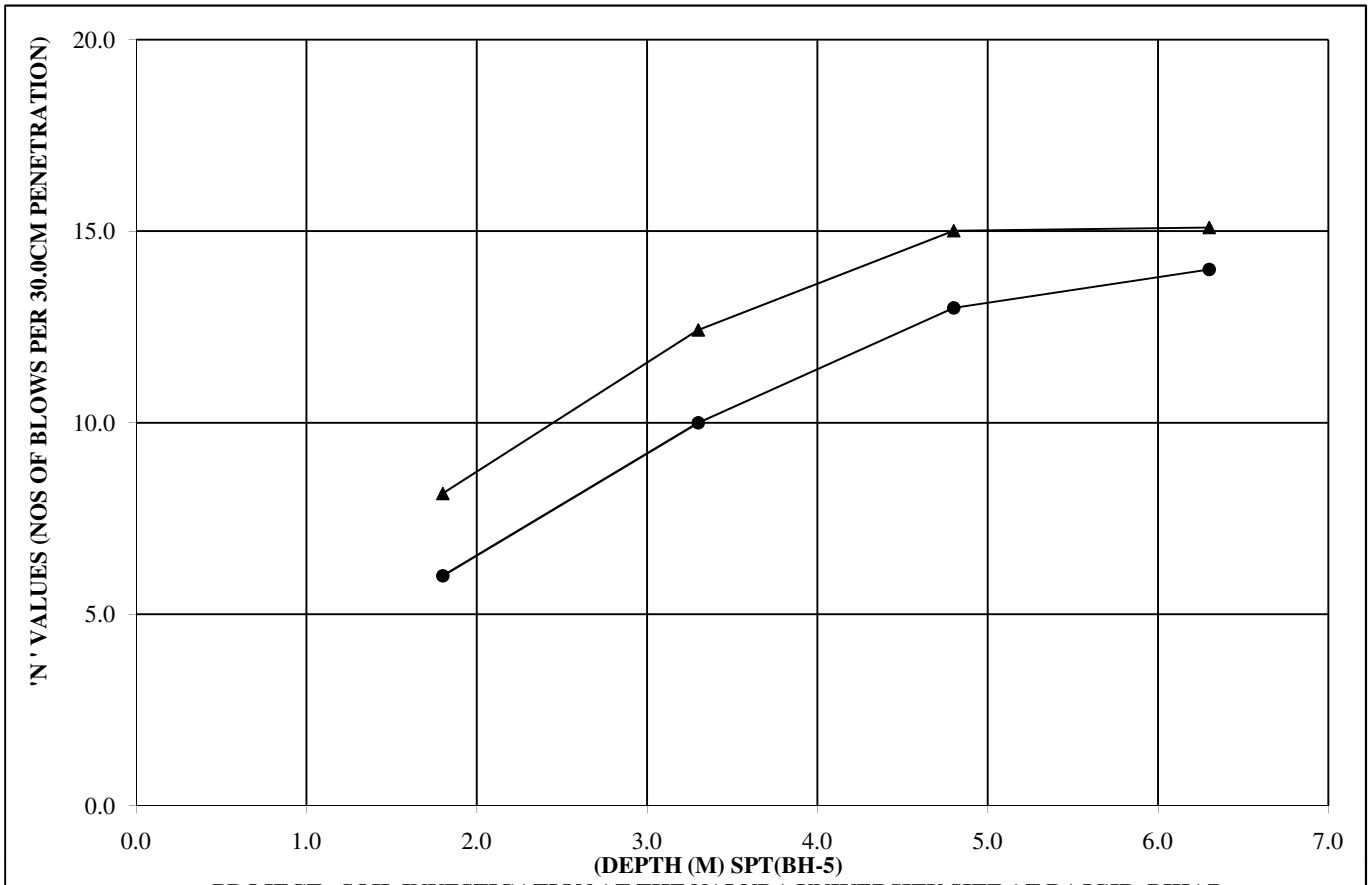
PROJECT= SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR,BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)



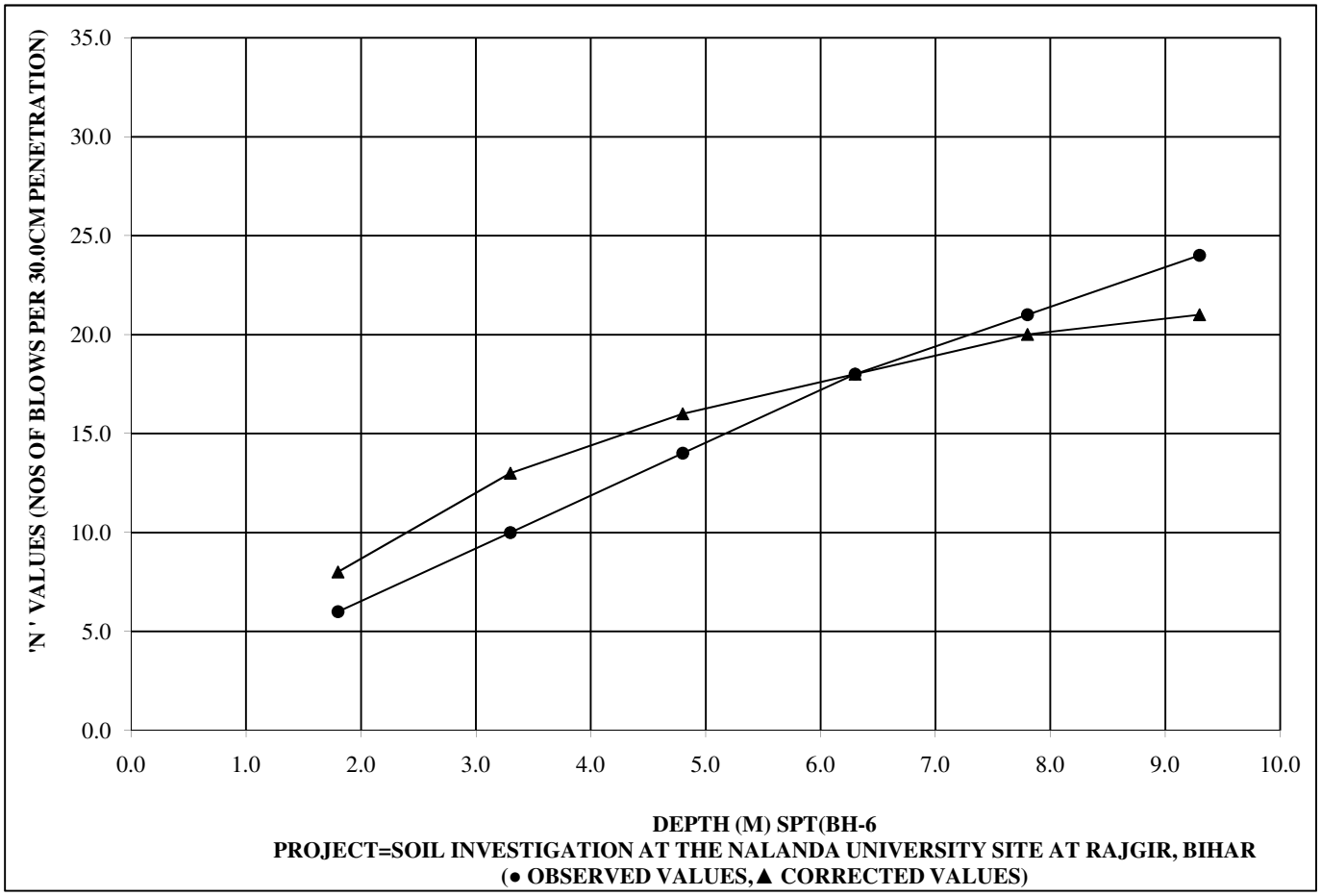
PROJECT= SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE ARAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)



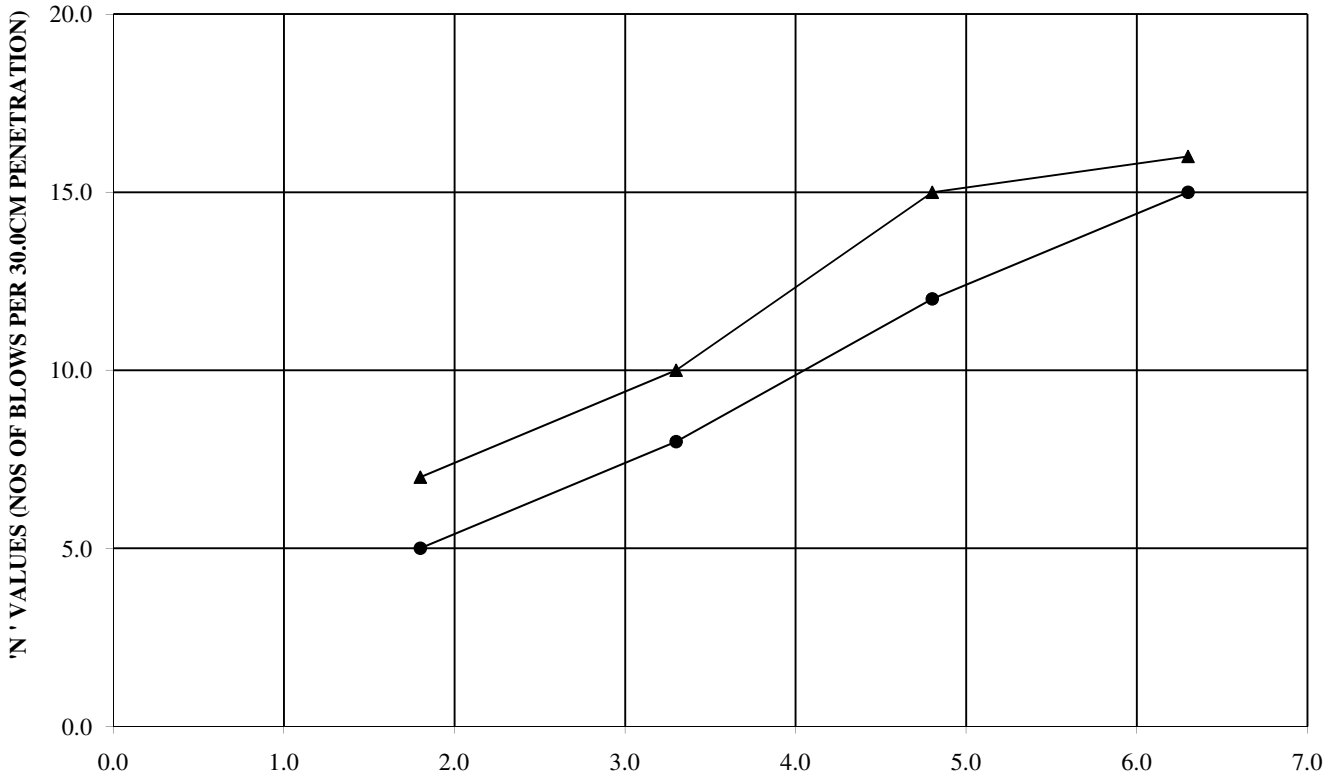
PROJECT= SOIL INVESTIGATION AT THE NALNDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)



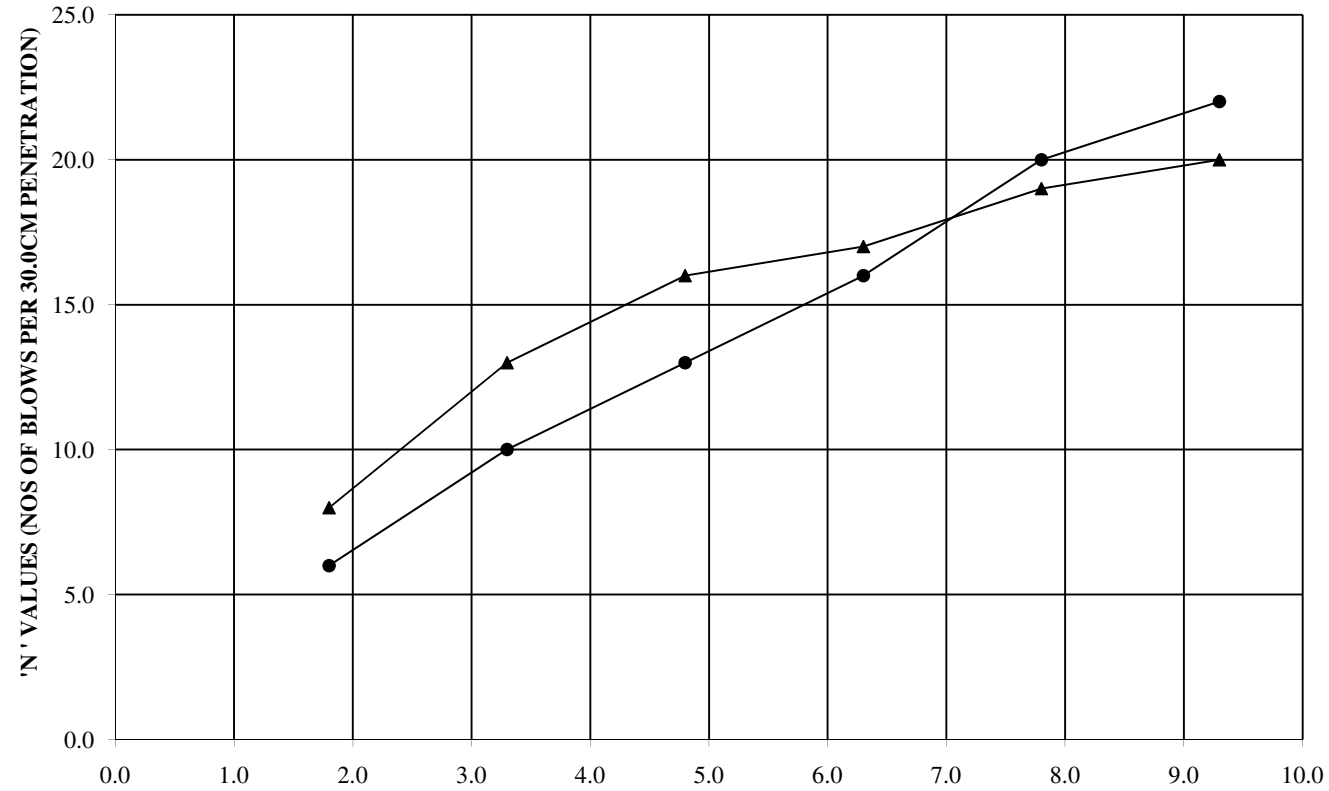
PROJECT= SOIL INVESTIGATION AT THE NALNDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)



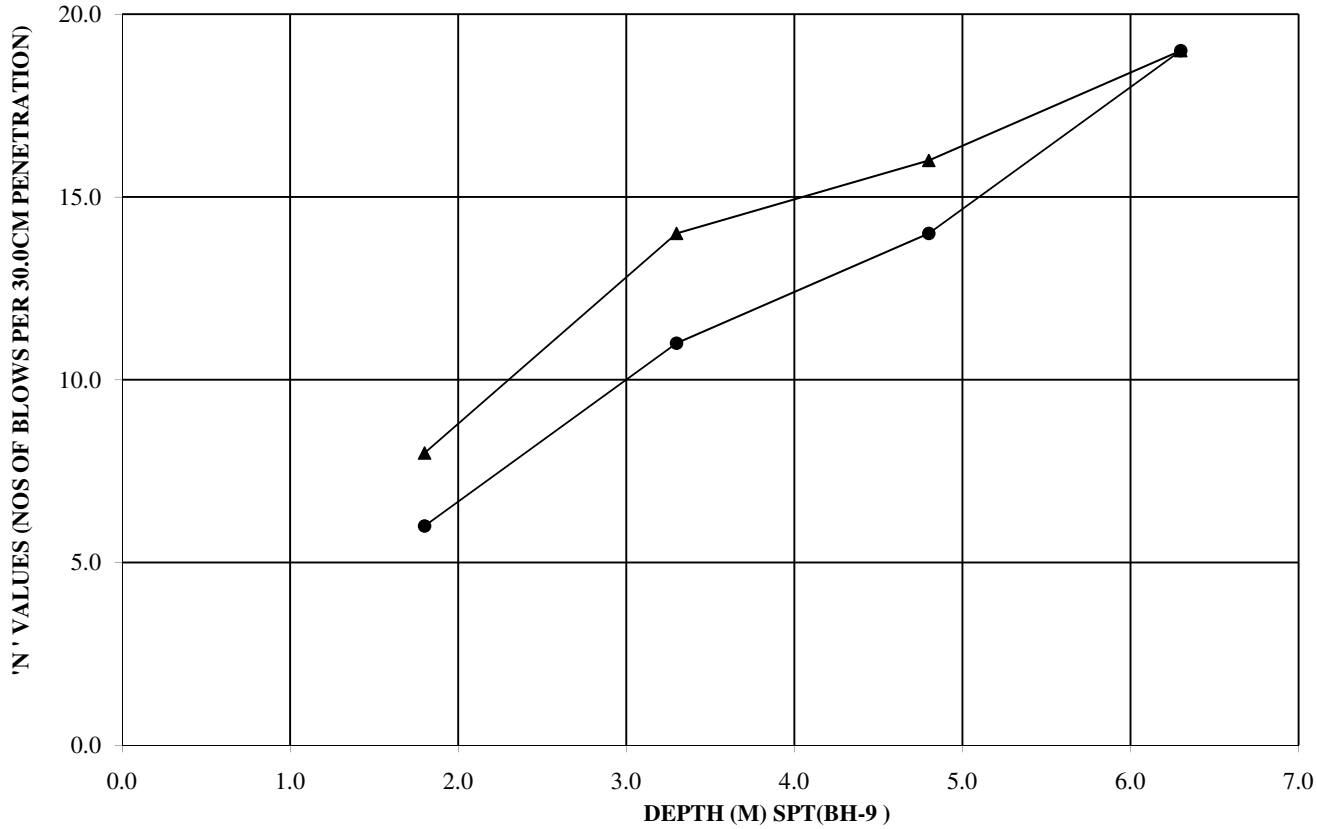
PROJECT=SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)



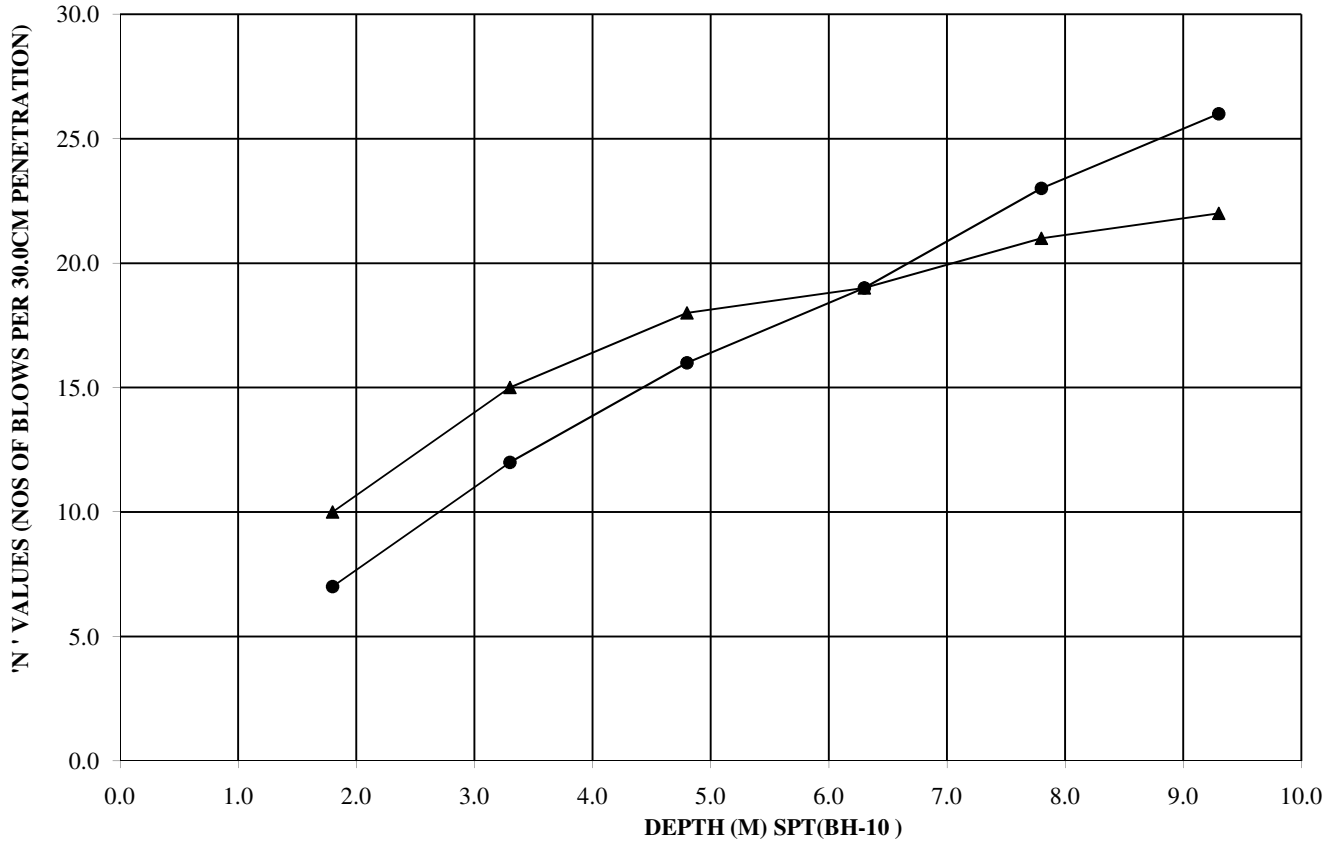
DEPTH (M) SPT(BH-7)
PROJECT=SOIL INVESTIGATION AT THE NA;NDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)



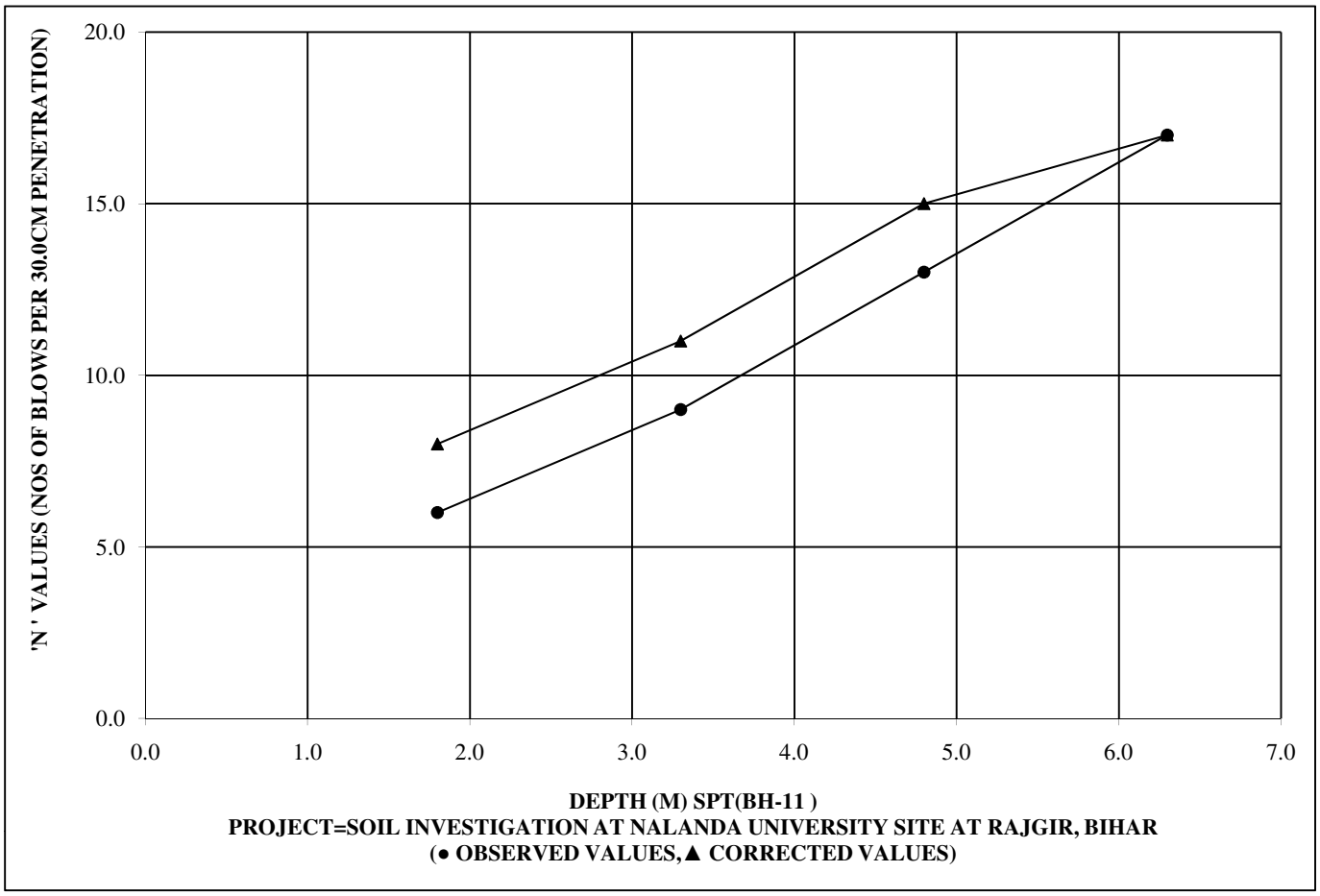
DEPTH (M) SPT(BH-8)
PROJECT=SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

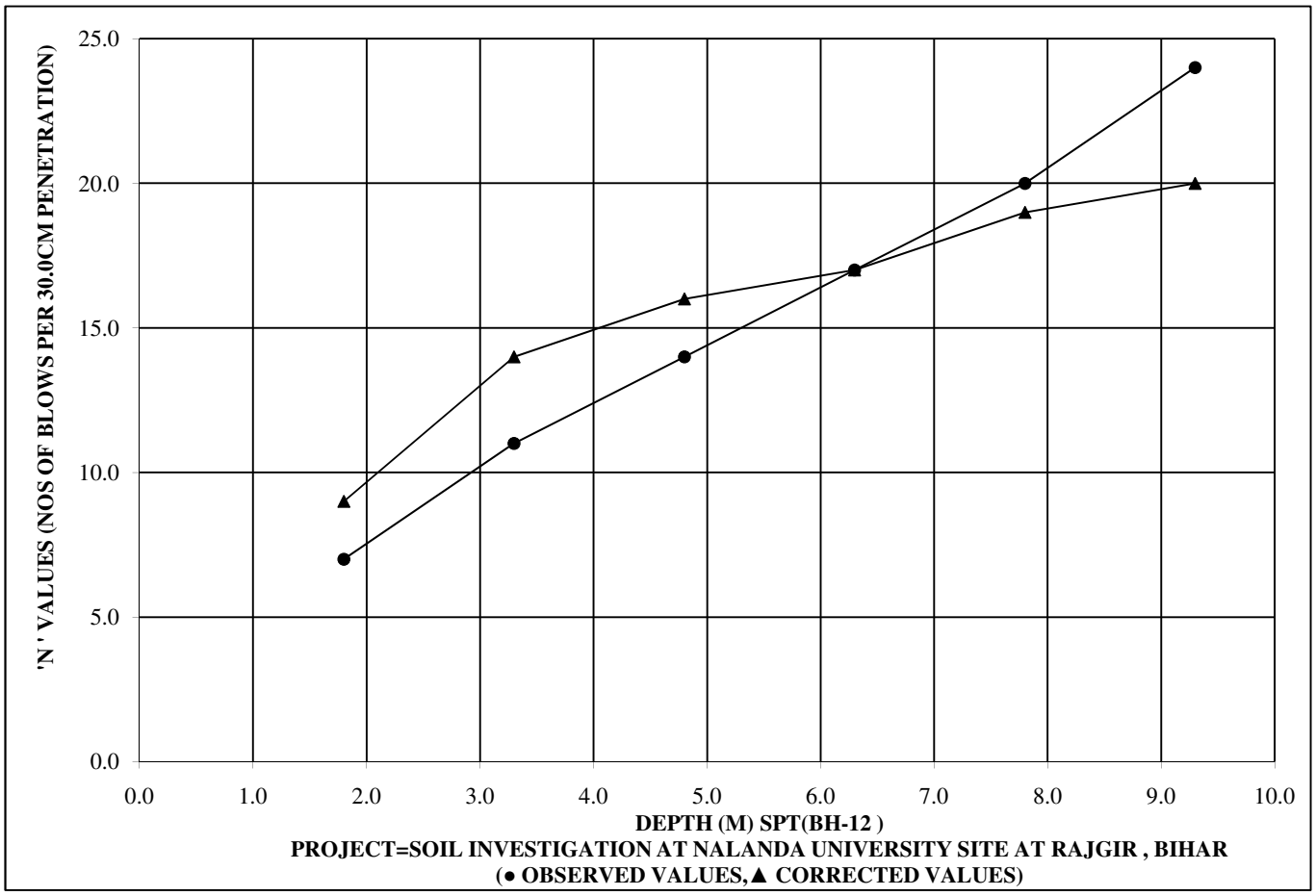


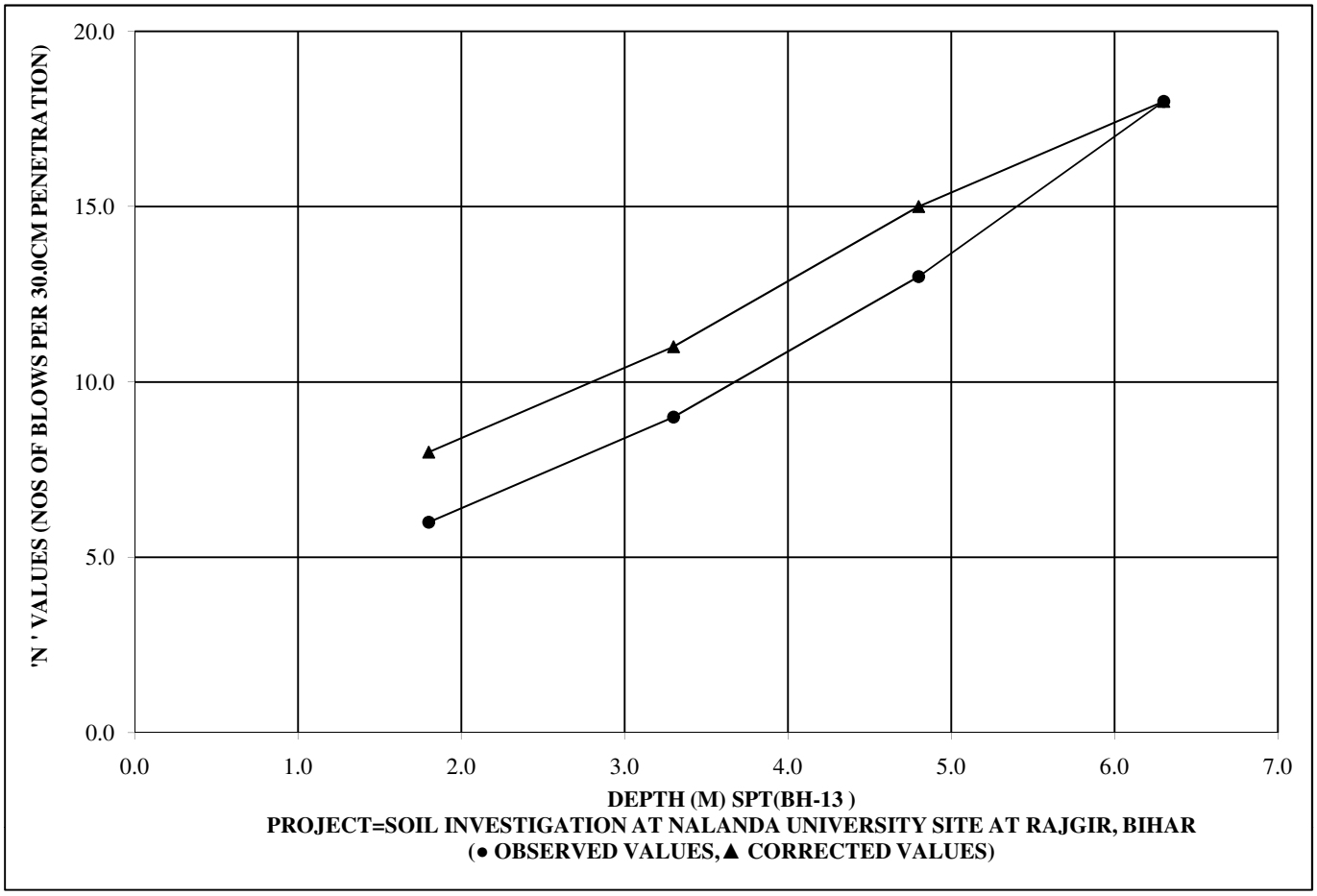
PROJECT= SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

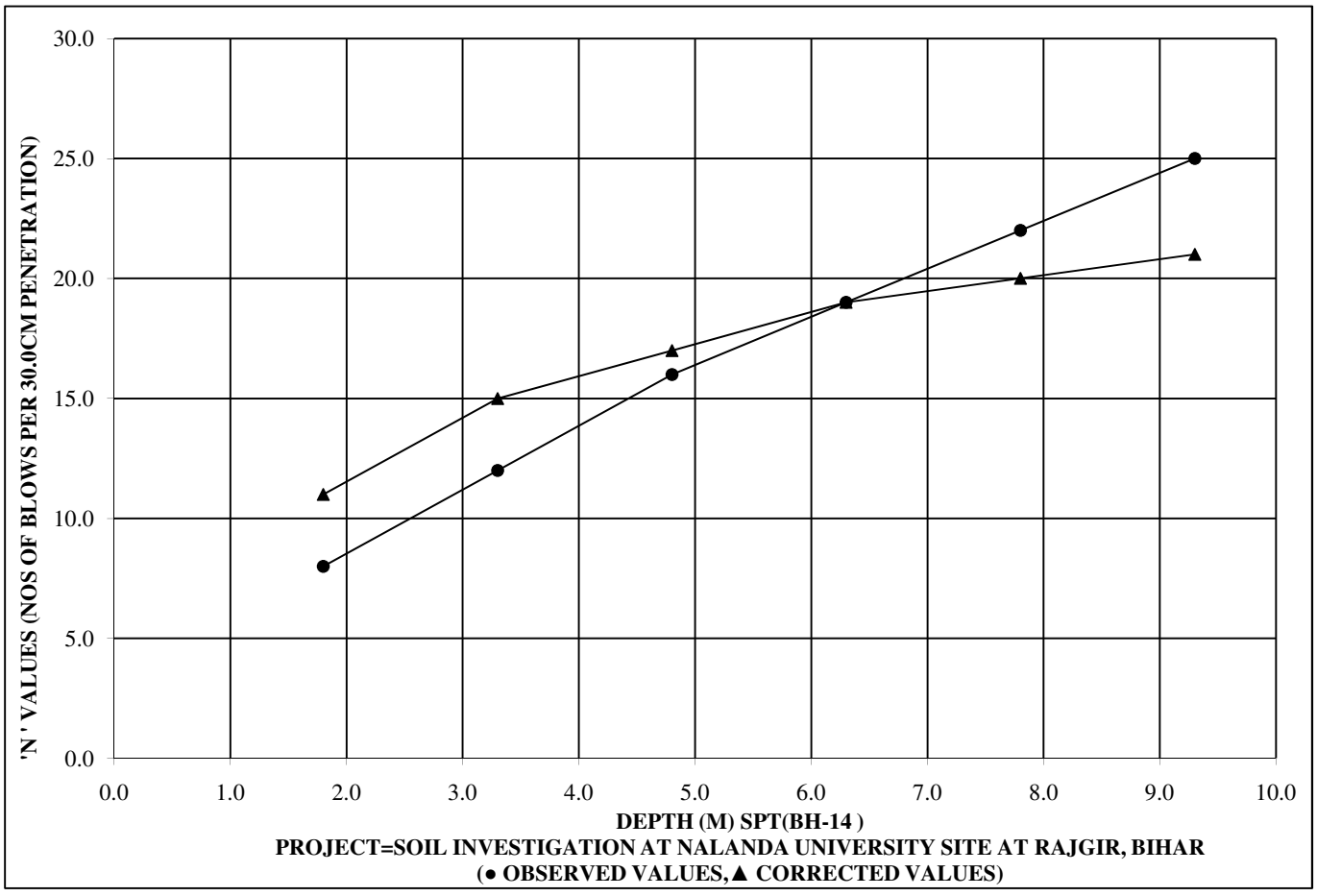


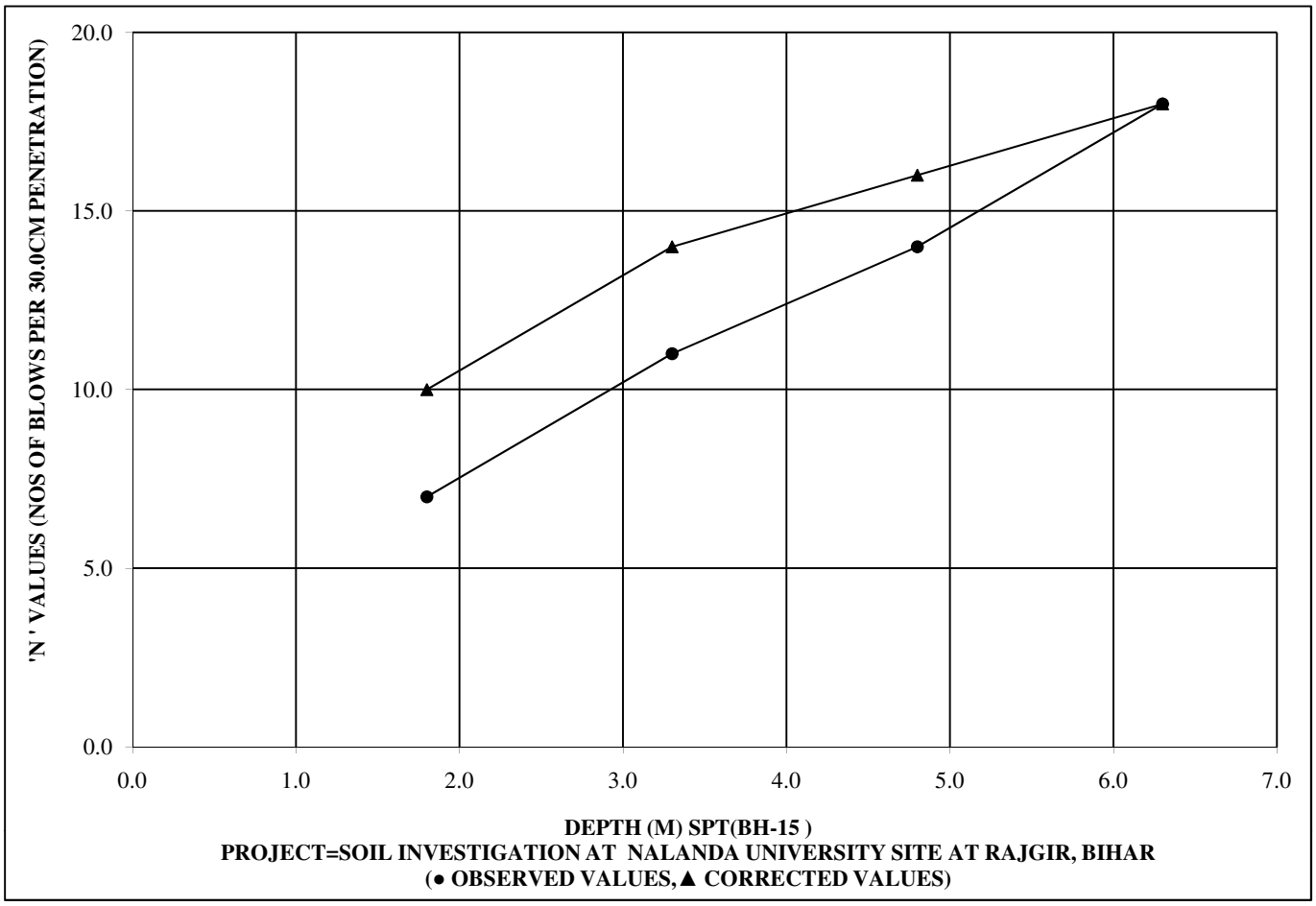
PROJECT=SOIL INVESTIGATION AT NALAMDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

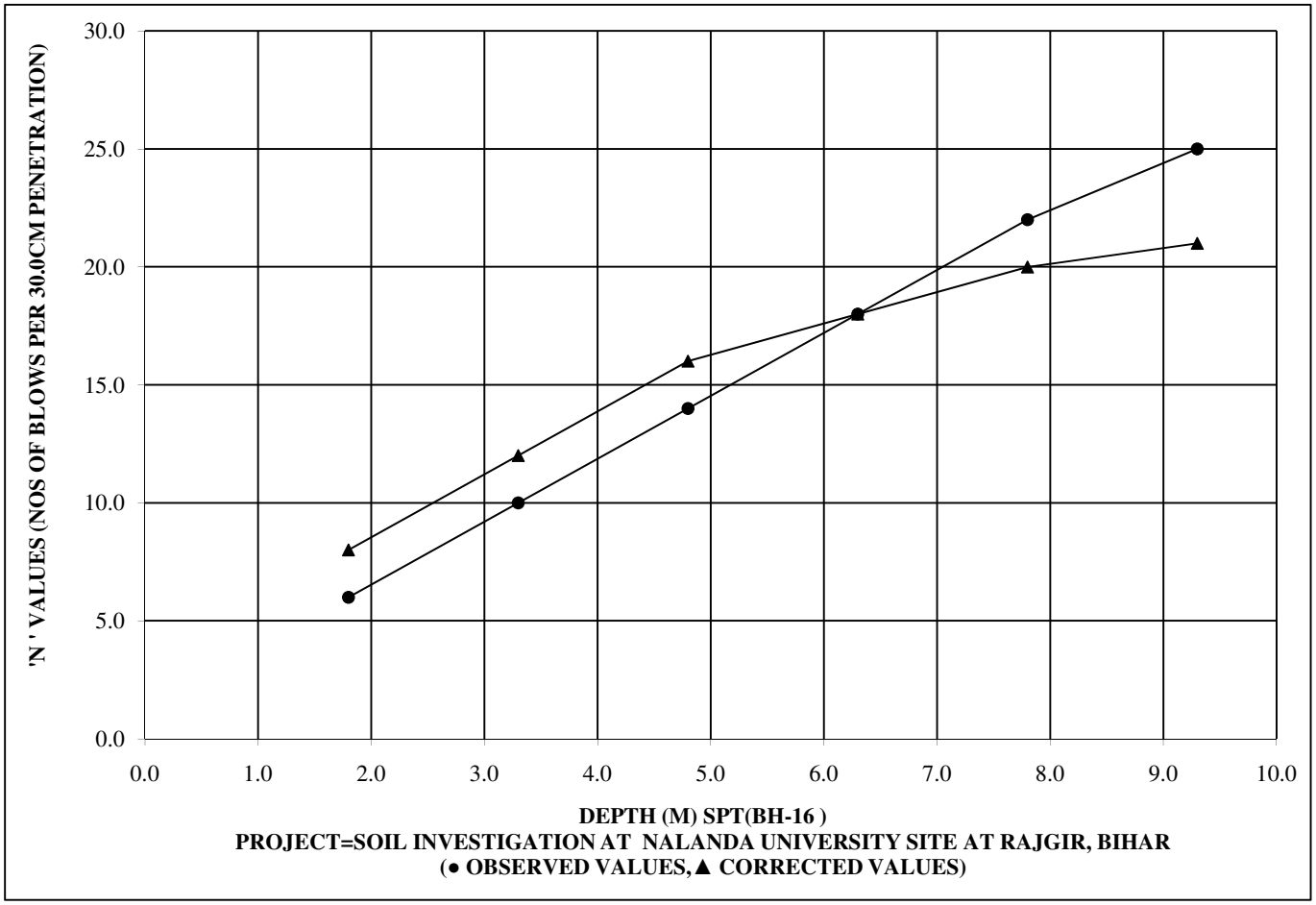

'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
DEPTH (M) SPT(BH-11)
PROJECT=SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

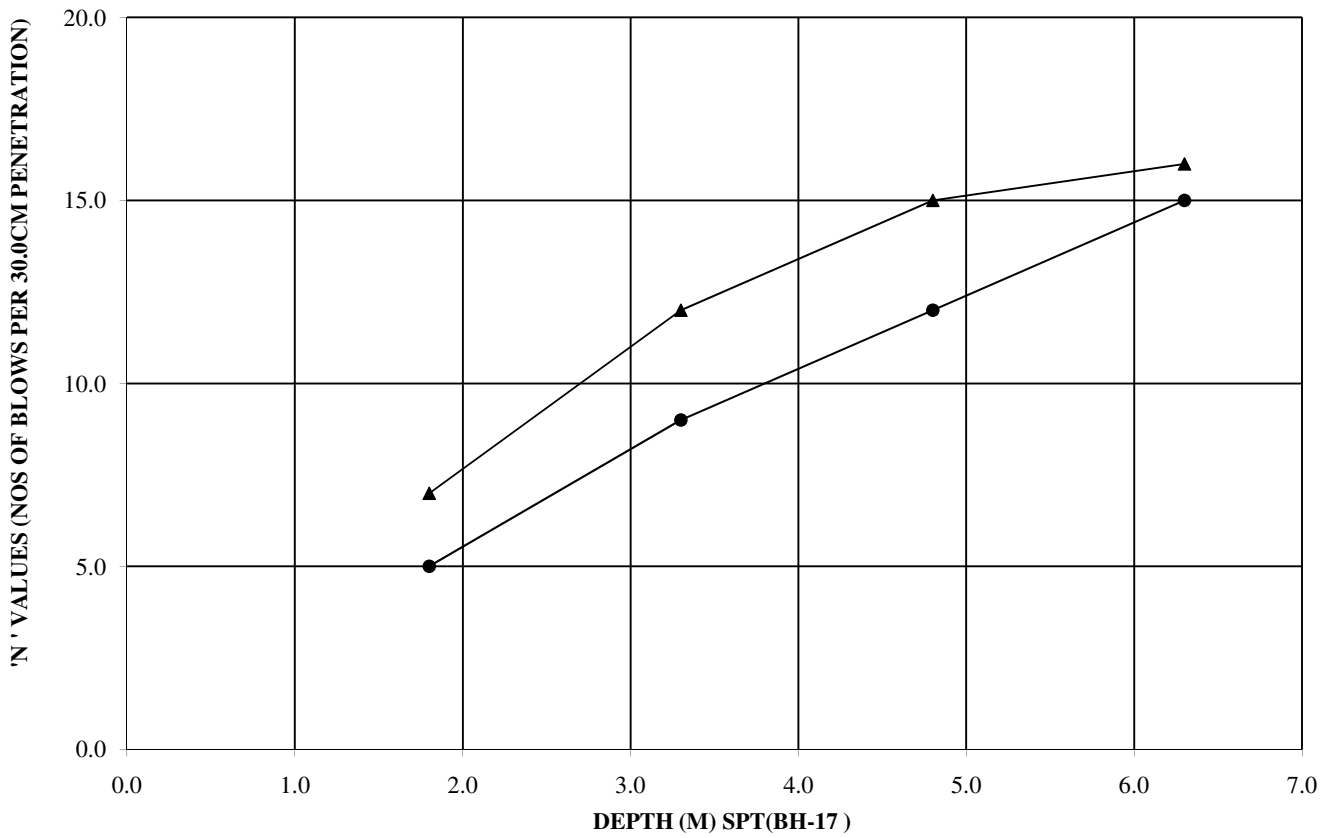

'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
25.0
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
DEPTH (M) SPT(BH-12)
PROJECT=SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR , BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)


'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
DEPTH (M) SPT(BH-13)
PROJECT=SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

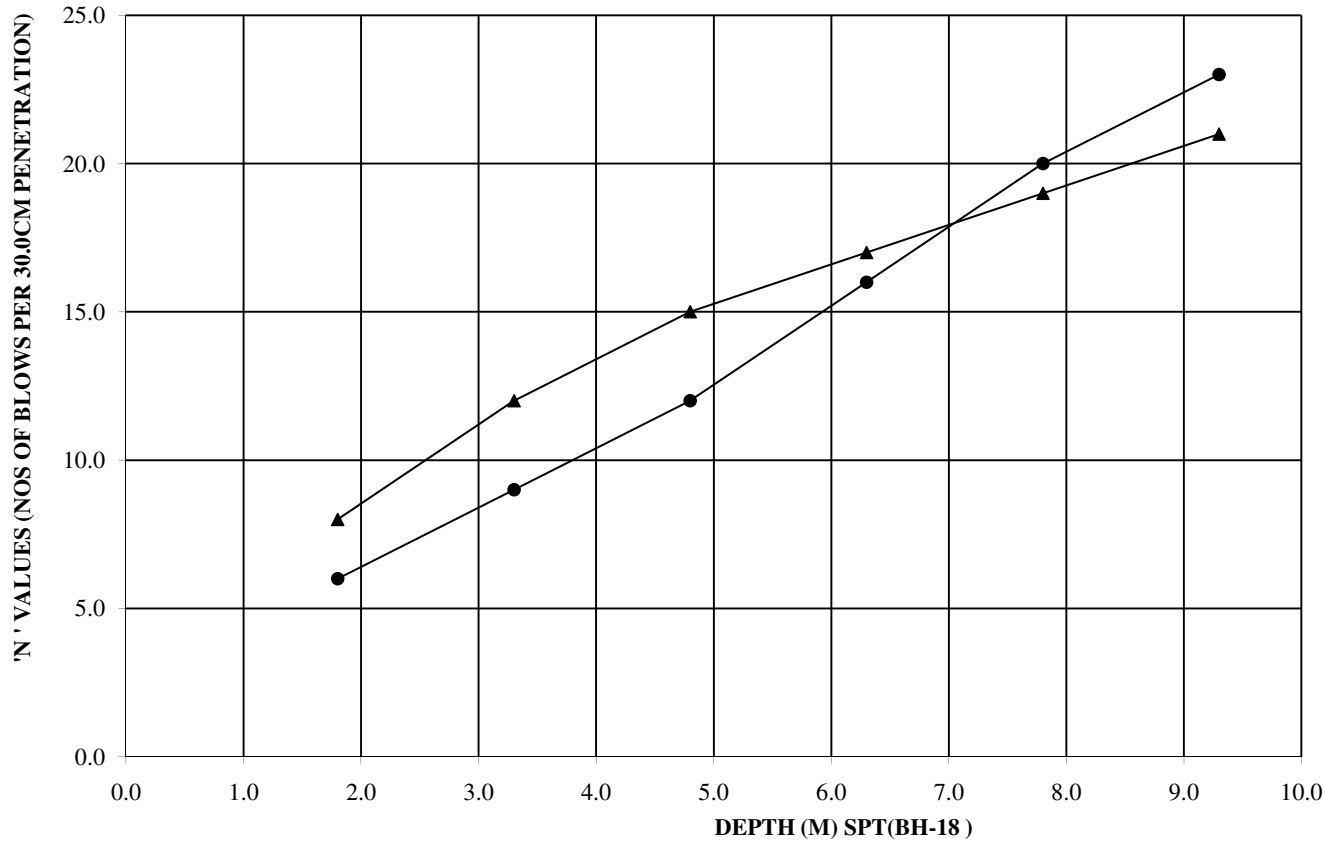

'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
DEPTH (M) SPT(BH-14)
PROJECT=SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)


'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
DEPTH (M) SPT(BH-15)
PROJECT=SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

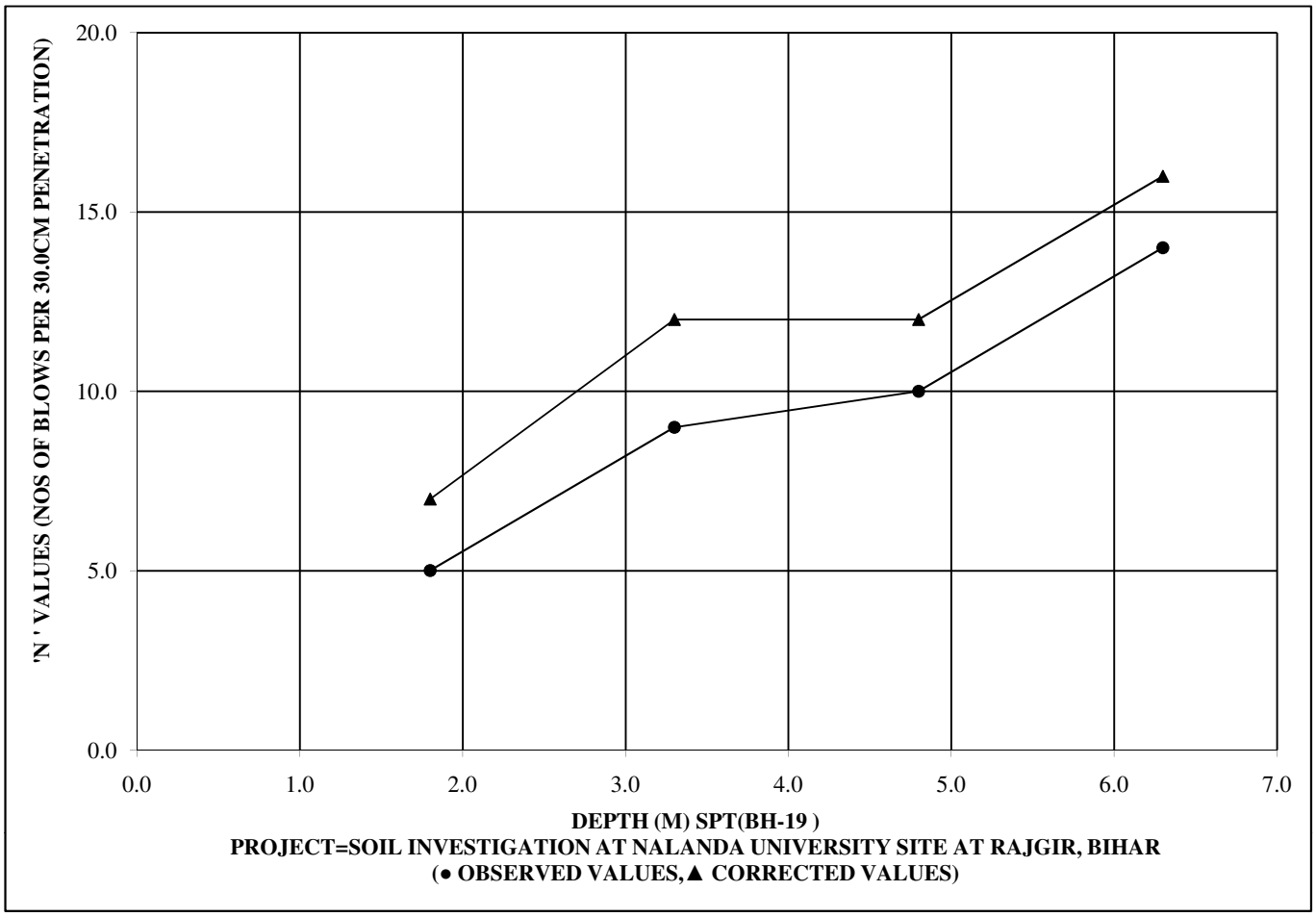

'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
DEPTH (M) SPT(BH-16)
PROJECT=SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

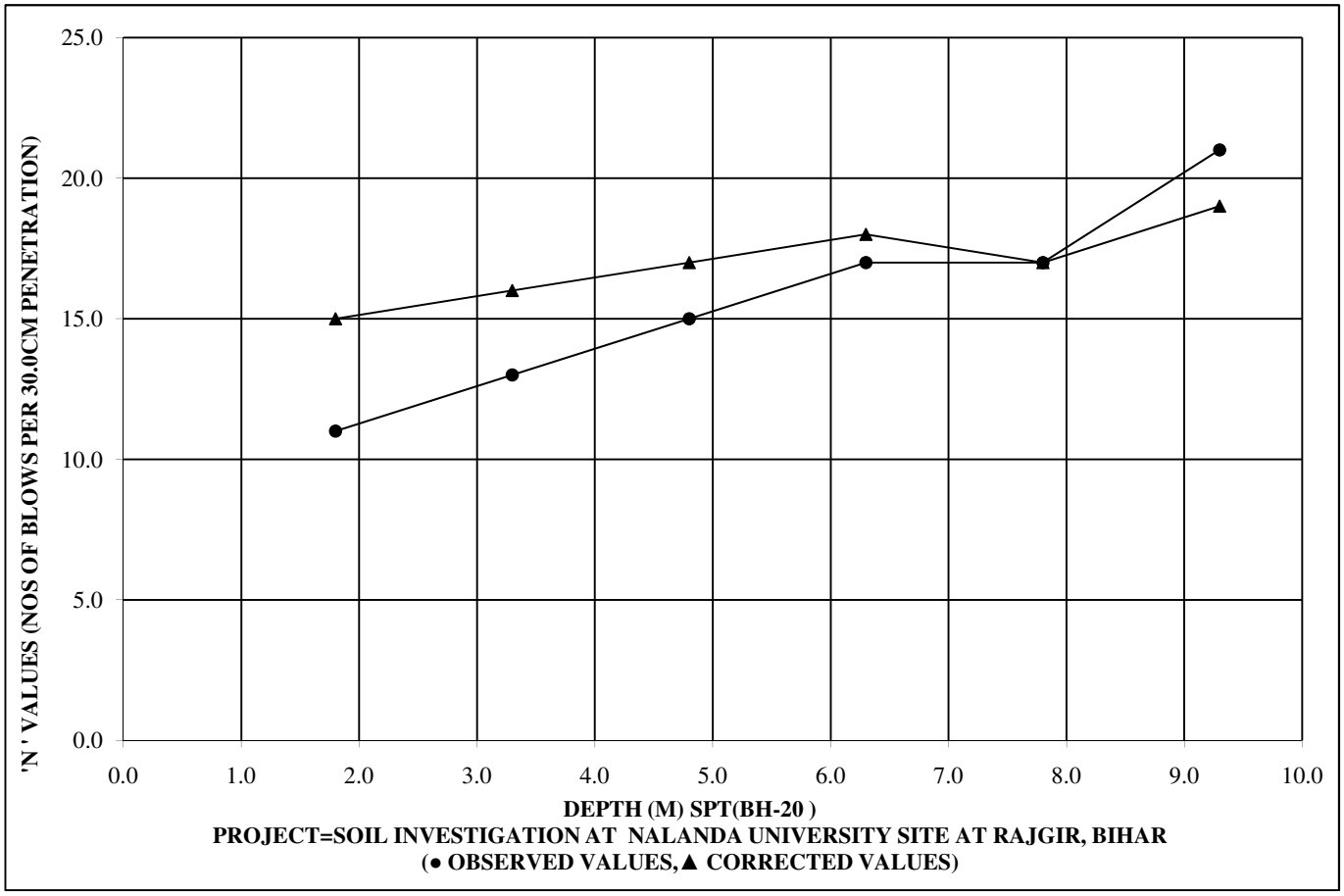


PROJECT= SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)



PROJECT=SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)


'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
DEPTH (M) SPT(BH-19)
PROJECT=SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)


'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
25.0
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
DEPTH (M) SPT(BH-20)
PROJECT=SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982

LOCATION				**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.**										
TYPE OF SUB SOIL				**SILTY CLAY**										
DEPTH OF TEST				**1.50M BELOW G.L..**										
CONDTION OF TEST				**NATURAL MOISTURE CONDITION**										
SIZE OF PLATE				**30.0x 30.0SQUARE CM**										
SEATING LOAD				**126 KG**										
							TEST 1 LOCATION NO 4							
				Dial Gauge -1			**Dial Gauge -2**							
Load (Kg)	**Size of plate(cm)**	**Area of Plate (sqcm)**	**Pressure(Kg/sqcm)**	**Initial Settlements (mm)**	**Final settlements(mm)**	**Net Settlements(mm)**	**Initial Settlements(mm)**	**Final settlements(mm)**	**Net Settlements(mm)**	**Avg Settlement(mm)**	**Cumulative Settlements (mm) of Plate**	**Settlement of actual Footing 1.0 m wide**	**Settlement of actual Footing 2.0 m wide**	**Settlement of actual Footing 3.0 m wide**
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1000.0	30.0	900.0	1.1111	0.00	2.80	2.80	0.00	3.36	3.36	3.08	3.08	7.29	9.32	10.18
2000.0	30.0	900.0	2.2222	2.80	5.75	2.95	3.36	6.04	2.68	2.82	5.90	13.95	17.83	19.49
3000.0	30.0	900.0	3.3333	5.75	11.25	5.50	6.04	11.35	5.31	5.41	11.30	26.75	34.18	37.36
4000.0	30.0	900.0	4.4444	11.25	17.25	6.00	11.35	17.56	6.21	6.11	17.41	41.20	52.64	57.54
5000.0	30.0	900.0	5.5556	17.25	25.23	7.98	17.56	25.36	7.80	7.89	25.30	59.87	76.51	83.62

ALLOWABLE BEARING CAPACITY

DEPTH OF FOOTING Below existing GL(M)	**WIDTH OF FOOTING (M)**	**SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM**
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	15.47
1.5	2.00	12.10
1.5	3.00	11.07

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
LOCATION				PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.										
TYPE OF SUB SOIL				SILTY CLAY										
DEPTH OF TEST				1.50M BELOW G.L..										
CONDTION OF TEST				NATURAL MOISTURE CONDITION										
SIZE OF PLATE				30.0x 30.0SQUARE CM										
SEATING LO	1			126 KG										
							TEST 2 LOCATION NO 5							
				Dial Gauge -1			Dial Gauge -2							
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure(Kg/sqcm)	Initial Settlements (mm)	Final settlements(mm)	Net Settlements(mm)	Initial Settlements(mm)	Final settlements(mm)	Net Settlements(mm)	Avg Settlement(mm)	Cumulative Settlements (mm) of Plate	Settlement of actual Footing 1.0 m wide	Settlement of actual Footing 2.0 m wide	Settlement of actual Footing 3.0 m wide
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	2.22	2.22	0.00	2.05	2.05	2.14	2.14	5.05	6.46	7.06
1000.0	30.0	900.0	1.1111	2.22	5.75	1.34	2.05	5.43	3.38	2.36	4.50	10.64	13.60	14.86
2000.0	30.0	900.0	2.2222	5.75	11.15	5.40	5.43	11.10	5.67	5.54	10.03	23.74	30.34	33.16
3000.0	30.0	900.0	3.3333	11.15	16.48	5.33	11.10	16.17	5.07	5.20	15.23	36.05	46.06	50.35
4500.0	30.0	900.0	5.0000	16.48	25.60	9.12	16.17	25.10	8.93	9.03	24.26	57.41	73.36	80.18

ALLOWABLE BEARING CAPACITY		
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	14.52
1.5	2.00	11.36
1.5	3.00	10.39

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982

LOCATION				**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.**										
TYPE OF SUB SOIL				**SILTY CLAY**										
DEPTH OF TEST				**1.50M BELOW G.L..**										
CONDTION OF TEST				**NATURAL MOISTURE CONDITION**										
SIZE OF PLATE				**30.0x 30.0SQUARE CM**										
SEATING LO	**1**			**126 KG**										
							TEST 3 LOCATION NO 6							
				Dial Gauge -1			**Dial Gauge -2**							
Load (Kg)	**Size of plate(cm)**	**Area of Plate (sqcm)**	**Pressure(Kg/sqcm)**	**Initial Settlements (mm)**	**Final settlements(mm)**	**Net Settlements(mm)**	**Initial Settlements(mm)**	**Final settlements(mm)**	**Net Settlements(mm)**	**Avg Settlement(mm)**	**Cumulative Settlements (mm) of Plate**	**Settlement of actual Footing 1.0 m wide**	**Settlement of actual Footing 2.0 m wide**	**Settlement of actual Footing 3.0 m wide**
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	4.23	4.23	0.00	5.33	5.33	4.78	4.78	11.31	14.46	15.80
1000.0	30.0	900.0	1.1111	4.23	8.78	4.55	5.33	9.54	4.21	4.38	9.16	21.68	27.71	30.28
1500.0	30.0	900.0	1.6667	8.78	13.25	4.47	9.54	13.87	4.33	4.40	13.56	32.09	41.01	44.83
2000.0	30.0	900.0	2.2222	13.25	18.45	5.20	13.87	18.54	4.67	4.94	18.50	43.78	55.94	61.14
3000.0	30.0	900.0	3.3333	18.45	25.10	6.65	18.54	25.30	6.76	6.71	25.20	59.64	76.22	83.31

ALLOWABLE BEARING CAPACITY

DEPTH OF FOOTING Below existing GL(M)	**WIDTH OF FOOTING (M)**	**SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM**
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	9.31
1.5	2.00	7.29
1.5	3.00	6.67

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
LOCATION				PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.										
TYPE OF SUB SOIL				SILTY CLAY										
DEPTH OF TEST				1.50M BELOW G.L..										
CONDTION OF TEST				NATURAL MOISTURE CONDITION										
SIZE OF PLATE				30.0x 30.0SQUARE CM										
SEATING LOAD				126 KG										
							TEST 4 LOCATION NO 8							
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure(Kg/sqcm)	Initial Settlements (mm)	Final settlements(mm)	Net Settlements(mm)	Initial Settlements(mm)	Final settlements(mm)	Net Settlements(mm)	Avg Settlement(mm)	Cumulative Settlements (mm) of Plate	Settlement of actual Footing 1.0 m wide	Settlement of actual Footing 2.0 m wide	Settlement of actual Footing 3.0 m wide
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	2.35	2.35	0.00	2.54	2.54	2.45	2.45	5.79	7.40	8.08
1000.0	30.0	900.0	1.1111	2.35	7.58	5.23	2.54	8.45	5.91	5.57	8.02	18.97	24.24	26.50
1500.0	30.0	900.0	1.6667	7.58	15.26	7.68	8.45	16.25	7.80	7.74	15.76	37.29	47.65	52.08
2500.0	30.0	900.0	2.7778	15.26	25.10	9.84	16.25	25.23	8.98	9.41	25.17	59.56	76.11	83.19

ALLOWABLE BEARING CAPACITY		
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	7.77
1.5	2.00	6.08
1.5	3.00	5.57

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
LOCATION				PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.										
TYPE OF SUB SOIL				SILTY CLAY										
DEPTH OF TEST				1.50M BELOW G.L..										
CONDTION OF TEST				NATURAL MOISTURE CONDITION										
SIZE OF PLA	1			30.0x 30.0SQUARE CM										
SEATING LOAD				126 KG										
							TEST 5 LOCATION NO 3							
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure(Kg/sqcm)	Initial Settlements (mm)	Final settlements(mm)	Net Settlements(mm)	Initial Settlements(mm)	Final settlements(mm)	Net Settlements(mm)	Avg Settlement(mm)	Cumulative Settlements (mm) of Plate	Settlement of actual Footing 1.0 m wide	Settlement of actual Footing 2.0 m wide	Settlement of actual Footing 3.0 m wide
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	3.45	3.45	0.00	2.97	2.97	3.21	3.21	7.60	9.71	10.61
1000.0	30.0	900.0	1.1111	3.45	7.40	3.95	2.97	7.25	4.28	4.12	7.33	17.34	22.16	24.21
1500.0	30.0	900.0	1.6667	7.40	11.40	4.00	7.25	11.27	4.02	4.01	11.34	26.83	34.28	37.47
2000.0	30.0	900.0	2.2222	11.40	16.20	4.80	11.27	16.12	4.85	4.83	16.16	38.25	48.88	53.42
2500.0	30.0	900.0	2.7778	16.20	19.97	3.77	16.12	19.98	3.86	3.82	19.98	47.28	60.42	66.03
3000.0	30.0	900.0	3.3333	19.97	25.23	5.26	19.98	25.10	5.12	5.19	25.17	59.56	76.11	83.19

ALLOWABLE BEARING CAPACITY		
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	9.33
1.5	2.00	7.30
1.5	3.00	6.68

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
LOCATION				PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.										
TYPE OF SUB SOIL				SILTY CLAY										
DEPTH OF TEST				1.50M BELOW G.L..										
CONDTION OF TEST				NATURAL MOISTURE CONDITION										
SIZE OF PLA	1			30.0x 30.0SQUARE CM										
SEATING LOAD				126 KG										
							TEST 6 LOCATION NO 12							
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure(Kg/sqcm)	Initial Settlements (mm)	Final settlements(mm)	Net Settlements(mm)	Initial Settlements(mm)	Final settlements(mm)	Net Settlements(mm)	Avg Settlement(mm)	Cumulative Settlements (mm) of Plate	Settlement of actual Footing 1.0 m wide	Settlement of actual Footing 2.0 m wide	Settlement of actual Footing 3.0 m wide
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	3.80	3.80	0.00	4.25	4.25	4.03	4.03	9.53	12.17	13.31
1000.0	30.0	900.0	1.1111	3.80	8.75	4.95	4.25	9.52	5.27	5.11	9.14	21.62	27.63	30.20
1500.0	30.0	900.0	1.6667	8.75	17.05	8.30	9.52	17.93	8.41	8.36	17.49	41.40	52.90	57.82
2000.0	30.0	900.0	2.2222	17.05	25.30	8.25	17.93	25.45	7.52	7.89	25.38	60.06	76.75	83.88

ALLOWABLE BEARING CAPACITY		
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	6.17
1.5	2.00	4.83
1.5	3.00	4.42

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
LOCATION				PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.										
TYPE OF SUB SOIL				SILTY CLAY										
DEPTH OF TEST				1.50M BELOW G.L..										
CONDTION OF TEST				NATURAL MOISTURE CONDITION										
SIZE OF PLA	1			30.0x 30.0SQUARE CM										
SEATING LOAD				126 KG										
							TEST 7 LOCATION NO 9							
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure(Kg/sqcm)	Initial Settlements (mm)	Final settlements(mm)	Net Settlements(mm)	Initial Settlements(mm)	Final settlements(mm)	Net Settlements(mm)	Avg Settlement(mm)	Cumulative Settlements (mm) of Plate	Settlement of actual Footing 1.0 m wide	Settlement of actual Footing 2.0 m wide	Settlement of actual Footing 3.0 m wide
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	4.90	4.90	0.00	4.37	4.37	4.64	4.64	10.97	14.02	15.32
1000.0	30.0	900.0	1.1111	4.90	7.90	3.00	4.37	7.46	3.09	3.05	7.68	18.18	23.23	25.39
1500.0	30.0	900.0	1.6667	7.90	12.45	4.55	7.46	12.33	4.87	4.71	12.39	29.33	37.47	40.96
2500.0	30.0	900.0	2.7778	12.45	25.25	12.80	12.33	25.12	12.79	12.80	25.19	59.61	76.17	83.26

ALLOWABLE BEARING CAPACITY		
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	7.77
1.5	2.00	6.08
1.5	3.00	5.56

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982

LOCATION				**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.**										
TYPE OF SUB SOIL				**SILTY CLAY**										
DEPTH OF TEST				**1.50M BELOW G.L..**										
CONDTION OF TEST				**NATURAL MOISTURE CONDITION**										
SIZE OF PLA	**1**			**30.0x 30.0SQUARE CM**										
SEATING LOAD				**126 KG**										
							TEST 8 LOCATION NO 13							
Load (Kg)	**Size of plate(cm)**	**Area of Plate (sqcm)**	**Pressure(Kg/sqcm)**	**Initial Settlements (mm)**	**Final settlements(mm)**	**Net Settlements(mm)**	**Initial Settlements(mm)**	**Final settlements(mm)**	**Net Settlements(mm)**	**Avg Settlement(mm)**	**Cumulative Settlements (mm) of Plate**	**Settlement of actual Footing 1.0 m wide**	**Settlement of actual Footing 2.0 m wide**	**Settlement of actual Footing 3.0 m wide**
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	7.40	7.40	0.00	6.53	6.53	6.97	6.97	16.49	21.07	23.02
1000.0	30.0	900.0	1.1111	7.40	11.72	4.32	6.53	10.95	4.42	4.37	11.34	26.83	34.28	37.47
1500.0	30.0	900.0	1.6667	11.72	18.75	7.03	10.95	17.95	7.00	7.02	18.35	43.43	55.50	60.66
2000.0	30.0	900.0	2.2222	18.75	25.45	6.70	17.95	25.10	7.15	6.93	25.28	59.82	76.45	83.55

ALLOWABLE BEARING CAPACITY

DEPTH OF FOOTING Below existing GL(M)	**WIDTH OF FOOTING (M)**	**SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM**
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	6.19
1.5	2.00	4.84
1.5	3.00	4.43

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
LOCATION				PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.										
TYPE OF SUB SOIL				SILTY CLAY										
DEPTH OF TEST				1.50M BELOW G.L..										
CONDTION OF TEST				NATURAL MOISTURE CONDITION										
SIZE OF PLA	1			30.0x 30.0SQUARE CM										
SEATING LOAD				126 KG										
							TEST 9 LOCATION NO 14							
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure(Kg/sqcm)	Initial Settlements (mm)	Final settlements(mm)	Net Settlements(mm)	Initial Settlements(mm)	Final settlements(mm)	Net Settlements(mm)	Avg Settlement(mm)	Cumulative Settlements (mm) of Plate	Settlement of actual Footing 1.0 m wide	Settlement of actual Footing 2.0 m wide	Settlement of actual Footing 3.0 m wide
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	4.05	4.05	0.00	3.80	3.80	3.93	3.93	9.29	11.87	12.98
1000.0	30.0	900.0	1.1111	4.05	7.15	3.10	3.80	6.58	2.78	2.94	6.87	16.25	20.76	22.69
1500.0	30.0	900.0	1.6667	7.15	10.32	3.17	6.58	9.20	2.62	2.90	9.76	23.10	29.52	32.26
2000.0	30.0	900.0	2.2222	10.32	15.40	5.08	9.20	14.20	5.00	5.04	14.80	35.03	44.76	48.93
2500.0	30.0	900.0	2.7778	15.40	20.25	4.85	14.20	19.75	5.55	5.20	20.00	47.34	60.49	66.12
3000.0	30.0	900.0	3.3333	20.25	25.30	5.05	19.75	25.10	5.35	5.20	25.20	59.64	76.22	83.31

ALLOWABLE BEARING CAPACITY		
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	9.31
1.5	2.00	7.29
1.5	3.00	6.67

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
LOCATION				PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.										
TYPE OF SUB SOIL				SILTY CLAY										
DEPTH OF TEST				1.50M BELOW G.L..										
CONDTION OF TEST				NATURAL MOISTURE CONDITION										
SIZE OF PLA	1			30.0x 30.0SQUARE CM										
SEATING LOAD				126 KG										
							TEST 10 LOCATION NO 15							
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure(Kg/sqcm)	Initial Settlements (mm)	Final settlements(mm)	Net Settlements(mm)	Initial Settlements(mm)	Final settlements(mm)	Net Settlements(mm)	Avg Settlement(mm)	Cumulative Settlements (mm) of Plate	Settlement of actual Footing 1.0 m wide	Settlement of actual Footing 2.0 m wide	Settlement of actual Footing 3.0 m wide
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	2.12	2.12	0.00	1.95	1.95	2.04	2.04	4.82	6.16	6.73
1000.0	30.0	900.0	1.1111	2.12	4.22	2.10	1.95	3.95	2.00	2.05	4.09	9.67	12.36	13.50
2000.0	30.0	900.0	2.2222	4.22	9.17	4.95	3.95	8.78	4.83	4.89	8.98	21.24	27.15	29.67
3000.0	30.0	900.0	3.3333	9.17	14.65	5.48	8.78	14.45	5.67	5.58	14.55	34.44	44.01	48.10
4000.0	30.0	900.0	4.4444	14.65	19.90	5.25	14.45	19.81	5.36	5.31	19.86	46.99	60.05	65.64
5000.0	30.0	900.0	5.5556	19.90	25.30	5.40	19.81	25.10	5.29	5.35	25.20	59.64	76.22	83.31

ALLOWABLE BEARING CAPACITY		
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	15.52
1.5	2.00	12.15
1.5	3.00	11.11

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
LOCATION				PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR ,										
TYPE OF SUB SOIL				SILTY CLAY										
DEPTH OF TEST				1.50M BELOW G.L..										
CONDTION OF TEST				NATURAL MOISTURE CONDITION										
SIZE OF PLA	1			30.0x 30.0SQUARE CM										
SEATING LOAD				126 KG										
							TEST 11 LOCATION NO 16							
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure(Kg/sqcm)	Initial Settlements (mm)	Final settlements(mm)	Net Settlements(mm)	Initial Settlements(mm)	Final settlements(mm)	Net Settlements(mm)	Avg Settlement(mm)	Cumulative Settlements (mm) of Plate	Settlement of actual Footing 1.0 m wide	Settlement of actual Footing 2.0 m wide	Settlement of actual Footing 3.0 m wide
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	1.45	1.45	0.00	1.30	1.30	1.38	1.38	3.25	4.16	4.55
1000.0	30.0	900.0	1.1111	1.45	2.54	1.09	1.30	3.1	1.80	1.45	2.82	6.67	8.53	9.32
2000.0	30.0	900.0	2.2222	2.54	5.14	2.60	3.10	5.25	2.15	2.38	5.20	12.30	15.71	17.17
3000.0	30.0	900.0	3.3333	5.14	9.58	4.44	5.25	8.25	3.00	3.72	8.92	21.10	26.96	29.47
4000.0	30.0	900.0	4.4444	9.58	14.26	4.68	8.25	13.25	5.00	4.84	13.76	32.56	41.60	45.47
5000.0	30.0	900.0	5.5556	14.26	17.75	3.49	13.25	18.70	5.45	4.47	18.23	43.14	55.12	60.25
6000.0	30.0	900.0	6.6667	17.75	25.10	7.35	18.70	25.35	6.65	7.00	25.23	59.70	76.29	83.39

ALLOWABLE BEARING CAPACITY		
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	18.61
1.5	2.00	14.56
1.5	3.00	13.32

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
LOCATION				SILTY CLAY										
TYPE OF SUB SOIL				PROJECT NALANDA RAJGIR										
DEPTH OF TEST				SILTY CLAY										
CONDTION OF TEST				1.50M BELOW G.L..										
SIZE OF PLATE				NATURAL MOISTURE CONDITION										
SEATING LO	1			30.0x 30.0SQUARE CM										
				126 KG										
							TEST 12 LOCATION NO 19							
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure(Kg/sqcm)	Initial Settlements (mm)	Final settlements(mm)	Net Settlements(mm)	Initial Settlements(mm)	Final settlements(mm)	Net Settlements(mm)	Avg Settlement(mm)	Cumulative Settlements (mm) of Plate	Settlement of actual Footing 1.0 m wide	Settlement of actual Footing 2.0 m wide	Settlement of actual Footing 3.0 m wide
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	8.54	8.54	0.00	8.25	8.25	8.40	8.40	19.87	25.39	27.75
1000.0	30.0	900.0	1.1111	8.54	17.58	9.04	8.25	16.54	8.29	8.67	17.06	40.38	51.60	56.40
1500.0	30.0	900.0	1.6667	17.58	25.12	7.54	16.54	25.10	8.56	8.05	25.11	59.43	75.95	83.01

ALLOWABLE BEARING CAPACITY		
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	4.67
1.5	2.00	3.66
1.5	3.00	3.35

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
LOCATION				SILTY CLAY										
TYPE OF SUB SOIL				PROJECT NALANDA RAJGIR										
DEPTH OF TEST				SILTY CLAY										
CONDTION OF TEST				1.50M BELOW G.L..										
SIZE OF PLATE				NATURAL MOISTURE CONDITION										
SEATING LO	1			30.0x 30.0SQUARE CM										
				126 KG										
							TEST 13 LOCATION NO 18							
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure(Kg/sqcm)	Initial Settlements (mm)	Final settlements(mm)	Net Settlements(mm)	Initial Settlements(mm)	Final settlements(mm)	Net Settlements(mm)	Avg Settlement(mm)	Cumulative Settlements (mm) of Plate	Settlement of actual Footing 1.0 m wide	Settlement of actual Footing 2.0 m wide	Settlement of actual Footing 3.0 m wide
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	7.45	7.45	0.00	8.12	8.12	7.79	7.79	18.43	23.55	25.74
1000.0	30.0	900.0	1.1111	7.45	15.34	7.89	8.12	16.45	8.33	8.11	15.90	37.62	48.08	52.55
1500.0	30.0	900.0	1.6667	15.34	25.40	10.06	16.45	25.30	8.85	9.46	25.35	60.00	76.67	83.80

ALLOWABLE BEARING CAPACITY		
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	4.63
1.5	2.00	3.62
1.5	3.00	3.31

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
LOCATION				SILTY CLAY										
TYPE OF SUB SOIL				PROJECT NALANDA RAJGIR										
DEPTH OF TEST				SILTY CLAY										
CONDTION OF TEST				1.50M BELOW G.L..										
SIZE OF PLATE				NATURAL MOISTURE CONDITION										
SEATING LO	1			30.0x 30.0SQUARE CM										
				126 KG										
							TEST 14 LOCATION NO 17							
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure(Kg/sqcm)	Initial Settlements (mm)	Final settlements(mm)	Net Settlements(mm)	Initial Settlements(mm)	Final settlements(mm)	Net Settlements(mm)	Avg Settlement(mm)	Cumulative Settlements (mm) of Plate	Settlement of actual Footing 1.0 m wide	Settlement of actual Footing 2.0 m wide	Settlement of actual Footing 3.0 m wide
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	12.45	12.45	0.00	11.25	11.25	11.85	11.85	28.05	35.84	39.17
1000.0	30.0	900.0	1.1111	12.45	25.12	12.67	11.25	25.35	14.10	13.39	25.24	59.73	76.33	83.42

ALLOWABLE BEARING CAPACITY		
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	3.10
1.5	2.00	2.43
1.5	3.00	2.22

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
LOCATION				SILTY CLAY										
TYPE OF SUB SOIL				PROJECT NALANDA RAJGIR										
DEPTH OF TEST				SILTY CLAY										
CONDTION OF TEST				1.50M BELOW G.L..										
SIZE OF PLATE				NATURAL MOISTURE CONDITION										
SEATING LO	1			30.0x 30.0SQUARE CM										
				126 KG										
							TEST 15 LOCATION NO 2.							
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure(Kg/sqcm)	Initial Settlements (mm)	Final settlements(mm)	Net Settlements(mm)	Initial Settlements(mm)	Final settlements(mm)	Net Settlements(mm)	Avg Settlement(mm)	Cumulative Settlements (mm) of Plate	Settlement of actual Footing 1.0 m wide	Settlement of actual Footing 2.0 m wide	Settlement of actual Footing 3.0 m wide
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	1.45	1.45	0.00	1.55	1.55	1.50	1.50	3.55	4.54	4.96
1000.0	30.0	900.0	1.1111	1.45	4.57	3.12	1.55	4.75	3.20	3.16	4.66	11.03	14.09	15.40
1500.0	30.0	900.0	1.6667	4.57	12.90	8.33	4.75	14.27	9.52	8.93	13.59	32.15	41.09	44.91
2000.0	30.0	900.0	2.2222	12.90	25.10	12.20	14.27	25.32	11.05	11.63	25.21	59.67	76.25	83.34

ALLOWABLE BEARING CAPACITY		
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	6.21
1.5	2.00	4.86
1.5	3.00	4.44

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
LOCATION				SILTY CLAY										
TYPE OF SUB SOIL				PROJECT NALANDA RAJGIR										
DEPTH OF TEST				SILTY CLAY										
CONDTION OF TEST				1.50M BELOW G.L..										
SIZE OF PLATE				NATURAL MOISTURE CONDITION										
SEATING LO	1			30.0x 30.0SQUARE CM										
				126 KG										
							TEST 16 LOCATION NO 1							
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure(Kg/sqcm)	Initial Settlements (mm)	Final settlements(mm)	Net Settlements(mm)	Initial Settlements(mm)	Final settlements(mm)	Net Settlements(mm)	Avg Settlement(mm)	Cumulative Settlements (mm) of Plate	Settlement of actual Footing 1.0 m wide	Settlement of actual Footing 2.0 m wide	Settlement of actual Footing 3.0 m wide
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	1.60	1.60	0.00	1.63	1.63	1.62	1.62	3.82	4.88	5.34
1000.0	30.0	900.0	1.1111	1.60	4.51	1.34	1.63	4.25	2.62	1.98	3.60	8.51	10.87	11.88
2000.0	30.0	900.0	2.2222	4.51	9.50	4.99	4.25	9.45	5.20	5.10	8.69	20.57	26.28	28.73
3000.0	30.0	900.0	3.3333	9.50	16.45	6.95	9.45	16.20	6.75	6.85	15.54	36.78	47.00	51.37
4000.0	30.0	900.0	4.4444	16.45	22.70	6.25	16.20	23.18	6.98	6.62	22.16	52.44	67.01	73.24
4500.0	30.0	900.0	5.0000	22.70	25.15	2.45	23.18	25.40	2.22	2.34	24.49	57.96	74.07	80.96

ALLOWABLE BEARING CAPACITY		
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	14.38
1.5	2.00	11.25
1.5	3.00	10.29

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
LOCATION				SILTY CLAY										
TYPE OF SUB SOIL				PROJECT NALANDA RAJGIR										
DEPTH OF TEST				SILTY CLAY										
CONDTION OF TEST				1.50M BELOW G.L..										
SIZE OF PLATE				NATURAL MOISTURE CONDITION										
SEATING LO	1			30.0x 30.0SQUARE CM										
				126 KG										
							TEST 17 LOCATION NO 11							
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure(Kg/sqcm)	Initial Settlements (mm)	Final settlements(mm)	Net Settlements(mm)	Initial Settlements(mm)	Final settlements(mm)	Net Settlements(mm)	Avg Settlement(mm)	Cumulative Settlements (mm) of Plate	Settlement of actual Footing 1.0 m wide	Settlement of actual Footing 2.0 m wide	Settlement of actual Footing 3.0 m wide
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	3.25	3.25	0.00	3.45	3.45	3.35	3.35	7.93	10.13	11.07
1000.0	30.0	900.0	1.1111	3.25	7.12	3.87	3.45	6.52	3.07	3.47	6.82	16.14	20.63	22.55
2000.0	30.0	900.0	2.2222	7.12	12.60	5.48	6.52	12.47	5.95	5.72	12.54	29.67	37.91	41.44
3000.0	30.0	900.0	3.3333	12.60	18.25	5.65	12.47	18.05	5.58	5.62	18.15	42.96	54.90	60.00
4000.0	30.0	900.0	4.4444	18.25	25.32	7.07	18.05	25.15	7.10	7.09	25.24	59.73	76.33	83.42

ALLOWABLE BEARING CAPACITY		
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	12.40
1.5	2.00	9.71
1.5	3.00	8.88

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
LOCATION				SILTY CLAY										
TYPE OF SUB SOIL				PROJECT NALANDA RAJGIR										
DEPTH OF TEST				SILTY CLAY										
CONDTION OF TEST				1.50M BELOW G.L..										
SIZE OF PLATE				NATURAL MOISTURE CONDITION										
SEATING LO	1			30.0x 30.0SQUARE CM										
				126 KG										
							TEST 18 LOCATION NO 10							
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure(Kg/sqcm)	Initial Settlements (mm)	Final settlements(mm)	Net Settlements(mm)	Initial Settlements(mm)	Final settlements(mm)	Net Settlements(mm)	Avg Settlement(mm)	Cumulative Settlements (mm) of Plate	Settlement of actual Footing 1.0 m wide	Settlement of actual Footing 2.0 m wide	Settlement of actual Footing 3.0 m wide
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	3.42	3.42	0.00	3.90	3.90	3.66	3.66	8.66	11.07	12.10
1000.0	30.0	900.0	1.1111	3.42	6.90	3.48	3.90	7.7	3.80	3.64	7.30	17.28	22.08	24.13
1500.0	30.0	900.0	1.6667	6.90	12.55	5.65	7.70	12.85	5.15	5.40	12.70	30.06	38.41	41.98
2000.0	30.0	900.0	2.2222	12.55	18.54	5.99	12.85	18.24	5.39	5.69	18.39	43.53	55.62	60.79
2500.0	30.0	900.0	2.7778	18.54	25.32	6.78	18.24	25.15	6.91	6.85	25.24	59.73	76.33	83.42

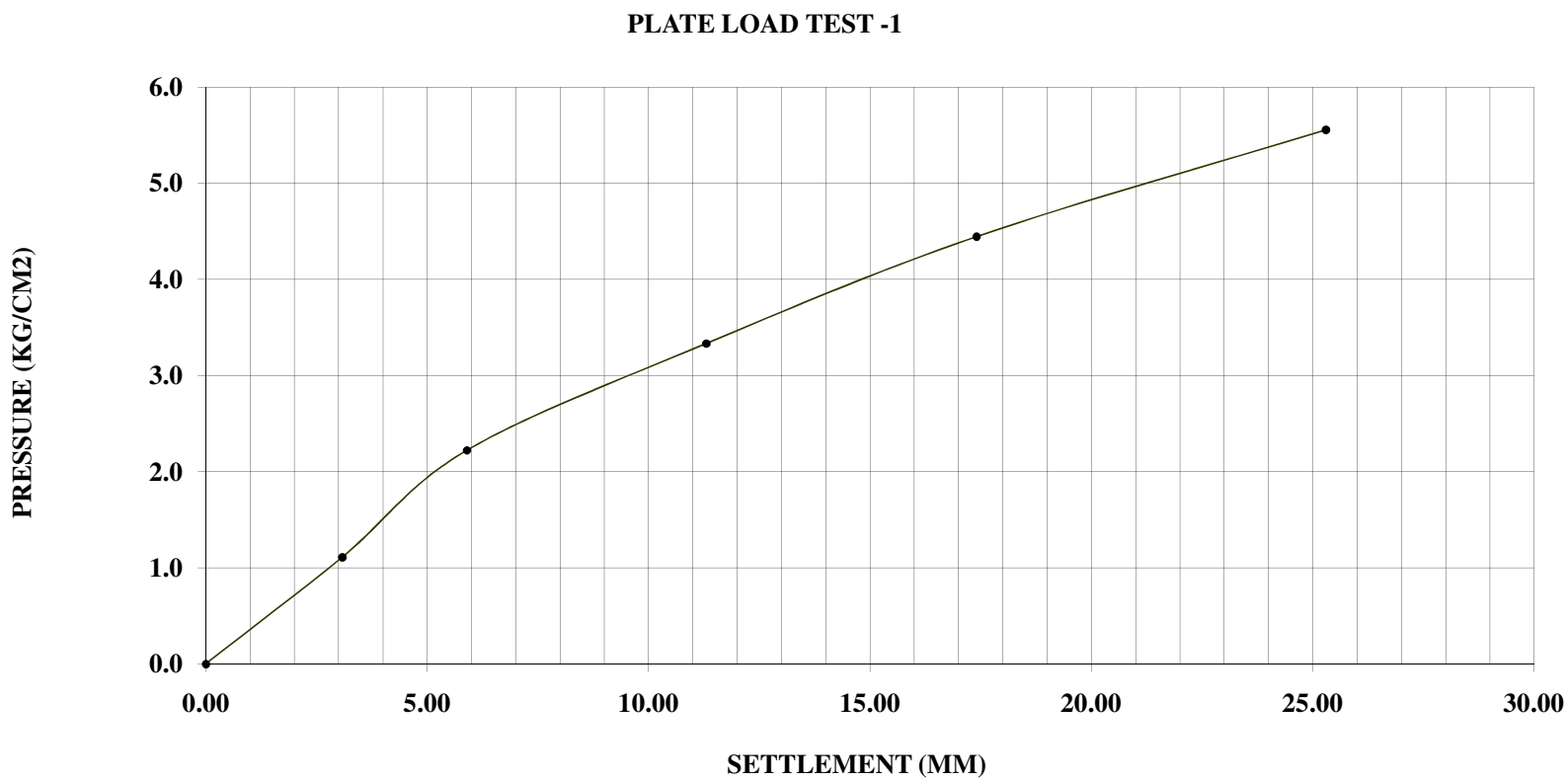
ALLOWABLE BEARING CAPACITY		
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	7.75
1.5	2.00	6.07
1.5	3.00	5.55

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
LOCATION				SILTY CLAY										
TYPE OF SUB SOIL				PROJECT NALANDA RAJGIR										
DEPTH OF TEST				SILTY CLAY										
CONDTION OF TEST				1.50M BELOW G.L..										
SIZE OF PLATE				NATURAL MOISTURE CONDITION										
SEATING LO	1			30.0x 30.0SQUARE CM										
				126 KG										
							TEST 19 LOCATION NO 7							
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure(Kg/sqcm)	Initial Settlements (mm)	Final settlements(mm)	Net Settlements(mm)	Initial Settlements(mm)	Final settlements(mm)	Net Settlements(mm)	Avg Settlement(mm)	Cumulative Settlements (mm) of Plate	Settlement of actual Footing 1.0 m wide	Settlement of actual Footing 2.0 m wide	Settlement of actual Footing 3.0 m wide
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	4.25	4.25	0.00	4.58	4.58	4.42	4.42	10.45	13.35	14.60
1000.0	30.0	900.0	1.1111	4.25	9.45	5.20	4.58	9.6	5.02	5.11	9.53	22.54	28.81	31.49
1500.0	30.0	900.0	1.6667	9.45	14.85	5.40	9.60	15.30	5.70	5.55	15.08	35.68	45.60	49.83
2000.0	30.0	900.0	2.2222	14.85	25.10	10.25	15.30	25.30	10.00	10.13	25.20	59.64	76.22	83.31

ALLOWABLE BEARING CAPACITY				MODULUD OF SUBGRADE REACTION Kg/cm3							
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM		PLATE SIZE CM	Pressure (Kg/sqcm) at 1.25 mm Settlement	Final settlements(mm)	Un corrected MODULUS OF SUBGRADE REACTION (K) (Kg/cm3) (As Per Corrected Load Settlement Curve)	CORRECTION FOR PLATE SIZE EQ. 75.0 CM K VALUES as per clause 5.1.1 Fig 3	CORRECTION FOR LOAD DEFLECTION CURVE AS PER 5.1.2	CORRECTION FOR BENDING OF PLATE AS PER 5.1.3	CORRECTION FOR SATURATION as per IS 9214-1979 clauses 5.1.4.1 to 5.1.4.4
		ISOLATED SQUARE/STRIP FOOTING		30.0	0.220	0.125	1.76	0.70	-	0.70	0.63
1.5	1.00	6.21									
1.5	2.00	4.86									
1.5	3.00	4.45									

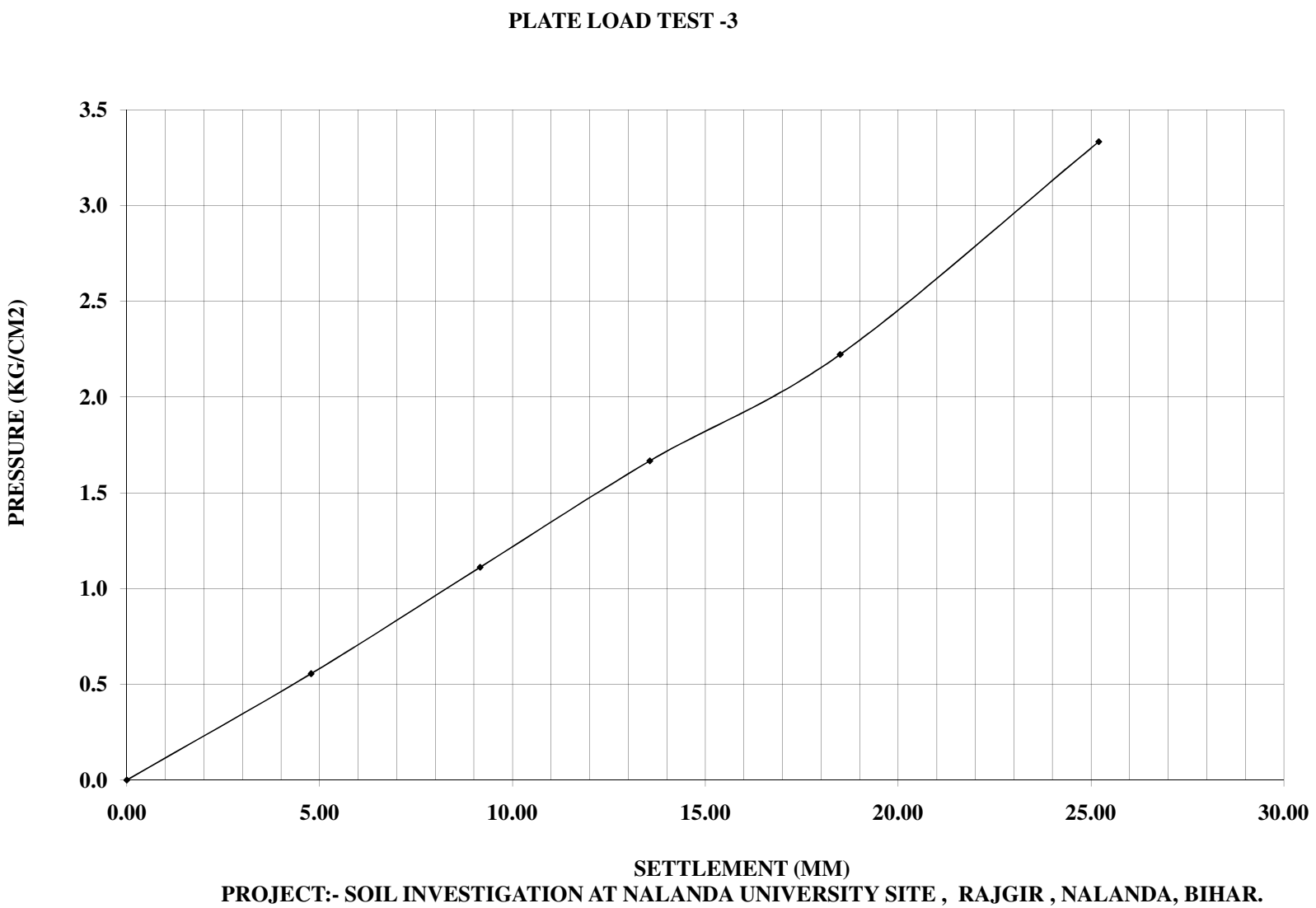
OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
LOCATION				1.50M BELOW G.L..										
TYPE OF SUB SOIL				PROJECT NALANDA RAJGIR										
DEPTH OF TEST				SILTY CLAY										
CONDTION OF TEST				1.50M BELOW G.L..										
SIZE OF PLATE				NATURAL MOISTURE CONDITION										
SEATING LO	1			30.0x 30.0SQUARE CM										
				126 KG										
							TEST 20 LOCATION NO 20							
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure(Kg/sqcm)	Initial Settlements (mm)	Final settlements(mm)	Net Settlements(mm)	Initial Settlements(mm)	Final settlements(mm)	Net Settlements(mm)	Avg Settlement(mm)	Cumulative Settlements (mm) of Plate	Settlement of actual Footing 1.0 m wide	Settlement of actual Footing 2.0 m wide	Settlement of actual Footing 3.0 m wide
0.0	30.0	900.0	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500.0	30.0	900.0	0.5556	0.00	7.85	7.85	0.00	7.97	7.97	7.91	7.91	18.72	23.92	26.15
1000.0	30.0	900.0	1.1111	7.85	13.92	6.07	7.97	14.25	6.28	6.18	14.09	33.34	42.60	46.56
2000.0	30.0	900.0	2.2222	13.92	25.13	11.21	14.25	25.40	11.15	11.18	25.27	59.80	76.42	83.52

ALLOWABLE BEARING CAPACITY				MODULUD OF SUBGRADE REACTION Kg/cm3							
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM		PLATE SIZE CM	Pressure (Kg/sqcm) at 1.25 mm Settlement	Final settlements(mm)	Un corrected MODULUS OF SUBGRADE REACTION (K) (Kg/cm3) (As Per Corrected Load Settlement Curve)	CORRECTION FOR PLATE SIZE EQ. 75.0 CM K VALUES as per clause 5.1.1 Fig 3	CORRECTION FOR LOAD DEFLECTION CURVE AS PER 5.1.2	CORRECTION FOR BENDING OF PLATE AS PER 5.1.3	CORRECTION FOR SATURATION as per IS 9214-1979 clauses 5.1.4.1 to 5.1.4.4
		ISOLATED SQUARE/STRIP FOOTING		30.0	0.210	0.125	1.68	0.67	-	0.67	0.60
1.5	1.00	6.19									
1.5	2.00	4.85									
1.5	3.00	4.43									

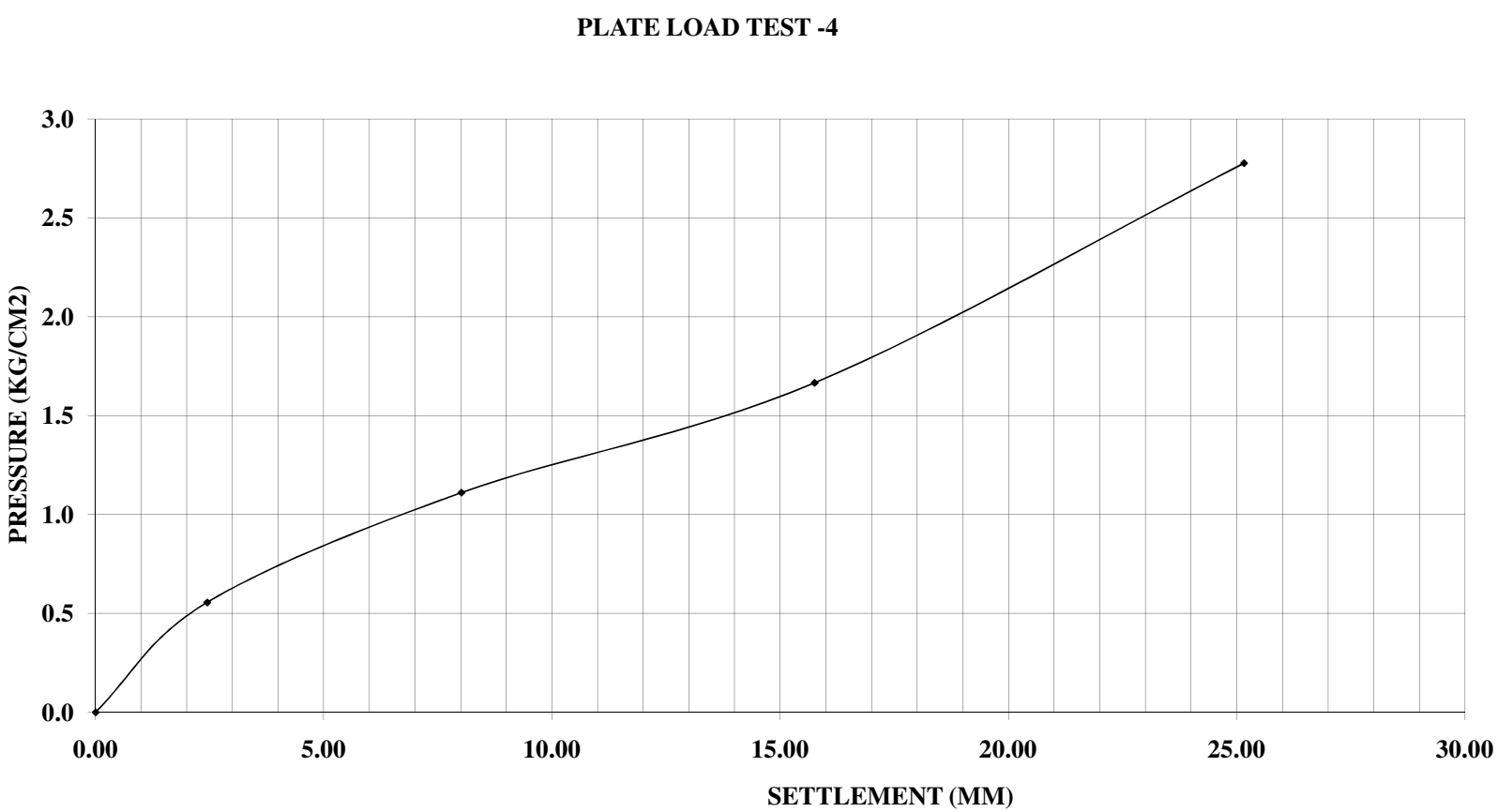


PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR ,NALANDA, BIHAR., DELHI.

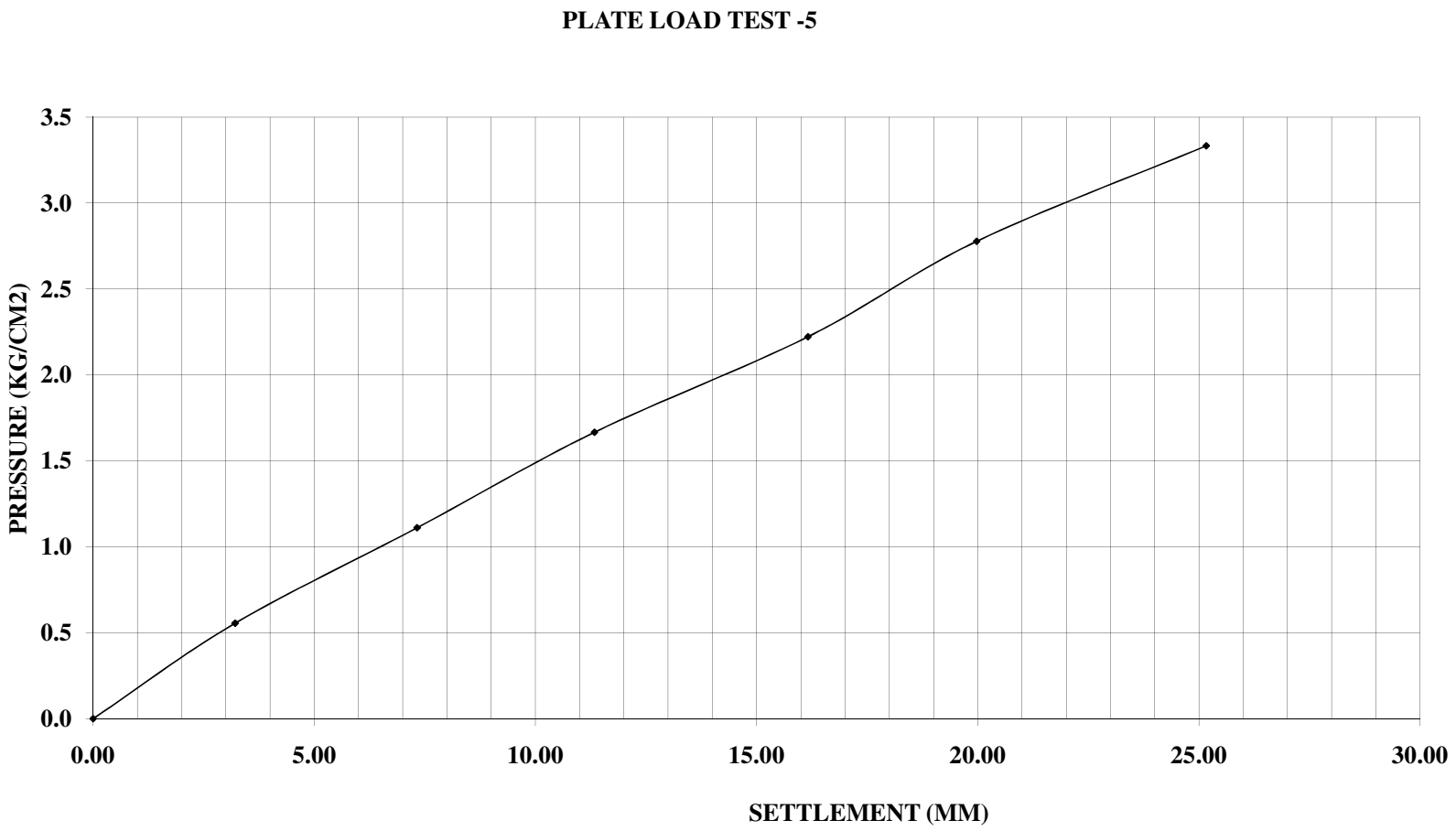
PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.



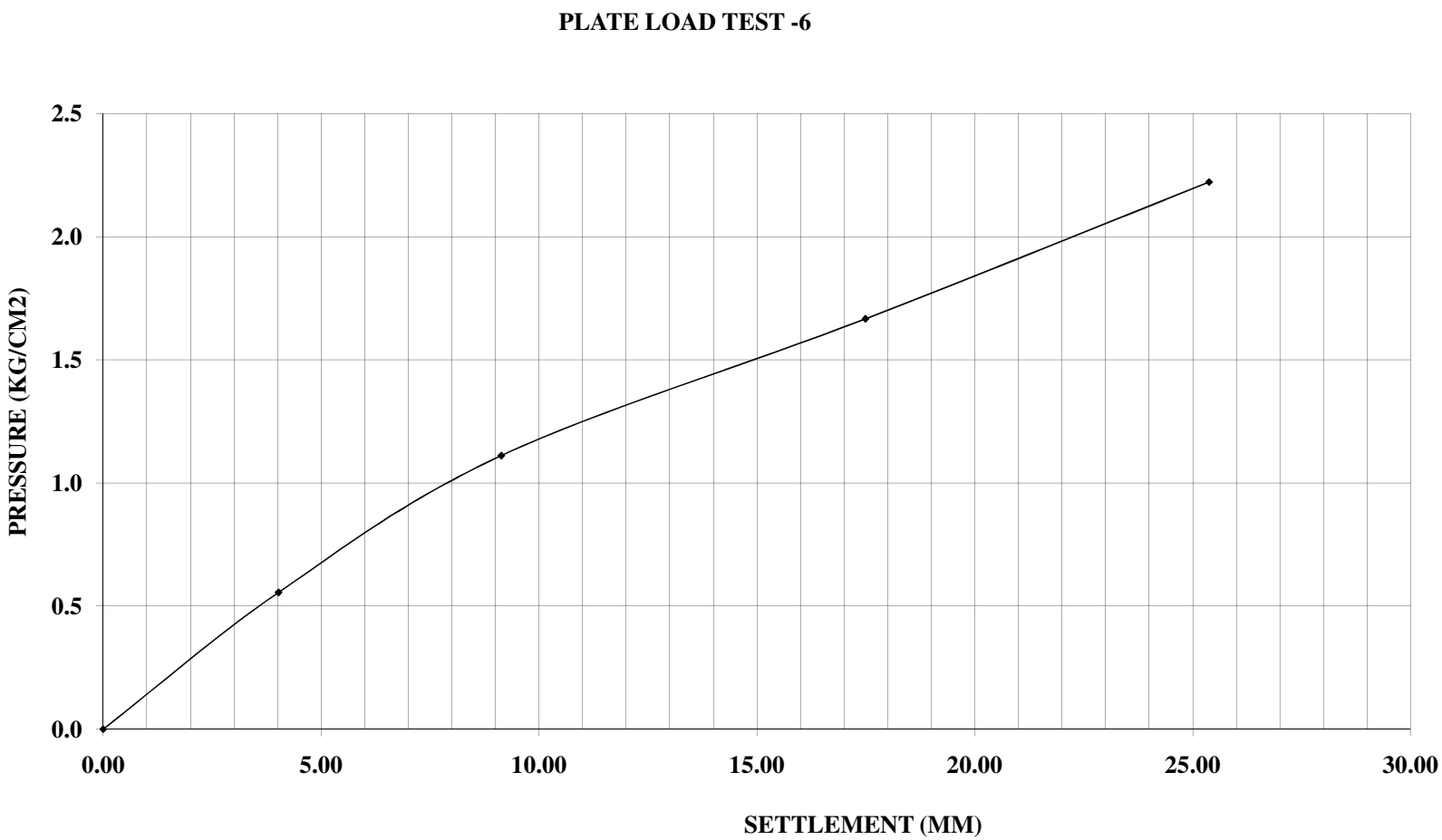
PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.



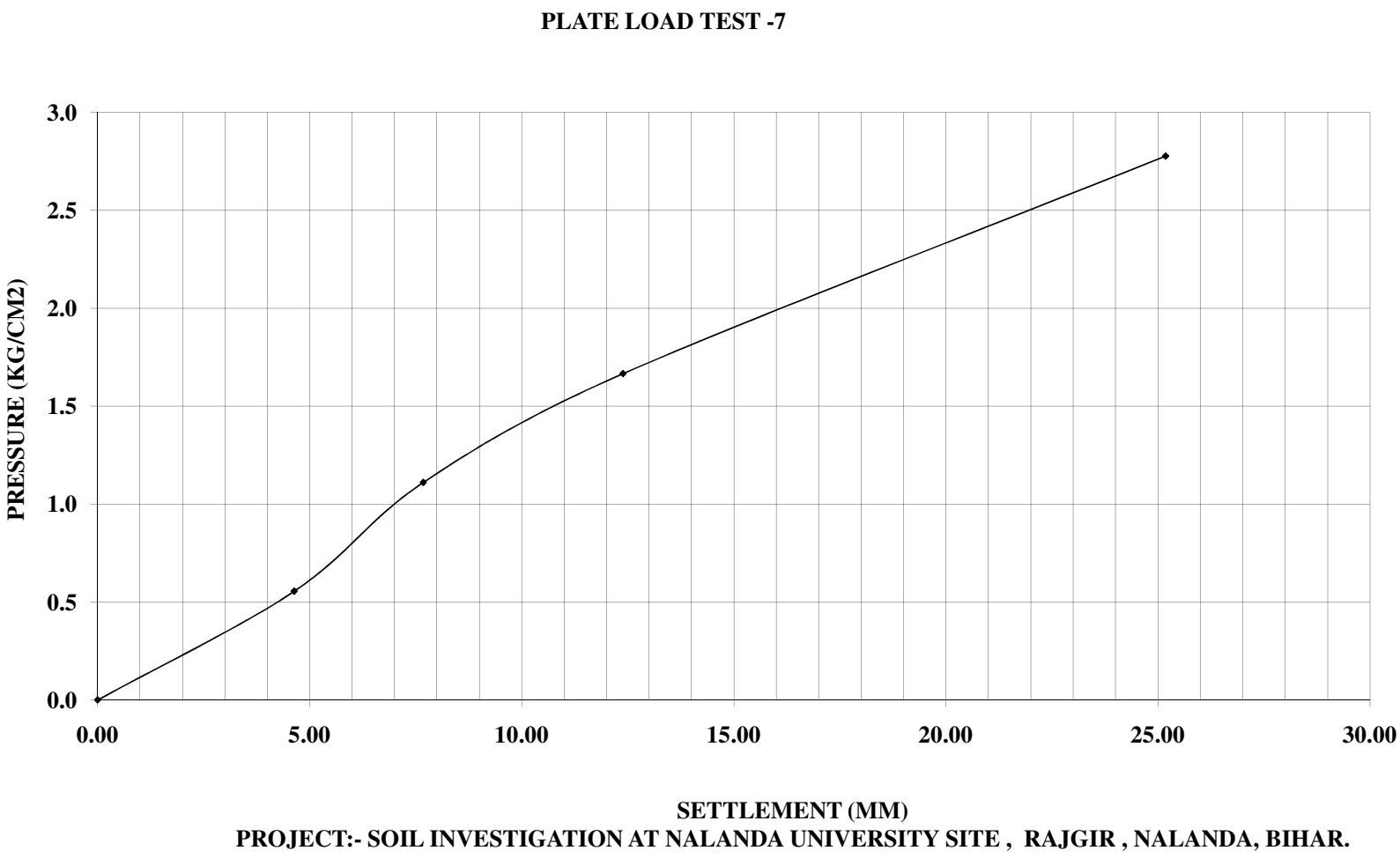
PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.



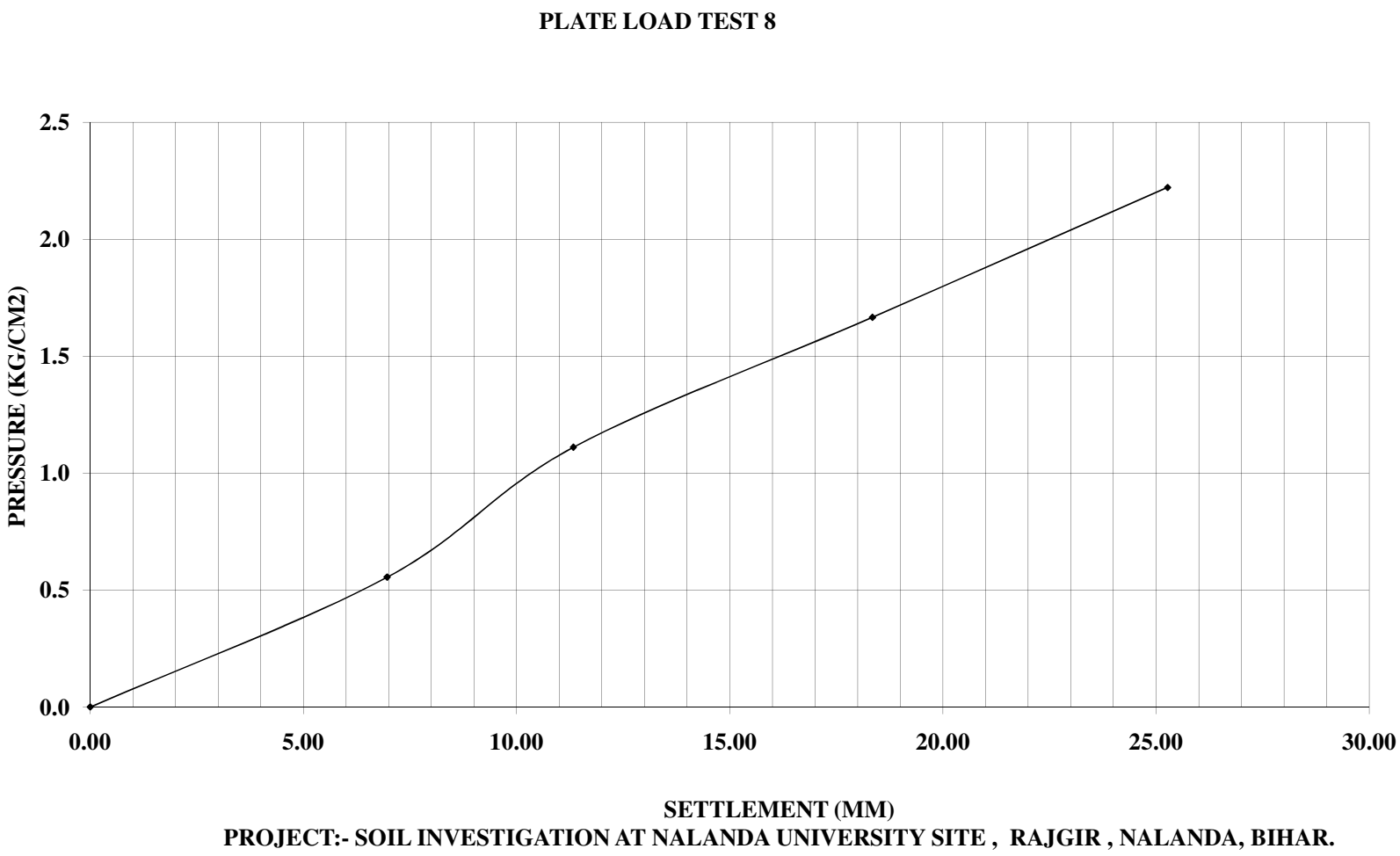
PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.



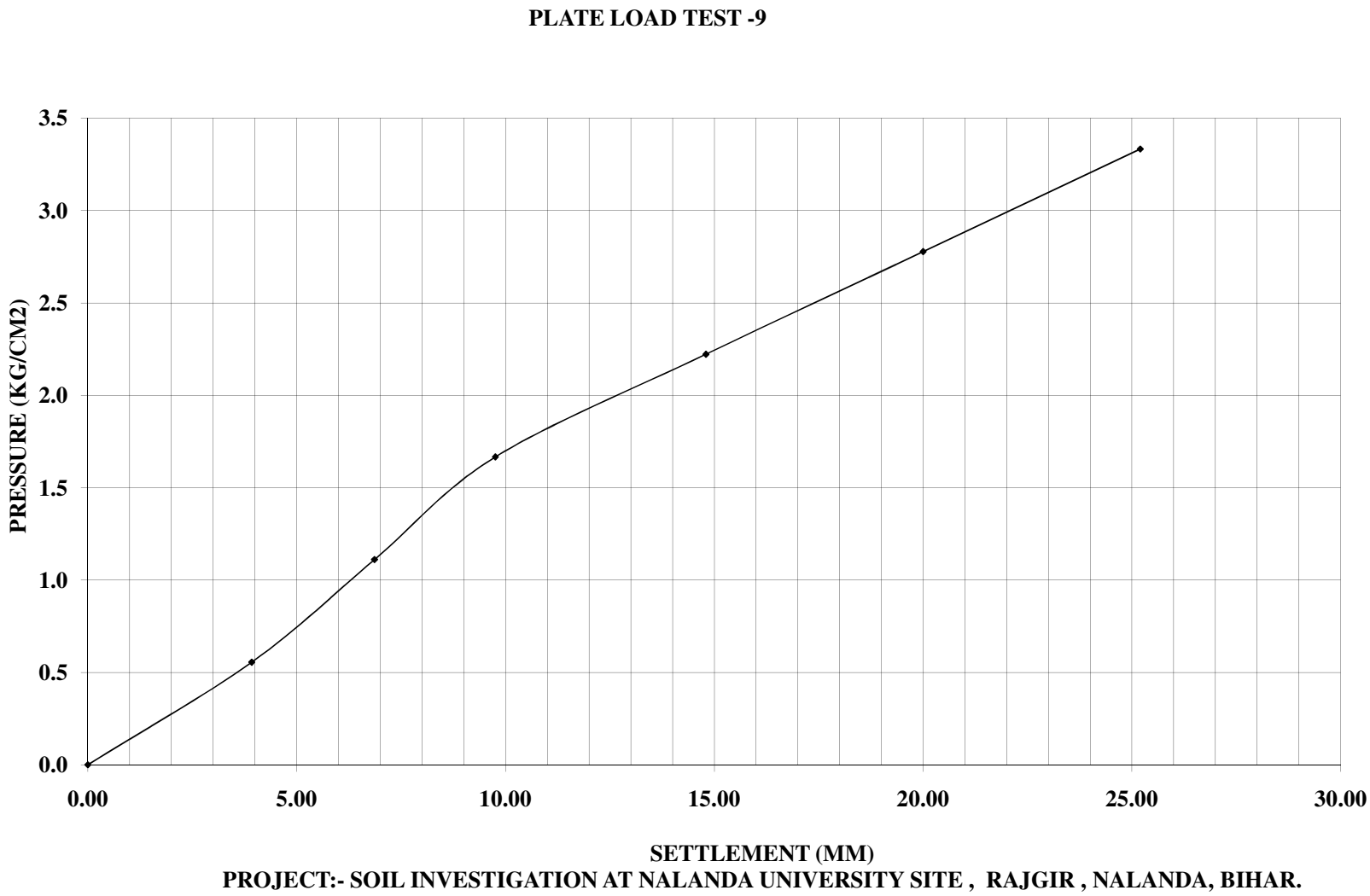
PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR..



PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.

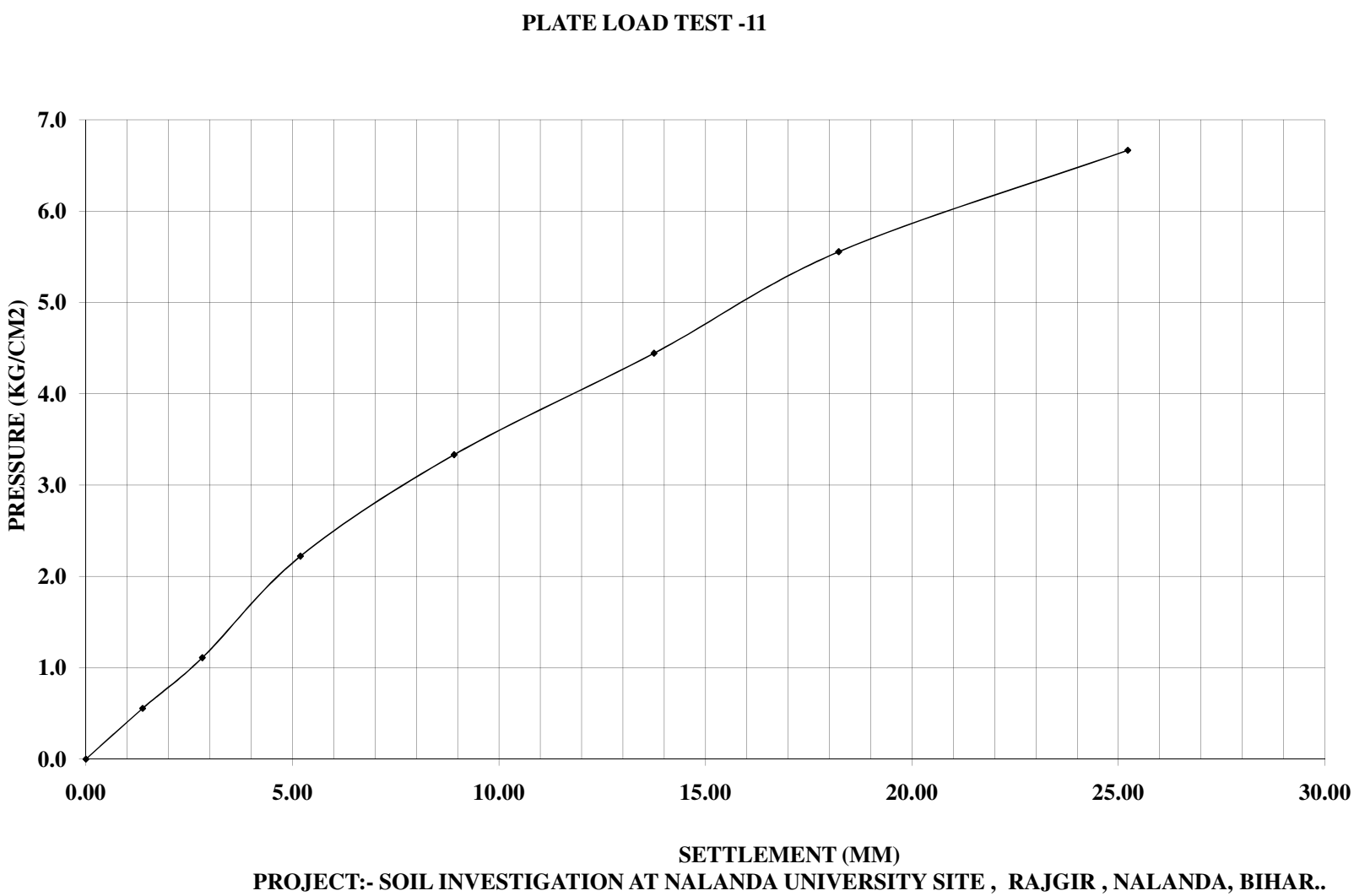


PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.

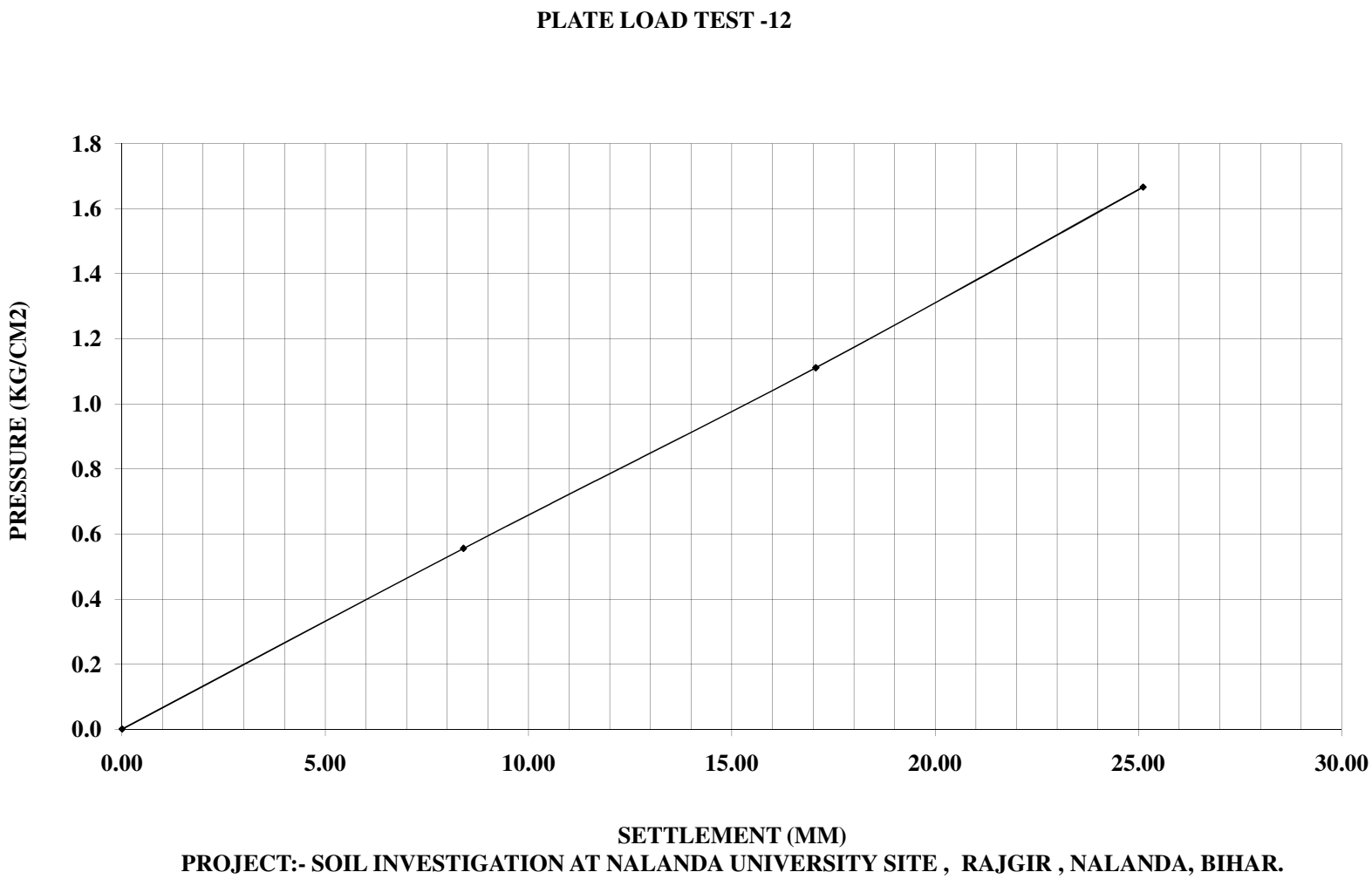


PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.

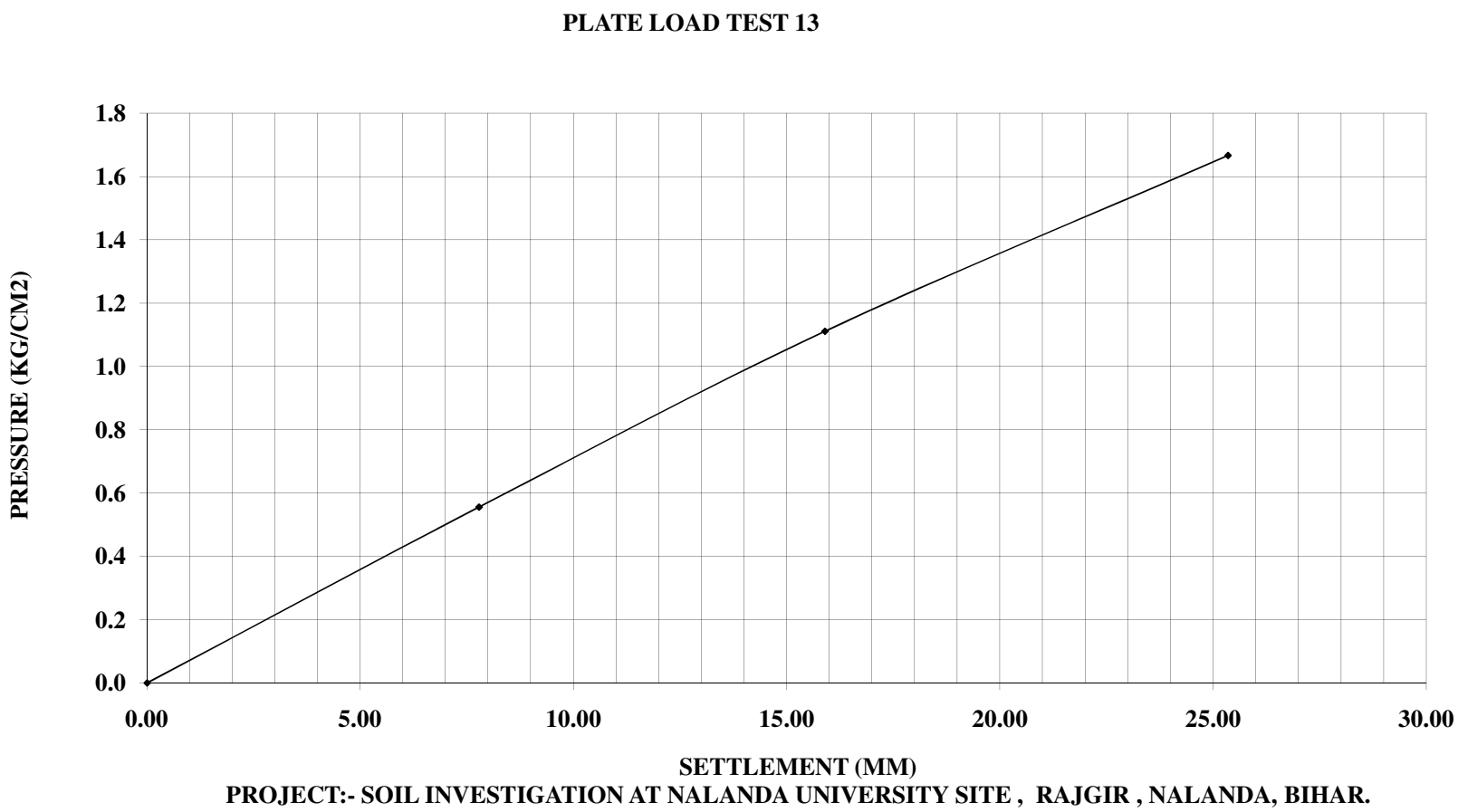
PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR..



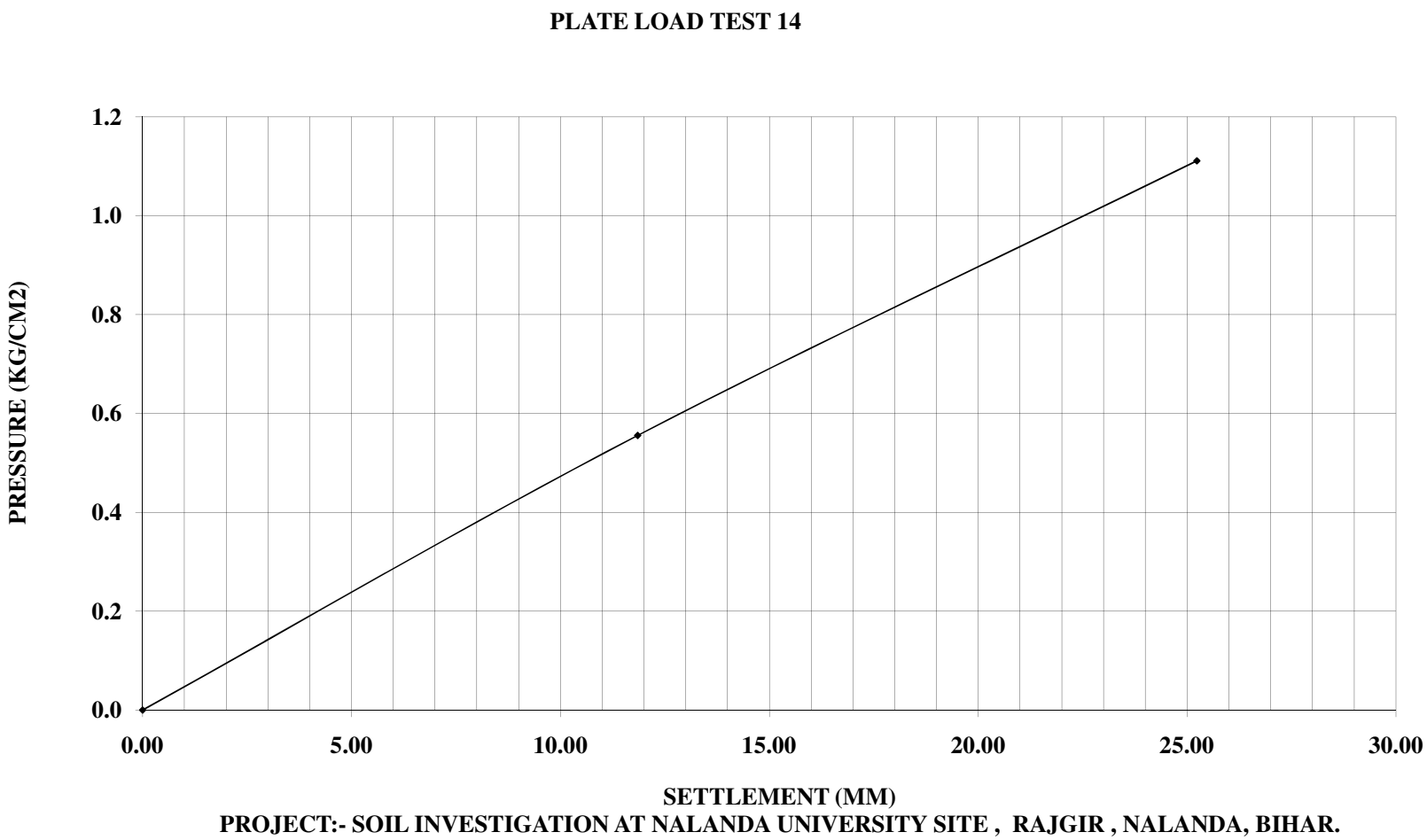
PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR..



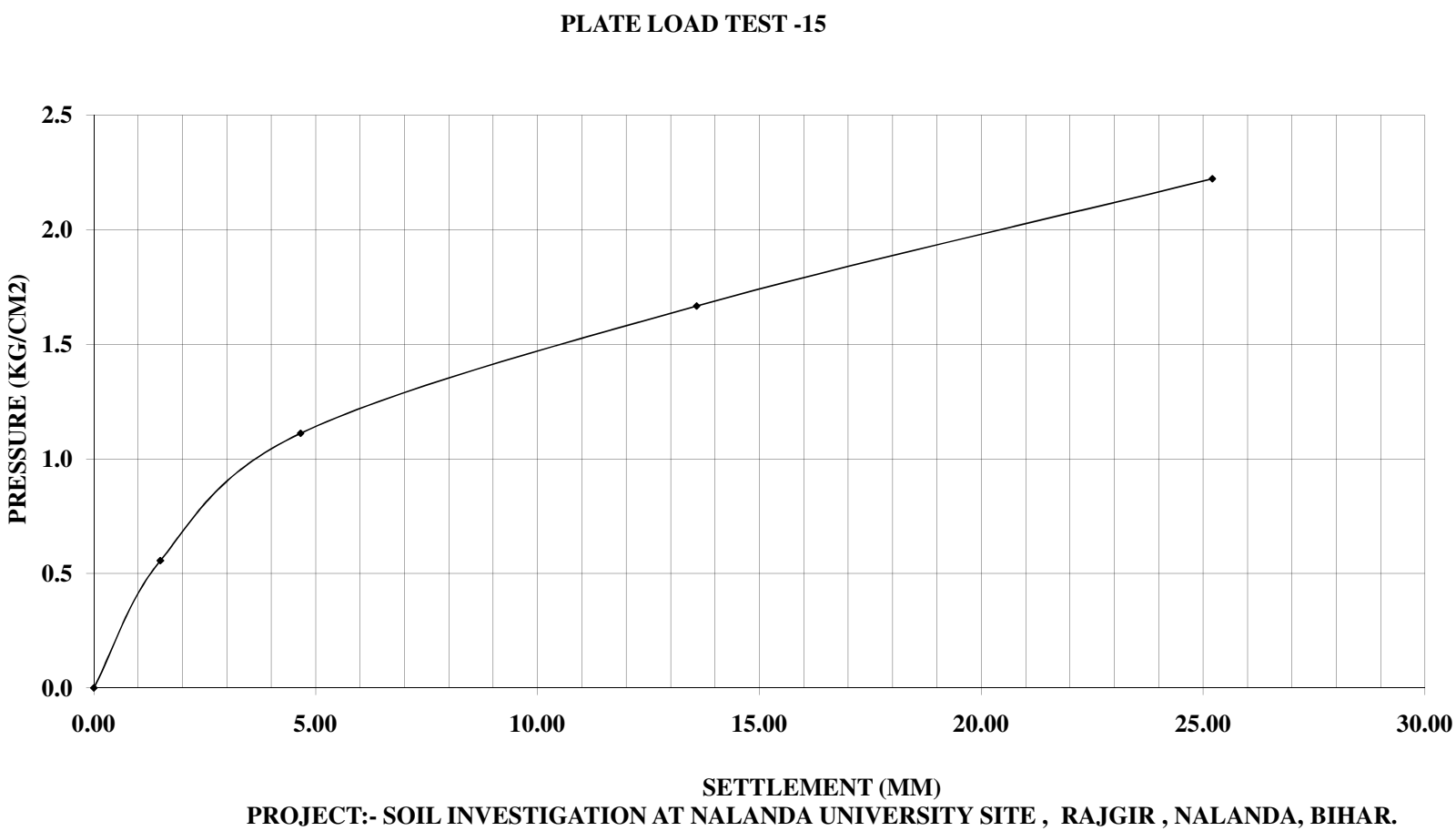
PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.



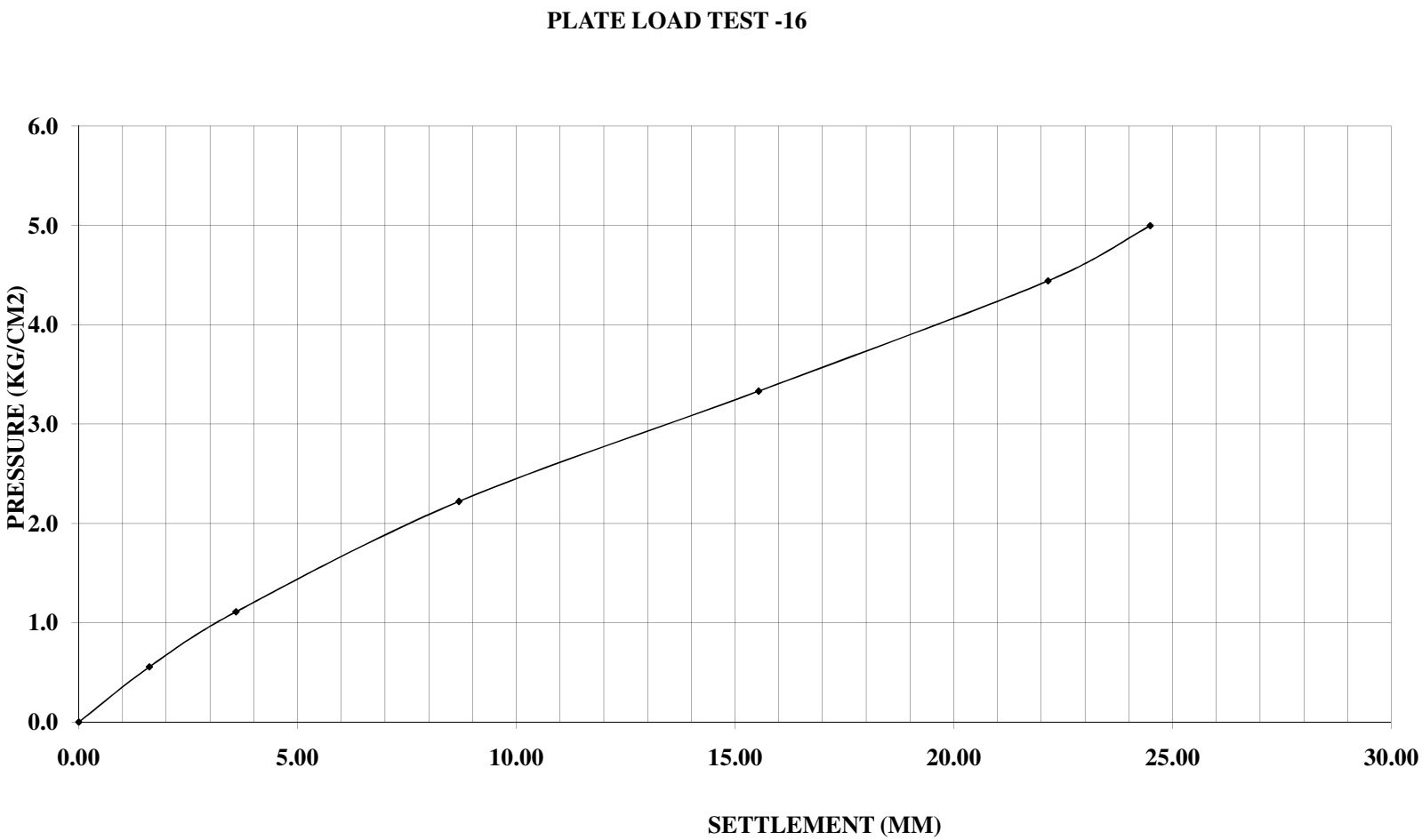
PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.



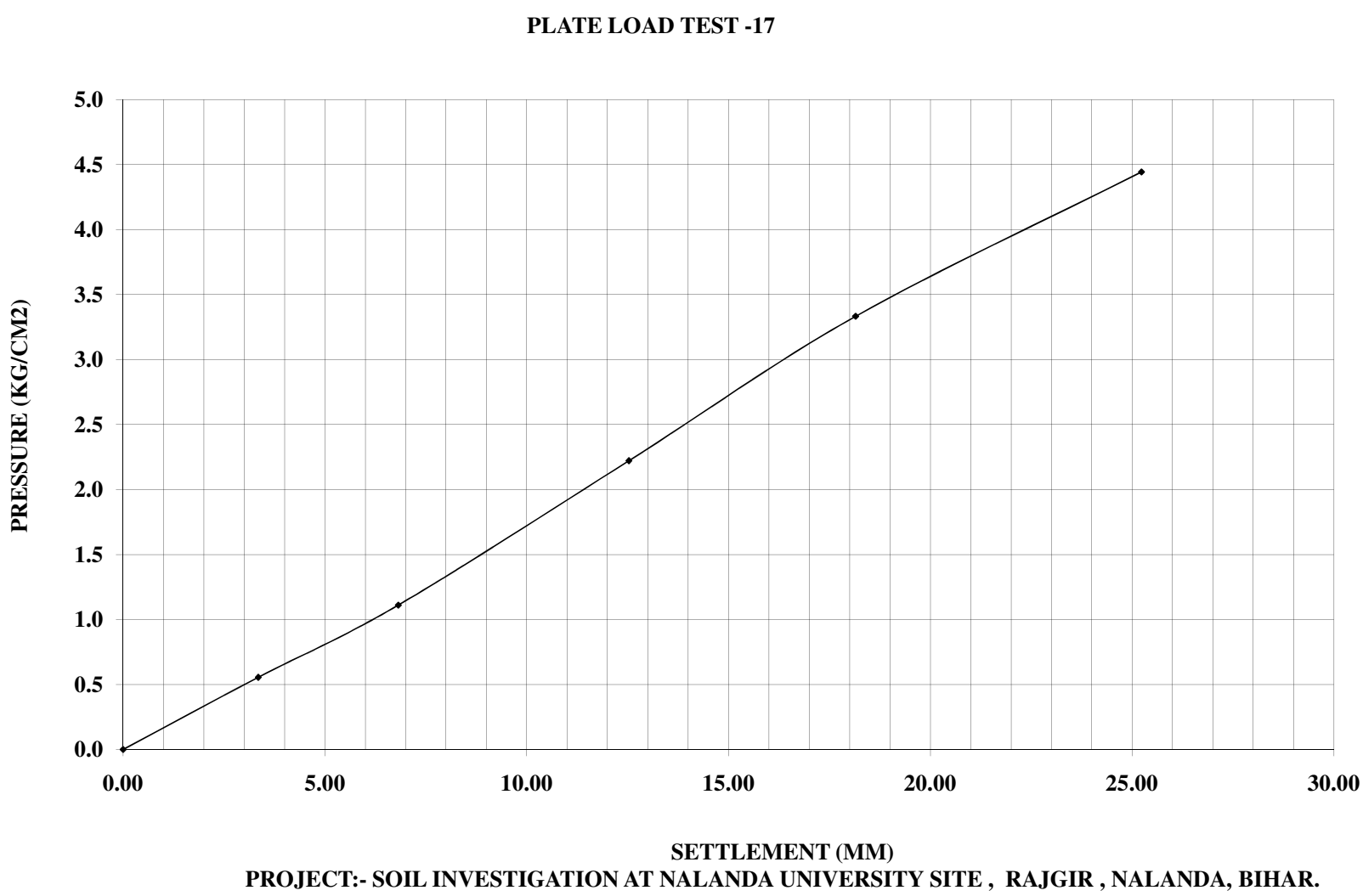
PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.



PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.



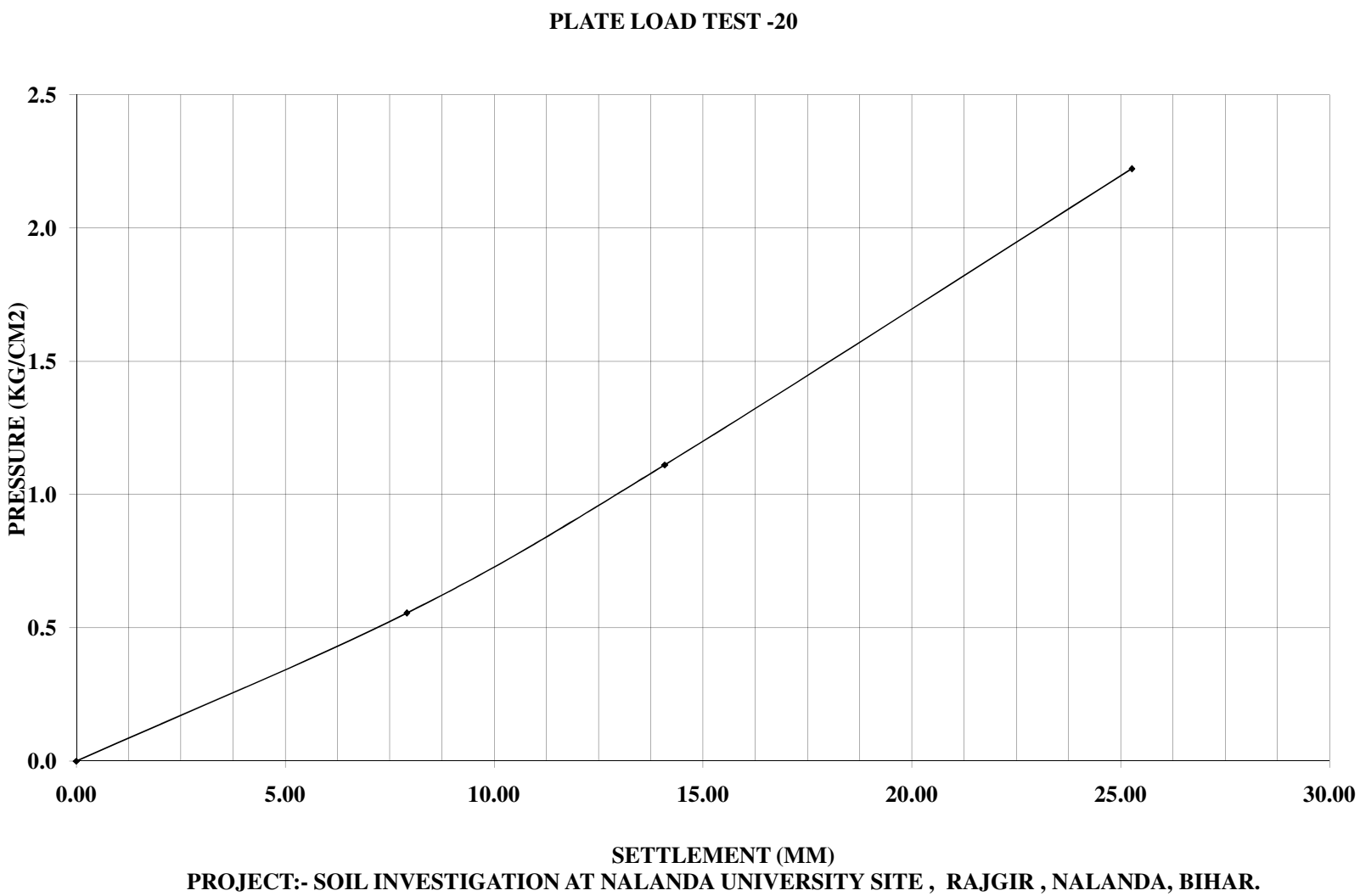
PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.



PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.

PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.

PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.



PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

Liquid Limit	**34.62**		**MDD**	**1.895**	Gm/cc	
Plastic Limit	**20.15**		**OMC**	**24.32**	**%**	
Plasticity Index	**14.47**		**NMC**	**18.97**	**%**	
CBR NO- 1						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**21.854**
1.0	0	0	0		**1.000**	**38.411**
2.0	0.5	3.3	21.85		**1.500**	**52.980**
3.0	1	5.8	38.41		**2.000**	**67.550**
4.0	1.5	8	52.98		**2.500**	**76.159**
5.0	2	10.2	67.55		**3.000**	**81.457**
6.0	2.5	11.5	76.16	**5.56**	**4.000**	**91.391**
7.0	3	12.3	81.46		**5.000**	**96.689**
8.0	4	13.8	91.39		**7.500**	**105.960**
9.0	5	14.6	96.69	**4.71**	**10.000**	**113.907**
10.0	7.5	16	105.96		**12.500**	**118.543**
11.0	10	17.2	113.91			
12.0	12.5	17.9	118.54			

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

Liquid Limit	**33.68**		**MDD**	**1.856**	Gm/cc	
Plastic Limit	**20.64**		**OMC**	**23.04**	**%**	
Plasticity Index	**13.04**		**NMC**	**19.01**	**%**	
CBR NO- 2						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**18.543**
1.0	0	0	0		**1.000**	**35.099**
2.0	0.5	2.8	18.54		**1.500**	**50.199**
3.0	1	5.3	35.10		**2.000**	**60.265**
4.0	1.5	7.58	50.20		**2.500**	**72.185**
5.0	2	9.1	60.26		**3.000**	**76.821**
6.0	2.5	10.9	72.19	**5.27**	**4.000**	**82.119**
7.0	3	11.6	76.82		**5.000**	**87.417**
8.0	4	12.4	82.12		**7.500**	**92.715**
9.0	5	13.2	87.42	**4.25**	**10.000**	**99.338**
10.0	7.5	14	92.72		**12.500**	**101.987**
11.0	10	15	99.34			
12.0	12.5	15.4	101.99			

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

Liquid Limit	**33.76**		**MDD**	**1.85**	Gm/cc	
Plastic Limit	**20.13**		**OMC**	**23.11**	**%**	
Plasticity Index	**13.63**		**NMC**	**19.06**	**%**	
CBR NO- 3						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**20.530**
1.0	0	0	0		**1.000**	**37.748**
2.0	0.5	3.1	20.53		**1.500**	**52.980**
3.0	1	5.7	37.75		**2.000**	**64.238**
4.0	1.5	8	52.98		**2.500**	**72.848**
5.0	2	9.7	64.24		**3.000**	**80.132**
6.0	2.5	11	72.85	**5.32**	**4.000**	**91.391**
7.0	3	12.1	80.13		**5.000**	**96.689**
8.0	4	13.8	91.39		**7.500**	**107.947**
9.0	5	14.6	96.69	**4.71**	**10.000**	**115.232**
10.0	7.5	16.3	107.95		**12.500**	**123.179**
11.0	10	17.4	115.23			
12.0	12.5	18.6	123.18			

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

Liquid Limit	**33.25**		**MDD**	**1.842**	Gm/cc	
Plastic Limit	**20.39**		**OMC**	**23.1**	**%**	
Plasticity Index	**12.86**		**NMC**	**18.62**	**%**	
CBR NO- 4						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**19.205**
1.0	0	0	0		**1.000**	**31.788**
2.0	0.5	2.9	19.21		**1.500**	**45.695**
3.0	1	4.8	31.79		**2.000**	**55.828**
4.0	1.5	6.9	45.70		**2.500**	**67.550**
5.0	2	8.43	55.83		**3.000**	**76.821**
6.0	2.5	10.2	67.55	**4.93**	**4.000**	**84.768**
7.0	3	11.6	76.82		**5.000**	**88.742**
8.0	4	12.8	84.77		**7.500**	**92.715**
9.0	5	13.4	88.74	**4.32**	**10.000**	**94.040**
10.0	7.5	14	92.72		**12.500**	**94.702**
11.0	10	14.2	94.04			
12.0	12.5	14.3	94.70			

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

Liquid Limit	**33.74**		**MDD**	**1.849**	Gm/cc	
Plastic Limit	**21.05**		**OMC**	**23.14**	**%**	
Plasticity Index	**12.69**		**NMC**	**19.23**	**%**	
CBR NO- 5						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**19.205**
1.0	0	0	0		**1.000**	**35.762**
2.0	0.5	2.9	19.21		**1.500**	**49.007**
3.0	1	5.4	35.76		**2.000**	**59.603**
4.0	1.5	7.4	49.01		**2.500**	**71.523**
5.0	2	9	59.60		**3.000**	**77.483**
6.0	2.5	10.8	71.52	**5.22**	**4.000**	**86.225**
7.0	3	11.7	77.48		**5.000**	**94.040**
8.0	4	13.02	86.23		**7.500**	**106.623**
9.0	5	14.2	94.04	**4.58**	**10.000**	**113.907**
10.0	7.5	16.1	106.62		**12.500**	**121.192**
11.0	10	17.2	113.91			
12.0	12.5	18.3	121.19			

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

Liquid Limit	**32.69**		**MDD**	**1.862**	Gm/cc	
Plastic Limit	**20.01**		**OMC**	**24.33**	**%**	
Plasticity Index	**12.68**		**NMC**	**11.1**	**%**	
CBR NO- 6						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**21.192**
1.0	0	0	0		**1.000**	**38.411**
2.0	0.5	3.2	21.19		**1.500**	**52.318**
3.0	1	5.8	38.41		**2.000**	**64.901**
4.0	1.5	7.9	52.32		**2.500**	**73.510**
5.0	2	9.8	64.90		**3.000**	**78.808**
6.0	2.5	11.1	73.51	**5.37**	**4.000**	**86.424**
7.0	3	11.9	78.81		**5.000**	**96.026**
8.0	4	13.05	86.42		**7.500**	**109.272**
9.0	5	14.5	96.03	**4.67**	**10.000**	**118.543**
10.0	7.5	16.5	109.27		**12.500**	**123.841**
11.0	10	17.9	118.54			
12.0	12.5	18.7	123.84			

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

Liquid Limit	**32.62**		**MDD**	**1.819**	Gm/cc	
Plastic Limit	**20.1**		**OMC**	**24.33**	**%**	
Plasticity Index	**12.52**		**NMC**	**18.65**	**%**	
CBR NO- 7						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**17.219**
1.0	0	0	0		**1.000**	**33.775**
2.0	0.5	2.6	17.22		**1.500**	**49.669**
3.0	1	5.1	33.77		**2.000**	**58.940**
4.0	1.5	7.5	49.67		**2.500**	**70.861**
5.0	2	8.9	58.94		**3.000**	**77.483**
6.0	2.5	10.7	70.86	**5.17**	**4.000**	**87.417**
7.0	3	11.7	77.48		**5.000**	**96.689**
8.0	4	13.2	87.42		**7.500**	**101.987**
9.0	5	14.6	96.69	**4.71**	**10.000**	**105.298**
10.0	7.5	15.4	101.99		**12.500**	**106.623**
11.0	10	15.9	105.30			
12.0	12.5	16.1	106.62			

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

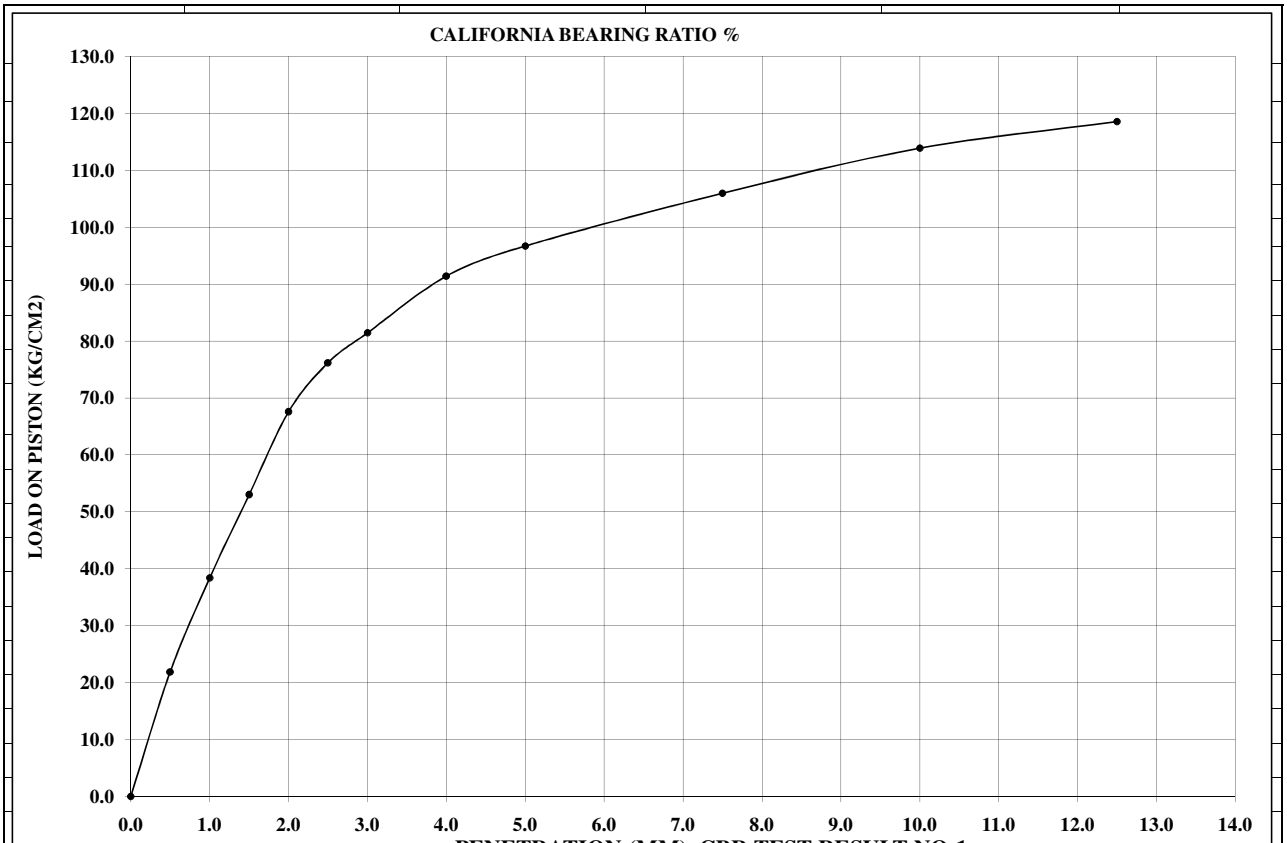
Liquid Limit	**34.02**		**MDD**	**1.816**	Gm/cc	
Plastic Limit	**22.16**		**OMC**	**24.02**	**%**	
Plasticity Index	**11.86**		**NMC**	**18.75**	**%**	
CBR NO- 8						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**17.550**
1.0	0	0	0		**1.000**	**34.437**
2.0	0.5	2.65	17.55		**1.500**	**53.974**
3.0	1	5.2	34.44		**2.000**	**63.907**
4.0	1.5	8.15	53.97		**2.500**	**72.384**
5.0	2	9.65	63.91		**3.000**	**82.119**
6.0	2.5	10.93	72.38	**5.28**	**4.000**	**90.728**
7.0	3	12.4	82.12		**5.000**	**98.675**
8.0	4	13.7	90.73		**7.500**	**109.272**
9.0	5	14.9	98.68	**4.80**	**10.000**	**113.907**
10.0	7.5	16.5	109.27		**12.500**	**116.556**
11.0	10	17.2	113.91			
12.0	12.5	17.6	116.56			

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

Liquid Limit	**32.62**		**MDD**	**1.826**	Gm/cc	
Plastic Limit	**21.04**		**OMC**	**24.36**	**%**	
Plasticity Index	**11.58**		**NMC**	**19.68**	**%**	
CBR NO- 9						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**23.841**
1.0	0	0	0		**1.000**	**38.411**
2.0	0.5	3.6	23.84		**1.500**	**54.305**
3.0	1	5.8	38.41		**2.000**	**67.550**
4.0	1.5	8.2	54.30		**2.500**	**74.834**
5.0	2	10.2	67.55		**3.000**	**80.795**
6.0	2.5	11.3	74.83	**5.46**	**4.000**	**94.702**
7.0	3	12.2	80.79		**5.000**	**100.662**
8.0	4	14.3	94.70		**7.500**	**109.272**
9.0	5	15.2	100.66	**4.90**	**10.000**	**115.232**
10.0	7.5	16.5	109.27		**12.500**	**115.894**
11.0	10	17.4	115.23			
12.0	12.5	17.5	115.89			

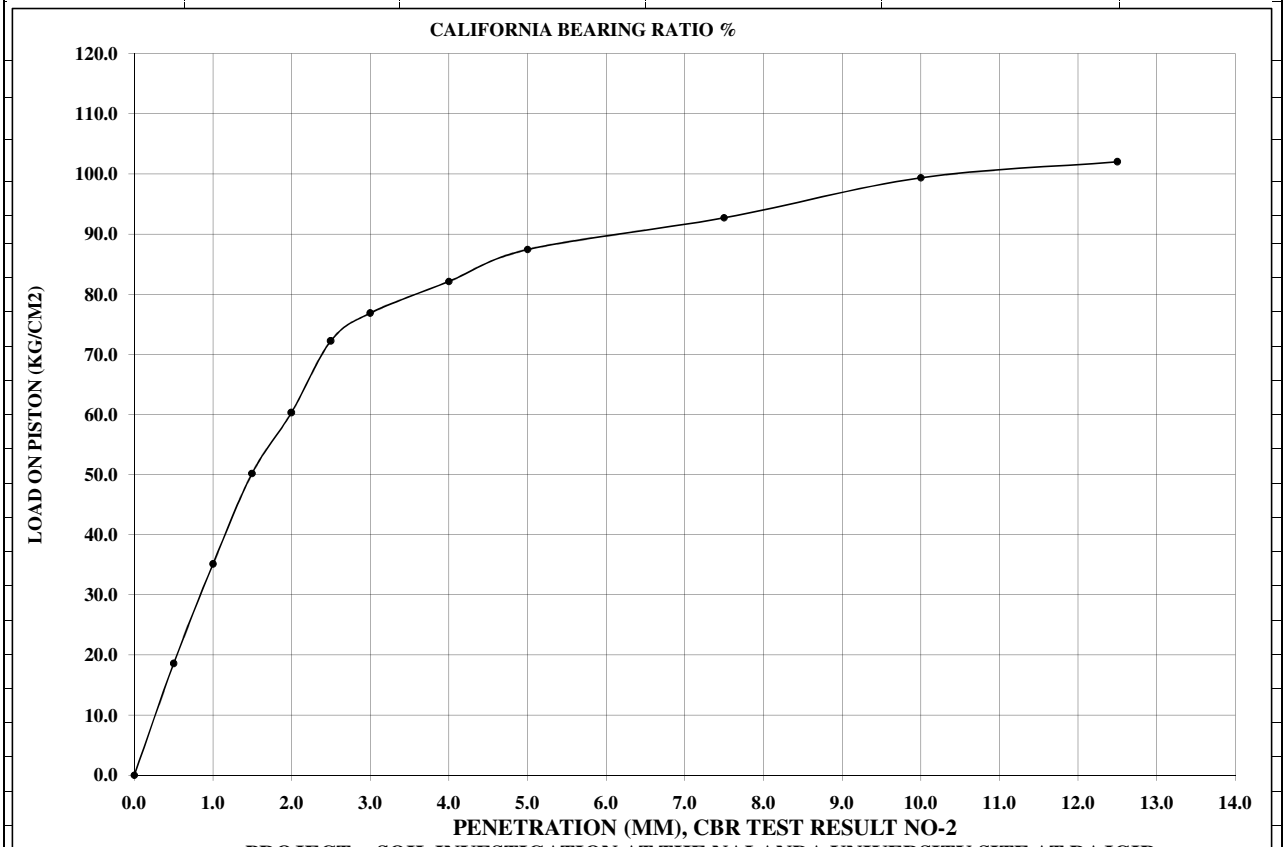
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

Liquid Limit	**33.16**		**MDD**	**1.811**	Gm/cc	
Plastic Limit	**20.48**		**OMC**	**24.66**	**%**	
Plasticity Index	**12.68**		**NMC**	**19.36**	**%**	
CBR NO- 10						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**13.245**
1.0	0	0	0		**1.000**	**26.490**
2.0	0.5	2	13.25		**1.500**	**39.735**
3.0	1	4	26.49		**2.000**	**52.980**
4.0	1.5	6	39.74		**2.500**	**67.550**
5.0	2	8	52.98		**3.000**	**74.834**
6.0	2.5	10.2	67.55	**4.93**	**4.000**	**86.093**
7.0	3	11.3	74.83		**5.000**	**90.066**
8.0	4	13	86.09		**7.500**	**98.675**
9.0	5	13.6	90.07	**4.38**	**10.000**	**102.649**
10.0	7.5	14.9	98.68		**12.500**	**106.623**
11.0	10	15.5	102.65			
12.0	12.5	16.1	106.62			



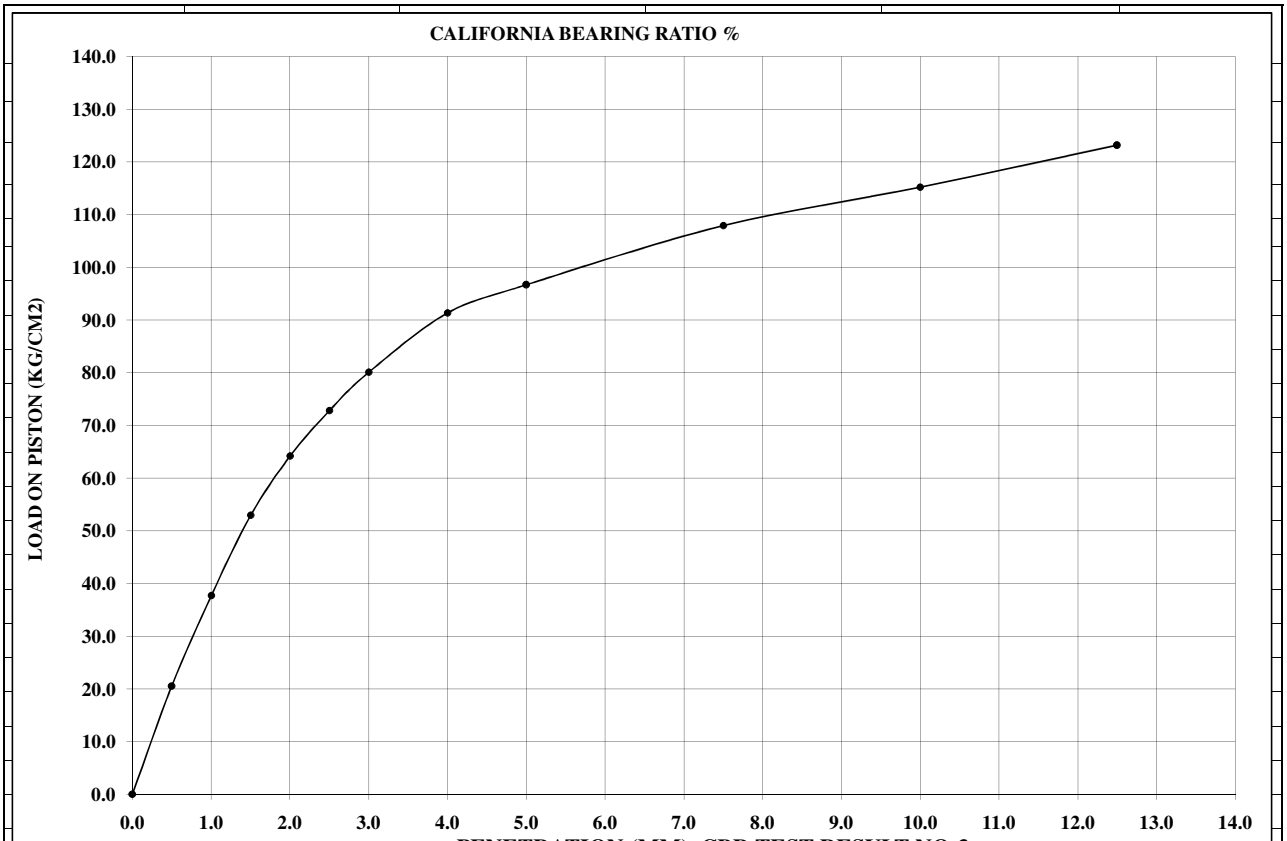
PENETRATION (MM), CBR TEST RESULT NO-1

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR

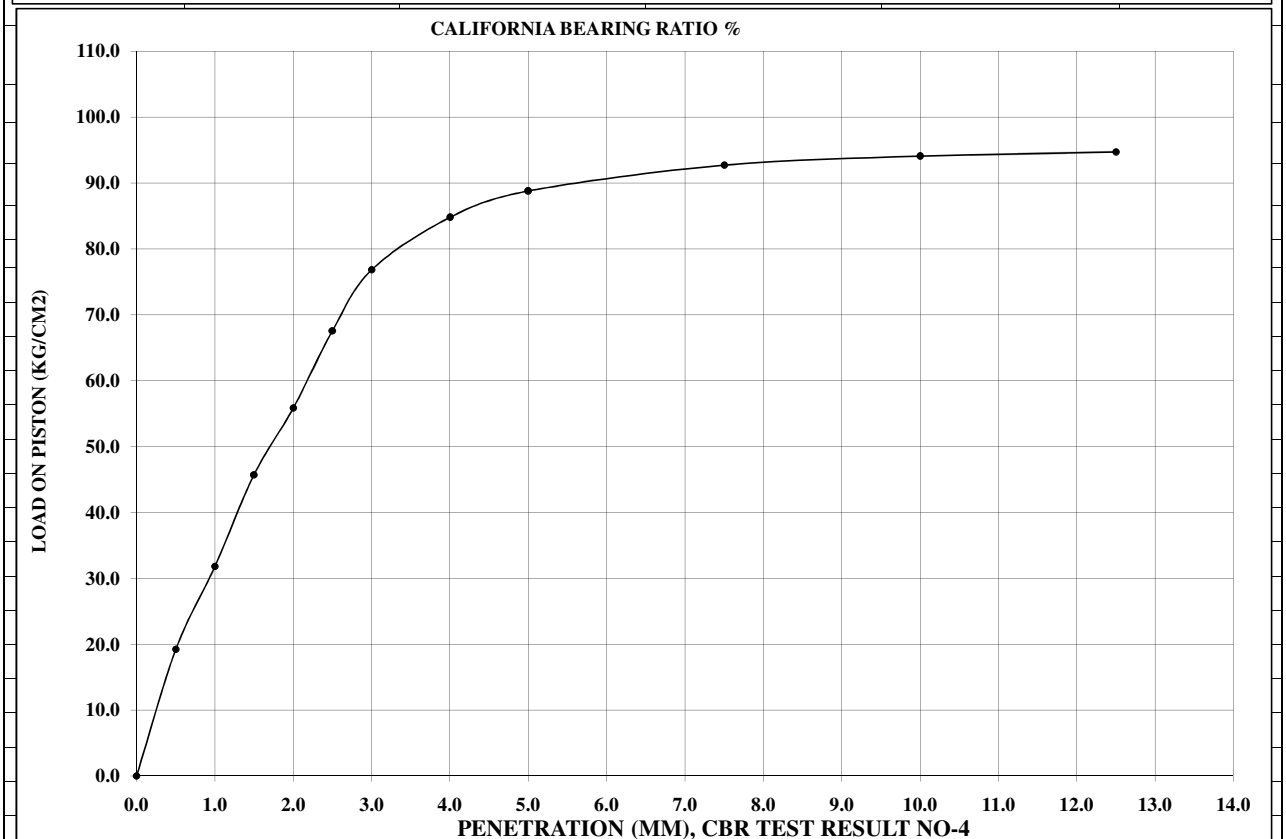


PENETRATION (MM), CBR TEST RESULT NO-2

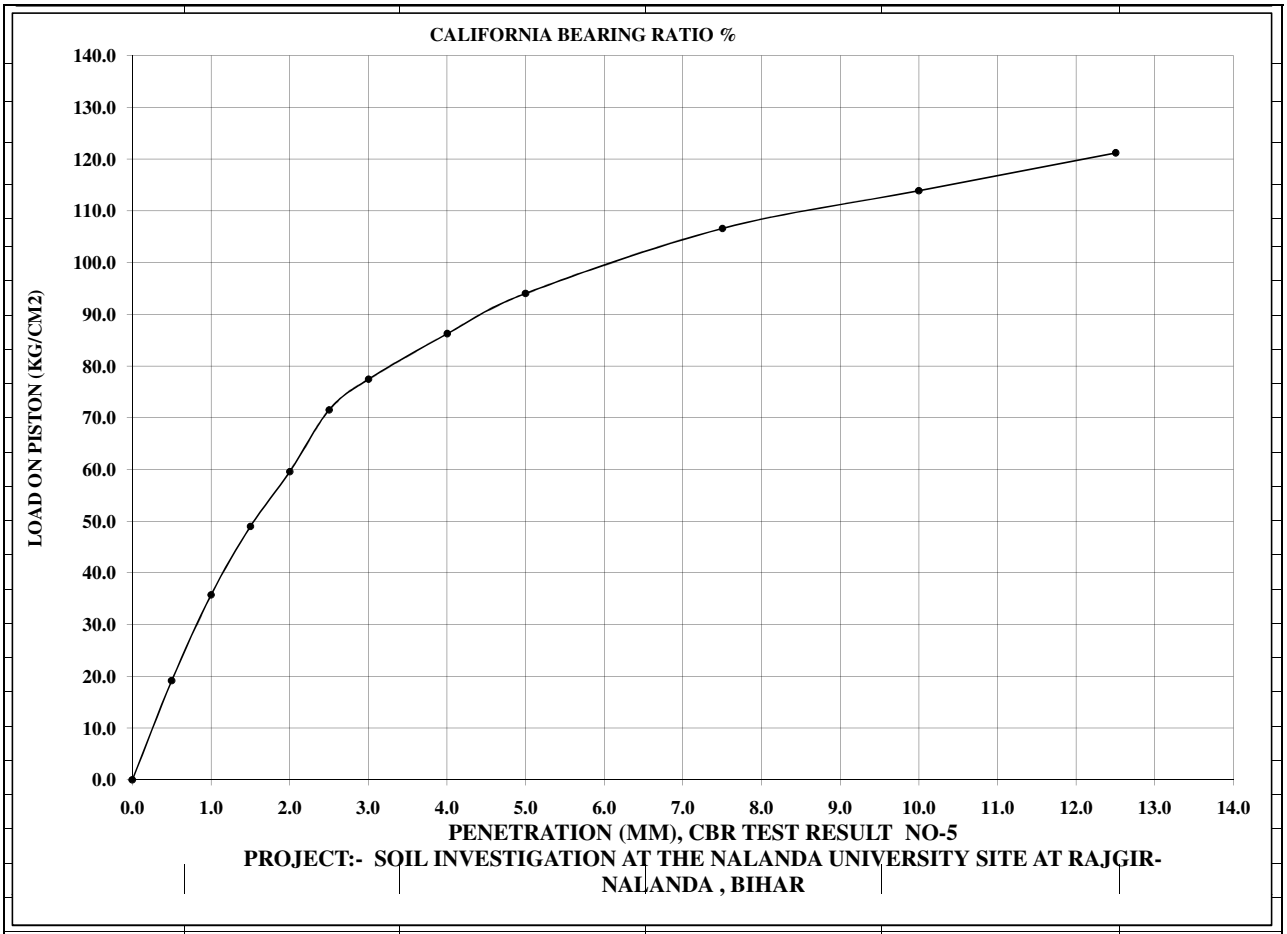
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR

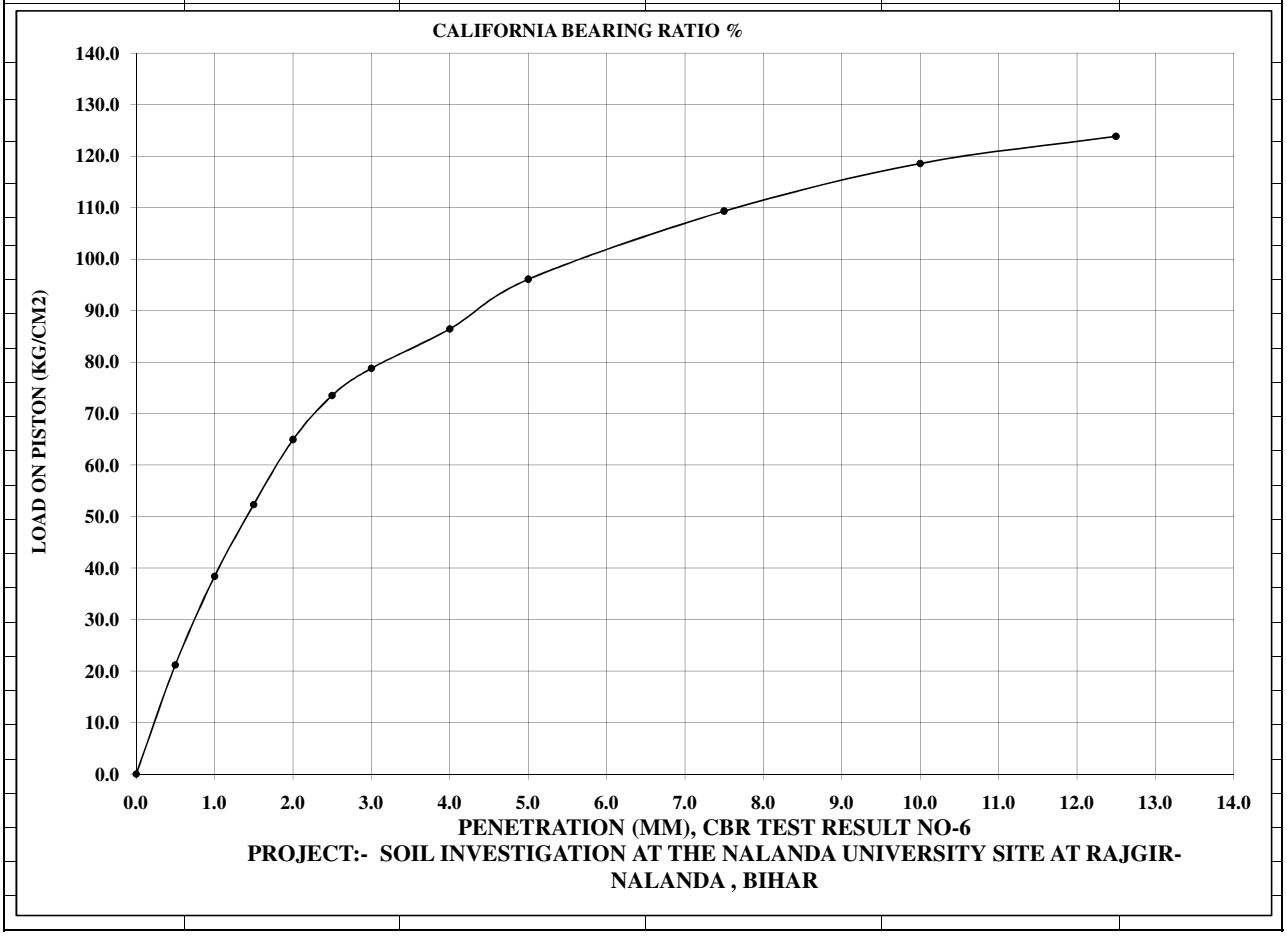


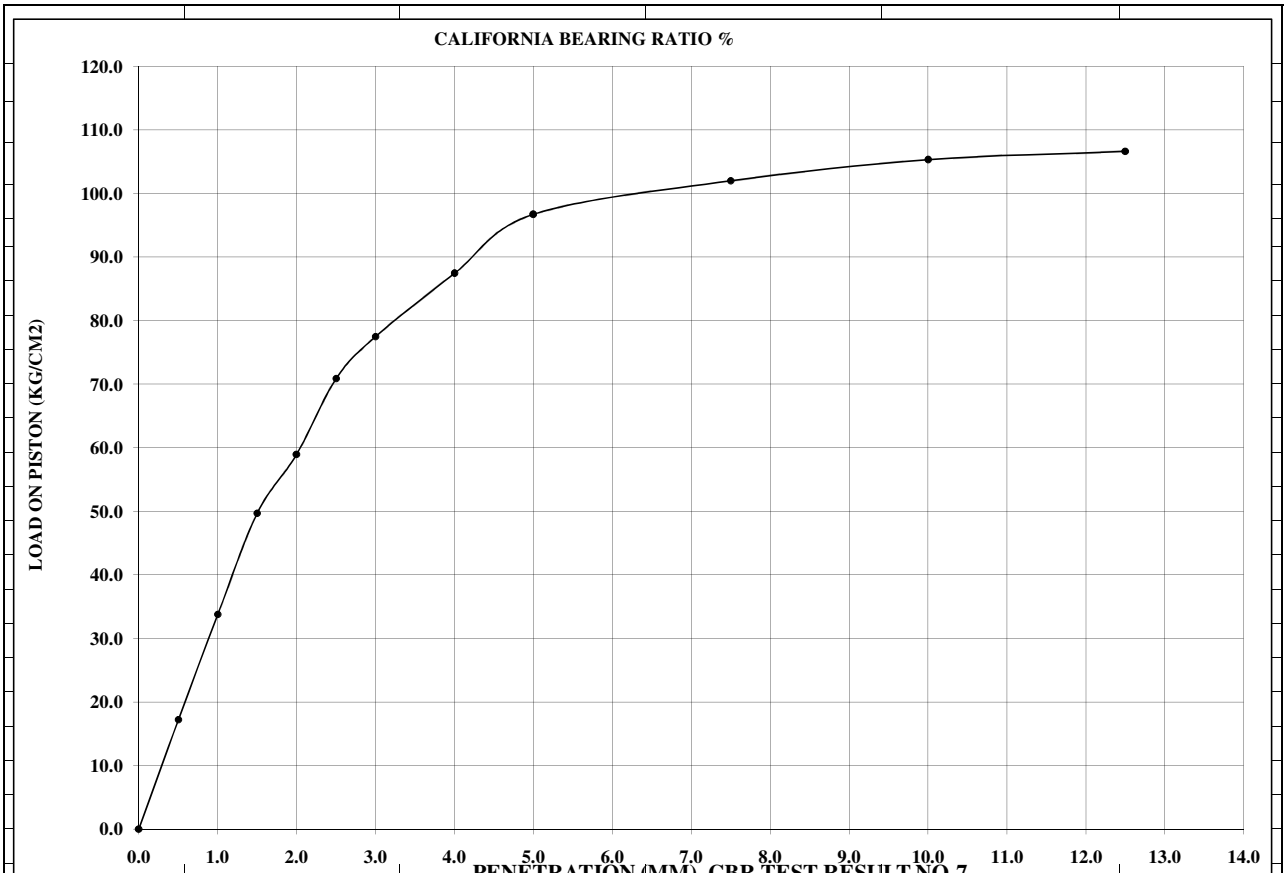
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR



PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR

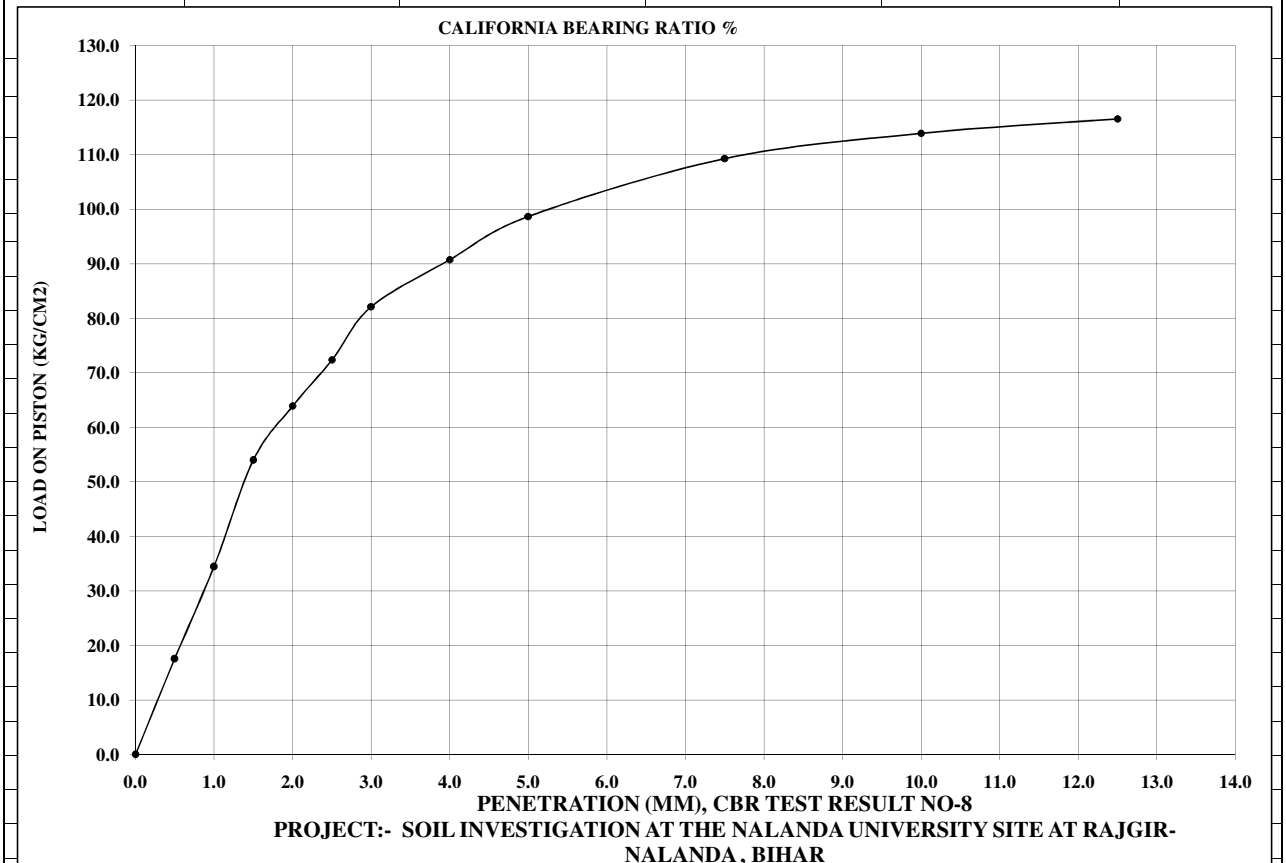

CALIFORNIA BEARING RATIO %
LOAD ON PISTON (KG/CM2)
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0
PENETRATION (MM), CBR TEST RESULT NO-5
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR


CALIFORNIA BEARING RATIO %
LOAD ON PISTON (KG/CM2)
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0
PENETRATION (MM), CBR TEST RESULT NO-6
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR



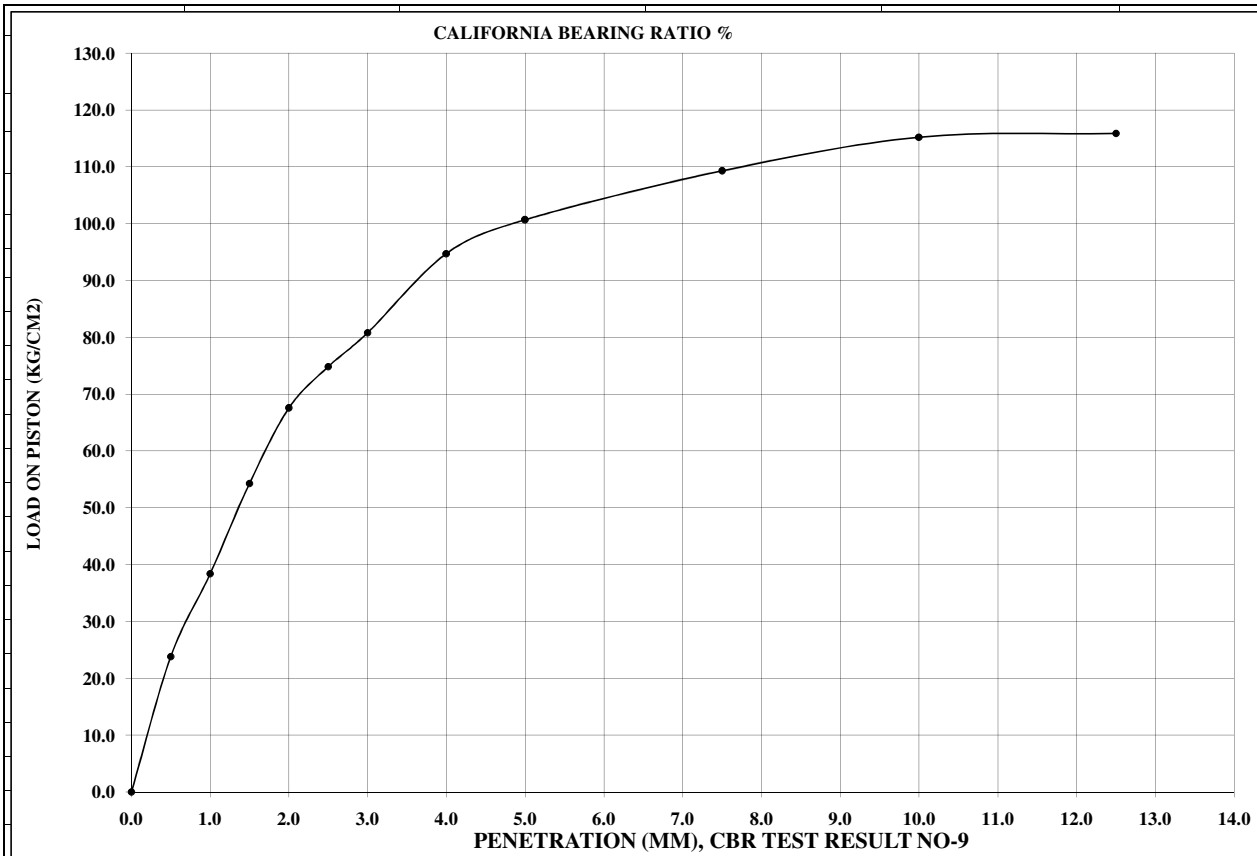
PENETRATION (MM), CBR TEST RESULT NO-7

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR



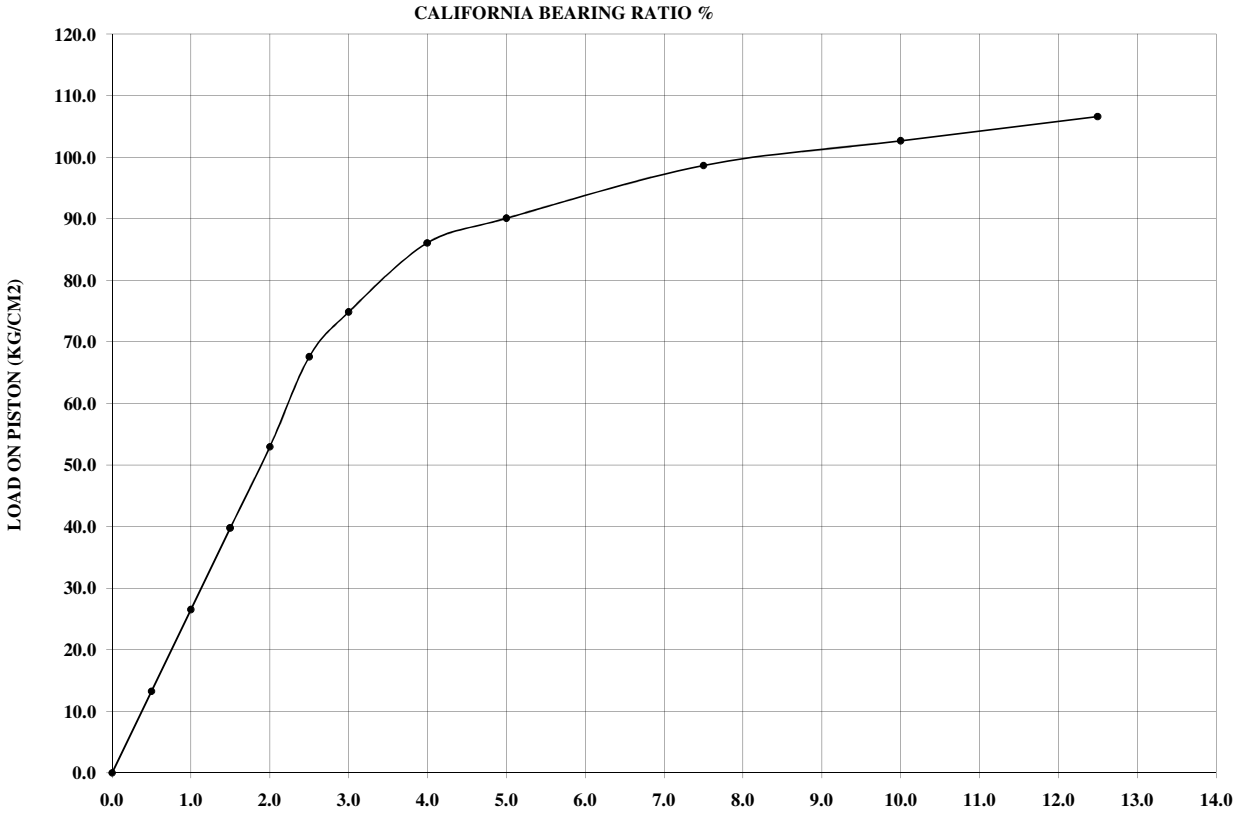
PENETRATION (MM), CBR TEST RESULT NO-8

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR



PENETRATION (MM), CBR TEST RESULT NO-9

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR



PENETRATION (MM), CBR TEST RESULT NO-10

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

Liquid Limit	**33.85**		**MDD**	**1.82**	Gm/cc	
Plastic Limit	**20.17**		**OMC**	**23.58**	%	
Plasticity Index	**13.68**		**NMC**	**20.01**	%	
CBR NO- 11						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**15.894**
1.0	0.00	0.0	0		**1.000**	**33.775**
2.0	0.50	2.4	15.89		**1.500**	**50.331**
3.0	1.00	5.1	33.77		**2.000**	**62.252**
4.0	1.50	7.6	50.33		**2.500**	**69.536**
5.0	2.00	9.4	62.25		**3.000**	**75.497**
6.0	2.50	10.5	69.54	**5.08**	**4.000**	**84.106**
7.0	3.00	11.4	75.50		**5.000**	**89.404**
8.0	4.00	12.7	84.11		**7.500**	**100.662**
9.0	5.00	13.5	89.40	**4.35**	**10.000**	**105.298**
10.0	7.50	15.2	100.66		**12.500**	**107.285**
11.0	10.00	15.9	105.30			
12.0	12.50	16.2	107.28			

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

Liquid Limit	**34.86**		**MDD**	**1.86**	Gm/cc	
Plastic Limit	**21.33**		**OMC**	**23.65**	%	
Plasticity Index	**13.53**		**NMC**	**19.76**	%	
CBR NO- 12						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**23.841**
1.0	0.00	0	0		**1.000**	**42.384**
2.0	0.50	3.6	23.84		**1.500**	**56.291**
3.0	1.00	6.4	42.38		**2.000**	**67.550**
4.0	1.50	8.5	56.29		**2.500**	**74.172**
5.0	2.00	10.2	67.55		**3.000**	**78.808**
6.0	2.50	11.2	74.17	**5.41**	**4.000**	**85.430**
7.0	3.00	11.9	78.81		**5.000**	**90.066**
8.0	4.00	12.9	85.43		**7.500**	**99.338**
9.0	5.00	13.6	90.07	**4.38**	**10.000**	**105.960**
10.0	7.50	15	99.34		**12.500**	**108.609**
11.0	10.00	16	105.96			
12.0	12.50	16.4	108.61			

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

Liquid Limit	**32.96**		**MDD**	**1.842**	Gm/cc	
Plastic Limit	**20.38**		**OMC**	**23.01**	%	
Plasticity Index	**12.58**		**NMC**	**18.44**	%	
CBR NO- 13						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**21.192**
1.0	0.00	0	0		**1.000**	**39.073**
2.0	0.50	3.2	21.19		**1.500**	**50.331**
3.0	1.00	5.9	39.07		**2.000**	**60.927**
4.0	1.50	7.6	50.33		**2.500**	**71.523**
5.0	2.00	9.2	60.93		**3.000**	**80.530**
6.0	2.50	10.8	71.52	**5.22**	**4.000**	**92.318**
7.0	3.00	12.16	80.53		**5.000**	**100.662**
8.0	4.00	13.94	92.32		**7.500**	**111.921**
9.0	5.00	15.2	100.66	**4.90**	**10.000**	**117.881**
10.0	7.50	16.9	111.92		**12.500**	**120.530**
11.0	10.00	17.8	117.88			
12.0	12.50	18.2	120.53			

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

Liquid Limit	**34.21**		**MDD**	**1.864**	Gm/cc	
Plastic Limit	**21.14**		**OMC**	**23.85**	%	
Plasticity Index	**13.07**		**NMC**	**18.61**	%	
CBR NO- 14						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**20.530**
1.0	0.00	0	0		**1.000**	**38.411**
2.0	0.50	3.1	20.53		**1.500**	**55.629**
3.0	1.00	5.8	38.41		**2.000**	**66.887**
4.0	1.50	8.4	55.63		**2.500**	**72.980**
5.0	2.00	10.1	66.89		**3.000**	**78.808**
6.0	2.50	11.02	72.98	**5.33**	**4.000**	**85.430**
7.0	3.00	11.9	78.81		**5.000**	**88.079**
8.0	4.00	12.9	85.43		**7.500**	**94.040**
9.0	5.00	13.3	88.08	**4.29**	**10.000**	**98.675**
10.0	7.50	14.2	94.04		**12.500**	**102.649**
11.0	10.00	14.9	98.68			
12.0	12.50	15.5	102.65			

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

Liquid Limit	**34.68**		**MDD**	**1.822**	Gm/cc	
Plastic Limit	**22.14**		**OMC**	**22.64**	%	
Plasticity Index	**12.54**		**NMC**	**18.42**	%	
CBR NO-15						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**16.556**
1.0	0.00	0	0		**1.000**	**34.437**
2.0	0.50	2.5	16.56		**1.500**	**50.331**
3.0	1.00	5.2	34.44		**2.000**	**60.927**
4.0	1.50	7.6	50.33		**2.500**	**70.861**
5.0	2.00	9.2	60.93		**3.000**	**75.497**
6.0	2.50	10.7	70.86	**5.17**	**4.000**	**83.444**
7.0	3.00	11.4	75.50		**5.000**	**88.742**
8.0	4.00	12.6	83.44		**7.500**	**100.662**
9.0	5.00	13.4	88.74	**4.32**	**10.000**	**106.623**
10.0	7.50	15.2	100.66		**12.500**	**109.272**
11.0	10.00	16.1	106.62			
12.0	12.50	16.5	109.27			

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

Liquid Limit	**33.65**		**MDD**	**1.878**	Gm/cc	
Plastic Limit	**21.86**		**OMC**	**24.06**	%	
Plasticity Index	**11.79**		**NMC**	**18.99**	%	
CBR NO-16						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**25.828**
1.0	0.00	0	0		**1.000**	**43.709**
2.0	0.50	3.9	25.83		**1.500**	**56.291**
3.0	1.00	6.6	43.71		**2.000**	**68.874**
4.0	1.50	8.5	56.29		**2.500**	**75.497**
5.0	2.00	10.4	68.87		**3.000**	**81.457**
6.0	2.50	11.4	75.50	**5.51**	**4.000**	**90.066**
7.0	3.00	12.3	81.46		**5.000**	**96.689**
8.0	4.00	13.6	90.07		**7.500**	**104.636**
9.0	5.00	14.6	96.69	**4.71**	**10.000**	**108.609**
10.0	7.50	15.8	104.64		**12.500**	**109.934**
11.0	10.00	16.4	108.61			
12.0	12.50	16.6	109.93			

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

Liquid Limit	**33.59**		**MDD**	**1.821**	Gm/cc	
Plastic Limit	**21.38**		**OMC**	**24.16**	%	
Plasticity Index	**12.21**		**NMC**	**19.12**	%	
CBR NO- 17						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**15.232**
1.0	0.00	0	0		**1.000**	**31.126**
2.0	0.50	2.3	15.23		**1.500**	**47.020**
3.0	1.00	4.7	31.13		**2.000**	**56.954**
4.0	1.50	7.1	47.02		**2.500**	**67.550**
5.0	2.00	8.6	56.95		**3.000**	**74.834**
6.0	2.50	10.2	67.55	**4.93**	**4.000**	**83.444**
7.0	3.00	11.3	74.83		**5.000**	**89.404**
8.0	4.00	12.6	83.44		**7.500**	**98.013**
9.0	5.00	13.5	89.40	**4.35**	**10.000**	**103.311**
10.0	7.50	14.8	98.01		**12.500**	**103.311**
11.0	10.00	15.6	103.31			
12.0	12.50	15.6	103.31			

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

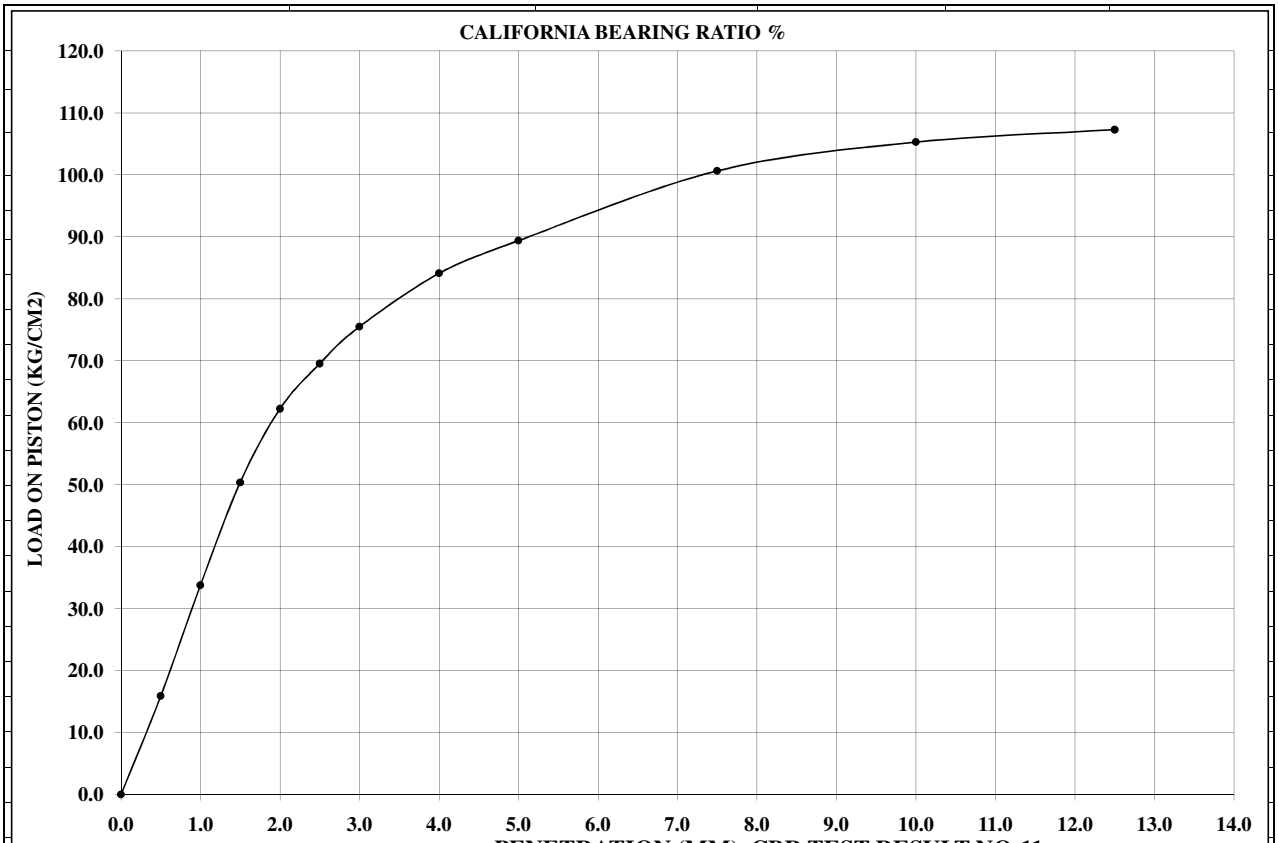
Liquid Limit	**33.96**		**MDD**	**1.833**	Gm/cc	
Plastic Limit	**20.17**		**OMC**	**24.05**	%	
Plasticity Index	**13.79**		**NMC**	**19.24**	%	
CBR NO- 18						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**23.179**
1.0	0.00	0	0		**1.000**	**39.073**
2.0	0.50	3.5	23.18		**1.500**	**54.305**
3.0	1.00	5.9	39.07		**2.000**	**64.238**
4.0	1.50	8.2	54.30		**2.500**	**72.980**
5.0	2.00	9.7	64.24		**3.000**	**79.801**
6.0	2.50	11.02	72.98	**5.33**	**4.000**	**92.053**
7.0	3.00	12.05	79.80		**5.000**	**100.000**
8.0	4.00	13.9	92.05		**7.500**	**110.596**
9.0	5.00	15.1	100.00	**4.87**	**10.000**	**113.907**
10.0	7.50	16.7	110.60		**12.500**	**116.556**
11.0	10.00	17.2	113.91			
12.0	12.50	17.6	116.56			

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

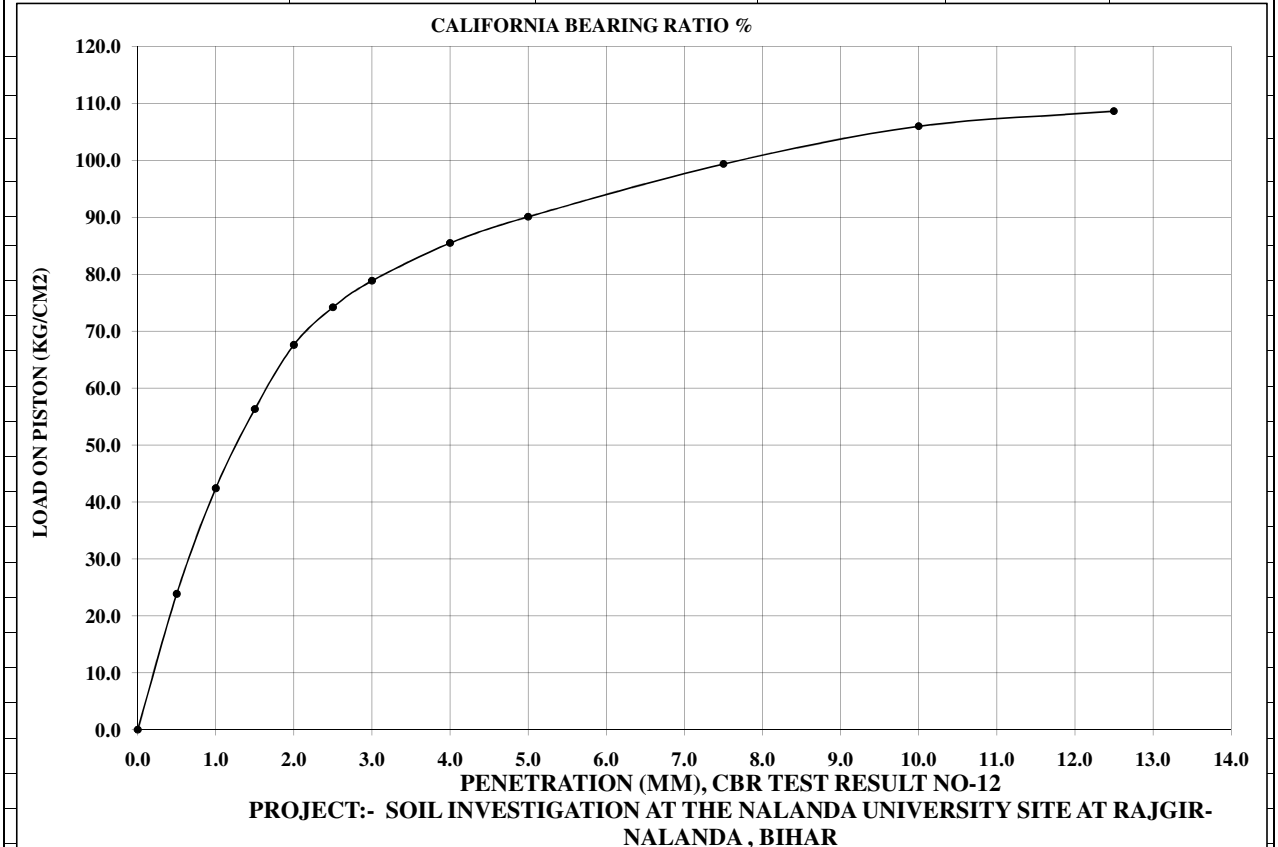
Liquid Limit	**32.62**		**MDD**	**1.823**	Gm/cc	
Plastic Limit	**21.04**		**OMC**	**24.22**	%	
Plasticity Index	**11.58**		**NMC**	**19.43**	%	
CBR NO- 19						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**17.219**
1.0	0.00	0	0		**1.000**	**35.762**
2.0	0.50	2.6	17.22		**1.500**	**51.656**
3.0	1.00	5.4	35.76		**2.000**	**62.252**
4.0	1.50	7.8	51.66		**2.500**	**70.199**
5.0	2.00	9.4	62.25		**3.000**	**74.172**
6.0	2.50	10.6	70.20	**5.12**	**4.000**	**84.106**
7.0	3.00	11.2	74.17		**5.000**	**90.066**
8.0	4.00	12.7	84.11		**7.500**	**97.351**
9.0	5.00	13.6	90.07	**4.38**	**10.000**	**101.325**
10.0	7.50	14.7	97.35		**12.500**	**103.311**
11.0	10.00	15.3	101.32			
12.0	12.50	15.6	103.31			

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

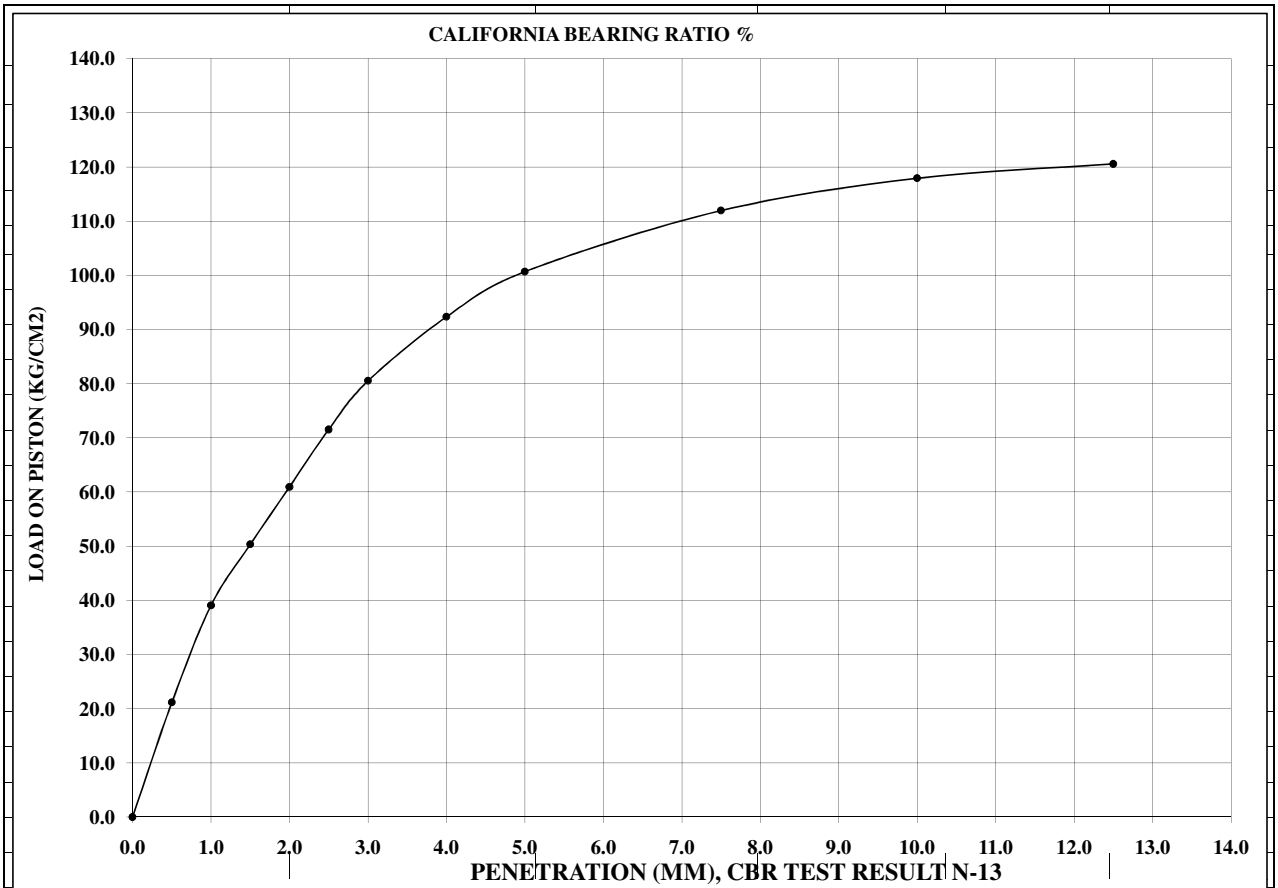
Liquid Limit	**34.02**		**MDD**	**1.864**	Gm/cc	
Plastic Limit	**21.68**		**OMC**	**23.16**	%	
Plasticity Index	**12.34**		**NMC**	**19.2**	%	
CBR NO- 20						
			SOIL TYPE	**CL**		
Soaking Condition	**Soaked**				**Settlemnt mm**	**Load Kg**
Plunger Diam cm	**5.0**	**Area CM2**			**0.000**	**0.000**
Sl No	**Settlemnt mm**	**Load Division**	**Load Kg**	**CBR %**	**0.500**	**23.179**
1.0	0.00	0.0	0		**1.000**	**44.371**
2.0	0.50	3.5	23.18		**1.500**	**55.629**
3.0	1.00	6.7	44.37		**2.000**	**67.550**
4.0	1.50	8.4	55.63		**2.500**	**75.497**
5.0	2.00	10.2	67.55		**3.000**	**82.781**
6.0	2.50	11.4	75.50	**5.51**	**4.000**	**92.053**
7.0	3.00	12.5	82.78		**5.000**	**96.026**
8.0	4.00	13.9	92.05		**7.500**	**103.974**
9.0	5.00	14.5	96.03	**4.67**	**10.000**	**107.285**
10.0	7.50	15.7	103.97		**12.500**	**108.609**
11.0	10.00	16.2	107.28			
12.0	12.50	16.4	108.61			



PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR

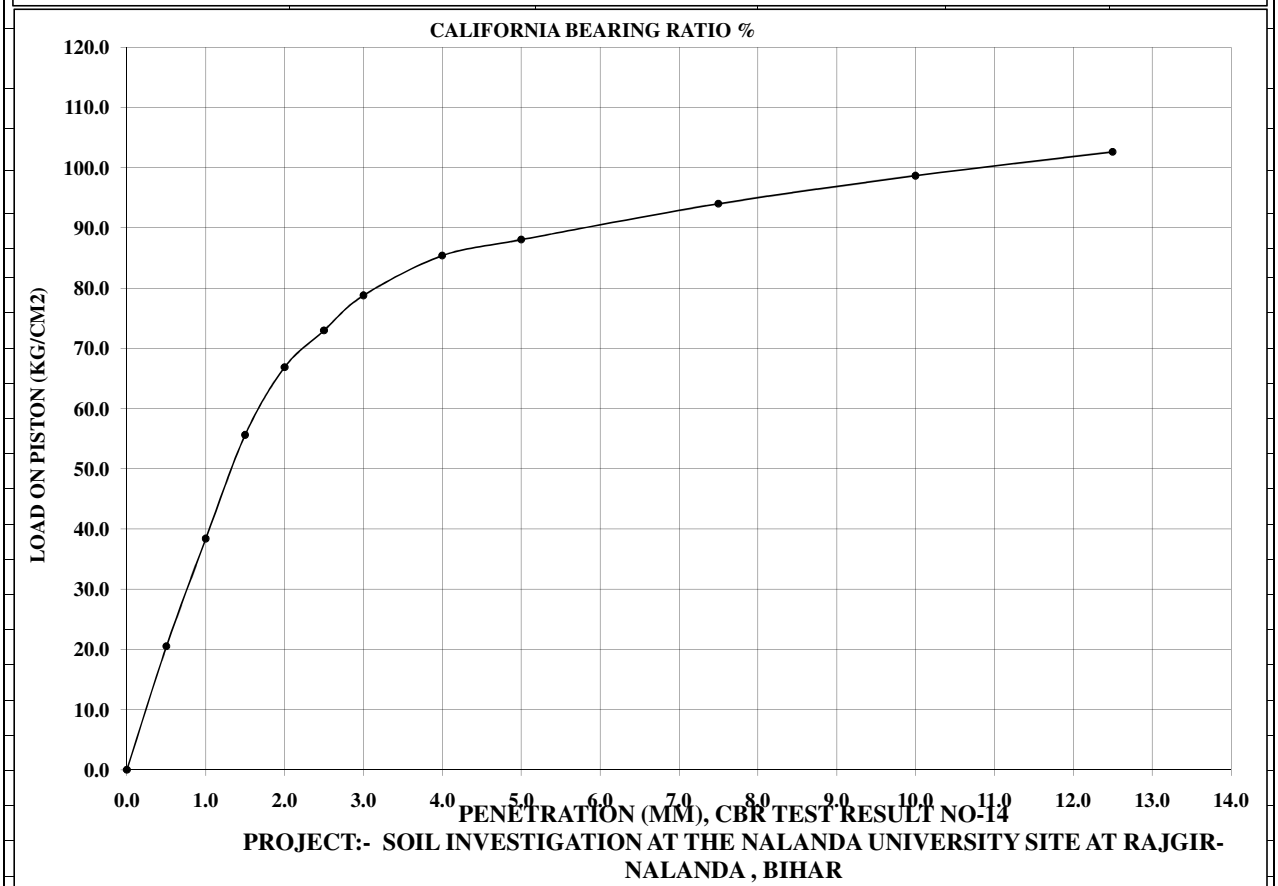


PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR



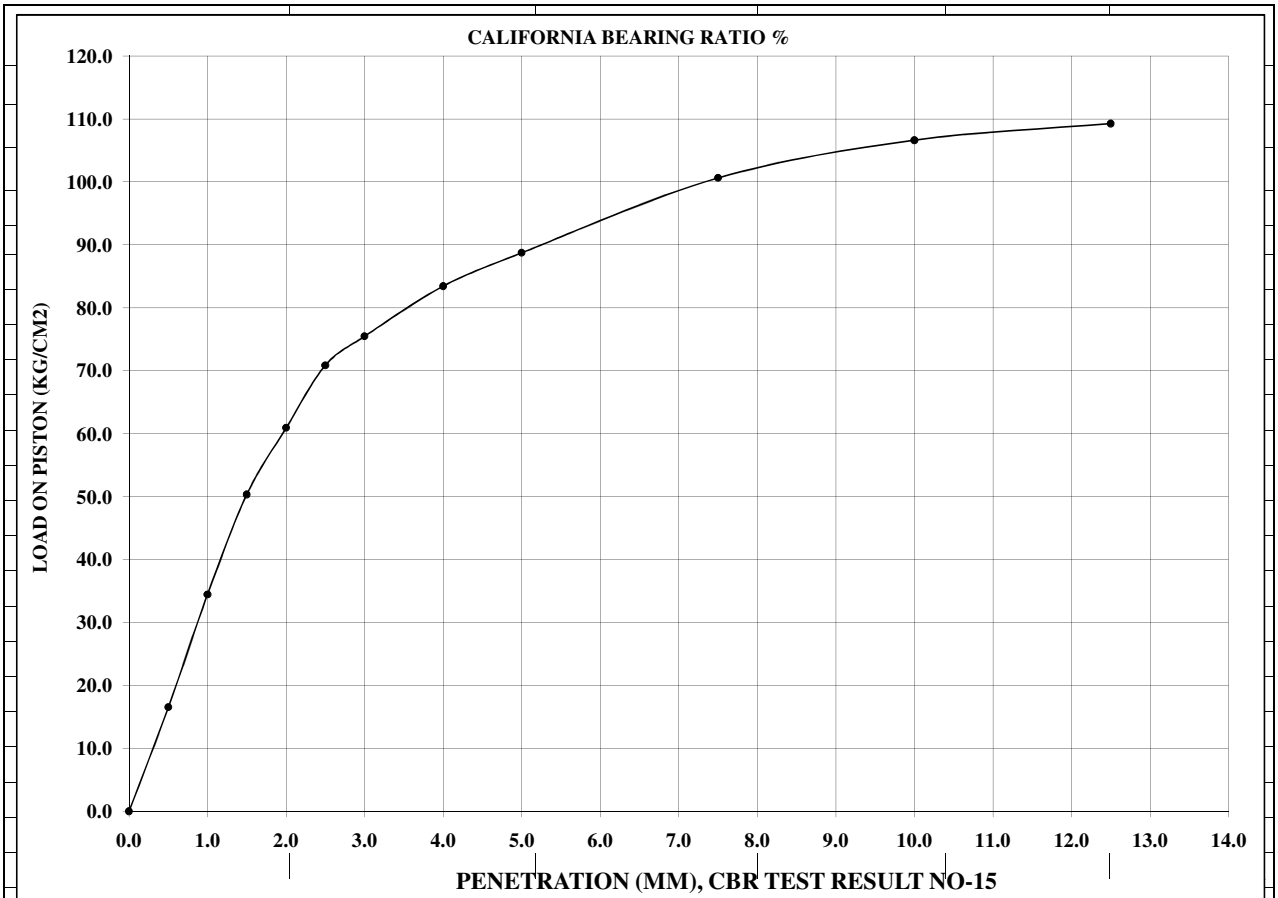
PENETRATION (MM), CBR TEST RESULT N-13

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR



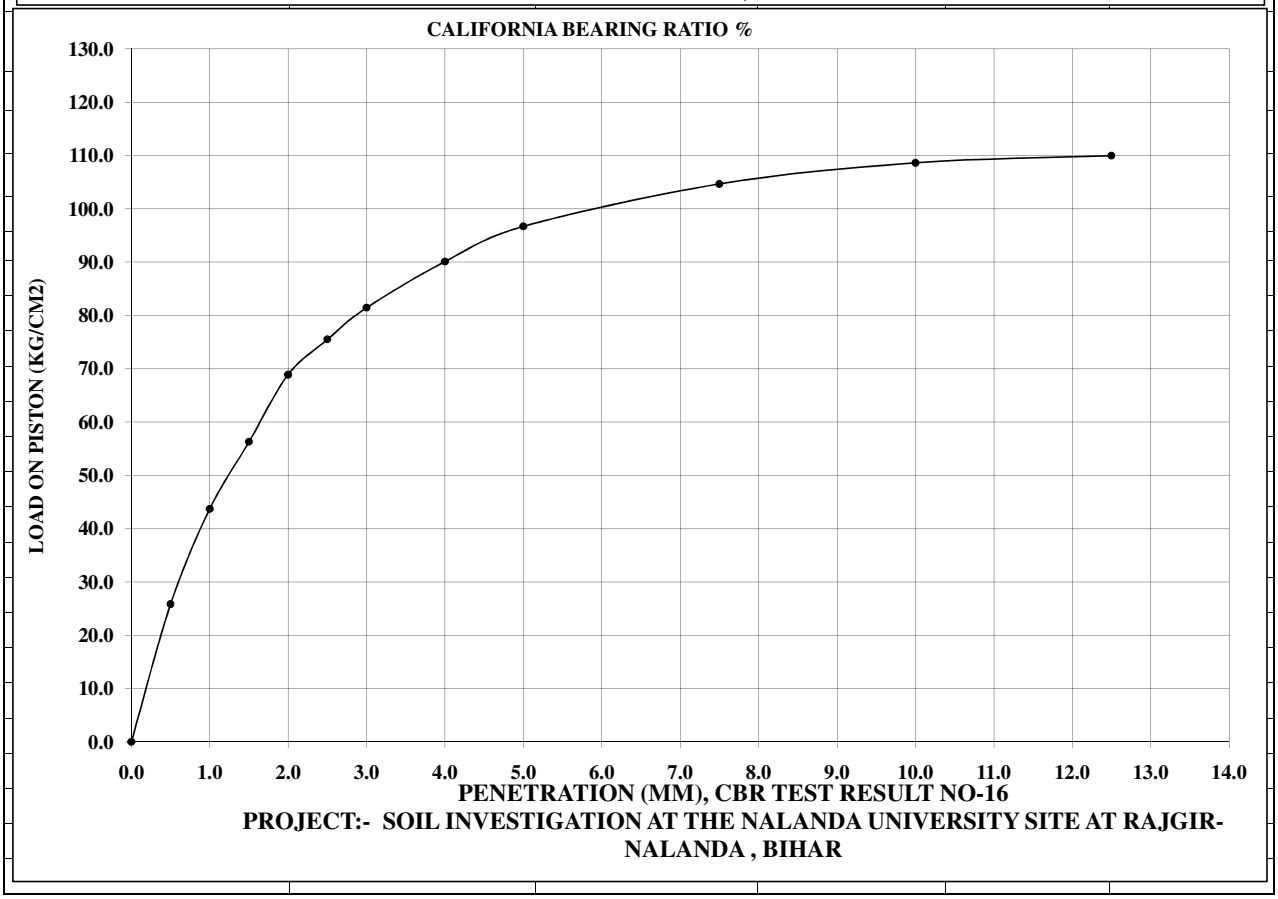
PENETRATION (MM), CBR TEST RESULT NO-14

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR



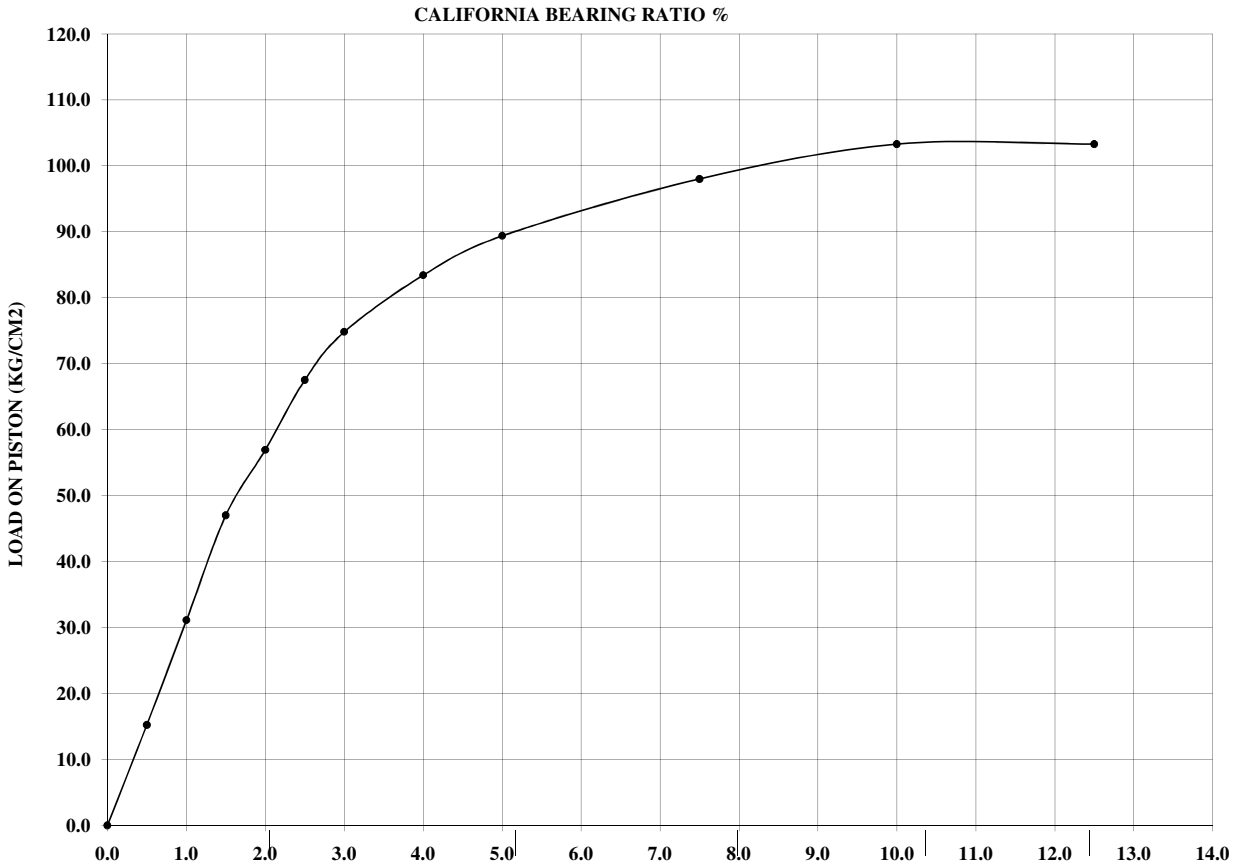
PENETRATION (MM), CBR TEST RESULT NO-15

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR

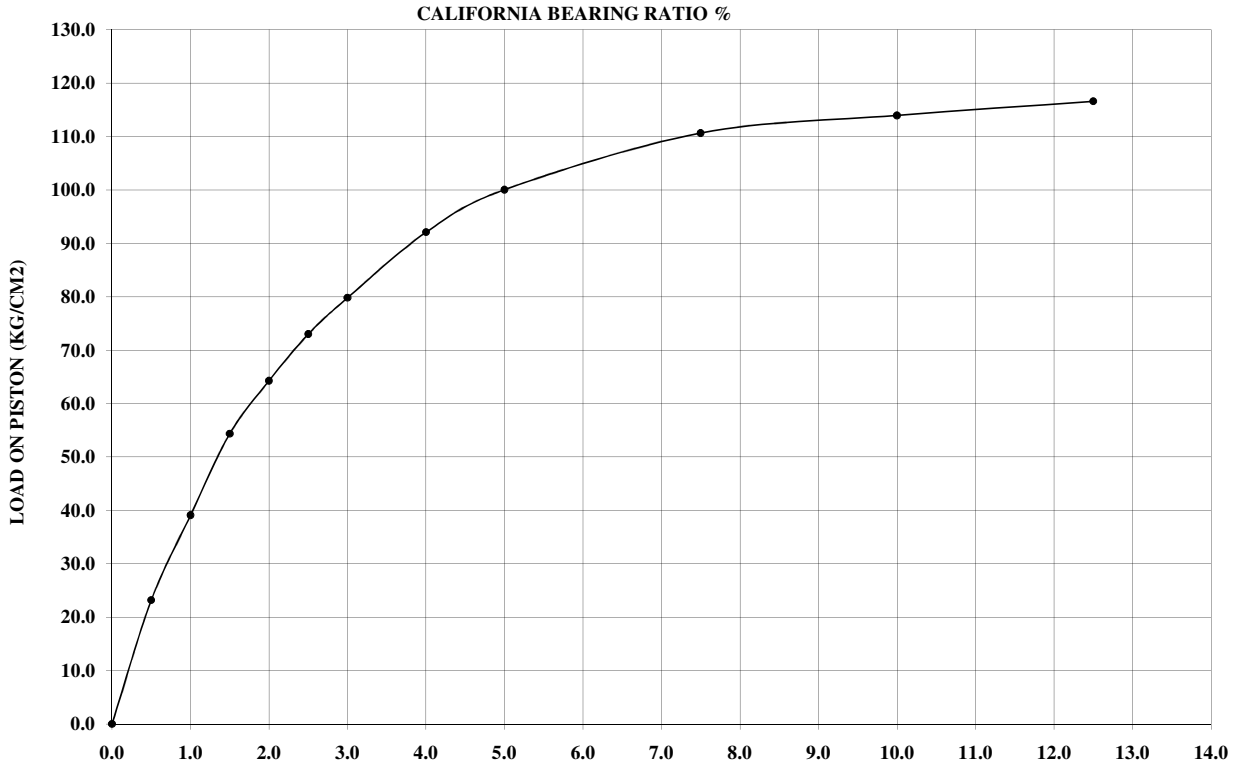


PENETRATION (MM), CBR TEST RESULT NO-16

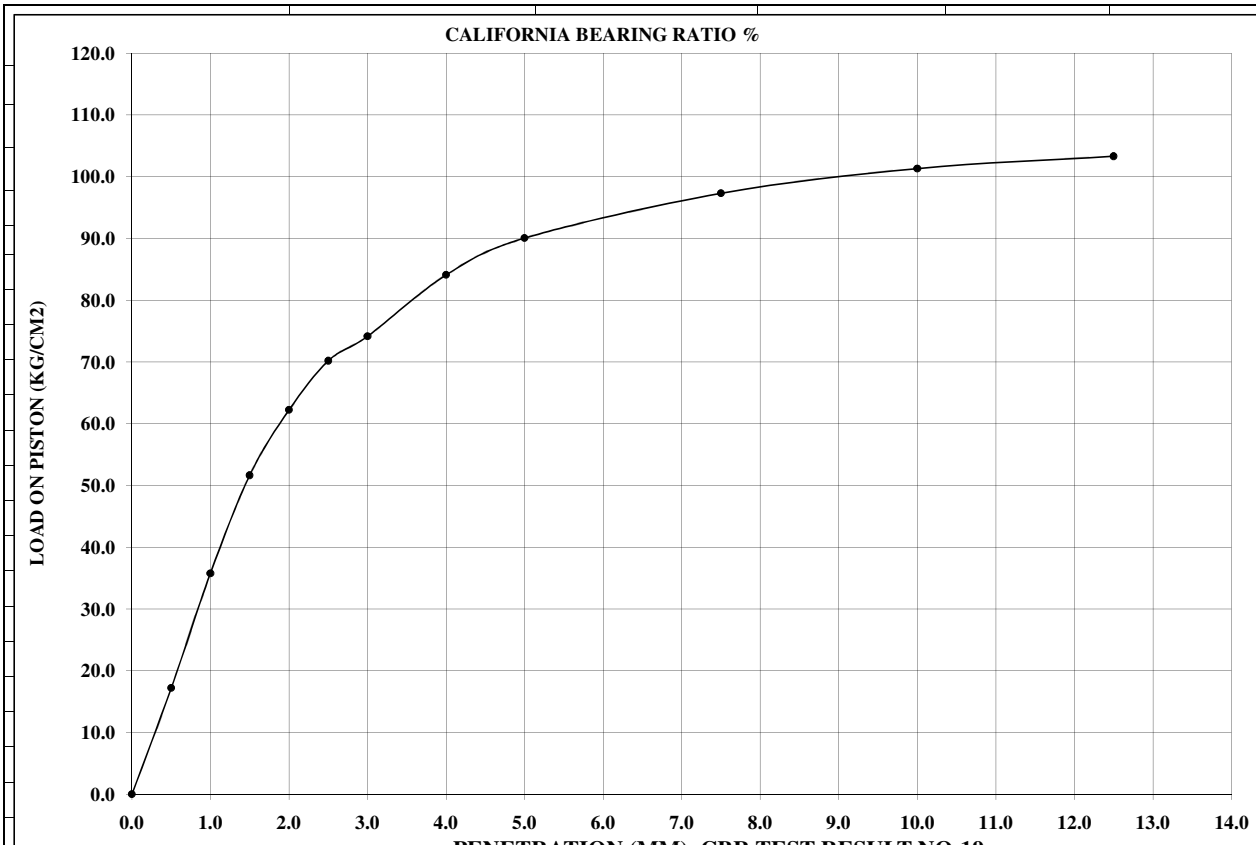
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR



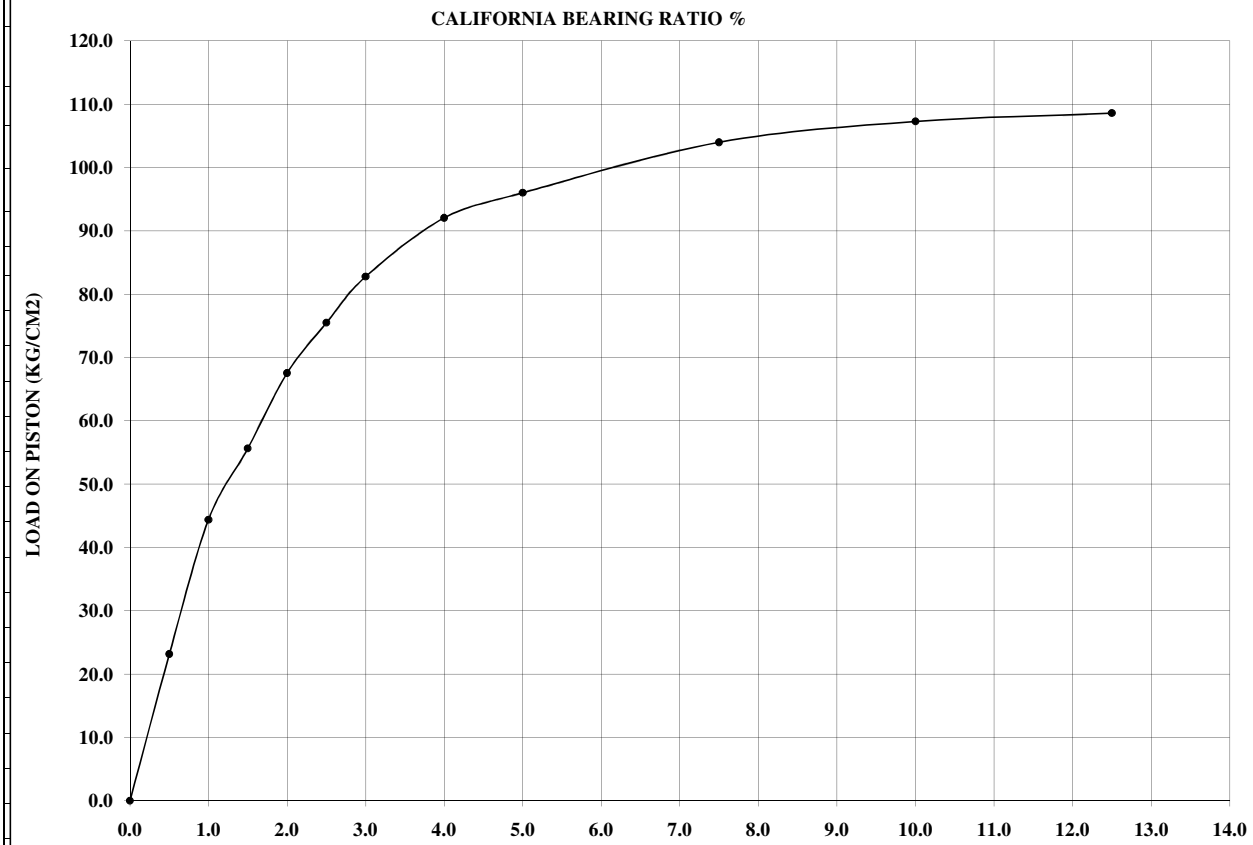
PENETRATION (MM), CBR TEST RESULT NO-17
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR



PENETRATION (MM), CBR TEST RESULT NO-18
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR



PENETRATION (MM), CBR TEST RESULT NO-19
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR

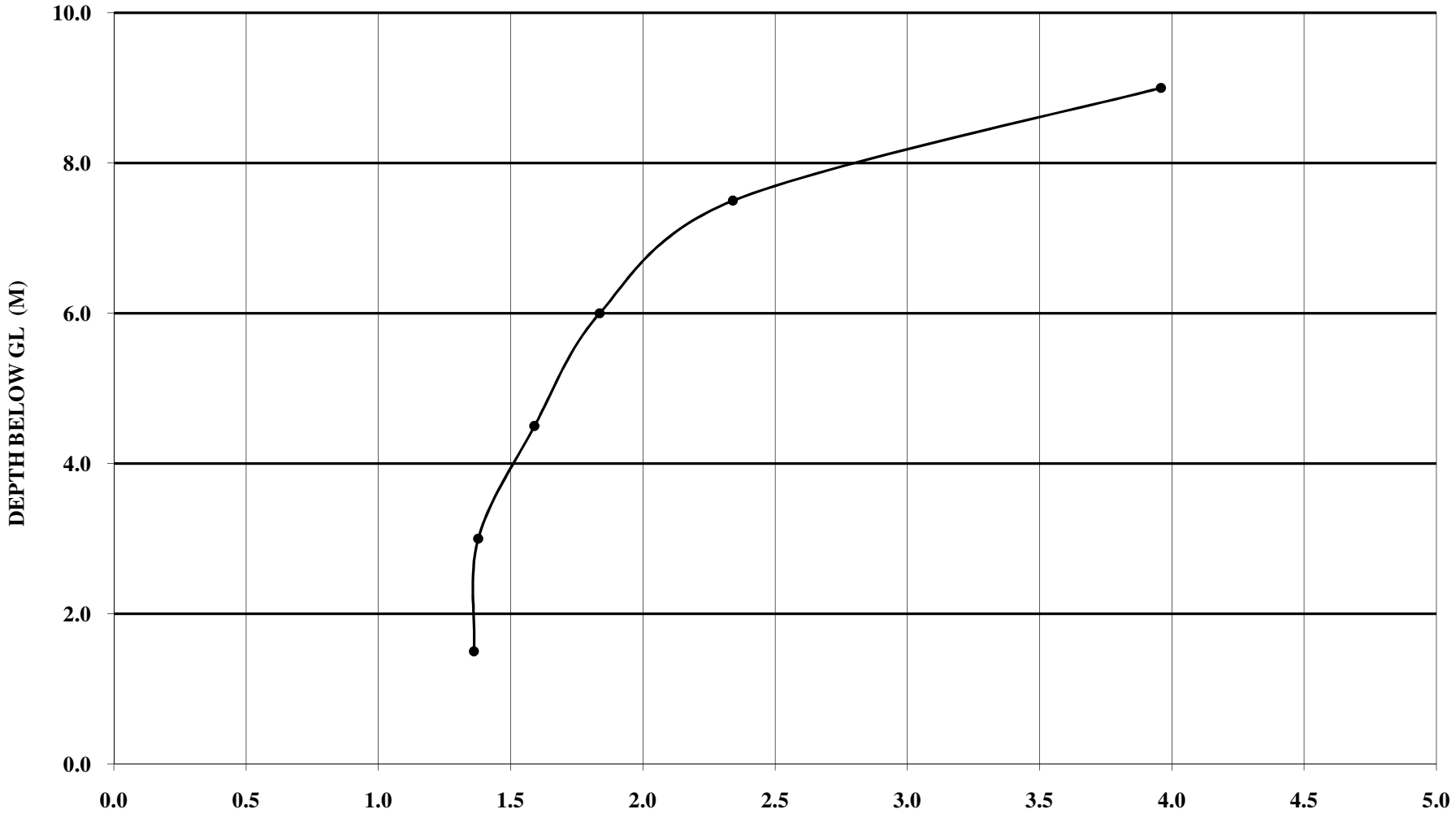


PENETRATION (MM), CBR TEST RESULT NO-20
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR

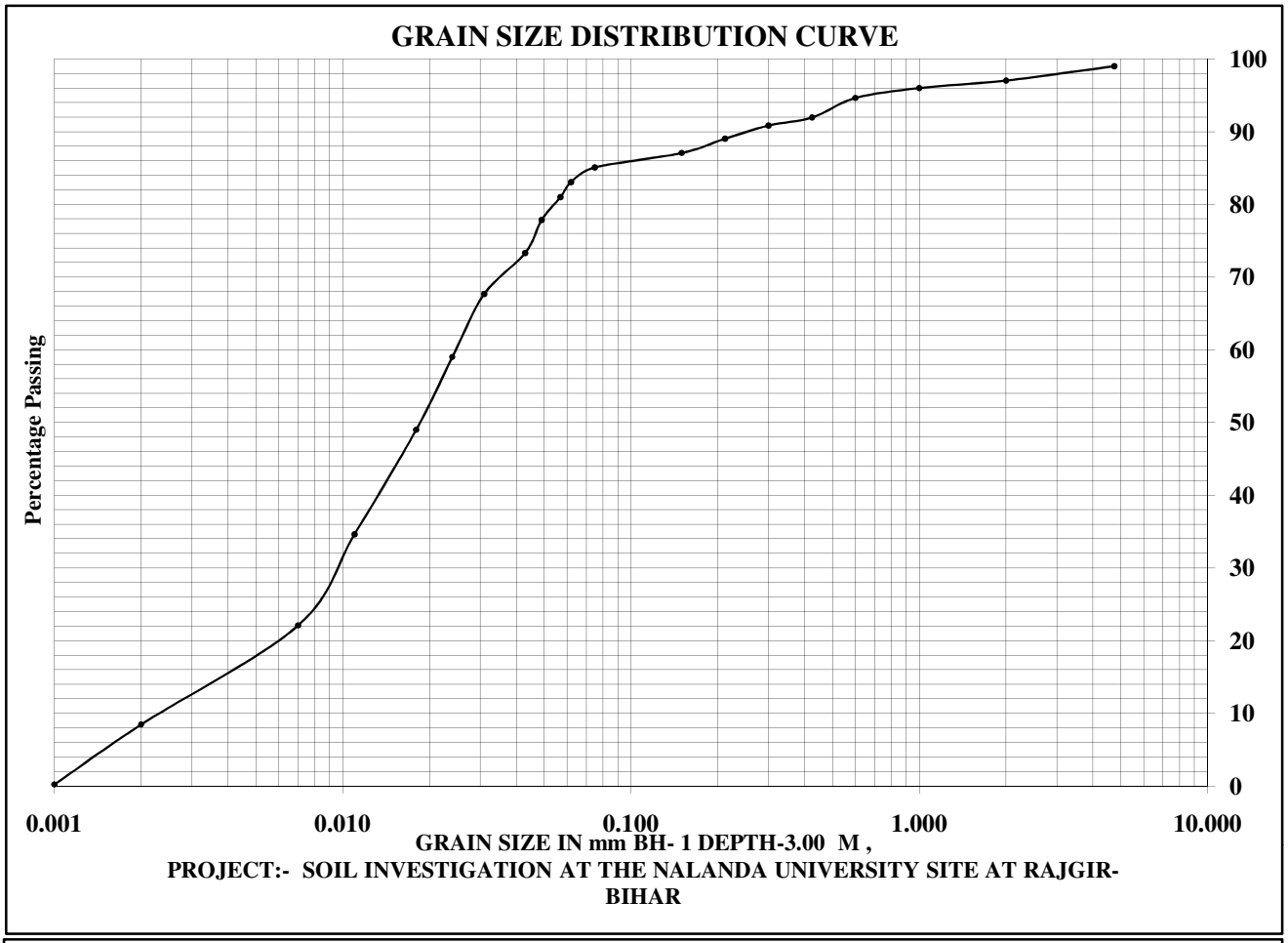
Evaluation of Liquefaction Potential Based on SPT(CRR)								PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.								
		Pa			1.0	Kg/cm2										
Depth Of Water Table Assumed (m) Below EGL					0.0											
Depth Below GL(m)	SPT Field Obsrved Value	Bulk density of Soil(Kg/cm2 *m)	Density of Water(Kg/ cm2*m)	Total Stress Ts	Hydrostatic Pressure Hs	Effective Stress Es(kg/cm2)	% Finer content (FC)	Cσ=1/(18.9-17.3Dr) <=0.3 as per Eq 13 P39	Overburden Correction factor Kσ =(1-Cσ*Ln(σ' v0))as per Eq 12 P39 <=1.0	Cn(Overburden/normalization) =(1/EStress) power m as per Eq 19P40	N1-60(Normalization Factor diamensionless) qty =Cn*qc as per Eq 3 P33	N1-60 cs (Clean Sand =(N1)60 +Δ (N1)60as per Eq 25 P44	Δ (N1)=exp((1.63+9.7/FC-(15.7/FC)2) as per Eq 26 P44	Relative DensityDr =0.478(qc1n) Power 0.264-1.063Eq 14 P39	m=0.784-0.521Dr as per Eq20 P 40 Fig 11	N1-60 cs/14.1as Per Eq 27 P44 (Part) (A)
1.50	5.0	0.188	0.100	0.2820	0.1500	0.1320	86	0.106	1.00	2.75	14	19	5.53	0.55	0.50	1.37
3.00	7.0	0.188	0.100	0.564	0.300	0.2640	86	0.105	1.00	1.95	14	19	5.53	0.54	0.50	1.36
4.50	10.0	0.197	0.100	0.860	0.450	0.4095	84	0.112	1.00	1.54	15	21	5.53	0.58	0.48	1.48
6.00	13.0	0.197	0.100	1.155	0.600	0.5550	83	0.120	1.00	1.32	17	23	5.53	0.61	0.47	1.61
7.50	17.0	0.199	0.100	1.454	0.750	0.7035	83	0.133	1.00	1.17	20	25	5.53	0.66	0.44	1.80
9.00	23.0	0.199	0.100	1.752	0.900	0.8520	80	0.160	1.00	1.07	25	30	5.54	0.73	0.40	2.13

	PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.											
Square (N1-60 cs/126)as Per Eq 27 P44 (Part) (B)	**Cube (N1-60 cs/23.6)as Per Eq 27 P44 (Part) (C)**	**Power4 (N1-60 cs/25.4)as Per Eq 27 P44 (Part) (D)**	**(A+B-C+D-28) as Per Eq 27 P44**	**Liquefaction Potential CRR =Exp((N1)60cs/14.1+((N1)60cs/126))2-((N1)60cs/23.6)3+((N1)60cs/25.4)4) as per Eq 27 P/44**	**Earthquake Moment Magnitude**	**Maximum Ground Accn (of g)**	**a(z)=-1.012-1.126 sin(z/11.73+5.133) as per eq 6bP34**	**bz=0.106+0.118 sin(z/11.28+5.142) as per eq 6cp34**	**rd=exp(a(z)+b(z)*M) as per Eq 6aP34**	**Magnitude scaling factor MSF=6.9*(exp(-M/4))-0.058 as per eq 8a P36**	**Cyclic Stress Ration Under Earthquake CSR m7.5=0.65*(σv0/σ 'v0)rd/MSF as per Eq 23 P43**	**Factor Of Safety**
0.023	0.54	0.33	-1.62	**0.1973**	7.00	0.120	-0.051	0.006	0.992	1.141	**0.145**	**1.361**
0.02	0.53	0.32	-1.63	**0.1960**	7.00	0.120	-0.134	0.015	0.974	1.141	**0.142**	**1.378**
0.03	0.70	0.46	-1.53	**0.2176**	7.00	0.120	-0.231	0.026	0.954	1.141	**0.137**	**1.590**
0.03	0.88	0.63	-1.41	**0.2433**	7.00	0.120	-0.341	0.038	0.931	1.141	**0.132**	**1.837**
0.04	1.25	1.00	-1.21	**0.2996**	7.00	0.120	-0.462	0.052	0.906	1.141	**0.128**	**2.340**
0.06	2.07	1.97	-0.71	**0.4899**	7.00	0.120	-0.591	0.066	0.880	1.141	**0.124**	**3.959**

LIQUIFACTION POTENTIAL OF SUB SOIL STRATA
PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR..
MOMENT MAGNITUDE 7.0 , MAX GROUND ACCELARATION 0.12g)



FACTOR OF SAFETY (I.E. RATIO OF LIQUFACTION RESISTANCES OF THE SUB SOIL STRATA TO SHEAR STRESS INDUCES DUE TO EARTHQUAKE)
PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.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Percentage Passing
100
90
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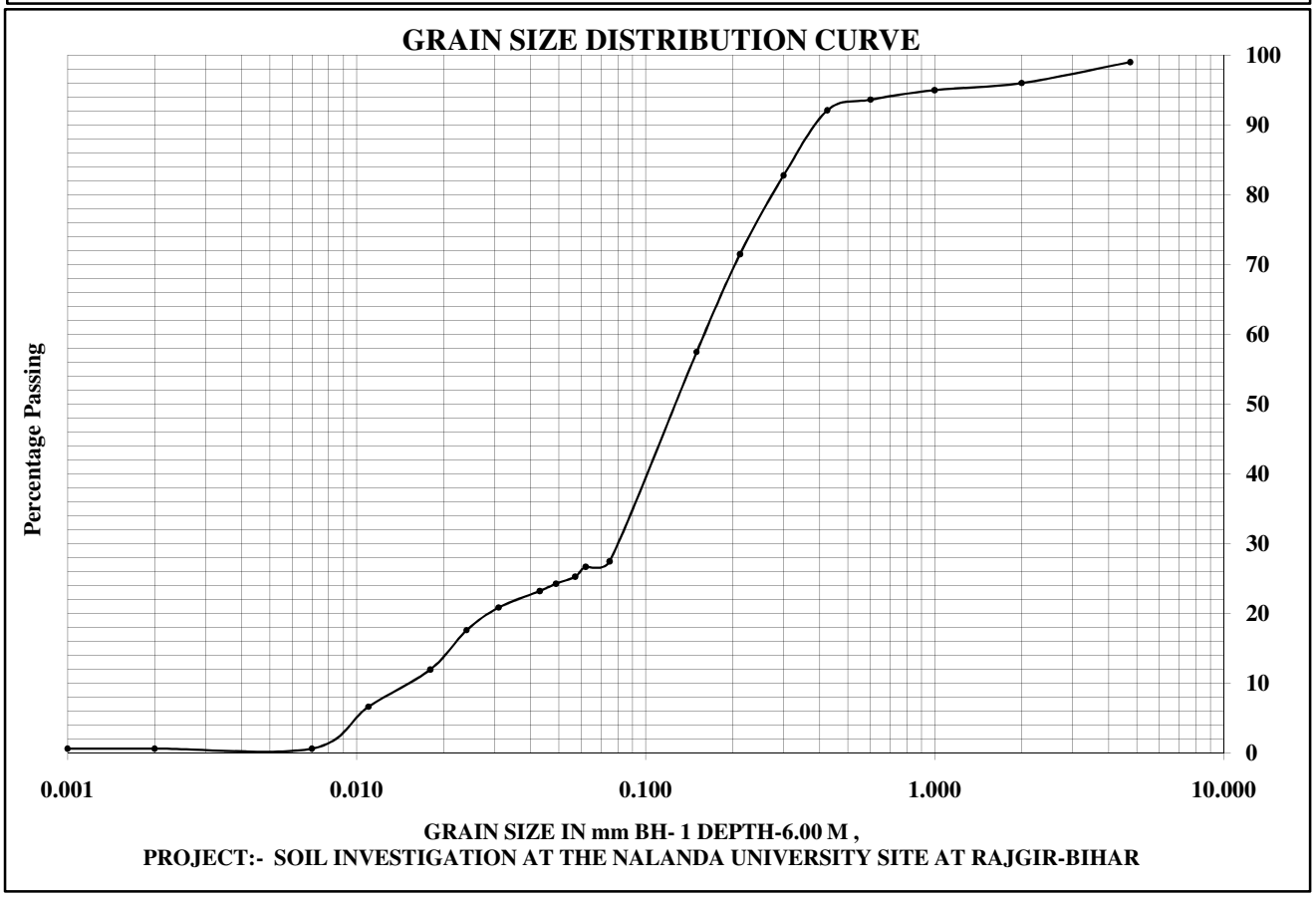
GRAIN SIZE IN mm BH- 1 DEPTH-3.00 M ,
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR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Percentage Passing
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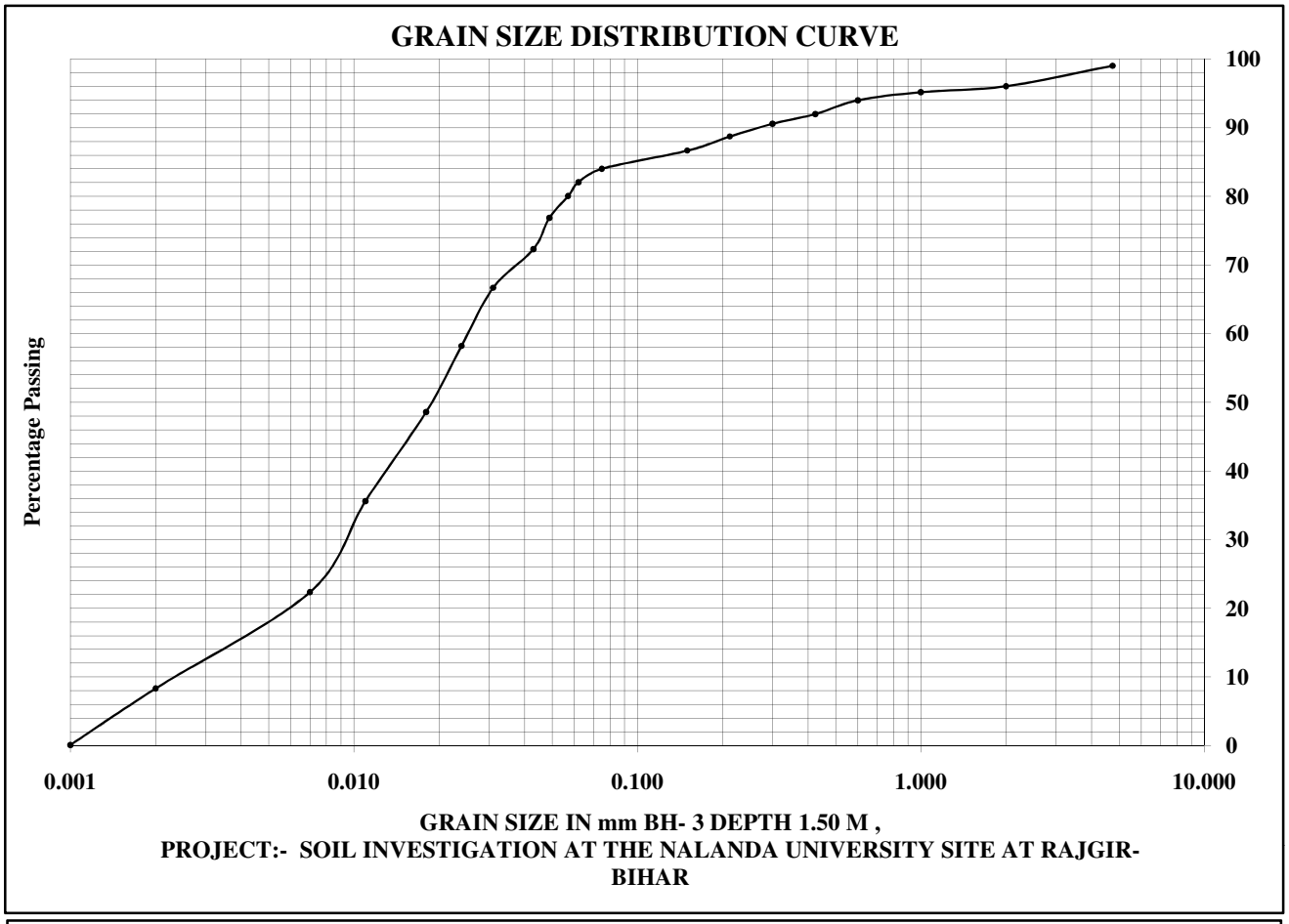
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR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Percentage Passing
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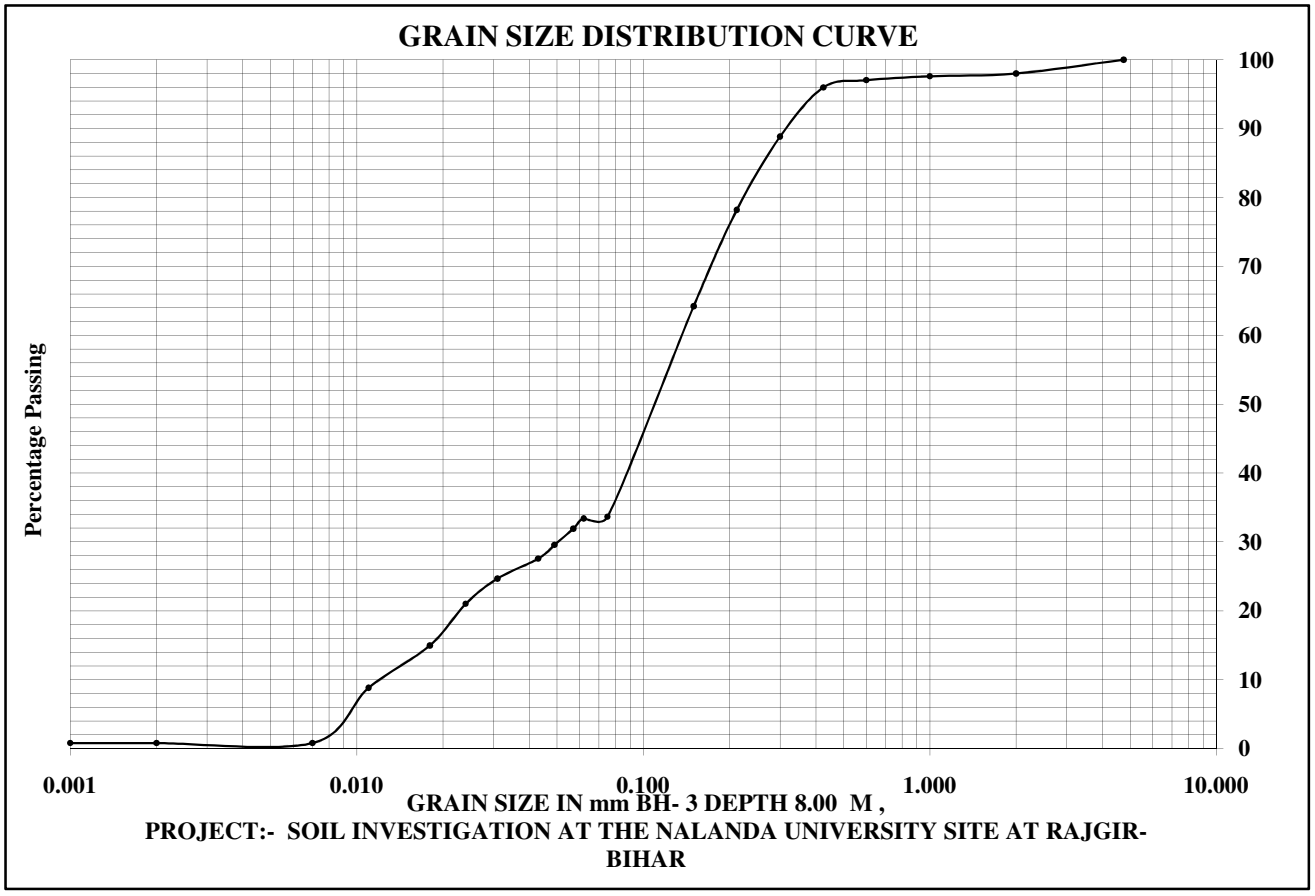
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR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Percentage Passing
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1.000
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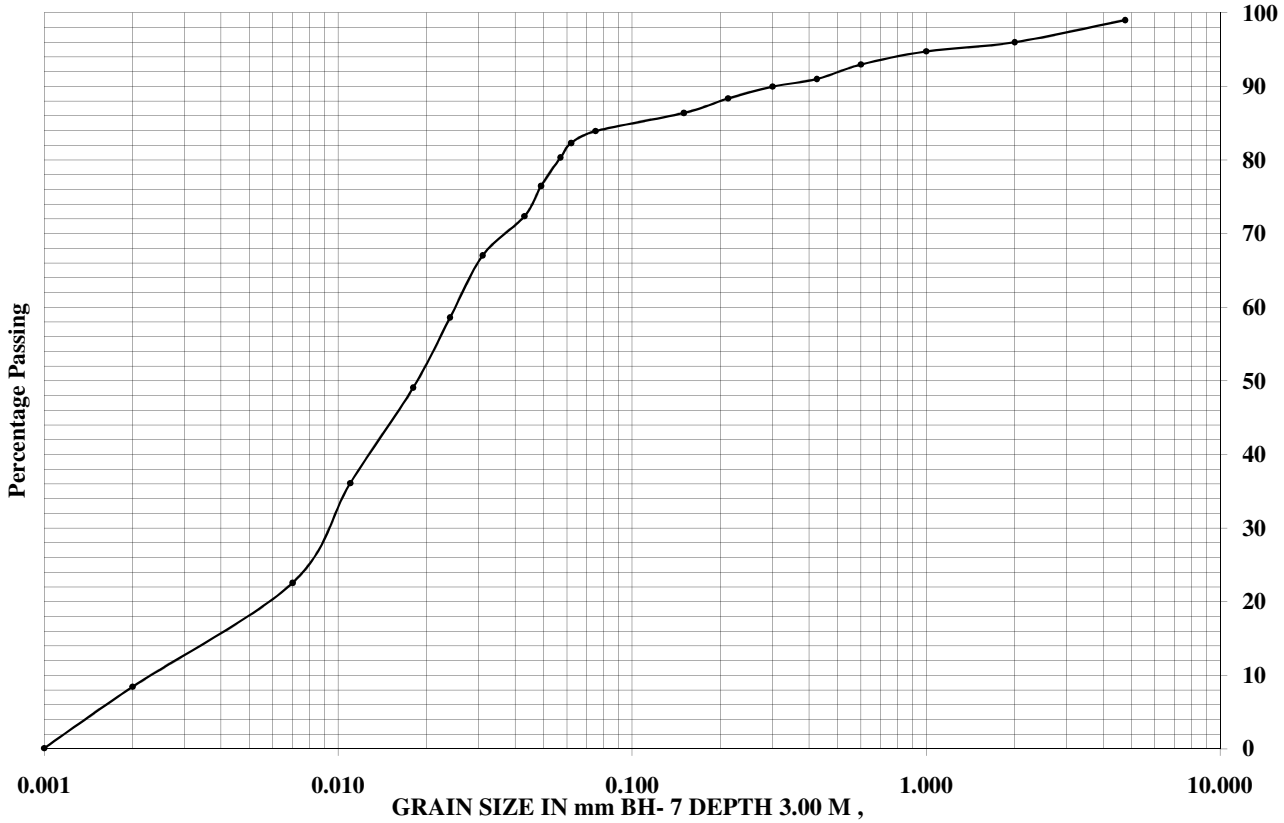
GRAIN SIZE IN mm BH- 3 DEPTH 8.00 M ,
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

GRAIN SIZE DISTRIBUTION CURVE



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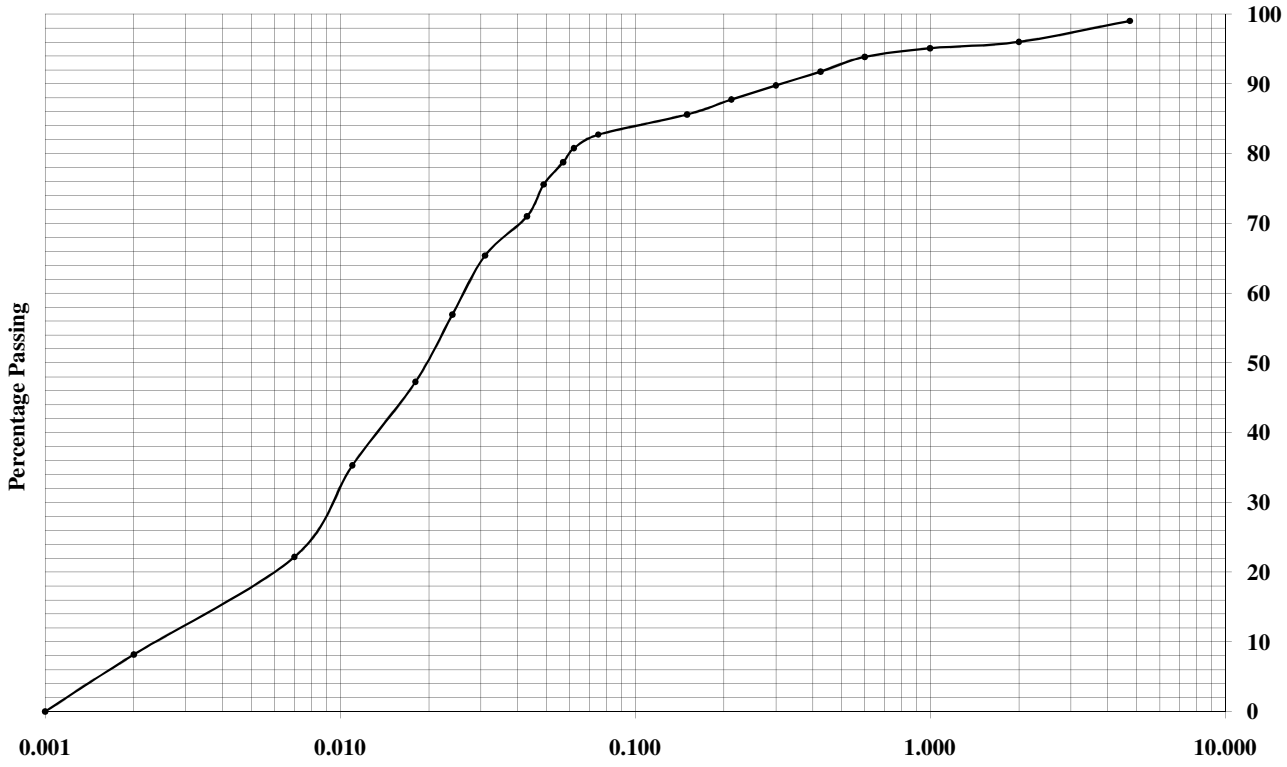
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

GRAIN SIZE DISTRIBUTION CURVE



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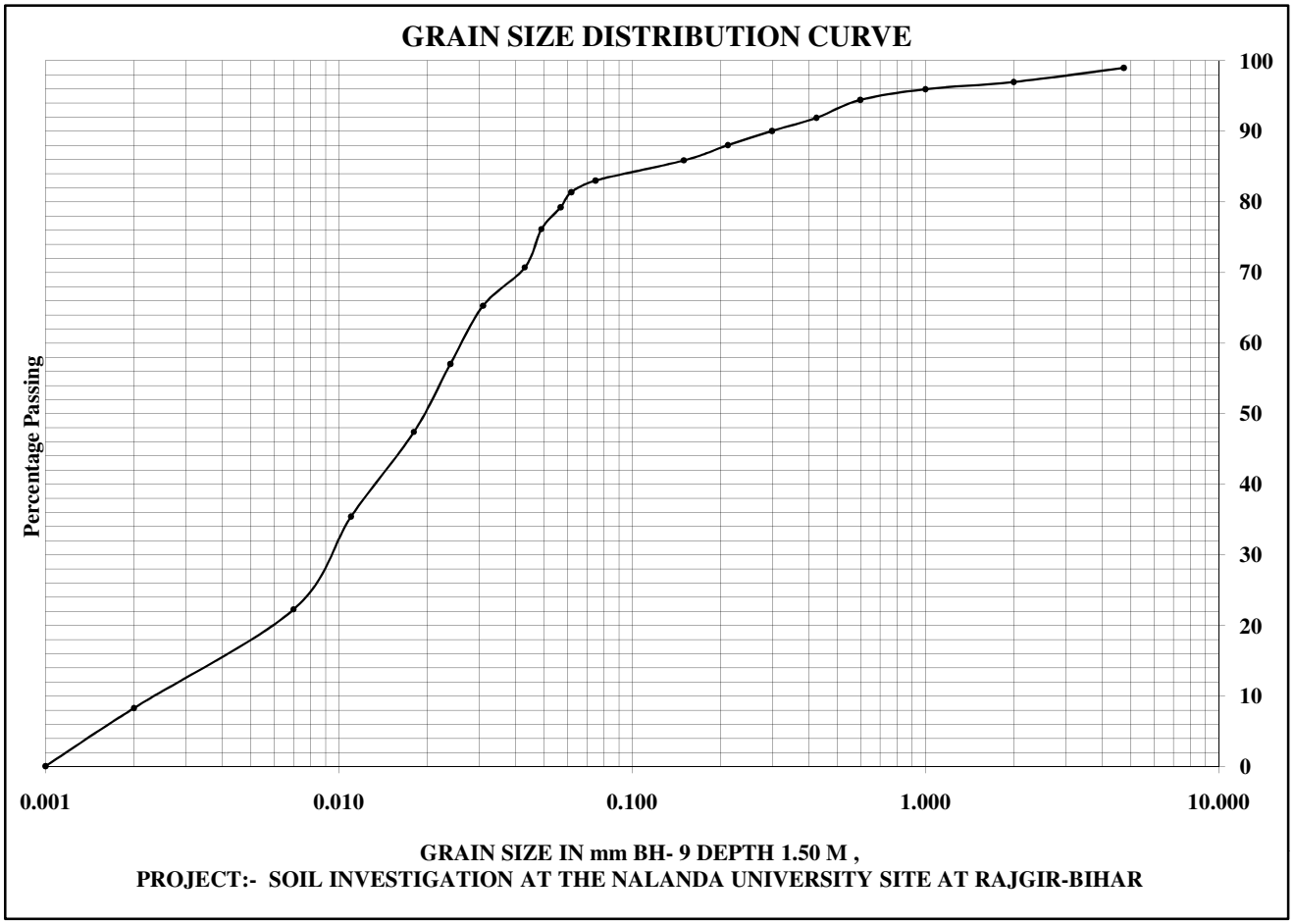
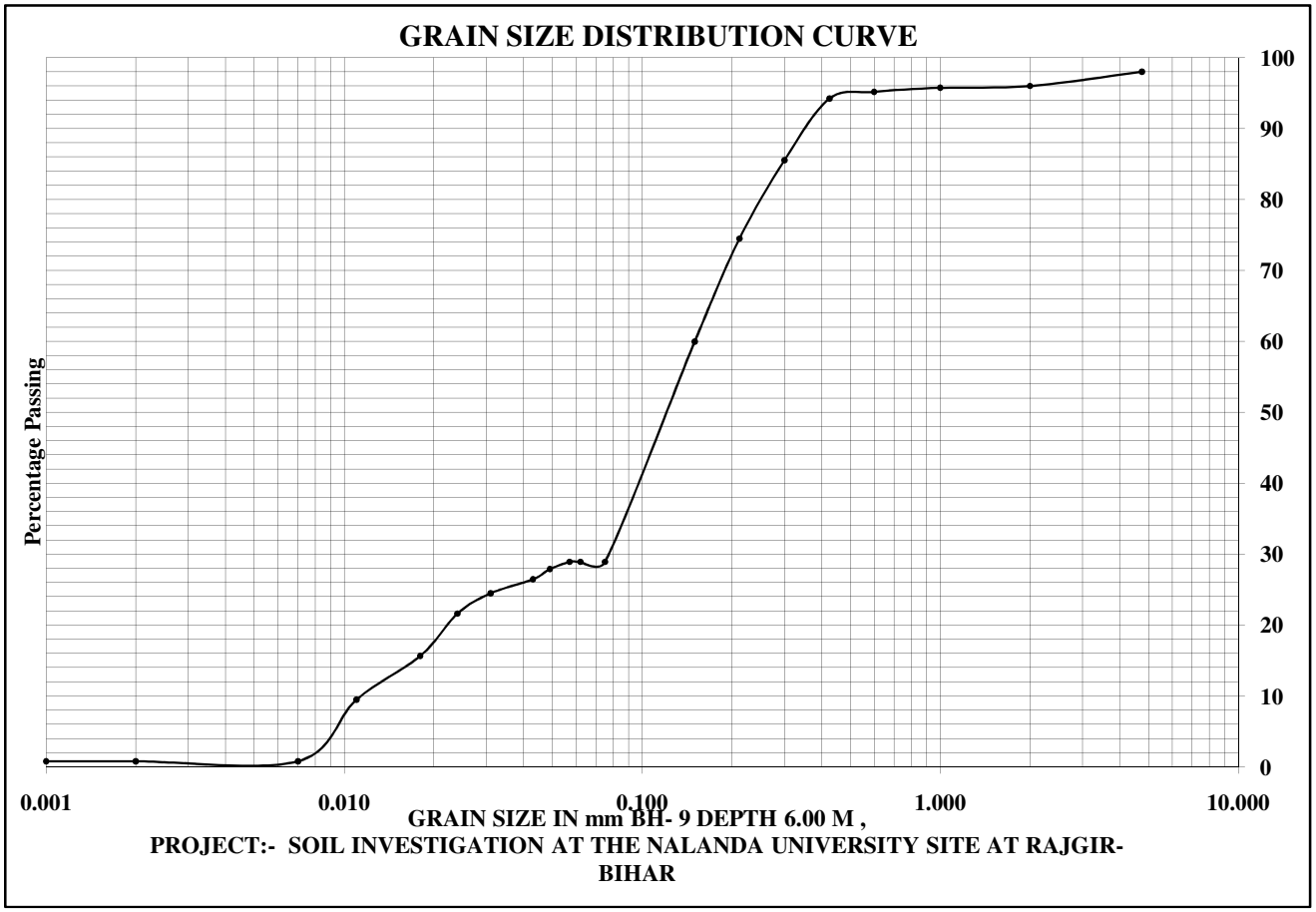
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR


GRAIN SIZE DISTRIBUTION CURVE
Percentage Passing
100
90
80
70
60
50
40
30
20
10
0
0.001
0.010
0.100
1.000
10.000
GRAIN SIZE IN mm BH- 9 DEPTH 1.50 M ,
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR


GRAIN SIZE DISTRIBUTION CURVE
Percentage Passing
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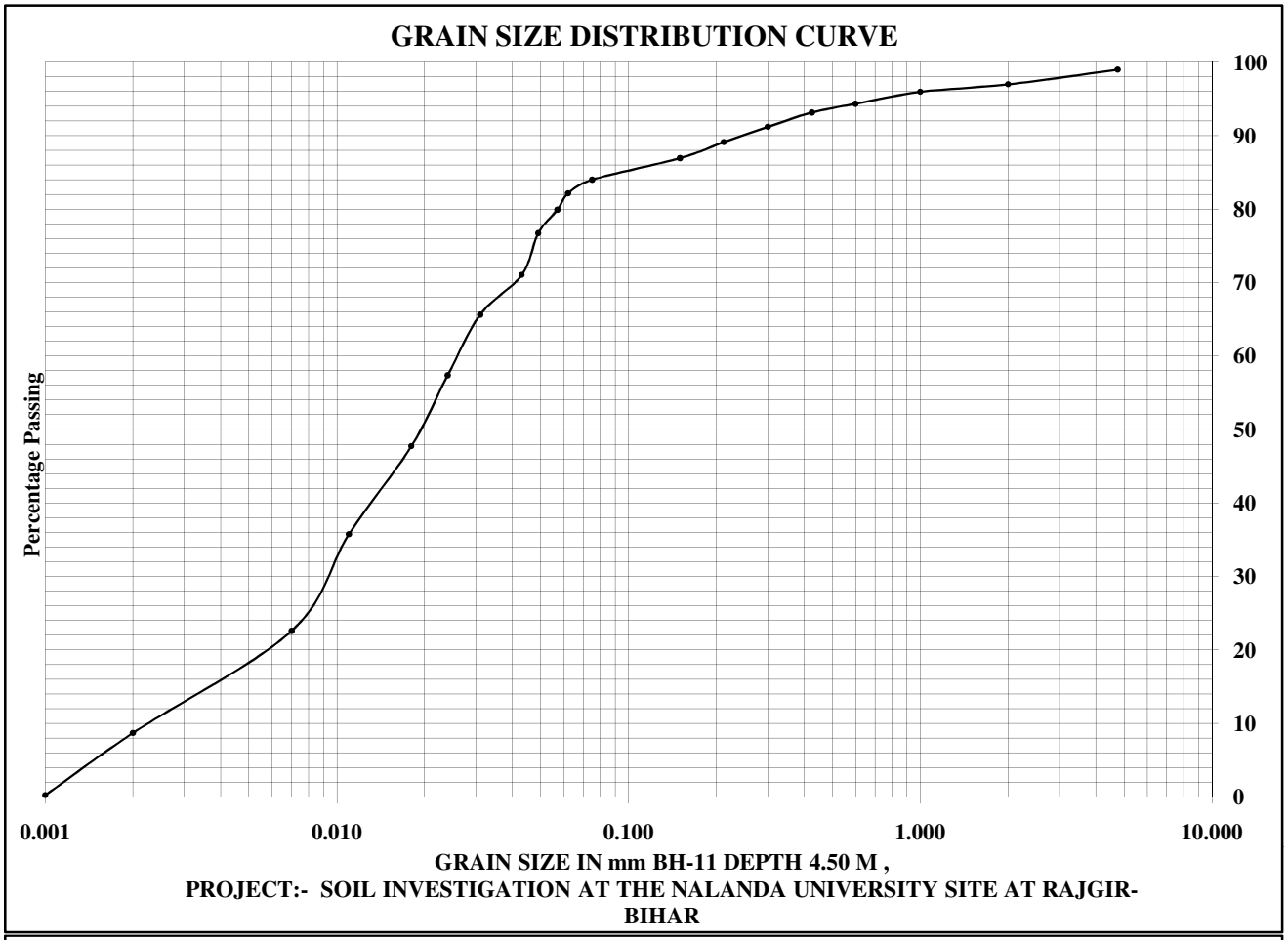
0.001
0.010
0.100
1.000
10.000
GRAIN SIZE IN mm BH- 9 DEPTH 6.00 M ,
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR


GRAIN SIZE DISTRIBUTION CURVE
Percentage Passing
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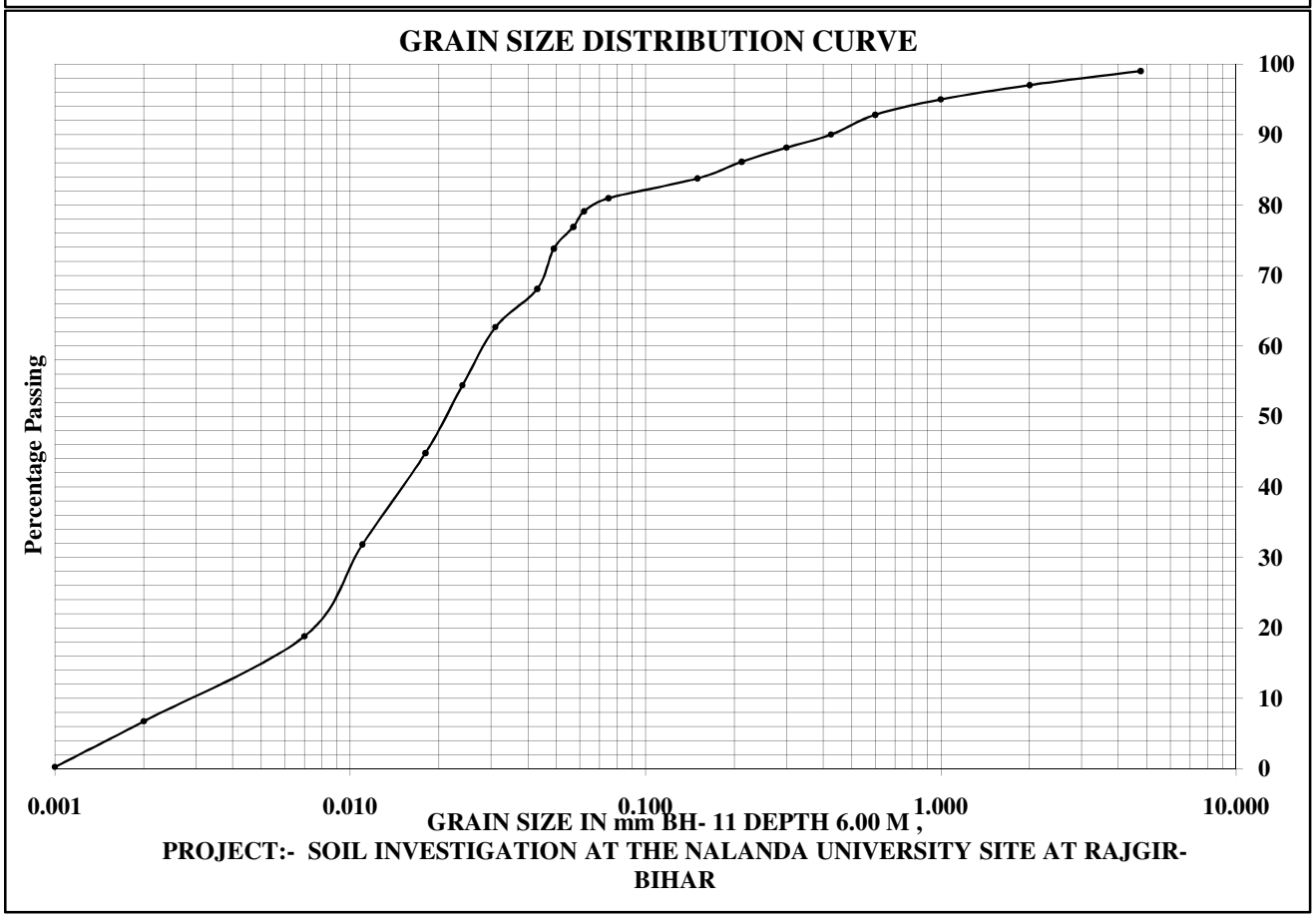
GRAIN SIZE IN mm BH-11 DEPTH 4.50 M ,
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR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Percentage Passing
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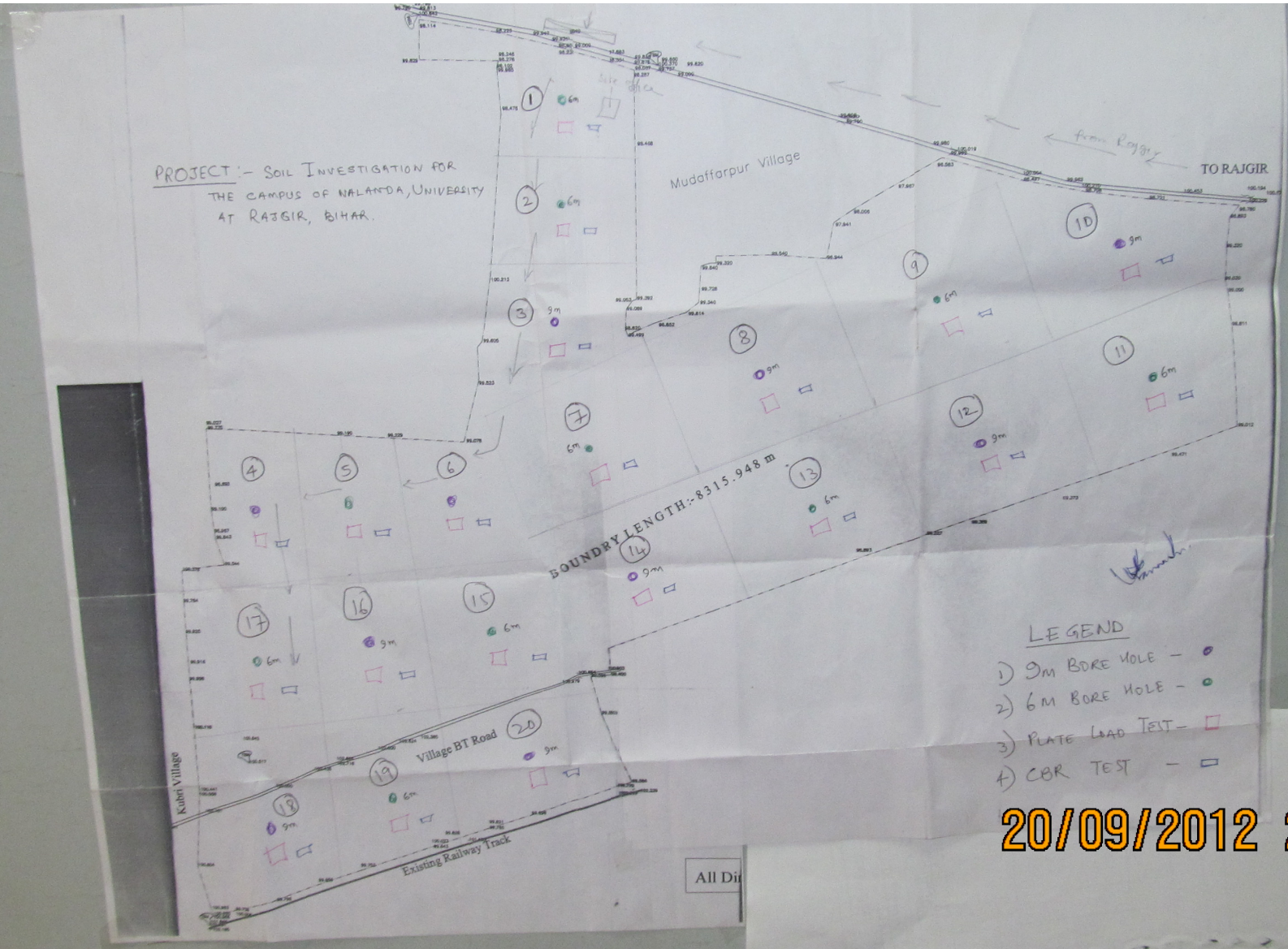
GRAIN SIZE IN mm BH- 11 DEPTH 6.00 M ,
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR



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REPORT ON SOIL RESISTIVITY MEASUREMENT AT M/S. NALANDA UNIVERSITY,BIHAR.

AUDIT CONSULTANT	CUSTOMER
M/S. JEF TECHNO SOLUTIONS PVT. LTD. #07, 13TH CROSS, 30TH MAIN, CT BED EXTENSION, BANASHANKARI 2ND STAGE, PADMANABHA NAGAR BANGALORE-560070.	M/S.NALANDA UNIVERSITY RAJGIR, DISTRICT NALANDA, PIN 803116, BIHAR.
PREPARED BY: PREAMKUMAR V ENGINEER-TECHNICAL SERVICES	**CHECKED AND APPROVED BY:** THAMIZH SELVAN N DEPUTY MANAGER-TECHNICAL SERVICES
SIGN:	**SIGN:**

This Report consist of 25 pages.

REVISION HISTORY:

4				
3				
2	REV-1	FINAL	29/03/2018	SITE PICS & DIRECTION DETAILS ADDED
1	REV-0	DRAFT	28/03/2018	INITIAL SUBMISSION
SL.NO.	**STATUS**		**DATE**	**REMARKS**

Report Generated on 29th March 2018.

SITE DETAILS:

Client Name	M/S. Nalanda University,Bihar.
Client Contact Details	1) Ms. Swati Krishna JE(Electrical),Nalanda University,Bihar. Mob: + 91 9958883290 Email: skrishna@nalandauniv.edu.in 2) Mr.Manoj Kumar AE(Electrical),Nalanda University,Bihar. Mob:+91 7033698507 Email:mkumar@nalandauniv.edu.in
Audit Engineers	Mr. Siddhant Das Mob: +91 7999069685 Email: siddhant@jeftechno.com

ACKNOWLEDGEMENT

We are glad to receive the PO from M/S.Nalanda University, Bihar for soil resistivity measurement and wish to convey our profound Thanks for the same. The Audit was carried on 27th March 2018 and we take this opportunity to thank Nalanda University electrical team for extending their fullest co-operation and support during the Test process and Data Collection.

It is indeed a great pleasure and proud privilege to present this Report.

This report is based on a detail study of Measurement of Soil Resistivity based on IEEE-80/81 standards.

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1. INTRODUCTION

An Earthing System Audit was carried out at M/S.Nalanda University,Bihar. The aim of the audit was to conduct soil resistivity measurement test at Eight locations.

Following Tests and Field Measurements were conducted at site.

- Wenner 4 point Method

2. EXECUTIVE SUMMARY

- The Average soil resistivity of the following eight locations was found to be **9.40 Ohm mtrs.**

Location	Average soil resistivity(ΩM)
Substation A	7.26
Substation B	9.43
Substation C	16.67
Substation D	6.63
Substation E	8.47
Substation F	8.62
Substation G	8.65
Substation H	9.48

- The Ideal Earth Pit Resistance value was calculated based on the respective soil resistivity values as per IS 3043.

3. REFERENCE STANDARDS

- IS 3043-1987 - Code of Practice for Earthing.
- IEE regulations
- BS 7430 - 2011 - Code or Practice for Protective Earthing of Electrical Installations.
- IEEE 81 -2012 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of Ground Systems.

4. DEFINITION

EARTH ELECTRODE (PIT): An earth termination system which carries the fault current to the earth.

RISER CONDUCTOR: A metal strip or conductor which is protruded from the grid conductor to connect the earth point of the exposed metal parts of equipment/earth pits are called as risers.

EARTH LOOP IMPEDANCE: The impedance of the total earth loop as seen by the current in case of a fault. i.e., the total impedance of the loop from the location of the fault to the earth and return. It includes the impedance of secondary winding of the distribution transformer, live conductor, and protective conductor.

PROSPECTIVE FAULT CURRENT (PFC): Value of fault current at a given point in a circuit, which results from a fault of negligible impedance between live conductors that have a difference of potential under normal operating conditions, or between a live conductor and an exposed conductive part.

CIRCUIT BREAKER: A Mechanical switching device that is capable of making, carrying and breaking currents under normal circuit conditions and of making, carrying for a specified time and automatically breaking currents under specified Condition Abnormal circuit conditions such as those of over current.

CONTINUITY: Continuity of earth conductor from equipment to earth pit to ensure the path for fault currents to earth. In cases where the open circuit is encountered, it is suggested to rectify the same immediately.

EARTH ELECTRODE (PIT) RESISTANCE: The measured values of resistances of individual earth pits and grid are tabulated. Measured value of the earth pit indicates that some of the existing earth pits have deteriorated and hence we suggest to have new earth pits in their place to improve reliability.

5. METRES & TEST EQUIPMENT USED FOR FIELD MEASUREMENTS

- Soil Resistivity Measurement - MEGGER DET4TC2, Sl.No.101281799

6. SOIL RESISTIVITY MEASUREMENT TEST

METHODOLOGY:

Soil resistivity was measured using Wenner method (4 point) with spacing range varying from 0.5 to 5 meters. The measured resistance 'R' value was then used to calculate the resistivity using the formula given in IEEE-81.

METHOD OF TAKING SOIL RESISTIVITY:

FOUR POINT METHOD

A good method for measuring the apparent resistivity of large volumes of undisturbed earth is four-point method (Wenner). Four auxiliary probes are installed on the earth, all at depth 'b' and spaced (in a straight line) at intervals 'a'. A test current ' I' is passed between the two outer probes. Then the potential 'V' between the two inner probes is measured with a potentiometer or high impedance voltmeter. Then the V/I Ratio give the resistance 'R' in ohm.

Equally spaced or Wenner Arrangement: With this arrangement, the probes are equally spaced, as shown in figure a. Let 'a' be the distance between two adjacent probes. Then the apparent resistivity ' ρ ' in the terms of the length units in which 'a' and 'b' are measured is

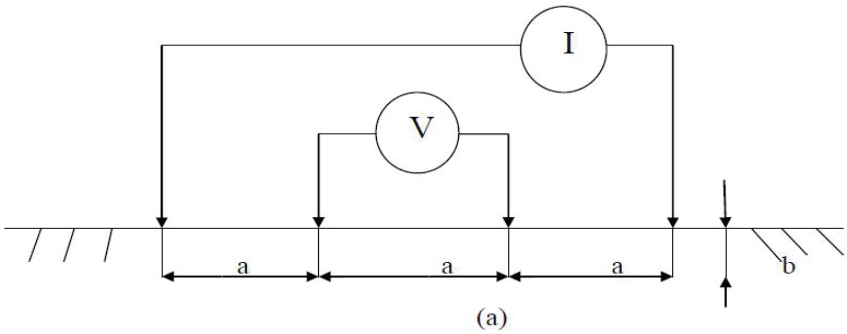
$$\rho_a = \frac{4\pi AR}{1 + \frac{2A}{\sqrt{(A^2 + 4B^2)}} - \frac{2A}{\sqrt{(4A^2 + 4B^2)}}}$$

ρ = Resistivity B = Depth of Probes A = Spacing of Probes R = Resistance (reading from meter)

Theoretically, the electrode should be point contacts or hemispherical electrode of radius 'b'. However, in practice, four electrodes are usually placed in a straight line at interval 'a', driven to a depth not exceeding 0.1a. Then the user can assume b=0 and equation becomes

$$\rho = 2\pi aR$$

then gives the apparent soil resistivity to the depth 'a'.



(a)

A set of readings taken with various probe spacing gives a set of resistivity's that when plotted against spacing, indicates whether there are distinct layers of different soil or rock and gives an idea of their respective resistance and depth.

THIS GRAPH SHOWING RELATION BETWEEN MOISTURE CONTENT AND SOIL RESISTIVITY

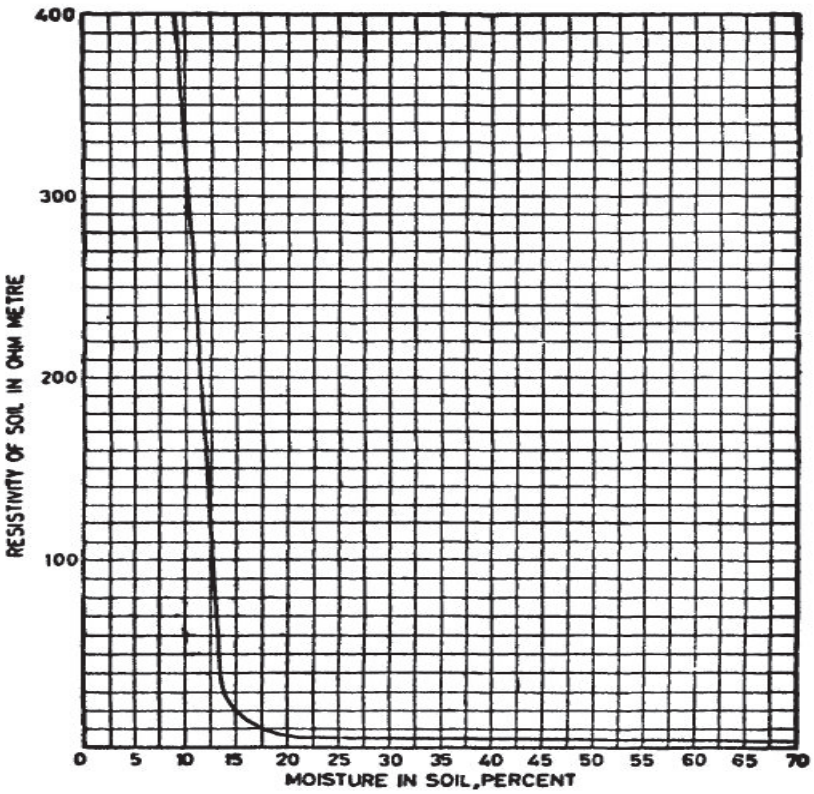
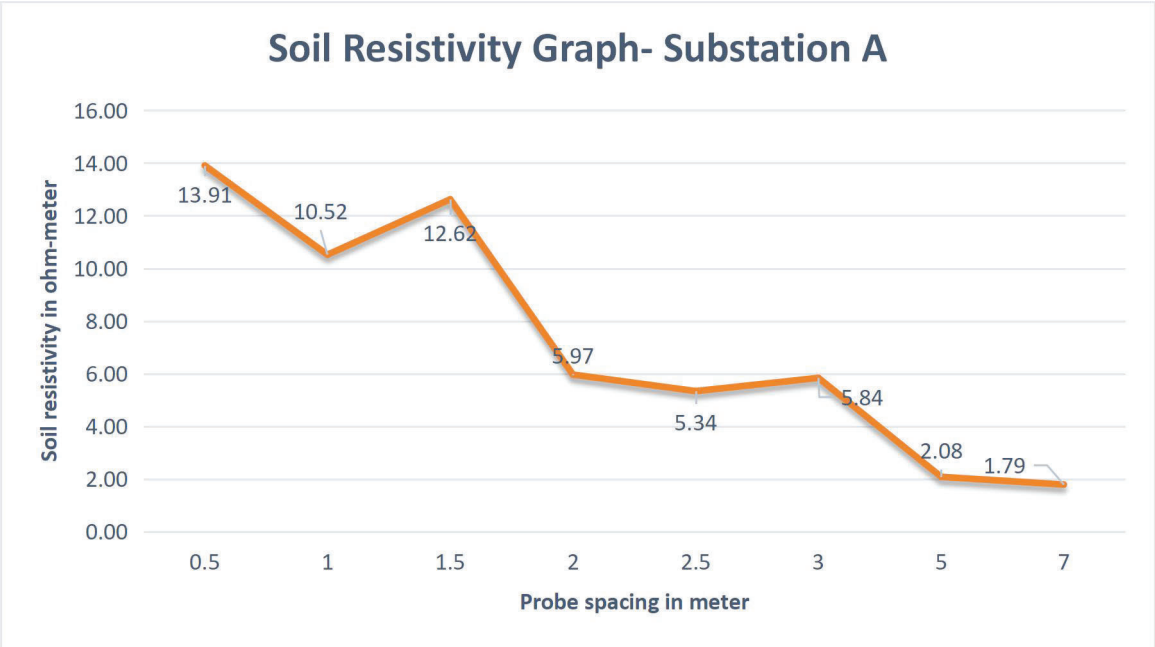


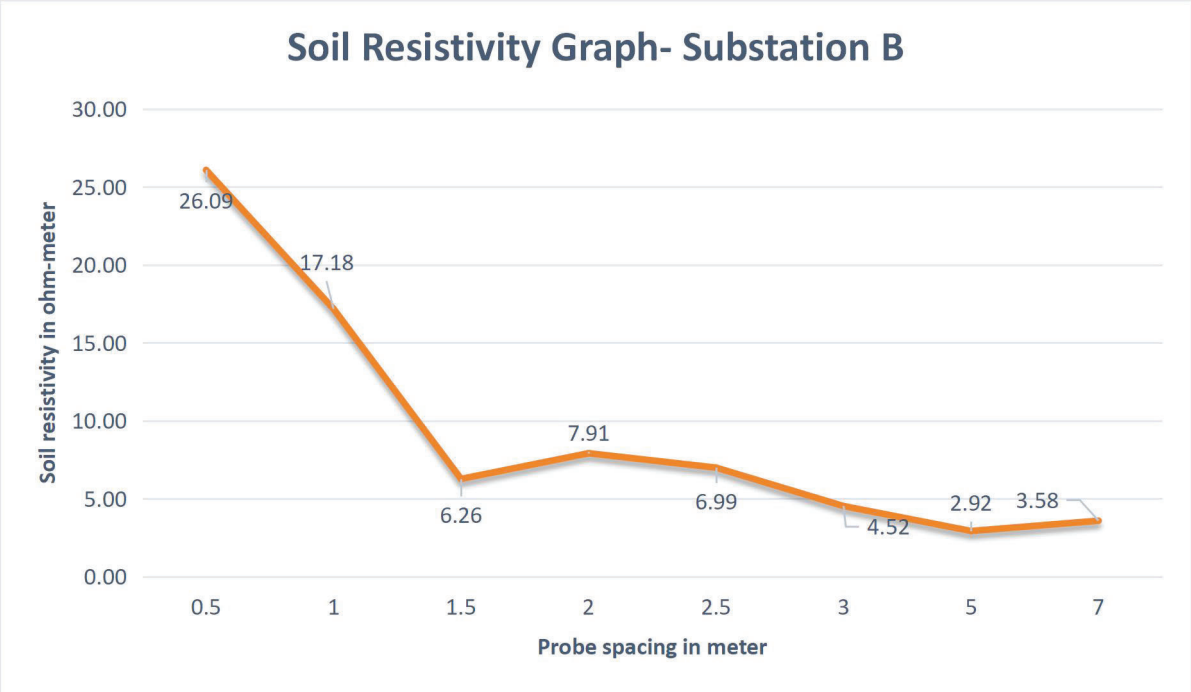
FIG. 9 VARIATION OF SOIL RESISTIVITY WITH MOISTURE CONTENT

SOIL RESISTIVITY MEASUREMENT RESULT :

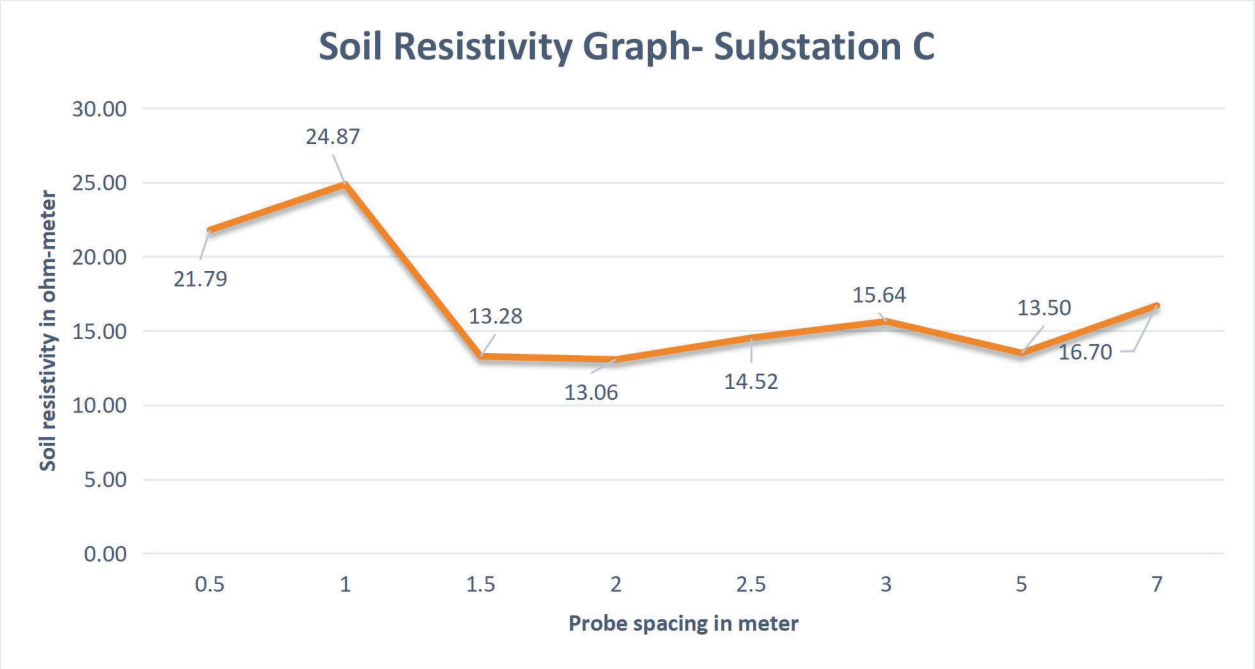
LOCATION No: Substation A						
Sl. No	Probe spacing (m)	Measured Resistance (Ω)		Calculated Resistivity (Ωm)		Average Resistivity
		Direction 1 (N-S)	Direction 2 (W-E)	Direction 1 (N-S)	Direction 2 (W-E)	
1	0.5	4.56	4.3	14.32	13.50	13.91
2	1	1.72	1.63	10.80	10.24	10.52
3	1.5	1.23	1.45	11.59	13.66	12.62
4	2	0.49	0.46	6.15	5.78	5.97
5	2.5	0.33	0.35	5.18	5.50	5.34
6	3	0.3	0.32	5.65	6.03	5.84
7	5	0.13	0.1	4.08	0.08	2.08
8	7	0.08	0.12	3.52	0.06	1.79
Average Soil Resistivity direction wise(Ωm)				**7.66**	**6.86**	
Average Soil Resistivity 7.26 Ohm Meters						



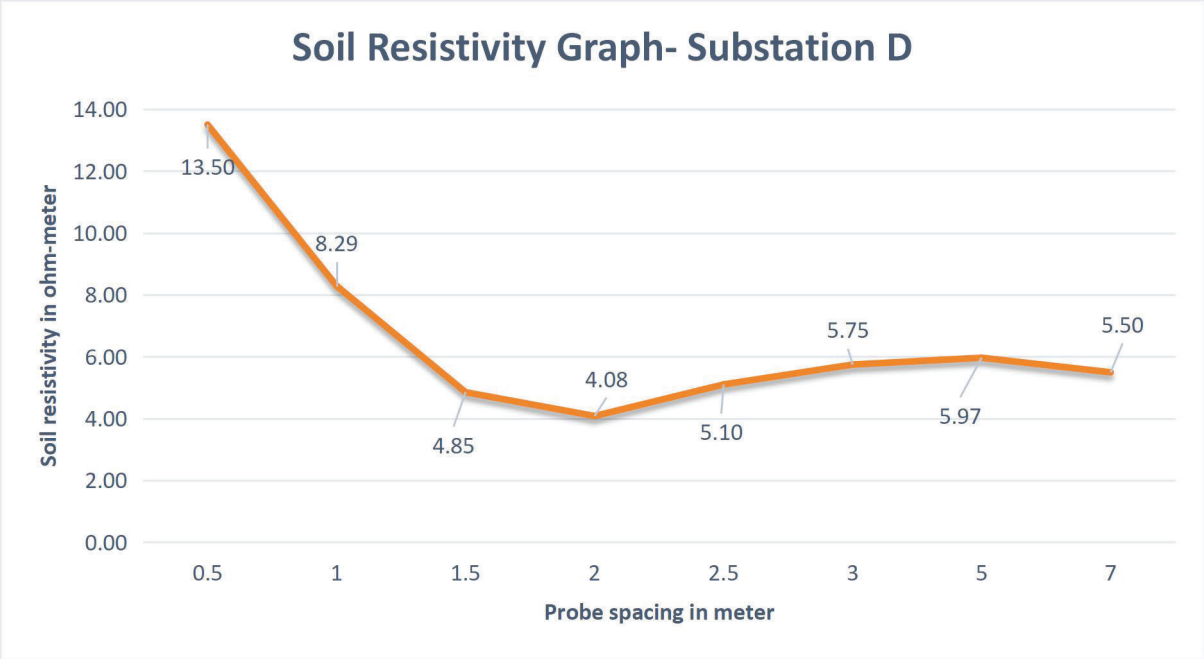
LOCATION No: Substation B						
Sl. No	Probe spacing (m)	Measured Resistance (Ω)		Calculated Resistivity (Ωm)		Average Resistivity
		Direction 1 (SE-NW)	Direction 2 (SW-NE)	Direction 1 (SE-NW)	Direction 2 (SW-NE)	
1	0.5	8.38	8.24	26.31	25.87	26.09
2	1	2.91	2.56	18.27	16.08	17.18
3	1.5	0.61	0.72	5.75	6.78	6.26
4	2	0.61	0.65	7.66	8.16	7.91
5	2.5	0.41	0.48	6.44	7.54	6.99
6	3	0.26	0.22	4.90	4.14	4.52
7	5	0.18	0.17	5.65	0.19	2.92
8	7	0.16	0.13	7.03	0.13	3.58
Average Soil Resistivity direction wise(Ωm)				**10.25**	**8.61**	
Average Soil Resistivity 9.43 Ohm Meters						



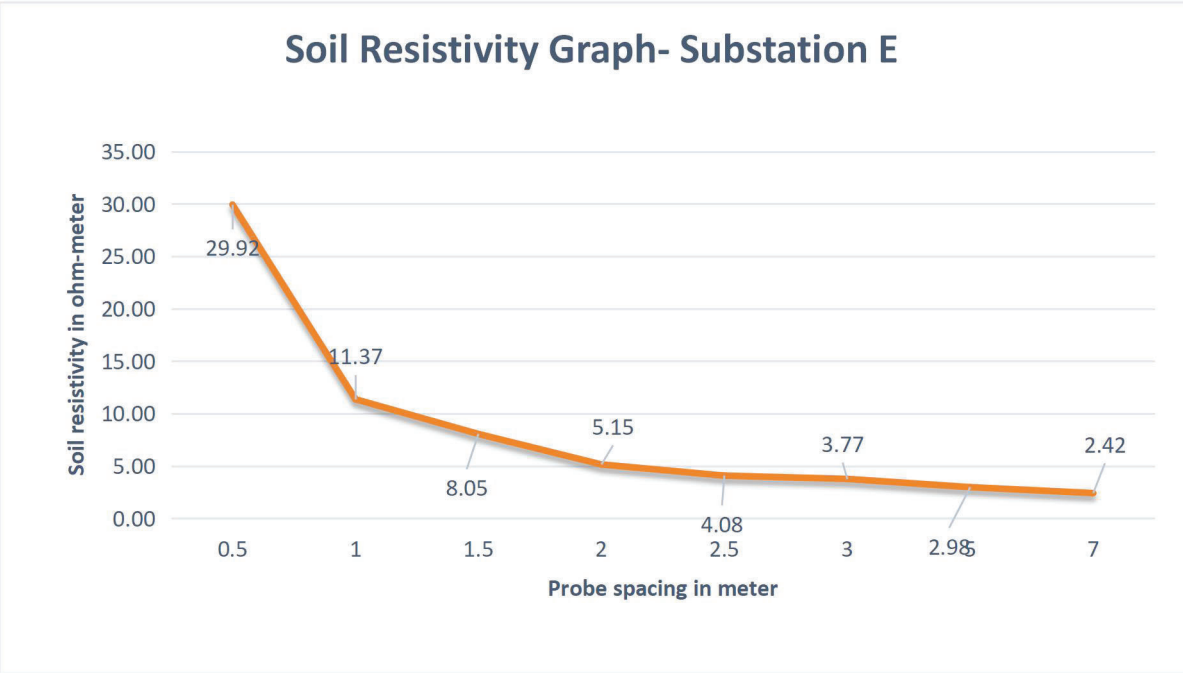
LOCATION No: Substation C						
Sl. No	Probe spacing (m)	Measured Resistance (Ω)		Calculated Resistivity (Ωm)		Average Resistivity
		Direction 1 (W-E)	Direction 2 (S-N)	Direction 1 (W-E)	Direction 2 (S-N)	
1	0.5	6.8	7.08	21.35	22.23	21.79
2	1	3.81	4.11	23.93	25.81	24.87
3	1.5	1.45	1.37	13.66	12.91	13.28
4	2	1.03	1.05	12.94	13.19	13.06
5	2.5	1.13	0.72	17.74	11.30	14.52
6	3	0.91	0.75	17.14	14.13	15.64
7	5	0.39	0.47	12.25	14.76	13.50
8	7	0.34	0.42	14.95	18.46	16.70
Average Soil Resistivity direction wise(Ωm)				**16.74**	**16.60**	
Average Soil Resistivity 16.67 Ohm Meters						



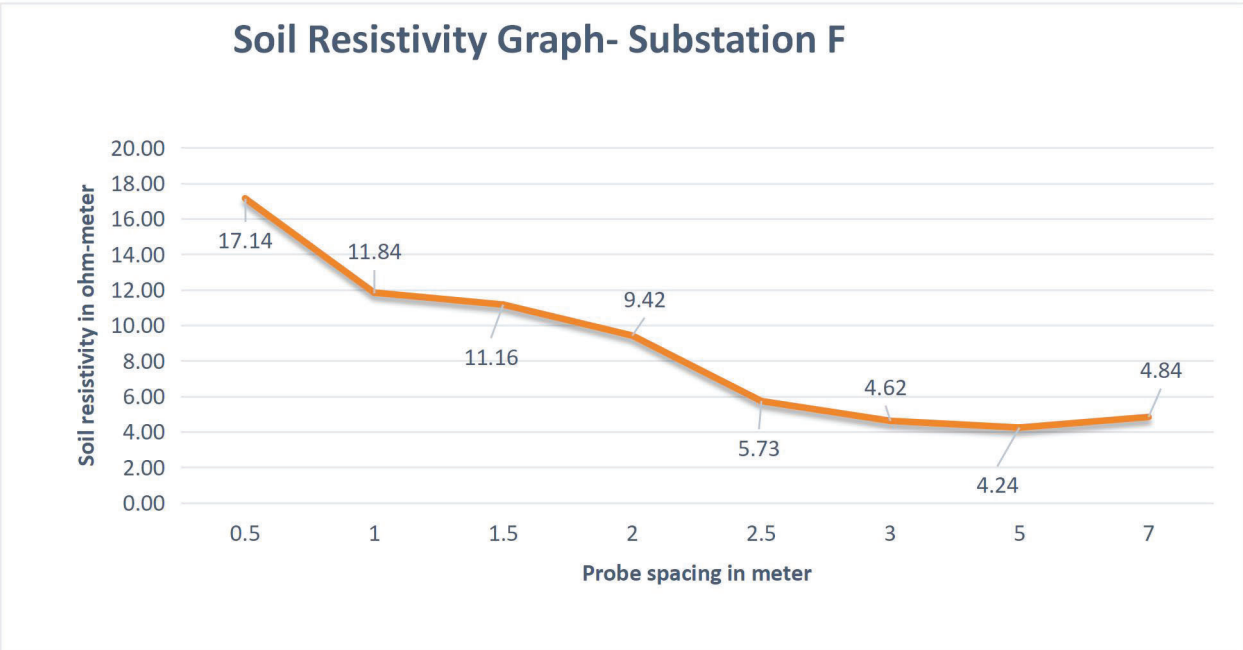
LOCATION No: Substation D						
Sl. No	Probe spacing (m)	Measured Resistance (Ω)		Calculated Resistivity (Ωm)		Average Resistivity
		Direction 1 (E-W)	Direction 2 (S-N)	Direction 1 (E-W)	Direction 2 (S-N)	
1	0.5	3.36	5.24	10.55	16.45	13.50
2	1	1.34	1.3	8.42	8.16	8.29
3	1.5	0.55	0.48	5.18	4.52	4.85
4	2	0.34	0.31	4.27	3.89	4.08
5	2.5	0.29	0.36	4.55	5.65	5.10
6	3	0.3	0.31	5.65	5.84	5.75
7	5	0.18	0.2	5.65	6.28	5.97
8	7	0.12	0.13	5.28	5.71	5.50
Average Soil Resistivity direction wise(Ωm)				**6.19**	**7.07**	
Average Soil Resistivity 6.63 Ohm Meters						



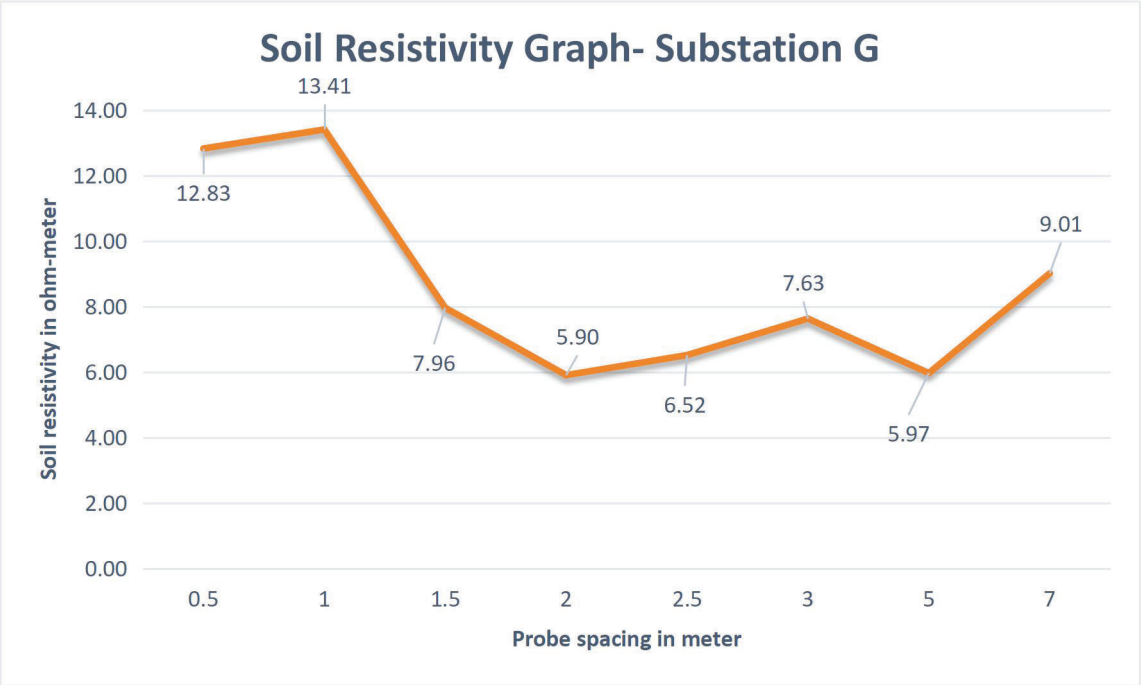
LOCATION No: Substation E						
Sl. No	Probe spacing (m)	Measured Resistance (Ω)		Calculated Resistivity (Ωm)		Average Resistivity
		Direction 1 (S-N)	Direction 2 (W-E)	Direction 1 (S-N)	Direction 2 (W-E)	
1	0.5	12.19	6.87	38.28	21.57	29.92
2	1	1.71	1.91	10.74	11.99	11.37
3	1.5	0.98	0.73	9.23	6.88	8.05
4	2	0.52	0.3	6.53	3.77	5.15
5	2.5	0.27	0.25	4.24	3.93	4.08
6	3	0.2	0.2	3.77	3.77	3.77
7	5	0.11	0.08	3.45	2.51	2.98
8	7	0.04	0.07	1.76	3.08	2.42
Average Soil Resistivity direction wise(Ωm)				**9.75**	**7.19**	
Average Soil Resistivity 8.47 Ohm Meters						



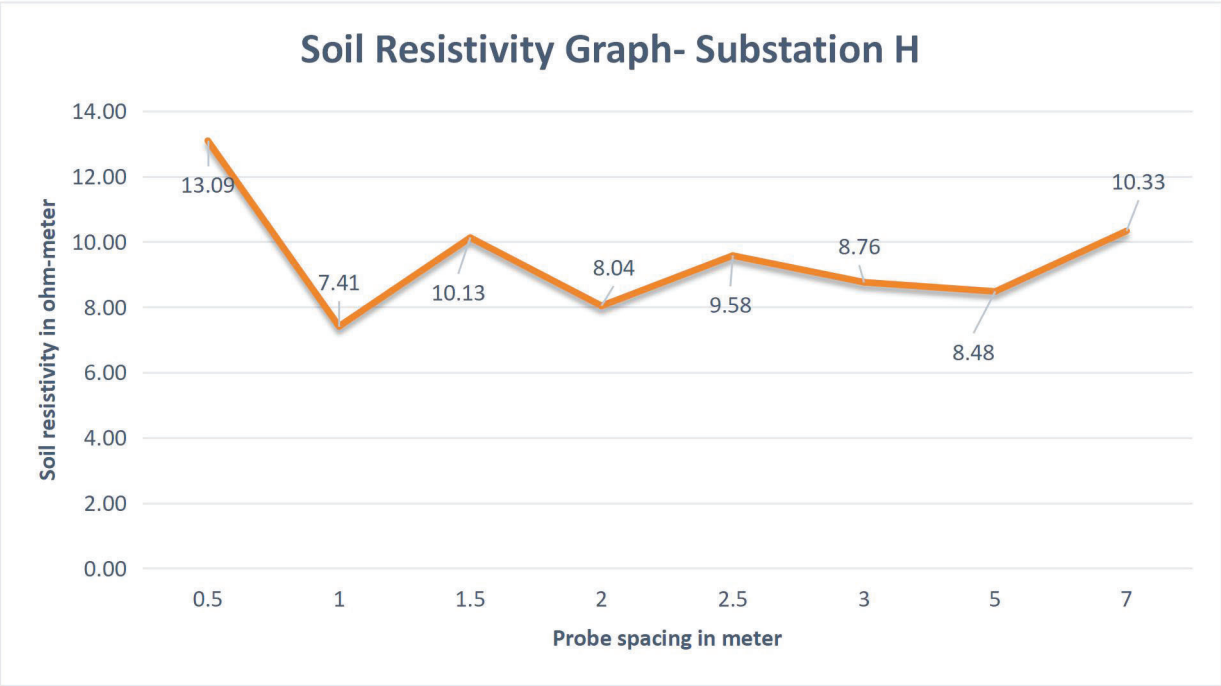
LOCATION No: Substation F						
Sl. No	Probe spacing (m)	Measured Resistance (Ω)		Calculated Resistivity (Ωm)		Average Resistivity
		Direction 1 (S-N)	Direction 2 (E-W)	Direction 1 (S-N)	Direction 2 (E-W)	
1	0.5	5.85	5.07	18.37	15.92	17.14
2	1	2.76	1.01	17.33	6.34	11.84
3	1.5	1.09	1.28	10.27	12.06	11.16
4	2	0.85	0.65	10.68	8.16	9.42
5	2.5	0.36	0.37	5.65	5.81	5.73
6	3	0.26	0.23	4.90	4.33	4.62
7	5	0.16	0.11	5.02	3.45	4.24
8	7	0.08	0.14	3.52	6.15	4.84
Average Soil Resistivity direction wise(Ωm)				**9.47**	**7.78**	
Average Soil Resistivity 8.62 Ohm Meters						



LOCATION No: Substation G						
Sl. No	Probe spacing (m)	Measured Resistance (Ω)		Calculated Resistivity (Ωm)		Average Resistivity
		Direction 1 (E-W)	Direction 2 (N-S)	Direction 1 (E-W)	Direction 2 (N-S)	
1	0.5	4.05	4.12	12.72	12.94	12.83
2	1	2.17	2.1	13.63	13.19	13.41
3	1.5	0.82	0.87	7.72	8.20	7.96
4	2	0.51	0.43	6.41	5.40	5.90
5	2.5	0.42	0.41	6.59	6.44	6.52
6	3	0.42	0.39	7.91	7.35	7.63
7	5	0.2	0.18	6.28	5.65	5.97
8	7	0.22	0.19	9.67	8.35	9.01
Average Soil Resistivity direction wise(Ωm)				**8.87**	**8.44**	
Average Soil Resistivity 8.65 Ohm Meters						



LOCATION No: Substation H						
Sl. No	Probe spacing (m)	Measured Resistance (Ω)		Calculated Resistivity (Ωm)		Average Resistivity
		Direction 1 (S-N)	Direction 2 (E-W)	Direction 1 (S-N)	Direction 2 (E-W)	
1	0.5	4.06	4.28	12.75	13.44	13.09
2	1	1.17	1.19	7.35	7.47	7.41
3	1.5	1.08	1.07	10.17	10.08	10.13
4	2	0.65	0.63	8.16	7.91	8.04
5	2.5	0.6	0.62	9.42	9.73	9.58
6	3	0.47	0.46	8.85	8.67	8.76
7	5	0.29	0.25	9.11	7.85	8.48
8	7	0.23	0.24	10.11	10.55	10.33
Average Soil Resistivity direction wise(Ωm)				**9.49**	**9.46**	
Average Soil Resistivity 9.48 Ohm Meters						



7. CONCLUSION

- Soil Resistivity was carried out at 8 location within campus.
- The average soil resistivity was found to be **9.40 Ohm mtrs**.

8. SITE PHOTOGRAPH:

1.03
Megger
DET4TC2
25/50V
TEST
Hz
OFF
Megger
16 V
5.1 Ω
15.1 Ω
15.1 Ω
20 mA
0.5 Ω
15.1 Ω
Made in the UK
www.megger.com

1.05
Rp
Rc
Megger
25/50V
TEST
Hz
OFF

0.37
Megger
DET4T
25/50V
TEST
Hz
OFF
V
A
Megger

0.47
Megger
DET4TC2
25/50V
TEST
Hz
OFF
V
A

TEST

9 . AUDIT REPRESENTATION

This Report is based on the Health Assessment Audit of the electrical installation carried out by us as per the scope defined in the purchase order referred elsewhere.

- It is our presumption that the data furnished to us by the audit is reliable, factual, accurate and complete in all aspects.
- Some Measurements & Readings were taken as a representative sample prevailing on the date of audit. This may or may not be a true representation of the actual conditions & parameters prevailing at the site.
- Technical Audit is a snap shot in time and the audit findings are based only on observations made and information obtained during the period of the on-site audit.
- While we are responsible for the readings and the reports furnished, we shall not be held liable for any fines, penalties, consequential damages or other sanctions that may be assessed / imposed against the audited facility by any local, state, or central regulatory authority based on any findings reported by us in the audit report.
- This audit has been conducted based on a specific requirement of the client organization and the report issued hereby is for meeting the specific requirement. Any other usage without our knowledge will not bind us for any liability arising from such usage.

10. FWCR

FIELD WORK COMPLETION REPORT

Date: 27/03/18

Place: Rajgir

JEF Techno Solutions had reported to site on 26/03/18 to carry out the Soil Resistivity test work at M/s. Nalanda University Campus & Site Rajgir

ReferencePO : NU/MAIN CAMPUS/2017-18/CLE/5 Dated:- 13/03/18

Details of Work

As per the PO, following site activities are completed:-

1. Soil Resistivity has been carried out at 8 location within campus

M/S JEF Techno had collected the data for detail study. Based on findings and analysis, the detailed report will be submitted by M/s. JEF Techno Solutions in a period of 10 working days from the date of MOM.

For M/S. Nalanda University

For M/S. JEF TECHNO SOLUTIONS,

Siddhant

Siddhant Das

VASTU-SHILPA CONSULTANTS AHMEDABAD 27/3/18

11.ANNEXURE-1: CALIBRATION CERTIFICATE

Equipment Name: MEGGER DET4TC2 Serial No: 101281799

BELTRONICS CALIBRATION LAB

bcl Since 2004

59, VENKATESHWARA LAYOUT, 6TH MAIN, APPURAO ROAD, CHAMARAJPET, BENGALURU - 18.
PHONE : 22427146, FAX : 26600901 E-mail : beltronicslab@gmail.com / beltronicslab@yahoo.in
Website : www.beltronicsindia.com

NABL ACCREDITED LABORATORY

C-0271 C-0849 C-1265

CALIBRATION CERTIFICATE

Customer Name And Address :	M/s . Jef Techno Solutions Pvt Limited. 7, 13th Cross, 30th Main CT Bed Road, Banashankari 2nd Stage, Bengaluru - 560 070

CAL CERTIFICATE NO	CALIBRATION DATE	CALIBRATION DUE ON	PAGE NO
SRF : 2479 04	15 September 2017	15 September 2018	1 of 2

Details of Device Under Calibration (DUC) :

Nomenclature :	Digital Earth Resistance Tester		
Make :	Megger	Recieved on :	14 September 2017
Model :	DET4TC2	Condition on Receipt :	Satisfactory
Sl.No :	101281799	Cal Procedure :	BCL/CAL/313
ID.No :	---	Calibrated At :	ET Lab
Environmental Condition :	Temperature: 25° ± 2°C & RH. 35% to70%		

Standards Used

Nomenclature	Make, Model	SL.No	Traceable To	Cert. No. / Cal Validity
Resistance Source	Beltronics, 605	405	BCL(B)	2289 01 - 24-02-2018
Digital Micro Ohm Meter	Motwane,LR2065	A03099F15	ETDC	CR/ECAL/48906 - 19-01-2018
The Standards Used are traceable to National Standards				

* Note:-

1. This Calibration Certificate relates only to the above DUC.
2. Calibration Certificate shall not be reproduced except in full, without the written approved from BCL
3. Result reported are valid at the time of and under the stated condition of measurement.
4. Any error in this report should be brought to Our knowledge within 45 days from the date of this certificate.
5. The usage of NABL Symbol is as per given in NABL Guidelines NABL - 133
6. Correction/Erasing Invalidate the Calibration Certificate

CALIBRATED BY		AUTHORISED SIGNATORY
Devika M	BELTRONICS CALIBRATION LAB # 59, Venkateshwara Layout, 6th Main, Appurao Road, Chamarajpet BENGALOORU-18	
Name & Designation		Name & Designation
Devika M /Cal Engineer		A.Anantha Swamy / CEO

Nālandā UNIVERSITY

BELTRONICS CALIBRATION LAB

bcl Since 2004

Cal Certificate No :	2479 04	Page No:	2 of 2

Calibration Results

Resistance measurement setting : 4P

Sl No	Parameter	Range	STD Input		DUC Reading		Error Claimed(±)	Error Observed(±)		Measurement Uncertainty (±)	
1	Resistance	20 Ω	5	Ω	4.93	Ω	0.13	-0.07	Ω	0.008	Ω
2			10		9.93		0.23	-0.07		0.010	
3		200 Ω	50		49.9		1.3	-0.1		0.065	
4			100		100.0		2.3	0.0		0.083	
5		2 kΩ	500		500		13	0		0.649	
6			1000		1002		23	2		831.316	
7		20 kΩ	5	kΩ	4.99	kΩ	0.13	-0.01	kΩ	0.006	kΩ
8			10		10.01		0.23	0.01		0.008	

Resistance measurement setting : V clamp & I clamp

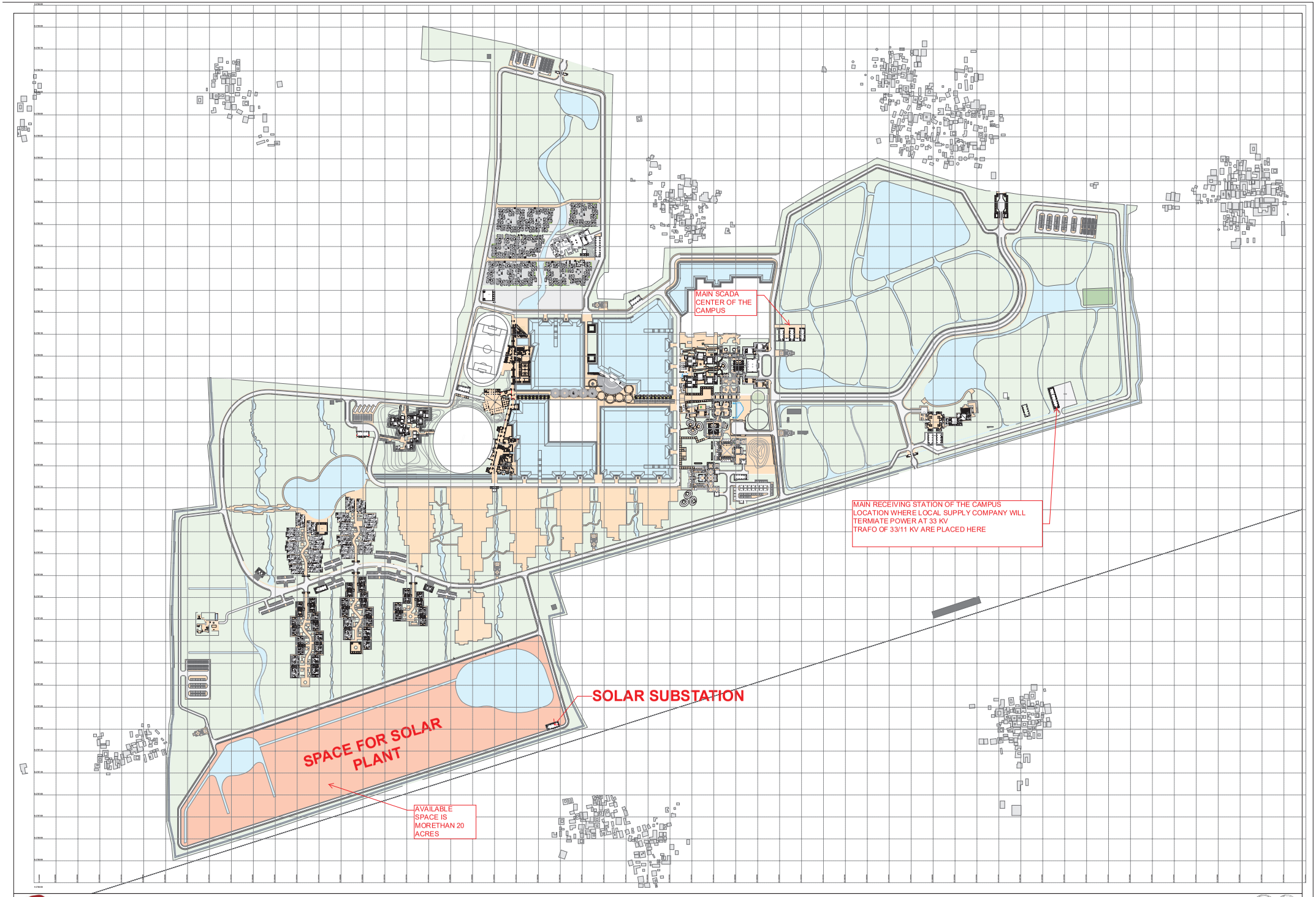
Nomenclature :	Vclamp	I clamp
Make :	Megger	Megger
Model :	----	----
Sl No :	101308275	101311793

Sl No	Parameter	Range	STD Input		DUC Reading		Error Claimed(±)	Error Observed(±)		Measurement Uncertainty (±)	
9	Resistance	199 Ω	0.90	Ω	0.89	Ω	0.09	-0.01	Ω	0.008	Ω
10			9.89		9.9		1.0	0.0		0.060	
*11			99.85		86.2		7.3	-13.7		0.130	

Remarks

1. "*" Indicates that the DUC Out of accuracy limit.
2. Measurement Uncertainty Reported is at 95 % Confidence level with K=2

CALIBRATED BY		AUTHORISED SIGNATORY
Devika M	BELTRONICS CALIBRATION LAB # 59, Venkateshwara Layout, 6th Main, Appurao Road, Chamarajpet BENGALOORU-18	
Name & Designation		Name & Designation
Devika M / Cal Engineer		A.Anantha Swamy/ CEO



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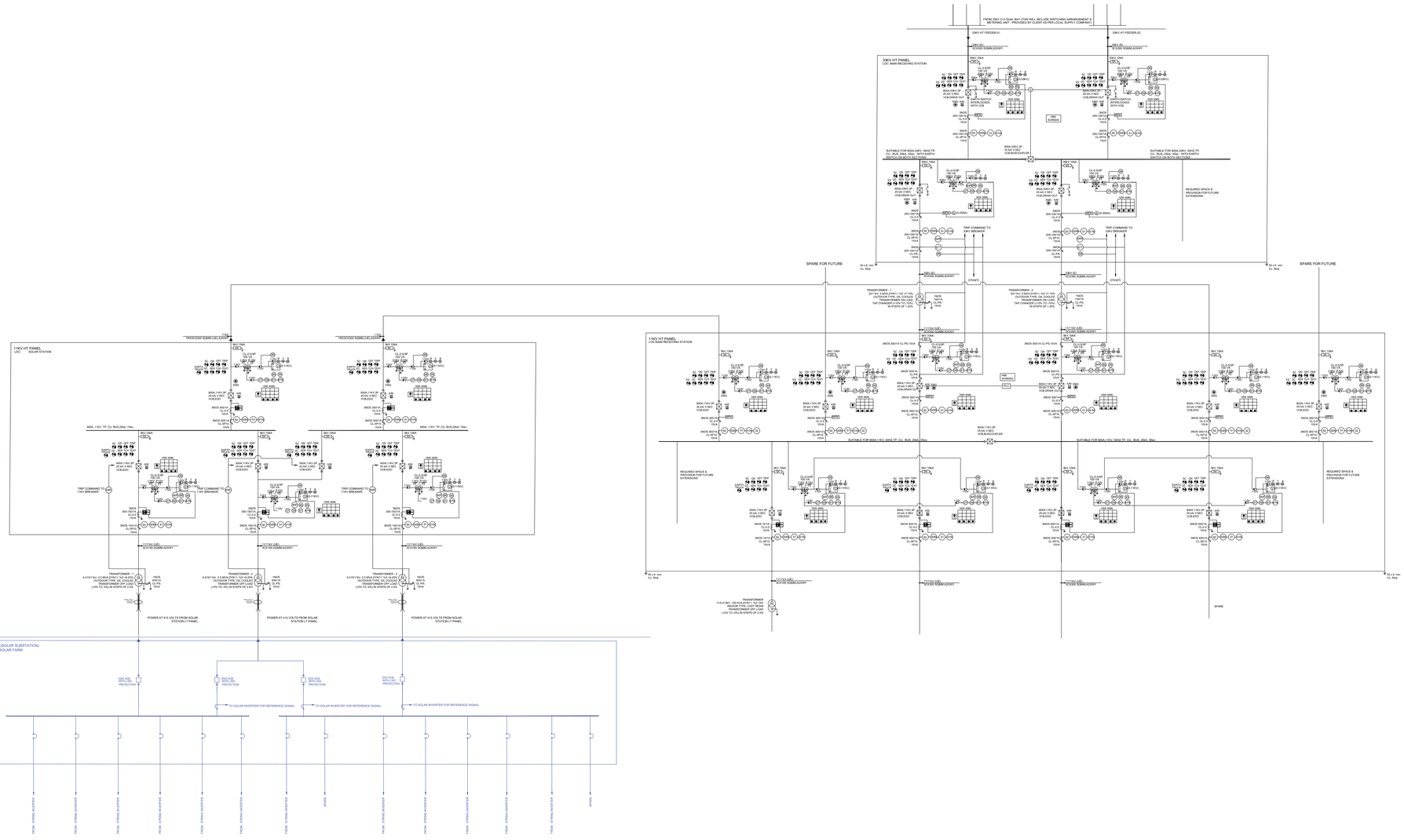

SLD FOR SCOPE CARITY OF PKG 4C - SOLAR

LEGEND

	TRANSFORMER
	VACUUM CIRCUIT BREAKER
	EARTH
	CURRENT TRANSFORMER
	ISOLATOR
	INDICATION LAMPS
	SC - SPRING CHANGED
	SP - SERVICE POSITION
	TP - TEST POSITION
	CSH - CONTROL SUPPLY HEALTHY
	LTPB - LAMP TEST PUSH BUTTON
	TCPB - TRIP COIL PUSH BUTTON
	ETPB - EMERGENCY TRIP PUSH BUTTON
E/F	EARTH FAULT RELAY
KWH	KILLO WATT HOUR METER
MFM	MULTI FUNCTION METER
E/M I	ELECTRICAL MEC. INTERLOCK
49	MACHINE OR TRANSFORMER THERMAL RELAY
27	UNDER VOLTAGE RELAY
59	OVER-VOLTAGE RELAY
51	AC TIME OVER-CURRENT RELAY
51N	TIME DELAY GROUND FAULT RELAY
V	VOLTMETER
VSS	VOLTMETER SELECTOR SWITCH
ASS	AMMETER SELECTOR SWITCH
A	AMMETER
	FUSE
	ANNUNCIATOR
	POTENTIAL TRANSFORMER
	CURRENT TRANSFORMER
27	UNDER VOLTAGE RELAY
59	OVER VOLTAGE RELAY
81	FREQUENCY RELAY
47N	PHASE SEQUENCE RELAY
86	LOCKOUT RELAY
TVM	TRIVECTOR METER
50	INSTANTANEOUS OVER CURRENT RELAY
50N	INSTANTANEOUS EARTH FAULT RELAY
51	AC TIME OVER CURRENT RELAY
51N	EARTH FAULT RELAY
SA	SURGE ARRESTER
95	PT FUSE FAILURE RELAY
60F	DC FAIL RELAY
98	NUMERIC RELAY FOR TRANSFORMER OTI AND WTI
64R	RESTRICTED EARTH FAULT RELAY
87B	BUS BAR DIFFERENTIAL PROTECTION RELAY
	HOOTER
A/M	AUTO / MANUAL SWITCH

NOTES :

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL OTHER RELATED DOCUMENTS FOR THIS PROJECT.
2. KINDLY REFER SCHEDULE E5.00 FOR FURTHER DETAILS.
3. ANY DEVIATION IN THIS DRAWING WITH RESPECT TO ANY OTHER RELATION DOCUMENT VIZ. BOQ, SPECIFICATION etc. SHALL BE BROUGHT INTO THE NOTICE OF THE CONSULTANT WELL IN ADVANCE.
4. NAME PLATES ON EACH PANEL SHALL DENOTE :
   4.1 PANEL TAG
   4.2 LOAD (IN KW)
   4.3 LOCATION
   4.5 VOLTAGE / S C LEVEL
5.EARTHING SHALL BE DONE IN ACCORDANCE WITH IEEE 80:2000.
6. ALL PANELS SHALL BE COMPATIBLE WITH SCADA.
7. ADDITIONAL (SPARE) 6 NOS. NO+NC CONTACT TO BE PROVIDED WITH EACH BREAKER.
8. ALL BREAKERS AND METERS SHALL BE COMMUNICABLE WITH SCADA, ADEQUATE SPARE DI/DO TO BE PROVIDED.
9. ALL HT & LT PANLES, BUS-BARS SHALL BE EXTENSIBLE TYPE FOR FUTURE EXPANSION
10.All Relays shall be Numerical relay with IEC 61850 communication protocol over RS 485

NOTES & INFORMATION

1. ANY DISCREPANCY FOUND SHALL BE BROUGHT TO THE NOTICE OF THE ARCHITECTS / ENGINEERS.
2. ALL DRAWINGS TO BE READ IN CONJUNCTION WITH RELEVANT STRUCTURAL, ARCHITECTURAL AND SERVICES DRAWINGS.
3. TERMINAL COMPARTMENT SHOULD BE PROVIDED TO TERMINATE 25 NOS CABLES OF 3.5C X 400 SQ.MM A2XFY CABLES FOR MLTP OF ACADEMIC SUBSTATION.

FOR TENDER

No.	Date.	Remarks.
Revisions		

Date	Prints	Issued to	Date	Prints	Issued to
Distribution of Prints					

Consultants

- ○ **Structural Consultants**
  VR SHAH Consulting Engineers
- ● **Services Consultants**
  dle MEP Services Consultants
- ○ **Landscape Consultants**
  Earthscapes Consultancy Pvt Ltd
- ○ **Road and Pathways Consultants**
  Arhmm Infra Consultants LLP

Project

Nalanda University, Rajgir, Bihar

Title

MASTER SINGLE LINE DIAGRAM HIGH SIDE – RELATED TO SOLAR PART PKG 4C

Dealt : V	Drawing No. NU–E–MSLD_4C
Checked : V	
Scale : N.T.S	Approved : V
Date : 14.9.2019	

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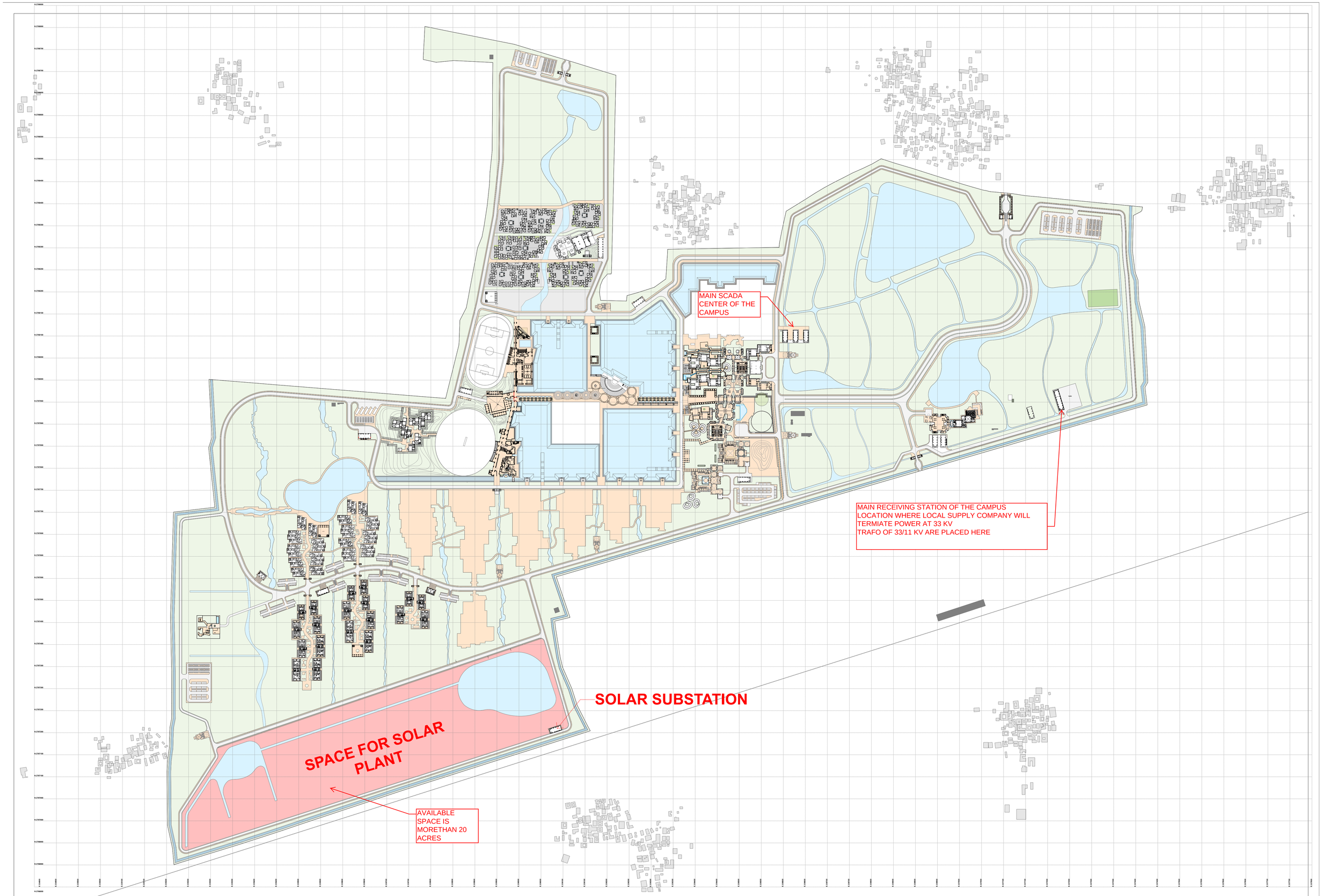

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