#### Dt: 11.06.2020

Corrigendum to Tender PACKAGE- 4C ENGAGING DESIGN, PROCUREMENT, INSTALLATION, COMMISSIONING & TESTING CONTRACTOR FOR SETTING UP 5 MW GRID CONNECTED GROUND
MOUNTED SOLAR PV SYSTEM AT PERMANENT CAMPUS OF NALANDA UNIVERSITY, RAJGIR, BIHAR.

Sr. No	Description as per Tender Document	to be read as
1	Title Page:- TENDER FOR ENGAGING CONTRACTOR FOR SETTING UP 5000 KW AC, 1.5ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM INCLUDING DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING UNDER EPCC MODE AT PERMANENT CAMPUS (PHASE I)	TENDER FOR ENGAGING CONTRACTOR FOR SETTING UP 5000 KW AC, 1.3ILR or Better/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM INCLUDING DESIGN, PROCUREMENT, INSTALLATION, TESTING & COMMISSIONING UNDER EPCC MODE AT PERMANENT CAMPUS (PHASE I)
2	Technical Specification, Make List, Item - Modules - Shall be Domestic Manufactured Only: Waaree/Vikram/PV- Powertech/REC/LG/VS	Technical Specification, Make List, Item - Modules - Shall be Domestic Manufactured Only: Waaree/Vikram/PV- Powertech/REC/LG/VS / Adani /BHEL/CEL
3	Technical Specification, Make List, Item - Inverter - Schneider/Delta/ABB/SMA/Huwai	Technical Specification, Make List, Item - Inverter - Schneider/Delta/ABB/SMA/Huwai/Solar Edge/Hitachi / Siemens
4	Technical Specification, Make List, Item - Optimizer - Solar edge / equivalent	Technical Specification, Make List, Item - Optimizer - Solar edge / Tigo Energy /Enphase- equivalent
5	NIT - Page 173 3.1 Net Minimum Guaranteed Generation (NMGG) to be quoted should be as follows, Year NMGG for 5000 KW Plant in Units(KWH) 1st Year 570000000 or higher	3.1 Net Minimum Guaranteed Generation (NMGG) to be quoted should be as follows, Year NMGG for 5000 KW Plant in Units(KWH) 1st Year 85,00,000 or higher
6	Technical Specification, 2.1.21 - The Contractor has to design, supply, installation & testing of required complete Plumbing system for cleaning of solar modules etc as may be required.	The Contractor has to design, supply, installation & testing of required complete Plumbing system for cleaning of solar modules etc as may be required. Ediquet 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.
7	NIT Document- Page 3,11 - Last Date of Submission of Tender - Date & time - Last Date of Bid submission on 14th April upto 3.30 PM	NIT Document- Page 11 - Last Date of Submission of Tender - Date & time - Last Date of Bid submission on 22.06.2020 upto 3.30 PM/as per CPPP
8	Notice Inviting Tender, Clause-1- Performance Guarantee, Page-83 - " The contractor needs to submit an additional performance guarantee of 5% of the tendered cost for the DLP as well as AMC period of total 7 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 5% which shall be valid till the completion of the DLP and AMC period combined."	Notice Inviting Tender, Clause-1- Performance Guarantee, Page-83 - " The contractor needs to submit an additional performance guarantee of <b>10%</b> of the Comprehensive O&M amount for the DLP & O&M period of total 7 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."
9	Notice Inviting Tender, Clause-9- Payment of Final Bill, Page-97 - " 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 O&M period."	Notice Inviting Tender, Clause-9- Payment of Final Bill, Page-97 - " 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."
10	Notice Inviting Tender, Clause-5.18- Payment of Final Bill, Page 164 - " Performance Guarantee of <b>5</b> % (Ten percent) of the Contract Value of comprehensive O&M amount in the form of Bank Guarantee/ FDR, valid up to entire O&M period."	Notice Inviting Tender, Clause-5.18- Payment of Final Bill, Page-164 - " Performance Guarantee of <b>10</b> % (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 the State Bank of India, valid up to entire <b>DLP &amp;</b> O&M period."
11	Notice Inviting Tender, General Guidelines for Bidders, Clause- 2 - Definitions-Sub Clause 2.8: Page-42 "Bidder" shall mean and refer to an individual, proprietary firm, firm in partnership, limited company (private or public), joint venture or corporation but shall not include a special purpose vehicle."	Notice Inviting Tender, General Guidelines for Bidders, Clause-2 - Definitions -Sub Clause 2.8: Page-42 "Bidder" shall mean and refer to an individual, proprietary firm, firm in partnership, limited company (private or public), corporation but shall not include a special purpose vehicle." Joint Venture Shall not be Allowed.
12	Form E- Structure of Organization- Point-7 - Page-55- "Has the bidder or any constituent partner in case of partnership firm/Limited Company/Joint Venture, ever been convicted by a court of law? If so, give details."	Form E- Structure of Organization- Point-7 - Page-55 "Has the bidder or any constituent partner in case of partnership firm/Limited Company, ever been convicted by a court of law? If so, give details."

13	Service Level Agreeement Format - Clause 2- General Terms, Sub clause 2.5- Relationship of Parties-Page-201 - "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, joint venture, agency relationship or otherwise between the parties."	Service Level Agreeement Format - Clause 2- General Terms, Sub clause 2.5- Relationship of Parties-Page-201 - "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.
14	Notice Inviting Tender- Schedule F- Clause 7 - Page-68 - Payment on Intermediate Certificate to be regarded as Advance - "Minimum Value shall be Rs. 2.0 Crores per Running Bill. (this limit of Rs. 4.0 crore will not apply to the first running bill and last running bill preceding the final bill) "	"Minimum Value shall be Rs. 2.0 Crores per Running Bill. (this limit of <b>Rs. 2.0 crore</b> will not apply to the first running bill and last running bill preceding the final bill) "
15	Integrity Agreement -Article 7- Sub Clause 3 - Page 28- "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."	"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. <b>In case of Consortium, the Lead partner shall have to meet all the eligibility criterias</b> <b>that has been laid down in the NIT to qualify to bid for the work.</b> "
16	Tender term in TS: '2.1.28 The contractor shall submit the detail design and dimension & other requirements of the structure in advance (at least 3 months) for foundation development by the University.'	Shall be read as: '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.'
17	Tender term in TS: '2.27 Type test certificates for all the tests specified for the factory built solar PV modules, and the component parts shall be submitted by the Bidder along with the bid.'	Shall be read as: '2.27 Type test certificates for all the tests specified for the factory built solar PV modules, and the component parts shall be submitted by the sucessful bidder in well advance alongwith GTP / GA submissions of the parts / equipments for approval from client, after design is apprved.'
18	Tender term in TS: Page 51 ' Location data - Proposed Site & Space allocated (Approx 47,300 Sqm)'	Shall read as 'Location data - Proposed Site & Space allocated (more than 20 acres, required exact space from this available area will be provided once detail design stage done & as required)' Reference layout is provided for perusal.
19	Tender term in TS: Page 11 clause 2.7 'will use Grid power only when the Solar Power is insufficient to meet the load requirement. Each PCU should be rated minimum 50 KW.'	Shall be read as: 'will use Grid power only when the Solar Power is insufficient to meet the load requirement. Each PCU should be rated minimum 50 KW & maximum 200 KW - volatage can be 800, 1000 OR 1500 V but as per SLD eventually it should be at 415V when it connectes to client side.'
20	Tender term in TS: Annexure B: Sr. No. 3 'Power Conditioning Unit (Inverters) :- String Inverter Above 98.2 % Efficiency Inverter. Max 10% Overloading. Min 50 KW to Max 100 KW ONLY'	Shall read as: 'Power Conditioning Unit (Inverters) :- String Inverter Above 98.2 % Efficiency Inverter. Max 10% Overloading. Min 50 KW to Max 200 KW ONLY'
21	Tender term in TS: Page 10 clause 2.6.f 'Fill factor of the module shall not be less than 0.70.'	Shall read as: 'Fill factor of the module shall not be less than 0.75.'
22	New term for Capacity Utilization Factor (CUF)	Minimum CUF shall be 19% subject to design confirmation by the third party
23	Definition of Similar works := "Designing / Engineering, Procurement, Installation, Testing, commissioning, Operation and maintenance of Solar Farm with all necessary components for generation and evacuation of Electricity for a minimum Plant size of 4 MW in a single order, in last seven years in India"	Definition of Similar works := "Designing / Engineering, Procurement, Installation, Testing, commissioning of Solar Farm with all necessary components for generation and evacuation of Electricity and successful completion of Operation and maintenance for minimum period of 2 years in a single order, in last seven years in India"
24	Soil Test Report	Soil Test report along with earth resistivity report is attached for the site for ready reference in Annexure 1 . However, sucessful bidder has to design as per actual at their risk and cost included in this bid
25	Solar Plant Masterplan	Solar Plant Master plan is attached herewith for ready reference as Annexure 2

26	NIT Page No 66 & 67: Milestone - Under Sr No 5: Completion of SITC work for the complete scope Under Sr No 09:	NIT Page No 66 & 67: Milestone - Under Sr No 5: 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. The Sr No 9 is type error which must be read as Sr No 06 in place of 9 - Final Handing over including Liasioning with SBPDCL/ BERC & Statuary / Government clearances/NISE/SECI/MNRE/3rd party( if required) of the entire 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. This including 3rd Party inspection Pre and Post of solar power plant design, drawing and vetting of documents
27	NIT Page NO 15- Clause 8. While submitting the revised tender, contractor 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. a) Earnest Money Deposit (EMD) INR 34.25 Lakhs shall be accepted only in the form of 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, DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY FOR OWNER P a g e   16 FOR CONTRACTOR 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.	<ul> <li>While submitting the revised tender, contractor 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.</li> <li>a) Earnest Money Deposit (EMD) INR 34.25 Lakhs shall be accepted only in the form of Deposit at BG-Bank</li> <li>Guarantee/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.</li> <li>Alternatively, a part of the EMD is acceptable in the form of bank guarantee of any scheduled bank having validity for 120 Days or more from the last date of receipt of tenders. In Such case Rs. 17,12,531/- (Rupees Seventeen Lakh Twelve Thousand Five Hundred Thirty One Only/-) will have to be deposited in the shape prescribed amount and balance can be accepted in form of bank Guarantee issued by a Scheduled bank, which is to be scanned and uploaded by the intending bidders.</li> <li>Alternatively-</li> <li>Bidder may submit the 100% EMD amount INR 34.25 Lakhs in the form of BG-Bank Guarantee in the prescribed shape issued by a Scheduled bank, which is to be scanned and uploaded by the intending bidders. The bank guarantee shall be in the format as prescribed in this document.</li> </ul>
28	NIT page No 02: The successful bidder 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 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.

Appendix - I

	Dt 05 to 11.06.2020			
	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERMANENT CAMPUS (PHASE I) PKG. 4C			
Sr. no.	Tender Reference	Item Description	Clarification Required	Reply from Nalanda University
Bidder 1				
1	Technical Specifications- 3.0 Make List,- Page 50	Modules- Shall be Domestic Manufactured Only: Waree/ Vikram / PV-Powertech / REC / LG / VS	Kindly Consider Adani Solar Module for this tender, As we are the largest manufacturer having 1200 MW manufacturing facility at Mundra, Gujarat	Please refer to Corrigendum being issued.
2	NIT Document- Information and Instructions To Bidders- Page 11	Pre-bid meeting shall be held with the prospective bidders in the office of Nalanda University, at Rajgir, on 23.03.2020, 2020 at 11.30 AM.	Request of Extension of the Pre-Bid Meeting Date upto 6th April 2020	Corrigendum was provided for the revise date & its been done. For latest date and time please refer to the Central Public Procurement Portal .
3	NIT Document- Page 14 - Financial Eligibility Citeria	Bidder should not have incurred any loss (Profit after tax should be positive) in more than two (2) years during available last Five consecutive financial years	Bidder should be allowed to use the Financial strength of its Parent Company using its Turnover, Profit & Loss statements etc.	NIT conditions shall Prevail
4	NIT Document- Page 15- Earnest Money Deposit (EMD)	Earnest Money Deposit (EMD) INR 34.25 Lakhs shall be accepted only in the form of 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	We request EMD to be accepted in the form of Bank Guarantee (BG)	Please refer to the co-orrigendum section
5	NIT Document- Page 84 - LD for Delay in Execution/ Supply.	Total amount of compensation for delay to be paid under this Condition shall not exceed 10% (Ten per cent) of the accepted Tendered Value of work	Maximum LD should be restricted to 5% of Value of work	NIT conditions shall Prevail
6	Technical Specifications- Page-11 - Connectivity/ Power Evacuation Voltage Level	In a grid interactive system AC power shall be fed to the grid at three phase 11 KV AC bus.	However, as per SLD provided it is shown that Solar Power Plant is connected to 415 V (LT side). Please confirm.	NIT conditions shall Prevail, please refer provided SLD connection of solar from solar vedor is at 415 V at client supplied Trafo, rest is at 11 & 33 KV
7	NIT Document- Page 11 - Last Date of Submission of Tender - Date & time	last Date of Bid submission on 14th April upto 3.30 PM	Looking at the extreme Corona Virus pandemic and lockdown situation; Request you to extend the bid submission date to 30th April, 2020.	Please refer to Corrigendum /s
Bidder 2				
1	NIT Document- Information and	Earnest Money - Rs. 34.25 Lacs (to be refunded after submission	Central Electronics Limited is a CPSU under the Department of Scoentific &	
	Instructions To Bidders- Page 11	of Performance Guarantee) e-Tender Processing Fee - Rs. 15000 (Fifteen Thousand Only)	Industrial Research, Ministry of Science & Technology, Govt. Of India and is exempted from Paying EMD in the Tender Floated by PSU's, State Nodal Agencies and Govt. Departments. Please Exempt CEL from Paying EMD.	The EMD in the form of 100% BG may also be submitted, for this alternative option please refer to the corrigendum section.
2	Technical Specifications- 3.0 Make List,-	Modules- Shall be Domestic Manufactured Only: Waree/	We Request you to please include Central Electronics Limited (CEL) in the	Please refer to the co-orrigendum section
	Page 50	Vikram / PV-Powertech / REC / LG / VS	Approved Makes of The SPV Module.	
Bidder 3				
1	Tender NIT: Clause 8.0(a) - Page 15 of 242	Earnest Money Deposit (EMD) INR 34.25 Lakhs (In the form of Deposit at Call receipt/Demand Draft drawn in favour of "Nalanda University")	As per Gazette notification dated 23/03/2012 for Public Procurement Policy notified by Government of India. Those who registered in Ministry of Micro, Small and Medium Enterprises, MSME's under NSIC are exempted for EMD, Document fee, etc. Many Central and state government entities (PSU) like, SECI, NSPCL, NHPC, NLC, Kandla Port Trust, NTPC, Cantonment Boards (Ministry of Defence), and	The EMD in the form of 100% BG may also be submitted, for this alternative option please refer to the corrigendum section.
2	Tender NIT: Clause 8.0(c) - Page 16 of 242	Etender processing fee of Rs. 15,000/-	others have issued tenders for solar plants in recent past, in which EMD is exempted against submitting of MSME Certificates. Since Our Company is registered with MSME, we would like avail benefits of EMD and tender processing fee exemption. We request Tendering authorities to exempt the MSME's from paying Applicable Bid Security allow us to participate and encourage small scale industries participation.	
3	Tender NIT- Page 1 and Page 4	ILR	ILR mentioned is 1.3 and 1.5 in Tender NIT.	Please refer to Corrigendum. Shall be 1.3 or Better

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Sr. no.	Tender Reference	Item Description	Clarification Required	Reply from Nalanda University
4	Technical Specifications- 3.0 Make List,-	Modules- Shall be Domestic Manufactured Only: Waree/	Kindly Confirm the Modules which bidder to consider. Is bidder allowed to	As per NIT read with corrigendum .
	Page 50	Vikram / PV-Powertech / REC / LG / VS	consider Open category modules or Only Indigenous modules with indigenous	
			cell allowed for this project?	
5	Technical Specifications- Page 66-67	Annexure B - BILL OF MATERIAL 5 MW GROUND	Different Items such as Solar modules, PCU, etc with specific configuration are	NIT conditions shall Prevail
		MOUNTED SOLAR FARM - DESIGN, PROCUREMENT,	mentioned. We request tendering authorities to kindly confirm whether bidder	Please refer ote below the said detail, sucessful
		INSTALLATION, COMMISSIONING & TESTING JOB	need to consider the exact same specifications only or may propose and design	bidder to provide detailed boq after design
			according to themselves also.	approval.
6	Tender NIT: Clause 8.0(a) - Page 16 of 242	Alternatively, a part of the EMD is acceptable in the form of	We request you to kindly clarify and confirm that Bidder can submit EMD in	
		bank guarantee of any scheduled bank having validity for 120	form of Bank Guarantee from any scheduled bank also for total amount of INR	The EMD in the form of 100% BG may also be
		Days or more from the last date of receipt of tenders. In Such	34.25 Lakhs.	submitted, for this alternative option please
		case Rs. 17,12,531/- (Rupees Seventeen Lakh Twelve Thousand		refer to the corrigendum section.
		Five Hundred Thirty One Only/-) will have to be deposited in		
		the shape prescribed amount and balance can be accepted in		
		form of bank Guarantee issued by a Scheduled bank, which is to		
		be scanned and uploaded by the intending bidders. The amount		
		of the EMD can be paid by multiple Deposits at Call		
		receipt/Demand Drafts along with Bank Guarantee of any		
		scheduled bank. The bank guarantee shall be in the format as		
		prescribed in this document.		
7	Technical Query	Evacuation of Power	Kindly confirm regarding the evacuation Voltage level of power from solar	AS per design and site /project requirement,
			power plant and also regarding the interconnection Point of Power generated	most probably at 11KV level.
0	Tandar dag: NIT Clause 5 25 Dags 172 of	2.1 NET MINIMUM CUADANTEED CENEDATION (NMCC):	from solar power plant.	Shall he at the Substation End. Also please refer
0	124	57000000 or higher for first Year	Relation and	to corrigendum section
	12-1			to configeration section.
9	Technical Query	Transmission line from plant to Substation / Interconnection	As per our understanding, Transmission line details not given in tender NIT. We	NIT conditions shall Prevail,
		Point	request you to kindly provide the details and distance/length of Transmission	please refer provided SLD connection of solar
			line from Plant to Interconnection point which bidder need to consider.	from solar vedor is at 415 V at client supplied
				Trafo which is in same solar plant area- all
				required cabeling etc is in this tender scope, rest
				is at 11 & 33 KV lines which will be provided by
				client.
				For Information, the distance between this solar
				sub-station & main receiving station of the
10	General Ouerv	Site Levelling/Land	We request Tendering authorities to kindly consider Tree cutting and approvale	campus is approximately 1800 m
10		one bevennig/ band	permissions related to it Levelling of land parcel and other clearances in their	The proposed land is within the campus
			scope.	bounday and mostly clear. Bidder to visit the
			acche.	site and also read the document carefully for the
				complete scope of work. No major tree cutting
				shall be required
11	Technical Query	Reverse Auction	Kindly confirm, project is awarded based on only L1 price from opening of the	NIT conditions shall prevail.
			financial bid. Or any Reverse Auction event will conduct?	No reverse auction will happen.
12	Commercial Query	GST Applicable	Kindly confirm that bidder need to quote the price including all applicable taxes	NIT conditions shall prevail.
			and duties in price bid.	Please refer to Clause-37
Bidder 4				
	NIT Document- Information and	Pre-bid meeting shall be held with the prospective bidders in	Request of Extension of the Pre-Bid Meeting Date by atleast 3 weeks	Corrigendum was provided for the revise date &
	Instructions To Bidders- Page 11	the office of Nalanda University, at Rajgir, on 23.03.2020, 2020 at		its been done. For latest date and time please
	<u> </u>	111.30 AM.		Ireter to the Central Public Procurement Portal.

	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERMANENT CAMPUS (PHASE I) PKG. 4C			
Sr. no.	Tender Reference	Item Description	Clarification Required	Reply from Nalanda University
2	2.1.23 / Page 7	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	All expenses associated with PDI like travelling, boarding and lodging expenses for the officials deputed by the Employer shall be in the scope of the Employer.	NIT conditions shall prevail. All such cost for PDI process shall be included, client will not pay any extra charges for any of the process for the complete job inless specified in NIT.
3	2.2 / Page 8	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.	*IS 14286:2019 and IS/IEC 61730:2016 were published in June 2019, but GoI has not issued Gazette Notification for mandatory compliance to these latest editions. And hence, no laboratory in the world is equipped and ready yet to perform tests as per these latest versions, but laboratories are accredited for IS 14286:2010 & IS/IEC 61730:2004 as per existing GoI's Gazette Notification. Therefore, it is requested to accept IS 14286:2010 and IS/IEC 61730:2004. *However, we will comply with certifications as per IS 14286:2019 and IS/IEC 61730:2016 if laboratories get equipped for these tests during the execution period of the project. Lead time for submission of these reports shall be approximately 6 months after laboratories get equipped.	NIT conditions shall prevail. In lieu of statutory provions alternate latest prevailing standards & practises may be allowed after receiving clarity on paper from autorised persons / heads of respective bodies of government.
4	2.3.1 / Page 8	The mechanical structures, electrical works and overall workmanship of the grid solar power plants must be warranted for a minimum of 15 years.	The product warranty for PV modules shall be limited to 10 years as per commonly accepted industry practice.	NIT conditions shall prevail.
5	2.5.3 / Page 10	Modules with output of 300 Wp or above shall be used.	These statements are contradictory. Please clarify on the requirement of the minimum module output.	NIT conditions shall prevail. Annexure B is indicative only, it is provided for
6	Annexure B / Page 66	Solar Modules: - Solar Modules of 325 Wp Capacity Manufactured on Automated Production Lines with 18.3 % Cell Efficiency		ready reference of bidder only. Please refer note in the same annexure.
7	2.6 (j) /Page 11	The PV module shall be provided with screen- less frame	Please elaborate what screen-less frame is.	NIT conditions shall prevail. PV module shall be provided with frame of anodized channel as specified in same para.
8	2.13 / Page 22	Tedlar sheet	The backsheet used in our PV modules is PET based (not Tedlar based) material consisting of three layered structure - outerlayer with fluro-polymer, middle layer with PET and inner layer with fluropolymer / UV resistant polymer. Kindly accept the same.	NIT conditions shall prevail. Vedor may provide equipments as per NIT or better.
9	2.27 / Page 47	Type test certificates for all the tests specified for the factory built solar PV modules, and the component parts shall be submitted by the Bidder along with the bid	Type test certificates shall be submitted at the time of supply of PV module.	Please refer corrigencum
10		Limitation of export of 5 MW ac only	Nalanda University informed during the pre bid meeting that a maximum of 5 megawatt AC power can be exported to the grid. BHEL suggested that they may bifurcate their 6.5 MW DC installation into 5MW and 1.5 MW blocks with 1.5 megawatt block mounted with zero export device. Zero export device can restrict the power from escaping to the grid. In case such is the solution there shall be extra cost incurred for zero export devices which might have to be built into the tender by Nalanda University.	NIT conditions shall prevail. When client explained concern about 5 MW AC only can be transferred to grid, please also note that this 5 MW will be after usage of source for campus load at the moment, hence bifercation it is possible that campus + grid jointly can absorb more than 5 MW ac at any given time. Vedor may provide bifercation / design & related system accordingly; any related charges shall be part of tender bid only.
11	-	GST rates	As per our understanding of solar EPC contracts there is applicability of 18% GST over 30% of the contractual value and 5% GST over 70% of the contractual value. However Nalanda University informed that there shall be applicability of 12% GST over the EPC contract as per CPWD norms. Please confirm	NIT Conditions shall prevail.

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Sr. no.	Tender Reference	Item Description	Clarification Required	Reply from Nalanda University
12	-	Site Survey	Customer is requested to please conduct a site survey over video call as it is not	NIT Conditions shall prevail.
			feasible to travel at least for the next one month interstate. Alternately due date of	Please refer corrigendum /s.
			submission may please be extended by over 45 days	
13	-	NO Interface with SECI	Nalanda University is the only pay master and customer for this contract BHEL	NIT conditions shall prevail.
			recognises. We understand that we do not have any interface with customer's	
			customer i.e.SECI however to support customers case with SECI on any issue	
			MENTIONED IN THE CONTRACT OF NALANDA UNIVERSITY WITH	
			BHEL we shall extend every possible support.	
14	-	Liasioning with DISCOM/SERC	During the pre bid meeting it was learnt that the bidder has to only liasion with	NIT conditions shall prevail.
			the discom for implementation of net metering however it was also discussed	Liaison with any autority or statutory body or
			that any issue arising due to the limit for net metering being at 1 MW shall be	any other office of related departments as may
			resolved by Nalanda University with the regulator or discom. Please confirm	be applicable is in the scope of this tender.
15	-	Addition of BHEL as a PV Module OEM	Nalanda University is requested to please add BHEL as an OEM of PV modules	Please refer corrigencum section
			in the vendor list as BHEL is amongst the oldest of PV module manufacturers in	
			the country. BHEL begun PV module manufacturing in 1980S and has an EPC	
			portfolio of solar projects of over 1.2 GW. Being a Government of India enterprise	
			we are under an obligation and consider it as our prime responsibility to use	
			make in India products specifically our own make of products in our projects.	
			Hence we shall use our own make of PV modules.	
16	-	-	Please specify the distance of scada control room from the project site	NIT conditions shall prevail.
				Approximately 2200 m, bidder to visit site for
				further clarity.
17	-	No tree cutting	It was informed during the pre bid meeting by Nalanda University that the	NIT conditions shall Prevail.
		No tree planting	project site shall not require any permission from horticulture department and	The proposed land is within the campus
			there shall be no requirement of tree cutting or deforestation for implementation	bounday and mostly clear. Bidder to visit the
			of the project. please confirm	site and also read the document carefully for the
				complete scope of work. No major tree cutting
10		T 1		shall be required.
18	-	Land surveys	Please confirm whether the bloder has to carry out topographical survey,	Ridden has to size the site for devite all
			geotechnical survey and son testing. Or Nalanda University shall furnish the	bloder has to visit the site for clarity, all
			reports if they have already conducted the same. As of how we understand that	required surveys, misning / leveling / cleaning
			apart from rooting the small shrubs there is no landfilling, grading, leveling or	work is in the scope of this tender.
			compacting required at site, please confirm	
19	-	BG	It is requested to please obtain all the securities in the form of bank guarantees	Please refer to the co-orrigendum section
			from the bidders	
20	-	ТОР	It is requested to please accept the following terms of payment through	NIT conditions shall prevail.
			Letter of Credit 10% interest free advance along with clear purchase orders	1
			70% of the complete contract value on dispatch of material against proof 15% of	
			the complete contract value on erection and commissioning 5% of the complete	
			contractual value on proving out	
21	-	TOP for O&M	100% for supply of sparse against dispatch including taxos & dutios 50% advance	NIT conditions shall prevail
<u></u>			for O&M contract with halance 50% through quarterly payments	
			ior own contract with balance 50% infough quarterly payments	
22	-	Delay in payments	In case of delay in payments we shall charge interest on the portion of payment	NIT conditions shall prevail.
			delayed as per market rates. Pl Confirm	

	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERMANENT CAMPUS (PHASE I) PKG. 4C			
Sr. no.	Tender Reference	Item Description	Clarification Required	Reply from Nalanda University
23	-	Land Sufficiency	During yesterday's pre bid discussion it was informed by Nalanda University that land is not a constraint for installation of 6.5 MW DC AND EXTRA LAND BEYOND THE MENTIONED FIGURE IN THE TENDER MAY BE PROVIDED IN CASE OF A SHORT FALL ON THE SAME LAND BLOCK. Please confirm	Please refer corrigendum ection and ensure the site visit.
24	-	Construction Water & Power	please confirm whether construction water and power shall be provided at site free of cost	NIT conditions shall prevail.
25	-	Water & Power for O&M	Please confirm whether water and electricity for O&M shall be available at site free of cost	NIT conditions shall prevail.
26	-	Power Optimisers	It is to submit that Power optimisers May only be used in case there is frequent shadow fall on the arrays else use of optimisers shall just incur more cost. Further the use of string inverters with multiple MPPTs shall offer optimisation of power considering the loss due to shadowing effect. There being very limited number of Power Optimiser vendors in the country (probably two or three), it shall unwillingly create a skewed competition as for one of the renowned makes of Power Optimisers, it is necessary to go to with the same make of Inverter, which is usually priced at 30% higher than the market. Hence it is requested to please waive off the requirement of Power Optimisers from the tender specifications	NIT conditions shall prevail. Please refer corrigendum /s for makes.
27	-	Earthing strip	Earthing strip mentioned in Annexure B is Cupper strip of 20x3 request to use GI earthing strip of size 25x5	NIT conditions shall prevail. Annexure B is indicative only, it is provided for ready reference of bidder. Please refer note in the same annexure. Bidder always may provide equipments / parts as per NIT or better subject to approval from university at the time of detail designing.
28	-	-	We shall be using AC Cables with AL conductor. Pl confirm	
29	-	-	MS structure galvanization thickness mentioned in clause 2.13.1 is 80Micron but in Annexure B mentioned as 120 Micron please clarify	
Bidder 5				
	Tender Document- 4CSLD -pg 1.of 1	Spare Feeders for evacuation	It is understood that there is existing spare breaker of 11KV in which the 5MW Solar Power plant is to be evacuated Kindly Confirm ? Ref: SLD	NIT conditions shall prevail. Separate 11 KV sub-station is under construction for Solar Power plant
2	Tender Document	Substation Location	Request to Provide the specification of Cable trench requirement and distance from Plant End to 11kV Substation.	NIT conditions shall prevail. Sub-staton will be costructed at same location where plant is proposed
3	Tender Document	SLD & PCU of 50kW minimum	Request to provide Central inverter Option Also	NIT conditions shall prevail. Please refer corrigendum section.
4	Tender Document- 4CTS-Pg 50 of 67 Approved Make List	3. Make List Inverters- Schneider/Delta/ABB/SMA/Huwai	Request to include Solar Edge Inverter as they are only Compatible with Optimizers	Please refer corrigendum section
5	Tender Document- 4CTS-Pg 50 of 67 Approved Make List	Optimizer Solar edge / equivalent	Solar Edge optimizers are compatible with only Solar Edge inverters based upon the module Wattpeak. Request to suggest additional make of Optimizers	Please refer corrigendum section

	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERMANENT CAMPUS (PHASE I) PKG. 4C			
Sr. no.	Tender Reference	Item Description	Clarification Required	Reply from Nalanda University
6	Tender Document- 4CTS-Pg 66 of 67	BOQ	Let us if know we need to match the required quantity only or we need to provide the actual quantities based upon our system design	NIT conditions shall prevail. Annexure B is indicative only, it is provided for ready reference of bidder. Please refer note in the same annexure. Bidder can provide equipments / parts as per NIT or better subject to approval from university at the time of detail designing
7	Tender Document- 4CTS-Pg 65 of 67	PVsyst Report	Request to provide the acutal generation requirement with PR	NIT conditions shall prevail. Successful bidder will be responsible for the design as the tender is called under EPCC mode. NMGG shall meet, please refer corrigendum section.
8	Tender Document- 4CTS-Pg 65 of 67	Generation Measuring Point	Request to Provide the Energy measurement point at plant end or at the substation	NIT conditions shall prevail. Shall be at the Sub-station end.
9	Tender Document- 4CTS-Pg 22 of 67 2.13 - Mounting Structures	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 rafter & Purlin memebr shall be made of MS HDG with min 80microns thickness or Pregalvanised sheet metal. Please confirm	Sucessful vendor can propose most efficient design & can execute as per approved design document but minimum requirement shall as per NIT or better
10	Tender Document- 4CTS-Pg 22 of 67 2.13 - Mounting Structures	The mounting structures shall be mounted on RCC pedestals through properly grouted J bolts.	Request you to give permission to consider Cast-in-Situ Pile foundation instead of RCC Pile foundation .	Sucessful vendor can propose most efficient design & can execute as per approved design document but minimum requirement shall as per NIT or better
11	Tender Document- 4CTS-Pg 46 of 67 2.25 Civil Works	<ul><li>1.2 Foundation System;</li><li>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.</li><li>Following kind of foundation may be provided:</li><li>a. Short pile RCC foundation (Min. 300mm dia.)</li><li>b. Rock anchor with concrete collar</li><li>c. Isolated, strip or raft foundation</li></ul>		Sucessful vendor can propose most efficient design & can execute as per approved design document but minimum requirement shall as per NIT or better
12	Tender Document- 4CTS-Pg 46 of 67 2.25 Civil Works	The GI piping network is to be designed with considering pressure to provide appropriate head at outlet point i.e. Garden Hydrant.	Request you to consider UPVC piping ararnegment for Moduel cleaning system.	Sucessful vendor can propose most efficient design & can execute as per approved design document but minimum requirement shall as per NIT or better
13	Tender Document- 4CTS-Pg 51 of 67	Location Data	Please share us the plot area marked or share us the land cordinates of four corners of land area	Please refer corrigencum /s. Location data is already provided in the NIT.
14	Tender Document- 4CTS-Pg 66 of 67	Module Mounting Structure:- 2.5mm Thickness Minimum 120 micron Minimum HDGI-2600 Ton	<ol> <li>Request you to clarify wether we have to consider 80 microns minimum HDGI.</li> <li>The tonnage provided for seems to me high. Request you to clarify the same. Or shall we consider our degined BOQ for MMS weightage.</li> </ol>	NIT conditions shall prevail. Annexure B is indicative only, it is provided for ready reference of bidder. Please refer note in the same annexure. Bidder can provide equipments / parts as per NIT or better subject to approval from university at the time of detail designing.

PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERM			
Sr. no.	Tender Reference	Item Description	Clarification Required
15	Tender Document- Notice inviting Tender -	Alternatively, a part of the EMD is acceptable in the form of	Shall we submit 34.25 Lakhs of Bank Guarantee Against EMD. Instead of
	NIT Clause 8 - Page 16 of 242	bank guarantee of any scheduled bank having validity for 120	50% DD & 50% BG. Kindly Clarify.
		Days or more from the last date of receipt of tenders. In Such	
		case Rs. 17,12,531/- (Rupees Seventeen Lakh Twelve Thousand	We humble request the tendering authority to consider current economic
		Five Hundred Thirty One Only/-) will have to be	situation which blocks the company cash for significant period of the time.
		deposited in the shape prescribed amount and balance can be	
		accepted in form of bank Guarantee issued by a Scheduled bank	
Bidder 6			
1	Technical Specifications- 3.0 Make List,-	Modules- Shall be Domestic Manufactured Only: Waree/	We request you to kindly approve our make and add in your list of approved
	Page 50	Vikram / PV-Powertech / REC / LG / VS	makes for Solar Projects.
Diddor 7		Inverters- Schneider/Delta/ABB/SMA/Huwai	
1	NIT Document-Information and	Pre-hid meeting shall be held with the prospective hidders in	Request of Extension of the Pre-Bid Meeting Date by two weeks
1	Instructions To Bidders- Page 11	the office of Nalanda University at Raigir on 23.03.2020, 2020 at	Request of Extension of the Fre-bld Meeting Date by two weeks
	instructions to bluders- tage th	11 20 AM	
2	Tender notice 1, pg 10f 242	1.5 ILR	Kinldy describe what is 1.5 ILR and its objective?
_			
3	cl 2, of Tender notice_1, pg 14/242	An agreement shall be executed by and between the NU and	Kinldy confirm in NU will sign single contract or divisible contract for Suppl
		the successful bidder	Service & O&M, as this is very vital for considering GST rate for bidding and
			bringing all bidders at par.
4	EMD, of Tender notice_1, pg 16/242	In Such case Rs. 17,12,531/- (Rupees Seventeen Lakh	As per industry practice we request NU to take full amount of EMD in the for
		Twelve Thousand Five Hundred Thirty One Only/-) will have to	of BG
		be deposited	
5	cl 10, of Tender notice_1, pg 18/242	5% Performance guarantee in the form of deposit	As per industry practice we request NU to take Security Performance in the f
			of BG
6	EMD, of Tender notice_1, pg 36/242	I/We undertake and confirm that eligible similar work(s)	NU may kindly note that in EPC contractor does hire/sublet the part of work
		has/have not been got executed through another contractor on	its vendor/subcontractor, however, the design, responsibility and accountability
		back to back basis.	under taken by EPC contractor, hence, we request NU to delete this clause.
7	Definitions, of Tender notice_1, pg 79/242	Market Rate	Since the agreement is signed at a contract value, the EPC contractor may exe
			the work as per their requirements/purchase preference of Price, NU may not
			forbid/should nto put any constraints in Market price to the contractor, hence
			this clause may be removed.
8	cl 9, of Tender notice_1, pg 83 & 97 /242	Additional Performance guarantee of 10%	There is contradiction in % of performance guarantee in both clauses in the
			mentioned pages. Pls clarify the Additional performance guarantee is for 5%
			10%, further, we request NU to accept this performance guarantee in the form
0			BG.
9	cl 3, of lender notice_1, pg 173 /242 and of	NMGG/CUF	As per prudent industry practice and as raditation is not under control of the
	63/67 of CIS		contrator, we request NU to accept radiation correction factor also for
			consideration of NMGG/CUF.

IANENT CAMPUS (PHASE I) PKG. 4C			
	Reply from Nalanda University		
	Please refer to the co-orrigendum section		
1			
đ	Please refer to Corrigendum Section. NIT condition read with the corrigendim will be applicable.		
	Comison dum was movided for the revise date &		
	its been done. For latest date and time please refer to the Central Public Procurement Portal .		
	Inverter Loading Ratio, it is defined as basis for detail design to be done by vendor & to calculate dc capacity of plant. Please refer corrigendum /s		
у,	The Contract shall be as per the NIT Conditions		
orm	NIT conditions shall prevail.		
form	NIT conditions shall prevail.		
to ity is	NIT conditions shall prevail.		
ecute t e,	NIT conditions shall prevail.		
of n of	Please refer to Corrigendum section.		
	NIT conditions shall prevail. Since NMGG & CUF is given, we are not defining PR now. Please refer corrigencum section. The best amoung the PR, CUF, NMGG and CPCU scheme guideline will be followed. Sucessful bidder will be responsible for efficient design in the given conditions and the tender is called under EPCC mode.		

	PREBID QUERIES FOR - TENDER FOR S	SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNE	CTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERM
Sr. no.	Tender Reference	Item Description	Clarification Required
10	Cl 3 of CTS, pg 50/67	Make list	Kindly confirm if only the mentioned makes are accepteble or the contractor is consider additional/other equavalent makes after submitting credentials to N
11	cl 38, of Tender notice_1, pg 132/242	Change in Tax	only change in GST is considered , Change in law & other taxes and duties ar not considered in Clause, we requuest WBSEDCL to add - If, after the date se (7) days prior to the date of Bid submission, in the country where the Site is located, any Change in Laws and regulations that subsequently affects the co and expenses of the Contractor and/or the Time for Completion, the Contract Price shall be correspondingly increased or decreased, and/or the Time for Completion shall be reasonably adjusted to the extent that the Contractor has thereby been affected in the Performance of any of its obligations under the Contract.
12	2.13.1 of 4CTS Pg 22	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.	In line with the string series, structure will be designed. For example, for 1000 system structure shall be 2P-20 & for 1500V system structure shall be 2P-30. Please confirm the same.
13	2.13.1 of 4CTS Pg 22	The frames and legs of structure assemblies shall be made of MS hot dip galvanization sections with minimum thickness of galvanization of 80 microns.	The column post shall be HDG. But Rafter & Purlin will be pre-galvanised / Galvalume. Please confirm the same.
14	2.13.1 of 4CTS Pg 22	The mounting structures shall be mounted on RCC pedestals through properly grouted J bolts	The column post will directly embedded into Pile. No separate baseplate arrangement will be provided to reduce the execution time. Please confirm the same.
15	2.13.1 of 4CTS Pg 23	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	The tilt angle & type of syructure (Fixed / Seasonal) shall be based on Pvsyst report. Please confirm the same.
16	2.25 of 4CTS Pg 45	Cutting and clearing of trees / plantation to remove the shadow.	Cutting Of Trees & corresponding permission shall be in client scope. Please confirm the same.
17		-	No specification provided for Road, Drain, control room etc. Please furnish th same.
18	7.3 of 4CTS Pg 66	String Inverter Above 98.2 % Efficiency Inverter. Max 10% Overloading. Min 50 KW to Max 100 KW ONLY	We can also use central Inverter also, please allow. Max 10 % overloading is mentioned here, however in other part of tender 5 MW ac and 6.5 MW dc is mentioned, this means 30% DC overloading on Inverter, please confirm the correct one.
19	2.7,g of 4CTS Pg 13	Ambient room temperature 5 to 55 °C	Ambient room temperature is mentioned in PCU technical specification. But per Annexure B inverter will be string inverter which will install outdoor. No room is required to install the string inverter. Here, Ambient room temperatu mentioned 5 to 55 °C. We request you to please provide the temperature at which we have to consider Inverter Capacity. Beyond 50 deg C inverter will derate. Request you to also allow 1500 V system Inverters.

MANE	ENT CAMPUS (PHASE I) PKG. 4C
	Reply from Nalanda University
or may NU.	NIT conditions read with corrigemdum shall prevail.
are seven costs act as	NIT conditions shall prevail.
000V	NIT conditions shall prevail,, sucessful vendor can propose most efficient design & can execute as per approved design document
/	Shall as per NIT or better
the	Shall as per NIT or better
st	NIT conditions shall prevail, sucessful vendor can propose most efficient design & can execute as per approved design document
the	NIT conditions shall prevail. Proposed land is within campus boundry allotted to clien, hence all such permisions & decisions will be taken by client. Shall as per CPWD Specifications & latest standard practice of works. Succesful bidder shall submit design for approval for the same.
S S	Please refer corrigendum section.
ıt as No Iture is I	Maximum Ambient temp at site is 50Deg, Refer corrigendum /s. Rest of the points mentioned shall as per NIT.

	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERM				
Sr. no.	Tender Reference	Item Description	Clarification Required		
20	2.7,h,f of 4CTS Pg 14	Isolation transformer 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)	Here we do not understand the requirement of 25 % higher trafo capacity on capacity. However, we can consider Trafo capacity based same as Inverter rat capacity. Please alow.		
21	2.14 of 4CTS Pg 13	String Monitoring Box : 6 sq.mm cable	We do not require SMU/ AJB if String Inveter to be used. Also the string cable size shall be based on the calculations. Please allow.		
22	2.7,g of 4CTS Pg 12	Isolation Trafo: 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.	String or central inverter is having transformer less topology and Inverter transformer based on available grid voltage is in owner scope. So isolation transformer is not required. Please confirm.		
23	2.15 of 4CTS Pg 23	Power Optimizers: A power optimizer shall be combination of both a string and micro inverter.	We do not understand the requirement of Power optimizer with combination String and Micro Inverters. Please clarify		
24	1.13.a of 4CTS Pg 36	Copper earth busbar of 25 mm x 3 mm shall be provided in the PCCs, MCCs, PDBS for the entire length of panel.	Please allow us to use GI Strip based on the calculations during detail engineering.		
25	7.10 of 4CTS Pg 66	Cu strip 20x3 for earthing = 4200 m	Here we understood DC side earthing and for this purpose 25x3 GI strip is sufficient. Please allow.		
26	7.6 of 4CTS Pg 66	Earthing Cable (Green) - 1C x 6 Sq.mm Cu conductor, PVC 1.1kV	Cable size shall be as recommended by module manufacturer. Please allow.		
27	4CTS Pg 51	Proposed Site & Space allocated (Approx 47,300 Sqm)	This will not be sufficient. Request to provide more land with details of conto and boundary in Auto Cad Format.		
28	2.1.1 of 4CTS Pg 57	Gi, ref Irradiance value at which Po is determined, i.e. 1 kW/m2	Target PR not mentioned and Ref GHI is not provided, request yo to provide same.		
29	4CTS Pg 64	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.	Here, target CUF not provided. Please confirm. Also please confirm, if stated "minimum 30% additional capacity or higher as required on compete DC side refering to DC to AC ratio.		
30	4CSLD Pg 1	Master SLD	<ol> <li>String inverter output voltage will be as per manufacturer standard.</li> <li>In case 1500 V system inverter will be 3 phase 3 wire. TPN bus duct will no required.</li> <li>Clarify the requirement of Inverter transformer LV side grounded.</li> </ol>		
31	2.2of 4CTS Pg 63	Eac is the number of units recorded in the plant end ABT meter, kWh	Bidder scope is limit upto ACB outgoing of LT panel, so please confirm energy/CUF will measure at inverter level through inverter inbuilt MFM.		

RMANI	ENT CAMPUS (PHASE I) PKG. 4C
	Reply from Nalanda University
on DC	NIT conditions shall prevail, sucessful vendor
rated	can propose most efficient design & can execute
	as per approved design document
ble	NIT conditions shall prevail, sucessful vendor
	can propose most efficient design & can execute
	as per approved design document
	NIT conditions shall prevail, sucessful vendor
	can propose most efficient design & can execute
	as per approved design document.
	Client transformer is 0.415/11KV as shown in the
	SLD.
on of	NIT conditions shall prevail, sucessful vendor
011 01	can propose most efficient design & can execute
	as per approved design document
	NIT conditions shall prevail, sucessful vendor
	can propose most efficient design & can execute
	as per approved design document
	NIT conditions shall prevail, sucessful vendor
	can propose most efficient design & can execute
	as per approved design document
/.	N11 conditions shall prevail, successful vendor
	can propose most enicient design & can execute
	as per approved design document
ntour	Please refer corrigendum /s.
	AutoCAD format will be shared at detail design
	stage requirement.
de the	Please refer corrigendum /s.
ed	Please refer corrigendum /s.
ide." is	Minimum DC capacity is asked as 6500 KW for
	5MWac Electrical outcome inline of the
	forecasted maximum demand and sanction load
	by SBPDCL .
	NIT conditions shall prevail., sucessful vendor
not	can propose most efficient design & can execute
	as per approved design document
	NIT conditions shall proved places refer as d
	SI D complete I T papel is in score of Tender
	<i>AC</i>
	±C.

	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERM				
Sr. no.	Tender Reference	Item Description	Clarification Required		
32	2.17e of 4CTS Pg 26	Digital Inputs: All Inputs should be suitable for 48V or 220 VDC. They will be connected to potential free contact from field.	Digital Inputs shall be suitable for 24VDC		
33	2.17f of 4CTS Pg 26	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.	Digital Outputs shall be suitable for 24VDC		
34	2.1.18 of 4CTS Pg 7	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.	Bidder scope is limit up to ACB ougoing at LT Panel. Starting from LV side busduct to 11kV all electrical equipment will be owner scope.		
35	7.3 of 4CTS Pg 66	String Inverter	Can we propose central inverter with 1500 V system?		
36	7 of 4CTS Pg 66	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.	<ol> <li>Major items which is mentioned in Annexure B is final, if any additional quantity or higher specification is required beyond mentioned in Annexure B be charge at actual as per unit rate.</li> <li>Additional minor items mentioned in 4CTS which need to be required to complete the project will be bidder scope.</li> </ol>		
37	4CTS Pg 51	Location data	Please provide proposed land demarcation with boundary marking. Please provide topography and soil test report.		
38	4CTS Pg 51	Proposed Site & Space allocated (Approx 47,300 Sqm)	Approx. double space is rquired than allocated space for 6.5 MWp solar plant.		
39	21.4.3 of 4CTS Pg 61	Energy injected into grid (kWh) (Source: Plant ABT Meter at GSS/injection point, Temporal Resolution: 15 minute)	PR will be calculated at inverter level as after inverter, strating from LV busdu will be owner scope.		
40	2.6.i of 4CTS Pg 10	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.	Can we offer Flouro based backsheet of Cybrid make which has a proven long term reliability record? Cybrid backsheet has a PVDF layer which has the sam performance as compared to Tedlar (PVF) based backsheet. Field testing reliability can be assured through various IEC based testing. We have performed various in house tests and third party testing including PVEL PQP with Cybrid backsheet and the power degradation even in PVEL testing (3 times IEC criteria) is very low. Basically Tedlar is not a back sheet specification, it is a trade mark of Dupoint company. Please remove Tedlar from module back sheet specification.		
41	2.5.1 XI of 4CTS Pg 9	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.	Please specify the requirement of internal road and pathway. We understood main gate to control room internal road. Pathway will be constructed on boundary of PV plant. Please confirm.		
42	19.H , VIof 4CNIT Pg 9	Drainage system	Drain will be constructed along the internal road. Please confirm.		

MANENT CAMPUS (PHASE I) PKG. 4C			
	Reply from Nalanda University		
	NIT conditions shall prevail., sucessful vendor		
	can propose most efficient design & can execute		
	as per approved design document		
	NIT conditions shall prevail., sucessful vendor		
	can propose most efficient design & can execute		
	as per approved design document		
	NIT conditions shall prevail., please refer said		
	SLD, complete LT panel is in scope of Tender		
	4C.		
	NIT conditions shall prevail.		
	Please refer corrigendum /s for capacity of		
	Inverters.		
	NIT conditions shall prevail.		
e B will	Whatever required for execution, based on		
	approved design suitable to given criteria is in		
,	vendor scope.		
	1		
•	Please refer corrigendum section.		
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ant.	Please refer corrigendum section.		
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sduct	Please refer corrigendum section.		
ong	NIT conditions shall prevail, sucessful vendor		
ame	can propose most efficient design & can execute		
	as per approved design document.		
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	NIT conditions shall prevail, sucessful vendor		
	can propose most efficient design & can execute		
	as per approved design document.		
	NIT conditions shall prevail, sucessful vendor		
	can propose most efficient design & can execute		
	as per approved design document		

	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERM			
Sr. no.	Tender Reference	Item Description	Clarification Required	
43	4CNIT Pg 204	Green Building	Please confirm the requirement of green building. We construct a control room for housing SCADA panel, UPS, LTDB, etc. We will construct rain water harvesting for control room. Please confirm this i sufficient for meet the green house requirement.	
44	6.1 of 4CNIT Pg 211	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).	Please confirm proposed land is trees and vegetation free. If anything is availa will replant by client as per suggestion of the landscape consultant. Bidder has to take care the construction of solar plant only. Please confirm.	
45	5.2.i of 4CNIT Pg 178	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	Please confirm any permanent module cleaning pipe network sytem required not. Cleaning frequency once in 3 moths can affect on generation.	
46	3.1 of 4CNIT Pg 173	1st Year NMGG 570000000 kWh or higher	Values looks to be missprinted as this value is not possible to achive, kindly recheck.	
Bidder 8				
1	Technical Specifications- 3.0 Make List,- Page 50	Modules- Shall be Domestic Manufactured Only: Waree/ Vikram / PV-Powertech / REC / LG / VS	we hereby request you to pls. incorporate our Jakson Module in same as reputed/preferred Make.	
Bidder 9				
1	Make List	-	Request for addition in Make list	
Bidder 10				
1	2. Scope of Work and Technical Specifications Clause No -2.1.13 Page-6	Average 30 Lux to be maintained through the solar farm when all the lights are on.	Please accept 1)Min avg 20 lux tansformer yard, metering point, security roo, control room. 2)Min avg 10 lux at perphery roads	
2	2. Scope of Work and Technical Specifications Clause No -2.1.19 Page-7	<ul> <li>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&amp;M staff, UPS &amp; Battery rooms, Local Scada Centre, external lighting within solar farms &amp; near vicinity to solar farms to be designed &amp; provided by solar vendor.</li> <li>2.1.20 The contractor has to ensure cleaning/washing as per the approved schedule.</li> </ul>	Please clarify below : The contract with execute the power evacuation from Solar PV modules to Inverter and upto LT panel 415VAC only.	

<mark>/ANE</mark>	ENT CAMPUS (PHASE I) PKG. 4C
	Reply from Nalanda University
	NIT conditions shall prevail, sucessful vendor
	can propose most efficient design & can execute
is	as per approved design document
lable	NIT conditions shall Prevail.
	The proposed land is within the campus
	bounday and mostly clear. Bidder to visit the
	site and also read the document carefully for the
	complete scope of work. No major tree cutting
	shall be required.
d or	Please refer corrigendum /s
aor	reuse rerer corrigenaum /s.
	The best possuble amoung PR and NMG G and
	CUF as per the site requirement shall be
	designed by the EPC contrcator inline of the NIT
	and 3rd party vetting /suggestion report.
	However, the typo error in NMGG is being
	rectified, please refer to Corrigendum section.
	Please refer to Corrigendum /s.
	NIT conditions shall prevail
	Siemense is already considered in approved
	make list for TTA LT Panels of the tender
	NIT conditions shall prevail.
l <b>.</b>	-
	NIT conditions shall prevail.
	Refer SLD.

	PREBID QUERIES FOR - TENDER FOR S	ITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNE	CTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERM
Sr. no.	Tender Reference	Item Description	Clarification Required
3	2. Scope of Work and Technical Specifications Clause No -2.1.19 Page-7	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.	Please provide GA drawings for room construction,Battery rooms, SCADA centre.
4	2. Scope of Work and Technical Specifications Clause No -2.1.21 Page-7	2.1.21 The Contractor has to design, supply, installation & testing of required complete Plumbing system for cleaning of solar modules etc as may be required.	Automatic or manual system, Please arrange water quality report, Any bore ,storage tanks availble at nearby area.
5	2.2 Codes and Standards Clause No -2.2 Page-8	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	Please aapprove to use mono perc solar modules which is latest technology ir current market.
6	2. Scope of Work and Technical Specifications Clause No -2.5.4 Page-10	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.	Please provide specification of weather monitoring system
7	2.6 PV Arrays Clause No -2.6 - 11(j) Page-11	The electrical output connections are taken through a weather proof (IP65 rated) junction box.	Please consider IP68 Junction box also as per the market avaibality which is equivalent to the requirement
8	2.7 Power conditioning unit Clause No -2.7 (f) Page-12	The degree of protection of the outdoor inverter panel shall be at least IP- 55.	Please accept the protection of outdoor inverters must be IP- 54 for central inverter and IP 65 for string inverter for indoor inverters minimum IP20 is sufficient as per the current market technology and availability.
9	2.7 Power conditioning unit Clause No - Page-	-	What type of inverter we have to use central or string or either please clarify
10	2.7 Power conditioning unit Clause No -2.7 (Table- f) Page-14	Output voltage range: 380-435 V AC	AS per the current market and inverter availability the output AC voltage is a 690V applicable for central & string inverters can be consider please accept.
11	2.7 Power conditioning unit Clause No -2.7 (Table- f) Page-14	Enclosure: IP 21 (if indoors) IP 54 (if outdoors)	page 12 mentined as IP-55 for utdoor contracdicting , please clarify
12	2.7 Power conditioning unit Clause No -2.7 (Table- f) Page-14	Enclosure: IP 21 (if indoors) IP 54 (if outdoors)	For indoor inverter IP20 is sufficient as per the current latest technology and market availability. page 12 mentined as IP-55 for utdoor contracdicting , plea clarify
13	2.20 Junctions/ Combiner Boxes & Other Electrical Components Clause No -2.2 Page- 31	Dust, water and vermin proof junction boxes of adequate rating and adequate terminal facility made of fire resistant Plastic (FRP)	Please consider Polycobonate type junction box also
14	Techincal Specifications - 3. Make List Table Page-50	Approved make list(Inverter : Schneider/Delta/ABB/SMA/Huwai)	Please accept, Sungrow , for central inverters-TBEA, Sineng, sungrow also.
15	7. ANNEXURE B -Table Page-66	Armoured XLPE Copper & Aluminium AC Cables as required from Inverter to AJB / Panel & AJB/Panel to Panel including laying, termination etc.	Please clarify there is typo error it should be inverter to Panel& panel to pane including laying and termination etc.

RMANE	ENT CAMPUS (PHASE I) PKG. 4C
	Reply from Nalanda University
A	Shall as per NIT, it will be as per approved
	detail design from sucessful tenderer
	-
re	Please refer to Corrigendum.
y in the	Shall as per NIT,
	Successful tenderer will be allowed to use
	material as per NIT or better without any extra
	cost, as per approved detail design & GTP
	submissionn from vendor.
	Shall as per NIT
	Shall be With minimum features of wind
	monitoring, system, rain monitoring system,
	weather forecasting system, pyrometer,
	Irradiation, Mod Temp and Amb Temp system
s	Shall as per NIT.
-	Successful tenderer will be allowed to use
	material as per NIT or better without any extra
	cost, as per approved detail design & GTP
	submissionn from vendor.
	Shall as per NIT,
	Successful tenderer will be allowed to use
	material as per NIT or better without any extra
	cost, as per approved detail design & GTP
	submissionn from vendor.
fy	Please refer corrigendum section
	String Inverters.
is upto	Please refer corrigendum /s.
t.	
	Chall as non NIT V don't '1'1
	strongest of contracticiting date IDEE
nd	Shall as per NIT
olease	Successful tenderer will be allowed to use
JICU5C	material as per NIT or better without any evtra
	cost as per approved detail design & CTP
	submissionn from vendor
	Shall as per NIT or better
	1 L
).	Please refer to Corrigendum /s.
anel	NIT conditions shall prevail.
	-

	PREBID QUERIES FOR - TENDER FOR S	ITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNE	CTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERM
Sr. no.	Tender Reference	Item Description	Clarification Required
16	7. ANNEXURE B -Table Page-66	Armoured XLPE Copper & Aluminium AC Cables as required from Inverter to AJB / Panel & AJB/Panel to Panel including laying, termination etc.	Please accept The cables from PV modules to AJB/ SMB will be copper and From AJB/SMB to inverter will Wither copper or aluminium,
17	SLA Manpower Requirements and working requirements Page-195	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.	As per contract manpower is more we need to reduce the manpower kindly comment on the same
18	SLA Manpower Requirements and working requirements Page-195	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.	As per contract manpower is more we need to reduce the manpower kindly comment on the same
19	ADDITIONAL CONDITIONS FOR GREEN BUILDING PRACTICES Clause No -6.1 Page-211	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).	Proper site survey required
20	General	-	Safety Guidelines given more in contract need to follow the same- kindly not points.
21	General	-	Site layout in autocad
22	General	-	Existing and proposed plant SLD
23	General	-	Soil test report
24	General	-	Distance between Solar plant to 415/11kV switch yard
25	Package 4C Technical Specification Clause No -2.25 Civil Works Page-45	Cutting and clearing of trees / plantation to remove the shadow.	Due to Covid 19 lockdown situation we cannot have a site visit , so requestin provide layout of the cad file with co ordinates along with topo and contour survey.
26	Package 4C Technical Specification Clause No -2.25 Civil Works Page-45	GEOTECHNICAL INVESTIGATION REPORT	Due to Covid 19 lockdown situation we cannot have a site visit and cannot conduct geo technical Investigation , so pls request to provide Investigation report of the plot , or near location any soil report for better understanding o strata to bid.
27	Package 4C Technical Specification Clause No -2.25 Civil Works Page-45	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.	For Module Cleaning System, Detail Specification is reuqired, pls clarify the same.
28	General	I1 MMS Specification	IMMS Detail specification is not provided, pls clarify the spec in detail.

MANE	ENT CAMPUS (PHASE I) PKG. 4C
	Reply from Nalanda University
	Shall as per NIT, as per approved detail design
	of sucessful tenderer
V	NIT conditions shall prevail.
	-
y	NIT conditions shall prevail.
	-
	Shall as per NIT, it will be part of detail design
	stage, bidder shall visit the site as per NIT to do
	necessary survey
ote the	NIT conditions shall prevail.
	1
	Please refer corrigendum /s.
	AutoCAD format will be shared at detail design
	stage requirement
	Shall as per NIT, please refer provided SLD
	F
	Shall as per NIT, part of detail design stage
	Shall as per NIT, the 11 KV Solar Sub-station
	will be in the same provided zone for Solar
	installation.
ing to	NIT conditions shall prevail.
r	1
	NIT conditions shall prevail.
n	1
of soil	
01 0011	
ne	Shall as per NIT or better, please refer
	corrigendum /s.
	0
	Shall as par NIT or bottor
	Shan as per INIT of better

	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERMANENT CAMPUS (PHASE I) PKG. 4C				
Sr. no.	Tender Reference	Item Description	Clarification Required	Reply from Nalanda University	
29	General	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.	Height of the fencing is not mentioned and need tenteative drawing for 10th post and corner , and also pls provide connection plate demnsions for the Mesh and iron Post.	Shall as per NIT, part of detail design stage	
30	General	Providing and erecting Min 6.5 m wide M.S. Gate of approved design.	Deatila specification of the gate equired like height, Sections of the gate, Leaf length, Paints etc required and also pls clarify Wheather gate is Wicket gate or Sliding gate. Pls clarify Type of Foundation .	Shall as per NIT, part of detail design stage	
Bidder 11					
1	Integrity Agreement -Article 7- Sub Clause 3 - Page 28- Notice Inviting Tender	<ul> <li>i. As per Article 7 (sub clause 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." <ul> <li>ii. As per the NIT document -:" However, in case of any omission in the tender/ contract document, the most recent version of correction slips (as on November 2019) of General Conditions of Contract (GCC) for CPWD Works, 2014 shall be the reference manual."</li> <li>iii. Post referring to the CPWD GCC 2019 for both Construction &amp; EPC contracts and CPWD Works Manual 2019-"Article 7 (sub clause3) - If the Contractor is a partnership or a consortium, this Pact must be signed by all the partners or by one or more partner holding power of attorney signed by all partners and consortium members. In case of a Company, the Pact must be signed by all partners and consortium members. In case of a Company, the Pact must be signed by all partners and consortium members. In case of a Company, the Pact must be signed by a representative duly authorized by board resolution "</li> </ul> </li> </ul>	Clarification on Consortium Formation Requested – no clear structure i.e. lead bidder / secondary bidder (or) financial partner / technical partner has been clarified – we request that the tender committee issue clarification on the nature and structuring of the consortium.	Please refer to Corrigendum - 1	
2	Notice Inviting Tender- Schedule F- Clause 7 - Page-68 - Payment on Intermediate Certificate to be regarded as Advance	"Minimum Value shall be Rs. 2.0 Crores per Running Bill. (this limit of Rs. 4.0 crore will not apply to the first running bill and last running bill preceding the final bill) "	To seek clarification on the payment terms – Whether the bill settlement will happen on a running basis.	Yes. Please read Clause 7 Detail description on Page 94 of NIT Document. Please refer to Corrigendum 1.	
3	NIT Document- Page 11 - Last Date of Submission of Tender - Date & time	last Date of Bid submission on 14th April upto 3.30 PM	Keeping in view of the travel restrictions placed by the Government it is our request that the bid submission should be extended by 20 days so as to enable qualified bidders to participate for the tender. I request the tender committee consider the current lockdown and consider our request for the extension of the bid submission date.	Please refer to Corrigendum - 1. For more claity and update, please refer to the CPPP.	
Bidder 12					
1	NIT/ Definitions/2.8/ Page No 42/ Definition	"Bidder" shall mean and refer to an individual, proprietary firm, firm in partnership, limited company (private or public), joint venture or corporation but shall not include a special purpose vehicle.	Joint Venture for this tender is allowed or not please clarify. If JV allowed then please provide us JV partners Qualification conditions along with minimum percentage sharing. Please confirm that Non Technical JV partner can form a joint venture with Solar company to bid this tender and also confirm that Non technical JV partner can be a lead partner.	JV not allowed, Please refer to Corrigendum - 1	

	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERMANENT CAMPUS (PHASE I) PKG. 4C				
Sr. no.	Tender Reference	Item Description	Clarification Required	Reply from Nalanda University	
2	NIT Page No 16/ EMD PAYMENT	Rs. 17,12,531/- (Rupees Seventeen Lakh Twelve Thousand Five	Please accept total EMD INR 34.25 Lakhs in form of BG	100% EMD can be submitted in the form of the	
		Hundred Thirty One Only/-) will have to be deposited in the	Also we request you to please exempt MSMEs from EMD deposit since	BG issued by the scheduled bank under RBI,	
		shape prescribed amount and balance can be accepted in form	government has already exempted them from submission of the same.	please refer to the corrigendum section	
		of bank Guarantee issued by a Scheduled bank, which is to be			
		scanned and uploaded by the intending bidders.			
3	NIT Page No 18/ performance guarantee for	5% (Five Percent) of the tender amount	We understand that total amount = Capex + Opex therefore bidder has to submit	NIT condition Shall prevail. PBG shall be % of	
			EPC PBG of 10% of Capex amount not of total amount. Please clarify	Complete Tender Amount. Please refer to	
				corrigendum -1	
4	NIT Page No 84/ Released of Security Depos	Security deposit shall be released after the completion of the	We request department to release BG against security deposit after work	NIT Condition Shall prevail	
		Defects Liability period (2 years)	completion because already there is a clause to submit additional PBG 10% for		
			O&M and DLP is a part of O&M		
5	NIT Page No 83/ performance guarantee for	The contractor needs to submit an additional performance	Bidder have to submit 10% of PBG for O&M as per NIT page no 83, please clarify	NIT Condition Shall prevail. Please refer	
		guarantee of 5% of the tendered cost for the DLP as well as	again why 5% PBG for DLP and AMC for 7 years have to be submitted as this is	Corrigendum - 1.	
		AMC period of total 7 years	already included in O&M PBG		
6	NII Page No 70 / Time Period	EPC - 12 Months O&M- 5 years including 2 years DLP AMC - 7	Please confirm us that DLP 2 years in included in O&M and is AMC 7 year is also	NIT Condition Shall prevail. DLP is of 2 years	
		years	in the scope of work	and AMC is of 5 years after that as per NII.	
7	NIT 2h page no 14 / average appual financia	average appual financial turneyer (grees) of Ps. 12.12 Crore	Please accept total average construction turnever in place of average appual	10tal 15 / Years.	
7	1011 20 page no 147 average annuar mancia	(Pupper Twolve Crore Twolve Lakh only) of Similar works	financial turnover (grocs) of Ps. 12.12 Crore (Punces Twolve Crore Twolve Lakh	init condition shan prevan	
		during the immediate last five conceptive financial years	ania) of Similar works		
		holomoo chooto on ding 21ct March 2010, dulu quditod hu	only) of Similar works		
		Charted A accurate Voer in which no turn availed by			
		charted Accountant. Tear in which no turnover is shown would			
		also be considered for working out the average.			
Bidder 13					
1	NIT	-	Please ease the previous experience criteria in the tender document, In lieu of that	NIT Conditions shall prevail.	
			we can present a undertaking in writing / Notarised document, to deliver the	-	
			project under stipulated time and resources with utmost quality.		
2	NIT	-	Please clarify the what is the qualifying criteria for a single (all) members of a	NIT Conditions shall prevail.	
			consortium as mentioned in Article -7 point 3 of the document.		
Bidder 14					
D'11 45	NIT		Request for EMD Exemption being MSME unit	NIT Conditions shall prevail.	
Bidder 15			Compare the function of the function of the set $1 = 57.00.000000000000000000000000000000000$	Places refer Comises during	
1	-	-	Generation for the first year mentioned is 57,00,000 unit i.e. 5700 Lakh units	r lease refer Corrigendum	
			wherein for a 0.5 MW DC project generation would be in the range of 85 Lakh		
			units (Tentatively PV syst is enclosed), Please clarify		
2	-	-	Evacuation Voltage & metering point	Shall as per NIT. Refer	
_			2 rueunion voluge & metering point.	Tender Schematic SLD provided.	
3	-	-	Details of Substation for connectivity (PE permission received by Nalanda	Shall as per NIT.	
			university if any) & scope of work in Substation area like bay extension, metering	Please refer schematic SLD provided. Bidder	
			yard etc	may visit the site for further details, all the	
				necessary arranegement including sitc of	
				required equipments shall include in scope to	
				complete the task as required.	
4	-	-	Line length (from Project to Substation metering point)	Shall as per NIT, the 11 KV Solar Sub-station	
				will be in the same provided zone for Solar	
				installation.	

	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERMANENT CAMPUS (PHASE I) PKG. 4C				
Sr. no.	Tender Reference	Item Description	Clarification Required	Reply from Nalanda University	
5	-	-	All Equipment suggested make list & specifications matrix	Please refer NIT & Complete Tender documents including latest corrigendum /s.	
6	-	-	Scope matrix (Project execution, Permissions related to the project, open access)	Shall as per NIT	
7	-	-	Is cost of O&M to be quoted extra post commissioning (2 years compulsory O&M period) or part of the total project cost?	Shall as per NIT. Included.	
8	-	-	Clarity about rate of penalties on generation guarantee (duration) or project delays or any other penalty.	Shall as per NIT	
9	-	-	Clear Scope of O&M services for two years period after commissioning & applicable penalties	Shall as per NIT, complete operation & mainttanace of the plant to be done by vendor till specified periode including comprehensive maintanance & required coordination with authorities & supply copmanies.	
10	-	-	Proposed tender Drawings if any?	Please refer NIT & Complete Tender documents including provided reference SLD & latest corrigendum /s.	
Bidder 16					
1		EMD	Please allow all EM in form of BG	NIT Condition Shall prevail	
2	General	As per Corringndum no.1 ,Last date of tender submission is 30/04/2020	Please extend the date up to 30/05/2020	Please refer Corrigendum /s.	
3	General	EMD exemption	As per the Public Procurement Policy for Micro and Small Enterprise (MSEs) order 2012, issued vide Gazette Notification number 503, dated 23.03.2012 by Ministry of Micro, Small and Medium Enterprise of Govt. of India, and specific to this tender, MSEs must be registered with any of the following agencies/bodies shall be exempted from bid bond submission on production of valid registration certificate i.e.udyog aadhar,Kindly allow EMD exemption	NIT Condition Shall prevail	
4	General	Net metering	As per attached SLD diagram,Net meter bot show,Kindly confirm power feeding through net meter or not ?	As per NIT. Power will be fed through net metering only at main source point of campus infra at 33 KV.	
5	Genral	Metring point	Please confirm the metering point	As per NIT. Metering point for NMGG will be at 11 KV Dedicated Solar Sub-sttaion for Solar scope.	
6	General	Power Transmission line	Kindly confirm Transmission line through Overhead or underground ?	As per NIT. Transmission line from Solar Sub-station to Main Receiving station of Campus is under ground (11 KV cables) & from Campus to Supply Company S/Y by overhead (33 KV) as per standard practise; however all these cables from Solar Sub-station to Main Receiving Station & to local company s/y will be provided by client. Please refer Tender Schematic SLD	
7	General	ROW	Right of Way if any, kindly consider it in your department scope.	NIT Condition Shall prevail	
8	General	Overloading	Upto 30% overloading is general practice in String Inverter; please clarify	NIT Condition Shall prevail	

	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERMANENT CAMPUS (PHASE I) PKG. 4C				
Sr. no.	Tender Reference	Item Description	Clarification Required	Reply from Nalanda University	
9	General	Substaion distance	Substation distance from the plant location	Shall as per NIT, the 11 KV Solar Sub-station will be in the same provided zone for Solar installation. Main receving station from this 11 KV solar sub- station is at 1800m distance. For more clarity, pleae ensure the site visit	
10	General	Grid interconnection and Metering point	Please clarify at what voltage level / evacuation voltage is the PCU of the PV is required to be integrated with the grid?	Shall as per NIT. Please refer Tender SLD	
11	Eligibilty	Solvency 9.70 crore	solvency need for aprox.5 crore as per need for other central/state tender kindly amend	NIT Condition Shall prevail	
12	BOM Point no,19	Complete SCADA System with Pc and License Software etc	Please delete License software to this line	NIT Condition Shall prevail	
13	2.5.1,point no.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	Please confirm Footpaths/pathways from Gate to all the solar panel or not ?,Please confirm	Shall as per NIT. Yes	
14	1.4.4	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	Not bolt specification not clear .Please confirm	Shall as per NIT, shall as per OEM stadards for equipments.	
15	3 ( Make List )	Shall be Domestic Manufactured Only: Waaree/Vikram/PV- Powertech/REC/LG/VS	REC/LG/VC is not efficient module manufacturere ,Please also add any indian or MNRE approved,Please amend	NIT Condition Shall prevail	
16	Inverter Make	Schneider/Delta/ABB/SMA/Huwai	Please alow TMEIC, sungrow, & All MNRE approved inverter with latest string inverer capcity range for all inverter manufacturers	NIT Condition Shall prevail	
17	TTA LT Panels including switchgears,Control relay	ABB/Siemens/Schneider/L&T	ABB not maucturere to this items,please amend this make & allow all approved make	NIT Condition Shall prevail, ABB provides TTA Panels, they generally provides through Perpitual System Integrator like SG.	
18	General	All BOM quantity	As per annexure B All BOM qty wrongly mentioned please delete the all qty & allow qty as per contrator design the plant	Shall as per NIT, Refer note below table in Annexure B.	
19	Annexure B	Module Mounting Structure:- 2.5mm Thickness Minimum 120 micron Minimum HDGI:- Quantity 2600 MT	Please amend structure weight i.e. 200-220 MT (Suitable of 6.5 MW DC) instead of 2600 MT	Shall as per NIT, Refer note below table in Annexure B.	
20	Annexure B	Power Conditioning Unit (Inverters) :- String Inverter Above 98.2 % Efficiency Inverter. Max 10% Overloading. Min 50 KW to Max 100 KW ONLY	Cacacity range 50-100 is old technology,Please allow latest capcity range up to 200 KW	NIT Condition Shall prevail	
21		50 KW Inverter output given in 400 V i.e. wrong	We request you to allow 1500V system for better plant quality and optimization	NIT Condition Shall prevail	
22	Annexure B	SCADA	As per make list not manufacturee as per make list,Please allow any indian make	NIT Condition Shall prevail	
23	Annexure B	Module cleaning arrangment	Please confirm meethod of module cleaning arrangments	Please refer latest Corrigendum /s.	
24	Annaxure B,Point 5	DC cables - 1C x 4 or 6 sq mm Tin Copper Solar Cable 1.1kV (Array to Inverter) :	320000 M i.e. totally wrong ,Please amend	Shall as per NIT, Refer note below table in Annexure B.	
25	General	scada make wrongly mentioned	Any indian make	NIT Condition Shall prevail	
Bidder 17				•	

	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERMANENT CAMPUS (PHASE I) PKG. 4C				
Sr. no.	Tender Reference	Item Description	Clarification Required	Reply from Nalanda University	
1	Page No. 6 Clause No.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	Bidders understanding is this, surveillance system of all key areas menas - Entrance, Control room, Security room only. However if we go to cover all the plant then adequate space is required to install CCTV cameras. Also , the CCTV pole shadow caste on PV module due to impact on Plant performance . Kindly clarify the same	NIT conditions shall prevail. All the area to be covered by surviliance system.	
2	Page No. 6 Clause No.2.1.13	Average 30 Lux to be maintained through the solar farm when all the lights are on.	As per Standard Requirement Average Lux Levels Should be as : Control Room - 300 Lux Store Room - 200 Lux Switchgear Room - 150 Lux Inverter Room - 150 Lux Street Lighting Roads - 10 Lux Yard / Substation - 20 Lux - General Area, 50 Lux on Equipments. large no. of Light pole shadow caste on PV module due to impact on Plant performance . Kindly clarify the same	NIT conditions shall prevail. The specified value in NIT is for plant area, vendor has to provide rest of the area lighting as per national prevailing standards or latest standard practise whichever is higher.	
3	Page No. 7 Clause No.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	Kindly Provide us the Location of 11KV S/S and tentative distance between Solar PV farm to 11KV S/S. Further for the designing of the transformer ( client scope), recommendation from Inverter shall be considered.	NIT conditions shall prevail. 11 KV Solar sub-station is in the same land of solar farm. 11/0.415 KV Trafo (Client scope) is already in other scope & under procurement, GTP will be provided to solar vendors at the time of detail designing.	
4	Page No. 7 Clause No.2.1.19	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.	Kindly specify the min. area requiremnt in sq. meter for O&M staff, UPS & Battery rooms, Local Scada Room	NIT conditions shall prevail. Being an EPC job, it has to be designed & provided to client by successful bidder at the stage of detai desiging as per latest nations standards & standard practises.	
5	Page No. 7 Clause No.2.1.20	CCTV,Pump & pipes, manual & robotics cleaning shall be within the schedule of O&M requirements	Bidder understand that Either of the manual or Robotics cleaning is required and choice will be of bidders only Kindly clarify the same	Please refer the corrigendum /s.	
6	Page No. 7 Clause No.2.1.26	A licensed PV System Software shall be provided by the contractor for plant analysis and its performances verifications.	Kindly clarify whether only Pvsyst report is required to submit or PV Syst Licensed Version software with Pvsyst report need to submit.	Shall as per NIT A licensed PV System Software shall be provided by vendor	
7	Page No. 197 Clause No.Tender Notice	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	As per Tender Notice SLA Clause on page 197, we understand that total AMC including DLP shall be of 7 years.	NIT condiions shall prevail.	
8	Page No. 8 Clause No.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.	Howevre as per 4CTS- Page 8, Clause 2.3.1 - Warranty of 15 years has been asked. Since both are contadictory kindly clarify the same.		
9	Page No. 9 Clause No.2.5.1 (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	Bidders understanding is that 1.5m wide Footpath/Pathways shall be provided only around the periphery of solar plant. Kindly clarify the same. Also kindly give the details( Road thickness , Width ) of Footpath/pathways and Cement Concrete road	NIT onditions shall prevail. Pathway shall be through out as required as per standard practise at all major mainanance passages - part of detail designing; all civil construction shall as per CPWD standards.	
10	Page No. 10 Clause No.2.5.3	Modules with output of 300 Wp or above shall be used. Photo / electrical conversion efficiency of SPV module shall be greater than 15%. (mono/multi crystalline)	As per present market scenario, we would propose to use 1500V system with PERC Cell Modules of 370/380/390Wp with Higher efficiency instead of 1000V system with 300/320/325/330Wp Modules. This will help in optimisation of the BOS and also lesser Land area is required. Kindly consider the requirement.	NIT Conditions shall prevail. Vendor may provide system as per NIT or better subject to approval from university at the time of detail designing stage.	

	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERMANENT CAMPUS (PHASE I) PKG. 4C				
Sr. no.	Tender Reference	Item Description	Clarification Required	Reply from Nalanda University	
11	Page No. 10 Clause No.2.6 (i)	High transmission glass is on the top and Tedlar sheet at bottom side of the module should be provided.	As standard availability in market Back sheet PVDF instead of tedler as per IEC 61215	NIT Conditions shall prevail. Vendor may provide system as per NIT or better subject to approval from university at the time of detail designing stage.	
12	Page No. 11 Clause No.2.6(l)	The PV modules shall be provided with antireflection coating and back surface field (BSF) structure to increase conversion efficiency	As per module manufacturer suggestion, These specification irrelevant of Crystalline module technology (mono/Poly ) , Please review and confirm the same .	NIT Conditions shall prevail. Vendor may provide system as per NIT or better subject to approval from university at the time of detail designing stage.	
13	Page No. 12 Clause No.2.7(g)	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.	As per tender requirement string Inverter has been selected and output voltage of the inverter shall be monitored by PWM technology to meet the requirement, hence Isolation transformer is not applicable. Furthermore considering current market scenario we would propose to use 1500V Inverter system instead of 1000V Inverter. in this case the transformer LV voltge 800V instead of 415 V .Kindly Consider the same.	NIT conditions shall prevail. 11/0.415 KV Trafo (Client scope) is already in other tender scope & under procurement, GTP will be provided to solar vendors at the time of detail designing. An isolation Tansformer with required voltage canges to be provided by vendor in such case.	
14	Page No. 14 Clause No.2.7 (h (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.	LT Panel and Inverter duty Transformer shall be act as Galvanic Isolation from Grid to PCU and DC Component, hence any other isolation not applicable.	NIT Conditions shall prevail. Vendor may provide complete system & details as per actual requirement after detail design for client's approval.	
15	Page No. 17 Clause No.2.7	Grounding PCU includes ground lugs for equipment and PV array groundings. The DC circuit ground is a solid single point ground connection.	Sine String Inverter are proposed for this tender, so Inverter negative Grounding/ PV array is not applicable. However Anti PID kit shall be used to mitigate the effect of PID.	NIT Conditions shall prevail. Vendor may provide complete system & details as per actual requirement after detail design for client's approval.	
16	Page No. 20 Clause No.2.1	Metering Scheme	Please provide the location of meter and class of Meter	NIT conditions shall prevail. Please refer schematic SLD provided.	
17	Page No. 22 Clause No.2.13.1	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.	In Annexure B - BOQ, Galvanization of Structure has been given 120 micron instead of 80 micron, kindly clarify the Galvanization thickness for the Structure. Furthermore can we select Galvalume Material instead of Aluminium Alloy. Kindly clarify the same.	NIT conditions shall prevail. Annexure B is indicative only, it is provided for ready reference of bidder. Please refer note in the same annexure. Bidder can provide equipments / parts as per NIT or better subject to approval from university at the time of detail designing.	
18	Page No. 23 Clause No.2.13.1 (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.	Kindly clarify the angle of inclination and whether structure shall be designed for Fixed Type or sesonal type.	NIT Conditions shall prevail. Vendor may provide complete system & details as per actual requirement after detail design for client's approval.	
19	Page No. 23 Clause No.2.14	String Monitoring Box	Since String inverters are proposed hence String Monitoring Box is not applicable. Kindly clarify the same.	NIT Conditions shall prevail. Vendor may provide complete system & details as per actual requirement after detail design for client's approval.	

	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERMANENT CAMPUS (PHASE I) PKG. 4C			
Sr. no.	Tender Reference	Item Description	Clarification Required	Reply from Nalanda University
20	Page No. 26 Clause No.2.17	RTU-(d) The RTU shall support IEC-103, IEC-104, MODBUS-RTU and many other IEC protocols for substation and tele control level communication	Kindly provide us detialed scheme of the communication through IEC-101, IEC- 104, IEC-60865, and also distance from the site and SLDC location	NIT Conditions shall prevail. Being an EPC job, sucesfuld bidder has to design & provide all required data for approval. The distance between 11 KV Solar Sub-sttaion to Main receiving power station of the campus is 1800m while main scada center of the campus is approximately 2100m away. Bidder to visit the site for better calrity.
21	Page No. 27 Clause No.2.17 (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	Since HT Side is in the client scope, so kindly provide us the detailed list of DI/DO, AI/AO, Modbus, TCP IP, Optical Fiber communication device.	NIT conditions shall prevail. Client supplied item is covered in client side SCADA, however for required intigration & cordination this data will be provided at the stage of detail designing.
22	Page No. 28 Clause No.2.18 (ii)	The cable shall be 1.1 KV grade, heavy duty, stranded copper conductor, XLPE insulated	As per standard Industry practice, we would like to propose Aluminium cable from Inverter to LT Panel to Transformer instead of Copper Cable. However copper String cable of 4 sq mm shall be used from modules to Inverter. Kindly clarify the same.	NIT Cnditions shall prevail. Vendor may provide system as per NIT or better subject to approval from university at the time of detail designing stage.
23	Page No. 28 Clause No.2.18 (iii)	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	Kindly clarify what is meant by 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). However average Voltage drop from Modules to Inverter shall be 1% and from Inverter to LT Panel shall be around 5% at 415 V level. however if in case design 1500DCV system instead 1000DCV with inverter output voltage 800V the the total Losses AC and DC side shall optimized and less voltage drop. Kindly consider the same.	NIT Cnditions shall prevail. Vendor may provide system as per NIT or better subject to approval from university at the time of detail designing stage.
24	Page No. 31 Clause No.2.21	Control & Instrumentation System	Provide the detials of Electrical Work Station & Operating Work Station	NIT Cnditions shall prevail. It will be part of detail designing, details will be provided accordingly.
25	Page No. 31 Clause No.2.22	Solar Island	Provided PLC based SCADA system fro controling of Transformer & Switchgear	NIT Cnditions shall prevail.
26	Page No. 32 Clause No.2.23 (1.1)	LT Panel	We would like to propose Outdoor type LT Panel as per site condition. Kindly consider the same.	NIT Cnditions shall prevail.
27	Page No. 45 Clause No.2.25	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	For the Module cleaning system we would like to know whether can we use uPVC/ HDPE Pipe instead of GI Pipe. Further kindly let us know water tank shall be Sintex Type or shall be underground RCC type Kindly clarify the same.	Please refer corrigendum /s. Rest shall as per NIT.

	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERMANENT CAMPUS (PHASE I) PKG. 4C				
Sr. no.	Tender Reference	Item Description	Clarification Required	Reply from Nalanda University	
28	Page No. 46 Clause No.2.25 (1.2)	Foundation System	Kindly share us SBC report and contour drawing if there is any	NIT conditions shall prevail. Being an EPC job, it has to be studied, designed & provided to client by successful bidder at the stage of detai desiging as per latest nations standards & standard practises.	
29	Page No. 50 Clause No.3	Make List	We would like to propose some other make list too apart from availabel in the list: Modules - Goldi, Saatvik Inverter - Ingeteam, Solar Edge Optimizer - TTA LT Panels - System House SCADA - Adaptive, System House WMS - Jambhekar, Meatech, Webdyn IP Based CCTV - Hick Vision	Please refer corrigendum /s. Rest shall as per NIT.	
30	Page No. 51 Clause No.	<u>Location Data</u> Proposed Site & Space allocated (Approx 47,300 Sqm)	As per standard practice with 330Wp Modules, per Megawatt Land requirement is around 3.6 to 3.7 Acre. However as per projected land by NU total land is 11.68 ACRE and per Megawatt Land is coming around 1.798 Acre which is much lesser than the requirement. Subject to Projected Area provided by NU, we will ask to provide some extra land to install the required capacity. Please clarify on the same.	Please refer corrigendum /s.	
31	Page No. 56 Clause No.2.1.1	FUNCTIONAL GUARANTEE TESTS FOR SOLAR PV PLANT	-	As per NIT read with corrigendum and design confirmation/suggestion by the third party.	
32	Page No. 66 Clause No.7	ANNEXURE - B 1. Solar Modules - 325 Wp 2. MMS - 2.5mm Thickness Minimum 120 micron Minimum HDGI 3. Power Conditioning Unit / Inverters 5. DC Cables 1CX4 sqmm or 6 sq mm 14. Armoured XLPE Copper & Aluminium AC Cables as required from Inverter to AJB / Panel & AJB/Panel to Panel including laying, termination etc	<ol> <li>We would like to propose 1500V Solar Modules of Rating 370Wp / 380Wp/390Wp with PERC cell, instead of 325Wp.</li> <li>Please clarify what will be the thickness of Galvanisation, whether it should be 80 micron or 120 Micron.</li> <li>We would suggest to use 1500V String Inverter with Minimum rating of 50KW or higher as per requirement Instead of 1000V system.</li> <li>Please clarify what should be cable size 4 sq mm or 6 sq mm. However for string Inverter 4 sq mm cable shall be sufficient to cater the site requirement.</li> <li>Kindly clarify whether cable shall be of Aluminium or Copper from Inverter to LT Panel and from LT Panel to Transformer.</li> </ol>	NIT conditions shall prevail. Annexure B is indicative only, it is provided for ready reference of bidder. Please refer note in the same annexure. Bidder can provide equipments / parts as per NIT or better subject to approval from university at the time of detail designing.	
33	Page No. 173 Clause No.NIT	NET MINIMUM GUARANTEED GENERATION (NMGG) 1st Year - 570000000 or higher	Proposed Generation for fisrt year is way too much hgiher than expected generation at site. Expected Generation Could be : 900 MWh(fixed tilt) at GHI-1783 kWh/Sq.mt . it is difficult to guarantee of absolute generation . Request to NU Please provide annual DHI,DNI, GHI of location and we suggest the generation guarantee link with annual irradiation value, as it is standards in all Public sector companies' and SECI Project	Please refer corrigendum sction or above clarifications.	
34	Page No. 194 Clause No.Tender Notice	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 AMC period shall be for 60 Months.	Bidder understanding is this, there are total of 7 years of AMC which includes 2 Years of DLP + 5 Years of AMC. Kindy clarify the same.	NIT Condition Shall prevail	

	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERMANENT CAMPUS (PHASE I) PKG. 4C				
Sr. no.	Tender Reference	Item Description	Clarification Required	Reply from Nalanda University	
35	Page No. 43 Clause No.NIT	7. Initial CRITERIA FOR ELIGIBILITY (TECHNICAL TENDER) 7.1 The eligibility criteria applicable for the bidders for the present tender in terms of the scope of Work shall be: 7.1.1 The bidder should have satisfactorily completed Three similar works each costing not less than Rs. 9.70 Crores (Rupees Nine Crore Seventy Lakh only) or completed two similar works each costing not less than Rs. 14.55 crores (Rupees Fourteen Crore Fifty five Lakh only) or completed one similar work each costing not less than Rs. 19.40 crores (Rupees Nineteen Crore Forty Lakh only) during the last seven (7) years ending previous day of the last day of submission of Tender. For this purpose cost of work shall mean gross value of the completed work.	We, SAEL are Developer (IPP) and having our own In-House EPC Division for executing our Own IPP (RESCO) Projects where we had sign PPA with various state discoms. We have executed 150+ MW Project as IPP & with In-House EPC for SAEL & Group Company Project, tender floated by Various Govt. Agencies in Uttar Pradesh, Punjab and Maharashtra.CA cost of all projects available. So, requesting you to kindly confirm that the above mentioned Project shall be considered for meeting the required subject Tender Technical Eligibility Criteria.	NIT Condition Shall prevail	
36	Page No. 150 Clause No.NIT	CLAUSE.5.11: Warranty/Guarantee and Defect Liability period Warranty/Guarantee: As per the SECI/MNRE Guideline read withthis NIT 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.	Kindly clarify the precise warranty required by Employer because in tender there are places where you mentioned the warranty required by your side and this clause Warranty/Guarantee and Defect Liability period Warranty/Guarantee: As per the SECI/MNRE Guideline read withthis NIT whichever will be maximum. Kindly clarify the same.	NIT Condition Shall prevail	
37	Page No. 66 Clause No.NIT	Milestone of Works (Time duration 18 Months) Total Time allowed for execution of work 12 (Twelve) Months thereafter DFL, O&M.	Is it 12 months or 18 months? Kindly clarify the timeline for completion of work.	NIT Condition Shall prevail	
38	Page No. 163 Clause No.NIT	Clause.5.17 : On Account Payment of Interim Bills 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.	From approval/vetting of documents with the mentioned competent autorities(SECI/NISE etc) an additional fee will be required by them it will also increase the cost of EPC at bidding stage also.It is requested to kindly remove the clause.	NIT Condition Shall prevail	
39	Page No. 164/97 Clause No.NIT	PAGE:164_ 6. Performance Guarantee of 5 % (Ten percent) of the Contract Value of comprehensive O&M amount in the form of Bank Guarantee/ FDR, valid up to entire O&M period. PAGE:97 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 O&M period.	Is it a single performance guarantee of 5% or 10% mentioned in the contarct. Kindly clarify the same.	NIT Condition Shall prevail	

	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERMANENT CAMPUS (PHASE I) PKG. 4C				
Sr. no.	Tender Reference	Item Description	Clarification Required	Reply from Nalanda University	
40	Page No. 101 Clause No.NIT	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.	As EPC contractor already giving a BG of 110% of the amount of advance. Also the BG itself have an opening expense it is our request to the employer kindly remove the intrest rate of 10% per annum.	NIT Condition Shall prevail	
41	Page No. 164/75 Clause No.NIT	pge:164_ 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. pge: 75 _ 13. The bidder whose tender is accepted shall be required to furnish by way of Security Deposit for the fulfilment of the Contract, an amount equal to 2.5% of the tendered value of the work. The Security Deposit shall be collected by deductions from the running bills as well as final bill of the Contractor at the rates mentioned above. The Security Deposit shall also be accepted in cash or in the shape of Government securities, fixed deposit receipt of a scheduled bank or State Bank of India will also be accepted for this purpose provided conformity advice is enclosed.	Kindly clarify the security deposit method. Is it in the form of BG or in the form of deductions from the running bills as well as final bill of the Contractor at the rates mentioned above.	NIT Condition Shall prevail	
42	Page No. 65 Clause No.NIT	CLAUSE 1: Performance Guarantee: 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	We are requesting to kindly give 30 days from LOA for the mentioned work in this clause.	NIT Condition Shall prevail	
43	Page No. 65/67 Clause No.NIT	CLAUSE 5: Time and Extension for Delay :Number of days from the date of issue of letter of acceptance for reckoning date of start. =22 days	<ul> <li>1)As per the headline"Time and Extension for Delay" as the matter written below this is contradictory. Kindly give extact meaning of this clause.</li> <li>2) Also 2 time clause 5 mentioned in the tender on pge 65 and page 67 with different headings.</li> <li>3) Also clause 3 and clause 4 are missing on page 65</li> </ul>	NIT Condition Shall prevail	
44	Page No. 70 Clause No.NIT	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 4.23 is not available in the NIT. Kindly clarify the same.	NIT Condition Shall prevail	

	PREBID QUERIES FOR - TENDER FOR	SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNEC	CTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERM
Sr. no.	Tender Reference	Item Description	Clarification Required
45	Page No. 68 Clause No.NIT	<ul> <li>CLAUSE 7 : Payment on Intermediate Certificate to be regarded as Advances</li> <li>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.</li> <li>Minimum Value shall be Rs. 2.0 Crores per Running Bill. (this limit of Rs. 4.0 crore will not apply to the first running bill and last running bill preceding the final bill)</li> </ul>	We are requesting to kindly elobrate this clause.
46	Page No. 15 Clause No.NIT	Earnest Money Deposit (EMD) INR 34.25 Lakhs shall be accepted only in the form of 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.Alternatively, a part of the EMD is acceptable in the form of bank guarantee of any scheduled bank having validity for 120 Days or more from the last date of receipt of tenders. In Such case Rs. 17,12,531/- (Rupees Seventeen Lakh Twelve Thousand Five Hundred Thirty One Only/-) will have to be deposited in the shape prescribed amount and balance can be accepted in form of bank Guarantee issued by a Scheduled bank, which is to be scanned and uploaded by the intending bidders.	We are requesting to kindly take the complete amount of 34.25 lakhs EMD in form of bank guarantee.
47	Page No. 58 Clause No.NIT	AFFIDAVIT FOR SITE VISIT	You are requested to kindly give the extension on site visit & due date due to COVID-19 lockdown period.
Bidder 18			
2	Eligibility Criteria	<ul> <li>The bidder should have satisfactorily completed Three similar works each costing not less than Rs 9.70 Crores (Rupees Nine Crore Seventy Lakh only) or completed two similar works each costing not less than Rs. 14.55 crores (Rupees Fourteen Crore Fifty five Lakh only) OR completed one similar work each costing not less than Rs. 19.40 crores (Rupees Ninteen Crore Forty Lakh only) during the last seven (7) years ending previous day of the last day of submissio of Teder. For this purpose cost of work shall mean gross value of the completed work. This should be certified by an officer not below the rank of Executive Engineer / Project Manager or equivalent</li> <li>OR Any Panel Mannufacturer or Authorized agency of panel manufacurer who has done similar work of Designing, Engineering, Procurement, Installatio, Testing, commissioning,</li> </ul>	We have the experience of setting up of groud mounted Grid connect Solar Power Plants of Cumulative capacity 72MW (ranging from 870kW to 16MW) Developer mode for captive consumption We are Original Manufacturers Crystalline Solar Cells & Soar PV Modules wi plant capacity of 10MW for Solar Cells & 30MW of Solar PV Modules.
		Operation and maintaance o Solar Farm with all necessary of Electricity for a minimum Plant size of 4 MW.	
D:11 10			
1	Page No 15 of NITPoint 8 a	Earnest Money Deposit (EMD) INR 34 25 Lakhs	Request for EMD exemption for MSME companies
^			

RMANENT CAMPUS (PHASE I) PKG. 4C			
	Reply from Nalanda University		
	NIT Condition Shall prevail		
	100% EMD can be submitted in the form of the		
	BG issued by the scheduled bank under RBI,		
	please refer to the corrigendum section		
in the			
1			
to the	NIT Condition Shall prevail		
r	NIT Condition road with corrigondum soction		
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vv) III	Shan prevan		
with	NIT Condition Shall prevail		
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	NIT Condition Shall prevail		
	FFF		

	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERMANENT CAMPUS (PHASE I) PKG. 4C				
Sr. no.	Tender Reference	Item Description	Clarification Required	Reply from Nalanda University	
2	Page No 14 of NITPoint 4	The bidder shall furnish a solvency certificate of value not less than Rs. 9.70 Crores (Rupees Nine Crore Seventy Lakh only) certified by his bankers. Such certificate shall not be of a date, which is more than six months prior to the date of submission of tender.	Request you to remove solvency for eligibility criteria as we don't have bank limits so we will not get solvency certificate from bank	NIT Condition Shall prevail	
3	Page No 75 of NITPoint 13	The bidder whose tender is accepted shall be required to furnish by way of Security Deposit for the fulfilment of the Contract, an amount equal to 2.5% of the tendered value of the work. The Security Deposit shall be collected by deductions from the running bills as well as final bill of the Contractor at the rates mentioned above.	Request you to confirm the applicability and submission or deduction of security deposit as pg 75 suggest that 2.5% will be deducted from the running bills and pg 164 suggest submission of 2.5% security deposit from comissioning till end of DLB i.e. 24 months	NIT Condition Shall prevail	
4	Page No 164 of NITPoint 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.		NIT Condition Shall prevail	
5	Page No 11 of CTSPoint 2.7	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.	request you to confirm if net metering in scope of contractor and provision of net metering is available in Bihar above 1MW, Request you to provide relevant notifications of Bihar regarding net metering for projects . Also it was discussed in Pre bid meeting if no net metering provision will be available, then the project may be considered for Net banking policy, please explain the term Net Banking policy for Solar System projects	NIT Condition Shall prevail	
6	Page No 50 of CTSPoint 3	Modules: Shall be Domestic Manufactured Only: Waaree/Vikram/PV- Powertech/REC/LG/VS	Request you to add Jakson Solar Modules	NIT Condition Shall prevail	
7	Page No Point	Inverter: Schneider/Delta/ABB/SMA/Huwai	Request you to add Sungrow, Solis and Siemens Gamesa Inverter	Please refer corrigendum being issued	
8	Page No 66 of CTSPoint 7	Power Conditioning Unit (Inverters) :- String Inverter, Min 50 KW to Max 100 KW ONLY	Request to allow to use central inverter or allow inverter above 100Kw	Please refer corrigendum being issued	
9	Nit Page 180- Expert/NISE Opinion vide e-m	His-Suggestion : Wetaher monitoring station also required	Yes It is required alonwith sofware and harware for the forecasting and monitoing as mentioned at the NIT page 180 and TS page 50 & 66.		

Bidder 20		

	PREBID QUERIES FOR - TENDER FOR SITC OF 5000 KW AC, 1.3ILR/6.5DC CAPACITY GRID CONNECTED GROUND MOUNTED SOLAR PV SYSTEM FOR PROPOSED PERM			
Sr. no.	Tender Reference	Item Description	Clarification Required	
1	Integrity Agreement -Article 7- Sub Clause	i. As per Article 7 (sub clause 3) - "If the Contractor is a	Clarification on Consortium Formation Requested - no clear structure i.e. lead	
	3 - Page 28- Notice Inviting Tender	partnership or a consortium, this Pact shall be signed by all the	bidder / secondary bidder (or) financial partner / technical partner has been	
		partners or by one or more partners holding power of attorney	clarified - we request that the tender committee issue clarification on the natu	
		signed by all partners and consortium members. In case the	and structuring of the consortium.	
		contractor is a company, the Pact must be signed by a		
		representative duly authorized by board resolution of such		
		company."		
		ii. As per the NIT document -:" However, in case of any		
		omission in the tender/ contract document, the most recent		
		version of correction slips (as on November 2019) of General		
		Conditions of Contract (GCC) for CPWD Works, 2014 shall be		
		the reference manual."		
		iii. Post referring to the CPWD GCC 2019 for both		
		Construction & EPC contracts and CPWD Works Manual 2019-		
		"Article 7 (sub clause3) - If the Contractor is a partnership or a		
		consortium, this Pact must be signed by all the partners or by		
		one or more partner holding power of attorney signed by all		
		partners and consortium members. In case of a Company, the		
		Pact must be signed by a representative duly authorized by		
		board resolution "		
2	Notice Inviting Tender- Schedule F- Clause	"Minimum Value shall be Rs. 2.0 Crores per Running Bill. (this	To seek clarification on the payment terms – Whether the bill settlement will	
	7 - Page-68 - Payment on Intermediate	limit of Rs. 4.0 crore will not apply to the first running bill and	happen on a running basis.	
	Certificate to be regarded as Advance	last running bill preceding the final bill) "		
3	NIT Document- Page 11 - Last Date of	last Date of Bid submission on 14th April upto 3.30 PM	Keeping in view of the travel restrictions placed by the Government it is our	
	Submission of Tender - Date & time		request that the bid submission should be extended by 20 days so as to enable	
			qualified bidders to participate for the tender.	
			I request the tender committee consider the current lockdown and consider o	
			request for the extension of the bid submission date.	

MANENT CAMPUS (PHASE I) PKG. 4C			
Reply from Nalanda University			
Please refer to Corrigendum - 1			
Yes. Please read Clause 7 Detail description on Page 94 of NIT Document. Please refer to Corrigendum 1.			
Please refer to Corrigendum - 1			

# **NALANDA UNIVERSITY PROJECT: - SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE, RAJGIR, NALANDA, BIHAR.**



# SUBMISSION: -GEOTECHNICAL INVESTIGATION REPORT

 $\mathbf{TO}$ 

CONSULTANT (ADMINISTARTINON) ON BEHALF OF VICE CHANCELLOR, NALANDA UNIVERSITY 1ST FLOOR, INDIAN CONGRESS BUILDING SEC-6,RKPURAM, NEW DELHI-110022

SUBMITTED BY M/s ALLIED ENGINEERS SHOP NO 77,LSC. LU BLOCK, PITAMPURA,DELHI -110034 PH- 011-27348891,47507397. (M) 9350104466

> **EMAIL :-** <u>alliedengineers77@yahoo.co.in</u> <u>alliedengineers77@gmail.com</u>

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## FIGURE:-SITE LOCATION PLAN 132

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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 18<sup>th</sup> 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 <u>GEOLOGY OF THE REGION IN BRIEF</u>

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 Bathani village of Gaya district. Occurrence of such volcanonear 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 primary displays -preserved sedimentary structures verv such as stratification, cross-bedding, ripple marks, mud cracks and convolute-bedding.

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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 visà-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 .

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### 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 coefficient 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.

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#### 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.

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## **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.

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# **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  $110^{\circ}$ C. 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  $110^{0}$ C. 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.

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## (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 and recorded . The distance (H) corresponding to a reading Rh is the sum of the distance measured and recorded . 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.

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# 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 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 (Wa) 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.

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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.

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- (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  $\pm 20^{\circ}$ 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:

Wb (100+W) P = 100 - -----

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.

## **Sedimentation**

(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.

#### (b) meniscus correction :-

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
Х	=	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. NALANDA

#### **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.

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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 ( $\eta r$ )/y\*i\*r In which K27 = permeability at 27<sup>0</sup> C,  $\eta r$  = coefficient of viscosity at T<sup>0</sup> C  $\eta 27$  = 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

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## 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 ( $\gamma t/\gamma 27$ )

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# 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

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#### 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.

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  $\mu$  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.

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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

# <u>Plate Load Test:-</u>

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 . .

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# 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<u>ALLOWABLE BEARING CAPACITY :-</u>

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 B	EARING PRESSURE(I	<b>LOWEROF THETWO C</b>	CONSIDERATION)										
DEPTH OF	SIZE OF FOOTING	ALLOWABLE BE	ARING PRESSURE										
FOOTING Below	(m)	(T/	/M2)										
EGL (m)													
BH-1,2,3		(CONTINUOUS	(ISOLATED										
		STRIP FOOTING ) (T/M2)	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										
NALSONDA	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
		<b>RAFT FOUND</b> A	ATION (T/M2)
1.50	10.0 M x20.0M	6.9	9
1.50	15.0 M x30.0M	6.7	9
1.50	20.0 M x40.0M	6.7	2
		E FOUND ATIONS	

7.2:-<u>SINGLE UNDER REAMED PILE FOUNDATIONS.:-</u>

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 Ca	rrying Cap	oacity of Single	Under Ream	ed Pile Foundation	. (PROJEC	T:- SOIL									
INVEST	INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.)														
BIHAR.)															
Stem	Bulb	Cutt of	Length of	Safe load carryi	ng capacity	of single									
dia	diaOf	Level Of	reamed pile												
(cm.)	pile	Pile below	Cutt of												
	(cm)	GL(m.)	Level(m.)	-											
				In compression	In uplift	Lateral Thrust									
				(1)	(1)	(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									
\	120.0	1.0	2.0	50.1	10.7										

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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	34
45	$\frac{110000}{0}$	1.0	8.0	37.8	23.3	4.0
50	0 125.0	1.0	8.0	43.9	27.0	4 5
	120.0	1.0	0.0	13.9	27.0	1.0
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	20.7	3.4
45	$\frac{100.0}{0}$ 112.5	1.0	9.0	41.9	26.3	4.0
50	$\frac{112.5}{0}$	1.0	9.0	48.4	30.4	4.5
50.	125.0	1.0	9.0	-10.1	50.4	ч.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

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# **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.

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	CHEMICAL ANALYSIS OF WATER SAMPLE, PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA. BIHAR.														
-	ROULEI	SOIL		N	NALANDA	, BIHAR.				on,					
SL	LOCAT	DEP	AC	pН	ALKA	ACIDI	ΤΟΤΑ	Chlori	SULP	TOTAL					
NO	ION	TH	СЕР	VAL	LINIT	ΤΥΤΟ	L	de	HATE	ORGAN					
	(BH No)	(M)	EPT	UES	Y TO	NEUTR	SOLI DS IN	MG/L	MG/L	IC MATTE					
			ING		NEUI RALIS	ALISE 100 ML	DS IN MG/L								
			TER		E 100	OF	MIG/L			MG/L					
			IA		ML OF	WATE									
			AS		WATE	R									
			PE		R	0.5.14	2000	<b>7</b> 00	400	200					
			1S 456	>6	0-25 ML OF	0-5 ML	3000 МС/I	500 MC/I	400 MC/I	200 MC/I					
			2000		0.02N	N	MIG/L	MO/L	MO/L	MO/L					
			•		H2SO4	NaOH									
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	вн -18	4.50		8.34	33.4	1.85	527.00	9.34	102.00	181.00					
19.0	вн -19	3.00		8.19	33.6	1.88	522.00	9.36	107.00	169.00					
20.0	вн -20	6.00		7.95	33.5	1.83	534.00	9.27	112.00	174.00					

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PRO	S SOJECT:- SOIL INVES	OIL CHEMIC FIGATION A NALAI	CAL TEST RES T NALANDA U NDA, BIHAR.	ULT , NIVERSITY SITE , F	RAJGIR ,
SL NO	LOCATIONS BH NO	Depth of Sample Below EGL(m)	PE	CRMISSIBLE 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 <sup>3</sup>	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.

<b>P</b> ]	PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR																
S.	BORE	Per	Permeability Test Result (Depth Below EGL)														
No	HOLE	2.0 m	4.0 m	6.0 m	8.0 m												
	NO																
1	1.0	$2.55 \times 10^{-8}$ cm/sec	$3.18 \times 10^{-8}$ cm/sec	$3.28 \times 10^{-4}$ cm/sec	-												
2	6.0	$2.43 \times 10^{-8}$ cm/sec	$3.16 \times 10^{-8} \text{ cm/sec}$	$3.45 \times 10^{-8}$ cm/sec	$3.23 \times 10^{-8}$ cm/sec												
3	10.0	$2.39 \times 10^{-8}$ cm/sec	$3.17 \times 10^{-8}$ cm/sec	$3.41 \times 10^{-8}$ cm/sec	$3.51 \times 10^{-8}$ cm/sec												
4	12.0	$2.25 \times 10^{-8}$ cm/sec	$3.24 \times 10^{-8}$ cm/sec	$3.48 \times 10^{-8}$ cm/sec	$3.56 \times 10^{-8}$ cm/sec												
5	19.0	$2.47 \times 10^{-8}$ cm/sec	$3.15 \times 10^{-8}$ cm/sec	$4.32 \times 10^{-4}$ 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)

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ALL	IED E NO. M-1	NGIN 1/2012-	VEERS 13/1598 SOILPROFILE	C ADI NALA	ONSUL AINIST NDA UN	TAN RAT JIVE	IT ION RSIT	y Ul	SOII NIVER	LINVE SITY S	INVESTIGATION AT THE ITY SITE AT RAJGIR - NA		IE NALANDA NALANDA BIHAR		WATER TABLE 2.00 (M)				CATION <b>3H-1</b>	1 s	HEET N 1	10		
1PLE		)FILE	SOIL	feasured)	G DIS SIE	RAI RAI TRII VE A	N SIZ BUTI NALY	E ON (SIS	HYDROM ANALY	A	TTERI LIM	BERGS ITS	'	DEN gm	ISITY / cm <sup>3</sup>		/ITY	EX (%)/ RE		SHEARF UCC	PARAME C,TXL	CONS TI PARA	OLIDA ON METER	
TYPE OF SAM	DEPTH (m)	SUB SOIL PRC	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(ÌV SPT 'N' VALUES(ÌV	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTFNT (%)	SPECIFIC GRAV	FREE SWELIND	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	
a																								
SPT	1.50		Brownish colour Inorganic Silty Clay	8 1	1 1	3	4	7	85	34.20	20.40	13.80												
UDS	2.00		Highly Plasticity (CL)		1	3	6	9	81	34.26	20.49	13.77		1.89	1.58	19.57	2.68	32.5		0.03 0.65	28.0 8.0	<b>DST</b> 0.70	0.143	
SPT	3.00			13 1	5 1	2	5	7	85	34.22	20.45	13.75												
SPT	4.50			28 2	5 1	3	4	63	29															
UDS	5.00				1	2	3	62	32	REN	IOUL	DED U	DS	1.76	1.58	11.26	2.65			0.00	DST 30.50	0.68		
SPT	6.00		Inorganic Silty Sand (SM)	29 2	5 1	3	4	65	28															
	6.50																							

ALL	IED E	NGIN	EERS	AI	CON DMII	NSUL NISTI	FAN' RATI IVFI	T ION ISIT	VIIN	SOIL	ANVE	STIGA	TION	ATTH	E NAL	ANDA IDA BI		WA	ATER T	ABLE	LO	CATIO	N	SHEET 2	NO
	<u>INU. IVI-</u>	[]/2012-1	<u>5/1576</u> SOILT KOFILE		RAJ	GIRB	IHA	R			51115		і кајч	GIK-P	ALAI	DADI	IIAN		2.23 (1	<b>v1</b> )		BH-2		-	
MPLE		OFILE	SOIL	Measured)	Corrected)	GR DIST SIEV	AIN TRIB ZE AN	SIZ UTI VALY	E ON ISIS	HYDROM ANALY	А	TTERI LIM	BERGS ITS	,	DEN gm/	SITY / cm <sup>3</sup>	JRE	YTIV	EX (%)/ RE		SHEARF UCC	PARAME C,TXL	CONS TI PARA	OLIDA ON METER	TEST C %
TYPE OF SA)	DEPTH (m)	SUB SOIL PR	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(]	SPT 'N' VALUES((	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OM0
ď																									
SPT	1.50		Highly Plasticity	6	8	1	2	5	8	84	33.40	20.60	12.80												
UDS	2.00		Inorganic Silty Clay (CL)			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	<b>DST</b> 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												DST			
UDS	5.00		Min with group!			1	2	2	67	28	REM	IOULE	)ED UI	ÞS	1.79	1.61	10.98	2.65			0.00	31.0	0.64		
SPT	6.00		Inorganic Silty Sand (SM)	30	26	3	2	1	65	29															
	6.50																								

ALL	LED I B NO. M	NEERS 13/1598	CONSULTANT ADMINISTRATION SOIL INVESTIGATION AT THE NALANDA NALANDA UNIVERSITY UNIVERSITY SITE AT RAJGIR -NALANDA BIHAR ROFILE RAJGIR BIHAR					Y U	SOI NIVER	LINVE SITY S	ESTIGA SITE A	ATION T RAJ	ATTH  GIR -N	IE NAI NALAN	LAND NDA B	A IHAR	WA	ATER T 2.00 (N	ABLE MI)	LO	CATIO	N s	HEET ?	NO	
APLE		DFILE	SOIL PROFILE	Aeasured)	RAJGIR BIHAR (D) (D) (GRAIN SIZE D) (GRAIN SIZE ) (GRA						A	TTERI LIM	BERGS ITS	,	DEN gm/	SITY cm <sup>3</sup>	URE	VITY	EX (%)/ RE		SHEARPARAME UCC,TXL		CONS( TI( PARA)	CONSOLIDA TION PARAMETER	
TYPE OF SAM	DEPTH (m)	SUB SOIL PRO	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(N	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSUI	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
ſĹ																									
SPT	1.50			6	8	1	3	4	8	84	33.00	20.60	12.40												
UDS	2.00					1	2	4	9	84	34.02	20.69	13.33		1.91	1.58	21.01	2.67	35.5		0.03	27.5 8.50	DST 0.69	0.132	
SPT	3.00		Drak brownish Colour Highly Plasticity Inorganic Silty Clay	9	12	1	3	5	7	84	34.20	20.50	13.70												
SPT	4.50		(CL)	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	21	20	2	2	3	63	30															
UDS	8.00		(SM)			0	2	2	62	34	REN	IOUL	DEDU	DS	1.80	1.60	12.62	2.65			0.00	DST 32.50	0.66		
SPT	9.00		Brownish Colour Highly Plasticity	25	22	1	3	5	8	83	34.00	20.35	13.65												
	9.50		Inorganic Silty Clay (CL)																						

ALL	LIED I B NO. M	ENGI -11/2012-	A NA	CO ADM LAN	DNSUL INIST DA UN	TAN RAT	NT TON RSIT	TY U	SOI NIVEF	L INVI RSITY	ESTIG SITE A	ATION AT RA	N AT T JGIR -	HE NA NALA	LANE NDA F	DA BIHAR	WA	ATER T 2.00 (M	ABLE MI)	LO	CATIO BH-4	N S	SHEET NO 4		
APLE		DFILE	Aeasured)	Corrected)	IGIR I GF DIST SIEV	RAIN ΓRIE /Ε ΑΙ	I SIZ BUTI NALY	E ON 'SIS	HYDROM ANALY	А	TTERI LIM	BERGS ITS	,	DENSITY gm/cm <sup>3</sup>		URE	VITY	)EX (%)/ RE		SHEARPARAM UCC,TXL		CONSOLIDA TION PARAMETER		TEST 7%	
TYPE OF SAM	DEPTH (m)	SUB SOIL PRO	DISCRIPTION AND CLASSIFICATION		SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	BULK DENSITY DRY DENSITY		SPECIFIC GRAY	FREE SWELIND SWELL PRESSUI	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
T																									
SPT	1.50			5	7	1	2	5	8	82	35.00	20.00	15.00								0.04	28.0	DST		
UDS	2.00		Highly Plasticity			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					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		(CL)	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																								

ALL	IED E	NGIN	EERS	A	CON DMI	NSULI NISTR	TAN' RATI	F ON DELT		SOI	LINVE	STIGA	ATION T D A I	ATTH	IE NAI JALAN	LAND	A	WATER TABLE			LO	CATIO	N	SHEET NO		
JOB	NO. M-1	[]/2012-1	<u>13/1398</u> SOIL PROFILE		RAJ	GIR BI	HA]	R	I UI				I IAJ	<b>GIX-</b> 1	ALAI	UADI	IIAN		2.50 (1	M)		BH-5		3		
MPLE		OFILE	SOIL	Measured)	Corrected)	GF DIST SIEV	RAIN ΓRIE VE Al	I SIZ BUTI NALY	E NALY NALY ANALY		ATTERBERGS' LIMITS				DENSITY gm/cm <sup>3</sup>		URE	YTIY	)EX (%)/ RE		SHEARPARAME UCC,TXL		CONSOLIDA TION PARAMETER		TEST C %	
TYPE OF SA	DEPTH (m)	SUB SOIL PR	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(]	SPT 'N' VALUES(0	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (90)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OM	
Œ																										
SPT	1.50			6	8	1	2	4	8	85	34.80	20.40	14.40								0.04	20.0	DET			
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	<b>8.5</b> 0	0.68	0.110		
SPT	3.00		Highly Plasticity	10	13	1	3	7	7	82	35.70	20.30	15.40													
SPT	4.50		Inorganic Silty Clay (CL)	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																									

ALI	LIED I B NO. M	ENGI -11/2012-	<b>VEERS</b> -13/1598 -501 DDOEILE	A NA	CO ADM LAN	NSUL INIST DA UN	TAN RAT JIVE	IT ION RSII	Y U	SOI NIVER	LINVI SITY S	ESTIG SITE A	ATION AT RA,	N AT TI JGIR - 1	HE NA NALA	LAND NDA F	)A BIHAR	WATER TABLE 3.00 (M)			LO	CATIO BH-6	N S	SHEET NO 6	
APLE		)FILE	SOIL PROFILE	feasured)	(patrected)	IGIR I GI DIS SIE	BIHA RAIN ΓRIE VE AI	A <u>R</u> V SIZ BUTI NALY	E ON SIS	H Y DROM ANALY	ATTERBERGS' DENSITY LIMITS gm/cm <sup>3</sup>					JRE	JRE	EX (%)/ RE		SHEARPARAME UCC,TXL		CONSOLIDA TION PARAMETER		TEST %	
TYPE OF SAN	DEPTH (m)	SUB SOIL PRC	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(M	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	SHRINKAGE LIMIT BULK DENSITY DRY DRY DENSITY		MAX MOIS1 CONTENT (% SPECIFIC GR/		FREE SWELIND	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
ď			Dark Brownish Colour Highly Plasticity Inorganic Silty Clay (CL)		0			_		0.5	25.00	0.00	15.00												
SPT	1.50			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																								

ALL	IED E		A	COI DMI	NSULI NISTR	TAN' RATI	Г ОN		SOI	LINVE	ESTIG	ATION	ATT	IE NA	LAND	A	WATER TABLE			LO	CATIO	N	SHEET NO				
	NO. M-1	11/2012-1	<u>13/1598</u> SOILPRO	ILE	NAI	LANI RAJ	DA UNI GIR BI	IVEF [HA]	RSIT: R	Y UI	NIVER	SITYS	SITE A	T KA,	JGIR -	NALAI	NDA I	SIHAK		3.00 (M)			BH-7		/		
MPLE		OFILE	E SOIL				GF DIST SIEV	GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS			HYDROM ANALY	ATTERBERGS' DENS LIMITS gm/r					SITY / cm <sup>3</sup>	IRE	YTIY	EX (%)/ RE		SHEARI	PARAME C,TXL	CONS TI PARA	OLIDA ON METER	TEST C %	
TYPE OF SAI	DEPTH (m)	SUB SOIL PR	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES()	SPT 'N' VALUES(0	GRAVEL	COARSE	MEDIUM	FINE	SILTY+CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OM(		
Œ																											
SPT	1.50			Brownish colour	5	7	1	2	5	8	84	34.30	20.10	14.20								0.05	20.5	DOT			
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		Brownish colour		8	10	1	3	5	7	84	34.20	20.15	14.05													
SPT	4.50		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																										
ALI	LIED	E <b>NGI</b> I	NEERS	AI	CON DMII	NSULI NISTF	FAN' RATI	Г ON		SOI	LINVI	ESTIG	ATION	IATTI	HE NA	LAND	DA	WA	ATER I	ABLE	LO	CATIO	N S	SHEET	NO		
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<u>JO</u>	B NO. M	<u>-11/2012</u> -	<u>-13/1598</u> SOIL PROFILE	NAL	AND RAJO	DA UN GIR B	IVEI IHA]	RSIT R	Y U	NIVEF	RSITY	SITE A	AT RA	JGIR-	NALA	NDAE	BIHAR		<b>3.50</b> (1	M)		BH-8		8			
MPLE		OFILE	SOIL	Measured)	Corrected)	GF DIS SIEV	RAIN TRIE VE AI	I SIZ BUTI NALY	E ON 'SIS	HYDROM ANALY	A	TTERI LIM	BERGS ITS	1	DEN gm	SITY / cm <sup>3</sup>	JRE	VITY	EX (%)/ RE		SHEARI UCC	PARAME C,TXL	CONSO TI PARA	OLIDA ON METER	TEST C %		
TYPE OF SAI	DEPTH (m)	SUB SOIL PR	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Ì	SPT 'N' VALUES(0	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OM0		
G																											
SPT	1.50			6	8	0	2	5	8	85	35.50	20.50	15.00									07.5	DOT				
UDS	2.00		Highly Plasticity Inorganic Silty Clay			1	2	4	9	84	35.01	20.01	15.00		1.91	1.57	21.36	2.68	30.5		0.03	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												DET					
UDS	8.00					1	2	3	62	32	REM	OULE	EDUE	s	1.82	1.60	14.02	2.65			0.00	33.50	0.66				
SPT	9.00		Inorganic Silty Clay	22	20	1	3	4	8	84	35.90	20.70	15.20														
	9.50		(CL)																								

ALL	IED E	NGIN	EERS	A	CON DMI	NSULI NISTR	TAN] ATI	Г ON		SOI	LINVE	ESTIG	ATION	I AT TI	HE NA	LAND	A	WA	TER T	ABLE	LO	CATIO	N	SHEET	NO
JOB	<u>NO. M-1</u>	1/2012-1	<u>3/1598</u> SOIL PROFILE	NAL	ANE RAJ	DA UNI GIR BI	IVER IHAI	RSIT R	Y U	NIVER	SITY	SITE A	AT RA	JGIR-	NALA	NDA F	BIHAR	,,,,	2.50 (N	M)		BH-9		9	
MPLE		OFILE	SOIL	Measured)	Corrected)	GR DIST SIEV	AIN FRIB /E AI	SIZ UTI NALY	e On sis	HYDROM ANALY	A	TTERE LIM	BERGS ITS		DEN gm/	SITY / cm <sup>3</sup>	JRE	VITY	EX (%)/ RE		SHEARP UCC	PARAME C,TXL	CONS TI PARA	OLIDA ON METER	TEST %
TYPE OF SAI	DEPTH (m)	SUB SOIL PRO	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Ì	SPT 'N' VALUES(0	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
Œ																									
SPT	1.50			6	8	1	2	5	9	83	33.80	20.10	13.70												
UDS	2.00		Drak Brownish colour			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	<b>28.5</b> 9.50	<b>DST</b> 0.69	0.145	
SPT	3.00		Inorganic Silty Clay (CL)	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			19	19	2	2	1	65	30															
	6.50		(SM)																						

ALI	LIED I b no. m	ENGI -11/2012	<u>VEERS</u> -13/1598	A	CON DMI LANE	NSULI NISTR DA UNI	FAN' RATI IVEF	F ON RSIT	y Ul	SOII NIVER	LINVE SITY S	ESTIGA SITE A	ATION AT RAJ	AT TH JGIR - 1	HE NAI NALAI	LAND NDA B	A IHAR	WA	ATER T 3.00 (I	ABLE MI)	LO	CATIO	N S	HEET 1 10	NO
1PLE		)FILE	SOIL PROFILE	feasured)	orrected)	GIR B GF DIST SIEV	IHA RAIN FRIE VE AI	<b>R</b> I SIZ BUTI NALY	E ON SIS	HYDROM ANALY	A	ATTERI LIM	BERGS ITS	,	DEN gm	SITY / cm <sup>3</sup>	RE	/ITY	EX (%)/ 8E		SHEARI	PARAME	CONS TI PARA	)LIDA ON METER	TEST %
TYPE OF SAM	DEPTH (m)	SUB SOIL PRO	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(M	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRAV	FREE SWELIND	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
GL	1.50			7	10	1		5	0	94	24.50	20.10	14.40												
	2.00				10		3	5	8	84	34.50	20.10	14.40		1.83	1 53	19.77	2.68	35.0		0.03	28.0	DST	0.126	
SPT	3.00			12	15	1	3	4	7	85	32.50	20.10	12.00		1.05	1.55	19.17	2.00	55.0		1.27	10.00	0.75	0.120	
SPT	4.50			16	18	1	2	5	8	84	32.80	20.80	12.00												
UDS	5.00		Brownish Colour			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		Inorganic Silty Clay (CL)	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																								

ALL	IED E	NGIN	EERS	A	CON DMI	NSULT NISTR	ANT ATI VFP	C ON SITY	z U	SOI NIVER	LINVI RSITY :	ESTIG SITE /	ATION AT RA	NATTI IGIR -	HE NA NALA	LAND NDA F	)A RIHAR	WA	TER T	ABLE	LO	CATIO]	N	SHEET 11	NO
	<b>NO.</b> M-1	11/2012-1	<u>5/1596</u> SOILPROFILE	INAL	RAJ	GIRBI	HAI	811 I 8						JOIN					<b>5.50</b> (1)	VI)	1	BH-11			
MPLE		OFILE	SOIL	Measured)	Corrected)	GF DIST SIEV	AIN TRIB /E AI	SIZ UTI NALY	E ON ISIS	HY DROM ANALY	А	TTERI LIM	BERGS ITS	1	DEN gm	SITY / cm <sup>3</sup>	E	VITY	)EX (%)/ RE		SHEARF	PARAME C,TXL	CONSO TI PARA	OLIDA ON METER	TEST C %
TYPE OF SA	DEPTH (m)	SUB SOIL PR	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(]	SPT 'N' VALUES(0	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTUR CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OM
Œ																									
SPT	1.50			6	8	1	2	4	8	85	34.60	20.00	14.60									27.5	DOT		
UDS	2.00					0	1	5	9	85	34.68	20.09	14.59		1.93	1.61	20.14	2.67	33.0		0.03 1.19	7.50	0.66	0.142	
SPT	3.00		Brownish Colour	9	11	1	3	6	7	83	33.50	21.50	12.00												
SPT	4.50		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												
	0.50																								

ALI	LIED I B NO. M	ENGI -11/2012-	NEERS 13/1598 SOIL DROEILE	Al NAL	CON DMIN AND	NSULT NISTR DA UNI	ANT ATI VER	F ON SITY	τŪ	SOI JNIVEI	IL INVI RSITY	ESTIG SITE 4	ATION AT RA	N ATTI JGIR -	HE NA NALA	LANE NDAE	DA BIHAR	WA	ATER T 3.00 (I	ABLE M)	LO	CATIO B <b>H-12</b>	N S	SHEET 1 12	NO
APLE		DFILE	SOIL	Aeasured)	orrected)	GIR BI GF DIST SIEV	ΠΑΙ RAIN FRIE VE A	N SIZ BUTI NALY	E ON SIS	H Y DROM ANALY	A	TTERI LIM	BERGS ITS	'	DEN gm/	SITY / cm <sup>3</sup>	JRE	YTIV	EX (%)/ RE		SHEARI UCC	PARAME C,TXL	CONS( TI PARA]	OLIDA ON METER	TEST %
TYPE OF SAM	DEPTH (m)	SUB SOIL PRO	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(N	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSUI	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
ď																									
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	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		Brownish Colour	14	16	1	3	6	8	82	33.80	20.50	13.30												
UDS	5.00		Highly Plasticity Mix With Kankars Inorganic Silty Clay			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		(CL)	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																								

ALL JOB	IED E NO. M-J	NGIN 11/2012-1	EERS 1 <u>3/1598</u> SOIL PROFILE	A NAI	COI DMI LANI RAI	NSULI NISTR DA UNI CIR BI	FAN' RATI IVEF	F ON RSITT R	Y U	SOI INIVEI	IL INV RSITY	ESTIG SITE 4	ATION AT RA	N AT T JGIR -	HE NA NALA	LANE NDA B	DA SIHAR	WA	ATER T 3.00 (N	ABLE MI)	LO	CATIO BH-13	N	SHEET 13	NO
MPLE		<b>DFILE</b>	SOIL	Aeasured)	Corrected)	GI DIS SIE	RAIN TRIE VE A	I SIZ BUTI NALY	E ON 'SIS	HYDROM ANALY	A	TTERI LIM	BERGS ITS	1	DEN gm	ISITY / cm <sup>3</sup>	ξE	ЧТ	EX (%)/ RE		SHEARI UCC	PARAME C,TXL	CONS TI PARA	OLIDA ON METER	TEST 0 %
TYPE OF SAI	DEPTH (m)	SUB SOIL PRO	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(À	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTUF CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OM0
Œ																									
SPT	1.50			6	8	1	2	4	7	86	34.40	20.00	14.40												
UDS	2.00					1	1	4	9	85	35.48	20.07	14.41		1.91	1.57	21.75	2.67	37.0		0.03 1.16	27.5 8.00	<b>DST</b> 0.70	0.141	
SPT	3.00		Brownish Colour	9	12	1	3	5	8	83	35.45	20.50	14.95												
SPT	4.50		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 6.50			18	18	1	2	8	9	80	34.60	14.30	20.30												

ALI	LIED	ENGI	NEERS	Al	CON DMI	NSULT NISTE	FAN' RATI	Г ON	u U	SOI NIVEF	L INVI RSITY :	ESTIG SITE /	ATION AT RA	N ATTI JGIR -]	HE NA NALAI	LAND NDA F	A SIHAR	WA	ATER T	ABLE	LO	CATIO	N S	HEET	NO
	<u>B NO. M</u>	<u>-11/2012</u> .	<u>-13/1598</u> SOIL PROFILE		ANL RAJ	DA UNI GIR BI	іуеь [НА]	KSITY R	Ŷ					0000					2.80 (1	M)	] ]	BH-14		14	
MPLE		OFILE	SOIL	Measured)	Corrected)	GH DIS SIE	RAIN TRIE VE AI	I SIZ BUTI NALY	E ON (SIS	HYDROM ANALY	A	TTERI LIM	BERGS ITS	'	DEN gm	SITY / cm <sup>3</sup>	URE )	VITY	DEX (%)/ JRE		SHEARI UCC	PARAME C,TXL	CONS TI PARA	OLIDA ON METER	C %
TYPE OF SA	DEPTH (m)	SUB SOIL PR	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES()	SPT 'N' VALUES(	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOIST CONTENT (%	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OM
G																									
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	16	17	1	3	7	7	82	31.80	21.80	10.00												
UDS	5.00		(CL)			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																								

ALL JOB	IED E NO. M-	NGIN 11/2012-1	Z <mark>EERS</mark> 1 <u>3/1598</u> SOIL PROFILE	A	CON DMI ANE	NSULI NISTR DA UNI	FANT RATI IVER	F ON RSITY	Y U	SOI NIVEF	LINVI RSITY	ESTIG SITE A	ATION AT RA	N AT TI JGIR -	HE NA NALA	LAND NDAB	OA SIHAR	WA	ATER T 2.50 (1	ABLE M)	LO	CATIO BH-15	N	SHEET 15	NO
MPLE		OFILE	SOIL	deasured)	Corrected)	GIK B GI DIS SIE	RAIN TRIE VE A	I SIZ BUTI NALY	E ON (SIS	HYDROM ANALY	A	TTERI LIM	BERGS ITS	1	DEN gm	ISITY / cm <sup>3</sup>	Ш	VITY	EX (%)/ RE		SHEARI UCC	PARAME C,TXL	CONS TI PARA	OLIDA ON METER	TEST 7 %
TYPE OF SAM	DEPTH (m)	SUB SOIL PRO	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(À	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTUR CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
Œ																									
SPT	1.50			7	10	1	3	7	7	82	34.95	20.80	14.15												
UDS	2.00					1	3	5	10	81	34.97	20.84	14.13		1.88	1.56	20.64	2.68	34.0		0.04	28.5 9.00	DST 0.72	0.135	
SPT	3.00		Dark Brownish Colour	11	14	1	3	5	8	83	34.80	20.60	14.20												
SPT	4.50		Highly Plasticity Inorganic Silty Clay (CL)	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																								

ALI	LIED I B NO. M	ENGI -11/2012	<u>NEERS</u> -13/1598	A NAI	COI DMI LANI	NSUL' NISTI DA UN	FAN' RATI IVEI	T ON RSIT	Y U	SOI NIVEH	IL INVI RSITY	ESTIG SITE #	ATION AT RA	N ATT JGIR -	HE NA NALA	LANE NDA F	)A BIHAR	WA	ATER T 3.00 (I	ABLE MI)	LO	CATIO	N S	HEET 1 16	NO
<b>1PLE</b>		)FILE	SOIL PROFILE SOIL	feasured)	(patriced)	GIR B GH DIS SIEV	IHA RAIN FRIE VE AI	R I SIZ BUTI NALY	E ON (SIS	HYDROM ANALY	А	TTERE LIM	BERGS ITS	'	DEN gm	SITY / cm <sup>3</sup>	JRE	YTTY	EX (%)/ RE		SHEARF	PARAME C,TXL	CONS( TI( PARA)	OLIDA ON METER	TEST %
TYPE OF SAM	DEPTH (m)	SUB SOIL PRC	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(N	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRAV	FREE SWELINDI SWELL PRESSUF	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
D	1.50				0					0.6	25.10	20.10	15.00												
SPT	1.50		Brownish Colour Highly Plasticity	6	8	1	2	4		86	35.10	20.10	15.00								0.03	28.0	DST		
UDS	2.00		Inorganic Silty Clay (CL)			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									DOT			
UDS	5.00					0	2	1	67	30	RE	MOUI	DEDU	DS	1.74	1.55	12.46	2.65			0.00	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	RE	MOUI	DEDU	DS	1.77	1.54	14.57	2.65			0.00	DST 34.00	0.72		
SPT	9.00		Highly Plasticity Inorganic Silty Clay	25	22	1	3	5	9	82	31.00	22.25	8.75												
	9.50																								

ALL	IED E	ENGIN	EERS	A	CO DMI	NSUL' INISTI	TAN RATI	T ION	<b>V T D</b>	SOII	LINVE	STIGA	TION	ATTH	E NAI		A	WA	ATER T	ABLE	LO	CATIO	N	SHEET	'NO
JOB	<u>NO. M-</u>	11/2012-1	<u>13/1598</u> SOIL PROFILE	NAI	LANI RAJ	DA UN [GIR B	IVEI IHA	RSIT R	Y UI	NIVER	SITY S	STE A	I KAJ	GIK-P	NALAN	DABI	HAK		2.25 (1	M)	]	BH-17		17	
MPLE		OFILE	SOIL	Measured)	Corrected)	GH DIS SIE	RAIN TRIE VE Al	I SIZ BUTI NALY	E ON 'SIS	HY DROM ANALY	A	TTERI LIM	BERGS ITS	1	DEN gm	SITY / cm <sup>3</sup>	٤E	VITY	JEX (%)/ RE		SHEARI UCC	PARAME C,TXL	CONSO TI PARA	OLIDA ON METER	TEST C %
TYPE OF SA	DEPTH (m)	SUB SOIL PR	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(]	SPT 'N' VALUES(0	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTUR CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OM
Œ																									
SPT	1.50			5	7	1	2	4	7	86	34.80	20.00	14.80												
UDS	2.00					0	1	6	9	84	34.86	20.91	13.95		1.93	1.61	19.68	2.67	31.5		0.03	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																								

ALL	LIED I B NO. M	ENGI -11/2012	<u>NEERS</u> -13/1598	AI NAL	CON DMII AND	NSULT NISTR DA UNI	AN] ATI VER	ſ ON SIT	Y U.	SOI NIVER	LINVE RSITY S	ESTIGA SITE A	ATION AT RA,	ATTH JGIR - 1	IE NA NALA	LAND NDAB	A IHAR	WA	ATER T. 2.00 (N	ABLE	LO	CATIO	N S	HEET 1 18	NO
			SOIL PROFILE		RAJ	<u>GIR BI</u>	HAI	2	_					-					(- i	·/		3H-18			
MPLE		OFILE	SOIL	Aeasured	Corrected)	GR DIST SIEV	AIN TRIB ZE AI	SIZ UTI NALY	E ON 'SIS	H Y DRON ANALY	A	TTERE LIM	BERGS ITS	,	DEN gm/	SITY cm <sup>3</sup>	URE	ЧТҮ	EX (%)/ RE		SHEARF UCC	PARAME C,TXL	CONSC TIC PARA!	)LIDA )N METER	TEST 7 %
TYPE OF SAI	DEPTH (m)	SUB SOIL PRO	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(À	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOIST CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
Œ																									
SPT	1.50		Brownish Colour	6	8	1	3	7	9	80	34.00	20.00	14.00									20.0	DCT		
UDS	2.00		Highly Plasticity Inorganic Silty Clay (CL)			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	RF	MOU.	LDED	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												DOT			
UDS	8.00					0	1	2	68	29	R	EMOU	LDED	UDS	1.74	1.53	13.89	2.65			0.00	32.50	0.73		
SPT	9.00			23	20	2	1	3	63	31															
	9.50																								

ALL	IED E	NGL	NEERS	AD	CON DMII	NSULT NISTR	AN]	Г ON		SOI	LINVE	STIGA	ATION	ATTE	IE NA	LAND	A	WA	TER T	ABLE	LO	CATIO	N	SHEET	NO
JOB	<u>NO. M-1</u>	1/2012	<u>2-13/1598</u> SOIL PROFILE	NALA	AND RAJO	A UNI GIR BI	VER HAI	RSITY R	Y UI	NIVER	SITY S	SITE A	T RAJ	GIR-1	NALA	NDA B	IHAR		2.00 (N	(Iv	1	BH-19		19	
MPLE		OFILE	SOIL	Measured)	Corrected)	GR DIST SIEV	AIN FRIB /E AN	SIZ UTI NALY	E ON 'SIS	HYDROM ANALY	A	TTERE LIM	BERGS' ITS		DEN gm	ISITY / cm <sup>3</sup>	E	VITY	EX (%)/ RE		SHEARF UCC	PARAME C,TXL	CONSO TI PARA	OLIDA ON METER	TEST 0 %
TYPE OF SAI	DEPTH (m)	SUB SOIL PRO	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(À	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTUF CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
Œ																									
SPT	1.50		Drak Brownish colour	5	7	1	2	5	8	84	35.19	20.35	14.84								0.05	20.5	DOT		
UDS	2.00		Inorganic Silty Clay (CL)			1	2	6	9	82	35.22	20.43	14.79		1.90	1.56	21.69	2.68	41.5		1.19	<b>8.50</b>	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									DST			
UDS	5.00					1	2	2	67	28	REM	OULD	EDUD	S	1.75	1.54	13.76	2.65			0.00	32.00	0.72		
SPT	6.00		Light Grayish Colours Inorganic Silty Sand (SM)	19	16	2	2	1	65	30															
	6.50																								

ALL	ALLIED ENGINEERS JOB NO. M-11/2012-13/1598 SOILPRO				CON DMII	NSULT NISTR	IAN] RATI	r on sity	V IIN	SOII JIVER	LINVE SITY S	STIGA ITE A'	TION F RAI	ATTH GIR - N	E NAI JALAN	ANDA	HAR	WA	TER T	ABLE	LO	CATION	N S	HEET	NO
<u>J01</u>	<u>5 NO. M</u> ·	-11/2012-	SOIL PROFILE		RAJ	GIR BI	HAI	R			51115		1 1010	UIII I		DITDI			2.00 (1	<b>(1</b> )		3H-20		20	
MPLE		OFILE	SOIL	Measured)	Corrected)	GF DIST SIEV	RAIN ΓRIB VE Al	SIZ UTI NALY	E ON 'SIS	HYDROM ANALY	А	TTERI LIM	BERGS ITS	,	DEN gm/	SITY ′ cm <sup>3</sup>	URE )	VITY	)EX (%)/ RE		SHEARF UCC	PARAME C,TXL	CONSO TIO PARAN	OLIDA ON METER	C %
TYPE OF SA	DEPTH (m)	SUB SOIL PR	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(]	SPT 'N' VALUES(	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOIST CONTENT (%	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OM
GL																									
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			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		(CL)	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	REN	IOULI	DEDUI	DS	1.76	1.56	12.63	2.65			0.00	31.50	0.70		
SPT	6.00		Inorganic Silty Sand	15	18	2	1	1	61	35															
SPT	7.50		(SM)	21	17	1	2	2	63	32												DST			
UDS	8.00					1	1	2	69	27	REN	IOULI	DEDUI	DS	1.79	1.57	13.97	2.65			0.00	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																								





















	0	BSERVATI	ION AND C	ALCULAT	ION FOR	DETERMIN	NATION OF	F MODUL	US OF SUBGRAD	DE REACTIO	ON AS PER	IS 1888:1982	2	
]	LOCATION			PRO	JECT:- SO	DIL INVEST	IGATION A NALA	AT NALAN ANDA, BIH	NDA UNIVERSIT IAR.	Y SITE, RA	AJGIR,			
TYPE OF SU	B SOIL			SILTY C	LAY									
DEPTH OF 7	TEST			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	JRE CONDI	TION							
SIZE OF PLA	АТЕ			30.0x 30.0	SQUARE (	СМ								
SEATING LO	DAD			126 KG	-		-			-				
							TEST	Г 1 LOCA	TION NO 4					
				1	Dial Gauge	-1		Dial Gau	ige -2					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV DEDTH OF	WIDTH OF	SAFE/AL												
FOOTING Below existing GL(M)	FOOTING (M)	BEA BEA CAPACI (CONSI ALLO SETTLE 50.0	RING ITY T/M2 DERING WABLE MENT AS MM											
		ISOL SQUAR FOO	ATED RE/STRIP DTING											
1.5	1.00	15	5.47	4										
1.5	2.00	12	2.10	1										
1.5	3.00	1.07	Ţ											

	0	BSERVATI	ION AND C	ALCULAT	ION FOR	DETERMIN	NATION OF	MODUL	US OF SUBGRAD	DE REACTIO	ON AS PER	IS 1888:1982	2	
	LOCATION			PRO.	JECT:- SO	OIL INVEST	IGATION A NALA	AT NALAI NDA, BIH	NDA UNIVERSIT IAR.	Y SITE, RA	AJGIR,			
TYPE OF SU	UB SOIL			SILTY C	LAY									
DEPTH OF	TEST			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	JRE CONDI	TION							
SIZE OF PL	ATE			30.0x 30.0	SQUARE (	СМ								
SEATING L	¢ 1			126 KG										
							TEST	C 2 LOCA	TION NO 5					
				] ]	Dial Gauge	-1		Dial Gau	1ge -2					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV DEPTH OF FOOTING Below existing GL(M)	WABLE BEAI WIDTH OF FOOTING (M)	RING CAPA SAFE/ALI BEA CAPACI (CONSI ALLO' SETTLE 50.0	ACITY LOWABLE RING TY T/M2 DERING WABLE MENT AS MM											
		ISOL SQUAR FOO	ATED E/STRIP TING	-										
1.5	1.00	14	1.52	+										
1.5	2.00	11		┨										
1.5	3.00 10.39		1.39	1										

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
]	LOCATION			PRO.	JECT:- SO	IL INVEST	IGATION A	AT NALAN	NDA UNIVERSIT	Y SITE , RA	AJGIR ,			
		-					NALA	NDA, BIH	IAR.		•			
TYPE OF SU	B SOIL			SILTY C	LAY									
DEPTH OF 1	TEST			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	IRE CONDI	TION							
SIZE OF PLA	ATE			30.0x 30.0	SQUARE (	CM								
SEATING LO	1			126 KG	-	-	-							
							TEST	G 3 LOCA	TION NO 6					
				I	Dial Gauge	-1		Dial Gau	ige -2					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	VABLE BEAI	RING CAPA	ACITY											
DEPTH OF	WIDTH OF	SAFE/ALI	LOWABLE											
FOOTING	FOOTING	BEA	RING											
Below	(M)	CAPACI	TY T/M2											
existing		(CONSI	DERING											
GL(M)		ALLO SETTI E	WADLE MENT AS											
		50.0	MM											
		ISOL SQUAR FOO	ATED E/STRIP TING											

1.00

2.00

3.00

9.31

7.29

6.67

1.5

1.5

1.5

OBSEF	RVATION AN	ID CALCU	LATION FC	OR DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	5 PER IS 188	8:1982			
]	LOCATION			PRO	JECT:- SO	IL INVEST	IGATION A NALA	AT NALAN ANDA, BIH	NDA UNIVERSIT IAR.	Y SITE, RA	AJGIR,			
TYPE OF SU	JB SOIL			SILTY C	LAY									
DEPTH OF ?	ГЕЅТ			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	JRE CONDI	TION							
SIZE OF PL	ATE			30.0x 30.0	SQUARE (	CM								
SEATING LO	OAD			126 KG	-		-			-				
							TEST	Γ 4 LOCA	TION NO 8					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	VABLE BEAL	RING CAPA	ACITY	1										
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALI BEA CAPACI (CONSI ALLO SETTLE 50.0	LOWABLE RING ITY T/M2 IDERING WABLE IMENT AS ) MM											
15	1.00	ISOL SQUAR FOO	ATED RE/STRIP DTING											
1.5	2.00			1										
1.5	3.00	5		1										

OBSE	RVATION AN	D CALCUI	LATION FO	R DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	SPER IS 188	8:1982			
	LOCATION			PRO,	JECT:- SO	IL INVEST	IGATION A	AT NALAI	NDA UNIVERSIT	Y SITE, RA	AJGIR ,			
							NALA	NDA, BIH	IAR.					
TYPE OF SU	JB SOIL			SILTY C	LAY									
DEPTH OF	TEST			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	JRE CONDI	TION							
SIZE OF PL	<u>A 1</u>			30.0x 30.0	SQUARE (	CM								
SEATING L	OAD			126 KG	1									
	<i></i>						TES	F 5 LOCA	TION NO 3			<b>a</b>	a	
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	WABLE BEAI	RING CAPA	ACITY											
DEPTH OF	WIDTH OF	SAFE/AL	LOWABLE											
FOOTING	FOOTING	BEA	RING											
Below	(M)	CAPACI	TY T/M2 DEDINC											
CI (M)			DEKING WARI F											
		SETTLE	MENT AS											
		ISOL	ATED											

SQUARE/STRIP FOOTING

9.33

7.30

6.68

1.5

1.5

1.5

1.00

2.00

3.00

OBSEI	RVATION AN	ID CALCUI	LATION FO	R DETER	MINATIO	N OF MODU	ULUS OF S	UBGRADI	E REACTION AS	PER IS 188	8:1982			
	LOCATION			PRO.	JECT:- SO	IL INVEST	IGATION A	AT NALAN	NDA UNIVERSIT	Y SITE, RA	AJGIR ,			
							NALA	NDA, BIH	IAR.					
TYPE OF SU	JB SOIL			SILTY C	LAY									
DEPTH OF '	TEST			1.50M BE	LOW G.L.									
CONDTION	OF TEST			NATURA	L MOISTU	RE CONDI	TION							
SIZE OF PL	A 1			30.0x 30.0s	SQUARE (	CM								
SEATING L	OAD			126 KG										
							TEST	6 LOCA	TION NO 12					
Load (Kg)	Size of	Area of	Pressure(	Initial	Final	Net	Initial	Final	Net	Avg	Cumulative	Settlement	Settlement	Settlement
	plate(cm)	Plate	Kg/sqcm)	Settlemen	settlemen	Settlement	Settlement	settlemen	Settlements(mm)	Settlement(	Settlements	of actual	of actual	of actual
		(sqcm)		ts (mm)	ts(mm)	s(mm)	s(mm)	ts(mm)		mm)	(mm) of	Footing 1.0	Footing 2.0	Footing 3.0
											Plate	m wide	m wide	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
ALLOV	WABLE BEAI	RING CAPA	CITY											
DEPTH OF	WIDTH OF	SAFE/ALI	LOWABLE	1										
FOOTING	FOOTING	BEA	RING											
Below	(M)	CAPACI	TY T/M2											
existing		(CONSI	DERING											
GL(M)		ALLO	WABLE											
		SETTLE	MENT AS											
		ISOL	ATED											
		SQUAR	E/STRIP											
		FOO	TING											
1.5	1.5 1.00 6.17			1										
1.5	1.5 2.00 4.83													
1.5	3.00	4.	.42	Ĭ										

OBSER	<b>RVATION AN</b>	D CALCUI	LATION FO	OR DETERI	MINATIO	N OF MOD	ULUS OF S	UBGRADI	E REACTION AS	5 PER IS 188	8:1982			
]	LOCATION			PRO,	JECT:- SO	IL INVEST	IGATION A	AT NALAI	NDA UNIVERSIT	Y SITE, RA	AJGIR ,			
							NALA	NDA, BIH	IAR.					
TYPE OF SU	B SOIL			SILTY C	LAY									
DEPTH OF 1	TEST			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	JRE CONDI	TION							
SIZE OF PLA	1			30.0x 30.0s	SQUARE (	CM								
SEATING LO	DAD			126 KG			-							
							TEST	Г7 LOCA	TION NO 9					
Load (Kg)	Size of	Area of	Pressure(	Initial	Final	Net	Initial	Final	Net	Avg	Cumulative	Settlement	Settlement	Settlement
	plate(cm)	Plate	Kg/sqcm)	Settlemen	settlemen	Settlement	Settlement	settlemen	Settlements(mm)	Settlement(	Settlements	of actual	of actual	of actual
		(sqcm)		ts (mm)	ts(mm)	s(mm)	s(mm)	ts(mm)		mm)	(mm) of	Footing 1.0	Footing 2.0	Footing 3.0
											Plate	m wide	m wide	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
ALLOW	VABLE BEAF	RING CAPA	CITY	4										
DEPTH OF	WIDTH OF	SAFE/ALI	LOWABLE											
FOOTING	FOOTING	CADACI	KING TV T/M2											
Delow	(11)	(CONSI	DERING											
GL(M)		ALLO	WABLE											
GL(III)		SETTLE	MENT AS											
			ATED	+										
	ISOLATED SOUARE/STR													
	SQUARE/STR FOOTING													
1.5	15 1.00 7.77			4										
1.5	1.5 1.00 7.77   1.5 2.00 6.08			4										
1.5	2.00 6.08   3.00 5.56		56	1										

OBSEI	RVATION AN	D CALCU	LATION FO	OR DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	5 PER IS 188	8:1982			
	LOCATION			PRO	JECT:- SO	IL INVEST	IGATION A NALA	AT NALAI ANDA, BIH	NDA UNIVERSIT IAR.	Y SITE , RA	AJGIR ,			
TYPE OF SU	JB SOIL			SILTY C	LAY									
DEPTH OF T	ГЕЅТ			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	IRE CONDI	TION							
SIZE OF PL	A 1			30.0x 30.0	SQUARE (	СМ								
SEATING L	OAD			126 KG					•					
							TEST	8 LOCA	TION NO 13					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	VABLE BEAL	RING CAP	ACITY	4										
DEPTH OF	WIDTH OF	SAFE/AL	LOWABLE											
FUUTING	FOOTING (M)		IKING ITV T/M2											
existing	(141)	(CONSI	ITT 1/ML2											
GL(M)		ALLO	WABLE											
		SETTLE	MENT AS											
		50.0	) MM											
		ISOI	ATED	+										
		SQUAR FOC	RE/STRIP DTING											
1.5	1.00	6	.19	1										
1.5	2.00	4	.84											
1.5	3.00	4	.43	1										

OBSEF	RVATION AN	D CALCU	LATION FO	R DETER	MINATIO	N OF MODU	JLUS OF S	UBGRADI	E REACTION AS	PER IS 188	8:1982			
]	LOCATION			PRO,	JECT:- SO	IL INVEST	IGATION A NALA	AT NALAN NDA, BIH	NDA UNIVERSIT IAR.	Y SITE , RA	JGIR,			
TYPE OF SU	B SOIL			SILTY C	LAY									
DEPTH OF 7	FEST			1.50M BE	LOW G.L.									
CONDTION	OF TEST			NATURA	L MOISTU	RE CONDI	TION							
SIZE OF PLA	1			30.0x 30.0	SQUARE (	CM								
SEATING LO	OAD			126 KG										
							TEST	9 LOCAT	FION NO 14					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	VABLE BEAI	RING CAPA	ACITY											
DEPTH OF FOOTING Below existing GL(M) 1.5 1.5	WIDTH OF FOOTING (M) 1.00 2.00	SAFE/ALI BEA CAPACI (CONSI ALLO SETTLE ISOL SQUAR FOO 9 7	LOWABLE RING TY T/M2 DERING WABLE MENT AS ATED E/STRIP TING 31 .29											
1.5	2.00 7.29   3.00 6.67													

OBSEH	RVATION AN	D CALCUI	LATION FO	OR DETERI	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	5 PER IS 188	8:1982			
	LOCATION			PRO,	JECT:- SO	IL INVEST	IGATION A	AT NALAI	NDA UNIVERSIT	Y SITE, RA	AJGIR ,			
							NALA	NDA, BIH	IAR.					
TYPE OF SU	JB SOIL			SILTY C	LAY									
DEPTH OF T	ГЕЅТ			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	JRE CONDI	TION							
SIZE OF PL	A 1			30.0x 30.0s	SQUARE (	СМ								
SEATING L	OAD			126 KG				-						
							TEST	10 LOCA	TION NO 15					
Load (Kg)	Size of	Area of	Pressure(	Initial	Final	Net	Initial	Final	Net	Avg	Cumulative	Settlement	Settlement	Settlement
	plate(cm)	Plate	Kg/sqcm)	Settlemen	settlemen	Settlement	Settlement	settlemen	Settlements(mm)	Settlement(	Settlements	of actual	of actual	of actual
		(sqcm)		ts (mm)	ts(mm)	s(mm)	s(mm)	ts(mm)		mm)	(mm) of	Footing 1.0	Footing 2.0	Footing 3.0
											Plate	m wide	m wide	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
ALLOV	VABLE BEAI	RING CAPA	ACITY	1										
DEPTH OF	WIDTH OF	SAFE/ALI	LOWABLE											
FOOTING	FOOTING	BEA	RING											
Below	(M)	CAPACI	TY T/M2											
CL (M)			DEKING WADI F											
GL(WI)		SETTLE	MENT AS											
		501100		4										
		ISOL	ATED E/STDID											
	SQUARE/STR FOOTING													
		100	1110	4										
1.5	1.5 1.00 15.52			ļ										
1.5	1.5 2.00 12.15													
1.5	2.00 12.15   3.00 11.11													

OBSE	RVATION AN	ND CALCU	LATION FC	OR DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	5 PER IS 188	8:1982			
	LOCATION			PRO	JECT:- SO	IL INVEST	IGATION A	AT NALAI	NDA UNIVERSIT	Y SITE, RA	AJGIR ,			
TYPE OF S	UB SOIL			SILTY C	LAY									
DEPTH OF	TEST			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	JRE CONDI	TION							
SIZE OF PL	A 1			30.0x 30.0	SQUARE (	СМ								
SEATING L	OAD			126 KG										
							TEST	11 LOCA	TION NO 16					
Load (Kg)	Size of	Area of	Pressure(	Initial	Final	Net	Initial	Final	Net	Avg	Cumulative	Settlement	Settlement	Settlement
	plate(cm)	Plate	Kg/sqcm)	Settlemen	settlemen	Settlement	Settlement	settlemen	Settlements(mm)	Settlement(	Settlements	of actual	of actual	of actual
		(sqcm)		ts (mm)	ts(mm)	s(mm)	s(mm)	ts(mm)		mm)	(mm) of	Footing 1.0	Footing 2.0	Footing 3.0
											Plate	m wide	m wide	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
ALLO	WABLE BEA	RING CAPA	ACITY		-	-	-	-	-	-	-	-	-	
DEPTH OI	F WIDTH OF	SAFE/AL	LOWABLE											
FOOTING	FOOTING	BEA	RING											
Below	(M)	CAPAC	ITY T/M2											
existing		(CONSI	IDERING											
GL(M)		ALLO SETTI E	WABLE MENT AS											
		SETTLE 50.0		4										
		ISOL	LATED											
		SQUAR	KE/STRIP											
		ruu	TING											
1.5	1.00	18	8.61	]										
1.5	1.5 2.00 14.56													
1.5	3.00	13	3.32											

OBSEI	RVATION AN	D CALCUI	LATION FC	R DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	5 PER IS 188	8:1982			
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				NATURA	L MOISTU	JRE CONDI	TION							
SEATING LC 1				30.0x 30.0	SQUARE (	CM								
				126 KG										
					TEST 12 LOCATION NO 19									
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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							-							<b>.</b>
DEPTH OF WIDTH OF SAFE/ALLOWABLE				1										
FOOTING	ING FOOTING BEARING													
Below	(M)	CAPACITY T/M2												
existing		(CONSIDERING												
GL(M)		ALLOWABLE												
		SETTLE	MENT AS											
		ISOL SQUAR FOO	ATED E/STRIP TING											
1.5	1.00	4.67		1										
1.5	2.00	3.66		I										

1.5

3.00

3.35

OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982														
	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 CONDI			TION							
SEATING LO 1				30.0x 30.0SQUARE CM										
				126 KG										
							TEST 13 LOCATION NO 18							
Load (Kg)	Size of plate(cm)	Area of Plate (seem)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement	Initial Settlement s(mm)	Final settlemen ts(mm)	Net Settlements(mm)	Avg Settlement( mm)	Cumulative Settlements	Settlement of actual Footing 1.0	Settlement of actual Footing 2.0	Settlement of actual Footing 3.0
		(sqcm)		ts (IIIII)	ts(IIIII)	<b>3</b> (IIIII)	s(iiiii)	us(IIIII)		<i>)</i>	Plate	m wide	m wide	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
ALLOV														
DEPTH OF WIDTH OF SAFE/ALLOWABLE			T											
FOOTING	FOOTING	BEARING												
Below	(M)	CAPACITY T/M2												
existing	existing (CONSIDE)		DERING											
GL(M)		ALLOWABLE SETTLEMENT AS												
		ISOLATED		1										
		SQUARE/STRIP												
	FOOTING													
1.5	1.00	4.63		Ì										
1.5	2.00	3.62		ļ										
1.5	3.00	3.31		]										
OBSEI	RVATION AN	ID CALCUI	LATION FO	R DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	5 PER IS 188	8:1982			
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	LOCATION						SI	LTY CLAY	Y					
TYPE OF SU	JB SOIL					]	PROJECT	NALANDA	A RAJGIR					
DEPTH OF 7	ГЕST			SILTY C	LAY									
CONDTION	OF TEST			1.50M BE	LOW G.L.	•								
SIZE OF PL	АТЕ			NATURA	L MOISTU	JRE CONDI	TION							
SEATING L	1			30.0x 30.05	SQUARE (	CM								
				126 KG			-	-		2				
							TEST	14 LOCA	TION NO 17					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	VABLE BEAI	RING CAPA	ACITY						•	•	-	-	•	
DEPTH OF	WIDTH OF	SAFE/AL	LOWABLE	1										
FOOTING	FOOTING	BEA	RING											
Below	( <b>M</b> )	CAPACI	TY T/M2											
existing		(CONSI	DERING											
GL(M)		ALLO	WABLE											
		SETTLE	MENT AS											
		ISOL	ATED	1										
		SQUAR	E/STRIP											
		FOO	TING											
1.5	1.00	3.	.10	1										
1.5	2.00	2.	.43	]										
1.5	3.00	2.	.22	I										

OBSEF	RVATION AN	D CALCUI	LATION FO	R DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	5 PER IS 188	8:1982			
]	LOCATION						SI	LTY CLAY	Y					
TYPE OF SU	B SOIL					]	PROJECT	NALANDA	ARAJGIR					
DEPTH OF 1	TEST			SILTY C	LAY									
CONDTION	OF TEST			1.50M BE	LOW G.L.	•								
SIZE OF PLA	ATE			NATURA	L MOISTU	JRE CONDI	TION							
SEATING LO	1			30.0x 30.0	SQUARE (	СМ								
				126 KG			-		-	-				
							TEST	15 LOCA	TION NO 2.					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	VABLE BEAI	RING CAPA	ACITY	1										
DEPTH OF	WIDTH OF	SAFE/ALI	LOWABLE											
FOOTING	FOOTING	BEA	RING											
Below	(M)	CAPACI	TY T/M2											
existing			DEKING											
GL(MI)		SETTLE	MENT AS											
		501100	MM	ļ										
		ISOL	ATED											
		SQUAR FOO	E/STRIP TING											
1.5	1.00	6	.21	1										
1.5	2.00	4.	.86	]										
1.5	3.00	4.	.44	l										

OBSEF	RVATION AN	D CALCU	LATION FC	R DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	5 PER IS 188	8:1982			
]	LOCATION						SI							
TYPE OF SU	JB SOIL				PROJECT NALANDA RAJGIR									
DEPTH OF 7	ГЕST			SILTY C	LAY									
CONDTION	OF TEST			1.50M BE	50M BELOW G.L									
SIZE OF PLA	АТЕ			NATURA	ATURAL MOISTURE CONDITION									
SEATING LO	1			30.0x 30.0	0.0x 30.0SQUARE CM									
				126 KG										
							TEST	T16 LOCA	ATION NO 1					
Load (Kg)	Size of	Area of	Pressure(	Initial	Final	Net	Initial	Final	Net	Avg	Cumulative	Settlement	Settlement	Settlement
	plate(cm)	Plate	Kg/sqcm)	Settlemen	settlemen	Settlement	Settlement	settlemen	Settlements(mm)	Settlement(	Settlements	of actual	of actual	of actual
		(sqcm)		ts (mm)	ts(mm)	s(mm)	s(mm)	ts(mm)		mm)	(mm) of	Footing 1.0	Footing 2.0	Footing 3.0
											Plate	m wide	m wide	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
ALLOV	VABLE BEAF	RING CAPA	ACITY											
DEPTH OF	WIDTH OF	SAFE/AL	LOWABLE	1										
FOOTING	FOOTING	BEA	RING											

FOOTING Below existing GL(M)	FOOTING (M)	BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	14.38
1.5	2.00	11.25
1.5	3.00	10.29

OBSEI	RVATION AN	ND CALCUI	LATION FO	OR DETER	MINATIO	N OF MODU	ULUS OF S	UBGRAD	E REACTION AS	PER IS 188	8:1982			
	LOCATION						SI	LTY CLAY	Y					
TYPE OF SU	JB SOIL					]	PROJECT I	NALANDA	A RAJGIR					
DEPTH OF 7	TEST			SILTY C	LAY									
CONDTION	OF TEST			1.50M BE	LOW G.L.	•								
SIZE OF PL	ATE			NATURA	L MOISTU	JRE CONDI	TION							
SEATING L	1			30.0x 30.0	SQUARE (	CM								
				126 KG										
							TEST	17 LOCA	TION NO 11					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	WABLE BEA	RING CAPA	ACITY											
DEPTH OF	WIDTH OF	SAFE/AL	LOWABLE	T										
FOOTING Below existing GL(M)	FOOTING (M)	BEA CAPACI (CONSI ALLO SETTLE SETTLE SQUAR FOO	RING ITY T/M2 DERING WABLE MENT AS ATED E/STRIP TING 2.40	-										
1.5	2.00	9	.71											
1.5	3.00	8	.88											

OBSER	<b>VATION AN</b>	D CALCUI	LATION FC	OR DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	5 PER IS 188	8:1982			
]	LOCATION						SI	LTY CLAY	Y					
TYPE OF SU	B SOIL					]	PROJECT	NALANDA	A RAJGIR					
DEPTH OF T	TEST			SILTY C	LAY									
CONDTION	OF TEST			1.50M BE	LOW G.L.	•								
SIZE OF PLA	АТЕ			NATURA	L MOISTU	JRE CONDI	TION							
SEATING LO	1			30.0x 30.0	SQUARE (	CM								
				126 KG										
							TEST	18 LOCA	TION NO 10					
Load (Kg)	Size of	Area of	Pressure(	Initial	Final	Net	Initial	Final	Net	Avg	Cumulative	Settlement	Settlement	Settlement
	plate(cm)	Plate (sqcm)	Kg/sqcm)	Settlemen ts (mm)	settlemen ts(mm)	Settlement s(mm)	Settlement s(mm)	settlemen ts(mm)	Settlements(mm)	Settlement( mm)	Settlements (mm) of Plate	of actual Footing 1.0 m wide	of actual Footing 2.0 m wide	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
ALLOW	VABLE BEAH	RING CAPA	ACITY											
DEPTH OF	WIDTH OF	SAFE/AL	LOWABLE											
FOOTING	FOOTING	BEA	RING											
Below	( <b>M</b> )	CAPACI	TY T/M2											
existing		(CONSI	DERING											
GL(M)		ALLO	WABLE											
		SETTLE	MENT AS											
		ISOL	ATED	1										
		SQUAR FOO	E/STRIP TING											
1.5	1.00	7.	.75	1										
1.5	2.00	6	.07	]										
1.5	3.00	5.	.55	]										

]	LOCATION						SI							
TYPE OF SU	B SOIL					]	PROJECT	NALANDA	ARAJGIR					
DEPTH OF 1	FEST			SILTY C	LAY									
CONDTION	OF TEST			1.50M BE	LOW G.L.	•								
SIZE OF PLA	АТЕ			NATURA	L MOISTU	JRE CONDI	TION							
SEATING LO	1			30.0x 30.0	SQUARE (	СМ								
				126 KG										
							TEST	19 LOC	ATION NO 7					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	VABLE BEAF	RING CAPA	ACITY				MODUL	UD OF SU	BGRADE REACT	TON Kg/cm	13			
DEPTH OF	WIDTH OF	SAFE/AL	LOWABLE		PLATE	Pressure	Final	Un	CORRECTION	CORRECTI	CORRECTI	CORRECTI		
FOOTING	FOOTING	BEA	RING		SIZE CM	(Kg/sqcm) at	settlements(		FOR PLATE SIZE	ON FOR	ON FOR	ON FOR		
Below	( <b>M</b> )	CAPACI	TY T/M2			Settlement	11111)	SOF	VALUES as per	DEFLECTIO	OF PLATE	N as per IS	,	
existing		(CONSI	DERING			~~~~~		SUBGRA	clause 5.1.1 Fig 3	N CURVE	AS PER 5.1.3	9214-1979		
GL(M)		ALLO	WABLE					DE	_	AS PER 5.1.2		clauses		
		SETTLE 50.0	MENTAS ) MM					REACTIO N (K) (Kg/cm3) (As Per Corrected Load Settlement Curve)				5.1.4.1 to 5.1.4.4		
		ISOL SQUAR FOO	ATED E/STRIP TING		30.0	0.220	0.125	1.76	0.70	-	0.70	0.63		
1.5	1.00	6	.21			1	1	1	I	1	<u>I</u>	1	1	
1.5	2.00	4	.86	1										
	1			-										

OBSEI	RVATION AN	D CALCU	LATION FO	R DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	EREACTION AS	SPER IS 188	8:1982		<b>I</b>	<b>I</b>
02022	LOCATION	D CHECC			1.50M BELOW G.L       PROJECT NALANDA RAJGIR									
TYPE OF SU	JB SOIL	[				]	PROJECT	NALANDA	RAJGIR					
DEPTH OF T	ГЕЅТ			SILTY C	LAY		-							
CONDTION	OF TEST			1.50M BE	LOW G.L.									
SIZE OF PL	ATE			NATURA	L MOISTU	RE CONDI	TION							
SEATING LO	1			30.0x 30.0	SOUARE O	CM								
				126 KG	•				<b></b>					
							TEST	20 LOCA	TION NO 20					
Load (Kg)	Size of	Area of	Pressure(	Initial	Final	Net	Initial	Final	Net	Avg	Cumulative	Settlement	Settlement	Settlement
	plate(cm)	Plate	Kg/sqcm)	Settlemen	settlemen	Settlement	Settlement	settlemen	Settlements(mm)	Settlement(	Settlements	of actual	of actual	of actual
		(sqcm)		ts (mm)	ts(mm)	s(mm)	s(mm)	ts(mm)		mm)	(mm) of	Footing 1.0	Footing 2.0	Footing 3.0
											Plate	m wide	m wide	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
ALLOV	VABLE BEAI	RING CAPA	ACITY				MODUL	JD OF SU	BGRADE REACT	TION Kg/cm	3			
DEPTH OF	WIDTH OF	SAFE/AL	LOWABLE		PLATE	Pressure	Final	Un	CORRECTION	CORRECTI	CORRECTI	CORRECTI		
FOOTING	FOOTING	BEA	RING		SIZE CM	(Kg/sqcm) at	settlements(	corrected	FOR PLATE SIZE	ON FOR	ON FOR	ON FOR		
Below	( <b>M</b> )	CAPACI	TY T/M2			1.25 mm	mm)	MODULU S OF	EQ. 75.0 CM K	LOAD DEELECTIO	BENDING OF PLATE	SATURATIO		
existing		(CONSI	DERING			Settlement		SUBGRA	clause 5.1.1 Fig 3	N CURVE	AS PER 5.1.3	9214-1979		
GL(M)		ALLO	WABLE					DE	ciause entit tig e	AS PER 5.1.2		clauses		
		SETTLE	MENT AS					REACTIO				5.1.4.1 to		
		50.0	MM					N (K)				5.1.4.4		
								(Kg/cm3)						
								(As Per Corrected						
								Load						
								Settlement						
								Curve)						
		ISOL	ATED	İ	30.0	0.210	0.125	1.68	0.67	-	0.67	0.60	1	
		SQUAR	E/STRIP											
		FOO	TING											
1.5	1.00	6	.19		1	<u> </u>	ļ	1	ļ		Į	1	1	
1.5	2.00	4	.85	1										
1.5	3.00	4	.43	1										
				-										









































PROJECT:- SOII	LINVESTIGAT					
Liquid Limit	34.62		MDD	1.895	Gm/cc	
Plastic Limit	JH.04	-	ОМС	24.32		-
Diratisity Indox	20.15	-	NMC	10.07	<u>%</u>	_
Plasucity muca	14.47		NMC	10.7/	%	_
CRR NO- 1						
CDR IIO- I			SOIL TYPE	CL		
Sociation Condition	Soaked	-	SOILTIL		Sottlemnt mm	Lood Ka
Dimger Diam cm	5.0	Area CM2			0.000	0.000
SI 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			
12.0						
PROJECT:- SOII	LINVESTIGAT	ION AT THE	NALANDA UNIV	VERSITY SITE A	T RAJGIR-BIHAR	
PROJECT:- SOII	L INVESTIGAT		NALANDA UNIV	VERSITY SITE A	T RAJGIR-BIHAR	
PROJECT:- SOII	L INVESTIGAT		MDD OMC	VERSITY SITE A 1.856 23.04	T RAJGIR-BIHAR	
PROJECT:- SOII	L INVESTIGAT 33.68 20.64		MDD OMC	VERSITY SITE A 1.856 23.04 19.01	T RAJGIR-BIHAR	
PROJECT:- SOII Liquid Limit Plastic Limit Plasticity Index	20.64 13.04		MDD OMC	VERSITY SITE A 1.856 23.04 19.01	T RAJGIR-BIHAR Gm/cc % %	
PROJECT:- SOII Liquid Limit Plastic Limit Plasticity Index CBR NO- 2	L INVESTIGAT 33.68 20.64 13.04		MDD OMC	VERSITY SITE A 1.856 23.04 19.01	T RAJGIR-BIHAR Gm/cc % %	
PROJECT:- SOII Liquid Limit Plastic Limit Plasticity Index CBR NO- 2	L INVESTIGAT 33.68 20.64 13.04		MDD OMC SOIL TYPE	VERSITY SITE A 1.856 23.04 19.01 CL	T RAJGIR-BIHAR Gm/cc % % %	
PROJECT:- SOII Liquid Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition	L INVESTIGAT 33.68 20.64 13.04 Soaked		NALANDA UNI MDD OMC NMC SOIL TYPE	VERSITY SITE A 1.856 23.04 19.01 CL	T RAJGIR-BIHAR Gm/cc % % % Settlemnt mm	Load Kg
PROJECT:- SOII Liquid Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm	L INVESTIGAT 33.68 20.64 13.04 Soaked 5.0	ION AT THE	NALANDA UNIV MDD OMC NMC SOIL TYPE	VERSITY SITE A 1.856 23.04 19.01 CL	T RAJGIR-BIHAR Gm/cc % % % Settlemnt mm 0.000	
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit CBR NO- 2 Soaking Condition Plunger Diam cm SI No	L INVESTIGAT 33.68 20.64 13.04 Soaked 5.0 Settlemnt mm	ION AT THE Area CM2 Load Division	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg	VERSITY SITE A 1.856 23.04 19.01 CL CBR %	Gm/cc           %           %           Settlemnt mm           0.000           0.500	Load Kg 0.000 18.543
PROJECT:- SOII Liquid Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm SI No 1.0	L INVESTIGAT 33.68 20.64 13.04 Soaked 5.0 Settlemnt mm 0	ION AT THE Area CM2 Load Division 0	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0	VERSITY SITE A 1.856 23.04 19.01 CL CL CBR %	.T RAJGIR-BIHAR	Load Kg 0.000 18.543 35.099
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0	L INVESTIGAT 33.68 20.64 13.04 Soaked 5.0 Settlemnt mm 0 0.5	ION AT THE ION AT THE Area CM2 Load Division 0 2.8	NALANDA UNIT MDD OMC NMC SOIL TYPE Load Kg 0 18.54	VERSITY SITE A  L.856 23.04 19.01 CL CL CBR %	Gm/cc           %           Settlemnt mm           0.000           0.500           1.000           1.500	Load Kg 0.000 18.543 35.099 50.199
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0 3.0	L INVESTIGAT 33.68 20.64 13.04 Soaked 5.0 Settlemnt mm 0 0.5 1	ION AT THE ION AT THE Area CM2 Load Division 0 2.8 5.3	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10	VERSITY SITE A  1.856 23.04 19.01 CL CL CBR %	Gm/cc           %           Settlemnt mm           0.000           1.000           1.500           2.000	Load Kg 0.000 18.543 35.099 50.199 60.265
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0 3.0 4.0	L INVESTIGAT 33.68 20.64 13.04 Soaked 5.0 Settlemnt mm 0 0.5 1 1.5	ION AT THE ION AT THE Area CM2 Load Division 0 2.8 5.3 7.58	MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20	VERSITY SITE A  1.856 23.04 19.01 CL CL CBR %	Gm/cc           %           %           %           %           %           1           0.000           0.500           1.000           1.500           2.000           2.500	Load Kg 0.000 18.543 35.099 50.199 60.265 72.185
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0 3.0 4.0 5.0	L INVESTIGAT	ION AT THE ION AT THE Area CM2 Load Division 0 2.8 5.3 7.58 9.1	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20 60.26	VERSITY SITE A  1.856 23.04 19.01 CL CL CBR %	Gm/cc           %           Settlemnt mm           0.000           0.500           1.500           2.000           2.500           3.000	Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0 3.0 4.0 5.0 6.0	L INVESTIGAT	ION AT THE ION AT THE Area CM2 Load Division 0 2.8 5.3 7.58 9.1 10.9	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20 60.26 72.19	VERSITY SITE A  1.856 23.04 19.01 CL CL CBR % 5.27	Gm/cc           %           %           %           0.000           0.500           1.000           1.500           2.000           2.500           3.000           4.000	Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0 3.0 4.0 5.0 6.0 7.0	L INVESTIGAT 33.68 20.64 13.04 Soaked 5.0 Settlemnt mm 0 0.5 1 1.5 2 2.5 3	ION AT THE ION AT THE Area CM2 Load Division 0 2.8 5.3 7.58 9.1 10.9 11.6	NALANDA UNI <sup>¬</sup> MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20 60.26 72.19 76.82	VERSITY SITE A	Gm/cc           % <td>Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119 87.417</td>	Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119 87.417
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0	L INVESTIGAT	ION AT THE ION AT THE Area CM2 Load Division 0 2.8 5.3 7.58 9.1 10.9 11.6 12.4	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20 60.26 72.19 76.82 82.12	VERSITY SITE A  L.856 23.04 19.01 CL CBR % 5.27	Gm/cc           % <td>Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119 87.417 92.715</td>	Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119 87.417 92.715
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0	L INVESTIGAT 33.68 20.64 13.04 Soaked 5.0 Settlemnt mm 0 0.5 1 1.5 2 2.5 3 4 5	ION AT THE ION AT THE Area CM2 Load Division 0 2.8 5.3 7.58 9.1 10.9 11.6 12.4 13.2	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20 60.26 72.19 76.82 82.12 87.42	VERSITY SITE A	Settlemnt mm           0.000           0.500           1.000           2.500           3.000           4.000           5.000           7.500           10.000	Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119 87.417 92.715 99.338
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm SI No 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0	L INVESTIGAT	Area CM2           Load Division           0           2.8           5.3           7.58           9.1           10.9           11.6           12.4           13.2           14	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20 60.26 72.19 76.82 82.12 87.42 92.72	VERSITY SITE A  I.856 23.04 19.01 CL CL CBR % 5.27 4.25	T RAJGIR-BIHAR Gm/cc % % % Settlemnt mm 0.000 0.500 1.000 1.500 2.000 2.500 3.000 4.000 5.000 7.500 10.000 12.500	Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119 87.417 92.715 99.338 101.987
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0	L INVESTIGAT	Area CM2           Load Division           0           2.8           5.3           7.58           9.1           10.9           11.6           12.4           13.2           14	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20 60.26 72.19 76.82 82.12 87.42 92.72 99.34	VERSITY SITE A  I.856 23.04 19.01 CL CL CBR % 5.27 4.25	Gm/cc           % <td>Load Kg Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119 87.417 92.715 99.338 101.987</td>	Load Kg Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119 87.417 92.715 99.338 101.987
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0	L INVESTIGAT	ION AT THE ION AT THE Area CM2 Load Division 0 2.8 5.3 7.58 9.1 10.9 11.6 12.4 13.2 14 15 15.4	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20 60.26 72.19 76.82 82.12 87.42 92.72 99.34 101.99	VERSITY SITE A  I.856 23.04 19.01 CL CL CBR % 5.27 4.25	AT RAJGIR-BIHAR         Gm/cc         %	Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119 87.417 92.715 99.338 101.987
PROJECT:-       SOII         Liquid Limit       Plastic Limit         Plastic Limit       Plasticity Index         CBR NO- 2       Soaking Condition         Plunger Diam cm       SI No         1.0       2.0         3.0       4.0         5.0       6.0         7.0       8.0         9.0       10.0         11.0       12.0	L INVESTIGAT	ION AT THE ION AT THE Area CM2 Load Division 0 2.8 5.3 7.58 9.1 10.9 11.6 12.4 13.2 14 15 15.4	MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20 60.26 72.19 76.82 82.12 87.42 92.72 99.34 101.99	VERSITY SITE A	TRAJGIR-BIHAR         Gm/cc         %	Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119 87.417 92.715 99.338 101.987

PROJECT:- SOII	L INVESTIGAT	TON AT THE	NALANDA UNI	VERSITY SITE A	T RAJGIR-BIHAR	
Liquid Limit	33.76		MDD	1.85	Gm/cc	
Plastic Limit	20.12		ОМС	23.11	gillizee gillizee	
Plasticity Index	13.63		NMC	19.06	%	
	10.00					
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	/.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:- SOII	L INVESTIGAT	TION AT THE	NALANDA UNI	VERSITY SITE A	T RAJGIR-BIHAR	
			T			
Liquid Limit	33.25		MDD	1.842	Gm/cc	
Plastic Limit	20 39		ОМС	23.1	0/0	
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			
l I	1		1			

rkujeui:- suii		ION AT THE	NALANDA UNI	VERSITI SITE A	I KAJGIK-DIHAK	
Liquid Limit	33 74		MDD	1.849	Gm/cc	
Plastic Limit	21.05		ОМС	23.14	on a contract of the contract	
Plasticity Index	12 69		NMC	19.23	%	
	12.09					
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			
Liquid Limit	22.60		MDD	1.862	Credes	
Plastic Limit	32.69		омс	24.33	Gm/cc	
Diagticity Index	20.01		NMC	11.1	%	
Plasticity Index	12.68		NNIC	11.1	%	
CBR NO- 6						
Soaking Condition			SOIL TYPE	CL		
Plunger Diam cm	Soaked		SOIL TYPE	CL	Settlemnt mm	Load Kg
	Soaked 5.0	Area CM2	SOIL TYPE	CL	Settlemnt mm 0.000	 Load Kg 0.000
51 N0	Soaked 5.0 Settlemnt mm	Area CM2 Load Division	SOIL TYPE Load Kg	CL CBR %	Settlemnt mm 0.000 0.500	Load Kg 0.000 21.192
<b>51 No</b>	Soaked           5.0           Settlemnt mm           0	Area CM2 Load Division 0	SOIL TYPE Load Kg 0	CL CBR %	Settlemnt mm 0.000 0.500 1.000	Load Kg 0.000 21.192 38.411
1.0 2.0	Soaked           5.0           Settlemnt mm           0           0.5	Area CM2 Load Division 0 3.2	SOIL TYPE Load Kg 0 21.19	CL CBR %	Settlemnt mm 0.000 0.500 1.000 1.500	Load Kg 0.000 21.192 38.411 52.318
1.0           2.0         3.0	Soaked           5.0           Settlemnt mm           0           0.5           1	Area CM2 Load Division 0 3.2 5.8	SOIL TYPE Load Kg 0 21.19 38.41	CL CBR %	Settlemnt mm           0.000           0.500           1.000           1.500           2.000	Load Kg 0.000 21.192 38.411 52.318 64.901
1.0           2.0           3.0           4.0	Soaked           5.0           Settlemnt mm           0           0.5           1           1.5	Area CM2 Load Division 0 3.2 5.8 7.9	SOIL TYPE Load Kg 0 21.19 38.41 52.32	CL CBR %	Settlemnt mm           0.000           0.500           1.000           1.500           2.000           2.500	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510
1.0           2.0         3.0           4.0         5.0	Soaked           5.0           Settlemnt mm           0           0.5           1           1.5           2	Area CM2           Load Division           0           3.2           5.8           7.9           9.8	SOIL TYPE Load Kg 0 21.19 38.41 52.32 64.90	CL CBR %	Settlemnt mm           0.000           0.500           1.000           1.500           2.000           2.500           3.000	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510 78.808
1.0           2.0           3.0           4.0           5.0           6.0	Soaked           5.0           Settlemnt mm           0           0.5           1           1.5           2           2.5	Area CM2           Load Division           0           3.2           5.8           7.9           9.8           11.1	SOIL TYPE Load Kg 0 21.19 38.41 52.32 64.90 73.51	CL CBR %	Settlemnt mm           0.000           0.500           1.000           1.500           2.000           2.500           3.000           4.000	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510 78.808 86.424
1.0       2.0       3.0       4.0       5.0       6.0       7.0	Soaked           5.0           Settlemnt mm           0           0.5           1           2           2.5           3	Area CM2           Load Division           0           3.2           5.8           7.9           9.8           11.1           11.9	SOIL TYPE Load Kg 0 21.19 38.41 52.32 64.90 73.51 78.81	CL CBR %	Settlemnt mm           0.000           0.500           1.000           1.500           2.000           2.500           3.000           4.000           5.000	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510 78.808 86.424 96.026
1.0         2.0         3.0         4.0         5.0         6.0         7.0         8.0	Soaked           5.0           Settlemnt mm           0           0.5           1           2           2.5           3           4	Area CM2           Load Division           0           3.2           5.8           7.9           9.8           11.1           11.9           13.05	SOIL TYPE Load Kg 0 21.19 38.41 52.32 64.90 73.51 78.81 86.42	CL CBR %	Settlemnt mm           0.000           0.500           1.000           1.500           2.000           2.500           3.000           4.000           5.000           7.500	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510 78.808 86.424 96.026 109.272
1.0       2.0       3.0       4.0       5.0       6.0       7.0       8.0       9.0	Soaked           5.0           Settlemnt mm           0           0.5           1           1.5           2           2.5           3           4           5	Area CM2           Load Division           0           3.2           5.8           7.9           9.8           11.1           11.9           13.05           14.5	SOIL TYPE Load Kg 0 21.19 38.41 52.32 64.90 73.51 78.81 86.42 96.03	CL CBR % 5.37 4.67	Settlemnt mm           0.000           0.500           1.000           1.500           2.000           2.500           3.000           4.000           5.000           7.500           10.000	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510 78.808 86.424 96.026 109.272 118.543
1.0         2.0         3.0         4.0         5.0         6.0         7.0         8.0         9.0         10.0	Soaked           5.0           Settlemnt mm           0           0.5           1           1.5           2           2.5           3           4           5           7.5	Area CM2           Load Division           0           3.2           5.8           7.9           9.8           11.1           11.9           13.05           14.5           16.5	SOIL TYPE Load Kg 0 21.19 38.41 52.32 64.90 73.51 78.81 86.42 96.03 109.27	CL CBR % 5.37 4.67	Settlemnt mm           0.000           0.500           1.000           1.500           2.000           2.500           3.000           4.000           5.000           7.500           10.000           12.500	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510 78.808 86.424 96.026 109.272 118.543 123.841
1.0         2.0         3.0         4.0         5.0         6.0         7.0         8.0         9.0         10.0         11.0	Soaked           5.0           Settlemnt mm           0           0.5           1           2           2.5           3           4           5           7.5           10	Area CM2           Load Division           0           3.2           5.8           7.9           9.8           11.1           11.9           13.05           14.5           16.5           17.9	SOIL TYPE Load Kg 0 21.19 38.41 52.32 64.90 73.51 78.81 86.42 96.03 109.27 118.54	CL CBR % 5.37 4.67	Settlemnt mm           0.000           0.500           1.000           1.500           2.000           2.500           3.000           4.000           5.000           7.500           10.000           12.500	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510 78.808 86.424 96.026 109.272 118.543 123.841
1.0         2.0         3.0         4.0         5.0         6.0         7.0         8.0         9.0         10.0         11.0         12.0	Soaked           5.0           Settlemnt mm           0           0.5           1           1.5           2           2.5           3           4           5           7.5           10           12.5	Area CM2           Load Division           0           3.2           5.8           7.9           9.8           11.1           11.9           13.05           14.5           16.5           17.9           18.7	SOIL TYPE Load Kg 0 21.19 38.41 52.32 64.90 73.51 78.81 86.42 96.03 109.27 118.54 123.84	CL CBR % 5.37 4.67	Settlemnt mm           0.000           0.500           1.000           1.500           2.000           2.500           3.000           4.000           5.000           7.500           10.000           12.500	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510 78.808 86.424 96.026 109.272 118.543 123.841
1.0         2.0         3.0         4.0         5.0         6.0         7.0         8.0         9.0         10.0         11.0         12.0	Soaked           5.0           Settlemnt mm           0           0.5           1           1.5           2           2.5           3           4           5           7.5           10           12.5	Area CM2           Load Division           0           3.2           5.8           7.9           9.8           11.1           11.9           13.05           14.5           16.5           17.9           18.7	SOIL TYPE Load Kg 0 21.19 38.41 52.32 64.90 73.51 78.81 86.42 96.03 109.27 118.54 123.84	CL CBR % 5.37 4.67	Settlemnt mm           0.000           0.500           1.000           1.500           2.000           2.500           3.000           4.000           5.000           7.500           10.000           12.500	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510 78.808 86.424 96.026 109.272 118.543 123.841

PROJECT:- SOII	L INVESTIGAT	TION AT THE	NALANDA UNI	VERSITY SITE A	T RAJGIR-BIHAR	
Liquid Limit	32 62		MDD	1.819	Gm/cc	
Plastic Limit	32.02		ОМС	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
SI 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	50.940
4.0	1.5	/.5	49.67		2.500	70.861
5.0	2	10.7	58.94 70.86	5 17	3.000	97.417
7.0	2.3	10.7	70.80	5.17	5.000	06.680
7.0	3	13.2	87.42		7 500	101 087
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		12000	100020
12.0	12.5	16.1	106.62			
1210	1210	1011	100102			
			I			
PROJECT:- SOII	L INVESTIGAT	ION AT THE	NALANDA UNI	VERSITY SITE A	T RAJGIR-BIHAR	
Liquid Limit			MDD	1.816		
Plastic Limit	34.02		OMC	24.02	Gm/cc	
T lastic Linit	22.16		OMC	24.02	%	
Plasticity Index	11.86		NMC	18.75	%	
CBP NO- 8						
CDR NO- 8			SOIL TYPE	CI		
Societion Condition	Soalrad		SOILTITE	CL	Sottlownt www	Lood Ka
Plunger Diam cm	5 0	Area CM2				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:- SOI	L INVESTIGAT	TON AT THE	NALANDA UNI	VERSITY SITE A	T RAJGIR-BIHAR	
			T			
Liquid Limit	32.62		MDD	1.826	Gm/cc	
Plastic Limit	21.04		ОМС	24.36	%	
Plasticity Index	11.58		NMC	19.68	%	
			<b>P</b>			
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			
Liquid Limit	33.16		MDD	1.811	Gm/cc	
Plastic Limit	20.48		ОМС	24.66	o.	
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			
			1	1		










PROJECT:- SOIL	INVESTIGATION	AT THE NALAN	DA UNIVERS	ITY SITE A	T RAJGIR-BIHA	R
Liquid Limit	33.85		MDD	1.82	Gm/cc	
Plastic Limit	20.17		ОМС	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
SI 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			
					I	
PROJECT:- SOIL	INVESTIGATION	AT THE NALAN	DA UNIVERS	ITY SITE A	T RAJGIR-BIHA	R
						T
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
SI 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 I	NVESTIGATION	AT THE NALAN	DA UNIVERS	ITY SITE A	Г RAJGIR-BIHA	R
Liquid Limit			MDD	1.842	- <i>i</i>	1
Plastic Limit	32.96		OMC	23.01	Gm/cc	
	20.38		NR(C	10.44	%	
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 I	NVESTIGATION	AT THE NALAN	IDA UNIVERS	ITY SITE A	Γ RAJGIR-BIHA	R
Liquid Limit	34.21		MDD	1.864	Gm/cc	
Plastic Limit	21.14		ОМС	23.85	%	
Plasticity Index	13.07		NMC	18.61	%	
CBR NO- 14			COLL TRADE	CI		
			SOIL TYPE	CL		
Soaking Condition	Soaked	4 6140			Settlemnt mm	Load Kg
Flunger Diam cm	5.0 Sottlomnt mm	Area CM2	Lood Kg	CBD Ø	0.000	0.000
1.0				CDK //	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	
4.0	1.50	8.4	55.63		2.500	72.980
5.0	2.00	10.1	72.09	5.22	3.000	/8.808
0.0	2.50	11.02	72.98	5.33	4.000	00.070
7.0	3.00	11.9	78.81	-	5.000	88.0/9
8.0	4.00	12.9	85.45	4 30	/.500	94.040
9.0	5.00	13.3	88.08	4.29	10.000	98.0/5 102.640
11.0	10.00	14.2	94.04		12.500	102.049
11.0	12.50	14.9	90.08			
12.0	12.30	13.3	102.03			

PROJECT:- SOIL	INVESTIGATION	AT THE NALAN	DA UNIVERS	ITY SITE A	Г RAJGIR-BIHA	R
Liquid Limit	34.68		MDD	1.822	Gm/cc	
Plastic Limit	22.14		ОМС	22.64	%	
Plasticity Index	12.54		NMC	18.42	%	
CBR NO-15						
			SOIL TYPE	CL		<b>.</b>
Soaking Condition	Soaked	Amo CM2			Settlemnt mm	
SI No	Settlemnt mm	Load Division	Load Kg	CBR %	0.000	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		IDA UNIVERS		I KAJGIK-DIHA	.ĸ
Liquid Limit	22.67		MDD	1.878	G /	
- Plastic Limit	33.65		ОМС	24.06	Gm/cc	
Plasticity Index	21.86		NMC	18 00	% %	
T lasticity mucx	11.79		i i i i i i i i i i i i i i i i i i i	10.77	%0	
CBR NO-16						
			SOIL TYPE	CL		
Soaking Condition	Soaked				Settlemnt mm	Load Kg
Plunger Diam cm	5.0	Area CM2			0.000	0.000
SI 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	4	7.500	104.636
9.0	5.00	14.6	96.69	4.71	10.000	108.609
10.0	/.50	15.8	104.64	_	12.500	109.934
12.0	12.50	16.4	108.01			
12.0	12.50	10.0	107.73			

PROJECT:- SOIL I	NVESTIGATION A	T THE NALAN	DA UNIVERS	ITY SITE AT	' RAJGIR-BIHA	R
Liquid Limit	33.59		MDD	1.821	Gm/cc	
Plastic Limit	21.38		ОМС	24.16	0%	
Plasticity Index	12.21		NMC	19.12	<u>%</u>	
	12121				<i>,c</i>	
CBR NO- 17						
			SOIL TYPE	CL		
Soaking Condition	Soaked				Settlemnt mm	Load Kg
Plunger Diam cm	5.0	Area CM2			0.000	0.000
SI 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 I	NVESTIGATION A	T THE NALAN	DA UNIVERS	ITY SITE AT	' RAJGIR-BIHA	R
<b></b>			1000	1.022		
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 Sottlownt mm	Area CM2	LandKa		0.000	0.000
51 INO	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	04.238
4.0	1.50	8.2	54.30		2.500	72.980
5.0	2.00	9.7	64.24	F 22	3.000	/9.801
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			

Liquid Limit33.62MDDK20Gm/ccMinePlastic Limit21.64OMC24.22 $q_c$ Plastic Limit21.64ONC19.43 $q_c$ Plastic Limit11.88NNC19.43 $q_c$ Plastic Limit11.88NNC19.43 $q_c$ Souking ConditionSoukedNNC19.43 $q_c$ Souking ConditionSoukedNNC0.0000Souking ConditionSoukedCBR %0.50017.2191.00.00001.0035.7622.00.502.6417.221.500151.653.01.005.435.762.00094.6224.01.507.851.642.50070.1995.02.009.4462.253.00014.126.02.5011.274.175.00019.0567.03.0011.274.175.00010.31111.010.0015.3101.321.0011.010.0015.3101.321.0011.010.0015.3101.321.0011.012.5015.6103.311.0111.012.5015.6103.311.0112.012.5015.6100.311.0113.012.4NNC12.6 $q_c$ 14.113.60.011.02 $q_c$ 15.012.61.011.0	PROJECT:- SOII	L INVESTIGATION	NAT THE NALAN	DA UNIVERS	SITY SITE A	T RAJGIR-BIHA	AR	
Liquid Limit32.62NDD1.823Gm/ccParticle in the second								
Plastic Linit         21.04         ONC         34.22         max           Plasticity Index         11.58         NMC         19.43         %           CRR No. 19         Image Plant         NMC         19.43         %           CRR No. 19         Image Plant         Settermut         Image Plant         Settermut         Image Plant           Soking Condition         Soaked         Settermut         Image Plant         Settermut         Image Plant           SN N         Settermut         Load Division         Load R         CRR %         0.500         17.19           1.0         0.00         0         O         Image Plant         Image Plant <tdi< td=""><td>Liquid Limit</td><td>32.62</td><td></td><td>MDD</td><td>1.823</td><td>Gm/cc</td><td></td></tdi<>	Liquid Limit	32.62		MDD	1.823	Gm/cc		
Plasticity Index11.58NMC19.43*Soaking ConditionSoakedNMC19.43*Soaking ConditionSoakedNMC19.43*Soaking ConditionSoakedNMC10.40%Plastic LimitLoad KgCLSettlemit minLoad Kg1.00.00001.00035.7622.00.5017.2191.50051.4653.01.005.435.762.50074.1724.01.507.851.662.50070.1995.02.000.0074.1725.00094.1067.03.0011.274.175.00099.0068.84.0012.784.117.50097.3519.05.5013.690.074.3810.00010.32510.07.5014.797.3512.500103.3111.010.0015.310.33112.500103.3112.012.5015.6103.3112.500103.3111.010.0015.310.3212.50010.33111.010.0015.310.3212.50013.612.012.640MC23.06%12.50013.012.64OMC23.165.144.00014.010.0015.310.3112.5005.1415.015.6103.3112.5005.144.1611.010.0016.310.24%<	Plastic Limit	32.02		ОМС	24.22	07.	-	
Image         Image <th< td=""><td>Plasticity Index</td><td>21.04</td><td></td><td>NMC</td><td>19.43</td><td>% %</td><td>-</td></th<>	Plasticity Index	21.04		NMC	19.43	% %	-	
CHR NO- 19         Solit_TYPE         CL         Settlemut mm         Load Bysion           Soaking Condition         Soaked         Load Division         Load Kg         CBR %         0.500         17.719           1.0         0.000         0         0         1000         35.762         2.00         5.166           3.0         1.00         5.4         35.76         2.000         62.232           4.0         1.500         7.8         51.66         2.000         74.172           6.0         2.50         10.6         70.20         9.4         62.25         3.000         74.172           6.0         2.50         11.2         74.11         7.500         99.066         8.0         4.00         12.2         7.41         7.500         99.066           8.0         4.00         12.7         84.11         7.500         97.351         10.25         10.00         15.3         10.132         10.25         10.00         10.331         101.32         12.2         10.331         101.32         12.2         10.331         101.32         12.0         12.50         15.6         103.31         10.12         5.16         10.331         10.13.1         11.0         10.00		11.50		1.1.10				
Soaking Condition         Soaked         SOIL TYPE         CL         Settlemut num         Load Kg           Soaking Condition         \$50         Area CM2         0.000         0.000           SI No         Settlemut num         Load Kg         CBR %         0.500         17.219           1.0         0.00         0         0         1.000         \$5.76         2.000         \$5.253           2.0         0.50         2.6         17.22         1.500         \$5.166           3.0         1.00         5.4         35.76         2.000         74.172           6.0         2.50         10.6         70.20         \$1.2         4.000         84.106           7.0         3.00         11.2         74.17         \$5.000         99.066         8.0         4.000         12.7         84.11         7.500         97.351           9.0         5.00         13.6         90.31         10.32         10.001         15.3         101.32         11.2         10.001         10.331         11.2         12.001         103.31         11.2         10.001         10.331         11.2         10.001         10.31         11.0         10.001         15.1         10.31         11.2	CBR NO- 19							
Soaking Condition         Soaked         Area CM2         Settlemmt mode Division         Load Kg         CRR %         O.000         0.000           SN N         Settlemmt mode Division         Load Kg         CRR %         0.000         35.762           1.0         0.00         0         0         1.000         53.762         1.500         51.656           3.0         1.000         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         2.500         10.6         7.0.3         3.00         10.1.23         74.17         5.000         90.0666           8.0         4.00         12.7         84.11         75.00         97.351         12.500         103.311           11.0         10.00         15.3         101.32         101.32         101.32         101.331         11.3           12.0         12.50         15.6         103.31         11.5         103.31         11.5         103.31         11.5         101.32         11.5         11.5         11.5         11.5         10				SOIL TYPE	CL			
Pinnger Diam cm5.9Area CM2Ios0.0000.00017.219SN 00.0500017.2191.500157.622.00.502.617.221.50051.653.01.005.435.762.00062.254.01.5007.4035.762.00062.254.01.5007.462.254.00074.1226.02.5010.670.205.124.00084.1067.03.0011.274.175.00090.0668.04.0010.278.107.50090.359.05.0013.690.074.3810.000101.32510.07.5014.797.3512.500103.1111.010.007.50103.31101.3211.2112.012.5015.6103.311112.012.5015.6103.3111Hore Karter	Soaking Condition	Soaked				Settlemnt mm	Load Kg	
SNoSettlemut mmLoad DivisionLoad KgCBR %0.50017.2191.00.0000100035.762100035.7622.00.5015.6535.761.0054.8535.761.0054.2523.01.1005.435.761.0070.19970.1995.02.000.9.46.2251.0070.1916.02.500.9.0670.205.124.00074.1726.02.500.9.0670.205.124.00074.1729.05.0010.1274.174.38100.00101.3259.05.0013.619.13.11.000101.325100.01101.32510.07.5014.797.351.01.000101.32510.07.5014.797.351.01.01.00011.010.0015.3101.321.01.01.00011.010.0015.3101.321.01.01.011.010.0015.6103.311.01.01.011.010.0015.6103.311.01.01.011.010.0015.6103.311.01.01.011.010.0015.61.01.01.01.011.010.0015.61.01.01.01.011.010.0010.010.01.01.01.011.010.0010.0 <th>Plunger Diam cm</th> <th>5.0</th> <th>Area CM2</th> <th></th> <th></th> <th>0.000</th> <th>0.000</th>	Plunger Diam cm	5.0	Area CM2			0.000	0.000	
1.0         0.00         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         62.52         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         99.066           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         101.32         12.500         103.311           11.0         10.000         15.3         101.32         12.500         103.311           12.0         12.50         15.6         103.34         12.500         10.501           12.01         12.50         15.6         10.501         12.500         10.501	Sl No	Settlemnt mm	Load Division	Load Kg	CBR %	0.500	17.219	
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         103.31         11.0         10.000         15.3         101.32           12.0         12.50         15.6         103.31         1         1         1           PROJECT: SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR           Liquid Limit         34.02         MDD         1.864         Gm/cc         1           Plastic Limit <t< td=""><td>1.0</td><td>0.00</td><td>0</td><td>0</td><td></td><td>1.000</td><td>35.762</td></t<>	1.0	0.00	0	0		1.000	35.762	
3.0 $1.00$ $5.4$ $35.76$ $2.000$ $62.252$ $4.0$ $1.50$ $7.8$ $51.66$ $2.500$ $70.199$ $5.0$ $2.00$ $9.4$ $62.25$ $3.000$ $74.172$ $6.0$ $2.50$ $10.66$ $70.20$ $5.12$ $4.000$ $84.106$ $7.0$ $3.00$ $11.2$ $74.17$ $5.000$ $90.666$ $8.0$ $4.00$ $12.7$ $84.11$ $7.500$ $97.351$ $9.0$ $5.00$ $13.6$ $90.07$ $4.28$ $10.000$ $101.325$ $10.0$ $7.50$ $14.7$ $97.35$ $12.500$ $103.311$ $11.0$ $10.000$ $15.3$ $101.32$ $10.331$ $10.325$ $12.0$ $12.50$ $15.6$ $103.31$ $10.500$ $10.331$ $11.0$ $10.000$ $15.4$ $103.31$ $10.500$ $10.500$ $12.0$ $12.500$ $11.6$ $10.600$ $10.600$ $10.600$ $12.0$ $12.500$ $11.000$ $10.000$ $10.00$	2.0	0.50	2.6	17.22		1.500	51.656	
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         100.311           11.0         10.00         15.3         101.32	3.0	1.00	5.4	35.76		2.000	62.252	
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         10.1         10.000           12.0         12.50         15.6         103.31         10.1         10.000           12.0         12.50         15.6         103.31         10.1         10.000           Com/cc         10.000           Project: soil.investigation at the NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR           Project: soil.investigation at the NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR           Com/cc           Project: soil.investigation at the NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR           Com/cc         10.00 <td co<="" td=""><td>4.0</td><td>1.50</td><td>7.8</td><td>51.66</td><td></td><td>2.500</td><td>70.199</td></td>	<td>4.0</td> <td>1.50</td> <td>7.8</td> <td>51.66</td> <td></td> <td>2.500</td> <td>70.199</td>	4.0	1.50	7.8	51.66		2.500	70.199
6.0         2.50         10.6         70.20         5.12         4.000         84.106           7.0         3.00         11.2         74.17         5.00         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         97.351         12.800         103.311           11.0         10.00         15.3         101.32         1         1           12.0         12.50         15.6         103.31         1         1         1           12.0         12.50         15.6         103.31         1         1         1         1           Registration of the second	5.0	2.00	9.4	62.25		3.000	74.172	
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 <b>4.38</b> 10.000         101.325           10.0         7.50         14.7         97.35         12.500         103.31           11.0         10.00         15.3         101.32         10.00         10.331           12.0         12.50         15.6         103.31         10.12         10.00           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         %         11.0           Projectri: 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         %         11.0           Solar Condition         Soaked         DOU         0.000         0.000         0.000           Sol Area CM2	6.0	2.50	10.6	70.20	5.12	4.000	84.106	
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         103.31           11.0         10.00         15.3         101.32         101.31         10.31           12.0         12.50         15.6         103.31         10.00         10.00           PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR           Idea in the interval of the in	7.0	3.00	11.2	74.17		5.000	90.066	
9.0         5.00         13.6         90.07         4.38         10.00         101.325           10.0         7.50         14.7         97.35         12.50         103.31           11.0         10.00         15.3         101.32         -         -           12.0         12.50         15.6         103.31         -         -           12.0         12.50         15.6         103.31         -         -           Properties of the second	8.0	4.00	12.7	84.11		7.500	97.351	
10.0         7.50         14.7         97.35         12.50         103.31           11.0         10.00         15.3         101.32	9.0	5.00	13.6	90.07	4.38	10.000	101.325	
11.0         10.00         15.3         101.32         Image: constraint of the second sec	10.0	7.50	14.7	97.35		12.500	103.311	
12.0         12.50         15.6         103.31         Image: constraint of the second sec	11.0	10.00	15.3	101.32				
Image: Solution of the second secon	12.0	12.50	15.6	103.31				
Solit         Solit <th< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th></th<>								
Liquid Limit $34.02$ MDD $1.864$ Gm/cc           Plastic Limit $21.68$ OMC $23.16$ $\%$ Plastic Limit $12.34$ NMC $19.2$ $\%$ Plasticity Index $12.34$ NMC $19.2$ $\%$ CBR NO- 20                CBR NO- 20          SOIL TYPE         CL             Soaking Condition         Soaked         SOIL TYPE         CL             Soaking Condition         Soaked         Load Kg $0.000$ $0.000$ $0.000$ SI No         Settlemnt mm         Load Division         Load Kg         CBR % $0.500$ $23.179$ $1.0$ $0.00$ $0.0$ 0         1.000 $44.371$ $2.0$ $0.50$ $3.5$ $23.18$ $1.500$ $55.629$ $3.0$ $1.00$ $6.7$ $44.37$ $2.000$ $67.550$ $4.0$ $1.50$ $8.4$ $55.63$ $2.500$ $75.497$ <	PROJECT:- SOII	L INVESTIGATION	N AT THE NALAN	IDA UNIVERS	SITY SITE A	T RAJGIR-BIHA		
Plastic Limit         21.68         OMC         23.16         %           Plasticity Index         12.34         NMC         19.2         %           CBR NO- 20         Image: Comparison of the	Liquid Limit	34.02		MDD	1.864	Gm/cc	-	
Plasticity Index         12.30         NMC         19.2         Nome         Nome <th>Plastic Limit</th> <th>21.68</th> <th></th> <th>ОМС</th> <th>23.16</th> <th>0%</th> <th>-</th>	Plastic Limit	21.68		ОМС	23.16	0%	-	
Image: CBR NO- 20         Image: CBR NO- 20         Image: CBR NO- 20         SOIL TYPE         CL         Image: CL           Soaking Condition         Soaked         SOIL TYPE         CL         Load Kg           Plunger Diam cm         5.0         Area CM2         0.000         0.000           SI 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         <	Plasticity Index	12.34		NMC	19.2	%	_	
CBR NO- 20         Image: Mark and	-							
Image: Note of the section o	CBR NO- 20						-	
Soaking Condition         Soaked         Image Condition         Soaked         Image Condition         Load Kg           Plunger Diam cm         5.0         Area CM2         0.000         0.000         0.000           SI 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				SOIL TYPE	CL			
Plunger Diam cm         5.0         Area CM2         CBR         0.000         0.000           SI 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           11.0         10.00         16.2	Soaking Condition	Soaked				Settlemnt mm	Load Kg	
S1 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         12.50         108.609           11.0         12.50         16.4         108.61	Plunger Diam cm	5.0	Area CM2			0.000	0.000	
1.0         0.00         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         10.1         10.1         10.1           12.0         12.50         16.4         108.61         10.1         10.1         10.1         10.1         10.1         10.1         10.1         10.1         10.1	Sl No	Settlemnt mm	Load Division	Load Kg	CBR %	0.500	23.179	
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         108.609           11.0         10.00         16.2         107.28         10000         10000         1000	1.0	0.00	0.0	0		1.000	44.371	
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         100.00         100	2.0	0.50	3.5	23.18		1.500	55.629	
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	3.0	1.00	6.7	44.37		2.000	67.550	
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	4.0	1.50	8.4	55.63		2.500	75.497	
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	5.0	2.00	10.2	67.55		3.000	82.781	
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	6.0	2.50	11.4	75.50	5.51	4.000	92.053	
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               12.0         12.50         16.4         108.61	7.0	3.00	12.5	82.78		5.000	96.026	
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             11.0         10.00         16.4         108.61	8.0	4.00	13.9	92.05		7.500	103.974	
10.0         7.50         15.7         103.97 <b>12.500 108.609</b> 11.0         10.00         16.2         107.28	9.0	5.00	14.5	96.03	4.67	10.000	107.285	
11.0     10.00     16.2     107.28       12.0     12.50     16.4     108.61	10.0	7.50	15.7	103.97		12.500	108.609	
12.0         12.50         16.4         108.61	11.0	10.00	16.2	107.28				
	12.0	12.50	16.4	108.61				











Evaluation of Liquefaction Potential Based on SPT(CRR)									T:- SOIL INVE	STIGATION /	AT NALANDA	UNIVERSIT	Y SITE,RAJ	IGIR , NALAND	A, BIHAR.	
	Pa				1.0	Kg/cm2										
Depth	Of Water T	able Assume	d (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	Hydrostat ic 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 Ko =(1- Co*Ln(o' v0))as per Eq 12 P39 <=1.0	Cn(Overbur den/normali zation) =(1/EStress) power m as per Eq 19P40	N1- 60(Normali zation Factor diamension less) 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/14.1a s 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

		PROJEC	CT:- SOIL INVE	STIGATION AT NAL	ANDA UNIVE	ERSITY SITE ,	RAJGIR , NALAN	NDA, 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	Liquetaction 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+5.1 33) 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*(ex p(-M/4))- 0.058 as per eq 8a P36	Cyclic Stress Ration Under Earthquake CSR m7.5=0.65*(σv 0/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















# **NALANDA UNIVERSITY PROJECT: - SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE, RAJGIR, NALANDA, BIHAR.**



# SUBMISSION: -GEOTECHNICAL INVESTIGATION REPORT

 $\mathbf{TO}$ 

CONSULTANT (ADMINISTARTINON) ON BEHALF OF VICE CHANCELLOR, NALANDA UNIVERSITY 1ST FLOOR, INDIAN CONGRESS BUILDING SEC-6,RKPURAM, NEW DELHI-110022

SUBMITTED BY M/s ALLIED ENGINEERS SHOP NO 77,LSC. LU BLOCK, PITAMPURA,DELHI -110034 PH- 011-27348891,47507397. (M) 9350104466

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# FIGURE:-SITE LOCATION PLAN 132

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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 18<sup>th</sup> 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 <u>GEOLOGY OF THE REGION IN BRIEF</u>

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 Bathani village of Gaya district. Occurrence of such volcanonear 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 primary displays -preserved sedimentary structures verv 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 visà-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 coefficient 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.

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## 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.

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## **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.

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# **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  $110^{\circ}$ C. 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  $110^{0}$ C. 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.

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## (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 and recorded . The distance (H) corresponding to a reading Rh is the sum of the distance measured and recorded . 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.

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# 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 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 (Wa) 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.

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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.

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- (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  $\pm 20^{\circ}$ 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:

Wb (100+W) P = 100 - -----

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.

## **Sedimentation**

(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.

#### (b) meniscus correction :-

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
Х	=	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. NALANDA
#### **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.

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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 ( $\eta r$ )/y\*i\*r In which K27 = permeability at 27<sup>0</sup> C,  $\eta r$  = coefficient of viscosity at T<sup>0</sup> C  $\eta 27$  = 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

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### 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 ( $\gamma t/\gamma 27$ )

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# 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

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#### 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.

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  $\mu$  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.

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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

# <u>Plate Load Test:-</u>

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 . .

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# 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<u>ALLOWABLE BEARING CAPACITY :-</u>

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 NALANI	NALANDA UNIVERSI DA, BIHAR.	TY SITE, RAJGIR,
ALLOWABLE B	EARING PRESSURE(I	<b>LOWEROF THETWO C</b>	CONSIDERATION)
DEPTH OF	SIZE OF FOOTING	ALLOWABLE BE	ARING PRESSURE
FOOTING Below	(m)	(T/	/M2)
EGL (m)			
BH-1,2,3		(CONTINUOUS	(ISOLATED
		STRIP FOOTING ) (T/M2)	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
NALSONDA	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
		<b>RAFT FOUND</b> A	ATION (T/M2)
1.50	10.0 M x20.0M	6.9	9
1.50	15.0 M x30.0M	6.7	9
1.50	20.0 M x40.0M	6.7	2
		E FOUND ATIONS	

7.2:-<u>SINGLE UNDER REAMED PILE FOUNDATIONS.:-</u>

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 Ca	rrying Cap	oacity of Single	Under Ream	ed Pile Foundation	. (PROJEC	T:- SOIL									
INVEST	IGATION	AT NALANI	DA UNIVERS	ITY SITE , RA	JGIR , NA	ALANDA,									
BIHAR.)															
Stem	Bulb	Cutt of	Length of	Safe load carryi	ng capacity	of single									
dia	diaOf	Level Of	pile Below	Under	reamed pile										
(cm.)	pile	Pile below	Cutt of												
	(cm) GL(m.) Level(m.)   In compression In uplift Lateral   (T) (T) Thrust														
	In compressionIn upliftLateral(T)(T)Thrust(T.)														
				(1)	(1)	(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									
\	120.0	1.0	2.0	50.1	10.7										

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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	34
45	$\frac{110000}{0}$	1.0	8.0	37.8	23.3	4.0
50	0 125.0	1.0	8.0	43.9	27.0	4 5
	120.0	1.0	0.0	13.9	27.0	1.0
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	20.7	3.4
45	$\frac{100.0}{0}$ 112.5	1.0	9.0	41.9	26.3	4.0
50	$\frac{112.5}{0}$	1.0	9.0	48.4	30.4	4.5
50.	125.0	1.0	9.0	-10.1	50.4	ч.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

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## **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.

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	PROJECT:	- SOIL	CHEM INVES	ICAL A	NALYSIS	OF WAT ALANDA	ER SAM	PLE, SITY SIT	FE. RAJ	GIR .
-	ROULEI	SOIL		N	NALANDA	, BIHAR.				on,
SL	LOCAT	DEP	AC	pН	ALKA	ACIDI	ΤΟΤΑ	Chlori	SULP	TOTAL
NO	ION	TH	СЕР	VAL	LINIT	ΤΥΤΟ	L	de	HATE	ORGAN
	(BH No)	(M)	EPT	UES	Y TO	NEUTR	SOLI DS IN	MG/L	MG/L	IC MATTE
			ING		NEUI RALIS	ALISE 100 ML	DS IN MG/L			
			TER		E 100	OF	MIG/L			MG/L
			IA		ML OF	WATE				
			AS		WATE	R				
			PE		R	0.5.14	2000		400	200
			1S 456	>6	0-25 ML OF	0-5 ML	3000 МС/I	500 MC/I	400 MC/I	200 MC/I
			2000		0.02N	N	MO/L	MUL	MO/L	MO/L
			•		H2SO4	NaOH				
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	вн -18	4.50		8.34	33.4	1.85	527.00	9.34	102.00	181.00
19.0	вн -19	3.00		8.19	33.6	1.88	522.00	9.36	107.00	169.00
20.0	вн -20	6.00		7.95	33.5	1.83	534.00	9.27	112.00	174.00

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PRO	S SOJECT:- SOIL INVES	OIL CHEMIC FIGATION A NALAI	CAL TEST RES T NALANDA U NDA, BIHAR.	ULT , NIVERSITY SITE , F	RAJGIR ,
SL NO	LOCATIONS BH NO	Depth of Sample Below EGL(m)	PE	CRMISSIBLE 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:- S	OIL INVESTIC	GATION AT THE I	NALANDA UNIV R	ERSITY SITE AT
	SUMM	ARY OF CBR TES	T RESULTS	
S. NO/ LOCATION NO	DRY DENSITY (MDD) GM/CM <sup>3</sup>	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.

<b>P</b> ]	<b>ROJECT:</b>	- SOIL INVESTIG	GATION AT THE NA RAJGIR-BIHAR	LANDA UNIVERS	SITY SITE AT
S.	BORE	Per	rmeability Test Result	t (Depth Below EG	L)
No	HOLE	2.0 m	4.0 m	6.0 m	8.0 m
	NO				
1	1.0	$2.55 \times 10^{-8}$ cm/sec	$3.18 \times 10^{-8}$ cm/sec	$3.28 \times 10^{-4}$ cm/sec	-
2	6.0	$2.43 \times 10^{-8}$ cm/sec	$3.16 \times 10^{-8} \text{ cm/sec}$	$3.45 \times 10^{-8}$ cm/sec	$3.23 \times 10^{-8}$ cm/sec
3	10.0	$2.39 \times 10^{-8}$ cm/sec	$3.17 \times 10^{-8}$ cm/sec	$3.41 \times 10^{-8}$ cm/sec	$3.51 \times 10^{-8}$ cm/sec
4	12.0	$2.25 \times 10^{-8}$ cm/sec	$3.24 \times 10^{-8}$ cm/sec	$3.48 \times 10^{-8}$ cm/sec	$3.56 \times 10^{-8}$ cm/sec
5	19.0	$2.47 \times 10^{-8}$ cm/sec	$3.15 \times 10^{-8}$ cm/sec	$4.32 \times 10^{-4}$ 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)

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ALL	IED E NO. M-1	NGIN 1/2012-	VEERS 13/1598 SOILPROFILE	C ADI NALA	ONSUL AINIST NDA UN	TAN RAT JIVE	IT ION RSIT	y Ul	SOII NIVER	LINVE SITY S	STIGA SITE A	ATION AT RAJ	ATTE  GIR - ]	IE NA NALA	LAND NDA B	A SIHAR	WAT 2	TER TA 2.00 (M	BLE )		CATION <b>3H-1</b>	1 s	HEET N 1	10
1PLE		)FILE	SOIL	feasured)	G DIS SIE	RAI RAI TRII VE A	N SIZ BUTI NALY	E ON (SIS	HYDROM ANALY	A	TTERI LIM	BERGS ITS	'	DEN gm	ISITY / cm <sup>3</sup>		/ITY	EX (%)/ RE		SHEARF UCC	PARAME C,TXL	CONS TI PARA	OLIDA ON METER	
TYPE OF SAM	DEPTH (m)	SUB SOIL PRC	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(ÌV SPT 'N' VALUES(ÌV	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTURE CONTFNT (%)	SPECIFIC GRAV	FREE SWELIND	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	
a																								
SPT	1.50		Brownish colour Inorganic Silty Clay	8 1	1 1	3	4	7	85	34.20	20.40	13.80												
UDS	2.00		Highly Plasticity (CL)		1	3	6	9	81	34.26	20.49	13.77		1.89	1.58	19.57	2.68	32.5		0.03 0.65	28.0 8.0	<b>DST</b> 0.70	0.143	
SPT	3.00			13 1	5 1	2	5	7	85	34.22	20.45	13.75												
SPT	4.50			28 2	5 1	3	4	63	29															
UDS	5.00				1	2	3	62	32	REN	IOUL	DED U	DS	1.76	1.58	11.26	2.65			0.00	DST 30.50	0.68		
SPT	6.00		Inorganic Silty Sand (SM)	29 2	5 1	3	4	65	28															
	6.50																							

ALL	IED E	NGIN	EERS	AI	CON DMII	NSUL NISTI	FAN' RATI IVFI	T ION ISIT	VIIN	SOIL	ANVE	STIGA	TION	ATTH	E NAL	ANDA IDA BI		WA	ATER T	ABLE	LO	CATIO	N	SHEET 2	NO
	<u>INU. IVI-</u>	[]/2012-1	<u>5/1576</u> SOILT KOFILE		RAJ	GIRB	IHA	R			51115		і кајч	GIK-P	ALAI	DADI	IIAN		2.23 (1	<b>v1</b> )		BH-2		-	
MPLE		OFILE	SOIL	Measured)	Corrected)	GR DIST SIEV	AIN TRIB ZE AN	SIZ UTI VALY	E ON ISIS	HYDROM ANALY	А	TTERI LIM	BERGS ITS	,	DEN gm/	SITY / cm <sup>3</sup>	JRE	YTIV	EX (%)/ RE		SHEARF UCC	PARAME C,TXL	CONS TI PARA	OLIDA ON METER	TEST C %
TYPE OF SA)	DEPTH (m)	SUB SOIL PR	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(]	SPT 'N' VALUES((	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OM0
ď																									
SPT	1.50		Highly Plasticity	6	8	1	2	5	8	84	33.40	20.60	12.80												
UDS	2.00		Inorganic Silty Clay (CL)			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	<b>DST</b> 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												DST			
UDS	5.00		Min with group!			1	2	2	67	28	REM	IOULE	)ED UI	ÞS	1.79	1.61	10.98	2.65			0.00	31.0	0.64		
SPT	6.00		Inorganic Silty Sand (SM)	30	26	3	2	1	65	29															
	6.50																								

ALL	LED I B NO. M	NEERS 13/1598	A NAI	CO DMI LANI	NSUL NISTE DA UN	FAN' RATI IVEI	T ION RSIT	Y U	SOI NIVER	LINVE SITY S	ESTIGA SITE A	ATION T RAJ	ATTH  GIR -N	IE NAI NALAN	LAND NDA B	A IHAR	WA	ATER T 2.00 (N	ABLE MI)	LO	CATIO	N s	HEET ?	NO	
APLE		DFILE	SOIL PROFILE	Aeasured)	Corrected)	GIR B GF DIS SIEV	IHA RAIN ΓRIE VE AI	R I SIZ BUTI NALY	E ON SIS	HYDROM ANALY	A	TTERI LIM	BERGS ITS	,	DEN gm/	SITY cm <sup>3</sup>	URE	VITY	EX (%)/ RE		SHEARF	PARAME	CONS( TI( PARA)	DLIDA ON METER	TEST %
TYPE OF SAM	DEPTH (m)	SUB SOIL PRO	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(N	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSUI	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
ſĹ																									
SPT	1.50			6	8	1	3	4	8	84	33.00	20.60	12.40												
UDS	2.00					1	2	4	9	84	34.02	20.69	13.33		1.91	1.58	21.01	2.67	35.5		0.03	27.5 8.50	DST 0.69	0.132	
SPT	3.00		Drak brownish Colour Highly Plasticity Inorganic Silty Clay	9	12	1	3	5	7	84	34.20	20.50	13.70												
SPT	4.50		(CL)	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	21	20	2	2	3	63	30															
UDS	8.00		(SM)			0	2	2	62	34	REN	IOUL	DEDU	DS	1.80	1.60	12.62	2.65			0.00	DST 32.50	0.66		
SPT	9.00		Brownish Colour Highly Plasticity	25	22	1	3	5	8	83	34.00	20.35	13.65												
	9.50		Inorganic Silty Clay (CL)																						

ALL	LIED I B NO. M	ENGI -11/2012-	<b>NEERS</b> - <u>13/1598</u> SOIL DROELLE	A NA	CO ADM LAN	DNSUL INIST DA UN	TAN RAT	NT TON RSIT	Y U	SOI NIVEF	L INVI RSITY	ESTIG SITE A	ATION AT RA	N AT T JGIR -	HE NA NALA	LANE NDA F	DA BIHAR	WA	ATER T 2.00 (M	ABLE MI)	LO	CATIO BH-4	N S	HEET I 4	NO
APLE		DFILE	SOIL	Aeasured)	Corrected)	IGIR I GF DIST SIEV	SIHA RAIN ΓRIE /Ε ΑΙ	I SIZ BUTI NALY	E ON SIS	HYDROM ANALY	A	TTERI LIM	BERGS ITS	,	DEN gm	SITY cm <sup>3</sup>	JRE	VITY	EX (%)/ RE		SHEARF UCC	PARAME C,TXL	CONS TI PARA	OLIDA ON METER	TEST 7%
TYPE OF SAM	DEPTH (m)	SUB SOIL PRO	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(N	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRAY	FREE SWELIND SWELL PRESSUI	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
T																									
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			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		(CL)	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																								

ALL	IED E	NGIN	EERS	A	CON DMI	NSULI NISTR	TAN' RATI	F ON		SOI	LINVE	STIGA	ATION T D A I	ATTH	IE NAI	LAND	A	WA	ATER T	ABLE	LO	CATIO	N	SHEET	NO
JOB	NO. M-1	[]/2012-1	<u>I 3/1398</u> SOIL PROFILE		RAJ	GIR BI	HA]	R	I UI				I IAJ	<b>GIX-</b> 1	ALAI	UADI	IIAN		2.50 (1	M)		BH-5		3	
MPLE		OFILE	SOIL	Measured)	Corrected)	GF DIST SIEV	RAIN ΓRIE VE AI	I SIZ BUTI NALY	E ON ISIS	HYDROM ANALY	A	TTERI LIM	BERGS ITS	1	DEN gm	ISITY / cm <sup>3</sup>	URE	YTIV	)EX (%)/ RE		SHEARI UCC	PARAME C,TXL	CONSO TI PARA	OLIDA ON METER	C %
TYPE OF SA	DEPTH (m)	SUB SOIL PR	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(]	SPT 'N' VALUES(0	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (90)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OM
Œ																									
SPT	1.50			6	8	1	2	4	8	85	34.80	20.40	14.40								0.04	20.0	DET		
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	<b>8.5</b> 0	0.68	0.110	
SPT	3.00		Highly Plasticity	10	13	1	3	7	7	82	35.70	20.30	15.40												
SPT	4.50		(CL)	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																								

ALI JOI	LIED I B NO. M	ENGI -11/2012-	<b>NEERS</b> - <u>13/1598</u> SOIL DEOGEN E	A NA	CO ADM LAN	NSUL INIST DA UN	TAN RAT JIVE	IT ION RSII	Y U	SOI NIVER	LINVI SITY S	ESTIG SITE A	ATION AT RA,	N AT TI JGIR - 1	HE NA NALA	LAND NDA F	)A BIHAR	WA	ATER T 3.00 (I	ABLE M)	LO	CATIO BH-6	N S	HEET	NO
APLE		)FILE	SOIL PROFILE	feasured)	(patrected)	IGIR I GI DIS SIE	BIHA RAIN ΓRIE VE AI	A <b>R</b> N SIZ BUTI NALY	E ON 'SIS	H Y DROM ANALY	A	TTERI LIM	BERGS ITS	,	DEN gm	SITY / cm <sup>3</sup>	JRE	/ITY	EX (%)/ RE		SHEARF	PARAME C,TXL	CONS( TI PARA]	OLIDA ON METER	TEST %
TYPE OF SAN	DEPTH (m)	SUB SOIL PRC	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(M	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRAV	FREE SWELIND	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
ď					0			_		0.5	25.00	0.00	15.00												
SPT	1.50			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		Dark Brownish Colour Highly Plasticity Inorganic Silty Clay (CL)			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																								

ALL	IED E	'NGIN	EERS		A	COI DMI	NSULI NISTR	TAN' RATI	Г ОN		SOI	LINVE	ESTIG	ATION	ATT	IE NA	LAND	A	WA	ATER T	ABLE	LO	CATIO	N	SHEET	NO
	NO. M-1	11/2012-1	<u>13/1598</u> SOILPRO	ILE	NAI	LANI RAJ	DA UNI GIR BI	IVEF [HA]	RSIT: R	Y UI	NIVER	SITYS	SITE A	T KA,	JGIR -		NDA I	SIHAR		3.00 (1	M)		BH-7		7	
MPLE		OFILE	SOIL		Measured)	Corrected)	GF DIST SIEV	RAIN ΓRIE /Ε ΑΙ	SIZ UTI NALY	E ON 'SIS	HYDROM ANALY	A	TTERI LIM	BERGS ITS	'	DEN gm	ISITY / cm <sup>3</sup>	IRE	YTIY	EX (%)/ RE		SHEARI	PARAME C,TXL	CONS TI PARA	OLIDA ON METER	TEST C %
TYPE OF SAI	DEPTH (m)	SUB SOIL PR	DISCRIPTION AND CLASSIFICATIO	N	SPT 'N' VALUES()	SPT 'N' VALUES(0	GRAVEL	COARSE	MEDIUM	FINE	SILTY+CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OM(
Œ																										
SPT	1.50				5	7	1	2	5	8	84	34.30	20.10	14.20								0.05	20.5	DOT		
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		Brownish colour		8	10	1	3	5	7	84	34.20	20.15	14.05												
SPT	4.50		Highly Plasticity Inorganic Silty Cla (CL)	у	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																									

ALI	LIED	E <b>NGI</b> I	NEERS	AI	CON DMII	NSULI NISTF	FAN' RATI	Г ON		SOI	LINVI	ESTIG	ATION	IATTI	HE NA	LAND	DA	WA	ATER I	ABLE	LO	CATIO	N S	SHEET	NO
<u>JO</u>	B NO. M	<u>-11/2012</u> -	<u>-13/1598</u> SOIL PROFILE	NAL	AND RAJO	DA UN GIR B	IVEI IHA]	RSIT R	Y U	NIVEF	RSITY	SITE A	AT RA	JGIR-	NALA	NDAE	BIHAR		<b>3.50</b> (1	M)		BH-8		8	
MPLE		OFILE	SOIL	Measured)	Corrected)	GF DIS SIEV	RAIN TRIE VE AI	I SIZ BUTI NALY	E ON 'SIS	HYDROM ANALY	A	TTERI LIM	BERGS ITS	1	DEN gm	SITY / cm <sup>3</sup>	JRE	VITY	EX (%)/ RE		SHEARI UCC	PARAME C,TXL	CONSO TI PARA	OLIDA ON METER	TEST C %
TYPE OF SAI	DEPTH (m)	SUB SOIL PR	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Ì	SPT 'N' VALUES(0	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OM0
G																									
SPT	1.50			6	8	0	2	5	8	85	35.50	20.50	15.00									07.5	DOT		
UDS	2.00		Highly Plasticity Inorganic Silty Clay			1	2	4	9	84	35.01	20.01	15.00		1.91	1.57	21.36	2.68	30.5		0.03	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												DET			
UDS	8.00					1	2	3	62	32	REM	OULE	EDUE	s	1.82	1.60	14.02	2.65			0.00	33.50	0.66		
SPT	9.00		Inorganic Silty Clay	22	20	1	3	4	8	84	35.90	20.70	15.20												
	9.50		(CL)																						

ALL	IED E	NGIN	EERS	A	CON DMI	NSULI NISTR	TAN] ATI	Г ON		SOI	LINVE	ESTIG	ATION	I AT TI	HE NA	LAND	A	WA	TER T	ABLE	LO	CATIO	N	SHEET	NO
JOB	<u>NO. M-1</u>	1/2012-1	<u>3/1598</u> SOIL PROFILE	NAL	ANE RAJ	DA UNI GIR BI	IVER IHAI	RSIT R	Y U	NIVER	SITY	SITE A	AT RA	JGIR-	NALA	NDA F	BIHAR	,,,,	2.50 (N	M)		BH-9		9	
MPLE		OFILE	SOIL	Measured)	Corrected)	GR DIST SIEV	AIN FRIB /E AN	SIZ UTI NALY	e On sis	HYDROM ANALY	A	TTERE LIM	BERGS ITS		DEN gm/	SITY / cm <sup>3</sup>	JRE	VITY	EX (%)/ RE		SHEARP UCC	PARAME C,TXL	CONS TI PARA	OLIDA ON METER	TEST %
TYPE OF SAI	DEPTH (m)	SUB SOIL PRO	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(Ì	SPT 'N' VALUES(0	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
Œ																									
SPT	1.50			6	8	1	2	5	9	83	33.80	20.10	13.70												
UDS	2.00		Drak Brownish colour			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	<b>28.5</b> 9.50	<b>DST</b> 0.69	0.145	
SPT	3.00		Inorganic Silty Clay (CL)	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			19	19	2	2	1	65	30															
	6.50		(SM)																						

ALI	LIED I b no. m	ENGI -11/2012	<u>VEERS</u> -13/1598	A	CON DMI LANE	NSULI NISTR DA UNI	FAN' RATI IVEF	F ON RSIT	y Ul	SOII NIVER	LINVE SITY S	ESTIGA SITE A	ATION AT RAJ	AT TH JGIR - 1	HE NAI NALAI	LAND NDA B	A IHAR	WA	ATER T 3.00 (I	ABLE MI)	LO	CATIO	N S	HEET 1 10	NO
1PLE		)FILE	SOIL PROFILE	feasured)	orrected)	GIR B GF DIST SIEV	IHA RAIN FRIE VE AI	<b>R</b> I SIZ BUTI NALY	E ON SIS	HYDROM ANALY	A	ATTERI LIM	BERGS ITS	,	DEN gm	SITY / cm <sup>3</sup>	RE	/ITY	EX (%)/ 8E		SHEARI	PARAME	CONS TI PARA	)LIDA ON METER	TEST %
TYPE OF SAM	DEPTH (m)	SUB SOIL PRO	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(M	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRAV	FREE SWELIND	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
GL	1.50			7	10	1		5	0	94	24.50	20.10	14.40												
	2.00				10		3	5	8	84	34.50	20.10	14.40		1.83	1 53	19.77	2.68	35.0		0.03	28.0	DST	0.126	
SPT	3.00			12	15	1	3	4	7	85	32.50	20.10	12.00		1.05	1.55	19.17	2.00	55.0		1.27	10.00	0.75	0.120	
SPT	4.50			16	18	1	2	5	8	84	32.80	20.80	12.00												
UDS	5.00		Brownish Colour			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		Inorganic Silty Clay (CL)	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																								

ALL	IED E	NGIN	EERS	A	CON DMI	NSULT NISTR	ANT ATI VFP	C ON SITY	z U	SOI NIVER	LINVI RSITY :	ESTIG SITE /	ATION AT RA	NATTI IGIR -	HE NA NALA	LAND NDA F	)A RIHAR	WA	TER T	ABLE	LO	CATIO]	N	SHEET 11	NO
	<b>NO.</b> M-1	11/2012-1	<u>5/1596</u> SOILPROFILE	INAL	RAJ	GIRBI	HAI	811 I 8						JOIN					<b>3.50</b> (1)	VI)	1	BH-11			
MPLE		OFILE	SOIL	Measured)	Corrected)	GF DIST SIEV	AIN TRIB /E AI	SIZ UTI NALY	E ON ISIS	HY DROM ANALY	А	TTERI LIM	BERGS ITS	1	DEN gm	SITY / cm <sup>3</sup>	E	VITY	)EX (%)/ RE		SHEARF	PARAME C,TXL	CONSO TI PARA	OLIDA ON METER	TEST C %
TYPE OF SA	DEPTH (m)	SUB SOIL PR	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(]	SPT 'N' VALUES(0	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTUR CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OM
Œ																									
SPT	1.50			6	8	1	2	4	8	85	34.60	20.00	14.60									27.5	DOT		
UDS	2.00					0	1	5	9	85	34.68	20.09	14.59		1.93	1.61	20.14	2.67	33.0		0.03 1.19	7.50	0.66	0.142	
SPT	3.00		Brownish Colour	9	11	1	3	6	7	83	33.50	21.50	12.00												
SPT	4.50		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												
	0.50																								

ALL	LIED I B NO. M	ENGI -11/2012-	NEERS 13/1598 SOIL DROEILE	Al NAL	CON DMIN AND	NSULT NISTR DA UNI	ANT ATI VER	F ON SITY	τŪ	SOI JNIVEI	IL INVI RSITY	ESTIG SITE 4	ATION AT RA	N ATTI JGIR -	HE NA NALA	LANE NDAE	DA BIHAR	WA	ATER T 3.00 (I	ABLE M)	LO	CATIO BH-12	N S	SHEET 1 12	NO
APLE		DFILE	SOIL	Aeasured)	orrected)	GIR BI GF DIST SIEV	ΠΑΙ RAIN FRIE VE A	N SIZ BUTI NALY	E ON SIS	H Y DROM ANALY	A	TTERI LIM	BERGS ITS	'	DEN gm/	SITY / cm <sup>3</sup>	JRE	YTIV	EX (%)/ RE		SHEARI UCC	PARAME C,TXL	CONS( TI PARA]	OLIDA ON METER	TEST %
TYPE OF SAM	DEPTH (m)	SUB SOIL PRO	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(N	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSUI	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
ď																									
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	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		Brownish Colour	14	16	1	3	6	8	82	33.80	20.50	13.30												
UDS	5.00		Highly Plasticity Mix With Kankars Inorganic Silty Clay			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		(CL)	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																								

ALL JOB	IED E NO. M-J	NGIN 11/2012-1	EERS 1 <u>3/1598</u> SOIL PROFILE	A NAI	COI DMI LANI RAI	NSULI NISTR DA UNI CIR BI	FAN' RATI IVEF	F ON RSITT R	Y U	SOI INIVEI	IL INV RSITY	ESTIG SITE 4	ATION AT RA	N AT T JGIR -	HE NA NALA	LANE NDA B	DA SIHAR	WA	ATER T 3.00 (N	ABLE MI)	LO	CATIO BH-13	N	SHEET 13	NO
MPLE		<b>DFILE</b>	SOIL	Aeasured)	Corrected)	GI DIS SIE	RAIN TRIE VE A	I SIZ BUTI NALY	E ON 'SIS	HYDROM ANALY	A	TTERI LIM	BERGS ITS	1	DEN gm	ISITY / cm <sup>3</sup>	ξE	ЧТ	EX (%)/ RE		SHEARI UCC	PARAME C,TXL	CONS TI PARA	OLIDA ON METER	TEST 0 %
TYPE OF SAI	DEPTH (m)	SUB SOIL PRO	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(À	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTUF CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OM0
Œ																									
SPT	1.50			6	8	1	2	4	7	86	34.40	20.00	14.40												
UDS	2.00					1	1	4	9	85	35.48	20.07	14.41		1.91	1.57	21.75	2.67	37.0		0.03	27.5 8.00	<b>DST</b> 0.70	0.141	
SPT	3.00		Brownish Colour	9	12	1	3	5	8	83	35.45	20.50	14.95												
SPT	4.50		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 6.50			18	18	1	2	8	9	80	34.60	14.30	20.30												

ALI	LIED	ENGI	VEERS	Al	CON DMI	NSULT NISTE	FAN' RATI	Г ON	u U	SOI NIVEF	L INVI RSITY :	ESTIG SITE /	ATION AT RA	N ATTI JGIR -]	HE NA NALAI	LAND NDA F	A SIHAR	WA	ATER T	ABLE	LO	CATIO	N S	HEET	NO
	<u>B NO. M</u>	<u>-11/2012</u> .	<u>-13/1598</u> SOIL PROFILE		ANL RAJ	DA UNI GIR BI	іуеь [НА]	KSITY R	Ŷ					0000					2.80 (1	M)	] ]	BH-14		14	
MPLE		OFILE	SOIL	Measured)	Corrected)	GH DIS SIE	RAIN TRIE VE AI	I SIZ BUTI NALY	E ON (SIS	HYDROM ANALY	A	TTERI LIM	BERGS ITS	'	DEN gm	SITY / cm <sup>3</sup>	URE )	VITY	DEX (%)/ JRE		SHEARI UCC	PARAME C,TXL	CONS TI PARA	OLIDA ON METER	C %
TYPE OF SA	DEPTH (m)	SUB SOIL PR	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES()	SPT 'N' VALUES(	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOIST CONTENT (%	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OM
G																									
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	16	17	1	3	7	7	82	31.80	21.80	10.00												
UDS	5.00		(CL)			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																								

ALL JOB	IED E NO. M-	NGIN 11/2012-1	Z <mark>EERS</mark> 1 <u>3/1598</u> SOIL PROFILE	A NAI	CON DMI ANE	NSULI NISTR DA UNI	FANT RATI IVER	F ON RSITY	Y U	SOI NIVEF	LINVI RSITY	ESTIG SITE A	ATION AT RA	N AT TI JGIR -	HE NA NALA	LAND NDAB	OA SIHAR	WA	ATER T 2.50 (1	ABLE M)	LO	CATIO BH-15	N	SHEET 15	NO
MPLE		OFILE	SOIL	deasured)	Corrected)	GIK B GI DIS SIE	RAIN TRIE VE A	I SIZ BUTI NALY	E ON (SIS	HYDROM ANALY	A	TTERI LIM	BERGS ITS	1	DEN gm	ISITY / cm <sup>3</sup>	Ш	VITY	EX (%)/ RE		SHEARI UCC	PARAME C,TXL	CONS TI PARA	OLIDA ON METER	TEST 7 %
TYPE OF SAM	DEPTH (m)	SUB SOIL PRO	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(À	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTUR CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
Œ																									
SPT	1.50			7	10	1	3	7	7	82	34.95	20.80	14.15												
UDS	2.00					1	3	5	10	81	34.97	20.84	14.13		1.88	1.56	20.64	2.68	34.0		0.04	28.5 9.00	DST 0.72	0.135	
SPT	3.00		Dark Brownish Colour	11	14	1	3	5	8	83	34.80	20.60	14.20												
SPT	4.50		Highly Plasticity Inorganic Silty Clay (CL)	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																								

ALI	LIED I B NO. M	ENGI -11/2012	<u>NEERS</u> -13/1598	A NAI	COI DMI LANI	NSUL' NISTI DA UN	FAN' RATI IVEI	T ON RSIT	Y U	SOI NIVEH	IL INVI RSITY	ESTIG SITE #	ATION AT RA	N ATT JGIR -	HE NA NALA	LANE NDA F	)A BIHAR	WA	ATER T 3.00 (I	ABLE MI)	LO	CATIO	N S	HEET 1 16	NO
<b>1</b> PLE		)FILE	SOIL PROFILE SOIL	feasured)	(patriced)	GIR B GH DIS SIEV	IHA RAIN FRIE VE AI	R I SIZ BUTI NALY	E ON (SIS	HYDROM ANALY	А	TTERE LIM	BERGS ITS	'	DEN gm	SITY / cm <sup>3</sup>	JRE	YTTY	EX (%)/ RE		SHEARF	PARAME C,TXL	CONS( TI( PARA)	OLIDA ON METER	TEST %
TYPE OF SAM	DEPTH (m)	SUB SOIL PRC	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(N	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTU CONTENT (%)	SPECIFIC GRAV	FREE SWELINDI SWELL PRESSUF	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
D	1.50				0					0.6	25.10	20.10	15.00												
SPT	1.50		Brownish Colour Highly Plasticity	6	8	1	2	4		86	35.10	20.10	15.00								0.03	28.0	DST		
UDS	2.00		Inorganic Silty Clay (CL)			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									DOT			
UDS	5.00					0	2	1	67	30	RE	MOUI	DEDU	DS	1.74	1.55	12.46	2.65			0.00	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	RE	MOUI	DEDU	DS	1.77	1.54	14.57	2.65			0.00	DST 34.00	0.72		
SPT	9.00		Highly Plasticity Inorganic Silty Clay	25	22	1	3	5	9	82	31.00	22.25	8.75												
	9.50																								
ALL	IED E	ENGIN	EERS	A	CO DMI	NSUL' INISTI	TAN RATI	T ION	<b>V T D</b>	SOII	LINVE	STIGA	TION	ATTH	E NAI		A	WA	ATER T	ABLE	LO	CATIO	N	SHEET	'NO
------------	---------------	-------------	---	------------------	------------------	------------------	-----------------------	-----------------------	-----------------	------------------	-----------------	------------------	---------------------	--------------------	-----------------	---------------------------	----------------------------	--------------	------------------------------	---------------------	---------------------------------------	-----------------------	---------------------	----------------------	------------------------------
JOB	<u>NO. M-</u>	11/2012-1	<u>13/1598</u> SOIL PROFILE	NAI	LANI RAJ	DA UN [GIR B	IVEI IHA	RSIT R	Y UI	NIVER	SITY S	STE A	I KAJ	GIK-P	NALAN	DABI	HAK		2.25 (1	M)	]	BH-17		17	
MPLE		OFILE	SOIL	Measured)	Corrected)	GH DIS SIE	RAIN TRIE VE Al	I SIZ BUTI NALY	E ON 'SIS	HY DROM ANALY	A	TTERI LIM	BERGS ITS	1	DEN gm	SITY / cm <sup>3</sup>	٤E	VITY	JEX (%)/ RE		SHEARI UCC	PARAME C,TXL	CONSO TI PARA	OLIDA ON METER	TEST C %
TYPE OF SA	DEPTH (m)	SUB SOIL PR	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(]	SPT 'N' VALUES(0	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTUR CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OM
Œ																									
SPT	1.50			5	7	1	2	4	7	86	34.80	20.00	14.80												
UDS	2.00					0	1	6	9	84	34.86	20.91	13.95		1.93	1.61	19.68	2.67	31.5		0.03	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																								

ALL	LIED I B NO. M	ENGI -11/2012	<u>NEERS</u> -13/1598	AI NAL	CON DMII AND	NSULT NISTR DA UNI	AN] ATI VER	Г ON SIT	YU.	SOI NIVER	LINVE RSITY S	ESTIGA SITE A	ATION AT RA,	ATTH JGIR - 1	IE NA NALA	LAND NDAB	A IHAR	WA	ATER T. 2.00 (N	ABLE	LO	CATIO	N S	HEET 1 18	NO
			SOIL PROFILE		RAJ	<u>GIR BI</u>	HAI	2	_					-					(- i	·/		3H-18			
MPLE		OFILE	SOIL	Aeasured	Corrected)	GR DIST SIEV	AIN TRIB ZE AI	SIZ UTI NALY	E ON 'SIS	H Y DRON ANALY	A	TTERE LIM	BERGS ITS	,	DEN gm/	SITY cm <sup>3</sup>	URE	ΥTIΥ	EX (%)/ RE		SHEARF UCC	PARAME C,TXL	CONSC TIC PARA!	)LIDA )N METER	TEST 7 %
TYPE OF SAI	DEPTH (m)	SUB SOIL PRO	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(À	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOIST CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
Œ																									
SPT	1.50		Brownish Colour	6	8	1	3	7	9	80	34.00	20.00	14.00									20.0	DCT		
UDS	2.00		Highly Plasticity Inorganic Silty Clay (CL)			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	RF	MOU.	LDED	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												DOT			
UDS	8.00					0	1	2	68	29	R	EMOU	LDED	UDS	1.74	1.53	13.89	2.65			0.00	32.50	0.73		
SPT	9.00			23	20	2	1	3	63	31															
	9.50																								

ALL	IED E	NGL	NEERS	AD	CON DMII	NSULT NISTR	AN]	Г ON		SOI	LINVE	STIGA	ATION	ATTE	IE NA	LAND	A	WA	TER T	ABLE	LO	CATIO	N	SHEET	NO
JOB	<u>NO. M-1</u>	1/2012	<u>2-13/1598</u> SOIL PROFILE	NALA	AND RAJO	A UNI GIR BI	VER HAI	RSITY R	Y UI	NIVER	SITY S	SITE A	T RAJ	GIR-1	NALA	NDA B	IHAR		2.00 (N	(Iv	1	BH-19		19	
MPLE		OFILE	SOIL	Measured)	Corrected)	GR DIST SIEV	AIN FRIB /E AN	SIZ UTI NALY	E ON 'SIS	HYDROM ANALY	A	TTERE LIM	BERGS' ITS		DEN gm	ISITY / cm <sup>3</sup>	E	VITY	EX (%)/ RE		SHEARF UCC	PARAME C,TXL	CONSO TI PARA	OLIDA ON METER	TEST 0 %
TYPE OF SAI	DEPTH (m)	SUB SOIL PRO	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(À	SPT 'N' VALUES(C	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOISTUF CONTENT (%)	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OMC
Œ																									
SPT	1.50		Drak Brownish colour	5	7	1	2	5	8	84	35.19	20.35	14.84								0.05	20.5	DOT		
UDS	2.00		Inorganic Silty Clay (CL)			1	2	6	9	82	35.22	20.43	14.79		1.90	1.56	21.69	2.68	41.5		1.19	<b>8.50</b>	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									DST			
UDS	5.00					1	2	2	67	28	REM	OULD	EDUD	S	1.75	1.54	13.76	2.65			0.00	32.00	0.72		
SPT	6.00		Light Grayish Colours Inorganic Silty Sand (SM)	19	16	2	2	1	65	30															
	6.50																								

ALL	IED I	ENGI	NEERS		CON DMII	NSULT NISTR	IAN] RATI	r on sity	V IIN	SOII JIVER	LINVE SITV S	STIGA ITE A'	TION F RAI	ATTH GIR - N	E NAI JALAN	ANDA	HAR	WA	TER T	ABLE	LO	CATION	N S	HEET	NO
	<u>5 NO. M</u> ·	-11/2012-	SOIL PROFILE		RAJ	GIR BI	HAI	R			51115		1 1010	UIII I		DITDI			2.00 (1	<b>(1</b> )		3H-20		20	
MPLE		OFILE	SOIL	Measured)	Corrected)	GF DIST SIEV	RAIN ΓRIB VE Al	SIZ UTI NALY	E ON 'SIS	HYDROM ANALY	А	TTERI LIM	BERGS ITS	,	DEN gm/	SITY ′ cm <sup>3</sup>	URE )	VITY	)EX (%)/ RE		SHEARF UCC	PARAME C,TXL	CONSO TIO PARAN	OLIDA ON METER	C %
TYPE OF SA	DEPTH (m)	SUB SOIL PR	DISCRIPTION AND CLASSIFICATION	SPT 'N' VALUES(]	SPT 'N' VALUES(	GRAVEL	COARSE	MEDIUM	FINE	SILTY+ CLAY %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SHRINKAGE LIMIT	BULK DENSITY	DRY DENSITY	MAX MOIST CONTENT (%	SPECIFIC GRA	FREE SWELIND SWELL PRESSU	RELATIVE DENSITY	COHESION (C) (KG/CM <sup>2</sup> )	FRICTION ANGLE (Ø)	VOID RATIO	COMPRESSION INDEX	STD. PROCTOR MDD GM/CC/OM
GL																									
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			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		(CL)	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	REN	IOULI	DEDUI	DS	1.76	1.56	12.63	2.65			0.00	31.50	0.70		
SPT	6.00		Inorganic Silty Sand	15	18	2	1	1	61	35															
SPT	7.50		(SM)	21	17	1	2	2	63	32												DST			
UDS	8.00					1	1	2	69	27	REN	IOULI	DEDUI	DS	1.79	1.57	13.97	2.65			0.00	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																								





















	0	BSERVATI	ION AND C	ALCULAT	ION FOR	DETERMIN	NATION OF	F MODUL	US OF SUBGRAD	DE REACTIO	ON AS PER	IS 1888:1982	2	
]	LOCATION			PRO	JECT:- SO	DIL INVEST	IGATION A NALA	AT NALAN ANDA, BIH	NDA UNIVERSIT IAR.	Y SITE, RA	AJGIR,			
TYPE OF SU	B SOIL			SILTY C	LAY									
DEPTH OF 7	TEST			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	JRE CONDI	TION							
SIZE OF PLA	АТЕ			30.0x 30.0	SQUARE (	СМ								
SEATING LO	OAD			126 KG	-		-			-				
							TEST	Г 1 LOCA	TION NO 4					
				1	Dial Gauge	-1		Dial Gau	ige -2					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV DEDTH OF	WIDTH OF	SAFE/AL												
FOOTING Below existing GL(M)	FOOTING (M)	BEA BEA CAPACI (CONSI ALLO SETTLE 50.0	RING ITY T/M2 DERING WABLE MENT AS MM											
		ISOL SQUAR FOO	ATED RE/STRIP DTING											
1.5	1.00	15	5.47	4										
1.5	2.00	12	2.10	1										
1.5	3.00	11	1.07	Ţ										

	0	BSERVATI	ION AND C	ALCULAT	ION FOR	DETERMIN	NATION OF	MODUL	US OF SUBGRAD	DE REACTIO	ON AS PER	IS 1888:1982	2	
	LOCATION			PRO.	JECT:- SO	OIL INVEST	IGATION A NALA	AT NALAI NDA, BIH	NDA UNIVERSIT IAR.	Y SITE, RA	AJGIR,			
TYPE OF SU	UB SOIL			SILTY C	LAY									
DEPTH OF	TEST			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	JRE CONDI	TION							
SIZE OF PL	ATE			30.0x 30.0	SQUARE (	СМ								
SEATING L	¢ 1			126 KG										
							TEST	C 2 LOCA	TION NO 5					
				] ]	Dial Gauge	-1		Dial Gau	1ge -2					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV DEPTH OF FOOTING Below existing GL(M)	WABLE BEAI WIDTH OF FOOTING (M)	RING CAPA SAFE/ALI BEA CAPACI (CONSI ALLO' SETTLE 50.0	ACITY LOWABLE RING TY T/M2 DERING WABLE MENT AS											
		ISOL SQUAR FOO	ATED E/STRIP TING	-										
1.5	1.00	14	1.52	+										
1.5	2.00	11		┨										
1.5	3.00	10	1.39	1										

	0	BSERVATI	ION AND C	ALCULAT	ION FOR	ON AS PER	IS 1888:1982	2						
]	LOCATION			PRO.	JECT:- SO	IL INVEST	IGATION A	AT NALAN	NDA UNIVERSIT	Y SITE , RA	AJGIR ,			
		-					NALA	NDA, BIH	IAR.		•			
TYPE OF SU	B SOIL			SILTY C	LAY									
DEPTH OF 1	TEST			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	IRE CONDI	TION							
SIZE OF PLA	ATE			30.0x 30.0	SQUARE (	CM								
SEATING LO	1			126 KG	-	-	-							
							TEST	G 3 LOCA	TION NO 6					
				I	Dial Gauge	-1		Dial Gau	ige -2					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	VABLE BEAI	RING CAPA	ACITY											
DEPTH OF	WIDTH OF	SAFE/ALI	LOWABLE											
FOOTING	FOOTING	BEA	RING											
Below	(M)	CAPACI	TY T/M2											
existing		(CONSI	DERING											
GL(M)		ALLO SETTI E	WADLE MENT AS											
		50.0	MM											
		ISOL SQUAR FOO	ATED E/STRIP TING											

1.00

2.00

3.00

9.31

7.29

6.67

1.5

1.5

OBSEF	RVATION AN	ID CALCU	LATION FC	OR DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	5 PER IS 188	8:1982			
]	LOCATION			PRO	JECT:- SO	IL INVEST	IGATION A NALA	AT NALAN ANDA, BIH	NDA UNIVERSIT IAR.	Y SITE, RA	AJGIR,			
TYPE OF SU	JB SOIL			SILTY C	LAY									
DEPTH OF ?	ГЕЅТ			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	JRE CONDI	TION							
SIZE OF PL	ATE			30.0x 30.0	SQUARE (	CM								
SEATING LO	OAD			126 KG	-		-			-				
							TEST	Γ 4 LOCA	TION NO 8					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	VABLE BEAL	RING CAP	ACITY	1										
DEPTH OF FOOTING Below existing GL(M)	WIDTH OF FOOTING (M)	SAFE/ALI BEA CAPACI (CONSI ALLO SETTLE 50.0	LOWABLE RING ITY T/M2 IDERING WABLE IMENT AS ) MM											
15	1.00	ISOL SQUAR FOO	ATED RE/STRIP DTING											
1.5	1.5 1.00 7.77   1.5 2.00 6.08			1										
1.5	3.00	5		1										

OBSE	RVATION AN	D CALCUI	LATION FO	R DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	SPER IS 188	8:1982			
	LOCATION			PRO,	JECT:- SO	IL INVEST	IGATION A	AT NALAI	NDA UNIVERSIT	Y SITE, RA	AJGIR ,			
							NALA	NDA, BIH	IAR.					
TYPE OF SU	JB SOIL			SILTY C	LAY									
DEPTH OF	TEST			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	JRE CONDI	TION							
SIZE OF PL	<u>A 1</u>			30.0x 30.0	SQUARE (	CM								
SEATING L	OAD			126 KG	1									
	<i></i>						TES	F 5 LOCA	TION NO 3			<b>a</b>	a	
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	WABLE BEAI	RING CAPA	ACITY											
DEPTH OF	WIDTH OF	SAFE/AL	LOWABLE											
FOOTING	FOOTING	BEA	RING											
Below	(M)	CAPACI	TY T/M2 DEDINC											
CI (M)			DEKING WARI F											
		SETTLE	MENT AS											
		ISOL	ATED											

SQUARE/STRIP FOOTING

9.33

7.30

6.68

1.5

1.5

1.5

1.00

2.00

OBSEI	RVATION AN	ID CALCUI	LATION FO	R DETER	MINATIO	N OF MODU	ULUS OF S	UBGRADI	E REACTION AS	PER IS 188	8:1982			
	LOCATION			PRO.	JECT:- SO	IL INVEST	IGATION A	AT NALAN	NDA UNIVERSIT	Y SITE, RA	AJGIR ,			
							NALA	NDA, BIH	IAR.					
TYPE OF SU	JB SOIL			SILTY C	LAY									
DEPTH OF '	TEST			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	RE CONDI	TION							
SIZE OF PL	A 1			30.0x 30.0s	SQUARE (	CM								
SEATING L	OAD			126 KG										
							TEST	6 LOCA	TION NO 12					
Load (Kg)	Size of	Area of	Pressure(	Initial	Final	Net	Initial	Final	Net	Avg	Cumulative	Settlement	Settlement	Settlement
	plate(cm)	Plate	Kg/sqcm)	Settlemen	settlemen	Settlement	Settlement	settlemen	Settlements(mm)	Settlement(	Settlements	of actual	of actual	of actual
		(sqcm)		ts (mm)	ts(mm)	s(mm)	s(mm)	ts(mm)		mm)	(mm) of	Footing 1.0	Footing 2.0	Footing 3.0
											Plate	m wide	m wide	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
ALLOV	WABLE BEAI	RING CAPA	CITY											
DEPTH OF	WIDTH OF	SAFE/ALI	LOWABLE	1										
FOOTING	FOOTING	BEA	RING											
Below	(M)	CAPACI	TY T/M2											
existing		(CONSI	DERING											
GL(M)		ALLO	WABLE											
		SETTLE	MENT AS											
		ISOL	ATED											
		SQUAR	E/STRIP											
		FOO	TING											
1.5	1.00	6.	.17	1										
1.5	2.00	4.	.83											
1.5	3.00	4.	.42	Ĭ										

OBSER	<b>RVATION AN</b>	D CALCUI	LATION FO	OR DETERI	MINATIO	N OF MOD	ULUS OF S	UBGRADI	E REACTION AS	5 PER IS 188	8:1982			
]	LOCATION			PRO,	JECT:- SO	IL INVEST	IGATION A	AT NALAI	NDA UNIVERSIT	Y SITE, RA	AJGIR ,			
							NALA	NDA, BIH	IAR.					
TYPE OF SU	B SOIL			SILTY C	LAY									
DEPTH OF 1	TEST			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	JRE CONDI	TION							
SIZE OF PLA	1			30.0x 30.0s	SQUARE (	CM								
SEATING LO	DAD			126 KG			-							
							TEST	Г7 LOCA	TION NO 9					
Load (Kg)	Size of	Area of	Pressure(	Initial	Final	Net	Initial	Final	Net	Avg	Cumulative	Settlement	Settlement	Settlement
	plate(cm)	Plate	Kg/sqcm)	Settlemen	settlemen	Settlement	Settlement	settlemen	Settlements(mm)	Settlement(	Settlements	of actual	of actual	of actual
		(sqcm)		ts (mm)	ts(mm)	s(mm)	s(mm)	ts(mm)		mm)	(mm) of	Footing 1.0	Footing 2.0	Footing 3.0
											Plate	m wide	m wide	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
ALLOW	VABLE BEAF	RING CAPA	CITY	4										
DEPTH OF	WIDTH OF	SAFE/ALI	LOWABLE											
FOOTING	FOOTING	CADACI	KING TV T/M2											
Delow	(11)	(CONSI	DERING											
GL(M)		ALLO	WABLE											
GL(III)		SETTLE	MENT AS											
			ATED	+										
		SOUAR	A I ED F/STRIP											
		FOO	TING											
1.5	1.5 1.00 7.77													
1.5	2.00	6	.08	4										
1.5	3.00	5.	56	1										

OBSEI	RVATION AN	D CALCU	LATION FO	OR DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	5 PER IS 188	8:1982			
	LOCATION			PRO	JECT:- SO	IL INVEST	IGATION A NALA	AT NALAI ANDA, BIH	NDA UNIVERSIT IAR.	Y SITE , RA	AJGIR ,			
TYPE OF SU	JB SOIL			SILTY C	LAY									
DEPTH OF T	ГЕЅТ			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	RE CONDI	TION							
SIZE OF PL	A 1			30.0x 30.0	SQUARE (	СМ								
SEATING L	OAD			126 KG					•					
							TEST	8 LOCA	TION NO 13					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	VABLE BEAL	RING CAP	ACITY	4										
DEPTH OF	WIDTH OF	SAFE/AL	LOWABLE											
FUUTING	FOOTING (M)		IKING ITV T/M2											
existing	(141)	(CONSI	ITT 1/ML2											
GL(M)		ALLO	WABLE											
		SETTLE	MENT AS											
		50.0	) MM											
		ISOI	ATED	+										
		SQUAR FOC	RE/STRIP DTING											
1.5	1.00	6	.19	1										
1.5	2.00	4	.84											
1.5	3.00	4	.43	1										

OBSEF	RVATION AN	D CALCU	LATION FO	R DETER	MINATIO	N OF MODU	JLUS OF S	UBGRADI	E REACTION AS	PER IS 188	8:1982			
]	LOCATION			PRO,	JECT:- SO	IL INVEST	IGATION A NALA	AT NALAN NDA, BIH	NDA UNIVERSIT IAR.	Y SITE , RA	JGIR,			
TYPE OF SU	B SOIL			SILTY C	LAY									
DEPTH OF 7	FEST			1.50M BE	LOW G.L.									
CONDTION	OF TEST			NATURA	L MOISTU	RE CONDI	TION							
SIZE OF PLA	1			30.0x 30.0	SQUARE (	CM								
SEATING LO	OAD			126 KG										
							TEST	9 LOCAT	FION NO 14					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	VABLE BEAI	RING CAPA	ACITY											
DEPTH OF FOOTING Below existing GL(M) 1.5 1.5	WIDTH OF FOOTING (M) 1.00 2.00	SAFE/ALI BEA CAPACI (CONSI ALLO SETTLE ISOL SQUAR FOO 9 7	LOWABLE RING TY T/M2 DERING WABLE MENT AS ATED E/STRIP TING 31 .29											
1.5	3.00	6	.67											

OBSEH	RVATION AN	D CALCUI	LATION FO	OR DETERI	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	5 PER IS 188	8:1982			
	LOCATION			PRO,	JECT:- SO	IL INVEST	IGATION A	AT NALAI	NDA UNIVERSIT	Y SITE, RA	AJGIR ,			
							NALA	NDA, BIH	IAR.					
TYPE OF SU	JB SOIL			SILTY C	LAY									
DEPTH OF T	ГЕЅТ			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	JRE CONDI	TION							
SIZE OF PL	A 1			30.0x 30.0s	SQUARE (	СМ								
SEATING L	OAD			126 KG				-						
							TEST	10 LOCA	TION NO 15					
Load (Kg)	Size of	Area of	Pressure(	Initial	Final	Net	Initial	Final	Net	Avg	Cumulative	Settlement	Settlement	Settlement
	plate(cm)	Plate	Kg/sqcm)	Settlemen	settlemen	Settlement	Settlement	settlemen	Settlements(mm)	Settlement(	Settlements	of actual	of actual	of actual
		(sqcm)		ts (mm)	ts(mm)	s(mm)	s(mm)	ts(mm)		mm)	(mm) of	Footing 1.0	Footing 2.0	Footing 3.0
											Plate	m wide	m wide	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
ALLOV	VABLE BEAI	RING CAPA	ACITY	1										
DEPTH OF	WIDTH OF	SAFE/ALI	LOWABLE											
FOOTING	FOOTING	BEA	RING											
Below	(M)	CAPACI	TY T/M2											
CL (M)			DEKING WADI F											
GL(WI)		SETTLE	MENT AS											
		501100		4										
		ISOL	ATED E/STDID											
		SQUAR FOO	E/SI KIP TINC											
		100	1110	4										
1.5	1.00	15	5.52	ļ										
1.5	2.00	12	.15											
1.5	3.00	11	.11											

OBSE	RVATION AN	ND CALCU	LATION FC	OR DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	5 PER IS 188	8:1982			
	LOCATION			PRO	JECT:- SO	IL INVEST	IGATION A	AT NALAI	NDA UNIVERSIT	Y SITE, RA	AJGIR ,			
TYPE OF S	UB SOIL			SILTY C	LAY									
DEPTH OF	TEST			1.50M BE	LOW G.L.	•								
CONDTION	OF TEST			NATURA	L MOISTU	JRE CONDI	TION							
SIZE OF PL	A 1			30.0x 30.0	SQUARE (	СМ								
SEATING L	OAD			126 KG										
							TEST	11 LOCA	TION NO 16					
Load (Kg)	Size of	Area of	Pressure(	Initial	Final	Net	Initial	Final	Net	Avg	Cumulative	Settlement	Settlement	Settlement
	plate(cm)	Plate	Kg/sqcm)	Settlemen	settlemen	Settlement	Settlement	settlemen	Settlements(mm)	Settlement(	Settlements	of actual	of actual	of actual
		(sqcm)		ts (mm)	ts(mm)	s(mm)	s(mm)	ts(mm)		mm)	(mm) of	Footing 1.0	Footing 2.0	Footing 3.0
											Plate	m wide	m wide	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
ALLO	WABLE BEA	RING CAPA	ACITY		-	-	-	-	-	-	-	-	-	
DEPTH OI	F WIDTH OF	SAFE/AL	LOWABLE											
FOOTING	FOOTING	BEA	RING											
Below	(M)	CAPAC	ITY T/M2											
existing		(CONSI	IDERING											
GL(M)		ALLO SETTI E	WABLE MENT AS											
		SETTLE 50.0		4										
		ISOL	LATED											
		SQUAR	KE/STRIP											
		ruu	TING											
1.5	1.00	18	8.61	]										
1.5	2.00	14	4.56											
1.5	3.00	13	3.32											

OBSEI	RVATION AN	D CALCUI	LATION FC	R DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	5 PER IS 188	8:1982			
	LOCATION						SI	LTY CLAY	Y					
TYPE OF SU	JB SOIL					]	PROJECT	NALANDA	A RAJGIR					
DEPTH OF T	FEST			SILTY C	LAY									
CONDTION	OF TEST			1.50M BE	LOW G.L.	•								
SIZE OF PL	АТЕ			NATURA	L MOISTU	JRE CONDI	TION							
SEATING L	1			30.0x 30.0	SQUARE (	CM								
				126 KG			-	-	-	-				
							TEST	12 LOCA	TION NO 19					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	VABLE BEAR	RING CAPA	ACITY				-							
DEPTH OF	WIDTH OF	SAFE/ALI	LOWABLE	1										
FOOTING	FOOTING	BEA	RING											
Below	(M)	CAPACI	TY T/M2											
existing		(CONSI	DERING											
GL(M)		ALLO	WABLE											
		SETTLE	MENT AS											
		ISOL SQUAR FOO	ATED E/STRIP TING											
1.5	1.00	4.	.67	1										
1.5	2.00	3.	.66	I										

1.5

3.00

OBSE	RVATION AN	D CALCUI	LATION FC	R DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	PER IS 188	8:1982			
	LOCATION						SI	LTY CLAY	Y					
TYPE OF SU	JB SOIL					]	PROJECT	NALANDA	A RAJGIR					
DEPTH OF 7	TEST			SILTY C	LAY									
CONDTION	OF TEST			1.50M BE	LOW G.L.									
SIZE OF PL	ATE			NATURA	L MOISTU	RE CONDI	TION							
SEATING L	<b>(</b> 1			30.0x 30.0	SQUARE (	CM								
				126 KG			-	-	-	-				
							TEST	13 LOCA	TION NO 18					
Load (Kg)	Size of plate(cm)	Area of Plate (socm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(mm)	Net Settlements(mm)	Avg Settlement( mm)	Cumulative Settlements (mm) of	Settlement of actual Footing 1.0	Settlement of actual Footing 2.0	Settlement of actual Footing 3.0
		(sqcm)		ts (IIIII)	ts(IIIII)	<b>3</b> (IIIII)	s(iiiii)	us(IIIII)		<i>)</i>	Plate	m wide	m wide	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
ALLOV	WABLE BEAI	RING CAPA	ACITY											
DEPTH OF	WIDTH OF	SAFE/ALI	LOWABLE	T										
FOOTING	FOOTING	BEA	RING											
Below	(M)	CAPACI	TY T/M2											
existing		(CONSI	DERING											
GL(M)		ALLO SETTLE	WABLE MENT AS											
		ISOL	ATED	1										
		SQUAR	E/STRIP											
		FOO	TING											
1.5	1.00	4.	.63	1										
1.5	2.00	3.	.62	ļ										
1.5	3.00	3.	.31	]										

OBSEI	RVATION AN	ID CALCUI	LATION FO	R DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	5 PER IS 188	8:1982			
	LOCATION						SI	LTY CLAY	Y					
TYPE OF SU	JB SOIL					]	PROJECT	NALANDA	A RAJGIR					
DEPTH OF 7	ГЕST			SILTY C	LAY									
CONDTION	OF TEST			1.50M BE	LOW G.L.	•								
SIZE OF PL	АТЕ			NATURA	L MOISTU	JRE CONDI	TION							
SEATING L	1			30.0x 30.05	SQUARE (	CM								
				126 KG			•	-		2				
							TEST	14 LOCA	TION NO 17					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	VABLE BEAI	RING CAPA	ACITY						•	•	-	-	•	
DEPTH OF	WIDTH OF	SAFE/AL	LOWABLE	1										
FOOTING	FOOTING	BEA	RING											
Below	( <b>M</b> )	CAPACI	TY T/M2											
existing		(CONSI	DERING											
GL(M)		ALLO	WABLE											
		SETTLE	MENT AS											
		ISOL	ATED	1										
		SQUAR	E/STRIP											
		FOO	TING											
1.5	1.00	3.	.10	1										
1.5	2.00	2.	.43	]										
1.5	3.00	2.	.22	I										

OBSEF	RVATION AN	D CALCUI	LATION FO	R DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	5 PER IS 188	8:1982			
]	LOCATION						SI	LTY CLAY	Y					
TYPE OF SU	B SOIL					]	PROJECT	NALANDA	ARAJGIR					
DEPTH OF 1	TEST			SILTY C	LAY									
CONDTION	OF TEST			1.50M BE	LOW G.L.	•								
SIZE OF PLA	АТЕ			NATURA	L MOISTU	JRE CONDI	TION							
SEATING LO	1			30.0x 30.0	SQUARE (	СМ								
				126 KG			-		-	-				
							TEST	15 LOCA	TION NO 2.					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	VABLE BEAI	RING CAPA	ACITY	1										
DEPTH OF	WIDTH OF	SAFE/ALI	LOWABLE											
FOOTING	FOOTING	BEA	RING											
Below	(M)	CAPACI	TY T/M2											
existing			DEKING											
GL(MI)		SETTLE	MENT AS											
		501100	MM	ļ										
		ISOL	ATED											
		SQUAR FOO	E/STRIP TING											
1.5	1.00	6	.21	1										
1.5	2.00	4.	.86	]										
1.5	3.00	4.	.44	l										

OBSEF	RVATION AN	D CALCU	LATION FC	R DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	5 PER IS 188	8:1982			
]	LOCATION						SI	LTY CLA	Y					
TYPE OF SU	JB SOIL					]	PROJECT	NALANDA	A RAJGIR					
DEPTH OF 7	ГЕST			SILTY C	LAY									
CONDTION	OF TEST			1.50M BE	LOW G.L.	•								
SIZE OF PLA	АТЕ			NATURA	L MOISTU	JRE CONDI	TION							
SEATING LO	1			30.0x 30.0	SQUARE (	СМ								
				126 KG										
							TEST	T16 LOCA	ATION NO 1					
Load (Kg)	Size of	Area of	Pressure(	Initial	Final	Net	Initial	Final	Net	Avg	Cumulative	Settlement	Settlement	Settlement
	plate(cm)	Plate	Kg/sqcm)	Settlemen	settlemen	Settlement	Settlement	settlemen	Settlements(mm)	Settlement(	Settlements	of actual	of actual	of actual
		(sqcm)		ts (mm)	ts(mm)	s(mm)	s(mm)	ts(mm)		mm)	(mm) of	Footing 1.0	Footing 2.0	Footing 3.0
											Plate	m wide	m wide	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
ALLOV	VABLE BEAF	RING CAPA	ACITY											
DEPTH OF	WIDTH OF	SAFE/AL	LOWABLE											
FOOTING	FOOTING	BEA	RING											

FOOTING Below existing GL(M)	FOOTING (M)	BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS
		ISOLATED SQUARE/STRIP FOOTING
1.5	1.00	14.38
1.5	2.00	11.25
1.5	3.00	10.29

OBSEI	RVATION AN	ND CALCUI	LATION FO	OR DETER	MINATIO	N OF MODU	ULUS OF S	UBGRAD	E REACTION AS	PER IS 188	8:1982			
	LOCATION						SI	LTY CLAY	Y					
TYPE OF SU	JB SOIL					]	PROJECT I	NALANDA	A RAJGIR					
DEPTH OF 7	TEST			SILTY C	LAY									
CONDTION	OF TEST			1.50M BE	LOW G.L.	•								
SIZE OF PL	ATE			NATURA	L MOISTU	JRE CONDI	TION							
SEATING L	1			30.0x 30.0	SQUARE (	CM								
				126 KG										
							TEST	17 LOCA	TION NO 11					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	WABLE BEA	RING CAPA	ACITY											
DEPTH OF	WIDTH OF	SAFE/AL	LOWABLE	T										
FOOTING Below existing GL(M)	FOOTING (M)	BEA CAPACI (CONSI ALLO SETTLE SETTLE SQUAR FOO	RING ITY T/M2 DERING WABLE MENT AS ATED E/STRIP TING 2.40	-										
1.5	2.00	9	.71											
1.5	3.00	8	.88											

OBSER	<b>VATION AN</b>	D CALCUI	LATION FC	OR DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	E REACTION AS	5 PER IS 188	8:1982			
]	LOCATION						SI	LTY CLAY	Y					
TYPE OF SU	B SOIL					]	PROJECT	NALANDA	A RAJGIR					
DEPTH OF T	TEST			SILTY C	LAY									
CONDTION	OF TEST			1.50M BE	LOW G.L.	•								
SIZE OF PLA	АТЕ			NATURA	L MOISTU	JRE CONDI	TION							
SEATING LO	1			30.0x 30.0	SQUARE (	CM								
				126 KG										
							TEST	18 LOCA	TION NO 10					
Load (Kg)	Size of	Area of	Pressure(	Initial	Final	Net	Initial	Final	Net	Avg	Cumulative	Settlement	Settlement	Settlement
	plate(cm)	Plate (sqcm)	Kg/sqcm)	Settlemen ts (mm)	settlemen ts(mm)	Settlement s(mm)	Settlement s(mm)	settlemen ts(mm)	Settlements(mm)	Settlement( mm)	Settlements (mm) of Plate	of actual Footing 1.0 m wide	of actual Footing 2.0 m wide	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
ALLOW	VABLE BEAH	RING CAPA	ACITY											
DEPTH OF	WIDTH OF	SAFE/AL	LOWABLE											
FOOTING	FOOTING	BEA	RING											
Below	( <b>M</b> )	CAPACI	TY T/M2											
existing		(CONSI	DERING											
GL(M)		ALLO	WABLE											
		SETTLE	MENT AS											
		ISOL	ATED	1										
		SQUAR FOO	E/STRIP TING											
1.5	1.00	7.	.75	1										
1.5	2.00	6	.07	]										
1.5	3.00	5.	.55	]										

]	LOCATION						SI	LTY CLAY	Y					
TYPE OF SU	B SOIL		1			]	PROJECT	NALANDA	ARAJGIR					
DEPTH OF 1	FEST			SILTY C	LAY									
CONDTION	OF TEST			1.50M BE	LOW G.L.	•								
SIZE OF PLA	АТЕ			NATURA	L MOISTU	JRE CONDI	TION							
SEATING LO	1			30.0x 30.0	SQUARE (	СМ								
				126 KG										
							TEST	19 LOC	ATION NO 7					
Load (Kg)	Size of plate(cm)	Area of Plate (sqcm)	Pressure( Kg/sqcm)	Initial Settlemen ts (mm)	Final settlemen ts(mm)	Net Settlement s(mm)	Initial Settlement s(mm)	Final settlemen ts(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
ALLOV	VABLE BEAF	RING CAPA	ACITY				MODUL	UD OF SU	BGRADE REACT	TON Kg/cm	13			
DEPTH OF	WIDTH OF	SAFE/AL	LOWABLE		PLATE	Pressure	Final	Un	CORRECTION	CORRECTI	CORRECTI	CORRECTI		
FOOTING	FOOTING	BEA	RING		SIZE CM	(Kg/sqcm) at	settlements(		FOR PLATE SIZE	ON FOR	ON FOR	ON FOR		
Below	( <b>M</b> )	CAPACI	TY T/M2			Settlement	11111)	S OF	VALUES as per	DEFLECTIO	OF PLATE	N as per IS	,	
existing		(CONSI	DERING			~~~~~		SUBGRA	clause 5.1.1 Fig 3	N CURVE	AS PER 5.1.3	9214-1979		
GL(M)		ALLO	WABLE					DE	_	AS PER 5.1.2		clauses		
		SETTLE 50.0	MENTAS ) MM					REACTIO N (K) (Kg/cm3) (As Per Corrected Load Settlement Curve)				5.1.4.1 to 5.1.4.4		
		ISOL SQUAR FOO	ATED E/STRIP TING		30.0	0.220	0.125	1.76	0.70	-	0.70	0.63		
1.5	1.00	6	.21			1	1	1	I	1	<u>I</u>	1	1	
1.5	2.00	4	.86	1										
	1			-										

OBSEI	RVATION AN	D CALCU	LATION FC	R DETER	MINATIO	N OF MOD	ULUS OF S	UBGRAD	EREACTION AS	S PER IS 188	8:1982			<b>I</b>
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 CONDI			TION							
SEATING LO 1				30.0x 30.0SQUARE CM										
				126 KG										
							TEST 20 LOCATION NO 20							
Load (Kg)	Size of	Area of	Pressure(	Initial	Final	Net	Initial	Final	Net	Avg	Cumulative	Settlement	Settlement	Settlement
	plate(cm)	Plate	Kg/sqcm)	Settlemen	settlemen	Settlement	Settlement	settlemen	Settlements(mm)	Settlement(	Settlements	of actual	of actual	of actual
	- · ·	(sqcm)		ts (mm)	ts(mm)	s(mm)	s(mm)	ts(mm)		mm)	(mm) of	Footing 1.0	Footing 2.0	Footing 3.0
											Plate	m wide	m wide	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
ALLOV	VABLE BEA	RING CAPA	ACITY				MODUL	UD OF SU	BGRADE REACT	FION Kg/cm	3			
DEPTH OF WIDTH OF SAFE/ALL		LOWABLE		PLATE	Pressure	Final	Un	CORRECTION	CORRECTI	CORRECTI	CORRECTI	1		
FOOTING	FOOTING BE		RING		SIZE CM	(Kg/sqcm) at	settlements(	corrected	FOR PLATE SIZE	ON FOR	ON FOR	ON FOR		
Below	(M)	CAPACIT				1.25 mm Sottlomont	mm)	MODULU	EQ. 75.0 CM K	LOAD DEELECTIO	BENDING OF DIATE	SATURATIO		
existing		(CONSI	DERING			Settlement		SUBGRA	vALUES as per clause 5 1 1 Fig 3	N CURVE	AS PER 513	9214-1979		
GL(M)		ALLO	WABLE					DE	chuise still rig s	AS PER 5.1.2	no i Ek ono	clauses		
		SETTLE	MENT AS					REACTIO				5.1.4.1 to		
		50.0	) MM					N (K)				5.1.4.4		
								(Kg/cm3)						
								(As Per						
								Load						
								Settlement						
								Curve)						
		ISOLATED SQUARE/STRIP			30.0	0.210	0.125	1.68	0.67	-	0.67	0.60	1	
		FOO	TING											
1.5	1.00	6	19				<u> </u>	I	<u> </u>	1	<u> </u>	<u> </u>	1	
1.5	2.00	4.85		1										
1.5	3.00	4	4.43											
				1										








































PROJECT:- SOII	LINVESTIGAT					
Liquid Limit	34.62		MDD	1.895	Gm/cc	
Plastic Limit	JH.04	-	ОМС	24.32		-
Diratisity Indox	20.15	-	NMC	10 07	%	
Plasucity muca	14.47		NMC	10.97	%	
CRR NO. 1						
CDR IIO- I			SOIL TYPE			
Sociation Condition	Soaked	-	SOILTIL		Sottlemnt mm	Lood Ka
Dimger Diam cm	5.0	Area CM2			0.000	0.000
SI 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			
12.0						
PROJECT:- SOII	L INVESTIGAT	ION AT THE	NALANDA UNIV	VERSITY SITE A	T RAJGIR-BIHAR	
PROJECT:- SOII	L INVESTIGAT		NALANDA UNIV	VERSITY SITE A	T RAJGIR-BIHAR	
PROJECT:- SOII	L INVESTIGAT		MDD	VERSITY SITE A 1.856 23.04	T RAJGIR-BIHAR	
PROJECT:- SOII	20.64		MDD OMC	VERSITY SITE A 1.856 23.04 19.91	T RAJGIR-BIHAR	
PROJECT:- SOII Liquid Limit Plastic Limit Plasticity Index	20.64 13.04		NALANDA UNIV MDD OMC NMC	VERSITY SITE A 1.856 23.04 19.01	T RAJGIR-BIHAR Gm/cc % %	
PROJECT:- SOII Liquid Limit Plastic Limit Plasticity Index CBR NO- 2	L INVESTIGAT 33.68 20.64 13.04		NALANDA UNIV MDD OMC NMC	VERSITY SITE A 1.856 23.04 19.01	T RAJGIR-BIHAR Gm/cc % %	
PROJECT:- SOII Liquid Limit Plastic Limit Plasticity Index CBR NO- 2	20.64		NALANDA UNIV MDD OMC NMC SOIL TYPE	VERSITY SITE A 1.856 23.04 19.01 CL	T RAJGIR-BIHAR Gm/cc % % %	
PROJECT:- SOII Liquid Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition	L INVESTIGAT 33.68 20.64 13.04 Soaked		NALANDA UNIV MDD OMC NMC SOIL TYPE	VERSITY SITE A 1.856 23.04 19.01 CL	T RAJGIR-BIHAR Gm/cc % % % % Settlemnt mm	Load Kg
PROJECT:- SOII Liquid Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm	L INVESTIGAT 33.68 20.64 13.04 Soaked 5.0	ION AT THE	MDD OMC SOIL TYPE	VERSITY SITE A 1.856 23.04 19.01 CL	T RAJGIR-BIHAR Gm/cc % % % % Settlemnt mm 0.000	
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit CBR NO- 2 Soaking Condition Plunger Diam cm Sl No	L INVESTIGAT 33.68 20.64 13.04 Soaked 5.0 Settlemnt mm	ION AT THE Area CM2 Load Division	NALANDA UNI MDD OMC NMC SOIL TYPE	VERSITY SITE A 1.856 23.04 19.01 CL CBR %	T RAJGIR-BIHAR Gm/cc % % % Settlemnt mm 0.000 0.500	Load Kg 0.000 18.543
PROJECT:- SOII Liquid Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm SI No 1.0	L INVESTIGAT 33.68 20.64 13.04 Soaked 5.0 Settlemnt mm 0	ION AT THE ION AT THE Area CM2 Load Division 0	NALANDA UNF MDD OMC NMC SOIL TYPE Load Kg 0	VERSITY SITE A 1.856 23.04 19.01 CL CBR %	Image: Constraint of the second state of the second sta	Load Kg 0.000 18.543 35.099
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0	L INVESTIGAT 33.68 20.64 13.04 Soaked 5.0 Settlemnt mm 0 0.5	ION AT THE ION AT THE Area CM2 Load Division 0 2.8	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54	VERSITY SITE A 1.856 23.04 19.01 CL CBR %	Image: Constraint of the second state of the second sta	Load Kg 0.000 18.543 35.099 50.199
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0 3.0	L INVESTIGAT 33.68 20.64 13.04 Soaked 5.0 Settlemnt mm 0 0.5 1	ION AT THE ION AT THE Area CM2 Load Division 0 2.8 5.3	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10	VERSITY SITE A 1.856 23.04 19.01 CL CBR %	Gm/cc           %           Settlemnt mm           0.000           1.000           1.500           2.000	Load Kg Load Kg 0.000 18.543 35.099 50.199 60.265
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0 3.0 4.0	L INVESTIGAT 33.68 20.64 13.04 Soaked 5.0 Settlemnt mm 0 0 0.5 1 1.5	ION AT THE ION AT THE Area CM2 Load Division 0 2.8 5.3 7.58	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20	VERSITY SITE A  1.856 23.04 19.01 CL CL CBR %	T RAJGIR-BIHAR Gm/cc % % % Settlemnt mm 0.000 0.500 1.000 1.500 2.000 2.500	Load Kg 0.000 18.543 35.099 50.199 60.265 72.185
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0 3.0 4.0 5.0	L INVESTIGAT	ION AT THE           IO	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20 60.26	VERSITY SITE A 1.856 23.04 19.01 CL CBR %	T RAJGIR-BIHAR Gm/cc % % Settlemnt mm 0.000 0.500 1.000 1.500 2.000 2.500 3.000	Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0 3.0 4.0 5.0 6.0	L INVESTIGAT	ION AT THE ION AT THE Area CM2 Load Division 0 2.8 5.3 7.58 9.1 10.9	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20 60.26 72.19	VERSITY SITE A	T RAJGIR-BIHAR Gm/cc % % % Settlemnt mm 0.000 0.500 1.000 1.500 2.000 2.500 3.000 4.000	Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0 3.0 4.0 5.0 6.0 7.0	L INVESTIGAT 33.68 20.64 13.04 Soaked 5.0 Settlemnt mm 0 0.5 1 1.5 2 2.5 3	ION AT THE ION AT THE Area CM2 Load Division 0 2.8 5.3 7.58 9.1 10.9 11.6	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20 60.26 72.19 76.82	VERSITY SITE A 1.856 23.04 19.01 CL CBR % 5.27	Gm/cc         %	Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119 87.417
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0	L INVESTIGAT	ION AT THE ION AT THE Area CM2 Load Division 0 2.8 5.3 7.58 9.1 10.9 11.6 12.4	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20 60.26 72.19 76.82 82.12	VERSITY SITE A	Settlemnt mm           0.000           0.500           1.000           1.500           2.500           3.000           4.000           5.000           7.500	Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119 87.417 92.715
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0	L INVESTIGAT 33.68 20.64 13.04 Soaked 5.0 Settlemnt mm 0 0.5 1 1.5 2 2.5 3 4 5	ION AT THE ION AT THE Area CM2 Load Division 0 2.8 5.3 7.58 9.1 10.9 11.6 12.4 13.2	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20 60.26 72.19 76.82 82.12 87.42	VERSITY SITE A	T RAJGIR-BIHAR Gm/cc % % % Settlemnt mm 0.000 0.500 1.000 1.500 2.000 2.500 3.000 4.000 5.000 7.500 10.000	Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119 87.417 92.715 99.338
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm SI No 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0	L INVESTIGAT	Area CM2           Load Division           0           2.8           5.3           7.58           9.1           10.9           11.6           12.4           13.2           14	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20 60.26 72.19 76.82 82.12 87.42 92.72	VERSITY SITE A	T RAJGIR-BIHAR Gm/cc % % Settlemnt mm 0.000 0.500 1.000 1.500 2.000 2.500 3.000 4.000 5.000 7.500 10.000 12.500	Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119 87.417 92.715 99.338 101.987
PROJECT:- SOII Liquid Limit Plastic Limit Plastic Limit Plasticity Index CBR NO- 2 Soaking Condition Plunger Diam cm Sl No 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0	L INVESTIGAT	Area CM2           Load Division           0           2.8           5.3           7.58           9.1           10.9           11.6           12.4           13.2           14	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20 60.26 72.19 76.82 82.12 87.42 92.72 99.34	VERSITY SITE A	T RAJGIR-BIHAR Gm/cc % % Settlemnt mm 0.000 0.500 1.000 1.500 2.000 2.500 3.000 4.000 5.000 7.500 10.000 12.500	Load Kg Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119 87.417 92.715 99.338 101.987
PROJECT:-       SOII         Liquid Limit       Plastic Limit         Plastic Limit       Plasticity Index         CBR NO- 2       Soaking Condition         Plunger Diam cm       SI No         1.0       2.0         3.0       4.0         5.0       6.0         7.0       8.0         9.0       10.0         11.0       12.0	L INVESTIGAT	ION AT THE ION AT THE Area CM2 Load Division 0 2.8 5.3 7.58 9.1 10.9 11.6 12.4 13.2 14 15 15.4	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20 60.26 72.19 76.82 82.12 87.42 92.72 99.34 101.99	VERSITY SITE A	Image: Constraint of the system         Image: Constraint of the system <td>Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119 87.417 92.715 99.338 101.987</td>	Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119 87.417 92.715 99.338 101.987
PROJECT:-       SOII         Liquid Limit       Plastic Limit         Plastic Limit       Plasticity Index         CBR NO- 2       CBR NO- 2         Soaking Condition       Plunger Diam cm         SI No       1.0         2.0       3.0         4.0       5.0         6.0       7.0         8.0       9.0         10.0       11.0         12.0       11.0	L INVESTIGAT	ION AT THE ION AT THE Area CM2 Load Division 0 2.8 5.3 7.58 9.1 10.9 11.6 12.4 13.2 14 15 15.4	NALANDA UNI MDD OMC NMC SOIL TYPE Load Kg 0 18.54 35.10 50.20 60.26 72.19 76.82 82.12 87.42 92.72 99.34 101.99	VERSITY SITE A	TRAJGIR-BIHAR         Gm/cc         %	Load Kg 0.000 18.543 35.099 50.199 60.265 72.185 76.821 82.119 87.417 92.715 99.338 101.987

PROJECT:- SOII	L INVESTIGAT	TON AT THE	NALANDA UNI	VERSITY SITE A	T RAJGIR-BIHAR	
Liquid Limit	33.76		MDD	1.85	Gm/cc	
Plastic Limit	20.12		ОМС	23.11	gillizee gillizee	
Plasticity Index	13.63		NMC	19.06	%	
	10.00					
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	/.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:- SOII	L INVESTIGAT	TION AT THE	NALANDA UNI	VERSITY SITE A	T RAJGIR-BIHAR	
			T			
Liquid Limit	33.25		MDD	1.842	Gm/cc	
Plastic Limit	20 39		ОМС	23.1	0/0	
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			
	1		1			

- KOJECI 50II		ION AT THE	NALANDA UNI	VERSITY SITE A	T RAJGIR-BIHAR	
Liquid Limit	33 74		MDD	1.849	Gm/cc	
Plastic Limit	33.74		ОМС	23.14	cinizee	
Plasticity Index	21.05		NMC	19.23	%	
	12.03				70	
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			
Liquid Limit	22.69		MDD	1.862	Credes	
Plastic Limit	32.69		омс	24.33	Gm/cc	
Diagticity Index	20.01		NMC	11.1	%	
Plasticity Index	12.68		NMC	11.1	%	
CBR NO- 6			SOIL TYPE			
Soaking Condition	Sookod		SOILTITE	CL		
Plunger Diam cm	Soakeu		SOILTITE	CL	Settlemnt mm	Load Kg
SI No	5.0	Area CM2		CL	Settlemnt mm 0.000	Load Kg 0.000
	5.0 Settlemnt mm	Area CM2 Load Division	Load Kg	CL CBR %	Settlemnt mm 0.000 0.500	Load Kg 0.000 21.192
1.0	Source     5.0     Settlemnt mm     0	Area CM2 Load Division	Load Kg 0	CL CBR %	Settlemnt mm 0.000 0.500 1.000	Load Kg 0.000 21.192 38.411
1.0 2.0	Source           5.0           Settlemnt mm           0           0.5	Area CM2 Load Division 0 3.2	Load Kg 0 21.19	CL CBR %	Settlemnt mm 0.000 0.500 1.000 1.500	Load Kg 0.000 21.192 38.411 52.318
1.0 2.0 3.0	Source           5.0         Settlemnt mm           0         0.5           1         1	Area CM2 Load Division 0 3.2 5.8	Load Kg 0 21.19 38.41	CL CBR %	Settlemnt mm           0.000           0.500           1.000           1.500           2.000	Load Kg 0.000 21.192 38.411 52.318 64.901
1.0 2.0 3.0 4.0	Source           5.0           Settlemnt mm           0           0.5           1           1.5	Area CM2 Load Division 0 3.2 5.8 7.9	Load Kg 0 21.19 38.41 52.32	CL CBR %	Settlemnt mm           0.000           0.500           1.000           1.500           2.000           2.500	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510
1.0 2.0 3.0 4.0 5.0	Source           5.0           Settlemnt mm           0           0.5           1           1.5           2	Area CM2           Load Division           0           3.2           5.8           7.9           9.8	Joint Title           0           21.19           38.41           52.32           64.90	CL CBR %	Settlemnt mm           0.000           0.500           1.000           2.000           2.500           3.000	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510 78.808
1.0           2.0           3.0           4.0           5.0           6.0	Source           5.0           Settlemnt mm           0           0.5           1           1.5           2           2.5	Area CM2           Load Division           0           3.2           5.8           7.9           9.8           11.1	Joint Title           Load Kg           0           21.19           38.41           52.32           64.90           73.51	CL CBR %	Settlemnt mm           0.000           0.500           1.000           2.000           2.500           3.000           4.000	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510 78.808 86.424
1.0           2.0           3.0           4.0           5.0           6.0           7.0	Source           5.0           Settlemnt mm           0           0.5           1           1.5           2           2.5           3	Area CM2           Load Division           0           3.2           5.8           7.9           9.8           11.1           11.9	Load Kg 0 21.19 38.41 52.32 64.90 73.51 78.81	CL CBR %	Settlemnt mm           0.000           0.500           1.000           2.000           2.500           3.000           4.000           5.000	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510 78.808 86.424 96.026
1.0           2.0           3.0           4.0           5.0           6.0           7.0           8.0	Source           5.0           Settlemnt mm           0           0.5           1           1.5           2           2.5           3           4	Area CM2           Load Division           0           3.2           5.8           7.9           9.8           11.1           11.9           13.05	Joint Title           0           21.19           38.41           52.32           64.90           73.51           78.81           86.42	CL CBR %	Settlemnt mm           0.000           0.500           1.000           1.500           2.000           2.500           3.000           4.000           5.000           7.500	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510 78.808 86.424 96.026 109.272
1.0           2.0           3.0           4.0           5.0           6.0           7.0           8.0           9.0	Source           5.0           Settlemnt mm           0           0.5           1           1.5           2           2.5           3           4           5	Area CM2           Load Division           0           3.2           5.8           7.9           9.8           11.1           11.9           13.05           14.5	Joint Title           0           21.19           38.41           52.32           64.90           73.51           78.81           86.42           96.03	CL CBR % 5.37 4.67	Settlemnt mm           0.000           0.500           1.000           2.000           2.500           3.000           4.000           5.000           7.500           10.000	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510 78.808 86.424 96.026 109.272 118.543
1.0           2.0           3.0           4.0           5.0           6.0           7.0           8.0           9.0           10.0	Source           5.0           Settlemnt mm           0           0.5           1           1.5           2           2.5           3           4           5           7.5	Area CM2           Load Division           0           3.2           5.8           7.9           9.8           11.1           11.9           13.05           14.5           16.5	Joint Time           0           21.19           38.41           52.32           64.90           73.51           78.81           86.42           96.03           109.27	CL CBR % 5.37 4.67	Settlemnt mm           0.000           0.500           1.000           1.500           2.000           2.500           3.000           4.000           5.000           7.500           10.000           12.500	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510 78.808 86.424 96.026 109.272 118.543 123.841
1.0           2.0           3.0           4.0           5.0           6.0           7.0           8.0           9.0           10.0           11.0	Source           5.0           Settlemnt mm           0           0.5           1           1.5           2           2.5           3           4           5           7.5           10	Area CM2           Load Division           0           3.2           5.8           7.9           9.8           11.1           11.9           13.05           14.5           16.5           17.9	Joint Time           0           21.19           38.41           52.32           64.90           73.51           78.81           86.42           96.03           109.27           118.54	CL CBR % 5.37 4.67	Settlemnt mm           0.000           0.500           1.000           1.500           2.000           2.500           3.000           4.000           5.000           7.500           10.000           12.500	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510 78.808 86.424 96.026 109.272 118.543 123.841
1.0           2.0           3.0           4.0           5.0           6.0           7.0           8.0           9.0           10.0           11.0           12.0	Source           5.0           Settlemnt mm           0           0.5           1           1.5           2           2.5           3           4           5           7.5           10           12.5	Area CM2           Load Division           0           3.2           5.8           7.9           9.8           11.1           11.9           13.05           14.5           16.5           17.9           18.7	Joint Title           0           21.19           38.41           52.32           64.90           73.51           78.81           86.42           96.03           109.27           118.54           123.84	CL CBR %	Settlemnt mm           0.000           0.500           1.000           1.500           2.000           2.500           3.000           4.000           5.000           7.500           10.000           12.500	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510 78.808 86.424 96.026 109.272 118.543 123.841
1.0         2.0         3.0         4.0         5.0         6.0         7.0         8.0         9.0         10.0         11.0         12.0	Source           5.0           Settlemnt mm           0           0.5           1           1.5           2           2.5           3           4           5           7.5           10           12.5	Area CM2           Load Division           0           3.2           5.8           7.9           9.8           11.1           11.9           13.05           14.5           16.5           17.9           18.7	Joint Time           0           21.19           38.41           52.32           64.90           73.51           78.81           86.42           96.03           109.27           118.54           123.84	CL CBR % 5.37 4.67	Settlemnt mm           0.000           0.500           1.000           2.000           2.500           3.000           4.000           5.000           7.500           10.000           12.500	Load Kg 0.000 21.192 38.411 52.318 64.901 73.510 78.808 86.424 96.026 109.272 118.543 123.841

PROJECT:- SOII	L INVESTIGAT	TION AT THE	NALANDA UNI	VERSITY SITE A	T RAJGIR-BIHAR	
Liquid Limit	32 62		MDD	1.819	Gm/cc	
Plastic Limit	32.02		ОМС	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
SI 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	50.940
4.0	1.5	7.5	49.67		2.500	70.861
5.0	2	10.7	58.94 70.86	5 17	3.000	97.417
7.0	2.3	10.7	70.80	5.17	5.000	06.680
7.0	3	13.2	87.42		7 500	101 087
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		12000	100020
12.0	12.5	16.1	106.62			
1210	1210	1011	100102			
			I			
PROJECT:- SOII	L INVESTIGAT	ION AT THE	NALANDA UNI	VERSITY SITE A	T RAJGIR-BIHAR	
Liquid Limit			MDD	1.816		
Plastic Limit	34.02		OMC	24.02	Gm/cc	
T lastic Linit	22.16		OMC	24.02	%	
Plasticity Index	11.86		NMC	18.75	%	
CBP NO- 8						
CDR NO- 8			SOIL TYPE	CI		
Societing Condition	Soalrod		SOILTITE	CL	Sottlownt www	Lood Ka
Plunger Diam cm	5 0	Area CM2				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:- SOI	L INVESTIGAT	TION AT THE	NALANDA UNI	VERSITY SITE A	T RAJGIR-BIHAR	
			1			
Liquid Limit	32.62		MDD	1.826	Gm/cc	
Plastic Limit	21.04		ОМС	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			
Liquid Limit	33.16		MDD	1.811	Gm/cc	
Plastic Limit	20.48		ОМС	24.66	o.	
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	10.1	100.02			
	1		1	1		1











PROJECT:- SOIL	INVESTIGATION	AT THE NALAN	DA UNIVERS	ITY SITE A	T RAJGIR-BIHA	R
Liquid Limit	33.85		MDD	1.82	Gm/cc	
Plastic Limit	20.17		ОМС	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
SI 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			
					I	
PROJECT:- SOIL	INVESTIGATION	AT THE NALAN	DA UNIVERS	ITY SITE A	T RAJGIR-BIHA	R
						T
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
SI 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 I	NVESTIGATION	AT THE NALAN	DA UNIVERS	ITY SITE A	Г RAJGIR-BIHA	R
Liquid Limit			MDD	1.842	- <i>i</i>	1
Plastic Limit	32.96		OMC	23.01	Gm/cc	
	20.38		NR(C	10.44	%	
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 I	NVESTIGATION	AT THE NALAN	IDA UNIVERS	ITY SITE A	Γ RAJGIR-BIHA	R
Liquid Limit	34.21		MDD	1.864	Gm/cc	
Plastic Limit	21.14		ОМС	23.85	%	
Plasticity Index	13.07		NMC	18.61	%	
CBR NO- 14			COLL TRADE	CI		
			SOIL TYPE	CL		
Soaking Condition	Soaked	4 6140			Settlemnt mm	Load Kg
Flunger Diam cm	5.0 Sottlomnt mm	Area CM2	Lood Kg	CBD Ø	0.000	0.000
1.0				CDK //	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	
4.0	1.50	8.4	55.63		2.500	72.980
5.0	2.00	10.1	72.09	5.22	3.000	/8.808
0.0	2.50	11.02	72.98	5.33	4.000	00.070
7.0	3.00	11.9	78.81	-	5.000	88.0/9
8.0	4.00	12.9	85.45	4 30	/.500	94.040
9.0	5.00	13.3	88.08	4.29	10.000	98.0/5 102.640
11.0	10.00	14.2	94.04		12.500	102.049
11.0	12.50	14.9	90.08			
12.0	12.30	13.3	102.03			

PROJECT:- SOIL	INVESTIGATION	AT THE NALAN	DA UNIVERS	ITY SITE A	Г RAJGIR-BIHA	R
Liquid Limit	34.68		MDD	1.822	Gm/cc	
Plastic Limit	22.14		ОМС	22.64	%	
Plasticity Index	12.54		NMC	18.42	%	
CBR NO-15						
			SOIL TYPE	CL		<b>.</b>
Soaking Condition	Soaked	Amo CM2			Settlemnt mm	
SI No	Settlemnt mm	Load Division	Load Kg	CBR %	0.000	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		IDA UNIVERS		I KAJGIK-DIHA	.ĸ
Liquid Limit	22.67		MDD	1.878		
- Plastic Limit	33.65		ОМС	24.06	Gm/cc	
Plasticity Index	21.86		NMC	18 00	% %	
T lasticity mucx	11.79		i i i i i i i i i i i i i i i i i i i	10.77	%0	
CBR NO-16						
			SOIL TYPE	CL		
Soaking Condition	Soaked				Settlemnt mm	Load Kg
Plunger Diam cm	5.0	Area CM2			0.000	0.000
SI 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	4	7.500	104.636
9.0	5.00	14.6	96.69	4.71	10.000	108.609
10.0	/.50	15.8	104.64	_	12.500	109.934
12.0	12.50	16.4	108.01			
12.0	12.50	10.0	107.73			

PROJECT:- SOIL I	NVESTIGATION A	T THE NALAN	DA UNIVERS	ITY SITE AT	' RAJGIR-BIHA	R
Liquid Limit	33.59		MDD	1.821	Gm/cc	
Plastic Limit	21.38		ОМС	24.16	0%	
Plasticity Index	12.21		NMC	19.12	<u>%</u>	
	12121				<i>,c</i>	
CBR NO- 17						
			SOIL TYPE	CL		
Soaking Condition	Soaked				Settlemnt mm	Load Kg
Plunger Diam cm	5.0	Area CM2			0.000	0.000
SI 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 I	NVESTIGATION A	T THE NALAN	DA UNIVERS	ITY SITE AT	' RAJGIR-BIHA	R
<b>.</b>			1000	1.022		
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 Sottlownt mm	Area CM2	LandKa		0.000	0.000
51 INO	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	04.238
4.0	1.50	8.2	54.30		2.500	72.980
5.0	2.00	9.7	64.24	F 22	3.000	/9.801
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			

Liquid Limit33.62MDDK20Gm/ccMinePlastic Limit21.64OMC24.22 $q_c$ Plastic Limit21.64ONC19.43 $q_c$ Plastic Limit11.88NNC19.43 $q_c$ Plastic Limit11.88NNC19.43 $q_c$ Souking ConditionSoukedNNC19.43 $q_c$ Souking ConditionSoukedNNC0.0000Souking ConditionSoukedCBR %0.50017.2191.00.00001.0035.7622.00.502.6417.221.500151.653.01.005.435.762.00094.6224.01.507.851.642.50070.1995.02.009.4462.253.00014.126.02.5011.274.175.00019.0567.03.0011.274.175.00010.31111.010.0015.3101.321.0011.010.0015.3101.321.0011.010.0015.3101.321.0011.012.5015.6103.311.0111.012.5015.6103.311.0112.012.5015.6100.311.0113.012.4NNC12.6 $q_c$ 14.113.60.011.02 $q_c$ 15.012.61.011.0	PROJECT:- SOII	L INVESTIGATION	NAT THE NALAN	DA UNIVERS	SITY SITE A	T RAJGIR-BIHA	AR	
Liquid Limit32.62NDD1.823Gm/ccParticle in the second								
Plastic Linit         21.04         ONC         34.22         max           Plasticity Index         11.58         NMC         19.43         %           CRR No. 19         Image Plant         NMC         19.43         %           CRR No. 19         Image Plant         Settermut         Image Plant         Settermut         Image Plant           Soking Condition         Soaked         Settermut         Image Plant         Settermut         Image Plant           SN N         Settermut         Load Division         Load R         CRR %         0.500         17.19           1.0         0.00         0         O         Image Plant         Image Plant <tdi< td=""><td>Liquid Limit</td><td>32.62</td><td></td><td>MDD</td><td>1.823</td><td>Gm/cc</td><td></td></tdi<>	Liquid Limit	32.62		MDD	1.823	Gm/cc		
Plasticity Index11.58NMC19.43*Soaking ConditionSoakedNMC19.43*Soaking ConditionSoakedNMC19.43*Soaking ConditionSoakedNMC10.40%Plastic LimitLoad KgCLSettlemit minLoad Kg1.00.00001.00035.7622.00.5017.2191.50051.4653.01.005.435.762.50074.1724.01.507.851.662.50070.1995.02.000.0074.1725.00094.1067.03.0011.274.175.00099.0068.84.0012.784.117.50097.3519.05.5013.690.074.3810.00010.32510.07.5014.797.3512.500103.3111.010.0015.310.33112.500103.3112.012.5015.6103.3112.500103.3111.010.0015.310.3212.50010.33111.010.0015.310.3212.50013.612.012.640MC23.06%12.50013.012.64OMC23.165.144.00014.010.0015.310.3112.5005.1415.015.6103.3112.5005.144.1611.010.0016.310.24%<	Plastic Limit	32.02		ОМС	24.22	07.	-	
Image         Image <th< td=""><td>Plasticity Index</td><td>21.04</td><td></td><td>NMC</td><td>19.43</td><td>% %</td><td>-</td></th<>	Plasticity Index	21.04		NMC	19.43	% %	-	
CHR NO- 19         Solit_TYPE         CL         Settlemut mm         Load Bysion           Soaking Condition         Soaked         Load Division         Load Kg         CBR %         0.500         17.719           1.0         0.000         0         0         1000         35.762         2.00         5.166           3.0         1.00         5.4         35.76         2.000         62.232           4.0         1.500         7.8         51.66         2.000         74.172           6.0         2.50         10.6         70.20         9.4         62.25         3.000         74.172           6.0         2.50         11.2         74.11         7.500         99.066         8.0         4.00         12.2         7.41         7.500         99.066           8.0         4.00         12.7         84.11         7.500         97.351         10.25         10.00         15.3         10.132         10.25         10.00         10.331         101.32         12.2         10.331         101.32         12.2         10.331         101.32         12.0         12.50         15.6         103.31         10.12         5.16         10.331         10.13.1         11.0         10.00		11.50		1.1.10				
Soaking Condition         Soaked         SOIL TYPE         CL         Settlemut num         Load Kg           Soaking Condition         \$50         Area CM2         0.000         0.000           SI No         Settlemut num         Load Kg         CBR %         0.500         17.219           1.0         0.00         0         0         1.000         \$5.76         2.000         \$5.253           2.0         0.50         2.6         17.22         1.500         \$5.166           3.0         1.00         5.4         35.76         2.000         74.172           6.0         2.50         10.6         70.20         \$1.2         4.000         84.106           7.0         3.00         11.2         74.17         \$5.000         99.066         8.0         4.000         12.7         84.11         7.500         97.351           9.0         5.00         13.6         90.31         10.32         10.001         15.3         101.32         11.2         10.001         10.331         11.2         12.001         103.31         11.2         10.001         10.331         11.2         10.001         10.31         11.0         10.001         15.1         10.31         11.2	CBR NO- 19							
Soaking Condition         Soaked         Area CM2         Settlemmt mode Division         Load Kg         CRR %         O.000         0.000           SN N         Settlemmt mode Division         Load Kg         CRR %         0.000         35.762           1.0         0.00         0         0         1.000         53.762         1.500         51.656           3.0         1.000         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         2.500         10.6         7.0.3         3.00         10.1.23         74.17         5.000         90.0666           8.0         4.00         12.7         84.11         75.00         97.351         12.500         103.311           11.0         10.00         15.3         101.32         101.32         101.32         101.331         11.3           12.0         12.50         15.6         103.31         11.5         103.31         11.5         103.31         11.5         101.32         11.5         11.5         11.5         11.5         10				SOIL TYPE	CL			
Pinnger Diam cm5.9Area CM2Ios0.0000.00017.219SN 00.0500017.2191.500157.622.00.502.617.221.50051.653.01.005.435.762.00062.254.01.5007.4035.762.00062.254.01.5007.462.254.00074.1226.02.5010.670.205.124.00084.1067.03.0011.274.175.00090.0668.04.0010.278.107.50090.359.05.0013.690.074.3810.000101.32510.07.5014.797.3512.500103.1111.010.007.50103.31101.3211.2112.012.5015.6103.311112.012.5015.6103.3111Hore Karter	Soaking Condition	Soaked				Settlemnt mm	Load Kg	
SNoSettlemut mmLoad DivisionLoad KgCBR %0.50017.2191.00.0000100035.762100035.7622.00.5015.6535.761.0054.8535.761.0054.2523.01.1005.435.761.0070.19970.1995.02.000.9.46.2251.0070.1916.02.500.9.0670.205.124.00074.1726.02.500.9.0670.205.124.00074.1729.05.0010.1274.174.38100.00101.3259.05.0013.619.13.11.000101.325100.01101.32510.07.5014.797.351.01.000101.32510.07.5014.797.351.01.01.00011.010.0015.3101.321.01.01.00011.010.0015.3101.321.01.01.011.010.0015.6103.311.01.01.011.010.0015.6103.311.01.01.011.010.0015.6103.311.01.01.011.010.0015.61.01.01.01.011.010.0015.61.01.01.01.011.010.0010.010.01.01.01.011.010.0010.0 <th>Plunger Diam cm</th> <th>5.0</th> <th>Area CM2</th> <th></th> <th></th> <th>0.000</th> <th>0.000</th>	Plunger Diam cm	5.0	Area CM2			0.000	0.000	
1.0         0.00         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         62.52         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         99.066           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         101.32         12.500         103.311           11.0         10.000         15.3         101.32         12.500         103.311           12.0         12.50         15.6         103.34         12.500         10.501           12.01         12.50         15.6         10.501         12.500         10.501	Sl No	Settlemnt mm	Load Division	Load Kg	CBR %	0.500	17.219	
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         103.31         11.0         10.000         15.3         101.32           12.0         12.50         15.6         103.31         1         1         1           PROJECT: SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR           Liquid Limit         34.02         MDD         1.864         Gm/cc         1           Plastic Limit <t< td=""><td>1.0</td><td>0.00</td><td>0</td><td>0</td><td></td><td>1.000</td><td>35.762</td></t<>	1.0	0.00	0	0		1.000	35.762	
3.0 $1.00$ $5.4$ $35.76$ $2.000$ $62.252$ $4.0$ $1.50$ $7.8$ $51.66$ $2.500$ $70.199$ $5.0$ $2.00$ $9.4$ $62.25$ $3.000$ $74.172$ $6.0$ $2.50$ $10.66$ $70.20$ $5.12$ $4.000$ $84.106$ $7.0$ $3.00$ $11.2$ $74.17$ $5.000$ $90.666$ $8.0$ $4.00$ $12.7$ $84.11$ $7.500$ $97.351$ $9.0$ $5.00$ $13.6$ $90.07$ $4.28$ $10.000$ $101.325$ $10.0$ $7.50$ $14.7$ $97.35$ $12.500$ $103.311$ $11.0$ $10.000$ $15.3$ $101.32$ $10.331$ $10.325$ $12.0$ $12.50$ $15.6$ $103.31$ $10.500$ $10.331$ $11.0$ $10.000$ $15.4$ $103.31$ $10.500$ $10.500$ $12.0$ $12.500$ $11.6$ $10.600$ $10.600$ $10.600$ $12.0$ $12.500$ $11.000$ $10.000$ $10.00$	2.0	0.50	2.6	17.22		1.500	51.656	
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         100.311           11.0         10.00         15.3         101.32	3.0	1.00	5.4	35.76		2.000	62.252	
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         10.1         10.000           12.0         12.50         15.6         103.31         10.1         10.000           12.0         12.50         15.6         103.31         10.1         10.000           Com/cc         10.000           Project: soil.investigation at the NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR           Project: soil.investigation at the NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR           Com/cc           Project: soil.investigation at the NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR           Com/cc         10.00 <td co<="" td=""><td>4.0</td><td>1.50</td><td>7.8</td><td>51.66</td><td></td><td>2.500</td><td>70.199</td></td>	<td>4.0</td> <td>1.50</td> <td>7.8</td> <td>51.66</td> <td></td> <td>2.500</td> <td>70.199</td>	4.0	1.50	7.8	51.66		2.500	70.199
6.0         2.50         10.6         70.20         5.12         4.000         84.106           7.0         3.00         11.2         74.17         5.00         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         97.351         12.800         103.311           11.0         10.00         15.3         101.32         1         1           12.0         12.50         15.6         103.31         1         1         1           12.0         12.50         15.6         103.31         1         1         1         1           Registration of the second	5.0	2.00	9.4	62.25		3.000	74.172	
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 <b>4.38</b> 10.000         101.325           10.0         7.50         14.7         97.35         12.500         103.31           11.0         10.00         15.3         101.32         10.00         10.331           12.0         12.50         15.6         103.31         10.12         10.00           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         %         11.0           Projectri: 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         %         11.0           Solar Condition         Soaked         DOU         0.000         0.000         0.000           Sol Area CM2	6.0	2.50	10.6	70.20	5.12	4.000	84.106	
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         103.31           11.0         10.00         15.3         101.32         101.31         10.31           12.0         12.50         15.6         103.31         10.00         10.00           PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR           Idea in the interval of the in	7.0	3.00	11.2	74.17		5.000	90.066	
9.0         5.00         13.6         90.07         4.38         10.00         101.325           10.0         7.50         14.7         97.35         12.50         103.31           11.0         10.00         15.3         101.32         -         -           12.0         12.50         15.6         103.31         -         -           12.0         12.50         15.6         103.31         -         -           Properties of the second	8.0	4.00	12.7	84.11		7.500	97.351	
10.0         7.50         14.7         97.35         12.50         103.31           11.0         10.00         15.3         101.32	9.0	5.00	13.6	90.07	4.38	10.000	101.325	
11.0         10.00         15.3         101.32         Image: constraint of the second sec	10.0	7.50	14.7	97.35		12.500	103.311	
12.0         12.50         15.6         103.31         Image: constraint of the second sec	11.0	10.00	15.3	101.32				
Image: Solution of the second secon	12.0	12.50	15.6	103.31				
Solit         Solit <th< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th></th<>								
Liquid Limit $34.02$ MDD $1.864$ Gm/cc           Plastic Limit $21.68$ OMC $23.16$ $\%$ Plastic Limit $12.34$ NMC $19.2$ $\%$ Plasticity Index $12.34$ NMC $19.2$ $\%$ CBR NO- 20                CBR NO- 20          SOIL TYPE         CL             Soaking Condition         Soaked         SOIL TYPE         CL             Soaking Condition         Soaked         Load Kg $0.000$ $0.000$ $0.000$ SI No         Settlemnt mm         Load Division         Load Kg         CBR % $0.500$ $23.179$ $1.0$ $0.00$ $0.0$ 0         1.000 $44.371$ $2.0$ $0.50$ $3.5$ $23.18$ $1.500$ $55.629$ $3.0$ $1.00$ $6.7$ $44.37$ $2.000$ $67.550$ $4.0$ $1.50$ $8.4$ $55.63$ $2.500$ $75.497$ <	PROJECT:- SOII	L INVESTIGATION	N AT THE NALAN	IDA UNIVERS	SITY SITE A	T RAJGIR-BIHA		
Plastic Limit         21.68         OMC         23.16         %           Plasticity Index         12.34         NMC         19.2         %           CBR NO- 20         Image: Comparison of the	Liquid Limit	34.02		MDD	1.864	Gm/cc	-	
Plasticity Index         12.30         NMC         19.2         Nome         Nome <th>Plastic Limit</th> <th>21.68</th> <th></th> <th>ОМС</th> <th>23.16</th> <th>0%</th> <th>-</th>	Plastic Limit	21.68		ОМС	23.16	0%	-	
Image: CBR NO- 20         Image: CBR NO- 20         Image: CBR NO- 20         SOIL TYPE         CL         Image: CL           Soaking Condition         Soaked         SOIL TYPE         CL         Load Kg           Plunger Diam cm         5.0         Area CM2         0.000         0.000           SI 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         <	Plasticity Index	12.34		NMC	19.2	%	_	
CBR NO- 20         Image: Mark and	-							
Image: Note of the section o	CBR NO- 20						-	
Soaking Condition         Soaked         Image Condition         Soaked         Image Condition         Load Kg           Plunger Diam cm         5.0         Area CM2         0.000         0.000         0.000           SI 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				SOIL TYPE	CL			
Plunger Diam cm         5.0         Area CM2         CBR         0.000         0.000           SI 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           11.0         10.00         16.2	Soaking Condition	Soaked				Settlemnt mm	Load Kg	
S1 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         12.50         108.609           11.0         12.50         16.4         108.61	Plunger Diam cm	5.0	Area CM2			0.000	0.000	
1.0         0.00         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         10.1         10.1         10.1           12.0         12.50         16.4         108.61         10.1         10.1         10.1         10.1         10.1         10.1         10.1         10.1         10.1	Sl No	Settlemnt mm	Load Division	Load Kg	CBR %	0.500	23.179	
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         108.609           11.0         10.00         16.2         107.28         10000         10000         1000	1.0	0.00	0.0	0		1.000	44.371	
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         100.00         100	2.0	0.50	3.5	23.18		1.500	55.629	
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	3.0	1.00	6.7	44.37		2.000	67.550	
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	4.0	1.50	8.4	55.63		2.500	75.497	
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	5.0	2.00	10.2	67.55		3.000	82.781	
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	6.0	2.50	11.4	75.50	5.51	4.000	92.053	
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               12.0         12.50         16.4         108.61	7.0	3.00	12.5	82.78		5.000	96.026	
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             11.0         10.00         16.4         108.61	8.0	4.00	13.9	92.05		7.500	103.974	
10.0         7.50         15.7         103.97 <b>12.500 108.609</b> 11.0         10.00         16.2         107.28	9.0	5.00	14.5	96.03	4.67	10.000	107.285	
11.0     10.00     16.2     107.28       12.0     12.50     16.4     108.61	10.0	7.50	15.7	103.97		12.500	108.609	
12.0         12.50         16.4         108.61	11.0	10.00	16.2	107.28				
	12.0	12.50	16.4	108.61				










	Evalu	ation of Lique	efaction Pot	ential Ba	sed on SP	r(CRR)		PROJEC	T:- SOIL INVE	STIGATION /	AT NALANDA	UNIVERSIT	Y SITE,RAJ	IGIR , NALAND	A, BIHAR.	
			Ра		1.0	Kg/cm2										
Depth Of Water Table Assumed (m) Below EGL			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	Hydrostat ic 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 Ko =(1- Co*Ln(o' v0))as per Eq 12 P39 <=1.0	Cn(Overbur den/normali zation) =(1/EStress) power m as per Eq 19P40	N1- 60(Normali zation Factor diamension less) 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/14.1a s 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

		PROJEC	CT:- SOIL INVE	STIGATION AT NAL	ANDA UNIVE	ERSITY SITE ,	RAJGIR , NALAN	NDA, 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	Liquetaction 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+5.1 33) 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*(ex p(-M/4))- 0.058 as per eq 8a P36	Cyclic Stress Ration Under Earthquake CSR m7.5=0.65*(σv 0/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





















# REPORT ON SOIL RESISTIVITY MEASUREMENT AT M/S. NALANDA UNIVERSITY,BIHAR.

AUDIT CONSULTANT	CUSTOMER
M/S. JEF TECHNO SOLUTIONS PVT. LTD. #07, 13 <sup>TH</sup> CROSS, 30 <sup>TH</sup> MAIN, CT BED EXTENSION, BANASHANKARI 2 <sup>ND</sup> STAGE, PADMANABHA NAGAR BANGALORE-560070.	M/S.NALANDA UNIVERSITY RAJGIR, DISTRICT NALANDA, PIN 803116, BIHAR.
<b>PREPARED BY:</b> 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:**

SL.NO.	STA	TUS	DATE	REMARKS
1	REV-0	DRAFT	28/03/2018	INITIAL SUBMISSION
2	REV-1	FINAL	29/03/2018	SITE PICS & DIRECTION DETAILS ADDED
3				
4				

Report Generated on 29<sup>th</sup> March 2018.

#### SITE DETAILS:

Client Name	M/S. Nalanda University,Bihar.
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Audit Engineers	Mr. Siddhant Das Mob: +91 7999069685 Email: siddhant@jeftechno.com



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 27<sup>th</sup> 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.



**Nālandā** UNIVERSITY



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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	<b>EF</b> 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 ' $\rho$ ' in the terms of the length units in which 'a' and 'b' are measured is



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

$$\rho = 2\pi a R$$

then gives the apparent soil resistivity to the depth '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										
		Measured R	Resistance (Ω)	Calculated R						
Sl. No	Probe spacing (m)	Direction 1 (N-S)	Direction 2 (W-E)	Direction 1 (N-S)	Direction 2 (W-E)	Average Resistivity				
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				
Averag	e Soil Resisti	vity direction v	7.66	6.86						

Average Soil Resistivity 7.26 Ohm Meters





LOCATION No: Substation B										
	Probe	Measured R	Resistance (Ω)	Calculated R						
SI. No	spacing	Direction 1	Direction 2	Direction 1	Direction 2	Resistivity				
	(m)	(SE-NW)	(SW-NE)	(SE-NW)	(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 Resisti	ivity direction	wise(Ωm)	10.25	8.61					
	Average Soil Resistivity 9.43 Ohm Meters									





LOCATION No: Substation C										
	Probe	Measured F	Resistance (Ω)	Calculated R	Average					
SI. No	spacing (m)	Direction 1 (W-E)	Direction 2 (S-N)	Direction 1 (W-E)	Direction 2 (S-N)	Resistivity				
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				
Averag	ge Soil Resisti	vity direction w	vise(Ωm)	16.74	16.60					
		Average Soil I	Resistivity 16.67	7 Ohm Meters						



#### EARTH ASSESSMENT REPORT



Average Soil Resistivity 6.63 Ohm Meters





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LOCATION No: Substation E										
	Probe	Measured R	lesistance (Ω)	Calculated R	Average					
SI. No	spacing (m)	Direction 1 (S-N)	Direction 2 (W-E)	Direction 1 (S-N)	Direction 2 (W-E)	Resistivity				
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										
		Measured F	Resistance (Ω)	Calculated R						
SI. No	Probe spacing (m)	Direction 1 (S-N)	Direction 2 (E-W)	Direction 1 (S-N)	Direction 2 (E-W)	Average Resistivity				
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				
Averag	ge Soil Resisti	vity direction v	wise(Ωm)	9.47	7.78					

Average Soil Resistivity 8.62 Ohm Meters





	LOCATION No: Substation G									
		Measured F	Resistance (Ω)	Calculated R						
SI. No	Probe spacing (m)	Direction 1 (E-W)	Direction 2 (N-S)	Direction 1 (E-W)	Direction 2 (N-S)	Average Resistivity				
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	0.87 7.72		7.96				
4	2	0.51	0.43	6.41	5.40	5.90				
5	2.5	0.42	0.41	0.43         6.59         6.		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				
Averag	e Soil Resisti	vity direction	wise(Ωm)	8.87	8.44					
		Average Soil I	Resistivity 8.65	Ohm Meters						





LOCATION No: Substation H									
		Measured R	Resistance (Ω)	Calculated R					
Sl. No	Probe spacing (m)	Direction 1 Direction 2 (S-N) (E-W)		Direction 1 (S-N)	Direction 2 (E-W)	Average Resistivity			
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			
Averag	e Soil Resisti	vity direction	wise(Ωm)	9.49	9.46				
		Average Soil	Resistivity 9.4	8 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. <u>SITE PHOTOGRAPH:</u>





















#### **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 <u>Soil Resistivity test</u> work at M/s. <u>Nalanda</u> University Campus & Site Reigir Reference PO: <u>NU/MAIN CAMPUS 12017 - 18/21215</u> Dated: 13/03/18 **Details of Work** As per the PO, following site activities are completed:-Soil Resistivity has been carried out at 8 location within campus 1. 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 Das



# **11.ANNEXURE-1: CALIBRATION CERTIFICATE**

## Equipment Name: MEGGER DET4TC2 Serial No: 101281799



BELTRONICS CALIBRATION LAB

# 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

## 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 : Diaital Farth Resistance Tester

Make	:	Megger	Recieved on :	14 September 2017
Model	:	DET4TC2	Condition on Receipt :	Satisfactory
SI.No		101281799	Cal Procedure :	BCL/CAL/313
ID.No	:		Calibrated At :	ET Lab

Standards Used

	A CONTRACTOR OF A			
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
71	ne Standards Used o	ire traceable	L National Stand	lande

\* 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

 $\begin{aligned}
 \rho_{u}^{a} \mathcal{C}_{u}^{A} & M \\
 Name & Designation$ 

Devika M /Cal Engineer



AUTHORISED SIGNATORY
An A
Name & Designation
A.Anantha Swamy / CEO



# **BELTRONICS CALIBRATION LAB**

Cal Certificate No :	2479 04	Page No:	2 of 2
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**Calibration** Results

#### Resistance measurement setting : 4P

SI No	Parameter	Range	STE Inpu	) t	DUC R	Reading	Error Claimed(±)	Error Observed	((±)	Measurem Uncertaint	ient y (±)
1		20.0	5	Ω	4.93	Ω	0.13	-0.07	Ω	0.008	Ω
2	20	2012	10		9.93		0.23	-0.07		0.010	
3		200.0	50		49.9		1.3 .	-0.1		0.065	
4	<u> </u>	200 12	100		100.0		2.3	0.0		0.083	
5	Resistance	240	500		500		13	0		0.649	
6	<i>w</i>	2 KS2	1000		1002		23	2		831.316	
7		20.10	5	kΩ	4.99	kΩ	0.13	-0.01	kΩ	0.006	kΩ
8		20 812	10		10.01		0.23	0.01		0.008	

#### Resistance measurement setting : V clamp & I clamp

Nomenclature :	Vclamp	I clamp
Make :	Megger	Megger
Model :		'un datas na'
SI No :	101308275	101311793

SI No	Parameter	Range	STE Inpu	) t	DUC Re	eading	Error Claimed(±)	Error Observed	1(±)	Measuren Uncertaint	nent y (±)
9			0.90	Ω	0.89	Ω	0.09	-0.01	Ω	0.008	Ω
10	Resistance	<i>199</i> Ω	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



**Nālandā** UNIVERSITY
