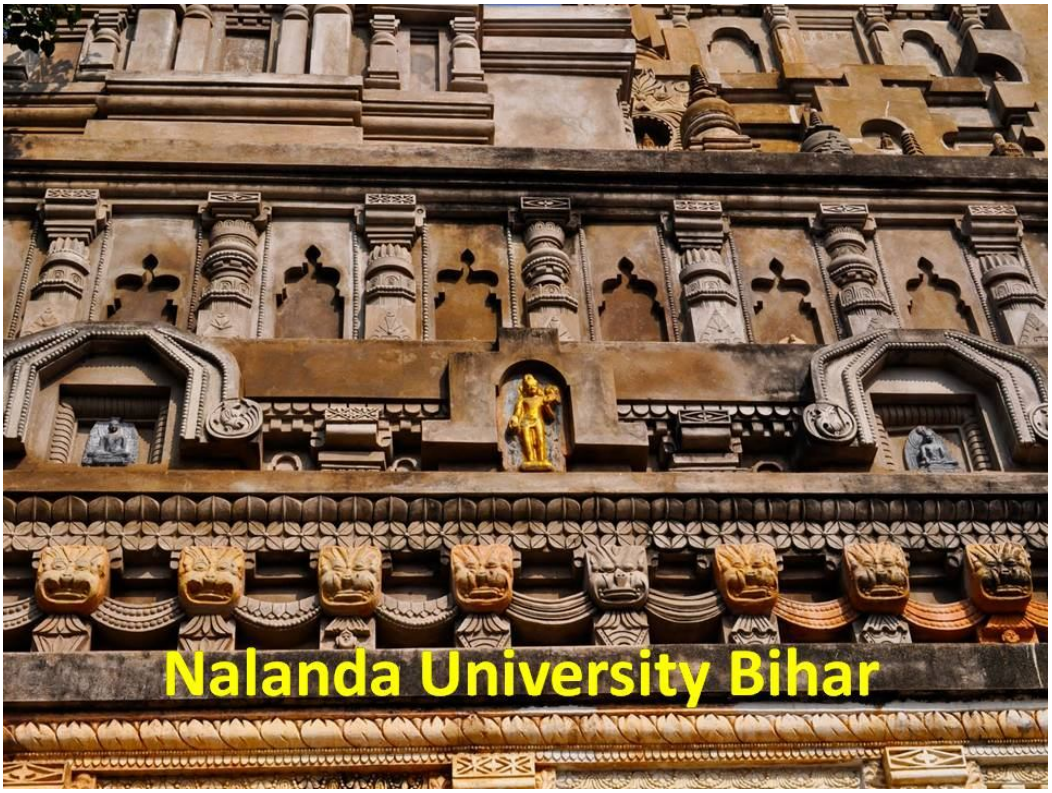
# NALANDA UNIVERSITY

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




## *SUBMISSION: -*
## *GEOTECHNICAL INVESTIGATION REPORT*

**TO**

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**(ADMINISTARTINON)**
**ON BEHALF OF VICE CHANCELLOR,**
**NALANDA UNIVERSITY**
**1ST FLOOR , INDIAN CONGRESS BUILDING**
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**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.**

# 1.0 INTRODUCTION

The Consultant (Administration) **Nalanda University** has proposed to construct New University building at Rajgir , Dist. Nalanda, Bihar . To design an appropriate, efficient and cost effective buildings , the generation of data of general geotechnical parameters viz sub soil profile consisting of physical characteristics such as atterbergs limits, Grain Size analysis, field moisture contents, Bulk and Dry unit weight, specific gravity, CBR Values , Chemical Properties and safe bearing capacity, for the preparation of Bore logs and other information along with ground water table from Existing Ground Level Considered essential.

In view to the above The Consultant (Administration) Nalanda University proposed to conduct a detailed geotechnical investigations (Field and Laboratory test) for the proposed development of entire area and entrusted the work of geotechnical investigations to **M/S Allied Engineers, Space No 77, LSC LU Block Pitam Pura DELHI - 110034**.

The Report presented here in deals with the field and laboratory investigation carried out to assess the nature of sub-soil strata and to evaluate such soil parameters as may be required for the development of the proposed site. The work of soil investigation was entrusted to M/s ALLIED ENGINEERS, New Delhi, by the Consultant (Administration) Nalanda University vides his office order No:-NU/39/12-13 Dated 18th September 2012.The soil investigation work was taken up during September – October 2012.

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**1.1:-LOCATION OF SITE :-**

The site was investigated for the purpose of overall development of university (i.e. Construction of buildings, roads etc) and to revive historical heritage of original Nalanda University at Rajgir , District Nalnda, Bihar. The "SITE" is Situated at a close distance from the Rajgir Town . The project site is located in a region comprising of alluvial soil deposits within shallow depth . At present the ground appeared to be a fairly leveled.

**1.2 GEOLOGY OF THE REGION IN BRIEF**

Nalnda-Rajgir metasedimentary belt is situated in parts of Munger, Nalanda and Gaya districts of Bihar. The mega-fold structure of the Rajgir belt and occurrence of several hot springs in the vicinity has attracted geologists from the time when geological mapping of the Indian subcontinent was still in its nascent stages. However, in the latest Geological map of India published by the Geological Survey of India (1998, 7th Edn.), the Munger-Rajgir metasediments have been depicted as probable time equivalent with the lower Vindhyans. These have experienced mild metamorphism and overall lithology and structure do not exactly conform to the nature of the Vindhyan sequence. The sequence is situated in the northwest of the Rajgir fold belt near Bathani village of Gaya district. Occurrence of such volcano-sedimentary sequence was hitherto not reported from the Munger Rajgir metasedimentary belt and provides a new perspective to the understanding of the litho-stratigraphic set-up of the area. Geological Setting. The most prominent geological feature in the study area is the NE-SW-trending Rajgir fold belt comprising alternate quartzite and phyllite unit. According to Srivastava and Sen Gupta (1967) this fold belt comprises two distinct quartzite bands interbedded with phyllites, whereas Thiagarajan and Banerjee (1967) and Sarkar and Basu Mallick (1979) contend that the Rajgir fold belt comprises a quartzite unit bounded by upper and lower phyllite units. These metasedimentary units have been intruded in the northern part by granite and basic rocks at places (Sarkar and Basu Mallick, 1979).The quartzite unit displays very -preserved primary sedimentary structures such as stratification, cross-bedding,ripple marks, mud cracks and convolute-bedding.

The phyllite unit is gradational as as in sharp contact with quartzite. The phyllite is essentially thinly laminated and shows variegated colour and of ferruginous nature. The alternate quartzite and phyllite units of the Rajgir fold belt have preserved clear evidences of two phases of deformation. The first phase of folding (F1) has given rise to the regional fold structure with closure at Giriak in NE and the dominant NE-SW-trending bedding parallel schistosity. The litho-units of volcano-sedimentary sequence of the study area have been classified into three divisions: (i) mafic volcanics, comprising pillow basalt and mafic pyroclasts (ii) acid volcanics,comprising rhyolite and (iii) volcanosedimentary sequence comprising tuff, banded chert and banded iron formation (BIF).

## 1.3 OBJECT OF INVESTIGATION:

In order to establish the infrastructural development in the entire university campus , the following data would be required: The soil profile down to probable depth of the proposed Structures indicating thicknesses of various soil strata. Classification of soils and physical characteristics of the sub-soil strata. Engineering properties of sub-soil at various depths. Location of ground water table depth below the ground surface. Quality of ground water vis-à-vis the standard norms. To obtain and evaluate the above information and parameters, both, field investigation as well as laboratory tests on soil and water samples have been analyzed to provide preliminary recommendations for the selection of sites for the proposed construction of Structures .

## 2.0 SCOPE OF INVESTIGATION:-

The Scope of the present soil investigation at the proposed site for the construction of Structures was decided by the Engineer – in charge to achieve the afore said objectives of the present investigation progarmme . The scope of the study included the following:-

Advancing 100/150 mm dia bore holes up to specified depths below the ground level at locations decided by Engineer-in-Charge.

Obtaining disturbed (D/S) undisturbed (UDS) soil samples at appropriate interval as per BIS specifications up to 6.0 m to 9.0 m depth .

Observing water table depth in all the bore holes after 24 hours of their completion.

Collecting water sample from the boreholes and to perform necessary chemical tests on them to assess the quality of ground water .

Conducting Grain-Size analysis on soil samples to determine co-efficient of uniformity and co-efficient of curvature of soil sample and to plot the resulting Grain Size distribution curves.

Performing the laboratory permeability test on undisturbed samples obtained from boreholes to find out the coefficient of permeability of the sub-soil strata at various levels.

Performing plate load test at 20 Nos location on 30.0 cm X 30.0 cm plate at 1.5 m depth or above water table which ever encounters earlier.

Performing laboratory CBR test at 20 Nos location as decided by Engineer in charge.

Performing Liquefaction analysis based sub soil parameter obtained from the bore holes.

Finally, the scope included preparation and submission of technical report containing the analysis and results of the characteristics and properties of the sub-soil strata of the proposed Structures site in 3-copies.

## 3.0 FIELD INVESTIGATION:-

### 3.1 DRILING BOREHOLES:-

Drilling of borehole is generally achieved by using auger. Helical auger is generally found more efficient in advancing boreholes. However, the augers can be used where the bore is dry and the soil has strength to stand of its own. It has been experienced that boreholes to be drilled in sandy stratum under submerged conditions generally cave-in / collapse. The alternative method in the above said site conditions is to advance the borehole by lowering casing pipe and using bailer to excavate and remove the soil from the borehole. Casing pipe when penetrates to greater depths below the water level in a sandy stratum, a phenomena named as "boiling of sand" comes into play. To over come this, water level within the casing pipe has to be maintained to be level slightly above the ground water table level. Yet another method to a stabilizing boreholes by using bentonite mud solution is implied too frequently. However, the present investigation programme did not allow the use of bentonite mud as the scope of work included to collect undisturbed samples for determining its co-efficient of permeability. The down ward movement of bailer gives upward moment of soil due to which the soil in the bottom of the borehole is filled up in the bailer. The bailer is then taken out and soil is again excavated and collected with the similar process and the borehole is advanced or cleaned.

### 3.2 SOIL SAMPLING:-

The undisturbed soil samples (UDS) were collected from the boreholes at every 3 m. vertical interval in all the boreholes as shown in the soil profile sheets (Bore log sheet 1 to 10). The UDS were collected by attaching thin-walled Shelby tubes having an area ratio of 8% to 'A' rods and driving it into the natural soil for 45 cm. depth. This method of collecting UDS was found workable for retrieving samples from shallow depths. However, sampling failed at greater depths below the water table by way of slippage of samples from the Shelby tubes . In this situation , thin walled piston sampler is used to collect the undisturbed soil samples .The sampling was achieved by using 100 mm dia samplers. The soil samples were then extruded from the samplers and were lab tested for determining various characteristics and engineering properties of soil as per the scope of the work.

**3.3 DEPTH OF WATER TABLE:**

The water table below the general ground level is measured in all the boreholes. The water table in any borehole is measured after 24 hours of its completion. The ground water table level equilibrates and stabilizes itself in the said intervening period. The observations from the boreholes at **"SITE"** indicated the presence of water table at an average depth of about 2.0 mtrs to 2.75 m below the existing general ground level. However the ground water level was measured at existing ground during monsoon season after heavy rainfall and certain part of site was waterlogged for very long period.

# 4.0 LABORATORY TESTS:-

**4.1Grain Size Analysis.**

An analysis of this kind express quantitatively the proportions by mass of the sizes of particles present in the soil. In a soil mass , the gravel, sand , silt and clay fraction are recognized as containing particles of decreasing magnitude. The analysis is covered under Indian standard : 2720 (part-4) – 1985, method of test for soils, "Grain Size Analysis". The results of grain size analysis may also be represented graphically in the form of a grain size distribution curve in which the cumulative percentages finer than known equivalent grain size plotted against these sizes, the latter being on a logarithmic scale. The results of grain size analysis are widely used in soil classification. The data obtained from grain size distribution curves is used to deal with a wide range of civil engineering problems.

Two methods are used for finding the distribution of grain sizes larger than 75-micron IS Sieve; the first method, wet sieving, shall be applicable to all soils and the second, dry sieving, shall be applicable only to soils which do not have an appreciable amount of clay. For the determination of distribution of grain sizes smaller than 75-miron, the pipette method or the hydrometer method is used.

**4.1.1SIEVE ANALYSIS OF SOIL PASSING 4.75 mm IS SIEVE AND RETAINED ON 75-MICRON IS SIEVE.**

**Analysis by wet sieving –** the portion of soil passing 4.75 mm IS sieve shall be oven-dried at 105 to $110^0$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.

b)

(b) **From the mass of the hydrometer**:-

The hydrometer shall be weighed to the nearest 0.1 g . The mass in grams shall be recorded as the volume of the hydrometer in millimeters. This includes the volume of bulb plus , the volume of the stem below the 1000 graduation mark . For practical purposes , error due to the inclusion of this stem may be neglected.

**Calibration :**

The sectional area of the 1000 ml measuring cylinder in which the hydrometer is to be used shall be determined by measuring the distance between two graduations. The sectional area (A) is equal to the volume included between the two graduations divided by the measured distance in centimeters between them. The distance from the lowest calibration mark on the stem of the hydrometer to each of the other major calibration marks (Rh) shall be measured and recorded . The distance from the neck of the bulb to the nearest H corresponding to a reading Rh is the sum of the distances measured as above . The distance from the neck of the bulb to the nearest calibration mark shall be measured and recorded . The distance (H) corresponding to a reading Rh is the sum of the distance measured as above .The distance h from the neck to the bottom of the bulb shall be measured and recorded as the height of the bulb . The distance h/2 locates the centre of volume of asymmetrical bulb .If any asymmetrical bulb is used , the centre of volume can be with sufficient accuracy by projecting the shape of the bulb on to a sheet of paper and locating the centre of gravity of the projected area . The effecting depth (Hr) corresponding to each of the major calibration marks (Rh) shall be calculated from the following formula :

$$H_R = H1 + 1/2[h - Vh/A]$$

Where

Hr= effective depth ;

H1 = length from neck of bulb , to graduation Rh, in cm;

H= twice the length from neck of the bulb to its centre of volume in cm

Vh= Volume of Hydrometer bulb in ml and

A= Area of measuring cylinder in cm2 .

The Factor (Vh/A) in the above equation shall not be applied to hydrometer reading taken after periods of sedimentation of half , one , two and four minutes . The relationships between Hr & Rh may be plotted as a smooth curve which may be used for finding the effective depth (Hr) corresponding to hydrometer reading (Rh) Obtained during test .

**Meniscus Correction:-**

The hydrometer shall be inserted in a 1000 ml measuring cylinder containing about 700 ml water .By replacing the eye slightly below the plane of the surface of the liquid and then raising it slowly until the surface seen as an ellipse becomes a straight line , the point where the plane intersects the hydrometer scale shall be determined . By placing the eye slightly above the plane of surface of the liquid , the point where the upper limit of the meniscus intersects the hydrometer scale shall be determined . The difference between the two readings shall be recorded as the meniscus correction Cm. This is a constant for a given hydrometer.

**Procedure and Pre- treatment of soil :-**

The percentage of soluble salts shall be determined. In case it is more than one percent, the soil shall be washed with water before further treatment, taking care to see the soil particles are not lost. Two samples each of mass 50 to 100 g approximately shall be obtained by riffling from the air dried sample passing the 4.75 mm IS Sieve. The actual amount of soil required will vary according to the type of soil, 50 g with a clay and 100 g with a sand soil. The moisture content (w) of one sample shall be determined by the method given in IS: 2720 (part-2) 1973. The other sample shall be accurately weighed (**W**a) to the nearest 0.01 g and placed in the wide mouth conical flask 150 ml of Hydrogen peroxide shall then be added and the mixture stirred gently with a glass rod for a few minutes after which it shall be covered with a cover glass and left to stand over night . The mixture in the conical flask shall be gently heated. Care shall be taken to avoid frothing over and the contents of the dish shall be periodically stirred. As soon as vigorous frothing has subsided, the volume shall be reduced to about 50 ml by boiling. With organic soils, additional peroxide may be required to complete the oxidation.

In the case of soil containing calcium compounds the mixture shall be allowed to cool and about 50 ml of hydrochloric acid added. The solution shall be stirred with a glass rod for a few minutes and allowed to stand for one hour or for longer periods, if necessary. If the soil contains a considerable amount of calcium salts, more acid may be required. When the treatment is complete, the solution shall have an acid reaction litmus. In the case of soils containing no calcium compounds of soluble salts and having a low organic content (less than 2 per cent), the pretreatment prescribed may be omitted and the dispersing agent shall be added direct to the soil taken for analysis.

The mixture shall than be filtered and washed with warm water until the filtrate shows no acid reaction to litmus. The damp soil on the filter paper and funnel shall be transferred without any loss what so ever to the evaporating dish (weighed to 0.01 g) using a jet of distilled water. Only the minimum quantity of distilled water shall be used. The dish and contents shall be placed in an oven and dried at 110° C. The dish and contents shall than be weighed to 0.01 g. and allowed to cool. They shall than be weighed to 0.01 g. and the mass of soil remaining after pre-treatment shall be recorded (**W**b).

**Dispersion of soil:**

To the soil in the evaporating dish, 100 ml of sodium hexametaphosphate solution shall be added and the mixture shall then be warmed gently for about 10 minutes and then transferred to the cup of the mechanical mixer using a jet of distilled water to wash all traces of soil out of the evaporation dish. The amount of water used may be about 150 ml. The soil Suspension shall then be stirred for 15 minutes. The suspension shall then be transferred to the 75 micron IS Sieve placed on a receiver and the soil shall be washed on this sieve using a jet of distilled water from a wash bottle. Particular care shall be taken to wash off all traces of suspension adhering to the dispersion cup. The amount of distilled water during this operation may be about 500 ml. The suspension that has passed through the sieve shall be transferred to the 1000 ml measuring cylinder and made up to exactly 1000 ml with distilled water. This suspension shall then be used for the sedimentation analysis. The material retained on the 75 micron IS Sieve may be over dried and analyzed and the cumulative percentages of the soil fraction retained on each sieve shall be calculated.

**Sedimentation**:

(a) A rubber bung shall be inserted in the mouth of the measuring cylinder which shall then be shaken vigorously and mouth of the measuring cylinder which shall then be shaken vigorously and finally be inverted end over end. Immediately the shaking has ceased, the measuring cylinder shall be allowed to stand and the stop watch started. The hydrometer shall be immersed to a depth slightly below its floating position and then allowed to float freely. Hydrometer readings shall be taken after periods of half, one, two and four minutes.

(b) The hydrometer shall then be removed slowly, rinsed in distilled water and kept in a cylinder of distilled water at the same temperature as the soil suspension.

(c) The hydrometer shall be re-inserted in the suspension and readings taken after periods of 8, 15 and 30 minutes, one, two and four hours after shaking. The hydrometer shall be removed, rinsed and placed in the distilled water after each reading. After 4 hours, hydrometer readings shall be taken once or twice within 24 hours, the exact periods of sedimentation being noted. Finally a reading may be taken at the end of 24 hours. In taking all reading, insertion and withdrawal of the hydrometer before and after taking a reading shall be done carefully to avoid disturbing the suspension unnecessarily. Ten seconds shall be allowed for each operation. Vibration of the sample shall be avoided. Other suitable time intervals may be used, provided they give nearly equally spaced points on the grain size distribution curve.

(d) The temperature of the suspension shall be observed and recorded once during the first 15 minutes and then after every subsequent reading. The temperature shall be read with an accuracy of least $\pm$0.5 C. Hydrometer readings shall also be taken in pure distilled water at the corresponding temperatures and the temperature correction (**M**t) calculated as the difference between this reading and the reading corresponding to the density of water at the calibration temperatures. A chart of such corrections for all temperatures may also be prepared for ready use. The temperature of the suspension over the period of the test should not differ from the mean temperature by more than $\pm$ 20°C in order not to cause an error in the particle size of more than 2 percent. This requirement will generally be fulfilled if the maximum difference in room temperature is not greater than about 8°C. If the variation in temperature is likely to be greater than this, the constant temperature bath should be used.

(e) The correction (x) to be applied for the dispersing agent shall be ascertained by placing exactly 50 ml of the sodium hexametaphosphate solution in a previously weighed glass weighing bottle and after evaporating the water by drying at 105 to 110° C in an oven, the mass of dispersing agent (Wd) shall be calculated.

The dispersing agent correction (X) shall then be calculated from the formula:

$$X = 2\ Wd$$

This correction is independent of the temperature. Alternatively, the correction may be obtained directly by making up a 1000 ml cylinder full of distilled water containing the same

proportion of dispersing agent and at the same temperature, and placing the hydrometer in this solution. The corrected zero reading may then be read directly, this correction shall be corrected for temperature.

**Calculations**

**Loss in mass in pre-treatment.** The loss in mass in pre-treatment of the soil shall be calculated using the formula as given below:

$$P = 100 - \frac{Wb\,(100+W)}{Wa}$$

**Sieving –**

The percent of soil sample passing each of the sieves used in the analysis shall be calculated using the mass of the pre-treated soil and as percentage of the total soil sample taken for analysis.

**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

X = dispersion agent correction

The values shall be calculated for all the values of D obtained and shall be expressed as percentage of finer than the corresponding value of D . These percentage shall than be expressed as combined percentages of the total soil sample taken for analysis.

## 4.2 DETERMINATION OF PERMEABILTY:

The knowledge of the permeability is essential in the solution of many engineering problems involving flow of water through soils such as:

(a) De watering and drainage of Excavations, back fills & sub grades ;

(b) Determining yield of water bearing strata ;

(c) Assessing seepage through the body of earth dams; and

(d) Computing losses from canals.

The constant head and falling head tests are used for most of the soil for determination of their permeability in the laboratory and covered under Indian Standard : 2720 (Part-17) 1986- Methods of test for Soils , " Laboratory Determination of permeability ". The tests are recommended for soils with coefficient of permeability in the range $10^{-3}$ to $10^{-7}$ cm/sec and maximum particle size of 9.5 mm.

### 4.2.1 PREPARATION OF TEST SPECIMEN:-

**Undisturbed Soil Sample :**

For testing undisturbed soils, undisturbed specimen shall be trimmed in the form a cylinder not larger than about 85 mm in diameter and having a height equal to that of the mould . The specimen shall be placed centrally over the porous disc of the drainage base fixed to the mould. The annular space between the mould and the specimen shall be filled with an impervious materials such as cement slurry, or a mixture of 10 percent dry powdered bentonite and 90 percent fine sand by weight to provide sealing between the soil specimen and the mould against leakage from the sides. When using the cement slurry, the mould shall be kept on a flat surface other than the porous disc .The mixture shall be compacted using a small tamping rod. The drainage cap shall then be fixed over the top of the mould.

**Saturation:**

In the case of soils of medium to high permeability, the specimen shall be subjected to sufficient head , flow or immersion so as to obtain full saturation . Soils of low permeability require flow under a high head for periods ranging from a day to a week depending upon the permeability and the head . Alternatively, in the case of soils of low permeability , the specimen shall be subjected to a gradually increasing vacuum with bottom outlet closed so as to remove to form the soils voids. The vacuum shall be increased to at least 70 cm of mercury which shall be maintained for 15 minutes or more depending upon the soil type . The evacuation shall be followed by a very slow saturation of the specimen with de-aired water from the bottom upwards under full vacuum. When the specimen is saturated, both the top and bottom outlets shall be closed.

### 4.2.2 CONSTANT HEAD TEST :-

For a constant head arrangement, the specimen shall be connected through the top inlet to the constant head water reservoir. The Bottom outlet shall be opened and when the steady state of flow has been established, the quantity of flow for a convenient time interval shall be collected and weighed or measured . Alternatively , the inlet may be at the bottom and water may be collected from the outlet at the top . The collection of the quantity of flow for the same time interval shall be repeated thrice.

The Linearity (of Darcy's Law ) between the hydraulic gradient and the average velocity of flow for the soil under test should be established by performing the test over a range of hydraulic gradient. The hydraulic gradients in the permeability test should preferably include the hydraulic gradients likely to occur in the field and deviation from linearity observed should be noted .

**Record of Observation:**

The inside diameter and the height of the permeability are measured and recorded as diameter D and length L of the specimen . The heights H1 and H2 are measured to determine the head loss H . The temperature of water T is also measured and recorded

During the test , observations are made of volume of water , Q collected in a graduated jar in time t and are recorded . For the propose of getting a quantitative description of the state of the sample , after the test, the weight of wet soil specimen Wt is measured and recorded . Its dry weight Ws is measured after drying for 24 hours The water content, w is computed and noted . From the knowledge of the specific gravity Gs of specimen and water content W , void ratio e0 and degree of saturation S are determined.

**Calculations**

The permeability Kr at temperature T is calculated as:

Kr =Q/(Ait)

K27= KrX ( ήr )/y*i*r

In which

K27 = permeability at $27^0$ C ,

ήr = coefficient of viscosity at $T^0$ C

ή27 = coefficient of viscosity at 27 C

Q=Quantity in cm3

A = area of specimen in cm 2

I = hydraulic gradient , and

T= time in seconds

### 4.2.3.FALLING HEAD TEST

For a falling head test arrangement, the specimen shall be connected through the top inlet to selected stand-pipe . The bottom outlet shall be opened and the time interval required for the water level to fall from a known initial head to a known final head as measured above the centre of out let shall be recorded. The Stand pipe shall be refilled with water and the repeated till three successive observations give nearly same time interval; the time intervals being recorded for the drop in head from the same initial to final values, as in the first determination. Alternatively, after selecting the suitable initial and final heads h1 and h2 respectively, the time intervals shall be noted for the head to fall from h1 to (h1- h2)1/2 and similarly form (h1- h2)1/2 to h2. The time intervals should be the same; otherwise the observations shall be repeated after refilling the stand – pipe.

**Record of observation**

The dimensions of specimen, length L and diameter D, are measured and recorded. Area a of stand pipe is recorded. The temperature T, of water is also measured and recorded . during the test, observation are made of initial time t1 final time t2 , initial head h1 , final head h2 In stand pipe and are recorded . h1/h2 and log 10 (h1./ h2 ) are calculated .

At the end of the test , the weight of soil specimen Wt is measured and recorded . Its dry weight Ws is measured after drying for 24 hours . The water content , w is computed and noted . From the knowledge of the specific gravity Gs of specimen and water content w , void ratio e and degree of saturation S are determined

**Calculations :**

At temperature T water, the permeability Kt is calculated as :

$Kt = 2.303[ a L/A\{tf-t i \}] \text{ Log } 10 (h1/h2)$

And the permeability at 27 0 C is given by $K27 = Kt ( \gamma t/\gamma 27)$

## 4.3LIQUID LIMIT, PLASTIC LIMIT & PLASTICITY INDEX

### 4.3.1 CONCEPT:

The behavior of all the soils and specially clays considerable differs with the presence of water. A clayey soil depending upon its water content may be almost like a liquid, or it may be quite hard too. The liquid and plastic limits of soils are dependent on the amount and type of clay in a soil. This also makes the basis for the soil classification system for cohesive soil.

Liquid Limit is the water content at which the soil has such a small shear strength that it flows to close a groove of standard width when jarred in a specified manner.

Plastic Limit is the water content at which the soil begins to crumble when rolled into threads of specified size. Liquid limit is the boundary between liquid and plastic states of soil.

Plasticity Index is the amount of water, which must be added to change a soil from its plasticity of the soil. The plasticity is measured by the 'plasticity index', which is equal to the liquid limit minus the plastic limit.

TEST PROCEDURE:

### 4.3.2 Liquid Limit

The test is conduct following the procedure as laid down in I.S: 2720 (part-5)-1985. About 100g of soil specimen passing through 425-micron sieve is mixed thoroughly with distilled water in the evaporating dish to form a homogeneous and uniform paste. A portion of the paste is placed in the cup of the liquid limit device. Fill the mix so as to have a maximum depth of 1 cm. draw the grooving tool through the sample along the symmetrical axis of the cup. Now, rotate the handle at the rate of about 2 revolutions per second and the numbers of bellows are counted till the two halves of the soil sample come into contact at the bottom of the grooves for a length of about 12 mm. Taking about 10 gm of soil from near the closed groove determine its water content by oven dying method. By evaporating and scarifying reduce the water content of the soil then repeat the foregoing operation and obtain at least 5 reading in the rage of 20-35 blows. The liquid limit is determined by plotting the graph on the semi-logarithmic graph between the number of blows as abscissa on a logarithmic scale and the corresponding water content as ordinate on simple linear scale. Generally these points lie in a straight line. The water content corresponding to 25 blows is taken as the value of liquid limit of the soil.

### 4.3.3 Plastic limit

About 15 gm of oven dried soil specimen passing through 425 micron sieve is taken and mixed thoroughly with distilled water until the soil mass becomes plastic enough to be easily moulded

into a ball with fingers. Take a portion of the ball and roll it on a glass palm of the hand to form the soil mass into a thread of uniform diameter throughout its length. Take care that diameter should be around 3 mm. when a diameter of 3 mm is reached, the soil is remoulded again into a. ball. This process of rolling and remoulding is repeated until the thread starts just crumbling at a diameter of 3 mm. The crumbling threads are kept for water content determination. Repeat the test with 2 more samples. The plastic limit is then taken as the average of the three water content values.

3.3.5 Plasticity Index

The plasticity index may be calculated as the difference of liquid and plastic limit. Thus, plasticity index (Ip)

Ip = WL - WP

## 4.40 LABORATIRY CBR TEST:

### 4.4.1 CONCEPT:

The CBR test is an adhoc penetration test development by the California state Highway Department of U.S.A. for the evaluations of sub-grade strengths for roads and pavements. One of the chief advantages of CBR method is the simplicity of the test procedure. Based on extensive CBR test data collected on pavements, which behaved satisfactorily, and those, which failed, an empirical design chart was developed correlating the CBR value and the pavement thickness. The basis of the design chart is that a material with a given CBR requires a certain thickness of pavement layer as a cover. A higher load needs a thicker pavement layer to protect the sub-grade. Design curves correlating the CBR value with total pavement thickness cover were developed by the California State Highway Department for wheel loads of 3175 kg, 4080 kg and 5450 kg representing light, medium and heavy traffic respectively. The CBR test can be performed in the laboratory as well as in the field. Since it is difficult to control the field variables precisely and also that the field testing requires heavy equipment and considerable time in creating worst moisture content conditions and penetration testing, it is generally recommended to opt for a laboratory CBR test. The laboratory CBR test can be performed either on undisturbed soil specimens obtained from the field or on the remoulded soil compacted in the laboratory either statically or dynamically. In static method of compaction there is a possibility of the actual density varying with the depth though the mean density may be the one desired. It is extremely difficult to obtain an undisturbed specimen of sandy or cohesionless soil deposit. Remoulded specimen, however, are used for almost all types of soils ranging from clay to gravel. Firstly the dry density of the remoulded sample shall be determined. It can either be field density or the maximum dry density determined by compaction test. The test can be conducted at any other density also if CBR is to be determined at a particular density. The water content used for compaction should be the optimum water content or the field moisture content as the case may be. The standards as laid down in I.S: 2720 (Part-16)-1979 are followed for laboratory of CBR-value.

### 4.4.2 TEST PROCEDURE:

Dynamic Compaction (for Remoulded Specimen) Weight the mould with base plate and collar. Keep the spacer disc on the base plate and a filter paper over the disc. Fix the mould to the base plate, with the disc inside the mould. Compact the wet soil in the mould using either light or heavy compaction.

For heavy compaction, compact the soil in 5 layers by giving 56 blows by 4.9 kg rammer to each layer. Remove the collar and trim off the excess soil in level with the top of the mould. Detach the base plate and remove spacer disc also. Determine the dry density of sample. Place the filter paper on the perforated base plate. Fix the mould upside down to the base plate so that surface of the specimen which was downwards in content with spacer disc during compaction is now turned upwards on which the penetration test is to be performed. The specimen is now ready for soaking or penetration test. Soaking of specimen may then be started by weighing the mould with base plate and the specimen. Keep the filter paper on the specimen and place the perforated top plate with adjustable stem over the specimen. Keep the mould in the tank in which water will be filled for soaking. Apply a surcharge in multiples of 2.5 kg (each 2.5 kg mass is equivalent to 70 mm of construction) equivalent to the expected pavement thickness over the material of which CBR is being determined. The minimum surcharge should be 5 kg. Now fill the water in the tank to immerse the mould, test specimen and surcharge masses, allowing free access of water to top and bottom of specimen. At the end of soaking, take out the mould and allow it to drain downwards for minutes. Remove the surcharge masses, the perforated top plate and the filter paper. Weigh the specimen to know the mass of water absorbed.

The mould containing the test specimen and the surcharge masses, sufficient to produce an intensity of loading equal to the weight of the base material and pavement (in the field) is placed on the lower plate of the testing machine. To prevent upheaval of soil into the hole of the surcharge weights, a 2.5 kg annular mass is placed on the soil surface prior is seating the penetration plunger after which the reminder of kept under a load of about 4 kg so that full contact is ensured. The stress and strain dial gauges are set to initial zero reading. Load is applied to the penetration plunger at the rate of 1.25 mm per minute. The load is recorded at penetration 0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 6.0, 7.0, 8.0, 9.0 & 10.0 mm. About 50-100 g of soil is taken immediately below the plunger for water content determination after the plunger is released.

The load penetration curve is generally convex upwards, although the initial portion of the curve may be concave upwards due to surface irregularities. A correction shall then be applied by drawing a tangent to the upper curve at the point of contra flexure. The corrected curve shall be taken to be this tangent plus the convex portion of the original curve with the original curve with the origin of strains shifted to the point where the tangent cuts the horizontal strain axis. Thus the penetration of plunger shall be read from this shifted zero point instead of original zero. Accordingly the corrected load shall be read corresponding to this penetration value.

**AEs**

Corrected load value shall be taken from the load penetration curve corresponding to the penetration value at which CBR is desired. The CBR is then determined as follows. CBR is reported to the nearest one percent.

CBR = (Pt / Ps) x 100

Where, Pt = Corrected test load corresponding to the chosen penetration from the load penetration curve, and

Ps = Standard load for the same depth of penetration.

# 5.0TEST RESULTS AND INTERPRETATIONS

The general description about " SITE" for proposed Structures has been presented in bore hole lay out plan . In all, 20 Nos boreholes each of 100-150 mm dia up to 6.0 m to 9.0 m depth were drilled as per the instruction of Engineer In-charge. These were designated as BH-1 to BH-20. Undisturbed Soil samples were collected at a regular vertical interval of 3 m from each boreholes. Although some of the samples were lost due to slippage as the sampling in sands under submerged condition is difficult. Water samples from bore hole were also colleted from different depths . The depth of water table in each boreholes was also measured upon their completion. Standard Penetration Test has also been conducted at 1.5 m interval as per IS 2131-1981 up to 9.0 m depth for assessment of safe /allowable bearing capacity.

### 5.1 LOCATION AND DEPTH OF BOREHOLE:

A Total of 20 boreholes (BH 1 to BH- 20) were excavated as per location and pattern shown in the bore hole lay out plan of the report. The bore holes 1 to 20 were drilled to different termination depth of 6.0 m to 9.0 m as per the exploration programs and directions of the Engineer-in – Charge .

### 5.2 RESULT OF GRAIN SIZE ANALYSIS :

In order to determine various sizes of particles and their respective proportions present in the soil samples obtained from the field bore holes, wet sieves analysis were performed .As the fractions finer than 75 μ were found in large quantity , the hydrometer analysis was required . The results of the grain size analysis have been presented in Grain Size Distribution curves .The results on the sieve analysis in the from of proportions of Gravels , Sand , Silts, Clays and also their gradation i.e Coefficient of Uniformity and Coefficient of Curvature have been worked out from the curves and presented in soil profile sheets .

5.3 **SOIL CLASSIFICATION:** The sub soil strata in the bore holes mainly consists of silty clay of low to intermediate plasticity (classified as CL/CI). There is poorly graded silty sandy soil (classified as SP-SM) in certain bore holes at 3.5m-4.0 m to 6.0m-8.0m depth .The sub soil is well graded within 4.0 m depth in almost all the bore holes .The strata beyond 4.0 m depth is also well graded in most of the bore holes but there is thin layers of poorly graded sandy strata in certain bore holes.

5.4 **RESULT OF STANDARD PENETRATION TEST:** The SPT N values in top layers are very poor. The N values ranges from 5 to 7 within 3.0 m depth. However it enhances up to 14 to 25 at 3.0 m to 9.0 m depth. The sub soil is termed as loose strata in top layers where as it is medium dense in deeper strata.

5.5 **GROUND WATER TABLE:-** The ground water table in the bore hole is observed at 2.0 m to 3.0 m depth below EGL. This ground water table will definitely rise up to existing ground level during heavy rains in the monsoon season. During our field investigation , the site was partly waterlogged for considerable period in the month of September & October 2012.

5.6 **LIQUEFACTION ANALYSIS :-**

In view of well graded sub soil system up to 3.0 m-4.0 m depth and poorly graded fine sandy strata (classified as SP-SM) under submerged condition beyond 3.0 m-4.0 m depth , it is observed that vibrations caused by earthquake may cause liquefaction or excessive total and differential settlements. as per IS 1893-2000. Under these circumstances , it is appropriate to adopt pile foundation instead of shallow footing .

The liquefaction analysis based on co-relations presented by I.M. Idriss and R.W.Boulangar (Department of civil & Environment Engg) University of California Davis CA95616-5924 has also been carried out using SPT N values and particle sizes within the influence zone of foundation. It is found that the sub soil strata is not liquefiable for earthquake moment magnitude of 7.0 and ground acceleration of 0.12g. However if higher values of earthquake moment magnitude and ground acceleration is considered , the strata becomes liquefiable in spite of well graded silty clayey soil .

# 6.0 PLATE LOAD TEST

## Plate Load Test:-

The Plate load test is performed as per IS-1888 –1982. The test has been conducted at natural sub soil at a depth of 1.5 m below EGL.using 30.0cmX30.0cm plate as per scope of work .

The scope of work was limited to mobilize necessary equipment and personnel at the site. Conducting 20 Nos plate load test on 30.0 cm square plate at specified depth below existing ground level ( i.e. at footing level) at the location decided by Engineer- in- Charge.

### 6.2FIELD INVESTIGATION:-

The plate load test was performed as per IS 1888-1982 and co- relation suggested as per clause 0.1to 5.3. The plate size used are 30.0 cm square and test pit of 5 times of the plate size at the foundation level ( i.e. Pit size 1.50m X1.50m) The final settlement of the plate is recorded as per clause 4.7.

### 6.3SUB SOIL CONDITION:-

The sub soil at the foundation level is semi saturated silty clayey strata at PLT -1 to PLT 20 .

### 6.4 ASSUMPTIONS :-

The settlement at the footing depth has been observed from the test results as per relevant co-relation using depth correction factor . The probable settlement of actual footing size of 1.0 m to 2.0 m for shallow footing has been deduced using clause 5.3 of the code . It is assumed that the sub soil condition within influence zone of plate is same as at test level The permissible settlement of 50.0 mm is considered for shallow footing .

### 6.5 Limitations:-

The plate bearing test does not incorporates consolidation settlement because of its short duration. However the sub soil condition at site is compressible There is large difference between influence zone of plate size and actual foundation hence extrapolation of plate results requires larger safety factors. Ground Water table effect on settlement of plate during the test is also ignored . .

## 6.6TEST RESULT:-

The plate load results are plotted on graphical form as pressure intensity vs settlement of plate load test. The failure point is read by plotting the load settlement values on LOG- LOG scale as per IS 1888-1962. In indefinable cases the failure is assumed at an settlement of 10% of the plate size as suggested by some author. Although LOG- LOG plot of load settlement curves gives a clear demarcation of elastic and plastic zone. In our case the settlement of sub soil fro actual footing is deduced by extrapolating the plate settlement. The ultimate bearing capacity of actual footing is considered as bearing pressure corresponding to 50.0 mm settlement. The factor of Safety in ultimate and safe load capacity is assumed as 3.0.

# CHAPTER 7

# RECOMMENDATIONS

Based on field investigation, laboratory test results, and analysis presented above, net bearing pressure values for shallow footing and raft foundation is analyzed and presented below. In view of very high water table and loose sub soil in top layers, the under reamed pile foundation for the proposed structures is also analyzed and recommended .

However shallow footing (i.e. isolated square footing/continuous strip footing / raft foundation) may be laid at the depth of 1.5 m below EGL with size ranging 1.0 m to 3.0 m (shallow footing) and 10.0 m to 20.0 m ( raft foundation) for light weight structure depending upon static load coming at footing level.

In view of very large site , the entire area is sub divided in to 5 groups . The Safe /allowable bearing capacity is analyzed for each group separately and submitted as per following .

## 7.1 ALLOWABLE BEARING CAPACITY :-

The allowable bearing capacity shall be lower of the values as obtained from above two consideration (i.e. shear failure criteria or settlement consideration ) as per following table.

| PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR. | | | |
|---|---|---|---|
| ALLOWABLE BEARING PRESSURE(LOWEROF THETWO CONSIDERATION) | | | |
| DEPTH OF FOOTING Below EGL (m) | SIZE OF FOOTING (m) | ALLOWABLE BEARING PRESSURE (T/M2) | |
| BH-1,2,3 | | (CONTINUOUS STRIP FOOTING ) (T/M2) | (ISOLATED SQUARE FOOTING ) (T/M2) |
| 1.50 | 1.00 | 6.30 | 6.30 |
| 1.50 | 2.00 | 5.58 | 5.58 |
| 1.50 | 3.00 | 4.81 | 4.81 |
| BH-4,5,6,15,16,17 | | | |
| 1.50 | 1.00 | 5.25 | 5.25 |
| 1.50 | 2.00 | 5.83 | 5.83 |
| 1.50 | 3.00 | 5.20 | 5.20 |
| BH-7,8,13,14 | | | |
| 1.50 | 1.00 | 6.13 | 6.13 |
| 1.50 | 2.00 | 5.43 | 5.43 |
| 1.50 | 3.00 | 4.72 | 4.72 |
| BH-9,10,11,12 | | | |
| 1.50 | 1.00 | 5.88 | 5.88 |
| 1.50 | 2.00 | 5.53 | 5.53 |

| | | | |
|---|---|---|---|
| 1.50 | 3.00 | 4.78 | 4.78 |
| **BH-18,19,20** | | | |
| 1.50 | 1.00 | 5.25 | 5.25 |
| 1.50 | 2.00 | 5.43 | 5.43 |
| 1.50 | 3.00 | 4.71 | 4.71 |
| | | **RAFT FOUNDATION (T/M2)** | |
| 1.50 | 10.0 M x20.0M | 6.99 | |
| 1.50 | 15.0 M x30.0M | 6.79 | |
| 1.50 | 20.0 M x40.0M | 6.72 | |

**7.2:-SINGLE UNDER REAMED PILE FOUNDATIONS.:-**

The Load carrying Capacity of under reamed pile has been worked out as per IS 2911(Part III)-1980 Appendix B Clauses 5.2.3.3 & 5.2.5, B.1.1 to B.1.7 Table -1 considering submerged condition of sub soil strata and SPT N values ranging as 2 or more for clayey soil .

The effective length of pile has been considered below the cut – off – level. The cutt of level of pile has been considered at 1.0 m below existing G.L. considering pile cap, grade beam etc.

Single under reamed pile foundation having stem dia. equal to 30.0cm to 50.0 cm of lengths 3.5 m to 12.0 m has been analyzed. The value of safe load carrying capacities of pile based on soil properties in compression & uplift as per IS 2911 (Part III)1980 has been tabulated below.

**Load Carrying Capacity of Single Under Reamed Pile Foundation . (PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.)**

| Stem dia (cm.) | Bulb diaOf pile (cm) | Cutt of Level Of Pile below GL(m.) | Length of pile Below Cutt of Level(m.) | Safe load carrying capacity of single Under reamed pile | | |
|---|---|---|---|---|---|---|
| | | | | In compression (T) | In uplift (T) | Lateral Thrust (T.) |
| 30.0 | 75.0 | 1.0 | 3.5 | 9.0 | 4.5 | 2.0 |
| 37.5 | 93.8 | 1.0 | 3.5 | 13.5 | 6.8 | 3.0 |
| 40.0 | 100.0 | 1.0 | 3.5 | 15.8 | 7.9 | 3.4 |
| 45.0 | 112.5 | 1.0 | 3.5 | 19.7 | 9.8 | 4.0 |
| 50.0 | 125.0 | 1.0 | 3.5 | 23.6 | 11.8 | 4.5 |
| | | | | | | |
| 30.0 | 75.0 | 1.0 | 5.0 | 12.9 | 7.5 | 2.0 |
| 37.5 | 93.8 | 1.0 | 5.0 | 18.6 | 10.5 | 3.0 |
| 40.0 | 100.0 | 1.0 | 5.0 | 21.1 | 12.0 | 3.4 |
| 45.0 | 112.5 | 1.0 | 5.0 | 25.7 | 14.3 | 4.0 |
| 50.0 | 125.0 | 1.0 | 5.0 | 30.4 | 16.9 | 4.5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 30.0 | 75.0 | 1.0 | 6.0 | 15.6 | 9.4 | 2.0 |
| 37.5 | 93.8 | 1.0 | 6.0 | 21.9 | 13.1 | 3.0 |
| 40.0 | 100.0 | 1.0 | 6.0 | 24.7 | 14.7 | 3.4 |
| 45.0 | 112.5 | 1.0 | 6.0 | 29.8 | 17.3 | 4.0 |
| 50.0 | 125.0 | 1.0 | 6.0 | 34.9 | 20.3 | 4.5 |
| | | | | | | |
| 30.0 | 75.0 | 1.0 | 7.0 | 18.2 | 11.4 | 2.0 |
| 37.5 | 93.8 | 1.0 | 7.0 | 25.3 | 15.6 | 3.0 |
| 40.0 | 100.0 | 1.0 | 7.0 | 28.2 | 17.4 | 3.4 |
| 45.0 | 112.5 | 1.0 | 7.0 | 33.8 | 20.3 | 4.0 |
| 50.0 | 125.0 | 1.0 | 7.0 | 39.4 | 23.6 | 4.5 |
| | | | | | | |
| 30.0 | 75.0 | 1.0 | 8.0 | 20.8 | 13.4 | 2.0 |
| 37.5 | 93.8 | 1.0 | 8.0 | 28.7 | 18.1 | 3.0 |
| 40.0 | 100.0 | 1.0 | 8.0 | 31.8 | 20.1 | 3.4 |
| 45.0 | 112.5 | 1.0 | 8.0 | 37.8 | 23.3 | 4.0 |
| 50.0 | 125.0 | 1.0 | 8.0 | 43.9 | 27.0 | 4.5 |
| | | | | | | |
| 30.0 | 75.0 | 1.0 | 9.0 | 23.4 | 15.3 | 2.0 |
| 37.5 | 93.8 | 1.0 | 9.0 | 32.1 | 20.7 | 3.0 |
| 40.0 | 100.0 | 1.0 | 9.0 | 35.3 | 22.8 | 3.4 |
| 45.0 | 112.5 | 1.0 | 9.0 | 41.9 | 26.3 | 4.0 |
| 50.0 | 125.0 | 1.0 | 9.0 | 48.4 | 30.4 | 4.5 |
| | | | | | | |
| 30.0 | 75.0 | 1.0 | 10.0 | 26.1 | 17.3 | 2.0 |
| 37.5 | 93.8 | 1.0 | 10.0 | 35.4 | 23.2 | 3.0 |
| 40.0 | 100.0 | 1.0 | 10.0 | 38.9 | 25.5 | 3.4 |
| 45.0 | 112.5 | 1.0 | 10.0 | 45.9 | 29.3 | 4.0 |
| 50.0 | 125.0 | 1.0 | 10.0 | 52.9 | 33.8 | 4.5 |
| | | | | | | |
| 30.0 | 75.0 | 1.0 | 11.0 | 28.7 | 19.3 | 2.0 |
| 37.5 | 93.8 | 1.0 | 11.0 | 38.8 | 25.7 | 3.0 |
| 40.0 | 100.0 | 1.0 | 11.0 | 42.5 | 28.3 | 3.4 |
| 45.0 | 112.5 | 1.0 | 11.0 | 49.9 | 32.3 | 4.0 |
| 50.0 | 125.0 | 1.0 | 11.0 | 57.4 | 37.1 | 4.5 |
| | | | | | | |
| 30.0 | 75.0 | 1.0 | 12.0 | 31.3 | 21.2 | 2.0 |
| 37.5 | 93.8 | 1.0 | 12.0 | 42.2 | 28.3 | 3.0 |
| 40.0 | 100.0 | 1.0 | 12.0 | 46.0 | 31.0 | 3.4 |
| 45.0 | 112.5 | 1.0 | 12.0 | 54.0 | 35.3 | 4.0 |
| 50.0 | 125.0 | 1.0 | 12.0 | 61.9 | 40.5 | 4.5 |

**SUGGESSTIONS :-**

**Note :-1.0** The safe load carrying capacity of piles have been worked out on the basis of IS: 2911 part – III – 1980 as per the assumptions and specification. The safe loads obtained above are only an assessment based on soil characteristics obtained from the test locations. Accordingly,as per IS specification & as per clause 5.3.1.2. of IS 2911(Part III) - 1980 for the final design / construction of foundations, the safe / allowable load carrying capacity of these piles should be taken by conducting actual initial load tests on these piles casted in representative area.

**2.0** The piles should have necessary structural strength to transmit / sustain the design loads.

**3.0** The safe load capacity of piles in up lift will be limited to the structural capacity of the piles in tension due to uplift if the same is lower .

**4.0** In view of High water table (Available at Existing ground ) , strict quality control has to be ensured during casting of pile under water.

**7.3:- MODULUS OF SUBGRADE REACTION :-**

Based on field investigation and correction as per I.S 1888-1892 and 9214-1979 clause 5.1.1to 5.1.4 , the value of modulus of sub grade reaction of plate **('K'=0.60 Kg/cm3 )** may be considered as design values .The modulus of sub grade reaction has been deduced from the plate load test results conducted at various locations inside the vast campus .The required observation and calculation sheet is enclosed .

**7.4 CHEMICAL ANALYSIS OF SOIL & WATER:-**

20 number water and soil samples has been collected from the bore holes at different depths and examined for chemical content . The test results are tabulated as per following. The analysis of sub soil & water sample shows that there is no aggressive chemical present in the sub soil system .

The water sample taken for chemical testing consists of shallow aquifer . During actual execution of work , the water sample may be drawn from the different aquifer (i.e. from very deep level ) . Such water sample may be re-examined for chemical content and decision regarding use of water may be taken as per the actual test results .

**CHEMICAL ANALYSIS OF WATER SAMPLE,**
**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.**

| SL NO | LOCATION (BH No) | DEPTH (M) | ACCEPTING CRITERIA AS PER IS 456-2000. | pH VALUES | ALKALINITY TO NEUTRALISE 100 ML OF WATER | ACIDITY TO NEUTRALISE 100 ML OF WATER | TOTAL SOLIDS IN MG/L | Chloride MG/L | SULPHATE MG/L | TOTAL ORGANIC MATTER IN MG/L |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | >6 | 0-25 ML OF 0.02N H2SO4 | 0-5 ML OF 0.02 N NaOH | 3000 MG/L | 500 MG/L | 400 MG/L | 200 MG/L |
| 1.0 | BH-1 | 4.50 | | 7.37 | 32.3 | 1.70 | 500.00 | 9.00 | 102.00 | 151.00 |
| 2.0 | BH-2 | 6.00 | | 7.30 | 31.6 | 1.82 | 520.00 | 9.12 | 106.00 | 158.00 |
| 3.0 | BH-3 | 4.50 | | 7.31 | 31.5 | 1.78 | 525.00 | 9.06 | 110.00 | 162.00 |
| 4.0 | BH-4 | 3.00 | | 8.05 | 32.1 | 1.75 | 541.00 | 9.14 | 112.00 | 160.00 |
| 5.0 | BH-5 | 1.50 | | 7.89 | 33.6 | 1.76 | 539.00 | 9.23 | 116.00 | 159.00 |
| 6.0 | BH-6 | 3.00 | | 7.64 | 32.8 | 1.81 | 537.00 | 9.20 | 119.00 | 172.00 |
| 7.0 | BH-7 | 4.50 | | 7.82 | 32.7 | 1.86 | 530.00 | 9.40 | 108.00 | 155.00 |
| 8.0 | BH-8 | 6.00 | | 7.96 | 31.9 | 1.89 | 535.00 | 9.52 | 113.00 | 179.00 |
| 9.0 | BH-9 | 3.00 | | 7.66 | 32.4 | 1.77 | 529.00 | 9.48 | 117.00 | 176.00 |
| 10.0 | BH-10 | 1.50 | | 7.92 | 33.6 | 1.72 | 524.00 | 9.16 | 108.00 | 182.00 |
| 11.0 | BH-11 | 6.00 | | 8.02 | 33.5 | 1.83 | 528.00 | 9.23 | 112.00 | 189.00 |
| 12.0 | BH-12 | 3.00 | | 8.63 | 32.7 | 1.74 | 515.00 | 9.41 | 104.00 | 164.00 |
| 13.0 | BH-13 | 4.50 | | 8.79 | 32.5 | 1.79 | 519.00 | 9.53 | 113.00 | 173.00 |
| 14.0 | BH-14 | 1.50 | | 8.14 | 32.4 | 1.73 | 523.00 | 9.49 | 107.00 | 170.00 |
| 15.0 | BH-15 | 3.00 | | 8.33 | 31.8 | 1.76 | 516.00 | 9.27 | 110.00 | 179.00 |
| 16.0 | BH-16 | 6.00 | | 7.94 | 32.4 | 1.79 | 517.00 | 9.33 | 104.00 | 182.00 |
| 17.0 | BH-17 | 3.00 | | 7.63 | 32.6 | 1.84 | 531.00 | 9.18 | 106.00 | 175.00 |
| 18.0 | BH -18 | 4.50 | | 8.34 | 33.4 | 1.85 | 527.00 | 9.34 | 102.00 | 181.00 |
| 19.0 | BH -19 | 3.00 | | 8.19 | 33.6 | 1.88 | 522.00 | 9.36 | 107.00 | 169.00 |
| 20.0 | BH -20 | 6.00 | | 7.95 | 33.5 | 1.83 | 534.00 | 9.27 | 112.00 | 174.00 |

| SOIL CHEMICAL TEST RESULT ,<br>PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR. | | | | | |
|---|---|---|---|---|---|
| **SL NO** | **LOCATIONS BH NO** | **Depth of Sample Below EGL(m)** | **PERMISSIBLE LIMIT** | | |
| | | | **Chloride as CL % by Mass (Volhards Method)** | **Sulphate as SO4% by Mass (Gravimetric)** | **pH as Per IS 2720Pt 26** |
| | | | <0.05% | <0.04% | >6.0 |
| 1.0 | BH-1 | 1.50 | 0.020 | 0.014 | 7.20 |
| 2.0 | BH-2 | 3.00 | 0.023 | 0.019 | 7.40 |
| 3.0 | BH-3 | 4.50 | 0.029 | 0.021 | 7.80 |
| 4.0 | BH-4 | 6.00 | 0.031 | 0.012 | 7.49 |
| 5.0 | BH-5 | 1.50 | 0.038 | 0.015 | 7.50 |
| 6.0 | BH-6 | 3.00 | 0.042 | 0.018 | 7.82 |
| 7.0 | BH-7 | 1.50 | 0.029 | 0.020 | 7.65 |
| 8.0 | BH-8 | 7.50 | 0.034 | 0.022 | 8.12 |
| 9.0 | BH-9 | 6.00 | 0.039 | 0.024 | 7.82 |
| 10.0 | BH-10 | 3.00 | 0.022 | 0.026 | 7.24 |
| 11.0 | BH-11 | 4.50 | 0.032 | 0.025 | 8.25 |
| 12.0 | BH-12 | 1.50 | 0.039 | 0.017 | 7.39 |
| 13.0 | BH-13 | 3.00 | 0.035 | 0.016 | 7.41 |
| 14.0 | BH-14 | 4.50 | 0.036 | 0.027 | 8.45 |
| 15.0 | BH-15 | 6.00 | 0.041 | 0.023 | 8.25 |
| 16.0 | BH-16 | 7.50 | 0.042 | 0.026 | 7.95 |
| 17.0 | BH-17 | 6.00 | 0.045 | 0.023 | 7.55 |
| 18.0 | BH-18 | 3.00 | 0.043 | 0.022 | 7.65 |
| 19.0 | BH-19 | 4.50 | 0.045 | 0.021 | 7.42 |
| 20.0 | BH-20 | 6.00 | 0.040 | 0.027 | 7.25 |

## 7.5 CBR TEST RESULTS:-

Based on laboratory investigation on the samples procured from site, and analysis on various test results, the detailed results are summarized as per following .

| PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR . | | | | |
|---|---|---|---|---|
| SUMMARY OF CBR TEST RESULTS | | | | |
| **S. NO/ LOCATION NO** | **DRY DENSITY (MDD) GM/CM$^3$** | **NATURAL MOISTURE CONTENT (NMC) %** | **OPTIMUM MOISTURE CONTENT (OMC) %** | **CALIFORNIA BEARING RATIO (CBR) %** |
| **1** | 1.895 | 18.97 | 24.32 | 5.56 |
| **2** | 1.856 | 19.01 | 23.04 | 5.27 |
| **3** | 1.850 | 19.06 | 23.11 | 5.32 |
| **4** | 1.842 | 18.62 | 23.10 | 4.93 |
| **5** | 1.849 | 19.23 | 23.14 | 5.22 |
| **6** | 1.862 | 19.21 | 24.33 | 5.37 |
| **7** | 1.819 | 18.65 | 24.33 | 5.17 |
| **8** | 1.816 | 18.75 | 24.02 | 5.28 |
| **9** | 1.826 | 19.68 | 24.36 | 5.46 |
| **10** | 1.811 | 19.36 | 24.66 | 4.93 |
| **11** | 1.820 | 20.01 | 23.58 | 5.08 |
| **12** | 1.836 | 19.76 | 23.65 | 5.41 |
| **13** | 1.842 | 18.44 | 23.01 | 5.22 |
| **14** | 1.864 | 18.61 | 23.85 | 5.33 |
| **15** | 1.822 | 18.42 | 22.64 | 5.17 |
| **16** | 1.878 | 18.99 | 24.06 | 5.51 |
| **17** | 1.821 | 19.12 | 24.16 | 4.93 |
| **18** | 1.833 | 19.24 | 24.05 | 5.33 |
| **19** | 1.823 | 19.43 | 24.22 | 5.12 |
| **20** | 1.864 | 19.20 | 23.16 | 5.51 |

## 7.6 PERMEABILITY TEST RESULTS:-

The permeability test has been carried out on selected UDS samples obtained from the bore holes and the detailed results are summarized as per following .

| PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR | | | | | |
|---|---|---|---|---|---|
| S. No | BORE HOLE NO | Permeability Test Result (Depth Below EGL) | | | |
| | | 2.0 m | 4.0 m | 6.0 m | 8.0 m |
| 1 | 1.0 | $2.55x10^{-8}$ cm/sec | $3.18x10^{-8}$ cm/sec | $3.28x10^{-4}$ cm/sec | - |
| 2 | 6.0 | $2.43x10^{-8}$ cm/sec | $3.16x10^{-8}$ cm/sec | $3.45x10^{-8}$ cm/sec | $3.23x10^{-8}$ cm/sec |
| 3 | 10.0 | $2.39x10^{-8}$ cm/sec | $3.17x10^{-8}$ cm/sec | $3.41x10^{-8}$ cm/sec | $3.51x10^{-8}$ cm/sec |
| 4 | 12.0 | $2.25x10^{-8}$ cm/sec | $3.24x10^{-8}$ cm/sec | $3.48x10^{-8}$ cm/sec | $3.56x10^{-8}$ cm/sec |
| 5 | 19.0 | $2.47x10^{-8}$ cm/sec | $3.15x10^{-8}$ cm/sec | $4.32x10^{-4}$ cm/sec | - |

**7.7 EXPANSIVENESS OF THE SUB SOIL SYSTEM: -** The sub soil strata contains liquid limit and plastic limit ranging from 32 to 36 and 20 to 22 respectively. The plasticity index ranges from 12 to 15.The free swell index ranges from 32 to 42.

As per IS 1498-1970 Table-8, the liquid limit less that 50, plasticity index less than 12 and free swell less than 50 , the degree of expansiveness is low and non critical. Therefore it is concluded that the sub soil strata does not contains high proportion of montmorillonite minerals beyond the permissible limit.

The above recommendations are based on the field data collected from the various limited test locations and result of laboratory test carried out on the soil sample recovered from test bore holes. In case the proposed structure are located away from the tests location and/ or the actual subsoil conditions varied during the excavation for various foundation and found to be different from what has been reported above, the consultants are to be referred for further advice prior to taking up to actual construction work at site.

**Consulting Engineer**

**(R.S. Kesharwani )**

**M.Tech. (Soil)**

**ALLIED ENGINEERS**

**JOB NO. M-11/2012-13/1598** SOIL PROFILE

**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**

**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR**

WATER TABLE **2.00 (M)**

LOCATION **BH-1**

**SHEET NO 1**

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS | | | | HYDROM ANALY | ATTERBERGS' LIMITS | | | | DENSITY gm / cm³ | | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%) / SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL | | CONSOLIDATION PARAMETER | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | GRAVEL | COARSE | MEDIUM | FINE | SILTY+ CLAY % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | BULK DENSITY | DRY DENSITY | | | | | COHESION (C) (KG/CM²) | FRICTION ANGLE (Ø) | VOID RATIO | COMPRESSION INDEX | |
| GL | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | Brownish colour Inorganic Silty Clay Highly Plasticity (CL) | 8 | 11 | 1 | 3 | 4 | 7 | 85 | 34.20 | 20.40 | 13.80 | | | | | | | | 0.03 | 28.0 | DST | | |
| **UDS** | **2.00** | | | | | 1 | 3 | 6 | 9 | 81 | 34.26 | 20.49 | 13.77 | | 1.89 | 1.58 | 19.57 | 2.68 | 32.5 | | 0.65 | 8.0 | 0.70 | 0.143 | |
| SPT | 3.00 | | | 13 | 16 | 1 | 2 | 5 | 7 | 85 | 34.22 | 20.45 | 13.75 | | | | | | | | | | | | |
| SPT | 4.50 | | | 28 | 25 | 1 | 3 | 4 | 63 | 29 | | | | | | | | | | | | | | | |
| **UDS** | **5.00** | | | | | 1 | 2 | 3 | 62 | 32 | **REMOULDED UDS** | | | | 1.76 | 1.58 | 11.26 | 2.65 | | | 0.00 | DST 30.50 | 0.68 | | |
| SPT | 6.00 | | Light Grayish Colour Inorganic Silty Sand (SM) | 29 | 25 | 1 | 3 | 4 | 65 | 28 | | | | | | | | | | | | | | | |
| | 6.50 | | | | | | | | | | | | | | | | | | | | | | | | |

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

**ALLIED ENGINEERS**

**JOB NO. M-11/2012-13/1598** SOIL PROFILE

**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**

**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR**

WATER TABLE **2.25 (M)**

LOCATION **BH-2**

**SHEET NO 2**

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS GRAVEL | COARSE | MEDIUM | FINE | HYDROM ANALY SILTY+ CLAY % | ATTERBERGS' LIMITS LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | DENSITY gm / cm³ BULK DENSITY | DRY DENSITY | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%)/ SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL COHESION (C) (KG/CM²) | FRICTION ANGLE (Ø) | CONSOLIDATION PARAMETER VOID RATIO | COMPRESSION INDEX | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GL | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | | 6 | 8 | 1 | 2 | 5 | 8 | 84 | 33.40 | 20.60 | 12.80 | | | | | | | | | | | | |
| | | | Highly Plasticity Inorganic Silty Clay (CL) | | | | | | | | | | | | | | | | | | 0.05 | 29.5 | DST | | |
| **UDS** | **2.00** | | | | | 0 | 2 | 5 | 8 | 85 | 33.89 | 20.69 | 13.20 | | 1.90 | 1.54 | 23.01 | 2.67 | 38.5 | | 0.74 | 9.5 | 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** | | | | | 1 | 2 | 2 | 67 | 28 | REMOULDED UDS | | | | 1.79 | 1.61 | 10.98 | 2.65 | | | 0.00 | 31.0 | 0.64 | | |
| | | | Mix with graval Inorganic Silty Sand (SM) | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 6.00 | | | 30 | 26 | 3 | 2 | 1 | 65 | 29 | | | | | | | | | | | | | | | |
| | 6.50 | | | | | | | | | | | | | | | | | | | | | | | | |

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## *ALLIED ENGINEERS*

***JOB NO. M-11/2012-13/1598***

SOIL PROFILE

**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**

**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR -NALANDA BIHAR**

WATER TABLE **2.00 (M)**

LOCATION **BH-3**

**SHEET NO 3**

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS | | | | HYDROM ANALY | ATTERBERGS' LIMITS | | | | DENSITY gm / cm³ | | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%)/ SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL | | CONSOLIDATION PARAMETER | | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | GRAVEL | COARSE | MEDIUM | FINE | SILTY+CLAY % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | BULK DENSITY | DRY DENSITY | | | | | COHESION (C) (KG/CM²) | FRICTION ANGLE (Ø) | VOID RATIO | COMPRESSION INDEX | |
| GL | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | | 6 | 8 | 1 | 3 | 4 | 8 | 84 | 33.00 | 20.60 | 12.40 | | | | | | | | 0.03 | 27.5 | DST | | |
| **UDS** | **2.00** | | | | | 1 | 2 | 4 | 9 | 84 | 34.02 | 20.69 | 13.33 | | 1.91 | 1.58 | 21.01 | 2.67 | 35.5 | | 1.18 | 8.50 | 0.69 | 0.132 | |
| SPT | 3.00 | | Drak brownish Colour Highly Plasticity Inorganic Silty Clay (CL) | 9 | 12 | 1 | 3 | 5 | 7 | 84 | 34.20 | 20.50 | 13.70 | | | | | | | | | | | | |
| SPT | 4.50 | | | 13 | 16 | 1 | 2 | 4 | 9 | 86 | 31.25 | 20.40 | 10.85 | | | | | | | | | | | | |
| **UDS** | **5.00** | | | | | 0 | 1 | 6 | 10 | 83 | 34.19 | 20.04 | 14.15 | | 1.95 | 1.58 | 23.05 | 2.68 | | | 1.24 | 8.00 | 0.69 | 0.096 | |
| SPT | 6.00 | | | 16 | 17 | 1 | 3 | 5 | 8 | 83 | 34.20 | 20.00 | 14.20 | | | | | | | | | | | | |
| SPT | 7.50 | | | 21 | 20 | 2 | 2 | 3 | 63 | 30 | | | | | | | | | | | | | | | |
| **UDS** | **8.00** | | Inorganic Silty Sand (SM) | | | 0 | 2 | 2 | 62 | 34 | **REMOULDED UDS** | | | | 1.80 | 1.60 | 12.62 | 2.65 | | | 0.00 | DST 32.50 | 0.66 | | |
| SPT | 9.00 | | Brownish Colour Highly Plasticity Inorganic Silty Clay (CL) | 25 | 22 | 1 | 3 | 5 | 8 | 83 | 34.00 | 20.35 | 13.65 | | | | | | | | | | | | |
| | 9.50 | | | | | | | | | | | | | | | | | | | | | | | | |

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

**ALLIED ENGINEERS**

**JOB NO. M-11/2012-13/1598**

SOIL PROFILE

**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**

**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR**

WATER TABLE **2.00 (M)**

LOCATION **BH-4**

**SHEET NO 4**

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS GRAVEL | COARSE | MEDIUM | FINE | HYDROM ANALY SILTY+ CLAY % | ATTERBERGS' LIMITS LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | DENSITY gm / cm³ BULK DENSITY | DRY DENSITY | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%)/ SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL COHESION (C) (KG/CM²) | FRICTION ANGLE (ø) | CONSOLIDATION PARAMETER VOID RATIO | COMPRESSION INDEX | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GL | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | | 5 | 7 | 1 | 2 | 5 | 8 | 82 | 35.00 | 20.00 | 15.00 | | | | | | | | | 0.04 | 28.0 | DST | | |
| **UDS** | **2.00** | | | | | 1 | 1 | 5 | 8 | 85 | 35.01 | 20.04 | 14.97 | | 1.88 | 1.57 | 19.86 | 2.68 | 40.0 | | | 0.80 | 9.00 | 0.71 | 0.124 | |
| SPT | 3.00 | | | 7 | 9 | 4 | 3 | 3 | 4 | 86 | 34.00 | 20.20 | 13.80 | | | | | | | | | | | | | |
| SPT | 4.50 | | | 10 | 12 | 1 | 3 | 5 | 8 | 84 | 34.20 | 21.00 | 13.20 | | | | | | | | | | | | | |
| **UDS** | **5.00** | | Highly Plasticity Inorganic Silty Clay (CL) | | | 0 | 2 | 8 | 7 | 83 | 31.16 | 20.12 | 13.04 | | 1.97 | 1.62 | 21.66 | 2.67 | | | | 1.29 | 8.50 | 0.65 | 0.094 | |
| SPT | 6.00 | | | 13 | 15 | 1 | 2 | 7 | 7 | 83 | 33.20 | 20.80 | 12.40 | | | | | | | | | | | | | |
| SPT | 7.50 | | | 17 | 17 | 1 | 2 | 5 | 8 | 84 | 32.00 | 20.90 | 11.10 | | | | | | | | | | | | | |
| **UDS** | **8.00** | | | | | 1 | 1 | 6 | 9 | 83 | 31.76 | 21.03 | 11.73 | | 1.99 | 1.62 | 23.02 | 2.68 | | | | 1.34 | 6.00 | 0.66 | 0.075 | |
| SPT | 9.00 | | | 23 | 20 | 1 | 3 | 7 | 9 | 80 | 31.70 | 21.50 | 10.20 | | | | | | | | | | | | | |
| | 9.50 | | | | | | | | | | | | | | | | | | | | | | | | | |

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

**ALLIED ENGINEERS**

**JOB NO. M-11/2012-13/1598** SOIL PROFILE

**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**

**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR -NALANDA BIHAR**

WATER TABLE **2.50 (M)**

LOCATION **BH-5**

**SHEET NO 5**

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS | | | | HYDROM ANALY | ATTERBERGS' LIMITS | | | | DENSITY gm / cm³ | | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%)/ SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL | | CONSOLIDATION PARAMETER | | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | GRAVEL | COARSE | MEDIUM | FINE | SILTY+ CLAY % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | BULK DENSITY | DRY DENSITY | | | | | COHESION (C) (KG/CM²) | FRICTION ANGLE (ø) | VOID RATIO | COMPRESSION INDEX | |
| GL | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | | 6 | 8 | 1 | 2 | 4 | 8 | 85 | 34.80 | 20.40 | 14.40 | | | | | | | | 0.04 | 29.0 | DST | | |
| **UDS** | **2.00** | | | | | 0 | 2 | 4 | 11 | 83 | 34.86 | 20.47 | 14.39 | | 1.91 | 1.59 | 20.44 | 2.67 | 37.5 | | 1.22 | 8.50 | 0.68 | 0.110 | |
| SPT | 3.00 | | | 10 | 13 | 1 | 3 | 7 | 7 | 82 | 35.70 | 20.30 | 15.40 | | | | | | | | | | | | |
| SPT | 4.50 | | Highly Plasticity 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 | | | | | | | | | | | | | | | | | | | | | | | | |

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| ***ALLIED ENGINEERS*** | **CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR** | **SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR** | WATER TABLE **3.00 (M)** | LOCATION **BH-6** | **SHEET NO 6** |
|---|---|---|---|---|---|
| ***JOB NO. M-11/2012-13/1598*** SOIL PROFILE | | | | | |

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS | | | | HYDROM ANALY | ATTERBERGS' LIMITS | | | | DENSITY gm / cm³ | | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%)/ SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL | | CONSOLIDATION PARAMETER | | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | GRAVEL | COARSE | MEDIUM | FINE | SILTY+ CLAY % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | BULK DENSITY | DRY DENSITY | | | | | COHESION (C) (KG/CM²) | FRICTION ANGLE (Ø) | VOID RATIO | COMPRESSION INDEX | |
| GL | | | | | | | | | | | | | | | | | | | | | | | | | |
| 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 | | | | | | | | | | | | | | | | | | | | | | | | |

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

## *ALLIED ENGINEERS*

***JOB NO. M-11/2012-13/1598*** SOIL PROFILE

**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**

**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR -NALANDA BIHAR**

WATER TABLE **3.00 (M)**

LOCATION **BH-7**

**SHEET NO 7**

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS GRAVEL | COARSE | MEDIUM | FINE | HYDROM ANALY SILTY+CLAY % | ATTERBERGS' LIMITS LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | DENSITY gm/cm³ BULK DENSITY | DRY DENSITY | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%)/ SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL COHESION (C) (KG/CM²) | FRICTION ANGLE (Ø) | CONSOLIDATION PARAMETER VOID RATIO | COMPRESSION INDEX | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GL | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | | 5 | 7 | 1 | 2 | 5 | 8 | 84 | 34.30 | 20.10 | 14.20 | | | | | | | | | 0.05 | 29.5 | DST | | |
| **UDS** | **2.00** | | | | | 1 | 2 | 3 | 10 | 84 | 34.37 | 20.17 | 14.20 | | 1.89 | 1.55 | 21.55 | 2.67 | 42.0 | | | 1.28 | 8.00 | 0.72 | 0.123 | |
| SPT | 3.00 | | | 8 | 10 | 1 | 3 | 5 | 7 | 84 | 34.20 | 20.15 | 14.05 | | | | | | | | | | | | | |
| SPT | 4.50 | | Brownish colour Highly Plasticity Inorganic Silty Clay (CL) | 12 | 15 | 1 | 2 | 6 | 8 | 83 | 31.00 | 21.50 | 9.50 | | | | | | | | | | | | | |
| **UDS** | **5.00** | | | | | 0 | 1 | 4 | 12 | 83 | 33.84 | 20.32 | 13.52 | | 1.97 | 1.59 | 23.67 | 2.68 | | | | 1.35 | 6.50 | 0.68 | 0.097 | |
| SPT | 6.00 | | | 15 | 16 | 1 | 3 | 4 | 9 | 83 | 32.80 | 20.30 | 12.50 | | | | | | | | | | | | | |
| | 6.50 | | | | | | | | | | | | | | | | | | | | | | | | | |

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

**ALLIED ENGINEERS**

**JOB NO. M-11/2012-13/1598**

SOIL PROFILE

**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**

**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR**

WATER TABLE **3.50 (M)**

LOCATION **BH-8**

**SHEET NO 8**

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS | | | | HYDROMETER ANALY | ATTERBERGS' LIMITS | | | | DENSITY gm / cm³ | | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELLINDEX (%)/ SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMETER UCC,TXL | | CONSOLIDATION PARAMETER | | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | GRAVEL | COARSE | MEDIUM | FINE | SILTY+ CLAY % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | BULK DENSITY | DRY DENSITY | | | | | COHESION (C) (KG/CM²) | FRICTION ANGLE (Ø) | VOID RATIO | COMPRESSION INDEX | |
| GL | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | | 6 | 8 | 0 | 2 | 5 | 8 | 85 | 35.50 | 20.50 | 15.00 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | 0.03 | 27.5 | DST | | |
| **UDS** | **2.00** | | Highly Plasticity Inorganic Silty Clay (CL) | | | 1 | 2 | 4 | 9 | 84 | 35.01 | 20.01 | 15.00 | | 1.91 | 1.57 | 21.36 | 2.68 | 30.5 | | 1.19 | 8.50 | 0.70 | 0.133 | |
| SPT | 3.00 | | | 10 | 13 | 1 | 3 | 6 | 7 | 83 | 34.00 | 21.50 | 12.50 | | | | | | | | | | | | |
| SPT | 4.50 | | | 13 | 16 | 3 | 3 | 3 | 2 | 89 | 33.12 | 20.90 | 12.22 | | | | | | | | | | | | |
| **UDS** | **5.00** | | | | | 0 | 2 | 5 | 10 | 83 | 35.10 | 20.04 | 15.06 | | 1.96 | 1.60 | 22.78 | 2.68 | | | 1.34 | 6.50 | 0.68 | 0.090 | |
| SPT | 6.00 | | | 16 | 17 | 1 | 1 | 2 | 61 | 35 | | | | | | | | | | | | | | | |
| SPT | 7.50 | | Inorganic Silty Sand (SM) | 20 | 19 | 2 | 3 | 3 | 62 | 30 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | DST | | | |
| **UDS** | **8.00** | | | | | 1 | 2 | 3 | 62 | 32 | **REMOULDED UDS** | | | | 1.82 | 1.60 | 14.02 | 2.65 | | | 0.00 | 33.50 | 0.66 | | |
| SPT | 9.00 | | Inorganic Silty Clay (CL) | 22 | 20 | 1 | 3 | 4 | 8 | 84 | 35.90 | 20.70 | 15.20 | | | | | | | | | | | | |
| | 9.50 | | | | | | | | | | | | | | | | | | | | | | | | |

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

| ***ALLIED ENGINEERS*** | CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR | SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR -NALANDA BIHAR | WATER TABLE **2.50 (M)** | LOCATION **BH-9** | **SHEET NO 9** |
|---|---|---|---|---|---|
| ***JOB NO. M-11/2012-13/1598*** SOIL PROFILE | | | | | |

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS GRAVEL | COARSE | MEDIUM | FINE | HYDROM ANALY SILTY+ CLAY % | ATTERBERGS' LIMITS LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | DENSITY gm / cm³ BULK DENSITY | DRY DENSITY | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%)/ SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL COHESION (C) (KG/CM²) | FRICTION ANGLE (Ø) | CONSOLIDATION PARAMETER VOID RATIO | COMPRESSION INDEX | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GL | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | | 6 | 8 | 1 | 2 | 5 | 9 | 83 | 33.80 | 20.10 | 13.70 | | | | | | | | | | | | | |
| **UDS** | **2.00** | | | | | 0 | 1 | 7 | 8 | 84 | 34.88 | 20.19 | 14.69 | | 1.94 | 1.59 | 21.94 | 2.68 | 38.0 | | 0.04<br>1.22 | 28.5<br>9.50 | DST<br>0.69 | 0.145 | | |
| SPT | 3.00 | | Drak Brownish colour 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 | | Inorganic Silty Sand (SM) | | | | | | | | | | | | | | | | | | | | | | | |

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

**ALLIED ENGINEERS**

**JOB NO. M-11/2012-13/1598**

**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**

**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR**

WATER TABLE **3.00 (M)**

LOCATION **BH-10**

**SHEET NO 10**

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS GRAVEL | COARSE | MEDIUM | FINE | HYDROM ANALY SILTY+ CLAY % | ATTERBERGS' LIMITS LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | DENSITY gm / cm³ BULK DENSITY | DRY DENSITY | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%)/ SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL COHESION (C) (KG/CM²) | FRICTION ANGLE (ø) | CONSOLIDATION PARAMETER VOID RATIO | COMPRESSION INDEX | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GL | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | | 7 | 10 | 1 | 3 | 5 | 8 | 84 | 34.50 | 20.10 | 14.40 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | 0.03 | 28.0 | DST | | |
| **UDS** | **2.00** | | | | | 0 | 1 | 7 | 6 | 86 | 34.53 | 20.18 | 14.35 | | 1.83 | 1.53 | 19.77 | 2.68 | 35.0 | | 1.27 | 10.00 | 0.75 | 0.126 | |
| SPT | 3.00 | | | 12 | 15 | 1 | 3 | 4 | 7 | 85 | 32.50 | 20.50 | 12.00 | | | | | | | | | | | | |
| SPT | 4.50 | | | 16 | 18 | 1 | 2 | 5 | 8 | 84 | 32.80 | 20.80 | 12.00 | | | | | | | | | | | | |
| **UDS** | **5.00** | | Brownish Colour Highly Plasticity Inorganic Silty Clay (CL) | | | 1 | 2 | 9 | 7 | 81 | 32.00 | 20.51 | 11.49 | | 1.84 | 1.49 | 23.11 | 2.68 | | | 1.31 | 8.00 | 0.79 | 0.110 | |
| SPT | 6.00 | | | 19 | 19 | 1 | 3 | 6 | 8 | 82 | 32.15 | 20.15 | 12.00 | | | | | | | | | | | | |
| SPT | 7.50 | | | 23 | 21 | 1 | 2 | 7 | 7 | 83 | 31.18 | 21.50 | 9.68 | | | | | | | | | | | | |
| **UDS** | **8.00** | | | | | 0 | 1 | 6 | 9 | 84 | 33.86 | 20.31 | 13.55 | | 1.89 | 1.51 | 24.86 | 2.68 | | | 1.42 | 6.50 | 0.77 | 0.092 | |
| SPT | 9.00 | | | 25 | 22 | 1 | 3 | 5 | 8 | 83 | 33.80 | 20.30 | 13.50 | | | | | | | | | | | | |
| | 9.50 | | | | | | | | | | | | | | | | | | | | | | | | |

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

**ALLIED ENGINEERS**

**JOB NO. M-11/2012-13/1598** SOIL PROFILE

**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**

**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR**

WATER TABLE **3.50 (M)**

LOCATION **BH-11**

**SHEET NO 11**

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS GRAVEL | COARSE | MEDIUM | FINE | HYDROM ANALY SILTY+ CLAY % | ATTERBERGS' LIMITS LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | DENSITY gm / cm³ BULK DENSITY | DRY DENSITY | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%)/ SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL COHESION (C) (KG/CM²) | FRICTION ANGLE (ø) | CONSOLIDATION PARAMETER VOID RATIO | COMPRESSION INDEX | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GL | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | | 6 | 8 | 1 | 2 | 4 | 8 | 85 | 34.60 | 20.00 | 14.60 | | | | | | | | 0.03 | 27.5 | DST | | |
| **UDS** | **2.00** | | | | | 0 | 1 | 5 | 9 | 85 | 34.68 | 20.09 | 14.59 | | 1.93 | 1.61 | 20.14 | 2.67 | 33.0 | | 1.19 | 7.50 | 0.66 | 0.142 | |
| SPT | 3.00 | | | 9 | 11 | 1 | 3 | 6 | 7 | 83 | 33.50 | 21.50 | 12.00 | | | | | | | | | | | | |
| SPT | 4.50 | | Brownish Colour Highly Plasticity Inorganic Silty Clay (CL) | 13 | 15 | 1 | 2 | 4 | 9 | 84 | 33.40 | 22.60 | 10.80 | | | | | | | | | | | | |
| **UDS** | **5.00** | | | | | 1 | 2 | 6 | 8 | 83 | 35.16 | 20.04 | 15.12 | | 1.96 | 1.59 | 22.89 | 2.68 | | | 1.26 | 6.50 | 0.68 | 0.110 | |
| SPT | 6.00 | | | 17 | 17 | 1 | 2 | 7 | 8 | 82 | 35.00 | 20.00 | 15.00 | | | | | | | | | | | | |
| | 6.50 | | | | | | | | | | | | | | | | | | | | | | | | |

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

**ALLIED ENGINEERS**

**JOB NO. M-11/2012-13/1598**

SOIL PROFILE

**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**

**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDABIHAR**

WATER TABLE **3.00 (M)**

LOCATION **BH-12**

**SHEET NO 12**

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS GRAVEL | COARSE | MEDIUM | FINE | HYDROM ANALY SILTY+ CLAY % | ATTERBERGS' LIMITS LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | DENSITY gm / cm³ BULK DENSITY | DRY DENSITY | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%)/ SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL COHESION (C) (KG/CM²) | FRICTION ANGLE (ø) | CONSOLIDATION PARAMETER VOID RATIO | COMPRESSION INDEX | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GL | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | | 7 | 9 | 1 | 3 | 5 | 9 | 82 | 33.00 | 20.00 | 13.00 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | 0.04 | 29.0 | DST | | |
| **UDS** | **2.00** | | | | | 1 | 2 | 7 | 9 | 81 | 33.94 | 20.19 | 13.75 | | 1.93 | 1.58 | 21.87 | 2.67 | 34.5 | | 1.17 | 9.50 | 0.69 | 0.132 | |
| SPT | 3.00 | | | 11 | 14 | 1 | 2 | 4 | 7 | 86 | 33.90 | 20.10 | 13.80 | | | | | | | | | | | | |
| SPT | 4.50 | | | 14 | 16 | 1 | 3 | 6 | 8 | 82 | 33.80 | 20.50 | 13.30 | | | | | | | | | | | | |
| **UDS** | **5.00** | | Brownish Colour Highly Plasticity Mix With Kankars Inorganic Silty Clay (CL) | | | 0 | 3 | 6 | 7 | 84 | 34.86 | 20.01 | 14.85 | | 1.97 | 1.60 | 22.98 | 2.68 | | | 1.25 | 8.00 | 0.67 | 0.100 | |
| SPT | 6.00 | | | 17 | 18 | 1 | 3 | 4 | 8 | 84 | 34.80 | 21.50 | 13.30 | | | | | | | | | | | | |
| SPT | 7.50 | | | 20 | 19 | 1 | 2 | 7 | 7 | 83 | 34.50 | 21.80 | 12.70 | | | | | | | | | | | | |
| **UDS** | **8.00** | | | | | 0 | 2 | 5 | 9 | 84 | 34.69 | 20.11 | 14.58 | | 2.02 | 1.62 | 24.53 | 2.68 | | | 1.32 | 6.50 | 0.65 | 0.089 | |
| SPT | 9.00 | | | 24 | 21 | 1 | 2 | 5 | 9 | 83 | 34.60 | 20.10 | 14.50 | | | | | | | | | | | | |
| | 9.50 | | | | | | | | | | | | | | | | | | | | | | | | |

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

## *ALLIED ENGINEERS*

***JOB NO. M-11/2012-13/1598*** SOIL PROFILE

**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**

**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR -NALANDA BIHAR**

WATER TABLE **3.00 (M)**

LOCATION **BH-13**

**SHEET NO 13**

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS GRAVEL | COARSE | MEDIUM | FINE | HYDROM ANALY SILTY+ CLAY % | ATTERBERGS' LIMITS LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | DENSITY gm / cm³ BULK DENSITY | DRY DENSITY | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%)/ SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL COHESION (C) (KG/CM²) | FRICTION ANGLE (ϕ) | CONSOLIDATION PARAMETER VOID RATIO | COMPRESSION INDEX | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GL | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | | 6 | 8 | 1 | 2 | 4 | 7 | 86 | 34.40 | 20.00 | 14.40 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | 0.03 | 27.5 | DST | | |
| **UDS** | **2.00** | | | | | 1 | 1 | 4 | 9 | 85 | 35.48 | 20.07 | 14.41 | | 1.91 | 1.57 | 21.75 | 2.67 | 37.0 | | 1.16 | 8.00 | 0.70 | 0.141 | |
| SPT | 3.00 | | | 9 | 12 | 1 | 3 | 5 | 8 | 83 | 35.45 | 20.50 | 14.95 | | | | | | | | | | | | |
| SPT | 4.50 | | Brownish Colour Highly Plasticity Inorganic Silty Clay (CL) | 13 | 16 | 1 | 3 | 7 | 7 | 82 | 34.40 | 21.22 | 13.80 | | | | | | | | | | | | |
| **UDS** | **5.00** | | | | | 1 | 2 | 5 | 8 | 84 | 34.69 | 14.50 | 14.50 | | 1.94 | 1.58 | 22.67 | 2.68 | | | 1.28 | 7.50 | 0.69 | 0.102 | |
| SPT | 6.00 | | | 18 | 18 | 1 | 2 | 8 | 9 | 80 | 34.60 | 14.30 | 20.30 | | | | | | | | | | | | |
| | 6.50 | | | | | | | | | | | | | | | | | | | | | | | | |

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

**ALLIED ENGINEERS**

**JOB NO. M-11/2012-13/1598**

SOIL PROFILE

**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**

**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR -NALANDA BIHAR**

WATER TABLE **2.80 (M)**

LOCATION **BH-14**

**SHEET NO 14**

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS | | | | HYDROM ANALY | ATTERBERGS' LIMITS | | | | DENSITY gm / cm³ | | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%)/ SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL | | CONSOLIDATION PARAMETER | | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | GRAVEL | COARSE | MEDIUM | FINE | SILTY+ CLAY % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | BULK DENSITY | DRY DENSITY | | | | | COHESION (C) (KG/CM²) | FRICTION ANGLE (Ø) | VOID RATIO | COMPRESSION INDEX | |
| GL | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | | 8 | 11 | 1 | 2 | 4 | 8 | 85 | 33.60 | 20.00 | 13.60 | | | | | | | | 0.05 | 29.5 | DST | | |
| **UDS** | **2.00** | | | | | 1 | 1 | 6 | 7 | 85 | 33.69 | 20.07 | 13.62 | | 1.89 | 1.57 | 20.74 | 2.67 | 40.5 | | 1.19 | 9.00 | 0.71 | 0.144 | |
| SPT | 3.00 | | | 12 | 15 | 1 | 2 | 5 | 8 | 84 | 31.50 | 21.50 | 10.00 | | | | | | | | | | | | |
| SPT | 4.50 | | | 16 | 17 | 1 | 3 | 7 | 7 | 82 | 31.80 | 21.80 | 10.00 | | | | | | | | | | | | |
| **UDS** | **5.00** | | Brownish Colour Inorganic Silty Clay (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 | | | | | | | | | | | | | | | | | | | | | | | | |

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

**ALLIED ENGINEERS**

**JOB NO. M-11/2012-13/1598** SOIL PROFILE

**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**

**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDABIHAR**

WATER TABLE **2.50 (M)**

LOCATION **BH-15**

**SHEET NO 15**

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS | | | | HYDROM ANALY | ATTERBERGS' LIMITS | | | | DENSITY gm / cm³ | | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%)/ SWELLPRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL | | CONSOLIDATION PARAMETER | | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | GRAVEL | COARSE | MEDIUM | FINE | SILTY+ CLAY % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | BULK DENSITY | DRY DENSITY | | | | | COHESION (C) (KG/CM²) | FRICTION ANGLE (Ø) | VOID RATIO | COMPRESSION INDEX | |
| GL | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | | 7 | 10 | 1 | 3 | 7 | 7 | 82 | 34.95 | 20.80 | 14.15 | | | | | | | | 0.04 | 28.5 | DST | | |
| **UDS** | **2.00** | | | | | 1 | 3 | 5 | 10 | 81 | 34.97 | 20.84 | 14.13 | | 1.88 | 1.56 | 20.64 | 2.68 | 34.0 | | 1.16 | 9.00 | 0.72 | 0.135 | |
| SPT | 3.00 | | | 11 | 14 | 1 | 3 | 5 | 8 | 83 | 34.80 | 20.60 | 14.20 | | | | | | | | | | | | |
| SPT | 4.50 | | Dark Brownish Colour 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 | | | | | | | | | | | | | | | | | | | | | | | | |

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

**ALLIED ENGINEERS**

**JOB NO. M-11/2012-13/1598**

SOIL PROFILE

**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**

**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR**

WATER TABLE **3.00 (M)**

LOCATION **BH-16**

**SHEET NO 16**

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS GRAVEL | COARSE | MEDIUM | FINE | HYDROM ANALY SILTY+ CLAY % | ATTERBERGS' LIMITS LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | DENSITY gm/cm³ BULK DENSITY | DRY DENSITY | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%)/ SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL COHESION (C) (KG/CM²) | FRICTION ANGLE (Ø) | CONSOLIDATION PARAMETER VOID RATIO | COMPRESSION INDEX | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GL | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | Brownish Colour Highly Plasticity Inorganic Silty Clay (CL) | 6 | 8 | 1 | 2 | 4 | 7 | 86 | 35.10 | 20.10 | 15.00 | | | | | | | | 0.03 | 28.0 | DST | | |
| **UDS** | **2.00** | | | | | 1 | 1 | 6 | 8 | 84 | 35.14 | 20.19 | 14.95 | | 1.91 | 1.59 | 20.38 | 2.68 | 36.5 | | 1.23 | 8.50 | 0.69 | 0.140 | |
| SPT | 3.00 | | | 10 | 13 | 1 | 3 | 5 | 9 | 82 | 34.90 | 21.00 | 13.90 | | | | | | | | | | | | |
| SPT | 4.50 | | | 14 | 16 | 1 | 2 | 7 | 7 | 83 | 34.50 | 20.50 | 14.00 | | | | | | | | | DST | | | |
| **UDS** | **5.00** | | | | | 0 | 2 | 1 | 67 | 30 | **REMOULDED UDS** | | | | 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 | | | | | | | | | | | | DST | | | |
| **UDS** | **8.00** | | | | | 1 | 1 | 2 | 62 | 34 | **REMOULDED UDS** | | | | 1.77 | 1.54 | 14.57 | 2.65 | | | 0.00 | 34.00 | 0.72 | | |
| SPT | 9.00 | | Highly Plasticity Inorganic Silty Clay (CL) | 25 | 22 | 1 | 3 | 5 | 9 | 82 | 31.00 | 22.25 | 8.75 | | | | | | | | | | | | |
| | 9.50 | | | | | | | | | | | | | | | | | | | | | | | | |

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

| ***ALLIED ENGINEERS*** | **CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR** | **SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDABIHAR** | WATER TABLE **2.25 (M)** | LOCATION **BH-17** | **SHEET NO 17** |
|---|---|---|---|---|---|
| ***JOB NO. M-11/2012-13/1598*** SOIL PROFILE | | | | | |

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS | | | | HYDROM ANALY | ATTERBERGS' LIMITS | | | | DENSITY gm / cm³ | | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%)/ SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL | | CONSOLIDATION PARAMETER | | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | GRAVEL | COARSE | MEDIUM | FINE | SILTY+ CLAY % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | BULK DENSITY | DRY DENSITY | | | | | COHESION (C) (KG/CM²) | FRICTION ANGLE (ϕ) | VOID RATIO | COMPRESSION INDEX | |
| GL | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | | 5 | 7 | 1 | 2 | 4 | 7 | 86 | 34.80 | 20.00 | 14.80 | | | | | | | | 0.03 | 27.5 | DST | | |
| **UDS** | **2.00** | | | | | 0 | 1 | 6 | 9 | 84 | 34.86 | 20.91 | 13.95 | | 1.93 | 1.61 | 19.68 | 2.67 | 31.5 | | 1.17 | 9.50 | 0.59 | 0.145 | |
| SPT | 3.00 | | | 9 | 12 | 1 | 3 | 5 | 8 | 83 | 34.70 | 20.50 | 14.20 | | | | | | | | | | | | |
| SPT | 4.50 | | Highly Plasticity Inorganic Silty Clay (CL) | 12 | 15 | 1 | 2 | 6 | 8 | 83 | 32.20 | 21.40 | 10.80 | | | | | | | | | | | | |
| **UDS** | **5.00** | | | | | 1 | 1 | 5 | 8 | 85 | 35.12 | 21.01 | 14.11 | | 1.98 | 1.63 | 21.36 | 2.68 | | | 1.29 | 7.50 | 0.64 | 0.092 | |
| SPT | 6.00 | | | 15 | 16 | 1 | 3 | 7 | 9 | 80 | 35.10 | 21.50 | 13.60 | | | | | | | | | | | | |
| | 6.50 | | | | | | | | | | | | | | | | | | | | | | | | |

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

| ***ALLIED ENGINEERS*** | **CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR** | **SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDABIHAR** | WATER TABLE **2.00 (M)** | LOCATION **BH-18** | **SHEET NO 18** |
|---|---|---|---|---|---|
| ***JOB NO. M-11/2012-13/1598*** SOIL PROFILE | | | | | |

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS | | | | HYDROM ANALY | ATTERBERGS' LIMITS | | | | DENSITY gm / cm³ | | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%)/ SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL | | CONSOLIDATION PARAMETER | | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | GRAVEL | COARSE | MEDIUM | FINE | SILTY+ CLAY % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | BULK DENSITY | DRY DENSITY | | | | | COHESION (C) (KG/CM²) | FRICTION ANGLE (ϕ) | VOID RATIO | COMPRESSION INDEX | |
| GL | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | Brownish Colour Highly Plasticity Inorganic Silty Clay (CL) | 6 | 8 | 1 | 3 | 7 | 9 | 80 | 34.00 | 20.00 | 14.00 | | | | | | | | 0.04 | 29.0 | DST | | |
| **UDS** | **2.00** | | | | | 1 | 1 | 3 | 10 | 85 | 34.39 | 20.08 | 14.31 | | 1.92 | 1.59 | 20.55 | 2.68 | 38.5 | | 1.22 | 9.00 | 0.68 | 0.132 | |
| SPT | 3.00 | | | 9 | 12 | 1 | 2 | 5 | 8 | 84 | 32.45 | 21.25 | 11.20 | | | | | | | | | | | | |
| SPT | 4.50 | | | 12 | 15 | 1 | 3 | 6 | 9 | 81 | 32.25 | 21.00 | 11.25 | | | | | | | | | | | | |
| **UDS** | **5.00** | | | | | 0 | 2 | 2 | 64 | 32 | **REMOULDED UDS** | | | | 1.72 | 1.53 | 12.78 | 2.65 | | | 0.00 | 31.00 | 0.74 | | |
| SPT | 6.00 | | | 16 | 17 | 2 | 2 | 1 | 65 | 30 | | | | | | | | | | | | | | | |
| SPT | 7.50 | | Light Grayish Colours Inorganic Silty Sand (SM) | 20 | 19 | 1 | 3 | 2 | 62 | 32 | | | | | | | | | | | | | | | |
| **UDS** | **8.00** | | | | | 0 | 1 | 2 | 68 | 29 | **REMOULDED UDS** | | | | 1.74 | 1.53 | 13.89 | 2.65 | | | 0.00 | DST 32.50 | 0.73 | | |
| SPT | 9.00 | | | 23 | 20 | 2 | 1 | 3 | 63 | 31 | | | | | | | | | | | | | | | |
| | 9.50 | | | | | | | | | | | | | | | | | | | | | | | | |

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

**ALLIED ENGINEERS**

**JOB NO. M-11/2012-13/1598** SOIL PROFILE

**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**

**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR**

WATER TABLE **2.00 (M)**

LOCATION **BH-19**

**SHEET NO 19**

| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS GRAVEL | COARSE | MEDIUM | FINE | HYDROM ANALY SILTY+ CLAY % | ATTERBERGS' LIMITS LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | DENSITY gm / cm³ BULK DENSITY | DRY DENSITY | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%)/ SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL COHESION (C) (KG/CM²) | FRICTION ANGLE (Ø) | CONSOLIDATION PARAMETER VOID RATIO | COMPRESSION INDEX | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GL | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | | 5 | 7 | 1 | 2 | 5 | 8 | 84 | 35.19 | 20.35 | 14.84 | | | | | | | | | 0.05 | 29.5 | DST | | |
| **UDS** | **2.00** | | Drak Brownish colour Highly Plasticity 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 | 8.50 | 0.72 | 0.140 | |
| SPT | 3.00 | | | 10 | 12 | 1 | 3 | 6 | 9 | 81 | 34.30 | 21.44 | 12.86 | | | | | | | | | | | | |
| SPT | 4.50 | | | 10 | 12 | 1 | 3 | 4 | 7 | 84 | 34.20 | 21.80 | 14.84 | | | | | | | | | | | | |
| **UDS** | **5.00** | | | | | 1 | 2 | 2 | 67 | 28 | **REMOULDED UDS** | | | | 1.75 | 1.54 | 13.76 | 2.65 | | | 0.00 | DST 32.00 | 0.72 | | |
| SPT | 6.00 | | Light Grayish Colours Inorganic Silty Sand (SM) | 19 | 16 | 2 | 2 | 1 | 65 | 30 | | | | | | | | | | | | | | | |
| | 6.50 | | | | | | | | | | | | | | | | | | | | | | | | |

*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.

**ALLIED ENGINEERS**

**JOB NO. M-11/2012-13/1598**

SOIL PROFILE

**CONSULTANT ADMINISTRATION NALANDA UNIVERSITY RAJGIR BIHAR**

**SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR - NALANDA BIHAR**

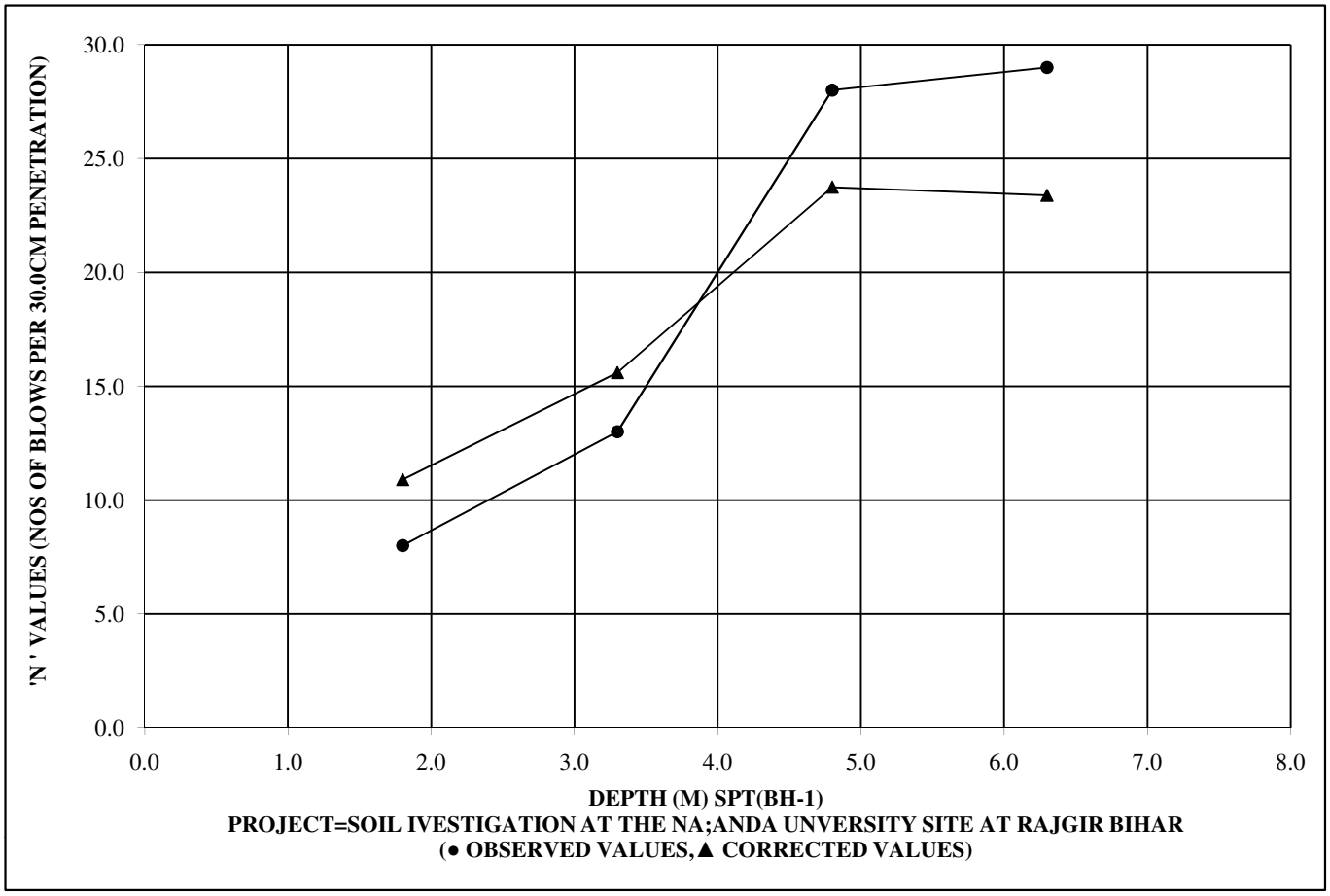
WATER TABLE **2.00 (M)**

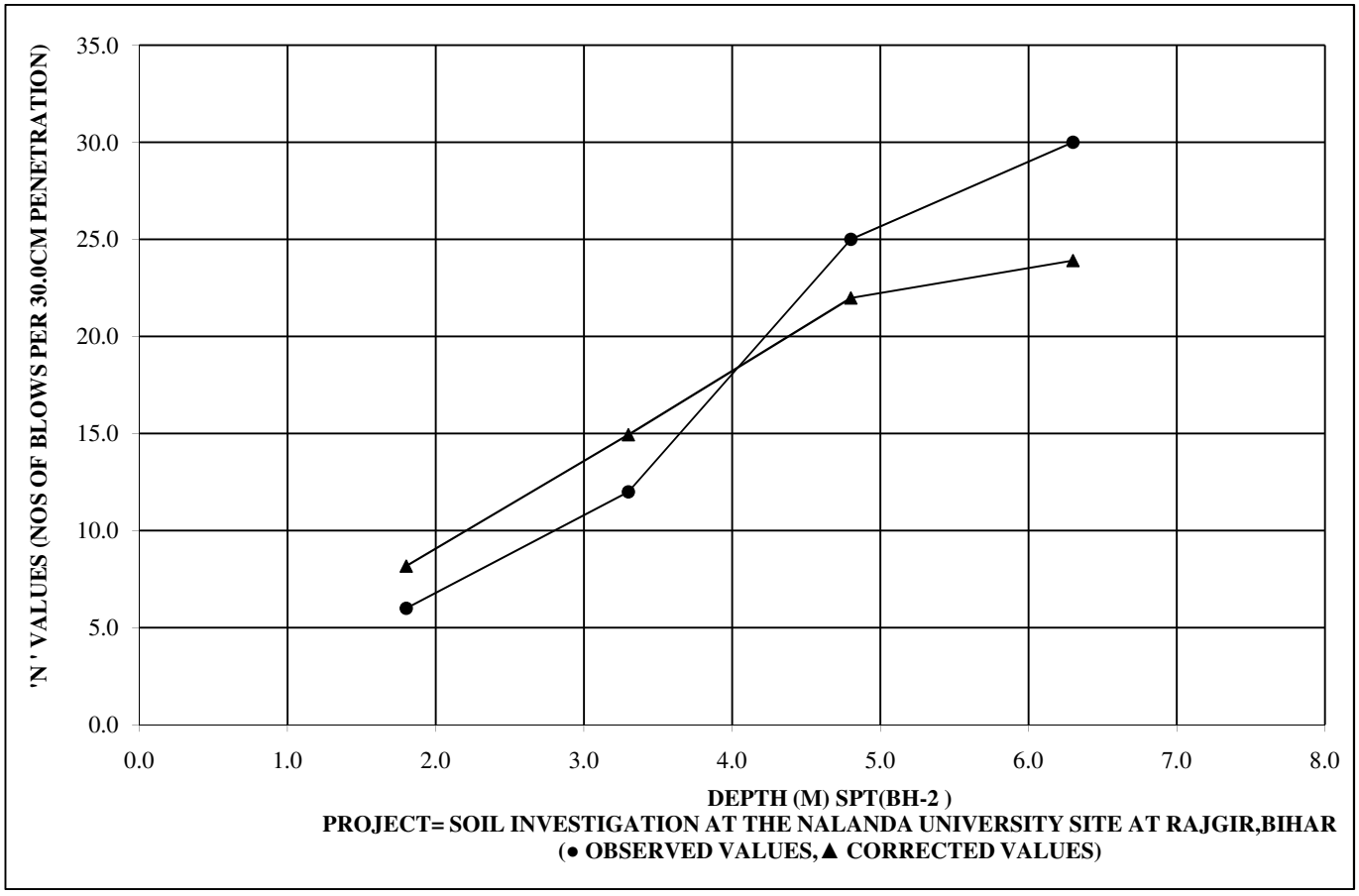
LOCATION **BH-20**

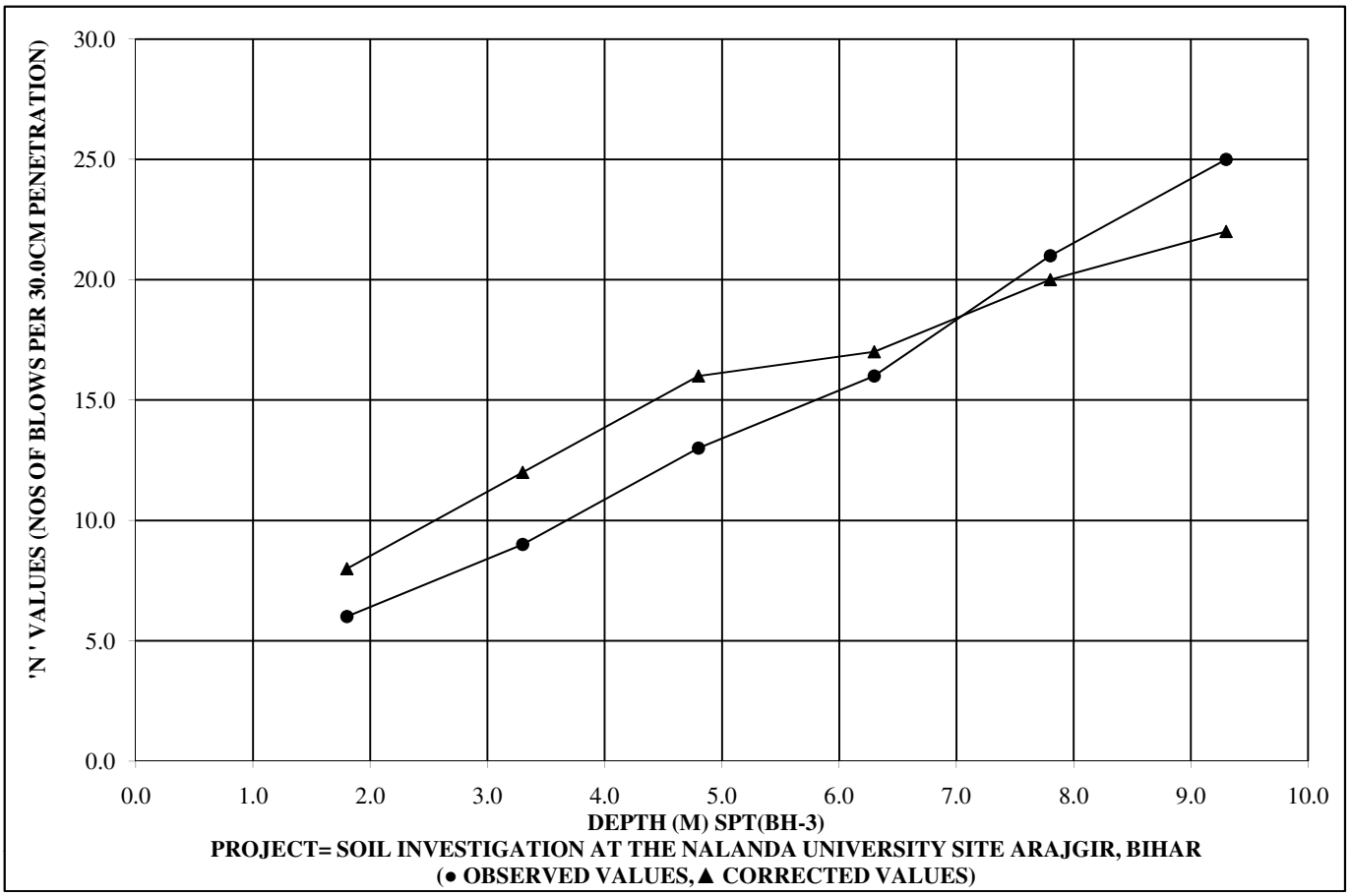
**SHEET NO 20**

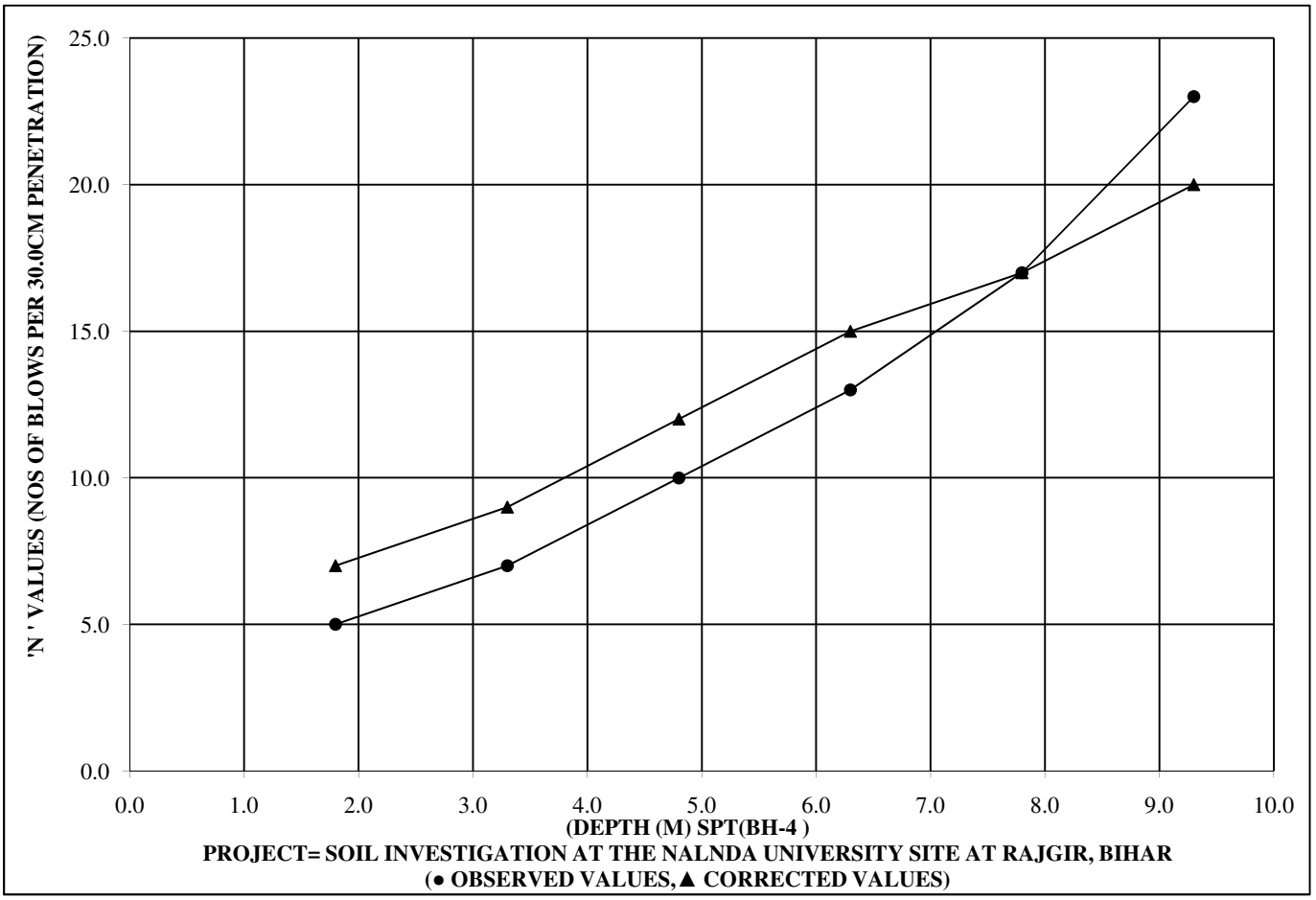
| TYPE OF SAMPLE | DEPTH (m) | SUB SOIL PROFILE | SOIL DISCRIPTION AND CLASSIFICATION | SPT 'N' VALUES(Measured) | SPT 'N' VALUES(Corrected) | GRAIN SIZE DISTRIBUTION SIEVE ANALYSIS | | | | HYDROM ANALY | ATTERBERGS' LIMITS | | | | DENSITY gm / cm³ | | MAX MOISTURE CONTENT (%) | SPECIFIC GRAVITY | FREE SWELINDEX (%)/ SWELL PRESSURE | RELATIVE DENSITY | SHEARPARAMET UCC,TXL | | CONSOLIDATION PARAMETER | | STD. PROCTOR TEST MDD GM/CC/OMC % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | GRAVEL | COARSE | MEDIUM | FINE | SILTY+ CLAY % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | SHRINKAGE LIMIT | BULK DENSITY | DRY DENSITY | | | | | COHESION (C) (KG/CM²) | FRICTION ANGLE (ϕ) | VOID RATIO | COMPRESSION INDEX | |
| CL | | | | | | | | | | | | | | | | | | | | | | | | | |
| SPT | 1.50 | | | 5 | 15 | 1 | 2 | 5 | 9 | 83 | 35.10 | 20.50 | 14.60 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | 0.03 | 27.5 | DST | | |
| **UDS** | **2.00** | | Brownish Colour Highly Plasticity Inorganic Silty Clay (CL) | | | 0 | 2 | 6 | 8 | 84 | 35.12 | 20.67 | 14.45 | | 1.91 | 1.56 | 22.48 | 2.68 | 31.0 | | 1.25 | 9.50 | 0.72 | 0.135 | |
| SPT | 3.00 | | | 9 | 16 | 1 | 3 | 7 | 9 | 80 | 35.00 | 20.00 | 15.00 | | | | | | | | | | | | |
| SPT | 4.50 | | | 12 | 17 | 1 | 2 | 4 | 7 | 86 | 31.50 | 21.50 | 10.00 | | | | | | | | | | | | |
| **UDS** | **5.00** | | | | | 0 | 1 | 2 | 65 | 32 | **REMOULDED UDS** | | | | 1.76 | 1.56 | 12.63 | 2.65 | | | 0.00 | 31.50 | 0.70 | | |
| SPT | 6.00 | | | 15 | 18 | 2 | 1 | 1 | 61 | 35 | | | | | | | | | | | | | | | |
| SPT | 7.50 | | Inorganic Silty Sand (SM) | 21 | 17 | 1 | 2 | 2 | 63 | 32 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | DST | | | |
| **UDS** | **8.00** | | | | | 1 | 1 | 2 | 69 | 27 | **REMOULDED UDS** | | | | 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 | | | | | | | | | | | | | | | | | | | | | | | | |

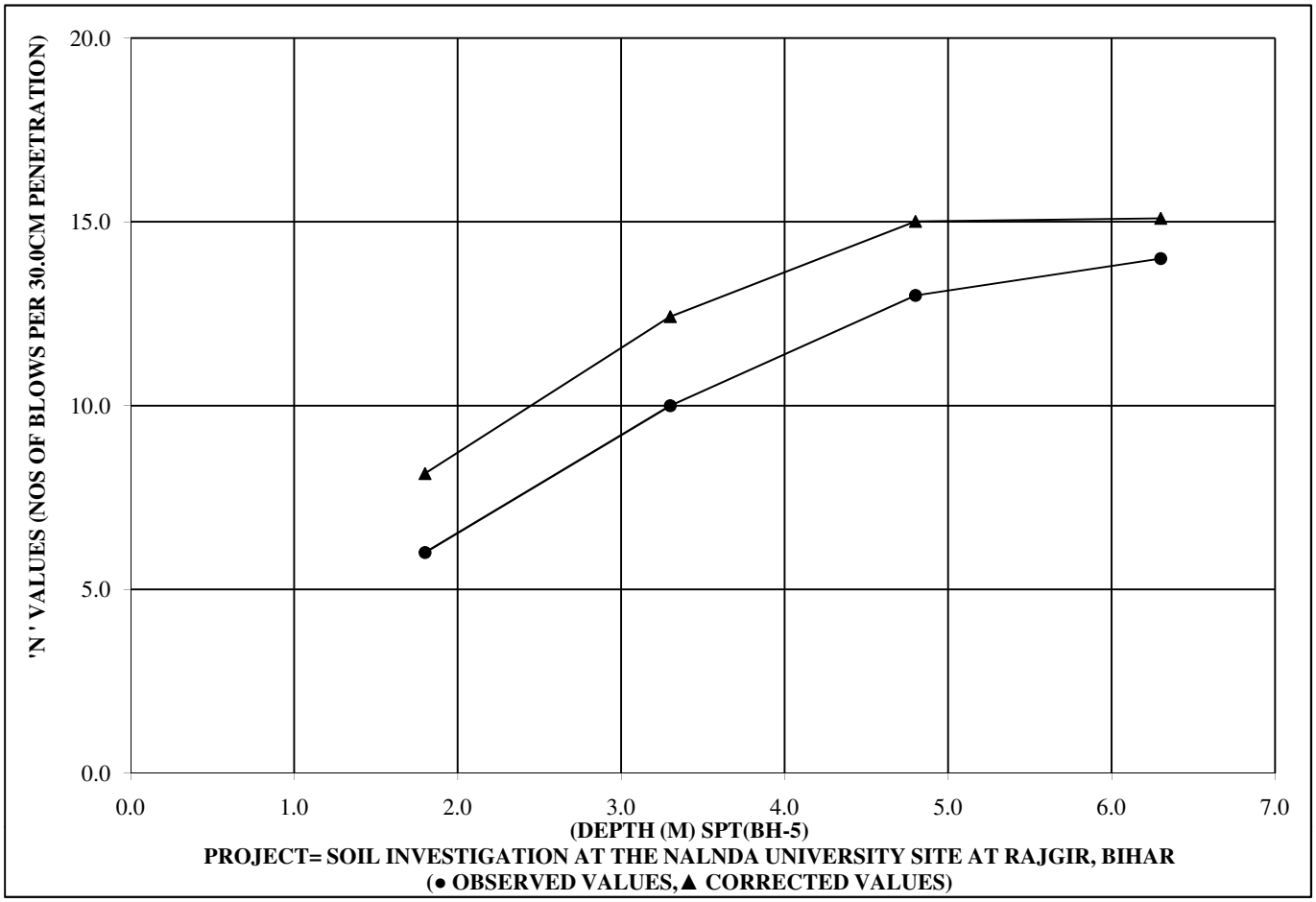
*DST-DIRECT SHEAR TEST ,UUT-UNCONSOL.UNDR.


'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
DEPTH (M) SPT(BH-1)
PROJECT=SOIL IVESTIGATION AT THE NA;ANDA UNVERSITY SITE AT RAJGIR BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

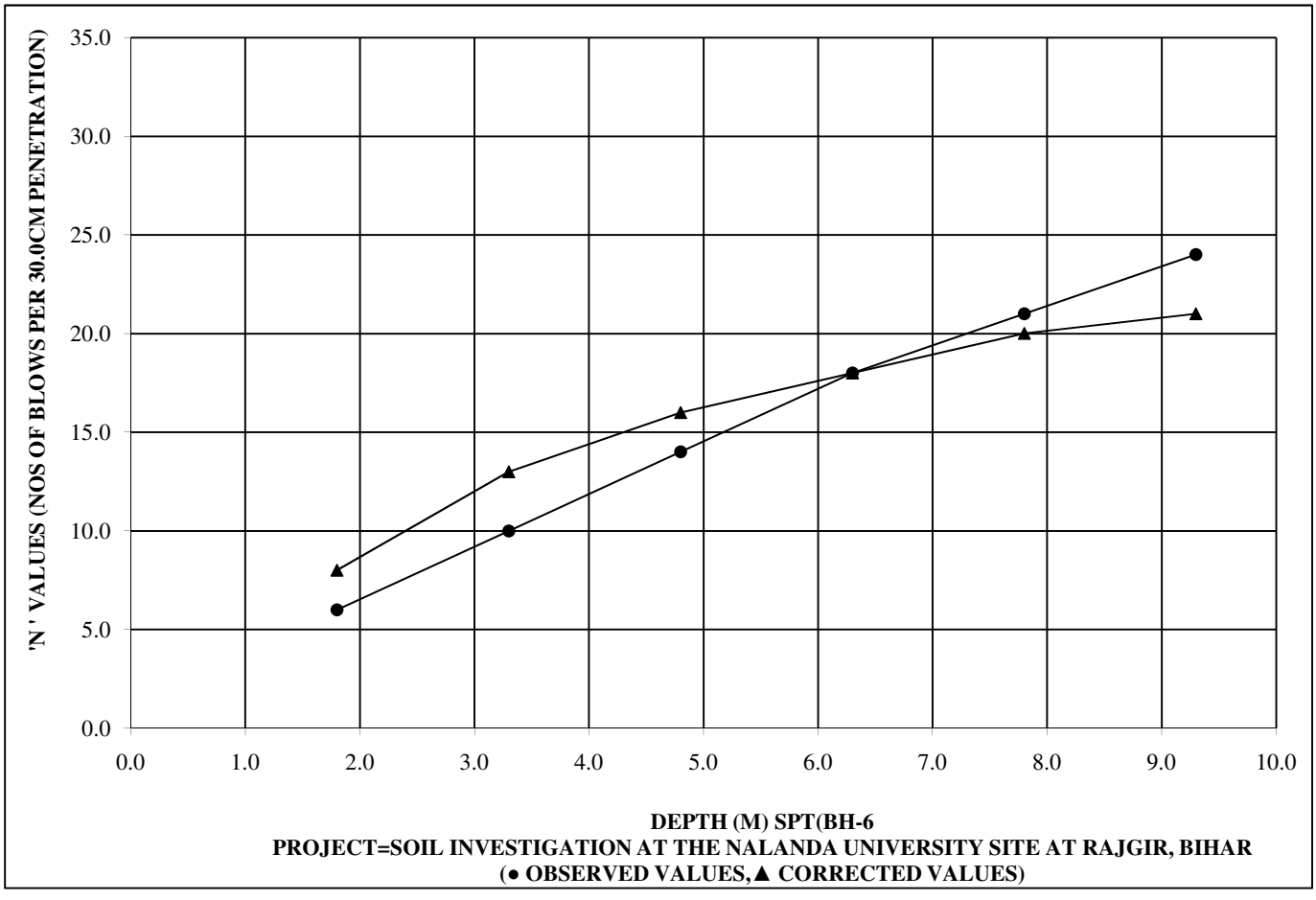

'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
DEPTH (M) SPT(BH-2 )
PROJECT= SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR,BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)


'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
DEPTH (M) SPT(BH-3)
PROJECT= SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE ARAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

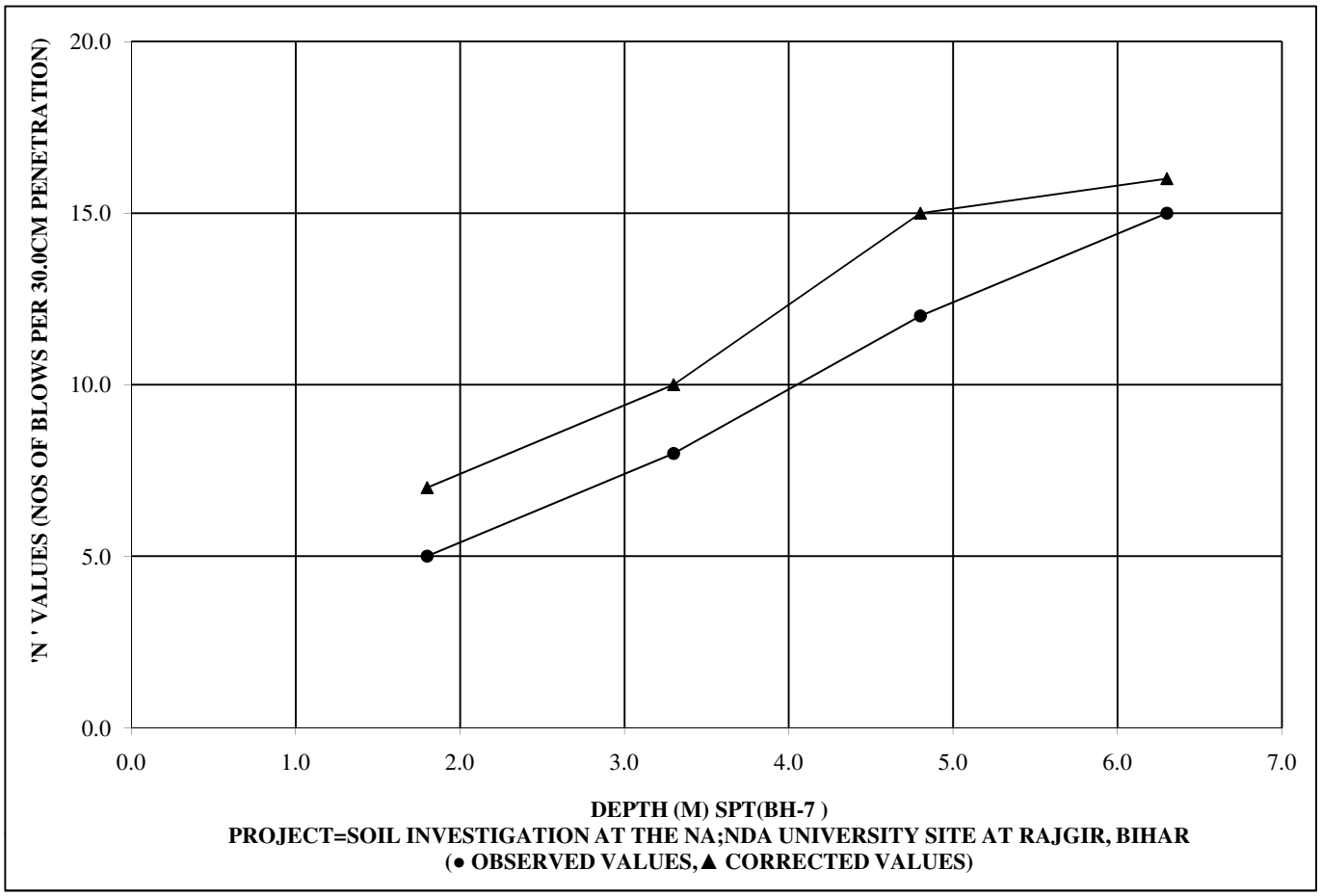

'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
25.0
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
(DEPTH (M) SPT(BH-4 )
PROJECT= SOIL INVESTIGATION AT THE NALNDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

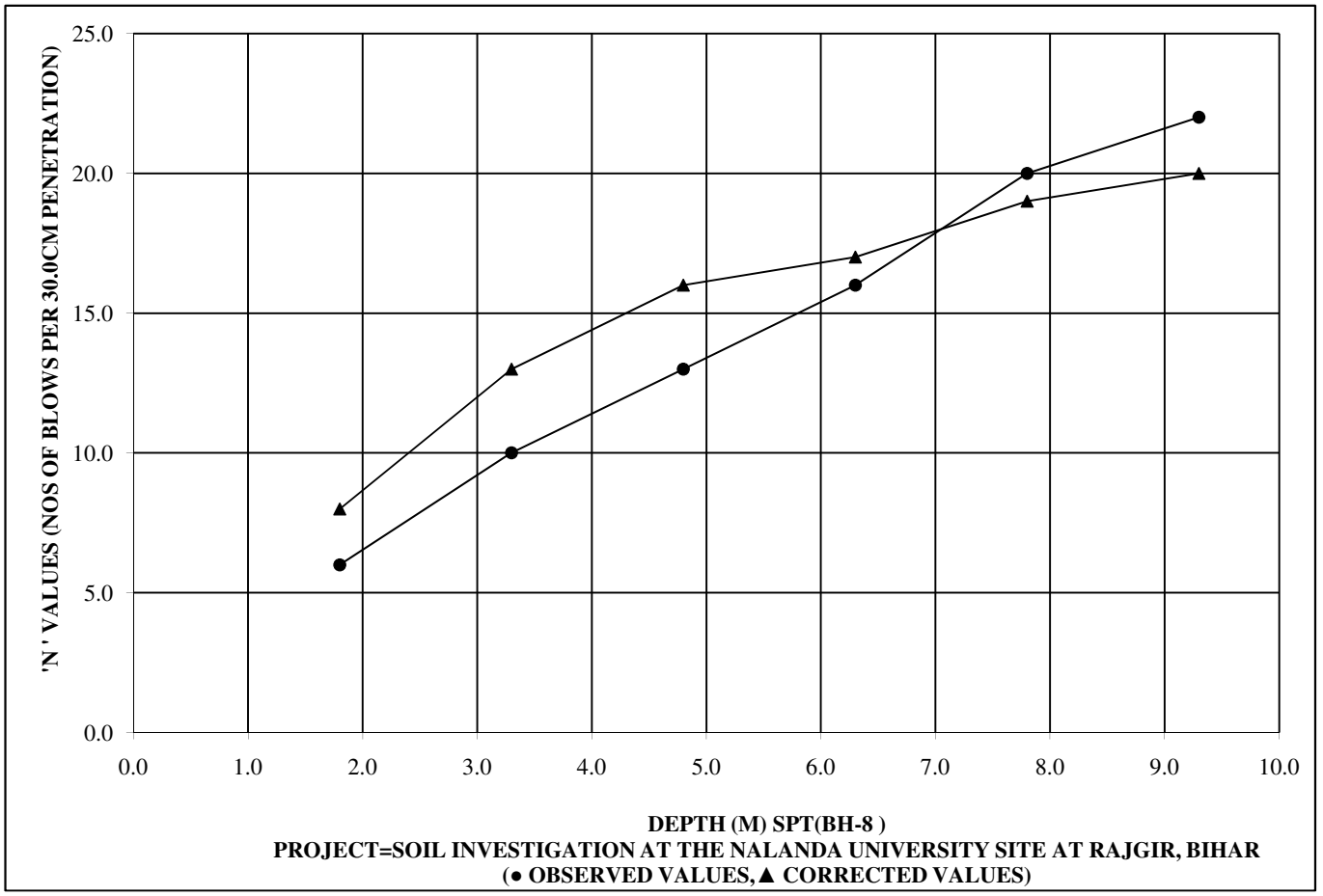


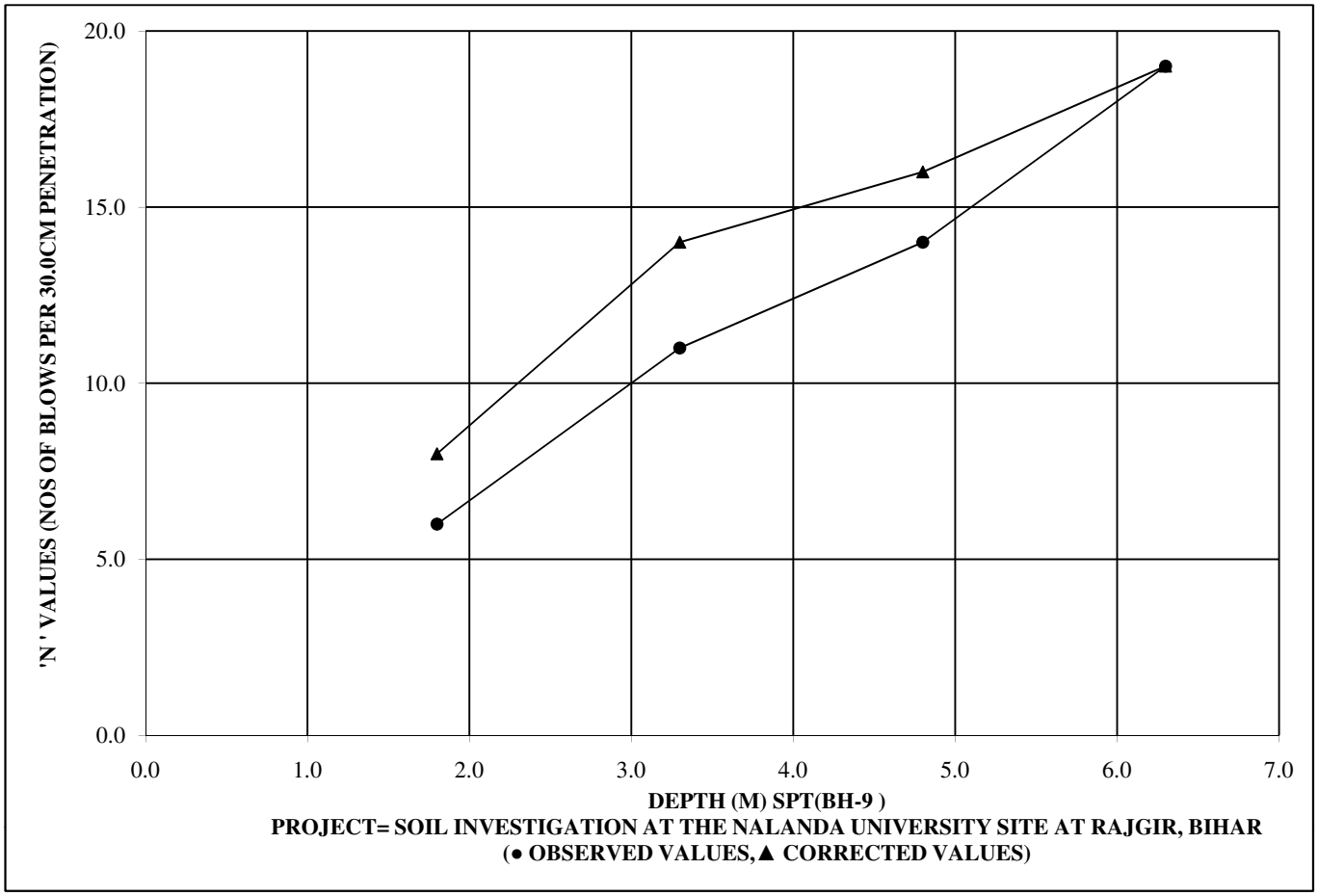

**PROJECT= SOIL INVESTIGATION AT THE NALNDA UNIVERSITY SITE AT RAJGIR, BIHAR**
**(● OBSERVED VALUES,▲ CORRECTED VALUES)**

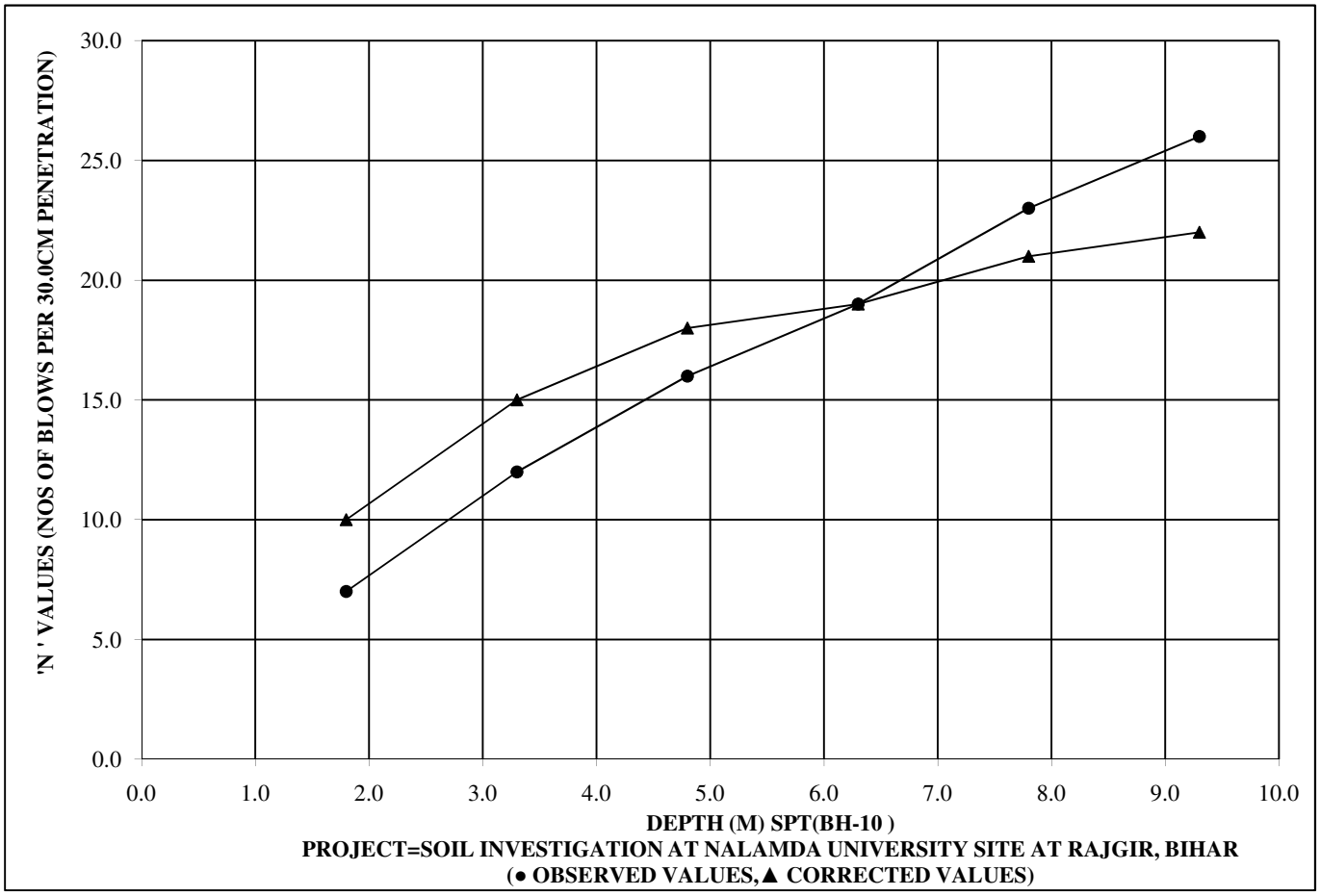


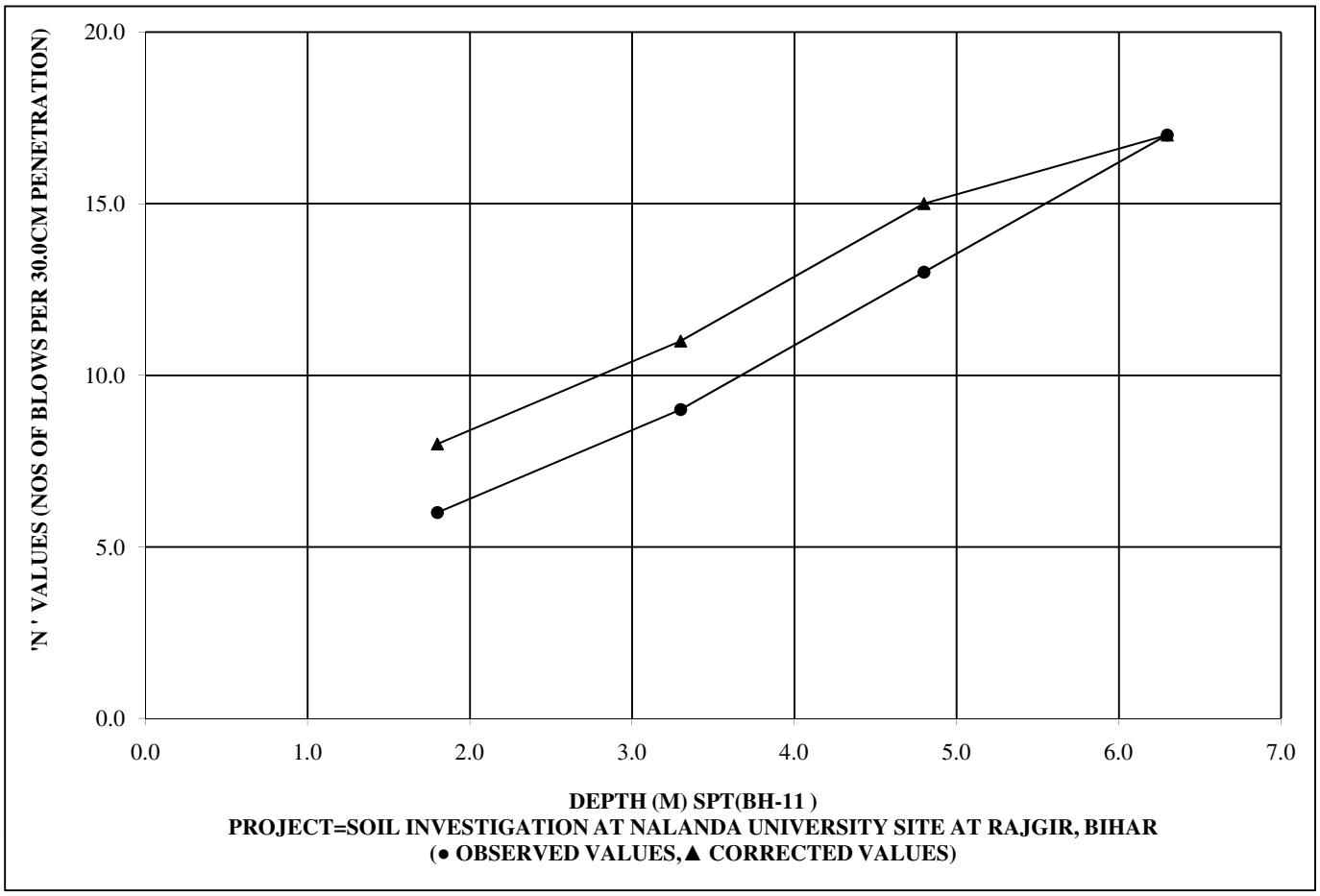

**PROJECT=SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR**
**(● OBSERVED VALUES,▲ CORRECTED VALUES)**

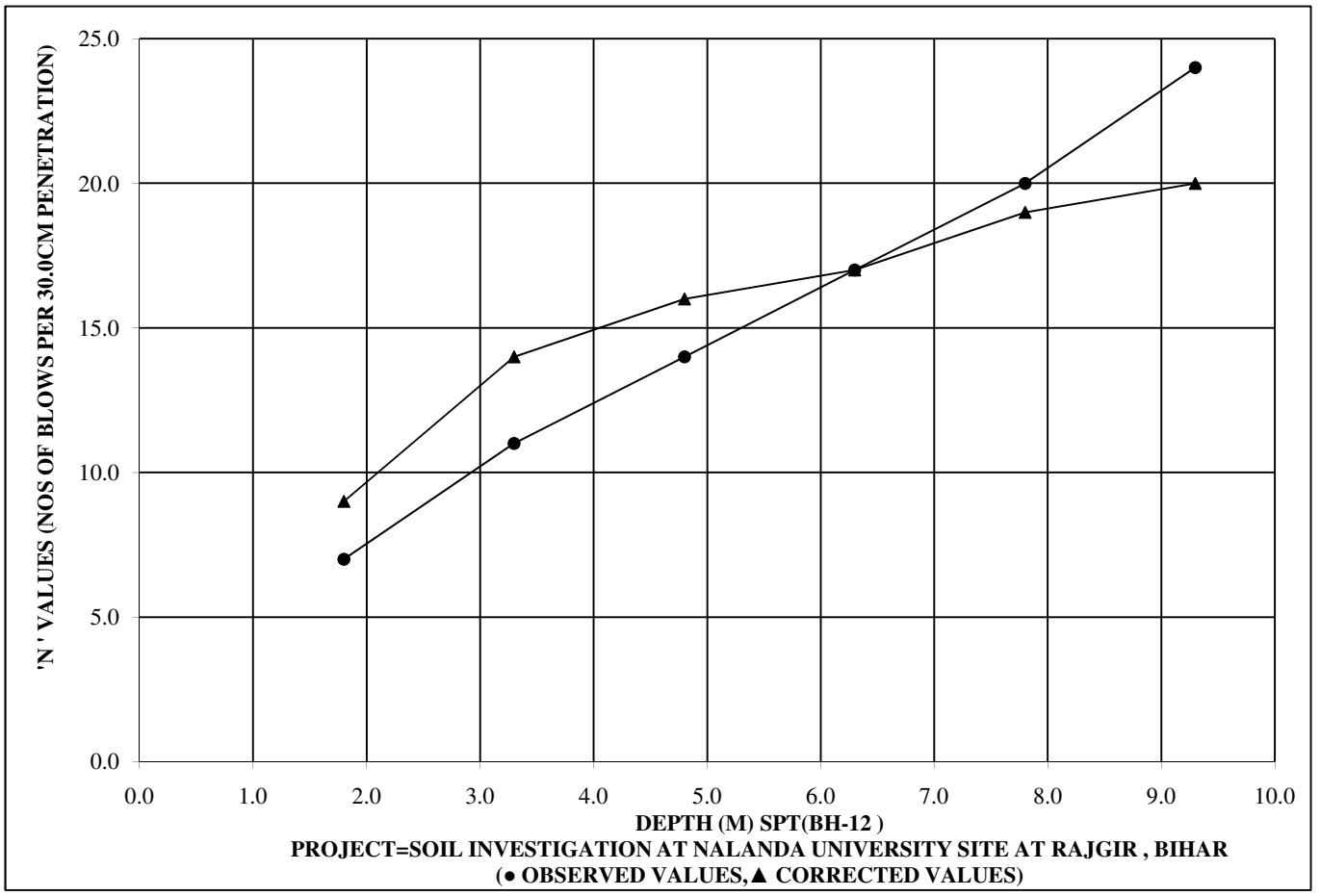

'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
DEPTH (M) SPT(BH-7 )
PROJECT=SOIL INVESTIGATION AT THE NA;NDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

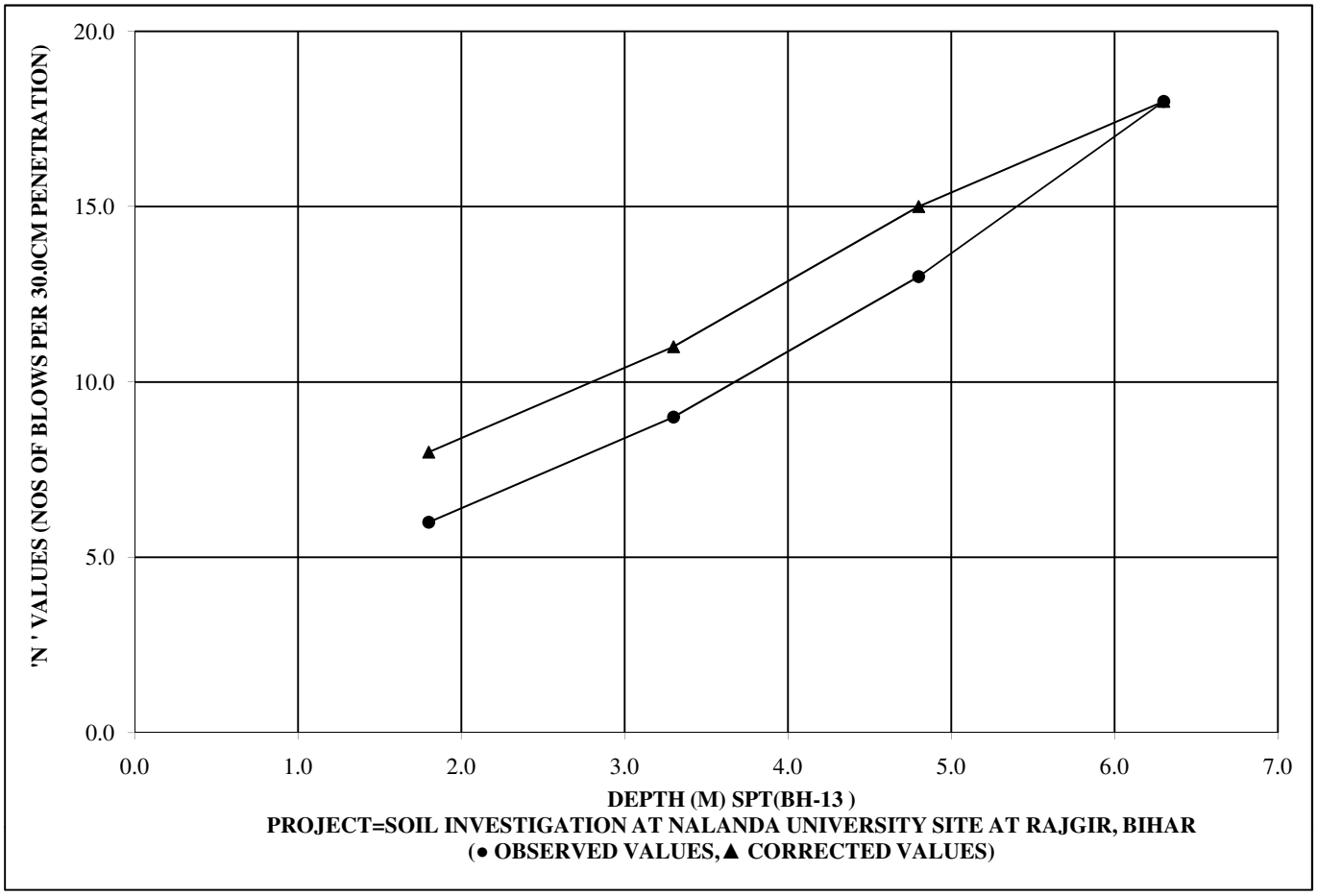

'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
25.0
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
DEPTH (M) SPT(BH-8 )
PROJECT=SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

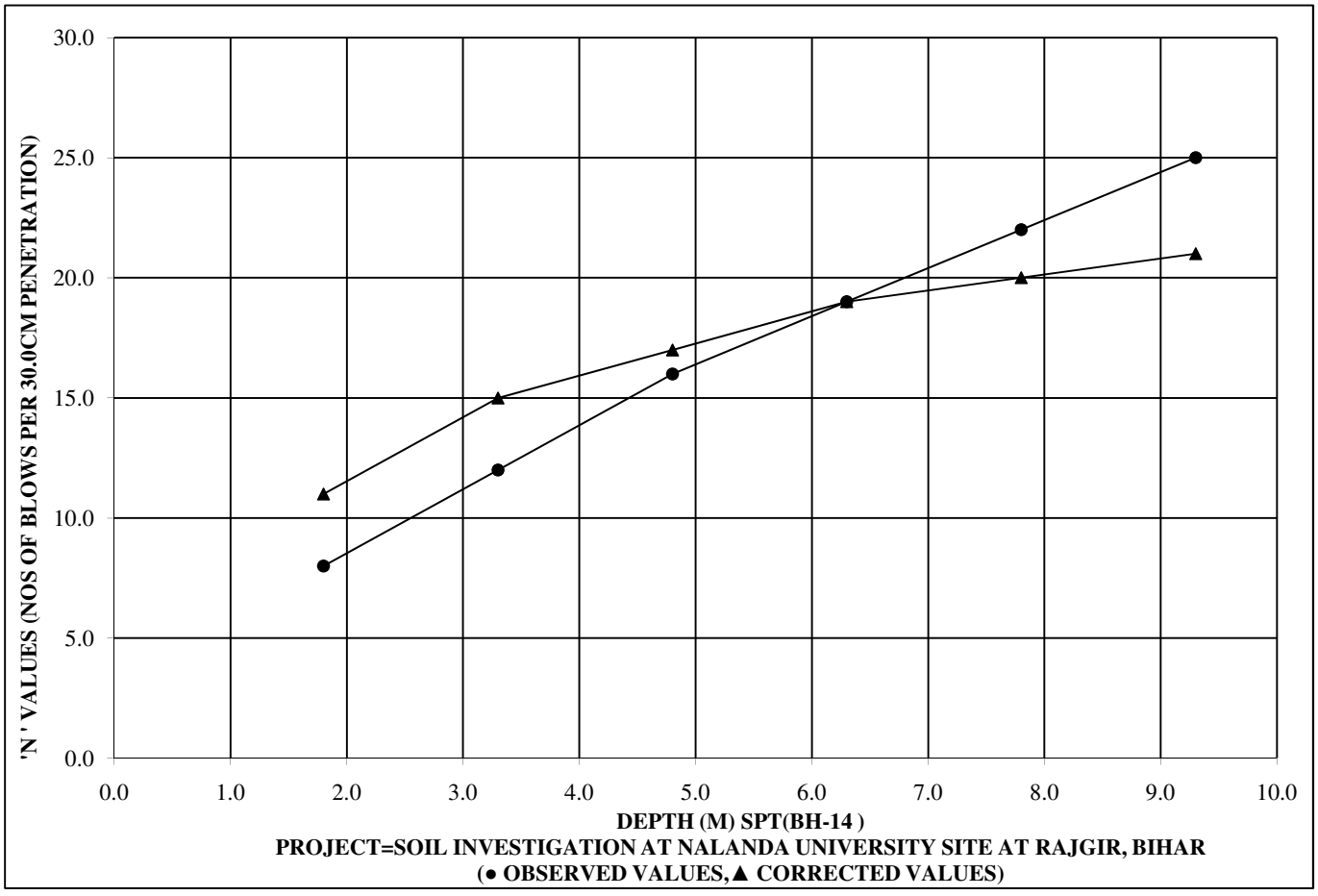

'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
DEPTH (M) SPT(BH-9 )
PROJECT= SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

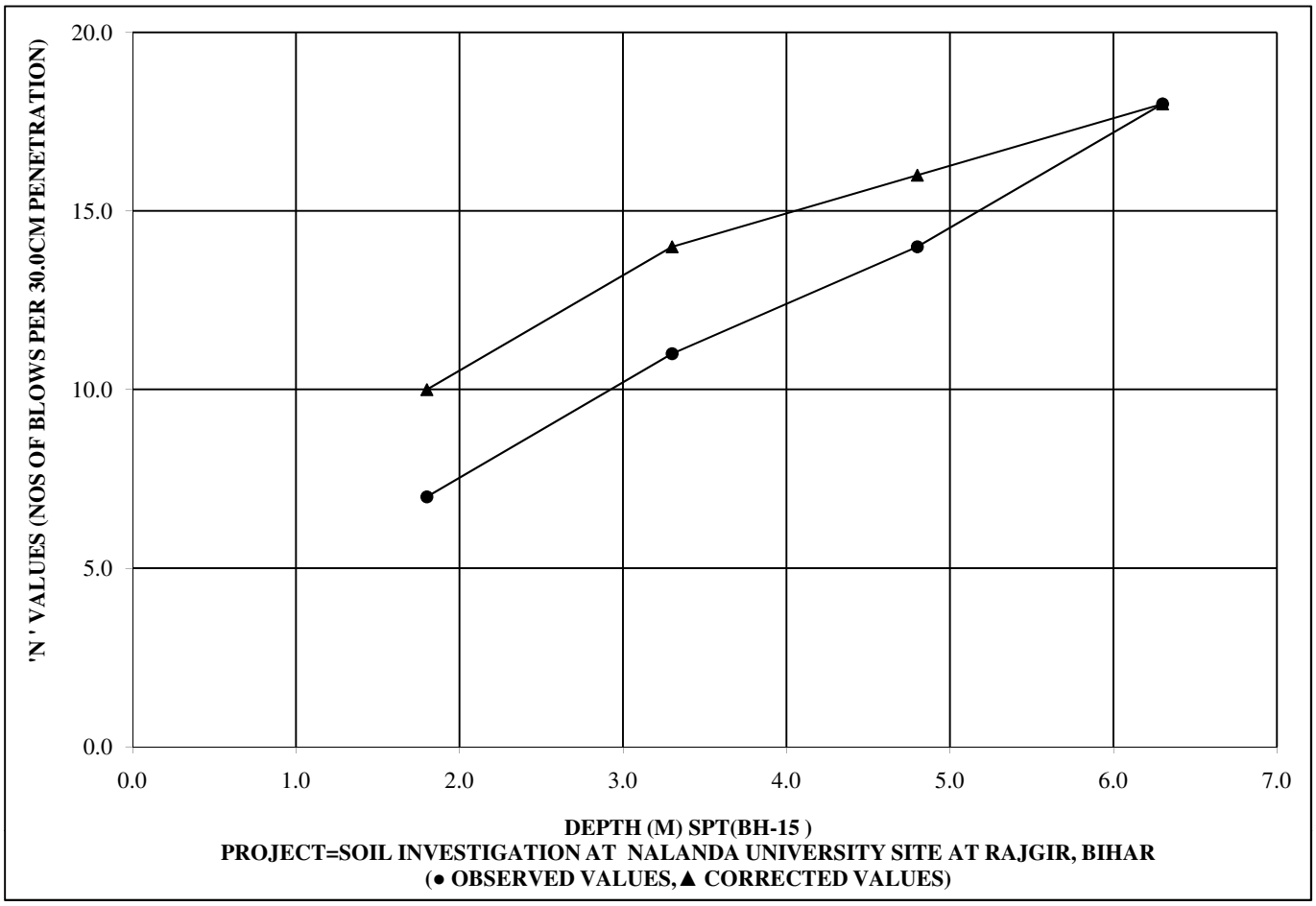

'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
DEPTH (M) SPT(BH-10 )
PROJECT=SOIL INVESTIGATION AT NALAMDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

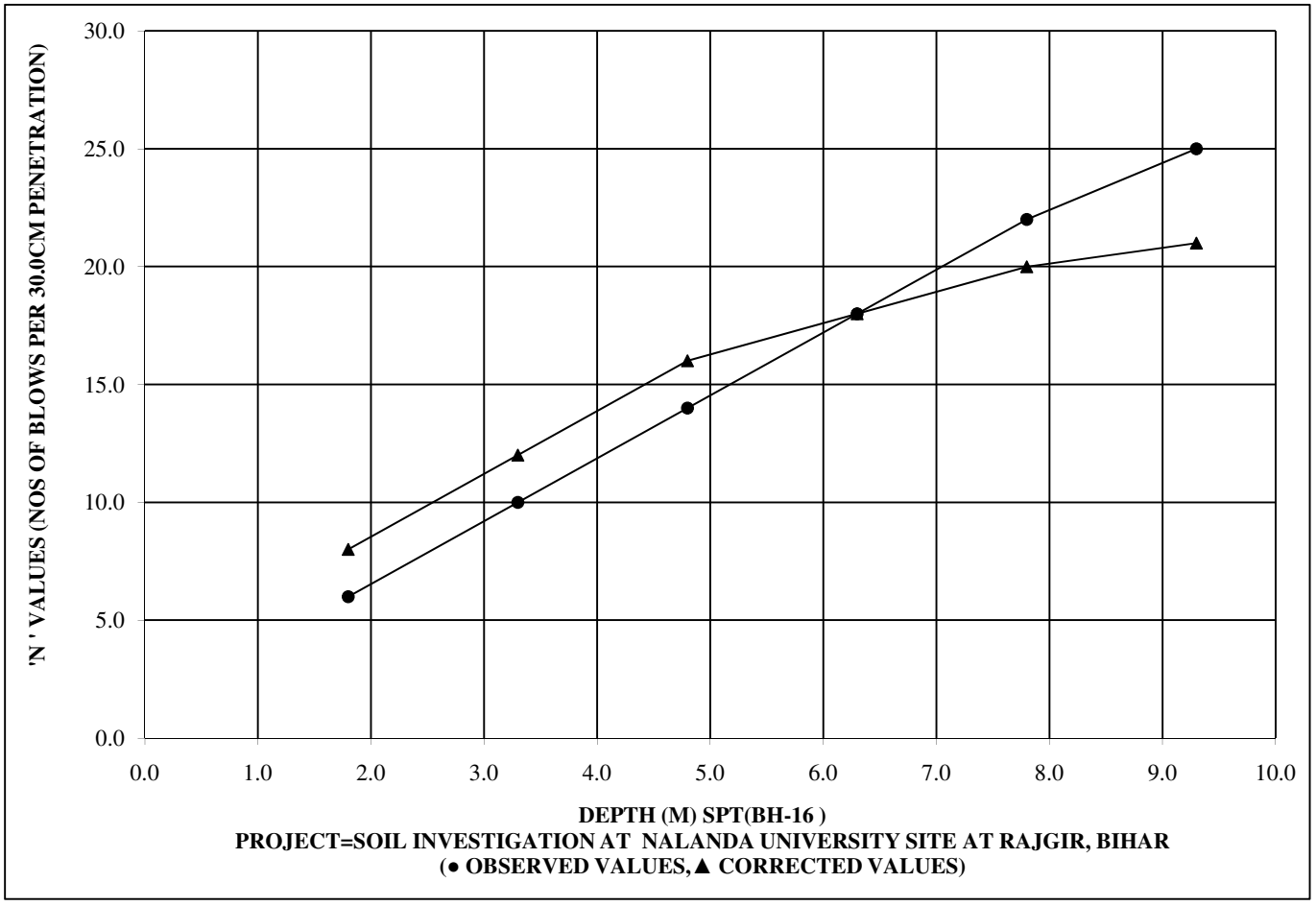

'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
DEPTH (M) SPT(BH-11 )
PROJECT=SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

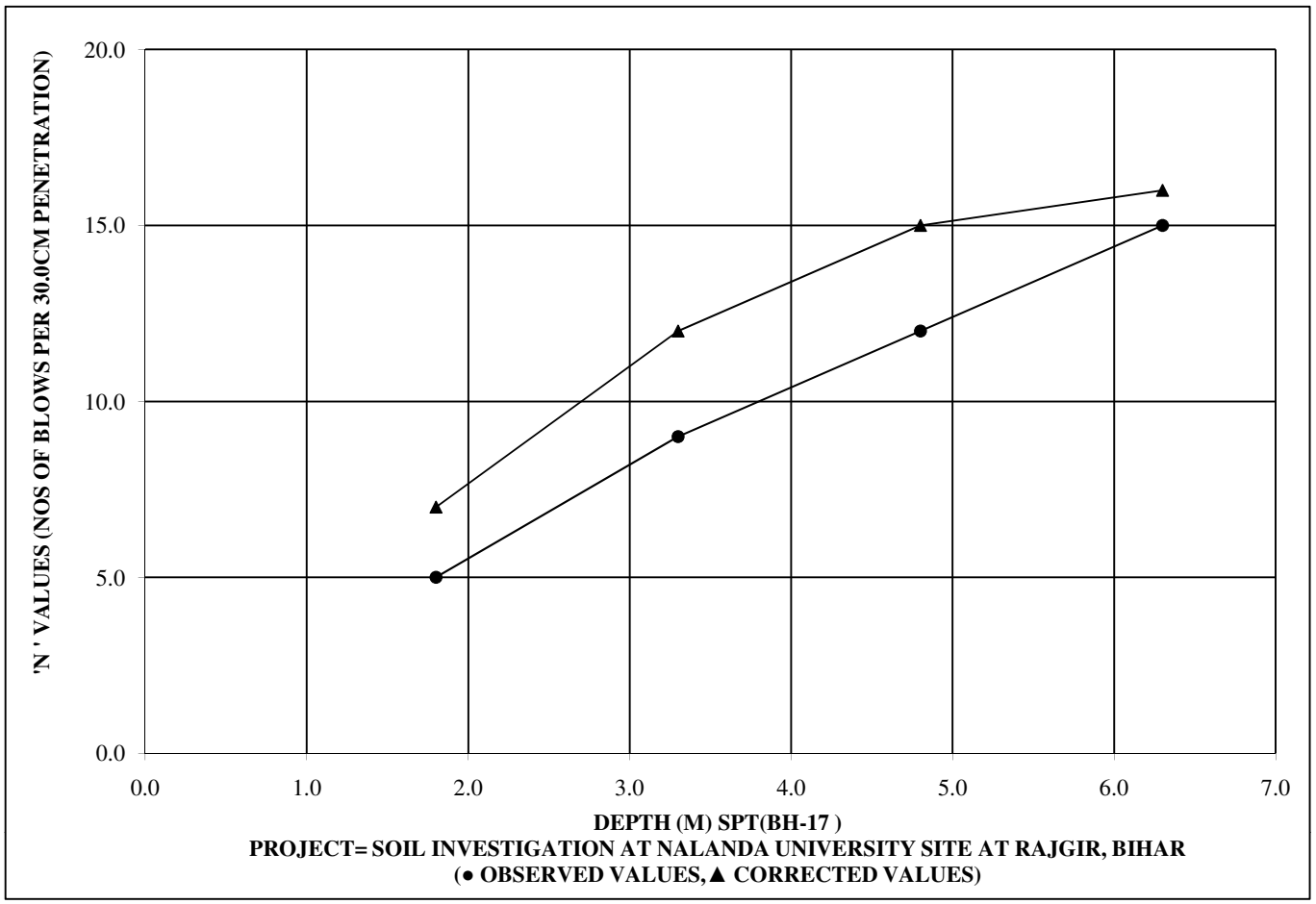

'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
25.0
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
DEPTH (M) SPT(BH-12 )
PROJECT=SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR , BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

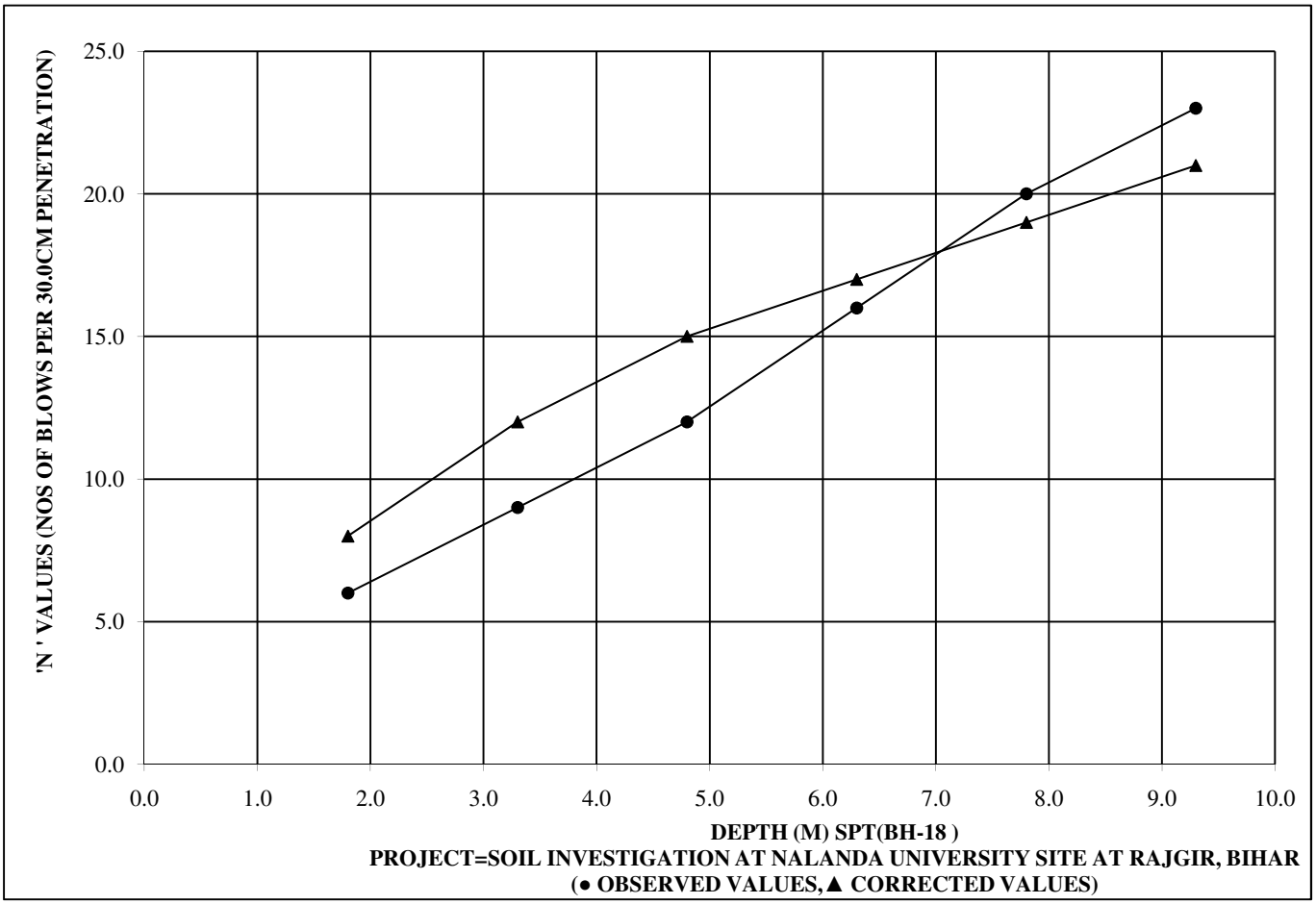

'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
DEPTH (M) SPT(BH-13 )
PROJECT=SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

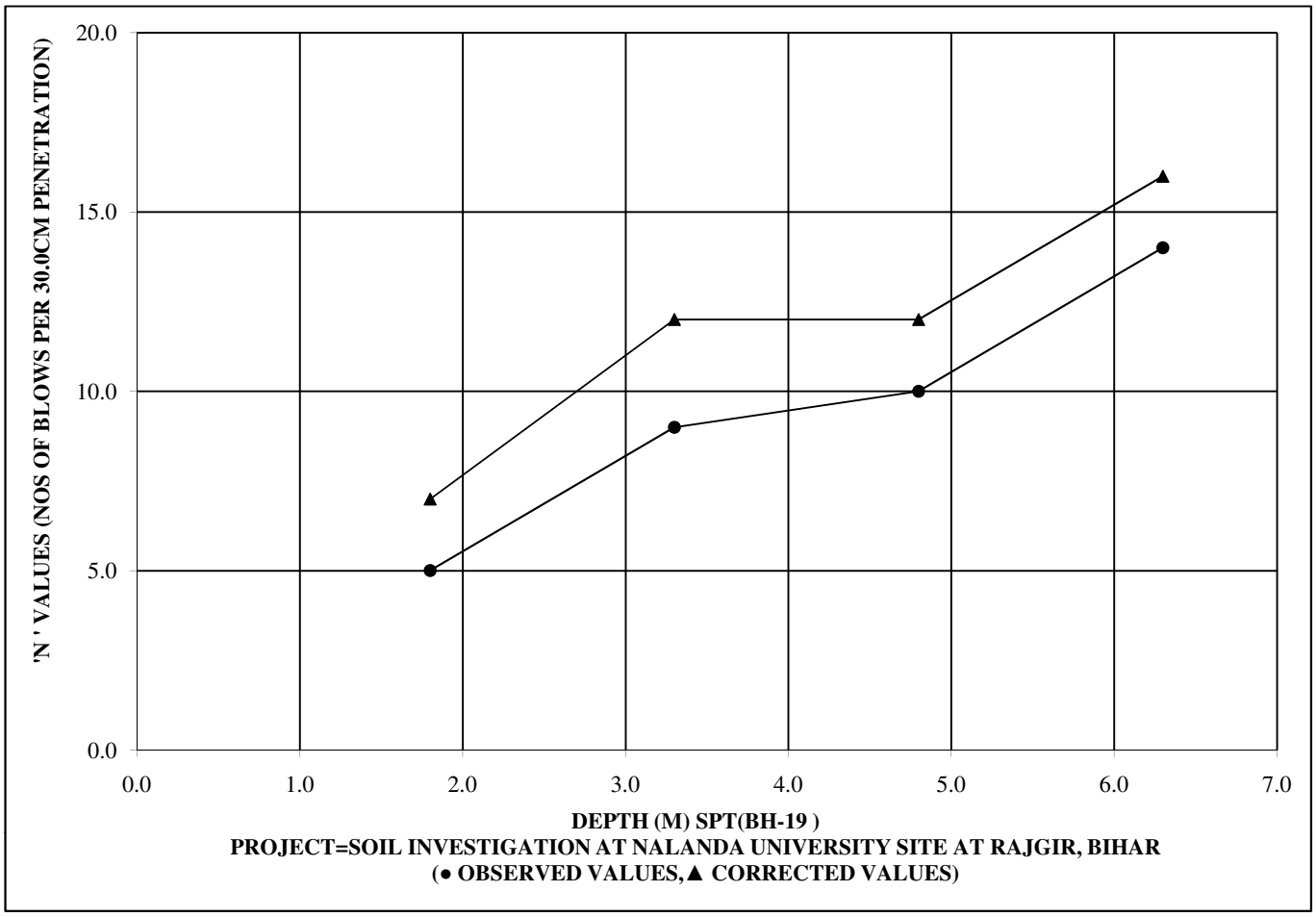

'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
DEPTH (M) SPT(BH-14 )
PROJECT=SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

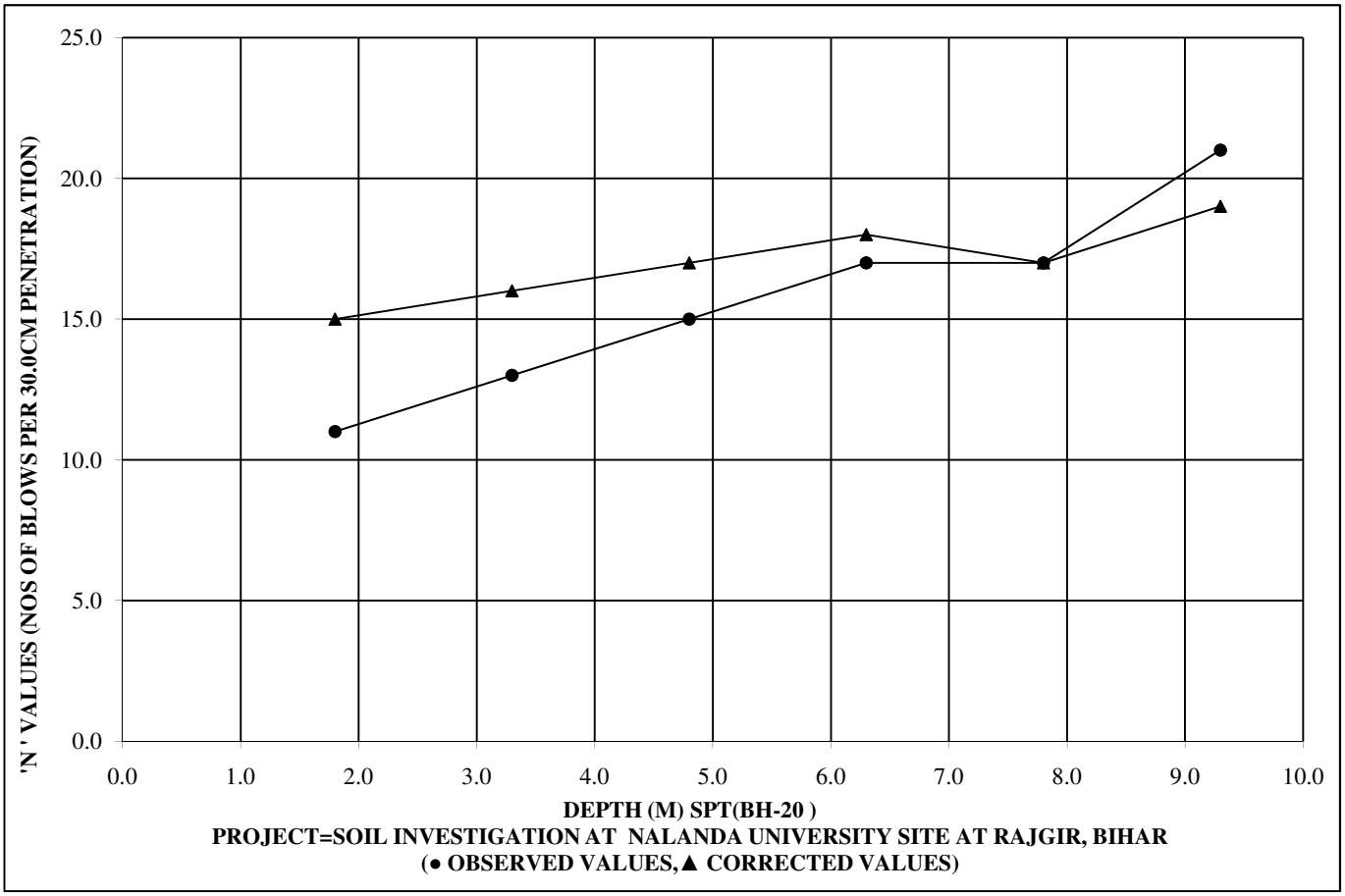

'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
DEPTH (M) SPT(BH-15 )
PROJECT=SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)


'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
DEPTH (M) SPT(BH-16 )
PROJECT=SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)


'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
DEPTH (M) SPT(BH-17 )
PROJECT= SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)


'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
25.0
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
DEPTH (M) SPT(BH-18 )
PROJECT=SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)


'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
DEPTH (M) SPT(BH-19 )
PROJECT=SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)


'N ' VALUES (NOS OF BLOWS PER 30.0CM PENETRATION)
25.0
20.0
15.0
10.0
5.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
DEPTH (M) SPT(BH-20 )
PROJECT=SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE AT RAJGIR, BIHAR
(● OBSERVED VALUES,▲ CORRECTED VALUES)

**OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOCATION** | | | | **PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.** | | | | | | | | | | |
| **TYPE OF SUB SOIL** | | | | **SILTY CLAY** | | | | | | | | | | |
| **DEPTH OF TEST** | | | | **1.50M BELOW G.L..** | | | | | | | | | | |
| **CONDTION OF TEST** | | | | **NATURAL MOISTURE CONDITION** | | | | | | | | | | |
| **SIZE OF PLATE** | | | | **30.0x 30.0SQUARE CM** | | | | | | | | | | |
| **SEATING LOAD** | | | | **126 KG** | | | | | | | | | | |
| | | | | | | | **TEST 1 LOCATION NO 4** | | | | | | | |
| | | | | **Dial Gauge -1** | | | **Dial Gauge -2** | | | | | | | |
| **Load (Kg)** | **Size of plate(cm)** | **Area of Plate (sqcm)** | **Pressure( Kg/sqcm)** | **Initial Settlements (mm)** | **Final settlements(mm)** | **Net Settlements(mm)** | **Initial Settlements(mm)** | **Final settlements(mm)** | **Net Settlements(mm)** | **Avg Settlement(mm)** | **Cumulative Settlements (mm) of Plate** | **Settlement of actual Footing 1.0 m wide** | **Settlement of actual Footing 2.0 m wide** | **Settlement of actual Footing 3.0 m wide** |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 0.00 | 2.80 | 2.80 | 0.00 | 3.36 | 3.36 | 3.08 | 3.08 | 7.29 | 9.32 | 10.18 |
| 2000.0 | 30.0 | 900.0 | 2.2222 | 2.80 | 5.75 | 2.95 | 3.36 | 6.04 | 2.68 | 2.82 | 5.90 | 13.95 | 17.83 | 19.49 |
| 3000.0 | 30.0 | 900.0 | 3.3333 | 5.75 | 11.25 | 5.50 | 6.04 | 11.35 | 5.31 | 5.41 | 11.30 | 26.75 | 34.18 | 37.36 |
| 4000.0 | 30.0 | 900.0 | 4.4444 | 11.25 | 17.25 | 6.00 | 11.35 | 17.56 | 6.21 | 6.11 | 17.41 | 41.20 | 52.64 | 57.54 |
| 5000.0 | 30.0 | 900.0 | 5.5556 | 17.25 | 25.23 | 7.98 | 17.56 | 25.36 | 7.80 | 7.89 | 25.30 | 59.87 | 76.51 | 83.62 |

**ALLOWABLE BEARING CAPACITY**

| **DEPTH OF FOOTING Below existing GL(M)** | **WIDTH OF FOOTING (M)** | **SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM** |
|---|---|---|
| | | **ISOLATED SQUARE/STRIP FOOTING** |
| 1.5 | 1.00 | 15.47 |
| 1.5 | 2.00 | 12.10 |
| 1.5 | 3.00 | 11.07 |

**OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOCATION** | | | | **PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.** | | | | | | | | | | | |
| **TYPE OF SUB SOIL** | | | | **SILTY CLAY** | | | | | | | | | | | |
| **DEPTH OF TEST** | | | | **1.50M BELOW G.L..** | | | | | | | | | | | |
| **CONDTION OF TEST** | | | | **NATURAL MOISTURE CONDITION** | | | | | | | | | | | |
| **SIZE OF PLATE** | | | | **30.0x 30.0SQUARE CM** | | | | | | | | | | | |
| **SEATING LO** | **1** | | | **126 KG** | | | | | | | | | | | |
| | | | | | | | **TEST 2 LOCATION NO 5** | | | | | | | | |
| | | | | **Dial Gauge -1** | | | **Dial Gauge -2** | | | | | | | | |
| **Load (Kg)** | **Size of plate(cm)** | **Area of Plate (sqcm)** | **Pressure( Kg/sqcm)** | **Initial Settlements (mm)** | **Final settlements(mm)** | **Net Settlements(mm)** | **Initial Settlements(mm)** | **Final settlements(mm)** | **Net Settlements(mm)** | **Avg Settlement(mm)** | **Cumulative Settlements (mm) of Plate** | **Settlement of actual Footing 1.0 m wide** | **Settlement of actual Footing 2.0 m wide** | **Settlement of actual Footing 3.0 m wide** | |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 2.22 | 2.22 | 0.00 | 2.05 | 2.05 | 2.14 | 2.14 | 5.05 | 6.46 | 7.06 | |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 2.22 | 5.75 | 1.34 | 2.05 | 5.43 | 3.38 | 2.36 | 4.50 | 10.64 | 13.60 | 14.86 | |
| 2000.0 | 30.0 | 900.0 | 2.2222 | 5.75 | 11.15 | 5.40 | 5.43 | 11.10 | 5.67 | 5.54 | 10.03 | 23.74 | 30.34 | 33.16 | |
| 3000.0 | 30.0 | 900.0 | 3.3333 | 11.15 | 16.48 | 5.33 | 11.10 | 16.17 | 5.07 | 5.20 | 15.23 | 36.05 | 46.06 | 50.35 | |
| 4500.0 | 30.0 | 900.0 | 5.0000 | 16.48 | 25.60 | 9.12 | 16.17 | 25.10 | 8.93 | 9.03 | 24.26 | 57.41 | 73.36 | 80.18 | |

**ALLOWABLE BEARING CAPACITY**

| **DEPTH OF FOOTING Below existing GL(M)** | **WIDTH OF FOOTING (M)** | **SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM** |
|---|---|---|
| | | **ISOLATED SQUARE/STRIP FOOTING** |
| 1.5 | 1.00 | 14.52 |
| 1.5 | 2.00 | 11.36 |
| 1.5 | 3.00 | 10.39 |

| OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | | | PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR. | | | | | | | | | | | |
| TYPE OF SUB SOIL | | | | SILTY CLAY | | | | | | | | | | | |
| DEPTH OF TEST | | | | 1.50M BELOW G.L.. | | | | | | | | | | | |
| CONDTION OF TEST | | | | NATURAL MOISTURE CONDITION | | | | | | | | | | | |
| SIZE OF PLATE | | | | 30.0x 30.0SQUARE CM | | | | | | | | | | | |
| SEATING LO | 1 | | | 126 KG | | | | | | | | | | | |
| | | | | | | | TEST 3 LOCATION NO 6 | | | | | | | | |
| | | | | Dial Gauge -1 | | | Dial Gauge -2 | | | | | | | | |
| Load (Kg) | Size of plate(cm) | Area of Plate (sqcm) | Pressure( Kg/sqcm) | Initial Settlements (mm) | Final settlements(mm) | Net Settlements(mm) | Initial Settlements(mm) | Final settlements(mm) | Net Settlements(mm) | Avg Settlement( mm) | Cumulative Settlements (mm) of Plate | Settlement of actual Footing 1.0 m wide | Settlement of actual Footing 2.0 m wide | Settlement of actual Footing 3.0 m wide | |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 4.23 | 4.23 | 0.00 | 5.33 | 5.33 | 4.78 | 4.78 | 11.31 | 14.46 | 15.80 | |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 4.23 | 8.78 | 4.55 | 5.33 | 9.54 | 4.21 | 4.38 | 9.16 | 21.68 | 27.71 | 30.28 | |
| 1500.0 | 30.0 | 900.0 | 1.6667 | 8.78 | 13.25 | 4.47 | 9.54 | 13.87 | 4.33 | 4.40 | 13.56 | 32.09 | 41.01 | 44.83 | |
| 2000.0 | 30.0 | 900.0 | 2.2222 | 13.25 | 18.45 | 5.20 | 13.87 | 18.54 | 4.67 | 4.94 | 18.50 | 43.78 | 55.94 | 61.14 | |
| 3000.0 | 30.0 | 900.0 | 3.3333 | 18.45 | 25.10 | 6.65 | 18.54 | 25.30 | 6.76 | 6.71 | 25.20 | 59.64 | 76.22 | 83.31 | |

| ALLOWABLE BEARING CAPACITY | | |
|---|---|---|
| DEPTH OF FOOTING Below existing GL(M) | WIDTH OF FOOTING (M) | SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM |
| | | ISOLATED SQUARE/STRIP FOOTING |
| 1.5 | 1.00 | 9.31 |
| 1.5 | 2.00 | 7.29 |
| 1.5 | 3.00 | 6.67 |

| OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | | PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR. | | | | | | | | | | | |
| TYPE OF SUB SOIL | | | SILTY CLAY | | | | | | | | | | | |
| DEPTH OF TEST | | | 1.50M BELOW G.L.. | | | | | | | | | | | |
| CONDTION OF TEST | | | NATURAL MOISTURE CONDITION | | | | | | | | | | | |
| SIZE OF PLATE | | | 30.0x 30.0SQUARE CM | | | | | | | | | | | |
| SEATING LOAD | | | 126 KG | | | | | | | | | | | |
| | | | | | | | TEST 4 LOCATION NO 8 | | | | | | | |
| Load (Kg) | Size of plate(cm) | Area of Plate (sqcm) | Pressure( Kg/sqcm) | Initial Settlements (mm) | Final settlements(mm) | Net Settlements(mm) | Initial Settlements(mm) | Final settlements(mm) | Net Settlements(mm) | Avg Settlement(mm) | Cumulative Settlements (mm) of Plate | Settlement of actual Footing 1.0 m wide | Settlement of actual Footing 2.0 m wide | Settlement of actual Footing 3.0 m wide |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 2.35 | 2.35 | 0.00 | 2.54 | 2.54 | 2.45 | 2.45 | 5.79 | 7.40 | 8.08 |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 2.35 | 7.58 | 5.23 | 2.54 | 8.45 | 5.91 | 5.57 | 8.02 | 18.97 | 24.24 | 26.50 |
| 1500.0 | 30.0 | 900.0 | 1.6667 | 7.58 | 15.26 | 7.68 | 8.45 | 16.25 | 7.80 | 7.74 | 15.76 | 37.29 | 47.65 | 52.08 |
| 2500.0 | 30.0 | 900.0 | 2.7778 | 15.26 | 25.10 | 9.84 | 16.25 | 25.23 | 8.98 | 9.41 | 25.17 | 59.56 | 76.11 | 83.19 |

| ALLOWABLE BEARING CAPACITY | | |
|---|---|---|
| DEPTH OF FOOTING Below existing GL(M) | WIDTH OF FOOTING (M) | SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM |
| | | ISOLATED SQUARE/STRIP FOOTING |
| 1.5 | 1.00 | 7.77 |
| 1.5 | 2.00 | 6.08 |
| 1.5 | 3.00 | 5.57 |

| OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | | | PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR. | | | | | | | | | | | |
| TYPE OF SUB SOIL | | | | SILTY CLAY | | | | | | | | | | | |
| DEPTH OF TEST | | | | 1.50M BELOW G.L.. | | | | | | | | | | | |
| CONDTION OF TEST | | | | NATURAL MOISTURE CONDITION | | | | | | | | | | | |
| SIZE OF PLA | 1 | | | 30.0x 30.0SQUARE CM | | | | | | | | | | | |
| SEATING LOAD | | | | 126 KG | | | | | | | | | | | |
| | | | | | | | TEST 5 LOCATION NO 3 | | | | | | | | |
| Load (Kg) | Size of plate(cm) | Area of Plate (sqcm) | Pressure( Kg/sqcm) | Initial Settlements (mm) | Final settlements(mm) | Net Settlements(mm) | Initial Settlements(mm) | Final settlements(mm) | Net Settlements(mm) | Avg Settlement( mm) | Cumulative Settlements (mm) of Plate | Settlement of actual Footing 1.0 m wide | Settlement of actual Footing 2.0 m wide | Settlement of actual Footing 3.0 m wide | |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 3.45 | 3.45 | 0.00 | 2.97 | 2.97 | 3.21 | 3.21 | 7.60 | 9.71 | 10.61 | |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 3.45 | 7.40 | 3.95 | 2.97 | 7.25 | 4.28 | 4.12 | 7.33 | 17.34 | 22.16 | 24.21 | |
| 1500.0 | 30.0 | 900.0 | 1.6667 | 7.40 | 11.40 | 4.00 | 7.25 | 11.27 | 4.02 | 4.01 | 11.34 | 26.83 | 34.28 | 37.47 | |
| 2000.0 | 30.0 | 900.0 | 2.2222 | 11.40 | 16.20 | 4.80 | 11.27 | 16.12 | 4.85 | 4.83 | 16.16 | 38.25 | 48.88 | 53.42 | |
| 2500.0 | 30.0 | 900.0 | 2.7778 | 16.20 | 19.97 | 3.77 | 16.12 | 19.98 | 3.86 | 3.82 | 19.98 | 47.28 | 60.42 | 66.03 | |
| 3000.0 | 30.0 | 900.0 | 3.3333 | 19.97 | 25.23 | 5.26 | 19.98 | 25.10 | 5.12 | 5.19 | 25.17 | 59.56 | 76.11 | 83.19 | |

| ALLOWABLE BEARING CAPACITY | | |
|---|---|---|
| DEPTH OF FOOTING Below existing GL(M) | WIDTH OF FOOTING (M) | SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM |
| | | ISOLATED SQUARE/STRIP FOOTING |
| 1.5 | 1.00 | 9.33 |
| 1.5 | 2.00 | 7.30 |
| 1.5 | 3.00 | 6.68 |

| OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | | | PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR. | | | | | | | | | | |
| TYPE OF SUB SOIL | | | | SILTY CLAY | | | | | | | | | | |
| DEPTH OF TEST | | | | 1.50M BELOW G.L.. | | | | | | | | | | |
| CONDTION OF TEST | | | | NATURAL MOISTURE CONDITION | | | | | | | | | | |
| SIZE OF PLA | 1 | | | 30.0x 30.0SQUARE CM | | | | | | | | | | |
| SEATING LOAD | | | | 126 KG | | | | | | | | | | |
| | | | | | | | TEST 6 LOCATION NO 12 | | | | | | | |
| Load (Kg) | Size of plate(cm) | Area of Plate (sqcm) | Pressure( Kg/sqcm) | Initial Settlements (mm) | Final settlements(mm) | Net Settlements(mm) | Initial Settlements(mm) | Final settlements(mm) | Net Settlements(mm) | Avg Settlement(mm) | Cumulative Settlements (mm) of Plate | Settlement of actual Footing 1.0 m wide | Settlement of actual Footing 2.0 m wide | Settlement of actual Footing 3.0 m wide |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 3.80 | 3.80 | 0.00 | 4.25 | 4.25 | 4.03 | 4.03 | 9.53 | 12.17 | 13.31 |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 3.80 | 8.75 | 4.95 | 4.25 | 9.52 | 5.27 | 5.11 | 9.14 | 21.62 | 27.63 | 30.20 |
| 1500.0 | 30.0 | 900.0 | 1.6667 | 8.75 | 17.05 | 8.30 | 9.52 | 17.93 | 8.41 | 8.36 | 17.49 | 41.40 | 52.90 | 57.82 |
| 2000.0 | 30.0 | 900.0 | 2.2222 | 17.05 | 25.30 | 8.25 | 17.93 | 25.45 | 7.52 | 7.89 | 25.38 | 60.06 | 76.75 | 83.88 |

| ALLOWABLE BEARING CAPACITY | | |
|---|---|---|
| DEPTH OF FOOTING Below existing GL(M) | WIDTH OF FOOTING (M) | SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM |
| | | ISOLATED SQUARE/STRIP FOOTING |
| 1.5 | 1.00 | 6.17 |
| 1.5 | 2.00 | 4.83 |
| 1.5 | 3.00 | 4.42 |

| OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | | | PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR. | | | | | | | | | | | |
| TYPE OF SUB SOIL | | | | SILTY CLAY | | | | | | | | | | | |
| DEPTH OF TEST | | | | 1.50M BELOW G.L.. | | | | | | | | | | | |
| CONDTION OF TEST | | | | NATURAL MOISTURE CONDITION | | | | | | | | | | | |
| SIZE OF PLA | 1 | | | 30.0x 30.0SQUARE CM | | | | | | | | | | | |
| SEATING LOAD | | | | 126 KG | | | | | | | | | | | |
| | | | | | | | TEST 7 LOCATION NO 9 | | | | | | | | |
| Load (Kg) | Size of plate(cm) | Area of Plate (sqcm) | Pressure( Kg/sqcm) | Initial Settlements (mm) | Final settlements(mm) | Net Settlements(mm) | Initial Settlements(mm) | Final settlements(mm) | Net Settlements(mm) | Avg Settlement( mm) | Cumulative Settlements (mm) of Plate | Settlement of actual Footing 1.0 m wide | Settlement of actual Footing 2.0 m wide | Settlement of actual Footing 3.0 m wide | |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 4.90 | 4.90 | 0.00 | 4.37 | 4.37 | 4.64 | 4.64 | 10.97 | 14.02 | 15.32 | |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 4.90 | 7.90 | 3.00 | 4.37 | 7.46 | 3.09 | 3.05 | 7.68 | 18.18 | 23.23 | 25.39 | |
| 1500.0 | 30.0 | 900.0 | 1.6667 | 7.90 | 12.45 | 4.55 | 7.46 | 12.33 | 4.87 | 4.71 | 12.39 | 29.33 | 37.47 | 40.96 | |
| 2500.0 | 30.0 | 900.0 | 2.7778 | 12.45 | 25.25 | 12.80 | 12.33 | 25.12 | 12.79 | 12.80 | 25.19 | 59.61 | 76.17 | 83.26 | |

| ALLOWABLE BEARING CAPACITY | | |
|---|---|---|
| DEPTH OF FOOTING Below existing GL(M) | WIDTH OF FOOTING (M) | SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM |
| | | ISOLATED SQUARE/STRIP FOOTING |
| 1.5 | 1.00 | 7.77 |
| 1.5 | 2.00 | 6.08 |
| 1.5 | 3.00 | 5.56 |

**OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOCATION** | | | | **PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.** | | | | | | | | | | | |
| **TYPE OF SUB SOIL** | | | | **SILTY CLAY** | | | | | | | | | | | |
| **DEPTH OF TEST** | | | | **1.50M BELOW G.L..** | | | | | | | | | | | |
| **CONDTION OF TEST** | | | | **NATURAL MOISTURE CONDITION** | | | | | | | | | | | |
| **SIZE OF PLA** | **1** | | | **30.0x 30.0SQUARE CM** | | | | | | | | | | | |
| **SEATING LOAD** | | | | **126 KG** | | | | | | | | | | | |
| | | | | | | | **TEST 8 LOCATION NO 13** | | | | | | | | |
| **Load (Kg)** | **Size of plate(cm)** | **Area of Plate (sqcm)** | **Pressure( Kg/sqcm)** | **Initial Settlements (mm)** | **Final settlements(mm)** | **Net Settlements(mm)** | **Initial Settlements(mm)** | **Final settlements(mm)** | **Net Settlements(mm)** | **Avg Settlement(mm)** | **Cumulative Settlements (mm) of Plate** | **Settlement of actual Footing 1.0 m wide** | **Settlement of actual Footing 2.0 m wide** | **Settlement of actual Footing 3.0 m wide** | |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 7.40 | 7.40 | 0.00 | 6.53 | 6.53 | 6.97 | 6.97 | 16.49 | 21.07 | 23.02 | |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 7.40 | 11.72 | 4.32 | 6.53 | 10.95 | 4.42 | 4.37 | 11.34 | 26.83 | 34.28 | 37.47 | |
| 1500.0 | 30.0 | 900.0 | 1.6667 | 11.72 | 18.75 | 7.03 | 10.95 | 17.95 | 7.00 | 7.02 | 18.35 | 43.43 | 55.50 | 60.66 | |
| 2000.0 | 30.0 | 900.0 | 2.2222 | 18.75 | 25.45 | 6.70 | 17.95 | 25.10 | 7.15 | 6.93 | 25.28 | 59.82 | 76.45 | 83.55 | |

**ALLOWABLE BEARING CAPACITY**

| **DEPTH OF FOOTING Below existing GL(M)** | **WIDTH OF FOOTING (M)** | **SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM** |
|---|---|---|
| | | **ISOLATED SQUARE/STRIP FOOTING** |
| 1.5 | 1.00 | 6.19 |
| 1.5 | 2.00 | 4.84 |
| 1.5 | 3.00 | 4.43 |

| OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | | | PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR. | | | | | | | | | | | |
| TYPE OF SUB SOIL | | | | SILTY CLAY | | | | | | | | | | | |
| DEPTH OF TEST | | | | 1.50M BELOW G.L.. | | | | | | | | | | | |
| CONDTION OF TEST | | | | NATURAL MOISTURE CONDITION | | | | | | | | | | | |
| SIZE OF PLA | 1 | | | 30.0x 30.0SQUARE CM | | | | | | | | | | | |
| SEATING LOAD | | | | 126 KG | | | | | | | | | | | |
| | | | | | | | TEST 9 LOCATION NO 14 | | | | | | | | |
| Load (Kg) | Size of plate(cm) | Area of Plate (sqcm) | Pressure( Kg/sqcm) | Initial Settlements (mm) | Final settlements(mm) | Net Settlements(mm) | Initial Settlements(mm) | Final settlements(mm) | Net Settlements(mm) | Avg Settlement( mm) | Cumulative Settlements (mm) of Plate | Settlement of actual Footing 1.0 m wide | Settlement of actual Footing 2.0 m wide | Settlement of actual Footing 3.0 m wide | |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 4.05 | 4.05 | 0.00 | 3.80 | 3.80 | 3.93 | 3.93 | 9.29 | 11.87 | 12.98 | |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 4.05 | 7.15 | 3.10 | 3.80 | 6.58 | 2.78 | 2.94 | 6.87 | 16.25 | 20.76 | 22.69 | |
| 1500.0 | 30.0 | 900.0 | 1.6667 | 7.15 | 10.32 | 3.17 | 6.58 | 9.20 | 2.62 | 2.90 | 9.76 | 23.10 | 29.52 | 32.26 | |
| 2000.0 | 30.0 | 900.0 | 2.2222 | 10.32 | 15.40 | 5.08 | 9.20 | 14.20 | 5.00 | 5.04 | 14.80 | 35.03 | 44.76 | 48.93 | |
| 2500.0 | 30.0 | 900.0 | 2.7778 | 15.40 | 20.25 | 4.85 | 14.20 | 19.75 | 5.55 | 5.20 | 20.00 | 47.34 | 60.49 | 66.12 | |
| 3000.0 | 30.0 | 900.0 | 3.3333 | 20.25 | 25.30 | 5.05 | 19.75 | 25.10 | 5.35 | 5.20 | 25.20 | 59.64 | 76.22 | 83.31 | |

| ALLOWABLE BEARING CAPACITY | | |
|---|---|---|
| DEPTH OF FOOTING Below existing GL(M) | WIDTH OF FOOTING (M) | SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS [illegible] |
| | | ISOLATED SQUARE/STRIP FOOTING |
| 1.5 | 1.00 | 9.31 |
| 1.5 | 2.00 | 7.29 |
| 1.5 | 3.00 | 6.67 |

| OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | | | PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR. | | | | | | | | | | | |
| TYPE OF SUB SOIL | | | | SILTY CLAY | | | | | | | | | | | |
| DEPTH OF TEST | | | | 1.50M BELOW G.L.. | | | | | | | | | | | |
| CONDTION OF TEST | | | | NATURAL MOISTURE CONDITION | | | | | | | | | | | |
| SIZE OF PLA | 1 | | | 30.0x 30.0SQUARE CM | | | | | | | | | | | |
| SEATING LOAD | | | | 126 KG | | | | | | | | | | | |
| | | | | | | | TEST 10 LOCATION NO 15 | | | | | | | | |
| Load (Kg) | Size of plate(cm) | Area of Plate (sqcm) | Pressure( Kg/sqcm) | Initial Settlements (mm) | Final settlements(mm) | Net Settlements(mm) | Initial Settlements(mm) | Final settlements(mm) | Net Settlements(mm) | Avg Settlement( mm) | Cumulative Settlements (mm) of Plate | Settlement of actual Footing 1.0 m wide | Settlement of actual Footing 2.0 m wide | Settlement of actual Footing 3.0 m wide | |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 2.12 | 2.12 | 0.00 | 1.95 | 1.95 | 2.04 | 2.04 | 4.82 | 6.16 | 6.73 | |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 2.12 | 4.22 | 2.10 | 1.95 | 3.95 | 2.00 | 2.05 | 4.09 | 9.67 | 12.36 | 13.50 | |
| 2000.0 | 30.0 | 900.0 | 2.2222 | 4.22 | 9.17 | 4.95 | 3.95 | 8.78 | 4.83 | 4.89 | 8.98 | 21.24 | 27.15 | 29.67 | |
| 3000.0 | 30.0 | 900.0 | 3.3333 | 9.17 | 14.65 | 5.48 | 8.78 | 14.45 | 5.67 | 5.58 | 14.55 | 34.44 | 44.01 | 48.10 | |
| 4000.0 | 30.0 | 900.0 | 4.4444 | 14.65 | 19.90 | 5.25 | 14.45 | 19.81 | 5.36 | 5.31 | 19.86 | 46.99 | 60.05 | 65.64 | |
| 5000.0 | 30.0 | 900.0 | 5.5556 | 19.90 | 25.30 | 5.40 | 19.81 | 25.10 | 5.29 | 5.35 | 25.20 | 59.64 | 76.22 | 83.31 | |

| ALLOWABLE BEARING CAPACITY | | |
|---|---|---|
| DEPTH OF FOOTING Below existing GL(M) | WIDTH OF FOOTING (M) | SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM |
| | | ISOLATED SQUARE/STRIP FOOTING |
| 1.5 | 1.00 | 15.52 |
| 1.5 | 2.00 | 12.15 |
| 1.5 | 3.00 | 11.11 |

| OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | | | PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , | | | | | | | | | | | |
| TYPE OF SUB SOIL | | | | SILTY CLAY | | | | | | | | | | | |
| DEPTH OF TEST | | | | 1.50M BELOW G.L.. | | | | | | | | | | | |
| CONDTION OF TEST | | | | NATURAL MOISTURE CONDITION | | | | | | | | | | | |
| SIZE OF PLA | 1 | | | 30.0x 30.0SQUARE CM | | | | | | | | | | | |
| SEATING LOAD | | | | 126 KG | | | | | | | | | | | |
| | | | | | | | TEST 11 LOCATION NO 16 | | | | | | | | |
| Load (Kg) | Size of plate(cm) | Area of Plate (sqcm) | Pressure( Kg/sqcm) | Initial Settlements (mm) | Final settlements(mm) | Net Settlements(mm) | Initial Settlements(mm) | Final settlements(mm) | Net Settlements(mm) | Avg Settlement(mm) | Cumulative Settlements (mm) of Plate | Settlement of actual Footing 1.0 m wide | Settlement of actual Footing 2.0 m wide | Settlement of actual Footing 3.0 m wide | |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 1.45 | 1.45 | 0.00 | 1.30 | 1.30 | 1.38 | 1.38 | 3.25 | 4.16 | 4.55 | |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 1.45 | 2.54 | 1.09 | 1.30 | 3.1 | 1.80 | 1.45 | 2.82 | 6.67 | 8.53 | 9.32 | |
| 2000.0 | 30.0 | 900.0 | 2.2222 | 2.54 | 5.14 | 2.60 | 3.10 | 5.25 | 2.15 | 2.38 | 5.20 | 12.30 | 15.71 | 17.17 | |
| 3000.0 | 30.0 | 900.0 | 3.3333 | 5.14 | 9.58 | 4.44 | 5.25 | 8.25 | 3.00 | 3.72 | 8.92 | 21.10 | 26.96 | 29.47 | |
| 4000.0 | 30.0 | 900.0 | 4.4444 | 9.58 | 14.26 | 4.68 | 8.25 | 13.25 | 5.00 | 4.84 | 13.76 | 32.56 | 41.60 | 45.47 | |
| 5000.0 | 30.0 | 900.0 | 5.5556 | 14.26 | 17.75 | 3.49 | 13.25 | 18.70 | 5.45 | 4.47 | 18.23 | 43.14 | 55.12 | 60.25 | |
| 6000.0 | 30.0 | 900.0 | 6.6667 | 17.75 | 25.10 | 7.35 | 18.70 | 25.35 | 6.65 | 7.00 | 25.23 | 59.70 | 76.29 | 83.39 | |

| ALLOWABLE BEARING CAPACITY | | |
|---|---|---|
| DEPTH OF FOOTING Below existing GL(M) | WIDTH OF FOOTING (M) | SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM |
| | | ISOLATED SQUARE/STRIP FOOTING |
| 1.5 | 1.00 | 18.61 |
| 1.5 | 2.00 | 14.56 |
| 1.5 | 3.00 | 13.32 |

| OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | | | SILTY CLAY | | | | | | | | | | | |
| TYPE OF SUB SOIL | | | | PROJECT NALANDA RAJGIR | | | | | | | | | | | |
| DEPTH OF TEST | | | | SILTY CLAY | | | | | | | | | | | |
| CONDTION OF TEST | | | | 1.50M BELOW G.L.. | | | | | | | | | | | |
| SIZE OF PLATE | | | | NATURAL MOISTURE CONDITION | | | | | | | | | | | |
| SEATING LO | 1 | | | 30.0x 30.0SQUARE CM | | | | | | | | | | | |
| | | | | 126 KG | | | | | | | | | | | |
| | | | | | | | TEST 12 LOCATION NO 19 | | | | | | | | |
| Load (Kg) | Size of plate(cm) | Area of Plate (sqcm) | Pressure( Kg/sqcm) | Initial Settlements (mm) | Final settlements(mm) | Net Settlements(mm) | Initial Settlements(mm) | Final settlements(mm) | Net Settlements(mm) | Avg Settlement( mm) | Cumulative Settlements (mm) of Plate | Settlement of actual Footing 1.0 m wide | Settlement of actual Footing 2.0 m wide | Settlement of actual Footing 3.0 m wide | |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 8.54 | 8.54 | 0.00 | 8.25 | 8.25 | 8.40 | 8.40 | 19.87 | 25.39 | 27.75 | |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 8.54 | 17.58 | 9.04 | 8.25 | 16.54 | 8.29 | 8.67 | 17.06 | 40.38 | 51.60 | 56.40 | |
| 1500.0 | 30.0 | 900.0 | 1.6667 | 17.58 | 25.12 | 7.54 | 16.54 | 25.10 | 8.56 | 8.05 | 25.11 | 59.43 | 75.95 | 83.01 | |

| ALLOWABLE BEARING CAPACITY | | |
|---|---|---|
| DEPTH OF FOOTING Below existing GL(M) | WIDTH OF FOOTING (M) | SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM |
| | | ISOLATED SQUARE/STRIP FOOTING |
| 1.5 | 1.00 | 4.67 |
| 1.5 | 2.00 | 3.66 |
| 1.5 | 3.00 | 3.35 |

| OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | | | SILTY CLAY | | | | | | | | | | | |
| TYPE OF SUB SOIL | | | | PROJECT NALANDA RAJGIR | | | | | | | | | | | |
| DEPTH OF TEST | | | | SILTY CLAY | | | | | | | | | | | |
| CONDTION OF TEST | | | | 1.50M BELOW G.L.. | | | | | | | | | | | |
| SIZE OF PLATE | | | | NATURAL MOISTURE CONDITION | | | | | | | | | | | |
| SEATING LO | 1 | | | 30.0x 30.0SQUARE CM | | | | | | | | | | | |
| | | | | 126 KG | | | | | | | | | | | |
| | | | | | | | TEST 13 LOCATION NO 18 | | | | | | | | |
| Load (Kg) | Size of plate(cm) | Area of Plate (sqcm) | Pressure( Kg/sqcm) | Initial Settlements (mm) | Final settlements(mm) | Net Settlements(mm) | Initial Settlements(mm) | Final settlements(mm) | Net Settlements(mm) | Avg Settlement( mm) | Cumulative Settlements (mm) of Plate | Settlement of actual Footing 1.0 m wide | Settlement of actual Footing 2.0 m wide | Settlement of actual Footing 3.0 m wide | |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 7.45 | 7.45 | 0.00 | 8.12 | 8.12 | 7.79 | 7.79 | 18.43 | 23.55 | 25.74 | |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 7.45 | 15.34 | 7.89 | 8.12 | 16.45 | 8.33 | 8.11 | 15.90 | 37.62 | 48.08 | 52.55 | |
| 1500.0 | 30.0 | 900.0 | 1.6667 | 15.34 | 25.40 | 10.06 | 16.45 | 25.30 | 8.85 | 9.46 | 25.35 | 60.00 | 76.67 | 83.80 | |

| ALLOWABLE BEARING CAPACITY | | |
|---|---|---|
| DEPTH OF FOOTING Below existing GL(M) | WIDTH OF FOOTING (M) | SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM |
| | | ISOLATED SQUARE/STRIP FOOTING |
| 1.5 | 1.00 | 4.63 |
| 1.5 | 2.00 | 3.62 |
| 1.5 | 3.00 | 3.31 |

| OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | | | SILTY CLAY | | | | | | | | | | | |
| TYPE OF SUB SOIL | | | | PROJECT NALANDA RAJGIR | | | | | | | | | | | |
| DEPTH OF TEST | | | | SILTY CLAY | | | | | | | | | | | |
| CONDTION OF TEST | | | | 1.50M BELOW G.L.. | | | | | | | | | | | |
| SIZE OF PLATE | | | | NATURAL MOISTURE CONDITION | | | | | | | | | | | |
| SEATING LO | 1 | | | 30.0x 30.0SQUARE CM | | | | | | | | | | | |
| | | | | 126 KG | | | | | | | | | | | |
| | | | | | | | TEST 14 LOCATION NO 17 | | | | | | | | |
| Load (Kg) | Size of plate(cm) | Area of Plate (sqcm) | Pressure( Kg/sqcm) | Initial Settlements (mm) | Final settlements(mm) | Net Settlements(mm) | Initial Settlements(mm) | Final settlements(mm) | Net Settlements(mm) | Avg Settlement( mm) | Cumulative Settlements (mm) of Plate | Settlement of actual Footing 1.0 m wide | Settlement of actual Footing 2.0 m wide | Settlement of actual Footing 3.0 m wide | |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 12.45 | 12.45 | 0.00 | 11.25 | 11.25 | 11.85 | 11.85 | 28.05 | 35.84 | 39.17 | |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 12.45 | 25.12 | 12.67 | 11.25 | 25.35 | 14.10 | 13.39 | 25.24 | 59.73 | 76.33 | 83.42 | |

| ALLOWABLE BEARING CAPACITY | | |
|---|---|---|
| DEPTH OF FOOTING Below existing GL(M) | WIDTH OF FOOTING (M) | SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM |
| | | ISOLATED SQUARE/STRIP FOOTING |
| 1.5 | 1.00 | 3.10 |
| 1.5 | 2.00 | 2.43 |
| 1.5 | 3.00 | 2.22 |

| OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | | | SILTY CLAY | | | | | | | | | | | |
| TYPE OF SUB SOIL | | | | PROJECT NALANDA RAJGIR | | | | | | | | | | | |
| DEPTH OF TEST | | | | SILTY CLAY | | | | | | | | | | | |
| CONDTION OF TEST | | | | 1.50M BELOW G.L.. | | | | | | | | | | | |
| SIZE OF PLATE | | | | NATURAL MOISTURE CONDITION | | | | | | | | | | | |
| SEATING LO | 1 | | | 30.0x 30.0SQUARE CM | | | | | | | | | | | |
| | | | | 126 KG | | | | | | | | | | | |
| | | | | | | | TEST 15 LOCATION NO 2. | | | | | | | | |
| Load (Kg) | Size of plate(cm) | Area of Plate (sqcm) | Pressure( Kg/sqcm) | Initial Settlements (mm) | Final settlements(mm) | Net Settlements(mm) | Initial Settlements(mm) | Final settlements(mm) | Net Settlements(mm) | Avg Settlement( mm) | Cumulative Settlements (mm) of Plate | Settlement of actual Footing 1.0 m wide | Settlement of actual Footing 2.0 m wide | Settlement of actual Footing 3.0 m wide | |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 1.45 | 1.45 | 0.00 | 1.55 | 1.55 | 1.50 | 1.50 | 3.55 | 4.54 | 4.96 | |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 1.45 | 4.57 | 3.12 | 1.55 | 4.75 | 3.20 | 3.16 | 4.66 | 11.03 | 14.09 | 15.40 | |
| 1500.0 | 30.0 | 900.0 | 1.6667 | 4.57 | 12.90 | 8.33 | 4.75 | 14.27 | 9.52 | 8.93 | 13.59 | 32.15 | 41.09 | 44.91 | |
| 2000.0 | 30.0 | 900.0 | 2.2222 | 12.90 | 25.10 | 12.20 | 14.27 | 25.32 | 11.05 | 11.63 | 25.21 | 59.67 | 76.25 | 83.34 | |

| ALLOWABLE BEARING CAPACITY | | |
|---|---|---|
| DEPTH OF FOOTING Below existing GL(M) | WIDTH OF FOOTING (M) | SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM |
| | | ISOLATED SQUARE/STRIP FOOTING |
| 1.5 | 1.00 | 6.21 |
| 1.5 | 2.00 | 4.86 |
| 1.5 | 3.00 | 4.44 |

| OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | | | SILTY CLAY | | | | | | | | | | | |
| TYPE OF SUB SOIL | | | | PROJECT NALANDA RAJGIR | | | | | | | | | | | |
| DEPTH OF TEST | | | | SILTY CLAY | | | | | | | | | | | |
| CONDTION OF TEST | | | | 1.50M BELOW G.L.. | | | | | | | | | | | |
| SIZE OF PLATE | | | | NATURAL MOISTURE CONDITION | | | | | | | | | | | |
| SEATING LO | 1 | | | 30.0x 30.0SQUARE CM | | | | | | | | | | | |
| | | | | 126 KG | | | | | | | | | | | |
| | | | | | | | TEST 16 LOCATION NO 1 | | | | | | | | |
| Load (Kg) | Size of plate(cm) | Area of Plate (sqcm) | Pressure( Kg/sqcm) | Initial Settlements (mm) | Final settlements(mm) | Net Settlements(mm) | Initial Settlements(mm) | Final settlements(mm) | Net Settlements(mm) | Avg Settlement( mm) | Cumulative Settlements (mm) of Plate | Settlement of actual Footing 1.0 m wide | Settlement of actual Footing 2.0 m wide | Settlement of actual Footing 3.0 m wide | |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 1.60 | 1.60 | 0.00 | 1.63 | 1.63 | 1.62 | 1.62 | 3.82 | 4.88 | 5.34 | |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 1.60 | 4.51 | 1.34 | 1.63 | 4.25 | 2.62 | 1.98 | 3.60 | 8.51 | 10.87 | 11.88 | |
| 2000.0 | 30.0 | 900.0 | 2.2222 | 4.51 | 9.50 | 4.99 | 4.25 | 9.45 | 5.20 | 5.10 | 8.69 | 20.57 | 26.28 | 28.73 | |
| 3000.0 | 30.0 | 900.0 | 3.3333 | 9.50 | 16.45 | 6.95 | 9.45 | 16.20 | 6.75 | 6.85 | 15.54 | 36.78 | 47.00 | 51.37 | |
| 4000.0 | 30.0 | 900.0 | 4.4444 | 16.45 | 22.70 | 6.25 | 16.20 | 23.18 | 6.98 | 6.62 | 22.16 | 52.44 | 67.01 | 73.24 | |
| 4500.0 | 30.0 | 900.0 | 5.0000 | 22.70 | 25.15 | 2.45 | 23.18 | 25.40 | 2.22 | 2.34 | 24.49 | 57.96 | 74.07 | 80.96 | |

| ALLOWABLE BEARING CAPACITY | | |
|---|---|---|
| DEPTH OF FOOTING Below existing GL(M) | WIDTH OF FOOTING (M) | SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM |
| | | ISOLATED SQUARE/STRIP FOOTING |
| 1.5 | 1.00 | 14.38 |
| 1.5 | 2.00 | 11.25 |
| 1.5 | 3.00 | 10.29 |

| OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | | | SILTY CLAY | | | | | | | | | | | |
| TYPE OF SUB SOIL | | | | PROJECT NALANDA RAJGIR | | | | | | | | | | | |
| DEPTH OF TEST | | | | SILTY CLAY | | | | | | | | | | | |
| CONDTION OF TEST | | | | 1.50M BELOW G.L.. | | | | | | | | | | | |
| SIZE OF PLATE | | | | NATURAL MOISTURE CONDITION | | | | | | | | | | | |
| SEATING LO | 1 | | | 30.0x 30.0SQUARE CM | | | | | | | | | | | |
| | | | | 126 KG | | | | | | | | | | | |
| | | | | | | | TEST 17 LOCATION NO 11 | | | | | | | | |
| Load (Kg) | Size of plate(cm) | Area of Plate (sqcm) | Pressure( Kg/sqcm) | Initial Settlements (mm) | Final settlements(mm) | Net Settlements(mm) | Initial Settlements(mm) | Final settlements(mm) | Net Settlements(mm) | Avg Settlement( mm) | Cumulative Settlements (mm) of Plate | Settlement of actual Footing 1.0 m wide | Settlement of actual Footing 2.0 m wide | Settlement of actual Footing 3.0 m wide | |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 3.25 | 3.25 | 0.00 | 3.45 | 3.45 | 3.35 | 3.35 | 7.93 | 10.13 | 11.07 | |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 3.25 | 7.12 | 3.87 | 3.45 | 6.52 | 3.07 | 3.47 | 6.82 | 16.14 | 20.63 | 22.55 | |
| 2000.0 | 30.0 | 900.0 | 2.2222 | 7.12 | 12.60 | 5.48 | 6.52 | 12.47 | 5.95 | 5.72 | 12.54 | 29.67 | 37.91 | 41.44 | |
| 3000.0 | 30.0 | 900.0 | 3.3333 | 12.60 | 18.25 | 5.65 | 12.47 | 18.05 | 5.58 | 5.62 | 18.15 | 42.96 | 54.90 | 60.00 | |
| 4000.0 | 30.0 | 900.0 | 4.4444 | 18.25 | 25.32 | 7.07 | 18.05 | 25.15 | 7.10 | 7.09 | 25.24 | 59.73 | 76.33 | 83.42 | |

| ALLOWABLE BEARING CAPACITY | | |
|---|---|---|
| DEPTH OF FOOTING Below existing GL(M) | WIDTH OF FOOTING (M) | SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM |
| | | ISOLATED SQUARE/STRIP FOOTING |
| 1.5 | 1.00 | 12.40 |
| 1.5 | 2.00 | 9.71 |
| 1.5 | 3.00 | 8.88 |

| OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | | | SILTY CLAY | | | | | | | | | | | |
| TYPE OF SUB SOIL | | | | PROJECT NALANDA RAJGIR | | | | | | | | | | | |
| DEPTH OF TEST | | | | SILTY CLAY | | | | | | | | | | | |
| CONDTION OF TEST | | | | 1.50M BELOW G.L.. | | | | | | | | | | | |
| SIZE OF PLATE | | | | NATURAL MOISTURE CONDITION | | | | | | | | | | | |
| SEATING LO | 1 | | | 30.0x 30.0SQUARE CM | | | | | | | | | | | |
| | | | | 126 KG | | | | | | | | | | | |
| | | | | | | | TEST 18 LOCATION NO 10 | | | | | | | | |
| Load (Kg) | Size of plate(cm) | Area of Plate (sqcm) | Pressure( Kg/sqcm) | Initial Settlements (mm) | Final settlements(mm) | Net Settlements(mm) | Initial Settlements(mm) | Final settlements(mm) | Net Settlements(mm) | Avg Settlement( mm) | Cumulative Settlements (mm) of Plate | Settlement of actual Footing 1.0 m wide | Settlement of actual Footing 2.0 m wide | Settlement of actual Footing 3.0 m wide | |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 3.42 | 3.42 | 0.00 | 3.90 | 3.90 | 3.66 | 3.66 | 8.66 | 11.07 | 12.10 | |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 3.42 | 6.90 | 3.48 | 3.90 | 7.7 | 3.80 | 3.64 | 7.30 | 17.28 | 22.08 | 24.13 | |
| 1500.0 | 30.0 | 900.0 | 1.6667 | 6.90 | 12.55 | 5.65 | 7.70 | 12.85 | 5.15 | 5.40 | 12.70 | 30.06 | 38.41 | 41.98 | |
| 2000.0 | 30.0 | 900.0 | 2.2222 | 12.55 | 18.54 | 5.99 | 12.85 | 18.24 | 5.39 | 5.69 | 18.39 | 43.53 | 55.62 | 60.79 | |
| 2500.0 | 30.0 | 900.0 | 2.7778 | 18.54 | 25.32 | 6.78 | 18.24 | 25.15 | 6.91 | 6.85 | 25.24 | 59.73 | 76.33 | 83.42 | |

| ALLOWABLE BEARING CAPACITY | | |
|---|---|---|
| DEPTH OF FOOTING Below existing GL(M) | WIDTH OF FOOTING (M) | SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM |
| | | ISOLATED SQUARE/STRIP FOOTING |
| 1.5 | 1.00 | 7.75 |
| 1.5 | 2.00 | 6.07 |
| 1.5 | 3.00 | 5.55 |

| OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | | | SILTY CLAY | | | | | | | | | | | |
| TYPE OF SUB SOIL | | | | PROJECT NALANDA RAJGIR | | | | | | | | | | | |
| DEPTH OF TEST | | | | SILTY CLAY | | | | | | | | | | | |
| CONDTION OF TEST | | | | 1.50M BELOW G.L.. | | | | | | | | | | | |
| SIZE OF PLATE | | | | NATURAL MOISTURE CONDITION | | | | | | | | | | | |
| SEATING LO | 1 | | | 30.0x 30.0SQUARE CM | | | | | | | | | | | |
| | | | | 126 KG | | | | | | | | | | | |
| | | | | | | | TEST 19 LOCATION NO 7 | | | | | | | | |
| Load (Kg) | Size of plate(cm) | Area of Plate (sqcm) | Pressure( Kg/sqcm) | Initial Settlements (mm) | Final settlements(mm) | Net Settlements(mm) | Initial Settlements(mm) | Final settlements(mm) | Net Settlements(mm) | Avg Settlement( mm) | Cumulative Settlements (mm) of Plate | Settlement of actual Footing 1.0 m wide | Settlement of actual Footing 2.0 m wide | Settlement of actual Footing 3.0 m wide | |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 4.25 | 4.25 | 0.00 | 4.58 | 4.58 | 4.42 | 4.42 | 10.45 | 13.35 | 14.60 | |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 4.25 | 9.45 | 5.20 | 4.58 | 9.6 | 5.02 | 5.11 | 9.53 | 22.54 | 28.81 | 31.49 | |
| 1500.0 | 30.0 | 900.0 | 1.6667 | 9.45 | 14.85 | 5.40 | 9.60 | 15.30 | 5.70 | 5.55 | 15.08 | 35.68 | 45.60 | 49.83 | |
| 2000.0 | 30.0 | 900.0 | 2.2222 | 14.85 | 25.10 | 10.25 | 15.30 | 25.30 | 10.00 | 10.13 | 25.20 | 59.64 | 76.22 | 83.31 | |

| ALLOWABLE BEARING CAPACITY | | | | MODULUD OF SUBGRADE REACTION Kg/cm3 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH OF FOOTING Below existing GL(M) | WIDTH OF FOOTING (M) | SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM | | PLATE SIZE CM | Pressure (Kg/sqcm) at 1.25 mm Settlement | Final settlements( mm) | Un corrected MODULUS OF SUBGRADE REACTION (K) (Kg/cm3) (As Per Corrected Load Settlement Curve) | CORRECTION FOR PLATE SIZE EQ. 75.0 CM K VALUES as per clause 5.1.1 Fig 3 | CORRECTION FOR LOAD DEFLECTION CURVE AS PER 5.1.2 | CORRECTION FOR BENDING OF PLATE AS PER 5.1.3 | CORRECTION FOR SATURATION as per IS 9214-1979 clauses 5.1.4.1 to 5.1.4.4 |
| | | ISOLATED SQUARE/STRIP FOOTING | | 30.0 | 0.220 | 0.125 | 1.76 | 0.70 | - | 0.70 | 0.63 |
| 1.5 | 1.00 | 6.21 | | | | | | | | | |
| 1.5 | 2.00 | 4.86 | | | | | | | | | |
| 1.5 | 3.00 | 4.45 | | | | | | | | | |

| OBSERVATION AND CALCULATION FOR DETERMINATION OF MODULUS OF SUBGRADE REACTION AS PER IS 1888:1982 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | | | 1.50M BELOW G.L.. | | | | | | | | | | |
| TYPE OF SUB SOIL | | | | PROJECT NALANDA RAJGIR | | | | | | | | | | |
| DEPTH OF TEST | | | | SILTY CLAY | | | | | | | | | | |
| CONDTION OF TEST | | | | 1.50M BELOW G.L.. | | | | | | | | | | |
| SIZE OF PLATE | | | | NATURAL MOISTURE CONDITION | | | | | | | | | | |
| SEATING LO | 1 | | | 30.0x 30.0SQUARE CM | | | | | | | | | | |
| | | | | 126 KG | | | | | | | | | | |
| | | | | | | | TEST 20 LOCATION NO 20 | | | | | | | |
| Load (Kg) | Size of plate(cm) | Area of Plate (sqcm) | Pressure( Kg/sqcm) | Initial Settlements (mm) | Final settlements(mm) | Net Settlements(mm) | Initial Settlements(mm) | Final settlements(mm) | Net Settlements(mm) | Avg Settlement(mm) | Cumulative Settlements (mm) of Plate | Settlement of actual Footing 1.0 m wide | Settlement of actual Footing 2.0 m wide | Settlement of actual Footing 3.0 m wide |
| 0.0 | 30.0 | 900.0 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 500.0 | 30.0 | 900.0 | 0.5556 | 0.00 | 7.85 | 7.85 | 0.00 | 7.97 | 7.97 | 7.91 | 7.91 | 18.72 | 23.92 | 26.15 |
| 1000.0 | 30.0 | 900.0 | 1.1111 | 7.85 | 13.92 | 6.07 | 7.97 | 14.25 | 6.28 | 6.18 | 14.09 | 33.34 | 42.60 | 46.56 |
| 2000.0 | 30.0 | 900.0 | 2.2222 | 13.92 | 25.13 | 11.21 | 14.25 | 25.40 | 11.15 | 11.18 | 25.27 | 59.80 | 76.42 | 83.52 |

| ALLOWABLE BEARING CAPACITY | | | | MODULUD OF SUBGRADE REACTION Kg/cm3 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH OF FOOTING Below existing GL(M) | WIDTH OF FOOTING (M) | SAFE/ALLOWABLE BEARING CAPACITY T/M2 (CONSIDERING ALLOWABLE SETTLEMENT AS 50.0 MM | | PLATE SIZE CM | Pressure (Kg/sqcm) at 1.25 mm Settlement | Final settlements( mm) | Un corrected MODULUS OF SUBGRADE REACTION (K) (Kg/cm3) (As Per Corrected Load Settlement Curve) | CORRECTION FOR PLATE SIZE EQ. 75.0 CM K VALUES as per clause 5.1.1 Fig 3 | CORRECTION FOR LOAD DEFLECTION CURVE AS PER 5.1.2 | CORRECTION FOR BENDING OF PLATE AS PER 5.1.3 | CORRECTION FOR SATURATION as per IS 9214-1979 clauses 5.1.4.1 to 5.1.4.4 |
| | | ISOLATED SQUARE/STRIP FOOTING | | 30.0 | 0.210 | 0.125 | 1.68 | 0.67 | - | 0.67 | 0.60 |
| 1.5 | 1.00 | 6.19 | | | | | | | | | |
| 1.5 | 2.00 | 4.85 | | | | | | | | | |
| 1.5 | 3.00 | 4.43 | | | | | | | | | |

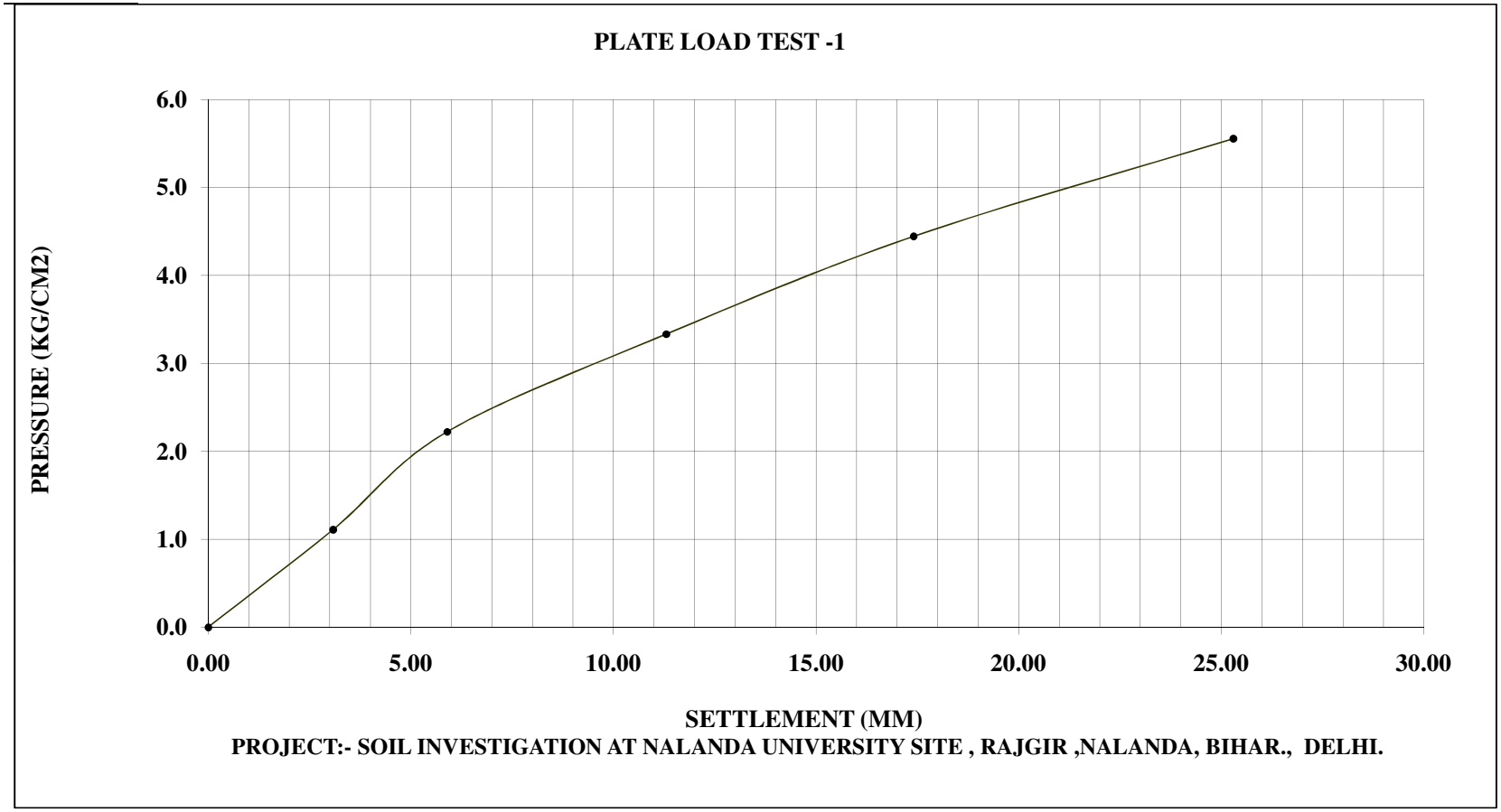


PLATE LOAD TEST -1
PRESSURE (KG/CM2)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.00
5.00
10.00
15.00
20.00
25.00
30.00
SETTLEMENT (MM)
PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR ,NALANDA, BIHAR., DELHI.

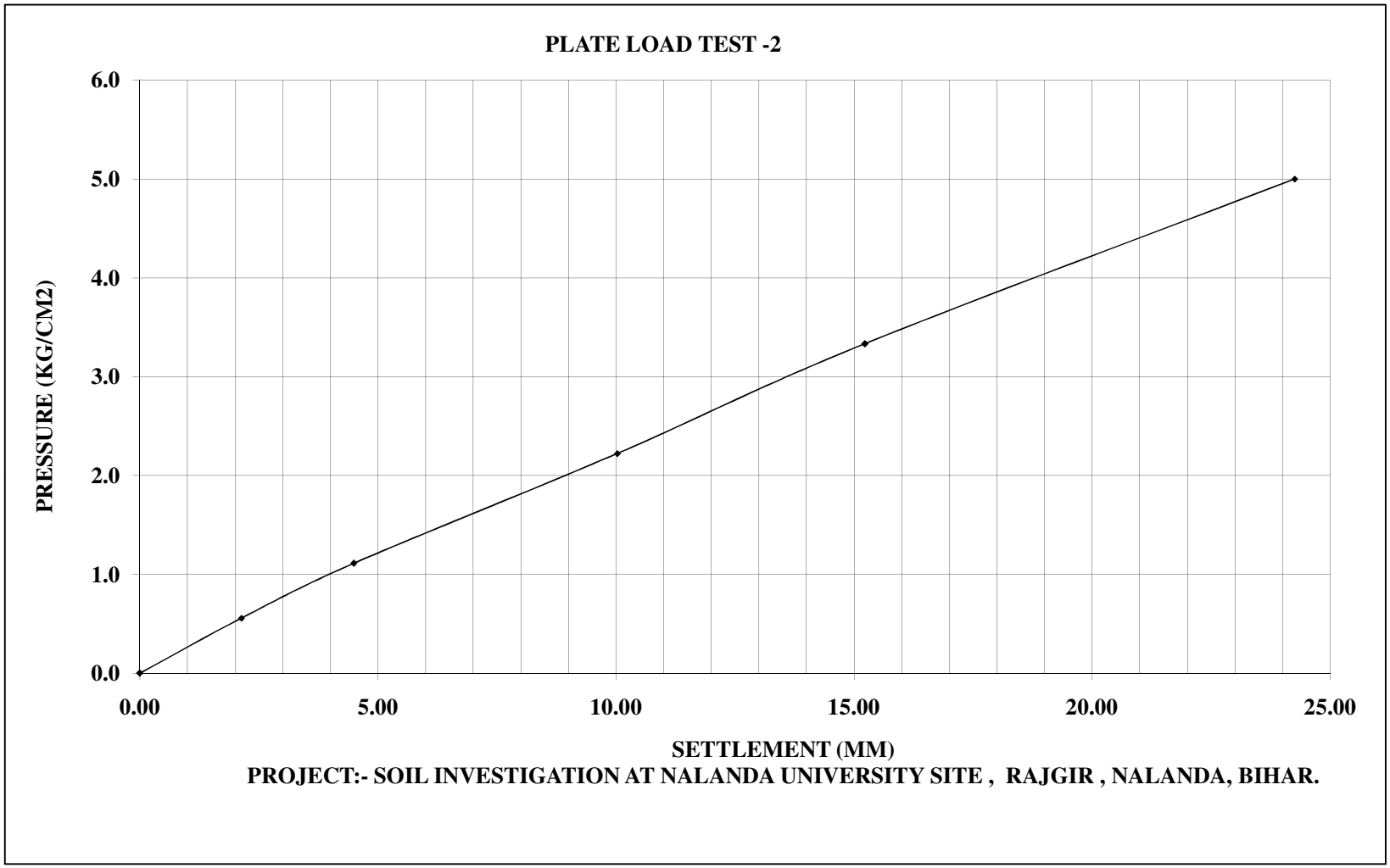
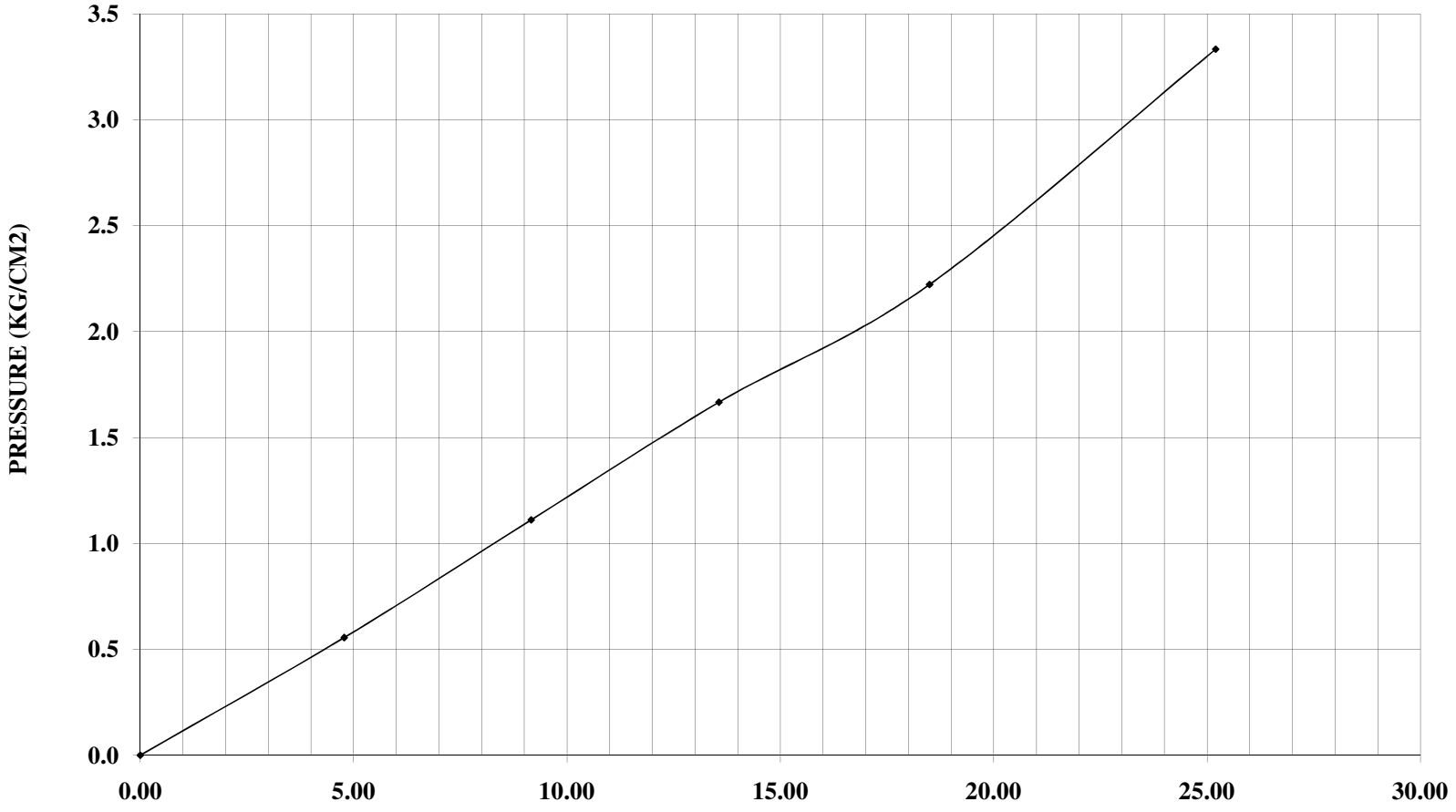


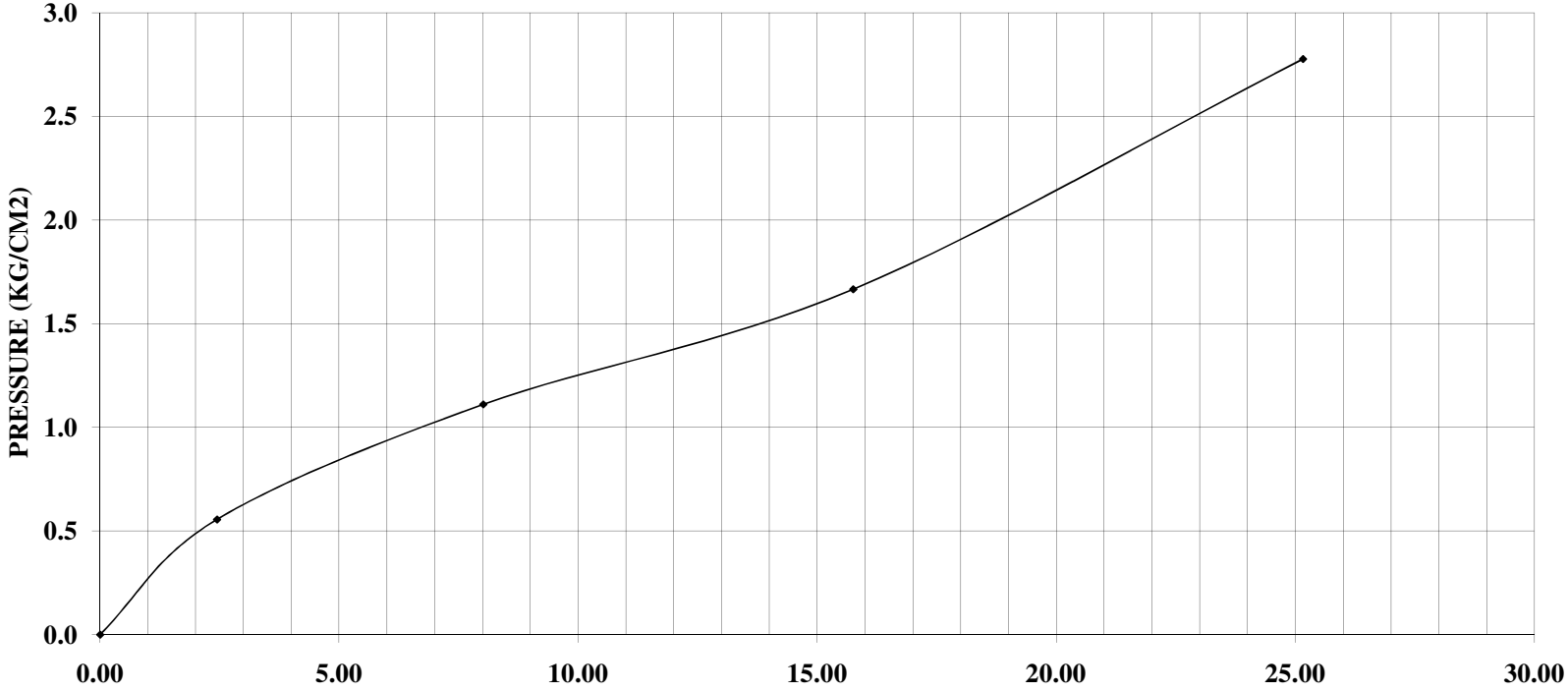
PLATE LOAD TEST -2
6.0
5.0
4.0
3.0
2.0
1.0
0.0
PRESSURE (KG/CM2)
0.00
5.00
10.00
15.00
20.00
25.00
SETTLEMENT (MM)
PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.

**PLATE LOAD TEST -3**



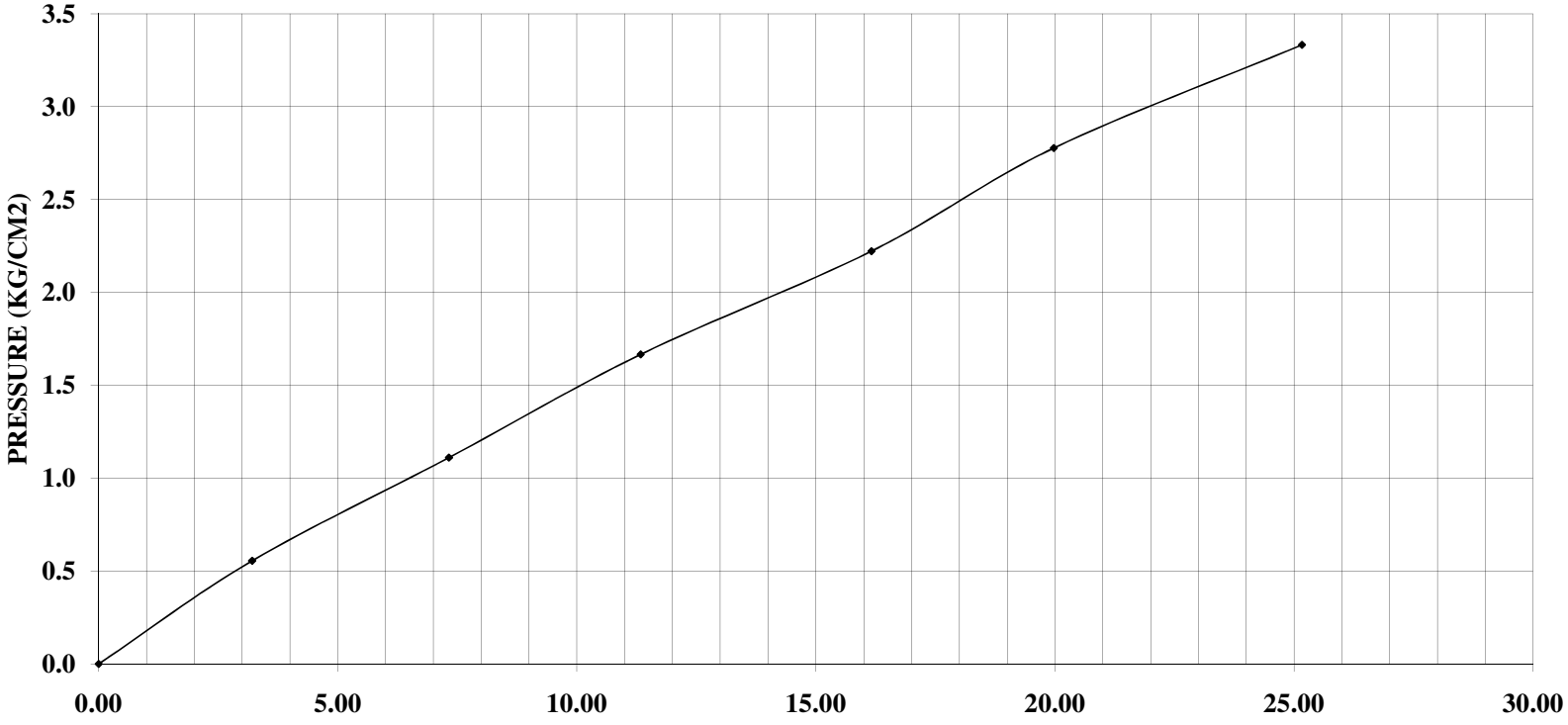

**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.**

**PLATE LOAD TEST -4**



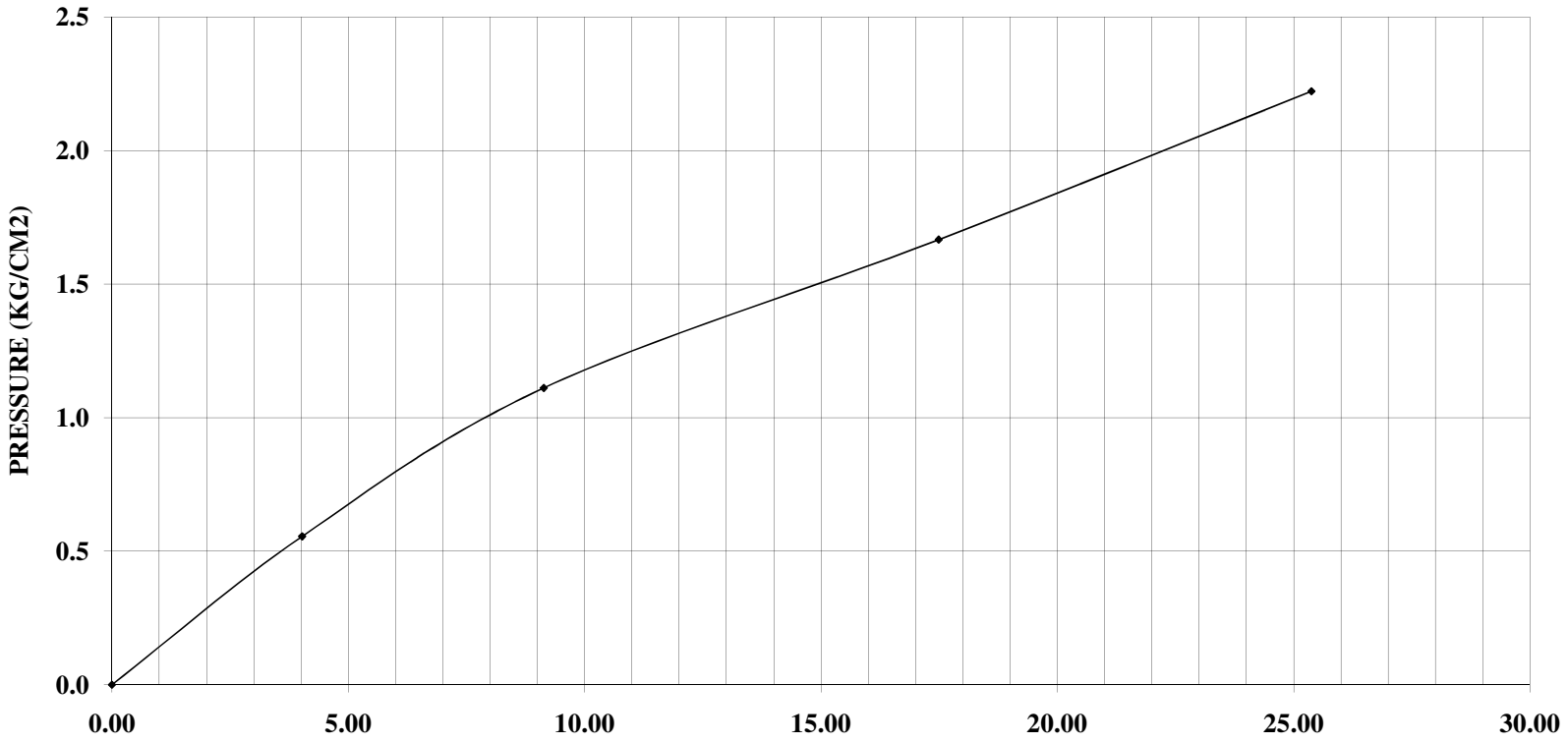

**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.**

**PLATE LOAD TEST -5**



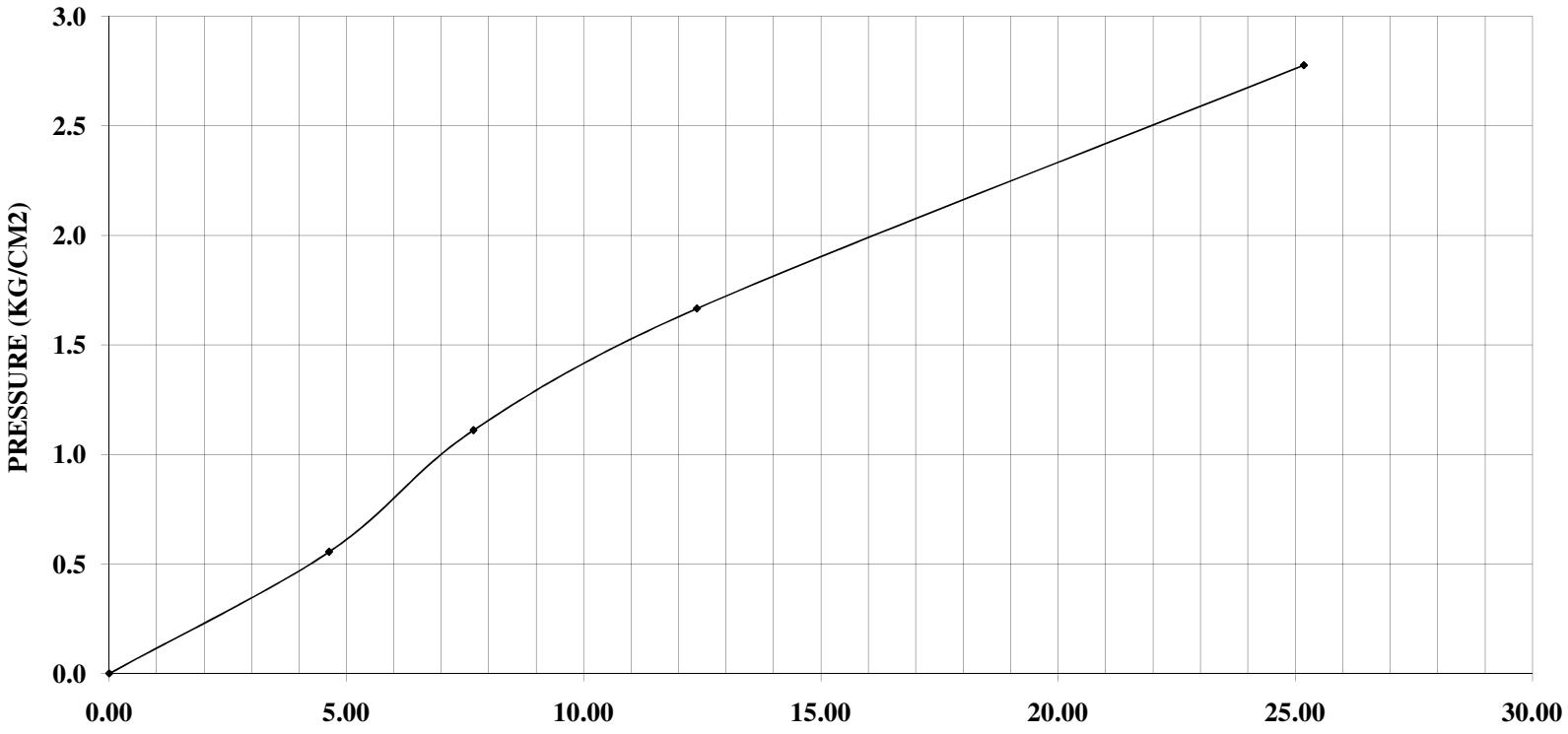

**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.**

**PLATE LOAD TEST -6**



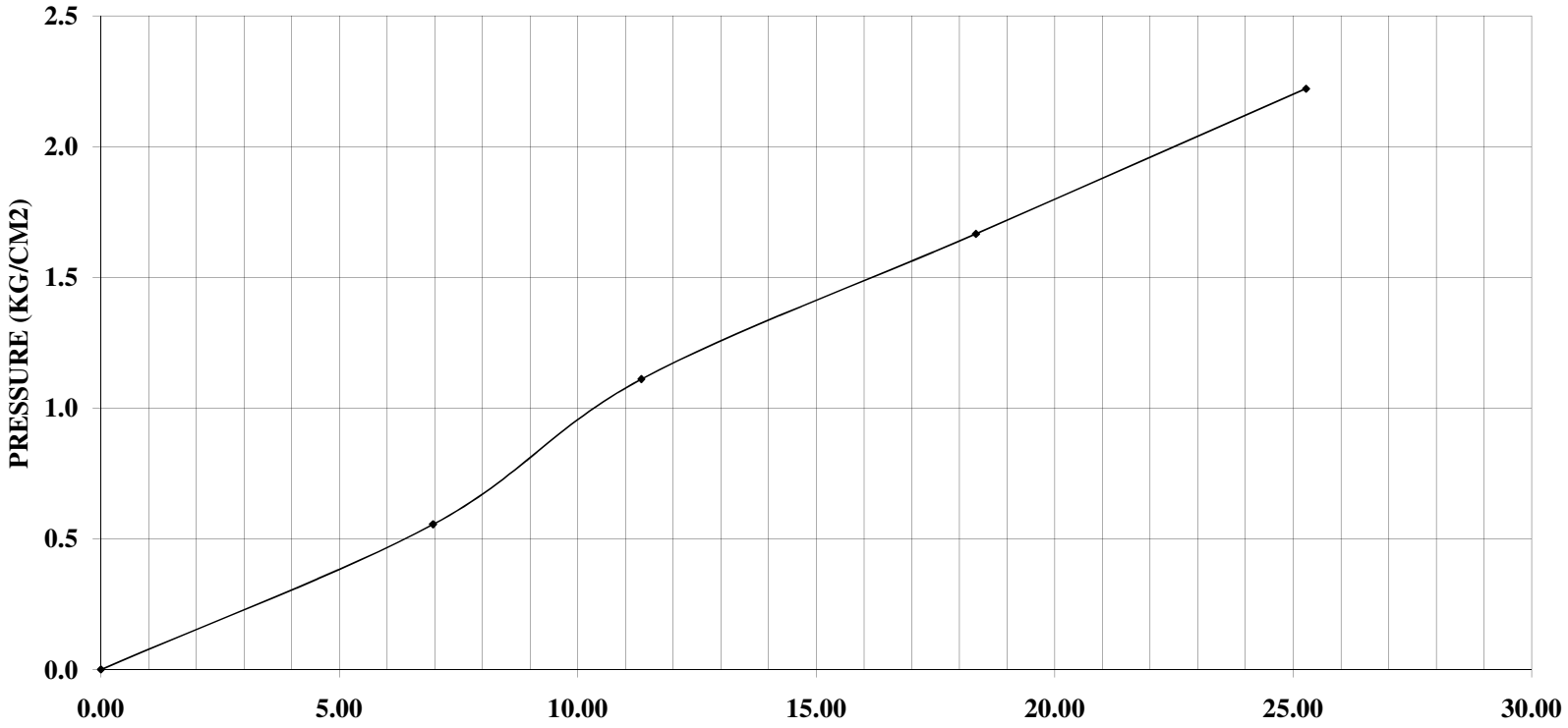

**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR..**

**PLATE LOAD TEST -7**



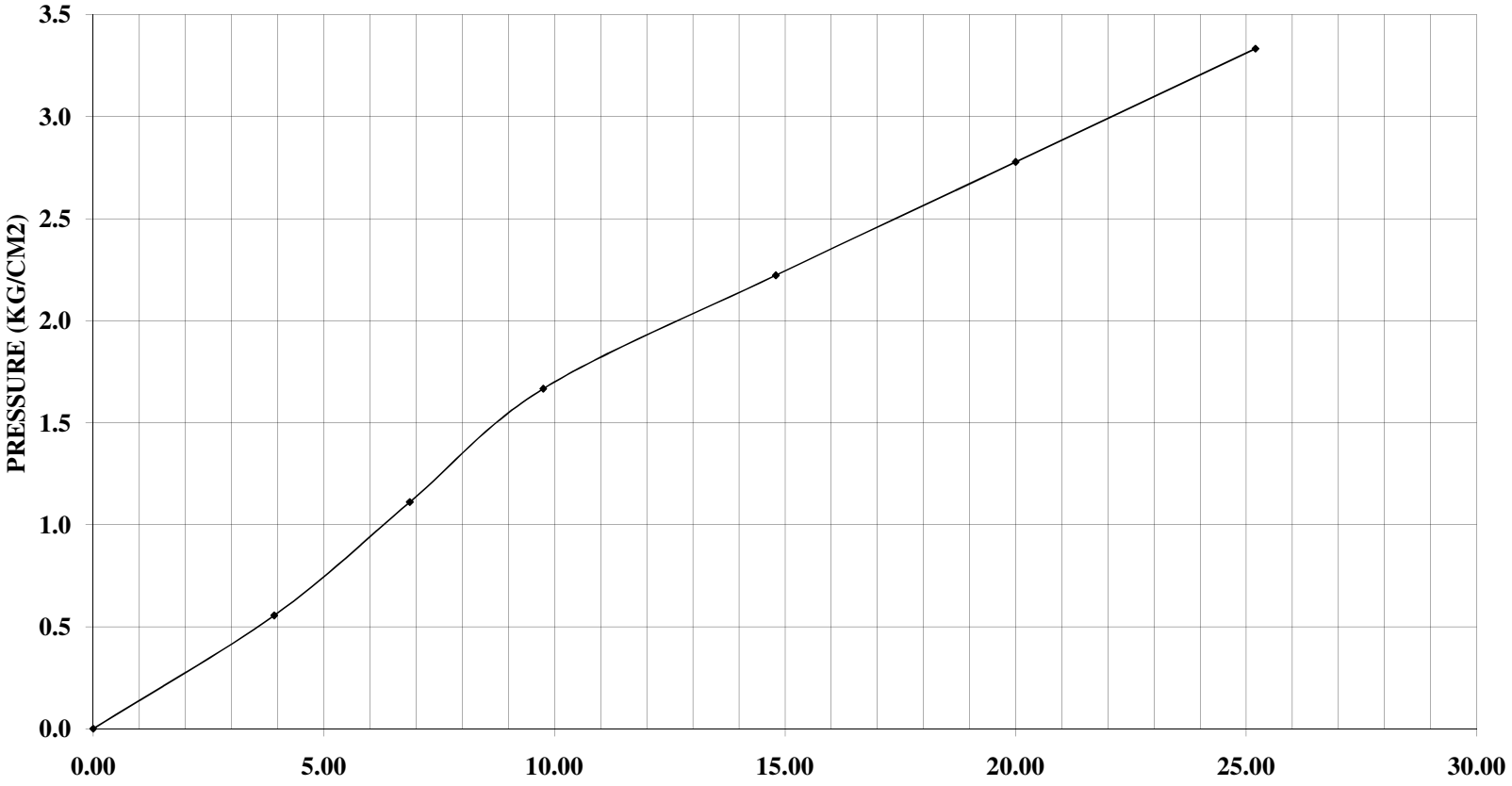

**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.**

**PLATE LOAD TEST 8**



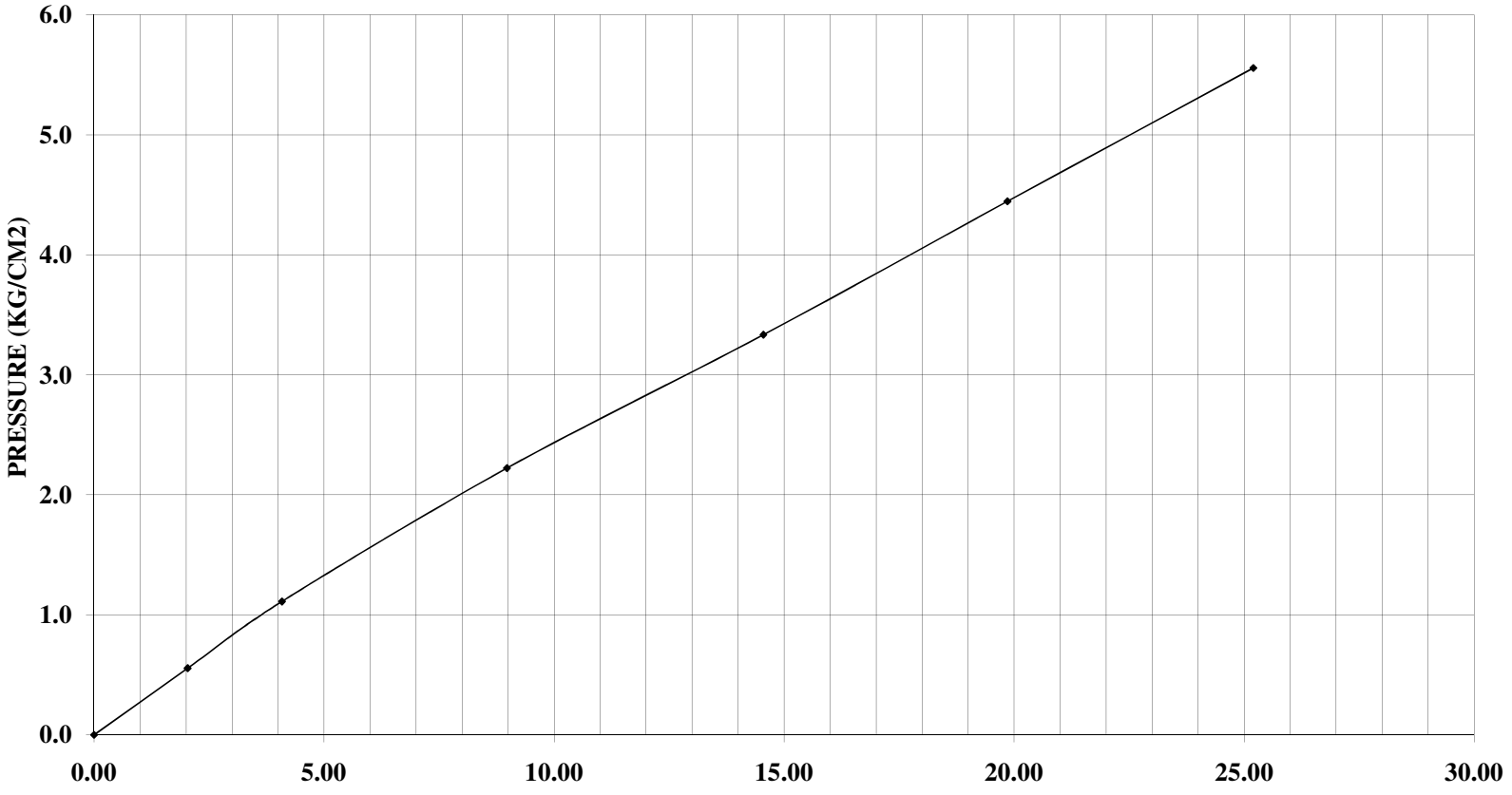

**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.**

**PLATE LOAD TEST -9**



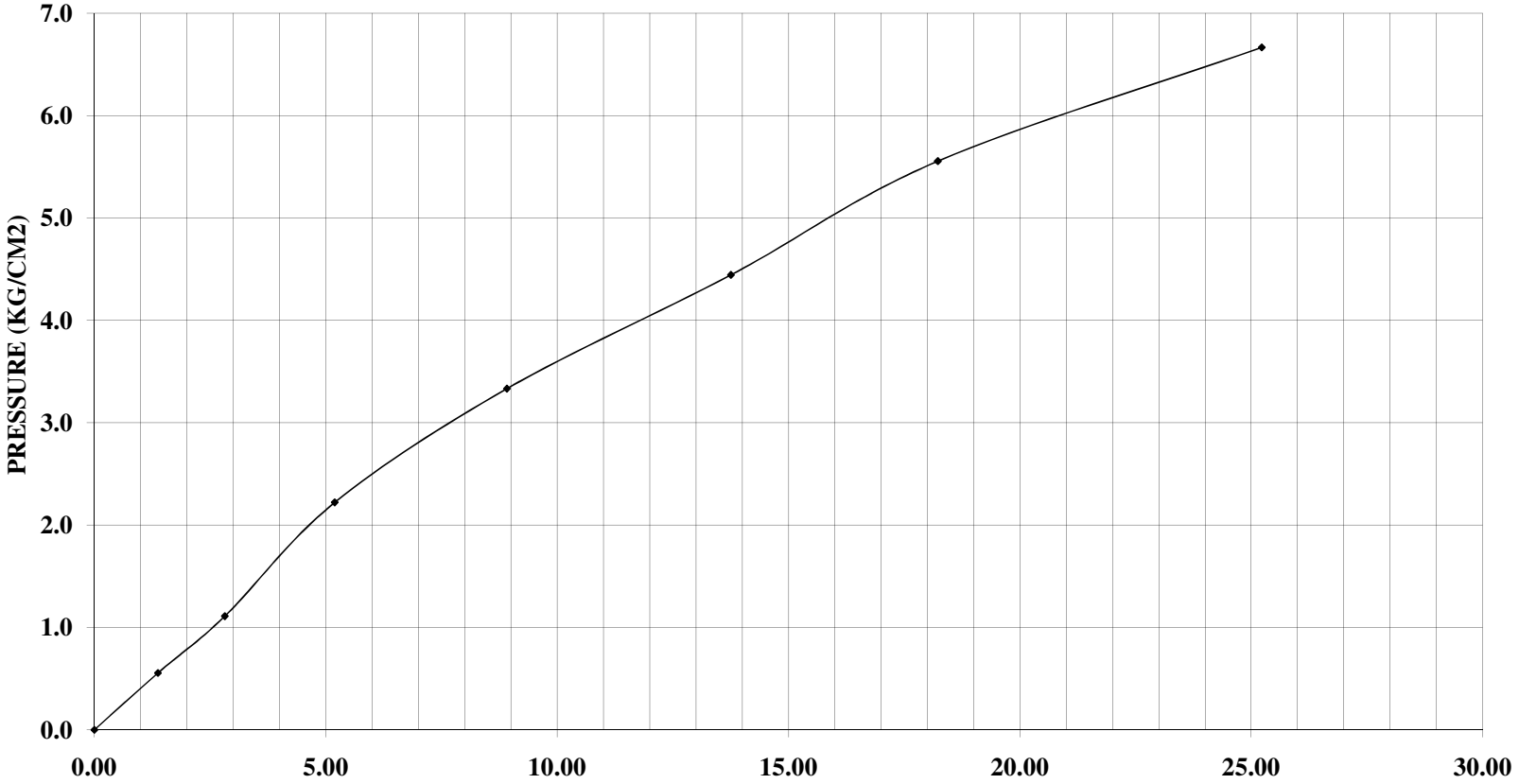

**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.**

**PLATE LOAD TEST -10**



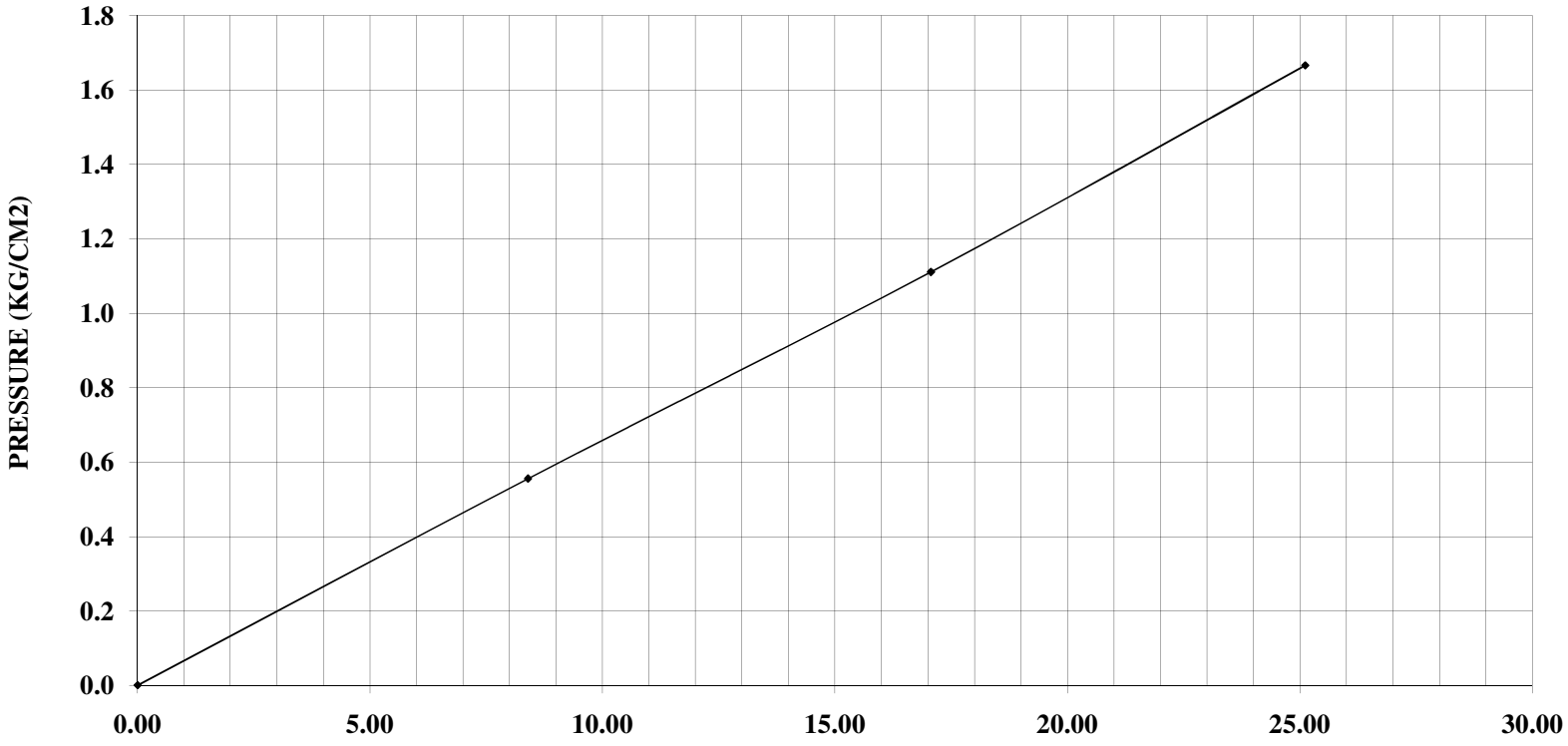

**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR..**

**PLATE LOAD TEST -11**




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

**PLATE LOAD TEST -12**




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

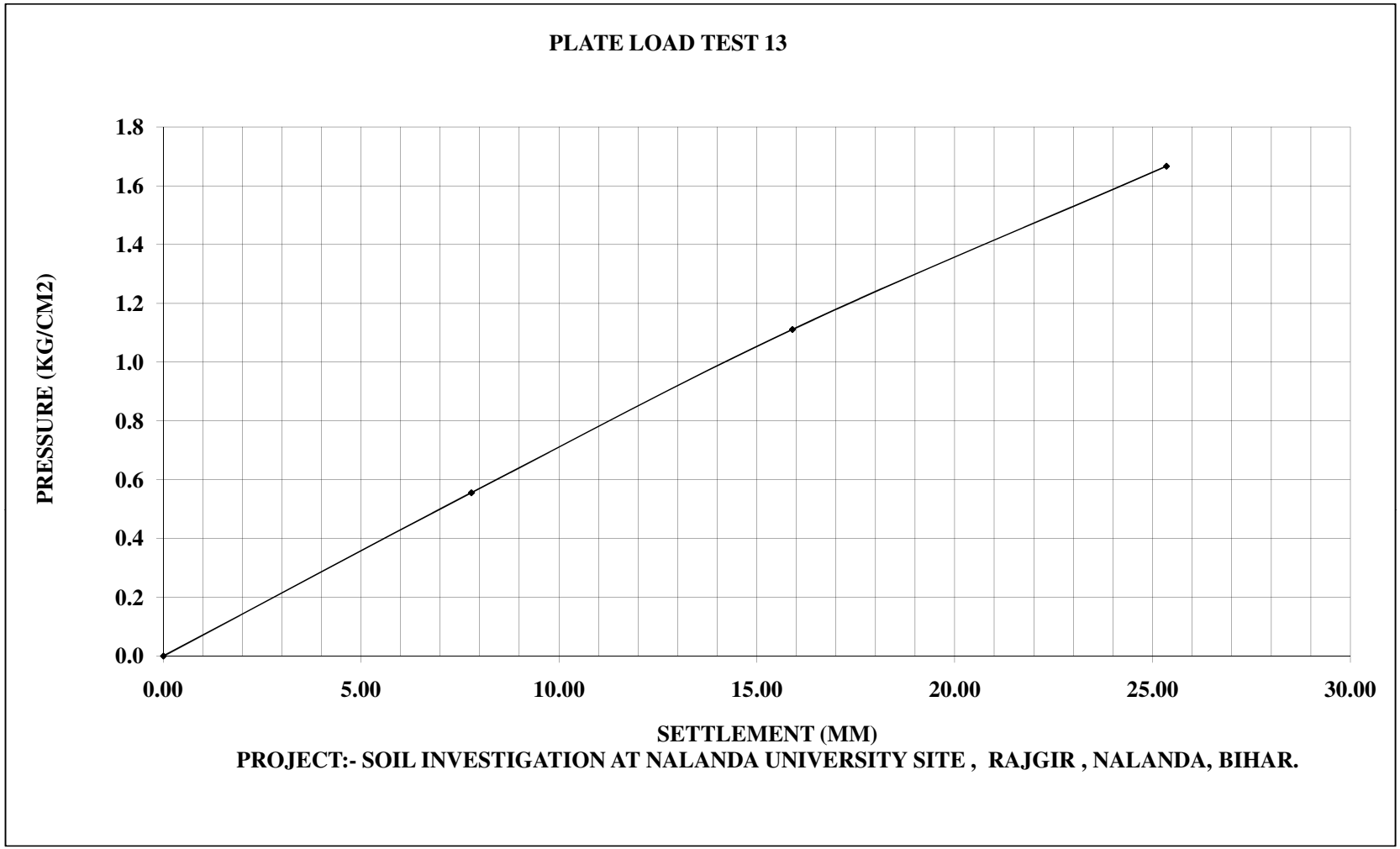
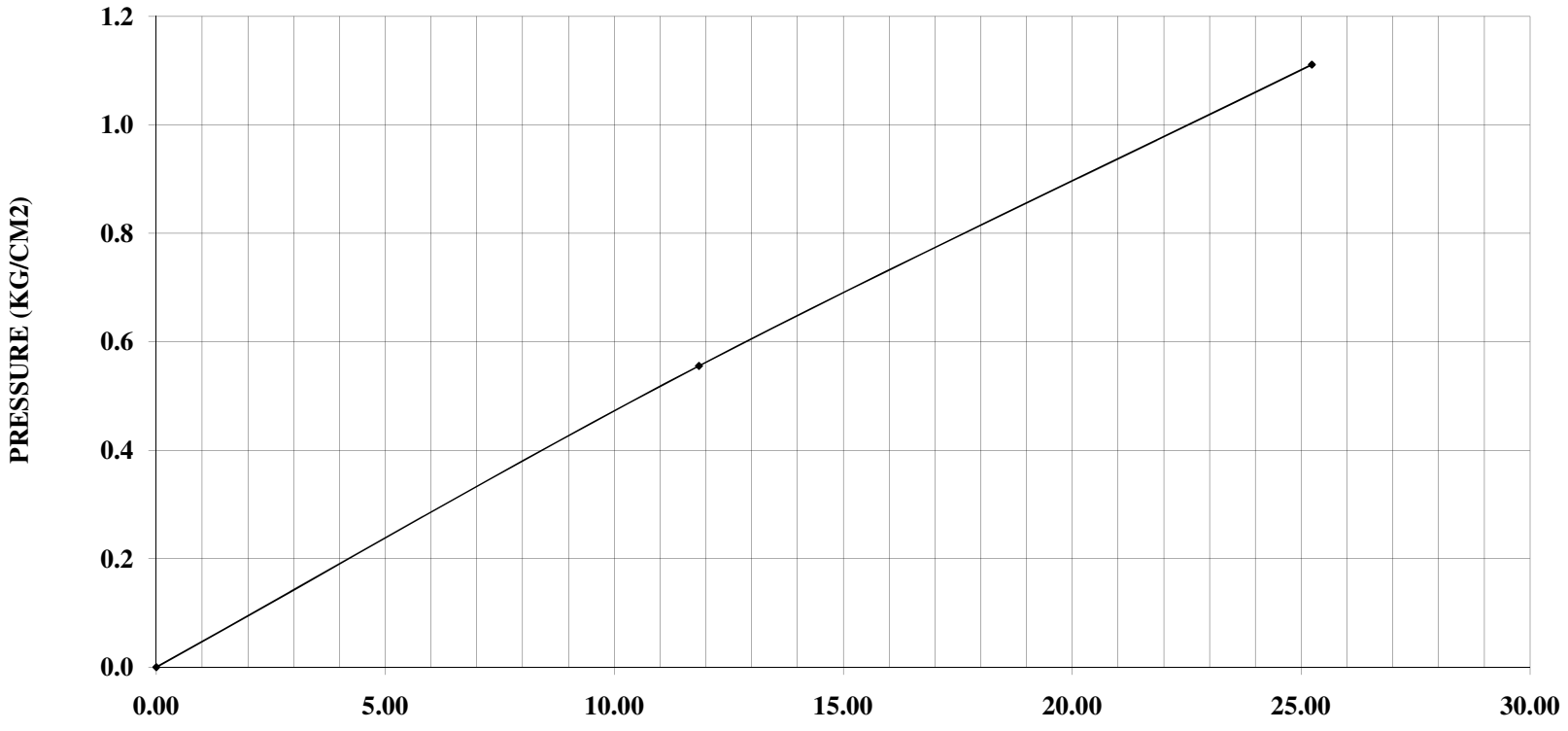


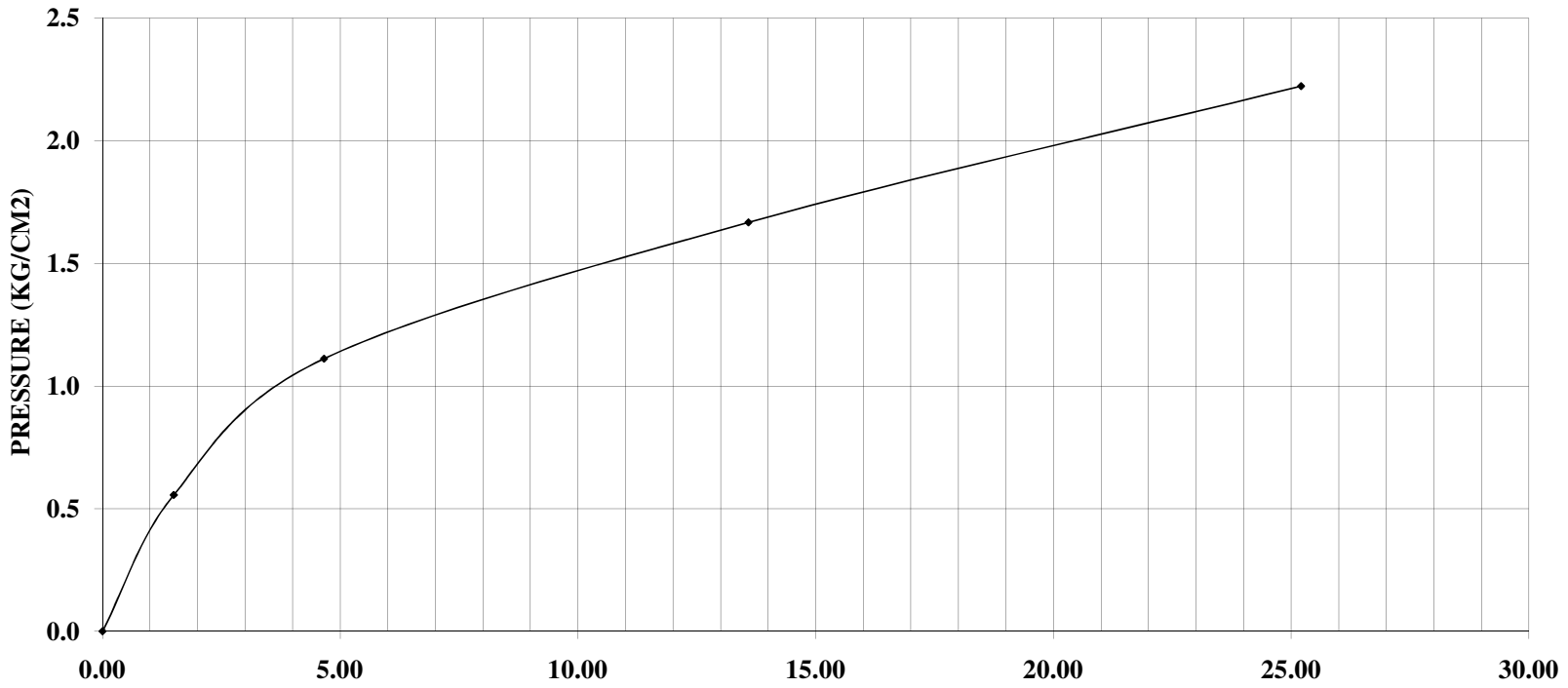
PLATE LOAD TEST 13
PRESSURE (KG/CM2)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.00
5.00
10.00
15.00
20.00
25.00
30.00
SETTLEMENT (MM)
PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.

**PLATE LOAD TEST 14**



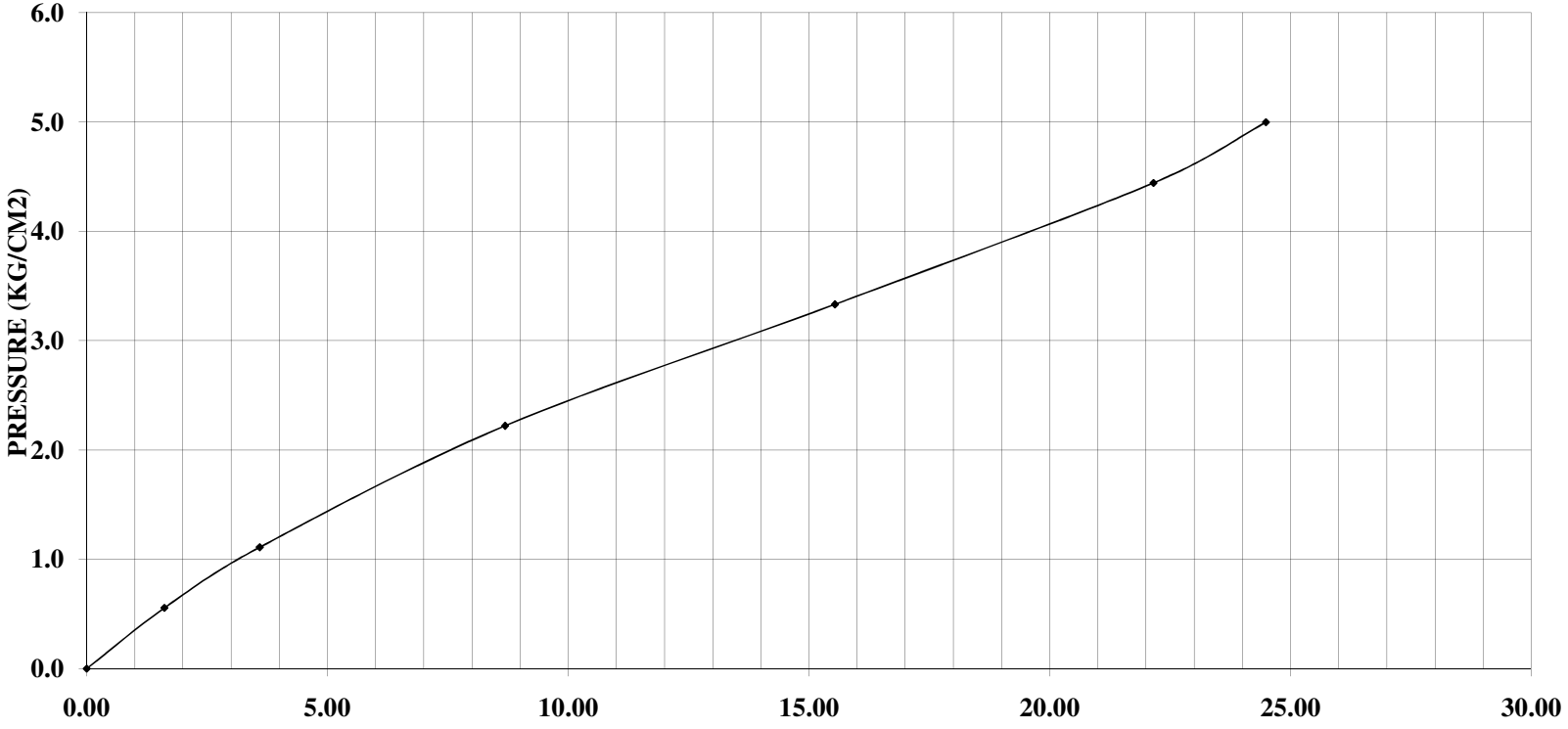

**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.**

**PLATE LOAD TEST -15**



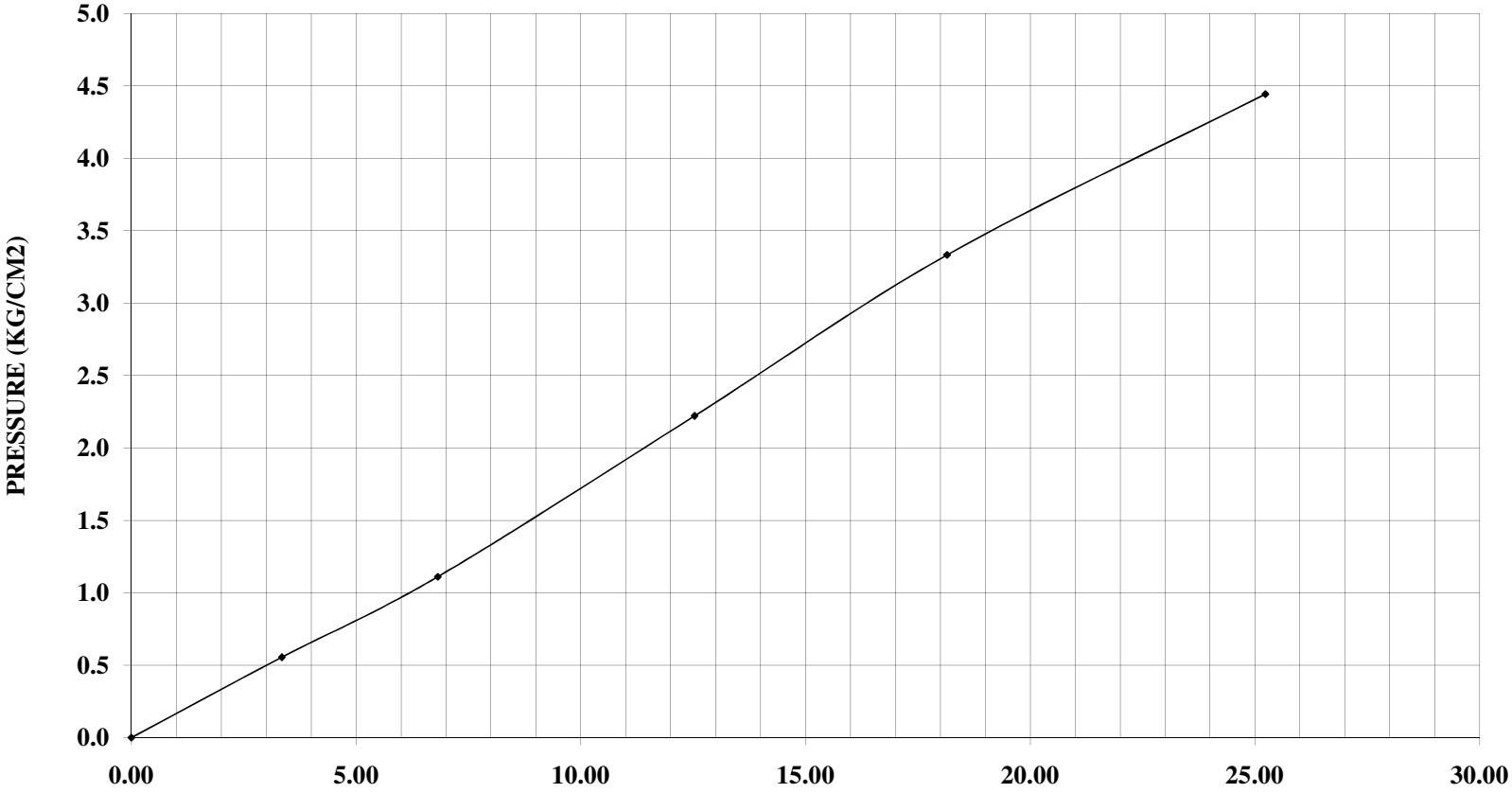

**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.**

**PLATE LOAD TEST -16**



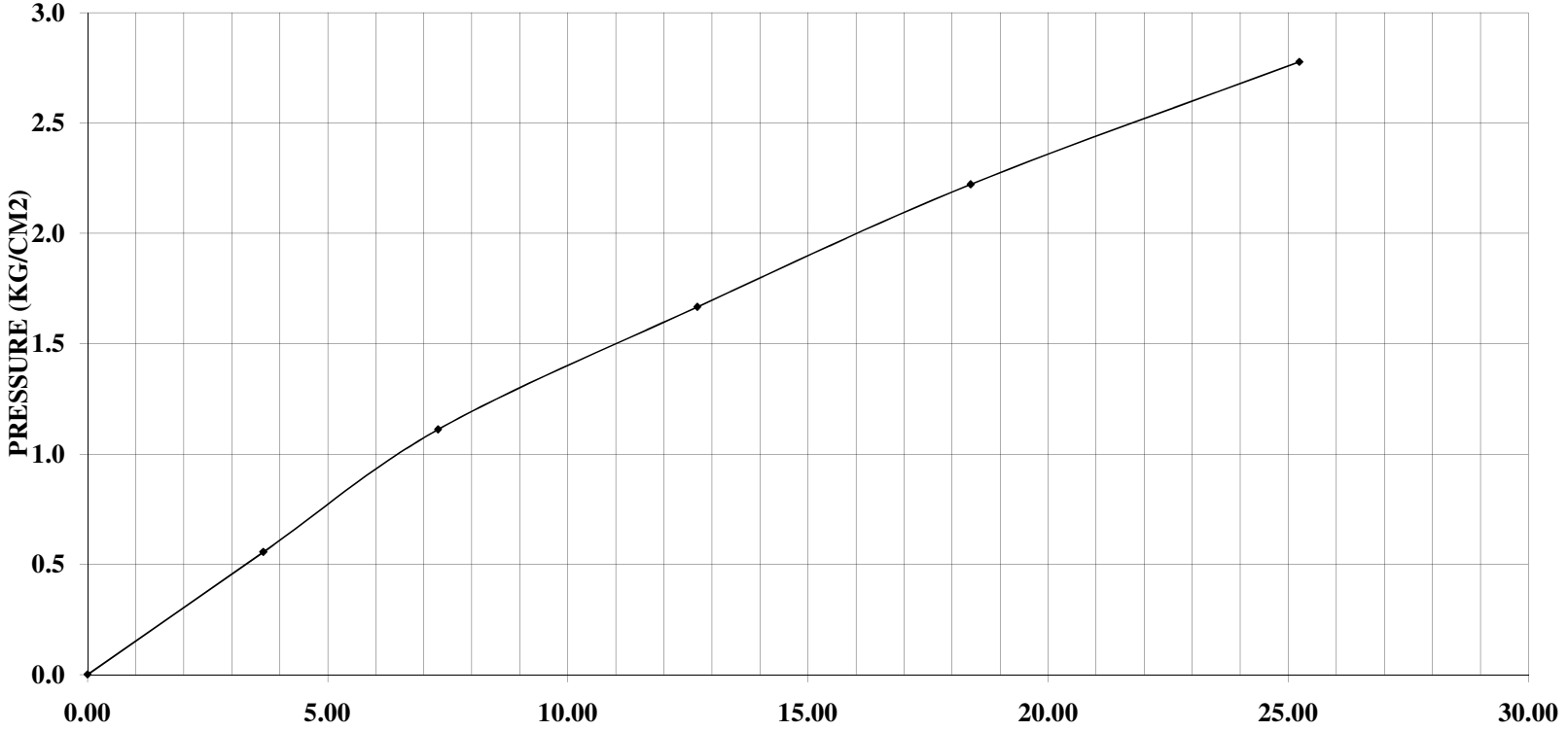

**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.**

**PLATE LOAD TEST -17**



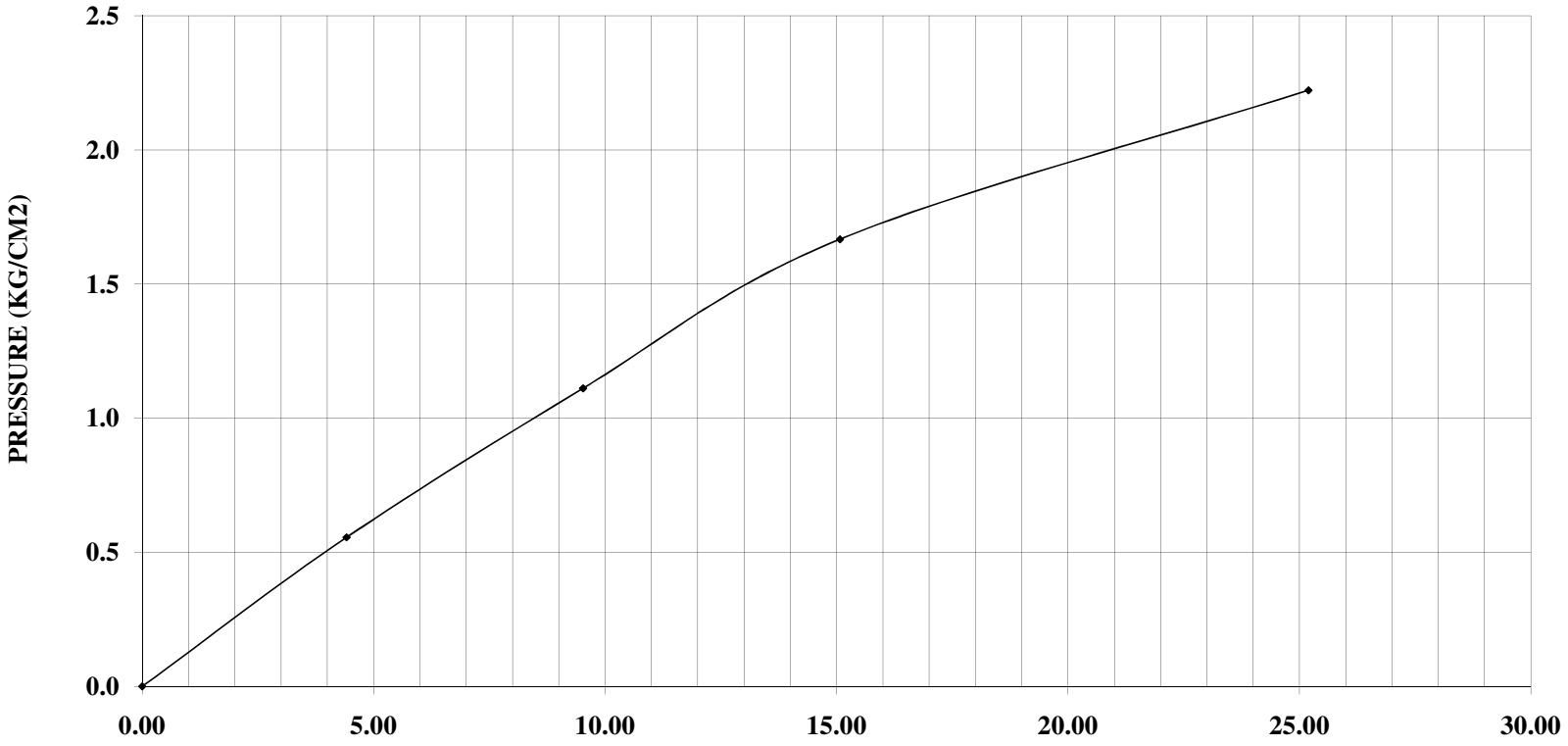

**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.**

**PLATE LOAD TEST -18**



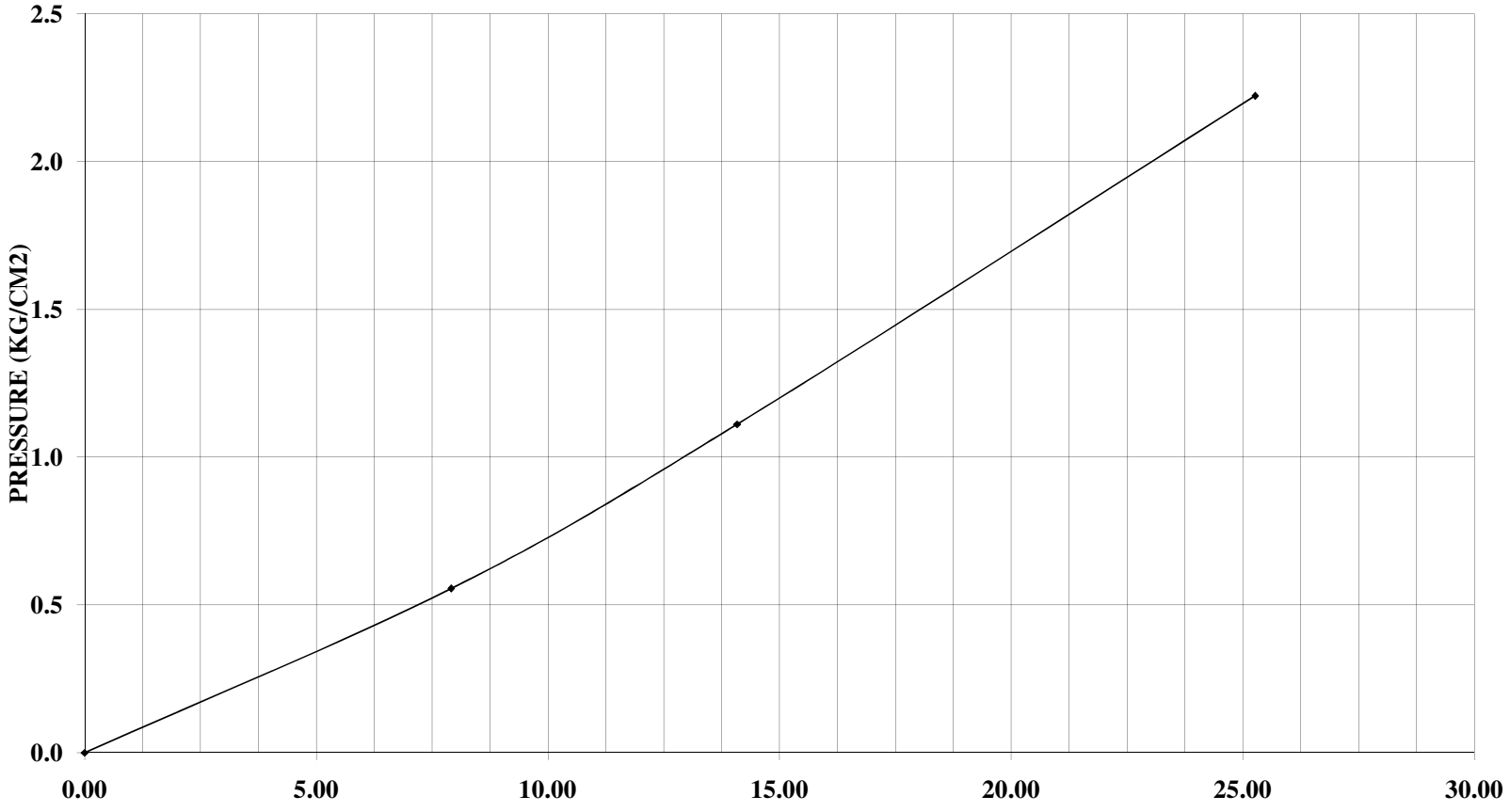

**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.**

**PLATE LOAD TEST -19**




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

**PLATE LOAD TEST -20**




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

**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **34.62** | | **MDD** | **1.895** | Gm/cc | |
| **Plastic Limit** | **20.15** | | **OMC** | **24.32** | **%** | |
| **Plasticity Index** | **14.47** | | **NMC** | **18.97** | **%** | |
| | | | | | | |
| **CBR NO- 1** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **21.854** |
| 1.0 | 0 | 0 | 0 | | **1.000** | **38.411** |
| 2.0 | 0.5 | 3.3 | 21.85 | | **1.500** | **52.980** |
| 3.0 | 1 | 5.8 | 38.41 | | **2.000** | **67.550** |
| 4.0 | 1.5 | 8 | 52.98 | | **2.500** | **76.159** |
| 5.0 | 2 | 10.2 | 67.55 | | **3.000** | **81.457** |
| 6.0 | 2.5 | 11.5 | 76.16 | **5.56** | **4.000** | **91.391** |
| 7.0 | 3 | 12.3 | 81.46 | | **5.000** | **96.689** |
| 8.0 | 4 | 13.8 | 91.39 | | **7.500** | **105.960** |
| 9.0 | 5 | 14.6 | 96.69 | **4.71** | **10.000** | **113.907** |
| 10.0 | 7.5 | 16 | 105.96 | | **12.500** | **118.543** |
| 11.0 | 10 | 17.2 | 113.91 | | | |
| 12.0 | 12.5 | 17.9 | 118.54 | | | |
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**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **33.68** | | **MDD** | **1.856** | Gm/cc | |
| **Plastic Limit** | **20.64** | | **OMC** | **23.04** | **%** | |
| **Plasticity Index** | **13.04** | | **NMC** | **19.01** | **%** | |
| | | | | | | |
| **CBR NO- 2** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **18.543** |
| 1.0 | 0 | 0 | 0 | | **1.000** | **35.099** |
| 2.0 | 0.5 | 2.8 | 18.54 | | **1.500** | **50.199** |
| 3.0 | 1 | 5.3 | 35.10 | | **2.000** | **60.265** |
| 4.0 | 1.5 | 7.58 | 50.20 | | **2.500** | **72.185** |
| 5.0 | 2 | 9.1 | 60.26 | | **3.000** | **76.821** |
| 6.0 | 2.5 | 10.9 | 72.19 | **5.27** | **4.000** | **82.119** |
| 7.0 | 3 | 11.6 | 76.82 | | **5.000** | **87.417** |
| 8.0 | 4 | 12.4 | 82.12 | | **7.500** | **92.715** |
| 9.0 | 5 | 13.2 | 87.42 | **4.25** | **10.000** | **99.338** |
| 10.0 | 7.5 | 14 | 92.72 | | **12.500** | **101.987** |
| 11.0 | 10 | 15 | 99.34 | | | |
| 12.0 | 12.5 | 15.4 | 101.99 | | | |
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**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **33.76** | | **MDD** | **1.85** | Gm/cc | |
| **Plastic Limit** | **20.13** | | **OMC** | **23.11** | **%** | |
| **Plasticity Index** | **13.63** | | **NMC** | **19.06** | **%** | |
| | | | | | | |
| **CBR NO- 3** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **20.530** |
| 1.0 | 0 | 0 | 0 | | **1.000** | **37.748** |
| 2.0 | 0.5 | 3.1 | 20.53 | | **1.500** | **52.980** |
| 3.0 | 1 | 5.7 | 37.75 | | **2.000** | **64.238** |
| 4.0 | 1.5 | 8 | 52.98 | | **2.500** | **72.848** |
| 5.0 | 2 | 9.7 | 64.24 | | **3.000** | **80.132** |
| 6.0 | 2.5 | 11 | 72.85 | **5.32** | **4.000** | **91.391** |
| 7.0 | 3 | 12.1 | 80.13 | | **5.000** | **96.689** |
| 8.0 | 4 | 13.8 | 91.39 | | **7.500** | **107.947** |
| 9.0 | 5 | 14.6 | 96.69 | **4.71** | **10.000** | **115.232** |
| 10.0 | 7.5 | 16.3 | 107.95 | | **12.500** | **123.179** |
| 11.0 | 10 | 17.4 | 115.23 | | | |
| 12.0 | 12.5 | 18.6 | 123.18 | | | |
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**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **33.25** | | **MDD** | **1.842** | Gm/cc | |
| **Plastic Limit** | **20.39** | | **OMC** | **23.1** | **%** | |
| **Plasticity Index** | **12.86** | | **NMC** | **18.62** | **%** | |
| | | | | | | |
| **CBR NO- 4** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **19.205** |
| 1.0 | 0 | 0 | 0 | | **1.000** | **31.788** |
| 2.0 | 0.5 | 2.9 | 19.21 | | **1.500** | **45.695** |
| 3.0 | 1 | 4.8 | 31.79 | | **2.000** | **55.828** |
| 4.0 | 1.5 | 6.9 | 45.70 | | **2.500** | **67.550** |
| 5.0 | 2 | 8.43 | 55.83 | | **3.000** | **76.821** |
| 6.0 | 2.5 | 10.2 | 67.55 | **4.93** | **4.000** | **84.768** |
| 7.0 | 3 | 11.6 | 76.82 | | **5.000** | **88.742** |
| 8.0 | 4 | 12.8 | 84.77 | | **7.500** | **92.715** |
| 9.0 | 5 | 13.4 | 88.74 | **4.32** | **10.000** | **94.040** |
| 10.0 | 7.5 | 14 | 92.72 | | **12.500** | **94.702** |
| 11.0 | 10 | 14.2 | 94.04 | | | |
| 12.0 | 12.5 | 14.3 | 94.70 | | | |
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**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **33.74** | | **MDD** | **1.849** | Gm/cc | |
| **Plastic Limit** | **21.05** | | **OMC** | **23.14** | **%** | |
| **Plasticity Index** | **12.69** | | **NMC** | **19.23** | **%** | |
| | | | | | | |
| **CBR NO- 5** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **19.205** |
| 1.0 | 0 | 0 | 0 | | **1.000** | **35.762** |
| 2.0 | 0.5 | 2.9 | 19.21 | | **1.500** | **49.007** |
| 3.0 | 1 | 5.4 | 35.76 | | **2.000** | **59.603** |
| 4.0 | 1.5 | 7.4 | 49.01 | | **2.500** | **71.523** |
| 5.0 | 2 | 9 | 59.60 | | **3.000** | **77.483** |
| 6.0 | 2.5 | 10.8 | 71.52 | **5.22** | **4.000** | **86.225** |
| 7.0 | 3 | 11.7 | 77.48 | | **5.000** | **94.040** |
| 8.0 | 4 | 13.02 | 86.23 | | **7.500** | **106.623** |
| 9.0 | 5 | 14.2 | 94.04 | **4.58** | **10.000** | **113.907** |
| 10.0 | 7.5 | 16.1 | 106.62 | | **12.500** | **121.192** |
| 11.0 | 10 | 17.2 | 113.91 | | | |
| 12.0 | 12.5 | 18.3 | 121.19 | | | |
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**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **32.69** | | **MDD** | **1.862** | Gm/cc | |
| **Plastic Limit** | **20.01** | | **OMC** | **24.33** | **%** | |
| **Plasticity Index** | **12.68** | | **NMC** | **11.1** | **%** | |
| | | | | | | |
| **CBR NO- 6** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **21.192** |
| 1.0 | 0 | 0 | 0 | | **1.000** | **38.411** |
| 2.0 | 0.5 | 3.2 | 21.19 | | **1.500** | **52.318** |
| 3.0 | 1 | 5.8 | 38.41 | | **2.000** | **64.901** |
| 4.0 | 1.5 | 7.9 | 52.32 | | **2.500** | **73.510** |
| 5.0 | 2 | 9.8 | 64.90 | | **3.000** | **78.808** |
| 6.0 | 2.5 | 11.1 | 73.51 | **5.37** | **4.000** | **86.424** |
| 7.0 | 3 | 11.9 | 78.81 | | **5.000** | **96.026** |
| 8.0 | 4 | 13.05 | 86.42 | | **7.500** | **109.272** |
| 9.0 | 5 | 14.5 | 96.03 | **4.67** | **10.000** | **118.543** |
| 10.0 | 7.5 | 16.5 | 109.27 | | **12.500** | **123.841** |
| 11.0 | 10 | 17.9 | 118.54 | | | |
| 12.0 | 12.5 | 18.7 | 123.84 | | | |
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**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **32.62** | | **MDD** | **1.819** | Gm/cc | |
| **Plastic Limit** | **20.1** | | **OMC** | **24.33** | **%** | |
| **Plasticity Index** | **12.52** | | **NMC** | **18.65** | **%** | |
| | | | | | | |
| **CBR NO- 7** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **17.219** |
| 1.0 | 0 | 0 | 0 | | **1.000** | **33.775** |
| 2.0 | 0.5 | 2.6 | 17.22 | | **1.500** | **49.669** |
| 3.0 | 1 | 5.1 | 33.77 | | **2.000** | **58.940** |
| 4.0 | 1.5 | 7.5 | 49.67 | | **2.500** | **70.861** |
| 5.0 | 2 | 8.9 | 58.94 | | **3.000** | **77.483** |
| 6.0 | 2.5 | 10.7 | 70.86 | **5.17** | **4.000** | **87.417** |
| 7.0 | 3 | 11.7 | 77.48 | | **5.000** | **96.689** |
| 8.0 | 4 | 13.2 | 87.42 | | **7.500** | **101.987** |
| 9.0 | 5 | 14.6 | 96.69 | **4.71** | **10.000** | **105.298** |
| 10.0 | 7.5 | 15.4 | 101.99 | | **12.500** | **106.623** |
| 11.0 | 10 | 15.9 | 105.30 | | | |
| 12.0 | 12.5 | 16.1 | 106.62 | | | |
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**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **34.02** | | **MDD** | **1.816** | Gm/cc | |
| **Plastic Limit** | **22.16** | | **OMC** | **24.02** | **%** | |
| **Plasticity Index** | **11.86** | | **NMC** | **18.75** | **%** | |
| | | | | | | |
| **CBR NO- 8** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **17.550** |
| 1.0 | 0 | 0 | 0 | | **1.000** | **34.437** |
| 2.0 | 0.5 | 2.65 | 17.55 | | **1.500** | **53.974** |
| 3.0 | 1 | 5.2 | 34.44 | | **2.000** | **63.907** |
| 4.0 | 1.5 | 8.15 | 53.97 | | **2.500** | **72.384** |
| 5.0 | 2 | 9.65 | 63.91 | | **3.000** | **82.119** |
| 6.0 | 2.5 | 10.93 | 72.38 | **5.28** | **4.000** | **90.728** |
| 7.0 | 3 | 12.4 | 82.12 | | **5.000** | **98.675** |
| 8.0 | 4 | 13.7 | 90.73 | | **7.500** | **109.272** |
| 9.0 | 5 | 14.9 | 98.68 | **4.80** | **10.000** | **113.907** |
| 10.0 | 7.5 | 16.5 | 109.27 | | **12.500** | **116.556** |
| 11.0 | 10 | 17.2 | 113.91 | | | |
| 12.0 | 12.5 | 17.6 | 116.56 | | | |
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**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **32.62** | | **MDD** | **1.826** | Gm/cc | |
| **Plastic Limit** | **21.04** | | **OMC** | **24.36** | **%** | |
| **Plasticity Index** | **11.58** | | **NMC** | **19.68** | **%** | |
| | | | | | | |
| **CBR NO- 9** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **23.841** |
| 1.0 | 0 | 0 | 0 | | **1.000** | **38.411** |
| 2.0 | 0.5 | 3.6 | 23.84 | | **1.500** | **54.305** |
| 3.0 | 1 | 5.8 | 38.41 | | **2.000** | **67.550** |
| 4.0 | 1.5 | 8.2 | 54.30 | | **2.500** | **74.834** |
| 5.0 | 2 | 10.2 | 67.55 | | **3.000** | **80.795** |
| 6.0 | 2.5 | 11.3 | 74.83 | **5.46** | **4.000** | **94.702** |
| 7.0 | 3 | 12.2 | 80.79 | | **5.000** | **100.662** |
| 8.0 | 4 | 14.3 | 94.70 | | **7.500** | **109.272** |
| 9.0 | 5 | 15.2 | 100.66 | **4.90** | **10.000** | **115.232** |
| 10.0 | 7.5 | 16.5 | 109.27 | | **12.500** | **115.894** |
| 11.0 | 10 | 17.4 | 115.23 | | | |
| 12.0 | 12.5 | 17.5 | 115.89 | | | |
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**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **33.16** | | **MDD** | **1.811** | Gm/cc | |
| **Plastic Limit** | **20.48** | | **OMC** | **24.66** | **%** | |
| **Plasticity Index** | **12.68** | | **NMC** | **19.36** | **%** | |
| | | | | | | |
| **CBR NO- 10** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **13.245** |
| 1.0 | 0 | 0 | 0 | | **1.000** | **26.490** |
| 2.0 | 0.5 | 2 | 13.25 | | **1.500** | **39.735** |
| 3.0 | 1 | 4 | 26.49 | | **2.000** | **52.980** |
| 4.0 | 1.5 | 6 | 39.74 | | **2.500** | **67.550** |
| 5.0 | 2 | 8 | 52.98 | | **3.000** | **74.834** |
| 6.0 | 2.5 | 10.2 | 67.55 | **4.93** | **4.000** | **86.093** |
| 7.0 | 3 | 11.3 | 74.83 | | **5.000** | **90.066** |
| 8.0 | 4 | 13 | 86.09 | | **7.500** | **98.675** |
| 9.0 | 5 | 13.6 | 90.07 | **4.38** | **10.000** | **102.649** |
| 10.0 | 7.5 | 14.9 | 98.68 | | **12.500** | **106.623** |
| 11.0 | 10 | 15.5 | 102.65 | | | |
| 12.0 | 12.5 | 16.1 | 106.62 | | | |
| | | | | | | |
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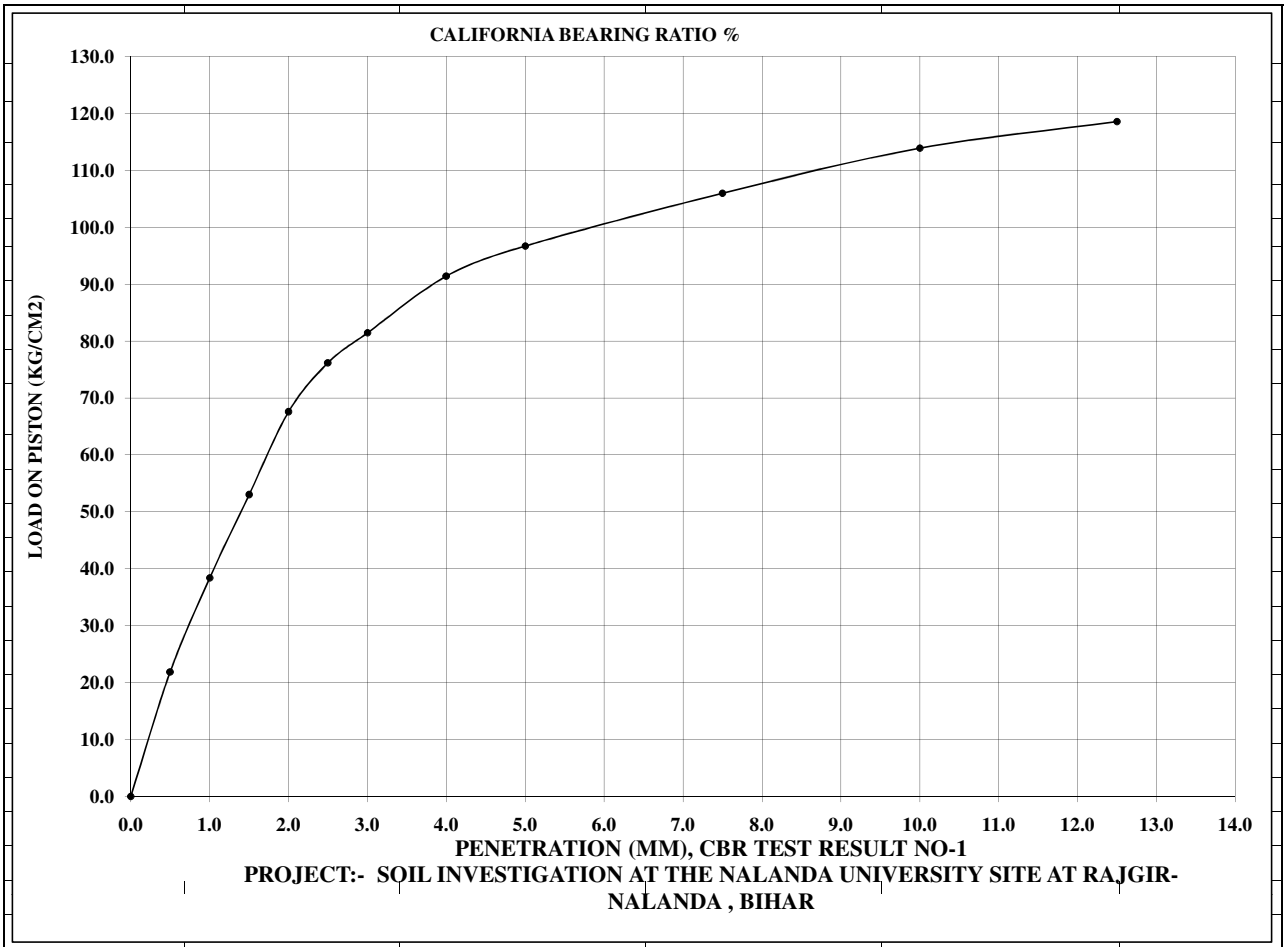
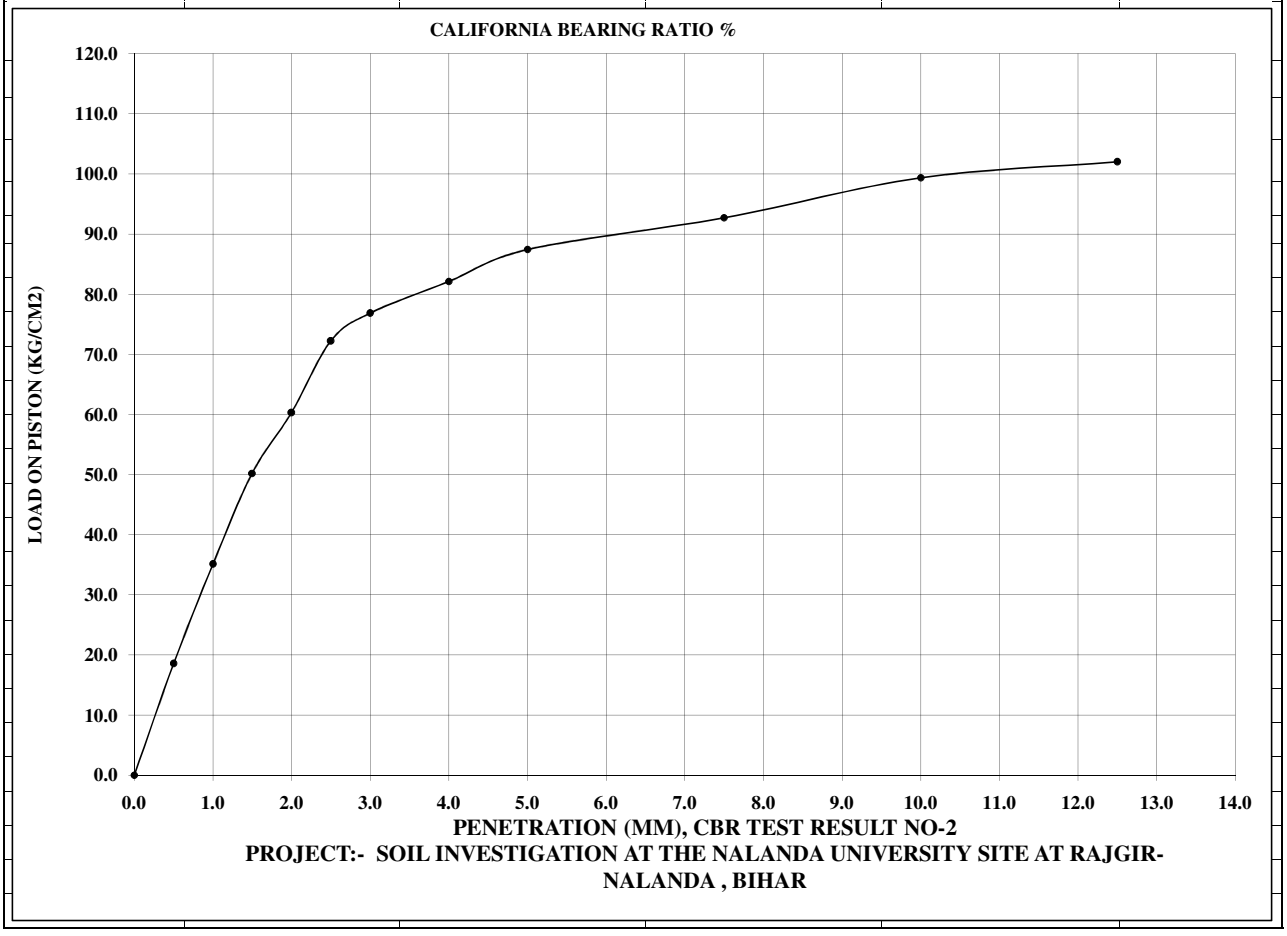
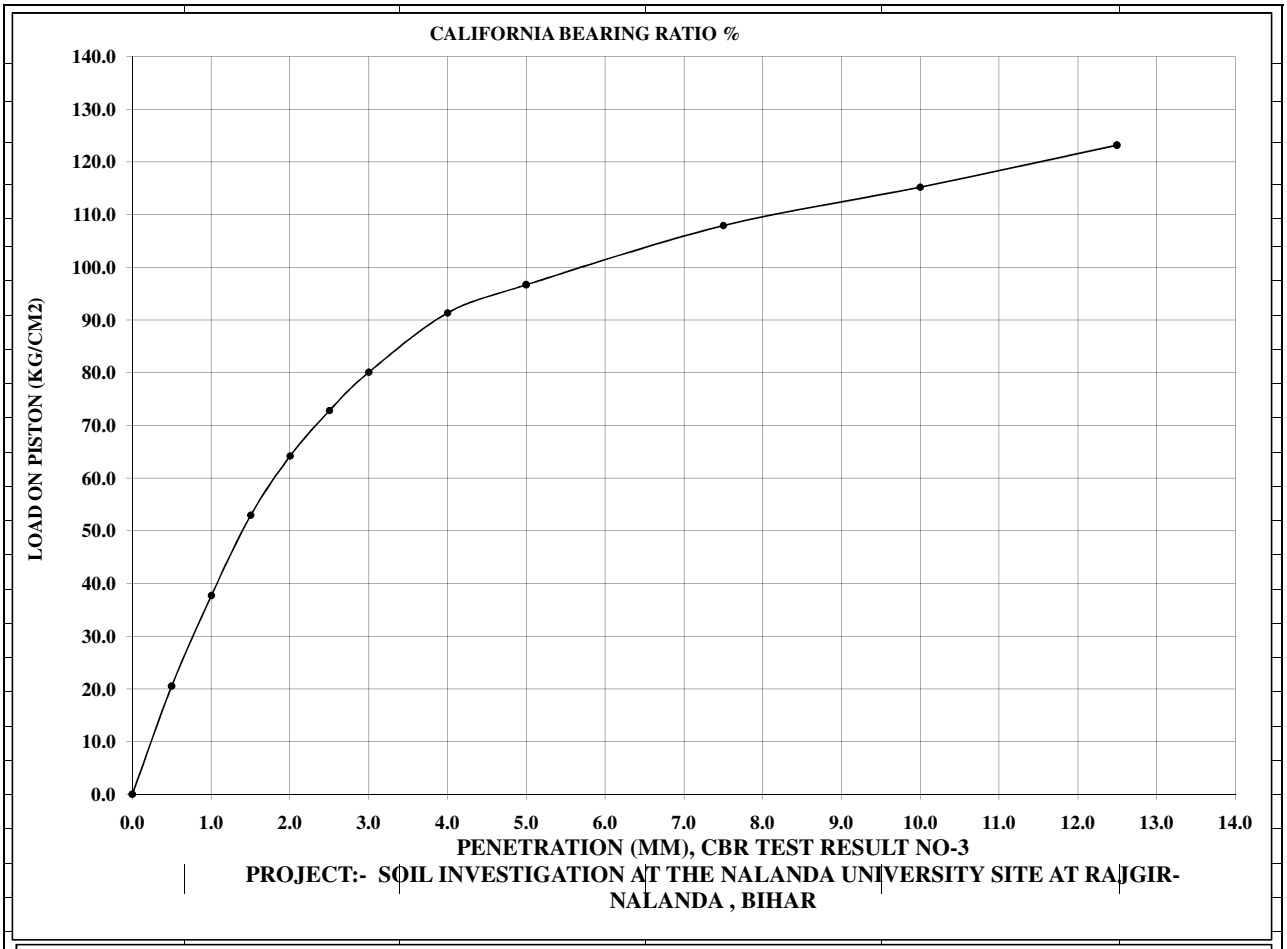
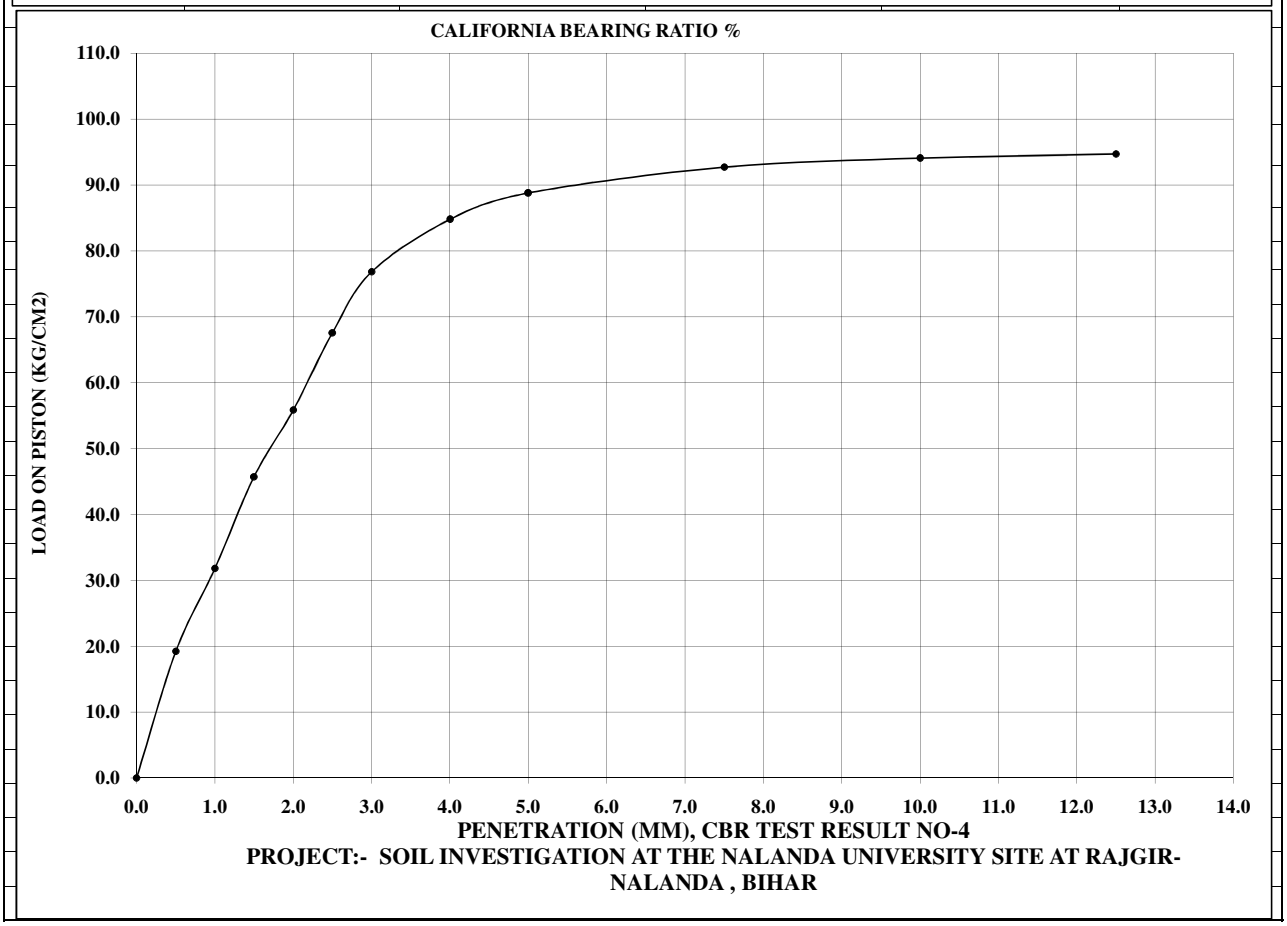
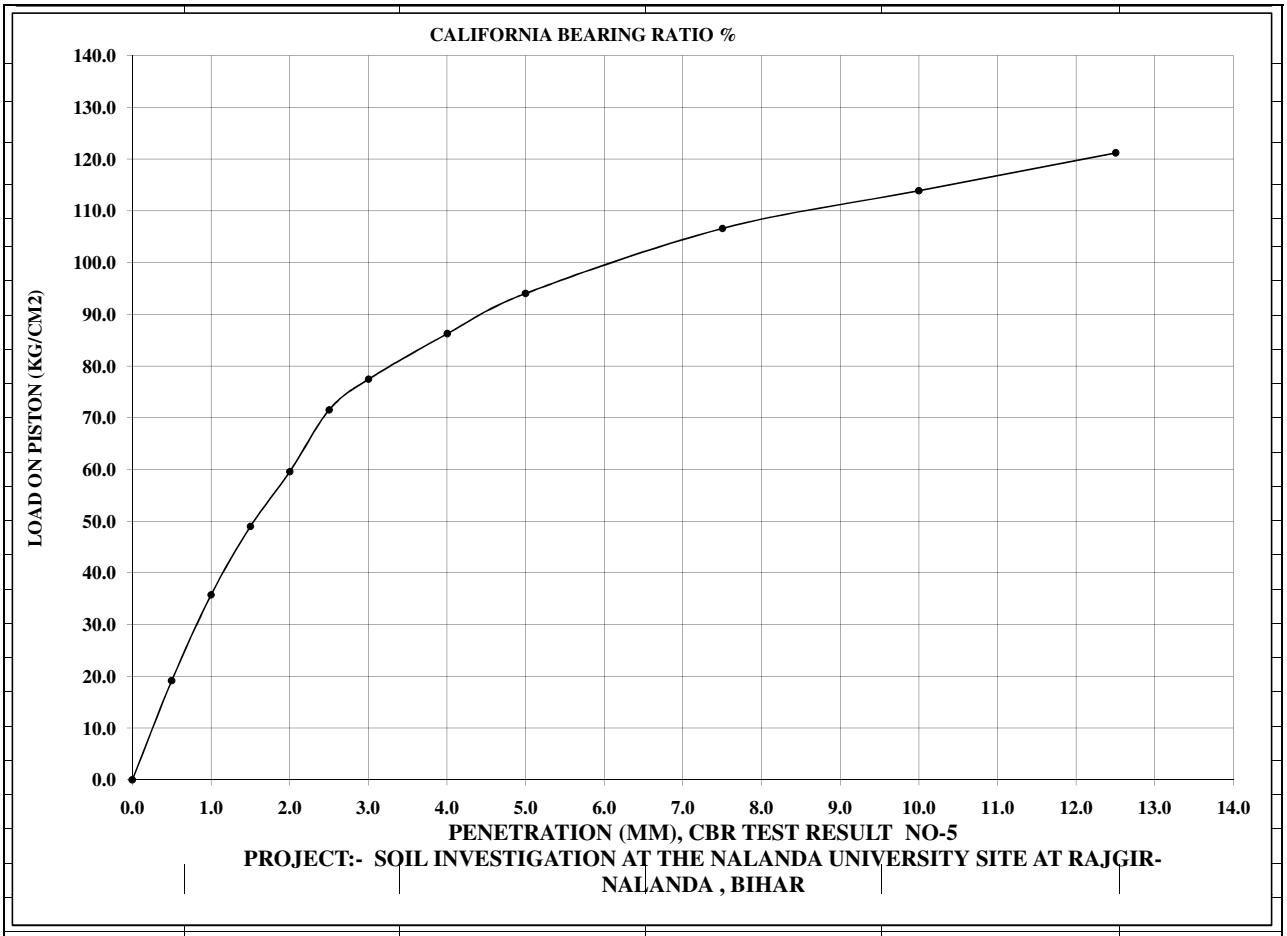
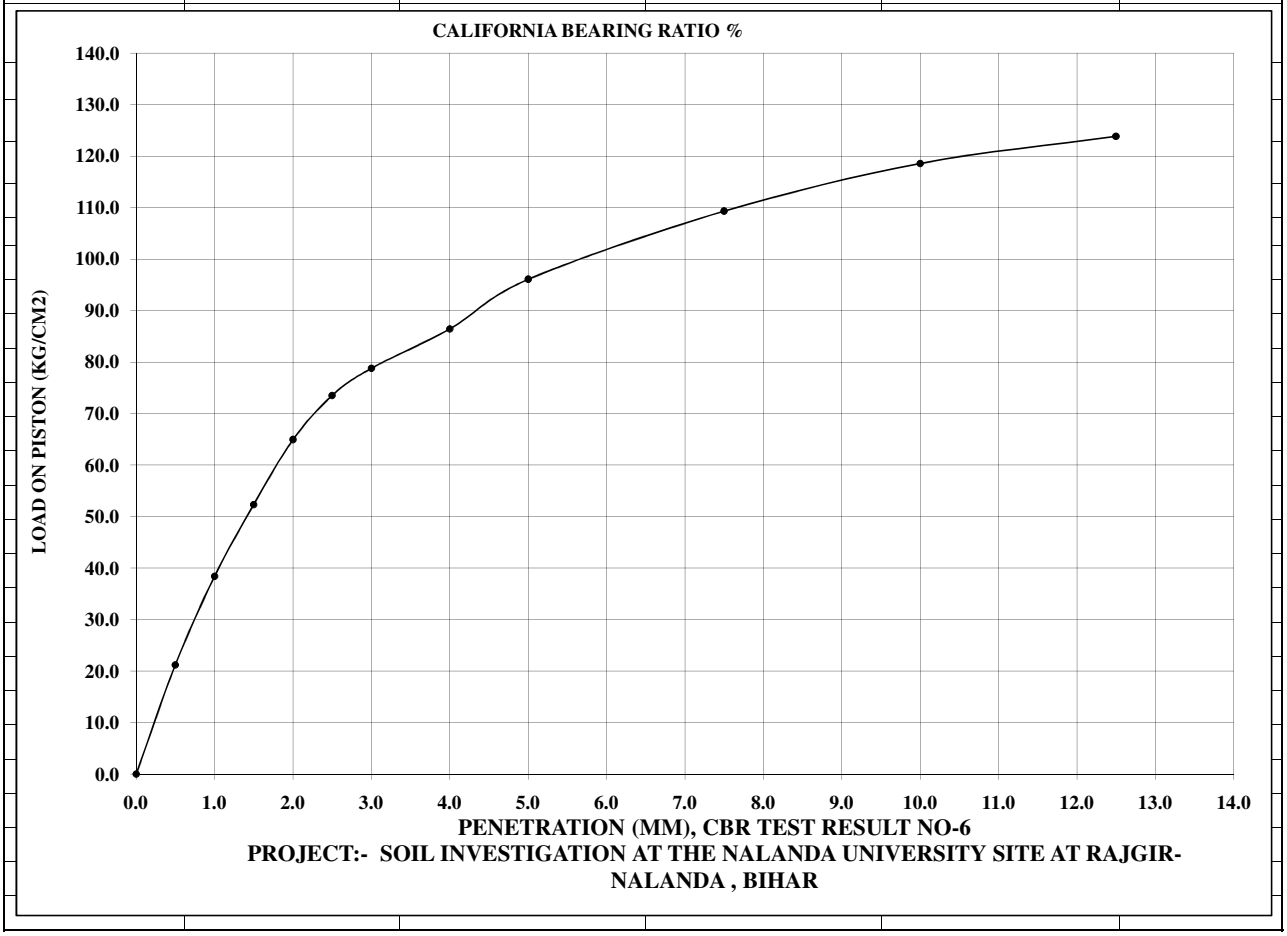

CALIFORNIA BEARING RATIO %
LOAD ON PISTON (KG/CM2)
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0
PENETRATION (MM), CBR TEST RESULT NO-1
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR

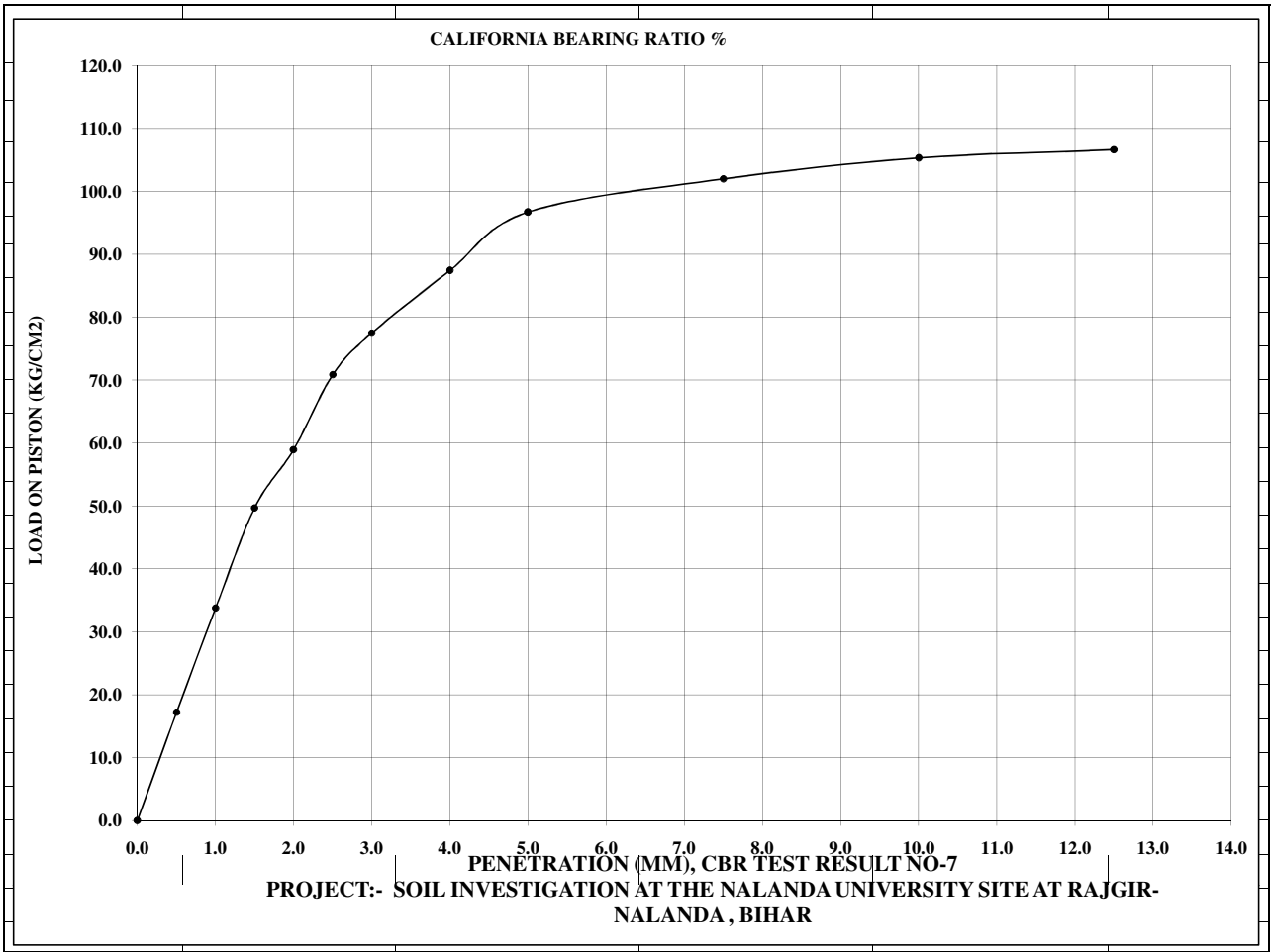

CALIFORNIA BEARING RATIO %
LOAD ON PISTON (KG/CM2)
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0
PENETRATION (MM), CBR TEST RESULT NO-2
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR

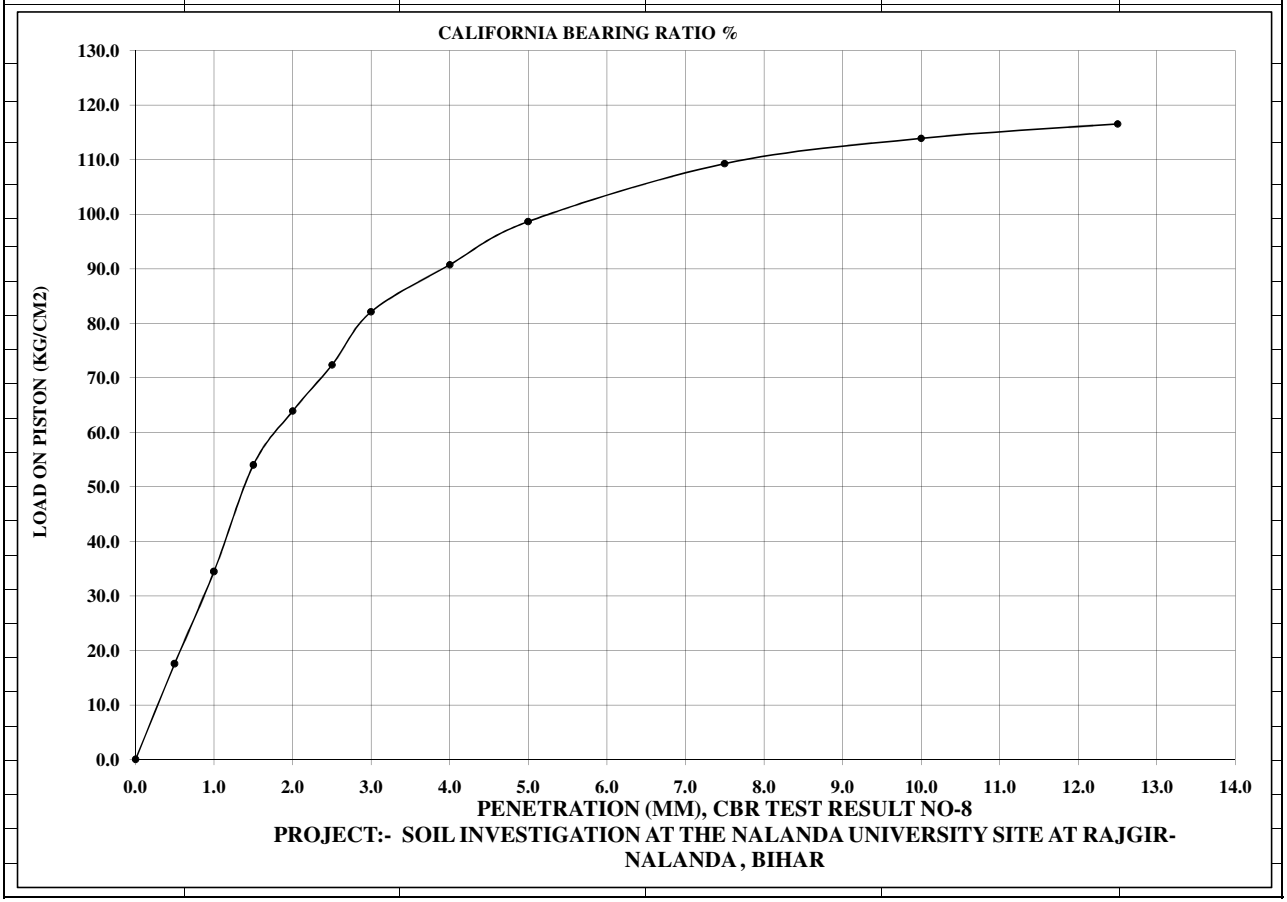

CALIFORNIA BEARING RATIO %
LOAD ON PISTON (KG/CM2)
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0
PENETRATION (MM), CBR TEST RESULT NO-3
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR

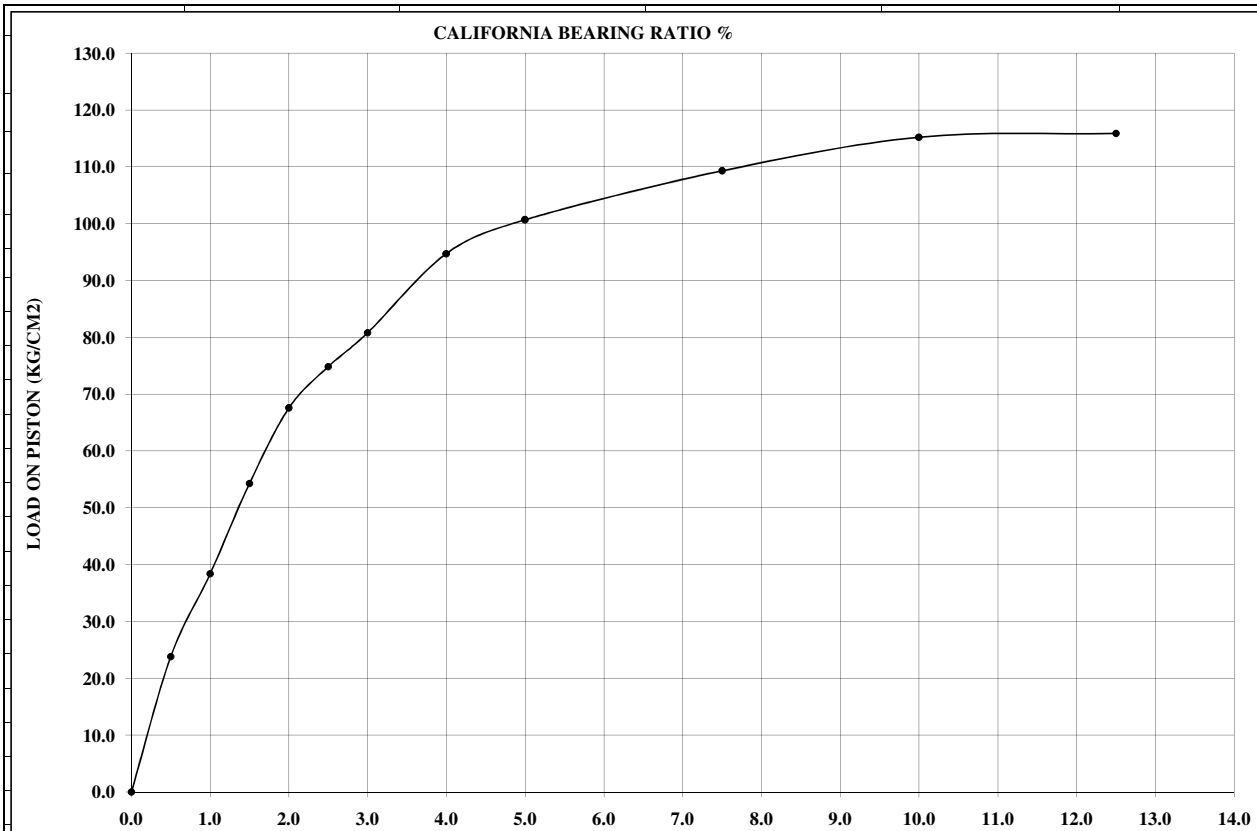

CALIFORNIA BEARING RATIO %
LOAD ON PISTON (KG/CM2)
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0
PENETRATION (MM), CBR TEST RESULT NO-4
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR


CALIFORNIA BEARING RATIO %
LOAD ON PISTON (KG/CM2)
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
PENETRATION (MM), CBR TEST RESULT NO-5
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR

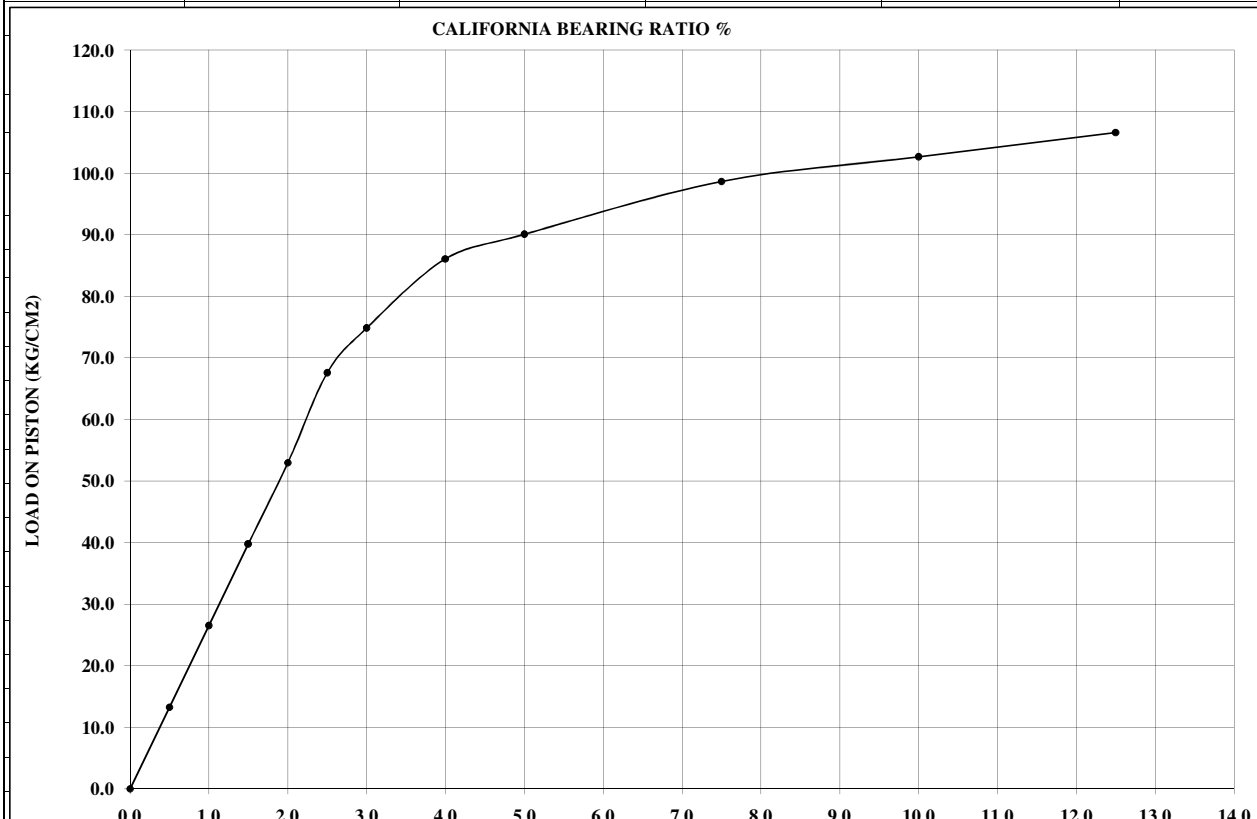

CALIFORNIA BEARING RATIO %
LOAD ON PISTON (KG/CM2)
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
PENETRATION (MM), CBR TEST RESULT NO-6
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR


CALIFORNIA BEARING RATIO %
LOAD ON PISTON (KG/CM2)
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
PENETRATION (MM), CBR TEST RESULT NO-7
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR


CALIFORNIA BEARING RATIO %
LOAD ON PISTON (KG/CM2)
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
PENETRATION (MM), CBR TEST RESULT NO-8
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR




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




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

**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **33.85** | | **MDD** | **1.82** | Gm/cc | |
| **Plastic Limit** | **20.17** | | **OMC** | **23.58** | *%* | |
| **Plasticity Index** | **13.68** | | **NMC** | **20.01** | *%* | |
| | | | | | | |
| **CBR NO- 11** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **15.894** |
| 1.0 | 0.00 | 0.0 | 0 | | **1.000** | **33.775** |
| 2.0 | 0.50 | 2.4 | 15.89 | | **1.500** | **50.331** |
| 3.0 | 1.00 | 5.1 | 33.77 | | **2.000** | **62.252** |
| 4.0 | 1.50 | 7.6 | 50.33 | | **2.500** | **69.536** |
| 5.0 | 2.00 | 9.4 | 62.25 | | **3.000** | **75.497** |
| 6.0 | 2.50 | 10.5 | 69.54 | **5.08** | **4.000** | **84.106** |
| 7.0 | 3.00 | 11.4 | 75.50 | | **5.000** | **89.404** |
| 8.0 | 4.00 | 12.7 | 84.11 | | **7.500** | **100.662** |
| 9.0 | 5.00 | 13.5 | 89.40 | **4.35** | **10.000** | **105.298** |
| 10.0 | 7.50 | 15.2 | 100.66 | | **12.500** | **107.285** |
| 11.0 | 10.00 | 15.9 | 105.30 | | | |
| 12.0 | 12.50 | 16.2 | 107.28 | | | |
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**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **34.86** | | **MDD** | **1.86** | Gm/cc | |
| **Plastic Limit** | **21.33** | | **OMC** | **23.65** | *%* | |
| **Plasticity Index** | **13.53** | | **NMC** | **19.76** | *%* | |
| | | | | | | |
| **CBR NO- 12** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **23.841** |
| 1.0 | 0.00 | 0 | 0 | | **1.000** | **42.384** |
| 2.0 | 0.50 | 3.6 | 23.84 | | **1.500** | **56.291** |
| 3.0 | 1.00 | 6.4 | 42.38 | | **2.000** | **67.550** |
| 4.0 | 1.50 | 8.5 | 56.29 | | **2.500** | **74.172** |
| 5.0 | 2.00 | 10.2 | 67.55 | | **3.000** | **78.808** |
| 6.0 | 2.50 | 11.2 | 74.17 | **5.41** | **4.000** | **85.430** |
| 7.0 | 3.00 | 11.9 | 78.81 | | **5.000** | **90.066** |
| 8.0 | 4.00 | 12.9 | 85.43 | | **7.500** | **99.338** |
| 9.0 | 5.00 | 13.6 | 90.07 | **4.38** | **10.000** | **105.960** |
| 10.0 | 7.50 | 15 | 99.34 | | **12.500** | **108.609** |
| 11.0 | 10.00 | 16 | 105.96 | | | |
| 12.0 | 12.50 | 16.4 | 108.61 | | | |
| | | | | | | |

**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **32.96** | | **MDD** | **1.842** | Gm/cc | |
| **Plastic Limit** | **20.38** | | **OMC** | **23.01** | *%* | |
| **Plasticity Index** | **12.58** | | **NMC** | **18.44** | *%* | |
| | | | | | | |
| **CBR NO- 13** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **21.192** |
| 1.0 | 0.00 | 0 | 0 | | **1.000** | **39.073** |
| 2.0 | 0.50 | 3.2 | 21.19 | | **1.500** | **50.331** |
| 3.0 | 1.00 | 5.9 | 39.07 | | **2.000** | **60.927** |
| 4.0 | 1.50 | 7.6 | 50.33 | | **2.500** | **71.523** |
| 5.0 | 2.00 | 9.2 | 60.93 | | **3.000** | **80.530** |
| 6.0 | 2.50 | 10.8 | 71.52 | **5.22** | **4.000** | **92.318** |
| 7.0 | 3.00 | 12.16 | 80.53 | | **5.000** | **100.662** |
| 8.0 | 4.00 | 13.94 | 92.32 | | **7.500** | **111.921** |
| 9.0 | 5.00 | 15.2 | 100.66 | **4.90** | **10.000** | **117.881** |
| 10.0 | 7.50 | 16.9 | 111.92 | | **12.500** | **120.530** |
| 11.0 | 10.00 | 17.8 | 117.88 | | | |
| 12.0 | 12.50 | 18.2 | 120.53 | | | |
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**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **34.21** | | **MDD** | **1.864** | Gm/cc | |
| **Plastic Limit** | **21.14** | | **OMC** | **23.85** | *%* | |
| **Plasticity Index** | **13.07** | | **NMC** | **18.61** | *%* | |
| | | | | | | |
| **CBR NO- 14** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **20.530** |
| 1.0 | 0.00 | 0 | 0 | | **1.000** | **38.411** |
| 2.0 | 0.50 | 3.1 | 20.53 | | **1.500** | **55.629** |
| 3.0 | 1.00 | 5.8 | 38.41 | | **2.000** | **66.887** |
| 4.0 | 1.50 | 8.4 | 55.63 | | **2.500** | **72.980** |
| 5.0 | 2.00 | 10.1 | 66.89 | | **3.000** | **78.808** |
| 6.0 | 2.50 | 11.02 | 72.98 | **5.33** | **4.000** | **85.430** |
| 7.0 | 3.00 | 11.9 | 78.81 | | **5.000** | **88.079** |
| 8.0 | 4.00 | 12.9 | 85.43 | | **7.500** | **94.040** |
| 9.0 | 5.00 | 13.3 | 88.08 | **4.29** | **10.000** | **98.675** |
| 10.0 | 7.50 | 14.2 | 94.04 | | **12.500** | **102.649** |
| 11.0 | 10.00 | 14.9 | 98.68 | | | |
| 12.0 | 12.50 | 15.5 | 102.65 | | | |
| | | | | | | |

**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **34.68** | | **MDD** | **1.822** | Gm/cc | |
| **Plastic Limit** | **22.14** | | **OMC** | **22.64** | *%* | |
| **Plasticity Index** | **12.54** | | **NMC** | **18.42** | *%* | |
| | | | | | | |
| **CBR NO-15** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **16.556** |
| 1.0 | 0.00 | 0 | 0 | | **1.000** | **34.437** |
| 2.0 | 0.50 | 2.5 | 16.56 | | **1.500** | **50.331** |
| 3.0 | 1.00 | 5.2 | 34.44 | | **2.000** | **60.927** |
| 4.0 | 1.50 | 7.6 | 50.33 | | **2.500** | **70.861** |
| 5.0 | 2.00 | 9.2 | 60.93 | | **3.000** | **75.497** |
| 6.0 | 2.50 | 10.7 | 70.86 | **5.17** | **4.000** | **83.444** |
| 7.0 | 3.00 | 11.4 | 75.50 | | **5.000** | **88.742** |
| 8.0 | 4.00 | 12.6 | 83.44 | | **7.500** | **100.662** |
| 9.0 | 5.00 | 13.4 | 88.74 | **4.32** | **10.000** | **106.623** |
| 10.0 | 7.50 | 15.2 | 100.66 | | **12.500** | **109.272** |
| 11.0 | 10.00 | 16.1 | 106.62 | | | |
| 12.0 | 12.50 | 16.5 | 109.27 | | | |
| | | | | | | |
| | | | | | | |

**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **33.65** | | **MDD** | **1.878** | Gm/cc | |
| **Plastic Limit** | **21.86** | | **OMC** | **24.06** | *%* | |
| **Plasticity Index** | **11.79** | | **NMC** | **18.99** | *%* | |
| | | | | | | |
| **CBR NO-16** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **25.828** |
| 1.0 | 0.00 | 0 | 0 | | **1.000** | **43.709** |
| 2.0 | 0.50 | 3.9 | 25.83 | | **1.500** | **56.291** |
| 3.0 | 1.00 | 6.6 | 43.71 | | **2.000** | **68.874** |
| 4.0 | 1.50 | 8.5 | 56.29 | | **2.500** | **75.497** |
| 5.0 | 2.00 | 10.4 | 68.87 | | **3.000** | **81.457** |
| 6.0 | 2.50 | 11.4 | 75.50 | **5.51** | **4.000** | **90.066** |
| 7.0 | 3.00 | 12.3 | 81.46 | | **5.000** | **96.689** |
| 8.0 | 4.00 | 13.6 | 90.07 | | **7.500** | **104.636** |
| 9.0 | 5.00 | 14.6 | 96.69 | **4.71** | **10.000** | **108.609** |
| 10.0 | 7.50 | 15.8 | 104.64 | | **12.500** | **109.934** |
| 11.0 | 10.00 | 16.4 | 108.61 | | | |
| 12.0 | 12.50 | 16.6 | 109.93 | | | |
| | | | | | | |

**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **33.59** | | **MDD** | **1.821** | Gm/cc | |
| **Plastic Limit** | **21.38** | | **OMC** | **24.16** | *%* | |
| **Plasticity Index** | **12.21** | | **NMC** | **19.12** | *%* | |
| | | | | | | |
| **CBR NO- 17** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **15.232** |
| 1.0 | 0.00 | 0 | 0 | | **1.000** | **31.126** |
| 2.0 | 0.50 | 2.3 | 15.23 | | **1.500** | **47.020** |
| 3.0 | 1.00 | 4.7 | 31.13 | | **2.000** | **56.954** |
| 4.0 | 1.50 | 7.1 | 47.02 | | **2.500** | **67.550** |
| 5.0 | 2.00 | 8.6 | 56.95 | | **3.000** | **74.834** |
| 6.0 | 2.50 | 10.2 | 67.55 | **4.93** | **4.000** | **83.444** |
| 7.0 | 3.00 | 11.3 | 74.83 | | **5.000** | **89.404** |
| 8.0 | 4.00 | 12.6 | 83.44 | | **7.500** | **98.013** |
| 9.0 | 5.00 | 13.5 | 89.40 | **4.35** | **10.000** | **103.311** |
| 10.0 | 7.50 | 14.8 | 98.01 | | **12.500** | **103.311** |
| 11.0 | 10.00 | 15.6 | 103.31 | | | |
| 12.0 | 12.50 | 15.6 | 103.31 | | | |
| | | | | | | |
| | | | | | | |

**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

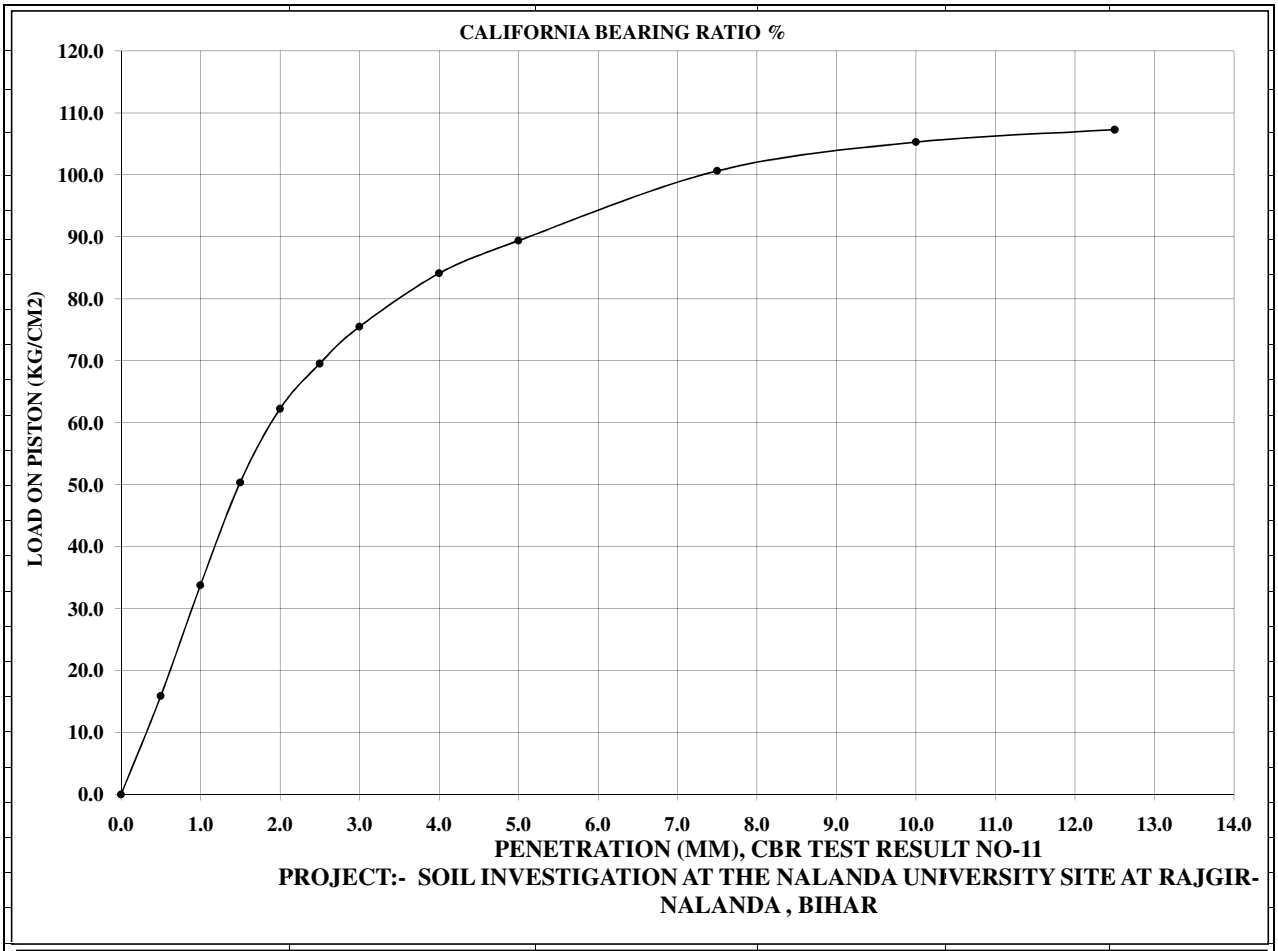
| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **33.96** | | **MDD** | **1.833** | Gm/cc | |
| **Plastic Limit** | **20.17** | | **OMC** | **24.05** | *%* | |
| **Plasticity Index** | **13.79** | | **NMC** | **19.24** | *%* | |
| | | | | | | |
| **CBR NO- 18** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **23.179** |
| 1.0 | 0.00 | 0 | 0 | | **1.000** | **39.073** |
| 2.0 | 0.50 | 3.5 | 23.18 | | **1.500** | **54.305** |
| 3.0 | 1.00 | 5.9 | 39.07 | | **2.000** | **64.238** |
| 4.0 | 1.50 | 8.2 | 54.30 | | **2.500** | **72.980** |
| 5.0 | 2.00 | 9.7 | 64.24 | | **3.000** | **79.801** |
| 6.0 | 2.50 | 11.02 | 72.98 | **5.33** | **4.000** | **92.053** |
| 7.0 | 3.00 | 12.05 | 79.80 | | **5.000** | **100.000** |
| 8.0 | 4.00 | 13.9 | 92.05 | | **7.500** | **110.596** |
| 9.0 | 5.00 | 15.1 | 100.00 | **4.87** | **10.000** | **113.907** |
| 10.0 | 7.50 | 16.7 | 110.60 | | **12.500** | **116.556** |
| 11.0 | 10.00 | 17.2 | 113.91 | | | |
| 12.0 | 12.50 | 17.6 | 116.56 | | | |
| | | | | | | |

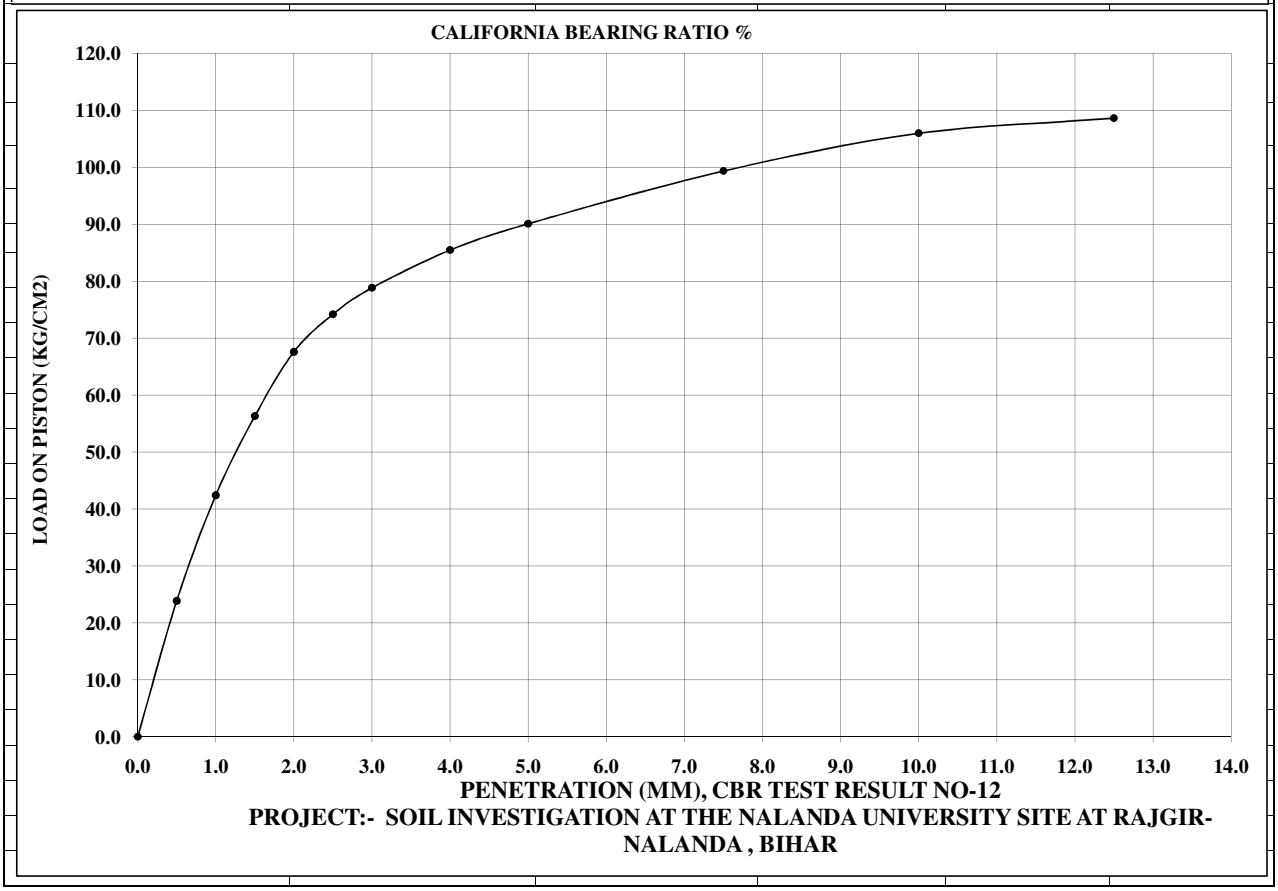
**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

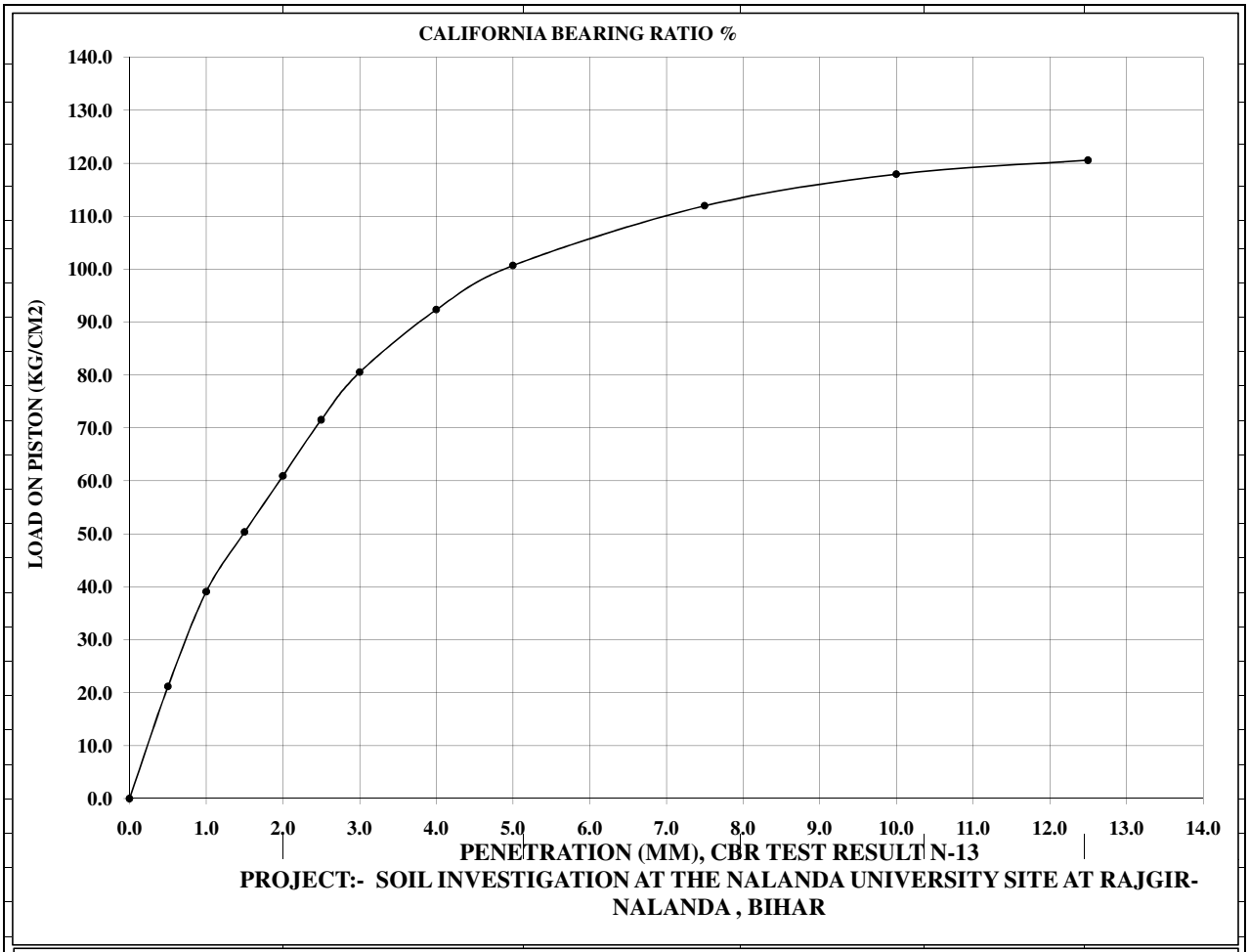
| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **32.62** | | **MDD** | **1.823** | Gm/cc | |
| **Plastic Limit** | **21.04** | | **OMC** | **24.22** | *%* | |
| **Plasticity Index** | **11.58** | | **NMC** | **19.43** | *%* | |
| | | | | | | |
| **CBR NO- 19** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **17.219** |
| 1.0 | 0.00 | 0 | 0 | | **1.000** | **35.762** |
| 2.0 | 0.50 | 2.6 | 17.22 | | **1.500** | **51.656** |
| 3.0 | 1.00 | 5.4 | 35.76 | | **2.000** | **62.252** |
| 4.0 | 1.50 | 7.8 | 51.66 | | **2.500** | **70.199** |
| 5.0 | 2.00 | 9.4 | 62.25 | | **3.000** | **74.172** |
| 6.0 | 2.50 | 10.6 | 70.20 | **5.12** | **4.000** | **84.106** |
| 7.0 | 3.00 | 11.2 | 74.17 | | **5.000** | **90.066** |
| 8.0 | 4.00 | 12.7 | 84.11 | | **7.500** | **97.351** |
| 9.0 | 5.00 | 13.6 | 90.07 | **4.38** | **10.000** | **101.325** |
| 10.0 | 7.50 | 14.7 | 97.35 | | **12.500** | **103.311** |
| 11.0 | 10.00 | 15.3 | 101.32 | | | |
| 12.0 | 12.50 | 15.6 | 103.31 | | | |
| | | | | | | |
| | | | | | | |

**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

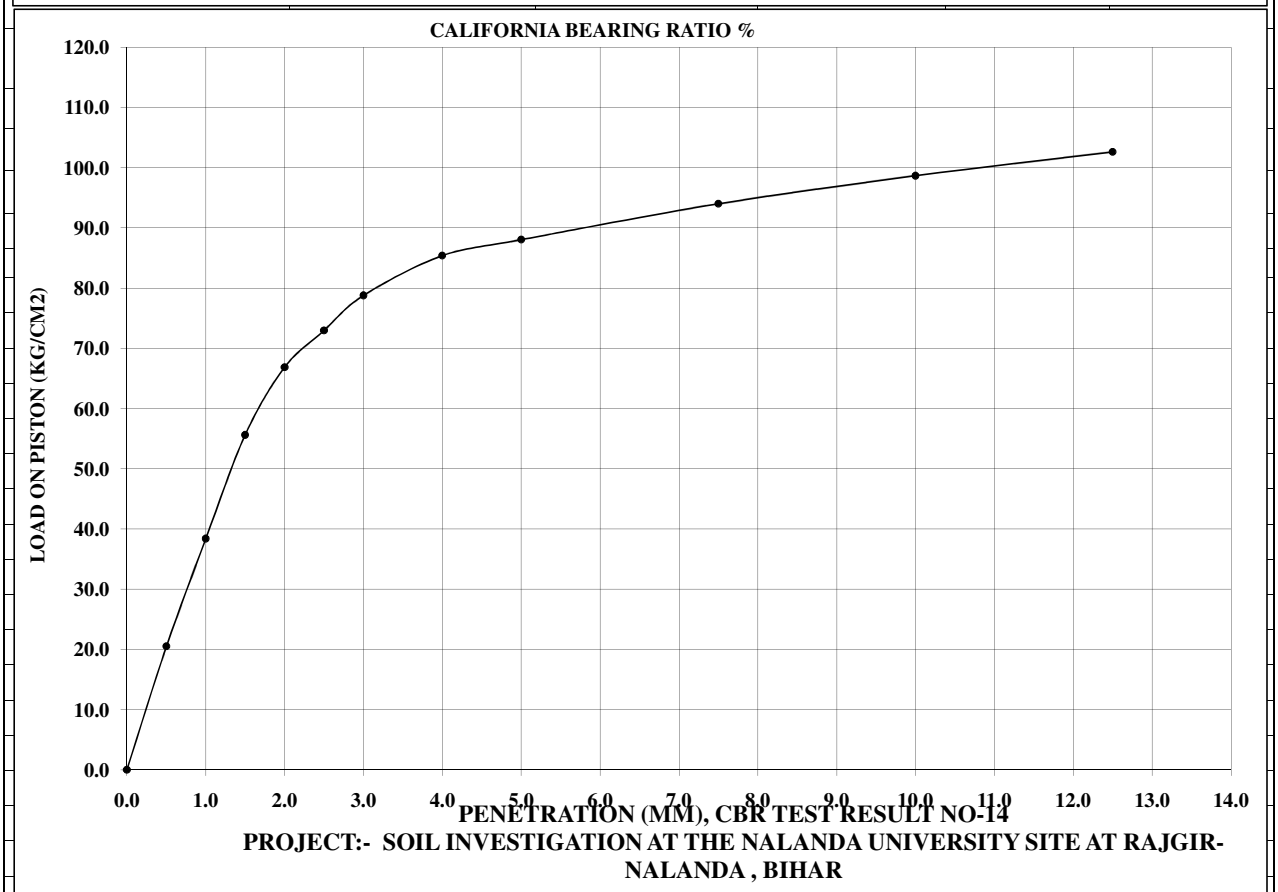
| | | | | | | |
|---|---|---|---|---|---|---|
| **Liquid Limit** | **34.02** | | **MDD** | **1.864** | Gm/cc | |
| **Plastic Limit** | **21.68** | | **OMC** | **23.16** | *%* | |
| **Plasticity Index** | **12.34** | | **NMC** | **19.2** | *%* | |
| | | | | | | |
| **CBR NO- 20** | | | | | | |
| | | | **SOIL TYPE** | **CL** | | |
| **Soaking Condition** | **Soaked** | | | | **Settlemnt mm** | **Load Kg** |
| **Plunger Diam cm** | **5.0** | **Area CM2** | | | **0.000** | **0.000** |
| **Sl No** | **Settlemnt mm** | **Load Division** | **Load Kg** | **CBR %** | **0.500** | **23.179** |
| 1.0 | 0.00 | 0.0 | 0 | | **1.000** | **44.371** |
| 2.0 | 0.50 | 3.5 | 23.18 | | **1.500** | **55.629** |
| 3.0 | 1.00 | 6.7 | 44.37 | | **2.000** | **67.550** |
| 4.0 | 1.50 | 8.4 | 55.63 | | **2.500** | **75.497** |
| 5.0 | 2.00 | 10.2 | 67.55 | | **3.000** | **82.781** |
| 6.0 | 2.50 | 11.4 | 75.50 | **5.51** | **4.000** | **92.053** |
| 7.0 | 3.00 | 12.5 | 82.78 | | **5.000** | **96.026** |
| 8.0 | 4.00 | 13.9 | 92.05 | | **7.500** | **103.974** |
| 9.0 | 5.00 | 14.5 | 96.03 | **4.67** | **10.000** | **107.285** |
| 10.0 | 7.50 | 15.7 | 103.97 | | **12.500** | **108.609** |
| 11.0 | 10.00 | 16.2 | 107.28 | | | |
| 12.0 | 12.50 | 16.4 | 108.61 | | | |
| | | | | | | |
| | | | | | | |


CALIFORNIA BEARING RATIO %
LOAD ON PISTON (KG/CM2)
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0
PENETRATION (MM), CBR TEST RESULT NO-11
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR

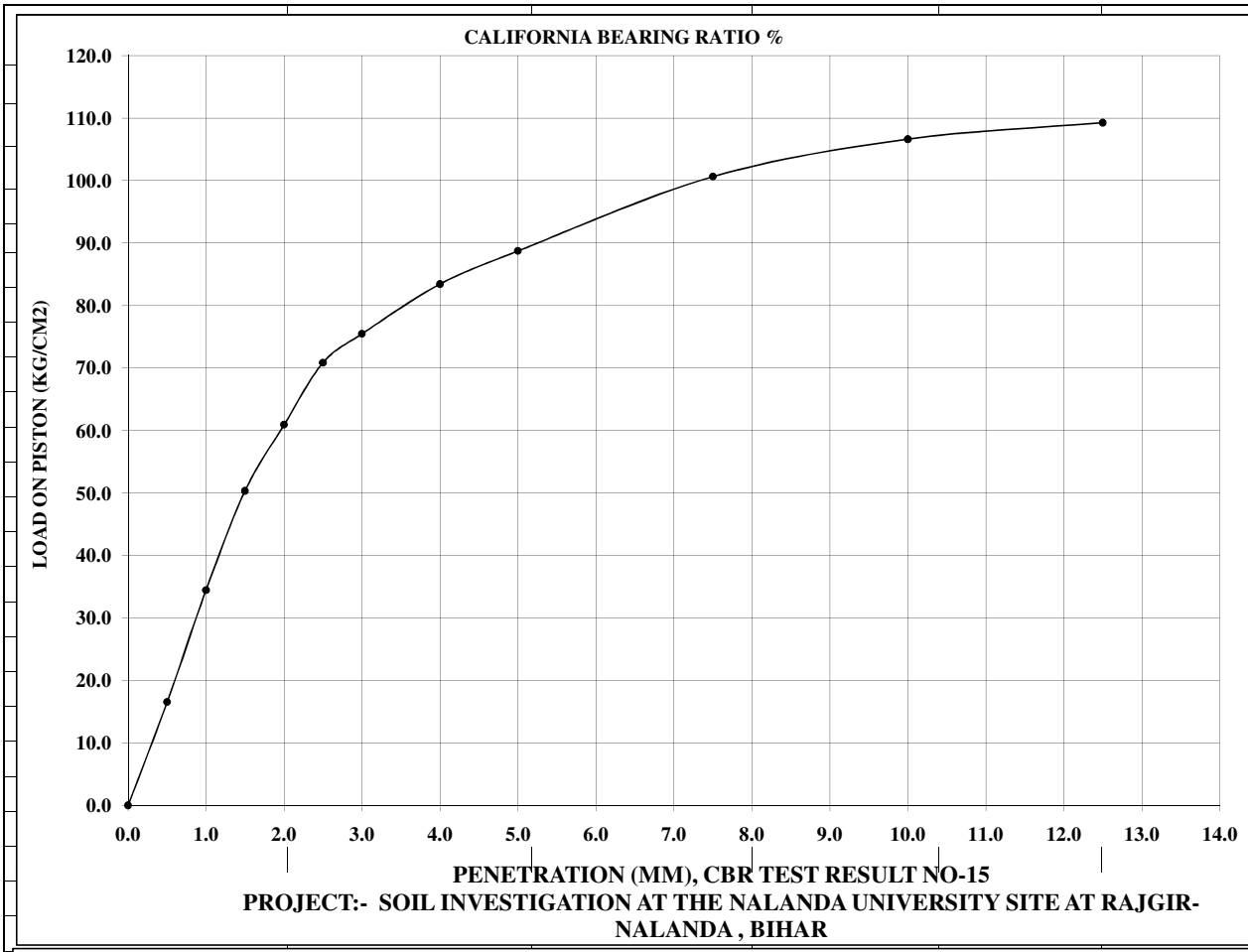

CALIFORNIA BEARING RATIO %
LOAD ON PISTON (KG/CM2)
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0
PENETRATION (MM), CBR TEST RESULT NO-12
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR

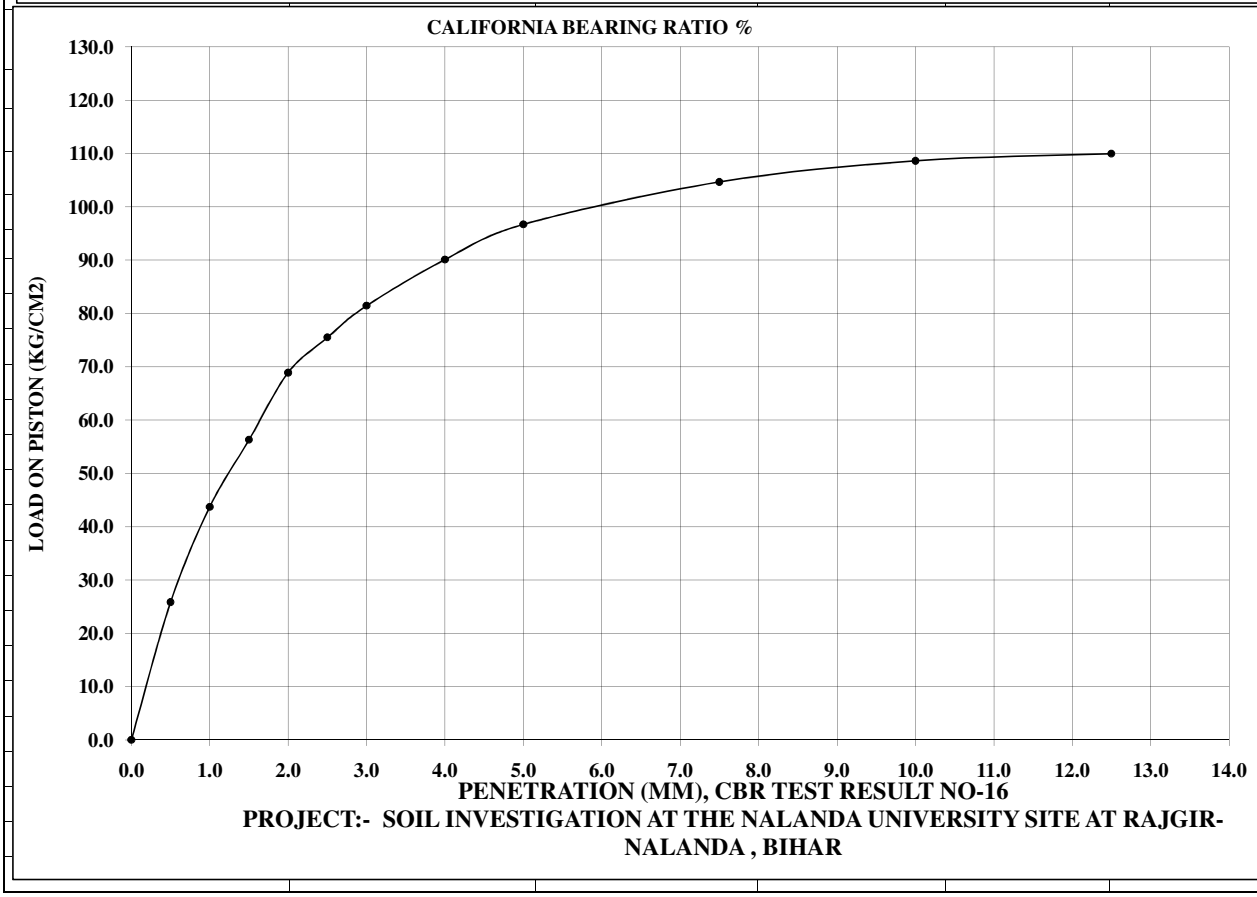


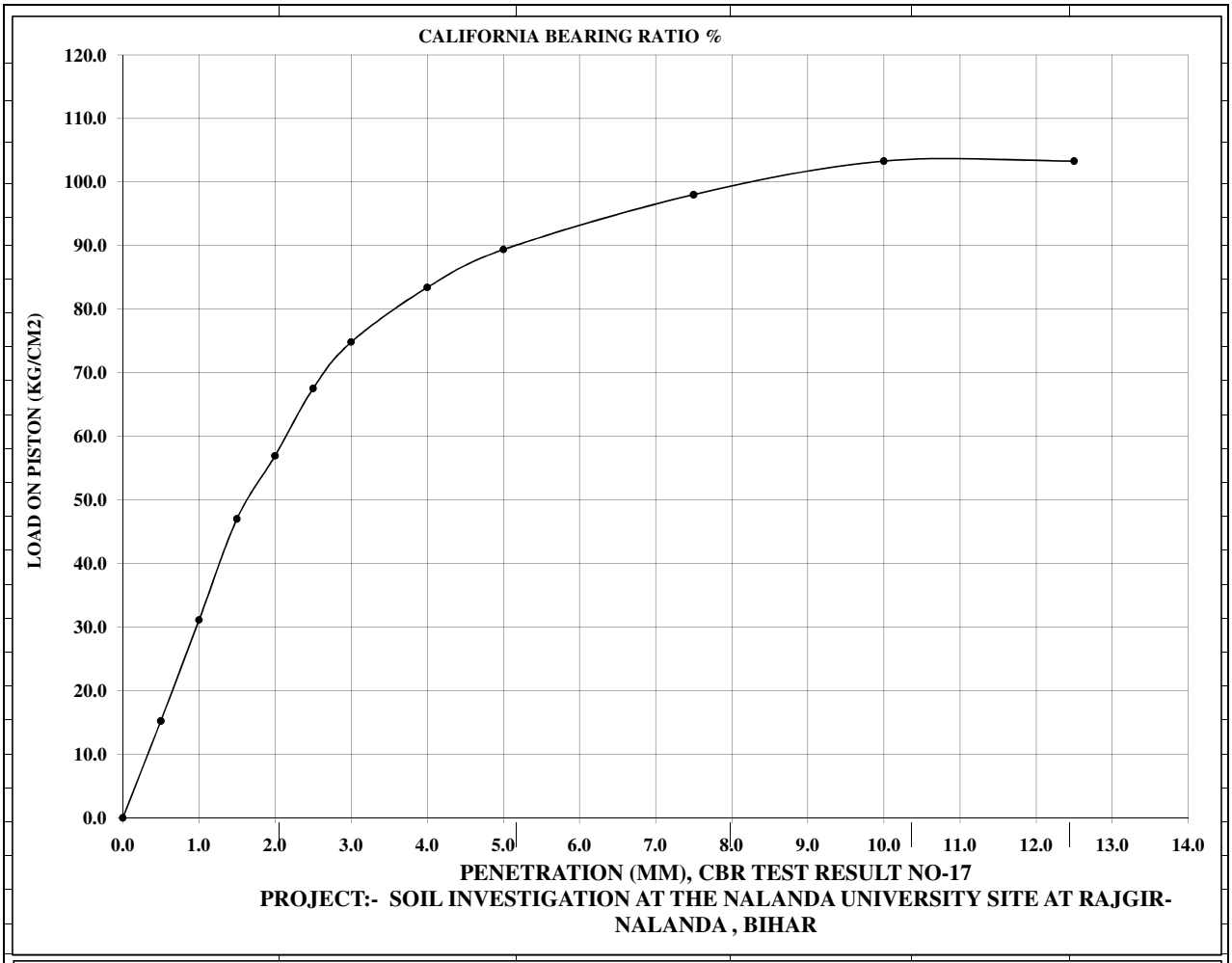

**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR**

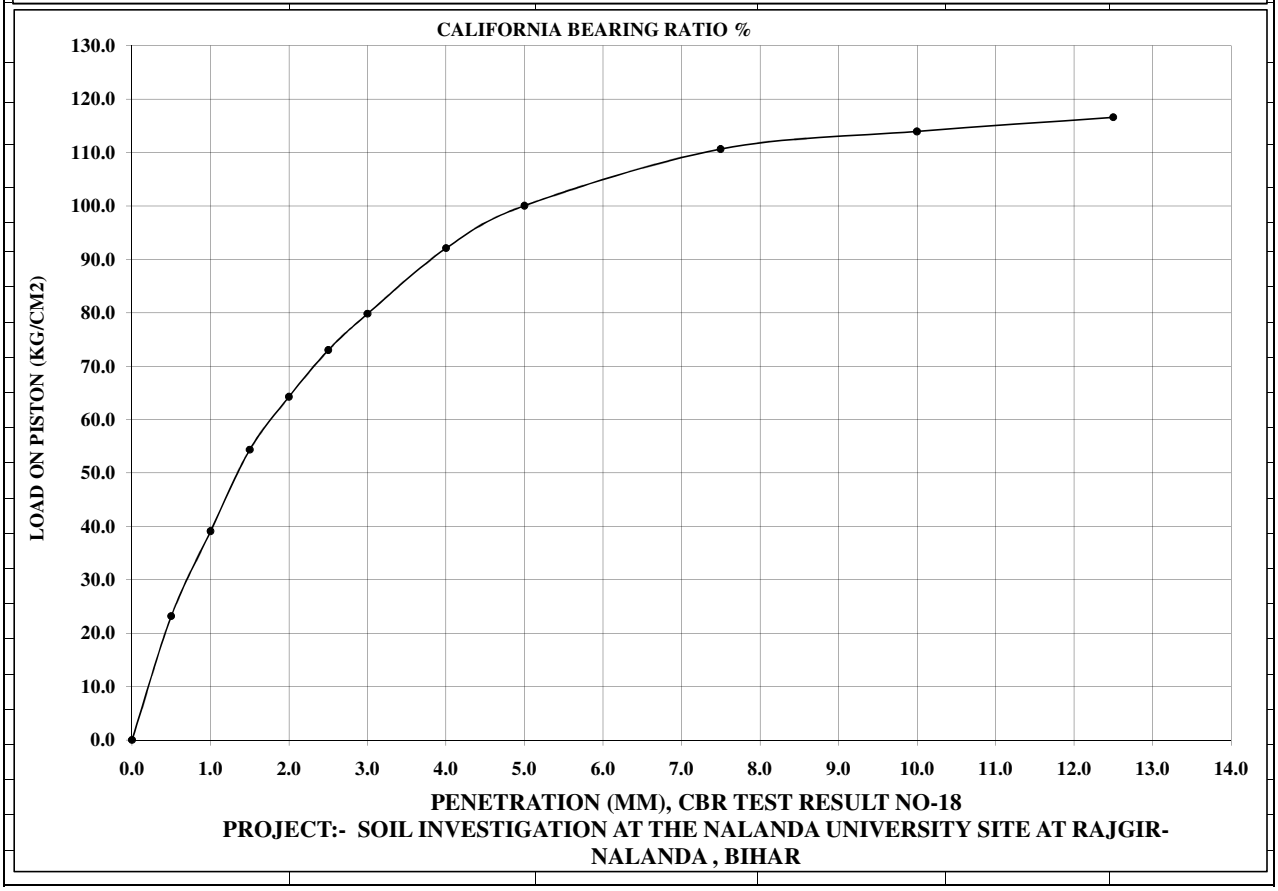


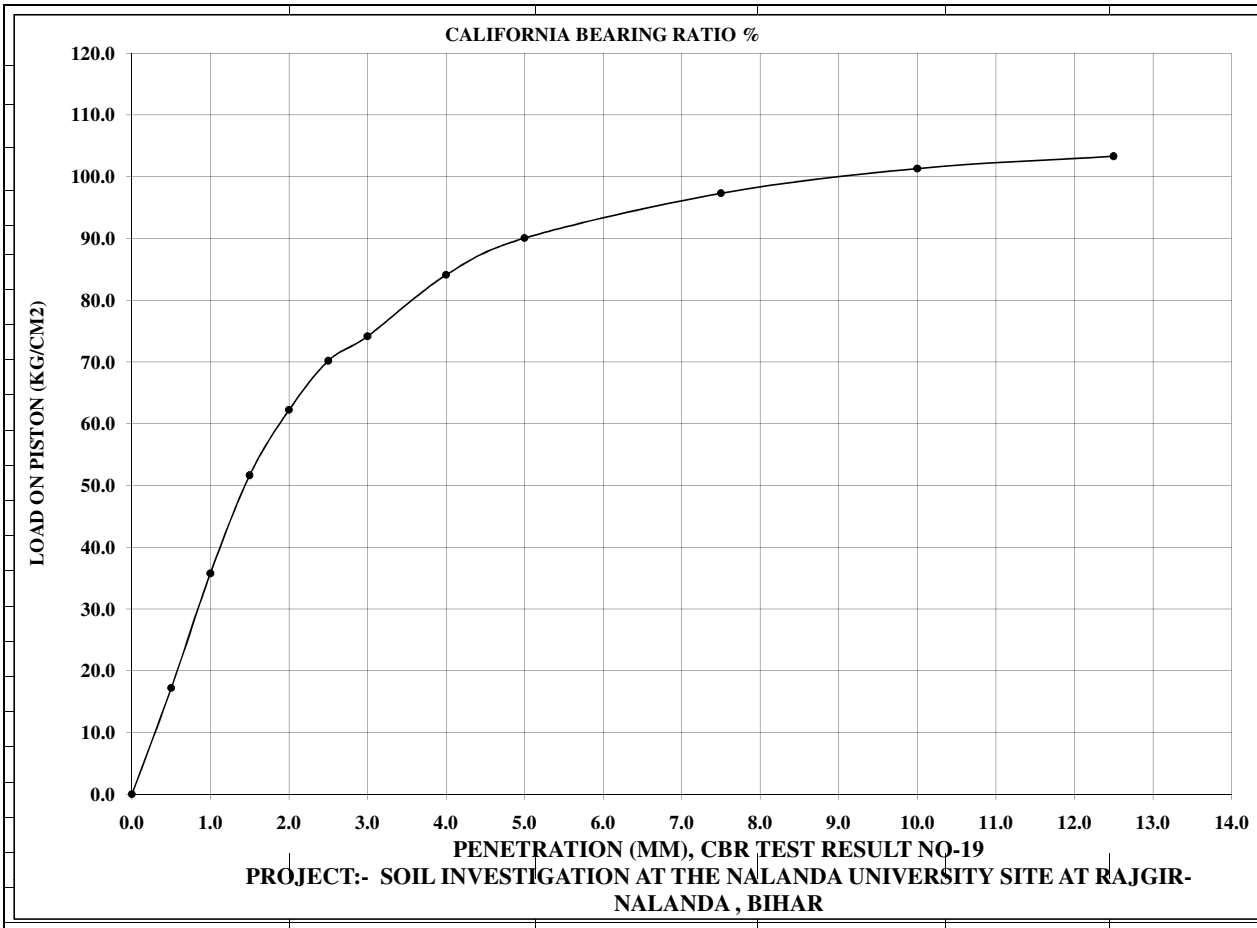

**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR**


CALIFORNIA BEARING RATIO %
LOAD ON PISTON (KG/CM2)
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0
PENETRATION (MM), CBR TEST RESULT NO-15
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR

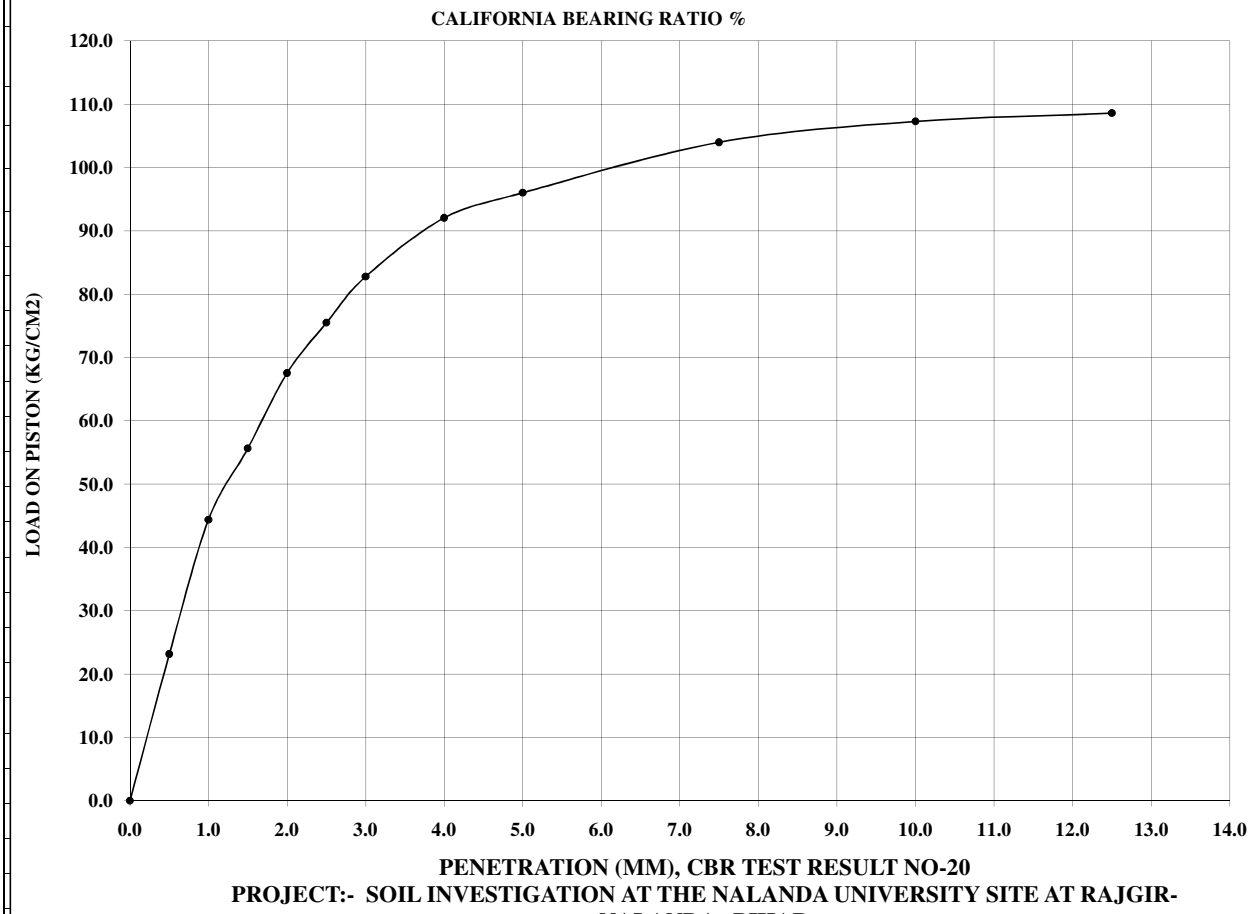

CALIFORNIA BEARING RATIO %
LOAD ON PISTON (KG/CM2)
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0
PENETRATION (MM), CBR TEST RESULT NO-16
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR


CALIFORNIA BEARING RATIO %
LOAD ON PISTON (KG/CM2)
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0
PENETRATION (MM), CBR TEST RESULT NO-17
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR


CALIFORNIA BEARING RATIO %
LOAD ON PISTON (KG/CM2)
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0
PENETRATION (MM), CBR TEST RESULT NO-18
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR




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

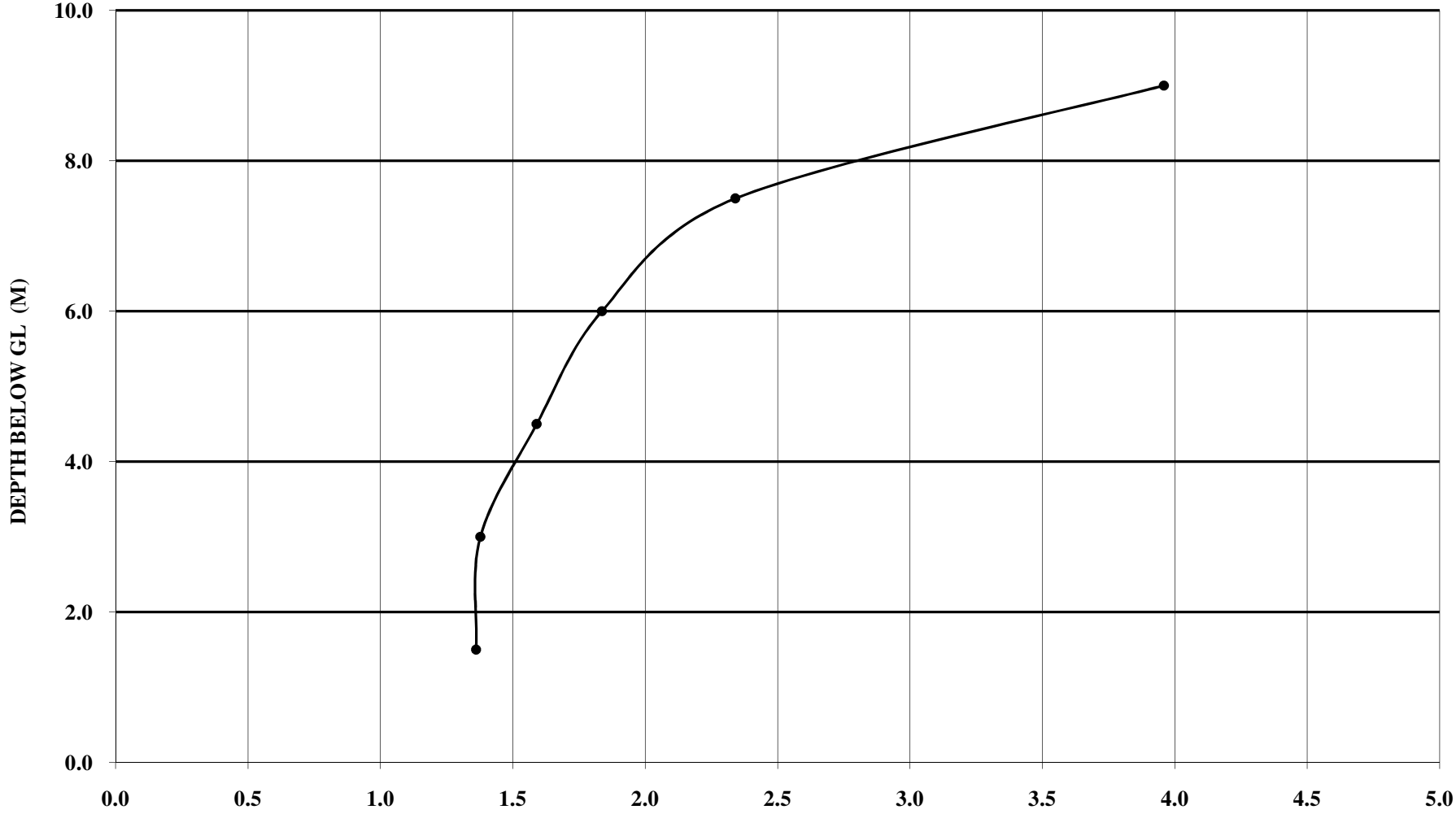



**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-NALANDA , BIHAR**

| Evaluation of Liquefaction Potential Based on SPT(CRR) | | | | | | | | PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pa | | | 1.0 | Kg/cm2 | | | | | | | | | | |
| Depth Of Water Table Assumed (m) Below EGL | | | | | 0.0 | | | | | | | | | | | |
| Depth Below GL(m) | SPT Field Obsrved Value | Bulk density of Soil(Kg/cm2 *m) | Density of Water(Kg/ cm2*m) | Total Stress Ts | Hydrostatic Pressure Hs | Effective Stress Es(kg/cm2) | % Finer content (FC) | Cσ=1/(18.9-17.3Dr) <=0.3 as per Eq 13 P39 | Overburden Correction factor Kσ =(1-Cσ*Ln(σ' v0))as per Eq 12 P39 <=1.0 | Cn(Overburden/normalization) =(1/EStress) power m as per Eq 19P40 | N1-60(Normalization Factor diamensionless) qty =Cn*qc as per Eq 3 P33 | N1-60 cs (Clean Sand =(N1)60 +Δ $_{(N1)60}$ as per Eq 25 P44 | Δ (N1)=exp((1.63+9.7/FC-(15.7/FC)2) as per Eq 26 P44 | Relative DensityDr =0.478(qc1n) Power 0.264-1.063Eq 14 P39 | m=0.784-0.521Dr as per Eq20 P 40 Fig 11 | N1-60 cs/14.1as Per Eq 27 P44 (Part) (A) |
| 1.50 | 5.0 | 0.188 | 0.100 | 0.2820 | 0.1500 | 0.1320 | 86 | 0.106 | 1.00 | 2.75 | 14 | 19 | 5.53 | 0.55 | 0.50 | 1.37 |
| 3.00 | 7.0 | 0.188 | 0.100 | 0.564 | 0.300 | 0.2640 | 86 | 0.105 | 1.00 | 1.95 | 14 | 19 | 5.53 | 0.54 | 0.50 | 1.36 |
| 4.50 | 10.0 | 0.197 | 0.100 | 0.860 | 0.450 | 0.4095 | 84 | 0.112 | 1.00 | 1.54 | 15 | 21 | 5.53 | 0.58 | 0.48 | 1.48 |
| 6.00 | 13.0 | 0.197 | 0.100 | 1.155 | 0.600 | 0.5550 | 83 | 0.120 | 1.00 | 1.32 | 17 | 23 | 5.53 | 0.61 | 0.47 | 1.61 |
| 7.50 | 17.0 | 0.199 | 0.100 | 1.454 | 0.750 | 0.7035 | 83 | 0.133 | 1.00 | 1.17 | 20 | 25 | 5.53 | 0.66 | 0.44 | 1.80 |
| 9.00 | 23.0 | 0.199 | 0.100 | 1.752 | 0.900 | 0.8520 | 80 | 0.160 | 1.00 | 1.07 | 25 | 30 | 5.54 | 0.73 | 0.40 | 2.13 |

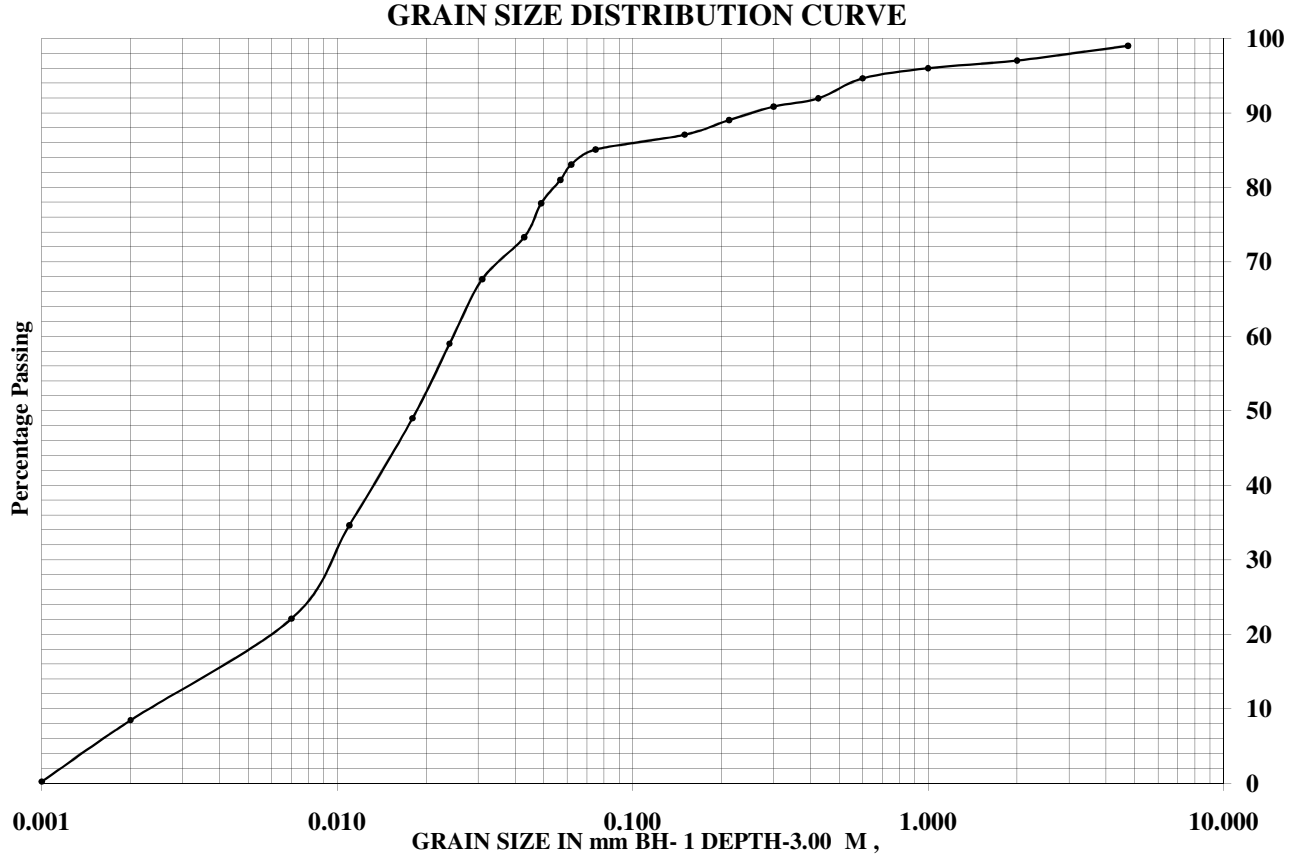
| | PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| **Square (N1-60 cs/126)as Per Eq 27 P44 (Part) (B)** | **Cube (N1-60 cs/23.6)as Per Eq 27 P44 (Part) (C )** | **Power4 (N1-60 cs/25.4)as Per Eq 27 P44 (Part) (D)** | **(A+B-C+D-28) as Per Eq 27 P44** | **Liquefaction Potential CRR =Exp((N1)60cs/14.1+((N1)60cs/126))2-((N1)60cs/23.6)3+((N1)60cs/25.4)4) as per Eq 27 P/44** | **Earthquake Moment Magnitude** | **Maximum Ground Accn (of g)** | **a(z)=-1.012-1.126 sin(z/11.73+5.133) as per eq 6bP34** | **bz=0.106+0.118 sin(z/11.28+5.142) as per eq 6cp34** | **rd=exp(a(z)+b(z)*M) as per Eq 6aP34** | **Magnitude scaling factor MSF=6.9*(exp(-M/4))-0.058 as per eq 8a P36** | **Cyclic Stress Ration Under Earthquake CSR m7.5=0.65*(σv0/σ 'v0)rd/MSF as per Eq 23 P43** | **Factor Of Safety** |
| 0.023 | 0.54 | 0.33 | -1.62 | **0.1973** | 7.00 | 0.120 | -0.051 | 0.006 | 0.992 | 1.141 | **0.145** | **1.361** |
| 0.02 | 0.53 | 0.32 | -1.63 | **0.1960** | 7.00 | 0.120 | -0.134 | 0.015 | 0.974 | 1.141 | **0.142** | **1.378** |
| 0.03 | 0.70 | 0.46 | -1.53 | **0.2176** | 7.00 | 0.120 | -0.231 | 0.026 | 0.954 | 1.141 | **0.137** | **1.590** |
| 0.03 | 0.88 | 0.63 | -1.41 | **0.2433** | 7.00 | 0.120 | -0.341 | 0.038 | 0.931 | 1.141 | **0.132** | **1.837** |
| 0.04 | 1.25 | 1.00 | -1.21 | **0.2996** | 7.00 | 0.120 | -0.462 | 0.052 | 0.906 | 1.141 | **0.128** | **2.340** |
| 0.06 | 2.07 | 1.97 | -0.71 | **0.4899** | 7.00 | 0.120 | -0.591 | 0.066 | 0.880 | 1.141 | **0.124** | **3.959** |

**LIQUIFACTION POTENTIAL OF SUB SOIL STRATA**
**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR..**
**MOMENT MAGNITUDE 7.0 , MAX GROUND ACCELARATION 0.12g)**




**FACTOR OF SAFETY (I.E. RATIO OF LIQUFACTION RESISTANCES OF THE SUB SOIL STRATA TO SHEAR STRESS INDUCES DUE TO EARTHQUAKE )**
**PROJECT:- SOIL INVESTIGATION AT NALANDA UNIVERSITY SITE , RAJGIR , NALANDA, BIHAR.**

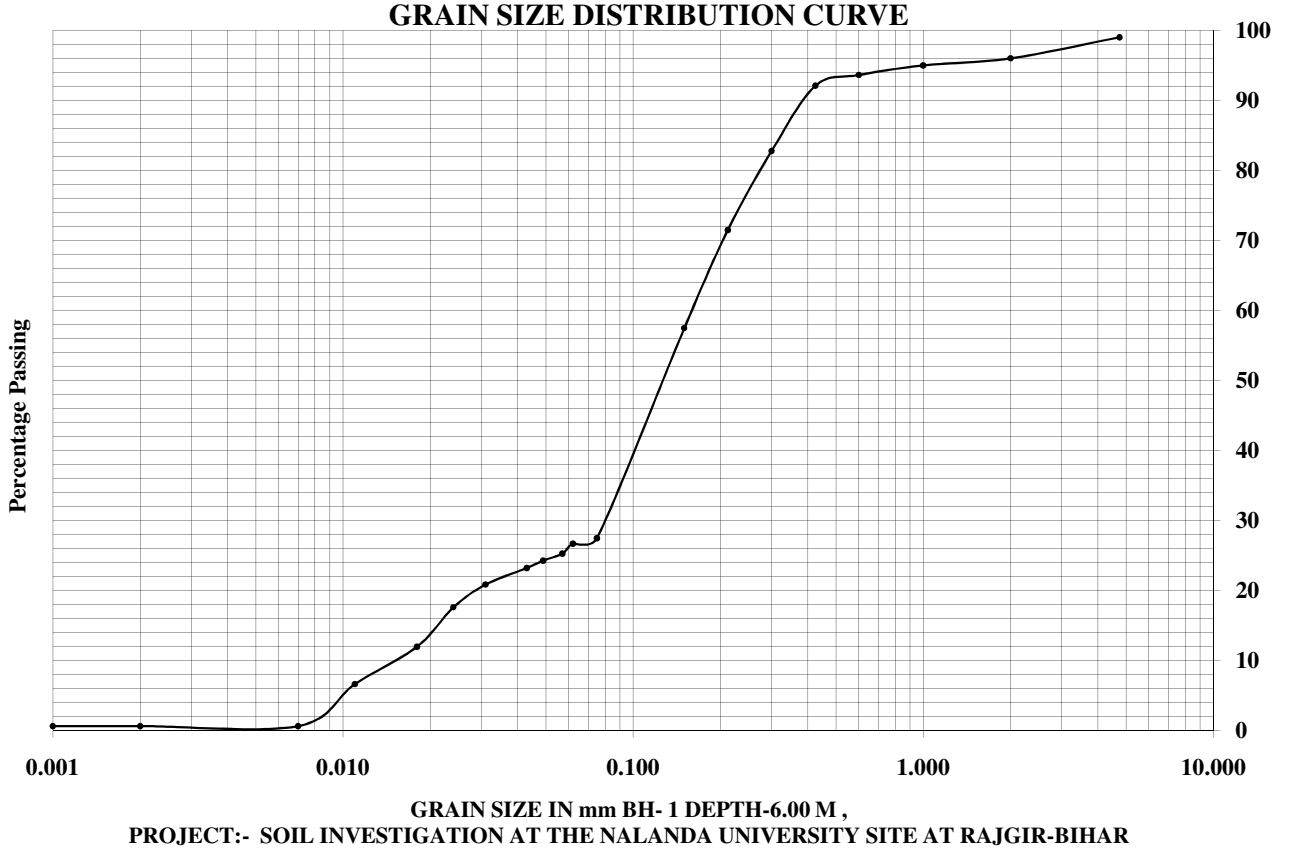
## GRAIN SIZE DISTRIBUTION CURVE




GRAIN SIZE IN mm BH- 1 DEPTH-3.00 M ,

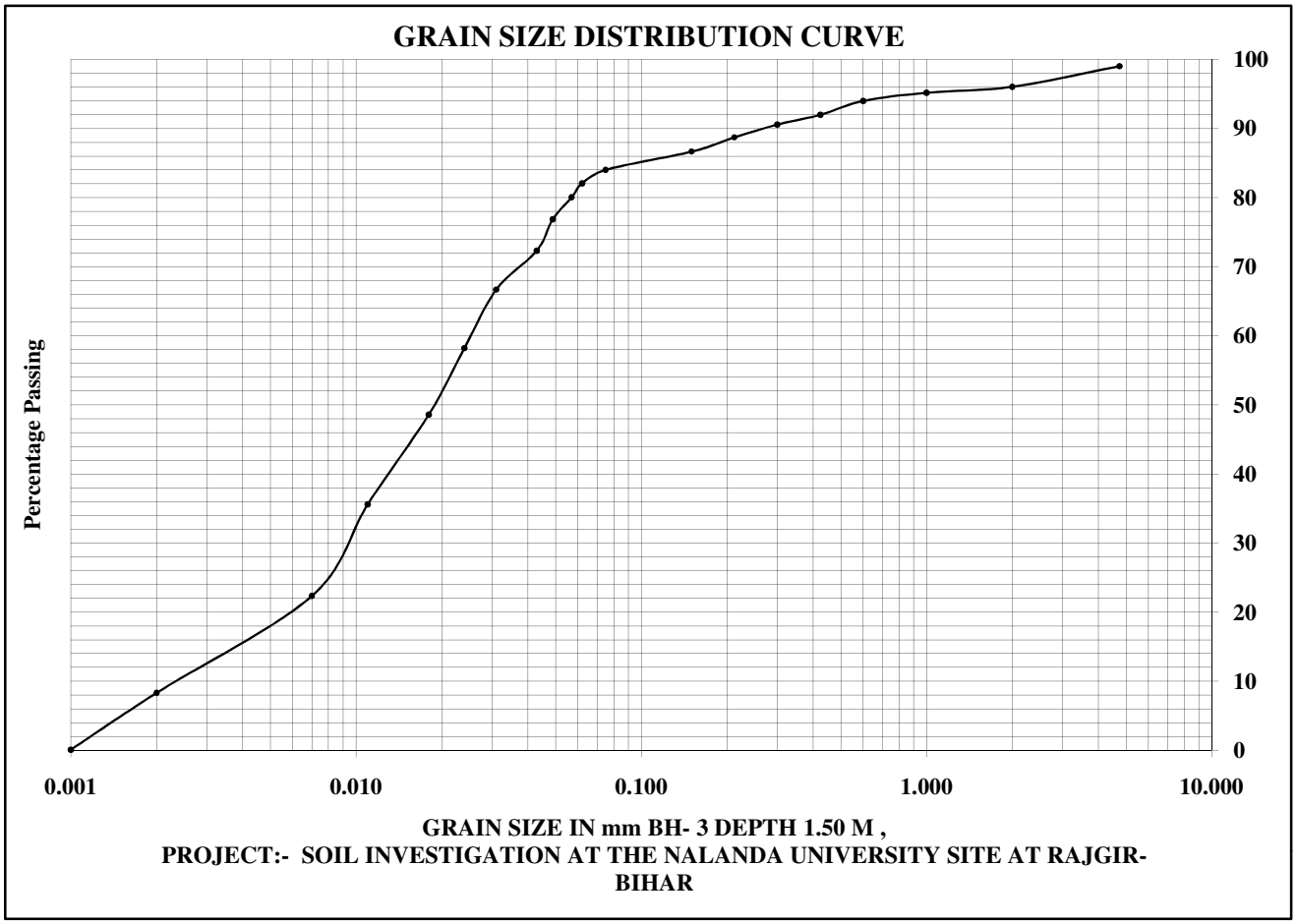
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

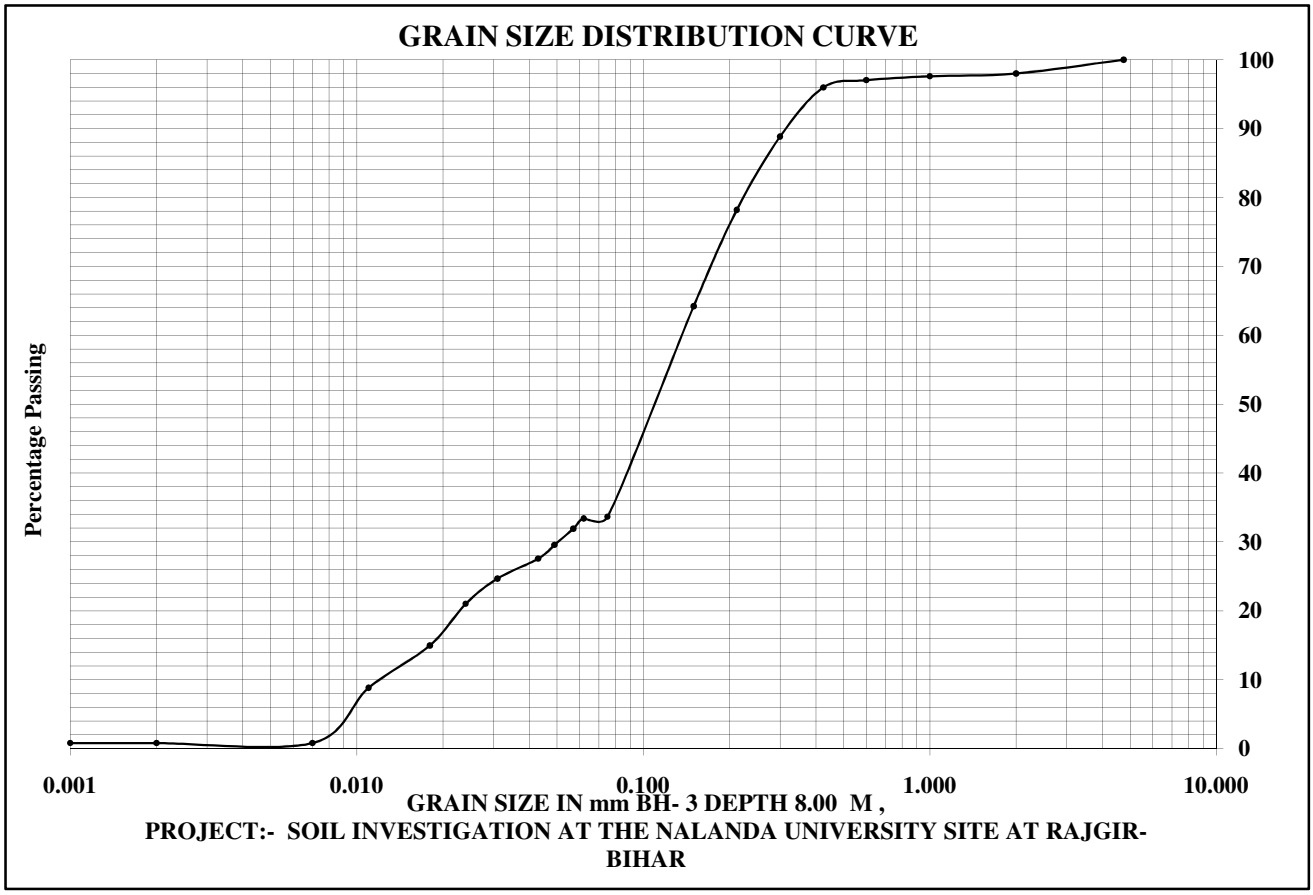
## GRAIN SIZE DISTRIBUTION CURVE



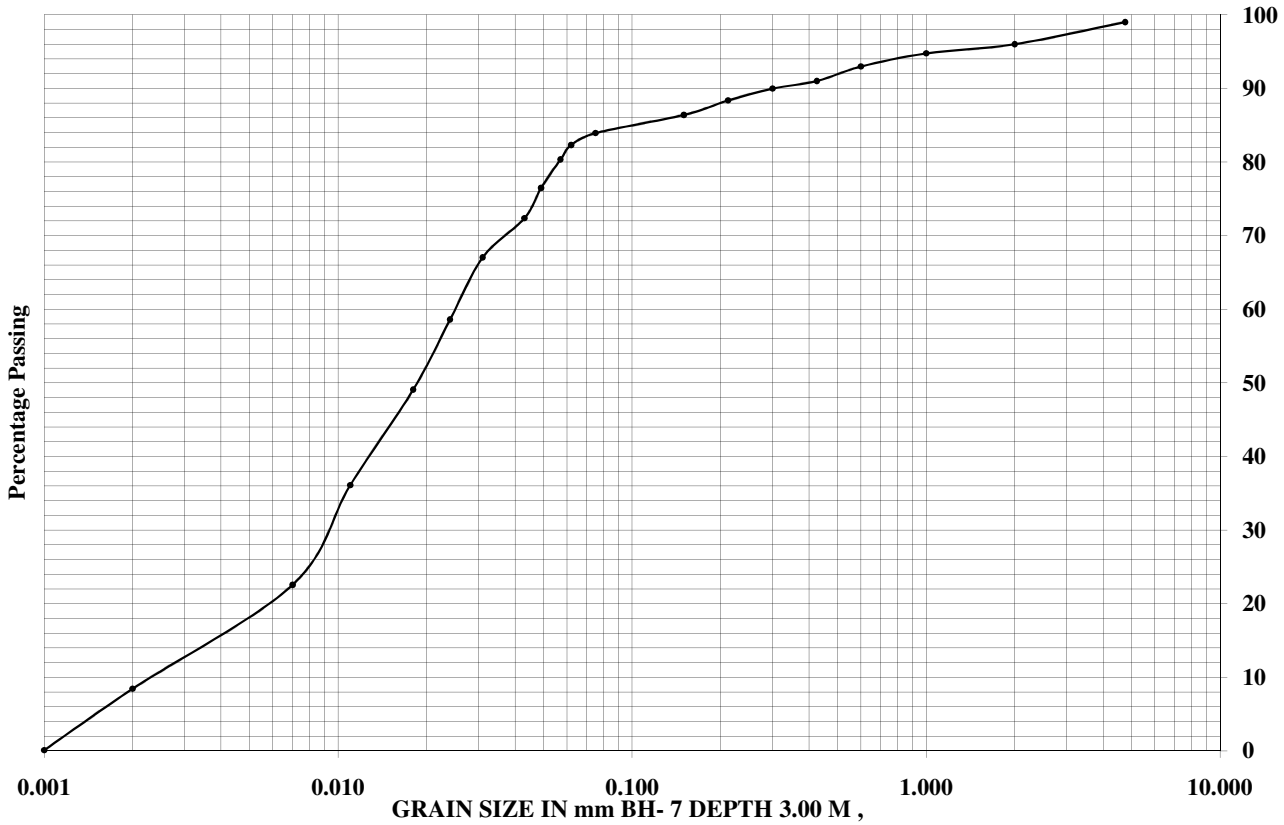

GRAIN SIZE IN mm BH- 1 DEPTH-6.00 M ,

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR


GRAIN SIZE DISTRIBUTION CURVE
Percentage Passing
100
90
80
70
60
50
40
30
20
10
0
0.001
0.010
0.100
1.000
10.000
GRAIN SIZE IN mm BH- 3 DEPTH 1.50 M ,
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

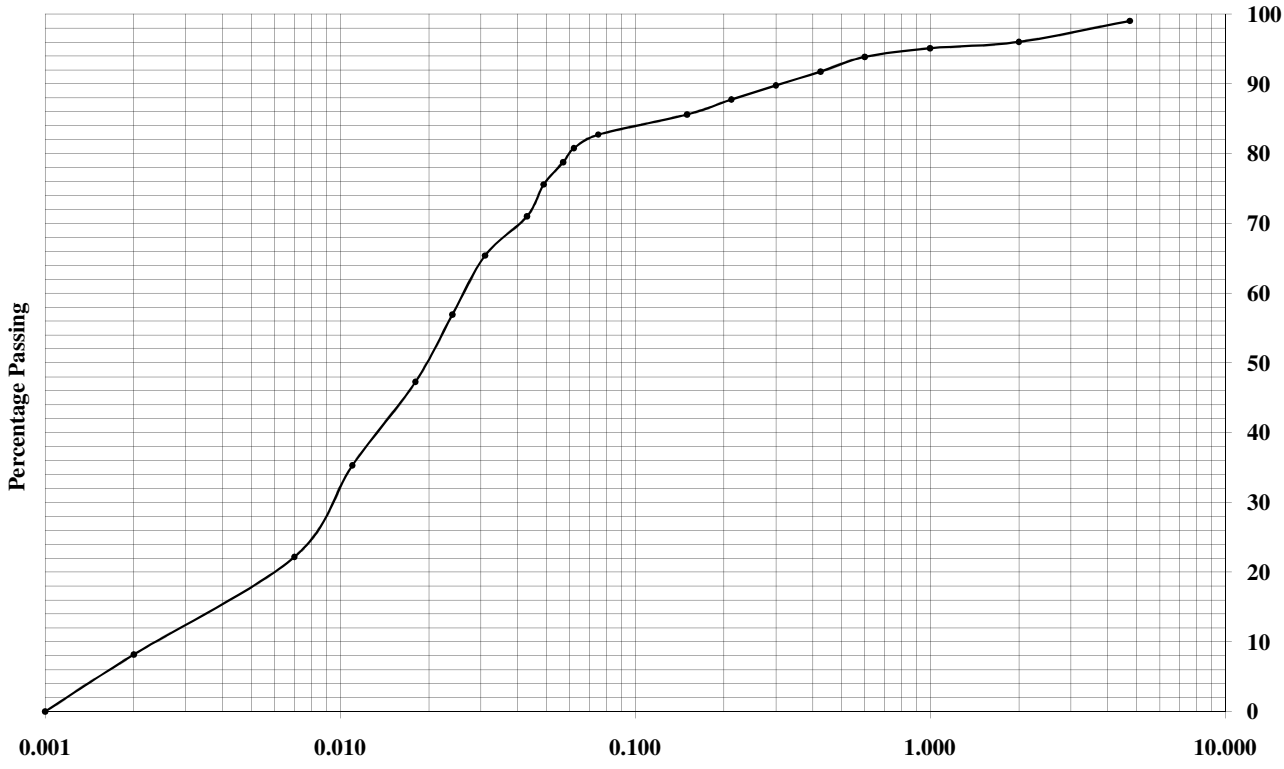

GRAIN SIZE DISTRIBUTION CURVE
Percentage Passing
100
90
80
70
60
50
40
30
20
10
0
0.001
0.010
0.100
1.000
10.000
GRAIN SIZE IN mm BH- 3 DEPTH 8.00 M ,
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

## GRAIN SIZE DISTRIBUTION CURVE



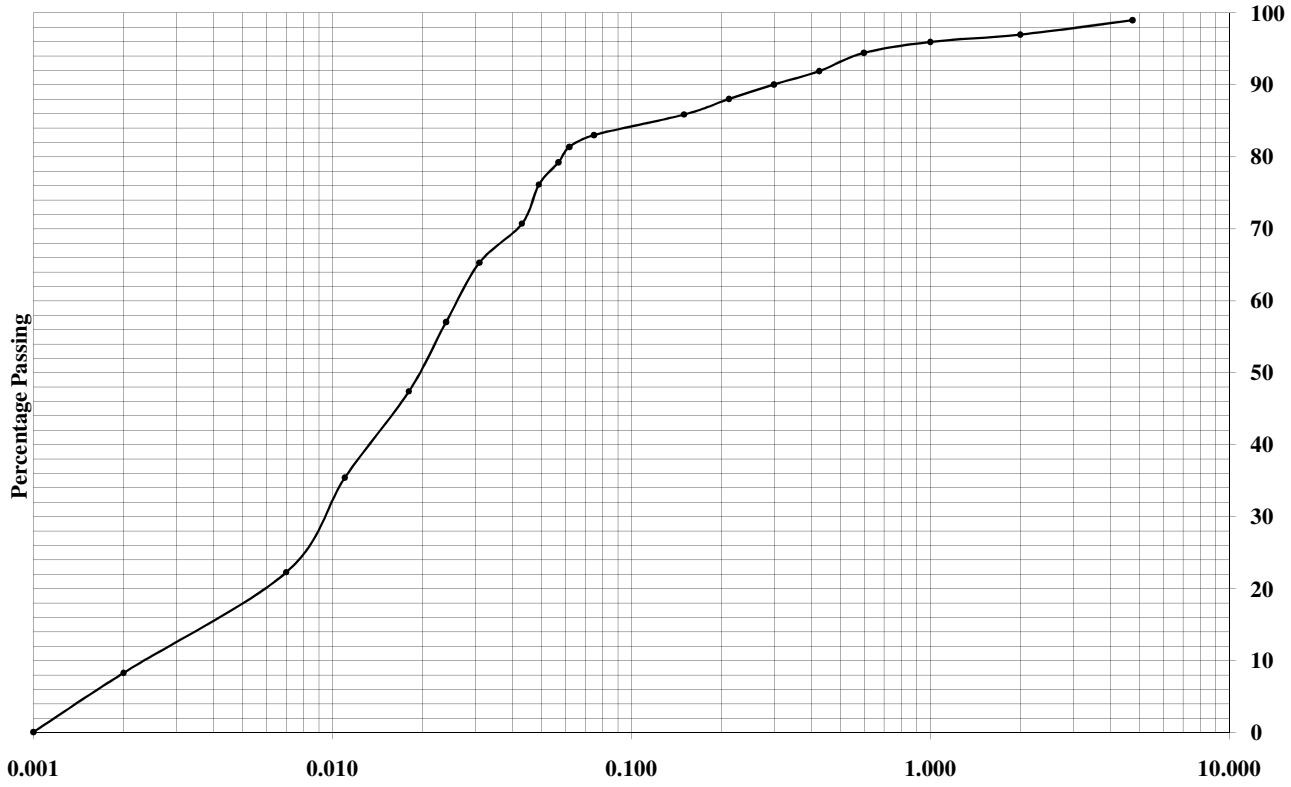

**GRAIN SIZE IN mm BH- 7 DEPTH 3.00 M ,**
**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

## GRAIN SIZE DISTRIBUTION CURVE



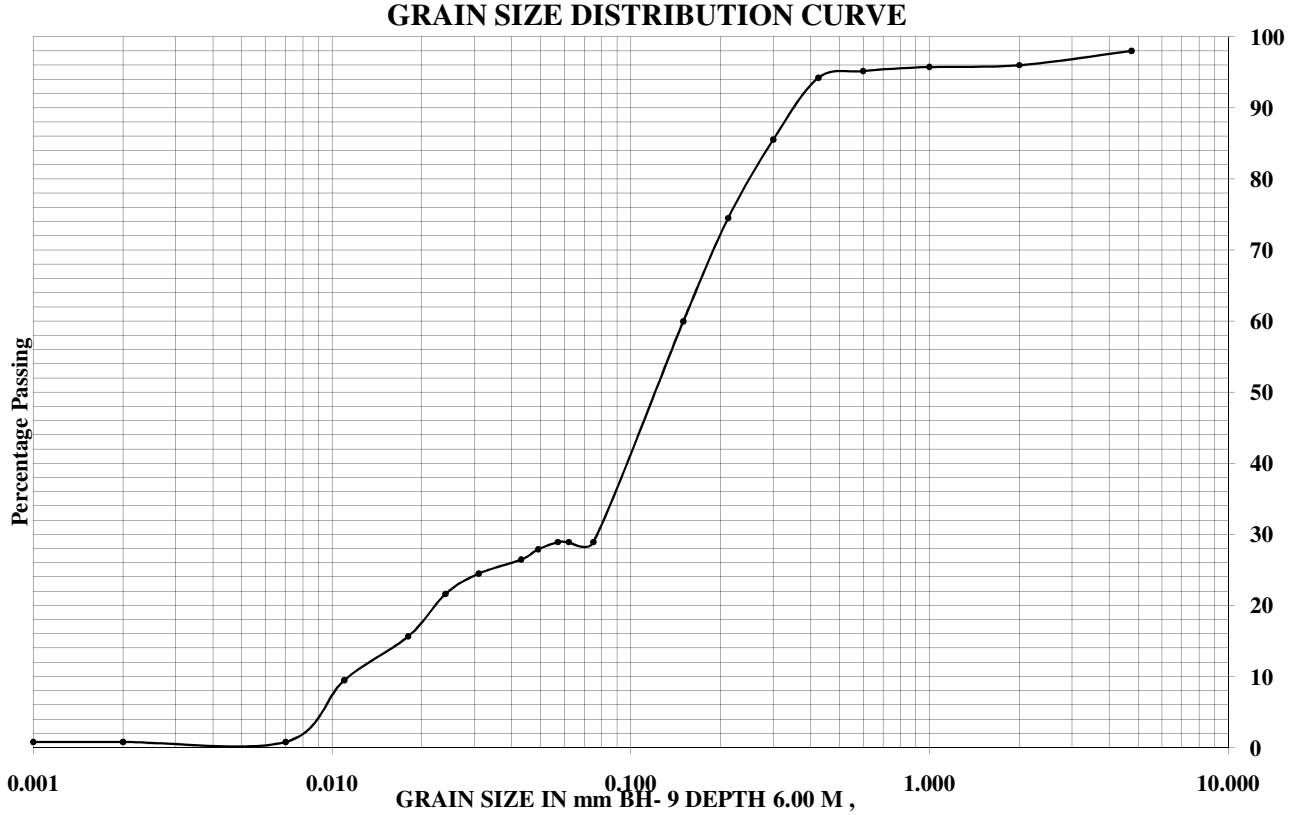

**GRAIN SIZE IN mm BH- 7 DEPTH 6.00 M ,**
**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

## GRAIN SIZE DISTRIBUTION CURVE



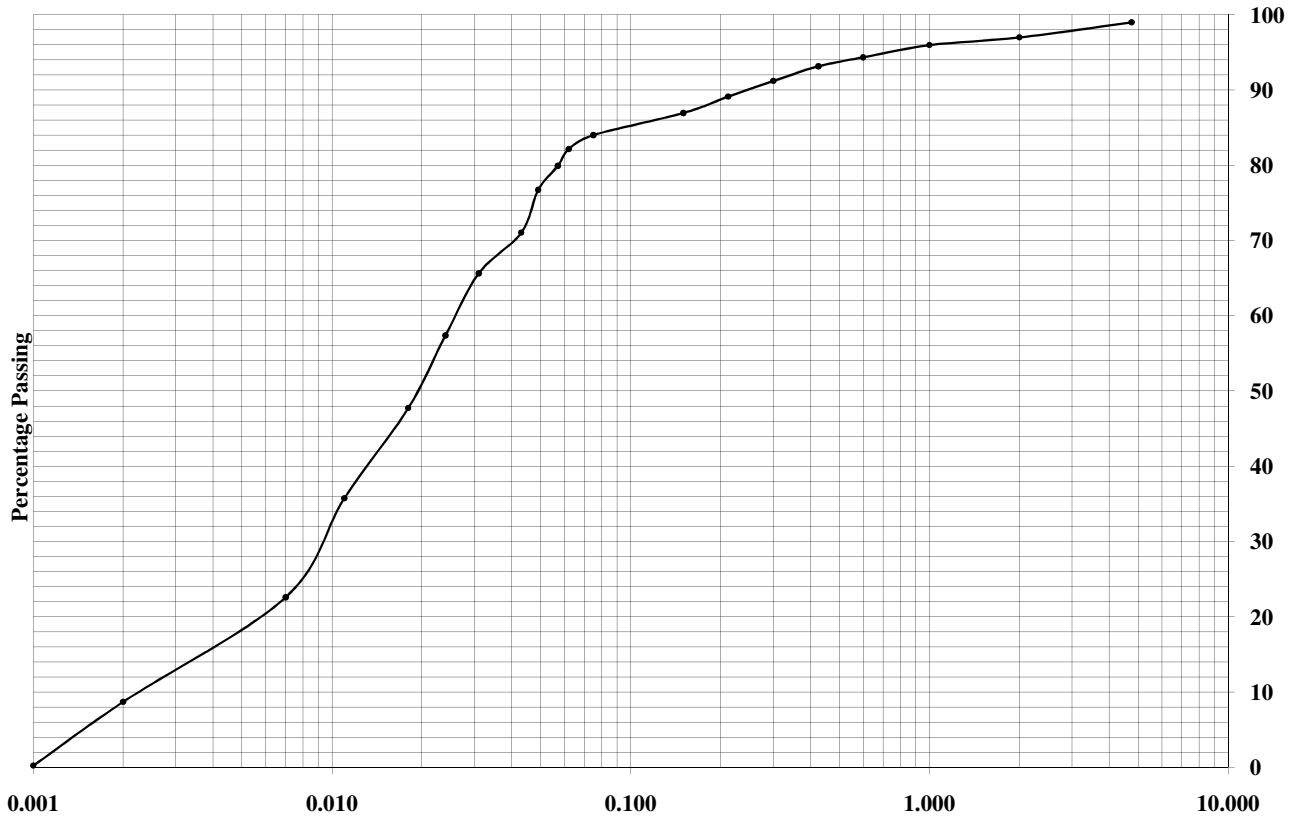

**GRAIN SIZE IN mm BH- 9 DEPTH 1.50 M ,**
**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

## GRAIN SIZE DISTRIBUTION CURVE




**GRAIN SIZE IN mm BH- 9 DEPTH 6.00 M ,**
**PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR**

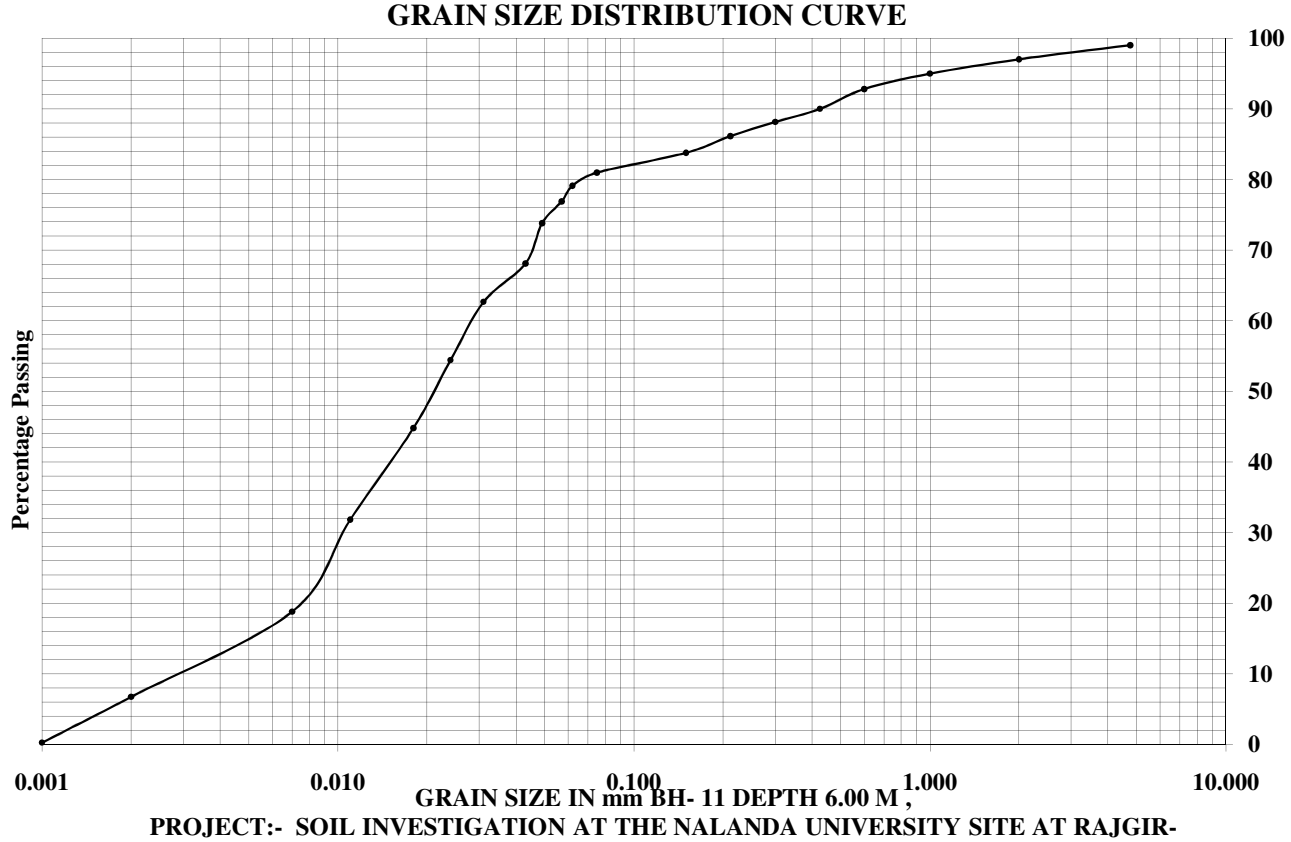
## GRAIN SIZE DISTRIBUTION CURVE




GRAIN SIZE IN mm BH-11 DEPTH 4.50 M ,

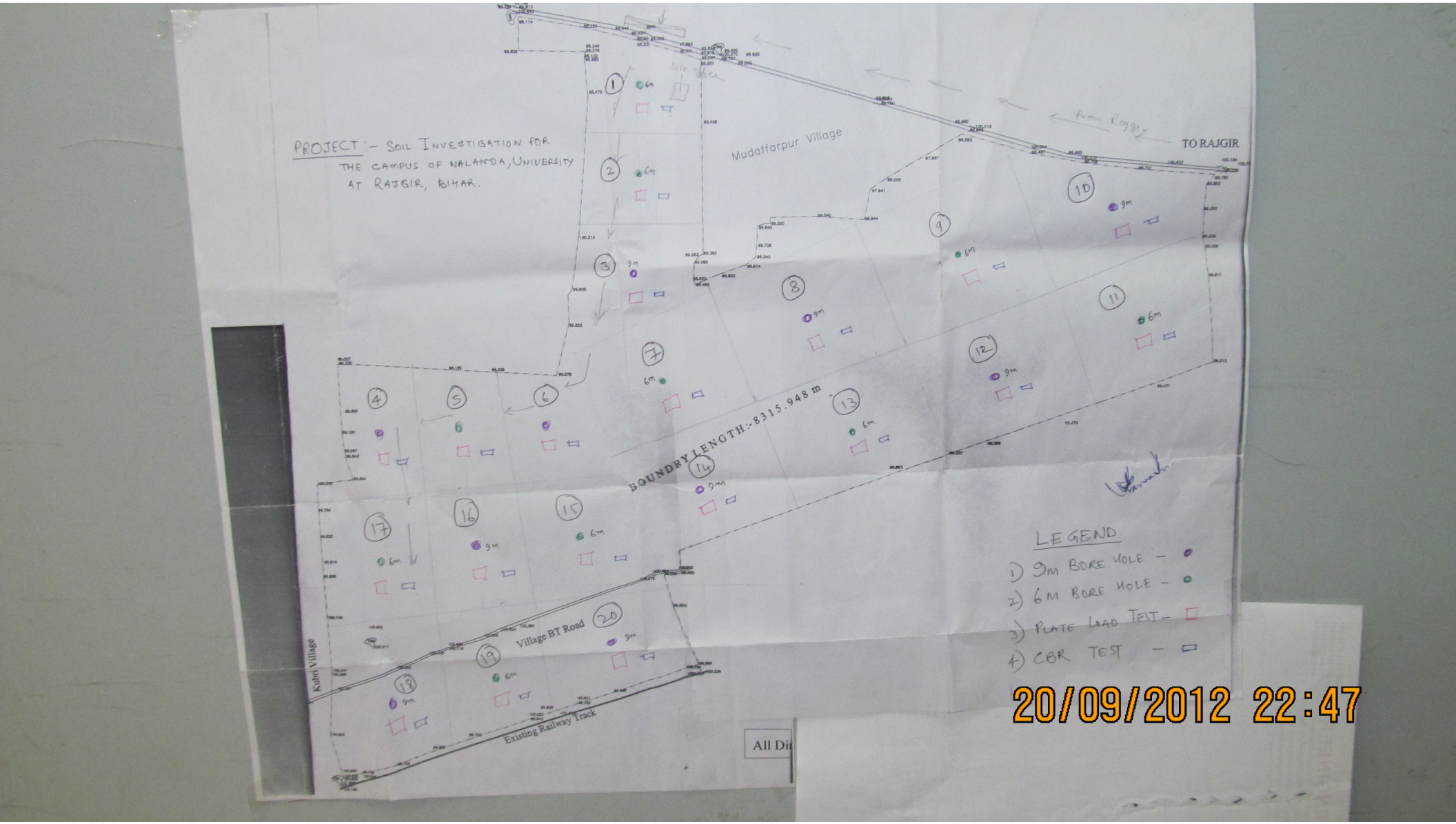
PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR

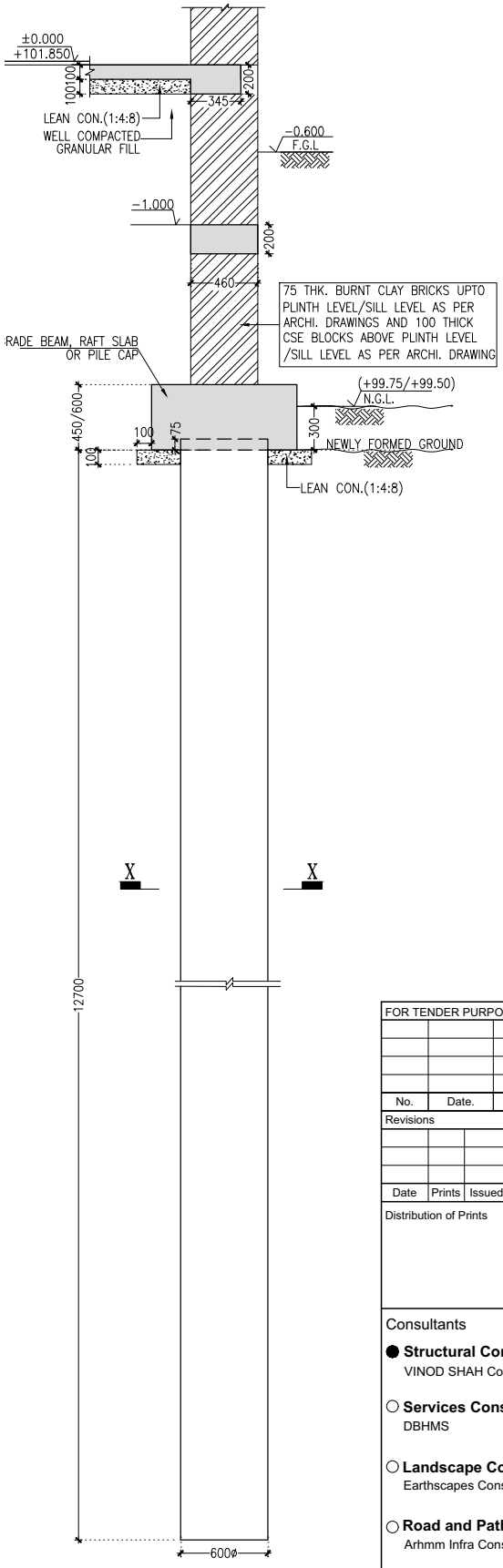
## GRAIN SIZE DISTRIBUTION CURVE



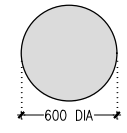

GRAIN SIZE IN mm BH- 11 DEPTH 6.00 M ,

PROJECT:- SOIL INVESTIGATION AT THE NALANDA UNIVERSITY SITE AT RAJGIR-BIHAR


PROJECT :- SOIL INVESTIGATION FOR THE CAMPUS OF NALANDA, UNIVERSITY AT RAJGIR, BIHAR.
Mudaffarpur Village
TO RAJGIR
BOUNDRY LENGTH :- 8315.948 m
Village BT Road
Existing Railway Track
Kuari Village
LEGEND
1) 9M BORE HOLE -
2) 6M BORE HOLE -
3) PLATE LOAD TEST -
4) CBR TEST -
20/09/2012 22:47




TYPICAL DETAIL OF PILE (P1)




SECTION X-X
(PILE P1)

FOR TENDER PURPOSE ONLY

| No. | Date. | Remarks. |
|---|---|---|
| | | |
| | | |
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| Date | Prints | Issued to | Date | Prints | Issued to |
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Project

**Nalanda University, Rajgir, Bihar**

Title

TYPICAL PILE DETAIL

| | | |
|---|---|---|
| Dealt : | KP | Drawing No. |
| Checked : | AJ | |
| Scale : | 1:50, 1:25 | |
| Date : | 07/09/2016 | |

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