Investigation of the Soil Behaviour of Different Soil Samples in College Campus

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Abstract:

The Soil Should be in a Good Condition for the construction of buildings and Soil should be always tested before the Construction of any building. The objective of our work was to assess the Soil condition of Different samples collected on our college campus and tests were carried out. Safe Bearing Capacity of the soil was determined by testing the different soil samples. The types of soil and tests for the soil sample was found out based on the obtained result.

Keywords:

Sieve analysis, Specific Gravity, Liquid limit, California Bearing ratio, Unconfined compression test, Proctor Compaction test, UCC, SBC

Introduction:

The term Soil is defined as an unconsolidated material, composed of solid particles, produced by the disintegration of rocks. The Void space between the particles may contain air, water or both. The solid particles may contain organic matter. Soil was formed by weathering of rock due to mechanical disintegration or chemical decomposition. Soil may be considered as an incidental material obtained from the geological cycle continuously in nature. In Todays, world construction become the Structural Significance and is the most important Source for Human beings. The Construction building determines the development of the nation. Before Construction of a building the Soil should be checked or tested properly. Proper testing of soil in a particular place helps in the construction. Safe Bearing Capacity of the soil should be checked. SBC of soil is performed to verify the soil's ability to support loads. Safe Bearing Capacity of soil is also known as Net Bearing capacity or Allowable Bearing Capacity of soil. Soil parameters like cohesion, friction, shear strength has a direct impact on the Bearing capacity of the soil. The Safe Bearing Capacity of soil is calculated from the California Bearing Ratio of the soil. The Six tests were done in our campus labarotary and collected the soil samples from P.S.R Engineering college campus. The tests done were Determination of Sieve analysis, Specific gravity of the soil, Liquid limit of the soil, California Bearing Ratio, Proctor Compaction test, Unconfined compression test. Sieve analysis is done to determine the grain distribution of the soil and hence helps in the identification of mechanical properties. These Mechanical properties determine whether the given soil can support the Proposed Engineering structure. The Fineness modulus of soil Fine sand is 2.2 – 2.6, for Medium sand 2.6 – 2.9 , for Coarse sand 2.9-3.2. Specific Gravity of soil sample is determined using pycnometer . The Specific gravity for types of soil , for Sand 2.65 – 2.67**,** Silty sand 2.67 – 2.70, Inorganic clay 2.70-2.80, Soils with mica or iron 2.75 – 3.00, Organic soils < 2.00. Liquid limit of soil is used to classify the fine grained soil. It is also used to determine SBC of soil. For silt soil with low pasticity, liquid limit is 25-35, for Silt soil with medium plastcity liquid limit is 35-50, for Clay soil with low plasticity, liquid limit is 25 – 35, for Clay soil with medium plasticity, liquid limit is 40 – 50, for Clay soil with high Plasticity, liquid limit is 60 – 85. California Bearing Ratio test is done to determine the bearing capacity soil for design of flexible pavements. Harder the material higher the CBR value. CBR Value of 2% is usually for clay , high quality subbase will have CBR values between 80% and 100% and some sands may have values around 10%. The CBR value of gravelly soil range from 20% to 80%**.** In Sandy soil, CBR value ranges from 5% to 40%. Fine grained soils CBR value are lower and they are ranging from 5% to 15%**.** The Proctor Compaction test is used to determine the optimal moisture content at which a given soil type will become dense and achieve its

maximum dry density of the soil.The Unconfined Compression test is used for measuring the shear strength of soil and mechanical properties of fine grained soils. For Very soft soil , UCC value of soil is < 0.25, For Soft soil , UCC value ranges from 0.25 – 0.50, For Firm Soil, UCC value ranges from 0.5 – 1, For Stiff soil , UCC value ranges from 1 – 2, For Very Stiff soil, UCC value ranges from 2-4, For Hard Soil, UCC value is > 4.

2.Materials and Methods:

The Soil Samples was collected from College Campus by digging the soil upto 1m. After Collection of the Soil samples , the tests for the Soil samples was done at Soil Mechanics laboratory at Our college Campus. The Tests are based on two types of properties of soil . They are Index Properties and Engineering Properties. Index Properties includes Seive Analysis, Specific Gravity and Liquid Limit of Soil. These Tests were carried out for determining the Grain Size distribution of the soil. Engineering Properties such as California Bearing Ratio (CBR), Unconfined Compression Test, Proctor Compaction Test for Soil . These tests were helpful in determining the shear strength of the soil. Safe Bearing Capacity of the soil determined using these Tests. Safe Bearing Capacity is found for the soil because to check the maximum pressure which thes oil can carry safely without the risk of shear failure . Based on the Values of Safe bearing capacity , the type of soil and strength of Soil were analyzed.

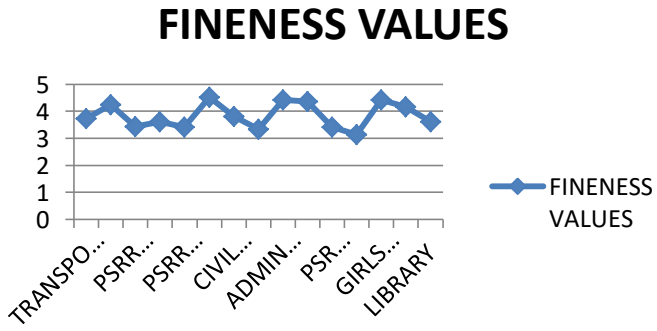
2.1.Seive analysis:

The Grained Size distribution of coarse grained soil is determined by this test. Soils having particles larger than 0.075 mm sieve are termed as Coarse Grained Soil. Coarse grained soil is classified mainly by sieve analysis. The grain size distribution curve gives an idea regarding the gradation of soil whether the soil is well graded or poorly graded. Hence for proportioning the selected soils,the grainsize distribution of each soil should be known.A set of specified sieves, sieve shaker, Weighing balance are the apparatus required conduct this test. 1000gms of Oven dried soil was taken and sieve the soil through 4.75mm, 2.36 mm, 1.18mm, 600µ, 300µ, 150µ and 75µ using a Seive shaker for 5 minutes. Each sieve and pan with soil retained on them is weighed carefully and the readings were noted. Fineness modulus of the soil is calculated by the ratio of cumulative percentage of soil retained in the sample to 100. Fineness modulus of the soil of the soil should be in the particular range as mentioned above in introduction.

Fineness modulus = Cumulative % weight retained in sample /100

For Seive analysis the Obtained Values are given in the graph shown.

Location	Fineness of soil sample values
Civil department	3.81
Biotechology	4.25
Transport yard	3.73
PSRR womens college canteen	3.42
CSE department	3.62
PSRR Womens college	3.42
B.Ed	3.13
Girls hostel	4.42
PSR Polytechnic college	4.17
PSR Arts and Science college	3.33
Admin block	4.42
Mechanical department	4.36
PSR canteen	3.42
Library	3.61
ECE department	4.52



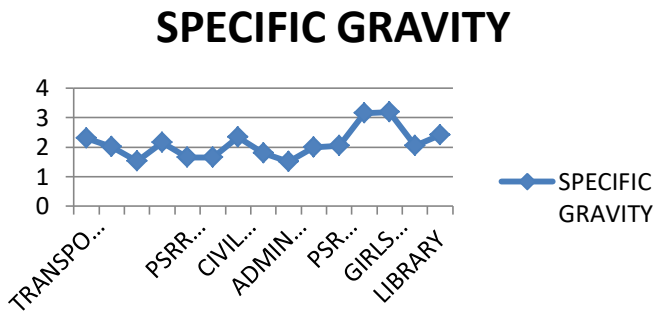
2.2 Specific gravity:

The objective of this test is to determine the specific gravity of soil fraction passing 4.75mm sieve by pycnometer. Pycnometer, distilled water ,Balance (0.1g sensitivity) are the apparatus required. The Pycnometer is thoroughly cleaned and dried, its empty weight is taken as W1 gm .

Take about 150g of dry soil and put it in the pycnometer and weigh its as W2 gm. The density bottle is then filled with distilled water up to the mak (marked in bottle) and weigh as W3 gm. The bottle is then emptied and completely fill the bottle with distilled water and weight it as w4 gm. The Trail and Error readings should be noted .

Location	Specific gravity of soil values
Civil department	2.34
Biotechnology	2.01
Transport yard	2.30
PSRR Womens college canteen	1.53
CSE department	2.16
PSRR Womens college	1.65
B.Ed	3.14
Girls hostel	3.18
PSR Polytechnic college	2.04
PSR Arts and Science college	1.8
Admin block	1.5
Mechanical department	2.0
PSR canteen	2.04
Library	2.4
ECE department	1.64

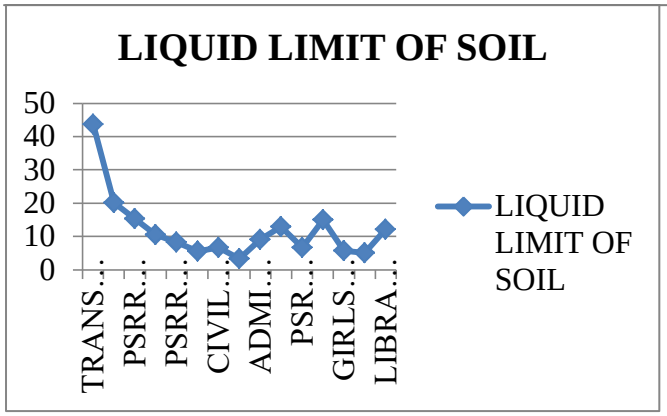
The Specific gravity of soil samples were analyzed and values are plotted in the graph.



2.3 LIQUID LIMIT OF SOIL:

The objective of this test is to determine the liquid limit of the soil sample using the casagrande type of mechanical apparatus. The liquid limit apparatus has a cup which is raised 1 cm above a flat base and then dropped by rotating a handle. The grooving tool has a cutting edge of standard dimensions used to form a groove in the middle of the soil sample. A gauge block is used to check thath the cup is adjusted to give a drop of exactly one cm. The apparatus required for this tests are Casagrande Liquid limit device with grooving tool, China clay dish, Balance to weigh upto an accuracy of 0.01 gm, spatula, container to dry the sample. Weigh about 120gms of soil passing through 420µ I.S.Seive. The Soil sample is placed on the evaporating dish and thoroughly mixed with water using spatula until the mass becomes a thick paste of putty like consistency. The Casagrande's device is checked to have a correct fall of 10 mm and placed a portion of the prepared paste over the brass cup. A Portion of the mixture is placed in the cup and leveled with the spatula to a maximum depth of 1 cm. The grooving tool is used to cut a groove in the middle of the soil cake. The cam is rotated at a rate of 2 blows per second and the rotations are counted until the groove closes over a length of 12 mm. A small quantity near the centre of test sampleis collected in a container and weighed it. The sample is kept in the oven for 24 hours and weighed. Thedifference of the two weights will give the weight of water and from that the moisture content is found out by the dry weight. The experiment is repeated by adding little more water. More trails are made to found out that the number of blows are more and less than 25 in each cases. Liquid limit of the soil directly found from the graph. Flow index can be calculated by the ratio of moisture content to the number of blows.

Location	**Liquid limit of soil values**
Civil department	6.64%
Biotechnology	12.14%
Transport Yard	43.70%
PSRRWomens college canteen	15.34%
CSE department	10.58%
PSRR Womens college	8.23%
B.Ed	15.08%
Girls hostel	5.67%
PSR Polytechnic college	5.02%
PSR Arts and Science college	3.32%
Admin block	9.02%
Mechanical department	12.91%
PSR canteen	6.64%
Library	12.14%
ECE department	5.53%

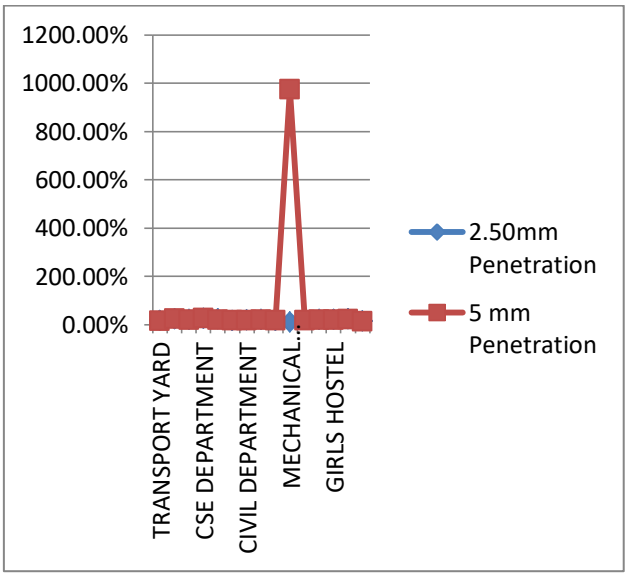


PSRR Womens college canteen	21.89%	18.49%
CSE department	26.67%	24.81%
PSRR Womens college	22.62%	18.97%
B.Ed	21.16%	19.46%
Girls hostel	21.16%	18.975
PSR Polytechnic college	22.62%	20.43%
PSR Arts and Science college	21.16%	18.97%
Admin block	16.05%	16.54%
Mechanical department	10.94%	9.73%
PSR canteen	20.43%	17.03%
Library	14.2%	13.62%
ECE department	16.05%	16.08%

2.4 California Bearing Ratio:

The objective of the experiment is to determine the California bearing ratio (CBR) of a compacted soil sample in the laboratory, both in soaked as well as unsoaked state. The method also covers the dtermination of CBR of undisturbed soil sample obtained from the field. Cylindrical mould (CBR Mould) with inside diameter extension collar 150 mm and height 175 mm provided with a detachable collar 50 mm height and a detachable perforated plate 10 mm thick , spacer disc 148 mm I diameter and 47.7 mm in height, along with a handle for screwing into the disc to facilitate its removal. Steel cutting collar which can fit flush with the mould both inside and outside. Metal rammers, penetration piston, Extension measuring apparatus ,loading device, two dial gauges leading to 0.01mm, Seive 4.75mm and 20 mm IS sieves, Miscellanous apparatus such as tins, filter papers, mixing bowl etc. Take about 5kg and compact so that their compacted densities range from 95% to 100% generally with 62 blows. Weigh Empty mould . Add water to the first specimen and compact 10 blows per layer. After compaction remove the collar and level the surface .Take sample for determination of moisture content.Take weight of empty mould + compacted specimens. Place the specimen under the penetration piston and apply load for 2.5mm penetration and 5mm penetration.Plot the graph for penetration and load.

Location	CBR value	
	2.50mm	5mm
Civil department	18.245	18.00%
Biotechnology	23.35%	22.87%
Transport yard	16.05%	14.5%



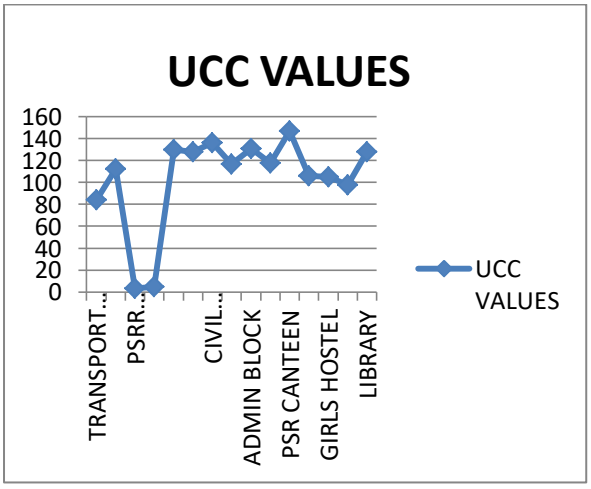
CBR Values

2.5 Unconfined Compression Test

The Unconfined Compression test is also called as U test is the special form of triaxial compression test where the lateral confining pressure is zero. This test is classified as undrained or quick test even though small amount of drainage takes place during the test. The test can be conducted on undisturbed and remolded cohesive soil samples. Normally this test is conducted to soil samples at natural water content. Unconfined Compression tester, Soil sample compression, gauge and proving ring are the apparatus used for this test. Unconfined compression tester consists of small load frame fitted with a proving ring to measure the vertical axial load is gradually applied to the soil specimen.The deformation of the sample is measured with the help of dial gauge. The ends of the cylindrical specimen are kept flat. Remolded soil specimen (38 mm dia) was prepared and is centrally mounted in the unconfined compression

tester.Adjusted the proving ring touch on the top of the soil sample. The vertical axial load is gradually applied to the soil specimen. Readings from the proving and dial gaue are taken.Set the dial gauge to zero. Compress the specimen until the cracks have definitely developed or the stress strain curve is well past its peak or until a vertical deformation of 20 percent is reached. Take the load dial readings approximately at every 1 mm deformation of the specimen. Plot the graph for stress and strain. The maximu stress fom this curve gives the values of the unconfined compression strength .

Location	Ucc values
Civil department	136.174
Biotechnology	112.266
Transport yard	84.149
PSRR Womens college	129.937
CSE department	153.846
PSRR Womens college canteen	125.779
B.Ed	106.029
Girls hostel	106.029
PSR Polytechnic college	97.713
PSR Arts and Science college	116.424
Admin block	112.266
Mechanical department	117.463
PSR canteen	146.569
Library	127.858
Ece department	127.858

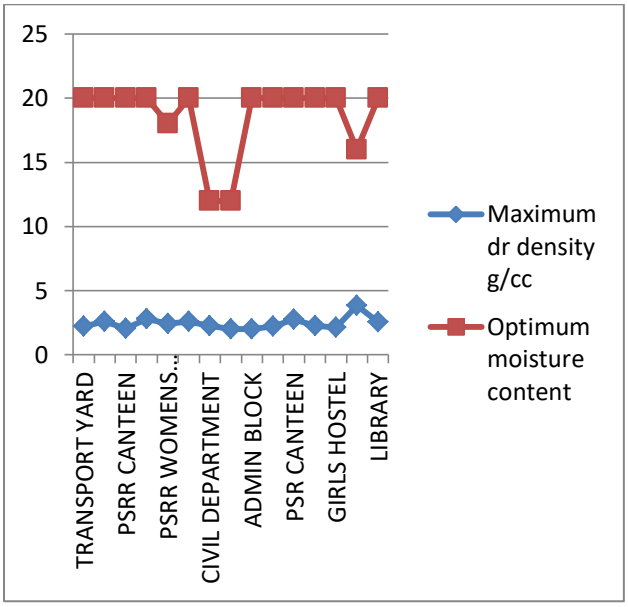


2.6 Proctor Compaction test:

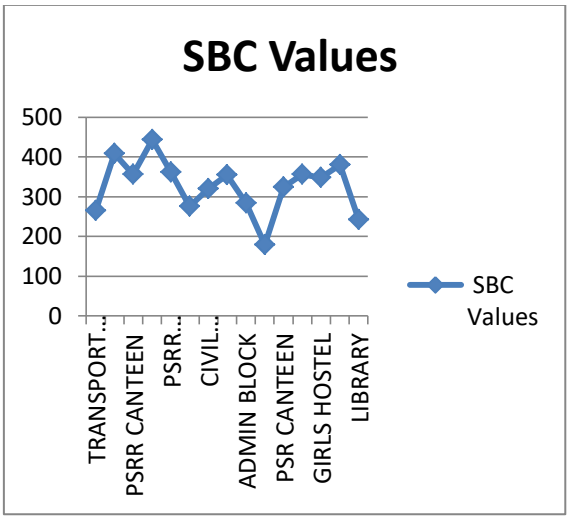
The objective of this test is to determine the Dry density and optimum moisture content of the soil. Cylindrical mould, Standard rammer, Straight edge, Drying crucibles, Measuring jar, Balance are the apparatus required. The mould is attached with detachable base plate and a removable collar. The volume of the mould is $[\frac{\pi d^2}{4} * h]$ 1000cm^3. A standard rammer has 50mm circular base and weighs 2.6 kg. The rammer equipped with suitable arrangements to control the height of the drop which is 310mm. Weigh the proctor mould with base and without collar. Take about 3 kg of air dried soil passing through 4.75mm sieve. Take known quantity of water 6% by weight of the soil and mix well with the soil. Attcah collar with proctor mould and fill the mixed soils in the mould in three equal layers. Compact each layer by the rammer weighing 2.6 kg allowing it to drop 25times from the height of 310mm.The total height of the compacted soil should be slightly more than the height of the mould. Remove the collar and cut out the projected soils to have a level surface with top of the mould. Then the weigh the mould with the soil in gm. Remove the soil from the cylinder and break up the soil by hand or by using soil removing machine. Then increase the moisture content of the soil by 20ml and mix it thoroughly. Repeat the experiment. In repeating process increase the moisture content 20ml until there is a considerable fall in the weight of the mould with compacted soil. Take samples from each operation an calculate the moisture content and dry density of the soil. Plot the graph and find the moisture content and dry density from the graph.

Location	Proctor compaction values	
	Maximum dry density g/cc	Optimum moisture content
Civil department	2.245	12
Biotechnology	2.210	20
Transport yard	2.213	20
PSRR Womens college	2.438	18
CSE department	2.660	20
PSRR Womens college canteen	2.068	20
B.Ed	2.269	20
Girls hostel	2.130	20
PSR Polytechnic college	2.305	20
PSR Arts and Science college	2.150	20
Admin block	2.014	20
Mechanical	2.214	20

department		
PSR canteen	2.775	20
Library	2.550	20
ECE department	2.354	20



		cotton soil
PSR canteen	323.385	Cohesive soil
Library	241.61	Medium sand
ECE department	275.01	Loose gravel



2.7 Safe Bearing Capacity of soil:

The Maximum pressure which the soil can carry safely without risk of shear failure is known as safe bearing capacity of soil. It is helpful in finding out the type of soil and its bearing capacity was known.

Location	**SBC of soil (kN/m^2)**	**Type of soil**
Civil department	320.16	Loose gravel
Biotechnology	408.37	Compact sand
Transport yard	265.325	Loose gravel
PSRR Womens college canteen	356.73	Dry sand
CSE department	444.05	Soft rock
PSRR Womens college	361.21	Dry sand
B.Ed	355.69	Compact sand
Girls hostel	348.53	Medium clay
PSR Polytechnic college	380.32	Soft rock
PSR Arts and Science college	354.52	Compact sand
Admin block	283.04	Loose gravel
Mechanical department	179.52	Black

Conclusion:

Based on the obtained results it can be concluded that the soil sample taken in PSR college campus is suitable for construction of building. The soil strata of the college campus was supported for construction purposes.

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