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Study On Shear Strength Parameters Of Clayey Soil Of Sabarkantha Region Of Gujarat (With Relative Compaction)

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ABSTRACT:

Different types of clayey soil available in sabarkantha region which have multiple behavior for soil structure. Understanding the behavior of clay is not easy, as slight variations in the existing conditions. The strength behavior of clayey soil can be interpreted from its relative compaction and mean confining pressure. In this clayey soil, high percent of (silt+clay) and less percent of sand content available, which pose major problem to soil structure. From this work, we can evaluate the effect of relative compaction on Shear strength parameters c and Ø of clayey soil. In this whole, experimental work carried out for sand+ 20%(silt+clay), sand+ 30%(silt+clay)and sand+ 40%(silt+clay).Unconsolidated un-drained tri-axial test performed for 34.43kPa, 68.97kPa and 103.40kPa. 85%, 90%, 95 and 100% relative compaction considered.

KEY WORDS: shear strength parameters, relative compaction, un-consolidated un-drained triaxial compression test.

1. INTRODUCTION

The word 'soil' is derived from the Latin word 'Solium', which means the upper layer of the earth that may be dug or plowed, specifically, the loose surface material of the earth in which plant grow. This definition of soil is used in the field of agriculture. Soil is made up of three particle sizes- sand, silt and clay.

Sand is the largest particle, silt is intermediate, and clay is the smallest. Soils have different textures depending upon the proportions of sand, silt, clay particles in the soil. Clay is made up of tiny particles less than 0.002 mm in diameter. By comparison, silt particles range from 0.002 to 0.05 mm size and sand particles from 0.05 to 2.0 mm.

All civil engineering structures are ultimately founded on soil and hence its stability depends on the geotechnical properties of soil. Conventional geotechnology is more concerned about rendering soil as an efficient load bearing stratum and designing foundations that can transfer load efficiently to subsurface. The aim of present research study is to study shear strength parameter of clayey soil with relative compaction of Sabarkantha region. In this paper Triaxial compression test performed for shear strength parameters of clayey soil. Triaxial shear devices have been historically used successfully to measure the peak shear strength of soils. In geotechnical projects, these tests are often used interchangeably to determine effective stress shear strength parameters. The shear strength of soil is the resistance to deformation by continuous shear displacement of soil particles upon the action of a shear stress. Shear strength is the principal engineering property which controls the stability of a soil mass under loads. It governs the bearing capacity of soils, the stability of slopes, the earth pressure against retaining wall, etc.

2. OBJECTIVE

The main objective of this paper is to evaluate the shear strength parameter of clayey soil using unconsolidated un-drained tri-axial test of relative compaction of 85%, 90%, 95% and 100% compaction on 20% , 30% and 40% proportion of (silt+clay) in sand.

3. MATERIALS AND PROCEDURE

3.1 Soil sample

The soil sample used in the laboratory study is a clayey soil taken from a sabarkanttha region of Gujarat.

3.2 Procedure:

Collected Clayey soil classified as inorganic clay of medium plastic by using sieve analysis method as per IS 2720-Part 4. For sand and (silt+clay), Soil sample washed with water through 75 micron sieve. Material passing through 75 micron sieve is (silt + clay) show figure 1(a & b) and retained material is (sand).After processing, soil was separated in (silt+clay) and sand material. The passing material is dried in the oven and pulverized.

As per Indian standard code, Atterberg limit test (IS 2720-Part-5) and standard proctor compaction tests (2720-part-7) performed to find out index properties , maximum dry density and optimum moisture content of the natural soil and 20%,30% and 40% (silt+clay) content in sand. Show in below table 1.

Triaxial test is mostly use for determine the shear strength parameters for soil at the required density and moisture content. Hear, triaxial compression test performed for sand+20% (silt+clay), sand+30% (silt+clay) and for sand+40% (silt+clay). In this test, prepared three cylindrical Triaxial samples for diameter 38 mm and length 76 mm for each 85%, 90%, 95% and 100% of relative compaction of unconsolidated un-drained Triaxial tests. Show in below figure. 2

Fig.1 (a) wet sieve analysis

4. RESULT AND DISCUSSIONS

Summary of the laboratory tests results are presented in table 1. Particle size distribution curve are shown in figure 2. The PI increases with increasing clay content. This is due to the fact that plasticity is offered only by the clay fraction with the sand acting as inert filler that does not have any physio-chemical interaction with the clay to affects plasticity.

Table: 1 Soil properties

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S. N	PROPERTIES	L.L (%)	P.L (%)	P.I (%)	MDD (kN/m^3)	OMC (%)
1	Natural soil	37	21.88	14.62	17.85	18
2	Sand+ 20%(silt+clay)	38	18.72	19.28	16.77	16
3	Sand+ 30%(silt+clay)	41.5	21.02	20.48	18.83	12
4	Sand+ 40%(silt+clay)	52	27.77	24.23	19.62	12

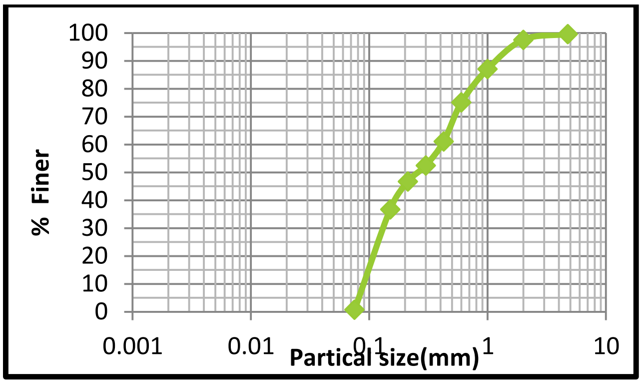

Fig. 2 particle size distribution curves

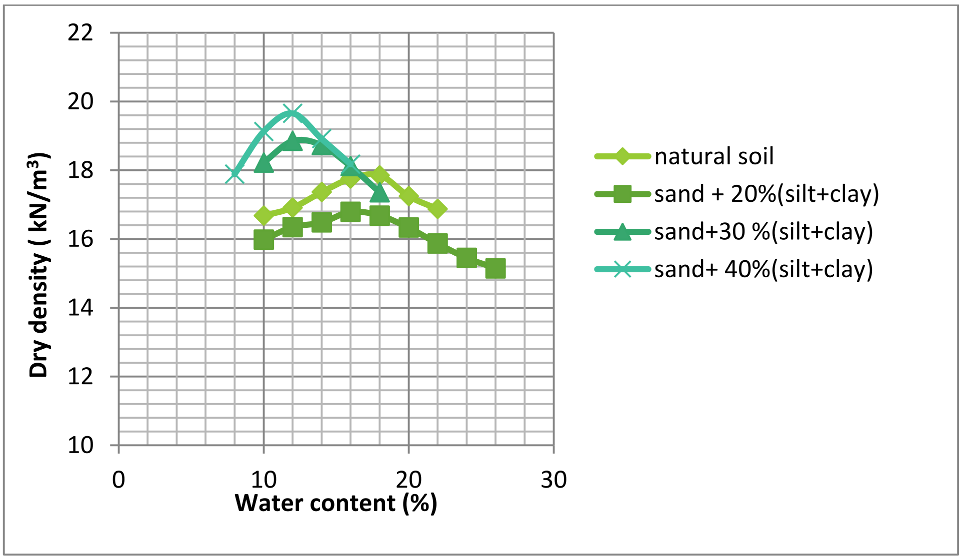

Fig.3 variation of maximum dry density with (silt+clay) content

The above fig. 3 shows the effect of clay content on dry density. Maximum dry density increases with clay content.

5. TRIAXIAL COMPRESSION TEST

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The Principal of triaxial test, soil specimen is subjected to a confining pressure σ_3 by applying pressure to the water in the cell. An additional axial stress $\sigma_3=\sigma_1-\sigma_3$ is than applied by loading the sample through the top cap on the soil. The test is repeated with a number of samples under other confining pressure and the results are interpreted by plotting the Mohr circles for the stress condition of each sample at the time of failure.

The sample was prepared as per IS: 2720 part11. Triaxial sample prepared for 20% (silt+clay), 30% (silt+clay) and 40% (silt+clay) content are use in sand content. Specimen length is 76mm and diameter 38 mm. show in below figure 6. Unconsolidated un-drained triaxial compression test performed for 34.43 kPa, 68.97 kPa, and 103.40 kPa.

Fig. 4 Triaxial compression machine

Fig.5 Triaxial test sample **Fig.6 Failure sample**

Table 3: The results obtained from the test

(a) Sand+20% (silt+clay)

Relative compaction (%)	Confining pressure (kN/m^2)	Deviator stress **σ_d= (P/A)** (kN/m^2)	Major principal stress **$\sigma_1=\sigma_d+\sigma_3$** (kN/m^2)	C (kN/m^2)	Ø (˚)
0.85	34.43	88.54	122.97	20	21
	68.97	126.02	194.99		
	103.40	157.6	261.00		
0.90	34.43	103.57	138.15	23	21
	68.97	143.65	212.62		
	103.40	285.04	288.00		

0.95	34.43	111.57	146.00	27	20
	68.97	146.03	215.00		
	103.40	177.6	281.00		
1	34.43	120.57	155.00	29	20
	68.97	159.03	228.00		
	68.97	197.6	301.00		

0.95	34.43	133.57	168	36	20
	68.97	177.03	246		
	103.40	212.6	316		
1	34.43	141.57	176	38	20
	68.97	183.03	252		
	68.97	218.6	322		

(b) Sand+30% (silt+clay)

Relative compaction (%)	Confining pressure (kN/m^2)	Deviator stress **σ_d= (P/A)** (kN/m^2)	Major principal stress **σ_1=σ_d+ σ_3** (kN/m^2)	C (kN/m^2)	Ø (˚)
0.85	34.43	114.57	149.003	30	19
	68.97	149.03	218		
	103.40	182.6	286		
0.90	34.43	125.57	160	33	18
	68.97	155.03	224		
	103.40	190.6	294		

(3) sand+ 40%(silt+clay)

Relative compaction (%)	Confining pressure (kN/m^2)	Deviator stress **σ_d= (P/A)** (kN/m^2)	Major principal stress **σ_1=σ_d+ σ_3** (kN/m^2)	C (kN/m^2)	Ø (˚)
0.85	34.43	184.13	218.62	40	28
	68.97	240.83	309.83		
	103.40	288.02	391.48		
0.90	34.43	207.80	242.23	44	28
	68.97	272.32	341.32		
	103.40	329.02	432.42		

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0.95	34.43	231.41	265.85	46	30
	68.97	303.82	372.80		
	103.40	355.6	459		
1	34.43	244.04	278.44	49	30
	68.97	305.03	374.55		
	68.97	374.64	478.00		

Typical variation of deviatory stress with axial strain corresponding variation of relative compaction (among 0.85, 0.90, 0.95, and 1) for 20% (silt+clay) is shown in below figure 7 to 9.

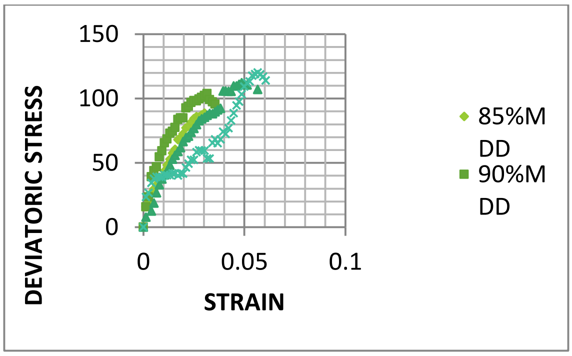

Fig.7 Strain Vs deviator stress for sand+20% (silt+clay) (σ3= 34.43 kPa)

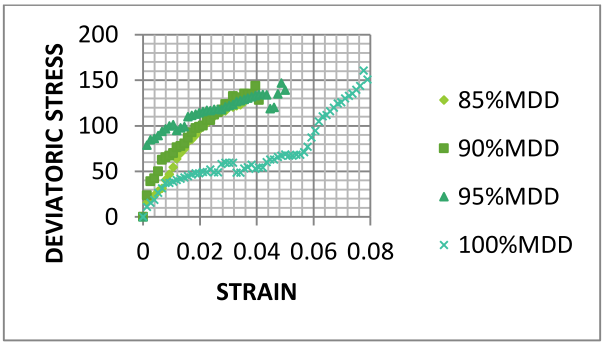

Fig.8 Strain Vs deviator stress for sand+20% (silt+clay) (σ3=68.97 kPa)

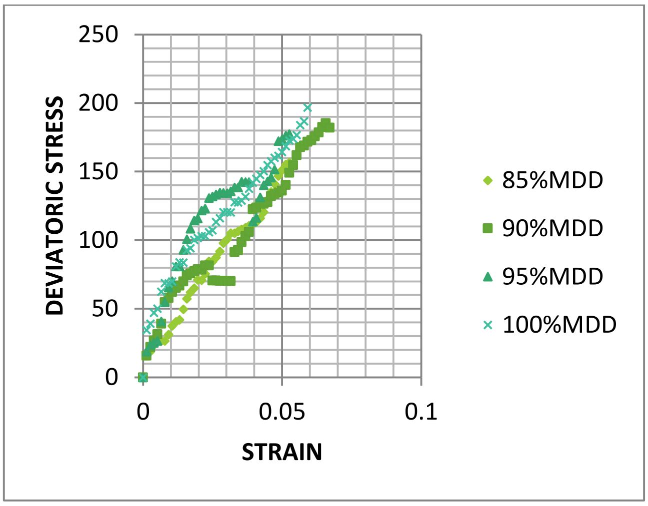

Fig.9 Strain Vs deviator stress for sand+20% (silt+clay) (σ3=103.40 kPa)

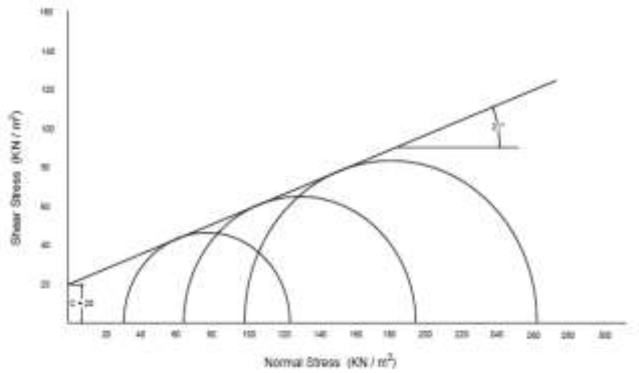

Fig. 10 Mohr circle for sand+20% (silt+clay)

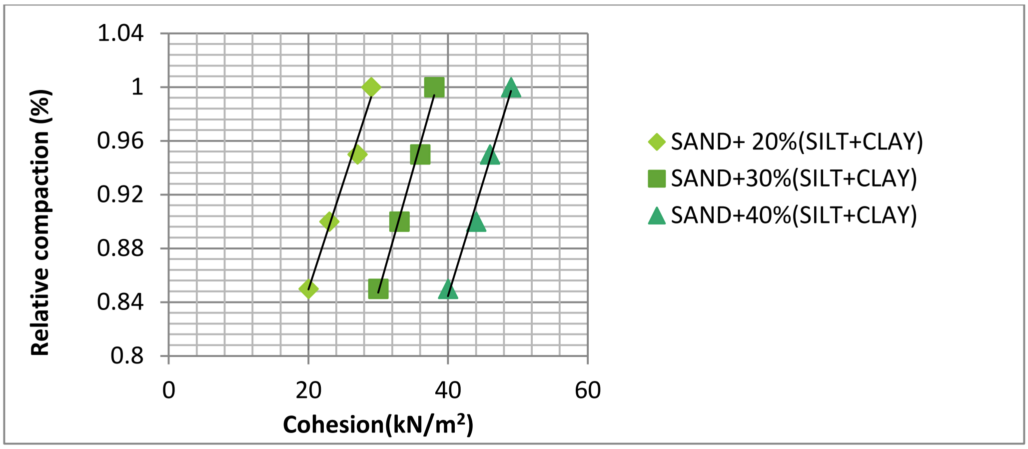

Fig.11 variation of clay content with cohesion

6. CONCLUSION:

From the above experimental work it can be concluded that

- Maximum dry density increased and optimum moisture content decreased with fine content.
- The angle of internal friction decreased and cohesion increased with fine content.

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