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Effects of Fines on Shear Parameter of Sandy Soil

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ABSTRACT

The occurrence and distribution of soil in nature is such that the various types of soil can be found together. The presence of fines in sand is generally recognized as problem in geotechnical engineering, because it influences the engineering properties of soil such as Strength, Relative Density and Classification of Soil. It was established that, the soils cohesion increase with increasing silt content, the angle of internal friction decreased with increasing silt content at the same moisture content.

Keywords: Shear parameters, fine contents, density.

I. INTRODUCTION

The mechanical behavior of clean sands was investigated first by Coulomb in the 18th century. It is a well-established fact that the resistance due to interlocking, friction and cohesion among the soil particles is the principal cause in deriving the shear strength of a soil. Many natural soil deposits and artificial fills contain matrices of coarse and fine soil fractions thus imparting frictional and cohesive properties. Thus, the interplay of these contributors, like interlocking, friction and cohesion is expected to affect the soil shear strength parameters c and ϕ. At smaller fine contents, the dry coarse grained soil may exhibit its usual dense or loose skeletal structures and the in between voids may be filled up by fines, not affecting the skeletal structure significantly. However, in case of higher amounts of fines having larger surface area, the contact of the coarse soil particles May diminish thus changing the whole matrix of the soil mass thus affecting the strength parameters.

II. LITRETURE REVIEW

1. Effects of Fines Contents on Engineering Properties of Sand-Fines Mixtures:

The one-dimensional consolidation test indicated that the behaviors of the material mixtures were similar to those of loose sand when the testing was conducted on constant-void-ratio and constant-relative-density specimens. However, with the same-peak-deviator-stress specimens, the behaviors of the material mixtures were similar to those of either loose sand or dense sand based on a fines content greater or smaller than 20%.

For the consolidated drained shear test, as the fines content increased, all parameters of deviator stress, volumetric strain, shear stress, internal friction angle, and cohesion increased. The critical state parameter (M) decreased for constant-void-ratio and constant-relative-density specimens and seemed stable with the same-peak-deviator-stress specimens. Moreover, as the fines content increased, type A also show degradation in the cohesion, internal friction angle, and critical state in the consolidated untrained shear test.

2. Shear Strength Behavior of Sand Clay Mixture

The plasticity index of the soils increase linearly with the amount of clay occurring in the soil. For areas with high clay content the soil becomes highly plastic that can sometimes lead to problems in foundation construction resulting in higher costs.

Clay content also increases the cohesion and decreases the friction angle. For such cases, the foundations can be designed as C - Ø soils using the appropriate bearing capacity equations. Assumptions that, the Voltaian soils are mostly sands and foundations designed as granular soils (Ø soils) can lead to catastrophic failures

In this way the series of experiments take place and in the first series we have 100% sand and in the second series we have 90% sand and 10% clay in the same way intermix sand and clay by which the voids in the clay gets occupied by the sand and the friction between them increases and the shear strength of the soil increases and the soil will destabilized in this way his is the main criteria of my study

3. Effect of Fine Content on Shear Strength Characteristics of Sand

Fine content has a significant effect on angle of internal friction, ϕ of a sandy soil.

It decreases with an increasing fine content. The ϕ value can decrease even up to 40% with an increase of fine content of 30%.

Fine content of less than 10%, in particular less than 5% has a little effect on angle of internal friction ϕ.

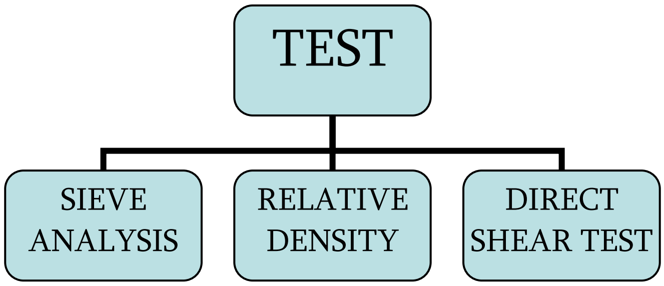
With the increase of fine content in a sandy soil, the cohesion parameter c increases, though the increase is very small. Its value could go up to 12 kN/m2 with a 30% increase of fines. Similar to friction value, it is also insignificant at fine contents less than 5%.

The variation of ϕ and c can be expressed the linear relationships given by equations (1a) through 2(b). However, their use should be very restricted.

III. METHODS AND MATERIAL

The experimental test program can be divided into three components. The first aim is to determine well graded sand and relative density.

The second aim is to determine the angle of internal friction and cohesion.



A quantity of natural sandy soil was carefully sieved to separately obtain clean sand and fines particles. The fines particles are defined as the grain size of soil that is able to pass through a 0.075 mm sieve. The sand-fines mixtures were prepared from these two materials for the various following combinations. All tests were conducted with four sand-fines mixtures defined by dry weight: 100% sand plus 0% fines, 85% sand plus 15% fines, 70% sand plus 30% fines, and 50% sand plus 50% fines.

IV. RESULTS

SIEVE ANALYSIS:-

As per IS: 2720 – PART 4 (1983)

This classification test determines the range of sizes of particles in the soil and the percentage of particles in each of these size ranges. This also called „grain-size distribution‟; „mechanical analysis‟ means the separation of a soil into its different size fractions.

OBSERVATION DATA:-

Weight of soil sample taken for analysis (gm)			400	
IS Sieve Designation	Mass of Soil Retained on sieve	Percentage Mass Retained	Cumulative Soil Retained as Percentage of Soil taken	Percent Finer
mm	gm	gm	%	%
4.75	0	0	0	100
2.36	46.92	11.73	11.73	88.27
2	10.2	2.55	14.28	85.72
1.18	40.2	10.05	24.33	75.67
0.60	91.52	22.88	47.21	52.79
0.425	68.28	17.07	64.28	35.72
0.30	56.4	14.1	78.38	21.62
0.15	37.12	9.28	87.66	12.34
0.075	49.36	12.34	100	0
Receiver	0	0	100	0

RELATIVE DENSITY TEST

Relative Density of cohesion less free-draining soil the ratio, expressed as a percentage, of the difference between the maximum index void ratio and the field void ratio of cohesion less soil to the difference between maximum and minimum index void ratio. Relative density and percentage compaction are commonly used for evaluating the state of compactness of a given soil mass. The engineering properties, such as shear strength, compressibility and permeability of a given soil depends on the amount of compaction.

OBSERVATION DATA:

Dia. Of Mould	15	cm
Ht. of Mould	17	cm
Empty Mould Weight	10947	gm
Mould + Sample Weight	15789	gm
Sample Weight	4842	gm
BEFORE VIBRATION		
Dia. Of Mould	15	cm
Ht. of Sample	17	cm
Volume of Sample	3004.2	cm^3
Minimum Density, γ_{min}	**1.61**	gm/cc
AFTER VIBRATION		
Dia. Of Mould	15	cm
Ht. of Sample	15.7	cm
Volume of Sample	2774.4	cm^3
Maximum Density, γ_{max}	**1.75**	gm/cc

DIRECT SHEAR TEST

The direct shear test used to determine the shear strength of soils on a predetermined failure surface.

This test used to measure the friction angle, undrained shear strength, and dilative and contractive tendencies of soils. This test can be conducted in both coarse (sand) soils and fine (clays) soil

OBSERVATION TABLE:-

DIAL GAUGE READING	DISPLACE-MENT (cm)	CHANGE IN LENGTH (cm)	AREA (cm2)	0.65 kg/cm2		1.15 kg/cm2		1.65kg/cm2	
				PROVING RING READING	SHEAR STRESS (kg/cm2)	PROVING RING READING	SHEAR STRESS (kg/cm2)	PROVING RING READING	SHEAR STRESS (kg/cm2)
0	0	6	36	0	0.000	0	0.0	0	0.000
50	0.05	5.95	35.7	36	0.256	62	0.44	102	0.726
100	0.1	5.9	35.4	46	0.330	81	0.58	145	1.040
150	0.15	5.85	35.1	56	0.405	91	0.65	162	1.172
250	0.25	5.75	34.5	55	0.405	98	0.72	165	1.215
300	0.3	5.7	34.2	51	0.379	90	0.66	164	1.218
400	0.4	5.6	33.6	0	0.0	0	0	0	0.0
500	0.5	5.5	33	0	0.000	0	0.0	0	0.000
600	0.6	5.4	32.4	0	0.000	0	0.0	0	0.000
				τ =	**0.438**	τ =	**0.803**	τ =	**1.255**

V. CONCLUSION

Dry density of sample goes on increasing as the particle size and percentage of fines increases. Void ratio obtained indirectly from dry density goes on decreasing on addition of fines content at 30%, 60% and 90% relative density for each sample. Angle of internal friction obtained from Direct Shear Test increases directly with increase in particle size and relative density. Angle of internal friction is higher in Dry State as compared to Saturated Sate. Angle of internal friction for Coarse Sand goes on decreasing while in case of Fine Sand it goes on increasing on addition of non-plastic fines in Dry State as well as Saturated State.

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