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INFLUENCE OF GRAIN SIZE DISTRIBUTION OF SAND IN THE ANGLE OF INTERNAL FRICTION IN PLANE STRAIN CONDITION

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ABSTRACT - *The wide range of particle size distribution ofsand by virtue of its sedimentological process of formation plays a significant role in engineering behaviour when used as fill material or foundation material. For design and analysis of any structure supported by sand the shear strength parameters of sand are vital and they should be obtained from laboratory test. Since the shear strength parameters are not only the intrinsic property of soil but also rate of shearing or loading and compaction and relative density which are index properties poses most important factors while conducting the tests.*

This article reports about attempts made to illustrate the effect of stress-strain rate and specimen size on shear strength parameters resulting from Direct shear test on dry cohesion less soil with different particle gradations.Direct shear testing was performed on all types of gradations to determine the angle of internal friction under normal stresses of 0.5kg/sq.cm, 1kg/sq.cm, 1.5kg/sq.cm and 2kg/sq.cm.

The result from this project shows that as the particle size within the sample increased, the angle of internal friction also increased.This attempt provides the stated issues which can and should be implemented in practice for better and safe design and prediction.

Key words – Sand, Relative density, Particle size gradation, DST.

1. INTRODUCTION

1.1 GENERAL

Sand is a naturally occurring granular material composed of finely divided rocks and mineral particles. It is defined by size, being finer than gravel and coarser than silt. Sand can also refer to a textural class of soil or soil type; i.e. a soil containing more than 85% sand-sized particles (by mass).The two main strategies dealt in this project are particle size and inter-granular friction between those particles.Particle size depends on the dimension recorded and how it was obtained. Particle size distribution can be determined by two different ways: Sieve analysis, for particles larger than 0.06mm and hydrometer analysis for smaller particles. Sand samples are analyzed using sieve analysis method. Soil particles vary in size from $1*10^{-5}$ mm (1 Å).The size of sand varies from 4.76-0.075mm.The next parameter is shear resistance. The shear strength of sands was first introduced by Coulomb

1.2 NEED OF THE PROJECT:

This study becomes essentialas it is qualitatively stated that sand gets compacted and enhances the confining stress around and below the foundation.However, it appears that no study has been carried out to confirm this behavior under various grain size condition. This project mainly deals with this phenomenon only.

1.3 OBJECTIVE

Separation of various particle size ranges constituting the study.Reconstitution of seven samples with different percentages from the sample particle size ranges and Perform direct shear tests on those seven samples.

2. LITERATURE REVIEW

MOHAMMAD NURUL ISLAM,et.al, discussed about the influence of particle size on the shear strength behavior of sands. To evaluate the effect of particle size, a series of direct shear tests were performed considering uniform particles of eight samples(0.075,0.15,0.212,0.3,0.6,1.18 ,1.72 and 2.76 and graded particles of two samples(0.075-1.18mm and 0.075-2.36mm).Three types of normal loads(0.05,0.10 and 0.15kN) were selected for each test. A theoretical approach was proposed to correlate the particle size and other macroscopic properties

3. METHODOLOGY

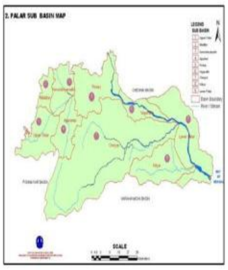
3.1 GENERAL

- Sample Collection
- Sample Preparation
- Index Properties:
- -Specific Gravity, Particle Size Distribution,Proctor Density
- Direct Shear Test

- Estimation of Shear Strength Parameters
- Results & Discussions

3.2. SAMPLE COLLECTION:

The sample for experimentwas collected from PALAR RIVER BASIN-Chengalpet. The obtained sample was then air dried for investigation.



3.3. SAMPLE PREPARATION

1. Natural sample Pure coarse sand-S1
2. Pure medium sand-S2
3. Pure fine sand-S3
4. 50% medium+50% coarse-S4
5. 50% fine+50% medium-S5
6. 50% coarse+50% fine-S6
7. 33.33% of (coarse+medium+fine sand)-S7

3.4. INDEX PROPERTIES: SPECIFIC GRAVITY:

The value of Gs for coarse, Medium and Fine Sand is tabulated as given below

Natural Sand	S1	S2	S3
2.75	2.37	2.73	2.48

3.4.1.PARTICLE SIZE DISTRIBUTION:

Soils, being products of mechanical and chemical weathering, are found in a wide range of particle sizes and shapes.

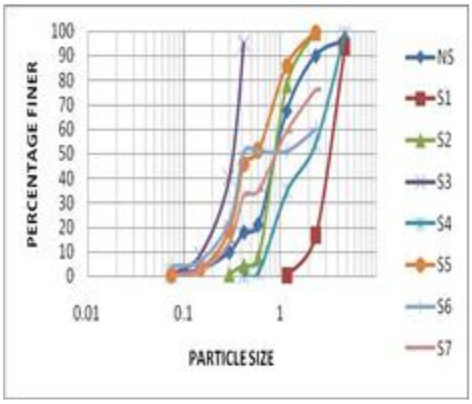


Fig.3.1 Grading curve of samples

3.4.2. PROCTOR DENSITY TEST:

Table 3.1 Density results

Wet density g	1.831	1.875	1.968	2.046	2.148	2.181
Dry density kg	1.797	1.810	1.865	1.905	1.960	1.958

3.5. DIRECT SHEAR TEST :

Cohesionless soils may be tamped in the shear box itself with the base plate and grid plate or porous stone as required in place at the bottom of thebox.Thus direct shear test are taken for 4 different loads such as 0.5kg/sq.cm, 1kg/sq.cm, 1.5kg/sq.cm & 2kg/sq.cm respectively

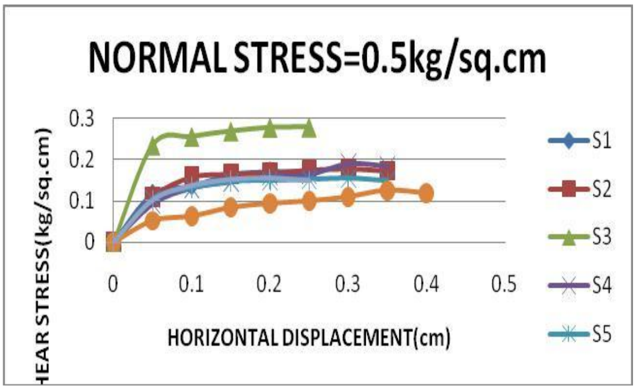


Fig 3.2 Comparison of Normal Stress of 0.5kg/sq.cm for sample

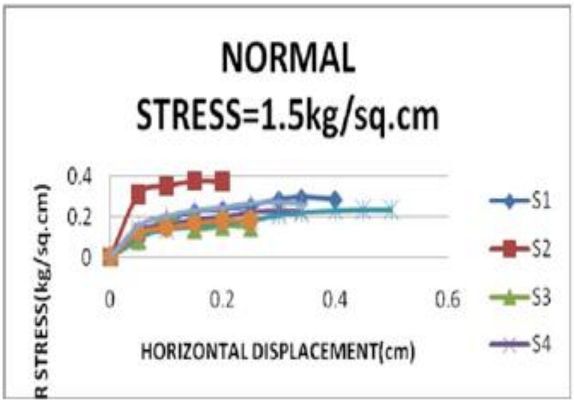


Fig 3.3 Comparison of Normal Stress of 1 kg/sq.cm for sample

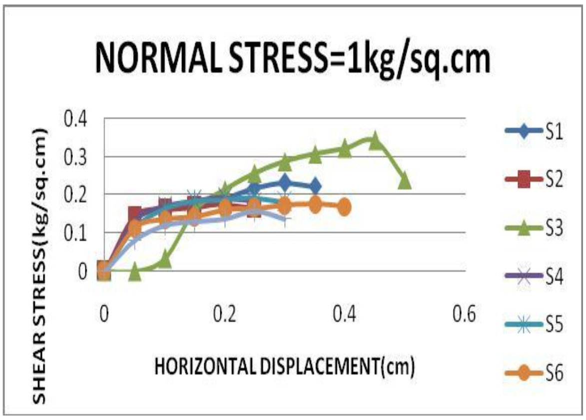


Fig 3.4 Comparison of Normal Stress of 1.5 kg/sq.cm for sample

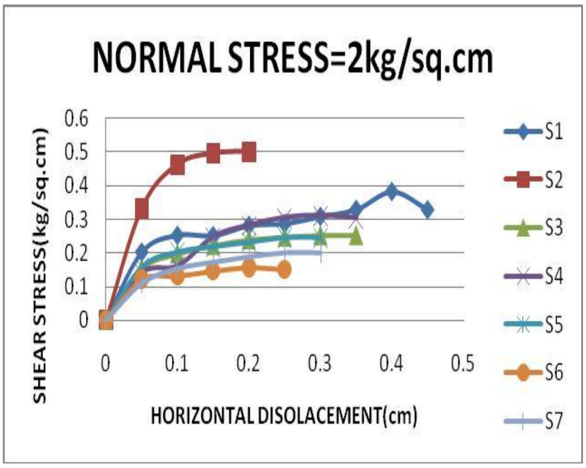


Fig 3.5 Comparison of Normal Stress of 2 kg/sq.cm for sample

3.6 RESULTS AND DISCUSSIONS

3.6.1 INTRODUCTION:

The primary aim of this work is tocharacterize the non-cohesive soil namely poorly graded sand. Series of grain size analysis direct shear tests have been performed in order to study the effect of particle size on stress-strain characteristics of the sand.

3.6.2 INTERPRETATION:

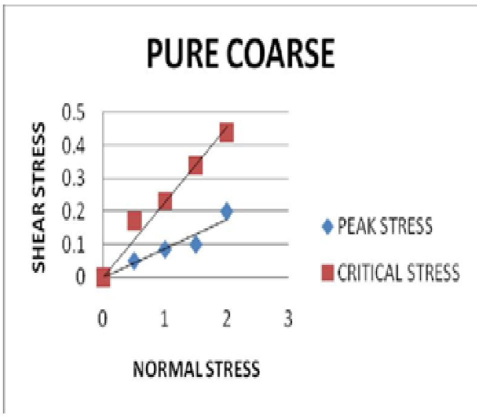


Fig 3.6 comparison of friction angles-Pure coarse sand

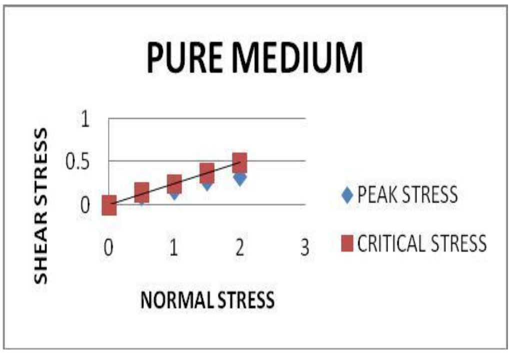


Fig 3.2 comparison of friction angles-Pure Medium sand

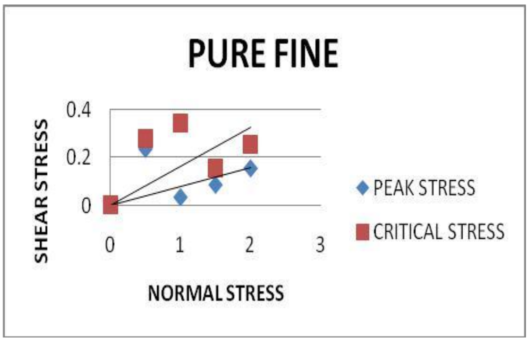


Fig 3.3 comparison of friction angles-Pure Fine sand

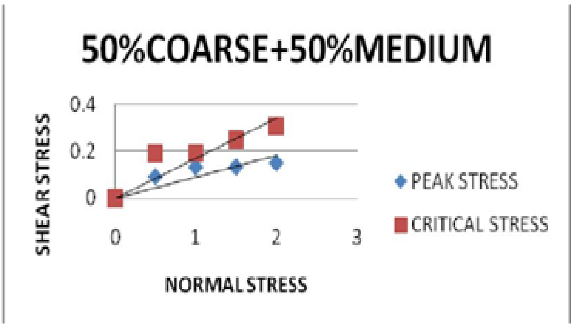


Fig 3.4 comparison of friction angles-50% Coarse+50% Medium sand

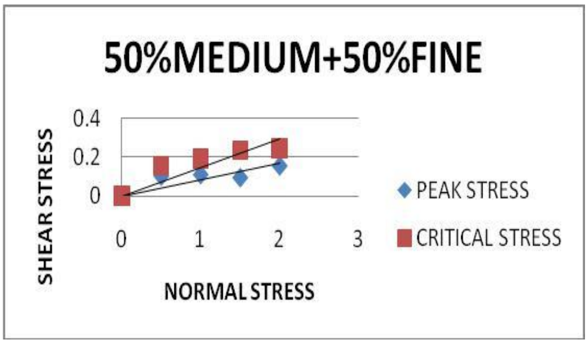


Fig 3.5 comparison of friction angles-50% Medium +50%Fine sand

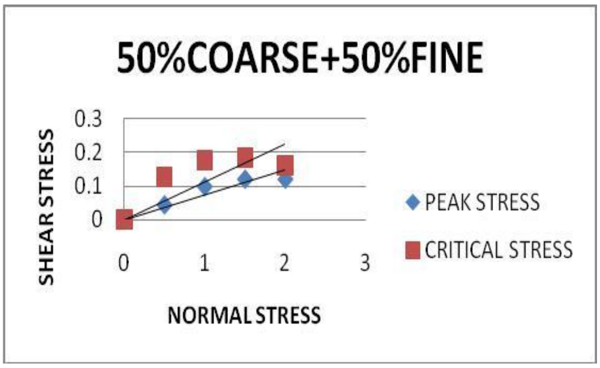


Fig 3.6 comparison of friction angles-50% Coarse+50%Fine sand

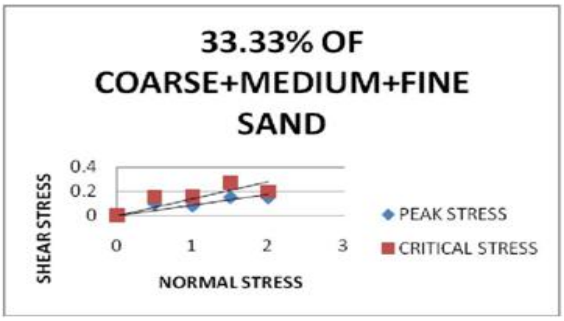


Fig 3.7comparison of friction angles-33.33% of Coarse+Medium+Fine sand

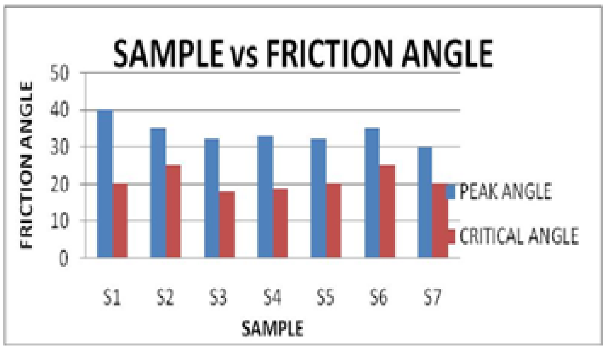


Fig 3.8 Sample vs Peak & Critical Friction Angle

Table 3.1 List of friction angle for seven samples

S.NO	SAMPLE	PEAK ANGLE(?p)	CRITICAL ANGLE (?c)
1	S1	40	25
2	S2	35	20
3	S3	32	18
4	S4	35	19
5	S5	32	20
6	S6	33	20
7	S7	30	20

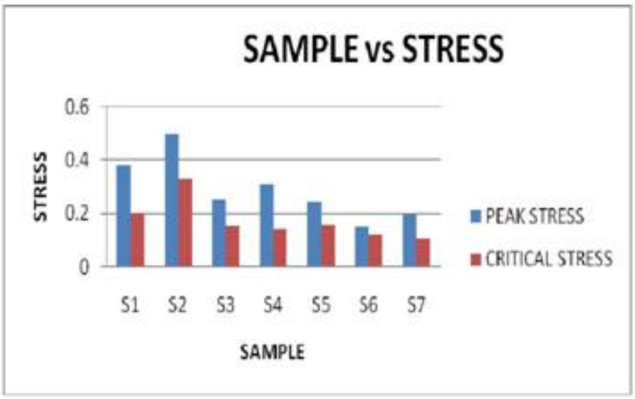


Fig 3.9 Sample vs Peak & Critical friction Stress

4. CONCLUSION:

The stiffness of the soil increases at every normal stress level in the case of sample containing equal amount of coarse, medium and fine The inter-granular stress level shows a peak value in the case of sample containing equal amount of coarse, medium and fine. The pure coarse grained soil exhibits elastic-plastic behavior up to a higher strain value compared to pure medium and pure fine. The peak φ value is the highest in the case of 50%coarse and 50%medium condition and marginally lower in the case of 50%fine and 50%coarse

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