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INFLUENCE OF PLASTIC FINES ON GEO-TECHNICAL CHARACTERISTICS OF SOIL MIXTURES

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ABSTRACT:

Sand with significant amount of fine is always encountered in the geotechnical project therefore the objective of this review paper is to study the behaviour of sand silt mixture with varying percentage of fine and to observed the volume change behaviour of sand with the varying percentage of fine. The test procedures were performed on specimens of different cases: a) constant void ratio index b) based on different relative densities c) different confining pressure such as 50kpa, kpa, 100Kpa, 150Kpa. The test results obtained for both the constant-void-ratio-index and constantrelative-density by the various researcher showed that as fines content increased, the internal friction angle decreased, from the previous literature review it is observed that the fine percentage ulterered the mechanical behaviour of sand. Again it is observed that the strength and liquefaction potential of soil increases as the percentage of fine increases to the certain extent.

Keywords: Soil mixtures, density, geotechnical.

1. INTRODUCTION:

In general, natural sand are generally consists of fines and sand containing fine with different proportions, significantly affects the engineering properties of sandy soil. There are, few studies have reported on the behaviour of sand fine mixture or soil with different fines contents in form of clay or silt. It was observed by P.R. Kalyan Chakravarthy [1] many man-made and natural soil deposits are neither clean sand nor pure clay, but rather a combination of these two materials of silt and gravel in various proportions. In order to find out the shear strength behaviour of the sand-silt mixtures and predict the settlement of foundations which will rest on those sand-silt mixture, it's became necessary to investigate the effect of silts on compressibility characteristics and shear strength characteristics of the sand. The stress-strain behaviour of pure sand is not as same as that mixed with fines. The quantity of plastic and non-plastic fines present in the sand influences the stress-strain behaviour of the sand. Where non-plastic silts have characteristics in common with both sand and clay. Mixed with non-plastic silts. Soils in nature are mixture of fine and coarse soils Fines in soil play a major role in the geotechnical properties of soil. The research focused on experimental study of the effect of fine content on engineering properties of sand. Vu To-Anh Phan [2] work on

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the effect of fine content on shear strength of sand and he has observed that The maximum and minimum void ratio reached minimum values with fines contents of 18% in the sand fines mixture. Mohamed Bensoula [3] observe the effect of fine content on hydraulic conductivity of sand fine mixture and he has conclude that the critical undrained shear strength decreases in a linear manner with an increase in the equivalent intergranular void ratio, while it increases with the increase of the equivalent relative density, this behaviour is valid for Fc ¬ 30% only. J. Yang[4] The addition of fines, either to Toyoura sand or to Fujian sand, resulted in an increase in strain softening, with the degree of softening increasing as higher percentages of fines were added. Adding silica fines to Fujian sand tended to produce an even less stable structure than adding the same amount of fines to Toyoura sand. The difference in particle shape of the two host sands can be a reason for the discrepancy in the macro-scale behaviour. A study were therefore carried out on natural silt and sand mixed together in various proportions, giving a range of soil structures, ranging from sand to silt dominating the soil matrix. These were prepared by varying the amount of fines added. On the direct shear test behaviour of sand-silt mixtures was then examined based on the concept of constant void ratio, and the variation in shear strength with increase in fines content was investigated.

2. LITERATURE SURVEY

Until recently, few studies have reported on the behavior of granular sandy and/or clayey soil with different fines contents. Sreedhar, M.V.S., et al. (2009), investigated on the role of fines content on CBR value of sand-clay mixtures and proposed a Critical Fines Content (CFC). They reported that, fines in excess of CFC transform the load bearing mechanism from cohesion-less behavior to cohesive behavior governed by plasticity. Vu To-AnhPhan, et al. (2016), investigated on the effects of fines content on cohesion, internal friction angle and critical state in the consolidated undrained shear test of sand-fines mixtures. Luis E. Vallejoa and Roger Mawby (2000), investigated the porosity influence on the shear strength of sand-clay mixtures. The previous investigations mainly focused on the effects caused by intrinsic properties of clays and low plasticity. To date, no explanation has been put forward to account for the influence of high plasticity soil fines fraction on the Shear Strength and why these limits of fine material in the mixture exist at which it either doesn't controls, partially controls or has full control on the engineering properties of the mixtures. This study describes such a study.

P.R. Kalyan Chakravarthy [1] the virgin sandy soil has been brought from Kumbakonam. A series of laboratory tests have been performed such as specific gravity and grain size distribution analysis tests on the collected virgin sandy soil sample. For better understanding on stress-strain strength behaviour of soils, the triaxial tests have also been performed on sand-silt mixtures.

3. METHODOLOGY

Fallowing is the test adopted in different study to observe the effect of fine content on engineering properties of sand. In some study triaxial test were conducted where as in some other study direct shear test have been conducted. Procedure adopted also different in different study which

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discussed below for the various studies .P.R. Kalyan Chakravarthy [1] to observe the stress-strain behaviour of sand and sand-fine mixtures, the triaxial test was used. So a series of triaxial tests have been performed on sand and sand-silt mixtures in dry state with the confining pressure of 50 kPa to 250 kPa at a strain rate of 0.12mm/min. The density at which test conducted is 1.47g/cc. Vu To-Anh Phan [2] to observe the characteristics of sand fine mixture the diameter and height of the specimens were 7.1 cm and 15 cm, respectively prepared, for static triaxial testing. The specimens were prepared using the wet tamping method. For sample preparation, dry sand and fines were mixed in the selected weight ratio. The dry mixture was first divided into five equal parts. To each part was added an amount of de-aired water and mixed into the wet mixture with an exact water content of 8%. Next, each part was set up in a mould covered by a rubber membrane and compacted to a given height. Finally, to make a good contact between the layers, the surface of each tamping layer was roughened to a depth of 5 mm using a knife. The same initial dry densities were maintained during test preparation. The specimen was subsequently saturated with flowing carbon dioxide CO2 for at least 30 minutes, and thereafter, de-aired water was allowed to flow through the specimen from the bottom to the top to ensure that the Skempton's coefficient B was 0.95 or greater at the end of the saturation process. In this study, a backpressure of 200 kPa was applied during the test to reach the saturation state. Umashankar B [9] the effect of plastic fines on shear strength of sands is studied using direct shear testing conducted in displacement-controlled mode. Tests are performed at 0.5mm/min and the samples are subjected to three normal stresses-50kPa, 100kPa, and 150kPa. In addition to determining the shear strength, this study also focused on volumetric changes of specimens during shearing in a direct shear box. Tests are conducted on specimens of sand with various fines content ranging from 0% to 25%, while maintaining a constant total density of 1.7 g/cc throughout. Plots of shear stress versus horizontal displacement of lower box, and vertical displacement versus horizontal displacement are plotted. M. A. Islam [11] in the current study Fines was obtained by sieving non-plastic soil (Gojaria sand) through #200 sieves. Obtained fines was added in varying amount (usually 0, 5, 10, 15%) with the soil samples. The experimental programs were performed to estimate the shear strength and angle of internal friction of the proposed sample.

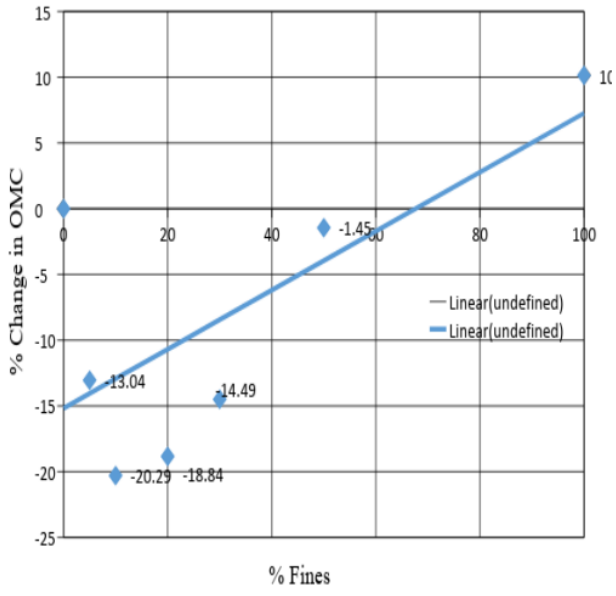

Fig. Variation in percentage change in OMC with fines content.

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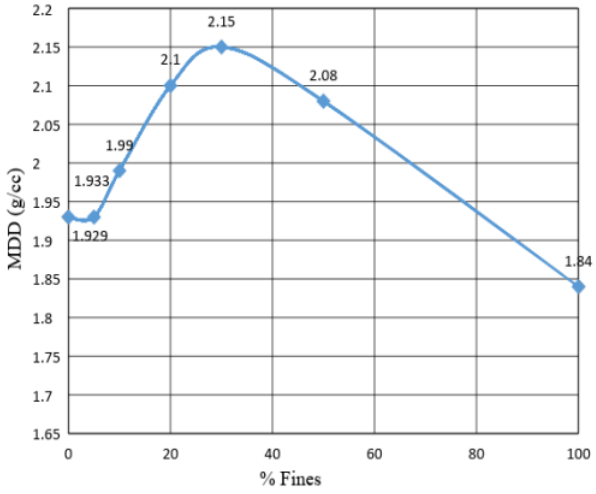
 A marginal increase is observed in the maximum dry density of the soil mixture with only 5% addition of plastic fines. Since the applied loads are carried by the sand skeleton, these fines have little effect on the behavior of the mixtures, as they are just residing in largely empty void spaces. However, the MDD is increasing beyond 5%, showing a peak point at 30% and then decreasing steadily. The increase in MDD is due to the void spaces between the sand particles are occupied by the finer particles. Upto 30% substitution, the fines contributed to improvise the gradation of soil and hence resulted in increased MDD. However, fines in excess of 30% may have contributed to change the gradation to poorly graded and hence causing a reduction in MDD. Further, with higher fines content, the relative ease with which particles can move under compaction effort gets decreased due to cohesion, resulting in a lesser MDD.



CONCLUSION

Based on the experimental results found in this project, the following conclusions are made. In general, it is found that, the plastic fines content has a definite influence on the shear strength characteristics of the soil mixtures. As the fines content increases up to a critical value is known as “Critical Fines Content (CFC)” the MDD, Shear Strength at MDD & OMC values increases considerably due to improvement in gradation of the mixture and hence the improvement in mechanical stability of the mixture. For the materials used in this study, the CFC was 30% and the increase in MDD and Shear strength values was up to 11.77% and 7.30% respectively. The effect of plasticity was more pronounced in saturation state. As the fines content increases the Plasticity Index increases; the Shear Strength at MDD & SMC values continuously decreases owing to the increase in plasticity of soil mixture. On the whole, this study helped in understanding the influence of plastic fines on compaction and shear strength characteristics of the soil mixtures. This study revealed that, in moist conditions, plastic fines up to CFC is beneficial. However, the presence of plastic fines in full saturation state results a steady drop owing to increase in plasticity. Further, this study brought out correlations useful in predicting the drop in characteristics of the mixtures as a function of fines content.

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