Shear Strength Characteristics of Crushed Limestone Sandstone and Gravel

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ABSTRACT:-Most of the previous constitutive models used for investigation of the shear behavior of rock material have been developed without consideration of the oversize particles. The size of experimental samples is an important limitation in this case. In this research a laboratory study has been planned to investigate the shear strength of rock materials containing different gravel contents. The tests conducted using a small scale direct shear apparatus with a 6cm × 6cm × 3cm shear box. Shear strength decreases with increase in particle breakage or decrease in particle size. The magnitude of crushing increases with an increase in normal stress but major crushing occurs during shear. The grain size distribution of the sample undergoes a continuous change with the application of shear and normal stress. For same particle size and gradation, shear strength of sandstones and gravel are different at normal stress. At high normal stress shear strength of gravel is more than sand stone due to its lower crushability.

Keywords: Shear strength, limestone, Sand stone, gravel, Crushablility

I. INTRODUCTION

Particle size has been shown both experimentally and theoretically to affect the mechanical behavior of soil/rock. The effect of the particle size on strength of granular media, some investigation has been done have found that the angle of internal friction increase with increase in particle size; while Marshal and the university of California team has found the opposite results. In addition to particle size and effects related to scaling large-scale materials down to what can be tested in typical geotechnical laboratories particle breakage during loading has been shown to affect the mechanical behavior of geomaterials. Geomaterials with large, angular or weak particles are especially prone to the phenomena of particle breakage. Due to the inherent challenges associated with the characterization of materials with large particle sizes, a rigorous description of the physical properties, and mechanical behavior of rock fill material requires an experimental framework. Granular materials are particle assemblies which are devoid of inter particle cohesion, and where the individual particles are independent of each other except for fractional interaction and geometric constraints incidental to the packing of the assemblies. The purpose of this investigation was to evaluate the effect of the fractional interaction between the particles and the effect of the geometric constraints among these particles on the shear strength of granular materials. The first step was to develop a theory to allow a separate consideration of the two mechanisms. The second step was to test the theory against available published data on granular materials.

II. LITERATURE REVIEW

Prof. S.R. Vaniya et. al, 2016, Studied that for workability, compressive strength, Split tensile strength and Flexural strength. Further, study of its durability will ensure greater dependability in its usage. So here in this project, manufactured sand has been used as replacement of fine aggregate by different percentage for making concrete of M- 25 and M-30. The percentage replacement will be 0%, 10%, 20%, 30%, 40%, 50% with natural fine aggregates. Cubes, beams and cylinders will be casted and tested compressive strength, Split tensile strength, and flexural strength as well as for durability properties.

C. Dhanalaxmi, Dr. K. Nirmal kumar, 2015, Studied that considerable research effort has been spent on the utilization of industrial by products (marble powder) and natural resources (limestone powder) as partial replacement of Ordinary Portland cement (OPC). The benefits of addition of supplementary materials to Ordinary Portland cement are well documented. Limestone powder substitution for cement makes perfect sense in these lower w/c concretes, saving money and energy and reducing carbon dioxide emissions.

Swapnil S. Fate, 2014, Studied that a review is presented in this paper about the application of crushed sand as a smart material in concrete. After a brief outline of the theoretical as well practical studies few measures are reviewed to replace natural sand with manufactured crushed sand. This helps in reducing the likely damage to the ecological balance due excessive sand lifting from river beds, affecting the ground water level.
Ibtehal Salem Fathi, 2014, Studied that crushed limestone is a waste material generated from cutting large stones in Mosul and other towns north of Iraq. These wastes need very large areas to gather them and cause big complaint for owners of these factories, so for the increasing demand to protect the normal environment, especially in buildup areas, the needs to use these wastes is very important.

Arun Patidar & Dr. H.K. Mahiyar, 2014, Studied that it has been concluded that liquid limit & plastic limit of the soil is reduced by adding of any ingredient individually. However the improvement in shrinkage limit is not suggestions. The standard proctor parameters are influenced negatively i.e. the optimum moisture content increases for 18% to 21% using HDPE and lime content while at 15% stone dust it reduced to 15% the maximum dry density is reduced for 1.71 to 1.55 gm/cm3.

T. Jeevetha et. al, 2014, Studied that self-compacting concrete is a flowing concrete mixture that is able to consolidate under its own weight. The highly fluid nature of SCC makes it suitable for placing in difficult conditions and in sections with congested reinforcement. Use of SCC can also help minimize hearing-related damages on the worksite that are induced by vibration of concrete.

Mr. Sanjay raj A et.al, 2014, Studied that in recent years, self-compacting concrete (SCC) has gained wide use for placement in congested reinforced concrete structures with difficult casting conditions. For such applications, the fresh concrete must possess high fluidity and good cohesiveness.

III. RESULTS & DISCUSSION

Series of tests were conducted on limestone, sandstone and gravel samples of three different ranges of particle size and they are denoted as follows:-

All the samples mentioned above were tested each at four different normal stresses of 0.5 kg/cm2, 5.55 kg/cm2, 13.89 kg/cm2, and 27.78 kg/cm2. In this series 36 tests were conducted.

Another series of tests were conducted with the same samples. In this case each sample was subjected to four different normal stresses and after each test the sample was taken out of mould for sieve analysis.

STRESS-STRAIN RELATIONSHIP

The direct shear test data for all the samples of limestone, sandstone and gravel, with different sizes of aggregates. The relationship between vertical and horizontal displacement at four different normal stresses.
In the case of limestone and sandstone the peak of the curve are well defined at high normal stress of the order 27.78 kg/cm$^2$ and 0.5 kg/cm$^2$ and these curves indicate brittle type of failure. However, at lower normal stress of the order of 0.5 kg/cm$^2$ and 5.55 kg/cm$^2$ the curves are almost constant it failure point.

In case of gravel, The shear displacement goes on increasing without an increase in shear force.

**PARTICLE BREAKAGE**

Study of gradation indicates the effect of stress on grain size distribution in the sample due to particle breakage or crushing. It is clear from table the amount of crushing decreases with increase in particle size. It indicates that lesser the particle breakage higher is the shear strength. The major amount of crushing takes place due to application of shear stress.
IV. CONCLUSIONS

The present studied conducted for determining the shear strength characteristics of limestone, sandstone and gravel. Shear strength decreases with increase in particle breakage or decrease in particle size. The magnitude of crushing increases with an increase in normal stress, but major crushing occurs during shear. The grain size distribution of the sample undergoes a continuous change with the application of shear and normal stress. For same particle size and gradation, shear strength of sandstone and gravel are different at normal stress. At high normal stress, shear strength of gravel is more than sandstone due to its lower crushability. At high normal stress, the shear strength of lime stone is lower than sandstone and gravel because of its higher magnitude of crushed.

V. Future scope

Shear strength characteristics will be carried out for more particle size. Effect of shape on shear strength characteristics. A systematic studied will be carried out of sandstone and gravel mixture.

VI. REFERENCES


