A Review: Shear Characteristics of Crushed Limestone, Sandstone and Gravel

Ritu Bala¹, Magandeep Bishnoi²
¹M.Tech Scholar, ²Assistant Professor Department of Civil Engineering, OITM Hisar, Haryana, India.
Ritukamboj60@Gmail.Com,Er.Magandeep8615@Gmail.Com

ABSTRACT:-The strength of a material may be broadly defined as the ability of the material to resist imposed forces. It is often measured as the maximum stress the material can sustain under specified loading and boundary conditions. The most important specification parameters are particle size and distribution, particle shape and texture, and physical and chemical properties to assess aggregate strength and durability. In with the use of heavier compaction equipment, these materials undergo crushing during compaction and exhibit marked change in their engineering properties. It is essential that the behavior of such materials should be investigated under appropriate stress range to account for the effect of crushing. There are several factors such as type of materials, gradation, particle size that may influence shear strength. However, not many studies exist in the literature that deals with a systematic assessment of above mentioned parametric influence on shear characteristics. Such needs have motivated this research proposal. There are a lot of model studies reported in the literature for determining shear strength. However, there is a need to evaluate the influence of crushing and effect of particle size on shear strength characteristics of crushed lime stone, sand stone and gravel. Shearing strength of a rock material is the most difficult to comprehend in view of the multitude of factors known to affect it. A lot of maturity and skill may be required on the part of the engineer in interpreting the results of the laboratory tests for application to the conditions in the field. In this study we find out the shear strength of sand stone, limestone and gravel and crushability of different material.

Keywords: Shear strength, density, Gravel content, Particle size, direct shear test.

I INTRODUCTION
In the present work, an experimental program on the variations of strength characteristics of the crushed limestone sand concrete subjected to high temperature was conducted in order to provide one of comprehensive study of crushed sand concrete when compare to the natural sand concrete
It was observed that the properties of crushed limestone sand concretes, although lower than that of siliceous sand concretes, remain completely comparable. The results showed that the use of crushed lime- stone sand was very encouraging for the broader use in the manufacture of concrete. The use of crushed sand as a fine aggregate has gradually increased in concrete industry due to the supplying shortage of natural sand and the growing restrictions to get natural sand for environmental protection. Furthermore, the quality of the crushed sand is strongly depends on the quality of original used rocks while the natural sand mostly has constant qualities. Also it was known that the crushed sand concrete generally indicated lower workability than that of the natural sand concrete. The most important specification parameters are particle size and distribution, particle shape and texture, and physical and chemical properties to assess aggregate strength and durability. The test results showed that up to of fines content in crushed sand could be used without adversely affecting concrete strength. The results show that concrete containing of limestone fines as replacement of crushed sand reduces the water permeability and increases chloride-ion permeability. Apart from maximum size, gradation and density of placement of rock fill, the crushability of rock has a greater influence on shear characteristics.

Direct shear test results of marshal and the University of California team indicates a definite reduction in angle of internal friction with increase in the particle size and also with increase in confining pressure. Apart from maximum size, gradation and density of placement of rockfill, the crushability of rock has a greater influence on shear characteristics. It has been established by the University of California team (Marachi, chan et al) that crushability as represented by breakage factor, varies linearly and directly with maximum size of particles, plotted on a logarithmic scale. It has also been established by this team that the shear strength reduces as a result of increase in crushability.

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.

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.

Saurabh Jain et.al. 2013, Studied that highway and pavement design plays an important role in the DPR projects. The satisfactory performance of the pavement will result in higher savings in terms of vehicle operating costs and travel time, which has a bearing on the overall economic feasibility of the project

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.

Noha M. Soliman A, 2013, Studied that in recent years Marble is considered one of the most important decorative building materials. Marble powder is one of the materials which severity affects the environment and health problems. It is produced from sawing, shaping, and polishing process.

III SCOPE
During the past decade their has been a trend towards building high dams, particularly for hydro-electric purposes. A rather thin clay cones sported by rockfill shoulders was, in many instances, the most economical and safe design for such high dams, but data on mechanical properties of rockfill were scare, adequate testing equipment was not available and cost of laboratory testing of rockfill was considered-prohibitive.

When the constructions of E1 Infiemillo Dam was started in 1960, the commotion Federal de Electrical pf Maxico undertook the design and manufacture of a equipment to test rock samples, Studies carried out on
1. Geometrical characteristics of the grain skeleton.
2. The evaluation of contact forces and their distribution.
3. The processes underlying particle breakage.

IV OBJECTIVES OF THE STUDY
The objectives of the present work are following:
1. To study the effect of particle size on shear strength.
2. To study the effect of crushing on the strength of material.
3. Identify the load carrying of particles from the size distribution

V MATERIALS USED
The present series of tests were conducted on crushed limestone, sandstone and sub-rounded river gravels of different particle sizes. Fragments of limestone and sandstone were angular in shape and the surface was full of asperities, whereas gravels were rounded to sub-rounded in shape having smooth external surface free from asperities.

In the laboratory, the specific gravity of limestone, sandstone and gravel was determined to be 2.61,2.62 and 2.64 respectively.

Limestone:-Limestone is a sedimentary rock composed primarily of calcium carbonate with the occasional presence of magnesium. Most limestone is biochemical in origin meaning the calcium carbonate in the stone originated from shelled oceanic creatures.

Limestone:-Limestone can also be chemical in origin in the case with travertine. Chemical limestone forms when calcium and carbonate ions suspended in water chemically bond and precipitate from their aquatic sources.

Sample (16 mm – 12.5 mm) i.e. limestone passing through 16 mm sieve and retained on 12.5 mm sieve.

Sample (12.50 mm – 10 mm).

Sample (10 mm – 6.5 mm).
Sandstone:-
Sandstone is a sedimentary rock comprised of lithified sands. Most is primarily quartz sand or a mix of quartz and feldspar sands in conjunction with interstitial cementing materials including calcite, clay, iron oxides, and silica. The lithification process results in a hard, dense material that takes on the color of its components, most commonly tan to yellowish or tinted pink to dark red.
Sample (16 mm – 12.5 mm)
Sample (12.50 mm – 10 mm).
Sample (10 mm – 6.5 mm).

Gravel:-
Gravel is a naturally occurring material water born pieces of rock in buried or current steam beds. These have normally rounded with smooth surface other properties dependent on parent rock. Crushed gravel is larger gravel particles that have been reduce in size by crusher.
Sample (16 mm – 12.5 mm)
Sample (12.50 mm – 10 mm).
Sample (10 mm – 6.5 mm).

VI. METHODOLOGY:-
The following test are conducted in this dissertation:-
SIEVE ANALYSIS:- Sieve analysis helps to determine the particle size distribution of the coarse and fine aggregates. This is done by sieving the aggregates as per IS: 2386 (Part I) – 1963. In this we use different sieves as standardized by the IS code and then pass aggregates through them and thus collect different sized particles left over different sieves.
The apparatus used are–
i) A set of IS Sieves of sizes – 80mm, 63mm, 50mm, 40mm, 31.5mm, 25mm, 20mm, 16mm, 12.5mm, 10mm, 6.3mm, 4.75mm, 3.35mm, 2.36mm, 1.18mm, 600µm, 300µm, 150µm and 75µm.
ii) Balance or scale with an accuracy to measure 0.1 percent of the weight of the test sample.

Specific Gravity of rock material:-
The Pycnometer is used for determination of the specific gravity of soil particles of both fine grained and coarse grained soils. The specific gravity of soil is determined using the relation:

\[ G = \frac{M_2 - M_1}{(M_2 - M_1) - (M_3 - M_4)} \]

M1 = mass of empty pycnometer
M2 = mass of dry soil
M3 = mass of soil and water
M4 = mass of water only
G = specific gravity of soil
Direct shear test:-
A direct shear test is a laboratory or field test used by geotechnical engineers to measure the shear strength properties of soil or rock material, or of discontinuities in soil or rock masses. The test is, however, standard practice to establish the shear strength properties of discontinuities in rock. The test is performed on three or four specimens from a relatively undisturbed soil sample. A specimen is placed in a shear box which has two stacked rings to hold the sample; the contact between the two rings is at approximately the mid-height of the sample. A confining stress is applied vertically to the specimen, and the upper ring is pulled laterally until the sample fails, or through a specified strain. The load applied and the strain induced is recorded at frequent intervals to determine a stress–strain curve for each confining stress. 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.

VII REFERENCES