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EXPERIMENTAL INVESTIGATION ON RICH MINERAL SILICA AND COCONUT SHELL IN CONCRETE

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Abstract:
Concrete plays a vital role in the design and construction of the nation's infrastructure. Almost three quarters of the volume of concrete is composed of aggregates. The current studies involved in the replacement of fine aggregate with Ecosand. In this study an attempt is made to use Ecosand which is a commercial by-product of cement manufacturing process introduced by ACC Cements, as fine aggregate replacement and crushed coconut shell as coarse aggregate. M_{20} grade of concrete is used. Different percentage addition of replacement materials are prepared for conducting the test. The strength characteristic in concrete with replacement of eco sand and crushed coconut shell was studied in detail. Rich mineral silica (Ecosand) being waste material generated from manufacture of cement from industry. It can be used to increases efficiency in concrete. Experimental results are also shows that the compressive strength, splitting tensile strength and structural behavior of concrete of rich mineral silica (Ecosand) and natural sand such that the combination of two aggregate can be increased efficiency in concrete. The project paper aims at analyzing the physical and mechanical properties of concrete. The main objective is to encourage the use of these 'seemingly' waste products as construction materials in low-cost housing.

1. Introduction:

Concrete is a major building material which is been used in construction industry throughout the world. It is an extremely versatile material and can be used for all types of structures. Concrete is a composite construction material composed mainly of cement, aggregate and water. The cement and other cementations' materials such as fly ash and slag cement, serve as a binder for the aggregate. The aggregates are of two kinds, coarse aggregate such as crushed limestone or granite and fine aggregate such as river sand or manufactured sand. Various chemical admixtures can also beaded to achieve varied properties. Water is mixed in concrete so that the concrete gets its shape and then gets hardened through a process called hydration. Aggregate occupy almost 70-75% of the total volume of concrete. The civil engineering construction particularly in the field of reinforced concrete has increased and as a consequence the availability of aggregate has reduced by a large amount. To meet the global demand of concrete in the future, it is becoming a more challenging task to find suitable alternatives to natural aggregates for preparing concrete. Natural aggregates are obtained from natural rocks. They are inert, filler materials and depending upon their size they can be separated into coarse aggregates and fine aggregates. The hike in cost of fine aggregate is another major issue in the construction field. Hence, an alternative construction material which can fully or partially replace the fine aggregate without affecting the property of concrete would be advantageous. The different materials that can be used as an alternative for natural fine aggregate include blast furnace slag, manufactured sand, crushed glass, copper slag, recycled aggregates, fly ash aggregate etc. The use of such materials not only results in conservation of natural. Resources but also helps in maintaining good environmental conditions by effective utilization of these byproducts which will otherwise remain as a waste material.

2. Experimental Program:

Testing of hardened concrete plays an important role controlling and confirming the quality of cement concrete. Systematic testing of raw materials fresh concrete and hardened concrete are inseparable part of any quality control program for concrete, which helps to the concrete with regard to both strength and durability. One of the testing hardened is the confirm that the concrete used at the site has developed the required strength.

Materials: Silica sand in concrete contributes to strength and durability two ways: As a pozzolan, silica sand provides a more uniform distribution and a greater volume of hydration products. As a filler, silica sand decreases the average size of pores in the cement paste.Eco sand effectiveness as a pozzolan and a filler depends largely on its composition and particle size which in turn depend on the design of the furnace and the composition of the raw materials with which the furnace is charged. Used as an admixture, eco sand can improve the properties of both fresh and hardened concrete. Used as a partial replacement for cement, eco sand can substitute for energy-consuming cement without sacrifice of quality. The Coconut Shell-cement composite is compatible and no pre-treatment is required. Coconut Shell concrete has better workability because of the smooth surface on one side of the shells. The impact resistance of Coconut Shell concrete is high when compared with conventional concrete. Moisture retaining and water absorbing capacity of Coconut Shell are more compared to conventional aggregate.

Mixing proportions: The mixing proportion is developed has per IS code method for characteristics strength of 20Mpa. The process of selecting suitable ingredients of concrete are determining their relative amount with the objective of producing a concrete of the required strength, durability and workability as economically as possible, termed the concrete mix design. The common method of expressing the proportions of ingredients of a concrete mix is in the term of parts or ratio of cement, fine and coarse aggregate. for example a concrete mix of proportions 1:2:4 means that cement, fine and coarse aggregate are in the ratio 1:2:4 or the mix contains one part of cement to part of fine aggregate and four part of coarse aggregate. The proportions are either

by volume or by mass. A constant proportions of silica sand and coconut shell are added to the concrete by 10% and 20%to replace the fine aggregate and coarse aggregate respectively.

3. Results and Discussion:

The fresh and hardened concrete is tested to study their properties. The purpose of testing of hardened concrete is to confirm that the concrete used at site has developed the required strength. The fresh concrete is tested for their workability. Testing also helps to achieve higher efficiency of the material used. It also gives assurance of the concrete with regard to both strength and durability. The results obtained from each tests are tabulated and graphically represented below.

Testing of Fresh Concrete:

Workability Test: Workability represents the amount of work which is to be done to compact the concrete in a given mould. The desired workability for a particular mix depends upon the type of compaction adopted and the complicated nature of reinforcement used in reinforced concrete. The measurement of workability is carried out by the slump test and proctor compaction test.

For Normal Concrete:

Slump Cone Test:

Slump cone value of fresh concrete
(true slump) = 60mm
Degree of workability = medium
Compaction factor test:
Empty weight of cylinder (W_1) =7.685 kg
Partial weight of cylinder (W_2) = 19.605 kg
Compacted weight of
Cylinder (W_3) = 21.250 kg
Compaction factor = W_2/ W_3= 0.922
Degree of workability = medium
FOR (10%) REPLACEMENT CONCRETE:
Slump cone test:
Slump cone value of fresh concrete (true slump) = 70mm
Degree of workability = medium
Compaction factor test:
Empty weight of cylinder (W_1) = 7.780kg
Partial weight of cylinder (W_2 = 16.90 kg
Compacted weight of cylinder (W_3) = 18.835 kg
Compaction factor = W_2/ W_3= 0.935
Degree of workability = medium

For (20%) Replacement Concrete:

Slump Cone Test:

Slump cone value of fresh concrete
(true slump = 70 mm
Degree of workability= medium

Compaction Factor Test:

Empty weight of cylinder (W_1)=7.78 kg
Partial weight of cylinder (W_2=15.53 kg
Compacted weight of cylinder (W_3) = 17.23 kg
Compaction factor = W_2/ W_3= 0.92
Degree of workability = medium

Testing of Hardened Concrete: In present study cube compression test, flexural test on cubes, split tensile test on cylinders on conventional concrete and silica sand concrete are carried out. The experimental results and discussion results for various tests are described below.

Compressive Strength Test: A cube compression test is performed on standard cubes of conventional concrete and silica sand and coconut shell concrete with partial replacement of 10% and 20% of size 150mm x 150mm after 3, 7, 14 and 28 days of immersion in water for curing. The results for the test are shown in Table No. 20 to Table No. 22. The compressive strength of the specimen is calculated by the following formula:

$$fcu = P/A$$

Where, P = Failure load in compression (KN)
A = Loaded area of cube (mm^2)

4. Conclusion:

Eco sand being industrial by product can be used as partial replacement of fine aggregate in concrete. The combined grading of fine aggregate confirms better packing pattern The cube compressive strength, cylinder split tensile strength obtained by using the combination of fine aggregate and Eco sand gives a higher value up to 20%.Low frictional resistance of Eco sand will increase the workability of concrete and hence will reduce admixture requirement The low rates of these industrial by product

and also increase in rate of sand and coarse aggregate day by day shows that usage of these material will prove cheaper. The low rates of these industrial by product and also increase in rate of cement day by day shows that usage of these materials the cement content it may be reduced. Increasing level of Ecosand produce decreased resistance of cracking. The ultimate load carrying capacity of concrete with 10% replacement of Ecosand by weight of natural sand approximately equal to that of without Ecosand reinforced concrete in compression test

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