A Comparative Study On Compressive Strength of Ordinary Concrete and Concrete Replaced With Ceramic Tiles and Eco Sand

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Abstract: Concrete is an essential component in determining the growth of country's infrastructure. It is a composite material comprising fine aggregate, coarse aggregate and cement. Due to the increasing demands for both fine and coarse aggregate, finding a replacement is essential. Eco sand which is the bi product of cement manufacturing industries is found to be a worthy replacement for fine aggregate. During tile manufacturing process, about 30% of the material are transformed into waste. This waste can be reused by replacing a certain quantity of coarse aggregate in concrete. In this paper, the compressive strength test results of conventional concrete and concrete replaced with M sand, Eco sand and ceramic tiles were compared. It has been identified that the latter is more efficient and leads to sustainable development. In brief, the concrete of M20 grade with replacement is found to attain higher strength than the conventional concrete.

Keywords: ceramic tiles, M sand, Eco sand, compressive strength

I. INTRODUCTION

Concrete is an important construction material that comprises aggregate, cement and water. A major volume of concrete of concrete is occupied by the aggregates. There is a great increase in the cost of construction due to increased infrastructural activities taking place around the world. Natural river sand being one of the most important ingredients of concrete, is becoming costlier due to its increased cost. Also over utilisation of resources results in environmental problems. Therefore one of the alternative material identified in place of river sand is eco sand. Eco sand is a bi- product of cement manufacturing industries. It is a very fine particle which increases the efficiency of concrete by increasing its strength and durability. Pores in concretes are reduced considerably because of its micro filling effect and shows increased resistance aganist moisture and thus increased durability. It is cost effective and has high strength and durability properties. By using eco sand in place of natural river sand will help the designers and contractors to address the issues of sustainability. During tile manufacturing process, about 30% of the material are transformed into waste. This waste can be reused by replacing a certain quantity of coarse aggregate in concrete. Eco sand is energy efficient, fire resistant, environment friendly,durable, light weight and has low maintenance and low construction cost. In this study the properties of concrete using eco sand and ceramic tiles are studied.

II. MATERIAL PROPERTIES

A. Cement

Cement is used for construction for the purpose of binding the materials that sets, hardens and adheres with other materials by binding them together. In this study ordinary Portland cement (OPC) of grade-53 is used.

B. M-Sand

In concrete, river sand is 100% replaced by Manufactured sand (M-Sand). Manufactured sand is produced from hard granite stone by crushing. M- sand is of cubical shape with grounded edges, washed and graded to as a construction material. The size of manufactured sand (M-Sand) is less than 4.75mm.

C. Eco Sand

Eco sand is a very fine particle, a bi-product of cement manufacturing industries which can be used to increase efficiency of concrete. It is used as a replacement material for fine aggregate.

D. Coarse aggregate

The aggregates whose size is greater than 4.75mm is used as coarse aggregates. They are primarily obtained from quarrying of rocks.

E. Water

In construction works water used for mixing and curing should be clean and free from oils, acids with pH in the range of 6-7, alkalis, salts, sugar and organic material.

F. Ceramic tile aggregate

Broken tiles obtained as waste from the tile manufacturing units and from demolished buildings are collected and crushed into small pieces either manually or by using a mechanical crusher. The resulting crushed tiles can be used as a replacement of coarse aggregate. The tile pieces that are greater than 4.75 mm are preferred. Here, the tile pieces passing through 16.5mm sieve and retained on 12mm sieve are used. The coarse aggregate is partially replaced by 20% of crushed ceramic tiles.

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III. METHODOLOGY

The current experimental investigation follows as below mentioned methodology

- Preliminary material study
- Mix design
- Casting and curing
- Test on hardened concrete (compressive strength)
- Analysis of compressive strength with ordinary concrete

A. Preliminary material study

Initially the materials required for preparation of concrete like cement, coarse aggregate, fine aggregate, eco sand, ceramic tile aggregates and water are studied thoroughly.

B.Mix design for M20 grade concrete

a) The target mean strength = 26.6 MPa

b) Water-cement ratio = 0.55

c) Maximum water content for 20 mm aggregates = 186 litres.

d) Cement Content, C= 338.18 kg/m3

e) Volume of coarse aggregate =0.62% (for water cement ratio= 0.50)

Volume of coarse aggregate = 0.61% (for water cement ratio= 0.55)

Volume of Fine Aggregates = 0.39%

Mix calculations

Volume of concrete= 1 cu.metre

Volume of cement = 0.107 cu.metre Volume of water = 0.186 cu.metre

Volume of all in aggregates = 0.707 cu.metre

Mass of coarse aggregate = 1201.05 kg 20% ceramic tiles = 240.21 kg

Mass of coarse aggregate = 960.84 kg

Mass of Fine aggregate (F.A.) = 755.5kg 20% eco sand = 151.1 kg

Mass of fine aggregate=604.4 kg

Water = 186 litres

C. Casting and curing

Casting is a manufacturing process in which concrete material is usually poured into a mould, which contains a hollow cavity of the desired shape and then allowed to harden.

Curing is the process of allowing the concrete to remain moist in order for the hydration process to continue. The concrete shows increased strength, hardness and density if it has free moisture and unhydrated cement inside it. In this study concrete cubes are casted and cured for 7, 14, 28 days.

D. Test on hardened property of concrete (Compressive strength test)

The compressive strength of concrete is found by applying a gradual load on concrete cubes of size 150mmx150mmx150mm at 7, 14 and 28 days of curing by using compression testing machine. The load at which the specimen fails gives us the value of the compressive strength.

E. Analysis of compressive strength of concrete with eco sand and ceramic tiles with ordinary concrete

NO. OF DAYS OF TESTING	AVERAGE VALUE OF CONTROL SPECIMEN (N\mm^2)	AVERAGE VALUE OF SPECIMEN WITH 20% REPLACEMENT OF FINE AGGREGATE WITH ECOSAND AND COARSE AGGREGATE WITH CERAMIC TILES (N\mm^2)
7 DAYS	14	30.43
14 DAYS	23.5	33.26
28 DAYS	26.6	35.10

Table 1. Average Compressive Strength Of Concrete Cubes

IV. CONCLUSION

In this study, a convincing and advantageous replacement for fine aggregate and coarse aggregate are found to be eco sand and ceramic tiles respectively. The replacement is done in increasing percentage of 20. The concrete specimens prepared by certain calculated percentage of eco sand and ceramic tiles are found to show an obvious increase in the strength of the structure. These materials tend to control the bleeding of concrete. This eventually avoids the segregation of the ingredients in the concrete mix. The maximum compressive strength (30.43N/mm2) was obtained at 20 % replacement at 7 days of curing. Thus 20% replacement with eco sand and ceramic tiles in fine and coarse aggregate gives the strength of M30 grade of concrete. This replacement is the need of the hour as it reduces the cost of concrete production. From the results of this study, it is concluded that acceptable yield is achieved when 20% replacement of eco sand and ceramic tiles is done. It has both environmental and economical benefits. It also promotes the use of industrial bi-products.

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