

Experimental Study on Strength Characteristics of Concrete with Marble Waste Aggregate along with Groundnut Husk Ash

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ABSTRACT: The production of concrete requires cement and aggregates in huge quantities. The production of cement in the industries on a large scale due to heavy demand for cement cause the increase in the environmental impact of these industries. Similar is the case of production of aggregates. In view of the need for the replacement of these materials, the materials that are considered as a huge waste and are difficult to be disposed are chosen. It was observed that there is a lot of wastage in the marble industry during the manufacture of marble stones for flooring. Also, ground nut husk is used as a source of fuel in sweet manufacturing units and also in the local oil mills. The ash obtained is difficult to be disposed and poses a great problem to the surrounding environment. In the present study, the cement is partially replaced by using Ground nut Husk Ash (GHA) and the aggregates are partially replaced by using Marble waste aggregates (WMA). The objective of the present study is to determine the possibility of using Ground nut Husk Ash (GHA) as a partial replacement of cement and Marble waste as a partial replacement of Coarse aggregate in concrete. The experimental study was conducted using constant replacement of 10% cement with GHA and then the replacement of coarse aggregate was varied from 0% to 25%. The experiments were conducted at a constant water/cement ratio. The strength characteristics of concrete were determined. The results of the experiments showed that the concrete mix properties so formed after the replacement adhere to the properties of normal concrete without any replacement. The concrete mix after replacement confirms to the concrete production standards and any of these mixes so formed can be used as an alternative to the normal concrete mix.

KEYWORDS: Groundnut Husk Ash, Waste Marble Aggregate, Ordinary Portland Cement, Compressive strength, Split-tensile strength.

I. INTRODUCTION

Concrete is the most popular binding material that is being used from many years and is serving the purpose of binding very effectively. Concrete doesn't represent a single material. It is the combination of binding material, aggregates and water. Concrete has many applications in design and construction industries. It has become indispensable and very popular because of its accessibility and ease of manufacturing. Even though numerous binding materials have been invented in the construction industry, the usage of this wonderful material has not decreased, but has been increasing everyday. But in the recent days, the manufacture of concrete ingredients is posing many problems. For example, the manufacturing of cement on a huge scale is increasing the environmental pollution. Similar is the case of aggregates, which may be replaced by using the alternate materials. The concrete industry is trying constantly to find the alternate materials for cement and also the aggregates. Fly-ash has been used as the alternate material for the

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replacement of cement since many years. Apart from these materials, for replacement many innovative materials are also been used as replacement materials in the recent construction works. Some of the replacement materials are the rice-husk ash, silica fume, Ground Granulated Blast furnace Slag (GGBS) etc., These replacement materials are been used in case of high strength concrete also. In my study, I have used Groundnut Husk Ash (GHA) as a partial replacement of cement. Groundnut Husk is the form of fuel used in sweet manufacturing units and the oil mills. The groundnut Husk after being used as fuel generates ash which can be used as a replacement material for cement, the disposal of which is the major hassle. Thereby there is decrease in the waste to be disposed and also there is effective usage of the waste that is generated. The aggregates are also being replaced by Waste Marble generated from the marble industry. Marble is the metamorphic rock obtained from the metamorphism of limestone. Marble is the material that is being used from ancient times for sculptures and other decorative works. The disposal of aggregate waste has become a great problem with the drastic increase in the construction activities. About 40% of the marble stone used in the industries will be disposed as a waste leading to waste generation of millions of tonnes. Marble countertops are been collected from the local marble industries. The waste generated may be during the cutting, finishing or polishing of the marble stones. This marble waste may be collected and is cut to the required size and can be used as a coarse aggregate replacement. This waste marble aggregate will have good binding as well as workability properties. Also, by utilising this waste generated on a large scale, the solution for the serious environmental pollution during the disposal can be obtained.

II. EXPERIMENTAL PROGRAM

MATERIALS USED AND THEIR PROPERTIES

Cement: Ordinary Portland Cement (OPC) of 43 grade has been used. The cement used in all the mixes is from the same batch. The tests on the cement were conducted according to IS 4032-1985. The cement is found to confirm the specifications according to IS 8112-1989.

Coarse aggregate: Crushed granular aggregate obtained from the local quarry is used as the coarse aggregate. The aggregate used is free from any of the deleterious substances. The aggregates are found to contain percentage of alkalis within prescribed limits which may otherwise provoke the alkali-aggregate reaction. The aggregates that are used satisfy the properties according to IS 2386-1963.

Fine aggregate: Locally available river sand has been used in the investigation. The fine aggregate must be free from any of the harmful substances which may cause the decrease in the quality of the concrete obtained. The fine aggregate must also satisfy the specifications according to IS 2386-1963.

Water: Water used for mixing and curing is fresh potable water, conforming to IS: 3025-1964 part 22, part 23 and IS: 456-2000. Combining water with a cementitious material forms a cement paste by the process of hydration. The cement paste glues the aggregate together, fills voids within it, and makes it flow more freely. A lower water-to-cement ratio yields a stronger, more durable concrete, whereas more water gives a free-flowing concrete with a higher slump.

Groundnut Husk Ash (GHA): The Groundnut Husk Ash (GHA) is used as a partial replacement of cement. The GHA is obtained from the local sweet manufacturing units in Ananthapuramu. The material obtained is free from any of the harmful substances.

Marble Waste Aggregate: The marble waste stone was generated during the cutting process. The waste marble stone are crushed into pieces manually. The aggregates passing through IS sieve 20mm and retained on 12.5mm were taken.

MIX PROPORTION: Based on the ingredient properties of concrete, M25 concrete mix design as per IS 10262-2009 was prepared and its proportion was 0.5: 1: 1.661: 2.851 (W: C: FA: CA) by weight.

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PROCEDURE:

The experimental study was carried out by the partial replacement of cement and coarse aggregate. The cement is partially replaced by Groundnut Husk Ash (GHA) and the coarse aggregate is partially replaced using Waste Marble Aggregate (WMA). A total of seven mixes were casted as control, M-1, M-2, M-3, M-4, M-5 and M-6. For each of the mix, six cubes and six cylinders were casted and tested. The cubes are of standard dimensions 150x150x150 mm and the cylinders are of length 300 mm and diameter 150 mm. Control mix indicates the normal M25 grade mix without any replacement material. All the remaining mixes contain a constant cement replacement of 10% by weight of cement with GHA and varying coarse aggregate replacements from 0% to 25% with WMA. The mixes were casted and are kept for curing. Then the compressive strength of concrete is determined for cubes and the split-tensile strength is determined for the cylinders. The results of the compressive strength of concrete after 7 days and 28 days curing were shown in figure 1 and figure 2 respectively. The results of the split-tensile strength of concrete after 7 days and 28 days curing were shown in figure 3 and figure 4 respectively.

III. EXPERIMENTAL RESULTS

TABLE - 1

COMPRESSIVE STRENGTH OF CUBES WITH AGGREGATE REPLACEMENT ALONG WITH CEMENT REPLACEMENT

Mix type	% of cement replacement by Groundnut Husk Ash (GHA)	% of Aggregate replacement by Waste Marble Aggregate (WMA)	Compressive strength in N/mm ²	
			7days	28days
Control	0	0	24.63	33.61
M1	10	0	25.09	35.78
M2	10	5	26.17	36.78
M3	10	10	27.41	37.23
M4	10	15	31.49	38.65
M5	10	20	23.68	34.57
M6	10	25	19.84	33.1

TABLE 2: SPLIT-TENSILE STRENGTH OF CYLINDERS WITH AGGREGATE REPLACEMENT ALONG WITH CEMENT REPLACEMENT

Mix type	% of cement replacement by Groundnut Husk Ash (GHA)	% of Aggregate replacement by Waste Marble Aggregate (WMA)	Split-tensile strength in N/mm ²	
			7days	28days
Control	0	0	2.18	2.48
R1	10	0	2.42	3
R2	10	5	2.61	3.22
R3	10	10	2.7	3.4
R4	10	15	2.98	3.73
R5	10	20	2.57	2.83
R6	10	25	2.19	2.57

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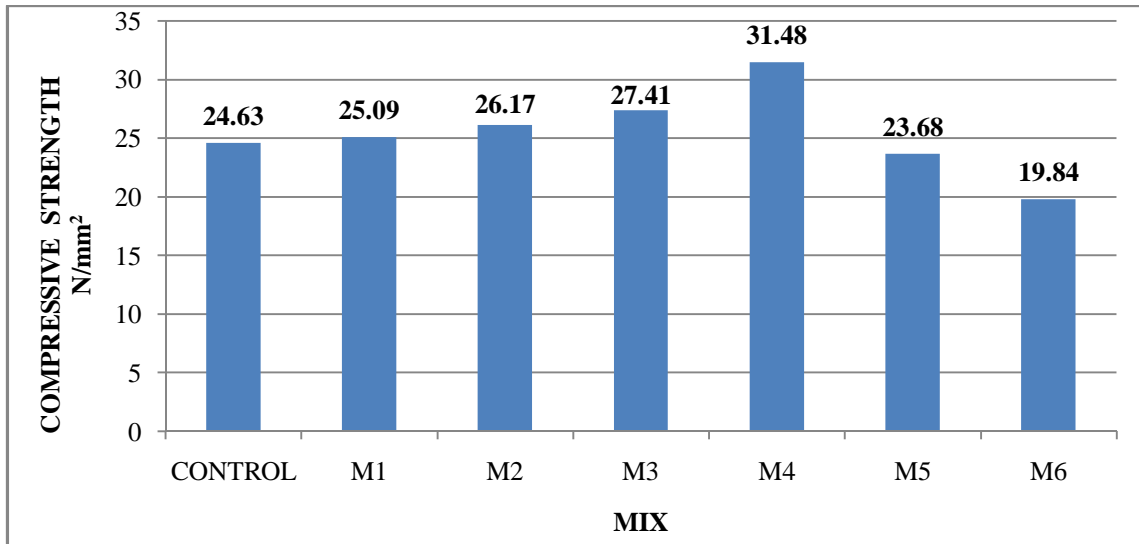


Fig 1: 7 day's Compressive strength in N/mm² with cement and coarse aggregate replacement

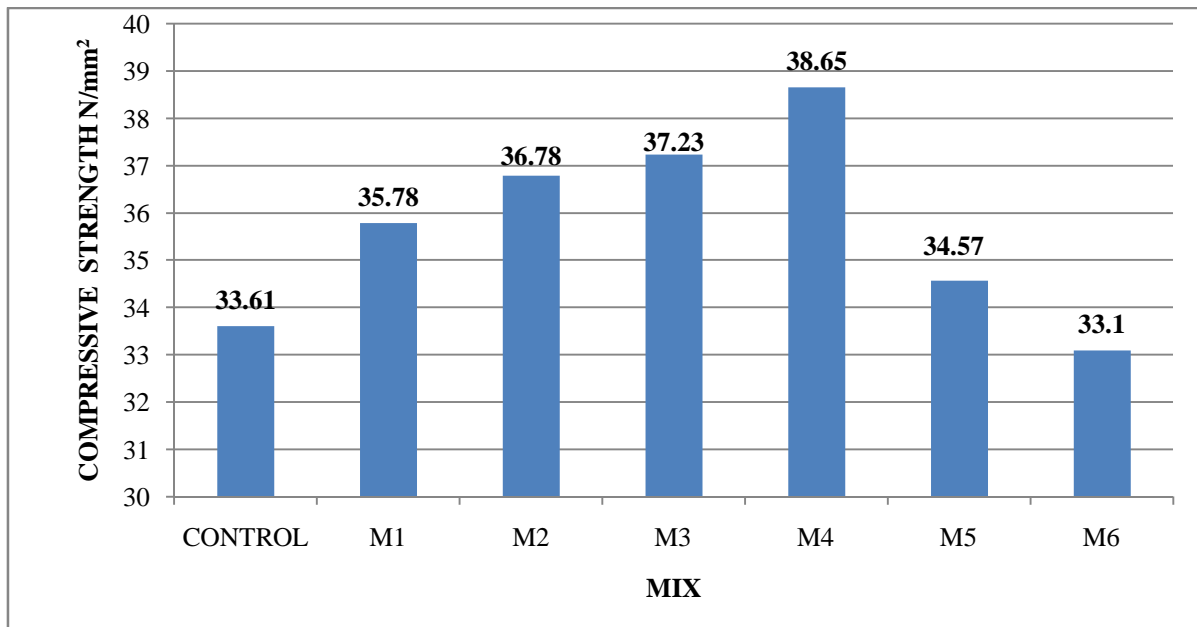


Fig 2: 28 day's Compressive strength in N/mm² with cement and coarse aggregate replacement

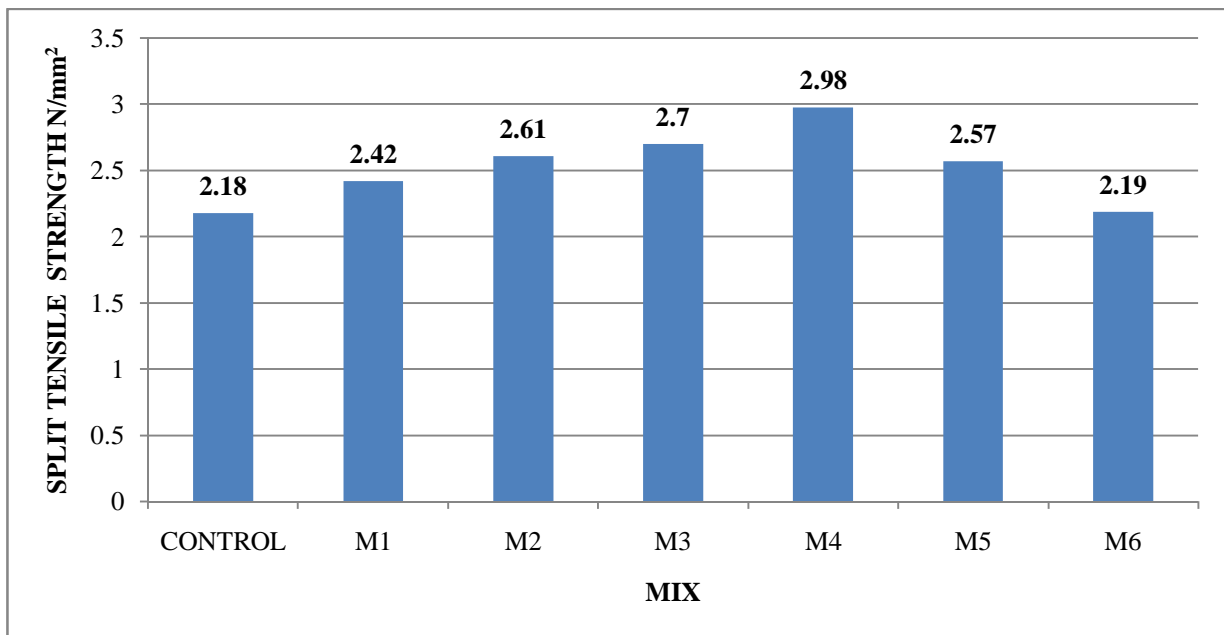


Fig 3: 7 days Split tensile strength in N/mm^2 with cement and coarse aggregate replacement

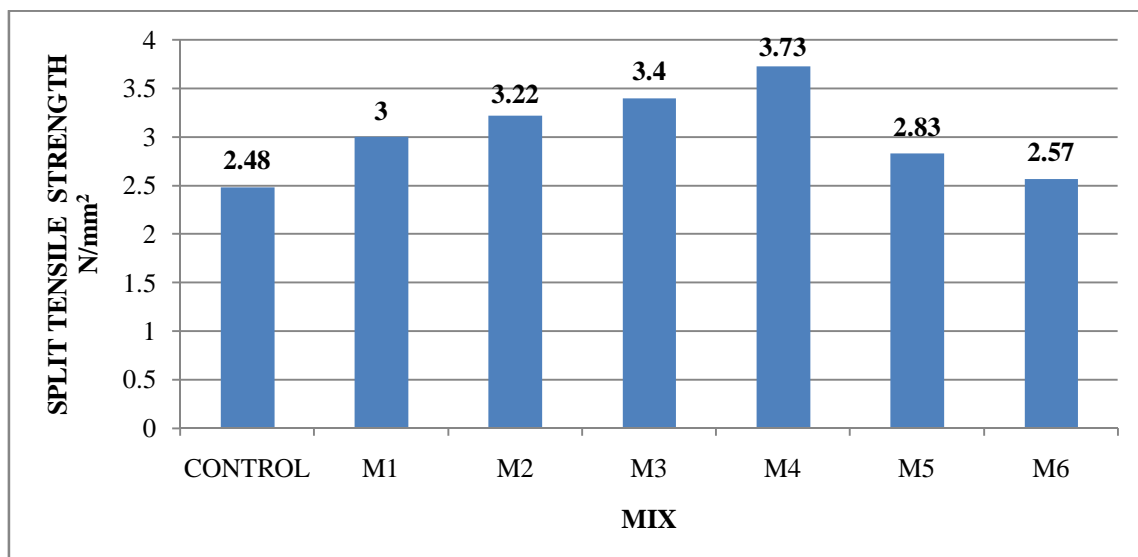


Fig 4: 28 day's Split tensile strength in N/mm^2 with cement and coarse aggregate replacement

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IV. CONCLUSIONS

Based on the results obtained from the tests conducted on various concrete mixes, with a constant replacement of cement up to 10% with Groundnut Husk Ash (GHA) and varying the replacement of coarse aggregate with Waste Marble Aggregate (WMA) from 0% to 25%, the following conclusions can be drawn.

1. The compressive strength of concrete with a constant replacement of cement with 10% of GHA and varying percentages of coarse aggregate replacements with WMA is found to increase up to 15% and then decreased when the replacement is more than 15%. Hence, 15% is the optimum replacement of coarse aggregate with a constant cement replacement of 10%.
2. The split-tensile strength of concrete with a constant replacement of cement with 10% of GHA and varying percentages of coarse aggregate replacements with WMA is found to increase up to 15% and then decreased when the replacement is more than 15%. Hence, 15% is the optimum replacement of coarse aggregate with a constant cement replacement of 10%.
3. From the results, it can be seen that the strength of the concrete mix is not much significantly greater than the control mix but the replacement materials are found to be suitable for usage based on the results.

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