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EXPERIMENTAL STUDY ON CONCRETE AS PARTIAL REPLACEMENT OF COARSE AGGREGATE AND FINE AGGREGATE BY JHAMA BRICKS AND MARBLE POWDER

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ABSTRACT

Due to the day-to-day innovations and development in construction field, the use of natural aggregates is increased tremendously and at the same time, the production of solid wastes from the demolitions of constructions is also quite high. Because of these reasons the reuse of demolished constructional wastes like Jhama Brick and Marble powder came into the picture to reduce the solid waste and to reduce the scarcity of natural aggregates for making concrete. Studies show that about 20-30% of material prepared in the marble manufacturing plants are transforming into waste. This waste material should have to be reused in order to deal with the limited resource of natural aggregate and to reduce the construction wastes. This present study is to understand the behavior and performance of Jhama Brick and Marble powder waste in concrete. The waste Jhama Brick are used to partially replace coarse aggregate by 0%, 10%, 15%, 20% and 25% . Marble powder is also used partial replace fine aggregate by 0%, 8%, 12%, 16% and 20%. M25 grade of concrete was designed and tested. The mix design for different types of mixes were prepared by replacing the coarse and fine aggregates at different percentages of Jhama Brick and Marble powder. Experimental investigations like workability, Compressive strength test, split tensile strength test, Flexural strength test for different concrete mixes with different percentages of waste crushed after 7, 14 and 28-days curing period has done. It has been observed that the workability increases with increase in the percentage of replacement of Jhama Brick and Marble powder increases. The strength of concrete also increases with the Jhama Brick and Marble powder aggregate up to 20% percentage.

Keywords: construction, replacement, aggregate, Jhama bricks, marble powder

1. INTRODUCTION

1.1 Jhama Brick & Marble powder Aggregate Concrete:

Crushed Jhama Brick are replaced in place of coarse aggregate and Marble powder in place of fine aggregate by the various percentage. The fine and coarse aggregates were replaced crushed Jhama Brick and Marble powder combinations that is replacement of coarse and fine aggregates at a time in single mix. For analyzing the suitability of these Jhama Brick and Marble powder in the concrete mix, workability test was conducted for different mixes having different percentages of these materials. Slump cone test is used for performing workability tests on fresh concrete. And compressive strength test is also conducted for 7,14 and 28 days curing periods by casting cubes to analyze the strength variation by different percentage of this waste materials. This present study is to understand the behavior and performance of Jhama Brick and Marble powder waste in concrete. The waste Jhama Brick are used to partially replace coarse aggregate by 0%, 10%, 15%, 20% and 25% .

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Marble powder is also used partial replace fine aggregate by 0%, 8%, 12%, 16% and 20%.

1.2 Environmental and Economic Benefits of Jhama Brick and Marble powder Aggregate Concrete:

The usage of Jhama Brick aggregate as replacement to coarse aggregate in concrete has the benefits in the aspects of cost and reduction of pollution from construction industry. The cost of concrete manufacturing will reduce considerably over conventional concrete by including Jhama Brick aggregate and Marble powder since it is readily available at very low cost and there-by reducing the construction pollution or effective usage of construction waste

2. MATERIALS & METHODOLOGY

Cement used in the experimental work is ORDIRARY PORTLAND CEMENT of 53 grades conforming to IS: 12269/1987. Aggregates are the important constituents in concrete. They give body to the concrete, reduce shrinkage and effect economy. The fact that the aggregates occupy 70-80 present of volume of concrete, it has some impact on various characteristics and properties of concrete. Crushed granite of 10mm & 20mm size are used as coarse aggregate. Fine aggregate which satisfied the required properties for experimental work and conforms to zone as per the specification of IS: 383-1970. Water plays a vital role in achieving the strength of concrete. For complete hydration it requires about 3/10th of its weight of water. It is practically proved that minimum water-cement ratio 0.35 is required for conventional concrete. Water participates in chemical reaction with cement and cement paste is formed and binds with coarse aggregate and fine aggregates. Bricks are a versatile and durable building and construction material with good load bearing properties. The bricks are burnt up to temperature of 800-900 degree centigrade in the brick kiln. If the temperature in the brick kiln is uncontrolled then the bricks are burnt excessively up to the temperature 1100-1200 degree centigrade. Due to this the bricks are sold at cheaper rate as they become out of shape. Therefore, this type of brick is known as over burnt brick. These bricks are also known as Jhama bricks. Jhama brick is produced due to over burning. This brick has irregular size and shape and it is also used as coarse aggregate in some places where the stone aggregate is not easily available or if available their cost is high. Marble Powder is made up of cutting of Marble rocks which now days widely used in construction work. Marble Powder can be used in concrete as partial replacement for cement or fine aggregates. Marble Powder helps in increasing strength of hardened concrete.

2.1 Objectives

1. Effect of Jhama Brick and marble powder concrete on workability.
2. Effect on Compressive strength of concrete.
3. Effect on Tensile strength of concrete.

2.2 Scope

1. To obtain Mix proportions of Control concrete by IS method.
2. To perform the specific gravity test, sieve analysis and slump test under Indian Standard methods.

3. CONCRETE MIX DESIGN

3.1 Mixing Procedure

Uniform mixing of concrete should be ensured to get correct test results of the specimen. For ordinary concrete, initially the coarse aggregate is weighed for required quantity per mix proportioning and poured in mixer; then Sand is weighed and poured into the mixer, which is completely dry. Cement is weighed and uniformly spread on the surface of sand and uniform mixing is ensured. Dry mixing is carried out, later water mixed with the dry mix, mixing is ensured up to a minimum of 5 minutes until uniform color of concrete is seen. Then concrete is placed in moulds as per procedure.

For Jhama Brick and marble powder, the above-explained procedure is followed except that before adding water to cement, sand and coarse aggregate. Jhama Brick and marble powder are thoroughly mixed with cement, sand and coarse aggregate, then the mixture of replacing materials, sand and Cement is mixed with water and further procedure is followed to achieve the different types of

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concrete with Jhama Brick at 10%, 15%, 20%, 25% and 30% volume fractions and marble powder at 4%, 8%, 12%, 16% and 20%.by addition of materials over volume of ordinary concrete.

Table 3.2 Amount of material required

Mix	Jhama Brick Content by Volume (%)	Marble Powder Content by Volume (%)	Cement Content (Kg)	Fine Aggregate (Kg)	Coarse Aggregate (Kg)	Jhama Brick (Kg)	Marble Powder (Kg)
Mix-1	0%	0%	19.44	30.3	55.86	0	0
Mix-2	10.0%	8.0%	19.44	30.3	55.86	13.15	11.04
Mix-3	15.0%	12.0%	19.44	30.3	55.86	19.80	16.60
Mix-4	20.0%	16.0%	19.44	30.3	55.86	26.30	22.1
Mix-5	25.0%	20.0%	19.44	30.3	55.86	33.00	27.60

4. EXPERINMENTAL INVESTIGATION

This chapter presents the details of experimental investigations carried out on the test specimens to study the strength characteristics of replacement of coarse and fine aggregates by Jhama Brick and Marble powder in different combinations. The experiment is conducted on Jhama Brick and Marble powder aggregate test specimens to ascertain the workability and strength related properties such as cube compressive strength, cylinder split tensile strength and prism flexural strength of various mixes. Three specimens are tested, and the average is reported for each mix for each test. All the tests are conducted as per Indian standards. Based on the strength test results of cube and cylinders the optimum percentage is arrived. Then the specimens are casted. After 7,14&28 days curing, the specimens are tested for compressive, Tensile and flexural strength.

5. RESULT AND DISCUSSION

This chapter deals with the presentation of test result, and discussion on compressive strength, tensile strength and flexural strength development of replacement of coarse and fine aggregates by Jhama Brick and Marble powder concrete over ordinary concrete at different percentage (0,10%, 15%, 20%, 25% and 0, 8%, 12%, 16% and 20%.) and different curing period.

5.1 Fresh Concrete Test Result

Table 5.1 Slump Value

Specimen	Slump Result
Mix-1	62 mm
Mix-2	73 mm
Mix-3	75 mm
Mix-4	78 mm
Mix-5	79 mm

5.2 - 7,14&28 days Compressive Strength

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Mix	7 Days N/mm^2	14 Days N/mm^2	28 Days N/mm^2
Mix-1	21.09	25.44	31.60
60Mix-2	22.70	29.55	36.94
Mix-3	24.06	31.59	39.48
Mix-4	23.47	27.95	34.94
Mix-5	22.34	26.46	33.0

5.3 - 7,14&28 days Split Tensile Strength

Mix	7 Days N/mm^2	14 Days N/mm^2	28 Days N/mm^2
Mix-1	3.177	3.36	4.21
Mix-2	3.414	3.46	4.34
Mix-3	3.814	3.95	4.65
Mix-4	4.226	4.51	5.11
Mix-5	4.407	4.93	5.39

5.4 - 7,14&28 days Flexural Strength

Mix	7 Days N/mm^2	14 Days N/mm^2	28 Days N/mm^2
Mix-1	5.80	6.0	7.12
Mix-2	6.08	6.66	7.40
Mix-3	6.56	7.02	7.82
Mix-4	6.76	7.16	7.95
Mix-5	7.8	8.46	9.48

5.5 Percentage Increase in Strength over conventional mix

Sl. No	Properties	Gain Over Normal Concrete
1.	Compressive Strength	+24.15%
2.	Split Tensile Strength	+28.02%
3.	Flexural Strength	+33.14%

6. CONCLUSION

In the light of the preceding results and discussion, the following can be concluded :

- The usage of Jhama Brick and Marble powder can be studied as it is similar to that of Jhama Brick and Marble powder waste generation and also it is quite hard compared to the natural crushed stones and fine aggregate using in conventional concrete. A combination of different Jhama Brick and Marble powder) in different proportions in concrete and their effects on concrete properties like strength, workability etc., can be determined.
- Replacement of coarse and fine aggregates by Jhama Brick and Marble powder in concrete, the physical properties like durability, permeability etc., can be analyzed to prepare a concrete with more advantageous than conventional concrete. The addition of Jhama Brick and Marble powder effect on the compressive strength has increasing by 24.15% with (Mix-3) of aggregate than start increasing and then decreases by with increase the aggregate quantities.
- The results of the splitting tensile strength tests show that, there is a increase in strength by increasing aggregate. it was found that highest splitting tensile strength was achieved by Mix-5 of

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aggregate, which was found about 5.39 N/mm^2 compared with other mix.

- The load carrying capacity is increased to 28.02 % compared with the conventional specimen. Based on the experimental test result there is an improvement in Flexural strength of the Mix-5 is higher at age of 7,14 &28 days respectively compared to all other mixes. High quantities of aggregate produced concrete with better workability and segregation, lower entrapped air and lower unit weight. A significant effect on the mode and mechanism of failure of concrete cylinders in a comp. testing with aggregate concrete.
- The (PCC) cylinders typically shatter due to an inability to absorb the energy by the test machine at failure. Aggregate concrete cylinders continue to sustain load and large deformations without shattering into pieces.

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