

Experimental Analysis of Concrete Using Marble Waste

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Abstract:

Use of marble for various decorative purposes is most common practice in construction industry. But in this process during various operations like cutting, polishing etc., the large amount of waste is generated which is hazardous to the environment. Marble waste affects the fertility of soil and causes soil pollution. Hence proper disposal is required for marble waste or it can be reused in various activities. Concrete is the mixture of cement, fine aggregate and coarse aggregate. Marble is the metamorphic rock having specific gravity is about 2.6 to 2.8 which is nearly similar to the normal aggregates. Hence the waste marble particles can be used in the concrete as partial replacement for fine aggregates [1]. This study represents the results of compressive strength of concrete at various percentage of replacement of fine aggregates with waste marble particles. It is found that the use optimum percentage of marble waste gives the good compressive strength which is nearly about 95 % of design strength. Reuse of marble waste will help to reduce the burden on environment.

Keyword: Marble waste, compressive strength, concrete.

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I. Introduction:

From ancient times, Marble has been used for construction. In the process of utilization of marble, a large amount of marble waste is generated. These marble waste elements are harmful to the environment [2]. If these ingredients are released into the water, the aquatic life is disrupted and. Small particles spread in the air and pollute the air. As per the Indian Bureau of mine total 1945 million tonnes of various grades of marble resources are available in our country. In same way India is the second largest granite producer in the world as it produces near about 130 million tonnes of granite. Rajasthan is the largest marble extraction state in India. As marble is used in multiple decorative works it produces large quantity of waste. Improper waste disposal causes number of impacts on environment as well as human health. As the waste generated is in the form of tiny pieces, powder, marble grid and slurry, they contaminated the air, water and soil also. When marble waste is dumped on land, it affects the fertility and productivity of soil. If the much amount of marble waste is dumped on the fertile land it will completely losses the productivity of soil and soil becomes infertile completely. During the rainy season, the slurry is carried out to the water bodies and affects the aquatic life also quality of the water get affected. Long time deposition of marble waste affects the percolation of rain water in ground and it will affect recharge of ground water table. [1] But due to effective reuse of marble waste it will help to reduce the burden on environment. The marble waste of specific sizes should be used as fine aggregates in concrete at some extent. The fine aggregates can be replaced by marble waste in the concrete and if it gives good strength then it will used in different components of building[2]. If the concrete is failed to gain required strength the it will be used in PCC. Though the marble waste will be collected from number of marble suppliers hence the properties of marble partials may vary slightly. As the specific gravity of marble is varies from 2.4 to 2.7 and compressive strength is about 115 N/mm² which is slightly less than the normal aggregates, we cannot replace the fine aggregates completely by marble waste [3]. It is also the way to produce green concrete to maintain the sustainability. The term 'Green Concrete' means fully or partially replacement of ingredients in concrete with the waste material or the material which is not harmful to the environment or the material which is useful to protect the environment from degradation [6]. This project represents the feasibility of the uses of marble waste as the fine aggregates in the concrete.

II. Experimental Methodology:

The material used in this research is marble powder and grid, which is collected from various marble suppliers from Kolhapur. Marble sample contains 94.23 % of calcium carbonate which is considered as good quality marble for construction purpose. Then the marble sample is sieved using the IS standard sieves

according to the IS 2386 (1963). The grain size passing through 4.75 mm and retained on 600-micron sieve is used for the test specimens. Marble waste sample is used as the replacement for fine aggregate in the M30 concrete as replacement about 19%, 19.5%, 20% and 20.5% [4]. For each replacement 3 concrete cubes about 150mm x150mm x 150mm are prepared. The cubes are tested at 7th, 14th and 28th day to get compression strength in the compressive testing machine.

Properties of material used for mix design:

Mix design of concrete is done as per the IS 10262 (2019) [6].

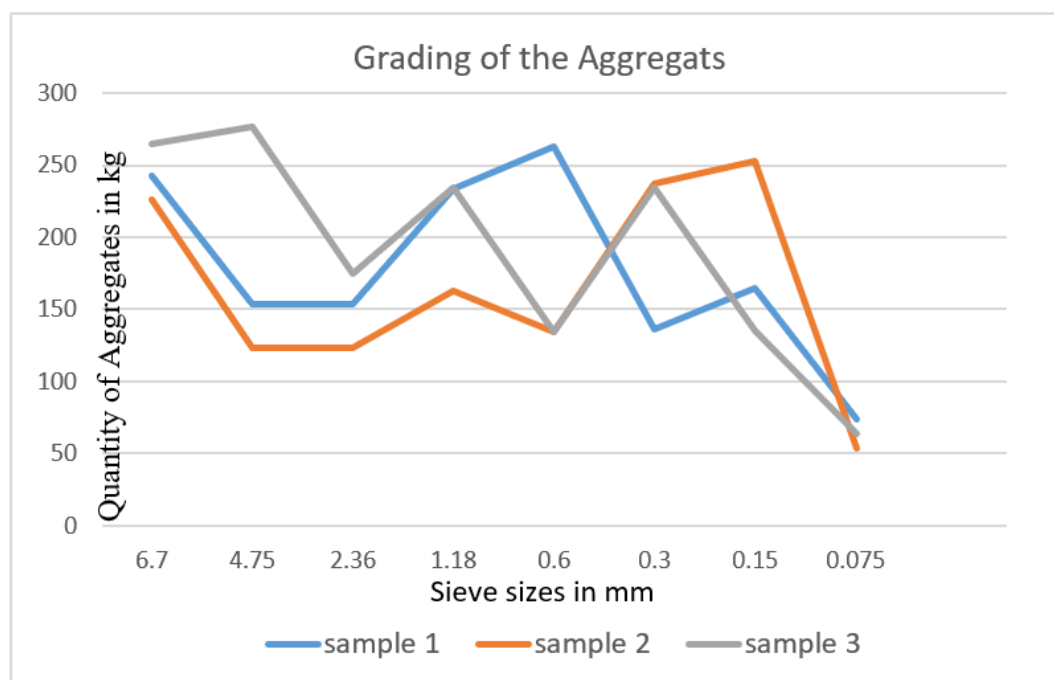
1. Cement:

The cement used to cast the specimen is Ordinary Portland Cement (OPC).

2. Fine Aggregates [7]:

Well graded fine aggregates are used in concrete. Following table shows the grain size distribution of fine aggregates. Sample no. 2 is used for the concrete [4].

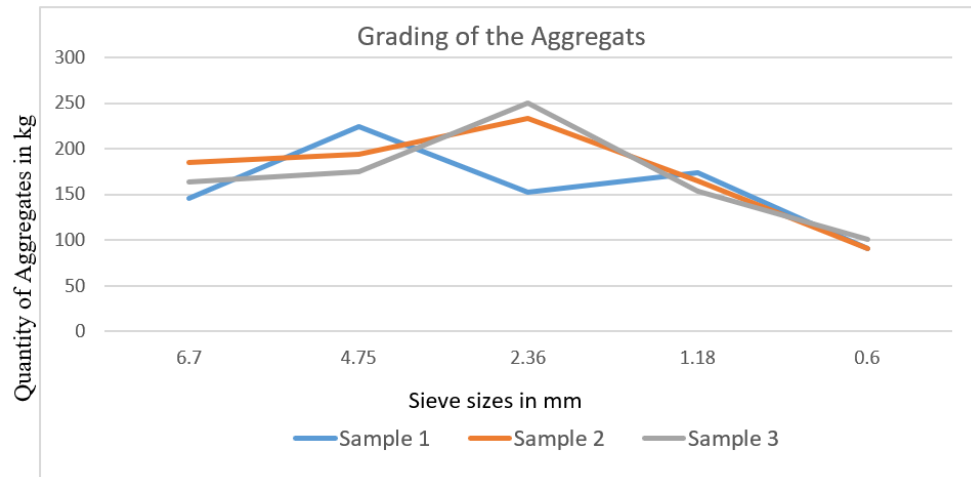
Sieve size in mm	Sample 1	Sample 2	Sample 3
9.5	0	0	0
6.7	242.22	226.48	264.55
4.75	153.63	123.44	276.45
2.36	153.74	123.33	174.29
1.18	233.84	162.65	234.4
0.6	263.12	134.11	134.46
0.3	136.45	237.46	234.45
0.15	164.87	252.35	135.45
0.075	73.4	53.66	63.76



3. Marble Waste [2]

Waste generate from marble industry is used as a concrete ingredient. Grain size passing through 4.75 mm and retained on 0.6 mm sieve is adopted for mix design. Sample 1 is adopted for partial replacement of fine aggregates.

Sieve size in mm	Sample 1	Sample 2	Sample 3
6.7	145.34	184.75	163.47
4.75	123.76	193.64	175.33
2.36	152.76	133.24	149.61
1.18	174.25	164.43	153.62
0.6	56.84	90.22	78.36



4. Coarse Aggregates

Angular shaped well graded aggregate larger than 4.74 mm and smaller than 12.5 mm are used for mix design.

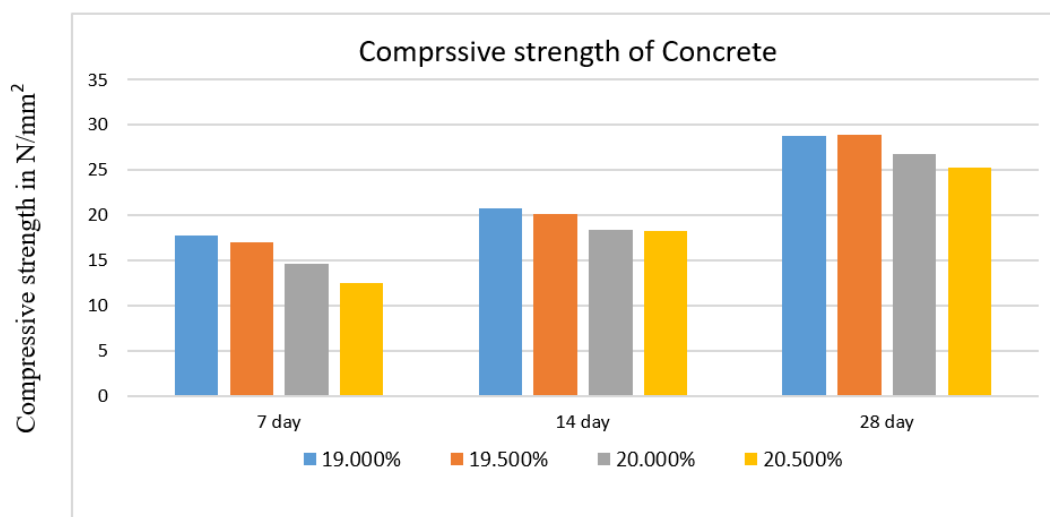
5. Water Cement Ratio

Water cement ratio is maintained as 0.63 which is slightly greater than the water cement ratio generally adopted for mix design. The reason behind it is marble is more porous in nature than aggregates hence required more water to achieve optimum workability.

Compressive strength of concrete [2] [3]:

Three cubes were casted using the marble waste as a partial replacement for fine aggregate as 19%, 19.5%, 20%, and 20.5% respectively to determine compressive strength of the concrete. [8] Twelve sets of cube for each series are casted to tests the compressive strength at 7th, 14th and 28th day of casting. [7] The results of the concrete cubes as per the percentage of marble waste are given below in the chart.

Sr. No.	Marble Waste in %	Compressive strength after 7 day	Compressive strength after 14 day	Compressive strength after 28 day
1	19	20.85	27.49	30.50
2	19.5	20.12	23.96	30.22
3	20	14.65	18.34	26.76
4	20.5	12.54	18.32	25.34



III. Conclusion:

- Up to 19 % to 19.5 % of replacement of fine aggregates with marble waste gives good compressive strength. But if the replacement of fine aggregate is beyond the 19.5 % then it will again reduce the strength of concrete. Near about 95% of strength is achieved against the mix design.

Declarations:

Funding Declaration

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Author Contribution

Rutuja Ravikant Patil studies the research papers and collect the data required for the further research and all the tests performed on the fine aggregates, marble and concrete including the analysis of test results. Yojana M. Pudale guides about the methodology carried out in the project and guides to study the relevant literature.

Clinical trial number

Not applicable to this article.

Ethical Approval

Not applicable to this article.

Consent to Participate

Not applicable to this article.

Consent to Publish

Not applicable to this article.

Data Availability Statement

All the data generated or analyzed during this study are included in this published article.

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