Utilization of Marble Dust in Polyethylene Fiber Reinforced Concrete

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Abstract.

Marble dust is used as a replacement for sand in conventional concrete which is highly efficient in increasing the strength without affecting its properties in fresh and hardened state. Concrete mix is adopted for partial replacement of sand with marble dust. Cubes, cylinders and prisms are cast and cured to conduct compressive strength, split tensile strength and flexural strength test at 28 days. Mix design calculation is done as per IS 10262:2009. Marble dusts are added at 10%, 20%, 30%, 40%, and 50%. .Polyethylene fiber is added to concrete in 0.2%, 0.4%, 0.6%, 0.8% and 1%.. Compressive strength, split tensile strength & flexural strength of the concrete mixtures has been obtained at 28 days. The results of the experimental work showed that replacement of marble dust with polyethylene fiber increase, up to 6% for compressive strength, & up to 8 % for split tensile strength & flexural strength of concrete.

Keywords — *Marble dust, Polyethylene fiber, Compressive strength, Split Tensile Strength, Flexural strength*

I. INTRODUCTION

Concrete is a widely used building material for various types of construction. For a long tide it is considered to be very durable material requiring a little or no conservation. Many atmosphere phenomena are known significantly the durability of strengthen concrete structures. Concrete structures are mostly polluted due to industrial areas, aggressive marine neighbourhood and other unfavourable conditions where other materials of construction are found to be nondurable. For many years, by-products such as fly ash, silica fume and slag are considered as waste materials. They have been successfully used in the construction agility for partial or full replacement for fine and coarse aggregates. Some of the by-products are also used as a Portland cement plight. Marble dust is widely used in the sand blasting industry and it has been used in the production of abrasive devices. Recent papers reviewed the potential use of Marble dust as a partial substitute of cement and aggregates in concrete.

It is now recognized that the concrete strength alone is not adequate, the quantity of harshness of the environmental condition to which concrete is exposed over its whole life is also equally important. Since marble dust contains more than 50% of silica content, strength factors are needful to find out, when it is replaced with fine aggregate in concrete. Although there are many studies that have been announced by investigators on the use of marble dust in cement concrete, some research has been carried out in India and other countries regarding the incorporation of marble dust in concrete. Therefore, to generate specific experimental data on strength characteristics of marble dust as sand replacement in concrete, this research is performed.

II. OBJECTIVES & SCOPE

A. Objective of the Project

- To attain the concrete strength of M30 Mpa
- Extend the life of the concrete.
- Reduce the thickness of concrete and save the quantities of concrete under the same intensity.
- To shorten the processing period and to save the cost of the project.
- To increase mechanical properties of concrete.

B. Scope of the Project

- The scope of this study is to find out the feasibility of using marble dust with polyethylene fiber in concrete to determine the mechanical properties of M30 grade concrete.
- In this study a comparison has been made between plain cement concrete and strength of polyethylene fiber reinforced concrete using marble powder as replacement for fine aggregate.

II. EXPERIMENTAL INVESTIGATION

In this investigation M30 grade of concrete with various proportions of marble powder as a replacement of fine aggregate with addition of polyethylene fiber are used. With the optimum results of marble dust, polyethylene fiber is added to the mix and to determine the strength of the concrete. M30 mix is designed as per IS 10262:2009 and its mix

ratio is found. The required materials are weighed and mixed manually.

A. *Cube Compressive Strength Test*

The cube compressive strength test was carried out on cube specimens of size 150 mm. For each mix combination, three identical specimens are tested at the age of 28 days as per IS: 516-1959. The test is carried out at a uniform stress of 140 kg/cm^2/ minute after the specimen had been cantered in the testing machine. Loading was continued till the specimen had failed. The reading at that instant of reversal gives the ultimate load.

B. *Splitting Tensile Strength Test*

Splitting tensile strength tests were carried out at the age of 28 days for the concrete cylinder specimens of size 150 mm diameter and 300 mm. The load was applied gradually till the specimen split and readings are noted. The splitting tensile strength has been estimated by using the relationship.

$$f_t = \frac{2P}{\pi dl}$$

C. *Flexural Strength Test*

Flexural strength test was carried out at the age of 28 days on the 150mmx150mmx750mm prism specimen by subjecting the specimen to two point loading as per IS: 516 – 1959. The flexural strength has been calculated using the formula

$$f_r = \frac{PL}{BD^2}$$

III. RESULTS AND DISCUSSION

A. *Compressive Strength of Marble Dust with Replacement of Fine Aggregate*

The cube compressive strength results at the ages of 28 days for different percentage of marble dust replacement levels with fine aggregate is presented. The development of compressive strength with age for different combinations is plotted in the form of graphs and is shown in Fig 1.The maximum strength of 32.86 N/mm^2 is obtained at 20% of replacement of marble dust. The result shows that the compressive strength increased with addition of marble dust up to 20% replacement of fine aggregate and further addition of marble dust, the compressive strength decreases. With the 20% replacement of fine aggregate with marble dust, various percentages of polyethylene fiber are added and the compressive strength of PEFRC is found out.

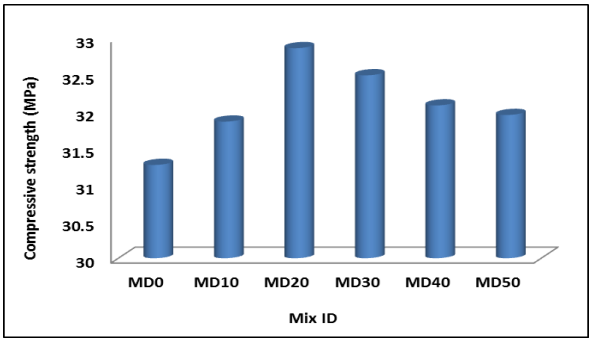

Fig 1: Compressive Strength of Marble Dust with Replacement of Fine Aggregate

B. *Compressive Strength of Various percentage of Polyethylene Fiber With Marble Dust*

Polyethylene fiber is added in various percentages (0.2%, 0.4%, 0.6%, 0.8%, and 1%) with 20% replacement of marble dust in fine aggregate. The mixes are designated as M1-20% with 0.2% PEF, M2-20% with 04% PEF, M3-20% with 0.6% PEF, M4-20% with 0.8% PEF, and M5-20% with 1% PEF. The compressive strength is found out and the results are plotted as graph and shown in Fig 2.The result revealed that the mix M3 shows higher compressive strength 33.06 N/mm^{2}when compared to other mixes. The increase in percentage of Mix M3 shows 5.75% than the control concrete.

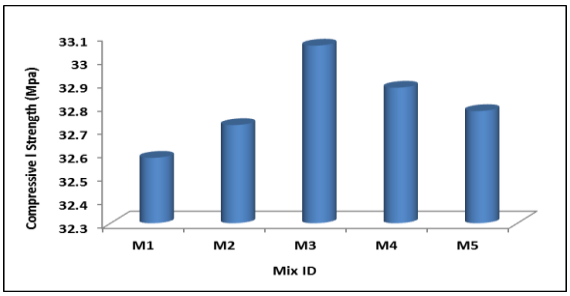

Fig 2: Compressive Strength of Various % of Polyethylene Fiber with Marble Dust

C. *Split Tensile Strength of Various percentage of Polyethylene Fiber With Marble Dust*

The splitting tensile strength of concrete mixtures at 28 days for 20 percent replacement of marble dust with various percentage of polyethylene fiber as an addition is presented in Fig 3. It is observed that the increase in splitting tensile strength is moderate for various percentage of fiber upto 0.4%. There is no increase in split tensile strength beyond 0.4% addition of polyethylene fiber. It is also observed during tests that the propagation of crack is slow because of fiber present in it.

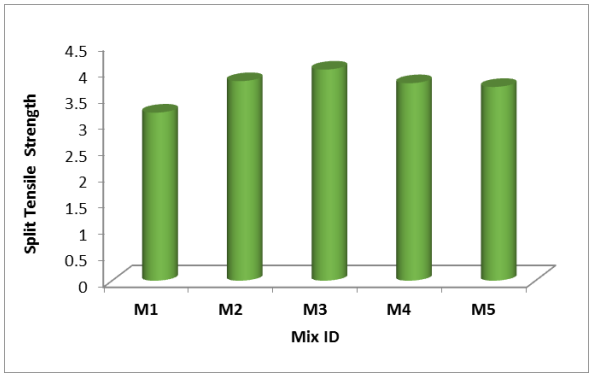

Fig 3: Split Tensile Strength of Various percentage of Polyethylene Fiber with Marble Dust

D. Flexural Strength of Various percentage of Polyethylene Fiber With Marble Dust

Fig 4 shows the variation of flexural tensile strength at 28 days for various combinations of polyethylene fiber along with 20% marble dust. The maximum flexural strength observed is 5.68 N/mm^2 in the mix M3 at 0.4 percent of polyethylene fiber. It is also observed that the flexural tensile strength decreases beyond the addition of 0.4 percent of polyethylene fiber.

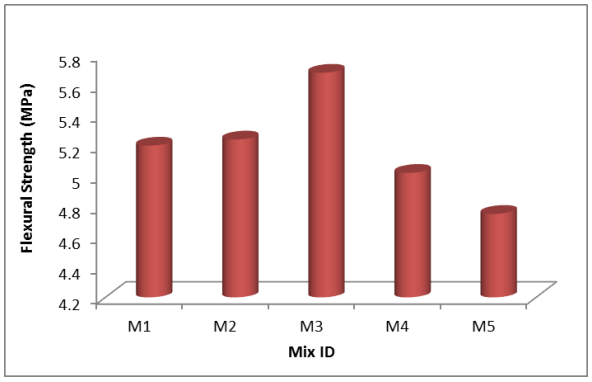

Fig 4: Flexural Strength of Marble Dust with the Addition Of Polyethylene Fiber

IV. CONCLUSIONS

- The desired percentage value of Marble dust in concrete is found to be 20%.
- The increse in percentage of compressive strength in PEFRC is found to be 6% than normal concrete.
- The maximum spliting tensile strength is found at 0.4 percent of polyethylene fiber with 20% marble dust in concrete.
- The maximum flexural strength is found in mix M3 and the maximum strength is found as 5.68 N/mm^2.

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