EFFECTS OF PARTIAL REPLACEMENT OF CEMENT WITH MARBLE POWDER ON PROPERTIES OF CONCRETE

Kirana V T[1], Ravichandran N K[2], Preethi T R[3], Darshan B K[4], Yogesh N R[5]

[1234]U.G Student, Department of Civil Engineering, STJIT Engineering College, Ranebennur, Karnataka, India
[5]Assistant Professor, Department of Civil Engineering, STJIT Engineering College, Ranebennur, Karnataka, India

---

Abstract- Leaving the waste materials to the environment directly can cause environmental problem. Hence the reuse of waste material has been emphasized. Partial replacement of cement by varying percentage of marble dust powder reveals that increased waste marble dust powder ratio result in increased workability and compressive strengths of the concrete Marble Dust Powder is settled by sedimentation and then dumped away, which results in environmental contamination, in addition to forming dust in summer and threatening both agriculture and public wellness. In this research work, Marble Dust Powder has replaced the (OPC & PPC) cement accordingly in the reach of 0%, ,10%, 20%, 30% by weight of M-20 grade concrete. Concrete mixtures were developed, tested and compared in terms of compressive strength to the conventional concrete. The purpose of the investigation is to analyze the behavior of concrete while replacing the Marble Dust Powder with Different proportions in concrete

Key Words: Cement, Concrete, Compressive Strength, Marble Dust Powder, Partial Replacement, Tensile Strength.

1. INTRODUCTION

Environmentally, when industrial wastes are recycled not only the CO2 emissions are reduced but residual products from other industries are reused and therefore less material is dumped as landfill and more natural resources are saved. Fly ash, blast furnace slag and silica fume are most widely used industrial wastes in place of cement for concrete production attributed to their reactivity nature called pozzolanic behavior. In addition to pozzolanas, other inert by-products and waste materials have been used in concrete and mortar production as inert filler for similar reasons. Among these, marble waste powder which using marble waste powder in cement and concrete production is a by-product of marble processing factory was studied by many researchers for its use in concrete and mortar production as sand replacing or cement replacing material. Marble is a metamorphic rock resulting from the transformation of a pure limestone. The purity of the marble is responsible for its color and appearance; it is white if the limestone is composed solely of calcite (100% CaCO3). Marble is used for construction and decoration, marble is durable, has a noble appearance, and is consequently in great demand.

1.1 SCOPE OF STUDY

In this project our main objective is to study the influence of partial replacement of cement with MDP. The compressive strength, tensile strength & flexural strength of ordinary Portland cement of 43 grade of concrete are obtained. Similarly, compressive strength, tensile strength & flexural strength were obtained for 10%, 20%& 30% replacement of cement with MDP by weight.

1.2 OBJECTIVES OF THE WORK

- To study the influence of partial replacement of cement with waste marble powder and to compare the strength of original mix with the partial varied marble powder in concrete mix
- To determine and to find the optimum percentage of marble powder which can be economically used to get a stronger concrete
- As marble powder acts like a pollutant so by partially replacing cement with marble powder there will be reduction

1.3 LITERATURE REVIEW

1.Aalok D et al., 2014 studied on "Experimental study on use of marble dust in concrete" and concluded that for M 25 grade concrete the compressive strength of cubes is increased when 50% of marble powder is added and further any addition of waste marble powder the strength gradually decreases. The split tensile strength of cylinders are increased with addition of waste marble powder up to 25% and decreases on further addition. The flexural strength is obtained at 50% of marble powder mix.

2.Abdullah Anwar et al., 2014 studied on "Study of compressive Strength of concrete by partial replacement of cement with marble dust powder" and concluded that marble dust powder has a potential to provide an alternative to cement and helps in maintaining the surroundings every bit well as economical balance. The compressive strength properties of concrete containing marble dust powder at 0%, 5%, 10%, 15%, 20% and 25% of Portland cement. The investigation was primarily to determine a resolution to the disposal problem of marble dust by making usage of it in concrete production for sustainable construction development. The result obtained for 28 day compressive strength confirms that the optimal percentage for replacement of cement with marble dust powder is about 10%. This will post less on the production of carbon dioxide and solving the environmental pollution by cement production, thereby enhances the urban surroundings.

3.Jashandeepsingh et al., 2015studied on "Partial replacement of cement with waste marble powder with M 25 grade" and concluded that up to 12% replacement of cement with waste marble there is an increase in all mechanical properties. The replacement of 12% of cement with waste marble powder attains maximum compressive and tensile strength. The optimum percentage for replacement of marble powder with cement is almost 12% cement for both cubes and cylinders. To minimize the costs for construction with usage of marble powder that is freely or cheaply available. To realm of saving the environmental pollution by cement production being our main objective.

2. MATERIALS:

2.1 Cement

Fig:2.1

Ordinary Portland cement is used in the project work, as it is readily available in the local market. The cement used in the project work has been tested for various preparations as per IS: 4031-1988 and found to be conforming to various specifications of IS: 1489-1991. The specific gravity was 3.05

2.2 Fine aggregate

Fig:2.2

The natural sand is used as fine aggregate for the study purpose

2.3 Coarse aggregate:

Fig:2.3

The fractions of 20mm are used as course aggregate.

2.4Water:

Water which is free from salts is generally considered for making concrete

2.5 Marble dust powder:

Fig:2.5

Marble powder of 90Micron passing is used. This waste marble Waste powder is replaced in increasing percentage from 0% to 30%.

3. METHODOLOGY

TESTS CONDUCTED ON MATERIALS

1. Cement: Initial & final setting time, Standard & normal consistency, Specific gravity.
2. Fine & coarse aggregate: Specific gravity, Moisture content, Particle size distribution.
3. Concrete:

   a)Fresh concrete: Slump test, Compaction factor, Vee - bee consistometer .

   b)Harden concrete: Compression test , Split tensile test , flexural test.

4. MIX DESIGN

Table-1: Mix proportion

Water Cement Ratio	Cement	Fine Aggregate	Coarse Aggregate
0.53	1	1.85	3.12

Table-2: Important Properties

Grade designation	43 GRADE
Type of cement	OPC
Maximum size of aggregate	20mm passing
Max water cement ratio	0.53
Workability	Good

5. TEST PROCEDURE

5.1 Compression Test:

For compressive strength test, the cubes of size 150 x 150 x 150 mm were cast and tested under compression testing machine of 2000 kN capacity as per IS: 516-1959

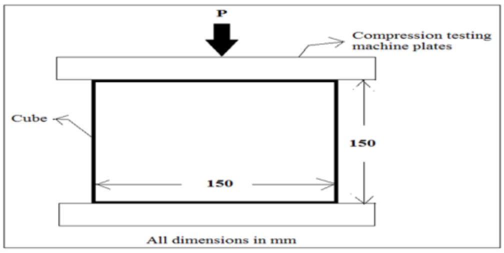


Fig 5.1 COMPRESSION TEST

PROCEDURE:

The following procedure is adopted to conduct the Compressive strength test.

1. Size of the test specimen is determined by averaging perpendicular dimensions at least at two places.
2. Place the specimen centrally on the compression testing machine and load is applied continuously and uniformly on the surface perpendicular to the direction of tamping.
3. The load is increased until the specimen fails and record the maximum load carried by each specimen during the test as shown in fig.

Compressive stress was calculated as follows
Compressive strength= P/A x 1000
Where, P = Load in KN
A = Area of cube surface = 150 x 150 mm^2

5.2 SPLIT TENSILE STRENGTH TEST:

For splitting tensile strength test, the cylinders of 150 mm diameter and length 300 mm were cast and were tested under compression testing machine as per IS: 5816-1999.

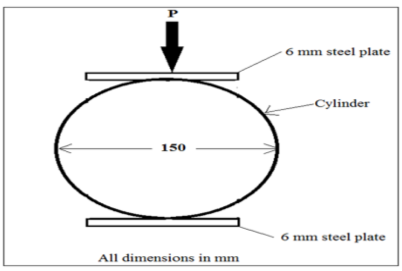


Fig 5.2 SPLIT TENSILE TEST

PROCEDURE:

The following procedure is adopted to conduct the tensile strength test.

1. Draw diametrical lines on two ends of the specimen so that they are in the same axial plane.
2. Determine the diameter of specimen to the nearest 0.2 mm by averaging the diameters of the specimen lying in the plane of pre-marked lines measured near the ends and the middle of the specimen. The length of specimen also shall be taken be nearest 0.2 mm by averaging the two lengths measured in the plane containing pre-marked lines.
3. Centre one of the plywood strips along the center of the lower platen. Place the specimen on the plywood strip and align it so that the lines marked on the end of the specimen are
4. Vertical and centered over the plywood strip. The second plywood strip is placed length wise on the cylinder centered on the lines marked on the ends of the cylinder.
5. Apply the load without shock and increase it continuously at the rate to produce a split tensile stress of approximately 1.4 to 2.1 N/mm^2/min, until no greater load can be sustained. Record the maximum load applied to specimen as shown in fig.
6. Computation of the split tensile strength was as follows.

Split tensile strength = 2P/πdL x 1000
Where,
P = Load in KN
π = 3.142
d = Diameter of cylinder = 150 mm
L = Length of cylinder = 300 mm

5.3 FLEXURAL STRENGTH TEST:

For the flexural strength test, beams of dimension 100 x 100 x 500 mm were cast and were tested on an effective span of 400 mm with two point loading as per IS: 516-1959.

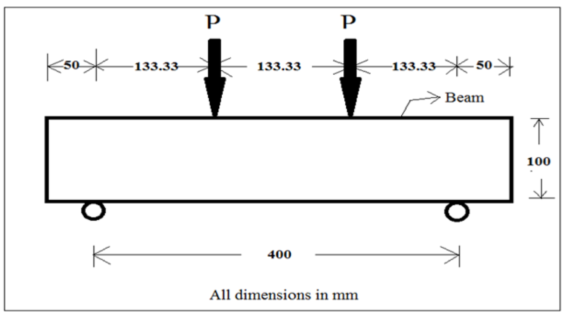


Fig 5.3 FLEXURAL STRENGTH TEST

PROCEDURE:

The following procedure is adopted to conduct the flexural strength test.

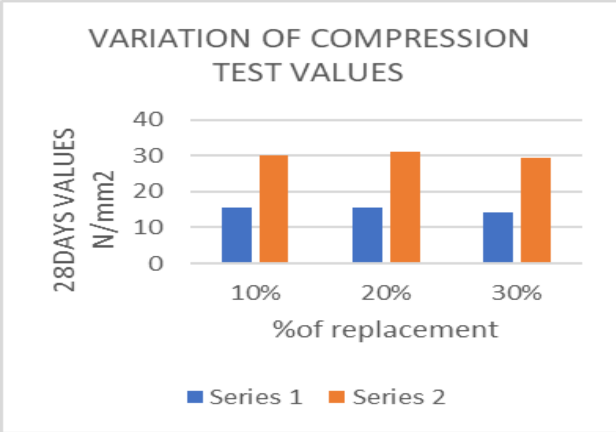
1. Brush the beam clean. Turn the beam on its side, with respect to its position as molded, and place it in the breaking machine.
2. Set the bearing plates square with the beam and adjust for distance by means of the guide plates furnished with the machine.
3. Place a strip of leather or similar material under the upper bearing plate to assist in distributing the load.
4. Bring the plunger of the jack into contact with the ball on the bearing bar by turning the screw in the end of the plunger.
5. After contact is made and when only firm finger pressure has been applied, adjust the needle on the dial gauge to "0".
6. Here we are applying two point loading on the beam specimen, apply load till it breaks and note that as failure load as shown in fig.
7. Computation of the flexural strength was as follows.

Flexural strength = $PL/bd^2 \times 1000$
Where,
P = Load in KN
L = Effective length of beam = 400 mm
b = Width of the beam = 100 mm
d = Depth of the beam = 100 mm

6. RESULTS AND DISCUSSION

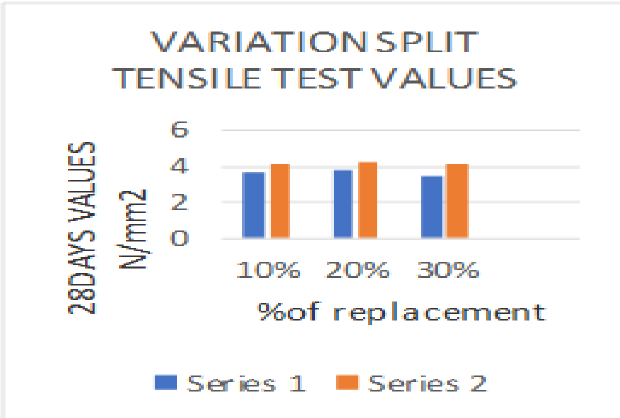
Table No.1 Compressive strength test results

Marble powder % of replacement	7 days	28 days
10%	15.45N/mm²	30N/mm²
20%	15.54N/mm²	31N/mm²
30%	15.25N/mm²	29.50N/mm²



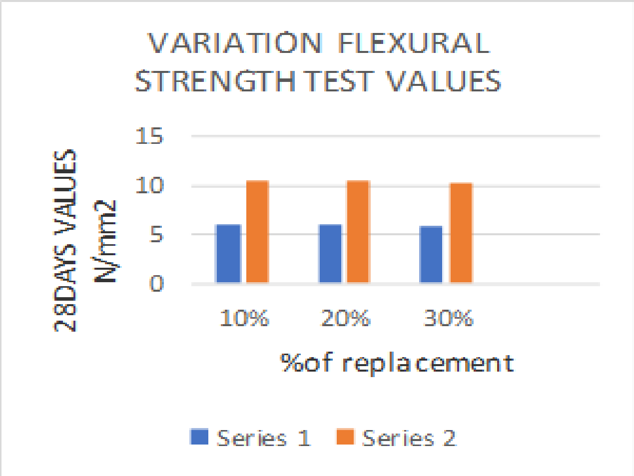
Marble powder % of replacement	7 days	28 days
10%	3.7N/mm²	4.15N/mm²
20%	3.8N/mm²	4.2N/mm²
30%	3.4N/mm²	4.1N/mm²

Table No.2 Split tensile test results



Marble powder % of replacement	7 days	28 days
10%	6N/mm²	10.4N/mm²
20%	6.10N/mm²	10.5N/mm²
30%	5.75N/mm²	10.24N/mm²

Table No.3 Flexural strength test results



7. CONCLUSIONS:

1. Due to waste marble powder, it proved to be very effective in assuring very good cohesiveness of mortar and concrete.

2. From the above study, it is concluded that the waste marble powder can be used as a partial replacement material for cement; and 20% replacement of marble dust gives an excellent result in strength aspect and quality aspect and it is better than the conventional concrete

3. The results showed that the substitution of 20%of the cement content by waste marble powder induced higher compressive strength, and improvement of properties related to durability.

4. The best possible way of disposal of waste material like waste marble powder can be by using it in concrete, which will reduce environmental burden.

REFERANCES

[1] Aalok D. Sakalkale, G.D. Dhawale, R.S.Kedar (2014) “Experimental study on use of waste marble dust in concrete”, IJERA, Vol. 4, Issue 10 (Part 6), pp 44-50.

[2] P.A.Shirule, AtaurRahman, Rakesh Gupta (2014) “Partial replacement of cement with marble dust powder”, technical journals.

[3] Abdullah Anwar, Juned Ahmad, Meraj Ahmad Khan, Sabih Ahmad, Syed aqeel Ahmad (2014) “Study of compressive strength of concrete by partial replacement of cement with marble dust powder”, IJMER, Vol 2, Issue 3, pp 1-4.

[4] Jashandeepsingh, R.S.Bansal (2015) “Partial replacement of cement with waste powder with M25 grade”, IJTRA, Vol. 3, issue 2, pp 202-205.

[5] Pooja J. Chavhan, S.D. Bhole (2014) “To study the behavior of marble powder as supplementary cementitious material in concrete”, IJERA, Vol. 4, Issue 4, pp 377-381.

[6] Ranjankumar, ShyamKishor Kumar (2014) “Partial Replacement of cement with marble dust powder”, IJERA, Vol. 5, Issue 8 (Part 4), pp 106114.

[7] Veena G. Pathan, Md.GulfamPathan “Feasibility and need of use of Waste marble powder in concrete production”, ICAET, pp 23-26.

[8] Syed Vigar Ahmed (2014) “Experimental investigation on partial replacement of cement by marble powder”, V.T.U, Gulbarga.