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EXPERIMENTAL INVESTIGATION ONGLASS FIBER REINFORCED CONCRETE WITH MARBLE POWDER USING PARTIAL REPLACEMENT METHOD

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ABSTRACT:In recent years Marble is considered one of the most important decorative building materials. Marble powder is one of the materials which severalty affects the environment and health problems. It is produced from sawing, shaping, and polishing process.When these marble powders are dumped in the nearby land and the natural fertility of the soil is spoiled. These can be avoided by replacing the cement by marble powder.Concrete is the most important building material in all countries because of ability to cast in to any form and shape. The presence of micro cracks in the mortar-aggregate interface is responsible for the inherent weakness of plain concrete. This weakness can be removed by inclusion of fibers in the mixture.

The aim of this project is to find out the experimentalbehaviour and durability property of fiber reinforced concrete with marble powder. Mixes are prepared for M30 grade concrete. The different proportions of marble powder added are 5%, 10%,15%,20%. The glass fiber is replaced by 0.1% by the volume of cement in every mix. The Compressive strength, Tensile strength, Modulus of rupture and Fire resistance test were determined for the hardened concrete. The results clearly showed that the effect of glass fiber and marble powder enhance the concrete strength.

Keywords: *Concrete, Marble Powder,Cement, Compression strength, Durability.*

1. INTRODUCTION

Marble powder is a by-product obtained during the quarrying process from the parent marble rock; which contains high calcium oxide content of more than 50%. The potential use of marble dust can be an ideal choice for substituting in a cementitious binder as the reactivity efficiency increases due to the presence of lime. Because of its extreme fineness, Marble powder is a highly effective pozzolanic material. Marble powder is used in concrete to improve its properties like compressive strength, bond

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strength, and abrasion resistance; reduces permeability; and therefore helps in protecting reinforcing steel from corrosion.

Portland Pozzolona cement concrete possesses a very low tensile strength, limited ductility and little resistance to cracking. Internal micro-cracks are inherently present in the concrete and its poor tensile strength is due to propagation of such micro-cracks, leading to brittle failure of concrete. Development of such type of concrete that has to meet special requirements, as strength of concrete increases brittleness of concrete also increases. This weakness and brittleness can be reduced by inclusion of Glass fiber in the concrete mix.

It has been reported that the addition of Glass fibers into concrete improves all engineering properties of concrete such as tensile strength, compressive strength, impact strength, ductility and toughness. The basic requirements of fibers for improving strength are high modulus of elasticity, adequate extensibility, and good bond at the interface, chemical stability and durability. The mechanical properties of glass fiber reinforced concrete are influenced by the type of fiber aspect ratio amount of fiber, strength of matrix, size, shape and method of specimen preparation, and size of aggregate.

2. OBJECTIVE OF THIS STUDY

The ultimate aim of this work is to ascertain the performance of concretes containing marble powder and glass fiberonventional concrete. The durability paramand compare it with the performance of cters are analysed to withstand the seength parameters.tr

3. LITERATURE REVIEW

Chandramouli, K et al (2010), studied the durability properties of M20 grades of concretes were estimated in terms of addition of 0.03%, 0.06%, 0.1% of glass fibre. Rapid chloride permeability test was carried out. It is observed that Chloride permeability of glass fibre reinforced concrete shows less permeability of chlorides into concrete when compared with 0% of GFRC (Glass Fiber Reinforced Concrete) .The GFRC reduces the cracks causing interconnecting voids to be minimum & due to the addition of 0.1% of glass fibres there is decrease of permeability by 17.59% .

Shirule, P.A et al (2012), had made a study on Partial replacement of cement with marble dust powder. In this study, M20 grade with nominal mix as per IS 456-2000 was used. Marble powder were added in concrete in step of 5% (0%,5%,10%, 15%,20%). It is observed that the Compressive strength of Cubes is increased with addition of waste marble powder up to 10% replace by weight of cement. The Split Tensile strength of Cylinders are increased with addition of waste marble powder up to 10% replace by weight of cement.

4. MATERIALS USED

4.1. Ordinary Portland Cement

Chettinad 53 grade of Ordinary Portland Cement conforming to IS 12269-2013 was used throughout the work.

4.2. Fine Aggregate

Locally available river sand passing through 4.75 mm IS sieve, conforming to grading zone-II of IS: 383-1970 was used.

4.3. Coarse Aggregate

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Crushed natural rock stone aggregate of maximum nominal size up to 20mm and aggregate passing 10mm were used. In this work the aggregates used are as per specifications of IS 383-1970.

4.4. Marble Powder

Marble powder is a highly pozzolanic material suitable for use in lime pozzolanic mixes and for Portland cement replacement.The marble powder used in this work is brought from marble powder shop in coimbatore and the particle less than 90 micron was used. The properties of the marble powder are presented in Table 1.

Table 1: Properties of the Marble powder

Sl.No.	*Properties of the Marble powder*	
1	Specific gravity	3.15
2	Fineness modulus	2.1%
3	Colour	White

Figure 1: Marble powder

4.5. Glass Fiber

Glass fiber has roughly comparable mechanical properties to other fibers such as polymers and carbon fiber. The Glass fibres used are of Cem-FIL Anti Crack – HD with an aspect ratio of 857.14. The properties of glass fiber as per manufacture's catalogue are given in Table 2.

Table 2: Properties of the Glass fiber

Sl.No.	*Properties of the Glass fiber*	
1	Corrosion resistance	High
2	Length	12mm
3	Modulus of elasticity	72 Gpa
4	Diameter	14 microns
5	Specific gravity	2.71
6	Alkaline resistance	High
7	Density	2680 kg/m^3

Figure 2: Glass fiber

4.6. Water.

Water conforming to as per IS: 456-2000 was used for mixing as well as curing of concrete specimens.

5. EXPERIMENTAL SET-UP

Experimental investigation is carried out to study the properties of M30 grade of concrete. Glass fiber of 0.1% is added to marble powder with various percentages of 0%, 5%, 10%, 15% & 20% by the volume of concrete. The cement 350 Kg/ m^3 with W/C Ratio 0.45. The 150 X 150 X 150 mm cubes, 150 X 300 mm Cylinder & 500 x 100 x 100mm prism were casted. The compressive

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strength, Split tensile strength, Flexural strength was carried out at the age of 7 and 28 days, at various % of marble powder and 0.1% of Glass fiber.

Table 3: Mix Design

Specification	Cement (Kg/m^3)	Fine Aggregate (Kg/m^3)	Coarse Aggregate (Kg/m^3)	Water (Kg/m^3)
Quantity	425	662.77	1225.9	191
Ratio	1	1.55	2.88	0.45

6. TEST RESULTS AND DISCUSSIONS

6.1 Workability

Slump test as per IS: 1199 - 1959 is followed. The obtained slump value for normal concrete is 50mm. This indicates medium workability. The obtained compaction factor value for normal concrete is 0.765. This indicates it gives medium workability.

6.2 Compressive Strength

Compressive strength of marble powder for 5%,10%,15% & 20% & glass fiber for 0.1% replacement with OPC at 7 and 28 days was given by34.44 Mpa, 37.2 Mpa, 40.11 Mpa, 34.04 Mpa, 32.55 Mpais showed in Table 1. & Figure 6.

Figure 3: Compressive Strength Test Setup

6.3 Split Tensile Strength

Split tensile strength of marble powder for 5%,10%,15% & 20% & glass fiber for 0.1% replacement with OPC at 7 and 28 days was given by 1.55 Mpa, 2.3 Mpa, 2.58 Mpa, 1.79 Mpa, 1.68 Mpa isshowed in Table 2. & Figure 7.

Figure4: Split Tensile Strength Setup

6.4 Flexural strength

Flexural strength of marble powder for 5%, 10%,15% & 20% & glass fiber for 0.1% replacement with OPC at 7 and 28 days was given by 6.3 Mpa, 8.83 Mpa,9.91 Mpa, 8.27 Mpa, 8.08 Mpa isshowed in Table 3. & Figure 8.

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Figure 5: Modulus of Rupture Test Setup

Table 4:- Experimental results of compressive strength of cube at 7days & 28 days of age.

Sl.No	Age of curing	Marble powder (%)	Glass fiber (%)	Compressive strength of cube (Mpa)
1	7	0	0	22.52
2	7	5	0.1	24.57
3	7	10	0.1	27.14
4	7	15	0.1	21.65
5	7	20	0.1	19.47
6	28	0	0.1	34.44
7	28	5	0.1	37.2
8	28	10	0.1	40.11
9	28	15	0.1	34.04
10	28	20	0.1	32.55

Table 5:Experimental results of Split tensile strength of cylinder at 28 days of age

Sl.No	Age of curing	Marble powder (%)	Glass fiber (%)	Split tensile strength of cylinder (Mpa)
1	28	0	0	1.55
2	28	5	0.1	2.31
3	28	10	0.1	2.58
4	28	15	0.1	1.79
5	28	20	0.1	1.68

Table 6: Experimental results of Flexural strength of prism at 28 days of age

Sl.No	Age of curing	Marble powder (%)	Glass fiber (%)	Flexural strength of prism (Mpa)
1	28	0	0	6.3
2	28	5	0.1	8.55
3	28	10	0.1	9.91
4	28	15	0.1	8.27
5	28	20	0.1	8.08

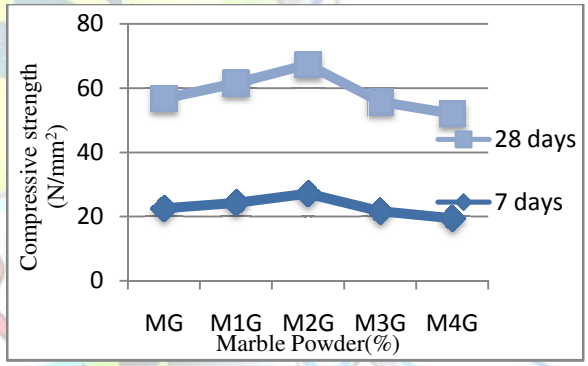

Figure 6: Graph on Compressive strength for Marble powder & Glass fiber at 7 & 28 days

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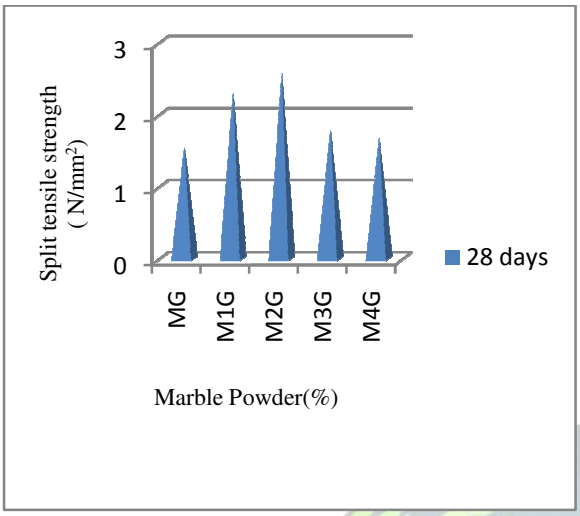

Figure 7: Bar chart on Split tensile strengthfor Marble powder & Glass fiberat 28 days

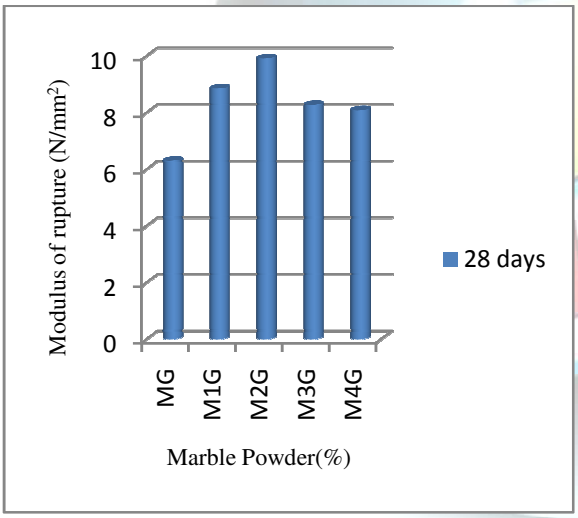

Figure 8: Bar chart on Flexural strength for Marble powder & Glass fiberat 28 days

6.5 Durability Test

Concrete cubes cast in 150x 150x150mm are cured in water for 28 days. For Fire resistance test, specimen is kept in the oven at 100^0C for 24 hours. Finally weight loss & loss in compressive strength is measured.

Table 7: Result for Fire resistance test in 28 days.

Specimen	% loss in weight	% loss in compressive strength
	28 days	28 days
Control Specimen	2.62	6.88
MPGFC	1.33	4.96

7. CONCLUSIONS

Marble powder is added as partial replacement for cement in glass fiber reinforced concrete. Following conclusions were obtained based on the experimental investigations

- The compressive strength, split tensile strength, flexural strength increases with the increase of marble powder
- At 10% of marble powder & 0.1% of glass fiber the compressive strength increases up to 15.1% for 28 days
- At 10% of marble powder & 0.1% of glass fiber there is 20.4% increase in initial Split Tensile strength for 28 days.
- At 10% of marble powder & 0.1% of glass fiber there is 30% increase in Flexural strength for 28 days.
- Increasing the marble powder higher than 10% & 0.1% glass fiber decreased the Compressive strength, Split tensile strength, Flexural strength of concrete mixes.

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- The concrete with marble powder is more durable, and it gives good resistivity to fire attack.

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