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Partial Replacement of Cement with Marble Powder And Silica Fume

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Abstract:

Leaving the waste materials to the environment directly can cause environmental problem. Hence the reuse of waste material has been emphasized. Waste can be used to produce new products or can be used as admixtures so that natural resources are used more efficiently and the environment is protected from waste deposits. Marble powder material (MP) is a very fine powder, obtained as a by-product of marble during the sawing and the shaping, and not recycling it due to environmental problems in the world. The possibility of using it and silica fume (S.F) separately as partial replacement of cement on mortar were studied and evaluated based upon the percentage of the partial cement replacement with both marble powder and silica fume separately In this project our main objective is to study the influence of partial replacement of cement with marble powder and silica fume to compare it with the compressive strength of ordinary M30 concrete. Replacement and addition ratio of both marble powder and silica fume with cement content separately at 0%, 10%, 20%, and 30% by weight were investigated. The mechanical properties of concrete were measured in terms of compressive strength at 7 ,14 and 28 days. We are also trying to find the percentage of marble powder & silica fume replaced in concrete that makes the strength of the concrete maximum.

Keywords-— **Cement, Marble powder, silica fume, compressive strength .**

I. Introduction

In the world of construction, concrete like other materials is playing an important role in development. Concrete is a composite material which is a mixture of cement, fine aggregates, coarse aggregates and water. The Cement among which plays an important role in strength of concrete. Other Pozzolanic materials such as marble dust, Silica Fume, Fly ash can also be used. It possesses many advantages including low cost, general availability, adaptability, no extra energy consumption, enhancement of concrete properties and utilization under different environmental conditions.

The goal of sustainable construction is to reduce the environmental impact of a constructed facility over its lifetime. During the cutting process about 25% marble is resulted in dust and Silica fume (SF) is a waste material that is products during the production of silicon and silicon alloys .Concrete is the main material used in the construction world. With the rapid development in the industrialization numerous industries are established and their rate is increasing day by day. Various industries such as Marble industry, steel mills etc. uses such materials that results in the production of various by-products such as silica fume, marble dust, fly ash and many others. In some countries these materials are dumped in open as of no use without knowing about their cementitious properties. Thus by doing so they are polluting the environment and also reducing the natural resources by cutting mountains. These by-products have cementations properties, so they can be used as replacement with cement.

II. Material

A. *Cement*

The cement use for the experimental studies was 53 grade OPC conforming to the specifications of Indian Standard Code IS: 8112-1989 shows in table 1. It was fresh and without any lumps

TABLE I. PHYSICAL PROPERTIES OF ORDINARY PORTLAND CEMENT

Sr No.	Table Column Head		
	Property	***Result***	***Limit***
1	***Finesse***	***1.64 %***	***<10***
2	***Initial setting time***	***150 min.***	***30 min***
3	***Finale setting time***	***185 min***	***600 min***
4	***Consistency of cement***	***30%***	**-**
5	***Specific Weight***	***3.15***	**-**
6	**Bulk Density (t/m^3)**	**1.78**	**-**
7	**Compressive strength**	**63.5**	**-**

B. *Aggregate*

TABLE II. PHYSICAL PROPERTIES OF AGREGATE

	Property	***C.S.***	***10 MM***	***20MM***
1	Bulk density	1.67	1.43	1.45

	Property	*C.S.*	*10 MM*	*20MM*
2	Specific gravity	2.53		
3	Fineness module	2.74	2.8	2.67

C. Marble

Marble powder-Marble powder is crushed or ground marble particles. These marble particles can still be used to make a solid object. Marble powder is often times added to concrete or synthetic resin to make counters or building stone.

TABLE III. MARBLE POWDER

SR NO	*Properties*	*Result*
1	Fineness module	2.03
2	Bulk density (kg/m^3)	1118
3	Specific gravity	2.8
4	color	white

D. Silica Fume.

Silica Fume also known as micro silica is an amorphous (non-crystalline) polymorph of silicon dioxide, silica. It is an ultrafine powder collected as a by-product of the silicon and ferrosilicon alloy production and consists of spherical particles with an average particle diameter

TABLE IV. SILICA FUME

SR. NO.	Properties	Result
1	Specific surface area (cm^2/gm)	17.2*10^3
2	Bulk density (kg/m^3)	355
3	Specific gravity	2.15
4	color	Light gray

E. Casting Details

The size of standard cubical moulds for the casting of a specimen is 150mm x 150mm x 150mm were casted according to the mix proportion.

F. Curing

concrete cubes were cured under water which is free from chlorides and sulphates and are placed for curing and tested after required curing.

G. Testing details

Concrete specimens were tested using compression testing machine (CTM) of capacity 200 tones and with a constant rate of load is 14 N/min for all specimens and were tested at different curing ages for 7days, 14days and 28 days

III. EXPERIMENTAL TEST RESULT & DISCUSSION

A. Workbility

Slump values of a concrete sample have been tested for a different sample of mix with different percentages of marble powder and silica fume as replacement of cement . The result showed that the workability of a concrete mix was decreases with increase in the marble powder dust content..

B. Strength

Compression strength

The compression test is carried out on a specimen cubical in shape. For compressive strength, cubes of size 150mm x 150mm x 150mm were casted.

1. Conventional mix

Cubes for compressive strength are tested at 7 day, 14days, and 28 days using compression testing machine.

TABLE V. NORMAL CONCRETE TEST RESULT

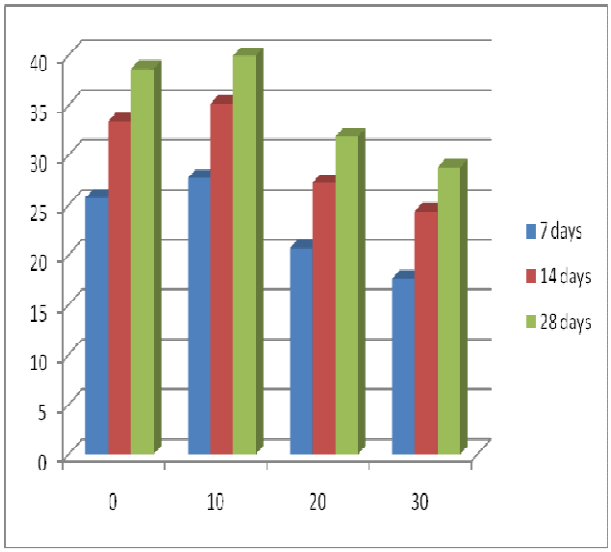
MIX ID	Avg. compressive strength		
	7days	*14days*	*28days*
CM	25.73	33.39	38.67

2. Replacement of cement with marble dust and silica fume

Mixes are made by replacing fine aggregate i.e., with 10%, 20%, 30% marble powder and silica fume. In 10%, 20%, 30% replacement ,the proportion of marble powder and silica fume is 0.8 and 0.2 respectively

TABLE VI. REPLACEMENT RESULTS

SR. NO.	Avg. compressive strength		
	7days	*14days*	*28days*
CM	25.73	33.39	38.67
10%	27.7	35.15	39.95
20%	20.67	27.22	31.85
30%	17.65	24.38	28.76



Graphical representation of cube strength with % replacement on X-axis and compressive strength in N/mm^2

IV. Conclusion

Due to analysis of the tests results, the following conclusions can be drawn

1. The maximum value for compressive strength was obtained with the use of 10% marble powder and silica fume as a partial replacement and the percentage of the is increasing
2. The compressive strength of concrete is decreased when marble powder and Silica fume content used as a partial replacement with percentage higher than 20%
3. The compressive strength of concrete decreased when marble powder and Silica fume content used as an replaced with percentage 20%, 30%, and is almost comparable at 20 %
4. Using marble powder and silica fume up to 20% as an additive materials enhancement the compressive strength up to 31.85%.
5. Based on the experiment result it showed that replacement of cement and sand by marble powder and silica fume we can replace up to the 20% of cement replacement.

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