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Use of Waste Marble Powder as Partial Replacement in Cement Sand Mix

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***Abstract*— As nowadays, marble is widely used in structures which increase the amount of waste that obtained from it. As marble powder is the waste product, obtained during the process of sawing and shaping of marble by marble rock, which contains heavy metals which make the water unfit for use. Marble powder creates environmental problems but due to a presence of high oxide calcium content, which is cementing property, marble can be used as in the partial replacement of cement in cement sand mix. In this study, we collect the waste marble powder from the industry and investigate its effects on the cement sand mix in different proportion and also compare the compressive, split tensile and flexure strength of cement sand mix. We also compare its workability and durability. The main objective of this study is to develop useful concrete mixes using waste marble powder as partial replacement of cement and sand.**

Keywords: Waste marble powder, concrete, compressive strength, flexure strength, split-tensile strength, workability, durability.

I. INTRODUCTION

Marble is obtained from the transformation of pure limestone. The purity of marble depends upon the colour of the marble. Since the ancient times, marble is widely used in monuments and historical buildings for decorative purpose. The various types of constituents present in marble, some of which varies from origin to origin. There are some chemical as well as mineral impurities which are associated with marble like quartz, muscovite, SiO2, limonite, Fe2O3. But some impurities like magnesia, phosphate, leads, zinc, alkalis and sulfides affect the properties of cement. In general, the large amount of marble powder dust is obtained during the cutting and forging process. In India, tons of waste has been produced from the industries. But there are some impurities present in the waste that cannot be easily disposed off. Such type of impurities mixed with soil and water. When they mix with soil, it reduces the porosity and permeability of the soil and also reduces the fertility of a soil. Also, if it mixes with water it pollute the water and make the water unfit for use. So it is necessary to use the waste in functional manner. Usually, this type of waste can be utilized by using it as a raw material or as a constituent in a material because they had a different chemicals present in it that causes a harmful effect on the environment.

Nowadays, concrete has a great advancement in concrete technology in which it can reduce the consumption of natural resources as well as the energy sources and that can further reduce the impact of pollutants on the surroundings. Due to hike in price, waste should be used in the constituents to decrease the cost and make the project cost effective.

In this experimental study, we had an experimental effect of marble dust powder on the concrete mix by partially replacing cement and sand with the marble powder dust. In this project, we check the effect on mechanical and physical properties of a concrete mix if varying marble powder dust is partially replaced in the concrete mix.

1.1 Research Significance

In this experimental study, fine marble powder dust was collected from the nearby source for the investigation. Different concrete mixtures were prepared by using different percentages of marble powder like 0%, 10%, 10% and 20% as a partial replacement of cement and sand mix. The mechanical and physical properties were checked on the 7 & 28 days.

II. EXPERIMENTAL METHODOLOGY & INVESTIGATION

2.1 Concrete Mix Constituents

2.1.1 Cement

The cement use for the experimental studies was 43 grade OPC conforming to the specifications of Indian Standard Code IS: 8112-1989 shows in table 1. It was fresh and without any lumps.

2.1.2 Aggregate

Normal river sand which is locally available in the market and confirming to Zone II as per IS 383 1970 as shown in table 2 and specific gravity of fine sand is 2.614 and coarse aggregates were used in this experiment whose fineness modulus is 2.65. Coarse aggregate used as 20 mm downsize. The lumps of clay and other foreign materials were separated out carefully. Sand was washed and dried before testing. The coarse aggregates were washed to remove dirt, dust and then dried to surface dry conditions.

TABLE I
CHARACTERISTICS PROPERTIES OF CEMENT

Characteristics	***Specified value as per IS:8112-1989***	***Experimental value***
Consistency of cement (%)	---	31.5
Specific gravity	3.15	3.01
Initial setting time (minutes)	>30	40
Final setting time (minutes)	<600	380
Compressive strength (N/mm^2) (i) 3 days (ii) 7 days (iii)28days	 >23 >33 >43	 25.10 36 48.10
Soundness (mm)	10	1.05
Fineness of Cement (gm)	10	1.5

TABLE II
PHYSICAL PROPERTIES OF FINE AND COARSE AGGREGATES

Sr.No	***Physical Properties***	***Fine Aggregates***	***Coarse Aggregates***
1	Specific Gravity	2.614	2.66
2	Free Moisture Content	2%	-
3	Water Absorption	1.80%	0.13%
4.	Fineness Modulus	2.86	2.65

TABLE III
PHYSICAL PROPERTIES OF MARBLE POWDER

Sr.No	***Physical Properties***	***Values***
1	Specific Gravity	2.210
2	Dry Moisture Content	1.58%
3	Bulk Density(kg/m^3)	1118
4.	Fineness Modulus	2.03

2.1.3 Supplementary Cementitious Materials

The marble powder was obtained by crushing marble powder forms in a marble industry. The bulk density was 1118.01 kg/m^3 and fineness modulus is 2.03 and has a specific gravity of 2.21.

2.1.4 Concrete Mixture Proportion

In this experimental study, the mix design is taken as M25. Water binder ratio is taken as 0.43. Different mixes was prepared by using a different percentage of marble powder (0%, 10%, 10% and 20%) namely MX0, MX1, MX2& MX3 as a partial replacement in the cement sand mix, where MX0 is control mix with no marble powder dust, MX1with 10% marble powder as partial replacement of sand, MX2 with 10% marble powder dust as partial replacement of cement and MX3 with 20% marble powder dust as partial replacement of cement and sand together.

Fig. I MARBLE POWDER

2.1.5 Casting Detail

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. The size of specimens of 150 mm diameter and 300 mm height of the cylinder size and the size of prism 100 x 100 x 500 mm were also casted according to the mix proportion and also by partial replacing of cement and sand with marble powder in different proportions.

2.1.6 Curing of Specimen

After the hardened of a specimen in about 24 hours then the casted concrete specimens were cured under water which is free from chlorides and sulphates are placed for curing and tested after required curing.

Fig. II CURING OF SPECIMEN

2.1.7 Testing the Specimen 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 and 28 days. Split tensile strength was testing on the 200 tones capacity machine and constant rate of a load is 2.4 N/mm^2/minute. Flexural strength testing was also conducted by using a 100kN capacity electrically operated flexural testing machine at a displacement rate of 0.05 mm/sec. Water absorption test was also conducted.

III. EXPERIMENTAL TEST RESULT & DISCUSSION

3.1 Workability

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

3.2 Strength

3.2.1 Compressive Strength

It can be noted that when cement is partially replaced by the marble powder up to 10% then the compressive strength of the mix increased up to 8.9% and when partially replace it with sand then again compressive strength increased up to 9% but when marble powder dust is partially replaced by cement and sand together by 20%(10%+10%) then its compressive strength decreased up to 11%. Hence result shows that marble powder when mixed with sand and cement together has low compressive strength as compared to the replacement of marble waste in cement and sand individually.

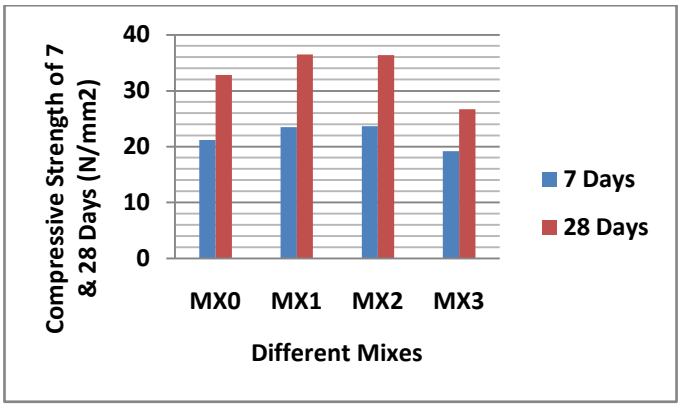

Fig. III GRAPH BETWEEN DIFFERENT MIXES AND COMPRESSIVE STRENGTH OF 7 & 28 DAYS

3.2.2 Split Tensile Strength

It can be noted that the split tensile strength for concrete mix increased with 8.7% when partially replaced by 10% marble powder dust against cement and also increased by 9.3% as in the partial replacement with sand having 10% marble dust powder. But the split tensile strength decreased for the mix which contains 20 % marble powder dust against cement (10%) and sand (10%) by 11%. Hence result shows that marble powder when mixed with sand and cement together has low split strength as compared to the replacement of marble waste in cement and sand individually.

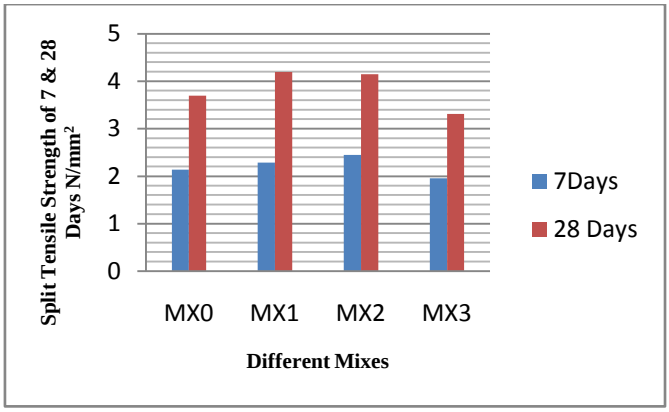

Fig. IV GRAPH BETWEEN DIFFERENT MIXES AND SPLIT TENSILE STRENGTH OF 7 & 28 DAYS

3.2.3 Flexural Strength

It can be observed that the flexure strength for the concrete mix containing 10% of marble powder dust in cement got increased by the value of 9.2% and for 10% replacement with sand the flexure strength also got increased about 9.3% but it decreased when the mix contains 20% marble powder dust against cement (10%) and sand(10%) about 10%. Hence result shows that marble powder when mixed with sand and cement together has low flexural strength as compared to the replacement of marble waste in cement and sand individually.

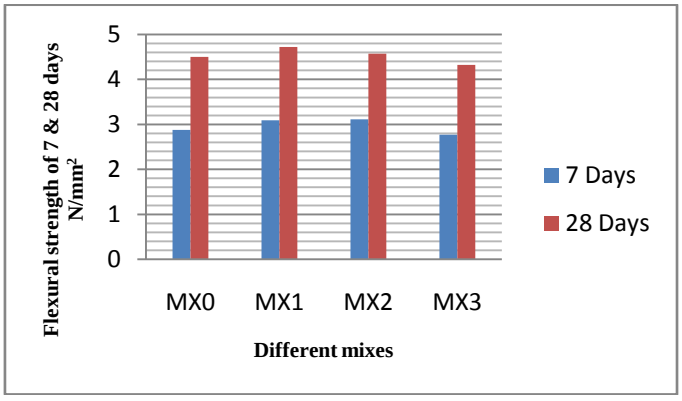

Fig. V GRAPH BETWEEN DIFFERENT MIXES AND FLEXURAL STRENGTH OF 7 & 28 DAYS

3.3 Durability

The result shows that marble powder when partial replaces with sand its durability decrease but when partial replaces with cement and cement sand mixture its durability comparatively increases. It can be noted that in all cases durability is more as compared to the control mix.

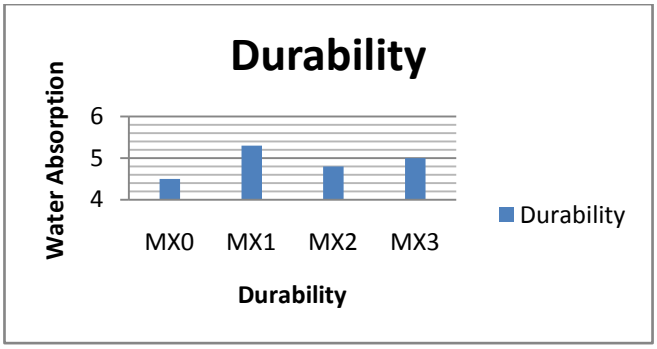

Fig. VI GRAPH BETWEEN DIFFERENT MIXES AND WATER ABSORPTION OF 28 DAYS

IV. CONCLUSION

Experimental investigation showed the following conclusions:

a) When cement is replaced with marble powder up to 10% weight a high strength concrete was achieved.
b) Increasing the amount of marble powder decreases the workability of concrete.
c) Based on the experiment result it showed that replacement of cement and sand by marble powder up to 10% increases the compressive strength but above 10% content of marble powder decreases the compressive strength.
d) Split tensile strength increases with increase in marble powder dust.
e) Compared to the control concrete flexural strength is maximum when replace with fine aggregate up to 10%.
f) Durability increases with increase in marble content but in small amount.

REFERENCES

(1) Er: Raj.p.singh kushwah, Prof (Dr.) Ishwar Chand Sharma, Prof (Dr.) PBL Chaurasia(2015) *Utilization of "Marble Slurry" In Cement Concrete Replacing Fine Aggregate.*American Journal of Engineering Research (AJER) e-ISSN : 2320-0847 p-ISSN : 2320-0936Volume-04, Issue-1, pp-55-58
(2) Bahar Demirel, *The Effect of the using Waste Marble Dust as Fine Sand on the Mechanical Properties of the Concrete* ISSN 1992 - 1950 ©2010, International Journal of the Physical Sciences Vol. 5(9), pp. 1372-1380, 18 August, 2010.
(3) Baboo Rai, Khan Naushad H , Abhishek Kr, Tabin Rushad S, Duggal S.K, *The effect of using marble powder and granules as constituents of fines in mortar or concrete* INTERNATIONAL JOURNAL OF CIVIL AND STRUCTURAL ENGINEERING Volume 1, No 4, 2011
(4) Hassan A. Mohamadien, *The effect of marble powder and silica fume as a partial replacement for cement on mortar* INTERNATIONAL JOURNAL OF CIVIL AND STRUCTURAL ENGINEERING, Volume 3, No 2, 2012.
(5) Noha M. Soliman, *Effect of using Marble Powder in Concrete Mixes on the Behavior and Strength of R.C. Slabs,* International Journal of Current Engineering and Technology ISSN 2277 - 4106 Vol.3, No.5 (December 2013)
(6) V. M. Sounthararajan and A. Sivakumar, *Effect of The Lime Content in Marble Powder for Producing High Strength Concrete***.** ARPN Journal of Engineering and Applied Sciences, VOL. 8, NO. 4, APRIL 2013 ISSN 1819-6608.
(7) Animesh Mishra, Abhishek Pandey, Prateek Maheshwari, Abhishek Chouhan, S. Suresh*, Shaktinath Das, *Green Cement For Sustainable Concrete Using Marble Dust*, Department of Chemical Engineering, Maulana Azad National Institute of Technology, (MANIT) Bhopal, Madhya Pradesh India, Research CODEN(USA): IJCRGG ISSN : 0974-4290 Vol.5, No.2, pp616-622, April-June2013.
(8) Prof. Veena G. Pathan, Prof. Md. Gulfam Pathan**,** *Feasibility and need of use of waste marble powder in concrete production* IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
(9) IS:8112-1989, Indian standard of ordinary Portland cement,43 grade-specification(second revision)
(10) IS: 383- 1970, Indian standard of specification for coarse and fine aggregates from natural sources for concrete(second revision)