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EFFECT ON PARTIAL REPLACEMENT OF FINE AGGREGATE AND CEMENT BY WASTE MARBLE POWDER/ GRANULES

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ABSTRACT

Due to the increase in demand of marble in structures, their adverse affect to the environment have also increased. From the research on Marble powder, it was found that it can be used as a filler in concrete and helps to reduce the total void content in concrete. This study shows the experimental investigations on the replacement of cement sand and both partially with the waste marble powder/waste marble granules. The study shows that the partial replacement of cement and sand by waste marble powder, the compressive strength get increased up to a certain percentage but get decreased with the combined replacement of combination of cement and sand.

KEYWORDS: Compressive Strength, Fine Aggregate, OPC 43 Grade, Waste Marble Powder, WMP

INTRODUCTION

With the increase in population and advancement of construction technology, the use of concrete has increased manifold in the recent years. This may lead to the depletion of natural resources. Presently on an average about 45-50 metric tons of marble is cut in a day in medium scale unit, which leads to huge quantity of marble dust. The disposal of marble dust is a serious threat to environment, so there is a strong need to utilize this solid waste as an alternative material to lessen the burden of this pollutant on environment. The present study was therefore planned to explore the possibility of usage of waste marble powder (WMP) as partial replacement of sand and cement for production of concrete. Marble as a building material especially in palaces and monuments has been in use for ages. However the use is limited as stone bricks in wall or arches or as lining slabs in walls, roofs or floors, leaving its waste at great quarry or at the sizing industry which is generally unattended for use in the building industry itself as filler or plasticizer in mortar or concrete. This huge unattended mass of marble waste consisting of very fine particles is today one of the environmental problems around the world. Marble blocks are cut into smaller blocks in order to give them the desired smooth shape. During the cutting process about 25% of the original marble mass is lost in the form of dust. One of the logical means for reduction of the waste marble masses calls for utilizing them in building industry itself. Some attempts have been made to find and assess the possibilities of using waste marble powder in mortar sand concrete. For this, strength and workability were compared with control samples of conventional cement sand mortar/concrete. The, utilization of the marble dust in various industrial sectors especially the construction, agriculture, glass and paper industries would help to protect the environment. Many studies have been reported in literature on the performance of the concrete containing waste marble dust or waste marble aggregate. Valeria et al [1] (2005) in their study observed that marble powder had very high Blaine fineness value

of about 1.5m2/g, with 90% of particles passing through 50μm-sieves and 50% through 7μm. The researcher also noticed that the marble powder had a high specific surface area, implying that its addition as mineral in mortars and concretes, especially in self-compacting concrete should impart more cohesiveness.. Hanifi Binici et al [2] (2007) stated that marble dust concrete has higher compressive strength than that of the corresponding limestone dust concrete having equal w/c and mix proportion. The results indicated that the Marble dust concrete would probably have lower water permeability than the lime stone concrete. As non pozzolanic fines it is at present the limestone and dolomite ones which are most frequently used to increase the content of fine particles in self-compacting concretes. Compared to normal plain concrete of the same w/c ratio and the same cement, the concrete having high limes tone filler content of suitable particle sized is tribution generally improves the strength characteristics. Kursat & Ragip [3] (2009) found some relationship between properties of fresh and hardened self-compacting concrete (SCC). They also described a method of preliminary mix design for SCC based on monogram. Bahar Demirel [4] et al (2010) took total of four series of concrete specimens including the control specimen, prepared in order to examine the effect of substituting marble dust (0, 25, 50 and 100% by weight) for the fine material (passing through 0.25 mm sieve) on the mechanical properties of the series. In the present study, experimental test on the concrete with different percent of waste marble powder in concrete has been investigated for the Compressive strength.

ADVANTAGE

- The waste material powder can be used for development of self compacting concrete.
- Due to high fineness marble dust, it is very effective in assuring good cohesiveness of concrete
- It will help in improving the environmental problems due to indiscriminate disposal of huge waste generated from marble industries.

LIMITATIONS

Only up to a certain percentage, the sand and cement can be replaced by the waste marble but after that limit the strength get decreased.

METHODOLOGY

To investigate the effect of waste marble on concrete, four different mix proportion specimens were casted and tested at the ages of 7 days and 28 days. After the evaluation of their strength the results were compared to control mix concrete.

MIX PROPORTION

Table 1

Sr. No	Cement	Sand	Marble Powder	Mix Designation
1	100%	100%	0%	MX0(control)
2	100%	90%	10%	MX1(sand)
3	90%	100%	10%	MX2(cement)
4	90%	90%	20%	MX3(sand and cement)

A design mix m-25 grade with w/c ratio 0.43 was adopted to prepare test samples. The mix design was done in accordance with IS: 10262:1982. It was ensured that Coarse and Fine aggregate chosen satisfy the specification

requirements of IS: 383:1970. The compressive strength of Concrete was tested by procedure specified in IS: 516-1959.

RESULTS AND DISCUSSIONS

The following results were obtained at 7 days and 28 days of testing for compressive strength for concrete mixes with varied proportions of marble dust particles.

Compressive Strength for 7 Days

Table 2

Mix Designation	Percentage of Marble	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
MX0	0	20.46 21.37 21.79	21.20
MX1	10	22.67 23.59 24.22	23.49
MX2	10	23.13 23.99 24.46	23.66
MX3	20	18.69 19.36 19.55	19.21

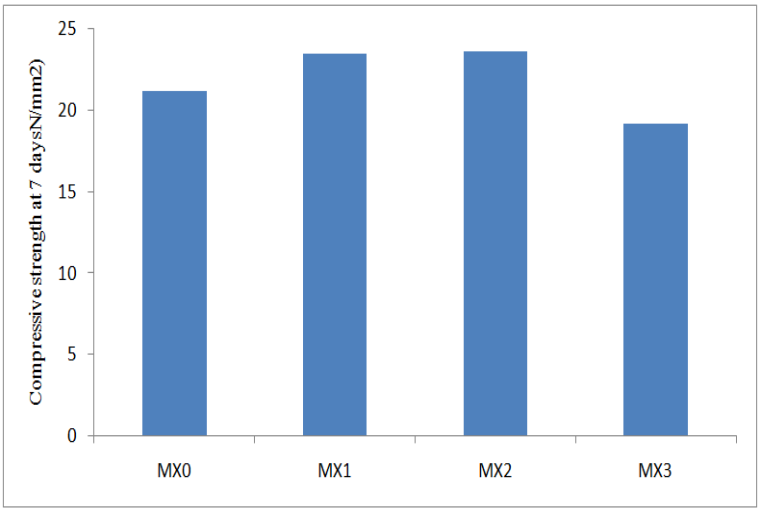

Figure 1

Compressive Strength for 28 Days

Table 3

Mix Designation	Percentage of Marble	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
MX0(control)	0	32.25 32.92 33.35	32.84
MX1(sand)	10	35.57 36.68 37.36	36.53
MX2(cement)	10	35.32	36.42

		36.212 37.75	
MX3(sand and cement)	20	29.36 29.54 30.23	29.71

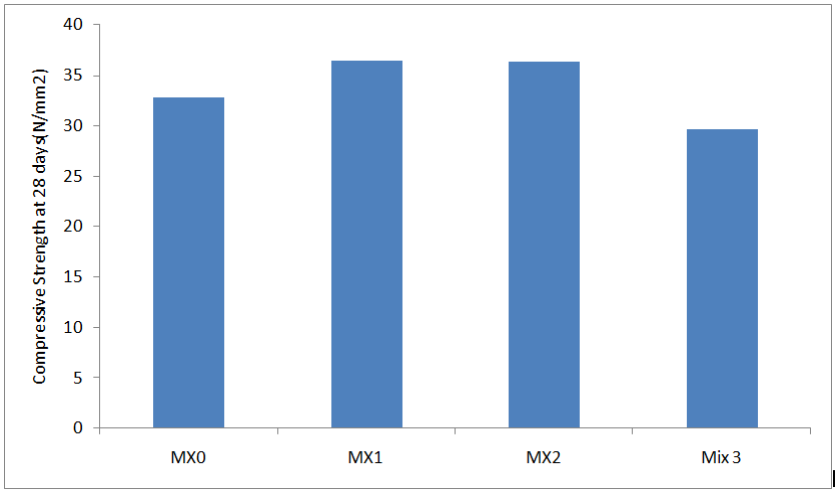

Figure 2

The experimental investigations show that by the partial replacement of sand the compressive strength increases by 11 % and when the cement is partially replaced by 10 % the compressive strength increases by 11% but when sand and cement was replaced by 20% of waste marble powder/granules, the compressive strength decreases by 10%.

CONCLUSIONS

The present investigation was undertaken to study the effect of WMP on strength characteristic of concrete. To achieve the objectives of the present study, the fine aggregates and cement was replaced by WMG/WMP in different percentages i.e. 0%, 10% against sand, 10% against cement and 20% against sand and cement respectively. The compressive strength was determined for the mixes at the curing age of 7 days and 28 days. The results obtained for the above mixes were compared to investigate the effects of partial replacement of sand and cement by WMP/WMG on the above strength parameters of concrete. The result obtained in the present study indicates that practically it is feasible to replace the fine aggregate and cement by waste marble powder for improving the strength characteristics of concrete but the strength get decreased when replace the fine aggregate and cement combined by waste marble powder by 20%, thus the combination of cement and sand cannot be replaced simultaneously. The optimum dosage of replacement by WMP is found to be 10% against sand as this mix gave maximum Compressive Strength at 28 days.

REFERENCES

1. Valeria Corinaldesi, Giacomo Moriconi, and Tarun R. Naik, (2005), “Characterstics of marble powder for its use in mortar and concrete”, NMET/ACI International symposium on sustainable development of cement and concrete, October 57,Toronto, Canada.
2. Hanifi Binici, Hasan Kaplan and Salih Yilmaz, (2007), “Influence of marble and limestone dusts as additives on some mechanical properties of concrete”, Scientific Research and Essay, 2(9), pp 372379.

3. Kursat Esat Alyamac, and Ragip Ince, (2009), “A preliminary concrete mix design for SCC with marble powders”, Construction and Building Materials, Vol. 23, pp 12011210.
4. Bahar Demirel, (2010), “The effect of the using waste marble dust as fine sand on the mechanical properties of the concrete”, International Journal of the Physical Sciences, 5(9), pp 13721380.
5. IS: 3831970, Specification for Coarse and Fine Aggregate from Natural Sources for Concrete—Bureau of Indian Standards, New Delhi.
6. IS: 102621982, Recommended Guidelines for Concrete Mix Design—Bureau of Indian Standards, New Delhi.
7. IS: 516:1959, Methods of Tests for Strength of Concrete—Bureau of Indian Standards, New Delhi.