Use of Waste Marble Slurry in Cement Concrete as Relacement of Cement

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***Abstract*—This Research paper is a live study on the above mentioned title "Concrete using Waste marble slurry" This paper consist the introduction of waste marble powder with its uses and properties. Various test results on waste marble powder concrete also described. It also consist the concrete mix design of M25 grade. The future recommendations are also discussed in addition.**

Keywords—Concrete Mix Design(CMD), Compression Testing Machine(CTM)

I. INTRODUCTION

As we know the term 'concrete" is a mixture of cement + sand + coarse aggregate with water. Concrete is a widely used in buildings as main constructional material. It is most important substance of a structure. In this project we replace cement by waste marble slurry because cement is costlier than waste marble slurry and some properties of cement are find in waste marble slurry. Marble powder is generated from sawing & polishing of marble blocks. Marble powder contains heavy metals which affect the human health environment. So to reduce thereharmful effects we use it as a replacement material in cement concrete. In the marble industry marble waste is generated in huge amount so disposal of this have great threat in front of industry. The Marble waste has cementing properties, so by using it we can replace cement and sand which will reduce the environmental & health effects as well as cost also.

II. OBJECTIVE

Marble powder contains heavy metals which affect the human health environment. The disposal of this waste is also a major problem faced in India and abroad also. So to prevent these harmful alarms the waste marble dust is used as a replaced material in cement concrete. The landfill which is used for disposal of waste marble dust is also minimized by this replacement.

Many engineers and senior faculties have also researched before us. In same manner we also research and studied about the waste marble. We collect waste marble and used it in concrete at various percentages and check the strength of concrete using various tests on concrete after 3, 7, 14& 28 days of curing. The research consists the effects and benefits of waste marble dust used as a replaced material. To perform the laboratory test in better way is the main object of this study.

III. MATERIALS AND METHODS

A. Materials

- Cement: Ordinary Portland cement was used because it is easily available in market. The cement was used in measuring whole tests. The Specific gravity of cement was 3.13 and the fineness of cement was 4%.
- Coarse Aggregate: The Coarse aggregate was used as natural coarse aggregate. The specific gravity of the coarse aggregate was 2.58. The Fineness modulus was 7.76
- Fine Aggregate: Natural river sand was used as fine aggregate. The Specific gravity of Fine aggregate was 3.42.
- Marble Powder: The waste marble powder was used in this study as replacement by cement.

B. Methods

- Fineness Modulus: This test was done with the help of various sieves. The aggregate was properly sieved by this test. The relative percentage of aggregate was determined by this test so we can say it like grain size distribution also. This test was done by sieve analysis in laboratory using Sieve shaker. The nominal size of the aggregate was determined by Fineness modulus test.
- Specific gravity: The specific gravity of an aggregate is a measure of quality of material. According to IS Code 2386(Part III)-1963 the strength is lower with lower specific gravity value .This test was done by using wire basket and Pycnometer.
- Slump Test: The Unsupported fresh concrete, flows to the sides and a sinking in height takes place. This vertical settlement is known as slump. Slump test is carried out by using marble powder with Concrete mix Design CMD method and the slump was measured by using temping rod and Steel rule.
- Compaction Factor Test: Workability gives an idea of the capability of being worked, i.e. idea to control the quantity of water in cements concrete mix to get uniform strength. Compaction test was done by using Compaction factor test apparatus.
- Compressive strength Test: This test was performed in Compression Testing Machine (CTM). The cylindrical cubes of size 150 mm dia and 300 mm height were used. The load is applied in Kilo Newton's (KN) and then calculate the split tensile strength according to IS code IS 516:1959.

- Split Tensile strength Test: This test was performed in Universal Testing Machine (UTM). The tensile strength of concrete is one of the basic and important properties. Splitting tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete.

S.No.	Sieve Size	Mass retained	Cumulative mass retained	Percentage cumulative mass retained (C)
1	80 mm	0	0	0
2	40 mm	0	0	0
3	20 mm	0.424	0.424	8.48
4	12.5 mm	2.404	2.828	56.56
5	10 mm	0.446	3.274	65.48
6	4.75 mm	1.304	4.578	91.56
7	2.36 mm	0	4.578	91.56
8	1.18 mm	0	4.578	91.56
9	600 micron	0	4.578	91.56
10	300 micron	0	4.578	91.56
11	150 micron	0	4.578	91.56
12	PAN	0.420	4.998	96.558
				$\sum C$ = 776.43
Fineness Modulus ($\sum C/100$)				7.76

IV. RESULTS AND DISCUSSION

A. Fineness Modulus Test : The test was conducted as per describe as per procedure. The test was then further spread and determine results 7.76 as Fineness Modulus. The test results were accurate as normal aggregate.

TABLE: 1 FINENESS MODULUS OF COARSE AGGREGATE

B. *Specific gravity Test :* The Specific Gravity test was conducted as per IS: 2386 (Part III) – 1963. The Specific gravity of coarse aggregate was determined as 2.74. The Specific gravity of fine aggregate was 2.68.

C. *Slump Test:* The Slump test was also conducted in laboratory according to IS: 1199 – 1959. The Test results are shown below from where we observed that workability decreases as percentage of waste marble increases.

D. *Compaction Factor Test:* This Test was performed as per IS: 1199 – 1959. The Test results were 0.93. It is observed that the workability of concrete increases with using Waste Marble Slurry.

E. Compressive strength Test: This Test was performed as per IS: *516* – 1959. The Test results were very positive and in increasing order. The strength was increased as compare to normal concrete cubes. This test was performed in Compression Testing Machine (CTM).

F.Split Tensile strength Test: This Test was performed as per IS: *5816* – 1999. The split tensile strength was also increased as compare tonormal cylindrical concrete cubes. This test wasperformed in Compression Testing Machine (CTM).

TABLE: 2 FINENESS MODULUS OF COARSE AGGREGATE

S.No.	Sieve Size	Mass retained	Percentage mass retained	Percentage cumulative mass retained (C)
1	4.75 mm	190	1.583	1.583
2	2.36 mm	150	1.25	2.83
3	1.18 mm	432	3.6	6.43
4	600 micron	4600	38.33	44.76
5	300 micron	5400	45	89.76
6	150 micron	940	7.83	97.59
7	PAN	288	2.4	99.99
				$\sum C$ = 342.94
Fineness Modulus ($\sum C/100$)				3.42

TABLE:3WATER ABSORPTION OF COARSE AGGREGATE

Weight of sample in air (W_1)	1.030 Kg
Weight of sample after 24 hrs. dry in oven (W_2)	1.022Kg
Water absorption $[(W_1-W_2) / W_1\} X 100]$	1.11%

TABLE : 4SLUMP VALUE

% of cement replacement with marble powder	Slump Value in mm
0%	47 mm
4%	45 mm
8%	45 mm
12%	44 mm

TABLE : 5COMPRESSICE STRENGTH OF CONCRETE

% of marble powder	Compressive strength N/mm^2		
	7 Days	14 Days	28 Days
MP 0%	21.33	32.44	34.22
MP 4%	22.66	34.66	35.11
MP 8%	24	36.44	36.88
MP 12%	25.77	37.77	37.98

TABLE : 6 COMPACTION FACTOR TEST

Water cement Ratio	0.45
Initial Weight of empty Cylinder (W_1)	11.400 Kg
Mass of Partially compacted concrete with cylinder (W_2)	22.000 Kg
Mass of fully compacted concrete with cylinder (W_3)	22.700 Kg
Compaction Factor $[(W_2-W_1)/(W_3-W_1)]$	0.93

IV. CONCLUSIONS

It has been observed that the waste marble dust can be used as a replacement of cement in concrete mortar up to 12%. The increment in compressive strength of concrete was observed upto 10.98% for the optimum composition of waste marble dust in concrete. Economic analysis reveals that for each 1m^3 of concrete roughly 371 kg of cement can be saved. Alternatively it translates in savings amounting up to 2100 Rs per cubic meter of concrete. The most important but indirect benefit of this study states that a otherwise waste material substance can be used in construction practices hence avoiding hazardous effects of waste marble dust in the environment.

As per past studies and researches it is so necessary to use the waste marble powder for the construction work. Necessary infrastructure should also be available for testing the quality of waste marble concrete. Project developers need to be educated on on-site waste management plans. Concerned authorities need to plan an awareness campaign, using the electronic and online media to promote the virtues of Waste marble powder.

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REFERENCES

[1] R.Kumar, S.Kishor Kumar, "Partial replacement of cement with marble dust powder"(IJERA)) – Volume 5 issue 8, (part-4) August 2015, pp 106-114.

[2] B.Demiral, "The effect of the using waste marble dust as fine sand on the mechanical properties of the concrete" (IJOPS) Vol. 5(9), pp 1372-1380, August 2010.

[3] P.J.Chavhan, S.D.Bhole, "To study the behavior of marble powder as supplementary cementations material in concrete (IJERA) volume 4, issue(version 1),April 2014, pp 377-381.

[4] V.M.Sounthararanjan, A.Sive Kuma, "Effect of the lime content in marble powder for producing high strength concret" (ARPNJEAS) Volume 8, no. 4, April 2013.