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Partial Replacement of Cement with Marble Dust Powder in Cement Concrete

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Abstract : In this study, the investigation of performance on the strength parameter of concrete mix by partial replacing the cement with marble powder is done. Since marble powder employed in the various type of construction work, therefore depending upon its properties, the marble powder is taken as partial replacement of cement as a material test were performed to examine the strength and durability performance of concrete mix with marble powder with different proportion varrying from 5% to 25% the test results shows that the strength parameter of concrete mix is improved. Marble dust replaced at the concrete with 5%, 10%, 15%, 20% & 25% of cement and then compared with Conventional concrete. Then analyze the variation between values of results with conventional concrete.
Keywords: Marble powder, Partial Replacement, compressive strength, concrete material.

I. INTRODUCTION

Now a day's marble powder is the source that causes of environmental troubles in the world. Therefore, maximum utilization of marble waste in various inpowderrial sectors, especially the construction, agriculture, glass and paper inpowderries would help to protect the environment. Concrete generally used in construction projects in the civil construction work because of its large structural strength and constancy. Concrete mixture contains of cement, aggregates and water. Aggregate can not only manage the potency of concrete but also influence the strength and performance of concrete. The development of concrete can decrease the utilization of environment resources and energy basis which sequentially further decrease the load of pollutants on the atmosphere. One of the reasonable means for decrease of the waste marble masses is by employing them in construction. Waste powder of Marble can be used to enhance the mechanical and physical functions of the conventional concrete. The chance of utilizing waste powder of marble as cementitious material in the preparation of concrete will also induce a relief on waste disposal issues. Currently the requirement for cement is quite high in developing countries because of rapid infrastructural enlargement which consequences in supply shortage and augment in the rate of material.

Before this study, different investigations are found the solutions on concrete composite materials. Natural resources are decreasing from the earth and increasing wastes from inpowderries generated simultaneously. The eco friendly and consistent enhancement for construction includes the utilization of non conventional and unusual waste materials, and use of waste material for reducing emissions in environments and decreasing the utilization of environmental resources. Sand is ordinary form of fine aggregate used in concrete production. In this experiment, and mixed with Marble powder is employed as fractional replacement with Cement. Marble powder is the waste which is generated from Marble finishing Inpowderries in construction which has similar physical and chemical actions of sand and utilized as replaced with cement.

II. MATERIALS AND METHODS

A. Materials

The materials used in the projects for making concrete mixture are cement, Fine aggregate, coarse aggregate, Marble powder, are detailed describe below:

1) Testing of Cement: Cement is by far the primary element of concrete, in that it presents the binding material for the discrete elements. Cement naturally generating from raw supplies and sometimes blended or interground with in powderrial wastes. The cement used in this experiment was Pozzolana Portland cement (PPC).

Table 1: Test of Cement

Tests Performed	Test process	Results
Consistency	Vicat Apparatus (IS: 4031 Part - 4)	32%
Initial setting time (min)	Vicat Apparatus (IS: 4031 Part -5)	110 min

Final setting time	Vicat Apparatus (IS: 4031 Part -5)	180 min
Specific gravity	Specific. gravity bottle (IS:4031 Part - 4)	3.03
Fineness	Sieve test on sieve no.9 (IS: 4031 Part – 2)	2%
Compressive strength 7days	(IS: 4031 Part-6)	22 N/mm^2

2) Fine Aggregate: The fine aggregate used of a river sand that is, clear from all styles of natural contamination was utilized in this investigational plan. The fine aggregate was moves through 4.75 mm sieve; the sand was most dried and without from any external material and had a specific gravity 2.6. The grading zone of fine aggregate was zone II as per IS specifications. However, it's currently well recognized that physical, chemical and thermal properties of aggregates considerably influence the properties and performance of concrete.

Table 2: Test of Fine aggregates

S. No.	*Test*	Result
1.	*Zone*	II
2.	*Specific gravity*	2.6
3.	*Fineness Modulus*	3.75
4.	*Water Absorption*	0.6%

3) Coarse Aggregate: Coarse aggregate is a substitute of concrete mixture used for building concrete material. They can be within the variety of unequal broken stone or naturally occurring gravel. Materials that are large to be maintained on 4.75mm sieve size are named coarse aggregates. Its highest size shall be up to 20 mm.

Table 3: Test of Coarse aggregates

S. No.	*Test*	Result
1.	*Water absorption*	0.22%
2.	*Specific gravity*	2.94
3.	*Fineness Modulus*	7.17

4) Water: Water is a main element of concrete because it actively contributes within the chemical Process with cement. While it assists to execute the strength of cement mixture, the number and quality of water is important to be appeared into very cautiously. Portable water is regularly measured satisfactory.

5) Marble powder: Waste generated in the stone manufacturing industries during, shaping, cutting and cleaning of marbles stones. Through this process, about 20-25% of the procedure marble is turn into the powder variety. India being the third (about 10%) Prime most exporter of marble in the world, every year million tons of marble waste forms processing plants is released. Because of the accessibility of huge amount of waste formed in the marble plant, this assignment has been intended and preceded.

Table 4: Physical properties of marble dust powder

S. No.	*Properties*	Result
1.	*Specific gravity*	3.03
2.	*Colour*	white
3.	*Form*	Powder
4.	*Odour*	*Odourless*
5.	*Fineness*	3%

6) Concrete mix Design: M 20 design mix of concrete has been used for the present work. The concrete mix proportion was 1:1.925:3.547 and water cement ratio was 0.50.

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III. EXPERIMENTAL PROCEDURE

The estimation of concrete with marble powder and Fine aggregates used as substitute of aggregate materials is completed during concrete specimen testing. Concrete include cement, water, fine aggregate, coarse aggregate. Concrete is replaced with alternative materials by varying percentage of replacement. The waste powder of marble is used as partial replacement for Cement in the range of 5%, 10%, 15%, 20%, and 25% by cement as per its weight and its optimum level is to be found. For analyzing the power of normal and other variation mix totally 54 cubes of size 150x150x150mm were casted for compression strength test. Then 6 beam of size 700x100x100mm is casted for flexural strength testing. Once 24hours completed from casting the concrete specimens are opened and allowed for continuous curing in a tank with portable water. The specimen are taken and tested at required 3rd day, 7th day & 28_{th} day from curing for compression test at 3rd day, 7th day & 28_{th} day and flexural test at 28th day from curing. Then compare the Strengths of M20 design mixes.

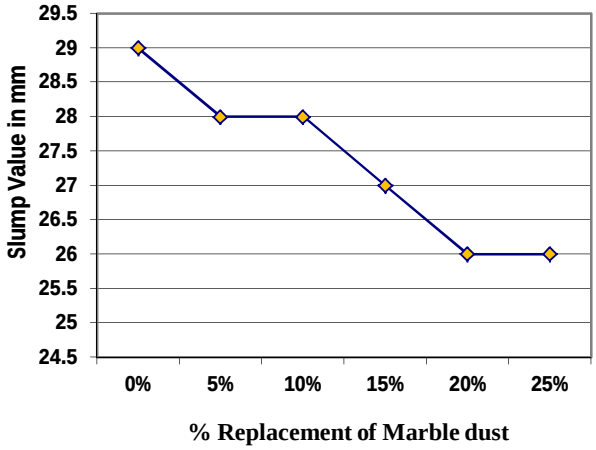
IV. RESULTS AND DISCUSSION

In this study the casted concrete is related to different tests to calculate the strength and other properties of the casted concrete. The main aim of the project is to monitor the developed strength attained by the concrete at various testing days from curing. Generally proper casting and curing of concrete will augment the strength of the concrete. For this project each test is carried out with 3 samples for every mix ratio and tested at required curing time. Then the average values are used for the investigations. The series of testing actions are detailed below:

Slump Cone Test: This experiment is executed to confirm the workability of newly casted concrete. This test independently executed on newly casted concrete and the Cement replacing with marble dust to find the workability. The slump is very valuable in identifying variations in the consistency of a mix of given nominal proportions; it is a measure of consistency of the fresh concrete. This test is conducted immediately after the concrete has been made.

Table 5: Slump value of Concrete Mix

% Replacement	Slump Value
0%	29mm
5%	28mm
10%	28mm
15%	27mm
20%	26mm
25%	26mm



A. *Compressive Strength Test*

Concrete is weak in tension and strong in compression so the concrete should be strong to attain high compression. In this study for each mix 3-samples were tested and the average strength is compared with nominal mix of M20 Mix. Compressive strength test finds out the high amount of compressive load a material can bear below facture limit. The results of compressive strength at the

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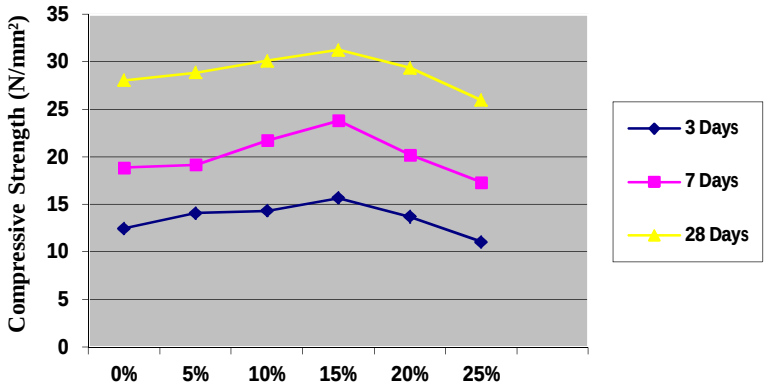
age 3rd day, 7th day & 28_{th} day are shown in table 6.

Table 6: Compressive Strength on Concrete M20 Cubes

Percentage Replacement of Marble powder	Compressive Strength (N/mm²)		
	3 Days	7 Days	28 Days
0%	12.50	18.9	28.10
5%	14.12	19.21	28.90
10%	14.37	21.77	30.15
15%	15.71	23.83	31.27
20%	13.76	20.24	29.38
25%	11.10	17.35	26.00

Graph.1 Compressive Strength of Concrete M20



% Replacement of Marble dust

B. Flexural strength

Flexural strength also called as modulus of rupture. In concrete flexure is the bending moment caused by the applied load, in which a concrete beam has compression at top and tensile stress at the bottom side. Beams on testing will fail in tension due to its property and shear will appear on concrete. In this experimental works totally 6-beams of size 700 x 100 x 100 mm are casted of M20 design mix concrete and other percentage of replacements as for 5%, 10%, 15%, 20% and 25% by weight of Marble powder with cement. Then compare the values of both design mixes. The flexural values of various mixes are displayed in Table.7.

Table.7: Flexural Strength of Concrete at 28 days

Percentage Replacement of Marble powder	Flexural Strength (N/mm²)
	M-20
0%	3.8
5%	3.84
10%	3.87
15%	3.94
20%	3.85
25%	3.6

Graph.4 Flexural Strength at 28 Days

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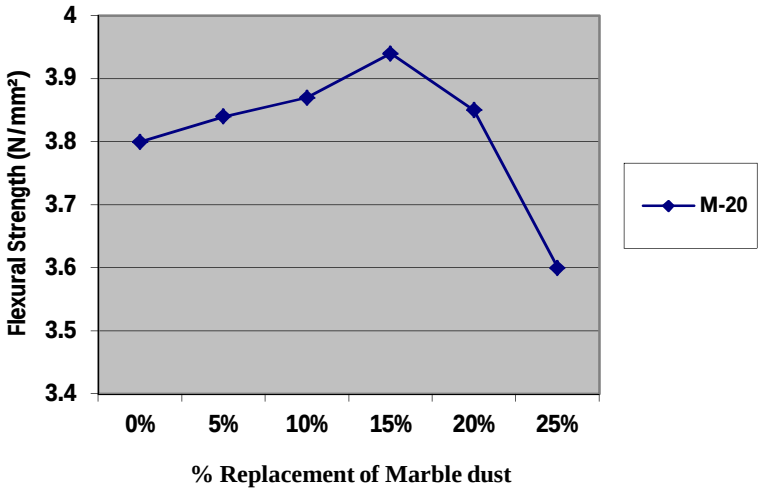

1) *Waste Management:* Marble powder or dust is mixed in the concrete as replacement material of Cement. It is the waste product of marble stone produces from surface finishing or stone in construction buildings or industries. The safe disposal of this waste requires sufficient area which is costly and will cause environmental pollution. The construction industry is the only area where the safe use of Marble powder or dust is possible. When it is introduced in concrete as a replacement material, it reduces the environmental pollution, space problem and also reduces the cost of concrete. Many researchers had already establish, Marble powder or dust achievable use as a replacement material in concrete. In this Experimental study Marble dust is used in concrete in the form of replacement material of Cement. For this study, M20 grade of concrete is prepared and the test are conducted for various substitute of cement using Marble dust as 0%, 5%, 10%, 15%, 20% & 25% in concrete ready with Cement.

V. CONCLUSION

A. A Marble dust is a type of waste mixed as a substitute to cement in concrete.
B. From this investigation, the Marble dust particles are waste of low cost material which would help to resolve solid waste disposal problem and protect environment from pollution.
C. Cost of Concrete production reduces when Marble dust is used as a bonding material with cement in concrete.
D. Marble dust behaves similar to cement as it contains Silica (SiO2) similar to cement.
E. Addition of Marble dust increases the density of concrete thereby increasing the Self-weight.
F. The Compressive Strength of Concrete material with fractional substitution of cement with Marble dust up to 15% can be comparable with conventional Concrete.

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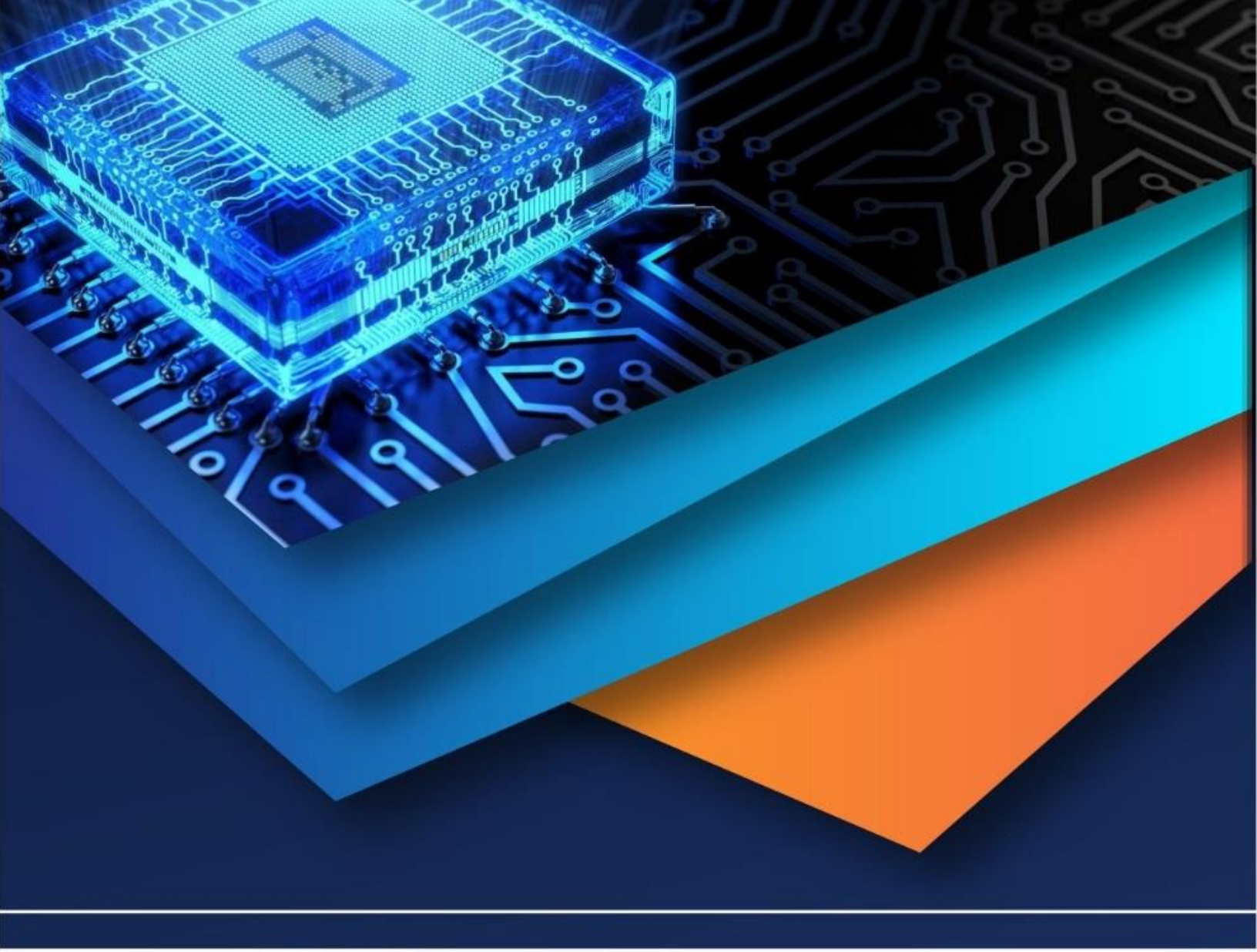

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