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"Experimental Investigation in Concrete by Partial Replacement of Sand with Marble Dust"

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Abstract - *Concrete is the most extensively used and adaptable building material which is generally used to resist compressive forces. Since the use of Sand and production of Sand creates much more environmental issues and is costlier also. The Sand is produced in a natural way. Mining of sand in Narmada River due to natural calamities there is a danger. In the coming time so we have to be ready to deal with this problem. So we are looking from marble dust. Marble Dust is a developing composite material that will allow the concrete industry to optimize materiel use, generate economic benefits and build structures that will be strong, durable and sensitive to the environment. . The marble dust was replaced with Sand at 0%, 5%, 10%, 15% and 20% by weight of sand in M20(1:1.5:3) grade concrete. Concrete mixes were experimentally tested and compared in terms of compressive strength of the conventional cement concrete at 7 days and 28 days for 150mmX150mmX150mm Sized cubes.*

Key Words: Cement, Concrete, Marble Dust, Partial Replacement, Durability, Compressive Strength, Flexural Strength, Split Tensile Strength.

1. INTRODUCTION

The use of marble dust or waste has been used since ancient times as a Building Material. The industries dispose of marble powder material, material of marble powder consisting of very fine powder. Which is the cause of environmental problems in around the world? Marble big blocks are cut into smaller blocks in order to give them the desired smooth shape. During the cutting process about 25% the original marble mass is lost in the form of dust. Now a day's marble waste is one of the causes of environmental problems around the world. Therefore, maximum utilization of marble waste in various industrial sectors, especially the construction, agriculture, glass and paper industries would help to protect the environment. Concrete is the most widely used construction material in the civil construction work because of its high structural strength and stability. Concrete is a heterogeneous mix of cement, coarse aggregate, fine aggregate (Sand) and water. Aggregate can not only limit the strength of concrete but also affect the durability and performance of concrete. Waste Marble powder can be used to improve the mechanical and physical properties of the conventional concrete. The possibility of utilizing waste marble powder as Cementations material in the production of concrete will also induce a relief on waste disposal issues. Now a days the demand for Sand is quite high in developing countries owing to rapid infrastructural growth which results in supply scarcity and increase in the cost of material. If the waste material is used in the production of the concrete the construction cost decreases.

2. LITERATURE REVIEW

Deepanshu Patel {1}:

Investigation was done that there are several wastes being released from the industries which leads to many environmental and health problems and so it becomes necessary to find an appropriate solution to the emission of these wastes. Marble dust powder is an inert material procured as an industrial by product during grinding, sawing, and polishing of marble dust is a cause to various environmental problems. These wastes can be used as the constituents of concrete by partially replacing the cement which makes it economical and also conserves our natural resources. This research objective mainly is to examine whether there is any possibility of used marble powder in concrete production. This study of various types of concrete mixes of M25 by replacement the cement with marble powder in various proportions (0%, 5%, 10% and 15%) by weight to determine the optimum percentage of replacement.

The testing for Compressive strength of these Concrete mixes is done at 7 and 28 days and the results are then compared with the Control Concrete. The results fined after the study shows that marble powder can be used as a replacement for cement. It is the concluded that the best proportion of marble dust powder is 10% with 28 days of curing for compressive strength test. Does not are affect the setting time of concrete after use of marble dust in concrete.

Abdullah Anwar et al. {2}:

Production of residues from industries and construction sectors has increased during last few years. Much of this wasteland has been land filled, without seeing it's possible for reuse or recycling.. The replacement of cement with Marble Dust Powder (MDP) produces a substantial modification in compressive strength, making them suitable for the fabrication of concrete. In this research study the (OPC) cement has been replaced by and MDP accordingly in the reach of 0%, 5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50% by weight of M-20 grade concrete. Concrete mix

was tested and compared to the compressive strength of the conventional concrete at 28 days. The aim of this research study is to study the behavior of concrete durability in comparison by partial replacement of cement with both MDP. The main purpose of this study is to finding and comparing out the characteristic of compressive strength of M20 grade ceramic waste powder concrete and marble dust powder concrete at the water - cement ratio of 0.50 for better fruitful replacement. Based on experimental investigations concerning the compressive strength of concrete, the following observations are drawn:

As compare to conventional concrete mix, on addition of marble dust powder than its characteristic compressive strength is decreased. So the marble dust powder has been replaced by up to 20% by weight of cement without affecting the characteristic strength of M20 grade concrete. On further replaced by cement with marble dust powder decreases the compressive strength.

3. FORMULATION OF RESEARCH

Stage 1: In this stage of work Sand is partially replaced by Marble Dust is partially replaced Marble Dust in different percentages as shown in the table below. 5 batches are prepared in different proportions including conventional concrete mix (Cement as binder, Sand as fine aggregates & Natural Coarse Aggregates). Cubes and Cylinders are casted for determining Compressive Strength, Split Tensile strengths & Bond Stress respectively at 7 & 28 days.

Table – 1 Formulation of work (Stage-1)

Batch Mix.	Cement (%)	Marble Dust (%)	Sand (%)	Aggregate (%)
1	100	0	100	100
2	100	5	95	100
3	100	10	90	100
4	100	15	85	100
5	100	20	80	100

Stage 2: Work density of concrete of all five types of mixes is also calculated & checked whether it is considered as light weight concrete or not. Density of light weight concrete is less than 2200 kg/m3.

4. METHODOLOGY

As Sand is halfway supplanted by Marble Dust, so in first phase of work 5 batches of various proportions of binders are arranged and cubes and cylinder are casted. Results acquired were examined and extent that gave ideal qualities is taken for the following stage.

Testing of materials:- Concrete (M-20)

1. Slump Test for concrete
2. Compressive Strength Test
3. Split Tensile Test
4. Bond Test of Concrete Test Procedure (IS-227-1967)

5. MATERIAL CALCULATIONS

(A) Material for one Concrete cubical mould:-

Total volume of concrete Mould =0.15 x 0.15 x 0.15 = 0.003375 m3

Dry Volume of concrete = 0.003375 m3 x 1.52 = 0.00513 m3

$$Cement = \frac{0.00513}{5.5} x\ 1\ x\ 1500 = 1.399\ kg = 1.4\ kg$$

Sand = 2.1 kg

Natural Course Aggregate = 4.2 kg

Note: -Extra Material used 10% for total weight of material.

(B) Material for one Concrete cylindrical mould:-

Total Volume of cylindrical Mould = 0.005302 m3

Dry Volume of concrete = 0.005302 m3 x 1.52 = 0.00806 m3

$$Cement = \frac{0.00806}{5.5} x\ 1\ x\ 1500 = 2.198\ kg = 2.2\ kg$$

Sand = 3.3 kg

Natural Course Aggregate = 6.6 kg

Note: - Extra Material used 10% for total weight of material.

6. CALCULATION & RESULTS ANALYSIS

Mix.	Days	Slump Value (mm)	Bond Strength (N/mm^2)	Compressive Strength (N/mm^2)	Split Tensile Strength (N/mm^2)	Density (kg/m^3)
1	**7**	82	3.45	13.73	2.74	2359
	28		5.05	21.62	4.01	
2	**7**	**70**	3.6	16.65	2.56	2162
	28		**4.95**	25.52	3.71	
3	**7**	**75**	**4**	17.46	2.35	2314
	28		5	25.86	3.38	

4	**7**	**72**	4.05	17.00	2.92	2459
	28		**5.8**	25.92	4.01	
5	**7**	**65**	**3.25**	13.03	2.70	2403
	28		**5.25**	21.75	3.74	

7. OUR RECOMMENDATION:-

S. No.	Experimental Study	Plane Concrete		Mix Concrete	
		Mix	Value	Mix	Value
1.	Slump Cone Test	Mix -01	82 mm	Mix-04	72 mm
2.	Compressive Strength Test	Mix -01	21.62 N/mm^2	Mix-04	25.92 N/mm^2
3.	Split Tensile Strength Test	Mix -01	4.1 N/mm^2	Mix-04	4.1 N/mm^2
4.	Bond Strength Test	Mix -01	5.05 N/mm^2	Mix-04	5.8 N/mm^2
5.	Density Test	Mix -01	2310 Kg/m^3	Mix-04	2310 Kg/m^3

Fig. Slump Test

Fig. Compressive Strength

Fig. Split Tensile Test

Fig. Bond Strength Test

8. CONCLUSIONS

Compressive strength, Split Tensile strength, Bond strength and Density of concrete mixes are tested with adding certain percentage of Marble Dust at 7 & 28 days of curing. Marble Dust is used in the concrete which is replaced by 0%, 5%, 10%, 15%, and 20% by the weight of Sand, optimum Marble Dust content to be 5% (by weight of Sand) is taken in our work and different properties of concrete is examined. After performing all the tests and analyzing their result, the following conclusions can be derived:

1. Maximum increase in compressive strength of concrete occurred when 10% sand (mix-03) replacement was done with Marble Dust.
2. Maximum increase in bond strength of concrete occurred when 15% sand (mix-04) replacement was done with Marble Dust.
3. Split tensile strength is maximum when 15% Sand (mix-04) replacement was done with Marble Dust by weight of Sand.

Using the Marble Dust as cement and aggregate in concrete can reduce the material cost in construction because of the low cost and abundant Industrial waste. This type of concrete we named "Marble Waste Concrete" can be used in rural or Industrial areas and places where Marble Dust is abundant and may also be used where cement and conventional aggregates are costly. Thus, economy can be achieved in construction. Marble Dust is also classified as structural Medium lightweight concrete. By reinforcing the concrete with Marble Dust which are Minimum Cost or freely available, we can reduce the environmental waste and split tensile strength increases in case of 5% Marble Dust.

9. REFERENCES

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BIOGRAPHIES

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