Comparative study on Strength Characteristics of Concrete using Marble Dust Powder and Quarry Dust as a Partial Replacement of Cement

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Abstract— Now a days, due to rapid development of Infrastructure in various Countries of world including India. The demand of Concrete structure is more. In order to fulfil this and also meet the necessity of concrete, the cement is replaced by Marble powder and Quarry dust. In my project the experimental investigation has been carried out in order to determine the strength characteristics of concrete with partial replacement of cement separately by two materials i.e.1) Marble powder 2) Quarry dust. A total of 54 cube of Size 150mmX150mmX150mm size and 27 cylinder of 150mm diameter & 300 mm height .The curing is done by immersing the specimen in the water tank for various days depend upon testing period. Compressive strength of cube is tested for CVC & various percentages of marble powder (5,10,15,20) and QD (5,10,15,20) specimen for 7 days & 28 days after curing.

Key words: Cement, Marble Powder, Quarry Dust, Strength Characteristic and Partial Replacement

I. INTRODUCTION

Concrete is widely used vital material in construction world. It is a heterogeneous mix of cement, aggregates & water, that hardens into a super strong building material. As the Concrete is easily available and affordable so it is used in various construction works. Now a days due to large scale Construction in India & other parts of world. Concrete has to meet a very high demand in order to accomplish the demand of Concrete various Components of concrete has to be produce artificially or naturally. As the production of Cement is now increasing due to which the environment is getting polluted by its harmful gases which are liberated into the atmosphere during its production, yearly production of cement in India and other countries of World is around 3 billion tons. By partially replacement of cement by marble powder & quarry dust separately by various % the concreting of specimen is done for cubes, cylinders & prism. The strength is determined for 7 days & 28 days for cube & 28 days for cylinders.

II. MATERIAL USED

A. Cement:

The basic component of the concrete is the cement. Generally cement is defined us as the material which posses excellent cohesive and adhesive properties and makes the concrete mix as a composite material.

Sl No	Properties	Results
1	Specific gravity	3.1
2	Setting Time 1. Initial setting time 2. Final setting time	 43 min 205 min
3	Consistency of Cement	30.5%
4	Finess	4%

Table 1: Physical Properties of OPC (53 grade)

B. Marble Powder (MP):

In India, and the other parts of the World, Marble is used as a decorative rock for buildings, especially in palaces and Monuments which has been in use for years ago, Marble is a Metamorplic rock resulting from the transformation of a pure lime stone. Generally the Marble gives an immense look.

C. Quarry Dust (QD):

It is the residue material which is the extraction of basalt rocks. Generally, Quarry dust is not finer as that of cement particles. The dust obtained from aggregate is passed through the IS Sieve of 75 micron to get finer particle.

Sl. No.	Test performed	MP Results	QD Results
1.	Specific gravity	2.2	2.5
2.	Moisture content	1.59%	2.1%
3.	Bulk density	1118 Kg/m^3	1750 Kg/m^3
4.	Fineness modulus	2.04	2.35

Table 2: Physical Properties of Marble Powder and Quarry Dust

D. Fine Aggregate (FA):

Aggregate passing through 4.75mm IS Sieve & retained on 150 micron are called fine aggregate. River sand is most commonly used as an fine aggregate.

E. Coarse Aggregate (CA):

Aggregate retained on 4.75mm IS sieve are called Coarse aggregate. But the Coarse aggregate is of many sizes but in my project the size of C.A used is 20mm.

Test on aggregate	FA Results	CA Results
Specific gravity	2.63	2.73
Moisture content	3.78%	3.1%
Bulk density	1.527 gms/cm^3	1.60 gms/cm^3
Finess	4.01%	5.77%

Table 3: Properties of Aggregate

III. MIX DESIGN

In India generally mix design is carried out by using Indian standard codes i.e, IS 456-2000, & IS 10262-2009. In my dissertation work I am using M30 grade of concrete & the mix is as follows 1 : 1.53 : 2.73 by water cement ratio as 0.45.

IV. EXPERIMENTAL SETUP

Concrete confirming to IS 516:1964 the size of the cube used is (150x150x150) mm, 54 in number. Cylinder of size 150mm height 300mm diameter, 27 in number, consisting of cement replaced by marble powder & quarry dust separately. In order to determine to strength characteristics of concrete for various curing period.

V. RESULTS AND DISCUSSION

A. Cubes:

The specimen of the concrete is tested for 7 days & 28 days in order to determine the initial strength for 7 days and final strength for 28 days. The cubes are tested in compressive testing machine, the results are shown below.

% Of Cement Replacement	Marble powder		Quarry dust	
	Average strength in N/mm^2		Average strength in N/mm^2	
	7 days	28 days	7 days	28 days
0	28	40.12	28	40.12
5	29.14	42.66	29.57	42.80
10	31.89	44.90	31.10	43.89
15	31.45	42.07	32.5	45.79
20	29.25	39.88	31.75	44.65

Table 4: Compressive Strength Test Results

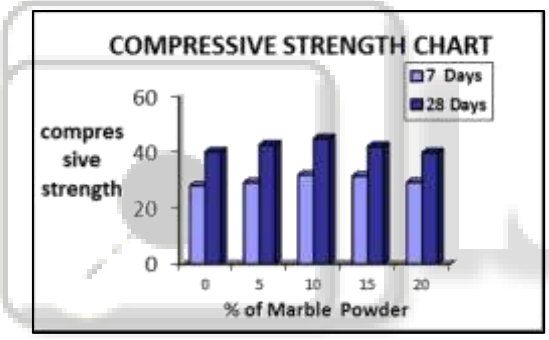

Fig. 1:

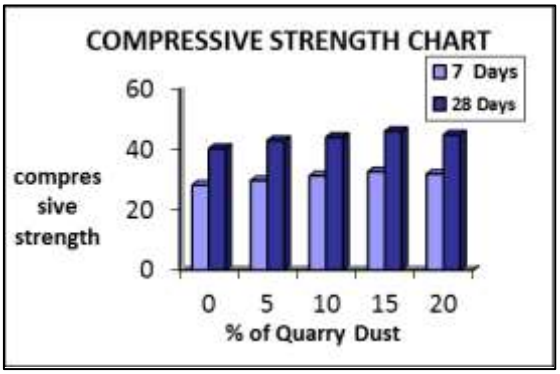

Fig. 2:

B. Cylinders:

The total 27 cylinders were tested in split tensile strength machine, the testing was done for 28 days in order to find the strength of cylinder, the results are shown below.

% of cement Replacement	Marble powder	Quarry dust
	Average split strength for 28 days in N/mm^2	
0	2.95	2.95
5	3.33	3.19
10	3.63	3.51
15	2.7	4.04
20	2.50	3.10

Table 5: Split Tensile Strength Test Results

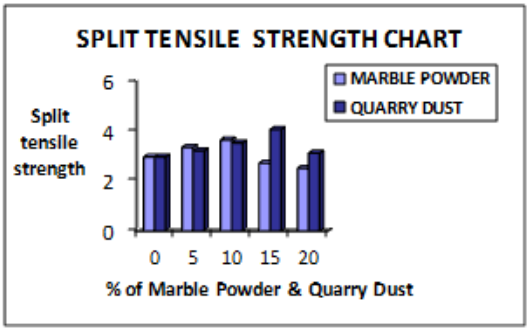

Fig. 4:

VI. DISCUSSION

1) At 10% for marble powder it was found that the initial compressive strength of cubes for 7 days was found to be increased by 12.1% as compare to that of CVC mix, similarly at 15% for Quarry dust it was found that the initial compressive strength of cubes for 7 days was found to be increased by 13.72% as compare to that of CVC mix.
2) At 10% for marble powder it was found that the initial compressive strength of cubes for 28 days was found to be increased by 10.6% as compare to that of CVC mix, similarly at 15% for Quarry dust it was found that the initial compressive strength of cubes for 28 days was found to be increased by 12.38% as compare to that of CVC mix.
3) In comparison with that of CVC at 10% it was found that the initial split tensile strength of cylinder for 28 days was found to be increased by 19.0% for marble powder, similarly at 15% it was found that the initial split tensile strength of cylinders for 28 days was found to be increased by 27.28% for quarry dust.

VII. CONCLUSION

1) Our investigation showed that the optimum replacement % of marble powder with cement is 10% and that of quarry dust is 15% for cubes, cylinders.
2) With addition of marble powder by 10% and quarry dust by 15% by weight of Cement, the compressive strength of cube is increased and any further addition of marble powder and quarry dust decreases the compressive strength.
3) As the water cement ratio is more, there is a decrease in workability.
4) Quarry dust was a better partial replacement of cement in concrete than the marble powder because it shows good strength and other properties of concrete.
5) By partial replacement of cement with quarry dust and marble powder, the environmental pollution caused by cement production can be reduced to a certain level.

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