Experimental Investigation on Partial Replacement of Cement with Marble Dust in Concrete Mix

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Abstract-After cutting and sawing marbles, in large amount of marble slurry produce. This marble slurry disposed to open land area, it make land pollution and harmful to land. It has good binding property and gives enough strength to concrete and due to this it is suitable to bear heavy load. In present study experimental investigation conducted on optimum marble dust replacement with cement. The replacement ratios which have been studied were 0%, 5%, 7.5%, 10%, 12.5%, and 15% by weight. Water – cement ratio kept 0.42. Concrete made with marble dust as cement replacement achieved better performance compared to normal concrete.

Keywords: **Marble Dust, Compressive Strength, Split Tensile Strength**.

Introduction

The cement used in concrete production is directly proportional to the CO_2 emission and approximately 900 kg of CO_2 are emitted for every ton of cement production. Cement manufacture contributes greenhouse gases both directly through the production of carbon dioxide when calcium carbonate is thermally decomposed, producing lime and carbon dioxide, and also through the use of energy, particularly from the combustion of fossil fuels.

The advancement of concrete technology can reduce the consumption of natural resources and energy sources and lessen the burden of pollutants on environment. The marble dust is generated in large amount from the stone processing plants which have significant impact on environment. In INDIA, the marble processing is one of the most thriving industry the effects if varying marble dust contents on the physical and mechanical properties of fresh and hardened concrete have been investigated.

Literature Review

Bahar Demirel) Presented in the study that the effects of using waste marble dust as a partial replacement in concrete mix. In the study Four different concrete-mixtures were prepared by replacing the fine sand (passing 0.25 mm sieve) with waste marble powder at different proportions like 0, 25, 50 and 100% by weight. To evaluate the effect on compressive strength of concrete with various percentages marble dust at the curing ages of 3, 7, 28 and 90 days. The properties like the porosity values, ultrasonic pulse velocity (UPV), and dynamic modulus of elasticity and the unit weights of the series were determined and compared with each other. It had been observed that the

addition of WMD such that would replace the fine material passing through a 0.25 mm sieve at particular proportions increase in compressive strength.

Hassan A. Mohamadien In this study effect of marble powder and silica fume of different percentages as partial replacement for cement on mortar is studied. In this study the different types of mortar mixtures with same workability, cement to sand ratio of 1:3 and water cementitious material ratio of 0.4, prepared with marble powder and silica fumes used in the mixes separately. In this study replacement of marble powder and silica fume with cement content separately at 0%, 5%, 10%, 15%, 20%, 30% and 50 % by weight were investigated. Different mechanical properties of mortar were measured in terms of compressive strength at 7 and 28 days and it revealed that the strength developments at 7, and 28 days and maximum development rate of compressive strength was observed at 15% replacement ratio for each the marble powder and silica fume separately. It showed that compressive strength was increased by 31.4%, 48.3% at 7, and 28 days respectively at 15% replacement ratio of silica fume with cement content and also in replacement of marble powder with cement content the compressive strength increased by 22.7%, 27.8% at 7, and 28 days at 15% replacement ratio of marble powder with cement content respectively.

Materials and Methodology

The characterization of materials which are used in concrete mix as per performed as per IS standards. The mix design is performed as per IS 10262-2009. Then the cubes and cylinders are casted by varying the percentage of marble dust as binding material in concrete mix varies from 0, 5, 7.5, 10, 12.5 & 15%. The specimens were weighed after curing of 7, 14 & 28 days to know the significance changes in density before testing compressive strength.

Table.1 **Physical Properties of materials**

Sl. no	Test Conducted	Results	IS code
1	Specific Gravity of Cement (OPC 53)	3.15	IS 12269:1987
2	Specific Gravity of Fine Aggregates	2.58	IS 2720:1980-Part 3
3	Specific Gravity of Coarse Aggregates	2.69	IS 2386:1963-Part 4
4	Specific Gravity of Marble Dust	2.68	IS 3812:2003
5	Water Absorption of Coarse Aggregates	0.5%	IS 2386:1963-Part 4

Table.2 **Density of concrete**

Sl. No	Percentage Marble Dust	7 Days (kg/m^3)	14 Days (kg/m^3)	28 Days (kg/m^3)
01	0	2454.22	2449.18	2440.88
02	5	2469.92	2464.00	2450.66
03	7.5	2472.88	2465.48	2458.66
04	10	2468.44	2460.14	2451.85
05	12.5	2455.01	2451.85	2438.23
06	15	2447.40	2442.96	2425.48

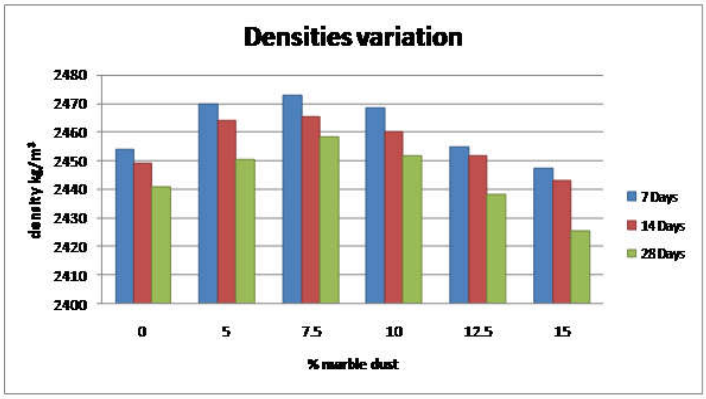

Figure.1 Density of concrete mix v/s Percentage of Marble dust

Table.3 **Compressive strength**

Sl. No	% of Marble Dust	7 Days (N/mm^2)	14 Days (N/mm^2)	28 Days (N/mm^2)
01	0	30.192	38.132	39.080
02	5	31.658	40.355	40.636
03	7.5	35.270	42.281	43.080
04	10	31.110	39.525	40.340
05	12.5	30.207	36.917	38.430
06	15	28.666	34.696	35.733

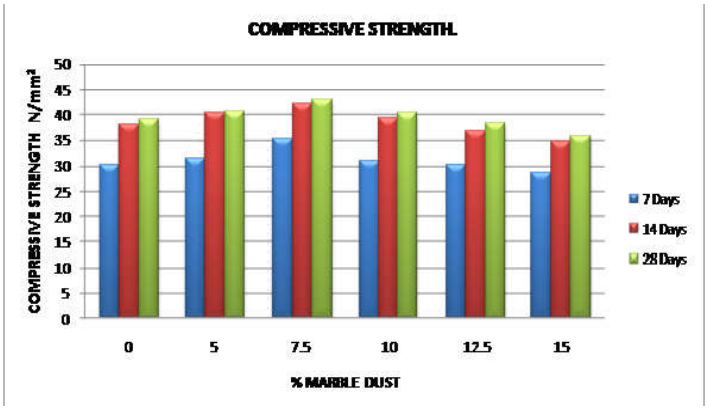

Figure.2 Compressive strength v/s Percentage of Marble dust

Table.3 **Split Tensile**

Sl. No	Percentage Marble Dust	7 Days (N/m^2)	28 Days (N/m^2)
01	0	3.710	5.826
02	5	4.031	6.110
03	7.5	5.650	6.917
04	10	4.909	6.522

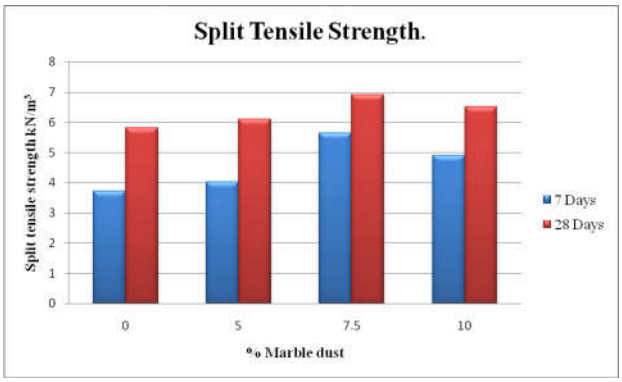

Figure.3 Split Tensile v/s Percentage of Marble dust

Conclusion

The Compressive strength of Cubes and split tensile are increased with addition of waste marble powder up to 15% replaced by weight of cement and further any addition of waste marble powder the strength decreases.

We found out the optimum percentage for replacement of marble powder with cement and it is 7.5% cement for both cubes and cylinders.

We have put forth a simple step to minimize the costs for construction with usage of marble powder which is freely or cheaply available.

We have also stepped into a realm the environmental pollution by cement production; being our main objective as Civil Engineers.

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