

OPPORTUNITIES FOR DEVELOPMENT OF LOW COST CONCRETE USING LOCALLY AVAILABLE MARBLE WASTE

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ABSTRACT –

The cost of concrete depends on the cost of the constituent materials, i.e. coarse aggregate, fine aggregate and binding materials. Use of alternative aggregate materials has great potential because of 75% of concrete is composed of aggregate. Natural sand is used as fine aggregate. Due to the excessive use of sand too much extraction is carried out from the river, resulting in the exploitation of natural resources, consequently increasing the cost of sand. Hence an alternative material to be used in place of sand without affecting the quality of concrete. In India, million tons of waste generated during cutting, grinding and polishing process from marble industries. This waste marble powder is used as fine aggregate by partial replacement of sand in making low cast concrete. In this experimental study, the possibility of utilizing waste marble powder as an alternative for fine aggregate (sand) in the production of low cost concrete is explored.

KEYWORDS – Marble powder, Sand, compressive strength.

1 INTRODUCTION –

Marble is a metamorphic rock resulting from the transformation of a pure limestone. Marble is used for construction and decoration; marble is durable, has a noble appearance, and is consequently in great demand. The result is that the marble waste which is 20% of total marble quarried has reached as high millions of tons. This huge unattended mass of marble waste consisting of very fine particles is today one of the environmental problems around the world. Concrete has been a leading construction material for over a century: its global production is about 3.8 billion cum roughly 1.5 tones per capita – according to Portland Cement Association data (Portland Cement Association). The high cost of concrete depends on the cost of the constituent materials. The cost of concrete can be reduced through the use of locally available alternative material, to the conventional ones. This paper is on use of waste marble powder as an alternative to expensive and depleting sand. The global consumption of natural sand as fine aggregate is too high due to its extensive use in concrete. The demand for natural sand is quite high in developing countries owing to the rapid infrastructural development in recent years. A situation that is responsible for the increase in the price of sand, and the cost of concrete. Expensive and scarcity of river sand which is one of the constituent material used in the

production of conventional concrete was reported in India. So, there is large demand for alternative materials for fine aggregates in the construction industry. To overcome from this crisis, replacement of natural sand with waste marble powder is an economic alternative.

2 MATERIALS

2.1 CEMENT

The cement used is Pozzolana Portland Cement of ACC cement co., which has specific gravity 3.10.

2.2 WASTE MARBLE POWDER

The specific gravity of marble is 2.577. Local available waste marble powder used as partial replacement of fine aggregate instead of sand in concrete.

2.3 AGGREGATE

The coarse aggregate passing through a 20 mm and retained on 10 mm sieve is used. Its specific gravity of 3.0. Good quality Narmada River sand used as a fine aggregate conforming to Zone- II of IS: 383 – 1970 have a fineness modulus of 2.72 and specific gravity of 2.64.

2.4 WATER

Potable water free from organic substance is used for mixing as well as curing of concrete.

3 METHODS

Based on the Indian Standard (IS: 10262 – 1982), design mix for M30 grade of concrete was prepared by partially replacing fine aggregate with five different percentages by weight of marble powder (0%, 10%, 20%, 30%, and 40%,). The concrete was left in the mould and allowed to set for 24 hrs before the cubes were de-molded and placed in the curing tank until the day of testing. The three specimens of each mix were prepared and left curing in the curing tank for 7, 28days.

Table No.1: Details of Replacement of Sand By Marble Powder as Fine Aggregate

Mix	Material by weight				
	Marble Powder %	Cement (Kg)	Sand (Kg)	Marble Powder (Kg)	Aggregate (Kg)
M30	0	428	600	0	1275
	10	428	540	60	1275
	20	428	480	120	1275
	30	428	420	180	1275
	40	428	360	240	1275



Fig 1: Compressive Strength Testing Machine



Fig 2: Electric Vibrating Table

Table No. 2: Compressive Strength

Sr. No.	% Replacement	7 Days Strength N/mm ²	28 Days Strength N/mm ²
1	0	27.04	39.55
2	10	27.11	40.59
3	20	27.18	41.04
4	30	25.92	36.15
5	40	23.85	33.48

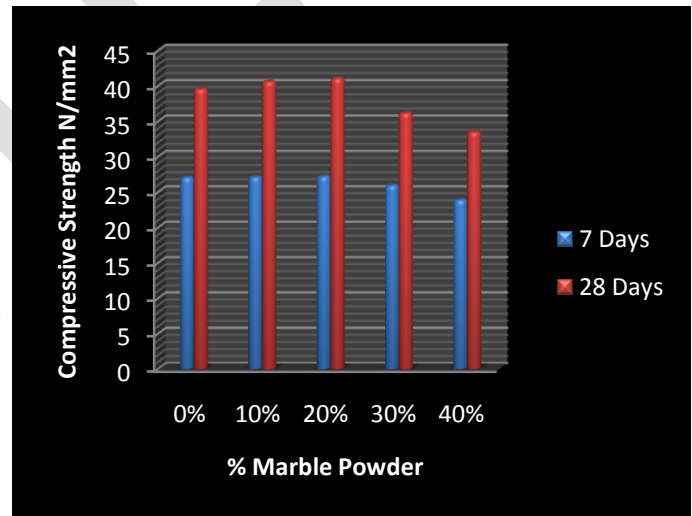


Fig 3: Average Compressive Strength of different percentage of Waste Marble Powder

4 TEST RESULTS

The test results are also presented graphically in fig 1. Increasing the percentage of waste marble powder up to 20% the compressive strength values of concrete tends to increase at each curing aging.

Table No. 3: Materials Rate Per Kg

Material	Rate per Kg (In Rupees)
Cement	6.00
Sand	0.85
Marble Powder	0.40
Coarse Aggregate	0.60

Table No. 4: Different Mix Proportion Cost

Marble %	Cement Rupees.	Sand Rupees.	Marble Powder Waste Rupees.	Coarse Aggregate Rupees.	Total Rate Rupees.
0	2568	510	0	765	3843
10	2568	459	24	765	3816
20	2568	408	48	765	3789
30	2568	357	72	765	3762
40	2568	306	96	765	3735

4 CONCLUSIONS

From the results (shown in fig.1 and table no.4), the following conclusions can be drawn

- Test result shows that the waste marble powder is capable of improving hardened concrete performance and compressive strength of the concrete has increased with increasing percentage of marble powder additions up to 20%.
- Using waste marble powder in the concrete mix to be very useful to solve environmental problems and also reduce its cost because this waste is available free or very nominal cost.
- The strength of 0% marble powder, 28 days is 39.55 N/mm² at this strength of concrete cost is Rs.3843. After adding the marble powder increases the strength. Compressive strength of 20% marble powder is 40.59 N/mm², at this strength of concrete cost is Rs.3789. By using the marble powder as partial replacement of sand up to 20%, the rate of the concrete is decreased and strength is increased.

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