Using Marble Detritus in Concrete Mix in the Percent Replacement of Cement

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ABSTRACT

Concrete mix design may be defined as the process of selecting suitable ingredients for construction of concrete and for determining their relative amounts with an objective to produce a concrete mix having the required, strength, workability, and durability in as economical manner as possible. The plastic and the hardened states are the two states governing the proportioning of ingredient of the concrete mix. If the concrete (in plastic state) is not workable it becomes difficult to be properly placed and compacted. Therefore, the property of workability becomes of vital importance. In today's context the cement is a very costlier ingredienthence present work is based on the effect of addition of Marble detritus on Portland cement concrete for the economical purpose without releasing any strength. The present study is based on studying the effects of replacement of 5% to 30% of cement in the interval of 5%, by marble detritus on Portland cement concrete.

Key words: Marble Detritus, Concrete, Compressive Strength, etc.

INTRODUCTION

The advancement of concrete technology can reduce the consumption of natural resources and energy sources and lessen the burden of pollutants on environment. Presently large amounts of marble Detritus are generated in natural stone processing plants with an important impact on environment and humans and Marble (stone) is metamorphosed limestone and, as such, only occurs where there was once a sea bed. In building industry,Marble has been commonlyused for various purposes like flooring, cladding etc., as abuilding material since the ancient times. The industry'sdisposal of the marble dust material, consisting of very finepowder, today constitutes one of the environmental problemsaround the world. In India, marble dust is settled bysedimentation and then dumped away which results inenvironmental pollution, in addition to forming dust insummer and threatening both agriculture and public healthand also the marble processing is one of the most thrivingindustry the effects . Therefore the scientific and industrialcommunity must commit towards more sustainablepractices.Marble dust is not only the economical material butalso improves the properties of the concrete so by

varyingmarble dust contents on the physical and mechanicalproperties of fresh and hardened concrete have beeninvestigated. While Cutting Marble there is a lot wastage of marble dust that can be utilized as a supplementary ingredient for concrete mix design in the partial replacement of cement.Test results show that this industrial mix is capable of improving hardened concrete performance up to 25%, Enhancing fresh concrete behavior. 63cubes has been casted. The compressive strength and split tensile strength of cubes was measured for 7 days, 14 days and 28 days.

MATERIALS AND METHODS

Ordinary Portland (43 grade) cement was used. It was tested as Per the Indian Standard Specifications IS: 8112-1989. Its properties are shown in Table 1. Marble detritus was obtained from local Industries. Fine aggregate wasnatural sand having a 4.75 mm nominal size. The coarse aggregate used in this investigation was 20 mm nominal size. Both aggregates were tested according to BIS: 383-1970.Their physical properties are given in Tables 2.

Table 1.Properties of Cement.

S. No.	Physical Properties	Results	BIS.8112-1989 Obtained Specifications
1	Normal Consistency (%)	33	-
2	Initial Setting Time (Min)	45	> 30
3	Final Setting Time (Min)	285	< 600
4	Fineness %	5	< 10
5	Specific Gravity	3.18	-

Table 2.Properties of Aggregates

S. No.	Properties	Coarse aggregate	Fine aggregate
1	Maximum size (mm)	20	4.75
2	Specific gravity	2.70	2.3
3	Total Water Absorption (%)	2.45	4.7
4	Fineness Modulus	6.25	1.85

The concrete mixis prepared so as to achieve target strength of 10N/mm^2 (i.e. M-15 concrete). The proportion used for concrete mixing is 1:2:4. The quantity of material used for construction of 9 cubes for each mix are tabulated below.

Table 3.Weight of materials used in concrete mix

Mix	M-15			
	Cement(kg)	Sand (kg)	Aggregate (kg)	Detritus (kg)
Mix 1 (0% of Detritus)	11.6	23.16	46.24	0
Mix 2 (5% of Detritus)	11.02	23.16	46.24	0.58
Mix 3 (10% of Detritus)	10.44	23.16	46.24	1.16
Mix 4 (15% of Detritus)	9.86	23.16	46.24	1.74
Mix 5 (20% of Detritus)	9.28	23.16	46.24	2.32
Mix 6 (25% of Detritus)	8.7	23.16	46.24	2.9
Mix 7 (30% of Detritus)	8.12	23.16	46.24	3.48

I. PREPERATION OF CONCRETE CUBES

The concrete cubes of 150mm were prepared in accordance to IS: 516for compressive strength, soon after casting, test specimens were covered with plastic sheets, and left in the casting room for 24 h at a temperature of about 26 ± 10C. They were de-molded after 24 hrs, and were put into a watercuring room until the time of testing.The cubes were kept in normal curing conditions for 7 days, 14 days and 28 days in water.

II. DETERMINATION OF WEIGHT OF CUBES

The weight of each concrete cube was measured with the help of electronic weighing machine having an accuracy of 10 grams.

III. TESTING FOR COMPRESSIVE STRENGTH

The concrete cubes were test for compressive strengths after the completion of their curing in normal conditions for 7 days, 14 days and 28 days in UTM.

IV. COMPARITIVE STUDY

Comparative study for weights and compressive strengths of concrete cubes of all the seven mixes is carried out.

RESULTS& GRAPHS

I. WEIGHTS OF CONCRETE CUBES

The comparison of weights of all the seven mix obtained are tabulated below:

Table 4. Weight of all concrete cubes for all seven mixes

Weight of Cubes (kgs)							
Cube No.	Mix 1 (0% of Detritus)	Mix 2 (5% of Detritus)	Mix 3 (10% of Detritus)	Mix 4 (15% of Detritus)	Mix 5 (20% of Detritus)	Mix 6 (25% of Detritus)	Mix 7 (30% of Detritus)
1	8.5	8.37	8.26	8.22	8.18	8.20	8.19
2	8.65	8.51	8.42	8.32	8.28	8.22	8.21
3	8.7	8.62	8.39	8.35	8.30	8.26	8.24
4	8.57	8.45	8.35	8.32	8.30	8.29	8.26
5	8.55	8.40	8.40	8.36	8.35	8.32	8.29
6	8.6	8.35	8.32	8.30	8.26	8.25	8.21
7	8.58	8.28	8.30	8.25	8.24	8.24	8.23
8	8.62	8.42	8.41	8.26	8.22	8.20	8.19
9	8.77	8.35	8.32	8.30	8.24	8.22	8.18
Average	8.61	8.41	8.35	8.29	8.26	8.24	8.22

II. COMPRESSIVE STRENGTH OF CUBES

The load sustained by cubes (before failure) as obtained after 7 days, 14 days and 28 days of curing are tabulated below.

Table 5. Load taken by cubes before failure

Load (KN)								
Cube No.	Mix 1 (0% of Detritus)	Mix 2 (5% of Detritus)	Mix 3 (10% of Detritus)	Mix 4 (15% of Detritus)	Mix 5 (20% of Detritus)	Mix 6 (25% of Detritus)	Mix 7 (30% of Detritus)	No. of Days
1	224	229	236	238	242	264	195	7 days
2	226	228	239	240	244	271	201	
3	227	229	240	241	246	270	202	
4	289	291	296	301	304	330	253	14 days
5	304	309	313	316	322	342	263	
6	303	307	315	318	332	345	257	
7	335	340	344	345	356	397	284	28 days
8	338	344	345	351	359	387	284	
9	337	348	352	354	360	400	279	

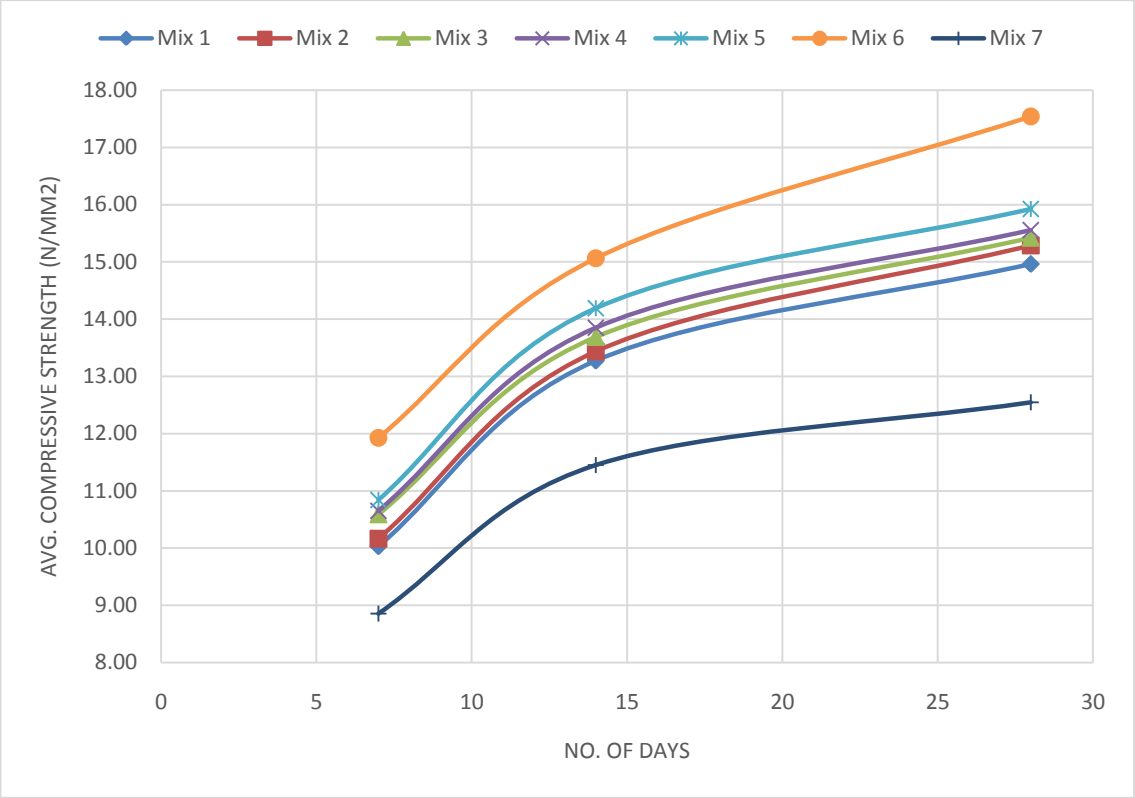
Table 6. Compressive strength of cubes obtained after 7 days, 14 days and 28 days of curing

Compressive Strength (N/mm^2)								
Cube No.	Mix 1 (0% of Detritus)	Mix 2 (5% of Detritus)	Mix 3 (10% of Detritus)	Mix 4 (15% of Detritus)	Mix 5 (20% of Detritus)	Mix 6 (25% of Detritus)	Mix 7 (30% of Detritus)	No. of Days
1	9.96	10.18	10.49	10.58	10.76	11.73	8.67	7 days
2	10.04	10.13	10.62	10.67	10.84	12.04	8.93	
3	10.09	10.18	10.67	10.71	10.93	12.00	8.98	
4	12.84	12.93	13.16	13.38	13.51	14.67	11.24	14 days
5	13.51	13.73	13.91	14.04	14.31	15.20	11.69	
6	13.47	13.64	14.00	14.13	14.76	15.33	11.42	
7	14.89	15.11	15.29	15.33	15.82	17.64	12.62	28 days
8	15.02	15.29	15.33	15.60	15.96	17.20	12.62	
9	14.98	15.47	15.64	15.73	16.00	17.78	12.40	

Table 7. Average Compressive strength of cubes obtained after 7 days, 14 days and 28 days of curing

Compressive Strength (N/mm^2)								
Cube No.	Mix 1 (0% of Detritus)	Mix 2 (5% of Detritus)	Mix 3 (10% of Detritus)	Mix 4 (15% of Detritus)	Mix 5 (20% of Detritus)	Mix 6 (25% of Detritus)	Mix 7 (30% of Detritus)	No. of Days
1	10.03	10.16	10.59	10.65	10.84	11.93	8.86	7 days
2	13.27	13.44	13.69	13.85	14.19	15.07	11.45	14 days
3	14.96	15.29	15.42	15.56	15.93	17.54	12.55	28 days

Fig. 2. Comparison of average compressive strength of cubes in 7 days, 14 days and 28 days



CONCLUSION

- The Compressive strength of concrete mix is increased with addition of waste marble detritus up to 25% replacement of cement.
- Further any addition of marble detritus will decrease the compressive strength of the concrete mix.
- There is a decrease in workability as the replacement level increases, and hence water consumption will be more.
- 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 of saving the environmental pollution by cement production; being our main objective as Civil Engineers.

ACHNOLEDGEMENT

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