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A Study on Compressive Strength of Concrete Using Stone Dust as a Partial Replacement of Fine Aggregate

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Abstract—*Concrete is mixture of cement, fine aggregate, coarse aggregate and water. We have studied the difference between compressive strength of concrete when it is mixed with stone dust and normal concrete (M20). The experiments are done to study the effect of partial replacement of fine aggregate with stone dust (5%, 10%, 15%, 20%, 25%, and 30% fine aggregate is being replaced with stone dust). It has been observed that the compressive strength of concrete goes on increasing with the increase in the percentage of stone dust. From the results, it can be concluded that stone dust can be used as a partial replacement of fine aggregate (natural sand).*

Keywords: *Concrete,Compressive strength, Coarse aggregate, Fine aggregate, Stone dust.*

INTRODUCTION

Cement concrete is one of the seemingly simple but actually complex material. Many of its complex behaviour are yet to be identified to employ this material advantageously and economically. Concrete is a site made material unlike other materials of construction and as such vary to a very great extent in its quality, properties and performance owing to the use of natural materials except cement from materials of varying properties. To make concrete of stipulated qualities , an intimate knowledge of the interaction of various ingredients that going to the making of concrete is required to be known , both in plastic condition and in the harden condition. This knowledge is necessary for concrete technologies as well as site engineers. Numerous tests are performed on wet concrete slump test to measure workability of concrete. In actual practice, test on workability on wet concrete are carried out to ensure uniform quality concrete only. Strength is not measurable at this stage with the available technology. Therefore the concrete samples are to be cured for 28 days in normal method to arrive at the compressive strength and for necessary follow up action.

WORKABILITY OF CONCRETE

The behaviour of fresh concrete from mixing up to compaction depends mainly on the property called "workability of concrete**".** According to **IS:6461(Part vii) - 1973,** workability is the property of freshly prepared concrete mix which determines the ease and homogeneity with which it can be mixed, placed, compacted and finished. Thus workability of concrete is mainly affected by water content, mix proportions, shape and size of aggregates, surface texture, grading of aggregates, use of admixtures, effect of environmental conditions and effect of time. The required workability for a particular mix depends upon the type of compaction adopted and the complicated nature of reinforcement used in the reinforced concrete. A workable mix should not segregate.

TESTS PERFORMED

(i) Sieve Analysis of Fine Aggregate-
Zoning is done from IS383:1970 (Table-4). The aggregate is confirming to Zone-III. Fineness Modulus is 2.89.

(ii) Sieve Analysis of Coarse Aggregate-
Gradation of coarse aggregate is done from IS383:970.

(iii) Sieve Analysis of Stone Dust-
Zoning is done from IS383:1970 (Table-4). The aggregate is confirming to Zone-II. Fineness Modulus is 3.13.

(iv) Specific Gravity-
The specific gravity of coarse aggregate, fine aggregate, stone dust and cement are 2.35, 2.23, 1.71, 2.33 respectively.

WORKABILITY OF CONCRETE

Workability of concrete is determined by slump test (IS 1199:1959). The slump mould has the shape of a frustum of a cone with top diameter 10cm, bottom diameter 20cm and height 30cm.

COMPRESSIVE STRENGTH TEST

The compressive strength test is performed by casting concrete cubes having dimensions 150mm x 150mm x 150mm by using M20 grade of concrete. The cubes were manually compacted by tamping rod during casting. The specimen are removed from the mould after 24 hours and subjected to water curing for 3, 7, 28 days. After curing, the specimen are tested for compressive strength using a calibrated compression testing machine having capacity of 2000 KN.

RESULTS AND DISCUSSIONS

6.1 Slump test results-

PERCENTAGE REPLACEMENT	SLUMP VALUE (mm) workability
Standard M20 concrete	70
5% fine aggregate replaced with stone dust	70.45
10% fine aggregate replaced with stone dust	71
15% fine aggregate replaced with stone dust	72.10
20% fine aggregate replaced with stone dust	73
25% fine aggregate replaced with stone dust	75
30% fine aggregate replaced with stone dust	79

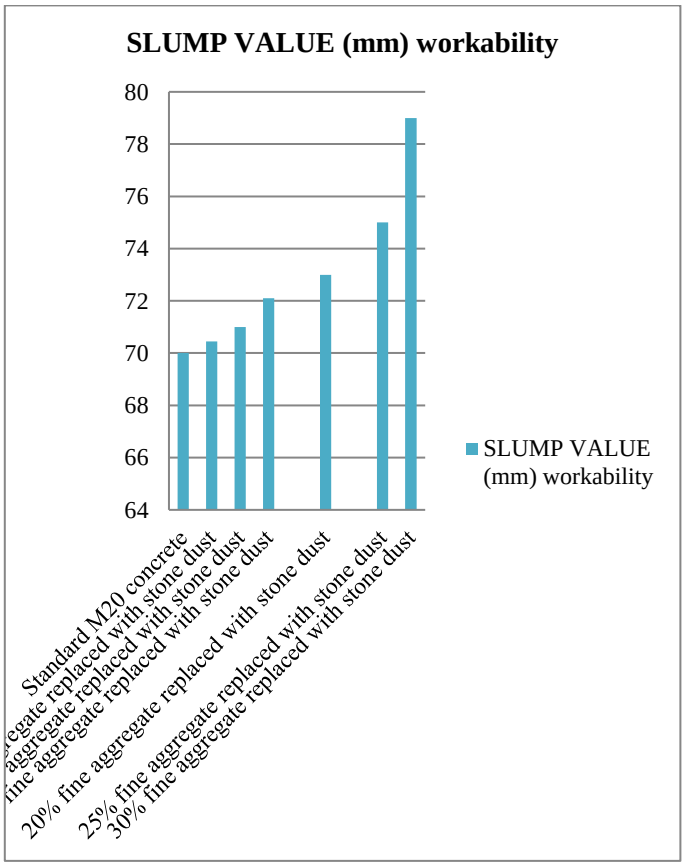

Fig. 1: Graph showing the relationship between slump value and normal concrete and concrete in which fine aggregate is partially replaced with different percentages of stone dust

6.2 Compressive Strength test results-

Sl. No.	Particular	3 days strength (N/mm^2)	7 days strength (N/mm^2)	28 days strength (N/mm^2)
1	Standard M20 concrete	20.36	20.97	21.43
2	5% fine aggregate replaced with stone dust	20.98	21.17	22.78
3	10% fine aggregate replaced with stone dust	21.12	21.26	22.99
4	15% fine aggregate replaced with stone dust	21.89	22.32	23.09
5	20% fine aggregate replaced with stone dust	22.56	22.95	23.88
6	25% fine aggregate replaced with stone dust	23.17	23.77	24.59
7	30% fine aggregate replaced with stone dust	24.70	25.90	26.87

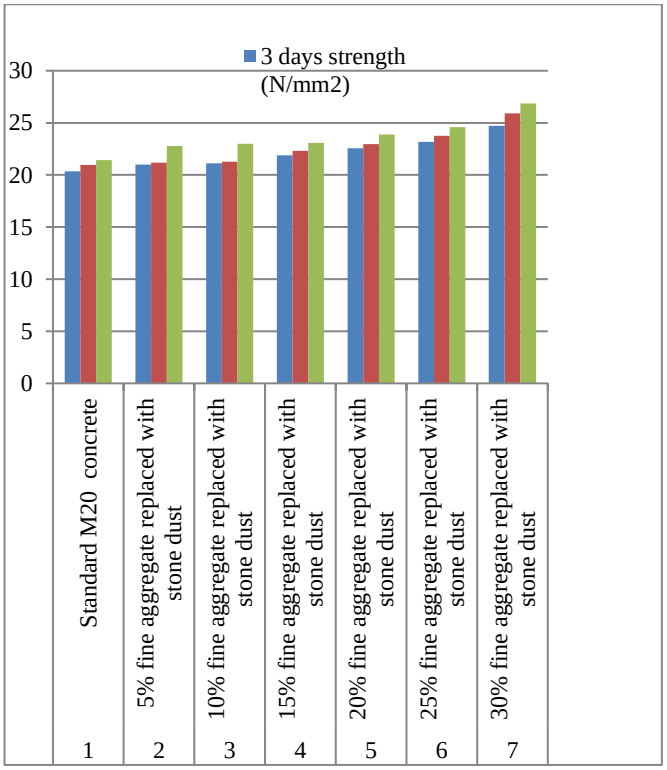

Fig. 2: Graph showing comparison of the compressive strength test results

CONCLUSION

The following observations are made regarding the resistance of partially replaced stone dust, based on limited experiments performed-

(i) The value of slump of M20 normal concrete is less than the value of replaced concrete, i.e., stone dust is partially replaced in place of fine aggregate.

(ii) With the increase in the percentage of stone dust, the value of slump also increases.
(iii) The value of compressive strength of M20 normal concrete is less than the value of replaced concrete, i.e., stone dust is partially replaced in place of fine aggregate.
(iv) When the percentage of stone dust increases, the value of compressive strength of concrete also increases.
(v) Waste utilization makes green concrete more environmental friendly.

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