AN EXPERMENTAL STUDY ON SELF COMPACTING CONCRETE BY REPLACING BY MARBLE SLUDGE POWDER AND QUARRY ROCK DUST

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Abstract: A self-compacting concrete (SCC) is the one that can be placed in the form and can go through obstacles by its own weight and without the need of vibration. It avoids having to repeat the same kind of quality control test on concrete, which consumes both time and labor. Construction and placing becomes faster & easier. It eliminates the need for vibration & reducing the noise pollution. It improves the filling capacity of highly congested structural members. SCC provides better quality especially in the members having reinforcement congestion or decreasing the permeability and improving durability of concrete. The forecast objective of this study is to traverse the feasibility of using SCC by examining its basic properties and durability characteristics i.e. water absorption, shrinkage, and sulfate resistance. However, because it usually requires a larger content of binder and chemical admixtures compared to ordinary concrete, its material cost is generally 20-50% higher, which has been a major encumbrance to a wider implementation of its use. There is growing evidence that incorporating high volumes of mineral admixtures and micro fillers as partial replacement for Portland cement in SCC can make it cost effective. However, the durability of such SCC needs to be proven. This research work consists of: (i) development of a suitable mix for SCC that would satisfy the requirements of the plastic state; (ii) casting of concrete samples and testing them for compressive strength, shrinkage, water absorption, sulfate resistance.

Keywords: SCC, PCC

I. INTRODUCTION

Making concrete structures without vibration have been done in the past. For examples, placement of concrete under water is done by the use of termite without vibration. Mass concrete, and shaft concrete can be successfully placed without vibration. But the above examples of concrete are generally of lower strength and difficult to obtain consistent quality. Modern application of self-compacting concrete (SCC) is focused on high performance, better and more reliable and uniform quality. Self-compacting concrete has been described as "the most revolutionary development in concrete construction for several decades". Originally developed in Japan to offset a growing shortage of skilled labor, it has proved to be beneficial from the following points.

- Faster construction
- Reduction in site manpower
- Better surface finish
- Easier placing
- Improved durability
- Greater freedom in design
- Thinner concrete sections
- Reduced noise level
- Safer working environment

Figure 1: Self-compacting concrete using in slab

II. MATERIALS& PROPERTIES

A. Cement:

OPC Grade 43 Ultra Tech bond was utilized for throwing shapes and chambers for every solid blend. The concrete was of uniform shading i.e. dark with a light greenish shade and was free from any hard bumps. Synopsis of the different tests led on bond are as under given underneath in Table 1.

Table 1: Properties of CEMENT

S NO	Characteristics	Values Obtained	Standard values
1	Normal Consistency	33%	-
2	Initial Setting time	48 min	Not be less than 30 minutes

3	Final Setting time	240 min	Not be greater than 600 minutes.
4	Fineness	4.8 %	<10
5	Specific gravity	3.09	-

B. Fine Aggregates:

The sand used for the experimental programme was locally procured and conformed to Indian Standard Specifications IS: 383-1970. The sand was first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm and then was washed to remove the dust. The fine aggregates belonged to grading zone III. The Specific gravity of given aggregate is 2.46.

C. Coarse aggregates:

Locally available coarse aggregates having the maximum size of 10mm was used in our work. The aggregate were washed to remove dust and dirt and were dried to surface dry condition. The Specific gravity of given aggregate is 2.66.

D. Water:

Water from such sources should be avoided since the quality of the water could change due to low water or by intermittent tap water is used for casting.

E. Fly ash:

Supplementary cementitious or inert materials, such as micro silica and fly ash, can be used to increase the viscosity and fresh concrete workability and to reduce the cost of self-compacting concrete.

F. Admixture:

Fosroc Auramix V200 is a chloride free, ready to use liquid admixture.

Figure 1: Fosroc Auramix V200

G. Quarry rock dust:

Quarry waste fine aggregate, which is generally referred as a crushing rock dust (CRD), causes an environmental load due to the disposal problem.

Figure 2: Quarry rock dust

H. Marble sludge powder

MSP is generated as a waste during the cutting and polishing of the marble. In India the amount of MSP generated is very substantial being in the range of 5-6 million tons per heaps of this MSP acquire large land areas and remain scattered all around , spoiling the aesthetics of the entire region and have affecting the tourism and industrial potential of the state.

III. EXPERIMENTAL PROGRAMME

MIX DESIGN:

For durability studies the Indian standard mix proportion (by weight) used in the mixes of conventional concrete and green concrete were fixed as 1:1.81:2.04, 1:1.73:2.04 after several trails. Based on properties of raw materials, two different mix proportions are taken and given in table. Mix A is controlled concrete using river sand and mix B is the green concrete using industrial waste (50% quarry rock dust and 20%marble sludge powder) as fine aggregate. The water/cement ratio for both the mixes was 0.55% by weight. Water reducing admixture was used to improve the workability and its dose was fixed as 250 ml/50kg of cement.

It is important to mention that none of the test methods for SCC has yet been standardized and the tests mentioned below are not yet perfected. They are mainly ad-hoc methods which have been devised for SCC.

Slump flow Test:

The slump flow test is done to assess the horizontal flow of concrete in the absence of obstructions. It is a most commonly used test and gives good assessment of filling

ability. It can be used at site. The test also indicates the resistance to segregation.

Figure 3: Slump Test

V-Funnel test and V-Funnel test at T5 min:

This test was developed in Japan. The equipment consists of a V-shaped funnel shown in Fig. The V- Funnel test is used to determine the filling ability (flow ability) of the concrete with a maximum size of aggregate 20 mm size. The funnel is filled with about 12 litre of concrete. Find the time taken for it to flow down. After this the funnel can be filled with concrete and left for 5 minutes to settle. If the concrete shows segregation then the flow time will increase significantly.

Figure 3: V-Funnel test

L Box test method:

This test is developed in Japan. The test assesses the flow of concrete, and also the extent to which the concrete is subjected to blocking by reinforcement. The apparatus is shown in Fig.

Figure 4: L Box Test

Table 2: Test results of freshly mixed concrete

Tests	MIX A	MIX B
Slump in mm	210	225
Slump Flow (mm)	420	450
V-Funnel Test (sec)	23	14
V-funnel test at T5 min (sec)	13	10
L–Box test (H2/H1)	0.95	0.91

COMPRESSIVE STRENGTH TEST:

Compressive strength of concrete depends on many factors such as water-cement ratio, cement strength, quality of concrete material, and quality control during production of concrete etc. Test for compressive strength is carried out either on cube or cylinder.

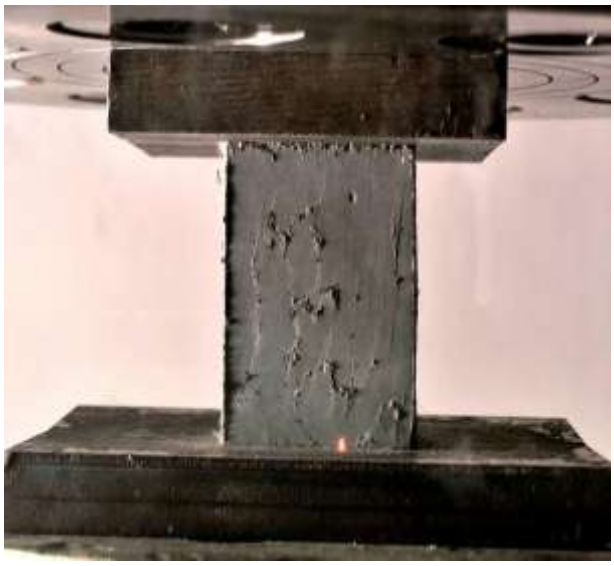


Figure 5: Compressive Strength Test

SPLIT TENSILE STRENGTH TEST:

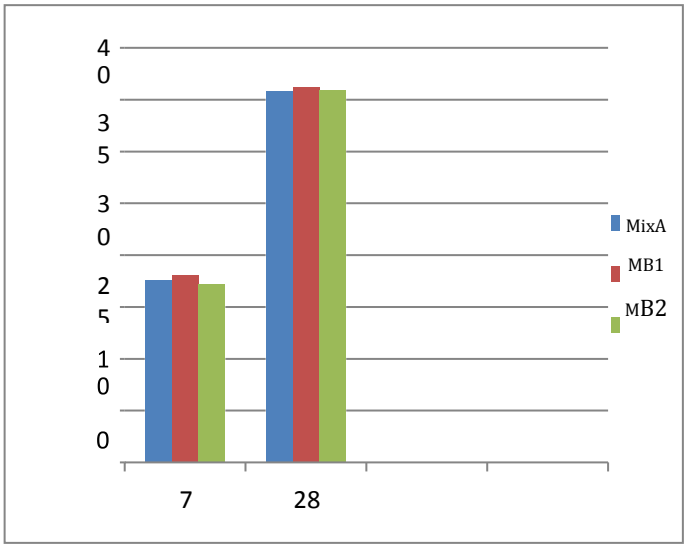
The split tensile strength of 150 mm diameter and 300 mm high concrete cylindrical specimens was determined to assess the effect of CRD and MSP on the tensile properties of the concrete

Figure 6: Split Tensile Strength Test

Table 3: Average compressive strength and split tensile strength of concrete

Mix	% of river sand	% of crusher dust	% of marble sludge	Avg.Compressive Strength (N/mm²)		Avg.Split Tensile Strength (N/mm²)	
				7 days	28 days	7 days	28 days
A	100	0	0	17.58	35.86	2.57	4.14
B1	50	30	20	18.12	36.25	2.68	4.85
B2		25	25	17.79	35.91	2.38	4.35

Comparison of Compressive Strengths:



Graph 1: Comparison of Strengths

IV. CONCLUSION

Throughout the world, the waste disposal costs have escalated greatly. At the same time, the concrete construction industry has realized that Marble Sludge Dust and Crusher Rock Dust is relatively inexpensive and widely available by-product that can be used for sand replacement to achieve excellent workability in fresh concrete mixtures. These materials can be used in the manufacturing of economical SCC in different ways. When the crusher rock dust and marble sludge dust were used as replacement of sand, the requirements of expensive chemicals such as HRWRA and viscosity modifying agent (VMA) decreased. Based on field experience and laboratory tests, the properties of SCC, when compared to conventional Portland cement concrete, can be summarized as follows:

- The possibility of developing low cost SCC by partial replacing of river sand with crusher rock and marble sludge dusts is feasible.
- The utilization of MSD and CRD in SCC solves the problem of its disposal thus keeping the environment free from pollution and enhance the resource productivity of the concrete construction industry.
- The partial replacement of fine aggregate with marble sludge and Crusher dust gives an excellent result in strength aspect and quality aspect. It induced higher compressive strength, higher splitting tensile strength as compared to ordinary SCC.
- The results showed that the substitution of Crusher and Marble sludge induced easier Flowability, Pumpability, and Compactability.
- Early-strength up to 7 days, which can be accelerated

with suitable changes in the mix design when earlier removal of formwork or early structural loading is desired.

- In fresh state, some of the mix results values were out of the EFNARC range and therefore before casting the concrete, the properties of freshly EFNARC concrete must be checked for SCC.

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