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Experimental Investigation on the Combined Effect of Mechanical Properties on Self Compacting Concrete with Fly Ash and Rice Husk Ash

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Abstract: **In recent days Self Compacting Concrete development in the construction point of view. The present study deals with the workability test (slump flow, v-funnel, J-ring, u-box and L-box) and mechanical properties (compressive strength, split tensile and flexural strength) with mixing of suitable super plasticizers (CONPLAST SP 430) and tested at the age of 7, 28, 56, 90 days. In this investigation, SCC was made by usual ingredients such as Cement, Fine Aggregate, Coarse Aggregate, Water and mineral admixtures fly ash (FA) and rice husk ash (RHA) and replacing cement with Rice Husk Ash and Fly ash in percentages of 100%RHA, 80%RHA+20%FA, 60%RHA+40%FA, 40%RHA+60%FA, 20%RHA+80%FA, 100%FA. This investigation was arrived as per guide lines of European Federation of National Association Representing for Concrete (EFNARC) using Nan-su mix design. Workability is good at all proportions except 100%RHA and 80%RHA+20%FA. The results concluded that split tensile and compressive strength is increased at 20%RHA+80%FA.**

Keywords: **Fly Ash, Rice Husk Ash, SCC, Workability test, Super Plasticizer, Compressive Strength, Split Tensile Strength, Nan-su mix design.**

1. INTRODUCTION

Self Compacting Concrete means which makes concrete without compaction or vibration. Self Compacting Concrete (SCC) was developed in the late 1980's by Japanese scientist Okamura. Japan has developed in early 1990's and used SCC that does not vibration to achieve full compaction. By the year 2000 SCC has become more popular in Japan for prefabricated products and mixed concrete. During 1989 European countries founded European Federation national Association Representing for concrete (EFNARC). SCC is a special type of concrete that does not require vibration for placing and compaction which is able to flow under its own weight through sections without segregation and bleeding. It also provides high workability, strength durability and having passing ability. It is environmental eco-friendly, as industrial wastes are used. The main reason to achieve this type of concrete is to reduce equipment cost, manpower and noise level. It has proved to be favorable from the following points such as quicker construction, better surface finish, easier placing, better durability, greater self-determination in design, thinner concrete sections and protected working environment. The modern SCC is in large quantity for Delhi Metro Project about 10000m^3 for making Dome, Tunnel lining, column casting. SCC is largely affected by the characteristics of materials and mix proportions; it becomes necessary to evolve a procedure for mix design of SCC. Okamura and Ozawa has proposed a mix proportioning systems. In this system, water / powder ratio by volume is to be 0.80 to 1.00, total powder content to be 160 to240 liters (400-600kg) per m^3, the fine aggregate content(38-40%),water content should not exceed 200 liters/m^3 must be more than the coarse aggregate content (28-35%) . SCC has mainly three essential properties i.e., passing ability, filling ability and

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segregation resistance. Rice Husk Ash is a highly pozzolanic reactive material because of high Silica content which is used to improve transition zone between the cement paste and aggregate in SCC. Rice Husk Ash is a binder material which is mainly used in manufacturing of low cost concrete blocks. Fly ash is a mineral admixture which is obtained from combustion of powder coal collected by electro-static precipitator. 30% of fly ash used for Hungry Horse Dam in America and 15% of fly ash used for Richard Dam in India.

2. MATERIALS

Cement: Ordinary Portland Cement 53 grade conforming to IS: 12269:1987.Specific gravity of cement is 3.15, Initial setting time-61min, Final setting time-302min.

Rice Husk Ash: Specific gravity is 2.05 and normal consistency is 27%.

Fly Ash: Locally available to IS: 3812:2000. Specific gravity is 2.20 and normal consistency is 40%

AGGREGATES: Locally available coarse and fine aggregates taken as per IS: 383-1970. Specific gravity of coarse aggregates is 2.76.Specific gravity of fine aggregate is 2.658.

Super Plasticizer: CONPLAST SP 430. The specific gravity of super plasticizer is 1.145.

3. EXPERMENTAL PROGRAM

I. WORKABILITY TESTS ON SCC:

1. Slump flow test: The slump flow test is used to evaluate the free deformability and flowability. A standard slump flow cone of height 300mmand having base and top diameter is 200mmand100mm respectively. A slump value is in between 650 to 800mm.

T_{50} Slump flow test: The same as the above slump flow test. When cone is lift, start the stop watch and note the time foe concrete to reach 500mm mark. This is called T_{50} test. It may be 2-5 sec.

2. J-Ring test: The J-ring test is used to determine the passing ability of SCC. The height of diameter of the J-ring is 100mm and having vertical bars is 300mm.After the test, the difference between the height in concrete inside and outside the ring is measured. It varies from 0 to 10mm.

3. L-Box test: This test belongs to measure the properties such as flowability, blocking and segregation of concrete. The ratio h_2/h_1 is called "Blocking Ratio". It is the ratio between the height of concrete surface in vertical column part in the apparatus (h1) and height of the concrete surface in the through at its far end (h2), after passing through vertical reinforcing bars. It is in between 0.8 to 1.0.

4. V-Funnel test: The version selected for evaluation in this study had a rectangular crossing tapering to a bottom opening of 65mm×75mm. The funnel was fitted with a trap door. A sample of fresh concrete of between 12 to 15 litres in volume is required .The V-funnel test is used to determine the deformability through restricted area.

II. WORKABILITY TEST RESULTS:

Table no: 1 Workability results for SCC

Description	Results obtained						Ranges
	100 RHA	80RHA 20FA	60RHA 40FA	40RHA 60FA	20RHA 80FA	100FA	-
Slump Flow test(mm)	676	670	666	660	655	652	650-800
J-Ring test(mm)	1.23	1.25	1.17	1.2	1.52	2.0	0-10
L-Box test	0.96	0.956	0.94	0.945	0.971	1.0	0.8-1.0
V-Funnel (sec)	9.8	10	10.27	10.13	11.43	11.40	6-12
T50Slump Flow test(sec)	3.4	4.0	3.9	4.4	4.7	5.0	2-5

Compressive Strength: 45 cube specimens of size 150*150*150mm are prepared for testing the compressive strength by using compaction testing machine. The ages of testing can be done by 7, 28 and 56 days. 7 days results gives initial compressive strength and 28 days results gives final compressive strength.

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Compressive Strength of cube =P/A

P=Applied load on cube (failure load).

A=Area of cube specimen.

Table no: 2 Compressive strength for cubes

MIX ID	Compressive strength in N/mm^2		
	7 days	28 days	56 days
100%RHA	18.10	28.16	30.00
80%RHA+20%FA	19.27	28.89	32.71
60%RHA+40%FA	22.06	30.62	33.94
40%RHA+60%FA	22.70	31.06	35.20
20%RHA+80%FA	25.13	37.82	39.27
100%FA	23.00	35.40	37.28

Split Tensile Strength: 45 cylinder specimens of sizes 150*300mm are prepared for testing the split tensile strength by using compaction testing machine. The ages of testing can be done by 7, 28 and 56 days. 7 days results give initial split tensile strength and 28 days results gives final split tensile strength.

Split Tensile Strength of cylinder=2P/3.14*L

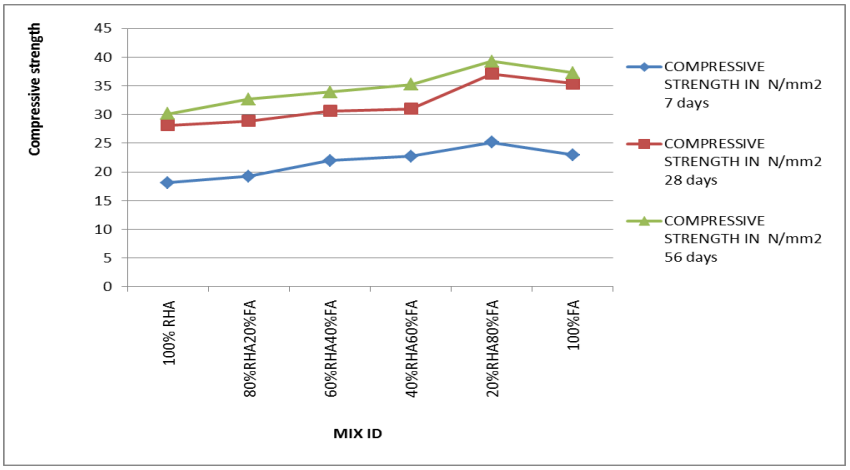
P=Applied load on cylinder (failure load).

A=Area of cylinder specimen.

Table no: 3 Split tensile strength for cylinders

MIX ID	Split Tensile Strength in N/mm^2		
	7 days	28 days	56 days
100%RHA	2.969	3.716	3.84
80%RHA+20%FA	3.072	3.762	4.002
60%RHA+40%FA	3.284	3.874	4.078
40%RHA+60%FA	3.335	3.897	4.153
20%RHA+80%FA	3.509	4.315	4.386
100%FA	3.357	4.165	4.274

4. RESULTS AND DISCUSSIONS



Graph 1: Compressive strength for cubes at different proportions of RHA and FA in SCC

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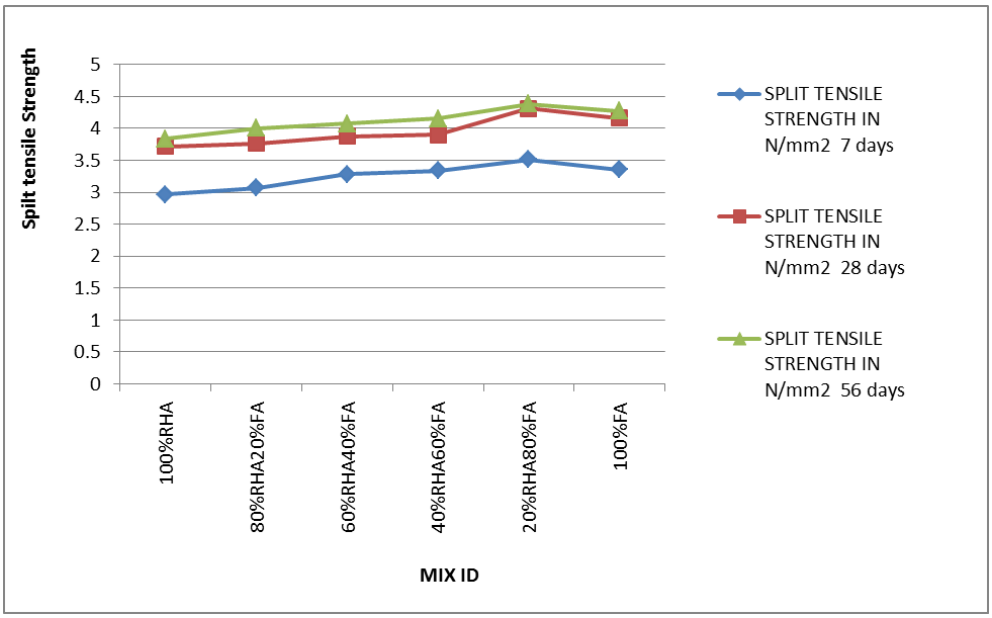

Graph 2: Split tensile strength for cylinders at different proportions of RHA and FA used in SCC

In table 1 the workability results are shows that, all proportions give good results except 100%RHA and 80%RHA20%FA.

From graph 1, the compressive strength is increased at 20%RHA80%FA is 37.82N/mm^2 then after the strength is decreased.

From graph 2, the split tensile strength is increased at 20%RHA80%FA is 4.315N/mm^2 then after the strength is decreased.

5. CONCLUSION

FROM THIS INVESTIGATION:

1. The compressive strength of concrete containing 80%FA+20%RHA for 28 days given better result is 37.82 N/mm^2 when compared to remaining mix proportions.

2. The split tensile strength of concrete containing 80%FA+20%RHA for 28 days given better result is 4.315 N/mm^2 when compared to remaining mix proportions.

3. In workability point view all mix proportions gives good results except 100%RHA and 80%RHA+20%FA.

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