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A Comparative Study on Compressive Strength, Split Tensile Strength and Flexural Strength of SCC of grade M40 containing Coarse aggregate of Size less than 6mm

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Abstract: ***Concrete is a brittle material. It is good in compression and weak in tension. Strength of concrete means the compressive strength of concrete of 150mm cube at 28 days. The quality of concrete is depicted by its compressive strength. The other strength such as flexural strength, split tensile strength are all ultimately depends on compressive strength of concrete. The strength of concrete never depends on strength of aggregate or the strength of the cement mortar matrix. But it depends on the interfacial transition zone except in light weight aggregate concrete. Here an attempt is made to test SCC for all three above said strengths and the behavior of SCC of grade M40 with silica fume and without silica fume is tested. The advantage of using aggregate of 6mm and less is justified with the amount of cement and its compressive strength.***

Keywords: Compressive Strength of SCC, Split tensile strength of SCC, Flexural strength of SCC

1. Introduction

All structural elements required strength to support the all different loads which are encountered in its service life time of the structure. Strength means the Compressive strength. Other strengths such as Flexural strength, Shear strength, Torsional strength and Bond strength are all depends on the compressive strength of concrete. Because it can be easily evaluated in laboratory and a relationship can be established with the above said strength parameters. Usually now according to IS-456 Code the minimum grade of concrete used for structural work except foundation is M20 and above. The aggregate size usually used to design the mix is 10mm to 20 mm size. Water cement ratio used is around 0.4 to 0.5 in Industry. So here an attempt is made with aggregates of size 6mm and below which requires more water cement ratio and cement content to obtain the design strength. The cement content is restricted to 450 kg/cum and water cement ratio of 0.4.

2. Methodology

Here we are considering SCCof mix M40 with water cement ratio of 0.4 and cement content less than 450kg/cum for sever environmental condition. The cement is replaced by silica fume of 5%, 10% and 20% with standard super plasticizer and viscosity modifying admixture. The three different tests are conducted for 7 days and 28 days and the results are tabulated.

The tests on Cubes, cylinders and beams of standard sizes are considered and for each replacement of silica fume the mix design is performed and its Cement content, water cement ratio, Super Plasticizer and VMA dosage is considered and the test results are tabulated.

Here no assumption on any parameters of concrete ingredients or mix design is made. Here the aggregate of lesser sizes are used and its strength, its behavior is studied with the different parentage of silica fumes and its result is justified.

Table 1: Mix Design of SCC

Silica Fume added in %	Cement Kg/cum	Silica Fume Kg/cum	Fine aggregate Kg/cum	Coarse aggregate Kg/cum	Water Kg/cum	Super Plasticizer %	VMA %
0	398	0.200	825.25	1006.5	179	3	2
5	415.91	21.84	825.25	1006.5	179	3	2
10	394.02	43.67	825.25	1006.5	179	3	2
20	350.24	87.56	825.25	1006.5	179	3	2

Table 2: Compressive strength

Percentage od Admixtures added	7 Days	28 Days
0	19.62	37.82
5	20.51	39.04
10	22.75	40.22
20	18.78	34.6

Table 3: Split Tensile strength

Percentage od Admixtures added	7 Days	28 Days
0	1.346	2.57
5	1.96	2.86
10	2.36	3.05
20	1.251	2.67

Table 4: Flexural Strength

Percentage od Admixtures added	7 Days	28 Days
0	1.1	2.05
5	1.23	2.25
10	1.38	2.25
20	1.05	2.04

3. Results and Discussion

Usually for normal concrete of grade M40, for sever exposure condition, with water cement ratio varying from 0.4 to 0.45, the cement content required is about 350 kg/cum.(IS-10263- Concrete Mix design) .Here the cement content used is varying from 350 kg/cum to 420 kg/cum which is less than 450 kg/cum. This indicates that to obtain the M40 strength the cement content required is more because aggregate size is 6mm and less with rough texture. The water cement ratio used is 0.4 and we obtain harsh mix so a standard super plasticizer with VMA indicates that as aggregate size goes on less it requires more cement and more water cement ratio to obtain the required workability and consistency. Here the aggregate quantity ,water content, plasticizer and VMA dosage is kept constant and the cement is replaced by silica fume to obtain the required strength.(Table1)

From Table 2 clearly indicated that 7 days and 28 days strength gives the following predictions:

1) At zero percentage the strength at 28 day is less than 40 MPa, it indicates that without silica fume the workability and the compaction factor of SCC is les. Because it is not achieved the required compaction density. So it indicates that even with super plasticizer and VMA the workability and flow ability to achieve the required density to obtain the Compressive strength is not achieved.
2) When the silica fume content is increased from zero to 5 and 10 percent the strength is approximately achieved indicating the workability and compaction of SCC is improved.
3) When it increases to 20 percentage again the compressive strength decrease indicating that the mix becomes non cohesive and it is not attaining the required strength.

From Table 3 spit tensile strength indicates that the cylinder with 10 percentage of silica fume gives good split tensile strength. Also from Table 2, the compressive strength at 10 % replacement gives good strength. So we can come to a conclusion that the relationship between compressive strength and split tensile strength is justified.

From Table 4: The flexural strength also indicates the same evidence that 10 % replacement of silica fume improves the Flexural strength Parameter.

4. Conclusion

Instead of using ordinary concrete of M40, with usual ingredients of concrete, it can be prepared by replacing cement by 10 percent. It indicates from the above table that the strength obtained is almost same as ordinary M40 concrete. By replacing the OPC by silica fume indicates the cost justification with utilization of Industrial waste. Here the method is same as usual concrete mix design but using the less size aggregate which may be considered as waste in some important construction considerations. The adoptability and gaining of strength is same as that of ordinary M40 grade concrete.

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