

## V – 22 MIX PROPORTION AND BASIC PROPERTIES OF STEEL FIBER REINFORCED SELF-COMPACTING CONCRETE

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### 1. Introduction

Self-compacting concrete is, by itself, a high performance concrete, which eliminates consolidation works, increased the reliability and durability of structures [1]. If such concrete can be reinforced by steel fiber, it may represent a good alternative in the design of industrial floors, direct floors, tunnel lining, warehouses etc [2], [3]. Plain concrete has relatively low tensile strength and it becomes brittle materials as compressive strength increases. Shrinkage cracking is one of the more common causes of cracking in concrete walls, slabs, and pavements in plain concrete. One of the methods to reduce the adverse effects of shrinkage cracking is reinforcing concrete with short, randomly distributed fibers. Only 0.25 percent of fiber by volume can substantially reduce crack widths resulting from restrained drying shrinkage [4]. Many research work have been done to improve concrete properties by adding short length fibers and proved that inclusion of short fiber in plain concrete enhance it's mechanical properties. Addition of fibers has shown to improve the ductility of normal and high strength concrete [2]. Short fiber also reduces the shrinkage by 20% reported by Swamy and Stavrides [5].

### 2. Experiment

#### 2.1 Materials

Materials used as follows. Portland cement sp. gr. 3.16, Blaine' value 3270 cm<sup>2</sup>/gm. Natural sand sp. gr. 2.63, unit wt 1.24 gm/cm<sup>3</sup>, FM=3.04. Crushed stone sp. gr. 2.62, unit wt 1.62 gm/cm<sup>3</sup>, maximum size 19 mm, FM=6.51, and absorption 1.41%. Steel fiber hooked ended,  $\phi$ =0.6 and 0.8 mm, length=30 mm. Viscosity agent  $\beta$ -1, 3-glucan. Air reducing agent derivated polyalkyleneglycol. Superplasticizer polycarboxylicether sp. gr. 1.04-1.06.

#### 2.2 Mix Proportion

Table 1 shows the mix proportion of the constituents and their content per cubic meter of concrete

Table 1 Mix proportion

Mix no	Steel fiber type	Fiber cont. %	Air cont. %	w/c (%)	s/a (%)	Unit weight kg/m <sup>3</sup>									
						Water	SP *	Cement	Fine Aggr.	Coarse Aggr.	Steel fiber	VA **	ARA ***		
0-0-05		0	2.5	39	0.598	188	7.5	500	978	653	0	0.5	0		
0-0-10												1.0			
0-0-15												1.5			
10-8-05	30/0.8 cx	1			0.587	190	8.67	510	933	653	78	0.5	30.6 gm		
10-8-10															1.0
10-8-15															1.5
10-8-20															2.0

\*SP= superplasticizer, \*\*VA= viscosity agent, \*\*\*ARA= air reducing agent

Mix number is to be read, as first number is the percentage of fiber volume (10 for 1 % of fiber) the second number after hyphen indicates the fiber diameter (8 for 0.8 mm) and the last number indicates the dosage of viscosity agent (05, 10, 15, and 20 for 0.5, 1.0, 1.5, and 2.0 kg) per cubic meter of concrete.

In this study, we studied slump flow (measured after 10 minutes from discharge), filling capacity (V-rot, opening 75mm×65mm) of fresh concrete for 19 mixes. Compressive, tensile and flexural strengths are tested for 3

samples for each mix according to JSCE-G 552 and JIS A 1113. 1.5 %, 1%, 0% fiber is added for two different diameter of fiber varying the dosage of viscosity agent as 0.5, 1.0, 1.5 and 2.0 kg/m<sup>3</sup> for each group.

3 Test results and Discussion

Table 2 shows test results of fresh concrete and visual inspection of the mixes

Table 2 Test results of fresh concrete

Mix no.	Steel fiber type	Fiber cont. (%)	Air cont. (%)	w/c (%)	s/a (%)	Slump flow mm	Test box Filling Height mm	Funnel flow time sec	Visual condition of mixes
0-0-05	30/0.8 cx	0	1.2	39	0.598	610	335	6.5	Good
0-0-10			2.3			630	335	10.7	Good
0-0-15			1.2			600	335	9.9	Good
10-8-05		1.0	0.7		0.587	685	315	12.0	Little segregation, foaming
10-8-10			2.2			620	320	10.0	Good
10-8-15			2.8			480	285	20.0	Good
10-8-20			3.2			540	310	34.0	Good

Mix containing 1 % of fiber ( $\phi=0.8$  mm) and viscosity agent 1 kg/m<sup>3</sup> has been satisfied the required properties of fresh self-compacting concrete. Also it shows a satisfactory strength at its hardened state. Other mix of this group passes the filling capacity test but shows segregation tendency and reduced in slump flow for the mix containing viscosity agent 0.5 kg/m<sup>3</sup> and 1.5 kg/m<sup>3</sup> respectively.

The higher percentage and more number of fiber causes blockage of fresh concrete in filling tester and in funnel (V-rot) and neither depend on the dosage of superplasticizer nor on viscosity agent it depends on the number of fiber per cubic meter of concrete. This study also shows that, there is a correlation between the two ingredients of self-compacting concrete, superplasticizer and viscosity agent which controls segregation as well as stiffening of fresh concrete. For this kind of superplasticizer and viscosity agent the ratio of viscosity agent to superplasticizer 0.05-0.12 is compatible for steel fiber reinforced self-compacting concrete.

4. Conclusion

Investigation shows that steel fiber reinforced self-compacting concrete is possible by using the optimal combination of steel fiber volume, superplasticizer, viscosity agent and air reducing agent. The properties of fresh concrete depend on (a) Number of fiber per unit volume of concrete. (b) Fiber length (c) VA/SP ratio (d) Aggregate content.

References

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