A Parametric Study of Self Compacting Concrete Using Fibres

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Abstract- *Portland cement is a very commonly used construction material. Concrete made with this cement has certain characteristics. It is relatively strong in compression but weak in tension and tends to be brittle. The weakness in tension can be overcome by the use of sufficient volume fraction of certain Fibers.In order to improve the mechanical properties of concrete it is good to mix cement with Fiber which have good tensile strength. Adding Fibers to concrete greatly increases the toughness of the material. Making concrete structures without vibration have been done in the past. For examples placement of concrete under water is done by the use of tremie without vibration. Mass concrete and shaft concrete can be successfully placed without vibration.*

Keywords- Fibre reinforced concrte(FRC) , Steel Fiber,Glass Fiber, Polypropylene Fibre reinforced concrete

I. INTRODUCTION

Portland cement is a very commonly used construction material. Concrete made with this cement has certain characteristics. It is relatively strong in compression but weak in tension and tends to be brittle. Because of the load and environmental changes, a micro crack appears in cement products. Therefore cement based materials have low tensile strength and cause brittle failure. Cement mortar and concrete made with Portland cement is a kind of most commonly used construction material in the world. These materials have inherently brittle nature and have some dramatic disadvantages such as poor deformability and weak crack resistance in the practical usage.

The weakness in tension can be overcome by the use of sufficient volume fraction of certain Fibers.In order to improve the mechanical properties of concrete it is good to mix cement with Fiber which have good tensile strength. Adding Fibers to concrete greatly increases the toughness of the material.

The use of Fibers also alters the behavior of the Fiber matrix composite after it has cracked, thereby improving its toughness. Fiber Reinforced Concrete is concrete containing fibrous material which increases its structural integrity. It contains short discrete Fibers that are uniformly distributed and randomly oriented. Fibers include steel Fibers, glass Fibers, synthetic fibers and natural fibers each of which lend varying properties to the concrete.

In addition, the character of fiber reinforced concrete changes with varying concretes, fiber materials, geometries, distribution, orientation, and densities. In a hybrid, two or more different types of fibers are rationally combined to produce a composite that derives benefits from each of the individual fibers.

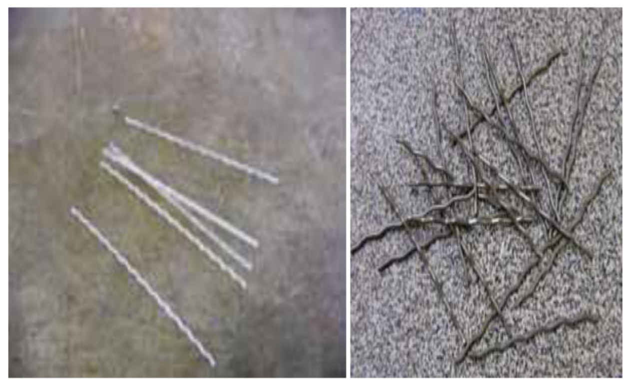

Figure 1.

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
- Improving durability
- Greater freedom in design
- Thinner concrete sections
- Reduced noise level
- Safer working environment

II. LITERATURE REVIEW

Durable fiber reinforced self-compacting concrete. Elsevier Science Ltd. 2003

- The concrete, which was prepared to manufacture thin precast elements for nonstructural applications, met both the self-compaction and mechanical requirements. The fiber addition proved to be very effective in counteracting drying shrinkage of self-compacting concrete, which is usually a great problem for this material, rich in powders and poor in the coarse aggregate fraction. Due to the very low porosity of its cementitious matrix, the rate of chloride ion diffusion was low. The resistance to freezing and thawing was moderate and can be improved by the superficial application of a hydrophobic agent, which notoriously reduces water ingress into concrete. However, reminding of the type of applications to which the thin precast elements are devoted, self-compacting concrete durability is most satisfactory and it appears competitive with other materials in manufacturing these elements.

Parameter-study on the influence of steel fibers and coarse aggregate content on the fresh properties of self-compacting concrete. Elsevier Science Ltd. 2001

- This paper describes the results of an experimental study performed to gain insight into the parameters that influence the flow mechanisms of self-compacting fiber-reinforced concrete. During this parameter-study two reference mixtures and 20 steel fiber-reinforced mixtures were tested. High deformability, segregation resistance and passing ability are characteristics that define the quality of SCC. Fibers do affect the workability of plain concrete; this study was performed to answer the question to what extent they affect the properties of SCC in the fresh state. The major findings of the study are: First, a method was proposed to design SCC reinforced with steel fibers. It was experienced that it was useful throughout the experiments.

Comparison between polyolefin fiber reinforced vibrated conventional concreteand self-compacting concrete. Elsevier, 2015

- This paper has examined the influence of the fresh state of PFRC on its mechanical properties and durability. Fracture tests performed on VCC and SCC reinforced with 3, 4.5 and 10 kg/m3 respectively of polyolefin fibers have shown similar behavior, enabling a confident use of PFRC. In addition, the mixes with a 10 kg/m3 dosage of fibers, VCC10 and SCC10, have met the requirements established in the standards that permit consideration of the contribution of the fibers in the structural design of a PFRC element. The differences in fracture behavior observed have been studied by analyzing the fracture surfaces generated. This has been performed by means of a counting procedure that showed that SCC seems to distribute the fibers more homogeneously within the specimen length. Moreover, the effect of the walls of the moulds seemed to have a significant influence on the positioning of the fibers in VCC specimens. This phenomenon has been assessed by Dividing the fracture surface generated in nine equal sectors and comparing the fibers found with an ideal disposition of the fibers within such a section.

III. METHODOLOGY

Test Done on Ingredients

1) Natural Coarse Aggregates

- Abrasion Value
- Impact Value
- Crushing Value
- Water Absorption
- Specific Gravity
- Fineness Modulus

2) Sand

- Water absorption
- Specific Gravity
- Silt Content
- Fineness Modulus

IV. PROPERTIES OF MATERIAL

Cement

Physical properties of cement

Table 1.

Sr. No.	Test	Result
1	Consistency	32.50%
2	Initial setting time	105
3	Final setting time	235
4	Soundness	2.45
5	Compressive strength after 3-days	29.39
6	Compressive strength after 7-days	39.52
7	Compressive strength after 28-days	57.18

1) CoarseAggregates

Physical Properties of C.A.

Table 2

Sr. No.	TYPE OF TEST	IS METHOD	20 mm DN	10 mm DN	REQUIREMENT
1	Water Absorption, %	IS:2386 (Part-3):1963 Reaffirmed 2011	0.95	0.9	-
2	Specific Gravity		2.875	2.85	-
3	Density, gm/cc		1.504	1.489	-
4	Impact Value, %	IS:2386 (Part-4):1963 Reaffirmed 2011	9.86	-	**Shall be <45%**
5	Crushing Value, %		11.24	14.15	**Shall be <45%**
6	Flakiness Index, %	IS:2386 (Part-1):1963 Reaffirmed 2011	11.56	12.59	**Combined Shall be < 30% (As Per MoRTH)**
7	Elongation Index, %		10.24	13.24	

2) Fine Aggregates

Physical Properties of F.A.

Table 3.

Sr. No.	PROPERTIES	Sr. No.
1	Zone Classification	II
2	Fineness Modulus	2.79
3	Silt Content,%	0.25
4	Density, gm/cc	1.56
5	Specific Gravity	2.66

3) Polypropylene Fibre

Table 4.

Appearance	White Fibers
Specific Gravity	0.91
Melting Point	165° C
Diameter	30 Micron
Length	12mm
Aspect Ration	400
Absorbency	< 0.1%.
Tensile Strength, N/mm^2	750

4) Steel Fibre

Table 5.

Base material	Carbon Steel fiber
Grade of steel	AISI steel 304
Fiber type	corrugated, Hooked end
Length (mm)	13mm
Diameter (mm)	0.60mm
UTS N/Mm^2	1000-1400±15%

V. RESULTS

Slump test of SCC without Fiber

Table 6.

DESIGN	CASTING DATE	SP %	W/P Ratio	SLUMP (MM)
1	03/01/2017	0.50	0.96	765

Slump Test (PF SCC)

Table 7

DESIGN	CASTING DATE	SP %	W/P Ratio	FIBER, % by weight of Cementations Material PF	SLUMP (MM)
2	05/01/2017	0.60	0.96	0.25	723
3	07/01/2017	0.65	0.96	0.50	745
4	10/01/2017	0.70	0.96	1.00	680
5	13/01/2017	0.73	0.96	1.50	690
6	17/01/2017	0.81	0.96	2.00	720

Flexural Strength

Table 8.

DESIGN	CASTING DATE	FIBER, % by weight of Cementatious Material				BEAM (Flexural Strength), N/mm^2	
		CF	PF	SF	GF	7 days	28 Days
1	03-01-2017	-	-	-	-	3.45	4.34
2	05-01-2017	-	0.3	-	-	3.49	4.41
3	07-01-2017	-	0.5	-		3.56	4.48
4	10-01-2017	-	1	-	-	3.58	4.51
5	13-01-2017	-	1.5	-	-	3.62	4.56
6	17-01-2017	-	2	-	-	3.45	4.36
7	23-01-2017	0.3	-	-	-	3.42	4.31
8	26-01-2017	0.5	-	-	-	3.49	4.39
9	28-01-2017	1	-	-	-	3.55	4.48
10	01-02-2017	1.5	-	-	-	3.53	4.45
11	05-02-2017	2	-	-	-	3.52	4.41

SCC Compressive Test of Steel fiber Concrete

Table 9.

DESIGN	SP, %	PF, %	CUBE (Compressive Strength), N/mm^2	
			7 Days	28 Days
12	0.60	0.25	32.46	41.44
13	0.60	0.50	34.58	44.78
14	0.60	1.00	35.82	46.23
15	0.60	1.50	37.16	47.98
16	0.60	2.00	37.89	48.27
17	0.60	10.00	39.56	49.53
18	0.60	15.00	40.23	51.43
19	0.60	20.00	40.36	51.56

Compressive Test of Glass fiber Concrete

Table 10.

DESIGN	SP, %	PF, %	CUBE (Compressive Strength), N/mm^2	
			7 Days	28 Days
20	0.60	0.25	32.01	40.55
21	0.70	0.50	32.89	41.23
22	0.72	1.00	33.01	41.96
23	0.75	1.50	34.15	43.13
24	0.83	2.00	33.62	41.29

Split tensile strength

Table 11.

DESIGN	CASTING DATE	FIBER, % by weight of Cementatious Material				CYLINDER (Split Tensile Strength), N/mm^2	
		CF	PF	SF	GF	7 days	28 Days
1	03-01-2017	-	-	-	-	2.98	3.78
2	05-01-2017	-	0.25	-	-	3.05	3.86
3	07-01-2017	-	0.50	-		3.06	3.88
4	10-01-2017	-	1.00	-	-	3.09	3.91
5	13-01-2017	-	1.50	-	-	3.08	3.93
6	17-01-2017	-	2.00	-	-	2.98	3.83
7	23-01-2017	0.25	-	-	-	2.97	3.80
8	26-01-2017	0.50	-	-	-	3.01	3.89
9	28-01-2017	1.00	-	-	-	3.11	4.01
10	01-02-2017	1.50	-	-	-	3.08	3.96
11	05-02-2017	2.00	-	-	-	3.06	3.93
12	08-02-2017	-	-	0.25	-	3.04	3.91

V. CONCLUSION

- As per above results we observed that upto 56 days strength polyester fibre perform well.
- In compressive strength it gives higher compressive strenth than normal concrete mixes. Here results after 90 days is missed.
- Same as higher stregnth observed in split tensile strength as well as flexural stregnth increased.
- In workability there difficulty observed. It didn’t give proper flow of concrete as per normal concrete.
- To getting workability here we used superplasticizers.

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