

Self Compacting Fibre Reinforced Concrete - A Review

Jayanta Chakraborty¹, Sulagno Banerjee²

¹PG Student, RKDF Institute of Science & Technology, SarvepalliRadhakrishnan University

²Assistant Professor, Seacom Engineering College, Howrah Dhulagarh

Abstract

It has been widely accepted that in concrete industry the conventional concrete mixes also suffer to plastic shrinkage during the setting period and even can often lead to cracking. Hence mixing of relatively small quantity of fibre can satisfactorily diminish this crunch by regulating the early age plastic shrinkage cracking. This paper discusses in detail a comprehensive review on various aspects of Glass and Steel Fibre Reinforced Self Compacting Concrete in regards to behaviour, applications and performance.

Keywords: Fibre Reinforced Self Compacting Concrete, Glass Fibres, Steel Fibres, And Mechanical Properties.

I. INTRODUCTION

“Fibre reinforced self-compacted concrete”(FRSCC) can be produced from cement, different sizes of aggregates, which incorporate with fibres. Fibre reinforced concrete can be explained as concrete having dispersed randomly oriented fibres. Generally concrete is brittle under tensile loading but mechanical properties of concrete may be improved by randomly oriented discrete fibres which prevent as well as control origination, propagation or merging of cracks. The fibres with adequate mechanical properties, being incorporated into concrete mix improves various properties such as toughness, increase resistance to fatigue, impact and also reduces spalling of the reinforcement cover and improves abrasion resistance flexural and shear strength. The contribution of fibres to each mechanical and durability characteristics depend on types of fibre , configuration, volume fraction aspect ratio and different mixture parameters. Glassfibres increases the strength of the concrete and decreases its unit weight.

A. Glass Fibres

Glass fibre is generally known as fiberglass. It is material made from extremely fine fibres of glass. Glass fibres are not heavy but, extremely strong, and robust. Interestingly the strength is lesser than that of carbon fibre and it is less stiff, less brittle. The raw materials of glass fibres are less expensive. Due to the extensive surface area to weight ratio, glass fibres are favourable. On the other hand the extensive surface area leads to chemical attack. By holding air within them, glass fibre gives maximum insulation to

heat. As compared to carbon fibre, glass fibre is more expensive. It has high tensile strength of about 1690 Mpa, approximately four times higher than that of steel. The elastic modulus of glass fibres is ten times higher than that of polypropylene fibres. Finally these fibres are alkali resistant. For better performance, the recommended dosage rate of glass fibres is 0.6 kg/m³.



Fig:1

B. Steel Fibres

In the building industry steel fibre is widely used. There are different types of steel fibres such as wave cut, end large steel fibre, deformed sheet and also hooked end steel fibre. Steel fibres improve several characteristics and properties of the concrete. It should be noted that the addition of steel fibres does not affect considerably the compressive strength and the modulus of elasticity of concrete. On the other hand it has a great impact on the residual tensile strength and flexural strength.



Fig:2

C. Need of Fibres in SCC

Addition of fibres improves the strength of concrete and the problem of developing microcracks with curing in self compacting concrete can be overcome by use of glass in concrete. Glass fibres supplies strength to the concrete whereas the matrix protects the fibres.

The primary role of fibres in a cementitious composite is to control cracks as well as to increase the tensile strength, toughness. The fibres also improve the deformation characteristics of the composite. Inclusion of glass fibres reduces the water permeability and increases the flexural strength due to its high modulus of elasticity. Energy is absorbed and cracking is reduced whenever the fibres are pulled out in the post cracking stage.

II. LITERATURE REVIEW

A. Workability

Abbas AL-Ameeri et al [1] observed the fresh properties of SCC with steel fibre. It has been indicated that there is reduction in workability with increase of steel fibre content.

1) Compressive Strength

One of the most important properties of concrete is the compressive strength of concrete. The quality of concrete is greatly related to compressive strength of concrete. Failure of concrete under compression indicates a mixture of crushing and shear failure. The particular strength depends on both cement paste and fibres. It is mentioned that higher binder ratio gives higher compressive strength.

Ganeshan. N et al [2] observed that the compressive strength improved on addition of 0.5% of steel fibres in the concrete. From the Experiment it was found that due to the incorporation of steel fibres the initial crack load and the post cracking performance were enhanced.

Dr. Mrs. S.A. Bhalchandra et al [3] observed that with increase in volume fraction there was hike in compressive strength. There is increase in compressive strength of 25.5% of Steel fibre reinforced SCC over normal SCC for the volume fraction of 1.75%.

M. Mariappan et al [4] observed that by adding 0.25% of steel fibres, compressive strength was increased nearly by 6%, whereas by adding 0.50% of steel fibres, compressive strength has increased nearly by 12% and by adding 0.75% of steel fibres, compressive strength was increased to the extent of 20%.

Shahana Sheril P.T. et al [5] experimented with glass fibres and found that with 0.05%, 0.1%, 0.15% and 0.2% of glass fibre there was an increase of

compressive strength by 8.2%, 9.2%, 7.02% and 3.5% respectively than the SCC without fibre for the M20 grade mixes and with 0.05%, 0.1%, 0.15% and 0.2% of glass fibre there was an increase in compressive strength of 5.1%, 7.1%, 5% and 2.3% respectively than the SCC without fibre for M30 grade mixes.

2) Split Tensile Strength

Dr. Mrs. S.A. Bhalchandra et al [3] observed from the experiment that by the addition of fibres the split tensile strength of the SCC increased. It was also found that the optimum volume fraction of fibres for increase in split tensile strength was 1.7%.

M. Mariappan et al [4] observed that by adding 0.25% of steel fibres, split tensile strength had increased by 54%, whereas by adding 0.50% of steel fibres, split tensile strength had increased nearly by 88% and by adding 0.75% of steel fibres, split tensile strength had increased nearly by double the amount in comparison with the ordinary self compacting concrete.

M. Paja k et al [6] investigated the flexural performance of straight and hooked end steel fibre reinforced self-compacting concrete. The type of steel fibres influences the post-peak performance of SCC. Also the addition of straight steel fibres influence the deflection-softening antiphon. Thus, at ultimate load the deflection of specimens reinforced with straight steel fibres was close to the deflection of conventional specimens. In case of the specimens reinforced with hooked end steel fibres the deflection at the ultimate load was much higher. Generally, Self compacting concrete indicates similar flexural behaviour to conventional concrete.

3) Flexural Strength

P. Srinivasa Rao et al [7] experimented that the addition of glass fibre in the self compacting concrete mix reduces bleeding, as well as reduces the probability of cracks and improves the surface integrity and homogeneity of concrete. It was also observed that the presence of glass fibres in glass fibre reinforced self compacting concrete beams had not improved any flexural strength.

Vinayak B. Jatale et al [8] found that by the incorporation of steel fibres in SCC increased the flexural strength to a great extent in comparison to conventional concrete. It had also been observed that the maximum value of flexural strength gave the WSF at 3.5% fibres content.

Abbas AL-Ameeri et al [1] observed that the optimum content of steel fibre was 0.75% to 1% at higher performance level. The increase in volume fraction of fibres increased the strengths correspondently. On the other hand the increase in fibres slightly decreased the U.P.V.

III. CONCLUSION

In view of the above discussions we can conclude as under :-

- a) Glass fibre reduces the possibility of cracks and improves the surface integrity as well as its homogeneity by the reduction in bleeding.
- b) Workability of self compacting concrete decreases with increase in steel fibre volume fraction. However, higher workability can be achieved with the addition of high range water reducers.
- c) Glass fibres increases the strength of concrete, without causing any problems.
- d) The addition of steel and glass fibres increases the compressive strength to a great extent .
- e) The addition of steel and glass fibres improves the durability and the fracture parameters of concrete.

REFERENCES

- [1] Abbas AL-Ameeri, "The Effect of Steel Fibre on Some Mechanical Properties of Self Compacting Concrete", American Journal of Civil Engineering, Vol. 1, No.3, 2013, pp. 102-110. doi:10.11648/j.ajce.20130103.14.
- [2] Ganesan.N, Indira. P.V & Santhosh Kumar P.T, "Strength and Behaviour of Steel Fibre Reinforced Self Compacting Concrete in Flexure", International conference on Advances in Concrete, Composites and Structures, held at SERC, Chennai, 6-8 January, 2005 PP 475-484.
- [3] Dr. Mrs. S.A. Bhalchandra and Pawase Amit Bajirao, "Performance of Steel Fibre Reinforced Self Compacting Concrete", International Journal Of Computational Engineering Research (ijceronline.com) Vol. 2 Issue. 4.
- [4] M. Mariappan and R. Rajesh Guna, "Structural Performance of Self Compacting Fibre Reinforced Concrete", International Journal of Science and Research (IJSR).
- [5] ShahanaSheril P.T., "Self Compacting Concrete Using Fly Ash and Glass Fibre", International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 2 Issue 9, September – 2013.
- [6] M. Paja k and T. Ponikiewski, "Flexural behaviour of self-compacting concrete reinforced with different types of steel fibres", Construction and Building Materials 47 (2013) 397-408.
- [7] P Srinivasa Rao, G K Vishawanadh, P Sravana and T SeshadriSekhar, "Flexural Behaviour Of Reinforced Concrete Beams Using Self Compacting Concrete", 34th Conference on OUR WORLD IN CONCRETE & STRUCTURES : 16-18 August 2009, Singapore.
- [8] Vinayak B. Jatale and M. N. Mangulkar, "Flexural Behavior of Self Compacting High Strength Fibre Reinforced Concrete (SCHSFRC)", International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622, Vol. 3, Issue 4, Jul-Aug 2013, pp. 2503-2505.