Indian J.Sci.Res. 17 (1): 107-109, 2017
ISSN: 0976-2876 (Print)
ISSN: 2250-0138 (Online)

AN EXPERIMENTAL STUDY ON FLEXURAL BEHAVIOR OF SELF COMPACTING CONCRETE USING PARTIAL REPLACEMENT OF CEMENT WITH STEEL FIBER

P. KARTHIKA[a1], S. KARTHIKRAJA[b] AND P. SETHUPATHI[c]

[a]Department of Civil Engineering, Nandha Engineering College, Erode, India
[b]Department of Civil Engineering, Mahendra Institute of Engineering and Technology, Mallasamudram, Namakkal, India
[c]Department of Civil Engineering, Sri Shanmugha College of Engineering and Technology, Sankari, India

ABSTRACT

Conventional concrete tends to present a problem with regard to adequate compaction in thin sections or areas of congested reinforcement, which leads to a large volume of entrapped air voids and compromises the strength and durability of the concrete. Self-Compacting Concrete (SCC) can minimize this problem since it was designed to compact under its own mass. For such application, the fresh concrete must possess high fluidity and good cohesiveness. The aim of the study is to investigate the flexural behavior of self compacting concrete (SCC) beams using steel fiber along with an addition of super plasticizer as admixture. It is proposed to use of steel fiber materials in the fresh concrete M30 grade 0%, 0.5%, 1%, 1.5% replacement of cement. Tests on fresh concrete were done to determine its workability. In this investigation, the properties of self compacting concrete with or without steel fibre concrete were determined by conducting slump flow test were determined. It is found that the compressive strength of SCC with 1% of steel fibre have 45.04N/mm2 which about 17% more than M30 grade concrete and the tensile strength of SCC with 1.5% of steel fibre have 4.41N/mm^2 which is about 18% more than ordinary concrete.

KEYWORDS: Self Compacting Concrete, Steel Fiber, Flexural Strength, Fiber Self Compacting Concrete.

Fibre reinforced concrete is relatively a new construction material developed through extensive research and development work during the last two decades. It has already found a wide range of practical applications and proved to be reliable construction material having superior performance characteristics compared to conventional concrete. Incorporation of fibre in concrete has found to improve several properties like tensile strength, cracking resistance, impact and wear resistance, ductility and fatigue resistance. Many fibres like asbestos, steel, nylon, coir, etc. have been used in the past. Out of these asbestos fibres concrete is successful although its exposure is detrimental to the health of human beings.

Use of SCC overcomes the problem of concrete placement in heavily reinforced sections and it helps to shorten construction period. Although concrete is a widely used construction material, it has major disadvantages such as low tensile strength and low strength to weight ratio, and it is liable to cracking. Self Compacting Concrete (SCC) as the name signifies should be able to compact itself without any additional vibration or compaction. Self compacting concrete should compact itself weight and under gravity. The SCC is that which gets compacted due to its self-weight and is deaerated (no entrapped air) almost completely while flowing in the form work. In densely reinforced structural members, it fills completely all the voids and gaps and maintains nearly horizontal concrete level after it is placed.

STEEL FIBRE

Fibre is a small piece of reinforcing material possessing certain characteristics properties. They can be circular or flat. The fibre is often described by a convenient parameter called aspect ratio. The aspect ratio of the fibre is the ratio of length and its diameter. Typically aspect ratio ranges from 30 to 150. fibre efficiency increases with increase in “Aspect ratio”.

Plain concrete possess a very low tensile strength, limited ductility and little resistance to cracking. Internal micro cracks are inherently present in the concrete and its poor tensile strength is due to the propagation of such micro cracks, eventually leading to brittle fracture of the concrete. In plain concrete and brittle materials, structural cracks (micro cracks) develop even before loading, particularly due to drying shrinkage or other cause of volume change. The width of these initial cracks seldom exceeds a few microns, but other two dimensions may be of higher magnitude (Table 1).

Table 1: Properties of steel fiber

Specific Gravity	7.86
Tensile strength N/mm2	400 – 1200
Young’s modulus GN/m2	200
Elongation at failure %	3.5

[1]**Corresponding author**

LITERATURE REVIEW

Ali R. Khaloo et.al investigated on the influence of length and volumetric percentage of steel fibres on energy absorption of concrete slabs with various concrete strengths by testing 28 small steel fibre reinforced concrete (SFRC) slabs under flexure. Test results indicate that generally longer fibres and higher fibre content provide higher energy absorption. The results are compared with a theoretical prediction based on random distribution of fibres. The theoretical method resulted in higher energy absorption than that obtained in experiment. A design method according to allowable deflection is proposed for SFRC slabs within the range of fibre volumetric percentages used in the study. The method predicts resisting moment–deflection curve satisfactorily.

Jeffery R. Roesler et.al conducted monotonic load tests on plain and fiber-reinforced concrete slabs on ground to monitor the effect of fiber type and dosage on the strength properties of concrete slabs. The results revealed that simple material tests do not always successfully predict the contribution of fibers in cases where structural geometry and boundary considerations control redistribution of load. The tensile cracking loads of plain and fibrous slabs were found to be similar, which had previously been reported for small- scale fiber specimens, but, there was a significant increase in the flexural strength of fiber-reinforced concrete slabs, relative to plain concrete slabs. Companion beam flexural strength tests also significantly underestimated the concrete slab flexural strength for both the plain and fibrous concrete slabs. The addition of fibers increased the collapse load of slabs, with the key factors affecting the magnitude of the collapse load being fiber type and quantity. Strain and deflection profile measurements showed that fibers assisted in crack propagation resistance, crack bridging, and load redistribution. The shape of the load deflection curves indicated that the synthetic and the steel-fiber-reinforced concrete slabs behaved similarly at different stages of cracking.

Uday Kumar et.al. investigated p to study the flexural behaviour of RC slabs reinforced with glass fibre reinforced plastic (GFRP) rebars. The RC slabs had a width of 500 mm, depth of 100 mm and had an overall length of 2200 mm. In all, eight numbers of RC slabs, including control specimens reinforced with high strength deformed (HSD) rebars were investigated in the present study. The parameters investigated were two types of GFRP rebars and percentage of reinforcement. The cracking load and load-deflection behaviour up to cracking load were almost the same for the RC slabs reinforced with HSD and GFRP rebars. The load carried by the RC slab reinforced with GFRP rebar was only 40% - 50% of ultimate load of the RC slabs reinforced with HSD rebars at a deflection corresponding to ultimate load of RC slab reinforced with HSD rebar. However, at 50 mm deflection, the load carried by RC slab with plain GFRP rebars was nearly the same as the ultimate load of the RC slab with HSD rebar. For the RC slab with ribbed GFRP rebars, it was 10% more than that of the RC slab with HSD rebar.

MATERIALS REQUIRED FOR CUBIC METRE

Table 2: Materials required per m^3

Material	Quantity
Cement	288 kg
Water	192 liter
Flyash	192 kg
Fine aggregate	488 kg
Coarse aggregate	1231 kg
Superplasticiser	1% of cement
VMA	0.1% of cement

CASTING OF SPECIMENS

Mould Details

The mould was made up of steel. Cube mould 150 x 150 x 150mm for casting cube test specimens. Cylinder mould 150mm dia and 300mm height for casting cylinder test specimen. Prism mould of 100x100mm cross section and 500mm long for casting flexure test specimens.

Casting Details Of Specimens

The ingredients of the concrete were weighted as per the design mix and hand mixing was adopted. The fresh concrete were cast in the standard mould for further tests. The specimens were demoulded from the mould after 24 hours and were placed in curing tanks.

TEST RESULTS

Test On Fresh Concrete

Table 3: Slump Cone Fresh Concrete Test Result

Mix	Result in mm
SCC+0%	730
SCC+0.5%	685
SCC+1%	670
SCC+1.5%	675

Strength Properties Of Concrete

Compressive Strength Of Cubes

The compressive strength of concrete cube was found for the control concrete and the admixtures used concrete. Table 4 shows the compressive strength of cubes with and without admixture.

Table 4: The Average Compressive strength of cubes in 28 days

Mix	Compressive strength (N/mm^2)
SCC+0%	41.72
SCC+0.5%	42.10
SCC+1%	44.04
SCC+1.5%	41.01

Split Tensile Strength Of Cylinder

The split tensile strength of concrete cylinder was found the control concrete and admixture used concrete as a replacement of cement (Table 5).

Table 5: The Average Split tensile strength of Cylinder in 28 days

Mix	Split tensile strength (N/mm^2)
SCC+0%	3.89
SCC+0.5%	4.20
SCC+1%	4.25
SCC+1.5%	4.42

RESULTS & DISCUSSION

Table 6: Hardened Concrete Properties

Mix	Compressive strength (N/mm^2)	Split tensile strength (N/mm^2)
SCC+0%	41.72	3.89
SCC+0.5%	42.10	4.20
SCC+1%	44.04	4.25
SCC+1.5%	41.01	4.42

It is observed from the test result the compressive strength and tensile strength of self compacting concrete with steel fibre are higher than the normal control concrete (Table 6).

CONCLUSION

- In this project, the mix design for control concrete grade of M30 have been design 1:1.02:2.57. The SCC with fly ash (192Kg), super plasticizer (1% of cement), and VMA (0.1%) mix quantities also arrived. Steel fibres if 0.5, 1.0 and 1.5 percentages are added and the tests have been conducted.
- The compressive and tensile strength of SCC with steel fibres are higher than normal concrete and SCC without fibres
- SCC have better surface finishing than normal concrete.

REFERENCES

Abibasheer B. and Sivakumar A., 2015. Simplified Mix Design Procedures for Steel Fibre Reinforced Self Compacting Concrete, **19**(1).

Darole J.S. and Kulkarni V.P., 2013. Effect of Hybrid Fiber on Mechanical Properties of Concrete, **3**(1).

Kumari T.G. and Puttappa C.G., 2012. Flexural Characteristics Of SFRSCC And SFRNC One Way Slabs, **2**(7).

Rahimi H. and Hutchinson A., 2001. Concrete Beams Strengthened With Externally Bonded FRP Plates, **5**(1). IS 456–2000, Indian code of practice for plain and reinforced concrete.

Murthy N.K. and Rao A.V.N., 2012. Mix Design Procedure for Self Compacting Concrete, **2**(9): 33-41.

Vijayanand M. and Angelescu N., 2010. Flexural Characteristics Of Steel Fibre Reinforced Self Compacting.

Vairagade V.S. and Kene K.S., 2012. Introduction to Steel Fiber Reinforced Concrete on Engineering Performance of Concrete, **1**(4).

Jatale V.B. and Mangulkar M.N., 2013. Performance of Self Compacting High Strength Fiber Reinforced Concrete (SCHSFRC), **7**(4):37-41.