Effect Of Mineral And Chemical Admixture On Fiber Reinforced Self Compacting Concrete

[1]Konda Udaya Devi,[2]M.Vasudev naidu,[3]S.Madan Mohan,[4]S.sanjeeva Rao, [5]S.Sreenatha Reddy

[1]PG student,Department of civil Engineering, Gurunanak institute of technology, JNTUH, [2]Guide:Professor of Civil Engineering, Gurunanak Institute of Technology, JNTUH, [3]HOD:Professor of Civil Engineering, Gurunanak Institute of Technology, JNTUH , [4]Project Co-ordinater:Professor of civil Engineering, Gurunanak Institute of Technology, JNTUH, [5]Principal of Gurunanak Institute of Technology, JNTUH India

ABSTRACT

The objective of this work is to investigate the toughness property of the fiber reinforced self compacting concrete (FRSCC) through experimental studies. Fibers are used to arrest the cracks in the concrete, and also improve the toughness property of the concrete. In this work, different (0.5%, 1.0%, 1.5%, and 2%) percent of steel fibers are added by volume of concrete and (0.5% & 1.0%) percent of poly-propylene are added bye mass of cementious material.
The mix design of self compacting concrete has been done according to the EFNARC guidelines. The limitations also achieved according to the European guidelines. By using different types of fibers the toughness property of the FRSCC has been studied. It has been observed that the toughness increased with increase in % of fibers up to 1.5%. While, increase in % fiber content beyond 1.5% resulted in lower toughness for the steel fibers. It give the only the limitation of steel fiber for SCC is up to 1.5% of volume of concrete. The comparative study also reported for mechanical properties of poly- propylene fiber reinforced self compacting concrete.

LITERATURE REVIEW

GENERAL

Self compacting concrete (SCC) is new design and casting of non conventional architecturally details and shapes. There is no need for compacting that can be flown in to tight and inaccessible spaces without requiring vibration. Fibers are used to reduce shrinkage cracking the presence of fibers in volume fraction increase the modulus of rupture, fracture toughness, and impact resistance. .

2.1 REVIEWS

a) Yakhlaf and Safiuddin (2013) reported the Properties of freshly mixed carbon fibre reinforced self-consolidating Concrete; he examined the effects of discrete pitch-based carbon fibres on the fresh properties of self-consolidating concrete. Different carbon fibre reinforced self-consolidating concrete mixtures were produced incorporating 0%, 0.25%, 0.5%, 0.75% and 1% carbon fibres by concrete volume with two water-to-binder ratios (0.35 and 0.40). The characteristic properties of SCC are determined. The hardened concretes were tested by a Scanning Electron Microscope to observe the distribution of fibres. Carbon fibres were well-distributed and they slightly decreased the unit weight of concrete

b) Vikrant and Kavita (2013) studied the strength of normal concrete using metallic and synthetic fibers, in metallic fibers, steel fibers of hook end with 50, 60 aspect ratio and crimped round (copper coated) of 52.85 aspect ratio containing 0% and 0.5% volume fraction were used without adding admixtures. In synthetic fibers category, fibrillated polypropylene fibers of15 mm, 20 mm and 24 mm cut length at 0.4% by weight of cement were used without adding admixtures. The positive effect of steel fibers with different aspect ratios and fibrillated polypropylene fibers with different cut length in compression and splitting strengths.

c) Corinaldesi and Moriconi (2011) studied the *c*haracterization of self-compacting concretes prepared with different fibers and mineral additions, he prepared self-compacting concrete mixes by using three different types of fibers made of steel, poly-vinyl-alcohol (PVA) and high toughness poly-propylene (PPHT) and two different types of mineral addition (limestone powder and powder from recycled concrete). Excellent performances were generally obtained, particularly for the self-compacting concretes prepared with steel fibers and powder from recycled concrete.

d) Sukontasukku (2004) determined the toughness properties of Steel and Polypropylene Fibre Reinforced Concrete Beam under Bending. In this study, two different methods (ASTM C1018 and JSCE SF-4) are used to measure the toughness of steel and polypropylene fibre reinforced concrete subjected to bending. The obtained information using the four toughness values at different deflections appeared to better clarify the characteristics of both FRCs.

e) Cifuentes and García (2013) he explains the influence of the properties of polypropylene fibres on the fracture behaviour of low-, normal- and high-strength FRC. A geometrical and mechanical property of polypropylene fibres on the fracture parameters and ductility of low, normal, and high-strength fibre-reinforced concrete was determined.

Bouzoubaa (2001) reported the studies on Self-compacting concrete incorporating high volumes of Class-F fly ash, The self-compacting mixtures had a cement replacement of 40%, 50%, and 60% by Class-F fly ash. The results show that an economical SCC could be successfully developed by incorporating high volumes of Class-F fly ash

OBJECTIVES AND SCOPE OF THE STUDY

3.1MAIN OBJECTIVES

The main objective of the project is to determine the toughness of self compacting concrete by adding the steel and poly-propylene fiber.

- An attempt has been made to study the compressive strength, split tensile strength and flexural strength properties of concrete with the use of fly ash in concrete is proved to be effective up to 30 %.
- Prepare the mix design for SSC with reference to EFNARC guideline to achieve the characteristic properties.
- Adding the steel fibers on total volume of concrete and for poly-propylene fiber added based on mass of the binder material.
- To compare the toughness property of the FRSCC using different types of fibers.

3.2 SCOUP OF THE STUDY

- Only steel and poly-propylene fibers are used in the concrete with different percentages.
- The toughness property has been considered in the experimental program. Fibers are used to reduce shrinkage cracking the presence of fibers in volume fraction increase the modulus of rupture, fracture toughness, and impact resistance.

PRILIMINARY TESTS

5.1TESTS ON CEMENT

The Ordinary Portland cement of 53 grades conforming to IS: 8112 1989 was used for the present experimental study. The important properties of this cement have been tested using Vicat apparatus, Le chatelier flask and the results are given Table 6.

5.1.1 CONSISTENCY TEST

The basic aim of this test is to find out the water content required to produce a cement paste of standard consistency as specified by the IS: 4031 (Part 4) – 1988. The principle of standard consistency of cement is that consistency at which the Vicat plunger penetrates to a point 5-7mm from the bottom of Vicat mould.

Procedure to find consistency of cement:

- 300gms of cement is weighed and mixed with a weighed quantity of water the time gauging should be between 3 to 5 minutes.
- The Vicat mould is filled with the paste and leveled with a trowel.
- The plunger is lowered gently till it touches the cement surface.
- The plunger is released allowing it to sink in to the paste and the reading is noted on the gauge.
- The above procedure is repeated taking fresh samples of cement and different quantities of water until the reading on the gauge is 5 to 7mm.

Table.5.1: Consistency of Cement

S. no	Wt of water in (gms) W_1	Wt of cement in (gms) W_2	$(W_2/W_1) \times 10$	Position in (mm)
1	75	300	40	6
2	78	300	38.4	5
3	81	300	37.03	6
4	84	300	35.7	6
5	87	300	34.48	5
6	90	300	33.3	6

As per IS 4031 [1968] it is in a range of 5 to 7 mm hence Pn=30% is taken.

Fig.5.1: Vicat Apparatus

5.1.2 INITIAL SETTING TIME

- Cement paste is prepared by gauging the cement with 0.85 times the water required to give a paste of standard consistency
- Start the stop watch the moment water is added to the cement.
- The Vicat mould should be filled completely with the cement paste gauged as above, the mould resting on a non-porous plate and smooth off the surface of the paste making it level with the top of the mould. The cement block thus prepared in the mould is the test block.
- The test block is placed under the rod bearing needle. Lower the needle gently in order to make contact with the surface of the cement paste and release quickly, allowing it to penetrate the test block. Repeat the procedure till the needle fails to pierce the test block to a point 5.0 ± 0.5mm measured from the bottom of the mould. The time period elapsing between the time, water is added to the cement and the time, the needle fails to pierce the test block by 5.0 ± 0.5mm measured from the bottom of the mould, is the initial setting time.
- The initial setting time of cement was 35 minutes.

5.1.3 FINAL SETTING TIME

The above needle is replaced by the one with an annular attachment. The cement should be considered as finally set when, upon applying the needle gently to the surface of the test block, the needle makes an impression therein, while the attachment fails to do so. The period elapsing between the time, water is added to the cement and the time, the needle makes an impression on the surface of the test block, while the attachment fails to do so, is the final setting time and was about 7hrs.

5.1.4 SPECIFIC GRAVITY OF CEMENT

Specific gravity of cement is found using le-chatelier flask.

- A clean and dry le-chatelier flask is weighed with its stopper (w1).
- A sample of cement is placed up to half of the flask (about 50 Gms) and weighed along with the stopper (w2).
- Kerosene is added to cement in flask till it is half full and thoroughly mixed glass rod to remove entrapped air and stirring is continued and kerosene is added till the graduated mark and weighed as (w3).
- The flask is filled with kerosene up to graduated mark and weighed as (w4) Specific gravity = $[(W_2-W_1)/ (W_2-W_1)-(W_3-W_4) \times 0.79] = 3.15$

Fig. 5.2: Testing on le-Chatelier flask

5.2 SPECIFIC GRAVITY OF FINE AGGREGATE

Specific gravity of fine aggregate is found by using pycnometer.

- The clean and dry pycnometer is weighed along with the lid (W_p).
- Pycnometer is then filled with fine aggregate up to half of it and then weighed (W_{ps}).
- The pycnometer is filled with water up to graduated mark and then weighed (W_a).
- Pycnometer is then filled with water and weighed (W_b).

Specific gravity = $[(W_{ps}-W_p)/ (W_{ps}-W_p) + (W_a-W_b)] = 2.74$

5.3 SPECIFIC GRAVITY OF FLY ASH

Specific gravity of fly ash is found using le-chatelier flask.

- A clean and dry le-chatelier flask is weighed with its stopper (w1).
- A sample of fly ash is placed up to half of the flask (about 30Gms) and weighed along with the stopper (w2).
- Kerosene is added to fly ash in flask till it is half full and thoroughly mixed glass rod to remove entrapped air and stirring is continued and kerosene is added till the graduated mark and weighed as (w3).
- The flask is filled with kerosene up to graduated mark and weighed as (w4).

Specific gravity = $[(W_2-W_1)/ (W_2-W_1)-(W_3-W_4) \times 0.81] = 2.1$

Table .5.2: Test Results on Cement

S.No	Test	Value
1	Specific gravity of cement	3.15
2	Normal consistency of cement	30%
3	Initial setting time of cement	35 minutes
4	Final setting time of cement	6 hrs. 30 min

CONCLUSION

It is concluded from the scope of this study that self compacting concrete with addition of fibers as follow:

The characteristic properties of FRSCC satisfied the European guideline for SCC. The flowablity obtained (640 mm), according to EFNARC (SP1 550-650mm). Addition of (up to 1.5%) steel fibers to SCC, although compressive strength was improved 49.98 MPa, for 2% of steel fibers it decreased slightly 49.09 MPa. By adding the poly-propylene fibers (0.5% and 1.0%) to fresh concrete the compressive strength is increased by 15%. Split tensile strength of steel fibers increased gradually for different volume of fibers 4.7 MPa. For polypropylene (1.0%) fibers split tensile strength was reduced slightly compared with (0.5%) addition of fibers. The flexural strength of concrete for poly-propylene fiber (12.46 MPa) increased gradually for steel fibers marginal decrement (3.9%) by adding 2% volume. The toughness of the steel fibers RSCC is higher as compared to that of PP RSCC. From the above it is concluded that the limitation of steel fiber for SCC is up to 1.5% of volume of concrete. For poly-propylene fiber the limitation is 1.0% of mass of binder material.

REFERENCES

[1] EFNARC Guidelines for self compacting concrete 2004
[2] Bernardinus Herbudiman and Adhi Mulyawan Saptaji (2013). "Self-Compacting Concrete with Recycled Traditional Roof Tile Powder." Procedia Engineering 54 (2013) 805 – 816.
[3] KC Panda & P K Bal (2013), "Properties of self compacting concrete using recycled coarse aggregate." Procedia Engineering 51 (2013) 159 – 164.
[4] L.A. Pereira-de-Oliveira, M.C.S. Nepomuceno, J.P. Castro-Gomes, M.F.C. Vila (2014) "Permeability properties of self Compacting concrete with recycled aggregates coarse" Construction and Building Materials 51 (2014) 113–120.
[5] Gritsada Sua-iam, Natt Makul (2013). "Use of increasing amounts of bagasse ash waste to produce self-compacting concrete by adding limestone powder waste" Journal of Cleaner Production 57 (2013) 308-319.
[6] Valeria Corinaldesi, Giacomo Moriconi (2011), "Characterization of self-compacting concretes prepared with different fibers and mineral additions", Cement & Concrete Composites 33 (2011) 596–601.
[7] M. Pajak, T. Ponikiewski (2013). "Flexural behavior of self-compacting concrete reinforced with different types of steel fibers", Construction and Building Materials 47 (2013) 397–408.
[8] P.L. Domone (2005). "Self-compacting concrete: An analysis of 11 years of case studies" Cement & Concrete Composites 28 (2006) 197–208.
[9] Hui Zhao, Wei Sun (2012). "Effect of initial water-curing period and curing condition on the properties of self-compacting concrete", Materials and Design 35 (2012) 194–200.
[10] H.A.F. Dehwah (2012), "Mechanical properties of self-compacting concrete incorporating quarry dust,

powder, silica fume or fly ash”, Construction and Building Materials 26 (2012) 547–551.

[11] P. Dinakar, M. Kartik Reddy (2013), “Behaviour of self compacting concrete using Portland pozzolana cement with different levels of fly ash”, Materials and Design 46 (2013) 609–616.

[12] Othmane Boukendakdji, El-Hadj Kadri (2012), “Effects of granulated blast furnace slag and superplasticizer type on the fresh properties and compressive strength of self-compacting concrete”, Cement & Concrete Composites 34 (2012) 583–590.

[13] K.M.A. Hossain, M.Lachemi (2013), “Strength and fracture energy characteristics of self-consolidating concrete incorporating polyvinyl alcohol, steel and hybrid fibres”, Construction and Building Materials 45 (2013) 20–29.

[14] Aref Sadeghi Nik, Omid Lotfi Omran (2013), “Estimation of compressive strength of self-compacted concrete with fibers consisting nano-SiO2using ultrasonic pulse velocity”, Construction and Building Materials 44 (2013) 654–662.

[15] I. Merta, E.K. Tschegg (2013), “Fracture energy of natural fibre reinforced concrete”, Construction and Building Materials 40 (2013) 991–997.

[16] Liberato Ferrara, Yon-Dong Park (2007), “A method for mix-design of fiber-reinforced self-compacting concrete”, Cement and Concrete Research 37 (2007) 957–971.

[17] S. Goel, S.P. Singh (2012), “Flexural fatigue strength and failure probability of Self Compacting Fibre Reinforced Concrete beams”, Engineering Structures 40 (2012) 131–140.

[18] Morteza H.A. Beygia, Mohammad T. Kazemi (2013), “The effect of water to cement ratio on fracture parameters and brittleness of self-compacting concrete”, Materials and Design 50 (2013) 267–276.

[19] Mustafa Sahmaran, Alperen Yurtseven (2005), “Workability of hybrid fiber reinforced self-compacting concrete”, Building and Environment 40 (2005) 1672–1677.

[20] Burcu Akcay, Mehmet Ali Tasdemir (2012), “Mechanical behaviour and fibre dispersion of hybrid steel fibre reinforced self-compacting concrete”, Construction and Building Materials 28 (2012) 287–293.