© 2016 IJSRSET | Volume 2 | Issue 3 | Print ISSN : 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

An Experimental Study on Compressive Strength of Steel Fibre Reinforced Concrete using Fibres of different Aspect Ratio

Pratik C. Sane, Dr. G. S. Doiphode

Department of Applied Mechanics & Structural Engineering, Faculty of Engineering and Technology, The Maharaja Sayajirao University, Vadodara, Gujarat, India

ABSTRACT

This paper deals with experimental study of compressive strength of SFRC using fibres with different aspect ratio. Fibre volume fraction was 0%, 0.5%, 1.0%, 1.5% & 2.0% of volume basis. The experiment conducted shows, that steel fibre addition to concrete improves flexural strength and drying shrinkage but decreases workability. Result data shows variation in 28 days compressive strength for M35 Grade of Concrete.

Keywords: SFRC (Steel Fibre Reinforced concrete), Aspect Ratio

I. INTRODUCTION

Concrete is the most widely used construction material in the world due to its ability to get cast in any form and shape. It also replaces old construction materials such as brick and stone masonary.

The strength and durability of concrete can be changed by making appropriate changes in its ingredients like cementitious materials, aggregates and water by adding some special ingredients. Hence concrete is very well suitable for wide range of application. However concrete has some deficiencies as listed below:

1) Low tensile strength
2) Low post cracking capacity
3) Brittleness and low ductility
4) Limited fatigue life
5) Incapable of accommodating large deformations
6) Low impact strength

The presence of micro crack in the mortar-aggregate interface is responsible for the inherent weakness of plain concrete. The weakness can be removed by inclusion of fibres in the mixture. Different types of fibres, such as those used in traditional composite materials can be introduced into the concrete mixture to increase its toughness, or ability to resist crack growth. The fibres help to transfer loads at the internal micro cracks. Such a concrete is called Fibre Reinforced Concrete (FRC).

II. MATERIAL & EXPERIMENTAL

1. Material:

The material used for this work includes Portland Pozzolana Cement, sand, grit, water, steel fibres & super-plasticizer.

Cement: Portland Pozzolana Cement confirming to I.S. 1489:1991 was used for the experimental work.
Sand: Locally available sand Zone-I with specific gravity 2.31 and fineness modulus of 3.29 confirming to I.S. 383:1970.
Coarse Aggregates: Grit of crushed granite stones of 10 mm size having specific gravity of 2.89 and fineness modulus of 3.39 conforming to I.S.-383:1970.
Water: Potable water was used for experimentation.
Super-plasticizer: To impart workability a super-plasticizer 0.5% to 0.7% by weight of cement conforming to BS 5075 Part 3 and ASTM C494:1977 type F was used.
Steel Fibres: In this experiment corrugated steel fibres were used. The aspect ratio adopted was 40.909 &

46.667 having length 45 & 35 mm with diameter 1.10 & 0.75 mm respectively.

2. Experimental Methodology

M-35 concrete was used with 10 mm coarse aggregates. The Concrete Mix Design was carried out based on Indian Standard Guidelines. The relation between various constituent arrived at was 1:1.99:2.07 respectively by weight and water cement ratio of 0.43.

For compressive strength test, cube specimens of dimensions 150 X 150 X 150 mm were cast. Super-plasticizer (0.5% to 0.7% by weight of cement) was added to this. The moulds were filled with 0%, 0.5%, 1.0%, 1.5% and 2.0% fibres. Vibration was given to the moulds using table vibrator. The top surface of the specimen was levelled and finished. After 24 hours the specimens were demoulded and were transferred to curing tank wherein they were allowed to cure for 28 days. After 28 days curing, these cubes were tested on compression testing machine as per I.S. 516-1959. The failure load was noted. In each category each three cubes were tested and their average value is reported. The compressive strength was calculated as follows:
Compressive strength (MPa) = Failure load / Cross sectional area.

II. RESULTS AND DISCUSSION

Experimental Results

Following graphs give compressive strength for M-35 grade of concrete with 0%, 0.5%, 1.0%, 1.5% & 2.0% steel fibres for aspect ratio 40.909 & 46.667.

Table 1 – Compressive Strength of SFRC with 0% fibres with M-35 grade

Compressive strength (MPa)	Average Compressive strength (MPa)
32.70 39.24 34.01	35.32

Table 2 – Compressive Strength of SFRC with 0.5%, 1.0%, 1.5% & 2.0% fibres

Different Aspect Ratio of fibres	For SFRC with 0.5% fibres		For SFRC with 1.0% fibres		For SFRC with 1.5% fibres		For SFRC with 2.0% fibres	
	Compressive Strength (MPa)							
		Avg.		Avg.		Avg.		Avg.
46.667	40.55 35.32 45.78	40.55	45.34 38.80 40.98	41.71	41.42 45.78 39.24	42.15	37.06 39.24 30.52	35.61
40.909	43.60 37.93 48.40	43.31	39.24 41.86 43.60	41.57	38.80 37.06 32.70	36.19	34.01 32.70 38.37	35.03

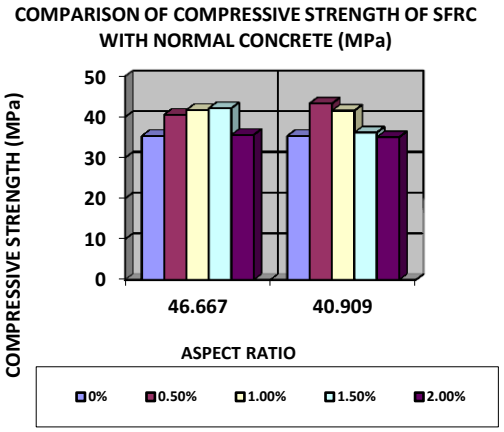

Figure 1. Comparison of compressive strength of SFRC of different aspect ratio with normal concrete

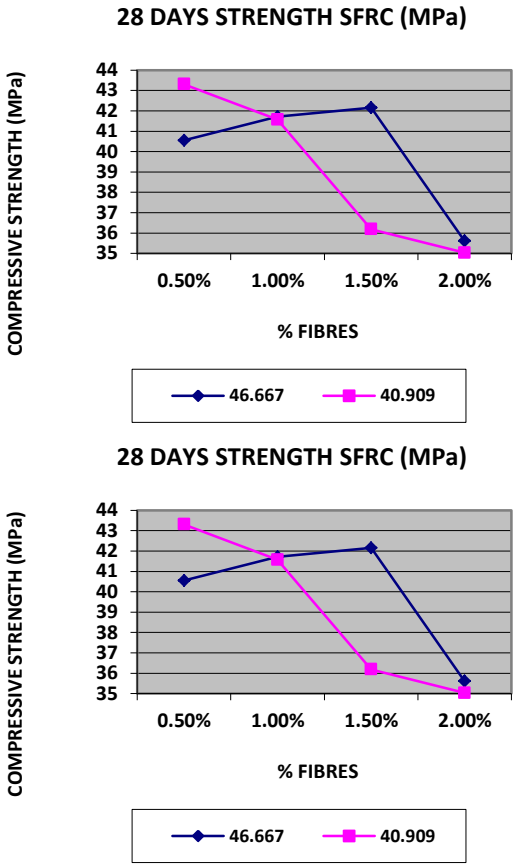

Figure 2. Variation of compressive strength of SFRC for different % of fibres used

Figure 3. Experimental setup of compression test

III. CONCLUSION

The following conclusions can be drawn from the present investigation.

1. Compressive strength is on higher side for 1.5% fibre volume for aspect ratio 46.667 & 0.5% fibre volume for aspect ratio 40.909.
2. As compared to aspect ratio of 40.909 the compressive strength for aspect ratio of 46.667 are on higher side for most of the cases.
3. With either aspect ratio the increase in the compressive strength of concrete for 2% fibre is negligible.

IV. REFERENCES

[1] Perumalsamy N. Balaguru & Surendra P. Shah "Fibre Reinforced Cement Composite".

[2] Bhushan L Karihaloo "Fracture Mechanics & Structural Concrete"

[3] Balaguru P & Najm H (2004) "High Performance Fibre reinforced concrete mixture proportion with high fibre volume fraction", Material Journal, volume 101, issue 4, July 1, 2004 pp281-286

[4] Damgir R.M. & Ishaque M.I.M. (2003) "Effect of silica fume and steel fibre composite on strength properties of High Performance Concrete", proceeding of the INCONTEST 2003, Coimbatore, 10-12 September 2003, PP 281-286

[5] Permalatha J & Govindraj V (2003) "Experimental Studies on Fibre Reinforced Concrete" proceeding of the INCONTEST 2003, Coimbatore, 10-12 September 2003, PP 462-468

[6] Er. Balvir Singh et.al "An Experimental Study on Compressive Strength of Fibre Reinforced Concrete with Fly ash"

[7] IS 456:2000 "Indian Standard Plain & Reinforced Concrete Code of Practice"

[8] IS 383:1970 "Specification for Coarse and Fine Aggregates from natural source"

[9] IS 1489:1991 "Portland Pozzolana Cement Specification"

[10] IS 10262:2009 "Indian Standard Concrete Mix Proportioning - Guidelines"

[11] IS 516:1959 "Indian Standard Methods of Tests for Strength of Concrete"