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MECHANICAL PROPERTIES OF FIBRE - REINFORCED CONCRETE

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Abstract – *Now a days, the waste disposal steel fibre has replaced and widely used in the industrialization. In the present study, steel fibre has been used as a fibre reinforced with numerous Percentage (0%, 0.1%, 0.2%, 0.3% and 0.4%) and AURAMIX400 chemical admixture also used and compared for the mechanical behavior. Cube, cylinder & beam specimen were casted for all type of concrete and were tested for compressive strength, split tensile strength and flexural strength respectively for study of mechanical properties. The experimental study shows that the effectively result with percentage of steel fibres used in concrete.*

Key Words: *Steel fibres, chemical admixture, AURAMIX400.*

1. INTRODUCTION

The concrete is cementitious binder material & widely used in civil engineering construction work such as building, bridge and road engineering. Cement, sand and aggregate are main constituents in concrete. The aggregate covered about 70% volume of concrete. The related experimental study of the mechanical properties i.e. compressive strength, split tensile strength & flexural strength of concrete were also fruitful. With the various development of engineering construction high performance concrete such as steel fibre was applied gradually in important engineering structural work.

The application of steel fibre concrete in civil engineering are the most popular due to its improvement of resistance to cracking, fatigue, abrasion, impact, durability and conventional reinforced concrete. Concrete is very well suitable for a wide range application. Concrete has some deficiencies such as Low tensile strength, Low post cracking capacity, Low ductility, Low brittleness, Fatigue life and Low impact strength.

The weakness can be removed by different type of fibres used in concrete mixture to increase its toughness or ability to resist crack growth and the fibre helps to transfer loads at the internal micro cracks.

2.0 EXPERIMENTAL STUDY

The various properties of concrete depend upon the many factors like water-cement ratio, shape and size of aggregate and type of aggregate etc. In the present experimental study cement, sand, coarse aggregate, water, steel fibres and super plasticizer has been used. The properties of all ingredients of concrete such as cement, fine aggregate, natural coarse aggregate and steel fibres determined as per Indian standard specifications.

2.0.1 Cement: Ordinary Portland cement of 43-grade has been used in present experimental work, and confirming as per IS: 8112-2013. The physical properties of cement i.e. normal consistency, fineness, initial and final setting times and specific gravity have been determined as shown in Table-1. The all properties of cement confirming as per IS: 4031-1988.

Table-1 Physical Properties of Cement

Properties	Result
Normal Consistency	30%
Fineness	2%
Soundness	1mm
Setting Time. a) Initial b) Final	 145 min. 247 min.
Specific gravity	3.15
Compressive strength (N/mm²) a) 3days b) 7days c) 28days	 24.20 34.53 44.40

2.0.2 Fine Aggregate: Natural sand obtained from river has been used as fine aggregate & the sand confirms to zone-III as per IS: 383-2016. The Properties of sand such as Fineness modulus, Specific Gravity and Bulk Density has been determined as per IS: 383-2016 The all properties of sand are shown in Table-2.

Table-2 Properties of Fine Aggregate

Properties	Result
Zone	III
Fineness Modulus	2.952
Specific Gravity	2.50
Bulk Density (Loose)	1630.0 Kg/m^3
Bulk Density (Compacted)	1647.0 Kg/m^3

2.0.3 Coarse Aggregate: Crushed stone in form of coarse aggregate to be used & confirming to graded aggregate with maximum nominal size 10mm & 20mm as per IS: 383-2016. The values of various test of concrete are shown in Table-3.

Table-3 Properties of Coarse Aggregate

Properties	Result	
	10mm	20mm
Specific Gravity	2.59	2.58
Impact Value	12.85%	12.97%
Crushing Value	15%	15.8%
Bulk Density (Loose)	1540.6 Kg/m^3	1571.8 Kg/m^3
Bulk Density (Compacted)	1563.6 Kg/m^3	1596.1 Kg/m^3

2.0.4 Water: Water is one of the most essential elements of cement concrete, so that potable water available at site it used for experiment.

2.0.5 Steel Fibres: In present experimental work steel fibre has been used in hooked end steel fibres. The different Percentage (0.1% 0.2% 0.3% 0.4%) of steel fibre has been used by the weight of concrete. The Some parameters of steel fibre are so in Table-4

Table-4 Properties of Steel Fibres

Properties	Result
Diameter	0.5to1.0mm
Length	25to60mm
Aspect Ratio	≥50
Tensile Strength	≥1000Mpa
Material	Low Carbon Steel Bar
Coating	Non-Bright
Packaging	20Kg/ Paper Bags

2.0.6 Chemical admixture: In the present experimental study, the (0.4%) AURAMIX400 chemical admixture has been used by the weight of cement. The all properties of chemical admixture are carried out as per IS: 9103-1999 and shown in Table-5.

Table-5 Properties of Chemical Admixture

Properties	Result
Appearance	Light Yellow Coloured Liquid
pH	Minimum 6.0
Volumetric Mass@20°C	1.09Kg/litre
Chloride Content	Nil to IS: 456
Alkali Content	Typically, less than 1.5gNa2O equivalent/litre of Admixture

2.0.7 Concrete Mix Design: The mix design calculation for present experimental work is carried out as per IS: 10262-2009. The same factors considered in mix design were standard deviation and water absorption etc. The mix proportion obtained for M25 grade concrete i.e. 1:1.67:3.21 with 0.45 water cement ratio. The quantities required of all ingredients of concrete are shown in Table-6.

Table-6 Concrete Mix Proportions

Material	Weight (kg/m^3)
Cement	372.42
Fine Aggregate	623.87
Coarse Aggregate	1197.55
Chemical Admixture	1.48
Water	182.91

3.0 METHODOLOGY & RESULTS.

3.0.1 Compressive Strength Test: To calculate compressive strength of steel fibre concrete dimension 150×150×150mm size cube were casted. After 24 hours these cubes were de-moulded and immersed in the curing tank. The curing of specimen at 7days and 28 days has been done. The testing of specimen has been carried out at 7days and 28 days as per IS: 516-1959. The test value parameter with different proportions of steel fibre concrete are given in Table-7 and graphically represented in Fig-2.

Fig-1 Compressive Strength Test

Table-7 Compressive Strength at 7&28 days

S. No	Fibre %	Compressive Strength (N/mm²)	
		7days	28 days
1	0.0%	22.48	32.47
2	0.1%	23.20	33.59
3	0.2%	24.23	34.88
4	0.3%	25.09	36.39
5	0.4%	24.45	35.55

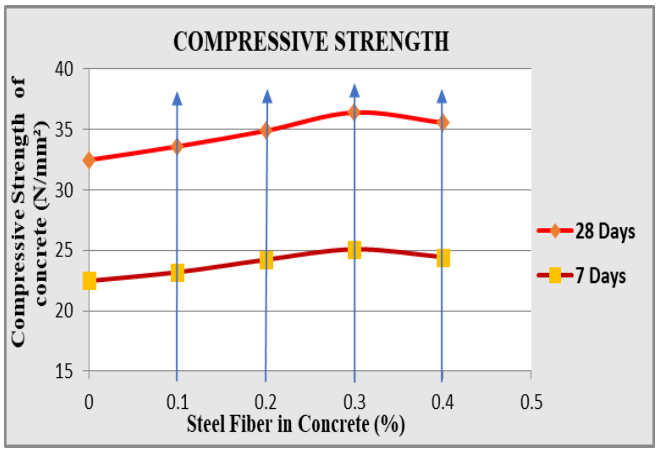

Fig-2 Compressive Strength of Steel Fibre Concrete & Normal Concrete

3.0.2 Split Tensile Strength Test: To find out split tensile strength of steel fibre concrete, 150mm diameter and 300mm height cylinder were casted. After 24 hours all specimen were de-moulded and immersed in curing tank. The curing of specimen at 7days and 28days has been done. The testing has been carried out at 7days and 28 days. The test result value of steel fibre concrete are given in Table-8 and graphically represented in Fig-4.

Fig-3 Split Tensile Strength Test

Table-8 Split Tensile Strength at 7&28 days

S. No	Fibres %	Split Tensile Strength (N/mm²)	
		7days	28days
1	0.0%	2.203	3.217
2	0.1%	2.338	3.377
3	0.2%	2.477	3.420
4	0.3%	2.551	3.637
5	0.4%	2.451	3.525

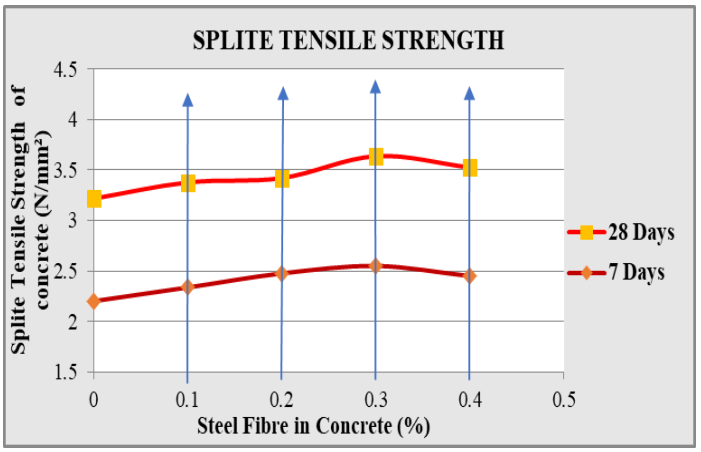

Fig-4 Split Tensile Strength of Concrete

3.0.3 Flexural Strength Test: For calculating flexural strength of steel fibre concrete 150x150x700mm size beam were casted. After 24 hours the beam specimen were de-moulded and immersed in the curing tank. The curing of specimen at 7days and 28 days has been done. The testing has been carried out at 7days and 28 days as per IS: 516-1959. The experimental test result of steel fibre concrete beam are given in Table-9 and graphically represented in Fig-6.

Fig-5 Flexural Strength Test

Table-9 Flexural Strength at 7&28 days

S. No	Fibre %	Flexural Strength (N/mm²)	
		7days	28days
1	0.0%	2.20	3.29
2	0.1%	2.34	3.34
3	0.2%	2.49	3.48
4	0.3%	2.58	3.66
5	0.4%	2.46	3.51

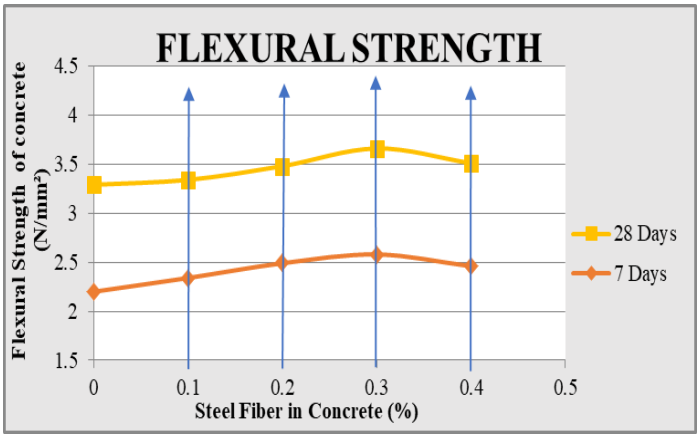

Fig-6 Flexural Strength of Concrete

4.0 CONCLUSIONS:

Based on the experimental study the following conclusion has been drawn -

1. The concrete mix gets harsher and less workable with increases of steel fibres content therefore use of admixture becomes necessary for obtained the proper workability.

2. The Compressive Strength of concrete increased 11.6% at 7 days and 12.1% at 28 days up to 0.3% of steel fibres. But decreased 2.6% at 7 days and 2.3% at 28 days with higher percentage i.e. 0.4% of steel fibres.

3. The Split Tensile Strength of concrete increased 15.8% at 7 days and 13.3% at 28 days up to 0.3% of steel fibres. But decreased 5% at 7 days and 3.2% at 28 days with higher percentage i.e. 0.4% of steel fibres.

4. The Flexural Strength of concrete increased 17.5% at 7 days and 11.5% at 28 days up to 0.3% of steel fibres. But decreased 4.9% at 7 days and 4.3% at 28 days with higher percentage i.e. 0.4% of steel fibres.

5. The workability of concrete is decreased with the increasing of steel fibre in concrete.

REFERENCES:

1. Indian standard guideline of method of test for aggregate for concrete IS: 2386 (PART-I particle size and shape)-1963.
2. Indian standard guideline of method of test for aggregate for concrete IS: 2386 (PART-III) Specific gravity, density, voids, absorption and bulking)-1963.
3. Indian standard guideline of methods of test for aggregates for concrete IS: 2386 (PART-IV mechanical properties)-1963.
4. Indian standard specification for coarse and fine aggregate from natural sources for concrete IS: 383-2016.
5. Indian standard recommended guidelines for concrete mix design, IS: 10262-2009 and IS: 456-2000.
6. L. Zhao, Mechanical properties of steel fibre reinforced concrete and Its application in subway engineering, southwest Jiao tong university, Chengdu, China, 2017.
7. P. Zhang and Q.F. Li, "Effect of polypropylene fibre on fracture properties of high-performance concrete composites," Science and engineering of composite materials vol. 19, no. 4, pp.407-414,2012.
8. ACI, Report on fibre reinforced concrete (ACI544.1R-96),2009.
9. IS: 383-2016. Specification for course and fine aggregate from natural sources for the concrete (second revision)" Bureau of Indian Standard, New Delhi.
10. IS: 516-1959. Method of test for strength of concrete" Bureau of Indian Standard New Delhi.
11. The Indian standard guideline method of test Split Tensile Strength of concrete. IS: 5816-1999.
12. Ganeshan N et al. (2007) steel fibre reinforced high performance concrete for seismic resistance structure' Civil engineering and construction review, December 2007, pp 54-63.
13. Bhikshma V, Ravande Kishor and Nitturkar Kalidas (2005) "Mechanical properties of fibre reinforced high strength concrete 'Recent advances in concrete and construction tech '6-8 Jan 2005. Chennai, pp 23-33.
14. Indian Standard Specification of Ordinary Portland Cement of 43-Grade IS: 8112-2013.
15. Soroushian P. and Bayasi (1991) "Fibre type effect on the performance of steel fibre reinforced concrete "ACI material journal, Mar-Apr 1991., vol 88no 2pp 129- 134