ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

# Fiber Adding and Its Effect on Concrete Strength

**K.Roja**
Department of Civil Engineering,
Vidya Jyothi Institute of Technology,
Hyderabad, T.S 500075, India.

**A D Sandeep Kumar**
Department of Civil Engineering,
Vidya Jyothi Institute of Technology,
Hyderabad, T.S 500075, India.

**A.Rambabu**
Department of Civil Engineering,
V.S.M College of Engineering,
Ramachandrapuram, Andhra Pradesh 533255, India.

***ABSTRACT***

***Fibers are usually used as résistance of cracking and strengthening of concrete. In this project, I am going to carry out test on steel reinforced concrete to check the influence on strength of concrete .According to various research papers, it has been found that steel fibers offer the utmost strength compared to glass and polypropylene fibers. Hence, in this project I was interested in finding the effect of steel fiber in concrete. An experimental investigation on the behavior of concrete specimens reinforced with steel and subjected to compressive and flexural loading is presented. Tests were conducted on specimens with 3 completely different fiber volume fractions. It was determined that SFRC specimens showed increased properties compared thereto of traditional specimens.***

## INTRODUCTION

### 1.1 General

The use of concrete for construction works has been going on for many decades now The only difference that is seen today from those in the past is its characteristics i.e. workability, strength and durability. These are the three basic properties of any concrete. These properties are improved in the concrete by the use various admixtures, aggregates and maintaining proper water cement ratio. Workable concrete is the one which exhibits very little internal friction between particles to produce full compaction. The factors that affect the workability of the concrete are Water Content, Mix proportions, Shape, Size and Grading of aggregates.

Strength is required for concrete to bear the desired stress when it is exposed to the working load condition. There are various factors affecting the strength of the concrete, including quality of cement, water-cement ratio, grading of the aggregates, degree of compaction, curing methods and testing time.

Durability is defined as the concrete can withstand to resist weathering action, chemical attack and abrasion while maintaining its intended engineering properties. It normally refers to the duration or life span of trouble-free performance. Various concretes require different degrees of durability; it determined on the exposure environment and desired properties. For example, will have different requirements if concrete exposed to tidal seawater than indoor concrete. The most important prosperity of concrete is its compressive strength. In most of the structures, concrete is basically used to resist the compressive strength_ Compressive strength is also used as a qualitative measure for other properties of hardened concrete- No exact quantitative relationship between compressive strength and flexural strength, tensile strength, wear resistance, or permeability has been established nor are they likely to be. However, approximate relationships, in some cases, have been established and these give much useful information to the engineers. It should be emphasized that compressive strength gives only an approximate value of these properties and that other tests specifically designed to determine theses properties should be useful if more precise results are required [1].

### 1.2 Fiber Reinforced Concrete (FRC)

Fibers are used as reinforcement from primitive time. Fiber concrete are often outlined as material consisting of concrete and discontinuous, discrete, uniform spread

**Cite this article as:** K.Roja, A D Sandeep Kumar & A.Rambabu, "Fiber Adding and Its Effect on Concrete Strength", International Journal & Magazine of Engineering, Technology, Management and Research, Volume 5 Issue 12, 2018, Page 137-143.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

fine fibers. The continuous meshes, woven fabrics and long wires or rods are not considered to be discrete fibers. Fiber reinforced concrete is one of the fastest growing segments in the concrete industry as more and more engineers ,architects, owners, specifies and concrete contactors are turning to the use of fibers to produce their reinforcing wants in their concrete applications. An Experimental Study on Mechanical and Durability Properties of Concrete Made with Natural and Artificial Fiber.The current Experimental Exploration is to survey Mechanical Properties and Durability properties of concrete with addition of little percentage by weight of Steel fibers.

Concrete is characterized by quasi-brittle failure, the nearly loss of loading capacity, once failure is initiated concrete can be modified to perform in a more ductile manner by the addition of every which way distributed separate fibers within the concrete matrix, which prevent and control initiation. Propagation and coalescence of cracks.

A variety of materials like plastic ,nylon polyester, glass, carbon, basalt and steel fibers can be used in fiber reinforced concrete .The characteristics of FRC depend upon many factors such as size ,type, elastic properties ratio and volume fraction of fibers for every application it has to be determined which kind of fiber is perfect in satisfying the aim .The fibers ar ready to forestall surface cracking through bridging action resulting in associate degree inflated impact resistance of the concrete .The addition of steel fibers to concrete significantly improves its properties of concrete in the hardened stage such as tensile strength, impact strength and flexural toughness [2].

These fibers already been used in many large projects involving the construction of industrial floors. pavement, highway –overlays. Etc in India

### 1. 3 Steel fiber reinforced concrete

Steel fiber ferroconcrete may be a material having fibers because the further ingredients, distributed uniformly arbitrarily in tiny percentages ,i.e between zero.3% and 2.5% by volume in plain concrete .SFRC products are manufactured by adding steel fibers to the ingredients of concrete in the mixer and by transferring the green concrete in to moulds. The product is then compacted and cured by the standard ways. Segregation or balling is one in every of the issues encountered throughout mixture and compacting SFRC. This should be avoided for uniform distribution of fiber. The energy required for mixing, conveying, placing and finishing of SFRC is slightly higher. Use of pan mixer and fiber dispenser to assist in better mixing and to reduce the formation of fibers balls is essential Additional fines and limiting maximum size of aggregates to 20 mm occasionally, cement contents of 320kg to 650 kg per cubic meter are normally needed [3].

Steel fiber reinforced concrete is a composite material having fibers as the additional ingredients, dispersed uniformly at random in small percentages,i.e between 0.3% and 2.5% by volume in plain concrete .SFRC products are manufactured by adding steel fibers to the ingredients of concrete in the mixer and by transferring the green concrete in to moulds. The product is then compacted and cured by the conventional methods. Segregation or balling is one of the problems encountered during mixing and compacting SFRC. This should be avoided for uniform distribution of fiber.The energy required for mixing, conveying, placing and finishing of SFRC is slightly higher. Use of pan mixer and fiber dispenser to assist in better mixing and to reduce the formation of fibers balls is essential Additional fines and limiting maximum size of aggregates to 20 mm occasionally, cement contents of 320kg to 650 kg per cubic meter are normally needed [4].

### 1.4 Properties of Concrete Improved By Steel Fibers

**Flexural strength:**

Flexural bending strength are often accrued of up to three times additional compared to standard concrete.

Fatigue resistance: nearly one ½ times increase in fatigue strength.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Impact resistance: greeter resistance to damage in case of a heavy impact.
Permeability: the material is very less porous.
Absorption resistance: more effective composition against absorption and spelling. Shrinkage: shrinkage crakes can be eliminated.
Corrosion: corrosion might have an effect on the fabric however it'll be restricted in sure areas.

### 1.5 Advantages of steel fiber

- High structural strength
- Reduced crack width and control the width tightly, thus improving durability
- Improve ductility
- Reduced crack widths and control the widths tigtly,thus improving durability
- Improve impact- and abrasion-resistance

## LITERAURE REVIEW

### 2.1 GENERAL

In this chapter, an elaborative discussion is made regarding works done so far in this area as literature review. Fibre reinforced concrete with different fibres and their behaviour studies are discussed at the initial subheadings. Works on waste materials are discussed in the subsequent the adding comprehensively.

### 2.2 REVIEWS ON FIBRE REINFORCED CONCRETE

### 2.2.1 History and Development

The concept of using fibres in a brittle matrix was first recorded with the ancient Egyptians who used the hair of animals and straw as reinforcement for mud bricks and walls in housing. This dates back to 1500 B.C. (Balaguruet al, 1992).

Ronald F. Zollo (1997) presented an overview regarding the history and development of Fibre Reinforced Concrete 30 years ago. According to this report, in the early 1960s, the works on fibre reinforced concrete had been started. A lot of research work has been conducted by many researchers on different fashions. But these projects have studied about steel fibres alone. So far, there were only a few works which have studied the other fibres like nylon, plastic, rubber and natural fibres. But those researches are completely1different from the current study, since they have concentrated along the material strength properties not on their structural behavior [5].

According to the terminology adopted by American Concrete Institute (ACI) Committee 544, there are four categories of Fibre Reinforced Concrete namely 1)SFRC (Steel Fibre Reinforced Concrete), 2) GFRC (Glass Fibre Reinforced concrete), 3) SNFRC (Synthetic Fibre Reinforced Concrete)and NFRC (Natural Fibre Reinforced Concrete). It also provides the information about various mechanical properties and design applications. Cement and Concrete Institute also published the classification of FRC in their website. Based on their classification, Fibres are classified into Glass, Steel, Synthetic (includes Acrylic, Agamid, Carbon, Nylon, Polyester, Polyethylene, Polypropylene) and Natural Fibres.

### 2.2.2 Mechanical Properties

Mechanical properties of high strength fibre reinforced concrete were also studied by Faisal Wafa and Samir . Ashour (1992). They tested504 test specimens fordifferent mechanical properties such as compressive strength split tensile strength, flexural toughness and modulus of rupture. The mix was designed to achieve compressive strength of 94 N/mm2. Three volume fractions of steel fibres such as 0.5%, 1.0% and 1.5% were selected. It was concluded that no real workability problem was encountered up to the addition of 1.5% volume fraction of fibres in concrete. Steel fibres enhanced the ductility and post cracking load carrying capacity of high strength concrete. Some empirical relations were proposed in terms of volume fraction of fibres and compressive strength of conventional concrete.

Nataraja et al (1998) conducted a study on steel fibre reinforced concrete under compression. Here the behaviour of steel fibre reinforced concrete under compression for cylinder compressive strength ranged from 30to 50 N/mm2. Round crimpled fibres with three volume fractions of 0.5percent, 0.75 percent and 1.0 percent and for two aspect ratios of 55 and 82are considered. The effect of fibre addition to concrete on compressive strength was studied. It was concluded that the addition of fibres increased the compressive strength and toughness. Some empirical equations were also proposed for compressive strength of concrete in terms of fibre rein forcing index [6].

Rami H. Haddad and Ahmed M. Asteyate (2001) found an interesting way of predicting the role of synthetic fibres such as poly propylene and nylon fibres in delaying steel corrosion cracks and improving the bond with concrete. Different lengths of polypropylene and nylon fibres with various volumes were mixed with concrete. Pullout tests and corrosion study were conducted and they were concluded that both the fibres contributed more in delaying the corrosion and improving the bond strength. Moreover it was pointed out that polypropylene fibres played more significant role than nylon fibre in the improvement of bond [7].

## EXPERIMENTAL INVESTIGATION

| 4.1. Design Specification | | |
|---|---|---|
| a) Grade designation | = | M25 |
| b) Type of cement | = | OPC 53 grade |
| c) Nominal Size of aggregate | = | 20mm |
| d) Minimum cement content | = | 320kg/mm2 |
| e) Maximum w/c ratio | = | 0.5 |
| f) Degree of workability | = slump 50 to 75mm | |
| C.F -0.9 | | |
| g) Exposure condition | = | severe (for Rcc) |
| h) Type of aggregate | = | angular shape |

| | 4.2 Test data for material | | |
|---|---|---|---|
| a) | Cement used OPC 43 grade conforming to IS 8112 | | |
| | Specific gravity of cement | = | 3.15 |
| b) | Coarse and Fine aggregate | | |
| | Specific gravity of coarse aggregate | = | 2.8 |
| | Specific gravity of fine aggregate | = | 2.6 |
| c) | Water absorption | | |
| | Coarse aggregate | = 0.5% | |
| | Fine aggregate | = 1% | |
| d) | Free moisture | | |
| | Coarse aggregate | = Nil | |
| | Fine aggregate | = Nil | |
| e) | Steel Fiber | = Nil | |

### Sieve Analysis of Coarse Aggregate

| IS Sieve Size mm | Analysis of Coarse Aggregate fraction (percentage passing) | | Percentage of different fractions | | |
|---|---|---|---|---|---|
| | I | II | I 35% | II 65% | Combined 100% |
| 20 | 100 | 100 | 35 | 65 | 100 |
| 16 | 100 | 100 | | | |
| 12.5 | 20 | 97.5 | | | |
| 10 | 0 | 82.5 | | | |
| 4.75 | 0 | 0 | | | |
| 2.36 | 0 | 0 | | | |

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

### Sieve Analysis of Fine Aggregate

| IS sieve size mm | Percentage passing | Remarks |
|---|---|---|
| 4.75 | 100 | |
| 2.36 | 95 | |
| 1.18 | 75.5 | |
| 600μ | 43 | Conforming to Zone III |
| 300 μ | 11.83 | |
| 150 μ | 5 | |
| 90 μ | 0 | |

### Mix proportion for (M25) Grade for Steel fiber

| Sn | SF (%) | W/C Ratio | Mix proportion | | | | |
|---|---|---|---|---|---|---|---|
| | | | Cement (Kg) | Sand (Kg) | C A (Kg) | Water (lit) | Steel Fiber(g) |
| 1 | 0 | 0.44 | 4.408 | 6.407 | 12.218 | 2 | 0 |
| 2 | 1 | 0.44 | 4.408 | 6.407 | 12.218 | 2 | 0.23 |
| 3 | 2 | 0.44 | 4.408 | 6..407 | 12.218 | 2 | 0.46 |
| 4 | 3 | 0.44 | 4.408 | 6..407 | 12.218 | 2 | 0.69 |

## EXPERIMENTAL PROGRAM

### 3.1 Introduction

The materials selected for this experimental study includes normal natural coarse aggregate, manufactured sand as fine aggregate, cement, super plasticizer, both end hooked steel fiber and portable drinking water. The physical and chemical properties ofeach ingredient has considerable role in the desirable properties of concrete likestrength and workability.

### 3.2Materials Used

1. Aggregates
2. Cement
3. Water
4. Fiber

## RESULTS AND DISCUSSIONS

### 5.1 General

In the present investigation an attempt has been made determine the effect of fibre by examining the slump, compressive strength, split tensile strength and flexural strength of the sample .For that cubes, cylinders and beams were casted using fibres The mixing was done using span mixer. The compression test and splitting tension test were conducted by the same compression testing machine which has a capacity up to 200 Tones

### 5.2 Effect on Workability

The theology fiber, of FRC is significantly different than that of similar mixes without even when only small fibre dosages are used, especially due to the relatively high stiffness and the geometry of the fibres. Therefore, it is often not convenient to characterize its workability in terms of parameters used for plain concrete. Nevertheless, the most common measure of workability and consistency of concrete is the slump test. The slump test is carried out according to IS 1199-1959

### Table Details Of Mixes Corresponding To slump

| Adding the fiber Mix | Water/cement Ratio | Slump (mm) |
|---|---|---|
| 0 | 0.4 | 70 |
| 1 | 0.4 | 60 |
| 2 | 0.4 | 55 |
| 3 | 0.4 | 50 |

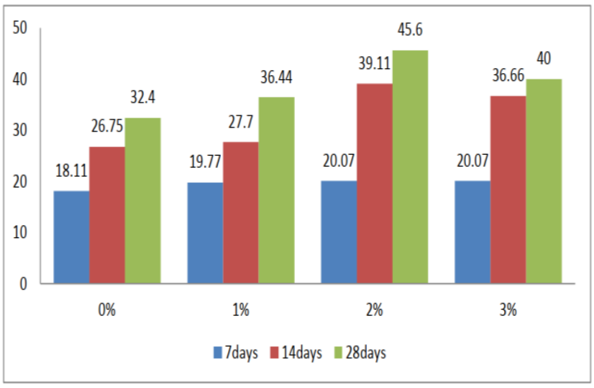
ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Here we can see that as fibre content increases slump increases slump decrease.
This means workability decreases.

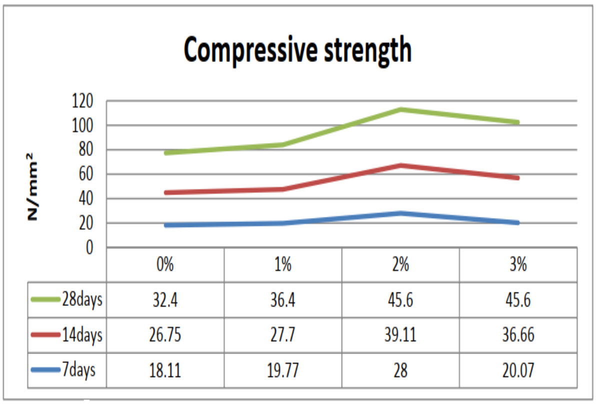
### 5.3 Compressive Strength

To study the 7, 14 and 28 days strength of strength of concrete mixes, three concrete cubes for each day were casted and tested in a set itself .The cube specimens were of size 150mmX150mmX150mm and were prepared and tested according to IS 516-1959.Crack pattern after testing of particular cube specimen is shown in fig 2.The cube compressive strength obtained after testing is as given in table 5.3

Compressive strength(MPa)




Mean Compressive strength (MPa) vs Adding fiber (%)




Mean Compressive strength (MPa) vs Adding fiber (%)

## CONCLUSION

The finding of the compressive strength indicate that the addition of steel fibre in concrete not only improve the strength characteristics but also the ductility. Research over the years have shown that fiber reinforcement has sufficient strength and ductility to be used as a complete replacement to conventional steel bars in some type of structures, foundations, walls , slabs.

The technology that is available today has made is possible to fiber reinforcement without the use of conventional steel bars in load carrying structures.

For this to be a reality, the fiber must be distributed and oriented as expected, which is difficult.If fibers may be used while not the requirement of steel reinforcement bars, the reinforcement a part of the development work are going to be eliminated.Hence the construction costs will be significantly reduced.

From the test results of compressive strength, split tensile strength, it can be seen that, in presence of steel fiber, there is an increases in compressive strength, spilt tensile strength. The crack formation is also very small in fiber specimens compared to the non fiber specimens

## REFERENCES

[1] Gustavo J parra-Montesinos “shear Strength of Beams with Deformed Steel Fibers ″. Concrete international/ November 2006

[2] Vikrant S Variegate et al “Introduction to Steel Fiber Reinforced Concrete on Engineering Performance of Concrete”. International Journal of Scientific & Technology Research Volume 1, Issue 4, May 2012

[3] Shah Surendra and Rangan (1994), “Effect of Fiber addition on concrete strength”, Indian Concrete Journal

[4] Yoon-KeunKwak et al., “Shear strength of steel fiber –reinforced concrete beams without stirrups”, ACI structural journal.2002

[5] Mukesh Shukla “Behaviour of Reinforced Concrete Beams with Steel Fibers under Flexural Loading “, International Journal of Earth Sciences and Engineering. Volume 04 .No 06 SPL, October 2011, pp843-846.

[6] Darryl Earth, "Steel Fibres Reinforced Concrete (SFRC)", Twintec Advisory paper

[7] Nataraja MC., DhangNand Gupta A P, (1998)."Steel Fibres Reinforced Concrete under Compression". The Indian concrete Journal 26(3). pp 353-356.