IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.53

Volume 4, Issue 2, April 2024

Experimental Study on Fibre Reinforced Concrete

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Abstract: *In recent years the applications of high strength concrete have increased many parts of the world. This growth has been possible as a result of recent developments in technology and demand for high strength concrete. There are many advantages in using high strength concrete in building construction. As in the case of conventional concrete, the use of steel fiber substantially increases the energy at break of high strength concrete. Although the initial cost may he high. Significant long-term saving would be ensured in reducing the needs for maintenance, repair and rehabilitation. Use of Steel Fibers in normal cement concrete improves Compressive strength of the concrete and helps to improve the serviceability of the structure. The experimental program was designed to the effect of steel fibers on compressive strength testing by using UTM machine on cubes of size (150mmX150mmX150 mm). The mix proposition for M30 grade of concrete. Then, the steel fiber were added in the unique proportions of 0.5%, 0.7% and 1%.*

Keywords: Steel Fiber, Concrete, Compressive Strength

I. INTRODUCTION

Application of Fibre Reinforced Concrete (FRC) is continuously growing in various application fields. FRC is widely used in structures. Due to the property that fibre enhances toughness of concrete, FRC is used on large scale for structural purposes. The fibre is described by a convenient parameter called aspect ratio. The aspect ratio of the fiber is the ratio of its length to its diameter. The principle motive behind incorporating fibers into a cement matrix is to increase the toughness and tensile strength and improve the cracking deformation characteristics of the resultant composite. For FRC to be a valuable construction material, it must be able to compete economically with existing reinforcing system. FRC composite properties, such as crack resistance, reinforcement and increase in toughness are dependent on the mechanical properties of the fiber, bonding properties of the fibre and matrix, as well as the quantity and distribution within the matrix of the fibres. It improves fatigue resistance makes crack pattern distributed. By making crack pattern distributed, it is meant that it decreases the crack width. Aramid fibre gives more compressive strength and crack resistance to concrete as compare to glass and steel fibres.

One of the undesirable characteristics of the concrete as a brittle material is its low tensile strength, and strain capacity. Therefore it requires reinforcement in order to be used as the most widely construction material. Conventionally, this reinforcement is in the form of continuous steel bars placed in the concrete structure in the appropriate positions to withstand the imposed tensile and shear stresses. Fibers, on the other hand, are generally short, discontinuous, and randomly distributed throughout the concrete member to produce a composite construction material known as fiber reinforced concrete (FRC). Fibers used in cement-based composites are primarily made of steel, glass, and polymer or derived from natural materials. Fibers can control cracking more effectively due to their tendency to be more closely spaced than conventional reinforcing steel bars. It should be highlighted that fiber used as the concrete reinforcement is not a substitute for conventional steel bars. Fibers and steel bars have different roles to play in advanced concrete technology, and there are many applications in which both fibers and continuous reinforcing steel bars should be used. Steelfiber (SF) is the most popular type of fiber used as concrete reinforcement. Initially, SFs are used to prevent/control plastic and drying shrinkage in concrete. Further research and development revealed that addition of SFs in concrete significantly increases its flexural toughness, the energy absorption capacity, ductile behaviour prior to the ultimate failure, reduced cracking, and improved durability (Altun et al., 2006). This paper reviews the effects of addition of SFs in concrete, and investigates the mechanical properties, and applications of SF reinforced concrete (SFRC).

II. LITERATURE SURVEY

Liberato Ferrara: The addition of fibers to self-compacting concrete (SCC) may take advantage of its superior performance in the fresh state to achieve a more uniform dispersion of fibers, which is critical for a wider structural use of fiber-reinforced concrete. Some useful, mainly empirical, guidelines are available for mix design of fiber-reinforced SCC. In this work a "rheology of paste model" is applied to the mix design of Steel Fiber Reinforced SCC (SFRSCC). Fibers are included in the particle size distribution of the solid skeleton through the concept of an equivalent diameter, defined on the basis of the specific surface. The influence of fibers (type and quantity) on the grading of solid skeleton, minimum content and rheological properties of the paste required to achieve the required self-compact ability and rheological stability were studied. Tests were conducted on both plain and fiber-reinforced concrete made with a variety of mix compositions. In addition, rheological tests were made with corresponding cement pastes.

D. Chaitanya Kumar: Study where carried out using an M20 grade of concrete and glass fiber is added as 0.5%, 1%, 2%, and 3%. And the specimens are cast for a compressive and tensile test of the concrete. In this experiment, concrete achieves strength when 2% of the fiber is added to the concrete and when 3% fiber is added to the concrete the strength of concrete declines. When the fiber is added 2% the strength of the concrete attains 26.98 Mpa of compressive strength, 2.94 Mpa of Flexural Strength and 3.57 Mpa of the Tensile strength of the concrete after 28 days of curing. In this experiment, the author mentioned that the work ability of the concrete is increased and thus the glass fiber reduces the crack under different loading**.**

Zoran J. Grdic: Abrasive resistance of concrete is reduced with the increase of water/cement ratio from 0.5 to 0.7 which is reflected in the increase the addition of fibers increases tensile strength across the whole range of W/C factors from 0.5 to 0.7 in respect to the benchmark concrete. The concretes with extreme compressive and tensile strength (at bending) have higher abrasive resistance, so these limits may serve as indicators of the abrasive–erosive resistance of concrete. The polypropylene fibrillated fibers verified better in respect to the monofilament fibers in terms of abrasive–erosive resistance of concrete.

VahidAfroughsabet: In recent years, an emerging technology termed, ''High-Performance Fiber-Reinforced Concrete (HPFRC)'' has become popular in the construction industry. The materials used in HPFRC depend on the desired characteristics and the availability of suitable local economic alternative materials. Concrete is a common building material, generally weak in tension, often ridden with cracks due to plastic and drying shrinkage. The introduction of short discrete fibers into the concrete can be used to counteract and prevent the propagation of cracks. Despite an increase in interest to use HPFRC in concrete structures, some doubts still remain regarding the effect of fibers on the properties of concrete. This paper presents the most comprehensive review to date on the mechanical, physical, and durability-related features of concrete. Specifically, this literature reviewaims to provide a comprehensive review of the mechanism of crack formation and propagation, compressive strength, modulus of elasticity, stress–strain behavior, tensile strength (TS), flexural strength, drying shrinkage, creep, electrical resistance, and chloride migration resistance of HPFRC. In general, the addition of fibers in high-performance concrete has been proven to improve the mechanical properties of concrete, particularly the TS, flexural strength, and ductility performance. Furthermore, incorporation of fibers in concrete results in reductions in the shrinkage and creep deformations of concrete. However, it has been shown that fibers may also have negative effects on some properties of concrete, such as the workability, which get reduced with the addition of steel fibers. The addition of fibers, particularly steel fibers, due to their conductivity leads to a significant reduction in the electrical resistivity of the concrete, and it also results in some reduction in the chloride penetration resistance

Gurunathan K: The tallying of polypropylene fibers, reckons fibers, fly ash and silica fume in different concrete mixes marginally improve the compressive strength at 28 days. The least percentage of fly ash and silica fume were added in concrete so that the presentation of the concrete increases. There is an increase from 3% to 9% in split tensile strength for all fiber mixes when equated with that of control mix. Then from the test results the authors determined that the volume fraction of hybrid fiber.

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In the construction of any industry or structure there is a common material used as concrete. And concrete is is used in very huge amount in the construction and industries. Many property of the the concrete like brittleness sometimes fails to bear tensile load which is the cause of brittle failure. Since the fibre have the property to increase the toughness of the concrete. In many experiments it is found that, steel fibre reinforced concrete have high resistance to cracking so the reason behind the increasing uses of steel fibre reinforced concrete to increase the hardness or toughness and to reduce the crack deformation characteristics. So I present this paper for theoretical discussion on the subject of of steel fibre reinforced concrete. And here we discuss use terms and models of behaviour that form ambitious for understanding material performance without mathematical details. Here we shown that flexural strength of steel fibre reinforced concrete is directly proportional to the the steel fibre content and inversely proportional to the water cement ratio. Why the different references from early and old authors are included as a means of tying the subject together along a timeline. In the current time by the historical review to build a background for what is currently understood about steel fibre reinforced concrete.

III. MATERIALS

3.1 Cement: A cement is a binder, a chemical substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used on its own, but rather to bind sand and gravel (aggregate) together. Cement mixed with fine aggregate produces mortar for masonry, or with sand and gravel, produces concrete. Concrete is the most widely used material in existence and is behind only water as the planet's most-consumed resource.

Cements used in construction are usually inorganic, often lime or calcium silicate based, which can be characterized as hydraulic or the less common non-hydraulic, depending on the ability of the cement to set in the presence of water (see hydraulic and non-hydraulic lime plaster).

3.2 Fine Aggregates: Fine aggregate, which may be granular material or crushed stone, is a fundamental component of concrete. The quality of the fine aggregate and the density of the fine aggregate both have a significant impact on the hardened qualities of the concrete.

The size of fine aggregate is defined as equal to or less than 4.75 mm. This means that the aggregates that can pass through a number 4 sieve with a mesh size of 4.75 mm are referred to as fine aggregates. These include clay, silt, and sand. Crushed gravel and crushed stone can also fall under this category. Fine aggregates are the structural filler that occupies most of the volume of the concrete mix formulas. Depending on composition, shape, size and other properties of fine aggregate you can have a significant impact on the output.

3.3 Coarse Aggregates: Coarse aggregates are those that cannot pass through an IS Sieve of 4.75mm. They are gravel or crushed stone that occurs naturally and is used to make concrete. Their largest size is 63 mm and higher. Blasting the stone quarries is typically how coarse aggregates are created. However, they are occasionally also hand-crushed. Stones of varying sizes can be crushed together in the machinery. On the other hand, only stones of comparable sizes are utilised when crushing by hand. To create high-quality concrete, coarse aggregates are mixed in a specific ratio.Natural river gravels and hard crushed rocks (granite and limestone) are the most widely used aggregates for structural concrete. Foamed slag, shattered bricks, clinkers, etc., are also utilised as coarse aggregates in non-structural concrete

3.4 Water: The water in the concrete mix should be clean and free of impurities. The change in water content with respect of cement decides the properties of the cement like how easily the concrete flows, but also affects the final strength of the concrete. Excess water implies to easier flow of concrete, but decreases its strength. Water is a transparent, tasteless, odourless, and nearly colourless substance, which is the main constituent of Earth stream, lakes, and oceans and the fluids of most living organisms. Its chemical formula is H_2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms, connected covalent bonds.

3.5 Steel Fiber: The fibers selected for our project is Steel Hooked End Fibers. This shape is probably the most popular and successful in the history of SFRC. Hooked-End (HE) fibers can be used in almost any known application for SFRC. For example HE 55/35 and HE 75/35 are primarily used in shotcrete applications. They provide excellent workability when using fibers with up to an aspect ratio of 60. Aspect ratios up to and including 80 provide satisfactory workability. Load transfer in the crack is very good with this fiber shape. Thus after the appearance of the first crack the loss of load-bearing capacity occurs quickly, but then stabilizes and in some cases even begins to increase again after large cracks have developed. HE fibers have lengths in the range of 35 to 60 mm, diameters range from 0.55 to 1 mm and tensile wire strengths range from 1100 to 1900 MPa.

The amount of fibres added in the concrete mix is expressed as a percentage of total volume of the composite (concrete and fibres), termed volume fraction (Vf). Vf typically ranges from 0.1 to 3%. Aspect ratio is defines as fibre length (l) by its diameter (d). The aspect ratio of Fibres of a non circular shape can be determines by using an equivalent diameter for the calculation of aspect ratio.

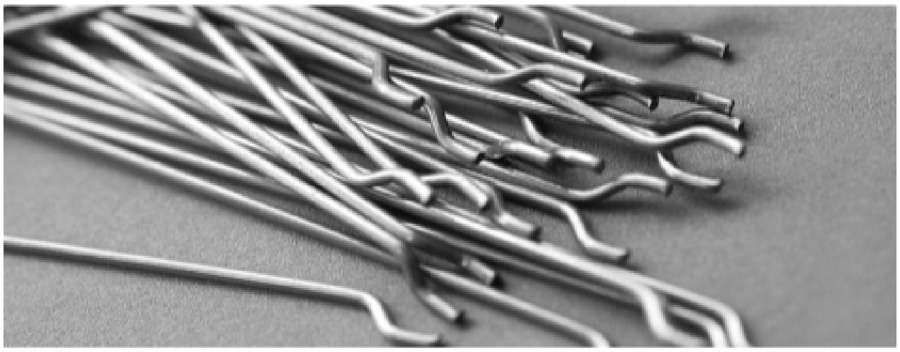
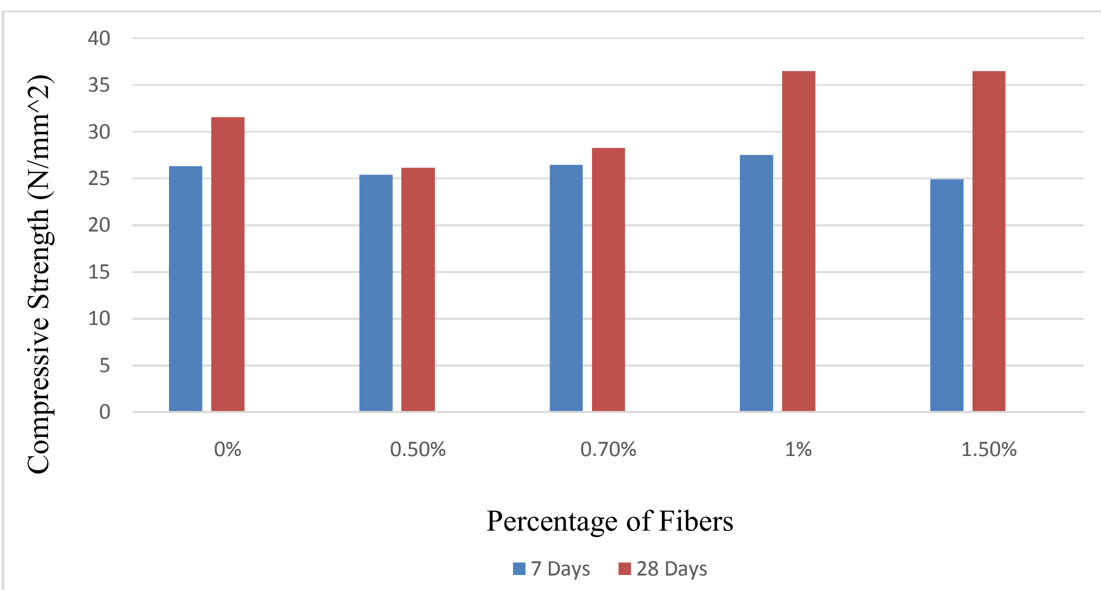


Fig. 1 Hooked Steel Fibers

IV. RESULTS

Table 1 Compressive Strength of Cubes after 7 days and 28 days

Sr No	Steel Fibers Percentage	Compressive Strength (N/mm^2)	
		7 Days	28 Days
1	0%	26.34	31.55
2	0.5%	25.4	26.13
3	0.7%	26.47	28.26
4	1%	27.54	36.49
5	1.5%	24.9	30.15



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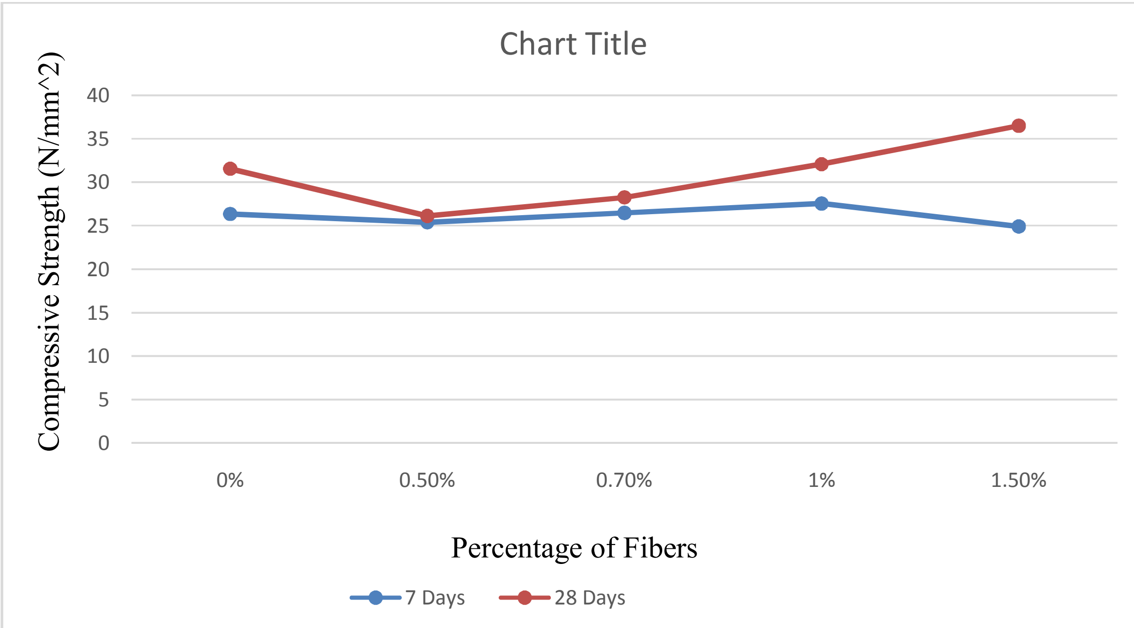
Graph 2 Liner Graph Representation of Cube



V. CONCLUSION

At present, FRC is specified especially when repair and increased durability is required for many non-conventional structures or concrete subjected to special conditions. The main role of fibers is to control cracking due to plastic shrinkage and drying shrinkage, providing additional energy absorption capability. It has also been reported that fibers may improve the static flexural strength of concrete as well as its impact strength, tensile strength, ductility and flexural toughness. Many modern reinforced concrete structures contain a wide range of reinforcing materials, made of either steel, polymers or alternative composite materials; they may or may not be combined with traditional steel reinforcement. The final composite will have a particular failure mechanism, which depends on the combination of the employed materials. Needless to say, these new design techniques are required to ensure the long-term durability of these special concretes. The successful experimental and theoretical methods will certainly be used in future concrete R&D activities.

By adding Steel fiber the compressive strength of the concrete is getting increased. We observed that by adding 1.0% of steel fibers, maximum compressive strength of concrete was obtained when compared with other proportions. We observed that by adding more than 1% steel fiber Compressive strength of the concrete Decreases

VI. ACKNOWLEDGEMENT

I wish to express my sincere Gratitude to my Guide Prof. A. M. Kadam and Co-guide Prof. A. S. Mehetre of Civil Engineering Department. Guru Gobind Singh Polytechnic, Nashik, for providing invaluable guidance and encouraging me to come up with such potential subject. I express my deep thanks to all the faculty members of Civil Engineering Department for providing the useful guidance and feel privileged to express my gratitude towards them.

I am also thankful to our respected Prof. P. G .Chavan, Head of Department(Civil) who constantly guided me throughout my thesis work.

I would like to thank our Respected Prof. S. R. Upasani, Principal, Guru Gobind Singh Polytechnic, Nashik for their encouragement at every step and those who helped me directly or indirectly this project.

REFERENCES

[1]. UtkarshR.Nishane "experimental studies on fiber reinforcement concrete", 2017, vol. 7, pp = 40-44.

[2]. Hamid PesaranBehbahani "Different Types of Fibers","Steel Fiber Reinforced Concrete: A Review", 2011, pp = 2.

[3]. Mr. K. C. Denesh1 , V. Senthilkumar2, "Material And Properties", "Experimental Study on The Steel Fiber Reinforcement Concrete", Volume 11 Issue I Jan 2023, pp = 2-4.

[4]. Anurag Mishra, Prof. Kirti Chandraul2, Prof. Manindra Kumar Singh3 "Material And Methodology", "Experimrntal Study on Steel Fiber Reinforced Concrete", Volume: 04 Issue: 11 | Nov -2017, ISO 9001:2008 Certified Journal, pp = 895-896.

[5]. Avinash Joshi , Pradeepreddy ,Punithkumar and Pramodhatker "History of FRC.", "Experimental Work on Steel Fiber Reinforcement Concrete", Volume 7, Issue 10, October-2016, ISSN 2229-5518, pp = 971-972.

[6]. The Euclid Chemical Company, "Performance-Based Specification ForFiber-Reinfored Concrete (FRC).", "Euclid Chemical".