STEEL FIBER REINFORCED CONCRETE

**THESIS**

SUBMITTED IN PARTIAL FULFILLMENT OF REQUIREMENT FOR THE AWARD OF THE

**MASTER OF TECHNOLOGY**

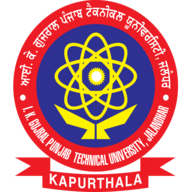
(Structural Engineering)

SUBMITTED BY

AMAN MITTAL

(2204094)

December 2023



**I.K GUJRAL PUNJAB TECHNICAL UNIVERSITY**

JALANDHAR, INDIASTEEL FIBER REINFORCED CONCRETE

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MANPREET SINGH BAINS

(2204097)

**GURU NANAK DEV ENGINEERING COLLEGE, LUDHIANA**

**(**An autonomous college under UGC Act, 1956)

December 2023

**I.K GUJRAL PUNJAB TECHNICAL UNIVERSITY**

JALANDHAR, INDIA

### CANDIDATE'S DECLARATION

I hereby certify that the work which is being presented in the thesis entitled “STEEL FIBER REINFORCED CONCRETE” by “AMAN MITTAL” in partial fulfilment of requirements for the award of degree of M.Tech. (Structural Engineering) submitted in the Department of (Civil Engineering) at GURU NANAK DEV ENGINEERING COLLEGE, LUDHIANA under PUNJAB TECHNICAL UNIVERSITY, JALANDHAR is an authentic record of my own work carried out during a period from 16 August 2023 to 25 December 2023 under the supervision of PROF.HARVINDER SINGH. The matter presented in this thesis has not been submitted by me in any other University / Institute for the award of M.Tech Degree.

Signature of the Student

This is to certify that the above statement made by the candidate is correct to the best of my/our knowledge

Signature of the Supervisor (s)

The M.Tech Viva Â–Voce Examination of (AMAN MITTAL) has been held on 1 December 2023 and accepted.

Signature of Supervisor(s) Signature of External Examiner

Signature of H.O.D.

### ABSTRACT

### Concrete is one of the world most widely used construction material. However, since the early 1800’s, it has been known that concrete is weak in tension. Weak tensile strength combined with brittle behavior result in sudden tensile failure without warning. This is obviously not desirable for any construction material. Thus, concrete requires some form of tensile reinforcement to compensate its brittle behavior and improve its tensile strength and strain capacity to be used in structural applications. Historically, steel has been used as the material of choice for tensile reinforcement in concrete. Unlike conventional reinforcing bars, which are specifically designed and placed in the tensile zone of the concrete member, fibers are thin, short and distributed randomly throughout the concrete member. Fibers are commercially available and manufactured from steel, plastic, glass and other natural materials. Steel fibers can be defined as discrete, short length of steel having ratio of its length to diameter (i.e. aspect ratio) in the range of 20 to 100 with any of the several cross-section, and that are sufficiently small to be easily and randomly dispersed in fresh concrete mix using conventional mixing procedure. The random distribution results in a loss of efficiency as compared to conventional rebars, but the closely spaced fibers improve toughness and tensile properties of concrete and help to control cracking. In many situations it is prudent to combine fiber reinforcement with conventional steel reinforcement to improve performance. Fibre Reinforced Concrete (FRC) is defined as a composite material essentially consisting of conventional concrete or mortar reinforced by the random dispersal of short, discontinious, and discrete fine fibres of specific geometry. Since Biblical times, approximately 3500 years ago, brittle building materials, e.g. clay sun baked bricks, were reinforced with horse-hair, straw and other vegetable fibres. Although reinforcing brittle materials with fibers is an old concept, modern day use of fibers in concrete is only started in the early 1960s. Realizing the improved properties of the fiber reinforced concrete products, further research and development on fiber reinforced concrete (FRC) has been initiated since the last three decades. This paper presents an overview of the mechanical properties of Steel Fiber Reinforced Concrete (SFRC), its advantages, and its applications.

### Keywords: Fiber Reinforced Concrete (FRC), Steel Fiber Reinfoced Concrete (SFRC), Mechanical properties.

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# INTRODUCTION

## GENERAL

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. Steel fiber (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).

# LITERATURE REVIEW

There are two methods to categorize fibres according to their modulus of elasticity or their origin. In the view of modulus of elasticity, fibres can be classified into two basic categories, namely, those having a higher elastic modulus than concrete mix (called hard intrusion) and those with lower elastic modulus than the concrete mix (called soft intrusion). Steel, carbon and glass have higher elastic modulus than cement mortar matrix, and polypropylene and vegetable fibres are classified as the low elastic modulus fibres. High elastic modulus fibers simultaneously can improve both flexural and impact resistance; whereas, low elastic modulus fibres can improve the impact resistance of concrete but do not contribute much to its flexural strength. According to the origin of fibres, they are classified in three categories of metallic fibers (such as steel, carbon steel, and stainless steel), mineral fibers (such as asbestos and glass fibers), and organic fibers. Organic fibers can be further divided into natural and man-made fibers. Natural fibers can be classified into vegetable origin or sisal (such as wood fibers and leaf fibers), and animal origin (such as hair fibers and silk). Man-made fibers can also be divided into two groups as natural polymer (such as cellulose and protein fibers), and synthetic fibers (such as nylon and polypropylene). Figure 1 shows the classification of fibers based on this method (James Patrick Maina Mwangi, 1985). Table 1 shows the properties of different types of fibers can be used in the concrete industry (Johnson and Colin, 1982).

# CONCLUSION

This paper presents an overview of the mechanical properties of Steel Fiber Reinforced Concrete (SFRC), its advantages, and its applications. During the last decades incredible development have been made in concrete technology. One of the major progresses is Fibre Reinforced Concrete (FRC) which can be defined as a composite material consisting of conventional concrete reinforced by the random dispersal of short, discontinious, and discrete fine fibres of specific geometry. Unlike conventional reinforcing steel bars, which are specifically designed and placed in the tensile zone of the concrete member, fibers are thin, short and distributed randomly throughout the concrete member. Among all kinds of fibers which can be used as concrete reinforcement, Steel Fibers are the most popular one. The performance of the Steel Fiber Reinforced Concrete (SFRC) has shown a significant improvement in flexural strength and overall toughness compared against Conventional Reinforced Concrete.

#### REFERENCES

(Behbahani et al., 2011)

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