

## Review on Mechanical Properties of M30 Concrete in addition with Steel Fiber and Jute Fiber

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**Abstract:** Various types of fibers have been used to enhance the mechanical properties of concrete. This review paper examines the effect on the mechanical properties of concrete with the addition of steel fibers and jute fibers. Since earlier periods fibers are being used as a reinforcing material in concrete. Generally, the fibers are used to control cracks in concrete. The addition of fibers in conventional concrete enhances its mechanical properties such as compressive strength, split tensile strength, and flexural strength. The factors affecting the fiber selection such as length, volume, and aspect ratio are also studied.

**Key Word:** Steel Fiber, Jute fiber, Compressive Strength, Split Tensile Strength, Flexural Strength.

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### I. Introduction

Concrete is the most commonly used construction material in the world of the construction industry due to its ability to mould to a shape. It remains in the fresh state, the time it is mixed until it is set. During that time, it can be transport, placed, and compacted. In the fresh state, the properties of concrete are very important because of the influence, the quality of the hardened concrete. By adding some special ingredients may lead to a change in strength and durability of concrete in a fresh stage of the concrete material. Concrete has some disadvantages like low tensile strength and low impact strength. It also possesses desirable properties like high compressive strength. Due to low tensile strength, limited ductility, and little resistance to cracking have limited its use for various applications.

In the newly constructed building, it has been seen that there is a major threat of the formation of cracks and increased drying shrinkage due to the improper curing of concrete. The normal concrete is brittle which means it has good compressive strength but has poor tensile strength whereas steel fiber possesses good tensile strength. But steel fiber has some disadvantages like corrosion property and due to continuing for a long-time exposurer to water and moisture. Whereas jute fiber does not have those disadvantages like continuing for a long-time exposurer to water and moisture. Therefore, this can be done by using jute fiber that do not have the above problems. The compressive strength, split tensile strength and flexural strength of concrete with both steel fiber and jute fiber have been compared in the above experiment.

The mechanical properties of the concrete could be improved by the addition of fibers. Different fibers are used in the concrete namely steel fiber and natural fiber. The improvement in mechanical properties of the fiber reinforced concrete depends on the dosage of the fiber.

#### 1.1 Steel Fiber

Steel fiber is one of the most commonly used fiber. Steel fiber transform brittle concrete into ductile ones. It reduces cracks and also improves tensile strength. Steel fiber reinforced concrete (SFRC) is a composite material made of cement, fine aggregate, coarse aggregate, and steel fiber. The main advantage of SFRC is its superior resistance to tensile strength and crack propagation. The fibers can able to hold the matrix together even after extensive cracking due to its bridging effect. SFRC has the ability to arrest cracks; therefore, fiber composites retain increased extensibility and tensile strength, both at first crack and at ultimate stress. The material is therefore transformed from a brittle to a ductile type of material which would increase substantially the energy absorption characteristics of the fiber composite and has the ability to withstand repeating applied load such as shock or impact loads. Steel fiber reinforced concrete has now become an advanced material which has now used in numerous engineering applications. The applications of steel fiber reinforced concrete are tunnel linings, slabs, and pavements.

#### 1.2 Jute Fiber

Jute Fiber is the cheapest fiber. The jute fiber come from the ribbon of the stem. The jute fiber are firstly extracted by the retting process. Jute fiber has some numbers of advantages. Jute fiber is a low-cost and eco-friendly product and has good durability and moisture retention capacity. It is widely being used in rural

road pavement construction. The biodegradable and low-priced jute products merge with the soil after using providing nourishment to the soil. On combustion, jute does not generate toxic gases because it is made of cellulose. In recent studies, it has been seen that jute fiber improves the resistance of concrete against cracking.

## **II. Review on Literature - National Scenario**

**G. Murali, A. S. Santhi, and G. Mohan Ganesh et. al, (2004)** investigated an experimental study on the fiber reinforced concrete using steel fibers. Crimped and hooked end steel fiber of length 50 mm and an aspect ratio equal to 50 was added to concrete in different proportions of 0%, 0.5%, 1.0%, and 1.5% with water-cement ratio of 0.42. A drop weight test has been performed. From the test results, it was proved that the fiber-reinforced concrete was effective under the impact loads thus improving the impact resistance.

**Prof. Basudam Adhikari, Mr. Rituparna Sen et. al, (2011)** investigated an experimental study on the fiber reinforced concrete using jute fiber and demonstrated the potentiality of jute fiber as a reinforced fiber concrete in cement composites for the use of sewer pipes, prestressed concrete pole, paver blocks. The test results of jute fiber reinforced cement concrete composite showed improvement in the mechanical properties.

**Siva Konda Reddy et al, (2012)** carried out an experimental study on the M60 grade concrete to find the durability of high-performance concrete with addition of micro-silica and steel fibers. Rapid chloride penetration tests were conducted. Test results indicate that the addition of steel fibers to HPC increased strength and durability.

**Dr. K. Chandrasekhar Reddy et. al, (2017)** investigated an experiment study on the mechanical properties of the M40 grade concrete using steel fibers. By the addition of steel fibers to concrete it improves the mechanical properties of concrete. There is a significant increase in the Compressive Strength of concrete with the addition of Hooked Steel fiber when compared to Straight and Crimped Steel fiber. The percentage increase in Compressive Strengths is Hooked End Steel fiber (28.6%), Straight Steel fiber (23.17%), and Crimped Steel fiber (19.6%).

**Gopi Raval et. al, (2017)** aims at providing environment-friendly fibers to fiber reinforced concrete where concrete is such basic component in which constant up-gradation has always been implemented to improve its properties by adding different additives. Jute Fiber is one such material that could be added to concrete to improve its mechanical properties and strength without having any environmental damage.

## **III. Review on Literature - International Scenario**

**Luca G. Sorelli, Alberto Meda, and Giovanni A. Plizzari et al, (2006)** investigated an experimental study on structural slab on ground with different volume fractions of steel fibers and were tested under a point load in the slab center. The results show here that the addition of steel fibers significantly enhance the bearing capacity and the ductility of slabs on the ground.

**Falah A. Almottiri et al, (2011)** investigated an experimental study on the structural behavior of reinforced concrete using steel fiber and fly ash. By the addition of steel fibers, it improves its flexural and tensile strength. By increasing the percentages of fly ash up to 30% and steel fibers up to 1.5% in concrete enhances the mechanical properties of the concrete.

**Jimmy Susetyo, Paul Gauvreau, and Frank J. Vecchio et. al, (2011)** investigated an experimental study on high-performance concrete with addition of steel fibers. By the addition of steel fibers on the concrete it was found that it controls the crack development and prevent the occurrence of large crack widths and also there is a significant increase in the post-cracking toughness, tensile strength and ductility of the concrete.

**Hassan Ghanem, Ph.D., and Yehia Obeid, M.S. et. al, (2015)** investigated an experimental study on the steel fiber reinforced self-compacting concrete. By the addition of fibers, it improves the compressive strength but it has a negative effect on the rheological properties of the self-compacting concrete. Test like Compressive strength and four-point bending test were performed. It was also known that the size of fiber is a key factor affecting the mechanical properties and toughness of the material.

**Lam Tian Fook, (2017)** investigated an experimental study on the mechanical properties of the concrete using kenaf fiber. Kenaf fiber is one of the organic fibers. And it has many advantages such as affordability, renewability, recyclability, and biodegradability. Its tensile properties are comparable to other natural fibers,

such as jute fiber. Fiber-reinforced concrete is to improve the concrete mechanical properties and also to prevent the development of cracks.

#### **IV. Advantages of Steel Fiber & Jute Fiber**

With the addition of steel fiber on concrete, it will increase the durability and also improved its mechanical properties like compressive strength, flexural strength, and split tensile strength also it will increase the impact and abrasion resistance. Savings will be greater for heavier crack control systems. Whereas jute is a natural fiber since it is a low-cost and eco-friendly product. It Can be easily transported and also while burning jute fiber it does not produce toxic gases.

#### **V. Limitation of Steel Fiber and Jute Fiber in Concrete**

The workability of the fresh concrete will decrease when the amount of fiber increase. Because too much of fibers in concrete will decrease workability due to congestion. If proper techniques and proportions do not use, the fibers may also cause a finishing problem. So, by adding fibers in the concrete it will increase its mechanical properties within a certain limit.

#### **VI. Previous Study Results**

Dayananda N, KeerthiGowda B S and G L Easwara Prasad study on the effect of on the mechanical properties of concrete using jute fibers. This investigation helps to know its effective usage and to restrict use of polymer fibers. Here in this experiment the fibers length cut into 1cm and then mixed with the conventional concrete. After casting and curing it was observed that the mechanical properties increase upto a certain limit. Because as the fiber content increase the level of compaction also decrease which leads to honeycomb in the concrete. So, these make the specimen weak from inside and tend to fail the compressive load when it is applied.

Milind V. Mohod carried out on the performance of Steel Fiber Reinforced Concrete on M30 grade concrete using hooked end steel fiber. Addition of steel fiber increases the mechanical properties upto a certain limit but it was observed that as the amount of steel fibers increases the workability also decreases. While testing the normal concrete specimens have shown some crack which leads into splitting into two parts. But the steel fibers reinforced concrete does not split because the steel fiber hold the matrix together due to its bridging effect.

#### **VII. Future Scope of Study**

Research is been done on the scope of steel fiber and jute fiber that are now viable at markets. Steel fiber reinforced concrete has now become an advanced material which has now used in numerous engineering applications. The applications of steel fiber reinforced concrete are tunnel linings, slabs, and pavements. Whereas jute fiber is a natural fiber and it is a low-cost and eco-friendly product and has good durability and moisture retention capacity. It is widely being used in rural road pavement construction. The biodegradable and low-priced jute products merge with the soil after using providing nourishment to the soil. A recent study has shown results of addition of steel fiber and jute fiber in the concrete gives maximum strength to the concrete.

#### **VIII. Conclusion**

This review paper enlisted the experimental study that has been carried out to investigate the mechanical properties of concrete with different percentages and proportions of Steel Fiber and Jute Fiber. The main objective of the review paper is to find out the mechanical properties like compressive strength, flexural strength, and split tensile strength. These studies can help to learn the mechanical properties of concrete.

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