

## Experiment Study: Sisal Fiber Reinforced Concrete

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### ABSTRACT

*One of the main fields of research that is becoming more and more relevant is fibre reinforced concrete. Fibers are used to enhance the tensile qualities of concrete without reducing its compressive strength. This study attempted to examine the impact of natural sisal fibre on concrete by partially substituting cement. For usage in concrete, sisal fibre is chemically processed in this instance. When compared to standard M25 concrete, fibre reinforced concrete with 1%, 2%, 3% of fibre replacing cement by volume has mechanical parameters such as compressive strength, split tensile strength, and flexural strength that are higher. Comparing fibre replacements of 1%, 2%, and 3% to ordinary concrete, the compressive strength at 28 days increased by 13.8%, 21%, and 16.3%, respectively. When compared to normal M25 concrete, fibre substitutions of 1%, 2%, and 3% enhance split tensile strength at 28 days by 24%, 56%, and 80% and first cracking load in flexure by 12.5%, 27.5%, and 20%.*

**Keywords:-** Sisal Fiber, Concrete, Compressive Strength, Split Tensile Strength, Flexural Strength

### INTRODUCTION

Concrete that has been reinforced with fibrous material (FRC) has a higher structural integrity. It has uniformly distributed, short discrete fibres that are randomly orientated. Steel, glass, synthetic, and natural fibres are examples of fibres. With different concretes, fibre materials, geometries, distribution, orientation, and densities, the characteristics of fibre reinforced concrete alter. Structure-wide cracks can appear in plain concrete and other brittle materials even before they are loaded, especially when drying shrinkage or other volume-changing factors are involved. When under load, microcracks spread and widen, forming new cracks where there were previously only tiny flaws. The structural fractures move slowly or with small leaps because they are slowed down by

numerous impediments, changing course as they pass the matrix's more resistant grains. The primary cause of the concrete's inelastic deformation is the growth of such microcracks. Fiber reinforced concrete is the name given to this kind of concrete. Sisal Fiber reinforced concrete is a composite material made of cement mortar or concrete mixtures with treated fibres distributed evenly throughout. It has also been utilised to make composite materials more durable.

### LITERATURE REVIEW

With adjusting the dosage of fibre content from 0.1%, 0.2%, 0.3%, 0.4%, and 0.5%, by volume of cement with length of 35mm sisal fibre, the mechanical parameters of M40 grade concrete, such as compressive strength and modulus of rupture, were examined. The amount of fibre that

increases compressive strength the most is discovered to be 0.3%. Vijaychandrakanth and Athiappan (2014). The number of natural fibres, including jute, sisal, coir, etc., that can be chemically modified to serve as fibre reinforcement components for composites is being studied. Natural fibres have the advantages of being readily available, simple and safe to use, and biodegradable. (2016) L. Nagarajan and S. Pavithra.

The percentages of 10%, 20%, and 30% by weight of slag and 1% by weight of sisal fibre are added to the cement research in concrete, respectively. At 7, 14, and 28 days after curing, concrete cubes are tested. Comparing the strength performance of normal concrete with that of slag blended fibre reinforced concrete. 2016 (P. Sathish, V. Muruges). The density of the proposed quarry dust and sisal fiber-based concrete was found to be quite low in comparison to conventional concrete. Constantly replace fine aggregate with quarry dust at a rate of 20%, and add sisal fibre at a rate of between 0.25 and 0.75% for the total volume of concrete. (J. Thivya and P. Sasikumar, 2017)

## MATERIALS AND METHODS

For this experiment, OPC 53 grade conforming to IS 12269-1987 is employed. River sand that meets IS 383-1970 is utilised. According to IS 383-1970,

angular aggregate with a nominal size of 20mm was employed. These aggregates' qualities have been evaluated and listed. Sisal fibre is a popular natural fibre that is also extremely easy to grow. It is a rigid fibre that has traditionally been used to make twine, rope, and the fibre core of elevator steel wire cables. It comes from the sisal plant. Agave sisalana is the botanical name for this plant. The fibre length is set at 20 mm. The sisal fibre is treated for 20 minutes with a 5% solution of NaOH (0.1 concentration) and then dried. The surplus NaOH was then rinsed away with 1% acetic acid. Sisal fibre is utilised in concrete after it has been cured at room temperature.

Table 1 shows the parameters of sisal fibre as provided by the supplier. The diameter varies significantly because it is a natural fibre. River sand is utilised as fine aggregates in the Zone II category. IS 383-1975 coarse aggregate with a nominal size of 20 mm is utilised. Portable water with a pH of 7.0 + 1 and meeting IS 456-2000 requirements was used to prepare and cure the concrete. For ordinary concrete, the water cement ratio is 0.43. As a superplasticizer, Conplast WL is utilised. 36 cubes with sides of 150 mm and 36 cylinders with sides of 150 mm 300 mm were cast and tested for compressive strength and split tensile strength at 7 days, 14 days, and 28 days.

**Table 1:-Physical Properties of Sisal Fiber**

Tensile Strength (Mpa)	385 to 728
Elongation of Break (%)	2.75
Diameter (mm)	0.8 to 1.2mm
Density (g/cm <sup>3</sup> )	1.58
Young's Modulus (Gpa)	9—22
Moisture %	6.55

### SLUMP VALUE

The slump value of conventional concrete is higher than the sisal fiber replaced concrete. The slump value decreased with increase in percentage of sisal fiber.

*Table 2:-Slump Values*

<i>Fiber %</i>	<i>Value</i>
0%	57 mm
1%	41 mm
2%	38 mm
3%	30 mm

### COMPRESSIVE STRENGTH

Finding the compressive strength of concrete is the most typical test performed on hardened concrete. Concrete is tested in

accordance with IS 516-1959. Each of the four blends must be produced into three samples, which will be tested after 7, 14, and 28 days.

*Table 3:-Average Compressive Strength*

Sisal fiber %	Compressive strength (N/mm <sup>2</sup> )		
	7 days	14 days	28 days
0%	16.2	23.1	26.5
1%	18.5	26.0	30.1
2%	20.2	26.2	30.2
3%	18.2	26.1	30

### SPLIT TENSILE STRENGTH

In this study, a cylinder is tested by splitting it along its central plane, perpendicular to the edges, and applying a compressive load to the opposing edges. At 7, 14, and 28 days, three specimens must be created for testing, accordingly.

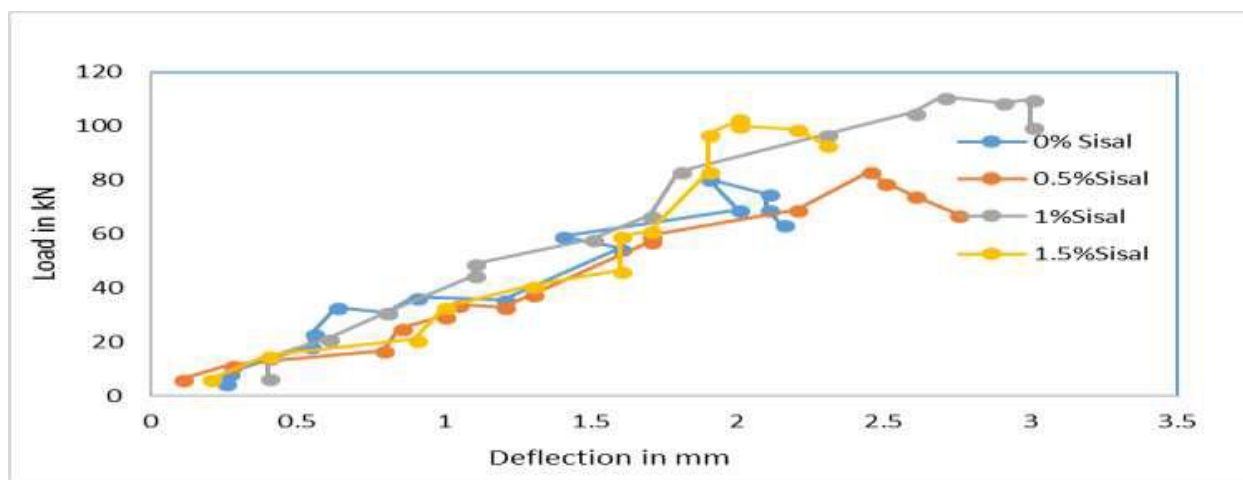
*Table 4:-Average Split Tensile Strength*

Sisal fiber %	Split tensile strength (N/mm <sup>2</sup> )		
	7 days	14 days	28 days
0%	1.6	1.8	2.3
1%	2.1	2.4	2.9
2%	2.6	3.1	3.8
3%	3.4	3.5	4.2

### FLEXURAL STRENGTH

There were 12 beams in the experimental programme. To investigate the impact of flexural strengthening, every beam was used. RCC beams that were cast with 1%,

2%, or 3% concrete as well as regular concrete were evaluated. Maximum ultimate load for 2% sisal fibre substituted RCC Beams made of M25 grade concrete is 113 kN.



**Fig.1:-Load deflection Curve in Flexure**

**Table 5:-Flexural Strength**

Sr. No.	Parameter	Conventional concrete	1 % sisal fiber	2 % sisal fiber	3 % sisal fiber
1	Initial crack load (kN)	42	44	50	47
2	Ultimate load (kN)	78	92	113	101
3	Ultimate deflection (Mid Span) mm	1.9	1.32	2.60	2.10

## CONCLUSION

From this experimental investigation, the following conclusion were arrived.

1. The use of natural sisal fibre improves concrete. The best sisal fibre percentage for maximal strength was 2% for compressive strength and 2% for split tensile strength. Workability declines when the fraction of sisal fibre substituted with 1%, 2%, or 3% of the volume of cement increases.
2. The flexural strength of the sisal fibre supplemented beam achieved is more than that of regular strength concrete. When the initial fracture load value increases, it shows that the strength of the concrete is greater than in traditional concrete. At 2% sisal fibre concrete replacement, the maximum ultimate flexure strength of the beam was achieved.

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