

# STUDY ON PROPERTIES OF SISAL FIBER REINFORCED CONCRETE WITH DIFFERENT MIX PROPORTIONS AND DIFFERENT PERCENTAGE OF FIBER ADDITION

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## Abstract

The present research was designed to check the workability and strength properties of sisal fiber reinforced concrete with different mix proportions and different percentage of fiber addition. The materials were chosen to improve the various strength properties of the structure to obtain sustainability and better quality structure. Short discrete vegetable fiber (sisal) was examined for its suitability for incorporation in cement concrete. The physical property of this fiber has shown no deterioration in a concrete medium. Fibers were brushed, lined up and cut to obtain 4cm length. Degree of workability of concrete mix with 0.2% super plasticizer and water cement ratio 0.45 had good workability with slump value 53mm and compaction factor 0.88, which is effective, was obtained. Materials were hand mixed with 0.5%, 1% and 1.5% addition of fiber in M20 and M25 mix design and casted in cubes and cylinders. The obtained specimens were subjected to tests aimed to check the compressive, tensile and flexural strength. An increase in compressive strength by 50.53% and tensile strength by 3.416% was observed for 1.5% addition of fiber in M20 mix design respectively. An increase in compressive strength by 52.51% and tensile strength by 3.904% was observed for 1.5% addition of fiber in M25 mix design respectively.

**Keywords:** Sisal fiber, workability, sustainability, mix design, compressive, tensile, flexural.

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## 1. INTRODUCTION

Sisal fiber is a species of Agava. It is botanically known as Agave sisalana. The material is chosen to improve the various strength properties of the structure to obtain sustainability and better quality structure. Short discrete vegetable fiber (sisal) was examined for its suitability for incorporation in cement concrete. The physical property of this fiber has shown no deterioration in a concrete medium. Leaves are dried, brushed and baled to form fiber. Concrete is a mixture of glue and fillers, cement and water act as glue and coarse and fine aggregate are the fillers. This concrete is strong in compression and 8 to 10 percentage weaker in tension. Reinforcement is introduced in concrete to improve its property and fibers have always been considered promising as reinforcement of cement.

The main disadvantage is that it is of high price. Addition of fiber reduces workability. Sisal fiber reinforced concrete should be hand mixed.

Sisal fiber reinforced concrete is the concrete with randomly distributed fibers. The failure strength and modulus of elasticity depends on the amount of cellulose and the orientation of the micro-fibers.

This study is done to find the physical properties of conventional concrete and sisal fiber reinforced concrete and to enhance the properties of concrete using sisal fiber by replacing cement with respective percentage of fiber and finding the strength variation on concrete in different mix proportions.

## 2. MATERIALS AND METHODOLOGY

Fiber was brushed, lined up and cut to obtain 4cm length. Then casting and testing of concrete specimens using different ratio of sisal fiber that is 0.5%, 1% and 1.5%.

### 2.1 Materials Used

- Cement Used-OPC
- Cement Specific Gravity-3.15
- Coarse Aggregate Specific Gravity-2.66
- Fine Aggregate Specific Gravity-2.60
- Super Plasticizer-0.2% to the weight of cement.
- Water cement ratio-0.45
- Sisal fiber addition-0.5%, 1%, 1.5% to the weight of cement

### 2.2 Workability

To find workability, considerable trial and error method was done using slump cone test to find slump in concrete and compaction factor test to find consistency. Water cement ratio of 0.45 was used.

### 2.3 Specimen Preparation

Materials were hand mixed to obtain the respective M20 and M25 design mix with the respective percentage of fiber addition. The mix designs were then placed in cube and cylinder molds. Demolding was done and specimens were obtained. Curing of the specimen is done until testing was done.

### 2.4 Strength Test

- Compressive Strength- Cubes were tested for compressive strength using compression testing machine.
- Tensile strength- Cylinders were tested for tensile strength using compression testing machine.



Fig -1: Compression testing machine

Compaction factor was effective for 0.45 water cement ratio with 0.2% addition of super plasticizers.

### 3.3 Compression Test

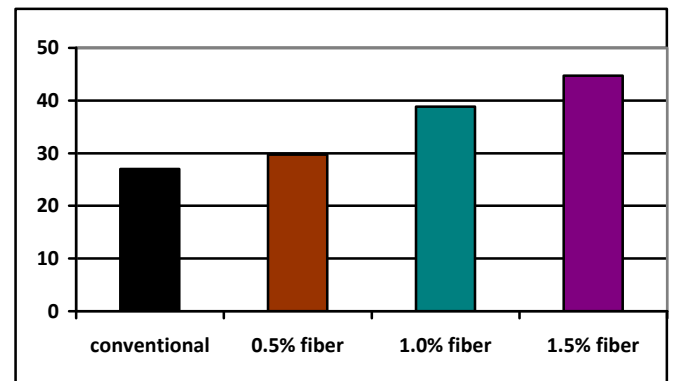


Chart -1: Graphical representation of M20 compressive strength

Table -5: Result of compression strength for M20

Percentage Addition Of Fiber	Percentage Increase In Strength
0.5%	0.168
1%	30.83
1.5%	50.53

## 3. RESULTS AND DISCUSSION

### 3.1 Slump Test

Table -1: Test without super plasticizers and 1.5% fiber

Water Cement Ratio	Slump Value in mm
0.35	1
0.40	3
0.45	4

Table -2: Test with super plasticizers and 1.5% fiber

Water Cement Ratio	Slump Value in mm
0.35	14
0.40	26
0.45	53

Concrete mixture with 0.2% super plasticizer and water cement ratio 0.45 had slump 53mm which was categorized as good workability.

### 3.2 Compaction Factor Test

Table -3: Test without super plasticizers and 1.5% fiber

Water Cement Ratio	Slump Value in mm
0.40	0.842
0.45	0.86
0.5	0.88

Table -4: Test with super plasticizers and 1.5% fiber

Water Cement Ratio	Slump Value in mm
0.40	0.92
0.45	0.86
0.50	0.88

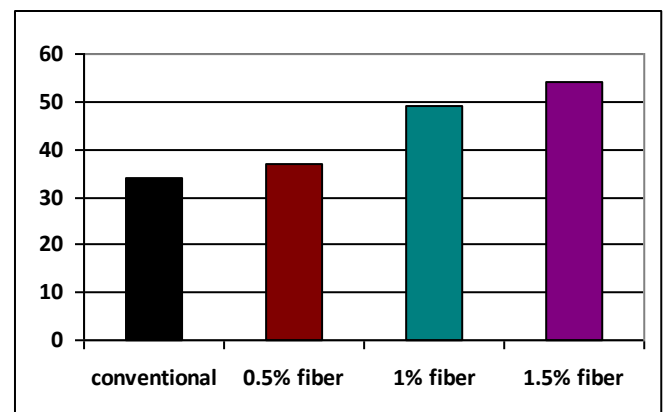


Chart -2: Graphical representation of M25 compressive strength

Table -6: Result of compression strength for M25

Percentage Addition Of Fiber	Percentage Increase In Strength
0.5%	4.32
1%	38.33
1.5%	52.51

Addition of 1.5% fiber in concrete gave almost 50% increase in compressive strength.

### 3.4 Tensile Strength

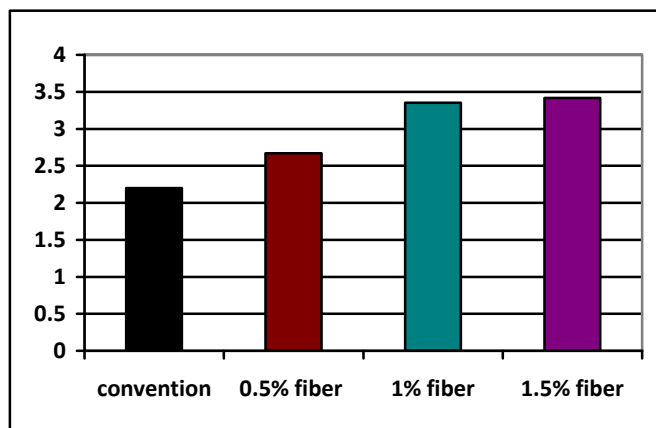


Chart -3: Graphical representation of M20 tensile strength

Table -7: Result of tensile strength for M20

Percentage Addition Of Fiber	Percentage Increase In Strength
0.5%	12.65
1%	41.37
1.5%	44.378

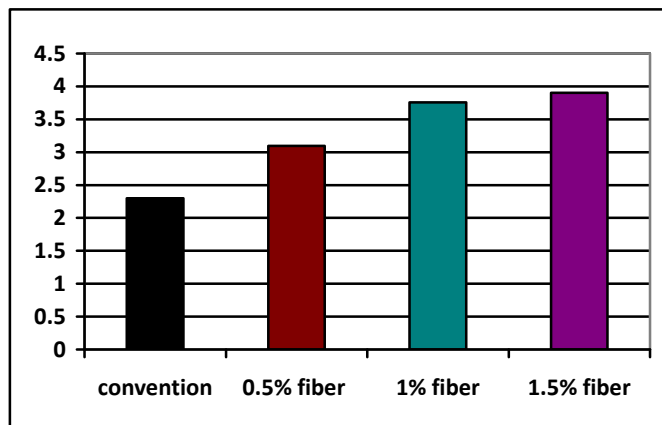


Chart -4: Graphical representation of M25 tensile strength

Table -8: Result of tensile strength for M25

Percentage Addition Of Fiber	Percentage Increase In Strength
0.5%	7.944
1%	30.83
1.5%	36.027

Addition of 1% and 1.5% of fiber on tensile strength of concrete is almost same.

### 3.5 Discussion

The workability of concrete was affected to a large extent on addition of sisal fiber. Only after addition of super plasticizer to the mix, the appropriate workability was achieved.

There was no much difference in compaction factor as the variation was very minute after the addition of fiber.

According to the study, 1.5% addition of fiber was more effective on compression strength for both the mix design M20 and M25.

Whereas percentage increase in the tensile strength was comparatively more in M20 than M25.

### 4. CONCLUSION

The study has concluded that there was an increase in slump value from 4mm to 53mm after addition of super plasticizer. Degree of workability for concrete mixture with 0.2% super plasticizer and water cement ratio 0.45 provided good workability.

Compaction factor increases by 0.02 to 0.03 after addition of super plasticizer.

Compression strength increased by 50.53% after addition of 1.5% fiber for M20 mix design, whereas the increase was up to 52.51% for the same percentage addition of fiber in M25.

Tensile strength increment was almost same for 1% and 1.5% addition of fiber. The increased tensile strength for M20 mix design with 1% and 1.5% addition of fiber was 41.37% and 44.378%. There was a decrease in percentage increase in tensile strength for M25 when compared with M20. The increase in tensile strength for M25 mix design with 1% and 1.5% addition of fiber is 30.83% and 36.027%.

It is concluded that 1.5% addition of fiber will give better strength

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