# Experimental Investigation of Mechanical Properties of Partially Prestressed Fiber Reinforced Concrete

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**Abstract -** *This research aims to evaluate the use of glass fiber, Polypropylene fiber, steel fiber on the properties of prestressed and partial reinforced concrete. Concrete is one of the most widely used to recognized development material hence an attempt has been made in the present investigation to study the behavior of glass fiber in concrete. The main aim of the study the effect of glass fiber on concrete. The work involves four mixes, the mix proportion of this mixes is (1:2.05:2.60) Grade M40 and water cement ratio is (0.38), super plasticizer 1.0% of cement content and glass fiber (0, 0.25, 1.0.1.5) % respectively. Fiber-reinforcement is predominantly used for crack control. Fiber-reinforced concrete is durable which resist weathering action, chemical attack, abrasion and other degradation processes during its service life with the minimal maintenance is equally important as the capacity of a structure to resist the loads applied on it. The purpose of this study is to investigate the workability and mechanical properties of glass fiber, Polypropylene fiber and steel fiber. The laboratory testing included splitting tensile strength test, flexural strength tests a compressive strength test. The addition of the glass fiber, steel fiber and polypropylene fiber into concrete can dramatically increase the split tensile strength, flexural strength and compressive strength of concrete.*

***Key Words***: *Compressive Strength, Flexural Strength, Glass Fiber, steel fiber, polypropylene fiber, Splitting Tensile Strength*

## 1. INTRODUCTION

The well-known inherent deficiencies of concrete are its tensile strength and its brittleness. These weaknesses of concrete lead to immediate collapse of plain concrete beams after formation of the first crack and its propagation, at very low values of tensile stress developed in the cross section due to direct (axial) and / or indirect (flexural, shear or torsion) nature of loading. Concrete is by nature a brittle material that performs well in compression, but is considerably less effective when in tension. Reinforcement is used to absorb these tensile forces so that the cracking which is inevitable in all high-strength concretes does not weaken the structure. Latest developments in concrete technology now include reinforcement in the form of fibers, notably polymeric fibers, as well as steel or glass fibers. Fiber-reinforcement is predominantly used for crack control and not structural strengthening. These deficiencies are overcome by fiber reinforced concrete and pre-stressed concrete systems. These systems are not improving the weaknesses of the concrete matrix but are aiding the concrete with tensile reinforcement for sharing almost totally the tensile load on the elements. Glass fiber concretes are mainly used in exterior building façade panels and as architectural precast concrete. Glass fiber reinforced concrete consists of high strength glass fiber embedded in a cementations matrix. Recently, the development of polypropylene fiber-reinforced concrete (PFRC) has also provided a technical basis for improving these deficiencies along with SFRC and GFRC.

## 2. OBJECTIVE

The objective of this study is to investigate the mechanical properties like shear strength, and torsion strength of concrete with of steel fiber, Glass Fiber, polypropylene fiber with constant volume.

## 3. RESEARCH METHODOLOGY

Research methodology is designed so as to meet the objective of the study. to investigate the mechanical properties like shear strength, and torsion strength of concrete with of steel fiber, Glass Fiber, polypropylene fiber with constant volume, 36 Cubes of size 150X150x150mm, 8 cylinders of size 300x150 mm and 24 prestressed beams of size 1500x150x150mm casted and laboratory tests for beams, cubes and Cylinder such as compressive strength, Split Tensile Strength and flexural strength are conducted in lab. The results are analyzed.

## 4. RESULTS AND DISCUSSION

**Table -1: Compressive Strength of M-40 Grade of Concrete**

| Fibers (%) | Compressive Strength , N/mm² | | |
|---|---|---|---|
| | 7 Days | 14 Days | 28 Days |
| 0% | 34.33 | 43.95 | 50.22 |
| 1.5% Steel Fiber | 36.51 | 46.66 | 52.70 |
| 0.1% Poly Propylene Fiber | 36.46 | 47.29 | 52.56 |
| 0.25% Glass Fiber | 27.16 | 43.23 | 51.37 |

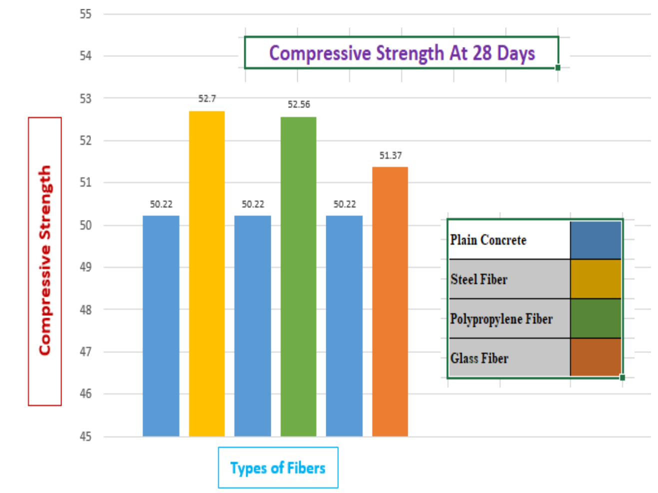


**Chart -1**: Compressive Strength at 28 days

**Table -2: Split Tensile Strength of M-40 Grade of Concrete**

| Fiber (%) | Split Tensile Strength, N/mm² 28 Days |
|---|---|
| 0% | 4.03 |
| 1.5% Steel Fiber | 4.32 |
| 0.1% Poly Propylene Fiber | 5.01 |
| 0.25% Glass Fiber | 5.37 |

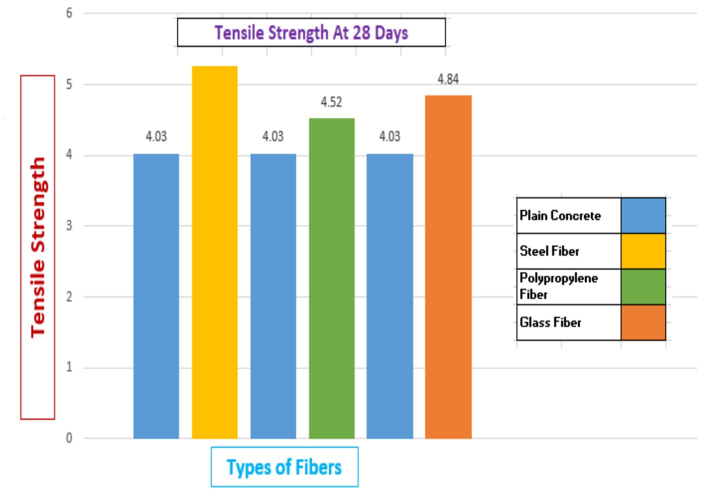


**Chart -2**: Tensile Strength at 28 days

**Table -3: Flexural Strength at 28 days of single point loading**

| Type of Fiber | Specimen | Failure Load (KN) | Average Failure Load (KN) | Flexural Strength (N/mm²) | % increase/decrease in flexural strength |
|---|---|---|---|---|---|
| Plain Beams (0%) | PL-RC-P-S-1 | 5.6 | 5.8 | 3.86 | ------ |
| | PL-RC-P-S-2 | 5.8 | | | |
| | PL-RC-P-S-3 | 6.0 | | | |
| Steel Fiber Beams (1.5%) | SF-RC-P-S-3 | 6.4 | 6.6 | 4.4 | 13.98 % |
| | SF-RC-P-S-3 | 6.6 | | | |
| | SF-RC-P-S-3 | 6.8 | | | |
| Polypropylene Fiber Beams (0.10%) | PP-RC-P-S-3 | 6.0 | 6.2 | 4.13 | 6.99 % |
| | PP-RC-P-S-3 | 6.2 | | | |
| | PP-RC-P-S-3 | 6.4 | | | |
| Glass Fiber Beams (1.5%) | GF-RC-P-S-3 | 6.2 | 6.06 | 4.04 | 4.66 % |
| | GF-RC-P-S-3 | 5.8 | | | |
| | GF-RC-P-S-3 | 6.2 | | | |

The increase in flexural strength of steel fiber, polypropylene fiber and glass fiber is 13.98 %, 6.99 % and 4.66 % respectively as compare to plain beams in single point loading.

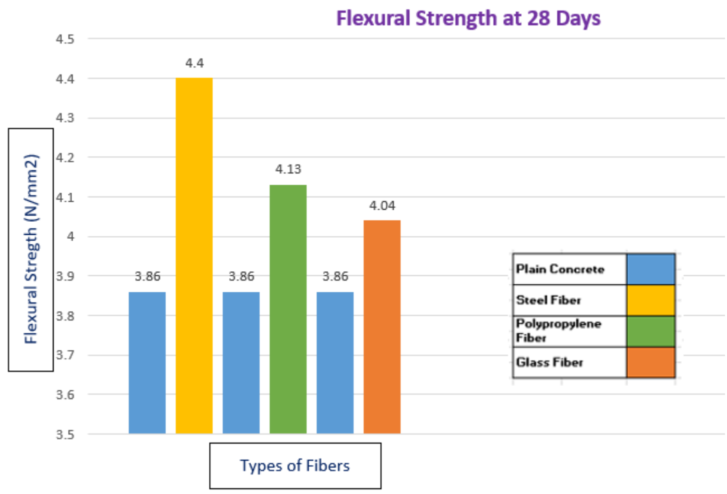


**Chart -3**: Flexural Strength at 28 days of single point loading

**Table -4: Flexural Strength at 28 Days of Two Point Loading**

| Type of Fiber | Specimen | Failure Load (KN) | Average Failure Load (KN) | Flexural Strength (N/m m²) | % increase/decrease in flexural strength |
|---|---|---|---|---|---|
| Plain Beams (0%) | PL-RC-P-S-1 | 7.4 | 7.46 | 3.31 | ------ |
| | PL-RC-P-S-2 | 7.2 | | | |
| | PL-RC-P-S-3 | 7.8 | | | |
| Steel Fiber Beams (1.5%) | SF-RC-P-S-3 | 8.2 | 8.8 | 3.91 | 1.81 % |
| | SF-RC-P-S-3 | 8.4 | | | |
| | SF-RC-P-S-3 | 9.8 | | | |
| Polypropylene Fiber Beams (0.10%) | PP-RC-P-S-3 | 9.0 | 9.31 | 4.14 | 2.80 % |
| | PP-RC-P-S-3 | 9.4 | | | |
| | PP-RC-P-S-3 | 9.6 | | | |
| Glass Fiber Beams (1.5%) | GF-RC-P-S-3 | 9.8 | 9.2 | 4.08 | 2.32 % |
| | GF-RC-P-S-3 | 9.2 | | | |
| | GF-RC-P-S-3 | 8.6 | | | |

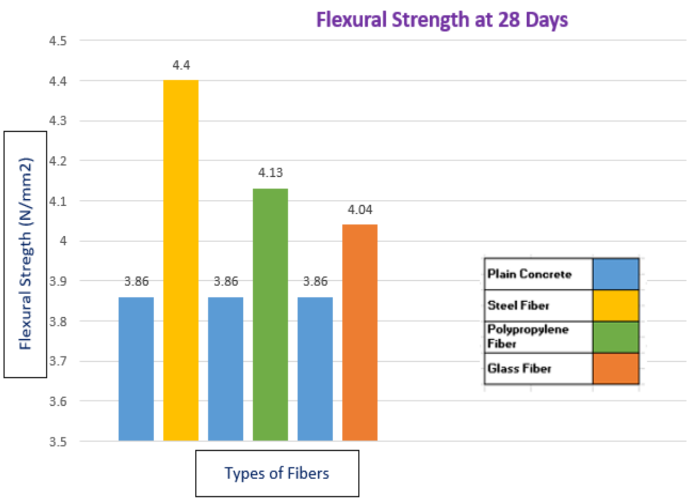


**Chart -4**: Flexural Strength at 28 days of Two point loading

## 5. CONCLUSIONS

1. This Study has reviewed and analyzed the intact methodology which involves analytical study, design of member, mix design procedure and prestressing procedure.

2. Inferences from the results indicate that addition of steel, glass and polypropylene fibers to the concrete beams greatly increase the Flexural strength of beam for both types of loading, i.e, single point loading and double point loading.

3. Inferences from the results also indicate that the cracks are more pronounced and occur more in conventional concrete beams than in Fiber Reinforced Concrete beams.

4. Inferences from testing indicate that among the three fibers, i.e., steel, glass and polypropylene, polypropylene reinforced concrete beams gives the lowest deflection for a particular value of load.

5. Inferences from the graph indicate that the flexural strength of polypropylene beam is slightly more than plain beams. By adding the polypropylene fiber in prestressed concrete beam we can improve impact strength of concrete.

6. Inferences from the results indicate that the use of polypropylene fiber in prestressed concrete enhances the mechanical properties like early compressive strength, flexural strength and improve the durability properties like water permeability, reduction in plastic shrinkage, cracking and alkali chemical attack etc Deflection of polypropylene is less than plain concrete because polypropylene is interlocking concrete particles and improves flexural strength also.

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