IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 1, June 2022
Impact Factor: 6.252

# Test on Strength Properties of Concrete Reinforced with Hybrid Fibres

**Pravin Kumar D[1] and Premalatha J[2]**
PG Student, Department of Civil Engineering[1]
Professor, Department of Civil Engineering[2]
Kumaraguru College of Technology, Coimbatore, Tamil Nādu, India
pravinkumar.20mse@kct.ac.in[1] and premalatha.j.ce@kct.ac.in[2]

**Abstract**: *This study presents the experimental study on effect of glass fibers, steel fibers and hybrid fibers (combination of steel and glass) in the mechanical properties of concrete in comparison with the conventional concrete. The steel fibers, glass fibers and their combination are added to the normal conventional concrete to impart good strength properties such as compressive strength, flexural strength and split tensile strength to the concrete. It also enhances the chemical resistance, permeability, impact strength and other properties of concrete. The aim of the work is to study the properties of steel fibers, glass fibers and hybrid fibers for the properties of concrete for different proportions from the test that are conducted for 7 days and 28 days of curing of the concrete.*

**Keywords**: Compressive strength, Flexural strength and split tensile strength

## I. INTRODUCTION

Concrete is a composite material composed of fine and coarse aggregate bounded together with the cement paste (water and cement) that hardens over time. It has high compressive strength, stiffness and durability under normal conditions, but it is weak in tension and it is a brittle material. To overcome this demerits it is reinforced with different materials like steel, wire, cable, fiber etc. So to overcome the demerit and enhance the properties of the normal concrete fiber reinforced concrete is used. Here in general fiber acts as the load carrying member that transfer load between the fibers and protecting it from external damaging and by using the fibres the concrete can be cast in thinner sections. The fibers can be divided into two groups:

- Fibers that have a moduli value lesser than the cement matrix. Examples are: Nylon, cellulose and polypropylene.
- Fibers that have a greater moduli value than cement. Examples are the glass, steel, asbestos fibers etc.

### 1.1 Glass Fibers

A fiber glass is a form of fiber-reinforced plastic where glass fiber is the reinforced plastic. This is the reason perhaps why fiber glass is also known as glass reinforced plastic or glass fiber reinforced plastic.

The glass fiber is usually flattened into a sheet, randomly arranged or woven into a fabric. According to the use of the fiberglass, the glass fibers can be made of different types of glass. Fiberglass is lightweight, strong and less brittle. The best part of fiberglass is its ability to get moulded into various complex shapes. This pretty much explains why fiberglass is widely used in bathtubs, boats, aircraft, roofing, and other applications.

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### 1.2 Steel Fibers

The fibers are made from hard-drawn low carbon high tensile steel wire and are continuously deformed conforming to the provisions of ASTM 820. Fiber concrete works because unlike mesh reinforcing, the steel fibers reinforce in three dimensions throughout the entire concrete matrix.

### 1.3 Material Properties

**Steel Fibres**

| | |
|---|---|
| **Fiber Length** | 30mm |
| **Equivalent diameter** | 0.75mm |
| **Aspect ratio** | 40 |
| **Tensile Strength** | 1600 Mpa |
| **Deformation** | Crimped |
| **Appearance** | Bright and clean wire |

**Glass Fibres**

| | |
|---|---|
| **Fiber Length** | 20mm |
| **Equivalent Diameter** | 0.5mm |
| **Aspect ratio** | 40 |
| **Tensile strength** | 1.85 Gpa |
| **Young's Modulus** | 70 Gpa |

### 1.4 Tests

Compressive strength test, split tensile test, flexural strength test were conducted for 0.5% of glass fiber, 0.5% of steel fiber and 0.5% of hybrid fiber (0.25% glass fiber + 0.25% steel fiber) added to the concrete.

#### 1.4.1 Compressive Strength Test

| **Mix** | **Compressive strength N/mm²** | | |
|---|---|---|---|
| **Duration** | | **7 Days** | **28 Days** |
| **Control mix** | Sample 1 | 26.94 | 38.49 |
| | Sample 2 | 27.41 | 38.87 |
| | Sample 3 | 26.91 | 39.04 |
| | **Avg.** | **27.09** | **38.8** |
| | Sample 1 | 28.36 | 48.06 |

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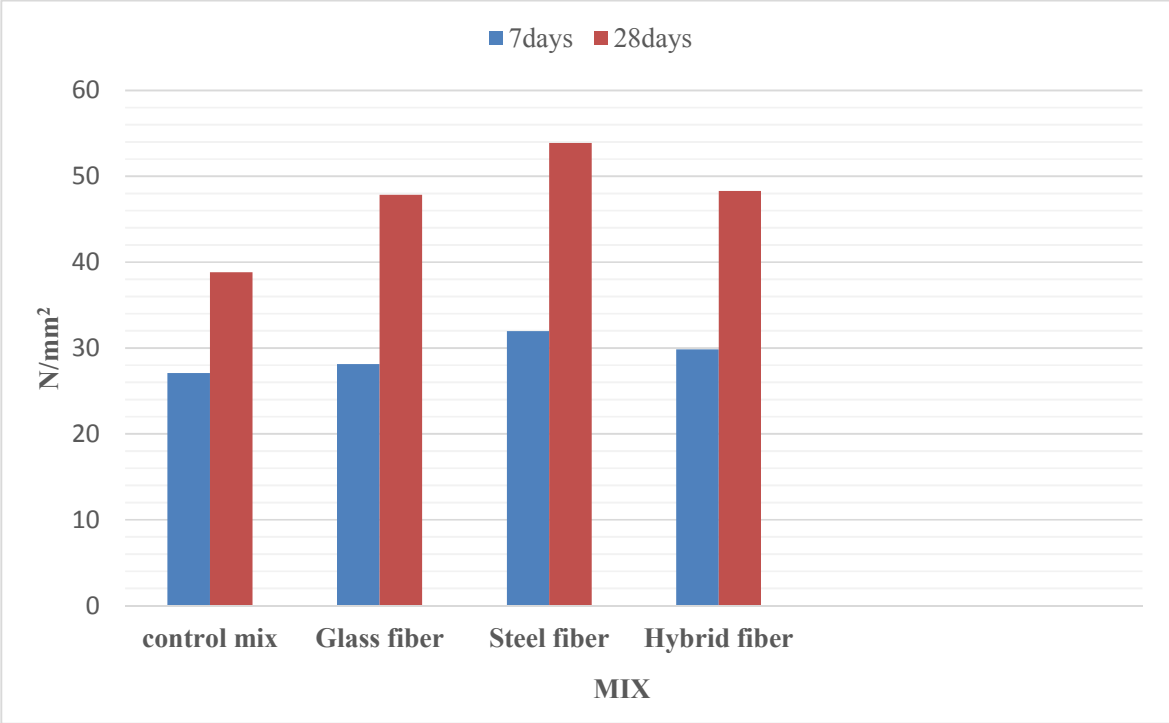
| | | | |
|---|---|---|---|
| **Glass fibre** | Sample 2 | 28.49 | 48.11 |
| | Sample 3 | 27.57 | 47.30 |
| | **Avg.** | **28.14** | **47.82** |
| **Steel fibre** | Sample 1 | 32.34 | 54.74 |
| | Sample 2 | 31.77 | 54.32 |
| | Sample 3 | 31.84 | 52.48 |
| | **Avg.** | **31.98** | **53.85** |
| **Hybrid fibre** | Sample 1 | 30.41 | 47.62 |
| | Sample 2 | 31.84 | 48.34 |
| | Sample 3 | 27.37 | 48.87 |
| | **Avg.** | **29.87** | **48.27** |

**Graph**




**1.4.2 Split Tensile Strength Test**

| **Mix** | **Split tensile strength N/mm²** | | |
|---|---|---|---|
| **Duration** | | **7 Days** | **28 Days** |
| **Control mix** | Sample 1 | 2.04 | 3.22 |
| | Sample 2 | 2.12 | 3.17 |
| | Sample 3 | 2.07 | 3.14 |
| | **Avg.** | **2.08** | **3.17** |
| **Glass fibre** | Sample 1 | 2.87 | 3.98 |
| | Sample 2 | 2.86 | 4.07 |
| | Sample 3 | 2.91 | 4.01 |
| | **Avg.** | **2.88** | **4.02** |
| | Sample 1 | 3.41 | 7.52 |

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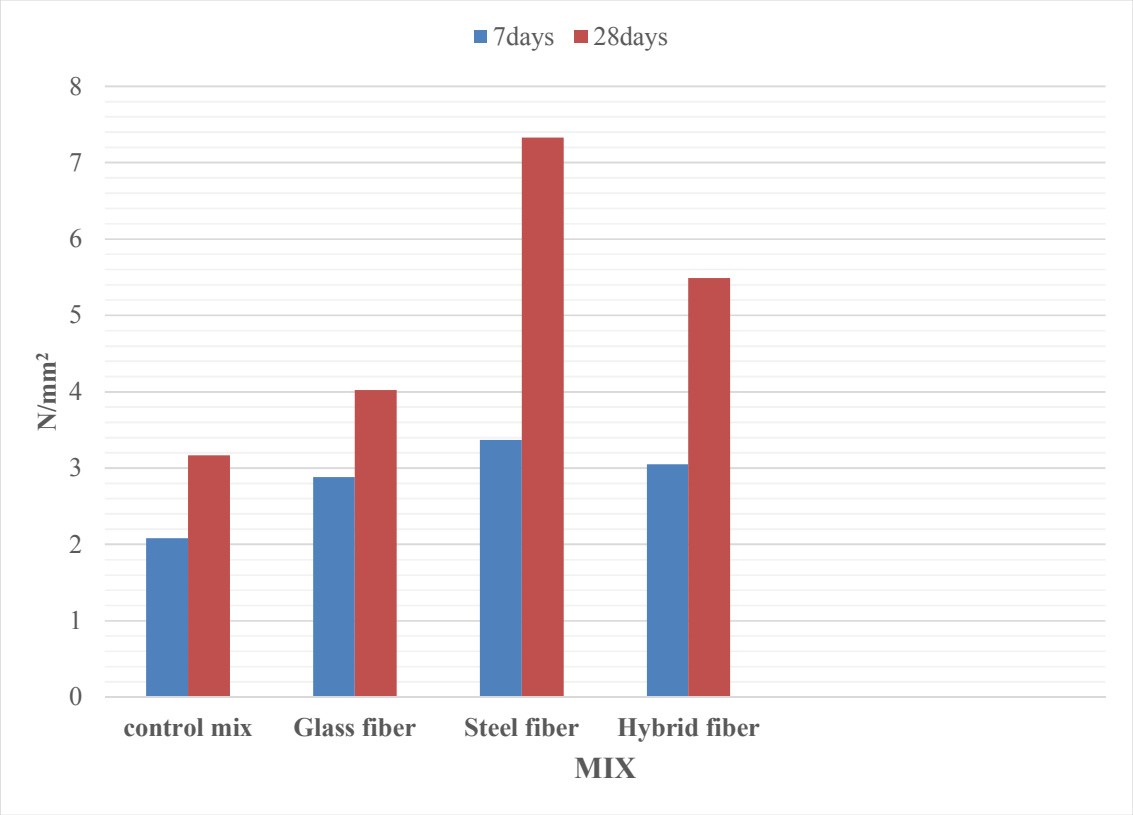
| | | | |
|---|---|---|---|
| **Steel fibre** | Sample 2 | 3.64 | 7.14 |
| | Sample 3 | 3.07 | 7.34 |
| | **Avg.** | **3.37** | **7.33** |
| **Hybrid fibre** | Sample 1 | 2.92 | 5.41 |
| | Sample 2 | 3.05 | 5.14 |
| | Sample 3 | 3.17 | 5.92 |
| | **Avg.** | **3.05** | **5.49** |

**Graph:**




**1.4.3 Flexural Strength Test**

| **Mix** | **Flexural strength N/mm²** | | |
|---|---|---|---|
| **Duration** | | **7 Days** | **28 Days** |
| **Control mix** | Sample 1 | 7.48 | 13.98 |
| | Sample 2 | 7.8 | 14.22 |
| | Sample 3 | 7.74 | 14.36 |
| | **Avg.** | **7.67** | **14.18** |
| **Glass fibre** | Sample 1 | 9.57 | 18.84 |
| | Sample 2 | 10.04 | 19.01 |
| | Sample 3 | 9.8 | 19.04 |
| | **Avg.** | **9.80** | **18.96** |
| **Steel fibre** | Sample 1 | 12.68 | 23.45 |
| | Sample 2 | 12.92 | 24.14 |
| | Sample 3 | 12.87 | 24.37 |

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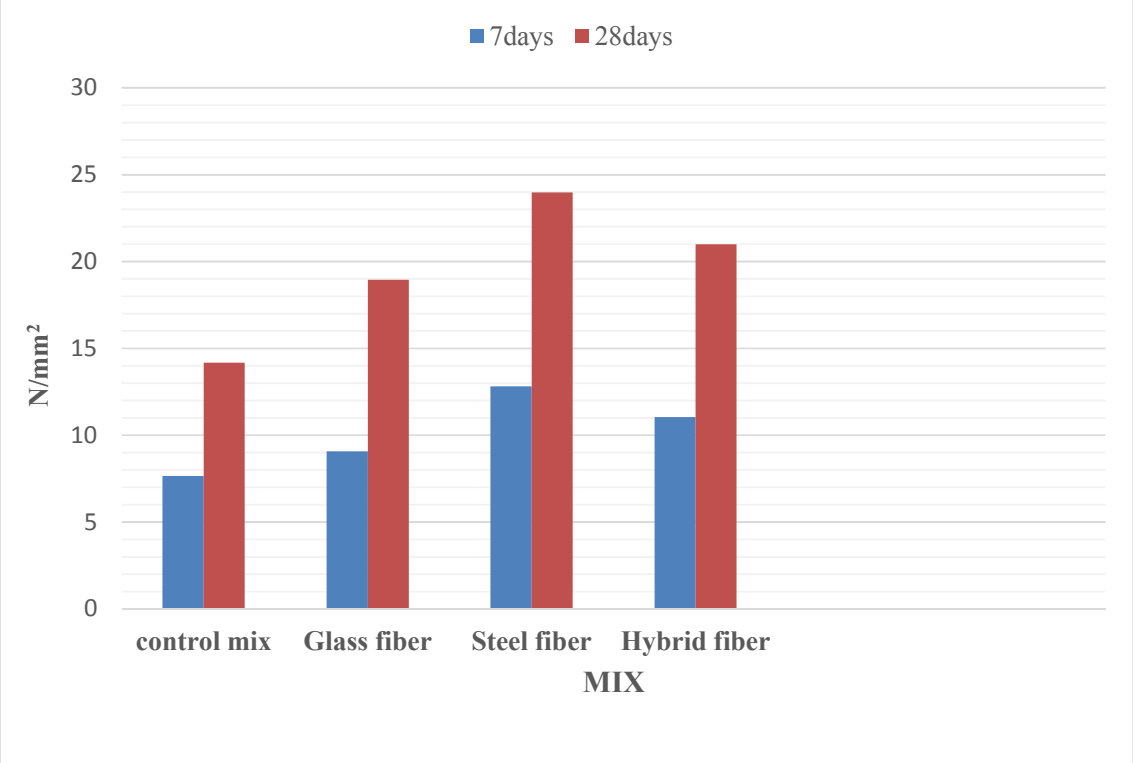
| | | | |
|---|---|---|---|
| | **Avg.** | **12.82** | **23.98** |
| **Hybrid fibre** | Sample 1 | 10.37 | 20.47 |
| | Sample 2 | 11.41 | 21.36 |
| | Sample 3 | 11.38 | 21.21 |
| | **Avg.** | **11.05** | **21.01** |

**Graph:**




### 1.5 Conclusion

- There is an increase in the mechanical properties of the concrete compared to normal concrete with the addition of the fibres.
- The compressive strength test results shows that there is an increase in strength around 20%, 30%, 25% for glass fibre, steel fibre and hybrid fibre mix respectively compared to control mix.
- The split tensile strength test results shows that there is an increase in strength around 20%, 55%, 40% for glass fibre, steel fibre and hybrid fibre mix respectively compared to control mix.
- The flexural strength test results shows that there is an increase in strength around 25%, 40%, 30% for glass fibre, steel fibre and hybrid fibre mix respectively compared to control mix.
- The impact strength test, permeability and chemical resistance test are to be carried out in the next phase of the project.

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