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# Study on Properties of Fibre Reinforced Concrete with Partial Replacement of Coarse Aggregate by Steel Slag

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***ABSTRACT—Fibre-reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibers that are uniformly distributed and randomly oriented. In addition, the character of fiber-reinforced concrete changes with varying concretes, fiber materials, geometries, distribution, orientation, and densities. Generally fibers do not increase the flexural strength of concrete, and so cannot replace moment–resisting or structural steel reinforcement. Indeed, some fibers actually reduce the strength of concrete. In this project work polyester fibers of 0.5%, 1%, 1.5% and 2% is used and its compressive, split tensile and flexural strength is determined. In this phase optimum dosage of concentration of fibers is determined. Steel slag was found to be the best replacement for natural aggregates of concrete. Steel slag which is produced as a waste material in the steel industry and has a negative impact on environment when disposed. In the course of future project work by the replacement of steel slag for the coarse aggregate in concrete of 25%, 50%, 75% & 100% with the addition of optimum polyester fibers to achieve the effective strength of concrete.***

***Keywords*— Polyester Fibres , *Steel Slag.***

## 1. INTRODUCTION

Concrete is one of the most widely used construction material in the world, it is usually associated with Ordinary Portland Cement (OPC) as the main component for making concrete. Production of one tonne of cement requires about 2 tonnes of raw materials of shale and limestone, and also releases large amount of carbon dioxide ($CO_2$) to the atmosphere that significantly contributes to Greenhouse gas Emissions. The amount of Carbon dioxide released during the manufacturing process of OPC is in the order of 1 ton for every ton of OPC produced. Globally, the OPC production contributes about 7% of the world's Carbon dioxide. This is adding about 1.6 billion tons of Carbon dioxide to the atmosphere.

Polyester Fibers Reinforced Concrete (PFRC) has been evaluated for use as a cement concrete pavement material. The study focused on laboratory evaluation of various mechanical and

durability properties of PFRC. The PFRC exhibited improved flexural strength and compressive strength, split tensile strength over that of plain cement concrete (PCC).There is no significant change/reduction in resistance to durability as compared to PCC. There is also no reduction in the long-term properties of PFRC. It is concluded that polyester fibers are alkali resistant, and PFRC can be used in the pavement quality concrete (PQC), and as over lays, with no adverse effect on concrete.Polyester B matrix composites possess the best mechanical properties compared to the other polyester types (A, C and D) with TLK fiber reinforcement.

## 2. Materials used

### 2.1 Properties of polyester fiber

Polyester is a very important manmade fiber. Polyester is produced with a long chain synthetic polyester is produced by melt spinning process.

**Table. 1 Properties of Polyester Fiber**

| Specific Gravity | Elongation At Break | Elastic Modulus | Elasticity | Melting Point | Color |
|---|---|---|---|---|---|
| 1.38 | 15-30% | 90 | Good | 250c | White |

### 2.2 Materials used

Ordinary Portland cement 53 grade was used for casting of all the specimens and clean dry river sand and natural aggregates will be used. The natural river sand passing through IS 4.75mm sieve the specific gravity of fine aggregate is 2.85. Then natural coarse aggregate with specific gravity of 2.67 and passing through IS 20mm sieve. Cubes of 150x150x150 mm, cylinders of 300x150 mm and prisms of 500x100x100 mm were cast, cured and tested for 7 days and 28 days.

## 3. Mix design

**Table 2: Mix Proportion ratio**

| Water (litre/$m^3$) | Cement (Kg/$m^3$) | Fine Aggregate (Kg/$m^3$) | Coarse aggregate (Kg/$m^3$) |
|---|---|---|---|
| 138 | 320 | 751 | 1356 |
| 0.4 | 1 | 2.34 | 4.23 |

## 4. Experimental results

### 4.1 Compressive strength

**Table 3. Compressive strength (% of fiber added)**

| Mix ratio | Compressive strength (N/mm$^2$) | | | | |
|---|---|---|---|---|---|
| **$M_{25}$** | **Conventional concrete** | **0.5%** | **1%** | **1.5%** | **2%** |
| **7 Days** | 18.25 | 20.14 | 23.85 | 23.95 | 18.54 |
| **14 Days** | 22.95 | 25.10 | 26.95 | 27.38 | 22.40 |
| **21 Days** | 26.95 | 30.15 | 30.20 | 27.85 | 25.15 |
| **28 Days** | 34.50 | 33.50 | 38.65 | 32.05 | 28.55 |

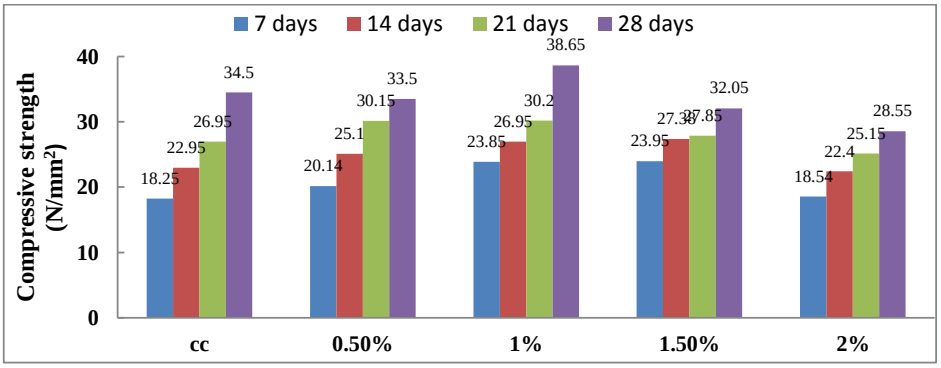


**Fig 1. Compressive strength of concrete**

### 4.2 Split tensile strength

**Table 4. Split Tensile Strength (% of fiber added)**

| Mix ratio | Split Tensile Strength (N/mm$^2$) | | | | |
|---|---|---|---|---|---|
| **$M_{25}$** | **Conventional concrete** | **0.5%** | **1%** | **1.5%** | **2%** |
| **7 Days** | 1.53 | 2.18 | 2.48 | 2.68 | 1.48 |
| **14 Days** | 1.88 | 2.38 | 2.75 | 2.74 | 1.68 |
| **21 Days** | 2.28 | 2.50 | 2.98 | 2.85 | 2.10 |
| **28 Days** | 2.65 | 2.68 | 3.12 | 2.98 | 2.45 |

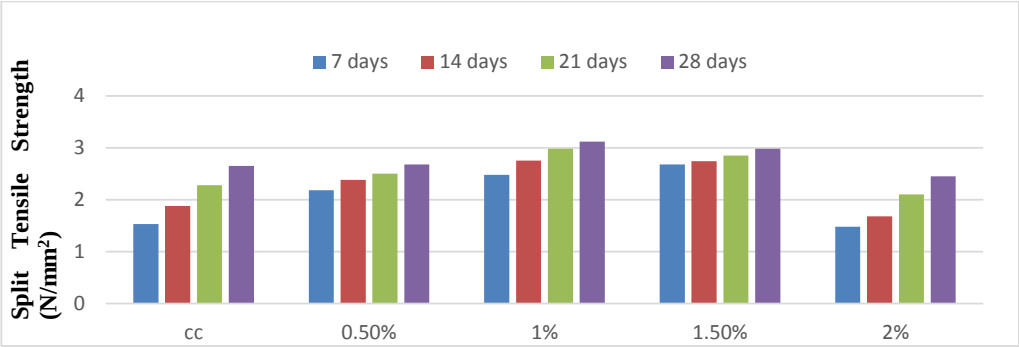


**Fig 2. Split Tensile strength of concrete**

### 4.3 Flexural strength

**Table 5 Flexural Strength (% of fiber added)**

| Mix ratio | **Flexural Strength (N/mm²)** | | | | |
|---|---|---|---|---|---|
| **$M_{25}$** | **Conventional concrete** | **0.5%** | **1%** | **1.50%** | **2%** |
| **7 Days** | 1.16 | 2.15 | 2.58 | 2.36 | 1.12 |
| **14 Days** | 1.88 | 3.85 | 3.88 | 4.25 | 1.5 |
| **21 Days** | 2.35 | 5.1 | 4.85 | 5.05 | 2.58 |
| **28 Days** | 3.28 | 5.88 | 7.18 | 6.15 | 3.15 |

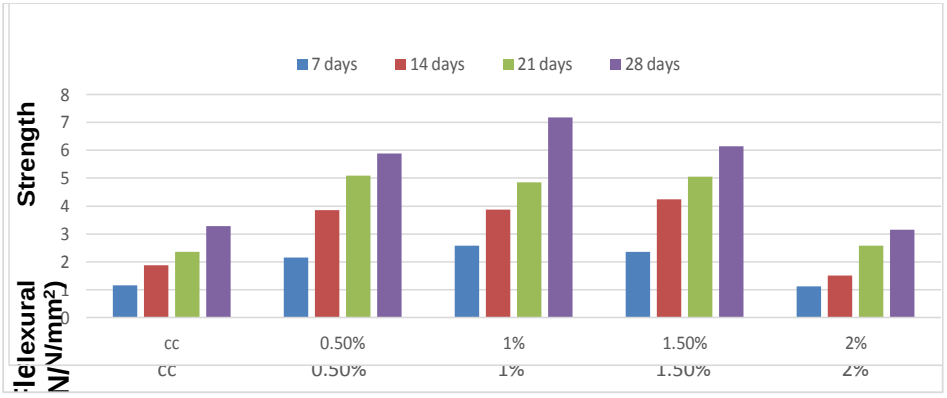


**Fig 3. Flexural strength of concrete**

## 5. CONCULSION AND FUTUREWORK

Compressive strength of 1% polyester fiber reinforced concrete has found to be 10% increase in strength, when compared to that of Conventional concrete. Split tensile strength of 1% polyester

fiber reinforced concrete has found to be 10% increase in strength, when compared to that of Conventional concrete.

Flexural strength of 1% polyester fiber reinforced concrete has found to be 20% increase in strength, when compared to that of Conventional concrete. Hence 1% concentration of polyester fiber is found to be the optimum dosage for his project work.

For the future work, the continuation of project research with the replacement of steel slag for the coarse aggregate to find the better optimum dosage and the effectiveness of concrete with the replacement.

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