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# Evaluating Strength Of Concrete Using Bottle Caps And PET

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**Abstract —** *Advancement in technology enhance human comforts and at the same time causes damage to environment. Waste plastic bottles are major cause of solid waste disposal also disposal of metals caps of soft drink bottles are a headache to environmental engineers and involves processes either to recycle or reuse. On the other hand concrete, is the most popular construction material, which is very strong in compression. It has some limited properties, low tensile strength, low ductility, and cracking associated with hardening and curing. Out of all these drawbacks low tensile strength is the important one and to counteract this some fiber like material can be added to concrete to increase its tensile strength. Therefore in our project an attempt has been taken to study the influence of addition of waste materials like metal caps of bottle and PET with dosage of 0.5% of total weight of concrete as fibers. In this investigation caps were cut into strips of size of 3mm width and 15mm length and PET were cut into strip of size of 4mm width and 30mm length.*

***Keywords-*** *PET Bottle waste, Metal caps of bottles, Concrete, Tensile strength.*

## I. INTRODUCTION

Now a days the importance of concrete in modern society become more intensive. If we see around us then we find structures of concrete components at every place such as high rise buildings, highways, bridges, tunnels, canal and dams. There is no avoidance of the impact of concrete material makes on our life. Thus, concrete plays an important role in the construction and improvement of our civil engineering and infrastructure development. In universal concrete is extremely strong in compressive strength, it is extremely weak in tensile strength. To release some of these sour properties of concrete, the wastage material as a fibers can be added as one of the elements of concrete. To get better properties of concrete fiber reinforced concrete (FRC) has been developed which is defined as concrete containing scatterded randomly oriented fibers. In the earlier in asbestos fibers, steel, glass and synthetic fibres such as polypropylene, polyethylene terephthalate fibres were used in concrete.

The primary objective of this investigation is to study experimentally the properties of fiber reinforced concrete containing wastage of PET and metal caps of bottle. The properties of concrete, namely, compressive strength, tensile strength and flexural strength were studied.

Detailed descriptions about the materials used, specimens tested and testing methods are essentials for an experimental investigation. Hence they are described in detail in the following sections.

### Details of specimens

Table-1 shows the details of the various test specimens. It is intended to find experimentally the effect of addition of PET and metal caps of bottles as fibers on the properties of concrete to be used for pavement construction. Hence the investigations are taken up to evaluate compressive strength, tensile strength and flexural strength of plain and fiber reinforced concrete specimens as per standards.

### Casting and curing of specimens

The constituent materials of concrete, viz., Cement, Sand and aggregates were tested as per the relevant Indian codes of Practice. Concrete of M30 grade was designed as per the procedure. Concrete mix is done by hand mixing and the specimens were cast as per the recommendations of IS: 516 - 1959. Fibres from the domestic waste were cut (Figure-1, 2) and added to the concrete at a dosage of 0.5% by volume of concrete.

Concrete was placed uniformly over the length of the mould in three layers and compacted satisfactorily. After compacting the entire concrete, the excess concrete at the top of the mould was stuck off with a wooden straight edge and

the top finished by a trowel. Demoulding was done after 24 hours and the specimens were cured under water. After 7days, 17days and 28days, the specimens were removed from curing tank and taken for testing.

## III. TESTING DETAILS

Three types of tests were performed on all concrete batches, namely, Compressive strength, Split tensile strength and flexural strength.

**Compressive strength test**

18 cubes of concrete mix were prepared and tested as per IS 516-1959 specifications at the age of 7days, 14days and 28days. After that from the test results analysis is done through comparison between normal concrete and fibre reinforced concrete.

**Splitting tensile strength test**

6 cylinder of concrete mix were prepared and tested as per IS 516-1959 specifications at the age of 28days. After that from the test results analysis is done through comparison between normal concrete and fibre reinforced concrete.

**Flexural strength test**

6 beams of concrete mix were prepared and tested as per IS 516-1959 specifications at the age of 28days. After that from the test results analysis is done through comparison between normal concrete and fibre reinforced concrete.

## IV. ANALYSIS OF THE RESULTS

**Comparison of compressive strength**

The influence of the addition of 0.5% fiber on the mixes tested is compared with plain concrete mix and the results are tabulated in Tables 9, 10 and 11. Compressive strength increases with the increase in the percentage of fibres and at 28 days increase is about 17.59% and it is prominent.

**Comparison of split tensile strength**

Table-10 shows the comparison results of split tensile strength of the concrete mixes with and without fibers. Split tensile strength of fiber reinforced concrete increases with the increase in percentage of fibres and at 28 days increase is about 0.68% and it is not prominent.

**Comparison of flexural strength**

Table-11 shows the comparison results of flexural strength of the concrete mixes with and without fibers. Flexural strength of fiber reinforced concrete increases with the increase in percentage of fibres and at 28 days increase is about 0.23% and it is not prominent.

**Table-1.** Details of specimens.

| Sr. No. | Name of test | Specimen | % of fiber added | No. Of specimen |
|---|---|---|---|---|
| 1. | Compression strength test | Cube (150mm x150mm x150mm) | 0%<br>0.5% | 9<br>9 |
| 2. | Split tensile strength test | Cylinder (150mm dia. and 300 mm height) | 0%<br>0.5% | 3<br>3 |
| 3. | Flexural strength test | Beam (150mm x 150mm x 70mm) | 0%<br>0.5% | 3<br>3 |

**Table-2.** Results of 7days cube compressive strength

| **Grade of concrete** | **% of fiber used** | **Sample No.** | **Load** (N) | **Compressive strength** ($N/mm^2$) |
|---|---|---|---|---|
| M30 | 0% | 1 | 567000 | 25.2 |
| | | 2 | 565000 | 25.11 |
| | | 3 | 465000 | 20.67 |
| | 0.5% | 1 | 632500 | 28.11 |
| | | 2 | 623000 | 27.69 |
| | | 3 | 613500 | 27.27 |

**Table-3.** Results of 14days cube compressive strength

| **Grade of concrete** | **% of fiber used** | **Sample No.** | **Load** (N) | **Compressive strength** ($N/mm^2$) |
|---|---|---|---|---|
| M30 | 0% | 1 | 600500 | 26.68 |
| | | 2 | 622500 | 27.66 |
| | | 3 | 650000 | 28.88 |
| | 0.5% | 1 | 664000 | 29.51 |
| | | 2 | 670000 | 29.77 |
| | | 3 | 681000 | 30.24 |

**Table-4.** Results of 28days cube compressive strength

| **Grade of concrete** | **% of fiber used** | **Sample No.** | **Load** (N) | **Compressive strength** ($N/mm^2$) |
|---|---|---|---|---|
| M30 | 0% | 1 | 877500 | 39 |
| | | 2 | 771500 | 34.28 |
| | | 3 | 855000 | 38 |
| | 0.5% | 1 | 960000 | 42.67 |
| | | 2 | 985500 | 43.8 |
| | | 3 | 992000 | 44.09 |

**Table-5.** Results of 28 days Split Tensile strength

| Grade of concrete | % of fiber used | Sample No. | Load (N) | Compressive strength ($N/mm^2$) |
|---|---|---|---|---|
| M30 | 0% | 1 | 190000 | 2.68 |
| | | 2 | 196000 | 2.77 |
| | | 3 | 218000 | 3.08 |
| | 0.5% | 1 | 191000 | 2.70 |
| | | 2 | 195500 | 2.77 |
| | | 3 | 221000 | 3.12 |

**Table-6.** Results of 28 days Flexural strength

| Grade of concrete | % of fiber used | Sample No. | Load (N) | Compressive strength ($N/mm^2$) |
|---|---|---|---|---|
| M30 | 0% | 1 | 7000 | 1.4 |
| | | 2 | 9000 | 1.8 |
| | | 3 | 10000 | 2.0 |
| | 0.5% | 1 | 9900 | 1.90 |
| | | 2 | 11000 | 2.2 |
| | | 3 | 11100 | 2.22 |

**Table-7.** Comparison of 7days cube Compressive strength results

| **Grade of concrete** | **Average Compressive Strength at 7 days**($N/mm^2$) | | **Increase in compressive strength of concrete by addition of fiber (C2-C1)/C1 x 100%** |
|---|---|---|---|
| **M 30** | **Plain concrete C1** | **0.5% with fiber C2** | |
| | **25.2** | **28.11** | **11.54%** |
| | **25.11** | **27.69** | **10.27%** |
| | **20.67** | **27.27** | **31.93%** |

**Table-8.** Comparison of 14days cube Compressive strength results

| **Grade of concrete** | **Average Compressive Strength at 14 days**($N/mm^2$) | | **Increase in compressive strength of concrete by addition of fiber (C2-C1)/C1 x 100%** |
|---|---|---|---|
| **M 30** | **Plain concrete C1** | **0.5% with fiber C2** | |
| | **26.68** | **29.51** | **10.61%** |
| | **27.66** | **29.77** | **7.62%** |
| | **28.88** | **30.24** | **4.71%** |

**Table-9.** Comparison of 28days cube Compressive strength results

| Grade of concrete | Average Compressive Strength at 28 days($N/mm^2$) | | Increase in compressive strength of concrete by addition of fiber (C2-C1)/C1 x 100% |
|---|---|---|---|
| | Plain concrete C1 | 0.5% with fiber C2 | |
| M 30 | 34.28 | 42.67 | 24.47% |
| | 38 | 43.8 | 15.26% |
| | 39 | 44.09 | 13.05% |

**Table-10.** Comparison of 28days cube Split Tensile strength results

| Grade of concrete | Average Split Tensile Strength at 28 days($N/mm^2$) | | Increase in compressive strength of concrete by addition of fiber (C2-C1)/C1 x 100% |
|---|---|---|---|
| | Plain concrete C1 | 0.5% with fiber C2 | |
| M 30 | 2.68 | 2.70 | 0.75% |
| | 2.77 | 2.77 | 0% |
| | 3.08 | 3.12 | 1.30% |

**Table-11.** Comparison of 28days cube Flexural strength results

| Grade of concrete | Average Flexural Strength at 28 days($N/mm^2$) | | Increase in compressive strength of concrete by addition of fiber (C2-C1)/C1 x 100% |
|---|---|---|---|
| | Plain concrete C1 | 0.5% with fiber C2 | |
| M 30 | 1.4 | 1.90 | 0.36% |
| | 1.8 | 2.2 | 0.22% |
| | 2.0 | 2.22 | 0.11% |

**Table-12.** Comparison of 28days Compressive, Tensile and Flexural strength test results

| % of Fibre | Compressive Strength ($N/mm^2$) | Tensile Strength ($N/mm^2$) | Flexural Strength ($N/mm^2$) |
|---|---|---|---|
| 0.00 % | 37.09 | 2.84 | 1.73 |
| 0.50 % | 43.52 | 2.86 | 2.11 |

**Figure-1.** Metal caps strips

**Figure-2.** PET strips

**Figure-3.** PET and Metal caps in dry

**Figure-4.** Casted moulds

**Figure-5.** Compressive strength Test

**Figure-6.** Cube after testing

**Figure-7.** Comparison of 7 days Cube Compressive Strength

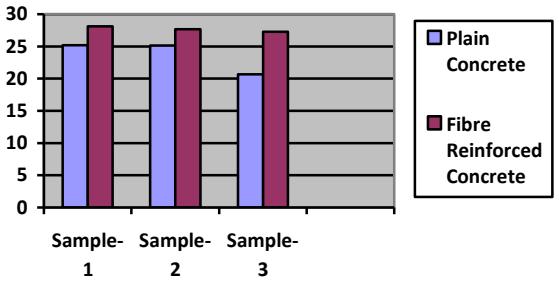



**Figure-8.** Comparison of 14 days Cube Compressive Strength

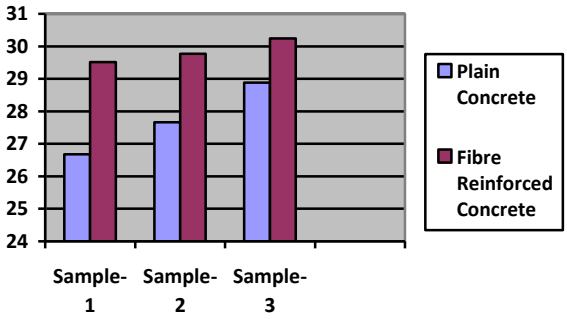



**Figure-9.** Comparison of 28 days Cube Compressive Strength

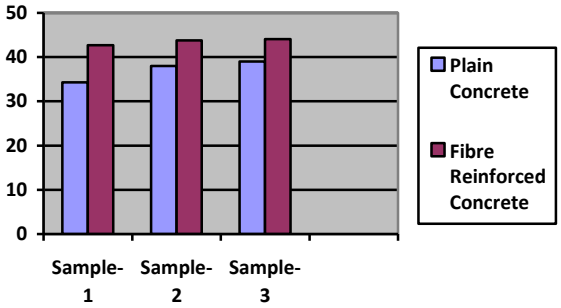



**Figure-10.** Comparison of 28 days Split Tensile Strength

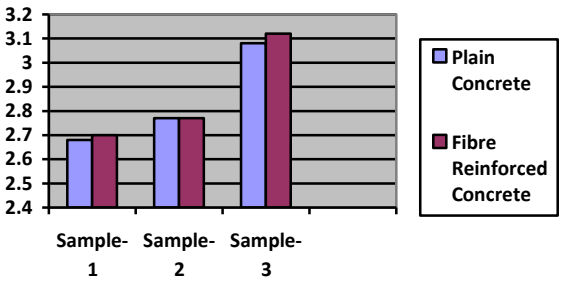
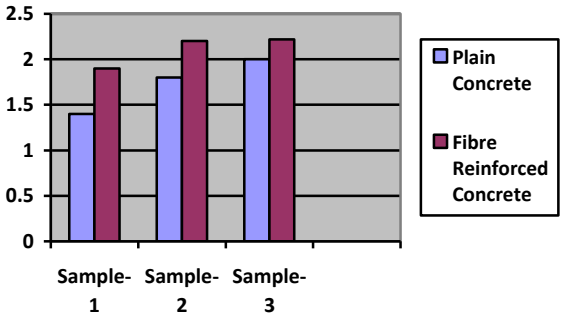



**Figure-11.** Comparison of 28 days Flexural Strength




## CONCLUSION

The conclusion outlined from the experiments is that compressive strength of the concrete can be stepped up with the prominent from the different waste materials which are hazardous from the view of solid waste disposal. These materials can be plastic bottles and metal caps of soft drinks which gives fibre properties to the concrete and reliable fibre reinforced concrete can be made.

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