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# Effect of Addition of Brass Coated Steel Fibre on Compressive Strength of Concrete

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***Abstract: Concrete is the most common material used in the construction industries. In the past few years many modification has been made due to produce concrete which has the desired characteristics. There is always a search for concrete with higher strength and durability. Plane concrete has good compressive strength but has low tensile strength, low ductility and low fire resistance .This thesis work aim to study characteristics and comparison of mechanical properties of brass coated steel fibre reinforcement concrete with conventional concrete. In order to achieve and verify that 0.25%, 0.75%, 1.3%, 1.8% fibre reinforcement by the volume of cement are used in this study with M25 7 & 28 days compressive strength. In this project the behaviour of compressive strength of cube using FRC is experimentally tested. The fibre used is brass coated steel fibre in various volume fractions. The main reason of adding brass coated steel fibre is to improve the post cracking response of the concrete i.e. to improve its energy absorption capacity and ductility and to provide a crack resistance and crack control.***
***Keywords: SFRC, FRC, OPC, UTM***

## I. INTRODUCTION

Concrete is considered a brittle material because of its low tensile strain capacity and poor fracture toughness. Reinforcement of concrete with short randomly distributed fibres can overcome brittleness and poor resistance to crack growth. Fibres, used as reinforcement can be effective in minimize the cracks at both micro and macro-levels. At the micro-level, fibre inhibit the initiation and growth of cracks, and after the micro-cracks converts into macro-cracks, fibres provide mechanism that abate their unstable propagation, provide effective bridging, and impart source of strength gain, toughness and ductility. Concrete can be modify to perform in a more ductile form by the addition of randomly distributed discrete fibres in the concrete matrix

## II. RESEARCH METHODOLOGY

Aim of this work is to present the information accumulated from various researches and to highlight the benefit out of using fibres. In conventional concrete now a day's different type of fibre are used.

### *A. Compressive Strength Behaviour With Brass Coated Steel Fibre Reinforcement Concrete*

In this research of mine, I had analysed the testing of the specimen of brass coated steel fibre reinforced concrete for compressive strength at 7 days and 28 days. The main concern was testing compressive strength.

A mix design of grade M-25 has been prepared with all the different proportion of the addition with % of the volume by brass coated micro steel fibre. These additions are 0.25%, 0.75%, 1.3%and 1.8%. A mix design with 0% (no addition) of brass coated micro steel fibre was also prepared to make a comparative analysis.

For testing of compressive strength of concrete cubes, a total 15 concrete cube with % of addition of brass coated micro steel fibre varying 0% -1.8% have been prepared for 7days testing and other 15 concrete cubes are prepared for 28days testing. Thus, total 30 specimens of concrete cubes are prepared for this research.

1) *Experimental Program:* Calculations for M -25 Mix Design was adopted from IS: 10262-2009, this has provided the calculation for the research work M-25 grade of concrete. The specifications and calculations of the materials for M-25 are listed below.
2) *General parameters*

Grade Designation: M – 25
Type of cement: OPC 43 grade confirming to be 8112
Max Nominal size of aggregate: 20 mm
Minimum Cement Content: 300 Kg/$m^3$
Max. W/c Ratio: 0.50
Workability: 75 mm slump
Type of Coarse Aggregate: Crushed

Exposure condition: Mild
Chemical admixture: Not used

3) *Mix Calculation for our research*

a) *Test data for materials:*

i) Cement used: OPC 43 grade confirming to IS8112
ii) Specific gravity of cement: 3.07
iii) Specific gravity of coarse aggregate: 2.8
iv) Specific gravity of fine aggregate: 2.66
v) Water absorption of coarse aggregate: 0.76
vi) Water absorption of fine aggregate: 1.10
vii) Free (surface) moisture

Coarse aggregate: Nil (absorbed moisture full)
Fine aggregates: Nil

viii) Sieve analysis coarse aggregate: Conforming to Table 2 of IS: 383

Fine aggregate: Conforming to zone III of IS: 383

b) *Target Strength For Mix Proportioning*

Concrete is designed for strength higher than characteristic strength for the sake of margin for statistical variation in results and variation in degree of control exercised at the site. This higher strength is defined as target mean strength. It is calculated as follows:

$f_{ck'} = f_{ck} + 1.65\ \sigma$

Where,

$f_{ck'}$ = Target average compressive strength at 28 days in N/mm$^2$

$f_{ck}$ = Characteristics compressive strength at 28 days in N/mm$^2$

$\sigma$ = Standard Deviation in N/mm$^2$

As per IS 10262: 2009, Standard Deviation = 4 N/mm$^2$

So

Target mean strength for M -25 = 25 + (1.65 X 4) = 31.6 N/mm$^2$

c) *Selection Of Water Cement Ratio*

From table 5 of IS 456-2000, the maximum water cement ratio =0.50 (Mild exposure)
Based on experience adopt water cement ratio as 0.45
0.45<0.50 hence ok

d) *Selection Of Water Content*

From table -2, maximum water content =186 litres
Estimated water content for 100mm slump = 186 +3/100 X 186=191.6 litres

e) *Calculation Of Cement Content*

Cement content =191.6/0.45=425.77Kg/m$^3$
From table 5 of IS: 456, minimum cement content for mild exposure condition =300 kg/m$^3$Hence Ok

f) *Proportion Of Volume Of Coarse Aggregate And Fine Aggregate Content*

From table 3, IS10262-2009 volume of coarse aggregate corresponding to 20mm size aggregate and fine aggregate zone III for the water cement ratio of 0.5=0.64
Actual water cement ratio 0.45
As the water cement ratio, reduced, it is desirable to increase the coarse aggregate proportion to reduce the fine aggregate.
The coarse aggregate is increasing at the rate of 0.01 for every decrease in the w/c ratio of 0.05
Corrected portion of volume of coarse aggregate = 0.64+ 0.01= 0.65
Aggregates are assumed to be SSD condition.

### B. *Mix Calculation*

The mix calculation as per unit volume of concrete shall be as follows

1) Volume of concrete = 1 m$^3$
2) Volume of the cement = Mass of cement /specific gravity of cement *1000
=[425.77/3.07]x[1\1000]= 0.138 m$^3$

3) Volume of water = [192\1] x [1/1000] =0.192 $m^3$
4) Volume of entrapped air= 2% for 20mm coarse aggregate= 0.02 $m^3$
[As per IS 10262-2009, the percentage of entrapped air is zero,
Still 2% is considered on practical experiences].
5) Volume of all aggregates (coarse + fine)
Volume of concrete – (volume of cement +volume of water + volume of
Entrapped air)
=1-(0.138+0.192+0.02) = 0.65 $m^3$
6) Volume of coarse aggregate = ex Volume of CA x specific gravity of CA
= 0.65 x 0.6 x 2.8 x 1000 = 1092 kg
7) Volume of fine aggregate = ex volume of F.A x specific gravity of F.A
= 0.65 x 0.4 x 2.66 x 1000 = 691.6 kg

TABLE: 4.1 MIX PROPORTION PER METER CUBE

| Cement (kg) | Water (kg) | Fine Aggregate (kg) | Coarse Aggregate (kg) |
|---|---|---|---|
| 426 | 192 | 692 | 1092 |
| 1 | 0.45 | 1.62 | 2.56 |

### C. Casting of Specimen
The materials were weighed accurately using a digital weighing instrument. For plain concrete, fine aggregates, coarse aggregates, cement, water added to the mixture machine and mixed thoroughly for three minutes. Steel fibres were sprinkled randomly inside the mixture after thorough mixing of the ingredients of concrete so that homogeneous mix is formed. Cubes of size 150mmx150mmx150mm cubes were casted for the compressive strength test.

### D. Curing
After casting the moulded specimens are stored in the laboratory and at a room temperature for 24 hours from the time at addition of water to dry ingredients. After this period the specimen are removed from the moulds immediately submerged in clean and fresh water.

Compressive strength test

This test was conducted as per IS 516-1959. The cubes of standard size 150mmx150mmx150mm were used to find the compressive strength of concrete. Specimens were placed on the bearing surface of UTM.

## III. RESULT

TABLE 1: RESULT OF 7 DAYS COMPRESSIVE STRENGTH

| Sample | 1st Reading | 2nd Reading | 3rd Reading | average | Compressive strength ($N/mm^{2}$) |
|---|---|---|---|---|---|
| S-0 | 478.12 | 492.75 | 518.40 | 496.42 | 22.06 |
| S-1 | 541.12 | 562.95 | 609.07 | 571.04 | 25.53 |
| S-2 | 650.25 | 614.25 | 610.42 | 624.97 | 28.46 |
| S-3 | 578.25 | 594 | 614.25 | 595.5 | 26.46 |
| S-4 | 551.25 | 582.75 | 614.25 | 582.75 | 25.90 |

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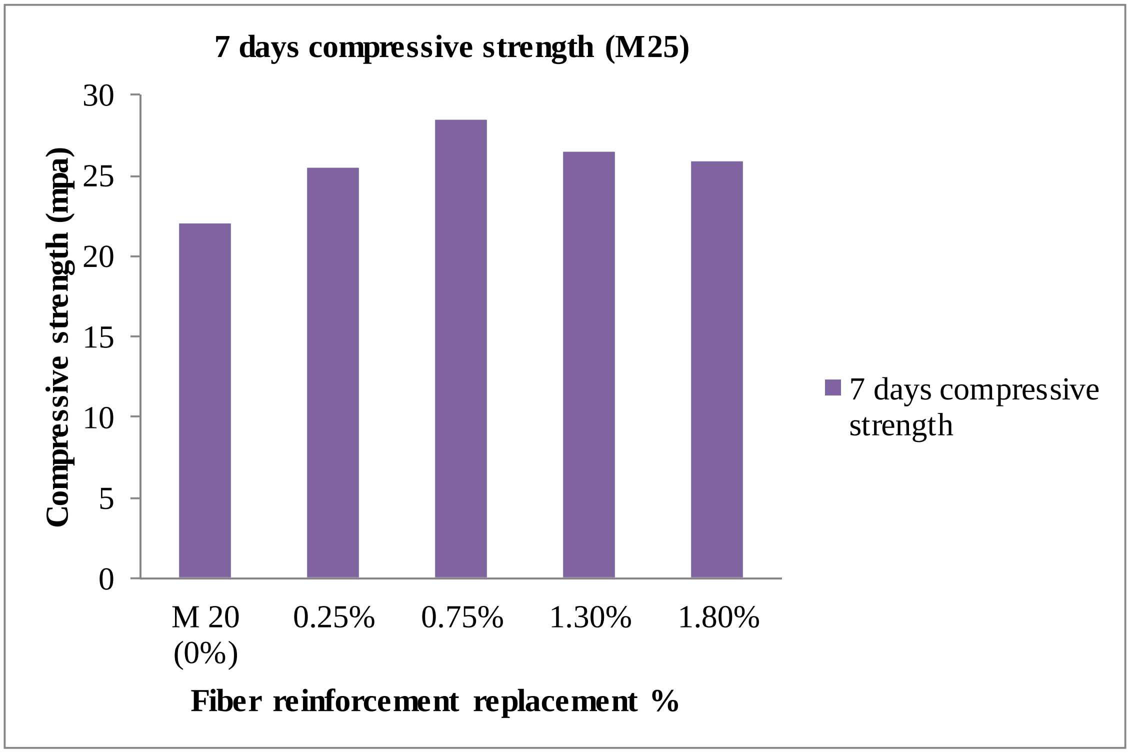



TABLE 1: RESULT OF 7 DAYS COMPRESSIVE STRENGTH

| Sample | 1st Reading | 2nd Reading | 3rd Reading | average | Compressive strength (N/mm2) |
|---|---|---|---|---|---|
| S-0 | 711 | 731.25 | 758.20 | | 32.6 |
| S-1 | 852.75 | 857.25 | 830.25 | | 37.63 |
| S-2 | 897.75 | 938.25 | 958.50 | | 41.40 |
| S-3 | 875.25 | 848.25 | 918 | | 39.13 |
| S-4 | 852.75 | 857.25 | 882 | | 38.40 |

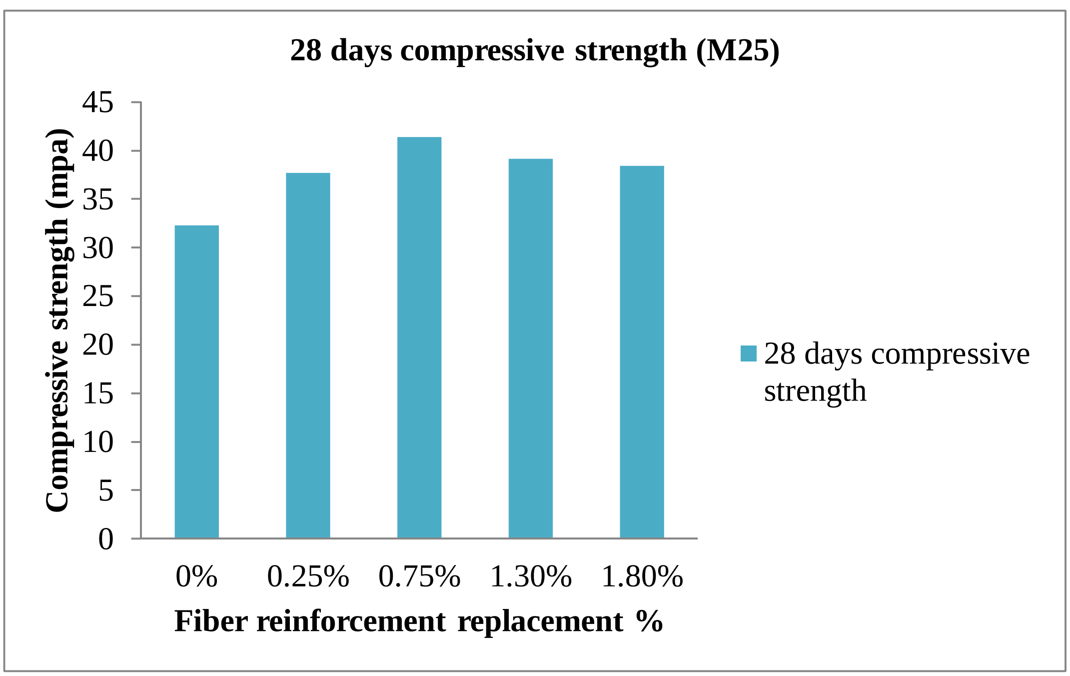
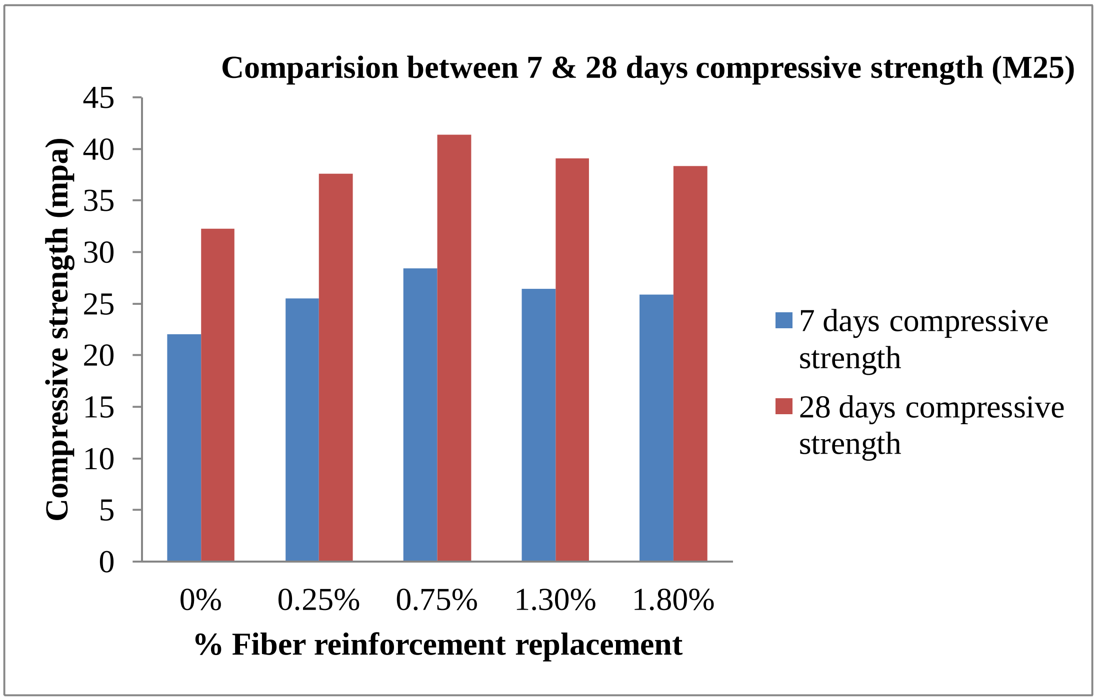


TABLE 5.6 : RESULT OF COMPRESSIVE STRENGTH (AFTER 7 DAYS & 28 DAYS)

| Identification mark | 7 Days average compressive strength (in N/mm$^2$) | 28 Days average compressive strength (in N/mm$^2$) |
|---|---|---|
| SD-0 (0% replacement) | 22.06 | 32.26 |
| SD-1 (0.25%replacement) | 25.53 | 37.63 |
| SD-2 (0.75%replacement) | 28.46 | 41.40 |
| SD-3 (1.3%replacement) | 26.46 | 39.13 |
| SD-4 (1.8% replacement) | 25.90 | 38.40 |




## IV. CONCLUSION

The strength of steel fibre reinforcement depends largely on the quantity of fibres added to it. The increase in the volume of fibres, increase approximately linearly.

Use of higher % of fibre is likely to cause segregation and hardness of concrete and workability of concrete is greatly reduced.

The 7 & 28 days compressive strength of the concrete increase linearly with the increase in amount of steel added to it, but to a maximum of 0.75% steel fibre.

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