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EXPERIMENTAL STUDY ON PROPERTIES OF CONCRETE WITH VARIOUS TYPES OF FIBERS AND ADMIXURES

Radhakrishnan K.K[1], prof.Rajalingam[2]
[1]P.G. Student, [2]Professor,Department of Civil Engineering, EASA College of Engineering and Technology Navakkarai, Coimbatore, India

Abstract- **The objective of this study is to compare the mechanical properties of concrete using various kinds of fibres as reinforcement. The artificial fibres such as Glass, Polypropylene and steel fibre were used. Admixtures such as silica fume and fly ash has been used to study the effects on strength of concrete. Different proportions of fibre mix were used and the compressive strength has been checked after seven days of curing. Then the optimum mix proportion was selected based on the results of trial mixes. Further the specimens have been cast with the optimum mix proportion and tested for properties such as compressive strength, split tensile strength and flexural strength after 7 days, 14 days and 28 days curing. Finally, the results were compared.**

Keyword: Fibre reinforced concrete, Glass fibre, polypropylene fibre, Steel fibre, admixtures

1. INTRODUCTION

Different types of fibres can be used in concrete as reinforcement to increase its tensile and flexural strengths. Artificial fibres such as Glass fibre, Polypropylene fibre and Steel fibre were used for this study.

Glass fibre (GF) and polypropylene fibre (PPF) combination in equal volume was used in concrete. Crimped Steel fibre alone was used in another set of concrete specimens. Fibres are added in various proportions and the optimum percentage was found as 1.0% by volume of concrete both for GF&PPF combination and Steel fibre reinforced concrete.

Cubes, Cylinders and Beams were cast using the optimum fibre percentage with and without adding admixtures and were tested for compressive strength, split tensile strength and flexural strength. Silica fume and Fly ash were used as admixtures by replacing cement 30% by weight in equal proportion.

2. MATERIALS USED

Ordinary Portland cement of 53 grade was used in this study. Crushed stone coarse aggregates and river sand fine aggregates were used. The nominal size of coarse aggregate used was 20mm. The fine aggregate used conformed to zone-II.

2.1 SILICA FUME

Silica fumes with white color were used in this study.

Properties: Specific gravity – 2.18, average particle size - 45 micron and specific area – 150000 to 300000 cm^2 /gm.

2.2 FLY ASH

In this case low calcium F-class fly ash was used.

Properties: Specific gravity – 2.08, average particle size - 45 micron.

2.3 GLASS FIBRE

Glass fibre also called fiber glass. It is a material made from extremely fine glass.

Properties: Diameter – 0.02mm, specific gravity – 2.7 and tensile strength – 1500 to 3700mpa.

2.4 POLYPROPYLENE FIBRE

Polypropylene is a thermoplastic. It is a linear structure based on the monomer CnH2n.

Properties: Diameter – 0.01mm, specific gravity – 0.90 and tensile strength – 80 to 600mpa.

2.5 STEEL FIBRE

Crimped Steel fibre was used.

Properties: Diameter – 1mm, specific gravity – 7.8, tensile strength – 500 to 2700mpa,and aspect ratio - 50.

2.6 SUPER PLASTICIZER

The supper plasticizer used was naphthalene-based formaldehyde. Commercially termed as Conplast-430. It was added @ 3% by weight of cementitious material.

Fig 1: Mixing and moulding of concrete with various fibres and admixtures

3. EXPERIMENTAL PROGRAMME

M25 concrete mix was used as control mix with proportion 1:1.4:2.65. For each concrete mix, three number of concrete cubes, cylinders and beams were cast and tested as per IS 516-1959. To obtain a homogenous mix, aggregates were mixed and binders were added to the mix. After remixing, water was added to the dry mix. Cube specimens of size 150mm x 150mm x 150mm, cylinder specimens of size 150mm x 300mm and beam specimens of 700mm x 150mm x 150mm were used to determine the compressive strength, split tensile strength and the flexural tensile strength respectively. After casting, the mould specimens were left in the casting area for 24 hours then de-mould and allowed for wet curing. The specimens were cured for 7, 14, and 28 day's period to determine the compressive, split tensile and flexural strengths. Flexural strength testing was carried out with two-point loading system.

The different combinations of mixes tested are given in table 3.1

Table 3.1 different mixes studied

Notations	Description
I	Ordinary concrete without admixture (Control mix M25)
II	Glass and poly propylene fibre concrete with admixtures
III	Steel fibre concrete with admixture
IV	Steel fibre concrete without admixture
V	Ordinary concrete with admixture

4. RESULT AND DISCUSSION

4.1 COMPRESSIVE STRENGTH

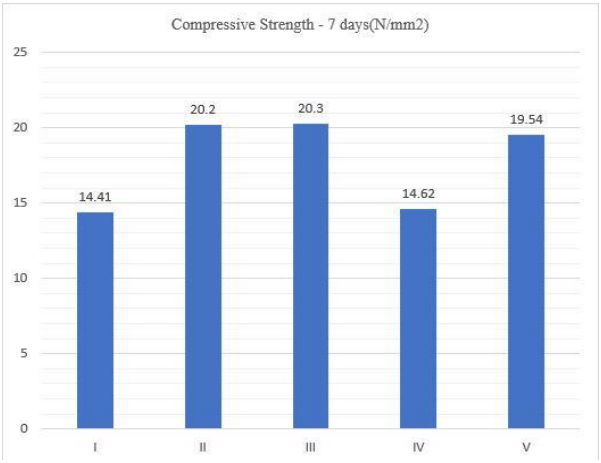

Fig 2: Compressive strength for 7 days for various mixes

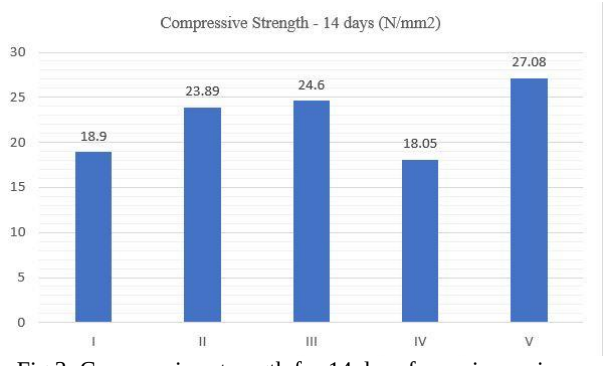

Fig 3: Compressive strength for 14 days for various mixes

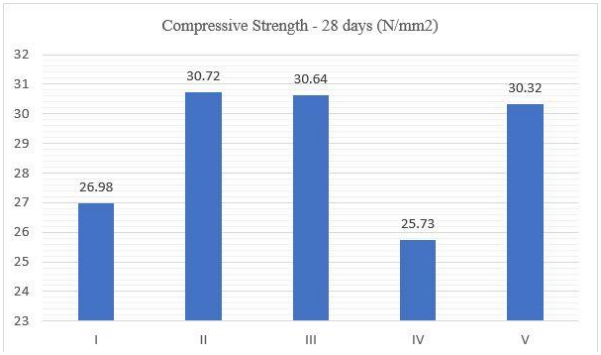

Fig 4: Compressive strength for 28 days for various mixes

4.2 SPLIT TENSILE STRENGTH

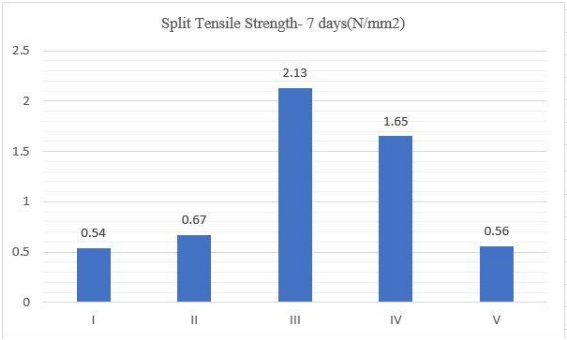

Fig 5: Split tensile strength for 7 days

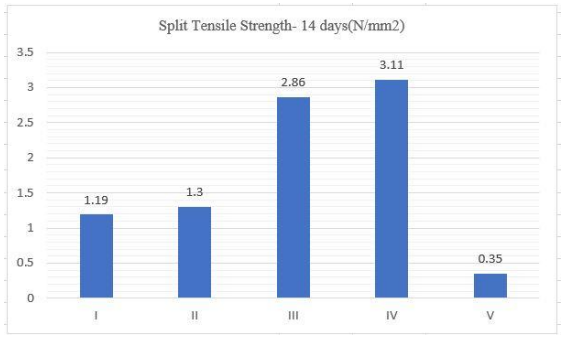

Fig 6: Split tensile strength for 14 days

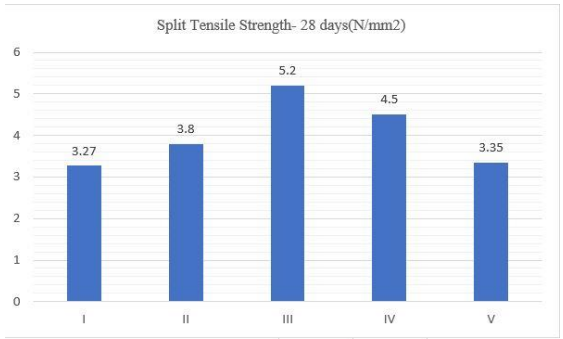

Fig 7: Split tensile strength for 28 days

4.3 FLEXURAL STRENGTH

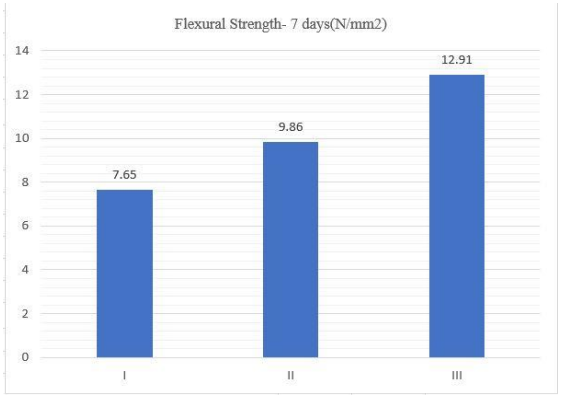

Fig 8: Flexural strength for 7 days

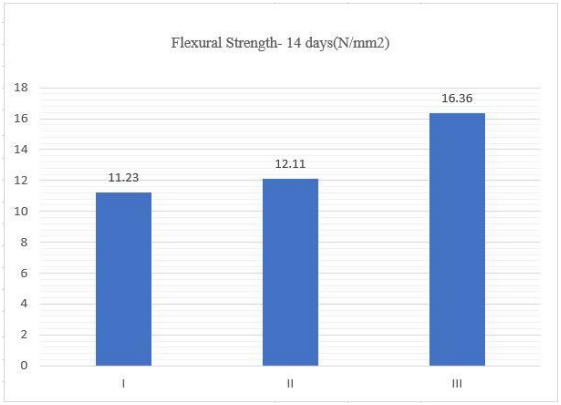

Fig 9: Flexural strength for 14 days

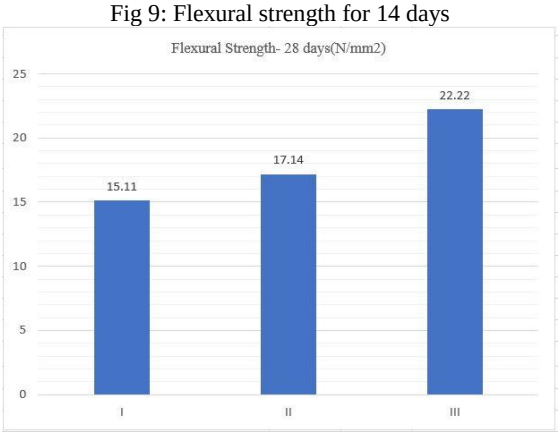

Fig 10: Flexural strength for 28 days

5. FINDINGS OF THE STUDY

Study 1: Comparison of cube compressive strength

1. Addition of fibres does not have any significant effect in the compressive strength.
2. Addition of admixtures significantly increases the compressive strength by approximately 20% over the control mix.

Study 2: Comparison of split tensile strength

1. Addition of admixtures does not have any significant effect in the case of split tensile strength.
2. Mixes with steel fiber had considerable increase in the split tensile strength by approximately 68% over control mix.
3. Addition of GF and PPF does not show any significant gain in the split tensile strength.

Study 3: Comparison of flexural strength

1. The failure pattern was similar at 7 days,14 days and at 28 days.
2. Addition of GF and PPF had marginal effect in the flexural tensile strength. However, there was a significant increase in the flexural strength in the case of steel fiber addition by 65 % over the control mix.

6. CONCLUSION

1. The addition of Glass fibre and polypropylene fibre does not have much significant effect in the compressive strength or split tensile strength or flexural strength. However there was variation in the failure pattern of the specimen during visual observation. Even after failure under load the specimens did not disintegrate.
2. The addition of steel fibre did not show any significant effect in the compressive strength, but there was significant increase in split tensile strength and flexural strength by around 65% over the control mix.
3. The addition of admixtures had significant effect in compressive strength, marginal effect in the flexural strength and negligible effect in the split tensile strength.

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