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FLEXURAL CHARACTERISTICS OF REINFORCED CONCRETE WITH CRIMPED STEEL FIBER AND POLYPROPYLENE

BHARANIDHARAN K

UG scholar, Dept. of civil Engineering, DSCE college,Perambalur, Tamilnadu, India.

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Abstract - *In this study, Secondary sector plays an important role in our country. Our construction technique sometimes results in failure such as collapse. To Overcome this failures, we are going to study the addition of polypropylene fiber and crimped steel fiber in the concrete. This will increase the flexural, shear performance and brittleness of the building even in the poor soil packing site. This study also improves the strength of reinforced concrete by providing the combination of polypropylene and crimped steel fiber. This project work polypropylene fiber and crimped steel fiber different percentage (0.4%, 0.8%, 1.2%) are added in the concrete and using M30. Tests on the concrete compressive strength, split tensile strength, flexural resistance.*

Key Words: Polypropylene fiber, Crimped steel fiber, Compressive strength, Split tensile strength, Flexural resistance.

1. INTRODUCTION

The fibers both polypropylene and crimped steel fiber are used to increase the the toughness and crack resistance. With the use of crimped steel fiber we can reduce the conventional reinforcement or even without conventional reinforcement, we can construct building. This fiber will increase the load carrying capacity this result in prevention of the building from collapse even if human error takes place in the building, these fibers will prevent from failure by increasing the load carrying capacity. One application of the fiber is to increase the load carrying capacity of concrete subjected to shear. Most of the design methods and tests procedures have been developed only for the evaluation of steel fiber reinforced concrete. The fiber controlled the crack resistance and corrosion of the building.

- Easy processing
- Low specific gravity
- Almost zero water adsorption
- Good chemical resistance
- Wide availability and low cost
- High ductility

1.1 POLYPROPYLENE FIBER

Polypropylene fiber is a synthetic fiber formed from a polypropylene melt. It is cheap, abundantly available, and like all manmade fibers of consistent quality. High ductility and reduction in amount of concrete.

Fig-1 Polypropylene fiber

1.2 CRIMPED STEEL FIBER

Crimped steel fibers are made from hard drawn steel wire, ensuring high tensile strength and close tolerances. It is glued into bundles, ensuring quick and easy mixing, with perfect homogenous distribution. It has high toughness. Greatly improved impact, fatigue, and resistance.

Fig-2 Crimped steel fiber

1.3 ADVANTAGES OF HIGH STRENGTH CONCRETE

1) Reduced maintenance and repair
2) The size of structural members like beams and columns are reduced since smaller section are enough to carry high loads
3) Since the size of members are reduced the cost of formworks are less.

4) Used in high rise building.

5) Bridges with long spans.

6) High load carrying buildings built on weak soil (low bearing capacity)

2. LITERATURE REVIEW

[1] SOON POH YA (2014) discussed about the flexural toughness characteristic of steel polypropylene hybrid fiber-reinforced oil palm shell concrete they concluded that the addition of 1% steel fiber and 0.9 % steel and 0.1% of polypropylene hybrid fiber enhanced the compressive and tensile strengths of the oil palm shell fiber reinforced concrete significantly splitting tensile and flexural strengths showed an improvement by up to 83% and 34% for the mixes with 0.9 % steel fiber and 0.1% polypropylene hybrid fiber

[2] PLE.O (2011) discussed about the effect of polypropylene fiber reinforced on the mechanical behavior of silty clay. They concluded that in all cases of loading, an improvement in strength and the benefits can reach an average value around 20% under confinement. A fiber reinforcement of 0.6% permits to increase strength limiting values of 100% in tension and the loss of ductility can be exceeded to 68% under confinement. On the contrary, under direct tensile tests the reinforced clay exhibits a benefit in ductility. For a fiber content equal to 0.6%, the change in the ductility reaches 62% and this relatively new improvement technique used in geotechnical projects will have to be tested, in France, in real conditions.

[3] GONZALO RUANO (2014) discussed about the shear retrofitting of reinforced concrete beams with steel-fiber reinforced concrete. They concluded that the fiber reinforced concrete improves structural properties and moreover the compatability between the base and the retrofitting materials but thinner cracking pattern, prevents the income of aggressive agents increasing the durability of the reinforcement.

3. METHODOLOGY

1) Reviewing the various literatures.

2) Selection of materials and collection of materials (cement, water, fine aggregate, coarse aggregate, polypropylene fiber, crimped steel fiber).

3) Testing of materials.

4) Preparation of mix design for M30.

5) Adding percentage of fibers (0.4%, 0.8%, and 1.2%).

6) Casting of specimens (cube, cylinder, beams).

7) Testing of specimens (compressive strength, split tensile strength, flexural strength).

8) Analysis of the test results

9) Conclusion and suggestion for future study

4. MIX DESIGN

Table -1: M30 Mix proportioning

Cement (kg/m³)	435
Fine aggregate (kg/m³)	685
Coarse aggregate (kg/m³)	1100
Water (lit/m³)	192
Water cement ratio	0.45

Mix ratio 1: 1.55: 2.50: 0.45

5. TEST RESULTS AND DISCUSSION

Size of cube = 150x150x150 mm

Size of cylinder = 150x300 mm

Size of beam = 140x230x1100 mm

5.1 COMPRESSIVE STRENGTH OF CONCRETE

Table -2: Test result of compressive strength

Fibers	7 days N/mm²	14 days N/mm²	28 days N/mm²
NIL	17.44	22.44	27.05
CSF+PF (0.4%+0.4%)	18.47	23.58	29.61
CSF+PF (0.8%0.8%)	18.56	24.98	30.50
CSF+PF (1.2%+1.2%)	20.84	26.32	32.72

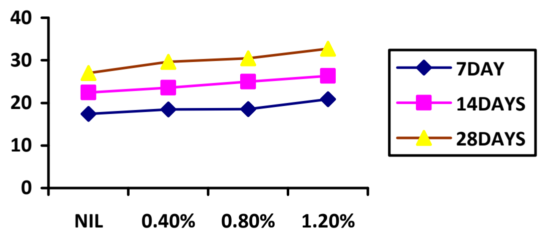

Chart -1: Compressive strength

5.2 SPLIT TENSILE STRENGTH OF CONCRETE

Table -3: Test result of split tensile strength

Fibers	7 days N/mm²	14 days N/mm²	28 days N/mm²
NIL	1.96	2.11	2.94
CSF+PF (0.4%+0.4%)	2.43	2.79	3.42
CSF+PF (0.8%0.8%)	2.51	2.85	3.58
CSF+PF (1.2%+1.2%)	2.64	3.01	3.89

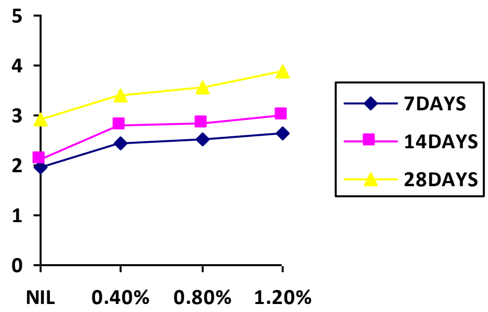

Chart -2: Split tensile strength

5.3 FLEXURAL STRENGTH OF CONCRETE

Table -4: Test results of flexural strength

Fibers	7 days N/mm²	28 days N/mm²
NIL	5.23	6.89
CSF+PF (0.4%+0.4%)	6.48	8.37
CSF+PF (0.8%0.8%)	7.74	9.72
CSF+PF (1.2%+1.2%)	8.07	11.21

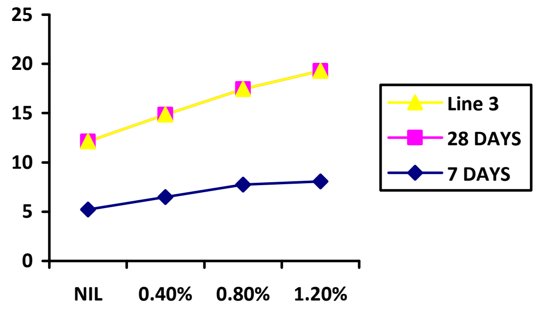

Chart-3: Flexural strength

6. CONCLUSION

The following conclusions were drawn with the limitation of experimental investigation.

- It has been observed that the incorporation of fibers to the mix increases the material toughness both in tension and compression, as represented by the toughness indexes of the ASTM AND JSCE standards.
- Compressive strength of the concrete is increased at 28 days as compared with control mix. There is an increase 21% using crimped steel fiber and polypropylene fiber 102% with the concrete.
- Increase in the split tensile strength is observed up to 32021% using crimped steel fiber and polypropylene fiber 1.2% with concrete compared to conventional concrete.
- The flexural strength is also increased 61% using crimped steel fiber and polypropylene fiber 1.2% with RCC.

7. SCOPE FOR FUTURE ENHANCEMENT

- Fiber dosage can be varied and studied for shear test.
- Hybrid fiber can be used for the study.
- Dimensions of the beam can be varied and studied.
- Orientation of fibers can be studied.

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