

Investigations on Properties of Concrete using Steel Fiber Reinforced as Partial Replacement of Coarse Aggregate

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ABSTRACT

Scope of using alternate materials as partial replacement of Coarse Aggregate is being searched for Concrete without sacrificing strength or increasing strength from economical & other aspects like; using industrial waste for its efficient use. Investigations were done on M-25 grade concrete by replacing coarse aggregate partially by steel fiber to get maximum strength. This Study presents the satisfactory results on various strength tests of concrete containing steel fiber as a partial replacement of coarse aggregate and would help to resolve solid waste disposal problem. However, further research work is still necessary in order to have a more in-depth understanding.

INTRODUCTION

The plain cement concrete has very low tensile strength, restricted pliability, and little protection from breaking. Inward miniaturized scale breaks are innately present in the concrete and its poor rigidity is because of the proliferation of such small cracks, in the long run prompting fragile disappointment of the concrete. The most generally acknowledged solution for this flexural shortcoming of cement is the regular fortification with high quality steel. Regardless of the way that these procedures offer flexibility to people, they however don't grow the trademark unbending nature of solid itself. In like manner the help putting and profitable compaction of RCC is amazingly troublesome if the solid is of low workability especially by virtue of overpowering solid (M-25). In plain concrete and near feeble materials, assistant parts (scaled down scale breaks) become even before stacking, particularly on account of drying shrinkage or distinctive purposes behind volume change. The width of these breaks on occasion outperforms a few microns, yet their two estimations may be of higher enormity.

Whenever stacked, the miniaturized scale airs out proliferate and up, and attributable to the impacts of pressure fixation, extra breaks frame in spots of minor deformities. The auxiliary splits continue gradually. The advancement of such miniaturized micro crack is the primary driver of inelastic twisting in concrete. It has been perceived that the expansion of little, firmly divided and consistently scattered strands to cement would go about as break arrester and would considerably enhance its static and dynamic properties. This sort of cement is known as fibre reinforced concrete

Fiber Reinforced Concrete

Enhancing the tensile properties of plain concrete numerous strategies have been developed. A considerable lot of the strategies prevailing with regards to making the concrete individuals impervious to strain, however none of them expanded the inborn tractable properties of plain concrete. The scattering of strands in concrete network to enhance its ductile properties has been drilled worldwide more than 3 past decades. The expansion of little firmly separated and consistently scattered filaments to cement would go about as break arrester and would considerably enhance its static and dynamic properties. This sort of concrete is known as fibre reinforced concrete. Fibre strengthened concrete can be

characterized as a composite material comprising of blends of bond, mortar, or concrete and broken, discrete, consistently scattered appropriate strands. Consistent lattices, woven textures and long wires or poles are not thought to be discrete fibres.

Objectives

The objectives of the research are outlined below:

- The aim project is to have a study comparison between mechanical performances of Steel Fiber reinforced concrete.

Workability Properties

Fresh mix characteristics are more emphasized in fibre concrete compared to the plain concrete, generally increasing weight fraction of fibres results in further reduction of fresh concrete workability. In this study, fibres as steel fibre scraps of different volume fractions like 3 %, 6 %, and 9 % and length of fibre lengths is 25mm to 40 mm.

Slump Test

Table 4.1 Slump Test Results

S. No.	% Replacement of Steel fibre waste	Slump for M25
1	0 %	69
2	2.5 %	64
3	5 %	56
4	7.5%	50
5	10%	39

Slump in mm

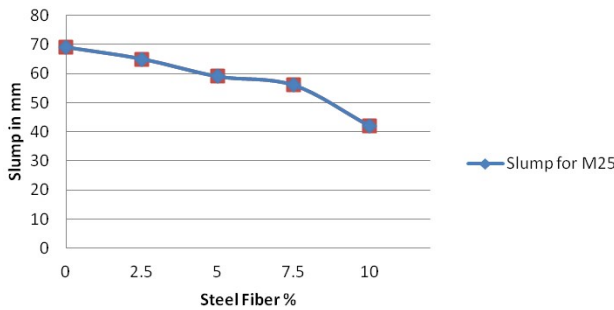


Figure -4.1 slump value with steel fiber (Grade M-25)

Discussion:

Slump test an incentive for M-25 review of solid blend with 0%, 2.5%, 5% and 7.5% steel fiber scrap blends are appeared in table and chart. Table-4.1 demonstrates the droop estimations of M-25 review cement and steel fiber solid extent. Their qualities are watched vary from 69 mm to 39 mm from 0% to 10% steel fibre waste for M25 grade concrete mixe. It is observed that with the increase in the addition of steel fibre waste, workability reduces gradually for M-25 grade concrete respectively.

Mechanical Strength

To evaluate the mechanical strength characteristics of concrete reinforced with steel fibres scraps materials, detailed experimental investigation was carried out and the results are discussed in the forthcoming sections.

Cube Compressive Strength

Totally 108 cube specimens of size 150 mm x150 mm x 150 mm with 3 mixes were casted and tested. Three volume fractions were considered for steel fibre scraps (2.5%, 5% and 7.5% of steel fibres scraps).

Table 4.2 – Compressive Strength of M25 Grade concrete in N/mm²

S. No.	% of Steel fibre	M25 Grade of Concrete		
		7 Days	14 Days	28 Days
1	0 %	18.12	22.25	25.19
2	2.5 %	19.69	25.35	29.43
3	5 %	20.2	25.90	29.80
4	7.5%	20.88	27.49	31.35

Compressive Strength of M-25grade concrete in N/mm²

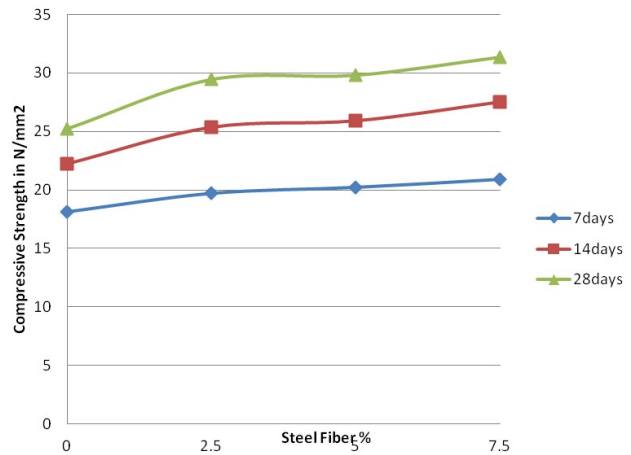


Figure 4.2 – Compressive Strength of M25 Grade concrete

Discussion:

The Result of compressive strength for M-25 review of cement on 3D shape example with 0%, 2.5%, 5% and 7.5% steel fiber scrap blends are appeared in table and chart. Table-4.2 gives the compressive quality estimations of M-25 review cement and steel fiber scrap concrete blends at 7, 14 and 28 days curing and their esteems are seen .With expansion of steel fiber scraps, compressive quality bit by bit increments from 18.12 N/mm² to 31.35 N/mm² with 0 % to 7.5 % of steel fiber waste.

Split Tensile Strength

Totally 108 cylinder specimens of size 100 mm diameter and 300 mm height with 3 different % mixes were casted and tested. Three weight fractions were considered for steel scrap fibers of constant length. Results for split tensile strength based on the values of test data. A sample comparison Figure for steel fibres scrap concrete is plotted to study conventional concrete strength which is shown in Fig. 4.3.The values of the split tensile strength of different mixes are shown in Table-4.3

Table 4.3– 7, 14 & 28 days Split tensile strength of Cylinder in N/mm²

Steel Fiber %	Split Tensile Strength for M25 Grade of Concrete in N/mm ²		
	7days	14days	28days
0	2.31	2.68	3.39
2.5	2.36	2.75	3.3
5	2.41	2.79	3.52
7.5	2.43	2.82	3.94

Split Tensile Strength for M25 Grade of Concrete in N/mm²

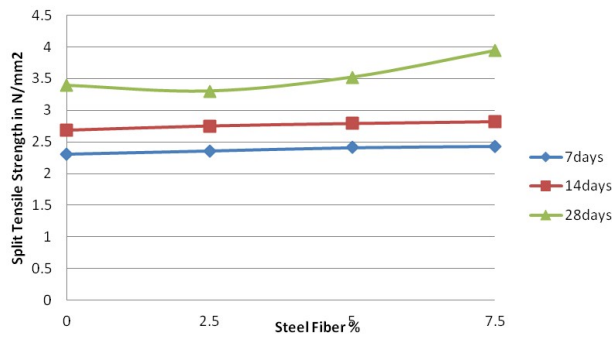


Figure 4.3 – 28 days Split tensile strength of Cylinder

Discussion:

for M-25 review of cement on chamber example with 0%, 2.5%, 5% and 7.5% steel fiber scrap blends are appeared in table and chart. Table-4.5 demonstrates the split quality estimations of M-25 review cement and steel fiber scrap concrete blends at 28 days curing and their esteems are watched. With the expansion of steel fiber scraps, the split rigidity of chamber expanding bit by bit from 2.31N/mm² to 3.94N/mm² with 0% to 7.5 % of steel fiber waste.

4.3.3 Flexural strength of Concrete:

The determination of flexural strength of the prepared samples is carried out as per IS code. The following table shows the flexural strength of various samples using different percentage of steel fibre scraps.

Table 4.4 – 7, 14 & 28 days Flexural Strength of concrete Beam in N/mm²

Steel Fiber %	Flexural Strength of M-25grade concrete Beam in N/mm ²		
	7days	14days	28days
0	2.22	2.78	3.73
2.5	2.46	3.86	4.52
5	2.53	4.32	4.91
7.5	3.02	4.48	5.44

Flexural Strength of M-25grade concrete Beam in N/mm²

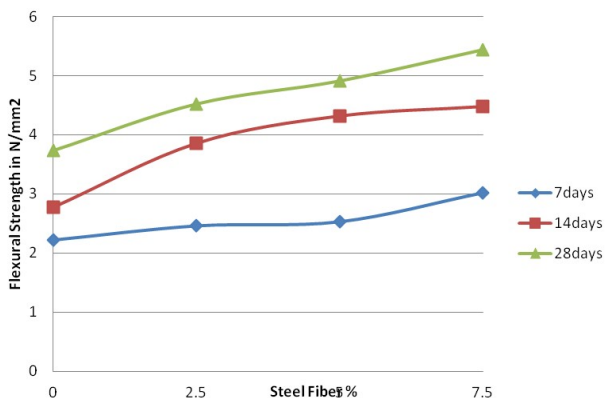


Figure 4.4 – Flexural Strength of concrete Beam

Discussion:

The Result of split rigidity for M-25 review of cement on pillar example with 0%, 2.5%, 5% and 7.5% Steel Fiber Waste blends following 28 days of curing are appeared in

table and diagram. It is seen that with the expansion of Steel Fiber Waste flexural quality esteem expanding step by step from 2.22N/mm² to 5.44N/mm² with 0% to 7.5 % of steel fiber waste.

Conclusion-

Based on the experimental investigation the following conclusion is given within the limitation of the test result.

- Addition of steel fiber waste resulted in significant improvement on the quality properties of solid (M-25) grade.
- Compared to plane cement the steel fiber waste expansion brought about better reinforcing (compressive, malleable and flexural) properties of cement.
- The ideal level of steel fiber waste included was 7.5 % since expanded fiber expansion brought about loss of workability.
- Slump of the concrete mix reduce from 69 mm to 39 mm on expanding the level of steel fiber (from 0% to 10%) for M-25 Concrete mix

Future scope of work

Based on the investigation made the following recommendations are forwarded for studies in Purpose of future excellence.

- The interesting results confirm the promising application of concrete reinforced with steel Fiber scrap from industries. However, further research work is still necessary in order to have a more in-depth understanding of the material properties and to evaluate possible practical applications.

CONCLUSION

- Compressive, Tensile and flexural quality is expanding on expanding the level of Steel Fiber Waste and most extreme quality was accomplished on account of 7.5% Steel Fiber Waste for review of solid M-25.

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