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Original Research Article

EXPERIMENTAL INVESTIGATION ON STRENGTH PROPERTIES OF STEEL FIBER CHIP FOR M-25, M-30& M-35 GRADES OF CONCRETE

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Abstract: This paper manages the trial Investigation on fiber reinforced concrete with M-25, M-30& M-35 grade concrete in addition of steel fiber chip with different dosages. The main objective of this paper work is to improve the quality strength parameters, for example, compressive strength, split tensile strength, flexural strength and slump test of concrete grade M-25, M-30& M-35 having different percentage of steel fiber chip (0%, 2%,4% and 6%). Compressive strength, split tensile strength, flexural strength increases up to 6 % steel fiber chip for M-25, M-30& M-35 grade of concrete. The experimental investigation is carried out on a total no of 72 specimen of compressive strength, split tensile strength & flexural strength each.

Keywords- Steel fiber chip, compressive strength. Split tensile strength. Slump value.

Introduction: Plain concrete processes a really low lastingness , limited ductility, and tiny resistance to cracking. Internal micro cracks are inherently present within the concrete and its poor lastingness is thanks to the propagation of such micro cracks, eventually resulting in brittle failure of the concrete. the foremost widely accepted remedy to the present flexural weakness of concrete is the conventional reinforcement with high strength steel. Restraining techniques also are wont to . Although these methods provide lastingness to members, they however do not increase the inherent lastingness of concrete itself. Also the reinforcement placing and efficient compaction of RCC is extremely difficult if the concrete is of low workable especially within the case of heavy concrete (M-25, M-30 & M-35 Grade of concrete). plain concrete and similar brittle materials, structural cracks (micro-cracks) develop even before loading, particularly thanks to drying shrinkage or other causes of volume change. The width of those cracks seldom exceeds a

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couple of microns, but their two dimensions could also be of upper magnitude.

Objective: The aim of our project is to use the Steel Fibers chips reinforcement to concrete. Our objective is to feature the Steel fibers chips (chip metal) fiber to the concrete and to review the strength properties of concrete with the variation in fiber content. i.e., to review the strength properties of concrete (M-25, M-30 & M-35 Grade) for fiber content of two , 4 & 6 at 7, 14 & 28 days. The strength properties being studied in our thesis are as follows:

1. Compressive strength
2. Split lastingness
3. Flexural strength

These properties are then compared to the traditional M-25, M-30 & M-35 grade cement concrete.

Literature review: Concrete is one among the foremost versatile building materials. It is often cast to suit any structural shape from ordinary rectangular beam or column to a cylindrical water tank during a high- rise building. it's readily available in urban areas at relatively low cost. Concrete is robust under compression but weak under tension. As such, a sort of reinforcement is required.

The most common sort of concrete reinforcement is by steel bars. the benefits in using concrete include high compressive strength, good fire resistance, high water resistance, low maintenance, and long service life. The disadvantages in using concrete include poor lastingness , and formwork requirement. Other disadvantages include relatively low strength per unit weight. The longitudinal rebar during a beam resists flexure (tensile stress) whereas the stirrups, which are wrapped round the longitudinal bar not only holds the longitudinal bars in position but also resist shear stresses. In a column, vertical bars resist compression and buckling stresses while ties resist shear and supply confinement to vertical bars. Steel fibre reinforced concrete comprises cement, aggregates and steel fibres. Steel fibre reinforcement can't be regarded as an immediate replacement of longitudinal reinforcement in reinforced and prestressed structural members. In tension, SFRC fails only after the steel fibre breaks or is pulled out of the cement matrix. Properties of SFRC in both the freshly mixed and hardened state, including durability, are a consequence of its composite nature. The mechanics of fibre reinforcement which strengthens concrete or mortar may be a continuing research topic.

Ahsana Fathima K M, et al (2014), describes the Behavioral study of steel fiber and polypropylene fiber. the most aim of this experiment is to review the strength properties of steel fiber and polypropylene fiber ferroconcrete of M-30 grade with 0%, 0.25%, 0.5% and 0.75% by volume of concrete. They showed the results that the polypropylene fiber ferroconcrete yield higher flexural strength with addition of 0.5% polypropylene fiber by volume of concrete.

Saeid Hesami, Saeed Ahmadi, Mahdi Nematzadeh et al, Construction and Building Materials 53 (2014): 680-691. The utilization of pervious concrete pavement is significantly increasing thanks to reduction of road runoff and absorption of noise. However, this sort of pavement can't be used for heavy traffic thanks to a high amount of voids and consequently low strength of pervious concrete. Rice husk ash (RHA) was utilized in order to strengthen pozzolanic cement paste and therefore the effect of 0%, 2%, 4%, 6%, 8 %, 10% and 12% weight percentages as a cement replacement in concrete mixtures on the mechanical properties was studied. Moreover, 0.2% Vf of glass (where Vf is that the proportion of fiber volume to total volume of concrete), 0.5% Vf of steel and 0.3% Vf of polyphenylene sulfide (PPS) fibers were wont to improve the mechanical properties of the pervious concrete.

Wenjie Ge Jiwen Zhang (2015) Flexural behaviors of hybrid concrete beams reinforced with BFRP (Basalt Fiber Reinforced Plastic) bars and steel bars are studied during this paper. Tensile test, standard pull-out test of BFRP bars, and static flexural experiment of 5 different hybrid ferroconcrete beams were made. The tests show that BFRP bars have high lastingness and lo w coefficient of elasticity compared with steel bars. The bond strength between ribbed BFRP bars and concrete is analogous to that of screwed steel bars with an equivalent diameter and there appears to be good bond performance. The bond strength of steel bars of 8 mm diameteris a little larger than that of steel bars of 10 mm diameter. The bond strength relative coefficient VF of BFRP b ars are often considered to be 1.0, it's proposed that hybrid RC beams should be utilized in structures that have high requirements of flexural capacity but low requirements of Deflection. The ductility of hybrid RC beams can meet the need when AF/AS is suitably controlled.

Methodology

Materials –The materials used in the projects for making concrete mixture are cement, Fine aggregate, coarse aggregate, Steel fiber chips, are detailed describe below:

Cement: Cements by far the primary constituent to concrete, in that it performs the binding substance for the discrete ingredients. Prepared out of naturally generating raw materials and sometimes blended printer ground with industrial wastes. The cement used in this studywasPortlandcementof43 grades conforming to IS8112-1989.

Fine Aggregate: Aggregates which engagen early 70 to 75 percent quantity of concrete are sometimes observed as inertingredients in more than one sense. However, it is now well recognized that physical, chemical and thermal properties of aggregates substantially influence the properties and performance of concrete. The fine aggregate (sand) used was clean drys and was sieved in 4.75mm sieve to take out all pebbles.

Coarse Aggregate: Coarse aggregate are used for building concrete. They could be in the form of unequal broken stone or naturally occurring gravel. Materials that are large to be maintained on 4.75 mm sieve size are named coarse aggregates. It highest size may be upto40 mm.

Water: Water is a main component of concrete a sit actively contributes in the chemical reaction with cement. Since it he lps to perform the strength giving cement gel, the amount and quality of water is essential to be looked into very carefully. Portable water is generally considered satisfactory.

Steel Fiber Chip: Stainless steel chip were taken as steel fibers forth is study. These are industrial waste of high-grade stainless steel with four sided strands, giving for cleaning edges to handle toughest jobs. Since each chip is made of a single strand of stainless steel, they will not tear or splinter. Also, they will not corrode. It has a good tensile strength and the fiber strips lengthvaryby1, 1.5 and2 inches. These fibers will improve toughness, durability and tensile strength of concrete

Table. 1 Physical Properties of 43 Grade Portland cement

S.No.	Physical Properties	Values of Portland Cement used	Requirements as per IS8112-1989
1	Standard Consistency	29.2 %	
2	Initial Setting Time	45 Minutes	Minimum of 30 minutes
3	Final Setting Time	265 Minutes	Maximum of 600 minutes
4	Specific gravity	3.15	-
5	Compressive strength in N/mm2 at 3 days	29	Not less than
6	Compressive strength in N/mm2 at 7 days	38.5	Not less than
7	Compressive strength in N/mm2 at 28 days	48	Not less than

Table2. Physical Properties of Fine Aggregate (Tests as per IS: 2386–1968: Part III)

S.No.	Physical properties	Values
1	Specific gravity	2.6
2	Fineness Modulus	2.83
3	Water Absorption	0.75%
4	Bulk density(kg/m3)	1654
5	Free moisture content	0.1%

Table3.PhysicalPropertiesofCoarse Aggregate (Tests asperIS:2386–1968PartIII)

S. No		V a
1	Specific gravity	2
2	Fineness Modulus	2.73
3	Water Absorption	0
4	Bulk density(kg/m3)	1
5	Free moisture content (%)	0 .
6	Aggregate Impact value (%)	1 1
7	Aggregate Crushing value (%)	2 5

Table4. Typical Properties of Steel Fiber Chip

S. No	Properties of Fibres	Steel Fiber Chip
1	Length used (mm)	40 to 60
2	Diameter (mm)	0.50
3	Available form	winded
4	Color	silver thin wires
5	Specific gravity	0.87
6	Water	210

Experimental Procedure: The estimation of concrete with Steel Fiber Chip and Fine aggregates used as substitute of aggregate materials is completed during concrete specimen testing. Concrete include cement, water, fine aggregate, coarse aggregate. Concrete is replaced with alternative materials by varying percentage of replacement. The Steel Fiber Chip is employed as partial replacement for fine aggregate and Cement within the range of 0%, 2%, 4% and 6% by weight in fact aggregate and cement and its optimum level is to be found. For testing the strength of normal and other variation mix totally 72-cubes of size 150x150x150mm were casted for compression strength test. Then 72-beam of size 700x100x100mm is casted for flexural strength testing. For testing the Split lastingness 72 -cylinders of150mmx300mm are casted as per mix design proportions. Once 24hours completed from casting the concrete specimens are de-moulded and allowed for continuous curing during a tank with portable water. The specimen are taken and tested at required 7th day y, 14th day & 28th day and tensile & durability test at 28th day from curing. Then compare the Strengths of M25 and M-30 design mixes.

Figure1Casting of Concrete

Figure 2: Compression Test Machine

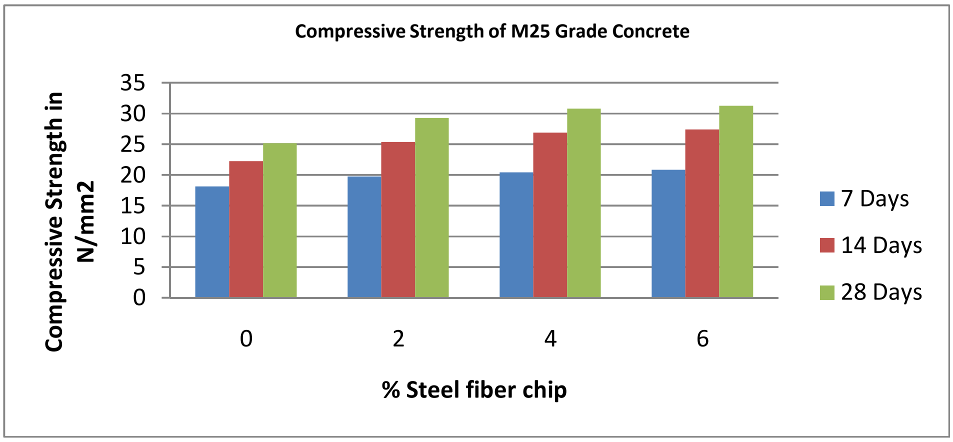
Results and Discussion: In this study the designed concrete is subjected to various tests to estimate the strength and other properties of the casted concrete. The main aim of the project is to monitor the developed strength attained by the concrete at various testing days from curing. Generally proper casting and curing of concrete will in crease the strength of the concrete. For this project each test is carried out with 3 samples for every mix ratio and tested at required curing time. Then the average values are used for the investigations. The series of testing procedures are detailed below:

Compressive Strength Test

Concrete is weak in tension and strong in compression so the concrete should be strong to attain high compression. In this study for each mix 3-samples were tested and the average strength is compared with nominal mix of M25 andM-30 grade. Compressive strength test finds out the high amount of compressive load a material can bear below facture limit. The results of compressive strength at the age of 7, 14 and 28 days are shown in table 5 &6.

Table.5 Compressive Strength on Concrete M25 Cubes

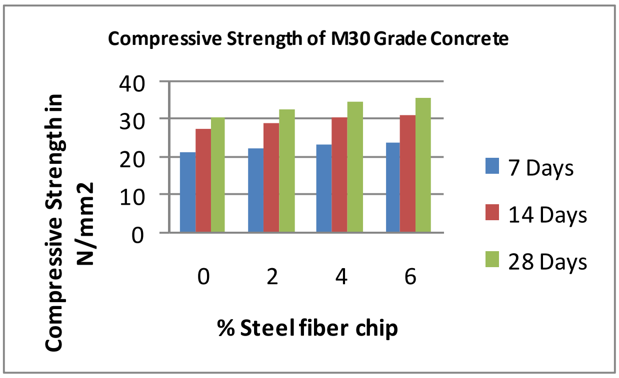
S.No.	% of Steel fibre chip	Grade of Concrete		
		7 Days	14Days	28Days
1	0 %	18.11	22.24	25.17
2	2%	19.77	25.40	29.30
3	4%	20.40	26.90	30.80
4	6%	20.88	27.40	31.25



Graph 1 – Compressive Strength of M25 Grade Concrete

Table6–Compressive Strength of M30 Grade concrete in N/mm²

S.No.	% of Steel fibre chip	Grade of Concrete		
		7 Days	14Days	28Days
1	0%	21.40	27.50	30.60
2	2%	22.54	29.10	32.90
3	4%	23.35	30.40	34.70
4	6%	23.78	31.30	35.86

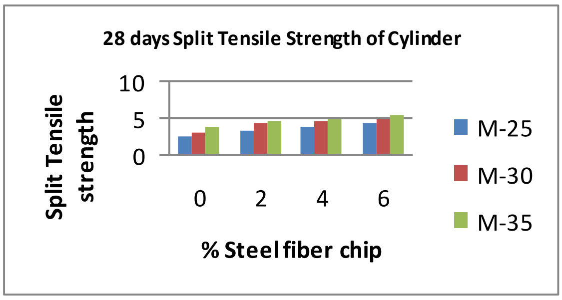


Graph 2 – Compressive Strength of M30 Grade Concrete

Split Tensile Strength Test: Totally 72 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 fiber chip of constant length. Results for split tensile strength based on the values of test data. A sample comparison graph for steel fibres chip concrete is plotted to study conventional concrete strength which is shown in Graph no3. The predicted value of the split tensile strength of different mixes has been compared with the experimental results in Table-7

Table.7 Split Tensile Strength of Concrete at 28Days

S. No.	% of Steel fibre chip	Grade of Concrete		
		M25	M30	M35
1	0%	2.4	3.10	3.82
2	2%	3.3	4.22	4.50
3	4%	3.8	4.50	4.92
4	6%	4.20	4.80	5.38

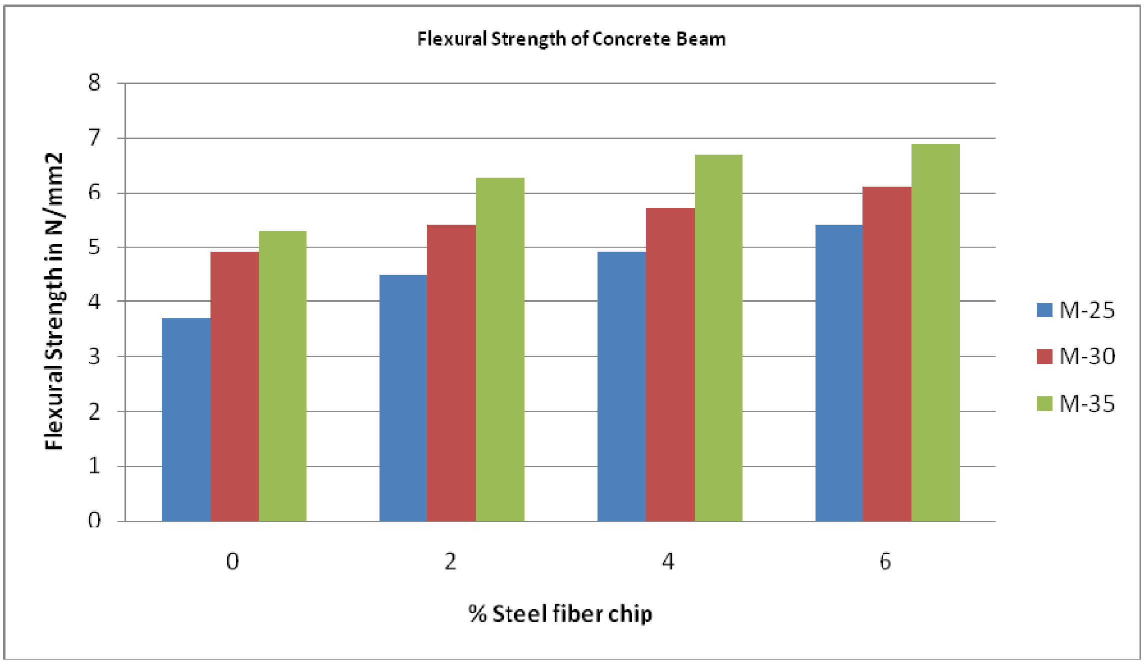


Graph 3 – 28 days Split Tensile Strength of Cylinder

Flexural strength Test: The determination of compressive and flexural strength of the prepared samples is carried out as per IS code. The following table the compressive and flexural strength of various samples using steel fibres cheep.

Table8–FlexuralStrengthofconcreteBeam

S. No.	% of Steel fibre chip	Grade of Concrete		
		M25	M30	M35
1	0%	3.70	4.90	5.29
2	2%	4.50	5.40	6.26
3	4%	4.90	5.70	6.67
4	6%	5.40	6.10	6.89



Graph 4 – Flexural Strength of Concrete Beam

Conclusion

❖ Addition of steel fiber cheep resulted in significant improvement on the strength properties of concrete (M -25, M-30, M-35) grade

❖ Compared to plane concrete the fiber addition resulted in better strengthening (compressive, tensile and flexural) properties of concrete.

❖ The maximum increase in compressive strength was observed of concrete grade M-25, M-30 and M-35 respectively at 6% of fiber cheep.

❖ compressive Tensile and flexural strength is continuously increased with increasing the percentage of steel and maximum tensile strength was achieved in the case of 6% steel fiber cheep for grade of concrete M-25,M-30 & ,M-35.

Recommendations

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 Fibers cheep 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. And also economic evaluation of the adoption of currently available steel fibers cheep technology should be investigated

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