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Structural Behaviour of Crimped Steel Fiber Reinforced Concrete Beam

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ABSTRACT - *Concrete is a delicate material which has a low strength and limited ductility. These weak points of concrete can be resolved by including fibers made up the various Materials with high technical specifications. This special type of concrete is known as special types of concrete which exhibits superior properties in terms of strength and durability method due to the addition of steel fibers when compared to conventional concrete. These inconsistent characteristics of steel fibers have highly influence on the performance of SFRC. M30 grade of concrete are 0.5%, 1.0 ,1.5%, 2.0%, 2.5%,3.0%,was planned in which workability tests were conducted to investigate the properties of the fresh concrete mixes. The concrete were investigated using Compressive Strength tests, and Flexural Strength were casted. Mechanical properties of concrete like durability tests and examination of micro structure of the concrete have been planned to be carried out.*

Key words: *m-sand, steel fiber, compressive strength, flexural strength.*

1. INDRODUCTION

which around us, but now also there is some problem to use concrete as a building Material. Generally, the Concrete structures Having very low tensile strength and limited Ductility, because of that using steel Reinforcement is a necessary one to bridge the Cracks and increase the tensile capacity of Concrete. The self-weight of concrete structure is greater than the steel structures with the Same load carrying capacity which requires Large support,the transportation and handling cost will be increased. The Steel fibre reinforced concrete (SFRC) can be used. Steel fibre reinforced Concretes are designed in such a way that, which may satisfy all the demands during Production, construction and service life of Structure. It has been proved that steel fibres. It have be effectively used in construction with its excellent flexural-tensile strength, resistance to splitting, impact resistance and excellent of the permeability and frost resistance. It is an effective way to increase toughness, shock resistance and resistance to plastic shrinkage cracking of the mortar.

2. MATERIAL USED

Material used in the study are (i) Portland Pozzolana cement (ii) crimped steel fiber and (iii) Blue granite crushed stone aggregate. All these materials are locally available.

The materials properties of Portland Pozzolana cement, crimped steel fiber and coarse aggregates are tested according the codal provisions and are given in the table 1, 2 and 3 respectively. The results obtained are therein checked with the nominal values.

Table – 1: Properties of cement

S.No.	Properties	Results	Nominal values as per IS 1489-1991
1	Standard consistency	30	26%-33%
2	Initial setting time (min)	75	Min 30
3	Final setting time (min)	190	Max 600

Table – 2 Properties of Fine Aggregate

S.No.	Test particulars	Fine aggregate	Nominal values
1	Specific gravity	2.83	2.5 to 3.0
2	Water absorption	0.23	< 0.6

Table-3 Properties of Coarse Aggregate

S.No.	Test particulates	Coarse aggregate	Nominal values
1	Specific gravity	2.83	2.5 to 3.0
2	Water absorption	0.36	< 0.6

Table -5 properties of steel fiber

S.No	Test Particulars	Steel Fiber
1	Specific gravity	2.62
2	Bulk density	2.65
3	Moisture content	nil

3. PREPARATION OFCONCRETE SPECIMENS

(1) M_{30} grade of concrete is used in the test (2) according to IS 456-2000. The specimens were ready in the following size moulds. (i) cube- 150mm X 150mm X 150mm (ii) cylinder – 150mm diameter and 300mm height (iii) prism – 100mm X 100mm X 500mm (4) specimens were cast with conventional concrete and also with crimped steel fibers. After 24 hours the moulds are removed and curing is done.

4. CONCRETE TESTING

4.1 slump cone test

The slump cone test is used to assess the horizontal free flow of in the absence of obstruction [5]. Mould is the shape of a truncated cone with internal diameter 200mm diameter at the base. 100mm diameter at the peak and a height of 300mm. concrete is pour in three layers and the cone is lifted in an upward direction. The difference in height of cone to the remaining concrte given the slump value.

4.2 Compressive Strength Test

Compressive strength test is the common test conducted on hardened concrete, partly because it is an easy test to perform and partly because most on the desirable Strength. The test is conducted on Compression testing machine of capacity 2000 KN.

Mechanical behavior of concrete was studied for M30 grade of cubes were casted and cured for 7 and 28days. Compressive strength of concrete is tested on cube at different percentage of steel and glass fiber content in concrete. The power of concrete has been tested on cube at 7 days curingand 28 days. And the results obtained are reported in table 4.3 & also shown in graph 4.2., in concrete 7 days test has been conducted to check the gain in initial strength of concrete & 28 days test gives the data of final strength of concrete at 28 days curing. Compression testing machine is used for testing the compressive strength concrete .After curing the concrete cube specimen was surface dried for 24 hrs. then the compressive test were taken using the compression testingmachine(CTM) using the formula compressive strength were calculated.

Compressive strength = load at failure/area

Area = 150mm x 150mm

Table-6 Compressive Strength Test

S.No.	% of Steel Fiber	C.S at 7 days(N/mm^2)	C.S at 28 days(N/mm^2)
1	0.5	21.73	39.63
2	1.0	26.72	44.70
3	1.5	28.20	43.25
4	2.0	29.36	45.57

4.3 Flexural Strength Test

Flexure Strength test is approved as per IS 516- 1999, a standard plain concrete beam rectangular cross section is simply supported and subjected to third point until failure. For two point loading at the peak and simply supported bottom, the flexural strength of the prism is obtained from (3).

Fs = 3PL/ $4bd^2$

Where,

Fs= Flexural strength of specimen in N/mm^2

P= Maximum load in N applied to the specimen

D= Measured diameter of the specimen in mm

b = measured width of the specimen in mm

Table -7 Flexural Strength Test

S.No.	% of Steel Fiber	F.S at 7 days (N/mm^2)	F.S at 28 days (N/mm^2)
1	0.5	5.22	6.05
2	1.0	5.32	6.01
3	1.5	5.58	5.96
4	2.0	5.69	6.10

5. DISCUSSION

1. It indicates the optimum volume fraction of fibers which gives maximum strength at 28 days is 3.0%.

2. The percentage augment in strength at this volume fraction of fibers over normal concrete at 7 and 28 days is 20.68% and 6.15% respectively.

3. Cracks occur in microstructure of concrete and fibers reduce the crack formation and propagation.

4. After optimum level, there is drop in compressive strength which indicates air entrapment in the concrete due to incorporation of high fiber volume fraction.

5. The Flexural strength increase by increase in fiber content up to 4.0% and then it decreases. The maximum values at 7 and 28 days are 5.83 and 7.01 respectively.

6. Thus, convenient is enhancement in flexural strength of concrete from 2.03% to 13.80% at 7 days and from 0.88% to 15.86 % at 28 days.

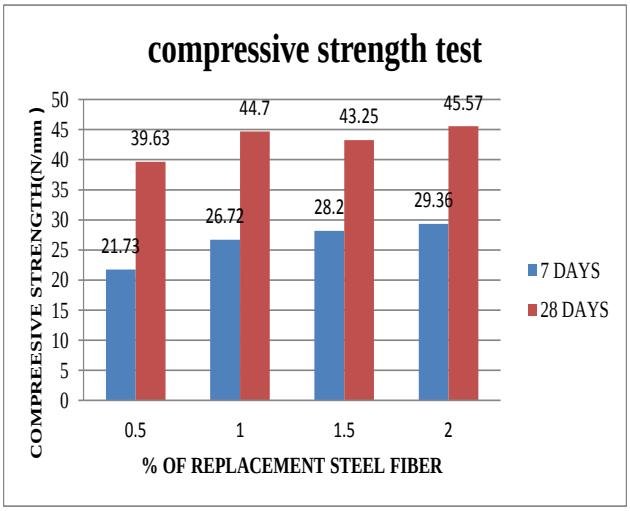

Chart-1 Compressive Strength Test

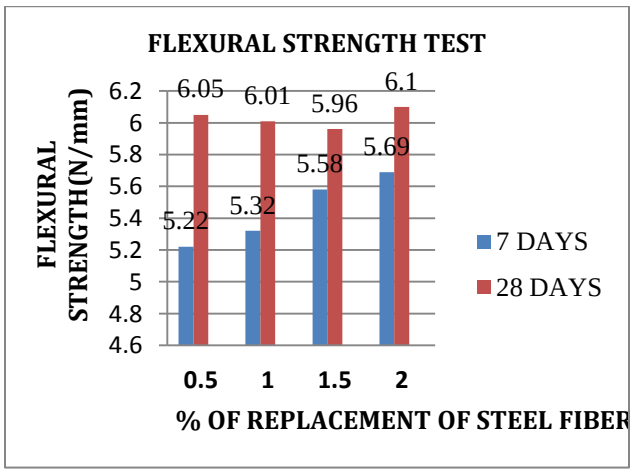

Chart-2 Flexural Strength Test

6. CONCLUSIONS

1) Workability decreases with increase in fibre content.
2) The wet dry density (7 and 28 Days) goes on decreasing as the percentage fibre volume fraction decreases.
3) The maximum percentage increase in compressive strength, flexural Strength, achieved are 6.15and 7.94respectively at 3.0%, 4.0%, of fiber volume fractions.
4) Adding of 2.0% fiber content value higher compressive strength than the conventional concrete during 28 days curing period.
5) The flexural strength of the concrete having fiber content higher than the conventional concrete after 28 days of curing.
6) In general, the satisfactory improvement in various strengths is observed with inclusion of Steel fibres in the plain concrete. However, maximum gain in strength of concrete is found to depen upon the amount of fibre content. The optimum fibre content to impart maximum gain in various strengths varies with type of the strengths.
7) Ductility of concrete is create to increase with inclusion of fibres at higher fibre content.
8) The width of cracks is originate to be less in SFRC than that in plain cement concrete beam.

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