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A Review on Performance of Steel Fibers Present in Tension zone only of High Strength Concrete

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ABSTRACT: Fiberd reinforced concrete (FRC) has been used in structural applications in order to enhance the structural performance under dynamic loading and reduce cracking and spalling phenomena by increasing toughness, ductility, and tensile strength of the concrete . High-performance fiber-reinforced cement based composite (HPFRC) is a high-strength FRC with enhanced high-performance characteristics. Recent studies has shown that HPSFRC has higher impact resistance than other types of concrete. Therefore , it ha been widely considered as a promising material for construction of important and strategic structures. HPSFRC panels are tested by drop projectiles up to an impact at which failure occurs. Machanical properties of HPSFRC are obtained to adefine material parameters in the MAT_SOIL_CONCRETE model in LS-DYNA. Which is used to simulate the behavior of HPSFRC panel under impact loading and perform prametric stidies . predicted crack and failure patterns on both sides of HPSFRC panel based on finet element simulation are good agreement with their corresponding experimental results.

Load and Diflection behavior of normal and high grade steel reinforced fiber concrete beams are investigated in this research . Test series consisted of 51 beams having 150x150x700 mm dimensions. The main parameters in the testing programe. Where the grade of concrete **M70** and the amount of steel fibers from **0%, 0.5%, 1.5%, 2%** are used at different depth of beam at **1/3th, 1/4th, 3/4th** and full depth of beam . Test are conducted on a beam to know displacement at different loadings of point load acting on a beam .Relation between load and diflection graph were examined at this test procedure.

1. INTRODUCTION.

In this era of world of concrete is most used material for compressive strength for building constructions. Tensile load carrying capacity is very low of concrete. This result in brittle failure of concrete components. To increase the performance of concrete under tensile loading or dynamic loading different types of fibers are added to concrete. Concrete is characterized by brittle failure which tends to for the complete loss of loading capacity , Once failure is installed the application the material can be overused by the inclusion of a small amount of short randomly distributed fibers(steel, glass, synthetic, and natural) and can be practice among others that remedy weakness of concrete, such as low growth resistance , high shrinkage, cracking, low durability, etc. Mainly steel fibered reinforced concrete (SFRC) has the ability of excellent tensile strength, flexural strength, shock resistance , fatigue resistance, ductility and crack arrest . Therefore , it has been applied a broad in various professional fields of construction, irrigation woks and architechure .Mostly steel fibers are seen to be performing well as compared to the other random fibe.

Steel Fiber Reinforced Concrete (SFRC) has an untapped potential application in construction practice due to its high dynamic energy adsorption capability and relatively simple construction technique . To tap such potential, the existing body of knowledge on SFRC must be expanded to provide a proper basis for official to add this method of construction to the provisions of building code. This thesis aims to that body of knowledge through experimental investigation on performance of steel fibers grade of concrete.

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A. Background

Concrete is one of the most versatile building materials. It can be cast to fit any structural shape from a cylindrical water storage tank to a rectangular beam or column in a high-rise building. It is readily available in urban areas at relatively low cost. Concrete is strong under compression yet weak under tension. As such, a form of reinforcement is needed. The most common type of concrete reinforcement is via steel bars.

The advantages to using concrete include high compressive strength, good fire resistance, high water resistance, low maintenance, and long service life. The disadvantages to using concrete include poor tensile strength, and formwork requirement. Other disadvantages include relatively low strength per unit weight.

II. LITERATURE REVIEW

B.Kriahna Rao, et al. performed an examination on steel fibers reinforced self – compacting concrete with steel fibers of different aspect ratios and different volume fractions. Fresh and hardened properties of the concrete were studied, and the change in ultimate strength was found. Results acquired from the majority of the mixes fulfill the lower and maximum cutoff points proposed by EFNARC. The results of this investigation show that optimum volume fraction and aspect ratio of fibers for good performance regarding strength was found to be 1% and 25 respectively. They also concluded that using high volumes of fly ash increases the workability characteristics of SCC mixtures.

Mounir M Kamal, et al. performed tests on SCC to study their mechanical properties and determine the optimum dosage of both steel and polypropylene fibers content to be used in SCC to satisfy the workability conditions. The effective optimum percentage for steel and polypropylene fibers was found to be 0.75% and 1% of cement content respectively. It was also found that addition of these fibers increases the compressive strength, reduces the bleeding, increases the impact resistance and further leads to more ductile failure pattern with the appearance of cracks prior to failure.

A.Khaloo, et al. studied the mechanical performance of SCC reinforced with steel fibers. They studied the effect of steel fibers on fresh properties of concrete, compressive strength, splitting tensile strength, flexural strength, and flexural toughness of SCC specimens. Different steel fibers volume fractions were studied, and reference mixes considered were of strength 40MPa and 60MPa. Results showed that with addition of 2% steel fibers workability reduces far below the minimum limits specified by EFNARC. The presence of steel fibers increased the splitting tensile strength and flexural toughness of the SCC specimens in low fiber volume, and it also showed that beams made with medium strength SCC had more flexural toughness compared to beams made with high strength SCC.

Mustafa Sahmaran, et al. Carried out and experimental program to investigate the effect of fibers on SCC. In their work they considered two different types of steel fibers. The authors concluded that by using considerable fibers inclusion i.e., $60kg/m^3$ it is possible to accomplish self compaction. All mixes considered had good flow – ability characteristics. The use of a commercial super plasticizer name 'Smart flow' proved to be economical also. This work also states that to get high workability and to retain that workability with the inclusion of fibers, the amount of paste in the mix should be increased and this gives better dispersion of fibers also.

Mustafa Sahmaran, et al. Made a study on fresh and mechanical properties of fiber reinforced self-compacting concrete incorporating high volume fly ash. Suitable super plasticizer and VMA were used to get a stable mix. Compressive strength, splitting tensile strength and ultrasonic pulse velocity of the concrete were studied for the hardened properties. The results of this work show that in spite of reduction in strength of concrete it is possible to produce FRSCC incorporating high – volume fly ash with 50% replacement of cementatious material. There is also increase in workability characteristics due to more paste content in the mix. This work also concludes that fibers geometry affects the properties of SCC mixes both in fresh and hardened states.

R.Deeb, et al. made a study on self compacting high and ultra – high performance concretes and the steps taken to develop them are briefly enlisted in this work. Their main aim was to research and report how the mixture of solids and liquids and the type of chemical admixture to be selected for developing concrete with self – compatibility which ensures right flowing and passing capacity even with the involvement of different types of steel fibers. The plastic viscosity of thus produced mixtures were estimated by a simple micromechanical procedure explained briefly in their paper. Their work concludes that it is successfully possible to attain self – compaction for high and ultra – high

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performance concrete mixes with good flow – ability and no segregation. A good paste content ensures good mix and distribution of fibers. Steel fibers of 30mm length and 0.55mm diameter with crimped ends showed an all over good performance compared to other long fibers used in this experiment.

Kishore S. Sable, et al. In their research explored the utilization of different steel fibers with various aspect ratios in structural concrete to upgrade the mechanical properties of self – compacting concrete. The study focuses on investigation of the properties of SCC with and without fibers, and also assesses the effect of fly ash replacement on the rheological properties of FRSCC.

Seshadri Sekahr T., et al. Carried out an experimental investigation on glass fibers reinforced self – compacting concrete and suggested an optimum percentage of fibers to be used to get the enhanced mechanical properties such as compressive strength, split tensile strength and flexural strength while satisfying the fluidity characteristics like flow – ability, filling – ability, passing – ability and resistance to segregation. The following conclusions were drawn from this report:

- As compared with conventional concrete the glass fibers reinforced SCC gives the higher strengths on long duration.
- The mechanical properties of glass fibers reinforced SCC are in accordance with the expected trends in conventional glass fibers reinforced concretes.

Seshadri Sekhar T., et al. Present an experimental investigation on the properties like workability and strength of glass fibers reinforced self – compacting concrete, using lowest possible water powder ratio in the development of SCC mixes. They concluded that the mechanical properties of glass fibers reinforced SCC of grades M50, M55, M60 and M65 are in accordance with the expected trends in conventional glass fibers reinforced concretes.

Arabi N.S. Al Qaudi et al., Investigated the effect of different specimen shape on mechanical properties of poyproplyene fiber reinforced SCC exposed to elevated temperature (200^0 - 600^0). They studied different shapes of specimen i.e. cylindrical and cubical specimens which were subjected to 200^0-600^0 temperature for a duration of 24 hours. The thermal shock induced by cylindrical specimens caused severe damage to the concrete and lead to reduction of compressive strength. This lead to a conclusion that shape of the specimen affects the mechanical properties under elevated temperatures. The addition of polypropylene fibers enhances the residual strength and fracture energy of concrete specimens when subjected to thermal shock. The experimental procedure was carried out with a constant water to powder ratio of 0.32 and fiber were varied with volume fraction 0%, 0.05%, 0.10% and 0.15%. Short PP fibers of 19mm length were used in this experiment. The specimens were cast and cured for 89 days in water at 20^0C and then tested at different elevated temperatures and heating period. The samples later were cooled down to room temperature and tested for compressive strength. Their study concluded that the use of polypropylene fibers does not affect the compressive strength upto 200^0 – 400^0 C but when the temperature is increased to 600^0C the compressive strength of the specimens is affected.

The optimum percentage of polypropylene fibers to be used for cylindrical specimen should be 0.05% and for cubical specimens it is 0.10% so that the compressive strength increases and provides fire resistance. The cubical specimens showed a better compressive strength that cylindrical specimens at elevated temperatures.

III. EXPERIMENTAL PROGRAMME

This chapter describes the test programme performed at Material testing Laboratory of Civil engineering Department at Vasireddy Venkatadri Institute of Technology college . The concrete mixing proportions of test specimens , mixing and casting sequences, test set up and test procedure is dicussed in detai in this chapter . photos are taken during preparation, casting and testing of specimens are also included.

A. Test specimens.

Test series consisted of 51 beams having 150x150x750 mm dimensions . The main parameters in the testing programme were the type of concrete (self compacting concrete SCC –SFRC) and the grade of concrete is M70 and 5 different percentages (0%, 0.5%, 1%, 1.5%, 2%) of steel fibers used at different depth of beams(0, 1/4th , 1/2th , 3/4th, full depths) of volume of concrete , used in test programme . Three specimens are cast for each mix, Details and designation of test specimen are shown in bellow table .

Percentage of steel fibers	M70 grade
0%	B/0.25 , B/0.5, B/0.75, B/1
0.5%	B/0.25, B/0.5, B/0.75, B/1
1%	B/0.25, B/0.5, B/0.75, B/1
1.5%	B/0.25, B/0.5, B/0.75, B/1
2%	B/0.25, B/0.5, B/0.75, B/1

IV. TESTS AND RESULTS

The beams are tested under UTM . Test set up were made such as point load are acting in that beam.Dail gauge are set up under the beam to know the deflection of a beam. In test set up load is gradually increased in the UTM machine and each 5kn load dail guage reading is noted .After load is gradually increased until beam is fail at a certain load dail gauge reading also noted until beam get failed at a certain load .The values of dailguage reading that is deflection reading under certain load is taken and graph should been plotted in between load and deflection values bellow table and graph is shown below.

UTM	DAIL GAUGE READING	DEFLECTION
0	25.22	0
5	25.22	0
10	25.22	0
15	25.20	0.02
20	25.18	0.04
25	25.15	0.07
30	25.10	0.12
35	25.05	0.17
40	24.94	0.28
45	24.87	0.35
50	24.81	0.41
55	24.75	0.47
60	24.64	0.58
65	24.43	0.79
70	24.31	0.91
75	24.16	1.06
80	23.45	1.77

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85	22.53	2.69
90	21.39	3.83
95	20.22	5

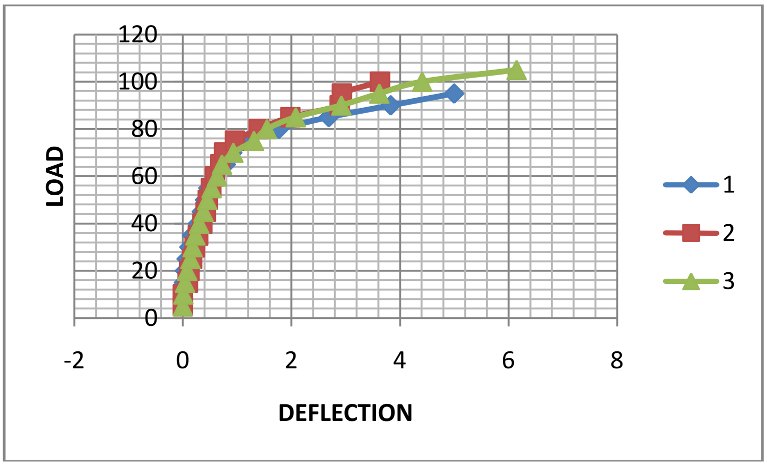

Figure 1-1graph plotted between load and deflection

In the test procedure strain energy values are also calculated and graph is also plotted in between percentage of steel fibers and fibers that are placed in abeam percentages.

V. CONCLUSION

Strain energy and flexural behaviour of normal and high grade steel reinforced fiber concrete beams were investigated in this research. Test series consisted of 51 beams having 150×150×700 mm dimensions. The main parameters in the testing program were the Grade of concrete M70 and the amount of Steel fibers (from 0 to 2%)and varying depth of a beam of four various percentages . Strain energy and flexural behaviours were obtained and evaluated in terms . when percentage of steel fibers are increased flexure strength are increased and strain energy would also increased.

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