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BEHAVIOUR OF CONCRETE SLAB PANEL WITH STEEL FIBER AND CHICKEN MESH

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Abstract:
Reinforced concrete slab is an horizontal member. which is used to carry the external load acting on a structure. The steel is strong in tension and weak in compression. The concrete is strong in compression and weak in tension. We are using steel fiber to improve the flexural properties of slab and improve the fatigue resistance also control cracks and joint stability. Steel fiber is common additives that can improve concrete performance. The aim of this project is to measure compressive and split tensile strength of concrete and flexural strength of the slab of M30 grade with the different percentage of steel fibers. Concrete specimens with fiber contents of 0.75% and 1.0% of 1mm diameter of hook end steel fiber of 50 aspect ratio used. It increases strengthening of slab by using steel fiber as a replacement of reinforcement on slab. The size of the slab was fixed. The dimensions of the slab were (0.48 m X 0.16m X 0.1m) .The flexural test results are compared with normal slab and SFRC slab with chicken mesh. The opening of chicken mesh is 25mm. It should resisted the cracks and also reduce the deflection on slab.

Keywords: Steel fiber reinforced concrete (SFRC), chicken mesh, flexural strength

I. INTRODUCTION

Concrete is a composite material containing hydraulic cement, water, coarse aggregate and fine aggregate. The resulting material is a stone like structure which is formed by the chemical reaction of the cement and water. This stone like material is a brittle material which is strong in compression but very weak in tension. This weakness in the concrete makes it to crack under small loads, at the tensile end. These cracks gradually propagate to the compression end of the member and finally, the member breaks. The formation of cracks in the concrete may also occur due to the drying shrinkage. These cracks are basically micro cracks. These cracks increase in size and magnitude as the time elapses and the finally makes the concrete to fail. The formation of cracks is the main reason for the failure of the concrete.

To increase the tensile strength of concrete many attempts have been made. One of the successful and most commonly used methods is providing steel reinforcement. Steel bars, however, reinforce concrete against local tension only. Cracks in reinforced concrete members extend freely until encountering are bar. Thus need for Multi directional and closely spaced steel reinforcement arises. That cannot be practically possible. Fiber reinforcement gives the solution for this problem so to increase the tensile strength of concrete a technique of introduction of fibres in concrete is being used. These fibres act as crack arrestors and prevent the propagation of the cracks. These fibers are uniformly distributed and randomly arranged. This concrete is named as fibre reinforced concrete. The main reasons for adding fibres to concrete matrix is to improve the post cracking response of the concrete.

A. Fiber History

The use of fibres to increase the structural properties of construction material is not a new process. From ancient times fibres were being used in construction. In BC, horse hair was used to reinforce mortar.. Asbestos

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was used in the concrete in the early 19th Century, to protect it from formation of crack. But in the late 19th century, due to increase structural importance, introduction of steel reinforcement in concrete was made, by which the concept of fibre reinforced concrete was over looked for 5-6decades, Later in 1939 the introduction steel replacing asbestos was made for the first time. But at that period it was not successful. From 1960, there was a tremendous development in the FRC, mainly by the introduction of steel fibres. Since then use of different types of fibres in concrete was made. In 1970's principles were developed on the working of the fibre reinforced concrete. Later the decades, codes regarding the FRC are being developed

B. Fibre Characteristics

Normally low carbon steel is used for manufacturing steel fibres. The wire strengths of 1000Mpa are achieved by pulling the wires through series of dyes. Corrosion is generally not an issue. The fibres are not interconnected so there can be no corrosion current, hence galvanizing is not recommended. They are four properties of fibres that are important while selecting fibers as secondary reinforcement in the concrete.

- Fibre geometry-aspect ratio
- Fibre deformation to improve bon
- Physical properties of the steel
- Fibre packaging to simplify mixing.

Dispersion of Steel Fibre in Concrete

One major problem with steel fibre concrete was "Balling". This happen for fibres with aspect ratio of L/D > 50 i.e. high performance fibres added in the concrete quickly. It has also been observed the volume percentage of fibres, types of aggregates intensify balling tendencies. Researchers developed a method where wire form forty spools is fed to a glue line where water dissolvable glue is applied. This phenomenon is known as collation. Collation of fibres was a major breakthrough in fibre technology. It is necessary in order to use high aspect ratio fibres without balling. Otherwise for a low aspect ratio<50, loose fibre are recommended. The fibres are packed in such packing, where the entire pack is dissolved with uniform dispersion of fibres.

Properties of Concrete With Steel Fibres

In addition to improvement of cracking behavior, steel fibre in concrete increase the dynamic load and fatigue strength Under equivalent stress, withstand greater no. of load cycles than plain concrete, hence we can use a reduced safety factor. If it is compared with other than polypropylene fibre, it is observed that steel fibre is better than PP Fibres in reducing crack width due to restrained drying shrinkage.

Shows the hook end steel fiber of 50mm length

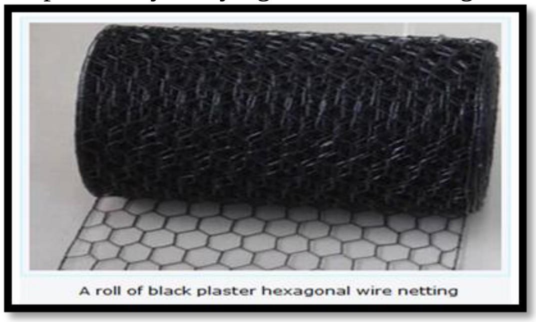
Scope

- ➢ To reduce cost of the construction
- ➢ To promote the low cost structures to the down trodden society.
- ➢ To increases moment capacity and cracking moment.
- ➢ To increase the ductility.
- ➢ To increases crack control.
- ➢ To increases rigidity.

- It should be easily adopted in field.

Chicken Mesh

Chicken wire has specific properties for plastering use. Chicken wire mesh is formed by twisting two adjacent wires at least four times, forming a strong honeycomb mesh structure. So, it has a high strength and durability. Even if a place is cut off, it will not lead to the entire chicken mesh structure destroyed. When using for plastering, plaster layer and the reinforcing metal layer have different thermal expansion coefficient. Therefore, subject to extreme changes in temperature, chicken wire (durable twisted woven mesh - no rigid mesh) is more acceptable for plastering than welded wire mesh or expanded metal. Using it when plastering effectively prevents plaster layer drying out and cracking.



Hexagonal type chicken mesh

MATERIAL PROPERTIES

Introduction

The physical properties of materials are very important to every concrete structures and it is tested before concrete mix design. The physical properties and characteristics of concrete ingredients are tested as per IS code provisions. The results are tabulated below and concrete mix design is calculated as per tabulated value.

Physical Properties of Cement

The cement was Pozzolona Portland cement (53 grade of Penna cement). The various laboratory tests conforming to Indian standard specification, IS: 4031-1996 specification, were carried out and the physical properties are shown in Table-1. These table shows percentage of fineness, consistency and initial and final setting time of PPC 53 grade cement as per IS 8112-1989.

Table 1 Physical Properties of Cement

Sl. No	Property	Units	Results Obtained	Values as per IS:1489-1991
1	Specific Gravity test	No units	2.28	3.15
2	Fineness test	%	8.5	<10
3	Setting time	Minutes Initial Final	39 590	30 600

Physical Properties of Fine Aggregate

Ordinary sand from river having fineness modulus of 2.92 was used. Sand after sieve analysis (Table 3) conforms to zone III as per IS: 383-1970.Natural river sand of maximum size 4.75mm was used as fine aggregate and was tested following IS: 383-1970. The sand confirmed to zone III. Coarse aggregate confirmed to BIS specifications. The fig shows the sample of river sand. Specific gravity of sand = 2.614

Table 2 Sieve Analysis for fine aggregate IS: 2386

IS Sieve	Weight Retained (kg)	Cumulative Weight (kg)	% of Retained	% of Passing
4.75mm	0.066	0.066	6.6	93.4
2.36mm	0.077	0.143	14.3	85.7
1.18mm	0.200	0.343	34.3	65.7
600mic	0.269	0.612	61.2	38.8
300mic	0.215	0.827	82.7	17.3
150mic	0.107	0.934	93.4	6.6
Below than 150mic	0.066	1.000	-	100

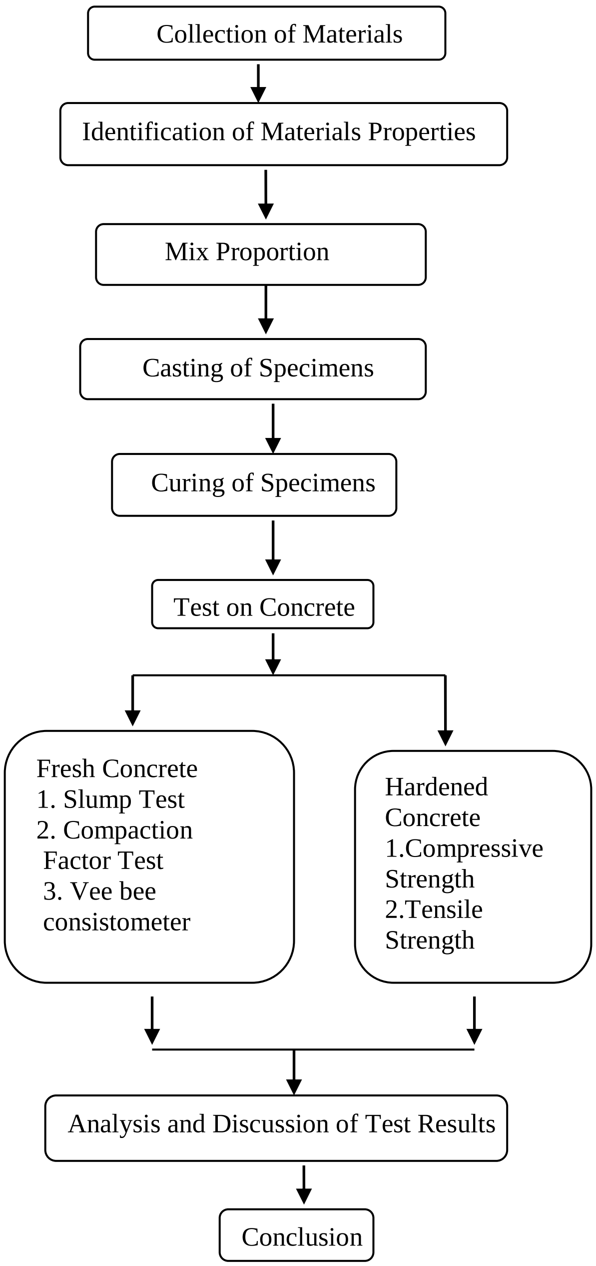
Physical Properties of Coarse Aggregate

Coarse aggregates are transported from stone quarries and 4.75mm to 20mm size as per IS sieves. It is most important ingredient of concrete. The fig shows sample of coarse aggregate size from 20mm.

Table3- Physical properties of coarse aggregate

Sl. No.	Property	Units	Results obtained	Value as per IS 2386
1	Specific gravity	No unit	2.78	2.884
2	% of water absorption	%	1	-
3	Impact value	%	15.5	20

EXPERIMENTAL METHODOLOGY



FLEXURAL STRENGTH TEST ON SLAB PANELS:

Specimen and reinforcement details:

The experimental programme consists of testing as per IS 516:1959 of 24 RCC slab panels specimens. The size of the slab panel is (480mm X 160mm). Two slabs are cast with Fe415 steel, two slabs are casted with steel fiber reinforced concrete and remaining two slabs are casted with SFRC and chicken mesh.

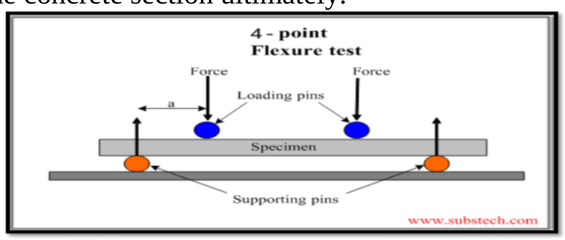
The depth of the slab is 100mm. The area of reinforcement in shorter directions 4 Nos of 10mm diameter @ 110mm c/c distance and the area of reinforcement in longer directions 3 Nos of 10mm diameter @ 65mm c/c distance.

Casting and Curing The mould is arranged properly and placed over a smooth surface. The sides of the mould exposed to concrete were oiled well to prevent the side walls of the mould from absorbing water from concrete and to facilitate easy removal of the specimen.

The reinforcement cages were placed in the moulds and cover between cage and form provided was 15 mm. Cement mortar block pieces were used as cover blocks. The concrete contents such as cement, sand, aggregate and water were weighed accurately and mixed. The mixing was done till uniform mix was obtained. The concrete was placed into the mould immediately after mixing and well compacted. The test specimens were remoulded at the end of 24 hours of casting. They were marked identifications. After 14 days of curing the specimen was dried in air.

Test set-up:

The specimen were tested by using Compression testing machine of 1000KN capacity by keeping the slab in horizontal position with two loading system of 5mm internal loading distance. The sustained loading was applied from top of the slab until we get the ultimate load that the steel in tension face can take no more upcoming loads and transfers it to the concrete section ultimately.



Shoes test setup of slab panel

Test results:

The ultimate load and elongation were noted down during the experimental programme. Then the distance between the line of fracture and the nearer support measured on the Centre line of the tensile side of the specimen. The test results were tabulated and graphs were plotted and shown below.

Table 4 Flexural strength of slab panel

S.No	Samples of slab	7 Days (N/mm^2) Pl/bd^2	14 Days (N/mm^2) Pl/bd^2
1	Normal R.C Slab	9.5	11.3
2	0.75% OF SFRC Slab	12.1	13.2

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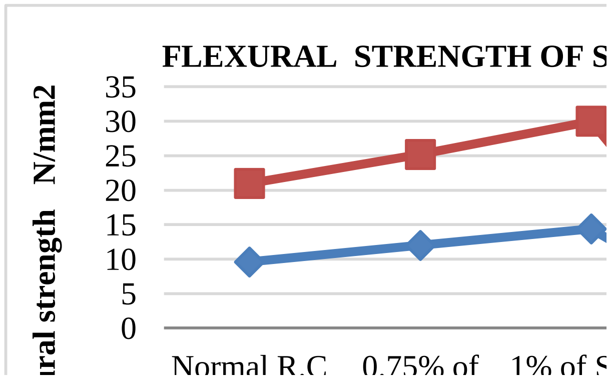
3	1% of SFRC Slab with Chicken Mesh	14.3	15.7



Flexural strength of slab panel

Materials

M30 grade concrete was used for casting beams, 20mm coarse aggregate and fine sand as fine aggregate. The reinforced beam consist of 3 nos. of 10 mm diameter bars in tension side and 2 nos. of 10 mm diameter bars in compression side with 8 mm diameter stirrups over the length of beam at 150 mm spacing.

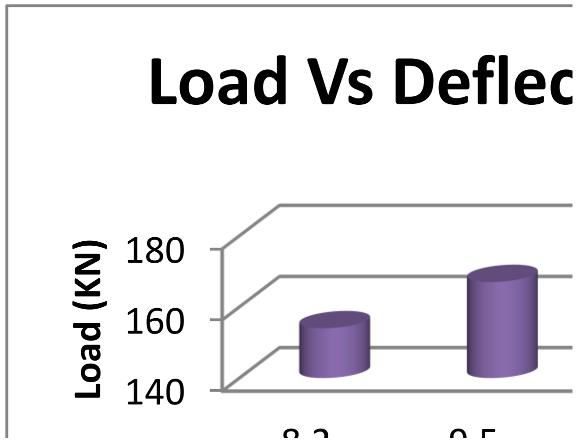
Specimens

The rectangular cross section of the beams was 150mm width, 150mm depth and 2440mm length. It is shown in figure.

Test setup

The beams were tested in the loading frame of 1000 kN capacity under two point loading. The load was applied gradually by means of hydraulic jack until the beam failed. The test set up is shown in figure. The deflection in the mid span and center of the opening was recorded. Testing arrangement of beam with opening is shown in figure.

FIG.5.4 LOADING FRAME TEST SETUP



Load Vs Deflecion graph

CONCLUSION

The steel fibers (hooked end) used in this project has shown considerable improvement in all the properties of concrete when compared to conventional concrete like. The study on the introduction of effect of steel fibers can be still promising as steel fiber reinforced concrete is used for sustainable and long-lasting concrete structures. Steel fibers are widely used as a fiber reinforced concrete all over the world. Lot of research work had been done on steel fiber reinforced concrete and lot of researchers work prominently over it. This review study tried to focus on the most significant effects of addition of steel fibers to the concrete mixes. The steel fibers are mostly used fiber for fiber reinforced concrete out of available fibers in market. According to many researchers, the addition of steel fiber into concrete creates low workable or inadequate workability to the concrete, therefore to solve this problem of super plasticizer without affecting other properties of concrete may introduce

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