Experimental Investigation on Fiber Reinforced Concrete Using Recycled Aggregates

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Abstract- *Concrete is the most widely utilized "man made" material globally for construction in many developing countries in all types of civil engineering works. Also, concrete is an environmental - friendly material and in areas of growing environment – related awareness that is of prime importance. Many of investigations were attempted by the researchers to improve the quality, strength and durability against adverse exposures, since decades. Portland cement concrete is considered to be a relatively brittle material. When subjected to tensile stresses, unreinforced concrete will crack and fail. Since the mid 1800's steel reinforcing has been used to overcome this problem. As a composite system, the reinforcing steel is assumed to carry all tensile loads. When fibers are added to the concrete mix, it too can add to the tensile loading capacity of the composite system. In fact, research has shown that the ultimate strength of concrete can be increased by adding fiber reinforcing. In this research paper, an attempt is made to use fibers only .The experimental investigation consisting of casting and testing of compression tests were conducted on 150x150x150mm cube and 150mmx300mm, cylindrical specimens using test method that gave the complete compressive strength, split tensile test and RC beam test using with and without steel fiber of volume fractions 0.75,1.5 and 2.5% of 0.75mm diameter of aspect ratio of 80 on normal aggregate concrete and recycled aggregate concrete. based on the results will find the superior crack resistance, improved tensile strength. The proposed sample will be tested at 7 days, 21 days and 28 days age of curing. These results will show whether the FRC is suitable for proper confinement or not for structures subject to extreme load conditions such as seismic loading and impact loading.*

I. INTRODUCTION

Concrete is weak in tension. Micro cracks begin to generate in the matrix of a structural element at about 10 to 15% of the ultimate load, propagating into macro cracks at 25 to 30% of the ultimate load. Consequently, plain concrete members cannot be expected to sustain large transverse loading without the addition of continuous bar reinforcing elements in the tensile zone of supported members such as beams or slabs.

II. LITERATURE REVIEW

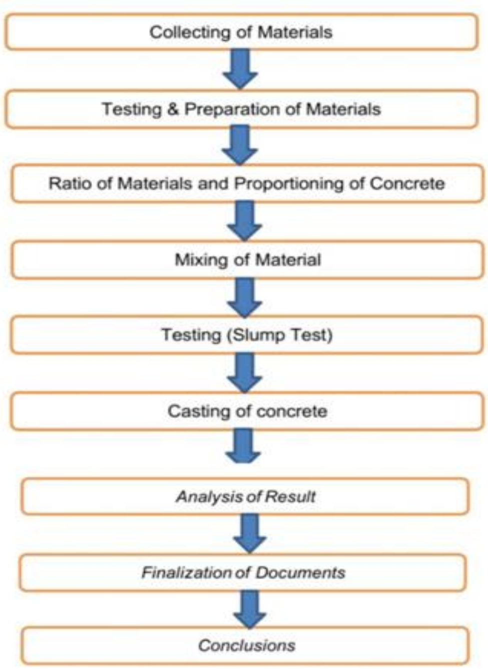
M. Sudhakar et.al, carried out the experimental investigation to study the behavior of ESFRC by varying the volume percentage content of steel fiber. Four rectangular reinforced concrete beams, with the steel fiber reinforced concrete in critical sections along with the stirrup confinement, have been tested. The findings of the investigation indicate that up to about 80 percent of ultimate strength, the behavior of ESFRC beams was similar to that of beams with rectangular tie confinement. The effect of the steel fiber was felt prominently beyond the post ultimate stage. The ductility is increased due to increase in percentage of fiber content.

Job Thomas et.al carried out the experimental program and an analytical assessment of the influence of addition of fibers on mechanical properties of concrete. Models derived based on the regression analysis of 60 test data for various mechanical properties of steel fiber-reinforced concrete have been presented. The various strength properties studied are cube and cylinder compressive strength, split tensile strength, modulus of rupture and post cracking performance, modulus of elasticity, Poisson's ratio, and strain corresponding to peak compressive stress. The variables considered are grade of concrete, namely, normal strength (35MPa), moderately high strength (65MPa), and high-strength concrete (85MPa), and the volume fraction of the fiber (Vf=0.0, 0.5, 1.0, and 1.5%).Rafat Siddique et. al, This paper presents about the evaluation of mechanical properties of concrete mixtures where the replacement of used-foundry sand were done. The used foundry sand whichis a by- product of ferrous and non-ferrous metal casting industries are successfully recycled and reused many times and it is removed from the foundry and termed as used/spent foundry sand when it can no longer be reused. Used foundry sand replaces the fine aggregate in three different percentages (10%, 20% and 30%) and test results were performed to obtain the properties of fresh concrete and found to be a marginal increase in the strength properties like compressive strength, splitting-tensile strength, flexural strength and modulus of elasticity as 28, 56, 91 and 365 days.

Paramasivam conducted a feasibility study on coconut fibre reinforced corrugated slabs measuring 915 mm long x 460 mm wide x 10 mm thick for low-cost housing. A cement–sand ratio of 1:0.5 and a water–cement ratio of 0.35 were used. Tests for flexural strength using third point loading were performed. A fibre length of 2.5 cm, a volume fraction of 3%, and a casting pressure of 0.15 MPa were recommended for producing slabs with a nominal flexural strength of 22 MPa. The thermal conductivity and absorption coefficient for low frequency sound were comparable with those of asbestos boards.

Ramakrishna and Sundararajan performed experiments on the impact resistance of slabs using a falling weight of 0.475 kg from a height of 200 mm. The slabs consisted of 1:3 cement–sand mortar with dimensions of 300 mm x 300 mm x 20 mm. They were reinforced with coconut, sisal, jute and hibiscus cannabin us fibers, having four different fiber contents of 0.5%, 1.0%, 1.5% and 2.5% by weight of cement and three fiber lengths of 20, 30 and 40 mm. A fiber content of 2% and a fiber length of 40 mm of coconut fibers showed the best performance by absorbing 253.5 J of impact energy.

III. METHODOLOGY



IV. MATERIALS

Cement :

Cement used in the experimental work is ORDIRARY PORTLAND CEMENT of 43 grades conforming to IS: 8112/1989.

Coarse Aggregates & Recycled Aggregate:

Crushed granite of 10mm & 20mm size are used as coarse aggregate. Recycled aggregate of sizes 16 mm to 10 mm graded obtained from the locally available demolished building waste was used in the present investigation.

Fine Aggregates

Fine aggregate which satisfied the required properties for experimental work and conforms to zone as per the specification of IS: 383-1970.

Steel Fibers:

Steel fibers are produced by cutting or chopping the wire & thin flat sheet. A number of steel- fiber types Indented round, Crimped round, Machined round, Hook-ended round, Flat sheet and crimped flat are available as reinforcement to concrete conforming IS: 280-1976 with an aspect ratio 30-250.

Water:

Clean potable water was used for mixing and curing of concrete.

Experimental Investigation:

This chapter presents the details of experimental investigations carried out on the test specimens to study the strength characteristics of SFRC in different combinations. The experiment is conducted on SFRC test specimens to ascertain the workability and strength related properties such as cube compressive strength, cylinder split tensile strength and prism flexural strength of various mixes. Three specimens are tested, and the average is reported for each mix for each test. All the tests are conducted as per Indian standards. Based on the strength test results of cube and cylinders the optimum percentage is arrived. Then the precast concrete panels are casted. After 7,14&28 days curing, the panels are tested for compressive, Tensile and flexural strength.

V. RESULTS AND DISCUSSION

Compressive strength :

The cube compressive strength test is carried out on cube specimens of size 150mm x 150mm x 150mm. All specimens are tested in saturated surface dry condition, after wiping out the surface moisture. For each mix combination, three identical specimens are tested at the age of 7,14&28 days using a compression testing machine.

Mix	7 Days N/mm²	21 Days N/mm²	28 Days N/mm²
Con-1	21.093	25.44	31.80
Con-2	22.702	29.55	36.94
Con-3	24.062	31.59	39.48
RCA-1	20.56	24.64	30.6
RCA-2	21.81	28.52	35.8
RCA-3	23.6	30.64	37.7

Split tensile strength:

This is an indirect test to determine the tensile strength of cylindrical specimens. Splitting tensile strength test is carried out at the age of 28 days for the concrete cylinder specimen of size 150mm diameter and 300mm length using universal testing machine. The load is applied gradually till the specimen split and the readings are noted.

Mix	7 Days N/mm²	21 Days N/mm²	28 Days N/mm²
Con-1	3.177	3.36	4.21
Con-2	3.414	3.46	4.34
Con-3	3.814	3.95	4.65
RCA-1	3.03	3.10	3.91
RCA-2	3.2	3.38	4.01
RCA-3	3.5	3.72	4.3

Table 6.9 :7,21&28 days Split Tensile Strength

Flexural Strength:

In order to determine the lateral load resistance, the prisms are tested for flexure. The prisms (100mm x 100mm x500mm) were placed horizontally and tested for flexural strength according to third point loading. The initial failure location was observed and found that the failure location of all prisms was within the middle third. The third point loading was used to determine the stress at failure.

Mix	Load in KN	FLEXURAL STRENGTH IN N/mm²
Con-1	17.8	7.12
Con-2	18.5	7.40
Con-3	19.5	7.82
RCA-1	16.42	6.6
RCA-2	17.5	7.0
RCA-3	18.4	7.4

Table 6.12: 28th Day Flexural Strength

VI. CONCLUSION

In the light of the preceding results and discussion, the following can be concluded: -

The addition of steel fibers' effect on the compressive strength has increased by 5% with (3.5%) of fiber then started increasing and then decreased by increasing the fiber quantities.

The results of the splitting tensile strength tests show that there is an increase in strength by increasing fiber. It was found that the highest splitting tensile strength was achieved by 3.5% of steel fibers, which was found to be about 5.39 N/mm2 compared with other mix. The load carrying capacity is increased to 8 % compared with the conventional specimen. Based on the experimental test result there is an improvement in Flexural strength of the 3.5% mix is higher at age of 7,21 &28 days respectively compared to all other mixes.

High quantities of fiber produced concrete with poor workability and segregation, higher entrapped air and lower unit weight.

A significant effect on the mode and mechanism of failure of concrete cylinders in a comp. testing with (FRC). The fiber concrete fails in a more ductile mode.

The (PCC) cylinders typically shatter due to an inability to absorb the energy by the test machine at failure.

Fiber concrete cylinders continue to sustain load and large deformations without shattering into pieces.

That improve the tensile and cohesion of concrete.

The fiber concrete fails in more ductile mode opposite the plain concrete that shattering into pieces.

It shows that Normal aggregate has good effectiveness for increasing the load carrying capacity, cracks and stiffness for the concrete beams compared between recycled aggregate.

SFRC can be used advantageously over normal concrete pavement. Steel fibers are being used due to their cost effective as well as corrosion resistance. PFRC requires specific design considerations and construction procedures to obtain optimum performance. The higher initial cost by 15-20% is counterbalanced by the reduction in maintenance and rehabilitation operations, making

SFRC cheaper. In a fast developing and vast country like India, structural stability contributes to grow**No table of contents entries found.**th and development.

Resistance to change though however small disturbs our society, hence we are always reluctant to accept even the best. Its high time that we overcome the resistance and reach for the peaks. PFRC opens a new hope to develop and globalize the quality and reshape the face of the "True Indian Structures".

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