Behaviour Study of Admixture And Coconut Fibre on Concrete Paste By Experimental

Baswaraj D Patil[1], A N Shaikh[2]
[1]Dept of Structural Engineering
[2]Assistant Professor, Dept of Structural Engineering
[1, 2] M S Bidve Engineering College, Latur

Abstract- *A research project has been undertaken to investigate the role of fibers in strength properties of M30 grade concrete at varying fibre contents and to compare it with that of conventional concrete. The various strength aspects analysed are the flexural, compressive strength of the coconut fiber reinforced concrete at varying percentages (2%,3.5%,5% by the weight of cement) of fibre. The influence of optimum dosage of admixture (superplasticizer) on workability and strength is also studied experimentally.*

Keywords- CFRC, Compressive strength, flexural strength, coconut fiber.

I. INTRODUCTION

Sustainability is a wide accepted concept in modern construction scenario. Even though the construction industry is revolutionizing in a significant manner in terms of both equipment and materials used, the cost of construction has skyrocketed along with the deteriorative impact on environment. This resulted in the adoption of a more balanced approach with the environment as its nerve centre to create a better world to live in. This has led to the adoption of a natural fibre like Coconut for the strength enhancement in concrete.
Coconut fibre is available in abundance at the test site, which makes it quite viable as a reinforcement material in concrete. Further, it acts as a new source of income for the coconut producer who gets the benefits of the new demand generated by the construction industry. In addition to this, it is an effective method for the disposal of coir mattress waste which will reduce the demand for additional waste disposal infrastructure and decrease the load on existing landfills and incinerators. The problem of high rate of water absorption of the fibre could be reduced by coating the fibres with oil. Moreover, the fibres being natural in origin is ecologically sustainable and can bring down the global carbon footprint quite effectively.

II. LITERATURE

The present investigation deals with behaviour study of admixture and coconut fibre on concrete paste by experimental with varying percentages of fibre. hence specific attention has been given to study the strength variations with varying fibre percentage of fibre by comparing with conventional concrete of M30 grade**. Slate FO (1976),** Investigated compressive and flexural strength of coconut fibre reinforced mortar. Two cement-sand ratios by weight, 1:2.75 with water cement ratio of 0.54 and 1:4 with water cement ratio of 0.82 were considered. Fibre content was 0.08%, 0.16% and 0.32% by total weight of cement, sand and water. Cylinders of 50 mm diameter and 100 mm height and beams of 50 mm x 50 mm x200 mm length were tested. They found that there is increase in strength due to the inclusion of fibre. **Cook et al (1978),** Reported the use of coconut fibre reinforced cement composites as low cost roofing materials. The parameters studied were fibre lengths (2.5, 3.75 and 6.35 cm), fibre volumes (2.5%, 5%, 7.5%, 10% and 15%) and casting pressure (from 1 to 2 MPa with an increment of 0.33 MPa). They concluded that the optimum composite consisted of fibres with length of 3.75 cm, a fibre volume fraction of 7.5% and is casted under the pressure of 1.67 MPa. A comparison revealed that this composite was much cheaper than locally available roofing materials. **Majid Ali et al (2011)**, He investigated and studied the versatility and application of coconut fibre in different fields. He concluded that Coconut fibre are reported as more ductile and energy absorbent material. It is concluded that coconut fibre have potential to be used in composite for different purpose.

III. MATERIALS USED

The cement used in the said investigation comprised of Ordinary Portland Cement (Ultratech Cement of 53 Grade) which was made available by local supplier from Panvel, Coarse aggregates of 20 mm and 10 mm nominal size having specific gravity 2.66 confirming to IS 383:1970 was used in this investigation. Crushed sand of zone-II having specific gravity 2.64 confirming to IS 383:1970 was used in this Investigation. The super plasticizer used, namely Master Glenium SKY8654, was procured from BASF Pvt. Ltd. Turbhe

Coconut fibers

The coconut fiber is collected from locally available shop. Average diameter of fiber is 0.0220 cm, the average length of the fiber is almost 25 cm. after analyzing and referring the journals, fiber was cut to 2.5cm.

IV. METHODLOLOGY

Tests are conducted to check the workability of concrete due to the addition of admixture and fibre is reinforced with concrete in order to enhance the strength and ductility of concrete and also to increase the energy absorption capacity of concrete. Optimum admixture dosage is obtained using Marsh cone test and dosage found is 0.4 %, M30 grade concrete being used as design mix and the mix ratio found to be 1: 1.918: 2.898 with water cement ratio of 0.5. workability tests such as slump and flow table tests are conducted to check the workability of conventional concrete and also CFRC. Total 72 Cubes and 72 prisms samples are casted for conventional, 2%, 3.5% & 5% fibre content. Samples are tested for 3days, 14days &28days to determine the compressive strength and flexural strength of concrete and results are tabulated and graphs are also plotted to study the behavior.

A. Equations

$$\text{Flow (\%)} = \frac{\text{Spread diameter} - 25}{25} \times 100 \quad (1)$$

$$f_c = \frac{P \times 100}{A} \quad (2)$$

Where

$\mathbf{f_c}$ = is compressive strength of concrete in N/mm^2
P = ultimate load resisted by concrete in Newton's
A = Area of cube in mm2

$$f = \frac{pl}{bd2} \text{ N/mm}^2 \quad (3)$$

Where
P is failure load of specimen, N
b is breadth of the specimen, mm
d is depth of specimen, mm

V. RESULTS AND DISCUSSIONS

A. Marsh cone test

Marsh cone test is conducted to obtained the optimum admixture dosage, trials are conducted with increased dose of admixture from 0.2% to 0.8%, with water cement ratio of 0.5 and it is found that the time of flow through marsh cone is optimum at 0.4% i.e. 6.25 sec.

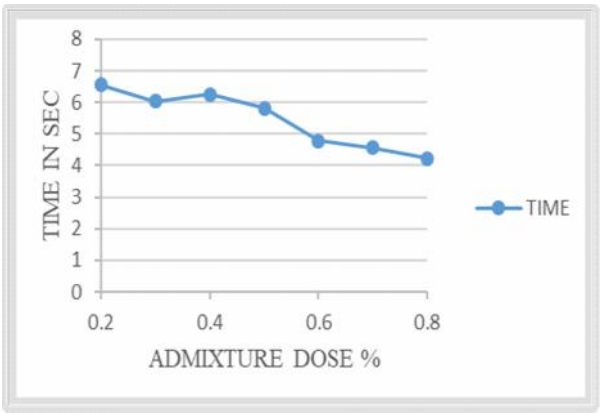


Fig. 1 Marsh cone test

B. Workability test

Slump and flow table tests are conducted to determine the workability of concrete. Tests are conducted for conventional concrete with &without fibre using admixture. It is observed that due to the addition of admixture the workability of concrete increases. The results of both slump and flow table test are tabulated below.

TABLE I. SLUMP TEST VALUES

Different mix	Normal concrete	with 2% fibre 100 AR	with 3.5% fibre 100 AR	with 5% fibre100 AR
Fresh Concrete without admixture	120mm	50mm	35mm	5mm
Fresh Concrete with admixture	145mm	105mm	85mm	30mm

TABLE II. FLOW TABLE TEST VALUES

Different mix	Normal concrete	with 2% fibre 100 AR	with 3.5% fibre 100 AR	with 5% fibre100 AR
Fresh Concrete without admixture	90%	55%	48%	40%
Fresh Concrete with admixture	95%	68%	59%	50%

C. Compressive strength of concrete

Compressive test is done using 150x150x150 mm cubes by varying the percentage of coconut fibre and also by adding admixture dosage. Graphs are plotted for different specimens as shown in below.

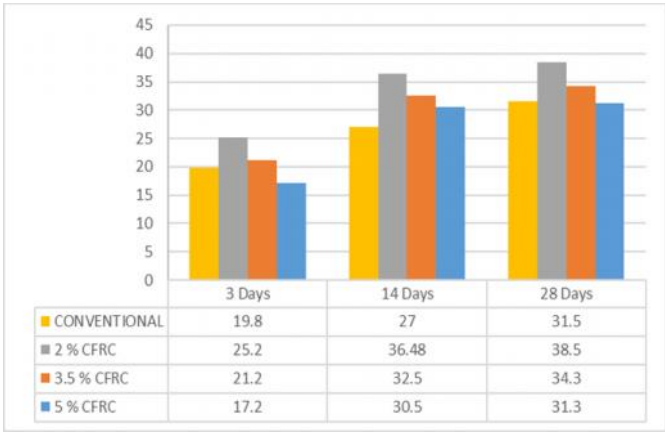


Fig.2 Compressive strength of concrete without admixture

Figure 2. depicts the compressive strength of concrete without admixture, it is observed that due to the addition of fibre the compressive strength of concrete increases. From figure it can be stated that the compressive strength of concrete at 28days is highest i.e. 38.5 Mpa at 2% fibre content.

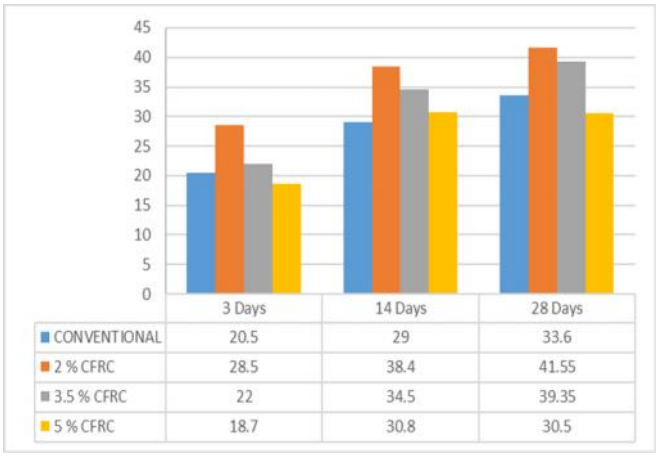


Fig.3 Compressive strength of concrete with admixture

Figure 3. shows the compressive strength of concrete with admixture, it is observed that due to the addition of admixture the flow increases and hence the compaction of concrete will be good. From figure it can be stated that the compressive strength of concrete at 28days is highest i.e. 41.55 Mpa at 2% fibre content. By comparing fig 2 & fig 3, it can be stated that the compressive strength of concrete for all the specimens is increased due to the addition of admixture dosage.

D. Flexural strenght of concrete

The flexural strength of concrete is performed by casting prisms of 100x100x500 mm. and are tested for two-point loading in flexural testing machine, results obtained are interpreted in the graphs as shown below.

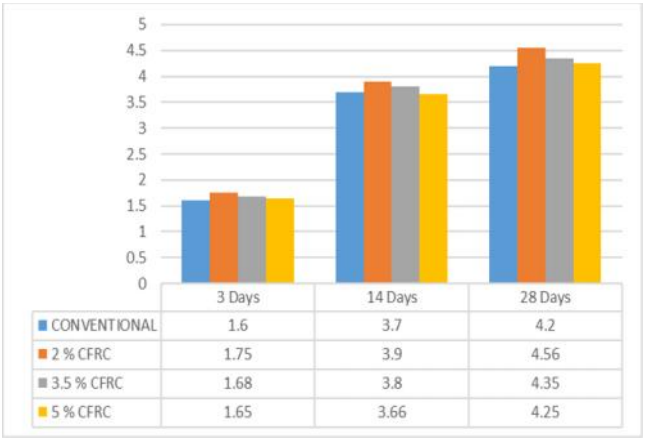
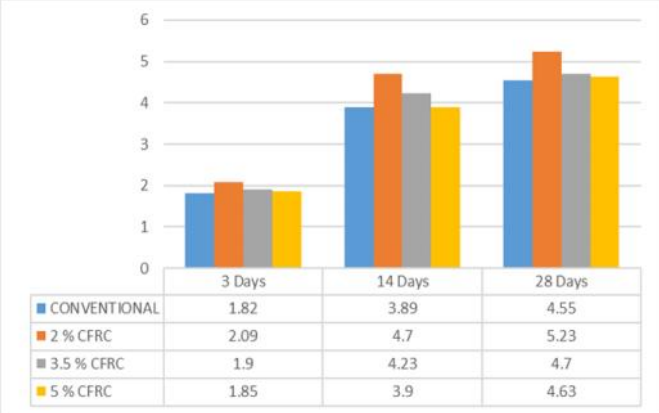


Fig.4 Flexural strength of concrete without admixture

From fig 4. It can be observed that flexural strength of concrete is increased due to the inclusion of fibre. The fibre increase the bonding and forms bridge in between the concrete particles and thereby increases the capacity to absorb

deformation From figure it can be stated at 28days the flexural strength is highest for concretet with 2% i.e. 4.56 Mpa.



	3 Days	14 Days	28 Days
CONVENTIONAL	1.82	3.89	4.55
2 % CFRC	2.09	4.7	5.23
3.5 % CFRC	1.9	4.23	4.7
5 % CFRC	1.85	3.9	4.63

Fig.5 Flexural strength of concrete with admixture

From fig 5. It can be stated that the flexural strength of concrete is increased due to the inclusion of fibre, here admixture plays an important role to increases the flow of concrete thereby increasing the compaction. Concrete is week in tension and strong in compression and by adding fibre to the concrete the tensile capacity of concrete can be increased. From figure it can be stated that the flexural strength of concrete at 28days is high at 2% fibre content i.e. 5.23Mpa.

VI. CONCLUSIONS

Coconut fibre is available in abundance at the test site, which makes it quite viable as a reinforcement material in concrete. Further, it acts as a source of income for the coconut producer who gets the benefits of the new demand generated by the construction industry. In addition to this, it is an efficient method for the disposal of coir mattress waste which will reduce the demand for additional waste disposal infrastructure and decrease the load on existing landfills and incinerators. Coconut fibres being natural in origin, is ecologically sustainable and can bring down the global carbon footprint quite effectively.

In the present investigation an attempt is been made to study the role of coconut fibres on the behaviour compressive and flexural strength of with various proportion of fibres.

Based on the limited study carried out, the following conclusions are drawn.

1) At 2% addition of coconut fibre with a admixture of 0.4%, compressive strength tests yielded best results. However, the compressive strength decreased on further fibre addition. This must be due to the fact that when the fibres are initially added to concrete, the finer sized fine aggregates enter into the surface pores in the fibre creating a better bonding between the fibre and mix, however further addition of fibres resulted in formation of bulk fibre in the mix which will lead to decrease in bonding. Hence there is an optimum value of fibre to cement ratio, beyond which the compressive strength decreases. Hence 0.4 was taken as the optimum dosage of admixture and optimum fibre content was taken as 2%.
2) When fibre content is increased there is an increase in flexural strength with a maximum at 2% of fibre. However, when the fibre content is increased beyond this value a downward slope of the graph is observed.
3) Due to its relatively higher strength and ductility, it can be a good replacement for asbestos fibres in roofing sheets, which being natural in origin pose zero threat to the environment.
4) It can also be used as the reinforcement material in cement fibre boards which can act as a good backing to tiles thereby improving its impact resistance and also in faux ceilings. The advantage of cement fibre boards is its ability to survive under moist environments unlike paper based gypsum boards
5) By replacing cement content with CF, decrement in the weight thus INERTIA OF STRUCTURE may result in to low density, slender and economical as well as green structures
6) With the addition of admixture cohesive mix can be made suitably workable.
7) It is a versatile material reported as most ductile and energy absorbent have wide scope in earthquake prone areas as well as in marine structures.

VII. SCOPE FOR FUTURE STUDY

1. The effect of coconut fibres on high strength concrete should be studied and thus the use of CFRC can be extended to industrial and commercial buildings. Since the corrosion study is not done, the applicability of CFRC in reinforced constructions could be tested.
2. Coconut fibre is a good insulator in itself and as such it can improve the thermal properties of concrete. This is particularly useful in a tropical country like India where the mercury levels are quite high for most part of the year, so as to maintain the room temperatures within comfort levels of its inhabitants. It can also reduce the load on air conditioning systems thus reducing the power consumption.
3. The acoustic properties of concrete reinforced with other natural fibres have been studied in the past using an impedance tube apparatus and the results are fair enough

to justify the use of coconut fibres as an alternative which is a good absorbent due to the presence of surface pores.

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