INCORPORATING COCONUT FIBRES IN STRUCTURAL CONCRETE TO ENHANCE THE MECHANICAL QUALITIES OF CONCRETE

[1]D.Chiranjeevi, [2]N.Jyothsna Redla, [3]Mudassur Draxi, [4]K.Rasagna
[1,2,3]Assistant Professor, [4]UG Student, [1,2,3,4]Department of Civil Engineering, Brilliant Grammar School Educational Society Group of Institutions Integrated Campus, Hyderabad, India

ABSTRACT
In this paper, coconut fibre reinforced concrete, or CFRC, is the focus of an experimental debate. It includes terminology and behavioural models that are often utilised and serve as a foundation for understanding material performance. This study intended to analyse how the strength of coconut fibre concrete varied at different fibre concentrations and compare it to that of traditional concrete. The flexural, compressive, and split tensile properties of the coconut fibre concrete at different loads of cement and fibre (10%, 20%, 30%, 40%, 50%, 60%) were all examined. With respect to the variation in % addition of coconut fibres, the result data clearly demonstrates percentage increases in compressive strength for M30 grade of concrete in 7 days, 14 days, and 28 days. This research is based on the use of coconut fibres in structural concrete to enhance the mechanical properties of concrete.
Keywords— Coconut fibre reinforced concrete, Conventional concrete, Flexural strength, Compressive strength, Split tensile strength,Coconut Fibres

INTRODUCTION

Aggregates, cement, and water are the main components of the composite material called concrete. More than any other man-made substance, concrete is utilized all over the world. In addition, behind water, concrete is the second most used material worldwide. Annual production of concrete is at 7.23 billion tonnes. Every person on the earth receives one tone of annual output. The demand for its components, including aggregates, cement, water, and admixtures, has increased because to the rapid rise of infrastructure development and building activities worldwide. Most of the concrete is made up of sources of typical aggregates. When concrete is produced on a big scale for construction projects utilizing traditional coarse material like granite, the natural stone deposits are moderately reduced the environment hence causing ecology imbalance. Extraction and processing of aggregates is also a major concern for environment. Therefore consumption of alternative waste material in place of natural aggregate in concrete production not only protects environment but also makes concrete a sustainable and environment friendly construction material. Different waste material like rubber, fly ash, glass, bottom ash, artificial sand etc. has been used as alternative for replacing natural aggregates. Apart from the above mention waste material, a few studies shows that agriculture waste coconut shell can also be used as coarse aggregate for concrete. Coconut fibre both raw and processed are used in this research. Coconut fiber, obtained from unripe coconut, is a natural fiber extracted from the husk of coconut. The coconut is steeped in hot seawater, and subsequently, the fibers are removed from the shell by combing and crushing, the same process as jute fiber. The individual fiber cells are narrow and hollow with thick walls made of cellulose, and each cell is about 1 mm long and 10–20 μm in diameter,. The raw coconut fibers show length varying from 15 to 35 cm and diameter from 50 to 300 μm. When they are immature and then become hardened and yellowed because a layer of lignin is deposited on their walls. Coconut fiber shows a good stiffness and is used in products such as floor mats, doormats, brushes, mattresses, coarse filling material, and upholstery.

WORKABILITY

The property of fresh concrete which determines easy and homogeneity in which is take the process is mixing, transporting, placing, compacting and finishing then If all these works is done easy manner then it is known as workability of concrete To find the workability of concrete thoroughly mix cement, sand And coarse aggregate accordingto designed mix proportions to form a homogenous mix of concrete.

Equipment’s required for Concrete Slump Test:

Mould for slump test, non- porous base plate, measuring scale, temping rod. The mould for the test is in the form of the frustum of a cone having height 30 cm, bottom diameter 20 cm and top diameter 10 cm. The tamping rod is of steel 16 mm diameter and 60cm long and rounded at one end.

Procedure:

- The mould for the slump test will be frustum of a cone, with 300 mm (12 in) of height. The base of cone is 200 mm(8in) in diameter and cone has a smaller opening at the top of 100 mm (4 in).
- For testing of workability, the base should be placed on a smooth surface and the container is filled with concretesample in three layers.
- Each layer should be tamped 25 times with a standard 16 mm (5/8 in) diameter of a steel rod, at rounded end.
- The top surface is struck off by means of screening and rolling motion of the temping rod when the mould is completelyfilled with concrete.
- For does not moving due to the pouring of concrete the mould must be firmly held against its base during the entire operation and this can be done by means of handles or foot - rests brazed to the mould.
- The concrete is levelled immediately after filling is completed, the cone is slowly and carefully lifted vertically, anunsupported concrete will now slump.
- The decrease in the height of the centre of the slumped concrete is called slump.
- The slump cone is measured by placing the cone just besides the slump concrete and the temping rod is placed over thecone so that it should also come over the area of slumped concrete.
- The decrease in height of concrete to that of mould is noted with scale

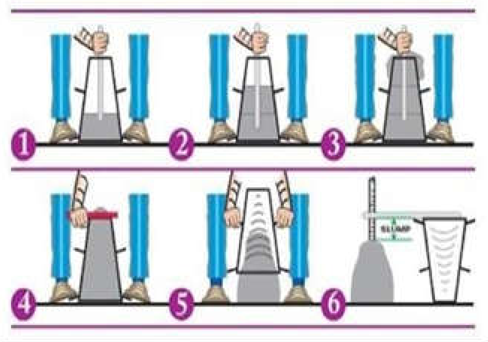


Figure-1: Concrete Slump Test Procedure

When the slump test is carried out, following are the shape of the concrete slump that can be observed:

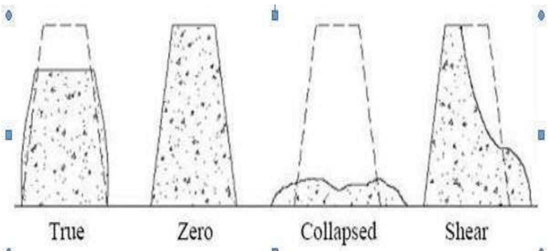


Figure-2: Types of Concrete Slump Test Results

True Slump – True slump is the only slump that can be measured in the test. The measurement is taken between the topof the cone and the top of the concrete after the cone has been removed as shown infigure-1.

Zero Slump – Zero slump is the indication of very low water- cement ratio, which results in dry mixes. These type ofconcrete is generally used for road construction.

Collapsed Slump – This is an indication that the water-cement ratio is too high, i.e. concrete mix is too wet or it is a high workability mix, for which a slump test is not appropriate. Shear Slump – The shear slump indicates that the result is incomplete, and concrete to be retested.

WORKABILITY RESULTS

The ideal concrete is the one which is workable in all conditions i.e, can prepared easily placed, compacted and moulded. In this chapter, the workabilityis assessed by two methods as follows:

Slump Cone Test:. The test was conducted for fresh concrete preparedbefore the moulding process. A total of 14 concrete mixes are prepared at different times. Workability Results obtained from slump cone test for M30 gradeof concrete is shown in table1.

Table 1: Test results from slump cone test for workability in mm

S.No	Mix ID	Water/cement ratio	Workablity (mm)
1	CW1	0.49	68
2	CW2	0.44	60

CW1:-Concrete with M30 grade

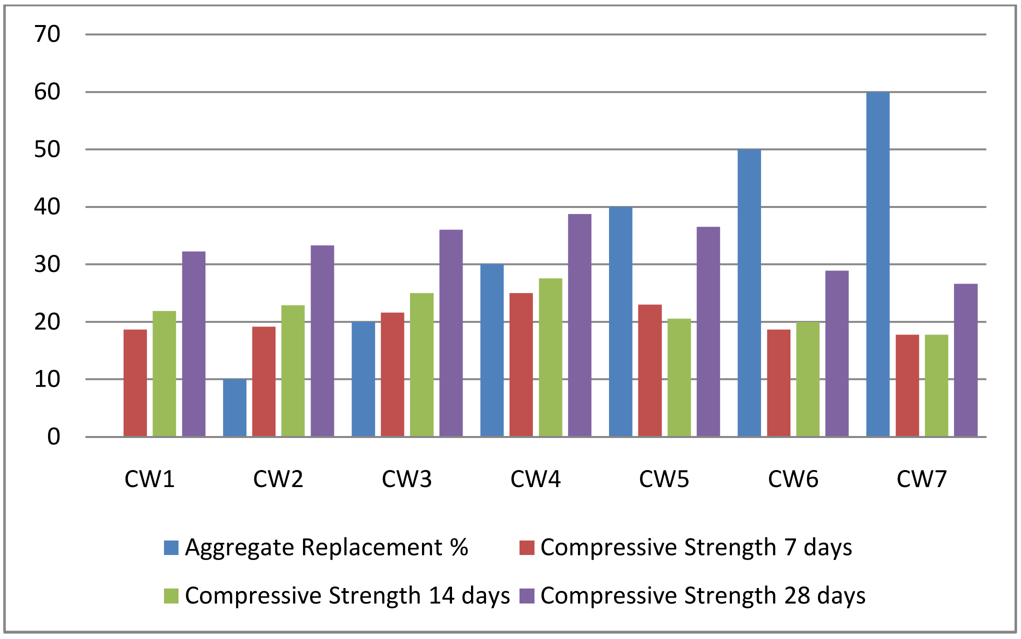
CW2:-Concrete with M30 grade with Coconut fibre

COMPRESSIVE STRENGTH

A Total Of 42 Cubes Of Size 150 X 150 X 150mm Were Casted And Tested For 7 Days, 14 Days And 28 Days Testing Each Of 13 Specimens After Conducting The Workability Tests. The Results Are Tabulated Below:

Table: 02: Compressive strength results of M30 grade of concrete for 7, 14 and 28 days

S.No	Mix ID	Aggregate Replacement %	Compressive Strength		
			7 days	14 days	28 days
1	CW1	0	18.67	21.9	32.22
2	CW2	10	19.15	22.88	33.31
3	CW3	20	21.60	25	36.04
4	CW4	30	25.01	27.56	38.77
5	CW5	40	23	20.55	36.55
6	CW6	50	18.66	20.00	28.88
7	CW7	60	17.77	17.79	26.6



Compressive Strength of Cubes(150x150x150) for M30 Mix for Percentage Replacement of Coconut Fibre.

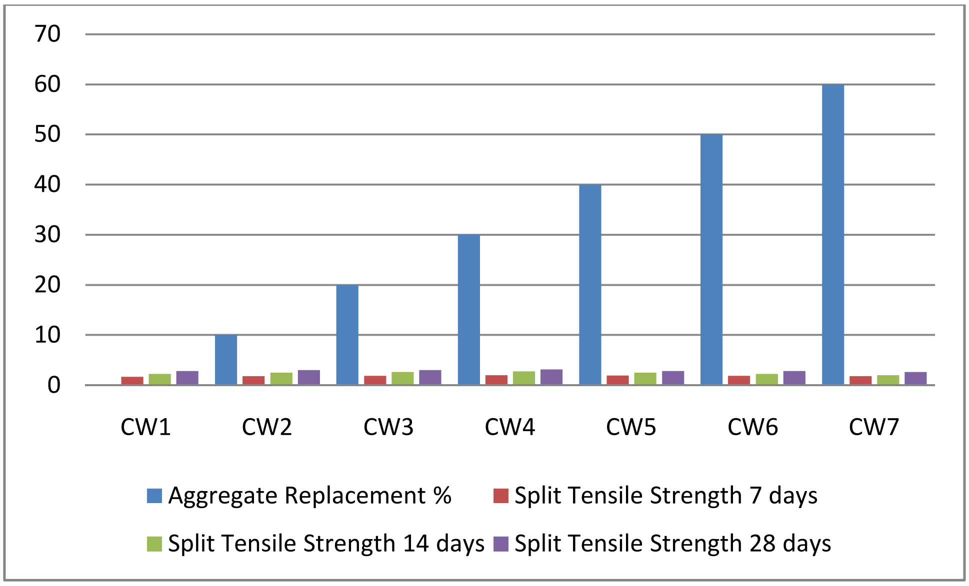
The strength i.e., the tensile strength, from the results is clearly in an increment way compared to the conventional concrete at all the curing ages of 7days, 14 days and 28 days. The replacement of aggregates by various proportions has positive effect on the strength of the concrete.

SPLIT TENSILE STRENGTH

The split tensile strength obtained by testing the cylindrical specimen for M30 grade of concrete to all the mixes designedfor various replacements are given below:

Table: 03: Split Tensile strength results of M30 grade of concrete for 7, 14 and 28 days

S.No	Mix ID	Aggregate Replacement %	Split Tensile Strength		
			7 days	14 days	28 days
1	CW1	0	1.69	2.24	2.82
2	CW2	10	1.76	2.50	2.97
3	CW3	20	1.84	2.64	3.02
4	CW4	30	1.98	2.72	3.11
5	CW5	40	1.92	2.50	2.82
6	CW6	50	1.85	2.24	2.8
7	CW7	60	1.81	1.98	2.63



Split tensile Strength of Cubes(150x150x150) for M30 Mix for Percentage Replacement of Coconut Fibre.

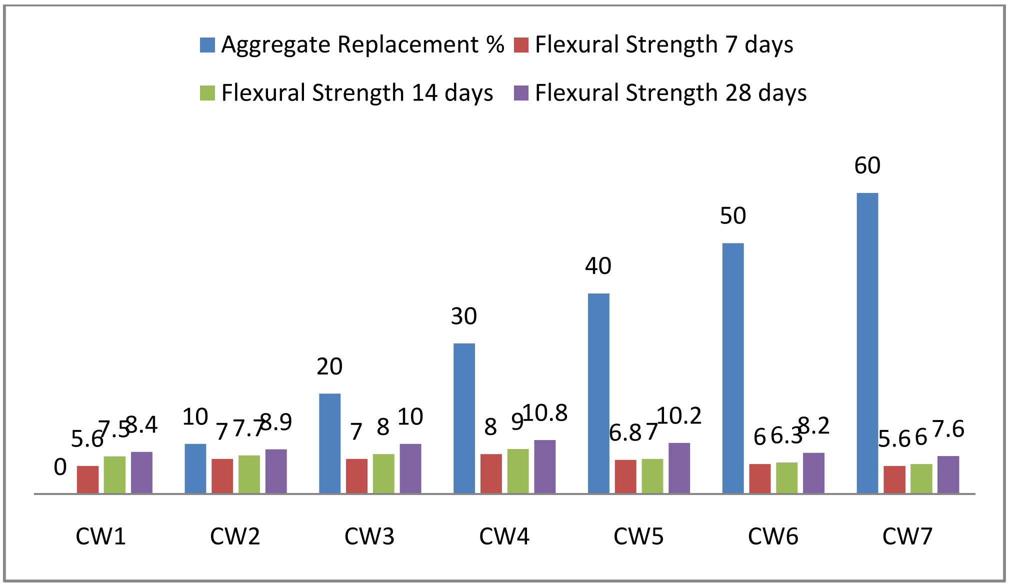
The strength i.e., the Split tensile strength, from the results is clearly in an increment way compared to the conventional concrete at all the curing ages of 7days, 14 days and 28 days. The replacement of aggregates by various proportions has positive effect on the strength of the concrete.

FLEXURAL STRENGTH

The flexural test was conducted for M30 mix only since it has the highest compressive and split tensile strength to compare it with conventional Concrete i.e., M30Grade. After Conducting the Workability Tests. The Results Are Tabulated Below for Flexural test results for 7, 14 and 28 days

S.No	Mix ID	Aggregate Replacement %	Flexural Strength		
			7 days	14 days	28 days
1	CW1	0	5.6	7.5	8.4
2	CW2	10	7	7.7	8.9
3	CW3	20	7	8	10
4	CW4	30	8	9	10.8

5	CW5	40	6.8	7	10.2
6	CW6	50	6	6.3	8.2
7	CW7	60	5.6	6	7.6



Flexural Strength of Cubes(150x150x150) for M30 Mix for Percentage Replacement of Coconut Fibre.

The strength i.e., the Flexural strength, from the results is clearly in an increment way compared to the conventional concrete at all the curing ages of 7days, 14 days and 28 days. The replacement of aggregates by various proportions has positive effect on the strength of the concrete.

CONCLUSIONS

From the results of the experimental investigation, the following conclusions are drawn on concrete without and with CS fibers.

a. The compression strength of conventional concrete for 28 days is 32.22Mpa and for CS FRC of 0.1 %, 0.2%, 0.3%, 0.4%, 0.5%, and 0.6% is 33.31, 36.04, 38.77, 36.55, 28.88, and 26.6Mpa respectively.
b. Therefore the compressive strength of CS FRC at 0.3% is higher when compared to other percentages.
c. When compared to conventional concrete the compression strength of CS FRC is 24% high. Hence 0.3% is adopted.
d. The split tensile strength of conventional concrete for 28 days is 2.82Mpa and for CS FRC of 0.1 %, 0.2%, 0.3%, 0.4%,0.5%, and 0.6% is 2.97, 3.02, 3.11, 2.82, 2.8 and 2.63Mpa respectively.
e. Therefore the split tensile strength of CS FRC at 0.3% is higher when compared to other.
f. When compared to conventional concrete the split tensile strength of CS FRC is 10.28 % high. Hence 0.3% is adopted.
g. The flexural strength of conventional concrete for 28 days is 8.4Mpa and for CS FRC of 0.1 %, 0.2%, 0.3%, 0.4%, 0.5%,and 0.6% is 8.9, 10, 10.8, 10.2, 8.2, and 7.6Mpa respectively.
h. Therefore the flexural strength of CS FRC at 0.3% is higher when compared to other percentage concentrations.
i. When compared to conventional concrete the compression strength of CS FRC is 28.57 % high. Hence 0.3% is adopted. Therefore, when compared to all percentages of CS fiber the maximum compressive strength, split tensile strength andflexural strength is achieved at 0.3%

REFERENCES

1. Majid Ali, Nawawi Chouw (2012),–Experimental investigations on coconut-fibre rope tensile strength and pullout from coconut fibre reinforced concrete‖, Construction and Building Materials, 41, 681–690
2. Reis J.M.L (2005),–Fracture and flexural characterization of naturalfiber-reinforced polymer concrete‖,
3. Construction and Building Materials 20 (2005) 673–678
4. Majid Ali, Anthony Liu, HouSou, Nawawi Chouw (2011),–Mechanical and dynamic properties of coconut fibre reinforced concrete‖ Construction and Building Materials 30 (2011) 814–825
5. Noor Md. Sadiqul Hassan, Habibur Rahman Sobuz (2012),–Use of coconut fibre in production of structural light weight concrete‖, Journal of applied sciences 12(9) 831-839, 2012
6. Vijay Chavada, A.A Parikh (2013), –An application review of coir fibre reinforced concrete‖, Vol. 2 Issue 4 ISSN: 2278-7844
7. A Zuraida, H Zahurin, I Sopiyan (2011),–Effect of fibre length variation on physical and mechanical properties of coir fibre reinforced concrete‖,Materials Physics and Mechanics 16 (2013) 107-117
8. P Nibasumba, X L Liu (2011),‖Recent developments in fibre reinforced concrete and their effect on concretecolumns analysis‖, Construction and Building Materials 2011;18(7):549–58
9. Joanna M Ferraz, Sabrina A Martins, Claudio H.S Del Menezzi (2013), –Effect of coir fibre treatment and coir- fibre ratio on properties of cement bonded composites‖, Bio Resources 6(3), 3481-3492
10. Dr.M.Sivaraja (2009), ‖Application of Coir Fibres as Concrete Composites for Disaster prone Structures‖
11. International Journal of Civil and EnvironmentalEngineering Sci., Vol. 33, No. 6, December 2009, pp. 719–729.
12. Izad Amir Bin Abdul Karim (2012),–Effect of coconut waste on concrete structure component‖ARPN Journal of Engineering and Applied Sciences, 30(2012). 2538 – 2547.
13. Yalley, P. P. and Kwan, A.S K (2008), –Use of coconut fibre as an enhancement of concrete‖, International Journal of Sustainable Construction Engineering &Technology, 27(5), 2008, pp. 575-582.
14. Kamel K.Alzboon and Khalid N.Mahasneh (2009), –Effect of Using MattressWaste on the Compression Strength and Slump Characteristics of Concrete‖, Construction and Building Materials 2009;23(2):865–71.
15. Nanayakkaza N.H, (2011) –Characterisation and determination of properties ofSri Lanka coconut‖, Journal of Natural Fibres, 2(1), 2011, pp 69-81.Bhowmick B.B. and Debnath C