May – June 2020
ISSN: 0193-4120 Page No. 7270 - 7275

Experimental and Analysis of RC Flexural Members with Coconut and Sugarcane Fibre

D Samuel Abraham[1*], Janakiraman S[2],
[1,2]Assistant Professor, Department of Civil Engineering, Karunya Institute of Technology and Sciences, Coimbatore, Tamilnadu, India.
[*]Corresponding Author - samuelabraham@karunya.edu

Article Info
Volume 83
Page Number: 7270 - 7275
Publication Issue:
May - June 2020

Article History
***Article Received**: 19 November 2019*
***Revised**: 27 January 2020*
***Accepted**: 24 February 2020*
***Publication**: 18 May 2020*

***Abstract*:**

This research describes experimental studies on the use of coconut fibre and sugarcane fibre as enhancement of concrete. The addition of coconut-fibres and sugarcane fibres significantly improved many of the engineering properties of the concrete, notably torsion, toughness and tensile strength. The ability to resist cracking and spalling were also enhanced. However, the addition of fibres adversely affected the compressive strength. When coconut fibre was added to plain concrete, the torsional strength increased (by up to about 25%) as well as the energy-absorbing capacity and when sugarcane fibre was added to plain concrete,the torsional strength increased(by up to about 30%) , but there is an optimum weight fraction (0.5% by weight of cement) beyond which the torsional strength started to decrease again. Similar results were also obtained for different fibre aspect ratios, where again results showed there was an optimum aspect ratio (1:2:5). An increase in fibre weight fraction provided a consistent increase in ductility up to the optimum content (0.5%) with corresponding fibre aspect ratio of 1:2:5. Overall the study has demonstrated that addition of coconut fibre and sugarcane to concrete leads to improvement of concrete the flexural ,compressive and the tensile stress,and according to the comparison of fibre we have found coconut fibre has less strength where sugarcane fibre has(compressive 0.44 %), higher than the coconut fibre Further work is however ,required to assess the long term durability of concrete enhanced with coconut fibres and sugarcane fibres.

Keywords: RC Beams, Fibre, coconut fibres and sugarcane fibres.

I. INTRODUCTION

Natural reinforcing materials can be obtained at low cost and low levels of energy using local manpower and technology. Utilization of natural fibres as a form of concrete enhancement is of particular interest to less developed regions where conventional construction materials are not readily available or are too expensive. Coconut and sisal-fibrereinforced concrete have been used for making roof tiles, corrugated sheets, pipes, silos and tanks The concept of using fibres as reinforcement is not new. Fibres have been used as reinforcement since ancient times. Historically, horsehair was used in mortal and straw in mud bricks. In the early 1900s, asbestos fibres were used in concrete. In the 1950s, the concept of composite materials came into being and fibrereinforced concrete was one of the topics of interest. Once the health risks associated with asbestos were discovered, there was a need to find a replacement for the substance in concrete and other building materials. By the 1960s, steel, glass (GFRC), and synthetic fibres such as polypropylene fibres were used in concrete. Concrete is one of such classical construction material, which achieved its strength, durability, stability, availability and adaptability. The application of concrete in the field of structural engineering often involves a technique of reinforcing with other materials to form a

May – June 2020
ISSN: 0193-4120 Page No. 7270 - 7275

composite material, so as to complement the undesirable properties of one to the other.

Coconut fibres obtained from coconut husk, belonging to the family of palm fibres, are agricultural waste products obtained in the processing of coconut oil, and are available in large quantities in the tropical regions of the worldCoconut fibre has been used to enhance concrete and mortar, and has proven to improve the toughness of the concrete and mortarFibres were chopped with sharp scissors maintaining a length from 15 to 35 mm. Chopped fibres were oven dried at 80°C for 5 h and used desiccators for cooling. Chopped fibres were used to determine the length, diameter, thickness, natural humidity, water absorption capacity and density of fibres.

Aggregates:

The coarse aggregate form crushed granite was collected from igneous origin. The particle size used ranges between 5 to 20 mm. River sand as fine aggregate was used to mix the concrete according to the ASTM Standard C33 (2006). All particles passing through ASTM sieve No. 4 aperture 4.75 mm but retained on sieve No. 230, aperture 63 µm.

Sugarcane fibre:

Materials And Method: The materials used for this project were locally sourced. Sugar cane bagasse rods were obtained from the rain forests of North-East Nigeria. These were cut into small relatively uniform strips using a sharp knife. The dimensions of the strips were measured with the aid of Vernier Calipers. The Sugar cane bagasse fibre were 38.44mm long and 1.8mm diameter (aspect ratio 21.36) with a mass of 26.74(kg).

Fine aggregates:

Aggregates most of which passes 4.75-mm BIS Sieve are known as fine aggregates

i) Natural sand - Fine aggregates resulting from the natural disintegration of rock and which has been deposited by streams or glacial agencies.

ii) Crushed stone sand - Fine aggregates produced by crushing hard stone.

iii) Crushed gravel sand - Fine aggregates produced by crushing natural gravel. According to size, the fine aggregates may be described as coarse, medium or fine aggregates. Depending upon the particle size distribution, the fine aggregates are divided into four grading zones as per BIS: 383-1970. The grading zones become finer from grading zone I to grading zone IV. The sand conforming to zone II was used in this study

1Sample Preparation: The test specimen were cubes of 100 × 100 × 100mm, rectangular beams of 500 x 100 x 100mm, and cylinders of 100mm in diameter and 200mm long mixed with sugar cane bagasse fibre in varying percentages from 0% to 1.25% and with the required dosage of super plasticizer to improve workability of the mix. Crushing of the cubes was carried out at 7, 14, 21 and 28 days respectively to determine the compressive strength of the concrete, the beams were subjected to flexural tests using the centre-point loading method, and splitting tensile strength test was performed on the cast cylinder samples at curing ages of 7, 14, 21 and 28 days.

Methodology:

To achieve the objectives of this study, there are many approaches and methods that should be taken. Methods of work such as literature review, methods of mixing and testing in the laboratory is important to get a more accurate analysis results. The volume of sugarcane are

0.5%, 1.0% and 1.5% and use volume method for the design mix concrete for normal concrete.

Mix design:

Cement = 335 kg/m3
Coarse aggregate = 1020.75 kg/m3
Fine Aggregate = 780.94 kg/m3
Water cement ratio = 0.55

Experimental investigation

Material Properties
1.Cement:Portland Pozzolana cement(53 Grade)andhaving specific gravity of 3.15

2.Fine Aggregate : Locally available M sand having specific
Gravity of 2.63, zone2(medium sand)
3. Coarse Aggregate : Crushed granite stones of 10-12.5 mm maximum size having specific gravity of 2.70

II REVIEW OF LITERATURE

"On residual strength of high-performance concrete with and without fibres at elevated temperatures**" (JianzhuangXiaoa ,2005)**
This paper investigated The relationship between the mass loss and the exposure temperature. In addition, the heated and cooled cubes and prisms were tested under monotonic compressive loading and four-point bending loading, respectively. The degradation of both the residual compressive strength and the residual flexural strength was analyzed. Furthermore, the effects of Natural fibers on the residual mechanical strength of HPC specimens at elevated temperatures were also investigated.

Huang gu (2009) have investigated tensile behavior of the coir fibre and related composites after NaOH treatment. Brown coir fibres were treated by NaOH solution with concentrations from 2% to 10% separately. In the case of NaOH density with 10%, lower tensile strength of the composite was noticed compared to the cases of 2%, 4%, 6% and 8%. They concluded after alkali treatment the elongation at break of the composites. This implied that the ductility of the alkali-treated coir fibre had been improved.

Majid Ali et al. (2009) has studied the dynamic behavior and load carrying capacity of CFRC beams as structural members without and with coconut rope. Natural coir fibres having a length of 7.5 cm and a fibre content of 3 % by weight of cement are used to prepare CFRC beams. Coconut rope having a diameter of 1cm and tensile strength of 7.8 MPa is added as the main reinforcement. They concluded that CFRC with coir rope rebars has the potential to be used as main structural members due to its increased damping and ductility

John V.M. et al (2005) have studied durability of slag mortar reinforced with coconut fibre. The ratio of mortar reinforcement using 1:1.5:0.5(binder: sand: water) with 2% coir fibre volume of mortar. The binder was blast furnace activated by 2% of lime and 10%of gypsum. They are concluded finally increasing durability at the presence of coir with using binder.

Rafat Siddique (2002) concentrated on achieving the optimum mechanical properties of concrete by replacing the fine aggregate with class F fly ash. The experiments were carried out to obtain the effects of 10%, 20%, 30%, 40% and 50% of class F fly ash in mechanical properties of concrete. The addition of class F fly ash at all percentages improved the compressive strength, splitting tensile strength, flexural strength and modulus of elasticity gradually but the optimum replacement level was evidenced as 50%.

Test Procedures:
Slump Test

i) The base is placed on a smooth surface and the container is filled with concrete in three layers, whose workability is to be tested. iii) Each layer is temped 25 times with a standard 16 mm (5/8 in) diameter steel rod, rounded at the end as shown in Figure 3.3(a). iv) When the mold is completely filled with concrete, the top surface is struck off (leveled with mould top opening) by means of rolling motion of the trowel.(v) The mould must be firmly held against its base during the entire operation so that it could not move due to the pouring of concrete and this can be done by means of handles or foot - rests brazed to the mould. vi)

May – June 2020
ISSN: 0193-4120 Page No. 7270 - 7275

Immediately after filling is completed and the concrete is leveled, the cone is slowly and carefully lifted vertically, an unsupported concrete will now slump as shown in Figure 3.3(c). vii) The decrease in the height of the center of the slumped concrete is called slump. viii) The slump is measured by placing the scale just besides the slump concrete. The decrease in height of concrete to that of mould is noted with scale

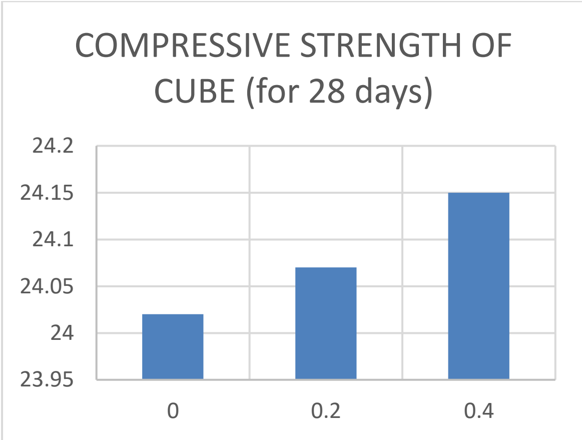
Compaction Factor Test:
Place the concrete sample gently in the upper hopper to its brim using the hand scoop and level it.Cover the cylinder.Open the trapdoor at the bottom of the upper hopper so that concrete fall into the lower hopper. Push the concrete sticking on its sides gently with the road.Open the trapdoor of the lower hopper and allow the concrete to fall into the cylinder below.Cut of the excess of concrete above the top level of cylinder using trowels and level it.Clean the outside of the cylinder.Weight the cylinder with concrete to the nearest 10 g. This weight is known as the weight of partially compacted concrete (W1).Empty the cylinder and then refill it with the same concrete mix in layers approximately 5 cm deep, each layer being heavily rammed to obtain full compaction.
Level the top surface.Weigh the cylinder with fully compacted. This weight is known as the weight of fully compacted concrete (W2).Find the weight of empty cylinder (W).

S.NO	W/C ratio	Coir Fibre	Slump	Compaction FActor
1	0.55	0.2 %	155	0.7
			160	0.75
			165	0.79
2	0.55	0.4%	165	0.89
			165	0.89
			170	0.9

Test Result :
Coir Fibre:

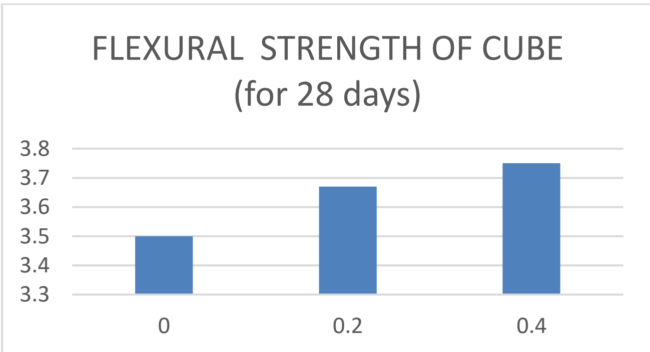
Copressive Strength Test

S.No	COIR FIBRE	COMPRESSIVE STRENGTH OF CUBE (for 28 days)
1	0	24.02
2	0.2	24.07
3	0.4	24.15



Flexural Strength Test:

SERIAL NUMBER	COIR FIBRE	FLEXURAL STRENGTH OF CUBE (for 28 days)
1	0	3.5
2	0.2	3.67
3	0.4	3.75

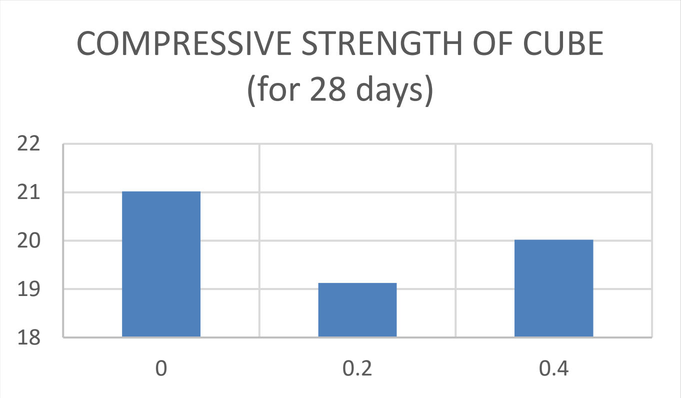


TEST Engineering & Management

May – June 2020
ISSN: 0193-4120 Page No. 7270 - 7275

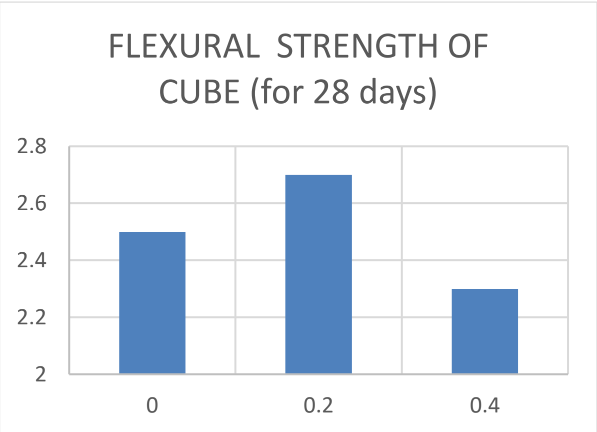
SUGARCANE FIBRE:
COMPRESSIVE STRENGTH

S.NO	SUGARCANE FIBRE	COMPRESSIVE STRENGTH OF CUBE (for 28 days)
1	0	21.12
2	0.2	19.13
3	0.4	20.02



FLEXURAL STRENGTH TEST

SERIAL NUMBER	SUGARCANE FIBRE	FLEXURAL STRENGTH OF CUBE (for 28 days)
1	0	2.5
2	0.2	2.7
3	0.4	2.3



RESULTS AND DISCUSSIONS

Coconut fibre being low in density reduces the overall weight of the fibre reinforced concrete thus it can be used as a structural light weight concrete.
2) By reinforcing the concrete with coconut fibres which are freely available, we can reduce the environmental waste.
3) Flexural strength increases in case of 3% fibre mix. Thus, economy can be achieved in construction.
4) Since, 5% & 7 % fibres do not show favorable results, it can be concluded that fibre content should not be used beyond 3%.

When the sugarcane fibre keep increasing, the tensile strength of the lightweight concrete was reduced. Physical characteristics of the concrete compressive strength and tensile strength of concrete shows that sugarcane fiber content affects the physical properties of ordinary concrete. The optimum value of sugarcane is 0.5% percent although they did not affect the compressive strength of concrete but in terms of tensile strength percent sugarcane fiber is still beyond the control of the tensile strength of normal concrete. However, the increment of sugarcane fibre in the lightweight concrete reduce the tensile strength of the lightweight concrete.

REFERENCES:

[1] M.S. Frías, E. Villar-Cocina and E. Valencia-Morales, Characterisation of sugar cane straw waste as pozzolanic material for construction: Calcining temperature and kinetic parameters, Waste Management, 27(53), 3–8, (2007)
[2] D. Govindarajan and G. Jayalakshmi, XRD, FTIR and microstructure studies of calcined sugarcane bagasse ash, Advances in Applied Science Research, 2, 544–9 (2011a)
[3] J.M. Irwan, S.K. Faisal, N. Othman and M.H. Wan Ibrahim, Performance of concrete using light waste PET fibre, Advanced Materials Research, 795, 352-335, (2013)
[4] F. Olutoge, O. Ofuyatan, A. Rachael and E. Opaluwa, Strength characteristics of concrete reinforced with sugarcane bagasse fiber, IOSR Journal of Mechanical and Civil Engineering, 12(3), 68-71, (2015)

May – June 2020
ISSN: 0193-4120 Page No. 7270 - 7275

[5] M.K. Yashwant and BG. Nareshkumar, An experimental study on bagasse ash as replacement for cement in ligthweight concrete, Int. J. of Latest Trends in Engineering and Technology, 3(3), 253-260, (2013)
[6] V. Srivastava, P. K. Mehta and S. Nath, Natural fiber in cement and concrete matrices. J. of Environment in Nanotechnology, 2(3), 63 – 66, (2013)
[7] G.C. Cordeiro, R.D. Toledo-Filho, L.M. Tavares and E.M.R. Fairbairn, Ultrafine grinding of sugar cane bagasse ash for application as pozzolanic admixture in concrete, Cement Concrete Research. 39,110–5, (2009)
[8] A. Bahurudeen, A.V. Marckson, A. Kishore and M. Santhanam, Development of sugarcane bagasse ash based Portland pozzolana cement and evaluation of compatibility with superplasticizers, Construction Building Materials, 68, 465–475, (2014)
[9] M. Frías, E. Villar and H. Savastano, Brazilian sugar cane bagasse ashes from the cogeneration industry as active pozzolans for cement manufacture, Cement Concrete Composite, 33, 490–496, (2011)
[10] M. Gesoglu, E. Güneyisi, A.H. Nahhab and H. Yazıcı, The effect of aggregates with high gypsum content on the performance of ultra-high strength concretes and Portland cement mortars, Construction Building Materials, 110, 346–354, (2016)
[11] A.M. Rashad, Metakaolin as cementitious material: history, scours, production and composition – a comprehensive overview, Construction Building Materials, 41(3), 3 – 18, (2013)
[12] EN 12390-3:2000, Design of concrete structures: Testing hardened concrete: Compressive strength for test specimens, British Standard Institution, London, (2000)
[13] EN 12390-6:2000, Design of concrete structures: Testing of hardened concrete: tensile strength test, British standard. British Standard Institution, London, (2000)
[14] S. Shahidan, H.B. Koh, A.M.S. Alansi and L.Y. Loon, Strength development and water permeability of engineered biomass aggregate pervious concrete, MATEC Web Conf., 47, 2–7 (2016)