Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 12, Issue 8, July 2021: 7852-7859

An Experimental Study on Fresh and Hardened Concrete Using Coconut Fibre as a Partial Replacement of Cement

Pramod Kumar Yadav[1], Syed Baqar Imam[2], Gaurav Hawadiya[3], Intezar Mahdi[4]
Department of Civil Engineering, Department of Mechanical Engineering
IFTM University, Uttar Pradesh, India
[1](ce1005600053@gmail.com), [2](imambaqar@gmail.com), [3](gaurav.hawadiya@gmail.com),
[4](intezarmahdi2002@gmail.com)

ABSTRACT: In today's scenario,sustainability may be a widely accepted concept. Despite the reality that the building industry is revolutionising in terms of both technology and products used, the expense of construction has increased day by day, resulting in a detrimental effect on the environment. As a result, a more balanced approach was introduced, with the environment as its nerve core, to create a much healthier universe to calculate in. As a result, a fibre like coconut has been used to increase the resilience of concrete.

Coconut fibre is readily accessible at the test site, making it a feasible alternative for concrete strengthening. It also offers a new source of income for coconut farmers, who can be benefited from the construction industry's increased demand. Furthermore, it is a cost-effective coir mattress waste disposal system that decreases the need for new waste disposal facilities while also reducing the burden on existing landfills and incinerators. The problem of the fibres absorbing a lot of water may be fixed by covering them with oil.

Coconut fibre reinforced concrete with varying percentages (4%, 5%, and 6% by the weight of cement) anda water cement ratio of 0.5. In this analysis, we find that the conventional compressive strength of concrete and coconut fibre reinforced concrete after 7 days and 28 days. By this study, we can analyse the compressive strength of concrete of coconut fibre reinforced concrete and compared the result with the conventional strength of concrete and we find that the compressive strength of coconut fibre reinforced concrete is better.

KEYWORDS: Coir mattress, compressive strength, coconut fibre reinforced concrete,

1. INTRODUCTION

Concrete is the most extensively used construction material on the planet. With developments in science and technology in the construction industry, the application of concrete as a building material has broadened. Steel reinforcing bars are widely used to strengthen concrete because it has low friction and flexure. The use of reinforced steel, on the other hand, is expensive. Efforts have been made all over the world to integrate multiple forms of fibres into concrete in order to make it safer, more durable, and cost-effective. Natural fibres, such as coconut fibre, have physical and mechanical properties that make them ideal for the development of reinforced concrete materials.Since coconut fibres are usually discarded as agricultural waste, they can be found in large quantities and are thus inexpensive.

The construction industry is undergoing two major transitions. One approach is by the progress of building technology, such as the use of automated construction equipment. Another trend is the implementation of high-performance building materials, such as high-strength concrete fibre reinforced concrete (FRC) is one of these high-performance materials that is steadily gaining popularity among civil engineers. The construction industry's research and production of fibres and matrix components, as well as fabrication techniques, has exploded in recent years.Their benefits

over other building materials include a high tensile strength to weight ratio, the ability to be moulded into different shapes, and possible resistance to environmental conditions, all of which can result in low maintenance costs. FRC composite is a good choice for creative construction because of these properties.Their use in construction includes both renovating old structures and designing new ones, and they can be applied to a number of structures, including offshore platforms, homes, and bridges (Thou, 2005).

The high costs, scarcity, and corrosion concerns that come with using steel fibres in concrete are all major roadblocks to the production of high-performance concrete. Coconut fibre is the most ductile of all natural fibres (Majid Ali et al. 2012) and has the ability to be used as a reinforcement medium in concrete.Since it is biodegradable, it would have a low environmental impact. This is also a way to recycle waste fibres from coir-based processing units into high-strength fabrics. They're often non-abrasive, affordable, and plentiful in nature. Coconut-fiber ropes are being tested to see how they can be used as vertical support in mortar-free interlocking systems. This is considered to be a cost-effective alternative for earthquake-resistant buildings.

2. OBJECTIVE

The aim of this study is to investigate the compressive strength of conventional concrete and coconut fibre concrete.

The objective of this study is:

1. To find out the compressive strength of the fibre reinforced concrete after 7 days and 28 days.
2. To find out the compressive strength of conventional concrete after 7 days and 28days.
3. To compare the results of fibre reinforced concrete and conventional concrete after 7days and 28 days.

3. MATERIALS USED

3.1 General

Based on the previous work, a comparison of strength properties of coconut fiber concrete is made with respect to conventional concrete and the influence of shape and length of fibers on strength are studied also. Tests are conducted on coconut fibers of length 5 cm varying fiber contents addition of 0.1%, 0.2%, 0.3%, 0.4%, 0.5% and 0.6% by weight of material. A similar quantity of raw untreated fiber is also used to compare the influence of shape and length of fibers.

3.2 Materials Collection

The materials used in this study are:-

S.NO	MATERIALS	TYPES
1	Cement	PPC
2	Fine aggregate	Sand
3	Coarse aggregate	Aggregates passing 20mm IS sieve and is retained to 12.5 mm sieve

4	Coconut fibre	For coconut fibre, we used waste material
5	Water	Collected from fresh water sources

Table-1: Materials collection

3.3 Coconut fibre

Before being used, they are cleaned and stranded. Treatment of fibres eliminates dust and other residual contaminants from the fibre, raising the surface of interaction between the fibre and the mixture, resulting in stronger attachment between the reinforcement and the concrete and, as a result, higher strength.To release the fibres and extract the coir dust, the fibre is washed in tap water for 30 minutes. After that, the fibres are cleaned and dried for another 30 minutes. This operation must be carried out three times. The straightened softened fibre is combed with a steel comb by hand.To speed up the drying process, the wet long fibres will be placed in a 30 ˚C oven for 10-12 minutes, eliminating the bulk of the moisture. The fibres are then fully dried in the open air, combed once more, and eventually cut into 5 cm lengths, soaked in oil for 15-20 minutes, and dried in the sun for 24 hours.

4. METHODOLOGY

The comparative analysis is done between result come-out from concrete mix with coconut fibre andthe conventional concrete.
The following flowchart in figure-1 illustrate the methodology followed in this work:

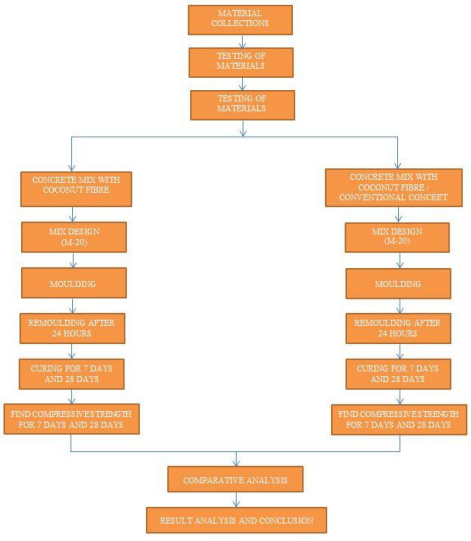

Figure-1: Flow chart of Methodology

4.1 CASTING OF CONCRETE CUBES

These specimens were allowed to remain in the steel mould for the first 24 hours at ambient conditions. After that these were de-moulded with care so that no edges were broken and were placed in the tank at the ambient temperature for curing.After de-moulding the specimens by loosening the screws of the mould, the cubes were placed in the water for 7 days 28 days.

Figure-2: Concrete cubes

4.2 CASTINGAND TESTING PROCEDURE OF CONCRETE CUBES

1. Take the mould of size 15×15×15 cm and pour concrete in the cubes in later with 35 blows with tamping rod.
2. Finished the top surface of mould by trowel after compaction of the last layer.
3. After completing 24 hours, removed the specimen from the mould while removing mould, take care of edges.
4. Specimen is submerged in clean and fresh water until the time testing (for 7 days and 28 days for curing).
5. Cube is placed in the compression testing machine and recorded the maximum load applied to the specimen.
6. And observe the appearance of concrete failure.

4.3 COMPRESSIVE STRENGTH TEST

Compressive is the capacity of a material or structure to withstand axial loads tendency to reduce the size. It is measured using the Universal Testing Machine. Concrete can be having to made high compressive strength, for example many concrete structures have compressive strengths in strength in excess of 50 MPa. Here the compressive strength of concrete cubes for the plain concrete or conventional concrete and fibre reinforced concrete are find out using compression testing machine is shown figure 3.

Figure-3: Compression Testing Test

5. RESULT AND DISCUSSION

Firstly, we are casting cubes for finding the compressive strength of concrete for 7 days and 28 days. We take three specimens which has w/c ratio is 0.5 and slump value is 120 mm.
The specimen 1 gives the compressive strength of conventional concrete at 7 days and 28 days which are 14.3 and 24.2 N/mm^2 respectively. The specimen 2 gives the compressive strength of conventional concrete at 7 days and 28 days which are 14.5 and 25.6 N/mm^{2}respectively. The specimen 3 is gives the compressive strength of conventional concrete at 7 days and 28 days which are 14.5 and 25.7 N/mm^{2}respectively.. The average compressive strength of conventional concrete at 7 days and 28 days is 14.43 N/mm^{2}and 25.16 N/mm^{2}respectively. Secondly, we are casting cubes for find the compressive strength of coconut fibre concrete and we take three specimens which have w/c ratio of 0.5 and added some percentage of coconut fibre with different proportion 4%, 5%, and 6%. The specimen 1 is gives the compressive strength of coconut fibre reinforced concrete, when 4% of coconut fibre added at7 days and 28 days which are 14.53N/mm^2 and 25.2 N/mm^{2}respectively. The specimen 2 is gives compressive strength of concrete, when 5% of coconut fibre is added for 7 days and 28 days are 16.8 and 26.4 N/mm^2. The specimen 3 is gives compressive strength of concrete, when 6% of coconut fibre is added for 7 days and 28 days are 15.6 and 27.1 N/mm^2. After that, we take averagof all specimens for 7 days are 15.64 and for 28 days is 26.3 N/mm^2.

Specimen	**Slump value (mm)**	**W/c ratio**	**Strength for 7 days (N/mm^2)**	**Strength for 28 days (N/mm^2)**
1	120	0.5	14.3	24.2
2			14.5	25.6
3			14.5	25.7
Average			14.43	25.16

Table-2: compressive strength for conventional concrete cubes

Specimen	**Slump value (mm)**	**%age of coconut fibre added**	**W/c ratio**	**Strength for 7 days (N/mm^2)**	**Strength for 28 days (N/mm^2)**
1	110	4	0.5	14.53	25.2
2	105	5		16.8	26.4

3	105	6		15.6	27.1
Average				15.64	26.3

Table-3: compressive strength for coconut fibre concrete cubes

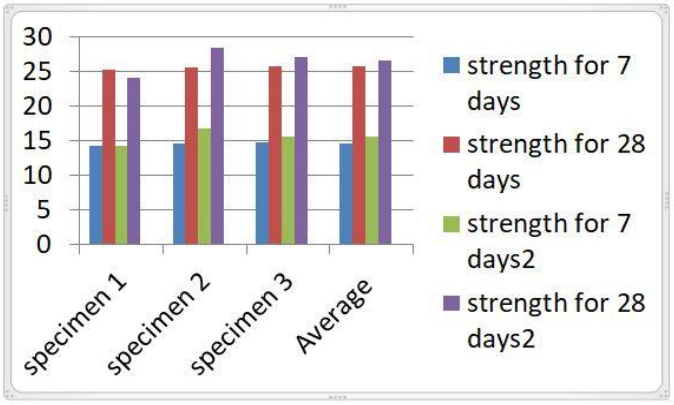

Figure-4: Comparison of compressive strength of conventional and coconut fibre concrete

S. NO	STRENGTH	CONVENTIONAL CONCRETE	COCONUT FIBRE CONCRETE	INCREASE %
1	Strength of 7 days	14.3	14.53	1.6
2		14.5	16.8	15
3		14.5	15.6	7.5
4	Strength of 28 days	24.2	25.2	4.1
5		25.6	26.4	3.1
6		25.7	27.1	5.4

Table 4: Compressive strength of conventional concrete and coconut fibre concrete

6. CONCLUSION

Coconut fibre is readily available, making it a suitable option for concrete reinforcement. It also serves as a source of income for coconut farmers, who profit from the increased demand created by the construction industry.

By this study, it is concluded that:

1. When added 4% of coconut fibre with water-content is 0.5, then the compressive strength for 7 days and 28 days are 14.53 and 25.2 N/mm^2 and conventional concrete for 7 days and 28 days are 14.3

and 24.1 N/mm^2 which is decreased by coconut fibre concrete that means percentage increase for 7 days and 28 days strength are 1.6 and 4.1%.

2. When added 5% of coconut fibre with water-content is 0.5, then the compressive strength for 7 days and 28 days are 16.8 and 26.4 N/mm^2 and conventional concrete for 7 days and 28 days are 14.5 and 25.6 N/mm^2 which is decreased by coconut fibre concrete that means percentage increase for 7 days and 28 days strength are 15 and 3 %.
3. When added 6% of coconut fibre with water-content is 0.5, then the compressive strength for 7 days and 28 days are 14.53 and 25.2 N/mm^2 and conventional concrete for 7 days and 28 days are 14.3 and 24.1 N/mm^2 which is decreased by coconut fibre concrete that means percentage increase for 7 days and 28 days strength are 7.5 and 5.4%.

Hence, when we added the coconut fibre with given proportion in conventional concrete then the compressive strength of the concrete is increased.

REFERENCES

1. Ali, Majid and Chouw, Nawawi (2012), "Experimental investigations on coconut-fiber rope tensile strength and pull out from coconut fiber concrete", *Construction and Building Materials, 41, 681-690.*
2. Reis J.M.L. (2005),"Fracture and flexural characterization of natural fiber reinforced polymer concrete", Construction *and Building Materials, 20, 673-678*.
3. Majid Ali, Anthony Liu, HouSou, Nawawi Chouw (2011), "Mechanical and dynamic properties of coconut fiber concrete*" Construction and Building Materials 30, 814-825.*
4. Noor Md. Sadiqul Hassan, HabiburRahmanSobuz (2012), "Use of coconut fiber in production of structural light weight concrete", *Journal of applied sciences 12(9), 831-839.*
5. Vijay Chavada, A.A. Parikh (2013), "An application review of coir fiber reinforced concrete", *Vol. 2 Issue 4 ISSN: 278-7844*
6. A Zuraida, H Zahurin, I Sopiyan (2011), "Effect of fiber length variation on physical and mechanical properties f coir coconut fiber concrete and their effect on concrete columns analysis", Construction and Building,*" Material Physics and Mechanics 16, 107-117.*
7. P. Nibasumba, X L Liu (2011), "Recent developments in coconut fiber concrete and their effect on concrete columns analysis", *Construction and Building Materials, 18(7): 549-58.*
8. Izad Amir Bin Abdul Karim (2012), "Effect of coconut waste on concrete structure component" *ARPN Journal of Engineering and Applied Sciences, 30, 2538-2547.*
9. Yalley, P.P. and Kwan, A.S.K. (2008), "Use of coconut fiber as an enhancement of concrete", *International Journal of Sustainable Construction Engineering & Technology, 27(5), pp. 575-582*.
10. Bhowmick B.B. and Debnath C.R. (2007), "Properties of coir", *Indian coconut journal, 15, (5), p. 12.*
11. A Concrete Mix Design IS 10262-2009.
12. A help of Book of Concrete Technology,*By M.S Shetty.*
13. Surendra P. Shah, James I. Daniel, DarmawanLudirdja, "Toughness of Glass Fiber reinforced concrete panels subjected to accelerated aging*", PCI Journal, September-October 1987, (pp 83-88).*
14. U. M. Ghare, "Manufacture of Glass Fibre Reinforced Concrete Products", Unit 1, Division ofYOGI group-UAE, August 2008. [12] Bentur, A, and Kovler, K, (1997) "Durability of some glass fibre reinforced cementations composites*",Fifth International Concrete on Structural Failure, Durability Retrofitting, Singapore, November 27-28,pp. 190- 199.*

15. Banthia, N, Yan, C.B, Lee W.Y, (1997) "Restrained shrinkage cracking in fiber feinforced concrete with polyolefin fibres", *Fifth International Concrete on Structural Failure, Durability Retrofitting, Singapore, November 27-28, pp. 456-463*.
16. Chandramouli, K, SrinivasaRao, P, Pannirselvam, N, SeshadriSekhar,T, and Sravana, Priyadrashini, T.P, (2010), " Strength and durability characteristic of glass fibre concrete", *International Journal of Mechanics of Solids,Vol. 5, No.1, pp. 15-26.*
17. Prof. R.M. Sawant, Jabeen Khan, MinalAher and AkashBundele, TComprehensive Study of High Strength Fiber Reinforced Concrete under Pull out Strength. *International Journal of Civil Engineering and Technology (IJCIET),6(1), 2015, pp.14–20.*
18. Chawla, K. and Tekwari, B. (2012), "Glass fibre Reinforced concrete",*Yahoo Group – Civil Engineering Portal, pp. 1-7*.
19. Muthuawamy K.R. and Thirugnanam G.S,(2013), "Mechanical properties of hybrid fibre reinforced high performance concrete", *Indian Concrete Journal, Vol 87, No. 4, April, pp. 50-55.*
20. Naaman. A.E (1997), "High Performance Fibre Reinforced cement composites distinctive attributes for fibre applications", *Fifth International Concrete on Structural Failure, Durability Retrofitting Singapore November 27-28. PP 429 - 439.*
21. Sinha, D.A, Varma, A.K and, Prakash, K.B, (2013), "Properties of ternary blended steel fibre reinforced concrete", *The Indian Concrete Journal, Vol- 87, August, pp. 26-30.*
22. Siddique, R, (1997), "Properties of concrete reinforced with low percentage of synthetic fibres", *Fifth International Concrete on Structural Failure, Durability Retrofitting Singapore November 27-28, pp. 448- 455.*
23. D. V. Soulioti, N. M. Barkoula, A. Paipetis and T. E. Matikas, (2011) "Effects of Fibre Geometry and Volume Fraction on the Flexural Behaviour of Steel-Fiber Reinforced", *An international journal for experimental mechanics (pp.535-541).*
24. H. E. M. Sallam and K. I. M. Ibrahim, The Compressive Strength of Fiber Reinforced Concrete (FRC) at High Elevated Temperatures. *International Journal of Civil Engineering and Technology (IJCIET), 6(8),2015, pp.53–60.*
25. N.Ghosni, B. Samali, H.valipour December(2014), "Flexural behaviour of high strength concrete composite incorporating long hooked end steel fibers",*23rd Australasian Conference on the Mechanics of Structures and Materials, (pp.327-332).*
26. Bhawukverma, July(2015)"Use of steel fiber reinforced concrete over plane concrete for shot-Crete in underground tunneling",*SSRG International Journal of Civil Engineering, (pp.9-12).*