International Journal of Engineering Research and Science & Technology

www.ijerst.org

ISSN : 2319-5991

Vol. 21 No. 3 (1) 2025

ijerst.editor@gmail.com

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International Journal of Engineering Research and Science & Technology

ISSN 2319-5991 www.ijerst.com
Vol. 21, No. 3(1), 2025

Research Paper

EFFECT OF UTILIZATION OF COIR FIBER IN M30 GRADE CONCRETE

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Abstract *High cost is the dominating factor of convectional construction material which is affecting the housing system. As an alternative method to overcome this drawback which is decreasing the strength of building, it is necessary to make research on any alternating materials which will decrease the cost and increase the strength of concrete. This convectional construction material also made some problem to the environment cannot lead to proper disposal and many more results on increasing the impact on the environment. But coconut fiber which is natural fiber makes no effect on environment and also increases the strength of concrete compare to use of convectional fiber. Concrete cubes of 150mmX150mmX150mm and beams of dimension 100mm×100mmx500mm were cast to take the compressive as well as split tensile strength test and it shows that the compressive strength of concrete increases with curing age but decrease with increase in quantity of coconut fiber, whereas its tensile strength increases. The optimum tensile strength that we get was 3.0 MPa. This research is carried out to bring awareness in field of Civil Engineering about the coconut fiber as good and hazardous less construction material.*

Key words : Self compacting concrete, steel fibres, corn husk fibres, strength, durability

Received: 01-7-2025 Accepted: 05-8-2025 Published: 12-8-2025

1. INTRODUCTION

Concrete made with Portland cement has certain characteristics: it is strong in compression but weak in tension and tends to be brittle. The weakness in tension can be overcome by the use of conventional steel bar reinforcement and to some extent by the inclusion of a sufficient volume of certain fibres. The use of fibres also alters the behaviour of the fibre-matrix composite after it has cracked, thereby improving its toughness. The overall goal for this research is to investigate the potential of using waste and low energy materials for domestic construction, principally in Ghana. The objective of this research is to experiment on the use of coconut fibres as an enhancement of concrete. Coconut fibres are not commonly used in the construction industry but are often discarded as wastes. 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 world, most especially in Africa, Asia and southern America. In Ghana, they are available in large quantities in the southern part of the country.

The specific objective of experimenting on coconut fibre as an enhancement of concrete is two fold. Firstly, to assess if the fibres of the species grown in Ghana would improve the mechanical properties of concrete like the species in Latin America and South East Asia. Secondly, once it was proven that vital mechanical properties of concrete and mortar could be enhanced by coconut fibre from species grown in Ghana, then further investigation would be carried out on improving the long term durability of concrete and mortar with coconut fibres as an enhancement. Ordinary concrete, when subjected to the rigorous test of time and extreme weather conditions, tends to crack and lose its strength.

Now a day's many researches are made on the natural fiber which are easily available in large quantity and are very cheap. Among this natural fiber which can be used for construction purpose is coconut fiber which can also be known with other names as Coir, Cocos nucifera, Arecaceae (Palm) .They are available commercially in three forms ,namely decorticated (mixed fiber),bristle (long fiber),mattress(relatively short fiber).They can be taken in use according to their requirement and the brown fiber are mostly used which are obtained from mature coconut .

According to the official website of International Year For Natural Fiber 2009 the cultivation of coconut tree are around 12 million worldwide which produces 5,00,000 tonnes of coconut fiber annually. This coconut fiber can be used in the concrete which is very important part of any construction .Normally, in convectional reinforced concrete we use steel bars which increase the weight as well as the cost of the concrete which cannot be easily affordable to all rulers as well as urban civilians.

Fig 1: Coconut and Coir fiber

Fiber reinforced concrete (FRC)

Fiber strengthened cement (FRC) might be characterized as a composite materials made with Portland concrete, total, and joining discrete broken filaments. Presently, for what reason would we wish to add such strands to concrete. Plain, unreinforced concrete is a fragile material, with a low elasticity and a low strain limit. The part of haphazardly disperses intermittent filaments is to connect over the breaks that create gives some post splitting "pliability". In the event that the filaments are adequately solid, adequately attached to material, and allow the FRC to convey critical worries over a moderately expansive strain limit in the post splitting stage.

There are, obviously, other (and presumably less expensive) methods for expanding the quality of cement. The genuine commitment of the filaments is to build the durability of the solid (characterized as some capacity of the zone under the heap versus avoidance bend), under a stacking. That is, the strands tend to expand the resist crest stack, and give a lot of vitality retention in post-crest segment of the heap versus avoidance bend. At the point when the fiber support is as short discrete strands, they act successfully as inflexible incorporations in the solid lattice.

The fiber fortification might be utilized as three dimensionally arbitrarily appropriated strands all through the basic part when the additional points of interest of the fiber to shear opposition and split control can be additionally used . Then again, the fiber cement may likewise be utilized as an elastic skin to cover the steel fortification when a more effective two – dimensional introduction of the strands could be gotten.

Coir fiber

Coconut fiber is extracted from the outer shell of a coconut. The common name, scientific name and plant family of coconut fiber is coir, Cocosnucifera and Arecaceae (Palm), respectively. There are two types of coconut fibers, brown fiber extracted from matured coconuts and white fibers extracted from immature coconuts. Brown fibers are thick, strong and have high abrasion resistance. White fibers are smoother and finer, but also weaker. However, steel reinforcement is still expensive for many people who want to build earthquake resistant houses. To overcome the difficulty, an economical but safe constructional material is needed. Natural fibers can be one possible material, as they are cheap and locally available in many countries. In this present work, the natural Coirfiber using in concrete.

Fig 2: Coir Fiber

Objectives of the study

The following are the objectives of the study considered

1. To calculate the Optimum content of coir fiber in concrete.
2. To find out the values of strength properties like, Split tensile strength, and compressive strength of the concrete having coir fiber.
3. Minimizing the cost incurred in the traditional material used in concreting.
4. To utilization of coir fiber is make better air penetration.
5. The utilization of coir fibre to make it cost effective and eco friendly
6. To find out some fresh characteristics of the concrete.

2. LITERATIURE REVIEWS

Mr. Harshal Langde, Mr. Suprit Mankar,et al.,(2022) 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 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.

Kishor B Vaghela, Madan Chandra Morya,et al.,(2018)

In civil engineering as a construction material In the field of agriculture, huge quantities of waste are generated from different crops. The waste so generated is generally left untouched on the land which affects the fertility of soil or if the waste is burnt, it affects the environment. This waste contains large quantities of fiber which can be utilized in concrete to reduce the quantity of waste and indirectly the cost of concrete. . The weakness in tension can be overcome by the addition of fibres. There is a comparative study on compressive strength, flexural strength and splitting tensile strength of coconut coir fiber with different percentages of coconut fibre..

P.R.Kalyana Chakravarthy, R. Janani and R. RathanRaj,et al.,(2006-2016)

In plain cement concrete the tensile properties is to be improved. The addition of steel fibres improves the resistance of conventionally reinforced concrete members towards cracking, deflection and other serviceability conditions. In addition, the replacement of coarse aggregates with coconut shell is one of the economical enhance Programme. Compressive strength for both conventional and coconut shell concrete targeted to M25 grade. The cubes were cast and tested for compressive strength to find the optimization of percentage of steel fibre. In this study steel fibres are added from 0.5 % to 2.0 % by volume fraction. From the test results, the optimized percentage of steel fibre for both conventional concrete and coconut shell concrete have been found as 1.0 % and 1.5 % respectively.

3. MATERIALS USED FOR THE STUDY

For this experimental study initially we have collect the necessary materials to make self compacting concrete the details of materials collection and specification are discussed in the below

3.1 Cement

In this investigation Ordinary Portland bond of 53Grade (ACC cement) has been obtained and has been utilized.

Fig 3: Ultra Tech OPC 53 Grade cement

3.2 Coir Fiber

Coir fibre is a natural fibre obtained from coconut shells used in carpets, wipers, brushes, mattresses and concrete. Coconut fibre obtained from coconut shells is inexpensive and can be purchased locally in many tropical and semi-tropical countries. Compared to other natural fibres, coconut fibre can

withstand 4 to 6 times the tension. In recent years, the potential of using coconut fibre to improve the performance of cement-based materials has attracted the attention of researchers. Coconut fibre is widely used in sheet, roof, concrete and other building materials. Cement mixtures reinforced with coconut fibres and castings of 1 to 2 MPa are currently used as inexpensive roofs. Coconut is a fibrous substance involving the hard-inner shell and outer layer of coconut. 10mm.

Fig 4: Coconut fibre of 10mm, 15mm & 20mm Length

3.3 Fine Aggregates

Fine aggregates are on a very basic level sands won from the land or the marine condition. Fine aggregates overall involve ordinary sand or crushed stone with most particles experiencing a 4.75mm sifter.

The fine all out used in this assessment is waterway sand which is obtained from close by association.

Fig 5: Fine aggregates

3.4 Coarse Aggregates

Coarse aggregates are particles more note less that 4.75mm anyway generally run between 9.5mm to 37.5mm in estimation. They can either be from basic, assistant or reused sources. Fundamental or virgin aggregates are either land or marine-won. Rock is a coarse marine-won aggregate, show up won coarse aggregates consolidate rock and crushed shake. In this study coarse aggregate of nominal sizes of 20mm, 12mm are used.

Fig 6: Coarse aggregates

3.5 Mix Design And Trials Used For The Study

Concrete Mix proportions for M30 grade concrete is 1:1.47:2.65 at w/c of 0.45

For this study of experimentation we assumed five trials to get the optimum value of strength and durability values which are shown in the below discussions

1. 0% coir fibers : Mix 1
2. 0.5% coir fibers : Mix 1
3. 1% coir fibers : Mix 1
4. 1.5% coir fibers : Mix 1
5. 2% coir fibers : Mix 1

4. METHODOLOGY

In order to test the strength and durability of self compacting concrete using steel fibers and corn fibers for M30 grade concrete we need to cast the cubes, cylinders and prism specimens for compressive strength, split tensile strength, flexural strength and durability of various curing periods. Along with those strength tests workability is also studied for various trial mixes. For this project the following methodology is used

4.1 Batching

Batching is the process of taking the quantity of materials required for the project. Generally measuring the material quantity is done by two methods one is weight batching, second is volume batching. In the present study we were taken weight batching to measure the materials quantity.

4.2 Mixing of the Concrete

After measuring the materials quantity we mixed the materials as per the trails. Firstly we have to mix coarse aggregates, fine aggregates, steel fibers and coir fibers for some time to get uniform mix after that add cement and silica fume to the mixture again mix for some more time to get same mix

throughout the material. Now add the water as per the calculations from the mix design to make freshly prepared concrete for M30 grade concrete.

4.3 Casting Of Specimens

After mixing the concrete materials we have to cast the specimens like cubes, cylinders, prisms to check the strength and durability. For this study we have to cast 45 cubes, 45 cylinder and 45 prisms to check the compressive strength, split tensile strength and flexural strength at 7days, 14 days and 28 days curing period along with these strength we have to cast 15 cubes for the durability of concrete for these five trial mixes.

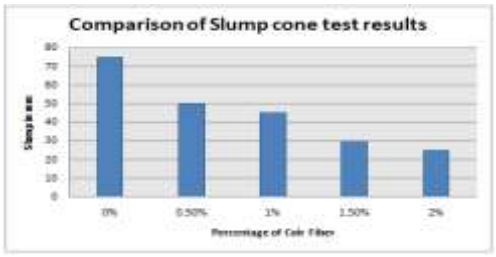
4.4 Curing of the specimens

In case of compressive strength, split tensile and flexural strength studies we have to cure the specimens for 7 days, 14 days and 28 days of curing periods with all five trial mixes.

4. RESULTS AND ANALYSIS

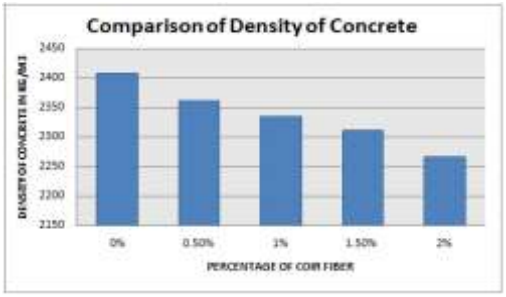
4.1 Workability Of Concrete

Workability is one of the most important property of the freshly prepared concrete mixtures in the present study workability of concrete mix is find out with the help of the slump cone test and compaction factor tests the below graph shows the slump cone comparison for various mixes



Graph 1: Comparison of slump cone test

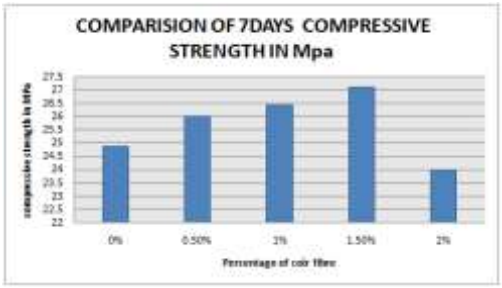
4.2 Density of the concrete



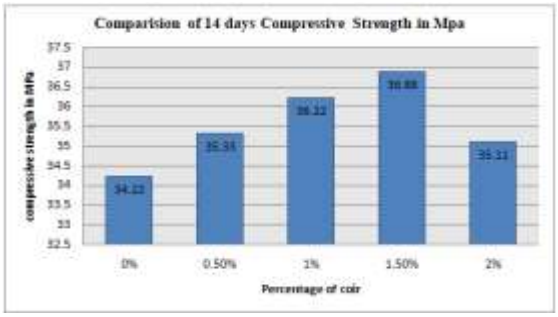
Graph 2: Comparison of compaction factor

4.3 Compressive Strength Of Concrete

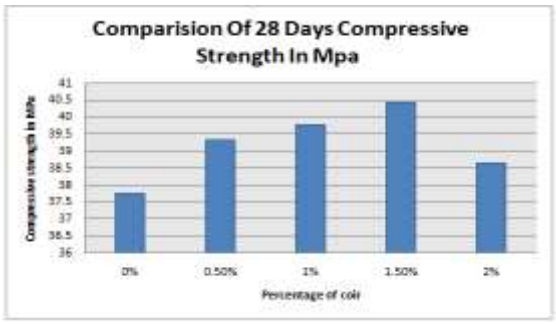
After curing cubes the compressive strength of concrete is resolved with the assistance of universal testing machine (UTM) for trial 1 to trial 5. The below figure shows the compressive strength of concrete for 7 days, 14 days and 28 days curing.



Graph 3: 7 days Compressive strength



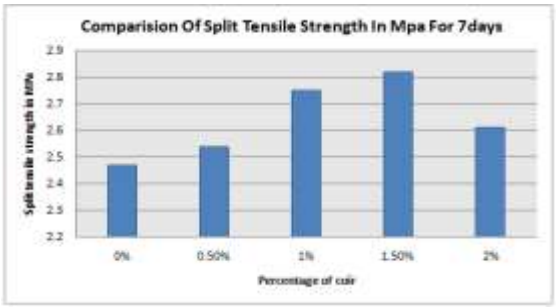
Graph 4: 14 days Compressive strength



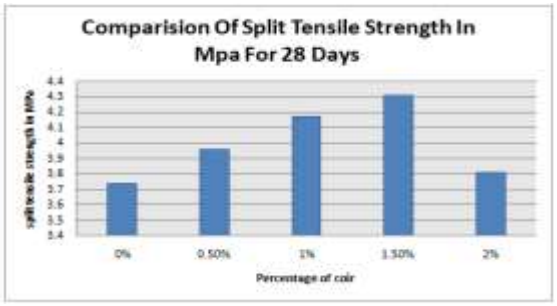
Graph 5: 28 days Compressive strength

4.4 Split Tensile Strength

Split tensile strength of concrete is determined for M30 grade concrete with the help of cylinder specimens for various mix trials from trial 1 to trail. The dimension of the cylinder was taken as 150mm diameter and 300mm length. The below graph shows the split tensile strength for 7days and 28 days.



Graph 6: Comparison of 7days tensile strength



Graph 7: Comparison of 7days tensile strength

5. CONCLUSIONS

Following conclusions have been derived by the investigation and experimental results: Coconut-fiber addition in the concrete increases the many properties of the concrete such as torsion, toughness and notably tensile strength which is the main properties of the concrete.

1. Due to the uniform diameter property of the coconut fiber there will be uniform distribution of the reinforcement throughout in the concrete which decrease the voids and make the concrete more tough.
2. Sometimes, it is noted that the coconut fiber which is to be used in the concrete will be available priceless or of negligible price which will make the concrete economy and as it is natural it will not create any pollution in the environment.
3. It is noted that if there is increase in the percent of coconut fiber in the concrete than 3% of cement there is decrease in the strength of the concrete which make it waste.
4. The values of the slump and decreases with increase in the percentage of coir fiber in M30 grade concrete.
5. The value optimal value of compressive strength was observed at 1.5% coir fiber in M30 grade concrete.
6. The value optimal value of tensile strength was observed at 1.5% coir fiber in M30 grade concrete.

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