

A REVIEW ON THE PERFORMANCE OF COCONUT FIBRE REINFORCED CONCRETE.

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ABSTRACT:

Processed Coconut fibre (coir) is one of the Natural fibers abundantly available in tropical regions, and is extracted from the husk of coconut fruit. The waste material obtained from the coconut fruit is utilized and used in constructions. The use of coconut fiber in concrete will reduce the massive amount of the waste produced and also increases the tensile properties in the concrete . Coconut fibre is cheap and has more resistant to thermal conductivity . The addition of coconut fibre significantly improved many of the engineering properties of the concrete like , toughness and tensile strength . It also has the ability to resist to cracking and spalling of concrete . From previous studies observed that mixing of coconut fibre in concrete a significant rise in tensile strength is observed and restraining the development of crack, Similarly the results were also obtained for each different volume fraction of 1%,2%,3%,4%,5% with different lengths of 20,30,40, 50 mm and grade of concrete M20,M30,M40 AND M60 were used .Among all these the volume fraction of 2%,3%,4%,5% and length of 20,30,40,50mm gives the best results for improving the strength of concrete .

By taking these reviews as reference ,the volume fraction of 4% and 5% with length of 30 and 40mm and M30 and M60 grade of concrete were considered in this study.

KEYWORDS: Fiber reinforced concrete, coconut fiber ,compression strength, tensile strength, torsion and toughness.

INTRODUCTION:

Coconut fiber is treated as natural fiber before using in concrete. Coconut fiber is extracted from the outer shell of the coconut. There are two types of coconut fibers, brown fiber extracted from matured coconut and white fibers extracted from immatured. These coconut fibers are easily available in large quantity and also cheap. The use of coconut fiber can lead to improvement in properties of cement concrete in addition providing a proper solution for disposal of natural waste. In most cases , this coconut fibers are dumped as agricultural waste, so can be easily available in large quantities hence making them cheap.

Coconut fiber , obtained from unripe coconut fruit is a natural fiber . The coconut is steeped in hot sea water and subsequently, the fibers are removed from the shell by combing and crushing .The coconut husk is composed of 75% fiber and 25% pith with high lignin and phenolic content . Due to the high lignin content , Coconut fiber is very elastic ,durable , and resistant to rotting .When coconut husk are being processed , The coco dust is separated from the fibre .

The long fibre of coir extracted from the coconut husk are used in manufacture of industrial products , For example mats and ropes making.

The advantages of using such fibers provides generally elimination of the need for waste disposal in landfills . Utilization of these fibers in concrete leads to an effective solid waste management technique .

2. LITERATURE REVIEW

2.1 USE OF COCONUT FIBER IN CONCRETE

Shinde et.al,

The goal of the project is to spread awareness of using coconut fiber as the fifth ingredient of concrete. In this study, the author used M20 grade of concrete by adding coconut. For this purpose 45 cylinders were casted. The test he conducted on the coconut fiber reinforced concrete were split tensile strength were evaluated at 7, 14, and 28 days. The tensile strength of concrete were found to be increased when the coconut fiber is also increased. After 28 days the tensile strength attained at 2.68, 2.90, 3.11, 3.25, 2.33 respectively when concrete produced at 1%, 2%, 3%, 4%, 5%. These test result showed that the coconut fiber reinforced concrete can be used in construction. The amount of coconut fiber increased in the concrete can increase in the tensile strength. The author concluded that the fiber added is 1%, 2%, 3%, 4%, 5%. Will increase the strength in concrete whereas, the coconut fiber of 5%. (or) more than strength decreases. Coconut fiber also increases the compaction factor value and slump value of concrete.

Rama Krishna et.al (2005),

This study investigated the variation of chemical composition and tensile strength for all four natural fibers, i.e., sisal, jute, coconut, hibiscus, and cannabis fiber. These fibers were subjected to continuous immersion for 60 days in water and subjected to alternate wetting and drying. Continuous immersion was found to be critical due to loss of tensile strength. Among all the fibers, coconut fiber gives the best result for retaining a good percentage of tensile strength in all test conditions. He carried an experimental on impact resistance of slabs. For all four different fiber content of 0.5%, 1.0%, 1.5% and 2.5%. By the weight of cement and their different length of 20, 30, 40mm. A fiber content of 2% and length of 40mm of coconut fiber which gives the best result by absorbing 2.5 and 3.5 J impact energy.

Hasan et.al (2012),

In this study, the experimental research was done on the reinforced concrete using coconut Portland cement was used in mixing process. The casted cubes of sizes of 100*100*100mm and prism of 100*100*300mm were casted for normal plain concrete. The mix ratio was used of 1:2:3 by the weight of cement. As the mix is ready it goes under slump test to avoid voids. The three layers cube and prism was filled and compacted with steel rod of 25 blows and results obtained was 54 mm for plain concrete and 38 mm for coconut fiber concrete. The specimen was kept for 24hrs and mould was removed and was transferred into the curing tank with 30 degrees. He also tested the coconut fiber reinforced concrete cubes for compressive strength and tensile strength. The volume strength and tensile strength. The volume of coconut fiber Percentage increases then, the compressive of concrete decreases. The content of 3% fiber with concrete the compressive strength was noted was 18.85 N/mm² which satisfies the structural requirement of light weight concrete as per this article.

Ghutham , and Robby (2016),

Experimental research was done on the characteristics of mechanical properties of coconut fiber and also enhance the strength of the concrete when concrete is added with coconut fiber. In his study, he mentioned that there are 2 types of coconut fibers available, they are white fiber and brown fiber are declared as matured fiber, whereas white as immature fiber. Among these two, brown fiber is mostly used because brown fibers have high strength. He also studied on the compressive strength, flexural strength and tensile strength. The maximum compressive strength was noted as 8.63N/mm² and lowest of 6.83N/mm² at 28 days of curing. For 7 days with 0.2% and 0.4% coconut fiber for compressive strength obtained was 6.22N/mm² and 6.75N/mm² respectively. Similarly, with flexural strength and tensile strength.

Ede.et.al,

He studied the effect of coconut fibers on the compressive and flexural strength of concrete by destructive and non-destructive test methods with the fibers lengths of 60mm and diameter of 0.75mm. In this paper he showed that the compressive strength of coconut fiber reinforced concrete is increased with the increase of fiber proportion up to 0.5% and then gradually decreased by 0.75% and 1.0% fibers concrete of samples were 4.58%, 38.13%, 8.56% and -2.42%. Respectively the result for flexural strength of concrete obtained at 28 days for 0.25%, 0.5% and 1.0% and 0.42% respectively.

Ali et.al,

Investigation on the study of mechanical and dynamic properties of coconut fiber reinforced concrete , with different lengths of 2.5, 5.0, 7.5cm and volume of 1%, 2%,3%,5% .In his study, He concluded that the fiber content of 5% with 50mm in length gains the most advantages in overall properties.

Wang et .al,

This study shows that the comparison between the performs of the plain concrete and the coconut fiber reinforced concrete by a drop weight device . The amount of coconut fibre was used of 1.5% by the weight of the cement, and different lengths of the fiber was 25mm, 50mm, and 75mm. he found that the addition of the fibers performed similar behavior for all lengths in the compressive dynamic strength. Whereas, CFRC had better performance in resisting of fragmentation and spallin+/g, because of the bridge function of coconut fibers distribution.

Ramli et .al,

Investigation on the effects of aggressive environments on the strength and durability of coconut fiber reinforced concrete. The results proved that the fibers plays a important role in restraining the development of cracks . The fiber content of 13% and 9% for compressive and flexural strength were improved . this paper recommended that the coconut fiber undergoes treatment prior and protect it against natural degradation or it will be replaced with non-corrosive fibers.

Liu et.al (2011),

Studied the influence of 1%, 2%, 3%, 5% of fiber content at different lengths of 2.5, 5, and 7.5 cm on the properties of concrete .The properties of plain cement concrete was used as reference. It was seen that the damping of CFRC beams increases with increase in fiber content. In his study, he observed that CFRC with fiber content of 5% and with length of 5cm produced the best results. The optimum percent of coconut fiber added was 5%., Which made to adopt addition of 4%, 5% and 6% coconut fiber by cement weight.

Baruah et.al (2007),

In his research work, he investigated on the mechanical properties of the plain concrete and coconut fiber reinforced concrete with the fiber content range from 0.5% 2%. S teel, synthetic jute and coconut fibers were used. The ratio taken for plain concrete was 1:1.67:3.64 and water cement ratio was 0.535.The length of 4cm and diameter of 0.4mm width volume fraction of 0.4mm width volume fraction of 0.5%, 1%, 1.5%, 2%. Were, added to the plain concrete to prepare the CFRC. After curing for 28days, the compressive strength, splitting tensile strength, modulus of rupture, using four point load test and shear strength. Among all the fiber content 2% gives the best results in their research.

Sai uday (2017),

“Studied on the behavior of the coconut fiber in concrete structure the CFRC”. The coconut fiber reinforced concrete improves the various engineering properties of concrete. The adding of coconut fiber improves the compressive strength, flexural strength and split tensile strength of concrete. He conducted an experiment on high strength concrete with the fiber content of 1%, 2%, 3%, 4%, 5% by cement weight. The split tensile strength compressive strength of cured concrete evaluated for 3days, 7days, 28 days. This research found that the optimum fiber content to be at 1% (by cement weight). This result shows that the coconut fiber can be used in the construction.

Aziz et.al (1981),

Investigation on the mechanical properties of cement paste composites for different volume fractions and lengths for coconut fibers . He concluded that the tensile strength and modulus of rupture of cement paste increased when the fiber length of 38mm and volume fraction of 4% or more will decrease in the strength of composite . The tensile strength of cement paste obtained was 1.9 , 2.5, 2.8, and 1.5Mpa . The modulus of rupture was 3.6 , 4.9, 5.45, 4.6 Mpa. Among all the volume fractions of 1%, 2%, 3%, 4%,5%,6% respectively, 4% volume fraction of coconut fiber gave the highest mechanical properties . The coconut fiber with a length of 38mm gave the maximum strength.

Ienamul Hasan Ali et al (2018),

Experiment study on the coconut fiber reinforced concrete . This paper presents the versatility of the coconut fiber is one of the natural fiber is easily available in the tropical region in which coconut fiber are used as reinforcement. The researches in few last decades was carried research on the fiber reinforced concrete were presented in this paper . The flexural strength of coconut fiber reinforced concrete increases for 1%,2%, 3% of fiber content for M20 grade used . When compared with plain concrete . The coconut fiber reinforced concrete is more effective than plain concrete . The main aim of this paper is to spread awareness of coconut fibers as a construction material.

Sobuz et al ,

Investigated on the physical and mechanical characteristics of chopped coconut fibers with different volume fraction and lengths . The fiber content of 1.0, 3.0 , 5.0, 7.0 respectively ,taken in to consideration . After 28 days of curing , the compressive strength of CFRC at 3% of fiber content is 18.85 Mpa in comparison with 31.57 Mpa for plain concrete . It satisfies the all structural requirements for light weighted concrete . CFRC gives a small number of cracks and decreasing the crack width . This paper concluded that the coconut fiber to be used in concrete to produced light weight structural concrete.

Yan et. at,

He studied the mechanical properties of fiber rein forced concrete compared with plain concrete coconut fibers improved the compressive strength, flexural strength ,and modified stress strain behavior improved also flexural strength, deflection, fracture energy from compressive test , which is the area under applied load to displacement curve and flexural toughness. The increase in fracture energy and flexural toughness were 550% and 424% respectively. The treated fiber of 5% weight of NaOH solution during 30mm duration of 20 degree Celsius, can further improve the mechanical properties of the CFRC.

Yalley P.P et al,

In this study , the addition of the coconut -fibers in the concrete will improve many of the engineering properties of the concrete , notably torsion, tensile strength , toughness. Coconut fiber also has a ability to resist the cracking and spalling coconut fiber in concrete is unlikely to replace steel for the vast majority of structures. They concluded that the use of the new materials in non structural applications in ones where the consequences of failure are not too severe.

Adewumi John Babafemi et al;

He did the study on the concrete with coconut fiber. The need of utilization of the waste materials for development is developing. The examination explored the impact of joining 0.5 and 1% of fiber content on the thickness , compressive quality, elasticity, and solidness of cement. The elasticity was resolved at 7, 14, 28 days, while the compressive quality was resolved as 56 days following code application. The toughness of the coconut fiber strengthened cement was examined as 1 ,3 and 5% magnesium sulfate for 28, 56 days in the wake of relieving in water for an underlying time of 28 days. The fuse of coconut fiber in concrete decreases its functionality and appeared to have no impact on the thickness. The coconut fiber improves the compressive strength and rigidity of cement. The fiber content of 1% gained best result.

Asasutjarit et.al,

Determined the investigation on the physical , mechanical and thermal properties of coconut fiber light weight cement board after 28 days of hydration. The physical properties (density, moisture content, water absorption and thickness swelling). Measured by Japanese industrial standard JIS A 5908-1994. The thermal properties are measured by using JIS R 2618. The mechanical properties are (modules of elasticity, modules of rupture and internal bond). The parameters studied in this investigation was fibre length , coconut fibre pre-treatment of mixture ratio . 5cm long boiled and washed fibers with optimum ratio of 2:1:2 gave the highest modulus of rupture . This paper suggested us to take 5cm length of coconut fibre after proper treatment for the removal of the dust.

P. Paramasivam et. al (1981),

“Prospects for natural fiber reinforced concretes in construction”, This paper reports the recent past and current research and developments for the effective utilization of natural fibers from coconut husk, sisal, sugarcane bagasse, bamboo, jute, wood, akwara, plantain for making concrete*. Factors affecting the properties of natural fiber reinforced concrete both in fresh and hardened states are critically discussed. An outline is also given of the prospects of this new material for potential applications in construction. Efficient and Economical methods of fiber extraction, treatment, conversion into usable forms, dispersion in the concrete mix, casting, placing and curing are highly essential. Strength, deflection, impact and abrasive resistance, water absorption, shrinkage, chemical resistance, acoustic requirements, thermal performance and durability parameters must be properly assessed.

Anila kumar et al (2018),

“Comparative study of strength properties of coconut coir fiber reinforced concrete due to partial replacement of cement by pozzolanic materials”, The main objective of the modern-day Civil Engineering is to achieve Sustainability and the term is also widely accepted by engineers worldwide. The construction industry is revolutionizing in terms of both equipment, materials. Thus, the basic cost of construction has increased exponentially along with detrimental effects on environment. Thus lot of research work is been carried to reduce the usage of non-renewable resources and to achieve economy. The primary objective of the current project is to investigate the strength properties of coconut coir fiber reinforced concrete due to partial replacement of cement by various pozzolanas. The coir fiber reinforced concrete along with GGBFS, is a good material to attain both compressive and flexural strength. Both fly ash, GGBFS has remarkably increased the strength properties.

Avinash singh et. al (2019),

“An experimental study on coconut fiber reinforced concrete”, Coconut fiber is obtainable in abundance, which makes it quite viable as a reinforcement material in concrete. This paper presents a experimental discussion on the subject of coconut fiber reinforced concrete, CFRC. It discusses usually used terms and models of behavior that kind a basis for understanding material performance with presenting mathematical details. In this research it is shown that flexural strength of coconut fiber reinforced concrete is directly proportional to the coconut fiber content and inversely proportional to the water-cement ratio. This study aimed toward analyzing the variation in strength of coconut fiber concrete at variable fiber contents and to establish it with that of conventional concrete. The various strength aspects analyzed are the flexural, compressive and lastingness of the coconut fiber concrete at variable percentages (1%, 2%, 3%, 4%, 5%) by the load of cement of fiber. This research is based on the use of coconut fibers in structural concrete to enhance the mechanical properties of concrete. It is observed that CFRC can be used to increase ultimate strength, durability because the satisfactory improvement in strength is observed with the inclusion of coconut fibers but the gain in strength is found to depend upon the amount of fiber content. Owing to its relatively higher strength and ductility, it can be good replacements for asbestos fibers in roofing sheets, which being natural in origin resulting less risk to the environment.

3. CONCLUSION:

1. Coconut fiber is a good insulator itself and as such it can improve the thermal properties of concrete. 2. As we increase the fiber percentage, the strength of coir fiber reinforced concrete is also increased progressively.
3. The coir fiber reinforced concrete is more effective than conventional concrete.
4. CFRC have a good flexural strength, ductility and physicochemical properties.
5. The increase in the coconut fiber in the concrete will increase the tensile strength .
6. Coconut fiber reinforced concrete helps in reduction of cracks and decrease in the crack width.

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