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Characteristics of Steel Fiber Concrete and Lightweight Concrete with Coconut Shells Substituted for Coarse Material

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ABSTRACT: The review discusses the high cost of building materials for even the most basic structures may be a significant global factor affecting lodging delivery. This has necessitated research on optional, economically successful building materials. Along with growing anxiety regarding the excessive misuse of regular and high-quality aggregate, the mixture made of agricultural and industrial wastes being a decent contemporary source for construction materials. This paper's purpose is to Examine the compressive, split tensile, and flexural strength properties of concrete made by partially replacing traditional coarse aggregate with coconut shell that has been ground up and granulated in M25 at 0%, 25%, and 50% quality concrete. After casting, the prism, cylinder, and cube were tested. Because structural LWC reduces self weight, improves seismic structural response, and requires less expensive foundations, it provides design flexibility and cost savings. When making LWC, this coconut shell can be crushed and utilized as a coarse aggregate. Coconut Shell Concrete (CSC) has the potential to be utilized in remote regions with a high coconut population, as well as in situations where traditional aggregates are prohibitively expensive. In order to strengthen concrete and enhance its qualities of fracture resistance, ductility, energy absorption, and impact resistance, a specific quantity of steel fiber is also added.

KEYWORDS: steel fiber (SF); Ground Granulated Blast Furnace Slag; reinforced concrete; replacement of coarse aggregate, Ordinary Portland cement.

I. INTRODUCTION

Concert The development of a project should include waste management as a key component. Waste management will be a part of the project to some extent for each of the main participants: the Owner, their Architectural and Engineering services (or Construction Management consultant), the Contractor, and Subcontractors. The owner and their A/E must first decide what levels of diversion are feasible and reasonable given the project's circumstances. They must also establish waste reduction goals.

For many years, the use of agricultural wastes in the construction sector has been investigated, but the results have been mixed. The construction industry can use these wastes as potential or replacement materials in nations where agricultural waste is dumped in large quantities. One agricultural waste that is produced in large quantities and that could be used as coarse aggregate in concrete is coconut shells. The Asia Pacific region accounts for eight of the top ten producers. India, the Philippines, and Indonesia are the three major producers, making up 75% of global output. With a 1.9-million-hectare area and an annual production of 2.74 million tones of copra equivalent, India ranks third among countries that produce coconuts. 90% of the people in India

In India, the average annual loss of coconuts is thought to be around 15 billion nuts. The shell of the coconut is typically discarded as waste after it has been hollowed out. The vast majority of this wasted CS resource is still being used for commercial purposes; its application as a building material, particularly in concrete, similar to other lightweight aggregates, is an intriguing area for future research. When making LWC, this coconut shell can be crushed and used as a coarse aggregate. Coconut Shell Concrete (CSC) may be used in rural areas, regions with an abundance of coconuts, and in locations where conventional aggregates are expensive. The crucial mechanical characteristics of CSC, including compressive, flexural, splitting tensile strength, and impact resistance, have been examined in this study.

II. LITERATURE REVIEW

Strength Kalyana Chakravarthy P R, Janani R, Ilango T, Dharani K (2023)

Cement is a binder material with various composition of Concrete but instantly it posses low tensile strength. The study deals with mechanical properties of that optimized fiber in comparison with conventional and coconut shell concrete. The accumulation of fibers arbitrarily dispersed in the composition increases the resistance to cracking, deflection and other serviceability conditions substantially. The steel fiber in extra is one of the revision in coconut shell concrete and the outcome of steel fiber in coconut shell concrete was to investigate and compare with the conventional concrete. For the given range of steel fibre from 0.5 to 2.0% , 12 beams and 36 cylindrical specimens were cast and tested to find the mechanical properties like flexural strength, split tensile, impact resistance and the modulus of elasticity of both conventional and coconut shell concrete has been studied and the test consequences are compared with the control concrete and coconut shell concrete for M25 Grade. It is fulfilled that, the steel fibers used in this venture has shown significant development in all the properties of conventional and coconut shell concrete while compared to controlled conventional and coconut shell concrete like, Flexural strength by 6.67 % for 1.0 % of steel fiber in conventional concrete and by 5.87 % for 1.5 % of steel fiber in coconut shell concrete.

S. Sebastin (2021)

The high cost of materials for any ordinary building could be a major factor that influences lodging conveyance around the world. This has required investigation for elective cost-successful materials in construction. With expanding concern over intemperate abuse of normal and quality aggregate, the aggregate created from industrial wastes and the farming waste being a reasonable modern source for building material. The point of this paper is to analyze characteristics compressive, split tensile and flexural strength of concrete produced by partial substitution of conventional coarse aggregate by pulverized, granular coconut shell in the graduation of 0%, 25%, 50% in M25 grade concrete. The cube, cylinder and prism were cast and tested. The test comes about appeared that compressive, split tensile and flexural strength of concrete diminished as the rate of shell expanded. Subsequently, to extend the tensile and flexural strength of concrete, 1% of steel fiber [2] and 0.25% of glass fibers [1] were included, and examples were cast. The test comes about appears that there's advancement within the flexural strength and tensile strength of concrete by around 10-20%. The investigation of this paper concludes that there's a cost decrease due to partial substitution of coconut shell additionally sensible tensile and flexural strength is achieved with expansion of steel and glass fiber.

Ichhpal Singh, Sukhdeep singh, Ipandeeep Singh (2020)

A wide assortment of materials utilized in road development i.e. soil, coarse aggregate, bituminous materials, concrete and miscellaneous for improved road execution under substantial traffic conditions. Various literature has been evaluated and ultimately the coconut shell has been used for various purposes, such as light weight concrete, landfill, structural concrete and also used in road construction. This investigation gives point by point assessment of the use of the coconut shell in road with partially replacing coarse aggregate in different proportions so that the usage of conventional aggregates should be reduced. In this experimental work we use coconut shell in different percentages which include 5%,10%,15%,20%,25%. The test which we performed for flexible pavement includes los Angeles Abrasion, aggregate impact value and aggregate crushing test. IN flexible pavement tests the value of los Angeles abrasion test is approximately 29.5 when we add 15% coconut shell which is less than 30, therefore it is suitable for bituminous roads up to 15% replacement of coconut shell. Above 15% the value goes on increasing up to 25% which is suitable for different type of roads such as bituminous bound macadam, water bound macadam, water bound macadam surfacing course, bituminous surface dressing and water bound macadam base course with bituminous surfacing. The crushing strength value is less than 30% when the replacement of coconut shell is in between 5%-25% and therefore it is good and the aggregate impact value is in between 10-20% with the usage of coconut shell in between 5%-25%, therefore it is strong.

Ramaiah Prakash, Rajagopal Thenmozhi, Sudharshan N. Raman, Chidambaram Subramanian (2019)

This study investigates the effect of steel fiber addition into eco-concrete made with fly ash, an industrial by product, as partial cement replacement material, and coconut shell, an agricultural waste, as coarse aggregates, on the mechanical properties. Two different mixes were developed, one with coconut shell only as coarse aggregates, and the other with both conventional aggregates and coconut shell as coarse aggregates. The cement content was replaced with class F fly ash at 10% by weight. Steel fibers of 0.25, 0.5, 0.75, and 1.0% by volume of concrete

were used. The properties investigated were slump, density, ultrasonic pulse velocity, compressive strength, split tensile strength, flexural strength, and modulus of elasticity (MOE). The findings indicated that the addition of steel fibers resulted in a reduced slump and slightly increased density in the fresh concrete mixes. Meanwhile, enhancements of up to 39% compressive strength and 17% MOE were also obtained. A substantial improvement in split tensile strength and flexural strength were also observed. Steel fiber addition also significantly reduced the brittleness of concrete containing coconut shell. The outcomes of the experiment revealed that steel fiber addition yielded a positive result on the mechanical properties of coconut shell concrete.

Sanjay Kumar Verma, and Sagar Shrivastava (2019)

The waste coconut shell may be utilized to replace natural coarse aggregate. In present study, compressive strength of concrete of M - 20 grades has studied by replacing natural coarse aggregates at 0%, 5%, 10%, 20% and 30%, by weight with coconut shell. Compressive strength of coconut shell concrete has been evaluated on 7, 14, 21 and 28 days. The compressive strength of coconut shell concrete was reduced as percentage replacement increased. Concrete mixtures were tested and compared in terms of compressive strength of the conventional concrete. The study result shows that Coconut Shell Concrete (CSC) can be used as light weight concrete. Use of Coconut Shell as a substitute of aggregate will not only is cost effective and ecofriendly, but also help to resolve the problem of shortage of conventional material such as coarse aggregate. Use of such materials also reduces the problem of disposal of waste material.

M.Daniel babu, K.Divya , Dr.K.Chandramouli (2018)

It is proposed to study the properties of concrete by partial replacing of coarse aggregate with coconut shell and addition of fibers to achieve target strength. The properties include compressive strength, splitting tensile strength and flexural strength. The use of construction is increasing day to day as the growth rate of population is increasing. These tests are conducted on the cube specimens of dimensions 150mmX150mmX150mm at different age's i.e. 7 and 28 days. The main objective of this investigation is to check the quality of concrete.

D.V.Naresh Kumar, P.M.Ganga Raju,(2017)

This research paper discusses the effect of coconut shells and fibers (polypropylene and steel fibers) on M30 grade concrete. The fibers used in this work are Polypropylene and Steel Hooked end fibers of 0.5 mm diameter and 60mm length. As the percentage of coconut shell replacement with coarse aggregate increases the strength properties decreases. With the addition of fibers like polypropylene and steel to the concrete with coconut shell, the strength properties of concrete increases some extent but not higher than the conventional concrete.

Kalyana Chakravarthy P R , Janani R , Ilango T , Dharani K (2017)

Cement is a binder material with various composition of Concrete but instantly it possesses low tensile strength. The study deals with mechanical properties of that optimized fiber in comparison with conventional and coconut shell concrete. The accumulation of fibers arbitrarily dispersed in the composition increases the resistance to cracking, deflection and other serviceability conditions substantially. The steel fiber in extra is one of the revisions in coconut shell concrete and the outcome of steel fiber in coconut shell concrete was to investigate and compare with the conventional concrete. For the given range of steel fiber from 0.5 to 2.0%, 12 beams and 36 cylindrical specimens were cast and tested to find the mechanical properties like flexural strength, split tensile, impact resistance and the modulus of elasticity of both conventional and coconut shell concrete has been studied and the test consequences are compared with the control concrete and coconut shell concrete for M25 Grade. It is fulfilled that, the steel fibers used in this venture has shown significant development in all the properties of conventional and coconut shell concrete while compared to controlled conventional and coconut shell concrete like, Flexural strength by 6.67 % for 1.0 % of steel fiber in conventional concrete and by 5.87 % for 1.5 % of steel fiber in coconut shell concrete.

Apeksha Kanojia, Sarvesh Kumar Jain (2016)

The research work was divided into two parts. First part was aimed to observe the effect of such replacement on compressive strength and density of concrete. In the second part, the aim was to find out the additional quantity of cement required to compensate for reduction in strength of concrete resulted due to this replacement. It was found that with increasing proportion of coconut shells, there is decrement in compressive strength. Results revealed that with 40% replacement of conventional coarse aggregate by coconut shell, 7 days compressive strength of concrete decreased by 62.6%; whereas decrease in 28 days compressive strength was only 21.5%. 40% replacement makes the concrete lighter by 7.47%. Further, it was revealed that for mix design of concrete of 20 N/mm² characteristic

strength, no additional cement is required for 5% replacement and only 3.6% additional cement was required for 10% replacement. The results confirm that although there is an increase in cost due to additional cement requirement, the advantages being many, including efficient utilization of waste coconut shell, reduction in natural source depletion etc, the use of coconut shell in concrete seems to be a feasible option. Such study will help to arrive at final decision regarding quantity of coconut shell for replacing conventional aggregates in concrete production.

III. COLLECTION OF MATERIALS

3.1 Cement

Portland cement produced by Sankar Company has been used throughout this investigation. Cement is the most widely used cementations Ingredient in present day concrete. The function of cement is first, to find the fine aggregate together and second to fill the voids in between fine aggregate and coarse particles to form a compact mass. Although cement constitutes only about 10 % of the volume of the concrete mix it is the active portion of the binding medium and the only scientifically controlled ingredient of concrete. Portland Pozzolana Cement 53 Grade conforming to Indian Standard IS 12269:1987 was used as a binder.

IV. PROBLEM STATEMENT

1. To investigate waste minimization methods Utilization of new building materials.
2. To determine the mix ratio that provides good strength when coconut shell is substituted.
3. To investigate the use of coconut shell concrete in construction waste management.
4. To contrast the mechanical characteristics of conventional concrete and concrete reinforced with coconut shell.
 - Cement
 - Fine Aggregate (River sand)
 - Coarse aggregate
 - Coconut shell
 - Steel fibre

V. CONCLUSION

The following statements can be drawn from the results tabulated in the prior chapter.

1. The desired characteristic compressive strengths for cubes in conventional concrete, Steel fibre and Coconut shell are obtained from the prescribed mix proportions of M25 grade of concrete.
2. When compared to Coarse aggregate, the strengths produced in concrete formed with a proportion of Steel fibre and Coconut shell attained high strengths.
3. In order to achieve workability and a water-to-cement ratio, super plasticizer is utilized.
4. The 30% substitution of Coarse aggregate with Steel fibre and Coconut shell during 28 days of curing produced extremely high strength.
5. It is demonstrated by the aforementioned experimental findings that Steel fibre and Coconut shell may be utilized as a Coarse aggregate substitute, lowering cement consumption and building costs. Utilizing industrial waste helps the environment and protects natural resources.

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