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Hybrid Fiber Reinforced Concrete: Steel And Coconut Coir

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ABSTRACT: Hybrid fiber reinforced concrete can be defined as concrete that reinforced bytwo or more types of fibers. This study aims to study the mechanical properties ofhybrid fiber reinforced concrete where the fibers used were consists of steel fiber andcoconut coir fiber. For this purpose six mixes, one normal control mix and fivehybrid fiber reinforced concrete mixes were prepared. The total content of two fibersis 3% by volume of mix where the total content of each fiber varied from 0.5% to2.5%. Slump Test and Compaction Factor Test was carried out for each mix in thefresh state in order to determine the workability of the hybrid fiber reinforcedconcrete. Meanwhile, compressive test and flexural test were carried out to study the mechanical properties of the hybrid fiber reinforced concrete. From the slump testand compaction factor test, all specimens show low workability except the sampleswhich contain more steel fibers than coir fibers. These two mixtures of samples giveresults of very low workability. For the result of Compressive and Flexural Test, the normal control mix shows normal strength development but all the hybrid fiberreinforced concrete mixes gain their strength lower the normal control mix. Theexpected outcome which is the strength of hybrid fiber reinforced concrete is higherthan the strength of normal concrete did not achieved. So, further research need to becarried out with some adjustment of method and material.

Key Point : Low cost,flexural test,hybrid fibre reinforced concrete.

I. INTRODUCTION

Concrete is an essential material with a worldwide estimated consumption of between 21 and 31 billion tons of concrete in 2006, concrete is the second most consumed substance on Earth after water. Concrete is a mixture of sand, gravel and/or other aggregates, bound together by a water-based binder, cement. Admixtures as modifyingagents and additives such as fine mineral powders are sometimes introduced to improve the characteristics of the fresh concrete, of the mixing process and/or of the final hardened material. ((Bureau International du Mon Manufacture) BIBM, 2013) Concrete is a building material that has been applied in construction field since a longtime ago. It is also a tremendously popular structural material to its low cost and easy of fabrication of construction. In building industry, concrete means a hard and solid material made from mixture of cementitious material, water and aggregate. There are many typesof cementitious material such as lime, geosynthetic, polysynthetic and mud; but the mostly used is Portland Cement. Although concrete is very strong and durable; but it has some weaknesses. One of them is low tensile strength. To increase the tensile strength of concrete, it needed to be reinforced by other material. The most popular method is steel reinforcement bar or 'rebar'. Instead of rebar, this research use fibers.

Fiber Reinforced Concrete is the concrete that reinforced by fibers, continuous filaments or thread. There are many types of fibers that have been applied in concrete. Some examples are steel, glass, natural and synthetic. Initially, fibers are used to prevent and control plastic and drying shrinkage in the concrete. Besides that, normally only onetype of fiber is mixed with concrete. After some research and improvement, the addition of fibers material in the concrete can also improve the other properties such as flexural strength, flexural strength fatigue resistance, and post crack strength (Pehbahani, 2010). There are also in some previous research, more than one types of fibers mixed inconcrete. The concrete that reinforced with more

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than one type of fiber is called Hybrid Fiber Reinforced concrete.

II. LITERATURE REVIEW

1."The mechanical and dynamic properties of coconut fiber reinforced concrete "
BY:- Majid Ali
Publishing Year:- 2018, ET. AlNewzealand

The mechanical and dynamic properties of coconut fiber reinforced concrete memberswere well examined. A comparison between the static and dynamic Moduli wasconducted. The influence of 1%, 2%,3% and 5% fiber contents by mass of cement andfiber lengths of 2.5, 5 and 7.5 cm is investigated. Noor Md.sadiqulHasan, et. al fromMalaysia, have investigated the physical and mechanical characteristics of concrete afteradding coconut fibers on a volume basis.

2. "Study of strength and durability of coconut fiber reinforced concrete inaggressive environmental"
By CF. Mahyuddin Ramli,
Publishing year:- 5 february 2015, makerere university, Kampala, Uganda

They conducted a micro structural analysis test using a scanning electron microscopefor understanding bonding behavior of studied strength and durability of CFRC inaggressive environment. Their aim was to mitigate the development of cracks in marinestructuresby introducing CF which would provide a localized reinforcing effect. Yalley, et.al.From UK performed various test to study the enhancement of concrete properties afteraddition of CF. their study focused on the CF obtained from Ghana Africa.

3.The mechanical and dynamic properties of coconut fiber reinforced concrete
BY:- Liu et al
Publishing Year:- 30 March 2016, Lahore, Pakistan

He studied the influence of 1%, 2%, 3% and 5% at fiber lengths of 2.5, 5 and 7.5 cm on properties of concrete. For a proper analysis the properties of plain cement concrete was used as reference. It was seen that damping of CFRC beams increases with the increase in fiber content. It was observed that CFRC with a fiber length of 5cm and fiber content of 5% produced the best results. In this study the optimum percent of coconut fiber added was 5%.

4.Introduction to mechanical properties of high-strength steel fiber reinforced concrete
BY:- Song P.S. and Hwang S
A.Right Publishing Year:- 14 December 2009 America

The brittleness with low tensile strength and strain capacities of high strength concrete can be overcome by addition of steel fibers. They investigated an experimental study were steel fibers added at the volume of 0.5%, 1.0%, 1.5% and 2.0%. The observation indicate that compressive strength of fiber concrete reached a maximum at 1.5%volume fraction, being 15.3% improvement over the HSC. The split tensile and Flexural Strength improved 98.3%

5 Comparative study of steel fiber reinforced concrete over control concrete.
By:- Vikrant S Vairagade, Kavita S. Kene, Tejas R Patil
Publishing Year:- April 2013, Nigeria

This paper deals with Experimental investigation for M-20 grade of concrete to study the compressive strength, and tensile strength of steel fiber reinforced concrete (SFRC) containing fibers of 0% and 0.5% volume fraction of hook end Steel fibers of 50 and 53.85 aspect ratio were used. A result data obtained has been analyzed and compared with a control specimen (0% fiber). A relationship between Compressive strength vs. days, and tensile strength vs. days represented graphically.

6. Experimental Study on Steel Fiber Reinforced Concrete For M-40 Grade
By:- A.M.SHENDE, A.M.PANDE & M.GULFAM PATHAN
Publishing Year:- April 2013.

This study presents Experimental Study on Steel Fiber Reinforced Concrete for M-40 Grade. Critical investigation for M-40 grade of concrete having mix proportion 1:1.43:3.04 with water cement ratio 0.35 to study the compressive strength, flexural strength, Split tensile strength of steel fibre Reinforced concrete (SFRC) containing fibers of 0%, 1%, 2% and 3% volume fraction of hook tain. Steel fibers of 50, 60 and 67 aspect ratio were used. A result data obtained has been analyzed and compared with a control specimen (0% fiber). A relationship between aspect ratio vs. Compressive strength, aspect ratio vs. flexural strength, aspect ratio vs. Split tensile strengthrepresented graphically. Result data clearly shows percentage increase in 28 days Compressive strength, Flexural strength and Split Tensile strength for M-40 Grade ofConcrete. It is observed that compressive strength, split tensile strength and flexural strength are on higher side for 3% fibres as

compared to that produced from 0%, 1% and 2% fibres.
All the strength properties are observed to be on higher side for aspect
ratio of 50 as compared to those for aspect ratio 60 and 67. It is observed that compressive strength increases from 11 to 24% with addition of steel fibres. It is observed that flexural strength increases from 12 to 49% with addition of steel fibres. It is observed that split tensile strength increases from 3 to 41% with addition of steel fibres.

7. Laboratory Characterization Of Steel Fiber Reinforced Concrete For Varying Fiber Proportion And Aspect Ratio
By:- Mohammad Adnan Farooq & Dr. Mohammad Shafi Mir
Publishing Year:- April 2013

This study presents Steel Fiber Reinforced Concrete for varying Fiber Proportion. The addition of fibers not only enhances therequisite properties of reinforced concrete but also changes the characteristics of the material from brittle to ductile. The paper presents the work done to determine the influence of change in Fiber volume fraction and Fiber aspect ratio on workability property of green concrete as well as on the compressive, flexural and split tensile strength properties of hardened concrete. The study determines the optimum volume fraction and aspect ratio of fiber required for achieving maximum strength and desirable workability. The study reveals that compressive and split tensile strength show similar behavior for different fiber content and aspect ratio while flexural strength shows different behavior. The study determine the Compressive Strength, Split Tensile Strength, Flexural Strength of concrete by adding steel fibre to the percentage of 1.0, 2.0 & 3.0% to the weight of the concrete.

8.Effects of Coconut Fibers on The Properties Of Concrete
By:- SHREESHAIL.B.H & JAYDEEP CHOUGALE
Publishing Year:- may 2017

This study presents effects of coconut fibers on the properties of Concrete. The testing of various material constituents of concrete was carried out according to the Indian Standard specifications. To identify the effects on workability and mechanical strength properties due to the addition of these coconut fibres, workability tests such slump, vee – bee, compaction factor test,Flow table tests, and the mechanical strength tests on standard specimens such as compressive strength, split tensile strength, modulus of rupture were conducted on the different aspect ratio. The standard cubes, cylinders and beams for conventional concrete and coconut fiber reinforced concrete were prepared and tested under compression testing machine and flexure testing machine respectively. The suitability of CFRC as a structural material is studied, in comparison with conventional concrete.

9. Coconut Fibre Reinforced Concrete
By:- Kshitija Nadgouda
Publishing Year:- sept 2014

This study presents coconut fibre reinforced concrete. Reinforcement of concrete is necessary to enhance its engineeringt properties. For this study, coconut fibres were used as they are freely available in large quantities. The study comprises of comparative statement of properties of coconut fibre reinforced concrete with conventional concrete based on experiments performed in the laboratory. The use of coconut fibres will also lead to better management of these waste fibres. The addition of coconut fibres improved the flexural strength of concrete by about 12%, they also formed good bonding in the concrete. The study found the optimum fibre content to be 3% (by weight of cement). Further work is required by changing the fibre content and aspect ratio to determine the optimum range of fibre content so that fibre reinforcedconcrete can be used where high flexural strength is required.

III. METHODOLOGY

1. COLLECTIONS OF RAW MATERIALS

The materials used in this study are Portland cement (OPC): ultratech cement Sand Aggregates passing through 4.75mm IS sieve Coarse aggregate: Aggregates passing through 20mm IS sieve Coconut fiber: locally available in kalaburgi Steel fiber: Collected from Ryan international factoryWater: Collected from local fresh water sources
Admixture: PAR PLAST-LW

2. TESTS ON MATERIAL

Tests on CementCement is an important constituent in concrete. The process of manufacture of cementconsist of grinding the raw materials mixing them intimately in certain proportions andburning them in kiln at a temperature 13000C to 15000C. To determine the variousproperties of cement different tests are done.
The tests done are
1. Standard Consistency
2. Initial Setting Time

3. Final Setting Time
4. Fineness of Cement

3.MIX DESIGN

Mix design is defined as the process of selecting suitable ingredients of concrete anddetermining their relative proportions with the object of producing concrete of certainminimum strength and durability as economically as possible. A Mix design wasconducted as per IS 10262-200 to arrive at M 25 mix concrete.

4.MIXING OF CONCRETE

The coarse aggregate and fine aggregate were weighed and the concrete mixture wasprepared by hand mixing on a water tightplatform. On the water tight platform cementand fine aggregates are mixed thoroughly until a uniform colour is obtained, to this mixture coarse aggregate was added and mixed thoroughly. Then water is added carefully making sure no water is lost during mixing. While adding water care should be taken to add it in stages so as to prevent bleeding which may affect the strength formation of concrete rising of water required for hydration to the surface. Clean and oiled mould for each category and filled in three layers. Each layer is tamped by 25 blows using standard tamping rod. The finishing was stopped as soon as the cement slurry appeare on the top surface of the mould

5.CASTING AND CURING

Concrete was cast in pre-oiled cast iron moulds.These specimens were allowed to remain in the steel mould for the first 24 hours at ambient condition. After that these were demoulded with care so that no edges were broken and were placed in the tank at the ambient temperature for curing. After demoulding the specimen by loosening the screws of the steel mould, the cubes were placed in the water for 7 days and 28 days.

6. TESTING OF SPECIMEN

The remoulded specimens after being cured for sufficient time period are taken out and dried in sunlight and tested under standard testing apparatus.

IV. CONCLUSION

Based on the experimental investigations on HFRC, the following observations can be drawn.

1. The brittle mode of failure is changed by the addition of steel fibre & coconut fiber into a more ductile one and such fibres were observed to improve the ductility of the concrete, its post-cracking load carrying capacity, and its energy absorption capacity.
2. The addition of steel fiber and coconut fiber results in an increase of 14.30% compressive strength, 36.6% increase in flexural strength and 10.16% increase in split tensile strength.
3. The improvement in flexural strength reveals that the toughness would be much more than that of non-fibrous concrete which improves ductility and durability of concrete.
4. Addition optimum dosage of 1% of steel fiber and 1% of coconut fiber gives maximum compressive strength up 42.68%
5. The rate of strength gain for 7 days strength of HFRC is very high as compared to conventional concrete and hence concludes that HFRC has high early Strength and continued strength development.
6. As % of fiber increases the split tensile strength also increases.
7. Workability drastically decreases when coconut fiber content is increased in concrete