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AN EXPERIMENTAL STUDY OF JUTE FIBER AND PARTIALLY ADDED FLY ASH WITH ORDINARY PORTLAND CEMENT IN CONCRETE

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Abstract - This work aims to study the behavior of jute fiber mixed in concrete as a reinforcing material for improving the mechanical properties of concrete. Several experiments were conducted on jute fibers, jute-cement mortar and jute fiber reinforced concrete in this research. For this study, a total of 24 mortar specimens for compressive strength and 144 concrete specimens i.e., 24 cubes and 6 cylinders each consisting of ordinary concrete, 0.5%, 1% jute fiber reinforced concrete and 10%, 15%, 20%, 25% fly ash are tested for their compressive & split tensile strength respectively for different curing periods such as 7 and 28 days. It is observed that the JFRC specimens with 1% jute content, cured up to 28 days has significant improvement of mechanical properties such as compressive strength and split tensile strength with respect to ordinary concrete. When Compared to the Nominal Concrete, The Jute fiber concrete gives strength which is 10% more.

Key Words **– Jute fiber, Fly Ash, Super plasticizer(MasterGlenium SKY 8233), Compressive Strength, Split-Tensile Strength.**

I. INTRODUCTION

Ordinary Portland Cement (OPC) becomes an important material in the production of concrete which act as its binder to bind all the aggregate together. However, the utilization of cement causes pollution to the environment and reduction of raw material (limestone). The manufacturing of OPC requires the burning of large quantities of fuel and decomposition of limestone, resulting in introduced to reduce the above problem. Recent advancements and research in material technology has led to the development of special concretes such as polymer concrete for high durability, fiber reinforced concrete for preventing cracks in concrete, high- and ultra-high- strength concrete for applications in tall buildings and bridges, light weight concrete for reducing foundation loads, and high performance concrete for special performance requirements. In both developing and developed countries, it has been a technological challenge in the field of the design of low cost and durable fiber reinforced cement concrete. The type of fibers currently been used include steel, carbon, polymers, glass and natural fibers. Cost-effective considerations have limited the usage of carbon fibers in cementitious composites on a marketable level for their non-ecological performance. Natural fibers have the potential to be used as reinforcement to special the innate scarcities in cementitious materials. Substantial researches are being done for usage of reinforcing fibers like jute, akwara, sisal, bamboo, sugarcane bagasse, coconut husk in cement composites typically in case of building materials.

JUTE FIBER

India is one of the large jute producing country. Jute is an important best fiber with a number of advantages. Jute has high specific properties, low density, less abrasive behavior to the processing equipment, good dimensional stability and harmlessness. Jute textile is a low cost eco friendly product and is abundantly available, easy to transport and has superior drapability and moisture retention capacity.

OBJECTIVE

- To evaluate the compressive strength of FRC using jute fibers.
- To study the properties of concrete by vibration in percentage of fly ash.
- To find out effect of super plasticizer on properties of jute fiber reinforced concrete having cement replaced with fly ash.

II. LITERATURE REVIEW

Amit Kumar Ahirwar (2016) experimental investigation to study the effects of replacement of cement (by volume) with different percentage of fly ash and effects of adding of processed natural coconut fiber on flexural strength, compressive force, split tensile force and modulus of elasticity was taken up. In this, Cement was replaced with percentage 10,20,30 and 40 % of Class C fly ash and of coconut fibers (0.50 and 1.0%) having 40 mm length were used. Experiment outcome show that the substitute of 43 grades ordinary Portland cement with fly ash showed an increase in compressive strength and flexural strength for the preferred mix proportion. The workability of concrete decreases with the increase in fly ash, the particle of Fly ash

reduces the amount of water required to produce a given slump.

Majid Ali (2015) the mechanical and dynamic properties of coconut fiber reinforced concrete (CFRC) members were well examined. A comparison between the static and dynamic moduli was conducted. The influence of 1%, 2%, 3% and 5% fiber contents by mass of cement and fiber length of 2.5, 5 and 7.5 cm is investigated. Noor Md. Sadiqul Hasan, et.al from Malaysia, have investigated the physical and mechanical characteristics of concrete after adding coconut fiber on a volume basis.

Baruah and Talukdar (2007) Investigated coir fiber reinforced concrete with the volume fraction 0 %, 0.5%, 1.0%, 1.5%, 2.0% by the volume fraction of concrete shows compressive strength, split tensile strength, modulus of rupture, shear strength and toughness continuously increases up to 2% volume fraction concrete

III. EXPERIMENTAL INVESTIGATION

Material testing is essential for the mix design of concrete. It gives the optimum amount of material required for a given strength and workability of concrete. Hence the properties of the following materials were found.

CEMENT:

Cement is a material that has cohesive and adhesive properties in the presence of water. Such cement are called hydraulic cement. Cement is a binding material in concrete, which binds the other material to form a compact mass. Generally OPC is used for all Engineering Construction works. OPC is available in three grades of 33, 43, and 53. In this project, 53 grade cement is used for the experimental study

FINE AGGREGATE :

M-Sand is a substitute of river sand for concrete construction.Manufactured sand is produced from hard granite stone by crushing.The crushed sand is of cubical shape with grounded edges, washed and graded to as a construction material. The size of manufactured sand (M-Sand) is less than 4.75mm.

TEST FOR FINE AGGREGATE

SI.NO	PROPERTIES	M-SAND
1	Specific Gravity	2.84
2	Fineness modulus	2.8
3	Water Absorption	5.4 %

COURSE AGGREGATE :

Construction aggregate, or simply aggregate, is a broad category of coarse- to medium-grained particulate material used in construction, including sand, gravel, crushed stone, slag, recycled concrete and geosynthetic aggregates. Aggregates are the most mined materials in the world. They are irregular broken stone or naturally-occurring rounded gravel used for making concrete. Coarse aggregates for structural concrete consist of broken stones of hard rock like granite and limestone (angular aggregates) or river gravels (rounded aggregates). In our studies 20mm aggregate is used

TEST FOR COARSE AGGREGATE

SI.NO	PROPERTIES	COARSE AGGREGATE
1	Specific Gravity	2.88
2	Impact Value	2.26
3	Water Absorption	0.5 %

Fly ash

Fly ash, also known as flue-ash, is one of the residues generated in combustion, and comprises the fine particles that rise with the flue gases. In this study Low-Calcium Fly ash (ASTMClass F), obtained from Thermal Power Plant at Thoothukudi. The specific gravity of fly ash is 2.23 and fineness of fly ash 4%.

Aggregates are the fine aggregate and coarse aggregate. The M-Sand as the fine aggregate and coarse aggregate from crushed rock, conforming to the requirements of IS 383-1970. 2.1.5

Properties of Fine Aggregate

Property	Fine	Fly ash
Specific gravity	2.84	2.23
Fineness modulus	2.83	4%
Water absorption	1.5 %	-

JUTE FIBER MIX PROCESS

The jute fiber reinforced concrete samples of mix design 1:1.5:3 (cement : sand : coarse aggregate, by weight) were fabricated by following process, for untreated and treated jute fiber reinforced concrete. Initially the chopped fibers of 6 cm length were immersed for 24 h in half of the total volume of water required for the concrete preparation in a container. Next the half of the total amount of cement required was added to wet jute in that container with constant stirring to obtain jut-cement slurry. Sand and rest of cement was mixed with this jute-cement slurry. The remaining amount of water, sand and aggregate was then added and the mixer. The fresh cement concrete thus obtained was cast immediately in molds and allowed to setting.

CASTING ON JUTE FIBERCONCRETE WITH

FLY ASH

CUBE

Ordinary Portland cement is used in the concrete matrix. Normal weight river sand and it is used for the concrete mix and used sand cement ratio and water cement ratio by weight were 1 and 0.34 respectively, and jute fibers are added with different ratios such as 0.5%, 1%and fly ash are added with different ratios such as 10%,15%, 20% & 25% then mixed with the concrete. The jute fiber concrete is poured into the mould. For each specimen type 3 cube sizes are 150 mm x 150 mm x 150 mm are cast to test the characteristic strength of the mix.

Figure: 3.8 Casting on cube

CYLINDER

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The jute fiber concrete is poured into the mould. For each specimen type 3 cylinder sizes are 150 mm diameter and 300 mm height are cast to test the characteristic strength of the mix.

Figure: 3.9 Casting on cylinder

CURING OF SPECIMEN

All the casted conventional and jute fiber concrete specimens such as cube, cylinder were cured by immersing into water for 28 days until the test. The specimens were brought out from water approximately 24 hours before testing and rest at room temperature till testing and rest at room temperature till testing.

MIX RATIO FOR M_{20} :

Cement = 340 Kg/m^3

Water = 140 L

Fine aggregate = 827 Kg/m^3

Coarse aggregate(20mm) = 1312 Kg/m^3

Mix Ratio – 1 : 1.5 : 3

RESULTS AND DISCUSSION

The compressive strength and flexural strength and split tensile strength test on conventional and jute fiber concrete has been conducted and its results have been discussed in this chapter.

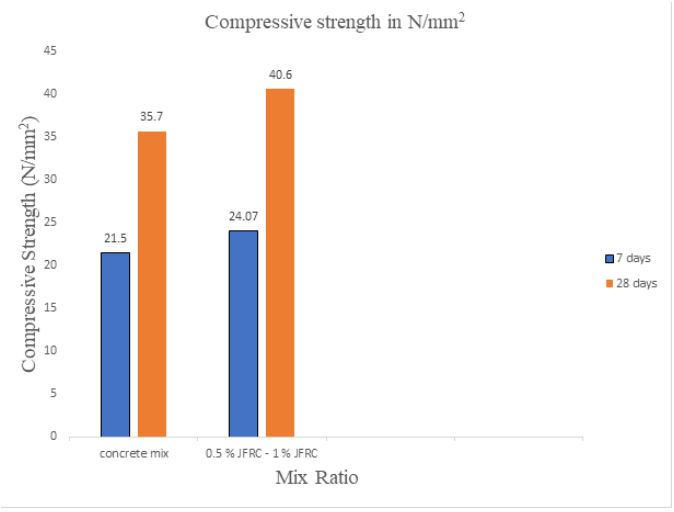
TEST RESULTS ON CONVENTIONAL CONCRETRE

CUBE

Table: 4.1 Test Results on conventional concrete cube Vs JFRC & Fly ash

Days	Compressive strength (MPa)			
	Normal	JFRC	Fly ash content in (%)	Fiber content in (%)
7	21.5	24.07	10 %	0.5 %
14	30.7	34.7	15 %	0.5 %
21	34.6	35.1	20 %	1 %
28	35.70	40.60	25 %	1 %

Optimum value of the cube specimenin1% jute fiber concrete & 25 % Fly ash value for 7 days 24.07 MPa and 28 days 40.60 MPa



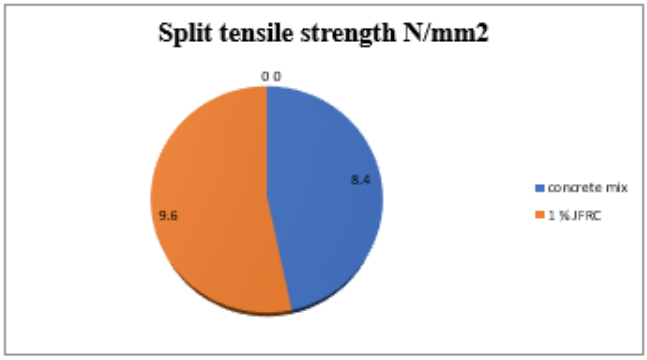
Compressive strength for cube

CYLINDER

Test results on conventional concrete cylinder Vs JFRC

Description	Fiber content in (%)	Fly ash content in (%)	Split tensile strength (MPa) 28 days
Normal	0	0	8.4
JFRC	1	25	9.6

Optimum value of cylinder specimen in 1% jute fiber concrete value for 28 days 9.6 MPa.



Split tensile strength for cylinder

CONCLUSION

The experimental values obtained from compressive strength of cube, flexural strength of beams and split tensile strength of cylinder for normal concrete M_{25} have been compared with jute fiber concrete and fly ash. the optimum value of jute fiber concrete for cubes, prisms and cylinder is 1 % and fly ash is 20 %. The early age of compressive, flexural and split tensile strength of concrete at 7 and 28 days, increasing with decreasing jute content and fly ash.

REFERENCES

1. B.VijayaRamanatha et.al. 'Evaluation of mechanical properties of abaca-jute-glass fiber reinforced epoxy Composite', Materials & Design., Vol.51, p.357-366, October 2013.
2. Tara sen and H.N.Jagannath Reddy on 'Strengthening of RC Beams in flexure using natural fiber textile reinforced composite system International Journal of Sustainable Built Environment, Vol.2, p.41-55, Jan 2013.
3. Pro.veerapuramSridharan and asst professor 'Optimization of machinability of Polyester/Modified

Jute Fabric Composite Using Grey Relational Analysis (GRA)' Procedia Engineering, Vol.64, p.1003-1012, 2013.
4. Prof.Basudam Adhikari and Prof SubhasishBasMajumder Materials Science Centre India Institute of Technology ' Development of jute fiber reinforced cement concrete composites', June 2011.
5. Prof.S.Pravin Kumar on ' Effect of alkai treatment on jute fiber composite', 2007.
6. H.M.Akil, M.F. Omar, A.A.M.Mazuki, S.Safiee, Z.A.M.Ishak, A.Abu Bakar Kenaf, Fiber Reinforced Composites: A Review. Material and Design 2011; 32: 4107-4121.
7. Sandeep Panchal, Dr.Shashikant Sharma. Mohd. Mohsin Khan, Anurag Sharma and Dr. Amrit Kumar Roy. Effect of Glass Reinforcement and Glass Powder on the Characteristics of Concrete. International Journal of Civil Engineering and Technology, 8(3),2017,pp.637-647.
8. T.Nishino, K.Hirao, M.KOTERA, K.Nakamae, H.Inagaki Kenaf, Reinforced Biodegradable Composite. Compos Sci Technol,63 (2003), pp. 1281-1286.
9. Choi, H.; Lim, M.; Kitagaki, R.;Noguchi, T.; Kim, G.;Restrained shrinkage behavior of expansive mortar at early ages. Constr. Build. Mater., 2015, 84, 468-476.
10. Nabi Saheb D, Jog JP. Natural fiber polymer composite: a review. Advanced Polymer Technology 1999; 18:351-63'.

IS CODE BOOK REFERENCE

1. IS 8112-1989: Specification For 43 Grades OPC.
2. IS 456-2000: Plain And Reinforced Concrete Code Of Practice (4th revision).
3. IS 383-1970: Specification And Properties Of Aggregates.
4. IS 3812(1): Specification For Fly Ash And Uses.

TEXT BOOK REFERENCE

1. M.S. Shetty "Concrete Technology".
2. F M Lea "Chemistry of Cement and Concrete"
3. A M Neville " Properties of Concrete"
4. D F Orchard "Concrete Technology"
5. M L Gambhi "Concrete Technology"

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