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AN EXPERIMENTAL INVESTIGATION ON IMPROVING MECHANICAL PROPERTIES OF CONCRETE USING GLASS FIBRE &COCONUT SHELL

[1]M. Manasa,[2]R. Venugopal Naik,[3]S. Sudheer Naik,
[4]T. Kalpana,[5]S.M.Paravez,
[12345] Department of Civil Engineering,
Sanskrithi School of Engineering, Puttaparthi – 515134(A.P),[5], India.

Abstract: A Cement is a binder material with various composition of Concrete but instantly it possesses low tensile strength. The study deals with mechanical properties of glass fiber coconut shell concrete with conventional concrete. The accumulation of fibers arbitrarily dispersed in the composition increases the resistance to cracking, deflection and other serviceability conditions substantially. The outcome of glass fiber coconut shell concrete was to investigate and compare with the conventional concrete. For M30 grade the given of glass fiber is 6 and 8%of volume of cement and replacement of 10% of aggregate with coconut shell, 15cubes and 15 cylindrical specimens were cast and tested to find the mechanical properties like compression, split tensile, for both conventional and glass fiber coconut shell concrete has been studied and the test consequences are compared with the conventional concrete and coconut shell concrete for

M30 Grade. The ultimate load carrying capacity of the cubes, Specimen was 0%, 12.5%, 18.75%, more than that of the normal concrete comparing to 0%, 6%, 8% of glass fiber with replacement of 10%of course aggregate with coconut shell respectively, the load deformation characteristics also improved to large extent over the normal concrete. The enhancement of Compressive strength, Tensile strength, for the GFRC cube different percentage of glass fiber added to the concrete was increasing by 15 to 20% compared to the conventional concrete.

Keywords **– 1. Glass Fibre, 2. Coconut Shell, 3. Mechanical Properties, 4. Compressive Strength, 5. Split Tensile Strength.**

I. INTRODUCTION

Utilization of concrete is increasing at a very high rate due to infrastructural development activities in the world. Concrete is one of the world's most widely used construction material. In addition, Concrete is the second most consumed substance in the world after water. Approximately ten billion tons of concrete is produced every year. Annual production represents one ton for every individual on the planet. There are some negative impacts of more production of concrete like continuous extensive extraction of aggregate from natural resources will lead to its depletion and ecological imbalance. So many researchers are in search of replacing coarse aggregate to make the concrete economical and to extend sustainable development. This environmental reason has generated a lot of concern in the infrastructural development world. The role of sugarcane bagasse, wood chips, plastic waste, fabric waste, polyethylene, rice husk ash, rubber tires, vegetable fibres, paper and pulp industry waste, vegetable fibres, paper and pulp industry waste, peanut shell, waste glass, broken bricks are some cases of replacing aggregates in concrete. Therefore, there is a need to explore and to find out suitable replacement material to substitute the natural stone. Coconut shell has high strength

and modulus properties. Coconuts are being naturally available in nature and since its shells are non-biodegradable; they can be used readily in concrete, which may fulfil almost all the qualities of the original form of concrete. In developed nations, the construction industries have identified many artificial and natural lightweight aggregates (LWA) that have replaced conventional aggregates thereby reducing the size of structural members. Coconut shell is categorized as light weight aggregate. The coconut shell when dried contains cellulose, lignin and ash in varying percentage. The purpose of this research is to disseminate awareness of using coconut shell as partial replacement of coarse aggregate in concrete and determining its compressive strength.

II. LITERATURE REVIEWS

1. Sanjay kumar varma, sagar shrivastava **"Use of coconut shell as substitution of coarse aggregate- an experimental analysis**" coconut shell included – 5, 10, 20 and 30% with 10% replacing of aggregates with coconut shell then obtained 20.10 N/mm2 compression strength at 28 days.

2. Fan Wu, Changwu Liu, Zhaofeng Diao, Bo Feng, Wei Sun, Xiaolong Li, and Shuang Zhao**"Improvement of Mechanical Properties in Polypropylene and GlassFibre Reinforced Peach Shell Lightweight Concrete"** Polypropylene, glassfiber reinforcement and peach shells PP – 0.25, 0.5 and 0.75%, GF – 0.25, 0.5 and 0.75%, PS – 360 kg/m3 , Mix – control, PP25, PP50, PP75, G25, G50 and G75, GF – 19mm, 22mm. Compressive Strength increased up to 6% - 19%, Tensile Strength 0.25% to 0.75, 10.2% - 36.6% and 7.5% - 54.3%, Flexural Strength 0.25% to 0.75%, 6.7% to 17.9% and 5.4% to 38%.

3. Md.Abid Alam , Imran Ahmad , Fazlur RehmanAuthor **"Experimental Study on Properties of Glass Fibre Reinforced Concrete"** M20 – 1:1.5:3, M30 – 1:1.2:1.4, GF – 12mm, W/C ratio of 0.50 and 0.42, GF – 0.02, 0.04 and 0.06 For M20 grade the slump value varies between 90 to 100 mm, The slump value varies between 65 to 75 mm The compressive strength increased 26.6% and 25.78% with respect to M20 and M30 grade. Increased tensile strength were observed to be 24.7% and 26.10%.

4. Jerin M. George, Ashish Babu, George Franco, Aseem Ali P **"Coconut Shell as a Substitute for Coarse Aggregate in Concrete"** replaced by crushed coconut shells in three different percentages namely 25%, 50% and 100% The strength tests done on the different mixes showed that coconut shell concrete where 25% of the coarse aggregate is replaced, shows properties similar to the nominal mix.

5. Farhaz Ahmed, Manju Dominic "**Properties of Glass Fiber Reinforced Concrete:A Review "** M20 – 1:1.5:3 , M30 – 1:1.1:1.2, GF percentage 0.1%, 0.2% and 0.3% by concrete weight After using GFRC the compressive strength increased around 25% to 30%. It resistant against cracking and more durable. It makes concrete impervious.

III. MATERIAL AND METHODLOGY

i) Materials: The PPC cement bag of 50kg, fine aggregates, coarse aggregates, glass fibre, coconut shell and water.

Cement: Pozzolana Portland cement available from local source was used in the investigation. The cement was tested for various proportions as per IS 8112-1989.The various properties of cement are tabulated.

Table 3.1 Testing of Cements

TESTING OF CEMENTS	RESULTS
Initial setting time	30 min
Final setting time	300 min
Fineness modulus	8%

Consistency	31 mm
Specific gravity of cement	3.16

WATER: The potable water available in our campus is used for mixing and curing of concrete.

FINE AGGREGATE: The fine aggregate used for all the specimens in river sand. The fine aggregate used for casting was sieved through IS 4.75 mm sieve. The various properties of fine aggregate are tabulated in table.

Table 3.2 Testing of fine aggregate

TESTING OF FINE AGGREGATE	**RESULTS**
Specific gravity of fine aggregates	2.73
Fineness modulus of fine aggregates	14.5

Table 3.3 Testing of coarse aggregate

TESTING OF COARSE AGGREGATE	**RESULTS**
Specific gravity of coarse aggregate	2.81
Fineness modulus of coarse aggregate	14.5

Coconut shell: Coconut is grown in more than 100 countries. India is the third largest, having cultivation in an area of about two million hectares for coconut production. Yearly output is close to approximately 8000 million nuts with an average of 4300 nuts per hectare (3.18 million tonnes). It also presents serious disposal problems for a local environment, is an abundantly available agricultural waste from local coconut industries. At present, coconut shell has also been burnt to produce charcoal and activated carbon for food and carbonated drinks and filtering mineral water use. The chemical composition of the coconut shell is similar to wood. It contains 33.61% cellulose, 36.51% lignin, 29.27% and ash at 0.61%.

Table 3.4 Coconut shell properties

TESTING OF COCONUT SHELL	**RESULTS**
Specific gravity of coconut shell pieces	1.33
Fineness modulus of coconut shell pieces	6.87

Glass fiber: Glass fibre reinforced concrete (GFRC) also called GRC or FRC is a cementitious, composite material, cast in thin shell shapes for use in construction. Consisting of Portland cement, aggregate, water, alkali-resistant glass fibres, polymer

and additives, the GFRC mix design is custom engineered depending on the requirements of the GFRC project and the GFRC part. Fiber reinforced concrete (FRC) is a concrete made primarily of hydraulic cements, aggregates and discrete reinforcing fibers. This is a composite material consisting of a matrix containing a random distribution or dispersion of small fibers, either natural or artificial, having a high tensile strength. Due to the presence of these uniformly dispersed fbers, the cracking strength of concrete is increased and the fibres acting as crack arresters. This may be attributed to the fact fibres suppress the localization of micro-cracks into macro-cracks and consequently the apparent tensile strength of the matrix increases.

Physical properties of glass fiber: 1. Density -2.50-2.55 g/cc**,** 2. Diameter -10-20 um, 3. Tenacity -6.3-11.7 g/d

- Extension at break (%) -2.5%
- Tensile strength (MPa) -2000-3500
- Young's modulus (GPa) -73
- Melting Point -700C

Table 3.5 Glass fibre Properties

GLASS FIBRE PROPERTIES	FILAMENT
Tensile Strength	3.0 Gpa
Density	2.68 g/cm3
Modulus of Elasticity	72Gpa
Filament diameter	14 microns
specific gravity	2.68
length	12mm

ii) Methodology:

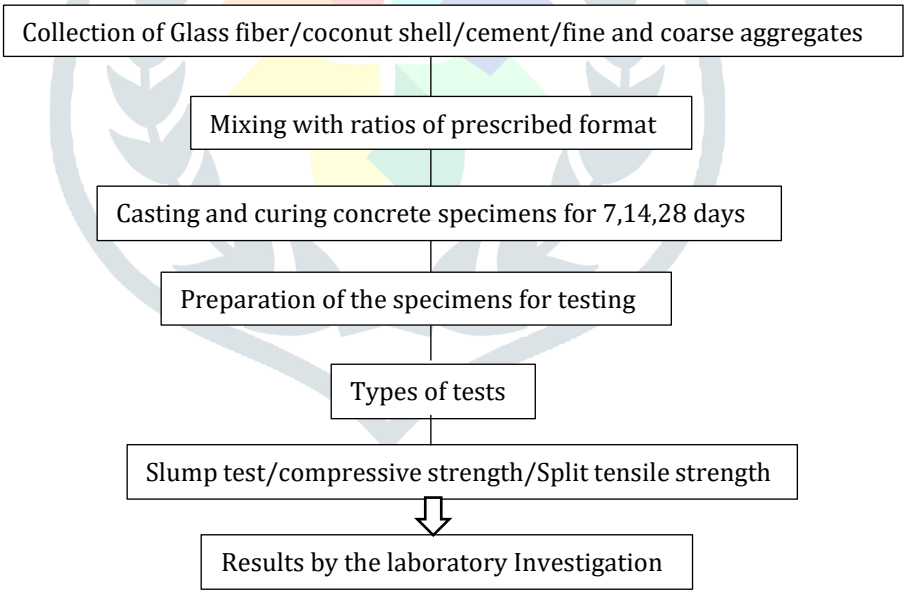


Fig -1: Procedure of making glass fibre & coconut shell concrete

IV. MIX PROPORTIONS

Concrete mix ratios are the proportions of concrete components such as cement, sand, aggregates and water. These mix ratios are decided based on type of construction and mix designs. However, building codes provides nominal and standard concrete mix ratios for various construction works based on experience and testing. These types of concrete mix ratios are discussed in this article.

Table 4.1 Mix proportions

CEMENT	F. A	C.A	WATER	ADMIXTURE
350	886	1110.73	157.6	22.53
1	2.53	3.17	0.45	0.064

V. RESULTS AND DISCUSSIONS

From the experimental studies which were given in the previous chapter comparison of test results are discussed in this chapter. The behavior of RC cube specimen and GFRC with partial replacement of aggregate with coconutshell under cyclic loading are discussed in detail. The Load carrying capacity, Equivalent static Load-Deflection behavior, Failure patterns, Ductility factor, Energy absorption capacity and Stiffness degradation factor of the 6% and 8% of Glass fiber and 10%of coconut shell were compared and discussed.

i) Slump cone test: The mold for the slump test is a frustum of a cone, 300mm (12in) of height. The base is 200mm (8in) in diameter and it has a smaller opening at the top of 100mm (4in). The base is placed on a smooth surface and the container is filled with concrete in three layers, whose workability is to be tested. Each layer is tamped 25 times with a standard 16mm (5/8 in) diameter steel rod, rounded at the end. When the mold is completely filled with concrete, the top surface is struck off (leveled with mould top opening) by means of screening and rolling motion of the tamping rod. The decrease in the height of the center of the slumped concrete is called slump. The decrease in height of concrete to that of mod is noted with scale. (usually measured to the nearest 5mm(1/4in). The slumped concrete takes various shapes, and according to the profile of slumped concrete, the slump is termed as,

1.Collapse slump
2.Shear slump
3.True slump

Figure 5.1 Slump cone test for concrete mix

iii) Compressive strength test

The compressive testing machine (2000 KN capacity) consist of a loading unit, a motorized pumping unit, a digital loading indicator, which are able to illustrate drawing.

Load frame of a steel cross head and machined steel base with solid plate connecting the base and the cross head. The hydraulic jack is fixed on the base. The upper platen has a self-aligning action and is attached to a block protruding from the cross head. The lower platen rests on the jack ram and is positioned centrally with the help of the cantering pin.

Table 5.1 Comparison Results of Compressive Strength for Cube Specimens (150x150x150 mm)

S.NO	PROPERTIES OF THE COMPANION SPECIMENS	AVERAGE COMPRESSIVE STRENGTH VALUE IN N/MM²
1	Normal concrete	37.77
2	6% of Glass Fibre+10%coconut shell	40.44

3	8% of glass fibre +10%coconut shell	42.5

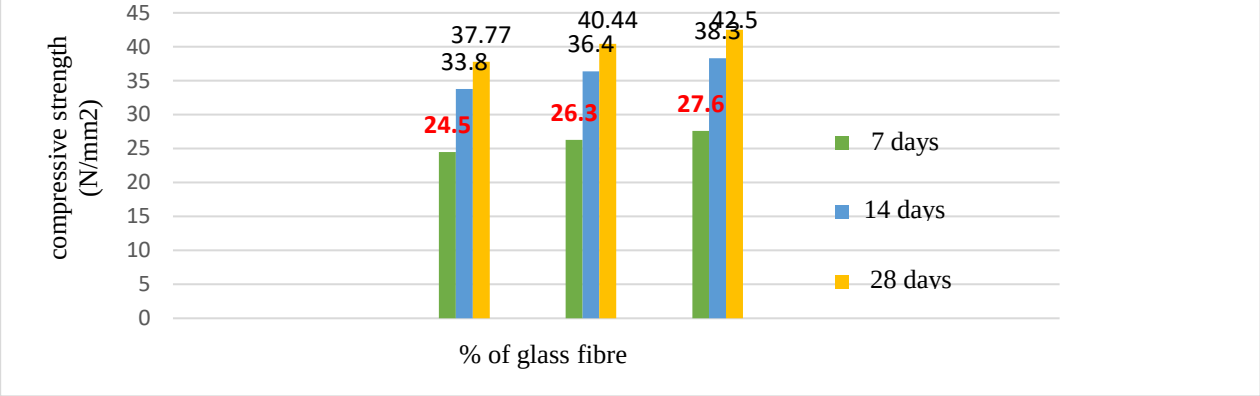


Figure 5.2 Compressive strength for cube specimens

Figure 5.3 Testing compressive strength for cube in UTM

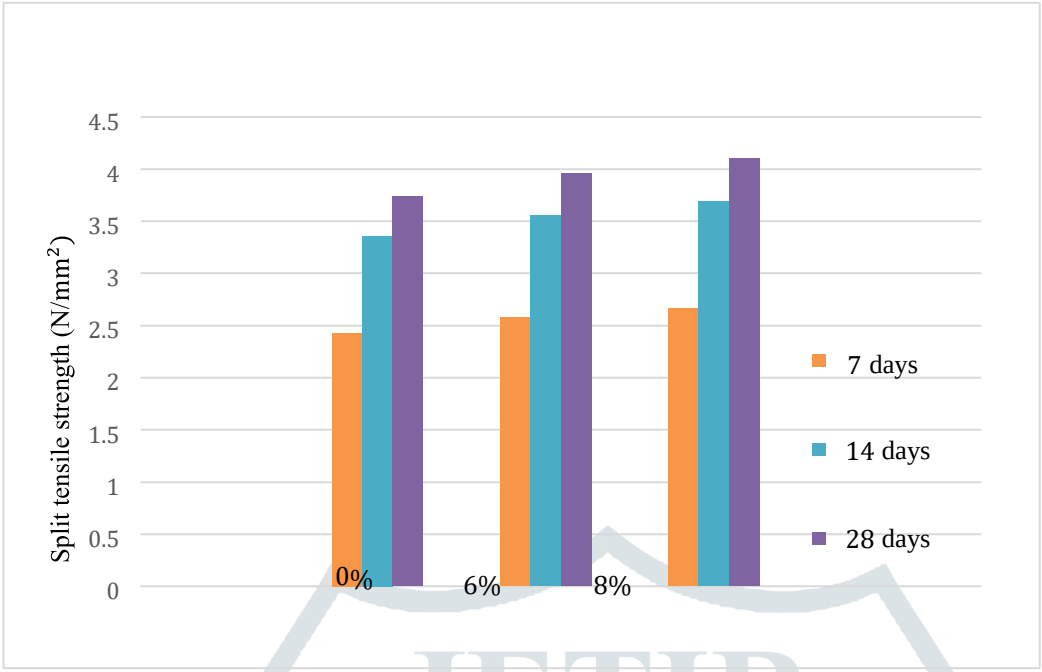
iv) Split tensile strength test for cylinder specimen: The sample size is cylinder of diameter 15 cm and height of 30 cm. The mould used is metal with mean internal diameter of the mould is 15 cm ± 0.2 mm and the height are 30 +/- 0.1 cm.

Figure 5.4 Split tensile strength for cylinder specimens

Table 5.2 Comparison Results of Tensile Strength for Cylinder Specimens (150x300 mm)

s.no	properties of the companion specimens	average tensile strength value in n/mm²
1	Normal concrete	3.74
2	6%glass fiber+10%coconut shell	3.96
3	8%glass fiber+10%coconut shell	4.1

Figure 5.5 Comparison of tensile strength of concrete (cylinder specimens)



IV) CONCLUSIONS

1. An experimental study was carried out on two numbers of GFRC with replacement 10% of aggregate with coconut shell cubes which are tested under forward cyclic loading based on the investigation report in earlier chapters the following conclusions are drawn, they are summarized below.
2. The ultimate load carrying capacity of the cubes, Specimen was 12.5%, 18.75%, more than that of the normal concrete comparing to 6%, 8% of glass fibre respectively, the load deformation characteristics also improved to large extent over the normal concrete.
3. The enhancement in the energy absorption capacity and ductility factor of the GFRC with replacement of 10 % course aggregate with coconut shell is linearly increase by increasing the percentage of the glass fibre added to the concrete. The enhancement of Compressive strength, Tensile strength, Flexural strength for the GFRC cube different percentage of glass fibre added to the concrete was increasing by 15 to 20% compared to the normal concrete.
4. In general, the GFRC with replacement of 10 % course aggregate with coconut shell proves to be an efficient and economical way of increasing the all strength factor for static and dynamic forces excited to the structures.

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