Experimental Study of Partial Replacement of Coarse Aggregate with Coconut Shell and Silica Fume with Cement

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Abstract— Using coconut shell (CS) as replacement should be urged as a priority in environmental concerns and construction cost lowering measure. The stainless-stell scrap material which is usually available in lathe industries are used in modern construction and likewise in pavement construction. The rising cost of structural material is a different concern, the explanation for enhance in cost is large demand of concrete in excess to scarcity of raw materials. Hence many researches are focusing on techniques of using waste material in concrete as to their properties. In this particular study, M25 grade of concrete was prepared by replacing coconut shell by 2.5%, 5%, 7.5% and 10% as a coarse aggregate and in addition to that 1% of Lathe Scrap & 10% of Silica Fume as a replacement of cement is used. Test were carried out to find the compressive strength, split tensile strength & flexural strength using cubes & sorptivity test were conducted to study the durability aspects.

Keywords: Coconut Shell (CS), Coarse Aggregate, Silica Fume

I. INTRODUCTION

Infrastructure development across the world created demands for construction material. Concrete is the premier civil engineering material. Concrete manufacturing involve consumption of ingredients like cement, aggregates, water & admixtures. Among all the ingredients, aggregates form1the major parts. Two billion of aggregate are produced each year in the United States. Production is expected to increase to more than billion tons per year by the year similarly; the consumption of the primary aggregate was 110 million tons in the UK in year 19601and reached nearly 275 on million tones by 2006.

Use of natural aggregates in this sort of charge leads to a query about the upkeep of herbal aggregates sources. In addition, operation associated with aggregates extraction and processing is the primary causes environmental*concern. In light of this within the current civil engineering production, using opportunity substances in vicinity of natural combination in concrete manufacturing makes concrete as sustainable and environmentally friendly construction cloth.

II. MATERIALS AND TESTS

A. Cement:

In the present work, ULTRATECH cement of 53 Grade conforming to IS: 12269-1987 is used. The physical properties of the cement were0tested and are tabulated in Table.

B. Fine Aggregate:

In the present work, Natural River sand was1used as fine aggregate. River Sand is naturally occurring granular material composed of finely divided rock & mineral particles. Sand passing through 4.75mm & retained on 150 microns IS sieve was used as fine aggregate. Test conducted as per IS 2386-1963. It has confirmed that sand comes under zone II.

C. Coarse Aggregate:

The coarse aggregates used were crushed stone type. The aggregates were used as per IS 2383:1970 specifications. The aggregates used were angular in shape. The maximum size of coarse aggregate was limited to 20 mm. Mixture of aggregates between 20-12.5mm & 12.5-10mm was used for better bonding.

D. Water

Water is the major reason for the chemical reactions in the concrete with cement which results in bonding. The quantity and quality of water has to be keenly observed. In this experimental work, ordinary potable tap water available at laboratory which is clean and free from salts, acids, alkalis and other harmful materials was used for mixing the concrete and curing the concrete specimen.

E. Chemical Admixture

The super plasticizer used is Master Glenium Sky 8233. It is manufactured by BASF construction chemical India Pvt. Ltd, Mumbai. It is an1admixture of a latest production based on modified polycarboxylicether. The product is developed for its applications in high5performance concrete. Master Glenium Sky 8233 is free from chloride & low alkali. It is well matched with all types of cements.

F. Coconut Shell

India produces about 20% of coconut produced in the world. Within India, Kerala produces 45% of that. Aggregate made of crushed coconut shell can be effectively used in concrete by partly replacing normal aggregate to a certain amount.

G. Silica Fume

Micro silica is a byproduct silicon metallic or ferrosilicon alloys. The most favorable use for silica fume is it can be used as cementations fabric in concrete. Because of chemical and physical properties of silica fume, it's far a totally reactive pozzolana. The content of silica fume in concrete will boom the electricity and durability.

H. Steel Scrap

The addition of steel scrap to cement concrete increases the engineering properties to high extent and therefore utilization of fiber strengthened concrete is increased day-by-day. The production of just one ton of cement release around one ton of carbon dioxide to the ambiance. The steel industry likewise produces huge impacts to the environment this is the time to consider the sustainable growth and lessen the waste developed or perhaps reuse it. The accessible steel fiber of diverse categories in market is usually considerably expensive.

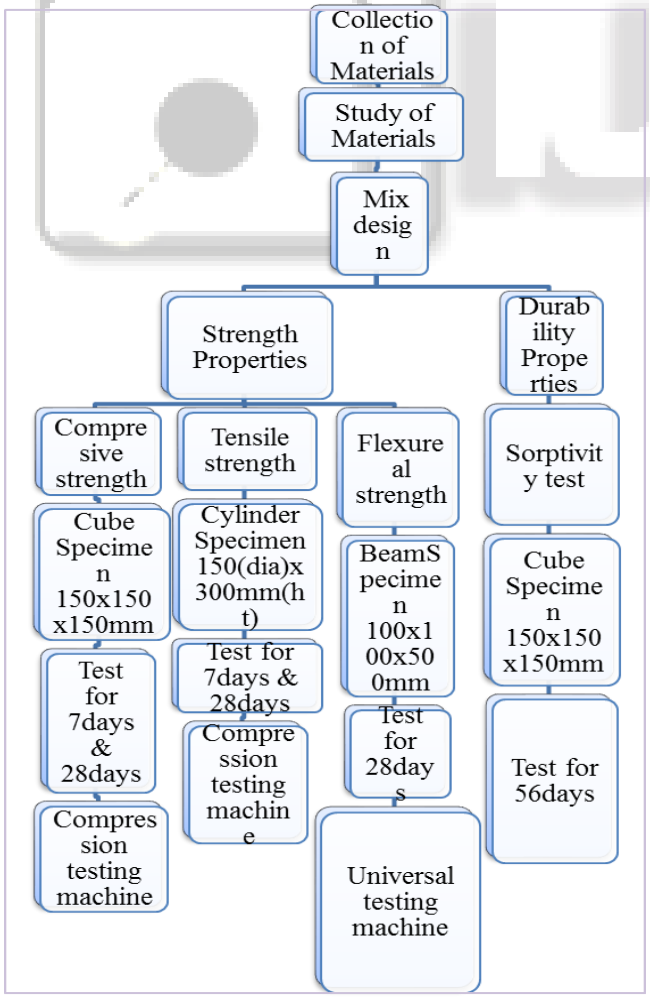
III. MIX DESIGN OF M25 GRADE CONCRETE

Mix Designation	Cement (kg/m^3)	Silica Fume (kg/m^3)	Fine Aggregate (kg/m^3)	Coarse Aggregate (kg/m^3)	Coconut Shell (kg/m^3)	Lathe Scrap (kg/m^3)	Chemical Admixture %
M	330	0	847.60	1147.88	0	0	0.75
M1	297	10	847.60	1147.88	0	0	0.75
M2	297	10	847.60	1147.88	0	1	0.75
M3	297	10	847.60	1119.18	2.5	1	0.75
M4	297	10	847.60	1090.48	5	1	0.75
M5	297	10	847.60	1061.78	7.5	1	0.75
M6	297	10	847.60	1033.1	10	1	0.75

Table 1: Mix Calculation

Super plasticizer (%)	Slump value in mm
0.5	True slump
0.75	98
1	Collapse

Table 2: Variation of Super Plasticizer



IV. METHODOLOGY

A. *Result and Discussion*

Mix	Super Plasticizers	Slump Value in mm
M	0.75%	97
M1	0.75%	98
M2	0.75%	99
M3	0.75%	101
M4	0.75%	102
M5	0.75%	104
M6	0.75%	105

Table 3: Slump Test Results

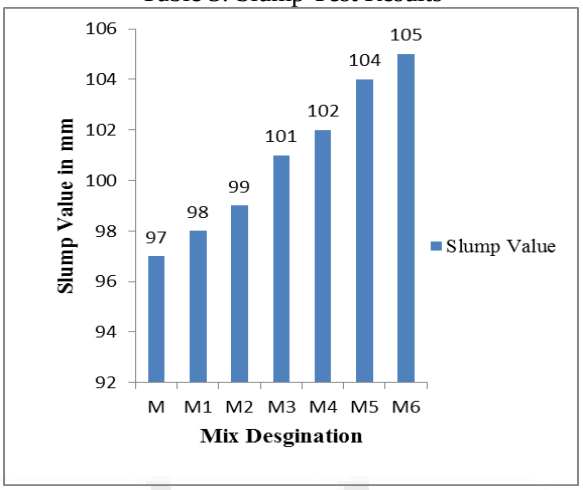


Fig. 1: Compressive Strength Test for 7 and 28 Days

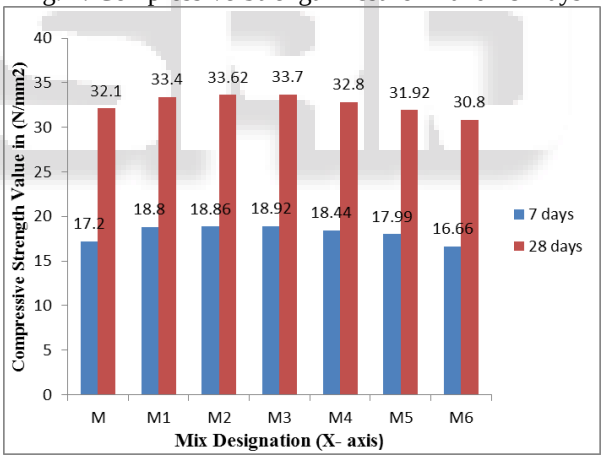


Fig. 2: Compressive Strength Test for 7 and 28 Days

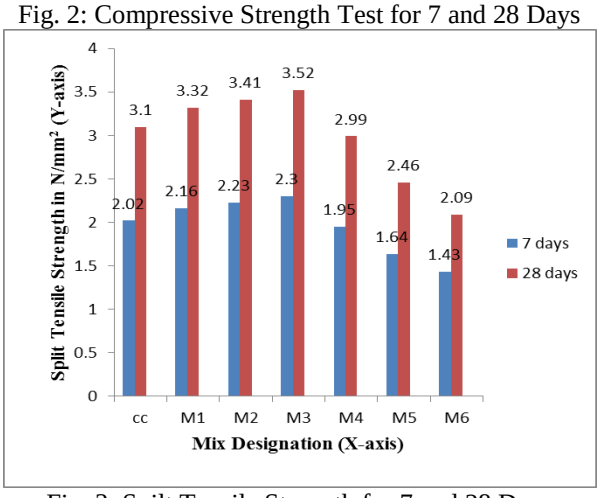


Fig. 3: Spilt Tensile Strength for 7 and 28 Days

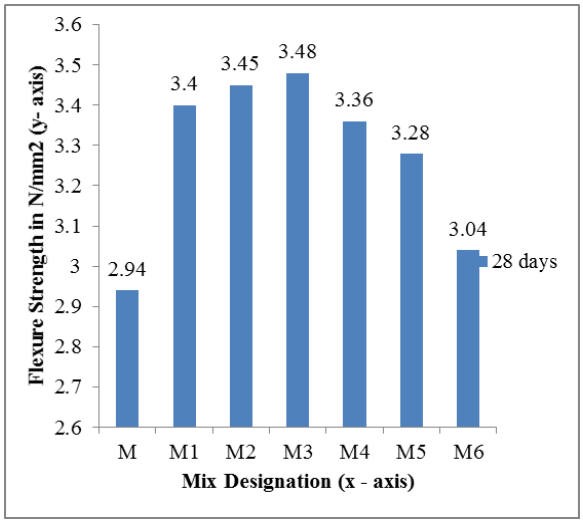


Fig. 4: Flexural Strength for 28 Days

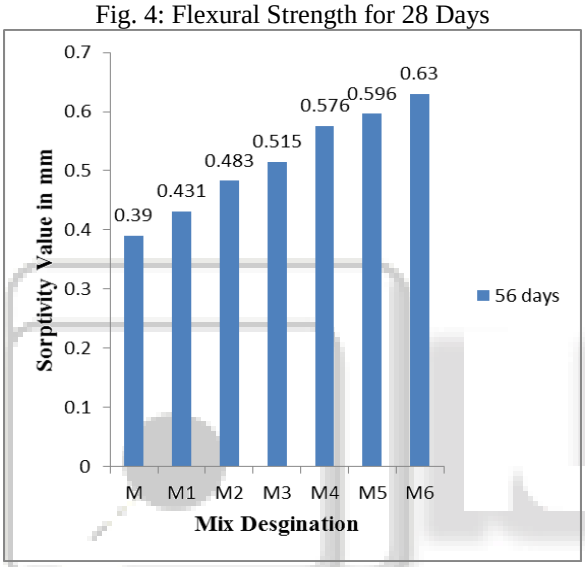


Fig. 5: Sorptivity Test

V. CONCLUSION

Based on the investigation the following conclusion were drawn.

- Workability of concrete increases as the % replacement of coconut shell increases compared to CC.
- Compressive strength of coconut shell based concrete decreases as the % replacement of coconut shell increases. But optimum % replacement found was to be 2.5% M3 mix which is 9.01% more for 7 days & 4.72% more for 28 days compare to CC.
- The split0tensile strength of M3 combination specimen was increased by 13.86% at 7 days and 13.54% for 28 days when compared to normal concrete mix.
- Flexural strength for M3 mix found to be optimum which is 18.36% more compare to CC.
- From sorptivity test it can be conclude that the capillary rise in coconut shell concrete increases linearly as the % replacement of coconut shell increases.
- From above results it0can be concluded that M3 concrete mix shows that better strength properties compared to normal concrete.
- Using coconut shell as replacement should be urged as a environmental security and abundant agricultural waste.
- Coconut shell is more suitable for lightweight aggregate when used to replace common coarse aggregate in concrete production. This can be useful for construction of low cost housing society.

VI. FUTURE SCOPE

- Study may be done, while considering other mineral admixture such as fly ash, GGBS etc.., with coconut shell to understand the strength and durability properties.
- The effect of temperature on the concrete developed can be studied.
- The durability test like0corrosive resistance, sulphate attack test can be taken up.

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