High Strength Concrete Made Using Manufactured Sand, Coconut Shell and Steel Fibre

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Abstract: This experimental study have been carried out to find the combined effect of 50% manufacturing sand as fine aggregate replacement, coarse aggregate with 50% coconut shell and steel, sisal fibres as reinforcement in high strength concrete. From the compressive strength and split tensile strength it was found that increase in fibre content in all the mixes the strength increases gradually.

I. INTRODUCTION

During the last few decades the "waste" materials have seen a transformation to the status of "by-products" and more recently "products" that are sought for construction and other applications. There is several residual material properties suited for concrete production. It can reduce the energy to make concrete, and it is also a more economical concrete than the conventional one. In construction sector there is always a growing demand for finding a suitable material which could effectively replace cement and fine aggregate since manufacture of cement causes environmental pollution and lacking of natural resources to a greater extent. Almost, all over the world have now introduced various measures aimed at reducing the use of primary aggregates and increasing reuse and recycling, where it is technically, economically, or environmentally acceptable. As a result, in developing countries like India, the informal sector and secondary industries recycle 15–20% of solid wastes in various building materials and components, Mathur (2006). Presently in India, about 960 million tones of solid wastes are being generated annually as by - products during industrial, mining, municipal, agricultural and other process. Of this 350 million tonnes are inorganic waste of industrial and mining sectors. However, it is reported that about 600 MT wastes have been generated in India from agricultural sources alone, Asokan Pappu (2007). (cengiz et.al, 2007) studied about concrete containing fly ash of 0%, 15% and 30% and steel fibres of volume fraction 0%, 0.25%, 0.5%, 1% and 1.5% found steel fibre improves the tensile strength, drying shrinkage, freeze – thaw resistance and reduce the workability. The addition of fly ash increase workability reduces unit weight of concrete. They finally concluded addition of 1% volume fraction of fibre increases in compressive strength 15%, tensile strength 30%. (Mueller et.al, 2009) studied with utilising three various fibres. From experimental study they found that combination of all different fibres have increase in ductility. The fibres hold the matrix together even after extensive cracking. (Kulkarni et.al, 2012) have studied the effect of M sand in M 20 grade concrete containing cement 53 grade , manufacturing sand , river sand and coarse aggregate with w / c 0.45. M sand and river sand under zone II according to sieve analysis. The compressive, split tensile, flexural strength of concrete with 60% replacement of natural sand reveals higher strength as compared to reference mix. The overall strength of concrete linearly increases from 0%, 20%, 40% and 60% replacement of natural sand by manufactured sand as compared with reference mix. M sand qualifies itself as suitable substitute for river

sand and reasonable cost ,good gradation and nice finish. Rogo et al (2010) have studied "Exploratory Study of Coconut Shell as Coarse Aggregate in Concrete". They have concluded that, coconut shell as full replacement of coarse aggregate in concrete for nominal mix of M20 (1:1.5:3) achieve 55% compressive strength of control concrete and which can be used for plain cement concrete. The flakiness index is six times greater for coconut shell when compared with gravel. Gsekaran et al (2011) studied the Mechanical and Bond Properties of Coconut Shell Concrete. They found that, the impact resistance of coconut shell aggregate concrete is high when compared with conventional concrete. So it can be used as flexural members. The experimental bond strength of coconut shell aggregate concrete is much higher compared to the theoretical bond strength as stipulated by IS 456:2000 and BS8110. Coconut shell concrete has better workability because of the smooth surface on one side of the shells and also the size of coconut shell used between 10mm to12mm.The splitting tensile strength of coconut shell concrete is 9 to 10% of its compressive strength. The coconut shell aggregate concrete achieve a compressive strength of 26.70 N/mm2 for M20 grade by trial mixes. Abubakar et al (2011) studied using Coconut Shell as Coarse Aggregate in Concrete. They have concluded that, coconut shell aggregate concrete achieve compressive strength of 16.5 N/mm2 for nominal mix (1: 1.5: 3) at 28 days. The cost of coconut shell aggregate concrete is 48% lesser than the cost of gravel used concrete. The specific gravity of coconut shell is lesser than the conventional coarse aggregate. From the results of compressive strength coconut shell concrete can be used as a plain concrete.

II. MATERIALS AND METHODOLOGY

A Materials

OPC as per IS 12269-1987 has been used for making the concrete mixtures with silica fume as 10% replacement for cement in concrete Sand of particles passing through 4.75mm sieve have been used with partially replaced using manufactured Sand and the crushed granite as coarse aggregate has been partially replaced with coconut shell of size 12 to 20mm. The fibres used in the study were hooked steel, and sisal fibres.

Fiber	Properties						
	Average fibre length	Diameter	Aspect ratio	Tensile strength (Mpa)	Specific gravity	Water Absorption (%)	Density in kg/m^3
hooked steel	50	1	50	532	7.85	33.33	7850

In this project coconut shell is used as coarse aggregate. Coconut shell has a surface texture of rough on convex side and smooth on concave side. The thickness of coconut shell is about 1.2mm to 3mm. Coconut shell is crushed manually to a required shape. The crushed coconut shell is flaky in nature and its edges are sharp and spiky. The water absorption of coconut shell is relatively high when compared to the normal natural aggregate so it should be used in Saturate Surface Dry condition. That is coconut shell is soaked in water for 24hours and taken out from water then place it in a dry surface for 3hours at room temperature before the casting of the concrete to avoid absorption of water from the concrete. Concrete mix proportion of 1:1.56:2.78 and water-cement ratio of 0.40 have been used.

B Casting of Specimens Details

Ingredients such as cement, sand, manufactured sand coarse aggregate and coconut shell were mixed together in dry condition in a pan mixer for a period of 2 min. water reducing admixtures were mixed thoroughly with the mixing water and added to the mixer. Finally, fibres were added to the mixer by dispersing it and then allowed to thoroughly mix with all the ingredients of concrete in the mixer itself for a period of at least 5 min thereby uniform dispersion of fibres were ensured.

C Mix Proportion (kg/m3)

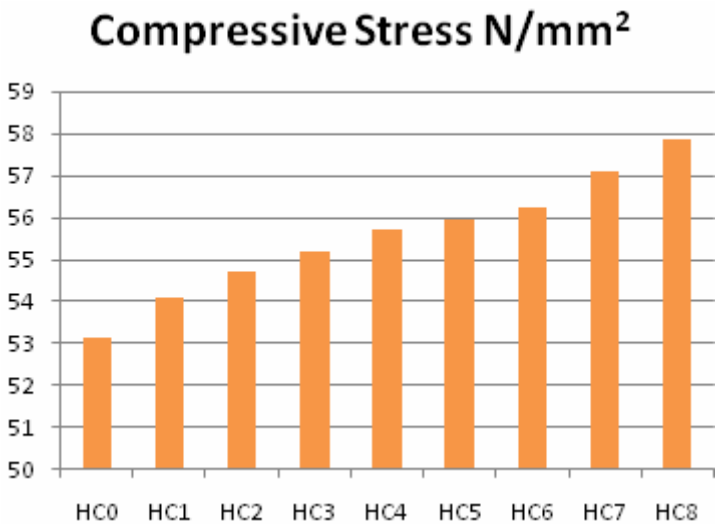
S.No	Cement	Silica fume	Fine Aggregate	M.Sand	Coarse Aggregate	Coconut Shell	Steel (%)
HC0	340	60	312	312	556	556	-
HC1	340	60	312	312	556	556	0.25
HC2	340	60	312	312	556	556	0.50
HC3	340	60	312	312	556	556	0.75
HC4	340	60	312	312	556	556	1.00
HC5	340	60	312	312	556	556	1.25
HC6	340	60	312	312	556	556	1.50
HC7	340	60	312	312	556	556	1.75
HC8	340	60	312	312	556	556	2.00

D Testing Procedure

The compressive strength test on cube (150mm) specimens and split tensile strength test on cylinder (150mm diameter and 300mm length) specimens at 28 days were carried out using universal testing machine.

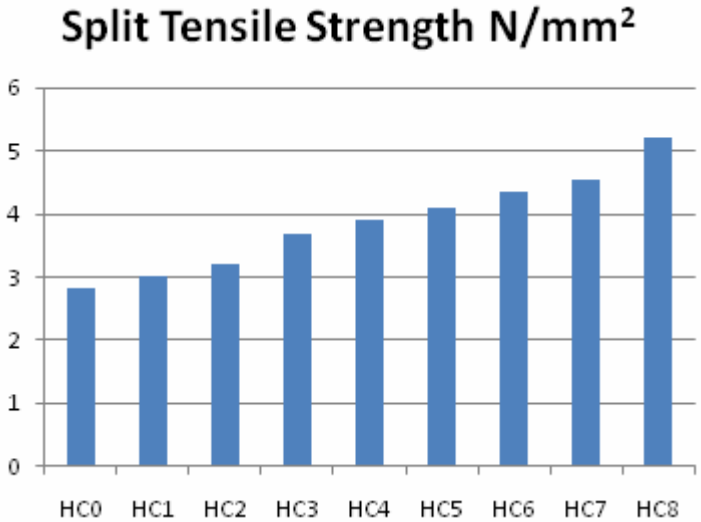
III. RESULTS AND DISCUSSION

A Compressive Strength



From the 28 days compressive strength results it is found that mix with partial replacement of M.Sand 50% for fine aggregate and 50% of 20mm aggregate using coconut shell as partial replacement for coarse aggregate with steel fibre proportionally varying from 0 to 2% at 0.25% interval. The compressive strength increases gradually due to increase in fibre percentage.

B Split tensile strength



From the Split tensile strength results it is found that due to increase in steel fibres the reduction of crack development at earlier stage which increases the split tensile strength gradually.

IV. CONCLUSION

From the result it was found that the 15% of silica fume, 50% manufacture sand and 50% coconut shell with 2% steel fibres have increased both strength and the splitting tensile strength of high strength concrete have improved very high.

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