A Concrete Made Using Manufactured Sand, Steel and Sisal Fibres

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Abstract - This paper focuses on the experimental investigation carried out to find the combined effect of manufacturing sand as fine aggregate replacement, steel, sisal fibres. Here the compressive strength test on cube specimens and split tensile strength test on cylinder specimens at 28 days were carried out. From the result it is found that upto 60% replacement with manufacture sand the compressive strength increases. The split tensile strength increases due to presence of fibres and then decreases due to initial crack development.

I. INTRODUCTION

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. (Okan.K et.al, 2007) have 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%. (G.M.Ganesh et.al, 2011) added fly ash and silica fume on high strength concrete. They found addition of silica fume provides an early strength and fly ash provides long term strength. The addition of 6% silica fume to different fly ash proportion has a high compressive strength than 10% silica fume. (Ward et.al, 2002) have studied the effect of silica fume and fly ash on heat of hydration of Portland cement. Silica fume simply went up the stack as smoke vented into the atmosphere. Silica fume is a by-product produced from silicon metal or ferrosilicon alloys. Silicon metal and alloy are produced in electric- arc furnaces the raw intensity and durability it also can improve the material overall performance as filler. Measurements of heat of hydration were carried out under isothermal conditions. The test results indicate that silica fume accelerates cement hydration at high water/Cement ratio and retards hydration at low water/cement ratio. The addition of silica fume alters the hydration process in the period of 2-20 hours after the start of hydration. Initial hydration of the cement is usually accelerated by the presence of silica fume. (Ribakov et.al, 2009) have studied with utilising three different 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. (Jadhav 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.
(uma et.al, 2012) studied the optimization of partial replacement of manufactured sand by natural sand with silica fume in High Performance Concrete. Addition of up to 50% of manufactured sand as sand replacement yielded comparable strength with that of the control mix. Further additions of manufactured sand caused reduction in the strength. The concrete with partial replacement of 5% cement with silica fume shows 18.8% greater compressive strength than conventional concrete when compared to 2.5 % and 1.5% of the silica fume. Average increase in compressive strength of concrete was found to be 11%, 12%, 18.8% and 5% for partial replacement of natural sand by M-Sand with 10 %, 30 %, 50% and 70%. The percentage of increase in the compressive strength is 18.88% and the flexure strength is 13.2% at the age of 28 days by replacing 50% of natural sand with M Sand and 5% of cement by silica fume.

II. MATERIALS AND METHODOLOGY

2.1 Materials

Ordinary Portland cement conforming to IS 12269-1987 has been used for making the concrete mixtures. Fine aggregate is partially replaced with manufactured Sand and the crushed granite as coarse aggregate. The fibres used in the study were hooked steel, and sisal fibres.

Properties	Sisal Fibre	hooked steel
Average fibre length	60	50
Diameter	0.75	1
Aspect ratio	80	50
Tensile strength (Mpa)		532
Specific gravity		7.85
Water Absorption (%)		33.33
Density in kg/m^3		7850

2.2 Casting of Specimens Details

Ingredients such as cement, sand, manufactured sand and coarse aggregate 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.

2.3 Mix Proportion (kg/m^3)

S.No.	Cement	Fine Aggregate	M.Sand	Coarse Aggregate	Steel	Sisal
1	380	570	-	1140	-	-
2	380	456	114	1140	1	1
3	380	342	228	1140	1	1
4	380	228	342	1140	1	1
5	380	114	456	1140	1	1
6	380	-	570	1140	1	1

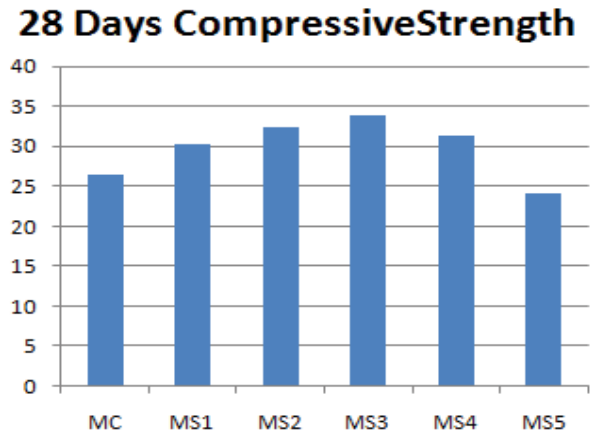
2.4 Testing Procedure

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

3.1 Compressive Strength

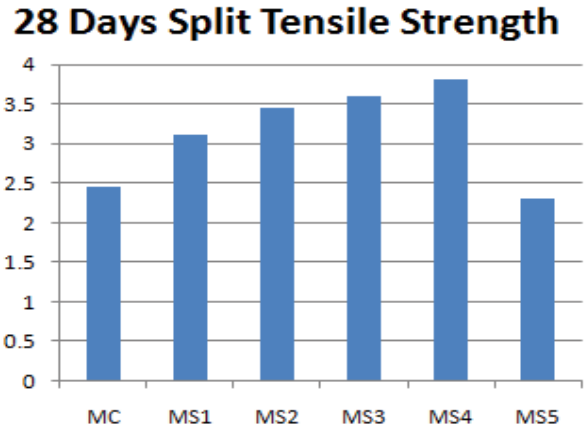
The results of 28 days cured compressive strength is shown below.



From the 28 days compressive strength results it is found that due to increase of M.Sand content from 0%, 20%, 40%, 60%, 80%, 100% as fine aggregate partial replacement. The compressive strength increases upto 60% replacement beyond that strength decreases.

3.2 Split tensile strength

The results of 28 days cured Split tensile strength is shown below.



From the 28 days Split tensile strength results it is found that due to increase of M.Sand content from 0%, 20%, 40%, 60%, 80%, 100% as fine aggregate partial replacement with steel and sisal fibres which induces the crack development at later stage which also increases the split tensile strength.

IV. CONCLUSION

From the result it was found that the manufacture sand can be used as partial replacement for fine aggregate which will reduce the cost and also the scar of natural resources. As for the strength it is found that increases upto 60%. Due to the presence of higher and lower modulus fibre the split tensile strength also increases with the partial replacement of fine aggregate.

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