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An Experimental Investigation on High Strength Self-Compacting Concrete Using Jute Fibre

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Abstract— Self-Compacting Concrete gets dense and compacted due to its own self weight. Experimental investigations have to been carried out to determine different characters like workability and strength of self-compacting concrete (SCC) with jute fibre. Short discrete vegetable fibres namely sisal, coir and jute have been examined for their suitability for incorporation in cement concrete. Jute is a natural fibres obtained from a plant which look like giant pineapples and during harvest the leaves are cut as close to the ground as possible. The soft tissues are scrapped from the fibres by hand or machine. The fibres are dried and brushes remove the remaining dirt, resulting in a clean fibre. The concrete is required to have properties like high strength, high durability, better serviceability and long life of concrete structures. Tests involving various fibre proportions for a particular mix design of SCC. Test methods used to study the properties of fresh concrete were slum test, flow test and compacting factor test. The properties like compression, Tensile and Flexural strength of SCC were also investigated by taking tests casting cube, cylinder and beams after curing of 7 and 28 days.

Keywords—**Self Compacting Concrete, Workability, Segregation, Aggregate, Super plasticizer, Fly Ash, Jute fibre**

I. INTRODUCTION

Self-Compacting Concrete (SCC), which flows under its own weight and does not require any external vibration for compaction, has revolutionized concrete placement. SCC, was first introduced in the late 1980's by Japanese researchers, is highly workable concrete that can flow under its own weight through restricted sections without segregation and bleeding. Such concrete should have a relatively low yield value to ensure high flow ability, a moderate viscosity to resist segregation and bleeding, and must maintain its homogeneity during transportation, placing and curing to ensure adequate structural performance and long term durability. The successful development of SCC must ensure a good balance between deformability and stability. Researchers have set some guidelines for mixture proportioning of SCC, which include i) reducing the volume ratio of aggregate to cementations material; (ii) increasing the paste volume and water-cement ratio (w/c); (iii) carefully controlling the maximum coarse aggregate particle size and total volume; and (iv) using various viscosity enhancing admixtures (VEA).

For SCC, it is generally necessary to use super plasticizers in order to obtain high mobility. Adding a large volume of powdered material or viscosity modifying admixture can eliminate segregation. The powdered materials that can be added are fly ash. Since, self-compatibility is largely affected by the characteristics of materials and the mix proportions, it becomes necessary to evolve a procedure for mix design of SCC. Okamura and Ozawa have proposed a mix proportioning system for SCC.

This project describes a procedure specifically developed to achieve self-compacting concrete. In addition, the test results for acceptance characteristics for self-compacting concrete such as slump flow, V-funnel and L-Box are presented. Further, the strength characteristics in terms of compressive strength for 7-days and 28-days are also presented.

II. OBJECTIVES

- L To determine the workability of SCC using slump come test, U-tube test, L-box test, V-funnel test.
- To study the strength characters of SCC like compressive strength, flexural test and split tension strength.
- To study the strength and behaviour of SCC while using jute fibres to the SCC
- To study the mix proportion for SCC material with jute fibres using standard codes of practice

III. MATERIAL PROPERTIES

For The materials used in this study were ordinary Portland cement of 53 grades conforming to IS: 8112, natural river sand, coarse aggregate of maximum size 12.5, fly ash from Mettur thermal power plant station, high range water reducing admixture of type Glenium B233, viscosity modifying agent of type Glenium stream 2, portable tap water available in the laboratory. The properties of these materials used in this project are explained below.

A. Cement

Cement is a binder, a substance used in construction that sets and hardens and can bind other materials together. The most important types of cement are used in the components in the production of mortar in masonry, and of concrete, which is a combination of cement and an aggregate to form strong building materials.

Concrete produced from Portland cement is one of the most versatile construction materials available in the world.

The Portland pozzolana cement of 53 grade conforming to IS: 8112: 1989 was used for the present experimental study.

The important properties of this cement have been tested and given below

Specific gravity of cement = 3.15

Initial setting time of cement = 35 min

Fineness modulus of cement = 1.75

B. Fly Ash

Fly-ash also known as ‘Pulverized Fuel Ash’ is one of the coal combustion produce, compost of the fine particles that are driven out of the boiler with the flue gases. Ash that falls in the bottom of the boiler is called bottom ash.

In modern coal fired power plants, fly-ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys. Together with bottom ash removed from the bottom of the boiler. It is known as coal ash.

TABLE 3.1 PHYSICAL PROPERTIES OF FLY ASH

S.no	Properties	Values
1	Fineness Modulus	78.60
2	Specific Gravity	2.10

TABLE 3.2 CHEMICAL PROPERTIES OF FLY ASH

S.no	Properties	Value in %
1	Silica	59.62
2	Alumina	26.43
3	Iron oxide	6.61
4	Calcium oxide	1.2
5	Magnesium oxide	0.76
6	Sulphur trioxide	0.58
7	Titanium oxide	1.56
8	Loss of ignition	1.76

C. Fine Aggregate

Nature river sand or M-sand with fraction passing through 4.75mm sieve and on 150um sieve was used and tested as per IS:2386:1983. The important properties tested for fine aggregate are given below

Specific gravity of fine aggregate = 2.72
Fineness modulus of fine aggregate = 2.85
Bulk density of fine aggregate = 1487.6kg/m3

D. Coarse Aggregate

Crushed granite coarse aggregate of size 12.5mm was used and tested as per IS: 2386:1983. The important properties tested for coarse aggregate are given below

Specific gravity of coarse aggregate = 3.02
Bulk density of fine aggregate = 1652.89 kg/m3

E. Water

Portable tap water available in laboratory with pH value of 7.0 + 1 and confirming to the requirement of IS:456:2000 was used for mixing concrete and curing the specimen as well

F. Admixtures

Glenium b233 and Glenium Stream 2 are confirming to the to the requirement of IS:9103:1979 as a high range water reducing admixture and Viscosity Modifying Agent was used in this study.

G. Jute Fibers

India is one of the large jute producing country. Jute is an important bastfibre 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.

Figure 3.1 Jute fibres

IV. MIX PROPORTIONS

A. General

The target mean strength of 25 MPa for the OPC control mixture the total binder content, fine aggregate and coarse aggregate is taken and the water to binder ratio was kept constant as 0.4 and the maintain a slump of (50-100 mm) for all mixtures.

The total mixing time was 3 minute, the samples were then casted and left for 24 hours after de-molding. They were then placed moisture content were taken into consideration and appropriately subtracted from the water/cement ratio used for mixing.

Experimental investigation of fresh mix Properties of conventional concrete was conducted based on IS: 516 - 1959 using a slump cone. Compressive and Flexural strength of each specimen was determined using IS: 516 – 1959 and splitting tensile strength of each specimen was determined using IS: 5816 - 1959. Length change was measured according to IS: 516 - 1959.

Cube with dimension of 150 × 150 × 150mm for compressive strength, prism with dimensions of 100 x 100 x 500 mm for flexural tensile strength, cylinder with 150 mm diameter and 300 mm height for Split tensile strength were used for casting. The concrete was left in the mould and allowed to set for 24 hours before the cubes were de moulded and placed in curing tank. The concrete cubes were cured in the tank for 7, 14 and 28 days.

B. Mix Design for M25 Grade Concrete

Design of M25 concrete mix as per: 10262-2009, B-9 Mix Proportions for Trail Number 1
Cement = 383.2 kg/m3
Water = 191.6 liters
Fine aggregate = 800.94 kg/m3
Coarse aggregate =1087.75 kg/m3
Water-cement ratio= 0.4

Table 4.1 M25 Concrete Mix Proportion.

S.No	Grade of concrete (N/mm2)	Cement	Fine Aggregate	Coarse aggregate	W/C
1.	25	1	1	2	0.4

Table 4.2 Material Quantity Ratio.

Grade of concrete (N/mm2)		Cement	Fine Aggregate	Coarse aggregate	W/C
40	Quantity	1	1.65	2.45	0.4
	Ratio	383.2 kg/m3	800.94 kg/m3	1087.75 kg/m3	191.6kg/m

V RESULT AND DISCUSSION

A. General

The experimental investigation is to find out the M25 grade design ratio of conventional concrete test report on this section. Here using the ratio of concrete mix is 1:1:2. IS 10262-2009 and IS 456 – 2000 codes are using to find the conventional concrete test. The normal concrete with water cement ratio of 0.5. 7 days and 14 days compressive strength, split tensile and flextural test were studied.

Table 5.1 Conventional Concrete Compression Strength Results for M25 Grade of Concrete

S.No	Mix Ratio	7 Days N/mm²	14 Days N/mm²
1	1:1.65:2.45	16.2	20.2
2		16.9	19.5
3		16.5	18.9

Fig 5.1 Compression Strength Results for M25 Grade Of Concrete

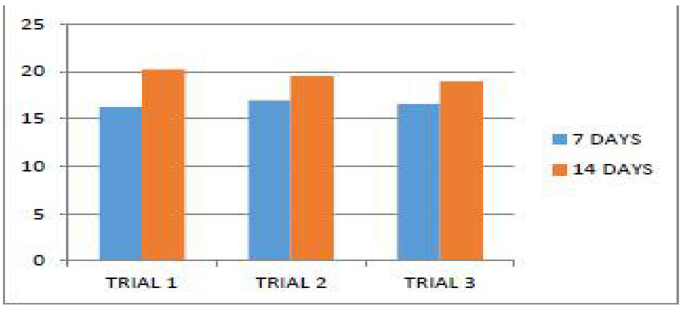


Table 5.2 Conventional Concrete Split Tensile Results for M25 Grade of Concrete

S.No	Mix Ratio	7 Days N/mm²	14 Days N/mm²
1	1:1.65:2.45	1.75	2.10
2		1.80	2.23
3		1.72	2.19

Fig.5.2 Split Tensile Result for M25 Grade of Concrete

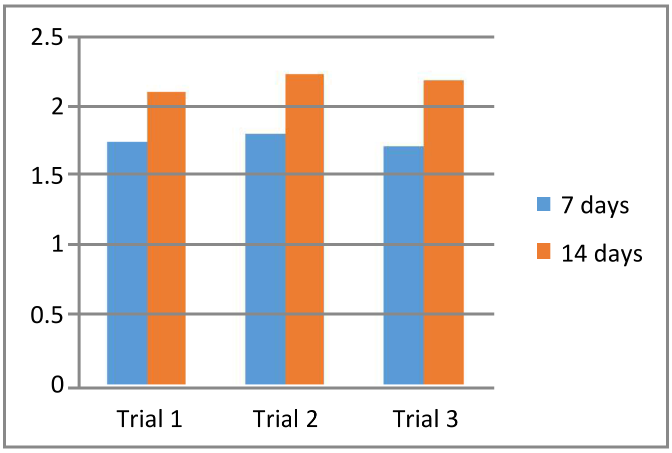
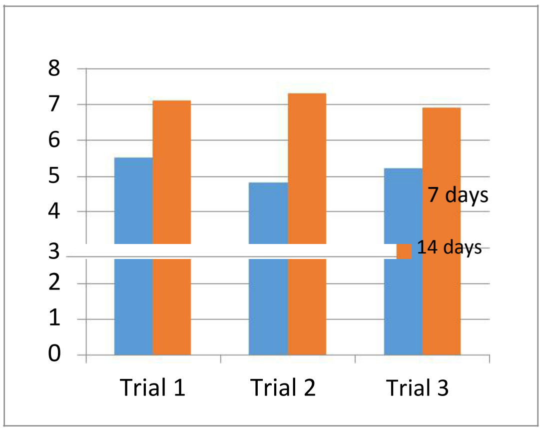


Table 5.3 Conventional Concrete Flexural Strength Results for M25 Grade of Concrete

S.No	Mix Ratio	7 Days N/mm²	14 Days N/mm²
1	1:1.65:2.45	5.5	7.1
2		4.8	7.3
3		5.2	6.9

Fig.5.3 Flexural Strength Result for M25 Grade of Concrete



VI CONCLUSION

Thus the results is improved by using the jute fiber technology. It improves the range of Compression Strength, flexural strength compared to the normal concrete. The comparison is done for 7 and 14 days for conventional concrete. Maximum 20% of the range can be improved by using the jute fiber technology. Which has been implemented by next phase. In future the following process are going to be done,

- Testing of Compressive Strength, Split Tensile Strength and Flexural Strength for SCC and SCC Using Jute Fibre
- Deflection Test for Conventional Beam, SCC Beam and SCC Using Jute Fibre Result

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