[Anwar, 3(10): October 2016]
DOI- 10.5281/zenodo.161804

ISSN 2348 -8034
Impact Factor-4.022

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

EXPERIMENTAL STUDY ON STRENGTH CHARACTER OF TERNARY BLENDED FIBRE REINFORCED SELF COMPACTING CONCRETE

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ABSTRACT

Generally SCC requires a large content of binder and chemical admixtures Compared to ordinary concrete; its material cost is generally 20-50% higher, which has been a major hindrance to a wider implementation of its use. There is growing evidence that incorporating high volumes of mineral admixtures and micro fillers as partial replacement for Portland cement in SCC can make it cost effective. However, the strength and durability of such SCC needs to be proven. Compared to normally vibrated concrete, self-compacting concrete possesses enhanced qualities and improves productivity and working conditions due to elimination of compaction. SCC generally has higher powder content than Normally Vibrated Concrete (NVC) which can increase cost and also cause temperature rise during hydration as well as possibly affect other properties such as creep and shrinkage, thus it is necessary to replace some of the cement by additions to achieve an economical and durable concrete.

Concrete is most widely used construction material because of ease of construction and its properties like compressive strength and durability. It is difficult to point out another material of construction which is versatile as concrete. It is well known that plain concrete is very good in resisting compressive strength but possesses low specific modulus, limited ductility and little resistance to cracking. Internal micro cracks inherently present in the concrete and its poor tensile strength is due to propagation of such micro cracks eventually leading to brittle failure of concrete. The inclusion of fibers in SCC will extend its benefits. To improve strength properties it is useful to reinforce the concrete with fibers. Steel fibers are having good tensile strength and are also chemically inert, so a trail is made to improve the Self Compacting Concrete properties. In this article steel fibers were used, and the effects of fiber inclusion on the workability of fiber reinforced self-compacting concrete (FR-SCC) is studied. It is observed that there is an overall improvement of all the properties of SCC with the blend of Fly Ash, Rice Husk Ash, Steel Fibers, Sika Viscocrete to improve the cement dispersion.

***Keywords:-** Strength Character, Ternary Blended fibre, Concrete etc.*

I. INTRODUCTION

Mechanism For Achieving Self-Compactbility

The method for achieving self-compactability involves not only high deformability of paste or mortar, but also resistance to segregation between coarse aggregate and zone of reinforcing bars (Okamura and Ozawa). Homogeneity of SCC is its ability to remain unsegregated during transport and placing.

Following methods were adopted by (Okamura and Ozawa) to achieve selfcompactibility

- Limited aggregate content
- Low water-powder ratio
- Use of super plasticizer

The frequency of collision and contact between aggregate particles can increase as the relative distance between the particles decreases and then internal stress near obstacles. Research has found that the energy required for flowing is consumed by the increased internal stress, resulting in blockage of aggregate particles. Limiting the coarse aggregate content, whose energy consumption is particularly intense, to a level lower than normal is effective in avoiding this kind of blockage. Highly viscous paste is also required to avoid the blockage of coarse aggregate when concrete flows through obstacles. When concrete is deformed, paste with a high viscosity also prevents localized increases in internal stress duetotheapproach of coarse 5 aggregate particles. High deformability can be achieved only by the employment of a super plasticizer, keeping the water/powder ratio to a very low value. Although SCC has many advantages, it also has some difficulties to be implemented locally, as its supply list is 2 to 3 times higher than that of Normal Cement Concrete (NCC) such a high premium has somehow limited SCC application to general construction. SCC is specified only to areas where it is must needed.

1.1 Reinforced Concrete

Reinforced concrete is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength. The reinforcement is usually steel reinforcing bars and is usually embedded passively in the concrete before the concrete sets. Reinforcing schemes are generally designed to resist tensile stresses in particular regions of the concrete that might cause unacceptable cracking and/or structural failure. Modern reinforced concrete can contain varied reinforcing materials made of steel, polymers or alternate composite material in conjunction with rebar.. Reinforced concrete may also be permanently stressed (in compression), so as to improve the behaviour of the final structure under working loads. The weakness in tension can be overcome to some extent by the inclusion of a sufficient volume of certain fibers. The use of fibers also alters the behavior of the Fiber -matrix composite after it has cracked, thereby improving its toughness.

1.2 Fiber Reinforced Concrete

Fiber reinforced concrete (FRC) may be defined as a composite materials made with Portland cement, aggregate, and incorporating discrete discontinuous fibers. Plain, unreinforced concrete is a brittle material, with a low tensile strength and a low strain capacity. The role of randomly distributes discontinuous fibers is to bridge across the cracks that develop provides some post- cracking "ductility". If the fibers are sufficiently strong, sufficiently bonded to material, and permit the FRC to carry significant stresses over a relatively large strain capacity in the post-cracking stage. There are, of course, other (and probably cheaper) ways of increasing the strength of concrete. The real contribution of the fibers is to increase the toughness of the concrete (defined as some function of the area under the load vs. deflection curve), under any type of loading. That is, the fibers tend to increase the strain at peak load, and provide a great deal of energy absorption in post-peak portion of the load vs. deflection curve.

1.3 Effect of Fibers in Concrete

Fibers are usually used in concrete to control cracking due to plastic shrinkage and to drying shrinkage. They also reduce the permeability of concrete and thus reduce bleeding of water. Some types of fibers produce greater impact–, abrasion–, and shatter–resistance in concrete. The amount of fibers added to a concrete mix is expressed as a percentage of the total volume of the composite (concrete and fibers), termed "volume fraction" The aspect ratio (l/d) is calculated by dividing fiber length (l) by its diameter (d). Fibers with a non-circular cross section use an equivalent diameter for the calculation of aspect ratio. If the fiber's modulus of elasticity is higher than the matrix they help to carry the load by increasing the tensile strength of the material. Increasing the aspect ratio of the fiber usually segments the flexural strength and toughness of the matrix. However, fibers that are too long tend to "ball" in the mix and create workability problems. The most important contribution of fiber reinforcement in concrete is not to strength but to the flexural toughness of the material. When flexural strength is the main consideration, fiber reinforcement of concrete is not a substitute for conventional reinforcement. The greatest advantage of fiber reinforcement of concrete is the improvement in flexural toughness.

1.4 Rice Husk Ash

Rice husk ash is obtained by burning rice husk in a controlled manner without causing environmental pollution. When it is properly brunt it has high SiO2 content and can be used as a concrete admixture. Rice husk ash exhibits high Pozzolonic characteristics and contributes to high strength and high impermeability of concrete. Rice husk ash essential consists of amorphous or non-crystalline silica with about 85- 90% cellular particle, 5% carbon and 2%

K2O. The specific surface of RHA is between 50000-100000 m2/kg. India produces about 122 million ton of paddy every day. Each ton of paddy produces about 40 kg of RHA. There is a good potential to make use of RHA as a valuable Pozzolonic material to give almost the same properties as that of microsilica. In USA highly Pozzolonic rice husk ash is patented under the trade name of Agrosilica and is marketed.it is having super Pozzolonic property when used in small quantity i.e. 10% by weight of cement and it greatly enhances the workability and impermeability of concrete.

II. LITREATURE REVIEW

Lappa[7] (2003) Developed SCC, fiber reinforced high strength mortars at delft university of technology, netherlands for the construction of sheet piles. In this study it was investigated if aggregate, available at the local dutch market as sand in large quantities with a maximum diameter of 2mm, could be used instead of the previously developed laboratory aggregates composed out of separate fractions. The mixtures were tested on their workability and SCC in the fresh state. The compressive strength, young's modulus, flexural strength and fracture energy were determined in the hardened state.

E.B. Pereira, J.A.O. Barros, A.F. Ribeiro, A. Camoes[8] (2003) had conducted the post cracking behavior of SFRSCC, adding the benefit of SCC to those resulting from the addition of discrete fibers to cement based materials, a high performance material, designated by SFRSCC, is obtained. In the present work the strategy followed to design SFRSCC is described, as well as, the experimental research carried out to characterize its flexural and compression behavior. A special effort is done to assess the post cracking behavior, carrying out three point notched beam tests.Kong hyun, Joon[9] (2003) Developed hydrophobic polyethlyene fiber reinforced SCC• by combining micro mechanical and rheological parameters in a compatible manner which exhibits in the fresh state and ductile strain hardening performance in the hardened state. The micromechanics method selects material ingredients for tensile ductility in the hardened state while the rheological behavior modifies the material ingredients for SCC behavior in the greed state.

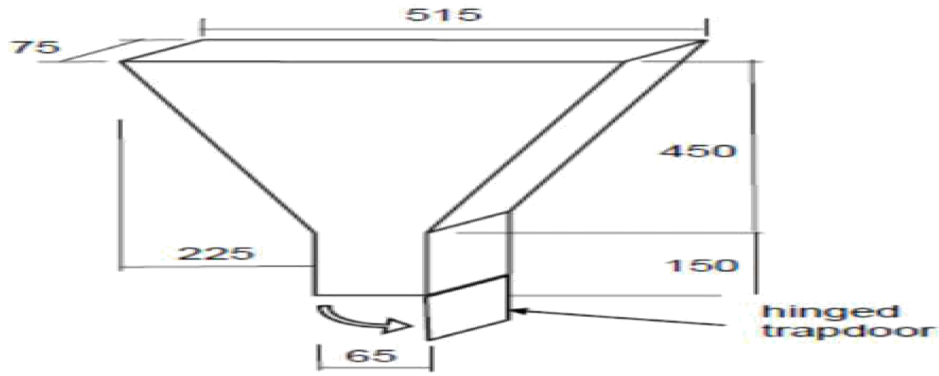
Methodology

About 6 litre of concrete is needed to perform the test, sampled normally. The base plate and inside of slump cone are moistened. The base plate is placed on level stable ground and the slump cone centrally on the base plate and hold down firmly. The cone is filled without tamping and the extra concrete is simply striked off the concrete level with the top of the cone with the trowel. Any surplus concrete is removed from around the base of the cone. The cone is raised vertically and the concrete is allowed to flow out freely. Simultaneously, stopwatch is started and the time taken for the concrete to reach the 500mm spread circle is recorded (This is the T50 time).The final diameter of the concrete in two perpendicular directions is measured. The average of the two measured diameters is the slump flow in mm.

Figure 3.2 slump cone test *Figure 3.3 self-compacting concrete*

III. V-FUNNEL TEST

The V-funnel test is used to assess the viscosity and filling ability of self-compacting concrete. It is filled with fresh concrete and the time taken for the concrete to flow out of the funnel is measured and recorded as the V-funnel flow time.



The funnel and bottom gate is cleaned and the inside surface including the gate is dampened. By closing the gate and the sample of concrete is poured into the funnel, without any agitation or rodding, then the top is striked off with the straight edge so that the concrete is flush with the top of the funnel. The container is placed under the funnel in order to retain the concrete to be passed. After a delay of (10 ± 2) s from filling the funnel, gate is opened and the time *t* is noted from opening the gate to when it is possible to see vertically through the funnel into the container below for the first time. *t* is the V-funnel flow time.

V-Funnel test

L-box is supported on a level horizontal base and the gate is closed between the vertical and horizontal sections. The concrete from the container is poured into the filling hopper of the L-box and allow to stand for (60 ± 10) s. Any segregation is recorded and then the gate is raised so that the concrete flows into the horizontal section of the box . When movement is ceased, the vertical distance is measured, at the end of the horizontal section of the L-box, between the top of the concrete and the top of the horizontal section of the box at three positions equally spaced across the width of the box. By difference with the height of the horizontal section of the box, these three measurements are used to calculate the mean depth of concrete as H2 mm. The same procedure is used to calculate the depth of concrete immediately behind the gate as H1 mm.

Figure 4 L-Box test

Figure 4.1 L-Box test

IV. CASTING OF SPECIMENS

The cast iron moulds are cleaned of dust particles and applied with mineral oil on all sides before concrete is poured in the moulds. The moulds are of size 150mm x 150mm for cubes, moulds 100x100x500mm for the beam specimens, moulds of diameter 150mm and height 300mm for the cylinder specimens. The moulds are placed on a level platform. The well mixed concrete is filled in to the moulds without vibration. Excess concrete was removed with trowel and top surface is finished level and smooth. Total 42 cubes, 21 beams and 21 cylinders were casted.

V. DESCRIPTION OF FLEXURE TESTING MACHINE

The machine consists of a motorized load frame. The lower platen has two rollers, the distance between which is adjustable. For 150 mm x 150 mm x 700 mm beam, the centre distance between the rollers is 600 mm, while it is 400 mm for beams of size 100 mm x 100 mm x 500 mm. The upper platen has also a pair of rollers whose distance adjustable. It is 200 mm centre to centre, for 150 mm x 150 mm x 700 mm size beam and 150 mm for 100 mm x 100 mm x 500 mm size beam. Total capacity of the machine is 100 KN. 150mm dia pressure gauge of 0-100 KN x 1 KN least count to indicate load is fixed on the load frame. A separate electrically cum hand operated pumping unit housed in a cabinet is supplied. On/Off switch and a slow/fast lever to control rate of loading are fitted on the front panel of the pumping unit. A facility for hand operation is provided. A micro switch and relay fitted inside the pressure gauge protect the unit from overloading. Hand operated version consists of a load frame. A small hand pumping unit is attached to the load frame. Since this is a hand operated light weight machine. It is useful for field laboratory also and The test method essentially involves applying a load at the centre of a beam of concrete 100 mm x 100 mm x 500 mm supported at its ends.. The specimens were supported on a pair of fixed rollers. A two-point loading scheme was used to apply loading to the specimens. The distance separating the two loading points was constant for al1 the specimens at 400 mm. The shear span separating the loading points from the supports was equal on both ends of the specimens creating a zero shear region between the two loading points

Compressive Strength of Ternary Blended SCC.

		Strength in		Avg. Strength in	
Sl.No.	Specimen	n/mm^2		n/mm^2	
		7 days	28 days	7 days	28 days
1	F0 RHA0	29.55	35.19		
2	F0 RHA0	28	32.7	28.78	33.96
3	F0 RHA0	28.8	34		
1	F30 RHA4	25.33	38		
2	F30 RHA4	25.11	37.77	25.25	37.96
3	F30 RHA4	25.33	38.13		
1	F30 RHA6	26.66	39.02		
2	F30 RHA6	25.77	40	25.84	39.59
3	F30 RHA6	25.77	39.77		
1	F30 RHA8	25.55	39.55		
2	F30 RHA8	25.33	38.22	25.47	39.1
3	F30 RHA8	25.55	39.55		
1	F30 RHA10	24.44	38.22		
2	F30 RHA10	25.34	37.77	24.74	38.14
3	F30 RHA10	24.44	38.45		
1	F30 RHA12	24.22	37.77		
2	F30 RHA12	24.89	35.55	24.52	36.29
3	F30 RHA12	24.45	35.55		

COMPRESSIVE STRENGTH OF TERNARY BLENDED FIBER REINFORCEDSELF COMPACTING CONCRETE

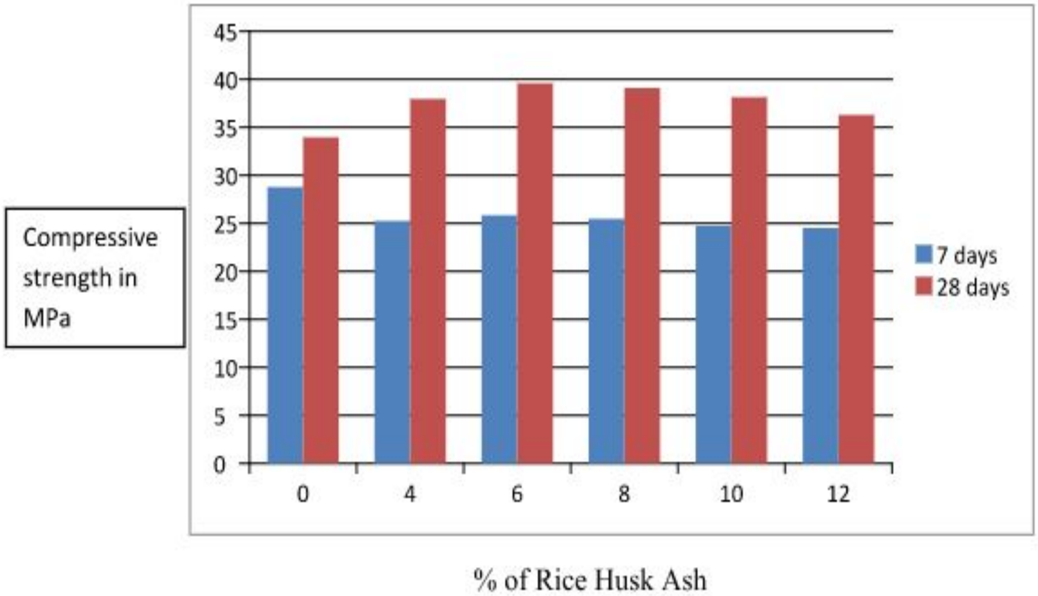


Figure 1 **Compressive Strength of % of Rice Husk As**

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