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Experimental Study On Self Compacting Concrete Using Industrial By-Products

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Abstract :

A self-compacting concrete (SCC) is the one that can be placed in the form and can go through obstructions by its own weight and without the need of vibration. Since its first development in Japan in 1988, SCC has gained wider acceptance in Japan, Europe and USA due to its inherent distinct advantages. The major advantage of this method is that SCC technology offers the opportunity to minimize or eliminate concrete placement problems in difficult conditions. It avoids having to repeat the same kind of quality control test on concrete, which consumes both time and labor. Construction and placing becomes faster & easier. It eliminates the need for vibration & reducing the noise pollution. It improves the filling capacity of highly congested structural members. SCC provides better quality especially in the members having reinforcement congestion or decreasing the permeability and improving durability of concrete. The primary aim of this study is to explore the feasibility of using SCC by examining its basic properties and durability characteristics i.e. water absorption, shrinkage, and sulfate resistance. An extensive literature survey was conducted to explore the present state of knowledge on the durability performance of self-consolidating concrete. However, because it usually requires a larger content of binder and chemical admixtures compared to ordinary concrete, its material cost is generally 20-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 durability of such SCC needs to be proven. This research work consists of: (i) development of a suitable mix for SCC that would satisfy the requirements of the plastic state; (ii) casting of concrete samples and testing them for compressive strength, shrinkage, water absorption, sulfate resistance. Local aggregates, cement, admixtures and additives produced by the local suppliers were used by in this work. The significance of this work lies in its attempt to provide some performance data of SCC so as to draw attention to the possible use of SCC.

Keywords: self-compacting concrete (SCC), high-range water reducing admixtures (HRWRS), viscosity enhancing admixtures (VEAs).

1. INTRODUCTION

Self-compacting concrete, also referred to as self-consolidating concrete, is able to flow and consolidate under its own weight and is de aerated almost completely while flowing in the formwork. It is cohesive enough to fill the spaces of almost any size and shape without segregation or bleeding. This makes SCC particularly useful wherever placing is difficult, such as in heavily-reinforced concrete members or in complicated work forms.

The objectives of this research were to compare the Splitting Tensile Strength and Compressive Strength values of self-compacting and normal concrete specimens and to examine the bonding between the coarse aggregate and the cement paste using the tension testing machine.

1. REQUIREMENT FOR SCC

Foundry fine sand and also reddish colored are like a magnet possesses pozzolanic houses hence increasing the holding houses and provides the higher quality durability concurrently this minimizes the charge problems. Plus minimizes this problems, Foundry squander disposal. Throughout disposal property turn out to be unproductive. It commences polluting the groundwater. Consequently it ought to be utilised in some helpful fashion. That might appeal in a pair of approaches Help out with getting better top quality of concrete. For countless years, the problem on the sturdiness of concrete set ups has become a major problem posed to be able to designers. To generate long lasting concrete set ups, ample compaction becomes necessary. Compaction intended for regular concrete is completed through vibrating. More than vibration can certainly result in segregation. Throughout regular concrete, it's tough to make certain homogeneous product top quality and also beneficial density in greatly strengthened places..

2. PRODUCTION OF SCC

Production of SCC obliges more experience and consideration than the customary vibrated cement. The plant work force would need preparing and experience to effectively deliver and handle SCC. At the outset, it might be important to complete a larger number of tests than common to figure out how to handle SCC and addition the experience.

Before any SCC is delivered at the plant and utilized at the occupation site, the blend must be appropriately planned and tried to guarantee agreeability with the venture particulars. The fixings and the hardware utilized as a part of building up the blend and testing ought to be the same fixings and gear to be utilized as a part of the last blend for the venture.

3. BENEFITS AND ADVANTAGES OF SCC

Modern, presently day self-compacting concrete (SCC) can be classified as an advanced construction material. The SCC as the name suggests, does not require to be vibrated to achieve full compaction. This offers many benefits and advantages over conventional concrete.

- क Improved quality of concrete and reduction of onsite repairs. Faster construction times.
- क Lower overall costs. Facilitation of introduction of automation into concrete construction.
- क Improvement of health and safety is also achieved through elimination of handling of vibrators.

4. LITERATURE REVIEW

Hajime Okamura: A new type of concrete, which can be compacted into every corner of a formwork purely by means of its own weight, was proposed by Okamura (1997). In 1986, he started a research project on the flowing ability and workability of this special type of concrete, later called self-compacting concrete. The self-compact ability of this concrete can be largely affected by the characteristics of materials and the mix proportions. In his study, Okamura (1997) has fixed the coarse aggregate content to 50% of the solid volume and the fine aggregate content to 40% of the mortar volume, so that self-compact ability could be achieved easily by adjusting the water to cement ratio and super plasticizer dosage only. A model formwork, comprised of two vertical sections (towers) at each end of a horizontal trough, was used by professor Okamura to observe how well self-compacting concrete could flow through obstacles.

Subramanian and Chattopadhyay: Subramanian and Chattopadhyay (2002) are research and development engineers at the ECC Division of Larsen & Toubro Ltd (L&T), Chennai, India. They have over 10 years of experience on development of self-compacting concrete, underwater concrete with anti washout admixtures and proportioning of special concrete mixtures. Their Research was concentrated on several trials carried out to arrive at an approximate mix proportion of self-compacting concrete, which would give the procedure for the selection of a viscosity modifying agent, a compatible super plasticizer and the determination of their dosages.

5. MATERIALS USED

CEMENT:

Ordinary Portland Cement (53 Grade) confirming to IS: 269-1976 was used throughout the investigation. Different tests were performed on the cement to ensure that it confirms to the requirements of the IS specifications. The physical properties of the cement were determined as per IS: 4031-1968.

Fig 1.OPC 53 grade cement

FINE AGGREGATES:

It is the aggregate most of which passes 4.75 mm IS sieve and contains only so much coarser as is permitted by specification.

Fig 2.fine aggregates

COARSE AGGREGATES:

It is the aggregate most of which is retained on 4.75 mm IS sieve and contains only so much finer material as is permitted by specification.

Fig 3. Coarse aggregates

Robo Sand:

Robo Sand is also called as manufactured sand obtained by crushing natural granite stone. Robo Sand is defined as a crushed granite aggregate produced by crushing natural granite stone.

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Fig 4. Robo sand

Fly Ash :

Benefits Fly ash can be a expenses effective substitute for Portland cement in some markets. In addition, fly ash could be known as an environmentally friendly produce, because it is a by-product and has low embodied energy. Fly ash is available in two color, and coloring agents can be added at the job site. Fly ash also requires less water than Portland cement, and it is easier to make use of in cold weather. Other benefits are:

क Produce various set times.

क Frozen weather resistance

क Depending on its use fly ash could produce higher strength gains.

क Can be used as an admixture.

WATER:

Fresh and clean water is used for casting and curing of specimen. The water is relatively free from organic matters, silt, oil, sugar, chloride and acidic material as per requirements of Indian standard.

Admixture

Admixtures are those ingredients in concrete other than Portland cement, water, and aggregates that are added to the mixture immediately before or during mixing.

Concrete should be workable, finish able, strong, durable, watertight, and wear resistant. These qualities can often be obtained easily and economically by the selection of suitable materials rather than by resorting to admixtures (except air-entraining admixtures when needed).

The major reasons for using admixtures are:

1. To reduce the cost of concrete construction.

2. To achieve certain properties in concrete more effectively than by other means.

Super plasticizer agent conplast (SP423) of 2.8 lit/m3 for all concrete mixes was used to Achieve good workability.

Fig 5.Conplast SP423

6. Mix design for M40 Grade concrete:

Per cubic meter requirement of ingredients

1. Cement – 319.33kgs
2. Sand - 825.45kgs
3. Metal - 1121.03kgs
4. Water -191.6 liters

Finally mix proportion becomes

1: 2.58 : 3.5@0.6 w/c

7. Experimental investigations

a. Compressive Strength

Cubes of size 150 mm x 150 mm x 150 mm were casted by partial replacement of cement with fly ash. The strength variation was monitored at the ages of 7, 28 and 90 days by conducting compressive strength test using compression testing machine.

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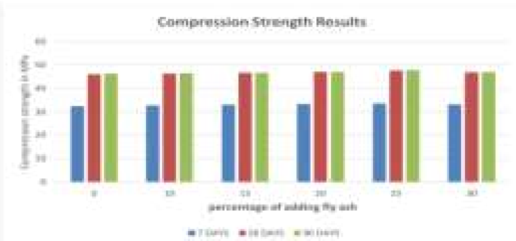
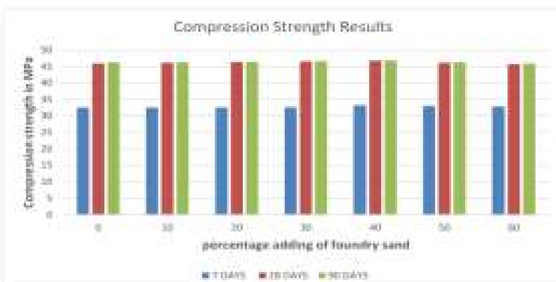
Replacement of fly ash

Sl. No	% of fly ash	% of Cement	7 days strength (MPa)	28 days strength (MPa)	90 days strength (MPa)
1	0	100	32.5	46.0	46.3
2	10	90	32.8	46.3	46.5
3	15	85	33.1	46.7	46.7
4	20	80	33.4	47.01	47.02
5	25	75	33.6	47.6	47.8
6	30	70	33.2	46.9	47.0



Replacement of foundry sand+ fly ash

Sl.No	Cement % + Fly ash %	Foundary sand %	7 days compressive strength(Mpa)	28 days compressive strength(Mpa)	90 days compressive strength(Mpa)
1	75+25	0	32.5	46.0	46.3
2	75+25	10	32.52	46.2	46.31
3	75+25	20	32.56	46.4	46.42
4	75+25	30	32.58	46.62	46.64
5	75+25	40	33.2	46.84	46.89
6	75+25	50	33.0	46.2	46.3
7	75+25	60	32.8	45.8	46



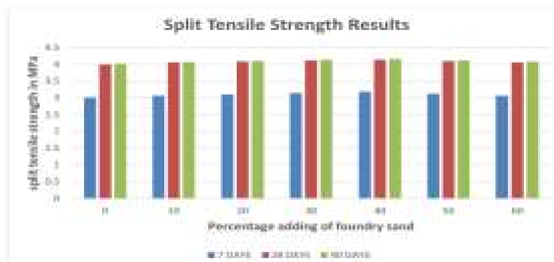
b. Split Tensile Test

Replacement of fly ash

Sl. No	Fly ash %	Cement %	7days Split tensile strength(Mpa)	28 days split tensile strength(Mpa)	90 days split tensile strength(Mpa)
1	0	100	3.0	4.0	4.02
2	10	90	3.05	4.06	4.08
3	15	85	3.1	4.14	4.16
4	20	80	3.18	4.19	4.21
5	25	75	3.22	4.24	4.25
6	30	70	3.01	4.10	4.12

Replacement of foundry sand +fly ash

Sl.No	Cement % + Fly ash %	Foundary sand %	7 days split tensile strength(Mpa)	28 days split tensile strength(Mpa)	90 days split tensile strength(Mpa)
1	75+25	0	3.0	4.0	4.02
2	75+25	10	3.06	4.06	4.07
3	75+25	20	3.1	4.09	4.1
4	75+25	30	3.14	4.12	4.14
5	75+25	40	3.18	4.14	4.16
6	75+25	50	3.12	4.10	4.12
7	75+25	60	3.06	4.06	4.08



c. Flexural Strength

Replacement of fly ash

Sl.No	Fly ash %	Cement %	7days Flexural strength(Mpa)	28days Flexural strength(Mpa)	90days Flexural strength(Mpa)
1	0	100	3.5	4.7	4.72
2	10	90	3.58	4.72	4.74
3	15	85	3.62	4.77	4.78
4	20	80	3.66	4.80	4.81
5	25	75	3.69	4.84	4.86
6	30	70	3.62	4.78	4.82

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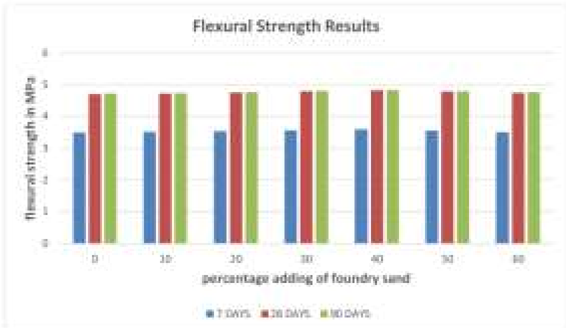
Replacement of foundry sand +fly ash

Sl. No.	Cement % + Fly ash %	Foundary sand %	7 days flexural strength(Mpa)	28 days flexural strength(Mpa)	90 days flexural strength(Mpa)
1	75+25	0	3.5	4.7	4.72
2	75+25	10	3.52	4.72	4.73
3	75+25	20	3.54	4.75	4.76
4	75+25	30	3.57	4.79	4.8
5	75+25	40	3.6	4.82	4.83
6	75+25	50	3.56	4.78	4.79
7	75+25	60	3.51	4.74	4.76



8. Conclusions

Self-compacting concrete can be obtained in such a way, by adding chemical and mineral admixtures, so that its split tensile and compressive strengths are higher than those of normal vibrated concrete.

By use of chemical and mineral admixtures, self-compacting concrete has shown smaller interface micro cracks than normal concrete, in-fact which lead to a better bonding between aggregate and cement paste and to an increase in split tensile and compressive strengths.

In addition, self-compacting concrete has two big advantages. One relates to the construction time, which in most of the cases is shorter than the time when normal concrete is used, due to the fact that no time is wasted with the compaction through vibration. The second advantage is related to the placing. As long as SCC does not require compaction, it can be considered environmentally friendly, because if no vibration is applied no noise is made.

The percentage increase in compressive strength at 7, 28 and 90 days of cement partially replaced with 25% fly ash were found to be 3%, 3.4% and 3.2%.

The percentage increase in split tensile strength at 7, 28 and 90 days of cement partially replaced with 25% fly ash were found to be 7%, 6% and 5%.

The percentage increase in flexural strength at 7, 28 and 90 days of cement partially replaced with 25% fly ash were found to be 5%, 3% and 3%.

Further the strength parameters were slightly enhanced when the coarse aggregate was replaced with different percentages of robo sand. The optimum percentage of robo sand to replace the coarse aggregate was found to be 40%.

The percentage increase in compressive strength at 7, 28 and 90 days of fine aggregate partially replaced with 40% robo sand were found to be 2%, 1.8% and 1.2%.

The percentage increase in split tensile strength at 7, 28 and 90 days of fine aggregate partially replaced with 40% robo sand were found to be 6%, 3.5% and 3.4%.

The percentage increase in flexural strength at 7, 28 and 90 days of fine aggregate partially replaced with 40% robo sand were found to be 2.8%, 2.5% and 2.3%.

The values of compressive strength, split tensile strength and flexural strength of both cement and coarse aggregate treated concrete to its optimum values at 28 days were found to be 46.84Mpa, 4.14Mpa and 4.82 Mpa respectively.

The % improvement of compressive strength, split tensile strength and flexural strength of both cement and coarse aggregate treated concrete to its optimum values at 28 days were found to be 2 %, 4% and 3% respectively.

References

1) Dietz, J. and J. Ma, "Preliminary Examinations for the Production of SelfCompacting Concrete Using Lignite Fly Ash", LACER No.5, pp.125-139 (2000).

2) Dodson, V., "Concrete Admixtures", VNR Structural Engineering Series (1990).

3) Duval, R. and E. H. Kadri, "Influence of Silica Fume on the Workability and the Compressive Strength of High-Performance Concretes", Cement and Concrete Research Journal, Vol. 28,Issue 4, pp.533-547 (1998).

4) BUREAU OF INDIAN STANDARDS," IS: 516-1970",Methods of Tests for Splitting Tensile Strength of concrete Cylinder, New Delhi

5) VenuMalagavelli, 'High Performance concrete with GGBS and Robo Sand', International Journal of Engineering Science and Technology, vol.2(10),5107-5113,2010

6) Priyanka A. Jadhav, Dilip K. Kulkarni 'Effect of replacement of natural sand by manufactured sand on the properties of cement mortar' International Journal Of Civil and Structural Engineering', volume 3, No 3, 2013.

7) B vijaya and Dr.s.elavenil, 'Manufactured sand, A solution and an alternative to river sand and in concrete manufacturing', Journal of Engineering Computers and Applied Sciences, volume 2, no., Feb 2013