EFFECT ON THE PROPERTIES OF SELF COMPACTING CONCRETE BY USING FLY ASH AND SILICA FUME

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Abstract: **Self-compacting concrete (SCC) is a streaming solid blend that can solidify under its own particular weight. The very liquid nature of SCC makes it reasonable for putting in troublesome conditions and in segment with congested support. Utilization of SCC can likewise help limit hearing-related harms on the worksite that are actuated by vibration of cement. Another preferred standpoint of SCC is that the time required to put vast areas is extensively decreased. This study presents the definition and history of Self-compacting concrete (SCC). Besides, it presents the crude material determination, prepared innovation and the blend extent plan strategy for Self-compacting concrete. In this paper the cement is replaced by Fly ash at a percentage of 15%, 30 % and 45 % and silica fume at a percentage of 4 %, 8% and 12 %. At last, the effect of compressive strength is investigated in this study.**

Keywords: **Self compacting concrete, Compressive strength, Mix proportion, Silica Fume, Fly Ash.**

1.0 INTRODUCTION

Bond based materials are the most copious of all man-made materials and are among the most vital development materials, and it is no doubt that they will keep on having the same significance later on. Nonetheless, these development and building materials must meet new and higher requests. When confronting issues of efficiency, economy, quality and condition, they need to contend with other development materials, for example, plastic, steel and wood. One heading in this development is towards self-compacting concrete (SCC), an adjusted item that, without extra compaction vitality, streams and unites under the impact of its own weight. The utilization of SCC offers a more industrialized creation. Not just will it diminish the unfortunate assignments for laborers, it can likewise lessens the specialized expenses of in situ cast solid developments, because of enhanced throwing cycle, quality, toughness, surface complete and unwavering quality of solid structures and wiping out a portion of the potential for human mistake. Be that as it may, SCC is a delicate blend, unequivocally reliant on the organization and the qualities of its constituents. It needs to have the incongruent properties of high stream capacity together with high isolation obstruction. This adjust is made conceivable by the scattering impact of high-extend water-diminishing admixture (superplasticizer) joined with cohesiveness created by a high convergence of fine particles in extra filler material.

Self-compacting concrete (SCC) speaks to a standout amongst the hugest advances in concrete innovation for a considerable length of time. Insufficient homogeneity of the cast concrete because of poor compaction or on the other hand isolation may definitely bring down the execution of develop concrete in-situ. SCC has been created to guarantee satisfactory compaction and encourage arrangement of cement in structures with congested fortification and in limited regions.

1.1 ADVANTAGES AND DISADVANTAGES OF SCC

Advantages:

SCC offers numerous preferences for the precast, pre-focused on solid industry and fore cast-in-situ development:

1. Low clamor level in the plants and building locales.
2. Eliminated issues related with vibration.
3. Less work included.
4. Quicker development.
5. Improved quality and strength.
6. Higher quality.
7. SCC can be set at a speedier rate with no mechanical vibration and less screeding, bringing about reserve funds in situation costs.

Disadvantages:

In spite of the fact that the utilization of SCC has numerous specialized, social, and general practical points of interest, its supply cost is a few times higher than that of ordinary cement contingent on the structure of the blend and quality control of cement maker. Such a high premium has some way or another restricted SCC application to general development. SCC is determined just to regions where it is generally required. These incorporate places where access to traditional vibration is troublesome, or where there are congested fortifications.

2.0 LITERATURE REVIEW

Dinesh. A et al did experimental study on the self compacting concrete. Self-compacting concrete is a streaming solid blend that can solidify under its own weight. The self-compacting solid streams effortlessly at appropriate speed into formwork without obstructing through the support without being vigorously vibrated. This undertaking manages the self-compacting solid where the bond is halfway supplanted with fly-fiery remains and silica seethe. Here Ordinary Portland Cement is supplanted with 5%, 10%, 15%, 20% and 25% of fly-ash remains and 2.5%, 5%, 7.5%, 10% and 12.5% of silica seethe. From the exploratory examinations, it is watched that there is increment in the crisp properties (functionality) and increment in the solidified properties (split-tensile and compressive strength) for substitution of silica fume. Thus, there is increment in the new properties (usefulness) and lessening in the solidified properties (split-rigidity and compressive quality) for substitution of fly fiery remains.

Bouzoubaa et al did an exploratory examination to assess the execution of SCC made with high volumes of fly fiery remains. Nine SCC blends and one control concrete were made amid the examination. The substance of the cementations materials was looked after consistent (400 kg/m3), while the water/cementations material proportions went from 0.35 to 0.45. The self-compacting blends had a concrete substitution of 40%, half, and 60% by Class F fly ash debris. Tests were completed on all blends to acquire the properties of new cement as far as consistency and solidness. The mechanical properties of solidified cement for example, compressive quality and drying shrinkage were too decided. The SCC blends created 28-day compressive quality running from 26 to 48 MPa. They detailed that efficient SCC blends could be effectively created by consolidating high volumes of Class F fly powder.

Nan Su et al proposed another blend plan technique for self-compacting concrete. To begin with, the measure of aggregates required was resolved, and the glue of folios was at that point filled into the voids of aggregates to guarantee that the solid accordingly got has stream capacity, self-compacting capacity and other wanted SCC properties. The measure of aggregates, folios and blending water, and sort and measurement of super plasticizer to be utilized are the central point affecting the properties of SCC. Droop stream, V-pipe, L-stream, U-box what's more, compressive quality tests were done to look at the execution of SCC, and the outcomes demonstrated that the proposed strategy could be utilized to create effectively SCC of high caliber. Contrasted with the strategy created by the Japanese Ready-Mixed Concrete Association (JRMCA), this strategy is less difficult, less demanding for execution and less time consuming, requires a littler measure of covers and spares cost.

3.0 MATERIALS USED

A. CEMENT

Cement is a fine, grey powder. It is mixed with water and materials such as sand, gravel, and crushed stone to make concrete. The cement and water form a paste that binds the other materials together as the concrete hardens. The ordinary cement contains two basic ingredients namely argillaceous and calcareous. In argillaceous materials clay predominates and in calcareous materials calcium carbonate predominates. Basic composition of cement is Grade 43 was used for casting cubes and cylinders for all concrete mixes. The cement was of uniform colour i.e. grey with a light greenish shade and was free from any hard lumps.

Figure 1: Cement

B. FINE AGGREGATES

The sand used for the experimental programme was locally procured and conformed to Indian Standard Specifications IS: 383-1970. The sand was first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm and then was washed to remove the dust.

Figure 2: Fine Aggregates

C. COARSE AGGREGATE

The material which is retained on IS sieve no. 4.75 is termed as a coarse aggregate. The crushed stone is generally used as a coarse aggregate. The nature of work decides the maximum size of the coarse aggregate. Locally available coarse aggregate having the maximum size of 10 mm was used in our work. The aggregates were washed to remove dust and dirt and were dried to surface dry condition. The aggregates were tested as per IS: 383- 1970.

Figure 3: Coarse Aggregates

D. WATER

Generally, water that is suitable for drinking is satisfactory for use in concrete. Water from lakes and streams that contain marine life also usually is suitable. When water is obtained from sources mentioned above, no sampling is necessary. When it is suspected that water may contain sewage, mine water, or wastes from industrial plants or canneries, it should not be used in concrete unless tests indicate that it is satisfactory. Water from such sources should be avoided since the quality of the water could change due to low water or by intermittent tap water is used for casting.

E. 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.

Figure 4: Fly Ash

F. SILICA FUME

Silica fume also known as condensed silica fume or micro silica is very fine, non-crystalline silica produced in electric arc furnaces as a by-product of the production of elemental silicon or silica-alloys. The specific gravity ranges from 2.2 to 2.3.

Figure 5: Silica Fume

3.1 MIX DESIGN

The mix proportioning for M20 grade concrete utilized in the current work. It's designed as per IS 10262-1982 standards. The combination proportioning adopted was cement: sand: coarse aggregate: water/cement quantitative relation severally. Mix proportion used in this study was 1:1.72:2.83 (M 25) conforming to IS 10262-2009 with water-cement ratio of 0.4 and Superplasticizer of 0.75%. The experimental investigation consisted by varying percentage of eggshell powder as partially replaced with ordinary Portland cement 43 grade. The cement is replaced by Fly ash at a percentage of 15%, 30 % and 45 % and silica fume at a percentage of 4 %, 8% and 12 %.

Mix designations followed are given below

Mix-0: 100 % cement and 0 % Supplementary Material
Mix-1: 85 % cement and 15 % fly ash
Mix-2: 75 % cement and 25% fly ash
Mix-3: 65 % cement and 35 % fly ash
Mix-4: 96 % cement and 4 % Silica Fume
Mix-5: 92 % cement and 8 % Silica Fume
Mix-6: 88 % cement and 12 % Silica Fume

4.1 COMPRESSIVE STRENGTH TEST

A test outcome is the normal of no less than three standard cured quality examples produced using the same solid example and tried at a similar age. In most cases quality prerequisites for concrete are at an age of 28 long periods of curing. The solid cubes, after 28 days were tried for their compressive quality in the following way. In the wake of cleaning of bearing surface of pressure testing machine, the hub of the example was painstakingly lined up with the focal point of push of the plate. No pressing was utilized between appearances of the test example and platen of testing machine. The heap was connected without stun and expanded consistently at rate of roughly 140 Kg/cm2 /min until the point that the obstruction of the example to the expanding load separated and no more noteworthy load could be supported. The compressive strength figured in Kg/cm2 from the greatest load maintained by the cube before disappointment.

Figure 6 shows the compressive strength of SCC by using Fly ash and Figure 7 shows the compressive strength of SCC by using Silica Fume.

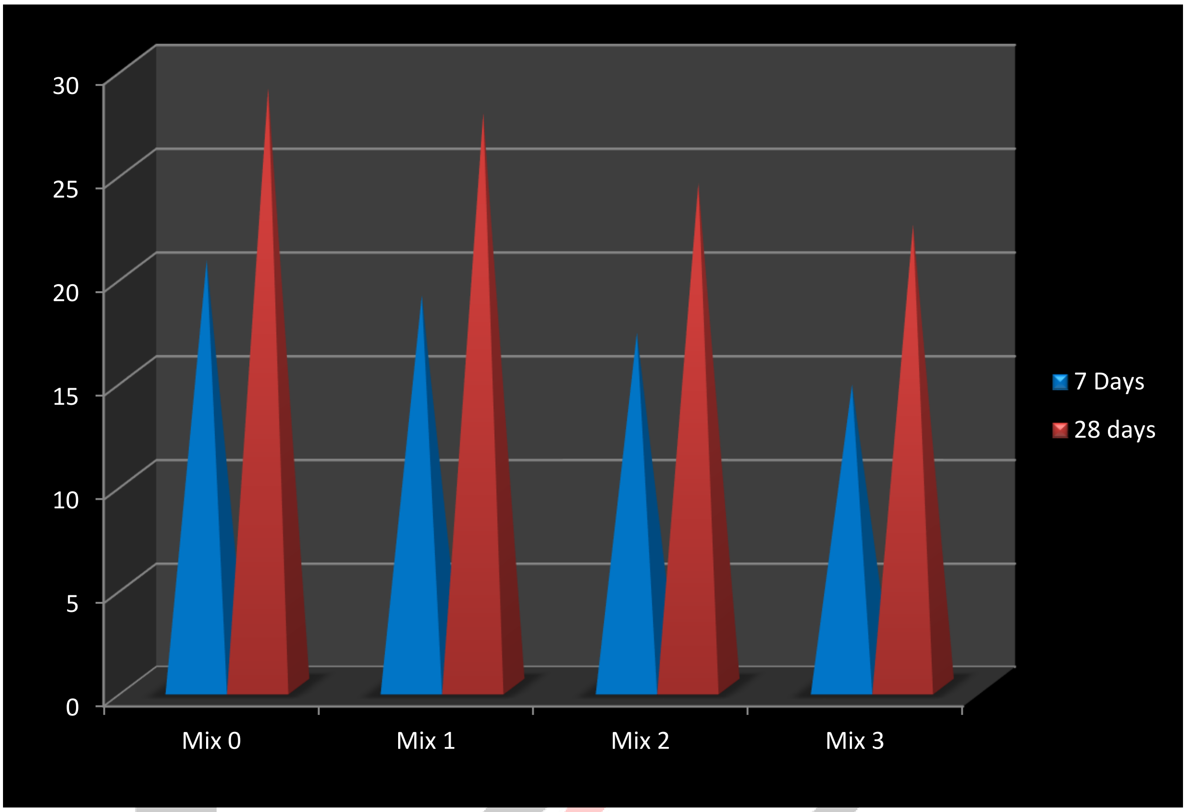

Figure 6: Compressive strength of Various Mixes by using Fly ash

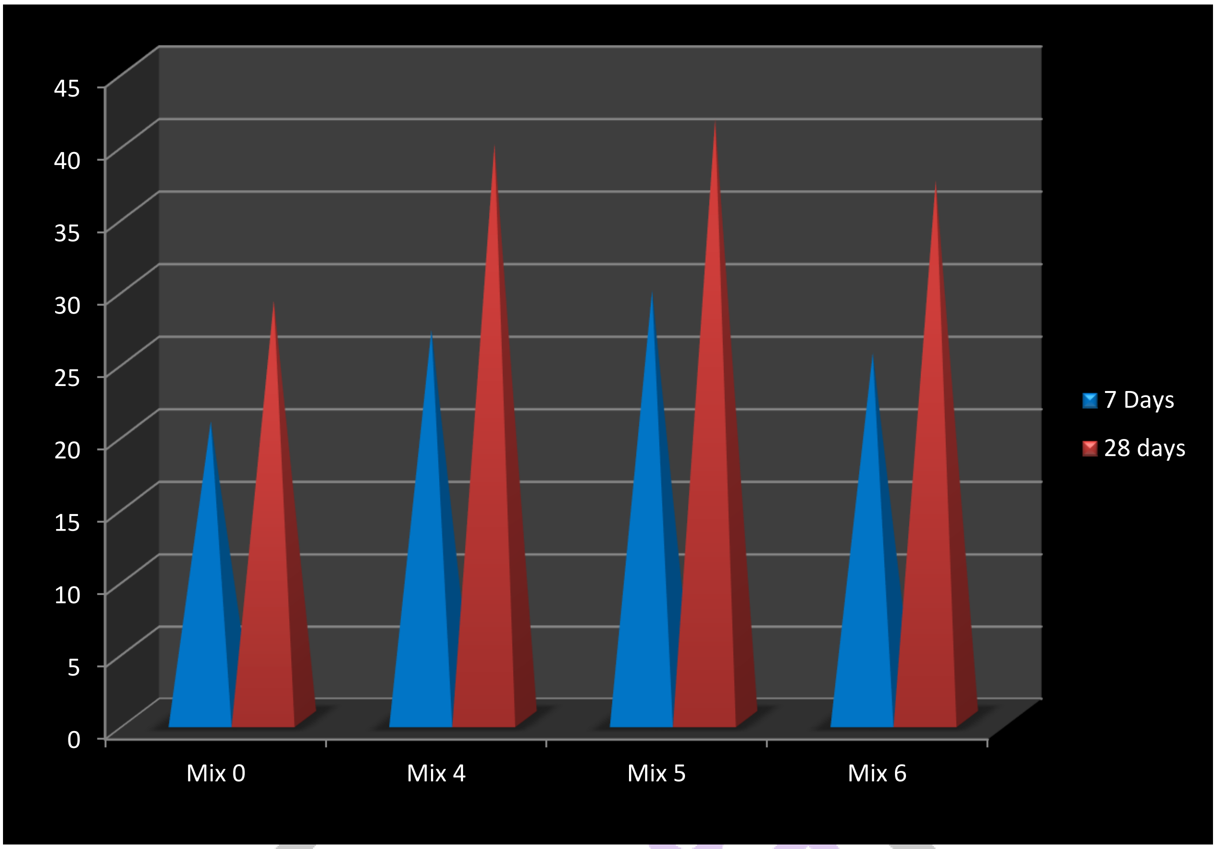

Figure 7: Compressive strength of Various Mixes by using Silica Fume

CONCLUSION

Based on the results obtained in the experimental investigation, the following conclusions are drawn.

1. For 35% fly ash replacement, the fresh properties observed were good as compare to 15% and 25% fly ash replacement. Hence if we increase the FA replacement we can have a better workable concrete.
2. At 8 % replacement of silica fume gives high strength
3. SCC gives good durability properties as compared to the ordinary concrete.
4. The maximum compressive strength for self compacting concrete can be obtained by addition of 15% of fly ash in mix as compared to addition of 25%, and 35% cement replacement by fly ash.
5. To increase the stability of fresh concrete (cohesiveness) using increased amount of fine materials in the mixes.

REFERENCES

[1] Bartos J. M., “Measurement of Key Properties of Fresh Self-compacting Concrete”, CEN/PNR Workshop, Paris (2000).
[2] D’Ambrosia M, Lange D, Brinks A (2005) “Restrained shrinkage and creep of self consolidating concrete”. In: Shah S (ed.) SCC 2005: 4th international RILEM symposium on self-compacting concrete, Chicago, November 2005.
[3] EN206-1: 2000 - Concrete Part 1 – “Specification, performance, production and conformity” 5. Eurocode 2 – European Standard prEN 1992-1: “Design of concrete structures. Part 1: General rules. 2 draft, (January 2001).
[4] Fujiwara H, “Fundamental Study on the Self Compacting Property of High- Fluidity Concrete”, Proceeding of the Japan Concrete Institute, Vol. 14, No.1, pp. 27-32, June 1992, pp. 27-32.
[5] Gainster R. and Gibbs J., (2001) “Self compacting concrete part 1 . The material and its property”. Jouranl Concrete, July/August 2001.
[6] Sahmaran, M., Yurtseven, A., Yaman, O. "Workability of hybrid fiber reinforced self-compacting concrete." Building and Environment. 40(12), pp. 1672-1677. 2005. DOI: 10.1016/j.buildenv.2004.12.014
[7] Gesoglu, M., Guneyisi, E., Kocabag, M. E., Bayram, V., Mermerdas, K. "Fresh and hardened characteristics of self-compacting concrete made with combine use of marble powder, limestone filler and fly ash." Construction and Building Materials. 37, pp. 160-170. 2012. DOI: 10.1016/j.conbuildmat.2012.07.092
[8] De Weerdt, K., Kjellsen, K. O., Sellevold, E., Justnes, H. "Synergy between fly ash limestone powders in ternary cement." Cement and Concrete Composites. 33(1), pp. 30-38. 2011. DOI: 10.1016/j.cemconcomp.2010.09.006
[9] Japan Society of Civil Engineers, ―Recommendation for Construction of Self Compacting Concrete, 157- 164 pp., 1998.
[10] IS: 12089 (Specification for Granulated Slag for Manufacture of Portland Slag Cement), Indian Standard Code of Practice, 1987.
[11] Nan Su., Kung-Chung Hsu., and His-Wen Chai., ―A simple mix design method for self compacting concrete