

LITERATURE REVIEW ON SELF-COMPACTING CONCRETE

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Abstract— Making concrete structure without compaction has been done in the past. Like placement of concrete underwater by the use of termie without compaction. Inaccessible areas were concreted using such techniques. The production of such mixes often used expensive admixtures and very large quantity of cement. But such concrete was generally of lower strength and difficult to obtain. This lead to the development of Self Compacting Concrete (SCC) The workability properties of SCC such as filling ability, passing ability and segregation resistance are evaluated using workability tests such as slump flow, V-funnel and L-Box tests.

Keywords- Self Compacting Concrete, flowability, passing ability, resistance to segregation, fly ash, superplasticizer.

I. INTRODUCTION

Self-compacting concrete (SCC) is an pioneering concrete that does not involve shuddering for insertion and compaction. It is able to gush under its own load, completely filling form work and achieve the full compaction, even in the occurrence of congested support. The hardened concrete is dense, uniform and has the same property and durability as standard vibrated concrete.

Making concrete structure without compaction has been done in the past. Like placement of concrete underwater by the use of termie without compaction. Inaccessible areas were concreted using such techniques. The production of such mixes often used expensive admixtures and very large quantity of cement. But such concrete was generally of lower strength and difficult to obtain. This lead to the development of Self Compacting Concrete (SCC) whose concept was first initiated by Japan in the mid of 1980s. SCC is a high performance concrete that consolidates under its self-weight, and adequately fills all the voids without segregation, excessive bleeding or any other separation of materials, without the need of mechanical consolidation. The key properties of SCC are- filling ability, passing ability and resistance to segregation. Filling ability helps SCC to flow through the formwork and completely fill all the spaces within it. Passing ability is the property by which it flows without any blocking. The benefit of resistance to segregation imparts the advantage to the

concrete in maintaining a uniform composition hence the paste and the aggregate bind together.

The application of SCC aims at obtaining a concrete of high performance, better and more reliable, improved durability, high strength and faster construction. For SCC it is generally important to use superplasticizers in order to obtain high mobility. Some volume of powdered materials such as silica fume, fly ash, glass filler, stone powder, etc. is also involved. Self-compacting concrete has been successfully used in Japan, Denmark, France, U.K., etc. It is widely been accepted because of its enhanced properties also it reduces noise pollution, saves time, labour and energy.

II. LITERATURE REVIEW

Ozawa et al. (1989) focused on the influence of mineral admixtures, like fly ash and blast furnace slag on the flowing ability and segregation resistance of self-compacting concrete. They found out that on partially replacement of OPC by fly ash and blast furnace slag the flowing ability of the concrete improved remarkably. He concluded that the best flowing ability and strength characteristics 10-20% of fly ash and 25-45% of slag cement by mass.

Domone and His-Wen (1997) performed a slump test for high workability concrete. A beneficial correlation between the slump values and flow was obtained from the laboratory test. It showed satisfying value of the slump flow.

Bui et al. (2002) discussed a speedy method in order to test the resistance to segregation of Self-compacting concrete. Extensive test programme of SCC with different water-binder ratios, paste volumes, combinations between coarse and fine aggregates and various types and contents of mineral admixtures was carried out. The test was helpful in concluding the method along with the apparatus used for examining the segregation resistance of SCC in both the directions (vertical and horizontal).

Xie et al. (2002) presented the preparation technology of high strength self- compacting concrete (SCC) containing ultrapulverised fly ash (UPFA) and superplasticizer (SP). Various parameters of concrete were selected namely good workability, high mechanical properties and high durability and SCC was developed. There was low slump loss in the fresh SCC mixture. The workability of high strength

SCC containing UPFA and SP can be evaluated by the method of combining slump flow and L-box test. Slump flow was 600-750 mm. Flow velocity of L-box test was 35-80 mm/sec.

Lachemi and Hossain (2004) presented the research on the suitability of four types of Viscosity Modifying Agent (VMA) in producing SCC. Fresh and hardened properties of SCC were studied by adding different VMA to SCC. The deformability through restricted areas can be evaluated using v-funnel test. In this test, the funnel was filled completely with concrete and the bottom outlet was opened, allowing the concrete to flow out. The time of flow from the opening of outlet to the seizure of flow was recorded. Flow time can be associated with a low deformability due to high paste viscosity, higher inter particle friction or blockage of flow. Flow time should be below 6 sec for the concrete to be considered as SCC. All the mix performed well with no significant segregation and jamming of aggregate was noticed.

Cengiz (2005) used fly-ash with SCC in different proportional limit of 0%, 50% and 70% replacement of normal Portland cement (NPC). He investigated the strength properties of self compacted concrete prepared using HVFA (high volume fly ash). Concrete mixtures made with water-cementitious material ratios ranged from 0.28 to 0.43 were cured at moist and dry curing conditions. He investigated the strength properties of the mix and developed a relationship between compressive strength and flexural tensile strength. The study proved that it is possible to convert an RCC (zero slump) concrete to a workable concrete with the use of suitable superplasticizer.

Ferrara et al. (2006) evaluated the HLSCC for all the basic properties namely flowability, segregation resistance ability and filling ability of fresh concrete. The tests of slump flow (for measuring of flowability) and the time which is required to reach the 500 mm of slump flow (S) (for measuring of segregation resistance ability) of HLSCC satisfied the expected capacity level in all mixes, the time is noted which is required to completely flow through V-funnel (S) (for measuring of segregation resistance ability) only satisfied the level in most of the LC mixed concrete (mix no. 2-4) and one of mixed concrete (mix no. 6).

Kumar (2006) reported the history of SCC development and its basic principle, different testing methods to test high-flowability, resistance against segregation, and passing ability. Different mix design methods using a variety of materials has been discussed in this paper, as the characteristics of materials and the mix proportion influences self-compact ability to a great extent, also its applications and its practical acceptance at the job site and its future prospects have also been discussed. Orimet test was performed, the more dynamic flow of concrete in this test simulates better the behavior of a SCC mix when placed in practice compared with the Slump-flow variation. The Orimet/J-ring combination test shows great promise as a method of assessing filling ability, passing ability and resistance to segregation.

Sahmaran et al. (2007) presented a paper on study of fresh and mechanical properties of a fibre reinforced self-compacting concrete incorporating high-volume fly ash in mixtures containing fly ash. Fifty percent of cement by weight was replaced with fly ash. It was found that the slump flow

diameters of all mixtures were in the range of 560-700 mm which was in acceptable range and the slump flow time was recorded to be less than 2.9 seconds.

Khatib (2008) investigated the properties of self-compacting concrete prepared by adding fly ash (FA). FA was used as a replacement for Portland Cement (PC). PC was replaced 0-80% by fly ash. For all the mixes water binder ratio was maintained as 0.36. Strength properties as well as the workability, shrinkage, absorption and ultrasonic pulse velocity were studied in this research. From the observations it was concluded that 40% replacement of FA resulted in strength of more than 65 N/mm² at 56 days. On increasing the amount of fly ash the high absorption values were obtained and absorption of less than 2% was exhibited.

Grđić et al. (2008) presented the properties of self compacting concrete, mixed with different types of additives: silica fume and fly ash. L-box test was used to assess the passing ability of SCC to flow through tight openings including spaces between reinforcing bars and other obstructions without segregation or blockage. L-Box has arrangement and the dimensions 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 h_2 mm. The same procedure was used to calculate the depth of concrete immediately behind the gate h_1 mm. The passing ability was calculated from the following equation:

$$P_a = h_2/h_1$$

where;

P_a is the passing ability and the value of P_a ranged between 2-10 mm.

h_1 and h_2 are the height in mm at near and far end of passing ability respectively.

Miao (2010) conducted a research on developing a SCC with cement replacement up to 80% in all the mixes and examining its fresh properties. Result show that the fly ash acts as a lubricant material; it does not react with superplasticizer and produce a repulsive force and the superplasticizer may only act on the cement. As a result, the larger the amount of fly ash contained, lesser the superplasticizer needed.

Heba (2011) presented an experimental study on SCC with two cement contents; the work involved three types of mixes, the first considered different percentages of fly ash, the seconds used different percentages of silica fumes and the third used mixtures of fly ash and silica fume. It was concluded that higher the percentages of fly ash the higher the values of concrete compressive strength until 30% of FA, however the higher values of concrete compressive strength is obtained from mix containing 15% FA.

III. CONCLUSION

To increase the stability of fresh concrete (cohesiveness) using increased amount of fine materials in the mixes. To development of self-compacting concrete with reduced segregation potential. The systematic experimental approach showed that partial replacement of coarse and fine aggregate with finer materials could produce self-compacting concrete with low segregation potential as assessed by the V-Funnel test. The amount of aggregates, binders and mixing water, as

well as type and dosage of super plasticizer to be used are the major factors influencing the properties of SCC. Slump flow, V-funnel, L-flow, U-box and compressive strength tests were carried out to examine the performance of SCC. If we add the mineral admixture replacement for we can have a better workable concrete. It has been verified, by using the slump flow, T50 cm slump flow J-ring test, L-box test and U-tube tests, that self-compacting concrete (SCC) achieved consistency and self-compatibility under its own weight, without any external vibration or compaction. SCC with mineral admixture exhibited satisfactory results in workability, because of small particle size and more surface area.

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