2nd International Conference on Current Research Trends in Engineering and Technology
© 2018 IJSRSET | Volume 4 | Issue 5 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

Effect of Fly ash on fresh properties of Self Compacting Concrete

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ABSTRACT

Making concrete structure without vibrations have been done in the past for example, placement of concrete under water is done by use of tremie without vibrations. Mass concrete can be successfully placed without vibration. but the above examples of concrete generally of low strength and difficult to obtain consistent quality. Modern application of self compacting concrete (SCC) is focused on high performance. Better and uniform quality. Study shows that increase in slump flow, l-box ratio, v-funnel as fly ash percentage increases as cement replacement in SCC mix.

Keywords: Ordinary Portland cement , without vibration, Fly Ash, super plasticizer.

I. INTRODUCTION

Recognizing the lack of uniformity and the complete compaction of concrete by vibration, researches at the university of Tokyo, Japan started in late 1980"s to developed SCC. By the early 1990"s Japan has developed the concrete which does not required vibration to achieve full compaction. By the year 2000, the SCC become popular in Japan for ready mix concrete.

Several European countries show the significance and potential of SCC developed in Japan. During 1989, they founded European federation of natural trade associations representing producers and applicators of specialist building products.

SCC was conceptualized in 1986 by Prof. Okamura at Ouchi University, Japan, at a time when skilled labour was in limited supply, causing difficulties in concrete-related industries. The first generation of SCC used in North American was characterized by the use of relatively high content of binder as well as high dosages of chemicals admixtures, usually super plasticizer to enhance flow ability and stability. Such high-performance concrete had been used mostly in repair applications and for casting concrete in restricted areas. The first generation of SCC was therefore characterized and specified for specialized applications.

It consist of three main fresh concrete properties: filling ability, passing ability and segregation resistance. . To reduce amount of honey combing, bleeding by which it gain higher strength.

Fly ash is majorly used in concrete because of the good heat reduction. Typical usage is about 15–30% replacement of cement.

Ordinarily, concrete is a dense, viscous material when mixed, and when used in construction, requires the use of vibration or other techniques (known as compaction) to remove air bubbles, and honeycomb-like holes, especially at the surfaces, where air has been trapped during pouring. This kind of air content (unlike that in aerated concrete) is not desired and weakens the concrete. However it is laborious and takes time to remove by vibration, and improper or inadequate vibration can lead to unidentified problems later. Additionally some complex forms cannot easily be vibrated. Self-consolidating concrete is designed to avoid this problem, and not require compaction, therefore reducing labour, time, and a possible source of technical and quality control issues.

II. EXPERIMENTAL

2.1 Materials

A PCB based superplasticizer was used. Dry material as ordinary Portland cement of M53 grade was used, uncrushed aggregates were used. The specific gravity was measured as 2.7 in the oven dry state. The fineness modulus of 0-4 mm (fine) aggregate was 2.78. The coarse aggregate was used as a mix of 4-10 mm and 10-20 mm gravel. Portland cement obtained from Government project site (Road and Building Department) and fly ash from Pyramid Chemicals pvt. Ltd. were used and water was Free from organic compounds, tasteless, fresh, odourless were used.

2.2 Mix Proportion

Following table showing mix design of SCC with addition of different proportion of fly ash.

Table 1 Mix proportion

Replacement of cement with fly ash	Cement (kg)	Fly ash (kg)	Sand (kg)	Coarse aggregate (kg)
A – 0%	580	0	1060	790
B – 10%	522	58	1060	790
C – 15%	493	87	1060	790
D – 20%	464	116	1060	790

The amount of powder content was 450–530 kg/m3 and fly ash replacement ratio ranges from 0% to 20% in the steps of 5% by volume. For all mixes, the sand to mortar volume ratio of 11% and the coarse aggregate to concrete volume ratio of 9.5% were maintained constant. The test of SCCs were carried out with the same fresh concrete properties, a slump flow of 700 ± 50 mm, a v-funnel time of 8.0 ± 3.0 seconds, l-box height H2/H1=0.8-1.0 and segregation index in sieve stability test of less than 15%. To enhance suitable for such structures as walls, columns and slab.

2.3. Mix procedure, casting, curing and testing

2.3.1. Mix procedure for SCC

From all materials, superplasticizer is one of the most important materials to produce SCC. A proper procedure of mixing should result in the greatest efficiency in its action. There are two methods of mixing superplasticizer to the mix, first is direct addition and second is delayed addition. In the direct addition, first the water and superplasticizer then the cement were mixed into the mixer which starts to mix followed by adding the fine aggregate. This method result to let cement get in contact with superplasticizer. For the delayed addition, all required materials except the superplasticizer are mixed with each other and the remaining mixing water was added with superplasticizer after several minutes from starting of mixing. It was conclude that the proper addition time of superplasticizer was 1.5–3 min which produced a mixture of high flowability and good consistence.

2.3.2. Tests on fresh SCC

Tests of SCC on fresh properties, include slump flow, v-funnel test, l-box test. The result of this test are given in table 2 and table 3.

Slump Flow:- The maximum flow of concrete in absence of any obstructions was conducted by slump flow test in which the slump cone was filled mixed without any compaction. The value of Slump flow is the average of the two diameters cone in perpendicular directions of the concrete after lifting the cone and until concrete stops flowing.

V-funnel:- This test is used to determined the filling ability properties (flowability) of the concrete. The funnel is filled up with 12 litre of concrete. Find the time taken for its flow down. V-funnel value is the time of concrete flowing from the opening at the bottom of the funnel. Both the test gives indications of flowability of concrete.

L- Box:- This test assesses the flow of concrete and also the extented to which the concrete is subjected to blocking by reinforcement. About 14 litre of concrete is required for the test and let it rest for 1 minute before the test.

The following results are obtain form the test on fresh properties of SCC are given below.

Table 2: Result of fresh properties with nominal mix.

Test	Property	Unit	Min.	Max.	Results
Slump Flow	Filling ability	mm	650	800	660
V-funnel	Filling ability	Sec	8.0	12	8.0
L-box	Passing ability		0.8	1.0	0.91

Table 3: Result of fresh properties on varying proportion of fly ash.

Test	Fly ash 10%	Fly ash 15%	Fly ash 20%
Slump flow	670	680	700
V-funnel	8.0	8.2	8.5
L-box	0.8	0.85	0.87

III. CONCLUSION

Fresh properties of SCCs with different proportion of fly ash are given and discussed. Based on the testing, the following conclusions are obtained:

- It conclude that slump flow and v-funnel time is constant, adding fly ash with cement would require increase in water/powder ratio and a reduction in amount of superplasticizer.
- In addition of 20% of fly ash SCC can be produced with good satisfactory fresh properties.
- SCC with fly ash not only gain required properties but also develop adequate mechanical and characteristics.
- Due to addition of fly ash there is increase in slump flow.
- Due to addition of fly ash there is increase in l-box.

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