International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 03 Issue 10
June 2016

A review on Self Compacting Concrete

Anuj Dhiman
(Lecturer CE Department GJGI)
Email: kumar.dhiman .anuj@gmail.com

Abstract:
Self-compacting concrete (SCC), which flows under its own weight and doesn't require any external vibration for compaction, has revolutionized concrete placement. Such concrete should have relatively low yield value to ensure high flow ability, a moderate viscosity to resists segregation and bleeding and must maintain its homogeneity during transportation, placing and curing to ensure adequate structural performance and long term durability. Self-compacting concrete (SCC) can be defined as a fresh concrete which possesses superior flow ability under maintained stability (i.e. no segregation) thus allowing self-compaction that is, material consolidation without addition of energy. Self-compacting concrete is a fluid mixture suitable for placing in structures with Congested reinforcement without vibration and it helps in achieving higher quality of surface finishes. Self-Compacting Concrete (SCC) is a modern concrete technology that allows significant advantages compared to conventional concrete. Extreme workability, self-compaction without vibration combined with high concrete quality allows new and interesting applications for the competitive users and creative specifies of concrete. The advantages of SCC are important for the applicators (contractors) and concrete producers (Ready mixed concrete, Precast well as for the final users of the structure. Knowledge about its properties, design and production is essential for the successful use of SCC. Creativity is also necessary, because the use of this technology is just starting to spread and new, interesting applications for SCC are found every day. This paper will give some information about the advantages of SCC, typical applications, influence on the cost, technical properties, test methods and creating a typical mix design. Another focus is a selection of case studies which shows a variety of projects where SCC has been used successfully. As can be seen, advantageous applications for SCC are very diverse, the reasons for using SCC can be very different.

KEYWORDS: Self Compacting Concrete; Flyash; Workability; Plasticizer.

Introduction:

Self-compacting concrete (SCC) is an innovative concrete that does not require vibration for placing and compaction. It is able to flow under its own weight, completely filling formwork and achieving full compaction, even in the presence of congested reinforcement. The hardened concrete is dense, homogeneous and has the same engineering properties and durability as traditional vibrated concrete. Concrete that requires little vibration or compaction has been used in Europe since the early 1970s but self-compacting concrete was not developed until the late 1980's in Japan. In Europe it was probably first used in civil works for transportation networks in Sweden in the mid1990's. The EC funded a multi-national, industry lead project "SCC" 1997-2000 and since then SCC has found increasing use in all European countries. Self-compacting concrete offers a rapid rate of concrete placement, with faster construction times and ease of flow around congested reinforcement. The fluidity and segregation resistance of SCC ensures a high level of homogeneity, minimal concrete voids and uniform concrete strength, providing the potential for a superior level of finish and durability to the structure. SCC is often produced with low water-cement ratio providing the potential for high early strength, earlier demoulding and faster use of elements and structures. The elimination of vibrating equipment improves the environment on and near construction and precast sites where concrete is being placed, reducing the exposure of workers to noise and vibration. The improved construction practice and performance, combined with the health and safety benefits make .SCC a very attractive solution for both precast concrete and civil engineering construction.

NECESSITY OF WORK

The need for very fluid concrete has been existing for a long time. In earlier times this always had to be done with a high increase of the water content. The results were poor stability of the concrete because of insufficient cohesion. Segregation and bleeding caused very low concrete quality. Other very negative effects were the reduced strength and durability as well as the increased porosity of the concrete which are a result of the high water content. First research into the new technology which we now know as Self-Compacting Concrete started in Japan in the early 1990s. Since then many researches studies on fundamental characteristics have been carried out. (Selection of literature: 1-9)
Modern developments like

• Increased technical requirements
• Growing pressure to rationalize working processes
• Increased focus on ecological considerations

Description

- SCC is characterized as an extremely soft and fluid concrete that does not need additional compaction, like vibrating, because of its outstanding self-compacting properties.
- SCC remains homogeneous and cohesive without segregation, separation or bleeding.
- The requirements of SCC result in a mix design which has a much higher proportion of fines than conventional concrete

DEVELOPMENT OF SCC IN INDIA The use of self–compacting concrete in India was actually a matter of academic interest in the initial stages. This was the case owing to the higher initial cost compared to the traditional method of concreting. But, as many construction companies repeatedly found themselves in situations of time constraints and placement difficulties, the method of self-compacting concrete started flourishing in Indian sub-continent too. In India, the development of concrete possessing self-compacting properties is still very much in its initial stages. Over the past couple of years, few attempts were made using European Guidelines for testing SCC in the laboratories and in the field. Ultra Tech Concrete, a division of Ultra Tech Cement Limited, and India's largest manufacturer of ready-mix concrete is the first commercial supplier of M80 Self-Compacting Concrete in India "Ultra Tech Free flow". There are many organization/academic institutions/cement companies in India who are working hard in the laboratory and field for the advancement and use of SCC in structures to minimize carbon emission and making cost effective construction product. Successful usage of high strength (M80) self-compacting concrete was reported for columns of Palais Royale, 320m tall residential building in Mumbai, India using a combination of cement, fly ash and silica fume or metakaolin. The Kesar Solitaire is a prestigious project being developed by Kesar Group, when completed would be a landmark on the Palm Beach Road in Navi Mumbai. The SCC mix was designed with "Corniche SF" brand Silica Fume to take care of the chloride ion permeability of the structure due to the saline water table.

Table : Calculation of the Water demand for 1m3 of Self Compacting Concrete mixture

Se

Material	SCC Mixture (kg/m^3)	Water Demand (% of mass)	Water Demand (kg/m^3)
Cement: fly ash (1: 0.387 by mass)	380+147 = 527	27.5	145
Aggregate Size 0/2 mm	824	1.73	14.25
Aggregate Size 2/8 mm	412	0.93	3.84
Aggregate Size 8/16 mm	412	1.06	4.37
Water Demand	-	-	167.5
W/C ratio = 0.45	-	-	171.0
Difference	-	-	3.5

Table : Self-Compacting Concretes in early Eighties

S.No	Ingredient	Self Leveling and very Cohesive concrete placed under water	Self Compacting concrete for mass concrete foundations
01.	Ordinary Portland Cement	400 kg/m^3	300 kg/m^3
02.	Fly Ash	-	90 kg/m^3
03.	Very fine sand (0.075 – 0.6 mm)	180 kg/m^3	-
04.	Sand (0 – 5 mm)	990 kg/m^3	670 kg/m^3
05.	Gravel (5 – 15 mm)	630 kg/m^3	305 kg/m^3
06.	Gravel (10 – 20 mm)	-	710 kg/m^3
07.	Water	190 kg/m^3	187 kg/m^3
08.	Plasticizer	7 kg/m^3	4 kg/m^3
09.	Water Cement ratio	0.47	0.62
10.	Slump	260 mm	220 mm

Kaiga and Rajasthan Atomic Power Project. Some pioneering efforts have been made in Delhi Metro Project. Debashis Das et al. [7] have carried out experimental investigation of SCC using Micro-silica andflyash from Thermal Power Plant, Dadari, Delhi. Vengala et al. [8] developed SCC using flyash from Thermal Power Station, Silchar, Karnataka. Naveen Kumar et al. developed SCC using blend of flyash and metakaolin [9]. Praveen Kumar et al. used stone crusher dust partially replacing aggregates to obtain SCC. In all the above investigations, European standards were followed for determining rheological properties of Self compacting concrete. Results of above mentioned investigations are reproduced in the following table

International Journal of Research
Available at https://edupediapublications.org/journals

p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 03 Issue 10
June 2016

Comparison of Self Compacting Concrete Case studies in India

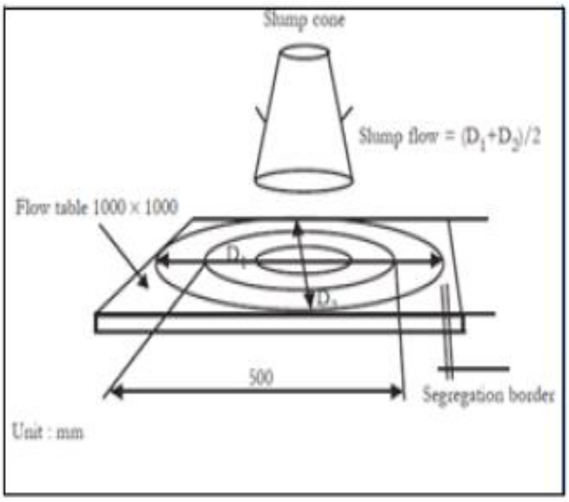
S No	Particulars	Delhi Metro Project	Tarapur Project	Kaiga Project	Debashis Das et al.	Vengala et. al.	Naveen Kumar et al.	Praveen Kumar et. al
01	Cement (kg/m^3)	330	300	225	291.2	431	450	250
02	Fly Ash (kg/m^3)	150	200	225	291.2	163.78	66	350
03	Kaolin (kg/m^3)	0	0	0	0	0	82	0
04	Sand (kg/m^3	917	976	1024	1062.2	849	789	935
05	Aggregate (kg/m^3)	764	664	762	455.2	650	664	623
06	Water (kg/m^3)	163	175	165	186.3	241	225	160.9
07	Plasticizer	2.4 %	2.4 %	1.80 kg/m^3	10 kg/m^3	0.65 %	0.5 %	2.3 %
Rheological Properties								
08	Slump (mm)	680	686	700	670	635	720	630
09	V Funnel Test (sec)	8	14	8.3	14	3.5	6.3	-
10	L Box Test	0.91	0.95	0.92	-	0.85	10	6.2
11	U Box Test (mm)	-	10	9.6	10	12.2	0.9	10
Compressive Strength								
12	7 days Strength (MPa)	33	48.06	40	30	38	25.27	23.5
13	28 days Strength (MPa)	44	56.93	51.3	50.1	51.2	47.57	32.6

COMMON TESTS OF SCC

The common tests currently used, although not standardized for assessments of fresh SCC [10] are described here.

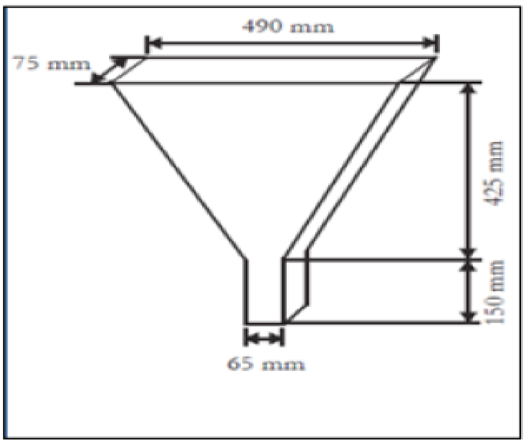
1. Slump Flow Test for Measuring Flowability:

The basic equipment used is the same as for the conventional Slump test is shown below in fig.2. The test method differs from the conventional one in the way that the concrete sample placed into the mould has no reinforcement rod and when the slump cone is removed the sample collapses. The diameter of the spread of the sample is measured, i.e., a horizontal distance is measured as against the vertical slump measured in the conventional test. While measuring the diameter of the spread, the time that the sample takes to reach a diameter of 500 mm (T50) is also sometimes measured. The Slump Flow test can give an indication about the filling ability of SCC and an experienced operator can also detect an extreme susceptibility of the mix to segregation.



2. V-funnel Test:

The V-funnel test was developed in Japan and used by Ozawa. The equipment consists of a V-shaped funnel, shown in below figure.3. The funnel is filled with concrete and the time taken by it to flow through the apparatus measured. This test gives account of the filling capacity (flowability). The inverted cone shape shows any possibility of the concrete to block is reflected in the result.

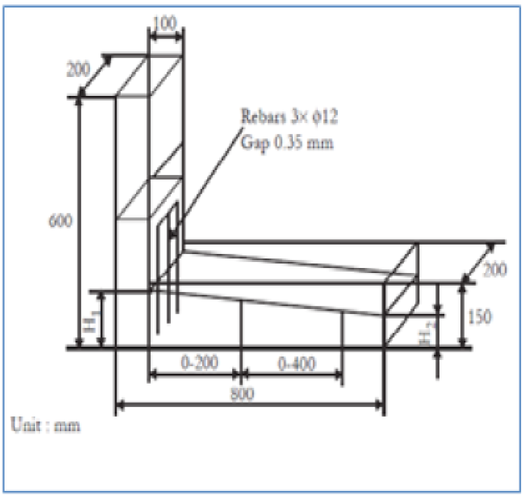


3. L-box Test:

The L-box test method uses a test apparatus comprising a vertical section and a horizontal trough into which the concrete is allowed to flow on the release of a trap door from the vertical section passing

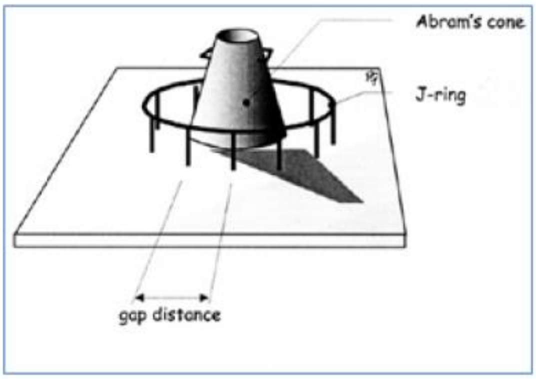
International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 03 Issue 10
June 2016

through reinforcing bars placed at the intersection of the two areas of the apparatus, shown in below figure.4.The concrete ends of the apparatus H1 and H2 measure the height of the concrete at both ends. The L-box test can give an indication as to the filling ability and passing ability.



4. **Blocking Ring (J-Ring) Test:**

The J-ring test is another type of method for the study of the blocking behaviour of self-consolidating concrete shown in figure.5. The apparatus consists of re-bars surrounding the Abram's cone in a slump-flow test, as in below figure. The spacing between the re-bars is generally kept three times of the maximum size of the coarse aggregate for normal placement of reinforcement consideration. The concrete flows between the re-bars after the cone is lifted and thus the blocking behavior/passing-ability of SCC can be assessed.



Conclusion

1. Self compacting concrete mix design tool is developed based on the key proportions of the constituents.
2. This tool is very simple and user friendly for the self compacting concrete mix design. It can be used for the SCC mix with or without blended cement and coarse aggregate with or without coarse aggregate blending.
3. This tool can also be enhanced for multi blended cements with more additives and also useful for Self compacting mortar design. It displays all necessary data for SCC mix design and also displays constituent materials for SCC or SCM for the required volume.
4. The increase in super plasticizer dosage the workability is increased. So, the r equired slum value.

References

[1] Krishna Murthy.N, Narasimha Rao A.V, Ramana Reddy I .Vand Vijaya sekhar Reddy.M Mix Design Procedure for Self Compacting Concrete IOSR Journal of Engineering (IOSRJEN)

[2] R Beissel, Sika AG, Self-compacting concrete: modern concrete and admixture technology *CI-PREMIER PTE LTD*

[3] Dr.Needhidasan Santhanam, Manoj Nallanathel, Monirupa Ananya Self Compacting Concrete – A Boon To Construction Industry GJRA - GLOBAL JOURNAL FOR RESEARCH ANALYSIS