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A Review on the Study of Principle Characteristics, Composition Mixture and Durability of Self-Compacting Concrete with Different Techniques

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Abstract**—***This article is the review study about the principle, properties, characteristics, method to form Self-compacting concrete, advantages and disadvantages of Self-compacting concrete. In this review article, SCC was made up of cement, fine aggregates, coarse aggregates, water and fly ash, etc. at different replacement level i.e. 10%, 20%, 30%, 40% and 50%. Concrete is a family of fine aggregate, water, binding material & coarse aggregate. But as always there is some limitation like self-compaction, surface finishes, etc. Hence to overcome this limitation, we try to make SCC with the help of mineral admixture. SCC is the concrete that can be placed & compacted under its own weight without any vibration effort. In 1980, Okamura first developed SCC in Japan. Significant research was carried out around the world for different applications of SCC with respect to identification of mix proportions and properties. This paper mainly tells about the mix proportions by various ecofriendly materials and to critically review the mechanical properties of SCC by partial replacement of cement and fine aggregate. The main observation was that the properties of SCC were improved to a considerable extent by the fine materials.*

Keywords**—** *Self-Compacting Concrete, fly ash, cement, fine aggregates, coarse aggregates, water, durability, Composition mixture, additive, super-plasticizer, workability, viscosity agents, flowability, passibility, solidification, etc.*

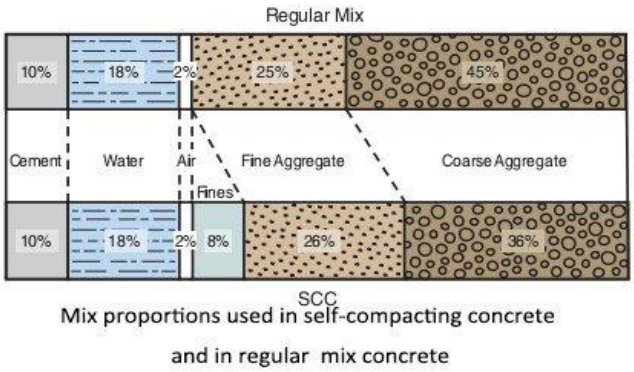
I. INTRODUCTION

It is a modern type of concrete which does not requires any mechanical process for its consolidation and compacting purpose. In modern society with development, more diverse, compact and complex structures are being built, for them the concrete which are being used is needed to be compaction by vibration process using vibrator for 100% compaction of concrete which is too not guaranteed. This process of compaction results in noise pollution, labour work loss, economical loss to the owner of the project. So a new type of concrete was needed to be developed and hence forth self-compacting concrete a brain child of Okamura and Ouchi from university of Tokyo, Japan in 1980's took place. The first positive point about this concrete were its filling ability, passing ability and resistance to segregation. i.e. it get compacted on its own and doesn't requires any external mechanical help, it flows without stucking on its path and does not segregate during consolidation and compaction.

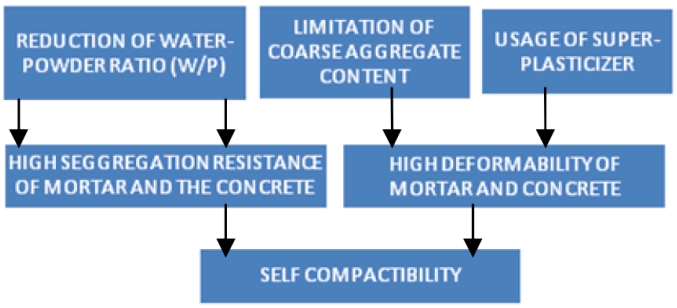
Because of this properties, complex structures can be constructed without any extra effort, or loss of extra finance and it can guarantee full compaction and hence it provides more strength then ordinary concrete in complex area where ordinary concrete lacks its strength because of low compaction or presence of gap. It is economical as it uses fined grain inorganic materials therefore dust can be used for its production which is considered as a by products from the industries. This self-compacting concrete is being under application in countries like Japan, France, Thailand, UK etc. And it has been accepted by many countries for construction work.

II. PRINCIPLE OF SELF-COMPACTING CONCRETE

The Self-Compacting Concrete is get compacted due to its self-weight. It fills all the void and gaps when it is placed horizontally. Self-Compacting Concrete consist of cement, aggregates, water, fly ash, additives, etc. High amount of super-plasticizer used for better workability and reduction of liquid limit. The use of viscosity-agents is for increasing the viscosity of the concrete.



Mix proportions used in self-compacting concrete and in regular mix concrete



III. PROPERTIES REQUIRED FOR THE TEST OF SELF-COMPACTING CONCRETE

Before the solidification of the Self-Compacting Concrete it requires the three major qualities.

- High-flow ability.

Volume 2, Issue 1, pp. 10-13, 2018. ISSN (Online): 2456-7361

- Resistance against segregation.
- Possibility means ability to pass through space between reinforcing bars.

IV. Workability Test Methods

For the determination of the Self-Compacting Concrete the following test are required.

- Slump Flow Test for measuring Flow ability.
- V-Funnel Flow Test.
- L-Box Test.

❖ Slump Flow Test for measuring Flow ability.

It consists of a Flow table of dimension 1000*1000 m, slump cone, segregation border. This method differs from the conventional one in which concrete sample was placed into the mould having no reinforcement rod and afterwards slump cone was removed and the sample was collapses. After that diameter was measured against the vertical slump. While measuring the diameter of collapse slump if it reaches the 500m of diameter then T_{50} is also can be measured.

This Slump Flow Test gives the indication about the filling ability of Self-compacting concrete. And the experienced operator can detect the extreme susceptibility of the mixture of segregation.

Slump Flow can be measured by,

$$(D_1+D_2) \div 2$$

Where, D_1- Horizontal Diameter

D_2- Vertical Diameter

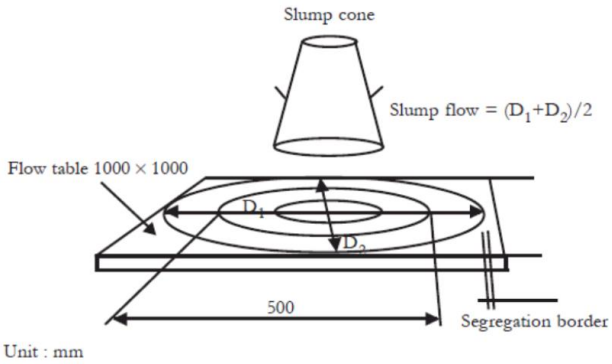


Fig. Slump flow test.

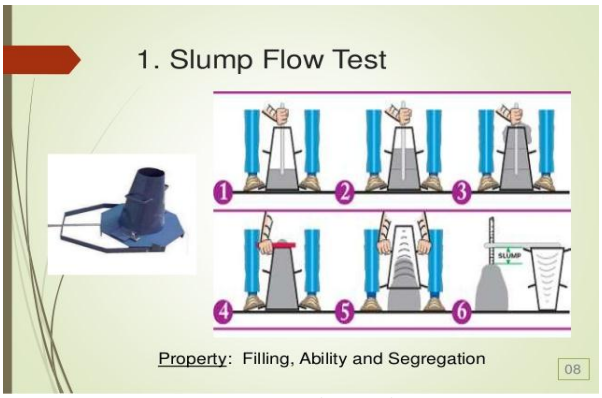


Fig. Showing steps of slump flow test.

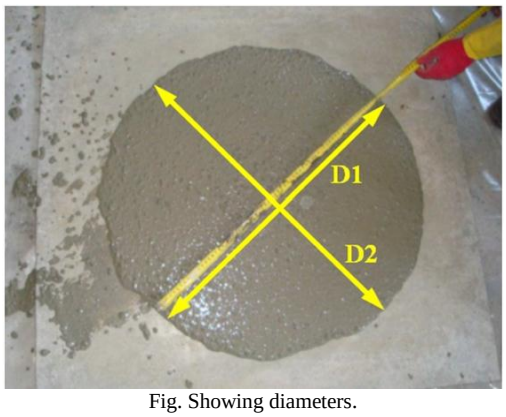


Fig. Showing diameters.

❖ V - Funnel Flow Test

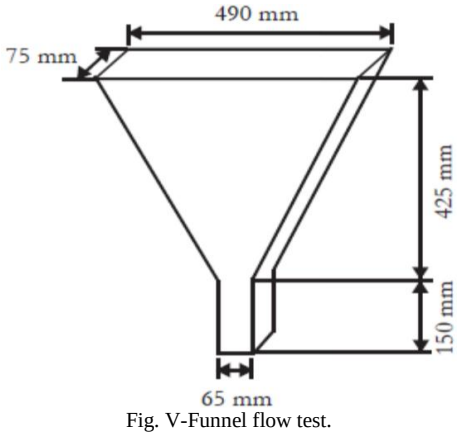


Fig. V-Funnel flow test.

This test was discovered by 'Ozawa' in Japan. It consists of a V shaped funnel. This funnel is filled with the concrete sample that have been test and the time taken by funnel to flow through the apparatus is measured. This test is used to find the flow ability.

Fig. V-funnel test instrument.

❖ L - Box Test

It consists of a one vertical section and one horizontal trough are arranged in L shape into which concrete can flow easily on the release of the trap door from vertical section which is passing through the reinforcing bars which is placed at the intersection of the two area of the apparatus.

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The ends H1 & H2 is used to measured the height of the concrete at the both ends. This test is used to find the filling ability and passing ability.

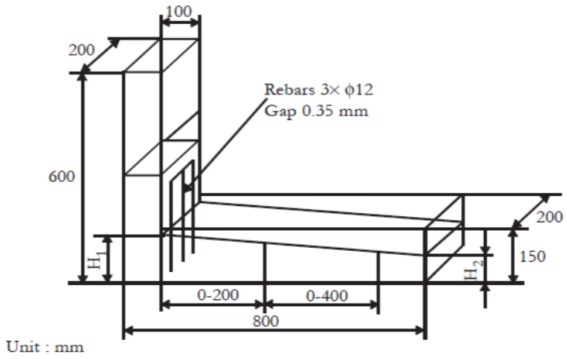

Fig. L-Box test.

Fig. L-Box test instrument.

V. Methods for Acehiving Self- Compactibility

The Methods for achieving Self-Compact ability involves high deformability of the paste. As well as resistance to segregation between coarse aggregate and paste, as the concrete flows. Through the confined zone of reinforcing bars. According to OKAMURA AND OZAWA there are three methods to achieve Self-Compactability.

1. LIMITED AGGREGATE CONTENT
2. POWDER RATIO
3. USE OF SUPERPLASTICIZER

As the relative distance between the particles decreases the frequency of collision as well as contact between the particles increases. To near the obstacles, the internal stress increases when concrete is deformed from their place. It is found that energy required for flowing is consume by the increased internal stress, resulting in the blockage of aggregate particle. As the content of coarse aggregate is set to be limited whose energy consumption is particularly intense which is lower than normal can be effective for avoiding this kind of blockage.

A highly viscous paste is also used to avoid the blockage of coarse aggregate particles when concrete flows through obstacles. In a deformed concrete, localized increase in the internal stress produce in the coarse aggregate particle can be prevented by paste with high viscosity. High deformability can be achieved only by the implementation of a super plasticizer, keeping the powder ratio value as low as.

VI. Conclusion

In this paper, different Self-Compacting techniques are discussed along with the properties of Self-compacting concrete, achievement of Self-compactibility. The Self-compacting concrete is basically used to fill the voids and gaps. Self-compacting concrete is made up of mixture of cement, aggregates, water, fly ash, additives in certain amount. The tests are Slump Flow Test, V-funnel Flow Test, L-Box Test are used to determine the workability of the Self-compacting concrete. In self-compacting concrete viscosity agents is used to increase the viscosity of concrete sample. High amount of super plasticizer is used to increase the workability of Self-compacting concrete. Self-compacting concrete is a brain child of necessity of humans with increase of the modern technology and construction where old concrete loses its efficiency due to lack of perfect compaction. It can be considered as an green concrete cause it use non organic fine particles such as dust which is an by product in many industries, so SCC can be considered as new step towards the green society.

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