

Self Compacting Concrete

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Abstract : This Case Study Report addresses experiments and theories on Self-Compacting Concrete. First, the options of "Japanese and Chinese Methods" are mentioned, within which the packing of sand and gravel plays a significant role. Here, the organize & fill of all solids within the concrete combine is a method for the event of recent concrete mixes. Mixes, consisting of scum mixed cement, gravel (4 – sixteen mm), 3 styles of sand (0 –1, zero – a pair of and zero – four mm) and a polycarboxylic ether kind super plasticiser, were developed. These mixes are extensively path, each in recent and hardened states, and find to grasp all sensible and technical necessities like medium strength and low value. It follows that the particle size distribution of all solids within the combine ought to follow the grading line as given by And reason and Hans Christian Andersen. moreover, the packing behaviour of the powders (cement, fly ash, stone powder) and aggregates (three sands and gravel) used are analysed intimately. It follows that their loosely concentrated void fraction are reduced to a similar extent (23%) upon vibration (aggregates) or mix with water (powders). when a protracted time, the paste slim mark of the powders are accustomed acquire one thing a linear relation between the deformation constant and therefore the product of Blaine price and particle density.

Keywords - Self Compacting Concrete; Particle size distribution; Mixture proportioning; Workability; Engineering properties.

I. INTRODUCTION

Self-compacting concrete (SCC) has been reported as "the nearly all revolutionary extension in concrete construction for many decades". Initially developed in Japan, SCC technology was construct doable by the a lot of earlier development of Superplasticiser for concrete. SCC has currently been preoccupied with keenness across Europe, for each web site and formed concrete work. Empirical application has been accompanied by a ton of analysis into the physical and mechanical characteristics of SCC and therefore the broad vary of data generated has been strain and combined during this guideline document. SCC is often constructed with low water-cement quantitative relation on condition that the possible for tall ill-timed strength, untimely demoulding and speedy use of components and structures. The clearance of vibratory instrumentation creates higher the surroundings on and shut by construction & formed sites wherever concrete is being placed, creates smaller the exposure of staff to noise and vibration. The superior construction application & production, combined with the health and safety advantages, build SCC a awfully smart trying resolution for each formed concrete and technology construction.

Development of SCC

The SCC idea was introduced into scientific world in Japan in 1986 by academic Hajime Okamura from Edo University. The primary model was developed in 1988 by K. music director from Edo University as a response to the growing issues related to concrete sturdiness and therefore the high demand for skilled employees. In Europe it absolutely was most likely 1st employed in civil works for transportation networks in Scandinavian nation, within the middle of 1990's. The international organisation funded a multi-national, business lead project SCC 1997-2000 and since then SCC has found increasing use altogether European countries. It's been begun that, in distinction with shake concrete, the workability belongings needed for self-compaction can't be kept on with comparatively merely over a reasonably long amount. In Japan, within the year 1988, SCC emerged on the scene and it's been the topic of various investigations so as to adapt it to trendy concrete production. At constant time the producers of additives have developed additional and additional refined plasticizers and stabilizers custom-made for the formed and therefore the premix business.

Fluctuations within the workability of shake concrete may be principally offset by the intensity of vibration applied throughout placement, however this is often impracticable with SCC. The results of production and convey on the workability properties of SCC should thus be taken into consideration within the initial testing. Requirements for constituent materials
The constituent materials, used for the assembly of Self-Compacting Concrete (SCC) shall be the materials shall be appropriate for the meant use in concrete and not contain harmful ingredients in such quantities which will be prejudicial to the standard or the sturdiness of the concrete, or cause corrosion of the reinforcement.

- Cement

- General suitability is established for cement
- Aggregates

The maximum size of the aggregates depends on the particular application and is usually limited to 20mm. Particles smaller than 0.125mm contribute to the powder content. The moisture content should be closely monitored and must be taken into account in order to produce SCC of constant quality.

Blend water

Suitability is established for blend water and for recycled water from concrete production.

Admixtures

Generally suitability as Type I (semi-inert) addition is established for:

- Filler aggregate
- Pigments

Generally suitability as Type II (pozzolanic or latent hydraulic) addition is established for:

- Fly ash
- Silica fume conforming
- Ground granulated blast furnace slag.

Typical additions are

- **Stone powder:** Finely crushed limestone, dolomite or granite may be used to increase the amount of powder: the fraction less than 0.125 mm will be of most benefit.

Note: Dolomite may present a durability risk due to alkali-carbonate reaction.

- **Fly ash:** Fly ash is a fine inanimate material with pozzolanic properties, which can be attached to SCC to make better its properties. Make better also the durability of the concrete.
- **Ground (granulated) blast furnace slag:** GGBS is a fine granular mostly latent hydraulic binding material, which can also be added to SCC to improve the rheological properties.
- **Ground glass filler:** This filler is usually obtained by finely grinding recycled glass. The particle size should be less than 0.1 mm and the specific surface area should be 2500 ²/g. Larger particle sizes may cause Alkali-Silica reaction.
- **Fibers:** regularly used types of fibers are steel or polymer. Fibers may be used to enhance the possessions of SCC in the same way as for normal concrete.

Application area

Introduction

SCC may be used in pre-cast appeal or for concrete placed on site. It can be manufactured in a site batching plant or in a ready mix concrete plant and delivered to site by truck. It can then be placed either by pumping or pouring into horizontal or vertical structures. In designing the mix, the size and the form of the structure, the dimension and density of reinforcement and cover should be taken in consideration. These aspects will all influence the specific requirements for the SCC.

Requirements

SCC can be designed to fulfill the requirements of EN 206 regarding density, strength development, final strength and durability. Due to the high content of powder, SCC may show more plastic shrinkage or creep than ordinary concrete mixes. These aspects should therefore be considered during designing and specifying SCC. Current knowledge of these aspects is limited and this is an area requiring further research. Special care should also be taken to begin curing the concrete as early as possible.

The workability of SCC is higher than the highest class of stability described within EN 206 and can be characterized by the following properties:

- Filling ability
- Passing ability
- Segregation resistance

Engineering properties

Self-compacting concrete and traditional shake concrete of similar compressive strength have comparable properties and if there are differences, these are usually covered by the safe assumptions on which the design codes are based. However, SCC composition does differ from that of traditional concrete so information on any small differences that may be observed is presented in the following sections.

Strength, the capability of a concrete construction to withstand environmental aggressive circumstances during its design working life without impairing the required performance, is usually taken into account by specifying environmental classes. This leads to limiting values of concrete composition and minimum concrete covers to reinforcement.

In the design of concrete structures, engineers may refer to a number of concrete properties, which are not always part of the concrete specification. The most relevant are:

- Compressive strength

- Tensile strength
- Modulus of elasticity
- Creep
- Shrinkage
- Coefficient of thermal expansion
- Bond to reinforcement
- Shear force capacity in cold joints
- Fire resistance

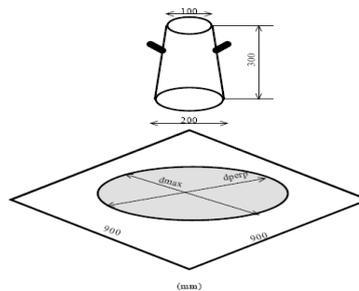
Where the value &/or the development of a specific concrete property with time is critical, tests should be convey out taking into account the subjection conditions and the dimensions of the structural member.

II. TEST DETAILS

Introduction

Testing plays an important role in controlling the quality of cement concrete work. Systematic testing of the raw materials, the fresh concrete and the hardened concrete is an inseparable part of any quality control programme for concrete which helps to achieve higher organization of the materials used and greater assurance of the production of the concrete in regard to both strength and durability.

Slump flow test



Procedure

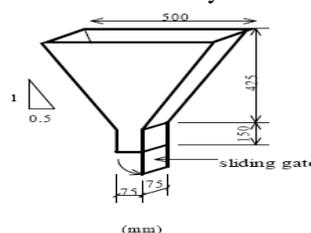
- About 6litre of concrete is needed to perform the test, sampled normally.
- Moisten the base plate and inside of slump cone, Place base plate on level stable ground and the slump cone centrally on the base plate and hold down firmly.
- Fill the cone with the scoop.
- Do not tamp, directly strike off the concrete level with the summit of the cone with the trowel.
- Remove any surplus concrete from around the base of the cone.
- Raise the cone vertically and allow the concrete to flow out freely.
- At the same time, start the stopwatch and record the time taken for the concrete to hold out the 500mm spread circle. (This is the T50 time).
- Calculate the final diameter of the concrete in two at 90 degree directions.

Calculate the average of the two measured diameters. (This is the slump flow inmm).

Note: Any border of mortar or cement paste without coarse aggregate at the edge of the pool of concrete.

V-funnel test

The V-funnel test, which is used to assess deformability rate of SCC flowing through a restricted area.





Procedure

- About 12litre of concrete is required to perform the take a look at, sampled usually.
- Set the V-funnel on firm ground.
- Moisten the within surfaces of the funnel.
- Keep the door hospitable permit any surplus water to empty.
- Close the door and place a bucket beneath.
- Become full the equipment completely with concrete while not compacting or tamping; merely cross out the concrete level with the highest with the trowel.
- Open inside ten sec when stuffing the door and permit the concrete to effuse below gravity.
- Start the timer once the door is opened, and record the time for the discharge to finish (the flow time).
- This is taken to be once lightweight is seen from on top of through the funnel.
- The whole take a look at should be performed inside five minutes.

Procedure flow time at T five minutes

- Do not clean or moisten the within surfaces of the funnel once more.
- Close the door and refill the V-funnel in real time when measurement the flow time.
- Place a bucket beneath.
- Fill the equipment fully with concrete while not compacting or sound, merely cross out the concrete level with the highest with the trowel.
- Open the door five minutes when the second fill of the funnel and permit the concrete to effuse below gravity.
- Simultaneously begin the timer once the door is opened, and record the time for the discharge to finish (the flow time at T five minutes).

Mix design methods

Superplasticiser-Fly ash mix: For 1 m³

Required Amount of Cement is 674kg

Required Amount of water is 173 lit

Required Amount of sand is 721kg

Gravel

i) 4/10mm – 247 kg

ii) 10/20mm – 575 kg

Used moulds sizes is 150mm x 150mm x 150mm.

L= 0.15m

B=0.15m

D=0.15m

Volume of cube mould is = 0.010125

Used cylinders sizes is 15cm x 30cm

Assuming water contents is 1.0, 1.1, 1.2,

Super plasticiser (SP2) is per 50kg's bag of cement 70ml.

Super plasticiser mix: For 3 cubes and 1 cylinder with the same composition

With “Sp”

- Coarse aggregate = 12.74kg's
- Fine aggregate = 11.2 kg's
- Water = 10.5 kg's (1.0)
- Cement = 10.5 kg's
- Super plasticisers = 150ml

Fly ash mix: For 3 cubes and 1 cylinder with the same composition With Fly ash.

- Coarse aggregate = 12.74kg's
- Fine aggregate = 11.2kg's
- Cement = 10.5kg's
- Water = 12.6kg's (1.2)

- Flyash = 2.1kg's

Superplasticiser-Fly ash mix: For 3 cubes and 1 cylinder with the same composition. With "Sp"+"Flyash"

- Coarse Aggregate = 12.74kg's
- Fine aggregate = 7.30kg's
- Water = 11.6kg's (1.1)
- Cement = 10.5kg's
- Flyash = 2.1kg's
- "Sp" = 150ml

Results for self compacting concrete :-

1. Compressive Strength of Super plasticizers

S. No	Identification Marks	Size of cube(mm)	Weight of cube(kg's)	Age in days	Max. Crushing load(KN)	Crushing strength (N/mm ²)
1.	S(Super plasticizers)	150X150	7.80	07	410	18.22
2.	S(Super plasticizers)	150X150	7.82	14	430	19.11
3.	S(Super plasticizers)	150X150	7.82	28	650	28.88

Crushing Strength = Load/Area = 410000/(150*150) = 18.22N/mm²

Crushing Strength = Load/Area = 430000/(150*150) = 19.11N/mm²

Crushing Strength = Load/Area = 650000/(150*150) = 28.88N/mm²

Average Crushing Strength = (18.22+19.11+28.88)/3
=22.07N/mm²

2. Compressive Strength of Super Plasticizers+Flyash

S. No.	Identification Marks	Size of cube(mm)	Weight of cube(kg's)	Age in days	Max. Crushing load(KN)	Crushing strength (N/mm ²)
1.	S+F (Super plasticizers + Fly ash)	150X150	7.93	7	310	13.8
2.	S+F (Super plasticizers + Fly ash)	150X150	7.77	14	500	22.22
3.	S+F (Super plasticizers + Fly ash)	150X150	7.77	28	745	33.11

Crushing Strength = Load/Area = 310000/(150*150) = 13.8 N/mm²

Crushing Strength = Load/Area = 500000/(150*150) = 22.22 N/mm²

Crushing Strength = Load/Area = 740000/(150*150) = 33.11 N/mm²

Average Crushing Strength = (13.8+22.22+33.11)/3
= 23.043 N/mm².

3. Compressive Strength of Flyash

S . N o	Identificatio n Marks	Size of cube(mm)	Weig ht of cube(kg's)	A ge in da ys	Max. Crus hing load(KN)	Crus hing stren gth (N/ mm ²)
1 .	F(Fly ash)	150X 150	7.59	7	180	8.00
2 .	F(Fly ash)	150X 150	7.84	14	430	19.1 1
3 .	F(Fly ash)	150X 150	7.84	28	730	32.4 4

Crushing Strength = Load/Area = 180000/(150*150) = 8.0 N/mm²

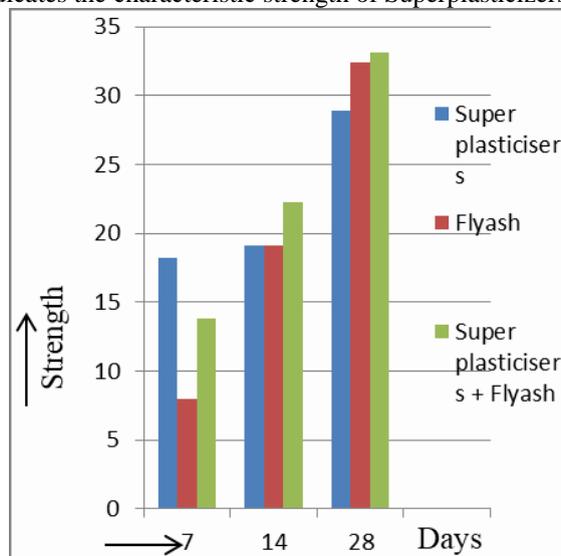
Crushing Strength = Load/Area = 430000/(150*150) = 19.11 N/mm²

Crushing Strength = Load/Area = 730000/(150*150) = 32.44 N/mm²

Average Crushing Strength = (8.0+19.11+32.44)/3
= 19.85 N/mm²

III. CONCLUSION

This project was conducted to study the effect of super plasticizer on properties of concrete with characteristic strength of 30 N/mm² . The properties of concrete containing SP had been successfully studied. The following bar chart indicates the characteristic strength of Superplasticizers, Flyash & Superplasticizers.



From the results of the study presented earlier, the following conclusions are offered:

- If we use only Superplasticiser initially workability is more and finally we get normal strength.
- If we use only fly ash along with normal ingredients initial setting time is increase and it is gaining strength very slowly compare to normal mix ingredients. Along with increasing structure age the strength also increasing, it requires more curing time, when time increasing the strength also increasing.
- If we prefer to use super plasticizers along with fly ash, initial setting time increasing little bit more and finally strength also increasing slowly along with increasing of structure age.
- The main objective of using all these plasticizers motive is.
 - We are using flyash for increasing of initial setting time and strength also increases along with age of structure.
 - We are preferring to use Superplasticiser in our blend works, it will increase the workability in initial stage and also it will motives the remaining ingredients to bind them quickly and strongly.
 - If we use Combination of these two of extra admixtures like fly ash and super plasticizers we doesn't required extra vibrators. Now it behaves like self compacted concrete materials mix.
 - For this design mix we required water content is 0.7 to 1.0 only.

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