BEHAVIORAL STUDY ON SELF COMPACTING CONCRETE

Mr P.Bikku
Department of Civil Engineering
Samskruti College Of Engineering
Ghatakesar,India
bikkucivil@gmail.com

Mr Potlapelli Avinash
Department of Civil Engineering
Samskruti College Of Engineering
Ghatakesar,India
avinashpotlapelli@gmail.com

Dr.C.Sorna chandra Devadaas
Department of Civil Engineering
Samskruti College Of Engineering
Ghatakesar,India
pstdevadass@gmail.com

Abstract-This Case Study Report addresses experiments and theories on Self-Compacting Concrete. First, the features of ‘‘Japanese and Chinese Methods’’ are discussed, in which the packing of sand and gravel plays a major role. Here, the arrange & fill of all solids in the concrete mix serves as a process for the development of new concrete mixes. Mixes, consisting of slag blended cement, gravel (4 – 16 mm), three types of sand (0 – 1, 0 – 2 and 0 – 4 mm) and a polycarboxylic ether type super plasticizer, were developed. These mixes are extensively trail, both in fresh and hardened states, and get to know all practical and technical requirements such as medium strength and low cost. It follows that the particle size distribution of all solids in the mix should follow the grading line as presented by And reason and Andersen. Furthermore, the packing behaviour of the powders (cement, fly ash, stone powder) and aggregates (three sands and gravel) used are analysed in detail. It follows that their loosely piled void fraction are reduced to the same extent (23%) upon vibration (aggregates) or blend with water (powders). After a long time, the paste narrow mark of the powders is used to obtain something a linear relation between the deformation coefficient and the product of Blaine value and particle density.

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

I. INTRODUCTION

Self-compacting concrete (SCC) has been report as “the nearly all revolutionary extension in concrete construction for several decades”. At first developed in Japan, SCC technology was construct possible by the much earlier development of Superplasticiser for concrete. SCC has now been taken up with keenness across Europe, for both site and precast concrete work. emipirical application has been accompanied bya lot of research into the physical and mechanical characteristics of SCC and the broad range of knowledge generated has been strain and combined in this guideline document. SCC is frequently construct with low water-cement ratio on condition that the likely for tall ill-timed strength, untimely demoulding and speedly use of elements and structures.

The clearance of vibrating equipment make better the environment on and close by construction & precast sites where concrete is being placed, make smaller the exposure of workers to noise and vibration. The superoir construction application & production, combined with the health and safety benefits, build SCC a very good looking solution for both precast concrete and civil engineering construction.

Development of SCC

The SCC concept was introduced into scientific world in Japan in 1986by Professor Hajime Okamura from Tokyo University. The first prototype was developed in 1988 by K. Ozawa from Tokyo University as a response to the growing problems associated with concrete durability and the high demand for skilled workers.

In Europe it was probably first used in civil works for transportation networks in Sweden, in the middle of 1990’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. It has been begin that, in difference with shake concrete, the workability belongings required for self-compaction cannot be carry on with relatively simply over a fairly long period.

In Japan, in the year 1988, SCC emerged on the scene and it has been the subject of numerous investigations in order to adapt it to modern concrete production. At the same time the producers of

Journal of Engineering Sciences

additives have developed more and more sophisticated plasticizers and stabilizers tailor-made for the precast and the ready-mix industry.

Fluctuations in the workability of shake concrete can be mainly offset by the intensity of vibration applied during placement, but this is not possible with SCC. The result of production and convey on the workability properties of SCC must therefore be taken into account in the initial testing.

Requirements for constituent materials

The constituent materials, used for the production of Self-Compacting Concrete (SCC) shall be the materials shall be suitable for the intended use in concrete and not contain harmful ingredients in such quantities that may be detrimental to the quality or the durability 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 attach 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 cm^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

Journal of Engineering Sciences

- 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

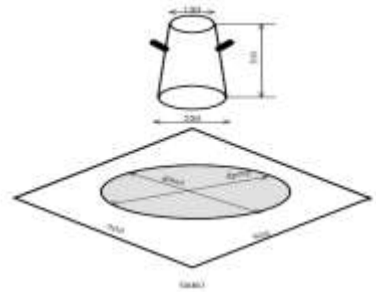
Where the value &/or the development of a specific concrete property with time is critical, tests should be convey out taking into account the subjection conditions and the dimensions of the structural member.

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 in mm).

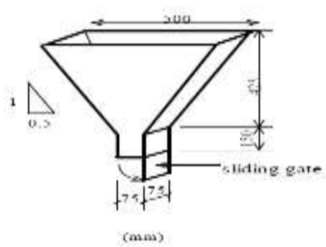
Note: Any border of mortar or cement paste without coarse aggregate at the edge of the pool of concrete.

V-funnel test

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

Journal of Engineering Sciences

JES Journal of Engineering Sciences
Vol11,Issue2,FEB/2020
ISSN NO:0377-9254



Procedure

- About 12litre of concrete is needed to perform the test, sampled normally.

Set the V-funnel on firm ground.

• Moisten the within surfaces of the funnel.

• Keep the door receptive permit any surplus water to empty.

• Close the door and place a bucket beneath.

• Become full the equipment altogether with concrete while not compacting or tamping; merely take out the concrete level with the highest with the trowel.

• Open inside ten sec when stuffing the door and permit the concrete to emanate underneath gravity.

• Start the stopo watch once the door is opened, and record the time for the discharge to complete (the flow time).

• This is taken to be once lightweight is seen from on top of through the funnel.

• The whole check must 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 instantly when measure the flow time.

• Place a bucket beneath.

• Fill the equipment utterly with concrete while not compacting or sound, merely take 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 emanate underneath gravity.

• Simultaneously begin the stopo watch once the door is opened, and record the time for

- the discharge to complete (the flow time at T 5 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

Journal of Engineering Sciences

Vol11,Issue2,FEB/2020
ISSN NO:0377-9254

- 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/mm²)
1.	S(Super plasticizers)	150X 150	7.80	07	410	18.22
2.	S(Super plasticizers)	150X 150	7.82	14	430	19.11
3.	S(Super plasticizers)	150X 150	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

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

Crushing Strength = Load/Area = 180000/(150*150) = 8.0 N/mm²
Crushing Strength = Load/Area = 430000/(150*150) = 19.11 N/mm²

S.No.	Identification Marks	Size of cube(mm)	Weight of cube(kg's)	Age in days	Max. Crushing load (KN)	Crushing strength (N/mm²)
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 =730000/(150*150) = 32.44 N/mm²
Average Crushing Strength = (8.0+19.11+32.44)/3 = 19.85 N/mm²

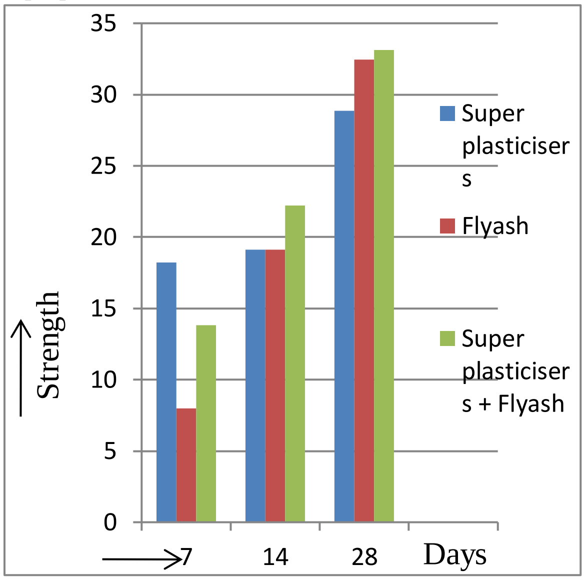
CONCLUSION

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 &

S.No	Identification Marks	Size of cube(mm)	Weight of cube(kg's)	Age in days	Max. Crushing load(KN)	Crushing strength (N/mm²)
1.	F(Fly ash)	150X 150	7.59	7	180	8.00
2.	F(Fly ash)	150X 150	7.84	14	430	19.11
3.	F(Fly ash)	150X 150	7.84	28	730	32.44

Journal of Engineering Sciences

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.

REFERENCES

[1] BROOKS, J Elasticity, shrinkage, creep and thermal movement. Advanced Concrete Technology –

[2]. Concrete properties, Edited by John Newman and Ban SengChoo, ISBN 0 7506 5104 0, 2003.

[3]. HARRISON, T AEarly-age thermal crack control in concrete. CIRIA Report 91, Revised edition 1992 ISBN 0 86017 3291

[4]. SONEBI, M, WENZHONG,Z and GIBBS, J Bond of reinforcement in self-compacting concrete – CONCRETE July-August 2001

[5]. CATHER, R Concrete and fire exposure. Advanced Concrete Technology – Concrete properties, Edited by John Newman and Ban SengChoo, ISBN 0 7506 5104 0, 2003.

[6]. DEN UIJL, J.A., ZelfverdichtendBeton, CUR Rapport 2002-4 -Onderzoek in opdracht van CUR Commissie B79 ZelfverdichtendBeton, Stichting CUR, ISBN 90 3760 242 8.

[7]. VAN KEULEN, D, C, Onderzoeknaareigenschappen van ZelfverdichtendBeton, RapportTUE/BCO/00.07, April 2000.

[8]. JANMAAT, D, WELZEN.M.J.P, Schuifkrachtoverdracht in schuifvlakken van zelfverdichtendbetonbijprefab elementen, Master Thesis, Rapport TUE/CCO/A-2004-6.

[9].Shikoku Island Concrete Research Association: Report by Self-Compacting Concrete Research Committee, "Self-Compacting Concrete in Shikoku Island" 2000 to 2002, 2002.

[10]. Japan Society of Civil Engineers: Concrete Library 93, High-fluidity Concrete Construction Guideline, 1999.