SELF COMPACTING CONCRETE USING FLY ASH AND SILICA FUME

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Abstract:- The development of new technology in the material science is processing rapidly. In last three decades a lot of research was carried out through out globe to improve the performance of concrete in terms of strength and durability qualities. Consequently concrete has no longer remained a construction material consisting of cement aggregate and water only, but has becomes a engineered custom tailored material with several new constituents meet the specific needs of construction industry. The growing use of concrete in special architectural configurations and closely spaced reinforcing bars have made it very important to produce concrete that ensures proper filling ability good structural performance and adequate durability .in respect years a lot of research was carried out throughout the world to improve the performance of concrete in terms of its most important properties, i.e. strength and durability.

Concrete technology has undergone from macro to micro level study in the enhancement of strength and durability properties from 1980s onwards. Till 1980 the research study was focused only to flow ability of concrete, so as to enhance the strength however durability did not draw lot of attention of the technologists. This type of study has resulted in the development of self compacting concrete (SCC), a much needed revolution in concrete industry.
Index Terms-Self Compacting Concrete, Super plasticizer Dosage, Silica Fume

CHAPTER 1
INTRODUCTION

1.1 GENERAL

The development of new technology in the material science is processing rapidly. In last three decades a lot of research was carried out through out globe to improve the performance of concrete in terms of strength and durability qualities. Consequently concrete has no longer remained a construction material consisting of cement aggregate and water only, but has becomes a engineered custom tailored material with several new constituents meet the specific needs of construction industry. The growing use of concrete in special architectural configurations and closely spaced reinforcing bars have made it very important to produce concrete that ensures proper filling ability good structural performance and adequate durability .in respect years a lot of research was carried out throughout the world to improve the performance of concrete in terms of its most important properties, i.e. strength and durability.

Concrete technology has undergone from macro to micro level study in the enhancement of strength and durability properties from 1980s onwards. Till 1980 the research study was focused only to flow ability of concrete, so as to enhance the strength however durability did not draw lot of attention of the technologists. This type of study has resulted in the development of self compacting concrete (SCC), a much needed revolution in concrete industry. Self Compacting Concrete is highly engineered concrete with much higher fluidity without segregation and is capable of filling every corner of form work under its self weight only. Thus SCC eliminates the needs of vibration either internal or external for the compaction of concrete without compromising its engineering properties.

This concrete was first developed in Japan in late 80s to combat to deterioration of concrete quality due to the lack of skilled labours, along with problems at the corners regarding the homogeneity and compaction of cast in place concrete mainly with intricate structures so as to improve the durability of concrete and structures. After the development of SCC in Japan 1988, whole Europe started working on this unique noise free revolution in the field of construction industry. At present many researchers working in numerous universities and government R&D organizations due to benefits of the uses of this concrete.

Self compacting concrete is basically a concrete which is capable of flowing into the form work without segregation, to fill uniformly and completely every corner of it by its own weight without any application of vibrations or other energy during placing. There is no standard self compacting concrete. Therefore each self compacting concrete has to be designed for the particular structure to be constructed. However working on the perimeters which affect the basic properties of self compacting concrete such as plastic viscosity, deformability, flow ability and resistance to segregation, self compacting concrete can be proportioned for almost any type of concrete structure.

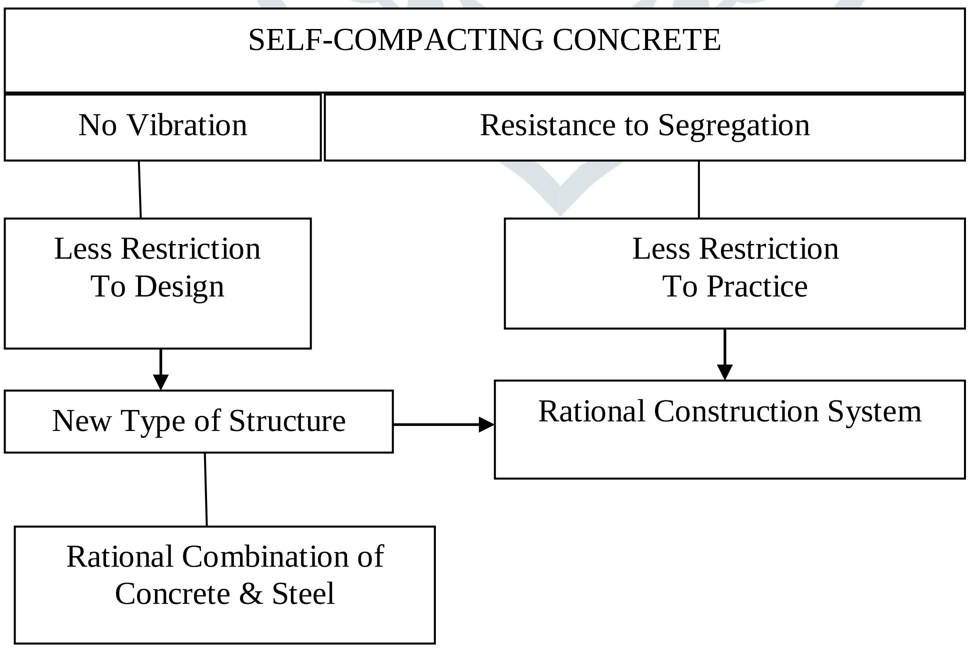


Fig 1.1 Rotational Construction System of Self Compacting Concrete.

To meet the concrete performance requirements, the following three types of self compacting concrete are available

1. Powder type of self compacting concrete : This is proportioned to give the required self-compactability by reducing water powder and provide adequate resistance. Super plasticizer and air entraining admixtures give the required deformability.

2. Viscosity agent type self compacting concrete: This type of proportioned to provide self compaction by the use of viscosity modifying admixture to provide segregation resistance. Super plasticizer and air entraining admixtures are used for obtaining the desired deformability.

3. Combination type of self compacting concrete: This type is proportioned so as to obtain self compactibility mainly by reducing the water powder ratio, as in the powder type and viscosity modifying admixture is added to reduce the quality fluctuation of the fresh concrete due to the variation of the surface moisture content of the aggregates and their gradations during the production. This facilitates the production control of the concrete

1.2 USES OF SELF COMPACTING CONCRETE

Contrasted with ordinarily vibrated cement (NVC), compacting toward oneself cement (SCC) has improved qualities and enhances profit and working conditions because of the disposal of compaction. SCC for the most part has higher powder content than NVC and in this manner it is important to supplant a portion of the bond by augmentations to accomplish a conservative and sturdy cement.

Japan has utilized compacting toward oneself cement (SCC) in scaffold, building and passage development since the mid 1990's. In the most recent five years, various SCC extensions have been developed in Europe. In the United States, the utilization of SCC in thruway span development is extremely constrained as of now. Then again, the U.S. precast solid industry is starting to apply the innovation to building cement. SCC has high potential for more extensive basic applications in thruway span development. The use of cement without vibration in expressway span development is not new. For illustrations, situation of cement submerged has been put without vibration, and shaft solid can be effectively put without vibration. These seal, mass and shaft cements are by and large of lower quality, under 34.5MPa and hard to achieve steady quality. Cutting edge utilization of compacting toward oneself cement (SCC) is centered around elite. Better and more solid quality, thick and uniform surface composition, enhanced sturdiness, high quality, and speedier development. Perceiving the absence of consistency and complete compaction of cement by vibration, analysts at the College of Tokyo, Japan, began in late 1980's to create SCC. By the mid

1990's Japan has created and utilized SCC that does not oblige vibration to accomplish full compaction. More uses of SCC in development have been accounted for in Japan as indicated in Fig As of the year 2000, the measure of SCC utilized for preassembled items (precast individuals) and prepared blended solid (cast set up) in Japan was around 400,000 mp

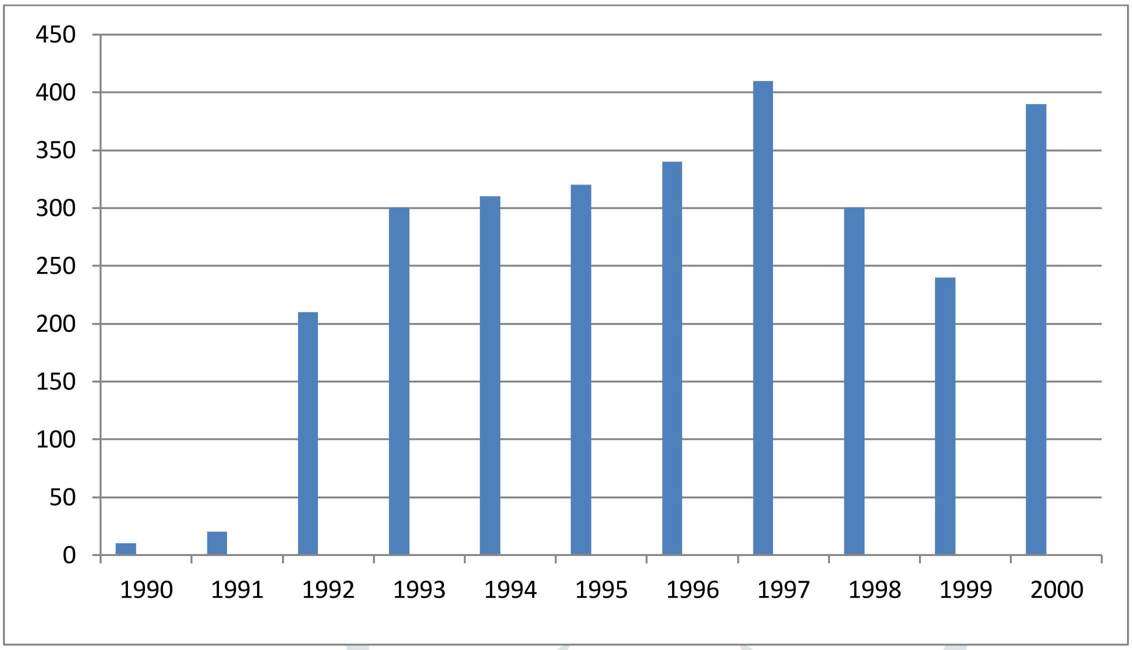


Fig 1.2: Amount of SCC Placement in Japan

A few European nations were occupied with investigating the essentialness and possibilities of SCC grew in Japan. These European nations shaped an expansive consortium in 1996 to leave on an undertaking went for creating SCC for viable applications in Europe. The title of the venture is Balanced Creation and Enhanced Workplace through utilizing Toward oneself compacting Cement. In the most recent six years, various SCC scaffolds, dividers and passage linings have been developed in Europe. In the United States, SCC is starting to increase interest, particularly by the precast solid industry and admixture makers. The precast solid industry is starting to apply the innovation to business ventures when details license. The applications range from design cement to complex private extensions.

1.3 BASIC PRINCIPLES AND REQUIREMENTS OF SCC

With regard to its composition, SCC consists of almost same constituent materials as conventional concrete, which are cement, aggregates, water and with the addition of chemical and mineral admixtures (fly ash, silica fume.) in different proportions. Usually, the chemical admixtures used are high-range water reduce also called superplasticizers and viscosity-modifying agents which change the properties of concrete. Mineral admixtures are used as an extra fine material, besides cement, and in some cases, they replace cement. However, high volume of superplasticizer for reduction of the liquid limit and for better workability, the high powder content "lubricant" for the coarse aggregates.

Effect of curing techniques on mechanical properties of self compacting concrete as well as the use of viscosity-agents to increase the viscosity of the concrete have to be taken into account. Fig 1.3 shows the basic principles for the production of SCC.

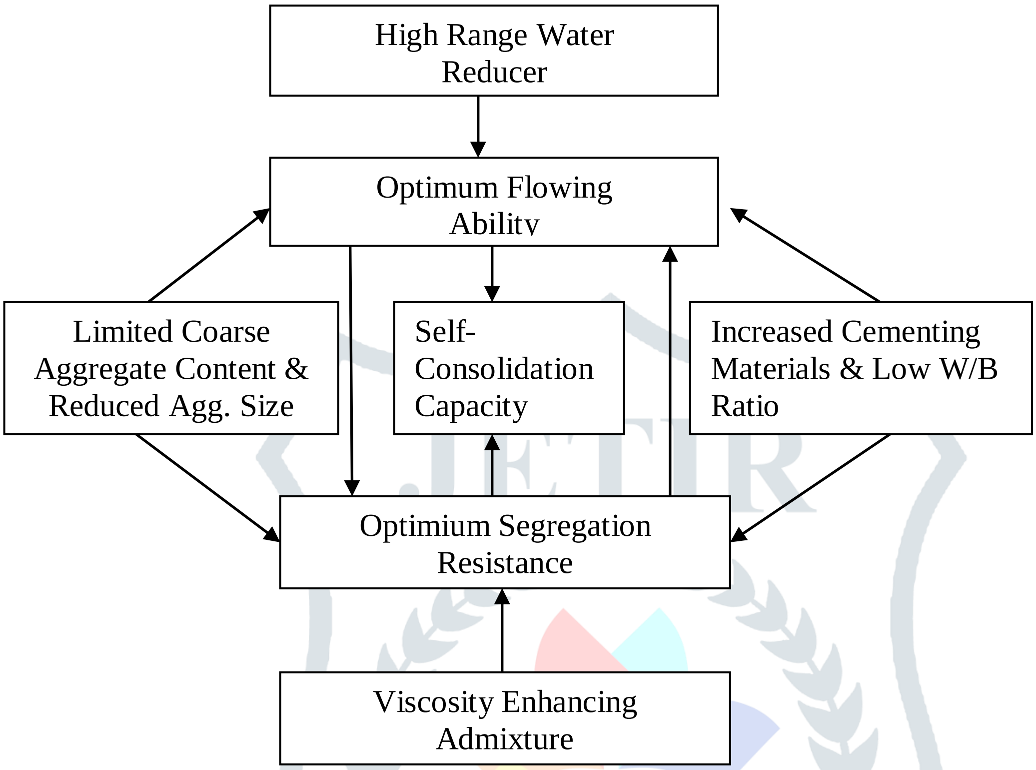


Fig 1.3 Basic Principles for the Production of SCC

Mineral admixtures are used to improve a particular concrete property such as workability, strength or compactability. The optimum amount to use should be established by testing to determine whether the material is indeed improving the property, and the correct dosage rate, as an overdose or under-dose can be harmful or not achieve the desired effect, because they react differently with different cements.

The particle size distribution and water absorption of mineral fillers directly affect the water demand in preparing of SCC. Calcium carbonate based mineral fillers are widely used and provides excellent properties and a good finish. Materials, such as fly ash, blast furnace slag, ground glass, limestone powder, silica fume etc. are commonly used as filler for producing self compacting concrete. Fly ash in appropriate quality may be added to improve the quality and durability of SCC.

. Silica fume improves the resistance to segregation and mechanical properties because of its high level of fineness and spherical shape.

This SCC concept has been necessary to triumph over these difficulties. This SCC concept could be explained because the concrete that will matches specific effectiveness and also uniformity requirements that will cannot always be received by employing regular components, standard mixing course of action and also curing methods. This SCC is usually an designed product comprising bare cement, aggregates, water and also admixtures together with several new constituents similar to colloidal silica, pozzolanic products, compound admixtures to keep up unique requirements, for instance, high-flowability, compressive durability, substantial workability, superior resistances to be able to compound or perhaps kinetic stresses, decrease permeability, sturdiness, level of resistance towards segregation, and also probability within lustrous reinforcement disorders. This houses, for instance, and also substantial level of resistance to be able to segregation allows the placement of concrete devoid of vibrations with reduced your time, sound and far a lesser amount of wear of tools

Utilization of SCC overcomes the problem of concrete positioning in greatly strengthened parts also it helps to limit design time. Self-compacting concrete is growing easily, in particular within the pre-cast industry where by their strengths tend to be easily understood and also employed. Excellent plasticizer promotes deformability with the decline of water/powder segregation level of resistance is usually greater. Large deformability and also substantial segregation level of resistance is usually received through restraining the number of rough blend. Nevertheless, the substantial medication dosage of super-plasticizer useful for decline on the fluid limit and also intended for better workability, the substantial powdered written content while 'lubricant' with the rough aggregates.

1.4 ADVANTAGES OF SCC

1) SCC shows a good filling ability especially around the reinforcement.

2) SCC is very well suited for special and technical demanding structures such as tunnel lining, as the possibility to compact the concrete is limited in the closed space between formwork and rocks.

3) It ensures better quality in-situ pile foundation.

4) Reduces noise at sites, the precast factory and neighbourhood. Hence it is a silent concrete.

5) Eliminates problems with blood circulation leading to "white fingers" caused by compacting equipments. Hence called healthy concrete.

6) Shortens the construction time by accelerating construction process.

7) Its ease of placement improves the productivity and cost saving through reducing equipments and labour equipments.

8) Reduction of wear and tear of forms, therefore it extends service life of the forms.

9) Because of the high fluidity, this concrete does not need any vibrations so that it allows to save energy and ensure stability cost in place.

10) Reduction of expenses and man power needed for patching and finished precast elements.

11) Construction with SCC is not affected by the skill of workers, shape and arrangement of reinforcing bars of structures.

12) SCC used at constructing sites reduces the chances of accident by reducing number of cables needed for the operation of compacting equipments. Hence, reduces the workers compensation premiums.

1.5 DISADVANTAGES OF SCC

1) The production of SCC places more stringent requirements on the selection of materials in comparison with conventional concrete.

2) An uncontrolled variation of even 1% moisture content in fine aggregate will have a much bigger impact on the rheology of SCC at very low water cement ratio (-.3). Proper stock pilling of aggregates, uniformity of moisture in the batching process, and good sampling practice are essential for SCC mixture.

3) A change in characteristics of a SCC mixture could be a warning sign for quality control while a subjecting judgement, may sometimes be more important than the quantity parameters.

4) The development of the SCC requires a large number of trial batches. In addition to the laboratory trial batches, field size trial batches should be used to stimulate the typical production conditions. Once a promising mixture has been established, further laboratory trail batches are required to quantify the characteristics of the mixture.

5) SCC is a costlier than conventional concrete initially based on concrete material cost due to the higher dosage of chemical admixtures i.e. high range water reducers and viscosity enhancing admixture. Increasing material cost can be easily offset with improvement in productivity, reductions in vibration cost and maintenance and proper uses of mineral admixtures.

1.6 SCOPE AND OBJECTIVES OF THE RESEARCH

To develop SCC with satisfactory fresh properties (i.e., flowability, filling and passing abilities adequate segregation resistance,), hardened properties (e.g., concrete compressive strength, splitting tensile strength, modulus of elasticity and flexural strength), Durability properties (Permeability test) by using locally available materials.

Keeping in view this investigation is mainly focused on to study the fresh and hardened properties of self compacting concrete. As there is no availability of SCC mix design standards in particular for strength of concrete, this investigation is focused on the different mix proportions with different supplementary cementitious materials of SCC satisfying both SCC performance and the desired strength. As already known that the increased content of powder (fines), fly ash, silica fume and admixtures leads to higher sensitivity, strength and durability and combination-type of self compacting concrete has been chosen in the self compacting concrete mix design so as to use moderate powder, fly ash silica fume and reasonable quantity of chemical admixtures such as conplast SP430 and Poly- Carboxylate Ether (PCE)

Also, keeping in view of the savings in cost and fresh, hardened and durability properties of SCC, the replacement level of silica fume and fly ash (FA) in the cement was kept SF25% and FA35% respectively, and the combination of silica fume and fly ash in the cement was kept (SF15% + FA25%) with combinations of admixtures such as (conplast SP430 and PCE) throughout the study.

The field of concrete technology has been miraculous change due to the invention of various admixtures. The admixtures modify the properties of fresh concrete and offer many advantages to the user.

The main aim of this experimentation is to find out the effect of addition of fly ash and silica fume on the properties of self compacting concrete containing two reasonable admixtures (Conplast SP430 and Poly- Carboxylate Ether (PCE))

The flow characteristics and strength characteristics of self compacting concrete produced from different waste materials and the percentages of that materials are found. The percentage of fly ash used in experimentation is 35% and the percentage of silica fume used in experimentation is 25% and combination of silica fume and fly ash used in experimentation is (SF15% + FA25%).

This investigation further studies on the various curing methods of self compacting concrete for better understanding the corrections of properties self compacting concrete. SCC mix proportions and CC has been done and benefits of SCC over CC have been discussed in order to promote the SCC in the building constructions to a large extent. Based on the background, methodology and scope of this project, the research comprises of the following:

i. Improved compaction around congested reinforcement.
ii. Potential to enhance durability through improved compaction of cover concrete
iii. Improved buildability (e.g : concreting deep elements in single lifts)
iv. Elimination of vibration leading to environment, health and safety benefits.
v. Quicker and easier concrete placement.
vi. Effect of Supplementary Cementing Materials (SCMs) such as silica fume and fly ash on fresh properties of self compacting concrete
vii. Effect of Supplementary Cementing Materials (SCMs) such as silica fume and fly ash blending on hardened properties of self compacting concrete.
viii. To identify admixture(s) for self curing of SCC and develop self curing self compacting concrete (SCSCC) and consequently find mechanical properties namely compressive and tensile strength of SCSCC
ix. Identifying various curing techniques for concrete and its procedures
x. To study the fresh properties of selected grade of self compacting concrete namely slump flow test, slump T_{50cm} test and J-test
xi. To study the mechanical properties of selected grade of SCC namely compressive strength and split tensile strength of hardened SCC and find the effect of different techniques of curing on these properties

1.7 PROPERTIES OF SELF COMPACTING CONCRETE

The main three properties of SCC in plastic state are

a. Filling ability (excellent deformability)
b. Passing ability (ability to pass reinforcement without blocking)
c. High resistance to segregation .

1. **Filling ability** :

Self compacting concrete must be able to flow into all the spaces within the formwork under its own weight. This is related to workability, as measured by slump flow or Orimet test.

The filling ability or flowability is the property that characterizes the ability of the SCC of flowing into formwork and filling all the spaces under its own weight, guaranteeing total covering of the reinforcement. The mechanisms that govern this property are high fluidity and cohesion of the mixture.

2 **.Passing Ability** :

Self compacting concrete must flow through tight openings such as spaces between steel reinforcing bars under its own weight. The mix must not block during placement.

The passing ability is the property that characterizes the ability of the SCC to between obstales-gaps between reinforcement, holes, and the narrow sections, without blocking. The mechanisms that govern this property are moderate viscosity of the paste and mortar, and the properties of the aggregates, principally, maximum size of the coarse aggregates. Stability or resistance to the segregation is the property that characterizes the ability the ability of the SCC to avoid the segregation of its components, such as the coarse aggregate. Such a property provides uniformity of the mixture during transport, placement and consolidation. The mechanism that govern this property are the viscosity and cohesion of the mixture.

3. High Resistance to segregation :

Self compacting concrete must meet the requirement of 1 and 2 while its original composition remains uniform. The key properties must be maintained at adequate levels for the required period of time (e.g. 20 min) after completion of mixing. It is the property 2 the passing ability and the property 3 resistance to segregation that constitute the major advance, form a merely super plasticizer fresh mix which may be more fluid than self compacting.

The above three key properties are to some extent related and inter-dependent. A change in one property will normally result in a change in one or both of the others. Both poor filling ability and segregation can cause insufficient passing ability, i.e. blocking. Risks of segregation increase as filling ability increases. SCC is actually a trade-off between filling ability and segregation resistance as shown in Figure 1.7

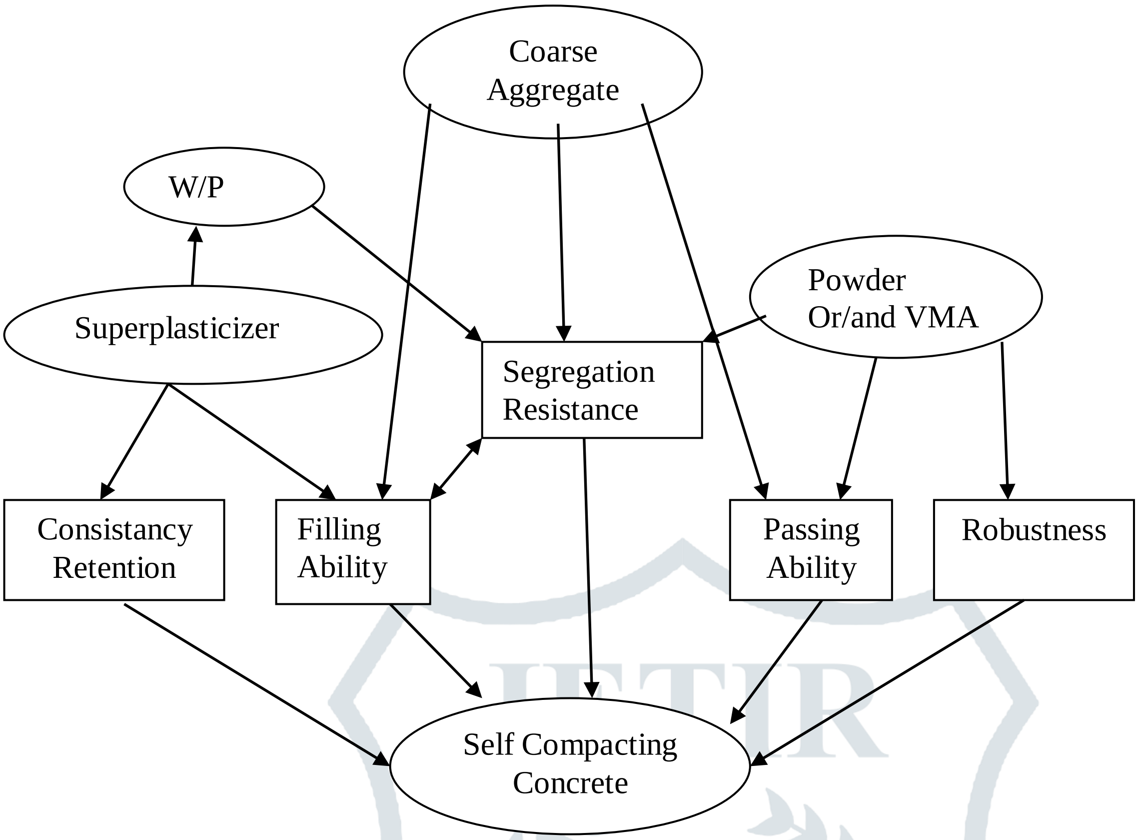


Fig. 1.7 Schematic of Ways to Achieve SCC

CHAPTER 2

LITERATURE REVIEW ON SELF COMPACTING CONCRETE

2.1. GENERAL

In this chapter the research work concerning to the various application and methods used for testing of the Self-compacting Concrete made by various cementitious materials and admixtures are discussed. This chapter gives a comprehensive review of the work carried out by various researchers in the field of Self-compacting Concrete.

1.Bertil Persson (2001) carried out an experimental and numerical study on mechanical properties, such as strength, elastic modulus, creep and shrinkage of self compacting concrete and corresponding properties of normal compacting concrete. The study included ratio (w/c) varying between 0.24 and 0.80.

2.Sri Ravindra rajah (2003) made an attempt to increase the stability of fresh concrete (cohesiveness) using increased amount of fine materials in the mixes. They reported about the development of self-compacting concrete with reduced segregation potential. The systematic experiment approach showed that partial replacement of coarse aggregate and fine aggregate with finer materials could produce self compacting concrete with low segregation. The result showed that fly ash could be used successfully in producing self compacting high strength concrete with reduced segregation potential.

3. Cristian Druta (2003) carried out an experimental study on to compare the Splitting Tensile Strength and Compressive Strength values of self-compacting and normal concrete specimens and to examine the bonding between the coarse aggregate and the cement paste using the Scanning Electron Microscope. In this experiment used mineral admixes Blast furnace slag, Fly Ash and Silica Fume and chemical Admixtures, it has been verified, by using slump flow test and U-tube tests that SCC achieved consistency and self-compatibility under its own weight, without any external vibration or compaction.

4 .Girish (2010) presented the results of an experimental investigation carried out to find out the influence of paste and powder content on self-compacting concrete mixtures. Slump flow, V funnel and J-ring tests were carried out to examine the performance of SCC. The results indicates that the flow properties of SCC increased with an increase in the paste volume. They conclude that paste plays an important role in the flow properties of fresh SCC in addition to water content.

5. Subramanian and Chattopadhyay (2002) are research and development engineers at the ECC Division of Larsen & Toubro Ltd (L&T), Chennai, India. They have over 10 years of experience on development of self-compacting concrete, underwater concrete with ant wash out admixtures and proportioning of special concrete mixtures and proportioning of special concrete mixtures. Their research was concentrated on several trails carried out to arrive at an approximate mix proportion of self compacting concrete, which would give the procedure for the selection of a viscosity modifying agent, a compatible superplasticizer and determination of their dosages. The Portland cement was patially replaced with fly and blast furnace slag.

6.Mayur B. Vanjare, & Shiram H. Mahure (2012) carried out an experimental study on to focus on the possibility of using waste material in a preparation of innovative concrete. One kind of waste was identified: Glass Powder (GP). The use of this waste was proposed in different percentages as an instead of cement for the production of self compacting concrete. The addition of glass powder in SCC mixes reduces the self compatibility characteristics like filling ability , passing ability and segregation resistance. The flow value decreases by an average of 1.3%, 2.5%, and 5.36% for glass powder replacement of 5%, 10% and 15% respectively.

7. Safiuddin (2008) observed that drying shrinkage occurs when concrete hardens and dries out at the early age. It induces potential flow channels in the form of microcracks. These cracks provide the access to deleterious agents, and thus affect the durability of concrete. The drying shrinkage of SCC does not differ very much from that of normal concrete. Several studies report that it could be even lower in SCC. In general, the reduced coarse aggregate content and the increased amount of cementing materials are expected to cause more drying shrinkage in SCC.

8.Hardik Upadhyay carried out an experimental study on different mix design methods using a variety of materials has been discussed, as the characteristics of materials and the mix proportion influences self- compatibility to a great extent. It can be a boon considering improvement in the concrete quality, significant advances towards automation and concrete construction processes, shortened construction time, lower construction cost and much improvement in working conditions as it reduces noise pollution.

9. Naik and Singh (1997) conducted tests on concretes containing between 15% and 25% by mass Class F and Class C fly ashes to evaluate compressive strength. The effects of moisture and temperature during curing were also examined. The results of the research showed that concretes containing Class C fly ash and were moist cured at 23^0 c developed higher early age (1 to 14 days) compressive strengths than the concretes with Class F fly ash.

10. R.V(2003) found that use of fine fly ash for obtaining Self compacting concrete resulted in an increase of the 28 day Compressive Strength Concrete by about 38%. Self compacting concrete was achieved when volume of paste was between 0.43 and 0.45

CHAPTER 3

METHODOLOGY

3.1 Study of literature review:

1) Identification of literature survey problems.
2) Procurement and selection of material.
3) Preliminary investigation of materials.
4) Development of mix design
5) Preparation on trail mix.
6) Optimization of Fly Ash and Silica Fume in self compacting concrete.

7) Conducting tests on fresh properties of SCC.

8) Casting and Curing the specimens.

9) Testing of specimens for hardened properties.

10) Feasibility study on self compacting concrete.

3.2 Experimental program:

1) Identification of materials and testing their properties

2) Preliminary investigation of materials

3) Optimization of FA and SF content in SCC

4) Optimization of superplasticizer content in SCC

5) Mix preparation on various trails using FA and SF

6) Moulding of mix proportions and testing in fresh state such as slump flow test, T_{50} slump test and j ring test

7) Study the effect of FA and SF on the fresh properties on SCC

8) Casting and curing of concrete and testing in hardened state such as compressive strength

9) Identify the effect of FA and SF on the hardened properties of SCC

3.3 Result analysis:

1) Conducting the tests

2) Correction errors of result

3) Note the result readings

4) Calculation of readings

5) Finalize the result tabular form

6) Finalize the result by showing in graphs

CHAPTER 4

MATERIAL AND TESTING ON MATERIALS

4.1 MATERIALS

The raw materials used in this experiment were locally available as a blinding agent, river sand as fine aggregates, crushed coarse aggregates and Portable tab water was used for mixing and curing throughout the entire work.

4.1.1 CEMENT

Use 43 Grade of cement of ordinary Portland cement (OPC).It is blended with water and materials.

Composition limits of Portland cement are tabulated in following table

Table 4.1.1 : Composition of Cement

INGREDIENTS	% CONTENT
Lime	60-67
Silica	17-25
Alumina	3-8
Iron Oxide	0.5-6
Mangnesia	0.1-4
Alkalies	0.4-1.3
Sulphur	1-3

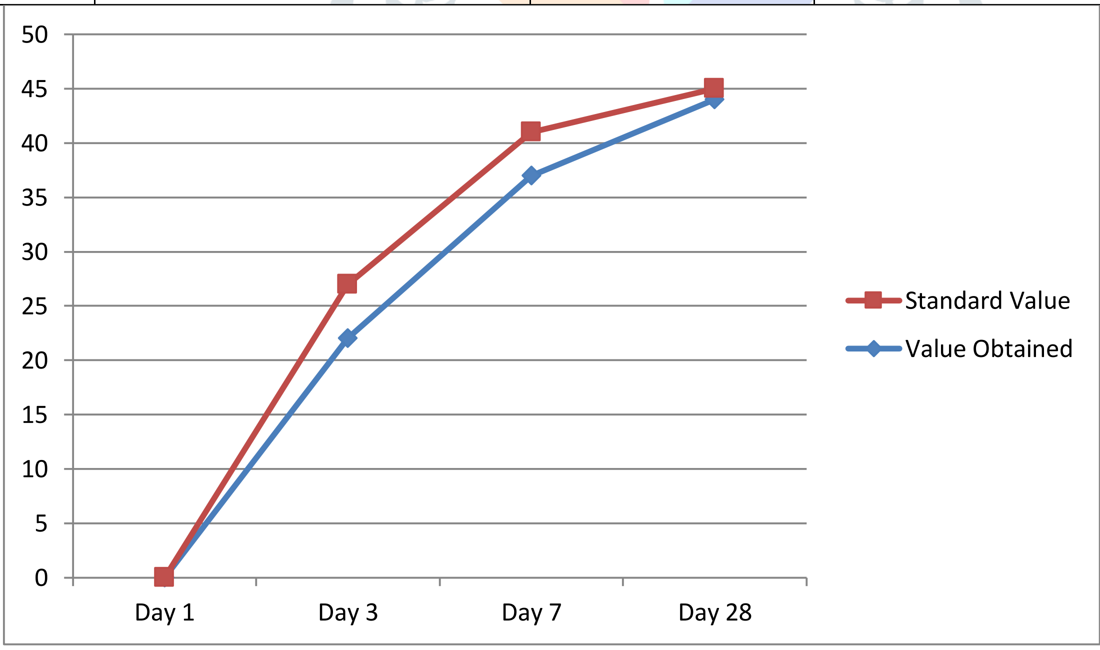
Grade 43 portland cement was utilised for throwing shapes and chambers for solid blend. The concrete was uniformly shaded i.e: dark with a light greenish shade and was free from any hard bumps. Synopsis of the different tests led on bond are as under given in Table 4.1.2

Table 4.1.2 : Physical properties of cement

S.No.	Characteristics	Values Obtained	Standard Values
1	Normal Consistency	31%	-
2	Initial Setting Time	44 min.	Not be less than 30 minutes
3	Final Setting Time	269 min.	Not be greater than 600 minutes
4	Fineness	6.1 %	<10

Compressive strength :- Cement: Sand(1:3)

1	3 days	22 N/mm^2	27 N/mm^2
2	7 days	37 N/mm^2	41 N/mm^2
3	28 days	44 N/mm^2	43 N/mm^2



Graph 4.1.1 Compressive Strength Vs Time

4.1.2. FINE AGGREGATES

The sand used for the experimental programme was locally. The sand was first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm and then was washed to remove the dust. Properties of the fine aggregate used in the experimental work are tabulated in Table 4.1.2.1

The aggregates were sieved through a set of sieves to obtain sieve analysis and the same is presented in Table 4.1.2.2.

Table 4.1.2.1 : Physical Properties of fine aggregates

Sr. No.	Characteristics	Value
1.	Bulk density	1.5 kg/m^3
2.	Fineness modulus	2.56 m^2/g
3	Water absorption	0.79%
4.	Grade zone (Based on percentage passing 0.60mm)	Zone III

Table 4.1.2.2 : Seive analysis of fine aggregates

Sr. No.	Sieve size	Mass retained	Percentage Retained	Cumulative percentage Retained	Percent passing
1	4.75mm	4.0 g	0.4	0.4	99.6
2.	2.36mm	75.0 g	7.50	7.90	92.1
3.	1.18mm	178.0 g	17.8	25.70	74.3
4.	600µ	220.0 g	22.0	47.70	52.3
5.	300µ	274.0 g	27.4	75.10	24.9
6.	150µ	246.5 g	24.65	99.75	0.25
7.				£=256.55	

Total weight taken =1000gm

Fineness Modulus of sand =2.56

Thus the fine aggregates belonged to grading zone III.

4.1.3. COARSE AGGREGATE

The material which is retained on IS sieve no. 4.75 is termed as a coarse aggregate. The crushed stone is generally used as a coarse aggregate. The nature of work decides the maximum size of the coarse aggregate. Locally available coarse aggregate having the maximum size of 10 mm was used in our work. The aggregates were washed to remove dust and dirt and were dried to surface dry condition. The aggregates were tested as per IS: 3831970. The results of various tests conducted on coarse aggregate are given in Table 4.1.3.1 and Table 4.1.3.2 shows the sieve analysis results

Table 4.1.3.1: Physical Properties of Coarse Aggregates

Sr. No.	Characteristics	Value
1.	Type	Crushed
2.	Total water Absorption	0.52
3.	Fineness Modulus	6.84

Table 4.1.3.2 : Sieve Analysis of Coarse Aggregate.

Sr. No.	Sieve Size	Mass Retained in gm	Percentage Retained	Cumulative percentage Retained	Percent passing
1.	20mm	0	0	0	100
2.	10mm	2512	83.7	83.7	16.3
3.	4.75mm	477	15.9	99.6	0.4
4.	PAN	11	0.36	£=183.3	

Total Weight taken =3000gm

Fineness Modulus of Coarse Aggregate= (183.3+500)/ 100

= 6.8

4.1.4. WATER

Water is the readily available most important component of SCC. The hydration of cement can take place only in the presence of water. Adequate water is required for the hydration of cement, leading to the formation of paste to bind the aggregates. In addition, water is required in conjunction with superplasticizer to achieve the self consolidation capacity of SCC. It contributes to attain good flowing ability of SCHPC by lubricating the fine and coarse aggregates.

4.1.4.1 Physical quality of water

Water intended for use in concrete should be clean, fresh and free of deleterious substances. Water containing harmful substances such as silts, suspended particles, organic matter, oil, or sugar can unfavorably affect the strength and setting properties of cement and disrupt the affinity between aggregate and cement paste Therefore, the suitability of water should be examined before use. As a rule, any water with a silt content below 2000 mg/L is suitable for use in concrete. In general, the potable or drinkable water is safe for use in concrete.

4.1.4.2 Chemical quality of water

The mixing water for SCC should be chemically safe. The pH of mixing water should be in the range of 6.0 to 8.0. It should not contain high amount of dissolved solids, chlorides, alkalis, carbonates, bicarbonates, sulfates, and other salts, which can interfere with the performance of concrete. Water containing chloride ion, SO_3 ion, and dissolved solids below 500, 1000, and 2000 mg/l, respectively, is generally satisfactory for making concrete , Though dissolved solids exceeding 2000 mg/l are not always harmful, they can affect the strength and setting properties of cement adversely. Therefore, when the suitability of water is questionable, it must be tested prior to use in concrete.

Table 4.1.4 Properties of water

Properties	Obtained values
Ph	8.0
Dissolved salts, mg/l	290
Suspended particles	Nil
Chlorides, mg/l	20

4.1.5. SUPPLEMENTARY CEMENT MATERIALS

4.1.5.1.FLY ASH

Fly ash is the finely divided residue resulting from the combustion of coal. It is a pozzolanic material that is commonly used in cement-based materials & the particles are generally finer than cement particles. Fly ash has a high amount of silica and alumina in a reactive form.

It is not only the chemistry provided by fly ash that compliments chemistry of cement, but also the physical properties of fly ash improve the rheology and microstructure of concrete by a great extent. Fly ash, on itself, cannot react with water, it needs free lime, produced on hydration of Portland cement, to trigger off its Pozzolonic effect. Once it is triggered, it can go on and on. In simple words, it means a much longer life for concrete structure.

The investigations was carried out on self compacting concrete using 35% of fly ash by weight of cement as partial replacement of cement. Based on the investigation that concluded that addition of Fly ash resulted in a decreases of superplasticizer content for same or better workability. The addition of Fly ash resulted as decrease in 7 days and 28 days compressive strength. The 28 days compressive strength decrease to 22-23 % as the Fly ash content is increased to 35%. The reduction in 7 days strength is more as compared to 28 days strength.

4.1.5.1.1 Benefits of using fly ash

1)It delays the heat of hydration and hence reduces the thermal cracks in concrete.

2) It improves the workability of concrete.

3) It makes the mix homogeneous and hence reduces segregation and bleeding.

4)The concrete finish is improved due to perfectly spherical fly ash particles.

5) The concrete permeability is substantially reduced which enhances the life of the structure.

6)Fly ash contributes to the long term strength in concrete.

4.1.5.2 SILICA FUME

Silica Fume is a by-product obtained after reducing high-purity quartz with coal in electric arc furnace by heating up to 2000^{o}C (3632^{o}F) during the production of silicon. By oxidation and condensation very fine spherical particles of Silica Fume are obtained which are highly reactive. Silica fume is another artificial pozzolanic mineral admixture. It also referred to as micro silica or condensed silica fume. When quartz is subjected to 2000^{0}C, reduction takes place and SiO vapors get into fuels. In the course of exit, the oxidation takes place and the product is condensed in low temperature zones. When the silica is condensed it attains non-crystalline state with ultra-fine particle size. The super fine particle is collected through the filters. After it cools and condensed, it is collected in bags. It consists of small spherical particles of amorphous silica with an average particle size of 0.1 microns and a surface area of 15,000-25,000 m^2/kg.

4.1.5.2.1 Role Of Silica Fume

The presence of silica fume (SF) in the concrete mix improves workability and makes the mix more mobile, yet cohesive. This is the consequence of a better dispersion of the cementitious particles and due to the surface characteristics of the silica fume particles, which are smooth and absorb little water during mixing. The workability of concrete containing silica fume is more sensitive to variations in the water content of the mix than ordinary mix. The mix containing silica fume has very low penetrability and good resistance to penetration and thereby reduces freeze and thaw effect.

4.1.6. ADMIXTURES

Admixture is defined as a material, other than cement, water and aggregates, which is used as an ingredient of concrete and is added to the batch immediately before or during mixing. Additive is a material which is added at the time of grinding cement clinker at the cement factory. Various admixtures are categorized based on their function in the concrete namely Plasticizers, Superplasticizers, Retarders and Retarding Plasticizers, Accelerators and Accelerating Plasticizer, Air-entraining Admixtures, Damp proofing and Waterproofing Admixtures, Gas forming Admixtures, Workability Admixtures, Grouting Admixtures, Bonding Admixtures, Colouring Admixtures.

4.1.6.1.Superplasticizer

Superplasticizer (SP) also called High Range Water Reducers (HRWR) is an essential component of SCC to provide the necessary workability. They reduce the yield stress and plastic viscosity of concrete by their liquefying action.

The main purpose of using a superplasticizer is to produce flowing concrete with very high slump that is to be used in heavily reinforced structures and in places where adequate consolidation by vibration cannot be readily achieved. The ability of a superplasticizer to increase the slump of concrete depends on such factors as the type, dosage, and time of addition, water / binder ratio and the nature of cement and filler materials. It has been found that for most types of cement, a superplasticizer improves the workability of concrete. The new generation superplasticizer **Poly-Carboxylate Ether (PCE**) are based particularly useful for production of SCC.

Using PCE polymers, give excellent water reduction as compared to normal plasticizers. This helps to reduce the w/c ratios and cement contents, even in normal concretes. Lower the w/c ratio, lower are the number of capillaries in concrete. It is also a well documented fact that PCE based admixtures do not have the side effects of retardation often seen with normal retarding superplasticizers. This is beneficial as workability time of concrete can be controlled

4.1.6.2. Conplast SP430

Conplast SP430 is a high range water decreasing admixture and is a chloride free, superplasticize. It is supplied as brown solution which instantly disperses in water. Conplast SP430 disperses the fine particles in the concrete mix, enabling the water content of the concrete to perform more effectively. The very high levels of water reduction possible allow major increases in the strength to be obtained.

4.1.6.2.1 Advantages

1.Major increase in the strength at early ages without increased cement contents are of benefit in precast concrete, allowing earlier stripping times.

2. Makes possible major reductions in water: cement ratio which allow the production of high strength.

3. Use in production of flowing concrete permits easier construction with quicker placing and

compaction and reduced labour costs without increasing water content.

4. Increased workability levels are maintained for longer than with ordinary sulphonated melamine admixture.

5. Minimizes segregation and bleeding and improves pumpability

6. The lower water content leads to quicker drying times.

7. Chloride free, safe for use in prestressed and reinforced concrete.

CHAPTER 5

MIX DESIGN AND TESTING

5..1 TYPICAL MIX PROPORTION

SCC has the same constituent materials as those for Conventional concrete but their relative proportions differ and need to be carefully selected. Generally speaking, lower coarse aggregate content and higher amounts of additions and cement, and admixtures (particularly superplasticizer) are required to achieve self compacting properties.

A simple mix proportioning system for SCC have proposed. The coarse and fine aggregate contents are fixed so that self compactability can be achieved easily by adjusting the powder content(cement, fly ash, silica fume) and superplasticizer dosages. The mix design procedure is as follows:

1). The coarse aggregate content (all particles larger than 4 mm and smaller than 10mm) is fixed in the range of 28 to 35% of the concrete volume

2). The fine aggregate content (all particles larger than 0.125 mm and smaller than 4.75 mm) is fixed in the range of 40 to 50% of the mortar volume.

3) The W/P ratio is of 0.45 (by mass), depending on the properties of the powder (i.e cement and filler having particles smaller than 0.125mm).

4). The superplasticizer dosage and the final W/ P ratio are determined through trial mixes so as to ensure self compactability using fresh properties tests.

5). The silica fume and fly ash percentages are determined through trial mixes, so as to ensure self compactability using fresh properties test.

The proposed mix proportions of SCC and recommended that workability tests should be conducted until consistent and compliant results are obtained. SCC tends to dry faster than conventional concrete because there is little or no bleed water at the surface.

5.1.1 Comparison of Mix Proportions of CC with SCC

SCC has the same constituent materials as those for CC but their relative proportions differ and need to be carefully selected. As shown in Fig 5.1.1 the coarse aggregate and W/P ratio of CC are significantly higher than those of SCC, the powder content is less, and the paste volume and sand/mortar volume ratio are within the SCC range. Table 5.1.1 shows the difference between mix designs of SCC and conventional concrete.

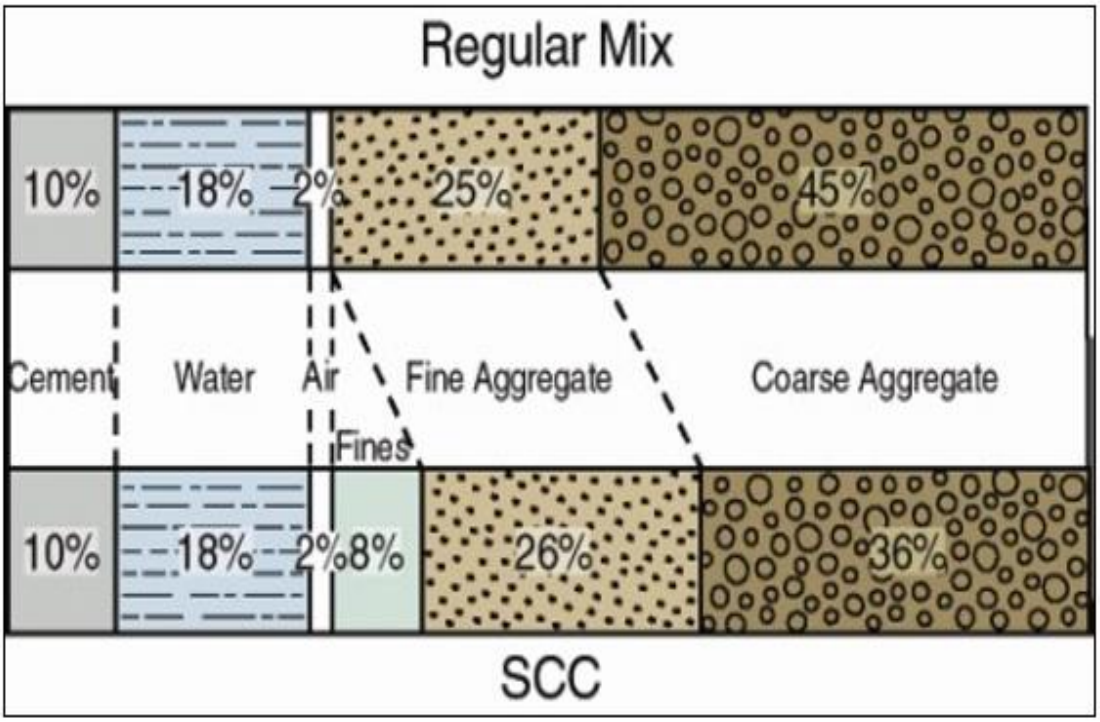


Fig. 5.1.1 : Constituent of Conventional Vs Self Compacting Concrete (by volume)

Table 5.1.1 Comparison of CC and SCC

Conventional Concrete	**Self Compacting Concrete**
W/c ratio is fixed first, considering strength	Coarse and fine aggregates are fixed first
W/c or water/ powder (W/P) ratio is sensitive to strength .Design of mix starts from w/c ratio.	W/P ratio is decided by self compactability. W/c ratio (by weight) is generally low for obtained W/ P ratio (by volume).
Strength is precious to the design.	Strength could often be regarded as sufficiently high for ordinary structures

5.2 MIX PROPORTION

5.2.1 M25 = (1:1:2) NORMAL SELF COMPACTING CONCRETE (NSCC)

Wet volume of concrete for 1 cube = 0.15×0.15×0.15 = 0.003375m^3

Dry volume = Wet volume × 1.54

Cement = $\frac{1}{4}$× 1.54 = 0.385m^3 = 0.385 × 1440 = 554 kg

= **1870 gm**

Sand = $\frac{1}{4}$× 1.54 = 0.385m^3 = 0.385 × 1600 = 616 kg

= **2080 gm**

Coarse Aggregatess = $\frac{2}{4}$× 1.54 = 0.77m^3 = 0.77×1680 =1293 kg

= **4360 gm**

Take W/C ratio = 0.45

Thereore water = 0.45×1.87

= **840 gm**

Mix the dry ingredients thoroughly & add the quantity of water and mix it to make a uniform & homogenous concrete for 3 cubes.

5.2.2 FIRST TRIAL TEST FOR CUBE SCC1(35%FA)

Total Powder Content = 1870 gm

Fly Ash = 35%

Fly Ash Content = 655 gm

Superplasticiser = 4%

Complast SP 430 =2% = 37 gm

Polycarboxylate Ether = 2% = 37 gm

Cement = 1870-(655+37+37)

= 1140 gm

Sand = 2080 gm

Coarse Aggregatess = 4360 gm

Take W/P ratio = 0.45

Water = 840 gm

5.2.3 SECOND TRIAL TEST FOR CUBE SCC2(25%SF)

Total Powder Content = 1870 gm

Silica Fume = 25%

Silica Fume Content = 467 gm

Superplasticiser = 5%

Complast SP 430 =3% = 56 gm

Polycarboxylate Ether = 2% = 37 gm

Cement = 1870-(467+56+37)

= 1310 gm

Sand = 2080 gm

Coarse Aggregatess = 4360 gm

Take W/P ratio = 0.45

Water = 840 gm

5.2.4 THIRD TRIAL TEST FOR CUBE SCC3F(25%FA+15%SF)

Total Powder Content = 1870 gm

Fly Ash + Silica Fume = 40%

Fly Ash = 25% = 468 gm

Silica Fume = 15% = 280 gm

Superplasticiser = 6%

Complast SP 430 =6% = 110 gm

Polycarboxylate Ether = 0% = 00 gm

Cement = 1870-(468+280+110)

= 1010 gm

Sand = 2080 gm

Coarse Aggregatess = 4360 gm

Take W/P ratio = 0.45

Water = 840 g

Table 5.2 proportioning of mix of all trails

Mix	Cement Gm	Water Gm	C.A gm	Sand gm	FA gm	SF Gm	SP Gm
NSCC	1870	840	4360	2080	-	-	-
SCC1	1170	840	4360	2080	655	-	74
SCC2	1310	840	4360	2080	-	467	93
SCC3	1010	840	4360	2080	468	280	110

5.3. TEST METHODS OF FRESH SELF COMPACTING CONCRETE

It has been examined that the SCC streams alone under its dead weight up to leveling, affectation out and combines itself subsequently with no passage of extra compaction vitality and without a nameable isolation. Because of the high substance of powder, SCC may indicate more plastic shrinkage or drag than conventional cement blends.

- Filling Capacity: Capacity of to fill a formwork totally under its own weight.
- Passing Capacity: Capacity to overcome hindrances under its own weight without obstruction. Hindrances are e.g. support and little openings and so on.
- Isolation Resistance: Homogeneous arrangement of solid amid and after the procedure of transport.

Sr. No.	Method	Property
1	Slump –Flow	Filling ability
2	T_{50cm} slump flow	Filling ability
3	J-ring	Passing ability
4	V-funnel	Filling ability
5	V^{-f}Unn^{e}l at $T_{50minutes}$	Segregation resistance
6	L-box	Passing ability
7	U-box	Passing ability
8	Fill-box	Passing ability
9	GTM screen stability	Segregation resistance
10	Orimet	Filling ability

Table 5.3.1 List of test methods for workability properties of SCC

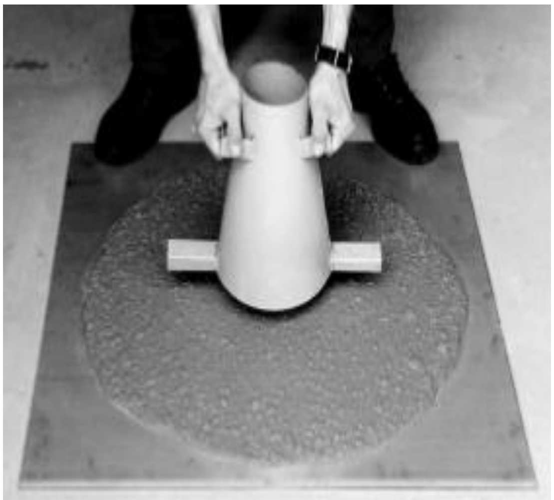
For the initial mix design of SCC all three workability parameters need to be assessed to ensure that all aspects are fulfilled. These requirements are fulfilled at the time of placing. Typical acceptance criteria for self compacting concrete are shown in table

Sr. No.	Method	Unit	Typical range Of values	
			Minimum	Maximum
1	Slump flow	Mm	650	800
2	T_{50cm} slump flow	Sec	2	5
3	J-ring	Mm	0	10
4	V-ring	Sec	6	12
5	V-funnel at T $T_{5minutes}$	Sec	0	3
6	L-box	(h2/h1)	0.8	1
7	U-box	(h2-hi)mm	0	30
8	Fill-box	%	90	100
9	GTM Screening stability test	%	0	15
10	Orimet	Sec	0	5

Table 5.3.2 Acceptance criteria for self compacting Concrete

5.3.1. SLUMP FLOW TEST

The slump flow test is used to assess the horizontal free flow of SCC in the absence of obstructions. The basic equipment used is the same as use in conventional slump test. The test method differs from the conventional one. Fig 5.3.1 shows Slump flow test.



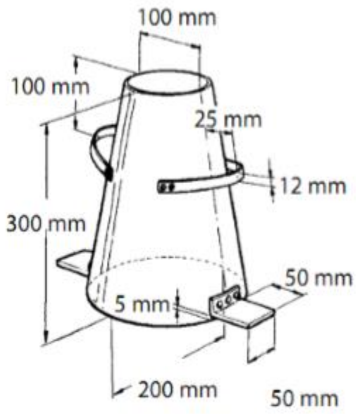


Fig 5.3.1 Slump Flow Test

The diameter of the spread of the concrete circle is a measure for the filling ability of the concrete. The slump flow test can give an indication as to the consistency, filling ability and workability of SCC.

In case of unstable mix, most of the coarse aggregate particles main in the center of the flow and only cement mortar flows. It gives no indication of the ability of the concrete to pass between reinforcement without blocking, but may give some indication of resistance to segregation. The higher the slump flow value, the greater is its ability to fill form work under its own weight. Acceptable range for SCC is from 650 to 800 mm.

5.3.2. T_{50}Slump Flow Test

The procedure for this test is same as slump flow test. When the slump cone is lifted, start the stop watch and find the time taken for the concrete to reach 500mm mark. This time is called T_{50}time. This is an indication of rate of spread of concrete. A lower time indicates greater flowability. It suggested that T_{50}time may be 2 to 5 secs.

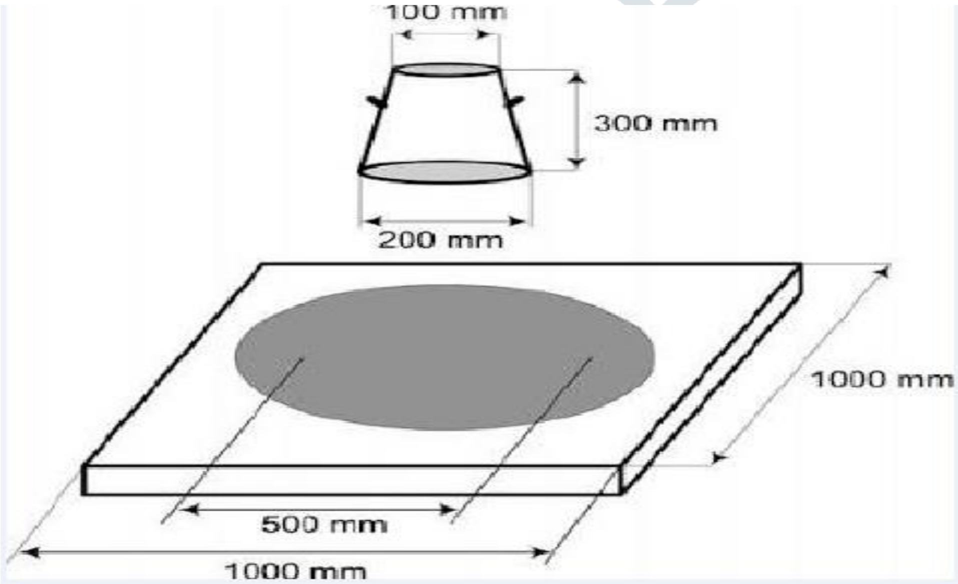


Fig. 5.3.2 T_{50}Slump Flow Test

5.3.3. J-Ring Test

This test denotes the passing ability of the concrete. The apparatus is composed of a ring with 16 or 18 vertical reinforcing rods, a slump cone and a rigid plate. When the cone is lifted, the concrete has to pass through the reinforcing bars as it flows across the plate. The passing ability is expressed as the height difference between the concrete inside and outside the bars, called the step height.

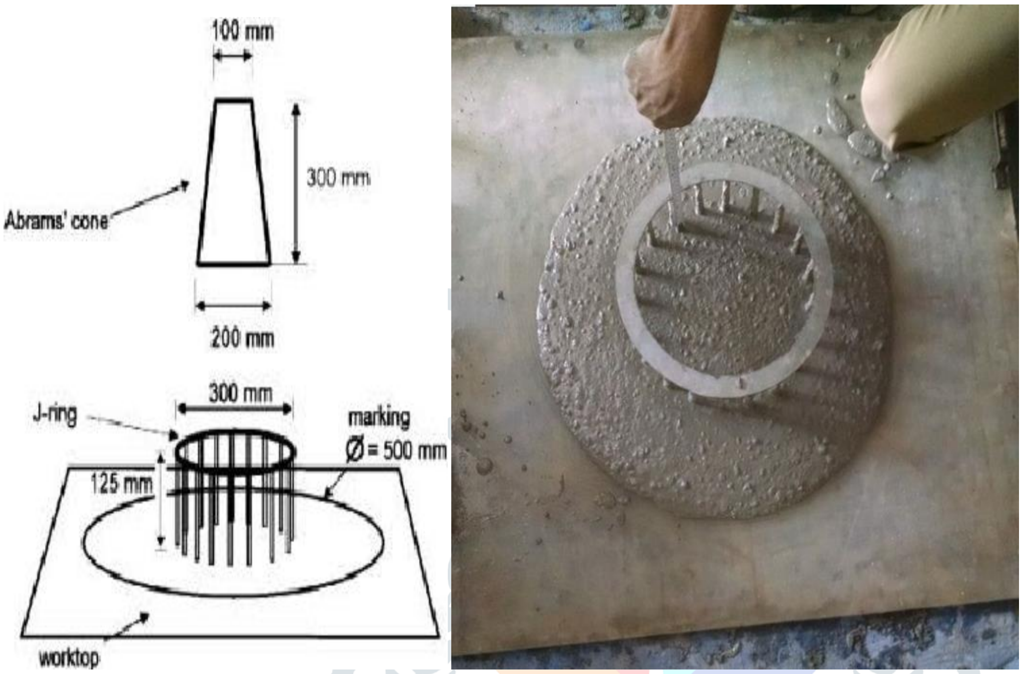


Fig. 5.3.3. J-Ring Test

Segregation resistance can be visually evaluated by observing the periphery after the concrete has stopped flowing. The number of bars has to be adjusted depending on the maximum size aggregate in the SCC mix. For SCC, maximum height difference up to 10 mm is considered as appropriate mix.

5.4. TEST METHODS OF HARDENED SELF COMPACTING CONCRETE

5.4.1. Compressive Strength

Self compacting concretes appear to develop in general higher compressive strength values as compared with conventional concrete of the same strength class. This is attributed to the changes in the interfacial transition zone (ITZ) caused by the different filler materials.

For SCC, achieving high strengths is not difficult, due to the presence of high powder content. However, achieving low and medium strength SCC is a difficult task. The paste volume had a predominant effect on the fresh concrete properties in comparison with water or powder content individually (for a given combination of aggregates).

5.5 CURING OF SELF COMPACTING CONCRETE

Even when good quality concrete is placed on the job site, curing is necessary to ensure the concrete provides good service over the life of the structure. Good concrete can be ruined by the lack of proper curing practices soon after concrete placement.

Curing has a major impact on the permeability of a given concrete. The surface zone will be seriously weakened by increased permeability due to poor curing. The importance of adequate curing is very evident in its effect on the permeability of the "skin" (surface) of the concrete.

The properties of hardened concrete, especially the durability, are greatly influenced by curing since it has a remarkable effect on the hydration of the cement

5.6 Methods of curing

5.6.1 Self curing method

The study was carried that the use of shrinkage reducing admixture polyethylene glycol (PCE) in concrete and noted that it helps in self curing and helps in better hydration and hence strength. He examined the affect of admixture (PCE) on compressive strength, split tensile strength and modulus of rupture by varying the percentage of PCE by weight of cement from 0% to 2.0%. It was found that PCE could help in self curing by giving strength on par with conventional curing. It was also found that 2% of PCE by weight of cement was optimum for concrete for achieving maximum strength without compromising workability.

5.6.2 Dry-Air Curing method

Dry curing is a curing method wherein the concrete cubes are left in open air to be cured at room temperature. Researchers have been working on the natural air drying of concrete since long. The experiment was carried out to study the effect of this type of curing on the properties of Concrete.

Dry-air curing produced 15.2%, 6.59% and 3.36% reduction in compressive strength, dynamic modulus of elasticity and ultrasonic pulse velocity respectively, this was owing to the early drying of concrete which virtually ceased hydration of the cement because the relative humidity within capillaries dropped below 80% and thus the formation of major reaction product Calcium silicate hydrate the major strength providing and porosity reducer stops before the pores are adequately blocked by it. Also, it caused 12.4% and 46.53% increase in initial surface absorption after 10 and 120 minutes respectively. This might be due to micro cracks or shrinkage cracks resulting from the early drying out of the concrete. Experimental results indicate that Dry-curing is not an efficient method to achieve good hardened properties of concrete.

5.6.3 Pounding or immersion method

This is a curing technique wherein the flat concrete surfaces such as slabs and pavements are cured by pounding of water around the perimeter of the surface with the help of sand dikes. It is an effective technique as it maintains a uniform temperature in the concrete and also prevents the loss of the moisture from the concrete.

This technique is used in laboratory experiments wherein the specimens are dipped in water after 24 hours of casting. The specimens are than tested for the strength after 7days and 28 days. Since pounding require considerable supervision and labour, this technique is generally used for small construction activity only.

CHAPTER 6

RESULTS AND DISCUSSION

6.1 SLUMP FLOW TEST

Results of slump value of all mixes such as replacement of cement by 35% of fly ash, replacement of cement by 25% of silica fume, combination of fly ash & silica fume(FA25% +SF15%) and normal self compacting concrete (NSCC) are shown in table 6.1

Mix	Slump (mm)
SCC1(35%FA)	675
SCC2(25%SF)	690
SCC3(25%FA+15%SF)	705
NSCC	660

Table 6.1 Slump flow result of SCC

From the above result table of slump flow test shows that there is maximum slump of SCC3 , so we can say that by increasing the powder content the filling ability of concrete is also increased. The mix containing 25%FA and 15%SF shows slump flow value is increased by 3.3% to that of NSCC

6.2 T_{50} SLUMP FLOW TEST

A lower time indicates greater flowability. It is suggested that T_{50}time may be 2 to 5 Secs. Results of T_{50} slump value of all mixes such as replacement of cement by 35% of fly ash, replacement of cement by 25% of silica fume, combination of fly ash & silica fume(FA25% +SF15%) and normal SCC are shown in table 6.2

Mix	T_{50cm} slump
SCC1(35%FA)	4.8
SCC2(25%SF)	4.5
SCC3(25%FA+15%SF)	4.0
NSCC	5

Table 6.2 result of T_{50m} slump value

From the above result table of T_{50cm} slump flow test shows that there is maximum flowability of SCC3 , so we can say that by increasing the powder content the flowability also goes on increasing. The mix containing 25%FA and 15%SF shows T_{50} slump flow value is increased by one Sec or 11.1% to that of NSCC.

6.3 J RING TEST

This test denotes the passing ability of the concrete. The passing ability is expressed as the height difference between the concrete inside and outside the bars, called the step height. For SCC, maximum height difference up to 10 mm is considered as appropriate mix.

Mix	Diameter (mm)	h2-h1(mm)
SCC1(35%FA)	565	1.3
SCC2(25%SF)	571	2.2
SCC(25%FA+15%SF)	578	3.1
NSCC	553	1.6

Table 6.3 result of J ring test

So we can say that by increasing the powder content the passing ability of concrete also goes on increasing. The mix containing 25%FA and 15%SF shows that passing ability is increased by 31% to that of normal self compacting concrete(NSCC).

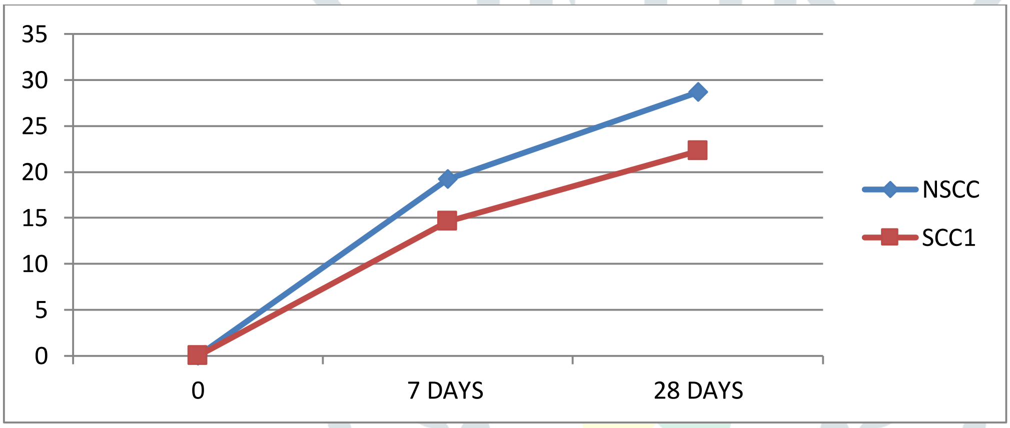
6.4 COMPRESSIVE DSTRENGTH

6.4.1 COMPRESSIVE STRENGTH OF SSC1(35%FA) and NSCC

In order to study the effect of compressive strength when fly ash is added into self compacting concrete as cement replacement, the cubes containing 35% of fly ash (35%FA) with 4% of superplasticizer were prepared and kept for curing for 7days and 28days. The result of compressive strength of respectives cubes is shown in table 6.4.1and graph 6.4.1 and is compare with the normal self compacting(NSCC)

Mix	**Compressive Strength(N/mm^2)**		**Average Compressive strength (N/mm^2)**	
	7days	28days	7days	28days
SCC1(35%FA)	15.6	22.6	14.6	22.3
	14.6	22.5		
	13.5	21.7		
NSCC	20.1	28.5	19.2	28.7
	19.4	29.7		
	18.2	28.1		

Table 6.4.1 result compressive strength of SCC1



Graph 6.4.1 compressive strength result of SCC1

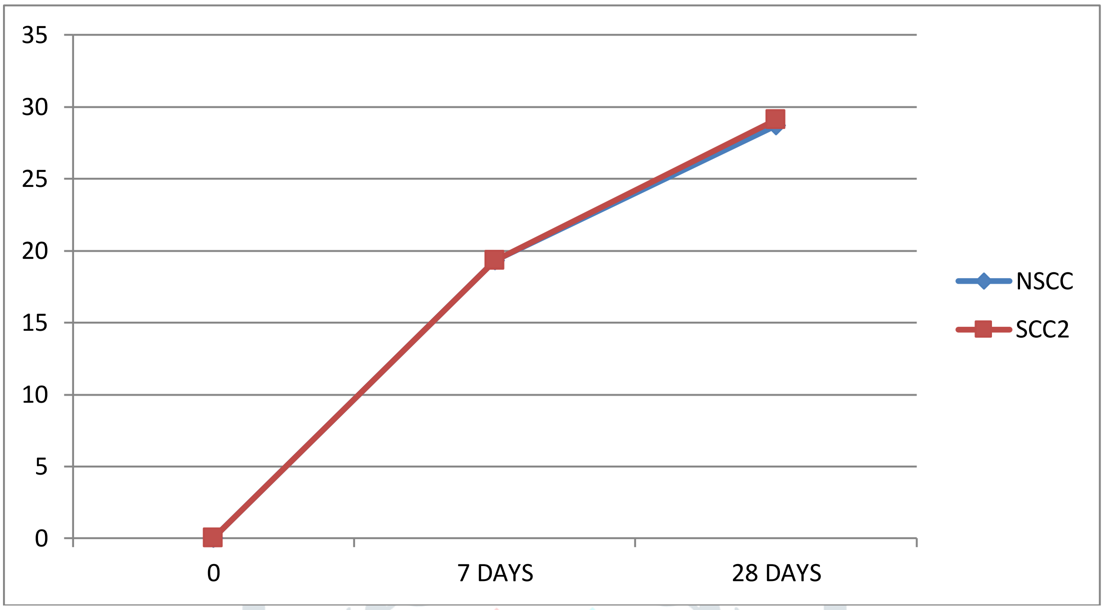
6.4.2 COMPRESSIVE STRENGTH OF SSC2(25%SF) and NSCC

In order to study the effect of compressive strength when silica fume is added into self compacting concrete as cement replacement, the cubes containing 25% of silica fume (25%SF) with 5% of superplasticizer were prepared and kept for curing for 7days and 28days. The result of compressive strength of respectives cubes is shown in table 6.4.2 and graph 6.4.2 and is compare with the normal self compacting(NSCC).

Mix	**Compressive Strength(N/mm^2)**		**Average Compressive strength (N/mm^2)**	
	7days	28days	7days	28days
	19.4	29.6		

SCC2(25%SF)	19.6	30.2	19.3	29.1
	18.9	27.7		
NSCC	20.1	28.5	19.2	28.7
	19.4	29.7		
	18.2	28.1		

Table 6.4.2 result of compressive strength of SCC2



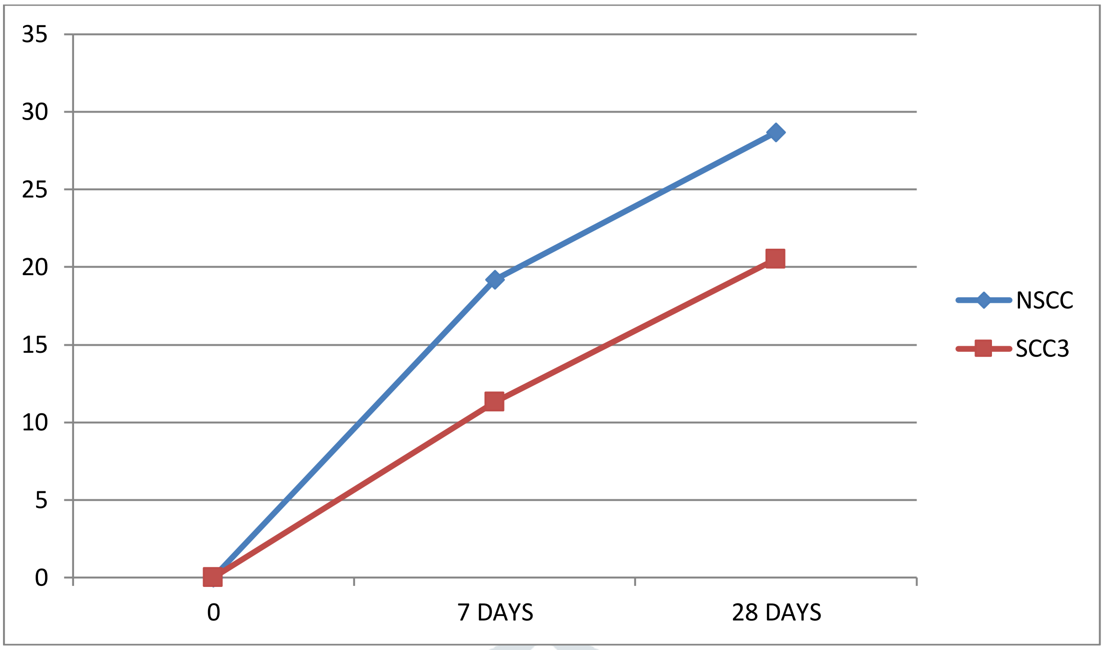
Graph 6.4.2 result of compressive strength of SCC2

6.4.3 COMPRESSIVE STRENGTH OF SCC3(25%FA+14%SF)

In order to study the effect of compressive strength when fly ash and silica fume is added into self compacting concrete as cement replacement, the cubes containing 25% of fly ash (25%FA) and 15% of silica fume (15%SF) with 6% of superplasticizer were prepared and kept for curing for 7days and 28days. The result of compressive strength of respectives cubes is shown in table 6.4.3 and graph 6.4.3and is compare with the normal self compacting(NSCC)

Mix	**Compressive Strength(N/mm^2)**		**Average Compressive strength (N/mm^2)**	
	7days	28days	7days	28days
SCC3(25%FA+15%SF)	11.7	20.2	11.3	20.5
	13.4	23.4		
	8.7	18.1		
NSCC	20.1	28.5	19.2	28.7
	19.4	29.7		
	18.2	28.1		

Table 6.4.3 result of compressive strength of SCC3



Graph 6.4.3 Compressive strength of SCC3

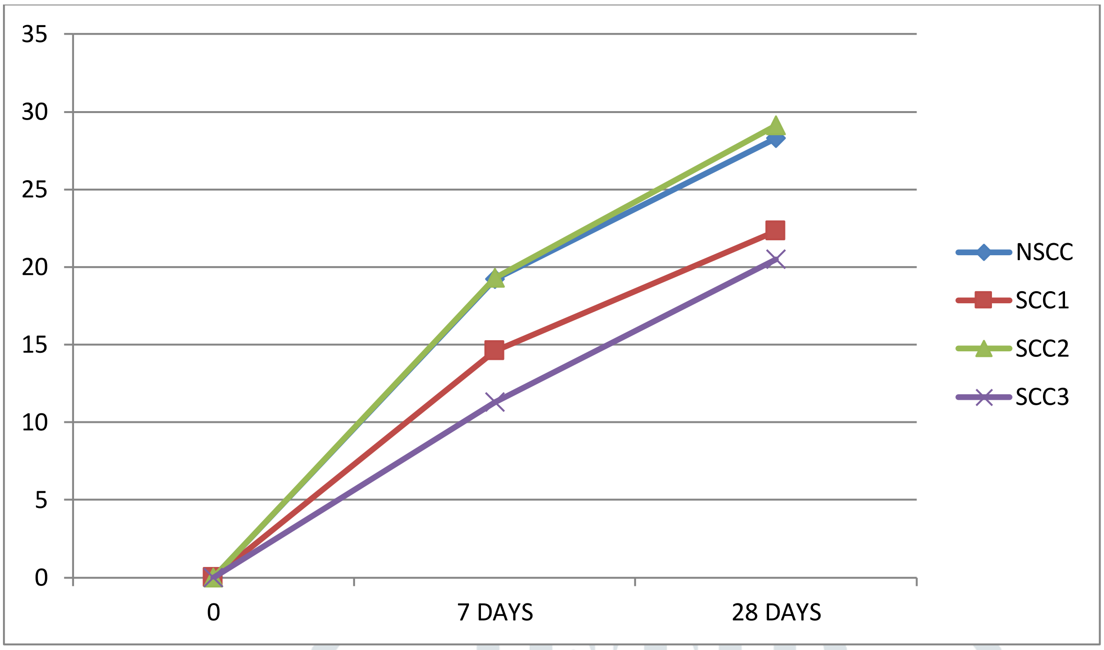
6.5 COMPRESSIVE STRENGTH OF ALL MIXES

In order to study the effect of compressive strength when fly ash and silica fume is added into self compacting concrete as cement replacement, the cubes containing 25% of fly ash (25%FA) and 15% of silica fume (15%SF) with different percentages of superplasticizer were prepared and kept for curing for 7days and 28days. The result of compressive strength of respectives cubes is shown in table 6.5 and graph 6.5.1 & 6.5.2 and is compare with the normal self compacting(NSCC)

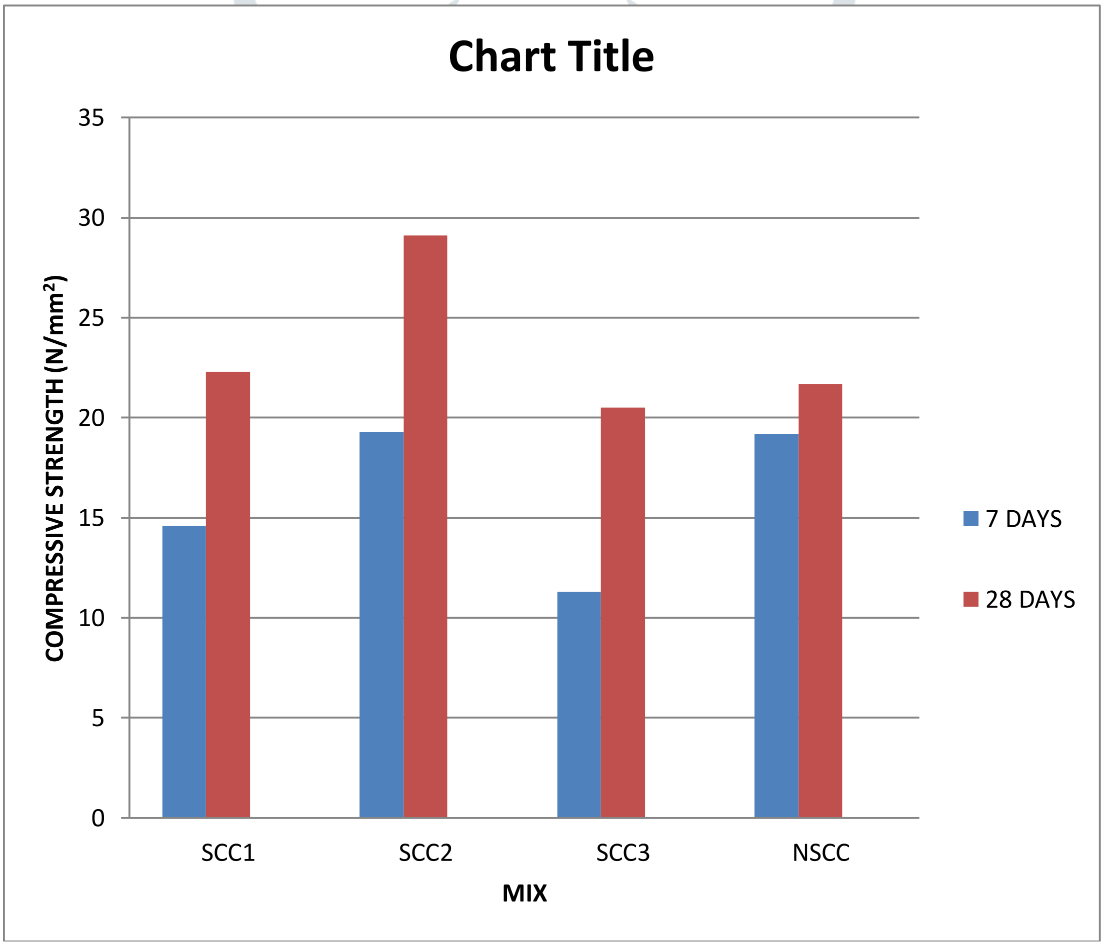
MIX	Compressive Strength (N/mm^2)		Average Compressive Strength (N/mm^2)	
	7days	28days	7days	28days
SCC1(35%FA)	15.6	22.6	14.6	22.3
	14.6	22.5		
	13.5	21.7		
SCC2(25%SF)	19.4	29.6	19.3	29.1
	19.6	30.2		
	18.9	27.7		
SCC3(25%FA+15%SF)	11.7	20.2	11.3	20.5
	13.4	23.4		
	8.7	18.1		
NSCC	20.1	28.5	19.2	28.7
	19.4	29.7		
	18.2	28.1		

Table 6.5 result of compressive strength of SCC

The above table shows that there in maximum comprerssive strength of mix which contain 25% of silica fume.



Graph 6.5.1 compressive strength of all mixes



Graph 6.5.2 of compressive strength at different ages

CHAPTER 7

SCOPE FOR FURTHER STUDY

The following experimental studies can be conducted in future with respect to self compacting concrete:-

-The effect of addition of silica fume / fly ash on the durability characteristics of self compacting concrete containing more than two admixtures.

-The effect of temperature on the properties of self compacting concrete containing more than two admixtures with silica fume / fly ash.

-The effect of addition of silica fume/ fly ash on the shrinkage and creep properties of self compacting concrete containing more than two admixtures.

-The effect of addition of silica fume / fly ash on the fresh properties of self compacting concrete containing more than two admixtures.

-The effect of addition of silica fume / fly ash on the hardened properties of the self compacting concrete containing more than two admixtures.

-Similarly there are lot more mineral admixtures which are the wastages of the industry. The other types of ingredients wastages used for manufacturer of concrete to reduce the problems of environment attack.

CHAPTER 8

CONCLUSIONS

In the present scenario there is a great need for self compacting concrete due to sickness of member and architectural requirement, also to improve durability of the structure.

Now the world is going to face greater need of high performance concrete, durability point of view and SCC where the conventional way of compacting may not be always useful under different site condition. So instead of going for the conventional concrete let us mix the concrete compacting on its own which is called as self compacting concrete.

The wastes such fly ash and silica fume used for making concrete mix. This concrete mix should be used for the construction activity it will reduce the problems of environment pollution at the same time. It reduces the cost of the construction and add it makes the concrete high performing from the durability point of view. So from these three points the project is under taken.

It has been observed that the compressive strength of self compacting concrete produced with the combination of admixtures such as (conplast SP430 and PCE) goes on increasing by 35% addition of fly ash. After 35% addition of fly ash, compressive strength starts decreasing, i.e. the compressive strength of self compacting produced with (conplast SP430 and PCE) is maximum when 35% fly ash is added. The compressive strength by 35% addition of fly ash is 14.6N/mm after the 7days of curing period and 22.3N/mm after the 28days of curing period.

Thus, it can be concluded that maximum compressive strength of self compacting concrete with the combination of admixtures (conplast SP430 and PCE) may be obtained by adding 35% fly ash, which is resulting from the combustion of coal.

It has been observed that the compressive strength of self compacting concrete produced with the combination of admixtures such as (conplast SP430 and PCE) goes on increasing by 25% addition of silica fume. After 25% addition of silica fume, the compressive strength starts decreasing i.e. the compressive strength of self compacting concrete produced with (conplast SP430 and PCE) is maximum when 25% silica fume is added. The compressive strength at 25% addition of silica fume is 19.3N/mm after the curing period of 7days and 29.1N/mm after the 28days of curing period.

Thus, it can be concluded that maximum compressive strength of self compacting concrete with the combination of admixtures (conplast 430 and PCE) may obtained by adding 25% silica fume

It has been observed that the compressive strength of self compacting concrete produced with the combination of admixture such as Conplast SP430 goes on increasing by 25% addition of fly ash and 15% addition of silica fume. After 25% addition of fly ash and 15% addition of silica fume, compressive strength starts decreasing, i.e. the compressive strength of self compacting produced with Conplast SP430 is maximum when 25% fly ash is added and 15% silica fume is added. The compressive strength by 25% addition of fly ash and 15% addition of silica fume is 11.2N/mm after 7days of curing and 20.5N/mm after 28days of curing.

Thus , it can be concluded that maximum compressive strength of self compacting concrete with the combination of admixture conplast SP430 may be obtained by adding 25% fly ash and 15% silica fume

It has been observed that the compressive strength of normal self compacting concrete (NSCC) is 19.2N/mm^2 at the curing period of 7days and 28.9N/mm^2 at the curing period of 28days.

It is concluded that maximum compressive strength of self compacting concrete is when 25% of total powder content is replaced by silica fume(25%SF) is 19.3N/mm after 7days of curing and 29.6N/mm after 28days of curing.

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