

# INFLUENCE OF MINERAL ADMIXTURES ON SELF COMPACTING CONCRETE

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## Abstract

The objective of this study is to present the effect of mineral admixtures in Self compacting high strength concrete. An experimental study of SCC using cement content. We used the OPC 53 grade cement, due to adding admixture such as Fly ash, Silica Fume, Marble stone powder and limestone powder. The concrete mix proportions are based on IS10262-2009. The mix proportion obtained for M50 grade concrete is 1:1.66:3.09. The fresh concrete test conducted for this method are Slump cone test, L box test and J Ring test. The hardened concrete test is Compressive Strength Test. The fresh concrete test we have to adopt as per *EFNARC* code provisions. The main objective of our study is to make the concrete as high strength with good compaction as well as to attain high strength with replacement of admixtures without any compaction. In our research the normal beam is made by using M50 grade concrete and with blended concrete self compacting concrete beam is made. For the selection of blended mix the admixtures with higher compressive strength is preferred. And both the beams are tested under loading frame for load deflection behaviour. And the ultimate capacity of both the beams is compared and tabulated.

## 1.1 SELF COMPACTING CONCRETE

Self Compacting Concrete (SCC) is a high performance concrete that can flow under its own weight to completely fill the form work and self consolidates without any mechanical vibration. Such concrete accelerates the placement, reduces the labour requirements needed for consolidation, finishing and eliminates environmental pollution. These are called first generation SCC is used mainly

for repair application and forecasting concrete in restricted areas, including sections that present limited access to vibrate. Such valued added construction material has been used in application justifying the higher material and quality control cost when considering the simplified placement and handling requirements of the concrete.

## 1.2 FLEXURAL STRENGTH

Flexural strength, also known as modulus of rupture, bend strength, or fracture

strength, is a material property, defined as the stress in a material just before it yields in a flexure test. The flexural

strength represents the highest stress experienced within the material at its moment of rupture.

### 1.3 SILICA FUME

Silica Fume is also known as microsilica, is an amorphous polymorph of silicon dioxide. It is an ultra fine powder collected as a by-product of the silicon and ferrosilicon alloys production and consists of spherical particles with an average particle diameter of 150nm. The main field of application is as pozzolanic material for high performance concrete. It is sometimes confused with fumed silica.

Silica fume is an ultra fine material with spherical particles less than 1µm in diameter. It is approximately 100 times smaller than cement particle. The specific gravity of silica fume is generally in the range of 2.2 to 2.3. Silica fume is added to Portland cement concrete to improve its properties, in particular its compressive strength, bond strength & abrasion resistance.

S.No	Properties	Results
1	Form	Ultra fine amorphous powder
2	Colour	White
3	Specific gravity	2.63
4	Pack density	0.76 gm/cc
5	Specific surface	20m <sup>2</sup> /g
6	Particle size	15 µm
7	Silica	99.89%

**Table 1.1 Properties of silica fume**

Trail (50%+25%+ 25%)	Slump flow (mm)	T <sub>50</sub> slump flow (sec)	J – ring test mm)	L box test
C+SF+FA	725	4	4	0.9
C+SF+MP	680	3	5	0.9
C+FA+MP	685	3	8	0.9

### 1.4 LIME STONE

Lime stone is the sedimentary rock composed largely of the minerals calcite, aragonite which are different crystal forms of calcium carbonate. Most lime stone is composed of skeletal fragments of marine organisms such as coral, Forams and molluscs. It is also used as building materials aggregate for the base of roads. For improving strength and durability properties, limestone powders produce a more compact structure by pore-filling effect.

It improves the viscosity of the concrete, hence the segregation of concrete is considerably reduced. Size of limestone particles, which can enhance the packing density of powder and reduce the interstitial void, thus decreasing entrapped water in the system. It increases the fluidity of concrete, therefore workability is incremented. It also increases the setting and hardening of concrete.

Parameters	Contents
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Primary Constituents	CaO
Specific Gravity	3.2-3.4
Bulk Density (Pebble Lime), lb./cu. ft.	55-60

**Table 1.2 Properties of Limestone****1.5 FLY ASH**

Fly ash is a another pozzolanic material it has been shown to be an effective addition for SCC providing increased cohesion and reduced sensitivity to changes in water content. However, high levels of fly ash may produce a paste fraction which is so cohesive that it can be resistant to flow.

Two classes of fly ash are defined by ASTM C618: Class F fly ash and Class C fly ash.

**1.6 MARBLE POWDER**

The advancement of concrete technology can reduce the consumption of natural resource and energy source and lessen the burden of pollution on environment .Presently Large amounts of marble dust are generated in natural stone processing plants with an important impact on environment and humans.

**1.7 SUPERPLASTICIZER**

Superplasticizers also known as highrange water reducers,are chemical admixtures used where well-dispersed particle suspension is required. These polymers are used as dispersants to avoid particle aggregation and to improve the flow characteristics for suspensions such as in concrete applications. The chemical name of Superplasticizer which we used was Conplast 550.

**2.EXPERIMENTAL INVESTIGATION****2.1 CEMENT**

Ordinary Portland cement(OPC) of Grade53 conformingIS12269-1987 Shown in . Table 2.1

PHYSICAL PROPERTY	RESULTS
Finess	91%
Normal Consistency	31%
Vicat initial setting time (minutes)	32 min
Vicat final setting time (minutes)	565 min
Specific gravity	3.1

**Table 2.1 Properties of Cement****2.2 FINE AGGREGATE**

The properties of Fine aggregate is given in

below Table 2.2.

S.NO	PROPERTY	RESULTS
1	Particle size, shape	Round , 4.75mm down
2	Fineness Modulus	4.14%
3	Silt content	1.67%
4	Specific Gravity	2.73
5	Bulking of Sand	4.16%

6	Bulk Density	1793 Kg/m <sup>3</sup>
7	Water absorption	0.28

**Table 2.2 Properties of Fine aggregate**

S.NO	PROPERTY	RESULTS
1	Diameter	12 mm
2	Area	113 mm <sup>2</sup>
3	Load For Yield	48.8 KN
4	Yield Strength	431.4 N/mm <sup>2</sup>
5	Ultimate Load	64.8 KN
6	Ultimate Stress	573.5 N/mm <sup>2</sup>
7	Changing Length	86mm
8	Original Length	600mm
9	Strain	0.14
10	Neck dia	7mm
11	% reduction in area	65.9%
12	% of Elongation	14%

**2.3 COARSE AGGREGATE**

The properties of coarse aggregate is given in below Table 2.3.

S.NO	PROPERTY	RESULTS
1	Particleshape&Size	Angular, 12mm
2	Fineness Modulus of 20mm aggregates	7.13%
3	Specific Gravity	2.66
4	Water Absorption	0.62%
5	Bulk Density of 20mm aggregates	1497 Kg/m <sup>3</sup>
6	Flakiness index	21.16%
7	Elongation index	38.22%

**Table 2.3 Properties of Coarse Aggregate**

**2.4 HIGH YIELDSTRENGTH DEFORMED BARS**

The properties of HYSD bars were given in Table 2.4.

**Table 2.4 Properties of HYSD Bars**

**2.5 DESCRIPTION OF SPECIMEN**

S.No	Types of SPECIMEN	Compressive strength in (N/mm <sup>2</sup> )		
		7days	14days	28days
1	SP <sub>1</sub>	37.85	46.7	54.7
2	SP <sub>2</sub>	40.4	50.5	58.08
3	SP <sub>3</sub>	34.9	43.2	51.3
4	SP <sub>4</sub>	34.5	42.6	49.9



The current experimental program includes specimens, the description of specimens are designed as follows. **Specimen1** is made up of conventional concrete of M50 grade. The specifications of remaining specimens are mentioned as follows

**SP<sub>2</sub>** : 50% of C + 25% of SF+ 25% of FFA

**SP<sub>3</sub>** : 50% of C + 25% of SF + 25% of MP

**SP<sub>4</sub>** : 50% of C + 25% of FA + 25% of MP

## 2.6 TESTS OF CONCRETE

Tests for Fresh concrete are

1. Slump Test
2. J Ring Test
3. L box test

Following are the Test results obtained for fresh concrete Test as shown in Table 2.5

### FRESH CONCRETE TEST RESULT

#### 2.6.1 COMPRESSIVE STRENGTH TEST

Tests for Hardened concrete is

(i) Compressive Strength of concrete



#### Fig 2.1 Compression test for cube specimen

7 days and 28 days compressive strength

Was given in Table 2.6

**Table 2.6**

### 3. DESIGN OF BEAM

Total length of the beam is 1500 mm with a rectangular cross section of width 150 mm and depth 200 mm. The beams design is based on IS456. 3Nos of 12 mm dia bars provided as main reinforcement and 2 Nos of 10 mm dia bars provided as Hanger bars. The stirrups are provided at 125 mm C/C distance. The using grade of concrete is M50 and the grade of steel is fy 500.

### 4. EXPERIMENTAL SET UP

The deep beams to be tested were placed in the loading frame of capacity 100 tons under two point loading and test set is shown in figure. The end condition of the beam was kept as a simply supported. The load cell was placed in the centre of the beam. Finding the deflection under the one third loading points, the deflectometers were

Placed and dial gauge was placed in the centre of the beam measure the mid deflection.

### 5. RESULTS AND DISCUSSION

Based on the experimental studies conducted on beam reinforced with High yield strength deformed bars and silica fume, fly ash. The following observations can be summarized. It is observed in beam with blended concrete beam has a lesser deflection than the normal Fe500 High yield strength bars. The maximum

load has given that is 100 KN for both beams. The two point under loading condition is to be applied.

The load deflection values of both the beams were recorded. The mid span deflection of beam was compared with that of their respective control beams. It was noted that the behaviour of the flexure deficient beam when bonded with blended concrete beam were better than the corresponding control beams

The comparison between Self compacting concrete beam and M50 conventional beam is shown in **Table 2.7**.

LOAD (KN)	DEFLECTION (mm)	
	M50	SCC (SF +FA(25%))
10	0	0
20	0.45	0.26
30	0.87	0.47
40	1.98	0.73
50	2.4	1.26
60	3.18	1.68
70	3.6	1.9
80	4.01	2.06
90	4.56	2.3
100	4.81	2.73

**Table 2.7 deflection values**

## 6.CONCLUSION

1.Compressive strength results of binary blended admixture self- compacting

concrete shows 8% higher than the conventional concrete.

2.The combination of Fly ash and silica fume, Marble powder and Silica fume, Fly ash and marble powder shows lower result than the control concrete due to inherent chemical reactions.

3.The compressive strength of binary blended self-compacting concrete with the combination of Fly ash and silica fume, Marble powder and Silica fume, Fly ash and marble powder shows low result than the conventional concrete.

4.In general, it is concluded that the combination of different admixtures (multi-blended) improves the strength and durability properties of concrete .

5.The compressive strength of binary blended self compacting concrete with the combination of silica fume and fly ash achieve more strength than the conventional concrete.

6.In our research the normal beam is made by using M50 grade concrete and with blended concrete self compacting concrete beam is made.For the selection of blended mix the admixtures with higher compressive strength is preferred.And both the beams are tested under loading frame for load deflection behavior.

7.Based on our research the Self compacting concrete beam with blended concrete can be used to attain the better compaction and good strength rather than nominal mix.Practically by usage of Self compacting concrete in R.C.C structures the honey combs can be reduced and better brittle behavior can be attained.

## 7. REFERENCES

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12.EFNARC Specification- European Level and CEN Technical Committees, to get the proportions of materials.

## 8. NOMENCLATURE

**Self Compacting Concrete:** Self Compacting Concrete(SCC) is a high performance concrete that can flow under its own weight to completely fill the form work and self consolidates without any mechanical vibration.Such concrete an accelerate the placement, reduce the labour requirements needed for consolidation, finishing and eliminate and environmental pollution

**Admixtures-** are those ingredients in concrete. other than portland cement, water, and aggre- gates that are added to the mixture immediately. before or during mixing

**Super Plasticizer:** Also known as **high range water reducers**, are chemical admixtures used where well-dispersed particle suspension is required. These polymers are used as dispersants to avoid particle segregation (gravel, coarse and fine sands), and to improve the flow characteristics of suspensions such as in concrete applications.

**Deflection** - The degree to which a structural element is displaced under a load

is termed as deflection. It may refer to an angle or a distance. Deflection can be calculated by standard formula or by methods such as virtual work, direct integration, Castigliano's method, Macaulay's method and the direct stiffness method among others methods.