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* codal 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.**

Keywords— Self compacting concrete, Fly ash, Silica Fume, Marble stone powder and lime stone powder

INTRODUCTION

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 an accelerate the placement, reduce the labour requirements needed for consolidation, finishing and eliminate and environmental pollution. The so called first generation SCC is used mainly for repair application and for casting 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 micro silica, is an amorphous polymorph of silicon dioxide. It is an ultrafine 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 ultrafine material with spherical particles less than 1μm in diameter. It is approximately 100times 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 and 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	$20m^2/g$
6	Particle size	15 μm
7	Silica	99.89%

Table 1.1Properties of silica fume

1.4LIME 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, Forms and molluscs. It 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 increase the settling and hardening of concrete**.**

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

Table 1.2 Physical properties of lime stone

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. The chief difference between these classes is the amount of calcium, silica, alumina, and iron content in the ash. The chemical properties of the fly ash are largely influenced by the chemical content of the coal burned

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. This project describes the feasibility of using the marble dust in concrete production as partial replacement of cement. In INDIA, the marble and granite stone processing is one of the most thriving industry the effects if varying marble dust content on the physical and mechanical properties of fresh and hardened concrete investigated.

1.7 SUPER PLASTICIZER

Super plasticizers 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 aggregation and to improve the flow characteristics for suspensions such as in concrete applications. The chemical name of Super plasticizer which we used was Conplast 550.

2 EXPERIMENTAL INVESTIGATION

2.1 CEMENT

Ordinary Portland cement (OPC) of grade 53 conforming IS 12269-1987 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^3
7	Water absorption	0.28

Table 2.2 Properties of Fine aggregate

2.3 COARSE AGGREGATE

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

S.NO	PROPERTY	RESULTS
1	Particle size, shape	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^3
6	Flakiness index	21.16%
7	Elongation index	38.22%

Table 2.3 Properties of coarse aggregate

2.4 HIGH YIELD STRENGTH DEFORMED BARS

The properties of HYSD bars were given in Table 2.4.

Trail (50%+25%+25%)	Slump flow (mm)	T_{50} 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

Table 2.4 Properties of HYSD bars

2.5 DESCRIPTION OF SPECIMEN

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

SP_2 : 50% of C + 25% of SF+ 25% of FFA

SP_3 : 50% of C + 25% of SF + 25% of MP

SP_4 : 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 Table2.5

FRESH CONCRETE TEST RESULT

Table 2.5 Fresh concrete test

S.NO	PROPERTY	RESULTS
1	Diameter	12 mm
2	Area	113 mm^2
3	Load For Yield	48.8 KN
4	Yield Strength	431.4 N/mm^2
5	Ultimate Load	64.8 KN
6	Ultimate Stress	573.5 N/mm^2
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%

2.6.1COMPRESSIVE 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

S.No	Types of SP	Compressive strength in (N/mm^2)		
		7days	14days	28days
1	SP_1	37.85	46.7	54.7
2	SP_2	40.4	50.5	58.08
3	SP_3	34.9	43.2	51.3
4	SP_4	34.5	42.6	49.9

Table 2.6 Compressive strength test

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 andslica fume, fly ash. The following observations can be summarized. It is observed in beam with blended concrete beamhas 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 2.8.

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 2.8 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 Slica 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 Slica 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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