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Research Papers

Experimental Investigation of Use of Microsilica in Self Compacting Concrete

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Abstract

This paper is described Project in detail and presents laboratory observation. Microsilica is used as a 10% replacement of cement by weight. Various test were conducted on fine aggregate & coarse aggregate, to determine specific gravity, bulk density, fineness modulus of aggregate, concrete mix proportion design using this parameter..For conventional concrete water cement ratio of 0.4 and for microsilica concrete is increased water contain about 20liter/m3. Water demand increases in proportion to the amount of microsilica added. Mixing the concrete and various test are conducted on fresh concrete i.e. Slump flow, V-Funnel, L-Box, U-Box and result are obtained. Using this concrete cube specimen are cast for testing different hardened properties of concrete. i.e. 3 Days, 7 Days, 14 Days, 28 Days Compressive strength of concrete.

Keywords: SSC, micro silica, M20, fly ash, Conventional Concrete, coarse aggregate, super plasticizer.

INTRODUCTION

Microsilica is a very fine pozzolanic material, as a byproduct of the production of elemental silicon or ferro silicon. Microsilica is an admixture used to enhance the properties of concrete. It is specifically used to produce self compacting concrete with high strength, more workability and other beneficial properties. Self-compacting concrete (SCC) is a flowing concrete mixture. The highly fluid nature of SCC makes it suitable for placing in difficult condition & in selections with congested reinforcement. Use of SCC can help in hearing related damages on the worksite that are induced by vibration of concrete, another advantages of SCC is that the time required to place large section in consider ability reduced. It is recently used at Mumbai for Bandra-Warli Sea Link Bridge.

MIX DESIGN (FOR M20)

1.Concrete Specification

Strength: Characteristic Compressive Strength (Fck) = 20N/mm2
Workability: = Medium
Durability: Exposure Condition = Mild

2.Materials Properties

a)Fine Aggregates
Zone = Zone 1
Specific Gravity = 2.2
Dry Loose Bulk Density (DLBD) = 1.39Kg/lit

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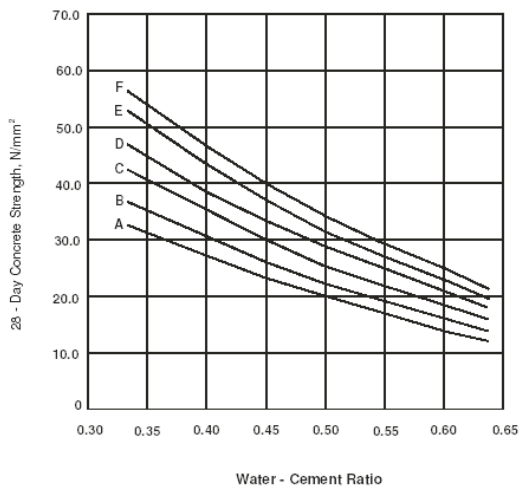
b)Coarse Aggregates
Specific Gravity = 2.58
Dry Loose Bulk Density (DLBD) = 1.45Kg/lit
Maximum Aggregate Size = 30mm
c)Cement
Type of Cement (Fm) = OPC 53 Grade
Standard Deviation (s) = 20.7Kg/cm3
Characteristic Strength of cement (Fc) = 49.58N/mm2
(Fc = Fm – 1.65 s)
Cement Grade = Grade "D"

3. Maximum W/C ratio = 0.55
4. Minimum Cement Content = 285Kg/m3
5. Slump – in mm = 75mm.
6. Slump – Degree in workability = Medium
7. Target Strength

Standard Deviation's' = 5N/mm2
Value of 't' = 1.65
Target Mean Strength Fm = 28.25N/mm2
(Fm = Fck + t x s)

Relation between free water/cement ratio and concrete strength at 28 days for different Cement curves IS: 10262-1982



3. Water - Cement ratio [
4. Final W/C = 0.48

C	FA	CA	Water
1	2.23	2.5	0.48

Water requirements of the mix
When no water reducing agent is used, the addition of microsilica to a concrete mix calls for more water to maintain a given slump. Water content can be held the same by using a water reducer or superplasticizer along with the microsilica. Water reducing agents appear to have a greater effect on microsilica concrete than on normal concrete. Thus water demands for given microsilica concrete can be controlled to be either greater or smaller than for the reference concrete.

Mix Proportion

Mixture	Cement (Kg/m^3)	SF (Kg/m^3)	FA (Kg/m^3)	Sand (Kg/m^3)	CA (Kg/m^3)	Water	SP (Kg/m^3)
CC	404			907	1010	194	
SCC-1	364	40		907	1010	214	
SCC-A	243	40	121	907	1010	214	9.67

Table-1: mix proportion for 1 cubic meter of concrete.

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Where,

CC = Conventional Concrete
SCC-1 = Self Compacting Concrete with 10% Microsilica.
SCC-A = Self Compacting Concrete wite 10% Microsilica,
30% Fly Ash, & 2.4% Superplasticizer.
SF = Silica Fume or Microsilica.
FA = Fly Ash.
CA = Coarse Aggregate.
SP = Superplasticizer.

EXPERIMENTAL PROGRAMME

FRESH CONCRETE TEST

In order to study the effect on fresh concrete properties when Microsilica and Fly Ash is added into the concrete as cement replacement, the SCC containing different proportion of microsilica and fly ash were tested for Slump flow, V- Funnel, L-Box, U-Box.

The result of fresh properties of Self compacting microsilica and fly ash concrete are included in table. Table shows the properties such as Slump flow, V- Funnel, L-Box, U-Box. In terms of slump flow, all SCC exhibited satisfactory slump flows in rang of 550-800 mm, which is an indication of a good deformability.

Fig: Slump Flow test in rang of 550-800 mm

Mixture	Slump Cone (mm)	Slump Flow (mm)	V-Funnel (sec)	L-Box (H_1/H_2)	U-Box (H_1-H_2)
CC	95				
SCC-1	160	550	14	0.67	55
SCC-A		700	11	0.89	10

Table-2: Properties of fresh concrete

HARDENED CONCRETE TEST

In order to study the effect on compressive strength when microsilica and fly ash is added into self compacting concrete as cement replacement, the cube containing different proportion of microsilica andfly ash are prepared and kept for curing for 3, 7,14 and 28 days. The tests are conducted on compressive testing machine of capacity 2000 KN.

CC = Conventional Concrete

Compressive strength of cubes

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Mix	Curing Period	Number Of Cube	Compressive strength(MPa)	Average Compressive strength(MPa)
M20	3 Days	1	12.21	
		2	9.8	10.25
		3	8.72	
	7 Days	1	16.13	
		2	13.08	13.95
		3	12.64	
	14 Days	1	19.18	
		2	17	18.18
		3	18.3	
	28 Days	1	21.36	
		2	23.54	24.3
		3	27.9	

Table-3: Testing of Conventional Concrete

SCC-1 = Self Compacting Concrete with 10% Microsilica.
Compressive strength of cubes

Mix	Curing Period	Number Of Cube	Compressive strength(MPa)	Average Compressive strength(MPa)
M20	3 Days	1	13.95	
		2	10.9	12.5
		3	12.64	
	7 Days	1	17.44	
		2	18.3	17.29
		3	16.13	
	14 Days	1	23.54	
		2	19.18	21.5
		3	21.8	
	28 Days	1	30.52	
		2	27.9	27.9
		3	25.28	

Table-4: Testing of Self Compacting Concrete with 10% Microsilica.

SCC-A = Self Compacting Concrete with 10% Microsilica, 30% Fly Ash, & 2.4% Superplasticizer.
Compressive strength of cubes

Mix	Curing Period	Number Of Cube	Compressive strength(MPa)	Average Compressive strength(MPa)
M20	3 Days	1	11.9	
		2	12.6	11.6
		3	10.3	
	7 Days	1	16.1	
		2	18.5	17.1
		3	16.7	
	14 Days	1	20.1	
		2	18.2	19.4
		3	19.8	
	28 Days	1	24.7-	
		2	-23.6	-24.3
		3	-24.6	

Table-5: Testing of Self Compacting Concrete with 10% Microsilica 30% Fly Ash, & 2.4% Superplasticizer.

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CONCLUSION

On the basis of experimentation work carried out, the following conclusions are drawn:

1. Due to the observed workability and high flow ability of SCC, it can be used in highly congested reinforcement structure as compare to conventional concrete.
2. 10% replacement of microsilica for cement gives the highest strength.
3. The compressive strength for design mixes 3 Days, 7 Days, 14 Days, 28 Days are obtained 11.6MPa, 17.1MPa, 19.4MPa, 24.3MPa respectively using 30% fly ash for 53 grade of cement.
4. Compressive strength of concrete is obtained nearly equal to the compressive strength of conventional concrete using 30% fly ash, 10% silica fume and 2.4% super plasticizer.
5. However, on a more rational basis of total cost, including the labour charges, formwork and making good finished surfaces, SCC can be more advantageous.
6. Fly ash is very cheap, it can be used successfully in place of cement, it gives good results at very low content.

REFERENCES:

1. **Friede Bernd -** "Microsilica Charecterization Of An Unique Additive", Sao Paulo, Brazil. October 15 - 18, 2006.
2. **Md Safiuddin, S. N. Raman and M.F.M. Zain -** "Effect of Different Curing Methods of the Properties of Microsilica Concrete", Australian Journal of Basic andApplied Sciences, 1(2): 87-95, 2007.
3. **Paramita Mondal, Surendra P. Shah, Laurence D. Marks, and Juan J. Gaitero -** "Comparative Study of the Effects of Microsilica and Nanosilica in Concrete", Transportation Research Board of the National Academies, Washington, 2010, pp.6–9.
4. **Nausha Asrar, Anees U. Malik, Shahreer Ahmed and Fadi S. Mujahed -** "CORROSION STUDIES ON MICROSILICA ADDED CEMENT IN MARINE ENVIRONMENT", Construction & Building Materials. Vol. 13, pp. 213-219 (1999).
5. **Hoang Minh , Nguyen Tuan -** "INFLUENCE OF MICROSILICA TO STEEL BAR PROTECTION ABILITY OF CONCRETE", The 3rd ACF International Conference- ACF/VCA 2008.
6. **David R. Lee -** "Characterisation and the diagenetic transformation of nonand micro-crystalline silica minerals", Department of Earth and Ocean Sciences, University of Liverpool, 4 Brownlow Street, Liverpool L69 3GP, UK (2005).
7. **Abul Kalam Azad, Husain Jubran Al-Gahtani, and Shamsad Ahmad -**"Chloride penetration into silica fume Concrete subject to Different Exposures".
8. **Md. Safiuddin, S.N. Raman and M.F.M. Zain** "Effect of Different Curing Methods on the Properties of Microsilica Concrete".
9. **M. S. Shetti** -"Textbook of Concrete Technology", S. Chand Publication.

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