International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2015): 6.391

Compressive Strength of Self Compacting Concrete Using Fly Ash and Micro Silica

Ashok P. Kalbande[1], Shriya A. Kalbande[2]

Assistant Professor, HOD Civil Engineering Department, GWCET, Nagpur

Assistant Professor, Real Institute of Management, Nagpur

Abstract: ***Microsilica is a very fine pozzolanic material, composed of amorphous silica or ferrosilican produced by electric arc furnaces as a byproduct of the production of elemental silicon or ferrosilicon. When microsilica used in concrete, it acts as a cementitious materials. The small microsilica particles fill space between the cement past matrix and aggregate particles. Microsilica also combines with calcium hydroxide to form additional calcium hydroxide through the pazzolonic reaction. Both are these reaction results in a denser, and less permeable materials. Microsilica is specifically used for self compacting concrete and high performance concrete.***

Keywords: SSC, microsilica, pazzolanic, calcium hydroxide, high performance concrete

1. Introduction

High strength concrete with a cube compressive strength around 100MPa can be easily achieved by incorporating microsilica with suitable water reducing agent and suitable aggregates. With constant W/C ratio, compressive strength of microsilica concrete is normally higher than conventional concrete. Researches indicate that the shape of W/C to strength curve of microsilica concrete is similar to conventional concrete but shifted to a higher level. Optimum dosage of silica depends on many factors including type of water reducing agent and type of cement. It can be determined using trial mixes and, 10% of SF by weight of cement is a good starting point.

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 and fly ash are prepared and kept for curing for 3, 7,14 and 28 days. The test are conducted on compressive testing machine of capacity 2000 KN.

Table 1: 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	
CC-1	364	40		907	1010	214	
SCC-A	282	40	80	907	1010	214	9.67
SCC-B	243	40	121	907	1010	214	9.67
SCC-C	202	40	162	907	1010	214	9.67

Table: mix proportion for 1 cubic meter of concrete.
Where,
CC= Conventional Concrete
SCC-1= Self Compacting Concrete with 10% Microsilica.
SCC-A= Self Compacting Concrete wite 10% Microsilica, 20% Fly Ash, & 2.4% Superplasticizer.
SCC-B= Self Compacting Concrete wite 10% Microsilica, 30% Fly Ash, & 2.4% Superplasticizer
SCC-C= Self Compacting Concrete wite 10% Microsilica, 40% Fly Ash, & 2.4% Superplasticizer
SF= Silica Fume or Microsilica.
FA= Fly Ash.
CA= Coarse Aggregate.
SP= Superplasticizer.

2. Compressive Strength

Table 2: CC= Conventional Concrete
Compressive strength of cubes

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: 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	

Licensed Under Creative Commons Attribution CC BY

Table 4: SCC-A= Self Compacting Concrete with 10% Microsilica, 20% 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	10.7	
		2	13.2	12.2
		3	12.6	
	7 Days	1	18.6	
		2	19.0	18.3
		3	17.3	
	14 Days	1	20.5	
		2	19.6	20.6
		3	21.8	
	28 Days	1	25.3	
		2	24.7	25.8
		3	27.5	

Table 5: SCC-B= 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 6: SCC-C= Self Compacting Concrete with 10% Microsilica, 40% 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	9.3	
		2	10.5	10.3
		3	11.2	
	7 Days	1	13.2	
		2	14.6	14.1
		3	14.4	
	14 Days	1	16.5	
		2	18.7	17.7
		3	17.8	
	28 Days	1	20.9	
		2	22.5	21.51
		3	21.2	

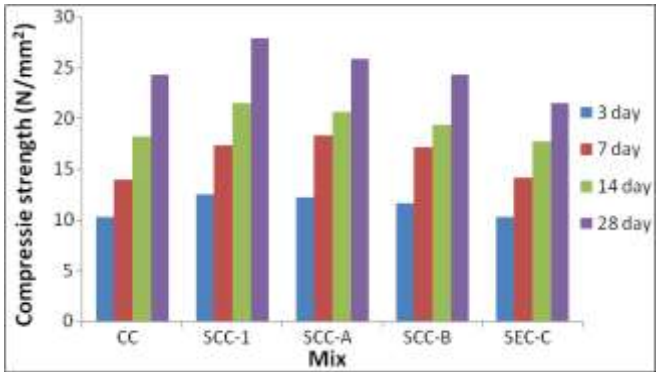

Figure 1: Compressive strength of SCC mixes at various ages

Where,

CC= Conventional Concrete
SCC-1= Self Compacting Concrete with 10% Microsilica.
SCC-A= Self Compacting Concrete wite 10% Microsilica, 20% Fly Ash, & 2.4% Superplasticizer.
SCC-B= Self Compacting Concrete wite 10% Microsilica, 30% Fly Ash, & 2.4% Superplasticizer
SCC-C= Self Compacting Concrete wite 10% Microsilica, 40% Fly Ash, & 2.4% Superplasticizer

3. Conclusion

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

1) 10% replacement of microsilica for cement makes a good strength of concrete.
2) 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 10% of Microsilica and 30% 0f Fly Ash for 53 grade of cement.
3) Compressive strength of conventional concrete is obtained nearly equal to the compressive strength of Self Compacting Concrete using 10% Microsilica, 30% fly ash and 2.4% super plasticizer.
4) SCC with 10% of Microsilica & 30% of Fly Ash replacement the fresh properties & compressive strength were good, after increase the % of Fly Ash above 30% the compressive strength of a concrete is decrease.
5) 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

Licensed Under Creative Commons Attribution CC BY

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.

www.ijsr.net
IJSR
ISSN (Online): 2319-7064

Licensed Under Creative Commons Attribution CC BY