INVESTIGATION OF DURABILITY STRENGTH PROPERTIES OF CONCRETE BY USING MICRO SILICA

M.SANATH KUMAR
Assistant Professor (Civil Engineering Department)
Methodist College of Engineering and Technology, Hyderabad.
msanthakumra@gmail.com nirajatechnologies@gmail.com

Abstract

Now a day's, To Study the binder system containing different levels of micro silica on mechanical properties of concrete. The work on concrete mixes having a water ratio of 0.35 and total binder content of 500kg/m3.The percentage of micro silica is replaced for cement are: 0%,6%, 10%, and 15%.Then the workability of fresh concrete were measured to evaluated particles were : strain due to creep, shrinkage, modulus of elasticity, compressive strength, moisture and swelling movement. As the proportion of micro silica increased and workability of Concrete decreased then mechanical properties such as compressive strength for 28 days and modulus improved. Percentage of micro silica replaced when doesn't on total shrinkage. Basic creep of concrete down at micro silica replacement levels .Swelling test after shrinkage and creep then increase the proportion of micro silica Lowered. Micro silica containing high strength concrete for creep and shrinkage.

Keywords: *Micro silica; High strength concrete; Elastic Modulus; Compressive strength; creep; shrinkage; swelling*

I.INTRODUCTION

Micro silica is also known as Silica Fume. When it is used in concrete, it acts as a filler and as a cementious material .The small micro silica particles fill spaces between cement particles and between the cement past matrix and aggregate particles. Micro silica also combines with calcium hydroxide to form additional calcium hydrate through the pozzolanic reaction. Both of actions result in a denser, stronger and less permeable material. micro silica is a mineral admixture composed of solid glassy spheres of so2.Most silica fume particles are less than 1 micron, 50 to 100 times finer than fly ash particles. In Industrial manufacture of silica fume is Metallic silicon in electric arc furnaces. Ferrosilicon product drawn off as liquid from the bottom of the furnace. Impurities are removed from condensed fume and control for silica fume particle size yields. It is used in production of high strength concrete, it is used in high Performance concrete structures, It can be used to build Marine structures and it reduces damage. Recommended dosage is 7-10% of the cement weight added to concrete.

II. LITERATURE REVIEW

In February Bahari, Ali, had done in 2012,micro structural properties of concrete can be studied with considering the variations of the micro silica, the silicate form and the contents of Si-OH in the mixture using X- Powder method, AFM (Atomic Force Microscopy) and X-Ray Diffraction (XRD) techniques. In May Dongmei Luo; Yinglong had done in 2010, The numerical simulation is performed with different size ratios of micro particles, and different configurations for representative volume element. The results show that the low radius ratios of micro particles produce a larger effective Young's modulus for its more uniform dispersion. In

April,Esmaeili, J.; Andalibi, K had done in 2013,The effects of adding Micro-Silica particles on the compressive strength and water permeability of concrete and its comparison with that of Micro-Silica were investigated in this work. The effect of Micro-silica were also studied in this work, which resulted in an increase in compressive strength of concrete in comparison with other concrete specimens tested in this study.

III. METHODOLOGY

STEP-1 :- Project initiation

STEP-2:- Study on properties of micro silica

STEP-3:- Mix design for controlled concrete

STEP-4:- Mix design for concrete with micro silica

STEP-5:- Casting of concrete cubes.

1. Micro silica 5%
2. Micro silica 10%
3. Micro silica 15%

STEP-6:- Tabulation of compressive strength.

STEP-7:- Rank the compressive strength of cubes and compare with controlled concrete.

STEP-8:- Determine optimum concrete cube

IV MIX DESIGN FOR M35 GRADE OF CONCRETE

Design stipulation:

Grade designation : M35

Type of cement : OPC grade conforming to IS 12269.

Maximum size of aggregate:-20mm

Maximum water cement ratio:-0.45

Degree of quality control: good

Workability :100mm(slump)

Exposure condition :- Mild

Test data for materials

Cement: OPC 53 grade

Specific gravity of cement: 3.15

Specific gravity of fine aggregate: 2.61

Specific gravity of coarse aggregate: 2.74

Target strength for mix proportioning:

$$F_{ck} = f_{ck} + t*s$$

where $F_{ck=}$ Target average compressive strength at 28 days

f_{ck}= Characteristic compressive strength at 28 days.

t= a constant depending on the accepted proportion low results and the number tests=1.65

s= standard deviation =5.0

$$F_{ck} = 35 + 1.65\times5$$
$$= 43.25 \text{ N/mm}^2$$

Selection of water- cement ratio:

From IS-456,

Maximum water cement ratio = 0.45

Based on experience,

Adopt water- cement ratio as 0.43

Selection of water content:

From table 2 of IS 10262-2009

Maximum water content for 20 mm aggregate is 186 lt (for 2 &50mm slump range)

Estimated water content for 100mm slump

= 186 +6/100*186

= 197 litre

Determination of cement content:

Water- cement ratio= 0.43

Water = 197 lit

Cement = 197/0.43

= 458 kg/m^3

since cement content > 450 kg/m3

Adopt cement content = 450 kg/m^3

Proportion of volume of coarse aggregate and fine aggregate content :

From table 3 of IS 10262-2009, volume of coarse aggregate corresponding to 20 mm aggregate and fine aggregate (zone-I) for water- cement ratio of 0.5=0.61

As the water- cement ratio is lower by 0.05, the proportion of volume of coarse aggregate is increased by 0.01.

Final volume of coarse aggregate = 0.61

Volume of fine aggregate = 1-0.61

= 0.39

MIXCALCULATIONS:

The mix calculations per unit volume of concrete shall be as follows

Volume of concrete = 1 m^3

Volume of cement =(mass of cement/ specific gravity of cement)/100

Volume of cement = (mass of cement)/(specific gravity of cement)/1000

= 450/(3.15*1000)

= 0.143 m^3

Volume of water =(mass of cement)/(specific gravity of cement)/1000

= 197/1000

= 0.197 m^3

Volume of all in aggregate = (a-(b + c))

= (1-(0.143+0.197))

= 0.660 m^3

Mass of coarse aggregate = d × volume of coarse aggregate× specific gravity of coarse aggregate× 1000

= 0.66 × 0.61 × 2.74 × 1000

= 1100 kg/m^3

Mass of fine aggregate = d × volume of fine aggregate × gravity of fine aggregate× 1000

= 0.66 × 0.39 × 2.61× 1000

= 672 kg/m^3

MIX PROPORTIONS FOR PLAIN CONCRETE :

Cement = 450 kg/m^3

Water = 197 kg/m^3

Fine aggregate = 654 kg/m^3

Coarse aggregate = 900kg/m^3

Water cement ratio = 0.43

Cement : F.A : C.A = 350 :900 : 654

= 1: 1.39: 2.33

For making 3 cubes of size 150 * 150 * 150 cm,

Quantities to be taken are:

Cement = 5.49 kg

Fine aggregate = 8.16 kg

Coarse aggregate = 13.38 kg

Water = 2.37liters

Water/cement ratio = 0.43

Concrete mix proportions and quantities:

Grade of concrete	M35	M35	M35	M35
Materials	Cement	F.A	C.A	Water
Proportion by weight	1	1.39	2.33	0.33
Quantities required for 1 m3	350	654	900	187

Proportions of Admixtures:

Different proportions of admixture will be taken but based on the previous literatures review we taken following proportion of admixtures will provide better results. Replacement of cement by the admixtures

(both condensed silica fume) by various percentages was carried out in the present research. The percentages of condensed silica fume were taken as 0,5,10 and 15 where as the percentages of nS were taken as 0, 1, 2 and 3. The various combinations used in the present research are given in the following table.

TABLE : percentage of admixtures used to replace the cement content

Mix no	% of micro silica
1`	0
2	0
3	5
4	5
5	0
6	10
7	10
8	0
10	15
	15

Concrete mix proportions for casting 1 cube :

Cement	F.A	C.A	Water	microsilica	w/c ratio
1.8225	2.723	4.455	0.798	0.000	0.43
1.8045	2.723	4.455	0.798	0.000	0.43
1.7315	2.723	4.455	0.798	0.091	0.43
1.7135	2.723	4.455	0.798	0.091	0.43
1.7865	2.723	4.455	0.798	0.036	0.43
1.640	2.7	4.45	0.7	0.1	0.43
5	23	5	98	82	
1.6045	2.723	4.455	0.798	0.182	0.43
1.7685	2.723	4.455	0.798	0.00	0.43
1.5495	2.723	4.455	0.798	0.273	0.43
1.4955	2.723	4.455	0.798	0.273	0.43

V DISCUSSION OF THE RESULTS:

The results which are obtained after the experimental work done on the concrete are explained in following.

The compressive strength for M35 grade in controlled concrete and compressive strength for M35 grade with the replacement of cement by micro silica particles are to be calculated in the following tables and also graphs are shown below.

Compressive Strength Results:

Effect of micro silica on strength:

With 0% micro silica the basic M35 concrete has given the design strength of 42.78MPa at 28 days and with 5% micro silica the strength has gone upto 44.31 MPa. There is gradual increase in compressive strength upto 10% where the value is 46.24 MPa. .Beyond 10% micro silica, the strength is coming down and the recorded value is 43.36 MPa for 15% micro silica.

Compressive strength for controlled concrete

Compressive strength values for M35 with the replacement of cement by micro silica :

Mix designation	Cement%	Micro silica%	Compressive strength
M00	100	0	42.79
M10	99	0	43.84
M20	98	0	46.24
M30	97	0	40.20
M05	95	5	44.31
M010	90	10	46.74
M015	85	15	43.36
M15	94	5	44.35
M210	88	10	47.67
M315	82	15	39.49

Mix	Compressive strength after 28 days
M35	42.628

VI CONCLUSIONS

The following are some of the conclusions we obtained from the experimental investigation

1. The Compressive strength of controlled concrete is compared with concrete made of admixtures

2. Micro silica particles in concrete will increase the strength. The highest compressive strength with 2% micro silica and 10% CSF appears to be the optimum in the present concrete mix.

3. Durability and workability of concrete will be increase if we use micro silica in concretes.

REFERENCES

1. *A.K. Mullick "Performance of with Binary cement blends" the Indian Concrete, January 2007.*
2. *Surenra P. Shah, et al. "Controlling Properties of Concretethrough micro Technology" (ACBM Centre, North WesternUniversity, USA), Proc. of the International Conference onAdvances in Concrete, ICI-ACECON 2010, 5-9 Dec., IIT, Madras, India, PP 1-8.*
3. *G. Quercia and H.I.H. Browwers, 'Applications of micro Silica in Concrete Mixtures', 8th Ph.D. Symposium in Kgs Denmark, June 2010.*
4. *Swupnan Kutchnhapati and N.P. Rajamane, 'micro Silica Improves Recycled Concrete Aggregates' Proc. of third Editions of Workshop on Engineering Materials and its Applications (WEMA), held on 2nd Dec.*
5. *Bee Chems 'Nano Silica Base additives for Cementing Operations' E-5 Puski Industrial Area, Site-1, Kanpur (U.P)- 208022(INDIA).*
6. *N. Neelamegam, J.K. Dattatreya and S. Goplakrishna "Pore structure effects in properties of concrete with Binary and Ternary Blends" International Conference in Advances in Concrete Composites and Structures.*