Study on Effect of Self-Compacting Concrete with Partial Replacement of Mineral Admixtures

HEMANT SHARMA
Research Scholar
Department of Civil Engineering
Acropolis institute of Technology & Research
Bhopal

NISHEET TIWARI
Assistant Professor
Department of Civil Engineering
MANIT, Bhopal

Abstract: **This project is experimental investigation on self compacting concrete by using mineral additive such as Fly ash, Micro silica & Metakaolin. Self Compacting concrete is a concrete that exhibit the high flow ability and avoid the segregation and bleeding. The industrial waste such as fly ash use in this project as a partial replacement of cement to produce concrete, thus minimizes the amount of cement and reducing the cost. Self−compacting concrete is one of "the most revolutionary developments" in concrete research; this concrete is able to flow and to fill the most restacked places of the form work without vibration. There are several methods for testing its properties in the fresh state: the most frequently used are Slump−flow test, L−box, U-box and V−funnel. This work presents properties of self−compacting concrete, mixed with different type's additives: fly ash, micro silica, metakaolin. So we added admixture ac-hypercrete and ac-viscocrete about 0.5% and 0.2% of total cementatious content in every mix thereafter. The compressive strength carried in the compressive testing machine. The additions of fly ash were 20%, 25%, 30% and 35% of concrete. It was seen that increase the percentage of fly ash resulted in the decrease of compressive strength.**

Key Words: **Self−Compacting Concrete, Slump−Flow Test, L-Box, V−Funnel Fly Ash, Micro Silica, Metakaolin.**

I. INTRODUCTION

Self-compacting concrete (SCC) is a flowing concrete mixture that is able to consolidate under its own weight. 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. When the construction company in Japan experienced a decline in the availability of skill labour in the 1930's a need for felt for a concrete that could overcome the problem of defective workmanship. SCC mainly used in highly congested reinforced concrete structure in seismic region and to overcome the problem of storage of skilled labours for the efficient compaction of concrete. Review of literature indicates that durability of SCC largely depends on the type of mineral admixtures. The application of concrete without vibration in highway bridge construction is not new. For examples, placement of seal concrete, mass concrete and shaft concrete can be successfully placed without vibration. These seal, mass and shaft concretes are generally of lower strength, less than 34.5 MPa and difficult to attain consistent quality. Modern application of self-compacting concrete (SCC) is focused on high performance and more reliable quality, dense and uniform surface texture, improved durability, high strength, and faster construction. By the early 1990's, Japan has developed and used SCC that does not require vibration to achieve full compaction. More and more applications of SCC in construction have been reported in Japan. As of the year 2000, the amount of SCC used for prefabricated products (precast members) and ready-mixed concrete (cast-in-place) in Japan was about 400,000 m^3.

II. OBJECTIVES OF THE STUDY

The main objective of this investigation is to determine the suitable percentage of fly ash , micro silica Metakaolin partially replacement and influence of different proportioning of super plasticizers in SCC that gives the highest value of concrete compressive strength

III. EXPERIMENTAL PROGRAM

In this investigation, 45-cubes, 45-cylinders are tested to investigate concrete compressive strength and split tensile strength of SCC with the combination of fly ash, silica fume and different proportioning of polycarboxyilc ether with the replacement of quarry dust. All test specimens of cube with 150 mm size and cylinders with diameter of 150mm and 300mm in length.

A. Material

Cement-53 grade (opc) , Aggregates , Fly ash, Micro silica, Metakaolin, Ac-hypercrete , Ac-viscocrete-p

B. SCC Mix Design

Several methods exist for the mix design of SCC. The general purpose mix design method was developed by nan-su. Method. In this study, the key

proportions for the mixes are done by volume. The detailed steps for mix design are described as follows

C. Testing Fresh Properties Of SCC

1. Slump Flow Test
2. V-Funnel Test
3. L-Box Test
4. Compressive strength test
5. Slump Test

IV. RESULT AND DISCUSSION

In order to study the effect on fresh properties of SCC when fly ash and silica fume as partial replacement of cement were tested for compressive strength and split tensile test. The result for compressive strength and split tensile strength were found

Percentage of fly ash	**20%**		**25%**		**30%**		**35%**	
Slump flow	5 min	30 min	5 min	30 min	5 min	30 min	5 min	30 min
	685mm	675mm	695mm	685mm	715mm	695mm	690mm	665mm
V-funnel	T0	T5	T0	T5	T0	T5	T0	T5
	12 sec	14 sec	10 sec	12 sec	12 sec	13 sec	12 sec	13 sec
L-box	0.8		0.9		0.7		0.7	
7 days compressive strength	27.8 N/mm^2		23.62 N/mm^2		19.74 N/mm^2		19.45 N/mm^2	
28 days compressive strength	40.46 N/mm^2		38.35 N/mm^2		35.39 N/mm^2		35 N/mm^2	

Percentage of micro silica	**4%**		**6%**		**8%**	
Slump Flow	5 min	30 min	5 min	30 min	5 min	30 min
	745mm	710mm	725mm	690mm	705mm	655mm
V-funnel	T0	T5	T0	T5	T0	T5
	10 sec	13 sec	11 sec	14 sec	10 sec	12 sec
L-Box	0.9		0.8		0.9	
7 days Compressive strength	23.58 N/mm^2		28.0 N/mm^2		32.46 N/mm^2	
28 days Compressive strength	38.86 N/mm^2		42.90 N/mm^2		47.93 N/mm^2	

Percentage of Metakaolin	**4%**		**8%**		**12%**	
Slump Flow	5 min	30 min	5 min	30 min	5 min	30 min
	740mm	700mm	715mm	680mm	700mm	680mm
V-funnel	T0	T5	T0	T5	T0	T5
	11 sec	13 sec	9 sec	11 sec	10 sec	13 sec
L-Box	0.8		0.8		0.9	
7 days Compressive strength	22.86 N/mm^2		23.67 N/mm^2		27.05 N/mm^2	
28 days Compressive strength	38.38 N/mm^2		41.62 N/mm^2		44.92 N/mm^2	

V. CONCLUSION

Finally reviewing all the results it was concluded that concrete mixes with 6% micro silica and 8% metakaolin over 35% fly ash as base were the better mixes among all because compressive strength which is one of the key property of concrete obtained in these two mixes for M-30 grade concrete were close to or rather slightly higher than 30MPa. More over filling ability, passing ability and blocking ratio as obtained on other mixes were also well within the limits but were slightly on a higher side which may give rise to problem of segregation which is undesirable.

VI. REFERENCE

[1]. ASTM C618-03 (Standard specification for coal fly ash and raw or calcined natural pozzolana for use in concrete)

[2]. ASTM C1240-10a (Standard specification for Silica Fume used in Cementatious Mixtures)

[3]. "laboratory-tests and Field-Experience of High-Performance SCC" by M. Collepardi, S. Collepardi, J.J. Ogoumah Olagot and R. Troli.

[4]. "Guidelines for testing fresh Self-Compacting Concrete" published by G. Schutter (2005).

[5]. "Guidelines and Specification for Self Compacting Concrete" published in "EFNARC" (February 2002).

[6]. N. Krishna Murthy, A.V. Narasimha Rao , Ramana Reddy I. Vand, M. Vijaya Sekhar Reddy described on "Mix Design Procedure for Self Compacting Concrete" published in the "IOSR Journal of Engineering (IOSRJEN)" (September 2012).

[7]. "Development of Self Compacting Concrete" by C.I. Goodier.

[8]. S. N. TANDE AND P. B. MOHITE (AUGUST 2007) "Applications of Self Compacting Concrete" Proceeding of International Conference on Concrete and Structure, Organized by CI PREMIER PTE LTD. SINGAPORE.

[9]. Cristian Druta referred in "Tensile Strength and Bonding characteristics of Self Compacting Concrete" (August 2003)

[10]. Pratibha Aggarwal, Rafat Siddique, Yogesh Aggarwal and Surinder M. Gupta described on "Self Compacting Concrete – Procedure for Mix Design" published in "Leonardo Electronic Journal of Practices and Technologies" (June-2008)

[11]. Frances Yang (9 March 2004) "CE 214: Concrete Technology Spring 2004, Self Consolidating Concrete"

[12]. Soo Duck Hwang, Kamal H. Khayat, Olivier Bonneau described on "Performance Based Specification of Self Consolidating Concrete Used in Structural Applications", published in "ACI Materials Journal"

[13]. Concrete Technology by M.S. Shetty.

