Modification in Self-Compacting Concrete

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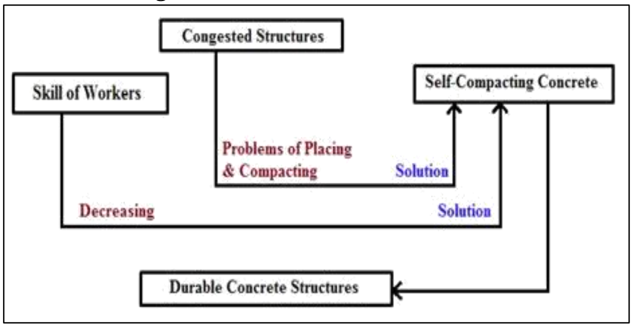
Abstract— Self-compacting concrete (SCC) is a concrete that does not require vibration for placing and compaction. In plastic state it is able to flow under its own weight, completely filling formwork and achieving full compaction, without any segregation and maintaining its homogeneity even in the presence of congested reinforcement and can flow through all shapes and obstructions. The hardened concrete is dense, homogeneous and has almost the same engineering properties and durability as normal concrete. By adding Polypropylene fibre, Polyester fibre. Glass fibre .Fibres arrests shrinkage cracks and increases resistance to water penetration, abrasion and impact. It makes concrete homogeneous and also increases compressive behaviour, ductility and flexural strength together with improving a structure‟s ability to absorb more energy the super plasticizer and viscosity modifying agent are added in Self compacted concrete. Test on fresh concrete is slump spread for all trial mixes. The mix that has the largest slump spread is tested with V-funnel, L-shaped box and U-shaped box Conventional specimens are also prepared for M20.By conducting tests for the specimens the properties of concrete will be investigate. This study ensures that using of fibre as substitutes in concrete gives a good approach to reduce cost of materials and will accomplish the better properties of self-compacted concrete at all ages.

Key words: Self-Compacted Concrete, Fibre, VMA – Viscosity Modified Agent, M20, Super Plasticizer, Slump Flow

I. INTRODUCTION

Self-compacting concrete (SCC) was first developed in Japan around the year1980. Professor Hajime Okamura of Kochi University of Technology of Tokyo, Japan is mainly responsible for initiating the development of such concrete. The need of such concrete arose from the scarcity of skilled manpower in Japan during this period. It was developed to overcome deficiency of skilled manpower and problems of placing and compacting congested civil engineering structures. Consequently it has been observed that SCC not only reduces the requirement of manpower, both skilled and unskilled, but also results in more durable concrete as illustrated in Fig



Self-compacting concrete offers a rapid rate of concrete placement, with faster construction times and ease of flowaround congested reinforcement. The fluidity and segregation resistance of SCC ensures a high level of homogeneity, minimal concrete voids and uniform concrete strength, providing the potential for a superior level of finish and durability to the structure. SCC is often produced with low water-cement ratio providing the potential for high early strength, earlier demoulding and faster use ofelements and structures.

The improved construction practice and performance, combined with the health and safety benefits, make SCC a very attractive solution for both precast concrete and civil engineering construction

II. SCOPE

Survey and estimations on Self-Compacting Concrete with high volume fly ash with various fibres.

The successful use of other industrial by products of wastes such as fly ash and silica fume in concrete set as good example for waste to be used in a different way.

III. NEED OF STUDY

For several years, the problem of the durability of concrete structures has been a major problem posed to engineers. To make durable concrete structures, sufficient compaction is required. Compaction for conventional concrete is done by vibrating. Over vibration can easily cause segregation. In conventional concrete, it is difficult to ensure uniform material quality and good density in heavily reinforced locations.

If steel is not properly surrounded by concrete it leads to durability problems. This is the problem mainly with heavily reinforced sections where a very high congestion of reinforcement is seen

The SCC concept can be stated as the concrete that meets special performance and uniformity requirements that cannot always be obtained by using conventional ingredients, normal mixing procedure and curing practices.

IV. OBJECTIVE

The main objective is to,Improved Concrete Quality Reduces noise at sites, the pre-cast factory, and neighbourhood, hence, it is a silent concrete, Construction with SCC is not affected by the skill of the workers, and shape and arrangement of reinforcing bars of the structures.

SCC use at construction sites reduces the chance of accident by reducing number of cables needed for the operation of compacting equipment, hence, reduces the workers compensation premiums.

It gives wide opportunity for the use of high-volumes of by-products materials. Such as fly ash, lime stone powder, quarry dust etc., since a higher volume of powder material is required for enhancing the cohesiveness and reducing the amount of super-plasticizer and viscosity modifying agents.

V. INGREDIENTS OF SCC

A. Cement

The amount of cement generally used in SCC is the same as normal concrete (NC). Sometimes little more cement is preferred, probably due to fact that SCC is still in its initial stage of application in our country. The addition of secondary cementing materials (SCM) like fly ash, GGBS, silica fumes is beneficial.

B. Water

Water used for mixing and curing shall be clean and free from injurious amount of oils, acids, alkalis, salts, organic materials or other deleterious materials.

C. Fly ash

The cement and water form a paste that binds the other materials together as the concrete harden state. In this experimental study, Class F fly ash is used.

D. Fine Aggregate

The fine aggregate, which is used in the investigation is clean river sand and conforming to zone II as per IS: 383-1970. The sand was first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm.

Sr. No.	Fine Aggregate	
1	Specific gravity	2.77
2	Water Absorption	1.0
3	Moisture content	Nil

Table 1: Basic Result of Fine Aggregate

E. Coarse Aggregate

The"coarse aggregate use as the crushed stone aggregate passing through 10 mm sieve. The aggregate occupy 70%-80% of the total volume of normal concrete. But Self Compacting Concrete (SCC) have only 50% of total volume of concrete. Coarse aggregate shall comply with the requirement of IS 383".

F. Super plasticizer

Admixture is most important constitute of self-compacting concrete (SCC) to achieving flow ability and passing ability. In this experimental study, Glenium sky 8784 is used. This admixture of older name is Glenium sky 8784.

G. VMA – viscosity modifying agent

VMA is most important constitute of self-compacting concrete (SCC) to achieving viscosity & strength. In this experimental study, Master matrix -2 is used.

Fibres are used as a secondary reinforcement material. Ordinary concrete, when subjected to the rigorous test of time and extreme weather conditions, tends to crack and lose its strength. It can lead to seepage and corrosion of primary steel and spauling of concrete. Fibres arrests shrinkage cracks and increases resistance to water penetration, abrasion and impact. It makes concrete homogeneous and also increases compressive behaviour, ductility and flexural strength together with improving a structure"s ability to absorb more energy. Thereby extending its life span and also reducing its maintenance costs. Ability to replace or reduce non-structural steel also reduces input costs.

Fibre Type	Polyester	Polypropylene	Glass
Length	12mm	12mm	12mm
Cross Section	Triangular	Triangular	Triangular
Melt Point (Oc)	240-260	160-180	300-350
Tensile Strength (Mpa)	897-1104	551-758	1034-3792
Young's Modulus (103mpa)	17.25	3.45	69
Ultimate Elongations (%)	50-70	25	1.5-3.5
Specific Gravity	1.36	0.90	2.5

Table 2: Properties of Fibres Used

VI. EXPERIMENTAL PLAN

A. Test procedure

1) Assessment of mix design methods
2) Selection of mixing procedures and test methods.
3) Selection of the target properties of self-compacting concrete for the subsequent tests
4) Selection of constituent materials

B. Mix proportions

Ingredients	Kg/m^3
Ordinary Portland Cement	200
Fly Ash	200
Water/paste ratio	0.40
Coarse Aggregate, 20mm	853
Sand	852
Super-plasticizer	1%wt. of paste(cement + fly ash)= 4
VMA	1% of Super-plasticizer=0.04
Fibres	0.15%wt. of paste(cement + fly ash)=0.6kg

Table 3: Mix proportions in Kg/m^3

VII. RESULTS AND DISCUSSIONS

Sr no.	Test Method	Unit	Criteria	Maximum value	Property
1	Slump flow	mm	500 - 800	670	Filling ability
2	L-Box	h2/h1	0.8 - 1	0.9	Passing ability
3	J-Ring	sec	0 - 10	6	Passing Ability
4	V-funnel	sec	8 - 12	9	Filling ability

Table 4: Fresh Properties Test as per EFNARC (European Guidelines)

S.NO.	TEST	UNIT	Obtained value
1	c. Slump Flow d. T_{50cm} Slump Flow Time	mm sec.	730 3
2	c. V- Funnel- T_0 d. V- Funnel- T_5	Sec. Increase over (2a) in sec	9 2

Table 5: Obtained experimental value

VIII. Results Analysis

A. Hardened concrete

Fibre 1 Polyester Fibre

	7 Days		14 Days		28 Days	
	LOAD (kN)	fck (N/mm^2)	LOAD (kN)	fck (N/mm^2)	LOAD (kN)	fck (N/mm^2)
	550	24.44	500	22.22	550	24.44
	400	17.78	525	23.33	550	24.44
	500	22.22	530	23.56	650	28.89
Avg.	483	21.48	518	23.04	583	25.93

Table 6(A): Load Bearing Capacity and Strength of Polyester Fibre

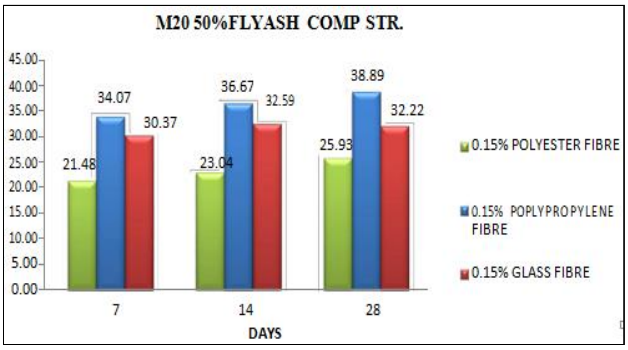
Fibre:2 Polypropylene Fibre

	7 Days		14 Days		28 Days	
	LOAD (kN)	fck (N/mm^2)	LOAD (kN)	fck (N/mm^2)	LOAD (kN)	fck (N/mm^2)
	675	30.00	600	26.67	650	28.89
	750	33.33	950	42.22	875	38.89
	875	38.89	925	41.11	1100	48.89
Avg.	767	34.07	825	36.67	875	38.89

Table 6(B): Load Bearing Capacity and Strength of Polypropylene Fibre

	7 DAYS		14 DAYS		28 DAYS	
	LOAD (kN)	fck (N/mm^2)	LOAD (kN)	fck (N/mm^2)	LOAD (kN)	fck (N/mm^2)
	500	22.22	550	24.44	550	24.44
	725	32.22	775	34.44	650	28.89
	825	36.67	875	38.89	975	43.33
Avg.	683	30.37	733	32.59	725	32.22

Table 6(C): Load Bearing Capacity And Strength Of Glass Fibre



Graph plotted

IX. Cost Analysis

Sr No.	Item Description	Quantity	Rate	Per	Amount(Rs.)
1	Cement	10	250	bag	2500
2	Fly Ash	10	120	bag	1200
3	Fine aggregate	0.55	900	m^3	495
4	Coarse aggregate	0.59	650	m^3	384
5	Super-plasticizer and VMA	4	160	kg	640
6	Fibres	5	50	bag	250
7	Water (approx.)				100
	Total				5570

Table 7: Cost Analysis of SCC (With Fibres)

X. Conclusion

On the basis of our survey and estimations on Self-Compacting Concrete with high volume fly ash with various fibres, we can conclude that this concrete will be replacing the Normal Concrete (NC) because of its many advantages.

From the studies one can say that crack development in SCC is controlled drastically with the addition of fibres. The strength of concrete varies with the type of fibre used in the work. Bond strength of SCC with reinforcement is generally found to be higher by 10 to 25% than with NC.

The surface of SCC is generally more superior and impermeable than the surface of Normal Concrete of same grade. Finally SCC is found to be more durable than NC because of lower permeability, absence of honey-combing and uniform quality.

References

[1] M. S. SHETTY Concrete Technology, by S. CHAND Publisher.
[2] EFNARC, "Specification and Guidelines for Self-Compacting Concrete", 2002, 36pp
[3] EFNARC, "The European Guidelines for Self-Compacting Concrete: Specification, Production and Use, 2005, 68pp

[4] Okamura, H; Ozawa, K. and M. Ouchi (2000) "Self-Compacting Concrete" Journal. Structural concrete March.
[5] Okamura, H (1997), "Self-Compacting High Performance concrete", Concrete International, Vol. 19, No. 7, pp-50-54.
[6] Okamura, H., and Ouchi, M., "Self Compacting Concrete", Journal of Advanced Concrete Technology, Vol.1. No.1. (2003) pp.5-15
[7] Self-Compacting Concrete for high performance structures by Marco Borronifor Ready-mix Concrete Production and Application Development
[8] Henderson, N. (2000) "Self Compacting Concrete at Millennium Point", Journal Concrete April.