STUDY OF MECHANICAL BEHAVIOUR OF SMART CONCRETE

Nishant Sharma[1], Iliyas Khaleel[2]

[1]M.Tech Scholar, [2]Assistant Professor
Bharat Institute of Technology

***Abstract*: The objective of this paper is to compare the mechanical behaviour of smart concrete with the conventional concrete. This research is proposed to adding chemical admixtures for making self-compacting concrete (SCC). Also it is proposed to use self-curing compound instead of conventional water curing. Many researchers studied about the self-compacting concrete only and not for self-compacting and self-curing concrete, but this study proposed a methodology for self-compacting and self-curing concrete. Self-Compacting Concrete (SCC) is achieved by reducing the volume ratio of aggregate to cementitious materials, increasing the paste volume and using various viscosity enhancing admixtures and super plasticizers. Curing techniques and curing duration significantly affects "curing efficiency". Techniques used in concrete curing are mainly divided into two groups namely, Water adding techniques and Water-retraining techniques. Self-curing technique is part of water retaining technique using various methods. In this paper self-compacting self-curing concrete (SCSCC) has been studied using Polyethylene Glycol 4000 (PEG4000). Mechanical properties such as compressive strength, split tensile strength and flexural behaviour of beam has been studied. The specimen with 1% PEG4000 performed well when compared to conventional specimen. The ultimate load and ultimate deflection for smart concrete beam was increased 23.53% and 35.48% when compared control beam.**

***Keywords*: CFT, Composite Materials, Columns, UPVC Columns**

1. INTRODUCTION

Self-Compacting Concrete (SCC) is a high workable concrete which has high strength and high performance which can flow under its own weight through restricted sections without segregation and bleeding (EFNARC, European Federation of Producers and Applicators of Specialist Products for Structures, 2002). SCC has substantial commercial benefits due to ease of placement in complex forms with congested reinforcement. Self-curing or internal curing is a technique which can be used to supply additional moisture in concrete for more effective hydration of cement and reduced self-desiccation.

Self-Compacting Concrete (SCC) was first developed in 1988 by professor Okamura intended to improve the durability properties of concrete structures. SCC is defined as concrete that is able to flow and consolidate under its own weight. SCC is considering to be one of the most successful innovations in industry of construction. Self -compacting concrete (SCC) is a highly flow able concrete which does not segregate and can spread into place, fill the formwork with heavily congested reinforcement without any mechanical vibration. In SCC, the aggregates contribute 60–70% of the total volume. Proper choice of aggregates has significant influence on the fresh and hardened properties of concrete. Aggregate characteristics such as shape, texture and grading influence workability, finish ability, bleeding, pump ability, segregation of fresh concrete and strength, stiffness, shrinkage, creep, density, permeability, and durability of hardened concrete. The advantages of SCC are: Improved quality of concrete and reduction of onsite repairs; Faster construction times; Lower overall costs; Facilitation of introduction of automation into concrete construction; Improvement of health and safety is also achieved through elimination of handling of vibrators; Possibilities for utilization of "dusts", which are currently waste products; Easier placing; Thinner concrete sections; Greater Freedom in Design. Many investigators have studied about the manufacture sand. Strength characteristics of SCC and use of waste products such as silica fume and introduction of fibres in improving strength characteristics of SCC have been studied and reported in the literature.
Self-curing or internal curing is a method that is used to provide supplementry moisture in the concrete for more effective hydration of cement and reduced self-desiccation.
There are two major methods available for internal curing of concrete. In the first method porous light weight aggregate is used to supply an internal source of water that replaces the water which is consumed by chemical shrinkage during the hydration of cement. The second method is which uses poly-ethylene glycol (PEG) and reduces the evaporation of water from the surface of the concrete and is helpful in water retention. In the present study the first method has been adopted. The use of fly ash, blast furnace slag and silica fume in SCC reduces the dosage of super plasticizer needed to obtain similar slump flow compared to concrete mixes made with only Portland cement.

Results:
1 1st Trial Mix for Self-Compacting Concrete

Cement =450kg/m^3
Sand =801 kg/m^3
Coarse aggregate = 801 kg/m^3

1:1.78:1.78

Effect of Different SNF Dosage in 1st Trial Mix

S. no.	w/c	SNF (%)	Slump flow table diameter (in mm)
1	.35	.5%	220mm*240mm
2	.35	.6%	260mm*280mm
3	.35	.7%	420mm*440mm
4	.35	.8%	410mm*390mm
5	.35	.9%	370mm*360mm
6	.35	1.0%	350mm*330mm

2 2nd Trial Mix Design for Self-Compacting Concrete

Cement = 550 kg/m^3

Sand = 880 kg/m^3

Coarse aggregate = 720 kg/m^3

1:1.6:1.3

2 Effect of different SNF dosage in 2nd trial mix.

S. no.	w/c	SNF (%)	Slump flow table diameter (in mm)
1	.35	.5%	280mm*300mm
2	.35	.6%	530mm*570mm
3	.35	.7%	560mm*600mm
4	.35	.8%	460mm*520mm
5	.35	.9%	500mm*470mm
6	.35	1.0%	490mm*470mm
7	.36	.5%	300mm*240mm
8	.36	.6%	620mm*580mm
9	.36	.7%	700mm*650mm
10	.36	.8%	600mm*560mm
11	.36	.9%	570mm*550mm
12	.36	1.0%	550mm*540mm

Composition of Concretes (kg/m3).

Mix no.	PEG4000	Cement (kg/ m3)	Water (kg/m3)	Fine aggregate (kg/ m3)	Coarse aggregate (kg/m3)	SNF (%)
M1	-	419.5	188.8	554	1195	-
M2	-	465	186	646.47	1070	-
M3	0%	550	198	880	720	0.7
M4	.5%	550	198	880	720	0.7
M5	1%	550	198	880	720	0.7
M6	1.5%	550	198	880	720	0.7
M7	2%	550	198	880	720	0.7

Test results of M1 mix

S. no.	Specimen	7 days Strength (N/mm^2)	28 days Strength (N/mm^2)
1	Cube	19.86	27.56
		21.34	29.2
		23.25	31.57
2	Cylinder	1.56	2.26
		1.67	1.9
		1.7	2.59
3	Beam	1.28	2.25
		1.47	2.28
		1.57	2.17

Test results of M2 mix

S. no.	specimen	7 days strength (Mpa)	28 days strength (Mpa)
1	cube	29.1	40.7
		30.2	42.3
		31.3	41.2
2	cylinder	2.12	3.02
		2.06	3.12
		2.24	3.06
3	beam	3.67	5.24
		3.58	5.6
		3.62	5.73

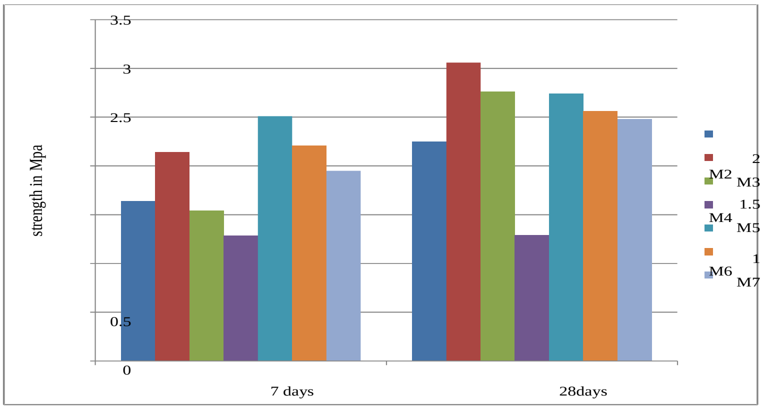
Test Results of M3 Mix

S.no	specimen	7 days strength (Mpa)	28 days strength (Mpa)
1	Cube	18.47	37.57
		21.74	36.55
		19.96	29.3
2	Cylinder	1.67	2.88
		1.52	2.79
		1.59	2.634
3	Beam	1.236	2.174
		1.25	2.574
		1.23	2.374

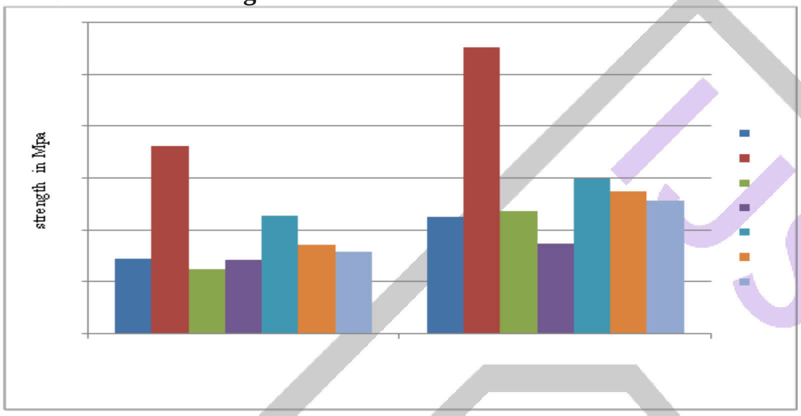
Test results of M4 mix

S no.	Specimen	7 days strength(Mpa)	28 days strength (
1	Cube	14.358	23.11
		14.127	23.18
		14.269	23.30
2	Cylinder	1.283	1.29
		1.33	1.1.32
		1.245	1.26
2	Beam	1.492	1.74
		1.428	1.69
		1.372	1.80

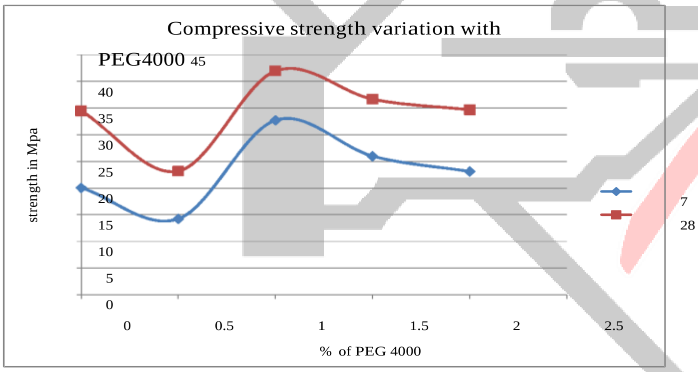
Compressive strength of cube



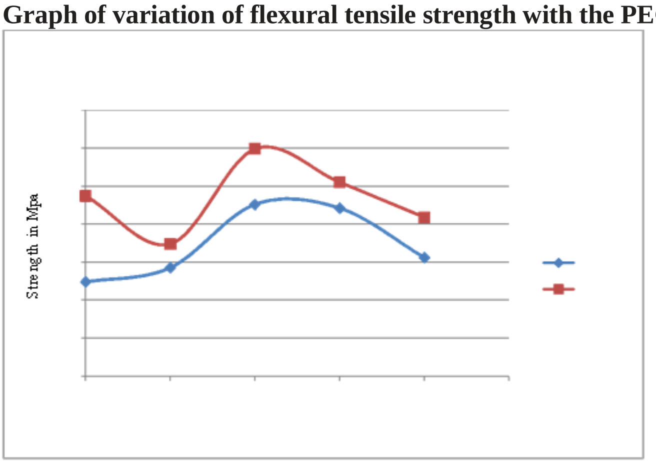
Flexural tensile strength of beam



Graph of variation of compressive strength with PEG4000.



Graph of variation of flexural tensile strength with the PEG4000



3. CONCLUSIONS

The following conclusions were drawn from this study.

- Strength of the specimen with 1% of PEG4000 increased when compared to the conventional specimen with M40.
- From the 7 days compressive strength results the specimen with 1% of PEG4000 increased with conventional specimen with M40 by 8.27%.
- From the 7 days splitting tensile strength results the specimen with 1 % of PEG4000 increased with conventional specimen with M40 by 17.28%.
- From the 28 days compressive strength results the specimen with 1% of PEG4000 increased with conventional specimen with M40 by 1.45%.
- From the 28 days splitting tensile strength results the specimen with 1% of PEG4000 increased with conventional specimen with by 22.22%.
- From 7 days flexural tensile strength results the specimen with 1% of PEG4000 decreased with conventional specimen with M40 by 37.57%.
- From 28 days flexural tensile strength results the specimen with 1% of PEG4000 decreased with conventional specimen with M40 by 45.65%.

REFERENCES

[1] ACI Committee 305R-99 "Hot Weather Concreting", Reported by ACI Committee 305, ACI Manual of Concrete Practice, (2009), pp3.

[2] C. Selvamony, M. S. Ravi Kumar, S. U. Kannan and S. Basil Gnanappa, (2010), "INVESTIGATIONS ON SELF-COMPACTED SELF-CURING CONCRETE USING LIMESTONE POWDER AND CLINKERS ", ARPN Journal of Engineering and Applied Sciences VOL. 5, NO. 3.

[3] Fauzi, M., (1995). The Study on the Physical Properties of Surface Layer Concrete under the Influence of Medium Temperature Environments. Ph.D. Thesis, Kyushu University, japan.

[4] Hans W. Reinhardt and Silvia Weber, (1998), "SELF-CURED HIGH PERFORMANCE CONCRETE", journal of materials in civil engineering November 1998.

[5] John Roberts and Ron Vaughn, (2013), "INTERNAL CURING IMPROVES FLEXURAL AND COMPRESSIVE STRENGTH OF PERVIOUS CONCRETE ", Northeast Solite Corporation Saugerties, New York.

[6] Magda. Mousa, Mohamed G. Mahdy, Ahmed H. Abdel-Reheem, Akram Z. Yehia, (2014), "MECHANICAL PROPERTIES OF SELF-CURING CONCRETE (SCUC) ", Housing and Building National Research Centre HBRC Journal.

[7] Mateusz Wyrzykowski; Pietro Lura; Francesco Pesavento; and Dariusz Gawin, (2012),"Modelling of Water Migration during Internal Curing with Superabsorbent Polymers ", journal ofmaterials in civil engineering © ASCE / AUGUST 2012.

[8] N. Yazdani, F.ASCE; M. Filsaime; and S. Islam, (2008), "Accelerated Curing of Silica-FumeConcrete ", journal of materials in civil engineering © ASCE / AUGUST 2008.

[9] Neville, A.M., (1996). Properties of Concrete, Fourth and Final Edition. John Wiley and Sons, Inc.,New York, USA.

[10] Nirav R Kholia, Prof. Binita A Vyas, Prof. T. G. Tank, (2013), "EFFECT ON CONCRETE BY DIFFERENT CURING METHOD AND EFFICIENCY OF CURING COMPOUNDS ", international journal of advanced engineering technology/Vol. IV/ Issue II/April-June, 2013.

[11] EFNARC (European Federation of Producers and Applicators of Specialist Products for Structures) Feb 2002 specification and guidelines for self-compacting concrete.

[12] Heba A. Mohamed (2011) "Effect of fly ash and silica fume on compressive strength of self-compacting concrete under different curing conditions "Ain Shams Engineering Journal Issue: 2, pp: 79-86.

[13] IS 456:2000 Annex J, self compacting concrete.