An Experimental Investigation of Effect of Variation of Curing Condition on Compressive Strength of Self Compacting Concrete

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Abstract— In this paper, we investigate the effect of curing condition on the self-compacting concrete with age and duration of lapses in curing of concrete. In this fast developing world where time is most precision, Builders and contractors cannot engage their valuable precision in 28 days in curing of each and every element of the structure unknowingly or under unavoidable circumstances. It may possible that curing could not be done continuously i.e. breaking of curing process; this is general problem for high rise structure where it resists speedy construction. Lack of scaffolding can also create a problem. This work is mainly concerned with mix design of self-compacting concrete of grade M25 and studies the variation of curing time on concrete compressive strength. These cubes for mix design of M25 self-compacting concrete were cast using OPC 43 grade cement concrete and were cured for 28 days with breaking of curing process for 1st day, 2nd day. In 84 numbers of cubes and also sample sets were cured continuously 7 days 14 days 21 days and 28 days and was tested for characteristics strength of concrete due to breaking of curing process within 1st 10days of curing, after10days continuous curing, breaking of curing process effects in the compressive strength of cement of concrete after 28 days. The concrete cubes gain strength about 31.6n/mm2 of the target compressive strength for OPC of cured for first 7, 14, 21, and 28 days respectively.

Key words: Self compacting concrete, compressive strength, curing, Ultratech 43 grade OPC variation

I. INTRODUCTION

Cement concrete is one of the seemingly simple but actually complex materials, many of its complex behaviors are yet to be identified to employ this material advantageously and economically. Concrete is a site made material unlike others materials of contraction and as such can vary to a very great extent in its quality, properties and performance owing to the use of natural materials except cement. Concrete properties are considerably dependent of temperature and humidity especially during the curing period. The temperature of curing and the duration of most curing are key factors for proper curing can be achieved by keeping the concrete completely saturated as possible until the water fill spaces are substantially reduced by hydration products. Concrete not cured and placed to dry in air, it will only 50% or less of the strength of continuously cured concrete. Improper curing would entail insufficient moisture thus causes production of cracks, less compressive strength and reduce long term durability.

The present scope of discussion in this study is to study the effect of variation of curing time on characteristics compressive strength of concrete and thus on target strength. In the present study, concrete with Ultratech cement OPC 43 grade is opted. Concrete grade of M-25 design mix with a slump 100mm is considered.

We cure the concrete cubes for 7, 14, 21, and 28 days and test for characteristics compressive strength further in the second part we test cubes of concreted M25 cured. All the cubes though have been subjected to curing at once but have been taken out successively to be dried for the time period of one day before being transferred to another curing tank in such a manner that after one day of curing cube one is taken out and allowed to dry for one day and one transferred to another tank for curing for rest of the period. Second cube have been taken out after two days' time period and a similar procedure have been adopted. Similarly all the cubes have been subjected to aforesaid process of curing and finally all the cubes are taken out from the second tank after 28 days and tested for compressive strength of concrete.

Necessity of project:

Curing duration, types of curing and gapped of curing will affect the strength of concrete. Actually in practice, curing time varies due to multiple reasons, shortage of water, lack of scaffolding and other construction constraints. Thus optimum curing period for type of cements grade is not available in practice.

Considering the above reasons, variation in curing time and different conditions on compressive strength of concrete needs to be investigated as time and condition may not allow 28 days of curing. Here we study the effect of curing time on self-compacting concrete of grade M-25.

II. LITERATURE REVIEW

Baris Ozer et.al (2004) said that the curing conditions affect the strengths of both the OPC concrete and pozzolanic cement concretes. Ramezanianpour et.al (1995) concluded that if a concrete is not well cured, particularly at the early age, it will not gain the required properties at desired level due to a lower degree of hydration, and would suffer from irreparable loss. Mamlouk et.al (2006) said if concrete is cured for only three days, it will reach about 60% of the strength of continuously cured concrete; if it is cured for seven days, it will reach 80% of the strength of continuously cured concrete. If curing stops for some time and then resumes again, the strength gain will also stop and reactivate.

Malhotra V.M. (1988) said that cement generally represent 12-14% of concrete weight. It plays an active part in the mixture by ensuring cohesion between aggregate grains and it introduces a decisive contribution to concrete mechanical strengths. During the hardening process, it generates shrinkage and heat dissipation phenomena which lead to material cracking.

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A. Materials and Methodology:

1) Materials:

The details of various materials used in the experimental investigation will be.

2) Coarse aggregate:

Crushed stone aggregate of maximum size 20mm and minimum size 12.5 mm confirming to IS-383-1970 was used, stone was brought from Kabrai (U.P.). The specific gravity was found to be 2.670

3) Fine Aggregate:

The fine aggregate passing through 4.75mm sieve was brought from Hameerpur U.P. The specific gravity was found to be 2.61. The grading zone of fine aggregate belongs to zone-I as per specification.

4) Cement:

Ultratech 43 grade OPC was used

5) Water:

Ordinary clean potable water free from suspended particles and chemicals used for mixing and curing of concrete.

6) Methodology:

Experimental procedure: following methods was used to investigate the effect of curing time on compressive strength of concrete. Concrete cubes were cast and cured with normally and were tested for the age of curing and some cubes were cured for 7, 14, 21 and 28 days and 28 sets of cubes for mix design M 25 were casted using Ultratech OPC 43 Grade cement cured for 28 days with breaking of curing process for 1st day, 2nd day.. 28th day and cube were tested. were tested for characteristic strength. The concrete cube size measuring 150×150×150 mm in dimension will be used.

B. Quantities of Mix Constituents for Cubes

	CONCRETE MIX		
	MIX CONSTITUENTS	**M - 25 Grade (kg/cum)**	**TRIAL BATCH (SSD)kg**
	Cement	234	5.85
	Flyash	126	3.15
	Water	155	3.88
	Sand	796	19.90
	20mm	415	10.38
	12.5mm	622	15.55
	W/C	0.43	0.43
	Admixture (BASF)	(0.6 - .8%)	54
(II)	The dosage of admixture may be adjusted as per ambient and site conditions.		
(III)	Trial Conducted at Site Lab.		

Table 1: Quantities of Mix Constituents for Cubes

C. Test Results for M-25, OPC 43 Grade Cement

S. no.	Age (Days)	Weight of cube (Kg)	Load (KN)	Strength (N/mm2)	Mean strength (N/mm2)
1	7	8.104	534	23.73	23.90
		8.110	542	24.08	
		8.105	538	23.91	
2	14	8.106	639	28.40	28.38
		8.111	637	28.31	
		8.108	640	28.44	
3	21	8.106	708	31.47	31.45
		8.111	709	31.51	
		8.106	707	31.38	
4	28	8.112	741	34.86	34.52
		8.116	784	34.84	
		8.118	776	34.48	

Table 2: Cube test reports for M-25 Grade RMC @ 7 days, 14 days, 21 days and 28 days

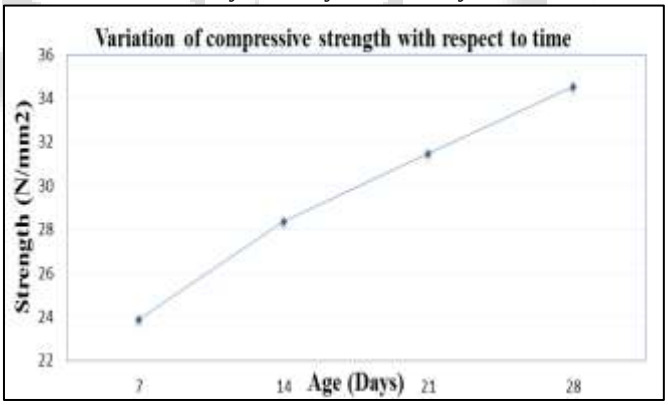

Fig. 1: Variation of Compressive Strength with Respect to Time

D. Effect of Variation of Curing on Compressive Strength

S. No.	Cubes Taken out for drying after casting (Days)	Allowed for drying in open	Weight of Cube (Kg.)	Load (KN)	Strength after 28 Days	Mean Strength (N/mm2)	% Deviation from max. strength
1	1 day	1 set	8.098	639	28.4	28.44	17.56
2			8.099	641	28.48		
3			8.111	640	28.44		
4	2 day	2 set	8.112	644	28.62	28.71	16.78
5			8.111	648	28.8		
6			8.113	646	28.71		
7	3 day	3 set	8.111	660	29.33	29.28	15.13

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8			8.112	658	29.24		
9			8.112	659	29.28		
10	4 day	4 set	8.111	662	29.42	29.43	14.69
11			8.114	661	29.37		
12			8.113	664	29.51		
13	5 day	5 set	8.112	670	29.77	29.91	13.30
14			8.108	675	30		
15			8.109	674	29.95		
16	6 day	6 set	8.111	680	30.22	30.17	12.55
17			8.108	678	30.13		
18			8.113	679	30.17		
19	7 day	7 set	8.114	681	30.26	30.24	12.35
20			8.113	682	30.11		
21			8.112	683	30.35		
22	8 day	8 set	8.112	684	30.4	30.40	11.88
23			8.115	683	30.35		
24			8.114	685	30.44		
25	9 day	9 set	8.123	689	30.62	30.59	11.33
26			8.112	688	30.57		
27			8.116	688	30.57		
28	10 day	10 set	8.118	690	30.66	31.08	09.90
29			8.116	705	31.33		
30			8.114	703	31.24		
31	11 day	11 set	8.111	708	31.46	31.46	08.80
32			8.114	709	31.51		
33			8.112	707	31.42		
34	12 day	12 set	8.113	711	31.6	31.60	08.40
35			8.114	712	31.64		
36			8.112	710	31.55		
37	13 day	13 set	8123	715	31.77	31.68	08.17
38			8.121	713	31.68		
39			8.118	711	31.6		
40	14 day	14 set	8.125	714	31.73	31.79	07.85
41			8.121	717	31.87		
42			8.123	715	31.77		
43	15 day	15 set	8.115	718	31.91	31.97	07.33
44			8.112	719	31.96		
45			8.114	721	32.04		
46	16 day	16 set	8.113	725	32.22	32.24	06.55
47			8.115	724	32.18		
48			8.109	727	32.31		
49	17 day	17 set	8.112	728	32.36	32.34	06.26
50			8.115	727	32.31		
51			8.111	728	32.36		
52	18 day	18 set	8.116	729	32.4	32.50	05.79
53			8.114	731	32.49		

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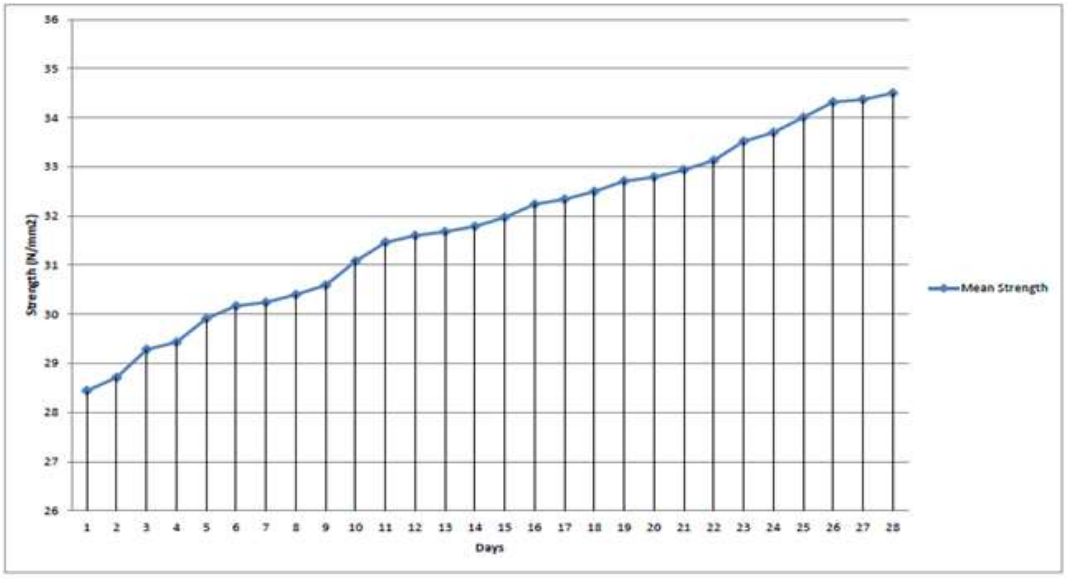
54			8.112	734	32.62		
55	19 day	19 set	8.122	736	32.71	32.71	05.19
56			8.118	735	32.66		
57			8.116	737	32.76		
58	20 day	20 set	8.125	738	32.8	32.79	04.90
59			8.121	738	32.8		
60			8.118	737	32.76		
61	21 day	21 set	8.121	740	32.88	32.94	04.52
62			8.112	741	32.93		
63			8.116	743	33.02		
64	22 day	22 set	8.115	745	33.11	33.13	03.97
65			8.118	745	33.11		
66			8.114	746	33.16		
67	23 day	23 set	8.118	748	33.24	33.52	02.84
68			8.114	758	33.69		
69			8.116	757	33.64		
70	24 day	24 set	8.111	752	33.42	33.70	02.32
71			8.112	760	33.78		
72			8.115	763	33.91		
73	25 day	25 set	8.121	761	33.82	34.01	01.42
74			8.123	770	34.22		
75			8.119	765	34		
76	26 day	26 set	8.116	768	34.13	34.32	00.05
77			8.117	775	34.44		
78			8.115	774	34.4		
79	27 day	27 set	8.116	772	34.31	34.37	00.04
80			8121	773	34.35		
81			8.123	775	34.44		
82	28 day	28 set	8.119	776	34.48	34.50	00.00
83			8.121	777	34.53		
84			8.117	776	34.48		

Table 3: Effect of variation of curing on compressive strength



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III. CONCLUSION

1) Cubes for Mix design M-25 were casted using Ultratech OPC 43 Grade cement and were cured for 7, 14, 21 and 28 days. The concrete cubes gain about 75.50%, 89.63%, 99.33%, and 109.03% of target characteristic compressive strength. From the results it can be said that, compressive strength attained by 21 Days curing is very near to the target strength. From the above finding we can conclude that curing of 21 days gives the desired target strength and can be used in construction industry which will be saving about 7 days of curing.
2) 28 sets of cubes for mix design M 25 were casted using Ultratech OPC 43 Grade cement cured for 28 days with breaking of curing process for 1st day, 2nd day.. 28th day and cube were tested. From the results and graph it can be said that discontinuity in curing for 1st twelve days have significant affect on the target strength but discontinuity in curing for single day after twelve days continuous curing will have little effect on target strength of concrete.

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