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Shrinkage & Elastic Shortening In Prestressed Beams Using Self Compacting Concrete

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Abstract – *This paper will focused on the improvement of the strength of concrete using waste material like fly ash which cause air pollution& also make that concrete self-compacting concrete(SCC) as instead of conventional concrete to reduce the cost which is required for vibration or compaction of concrete& pollution. Use of fly ash reduces the consumption of cement & hence economy is also achieved. Self Compacting Concrete is made by increasing the powder content & addition of superplasticizer. By the casting of prestressed beams using self-compacting concrete of various proportion of powder content calculation of errors like elastic shortening & shrinkage of prestressed beams using extensiometer & compressive strength is also calculated using compression testing machine(CTM) are also calculated. .From the graph we conclude the effect of increase in powder content on the losses of prestressed pretensioned beams & strength of prestressed beams using self compacting concrete. As the SCC is very suitable in case of heavy & complicated reinforced structure as its workability &flowability is high as compare to conventional concrete. For the preparation of prestressed beams high strength cement & steel is require.*

Keywords*:Flyash,CTM,elasticshortening,shrinkage,SCC, extensiometer, superplasticizer.*

I. Introduction

For general construction of any building we use conventional concrete which require compacting equipments like vibrators which increase the cost of construction & also noise pollution. Generally prestressing beams are casted using conventional concrete. Here we replace the conventional concrete by self-compacting concrete(SCC). As workability of SCC is high as compare to conventional concrete SSC compacted & flow due to it's own weight. To increase the workability &flowability of concrete we have to increase either powder content or water cement ratio& addition of superplasticizer. Here we use polycaboxylic based ether superplasticizer to improve workability as well as strength of concrete. We cast pretensioned prestressed beams. Prestressing require high grade of steel & cement therefore strength achieved is also high as compare to conventional concrete. Shrinkage of concrete is define as contraction due to loss of moisture & when the tendons are cut & pretressing force transferred to the member the concrete undergoes immediate shortening due to prestress. There are various types of losses:

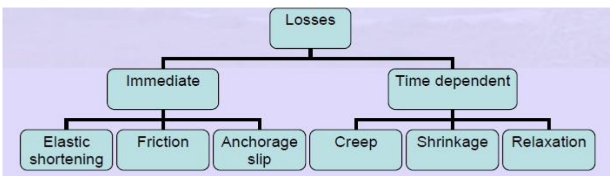


Fig.1 Types of losses

II. Materials & Methods

Materials required for SCC are cement,aggregate (coarse-20mm & fine 10mm & sand), standard flyash provided by DIRK industries, admixtures(polycarboxylicbased ether,prestressing steel. After the collection of material all the tests are condected to find the general properties of material like, For cement (fineness test,soundness test,initial& final setting time), For aggregate(fineness modulous,specific gravity,water absorption capacity,free surface moisture), for superplasticizer (appearance, pH,chloride content,alkali content). Steel of 4mm dia.& breaking stress is 1750N/mm^2 .

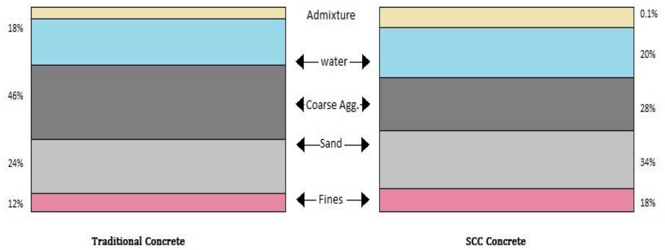


Fig.2 Comparison between traditional concrete & SCC

Fig.3 Flyash used **Fig.4 Prestressing Jack**

Tests on SCC:

1.Slump cone test 2.V-Funnel test. 3.L-Box test

III. Prestressing of tendons,Casting& Curing

Batching → Mixing → Prestressing of tendons →Casting of beams → Curing of beams → Testing of compressive strength .

1. Prestressing of tendons: Formwork is placed in position &adjusted for alignment. After placingof formwork, stress is applied to tendon using prestressing jack as shown in fig.

2.Casting: After prestressing of tendon Self-Compacting Concrete was prepared and the mix tested for properties of SCC, cubes and beams were casted.

Fig.5 Casting of blocks & beams

3.Curing: Cubes & small beams were removed from mould& placed in curing tank. While large beams are cured by using wet gunny bags. Curing was done for a period of 28 days & 56 days.

Fig.6 Curing of concrete blocks & beams

IV. Results & Discussion

Table.1 Mix design for different powder content proportion

Sr. No.	Particulars			Powder content		
1	**Mix Design**			**530**	**580**	**630**
	1	Cement		371	406	441
	2	Flyash		159	174	189
	3	%Replacement of cement by flyash		30%	30%	30%
	4	Natural sand(70%)		1267	1232	1197
	5	Coarse aggregate (30%)	10mm	380	369.6	359.1
			20mm	162.9	158.4	153.9
	6	Water/powder ratio		0.33	0.33	0.33
	7	Water		174.9	190	207.9
	8	Superplasticizer		1.3%	0.95%	0.85%

Table.2.Results of various tests of SCC

2	Tests on SCC		530	580	630
	1	V-funnel test			

2	Tests on SCC		530		580			630		
	1	V-funnel test								
		At 0 minuites	8		7.2			6.25		
		At 5 minutes	13		10			9.42		
	2	L-box test								
		H2/h1 Ratio	0.91		0.925			0.95		
	3	Slump test	B-1	B-2	B-1	B-2	B-3	B-1	B-2	B-3
		Diameter 1	730	680	680	730	690	700	730	720
		Diameter 2	720	670	700	710	710	730	740	740
		Diameter 3	730	670	690	720	690	720	730	710
		Diameter 4	720	660	690	720	710	710	720	730
		Average Slump	725	670	690	720	700	715	730	725

Table.3 Results of compressive strength of concrete blocks

3	Compressive strength of block			530		580		630	
	1	@7 Days	Block 1	32.44	34.52	36.44	40.89	38.78	40.04
			Block 2	36.44		40.89		38.22	
			Block 3	34.67		45.33		43.11	
	2	@28 Days	Block 1	51.11	51.70	56.89	60.00	54.67	53.45
			Block 2	53.78		56.44		52.00	
			Block 3	50.22		66.67		50.67	
	3	@56Days	Block 1	56.00	63.11	58.22	65.48	72.89	69.53
			Block 2	66.67		72.00		61.33	
			Block 3	66.67		66.22		74.67	

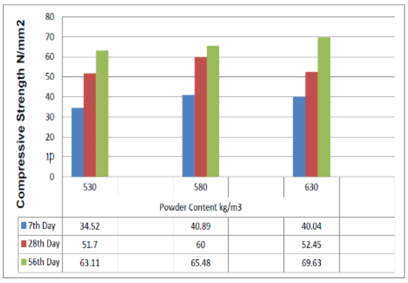
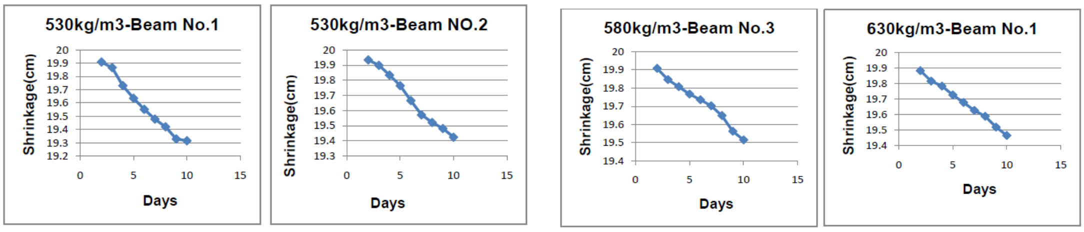


Fig.7 Graphical comparison for compressive strength

1.Shrinkage of concrete:

Shrinkage before release of prestressing force:



Powder Content	530 kg/m3		580kg/m3			630kg/m3		
m No.	1	2	1	2	3	1	2	3
Before Release	19.315	19.4245	19.443	19.474	19.5155	19.466	19.523	19.4135
After Release	19.0505	19.0945	19.136	19.17	19.2035	19.2165	19.172	19.0845
Difference	0.2645	0.33	0.307	0.304	0.312	0.2495	0.351	0.329
Average			0.3077			0.3098		

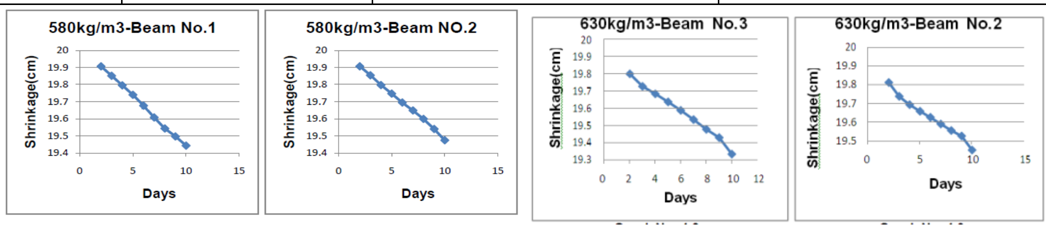
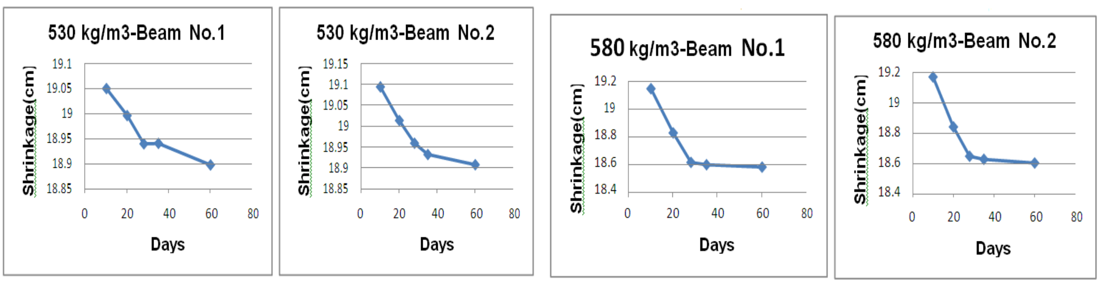


Fig.8 Graphical representation of shrinkage loss before releasing of prestressed force (1200x120x120)mm

Shrinkage after release of prestressing force:

Table.4.Elastic shortening



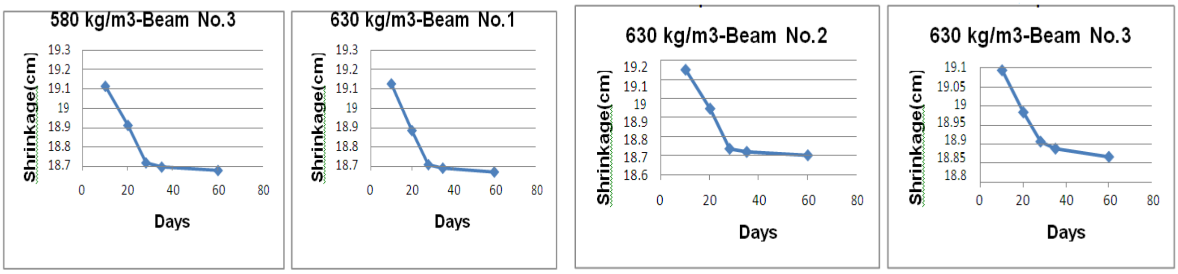


Fig.9 Graphical representation of shrinkage loss after releasing of prestressed force (1200x120x120)mm

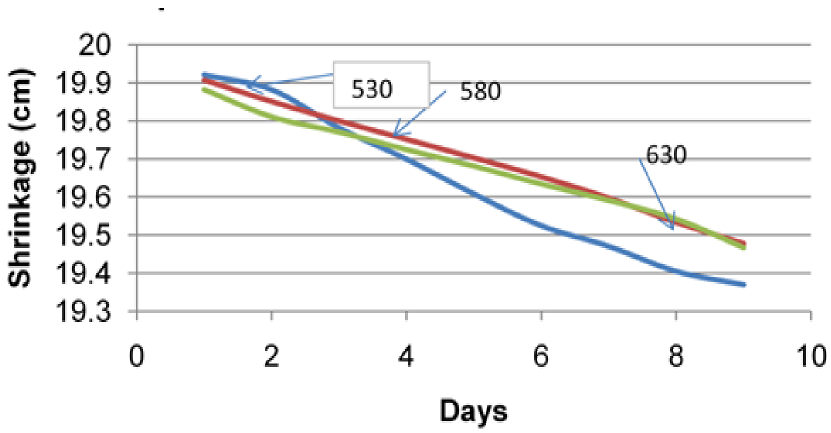


Fig.10.Shrinkage comparison of different powder content

2.Elastic shortening of concrete:

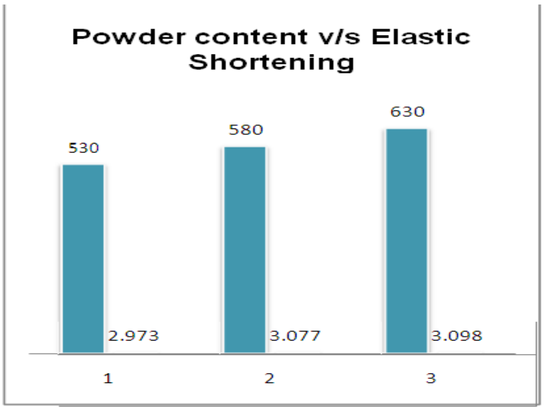


Fig.11 The graphical representation of elastic shortening with respect to powder content

From the above graph, it is clear that elastic shortening increases with increase in powder content. Thus subsequent losses due to elastic shortening also increases with increase in powder content.

V. Conclusion

1.The present investigation has shown that it is possible to design Prestressed concrete beams and other structures using self-compacting concrete incorporating fly ash.

At the age of 56 days,the compressive strength of cubes a)for powder content 530 kg/m^3 is 69.63N/mm^2

b)for powder content 580 kg/m^3 is 65.48N/mm^2

c) for powder content 630 kg/m^3 is 63.11N/mm^2

Thus,it can be concluded that – "Compressive strength of concrete increases with increase in powder content in a given volume of concrete."

2.Also the addition of fly ash in SCC improves microstructure of concrete that also helpful to enhance all mechanical properties with the durability of concrete. Use of fly ash reduces the consumption of cement due to which CO_2 emulsion in manufacturing process is reduced and economy is also achieved. By adding fly ash the disposal problem is neglected which reduces air pollution and land pollution.

3. On the basis of the compression tests carried out at the end of 7 days, 28 days and 56 days age of concrete, we have seen that the compressive strength of concrete is more at the age of 56 days compared to that of 28 days & 7days. Concrete achieves 55-60 % of its strength at the age of 7 days and 80-90 % of its strength at the age of 28 days itself Thus we can say that -Fly ash plays a major role in increasing the compressive strength of the concrete mix."

4. From the graphs of shrinkage v/s age of concrete, -it is seen that "rate of shrinkage decreases with the age of concrete."

5.There is increase in rate of shrinkage of concrete with increase in powder content in a given volume of concrete for the same grade.

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