International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue IX, September 2017- Available at www.ijraset.com

Experimental Investigation of Shrinkage Properties of Blended Cement Concrete

Swapnil C. Mane[1], Satish T.Rathod[2], Devdatta K. Mokashi[3]
[1,2,3] *Asst. Prof, Department of Civil Engineering, Bharati Vidyapeeth's, College of Engineering Lavale, Pune-412115, Maharashtra, India*

Abstract: ***Volume change is the most undesirable property of concrete, which affects the long-term durability and strength on structures. The shrinkage is important factor that which help to cause the cracks in floors and pavements. It is very difficult to make concrete which does not crack and shrink. Efforts are made to minimize the shrinkage and shrinkage cracks. The main objective of this experimentation is to study the effect of partial replacement of cement by Fly Ash on the shrinkage properties of concrete. The different percentages of Fly Ash replaced with cement in concrete. Results show the use of mineral admixture, reduces the shrinkage cracks in concrete.***
Keywords**: Concrete, Cement Replacement, Fly Ash, Shrinkage cracks, Shrinkage strain.***

I. INTRODUCTION

Concrete is by the most widely used construction material today. The mouldability and versatility of this material, the reinforcing and prestressing techniques have contributed largely to its widespread use. We can rightly say that we are in the age of concrete.
The volume change in concrete is important from the point of view that it causes unsightly cracks in concrete. One of the important factors that contributed to cracks in concrete (particularly in floors and pavements) is shrinkage. Cracking due to shrinkage of concrete has attracted considerable attention of architects, engineers and contractors. It can be one of the major problems in concrete construction.
Practically speaking it is difficult to make concrete which does not shrink and crack. It is only the question of magnitude. Now the question is how to reduce the shrinkage and shrinkage cracks in concrete structures. As shrinkage is an inherent property of the concrete, it demands greater understanding of the various properties of concrete, which influence its shrinkage characteristics.
The use of mineral admixture like fly ash has become popular in construction industry today, especially for high strength and low permeable concretes. This increases the water requirement in concrete mixture and do not increase the amount of shrinkage.

II. LITERATURE

Zongjin Li, et al., investigated on the crack width of high-performance concrete due to restrained shrinkage. The effect of silica fume, fly ash, blast furnace slag, and calcium nitrite inhibitor to restrained shrinkage cracking were presented.
Li Jianyong et al. carried out a study on creep and drying shrinkage behaviour of high performance concrete containing mineral admixture. Creep and drying shrinkage greatly reduced by use of GGBS and SF
In this research an attempt is made to study the shrinkage properties of concrete containing fly ash as partial replacement of cement. The replacement of cement is like 0%, 10%, 20%, 25%, 30%, 35% and 40% with Fly Ash. The shrinkage parameters like maximum length of crack, maximum width of crack, total number of cracks, total area of cracks, shrinkage strain in X-direction and shrinkage strain in Y-direction of concrete are calculated. The shrinkage parameters after 5 hours, 24 hours and 28 days of casting are calculated

III. MIX PROPORTION

Portland Pozzolana Cement (PPC) and locally available sand and aggregates were used in the experimentation. The specific gravity of fine and coarse aggregate is found to be 2.9 and 2.67 respectively. The fine aggregate is conforming to zone-I.
Concrete is prepared by a mix proportion of 1:1.84:3.17 with a W/C ratio of 0.52 which correspond to M20 grade of concrete as per IS: 10262-1982 specification.

IV. EXPERIMENTAL PROGRAM

This mix is poured into the slab mould of dimensions 505×305×55mm in which a welded mesh was kept at the base to act as restraint (to induce shrinkage). The concrete was vibrated and well compacted. The slab specimen was finished smooth after giving sufficient compaction both through table vibrator and hand compaction. Immediately after casting, the slab specimens were kept in

an open atmosphere along with the mould. The moment all the specimens were transferred to the open atmosphere the time was reckoned. For plastic shrinkage 5hrs observations were made.

After 5hrs and 24 hours from the time of transferring the specimens to open atmosphere the plastic shrinkage parameters such as length of crack, width of crack, total number of cracks, area of cracks and shrinkage strain in X and Y directions were noted down on a plastic sheet. For this purpose, a transparent plastic sheet is placed on a glass plate which in turn was kept on the surface of the concrete specimen and all the possible visible cracks were drawn on the sheet. The widths of cracks were measured with the help of a hand microscope as shown in fig.1. The minor cracks were drawn with the help of a magnifying lens.

These specimens were demoulded and transferred to the curing tank and they were allowed to cure for 28 days. After 28 days, the shrinkage parameters are noted down on the same plastic sheet.

A. Experimental results and discussion

The variation of above shrinkage parameters with various percentage replacement of Fly Ash are depicted in the form of graphs are as shown in the Fig. 2, 3, 4, 5 , 6 and 7. Table-I Shows the percentage decrease or increase in shrinkage parameters when cement is replaced by fly ash to normal concrete (concrete without Fly Ash).

From Table-I, it is observed that , among the all Percentage replacement of cement by fly ash, the 30% replacement shows the decrease in all shrinkage parameters and shrinkage strain along X and Y direction, after 5 hrs, 24hrs and 28days of curing when compared with reference concrete (concrete without fly ash).

This may be due to the fact that, 30% replacement of cement by Fly Ash may reduces the number of capillary pores through which water can evaporates, on which shrinkage depends. Addition of Fly Ash may change the morphological structure in which the fineness of cement may be affected thus reducing shrinkage. Also this may be due to the fact that 30% replacement of cement by Fly Ash with attached mortar to it may pack up the entire system to a dense mass so that less bleeding channels may be set up through which the evaporation takes place.

Fig.1. Shows the measurement of crack width by using Hand Microscope

TABLE-I
Percentage decrease in shrinkage parameters when cement is replaced by fly ash to reference concrete (concrete without fly ash)

Shrinkage Parameter	% of Replacement of cement by Fly Ash	Max. length of Crack			Max. Width of crack			Total No. of Cracks			Total Area of cracks		
		0-5 hrs	5-24 hrs	1-28 days	0-5 hrs	5-24 hrs	1-28 days	0-5 hrs	5-24 hrs	1-28 days	0-5 hrs	5-24 hrs	1-28 days
	10%	25.00	31.57	32.25	0.00	0.00	0.00	35.44	31.57	30.76	66.17	35.32	25.65
	20%	27.63	13.15	35.48	0.00	33.33	0.00	43.03	36.84	46.15	70.48	48.51	35.52
	25%	31.57	52.63	51.61	33.33	33.33	0.00	50.06	43.36	61.53	72.54	53.62	43.42
	30%	39.47	55.26	64.51	33.33	33.33	0.00	74.68	78.94	69.23	78.82	86.80	81.57
	35%	27.63	47.36	58.06	33.33	33.33	0.00	49.36	57.89	53.84	72.40	81.70	78.95
	40%	23.68	42.10	45.16	33.33	33.33	0.00	46.83	31.57	30.76	68.24	42.12	39.47

Table-II: Percentage Decrease In Shrinkage Strain For Concrete When Cement Is Replaced By Fly Ash To Reference Concrete (Concrete Without Fly Ash)

% of Replacement of cement by Fly Ash	Shrinkage Strain in					
	X – direction			Y – Direction		
	0-5 hrs	5-24 hrs	1-28 days	0-5 hrs	5-24 hrs	1-28 days
10%	0.00	07.15	7.15	0.00	12.50	12.50
20%	0.00	07.15	7.15	0.00	12.50	12.50
25%	0.00	07.15	7.15	0.00	12.50	12.50
30%	8.33	07.15	14.28	7.69	12.50	18.75
35%	0.00	07.15	7.15	0.00	12.50	18.75
40%	0.00	07.15	7.15	0.00	12.50	18.75

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue IX, September 2017- Available at www.ijraset.com

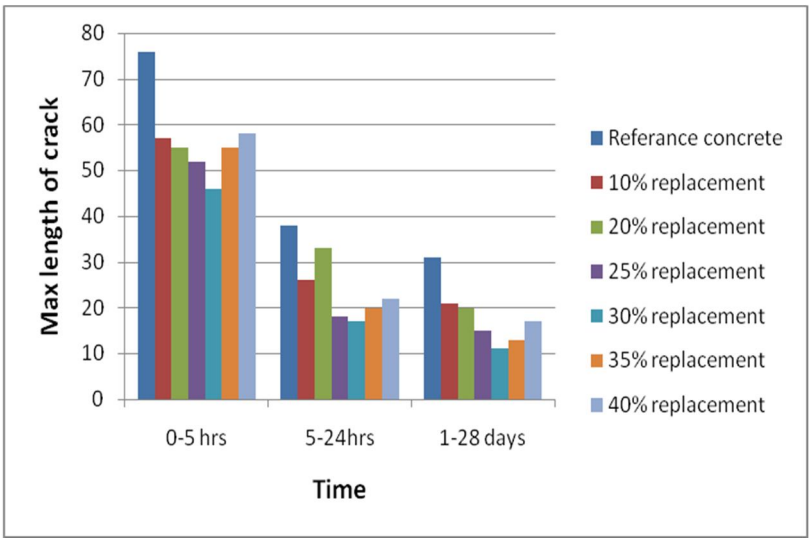

Fig. 2 Graph showing the variation of maximum length of crack when cement is partially replaced by Fly Ash

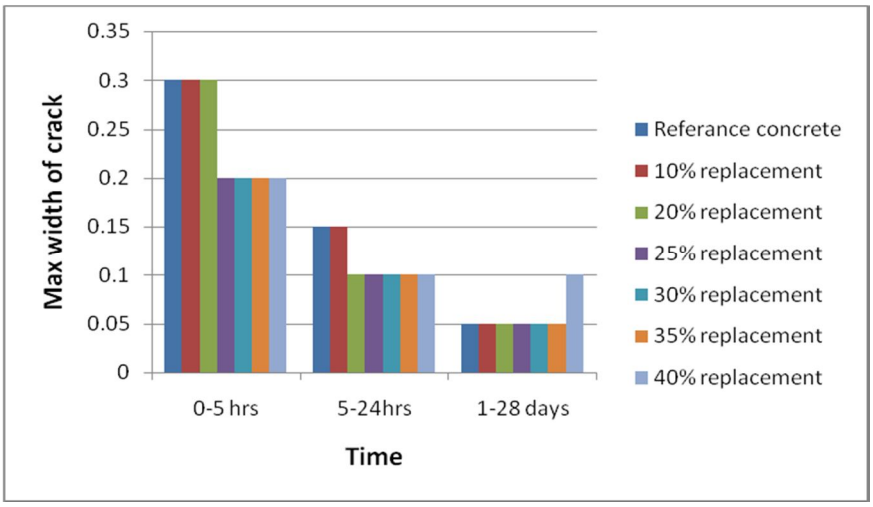

Fig 3. Graph showing the variation of maximum width of crack when cement is partially replaced by Fly Ash

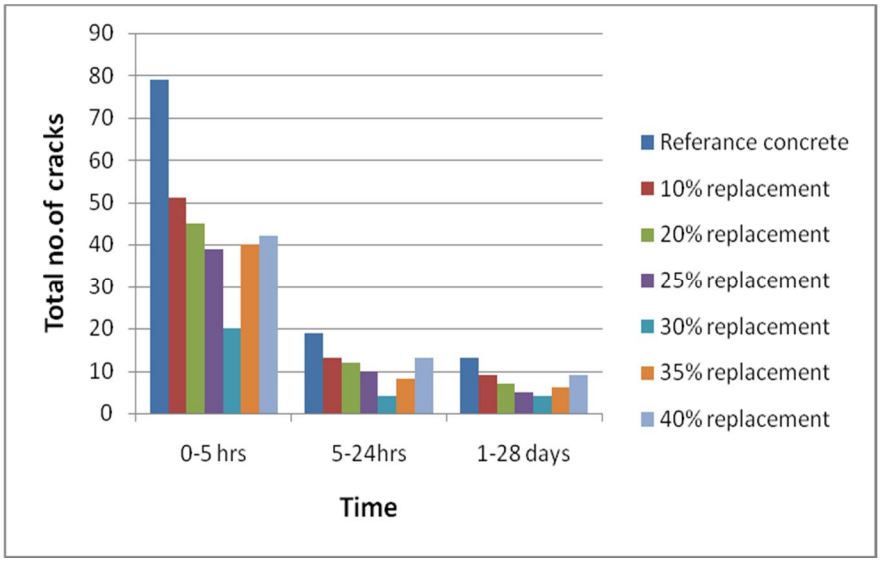

Fig 4. Graph showing the variation of total number of cracks when cement is partially replaced by Fly Ash

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue IX, September 2017- Available at www.ijraset.com

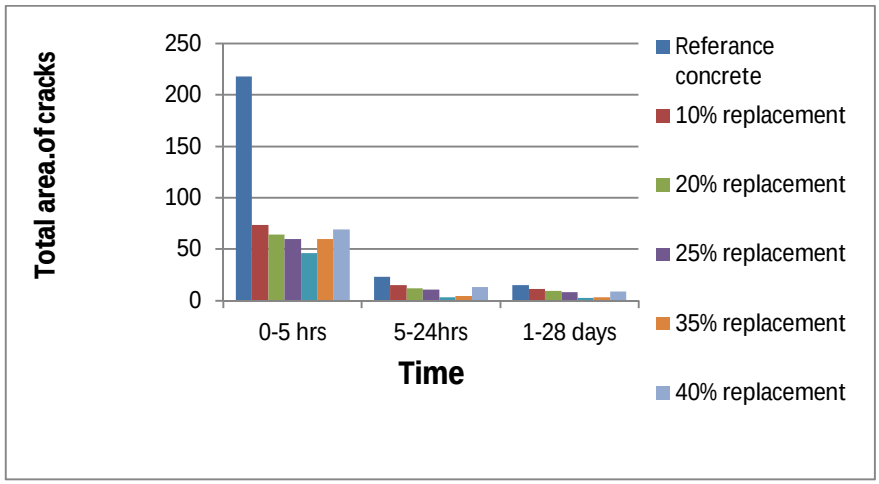

Fig 5. Graph showing the variation of total area of cracks when cement is partially replaced by Fly Ash

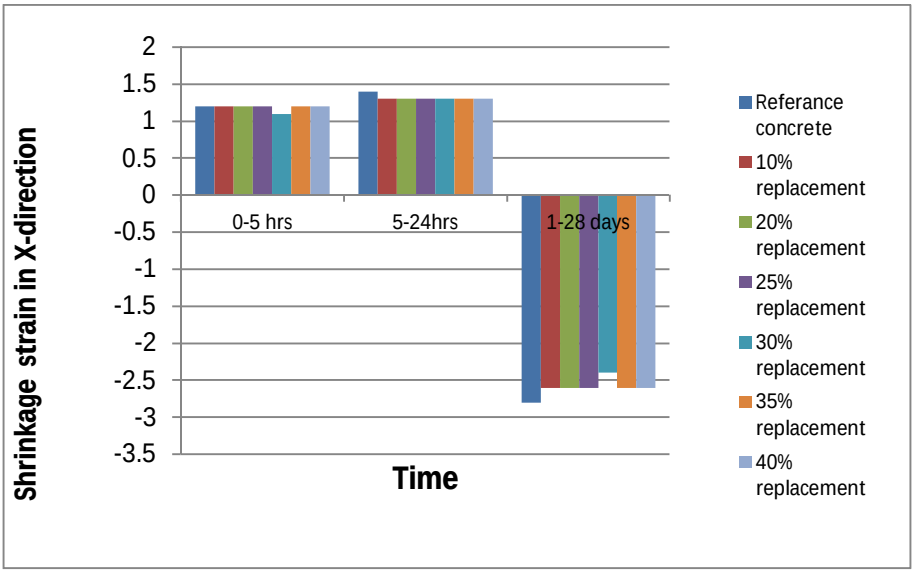

Fig. 6 Graph showing the variation of shrinkage strain in X direction when cement is partially replaced by Fly Ash

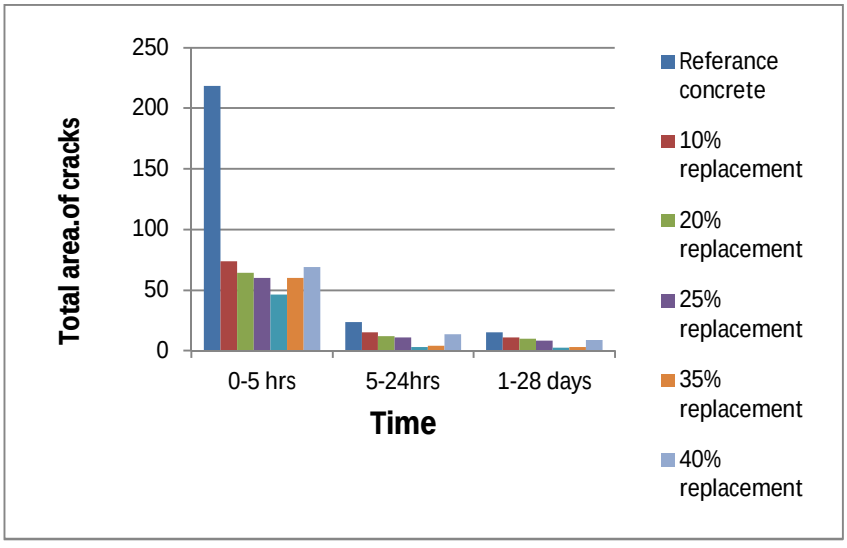

Fig 7. Graph showing the variation of shrinkage strain in Y direction when cement is partially replaced by Fly Ash

V. CONCLUSIONS

The following are the important conclusions that can be drawn from this study.

A. The shrinkage parameters like maximum length, maximum width, total number of cracks, total area of cracks, shows minimum, when 30% of cement is replaced by fly ash.

B. The shrinkage strain in X-direction and shrinkage strain in Y-direction shows minimum, when 30% of cement is replaced by fly ash.

C. 30% replacement of cement by fly ash the shrinkage is decreased by 60% when compared with concrete without fly ash.

REFERENCES

[1] IS: 10262-1982, recommended guide line for concrete mix design.
[2] Zongjin Li, Meng Qi, Zailiang Li and Baoguo Ma, (1999), "Crack Width of High Performance of Concrete due to Restrained Shrinkage", Journal of
[3] Materials in Civil Engineering, 214-223.
[4] Jianyong and Yao Yan, (2001), "A Study on Creep and Drying Shrinkage of High Performance Concrete", Cement and Concrete Research, 1203-1206.
[5] Kolluru Subramaniam, Roman Gromotka and Surendra Shah (2005), "Influence of Ultrafine Fly Ash on the Early age response and the Shrinkage Cracking potential of Concrete", Journal of Materials in Civil Engineering, Feb 2005, pp 45-53
[6] Pipat Termkhajornkit and Toyohanu Nawa (2005), "Effect of Fly Ash on Autogeneous Shrinkage", Cement and Concrete Research, pp 473-482.