Study of Plastic Shrinkage of Retempered Concrete

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Abstract

Plastic shrinkage in concrete is occurred due to moisture loss, it is one of the important parameter which affects behaviour of concrete. Therefore it is necessary to study mechanism of plastic shrinkage. In this paper, the attempt has been made for study of plastic shrinkage of retempered concrete, for retempering time 15,30,45,60,75, and 90 minutes. The process of remixing of concrete, if necessary, with addition of just the required quantity of water is known as "retempering of concrete". Sometimes, a small quantity of extra cement is also added while retempering. For this experiment, the two specimens of size 500X350X45 mm has been casted and kept to open atmosphere for 24 hours. The shrinkage parameters including length, width, numbers and total area of cracks has been determined.

Keywords: *Plastic shrinkage, moisture loss, retemperd concrete, shrinkage parameters*.

1. Introduction

Delay in the delivery of ready mixed concrete has the same result and leads many people in the concrete industry to regain the original slump by adding water, a process known as "retempering". Ready-mixed concrete, which is mixed at the plant, using a normal, well-designed concrete mix, should arrive at its destination with sufficient workability to enable it to be properly placed and fully compacted. In such circumstances, where there is a significant period of time between mixing and placing the concrete, there will be a noticeable reduction in the workability of the fresh concrete.

Shrinkage is the decrease of concrete volume with time. This decrease is due to change in moisture content of the concrete, which occurs without stress attributable to actions external to the concrete. Swelling is the increase of concrete volume with time. Shrinkage and Swelling are usually expressed as dimensionless strain (in/in. or mm/mm). Under given conditions of room temperature, shrinkage is primarily a function of the paste, but is significantly influenced by the stiffness of the coarse aggregate. While it is commonly assumed that lower w/c concrete exhibits less shrinkage than higher w/c mixtures, this general rule may be misleading and should be qualified. While it is true that concrete made using a low w/c typically exhibits lower drying shrinkage, these mixtures can exhibit a substantial increase in autogenous shrinkage, especially during the first 24 hours of material development.Plastic shrinkage cracks are due to the rapid loss of Water when they are still in plastic state. The crack appears when the evaporation rate exceeds the rate of water bleeding to compensate it. The crack occurs when the high evaporation rate causes the concrete surface to dry out before it set.These cracks affect the strength and durability of concrete and can be avoided by proper measures before placing the concrete. In this paper the attempt has been made to observe the shrinkage property of retempered concrete. Retempering is defined as "Addition of water and remixing of concrete." Retempering inevitably results in some loss of strength as compared with the original concrete. This paper presents the results of an experimental investigation carried out to evaluate the plastic shrinkage of retempered concrete.

2. Research Significance

In the circumstances like breakdown of any concreting equipment or quarrels between the labours or suddenly erupted strikes on the site may put the green concrete into difficult situation. In such above situations the concrete which is already mixed may have to wait for a longer time before entering into the formwork. This causes the loss of plasticity and if such concrete is used, the shrinkage and other characteristics of concrete are affected. Such concrete has to be either discarded or used with little addition of extra water and cement so that a part of plasticity is regained, and such

concrete is called retempered concrete. Therefore it is essential to study the shrinkage properties of retempered concrete containing 5% extra cement.

3. Experimental program and procedure

The main aim of this experimentation work is to find the effect of retempering on shrinkage property of concrete. Ordinary Portland cement and locally available sand and aggregates were used in the experimentation. The specific gravity of fine and coarse aggregate was 2.81 and 3.03 respectively. The plate moulds used for the experimentation were of dimension 500×300×45 mm. The ingredients of concrete were weighted according to proportion 1:1.78:3.59 with a water cement ratio 0.52 which corresponds to M20 concrete.

A steel mesh of opening 1"×1" of diameter 3.0 mm was kept at the base of plate mould which acts as a restraint to induce shrinkage. After thoroughly mixing all the ingredients in dry state, the required quantity of water was added in the mix and thoroughly mixed.. This concrete mix was covered with gunny bags for 15 minutes. The time was reckoned, the moment the water was added to the concrete mix. After 15 minutes the mix was poured into the plate moulds and the specimens were cast with sufficient compaction through vibration. This forms retempered concrete for 15 minutes. Similarly the specimens were prepared with retempered concrete with a retempering time of 30, 45, 60, 75 and 90 minutes.

Another set of retempered concrete specimens were cast by adding 5% extra cement and the required extra amount of water to balance a w/c ratio of 0.52.after casting, the observations were taken for plastic shrinkage after 5 hrs and 24 hrs. After 5hrs 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, total area of cracks and shrinkage strain in X and Y directions were noted down on a plastic sheet . The shrinkage in X and Y directions were measured with the help of hand microscope. The shrinkage along the direction of 500mm is considered as X-direction shrinkage and that along the direction of 300mm is considered as Y-direction shrinkage. The specimens were left in the open atmosphere for 24 hours. After 24 hours again the shrinkage parameters like length of crack, width of crack, total number of cracks, total area of cracks and shrinkage strain in X and Y direction were drawn on the same plastic sheet.

3.1 Test Results

The test results as per given below.

Table 1. Shrinkage parameters for without adding extra Cement for 15, 30 and 45 min.

Sr. No	Shrinkage Parameters		Retempering Time			
				15 min	30 Min	45 min
1	Maximum Length of crack		5hrs	112	110	80
			24hrs	65	52	68
2	Maximum Width of crack		5hrs	0.43	0.41	0.21
			24hrs	0.31	0.25	0.13
3	Total nos. of crack		5hrs	79	72	52
			24hrs	41	37	31
4	Total area of crack		5hrs	253.72	244.29	130.98
			24hrs	180.27	135.47	77.14
5	strain X $10^{-3.}$	X dire	5hrs	1.2	1.2	1.18
			24hrs	1.24	1.22	1.22
		Y. dire	5hrs	1.7	1.74	1.2
			24hrs	1.77	1.77	1.22

Table 2.Shrinkage parameters for without adding extra Cement for 60, 75 and 90 min.

Sr. No.	Shrinkage Parameters		Retempering Time			
				60 min	75 Min	90 min
1	Maximum Length of crack		5hrs	78	69	63
			24hrs	59	69	69
2	Maximum Width of crack		5hrs	0.09	0.09	0.08
			24hrs	0.09	0.08	0.09
3	Total nos. of crack		5hrs	50	28	21
			24hrs	37	27	23
4	Total area of crack		5hrs	124.34	65.41	39.09
			24hrs	74.37	41.85	36.01
5	strain X $10^{-3.}$	X dire	5hrs	1.14	1.04	1.02
			24hrs	1.18	1.06	1.04
		Y. dire	5hrs	1.48	1.45	1.45
			24hrs	1.45	1.49	1.47

Table 3.Shrinkage parameters by adding extra 5 % cement

Sr. No.	Shrinkage Parameters		Retempering Time			
				15 min	30 min	45 Min
1	Maximum Length of crack		5hrs	122	121	81
			24hrs	74	60	42
2	Maximum Width of crack		5hrs	0.41	0.33	0.20
			24hrs	0.28	0.21	0.14
3	Total nos. of crack		5hrs	90	87	65
			24hrs	47	41	55
4	Total area of crack		5hrs	398.63	325.27	248.83
			24hrs	255.38	191.81	111.32
5	strain X $10^{-3.}$	X dire	5hrs	1.30	1.30	1.22
			24hrs	1.32	1.26	1.22
		Y. dire	5hrs	1.9	1.8	1.7
			24hrs	1.9	1.85	1.65

Table 4.Shrinkage parameters by adding extra 5% Cement for 60, 75 and 90 min

Sr. No.	Shrinkage Parameters		Retempering Time			
				60 min	75 min	90 min
1	Maximum Length of crack		5hrs	79	71	43
			24hrs	37	72	32
2	Maximum Width of crack		5hrs	0.12	0.10	0.10
			24hrs	0.12	0.09	0.10
3	Total nos. of crack		5hrs	69	44	27
			24hrs	38	34	28
4	Total area of crack		5hrs	147.74	67.42	49.7
			24hrs	59.77	51.42	54.88
5	strain X $10^{-3.}$	X dire	5hrs	1.22	1.12	1.1
			24hrs	1.18	1.08	1.06
		Y. dire	5hrs	1.5	1.51	1.45
			24hrs	1.51	1.49	1.46

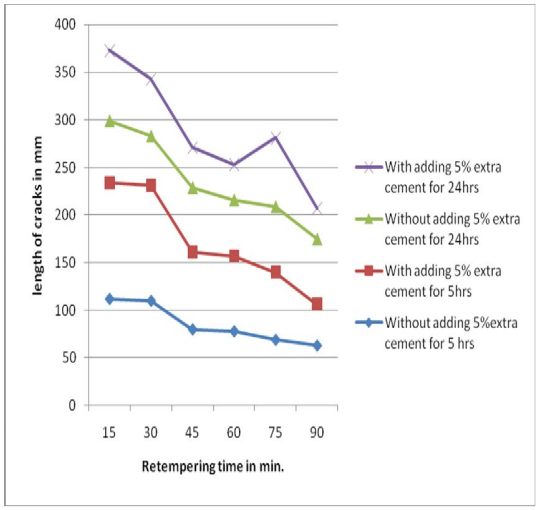

Figure.1. Variation of length of cracks w.r.t. different retempering times

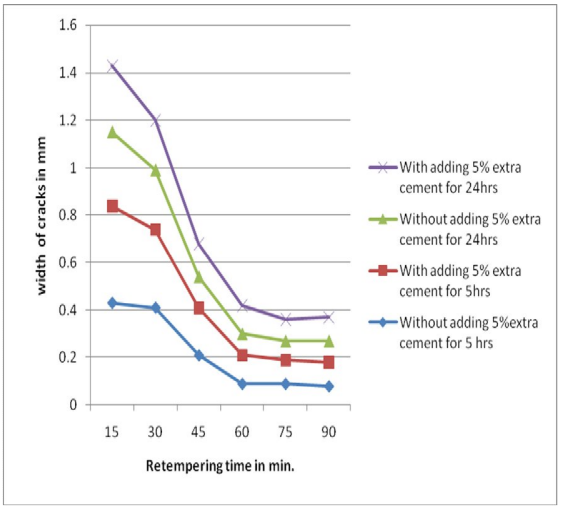

Figure.2. Variation of width of cracks w.r.t. different retempering times

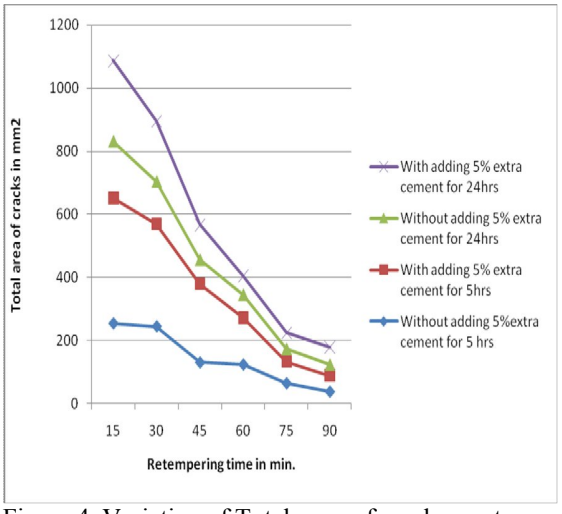

Figure.4. Variation of Total area of cracks w.r.t. different retempering times

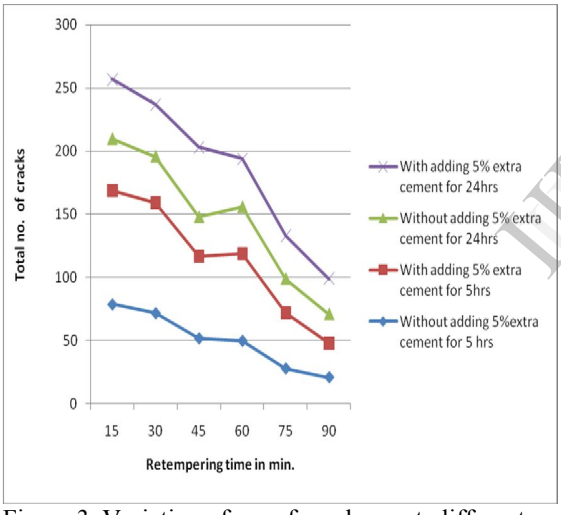

Figure.3. Variation of no. of cracks w.r.t. different retempering times

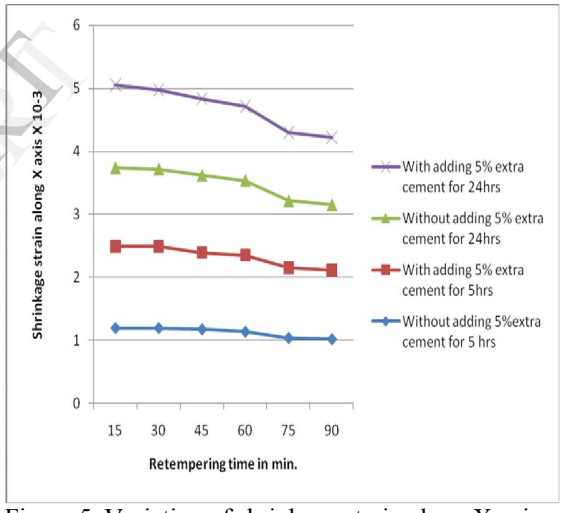

Figure.5. Variation of shrinkage strain along X axis w.r.t. different retempering times

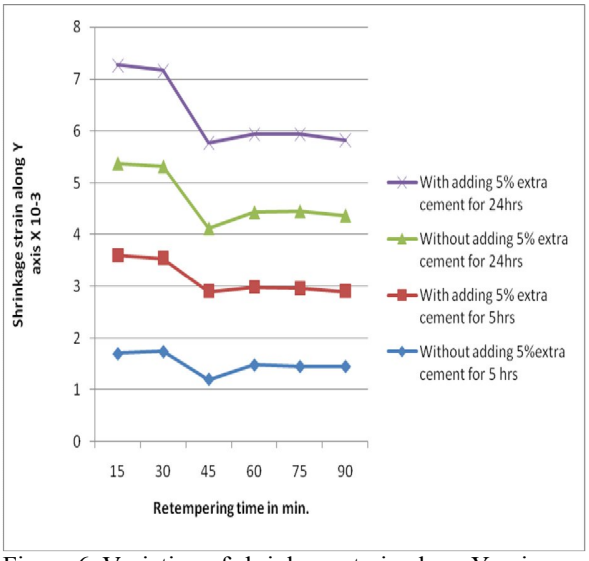

Figure.6. Variation of shrinkage strain along Y axis w.r.t. different retempering times

4. Conclusion

1. The length of the cracks goes on decreasing with increase in retempered time upto 90 minutes.
2. The width of the cracks goes on decreasing with increase in retempered time.
3. The number of the cracks goes on decreasing with increase in retempered time.
4. The above mentioned shrinkage parameters goes on increasing with percentage of cement.
5. Thus instead of wasting the bulk concrete, the retempering can be recommended adding extra 5% cement but it will shrink maximum.

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6.References

[1] Concrete Technology Book□s M.S. Shetty, S. Chand and Company Ltd., Gambhir Tata ML GRAW Hill Publication Third Edition and Krishnaswamy of Concrete Technology, I.S.456(2000.

[2] Dr. D. K. Kulkarni & Dr. K. B. Prakash; "Effect of addition of more than two chemical admixtures on the properties of retempered concrete", NBM&CW.

[3] M. Alhozaimy, (2007); "Effect of retempering on the compressive strength of ready-mixed concrete" in hot-dry environments", *Cement & Concrete composites* 29(2007) 124-127.

[4] Kiran M. Mane & Dr. D. K. Kulkarni, "Effect of retempering with retarding admixture on properties of concrete subjected to prolonged mixing", *Innovative Systems Design and Engineering.*

[5] Zdenek P. Bazant. Prediction of Concrete Creep and Shrinkage, Past, Present and Future, Nuclear Engineering Design, *Elsevie*r.203(2002)27-38.