



## Study of Drying Shrinkage of Retempered Concrete

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### Abstract

Drying 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 drying shrinkage. In this paper, the attempt has been made for study of drying 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. After demoulding the specimens it is transfer to the curing tank for curing and then after 28 days The shrinkage parameters including length, width, numbers and total area of cracks has been determined.

**Keywords:** Drying 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.

Drying shrinkage in concrete is due to drying and the associated decrease in moisture content. Therefore, it is necessary to estimate the moisture loss as accurately as possible in order to study drying shrinkage in concrete members. Correct prediction of concrete drying shrinkage inevitably requires understanding of the concrete moisture content and its variation. It is generally accepted that drying shrinkage is caused by capillary tension, solid surface tension, and withdrawal of hindered adsorbed water and interlayer water movement from the cement gel.

Drying shrinkage is not a problem if the concrete is free to move. If the concrete is restrained in any way, drying shrinkage will introduce tensile stresses which if they exceed the tensile strength of the concrete, will cause the concrete to crack. Shrinkage cracks, as opposed to flexural cracks, are parallel sided and in the case of slabs usually extend right through the slab thickness. Such cracks can cause water penetration/leakage and ultimately impair the durability of the concrete element. Therefore, control of cracking due to drying shrinkage is important and requires appropriate design and detailing of the concrete element. adequate reinforcement Where cracking reducing drying shrinkage will not necessarily prevent cracking which is also influenced by the restraint and the design and detailing of the concrete element.

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. These drying 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 drying 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 drying 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 specimens were left in the open atmosphere for 24 hours. After 24hrs the specimens were demoulded and transfer to the curing tank for 28 days. After 28 days curing the observations were taken for drying shrinkage 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.

#### 3.1 Test Results

The shrinkage parameters for 28 days are given below:-

Table 1. Shrinkage parameters for without adding extra cement for after 28 days.

Sr.no.	Shrinkage parameters		Retempering time					
			15min	30min	45min	60min	75min	90min
1	Max. Length of cracks		72	67	61	31	28	28
2	Max. Width of crack		0.09	0.07	0.06	0.06	0.05	0.05
3	Total no. Of cracks		37	31	12	8	8	5
4	Total area of cracks		37.01	29.09	9.84	7.49	7.35	7.2
5	Shrinkage strain $\times 10^{-3}$	X dire*	-1.26	-1.24	-1.24	-1.20	-1.10	-1.08
		Y dire*	-1.8	-1.78	-1.51	-1.50	-1.49	-1.49

Table 2. Shrinkage parameters for with adding 5% extra cement for after 28 days.

Sr.no.	Shrinkage parameters		Retempering time					
			15min	30min	45min	60min	75min	90min
1	Max. Length of cracks		67	53	31	35	64	48
2	Max. Width of crack		0.10	0.09	0.07	0.06	0.05	0.04
3	Total no. Of cracks		54	45	10	10	09	05
4	Total area of cracks		61.27	55.51	17.25	10.61	8.25	8.2
5	Shrinkage strain $\times 10^{-3}$	X dire*	-1.38	-1.34	-1.30	-1.26	-1.18	-1.16
		Y dire*	-1.96	-1.87	-1.66	-1.58	-1.51	-1.49

\* Indicate swelling i.e. shrinkage strain

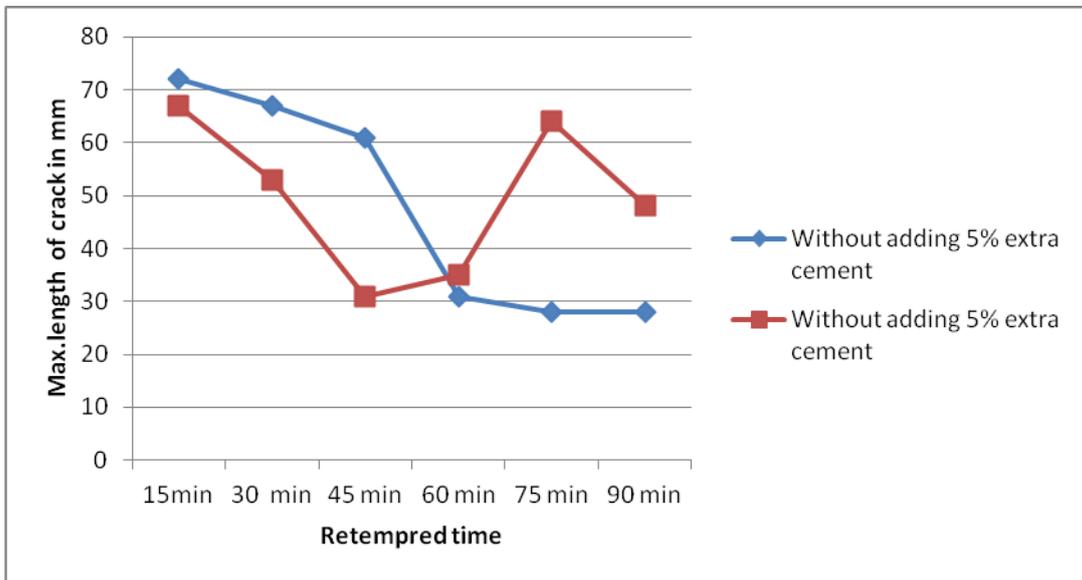


Figure 1. Showing variation in length w.t.m. time.

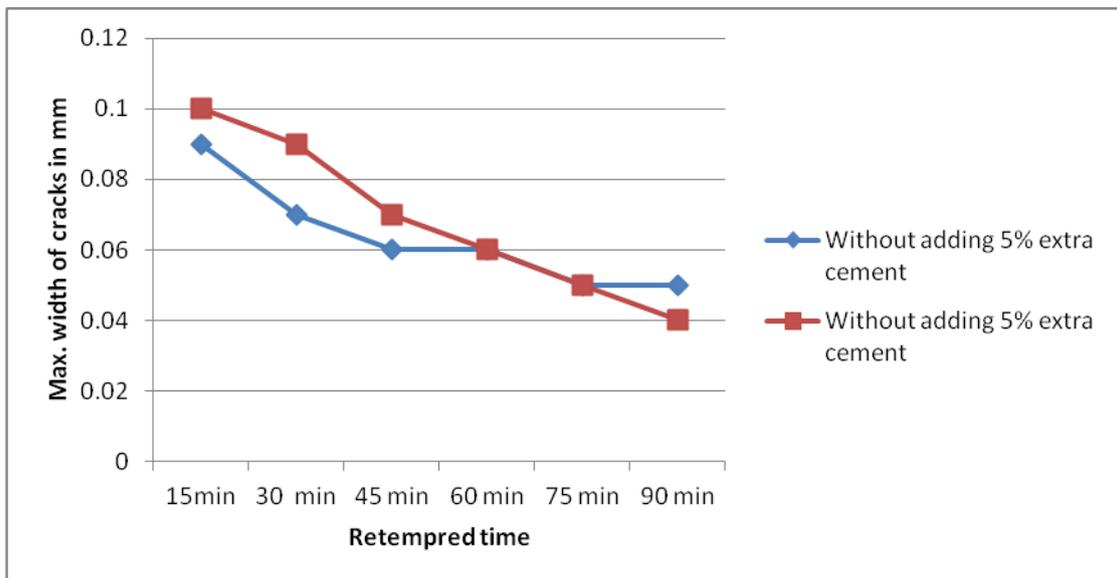


Figure 2. Showing variation in width w.t.m. time.

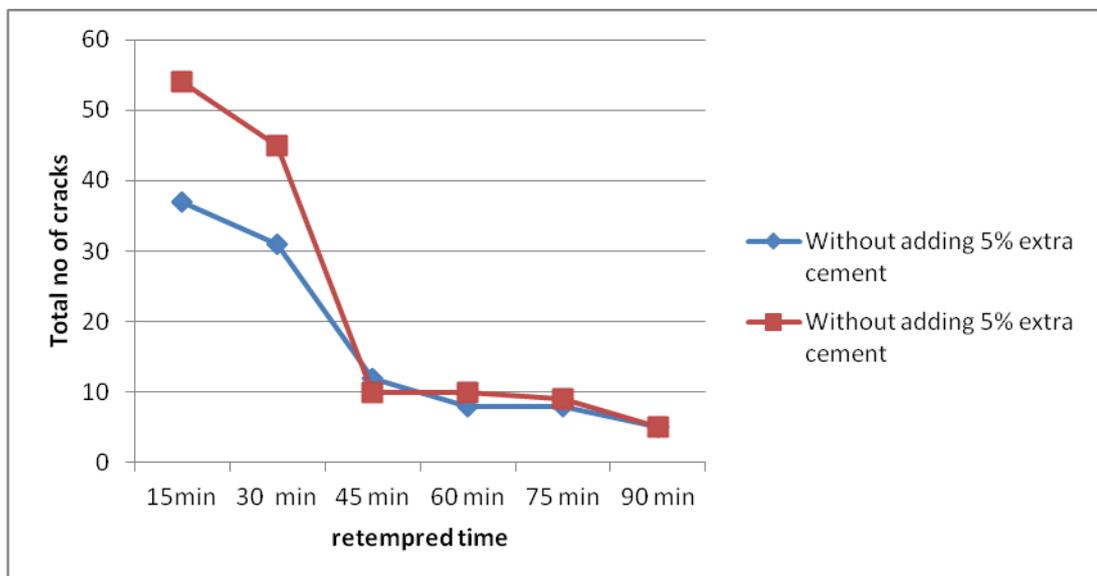


Figure 3. Showing variation total nos of cracks w.t.m. time.

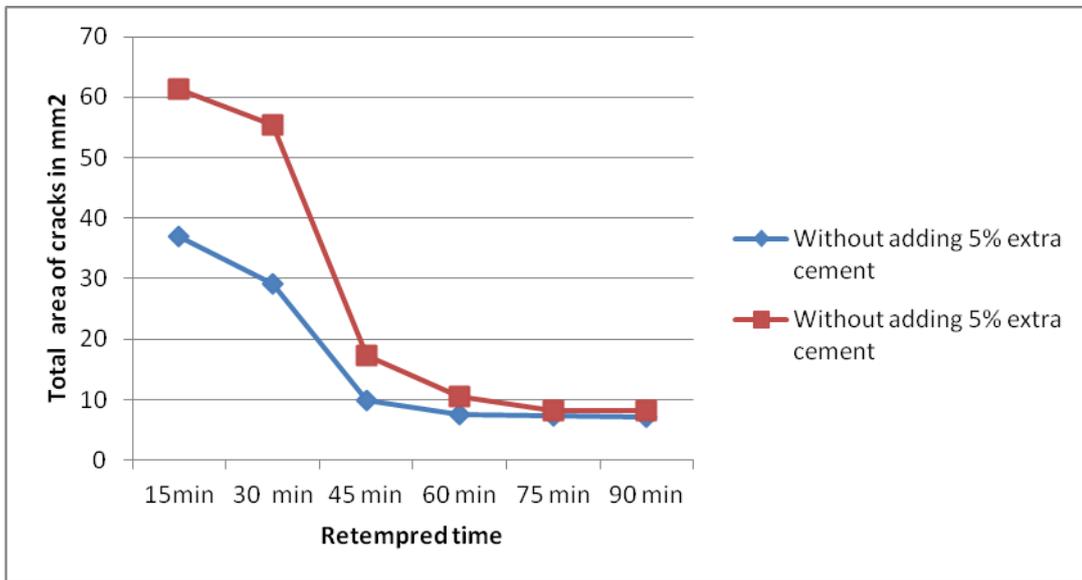


Figure 4. Showing variation total area of cracks w.t.m. time

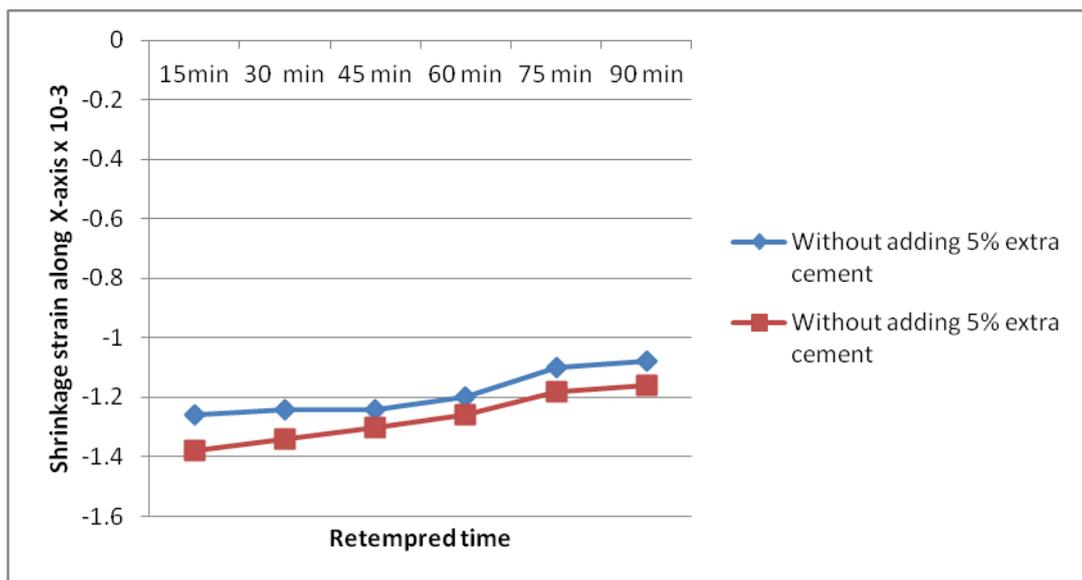


Figure 5. Showing variation shrinkage strain along X axis w.t.m. time.

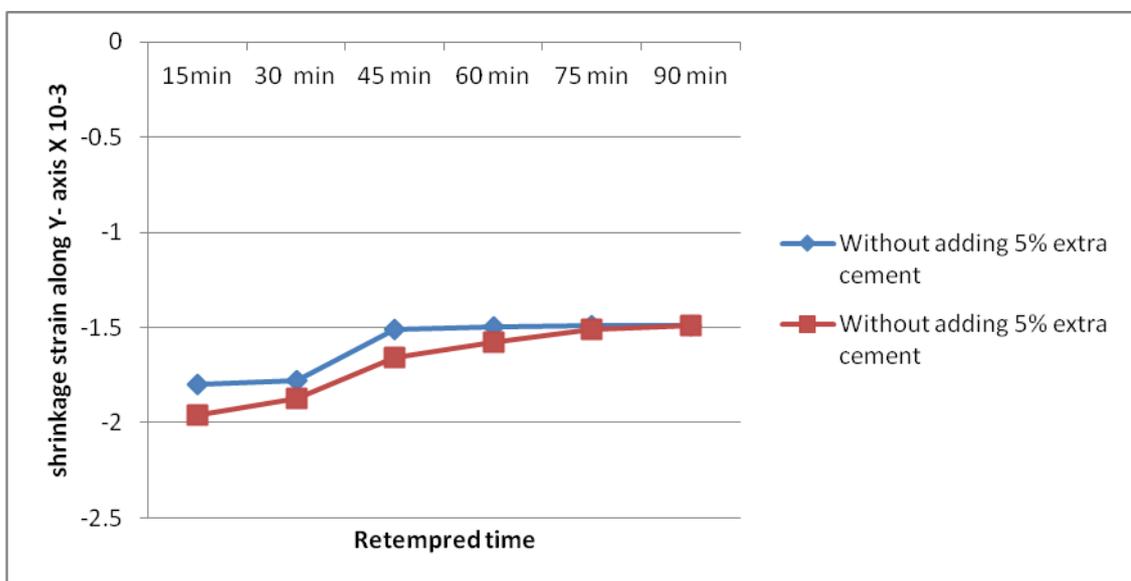


Figure 6. Showing variation shrinkage strain along Y axis w.t.m. time.

#### 4. Conclusion

It has been observed that the concrete without extra cement the drying shrinkage goes on decrease with retempering time. but it is also observed that the drying shrinkage increase increase in that concrete in which we added 5 % extra cement. It has been observed that the concrete produced with addition of 5% extra cement and water

shrink higher compared to concrete produced without 5% extra cement and water, This is true for the retempering times from 15 minutes to 90 minutes. Obviously this may be due to the fact of presence of 5% excess cement. Thus it can be concluded that the concrete produced with addition of 5% extra cement and water shrink all the retempering times up to 90 minutes.

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