Experimental Investigation of Addition of Combination of Admixtures on the Properties of Retempered Concrete

D.K.Kulkarni, K.B.Prakash.

Abstract - 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.

In such situations the concrete looses its plasticity. In retempered concrete addition of small quantity of cement and water along with combinations of admixtures can bring back the plasticity to concrete. Thus retempering becomes important in odd situations. In this paper an attempt is made to study the strength characteristics of concrete containing combination of admixtures at retempering time of 15 min upto 90 min. The combinations of admixture studied in this experimentation is

Superplasticiser + Air Entraining Agent + Retarder (S+AEA+R).

The tests are conducted to evaluate the strength characteristics of concrete like compressive strength, tensile strength, flexural strength and impact strength for different retempering times.

Index Terms: admixtures, air entraining agent, retarder, retempering, superplasticiser

I INTRODUCTION

One of the adverse effects of hot weather concreting is loss of slump. 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'[1].

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. If for any reason, the placement of the concrete is unduly delayed, then it may stiffen to an unacceptable degree and site staff would normally insist on the rejection of a batch or otherwise good concrete on the grounds of insufficient workability. If not rejected, excessive vibration would be needed to attempt to fully compact the concrete, with the risk of incomplete compaction, expensive repair, or, at worst, removal of the hardened concrete.

If abnormal slump loss is anticipated then the use of admixtures can give good results but with additional cost.[2, 3, 4]. However, in cases where unforeseen delay or some other cause has lead unexpectedly to poor workability, retempering of the concrete by water, while normally considered to be bad practice, may, in reality, be contemplated as a possible course of action. The increase in the water content of the concrete immediately prior to discharge will improve the consistency, but it is widely held that there must be a subsequent increase in the water/cement (w/c) ratio which will be detrimental to the hardened concrete [5, 6].

Adding water to a plastic mix to increase slump is an extremely common practice, even though it is not recommended because it increases the porosity of concrete. Concrete often arrives on site more than half an hour after initial mixing. Placement operations can take anywhere from 10 to 60 minutes, depending on the field conditions and the size of the load. When the slump decreases to an unacceptable level during the operations, water is added to the mix and, very often, experienced field inspectors will tolerate what can be termed 'reasonable' retempering, i.e., enough to increase slump by 50 or 60 mm[7].

II RESEARCH SIGNIFICANCE

In the circumstances like breakdown of any concreting equipment or quarrels between the labors 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 strength 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. Probably use of some admixtures may induce some good qualities to such

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retempered concrete. Therefore it is essential to study the characteristic properties of retempered concrete containing combination of admixtures.

III EXPERIMENTAL PROGRAMME

The main aim of this experimentation work is to find the effect of addition of more than two admixtures on the properties of retempered concrete. The combination of admixtures selected for the study on concrete is Superplasticiser + Air Entraining Agent + Retarder(S+AEA+R)

Ordinary Portland Cement and locally available sand and aggregates were used in the experimentation. The specific gravity of fine and coarse aggregate was 2.66 and 2.51 respectively. The experiments were conducted on a mix proportion of 1: 1.26:2.1 with w/c = 0.41 which corresponds to M20 grade of concrete. The admixtures and their dosages used in the experimentation are shown in table I.

After thoroughly mixing all the ingredients in dry state, the required quantity of water was added in the mix and thoroughly mixed. At this stage the different admixtures like superplasticiser, air entraining agent and retarders were added and a homogeneous concrete mix was obtained. 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 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 minutes, 45 minutes, 60 minutes, 75 minutes 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 0.41. All the specimens were demoulded after 12 hours of their casting and were transferred to curing tank to cure them for 28 days. After 28 days of curing the specimens were tested for their compressive strength, tensile strength, flexural strength and impact strength as per IS specifications.

For compressive strength test, the cubes of dimensions 150 X 150 X 150 mm were cast and were tested under compression testing machine as per I S 516-1959[8] For tensile strength test, the cylinders of diameter 100 mm and length 200 mm were cast and were tested under compressive testing machine as per I S 5816-1999[9] For flexural strength test the beams of dimensions 100 X 100 X 500 mm were cast and were tested on an effective span of 400 mm with two point loading as per I S 516-1959[8] For impact test four different test methods are referred in the literature.[10] Drop weight method being the simple method, was adopted to find the impact energy. Impact strength specimens were of dimensions 250 X 250 X 30 mm. A steel ball weighing 13.03 N was dropped from a height of 1 m on the centre point, which was kept on the floor. Number of blows required to cause first crack and final failure were noted down. From these number of blows, the impact energy was calculated as under.

Impact energy = w h N (N-m)
Where w = Weight of steel ball = 12.6 N
h = Height of drop = 1 m
N = Number of blows required for first crack orfinal failure as the case may be.

IV TEST RESULTS

Table II gives the compressive strength test results of retempered concrete. It also gives percentage increase or decrease of compressive strength w.r.t. reference mix. Table III gives the tensile strength test results of retempered concrete. It also gives percentage increase or decrease of tensile strength w.r.t. reference mix. Table IV gives the flexural strength test results of retempered concrete. It also gives percentage increase or decrease of flexural strength w.r.t. reference mix. Table V gives the impact strength test results of retempered concrete. It also gives percentage increase or decrease of impact strength w.r.t. reference mix.

The variation of these strengths are depicted in the form of graphs as shown in fig.1, 2, 3 and 4

V DISCUSSION OF TEST RESULTS

1. It has been observed that the concrete without any admixture shows maximum compressive strength, tensile strength, flexural strength and impact strength at a retempering time of 60 minutes. It is true for both concretes which are produced by adding 5% extra cement and water and concrete without adding 5% extra cement and water.

This may be due to the fact that the evaporated water up to 60 minute may bring down the w/c ratio resulting in an enhanced strength.

Thus it can be concluded that the concrete without any admixture show maximum strengths at a retempering time of 60 minutes.

2. It has been observed that the concrete produced with addition of 5% extra cement and water show higher compressive strength, tensile strength, flexural strength and impact strength as compared to concrete produced without 5% extra cement and water. This is true for all the retempering times from 15minutes to 90 minutes.

Obviously this may be due to the fact of presence of 5% extra cement.

Thus it can be concluded that the concrete produced with addition of 5% extra cement and water yields more strength, for all the retempering times up to 90 minutes.

3. It has been observed that the concrete with the combination of admixture (S+AEA+R) shows maximum compressive strength, tensile strength, flexural strength and impact strength at a retempering time of 45 minutes. It is true for both the concretes which are produced by adding 5% extra cement and water and concrete without adding 5% extra cement and water.

This may be due to the fact that the evaporated water up to 45 minute may bring down the w/c ratio resulting in an enhanced strength.

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Thus it can be concluded that the concrete with the combination of admixture (S+AEA+R) shows maximum strengths at a retempering time of 45 minute.

4. It has been observed that the concrete produced with addition of 5% extra cement and water show higher compressive strength, tensile strength, flexural strength and impact strength as compared to concrete produced without 5% extra cement and water, when the combination of admixture (S+AEA+R) is used. This is true for the retempering times from 15minutes to 90 minutes.

Obviously this may be due to the fact of presence of 5% extra cement.

Thus it can be concluded that the concrete produced with addition of 5% extra cement and water and with combination of admixture (S+AEA+R) yields more strengths for all the retempering times up to 90 minutes.

5. It has been observed that the compressive strength, tensile strength, flexural strength and impact strength of concrete produced with the combination of admixture (S+AEA+R) is higher than that without any admixture. This is true for all the retempering times and also it is true for the concrete produced by addition of 5% extra cement and water and concrete without 5% extra cement and water.

This is attributed to the fact that the addition of combination of admixture (S+AEA+R) induce more workability which will facilitate for full compaction and in turn this results in higher strengths.

Therefore it is concluded that the concrete produced with the combination of admixture (S+AEA+R) show higher strengths than that of without admixtures for all the retempering times.

VI CONCLUSIONS

1. The concrete without any admixture show maximum strengths at a retempering time of 60 minutes.
2. The concrete produced with addition of 5% extra cement and water yields more strength, for all the retempering times up to 90 minutes.
3. The concrete with the combination of admixture (S+AEA+R) shows maximum strengths at a retempering time of 45 minute.
4. The concrete produced with addition of 5% extra cement and water and with combination of admixture (S+AEA+R) yields more strengths for all the retempering times up to 90 minutes.
5. The concrete produced with the combination of admixture (S+AEA+R) show higher strengths than that of without admixtures for all the retempering times.
6. Thus instead of wasting the bulk concrete, the retempering can be recommended either with the use of combination of admixture (S+AEA+R) or without admixture.

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Table I: The admixtures and their chemical content and dosages used in the experimentation

Sr no	Admixture	Abbreviations used	Dosages used (by weight of cement)
1	Superplasticiser	S	1.1%
2	Air Entraining Agent	AEA	0.1%
3	Retarder	R	0.4%

Table II: Results of compressive strength

Retempering Time (minute)	Compressive strength of reference mix. (without admixture) (MPa)		Compressive strength with combination of admixture (S+AEA+R) (MPa)		Percentage increase or decrease of compressive strength w.r.t reference mix	
	with addition of 5% extra cement and water	without addition of 5% extra cement and water	with addition of 5% extra cement and water	without addition of 5% extra cement and water	with addition of 5% extra cement and water	without addition of 5% extra cement and water
15	19.00	18.05	24.07	23.45	26.68	29.92
30	19.35	19.15	24.88	24.50	28.58	27.94
45	26.5	23.5	26.81	26.00	1.17	10.64
60	29.85	24.3	30.00	29.05	0.50	19.55
75	23.9	23.4	29.35	28.27	22.8	20.81
90	23.25	22.2	29.00	28.00	24.73	26.13

Table III : Results of split tensile strength

Retempering Time (minute)	Split tensile strength of reference mix. (without admixture) (MPa)		Split tensile strength with combination of admixture (S+AEA+R) (MPa)		Percentage increase or decrease of split tensile strength w.r.t reference mix	
	with addition of 5% extra cement and water	without addition of 5% extra cement and water	with addition of 5% extra cement and water	without addition of 5% extra cement and water	with addition of 5% extra cement and water	without addition of 5% extra cement and water
15	4.03	4.00	4.39	4.05	8.93	1.25
30	4.28	4.15	5.29	5.10	23.59	22.89
45	5.75	5.68	6.76	6.47	17.56	13.91
60	7.30	6.97	7.40	7.09	1.37	1.72
75	6.75	5.97	6.82	6.35	1.04	6.36
90	5.44	5.06	5.70	5.07	4.78	0.20

Table IV : Results of flexural strength

Retempering Time (minute)	Flexural strength of reference mix. (without admixture) (MPa)		Flexural strength with combination of admixture (S+AEA+R) (MPa)		Percentage increase or decrease of flexural strength w.r.t reference mix	
	with addition of 5% extra cement and water	without addition of 5% extra cement and water	with addition of 5% extra cement and water	without addition of 5% extra cement and water	with addition of 5% extra cement and water	without addition of 5% extra cement and water
15	2.1	2.08	2.17	2.18	3.33	4.81
30	2.4	2.28	2.47	2.33	2.92	2.19
45	3.37	3.25	3.45	3.29	2.37	1.23
60	5.01	4.89	5.25	5.06	4.79	3.48
75	4.11	3.78	4.13	3.95	0.50	4.50
90	3.55	3.28	3.75	3.68	5.63	12.19

Table V : Results of impact energy

Retempering Time (minute)	Impact energy of reference mix. (without admixture) (N-m)		Impact energy with combination of admixture (S+AEA+R) (N-m)		Percentage increase of impact energy w.r.t reference mix	
	with addition of 5% extra cement and water	without addition of 5% extra cement and water	with addition of 5% extra cement and water	without addition of 5% extra cement and water	with addition of 5% extra cement and water	without addition of 5% extra cement and water
15	3.08	3.00	5.49	4.99	78.25	66.33
30	3.75	3.63	5.70	5.65	52.00	55.65
45	4.95	4.28	5.90	5.69	19.19	32.94
60	4.98	4.75	8.19	7.94	64.46	67.16
75	4.81	4.47	6.94	6.83	44.28	52.80
90	3.98	3.76	5.84	5.09	46.73	35.37

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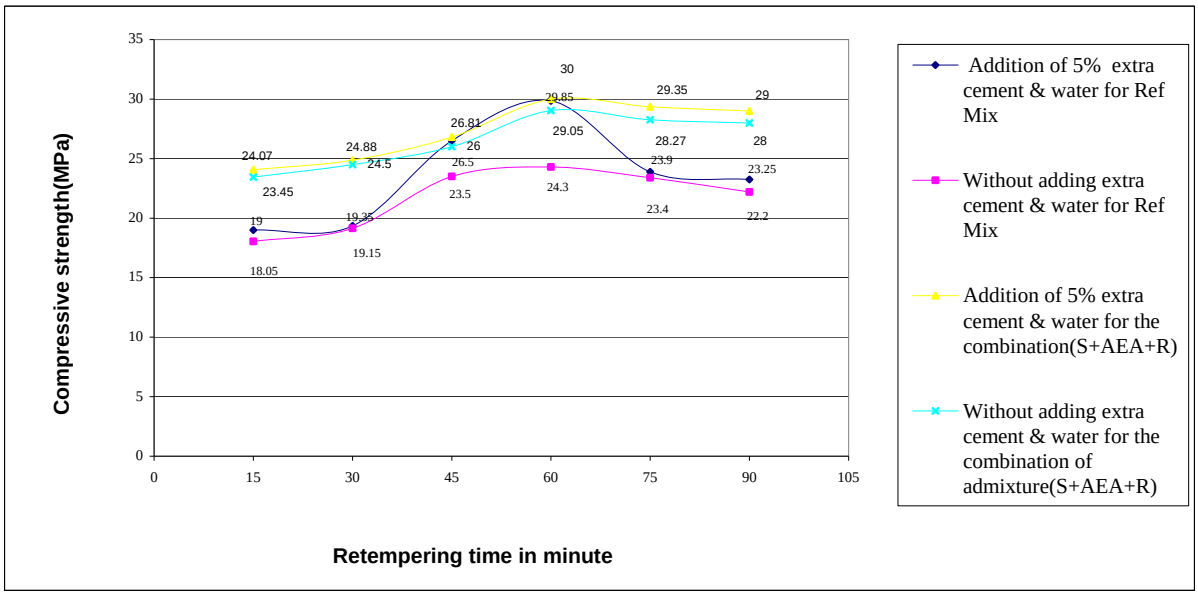

Fig 1 Variation of compressive strength w.r.t different retempering times

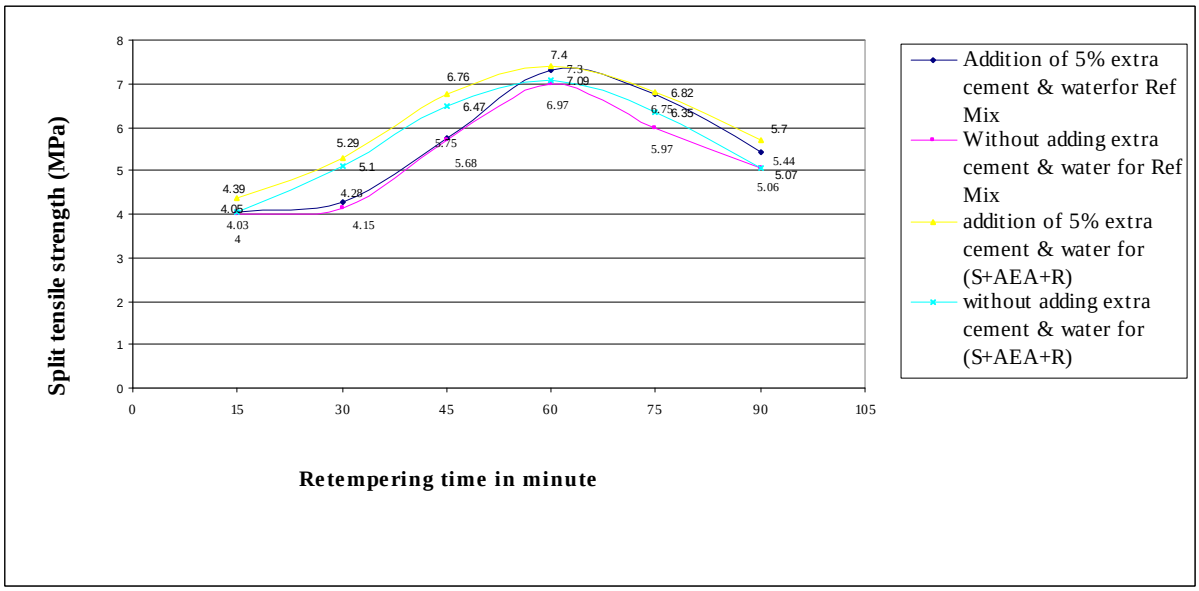

Fig 2 Variation of split tensile strength w.r.t different retempering times

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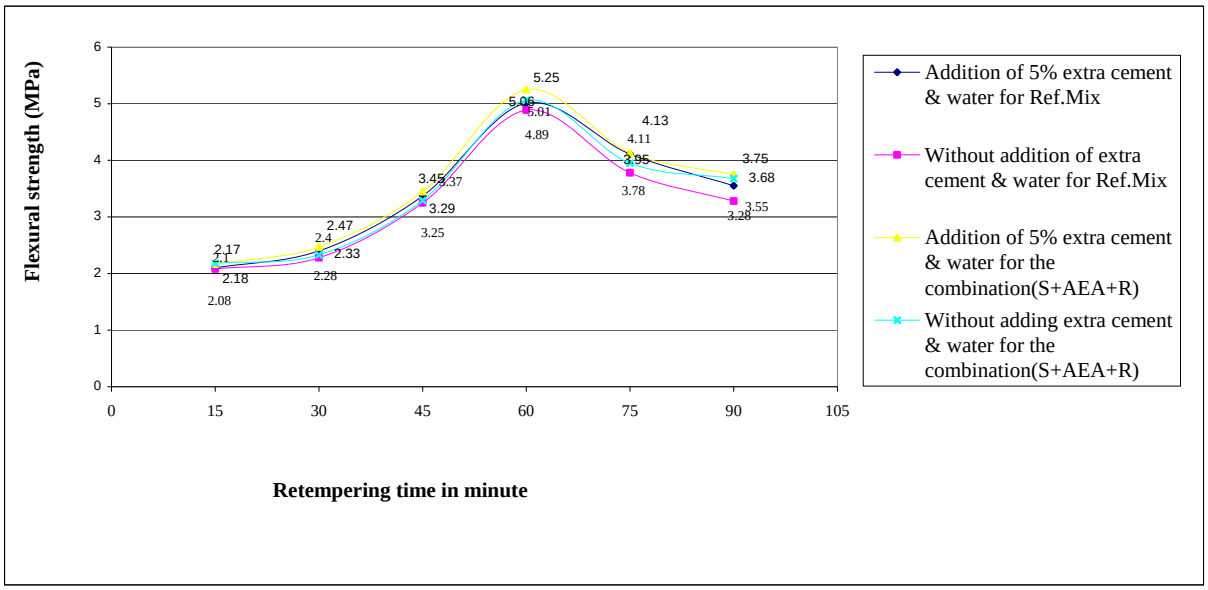

Fig 3 Variation of flexural strength w.r.t different retempering times

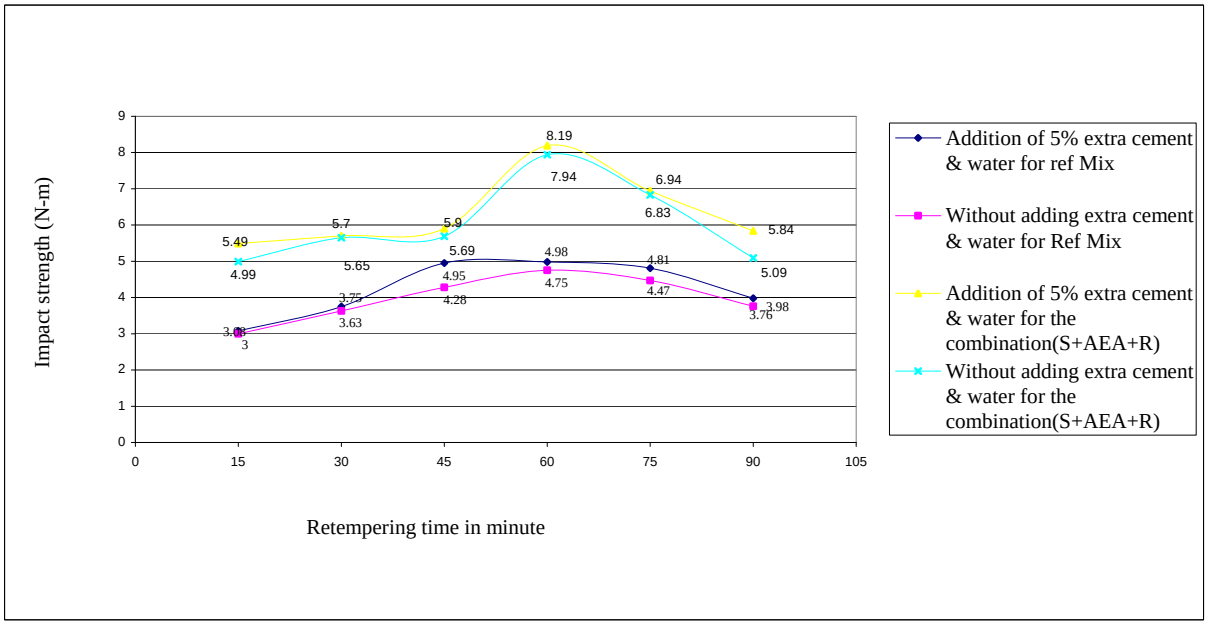

Fig 4 Variation of impact strength w.r.t different retempering times

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