

EFFECT ON DRYING SHRINKAGE EFFECT OF CONCRETE DUE TO THE ADDITION OF CARBON FIBRES AND PARTIAL REPLACEMENT OF CEMENT AND FINE AGGREGATES

Kumuda V¹, Veerendra Kumar K N²

¹Department of Civil Engineering, EWIT, Bangalore

²Department of Civil Engineering, VVIT, Bangalore

Abstract

The present study aims in checking the drying shrinkage effect of the concrete in which the cement and fine aggregates are replaced with admixtures like fly ash and bottom ash with a constant percentage of 0.5% carbon fibers to the relative volume of concrete respectively. In this investigation, concrete of M₂₅ grade is used. Fly ash is partial replaced for cement at 0%, 10%, 20%, 30%, 40%, 50% and bottom ash is partial replaced for fine aggregates at 0%, 10%, 20%, 30%, 40%, 50% with addition 0.5% of carbon fibers to the relative volume of concrete. The drying shrinkage effect of the carbon fibre reinforced concrete (CFRC) is studied using a specimen size of 75 X 75 X 150 mm cubes. After 28 days and 56 days of curing, the specimens are dried and tested in shrinkage measuring instrument. The result of CFRC is compared with the normal concrete having same water cement ratio (W/C). After obtaining the result the drying shrinkage is found to be higher in conventional concrete and it reduced with addition of fibres as they act as crack arrestors and also as replacement of cement and fine aggregates increases the drying shrinkage was found to be reduced as the shrinkage property depend on the factors such as size of aggregates, curing conditions and type of chemical admixtures being used.

Keywords: CFRC, W/C, Drying Shrinkage, Conventional concrete, Fly ash, Bottom ash.

1. INTRODUCTION

In construction activities concrete is the most commonly used material. When hardened it becomes strong and durable but it will be plastic and malleable in its fresh state. It is good in compression but weak in tension. Its strength can be achieved in tension by providing reinforcement. The aggregates are the major components of concrete. A broad range of environment and social consequences are produced by the use of cement and manufacture. The consequence is both harmful and acceptable. Production of cement causes pollution due to gas emissions. Attempts have been done to reduce green house gas. So by substituting conventional clinker with industrial by products like fly ash and bottom ash cement industries have taken actions. The use of industrial wastes is taking importance as additives, by this they increase strength, density and it reduces its impact on environment. Since 1900 the use of fiber to concrete has been experimented. Asbestos fiber were used to concrete in the beginning of 20th century. And in middle, I mean in 1950 the concept of composite of materials came into action. Fibre reinforced concrete was one among. The overall thinking is to get better strength of concrete. To focus on the strength of concrete the steel fiber and carbon fibers were added. By this the strength of concrete can be achieved. The backbone of modern civilization is energy. The major source of energy is electric power from thermal power station. 70% of the energy electricity is being generated by burning fossil fuels. Out of 70% nearly 61% is produced by coal fired plants. This results nearly 100 tons of ash produced

per year. This ash can be disposed off either dry or wet to a near by open area. Or by grounding both bottom ash and fly ash we can dispose. Or mixing with water we can pump it into artificial lagoon or dumping into yards. Through there is a report that will cause environmental pollution. Due to this reason the experiment research and investigating is on. The effect of use of bottom ash as a replacement of fine aggregates. To avoid the pollution bottom ash came into use.

2. PROBLEM DEFINITION

In the present experimental work, the properties of concrete are thoroughly studied for M₂₅ grade with fibres as reinforcing materials. In addition to this some of the industrial wastes (fly ash & bottom ash) obtained from thermal power plant having a little cementitious properties are substituted with cement and fine aggregate respectively. Both fly ash and bottom ash are replaced with cement and sand with following variations of 0%, 10%, 20%, 30%, 40% and 50% by weight of cement and sand respectively. The fibres used for this study is carbon at constant percentage of 0.5% volume of concrete respectively. Drying shrinkage effect on the fiber reinforced concrete is studied in this work.

3. METHODOLOGY

The Drying shrinkage effect of CFRC is determined at 28 and 56 days of curing by using cubes of size 75 X 75 X 150 mm

4. IMPLEMENTATION

This type of shrinkage is more effective when the concrete is young and decreases as concrete gets older. Concrete specimens of size 75 x 75 x 150 mm are casted to determine shrinkage parameter. Steel balls of diameter 6.5mm are cemented by using a cementing material at each end of the specimen as a reference point by making a depression. Once the steel balls are fixed they are cleaned and lubricated with grease to prevent corrosion during the process of curing. Then the specimens were immersed in water for 7 days. After removing the specimen from water the steel balls are thoroughly wiped to remove the grease attached to it. Then the lengths of the specimens were measured in length comparator to an accuracy of 0.005 mm and it is taken as original wet measurement. Then the specimen is oven dried for about 44 hours at temperature $50 \pm 10^{\circ}\text{C}$. After removing it from oven it is allowed to cool in a desiccators for 4 hours. The length of

the specimen is again measured and recorded as dry measurement. This process is continued till the dry measurement values are constant. After the wet and dry measurement has been taken, the length of the specimen is measured adjacent to steel balls to obtain dry length. Then it is determined by following formulae

$$\text{Drying Shrinkage} = \frac{[(\text{Original Wet Measurement} - \text{Dry Measurement})] \times 100}{\text{Dry Length}}$$

5. RESULTS

The values of drying shrinkage of CFRC tabulated in Table.1.1 and 1.2 and variation of strength is as shown in Fig.1.1 and 1.2.

Table 1.1: Drying Shrinkage Values of CFRC in % for 28 days

Replacement of FA & BA in % with 0.5% of Carbon Fibres	Original Wet Measurement (mm)	Dry Measurement (mm)	Dry Length (mm)	Drying Shrinkage in Terms of %
CC (Without fibres)	12.471	11.839	155.334	0.406
0% (With fibres)	13.485	12.982	159.478	0.416
10%	12.817	11.992	156.021	0.243
20%	10.674	10.468	156.924	0.195
30%	12.746	12.251	157.989	0.240
40%	11.875	11.156	158.250	0.355
50%	10.689	9.890	156.840	0.401

Table 1.2: Drying Shrinkage Values of CFRC in % for 56

Replacement of FA & BA in % with 0.5% of Carbon Fibres	Original Wet Measurement (mm)	Dry Measurement (mm)	Dry Length (mm)	Drying Shrinkage in Terms of %
CC (Without fibres)	10.622	10.308	152.334	0.206
0% (With fibres)	12.145	11.457	157.748	0.436
10%	11.972	10.843	156.243	0.346
20%	9.149	9.004	155.712	0.247
30%	11.356	11.267	157.561	0.301
40%	10.249	9.786	157.130	0.201
50%	9.345	9.987	155.670	0.321

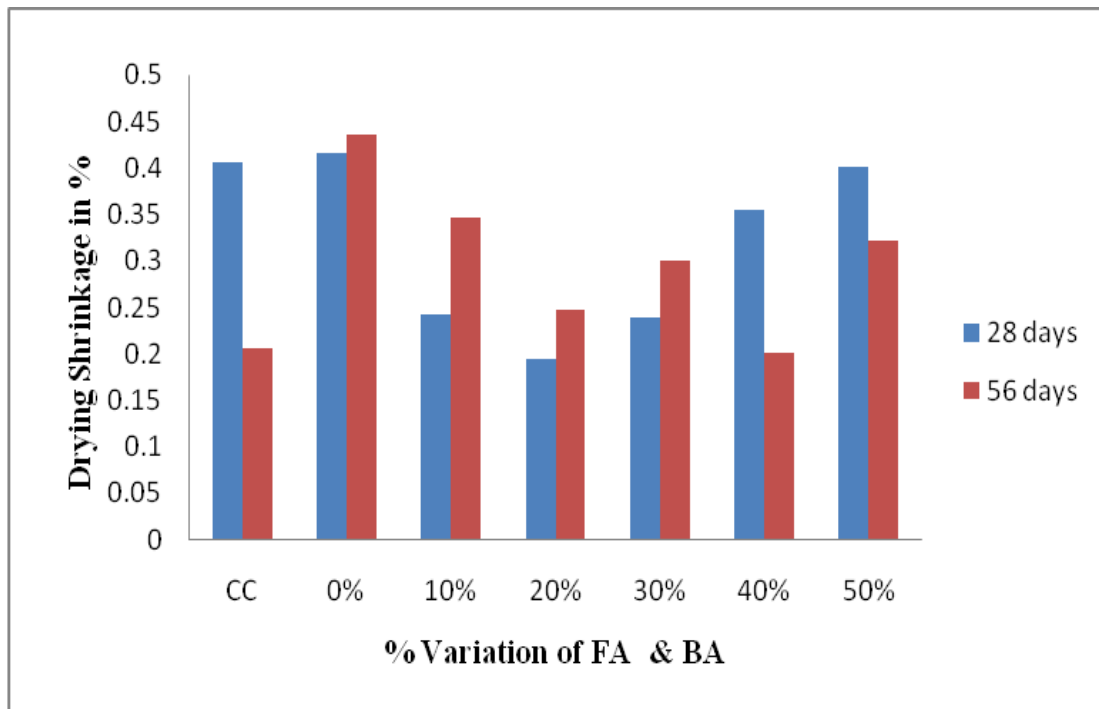


Fig 1.1: Drying Shrinkage of CFRC in Percentage

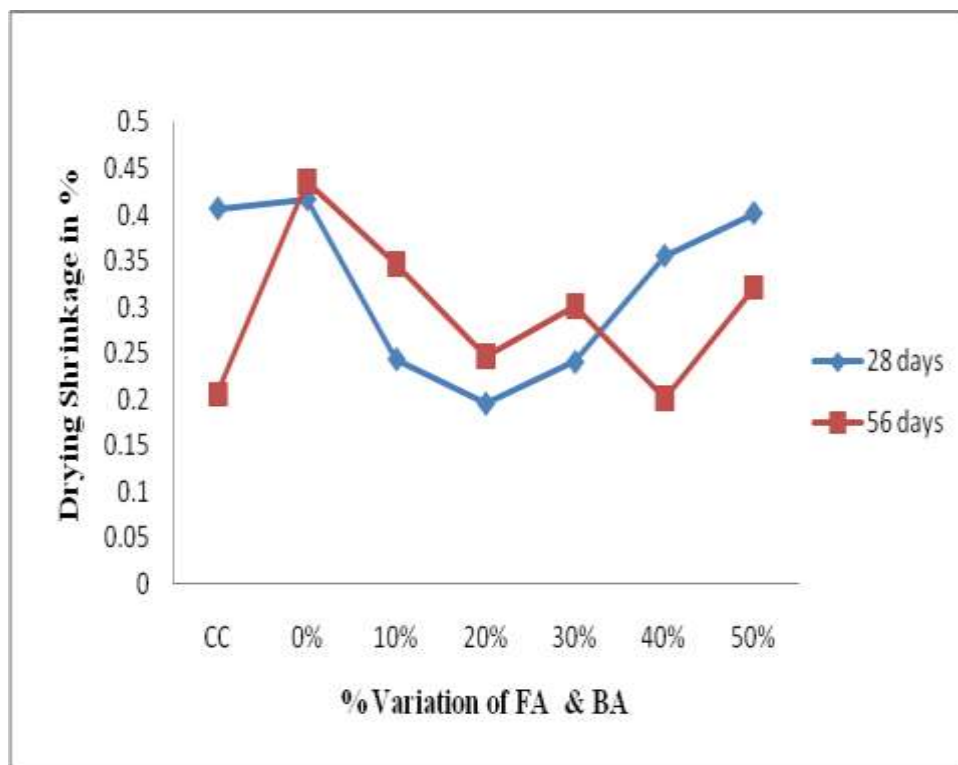


Fig 1.2

6. CONCLUSION

- The drying shrinkage is found to be higher in conventional concrete and it reduced with addition of fibres as they act as crack arrestors.
- In CFRC at 0% replacement the drying shrinkage is found to be increased for 28 and 56 days as percentage of replacement increases.

- Further with the replacement of fly ash and bottom ash the shrinkage reduces. Addition of fly ash reduces the water demand for a given mix which in turn reduces the drying shrinkage effect on concrete.
- Also the drying shrinkage depends on several factors such as size of aggregates, curing conditions and type of chemical admixtures being used.

SCOPE FOR FURTHER STUDY

- This study can be carried out by using different fibres with different grade of concrete.
- Drying shrinkage can be found out for longer periods.
- Other industrial by products can be use as replacement of constituent materials of concrete.

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Carbon Fibres



Drying Shrinkage Measuring Instrument



Specimens of Drying Shrinkage



Measuring Of Drying Shrinkage of CFRC