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Strength Analysis of Steel Fiber Reinforced Concrete with Different Types of Curing

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Abstract: ***Concrete is a composite material containing hydraulic cement, water, coarse aggregate and fine aggregate. The resulting material is a stone like structure which is formed by the chemical reaction of the cement and water. This stone like material is a brittle material which is strong in compression but very weak in tension. This weakness in the concrete makes it to crack under small loads, at tension end. These cracks gradually propagate to the compression end of the member and finally, the member breaks. The formation of creaks in the concrete may also occur due to the drying shrinkage. These cracks are basically micro cracks. These cracks increase in size and magnitude as the time elapses and the finally makes the concrete to fail. The formation of cracks is the main reason for the failure of the concrete. To overcome this and to increase the strength of concrete many attempts have been made. One of the successful and most commonly used methods is providing steel reinforcement. Fiber reinforcement gives the solution for this problem. In this paper we have***
used steel fibers, The aim of paper is to steel fibers with different curing methods. Our objective is to add the steel fibers of 0.5mm guage diameter to the concrete and to study the strength properties of concrete with the different curing method. i.e., to study the strength properties of concrete (M20 Grade) for fiber content of 5.0% by weight at 7days ,14days and 28days. The compressive strength being studied in our paper.
This paper is directed to evaluate effectiveness of different curing methods .Steel Fiber reinforced concrete was prepared with a water-cement ratio of 0.45. The specimens were cast for testing the compressive strength at 7, 14 and 28 days of curing respectively using three curing methods namely Air Drying, Immersion, and Gunny bag curing to cure the specimens until the day of testing and analysis strength. And compare , each other. The overall finding of this paper suggests that concrete should be cured by water curing to attain a better compressive strength but gunny bag and air curing are good results
. Keywords— cemet, aggregate, sand, steel fiber, and water

I. INTRODUCTION

Concrete is strong in compression but weak in tension. as concrete is brittle material the failure in concrete due to tension in sudden. there are also cracks in concrete due to shrinkage and these micro cracks propagate and leads to failure. To safeguard the concrete against flexural cracks fibers are used in concrete section which is known as fiber reinforced concrete. Fiber- reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibres that are uniformly distributed and randomly oriented. Fibres include steel fibres, glass fibres, synthetic fibres and natural fibres — each of which lend varying properties to the concrete. In addition, the character of fibre-reinforced concrete changes with varying concretes, fibre materials, geometries, distribution, orientation, and densities.

A. Affecting the Properties of FRC

Relative Fibre Matrix Stiffness
Volume of Fibres
Aspect Ratio of the Fibre
Orientation of Fibres
Workability and Compaction of Concrete
Size of Coarse Aggregate

B. Need for Curing

The necessity for curing arises from the fact that hydration of cement can take place only in water-filled capillaries. That is why a loss of water by evaporation from the capillaries must be prevented. Evaporation of water from concrete, soon after placing depends on the temperature and relatively humidity of the surrounding air and on the velocity of wind over the surface of the concrete.

Curing is essential in the production of concrete to have the desired properties. The strength and durability of concrete will be fully developed only if it is properly cured. The amount of mixing water in the concrete at the time of placement is normally more than required for hydration & that must be retained for curing. However, excessive loss of water by evaporation may reduce the amount of retained water below what necessary for development of desired properties. The potentially harmful effects of evaporation shall be prevented either by applying water or preventing excessive evaporation.

C. Curing Method

The two systems of maintaining a satisfactory moisture content are: (1) continuous or frequent application of water through ponding, sprays, steams, or saturated cover materials such as burlap or cotton mats, rugs, earth, sand, sawdust and straw. (2) prevention of excessive loss of water, from the concrete, by the application of a membrane forming curing compound to the freshly placed concrete.

D. Water Curing

Curing by water not more than 11 deg C cooler than the concrete is one of the most efficient way for curing concrete. The curing should begin as soon as possible after the casting of concrete. Any delay in curing will lead to evaporation of mixing water and the early drying may lead to shrinkage and cracking of concrete.

E. Covering Concrete Surfaces With Hessian Or Gunny Bags

This is a widely used method of curing, particularly for structural concrete. Thus exposed surface of concrete is prevented from drying out by covering it with hessian, canvas or empty cement bags. The covering over vertical and sloping surfaces should be secured properly. These are periodically wetted. The interval of wetting will depend upon the rate of evaporation of water. It should be ensured that the surface of concrete is not allowed to dry even for a short time during the curing period. Special arrangements for keeping the surface wet must be made at nights and on holidays

II. LITERATURE REVIEW

A. Setti, M. Taazount, S. Hammoudi, F. Setti, M. Achit-Henni[1] (August 2013)

This study relies on an experimental study conducted to examine compressive, flexural and abrasion resistance of steel fiber reinforced concrete specimens. The used Steel Fibers (S.F) are curved steel elements with a length to diameter ratio equal to 67. Concrete is made of local materials. The steel fiber contents examined are 0.5%, 1% and 1.5%. The purpose of this research is to investigate the mechanical performances of steel fibers reinforced concrete regarding compressive strength, flexural strength, mechanical abrasion and ductility according to the specimen age. The experimental results show a significant improvement in the mechanical behavior of the SFRC specimens in comparison with plain concrete without reinforcement. In this paper authors conclude that, Steel fibers also increase the abrasion resistance of SFRC materials. The optimal SF content to reduce the effect of abrasion is close to 1%.

B. Kavita S Kene, Vikrant S Vairagade and Satish Sathawane[2] (December 2012)

In this research paper authors observed that, The addition of these fibers into concrete mass can dramatically increase the compressive strength, tensile strength, flexural strength and impact strength of concrete. FRC has found many applications in civil engineering field. Based on the laboratory experiment on fiber reinforced concrete (FRC), cube and cylinders specimens have been designed with steel fiber reinforced concrete (SFRC) containing fibers of 0% and 0.5% volume fraction of hook end Steel fibers of 53.85, 50 aspect ratio and alkali resistant glass fibers containing 0% and 0.25% by weight of cement of 12mm cut length were used without admixture. Comparing the result of FRC with plain M20 grade concrete, this paper validated the positive effect of different fibers with percentage increase in compression and splitting improvement of specimen at 7 and 28 days, analyzed the sensitivity of addition of fibers to concrete with different strength.

III.RESULTS AND CONCLUSION

A. Immersion curing

After the steel fiber reinforced concrete cubes are casted and cured for 7 days period, the first cube passed at 518 KN load and the corresponding compressive strength is found to be 23.02 N/Sq.mm. Second cube passed at 518 KN load and corresponding compressive strength is found to be 23.02 N/Sq.mm. The third cube passed at 499 KN load and the corresponding compressive

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strength is found to be 22.17 N/Sq.mm.

The second test is conducted after 14 days of casting and curing. The first cube passed at 597 KN load and the corresponding compressive strength is found to be 26.51 N/Sq.mm. Second cube passed at 607 KN load and corresponding compressive strength is found to be 27 N/Sq.mm. The third cube passed at 578 KN load and the corresponding compressive strength is found to be 25.70 N/Sq.m

The last test is conducted after 28 days of casting and curing. The first cube passed at 738 KN load and the corresponding compressive strength is found to be 33 N/Sq.mm. Second cube passed at 727 KN load and corresponding compressive strength is found to be 32.31 N/Sq.mm. The third cube passed at 747 KN load and the corresponding compressive strength is found to be 33.30 N/Sq.m

B. Gunny bag curing

After the steel fiber reinforced concrete cubes are casted and cured for 7 days period,The first,second and thrid cubes passed at load 498.2 KN load and corresponding compressive strength is found to be 22.15 N/Sq.mm.

The second test is conducted after 14 days of casting and curing. The first cube passed at 607 KN load and the corresponding compressive strength is found to be 27 N/Sq.mm. Second cube passed at 568 KN load and corresponding compressive strength is found to be 25.24 N/Sq.mm. The third cube passed at 557 KN load and the corresponding compressive strength is found to be 24.75 N/Sq.mm. The last test is conducted after 28 days of casting and curing. The first cube passed at 668 KN load and the corresponding compressive strength is found to be 29.69 N/Sq.mm. Second cube passed at 697.50 KN load and corresponding compressive strength is found to be 31 N/Sq.mm. The third cube passed at 717.40 KN load and the corresponding compressive strength is found to be 31.85 N/Sq.m

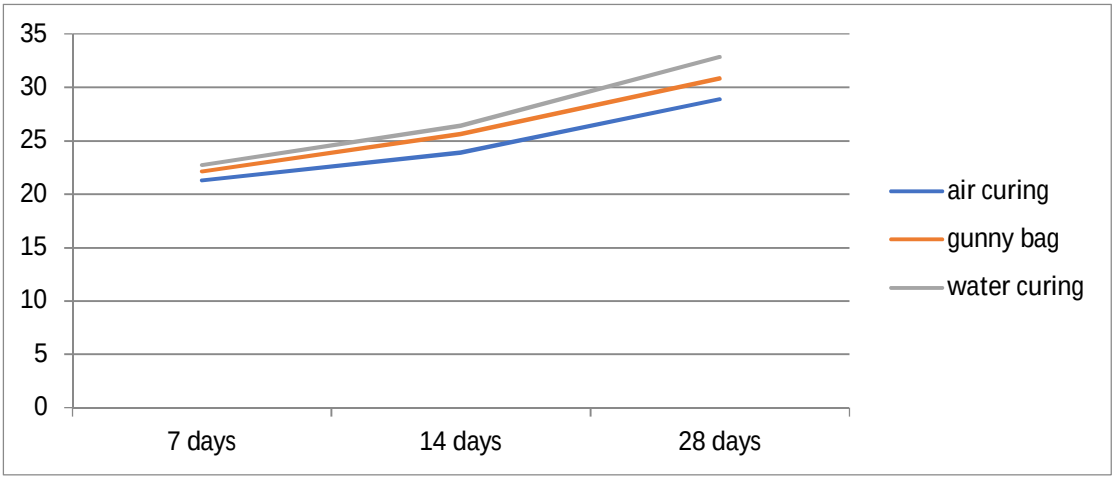
C. Air curing (winter)

After the steel fiber reinforced concrete cubes are casted and cured for 7 days period, the first cube passed at 469 KN load and the corresponding compressive strength is found to be 21 N/Sq.mm. Second cube passed at 478 KN load and corresponding compressive strength is found to be 21.25 N/Sq.mm. The third cube passed at 48 KN load and the corresponding compressive strength is found to be 21.70 N/Sq.mm.

The second test is conducted after 14 days of casting and curing. The first cube passed at 548 KN load and the corresponding compressive strength is found to be 24.35 N/Sq.mm. Second cube passed at 529 KN load and corresponding compressive strength is found to be 23.46 N/Sq.mm. The third cube passed at 538 KN load and the corresponding compressive strength is found to be 23.91 N/Sq.m

The last test is conducted after 28 days of casting and curing. The first and third cube passed at 657 KN load and the corresponding compressive strength is found to be 29.22 N/Sq.mm. Second cube passed at 648. KN load and corresponding compressive strength is found to be 28.80 N/Sq.mm.

Finaly, immersion curing is better strength than gunny bag and air curing but gunny bag curing is effective for the perpose of columns and beam curing ,and water shortage area and air curing not effective for summer season.



Graph representation of compressive strength for M-20 grade concrete (**SFRC)**

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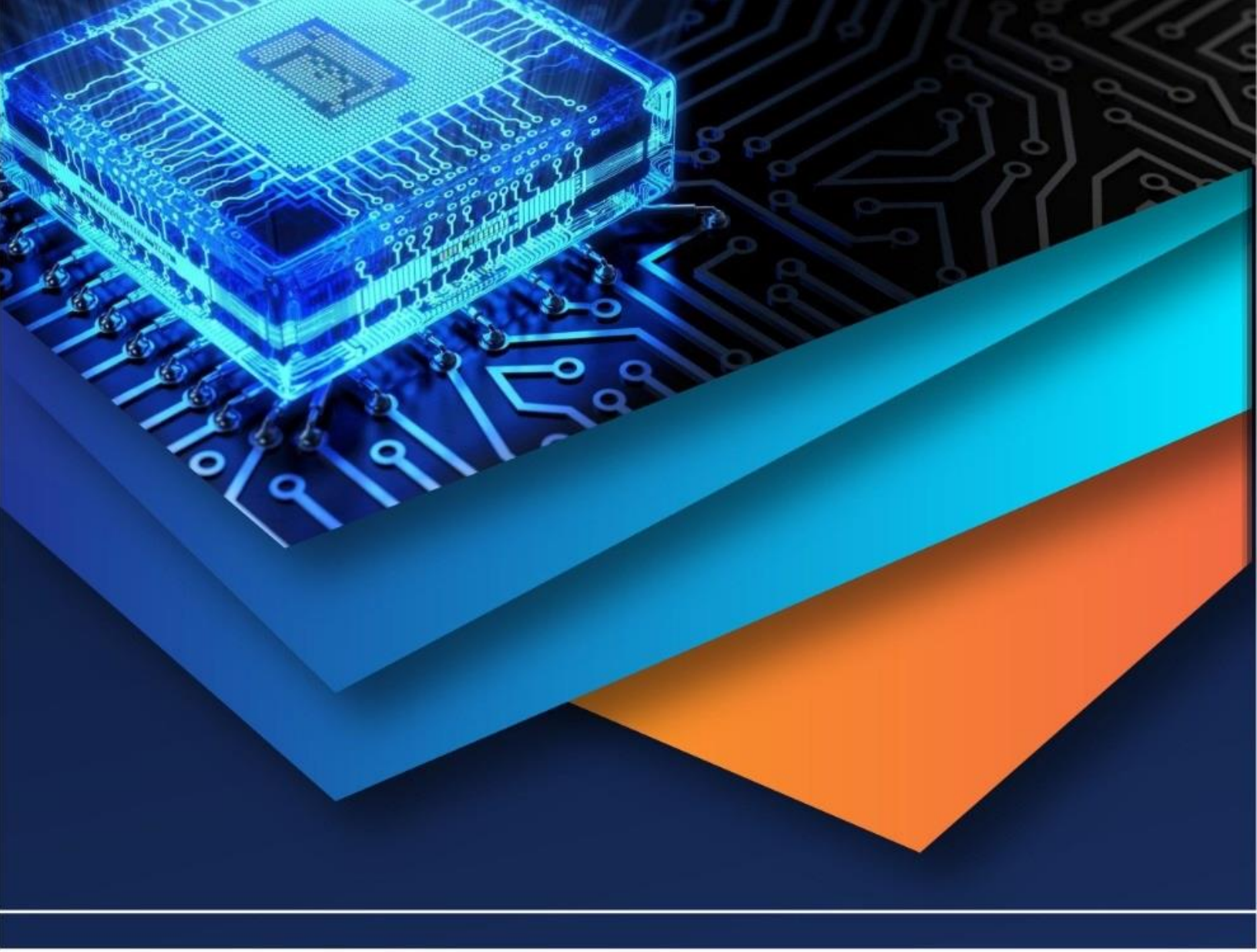

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