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A Review: "Experimental Study on Steel Fiber Reinforced ConcreteUsing flat Crimped & Round Crimped Type Steel Fiber."

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***Abstract:** Steel Fibre Reinforced Concretes are characterized by high tensile and flexural strengths and high ductility, as well as by a high compressive strength and a very good workability. Ductility and strength of concrete can be improved at lower fiber contents, where fibers are used in combination rather than reinforcement with a single type of fiber. Durability problems concerning one type of fiber may be offset with the presence of a second type of fiber. Steel Fiber is added by 1% volume of concrete. The different concrete mixesalong with control mix proportions as 100% round crimped type fiber, 50% round crimped type fiber -50% flat crimped type fiber and 100% flat crimped type fiber. Two types of crimped steel fiber i.e. round crimped type steel fiber and flat crimped steel fiber are used of length having 50mm. An extensive experimental investigation consisting of 12 specimen of size 50 x 10 x 10cm for determining flexural strength, 12 specimen for compressive strength and 12 specimen for split end test are used.In the experiment, an combination of steel fibre with concrete is used, which improved various mechanical properties and the strength. This review study is a trial of givingsome highlights for inclusion of steel fibers especially in terms of using them with new mix ratio combinations with concrete.*

***Keywords:** Round crimped type steel fiber, Flat crimped type steel fiber, Flexural strength, Compressive strength, Split end, fresh concrete.*

I. INTRODUCTION

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 butvery weak in tension. This weakness in the concrete makes it tocrack under small loads, at the tensile end. These cracks gradually propagate to the compression end of the member andfinally, the member breaks. The formation of cracks in the concrete may also occur due to the drying shrinkage. These cracks are basically micro cracks. These cracks increase in sizeand 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 increase the tensile strength of concrete many attempts have been made. One of the successful and most commonly used methods is providing steel reinforcement. Steel bars, however, reinforce concrete against local tension only. Thus need for multidirectional and closely spaced steel reinforcement arises. That cannot be practically possible. Fiber reinforcement gives the solution for this problem. So to increase the tensile strength of concrete a technique of introduction of fibers in concrete is being used. These fibers act as crack arrestors and prevent the propagation of the cracks. These fibers are uniformly distributed and randomly arranged. This concrete is named as fiber reinforced concrete. The main reasons for adding fibers to concrete matrix is to improve the post cracking response of the concrete, i.e., to improve its energy absorption capacity and apparent ductility, and to provide crack resistance and crack control. Also, it helpsto maintain structural integrity and cohesiveness in the material. The initial researches combined with the large volumeof follow up research have led to the development of a wide variety of material formulations that fit the definition of Fiber Reinforced Concrete.

II. LITERATURE REVIEW

A. Experimental Study on Steel Fiber ReinforcedConcrete for M-40 Grade. A.M. Shende, A.M. Pande, M. Gulfam Pathan (2012) International Refereed Journal of Engineering and Science(IRJES)

Critical investigation for M-40 grade of concrete having mix proportion 1:1.43:3.04 with water cement ratio 0.35 to study the compressive strength, flexural strength, Split tensile strength of steel fibre reinforced concrete (SFRC) containing fibers of 0%, 1%, 2% and 3% volume fraction of hook stain. Steel fibers of 50, 60 and 67 aspect ratio were used. A result data obtained has been analysed and compared with a control specimen (0% fiber). A relationship between aspect ratio vs. Compressive strength, aspect ratio vs. flexural strength, aspectratio vs. Split tensile strength represented graphically. Result data clearly shows percentage increase in 28 days Compressivestrength, Flexural strength and Split Tensile strength for M-40Grade of Concrete.

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B. *Method of Testing Flexural Toughness Of Steel Fiber Reinforced Concrete. M P Singh, S P Singh and A P Singh (2013), International Journal of Structural and Civil Engineering Research, vol. 2, No. 4, pp. 175-183.*

The paper presents results of an investigation conducted to study method of testing flexural toughness of SFRC. Steel fiber manufactured by steel sheet shearing method of dimensions of0.5x0.5x30 mm. coarse aggregate of size 15 mm, river sand asfine aggregate & Ordinary Portland cement. The method used was four-point loading method with 30 cm span. Specimens ofconstant cross section, toughness index is decreased the greaterthe length , while for specimens of identical lengths toughnessindex is higher with larger cross section & also it is found that ACI Committee 544 has not considered the effect of minutesettlement of the concrete beam at the supports

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C. *Toughness Enhancement in Steel Fiber Reinforced Concrete through Fiber Hybridization. Banthia N and Sappakittipakorn M (2007), Cement and Concrete Research, Vol. 37, pp. 1366-1372.*

This paper tells us that Crimped steel fibers with large diameters are often used in concrete as reinforcement. Such large diameter fibers are inexpensive, disperse easily and do notunduly reduce the workability of concrete. However, due to their large diameters, such fibers also tend to be inefficient andthe toughness of the resulting fiber reinforced concrete (FRC) tends to be low. An experimental program was carried out to investigate if the toughness of FRC with large diameter crimped fibers can be enhanced by hybridization with smaller diameter crimped fibers while maintaining workability, fiber dispensability and low cost. The results show that such hybridization indeed is a promising concept and replacing a portion of the large diameters crimped fibers with smallerdiameter crimped fibers can significantly enhance toughness. The results also suggest, however, that such hybrid FRCs fail to reach the toughness levels demonstrated by the smallerdiameter fibers alone.

D. *Flexural behavior and Toughness of Fiber Reinforced Concretes. V. Ramakrishnan , George Y. WU, and Girish Hosali, Transportation Research Record (TRR), 1226, pp. 69-77*

This paper presents the results of an extensive investigation to determine the behavior and performance characteristics of the most commonly used fiber reinforced concretes (FRC). A comparative evaluation of static flexural strength with and without four different types of fibers: hooked-end steel, straight steel, corrugated steel, and polypropylene. These fibers were tested in four different quantities (0.5, 1.0, 1.5, and 2.0 percentby volume), and the same basic mix proportions were used forall concretes. The test program included (a) fresh concrete properties (b) static flexural strength (c) pulse velocity. By Comparison of Toughness index of all types of Steel Fiber it isobserved that Straight Steel fibers have lower index values thanother.

E. *Experimental studies on Steel Fiber Reinforced Concrete. N. Shireesha, S. Bala Murugan , G. Nagesh Kumar, (2013) International Journal of Science and Research(IJSR) pp.no.598-602*

The Authors objective in this paper is to analyze systematicallythe effects of steel fiber reinforcement in concrete. Concrete mixes were prepared using M40 grade concrete and hooked end glued steel fiber with aspect ratio of 80 were added at a dosageof 0.5%, 1.0%, 1.5% volume fraction of concrete. The fiber reinforcement effects were analyzed for different types of distribution in the concrete beam. Third-point loading over an effective span of 400 mm on flexural testing machine to study toughness. Concrete specimen such as cubes of 100x100x100 mm, cylinders of 100mmx 300mm, beams of 100x100x500 mm was casted.

F. *Properties of Steel Fibrous Concrete Containing Mixed Fibers in Fresh and Hardened State. Y Mohammadi, S P Singh and S K Kaushik (2009), Construction and Building Material, Vol. 22, pp. 956- 965.*

The paper presents results of investigation carried out to study the properties of plain concrete and steel fiber reinforced concrete (SFRC) containing fibers of mixed aspect ratio. Compressive strength, split tensile and static flexural strength test were conducted to investigate the properties of concrete inthe hardened state. The specimen incorporated three different volume fractions i.e. 1%, 1.5% and 2% of corrugated steel fibers and each volume fraction incorporated mixed steel fibersof size 0.6 x 2 x 25 mm and 0.6 x 2 x 50 mm in different proportions by weight.

G. *Flexural toughness of hybrid steel fibrous Concrete using post-crack strength Method. Daman Kumar, S P Singh, A P Singh, Sarvesh Kumar , UKIERI concrete congress–innovations in concrete construction, pp.no.1195-1209*

The results of the investigation carried out by the authors showsthat addition of small uniformly dispersed discrete steel fibers to concrete substantially improves many of its engineering properties such as flexural strength, Compressive strength, flexural toughness, resistance to fatigue & amp; impact etc.

Fifteen different concrete mixes with different fiber content having mix proportions as: w/c = 0.46, cement =1, sand = 1.52, coarse aggregate = 1.88. Specimen for compressive strength test was 45 cubes of size 150 x 150 x 150 mm. Specimen for flexural tests was 45 beams of size 100 x 100 x 500mm. The beam specimens were tested under third-point flexural loading on a simply supported span of 450mm.The post-crack strength (PCS) results demonstrate the equivalent strengths of various composites beyond cracking. PCS curves indicate that the efficiency of the small diameter fibers is greater at small deflections and hence one can expect an improved serviceability.

H. *Performance characteristics of Synergy fiber– reinforced concretes Strength and toughness properties. S. Soma Sundar, K. P. Ramesh, Charles Pitts, Jr., and V. Ramakrishna, Transportation research record 1775 -97 Paper no. 97-105*

The results of an experimental investigation of the performance characteristics of concrete reinforced with a newly developed synthetic synergy Fiber are presented. There are four dosages of fiber added to the concrete were 0.5,1.0, 1.5&2.0 vol% of concrete. Cylinder was tested for static modulus (ASTMC469) & compressive strength (ASTMC39) & Beams were tested for (ASTM) American society for testing & material & (ARS TEST) average residual strength. Compressive strength depends on w/c ratio & air content if the w/c ratio is less, compressive strength will be more. Likewise, if the air content is more, the compressive strength will be less. ASTM toughness result showed that fiber, when added to the concrete, increase the concrete's toughness & ductility. The higher the fiber content is then the higher the toughness & ductility.ARS results showed that ARS increased considerably with an increase in fiber content

I. *Flexural behavior of self-compacting concrete reinforced with different types of steel fibers Pajak,T .Panikiewski, (2013) Construction and building materials47 (2013)pp. 397-408*

The aim of the present work is to investigate the flexural behavior of self-compacting concrete reinforced with straight & hooked end steel fibers with three type of trial i.e. 0.5%, 1.0% & 1.5% & fiber content 40, 80, 120 kg/m² respectively. The method used was three point bending test & compression test. Cubes specimens used were of dimension (150×150×150) mm. The test obtained an hardened SFR-SCC. The compressive strength of SCC was 73.4MPA. The addition of randomly distributed short steel fibers increases the compressive strengthof SCC.

J. *Flexural behavior of hybrid steel fiber reinforced self-consolidating concretes. S Dimas Alan Strauss Rombo , Flavio de Andrade Silva & Ramildo Dias Toledo Filho.*

The investigation of work shows that two tests were used to mechanically characterize the concrete reinforced with volumefraction of 1 and 1.5% hybrid steel fibers using four point bending test and round panel test on 100*100*400 mm size specimen. Addition of straight and hooked fiber to SCC can provide, among other advantages, crack control, increase in post crack strength, fatigue, impact, toughness and ductility. Hybridization of fiber reinforcement raised the serviceability limit state of concrete, contributing to increased toughness andload bearing capacity for small levels of displacement and crack openings.

K. *Laboratory Characterization of Steel Fiber Reinforced Concrete for Varying Fiber Proportion and Aspect Ratio. M A Farooq, Dr M S Mir (2013), International Journal of Emerging Technology and Advanced Engineering, Vol. 3, No. 2, pp. 75-80.*

The result of the investigation shows that addition of fibers notonly enhances the requisite properties of reinforced concrete but also changes the characteristics of the material from brittle to ductile. The paper presents the work done to determine the influence of change in Fiber volume fraction and Fiber aspect ratio on workability property of green concrete as well as on the compressive, flexural and split tensile strength properties of hardened concrete. The study determines the optimum volume fraction and aspect ratio of fiber required for achieving maximum strength and desirable workability. The study revealsthat compressive and split tensile strength show similar behavior for different fiber content and aspect ratio whileflexural strength shows different behavior.

L. *Fracture Toughness of Micro fibre Reinforced cement composite N. Banthia & J. Sheng. R.Esc.Minas,Ouro Preto,67(1), 27-32, jan-mar. 2014pp.no.251-266*

Toughness and strength improvement in cement based matricesdue to micro fiber reinforcementwere investigated**.** Cement paste and cement mortar matrices were reinforced at 1, 2 and 3% by volume of carbon, steel and polypropylene micro fiber. Specimen (25*25*225mm) were tested in four point bending.Considerable strengthening, toughening and stiffening of specimen due to micro fiber reinforcement was observed.

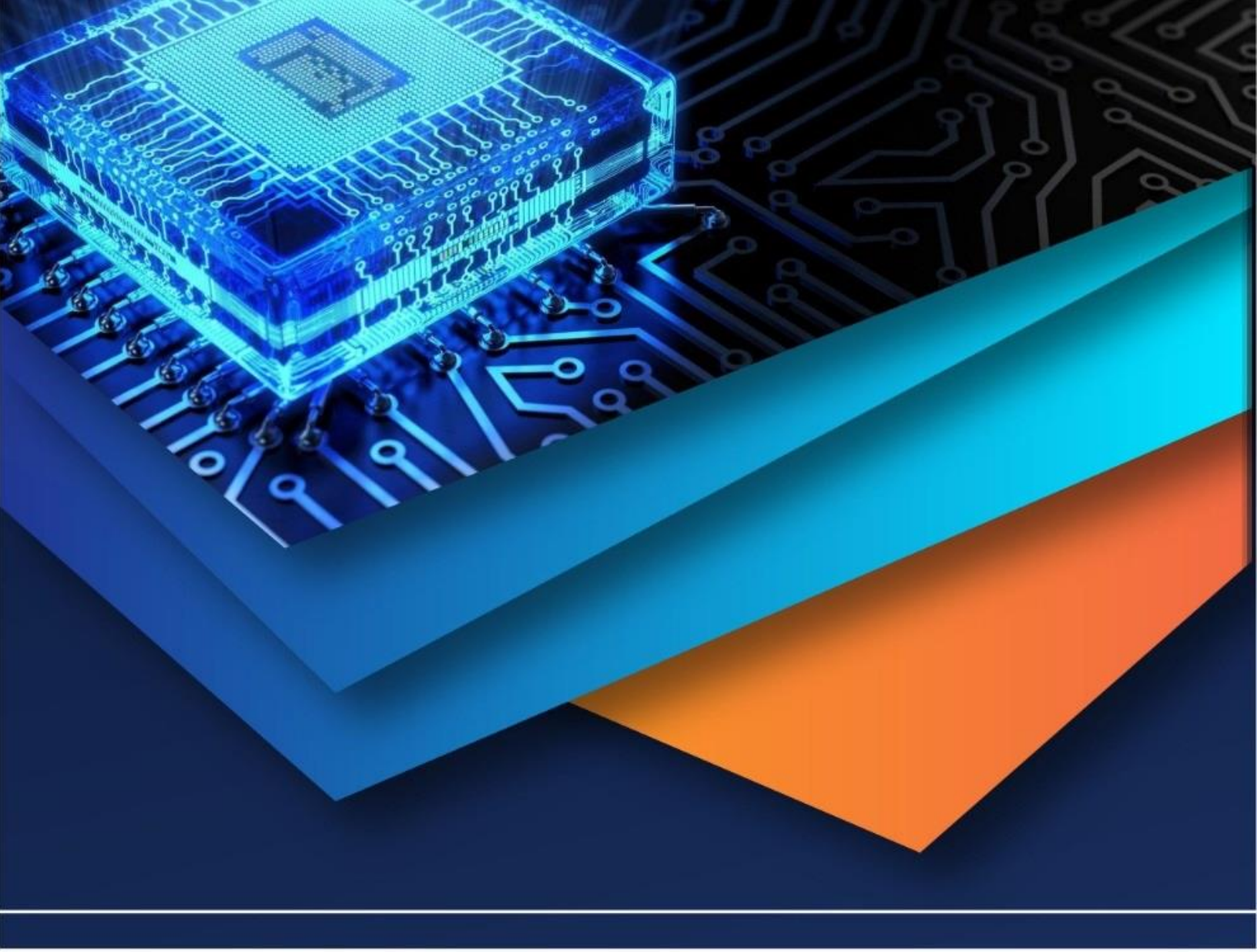
III. SUMMARY & CONCLUSION

A. Concrete is one of the most important material for designing of structure and development of cities sincevery early age till now.
B. Concrete is very strong in compression but comparatively too weak in tension.
C. Tensile and flexural strength of concrete can be enhanced buy adding an small amount of same or different type of reinforced steel fiber in differentproportion

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