International Journal of Computer Science
Scholarly Peer Reviewed Research Journal - PRESS - OPEN ACCESS
ISSN: 2348-6600

http://www.ijcsjournal.com Volume 5, Issue 2, No 04, 2017 ISSN: 2348-6600
Reference ID: IJCS-316 PAGE NO: 2106-2111

EVALUATION OF SPLIT TENSILE STRENGTH OF HIGH STRENGTH FIBERRE IN FORCED CONCRETE s

N.Deepa

PRIST University, Thanjavur.

A.Belciya Mary

Assistant professor

M.E structural engineering

PRIST University, Thanjavur.

Abstract— This paper deals with the results of an experimental investigation of the split tensile strength with steel fiber blended with the high strength concrete (M60). The fiber content varied from 0.5 to 5% by weight of cement at the interval of 0.5 %.Beams of 150mm x 150mm x 700 mm were tested for the flexural strength which was failed and broken in between middle third. The smaller broken piece was taken and tested for the split tensile test. A circulat bar of 6mm diameter was placed at a distance 150mm from the finished end and loaded till the failure and the tensile strength was found. Results and expressions by regression analysis are obtained. A significant improvement in the split tensile strengths is observed due to inclusion of steel fibers in the concrete

Keywords: Steel fibre, Residual strength, Fracture Resistance, Cyclic loading, split tensile strength.

1.INTRODUCTION

The study of high strength concrete has become interesting as concrete structures grow taller and larger. The usage of high strength concrete in structures has been increasingly worldwide and has begun to make an impact in India. “High strength concrete” explained on the basis of its compressive strength measured at a given age. In 1970’s, any concrete mix that shows a characteristics compressive strength of 40 MPa would have been considered high but now it has become normal phenomena. Later, concrete mixes with characteristic compressive strength of 60 Mpa and above will be considered as high strength concrete were commercially developed and used in high-rise buildings and long span bridges construction. Such high strength has been achieved through the introduction of such mineral and chemical admixtures. Fiber reinforced concrete may be defined as the composite materials made with Portland cement, aggregate, and incorporating short discrete discontinuous fibers. Plain reinforced concrete is a brittle material due to this the structure having low ductility, low tensile strength and a low strain capacity. The addition of steel fibers in concrete considerably improves the tensile

International Journal of Computer Science
Scholarly Peer Reviewed Research Journal - PRESS - OPEN ACCESS
ISSN: 2348-6600
http://www.ijcsjournal.com Volume 5, Issue 2, No 04, 2017 ISSN: 2348-6600
Reference ID: IJCS-316 PAGE NO: 2106-2111

strength, static flexural strength, durability, Impact strength, Shear and fatigue strength, shock resistance ductility and failure toughness.

However the degree of these improvements depends on the type, size, shape and aspect ratio of the steel fibers. Deformed steel fibers perform better in fresh concrete than straight fibers and also more efficient than straight steel fibers in improving the desired hardened concrete properties. Fibers reinforced concrete has been found more economical for use in air port and highway pavements. It is also used for thin sections concrete applications such as sewer pipes, bridges overlays and curtain walls. It is also rapidly gaining acceptance as a suitable material for repair and rehabilitation of concrete structures. The properties were assessed for fresh as well as hardened concrete. The effect of steel fibers content, high range water reducing admixture and the combined effect of rice husk ash and (HRWRA) in ultra high strength fiberreinforced concrete. From the tests, control concrete with 2%, 2.5% and 3% volume fractions of steel fibers showed a minimum-reduction in compressive strength at early period of curing2 .This paper evaluates the performance of hybrid fibers in high performance concrete on the fresh and hardened concrete properties 3 . The authors studied the mechanical properties of normal and high strength concrete with and without steel fibers in volume fractions. From the experimental results, showed that an improvement in compressive, split tensile strength and modulus of rupture improved to 1.0% steel fiber in volume fractions4 .Based on the experiments to assess the durability factors of high performance concrete with industrial wastes such as GGBFS and copper slag7 . This paper aims to clarify the effect of steel fiber on the flexural toughness of high performance concrete containing flyash and nano-SiO2.

2. LITERATURE SURVEY

The toughness characteristics of SFRC are beneficial in the shotcreting applications (such as tunnel lining) and in structural elements subjected to high rates of loading. One area of application where the beneficial effects of SFRC could be made use of is the construction of earthquake structures (Balasubramanian et al, 1997).

Other discrete fibers have been developed for concrete reinforcement namely glass, synthetic and natural fibers. Steel fibers are the most used in concrete applications due to the following reasons: economy, manufacture facilities, reinforcing effects and resistance to the environment aggressiveness (Barros and Figueiras, 1998).

The energy absorption capacity of plain concrete is low. The ability of SFRC to absorb energy is one of the most important benefits of the incorporation of fibers into plain concrete. For content of fibers used in practice, the increase on compression, tensile shear and torsional strength is only marginal (Balaguru and Shah, 1992).

In structures with super abundant supports, like slabs on soil and tunneling lines, the increase on the material energy absorption capacity provided by fiber reinforced enhances the cracking behaviour and increases the load bearing capacity

International Journal of Computer Science
Scholarly Peer Reviewed Research Journal - PRESS - OPEN ACCESS
ISSN: 2348-6600
http://www.ijcsjournal.com Volume 5, Issue 2, No 04, 2017 ISSN: 2348-6600
Reference ID: IJCS-316 PAGE NO: 2106-2111

of these structures. Due to the relevance of the energy absorption capacity on fibrous concrete, several procedures have been proposed to evaluate this property (Barros and Figueiras ,1998), resulting in some entities that are intended to reproduce this property ,namely, the toughness indexes, the equivalent flexural strength and the fracture energy. The other entities have reduced application on numerical simulation of SFRC structures.

The characteristics of concrete depend upon the kind of fibers utilized, volume proportion of the fibers and the aspect ratio of fibers. These conditions will improve the mechanical properties, including toughness, ductility tensile strength, shear resistance and loading limit of the fiber reinforced concrete. The materials that can be used for the fiber reinforcement include steel, glass, polyester, rayon, cotton and polythene. The most commonly used materials are steel and glass fibers that are acid resisting.

3. Objectives and Scope:

The investigation is focused to comparative study of experimental and analytical effect of various types of fibres on split tensile strength of HSFRC. The water to cementitious material ratio considered for the study of HSFRC of M80 grade was 0.25. The content of silica fume and fly ash in every mix was 5% and 10% by the weight of cementitious material. Three types of fibres considered for the study include, Polypropylene Fibres (PF), Sound Crimped Steel Fibres (SCSF) and Waving Steel Fibre (WSF). Dosage of fibre was varied from 0.5% to 4% at an interval of 0.5% by weight of cementitious material. Type of cement, fine aggregate, coarse aggregate, type of superplasticiser and its dosage are kept constant in every mix. The comparative investigation is done by using Dr. Y. M. Ghugalas formula, i.e.

$$f_{cys} = \left[1.011 + V_f \left(\frac{E_m}{E_f} \right) \right] \log_e f_{cu}$$

4. Compression and Split tensile strength Test

A total of 45 cubes for compression test and 45 cylinders for split tensile test were tested in ASTM Compression testing machine of 3000 kN capacity in according to ASTM C39, the load was applied at the rate of 2.9 kN/sec. The test was conducted on 7, 14 and 28 days. The compressive strength values are taken as the average of three values for different mixers are shown in Figure1. Flexural strength test The Beams (Prism) was tested in Flexural strength testing machine of 100 kN capacity accordance with ASTM C 78 to determine the flexural strength of concrete with and without steel fiber under three point loading. The centre distance between supporting rollers for Beams (prism) as 400 mm and centre distance between loading rollers as 133 mm. The strength values at 28 days are shown in Figure 4. Durability characteristics such as sorptivity according to ASTM C 1585, sulphate and chloride resistance were studied by making cylinder and cube specimens for different percentage of steel fiber in volume fractions is done for 28 days curing according to ASTM C 267 and control concrete

International Journal of Computer Science
Scholarly Peer Reviewed Research Journal - PRESS - OPEN ACCESS
ISSN: 2348-6600
http://www.ijcsjournal.com Volume 5, Issue 2, No 04, 2017 ISSN: 2348-6600
Reference ID: IJCS-316 PAGE NO: 2106-2111

were compared with concrete specimens with steel fibers.

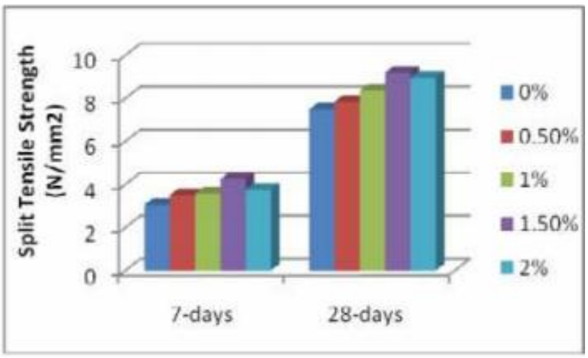
5. Residual strength Test (Four point bending)

The Residual strength of fiber reinforced concrete was determined as per ASTM C 1399 – 07a procedure. A steel plate of 12mm thickness was kept below the specimen. The steel plate was used to help control the rate of deflection when the beam cracks. After the beam cracked in a specified manner, the steel plate was removed and the cracked beam was reloaded to obtain data to plot a reloading load– deflection curve. If cracking had not occurred after reaching a deflection of 0.20 mm the test was discarded. The average residual strength (ARS) for each beam was calculated using the loads determined at reloading curve deflections of 0.50, 0.75, 1.00, and 1.25 mm. ARS= ((PA+PB+PC+PD)/4) X k Where: k=L/bd2 PA+PB+PC+PD = Sum of recorded loads at specified deflections L= Span length b= Average width of the beam d= Depth of the beam

6. Split Tensile Test

The results of the split tensile tests carried out on the cylinders are shown in Table 2. It can be seen from the results that there is a good amount of enhancement in the tensile strength propertyof the concrete upon the addition of the steel fibers. The value increased about 79% at the fiber volume of 1%. One of the major objectives of adding the steel fibers in concrete is to enhance its tensile strength. The fibers used in this study have achieved the objective. Average Residual Strength From the results the peak load was observed at 26.9kN, 38.4kN and 43.2kN respectively for 0.5%, 0.75% and 1% fiber replacements at initial loading. Figures 2 to 4 shows the typical load-deflection curves (initial loading and reloading) for 0.5%, 0.75% and 1% SFRC. It was observed that average residual strength increases as fiber volume increases

The split tensile strength varies from 3 MPa to 4.25 MPa for 7 days and 7.48 MPa to 9.2 MPa for 28 days. Test results shows maximum 23% increases in split tensile strength at 28 days. Split tensile test does not give perfect estimation about direct tensile strength due to mixed stress field and fibre orientation but its failure pattern gives good idea about ductility of the material. Failure patterns of splitting tensile test indicate that specimens after first cracking do not separate unlike the concrete failure. Large damage zone is produced due to closely spaced micro cracks surrounding a splitting plane. Fibre bridging mechanism is responsible for such enhanced ductile failure patter



International Journal of Computer Science
Scholarly Peer Reviewed Research Journal - PRESS - OPEN ACCESS
ISSN: 2348-6600
Since 2012
http://www.ijcsjournal.com Volume 5, Issue 2, No 04, 2017 ISSN: 2348-6600
Reference ID: IJCS-316 PAGE NO: 2106-2111

7. STATEMENT OF THE PROBLEM

Over the years, the use of concrete has being limited to conventional structures, therefore the need for concrete use under special conditions e.g in seismic areas has brought forth the need for concrete that possesses higher durability in terms of strength. In this regard, fibers have been studied and are believed to have the ability to enhance this property in concrete

8. CONCLUSION AND FUTURE WORK

Compressive strength of material increases with increasing fibre content. Strength enhancement ranges from 8% to 16% for PFRC. • Strength enhancement in splitting tensile strength due to polypropylene fibre addition varies from 5% to 23%. Split tensile strength at 28'days is approximately 50% higher than 7 day's strength. • During the test it was visually observed that the PFRC specimen has grater crack control as demonstrated by reduction in crack widths and crack spacing. The flexural strength increases with increasing fibre content. The maximum increase in flexural strength of PFRC is 36%. • The percentage increase in shear strength of the polypropylene fibre mix varies from 23% to 47%. This is because of fibres enhances the load carrying capacity of mix

9. REFERENCES:

1. P.S.Song., S. Hwang., "Mechanical properties of high strength steel fibre-reinforced concrete", Construction and Building MATERIALS, 18 (2004) 669-673

2. S.P.Singh and S.K.Kaushik, "Flexural Fatigue Analysis of steel fibre reinforced concrete",ACI Material Journal, Vol.98,No.4,JulyAugust2001,pp.306-312.

3. Fuat Koksal and Fatih Altun, "Combine effect of Silica fume and steel fibre on the mechanical properties of high strength concrete", Construction and building materials, 23(2007), pp.441-454.

4. Job Thomas and Ananth Ramaswamy, " Mechanical Properties of Steel Fibres Reinforced Concrete", Journal of Materials in Civil Engineering, May2007, Vol. 19,No.5, pp.385-392.

5. P.Balaguru, Ramesh Narahari and Mahendra Patel "Flexural Toughness of Steel Fiber Reinforced Concrete", ACI Materials Journal,Nov-Dec.1992, Vol.89, No.6, pp.-541-546.ACI Committee 211.1-91(1994):

6. Standard Practice for selecting Proportions for Normal, Heavyweight, and Mass Concrete, Part 1, ACI Manual of Concrete Practice, 1994. ASTM C1399-07a: Standard Test Method for Obtaining Average Residual-Strength of FiberReinforced Concrete Balaguru P.N., Shah S.P.: Fiber reinforced cement

International Journal of Computer Science
Scholarly Peer Reviewed Research Journal - PRESS - OPEN ACCESS
ISSN: 2348-6600
Since 2012
http://www.ijcsjournal.com Volume 5, Issue 2, No 04, 2017 ISSN: 2348-6600
Reference ID: IJCS-316 PAGE NO: 2106-2111

composites, McGraw-Hill International Editions, Civil Engineering Series, (1992).

7. Balasubramanian K, Krishnamoorthy T.S, Bharat kumar B.H, Gopala Krishnan S. (1997): Study of the behaviour of steel fiber rein forced concrete under cyclic loading, SERC Project Report No. CCL-OLP 05741-RR-97-1 October 1997,pp1-6

8. Barros J.A.O., Figueiras J.A.: Experimental behaviour of fiber concrete slabs on soil, Journal Mechanics of Cohesive-frictional Materials, Vol. 3, 277-290, (1998).

9. Francesco Bencardino, Lidia Rizzuti, Giuseppe Spadea and Ramnath N. Swamy: Stress-Strain Behavior of Steel Fiber-Reinforced Concrete in Compression, journal of materials in civil engineering © ASCE, march 2008,pp 255-263