A REVIEW ON PERFORMANCE OF STEEL FIBRE REINFORCED CONCRETE AND MODULUS OF ELASTICITY

K.VENKAT RAO
(M.Tech) Structural Engineering, Dept. of Civil Engineering

J.SUPRIYA
Associate Professor, Dept. of Civil Engineering Priyadarshini Institute of Technology & Management

ABSTRACT

Fiber reinforced concrete has been successfully used in slabs on grade, shotcrete, architectural panels, precast products, offshore structures, structures in seismic regions, thin and thick repairs, crash barriers, footings, hydraulic structures and many other applications. The usefulness of fiber reinforced concrete in various Civil Engineering applications is thus indisputable. This review study is a trial of giving some highlights for inclusion of steel fibers especially in terms of using them with new types of concrete. The various strength parameters studied are compressive strength and flexural strength as per the relevant IS standards. The experimental results indicate that the addition of steel fibre into concrete significantly increases the flexural strength. It also indicates that at constant percentage of fibre, that is 1.5% by increasing the aspect ratio of fibre from 40 to 70, flexural strength increased from 36.7% to 58.65%. The research paper proposes that due to these properties of steel fibre reinforced concrete, it can be used for the design of curvilinear forms.

Keyword: *Experimental investigation, Fibre reinforced concrete, flexural strength, compressive strength, aspect ratio, steel fibres.*

I. INTRODUCTION

Fibre reinforced concrete is a relatively new construction material developed through extensive research and development work during the last two decades. It has been proved as a reliable construction material having superior performance characteristics compared to the conventional concrete. Incorporation of fibres in concrete has been found to improve several of its properties; cracking resistance, ductility and fatigue resistance , impact and wear resistance.[1] Even though interest in this new material was generated about two decades ago, large scale use of FRC has been on the increase only over the past ten years. Several improvements have been made in mixing and placing of the fibre reinforced concrete. A fibre-reinforced composite is a material system made primarily of varying amount of particular fibre reinforcement embedded in a protective material called a matrix. The degree of performance of a fibre reinforced composite depends on the fibre, its orientation, loading and the matrix.

Fibre reinforced concrete has found interesting new applications in the past two decades due to its inherent superiority over normal plain and reinforced concrete in the following properties: higher flexural strength, better tensile strength and modulus of rupture, higher shear strength, higher shock resistance, better ductility and fatigue resistance, crack resistance and failure toughness [2]. FRC is now increasingly used in structures such as airport pavement, bridged decks, machine foundations, blast resistant structures, piles, pipes, sea protective structure, hip-hulls and storage tanks. A. Significance

Though Concrete is most commonly used structural material it possess very low tensile

strength, limited ductility and little resistance to cracking.

In past two decades, compressive strength of concrete has improved substantially but this has not been accompanied by noticeable improvement in either tensile strength or extensibility. Compressive strength of 50-60N/mm2 are easily achieved at present. The flexural tensile strength however for the same concrete would be less than 7N/mm2, with its extensibility varying between 0.015 to 0.03 percent. These defects in the concrete properties make it difficult to meet the serviceability requirements of deflection or cracking [3].

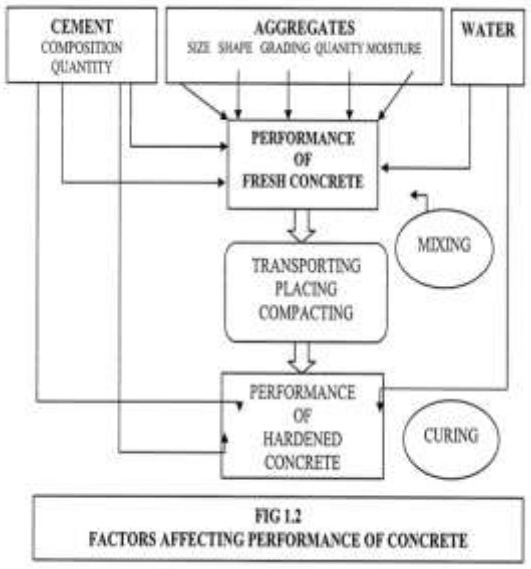

Fig1: Factors affecting performance of concrete

In plain concrete and similar brittle material, structural cracks (micro cracks) develop even before loading, particularly due to drying shrinkage or other causes of volume change. The width of these initial cracks seldom exceeds a few microns. When loaded these micro cracks propagate and open up and due to stress concentration, additional micro cracks are formed as shown in Figure i [3]. The micro cracks are the main cause for elastic deformation in concrete. Fibre reinforced cement and concrete were developed to overcome these problems [4]. The incorporation of short discrete cracks propagates into a slow controlled growth. This gives the cement-based materials maximum ductility overcoming its low tensile strength properties.

3. EXPERIMENTAL INVESTIGATION

3.1 Test materials and mix proportions Portland pozzolona cement with ISI mark was used for test on fresh and hardened concrete. The compressive strength was 23.77 MPa and 33.21 MPa at 7 days and at 28 days respectively. Local river sand with fineness modulus 3.17 was used. The coarse aggregate with basalt origin, maximum size 20mm used from local stone crusher. Portable water, with pH of 7.1, was used. The design mixed M30with proportion 1:1.54:3.31(Cement: Fine aggregate: Coarse Aggregate) for concrete on weight basis. The mix design was done as per IS 10262:2009. Water cement ratio of 0.5kept constant for concrete.

3.2 Specimen details Cube moulds of 150x150 x150 mm and cylindrical moulds of 150 mm diameter and 300 mm long are used for casting the specimen for compressive strength and split tensile strength test respectively. For flexure test, specimen size of 150x150x700 mm is cast. Specimens were cured for 28 days. But out

of 4 specimens 3 specimens of compressive strength test are cured for 7 days and 3 specimens were cured for 3 days to obtain the compressive strength after 7 days and 3 days respectively.

3.3 TEST AND DISCUSSIONS

1) The results of flexural strength tests are tabulated. It was observed from graph 5,6 that addition of steel fibres to cement concrete, the flexural strength significantly increased. It is seen that addition of 2.5% of fibre with aspect ratio 70, the flexural strength is nearly twice the plain concrete strength.

2) Steel fibres to concrete, the compressive strength is slightly decreased. At aspect ratio 50 & 2.5% volume of fibres shows strength, which is nearer to the strength of plain concrete.

3) It was observed that the addition of fibres decreases the workability. Also it was observed that at constant volume of fibre as aspect ratio increases, the workability is decreased.

CONCLUSION The variation of direct compressive strength for concrete cubes was found to be inconsistent with the increase in percentage of fibers. The splitting tensile strength was increased by 20-22% for concrete cylinder samples with 0.5% fibre content in M20 and M30 Grade concrete mixes. Much research on readily available fibres was conducted with an additional input of cost for the purchase of fibres. But these tests were thus a true example of sustainable development as the recycling of scraps from lathe shops is done to improve the behavior of concrete and also the cement content was partially replaced by fly ash in higher grade concrete.

REFERENCES

[01] Banthia N (2012),"FRC: Milestone in international Research and development", proceedings of FIBCON2012, ICI, Nagpur, India, February 13-14, pp 48

[02] Nataraja M.C., Dhang N. and Gupta A.P, (1998), "Steel fiber reinforced concrete under compression", The Indian Concrete Journal, 26(3), pp 353-356.

[03] Nataraja M.C., Dhang, N. and Gupta, A. P (1999), "Stress-strain curve for steel fiber reinforced concrete in compression", Cement and Concrete Composites, 21(5/6), pp 383- 390. [04] Song P.S. and Hwang S (2004), "Mechanical properties of high-strength steel fiber reinforced concrete "Construction and Building Materials, pp 669-676.

[05] Brown J. & Atkinson T.(2012),"Propex Concrete Systems (International), United Kingdom", proceedings of FIBCON2012, ICI, Nagpur, India, February 13-14

[06] Chen B, Liu J (2000),"Contribution of hybrid fibers on the properties of the control concrete hybrid fibers. Cem. Con. Comp". 22(4): 343-351

[07] Shah Surendra and Rangan(1994), "Effect of Fiber addition on concrete strength", Indian Concrete Journal

[08] Byung Hwan Oh(1992), "Flexural Analysis of Reinforced Concrete Beams

Containing Steel Fibers", Journal of Structural Engineering, ASCE, Vol 118, No.10

[09] Barros JAO, Figueiras JA(1992), "Flexural Behavior of SFRC, testing and Modeling", Journal of Materials in Civil Engineering, Vol 11, No.4

[10] Chen S. (2004), "Strength of steel fiber reinforced concrete ground slabs", structures and Buildings" Issue SB2

[11] Dwarakanath HV, Nagaraj TS.(1991)," Comparative Study of Predictions of Flexural Strength of Steel Fiber Concrete", ACI Materials Journal, Vol 88, N0. 73, pp.49-58.

[12] James J, Beaudoin (1990)"Handbook of Fiber Reinforced Concrete; principles, properties, Development and Applications", Noyes Publications, New Jersey, United State of America,.pp.57-63

[13] Patton ME, Whittaker WL.(1983) "Effects of fiber Content and Damaging Load on Steel Fiber Reinforced Concrete Stiffness", ACI Journal, Vol .80, No.1 [14] Rossi P, Acker P, Malier Y.(1987)"Effect of steel fibers at two different stages", The Material and the Structures, Vol.20, pp.34-39.

[14] BS 1881: Part 121:1983," Testing concrete Method for determination of static modulus of elasticity in compression".

[15]. ASTM C 469-94" Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression"