Study and Strength Analysis of Fiber Reinforced Concrete

Sikandar Shakil[1] Lollo Chande[2] Eyasu H/Mariam[3] Mahaboob Patel[4]
[1,4]Assistant Professor [2]Head of Department
[1,2]Department of Civil Engineering [3]Department of Architecture Engineering
[4]Department of Mechanical Engineering
[1,2,3,4]Wolaita Sodo University, Ethiopia, East Africa

Abstract— Concrete is a composite material composed of fine and coarse aggregate bonded together with a fluid cement (cement paste) that hardens over time. The cement reacts chemically with the water and other ingredients to form a hard matrix that binds the materials together into a durable stone-like material that has many uses. The resulting 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. To increase the strength of concrete many attempts have been made. One of the commonly used methods is providing Fiber Reinforced Concrete (FRC). Today the construction industry is in need of finding cost effective materials for increasing the strength of concrete structures. Hence an attempt has been made in the present investigations to study the influence of addition of waste materials like waste steel powder & soft drink bottle caps, empty waste tin from workshop at a dosage of 1% of total weight of concrete as fibers. The present paper reviews the literature related to the utilization of waste material and its various effects on compressive strength, split tensile strength, flexural strength and workability of concrete. The steel powder, empty tins, soft drink bottle caps were deformed into the rectangular strips of 3mm width and 10mm length.

Key words: Strength Analysis, Fiber Reinforced Concrete (FRC)

I. INTRODUCTION

Admixtures are ingredients other than water, aggregates, cement and fibers that are added to the concrete batch immediately before or during mixing in nominal quantities. Use of admixtures to concrete has long been practiced since 1900. In the early 1900s, asbestos fibers were used in concrete, and in the 1950s the concept of composite materials came into being and fiber reinforced concrete was one of the topics of interest. By the 1960s, steel, glass (GFRC) and synthetic fibers such as polypropylene fibers were used in concrete, and research into new fiber reinforced concrete continues today. Concrete in general is weak in tensile strength and strong in compressive strength. The main aim of researchers or concrete technologists is to improve the tensile strength of concrete. To overcome this serious defect, partial incorporation of fibers is practiced. Fiber-reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibers that are uniformly distributed and randomly oriented. Fibers include steel fibers, glass fibers, synthetic fibers and natural fibers – each of which lends varying properties to the concrete. In addition, the character of fiber reinforced concrete changes with varying concretes, fiber materials, geometries, distribution, orientation, and densities.

Great quantities of steel waste fibers are generated from industries related to lathes, empty beverage metal cans and soft drink bottle caps. This is an environmental issue as steel waste fibers are difficult to biodegrade and involves processes either to recycle or reuse. Fiber reinforced concrete is an interesting topic discussed by numerous researchers in the last two decade.

II. LITERATURE REVIEW

Nguyen Van Chanh[1]carried out investigations on mechanical properties, technologies, and applications of SFRC. As it is now well proved that one of the major property of steel fibre reinforced concrete (SFRC) is its superior resistance to cracking and crack propagation. As a result of this competence to arrest cracks, fibre composites possess increased extensibility and tensile strength, both at first crack and at ultimate, particular under flexural loading; and the fibres are capable to hold the matrix together even after extensive cracking. The net result of all these is to impart to the fibre composite pronounced post – cracking ductility which is unheard of in ordinary concrete. The metamorphosis from a brittle to a ductile type of material would increase substantially the energy absorption characteristics of the fibre composite and its ability to defy repeatedly applied, shock or impact loading.

L. Sorelli and F. Toutlemonde[2] have focused on the application of SFRC in tunnel lining segments, as an alternative to standard RC segments. Because of the structural applications of Steel Fiber Reinforced Concrete (SFRC) have recently been increasing due to the enhancement of material properties, such as toughness under tension and durability. Based on an accurate experimental investigation on full scale specimens, a smeared crack model, which implements the Hilleborg's criteria, was used. In order to assess the SFRC reliability, number of tensile tests on cylinders drilled out from a reference full scale specimen was carried out. The tensile constitutive relation, which is the fundamental property for SFRC materials, was chosen on a probabilistic fashion accounting for the actual dispersions of fiber in the tunnel segment due to the casting procedure. According to the finite element analysis, the structural response of such structures was found to be very sensitive to the fiber dispersion. Finally, the AFREM recommendation for SFRC materials and the simplified struts and ties model were evaluated by means of a parametric analysis.

G. Murali et. al. [3] studied the influence of addition of waste materials like lathe waste, soft drink bottle caps, empty waste tins, waste steel powder from workshop at a dosage of 1% of total weight of concrete as fibres. The lathe waste, empty tins, soft drink bottle caps were deformed into the rectangular strips of 3mm width and 10mm length.

Experimental investigation was done using M25 mix and tests were carried out as per recommended procedures by relevant codes. The results were compared with conventional concrete and it was observed that concrete. Blocks incorporated with steel powder increased its compressive strength by 41.25% and tensile strength by 40.81%. Soft drink bottle caps reinforced blocks exhibited an increase in flexural strength of concrete by 25.88%. The specimen with steel powder as waste material was found to be good in compression which had the compressive strength of 41.25% more than the conventional concrete.

Fig. 1: Variours Type of Wastes

Different Strength Value after 28 days of Curing			
S. No.	Notation	Compressive strength	No. of cubes
1	Conventional	28	9
2	Steel Powder	38.88	9
3	Soft drink bottle cap	34.22	9
4	Beverage tins	30.77	9

Table 1: Different Strength Values

III. CONCLUSIONS

1) Fiber addition improves ductility of concrete & its post-cracking load carrying capacity.
2) Increases the cube compressive strength of concrete in 7 days to an extent of 0.68%
3) The most important contribution of fibre reinforcement in concrete is not to strength but to the flexural toughness of materials.
4) The increase in the various mechanical properties of the concrete mixes with polythene fiber is not in same league as that of the steel fiber.
5) Increases the cube compressive strength of concrete in 28 days to an extent of 5.12%
6) Increases the cylinder compressive strength of concrete in 28 days to an extent of 3.84%.Increases the split tensile strength to an extent of 1.63%

REFERENCES

[1] Nguyen Van Chanh "Steel Fiber Reinforced Concrete" Ho Chiminh City University of Technology, pp 108 – 116.
[2] L. Sorelli1, F. Toutlemonde"On the design of steel fiber reinforced concrete tunnel lining segments "Eleventh International Conference on Fracture, Turin (Italy), 2005, pp 20 -27.
[3] G.Murali, C.M.Vivek Vardhan, R.Prabu, Z.Mohammed Sadaquath Ali Khan, T.Aarif Mohamed and T.Suresh, "Experimental Investigation on fibre Reinforced Concrete Using Waste Materials", International Journal of Engineering Research and Applications (IJERA), ISSN: 2248-9622, Vol. 2, Issue 2, Mar-Apr 2012, pp. 278-283
[4] 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
[5] Shamim, M. and Kumar, V. (1999). .Behaviour of Reinforced Concrete Beam-Column Joint.A Review., Journal of Structural Engineering, ASCE, Vol. 26, No. 3, pp. 207.213.
[6] Mehrdad Mahoutian, Amir Bonakdar, Mahdi Bakhshi, Babak Ahmadi and Yaghoub Farnam "Fiber Reinforced Concrete, Improvement of mechanical properties of concrete" Construction Materials Institute, 2001, pp 1 - 2.

