INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 4, Issue 3)
Available online at: www.ijariit.com

Characteristic behaviour of crush glass fibers on the strength of concrete tile

Anil Hans
anilhans1833@gmail.com
Om Institute of Technology and Management, Hisar, Haryana

Nitin Thakur
er.nitaig@gmail.com
Om Institute of Technology and Management, Hisar, Haryana

ABSTRACT

The effect of glass fiber on flexural strength, split-tensile strength, and compressive strength was studied for different fiber content on M-20 grade concrete designed as per IS 10262. The maximum size of aggregates used was 20mm. To study the effect on compressive strength, flexural strength, split-tensile strength 6 cubes, 6 prisms and 6 cylinders were cast and tested. After that, a practical application of GFRC in the form of cement concrete tiles was taken into consideration and no special technique was used to produce these tiles. The thickness of the tiles was 20mm and maximum size of aggregates used was 8mm. The water-cement ratio was kept consistent and the admixture content was varied from 0.8 to 1.5 percent to maintain slump in between 50mm to 100mm. The size of short fibers Used was 30mm and the glass fibers were alkali resistant. The effect of these short fibers on wet Transverse strength, compressive strength, and water absorption was carried out. Six full-sized Tiles 400mm*400mm*20mm were tested and the results recorded. Pulse velocity tests were also conducted.

Keywords: *Glass fibers, Concrete tile, Pulse velocity tests.*

1. INTRODUCTION

One of the most important building materials is concrete and its use has been ever increasing in the entire world. The reasons being that it is relatively cheap and its constituents are easily available, and has usability in wide range of civil infrastructure works. However concrete has certain disadvantages like brittleness and poor resistance to crack opening and spread. Concrete is brittle by nature and possess very low tensile strength and therefore fibres are used in one form or another to increase its tensile strength and decrease the brittle behavior. With time a lot of experiments have been done to enhance the properties of concrete both in fresh state as well as hardened state. The basic materials remain the same but super plasticizers, admixtures, micro fillers are also being used to get the desired properties like workability.

Reinforcement is provided in the concrete not only to improve its tensile property but also to improve the durability properties of concrete. Concrete structures are subjected to very aggressive environment. To overcome the deterioration of concrete and to enhance the durability of concrete, reinforcement is provided. Without reinforcement concrete is imperiled to catastrophic failure when it is subjected to pure compressive force. Reinforcement provided in concrete will prohibit such catastrophic failure and also reduce the progression of cracks, thereby enhancing the mechanical property of concrete. Addition of fiber in concrete will decrease the development of holes at certain degrees and also the failure of concrete at interface zone gets reduced CRUSH glass fibers which are alkaline resistant shows marginal increase in strength properties of concrete. Workability of concrete is not much affected by the addition of fibers with consistent increase in addition of fibers up to 1% shows marginal improvement in strength of concrete. Such 1% addition of glass fiber in concrete shows the saturation limit, which means addition of fiber beyond 1% shows marginal reduction in strength of the concrete glass fibers which are alkaline resistant can be used in retrofitting of concrete structures. Innovations were made in glass fiber reinforced concrete with gypsum plaster can be used for construction of hollow panels. Such hollow wall panels can be used as load bearing structures the ratio of surface area to weight is high compared to other fibers. Thermal conductivity of glass fiber reinforced concrete is in the order of 0.05 w/mk. Use of Glass fiber in tension zone of reinforced concrete beam reduces the cracking and improves the durability. This is mainly due to the redistribution of moments within the reinforcement. Altering the composition of cement matrix with E glass fiber and alkaline resistant glass fiber will improve the strength and durability of concrete. Aspect ratio has greater influence on strength and durability properties of concrete. Glass fiber reinforced shows good fire resistant property up to 1% replacement addition of glass fiber in concrete reduces bleeding, improves the homogeneity and thereby reducing the probability of cracks major problem that arises while providing reinforcement is corrosion. Glass fibers are not susceptible to corrosion, but its gets deteriorated due to chloride ingression. Glass fiber reinforced concrete shows less ingression of chloride ions into concrete.

Ultrasonic pulse velocity behavior of glass fiber reinforced shows better results
Fibers which are applied for structural concretes are classified according to their material as Steel fibers, Alkali resistant Glass fibers (AR), Synthetic fibers, Carbon, pitch and Polyacrylonitrile (PAN) fibers.

1.1 Glass Fibre Reinforced Concrete

Glass fiber Reinforced concrete (GFRC) is a Cementitious composite product reinforced with discrete glass fibers of varying length and size. The glass fiber used is alkaline resistant as glass fiber is susceptible to alkali which decreases the durability of GFRC. Glass strands are utilized for the most part for outside claddings, veneer plates and different components where their reinforcing impacts are required during construction. GFRC is stiff in the fresh state has a lower slump and hence less workable, therefore water reducing admixtures are used. Further, the properties of GFRC depends on various parameters like the method of producing The product. It can be done by various methods like spraying, casting, extrusion techniques etc.

Cement type is also found to have a considerable effect on the GFRC. The length of the fiber, sand/filler type, cement ratio methods and duration of curing also affect the properties of

2. LITERATURE REVIEW

Concrete which is one of the most important construction material and is brittle in nature with very good compressive strength but weak in tension and flexure as a result concept of fiber reinforced concrete has developed. The term fibre-reinforced concrete (FRC) is defined by AC1 116R, Cement and Concrete Terminology, as concrete containing dispersed randomly oriented fibers. With time a lot of fibers have been used in order to improve the properties of concrete and even waste materials like fly ash, silica fumes have also been used. The concept of using natural fibers has also evolved but its durability remains questionable. The work done by using different fibers, waste materials, and their effects are discussed below in a sequential Manner.

Use of fibers in a brittle is not a new concept, the Egyptians used animal hairs, straw to reinforce mud bricks and walls in houses, around 1500 B.C. (Balaguru et al, 1992).

Ronald F. Zollo presented a report on fiber reinforced concrete in which he had mentioned about 30 years of development and research in this filed. In the report, it is claimed that the work on FRC started around 1960. Since then a lot of work has been done on FRC using different methods of production as well as different types of fiber, size of fiber, orientation and distribution. American Concrete Institute (ACI) Committee 544 divided FRC broadly into four categories based on fiber material type. SFRC, steel fiber FRC; GFRC, glass fiber FRC; SNFRC, synthetic fiber FRC including carbon fibers; and NFRC, for natural fiber FRC.

The idea of fiber support has been produced in current times and weak cement based brittle matrix was strengthened with asbestos filaments when in around 1900 the alleged Hatschek innovation was created for the creation of plates for material, funnels, and so forth. Later, glass fibers were proposed for the fortification of concrete glue and mortar by Biryukovichs. The ordinary E-glass fibers are not durable and resistant in highly alkaline Portland cement paste.-

Majumdar and Ryder invented Alkali Resistant glass fibers by adding Zircon oxide (ZrO_2).

Romualdi and his co-author's published important influences of the use of steel fiber in concrete which lead the development of steel fiber reinforced cement (SFRC). Over the last 40 years, a lot has been done to develop the cement-based matrices. The fundamental reason for short scattered filaments is to control the break opening and proliferation. Basic groups of fibers applied for structural concretes and classified according to their material are Brandt:

- Steel fibers of different shapes and dimensions, also microfibers;
- Glass fibers, in cement matrices used only as alkali-resistant (AR) fibers;
- Synthetic fibers made with different materials: polypropylene, polyethylene, and polyolefin, polyvinyl alcohol (PVA), etc.;
- Carbon, pitch, and polyacrylonitrile (PAN) fibers.

Steel fibers are most important for structural concrete. Studies also reveal that hooks at the end of the steel fibers, shape, size etc may improve the fiber matrix bond and also the efficiency may be increased. It has also been observed that due to the presence of fibers large cracks are replaced with a dense system of micro-cracks. Opening, propagation of micro cracks are controlled by fine fibers as they are densely dispersed in a cement matrix. Longer fibers 50 or 80 mm can increase the final strength of FRC and may help in controlling large cracks. The under load behavior of an SFRC is completely modified with the increase of fibre volume and efficiency.

Not only steel fibers PVA fibers either monofilament or fibrillated polypropylene size varying 10 mm to 80 mm diameter varying 0.5 mm to 1.5 mm are used in high volumes (0.5-2%), it can increase the impact and fatigue strength as well as the strength and toughness of the structural concrete elements. Polypropylene fibers are low modulus and can serve two different purposes

3. RESULTS

Compressive Strength of Concrete (in N/mm2)

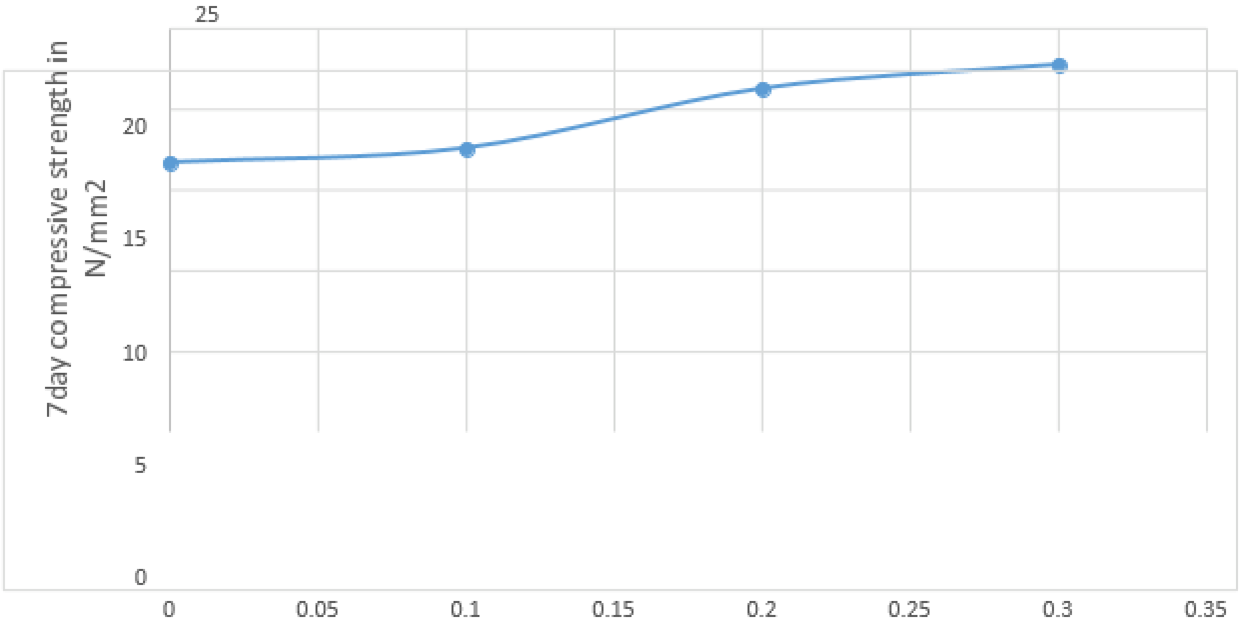
The 7 days compressive strength was studied and the values of 3 samples studied are shown in the tabular form. Table 1 shows the data of 7 days compressive strength obtained. Table 1 gives the 7-day compressive strength of concrete with the maximum nominal size of aggregates 20mm. The 7 days compressive strength was also plotted Fig2 by taking the average of this three values overall an increase in the compressive strength was observed with the addition of fibers.

Table 1 7days compressive strength of concrete

Serial number	Without fibre	0.1% fibre	0.2%	0.3%
1	16.78	17.69	21.29	22.21
2	16.39	17.29	20.78	22.69
3	16.45	17.31	21.29	23.07

Flexural Tensile Strength (in N/mm2)

The 7 days Flexural Tensile strength was studied and the values of 3 samples studied are shown in the tabular form. Table 5 shows the data of 7 days flexural tensile obtained. Table 5 gives the 7-day compressive strength of concrete with the maximum nominal size of aggregates 20mm. The 7 days compressive strength was also plotted Fig6 by taking the average of this three values overall an increase in the compressive strength was observed with the addition.



Glass fiber content in %

The 28 days Split Tensile strength was studied and the values of 3 samples studied are shown in the tabular form. Table 4 shows the data of 28 days compressive strength obtained. Table 4 gives the 28 days compressive strength of concrete with the maximum nominal size of aggregates 20mm. The 28 days Split Tensile strength was also plotted Fig5 by taking the average of this three values overall an increase in the compressive strength was observed with the addition of fibers.

Split Tensile Strength comparison (in N/mm2)

The 7 days Split Tensile strength was studied and the values of 3 samples studied are shown in the tabular form. Table 3 shows the data of 7 days compressive strength obtained. Table 3 gives the 7 days compressive strength of concrete with the maximum nominal size of aggregates 20mm. The 7 days compressive strength was also plotted Fig4 by taking the average of this three values overall an increase in the compressive strength was observed with the addition of fibers.

Table 3 7 days Split Tensile Strength of Concrete

Table 3 7days Split Tensile Strength of Concrete

Serial number	Without fibre	0.1%	0.2%	0.3%
1	1.478	1.82	2.395	2.400
2	1.628	1.75	2.31	2.410
3	1.449	1.87	2.32	2.267

The 28 days Split Tensile strength was studied and the values of 3 samples studied are shown in the tabular form. Table 4 shows the data of 28 days compressive strength obtained. Table 4 gives the 28 days compressive strength of concrete with the maximum nominal size of aggregates 20mm. The 28 days Split Tensile strength was also plotted Fig5 by taking the average of this three values overall an increase in the compressive strength was observed with the addition of fibers.

4. CONCLUSION

In this experimental program, the effect of short discrete glass fibers on the compressive, split tensile strength and flexural strength of concrete was studied.

The effect of glass fibers on cement and concrete tiles which are produced by vibration method is also studied. The properties studied are a compressive strength, wet transverse strength, and water absorption. The concrete mix gets harsher and less workable with increase of fiber content, therefore, use of admixture become necessary. However, even after giving a dosage of admixture as high as 1.5% proper workability could not be obtained and some segregation was observed. Therefore it was not possible to go beyond 0.7% fiber content.

The various observation based on the experimental result are as follows:

The compressive strength of concrete without admixture is not affected by the presence of short discrete glass fibers with fiber content in the range 0.1 to 0.3 % of fiber content by weight of concrete.

The split tensile strength of concrete increases with the addition of glass fibers.

5. REFERENCES

[1] Cook D.J., Pama R.P., Weerasinghe H.L.S.D. "Coir fiber reinforced cement as a low-cost roofing material". Build Environ 1978;13(3):193–8.
[2] Perez-Pena .M and Mobasher .B, "Mechanical properties of fiber reinforced lightweight concrete composites ". Cement and Concrete Research, Vol. 24, No. 6, pp.1121-1132, 1994
[3] Brandt AM."Cement-based composites: materials, mechanical properties and performance". London: E&FN Spon; 1995. p. 470
[4] Nakamura H, Mihashi H. "Evaluation of tension softening properties of fiber reinforced cementitious composites." Fracture Mechanics of Concrete Structures 1998; I:499e510.
[5] Mirza F.A., Soroushiannd P. "Effects of alkali-resistant glass fiber reinforcement on crack and temperature resistance of lightweight concrete." Cement and Concrete Composites 2002;24(2):223–7
[6] Robert S.P. Coutts ."A review of Australian research into natural fiber cement composites" Cement & Concrete Composites 27 (2005) 518–526
[7] Khosrow Ghavami. "Bamboo as reinforcement in structural concrete elements".Cement & Concrete Composites 27 (2005) 637–649
[8] Huang Gu, Zuo Zhonge "Compressive behavior of concrete cylinders reinforced by glass and polyester filaments". Materials and Design 26 (2005) 450–453
[9] Andrzej Brandt .M "Fibre-reinforced cement-based (FRC) composites after over 40 years of development in building and civil engineering". Composite Structures 86 (2008) 3–9

