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Effect of Chopped Glass Fibers on the Strength of Concrete Tiles

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ABSTRACT

The effect of glass fibre on flexural strength, split-tensile strength and compressive strength was studied for different fibre 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 casted and tested. After thata practical application of GFRCin the form of cement concrete tiles was taken into consideration and no special technique was used to produce this 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 .8 to 1.5 percent to maintain slump in between 50mm to 100mm.The mix proportion used was 1:1.78:2.66. The size of short fibres used were 30mmand the glass fibres were alkali resistant. The effect ofthis short fibres 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 was also conducted.

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 behaviour. 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, Increase or decrease in setting time and higher compressive strength.

Glass fibre reinforced concrete (GFRC) is a cementitous composite product reinforced with discrete glass fibres of varying length and size. The glass fibre used is alkaline resistant as glass fibre are 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 fresh state has lower slump and hence less workable, therefore water reducing admixtures are used.

The main area of FRC applications are as follows

- Runway, Aircraft Parking and Pavements
- Tunnel lining and slope stabilization
- Blast Resistant structures
- Thin Shell, Walls, Pipes, and Manholes
- Dams and Hydraulic Structure
- Different Applications include machine tool and instrument frames, lighting poles, water and oil tanks and concrete repairs.

The purpose of this research is to explore the compressive strength, split-tensile strength and flexural strength properties of concrete reinforced with short discrete fibers. The study was carried out on M-20 grade concrete the size of glass fibers

used was 30mm and the fiber content was varied from 0% to 0.3% of the total weight of concrete. In studying the above three properties no admixture was used. Also the effect of glass fiber on cement and concrete tiles was studied whose fibre content was varied from 0% to 0.7% of the total weight of concrete. Cement and concrete are heavy duty tiles which are used at various places and is of practical use.

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 fibre 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 fibres. With time a lot of fibres 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 fibres has also evolved but its durability remains questionable. The work done by using different fibres, waste materials and their effects are discussed below in a sequential manner.

Use of fibres 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 fibre 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 than a lot of work has been done on FRC using different methods of production as well as different types of fibre, size of fibre, orientation and distribution.

Steel fibres are most important for structural concrete. Studies also reveal that hooks at the end of the steel fibres, 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 dense system of micro-cracks. Opening, propagation of micro cracks are controlled by fine fibers as they are densely dispersed in cement matrix. Longer fibres 50 or 80 mm can increase the final strength of FRC and may help in controlling large cracks. The under load behaviour of a SFRC is completely modified with the increase of fibre volume and efficiency.

Fibre-reinforced polymer (FRP) bars can be used to replace steel reinforcement conventional steel has the inherent problem of corrosion as a result of which it undergoes expansion and concrete cracking may occur; therefore, FRP rebar may be used as an alternate. The use of this fibre excludes the problem of corrosion and increases the ductility of the FRP-reinforced concrete beams but the load deflection was found to be higher. (Mohamed S. Issa, Ibrahim M. Metwally, Sherif M. Elzeiny 2010).

MATERIALS AND METHODS

Concrete is the most widely used construction material. The basic materials of concrete are Portland cement, water, fine aggregates i.e. sand and coarse aggregates. The cement and water form a paste that hardens and bonds the aggregates together. Concrete in fresh state is plastic and can be easily moulded to any shape, as time passes it hardens and gains strength. The initial gain in strength is due to a chemical reaction between water and C2s and latter gain in strength is due to reaction between C3s and water. Concrete is produced by either following nominal mix proportions in which the mix proportions are fixed as per grade of concrete required or mix design proportions, latter produces more economical concrete.

Cement is an extremely ground material having adhesive and cohesive properties which providea binding medium for the discrete ingredients. The processes used for manufacture of cement canbe classified as dry and wet. The cement commonly used is Portland cement, it is also defined as hydraulic cement, i.e.a cement which hardens when it comes with water due to chemical reaction but there by forming a water-resistant product. Portland cement is obtained when argillaceous and calcareous materials are grounded to fine powder and mixed in definite proportion and fused at high temperature.

EXPERIMENTAL SETUP

Various tests conducted on the specimens are described below along with the description and importance. There were two ways in which the investigation was carried out one in which only cubes, cylinders and prisms were casted and the grade of concrete was M-20.The proportioning of the concrete was .The nominal maximum size of aggregate was 20mm and no admixture was used.

Compressive strength

The most important property of concrete is its compressive strength and durability. Concrete is mostly used in construction where load transferred is mostly via compressive strength. In order to check the effect of fibres on the compressive strength of concrete 150mm cubes were cast and tested. The cubes were tested at the age of 7days and 28 days and the variation was noted. Fibre content was varied from 0% to 0.3% when the nominal maximum size of aggregates was 20mm and no admixture was used. The water cement ratio was fixed at 0.5.The workability of the mix was observed to come down but however no extra water was used.

Split Tensile Strength

Concrete may be subjected to tension in very rare cases and is never designed to resist direct tension. However, the load at which cracking would occur is important and needs to be determined. The tensile strength of concrete as compared to its compressive strength is very low and is found to be only 10-15 % of the compressive strength. There are various factors which influence the tensile strength of concrete like aggregates, age, curing, air-entrainment and method of test.

Procedure

Experiments started with the preliminary tests on material properties as per the Indian standards. Composites being made of cement, fiber and sand as major components tests were conducted for standardizing properties of these materials. Tests of physical properties of sand, cement and fiber were conducted first and then they were used in the research. NO tests were conducted on water as ordinary tap water from govt. water supply was used throughout the research work.

Test on sand

Specific gravity test: The specific gravity of sand was measured using a pycnometer by the procedure confirming to IS 2386 part iii-1963.The specific gravity was found to be 2.66 Sieve analysis of sand : In order to ascertain the particle sine distribution of sand Dry sieve analysis was carried out. The sieve sizes were as per IS 2386-part I. The zone of sand was zone iii.

RESULTS

The results obtained are show nbelowintabular form

Compressive Strength of Concrete (inN/mm^2)

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 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 addition of fibers.

Table17dayscompressivestrengthofconcrete

Serial number	Without fibre	0.1%fibre	0.2%	0.3%
1	16.89	17.77	21.33	22.22
2	16.44	17.33	20.88	22.67
3	16.44	17.33	21.33	23.11

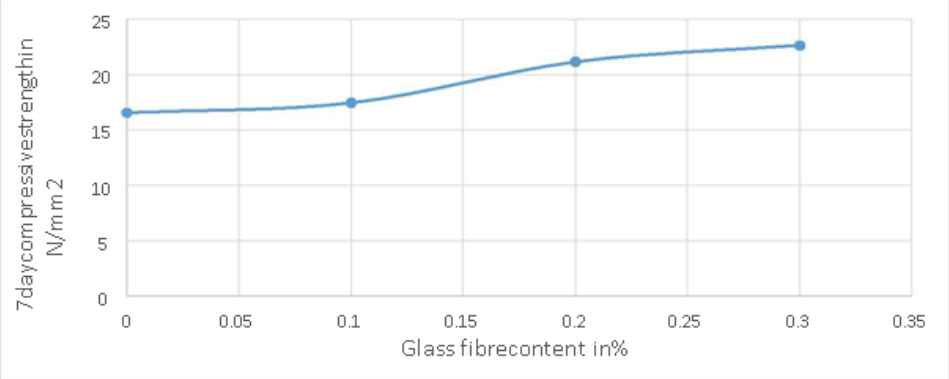

Figure2: Effectof Glass fibers on7daycompressivestrength

CONCLUSIONS

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 are also studied. The properties studied are 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 becomes necessary. However, even after giving 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.

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