Performance of Synthetic Fiber in Concrete

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***Abstract*— As we can see the global warming issues in the atmosphere various inventions and researches has been made to minimize this effect by using synthetic fiber in concrete. Synthetic fiber is mostly preferred due to the advantages of it is compared with other materials. Different types of synthetic fibers is used in concrete for enhancing the various mechanical properties, to increase life span as they have wide range of advantages such as high ductility, resistance to plastic shrinkage during the process of curing, high tensile and compressive strength, resistance to impact, resistance to abrasion with low cost. This review aims to provide information regarding the factors affecting mechanical performance and durability of concrete and advances made with them. Different test also has been performed on synthetic fiber reinforced concrete.**

***Index Terms* — Compression test, impact value, plastic shrinkage, synthetic fiber**

INTRODUCTION

Synthetic fibers are thread like material which has been used in concrete as well as for various purposes. Fiber can be produced by means of different types of plants as well as vegetables and some of trees too. (Leaves, wood, bamboo, coconut shells etc) by using this materials like synthetic fiber, nylon thread and many other synthetic materials has been made. Researchers had gone through different studies regarding fiber reinforced concrete using human hair, tyre crumbles, bamboos, coconut shells etc, all this helps to achieve high tensile and compressive strength of concrete also for enhancing different mechanical properties of concrete. Normally fibers are of two main type's natural organic and inorganic fiber, inorganic fiber includes asbestos, basalt etc. and organic includes plant leaves, coconut shells, bamboo, jute, sugarcane, bananas etc. This different type of Natural fiber has been used from ancient times for construction of various structures.

The use of natural fiber becomes very effective as it is very low in budget and because of its availability also it reduces the pollution impact on earth, it is used in wide range for enhancing the behavior of concrete, it becomes very cheap and effective.

The use of synthetic fiber leads to overall development of structures, it also includes easy handling of fiber because of the property of flexibility. For the use of very high percentage of fiber in concrete, there is need to organize different methods of casing, the increasing strength of concrete is also depends up on the properties of fiber to be used, including fiber material as type of fiber, length and diameter i.e dimensions/ quantity of fiber etc. As concrete is having different deficiencies such as low tensile strength, cracking capacity, brittleness and low ductility etc, the use of rigid pavement is minimum in India, and hence bituminous pavement is preferred mainly. Plain Portland cement concrete possesses a low tensile strength also low tensile strain capability, and hence number of micro cracks occours during its hardening and setting process.

Fiber reinforced concrete satisfies two of much requirements of pavement materials also it is economical and reduces pollution causing parameters, which is having longer durability, cheap in cost and much more efficient compare to other materials. With the use of synthetic fiber a mesh of synthetic thread is made passing through the holes made in the mould of size 15cm*15cm*15cm at equal interval of distance and tied which will act like pre stressed member as concrete is fill after the threads has been tied. Synthetic fiber enhance the load carrying capacity and impermeability to water over flexible pavements, also the modulus of elasticity of synthetic fiber reinforced is more due to its flexible nature. Due to cheap in cost and its availability synthetic fiber is used in wide range also many researches are going to check the properties of

concrete under use of synthetic fiber in different ways. Various test such as slump cone test, compression test, impact test, etc has been also performed.

METHODOLOGY

a)Slump Cone Testing:

Slump cone was used to find the slump of the concrete as per the requirement of IS 1199-1959

Fig. Slump cone testing

Oil is applied on the base plate and interior surface of the slump cone. The slump cone is kept on a leveled surface and filled with fresh concrete in three layers, approximately one-third of height of the cone. Each layer is tamped 25 times with a tamping rod. After compacting the to player, the concrete surface is struck off. The slump cone is removed by rising it slowly in vertical direction. The slump is recorded as the height to which concrete settle from the height at the highest point of the concrete.

a)Compression Strength Testing

A 2000 kN digital compressive testing machine issued for determine the compressive strength of hardened concrete as per the requirement of IS 516-1959 using standard 150mm*150mm cubes.

For cubes, before starting the test the weight of the sample are recorded. The plates of the machine are cleaned and the specimen is kept centrally between the two plate. Load is applied gradually on the specimen at the rate of 5.15Kn/s up to failure. Once the sample is failed, the failure pattern is recorded and the compressive strength is calculated from the maximum load recorded in the test.

b)Specific Gravity of Fine Aggregate:

In concrete technology, specific gravity of aggregate is made use of in design calculation of concrete mixes. Specific gravity of aggregate is necessary to be taken when we are dealing with light weight and heavy weight concrete. The Average specific gravity of the rocks lies between 2.6to2.8.

Make the pycnometer dry & weight it with it scap& ring Un screw the cap & Rut 200 gms of aggregate & weight it Add water to the top of brass cap. Remove all the trapped dry by pouring additional water. Dry the pycnometer & fell It to the top with & weight it repeat the procedure. Find the average specific gravity by using formula.

Observations and sample calculations are mentioned in annexure II

Fig. -Pycnometer

c) Specific Gravity of Coarse Aggregate:

In concrete technology, Properties such as crushing strength, durability, modulus of elasticity, maximum size, shape characteristic, need special consideration while selecting the coarse aggregate for medium strength aggregate for concrete. In case of normal concrete it may be desirable to use larger size aggregate to reduce the volume of cement paste resulting in an economic mix design. However one of the important factors that determine the maximum size of aggregate is the bond between mortar and aggregate. Larger size particle sand result in the lower strength of concrete. Considering these aspects 20mm size aggregate was considered suitable for medium strength concrete. Indian code does not specify limit on flakiness and elongation in dices.

Fig. -Specific Gravity Apparatus

MODELING AND ANALYSIS

Cement:

Cement 53-grade of ordinary Portland cement was used to throughout the experimental work. Cement was tested in laboratory and results are as fallows. Ordinary Portland Cement conforming to ACI standard was used for the experiment and locally available fine aggregate was used.

Sand:

Sand-Locally available sand was used as fine aggregate. This sand confirms to zone II of IS 383-1983 and before use the necessary tests were carried out and results are given in table.

Coarse Aggregate:

Coarse Aggregate Properties such as crushing strength, durability, modulus of elasticity, maximum size, shape characteristic, need special consideration while selecting the coarse aggregate for medium strength aggregate for concrete.

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Fine Aggregate:

Sand is used as a kind of fine aggregate in cement concrete. Sand particles must have sharp and angular edges. Size of sand particles should be passes through 4.75mm sieve.

Water:

Water is a major component in the mix of mortar. Too little or too much water will significantly affect the mix and the overall strength of the mortar.

Synthetic fibers:

The type of fiber used is shown in figure. synthetic fiber mechanical and geometric properties are significantly different from existing synthetic fiber, which are use to control plastic shrinkage cracking. The fiber nominal length is 40 mm and has an aspect ratio (fiber length divided by effective fiber diameter) of 90 and a specific gravity of approximately 0.92. The fiber features a rectangular cross section, a mean width of 1.4 mm, and a mean thickness of 0.105 mm. The average tensile capacity of the fiber is 600MPa with the modulus of elasticity of aggregate was targeted at 55:45 to maintain workability and sufficient paste for coating the fibers. The coarse aggregate utilized within the mixture was crushed limestone with two maximum sizes of aggregate as 25mm and a specific gravity as 2.62. The fine aggregate content was natural sand along with specific gravity of 2.66. The Re3 of the plain concrete was increased from 2% to24 and 39% with the addition of 0.32 and 0.48% synthetic fiber, respectively.

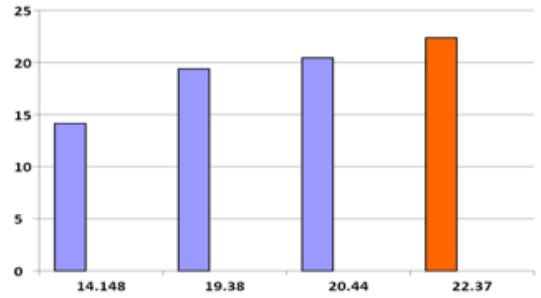
TableNo.3.1.3:Grading limits of fine aggregates IS:383-1970:

IS Sieve designation	Grading Zone I	Grading Zone II	Grading Zone III	Grading Zone IV
10mm	100	100	100	100
4.75mm	90-100	90-100	90-100	95-100
2.36mm	60-95	75-100	85-100	95-100
1.18mm	30-70	55-90	75-100	90-100
600micron	15-34	35-59	60-79	80-100
300micron	5-20	8-30	12-40	15-50
150micron	0-10	0-10	0-10	0-15

TableNo.3.1.3: Grading limits of fine aggregates IS:383-1970:

IS Sieve Designation	40mm nominal size	20mm nominal size
80mm	100	-
40mm	95-100	100
20mm	45-75	95-100
4.75mm	25-45	30-50
600micron	8-30	10-35
150micron	0-6	0-6

Fig: Compressive strength results of C-95:FA-5 with different volume fraction of CA&RA



RESULTS AND DISCUSSION

The following strength tests were carried out after 28 days on RC and CC specimen in order to carry out comparative studies of these concrete.

1. Compressive strength test

It is observed from fig. 4.1 of C-95: FA-15, after 28 days the strength development almost similar in both CA-4: RA-0 and CA-0: RA-4; or slightly less in CA-0: RA-4; but as per as cost is concerned CA-0:RA-4 IS on cheaper side. The variation in compressive strength of concrete as function of age showed that reduction in compressive strength of RA as compared to NA as 16.64% at 28 days with same ingredients. So, in short CA-0. RA-4 is feasible and advisable where little fluctuation in compressive strength should be allowed. And it will be economical. Also other specimen viz, CA-2:RA-2 &CA-3:

CONCLUSION

By the above review it is concluded that the purpose of synthetic fiber in concrete which has occurred from natural sources from rural and urban areas, it enhance the behavior of concrete also various properties of them. And, results in cheap, tough, and realistic in rural areas where, this are comfortably available. The addition of fiber enhances the crack resistance and crack width reduced too. By using synthetic, it results in stranger, safe and economical structure and these are freely and easily available, the compressive strength of synthetic fiber composite is not affected much to certain fiber content workability of concrete is adversely affected by fiber addition, it also reduce cracks. The fracture toughness of synthetic fiber is improved.

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