Experimental Study on Steel & Glass Fiber Reinforced Concrete

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Abstract **- In this modern age, civil engineering constructions have their own structural and durability requirements, every structure has its own intended purpose and hence to meet this purpose, modification in traditional cement concrete has become mandatory. In today's world, concrete is most well liked because of its good compressive strength and durability. Concrete could be a relatively brittle material, when subjected to normal stresses and impact loads, as result for their characteristics plain concrete members couldn't support loads and tensile stresses that occurred, in concrete beams and slabs. Over the decades, there has been a big increase within the use of fibers in concrete for improving its properties like compressive strength and workability, durability. In this paper effect of steel and glass fibers on the compressive strength of concrete for M30 grade have been studied by varying percentage of steel and glass fibers in concrete. Steel and glass fiber varying by 1%, 1.5% and 2%. Concrete cubes of size 150mmX150mmX150mm were tested for compressive strength. It has been found that steel fibers added in specific percentage to concrete improves the mechanical properties, durability and serviceability of the structure. It is now established that one of the important properties of steel fiber reinforced concrete (SFRC) is its superior to cracking and crack propagation. Glass fiber has the advantages of having higher tensile strength and fire-resistant properties, thus reducing the loss of injury during fire accident of concrete structures. The addition of steel reinforcement and glass reinforcement significantly increases the strength of concrete at all ages fresh and hardend, and results of steel fiber reinforced concrete the development of micro-cracks in concrete structure must be checked. The concrete having following ingredient such as cement, fine aggregate, coarse aggregate, water, steel fiber, glass fiber and superplasticizer. Hence compressive behavior of composite concrete with the varying percentage of such fibers have been studied.**

Index Terms **- Glass Fiber, Steel Fiber, Compressive Strength**

1.INTRODUCTION

The demand of higher better concrete is increasing day by day. Improved quality of concrete will only perform better if concrete improves workability, durability, flow ability & resistance to chemical attack/corrosion and reduce w/c ratio, heat of hydration & segregation mainly. For the fulfillment of above properties waste produced from the steel & other industries are used for effective & efficient strength & durability of concrete. Fibers has been added into OPC which varies from 1% to 2% by total weight of OPC and partial replacement of OPC by Steel and Glass Fibers.

2.FIBER REINFORCED CONCRETE

Fiber Reinforced Concrete defined as a composite material of cement, motor, or concrete and discontinuous, discrete, and uniformly dispersed fibers. FRC having fibrous material, and it is increasing its structural integrity. It contains short discrete fibers that are uniformly distributed and randomly oriented. Concrete is that the most widely used structural material within the world with an annual production of over seven billion tons. For a variety of reasons much of this concrete is cracked. The reason for concrete to suffer cracking could also be attributed to structural, environmental, or economic factors, but most of the cracks are formed because of the inherent weakness of the material to resist tensile forces. Again, concrete shrink and can again crack when it is restrained. It is now well established that steel fiber reinforcement offers an answer to the matter of cracking by making concrete tougher and more ductile. It has also been proved by extensive research and field trials administered over the past three decades, that addition of fibers to conventional plain

or reinforced and prestressed concrete members at the time of mixing imparts improvements many of the properties of concrete, those associated with strength and durability and performance. The weak matrix in concrete, when reinforced with fibers, uniformly distributed across its entire mass gets strengthened enormously, thereby rendering the matrix to behave as a composite material with properties significantly different from conventional concrete.

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 lend varying properties to the concrete. In addition, the character of fiber-reinforced concrete changes with varying concretes, fiber materials, geometries, distribution, orientation, and densities.

Fiber reinforced concrete (FRC) is a new structural material which is gaining increasing importance. Addition of fiber reinforcement in discrete form improves many engineering properties of concrete.

Steel Fiber R/f Concrete-

1. Is a composite material comprised of portland cement, aggregate, and fibers.
2. Steel fiber-reinforced concrete is basically a cheaper and easier to use form of rebar reinforced concrete. 3)Steel fiber-reinforced concrete uses thin steel wires mixed in with the cement. This imparts the concrete with greater structural strength, reduces cracking and helps protect against extreme cold.
3. The function of the irregular fibers distributed randomly is to fill the cracks in the composite.
4. In this investigation steel fiber of 1mm diameter, 35mm length are used.

Glass Fiber R/f Concrete-

1. Glass fiber–reinforced concrete is (GFRC) basically a concrete composition which is composed of material like cement, sand, water, and admixtures, in which short length discrete glass fibers are dispersed.
2. Inclusion of these fibers in these composite results in improved tensile strength and impact strength of the material.
3. The glass fiber helps insulate the concrete in addition to making it stronger.
4. Glass fiber also helps prevent the concrete from cracking over time due to mechanical or thermal stress.
5. In this investigation glass fibers of 10 micron in diameter are used, which is white in colour and having length to 12 mm.

3.MATERIALS

1) Cement-

Ordinary Portland Cement is used in the project work, as it is readily available in the local market, which is grey in colour. Ordinary Portland Cement of 53 grade confirming to IS specification was used.

2) Fine Aggregate-

Locally available river sand conforming to grading zone 2 of IS:383-1970. Clean and dry river sand available locally will be used. Sand passing through IS 4.75mm sieve will be used for casting all the specimens.

3) Coarse Aggregate-

Crushed annular granite metal from the local source will be used as coarse aggregate. The coarse aggregate used in project work of 20mm size.

4) Glass Fiber-

It is the material made from extremely fine fibers of glass, 10 micro-meter in diameter and 12 mm long. It is a light weight, extremely strong and robust material. There are distinctive sorts of fiber, however in these we used 100% Fibrillated Polypropylene Fiber which is white in colour by Bajaj Reinforcement Company.

5) Steel Fiber-

Percentage of fibers was varied from 0 to 2% crimpled and hooked end steel fibers of 1 mm diameter with 35 mm length is used by Perfect Solution Company, and its aspect ratio is 80. Density of steel fibers is 7850kg/m3.

6) Water-

Water should be free from acids, oils alkalis, vegetables or organic impurities. Soft waters also produce weaker concrete. Water has two functions in a concrete mix, firstly its reacts chemically with the cement to form the cement paste in which the inert aggregates are held in suspension until the cement paste has hardened. Secondly, its serves as a lubricant in a mixture of fine aggregates and cement.

7) Super plasticizer-

In this mix process we use superplasticizer name FOSROC it will be generally used in concrete mixing. It is available generally in market. The superplasticizer reduces the water content in the mix up to 30 % so that the concrete will be more workable. Specific gravity 1.01-1.11 was used to maintain the workability of mix.

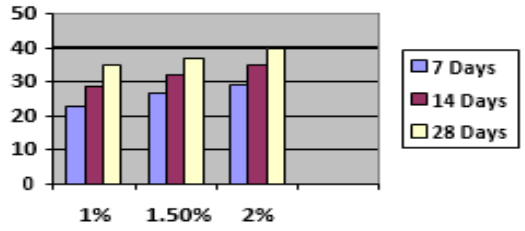
4.METHODOLOGY

The collection of material for the Glass fiber reinforced concrete and Steel fiber reinforced concrete are obtained for M30 concrete mixes were collected and casted. The conventional concrete was cured in water M30 Grade mixes were designated in accordance with IS:10262-2009.Convetional concrete was casted with M30 mix and made to water curing. Another set of cubes were casted using Glass Fiber and Steel Fiber of 1%, 1.5% and 2% with M30 concrete and allowed for water curing. Cubes were casted for 7, 14, 28 days for conventional concrete glass fiber and steel fiber to study the compressive strength. For this experimental study a total 54 cube were casted for determine the strength. The specimens are taken from the water after 7 days, 14 days and 28 days and visual observation are made.

5.RESULT AND DISCUSSION

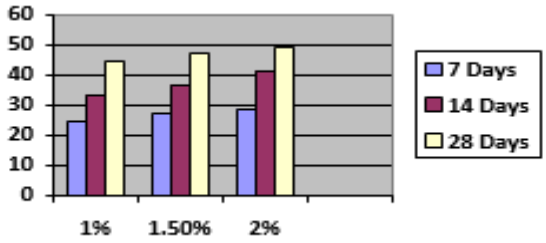
The compressive strength of concrete at 7,14 and 28 days curing of cube for M30 grade of concrete are given in the fig and values in chart. The results shows that there is increase in compressive strength in case of glass fiber reinforced concrete and Steel fiber reinforced concrete specimen when compared to conventional concrete.

Table No 1- Compressive Strength of M30 Grade Concrete with 1%, 1.5%, 2% of Glass Fiber



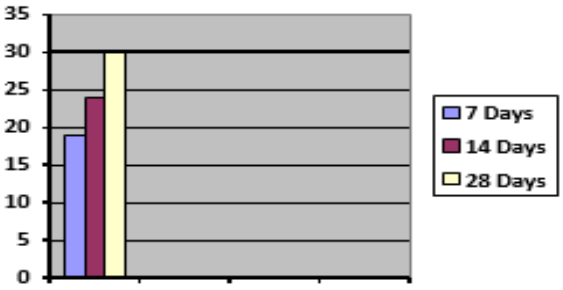
	7 Days	14 Days	28 Days
1%	22.99	28.65	34.95
1.5%	26.85	32.09	36.98
2%	28.89	34.99	40.01

Table No 2- Compressive Strength of M30 Grade Concrete with 1%, 1.5%, 2% of Steel Fiber



	7 Days	14 Days	28 Days
1%	24.80	33.24	44.81
1.5%	27.1	36.82	47.43
2%	28.54	41.47	49.54

Table No 3- Compressive Strength of M30 Grade of Conventional Concrete



	7 Days	14 Days	28 Days
Conventional Concrete	18.85	23.80	30.01

6.CONCLUSION

The following conclusion could be drawn from present investigation.

1. It is observed that compressive strength of 7th, 14th, and 28th day of M30 grade of concrete will be maximum strength in 2% of glass fiber at 28 days, minimum strength in 1% of glass fiber.
2. It is observed that compressive strength of 7th, 14th, and 28th day of M30 grade of concrete. Maximum strength in 2% of steel fiber at 28 days and minimum strength in 1% of steel fiber.
3. Maximum compressive strength for M30 Grade of concrete was obtained by addition of 2% of glass and steel fiber.

4. It is observed that compressive strength increases from 8 to 21% for 28 days.
5. Workability of concrete increases by the use of glass fiber reinforced concrete.
6. Fibers are superior crack resistance.

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