COMPARATIVE STUDY OF GLASS REINFORCEMENT CONCRETE AND NORMAL CONCRETE

A DESSERTATION-II REPORT

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CERTIFICATE

It is certified that this project report entitled **" Comparative Study Of Glass Reinforced Concrete And Normal Concrete"** submitted by "**KARAN SINGH**, Reg no: 11300595"student of Civil Engineering Department, **Lovely Professional University, Phagwara, Punjab** who carried out the project work under my supervision. To the best of my knowledge, the matter embedded in the project report has not been submitted to any other University/ Institute for the award of any degree or diploma

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ABSTRACT

All of us know that the normal concrete possess very low tensile strength, limited ductility and little resistance to cracking. So this paper focuses towards the experimental investigation of the mechanical properties of glass fiber reinforced concrete with conventional concrete. Fibers while delivered in certain percentage in the concrete improves the property as crack resistance, ductility, as flexural strength and durability. So for enhancing the durability of the structure we are the use of glass fiber. Glass-fibre reinforced concrete (GRFC) is a fabric product of a cementatious matrix composed of cement, sand, water and admixtures, wherein brief duration glass fibers are dispersed. It has been broadly used within the creation enterprise for non-structural factors, like façade panels, piping and channels. GRC gives many advantages, inclusive of being lightweight, heat resistance, appropriate look and strength. For this experimental work we are using glass fibers on the volume fractions of 0.5%, 1% and 1.5%. After the casting of cubes, beams and cylinder with the above stated quantity fractions we can carry out specific test which include compressive strength, tensile strength and flexural strength respectively. After the completion of this work we compare the results of glass fiber strengthened concrete with that of the normal concrete. From evaluating those two we are able to see that how the addition of the fibers will have an effect on the mechanical properties of conventional concrete and we check that the addition of fibers improves the strength of concrete or not.

CHAPTER 1

INTRODUCTION

1.1. GENERAL

In construction field concrete is one of the most used creation material. Concrete has various desired properties like high stiffness, high compressive strength and high durability under usual environmental elements. As all of us know that concrete is brittle in nature and also we know that it is weak in tension. Concrete has two insufficiencies, low strain at fracture and low tensile strength. To overcome from this problem we use reinforcement in concrete. Normally reinforced concrete consists of pre stress tendons and continuous distorted steel bars. The benefit of reinforcing and pre-stressing technology using metal reinforcement as excessive tensile metal wires have helped in overcoming the incapacity of concrete in concern but the ductility importance of compressive strength.

1.1.1. Fiber reinforced concrete(FRC)

FRC is a concrete which have fibrous material in concrete that increases the structure integrity. It also includes the short discrete fibers that are randomly oriented and uniformly distributed. FRC is a concrete made primarily of discrete reinforcing fibers, aggregates and hydraulic cements. It is a comparatively new material in construction field. It is a composite fabric consisting of a matrix containing a random distribution of small fibers, both natural or synthetic, having an excessive tensile strength. The cracking power of concrete is multiplied as we add the uniformly dispersed fibers and the fibers performing as crack arresters. All of us know that concrete is always weak in tension so we use the fibers to raise the tensile strength of concrete. It is also found that if we will provide the fibers in small size, uniformly distributed and closely spaced then it will help in decreasing the occurrence of the cracks and will develop its static and dynamic properties.

1.2. Necessity of fiber reinforced concrete(FRC)

- Fiber reinforced concrete (FRC) reduces the bleeding of water in concrete and thus also reduces the porousness of concrete.
- Ductility of the concrete improves by adding fibers and the primary function of the fibers is to fill the cracks that develops in concrete
- There is large development in the post-cracking conduct of concrete which contains fibers because of each drying shrinkage and plastic shrinkage.
- Fibers imparts the extra resistance towards impact load.
- Some forms of fibers produce shatter resistance and extra abrasion in concrete.

All of us know about the benefits of the concrete and it is also known to us that concrete fails in tension. So now we will concentrate on the various properties of the glass fibers for this research work and see how it will affect the concrete. In my research I will use glass fiber as a reinforcing material (GFRC). Glass fiber concretes are especially used in outward constructing façade panels and as architectural precast concrete. Glass fiber is superb in making shapes at the front of any constructing and it's far much less dense than metallic like steel.

1.3. MATERIAL USED

In this research work we are going to use different materials and there name are as follow:

a) Ordinary Portland Cement (OPC): in this research I am using OPC of 43 grade.
b) Fine aggregates: The fine aggregates are those that can easily pass through the IS Sieve 4.75 mm and should have finesse modulus 2.50-3.50 and silt contents should be restricted upto 4%.

c) Coarse aggregates: The coarse aggregates are those aggregates which are retained on IS Sieve 4.75mm. It has to be hard, solid, thick, tough and clean. It must be free from vein, disciple coatings and harmful measure of broke down pieces, antacids, vegetable issues and different injurious substances. It has to be generally cubical fit as a fiddle. Flaky pieces have to be maintained a strategic distance from.

d)Fibers: There are one fiber that we will be going too use in the research work are: **Glass fiber**

So we are going to use above materials for the research work. All of us know that cement is a binding agent so we are using OPC of 43grade.

Similarly, we are using angular coarse aggregate of 20mm with the specific gravity of 2.65 and water absorption of 0.5%.

Fine aggregates can be named as very fine particles such as the sand that we are using in the research work with the specific gravity of 2.68 and water absorption of 1%.

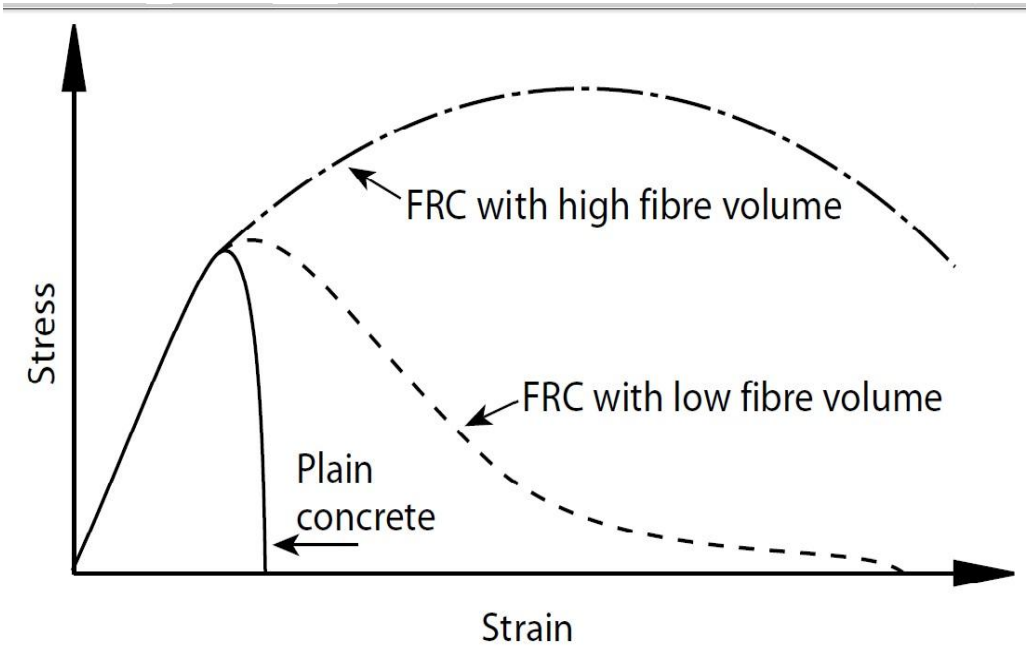

Fig 1. Difference between plain concrete and fiber reinforced concrete

1.4. Glass fiber

It is a material which includes extremely fine particles of glass. Glass fiber is very light in weight and it is also resists the corrosion. It is made up of natural fibers, so is not harmful for human health as its products are natural pure. It has various properties like resistance to pressure, high bending, pulling and high temperature resistance, resistance against chemical and biological influences. Glass fiber has excellent heat, sound and electronics insulation capacity. Glass fiber concretes are especially used in outdoor constructing façade panels and as architectural precast concrete. This glass fiber is superb in making shapes at the front of any constructing and it's far much less dense than metallic like steel.

1.4.1 Glass fiber reinforced concrete(GFRC)

Glass fiber reinforced concrete (GFRC) is essentially a cement grout with countless parts of entrenched glass fibers. Fibers are the principal load carrying members.

Fig.2 Glass Fiber

- Glass fibers provides high tensile strength from 1020 to4080N/mm^2.
- Glass fibers are generally of 25mm length are used.
- Glass fibers improves the ductility, impact strength, flexural strength and it also provides the resistance to thermal shock.
- Glass fibers are generally used in roofs and ducts, sewer lining, swimming pools and formworks etc.

1.5. Types of glass fibers

1.5.1. A-glass: This kind of glass is very near to normal glass. Due to its composition, this type of glass is very near to window glass.

1.5.2. C-glass: This sort of glass suggests better resistance against chemical effect.

1.5.3. E-glass: This type of glass gives the very good insulation to electricity with the combined characterstics of c-glass.

1.5.4. AE-glass: This kind of glass shows very good resistance towards the alkali resistance glass.

1.6. Specifications of glass fibers

Table 1

Letter designation	Properties of glass fibers
Chemical	High chemical durability
Alkali	High Alkali or Soda Lime Glass
Strength	High Strength
Electrical	Low Electric Conductivity
Modulus	High Stiffness
Dielectric	Low dielectric constant

1.7. Advantages of glass fibers over normal concrete

- GFRC is very light weight and it is 75% light weight as compare to normal concrete.
- GFRC does not need any type of additional reinforcement as the addition of glass fibers in concrete is done by internally.
- Pouring and spraying of GFRC is very easy it does not require any type of heavy or expensive equipments.
- GFRC is very hard to crack but it is very easy to cut.
- The flexural strength of GFRC is very high as cpmpare to its weight ratio.
- When GFRC is sprayed or poured then the surface finishing is very good as compare to normal concrete as there is no pits and bugs.

CHAPTER 2

LITERATURE REVIEW

Eng. Pshtiwan N. Shakor, et al, [1]

The motive of this research is to indicate the changes in flexural and compressive strength by using varying sizes of cubes. This is to be conducted for concrete without glass fiber and with glass fiber to indicate the differences. In this paper we located that alkali resistance glass fiber can control shrinkage cracks effortlessly. It indicates this property particularly in facing cause or rendering. Most important thing in GRFC is water cement ratio maximum upto 0.35, which helps to control the bonding and shrinkage by glass fiber. GRFC may be used as substitute material of natural stone, in particular in those international locations where stone is much less or unavailable. Glass fiber allows concrete to increase compressive strength till specified limit. A restrict exists to a particular percent from glass fiber combined with concrete due to the fact growing it impacts at the bond of materials as is visible in the result. For 1.5% of cementitous weight shows excellent outcomes are acquired as compared to other outcomes. Particular percentage from glass fiber blended with concrete because increasing it impacts on the bond of materials as is seen inside the end result. More air entraining is increased in the concrete when we use 20mm of coarse aggregates. To solve the problem of reduced flexural strength only 10mm of coarse aggregates should be used.

Yasir Khan, et al, [2]

This paper defined the Experimental Investigation on Durability and strength properties of glass fibers and steel reinforced concrete composite. we discovered that for this M35 grade of concrete with constant water cement ratio of 0.45 is designed mixed, cylinders and cubes are casted. The durability and strength properties are carried out for various mix designs and compared with normal concrete. split tensile strength and compressive strength for cubes are obtained for 7 and 28 days. The diverse mix designation set for FRC are tested for 7 and 28 days and in evaluation with everyday conventional concrete. we located that the Compressive strength of fiber strengthened concrete composite with various mix designs observed better as compared to normal concrete for 7 and 28 days of curing. The Split Tensile strength of fiber strengthened concrete composite with diverse mix designation confirmed better strength as compared to normal concrete. The most advantageous dose of (2% & 2.5%) steel and Glass Fiber confirmed better results consequences in comparison to other dosages of fibers. Slump will lose at the higher percentage of Steel and Glass Fiber. Density of concrete increases as percent of fiber dosages of Steel and Glass. The water absorption capacity of mix designation (2.5 & 3%) & (2 &2.5%) fiber composite showed least value as equated to other mix designation. The Percentage of porosity (2% & 2.5%) FRC composite showed least value among numerous mix Designations.

Shrikant Harle, et al, [3]

The main objective of this research is when glass fiber is added into the concrete evaluate the changes in properties of concrete. In this we evaluated that the durability and strength of concrete can be modified through making appropriate changes in its components like aggregates, cementious materials and water by using adding a few unique ingredients. In this paper we found that the alkali glass fiber (AR- glass fiber) shows better results as comparison to other glass fibers. Split tensile strength, compressive strength and flexural strength is more in AR-glass fibers as compare to other glass fibers. When we add 0% glass fibers in the concrete it is located that flexural strength and split tensile strength increases from 15 to 20%. It is also located that 20 to 25% increase in compressive strength found when we compare compressive strength of glass fiber with 28 days.

Rama Mohan Rao. P, et al, [4]

The main purpose of this study is when we add fly ash based concrete check the effects of glass fibers. In this study we add glass fibers in various extent proportions and study the flexural strength, split tensile strength, compressive strength of concrete when we replace 25 to 40% of cement by fly ash. As per the Indian Standards the standard sizes of the molds of cylinders, cubes and beams were cast for each mix. After this as per the Indian standards they are tested for 7, 28 and 56 days for compressive, flexural and split tensile strength. Their is slightly improvement in concrete for 28 days compressive strength when we add fly ash. So in this study we get that as the fly ash percentage increases performance of concrete decreases. As we compared fiber mix with control mix there is an increase in compressive strength 8.5% to 12% for all fiber mixes. Better strength values on par with control mix is obtained when the volume fraction of glass fiber 0.3% is mixed.

K.I.M.Ibrahim, et al, [5]

This paper defined as the experimental investigation of mechanical properties of glass fiber. Glass fiber reinforced concrete is used to make beams, cubes and cylinders containing 0% ,0.1% ,0.3%and 0.5% glass fiber volume fraction. As we compare the plain concrete with the results of glass fibers, this paper confirmed that the percentage increase of glass fiber in concrete gives the positive effects splitting, flexural and compression strength development of specimens at 7 and 28 days. When the 0.1% of glass fiber is added, flexural strength increases about 11.8, split tensile strength increases about 27.1% and compressive strength increases about 7.5% over conventional concrete. When the 0.3% of glass fiber is added, flexural strength increases about 41.2%, split tensile strength increases about 71.8% and compressive strength increases about 17% over conventional concrete. When the 0.5% of glass fiber is added, flexural strength increases about 58.8%, split tensile strength increases about 94.8% and compressive strength increases about 22.3% over conventional concrete. The strength of concrete increases immensely when we reinforcing with glass fiber.

Mr.Yogesh S.Lanjewar, et al, [6]

The main objective of this paper is to check the compressive strength of glass fiber concrete. In this paper we located that on the addition of glass fibers within the concrete it's been determined that the concrete achieved considerably greater strength than that of the conventional concrete. Comparing with everyday concrete strength, the received results resembles that for 7 days, on addition of 1% glass fibers the concrete strength multiplied via 27.08% while on addition of 2% glass fiber 6.34% strength increment is discovered. On the other side when we check the results for 28 days, we get 14.47% increased in concrete strength when we add 1% glass fibers in concrete. While 7.68% increased in concrete strength is observed when 2% glass fibers is added. For 28 days concrete gives more strength when we add glass fibers and coir in normal concrete. After comparing both 7 days and 28 days we get that the 1% glass fiber gives more strength then 2% of glass fibers.

A.Bahar,et al, [7]

This paper is defines the advantages Of Using Glass Fiber Reinforcement In Construction. In this paper we found that Glass Fiber Reinforced Concrete can be used wherever a tough, weather resistant to weather, light, eye-catching, resistance to fire, waterproof, attractive material is essential. It has many mechanical and physical remarkable strengths. The immoderate tensile strength that is better than that of steel. Steel has better modulus of elasticity as compare to glass fiber as we know that concrete has low modulus of elasticity and permit concrete to crack, while the concrete cracks appears glass fibers play their position and do not permit the crack to propagate consequently, new cracks in different position seems. GFRC properties are dependent upon the production methods and quality of the material. Steels are eliminated inside the GFRC so that, no corrosion will arise and no minimum cover is needed. The main element is erosion in AR glass fibers because it can stand acid, alkaline and salt. The passage of time and consequences of different climate situations and freeze-thaw cycles had little or no outcomes on tensile ultimate strength, flexural ultimate strength and tensile ultimate strength. GFRC goods have been used for architectural services for decades but the improvement and innovation of GFRC industries recommend many new applications like: marine structures, septic tanks, coastal and marine structures, water storage tanks, water and wastewater pipelines and many others.

SrinivasaRao, et al, [8]

This study paper performed on chemical resistance to glass reinforced fiber. In this we studied that the durability of concrete from the component of resistance to acid assault on concrete increases by way of adding AR-glass fibers in concrete. It used to be learned that there was once no affect of sulphates on concrete. Chloride permeability of glass fiber reinforced concrete suggests so much less permeability of chlorides into concrete whilst in comparison with usual concrete.

S. H. Alsayed, et al, [9]

This paper defines the use of Glass Fiber Plastic Bars as strengthened Bars. For concrete constructions we learn the glass fiber reinforcing plastic bars efficiency as a reinforcing material. For concrete structures we study the glass fiber reinforcing plastic bars performance as a reinforcing material. The study found that the flexural potential of concrete beams strengthened with the aid of GFRP bars can be accurately anticipated using the ultimate layout concept. The be trained moreover placed that the GFRP bars have low modulus of elasticity, deflection criteria could manage the layout of intermediate and long beams strengthened with GFRP bars.

Md.Abid Alam, et al, [10]

This research paper is performed on Tentative Study on Properties of Glass Fiber Reinforced Concrete. In this paper we have a look at that AR-glass fibers have been used inside the concrete mixes. A total of eight mixes were organized with the aid of varying the percentage of glass fibers and grade of concrete mixes. Based on the outcomes the compressive and tensile strength become suggested to increase as much as 26.19% and 25.4%. However by the addition of fibers, the workability of concrete mixes is not much affected. The tensile strength of concrete is improved which shows the use of glass fibers in concrete mixes may additionally lessen its failing of low tensile strength without affecting its workability and compressive strength. The use of AR-glass fibers extensively improves the compressive as well as tensile strength regardless of affecting the workability of concrete mixes. The compressive strength of concrete display a marginal growth on addition of fibers to concrete mixes. Increased strength turned into pronounced as 26.6% and 25.78% for M 20 and M 30 grade of concrete. However in addition of fibers improves average power up to 7% for M 20 grade and 8.8% for M 30 grade of concrete. The tensile strength of concrete additionally indicates an growing trend. For M 20 & M 30 grade of concrete multiplied tensile strength were located to be 24.7% and 26.10%. Again in addition inclusion of fibers notably improves the average tensile strength. The percentage increased in strength for better grade of concrete is marginally excessive.

Shrikant M. Harle, et al, [11]

The main objective of this study is to check the performance of glass fiber reinforced concrete. we studied Though the initial value is high the general value is greatly decreased because of the good properties of fiber strengthened concrete. The GFRC confirmed almost 20 to 25% increased in split tensile strength, compressive strength and flexural in comparison with 28 days compressive strength of simple concrete. While to improve the durability from the issue of acid attacks on concrete using AR glass fibers had proven true result. So, the GFRC may be used for blast resisting systems, dams, hydraulic systems.

Tejas R Patil, et al, [12]

This paper defines the Comparative Study of Steel and Glass Fiber Reinforced Concrete Composites. we found that the cylinders and cubes are designed with AR-glass fiber 0% and 0.25% Also designed via the metallic fiber reinforced concrete containing 0% and 0.5% extent proportions of hook and factor ratio of metallic fibers 53.85, 50 by using weight of cement of 12mm reduce length had been used without admixture. Comparing the results of plain M20 grade concrete and fiber reinforced concrete (FRC), this paper proves the nice consequences of various fibers with the growing percent of in splitting and compression improvement of specimen at 7 and 28 days, analyse the sensitivity of concrete with the addition of fibers with extraordinary strength. By addition of 0.5% for M20 concrete most compressive strength was obtained, 50 mm duration, hook end steel fibers.by addition of 0.5% for M20 concrete maximum split tensile strength was obtained 50 mm length, hook end steel fibers. The ratio become discovered to be nearly 3:4 for compressive strength of cylinders to the compressive strength of cube. Addition of fibers influences the workability of concrete. Workability of concrete in comparison to different fibers is reduced via addition of fibers for unique volume fraction. It was found that in split tensile test cracks are goes on reducing by adding glass fiber or with the increase of fiber dose. Also in the flexural test cracks are goes on reducing with the increase in the fiber dose and glass fibers has more flexural strength then steel fibers.

CHAPTER 3

Research Methodology

We are directing this research work for seeing that how the addition of the fibers to the matrix can be useful for the enhancement of the concrete mechanical properties. So in this research work we are going to conduct different test on the materials to be used. After casting of the concrete we will also perform different test on the specimen. As we are going to make M25 grade concrete so for this we have to make mix design. So before making mix design we need to perform different tests on the materials we will be using.

3.1. Materials to be used

We are using various materials in this research are following as:

3.1.1. Coarse Aggregate:

In this research work I am going to use angular aggregates as we all know that the angular aggregates have well defined edges and because of this property of these aggregates the formation of the composite takes place easily. We perform sieve analysis test on angular aggregates and we get 20mm size of aggregates for this research work.

3.1.2. Fine Aggregate:

As we all know that the fine aggregates are used to fill the free spaces in the matrix so in this research work we are going to use sand as fine aggregates. As it fills the pores in the matrix so it increases the strength of the matrix.

3.1.3. Ordinary Portland Cement (OPC):

we are going to use ordinary Portland cement (OPC) of 43 grade in this research work. All of us know that for the common residential work 43 grade of OPC is used in most of the times. In this research we are going to use M25 grade of concrete. This cement should be such that with time it will be able to gain the strength and will be able to endure minimum strength of 430kg/sqcm. So in this research we are going to use OPC 43grade.

3.2. Test On Material:

We have to perform different tests on materials before using in our research:

- **Sieve analysis:**
  This test is completed on the aggregates to recognize the size of aggregates that we are going to use in our mix design that is M25 grade.

- **Water absorption test:**
  This test is accomplished on the aggregates to know that the how much water absorption is done by the aggregates during the preparation of mix.

- **Specific gravity test:**
  This test is done on the aggregates to recognize the strength of the aggregates in addition to understand the quality of the materials.

3.2.1. Specific Gravity and Water Absorption Test of Fine Aggregate:

This test we are able to perform to take a look at the aggregates and will see whether the sand that we're going to use in research work is good in quality or not. Also we are determining that the sand we are using to prepare mix absorb how much amount of water. So for this test we will use pycnometer**.**

Firstly we will take the weight of the empty pycnometer (W1)

Secondly we will take the weight of pycnomter with sand is pour in it (W2)

Third we will take the weight of the pycnometer when water is pour in the pycnometer along with the sand (W3)

After that we will take the weight of pycnomter with only water in it (W4)

Specific gravity = (W2-W1)/ (W2-W1)-(W3-W4)

3.2.2. Specific Gravity and Water Absorption Test of Coarse Aggregate:

Specific gravity test is done on the aggregates to recognize the strength of the aggregates in addition to understand the quality of the materials. We need to discover the specific gravity of aggregates because it will be required for the preparation of the mix design so that it will be used for the formation of the matrix. So the procedure of test is as follow:

W1= It is weight of aggregate that is suspended in the water with basket

W2= Only weight of basket will be considered.

W3=Weight of the saturated dry aggregate will be considered.

W4= Weight of oven dry aggregate.

Specific Gravity= W3/(W3-(W1-W2)

Water Absorption= ((W3-W4)/W4)*100

3.2.3. Sieve Analysis Test:

This test is completed on the aggregates to recognize the size of aggregates that we are going to use in our mix design. Sieve analysis test gives us the particle size of the fine and coarse aggregates. In this we will use various sieves for having aggregates of different size as per instructions of IS 2386(part1)-1963. we require 20mm angular aggregate for this research work.

3.3. Tests After Casting:

After we are done with tests on the materials we have to cast the cubes, cylinders and beams to check the compressive, flexural and split tensile strength. So the following are the tests are followed as:

3.3.1. Split Tensile Strength Test:

As all of us understand that concrete is good in compressive strength but lacks in tensile strength. The tensile strength of the concrete is one of the primary element that we should taken into consideration even as making a concrete. So split tensile strength is executed at the concrete cylinder to know the tensile strength of concrete.

For split tensile strength we have to forged a cylinder and after casting we must perform take a look at on the moist specimen after 7 days. We need to perform this test on compression testing machine for the specified range. Before putting the cylinder inside the gadget we want to region a plywood strip at the lower plate after which place the specimen. Then place the opposite plywood strip on above and begin applying the load to it and note down the breaking load (pi).

Split tensile strength=2P/piDL

P = applied load on the specimen

D = It is the diameter of the specimen

L= It is length of the specimen

Pi = breaking load of the specimen

Fig.3 split tensile strength test

3.3.2. Compressive Strength Test:

All of us know that the concrete is already good in the compressive strength so we check that when we add glass fibers to the mix and after the formation of the cube we will compare that whether the adding of the fibers will increase the compressive strength or decrease it.

So in this test after casting of the cube we will put it in the compressive strength testing machine for seeing whether after the addition of the glass fibers is there any increase in the strength of the concrete or decrease in the strength of the concrete.

Compression Strength Test is done to check whether concreting is done properly or not. We will perform the test on 100mm*100mm of cube mold. The concrete is poured in the mold and then will be tempered properly such that there should be no formation of air voids. We will make M25 grade cubes and then will be tested by Universal Testing Machine(UTM) after 7, 14, 28 days curing at the rate of 140 kg/cm2 per minute till there is failure seen in the specimen.

Compressive Strength = Load / Area

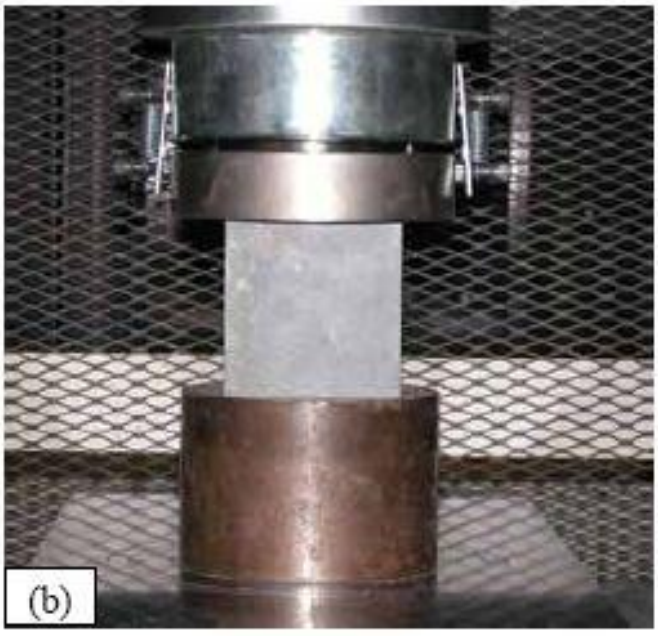

Fig.4 compression strength test

3.3.3. Flexural Strength Test of Concrete:

This Test will be done to recognize the bending strength of the concrete. After this we take a look that how much load a beam can convey without breaking.

Beam Mold: Size of the beam is 100mm*100mm*500mm. This test will be conducted with the help of third- point loading. In this test the beam should be rested on the two roller on each side such that if we are using 500mm length beam then on both side of the beam 10mm on beam should be left outside of the rollers and third roller should be applied at the center of the beam at the rate of 180kg/min.

Flexural Strength(fb) =3pa/bd2

P=Maximum load

d= failure point depth

b= width of specimen

l= supported length

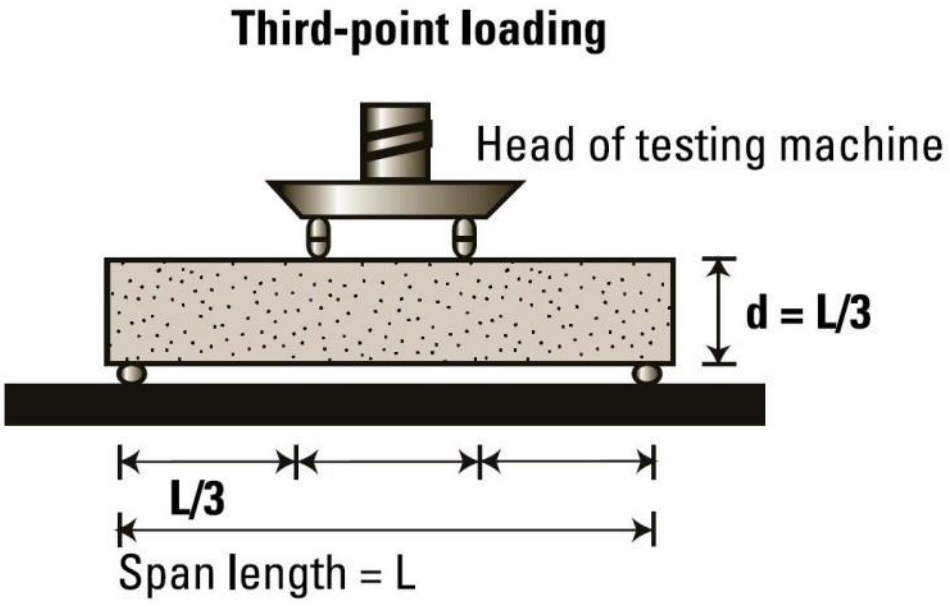

Fig. 5 Flexural strength test

CHAPTER 4

RESULTS AND CONCLUSION

The main objective of this research is to compare the mechanical properties of conventional concrete with glass fiber reinforced concrete. So for that we need to perform the compressive, tensile and flexural strength test on the cube, cylinder and beam respectively. So before that we need to perform the test on the materials that will be used in the casting of the cubes, beams and cylinders.

So following are the test that we have performed on the materials:

4.1. Test On Materials:

4.1.1. Specific Gravity and Water Absorption of Fine Aggregates (Sand):

This test we are able to perform to take a look at the aggregates and will see whether the sand that we're going to use in research work is good in quality or not. Also we are determining that the sand we are using to prepare mix absorb how much amount of water.

In this test we have firstly taken the weight of the pycnometer that is (W1) = 628.5gm

Then we have taken the 500gm sand and pour it in the pycnometer and then I have taken the weight that is (W2) = 1128.5gm

Now we will take the combined weight of pycnometer, sand and this time we will also pour water in the pycnometer and termed as (W3) = 1669gm

Finally (W4) is the weight of pycnometer with the water \=1356gm

Specific gravity = W2-W1/(W2-W1)-(W3-W4)

= 500/500-313

=2.68

Water Absorption of the fine aggregates that is sand is 1%.

4.1.2. Specific Gravity and Water Absorption Test of Coarse Aggregate:

Specific gravity test is done on the aggregates to recognize the strength of the aggregates in addition to understand the quality of the materials. We need to discover the specific gravity of aggregates because it will be required for the preparation of the mix design so that it will be used for the formation of the matrix. In this we will take 2kg of aggregate.

(W1) is the weight of wire basket and aggregate both induced in water=2597gm

(W2) is the weight of the wire basket alone in water=1352gm

(W3) is the weight of the dry aggregate =2002gm

(W4) is the weight of the oven dry aggregate= 1988gm

Specific Gravity = W3/(W3-(W1-W2)

= 2002/757

= 2.65

Water Absorption= ((W3-W4)/W4) *100

= ((2002-1988)/1988) *100

= 0.5%

4.2. Design A Concrete For Strength M25:

4.2.1. Specification of Materials:

Table 2

Grade designation	M25
Maximum formal sizes of aggregates	20mm
Water cement ratio	0.45
Type of cement	OPC 43 grade
Minimum cement content	320kg/m^2
Workability	75mm (slump)
Type of aggregates	Angular aggregates
Chemical admixture	Nil

4.2.2. Test-Data For Materials:

Table 3

Cement used	OPC 43grade
Specific gravity of cement	3.10
Specific gravity of coarse aggregates	2.65
Specific gravity of fine aggregates	2.68
Water absorption of coarse aggregates	0.5
Water absorption of fine aggregates	1
Chemical admixture	Nil

Now are the steps that will be done for the mix design of the concrete and that mix design will help us to know the ratio according to which we will consider the amount of cement, sand aggregate, coarse aggregate and water to be used for the making of cube, beam and cylinder.

Step 1- Targeted Strength = Fck = fck+*S

= 25 + 1.65*4 = **31.6 N/mm^2**

Step 2- selection of water cement ratio:

Maximum water cement ratio from IS 456: 2000 = 0.50 for M25 grade of concrete

Step 3- selection of water content:

Maximum Water Content for the 20mm aggregate is 186 litre for the 50mm slump

So 186*6/100+186 = 197 litres

So as we are not using any chemical therefore no change will be there then 197 litre is OK

Step 4-Calculation of Cement Content:

As water cement ratio is 0.50

So therefore Cement Content = 197/0.50 = **394kg/m^3**

Step 5- Calculation of Mix Proportions:

a) Volume of concrete = 1m^3

b) Volume of Cement = Mass Of Concrete/Specific Gravity of cement* 1/1000

= 394/3.10*1/1000

= 0.127 m^3

c) Volume of Concrete = Mass of Water/Sp. Gravity Of water*1/1000

= 197/1*1/1000

=0.197m^3

d) Volume of the admixture is nil as we are using no chemical admixture in the research.

e) Volume of all in aggregate = [a-(b+c+d)]

= [1-(0.127+0.197+0)]

=0.676m^3

f) Mass of coarse aggregate = e * Volume of Coarse aggregate* S.G. of C.A*1000

=0.676*0.62*2.65*1000

=1110.668kg/m^3

g) Mass of fine aggregate = 0.676*0.38*2.68*1000

=688.43kg/m^3

4.2.3. MIX PROPORTIONS

Table 4

cement	394kg/m^3
water	197
fine aggregates	688.43kg/m^3
coarse aggregates	1110.68kg/m^3
chemical admixture	Nil
water cement ratio	0.5

4.3. To Express the Proportion In Usual Way:

As we know about the mix design ratio for M25 grade of concrete is given as:

C : F.A. : C.A. : Water

1 : 1 : 2 : 0.5

So based on this ratio we will cast the cubes, cylinders and beams for compression test, split tensile test and flexural test respectively.

So firstly before the casting of the cubes we need to prepare the mix ratio of fine aggregates, coarse aggregates and cement respectively.

For cubes:

Volume of cube = 0.1*0.1*0.1m^3 = **0.001m^3**

Cement = Volume of cube * 394*(1cube) = **0.394kg**

Fine Aggregate= Volume of Cube * 688* 1(cube) = **0.688kg**

Coarse aggregate = Volume of cube * 1110*(1 cube) = **1.11kg**

For Beam:

Volume of beam = 0.5*0.1*0.1 = **0.005m^3**

Cement = Volume of beam * 394*(1beam) = **2.28kg**

Fine Aggregate= Volume of beam * 688* 1(beam) = **3.49kg**

Coarse aggregate = Volume of beam * 1110*(1 beam) = **5.31kg**

CHAPTER 5

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