Experimental Study on Compressive Strength of Glass Fibre Reinforced Concrete by Using Manufactured Sand

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Abstract – A huge quantity of concrete is consumed by the construction industry all around the world. In India, the conventional concrete is produced by using natural sand from river beds as fine aggregate. This result in the acute shortage of river sand and it will badly affect the construction sector. The promotional use of M-Sand will conserve the natural resources. Concrete is an Irreplaceable component in construction industry as of today. The need for improving performance of concrete is increasing day by day due to its huge usage throughout the world. Many improvements have been taking place in concrete, both chemically and minerally by using several additives. Most of the works on concrete have been on admixtures such as flyash, rice husk ash, stone dust etc., in the same way different fibres has been used to improve strength of concrete, especially to improve its strength during tensile loads. Glass fibre has been used as a replacement to M-sand in concrete by 1, 2, 3, 4 and 5% to study the behavioral changes of concrete. Glass fibre reinforced concrete is made of a cementitious matrix composed of cement, sand and water in which short length glass fibres are dispersed.

Index Terms – River sand, M-sand, Chopped AR Glass Fibre, Compressive Strength, Split Tensile, Durability.

1. INTRODUCTION

Concrete is a composite building material consisting of Cement, Water and Aggregates in suitable proportions. The Chemical reaction between cement and water binds the Aggregates into a hard Solid Mass. Concrete Structures have become very common in Civil Engineering Constructions Worldwide. Concrete is the most widely used material in construction industry. It has become a universal building material for its high Compressive Strength, adoptability of gaining any shape and form and its resistance to fire and corrosion with very low maintenance costs. Concrete with high strength along with long term durability, serviceability are the need of the day. With the environmental issues raising because of extraction of sand from rivers, the demand for replacement of Sand is widely increasing. The decrease in availability of Natural sand is also a cause for the demand for replacement of Sands worldwide. Civil engineers have to promote the use of Manufactured Sand as the demand for ban on sand mining is increasing day by day in various regions.

Due to its consistent gradation with minimum impurities, manufactured sand is reported to be a widely used material by the technicians of major projects all round the world. According to IS code provisions, M30 grade concrete was made and is checked for Compressive, Split Tensile and Durability respectively. It can be stated that by use of manufactured sand in place of river sand, the strength of concrete is very much increased. The increase in usage of glass fibre in various categories has influenced even the construction field. The flexibility and non-toxic nature of today's glass fibre makes it a suitable building material and a very good additive for concrete mix. So, in this Investigation along with replacement of Natural Sand with Manufactured Sand we also study the behavior of concrete with inclusion of glass fibre in different percentages. The compressive, Split Tensile Strength and durability are tested for concrete cubes made of different percentages of M-sand and Glass fibre. For Durability tests, Concrete is cured both in Acid and Base and decrease in weights and Compressive Strengths are tested.

2. NATURAL SAND VS MANUFACTURED SAND

River Sand is formed by the attrition process of hard rock which occurs naturally by which the river sand attains smooth surface texture and shape. The moisture carried by the sand in between particles helps for the workability of concrete. But the characteristics of concrete is affected much by silt and clay content of river sand which is unavoidable even after fine grading of sand because of its natural occurrence. Grading to obtain the required fineness modulus between 2.4 to 3.1 becomes tough for river sand. As we have no control over natural processes, it has been verified that across various

regions of south the probability of getting consistent quality of sand in terms of grading and silt and clay content is very low.

Whereas we can attain required fineness modulus of sand by VSI method of attrition and required shape and surface textures are maintained by process of washing the crushed particles. The fineness modulus between 2.4 to 3.1 and Zone-II can be achieved by using good screening system. The Compressive strength, Split tensile strength, durability can be increased due to the use of well processed Manufactured Sand.

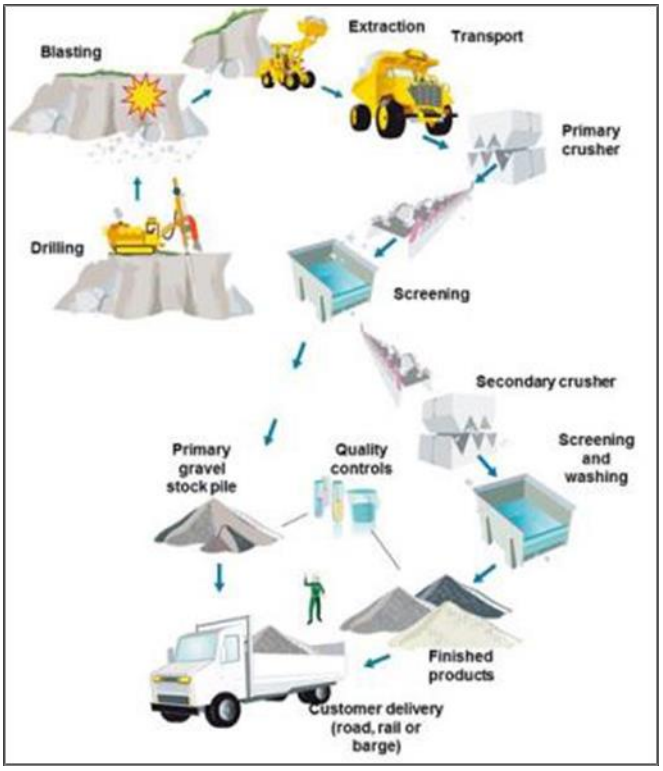

Fig. Procedure of processing Manufactured sand

3. GLASS FIBRE

Glass fibre also termed as Fibre glass is a light weight, extremely strong, robust material made by Extremely fine fibres of Glass. The low cost raw materials used to produce it and its low brittle nature make Glass fibre reliable than other metals whose bulk strength and weight properties are less favourable compared to Glass fibre. Glass being the most familiar, oldest performance fibre since 1930s, can be easily produced by molding. It can be stated that the strength and durability increases with reasonable percentage of inclusion of glass fibre supplements in concrete mix.

The recent researches by known concrete precast industries has been carried out to check the reliability of Glass fibre as a building material, as its low weighing and improved tensile strengths attract the technicians all over the world. Especially the need for light weight concretes for easy transport and installation led to the research on Glass fibre.

Fig. Glass Fibre

The reinforcing systems with carbon or glass strands and stainless steel bars are analyzed to obtain GFRC with high durability which leads to corrosion free concrete. The characteristic properties of Glass fibre are yet to be known in detail, even if they are widely used in non-structural elements, with average mechanical properties. The mechanical strengths, Young's modulus, creep and shrinkage and stress-strain diagrams are determined for Glass fibre using experimental results. Even though the material characteristics depend mainly on the production methods, tests are carried out with different percentages of cementitious matrix in plain mortar to obtain required mechanical properties.

3.1. TYPES OF GLASS FIBRE

i. A-glass: It is mainly used in manufacture of process equipment in Germany and its composition is close to generally used window glass.

ii. C-glass: C-Glass has a very good resistance to Chemical reactions.

iii. E-glass: E-Glass shows good electrical resistance including its resistance to Chemical reactions as C- Glass.

iv. AE-glass: AE-Glass is the alkali resistant glass, which is used in this investigation.

Fig. Crushed Glass Fibre

Generally, additives like quartz sand, soda, sodium sulphate, potash, feldspar and a number of refining and dying additives are added while manufacturing Glass. The classification and characteristics of Glass fibre depend upon the raw materials used to make it.

4. SCOPE OF PRESENT WORK

i. Review and research of glass fibres

ii. Construct the concrete specimen by twenty seven cubes by partial replacement of cement by Glass fibre with different percentages (0%, 1%, 2%, 3%, 4%and 5%) by weight of cement.

iii. Investigation and laboratory testing on concrete cube.

iv. Analysis the results and recommendation for further research work.

5. OBJECTIVES OF INVESTIGATION

a. M-Sand

1. Natural Sand has been used for making of mortar or Concrete since the invention of Cement.
2. The word Natural Sand itself states that it is a Naturally occurring Material, which is generally formed by weathering effect of rocks due to various factors.
3. Generally Sands are available in River beds and Sea shores whereas the nearest available resource is given preference.
4. However, Sand in Sea Shore is not preferred due to its high Salt Content which highly decreases the Durability of Concrete.
5. By this the usage of River sand is increasing day by day which is decreasing the availability of this natural resource, so there is a need to find an alternative or a replacement for River Sand.
6. M-Sand is artificially occurring sand in Stone Crushing factories called Crusher Dust which can be a perfect replacement for Natural sand as it can be crushed into required sizes and its reactivity to acid and base circumstances is also very less.
7. So, in this Investigation M-Sand has been used as replacement for River sand in different percentages and various tests has been carried out.

b. Glass Fibre

1. Glass fibre is a modern day material which has been used in various Industries successfully and various experiments have been carried out towards its usage in civil engineering works.
2. The Flexibility nature and non toxic nature of Glass fibre makes it a reliable building component now a days.
3. So, in this Investigation Glass fibre has been used as replacement for Cement in different percentages and various tests has been carried out.
4. It has been used in percentages of 1%, 2%, 3%, 4% and 5% replacements for Cement and several cubes have been casted in these percentages for investigation.
5. Workability test, Compressive Strength Test, Split Tensile Strength Test and Durability tests for Compressive Strength and Weights have been carried out both in Acidic and base circumstances.
6. The Strengths of these cubes have been compared with Strengths of Cubes with 0% Glass fibre i.e.., 100% Cement such that the percentage increase or decrease in Compressive Strength, Split Tensile Strength, Workability, Compressive Strengths and weights of cubes in Acid and Base Circumstances.
7. The main objective of using Glass fibre is to draw the Impact of it on various implying factors of Concrete's utility and to check whether it can be a better replacement for Cement.
8. However, as very low percentages of Glass fibres are used, they are added to cement and not replaced.

9. RELATED WORKS

[1.1] Chandramouli. K, et.al, (2010) conducted a study to investigate the strength properties of glass fibre reinforced concrete. The author has observed that the addition of glass 1fibres increases the compressive strength from 20 to 25% & increased the tensile & flexural strength from 15 to 20%. The author also has observed that addition of glass fibres reduces the bleeding of concrete & reduces the probability of cracks.

[1.2] P. Sangeetha, (2011) has concluded that Glass fibre with combination of admixtures shows good result both in compressive & impact test.

[1.3] Eng. Psthiwar. N. Shakor et.al, (2011) have observed that glass fibre helps the concrete to increase compressive strength until indicated limit. For 1.5% of cemetitious weight gained best results have been obtained as compared to other results. The author also has found that the air entrainment affects the tensile strength to compressive strength ratio particularly in rich mixes.

[1.4] S.U. Kannan, et al, (2010) conducted experiments on the effect of AR Glass polymer fibers in self compacting and self curing concrete. Based on the results obtained the author has concluded that the lowest volume of fibers 0.2% makes the concrete impermeable with good workability and more compressive strength. The author has also pointed out that the maximum compressive strength & maximum resistance to

penetration is obtained at 1% volume of fibres with 0.8% of super plasticizer.

10. EXPERIMENTAL INVESTIGATIONS

General

In this investigation the exploratory examination is completed to acquire the Compressive strength quality, Split Tensile, Workability and Durability of M30 evaluation of cement by halfway supplanting of bond with M-sand and Glass fibre. In the present examination, Concrete examples were readied with different extents of Glass fibre 0%, 1%, 2%, 3%, 4%, 5% and M-sand 0%, 25%, 50%, 75%, 100% of bond substitution of weight.

Mixing of Concrete

At first the mixed design is carried in ACI method the outline of solid blend requires complete learning of different properties of the constituent materials. fixings, for example, bond and M-sand are blended, to which the fine total and coarse total are included and completely blended. Water and Glass fibres are measured precisely. At that point it is added to the dry blend and it is completely blended until a blend of uniform shading and consistency is accomplished which is then prepared for throwing. Before throwing of examples, workability is measured as per the code IS 1199-1959 by droop and compaction variable tests.

Fig. Mixing of Glass Fibre

Casting

The standards moulds were fitted such that there are no gaps between the plates of the moulds. If there is any gap, they were filled with plaster of Paris. The moulds were then oiled and kept ready for casting. Concrete mixes are prepared according to required proportions for the specimens by hand mixing; it is properly placed in the moulds in 3 layers. Each layer is compacted 25 blows with 16 mm diameter tamping rod. After the completion of the casting, the specimens were vibrated on the table vibrator for 2 minutes. At the end of vibration the top surface was made plane using trowel. After 24 hours moulds were removed and concrete specimens were kept for wet curing.

Curing

The test specimens are stored in place free from vibration, specimens are removed from moulds after 24 ± half an hour time of addition of water to dry ingredients. After this period, the specimens are marked and removed from the moulds and unless required for test within 24 hours immediately submerged in clean fresh water and kept there until taken out just prior to test. The water in which the specimens are submerged, are renewed every seven daysand are maintained at temperature of 27°±2°C.The specimens are not allowed to become dry at any time until they have been testing. The specimens were put under curing for 28 days.

11. TESTS ON HARDENED CONCRETE

11.1. COMPRESSIVE STRENGTH OF CONCRETE

Compressive strength was found out as per IS 516-1959. The compressive strength test was conducted after 28 days of curing. Standard cast iron moulds of dimensions 150 x 150 x 150 mm were used to cast the specimen. The capacity of the compressive strength testing machine used was 2000KN. The Compressive Testing Machine.

Fig. Cube after failure in compressive testing machine

11.2. SPLIT TENSILE STRENGTH OF CONCRETE

Assuming concrete specimen behaves as an elastic body a uniform lateral tensile stress of Part elasticity (Ft) action alone the vertical plane causes the failure of the specimen, which can be calculated from the formula.

$Ft = 2P/\pi DL.$

Where P= load at failure,

D= depth of cube and

L=length of the cube.

Fig. Cube after failure in split tensile test

11.3. DURABILITY OF CONCRETE

Durability of Concrete is defined as the ability to resist weathering action and chemical attack, while maintaining the desired engineering properties. Due to the use of inappropriate materials, poor construction practices, insufficient curing, and/or improper mix designs, many structures show serious premature deterioration. The durability of concrete is tested by following tests.

a. Acid (H_2So_4) attack Test

b. Base (Nacl) attack Test

a. Acid Attack Test

The concrete cube specimens of various concrete mixtures of size 150 mm were cast and after 28 days of water curing, the specimens were removed from the curing tank and allowed to dry for one day. The weights of concrete cube specimen were taken. The acid attack test on concrete cube was conducted by immersing the cubes in the acid water for 90 days after 28 days of curing. Sulphuricacid (H2so4) with pH of about 2 at 5% weight of Water was added to water in which the concrete cubes were stored. The pH was maintained throughout the period of 90 days. After 90 days of immersion, the concrete cubes were taken out of acid water. Then, the specimens weretested for compressive strength. The resistance of concrete to acid attack was found by the % loss of weight of specimen and the % loss of compressive strength on immersing concrete cubes in acid water.

b. Base Attack Test

To determine the resistance of various concrete mixtures to alkaline attack, the residual compressive strength of concrete mixtures of cubes immersed in alkaline water having 5% sodium chloride (Nacl) of by weight of water was found. The concrete cubes which were cured in water for 28 days were removed from the curing tank and allowed to dry for one day. The weights of concrete cube specimen were taken. Then the cubes were immersed in alkaline water continuously for 90 days. The alkalinity of water was maintained same throughout the test period. After 90 days of immersion, the concrete cubes were taken out of alkaline water. Then, the specimens were tested for compressive strength.

The resistance of concrete to alkaline attack was found by the % loss of weight of specimen and the % loss of compressive strength on immersion of concrete cubes in alkaline water.

Fig. Cubes cured in Acid and Base

12. RESULTS AND DISCUSSIONS

Workability

The slump value for conventional concrete of M30 grade is 79.5 mm. Thus, Workability of M30 Grade Concrete is measured by conducting Slump cone test and obtained the value of Slump as 79.5 mm.

When Natural sand is replaced with different percentages[25%, 50%, 75%, 100%] of M-sand with a little 4varying percentages of Glass fibre[1%, 2%, 3%, 4%, 5%] the Workability varies as follows.

Effect of Glass fibre & M-sand on Workability

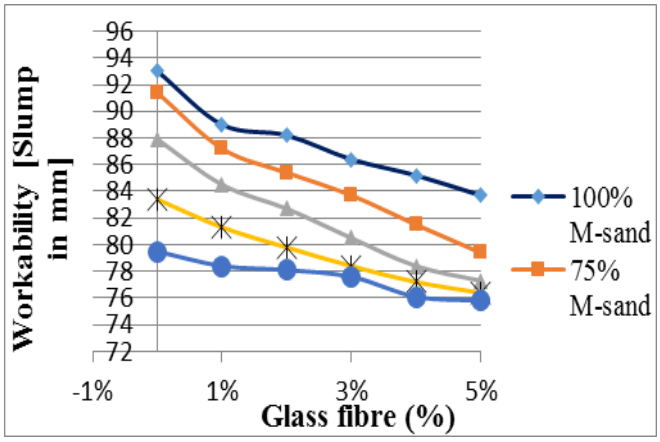

Fig. Effect of M-sand and Glass fibre on Workability of Concrete

The percentage decrease in Workability has very low of 0.78% at 25% M-sand with 5% Glass fibre compared to 0% M-sand with 5% Glass fibre and the percentage decrease in Workability has very high of 14.51% at 100% M-sand with 0% Glass fibre compared to 0% M-sand with 0% glass fibre. This Shows Workability increases with the replacement of Natural Sand with M-sand.

The percentage decrease in Workability has very low of 1.4% at 0% M-sand with 1% Glass fibre compared to 0% Glass fibre with 0% M-sand and the percentage decrease in Workability has very high of 15.11% at 75% M-sand with 5% Glass fibre compared to 0% Glass fibre with 75% M-sand.

In the above details, we can state that Manufactured sand increases the Workability of concrete and we can sense that replacing cement with too much of fibres decreases its bonding strength.

Compressive Strength

The compressive Strength of concrete is done after curing of concrete for 7 days and 28 days respectively. The compressive Strength of concrete after 7 days 28 days is as follows.

Effect of Glass fibre & M-sand on 7 days Compressive Strength of Concrete

The percentage increase in Compressive Strengthat 7 days has a very low of 1.96% at 25% M-sand with 0% Glass fibre compared to 0% M-sand with 0% Glass fibre and the percentage increase in Compressive Strength has very high of 11.15% at 100% M-sand with 5% Glass fibre compared to 0% M-sand with 5% glass fibre. This Shows Compressive Strength increases with the replacement of Natural Sand with M-sand.

The percentage increase in Compressive Strengthat 7 days has very low of 4.10% at 0% M-sand with 1% Glass fibre compared to 0% Glass fibre with 0% M-sand and the percentage decrease in Compressive Strength has very high of 9.31% at 25% M-sand with 3% Glass fibre compared to 0% Glass fibre with 25% M-sand.

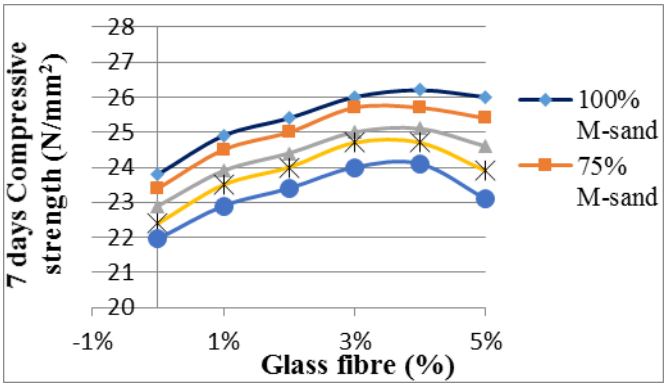

Fig. Effect of M-sand and Glass fibre on 7 days Compressive Strength of Concrete

Effect of Glass fibre & M-sand on 28 days Compressive Strength of Concrete

The percentage increase in Compressive Strength at 28 days has a very low of 1.76% at 25% M-sand with 4% Glass fibre compared to 0% M-sand with 4% Glass fibre and the percentage increase in Compressive Strength has very high of 9.62% at 100% M-sand with 5% Glass fibre compared to 0% M-sand with 5% glass fibre. This Shows Compressive Strength increases with the replacement of Natural Sand with M-sand.

The percentage increase in Compressive Strength at 28 days has very low of 2.47% at 100% M-sand with 1% Glass fibre compared to 0% Glass fibre with 100% M-sand and the percentage decrease in Compressive Strength has very high of 6.15% at 0% M-sand with 4% Glass fibre compared to 0% Glass fibre with 0% M-sand.

By this data, we can Conclude that Manufactured sand increases the Compressive Strength of Concrete to a great extent, Whereas when Glass fibre is added the Compressive Strength increases upto some extent but after a certain level addition of Glass fibre shows negative effects. In the Investigation the Compressive Strength increased upto 4% addition of glass fibre and then Decreased.

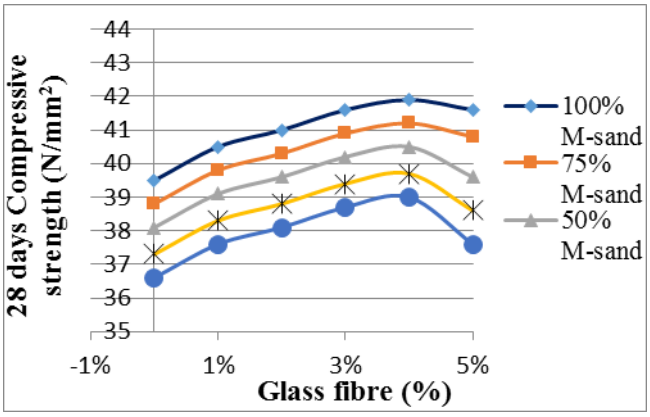

Fig. Effect of M-sand and Glass fibre on 28 days Compressive Strength of Concrete

Split Tensile Strength

As Concrete is weaker in tension, the failure of concrete is possible to occur when it is subjected to tensile forces. So, to check the strength of concrete to resist Tensile loads, Split Tensile test is conducted. Similar to the Compressive test, the Split Tensile Strength test of concrete is done after curing of concrete for 7 days and 28 days respectively.

Effect of Glass fibre & M-sand on 7 days Split Tensile Strength of Concrete

The percentage increase in Split Tensile Strength at 7 days has a very low of 2.95% at 25% M-sand with 4% Glass fibre compared to 0% M-sand with 4% Glass fibre and the

percentage increase in Split Tensile Strength has very high of 13.33% at 100% M-sand with 5% Glass fibre compared to 0% M-sand with 5% glass fibre. This Shows Split Tensile Strength increases with the replacement of Natural Sand with M-sand.

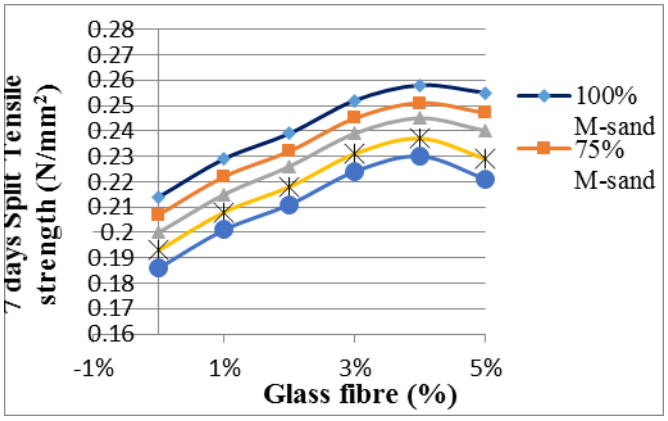

Fig. Effect of M-sand and Glass fibre on 7 days Split tensile strength of Concrete

The percentage decrease in Split Tensile Strength at 7 days has very low of 6.55% at 100% M-sand with 1% Glass fibre compared to 0% Glass fibre with 100% M-sand and the percentage decrease in Split Tensile Strength has very high of 19.13% at 0% M-sand with 4% Glass fibre compared to 0% Glass fibre with 0% M-sand.

Effect of Glass fibre & M-sand on 28 days Split Tensile Strength of Concrete

The percentage increase in Split Tensile Strength at 28 days has a very low of 2.21% at 25% M-sand with 4% Glass fibre compared to 0% M-sand with 4% Glass fibre and the percentage increase in Split Tensile Strength has very high of 10.39% at 100% M-sand with 5% Glass fibre compared to 0% M-sand with 5% glass fibre. This Shows Split Tensile Strength increases with the replacement of Natural Sand with M-sand.

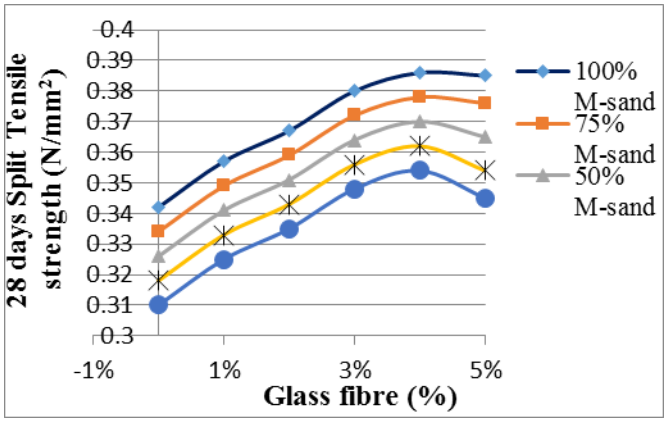

Fig. Effect of M-sand and Glass fibre on 28 days Split tensile strength of Concrete

The percentage decrease in Split Tensile Strength at 28 days has very low of 4.20% at 100% M-sand with 1% Glass fibre compared to 0% Glass fibre with 100% M-sand and the percentage increase in Split Tensile Strength has very high of 12.43% at 0% M-sand with 4% Glass fibre compared to 0% Glass fibre with 0% M-sand.This doesn't mean Concrete gets stronger in tension, but it assures to resist even more tensile loads than the Normal, Natural, Conventional Concrete. Here, Tensile Strength of cube increases upto 4% addition of Glass fibre and beyond that it decreases its Tensile Strength.

Durability

The Durability of concrete cubes have been checked by using two types of tests i.e., Compressive Strength tests and Weight Tests. For obtaining Durability, concrete cubes are cured in both Acid(H_2SO_4) and Base(NaCl) for 28 days and tested. The durability test is required to know the resistance shown by concrete under different circumstances and worsen environments which may lead to failure of Concrete.

Generally, there are many types of tests to check the Durability of Concrete which include Water Absorption Test, Acid Attack Test, Base Attack test etc.., In this Investigation, we successfully performed both Acid Attack and Base Attack test by curing the cubes for 28 days in both Acid and Base. Then, the cubes have been tested for variation in Weight and Compression Strengths.

Durability Compressive Strength

Durability itself means the capacity to sustain and it is a well known fact that Concrete is very good in Compression and for that cause it is a most reliable Building Compound. So, it is clear that Compressive Strength is the main Strength of concrete. Thus, in this Investigation, Compressive Strength is checked to estimate the durability of Concrete. And Concrete undergoes many physical and chemical reactions in the long term due to prevailing environmental conditions, exposure to various chemical compounds both Acid(H_2SO_4)` and Base.

Thus the reactiveness of Concrete, in such conditions is observed by both Acid Attack and Base Attack tests. In such conditions, Greater Impact will be on Weight of the Buiding compound that is subjected to these abnormal conditions. So, here in this Investigations, after subjecting to such Acidic(H_2SO_4) and Base conditions, the cubes are checked for weight and is compared to the weight of the cubes before curing in those conditions. Thus, we can have a good view on the Durability of Concrete under abnormal conditions. The Compressive Strengths of Conventional Concrete Cubes are compared to those having additives and replacements of Glass fibre and M-sand. The Weights after 28 days curing has been compared with Initial Weight of Cubes and the Results are listed below.

Effect of M-sand and Glass fibre on Compressive strength of Concrete when immersed in Acid[H_2 So_4] for 28 days

The percentage increase in Compressive Strength of cube cured in Acid for 28 days has a very low of 1.55% at 25% M-sand with 4% Glass fibre compared to 0% M-sand with 4% Glass fibre and the percentage increase in Compressive Strength has very high of 8.60% at 100% M-sand with 5% Glass fibre compared to 0% M-sand with 5% glass fibre. This Shows Compressive Strength increases with the replacement of Natural Sand with M-sand.

The percentage decrease in Compressive Strength of cube cured in Acid for 28 days has very low of 2.34% at 75% M-sand with 1% Glass fibre compared to 0% Glass fibre with 75% M-sand and the percentage decrease in Compressive Strength has very high of 7.07% at 0% M-sand with 4% Glass fibre compared to 0% Glass fibre with 0% M-sand.

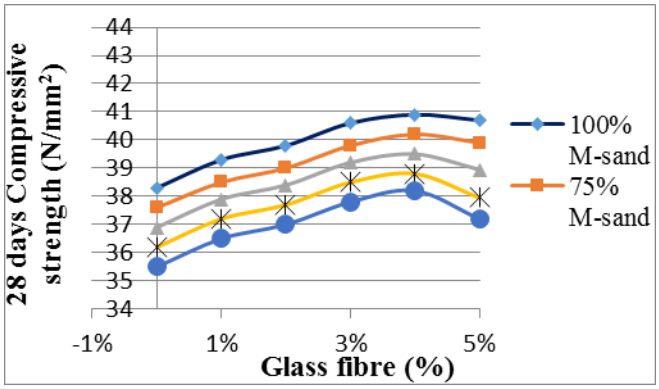

Fig. Effect of M-sand and Glass fibre on Compressive strength of Concrete when immersed in Acid[H_2 So_4] for 28 days

Effect of M-sand and Glass fibre on Compressive strength of Concrete when immersed in Base[NaCl] (N/mm^2) for 28 days

The percentage increase in Compressive Strength of Cube cured in Base for 28 days has a very low of 1.78% at 25% M-sand with 4% Glass fibre compared to 0% M-sand with 4% Glass fibre and the percentage increase in Compressive Strength has very high of 8.84% at 100% M-sand with 5% Glass fibre compared to 0% M-sand with 5% glass fibre. This Shows Compressive Strength increases with the replacement of Natural Sand with M-sand.

The percentage increase in Compressive Strength of Cube cured in Base for 28 days has very low of 2.51% at 100% M-sand with 1% Glass fibre compared to 0% Glass fibre with 100% M-sand and the percentage decrease in Compressive Strength has very high of 6.74% at 0% M-sand with 4% Glass fibre compared to 0% Glass fibre with 0% M-sand.

By these results it is clear that replacement of cement and Natural sand with glass fibre and M-sand is more reactive to Acid Attack with Decrease of Compressive Strength when compared with Compressive Strength of Concrete cubes at 28 days conventionally mixed. It is less reactive to Base Attack with low decrease of Strength than those cured in acid. Curing in Base decreases the weight of cube compared to Conventional Concrete but not as much as Cubes cured in Acid does.

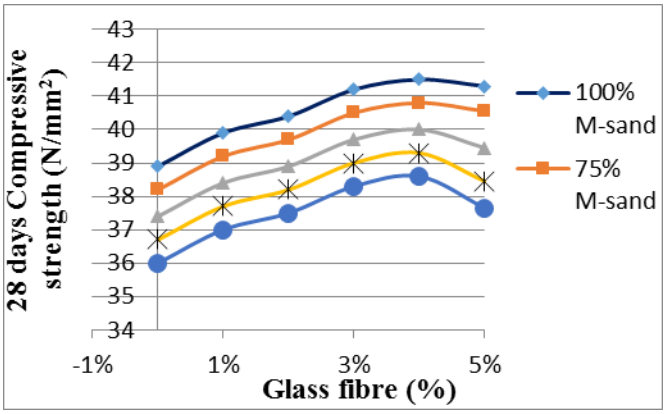

Fig. Effect of M-sand and Glass fibre on Compressive strength of Concrete when immersed in Base[NaCl] (N/mm^2) for 28 days

Durability Weight loss

Effect of M-sand and Glass fibre on Weight of Concrete when immersed in Acid[H_2 So_4] for 28 days

The percentage increase in Weight loss of cube cured in Acid for 28 days has a very low of 0.82% at 25% M-sand with 4% Glass fibre compared to 0% M-sand with 4% Glass fibre and the percentage increase in Weight loss has very high of 6.42% at 100% M-sand with 5% Glass fibre compared to 0% M-sand with 5% glass fibre. This Shows Weight loss decreases with the replacement of Natural Sand with M-sand.

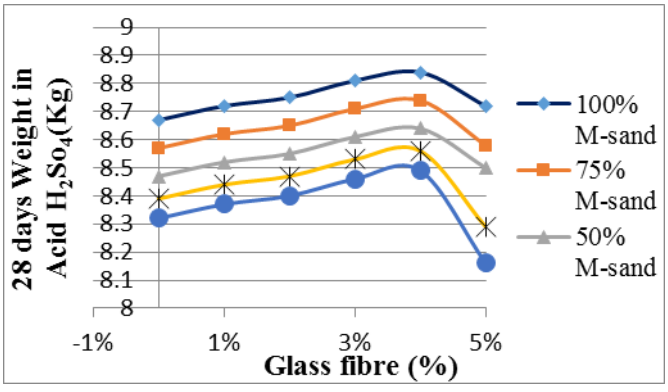

Fig. Effect of M-sand and Glass fibre on Weight of Concrete when immersed in Acid[H_2 So_4] for 28 days

The percentage decrease in Weight loss of cube cured in Acid for 28 days has very low of 0.57% at 100% M-sand with 1% Glass fibre compared to 0% Glass fibre with 100% M-sand and

the percentage decrease in Weight loss has very high of 2.00% at 0% M-sand with 4% Glass fibre compared to 0% Glass fibre with 0% M-sand.

Effect of M-sand and Glass fibre on Weight of Concrete when immersed in Base (NaCl) for 28 days

The percentage increase in Weight loss of Cube cured in Base for 28 days has a very low of 0.70% at 25% M-sand with 4% Glass fibre compared to 0% M-sand with 4% Glass fibre and the percentage increase in Weight loss has very high of 5.24% at 100% M-sand with 5% Glass fibre compared to 0% M-sand with 5% glass fibre. This Shows Weight loss decreases with the replacement of Natural Sand with M-sand.

The percentage increase in Weight loss of Cube cured in Base for 28 days has very low of 0.57% at 100% M-sand with 1% Glass fibre compared to 0% Glass fibre with 100% M-sand and the percentage decrease in Weight loss has very high of 1.99% at 0% M-sand with 4% Glass fibre compared to 0% Glass fibre with 0% M-sand.

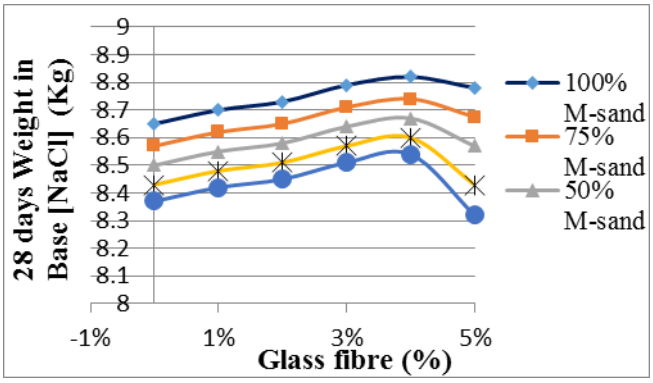

Fig. Effect of M-sand and Glass fibre on Weight of Concrete when immersed in Base (NaCl) for 28 days

13. CONCLUSIONS

Based on the test examination, we can conclude that

1. By replacing the Natural sand with M-sand at different percentages say 0%, 25%, 50%, 75%, 100%, Workability is reduced by 0.79% to 14.52% and Similarly, By using Glass fibre at different percentages say 1%, 2%, 3%, 4%, 5%, Workability is reduced by 1.4% to 12.15%.

2. By replacing the Natural sand with M-sand at same percentages as above the 7 days and 28 days Compressive Strength is increased by 1.96% to 11.15% and 1.76% to 9.62% respectively and similarly by using Glass fibre at same quantities as above the 7 days and 28 days Compressive Strength is increased by 4.10% to 9.31% and 2.47% to 6.15% respectively.

3. By replacing the Natural sand with M-sand at same percentages as above the 7 days and 28 days Split Tensile Strength is increased by 2.95% to 13.33% and 2.21% to 10.31% respectively and similarly by using Glass fibre at same quantities as above the 7 days and 28 days Split Tensile Strength is increased by 6.55% to 19.13% and 4.20% to 12.43% respectively.

4. By replacing the Natural sand with M-sand at same percentages as above, when immersed in Acid[H_2 So_4] and Base (NaCl),the 28 days Compressive Strength is increased by 1.55% to 8.60% and 1.78% to 8.84%respectively. similarly by using Glass fibre at same quantities as above the 28 days Compressive Strength is increased by 2.34% to 7.07% and 2.51% to 6.71% respectively.

5. By replacing the Natural sand with M-sand at same percentages as above, when immersed in Acid[H_2 So_4] and Base (NaCl) for 28 days, Final Weight of Concrete Cube is decreased by 0.82% to 6.42% and 0.7% to 5.24% respectively. similarly by using Glass fibre at same quantities as above the Final Weight of Concrete Cube is decreased by 0.57% to 2.00% and 0.57% to 1.99% respectively.

6. Thus, in this Investigation it is proven that Glass fibre increases the Characteristic Strength of Cement upto 4%, beyond this limit if large amount of Cement is replaced with Glass fibre, Cement loses its bond Strength effecting whole properties of Concrete.

7. Whereas replacement of river sand or Natural sand with M-sand, proves good in all the circumstances and can be used as a replacement for Natural sand Wherever available. But, it increases the economy of the construction when it is to be transported for longer distances.

8. However, if available, M-sand is a better replacement for Natural sand and it also decreases environmental effects due to over usage of Natural sand.

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