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A Study on Fresh & Hardened properties of Glass FiberReinforced M30 Grade concrete using Manufactured Sand

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Abstract : The major problem that the world is facing today is the environmental pollution. In the construction industry mainly the production of ordinary Portland cement (OPC) will cause the emission of pollutants which results in environmental pollution. The production of one ton of Portland cement emits approximately 850kg of CO2 into the atmosphere. An effort in this regard is the replacement of Portland cement with materials of biological origin or by-product materials such as Glass Fibers and manufactured sand in place of natural sand etc. Tests were carried out on 150mmX150mmX150mm cubes.

***IndexTerms* - FiberReinforced, Glass, Manufactured Sand**

I. INTRODUCTION

1.1 General

Concrete is a compound structure material conforming of Cement, Water and Aggregates in suitable proportions. The Chemical response between cement and water binds the Aggregates into a hard Solid Mass. Concrete Structures have come truly common in Civil Engineering Constructions Worldwide. Concrete is the most extensively used material in construction assiduity. It has come a universal structure material for its high Compressive Strength, adaptability of gaining any shape and form and its resistance to fire and erosion with veritably low conservation costs. Concrete with high strength along with long term continuity, utility are the need of the day. With the environmental issues raising because of birth of beach from gutters, the demand for relief of Beach is extensively adding . The drop in vacuity of Natural beach is also a cause for the demand for relief of Sands worldwide. Civil masterminds have to promote the use of Manufactured Sand as the demand for ban on beach mining is adding day by day in colorful regions

1.2 Manufactured Sand

Crushing the Rock to gain the needed grain size of total can be nominated as Cultivated sand (M- Sand). The coarser gravestone are crushed in a special gravestone clincher in order to achieve the required grain size and the material is washed to remove the fine gemstone greasepaint. The characters of Concrete with River Sand is compared with characteristics of Concrete with M- Sand and Glass fibre to prove that M-Sand is a good relief of Natural Sand and to study the best of Glass fiber on Characteristics of Concrete. We believe that Manufactured Sand is commodity rather more specific than just classified clincher dust The end is to produce material that can be used as 100 relief for the stylish quality natural sand, where natural sand is the usual choice. The Manufactured Aggregates i.e., crushed hard gemstone in construction technology have been in use since Roman times. still, natural aggregates feel to be provident, for the same reason Manufactured aggregates are concentrated to regions or systems where vacuity of Natural aggregates is really low.

1.3 Natural Sand Vs Manufactured Sand

River Sand is formed by the waste process of hard gemstone which occurs naturally by which the swash sand attains smooth face texture and shape. The humidity carried by the sand in between patches helps for the plasticity of concrete. But the characteristics of concrete is affected important by ground and complexion content of swash sand which is necessary indeed after fine grading of sand because of its natural circumstance. Grading to gain the needed fineness modulus between2.4 to3.1 becomes tough for swash sand. As we've no control over natural processes, it has been confirmed that across colorful regions of south the probability of getting compatible quality of sand in terms of grading and sediment and complexion content is truly low.

Whereas we can attain needed fineness modulus of sand by VSI system of waste and needed shape and exterior textures are maintained by a process of washing the crushed granules. The fineness modulus between2.4 to3.1 and Zone- II can be achieved by using good screen system. The Compressive strength, Split tensile strength, continuity can be increased due to the use of well reused Manufactured Sand.Fig

The generally used fibers in manufacturing FRC strengthening systems are Steel, Carbon, Agamid and Glass fibers. The most generally used fibers are Steel fibers which are made manually by carbon or stainless steel as their quality and volume impact the mechanical properties of concrete, generally decided for crack control. E-Glass which is known for its electrical resistance, is the generally used reinforcing fiber. Glass fibers have a wider operation around the world as it is cheaper in cost. Use of Glass fiber in concrete mix depends on factors like Glass composition, size, orientation and volume of Glass fiber. These factors play an important part in achieving desired progression mechanically, thermally and electrically.

Polypropylene fibers are thermo plastics produced from Propylene gas. Propylene gas is attained from the petroleum by products or cracking of natural gas feed stocks is used in producing thermo plastic Polypropylene fibers. The addition of Polypropylene fiber which are easy to handle and largely compatible in all chemical admixtures of concrete increases Strength of concrete by reducing minute micro cracks, which are formed in curing process and are subordinated to rapid stress making Concrete weak to tensile loads.

1.5 Glass Fiber

Glass fiber also named as Fiber glass is a light weight, extremely strong, robust material made by Extremely fine fibers of Glass. The low-cost raw materials used to produce it and its low brittle nature make Glass fiber dependable than other metals whose bulk strength and weight properties are less favorable compared to Glass fiber. Glass being the most familiar, oldest performance fiber since 1930s, can be readily produced by molding. It can be stated that the strength and continuity increases with reasonable percentage of addition of glass fiber supplements in concrete mix.

The factors of Glass Fiber Reinforced Concrete are Portland Cement, water, Aggregates both coarse and fine with alkali resistant glass fiber as reinforcing material. The Tensile and Impact Strength of concrete are bettered by the use of GFRC. GFRC is being used substantially in nonstructural industries like façade panels which use about 80 of GFRC for its production, Sanitation networks and unrecoverable decorative form works and have been applied in various structural elements for 30 years. The durability of Glass fiber has been an issue as its reactivity to alkalinity of cement mortar is high, but significant progression in technology lead to the invention of utmost dependable, durable alkali resistant Glass fibers. And the wide range of mortar essentials available which help embrittlement of GFRC make it a safe structure material in construction industry present.

The recent studies by known concrete precast industries have been carried out to check the trustability of Glass fiber as a structure material, as its low importing and enhanced tensile strengths attract the technicians each over the world. Especially the need for lightweight concretes for easy transport and installation led to the exploration on Glass fiber. The reinforcing systems with carbon or glass sand and stainless steel bars are analyzed to obtain GFRC with high continuity which leads to erosion free concrete. The characteristic properties of Glass fiber are yet to be known in detail, indeed if they're extensively used in nonstructural elements, with average mechanical properties. The mechanical strengths, Young's modulus, creep and loss and stress-strain figures are determined for Glass fiber using experimental results. Indeed though the material characteristics depend substantially on the production styles, tests are carried out with different percentages of cementitious matrix in plain mortar to gain needed mechanical properties.

Fig 1.3 Glass Fiber

1.5.1 Types of Glass Fiber

Scope of present work

Review and exploration of glass fibers

Investigation and laboratory testing on concrete moulds.
Analysis the results and recommendation for farther exploration work.

1.7 Applications of GFRC worldwide

1.7.1 Cladding

Much earlier, in the late 1970's, GFRC panels are used on exterior wall of prefabricated timber frame buildings constructed to meet the shortage of dwellings in Scotland.

1.7.2 Road and Rail sound walls

Throughout the world, new roadways and mass conveyance rail systems contend for space in formerly developed civic areas. The result is that major business routes are set up near to marketable and domestic areas and it becomes necessary to suppress noise pollution to the surroundings. GFRC noise walls are being decreasingly used since they are light in weight and offer simplicity and speed of construction without taking the use of heavy lifting.

1.7.3 Ducts and Channels

For drainage and transporting liquids represent another operation for GFRC. commercially available high volume, rainwater drainage channel used in parking lots, road and trace operations. These channels are designed for optimum inflow capacity and are available in different cross-sectional sizes with lengths were ranging up to 2 measures(6.6 bases). Further, these channels are light, easy to install in long sections with reduced excavation, conservation free, and bear smaller ground traps or manholes due to their superior hydraulic performance. The channels are produced by vibration casting AR fibers mix into two-part mold.

1.8 Objectives:

The main objects of this design are as below

To develop fiber reinforced concrete by replacing natural sand by manufacturing sand and small proportions of diced alkali resistant glass fibers.

To examine the plasticity of manufacturing sand and using admixture in concrete.

To research the performance of these concrete terms of its compressive strength, resolve tensile strength and bond strength.

2 LITERATURE REVIEW

2.1 General

In this design it has been achieved to review the literature available in the field of Fiber Reinforced Concrete by using manufactured sand. Some of the important literature connected with this content is furnished below.

2.2 Literature Review

Chandramouli. K,et al., (2010) conducted a study to probe the strength properties of glass fiber 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 fibers reduces the bleeding of concrete & reduces the probability of cracks.

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

Eng. Psthiwar.N. Shakoret.al, (2011) have observed that glass fiber helps the concrete to increase compressive strength until indicated limit. For1.5 of cementitious weight gained the best results have been attained as compared to other results. The author also has set up that the air entrainment affects the tensile strength to compressive strength rate particularly in rich composites.

Mahendra.R. Chitlange & Prakash.S. Pajgade,(2010) have delved the strength properties of artificial sand as fine total in SFRC. The author has reported that there's consistent increase in the strength of plain concrete when natural sand is completely replaced by artificial sand. The author has also refocused out that the full relief of natural sand by artificial sand considering the specialized, environmental & marketable factors is effective.

H.M.A. Mazes,et.al,(2011) have conducted studies to determine the relative performance of concrete by using greasepaint sand. From the trials the author has observed that the compressive strength of mortar & concrete using gravestone greasepaint gives impressive result than that of normal sand.

V.R.K. NarasinhaRaju,T. Appa Reddy,(2009) have conducted trials for different concrete mix proportions at different chance relief situations of swash sand by manufactured fine total. The author has concluded that the relief of natural sand by manufactured fine total improves the plasticity & compressive strength.

R.Ilangovana,et.al,(2008) have reported that the use of Quarry rock dust as fine total in concrete manufacturing is effective.

3 MATERIAL PROPERTIES

3.1 General

The experimental program was carried out to estimate the mechanical properties i.e., compressive strength and split tensile strength with replacing glass fiber. The program involves casting and testing of total samples. The samples of standard cubes of 150mmx150mmx150mm are casted with and without glass fiber. In first batch the samples were cast with 0 fiber content and remaining four batches were cast by using fiber varying with 1, 2 and 3 by the weight of the cement.

The materials generally used in the concrete mix are cement, fine aggregate(M- Sand & River Sand), coarse aggregate, fibers & water. The materials used in this design for concrete mix are,

3.2 Materials used

The materials used in the investigation are:

Cement

Aggregates

Fine Aggregates

River Sand

Manufacturing Sand (M-sand)

Coarse Aggregates

Glass fibres

Mild Steel bars and HYSD bars

Water

Control cracking

Increase flexibility

Reduction in water permeability

Reduction in rebound loss in concrete

Safe and easy to use

Use of slightly dispersed Diced AR Glass Fiber reduces segregation and bleeding, performing in a more homogeneous mix. This helpsto achieve good strength and decrease permeability which improve durability.

3.2.4Water

Portable water have been used in this experimental work for preparing cubes and curing as well. The pH value of the water used is not less than 6.

4 OBJECTIVES OF INVESTIGATION

4.1M-Sand:

Natural Sand has been used for making of mortar or Concrete since the invention of Cement.

The word Natural Sand itself states that it's a Naturally occurring Material, which is generally formed by weathering effect of rocks due to various factors.

Generally, Sands are available in Riverbeds and ocean props whereas the nearest available resource is given preference.

still, Sand in Sea Shore isn't preferred due to its high Salt Content which largely decreases the Durability of Concrete.

By this the use of River sand is adding day by day, which is dropping the availability of this natural resource, so there's a need to find an alternative or a substitute for River Sand.

M- Sand is artificially being sand in Stone Crushing manufactures called Crusher Dust which can be a perfect substitute for Natural sand as it can be crushed into needed sizes and its reactivity to acid and base circumstances is also truly less.

So, in this research M- Sand has been used as substitute for River sand in different percentages and various tests has been carried out.

5 MIX DESIGN

5.1 General:

In thisproject, IS 10262-2009 have been used to know the proportions for the M30 grade of Concrete, and the Mix Design is as mentioned below.

5.2 Mix Design for M30Grade Concrete:

M-30 GRADE CONCRETE MIX DESIGN		
As per MORT&H&IS 10262-2009		
I	Stipulations for Proportioning	
	Grade	M30
	Cement	OPC 53 grade
	Maximum size of Aggregate	20 mm
	Minimum Cement content (kg/m3)	310 kg/m3
	Maximum Water/ Cement Ratio	0.45
	Workability (slump)	50-75 mm (Slump)
	Exposure Conditions	Normal
	Supervision	Good
	Aggregates	Crushed Angular Aggregates
	Maximum Cement Content	540 kg/m3
	Chemical Admixture used	Superplasticizer
II	Test Data for Materials	
	Cement Used	OPC 53 grade
	Specific Gravity of Cement	3.15
	Specific Gravity of Water	1.00
	Chemical Admixture company	BASF Chemicals
	Specific Gravity of Coarse Aggregate	2.884
	Specific Gravity of Sand	2.605
	Water Absorption of Aggregates	0.97%

	Water Absorption of fine aggregates	1.23%
	Surface Moistureof Aggregates	-
	Surface Moisture of Sand	-
	Sieve Analysis of Coarse Aggregates	Analysis Done
	Specific Gravity of Combined Coarse Aggregates	2.882
	Sieve Analysis of Fine sand	Analysis Done
III	Target Strength for Mix Proportioning	
	Target Mean Strength (N/mm2)	42N/mm2
	Characteristic Strength at 28 days (N/mm2)	30N/mm2
IV	Selection of Water Cement Ratio	
	Maximum Water Cement Ratio	0.45
	Adopted Water Cement Ratio	0.42
V	Selection of Water Content	
	Maximum Water content	186 L
	Estimated Water content for 50-75 mm Slump	160 L
	Superplasticizer used	0.5 % by weight of cement
VI	Calculation of Cement Content	
	Water Cement Ratio	0.42
	Cement Content (160/0.42)	380 kg/m3
		greater than 310 kg/m3
VII	Proportion of Volume of Coarse Aggregates& Fine Aggregates Content	
	Volume of Coarse Aggregates	62.00%
	Adopted Vol. of C.A.	62.00%
	Adopted Volume of Sand (1-0.62)	38.00%
VIII	Mix Calculations	
	Volume of Concrete (m3)	1.00
	Volume of Cement (m3)	0.12
	(Mass of Cement) / (Sp. Gravity of Cement)x1000	
	Volume of Water (m3)	0.160
	(Mass of Water) / (S. Gravity of Water)x1000	
	Volume of Admixture @ 0.5% (m3)	0.00160
	(Mass of Admixture)/(S. Gravity of Admixture)x1000	
	Volume of All in Aggregate (m3)	0.718
	S. no. 1 – (S. no. 2+3+4)	
	Volume of Coarse Aggregate (m3)	0.445

	S. no. 5 x 0.62	
	Volume of Fine Aggregate (m3)	0.273
	S. no. 5 x 0.38	
IX	Mix Proportions for One Cum of Concrete (SSD Condition)	
	Mass of Cement (kg/m3)	380
	Mass of Water (kg/m3)	160
	Mass of Fine Aggregates(kg/m3)	711
	Mass of Coarse Aggregates in (kg/m3)	1283
	Water /Cement Ratio	0.42

Table 5.1Mix proportion for M30

Cement(Kg/m3)	Fine aggregates (Kg/m3)	Coarse aggregates (Kg/m3)	Water(lit/m3)
1	1.871	3.376	0.42
380	711	1283	160

CHAPTER 6

EXPERIMENTAL INVESTIGATIONS

6.1 General

In this disquisition the exploratory examination is completed to acquire the Compressive strength quality, Split Tensile, Workability and Durability of M30 evaluation of cement by partly substituting of bond with M- sand and Glass fiber. In the present examination, Concrete specimens were readied with different extents of Glass fiber and M- sand 25%, 50%, 75%, 100% of bond replacement of weight.

Quantities of Materials to be used in this Project

Where

CC = Conventional Concrete of M30 Grade
M1 = 25% of Manufacturing Sand substituted M30 Grade Concrete
M2 = 50% of Manufacturing Sand substituted M30 Grade Concrete
M3 = 75% of Manufacturing Sand substituted M30 Grade Concrete
M4 = 100% of Manufacturing Sand substituted M30 Grade Concrete

6.2 Mixing of Concrete

At first the mixed design is carried in ACI system the figure of solid mix requires complete literacy of different properties of the component materials. seasoning, for illustration, bond and M- sand are blended, to which the fine total and coarse aggregate are included and fully blended. Water and Glass fibers are measured precisely. At that point it is added to the dry mix and it's fully blended until a mix of even shading and thickness is fulfilled which is also prepared for throwing. Before throwing of samples, workability is measured as per the code IS 1199- 1959 by droop and compaction variable tests.

6.3 Workability of Concrete:

The workability of the concrete was set up by using slump cone test. The slump outfit consists of a conical shape frustum of top diameter 10 cm and bottom diameter 20 cm with a height 30 cm. The concrete mix is placed in slump cone in three equal layers. Each layer was tampered by given 25 blows with a bullet end tamping rod. After completion of last layer redundant concrete was removed and position. instantly the slump cone was raised overhead, this allows the concrete subside. The subsidence of concrete was known as SLUMP. The slump value can be measured by taking the difference between height of subside concrete and mould height. The following table gives a clear image about slump values for different workabilities.

Slump values of Concrete with 20 mm or 40 mm maximum size of aggregate.

Table 6.1 Degree of Workability

Degree of Workability	Slump Value
Very low	___
Low	25-75
Medium	50-80
High	90-100
Very high	_____

6.4 Moulds used for Casting:

The Standard cube moulds of 150 x 150 x 150 mm made of cast iron used for the concrete specimens for testing of compressive strength, split tensile strength and durability.

6.4.1 Casting

The basic moulds were fitted like that there are no gaps between the plates of themoulds.However, they were filled with plaster of Paris, If there is any gap. The moulds were then greased and kept ready for casting. Concrete mixes are prepared according to needed proportions for the samples by hand mixing; it's rightly placed in the moulds in 3 layers. Each subcaste is compacted 25 blows with 16 mm diameter tamping rod. After the completion of the casting, the samples were vibrated on the table vibrator for 2 minutes. At the end of vibration the external surface was made a plane using trowel. After 24 hours moulds were

removed and concrete samples were kept for wet curing.

Fig 6.2 Casting of Cubes

6.6.2 Split Tensile Strength of Concrete

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

$Ft = 2P/\pi DL$.

Where,

P= load at failure,

D= Diameter and

L=length of the cube.

The load condition produces a high compressive stress incontinently below the two generators to which the weight is applied. But the larger portion corresponding to depth is subordinated to a steady tensile stress acting horizontally. It's estimated that the compressive stress is acting for about1/6 depth and the remaining5/6 depth is subordinated to tension. The main advantage of this system is that the same type of specimen and the same testing machines as are used for the compression test can be employed for this test. Strength determined in the splitting test is believed to be near to the true tensile strength of concrete, then the modulus rupture. Splitting strength gives about 5 to 12% high value than the direct tensile strength.

Fig 6.5 Split Tensile Test

6.6.4 BOND STRENGTH TEST:

The mechanics of bond stresses assure the reinforcement is solidly anchored to the embracing concrete. Analysis and the design of the reinforced concrete compound members are based on the supposition that no slippage will do in the interface of steel and concrete. This bond stress enables the two materials to form a compound member. The effectiveness of reinforced concrete structural member is based on the acceptable composite action between the steel and concrete.

Procedure:

Cast cubes upto a height of 200 mm with a 10 mm dia rod placed at the centre of cylinder.

Remove the samples from the moulds after 24 hours and put them in water. Test them after 28days

Perform the pull out test on 100 KN universal testing machine using pull out test attachment at 28 days age.

Attach a dial hand for finding out the slip between steel and concrete and plot the bend between load and slip.

Note the load at 0.125 mm slip and at bond failure

Fig:6.6 Preparation of cubes for bond

SLIP OF BARS:

During slip the bar that comes out of the cube as shown in figure 6.7: which will occur in case of MILD steel bars.

Fig:6.7Slipping of bar

The average bond strength at 0.125 mmof slip = (P1)/ (π*d*l)

The average bond strength at time of failure = (P2)/ (π*d*l)

σ = ultimate bond stress

P1,2 = Load at 0.125 mm slip (P1), Load at bond failure (P2)

d = dia of bar

l = length of bar

YIELDING OF BARS:

In yielding of bars the may broken during testing without slipping as shown In figure6.8 which will come down in case of HYSD bars..

Fig:6.8 Yielding of Bar

CRACKS/CRUSHING OF CONCRETE:

The cracks were also may develop in cubes during testing in UTM as shown in figure6.9 which will come down in case of HYSD bars.

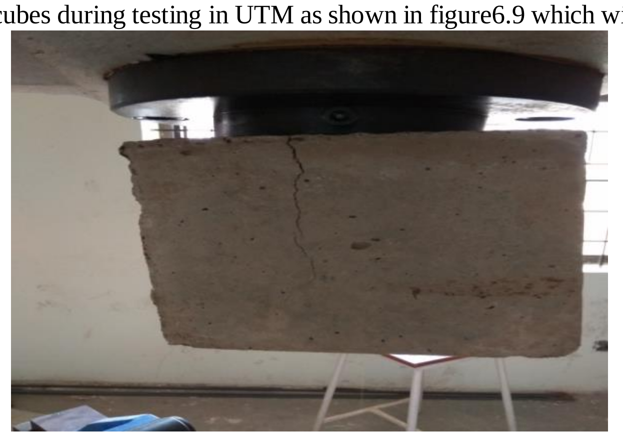

Fig:6.9 Cracks

7 EXPERIMENTAL RESULTS& DISCUSSIONS OF TEST RESULTS

7.1 General

In this chapter the results of workability, compressive strength, split tensile strength and durability tests for different Concrete Mix proportions of M30 with varying percentage of M- sand and Glass fiber replaced with cement are shown and talked over.

7.2 Workability

In the workability test experimental investigation has been carried outusing Slump Cone Test for M30 grade concrete by Glass fiber percentage 0%,0.5, 1%,1.5,2%,2.5, 3%and M-sand 0%, 25%, 50%, 75% and 100% as shown in the following tables and graphs.

Table 7.1 Workability test with different proportions of M-sand and Glass fiber

Workability [Slump in mm]					
	M30 Grade Concrete				
Glass fibre(%)	0% M-sand	25% M-sand	50% M-sand	75% M-sand	100% M-sand
0%	79.6	77.5	76.6	74.5	72.2
0.5%	79	77.1	75.9	73.7	71.4
1%	78.3	76.4	75.3	73.2	70.7
1.5%	77.4	75.3	73.9	72.3	70
2%	76.4	74.2	72.6	71.5	69.4
2.5%	75.4	73.5	71.9	70.3	68.6
3%	74.1	72.9	71.2	69.4	68

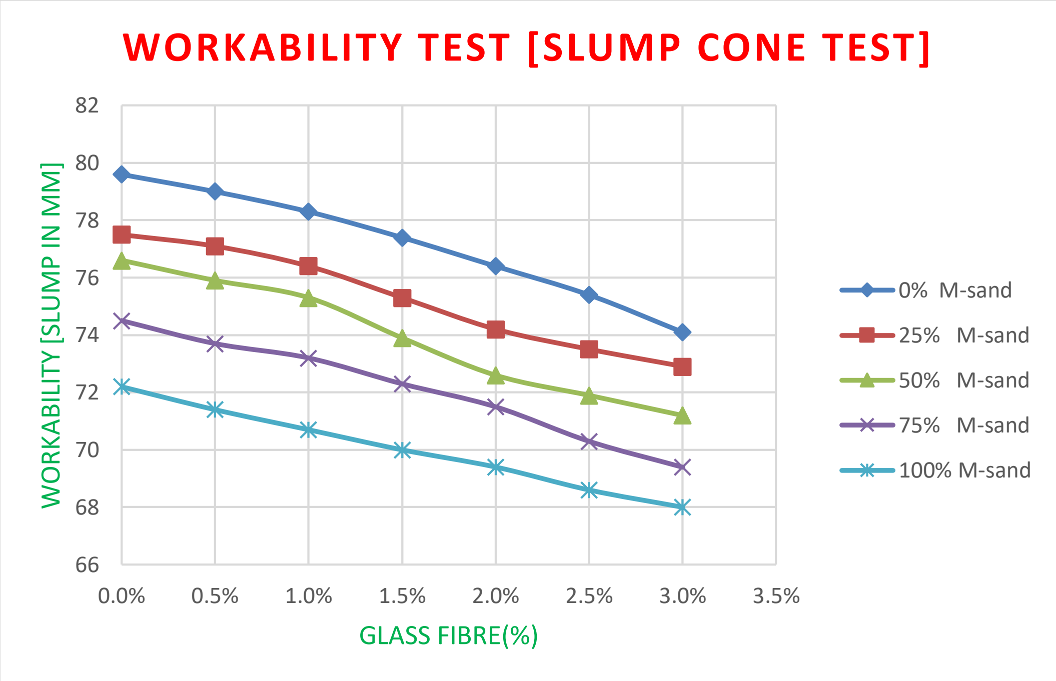

Fig 7.1 Effect of M-sand and Glass fiber on Workability of Concrete

7.3 Compressive Strength

In the compressive strength test experimental investigation has been carried for the cement specimens of M30 grade concrete by Glass fire percentages0%,0.5%, 1%,1.5%,2%,2.5%, 3% and M-sand 0%, 25%, 50%, 75% and 100% of 7days, 28 days as shown in the following tables and graphs.

Table 7.2 Compressive Strength for 7 days for different proportions of M-sand and Glass fiber

7 days Compressive strength(N/mm2)					
	M30				
Glass fibre(%)	0% M-sand	25% M-sand	50% M-sand	75% M-sand	100% M-sand
0%	22.3	23.3	24.5	25.7	26
0.5%	22.7	23.9	25	26.2	26.6
1%	23.2	24.6	25.5	26.9	27.2
1.5%	23.35	24.8	25.9	27.2	27.75
2%	23.7	25.3	26.1	27.7	28.4
2.5%	23.9	25.4	26.8	28.1	28.8
3%	24.3	25.9	27.4	28.6	29.4

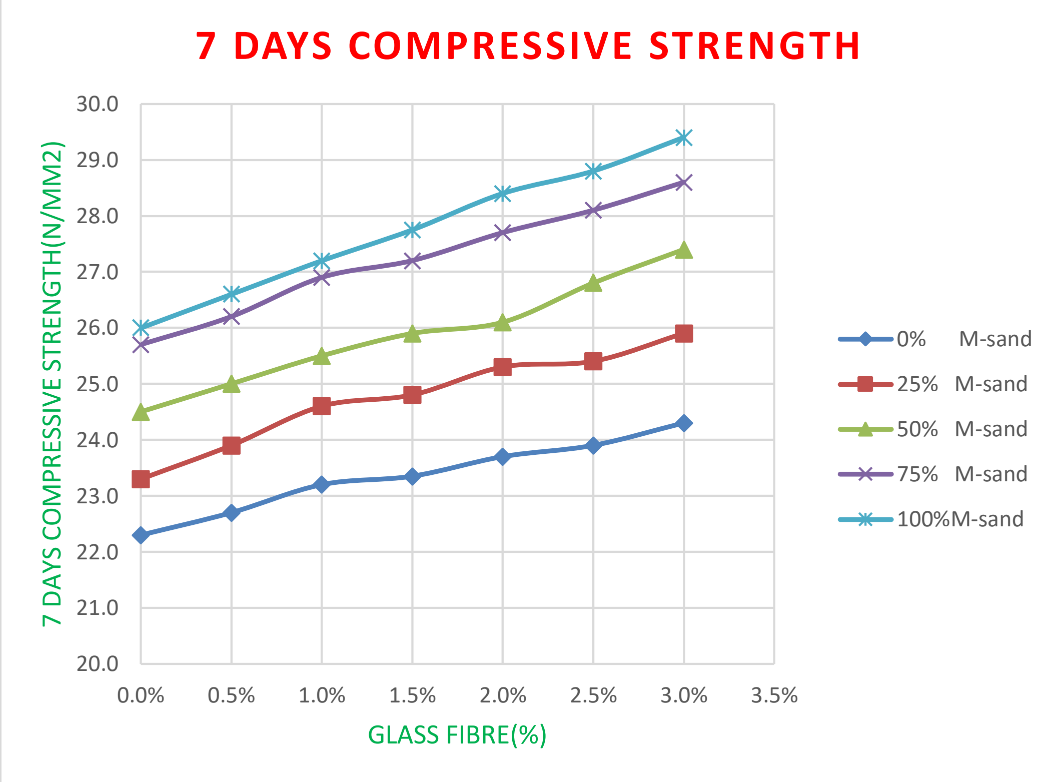

Fig 7.2 Effect of M-sand and Glass fibre on 7 days Compressive Strength of Concrete

Table 7.3 Compressive Strength for 28 days for different proportions of M-sand and Glass fiber

28 days Compressive strength(N/mm2)					
	M30				
Glass fibre(%)	0% M-sand	25% M-sand	50% M-sand	75% M-sand	100% M-sand
0%	36.9	37.6	38.2	39	39.6
0.5%	37.3	38	38.8	39.5	40.2
1%	37.9	38.7	39.4	40.1	40.8
1.5%	38.2	38.8	39.6	40.3	41
2%	38.3	39	39.9	40.6	41.3
2.5%	38.7	39.3	40.2	40.8	41.5
3%	39	39.8	40.5	41.2	41.9

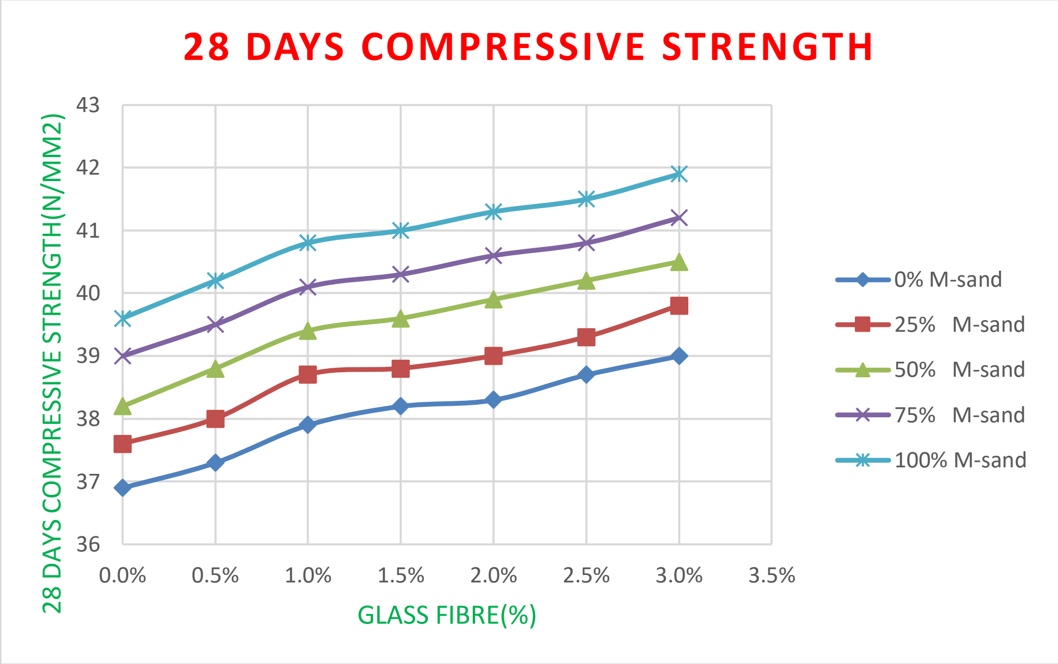

Fig 7.3 Effect of M-sand and Glass fibre on 28 days Compressive Strength of Concrete

7.4 Split Tensile Strength

In the Split Tensile strength test the experimental research has been carried for the cement cubes of M30 grade concrete by Glass fiber percentage 0%, 0.5%, 1%, 1.5%, 2%, 2.5% and3% and M- sand 0%, 25%, 50%, 75% and 100% of 7days, 28 days as shown in following tables and graphs..

Table 7.4 Split Tensile Strength for 7 days for different proportions of M-sand and Glass fiber

7 days Split Tensile strength(N/mm2)					
	M30				
Glass fibre(%)	0% M-sand	25% M-sand	50% M-sand	75% M-sand	100% M-sand
0%	0.207	0.214	0.22	0.228	0.235
0.5%	0.214	0.221	0.228	0.235	0.242
1%	0.223	0.229	0.236	0.244	0.251
1.5%	0.226	0.233	0.241	0.247	0.254
2%	0.232	0.239	0.247	0.254	0.260
2.5%	0.238	0.245	0.253	0.259	0.266
3%	0.245	0.252	0.260	0.267	0.274

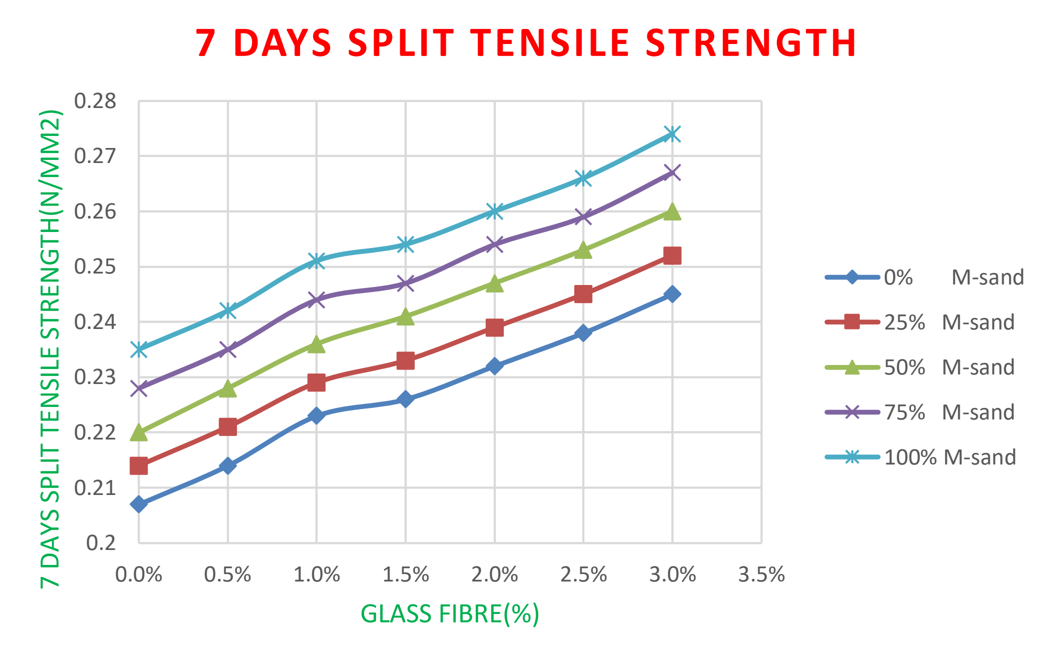

Fig 7.4 Effect of M-sand and Glass fiber on 7 days Split tensile strength of Concrete

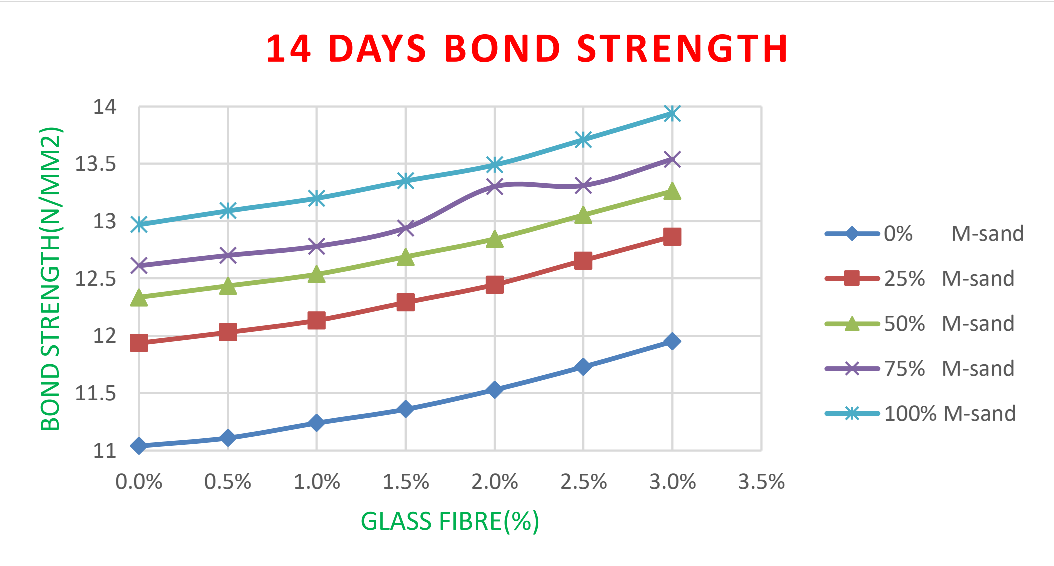

Fig 7.8Effect of M-sand and Glass fiber on 14 days Bond strength of Concrete for Mild Steel

Table 7.9 Bond Strength for 28 days for different proportions of M-sand and Glass fiber

Bond strength(N/mm2)					
	M30				
Glass fibre(%)	0% M-sand	25% M-sand	50% M-sand	75% M-sand	100% M-sand
0%	12.203	13.4	13.7	14.44	14.6
0.5%	12.3	13.60	14	14.6	14.80
1%	12.404	13.7	14.2	14.67	15.0
1.5%	12.557	13.85	14.26	14.81	15.05
2%	12.711	14.01	14.42	14.95	15.19
2.5%	12.921	14.23	14.62	15.17	15.42
3%	13.133	14.45	14.85	15.37	15.64

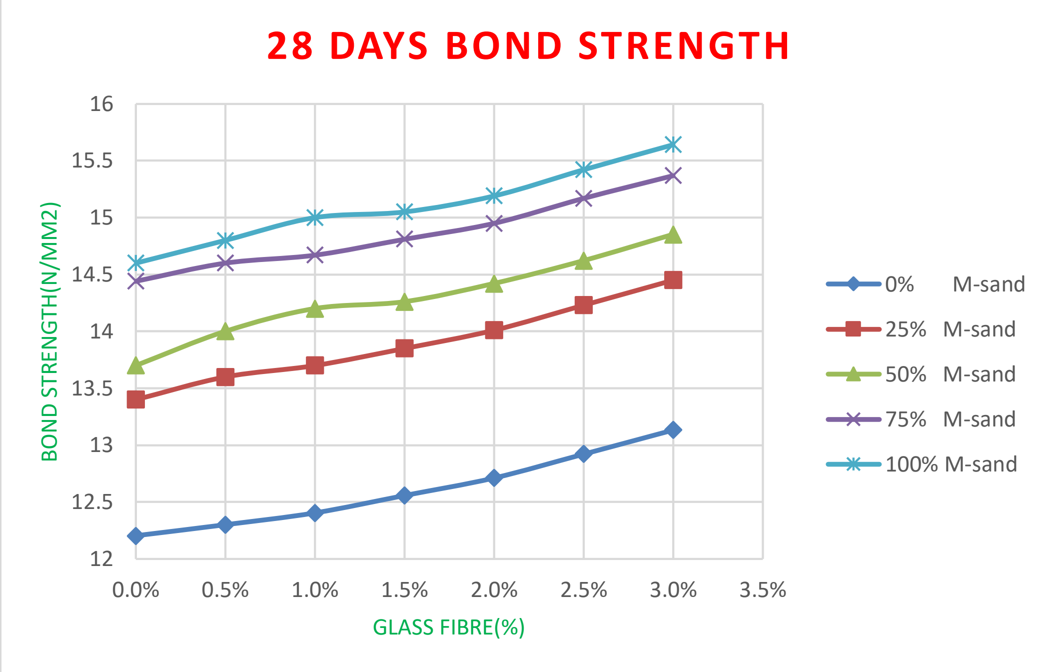

Fig 7.9 Effect of M-sand and Glass fiber on 28 days Bond strength of Concrete for Mild Steel

7.6 DISCUSSIONS OF TEST RESULTS:

7.6.1 Workability Test:

Bythe replacement of Manufacturing sand in the place of Natural Sand, the Workability of Concrete is decreased by 9.54% up to 100% replacement. It is also further changed with the addition of glass fibers of 0%,0.5%,1%,1.5%, 2%,2.5% & 3%. Workability is decreased by 1.88%, 6.2%, 7.06%, 6.99%, 5.83% for CC, M1, M2, M3, M4 mixes with glass fiber of of 0%,0.5%,1%,1.5%, 2%,2.5% & 3%addition.

7.6.2 Compression Test:

For 7 days:

By the replacement of Manufacturing sand in place of Natural Sand, the Compressive Strength of Concrete is gained by 16.67% up to 100% replacement. It is also further changed with the addition of glass fibers of of 0%,0.5%,1%,1.5%, 2%,2.5% & 3%. Compressive Strength is gained by 9%,10.76%,11.89%,11.33%,13.13% for CC, M1, M2, M3, M4 mixes with glass fiber of 0%,0.5%,1%,1.5%, 2%,2.5% & 3% addition.

For 28 days:

Bythe replacement of Manufacturing sand in place of Natural Sand, the Compressive Strength of Concrete is gained by 7.88% up to 100% replacement. It is also further changed with the addition of glass fibers of of 0%,0.5%,1%,1.5%, 2%,2.5% & 3%. Compressive Strength is gained by 5.71%,5.6%, 5.48%,5.38%,5.29% for CC, M1, M2, M3, M4 mixes with glass fiber of of 0%,0.5%,1%,1.5%, 2%,2.5% & 3% addition.

8 CONCLUSIONS

Based on the test examination, we can conclude that the mix of M- sand and Glass fiber can be employed as Ordinary Portland bond replacement for solid readiness up to a reasonable extent. Based on experimental results the following conclusions are drawn.

1. By replacing the Natural sand with M- sand at different percentages say 0%, 25%, 50%, 75%, 100%, Workability is reduced by0.79% to14.52% and alike, By using Glass fiber at different percentages say 0%,0.5%,1%,1.5%, 2%,2.5% & 3%, Workability is reduced by1.4% to12.15%.
2. By replacing the Natural sand with M- sand at same percentages as above the 7 days and 28 days Compressive Strength is increased by1.96% to11.15% and1.76% to9.62% respectively and likewise by using Glass fiber at same amounts as above the 7 days and 28 days Compressive Strength is increased by4.10% to9.31% and2.47% to6.15% 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 by2.95% to13.33% and2.21% to10.31% respectively and likewise by using Glass fiber at same amounts as above the 7 days and 28 days Split Tensile Strength is increased by6.55% to19.13% and4.20% to12.43% respectively.
4. By replacing the Natural sand with M- sand at same percentages as above the 3 days, 7 days, 14 days and 28 days Bond Strength is increased by2.95% to13.33% ,2.68% to12.12%,2.75% to12.33% and2.21% to10.31% respectively and likewise by using Glass fiber at same amounts as above the 3 days, 7 days, 14 days and 28 days Bond Strength is increased by2.95% to15.67%,2.68% to16.11%,2.75% to14.56% and2.21% to16.73% respectively.
5. Therefore, in this research it's proven that Glass fiber increases the Characteristic Strength of Cement up to 3, beyond this limit if large amount of Cement is replaced with Glass fiber, Cement loses its bond Strength effecting whole properties of Concrete.

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

7. However, if available, M- sand is a better substitute for Natural sand and it also decreases environmental effects due to over use of Natural sand.

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