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Comparative study of conventional concrete with glass fiber reinforced polymer concrete

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***Abstract*— Concrete has been used as a part of different structures everywhere all through the world since most recent two decades. As of late a couple foundation ventures have additionally observed particular use of concrete. The advancement of concrete has achieved the fundamental requirement for added substances both chemical and mineral to enhance the execution of concrete. The greater part of the advancements over the work has been upheld by nonstop change of these admixtures. Consequently assortment of admixtures, for example, fly ash, rice husk ash, stone dusts have been utilized so for. Likewise unique assortments of strands have underneath attempted as increments. Consequently, an endeavor has been made in the present examination to concentrate the conduct of Glass fibres in Concrete. To achieve the setout targets of the present examination, Glass fibres utilized as a part of Concrete.**

Glass fiber Reinforced Concrete (GFRC) is tried for Compression, split tension and flexural strengths. The results are very promising for utilization of Glass fibres in delivering Concrete. From the consequences of the examination did in the most recent years on fiber reinforced cement based materials, it can be brought up that, for the fiber substance normally utilized by and by, the post-peak tensile conduct is the most enhanced material trademark. In any case, troubles in completing legitimate direct tensile tests have restricted the examination in this field. The shortage of examination on the elastic conduct of glass fiber reinforced concrete (GFRC) is additionally presumably because of the maturing issues of GFRC frameworks. To add to a superior learning of the uniaxial tensile conduct of GFRC, deformation controlled uniaxial tensile tests were done at Stevin Laboratory (NL). Polymer-altered glass fiber reinforced cement (PGFRC) Samples produced by splash up and premix systems, and GFRC Samples are tried at 28 years old days. The test reaction of the tried examples is represented and the outcome.

I. INTRODUCTION

Glass fibre–reinforced concrete (GRC) comprises essentially of a cementitious grid made out of cement, sand, water, and admixtures, in which short length glass fibres are scattered. The effect of the fibres in this composite prompts to an expansion in the pressure and effect quality of the material. GRC has been utilized for more than 30 years in a few development components, mostly non structural ones, similar to veneer boards (around 80% of the GRC generation), channeling for sanitation arrange frameworks, enlivening non recoverable formwork, and different items . In the start of the GRC advancement, a standout amongst the most concerning issues was the strength of the glass fibres, which got to be distinctly delicate with time, because of the alkalinity of the cement mortar. From that point forward, huge advances have been made, and by and by, the issue is for all intents and purposes understood with the new sorts of antacid safe glass fibres and with mortar added substances that keep the procedures that prompt to the embrittlement of GRC.

The light-weight attributes and enhanced rigidity of GRC when contrasted with solid drove with a current research program to concentrate the suitability of its utilization as an auxiliary material. The examination was created in relationship with concrete precast organizations for which the alluded enhanced qualities are particularly engaging as the lessened weight of the precast components is essential for transportation and establishment. To get a GRC with high durability, reinforcement systems were additionally broke down, considering carbon or glass strands and stainless steel bars, prompting to consumption free solutions. Although a portion of the normal mechanical properties of GRC are known, right now utilized for non structural components, when basic outline is viewed as, an a great deal more entire portrayal is required.

Trial tests were then performed on GRC samples to decide its mechanical strength, Young's modulus, creep and shrinkage conduct, and stress–strain charts. As the material attributes were especially reliant on the creation strategies, the test tests needed to consider cementitious matrix with various plain mortar preparations, with a few sorts of glass filaments and strengthened with carbon or glass strands or with steel components.

II. Literature review

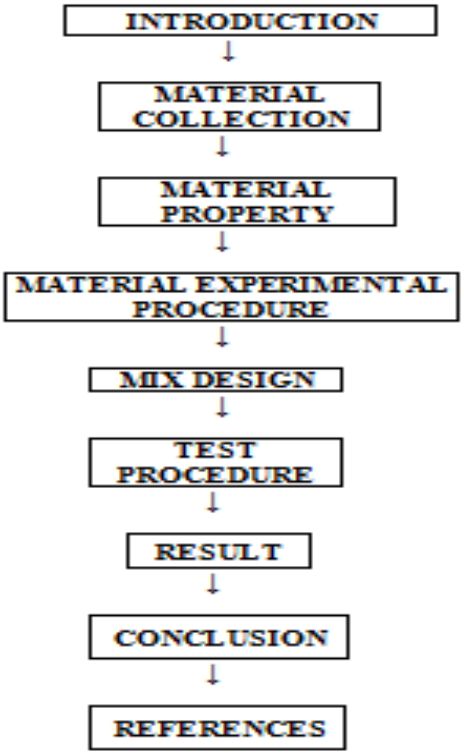
Griffiths directed review to examine the mechanical properties of glass fiber fortified polyester polymer concrete**.** They concluded the modulus of rupture of polymer concrete containing 20% polyester resin and about 79% fine silica aggregate is about 20 MPa.

The expansion of around 1.5% slashed glass fibres (by weight) to the material expands the modulus of rupture by around 20% and the fracture toughness by around 55%. Glass fibres enhance the quality of the material by expanding the compel required for deformation and enhance the toughness by expanding the vitality required for split spread.

Sorousshian reported the results of an experimental study on the relative effectiveness of different types of steel fibre in concrete. The creator watched that the incorporation of fibres abatements the workability of fresh concrete and this impact is more articulated for fibres with higher aspect proportions. The impacts of fiber fresh mix workability on new blend workability, as spoke to both subjectively and by the modified droop and cone time, appear to be inconsequential. Pleated filaments result in somewhat higher droop values when contrasted and straight and snared strands. Rao concentrated the impact of glass strands on the mechanical properties of M20 and M30 evaluations of concrete.

Wong, and C.S. Poon in their concentrated entitled Effect of fly ash and silica fume on compressive and fracture practices of concrete had finished up improvement in quality properties of concrete by including diverse rate of fly ash remains and silica fume. Tahir Gonen and Salih Yazicioglu concentrated the impact of paired and ternary mix of mineral admixtures on the short and long haul exhibitions of concrete and finished up many enhanced solid properties in crisp and hardened states**.**

III. Methodology



IV. Materials Collection

Cement

Customary Portland concrete, 53Grade fitting in with IS: 269 – 1976.Ordinary Portland cement, 53Gradewas utilized for throwing every one of the Specimens. Distinctive sorts of cement have diverse water necessities to deliver glues of standard consistence. Particular sorts of cement cement additionally will deliver concrete have an alternate rates of quality improvement. The decision of brand and kind of cement is the most vital to deliver a decent nature of concrete. The sort of concrete influences the rate of hydration, so that the qualities at early ages can be significantly affected by the specific cement utilized. It is likewise vital to guarantee similarity of the synthetic and mineral admixtures with bond.

Fine Aggregate

Locally accessible stream sand fitting in with Grading zone II of IS: 383 –1970. Perfect and dry stream sand accessible locally will be utilized. Sand going through IS 4.75mm Sieve will be utilized for throwing every one of the examples.

Coarse Aggregate

Locally accessible pulverized blue rock stones adjusting to reviewed graded aggregate ostensible size 12.5 mm according to Seems to be: 383 – 1970. Crushed granite aggregate with particular gravity of 2.77 and going through

4.75 mm sifter and will be utilized for throwing all examples. A few examinations presumed that most extreme size of coarse aggregate ought to be limited in quality of the composite. Notwithstanding bond glue – aggregate proportion, aggregate sort affects concrete dimensional security.

GLASS FIBER

Glass fiber-Glass fiber-reinforced polymer (GFRP) reinforcing bars were utilized as of main reinforcement for concrete structures. The non corrodible GFRP material displays straight flexible anxiety strain attributes up to disappointment with generally low modulus of versatility contrasted with steel. This raises worries on GFRP execution in structures where energy dissipation, through plastic conduct, is required. Glass fiber additionally called fiberglass. It is material created utilizing to an extraordinary degree fine Fiber of glass Fiber is a lightweight, to an incredible greatly solid, and vigorous material. In spite of the fact that quality properties are to some degree lower than carbon fiber and it is less firm, the material is commonly far less weak, and the crude materials are a less costly with higher benefit. Its mass quality and weight properties are likewise exceptionally good when contrasted with metals, and it can be effortlessly framed utilizing shaping procedures.

Types of Glass Fibre

1.A-glass: as to its structure, it is near window glass. In the Federal Republic of Germany it is primarily utilized as a part of the make of process gear.

2.C-glass: This sort of glass shows better imperviousness to substance affect.

3. E-glass: This sort of glass consolidates the attributes of C-glass with great protection to power.

4.AE-glass: Alkali resistant glass.

For glass comprises of quartz sand, pop, sodium sulphate, potash, feldspar and various refining and kicking the bucket added substances. The qualities, with them the order of the glass fibres to be made, are characterized by the mix of crude materials and their extents. Material glass fibres for the most part demonstrate a round.

Uses of Glass Fibre or Glass Yarn

Glass fiber is made in an extensive variety of fine diameters across. Some of them are fine to the point that they can be seen just through a magnifying lens. This nature of fineness contributes enormously to the adaptability of glass fibres. Different makers deliver distinctive sorts of glass fibres for various end employments. Glass filaments them are utilized for different reason.

1. For making home decorations textures;
2. For making clothes and articles of clothing; and
3. For the reason tires and strengthened plastics.

There are sure glass strands that can oppose warm upto 7200oC and can withstand powers having pace of 15,000 miles for every hour. These sorts of glass filaments are utilized as

1. Fiber windings around rocket cases;
2. Nose cones;
3. Exhaust spouts; and
4. Heat shields for aeronautical gear

Some different sorts of glass strands are inserted into different plastics for quality. These are utilized as a part of.

1. Boat bodies and seats;
2. Fishing poles; and
3. Wall framing

Some different sorts of glass strands are utilized for strengthening electrical protection. However different sorts are utilized as batting for warmth protection in coolers and stoves.

Thermal Properties

Glass fibres are valuable warm protectors as a result of their high proportion of surface range to weight. Be that as it may, the expanded surface region makes them considerably more vulnerable to concoction assault. By catching air inside them, squares of glass fiber make great warm protection, with a warm conductivity of the request of 0.05 /(m•K).

Fibre type	Tensile strength (MPa)	Compressive strength (MPa)	Density (g/cm^3)	Thermal expansion (µm/m·°C)	Softening T (°C)	Price ($/kg)
E-glass	3445	1080	2.58	5.4	846	~2
S-2 glass	4890	1600	2.46	2.9	1056	~20

WATER

Throwing and curing of examples were finished with the consumable water that is accessible in the college premises.

SUPER PLASTICIZER

In present day solid practice, it is basically difficult to make elite cement at satisfactory workability in the field without the utilization of super plasticizers. Conplast SP-230(200ml per 50kg) was used for the experimental work.Use of Super plasticizer: Conplast-SP230

V. MIX DESIGN

Design Stipulations

Grade Designation M-40
Type of cement O.P.C-53grade
Fine Aggregate Zone-I
Sp. Gravity Cement 2.96
Sp. Gravity Fine Aggregate 2.98
Sp. Gravity Coarse Aggregate 2.98

Target Mean Strength

$F_{ck} = f_{ck} + (Sxt)$

where,

F_{ck} = target average compressive strength at 28 days.

f_{ck} = characteristic compressive strength at 28 days,

s = Standard deviation (Table 8 of IS10262-1982) = 6.6 N/mm^2,

= 40 + (6.6 x 1.65)

(t= 1.65 and s = 6.6) from IS 10262:2009

= 50.89MPa

Selection Of Water Cement Ratio

W/c ratio = 0.4 from IS 456:2000 table no: 5
W/c ratio = 0.35 from IS 10262-1982 table no: 5

w/c = 0.35

Air Content

Entrapped air = 2% for 20mm aggregate (from IS 10262:1982 table3).

Calculate Of Water Content

Maximum water content for 20 mm aggregate

Water content =191.58Kg. (As per Table No. 4, IS: 10262and slump value consider).

Sand Content

Assume F.A. by % of volume of total aggregate = 36.5 %

Calculate The Cement Content

Cement content = water content/w/c ratio

=191.58/ 0.35

= 547.37 kg/m^3

Calculate C.A &F.A (As Per Is: 10262, Ci, No.3.5.1)

$V = (w+(c/s_c) + (1/p)\ (f_a / sf_a)) \times (1/1000)$

$1-0.02 = (191.58+ (547.37/2.96) + (1/0.365) \times (f_a/2.98) \times (1/1000)$ F_a= 656.42kg/m^3

Coarse Aggregate

$C.A = (1-P/P)\ X\ f_a \times (s_{ca}/ s_{fa})$

= (1-0.365/0.365) x 656.42 x (2.98/2.98)

= 1141.99kg/m^3

Hence mix design per m^3.

5.2 MIX PROPORTION

Cement (kg)/m3	FA (kg)/m3	CA (kg)/m3	Water (kg)/m3
547.37	656.42	1141.99	191.58

VI. TESTING PROCEDURE

COMPRESSIVE STRENGTH

In the investigation of strength of materials, the compressive strength is the limit of a material or structure to withstand loads having a tendency to decrease estimate. It can be measured by plotting connected constrain against disfigurement in a testing machine. A few materials break at their compressive strength point of confinement; others distort irreversibly, so a given measure of disfigurement might be considered as the farthest point for compressive load. Compressive strength is a key an incentive for plan of structuresAt the season of testing, every example must keep in compressive testing machine. The most extreme load at the breakage of concrete block will be noted. From the prominent qualities, the compressive strength may computed by utilizing beneath recipe.

Compressive Strength = Load / Area

Size of the test specimen=150mm x 150mm x 150mm

FIG 2 COMPRESSION TEST

SPLIT TENSILE STRENGTH

The span of cylinders 300 mm length and 150 mm distance across are set in the machine with the end goal that heap is connected on the inverse side of the 3D squares are threw. Adjust deliberately and load is connected, till the example breaks. The equation utilized for estimation.

Split tensile strength = 2P/ µdl

Fig 3 Split Tensile Test

FLEXURAL STRENGTH TEST

Amid the testing, the beam examples of size 7000mmx150mmx150mm were utilized. Examples were dried in outside following 7 days of curing and subjected to flexural strength test under flexural testing gathering. Apply the heap at a rate that always builds the greatest worry until rupture happens. The fracture demonstrates in the tension surface inside the center third of traverse length. The flexural strength was gotten utilizing the equation (R)

$R = Pl/bd^2$

Where,

R = Modulus of rupture (N/mm^2)

P = Maximum applied load (N/mm^2)

l = Length of specimen (mm)

b = Width of specimen (mm)

d = depth of specimen (mm)

Fig 4 Flexural Strength Test

VII. TEST RESULTS

7.1 COMPRESSIVE STRENGTH TEST

Mix design	Mix id	Compressive strength(N/mm²)	
		7 days	28 days
M40	CONVENTIONAL CONCRETE	20.22	33.44
		20.00	33.33
		20.44	32.88
	AVG	**20.22**	**33.22**
	GFRP USED IN CONCRETE	25.33	38.23
		25.77	39.1
		24.88	38.6
	AVG	**25.33**	**38.64**

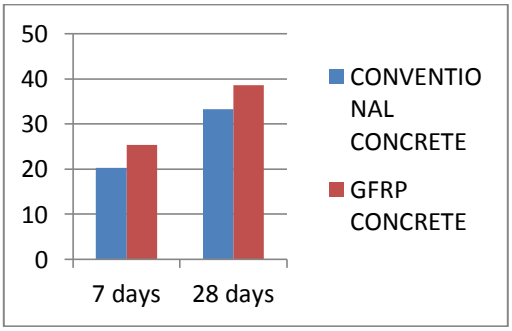


FIG 5 GRAPH SHOWS THE COMPARATIVE OF COMPRESSIVE TEST RESULTS

SPLIT TENSILE STRENGTH

Mix design	Mix id	Split Tensile strength(N/mm²)	
		7 days	28 days
M40	CONVENTIONAL CONCRETE	2.115	3.17
		2.115	3.102
		2.19	3.243
	AVG	**2.14**	**3.17**
	GFRP USED IN CONCRETE	2.83	3.8
		2.679	3.75
		2.961	3.88
	AVG	**2.82**	**3.81**

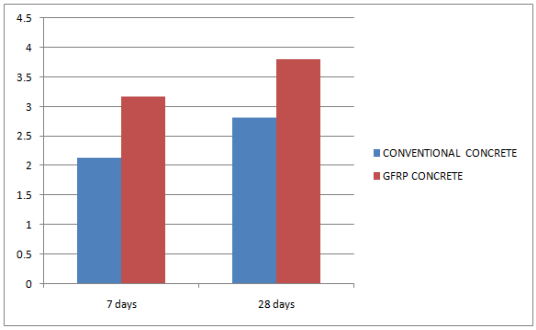


FIG 6 GRAPH SHOWS THE COMPARATIVE OF SPLIT TEST RESULTS

FLEXURAL STRENGTH TEST

Mix design	Mix id	Flexural strength(N/mm²)	
		7 days	28 days
M40	CONVENTIONAL CONCRETE	2.8	3.44
		2.75	3.3
		2.5	3.25
	AVG	**2.68**	**3.33**
	GFRP USED IN CONCRETE	4	3.8
		3.75	3.73
		3.5	3.91
	AVG	**3.75**	**3.81**

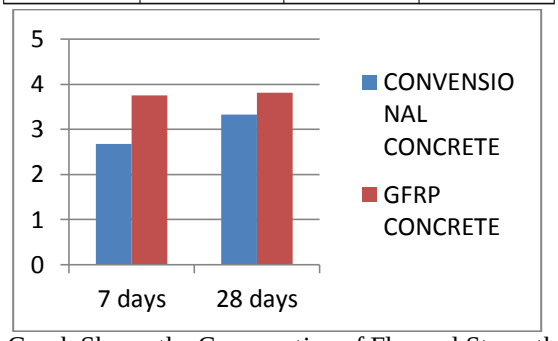


Fig 7 Graph Shows the Comparative of Flexural Strength Test Results

VIII. CONCLUSION

The conclusions drawn from these experimental investigations are as follows.

- The Strength of concrete containing Glass fibre was high compared with that of the conventional mix.
- Comparison of both conventional concrete and GFRP concrete with a grade of M40.
- The test results of compression, split tensile, flexural shown GFRP used concrete attain more strength compared to conventional concrete at 7, 28 days testing.
- The presence of GFRP in concrete mixes acts as pore fillers and causes reduction in the pores, resulting fine and discontinuous pore structures and thereby increases the impermeability of concrete.
- So we are concluded through our results GFRP mixed concrete will gives best results.

Use either SI (MKS) or CGS as primary units. (SI units are strongly encouraged.) English units may be used as secondary units (in parentheses). This applies to papers in data storage**.** For example, write "15 Gb/cm^2 (100 Gb/in^2)." An exception is when English units are used as identifiers in trade, such as "3½-in disk drive." Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity in an equation.

The SI unit for magnetic field strength *H* is A/m. However, if you wish to use units of T, either refer to magnetic flux density *B* or magnetic field strength symbolized as $\mu_0 H$. Use the center dot to separate compound units, e.g., "A·m^2."