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RESEARCH ON THE BEHAVIOUR OF REINFORCED CONCRETE MADE OF GLASS FIBRES

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ABSTRACT

In order to examine the possible advantages and difficulties of this original composite material, this thesis provides a thorough analysis of the Action of reinforced concrete (RC) reinforced with glass fibres. Because of its structural adaptability, reinforced concrete has long been a mainstay in the building industry. The addition of glass fibres can improve the material's mechanical qualities and longevity.

The study starts with a thorough analysis of the body of prior research on the composition, production method, and characteristics of glass fiber reinforced concrete (GFRC). Experiments, such as tensile, compression and bending testing, are then carried out to measure the mechanical Action of GFRC below varied loading circumstances. A thorough analysis is conducted to determine how characteristics such fibre content, aspect ratio, and dispersion affect the mechanical performance of GFRC.

Additionally, Glass fibre reinforced concrete (GFRC's) durability is examined by subjecting it to external stresses such moisture, chemical erosion, and temperature changes. By evaluating GFRC's resistance to deterioration mechanisms like sulphate attack and alkali-silica reaction (ASR), information about its long-term performance and service life is obtained.

The study also looks at the structural uses of GFRC, such as how it might be used in beams, columns, and other structural components. To have a deeper comprehension of the structural reaction and presentation of GFRC components, finite element analysis (FEA) is used to model and simulate their Action under various stress circumstances.

The research's conclusions advance our knowledge of GFRC and its applications in structural engineering. Through the clarification of the mechanical properties and longevity of RC reinforced with glass fibres, this research endeavours to offer significant perspectives for enhancing the planning and building of robust and sustainable infrastructure. The results should help researchers, engineers, and practitioners understand the advantages and difficulties of adding glass fibres to reinforced concrete, which will eventually encourage the use of this novel material in building techniques.

Key Words: Glass fiber reinforced concrete (GFRC), Reinforced concrete, Structural behavior, Glass fiber reinforcement, Mechanical properties,Durability,Flexural strength

1. INTRODUCTION

For various years reinforced concrete (RC) has been an essential structural material because of its exceptional structural qualities and adaptability. But the search for materials with improved durability and mechanical qualities has prompted researchers to investigate novel composites. One such composite that is gaining popularity is glass fiber-reinforced concrete. GFRC offers possible gains in strength, ductility, and durability by fusing the advantages of conventional reinforced concrete with the special qualities of glass fibres. Glass fibre integration into concrete matrices offers a way to solve problems with conventional reinforced concrete constructions, like corrosion, shrinkage, and cracking.

The goal of this investigation is to examine the Action of GFRC, specifically focusing on its durability and mechanical presentation. This study goals to shed light on the optimisation of GFRC mixtures for structural applications by methodically examining the effects of several parameters, including as fibre content, aspect ratio, and distribution. Furthermore, a detailed analysis of GFRC's durability features, including its capacity to withstand environmental stresses including moisture intrusion, chemical erosion, and temperature changes, will be conducted. Evaluate GFRC's long-term Action under various exposure scenarios to determine whether it is suitable for resilient and sustainable infrastructure.

Evolution of Reinforced Concrete

Since its invention in the 19th century, reinforced concrete has seen substantial development, revolutionising the building industry. The idea was first developed by J oseph Monier in the 1860s as a way to reinforce garden pots using iron mesh set in concrete. Over time, the idea expanded to become a structural element for infrastructure and structures. However, in the late 19th and early 20th centuries, reinforced concrete became widely used in building thanks to the efforts of François Coignet and Ernest L. Ransome. Reinforced concrete received constant improvement as a result of developments in materials science and engineering, improving structural efficiency durability and adaptability. In today's modern construction, reinforced concrete is used extensively in everything from residential structures and infrastructure projects to skyscrapers and bridges. It shapes the built environment and makes it possible to realise architectural and engineering marvels.

Steel Reinforced Concrete

A compound material made of RC with the bars made of steel is called steel reinforced concrete. By combining the strength in tensile of steel with the strength in compression of

concrete a versatile building material is produced. The concrete encases and shields the steel reinforcement from corrosion and fire, while the steel reinforcement—typically in the form of bars or mesh—offers resistance against tensile pressures. This combination produces a material that is strong, adaptable, and frequently used in construction. It can support heavy loads and provide structural stability in a variety of settings, including highways, bridges, buildings, and dams.

2. FIBRE REINFORCED CONCRETE

The use of FRC adds a new level of complexity to the Action of glass fiber RC research. This study investigates how FRC recovers tensile strength, flexural capacity, and crack resistance by incorporating glass fibres into the concrete matrix. In order to comprehend how factors like fibre orientation, content, and aspect ratio affect mechanical qualities, the inquiry explores these and other related topics. In addition, the resilience of FRC to environmental elements such as moisture and chemical exposure is assessed, providing information about its long-term functionality. This study emphasises how glass fibre reinforcement can be implemented to enhance the longevity and Action of reinforced concrete structures.

Development of FRC

In the context of studying the action of reinforced concrete made of glass fibers the growth of FRC represents a pivotal advancement. By incorporating glass fibers into the concrete mix, this research aims to enhance the structural performance and durability of traditional reinforced concrete. Investigating parameters such as fiber dispersion, orientation, and content facilitates understanding how FRC improves tensile strength, ductility, and crack resistance. Furthermore, assessing FRC's response to environmental factors like moisture and chemical exposure provides valuable insights into its suitability for long-term applications. This research underscores the significant role of GFRC in advancing the action and resilience of reinforced concrete constructions.

Importance of FRC

Optimising the performance and endurance of reinforced concrete buildings requires a thorough understanding of the Action of FRC particularly with regard to glass fibres. Gaining knowledge about how glass fibres improve tensile strength, ductility, and fracture resistance may help designers create structures that are more robust and long-lasting. This study contributes to the development of sustainable infrastructure solutions by evaluating the reaction of FRC to environmental conditions like as moisture and chemical exposure. In the end, studying the Action of glass FRC advances construction methods by providing creative solutions for stronger, safer structures and infrastructure.

Action of fibre in concrete

By preventing fracture development and propagation, fibres in concrete help to enhance the material's mechanical qualities, such as tensile strength and ductility. They improve the material's toughness and endurance, especially in situations where there is dynamic loading or severe weather conditions. Aspect ratio, fibre type, and matrix dispersion are some of the variables that affect how fibres behave in concrete. The best possible reinforcement is ensured by the proper alignment and distribution of fibres, which successfully reduces shrinkage and thermal cracking. Fibres may also improve the concrete's flexural and impact resistance, which qualifies it for a range of structural and non-structural uses. Studying the way fibres interact with the matrix during mixing, placing, and curing is essential to understanding how fibres behave in concrete. In concrete, several fibre types—including steel, polypropylene, and glass—display unique qualities and performance characteristics. All things considered, the Action of the fibres in concrete is crucial for the design and construction of strong, robust buildings that can survive a range of loading scenarios and environmental difficulties.

DIFFERENT TYPES OF FIBRES

Asbestos fibre

Thin, needle-like strands of asbestos are made of naturally occurring minerals. These fibres have long been prized in a variety of sectors, including manufacturing and construction, for their strength, insulating qualities, and resistance to heat. On the other hand, extended exposure to asbestos fibres in the air presents serious health hazards, including the development of lung conditions such asbestosis, lung cancer, and mesothelioma. When disturbed, as happens during renovations or demolitions involving asbestos-containing materials, asbestos fibres may quickly become airborne. Even with little exposure, breathing in these fibres may lead to long-term health issues. Many nations have imposed stringent laws governing the use, storage, and disposal of products containing asbestos because of the serious health risks. To reduce the hazards to one's health and avoid exposure, asbestos-containing products must be properly identified and managed.

Carbon Fibre

Carbon fibres are slender filaments made mostly of carbon atoms and are well-known for their remarkable stiffness and strength-to-weight ratio. They are widely used in high-performance applications in a variety of sectors, including sports equipment, automobile, and aircraft. Precursor materials, usually pitch or polyacrylonitrile (PAN), are heated and converted in a multi-step process to create carbon fibres. Remarkable characteristics of the resultant fibres include minimal thermal expansion, high tensile strength, and resilience to fatigue and corrosion. Carbon fibres are widely used in the production of composite materials, where they are incorporated into a matrix, such epoxy resin, to produce composites that are reinforced with carbon fibres. Because of their exceptional mechanical qualities, these composites are perfect for difficult conditions where lightweight, long-lasting constructions are needed. The goal of ongoing research into carbon fibre technology is to increase its performance attributes and broaden its range of uses.

Aramid Fibre

Synthetic fibres called aramid are renowned for their remarkable abrasion resistance, heat resistance, and strength. They are often used in industries including aerospace, military gear, and protective apparel that call for high-performance materials. An extensive, chain-like molecule called an aromatic polyamide is transformed chemically to create arabidopsides. The resultant fibres are stronger than steel in terms of weight-for-weight because to their exceptional tensile strength. Aramid fibres are highly valued due to their low weight and ability to withstand chemical and UV damage. To enhance the way things work qualities of materials used in crucial applications, they are often added to composites. In order to increase aramid fibres' performance and broaden their range of uses, research and development are still being done.

Metallic Fibre

Slender strands of metal, usually copper, aluminium, or stainless steel, make up metallic fibres. Because of their strength, conductivity, and thermal qualities, they are used in many different sectors. In textiles like clothes and upholstery, metallic fibres are often used for strength, conductivity, or ornamental purposes. Metallic fibres are often utilised as reinforcement in composite materials in industrial applications to improve mechanical qualities including toughness and rigidity. Because of their resilience and conductivity, they may also be used in electrical applications and filtering systems. To suit changing industrial demands, research on new applications and production methods for metallic fibres is still ongoing.

Polypropylene, Polyethylene, Nylon Fiber

Because of their desired qualities and adaptability, synthetic materials such as nylon, polyethylene, and polypropylene are extensively employed in a variety of applications. Because of their low density, resilience to moisture, and high tensile strength, polypropylene Fibres are useful for many different applications including carpets, geotextiles, and concrete reinforcement. Excellent chemical resistance, pliability, and durability make polyethylene fibres ideal for use in protective gear, ropes, and packaging materials. Because of its strength, flexibility, and resilience to abrasion, nylon fibres are highly prized and are often used in industrial applications including fishing lines and brushes, textiles, and automotive parts. These fibres may have their qualities customised to match the needs of certain applications thanks to manufacturing techniques like melt spinning and extrusion. Research and development endeavours persist in investigating inventive applications and improvements in processing methodologies for these adaptable synthetic fibres.

Glass Fibre

Glass fibres are very strong glass strands that are resistant to heat, corrosion, and tensile strain. They are often used as reinforcing in fibreglass and other composite materials to improve mechanical qualities like stiffness and impact resistance. Melted glass is shaped into fine strands by the extrusion or drawing process, which creates glass fibres. Depending on the function, these fibres are subsequently sliced into small lengths, woven into textiles or mats, or utilised as continuous strands. Glass fibres are often used in aircraft constructions, automobile parts, maritime vessels, and insulation for building materials. In addition, they find use in filtration systems, electrical insulation, and consumer items including domestic appliances and athletic gear. In order to satisfy changing industry demands, research and development efforts are concentrated on enhancing the durability, adaptability, and sustainability of glass fibre manufacturing methods.

3. OBJECTIVES

The main target of this study is to thoroughly observe the presentation GFRC under different structural and environmental circumstances.

Experimental Studies: Performing controlled laboratory studies to assess the mechanical characteristics of GFRC, including as tensile strength, compressive strength, and flexural strength.

Numerical simulations use sophisticated computational techniques to simulate the Action of GFRC (Glass Fibre Reinforced Concrete) under various stress circumstances and geometries. This enables us to get valuable insights into its structural performance.

Durability Assessment: Examining the capacity of GFRC to withstand environmental variables such as moisture infiltration, chemical corrosion, and freeze-thaw cycles in order to evaluate its long-term resilience.

The mix design of GFRC is optimised to improve its mechanical qualities and workability, while minimising material consumption and manufacturing expenses.

Structural Applications: Investigating the viability and efficacy of GFRC in different structural uses, such as beams, columns, and façades, by conducting experimental tests and analytical research.

Exploring the architectural possibilities of GFRC for various applications such as decorative components, cladding panels, and ornamental features, taking into account both aesthetic and structural factors.

Comparative Analysis: This study goal is to compare the utilization of GFRC with conventional RC and other FRC materials in order to determine its specific benefits and limits.

In summary, the study seeks to provide significant knowledge on the Action and possible uses of GFRC in construction, so helping to the progress of sustainable and creative building materials.

4. LITERATURE REVIEW

the significant prized characteristics of concrete are its durability and longevity. They are associated with the cement paste that is hydrated and the internal structure of concrete. These have a direct connection to other concrete properties including strain, stress, and elasticity. Reinforcing concrete further enhances these strength attributes. Because fibre reinforced concrete is so versatile in its production processes, it may be a useful and reasonably priced building material. Understand the relationship among stress strain and adaptability, which is a feature of concrete as this is the area where the most cement is used. This will provide information on how to prevent the significant from occurring inadvertently.

Faiz A et. Al. An investigation was conducted to examine the impact of alkali resistance glass fibre reinforcement on the temperature, bending rigidity, ductility, confined shrinking bursting, and split tolerance of flexible concrete. The researchers used fibres of glass with a total mass portion of 3 percent to carry out the study. The authors proved the efficacy of alkali resistant glass fibres in reducing restricted shrinking cracks in lightweight concrete. A decrease in fracturing widths is another effect of the fibres' stimulation of repeated crack. The fibres considerably enhance the concrete's qualities at 0.25 percent volume fraction.

Sanjay Kumar et.al. Short steel-fiber reinforced concrete columns' flexural Action has been studied.Tests on considerable grade M40 with extents ranging from 1.75 to 2.55, and a W/C ratio of 0.38, were carried out. 0%, 0.5 % 1.0 % and 1.5 % fibre volume components, respectively, were subjected to view point proportions of 25 and 35. bending strength measurements of (125 x 150 x 1100) mm radiates were made below a two-point load. The test findings showed that, with an ideal fibre volume of 1%, the filament reinforced pillar had greater strength and flexibility. In contrast, a compressive strength gain that is more significant occurs when the aspect ratio is 35. Specimens with aspect ratios of 25 and 35 and 0.5 percent fibre had an 11–15% improvement in moment-bearing capability. The samples with 1.0 percent fibre and 25–35% perspective ratios showed respective expansion increases of 16 and 17 percent. The second conveyance limit was lowered by adding 1.5% fibre into radiates.

Yeol Choia et. Al. In an attempt to use testing and analytical information to find a association among the compression force and the strength of split tensile of GFRC and PRFC, they looked at the bending, contraction, and split stress characteristics of polyethylene FRC and GFRC. The researchers developed a numerical formula as an expression of the fibre reinforcing ratio and, using a linear regression evaluation, found that the strength of split tensile of SFRC is 0.09 times the compressive strength and 0.67 times the flexural strength.

Yuwaraj M. Ghugal et. al. The effectiveness of glass fibre reinforced concrete that is impervious to alkaline solutions was investigated by the investigators. It was looked at how glass filaments affected various sample estimations of performance, width, and characteristics including split strain, stress, bending, and strength of bonds. It was found that the ideal fibre

content did not provide the same strength. It was shown that adding more fibre to GFRC causes its density to slightly rise while its ability to work decreases. The strength metrics and load-

bearing capacity of the concrete show higher values than The concrete standard demonstrates an augmentation in both bending stiffness and flexibility.There is no strict formula for calculating the parameters of fbending strength split rigidity and versatile modulus poisson proportion in relation to fibre volume rate, compressive strength, and perspective ratio.

K. Holschemacher et. al. An experiment was carried out to find out how steel filaments influenced the flexure, tension and fracture characteristics of HSC reinforced with regular steel bars. To help choose the right kind and amount of fibre three different kinds of variable fibres with two hooked ends that differ in corrugations and ultimate tensile strength were evaluated. According to the developers, at fibre concentrations of 20 and 40 kg/m^3 the pillars vanished in shear and pressure at 60 kg/m^3 the samples fizzled in pressure The HSC has a transverse backing of 1% that disappears entirely by pressure.

M. J. Roth et. al. UHGS fibres were used to strengthen concrete in experimental studies. The developers examined the material and mechanical Action of the bending response using the 3rd point twisting direct strain approach and they guided research using exploratory data. The researchers came to the conclusion that exceptionally high strength GFRC boards had a much higher flexible solidity value than traditional cement and that, at first, the pile removal response of these boards was basically bilinear. The concentration and stochastic distribution of the The glass fibers accounted for the extensive range of movement seen at the point of final collapse.

Byung Wan Jo et. al. The elastic modulus and stress-strain Action of SFRC were investigated experimentally. Under pressure, a variety of concrete strengths—30 MPa, 50 MPa, and 70 MPa—were assessed with steel fibre volume fractions of 0%, 0.5 percent, 0.75 percent, 1.0 percent, and 1.5%. Hollow, round specimens measuring 300 mm by 150 mm were used. The researcher postulated that SFRC was flexible at the highest load and that the flexible modulus grew quickly with the fibre content by comparing the experimental findings with previously predicted flexible moduli.

Akash Jain et. al. The study investigates the influence of multiple variables associated with concrete mixture, substances, and craftsmanship on Rebound Number (RN) and UPV. The factors under consideration include deliberately generated mistakes, inadequate compacting and varying durations of wet curing. As the strength in compression of the concrete increased, there was a corresponding growth in the readings of the Rebound Hammer. The UPV values were significantly affected by the types of cements and aggregates used, the level of damp curing, and the presence of faults and voids in the concrete. These factors had a greater impact on the UPV values compared to their impact on the calculated abilities of the concrete.

5. METHODOLOGY

Cement

The study used locally accessible Portland Pozzolana cement especially grade 33 from the local

brand, which adheres to the Indian Standards (B.I.S). The cement was subjected to thorough testing to evaluate its different properties in compliance with the IS: 4031 – 1988 criteria. The results verified that it adhered to the specifications given in IS: 1489-1999 Part-1, therefore assuring that it satisfied the necessary criteria for utilisation in the investigate on the presentation of reinforced concrete composed of glass fibres.

Table 1: Features Of Cement

S.no	characteristics	Outcome
1	Consistency of cement	29%
2	Specific Gravity of cement.	2.9
3	Initial Setting Time of cement.	45 min.
4	Final Setting Time of cement.	165 min.
5	Soundness of cement.	1.5mm

Fine Aggregate

For study purpose the fine aggregates are obtained from a local source and comprised of rock dust from zone 2. The material complied with the parameters specified in the IS:2386 and IS:383 standards. Table 4.2 in the research contains recorded information on qualities such as specific gravity and sieve analysis.

Table 2: Characteristics of fine aggregates

s. no.	characteristics	result
1	Sp.gr	2.65
2	bulk density(kg/m^3)	1640

Table 3: Investigation of Fine Aggregates By means of Sieves

s.no.	I S sieve	Wt. Retained. In gm	Cumulative wt. Retained in gm	Cumulative % wt. retained	Cumulative % wt. passing
1	4.75	0	0	0	100
2	2.35	105	105	10.5	89.5
3	1.18	91	201	19.6	80.4
4	500µ	185	403	41.2	61.5
5	400µ	419	836	91.2	18.5
6	200µ	112	935	93.5	8.2
7	100µ	61	987	99.5	1.8

Coarse Aggregate

The study used nearby accessible coarse aggregate with a specific gravity of 2.69. The aggregate consisted of particles with a diameter of 20 mm, and 60% of these particles were able to pass through a sieve with a 20.0 mm opening. 40% of the material was acquired from sieves that passed through a 10.0 mm opening and were kept on a 4.75 mm opening, in accordance with the IS: 383 requirements.

The research includes comprehensive information on the characteristics of the coarse aggregate, which may be found in Table 4.4

Table 4.: Characteristics of Coarse Aggregate

s. no.	property	value
1	Sp.gr	2.69
2	bulk density of coarse aggregate i in (kg/m^3)	1650

Water

Water is an essential element of concrete requires careful Deliberation during its production and excellence assessment. The consequence of cement in assisting the hydration process directly influences the development of concrete strength and other desired qualities. In this study, locally available potable water from the concrete laboratory was used for both mixing and curing. It is crucial to guarantee the presence of uncontaminated and appropriate water in order to preserve the quality and effectiveness of the concrete specimens throughout the whole research.

Super plasticizer

The study used an admixture from the brand GREENO LANTER MIX, which consisted of a combination of carefully chosen high molecular weight polycarboxylate ether (PCE) and organic polymer. The company's suggested dose varied between 200ml and 250ml per 50 kg of cement. The primary purpose of this superplasticizer (S.P.) is to augment the fluidity and workability of the concrete mixture.

The presence of Portland Pozzolana cement in concrete mixes results in the formation of small clusters of cement particles, known as flocculation. This phenomenon may cause water to be trapped and impede the lubricating process. Upon the introduction of plasticizers, they are assimilated by cement particles, resulting in repulsive forces that

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surpass the attractive forces. Deflocculation, a phenomena assisted by the zeta potential, is influenced by the kind, solid content, and quality of the superplasticizer.

Consequently, the polymer molecules that are absorbed enable the cement particles to separate, allowing trapped water to be released and enhancing the flowability of the mixture. This technique eventually improves the workability of the concrete, enabling easier handling and placing during construction.

Figure .1: super plasticizer in the mixture.

Glass Fibre

The glass fibre was bought From general store. glass fibres with a filament length of 12 mm were used. The concrete mixture was reinforced with glass fibre, with the quantity of glass fibre determined by the wt. of cement used and is expressed in percentage.

Table 5: Alkali Resistant Glass Fiber's characteristics.

Types of Fibres		Density in kg/m^3	Modulus of Elasticity in MPA	Tensile Strength in MPA	Dia. In Micron	Length mm	No of fibres in millon/kg
Alkali resistant		2600	73	1700	13	11	216

Figure 2: Glass fibre that resists alkali.

6. RESULT

The compressive strength test outcomes of GFRC at various ages.

This test was executed as per IS: 516-1959 criteria. Tables 5.1 and 5.2 show the outcomes of the compressive strength tests performed on cube specimens that were 150 mm by 150 mm by 150 mm in size and had different fibre contents by weight of cement. These findings are given for two distinct testing ages, namely seven and twenty-eight days after specimen casting.

Table 6 seven days strength in compression of GFRC with varying content of fibres

Concentration of fibre (%)	Failure load (kn)	Failure stress (mpa)	Strength in compression (mpa)	Change (%)
0	591.3	26.28	25.03	-
	623	27.69		
	473.4	21.04		
0.5	612.9	27.24	26.77	+6.95
	666.2	29.61		
	528	23.47		
1	660.6	29.36	27.9	+11.46
	604.8	26.88		
	648.7	28.83		
1.5	618.3	27.48	29.08	+16.18
	680.4	30.24		
	664.2	29.52		
2	614.92	27.33	27.46	+9.71
	651.1	28.94		
	587.7	26.12		

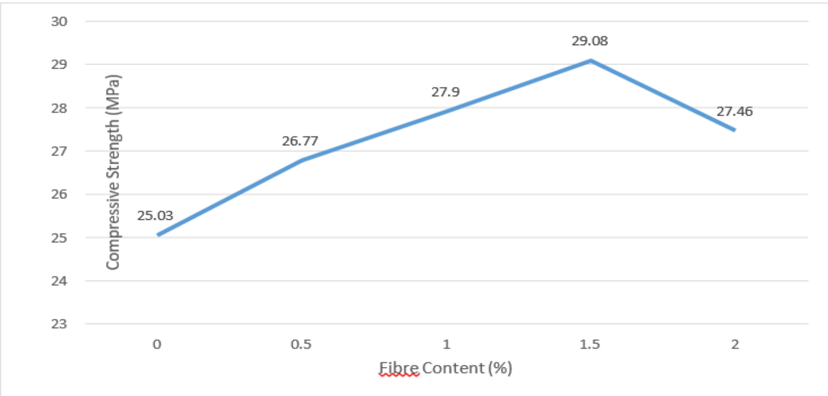

Figure 3: relationship between strength in compression and concentration of fibre after 7 days

Table 7. 28-day strength in compression of GFRC with varying fibre content

Concentration of fibre (%)	Failure load (KN)	Failure stress (MPa)	Strength in compression (MPa)	Difference (%)
0	885.6	39.36	40.03	-
	941.4	41.84		
	875.48	38.91		
0.5	907.2	40.32	41.82	+4.47
	984.15	43.74		
	931.9	41.42		
1	1030.7	45.81	43.71	+9.19
	995.4	44.24		

	924.3	41.08		
1.5	1026.4	45.62	46.53	+16.23
	1095.9	48.71		
	1018.8	45.28		
2	995.4	44.24	43.92	+9.71
	953.8	42.39		
	1015.6	45.14		

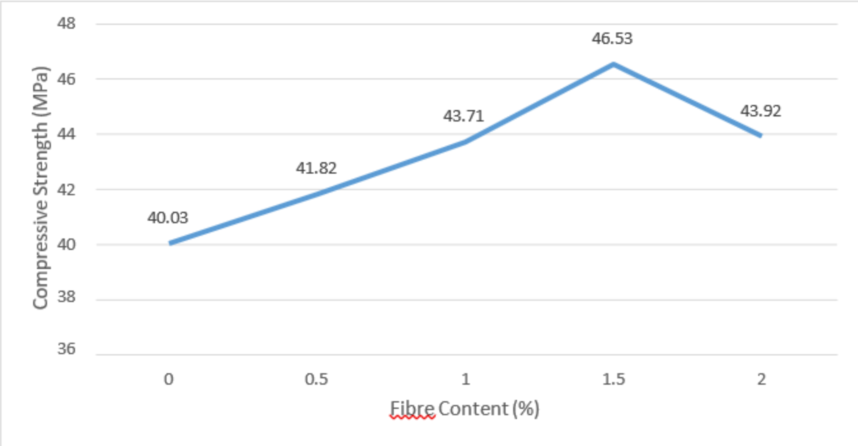

Figure 4 : Examining the connection among compressive strength and fibre content at the 28-day mark.

Observation:

- It is evident that the concrete becomes much stronger over time since the strength in compression after 7 days is about 65% of the strength after 28 days.
- A larger fibre content is associated with a discernible increase in compressive strength. This implies that adding fibres improves the concrete's mechanical qualities.
- In both the 7-day and 28-day tests, the fibre content of 1.5% yields the greatest compressive strength, suggesting that this is the ideal fibre level for increasing strength.
- Adding fibres to the sample leads to a significant 16% increase in its compressive strength when compared to the sample without any fibres.

Outcomes of bending tests conducted on GFRC at various stages

The bending strength test was exucuted as per IS: 516-1959 criteria. Tables 6.3 and 6.4 show the outcomes of the flexural strength tests performed on beam specimens that were 100 mm by 100 mm by 500 mm in size and had varied fibre contents by weight of cement. These findings are given for two distinct testing ages, namely seven and twenty-eight days after specimen casting.

Table 8 : 7-day bending strength of (GFRC) with varying fibre content

Concentration of fibre (%)	Failure load (kn)	Failure stress (mpa)	Bending strength (mpa)	Difference (%)
0	9	3.6	3.73	-
	9.5	3.8		
	9.5	3.8		
0.5	11.5	4.6	4.4	+17.96
	11	4.4		
	10.5	4.2		
1	12	4.8	4.73	+26.8
	11	4.4		

	12.5	5		
1.5	13	5.2	5.33	+42.89
	13.5	5.4		
	13.5	5.4		
2	12.5	5	5	+34.04
	13	5.2		
	12	4.8		

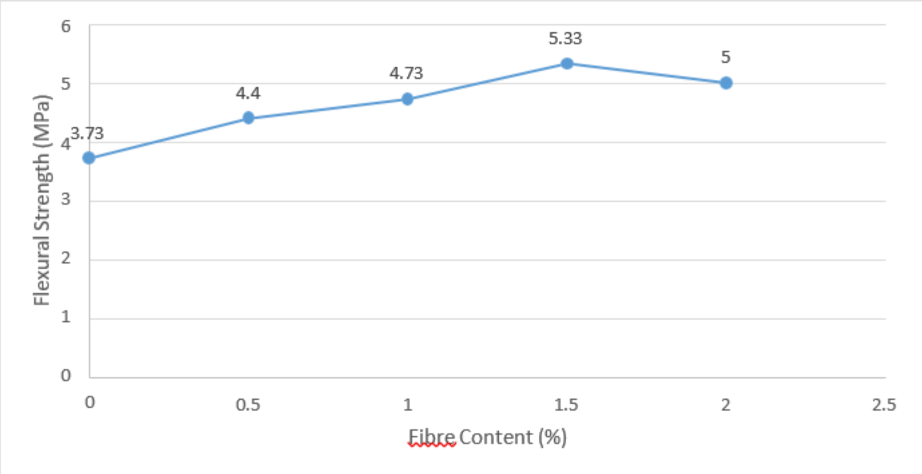

Figure 5: relationship between bending strength and concentration of fibre after 7 days

7. CONCLUSION

The results of the investigational study approved out in Part 6 consistently show that increasing fibre content enhances the toughened characteristics of GFRC. It is evident from a thorough examination of many graphs and tables that improvements in the mechanical properties of GFRC are positively correlated with an increase in fibre content.

Glass fibre reinforced concrete (GFRC) has a much higher compressive strength as a result of the fibre content added. After seven days and twenty-eight days, respectively, it was discovered that the 1.5% fibre specimen's compressive strength was 16.18% and 16.23% more than that of the 0% fibre specimen under control.

- Fibre incorporation increases flexural strength and decreases the need for steel reinforcement to achieve the same strength. Because less steel is used, this leads to cost savings.
- As fibre content rises, flexural strength also increases, peaking at 1.5%. After seven days and twenty-eight days, the flexural strength was found to be 36.27% and 42.89% greater than that of the controlled specimen with 0% fibre content.
- The failure mode is mostly brittle, as the flexural strength test makes clear. A greater proportion of fibres could be required to cause ductile failure.
- By addressing the concrete's inherent weakness under tension, the adding of glass fibre rises the material's stretchable strength.
- The inclusion of fibre greatly raises the split tensile strength of GFRC; after 7 and 28 days respectively increases are 41.22% and 38.15% more than the controlled sample with 0% fibre content; an ideal fibre content is 1.5%.
- According to the investigation's findings, 1.5% fibre content is ideal for better qualities across the board.
- Rebound Hammer testing and other non-destructive tests show strong connection with destructive compressive strength tests, with an accuracy of within ±25%, according to IS: 13311 (Part 2)– 1992.
- Rebound hammer evaluations rise with age, which corresponds to the gradual hardening of concrete.
- According to the findings of the UPV test, increased fibre content is correlated with an increase in pulse velocity, which is related to the concrete quality rating. A significant proportion of the specimens exhibited high quality, with a few even qualifying as exceptional.
- Age-related velocity increases are negligible.
- To properly evaluate the quality of concrete, both non-destructive tests must be used.

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