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Enhancement of Structural Integrity Using Glass Fibre Wrapping

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Abstract: ***This study investigates the effectiveness of glass fiber wrapping in enhancing the structural integrity of concrete structures. Experiments were conducted on concrete cubes wrapped with glass fiber-reinforced polymer (GFRP) sheets. The result shows that the GFRP wrapping significantly improves the compressive strength and durability of the concrete cubes. The wrapping also reduces the crack width and propagation, enhancing the overall structure integrity. The findings of this study demonstrate the potential of glass fiber wrapping as a cost-effective and efficient technique for retrofitting and strengthening existing concrete structures.***

Keywords: Glass fibre wrapping, Structural Integrity, Concrete structures, Retrofitting, Strengthening

I. INTRODUCTION

The use of glass fibre wrapping to enhance the structural integrity of concrete has gained significant attention in recent years. This advanced technique involves encasing concrete elements in glass fibre-reinforced polymer (GFRP) sheets to provide essential external reinforcement. GFRP wrapping effectively increases compressive and tensile strength, reduces crack width, and offers a transformative solution for concrete rehabilitation. Concrete structures are often vulnerable to various environmental and mechanical challenges. GFRP wrapping stands out as a cost-effective method for retrofitting and strengthening these structures. Its widespread application in civil engineering—such as bridge repairs, building retrofitting, and pipeline rehabilitation—demonstrates its versatility and effectiveness, ultimately enhancing the safety and longevity of our built environment. This study is set to rigorously explore the transformative potential of Glass Fiber Reinforced Polymer (GFRP) wrapping in bolstering the structural integrity of concrete structures. By examining the compressive and tensile behaviour of GFRP-wrapped concrete cubes, along with assessing their durability and crack resistance, this research aims to unveil critical insights into the efficacy of GFRP wrapping as a robust solution for enhancing concrete infrastructure.

II. LITERATURE REVIEW

1) Interlaminated shear strength of glass fibre reinforced epoxy composites enhanced with multi-– walled carbon nanotubes

Zhihang Fan, Michael H Santare, Suresh G Advani, Composite part A : Applied science and manufacturing 39 (3),540-554,2008 , Volume 39, issue 3, March 2008.

Abstract: In this study, we examine the interlaminar shear strength (ILSS) of traditional glass fibre reinforced epoxy composites enhanced by strategically injecting multi-walled carbon nanotube (MWNT) – epoxy suspension into stationary glass fibre mats. The suspensions were prepared by combing the techniques of high speed mechanical stirring, ultrasonic agitation and acid oxidation. Two types of process designs were introduced to fabricate the hydride MWNT/glass/epoxy composite and their relative merits were discussed.

2) Fibre Wrapping A Way For Externally Strengthening RIB Pillars

The Indian Mining & Journal, Vol 53 No.08, august 2014 pp. 25-30 Printed in India@ the IMP Publication ISSN. 0019-5944

Abstract: A huge quantity of coal is locked up in different coal fields in India due presence of various surface Features. The mostly the locked up in coal is at a shallow depth in this technical paper method to increase the inherent strength of the ribs are proposed CFRP and GFRP wrapping of the ribs, As the strength of the ribs is increased significantly so it will be possible by to avoid any stability problem during depillaring And also to avoid surface subsidence

3) Processing of Glass Fibres in Textile Industries

International Journal on Textile Engineering and Processes, ISSN: 2395-3578, Vol 1, Issue 2, April 2015

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Abstract: The idea of making yarns and fabrics from glass is hundreds of years old. The earliest Egyptian glass vessels, used as containers for oils, unguents and perfumes, were built from glass fibres spun laboriously by hand round lightly glazed cores of clay. During the Renaissance, artisans were drawing out a " spun glass " of fine glass strands or rods for decorative purposes on goblets and vases. There followed many efforts to produce glass filaments for textile purposes.

III.METHODOLOGY

A. Selection Of Material

1) Ordinary Portland Cement: -The OPC is a mixture of limestone, clay, sand, and other minerals, which are crushed ,ground and blended.

2) Fine Aggregate: - Fine aggregate helps to improve the bonding between the glass fibre wrapping and the concrete substrate. The fine aggregate particles provide a mechanical interlock, allowing the glass fibre wrapping to adhere better to the concrete.

3) Coarse Aggregate: - In the comparative analysis of conventional concrete, the coarse aggregate used plays a crucial role in determining the mechanical properties and overall performance of the concrete mixtures.

4) Water: - The water should be fit for drinking. The water is used for mixing as well as for curing the samples.

5) GFRP Sheet: - Glass fibre sheet is also known as glass fibre polymer (GFRP) sheet, is a composite material made from glass fibres and a polymer matrix.

6) Epoxy Resin: - Epoxy resin is a common adhesive used to bond glass fibre sheets to various substrates. Epoxy resin has high mechanical strength, making it suitable for structural applications.

7) Hardener: - Hardener for GFRP (Glass Fiber Reinforced Polymer) sheet is a crucial component that helps to cure and harden the resin, creating a strong and durable bond between the glass fibres and the polymer matrix.

B. Concrete Mixing Proportion Of M-25 Grade

1.	Grade Of Concrete	M-25
2.	Type Of Cement to be used	OPC 53 Grade Conforming to IS 12269:2013
4.	Maximum Size of Aggregate	20mm
5.	Maximum Water/Cement Ratio	0.55
6.	Minimum Cementitious Content	300 kg/m³
7.	Exposure Condition	Mild (For Reinforced Concrete)
8.	Degree of Quality	Good
9.	Type of Aggregate	Crushed Angular Aggregate
10.	Maximum Cement Content	450 kg/m³
11.	Chemical Admixture Type	PCE

C. Casting Of Concrete Cube

1) Prepare Cube Mold

2) Mix Concrete

3) Fill Cube Mold

4) Finishing

D. Curing Of Cube

1) Initial Curing

2) During of cubes

3) Moist curing

4) Temperature control

5) Quality Assurance

E. Wrapping The GFRP Sheet On Cube

The Glass Fiber Reinforcement Polymer sheet on cube is a technique used to enhance the structure integrity and durability of concrete structure. This method involves wrapping a GFRP sheet around a concrete cube to provide external reinforcement. The GFRP sheet is bonded to the concrete using a suitable adhesive.

F. Testing Result

Compressive Strength Test

1) Preparation of concrete cubes
2) Curing of concrete cubes
3) Testing set up
4) Alignment and pre-loading
5) Loading and failure
6) Calculation of compressive strength
7) Reporting of results
8) Quality assurance

Fig : - DCTM

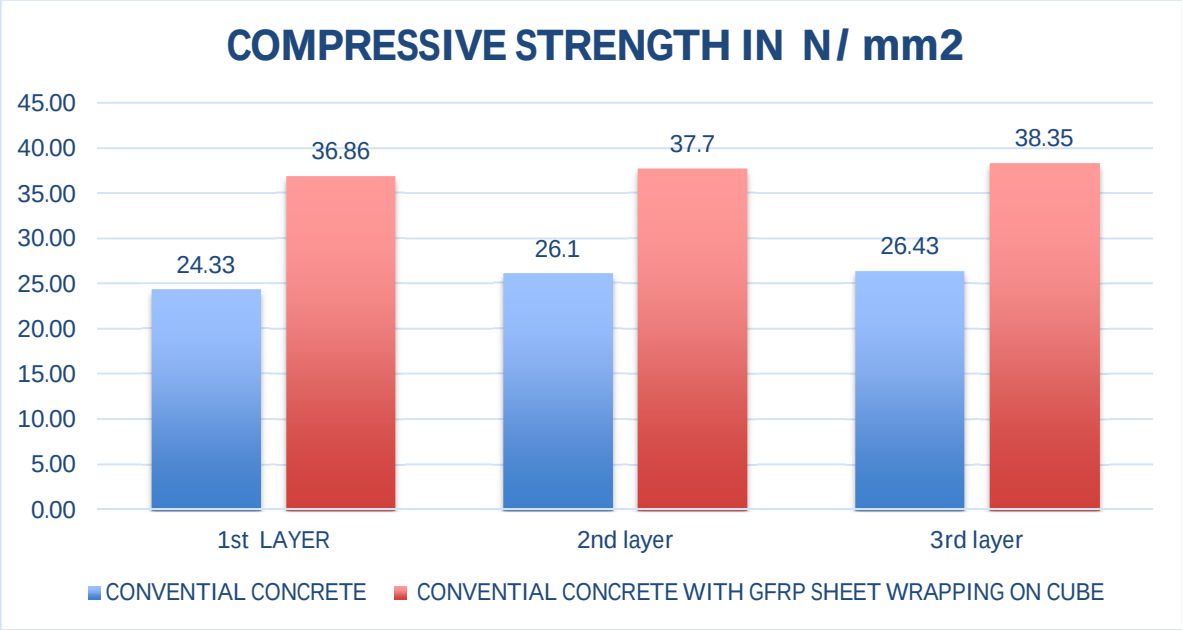
G. Observation

Average Compressive Strenth For Conventail Concrete 28 Days Curing

Block No.	Grade of concrete	Area	Load	Compressive Strength	Average Compressive Strength
		Mm2	KN	N/mm2	N/mm2
1.	M25	22500	564.7	24.33	25.62
2.		22500	600.9	26.10	
3.		22500	593.4	26.43	

Average Compressive Strenth For Conventail Concrete 28 Days Curing With Glass Fiber Sheet In 3 Days Curing

Block No.	Grade of concrete	layers	Area	Load	Compressive strength	Average compressive strength
			Mm2	KN	N/mm2	N/mm2
1.	M25	1st layer	22500	829.5	36.86	37.68
2.		2nd layer	22500	850.0	37.7	
3.		3rd layer	22500	863.0	38.5	



IV. AIM AND OBJECTIVES OF PROJECT

A. *Aim*

To Perform a Enhancement of structure integrity using glass fibre wrapping

B. *Objectives*

1) Strengthening Structural Components**:** Glass fibre wrapping is used to reinforce and strengthen columns, beams, walls, and other load-bearing elements. This increases the overall load capacity and ensures the structure can handle higher stresses without failure.
2) Seismic Resistance Improvement**:** The use of glass fibre wrapping helps in enhancing the seismic resistance of structures. This is particularly useful in areas prone to earthquakes, as it can absorb and dissipate seismic forces, preventing damage and collapse.
3) Corrosion Protection**:** Glass fibre wrapping serves as a protective barrier that shields steel reinforcement from corrosion due to moisture or chemical exposure, increasing the lifespan of concrete structures, especially in harsh environments like marine or industrial settings.
4) Reduction of Structural Defects**:** Glass fibre wrapping can repair and prevent further propagation of cracks and other structural defects. The wrap provides a strong, durable surface that restores the structural integrity and prevents the failure of damaged elements.

C. *Problem Statement*

The construction industry is constantly seeking innovative materials and techniques to enhance the performance, durability, and sustainability of concrete structures. One promising approach involves the use of GFR concrete, to promote self-healing of cracks, thereby improving the durability and longevity of concrete structures. Additionally, the incorporation of supplementary materials like glass fibre resin has been shown to enhance the properties of concrete, offering environmental and economic benefits

V. CONCLUSION

1) It provides long-lasting protection against environmental factors like moisture, UV radiation, and temperature extremes, reducing material degradation over time.
2) Glass fiber wrapping significantly enhances the tensile, compressive, and shear strength of structural elements, improving their load-bearing capacity.
3) Glass fiber wrapping is a cost-efficient alternative to traditional reinforcement methods such as steel or carbon fiber, making it accessible for both new and retrofitted structures.

4) The lightweight properties of glass fiber make it an ideal solution for reducing the weight of structures without compromising strength or performance.

5) The durability and strength of glass fiber-wrapped structures reduce the need for frequent repairs and maintenance, leading to long-term cost savings.

6) Glass fiber wraps can be applied with minimal visual impact, maintaining the aesthetic appearance of the structure while enhancing its integrity.

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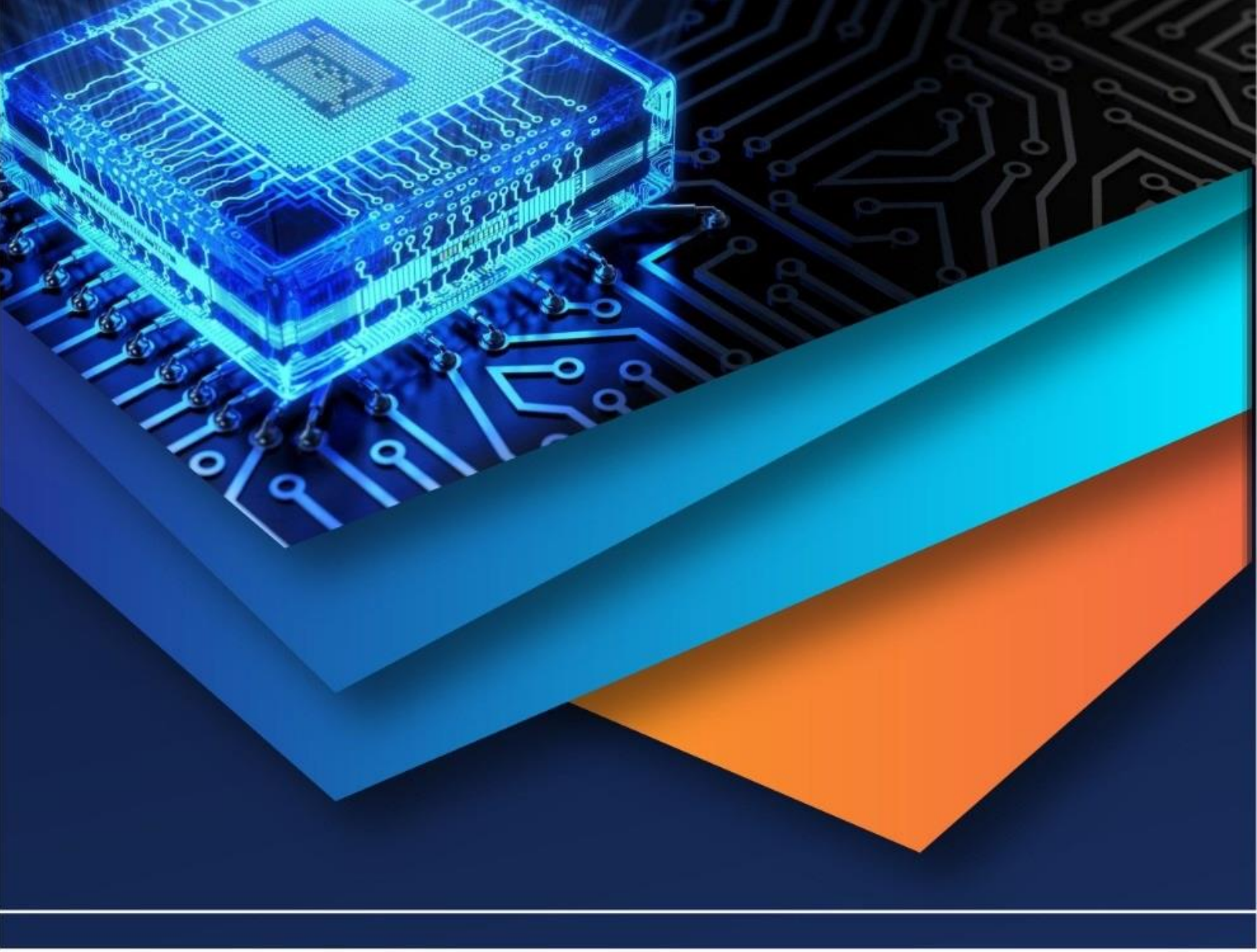

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