APPLICATION OF GLASS FIBER REINFORCED POLYMER (GFRP) IN RETROFITTING OF MASONRY WALL

Ankit Kumar[1] **(**aksharma181094@gamil.com**)**

[1]MTech (scholar), Structural Engineering, Rama University, Kanpur, UP, India

Satya Veer Singh[2] **(**satyaveer687@gmail.com**)**

[2]Assistant Professor, Department of Civil Engineering, Faculty of Engineering and Technology, Rama University, Kanpur, UP, India

Pawan Pandey[3] (pawanpandey.civil@gmail.com)

[3]Assistant Professor, Department of Civil Engineering, IITM, Bilhaur, Kanpur, UP, India

ABSTRACT

In present era, there are so many buildings which collapse fully or partially due to lake of maintenance, improper construction method and material or even due to earthquake. They need repairing to make them safe. Repair are always neglected or delayed by many people in most of building owing to lack of awareness and financial ability and so it leads to major hazards. Hence, it is needed proper repair and reconstruction application. In this project we have more focus on repairing on building which has required maintenance, because most of problem occurs after certain life of building. In addition, we have also focus on repairing of that sort of structure which has more than of their certain life and which has affected by some disaster like earthquake, flood, etc. At last, we will suggest some useful innovative materials and its application, how to apply on damage part, which would ultimately improve the strength of the structure.

To overcome this problem advanced composite materials such as carbon fiber reinforced polymer (CFRP) composites are used for retrofitting of structures. CFRP repair is a simple way to increase both the strength and design life of a structure. Because of its high strength to weight ratio and resistance to corrosion, these repair method is ideal for deteriorated concrete structure.

This work is focused on effects of CFRP wrapping for standard and deteriorated masonry wall panels with and without CFRP wrapping. The objective of study to carry out comparative study of the standard masonry wall with masonry wall wrapped with CFRP in terms of structural performance.

Keywords: *Repair, Retrofitting, Rehabilitation, Innovative material (Glass fiber wrap, Carbon Laminate*).

1. INTRODUCTION

Earthquake can pose one of the greatest challenges to the designer of buildings and other civil engineering structure. The potential for violent ground motion lasting not more than few minutes to cause great destruction has been amply demonstrated by recent events. Experience from past earthquakes and results of structural analysis indicate that a large proportion of the existing reinforcement concrete building in Gujarat (or anywhere) in vulnerable to damage or event collapse during a strong earthquake. These structures are possessing neither sufficient strength nor ductility to perform satisfactorily during future past, and not just which have been those damaged during earthquake. However, the redesigning of all damaged or non-damaged (conceptual error design) structure are very difficult. Replacement of damaged building or existing unsafe building by reconstruction is generally, avoided due to a number of reasons, the main ones among them is Higher cost of Repair and retrofitting. The retrofitting work carried out in various regions, although on a small scale, offers a number of lessons that could be valuable for the further development of retrofitting as well as for its promotion as the most attractive option for reducing vulnerability.

A Fiber Reinforced Polymer (CFRP) composite is characterized as a polymer (plastic) lattice, either thermo set or thermoplastic, that is fortified (consolidated) with a fiber or other strengthening material with an adequate viewpoint ratio(length to thickness) to give a discernable repairing capacity in at least one headings. FRP composites are unique in relation to customary development materials, for example, steel or Aluminum.

- Repair: The main purpose of repair is to bring back the architectural shape of the building so that all services start working and the functioning of building is resumed quickly.
- Retrofitting: Retrofitting is the seismic strengthening carried out to upgrade the seismic resistance of a damaged building.
- Rehabilitation; It is the act of restoring something to its original state.

2. PROCEDURE

A. Using Innovative Materials:

Current research on advance material in civil engineering is mainly concentrated on high performance concrete and steel, and some of the other materials are also used to regain structural strength. Like Glass fiber wrap, Carbon fiber wrap and Carbon laminates. By using this material, we can improve strength of structural member which have been damaged. High specific stiffness and specific weight combined with superior environmental durability of these materials have made them a competing alternative to the conventional strengthening methods. It was shown through experimental and analytical studies that this material can be applied to various structural members including columns, beams, slabs, and walls to improve their structural performance such as stiffness, load carrying capacity, and ductility. Here, we are used two different material Glass fiber wrap and Carbon laminates on precast concrete beam (M25 Grade) and calculate its new strength.

Procedure for Glass Fibre Wrapping:

i. Step-1:

Grind the corner of the beam at 1 inch, which is covered by the glass fiber wrap.

ii. Step-2:

The next step was applying an adhesive-compatible (epoxy) primer. The primer that comes in two components was mixed thoroughly with a drill equipped with an agitator until a smooth homogeneous mass was obtained.

iii. Step 3:

When the primer will be in sticky form then applied the saturate on the primer. The saturate will be in two parts, so mix properly and applied on the beam.

iv. Step-4:

Then, after the 5 minutes wrapped the glass fiber on the surface and press with the rollers. The glass fiber will be taken the 45 minutes for the bonding with the saturated beam.

v. Step-5:

After the wrapped of glass fiber, applied the 1 layer of saturate on the glass fiber for proper bonding.

Procedure for Carbon lamination:

i. Step-1:

Before bonding the laminates on the concrete, the surface were ground to remove all contamination and weak surface layers and to expose the aggregates. Surface preparation generally has a much greater influence on long term bond durability than it does on initial bond strength, so that a high standard of surface preparation is essential for promoting long term bond performance. After this the dust and debris were removed by air blast.

ii. Step-2:

The next step was applying an adhesive-compatible (epoxy) primer. The primer that comes in two components was mixed thoroughly with a drill equipped with an agitator until a smooth homogeneous mass was obtained.

iii. Step-3:

The epoxy adhesive is prepared the same way as the primer, by mixing the two components. The mixture was then applied evenly with a trowel ensuring that on the rough surface all gaps are covered. The epoxy adhesive's thickness was maintained constant at 2 mm throughout the length, for all of the beams.

iv. Step-4:

After uncoiling, the laminates to be installed were cut to the proper length. Surface preparation of the composite plates was accomplished by stripping off a clean, scrubbed, nylon peel-ply layer molded into one surface during composite fabrication. The laminates were placed in their final position by using light finger pressure. After checking the location and the alignment with the help of a rubber roller and a trowel the excess adhesive was removed.

B. Advantages:

- Upgrade load bearing capacities of concrete and masonry structures.
- Increase bending strength of concrete beams, slabs, and walls.
- Increases shear strength of concrete beams and walls.
- Restore capacity of concrete structure loss due to deterioration.
- Replace reinforcing steel lost to corrosion.
- Correct design/construction errors.

- Substitute missing reinforcing steel.
- Prevent brittle shear failures of concrete beams and walls.

C. ***Comparisons:***

Comparison of beam without wrapping, wrapping with glass fibre beam and carbon laminated beam.

Table-1: Flexural Strength of Beams after 28 Days

Sr. no.	*Beams*	*Materials*	*Maximum load(KN)*	*Strength(N/mm$^{2)}$*	*Average strength (N/mm^2)*
1	*Beam-1*	*BEAM WITHOUT WRAPING*	*20*	*3.94*	*3.73*
2	*Beam-2*		*16*	*3.52*	
3	*Beam-3*		*18*	*3.73*	
4	*Beam-1*	*GLASS FIBRE WRAPPING*	*54*	*10.99*	*10.09*
5	*Beam-2*		*52*	*10.78*	
6	*Beam-3*		*40*	*8.5*	
7	*Beam-1*	*CARBON LAMINETS*	*86*	*16.8*	*15.07*
8	*Beam-2*		*72*	*14.93*	
9	*Beam-3*		*60*	*13.48*	

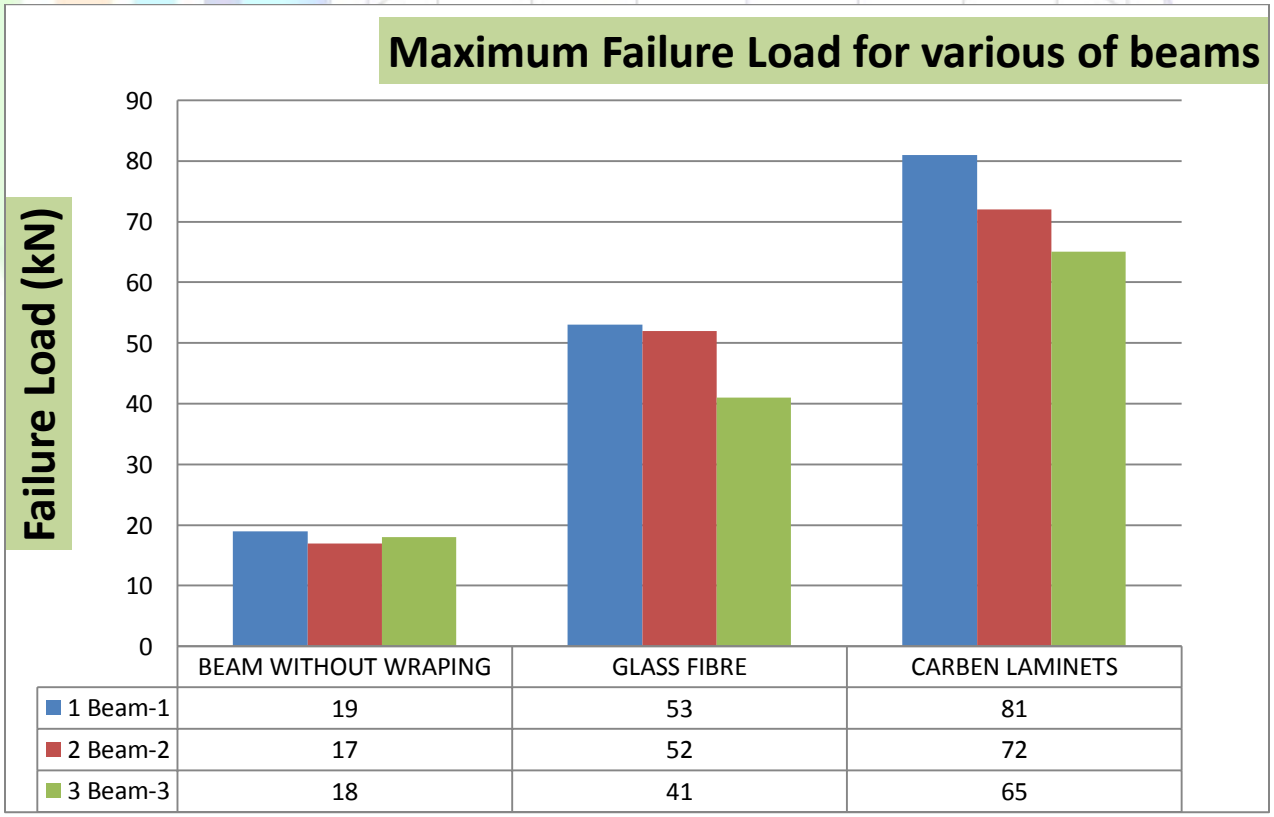
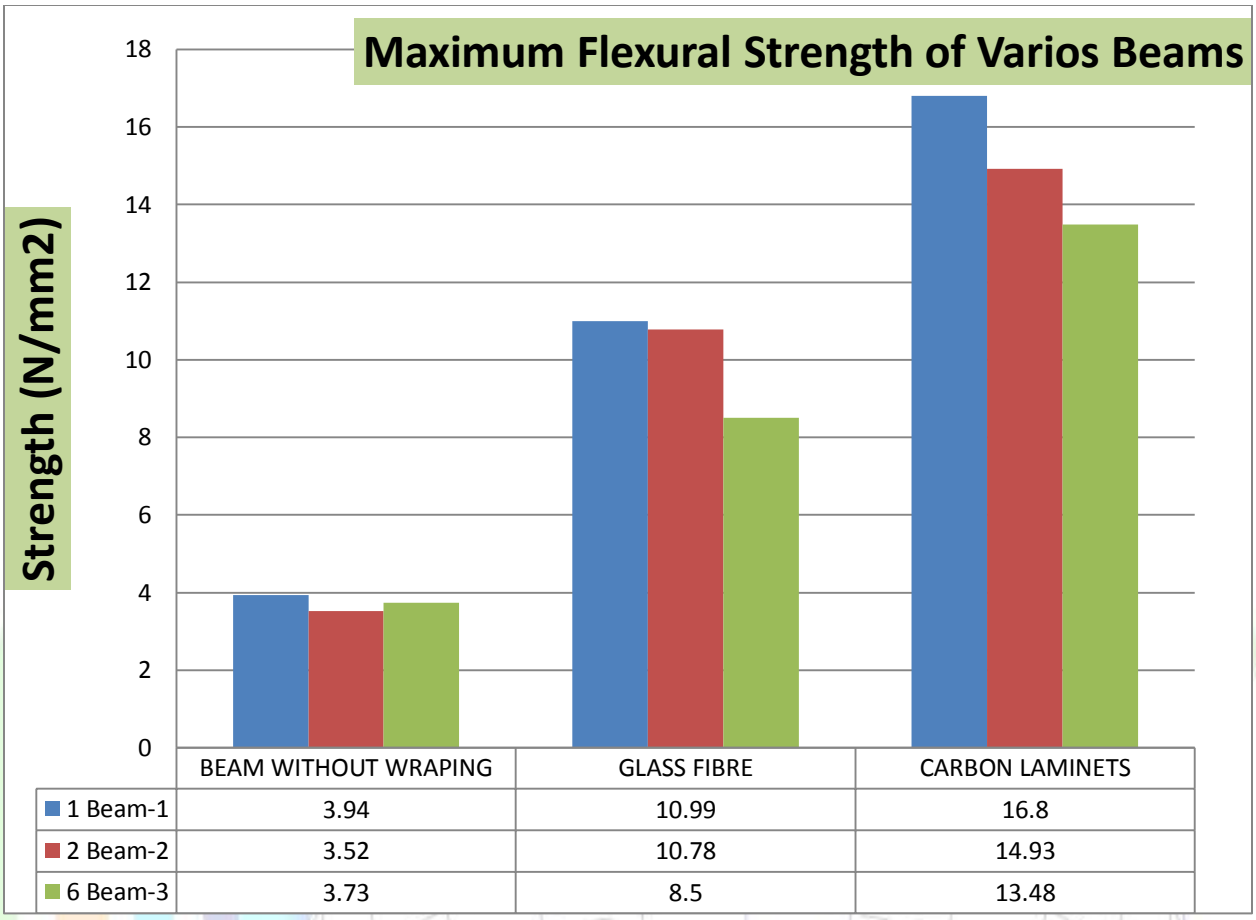


Figure-1: Graph for maximum failure load (kN)



	BEAM WITHOUT WRAPING	GLASS FIBRE	CARBON LAMINETS
1 Beam-1	3.94	10.99	16.8
2 Beam-2	3.52	10.78	14.93
6 Beam-3	3.73	8.5	13.48

Figure-2: Graph for maximum flexural strength (N/mm^2)

3. CONCLUSSIONS

Reviewing the literature & from visit of different buildings which requires repair or retrofitting. We will suggest the methods of repair or retrofitting for such buildings.

From the visit of already retrofitted building, we take that case as a case study of our project and study all the aspects considered while retrofitting carried out.

Based on comprehensive experimental study carried out on concrete by using glass fiber and carbon laminates; the following measured conclusions are flexural strength and compressive strength: -

- Result of flexural strength of wrapped glass fiber beam is 2.7 times and wrapped carbon laminates beam is 4 times more than normal beam without wrapped.
- By result of test, we conclude that the strength of beam with wrapping by glass fiber and carbon laminates is increase as compare to the normal beam.

REFERENCES:

[1] CPWD handbook of repair and rehabilitation.

[2] Arya, A.S. (1986), Guidelines for Earthqual Resistant Non-Engineered Construction, lAEE Committee, The International Association for Earthquake Engineering, Tokyo.

[3] Brühwiler, E., Fehling, E., Bunje, K. & Pelke, E. 2007.Design of an innovative composite road bridge combining reinforced concrete with Ultra-High Performance Fibre Reinforced Concrete. Proceedings, IABSE Symposium "Improving Infrastructure Worldwide" Weimar, September 2007.

[4] G.R. Reddy, Akanshu Sharma, P.N. Dubey, Y.M. Parulekar, "SEISMIC RETROFITTING OF LIFELINE STRUCTURES AND SYSTEMS", Proceedings for WSRR 09, IIT Bombay, ASTR, (2010).

[5] Dr. B.N. Pandya, Dr. M. M. Murudi, Dr. A. A. Bage, "SEISMIC RETROFITTING OF REINFORCED CONCRETE BUILDINGS", Proceedings for WSRR 09, IIT Bombay, ASTR, (2010).

[6] A.K.Ghosh and H.S Kushwaha, "Studies on response of structures, Equipment and piping.

[7] Material Testing laboratory (SNPIT & RC Umarkh). Saghafi M. H., "Seismic performance of URM panels reinforced by FRP", Department of Civil Engineering, University of Semnan, 2009.

[8] Amit Dum, Chandrakant Pol "CFRP Application in Retrofitting of Masonry".

[9] Tejas D Kukadiya K, Vyom B Pathak, Repair, Rehabilitation and Retrofitting of Building, Department of Civil Engineering, S.N.P.I.T. & R.C., Bardoli, India.

[10] Mohammad Z. Kabir, "Experimental investigation on out-of-plane behavior of GFRP retrofitted masonry panels", Construction and Building Materials, Vol. 131, pp. 630-640, 2017.