

# ANALYTICAL STUDY ON RETROFITTING TECHNIQUES OF RECTANGULAR COLUMN WITH DIFFERENT WRAPPING MATERIALS

Akanksha Chandrakant Slave<sup>1</sup>, Prof. A. S. Patil<sup>2</sup>

JSPM'S Rajarshi Shahu College of Engineering, Pune .<sup>1,2</sup>

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**Abstract:** Civil engineering structures may be damaged due various causes such as earthquakes, cyclones, blasting, etc. This kind of loading collapses the structure prematurely or causes extensive damage to them. When the damage is minor, it is possible to retrofit the structure. A review of the available literature has disclosed that umpteen numbers of retrofitting methodologies are available. Among them, efficient and effective method of repairing damaged structures is the application of Fiber Reinforced Plastics (FRP). In the past, several structures have been rehabilitated using the FRP techniques. This report describes a review of using the FRP techniques, their applications, case studies of repairing civil engineering structures, and appropriate concluding remarks.

**Keywords:** Fiber Reinforced Plastics, Retrofitting

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## I INTRODUCTION

Retrofitting is making changes to a current building to safeguard it from flooding or different risks, for example, over the top breezes and seismic tremors. You have effectively obvious an occasion of these adjustments, and you'll concentrate more inside the accompanying parts. In any case, you might be thinking at this factor why retrofitting is crucial .Why aren't houses and different buildings constructed in such a manner that they won't want these adjustments? One purpose is that construction technology, which includes both strategies and materials, keeps to improve, as does our know-how of dangers and their outcomes on homes. Many homes existing nowadays were built when little changed into known about where and how regularly floods and different hazardous activities would occur or how homes ought to be protected, and houses being built today may advantage from improvements based on what we study in the future. As a result, retrofitting has turned out to be an important and critical device in risk mitigation.

Jacketing of sections is made out of presented concrete with longitudinal and transverse support around the current segments. This kind of reinforcing improves the pivotal and shear power of sections while the flexural intensity of segment and power of the bar segment joints keep on being the equivalent. It is likewise found that the jacketing of segments isn't effective for upgrading the pliability. A foremost advantage of column jacketing is that it improves the lateral load ability of the constructing in a fairly uniform and distributed way and as a result averting the attention of stiffness as inside the case of shear walls. This is how essential strengthening of foundations may be avoided. In addition the authentic function of the building may be maintained, as there are not any main changes within the unique geometry of the building with this technique.

Structural building structures can be harmed due different reasons which incorporate quakes, violent winds, impacting, and so forth. This sort of stacking breakdown the shape forthright or reasons tremendous damage to them. At the point when the harm is minor, it is conceivable to retrofit the structure. An evaluation of the to be had composing has uncovered that umpteen amounts of retrofitting systems are open. Among them, gainful and fruitful procedure for fixing hurt structures is the utilization of Fiber Reinforced Plastics (FRP). Previously, a couple of structures had been reestablished using the FRP techniques. This paper presents a huge chart of using the FRP techniques, their undertakings, relevant examinations of fixing basic structure systems, and appropriate wrapping up remarks

## II LITRATURE REVIEW

Arif, M., Akhtar et. al. [1] Providing low price housing especially to center and low earnings organization each in rural and concrete regions is a serious country wide problem. The magnitude and acuteness of the troubles is glaringly greater said in urban areas. Also the traditional construction substances are becoming excessively costly day by using day. Innovative and low fee construction materials and techniques thereby come to be pressing need. Retrofiring might also serve as one such alternative. It has verified itself as an high-quality fabric for low fee housing. It has high diploma of ductility and strength absorbing ability and has been increasingly used both in terrestrial and marine environments as a structural grade material device, which competes favorably with strengthened concrete and other constructing materials (Hermosura, and Austriaco, 1994; Ramli and Wahab, 1994; Arif et al.1994; Naaman, 2006).Investigations on the use of pre-solid retrofitting factors in low price housing have proved the effectiveness of the material device beneath static conditions.

D. G. Gaidhankar et al [2] Ferro cement is a sort of skinny wall bolstered concrete constructed of hydraulic cement mortar reinforced with intently spaced layers of continuous and relatively small size twine mesh". Mesh may be made from steel or other appropriate substances. The matrix may include discontinuous fibers. This definition ignores as crucial form of reinforcement currently in use in retrofitting i.e. The combination of metal rods and twine mesh. India has been recognized as a growing financial system which has a tendency to give upward thrust to a number of infrastructure developments especially the constructing projects. RCC is most widely used in all over world due to its high load sporting capacity however the fee of cement and steel is increasing day-by-day. So, we require a substitute to concrete which gives the electricity as that of RCC with low fee. In Ferro cement, hydraulic cement mortar with closely spaced small diameter cord meshes is used. To improve positive traits of retrofitting diverse materials along with admixtures, silica fumes, fly ash and fibers are used. Generally, the thickness of retrofitting degrees from 20 – 50 mm. Retrofitting is a twine mesh reinforcement impregnated with mortar to produce elements of small thickness, high sturdiness and resilience and, when properly shaped, high strength and rigidity. To skip these troubles and directly determine the reaction of retrofitting in unconventional applications, numerical simulations exploiting the Finite Element Method (FEM) have yielded crucial outcomes in current years..

S. Dharanidharan et al [3] A massive number of civil systems everywhere the world are in a nation of considerate deterioration today due to carbonation, chloride attack, etc. Moreover numerous civil constructions are no longer considered safe due to growth load specifications inside the layout codes or due to overloading or due to beneath layout of existing systems or due to lack of best control. In order to keep efficient serviceability, older structures should be repaired or strengthened in order that they meet the equal necessities demanded of the structures built today and in future. These ends in the improvement of Ferro cement systems. Ferro cement is a kind of thin-wall reinforcement concrete commonly constructed of hydraulic cement mortar, reinforced with carefully spaced layers of continuous and relatively small diameter mesh.

Hamid Eskandari et al [4] Ferro cement, also called reinforced concrete, is acquired through blending cement with sand mortar and applying the mixture over a few layers of woven or welded steel mesh with small-diameter holes. It is widely used in shipbuilding, water and food garage tanks, water transport tubing, silos, roofs, urban and rural houses, and shape repair. Retrofitting's especially popular due to the fact its raw substances are available, it is easy to prepare and shape, and it's miles fireplace resistant. It is likewise recognized to promote the seismic resistance of masonry structures. Research has indicated the use of additives inclusive of fibers, silica, fly ash, and resin

to growth the power of mortar in Ferro cement. Although the want for experimental research to offer the basis for layout equations continues however via making use of the FEM, can reduce the time and fee of otherwise costly experimental tests, and may higher simulate the loading and support situations of the actual structure. So to this give up the FEM is utilized by Nassif and Najm to investigate the conduct of retrofitting composite beams beneath a two-point loading system.

Sadik Can Girginaet al [5] studied the seismic performance factors for precast buildings with hybrid beam-column connections. Hybrid connections were constructed by welding of corbel plates to beam end plates where beam longitudinal re bars were welded, and casting of concrete through the designated gaps in beam tops and column elements at site. Their study presents the development of a numerical model for hybrid connections to be used to assess seismic performance of multi-storey precast concrete structures. The numerical model included truss-based elements for beam-column connections and fiber-based elements for beams and columns. Lateral load-drift ratio relations for the measured and computed cyclic responses of a precast connection were compared. In addition, two-dimensional three- and five- storey precast concrete frames were designed for seismic performance evaluation. Frame models were analyzed by performing nonlinear static pushover analyses and incremental dynamic analyses with representative ground motions. Response modification factors were obtained and evaluated for seismic design of precast concrete buildings.

Y. B. I. Shaheen et al [6] Ferrocement is kind of fortification cement. It typically made out of pressure driven concrete mortar reinforced with painstakingly divided layers of persistent and relatively little size string network. The work can be made from metal or other suitable materials (Blake, 2001). It is minimal effort, tough, climate obstruction, lightweight and particularly its flexibility contrasting with the strengthened solid (Ali, 1995). Their test outcomes showed that utilizing the retrofitting coat expands the hub load capacity and the hub firmness of fixing fortified solid segment when contrasted with the oversee segments. Kaish et al. (2011) and Xiong (2004) explored the chance of utilizing retrofitting coat in reinforcing of square fortified solid brisk segment

Amlan K. Sengupta et al [7] After the tremor in Bhuj, Gujarat, in 2001, there has been a purposeful exertion to address the seismic helplessness of existing structures in India. This paper is a piece of an undertaking, whose point is to advance techniques to evaluate the seismic weakness of fortified solid three-to ten-storeyed, private and business structures and to propose retrofit measures for the basically inadequate structures. For the structures tended to in the task, the basic component insufficiencies are lacking shear limit, center restriction and rebar grafting of sections; deficient shear limit, rebar safe haven and plastic pivot turn capacity of shafts and insufficient control

of pillar to-segment joints.. Without authority components in the piece and legitimate enumerating of the associations with the structure outline, there is absence of necessary activity of the horizontal burden opposing components. The neighborhood retrofit procedures of section, shaft, pillar to-segment joint, divider and establishment fortifying are inspected. Under worldwide retrofit techniques, the expansion of infill dividers, shear dividers and steel supports, and the decrease of the structure inconsistencies are referenced. A point by point contextual analysis is accounted for. In the end, issues relevant to retrofit are talked about.

Komal Bedi et al [8] The retrofit framework is a well known term that can comprise of many medicines, including: upkeep, recovery, recuperating and reproduction. Choosing the exact treatment approach is a remarkable endeavor required inside the retrofit procedure and should be chosen by and by for every task. Contingent upon task destinations, security and upkeep of structures may include a variety of various specialized contemplations, alongside fire life wellbeing, geotechnical dangers and cures, enduring and water penetration, auxiliary execution under seismic tremor and wind loads. Conservation is portrayed on the grounds that the way of utilizing measures to continue the predominant structure, respectability, and materials of a notable property. Restoration alludes to the way toward making new utility for an advantages through fix, changes and increments while holding those capacities which pass on it's verifiable, social, or compositional qualities. Reclamation is the methodology of as it ought to reestablish an assets as it existed at a chose timeframe. Recreation is characterized on the grounds that the demonstration of repeating a things at a particular term of time.

Giuseppe Oliveto et al [9] Seismic retrofitting of developments helpless to tremors is a current difficulty of wonderful political and social importance. The greater part of the Italian structure stock is at risk to seismic movement regardless of whether situated in districts that have for quite some time been thought about of over the top seismic danger. During the past thirty years moderate to inordinate quakes have come upon in Italy at terms of five to ten years. Such exercises have obviously demonstrated the weakness of the building stock especially and of the assembled condition when all is said in done. The seismic risk inside the locales, where those tremors have come to fruition, has been perceived for quite a while as a result of comparative events that occurred in the past. The seismic retrofitting of strengthened solid homes not, at this point intended to withstand seismic development is mulled over. After to sum things up presenting how seismic development is portrayed for format purposes, techniques for surveying the seismic helplessness of existing homes are introduced. The traditional strategies for seismic retrofitting are checked on and their feeble focuses are

recognized. Present day techniques and ways of thinking of seismic retrofitting, comprehensive of base seclusion and force scattering gadgets, are audited. The introduction is represented through case examination of genuine structures where customary and dynamic retrofitting techniques were applied.

Keiji Kitajima et al [10] The Hyogoken-Nanbu Earthquake which happened in January 1995 made incredible harm structures having poor quake opposing limit that were planned dependent on the norms set up before the reception of the New Seismic Design Code (the current code of Japan). As an exercise gained from the experience, a law concerning the advancement of seismic retrofitting of structures was executed in December of that year trying to advance seismic conclusion and seismic retrofit of existing structures. The reason for this examination is to build up a seismic retrofitting technique which expands tremor opposing limit of the structure by retaining the vitality, which is contribution to the structure during a quake, with dampers which are added to the structure. This paper first gives a framework of the examination, breaks down the reaction attributes of structures retrofitted with dampers, and presents instances of damper retrofitting of structures of preliminary plan. It at that point portrays trial concentrates on unit execution test for grating dampers, on the association between the current structure and damper-supports, and on a pseudo-powerful test on fortified solid edges retrofitted with dampers.

### III METHODOLOGY

#### Retrofitting Techniques

- Conventional techniques
  - a. Section enlargement.
  - b. External plate bonding.
  - c. External post tensioning.
  - d. Ferro cement covering.
- Advanced strengthening techniques
  - a. Fiber Reinforced polymer(FRP) composites

Section growth consists in putting additional concrete around an current structural Element to growth its seismic resistance. This is the oldest technique of seismic Retrofitting. Typical applications encompass bridge deck, column wrapping, and joint Strengthening. This approach is easy and economically effective; however labor extensive Entire cross section of member is increased. Additional structural reinforcement metallic with shear stirrups. Process involves surface preparation, additional Reinforcement and concrete curing.

- **Reinforced Concrete Jacketing:**

Reinforced cement jacketing might be utilized as a reestablish or reinforcing plan. Harmed regions of the current individuals should be fixed past to their jacketing. There are two primary elements of jacketing of segments.

(I) Increase in the shear limit of segments with a reason to achieve a strong section helpless shaft structure and

(ii) To upgrade the section's flexural vitality with the guide of the longitudinal metal of the coat made relentless through the piece machine are secured with the establishment. It is accomplished by passing the spic and span longitudinal fortification through openings penetrated inside the chunk and with the guide of putting new cement inside the bar section joints as delineated in parent 1. Restored areas are planned along these lines all together that the flexural power of segments must be more prominent than that of the shafts. Transverse steel above and beneath the joint has been outfitted with subtleties, which incorporates two L-formed ties that cover slantingly in inverse corners. The longitudinal support normally is concentrated inside the section corners because of the life of the shafts where bar groups have been utilized as appeared in decide 1. It is typically suggested that not, at this point more noteworthy than 3 bars be packaged together. Windows are regularly exhausted through the piece to allow the metallic to experience just as to permit the solid throwing process.

#### IV DESIGN AND ANALYSIS

Reinforced concrete jacketing improves column flexural strength and ductility. Closely spaced transverse reinforcement provided in the jacket improves the shear strength and ductility of the column. The procedure for reinforced concrete jacketing is as follows:

The seismic demand on the columns, in terms of axial load  $P$  and moment  $M$  is obtained.

The column size and section details are estimated for  $P$  and  $M$  as determined above.

The existing column size and amount of reinforcement is deducted to obtain the amount of concrete and steel to be provided in the jacket.

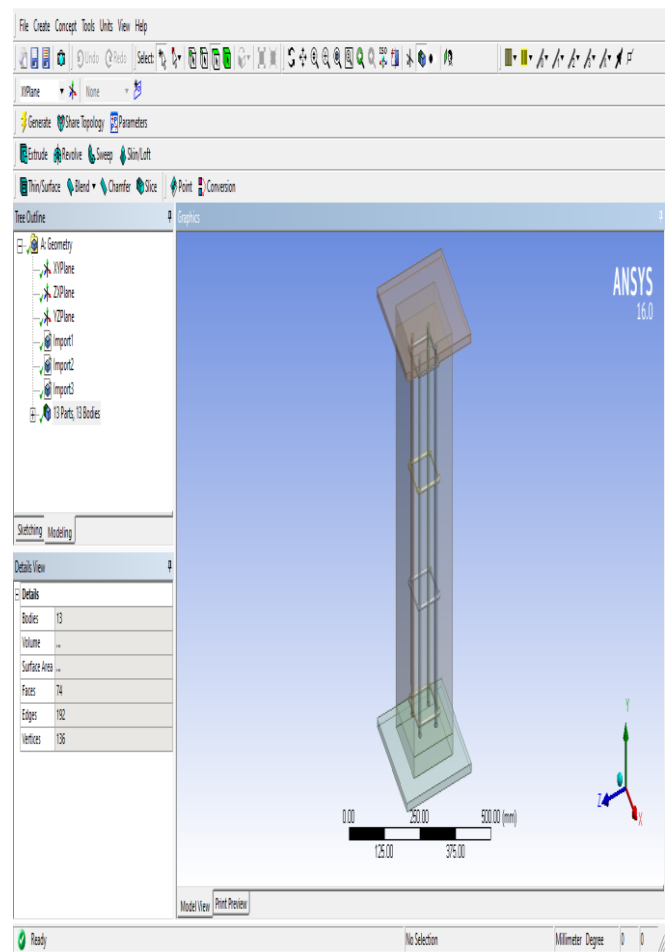
The extra size of column cross-section and reinforcement is provided in the jacket.

Increase the amount of concrete and steel actually to be provided as follows to account for losses.

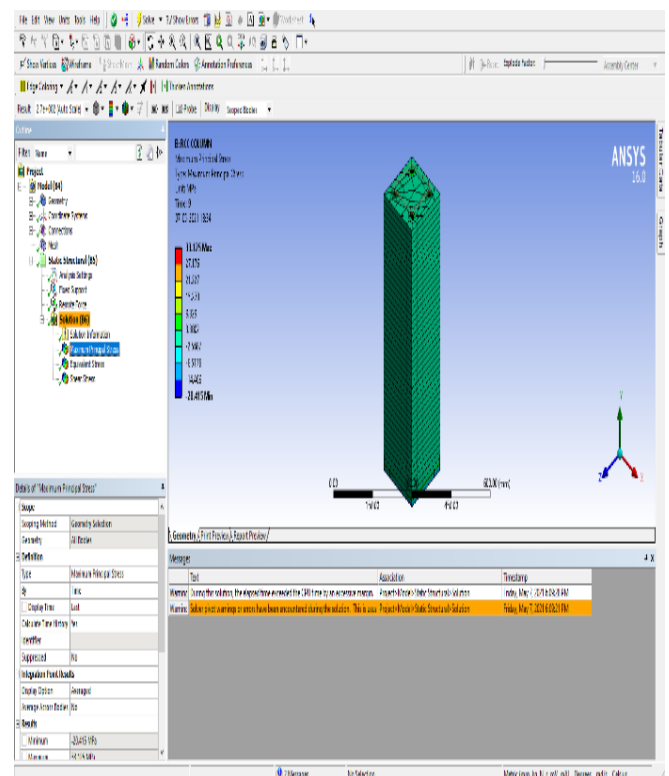
#### V RESULT AND DISCUSSION

<b>MODEL NO.1</b>	RECTANGULAR COLUMN WITHOUT JACKET
<b>MODEL NO.2</b>	RECTANGULAR COLUMN WITH NC JACKET
<b>MODEL NO.3</b>	RECTANGULAR COLUMN WITH GFRP JACKET
<b>MODEL NO.4</b>	RECTANGULAR COLUMN WITH CFRP JACKET

#### MODELING IN ANSYS



#### RECTANGULAR RCC COLUMN WITHOUT JACKET

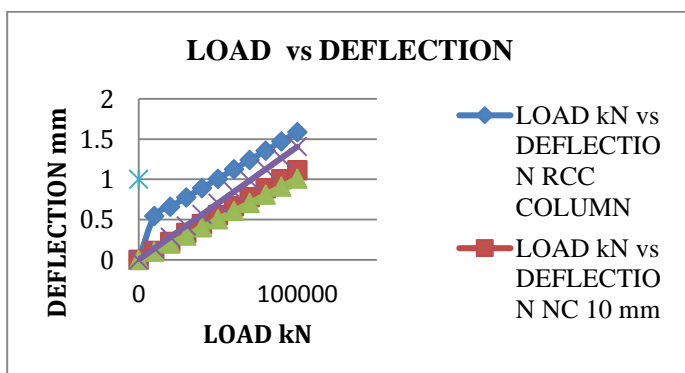


**VI RESULTS IN ANSYS**

<b>RP LOAD kNvs DEFLECTION</b>				
<b>LOAD kN</b>	<b>RCC COLUMN</b>	<b>NC 10 mm</b>	<b>CFRP 400 gsm</b>	<b>GFRP 900 gsm</b>
0	0	0	0	0
10000	0.54291	0.111254	0.10114	0.1405846
20000	0.65905	0.222497	0.20227	0.2811553
30000	0.77518	0.33374	0.3034	0.421726
40000	0.89131	0.444994	0.40454	0.5623106
50000	1.0074	0.556237	0.50567	0.7028813
60000	1.1236	0.66748	0.6068	0.843452
70000	1.2397	0.778734	0.70794	0.9840366
80000	1.3558	0.889977	0.80907	1.1246073
90000	1.472	1.00122	0.9102	1.265178
100000	1.5881	1.11243	1.0113	1.405707

The above table shows the value of applied RP load and the output on RCC column, NC 10mm, CFRP 400gsm and GSRP 900gsm. The applied load is from 0 to 100000 with respective gaps which showed in the table. With the increasing load the deflection of each and every column is increasing as showed in table.

**Graph 6.1: LOAD vs DEFLECTION**



The above graph shows the deflection with increasing load, the load is applied from 0 to 100000 KN. And the deflection starts from 0 to 1.6 mm. The total deflection with increasing load in ansys is concluding that the maximum deflection is having for

RCC column, and the minimum deflection is having in CFRP by 10-20%.

**VII CONCLUSION**

From study it is understood that By using retrofitting technique we achieve maximum strength at low cost and From the Analytical investigation of Nano cement, CFRP And GFRP jacketed RCC column under concentric load in ANSYS and the following concluding remarks could be made that CFRP jacketing technique could be used effectively, if proper jacketing scheme is introduced for the RCC Column.

- The total deflection with increasing load in ansys is concluding that the maximum deflection is having for RCC column, and the minimum deflection is having in CFRP by 10-20%.
- The stress with increasing load deflection in ANSYS is conclude that the maximum stress strain capacity is having for GFRP column, and the minimum stress strain capacity having for the RCC column by 15-20%.
- shear stress for RCC column is 16.8, for NC 10 mm is 15.059 , for CFRP is 13.69 and, for GFRP is 19.0291 and the minimum shear stress for CFRP column and maximum shear stress for GFRP by 20-25%.
- equivalent stress for RCC column is 92.7, for NC is 98.49, and for CFRP is 89.52 and, for GFRP is 124.46 and the minimum equivalent stress for CFRP column and maximum equivalent stress for GFRP by 20-25%.
- Maximum principle stress for RCC column is 108.5, for NC is 108.35, and for CFRP is 98.5 and, for GFRP is 136.915 and the result for Maximum principle stress for CFRP column is minimum and result for Maximum principle stress for GFRP is maximum by 20-25%..

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