Retrofitting of RC Circular Column Using Carbon Strips

Miss. Sathe Pooja Ramchandra[1], Prof. M.N. Shirsath [2]
[1] Dept of Civil Engineering,
[2]Asst. Professor & Guides, Dept of Civil Engineering,

Abstract- *The retrofit process is a general term that may consist of a variety of treatments, including: preservation, rehabilitation, restoration and reconstruction. Selecting the appropriate treatment strategy is a great challenge involved in the retrofit process and must be determined individually for each project. Depending on project objectives, preservation and renovation of buildings may involve an array of diverse technical considerations, such as fire life safety, geotechnical hazards and remedies, weathering and water infiltration, structural performance under earthquake and wind loads. The paper presents some aspects regarding a research program that studies the behavior of reinforced concrete slabs retrofitted by using Fiber Reinforced Polymer composites. Theoretical and experimental investigations are being performed in order to determine the effectiveness of these strengthening solutions. Eight specimens, including two strengthened after being loaded to yield level to imitate strengthening with some damage and one strengthened under a sustained axial load to imitate strengthening under service condition, were tested under constant axial load and lateral cyclic load to investigate seismic performance of RC columns strengthened with carbon fiber reinforced polymer sheets (CFRP sheets). The ductility enhancement with the confinement of CFRP sheets was studied by the strain development and distribution in the CFRP sheets. Based on the experimental results, a confinement factor of CFRP and an equivalent transversal reinforcement index were suggested. Thus, the seismic design method of the current Chinese seismic design code for RC columns can be directly used in determining the amount of CFRP required for seismic strengthening.*

Keywords- CFRP, retrofit process, Carbon sheet

I. INTRODUCTION

Nowadays, civil engineering considers more and more the composite materials, especially the Fiber Reinforced Polymers (FRPs). The composite materials' properties have made their use to prove a real success in a series of applications from local strengthening to highly complex works. Preferring composites in some applications instead of traditional steel or reinforced concrete (RC) based strengthening solutions is grounded on many reasons. The composites` very high corrosion resistance along with the short amount of needed construction time and low weight are probably the most important of all.

One of the experimental programs that are in progress at the "Politehnica" University of Timisoara concerns the study of retrofitting solutions that involve the use of FRP for two-way RC slabs with cut-outs. In many situations, openings are needed in slabs, in places that were not considered during the design of a building. This need emerges mostly due to a series of changes in functionality. There is also the case in which some openings were considered in the design process but due to changes in functionality or in destination, the loads to which the slabs are subjected become much higher. In either one of these situations, the slab's overall behavior becomes deficient, both as stiffness and load bearing capacity. The area in which these effects are of most importance is the area around the cut-out, where stresses are highly concentrated. Any situation from the two previously mentioned, leads also to an important change in the overall failure mode, leading to new and unexpected ones.

A. Objective

- To study the mechanical behavior of CFRP.
- To study the effects of various wrapping Conditions on strength and ductility of concrete cylinders confined with CFRP composites.
- To study behavior of concrete cylinders confined with CFRP composites.
- To propose an analytical Modeling and to compare results on Finite element modeling by using ANSYS.
- To propose the design methodology for the concrete column wrapped with CF

II. L ITERATURE REVIEW

Behavior of Axially Loaded CFRP Confined Large-Scale Capsule-Shaped RC Short Columns with Higher Cross-Sectional Aspect Ratio Abd El Rahman [1] This paper aimed to experimentally and analytically investigate the behavior of reinforced concrete (RC) short capsule-shaped columns

confined with carbon fiber-reinforced polymer (CFRP) sheets. The efficiency of FRP-confined strengthening system depends mainly on different encountered parameters such as the FRP confinement ratio, shape and size of cross-section, and cross-sectional aspect ratio of non-circular columns. The proposed model is compared with the existing model, showing good agreement with the experimental results and it is improved performance and gives reasonable predictions of load carrying capacity of FRP-confined columns.

Strengthening Of RC Circular Column Wrapped With Carbon Fiber Reinforced Polymer (CFRP) K.Pradeeba[2] This paper deals with Experimental and analytical studies of different parameters on concrete column wrapped with carbon fiber reinforced polymer (CFRP) are taken and investigated. Wrap thickness (l Layer), fiber orientation and the combinations of them were investigated. The results demonstrated significant enhancement in the compressive strength, stiffness and ductility of the CFRP-wrapped concrete column as compared to unconfined concrete column. An analytical model for ultimate stress and strain of confined concrete has been proposed.

A Literature Review On The Effect Of Ferrocement And Frp Column Jacketing Renjith Raju [3] This paper presents the compilation of the literature review of Ferrocement and FRP jacketing for strengthening the concrete column. All the casted specimens are tested by applying load. Axial load, lateral bulging, crack pattern etc. of column will be measured for the effectiveness of all two type jacketing.

III. METHODOLOGY

Here we are follow certain steps for our research.

1. Finding out the scope of research work.
2. Survey of Research paper related to this objective.
3. Finalizing Objective and Problem Statement Definition.
4. Design & Development of Experimental setup & selection of measuring instrument required.
5. Fabrication of Experimental Setup.
6. Experimentation/ Testing for selected parameter.
7. Study of Result & conclusion.

IV. PROBLEM STATEMENT

A. Preparation for design calculation

The planned experimental program consists of five columns of 1200mm length x 150mm□. Out of the five columns two are controlled specimen and three are wrapped with CFRP woven.

- Dia of Specimen =150mmø
- Height of Specimen =1200mm
- Main Reinforcement =12mmø - 6Nos
- Stirrups =6mmø -120mmc/c
- CFRP =0.42mm
- Axial load (Pu) = 392.593 KN

V. RESULTS AND DISCUSSION

A. Total Deformation

Table Total Deformation

Load (kN)	Total Deformation in mm			
	Only Middle span	One end and Middle span	Middle span and second end	At both ends of column
0	0	0	0	0
50	0.0011	0.001076	0.001054	0.000949
100	0.00133	0.001308	0.001282	0.001154
150	0.00157	0.001537	0.001506	0.001355
200	0.00181	0.001779	0.001743	0.001569
250	0.00204	0.002001	0.001961	0.001765
300	0.00257	0.002518	0.002467	0.00222

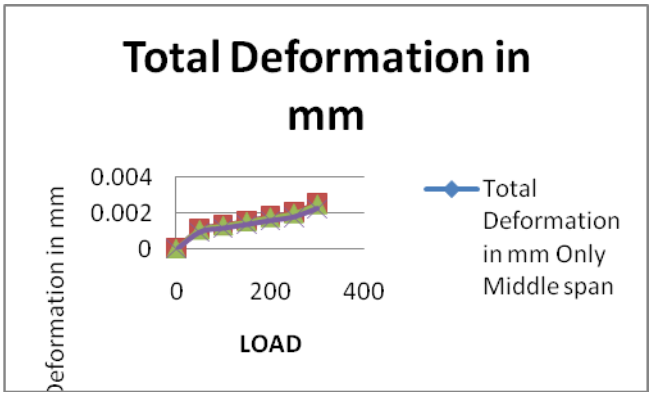


Fig.1Total Deformation

Above Fig. shows the results CFRP columns for Total Deformation in ANSYS for four different condition of CFRP in column and it conclude that the CFRP at both end of column give less result of total deformation in mm than the other conditions by 10-15%

Equivalent Stress

Table Equivalent Stress

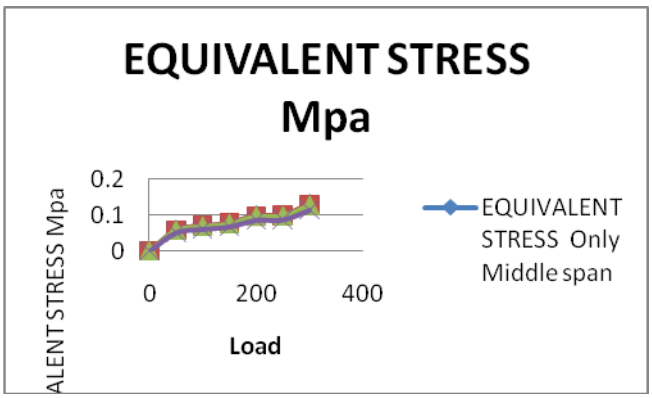
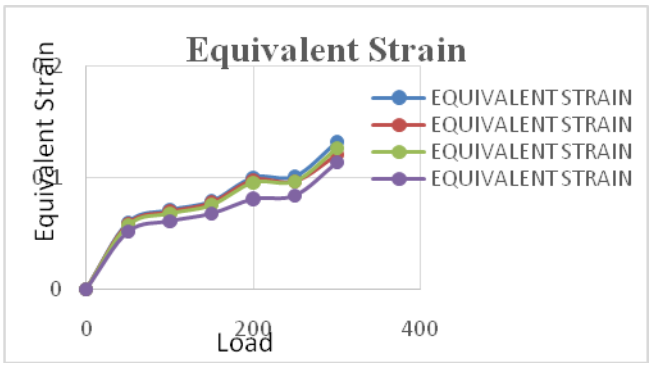


Fig.2Equivalent Stress

Above Fig. shows the results CFRP columns for Equivalent Stress in ANSYS for four different condition of CFRP in column and it conclude that the CFRP at both end of column give less result of Equivalent Stress than the other conditions by 15-20%

Equivalent Strain



Shear Stress

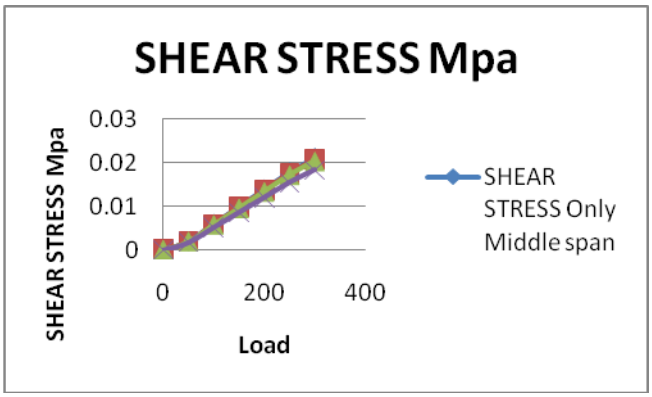


Fig.3Shear Stress

Above Fig. shows the results CFRP columns for Equivalent Stress in ANSYS for four different condition of CFRP in column and it conclude that the CFRP at both end of column give less result of Equivalent Stress than the other conditions by 15-20%

Shear Strain

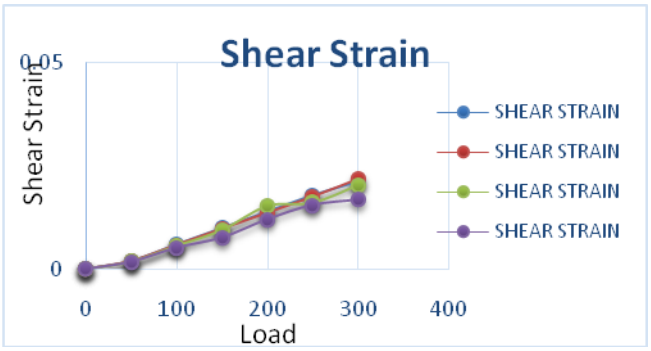


Fig.4Shear Strain

Normal Stress

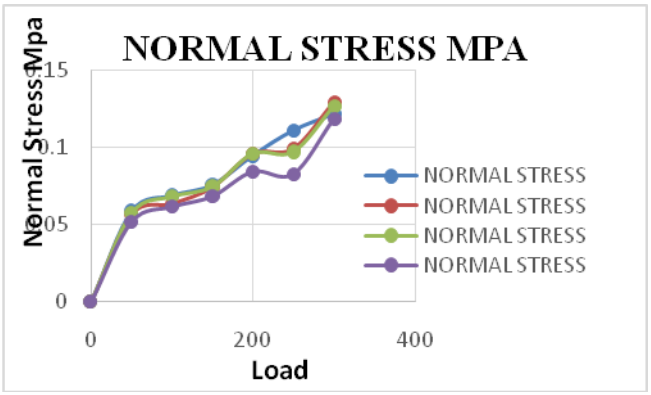


Fig 5 Normal Stress

Normal Strain

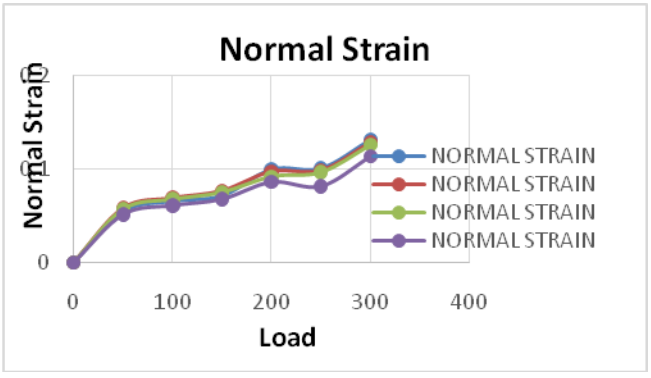


Fig 6Normal Strain

VI. CONCLUSION

1. From study it is understood that By using retrofitting technique we achieve maximum strength at low cost and From the Analytical investigation of CFRP column in

ANSYS by using different condition as following results conclude that CFRP at both end having economic results than other three conditions

2. The ultimate load carrying capacity of the strengthened column is more than the controlled column.
3. Analytical analysis is also carried out to find the ultimate moment carrying capacity and compared with the Experimental results.
4. Use of CFRP columns improves load carrying capacity, delay crack formation and energy absorption capability of Column reinforced with CFRP.
5. Above Fig. shows the experimental investigation For Axial Stress of high strength concrete columns for four different condition of CFRP in column and it conclude that the CFRP at both end of column give less results than the other condition by 5-10%
6. Above Fig. shows the experimental investigation For Axial Deflection of high strength concrete columns for four different condition of CFRP in column and it conclude that the CFRP at both end of column give less results than the other condition by 10-15%
7. Above Fig. shows the results CFRP columns for Total Deformation in ANSYS for four different condition of CFRP in column and it conclude that the CFRP at both end of column give less result of total deformation in mm than the other conditions by 10-15%
8. Above Fig. shows the results CFRP columns for Equivalent Stress in ANSYS for four different condition of CFRP in column and it conclude that the CFRP at both end of column give less result of Equivalent Stress than the other conditions by 15-20%
9. Above Fig. shows the results CFRP columns for Equivalent Stress in ANSYS for four different condition of CFRP in column and it conclude that the CFRP at both end of column give less result of Equivalent Stress than the other conditions by 15-20%

REFERENCES

[1] Abd El Rahman Megahid Ahmed et. al. “Behavior of Axially Loaded CFRP Confined Large-Scale Capsule-Shaped RC Short Columns with Higher Cross-Sectional Aspect Ratio” Journal of Civil August 7, 2018

[2] .Pradeeba et. al. “Strengthening Of RC Circular Column Wrapped With Carbon Fiber Reinforced Polymer (CFRP)” IJIRSET 22nd March 2018

[3] Renjith Raju “A Literature Review On The Effect Of Ferrocement And Frp Column Jacketing” IJARIIE-ISSN (O)-2395-4396 , Vol-4 Issue-2 2018

[4] Evgenia Anagnostou “Seismic retrofitting of damaged RC columns with lap-spliced bars using FRP sheets” Elsevier Ltd. 20 February 2019

[5] Mohannad H. Al-Sherrawi “Analytical Model for Construction of Interaction Diagram for RC Columns Strengthened by Steel Jacket” (IJSR) Volume 6 Issue 10, October 2017

[6] Shubham S Narwade “Carbon Fiber: The Future of Building Materials” (IJSR) Volume 8 Issue 6, June 2019

[7] Sayed Behzad Talaeitaba “Retrofitting of reinforced concrete columns using near-surface-mounted steel rebar and fiber-reinforced polymer straps under eccentric loading” Advances in Structural Engineering 2019

[8] Stefan Kaeseberg “Assessment of Standards and Codes Dedicated to CFRP Confinement of RC Columns” MDPI 6 July 2019

[9] Hanan Suliman Al-Nimry “Axial–Flexural Interaction in FRP-Wrapped RC Columns” International Journal of Concrete Structures and Materials 2019

[10] Saim Raza “Strengthening and Repair of Reinforced Concrete Columns by Jacketing: State-of-the-Art Review” MDPI 9 June 2019

[11] Mahmod Samak “Strengthening Of Short R.C. Columns By FRP Jackets” International Journal of Innovations in Engineering and Technology Volume 10 Issue 1 April 2018