AN EXPERIMENTAL STUDY ON GFRP CONFINEMENT IN RC COLUMN

N. Aravinth raj[1]G. Sasi kumar[2]C.Murugan[3]
1, 2, 3 Ug scholar Civil Engineering
Arjun College of Technology, Coimbatore- 642120

Abstract:- An investigation on the compressive behaviour of new type composite column was done in this study. the composite column consists of a steel hollow section in filled as a well as confined with concrete and wrapped with GFRP. the experimental study was carried out with a grade of concrete M_{20} as confinement. It is known fact that performance of conventional concrete on enhanced by external fibre reinforced polymer confinement. This technique is considered superior to steel jacketing in terms of confinement strength, ductility, sectional areas, weight, corrosion resistance, ease of installation. Here a study on the behaviour axially loaded short reinforced concrete columns that have been strengthened with glass fibre reinforced polymer sheets. The experimental results clearly shows that glass fibre reinforcement polymer confinement enhances the compressive strength and split tensile strength of cube & circular columns. The observed results indicate that the external confinement using Glass Fibre Reinforced Polymer (GFRP) enhances the mechanical properties of Reinforced Concrete specimens. According to the FRP type, properties of FRP type concrete shows better result in which specimen with CSM wrap increase by 21% Comparing with Normal concrete For Cylindrical column.

Key words: OPC cement, GFRP-Glass fibre reinforced polymer, GP Resin, Compressive strength test, Split tensile strength test.

. I. INTRODUCTION

Strengthening and upgrading of newly built and existing structures are standing in the first among the major challenges that civil engineers are currently facing. The best answer to these needs is the use of external confinement of RC members using fiber reinforced polymer sheets. Such strengthening technique has proved to be very effective in enhancing their ductility and axial load capacity. Several studies on the performance of FRP wrapped columns have been conducted, using experimental approaches Concrete with strengths higher than 40 MPa is generally referred to as high strength concrete. Some basic concepts relating to strength and ductility have been introduced in ACI code with respect to the compression member (American Concrete Institute, 1999). With developments in technology, the use of high strength concrete members has proved to be most promising in terms strength, stiffness, durability and economy. As the strength of concrete increases, it becomes more brittle. The lack of ductility of high strength concrete columns can result in sudden failure. Several research works have proved that the strength and ductility can be improved by the use of spiral confinement, rectangular and circular lateral ties. In recent years, external wrapping has been identified as an effective method of confining concrete. Among the various materials available for the purpose, FRP has proved to be more beneficial. The application of FRP in the construction industry can eliminate some unwanted properties of high strength concrete, such as the brittle behavior of high strength concrete. FRP is particularly useful for strengthening columns and other unusual shapes. Several research studies have been reported an improving the strength and ductility of normal strength columns.

Fiber reinforced polymer (FRP) jackets provide an effective retrofit strategy for structurally deficient concrete columns. The majority of structural deficiencies in existing concrete columns can be attributed to lack of transverse reinforcement. Columns with insufficient transverse reinforcement suffer; i) brittle crushing of unconfined concrete, ii) premature shear failure and iii) reinforcement splice failure if the longitudinal reinforcement is spliced at or near a potential plastic hinge region. FRP sheets provide an excellent opportunity to enhance column resistance in all three areas of weakness

II. MATERIAL USED

A.Cement: Ordinary Portland cement 53 grade from A1 Cement Company was used for this study. This cement is the most widely used one in the construction industry in India.

B.Coarse and fine aggregates: Locally available river sand with specific gravity 2.67 and fineness modulus 3.39 and locally available quarried and crushed stones of 20 mm and down size with specific gravity 2.79 and fineness modulus 7.81 were used as fine and coarse aggregates respectively throughout the investigation in all concrete mix.

C.Water: Water is required for the cement to hydrate and solidify. Water having qualities of potable water was used in the experiment

D.FIBRE REINFORCED POLYMER:- Nowadays, FRP composite materials have become an attractive solution for the repair and strengthening of structures, particularly concrete structures; this is due to the numerous advantages of these materials, namely their good behavior towards corrosion, their lightness and their better strength.

Three types of Fiber reinforced polymers are mainly used for strengthening of existing structures. Glass Fiber Reinforced Polymer (GFRP) ,Carbon fiber Reinforced Polymer (CFRP) Aramid Reinforced Fiber Polymer (AFRP)

GLASS FIBRE REINFORCED POLYMER:-

Among those three, CFRP is found to be most effective in enhancing the shear capacity of the beam. FRP is effectively used in strengthening of RC beams due to its light weight, non-corrosive nonmagnetic nature, and resistance to chemicals. Also the formability of FRP makes its application techniques very easy to install.

III.MIX DESIGN

A. Mix Ratio:- Mix Design is carried out by using Indian standard codes i.e. IS 456 -2000, & IS 10262-1982. In my dissertation work I am using M20 grade conventional concrete & the mix details are as follows.

M20Grade	Cement (kg)	FA (kg)	CA (kg)	Water
Quantity	383	531.63	1292.0	192
Proportions	1	1.38	3.3	0.5

B.TRAIL MIXES:-

INSTALLATION OF GFRP LAMINATE :-

After 28 days of curing, the GFRP sheets were applied to the specimens by manual wet lay-up process. The concrete specimens were cleaned and completely dried before the resin was applied. The mixed vinyl ester resin was applied directly on to the substrate. The fabric was placed carefully into the resin with gloved hands and smooth out any irregularities or air pockets. Finally a layer of resin was applied to complete the operation. The wrapped specimens were left at room temperature for one week for the vinyl ester resin to harden adequately before testing. Specimens were wrapped with GFRP sheets, among which normal strength specimens were wrapped with chopped strand Mat. concrete one layer & two layer coating sheet used

GFRP sheet used in concrete apply to the three type of resin is used GP Resin & cobalt & catalyst.

IV.TESTING RESULT

A.Compressive strength Test: A compression testing apparatus is used to determine the compressive strength of the concrete. The cubes were tested and the ultimate loads were recorded.

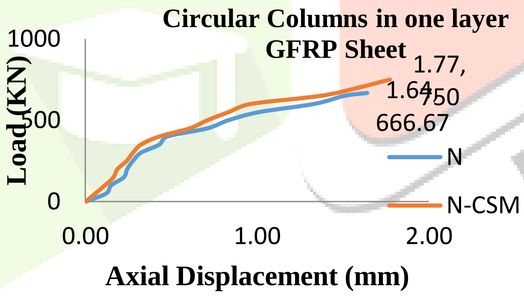
Compressive strength = P/A

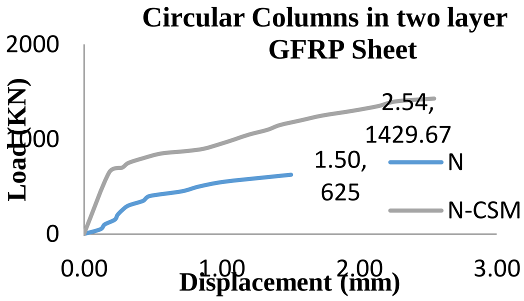
% of Replacement	7 days(N/mm^2)	28 days(N/mm^2)
CC mix	14.8	23.47

B. Split tensile strength test: To determine the behaviour of materials under axial loading, a split tensile test method is used.

Split tensile strength = $2P/\pi ld$

Designation	**Max. Load (KN)**	**Max. Defln (mm)**	**Max. Stress (MPa)**	***fco***	***fcc***	***fcc/fco***	***% Gain***
SN	666.67	1.64	29.63	28.63		1.00	-
SNC	750.00	1.77	33.33	-	33.33	1.12	12.50
CN	625.00	1.50	27.78	27.78	-	1.00	-
CNC	1429.67	2.54	63.54	-	63.54	2.29	122.08





V.RESULT AND DISCUSSION

The following conclusions were made based on experimental study

Based on the results of this investigation, the previous observations on the efficiency of confining FRP wraps have confirmed. More specifically, the following concluding remark can be made.

- The observed results indicate that the external confinement using Glass Fibre Reinforced Polymer (GFRP) enhances the mechanical properties of Reinforced Concrete specimens, in different amount according to the FRP type, concrete properties and cross-section shape
- The efficiency of GFRP confinement is higher for circular columns than for square sections, as expected. The increase in ultimate strength of sharp edged sections is low, although there is a certain gain of load capacity and ductility.
- The failure of GFRP confined specimens occurred in a sudden and explosive way preceded by typical creeping sounds. For cylindrical specimens, the fibre rupture starts mainly in their central zone, then propagates towards other sections. Regarding confined concrete square columns, failure initiated at or near corners, because of the high stress concentration at these locations. The GFRP confinement on Normal-strength concrete specimens produced higher results in terms of strength and ductility.
- Comparing with Chopped Strand Mat (CSM) GFRP wrap shows better result in which specimen with CSM wrap gains 121% For Cylindrical column with CSM is 122% .
- External confinement using GFRP composite is more effective than reinforcing bars

VI.REFERENCE

- **M. Seffo, M. Hamcho,** "Strength of Concrete Cylinder Confined by Composite Materials (CFRP)" Energy Procedia 19 (2012): 276285
- **Rahul Raval[a], Urmil Dave[b]''** Behavior of GFRP wrapped RC Columns of different shapes, Procedia Engineering 51 (2013) 240 – 249
- **Raphaelle SADONE, Marc QUIERTANT Julien MERCIER''** Experimental study on rc columns retrofitted by frp and subjected to seismic loading, 58 Boulevard Lefebvre, 75015 PARIS
- **Athira M. A.[1], Meera C. M.[2] ''** Experimental Study on RC Columns Wrapped With Hybrid FRP Sheets
- **K. P. Jaya , Jessy Mathai ''** Strengthening of RC Column using GFRP and CFRP
- **Shamim A. Sheikh, Yimin Li,** "Design of FRP confinement for square concrete columns" Engineering Structures 29 (2007): 1074-1083.