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Review on using Glass Fiber Reinforced Polymer in Concrete

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ABSTRACT
Retrofitting of reinforced concrete member in earthquake zone area is a major problem. It is necessary to improve not only strength but improve the ductility. Now a day to improve the such properties of concrete we can use glass fiber reinforced polymers. The glass fiber reinforced polymer wrapping was done using ACI 440.2R.08 provisions. The GFRP layers provides on outside of specimens. All the test specimen were loaded to fail in axial compression & strain of the columns. It can be used in various types of columns specimens like circular, rectangular or square.

Keywords
glassfiber, compressive strength, axial strain,Rccolumn,shape.

1. INTRODUCTION
Ease of UseThere are various methods used to repair or retrofit the different type of columns specimen damaged by earthquake or some other reasons. The main reason to used the GFRP is to improve the strength & ductility of the concrete member. The main purpose is to prevent the the concrete cover from damaged due to spalling or other chemical reaction. Due to the earthquake or other damage the building need to the strengthened to increase strength, stiffness and ductility.Nowadays the use of fiber Reinforced polymer material are very popular in civil engineering construction field. One of the most famous use of GFRP is retrofitting of circular & rectangular columns with GFRP sheets. The load carrying capacity of the wrapped concrete specimen is governed by mechanical properties such as

Tensile elasticity modulus and poisson's ratio of the wrapping sheet. In 2006 and Manuel and Carlos have conducted test on circular cylindrical columns of concrete with GFRP subjected to axial loading for different heights it was found that if the layer of GFRP increased the load carrying capacity is also increased. The popularity is due to its well known advantages including high strength-to-weight ratio and excellent corrosion resistance. The GFRP are provided in horizontal direction to the length of column in RC column. The GFRP wrapping is done in both vertical &horizontal direction in a RC column. GFRP wrapped RC column are better than steel reinforced concrete column. R.Kumutha studied the behavior of RC column strengthened using GFRP. There aspect ratio (a/b) where a & b are respectively the longer & shorter sides of column c/s a/b=1.0, a/b=1.25, and a/b=1.66 over considered. The specimen wrapped with 0, 1 and 2 layers of GFRP investigated. That wrapped layer of GFRP improved the compressive strength of specimen with increased the layer of GFRP. The column designed with IS 456 provisions,. The column can be strengthen with one single layer of GFRP investigated by testings.

2. LITERATURE REVIEW
Manish Kumar Tiwari, Rajiv Chandak, R.K.Yadav are studied about the GFRP material used in concrete column specimen. To improve the properties of concrete member in a earthquake zone area they used the GFRP material in construction. They used GFRP sheets in construction of column specimen. They are find out that if the % of the GFRP material increased the strength, ductility or other properties of concrete increases.[1]Rahul Raval, Urmail Dave are make a study on the behavior of GFRP wrapped RC columns with different shapes. They find out that the use of GFRP in the concrete member increased the strength and ductility of the specimen. They use IS:456:2000 specification for the construction. They done design of GFRP wrapping using ACI440.2R.08 provision. They found out GFRP wrapped circular columns undergone more axial deformation as compared to that square and rectangular columns.[2]R.Kumutha, M.S.Palanichamy studied to strengthened bridge or other existing structures by using economical, fast and efficient methods. The bridge pier are need to strengthened to improve its properties against insufficient or deteriorating of reinforced concrete. They used two methodsto improved strength of circular columns. They used steel jacks and fiber reinforced polymer methods.[3]

Azadeh Parvin and David Brighton study on the progress in the area of fiber reinforced polymer strengthening of columns for several loading scenarios including the strength of concrete member can save lives by preventing collapse, reduced the damage to infrastructure & need for their costly replacement. The use of FRP increase the original design strength for possible axial, or flexure & in some cases allow the structure to carry more load than it was designed for.[4]

3. EXPERIMENTAL INVESTIGATION
Experiments were conducted on circular and rectangular specimen. In April 2014 Manish Kumar Tiwari done some test on the circular specimen. He take 5 specimen C-1, with 0 GFRP layer, 6 no of 6mm dia longitudinal reinforcement and 5mm dia of 90mm c/c stirrups. Similarly he used other 4 circular specimen with increased of GFRP layer. He selected the specimen of height 300mm & 150mm in diameter. The ingradient used in concrete was OPC of 43 grade, local river sand with sp. gravity 2.645 & clean portable water. A design mix of m-30 (1:1.73:3.23) used, Fe415 grade steel is used as longitudinal reinforcement & lateral ties. Before providing the GFRP sheet the surface cleaning, then epoxy adhesive was provide for bonding GFRP sheets on the specimen. Then GFRP sheets wrapped externally by 2, 4 , 6 &8 layers. Similarly Rahul Raval & Urmi Dave done test on the

rectangular specimen. For testing the vertical displacement of the column Pspecimen was measured by linear variable differential transducers with a 50mm travel which mounted on the frames. The design of RC column is prepared on the basis of IS456 specification. The column cast with the height of 1m each, with size 110mm*210mm with area 23100. The RC column cast of concrete mix with 28 days compressive strength of 15 MPA. The properties of material as per weight was 0.60:1:3.25:5 (water, sand, c.a.) .

Fig.1Sheet Roll

Fig.2 Unidirectional Gfrp Sheet

4. STRENGTHENING OF COLUMNS

Beforeapplication of the GFRP sheet on the columns first the required area make rough by using a sand paper texture and cleaned with an air blower to removed all dirt. One the surface make clean and ready to used the epoxy resin was mixed according to manufacturer's instructions. Mixing is carried out in plastic container and mixing continued untile the composite fabricplaced & one layer of epoxy coating applied. Then second layer of epoxy applied & after that the GFRP sheets placed. The process is carriedout at room temp. The specimen after application of GFRP sheets test after 24 hr at room temp. For RC column three different shapes of formwork of 1meter length is used, concrete is prepared according to instruction 20mm clear cover is provided in columns. Before application of GFRP sheets the concrete surface needed to cleaned perfectly with wire brush to remove all dirt & dust by using girding machine the even surface get smooth. If there are only voids then they filled with putty. After the finishing of putty the primer coat is applied. The saturation made with base and hardner with equal properties applied on the specimen with hand brush. After application of saturation the GFRP sheets wrapped around the columns.

Fig.3 Application Of Prime

Fig.4 Grinding Of Rc Column

Fig.5 Application Of Saturant

Fig.6 Application Of Gfrp Sheet

5. EXPERIMENTAL RESULT AND DISCUSSION

For a circular column they use the different columns with or without GFRP wrapping sheets. In the specimen where the GFRP wrapping is not done the failure in the form of concrete crushing and cracks developed in the heights of columns, and in the specimen where the GFRP sheets are used the failure occurred due to stress in regions. According to results the avg. compressive strength of specimen is increased with the increased in layer of GFRP specimen. In the RC column specimen exhave higher axhibits lowest axial load carrying capacity increased of 14% & 7% in axial load carrying capacity were observed for circular & square columns., as compaired to rectangular columns. The GFRP sheets wrapping for rectangular columns increases the axial load carrying capacity by 70-80% on other hand the circular column capacity increased by 158.75%. GFRP wrapped RC column have higher axial deformation. Less effect of GFRP material on RC columns may be attributed to the slenderness effect of the rectangular shape of the columns. GFRP confinement is less effective in improving the axial strength of rectangular columns as compared to that of circular columns. Even stress distribution has resulted into highest ultimate axial strength for GFRP wrapped circular column as compaired to rectangular column. GFRP wrapped circular column attained higher strain value as compaired to rectangular column with further loading increases. It can be observed that with the change in shape of specimen from circular to rectangular the confinement ratio fcc/fco descreases. Confinment by GFRP improved the performance of circular columns as compaired to rectangular columns. Rectangular column failed after reaching to their ultimate compressive strength & that resulted into splitting of concrete in between the stirrups. In case of control columns the mode of failure has been characterized by shearing & splitting. Circular columns failed due to shearing effect under axial loading. Rectangular column failed from longer sides due to the slenderness effect. This is evident as less compressive load is required to break the concrete due to large variation in c/s dimension for RC column. According to test done before on the RC column the failure of the GFRP wrapped RC column have beendivide into three types:-

1)Tensile rupture of GFRP at corner.

2)Delamination of the GFRP layer.

3)Combination of delamination & tensile rupture of the GFRP layer.

GFRP wrapped circular columns failed from middle portion because of tensile rupture of GFRP layer

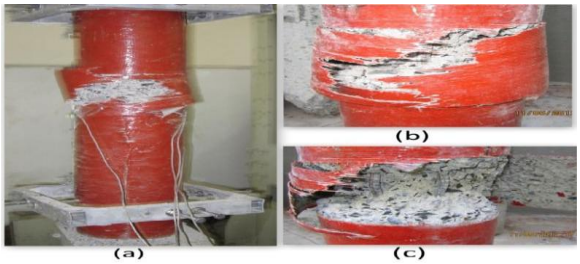

Fig.7 Failure of GFRP wrapped circular column

6. CONCLUSION

- GFRP wrapping improve the load carrying capacity without increasing the size of column.
- GFRP wrapping for circular column produced heights increment in axial load of 159% as compaired to rectangular column.
- Control & GFRP wrapped circular column get higher axial deformation as compaired to rectangular columns.
- Improper saturation of GFRP wrap during the wrapping can be attributed some kind of failure.
- GFRP wrapped circular column failed without any sign of debonding as the shape changes from square to rectangular, the failure zone shifted corner to sides.
- Failure of RC column occurred due to combination of delamination /debonding as well as rupture of GFRP material.
- If the layer of wrapped GFRP in the specimen is increased with 8% the strength increases to 47% of the strength confinement. From the study it can be findout that the column can be confined with GFRP sheets & we can increased the strength of material in both circular & rectangular column specimen.

7. REFERENCES

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