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RC Structure Retrofitting by CFRP

(Carbon Fibre Reinforced polymer)

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Abstract- *Some existing reinforced concrete structures do not have sufficient seismic capacity, therefore, various retrofitting techniques are proposed. However, such techniques are not always adequate from the viewpoint of the increase in weight and the maintenance of the function. In order to overcome these problems, The method developed a new method using carbon fibre, which is a material of high strength, light weight and good durability, and recently developed as a 'high-tech' material. In this paper, basic design, application techniques and durability of carbon fibre are introduced. This reinforcing system is more economical than conventional ones, and it has been used to improve the earthquake resistance of concrete structure. This system is also applicable to reinforcing buildings and freeway piers.*

Keywords- *Repair, Restoration, Retrofitting, Carbon Fibre, Wrapping, Durability, Light weight*

ABOUT CARBON FIBRE REINFORCED POLYMER

Only a few years ago, the construction market started to use FRP for structural reinforcement, generally in combination with other construction materials such as wood, steel, and concrete. FRPs exhibit several improved properties, such as high strength-weight ratio, high stiffness-weight ratio, flexibility in design, non-corrosiveness, high fatigue strength, and ease of application. The use of FRP sheets or plates bonded to concrete beams has been studied by several researchers. Strengthening with adhesive bonded fiber reinforced polymers has been established as an effective method applicable to many types of concrete structures such as columns, beams, slabs, and walls. Because the FRP materials are non-corrosive, non-magnetic, and resistant to various types of chemicals, they are increasingly being used for external reinforcement of existing concrete structures. From the past studies conducted it has been shown that externally bonded glass fiber-reinforced polymers (GFRP) can be used to enhance the flexural, shear and torsional capacity of RC beams. Due to the flexible nature and ease of handling and application, combined with high tensile strength-weight ratio and stiffness, the flexible glass fiber sheets are found to be highly effective for strengthening of RC beams. The use of fiber reinforced polymers (FRPs) for the rehabilitation of existing concrete structures has grown very rapidly over the last few years. Research has shown that FRP can be used very efficiently in strengthening the concrete beams weak in flexure, shear and torsion. Unfortunately, the current Indian concrete design standards (IS Codes) do not include any provisions for the flexural, shear and torsional strengthening of structural members with FRP materials. This lack of design standards led to the formation of partnerships between the research community and industry to investigate and to promote the use of FRP in the flexural, shear and torsional rehabilitation of existing structures. FRP is a composite material generally consisting of high strength carbon, aramid, or glass fibers in a polymeric matrix (e.g., thermosetting resin) where the fibers are the main load carrying element.

Among many options, this reinforcement may be in the form of preformed laminates or flexible sheets. The laminates are stiff plates or shells that come pre-cured and are installed by bonding them to the concrete surface with a thermosetting resin. The sheets are either dry or pre-impregnated with resin and cured after installation onto the concrete surface. This installation technique is known as wet lay-up. FRP materials offer the engineer an outstanding combination of physical and mechanical properties, such as high tensile strength, lightweight, high stiffness, high fatigue strength, and excellent durability. The lightweight and formability of FRP reinforcement make FRP systems easy to install. Since these systems are non-corrosive, non-magnetic, and generally resistant to chemicals, they are an excellent option for external reinforcement. The properties of FRP composites and their versatility have resulted in significant saving in construction costs and reduction in shut down time of facilities as compared to the conventional strengthening methods (e.g., section enlargement, external post-tensioning, and bonded steel plates). Strengthening with externally bonded FRP sheets has been shown to be applicable to many types of RC structural elements. FRP sheets may be adhered to the tension side of structural members (e.g., slabs or beams) to provide additional flexural strength. They may be adhered to web sides of joists and beams or wrapped around columns to provide additional shear strength. They may be wrapped around columns to increase concrete confinement and thus strength and ductility of columns. Among many other applications, FRP sheets may be used to strengthen concrete and masonry walls to better resist lateral loads as well as circular structures (e.g., tanks and pipelines) to resist internal pressure and reduce corrosion. As of today, several millions of square meters of surface bonded FRP sheets have been used in many strengthening projects worldwide.

A combination of two or more materials (reinforcement, resin, filler, etc.), differing in form or composition on a macro scale. The constituents retain their identities, i.e., they do not dissolve or merge into each other, although they act in

concert. Normally, the components can be physically identified and exhibit an interface between each other. The different retrofitting methods available like, Over Slabbing, Sprayed Concrete with Additional Reinforcement, Steel Plate bonding, Grouting, Jacketing, Fibre Wrap Technique etc.

The study introduces a analytical calculations to accurately predict the behaviour of concentrically loaded RC structure wrapped with CFRP strips while taking into account the interaction between internal steel and external CFRP reinforcement.

Based on the current state of the art, the proposed work will allow a better understanding of the behaviour of using CFRP Strips for wrapping RC structure and the parameters that influence the effectiveness of partial wraps. Throughout this work, rectangular specimens are studied, and all fibres are orientated in the hoop direction.

The purpose of this research is to investigate the efficacy of FRP as a strengthening material for columns. The scope of this project was divided into following objective:

Non-destructive testing of RC columns to investigate the strength, homogeneity and uniformity in concrete.

Analytical calculations as per American and Canadian codes for strengthening of RC members by using FRP.

Execution of strengthening system on site in accordance with outcome of Analytical Calculations.

Expected Conclusion

Use of Carbon fibre resulted in remarkable improvement in the behaviour of column resulting in significant increase in ductility, energy absorption capacity and strength. The CFRP wraps are highly effective in confining the core concrete. The high strength low weight ratio and less labour required for strengthening of all structure member. The behaviour of appropriately retrofitted columns under simulated earthquake load matches or exceeds the performance of columns designed according to the seismic provisions of ACI CODE.

