Experimental Investigation an Buckling Behaviour for Seismic Retrofitting of RC Column using CF and GF

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***Abstract*— Reinforced concrete structures often have to face modification and improvement of their performance during their service life. The repair and retrofitting of existing structures has become a major part of construction activity in many countries. The aim of the present study is to investigate the behaviour of retrofitted reinforced concrete column. In this thesis, the retrofitting was done by wrapping glass fibre and carbon fibre using epoxy as binding agent. In this thesis flexure failure was considered and it is strengthened by retrofitting. The result was focused on maximum deflection, ultimate load and mode of failure of concrete elements. In the present work all the columns that are strengthened using externally bonded are expected to withstand higher load compared to the control column. The columns are tested to failure by applying two points loading to evaluate the enhancement of flexural strength due to strengthening of column with GF&CF with different geometry on the face of the column.**

***Keywords*— Glass fibre and Carbon fibre, epoxy resin , Compressive strength, Flexural strength, Deflection**

I.INTRODUCTION

Reinforced concrete structures often have to face modification and development of their performance during their service life. The main reasons for the change in their use are new design standards, deterioration due to corrosion in the steel caused by exposure to an aggressive environment and accident events such as earthquakes.

The repair and retrofitting of existing structures has become a major part of construction action in many countries. To a large extent, this can be attributed to the aging of the infrastructure. Some of the structures are injured by environmental effects, which include the corrosion of steel, variations in temperature and freeze-thaw cycles. There are always cases of construction-related and design-related deficiencies that need modification. Many structures, on the other hand, need strengthening because the allowable loads have increased or new codes have made the structures imperfect. This last case applies mostly to seismic regions, where new standards are more stringent than the old. In such circumstances there are two possible solutions: replacement or retrofitting. Full structure replacement might have determinate disadvantages such as high expenditure for material and labour, a stronger environmental impact and difficulty due to disruption of the function of the structure e.g. traffic problems. When possible, it is often healthier to repair or upgrade the structure by retrofitting**.** The recent development of strong epoxy glue has led to a technique which has great probable in the field of improvement structures. These materials have superior ultimate strength and lower density than steel. The installation is easier and impermanent support until the adhesive gains its strength is not necessary due to the low weight. They can be formed on site into difficult shapes and can also be easily cut to length on site.This work is a study of the behaviour of concrete beams strengthened with Glass Fibre and Carbon fibre (GF&CF), using experiments. GF&CF composite mats, fabrics and rods can be effectively applied outwardly and internally over the RC elements for strengthening purpose. Such strengthening leads to improved ductility, energy absorption capacity, and improved load carrying capacity of the RC members. These composites are hence used in the superior scale for the rehabilitation of earthquake-affected structures.In retrofitting, there are numerous methods adopted such as enlarging the cross section element, shortening the span by providing the supports, external or internal post-tensioning and steel plate bonding or Fibre reinforced polymer composite. The shear and flexure failure in any structural element is catastrophic in nature. So the strengthening of structural element such as beams in shear and flexure is necessary. Three types of Fibre reinforced polymers are mostly used for strengthening of existing structures namely Glass Fibre (GF), and Carbon Fibre (CF), Among these two, CF is establish to be most useful in enhancing the shear capacity of the column. It is successfully used in strengthening of RC column due to its light weight, non-corrosive non-magnetic nature, and resistance to chemicals.

II.EXPERIMENTAL STUDY

A. Material Properties

The materials to be used for experimental work was tested in the laboratory. Their details and properties are as follows:

Cement: Ordinary Portland 53 grade cement from a single lot is used for the study. All the tests are carried out in accordance with method laid down in IS: 8112-1989. The specific gravity of cement obtained is 3.15. The standard consistency is 34%.

Fine Aggregate: Locally available sand is used as fine aggregate in the cement mortar and concrete mix. Fineness modulus of fine aggregate is 2.61 and its specific gravity obtained as 2.6.

Coarse Aggregate: Crushed stone aggregate (locally available) of 20mm and 12mm were used throughout the experimental study. The aggregate was tested as per Indian Standard Specifications IS: 2386-1963.Fineness modulus of fine aggregate is 6.95 and its Specific gravity is 2.64.

Water: The water is requierd for preparation of mortar, mixing of cement concrete and for curing work during construction work. The quality and capacity of water has much effect on cement concrete and the strength of mortar in construction work. Quality of Water used for curing and mixing should be clean and free from injurious quantities of acid,alkalis,oils, salt, sugar, organic materials, vegetable growth and other substances that may be dangerous to stones,bricks, concrete or steel. Potable water is generally considered adequate for mixing.

Reinforcement: HYSD steel of grade Fe-415 of 16mm diameters were used as longitudinal steel 8mm bars are used as hanger bars. 6mm diameter bars are used as shear stirrups.

Epoxy Resin: The resins that are used in fibre reinforced composites can also be called to as 'polymers'. All polymers shows an important common property in that they are composed of long chain-like units. Man-made polymers are usually called 'synthetic resins' or simple 'resins'. Polymers can be classified under two types, 'thermosetting' and 'thermoplastic', according to the effect of heat on their properties. Thermosetting materials or thermosets are created from a chemical reaction in situ where the resin and hardener are mixed and then suffer a non-reversible chemical reaction to form a hard, infusible product. The three types of resin are polyester resin, vinyl ester resin, epoxy resin. The binding property of the resin with concrete and that of FRP is influenced by the type of grade and the environment in which it is retrofitted. It is extremely important that there is a good natured bond, so that the concrete and fibre acts as a composite. The flexural strength of the retrofitted beams largely depends on the composite nature of the element.

Woven Roving(E glass): Glass fibers are commonly used in the naval and industrial fields to manufacture composites of medium-high performance. Their strange characteristic is their high strength. Glass is mostly made of silicon (SiO_2) with a tetrahedral structure. Some aluminium oxides and other metallic ions are then added in different proportions to either ease the working operations. The production technology of fiber glass is effectively based on spinning a batchmade of alumina, sand, and limestone. The constituents are dry mixed and brought tomelting in a tank. The melted glass is carried directly on platinum bushing sand, by gravity, passes through ad hoc holes located on the bottom. The filaments are then grouped to form a strand usually made of 204 filaments. The single filament has an average diameter of 10 µm and is normally covered with a sizing. The yarns are then bundled, in the majority cases without twisting, in a roving.Glass fibers are also available as thin sheets, called mats. A mat may be made of both long continuous and short fibers ,randomly arranged and kept together by a chemical bond. The width of such mats varies between 5 cm to 2 m, their density being roughly 0.5 kg/m^3.FRP composites based on fiberglass are usually denoted as GF&CF. Woven Roving is made from continuous glass fibre roving which are interlaced heavy weight fabrics, compatible with most resin systems. Glass fibre reinforced polymer is both economically and environmentally preferable to repair or strengthen the structures rather than to replace them totally. With the development of structurally effective adhesives, there have been noticeable increases in strengthening using steel plates and FRP laminates.

B. Concrete Mix

M30 grade concrete mix is designed as per standard procedure using the properties of materials. The water-cement ratio used in the design is 0.5. The mix proportion of material comes out to be 1:1:2(cement: sand: aggregate) and compressive strength of materials after 14 days is 24.3 MPa.

C. Methodology

The strengthening of reinforced concrete beam by using glass fibre reinforced polymer sheet has to be studied in the present investigation. Concrete mix of strength M30 has been designed.

D. Physical Tests on Concrete

To study the properties of concrete in fresh and hardened state, standard tests has to be conducted. The testing methods of concrete as per IS guidelines has been used for testing concrete specimen.

Slump Test: Slump test is intended for measuring workability of concrete. Table 1 shows the slump cone test results of the M30 concrete mix

TABLE 1. Slump Cone Test Results

Trial No.	M30 Slump cone (mm)	Slump prescribed by IS:456-2000 code	Remarks
1	78	The Recommended slump values for concrete RCC beams and slabs are 50-100	Satisfied as per IS:456-2000
2	76		
3	79		
4	80		

III. CONCLUSION

The mix design for the experiment is 0.4:1:0.78:2.36. The strength of the concrete cylinder is increased by using glass fibre reinforced polymer sheet.Hence the glass fibre reinforced polymer sheet shows better results for increasing strength.

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