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Experimental Study of Maintenance and Treatment of R.C.C. Building by Fiber Reinforced Plastic

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ABSTRACT

Fiber Reinforced Polymer (FRP) as an external reinforcement is used extensively to deal with the strength requirements related to flexure and shear in structural systems. But the strengthening of members subjected to torsion is explored only recently. Torsion failure is an undesirable brittle form of failure which should be avoided specially in the earthquake prone areas. In the present work, the behavior and performance of rectangular reinforced concrete beams strengthened with externally bonded Fiber Reinforced Polymer (FRP) fabrics subjected to combined flexure and torsion is studied experimentally. Three sets of concrete cylinders were tested for their ultimate strengths. In SET I three concrete cylindersF1 Without wrap FRP, F2 Single wrap FRP, F3 Double wrap FRP (F1, F2 and F3) are tested. In SET II three concrete cylinders S1Without wrap FRP, S2 Single wrap FRP, S3 Double wrap FRP (S1, S2 and S3) are tested. In SETIII three concrete cylinders R1 Without wrap FRP, R2 Single wrap FRP, R3 Double wrap FRP (R1, R2 and R3) are tested. The concrete cylinders F1, S1 and R1 were taken as the control concrete cylinders.

KEYWORDS: *Fiber Reinforced, Polymer, flexure, concrete, beams, shear, compared*

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INTRODUCTION

1. Previously, the retrofitting of reinforced concrete structures, such as columns, beams and other structural elements, was done by removing and replacing the low quality or damaged concrete or/and steel reinforcements with new and stronger material. However, with the introduction of new advanced composite materials such as fiber reinforced polymer (FRP) composites, concrete members can now be easily and effectively strengthened using externally bonded FRP composites.
2. Retrofitting of concrete structures with wrapping FRP sheets provide a more economical and technically superior alternative to the traditional techniques in many situations because it offers high strength, low weight, corrosion resistance, high fatigue resistance, easy and rapid installation and minimal change in structural geometry. In addition, FRP manufacturing offers a unique opportunity for the development of shapes and forms that would be difficult or impossible with the conventional steel materials. Although the fibers and resins used in FRP systems are relatively expensive compared with traditional strengthening materials, labour and equipment costs to install FRP systems are often lower. FRP systems can also be used in areas with limited access where traditional techniques would be impractical.
3. Several investigators took up concrete beams and columns retrofitted with carbon fiber reinforced polymer (CFRP) glass fiber reinforced polymer (GFRP) composites in order to study the enhancement of strength and ductility, durability, effect of confinement, preparation of design guidelines and experimental investigations of these members. The results obtained from different investigations regarding enhancement in basic parameters like strength/stiffness, ductility and durability of structural members retrofitted with externally bonded FRP composites, though quite encouraging, still suffers from many

limitations. This needs further study in order to arrive at recognizing FRP composites as a potential full proof structural additive. FRP repair is a simple way to increase both the strength and design life of a structure. Because of its high strength to weight ratio and resistance to corrosion, this repair method is ideal for deteriorated concrete structure.

1. Additional strength may be needed to allow for higher loads to be placed on the structure. This is often required when the use of the structure changes and a higher load- carrying capacity is needed. This can also occur if additional mechanical equipment, filing systems, planters, or other items are being added to a structure.
2. Strengthening may be needed to allow the structure to resist loads that were not anticipated in the original design. This may be encountered when structural strengthening is required for loads resulting from wind and seismic forces or to improve resistance to blast loading. Additional strength may be needed due to a deficiency in the structure's ability to carry the original design loads.
3. Deficiencies may be the result of deterioration (e.g., corrosion of steel reinforcement and loss of concrete section), structural damage (e.g., vehicular impact, excessive wear,

MATERIALS AND METHODS

Typical Properties	Density (g/cm^3)	Young's Modulus (GPa)	Tensile Strength (GPa)	Tensile Elongation (%)
High Strength	1.8	230	2.48	1.1
High Modulus	1.9	370	1.79	0.5
Ultra-High Modulus	2.0 - 2.1	520 – 620	1.03 - 1.31	0.2

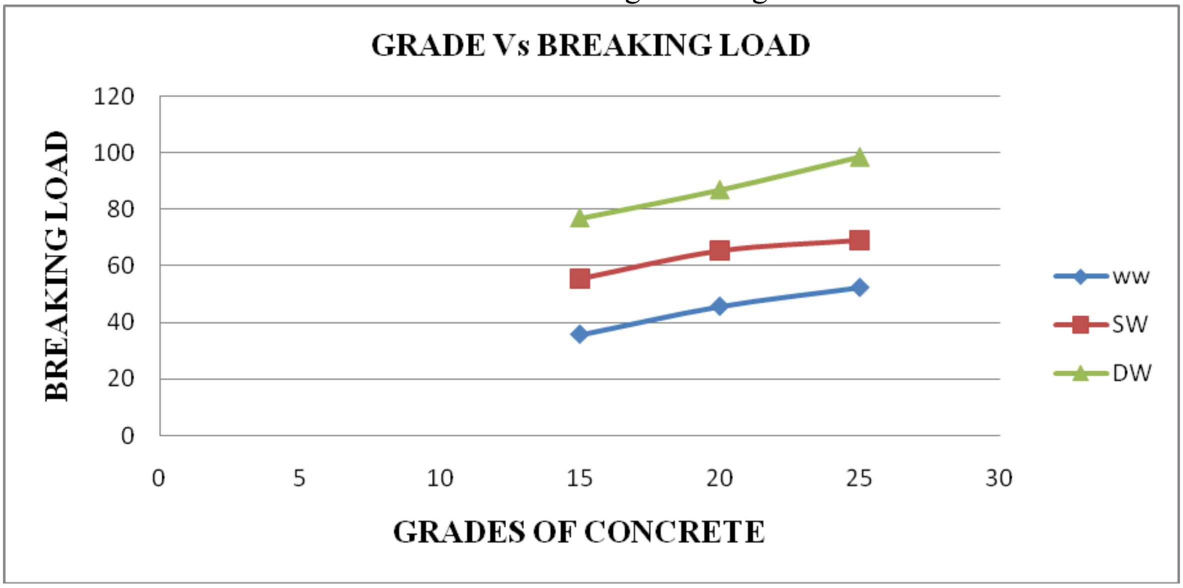
Typical properties of Carbon Fiber

Results for M-20 grade of concrete in Case -I

Sr. No.	Grade of Concrete	Cylinder Status	Breaking Load (MT)	Strength Kg/cm2	Remark
1.	M-20	Without warp	45.75	259	Initial stage
2.	M-20	Single warp	65.45	370.55	Increased by 43% from initial stage
3.	M-20	Double warp	87	492.56	Increased by 33% from single warp

Material	Density (g/cm^3)	Tensile Modulus (E) (GPa)	Tensile Strength (σ) (GPa)	Specific Modulus (E/σ)	Specific Strength	Relative Cost
E-glass	2.54	70	3.45	27	1.35	Low
S-glass	2.50	86	4.50	34.5	1.8	Moderate
Graphite, high modulus	1.9	400	1.8	200	0.9	High
Graphite, high strength	1.7	240	2.6	140	1.5	High
Boron	2.6	400	3.5	155	1.3	High
Kevlar 29	1.45	80	2.8	55.5	1.9	Moderate
Kevlar 49	1.45	130	2.8	89.5	1.9	Moderate

Combined result for breaking load on grades case-I



CONCLUSION

In this thesis we have chosen some buildings described in four cases in BHEL area which has been damaged due to soil settlement. In this study we have taken some of the columns as shown in figures of damaged building. This experimental study consists of casting of three sets of reinforced concrete (RC) cylinders of size 150mm diameter and 300mm height. In SET I three cylinders of M-15 grade of concrete were casted, out of which one is unreinforced and other two were strengthened using continuous fiber reinforced polymer (FRP) sheets. In SET II three cylinders of M-20 grade of concrete weak in shear were casted, out of which one is the unreinforced and other two were strengthened by using continuous fiber reinforced polymer (FRP) sheets in shear. In SET III three cylinders of M-25 grade of concrete weak in shear were casted, out of which one is the unreinforced and other two were strengthened by using continuous fiber reinforced polymer (FRP) sheets in shear. The strengthening of the cylinder is done with varying configuration and layers of FRP sheets. Experimental data on load and failure modes of each of the cylinder were obtained. The change in load carrying capacity and failure mode of the cylinder are investigated as the amount and configuration of FRP sheets are altered.

Results

After applying all the required tests we calculate the strength of concrete grade and conclude overall result of this exercise.

Results for M-15 concrete grade cylinders-

Firstly we have checked the strength of normal concrete cylinder without FRP warp which is taken out for all four cases average value of compressive strength is 199.35 Kg/cm^2. After that we applied FRP on concrete cylinder with single warp and strength was tested which is taken out for all four cases average value of compressive strength are 318.51 Kg/cm^2 increased by 59.7% from initial stage. Now after testing FRP on concrete with single warp we applied double warp of FRP on concrete for testing the strength of cylinder and we get the strength for all four cases average value of compressive strength are 429.25 Kg/cm^2 which is increased by 34.76% from single warp and 115% from initial stage.

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