INVESTIGATION ON PERFORMANCE OF HEAVILY CRACKED CONCRETE BEAM STRENGTHENED WITH CARBON FIBER REINFORCED POLYMER (CFRP) SHEETS

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DECLARATION

I declare that, this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out research for the Masters Dissertation under my supervision.

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ABSTRACT

Repair and retrofit of existing structures especially buildings, bridges, water tanks etc., have been amongst the most significant challenges in Civil Engineering. In the past construction was evolved from thousands of years back with various construction materials such as rocks, clay bricks and timber etc. There after concrete was introduced as a sustainable construction material which is most suitable than that of previously used materials.

Although concrete has high compressive strength, it is very weak in tension and become brittle under tensile loads. Because of these reasons, Engineers moved to reinforced concrete structures. Since concrete structures are long lasting structures, carrying out the rehabilitation work of existing structures becomes more vital.

Nowadays, there are different kind of problems were encountered in construction field due to original design, construction errors or poor construction supervision, damages of earthquakes etc.. That needs to be retrofitted to meet the demand usage in a more economic and effective ways. The techniques based on the externally bonded Fiber Reinforced Polymer (FRP) materials is one of the most widely application for retrofitting existing damaged structures.

The use of Carbon Fiber Reinforced Polymer (CFRP) in strengthening reinforced concrete structures has become popular retrofit technique. The technique of strengthening reinforced concrete structures by externally bonded CFRP fabric was started in 1980s and has attracted researchers around the world wide.

The aim of this research is to investigate the flexural behavior of pre cracked and non-cracked reinforced concrete beams going to be strengthened with different configurations of Carbon Fiber Reinforcement Polymer layers.

12 Nos. of Reinforced concrete beams of the width 125mm, depth 200mm and length of 1900mm were prepared and tested for this investigation. Beams were tested in accordance with ASTM C78 guidelines

Beams consist of different CFRP arrangements such as non-anchored CFRP sheet, CFRP sheet with end anchors and CFRP sheet with end and intermediate anchors at cracked locations.

FRP can be bonded to reinforced concrete elements using different methods such as external bonding, wrapping and near surface mounting. FRP sheets can be sticked to the tension face of a structural element to provide flexural strength or sticked along the web of a beam to provide shear strength.

Observation shows that increment of flexural capacity is in between 81% to 110% in beams those strengthened with CFRP sheets with respect to non-strengthened beams. Highest strength gained was observed in cracked beams strengthened with CFRP with end anchors and intermediate anchors. Similar behavior was observed in non-anchored CFRP strengthened cracked and non-cracked beams. However the flexural capacity was high in CFRP strengthened cracked beams. All the cracked beams failed in debonding. But some non-cracked beams failed by rupture of CFRP.

At the end of this dissertation, presents the experimental procedure, results, analysis and conclusion.

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CFRP	Carbon Fiber Reinforced Polymer
EB	Externally Bonded
ETS	Embedded Through Section
FRP	Fiber Reinforced Polymer
NSM	Near Surface Mounted
As	Area of tension reinforcement
Asv	Area of links at neutral axis level
b	Effective breadth of section
b_v	Breadth of section for shear
d	Effective depth of the tension reinforcement
f_{cu}	Characteristic strength of concrete
f_{yv}	Characteristic strength of links
f_y	Characteristic strength of links
M	Design ultimate resistance moment
S_v	Spacing of link along the member
v_c	design shear strength of concrete

LIST OF APPENDIX