Ain Shams University
Faculty of engineering
Structural Engineering Department

Punching Behavior of RC Slabs Retrofitted with FRP Sheets

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A Thesis
Submitted in Partial Fulfillment for the Requirements
of the Degree of Master of Science
in Civil Engineering

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APPROVAL SHEET

Thesis **:** Master of Science in Civil Engineering (Structural)
Student Name **:** Mohamed Sahab Mohamed Mohamed Seliem
Thesis Title **:** Punching behavior of RC Flat Slabs Strengthened with CFRP Sheets

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STATEMENT

This dissertation is submitted to Ain Shams University to fulfill the Master of Science degree in Structural Engineering. The work included in this thesis has been carried out by the author in the Department of Structural Engineering, Ain Shams University, from March. 2010 to February 2015.No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

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TABLE OF CONT ENTS

LIST OF FIGURES

LIST OF TABLES

NOMENCLATURE

A_c	The area of concrete
A_{FRP}	The area of vertical FRP reinforcement per hole
A_{tr}	The total cross-section area of all transverse reinforcement
b_0	The perimeter length of the critical section
b_n	The effective width of the slab at the level of reinforcement
b_d	The length of the perimeter of the critical section at which dowel action is expected to take place.
c	The cover based on centerline bar dimensions
c	The column dimension
d	The effective slab depth
d_b	The reinforcement bar diameter
E_{FRP}	The Elastic Modulus of FRP.
E_f	Modulus of elasticity of Fibers
f_{ck}	The characteristic concrete strength in MPa
f_{ctk}	The characteristic tensile strength of concrete
F'_C	The concrete cylindrical compressive strength
f_{ct}	The tensile strength of concrete
$f_{c,cube}$	The cube compressive strength of concrete.
f_s	The steel stress at the section
f_y	The yield strength of the reinforcement
f_c'	The concrete compressive strength
f_{yt}	The Specified yield strength of transverse reinforcement
K	The ultimate stiffness of the test slabs