شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

HANAA ALY

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جامعة عين شمس

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HANAA ALY

Ain Shams University
Faculty of Engineering
Structural Engineering Department

Punching Shear of High Strength Polypropylene Fiber Reinforced Concrete Slabs Interior Column Connection

A Thesis submitted in partial fulfillment of the requirements of the degree of
Master of Science in Civil Engineering
Structural Engineering Department

By

Omar Abd El-Nasser Abdou Mansour

Bachelor of Science in Civil Engineering
Structural Engineering Department
Faculty of Engineering, Ain Shams University, 2017

Supervised By

Prof. Dr. Ayman Hussein Hosny Khalil

Professor of Reinforced Concrete Structures, Structural Engineering Department
Faculty of Engineering, Ain Shams University

Dr. Ibrahim Abdel-Latif Yousif

Assistant Professor, Structural Engineering Department
Faculty of Engineering, Ain Shams University

Dr. Ezz El-Din Mostafa Salah Araffa

Assistant Professor, Structural Engineering Department
Faculty of Engineering, Ain Shams University

Cairo - 2021

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THESIS APPROVAL

Examiners Committee	**Signature**
Prof. Dr. Mohamed El-Saeed Eissa Professor of Reinforced Concrete Structures Faculty of Engineering - Cairo University	……
Prof. Dr. Mohamed Abdel Moaty Khalaf Professor of Properties and Testing of Materials Faculty of Engineering - Ain Shams University	……
Prof. Dr. Ayman Hussein Hosny Khalil Professor of Reinforced Concrete Structures Faculty of Engineering - Ain Shams University	……

Statement

This thesis is submitted as a partial fulfillment of the requirements for the degree of Master of Science (M.Sc.) in Civil Engineering (Structural Department), Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

Omar Abd El-Nasser Abdou Mansour

Signature: ……...…….

Date:

Researcher Data

Name	**:** Omar Abd El-Nasser Abdou Mansour
Date of birth	**:** 6th November 1993
Place of birth	**:** Cairo, Egypt
Academic degree	**:** Bachelor of Civil Engineering
Field of specialization	**:** Structural Engineering
University issued the degree	**:** Ain Shams University
Date of issued degree	**:** 2017
Current job	**:** Structural Design Engineer

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ABSTRACT

Punching shear failure is caused by the transfer mechanism of shear forces from the slab to the slab-column connection. These shear stresses are developed from gravity loads and unbalanced moments. Once these shear stresses exceed the slab's shear capacity, punching occurs with no warning. Punching shear failures are generally brittle phenomena. Recently, using fibers has proven to give good results as a new technique to improve the punching shear resistance, and cracking control of slab-column connections. This study investigates mainly the influence of high strength crimped polypropylene fibers on the punching shear of slab interior column connection.

In the first part of the thesis, an experimental program was carried out to investigate the influence of polypropylene fibers on the properties of hardened concrete. Concrete specimens have been tested at different ages to determine the mechanical properties of concrete, namely, compressive strength, tensile splitting strength, flexural strength, and direct tensile strength. Samples with polypropylene fibers dosage of 2.5 kg/m³ showed the best results. The compressive, split tensile and flexural strengths improved significantly with an increase in strength up to 53, 45 and 40%, respectively.

The second part of the thesis employs nonlinear finite element method using ANSYS 19.0 software to investigate the punching shear strength of reinforced concrete slab-column connections focusing on four main parameters, namely, the inclusion of polypropylene fibers, flexural reinforcement ratio, column size and concrete compressive strength.

This finite element analysis comparative study includes modeling eighteen full scale slab-column connection of dimensions 3500x3500x220 mm and volumetric fiber contents 0 kg/m³ and 2.5 kg/m³. Slabs are divided into six groups and reinforced with two flexural reinforcement ratios of 0.80% and 1.27%. Compression longitudinal steel bars are of diameter 12 mm and spaced 125 mm center to center in both directions for all specimens. Columns are of size 300x300 mm and 500x500 mm, reinforced with four longitudinal steel bars of diameter 16 mm and eight longitudinal steel bars of diameter 18 mm, respectively.

The inclusion of polypropylene fibers by dosage 2.5 kg/m³ enhanced the mechanical properties of concrete which resulted in increasing the punching shear capacity ranging from 11% to 59% and the slab deflection at service loads increased ranging from 5% to 56%.

Other parameters such as increasing the flexural reinforcement ratio from 0.80% to 1.27% slightly increased the punching shear strength ranging from 6% to 11% and reduced the slab deflection at service loads ranging from 8% to 13% as the stiffness of the slabs increased.

As the critical punching shear perimeter increased by changing the column size from 300x300 mm to 500x500 mm resulted in increasing both the punching shear capacity ranging from 25% to 30% and the slab deflection at service loads ranging from 16% to 22%.
Increasing the concrete compressive strength from 25.20 MPa to 50.30 MPa resulted in increasing both the punching shear capacity ranging from 37% to 64% and the slab deflection at service loads ranging from 31% to 56%.

Keywords: Polypropylene fibers, Fiber-reinforced concrete, Punching shear strength, Flat slabs, Slab interior column connection, Experimental testing, Finite element method.

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