شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

# بسم الله الرحمن الرحيم

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## قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

## يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

HANAA ALY

Cairo University

# INVESTIGATION OF OUT-OF-PLANE BENDING BEHAVIOR OF PRECAST CONCRETE SANDWICH PANELS

By

**Mohamed Fawzy Abdel Aziz Gomaa**

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
**DOCTOR OF PHILOSOPHY**
**in**
**Structural Engineering**

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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**Title of Thesis:**

Investigation of out-of-Plane Bending Behavior of Precast Concrete Sandwich Panels

**Key Words:**
Concrete; Sandwich Panels; Insulated Panels; Precast Panels; Flexural Capacity of Precast Concrete Panels

**Summary:**

Precast concrete sandwich panel (PCSP) is composed of two concrete layers, known as wythes, separated by a rigid layer of insulation. The out-of-plane bending behavior of sandwich panel heavily depends on the shear force transferred between the wythes through elements known as shear connectors. Fully composite and non-composite panels can be readily analyzed, but there is uncertainty between designers in evaluating of partially composite panels because their behavior is much more complex and typically rely on test results. In this research a 3D non-linear finite element model utilizing ANSYS software, V19.3, was developed and validated against published test data, then a parametric study followed. The parametric considered some parameters that believed to impact the out-of-plane bending such as: shear connectors shape and distribution, connectors area, panel length, effect of foam core bond in composite action, concrete grade, wythes thickness, adding ribs to the structural wythe, and use of GFRP material in the shear connectors. The results of the developed model were in a good agreement with the test results and this was sufficient to employ the model to capture the variation effect of the parameters presented in this study.

# Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Mohamed Fawzy Abdel Aziz Gomaa  Date: / / 2021

Signature:

# Acknowledgments

All praise belongs to Allah, Almighty, for the countless graces I have and the continuous support I receive from Allah along with supporting me to achieve my targets from the postgraduate studies of learning new issues and increasing my knowledge.

The author wishes to express his most hearted thanks to prof. Dr. Walid Abdel Latif Attia and Prof. Dr. Ahmed Hassan Amer for their wise sincere supervision, guidance, interest, patience, and recommendations.

The author wants to dedicate this research to his father's soul, his mother, his wife, and his daughters Laila and Karma.

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