



شبكة المعلومات الجامعية  
التوثيق الإلكتروني والميكرو فيلم

# بسم الله الرحمن الرحيم



**HANAA ALY**



شبكة المعلومات الجامعية  
التوثيق الإلكتروني والميكروفيلم



## شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلم



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# جامعة عين شمس التوثيق الإلكتروني والميكروفيلم

## قسم

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



## يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار



**HANAA ALY**



Faculty of Engineering  
Structural Engineering Department

# **EFFECT OF AXIAL TENSION ON THE SHEAR STRENGTH OF REINFORCED CONCRETE SLABS**

A Thesis

Submitted in Partial Fulfillment of the  
Requirements for the Degree of Master of Science in Civil Engineering  
(Structural Engineering)

Prepared by

**MAY SALAH EL-DIN ABD ELAZIM KHALIL**

B.Sc. in Structural Engineering, June 2017  
Faculty of Engineering, Ain Shams University

## **Supervisors**

**Prof. Dr. AMR ALI ABDELRAHMAN**

Professor of Concrete Structures  
Faculty of Engineering, Ain Shams University, Cairo, EGYPT

**Dr. MAHMOUD MOHAMED EL-KATEB**

Assistant Professor of Structural Engineering  
Faculty of Engineering, Ain Shams University, Cairo, EGYPT

2021



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Faculty of Engineering, Ain Shams University

## **THESIS APPROVAL**

### **EXAMINERS COMMITTEE**

**Prof. Dr. TAMER HASSAN ELAFANDI**

Professor of Concrete Structures

**Prof. Dr. HUSSEIN OSAMA OKAIL**

Professor of Concrete Structures

Faculty of Eng., Ain Shams University

**Prof. Dr. AMR ALI ABDELRAHMAN**

Professor of Concrete Structures

Faculty of Engineering, Ain Shams University.

### **SIGNATURE**

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Date: 2 /12 /2021

## **STATEMENT**

This dissertation is submitted to Ain Shams University, Faculty of Engineering for the Master of Science in Structural Engineering.

The work included in this thesis was carried out by the author in the department of Structural Engineering, Faculty of Engineering, Ain Shams University.

No part of it has been submitted for a degree or a qualification at any other scientific entity.

Date: 2/12 /2021

Signature: -----

Name: *MAY SALAH EL-DIN ABD ELAZIM*



## Researcher Data

Name : May Salah EL-Din Abd EL Azim  
Date of birth : 24 April 1994  
Place of birth : Cairo, Egypt  
Academic Degree : B.Sc.in Structural Engineering, 2017.  
University : Ain Shams University  
Date : June 2017  
Grade : Excellent with Honor  
Current job : Teaching Assistant, Badr University

## DEDICATION

I thank GOD who guided and helped me to finish this work in the proper shape. I wish to dedicate this work to who support and encourage me during the thesis work. I would like to thank **Prof. Amr Abdelrahman**, Professor of concrete structures, faculty of engineering, Ain Shams University, for his effort, guidance and invaluable advices through the work.

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**To My Parents,**

**My Brothers,**

For the encouragement and support to complete this work.

## **Thesis Summary**

### **EFFECT OF AXIAL TENSION ON THE SHEAR STRENGTH OF REINFORCED CONCRETE SLABS**

For the aesthetics of buildings, modern architectural constraints are pushing engineers to provide longer clear spans without expansion joints. In some cases, the building is chosen to be continuous for better lateral load resistance and rigid frame action. The absence of expansion joints leads to the occurrence of axial stress in addition to the shear stress simultaneously on the reinforced concrete members as a result of temperature change, shrinkage in the restrained members, and so on. Few experimental work addressing the effect of axial stress on the shear strength of reinforced concrete (RC) slabs were reported in the literature. Most of the experiments that were found in the literature were conducted on reinforced concrete (RC) beams. The axial stresses may be compressive or tensile stresses. It is well known that the axial compression force increases the shear capacity for RC structures without shear reinforcement and the axial tension force reduces the shear capacity. Compression forces increase the compression area and delay the formation of cracks giving the structure greater shear capacity. On the other hand, the compression area is reduced by the tension forces, which reduces the shear capacity of RC structures. In the previous studies, the effect of the axial tension load on shear resistance was studied far less than the influence of compressive loads. Until now, it is not clear how much the shear strength of RC slabs will be affected due to axial tension forces.

The main objectives of this research were to study the behavior of RC slabs under axial tension, to investigate the effect of axial tension on the shear strength

of RC one-way slabs without shear reinforcement, and to verify the applicability of different design codes for RC slabs under shear and axial tensile loads.

To fulfill the previously mentioned objectives, The experimental work was done on six slab specimens (one-way R.C slabs with one side cantilever) with dimensions (500 mm width and 140 mm thickness) with a clear span between supports 1600 mm and a cantilever 400 mm long (total length = 2000 mm). All slabs were without shear reinforcement with the same ratio of longitudinal reinforcement. The tested specimens were coded from S1 to S6 respectively. The first specimen (S1) was considered as the reference specimen since it was not exposed to any axial load. The other five specimens were exposed to different level of axial tension. The slabs were designed to investigate the one way shear resistance subjected to line load at the edge of the cantilever. The shear span ratio was equal for all specimens.

Comparison between the experimental results and the design codes (ACI 318-14, ECP 203-2020, ACI 318-19 and Eurocode 2) was carried out. The experimental results declared that the application of axial tensile stress of 0.75 of the concrete tensile strength reduced the shear capacity by 20% while the application of tensile stress of 1.25 of the concrete tensile strength reduced the shear capacity by 50%. A proposed model was introduced to state the effect of axial tension on the shear strength of RC slabs. The proposed model depended on the level of the applied axial tension.

The current research was divided:

#### Chapter (1): Introduction

This chapter included a summary of the thesis in addition to its objective, methodology, and the thesis outlines.

#### Chapter (2): Literature Review

This chapter included a review of the preceding experimental work carried out to study the effect of axial tension on the shear strength of reinforced concrete members. The previous experimental work was classified into experimental results from reinforced concrete beams and results from reinforced concrete slabs. Besides, an overview of the assumptions concerning the shear strength of reinforced concrete members under axial tension in the available design codes.

#### Chapter (3): Experimental Program

This chapter represented a detailed description of the experimental work that was carried out in the research including; specimen details, the properties of the used materials, test setup, instrumentations, etc...

#### Chapter (4): Experimental Results and Discussion

This chapter discussed the experimental observations and results, such as crack patterns, failure modes, load-deflection curves and steel strains. Also, it contained a discussion of the results and a comparison between the experimental results and design codes.

## Chapter (5): Conclusions and Recommendations

This chapter included the conclusions of this research, recommendations, and suggestions for future work.

Key words:

Shear strength, Axial load, Slabs without shear reinforcement, Line loads, and Angle of inclination of shear crack.

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