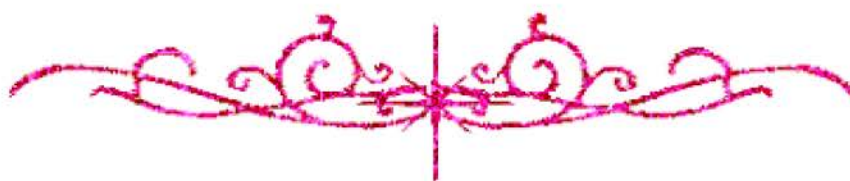


سامية محمد مصطفى



شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم



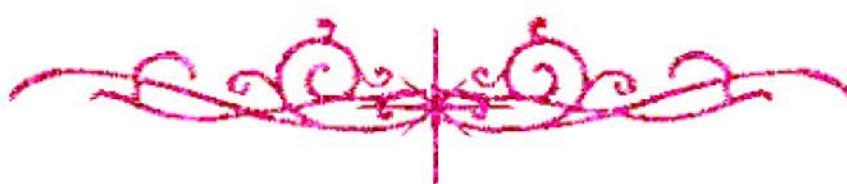
سامية محمد مصطفى



شبكة المعلومات الجامعية



شبكة المعلومات الجامعية التوثيق الالكتروني والميكرو فيلم



سامية محمد مصطفى



شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

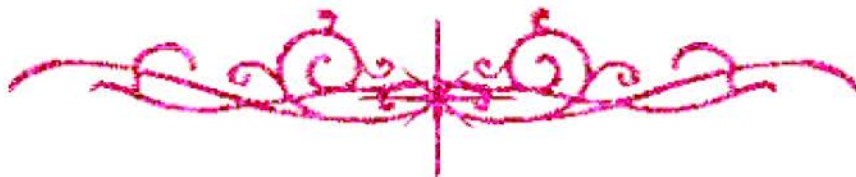
قسم

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



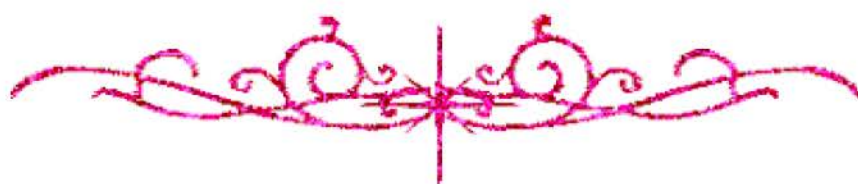
سامية محمد مصطفى



شبكة المعلومات الجامعية



بعض الوثائق الأصلية تالفة



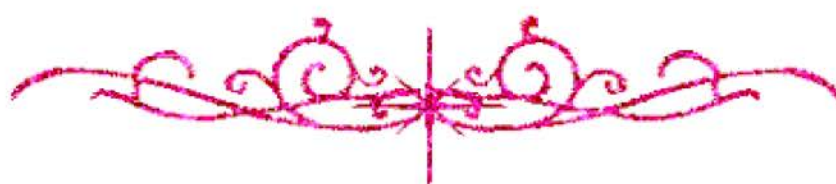
سامية محمد مصطفى



شبكة المعلومات الجامعية



بالرسالة صفحات لم ترد بالأصل



**FRACTURE BEHAVIOR OF REINFORCED CONCRETE
FLANGED BEAMS UNDER FOUR POINT BENDING
IN DISPLACEMENT CONTROLLED ENVIRONMENT**

By
Noran Mohamed Magdy Mohamed Abd El-Wahab

B.S.C. in Civil Engineering(Honors)-Cairo University-2004

A thesis Submitted to the
Faculty of Engineering at Cairo University
in partial fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
In
STRUCTURAL ENGINEERING

Supervised by

Prof. Dr. Nabil A.B. Yehia

Professor of Concrete Structures, Faculty of Engineering,
Cairo University.



FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2006

B

10270

FRACTURE BEHAVIOR OF REINFORCED CONCRETE FLANGED BEAMS UNDER FOUR POINT BENDING IN DISPLACEMENT CONTROLLED ENVIRONMENT

By
Noran Mohamed Magdy Mohamed Abd El-Wahab

B.S.C. in Civil Engineering (Honors)-Cairo University-2004

A thesis Submitted to the
Faculty of Engineering at Cairo University
in partial fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
In
STRUCTURAL ENGINEERING

Approved by the Examining Committee:

Prof Dr.	Nabil A.B. Yehia	Advisor
Prof Dr.	Ahmed M. Farahat	member
Prof. Dr.	Hossam Sallam	member

N. Yehia
Farahat
Hossam Sallam

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2006

ABSTRACT

A four point bend test in a displacement controlled environment is used to investigate the fracture behavior of the T- shaped reinforced concrete beams. Two parameters were investigated: the ratio of flange width to web width (B/b) and the ratio of flange thickness to beam's height (t_f/h). The testing program comprises 12 beams; 3 having rectangular section and 9 having T-section. All beams are 1400 mm in length with a mid span height of 300 mm and a mid span notch of 90 mm. The beams are classified into 3 groups. In the first group, the tested beams have variable flange width to web thickness (B/b):1, 1.5, 2, 2.5, constant ratio of flange thickness to beam height (t_f/h) =0.2 and a reinforcement ratio=0.6%. The second group of beams has variable flange width to web thickness (B/b):1, 1.5, 2, 2.5, constant ratio of flange thickness to beam height (t_f/h) =0.15 and a reinforcement ratio 0.48%. The third group of beams has variable flange thickness to beam height (t_f/h):0, 0.1, 0.15, 0.2, constant ratio of flange width to web thickness (B/b) =1.5 and a reinforcement ratio 0.73%. Measurements included load, steel strain, concrete strain and deflection. Tracking for the mid span crack at each load increment was carried out. The analytical model proposed by Baluch et al. was employed. The experimental results were checked against the new fracture mechanics approach. Also, the experimental results were compared to the results of a finite element program. However, the experimental program revealed that the ratio of flange width to web width (B/b) is more effective than the ratio of flange thickness to beam's height (t_f/h). In addition to that, both the fracture mechanics

approach and the finite element program are in a good agreement with the experimental results.

ACKNOWLEDGEMENT

In the beginning, I thank God who guided me in this thesis. I also would like to express my deepest thanks and gratitude to all the people who helped me during the course of this work. Therefore the following expresses only a part of my appreciation to them.

I would like to express my deepest gratitude, thanks and appreciation to Prof. Dr. Nabil A.B. Yehia who in the first place devoted sincerely his time and effort in supervising this thesis. I doubt that without his valuable assistance, fruitful discussion and continuous encouragement, I could have completed this work. It has been an honor and privilege to work with him for his outstanding examples of scientific dedication in his field.

My sincere thanks also extends to Prof. Dr. Ahmed Farahat for providing me with the software package. Also, I would like to thank deeply Prof. Dr. Sameh Hilal for facilitating the experimental work.

I would like also to thank all the members of the concrete research laboratory, Faculty of Engineering, Cairo University, for their help and kind assistance in using the laboratory facilities.

Finally, I would like to thank my parents for their continuous assistance and encouragement although I know that this only expresses a small part of repaying their debt. All what I can say that without their assistance I even would not have been able to become an engineer.

TABLE OF CONTENTS

ABSTRACT.....	iv
ACKNOWLEDGEMENT.....	v
TABLE OF CONTENTS.....	vii
LIST OF TABLES.....	xii
LIST OF FIGURES.....	xiii

CHAPTER 1: INTRODUCTION

1.1 General.....	1
1.2 Objectives and Scope of the Research.....	1
1.3 Summary of Contents.....	1

CHAPTER 2: LITERATURE REVIEW

2.1 General	3
2.2 Historical Background.....	5
2.3 Modes of Fracture.....	10
2.4 Fracture of Plain Concrete.....	11
2.4.1 Behavior under Tension.....	11
2.4.2 Behavior under Compression.....	12
2.4.3 Experimental Evaluation of Fracture Parameters	
2.4.3.1 The Euro Code Method.....	13
2.4.3.2 The ASTM Method.....	14
2.4.3.3 Size Effect Method.....	15
2.4.3.4 Compliance Calibration Technique.....	16

2.4.4 Models for Plain Concrete.....	17
2.4.5 Size Effect on Nominal Strength of Plain Concrete.....	20
2.5 Fracture of Reinforced Concrete Beams.....	25
2.5.1 Approaches to Study Fracture in RC Beams.....	25
2.5.1.1 Hillerborg Model.....	25
2.5.1.2 Baluch et al. Model.....	30
2.5.1.3 Gerstle Model.....	33
2.5.2 Minimum Reinforcement Ratios for Flexural Members.....	40
2.5.3 Size Effect on Reinforced Concrete Beams.....	43
2.5.4 Shape Effect on Reinforced Concrete Beams.....	44
2.6 Finite Element.....	44
2.6.1 General.....	44
2.6.2 Importance of Finite Element.....	45
2.6.3 Historical Background.....	46
2.6.4 Different Approaches in Dealing with Cracks and Their Propagation.....	46
2.6.5 Crack Modeling.....	48
2.6.5.1 Discrete Crack Approach.....	48
2.6.5.2 Smeared Crack Approach.....	51
2.6.6 Models Applying Finite Elements.....	52
2.6.6.1 Hillerborg Model [32].....	52
2.6.6.2 Rokuga Model [84].....	56