

**OPTIMIZATION OF STEEL REINFORCEMENT IN
REINFORCED CONCRETE BEAM WITH OPENINGS BY
NUMERICAL AND EXPERIMENTAL COMPARISON**

By

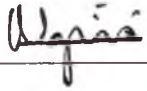
MOHD NAJMI BAHRUDIN

Report is submitted as
the requirement for the degree of
Bachelor Engineering (Hons) (Civil)

**UNIVERSITI TEKNOLOGI MARA
DECEMBER 2006**

DECLARATION

I, Mohd Najmi Bahrudin, 2003339638 confirm that the work is my own and that appropriate credit has been given where reference has been made to the work of others.

()

4 DECEMBER, 2006

ACKNOWLEDGEMENT

First of all I would like to express my gratitude to the Almighty ALLAH s.w.t, in giving me the strength, courage and guidance to complete this report. I would like to thank my supervisor in completing this proposal, Mr Zaini Endut, for his patients, guidance and also his valuable advice throughout this preparation in planning and completing of this thesis report. I would also like to thank Mr. Amer Yusuff, Head of Civil Engineering Faculty. My deepest appreciation goes to my parents, Mr. Bahrudin B. A. Rahman and Wan Fatimah Wan Ngah for supporting in all aspect of my life.

I also would like to thank Mr. Efendi, Mr Abdullah and Mr saleh the technicians who spends a lot of time to monitor me and giving guides while handling the equipments, Not forgotten to Greg Alvin, Nurul Izza, Nurul Aini, Mohd Harif and also to all my classmates, your helps are truly appreciated and I will always remember it.

Special thanks are extended to all lectures in Faculty of Civil Engineering, technicians and friends for helping in so many ways in completing this report. May Allah bless upon all of you.

Finally, Great Thank to the Almighty where on His permission that I could complete my thesis.

ABSTRACT

The purposed of the study is to optimize the reinforcement in RC beam that have transverse openings at the web section of the beam. The laboratory works results (actual results) are compared with the results using simulation in order to determine the behavior of the reinforced concrete beam. The comparison process is one of the important processes in this research in order to fully utilize the simulation works in the future.

The behaviors of the RC beam in terms of cracking pattern, ultimate strength, mode of failure and also the deformation are obtained from experimental works and simulation using LUSAS software. All the experimental works are carried out at the Heavy Structure Laboratory of UiTM Pulau Pinang.

The comparison shows that the results obtained from experimental works and simulation using LUSAS software are quiet close to each other. The simulation works shows that it can be use to investigate the behaviors of the actual beam in order to understand the reason behind the results that obtained from experimental works.

LIST OF FIGURES

FIGURE	TITLE	PAGE
1.0	Details of RC beam with opening	3
2.1	Geometry of the leonhardt's beam no 1	9
2.2	Load displacement curve of shear beam	9
2.3	Crack pattern as observed in the experiment	10
2.4	Models of crack pattern	10
2.5	Schematic view of the test setup	14
2.6	Crack pattern of the tested beam	15
3.1	Stresses distribution I the beam with openings	17
3.2	Compression area	18
3.3	Tension area	18
3.4	The steel reinforcement arrangement	20
3.5	Sample of beam with transverse openings	21
3.6	Ordinary Portland cement	22
3.7	Coarse aggregate	23
3.8	Fine aggregate	24
3.9	Sample of formwork	27
3.10	Sample of bent steel reinforcement (main bar)	27
3.11	Sample of installed reinforcement	28
3.12	Casting process	29