

**UNIVERSITI TEKNOLOGI MARA**

**SEISMIC PERFORMANCE OF 3-STOREY  
TUNNEL FORM SYSTEM BUILDING WITH  
DOUBLE UNITS SUBJECTED TO LATERAL  
CYCLIC LOADING**

**SALEHA BINTI MD. SALLEH**

Dissertation submitted in partial of requirement  
for the degree of  
**Master of Science**

**Faculty of Civil Engineering**

June 2013

## AUTHOR'S DECLARATION

I declare that the work in this dissertation was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This topic has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

In the event that my dissertation be found to violate the conditions mentioned above, I voluntarily waive the right of conferment of my degree and agree be subjected to the disciplinary rules and regulations of Universiti Teknologi MARA.

Name of Candidate : Saleha Binti Md.Salleh

Candidate I.D. No. : 2011100653

Programme : Master of Science (Structure)

Faculty : Civil Engineering

Thesis Tittle : Seismic Performances of 3-storey Tunnel Form System Building with double units subjected to Lateral Cyclic Loading

Signature of Candidate: ..........

Date : June 2013

## ABSTRACT

Introduction of earthquake surrounding in Malaysia was need of problem statement to study on behaviour of building against seismic loading. Analysis is purposely to identify the behaviour of building under seismic loading in terms of level of damage. Commonly building in Malaysia is already practising BS8110: Part 1 under static load. This study is more or less concern on high-rise building which normally design on structure using shear wall and slab system. This study and analysis is under tunnel form system building which limited to 3-storey and double units. The design is according to BS8110: Part 1 Design specification for concrete. Material properties of the concrete practising to similar condition in construction in Malaysia where is concrete strength, reinforcement strength for high yield and mild steel, BRC wire mesh for wall, minimum concrete cover by 30N/mm<sup>2</sup>, 460 N/mm<sup>2</sup> (high yield steel) , 250 N/mm<sup>2</sup> (mild steel), 485 N/mm<sup>2</sup> (BRC wire mesh) and 25mm respectively. The prototype building will construct on one third (1:3) from actual scale for whole respective parameter that involved during construction until testing. The testing will be based on lateral cyclic loading. The testing on prototype building will be resulted the hysteresis loop of reinforced concrete behaviour under seismic loading. Yet the equivalent viscous damping is determined by the equivalent area of hysteresis loop in tension and compression zone that purposely to help by absorbing the energy induced from the ground shaking. The reinforced concrete behaviour, ductility, stiffness, equivalent viscous damping, cracks, tension and compression coupling will be focus in further experimental and laboratory stage.

*Keywords: reinforced concrete behaviour, ductility, stiffness, equivalent viscous damping, tunnel form system, lateral cyclic loading.*

## ACKNOWLEDGEMENT

In the name of Allah the most graceful and merciful. From God's blessing that now I have completed for my thesis regarding **"SEISMIC PERFORMANCE OF 3-STOREYS TUNNEL FORM SYSTEM BUILDING WITH DOUBLE UNITS SUBJECTED TO LATERAL CYCLIC LOADING"**. Alhamdulillah, all these will surely be possible with the good health, environment and divine inspiration awarded from Allah s.w.t.

Dedicating greeting and thankful to people who encourage, supporting and always been close to me during my hard time to complete this research proposal. First and most thanks to special people who are really assist and together for ensure the whole research proposal process is successful to its main objective. She is my supervisor Dr. NorHayati binti Abd.Hamid who is very experiencing lecturer on seismic study. She give me a lot of inspiration at every angle, wish Allah blessing for your kindness and attention.

Not to forget, my lovely family especially dedicated to my husband and daughter who are always been close to me. At every hard situation, they will be in side to supporting me. Honestly, this writing of research proposal is a very difficult moment to having exact information, to spending time for writing and less time from family. All the challenges time, will make me more toughness and determination to ensure the successful of this research proposal. Really thankful to all participants members who will giving the effort together during construction and the most thankful to all technician person especially Mr. Tarmizi, Mr. Syamir, Mr. Baharuddin and Mr. Faiz. They are really helpful and experience on handling the construction and testing until this experimental study achieving the successful. Thanks to all of them and May Allah bless to all of us.

# TABLE OF CONTENTS

	<b>Page</b>
ABSTRACT	i
ACKNOWLEDGEMENT	ii
TABLE OF CONTENTS	iii
LIST OF FIGURES	vi
LIST OF TABLES	x
APPENDIX	
<b>CHAPTER 1: INTRODUCTION</b>	
1.1 Background of study	1
1.2 Problem statement	6
1.3 Objective of the study	7
1.4 Scope and limitation of the study	8
1.5 Significance of Research	9
<b>CHAPTER 2: LITERATURE REVIEW</b>	
2.1 Introduction	11
2.2 Seismic performances of building under Post Earthquake	12
2.3 Damage behaviour of the tunnel form system under earthquake attack	14
2.4 Brittle failure mechanism of tunnel form building	17
2.5 Influenced cyclic loading in connection	19
2.6 Design requirement in RC building under seismic loading	19
2.7 Model of concrete	21
2.8 Steel reinforcement material model	22
<b>CHAPTER 3: RESEARCH METHODOLOGY</b>	
3.1 Introduction	23
3.2 Design and Analysis of Building using BS8110: Part 1	25
3.3 Construction of Prototype Building	29
3.3.1 Testing on Material of Concrete	29