

THE UNDRAINED SHEAR STRENGTH OF  
SOFT CLAY REINFORCED WITH  
SINGLE ENCAPSULATED LIME BOTTOM  
ASH COLUMN

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### **SUPERVISOR'S DECLARATION**

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor of Civil Engineering.

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.



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## LIST OF SYMBOLS

$A_c$	Area of lime bottom ash column
$A_s$	Area of kaolin clay sample
$c$	Cohesion
$c'$	Apparent cohesion
$D_c$	Diameter of lime bottom ash column
$D_r$	Relative density
$G_s$	Specific gravity
$H_c$	Height of lime bottom ash column
$H_s$	Height of kaolin clay sample
$v$	Specific volume
$V_c$	Volume of lime bottom ash column
$V_s$	Volume of kaolin clay sample
kN	Kilo Newton
kPa	Kilo Pascal
$M_g$	Mega Gram
MN	Mega Newton
m/s	Metre per second
mm	Millimetre
$\mu\text{m}$	Micrometre
$e$	Void ratio
$W_L$	Liquid limit

$W_p$	Plastic limit
$I_p$	Plastic index
$w_{opt}$	Optimum moisture content
$\gamma$	Unit weight
$\gamma_{max}$	Maximum unit weight
$q_u$	Deviator stress
$s_u$	Undrained shear strength
$\Delta s_u$	Improvement undrained shear strength
$\rho_d$	Dry density
$R^2$	Correlation cohesion
%	Percent
°	Degree



## **LIST OF ABBREVIATIONS**

AASHTO	American Association of State Highway and Transportation Officials
ASTM	American Society for Testing and Materials
BA	Bottom Ash
BS	British Standard
BSCS	British Soil Classification System
C	Controlled Sample
CU	Consolidated Undrained
LL	Liquid Limit
LBA	Lime Bottom Ash
LBAC	Lime Bottom Ash Column
PL	Plastic Limit
S	Single Column
SEM	Scanning Electron Microscope
UCT	Unconfined Compression Test
US	United States
USCS	Unified Soil Classification System