

**FLEXURAL BEHAVIOUR OF REINFORCED  
CONCRETE BEAM WITH RECTANGULAR  
WEB OPENING**

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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 Engineering (Hons) 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

$\emptyset$	Diameter
$\sigma$	Stress
P	Load
A	Cross sectional area
$\epsilon$	Strain
$\Delta L$	Change in length
$L_o$	Original Length
$f_{ck}$	Compressive strength
$f_{cu}$	Concrete strength
$F_{cc}$	Stress in concrete in compression
$F_{st}$	Stress in steel in tension
$f_{yy}$	Shear link strength
$f_{yk}$	Reinforcement strength
$\epsilon_{st}$	Steel strain
$\kappa$	Neutral axis depth
z	Lever arm
$\emptyset_{Bar}$	Diameter of reinforcement of main bar
$\emptyset_{Link}$	Diameter of reinforcement of shear link
n	Modulus of elasticity transformation coefficient for steel to concrete
E	Modulus of elasticity
$A_s$	Area of reinforcement
$I_{cr}$	Moment of Inertia of cracked, transformed section
I	Moment of inertia

## **LIST OF ABBREVIATIONS**

ASTM	American Society for Testing and Materials
ACI	American Concrete Institute
BS	British Standard
C	Control Beam
S	Beam with small opening
M	Beam with medium opening
L	Beam with large opening