FINITE ELEMENT ANALYSIS OF SQUARE TUBULAR T-JOINT UNDER STATIC LOADING

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SUPERVISOR'S DECLARATION

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

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STUDENT’S DECLARATION

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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ABSTRAK

Kertas ini menunjukkan tingkah laku segi empat tiub bentuk T melalui kajian berangka. Pertama, beban statik yang digunakan untuk menjalankan prestasi statik pada segi empat tiub bentuk T dengan nisbah lebar berbeza pada tiang dan rasuk. Analisis linear pada tiub bentuk T termasuk corak kecemaran dan pembangunan beban statik dan anjakan akan diterangkan. Model unsur kajian berangka bagi simulasi tiub betntuk T di bawah beban statik adalah dicadangkan. Akhirnya, simulasi berangka yang sedang dijalankan untuk menyiasat mekanisme kegagalan tiub bentuk T di bawah beban statik. Dalam analisis "eigenvalue" untuk segi empat tiub bentuk T juga dicadangkan. Oleh itu, kaedah unsur kajian berangka akan digunakan untuk menganggarkan tekanan maksimum dan tekanan "buckling" yang kritikal. Secara umum, penyiasatan wajar menilai tingkah laku statik untuk segi empat tiub bentuk T.

ABSTRACT

This paper analyses the behaviour of square tubular T-joint by means of numerical studies. Firstly, a static loading is employed to carry out the monotonic static performance on cold-formed square tubular T-joints with different width ratio of brace/chord. The linear analysis of tubular T-joints including the deformation pattern and the development of static loading and displacement will be described. Complementary finite element model for simulating the tubular T-joints under static loading is proposed. Finally, the numerical simulations are carried out to investigate the failure mechanism of T-joints under static loading. The eigenvalue analysis of square tubular T-joints also proposed. Therefore, finite element method will be used to estimate the maximum stress and critical buckling stress. In general, the investigation to reasonably evaluate the static behaviour of square tubular T-joints.

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LIST OF SYMBOLS

D	Chord Outside Diameter
d	Brace Outside Diameter
T	Chord Wall Thickness
t	Brace Wall Thickness
L	Chord Length
l	Brace Length
θ	Brace Inclination
β	Width Ratio of Brace/Chord
ε	Strain
σ	Stress
T	T-joint
Y	Y-joint
K	K-joint
X	X-joint
TY	TY joint
DY	Double Y joint
DT	Double T joint
DK	Double K joint
DTDK	Double T Double K joint
kN	Kilo Newton
QSL8	Thin Shell Element Name
U	U-axis Direction
V	V-axis Direction
W	W-axis Direction
X	X-axis Direction
Y	Y-axis Direction
Z	Z-axis Direction

LIST OF ABBREVIATIONS

ANSYS	ANalysis SYStem
CHS	Circular Hollow Section
FE	Finite Element
FEA	Finite Element Analysis
HSS	Hollow Structural Section
LUSAS	London University Stress Analysis System
PDE	Partial Differential Equation
3D	Three-Dimensional

CHAPTER 1

INTRODUCTION

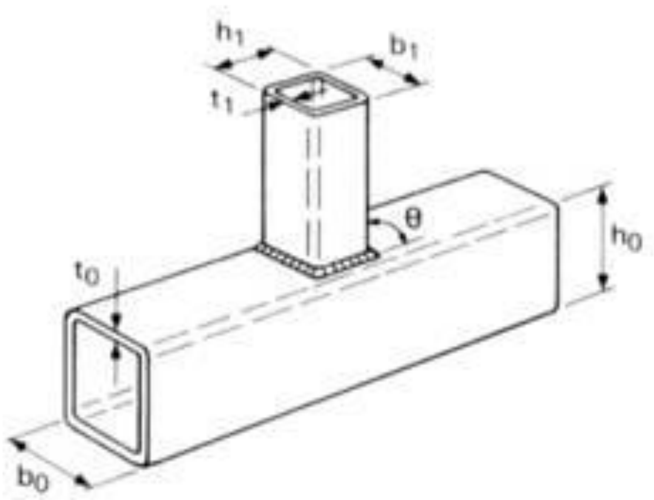
1.1 Introduction

Nowadays industrial building, offshore platform and breakwater has widely used and being significantly in architectural and structural systems. All the main tubular structures of topside have a mixed deck or support frame and important amount of rolled sections are used. The structures have been uncovered and exposed to a big collision as a part of force on the joints. These collisions can cause collapse to structures, reducing the strength of joints and affecting the structure stability. Therefore, it is important to predict the burden damage during design phase so that the structures will be strong and last longer in future.

Square tubular according to en.wikipedia.org is a part of hollow structural section (HSS) which is type of metal biography. Hollow structural section has many types such as circular, square or rectangular hollow section. Square tubular commonly used in welded steel frames as the frame will expose to multiple type of loading. Since this tubular widely used in structural system, this is because the efficient shapes have uniform geometry thus gives static strength characteristic.

For the structure construction, there are need some joint between members at some point to complete full structures. These points are called as tubular joints. The main member of part of tubular joint is called as chord while the secondary member is called as brace. The connections on the tubular joints are based on the shape of alphabetical letter such as Type T, Type K, Type N etc. There is a lot combination of connection on structural system. There can be a DT joint (Double T joint) which is has double T joint.

For tubular joint must have a high strength to hold the forces that acting on the section between beam and column in the structures. The forces that high from the capable on the joint, the structures will be collapsed. To make the structures not collapse in future, there are the common connection that used at the joint. For the joint, the toe weld is use since it has direct and efficient in transferring forces from one section to another section.



$B = b_1 / b_2$

$\mu_1 = b_1 / t_1$

$\mu_o = b_o / t_o$

$\gamma = b_o / (2t_o)$

Figure 1.1: Tubular T-joints (de Matos, Costa-Neves, de Lima, Vellasco, & da Silva, 2015)

1.2 Problem Statement

In the industry, there are many type of configurations on the tubular joints such as tubular T joints. When the force impacted on the members, the joints also affected. The result on the joints will represents the image of the building based on the size of brace and chord. Hence, if fault in design on the size of braces and chord members, it will affect to the collapse and instability of the building.

To optimize the cost and risks on the structures, the right design on the tubular joints need developed. Different thickness of chord and width ratio of brace/chord gives the different results on the strength of the tubular joints. The static behaviour for common configuration of tubular t-joints with different chord thickness and width ratio of brace/chord can determine the highest strength occur on the joints thus can optimize the cost and risks on the structure.

1.3 Objective

The objective of this research is to study the behaviour of the tubular T-joints under static loadings as shown below.

i. To investigate the static strength of tubular T-joints using finite element.

ii. To study the deformation modes of tubular T-joints under compressive loading.

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