UNIVERSITI TEKNIKAL MALAYSIA MELAKA

EXAMINATION OF BUCKLING BEHAVIOUR OF CONE-CYLINDER TRANSITION UNDER AXIAL COMPRESSION

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Automotive) with Honours.

by

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2018

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: EXAMINATION OF BUCKLING BEHAVIOUR OF CONE-CYLINDER TRANSITION UNDER AXIAL COMPRESSION

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I hereby, declared this report entitled EXAMINATION OF BUCKLING BEHAVIOUR OF CONE-CYLINDER TRANSITION UNDER AXIAL COMPRESSION is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive) with Honours. The member of the supervisory is as follow:

Signature: ……………………………………………….

Supervisor : DR.OLAWALE IFAYEFUNMI

ABSTRAK

Penyelidikan ini bertujuan untuk mengkaji pengaruh sudut kon dan ketinggian kerucut pada tingkah laku tenggelam peralihan silinder yang tertimbun kepada mampatan paksi. Kerja penyelidikan ini melibatkan 12 spesimen silinder kon yang mempunyai 6 kes. Setiap kes mengandungi 2 sampel. 12 spesimen tersebut difabrikasikan menggunakan lembaran keluli yang berketebalan 1mm. Perisian SolidWorks digunakan untuk melukis model kon dan silinder dalam lukisan 2D. Lukisan itu diimport ke perisian FlowPath manakala mesin jet air digunakan untuk memotong lembaran keluli kepada 12 sampel kon dan silinder. 12 sampel tersebut telah menjalani proses penggulungan dan kimpalan untuk membentuk bentuk silinder kon. Ujian mampatan aksial pada 12 spesimen silinder kon telah dilakukan dengan menggunakan mesin ujian sejagat. Kajian yang dilakukan adalah untuk membandingkan hasil eksperiment dan berangka. Data hasil semua spesimen ditunjukkan dalam laporan ini. Keputusan eksperimen menunjukkan bahawa apabila sudut kon berubah, beban juga akan berubah, sama ada ia meningkat atau menurun.

ABSTRACT

This research aims to investigate the influence of cone angle and cone height on the buckling behaviour of cone-cylinder transition subjected to axial compression. This research work involves 12 specimens of cone-cylinder which have 6 cases. Each case contains 2 sample. Those 12 specimens were fabricated using 1mm mild steel sheet. SolidWorks software was used to draw the model of cone and cylinder in 2D drawing. The drawing was imported to the FlowPath software while water-jet machine was used to cut the mild steel sheet into 12 sample of cones and cylinders. Those 12 samples were undergone rolling and welding processes to form cone-cylinder shape. Axial compression test on 12 specimens of cone-cylinder were done using universal testing machine. The research conducted was to compare experimental and numerical results. The results data of all specimens were presented in this report. The experiment results indicated that as the cone angle changes, the load will also changes, either increase or decrease

DEDICATION

This report is dedicated to my beloved parents, my siblings and my friends, who always support me during this final year project work. Last but not least, my final year report group mates who were always with me to complete my final year project research.

ACKNOWLEDGEMENTS

First of all, I would like to take this opportunity to express my sincere gratitude to my supervisor Dr Olawale Ifayefunmi from Faculty of Mechanical and Manufacturing Engineering Technology, Universiti Teknikal Malaysia Melaka (UTeM) for his guidance, supervision and support towards the process of this final year project report.

In addition, I like to acknowledge the help received from Mr. Shafiq and Mr. Azizul, the technician from Faculty of Mechanical and Manufacturing Engineering Technology for guiding us during our project work. Special thanks to the Faculty of Mechanical and Manufacturing Engineering Technology, UTeM, for the short funding for this project.

Last but not least, I will like to say a big thank you to my parents, siblings and friends for the encouragement and support that were given to me.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF SYMBOLS

h1	**-**	Height of cylinder
h2	**-**	Height of cone
r	**-**	Radius of cylinder
r1	**-**	Top radius of cone
r2	**-**	Bottom radius of cone
β	**-**	Angle of cone

LIST OF ABBREVIATIONS

UTeM	Universiti Teknikal Malaysia Melaka
FEM	Finite Element Method
CAD	Computer Aided Drawing
VFD	Variational finite-difference
MIG	Metal Inert Gas

CHAPTER 1

INTRODUCTION

1.1 Background

Cone-cylinder shell has a wide range of application in structural engineering. Some of the application that are used is pipes, pressure vessels, tanks, silos and roof structures. Internal pressurization causes large circumferential compressive stresses in the crossing point of the substantial end of a cone and a cylinder. These stresses can lead to failure of the intersection either symmetric or non-symmetric buckling (Teng, 1994 & 1995).

Conical shells are frequently used as transition elements to join cylindrical shells. In term of different angle and height of cones, it is important to determine the best geometry of cone if the structure subjected with different loading condition such as axial compression.

In term of stability of cone-cylinder, it have been investigated by the Rayleigh-Ritz strategy. By using analytical and finite element methods, the stresses in the cone-cylinder with a toroidal segment as a transition, subjected to external hydrostatic pressure can be calculated (Anwen, 1998) . Then, it will be compared with the cone-cylinder shells without transition.

1.2 Problem Statement

Most of the literature review states that thin walled cone-cylinder usually buckle elastically under axial compression. The buckling strength for axially loaded cone-cylinder is usually lower than the theoretical elastic critical stress. The presence of imperfections and geometric nonlinearity is the cause of buckling strength decreases. However, the presence of accompanying internal pressure reduces the effect of imperfections by increasing the buckling strength of the shells.

The influences in buckling mode of cone-cylinder are the material properties and the load applied at cone-cylinder. Besides that, the way of rolling the cylinder and cone shape might effect the buckling mode. Cylindrical panels are easy to roll, as they can be produced by simply keeping the axis in parallel. However, it is quite difficult to obtain precise conical shapes using the manual rolling process and it must carefully controlled during the process.

To weld together the shell components is another difficult task since this project have different angle and height of the cones. Perfect welding is required to ensure that the weld is strong enough so that structural failure can be prevented and all of the geometry cone-cylinder is similar to those in real structure.

1.3 Objectives

Based on the problem statement, the objective of this project is:

- To study the effect of different angles and height of cones on buckling behaviour of cone-cylinder intersection
- To determine the numerical and experimental result on buckling behaviour of cone-cylinder intersection

1.4 Scope of Study

The project is related with the buckling behaviour of cone-cylinder intersection with different angles of cones. The cone angles that includes is 11.31°, 16.7°, 26.57°, 8.53° and 18.43°. It was determine by the calculation of the cones with different height, top radius and bottom radius. The material that was chosen for the project is mild steel with 1mm thickness. All sample was drawn by using Solid work in 2D design. Each sample have 2 identified samples in order to achieve the accurate data. The total specimen that have to be draw is 24 including 12 for cones and 12 for cylinder. The product of each specimens was then subjected to compression test by using INSTRON Universal Testing Machine. The result obtained from the test was then recorded and tabulated and it will then be compare with numerical outcomes.