UNIVERSITI MALAYSIA PAHANG
FACULTY OF MECHANICAL ENGINEERING

We certify that the project entitled *"Finite element method modeling fukui sheet metal formability test"* is written by *Ammar Bin Ismail @ Mukhtar*. We have examined the final copy of this project and in our opinion; it is fully adequate in terms of scope and quality for the award of the degree of Bachelor of Engineering. We herewith recommend that it be accepted in partial fulfillment of the requirements for the degree of Bachelor of Mechanical Engineering.

Examiner Signature

FINITE ELEMENT METHOD MODELING FUKUI SHEET METAL FORMABILITY TEST

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A report submitted in partial fulfilment of the requirements
for the award of the degree of
Bachelor of Mechanical Engineering

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SUPERVISOR'S DECLARATION

We hereby declare that we have checked this project and in our opinion this project is satisfactory in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering.

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

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LIST OF SYMBOLS

σ	Stress
τ	Shear
t	Time
mm	Milimeter
r	Radius
A	Area
F	Force
P	Load

LIST OF ABBREVIATIONS

AISI	American Iron and Steel Institute
ASTM	American Society for Testing and Materials
2D	Two dimensional
3D	Three dimensional
CCV	Conical Cup Value
FEA	Finite Element Analysis
FEM	Finite Element Model
CAD	Computer Aided Drawing

ABSTRACT

The main objective of this project is to create Fukui conical cup model using finite element method to investigate the formability of sheet metal. The Fukui testing involved both deformation drawing and stretching. The elastic and plastic material properties are testing with plane stress and axis symmetric. There are three types of material aluminium, brass and steel are used to this project. The project begins with die design with AutoCAD and Solidworks. The project is further to modeling finite element with Algor FEA. The simulation started with elastic and plastic material model with plane stress. Then the material model is changed to axis symmetric with elastic and plastic material. The data collection taken to making graph of displacement. The simulation taken different time for each material. The variables for this project are variety of sheet metal and geometry type plane stress and axis symmetric. The constant of this simulation are thickness of sheet metal and displacement of the indenter to deform the material. All the data from Algor's software will show the different value of displacement when transferred to Microsoft Excel. The axisymmetric geometry type shown the data are not too overlapping each other compare to plane stress. From the data documentation, the discussion and result were conclude for making the developing Fukui conical cup sheet metal formability modeling.

ABSTRAK

Tujuan utama projek ini adalah untuk membina model cawan berbentuk kon Fukui menggunakan kaedah elemen hingga untuk menyiasat kadar kebolehan logam untuk penraikan dan lembaran logam. Percubaan Fukui yang terlibat baik deformasi menggambar dan peregangan. Elastik dan sifat bahan plastik uji pada regangan dan paksi simetri. Ada tiga jenis bahan berlainan dari kepingan logam iaitu seperti aluminium, tembaga dan besi digunakan untuk projek ini. Projek ini bermula dengan lakaran pada perisian AutoCAD dan Solidworks. Simulasi bermula dengan bahan plastik elastik dan model regangan. Kemudian model bahan berubah menjadi paksi elastik dan simetris dengan bahan plastik. Pengumpulan data diambil untuk membuat graf perpindahan. Masa yang diambil untuk simulasi berbeza untuk setiap jenis bahan. Pemboleh ubah dalam projek ini adalah seperti pelbagai jenis logam dan geometri jenis regangn dan paksi simetri. Pemalar untuk simulasi ini adalah ketebalan dari lembaran logam dan perpindahan penujah untuk menjalankan proses keboleh lanturan kepingan loga mengikut penarikan dan lembaran. Semua data dari perisian Algor akan menunjukkan nilai yang berbeza dan dipindahkan ke perisian Microsoft Excel. Jenis geometri yang dipaparkan axisymmetrik tidak terlalu menindih antara satu sama lain berbanding dengan model regangan.

CHAPTER 1

INTRODUCTION

1.1 SHEET FORMABILITY TEST

Formability is a measure of the amount of deformation a material can withstand prior to fracture or excessive thinning. Sheet metal forming ranges from simple bending, to stretching, to deep drawing of complex parts. Therefore, determining the extent to which a material can deform is necessary for designing a reproducible forming operation. Mechanical properties greatly influence formability, and forming properties may vary from coil to coil, it is essential to test incoming sheet material. However, the outcome of a forming process depends on both material characteristics and process variables such as strain, strain rate and temperature. In fact, stress and strain fields are so diverse during a forming process that no single test can reliably predict the formability of materials in all situations.

The important point to bear in mind is that they change gradually and predictably as the yield strength of the steel increase. No discontinuous drop in formability is experienced. Certain formability modes are insensitive to yield strength. Therefore, knowing the charge in formability parameters expected, compensation can be made in part design, tool design, lubricant selection and press parameters [1]. Sheet metal parts are usually made by forming in a cold condition, although many sheet metal parts are formed in a hot condition because the material when heated has a lower resistance to deformation. Strips or blanks are very often used as initial materials, and are formed on presses using appropriate tools. The shape of a part generally corresponds to the shape of tool.

Sheet metal forming process is used for both serial and mass production. Their characteristics are high productivity, highly efficient use of material, easy servicing machines, the ability to employ workers with relatively less basic skills and other advantageous economic aspects. Parts made from sheet metal have many attractive qualities: good accuracy of dimension, adequate strength, light weight and a broad range of possible dimensions.

However it is not possible to evaluate accurately the formability of the materials in terms of these parameters. The complete assessment of the formability, the direct methods, such as the Ericksen test, Swift cup test, and Fukui conical cup test have been used for determination of formability [2].

1.2 PROJECT BACKGROUND

The sheet metal is a very important thing nowadays, because of many applications use this material. Even though, there are limitation of sheet metal formability and many cases while deforming the sheet metal, the component fractures at certain point. The causes of failure are parameters related to forming process. The project is expected to find the sheet formability by using finite element method. The project is using finite element modeling of Fukui Sheet Metal Formability Test to investigate the ability of sheet metal to be shaped.

This research will overcome this problem with finite element analysis with find the elastic and plastic deformation of sheet metal with four different materials with same thickness. The aluminum, brass, steel and iron are the variables of this simulation with the constant thickness.

1.3 PROBLEM STATEMENT

In many cases, while deforming sheet metal, the causes of failure are related to forming process. This developing the Fukui finite element modeling will solve and investigates the performance of sheet metal with the simulation testing. According the

three different of sheet metal will give the different of formability each sheet metal. It solve sheet metal forming problem with identify where a forming process is predicted to fail. The Fukui sheet metal involved both deformation stretching and drawing.

1.4 THE OBJECTIVE OF THE RESEARCH

Create the working finite element model of Fukui Sheet Metal Formability Test.

1.5 SCOPES OF THE PROJECT

This modeling is focus on the elastic and plastic material model. The scopes of this project are:

(i) The material that used in this project which is divided with three materials like aluminum, brass, and steel

(ii) Design and simulate the modeling of Fukui Sheet Metal Testing

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