UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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SIMULATION OF CRASH IMPACT ON A FORMED SHEET METAL USING HYPERCRASH AND RADIOSS

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Technology Automotive (Department of Mechanical Engineering Technology) (Hons.)

by

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2015

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Simulation of Crash Impact on a Formed Sheet Metal Using Hypercrash and Radioss**

SESI PENGAJIAN: **2015/2016 Semester 1**

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I hereby, declared this report entitled "SIMULATION OF CRASH IMPACT ON A FORMED SHEET METAL USING HYPERCRASH AND RADIOSS" 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 Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (AUTOMOTIVE) (Hons.). The member of the supervisory is as follow:

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ABSTRAK

Pembentukan logam adalah salah satu proses pembuatan yang paling banyak digunakan untuk menghasilkan pelbagai produk dalam pelbagai industri. Hasil daripada pembentukan logam tersebut ia telah mendapat banyak perhatian dalam teknologi moden. Ini kerana dengan logam yang boleh dibentuk menjadi bentuk yang berguna melalui proses ubah bentuk plastik di mana isipadu dan jisim logam tersebut dipelihara dan logam disesarkan dari satu lokasi yang lain. Penarikan dalam adalah salah satu kepingan logam banyak digunakan untuk proses pembentukan dalam industri untuk pengeluaran besar-besaran komponen cawan berbentuk dalam masa yang singkat. Meningkatkan ketepatan prototaip maya membantu memendekkan masa penghasilan produk dan mengurangkan bilangan prototaip fizikal. Salah satu cara di mana ketepatan analisis pelanggaran boleh diperbaiki untuk mengenalpasti kesan dan sifat bahan tersebut. Keadah analisis pelanggaran ini adalah untuk mempercepat sifat yang terbentuk dan mengurangkan masa yang diambil untuk menjalankan analisis tersebut. Cawan sebagai model yang telah dijadikan untuk proses ini daripada membentuk simulasi pelanggaran. Sifat bahan dalam komponen DP600 keluli telah dipilih sebagai bahan untuk proses pembentukan cawan tersebut. Hasil daripada analisis tersebut, terdapat beberapa kesan seperti tegangan, pra-kerosakan dan ketebalan. RADIOSS digunakan untuk memanipulasikan proses pelanggaran ini.

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ABSTARCT

Sheet metal forming is one of the most widely used manufacturing processes for the fabrication of a wide range of products in many industries. The reason behind sheet metal forming gaining a lot of attention in modern technology is due to the case with which metal may be formed into useful shapes by plastic deformation processes in which the volume and mass of the metal are conserved and metal is displaced from one location to another. Deep drawing is one of the extensively used sheet metal forming processes in the industries to have mass production of cup shaped components in a very short time. Improving the accuracy of virtual prototypes helps to shorten product development times and reduce the number of physical prototypes required. One way in which the accuracy of crash analysis can be improved to include the effects of forming in material properties. Forming to crash method to rapidly estimate the formed properties and reduce the time taken to conduct the analysis during concept design. A cup as the model was developed for modelling the process from forming simulation to crash simulation. The material properties in a component of the steel DP600 were experimentally characterized. The influences of stress, strain and pre-damage caused by forming on the crash behavior were investigated and analyzed. A general material model which describes and damage was developed and implemented for forming and crash simulation. Finite element analysis software RADIOSS is used to simulate the process in crash simulation.

DEDICATION

I dedicate my dissertation work to my family and all my friends. An enormous gratitude to my loving mom, Maisarah Binti Mohd Noor whose words of encouragement and push for tenacity ring in my ears. My lovely father, Ab Kadar Bin Embi and sister, Najihah and Nawal Fadhlin that always support and believe in me.

I also dedicate this dissertation to my supervisor, En. Saiful Naim Bin Sulaiman that work and collaborate with me to finish this study. Not forgetting, all my course mates from BETA KOHORT 2 who have supported me throughout the process. I will always appreciate all they have done.

ACKNOWLEDGEMENT

With the name of Allah, the Most Gracious and the Most Merciful, I am most grateful to Allah the Almighty who has given me strength, determination and patience to complete the final year project report. First of all, I would like to thank my family for giving words of encouragement to me in order to pursue my studies. I would like to express my special gratitude to En. Saiful Naim Bin Sulaiman as supervisor for giving a very useful guidance to me regarding the engineering terms, equation involved, report writing guidelines and support in order to complete this report. Furthermore, I would like to thank my friends for giving me moral support in the completion of this report. Lastly, I would like to express my gratitude to University Malaysia Melaka (UTeM) for giving me chance to complete this report as one of the task to accomplish my degree in Bachelor of Mechanical Engineering

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LIST OF ABBREVIATIONS

FEA	-	Finite Element Analysis
3D	-	3 Dimension
FE	-	Finite Element
FEM	-	Finite Element Method
CAD	-	Computer Aided Design

CHAPTER I

INTRODUCTION

1.1   OVERVIEW

Forming is a broad term covering many different manufacturing processes. In general, forming process is a particular manufacturing process which make use of suitable method such as compression, tension and shear or combined stresses to cause plastic deformation of the material to produce required shapes. There are many types of forming processes like forging, extrusion, rolling, sheet metal working, electromagnetic forming, etc. In the manufacturing, almost all shape are made by a forming process. Some examples include aluminum or steel frame of doors and windows, coins, springs, elevator doors, cables and wires and almost all sheet-metal. In metal forming simulation, the forming of sheet metal is simulated on the computer with the help of special software. Simulation makes it possible to predict errors and problems, such as wrinkles or splits in parts, on the computer at an early stage in forming. It also can save the cost and in this way, it is not necessary to produce real tools to run actual tests. Forming simulation has become established in the automotive industry since it is used to develop and optimize every sheet metal part. To illustrate a good metal forming process, there must be a good simulation model of the real process.

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1.2   PROBLEM STATEMENT

Sheet metal parts are used to construct most of the body parts of the car such as the front bumper and door. These part are responsible to protect the safety of driver and passengers during accident. In such situation, those parts are subjected to crash due to collision and hence prevent the passenger from any injuries. Because of that, design of that parts are very critical. To create a good design of formed sheet metal parts, it is important to understand the behavior of parts during crash event. Simulation method is a good approach as it saves the cost of fabricating prototypes.

In this study, simulation will be used to describe the effects of forming simulation result on crash and the impact of the method of transferring one simulation to the next. Simulation project involve forming simulation to calculate the internal stress and strain from forming process. This data will be used later in the crash simulation of that parts. It aims to study the parameters affecting the internal stress/strain and what effect it has on the crash impact.

Before this, the process of forming just be done without using in crash simulation because it trust the properties of the material and the thickness that being used. Now days, in crash simulation can helps improve the accuracy of virtual prototypes to shorten product development times and reduces the number of physical prototypes required. One way in which the accuracy of crash analysis can be improved is to include the effect of forming in the material properties.

1.3 OBJECTIVE

Based on the problem statement, the objective have be drawn:

i. To simulate the sheet metal forming using HyperForm.
ii. To study the effect of sheet metal thickness towards stress in forming simulation.
iii. To study the effect of formed cup with different thickness towards crash behavior in crash simulation.
iv. To study Hyperwork capability in crash simulation and evaluate.

1.4 SCOPE OF STUDY

The study will be based on involve simulation without experiments and gets the same results with different ways. The subject of this project, to form a cup from sheet metal using deep drawing process. In the forming process, it gives some effect like strain and stress and the effect of that will applied in the crash simulation. Model in the crash simulation it will used the Radioss software.

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CHAPTER II
LITERATURE RIVIEW

2.1 INTRODUCTION OF SHEET METAL FORMING

Sheet metal is one of the most important semi-finished products used in the steel industry, and sheet metal forming technology is therefore an important engineering discipline within the area of mechanical engineering. Sheet metal is characterized by high ratio of surface to thickness. Sheet metal forming is basically conversion of flat sheet metal into a product of desired shape without defect like fracture or excessive localized thinning (Gardeen and Daudi, 1983).

The products made by sheet metal forming processes include a large variety of shapes and sizes, ranging from simple bends to double curvatures with shallow or deep recesses. Typical examples are metal desks, appliance bodies, aircraft panels, beverage cans, auto bodies, and kitchen utensils. In many cases while deforming the sheet metal, the component fractures at certain point. The causes of failure are parameters related to forming process. The sheet metal is available as flat pieces. The sheet metals are formed by running continuous sheet of metal through a roll slitter. The sheet metal thickness is called gauge and the

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gauge of sheet metal ranges from 30 gauges to 8 gauges. The thinner the metal is, the higher of gauge.

There are many application that use sheet metal like car bodies, airplane wings, roofs, lab table and many more. In automobiles the sheet metal is deformed into the desired and brought into the required form to get car part body pressings like bonnet, bumpers, doors, etc. In aircraft's sheet metal is used for making the entire fuselage wings and body. In domestic applications sheet metal is used for making many parts like washing machine body and covers, iron tops, timepiece cases, fan blades, cooking utensils and etc.
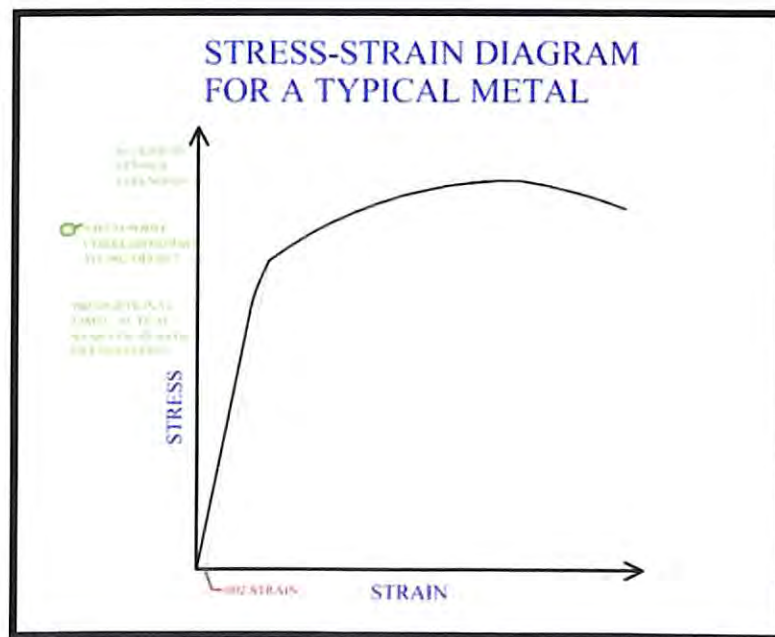

Figure 2.1: Stress-strain diagram for a typical metal (Daudi, 1983)

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It can be seen by the stress-strain graph that once the yield point of the metal is reached and it is deforming plastically, higher level of stress are needed to continue its deformation. The metal actually get stronger, the more it is deformed plastically. This is called strain hardening or work hardening. As may be expected, strain hardening is very important factor in metal forming process. Strain hardening is often a problem that must be overcome, but many times strain hardening when used correctly, is a vital part of the manufacturing process in the production of stronger parts.

2.2 DIFFERENT TYPES OF METAL FORMING PROCESSES

Metal forming processes can be classified under two major groups, bulk deformation and sheet metal working. Bulk deformation processes and sheet metal processes. Bulk deformation is characteristic in that the work formed has low surface area to volume ratio. In sheet metal working, the metal being processed will have a high surface area to volume.

2.2.1 Types of bulk deformation

Rolling

Rolling is a metal forming that deforms the work by the use of rolls. The process include flat rolling, shape rolling, ring rolling, gear rolling and the production of seamless tube and pipe by rotary tube piercing or roll piercing.

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Forging

Forging is the process where heated metal is beaten with a heavy hammer to give it required shape. However, forging is used to make many more complex shapes and to let the metal form into a shapes. The hammer and the supporting pieces are cut into the reverse of the required shape or in other words, they form the forging dies.

2.2.2 Types of sheet metal working

Bending

Bending is the plastic deformation of the work over an axis, creating a change in the part's geometry. Similar to other metal forming processes, bending changes the shape of the work piece, while the volume of material will remain the same.

Deep drawing

Deep drawing is a metal forming process in which a flat piece of plate or sheet is forced into a die cavity to form a shape such as a cup.

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2.3   DEEP DRAWING BACKGROUND

Deep drawing is a manufacturing process that used extensively in the forming of sheet metal into cup or box like structures. Pots and pans for cooking, containers, sinks, automobile parts are among a few of the items manufactured by sheet metal deep drawing. This process is called drawing and is not to be confused with the bulk deformation process. A basic deep drawing operation could be the forming of a flat sheet into a three dimensional cup or box. The shape of deep drawn part is not limited to a circle or square, more complex contours are possible. For the primary sheet metal deep drawing process the part will have a flat base and straight sides.

2.3.1   The process of deep drawing

Deep drawing is a manufacturing process of forming sheet metal stock, called blanks, into geometrical or irregular shapes that are more than half their diameters in depth. Deep drawing involves stretching the metal blank around a plug and then moving it into a molding cutter called a die. Common shapes of deep drawn products including cylinders for Aluminum cans and cups for baking pans. Irregular items, such as enclosure covers for truck oil filters and fire extinguishers, are also commonly manufactured by the deep drawing method. The drawing of sheet metal or commonly known as deep drawing is a process which a punch is used to force a sheet metal to flow between the surfaces of a punch a die.

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