SIMULATION OF METAL STAMPING FOR PANEL FRONT DOOR INNER PART FOR NEW AUTOMOTIVE MODEL DEVELOPMENT

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“Dedication”

To my beloved mother and father
Azizah Ahmad
Mesuan Rasid

My beloved wife and childrens
Sit Mariaton Abd Moksin
Nurin Batrisyia
Muhammad Safir Haziq
Muhammad Wafiq

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ABSTRACT

The development of metal stamping part in the automotive industry is become more challenging due to the need of all car makers to reduce the development lead time for new model as well as to reduce the body car weight in order to reduce the fuel consumption. In order to reduce the lead time, forming simulation software is used whereas Tailored Welded Blank (TWB) material is used to reduce the weight, part quantity and overall manufacturing cost. In this study the panel front door inner part is selected by reason of its potential of using TWB material. Foming simulation software is used due to its ability to analyze and to predict the quality of stamping part after the stamping process is done. The software used are CATIA and AUTOFORM. CATIA software is used to create detail radius and also the shape of the study part while AUTOFORM software is used to analyze and to predict the result of panel quality so that if there is any problem occur it can be solve at the early stage. Analysis is then done on the formability, thinning condition and surface quality such as crack and wrinkle to determine the problem at the early stage of new model development. In this part study to counter the crack problem, the dies face and draw bead shape are modified while the crack problem at the inner area is solved by introducing the 'lance cut' at15mm from die close condition. The cost merit of using TWB material for panel front door inner is proven.

ABSTRAK

Pembangunan produk logam tekanan di dalam industri otomotif menjadi semakin mencabar dikalangan pengeluar kereta dari segi keperluan mengurangkan masa pembangunan untuk model baru selain untuk mengurangkan berat badan kereta dan seterusnya dapat mengurangkan penggunaan bahan api. Sehubungan dengan itu perisian simulasi telah dibangunkan dan digunakan untuk mengurangkan masa pembangunan manakala bahan 'Tailored welded blank (TWB)' pula digunakan untuk mengurangkan berat badan kereta, jumlah produk logam dan kos pengeluaran secara keseluruhannya. Di dalam kajian ini produk yang dipilih adalah bahagian dalam pintu hadapan kereta kerana ia berpotensi untuk menggunakan bahan TWB. Perisian simulasi pembentukan digunakan kerana ia berupaya untuk menganalisa dan menjangkakan kualiti produk logam tekanan selepas proses tekanan. Perisian yang digunakan adalah CATIA dan AUTOFORM. CATIA adalah perisian yang digunakan untuk membuat jejari produk secara terperinci dan bentuk produk yang akan dikaji. AUTOFORM pula adalah perisian yang digunakan untuk menganalisa masalah dan menjangkakan masalah kualiti produk dan seterusnya penyelesaian masalah boleh dilakukan pada peringkat awal pembangunan. Kebolehan pembentukan, keadaan kenipisan bahan dan kualiti produk seperti pecah dan berkedut dikaji untuk menentukan punca masalah pada peringkat awal pembangunan model baru kereta. Masalah kepecahan di bahagian dalam hadapan pintu kereta diatasi dengan mengubah bentuk permukaan acuan dan bentuk 'draw bead'. Kepecahan di bahagian dalam bahagian yang dikaji pula dilakukan dengan melakukan 'lance cut' pada kedudukan 15mm dari bahagian bawah acuan.Penggunaan bahan TWB di bahagian dalam pintu hadapan telah terbukti dapat menjimatkan kos pengeluaran sesebuah kereta.

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LIST OF ABBREVIATIONS AND SYMBOLS

CO_2	-	Carbon dioxide
Dep	-	Depreciation
FC	-	Financial Charge
FLC	-	Forming Limit Curve
FLD	-	Forming Limit Diagram
FO	-	Fixed Overhead
Min	-	Minute
MPa	-	Mega Pascal
Nd:YAG	-	Neodymium-doped Yttrium Aluminium Garnet
n value	-	Exponent Hardening
r value	-	Lankford Coefficient
RM	-	Ringgit Malaysia
R	-	Reject
VO	-	Variable Overhead
W	-	Warranty

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CHAPTER 1

INTRODUCTION

1.1 Background

In the automotive industry, the sheet metal forming process has been widely applied for making car body components especially in metal part components such as door panel, under body structure, side body panel and upper body structure. In traditional manufacturing processes, design, selection of material, determination of dimension and shape of the blank material and stamping process planning will be determine with several tryout processes. This “trial and error” process result having a lot of resources consumption, high production cost and will effect long development cycle. The foundation of a finite element software simulation analysis system of sheet metal forming fulfills the “trial and error” processes with the computer. The use of forming simulation method can be lead the cost saving in prototype tool construction and die tryout stages and then this simulation can significantly reduce the overall development time and increase product quality.

Severe competition in the automotive industry forces the car makers to come up with the innovative solution to reduce manufacturing cost, improving product performance and to reduce total vehicle weight. One of the strategies is to reduce metal body part with introduction of the tailored welded blank material (TWB) for the certain metal body part. The development of TWB material can offer a unique opportunity to meet all these goals simultaneously.

"The advantages of using TWB material in automotives industry is the reduction of product weight and this hence fuel consumption is lowered (Narayanan and Narasimhan, 2008)."

1.2 Problem Statement

Based on the literature review of the past research on metal stamping simulation and tailored welded blank, the following item can be concluded:

i. Lack of the result regarding forming simulation of TWB material that can be used as a basis for the next new model development.

ii. Cost comparison study in manufacturing process and raw material between conventional material type or method and tailored welded blank material is not available.

iii. The traditional way in the new car model development required a long period of period of trial and error during tryout stage. Therefore with using computer simulation that activity can be reduced and countermeasure of problem during trial stage can be determined during this forming simulation stage.

1.3 Objective of The Study

The objectives of this research are stated below:

i. To conduct sheet metal forming simulation study on an automotive part for a new car development.

ii. To provide feedback and solution or countermeasure at the early stage of new model development.

iii. To identify the cost saving using Tailor Welded Blank (TWB) material compared with conventional material type or method for the identified part.

1.4 Scope of The Study

This study has been conducted based on the following scopes:

i. The sheet metal stamping simulation will be conducted using the AUTOFORM software.

ii. The part chosen for this case study is the Panel Front Door Inner, which is potentially suitable for TWB application.

iii. The study was limited to formability, thinning condition and panel quality such as crack and wrinkle.

iv. The study on cost comparison between TWB material and normal material for Panel front Door inner and surrounding part related, the cost related directly to the stamping operation will be considered.

1.5 Thesis Organization

This thesis is divided into the six chapters. The chapter one is provided overview of the studied. The chapter two was summarize of the literature review of the tailored welded blank, forming simulation and related topic that guided the study towards achieving the thesis objective. The chapter three was research methodology for this forming simulation. All the simulation result data and cost analysis will be presented in the chapter four. In the chapter five discussions on the result of forming simulation and cost comparison will be discussed. The conclusion of the study and the recommendation for future work will be given in the chapter six.