DESIGN AND ANALYSIS OF OPTIMUM CLEARANCE OF AN OPEN SMALL THIMBLE BENDING DIE

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This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Design)

By

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **DESIGN AND ANALYSIS OF OPTIMUM CLEARANCE OF AN OPEN SMALL THIMBLE BENDING DIE**

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DECLARATION

I hereby, declared this report entitled "Design and Analysis of Optimum Clearance of an Open Small Thimble Bending Die" is the results of my own project except as cited in references.

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Date :

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfilment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Design). The member of the supervisory committee is as follow:

……

Principal Supervisor

ABSTRACT

This final year project entitled, "Design and Analysis of Optimum Clearance of an Open Small Thimble Bending Die". The project focused on the design of bending die and to determine the optimum clearance of bending die whether it is able to reduce defect in producing a thimble open small. The bending die was designed by using SolidWorks. The material used for the Open Small Thimble is mild steel flat of 2mm and tool steel for the die. By using Explicit Dynamic Analysis from ANSYS software, the result of the Finite Element Analysis of the new design of bending die will be obtained. The analysis decides the optimum clearance in relation to velocity of upper die in order to have good bending finish with longer life span of die. From the analysis, 0.2 mm is the optimum clearance of the bending die. The clearance 0.2 mm is chosen because its meet all criteria needed in bending process to produce thimble open small. The criteria obtained for the 0.2 mm clearance are the value of total deformation is 79.37mm, shortest time taken to bend the mild steel plate is 2.95×10^{-4}s and there is no tear defect occurred based on the total deformation, shear stress, equivalent elastic strain and equivalent stress. As a result, the new design of bending die presents the shortest process of bending in producing the thimble open small with better productivity, lower cycle time, less manpower and lowest cost compared to existing design with the similar.

DEDICATION

Very thankful to Allah and special thanks to my beloved mother, Hasnah binti Abdulla, my beloved supervisor, Baharudin bin Abu Bakar, my family and friends.

ACKNOWLEDGEMENT

First of all, thanks to my bachelor degree final year project supervisor, Engr. Baharudin Bin Abu Bakar for his guide, help and support towards this project. With his advice, this project can be done according to the plan.

Special thanks to my family for their moral support and some advice and financial support. Thanks also to my academic staff in Universiti Teknikal Malaysia Melaka (UTeM) for teaching me a lot, so that I can finish this project. Thanks also to my friend that share the knowledge and idea to finish this project.

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A	-	Area
AISI	-	American Iron and Steel Institute
ASTM	-	American Society Testing and Material
CAD/CAM	-	Computer-aided design and computer-aided manufacturing
CATIA	-	Computer Aided Three-dimensional Interactive Application
CNC	-	Computer numerical control
DOD STD	-	Department of Defense Standard
DXF	-	Drawing eXchange Format.
EDM	-	Electrical discharge machining
F	-	Force
FEA	-	Finite Element Analysis
FEM	-	Finite element method
IGES	-	Initial Graphics Exchange Specification
in	-	Inches
mm	-	Millimetre
OSHA	-	Occupational Safety and Health Administration
Pa	-	Pascal
Psi	-	Pounds per square inch
PSM	-	Project Sarjan Muda
T	-	Metal Thickness
3D	-	Third Dimensional
%	-	Percent

CHAPTER 1
INTRODUCTION

In this introductory chapter, it contains a brief explanation about this project and the background of the project title, "Design and analysis of optimum clearance of an open small thimble bending die". Basically, this chapter discusses about the introduction of the background, problem statement, objective and scope.

1.1 Introduction

Bending is a metal forming process, it requires force to change the sheet metal to forming an angled or sheet profile. For the bending operation cause deformation along axis. Bending dies is to classify according to their design. To perform single bending operation, die are designed which may include L, V, U or Z bend or other profile. (Boljanovic, 2004)

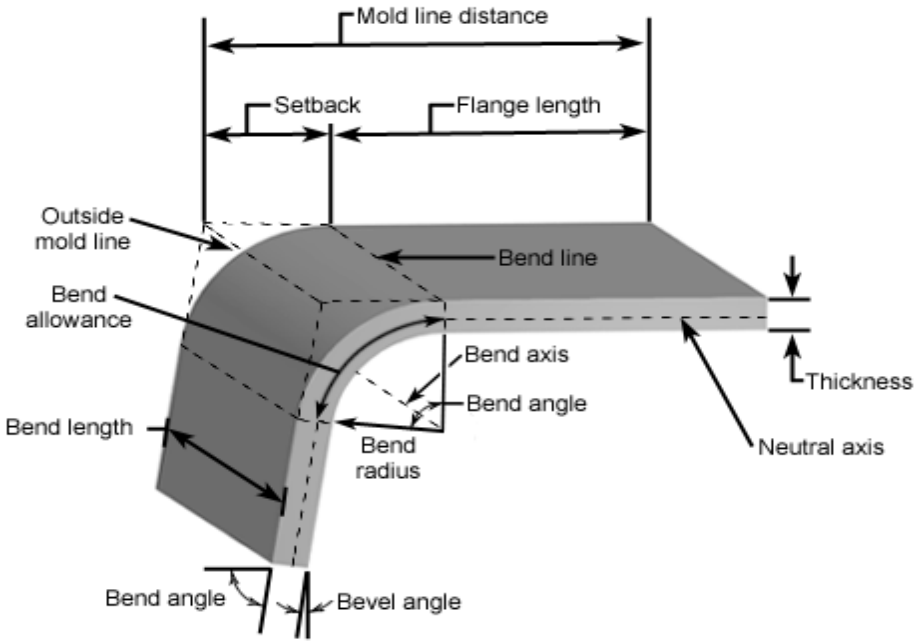

Figure 1.1: Sheet metal bending profile

(CustomPartNet, 2009)

Bending die has been designed to bend the workpiece known as a flat sheet plate of mild steel. Basically, the thickness and width of the workpiece being used by the company are 2mm and 8 mm in thickness and width. The workpiece that commonly been used in the bending die to be done the bending die process where the plate of the workpiece will be drawn to a certain diameter and height trough a bending die. After redesign the bending die, will be analyzed to get the optimum clearance by using a simulation study on FEA by using the plate workpiece. Therefore, the simulation is very significant in a bending die design process. Simulation enables to analyze the design in factor of quality, performance, characteristics and properties of the bending die before development process. In simulation, finite element method, FEM is used for investigation the precision of bending die process. The ANSYS software with actual specification from the industry for an open small thimble will be used to analyze the optimum clearance that will be applied in bending die to get the best surface finish. Apart from that, from the analysis results, the major defect of the burring and tearing can be reduced to produce an open small thimble.