

DESIGN AND MODEL MAKING OF BENDING DIE

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APPROVAL

This PSM submitted to the senate of UTeM and has been as partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Design Manufacturing). The members of the supervisory committee are as follow:

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ABSTRACT

This project is to design and model making a bending die from polystyrene. The project is carried out to produce a bending die through a step from manual sketching, design consideration analysis, CATIA drawing, CNC code generate in manual by using CNC simulator and automatically through CATIA machining software, and at the final stage of CNC machining to produced the middle part (major part) of bending die using polystyrene density of 20kgm^3 . The process flow of the project start from generate idea of basic design of bending die, followed by sketching, model making, and final stage is to do CNC machining to get the dies model. This paper consists of criteria investigation about the characteristics of final product of bending die that occurred after bending process where later the bending cast will be analyzed based on the diagram of the output product, and also the main component of bending die. CNC program will be generate when the real shape of base bending die are drawn on the software of CATIA. Using CNC 3 axis machine programmed with help CAD/CAM software package, the part machined to get the final product of this project.

DEDICATION

For My Mum and Dad with lots of love.

ACKNOWLEDGEMENT

Dear mummy and daddy at Ranau Sabah, thanks for your prayer, emotion, and financial support. Not to forget my long distance sister, Frances. Far away doesn't means we are separate. Straight in our heart, we are always together. Thanks for strengthen me each time I'm feeling down. I would like to thanks all that supported me from everywhere. God richly bless you all.

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LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

A	-	Part under consideration
CNC	-	Computer Numerical Control
CAD/CAM	-	Computer Aided Design and Computer Aided Manufacturing
CATIA	-	Integrated System
E	-	Elastic modulus
I	-	Polar moment of inertia, moment of inertia, geometry factor
k	-	Constant.
L	-	Length of the bend
L_b	-	Bend allowance,
M	-	Internal bending moment
NC	-	Numerical Control
NCS	-	Numerical Control Sculpture
OBO	-	Outcome Based Objectives
P	-	Maximum bending force
R	-	Bend radius
R1	-	Radius of curvature of bend
R2	-	Radius of curvature of a product
T	-	Thickness of the sheet
UTeM	-	Universiti Teknikal Malaysia Melaka
UTS	-	Ultimate Tensile Strength of the Material
W	-	Size of die opening
Y	-	Yield stress
y	-	Distance from the neutral axis, Lewis form factor
α	-	Bend angle (in radians)
σ	-	Normal stress, standard deviation,
θ_1	-	Bending angle of a bend
θ_2	-	Bending angle of a product

CHAPTER 1

INTRODUCTION

1.1 Background

There are so many types of fancy shape of bending product in the market nowadays all around the world. But for real, the “many types and are so lot in quantity” of bending product was actually and mostly have been produced by using only a little quantity of bending die. For beginner in this type of advanced technology, need to know that even for simple product, production of bending die is still as complicated as molecule structure of water. In the past few years, only certain bending die was exists in the catalogue of fabrication tool of manufacturers. But these days, more than 10 or even hundreds fancy die with the name bending in front of it, have so much with its various shape, consists differ material and for sure with so much variety in its application. This situation comes consistent with the daily improvement from all the fabrication tool in the manufacturing industry as the machines technology always comes forward very fast and all the machining process has to be done in time with absolutely high quality in its product.

At first, bending shape is having a sharp corner, failure during performance just after several months in use and so on. But now, studying of spring back and corner radius, smooth circular shape and complicated but simple design can be the most criteria of latest design. In this case, a whole lot more can be seen especially when it is related with manufacturing of fabrication tool in globally. Each and every fabricate tool that has been developed must has its specific applications. As it always correlated with the shape of material that has to bend out, type of the material, cutting conditions, cutting parameters and bending process itself, as usual are divide into two processes,

pressing and bending. When a tool change is needed or anticipated, a performance comparison should be made before selecting the right tool for the job and in this case the phrase “the most expensive tool is always the best tool” should be considered more. The best tool is the one that has been carefully chosen to get the job done quickly, efficiently and economically.

1.2 Problem Statement

The typical problem faced by most bending die in the world is the appearance of feed back and neither feed go upon work piece which occur after bending process. For research on minimizing the error upon product, study for this problem have been done for finding the way on how to fix the problem. To produce bending die required lot in cost. Instead of that, more economic tool of bending die component is better to produce much cheaper product to cover the tool production cost. Sample product for this project of designing and model making of bending die are rack holder.

In reason of redesign of unlock boot component, it is ideal to study about the comfortable of user during opening their boot engine. Take in mind was during pressing up; easily slip hand if their hand a little bit oily will be a reason of anger.

Ideas occur to redesign main component of the boot unlock component to turn it into a stylish, futuristic and compact dimension. From the flat shape which less interest for the nowadays new generation; redesign will be done for creating its dimension to more ergonomic shape which a curve designed at the side where we called handle during pressing the component up. It still having a high quality in strength and which size could be decreased in size while maintaining the quality for cost saving.

As getting inspirational from this kind of situations, this paper are consists research of this spring back and spring go. In bending deformation, the spring back increases through augmentation of the clearance between punch and work piece. The sheet metal forming industry has become one of the major manufacturing centres for the

automobile, aerospace, and electrical industries. The popularity of sheet metal products is attributable to their light weight, great interchange ability, good surface finish, and low cost. In addition, compared with cast or forged products, intricate parts can be formed using sheet metal. At the end of this study, outcome will be the bending die tool. So in the mean time includes the investigation of wear characteristics on cutting tool that emerge on a high technology and NC type machine.

1.3 Objectives of the Project

The main objectives of this research are to investigate the feed back element on bending die performance, which at final stage; we can design a bending die with attractable shape for rack holder and manufactured it. The outcome of the study will be:

- ℵ Design a bending die for a press part in part of unlock boot component.
 - Here, we will study about the characteristic and component inside the bending die itself and to find way to eliminate the quantity of part component to be used together with this tool. Also we can study the way to simplify the rapid movement that unnecessary to minimize wear of tool.

- ℵ Make a poly model of the bending die for boot component.
 - Poly model are necessary to built for it could be the reference for final stage of the project which we need to sketch the shape first, then draw it with technology of CATIA.

- ℵ To make a CNC program for bending die
 - From reference of poly model and CATIA drawing, G code for milling machining of the bending die will be develop and are test using CNC Simulator.

§ To machining a poly model using CNC machine

- This machining experimentation is carried out using a CNC Milling machine or its original name is Numerical Control Sculpture (NCS) machine. Moreover, this machine runs based on NC program, have the ability to cuts various shapes on a material and can runs in a longer period of time. The NC programmer is developed based on design of the material shape that are adapt from a CAD/CAM, CATIA software.

1.4 Scope and Key Assumptions

Scope of assumption for this project is Proton Saga users which in prediction are finding difficulty of comfort while facing engine problem. The demographic data as well as the gender of the participants in this study are neglected. Therefore, the historical background, hometown cultural and previous experiences of each participant are not taken into account in this study.

Thus, the result analyzed is only applicable to those particular Proton Saga users as internal reference only. As time passes by, the expectations or preferences of the customers will change and consequently the result analyzed before is not appropriate enough. The study needs to be carried out regularly to update and follow the market changing trend.

1.5 Importance of the Project

This project can generate an improvement to the component design for automobile which develop drastically in Malaysia but for nationwide, helping others to think out of the box for designing and develop such simpler and less cost but are applicable bending die for fabrication manufacturing. Study of spring back and spring go will also useful in solving problem in selecting material for such particular component.

1.6 Definition of terms

Die operations are often named after the specific type of die that performs the operation. For example a bending operation is performed by a bending die. Operations are not limited to one specific die as some dies may incorporate multiple operation types.



Figure 1.1: Press with bending die

Bending: The bending operation is the act of bending blanks at a predetermined angle. An example would be an "L" bracket which is a straight piece of metal bent at a 90° angle. The difference between a forming operation and a bending operation is the bending operation creates a straight line bend (such as a corner in a box) as where a form operation may create a curved bend (such as the bottom of a soda can).

1.7 Summary

The technology and design of bending die for bend part in Malaysia conquer by the designer from Japan which less Malaysian are involve in producing this tool. For the reason, study of die design are distributed nowadays in Malaysia to swot up the case and technique of design and manufacturer for future use, and for main reason are to break the Japanese majority in advanced design. The objectives of this thesis are to:

1. Design a bending die for a press part in part of unlock boot component.
2. Make a poly model of the bending die for boot component.
3. To make a CNC program for bending die
4. To machining a poly model using CNC machine

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Bending is the most common forming operation. We simply have to look at the components in an automobile or an appliance such paper clip or file cabinet to appreciate how many parts is shaped by bending. Bending is used not only to form flanges, seams and corrugations but also to impart stiffness to the part (by increasing its moment of inertia).¹

Bend allowance is the length of the neutral axis in the bend and is used to determine the blank length for a bent part. However, the position of the neutral axis depends on the radius and angle of bend. An approximate formula for the bend allowance, L_b , is given by

$$L_b = \alpha(R + kT)$$

Where α is the bend angle (in radians), T is the sheet thickness, R is the bend radius, and k is a constant. Note that for the ideal case, the neutral axis is at the center of the sheet thickness, $k = 0.5$, and hence,

$$L_b = \alpha[R + T/2]$$

Usually k values range from 0.33 (for $R < 2T$) to 0.5 (for $R > 2T$)

¹ In bending, the outer fibers of the material are in tension, while the inner fibers are compression. Because of the Poisson's ratio, the width of the part (bend length, L) in the outer reagent is smaller, and in the inner region it is larger than the original width. This phenomenon may easily be observed by bending a rectangular rubber eraser.