DESIGN AND ANALYSIS OF DEEP DRAWING DIE FOR BRASS SOCKET BY USING FINITE ELEMENT ANALYSIS

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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

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SESI PENGAJIAN: 2011/12 Semester 2

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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:

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ABSTRAK

Disebabkan oleh kesukaran hubungan-hubungan daya yang berkuasa tinggi, perubahan bentuk bahan dan kecacatan benda kerja telah berpunca daripada beberapa kombinasi faktor. Dalam penyelidikan ini, kaedah paling biasa telah digunakan dalam mengkaji perubahan bentuk bahan, kecacatan benda kerja dan daya lekapan dengan menggunakan kaedah unsur terhingga. Menggunakan kuasa penumbuk yang tidak mencukupi melalui proses lukisan mendalam telah menyebabkan bahan kerja berkedut dan atau terkoyak, tetapi sekiranya kuasa penumbuk terlalu tinggi juga menyebabkan kecacatan bahan kerja. Matlamat penyelidikan ini ialah untuk merekabentuk satu set lukisan mendalam serta menganalisa sama ada proses lukisan mendalam dapat mengurangkan kecacatan bahan kerja atau tidak dalam menghasilkan satu soket loyang. Dengan menggunakan Analisis Dinamik yang eksplisit daripada perisian ANSYS, hasil Analisa Unsur Terhingga (FEA) untuk reka bentuk baru bagi set lukisan mendalam akan diperolehi. Hasil daripada analisa tersebut, daya penumbuk maksimum dalam proses lukisan mendalam telah dapat diketahui dan ianya mampu mengurangkan proses lukisan mendalam untuk menghasilkan soket loyang. Dalam erti kata lain, rekabentuk baru set lukisan mendalam dapat mengurangkan proses lukisan mendalam dalam menghasilkan soket loyang dengan produktiviti tertinggi, kitaran masa terkecil, tenaga kerja yang kurang dan kos yang paling rendah berbanding menggunakan rekabentuk lukisan mendalam yang sedia ada dengan nilai daya penumbuk yang sama.

ABSTRACT

The difficulty of force relations, workpiece deformation can be caused by a combination of factors. The most common method has been used in analyzing workpiece deformation and fixturing forces by using finite element analysis. Using insufficient punch force gave rise to wrinkled and or torn of the workpiece during the deep drawing process and application of too much punch force also would result unnecessary defects and high contact deformation to the workpiece. The aims of this research were to design a deep drawing die and determine whether a deep drawing process is able to reduce or not in producing a brass socket. By using Explicit Dynamic Analysis from ANSYS software, the result of the Finite Element Analysis for new design of deep drawing die will be obtained. From the result, the maximum punch force of deep drawing die was known and able to reduce the deep drawing process to produce the brass socket. As a result, the new design of deep drawing die presents the shortest process of deep drawing in producing the brass socket with highest productivity, smallest cycle time, less manpower and lowest cost compared to existing design with the same value of punch force.

DEDICATION

For My Father, Hashim Bin Yunus & all my family especially my youngest brother, Mohd Hafizudin Bin Hashim who is always beside me either in a difficult situation or in easy situations. He will very happy if he knows his name is in this report.

ACKNOWLEDGEMENTS

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TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

JBSB	-	Jati Beringin Sdn.Bhd.
TNB	-	Tenaga Nasional Berhad
TMB	-	Telekom Malaysia Berhad
FEA	-	Finite Element Analysis
DIN	-	Deutsches Institut fur Normung, German Institute for Standardization
CES	-	Canbridge Education Selector
3D	-	Third Dimensional
AISI	-	American Iron and Steel Institute
UTS	-	Ultimate Tensile Strength

CHAPTER 1
INTRODUCTION

This first chapter will discuss about the introduction of the deep drawing die for producing the brass socket of TNB's pole with different height at Jati Beringin Sdn. Bhd. (JBSB). In this part, the briefing of the background, problem statement, objectives, scope, and structure of the research are discussed.

1.1 Backgrounds

1.1.1 Company

Jati Beringin Sdn. Bhd. (JBSB) was incorporated on 2 September 1997 and operated at Pantai Belimbing, Krubong and Teluk Mas, Melaka. Established by Mr. Asmadi Bin Wahid and his brother Mr. Daud Bin Wahid whose highly experiences in the engineering field. Owned a factory on the 0.5 acres of land in Pantai Belimbing, the 2.5 acres of land in Krubong, and 1 lot of SME Bank in Teluk Mas which they are equipped with a lot of modern machinery and equipment to ensure the smooth operation in order to produce the high standard and quality product. Major in metal fabrication, this company has become a vendor for Tenaga Nasional Berhad (TNB) and Telekom Malaysia Berhad (TMB) to supply pole accessories. Other than that JBSB also involved in furniture manufacturing like to supply steel, lab furniture, office, built-in furniture, interior renovation, custom made steel product for private and government sectors (door, grill, drain cover, etc.), and custom made steel work such as turning, milling, grinding and welding. Today, with all the dynamic, progressive, high education and experience JBSB has become a very competitive and

strong company. Until September 2011, JBSB already has a paid up capital of RM1.5 millions.

1.1.2 Deep Drawing Die

Deep drawing dies in Jati Beringin Sdn. Bhd. (JBSB) is used to produce the brass socket of TNB's pole with different height that is 7.5meters (m), 9.0m and 10.0m. Actually, deep drawing die has used two different types of concept in producing the brass socket that is drawn from the plate into the cup and drawn from the cup into the cup. The deep drawing concepts used in producing brass socket are shown in figure 1.1.

Drawn from plate into cup

Drawn from the cup into the cup

Figure 1.1: Deep drawing concept

(Source: Jawad, 2008)

1.2 Problem Statement

Deep drawing is one of the most important processes for forming sheet metal parts. It is widely used for mass production of hollow shapes in the packaging industry, automotive industry, etc. Deep drawing is a tensile-compressive forming of a sheet blank (or, depending on the material, also of foils or plates) to a hollow body open on one side or the forming of a pre-drawn hollow shape into another with a smaller cross-section without an intentional change in the sheet thickness.

Previously, the deep drawing concepts for producing the brass socket have been mentioned in section 1.1.2 that is drawn from the plate into the cup and drawn from the cup into cup such as drawn from the cup with 20mm diameter into the cup with 19mm diameter. Actually, to produce the brass socket need eight steps in detailed. Step one has used the concept one that is drawn from the plate into cup. Step two until six has used the concept to that is drawn from the cup into the cup. Step seven is removed the wrinkling and tearing that occurred. The last step is making the thread on the brass socket before it's ready to pack.

The major problem for this research is related to the processes itself in producing the brass socket. This means that, if the processes take a long time to complete, the productivity is low and the cycle time is increased. Because of that, it requires more than five stamping machines and manpower to run each of the machines. The company wants to reduce the usage of stamping machines in producing the brass socket. That's why, this research is necessitate to overcome the difficulty.

Besides that, the whole processes involve seven sets of deep drawing die per unit production to produce the brass socket. This serious problem has to overcome because the average cost of purchasing one set of deep drawing die is about RM5, 000 and above. Each of seven process need at least two deep drawing die set for every five years. Another one set is used as an encouragement for deep drawing die set if any problem occurred while making the whole processes.

1.3 Objectives

The objectives of this research are:

(a) Investigate the design parameters of deep drawing dies.
(b) Analyze the deep drawing dies using Finite Element Analysis (FEA).
(c) Propose new design of deep drawing dies.

1.4 Scope

Few necessary elements must be considered to guarantee the objectives of this research achieved. Besides that, the deep drawing die is analyzed by using Finite Element Analysis (FEA) and also studied and do research about the process of a brass socket making to identify which process can be reduced. The scopes of this research are as follows:

(a) Investigate the deep drawing process base on literature study from many sources.
(b) Analyze the existing process of making brass socket and identify which process can be reduced for new deep drawing die.
(c) Analyze the new deep drawing die designs by using Finite Element Analysis (FEA) from ANSYS software with actual specification from the industry of a brass socket making.

1.5 Structure of the Research

Chapter 1 covers the introduction of the research with looking at problem statement, objective and scope of the research. The methodology of this research also clarifies momentarily from PSM I in semester 1 until PSM II in semester 2. Besides that, the significance of the research structure and finding also discussed properly in this chapter.

Chapter 2 consists of literature review which covering the basic principal of Finite Element Analysis (FEA) and also the parameters of designing a deep drawing die. Besides that, the deep drawing process in producing the brass socket also explains in detailed in this chapter. Thus, the deep drawing die is made from a variety of materials and the importance of material influencing the performance of the deep drawing die will be covered in this chapter. Also covered in this chapter is the several related research journals that used to summaries about the overall work related to the deep drawing die.

Chapter 3 contains a methodology of the research which is explained the flow of the whole research had been done. Planning is a part of project management, which relates to the use of schedules such as Gantt charts to plan and subsequently report the progress of the research. In this chapter, all progress has been divided into five basic phases which is consist of Planning, Concept Development, Details design, Analysis and refinement, Report submission and presentation.

Chapter 4 covers the procedure of the analysis by using ANSYS Workbench 12.0. In this chapter, the detail procedure will be reported as the most common method used in analyzing the brass deformation and fixturing forces by using Finite Element Analysis (FEA). Based on this analysis, the deep drawing defect for brass socket also can be found and reduce simultaneously. Besides that, the step to interpreting the result from the software also will be covered in this chapter.

Chapter 5 continues the discussion on the result that obtained from the simulation. By using Explicit Dynamic Analysis by using ANSYS software, the result of the Finite Element Analysis (FEA) for the new design will be compared with the current design. From the result, the reducing process of deep drawing die in producing the brass socket will be discussed directly.

Chapter 6 is the final chapter that consists of conclusions and future work recommendations. The conclusion of the research is made based on the action which has been done throughout two semesters. The conclusion usually made from the discussion chapter which is in the Chapter 5. After making a conclusion, the recommendations of future works related to this area can easily make based on the area that has not been explored in this research.

1.6 Gantt Chart

Please refer to **Appendix A** for the planned of PSM I and PSM II.

CHAPTER 2
LITERATURE REVIEW

In this second chapter, Literature review is to review the critical points of current knowledge on this particular project. In this chapter, also discusses the study that will be related to the project would be exercised. Besides, the project must be carried out with the theory, observation, recitation, understanding and documentations that related to how to design and analyze a lifting mechanism of deep drawing dies for brass socket or any related details. Therefore, it is necessary to achieve objectives of the project in more effectiveness and perfect.

2.1 Deep Drawing Process

2.1.1 Definition

Deep drawing is one of the most important processes for forming sheet metal parts. It is used widely for mass production of hollow shapes in the packing industry, automotive industry, manufacturing industry, etc. According to the definition in DIN 8584, deep drawing is the tensile compressive forming of a sheet blank (or, depending on the material, also of foils or plates) to a hollow body open on one side or the forming of a pre-drawn hollow shape into another with a smaller cross-section without an intentional change in the sheet thickness (Siegert K. and Wagner S., 1994).