DESIGN AND FABRICATE A MOULD FOR TENSILE TESTING FOR POWDER SPECIMEN

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ABSTRACT

Development of this mould is to produce a tensile test specimen in the form of powder that according to the American Standard of Testing and Material (ASTM). Students can make the specimen on themselves and determine the tensile stress of the specimen by doing some experiments. The punch and die are made from Stavax steel and for the base and stand, they are made from mild steel. Whole of this project is particular involves the mould. Diploma final year project will allocate one semester to complete the project. This project also required the adequate student to finish a task given. The tasks division need to be applied, for the entirely two part will be make that is a process to development of parts and assemble the mould. In conclusion, this project has achieve its goal through the successful of the product making.

ABSTRAK

Penghasilan acuan ini adalah untuk menghasilkan specimen bagi ujian tegangan dalam bentuk serbuk, merujuk kepada piawaian American Standard of Testing and Material (ASTM). Para pelajar boleh menghasilkan spesimen ini sendiri dan mengetahui daya tegangan specimen tersebut dengan menjalankan beberapa ujikaji. Penebuk dan acuan diperbuat daripada besi jenis Stavax manakala untuk pendiri dan tapak, ianya diperbuat daripada besi lembut berkarbon. Kesuluruhan projek ini adalah melibatkan mereka bentuk acuan. Projek tahun akhir bagi diploma ini mempunyai tempoh satu semester untuk disiapkan. Projek ini juga memerlukan pelajar untuk menyiapkan tugasan yang diberi. Di dalam projek ini, pembahagian tugasan diperlukan. Secara kesuluruhannya, projek ini dipecahkan kepada dua bahagian iaitu proses menghasilkan acuan dan proses mencantumkan kedua-dua bahagian acuan tersebut. Kesimpulannya, projek ini telah berjaya mencapai matlamatnya dengan kejayaan penghasilan produknya.

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CHAPTER 1

INTRODUCTION

1.1 Project Synopsis

1.1.1 General Project Synopsis

The project involves designing and fabricating a mould for tensile testing specimen for powder. This mould could be use by other students in order to test the powder specimen. As the Diploma final year project allocates the duration of one semester, this project only focused on designing and fabricating the mould. Basically the instrument for testing consists of tensile, compression, bending and shear test.

The project will be funded by student final year project funding, UMP short term project funding as well as sponsorship attained from industrial sponsors in terms of equipments, products and also monetary funding.

1.1.2 Specific Project Synopsis

My project title is Design and Fabricate a mould for tensile testing for powder specimen. The project involves designing and fabricating a mould (punch and die) that will be pressed by compression machine up to 50 tonne. Actually, this type of mould are not available at UMP material lab, and perhaps in market. All specimens

for tensile testing that can be found in the market are produced by machining technology such as turning and casting. This project also required the skills in designing, fabricating and also in making a decision.

1.2 Project Scope

1.2.1 The software that has been used to design the mould is SolidWorks and AutoCAD

1.2.2 Fabrication processes involve all necessary manufacturing method including cutting, milling, drilling and grinding.

1.2.3 Material that is used to fabricate this mould is stavax.

1.3 Project Objective

1.3.1 General Objective

Objective of the diploma final year project is to practice the knowledge and skill that have been gathered, before in problem solving using academic research, to become an engineer that have enough knowledge and skill.

This project is very important in order to train and increase students capability for answering, questioning, researching, data gathering, decision making and then problem solving by research or scientific research.

This project on another way will educate students in communication like in a presentation and educate them to defend their research in the presentation.

This project also will generate student's capability to make a good research report in thesis form or technical writing.

This project otherwise can produce and train student on capable of doing works with minimal supervisory and more independent in searching, detailing and expanding the knowledge and experiences.

1.3.2 Specific Project Objective

Basically this project is base on this objective:

1.3.2.1 To design a mould for tensile testing that meets the need of the required testing.

1.3.2.2 To fabricate a mould for tensile testing for powder specimen.

1.4 Project Planning

This project is begun searching for information via internet, books, supervisor, and others relevant academic material that related to the title. The findings of information was not stop there. It continues along the way of this project because knowledge is so many to learn.

At the same week, time management (Gantt Chart) and flowchart for the project is scheduled. This is done by using Microsoft Office Publisher using Gantt chart system. This also takes a week to accomplish.

At the same time, several meeting with my supervisor need to be arranged. This is for discussing about the definition, scope of title and tool requirement which

included software (SolidWorks, AutoCAD) and hardware (machining: milling or drilling).

The second week, the project title acceptance form need to be submitted, followed by study the literature review of dimensioning and the information on tensile test in compression mode at vertical direction. It focused on previous research which quite similar with my project, this takes a week to be done.

The title are well clear at third week, it consist of scope and objective for the project. At this week, the meeting with supervisor only focused to choose the right design which is according to the American Standard for Testing and Material (ASTM).

At this week the sketch should finish with the right dimension and have to be approved by the supervisor. For the engineering drawing, software that were used is Solidwork, the software is used to generate 3D model and AutoCAD which was used to convert in EDM Wirecut machine for cutting process. This project consists of:

1.4.1 Bar : 28mm x 256mm x 150mm

1.4.2 Bar : 120mm and above

1.4.3 Rod: length (10mm), diameter (10mm)

The sketching of the project takes about 2 weeks to be done. It is complicated due to the available material at the lab and another problem that should consider such as what are the appropriate machining method to be used. At the fourth week, the best material suited with design and machine should be decided.

The fifth week is preparation of project progress and progress report writing, these tasks take one week to be done. At this week the progress mid term

presentation and progress report should be approved and submit to supervisor. At the same time, the speech for the presentation should be prepared.

The fabrication process is scheduled to takes on the sixth week. Because of several material arrival was delayed, the fabrication process has been postponed. On this week, for mid - term presentation need to be prepared, it's consist of content, design and further information about the project.

Week seventh, this week are time for mid - term presentation. The main objective for that presentation is to show how far the work progress especially for individual project. In this week, the fabrication process is begun with cutting the core material which used Horizontal Bendsaw Machine.

Next is machining, correction, assembly, testing, and finishing process. This task scheduled to take about the rest of the weeks.

Next task is the final report writing and final presentation preparation. This take about one week to accomplished. The report is guided by UMP Thesis writing guided and also the guidance of my supervisor.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Firstly the concept from the research conduct state, a tensile testing is a laboratory test used by geotechnical engineers to find the tensile strength parameters of solid specimen. In the U.S., the standard defining how the test should be performed in ASTM D 3080.

This project is provided the instrument for producing a mould for tensile testing for powder specimen that will be compressed by hydraulic compression machine up to 50 tonne.

This chapter is summarizing of all the literature review gathered from many academic resources.

2.2 Current Technology

Manufacturing method that is used to produce powder specimen nowadays are casting and turning. Manufacturer still not produced specimen that use powder metallurgy method.

2.3 Manufacturing Method

Manufacturing method that is used to fabricate this product including cutting and polishing machine such as horizontal bandsaw machine, conventional milling machine, small hole drill edm, wire cut edm and surface grinding machine.

2.4 Conventional Milling Machine

2.4.1 Introduction

A milling machine is a machine tool used for the complex shaping of metal and other solid materials. Its basic form is that of a rotating cutter or endmill which rotates about the spindle axis (similar to a drill), and a movable table to which the workpiece is affixed. That is to say, the cutting tool generally remains stationary (except for its rotation) while the workpiece moves to accomplish the cutting action. Milling machines may be operated manually or under computer numerical control (cnc).

Milling machines can perform a vast number of complex operations, such as slot cutting, planing, drilling, rebating, routing, etc. Cutting fluid is often pumped to the cutting site to cool and lubricate the cut, and to sluice away the resulting chips.

2.4.2 Types of Milling Machines

There are two main types of mill: the vertical mill and the horizontal mill. In the vertical mill the spindle axis is vertically oriented. Milling cutters are held in the spindle and rotate on its axis. The spindle can generally be extended (or the table can be raised/lowered, giving the same effect), allowing plunge cuts and drilling. There are two subcategories of vertical mills: the bedmill and the turret mill. Turret mills,

like the ubiquitous Bridgeport, are generally smaller than bedmills, and are considered by some to be more versatile. In a turret mill the spindle remains stationary during cutting operations and the table is moved both perpendicular to and parallel to the spindle axis to accomplish cutting. In the bedmill, however, the table moves only perpendicular to the spindle's axis, while the spindle itself moves parallel to its own axis. Also of note is a lighter machine, called a mill-drill. It is quite popular with hobbyists, due to its small size and lower price. These are frequently of lower quality than other types of machines, however

A horizontal mill has the same sort of x–y table, but the cutters are mounted on a horizontal arbor across the table. A majority of horizontal mills also feature a +15/-15 degree rotary table that allows milling at shallow angles. While endmills and the other types of tools available to a vertical mill may be used in a horizontal mill, their real advantage lies in arbor-mounted cutters, called side and face mills, which have a cross section rather like a circular saw, but are generally wider and smaller in diameter. Because the cutters have good support from the arbor, quite heavy cuts can be taken, enabling rapid material removal rates. These are used to mill grooves and slots. Plain mills are used to shape flat surfaces. Several cutters may be ganged together on the arbor to mill a complex shape of slots and planes. Special cutters can also cut grooves, bevels, radii, or indeed any section desired. These specialty cutters tend to be expensive. Simplex mills have one spindle, and duplex mills have two. It is also easier to cut gears on a horizontal mill.

A more complex form of the milling machine is the *Universal* milling machine, in which the rotating cutter can be oriented vertically or horizontally, increasing the flexibility of the machine tool. The table of the universal machine can be swiveled through a small angle (up to about 15 degrees), enabling the axis of the spindle to coincide with the axis of a helix to be milled with the use of a gear driven indexing attachment.

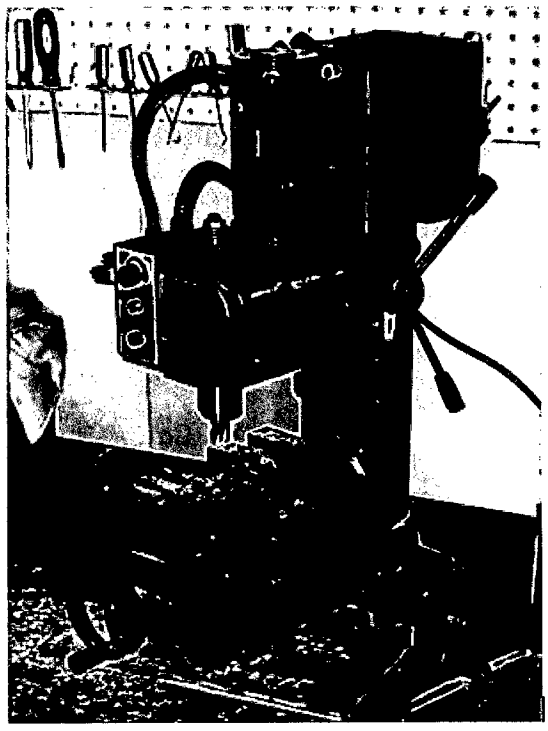

Figure 2.1: Conventional milling machine

2.5 Small Hole Drill EDM

2.5.1 Introduction

Is used to make a through hole in a workpiece in through which to thread the wire in Wire-cut EDM machining. The small hole drilling head is mounted on wire-cut machine and allows large hardened plates to have finished parts eroded from them as needed and without pre-drilling. There are also stand-alone small hole drilling EDM machines with an *x–y* axis also known as a super drill or *hole popper* that can machine blind or through holes. EDM Drills bore holes with a long brass or copper tube electrode that rotates in a chuck with a constant flow of distilled or deionized water flowing through the electrode as a flushing agent and dielectric. The electrode tubes operate like the wire in wire-cut EDM machines, having a spark gap and wear rate. Some small-hole drilling EDMs are able to drill through 100 mm of soft or through hardened steel in less than 10 seconds, averaging 50% to 80% wear

rate. Holes of 0.3 mm to 6.1 mm can be achieved in this drilling operation. Brass electrodes are easier to machine but are not recommended for wire-cut operations due to eroded brass particles causing "brass on brass" wire breakage, therefore copper is recommended.

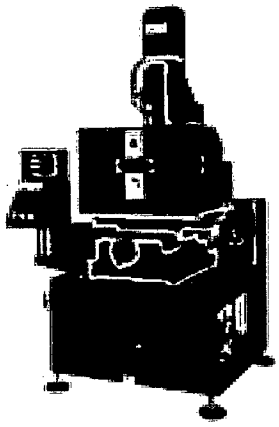

Figure 2.2: Small Hole Drill EDM

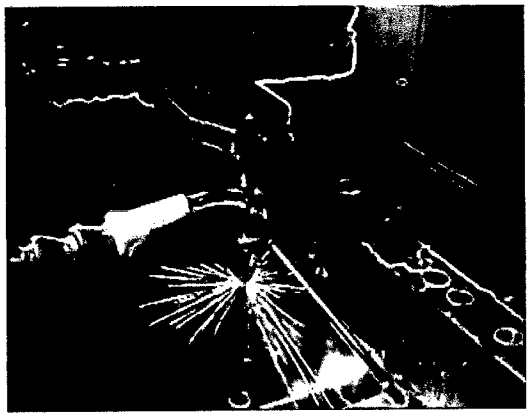

Figure 2.3: Discharging process

2.6 Wire Cut EDM

2.6.1 Introduction

The EDM process was improved by two Russian scientists, Dr. B.R. Lazarenko and Dr. N.I. Lazarenko in 1943. In wire electrical discharge machining (WEDM), or wire-cut EDM, a thin single-strand metal wire, usually brass, is fed through the workpiece, typically occurring submerged in a tank of dielectric fluid. The wire, which is constantly fed from a spool, is held between upper and lower diamond guides. The guides move in the *x–y* plane, usually being CNC controlled and on almost all modern machines the upper guide can also move independently in the *z–u–v* axis, giving rise to the ability to cut tapered and transitioning shapes (circle on the bottom square at the top for example) and can control axis movements in *x–y–u–v–i–j–k–l–*. This gives the wire-cut EDM the ability to be programmed to cut very intricate and delicate shapes. The wire is controlled by upper and lower diamond guides that are usually accurate to 0.004 mm, and can have a cutting path or *kerf* as small as 0.12 mm using Ø 0.1 mm wire, though the average cutting kerf that achieves the best economic cost and machining time is 0.335 mm using Ø 0.25 brass wire. The reason that the cutting width is greater than the width of the wire is because sparking also occurs from the sides of the wire to the work piece, causing erosion. This "overcut" is necessary, predictable, and easily compensated for. Spools of wire are typically very long. For example, an 8 kg spool of 0.25 mm wire is just over 19 kilometers long. Today, the smallest wire diameter is 20 micrometres and the geometry precision is not far from +/- 1 micrometre. The wire-cut process uses water as its dielectric with the water's resistivity and other electrical properties carefully controlled by filters and de-ionizer units. The water also serves the very critical purpose of flushing the cut debris away from the cutting zone. Flushing is an important determining factor in the maximum feed rate available in a given material thickness, and poor flushing situations necessitate the reduction of the feed rate.

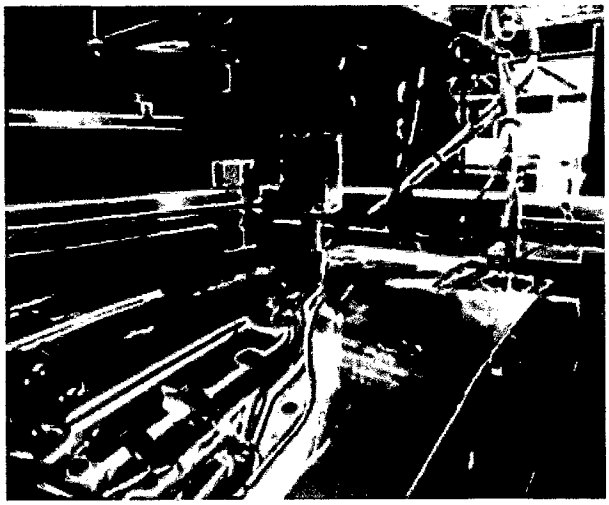

Figure 2.4: Wire cut EDM machine

2.7 Surface Grinding Machine

2.7.1 Introduction

A surface grinder is a machine tool used to provide precision ground surfaces, either to a critical size or for the surface finish. The typical precision of a surface grinder depends on the type and usage, however +/- 0.002 mm (+/- 0.0001") should be achievable on most surface grinders.

The machine consists of a table that traverses both longitudinally and across the face of the wheel. The longitudinal feed is usually powered by hydraulics, as may the cross feed, however any mixture of hand, electrical or hydraulic may be used depending on the ultimate usage of the machine (ie: production, workshop, cost). The grinding wheel rotates in the spindle head and is also adjustable for height, by any of the methods described previously. Modern surface grinders are semi-automated, depth of cut and spark-out may be preset as to the number of passes and once setup the machining process requires very little operator intervention.

Spark out is a term used when precision values are sought and literally means "until the sparks are out (no more)" .It involves passing the workpiece under the

wheel, without resetting the depth of cut, more than once and generally multiple times. This ensures that any inconsistencies in the machine or workpiece are eliminated.

As with any grinding operation, the condition of the wheel is extremely important. Diamond dressers are used to maintain the condition of the wheel, these may be table mounted or as the first image shows, mounted in the wheel head where they can be readily applied.

The machine has provision for the application of coolant as well as the extraction of metal dust (metal and grinding particles).

Depending on the workpiece material, the work is generally held by the use of a magnetic chuck. This may be either an electromagnetic chuck or a manually operated, both types are shown in the first image.

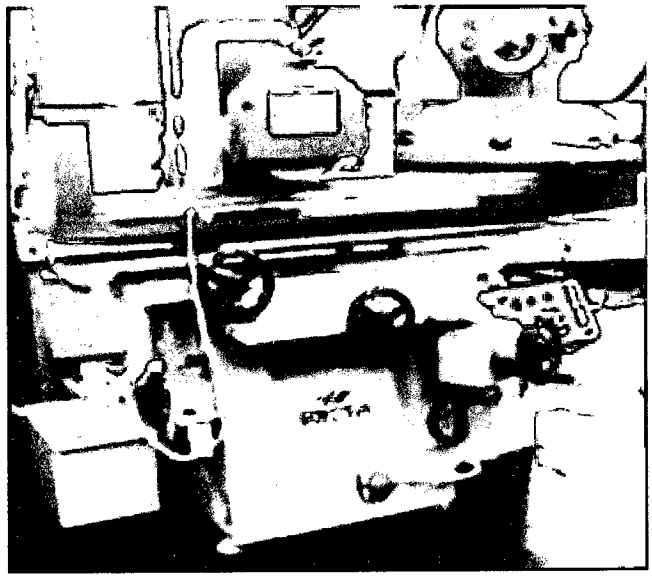

Figure 2.5: Surface grinding machine

CHAPTER 3

PROJECT METHODOLOGY

3.1 Project Flow Diagram

From the figure 3.2, the project starts with literature review and research about the title. This consist a review of the concept of tensile – mostly based on subject Solid mechanics, current technology on tensile specimen in market and design that suit with the compression machine at UMP Mechanical lab. These tasks have been done through research on the internet, books and others sources.

After gathering all the relevant information, the project undergoes design process. In this step, the knowledge gathered from the review is use to make a sketch design that suitable for the project and applicable used in UMP lab. After designing process, the design is drawn by using SolidWorks software so that 3D drawing can be generated.

After the engineering drawing finished include detail design and approved by supervisor, the drawing was used as a reference for the next process which is fabrication process. This process is consists of fabricating the parts that have been designed before by following the dimension using various type of manufacturing process. The manufacturing processes included are cutting, drilling, milling, and finishing. To go through all this fabrication process, it used varies machine such as Horizontal Bendsaw machine, Milling machine, EDM Wirecut machine and super drill machine. During the fabrication process, if there is something wrong occured

such as the dimension is not balance, the process stop and reverse to the previous step, for checking the drawing again.

The fabrication process was followed by the testing. The testing is to gathered all the information about strength, durability, crash safety for the design that has been fabricated. The test process is to see whether the instrument are functioning or not. If this mould is working, its will go through the next process that is report writing. And if the mould is not working properly, the process should start again with designing.

After all the processes mentioned are done, all materials for report writing are gathered. The report writing process will be guided by the UMP final year project report writing. This process also included the preparation of slide for the final presentation.

The project ended after the submission of the report and the slide presentation has been present.

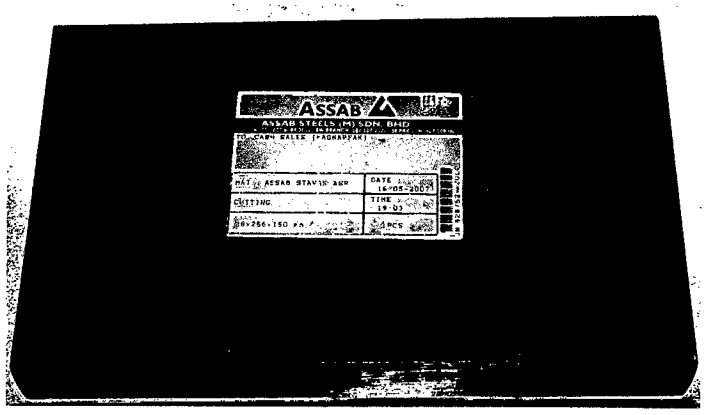

Figure 3.1: Raw material