

Designing Bevel Preparation Tool Using Inventor for the Preparation of Angles in Welding Process

Nasir, M. A. & Abdullah, N. H. L.*

Faculty of Technical and Vocational Education,
Universiti Tun Hussein Onn Malaysia, Parit Raja, 86400, Johor, MALAYSIA

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Abstract: This study was performed to test the design and analyze the strength of the bevel preparation tool in the preparation of the workpiece for the welding process. The purpose of this study is to perform stress analysis of a product that can be used by the user in the process of providing bevel for plate work for the welding process. ADDIE's design model serves as a guide in the development of this product. The ADDIE model consists of five phases namely analysis phase, design phase, development phase, implementation phase, and evaluation phase. This study also involves Autodesk Inventor software to perform stress analysis in product evaluation of bevel preparation tool in the welding process. thus can find data on mises stress, 1st principal stress, 3rd principal stress, displacement, and safety factor. The simulation results showed that it could withstand 527.029MPa and a safety factor of 0.474357 ul up to 15 ul. In conclusion, the bevel preparation tool in the welding process is able to assist in the preparation of the corners and can withstand durability when applied to this product.

Keywords: *bevel preparation, stress analysis, welding process, finishing process*

1. Introduction

Technical and Vocational Education Training (TVET) is one of the fields of education responsible for providing skilled manpower resources in various employment sectors. Apart from that, there are several levels of study introduced by the Ministry of Higher Education Malaysia and one of them is the Degree in Engineering Technology (B. Tech), Diploma in Skills and Malaysian Skills Certificate. Thus, in terms of learning, the engineering field is divided into two i.e. theory and practical. In the field of TVET technical engineering students are exposed to the current skills of operating high-tech equipment or machines Hence the technical field can produce a skilled workforce. Therefore, the Malaysian Education Development Plan, 2015-2025 (PPPM) has emphasized the need for TVET to assist the country in developing the economy and improving the professional labor market. Awing Kechik (2011) concluded that this TVET flow

*Corresponding author: hidayahl@uthm.edu.my
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can generate more robust economic development with the presence of skilled and semi-skilled manpower required by the industry. In this regard, there are fields that have a place in industry as well as in institutions, namely the field of welding. The field of welding is a field that receives less attention but is increasing over time because the needs of the industry in the field of welding in the country is increasing.

TVET provides welding technology programs. According to the Ministry of Education Malaysia (2019) welding technology will provide welding students according to bs / aws level, processes and techniques, classification of metal materials and techniques. Students will also be able to learn procedures and techniques of mechanical and thermal cutting, engineering drawing, fabrication, installation of nail welds and shielded metal arc welding. In the meantime, the welding process is a technology found in manufacturing technology. Manufacturing technology is a process of producing products found in various industries, namely construction, transportation and others. Therefore, the manufacturing technology industry is closely related to the welding process because in the production of a product for the manufacturing technology industry will involve the welding process during the production of a product. Therefore, the preparation of materials in the welding process is a very important thing to start the integration between metals.

According to Masrom, Hamzah and Sahit (2015), welding is a process of combining metal with other metals using heat or pressure. Therefore, before starting the welding process, the bevel plate should go through the process of purification to remove porosity and burr on the bevel plate. Students of Welding and Metal Fabrication, FPTV use conventional methods which take a long time in bevel preparation . In fact, the conventional method does not produce a good surface of bevel. This is because the use of hand grinder machines would result in non-uniform bevel angles and are difficult to weld. Hand grinder aims to get the edges of the material according to the code and standards in the welding process. Therefore, the use of hand grinder is used to obtain more even angle for easy penetrate in the welding process

Therefore, bevel preparation tools in the welding process would assist students in carrying out the preparation easier apart from time saving in the bevel preparation. In order to produce this bevel preparation tool, the ADDIE design model was used as a guideline. This bevel cut is done for the preparation process on the edge of hollow material. According to Akbar and Kusharjanta (2015) preheat is a method used to reduce rust at the bevel cut. The angle cuts on the working materials, would not only produce rough surfaces but also at the support bottom of the working material. To get a smooth or neat surface and uniform use of hand-sewing machines should be done. To get a smooth or neat and uniform surface, a hand grinding machine is used. This is done as the next step to get a smooth cut according to the standard code of welding.

According to Cary and Helzer (2005), welding is the process of connecting two substances that have the same properties or nearly the same as using the heating method. The bevel cutting is done to create bevel on the plate or pipe in preparation for the edge for the grinding welding work. Prior to welding work is the preparation of material that is indispensable (Jeffus, 2017). The formation of bevel is performed using the oxy-acetylene welding method and should be in accordance with the specification of bevel plate set by the American Society of Mechanical Engineers (ASME) as shown in Figure 1.

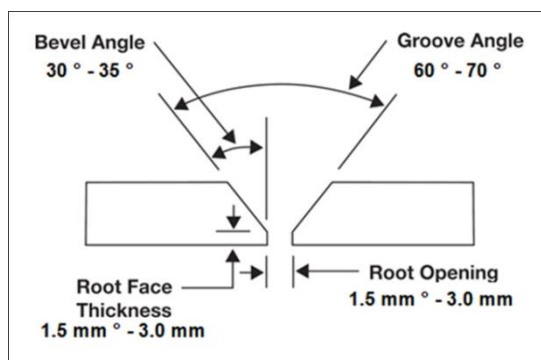


Figure 1: Specification of Bevel Plate

Therefore, bevel surfaces should be cleared of the oxy-acetylene welding effect so that the weld joints are connected to the high-quality corners (Jeffus & Baker, 2017). The Bevel Preparation Tool is designed to save time for the finishing process. Factors such as ergonomics, safety, economics and functionality are being considered in designing the Bevel Preparation Tool. Mechanical factors involve the selection of material and work processes that will be done to produce the machine. The selection of the selected material should be appropriate and used in the correct way of operation based on the properties of the material in order to function as intended.

This study focused more on the preparation of bevel angles which is more time-saving as well as to secure consumer safety. In addition, this bevel corner setup would also produce a tidier curve according to ASME codes and standards. This process forms an bevel angle made from the resultant cutting of oxyacetylene to perform an bevel angle on a more uniform and standard workpiece. According to Masrom, Hamzah and Sahit (2015), guidelines in the American Welding Society (AWS) would improve the quality of welding. Therefore, this study was conducted to facilitate the process of preparation of bevel angles before starting the welding process. The right bevel angle according to AWS is important to avoid any defects during the welding process.

2. Methodology

Researchers use the ADDIE model (Figure 2) because it is one of the instructional models that often form the basis for other design models (Aris, Yahaya, Harun & Tasir, 2000). There are

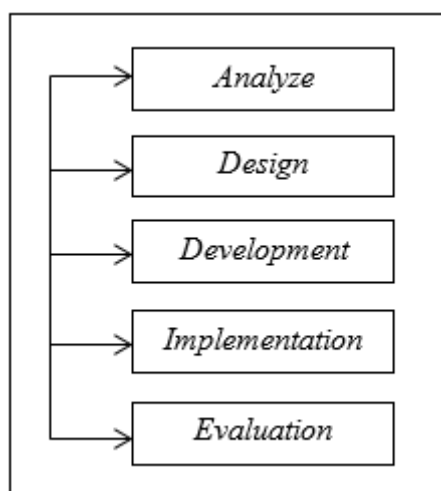


Figure 2: Flow Chart of ADDIE Model (Aris, Yahaya, Harun & Tasir, 2000)

five phases in this model consisting of Analysis Phase, Design Phase, Development Phase, Implementation Phase and Evaluation Phase.

2.1 Analysis Phase

Analysis was conducted to identify problems and determine project design requirements. Researchers conducted a survey at the Welding and Metal Fabrication Laboratories, FPTV. As a result of the survey, it was found out that students have been using hand grinder and file for bevel finishing process. This conventional method takes a long time to do the process. In addition, the researcher also made comparisons between machines that make bevel on plate found in the industry.

The analysis phase was the first phase that needed to be done before product development as shown in Figure 2. At this phase, the researcher has analyzed the background of the problem and the objectives of the study to make a step in the process of developing bevel angle preparation tools in the welding process. This phase has some analysis that needs to be done in identifying student's problems during the process of preparing bevel angles. All relevant information was analyzed to make a conclusion on the needs of welding students to do workshop practicals in order to make workshop practicals more efficient.

This was also the phase, where the researcher conducted a preliminary survey in the welding workshop which involved students and welding lecturers who were doing practical workshops. Herein, some information has been collected and one significant information is that the process of preparing bevel angles takes a long time and is less tidy. In fact, researchers found that the lack of equipment in the FPTV welding workshop caused students to take a long time to complete the bevel angle. Thus, the product development process was implemented according to the framework to ensure that all things can be done according to the set time period.

2.2 Design Phase

The researcher designed the Bevel Preparation Tool in the preparation of the workpiece for welding process to facilitate the finishing process and to reduce the time of bevel finishing process. The researcher used the Autodesk Inventor software for the design. The design phase was the phase that involved the designing process, for the detailed design of the prefix. In this design phase, several aspects were taken into account, namely the initial ideas and the production of the design. This was also the phase in determining the design by studying the suitability and specifications of the bevel angle preparation tool. The researchers identified problems that occurred based on the initial survey analysis which was implemented. Based on the analysis, the researcher has decided to design an bevel angle preparation tool covering important things such as safety, size, functionality and mobility as shown in Figure 3.

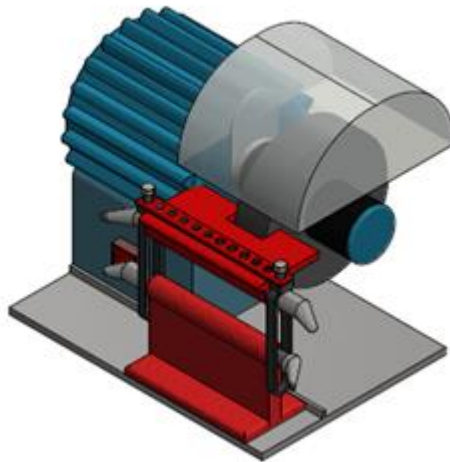


Figure 3: The Bevel Tool Preparation Machine Isometric Drawing

2.3 Development Phase

Development phase is a phase where finished product is utilized in a real situation after being tested for its stability, safety and user's security handling apart from completing and stream dating any necessary works. For example, solving any technical problems involved and testing the effectiveness of the tool in accordance with the needs of the researcher. Once the production of this tool is ready, the tool was presented to the supervisor to identify any problems that needed to be fixed or rectified as well as improvements that needed to be done. Once the design is fully completed, experiments were carried out to analyze the stability of the operating tools as well as to see whether it could function properly and could produce the desired bevel angle. Hence, experiments were conducted to ensure that the project's design objectives were achieved.

2.4 Implementation Phase

Testing on the bevel tool preparation tool was carried out and assessed using inventor autodesk software during this implementation phase. In addition to that, the software was also utilized to analyze the design to compress data in terms of pressure testing on the compatible angle setup tool and several other tests such as stress tests and safety factors. In fact in this phase the effectiveness and smoothness of the product was also tested. This is to ensure consumer safety and to avoid accidents. Simultaneously, the researcher tested the tool to identify any possible defects or problems before going to the next phase, that is the evaluation phase.

2.5 Evaluation Phase

Evaluation phase was carried out so that researchers would be able to know the assessment of the design, safety and also the functionality of the angle preparation tool apart from its effectiveness as well as to evaluate the stress analysis, problems and defects occurring in the product. Completed product was handed over to experts for evaluation and assessment using Autodesk Inventor software. Experts in the field of welding and mechanics provided views and opinions on improvements that could be added in the bevel angle preparation tools.

All ideas or views from the experts were used by the researcher in refining and improving the product to be produced and recommendations for further study

3. Results and Discussions

Simulations were conducted using AutoDesk inventor software for the bevel preparation tool based on the criteria and specification set. Table 1 shows the results after stress testing on Bevel preparation tool was performed. The purpose of this analysis is to test the durability of the materials used in the development of the Bevel Preparation Tool.

Table 1: Shows result after performing stress testing on bevel preparation tool

Name	Minimum	Maximum
Volume	1195940mm ³	-
Mass	9.56749 kg	-
Von Mises Stress	0 MPa	527.029 MPa
1st Principal Stress	-129.375 MPa	539.65 MPa
3rd Principal Stress	-589.531 MPa	31.4335 MPa
Displacement	0 mm	0.799947 mm
Safety Factor	0.474357 ul	15 ul

The design of the Bevel Preparation Tool has several connected and supportive parts to support the pressure applied. These parts such as thread bar and lock nut are essential to support and enable the Bevel Preparation Tool to work properly. According to Pratama Putra (2015), several factors need to be considered in designing a product including attractive design, material selection, material strength, etc. These play an important role in a product in order for the product to withstand the load imposed. Thus, the selection of materials for each component is very important as it determines the product's ability to meet the desired load.

Therefore, the results from the analysis in chapter five showed that the products produced were able to withstand the load that has been imposed. This can be seen through the findings obtained through the tension analysis conducted. When a load of 10 MPa was applied to the product, it was able to withstand the maximum load of 527 MPa. The contributing factors in ensuring the quality of the product is the correct use of the material and the design of the product itself. Improper use of iron would result in the product not being able to meet the load. Therefore, the study of the design and properties of the material itself is very important to enable this research to meet the needs of the user.

4. Conclusions

The rapid development of science and technology has led to many new discoveries that could facilitate a work process in improving the quality of work produced. In the welding process, the use of technology will also change from time to time in order to improve the quality of the products produced especially in the process of welding angular plate welding work. With the advancements in technology and innovation it is facilitating the preparation of bevel angles in welding process as well as using conventional methods that use handmade machines which

require high skills in preparing bevel angles. Therefore, the researchers hopes that the bevel preparation tool in the welding process could assist teaching staffs as well as students in the teaching and learning sessions.

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