



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**ERGONOMICS SAFETY APPROACH IN  
WELDING SHOP  
(A CASE STUDY IN UTeM)**

Report submitted in accordance with partial requirements of the Universiti  
Teknikal Malaysia Melaka for the Bachelor of Manufacturing Engineering  
(Manufacturing Process)

By

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## **APPROVAL**

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Process). The members of the supervisory committee are as follow:

**MOHAMAD NIZAM BIN AYO**  
(Main Supervisor)

## **ABSTRACT**

This paper represents a case study which investigated the safety ergonomics problems faced in the welding workshop of Universiti Teknikal Malaysia Melaka. The safety welding is investigated to increase the safety awareness of users in the welding workshop. The ergonomic safety concept will be focused in the interaction between users and the welding activities. Welders who perform the welding tasks under heat stress always experience with various types of injuries such as MSD, CTD, low back pain, skin burns, eyes pain and others. This indirectly influenced concentration in their welding task because of the injuries suffers. The risk of the hazards and injuries are still increasing although there are a lot of safety rules created in the welding shop. Most of the safety devices have been provided in the workshop but the concept about ergonomic safety do not enhance well. This will affect performance of the welders in their works. Besides, the project will also brief through a lot on postural analysis. The approach method used in this thesis is observation method. The welding safety awareness checklist is used to expose the safety precaution and help to provide suggestions or ideas in the work improvement while the RULA software is used to assess the welding postures in the welding workshop. From the results, there are a lot of safety issues that should be concerned about such as the hazards precaution, personal protective equipments, workstation etc. The welding postures should be improved since most of the postures posed are out of the safe range. A lot of revised were done to improve the working posture. Hence, the ergonomics concept should be introduced so that users can practice healthier life and avoid from injuries when conducting their works in welding workshop. A lot of suggestions to improve the safety and welding postures problems are proposed and presented in this paper.

## ABSTRAK

Projek ini merupakan satu kajian penyelidikan mengenai masalah keselamatan ergonomi yang dihadapi di dalam bengkel kimpalan yang terletak di dalam Universiti Teknikal Malaysia Melaka. Penyelidikan dijalankan dengan tujuan untuk meningkatkan kesedaran keselamatan pengguna di dalam bengkel kimpalan. Konsep keselamatan ergonomi dititikberatkan dalam interaksi antara pengguna dan aktiviti kimpalan supaya menghasilkan kerja dengan berkesan dan selamat. Pengimpal menjalankan aktiviti kimpalan sentiasa mengalami tekanan kepanasan yang menyebabkan pelbagai jenis kecederaan dan kesakitan. Kesakitan tersebut menyebabkan pengimpal tidak dapat menumpukan perhatian dalam kerja dengan secara tidak langsung. Walaupun terdapat peraturan keselamatan di dalam bengkel, tetapi kemalangan tetap berlaku. Kebanyakan alat-alat keselamatan telah disediakan di dalam bengkel. Selain itu, projek ini juga menganalisis pelbagai jenis gaya tubuh yang menjalankan aktiviti kimpalan. Kaedah pemerhatian digunakan dalam projek ini. Kajian soal selidik digunakan untuk mengawasi keselamatan dalam bengkel dan berguna sebagai petunjuk meningkatkan kesedaran keselamatan. Perisian RULA pula digunakan untuk menganalisis gaya tubuh semasa menjalankan kerja kimpalan. Daripada keputusan, banyak isu keselamatan perlu diberikan perhatian dan langkah berjaga-jaga perlu dilaksanakan dengan tegas. Gaya tubuh semasa kerja kimpalan perlu diperbaiki. Konsep ergonomik perlu diperkenalkan supaya pengguna bengkel mengamalkan kerja hidup yang sihat dan mengelakan diri daripada kecederaan. Terdapat beberapa langkah keselamatan telah dicadangkan di dalam kertas kerja ini.

# **DEDICATION**

For my beloved family

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# LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

ANSI	-	American National Standard Institute
COP	-	Code of Practice
CTD	-	Cumulative Trauma Disorder
LBP	-	Low Back Pain
MIG	-	Metal Inert Gas
MSDs	-	Musculoskeletal Disorder
NIOSH	-	National Institute Of Occupational Safety and Health
OSHA	-	Occupational Safety and Health Act
PPE	-	Personnel Protective Equipment
PSM	-	Project Sarjana Muda
RSI	-	Repetitive Strain Injuries
RULA	-	Rapid Upper Limb Assessment
TIG	-	Tungsten Inert Gas
UECTDs	-	Upper-Extremity Cumulative Trauma Disorder
US	-	United States
UTeM	-	University Teknikal Malaysia Melaka
WMSDs	-	Work-related Musculoskeletal Disorders

# **CHAPTER 1**

## **INTRODUCTION**

There are lots of definitions for conceptual of ergonomics, but it does not vary in between of them. Ergonomics can be defined as the scientific discipline that concerns with the understanding of interaction between humans and work system. The name of ergonomics come from the Greek words that ‘ergon’ means work or effort of human while ‘nomos’ means natural law (Sheridan, 2002). Ergonomics also called as biotechnology, human engineering and human factors engineering. It is a multidisciplinary activity striving to assemble information on people’s capabilities and capacities and to use that information in designing jobs, product, workplaces and equipment. It’s also concerned with trying to reduce unnecessary stress in these interactions, and usually intended to maximize the productivity by reducing operator fatigue and discomfort. For example, as refer to Figure 1.1, the Personal Protective Equipment (PPE) such hand shield, glove, apron and other are ergonomically design for human to protect them from injuries or burns. This Personal Protective device functions as safety protection while conducting the welding activities.



**Figure 1.1: PPE Used In Welding Workshop**

Source: Welding workshop of UTeM (2007)

Originally, ergonomics was about designing to achieve maximum efficiency and to avoid physical discomfort or pain in the working environment. Ergonomics looks at ways of reducing fatigue by focusing on how work affects people. The value of this definition is the relationship it establishes between the variables, humans, objects, environments, and their varied and complex interactions. This interrelationship is important for it permits us to focus our attention on these variables as they contribute to variety of disorders.

Ergonomics risks factors are the aspect of a job or task that impose a biomechanical stress on the worker and it can be classified into several types such as force, vibration, repetition, contact stress, awkward postures, extreme temperature and static posture. All of these risks factors will bring consequences to the human body such as the Musculoskeletal Disorder (MSDs), Cumulative Trauma Disorder (CTD), Chronic Back Injuries, Low Back Pain (LBP), Repetitive Strain Injuries (RSI), Repetitive Motion

Disorders and other injuries. The higher risks of injuries if working under discomfort posture in long working duration. The high vigilances or alerts should be taken early to avoid these injuries. For example, muscle strains may seem like minor injuries, but they can turn into chronic conditions in long term duration. It is very important to remember that prevent is better than treatment. The long term duration working hours is really a burden to the workers to concentrate in their works.

So, this case study is carried out to investigate the safety problems faced in the welding workshop of University Teknikal Malaysia Melaka (UTeM), that may bring negative effects to the human and hence influence the healthy life of the welders. The safety welding will be investigated to increase the safety awareness of users in the welding workshop. It is very important for every welder to know about the safety in the workshop. Although there are a lot of safety rules in the workshop but the most significant question is how strictly the safety rules of workshop are enforced. The welders need to increase their safety precaution based on the ergonomics concept so that they can work under a safe and healthy working environment. Understanding and acting in accordance with the safety rules and safe working procedures making full use of the safety equipment and personal protective equipment necessary to perform the assigned task is important in the welding workshop.

The case study also presents the unsafe working posture that may produce diseases to the welders when they operate with the welding machine in long and short term duration. This investigation is mostly carried out by using the ergonomics concept in safety approach towards work improvement. A postural analysis tool is available for assessing exposure of workers to the risks and potentially hazardous task within the workstation. Postural analysis tools are classified into observation method and direct measurement method. The postural analysis tools used in this case study are belonging to the observation method such as Rapid Upper Limb Assessment (RULA) and awareness checklist. Solutions to improve safety in the welding workshop are proposed

to reduce the risks that confronted by the welders. It is important to remember that prevention is the vaccine for the disease of injury.

## **1.1 Background Study**

Welding is the most common way of permanently joining metal parts. In this process, heat is applied to metal pieces, melting and fusing them to form a permanent bond. Welding fume is a mixture of particles generated by vaporization, condensation and oxidation of substances which are transferred through the arc. The particles are very small and remain suspended in the air for long periods, where they may be breathed. Small particles are respirable which means that they may penetrate the innermost regions of the lung where they have the most potential to do harm. If inhaled, welding fume may be hazardous to health and must be controlled to limits laid down by regulations. The proper safety should be implemented to make sure the injuries not happened whenever conduct with welding machine.

This case study presents the investigation of working posture in the welding workshop in UTeM. The study is more focuses on the ergonomics safety concept in interaction among users and the welding machines. It is believe that most of the students from Faculty Manufacturing Engineering and Faculty Mechanical Engineering conduct their laboratory project by using the welding machines in the workshop. Users use many types of welding equipment set up in a variety of positions, such as flat, vertical, horizontal, and overhead. They may perform manual welding, in which the work is entirely controlled by the welder, or semiautomatic welding, in which the welder uses machinery, such as a wire feeder, to perform welding tasks. Although safety of the welding had reminded to the users but the injuries or accidents still can't avoid. There are a lot of safety that need obeyed by the users before conduct the welding process. Welding safety such as wear the personal protective equipments such as apron, hand shield, gloves and the others are concerned in the workshop. But are these protective

equipments really function well and guarantee the users' safety? This is a question that always concerns the users and others that need further investigation. It is very dangerous if the safety does not enhance strictly and ergonomically. The accidents or injuries can not be expected but safety can be learned to avoid it. The ergonomics work improvement in the welding shop should be proposal and implement efficiency, so that the risk of accidents or injuries can be reduced and provides a healthy welding working environment to the users.

The project is carried out by using the postural analysis tools in observation method to access working posture of the users. The data checklist shows the problems confronted in welding workshop and gives the ideas for making improvement more easily since the problems exists is verified. In the other hands, the analysis of the working posture users is done by photo capture and orientations of body posture of the images of working postures that have been captured is measured by using the protractor. Data requirements is key in to the Ergoweb software to determine safe or unsafe postural of users. The data is then revised few times to provide the correct posture suggestion for user. Proper ergonomics solutions are found to solve the problems confronted so that the users can avoid themselves from injuries and accidents and work under comfort working environment. Welding users need good eyesight, hand-eye coordination, and manual dexterity. They should be able to concentrate on detailed work for long periods and be able to bend, stoop, and work in awkward positions safely.

## **1.2 Problem Statement**

Commonly the users or welder that operate with the welding machine or working under welding heat stress in the workshop will confronted or experienced with various types of diseases or injuries which can be classified as physiologically and psychologically injuries. They will more experienced in musculoskeletal Disorder, Repetitive Strain Injuries, low back pain, Cumulative Trauma Disorder, eye pain, skin in

burns from hot metal, spattering slag and from handling hot tools or electrodes or even from ultra light. These indirectly influences daily life such can not concentrate well in their works because of the injuries suffer. It should be thinking deeply about these questions such have the safety rule obey by user or enhance strictly by superiors to protect users from injuries? Why most of the users still feel discomfort after welding activities? Why still many users are infected with diseases such as red eye discomfort, wrist and shoulder pain under static posture for long period and others diseases although they have obeyed to the safety rules? Are the problems exist cause of the poor design of the personal protective equipments in the workshop? All of these questions need to investigate seriously to improve human safety in workshop in order to reduce the risks of injuries. Workbench design and use of positioning aids to accommodate work posture in the welding workshop are not efficiency. There are just has standing workbench design in the workshop and really a burden to the users to work in long term duration. The poor ventilation system in the workshop brings the effect to the respiratory human and the poor designed canopy hook makes contaminant can't removes away from the breathing zone of the operator easily. Although most of the safety devices have been provided in the workshop but the concept about ergonomic safety do not enhance well and hence affect performance of the welders in their work. The ergonomics concept should be introduced so that users can practice healthier life and avoid from injuries when conduct their works in welding workshop.

### **1.3 Objective**

In order to complete one of the assessments of the course BMFG 4913, Project Sarjana Muda, a case study about the ergonomic safety concept approach towards work improvement is investigated in welding workshop of Universiti Teknikal Malaysia Melaka. The objectives of this project are as the following:

- (a) To investigate and recognize to the safety precaution in the welding workshop.
- (b) To identify the problems working posture confronted in the welding workshop in order to assess the working posture by making right judgment during analysis postural.
- (c) To propose solutions to improve safety in the welding workshop.

## **1.4 Scope**

In order to understand the basic about the ergonomics, a specific ergonomics concept about safety in the welding workshop in UTeM will be introduced. The safety interaction among welders, machines and environment will be investigated by using observation method. The aspect that relates to the consideration about the ergonomics safety such as hand power tools, machine safety, personal protective equipment, workbench design and the ventilation system will be briefly discussed. The photos of working posture will be captured and analyze by using the postural analysis tools. However, chemical or radiation hazards and correct lifting techniques will not be discussed in this project.

Apart from that, this project will also brief through a lot of postural analysis tools. Generally, the postural analysis tools are classified in two categories such observation method and direct measurement method. In this case study, the observation method such as RULA assessment tool will be used to assess the working posture of the welder. The direct measurement tools will not be focused in case study because of limitation tools in Ergonomics Laboratory since all of the high technology direct measurement tools are in high cost. Awareness checklist will be created with the purpose to increase basic