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ERGONOMICS EVALUATION AND DESIGN OF THE HAND TOOLS USED IN MANUFACTURING INDUSTRIES

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This report is submitted in partial fulfillment of the requirements for the Bachelor of Mechanical Engineering (Design & Innovation)

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APRIL 2009

"Hereby, I declared that this project report has written by me and is my own effort and that no part has been plagiarized without citation"

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ACKNOWLEDGEMENT

First and foremost thanks to Allah S.W.T for giving me the courage, confidence and patience in order to complete this project. I would like to express my gratitude to my supervisor, Mr. Shafizal who guides me through completing this project. He gave me lot of ideas, advises and encouragement that helps me for completing this research.

Lot of thanks to all my friends who help me a lot in generating ideas and information that very useful in this research. Not to forget, my families for their support and blessing.

ABSTRACT

In manufacturing industries the percentage of injuries that occur is higher than other sector. Most of the injuries linked to the used of hand tools. The injuries may cause from the poor design of the hand tools itself. This report presents the findings the redesign an existing hand tools and making analysis on the ergonomics design of the hand tools. By having fully understanding the ergonomics design of the hand tools and CATIA software can be applied together to carry out the new designed which are more safe and ergonomic hand tools. The existing and new design will be compare using 'RULA Analysis' module in CATIA. The particular strength of this research is to reduce injuries in using hand tools by designing an ergonomically well-designed hand tools.

ABSTRAK

Di dalam industri pembuatan, peratusan kecederaan yang berlaku adalah tinggi berbanding dengan sektor yang lain. Kebanyakan kecederaan berpunca daripada pengunaan peralatan tangan. Kemalangan tersebut berpunca daripada reka bentuk peralatan tangan yang naif. Laporan ini membentangkan keperluan untuk mereka bentuk kemabali peralatan tangan dan membuat analisa pada reka bentuk peralatan tangan yang ergonomik. Dengan memahami reka bentuk yang ergonomik dan juga perisian CATIA boleh diaplikasikan bersama untuk meraka bentuk peralatan tangan yang tidak merbahaya dan ergonomik. Reka bentuk yang sedia ada dan yang baru dibandingkan dengan meggunakan modul yang terdapat di dalam CATIA. Teras kekuatan kajian ini adalah untuk mengurangkan kecederaan dengan mereka peralatan tangan yang ergonomik.

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CHAPTER 1

INTRODUCTION

1.1 Background

In a large number of industrial occupations, hand tools are primary tools. A major concern of these industries is the higher percentage of injuries that occur annually. In many occupations, some of the major causes of work-related disorder and disease are linked to the use of hand tools. It has shown that tool design may play an important role in development of work related problems in the upper limbs. Poor design of a hand tools may result in cumulative trauma disorders. Occupational accidents can be linked directly to the use of specific hand tools as well.

Ergonomically well design hand tools may reduce the risk of occupational injuries. It is also provide comfortable work for the users and give high product quality to the consumers. As the use of hand tools may play an important role in the developments of disorders and accidents, it is obvious that improvements in the design of hand tools are essential for promoting professional users health, particularly where there is intensive exposure.

1.2 Objective

The main objective of this project is to design and perform ergonomics analysis of hand tools that are used in manufacturing industries.

1.3 Scope

The scopes of this project are;

i. Study on the literature review of the ergonomics design for hand tools that are used in manufacturing industries.
ii. Carry out conceptual design of the hand tools.
iii. Apply the concept of ergonomics in designing the hand tools.
iv. Study on the drawing tool and analysis tool (RULA analysis) using CATIA.
v. Carry out an analysis of ergonomics design by using RULA analysis in CATIA.
vi. Comparison between the existing design and new designs.

1.4 Problem Statement

A major concern of industries is the high percentages of injuries that occur annually. The relationship between occupational musculoskeletal disorders and the use of hand tools is well known. Poor design of hand tools may result in cumulative trauma disorders. Occupational accidents can be linked directly to the use of specific tools. As the use of hand tools plays such an important role in the development of disorders and accidents, this project will try to overcome the problem by designing an ergonomics hand tools. Ergonomically well-designed hand tools used in work situations with balanced work content reduce the risk of occupational injuries of the hand, wrist and forearm. It‟s also provided comfortable work for the users and gives high product quality to the customers.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Injuries to the human body resulting from the use of hand tools can be classified as cumulative effect trauma or single-incident trauma. Cumulative effect trauma involves progressive damage to the tendons, tendon sheaths and related bones, and nerves of the hand, wrist, elbow and arms, resulting from long-term or improper use of a hand tool (Mital and Sanghavi, 1986).

Although it is impossible to eliminate all injury potential, maybe simple design modifications to the tools can change an unsafe tool into a relatively safe one. Take an example, the innovation of guards on hand tools have proved useful in the prevention of slipping of the hand over the blade and it can reduce the percentage of an injuries.

Mostly cheap tools that widely sold in market nowadays, made from unsuitable materials and poor workmanship. This will contribute to an injury to the users. Some examples include wrenches and spanners which open under normal working pressure, and hammer which chip or shatter when a blow is struk. Also, chisels and punches made of soft material often 'mushroom' with repeated blows, and knives of poor quality will lose their edge.

The texture of the tool handle is another important design consideration. Some grips can be improved by increasing the friction between the hand and the handle. The texture of the handle is not merely aesthetic but also functional (Fraser, 1983). A non-slip texture may also abrade the skin of the hands and inhibit adjustment of hand position (Drury, 1980). Design of hand grip should be based on the type of gripping action used (Drury and Pizatella, 1983), and the contact should be maximized as this will minimize shear stress on the skin (Pheasant and O'Neill, 1975).

Handle design for hand tools has been addressed by many authors (Van Cott and Kinkade, 1977; Greenberg and Chaffin, 1979; Woodson, 1981; Konz, 1983; Chaffin and Andersson, 1984; Chaffin, 1991). However, the problem of size and shape in the context of minimizing stress on the user or maximizing tool efficiency has not been well covered. Although considerable work has been done on grip strength, there is limited information about handle size, handle shape, and force capability (Cochran and Riley, 1986).

A few research studies have examined some aspects of handle design. Pheasant and O'Neill (1975) examined various screwdriver handle designs available in the UK and compared them with smooth and rough cylinders. Ayoub and LoPresti (1971) used electromyography in a study to find the optimum size of cylindrical handles for rotational tasks. The result of these two studies compared well. Mital and Channaveeraiah (1988) examined the effect of shape, wrist orientation and duration of repeated exertions on the maximum torque that could be exerted in different postures.

Riley and Cochran (1980) conducted a study on improved knife handle designs. On examining the cross-sectional perimeter of knife handles being used in a meat packing company, they determined that handles were too small. Bobjer (1989) examined the design of knives for the meat packing and processing industry that would reduce cumulative trauma disorders, and yet be comfortable to work with. The result of the work was to design two types of knife, a general-purpose knife and a dagger-grip knife, each of which is fitted with two handle sizes.

Cochran and Riley (1986) evaluated two variables affecting the performance of tang guards in preventing injury due to the hand slipping forward on a knife handle. They concluded that the height of the guard has a significant effect for both males and females.

Konz (1986) examined bent hammer handles, suggesting that when a tool gripped with a power grip has its working part extended above the hand, then a curve in the handle may be beneficial.

The classic work by Napier (1965) has distinguished between two discrete patterns of prehensile movement in which an object is held partly or wholly within the compass of the hand. These patterns were defined from both the anatomical and functional point of view. They were termed 'precision grip' and 'power grip'. With the precision grip, the edge is pinched between the flexor aspects of the fingers and the opposing thumb. The power grip occurs when the hand makes a 'fist' with four fingers on one side of the tool grip and the thumb reaching around the other side to 'lock' on the first finger. More recent work has been done to improve the description of the coupling of the hand (Kroemer, 1986). This improved notation gives a better understanding and definition of how the hand interacts with the control. To this end, the precision and power grips are insufficient. As an example of the system proposed by Kroemer, the precision grip is described as the 'thumb-two-finger grip'. Imrhan (1991) looks at the influence of wrist position on different types of pinch strength.

Electromyography has been used for two decades to evaluate industrial designs by quantifying muscle activities (Khalil, 1973), muscular effort, fatigue and the effectiveness of training (Lavender and Marras, 1990).

Tthe problem of obtaining ergonomically designed handles which are sized properly in the context of comfort and safety for the user needs to be addressed with more urgency.