

A PRELIMINARY DESIGN OF DESKTOP DESK: AN ERGONOMICS APPROACH

SAJIMAR BIN ABDUL GAJIR

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering

Signature :

Name of Supervisor : Pn Nurul Shahida Bt Mohd Shalahim

Position : Lecturer

Date :

STUDENT'S DECLARATION

I hereby declare that the work in this project is my own except for quotations and summaries which have been duly acknowledged. The project has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature :

Name : Sajimar B Abdul Gajir

ID Number : MA 06054

Date :

Dedicated to my beloved family

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Abstract

This study is about designing a desktop desk using ergonomics technique in order to avoid or minimize the chance of developing Musculoskeletal Disorders (MSD) among the workers. MSD happens due to the product or tools that is not ergonomics. MSD starts to develop when a workers is doing a job repeatedly. The problem statement for this study is the musculoskeletal disorder that occurs when the action was doing statically for a long period time and repetitive. There are three objectives for this study. The first objective of this study is to design a desktop desk with ergonomics approach using Solidworks. The preliminary design will be design using Solidworks. The second objective is to simulate the designed desktop table using Algor. This is to analyze the force affecting the desktop when it is subjected to the force and its deformation value. This study also uses the algor to simulate the critical part like the vertical structure that supports the desktop desk. The third objective is to analyze the bending moment of the desk. First stage of this study was collecting data via literature review and find out the problem that occur in the desk that have been designed. This design will be upgraded and modified to overcome and ensure that the same problem not occur again in the future. In the end, this study is targeting to overcome the musculoskeletal disorder problem that has been a nightmare to the human being.

Abstrak

Kajian ini adalah tentang mereka bentuk meja desktop menggunakan pendekatan ergonomik untuk mengelakkan atau meminimumkan kemungkinan peningkatan Muskuloskeletal Disorder (MSD) di antara para pekerja. MSD terjadi kerana produk atau alat yang tidak ergonomik. MSD berlaku ketika seorang pekerja melakukan pekerjaan berulang kali. Permasalahan untuk kajian ini adalah MSD yang berlaku ketika pekerjaan itu dilakukan secara statik untuk jangka masa yang panjang dan berulang-ulang. Ada tiga objektif untuk kajian ini. Objektif pertama kajian ini adalah untuk mereka bentuk sebuah meja desktop dengan pendekatan ergonomik menggunakan Solidworks. Lakaran awal akan dilakar menggunakan Solidworks. Objektif kedua adalah untuk mensimulasikan meja desktop yang direka menggunakan Algor. Ini adalah untuk menganalisis daya yang mempengaruhi desktop ketika dikenakan daya dan nilai kerosakan. Kajian ini juga menggunakan perisian algor untuk mensimulasikan bahagian penting seperti struktur menegak yang menyokong desktop meja. Objektif ketiga adalah untuk menganalisis saat menekuk meja. Tahap pertama daripada kajian ini adalah mengumpul data melalui kajian tesis dan mengetahui masalah yang terjadi pada meja yang telah direka bentuk. Reka bentuk ini akan ditambah baik dan diubahsuai untuk mengatasi dan memastikan bahawa masalah yang sama tidak berlaku lagi di masa depan. Konklusinya, kajian ini mensasarkan untuk mengatasi Muskuloskeletal Disorder, yang telah menjadi mimpi buruk bagi manusia.

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LIST OF ABBREVIATIONS

CTDs	Cumulative trauma disorders
MSD	Musculoskeletal disorders
SME	Small and medium enterprise
RSIs	Repetitive strain injury
RMI	Repetitive movement injury
RP	Rapid prototype

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The most common form of the computer desk is a variant of the ergonomic desk, which has an adjustable keyboard tray and sufficient desktop space for handwriting. Provisions for a monitor shelf and holes for routing cables are integrated in the design, making it easier to connect the computer components together. The typical of the computer desk provides space for a keyboard, mouse, monitor, printer and speakers. Cubicle desk designs for business and government workplaces include a range of shelves, trays and cable-routing holes for computer systems. In some computer desks, the cabling is affixed to the modesty panel at the back of the desk, to create a neater appearance.

The personal computer will have its own desk. This is the reality because without the desk, the user will not feel comfortable using the computer. But, do these desks really suit the user? We must consider all the possibility and design a desk that gives a minimum injury and gives maximum comfortable to the user. We will see these problems in context of ergonomics. What is ergonomics? Ergonomic is the scientific discipline concerned with designing according to the human needs, and the profession that applies theory, principles, data, and methods to design in order to optimize human well-being and overall system performance.

The computer itself is normally separate from the desk, which is designed to hold a typically-sized computer, monitor and accessories. Cabling must be routed

through the channels and access openings by the user or installer. A small number of computers are built within a desk made especially for them, like the British idesk. Various proposals for the "Office of the future" suggested other integrated designs, but these have not been taken up. This was taken from Genaidy, A., Karwowski, W., Succop, P., Kwon, Y. G., Alhemoud, A., & Goyal, D. (2000), A classification system for characterization of physical and non-physical work factors. *International Journal of Occupational Safety and Ergonomics*, 6(4), 535–555.

So, this study is to design and develop the desk or the table using the ergonomics approach and replace the old table for office use with the new table that more comfortable and if can, all parts are ergonomic.

1.2 PROJECT OBJECTIVE

The objectives of this study are:

- 1) To design a desktop table with ergonomics approaches using Solidworks.
- 2) To simulate the designed desktop table using Algor.
- 3) To analyze the bending moment of the desktop desk.

1.3 PROJECT SCOPE

Without yet considering unforeseeable problems that might crop up later, these are the exclusions and the things known but not attempted to solve:

- 1) To developed pineapple peeler is only prototype and it is not readily functional as a commercial product.

1.4 DRAFT ORGANIZATION

Chapter 1 is discussing about the importance to design a desktop desk that use ergonomics approach in the design and how the ergonomics approach will reduce the effect to the user. There are a few example of effect to the user which is the musculoskeletal disorder, neck and shoulder pain, and many more. The objectives and the scopes of this study also mentioned in this chapter.

The literature review in this study will be discussed further in chapter 2. In this chapter, the definition of ergonomics will be explained in details and discuss about the history of the ergonomics and also how the ergonomics can reduce the injury to the user when applied to the design of the desktop desk. This chapter will ensure that the desktop desk that designed is ergonomics according to the comparison of the effect of musculoskeletal disorder to the human being.

The description of step of method will be explained in chapter 3. This chapter explains the method used in conducting this study. The methods that will be covered are designing and simulate using Algor. The designing is done by Solidworks and Algor. For the rough sketch, the design was drawn in the A4 paper. After the final sketch was determined, the design will be drawing in the autocad 2006 before transfer it to the solidwork 2006. This study use 2 type of drawing software to ensure the drawing process becomes easier. Then, the drawing will be analyzed using the algor to determine the bending moment of this study. The algor also used in determine the deformation if this project.

Chapter 4 is about analysis of the collected data from the journals and books. The experiment conduct by the previous researchers will be analyzed and then discuss about the ergonomics desk that will be fabricated is exactly using the ergonomics approach or not. The analysis is also testing the critical part of the ergonomics desktop desk to ensure that the desktop is stable and safety to the human being. The assumption force that applied to this project is 1000 N. The analysis is done to ensure if the material used in this project is the most suitable material that can resist the load force.

Chapter 5 will discuss about the achievement of the project and also recommendation regarding to the project for the benefits and guidance in the future task.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Ergonomics is a term that has been widely used in the designing of the furniture around the world. In this study, the ergonomics aspects or principles will be applied in the design of the desktop desk. There are five principles of ergonomics which are safety, comfort, ease of use, productivity or performance, and aesthetics. All of these aspects will be injected to this study to overcome the major problem that still happen today. What can be done through this study is upgraded and modified the design of the desktop desk that already invented before to ensure that the musculoskeletal disorder and the work-related neck problem can be overcome. In ergonomics, the application is not only limited to a few things only but it is actually include all the things, machines or any kind of things that have been used by the human being.

2.2 ERGONOMICS

2.2.1 HISTORY OF ERGONOMICS

World War II prompted greater interest in human-machine interaction as the efficiency of sophisticated military equipment such as airplanes could be compromised by bad or confusing design. Design concepts of fitting the machine to the size of the soldier and logical/understandable control buttons evolved.

After World War II, the focus of concern expanded to include worker safety as well as productivity. Research began in a variety of areas such as first perceived maximum load that can be carried, pushed or pulled. Secondly is the compressive low back disk force when lifting. Then thirdly is the cardiovascular response when performing heavy labor and the fifthly and the last is the muscle force required to perform manual tasks.

Areas of knowledge that involved human behavior and attributes (i.e., decision making process, organization design, human perception relative to design) became known as cognitive ergonomics or human factors.

Areas of knowledge that involved physical aspects of the workplace and human abilities such as force required to lift, vibration and reaches became known as industrial ergonomics or ergonomics. The broad group focuses and name duality continues at this time. Contributors to ergonomics/human factors concepts include industrial engineers, industrial psychologists, occupational medicine physicians, industrial hygienists, and safety engineers. Professions that use ergonomics/human factors information include architects, occupational therapists, physical therapists, occupational medicine nurses, and insurance loss control specialists.

2.2.2 DEFINITION OF ERGONOMICS

Ergonomics is defined as "The applied science of equipment design, as for the workplace, intended to maximize productivity by reducing operator fatigue and discomfort." This was written by Zandvliet DB and Straker LM. The title of the journal is Physical and psychosocial ergonomic aspects of the learning environment in information technology rich classrooms. Ergonomics (2001). Ergonomics is not just about how comfortable our desktop desk is. It's about how we feel every day at work and how our work affects our lives. The Industrial Age (followed by the Information Age) has brought us many things that would never have been possible without highly organized labor and methods of production.

So what does that mean to the average office worker? Basically, it means the use products and techniques to make our office environments more comfortable and protect us from repetitive movement injuries associated with modern desk work. By take the opinion that has been done by the scientists, they called "Ergonomists" make it their life to develop comfortable, safe objects for us to use at work and at home. Ergonomics, as a formal discipline and recognized science is relatively new but its roots are deeply rooted in ancient times. Thus, the science of ergonomics is the study of how laws of nature affect us and our work environment. In an office environment, this includes how the body interacts with workspace, computers, tools, and furniture.

Table below shows the different definition from the different persons. The table also show how they define the ergonomics even the definition is still in the same contacts.

Table 2.1: Definitions of ergonomics

No.	Author	Year	Definition
1	Christensen	1987	The importance of a "good fit" between humans and tools was probably realized early in the development of the species.
2	Wojciech Jastrzebowski	1857	Coined the term "ergonomics" in 1857. The word comes from two Greek words: ergon (work) and nomos (laws). Ergonomics is often defined as the practice of designing the job to fit the worker, not forcing the worker to fit the job.
3	Bernardino Ramazinni	1633-1714	To minimize work stressors, both physical and environmental to reduce the potential for bodily harm.
4	Frederick W. Taylor	Early 1900's	Scientific management, a method that improved worker efficiency by improving the job process. For example is by increased worker production and wages in a shoveling task by matching the shovel with the type of material that was being moved

2.2.3 PRINCIPLES (ASPECTS) OF ERGONOMICS

The figure 2.1 shows the important part that has to be considered before design an ergo desktop desk. The ergonomically correct position for reading and writing is before an inclined surface. Monks who had to spend hours every day hand-lettering manuscripts knew this. So did Benjamin Franklin, professional artists, draftsmen, and writers down through the ages. When the body is properly aligned, the eyes function easier without stress. When the eyes aren't straining, postural tension and accompanying fatigue lessen.

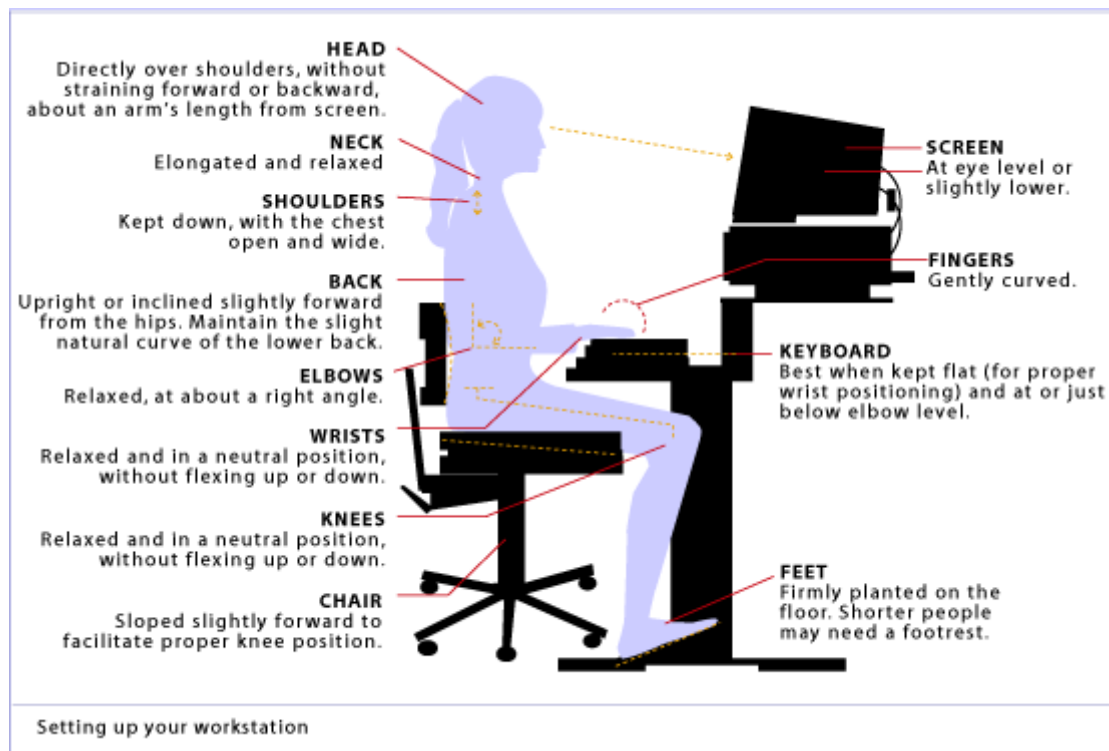


Figure 2.1: Parts of the ergonomics desktop

Source: (<http://www.medbroadcast.com/images/ErgonomicsWorkstation.gif>.)

That's the idea behind the ergo desk. The ergo desk was devised by an eye doctor who noticed patient after patient suffering from posture-induced eye strain. By placing reading and writing materials atop the ergo desk instead of a flat desktop, our posture

straightens, our eyes relax and the aches disappear. We'll find ourselves sitting longer, concentrating better, and working more productively than ever before.

There are five aspects of ergonomics that's safety, comfort, ease of use, productivity or performance, and aesthetics. Based on these aspects of ergonomics, examples are given below of how products or systems could benefit from redesign based on ergonomic principles. The benefits of an ergonomic redesign often cross over into more than one category. The first one is safety. We can take the medicine bottles as an example. The print sizes could be enlarged so those with impaired vision can more easily read the label instructions. Ergonomics can discover the optimum font style, color and size to enhance readability using the limited space available on a medicine label.

The second aspect is comfort and we can take the alarm clock display as an example. Some displays are harshly bright, drawing one's eye to the light or keeping one awake when surroundings are dark. Ergonomic principles could redesign this based on contrast principles and include automatic dimming functions in low-light environments such as when a user has turned off the room lights to sleep.

Thirdly is the ease of use. There are too much things that can be considered but we only see the common one that is street signs. If we drive in an unfamiliar area, it can be quite difficult to spot street signs. This could be addressed by using principles of visual detection to make street signs more visible.

The fourth aspect is the productivity or performance. The example is office furniture and equipment. The use of ergonomically designed office furniture and equipment such as office chairs and computer input devices can drastically reduce work-related injuries and employee absences.

Lastly is aesthetics. The example is the signs in the workplace. The signage could be made more aesthetic by using a consistent format throughout the workplace.

On the other aspect of view, the purpose of the ergonomics is to enable a work system to function better by improving the interactions between user and machines. Better functioning can be defined more closely. We can take example as more output from fewer inputs to the system can increase the reliability and efficiency. But, whatever the definition is used should, be made at the level of the total work system and not just one component only. If we improving the machine to give more comfortable to the user, this workstation redesign are incorrect reason for the application of ergonomics because we need to didn't improve some aspect of the total works systems such as reduced absenteeism and fewer accidents due to better working condition. This fact was written by Villanueva MBG, Jonai H, Saito S. and the title of journal is Ergonomic aspects of portable personal computers with flat panel displays (PC-FPDs): evaluation of posture, muscle activities, discomfort and performance. *Ind Health* (1998);36:282–9.

2.2.4 MUSCULOSKLETAL DISORDER

Musculoskeletal symptoms, defined as aches, pains, and discomfort (Kuorinka et al., 1987) in the spine and extremities, are a major health issue in the workplace due to a number of reasons, a few of which will be mentioned here. First, occupationally-related musculoskeletal symptoms may be impacted by a large number of exposure variables. Second, many of the exposure variables cannot be determined independently of the worker because of the interaction between acting workload from the environment and worker characteristics (Burdorf & van der Beek, 1999). Third, the definition of musculoskeletal outcomes is largely dependent upon the worker in the absence of biological information leading to their objective assessment. Consequently, the complexity surrounding musculoskeletal symptoms should be treated with a holistic approach until the biological basis of musculoskeletal disorders is unraveled.

A musculoskeletal disorder is a condition where a part of musculoskeletal system is injured over time. The disorder occur when the body part is called on to work harder, stretch farther, impact more directly or otherwise functions at a greater level than it is prepared for. The immediate impact may be minute, but when it occurs repeatedly the constant trauma cause damage. The term musculoskeletal disorder identifies a large group of conditions that result from traumatizing the body in either a

minute or major way over a period of time. It is the build up of trauma that causes the disorder. These conditions are often focused on a joint and affect the muscle and bone. However other areas can be strained and their response to that trauma can be an injury.

(MSDs) can affect the body's muscles, joints, tendons, ligaments and nerves. Most work-related MSDs develop over time and are caused either by the work itself or by the employees' working environment. They can also result from fractures sustained in an accident. Typically, MSDs affect the back, neck, shoulders and upper limbs; less often they affect the lower limbs.

Musculoskeletal disorders denote any abnormalities or illnesses that affect either the muscular or skeletal system. Examples of muscular disorders include foot drop (when the ankles and toes turn upward) and shin splints (inflammation of the connective tissue on the calf). Skeletal disorders are varied and many, and two examples are bone spurs (bony projections on joints) and arthritis (inflammation and pain in the joints). These disorders are often painful and debilitating if left untreated, but many successful treatments and therapies exist to make the conditions more manageable.

2.2.5 GOALS OF ERGONOMICS

The following points are among the purposes or goals of ergonomics such as occupational injury and illness reduction. If the workers are in good health, all the progress in that company will be progress smoothly and can get more beneficial. So, the machine must be in good condition and does not affect the health of the workers. Besides of that the company must prepare workers compensation costs containment. This must be done by the company as showing their appreciating to those who have any problems because the workers have done too much for the company.

The other goal is productivity improvement. This can be achieving by taking the employee's heart. If the heart is feeling happy, all the works can be done faster and having high quality. Work quality improvement is the other main goals for ergonomics and can be done by preparing the latest technology to the workers. In fact, not only the quality can be improved but we can save our time too in producing any product. The

absenteeism reduction must be done because the high rate of absenteeism is costing the company a lot of money.

The methods by which these goals are obtained are there are an evaluation and control of work site risk factors. This is important to the workers because they can go to the workplace with smiling face and can return to their home safety. The identification and quantification of existing work site risk conditions can be done to avoid any problems that we can't imagine to the employees. If the problems are known, we can take the safety steps and we also can think a way to overcome those problems. We also can have recommendation of engineering and administrative controls to reduce the identified risk conditions. The sources are written by the Webster J, Trevino L, Ryan L. in the journal of The dimensionality and correlates of flow in human computer interactions. *Comput Hum Behav* (1993);9:411–26.

2.3 DESKTOP DESK

2.3.1 PROBLEM THAT OCCUR IN DESKTOP DESK NOWADAY

Table 2.2 shows the summary of the problem of the desktop nowadays based on the journals in science direct. The summary was done in a table to ensure that the problem occur nowadays can be highlighted and then overcome in this study.

Table 2.2: Problem in desktop desk

	MAJOR	MINOR
1	Viewing distances –Solution is design the desk that have adjustable height	Static exertion –Solution is design a desk with the fillet shape of edge
2	Our head and neck turned to the side for a prolonged period loads neck muscles unevenly and increases fatigue and pain- Solution is design a desk that placed the monitor at the centre.	Grip –Solution is design the desk with the surface made from rubber