PRODUCTIVITY IMPROVEMENT THROUHG RE-DESIGN WORKPLACE AREA

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ABSTRACT

For industrial use, ergonomics has traditionally been used to solve the injuries problem from repetitive motion, prolonged postures, and some other physical risks. However, the utility of ergonomics is not just only limited to solve the injuries problem. Good ergonomics investment also can be applied to improve productivity. This project are carried out at Sidmann Composite Sdn Bhd. The Objective of this project are propose a new workplace with ergonomics features for Sidmann Composite Sdn. Bhd. to reduce the level of musculoskeletal risks of the workplace and improve the production process's cycle time. In order to ensure the objectives are met. A comprehensive data collection was divided into three phase, such as phase one is to perform up-front analysis, phase two is to determine the existing working process risk and operational impact, phase three is to estimate proposed working process risk and operational impact. The assessment was carried out by Rapid Entire Body Assessment (REBA) and Strain Index (SI) to assess the level of musculoskeletal risk in this company. Methods-Time Measurement (MTM) was used to determine the labor time for the performing task improvement. Finally, existing process and proposed process was compared in this project.

ABSTRAK

Dalam sektor industri, ergonomik secara tradisinya telah digunakan untuk menyelesaikan masalah kecederaan dari gerakan berulang-ulang, postur yang berpanjangan, dan beberapa risiko fizikal yang lain. Walau bagaimanapun, utiliti ergonomik tidak hanya terhad untuk menyelesaikan masalah kecederaan, aplikasi ergonomik yang sesuai juga boleh meningkatkan produktiviti. Objektif projek ini adalah mencadangkan tempat kerja baru dengan ciri-ciri ergonomik untuk Sidmann Komposit Sdn. Bhd untuk mengurangkan tahap risiko otot tempat kerja dan meningkatkan masa kitaran proses pengeluaran. Kaedah yang digunakan untuk menjalankan projek ini berlaku dalam tiga fasa. Fasa 1 adalah melaksanakan analisis awal, fasa 2 adalah untuk mencari risiko kesakitan otot yang ada semasa berkerja dan kesan operasi tugas, fasa 3 adalah menganggarkan tahap risiko kesakitan otot semasa berkerja dan kesan operasi tugas. Reka bentuk tempat kerja baharu akan dijalankan sebelum memulakan fasa 3. Rapid Entire Body Assessment (REBA) and Strain Index (SI) akan diguna untuk menilai tahap risiko kesakitan otot semasa bekerja dalam syarikat ini. Kaedah Pengukuran Masa (MTM) akan digunakan untuk mencarikan masa bekerja semasa melaksanakan tugas. Akhirnya, proses yang digunakan sekarang akan digunakan untuk menbandingkan dengan proses yang dicadangkan.

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LIST OF SYMBOLS

in	-	Inch
TMU	-	Time measurement unit
s	-	Second
cm	-	centimeter
REBA	-	Rapid Entire Body Assessment
SI	-	Strain Index
OCRA	-	The occupational Repetitive Actions
QEC	-	Quick Exposure Check

CHAPTER 1

INTRODUCTION

1.1 Introduction

Ergonomics derived from Greek, ergon (work) and nomos (laws) to denote the science of work, ergonomics is the scientific discipline concerned with the understanding of the interactions between humans and work. There are three types of ergonomics, such as Physical ergonomics, Cognitive ergonomics, and Organizational ergonomics. The type of ergonomics that study in this final year project is Physical ergonomic, this study is concerned with human anatomical, anthropometric, physiological and biomechanical characteristics as related to physical activity.

For industrial use, ergonomics has traditionally been used to solve the injuries problem from repetitive motion, prolonged postures, and some other physical risks. However, the utility of ergonomics is not just only limited to solve the injuries problem. Good ergonomics investment also can be use to improve productivity.

1.2 Background of Study

Ergonomics isn't just a catchy buzz word. Ergonomics is a kind of science. The history of ergonomics can started with the ancient Greeks. There is evidence that the Greeks was used principle of ergonomics as early as the 5th century BC.

In the 19th century the 'scientific management'; method was introduced by Frederick Winslow Taylor. This method was aimed at increasing the efficacy of a worker by improving the process of the task. For example, Taylor found out that by reducing the weight and size of coal shovels, the amount of coal being shoveled by workers could be tripled. These ideas led to reduced work injuries and an increase in production levels. This indicates the use of basic ergonomic concepts at that time.

In the 20th Century and Beyond, ergonomics is start become formalized to fit the soldiers needs during the World War II. The military use ergonomics principles to design equipments and weapons. A notable case involved Lieutenant Alphonse Chapanis redesign of aircraft controls with ergonomics features, he was able to increase control panel ease-of-use and reduced the number of crashes that had.

An industrial survey that conducted by Ali et al. (2001) in the Kinta Valley area in Perak state discovered some interesting findings, none of those interviewees had taken ergonomics or human factors engineering courses during their study, they was no knowledge of ergonomics linkages to industrial safety and health.

In a recent study on ergonomics awareness in Malaysian manufacturing industries by Mustafa et al. (2009), they discover about that 35.6% of Malaysian manufacturing industries have a high level of ergonomics awareness and 33.3% of the manufacturing industries implemented ergonomics programs. Among those

ergonomics programmes implemented, orientation was mostly used (44.4%) and proves the most effective.

From above, we can know that ergonomics is getting famous now in Malaysia to use in workplace area like factory, office, school, and other more. By investing ergonomics in office furniture and other working environments, we can learn from ancient Greek's wisdom to implement in nowadays ergonomics to increase productivity, increase comfort, and decrease musculoskeletal risks.

1.3 Backgrouond of Company

Sidmann Composite Sdn Bhd formerly known as Sidmann Tank Sdn Bhd was a company that doing business on fabricate and supply Fiberglass composite product. The company is a project-based business, providing product design and fabrication following the customer's requirement. Since the company is a project-based business, most of the works of fabrication was doing manually by hands. This project was carried out to help to improve the workplace environment for manual work workplace to improve productivity and reduce working musculoskeletal risk. Logo of Sidmann Composite Sdn. Bhd. was showed in Figure 1.1

Figure 1.1: Sidmann Composite Sdn. Bhd. logo

1.4 Problem statements

Ergonomics has traditionally been used to reduce the number of occupational injuries by discovering those postures and tacks that create significant musculoskeletal stresses. However, the principles which underlie ergonomics can potentially be used to improve productivity as well. Ergonomics guidelines may allow prediction of those postures and workplace layouts that maximize the speed at which employees can work.

The study for the project will be carried out at Sidmann Composite Sdn. Bhd. From the observation at workplace showed in Figure 1.2, productivity is not at the optimum level due to lack of ergonomics features. The company is also lack of ergonomics expert, they also lack of experience on ergonomics investment, this problem may cause them experience a lot of wastes on their organisation.

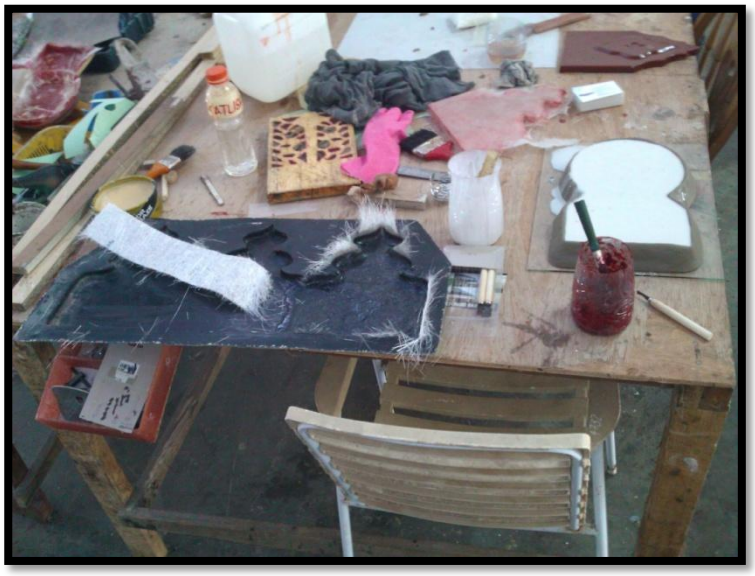

Figure 1.2: Working environment in Sidmann Composite Sdn. Bhd.

1.5 Project Aim and Objectives

There are three objectives for this project,

i) To propose a new work place with ergonomic features for Sidmann Composite Sdn. Bhd.
ii) To reduce the level of musculoskeletal risks of the workplace.
iii) To improve the production process's cycle time.

1.6 Project scopes

This project is carried out at Sidmann Composite SDN. BHD. The study comprise of three element,

i) To study the predetermined time technique used in function task analysis.
ii) To implement ergonomics knowledge in workplace area layout design.
iii) To study the relation between ergonomics and productivity.

CHAPTER 2

LITERATURE REVIEWS

2.1 Workplace working postures

The meaning of ergonomics is the laws of work. Scientific was discipline that ergonomics is the interaction between the person and their working place. There was also got some injuries due to poor ergonomics, commonly caused by repetition and over strain at tendons and joints, unbalanced and prolonged postures, and chronic(cyclic inflammation and weakness). Our human spine was divided into 5 areas, each vertebrae is separated by an inter vertebral disc. The inter vertebral disc was acted as shock absorbers. When we are working for a fixed posture, the disc was gradually pushed over time. It increased pressure on the back wall of the disc, and this will cause the back pain. Figure 2.1show that different postures will produce different inter vertebral disc pressures.

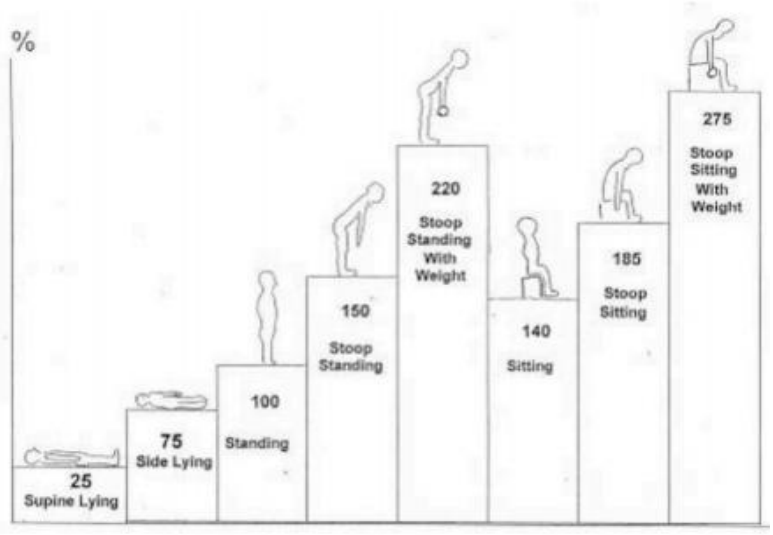

Figure 2.1: Inter vertebral Disc Pressures (Nechemson, 1960)

2.2 Standing Posture

Standing work can be categorized based on leg movements like dynamic activity and static activity. Dynamics activity was the activity that involved leg movement, and static activity was the activity with no leg movement or with standing posture. The person need or want to stand while working at their working place. To be ergonomics, an appropriate desk can be designed and selected for the type of work they performed. According to Grandjean (1997), the desk height for a standing person can range from 28-43" depending on what they work performed, either is for precision, light, or heavy work. Figure 2.2 show that different work surface heights can be used depending on the type of work performed.

Different task require different work surface height,

i) Precision work, 5cm above elbow height.
ii) Light work, 5-10cm below elbow height.
iii) Heavy work, 20-40cm below elbow height.

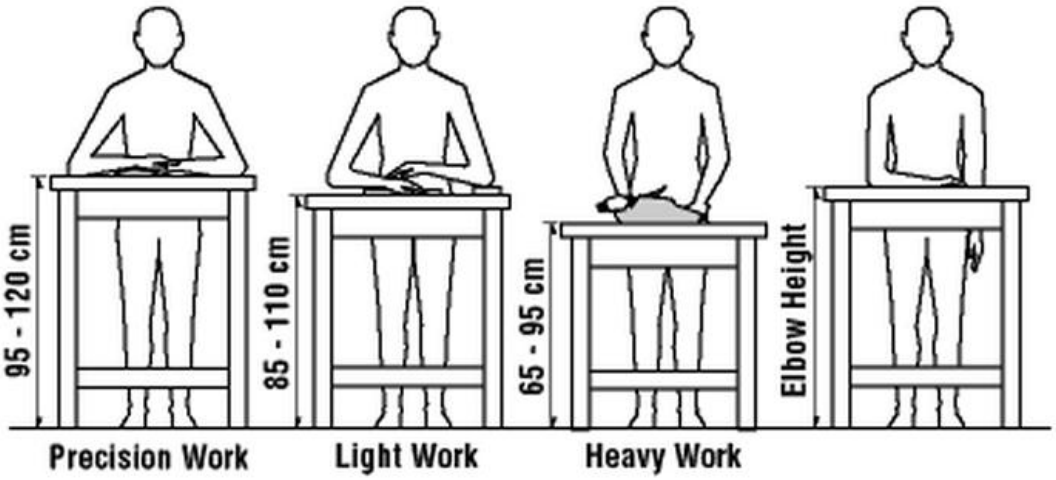

Figure 2.2: Different work surface heights can be used depending on the type of work performed

2.3 Common Workplace Motions

The workplace should be comfortable and adapt to needs as much as possible. A good workplace design should in mind can lead to higher the person productivity and also reduce the risk of injury and illnesses. In Figure 2.3, there are 4 Zone that user might encounter while working:-

i. Zone 0 (Green Zone)
   Preferred zone for most movements. Puts minimal stress on muscles and joints.
ii. Zone 1 (Yellow Zone)
   Preferred zone for most movements. Puts minimal stress on muscles and joints.
iii. Zone 2 (Red Zone)

More extreme position for limbs, puts greater strain on muscles and joints.

iv. Zone 3 (Beyond Red Zone)

Most extreme positions for limbs, should be avoided if possible, especially with heavy lifting or repetitive tasks.

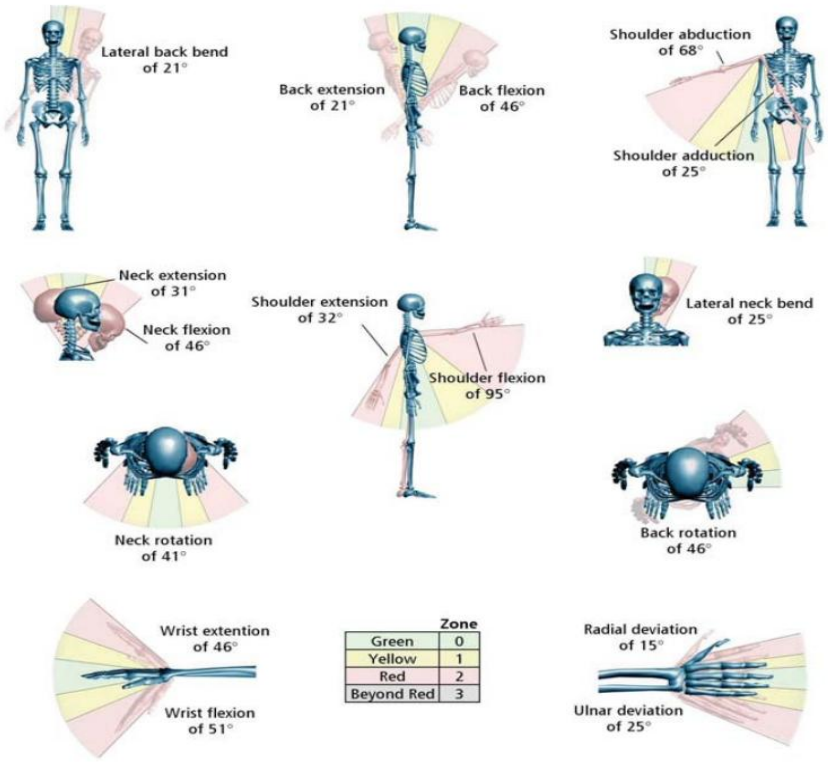

Figure 2.3: Various ranges of motion for different joints

Source: Ergonomics and Design, A Reference Guide [Scott Openshaw and Erin Taylor, 2006]

2.4 Standing Workstation Design Principles

The design of workstations have to demonstrate minimal physical stresses to the worker that may lead to localized fatigue, pain and uncomfortable to the worker.

i. Re-design task to allow worker to sit or stand whenever necessary to do so.
ii. Provide workstation accessories like A cushioned surface to stand on, Adjustable working surface, and other suitable accessories.
iii. Arrange for task variation so that worker can perform different tasks so that allow the legs to move to reduce static loading.
iv. Job or employee rotation.
v. Introduce frequency short breaks for worker to recover from fatigue during working.
vi. Proper and sufficient lighting. The required lighting must varies for general work and close-up work. Postures may be affect the light intensity when worker doing the close-up work, so have to make sure that proper lighting is designed for worker to do general work and close-up work.

Source: Ergonomics and Design, A Reference Guide [Scott Openshaw and Erin Taylor, 2006]

Optimal working postures was a critical factor to achieve work efficiency and human well-being. With the simple rules described in Figure 2.4, it is possible to make a excellent workplace.

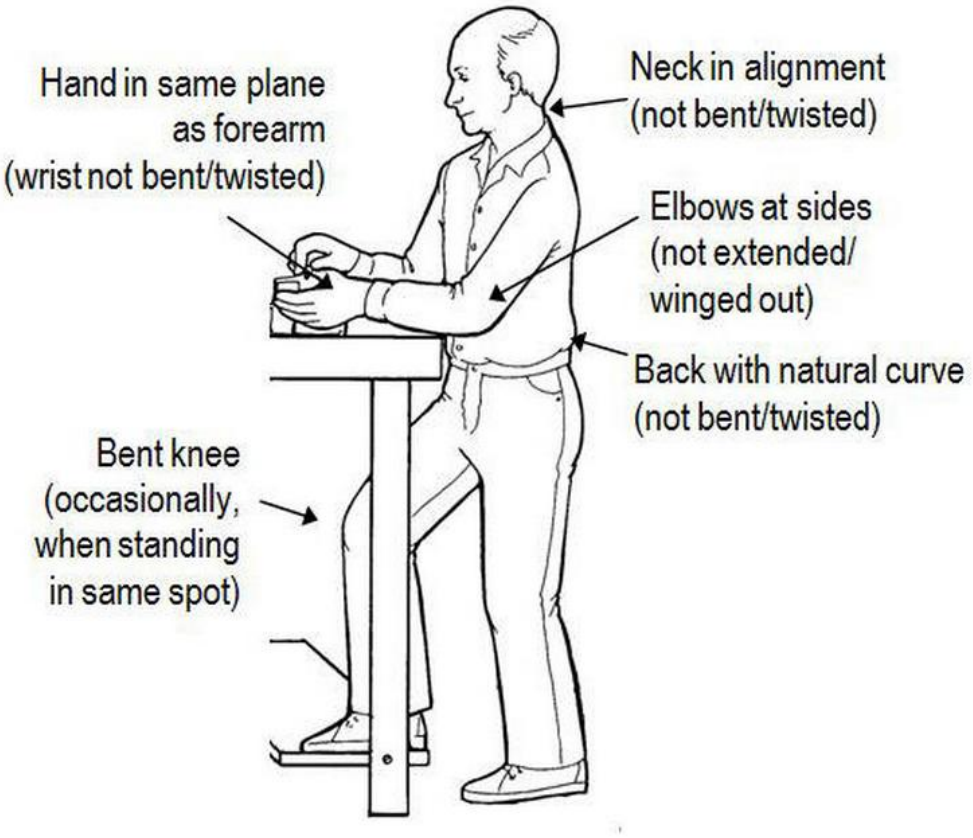

Figure 2.4: Optimal working position (Standing)

Source: Work in Optimal Position [Dan macLeod, Ergonomics consultant CPE, MA, MPH, 2012]

2.5 Examples of Musculoskeletal Disorders

Figure 2.5 shows the example of musculoskeletal disorders.

Body Parts Affected	Symptoms	Possible Causes	Workers Affected	Disease Name
thumbs	pain at the base of the thumbs	twisting and gripping	butchers, housekeepers, packers, seamstresses, cutters	De Quervain's disease
fingers	difficulty moving finger; snapping and jerking movements	repeatedly using the index fingers	meatpackers, poultry workers, carpenters, electronic assemblers	trigger finger
shoulders	pain, stiffness	working with the hands above the head	power press operators, welders, painters, assembly line workers	rotator cuff tendinitis
hands, wrists	pain, swelling	repetitive or forceful hand and wrist motions	core making, poultry processing, meatpacking	tenosynovitis
fingers, hands	numbness, tingling; ashen skin; loss of feeling and control	exposure to vibration	chain saw, pneumatic hammer, and gasoline-powered tool operators	Raynaud's syndrome (white finger)
fingers, wrists	tingling, numbness, severe pain; loss of strength, sensation in the thumbs, index, or middle or half of the ring fingers	repetitive and forceful manual tasks without time to recover	meat and poultry and garment workers, upholsterers, assemblers, VDT operators, cashiers	carpal tunnel syndrome
back	low back pain, shooting pain or numbness in the upper legs	whole body vibration	truck and bus drivers, tractor and subway operators; warehouse workers; nurses aides; grocery cashiers; baggage handlers	back disability

Figure 2.5: Examples of Musculoskeletal Disorders

Source: U.S. Department of Labor Occupational Safety and Health Administration, 2000

2.6 Tools assessing Musculoskeletal Risk

There are two suitable tools that can assess in this project, Rapid Entire Body Assessment (REBA), and Strain Index (SI). In this two kind of tools, REBA is a tool that assess postural score for body (i.e. legs, trunk, neck.), and the upper distal extremities (i.e. upper arm, lower arm, and wrists.). SI is a tool that assessed a task's upper distal extremity (i.e. finger, hands, wrist.). These tools are designed to measure the type of musculoskeletal risk observed in operating tasks.

2.7 Rapid Entire Body Assessment (REBA)

REBA is a tool to assess the posture for risk of work-related musculoskeletal disorders (WRMSDs), it was proposed by Hignett and McAtamney,UK (2000). It is designed to provide a quick and easy observational postural analysis for whole body activities in health-care and other service industries.

The REBA score can be calculated by referring the instruction highlighted in Figure 2.6 to get the result from REBA Assessment Worksheet Tables. From the Figure 2.6, analyst can get the score for Group A (Trunk, Neck and Legs) postures and the Group B (Upper Arms, Lower Arms, and Wrists) postures for left and right hand. Score A is the sum of the Table A score and the Load / Force score. Score B is the sum of the Table B score and the Coupling score for each hand. Score C is read from Table C, by entering it with the Score A and the Score B. The REBA score is the sum of the Score C and the Activity score. The degree of risk is found in the REBA Decision table.

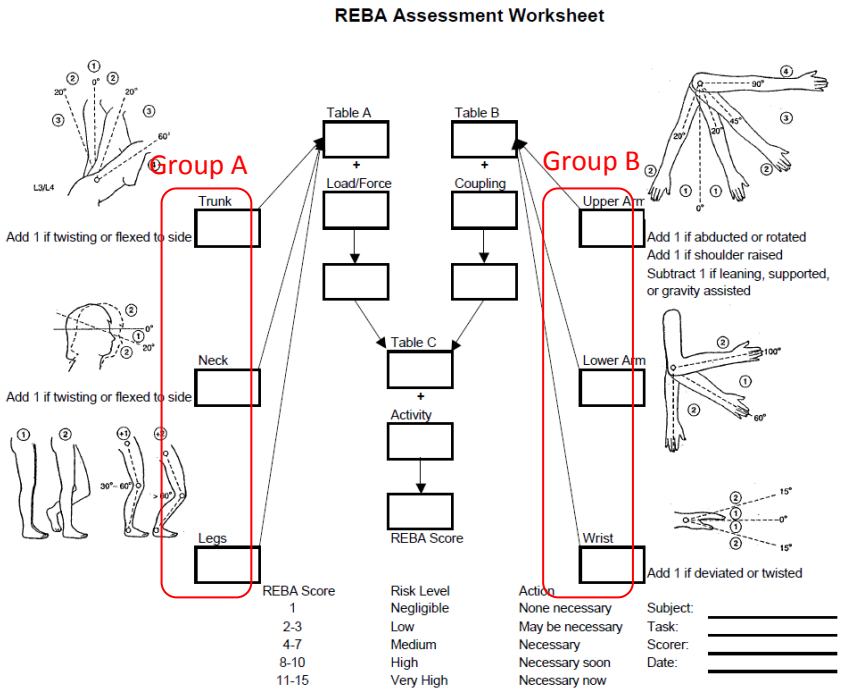

Figure 2.6: REBA Assessment Worksheet

2.8 Strain Index (SI)

The Strain Index is a tool used to evaluate a job's level of risk for developing a disorder of the hand, wrist, forearm, or elbow. This tool is used to evaluate six task variables like intensity of exertion, duration of exertion, exertions per minute, hand/wrist posture, speed of work, and duration of task per day. The sum of the six task variable multipliers produces a number called the strain Index score. In Figure 2.7, the score is used to identify the level of task risk. This tool is fully described by Moore, J. S. and Garg, A., 1995.