

DESIGNING WORKBENCH ON THE SAWMILL STATION TO REDUCE PHYSICAL LOAD AT SURYA MAS FACTORY

Lamto Widodo¹, Andres¹, Fransisca Lipin²

¹Lecturer of Industrial Engineering Department, Tarumanagara University, Jakarta

² Alumni of Industrial Engineering Department, Tarumanagara University, Jakarta
e-mail: lamtow@yahoo.com; fransiscalipin@yahoo.com

ABSTRACT

Surya Mas Factory is performed sawing activity slet aluminum and iron for Rolling Door. Sawing activity is done manually, by using the technology of metal saws and carried out in conditions of squatting. Based on the results of a preliminary study, 100% of respondents state very uncomfortable with the squatting conditions at work. Based on the questionnaire Nordic Body Map which is refers to workers, said that the body parts that often have physical complaints are complaints at the waist, legs, calves, ankles, back, and neck. With the existence of these complaints, it is proposed an ergonomic workbench design called FLET. FLET is a workbench that has a tools intended for sawing objects work done in a standing position. The design of FLET use an antropometric approach, which antropometric data used is high standing elbow condition. Designing Work Desk FLET using CATIA software and also use RULA analysis. At the time of sawing in a crouched position, RULA analysis showed a value of 6 which means working posture is outside the range of safe, while at the draft table FLET results the value of 1 and 2, which means that the design is acceptable.

Key words: Ergonomics, Anthropometry, FLET workbench, RULA

1. INTRODUCTION

Sawing is an activity cutting a workpiece that is quite important and fairly often used in the manufacturing industry. Today, there are many workers who cut the workpiece using a hacksaw manually. Most of the workers cut the workpiece with a squatting position in a long time. Squatting posture in a lamai can cause pain and sick on particular body parts. By doing this position every day possible physical incidence of disorders unlikely to be a permanent injury.

Surya Mas company is a commercial enterprise engaged in sales of doors and door repair services where commercial enterprise has 9 employees. In Surya Mas Company, workers sawing a squatting position without any special workbench. Squatting position raises a variety of discomfort, rapidly experience fatigue, and physical complaints such as aches and pains on the waist. Unconsciously this fact significantly influence for employees performance to further perform activities. The purpose of this study was to design a

workbench for sawing the iron bars, aluminum bars, and more. This table is designed in such a way that the resulting working desk ergonomically, practical and functional, with the aim to reduce physical complaints in workers sawing activity.

2. LITERATURE REVIEW

2.1. Product Design

According to Ginting (2010), the design can be interpreted as one of the extensive activity of design and technological innovation are proposed, created, exchanged (through buying and selling) and functional. The focus attention of an ergonomically assessment will point to the achievement of a designing a product that meets the requirements of 'fitting the task to the man', so that the designer should always think about the interests of human, the subject of safety, health, security and comfort. Size of a tool (product) in the form of the workpiece and the installation should be designed according to the size of human body. So, instead of of human

adapted the tool, but the tool should be adjusted to of human. In order to design a device according to human standards, product design should be adjusted to human anthropometric data.

2.2. Ergonomics

According to Nurmianto (1996), the term "ergonomics" is derived from the Latin is ergos (work) and nomos (laws of nature) and can be defined as the study of human aspects of the environment are reviewed in anatomy, physiology, psychology, engineering, management and designs. Ergonomics is also called Human Factors. Ergonomics are also used by some experts on the the field such as: anatomist, architecture, product design, physics, physiotherapy, occupational therapy, psychology, and industrial engineering. Application of ergonomics generally include engineering activities (design) and redesign. This can include hardware such as tools, benches, platforms, chairs, workholders, controls, instrument displays, acces ways, doors, windows, and others. Ergonomics may contribute as well as the work of an organization design, software design, improving safety and health, as well as the design and evaluation of products.

2.3. Anthropometric

According to Nurmianto (1996), anthropometry is a set of numerical data relating to the physical characteristics of the human body size, shape and strength and applicability of these data to the handling of design issues. Anthropometric term derived from 'anthro' meaning human, and 'metric' which means the size. Anthropometric The data relating to the physical condition of the human body, such as height, weight, body size, head circumference, and so on. The data dimension of human body is useful for designing products with the purpose of determining compatibility of the products and the people behind the. Anthropometric The data is very important in determining the device and how to operate it.

2.4. Biomechanics

According to Philips (2000), biomechanics is the study of mechanics applied to

biological systems. Biomechanics is a sub-discipline of biophysics and biomedical. Biomechanics consists of three topics, that is:

1. Biostatics: the study of the structure of living beings are related to the forces when they interact.
2. Biodynamics: the study of the fundamentals and the distribution of motion (force related) made living beings.
3. Bioenergetics: the study of energy transformations that occur in a living body. Biothermodynamics related to bioenergetic processes.

2.5. Nordic Body Map

Nordic Body Map is one of subjective measurement method to measure muscle soreness of workers. Questionnaires Nordic Body Map is one of ergonomics checklist questionnaire. Nordic Body Map Questionnaire is a questionnaire that is used to determine the discomfort of the workers. This questionnaire uses images of the human body that is divided into nine main sections. If needed, body image can be divided into more carefully into 27 parts of the body like the upper arm below the upper left and lower right arm. Each respondent had to fill in whether or not the complaint suffered, both before and after doing the work. Then it will count the number of answers given by the respondents and calculated the percentage each member of the body.

2.6. RULA (Rapid Upper Limb Assesment)

According to Cahyati (2005), Rula is a tool to evaluate risk factors postures, static muscle contraction, repetitive movements, and styles used for a particular job. Each factor has contribution of each to a calculated value. Those values are summed and applied to the table to determine the Total Score. Total score indicates the extent to which workers are exposed to the risk factors above and based on that value, it can be suggested action will be taken. Here is the value of the analysis RULA:

A value of 1 or 2 = Action Level 1. Green color. For this range of work posture can be

worth 2 or less for each group and the value of muscle contraction and force of 0. Recommendations: risks of workers exposed to risk factors is relatively low and is still considered acceptable, as long as workers are not too long or repeated in these conditions.

Value of 3 or 4 = Action Level 2. Yellow color. Posture work outside the safe range, or working posture is still acceptable, but characterized by repetitive movements, static muscle contraction, or spending a significant force. Recommendation: further analysis and possible changes needed.

Value of 5 or 6 = Action Level 3. The color orange. Posture work outside the safe range. Repetitive movements and / or static muscle contraction is required, and may be required significant expenditures style. Recommendation: Further analysis and change is needed immediately.

Value 7 = Action Level 4. Red color. Posture work outside the range of safe, repetitive movements and / or static muscle contraction is required, and may be required significant expenditures style. Recommendation: Further analysis and change is needed very soon.

3. RESULTS AND DISCUSSION

Data collection was done by spreading questionnaire consisting of general questionnaire and questionnaire Nordic Body Map at UD Surya Mas to workers. Data collection Body Map Nordic questionnaire aims to find parts of the body of workers was sick at the time before and after work. After data collection, the data processed and further it can be concluded that there is an increase in complaints by workers in some parts of the body after sawing job, especially on the waist, left calf, right calf, left ankle, right ankle, left leg, and right leg.

The complaints in some parts of the body indicates that the work stations in the sawing must be corrected immediately. Ten sequences of physical complaints ranging from the most pain can be viewed in Table 1.

After doing rank, the next stage that is to analyze the possibilities of the cause of the of physical complaints. Here's a table of the analysis of the possible causes of physical complaints suffered by of workers (Table 2).

Table 1. Sequence Physical Complaints

No	Complaint	Not pain	Enough Pain	Pain	Very Pain
1	Complaint on the waistband	0	0	2	7
2	Complaints on the left leg	0	0	2	7
3	Complaints on the right leg	0	0	2	7
4	Complaints on the left calf	0	0	3	6
5	Complaints on the right calf	0	0	3	6
6	Complaints on the left ankle	0	0	4	5
7	Complaints on the right ankle	0	0	4	5
8	Complaints on the the back	0	1	4	4
9	Complaints on the neck	0	2	4	3
10	Complaints on the the right forearm	0	2	4	3

Table 2. Analysis of Possible Causes of Physical Complaints

No	Complaint	Analysis of Possible Causes of Physical Complaints
1	complaint on the waistband	Results of direct interviews of workers concluded that the position of sawing is done in a squatting position allows waist pain Under squat, looks very bent spine, causing excessive load on the muscles of the back, it caused the emergence a complaint to the spine and back pain In the squat position and bend the narrowing distance between the vertebrae which resulted in excessive pressure on the pads between segments. Due to the pressure (compression) continues, the pads pressing of nerve fibers that cause pain around the spine, causing the emergence of a complaint at the waist
2	Complaints on the right and left leg	Work squatting position is the position was not natural causes a pedestal legs and accept the burden of excess weight. This can cause to pain and legs complaints such as a worker suffered soreness and pains The position of legs that tends to tiptoe when sawing can cause pain and tingling Position the legs that hold the upper thigh can cause the legs become tired quickly
3	Complaints on the right and left calf	The position of the thigh and calf were folded together when squatting position can cause excessive soreness. The position folded in a long period of time can cause excessive muscle contractions. It can cause a variety of complaints such as cramps in the calf, tingling, rapidly feel sore, pain, etc.
4	complaints on the right and left ankle	Squatting position when sawing can cause ankles are bent conditions. Squatting position causing excessive load on the feet. Conditions ankle bent in a period of time long enough to cause the flow of blood into the circulation of less smoothly, causing a variety of complaints such as pain, numbness, etc.
5	complaints on the the back	Position of work crouched in a long time can cause lower back pain due to condition the joints of the spine in a state of bowing
6	complaints on the neck	The position of head which is concentrated look towards objects sawed continuously and for long periods of time allows for the emergence of complaints in the neck. The position eyes look towards the object that is located under head causes the neck muscles should be flexed causing excessive interest that can cause pain and cramping
7	complaints on the the right forearm	The position sawing is done continuously can cause the arm became sore and stiff

Based on the results of the questionnaire and the analysis of the possible causes of a complaint, the design phase is then performed improved the work station. Results of improved work at the sawing station is the workbench that contains a tool intended to support the activities of sawing. The dimensions of the design workbench sawing (FLET) is determined based on anthropometric data of

Indonesian people. It is intended to produce a good design workbench and ergonomic design that is expected to reduce physical complaints experienced by the workers.

The dimensions of the body that is used is a high elbow in a standing position, to determine the height workbench suitable sawing.

Rula Analysis is a tool to evaluate risk factors postures, static muscle contraction, repetitive movements, and styles used for a particular job. Rula analysis aims to identify the move-move that led to the risk of trauma or injury to the cumulative

(cumulative trauma disorder) for workers sawing activities. The image below is the result of analysis of the activities of sawing using FLET workbench.

Rula Analysis of sawing activity in a squatting position

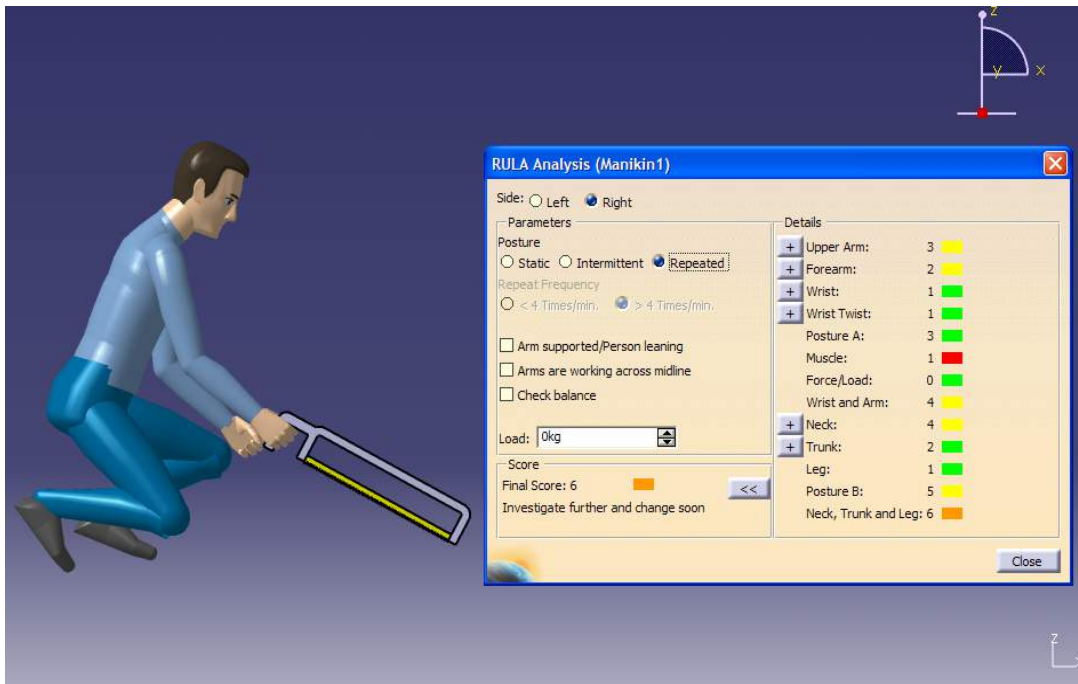


Figure 2. A side view of Work Sawing In Squatting Position

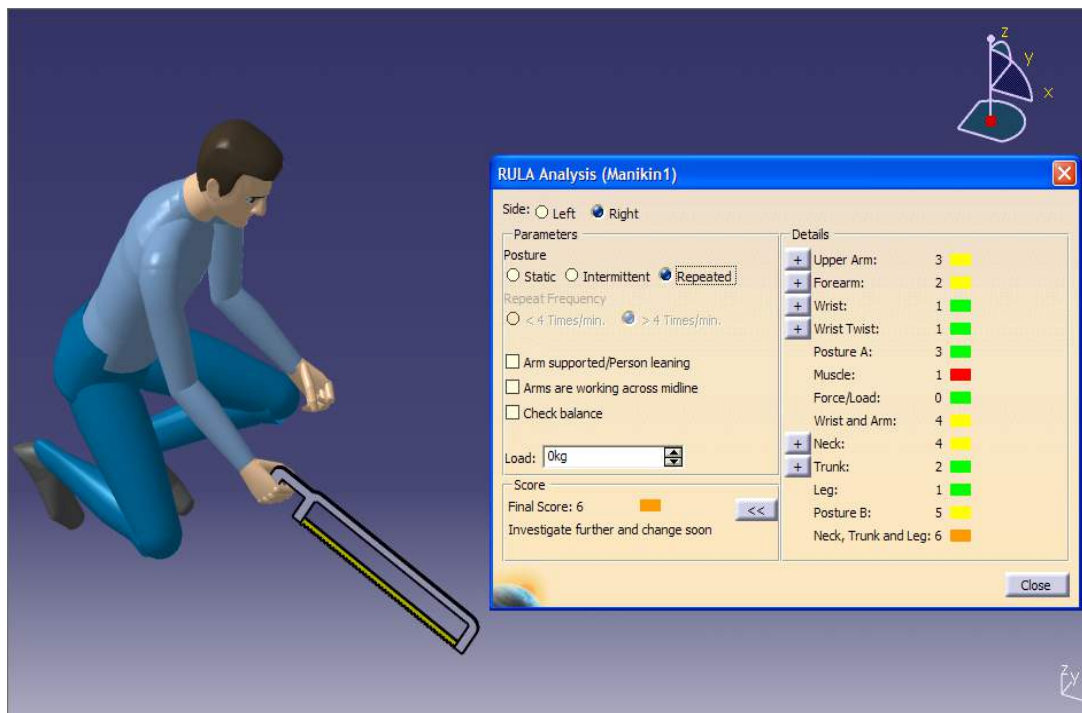


Figure 3. A front view of Work Sawing In Squatting Position

RULA Analysis of FLET Workbench

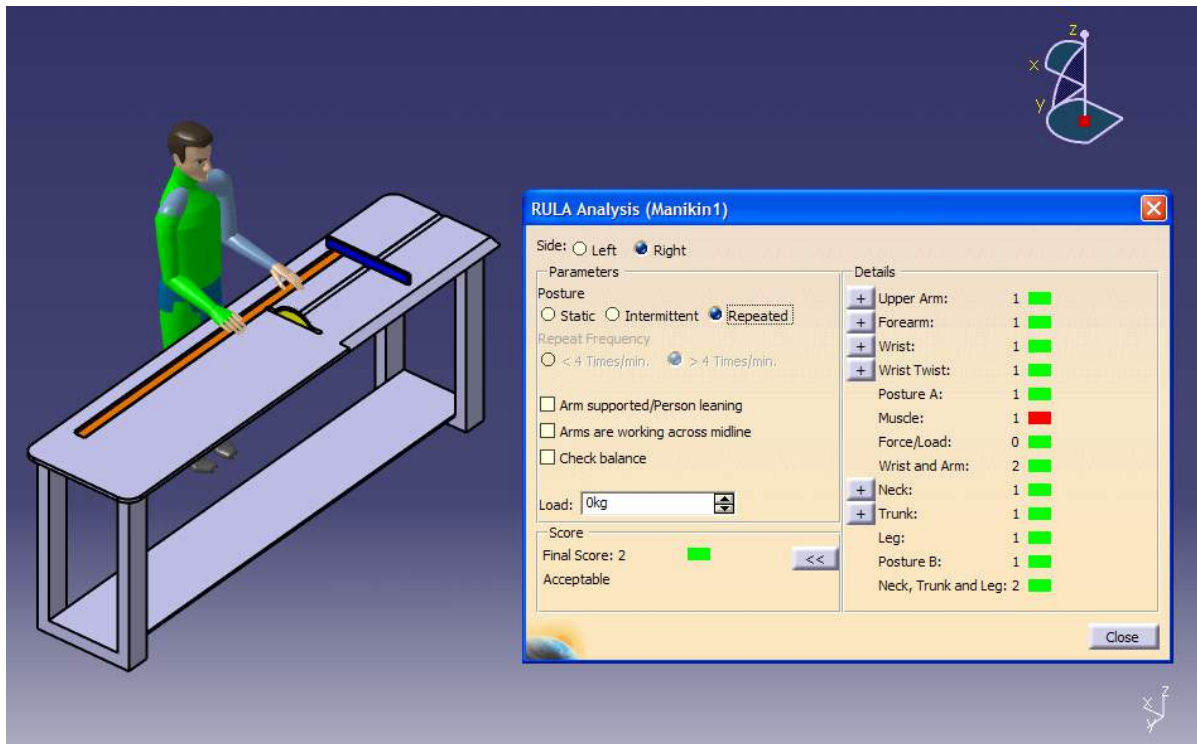


Figure 4. Sawing job by FLET workbench

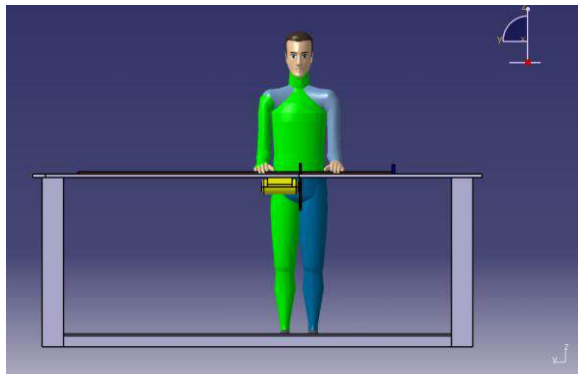


Figure 5. The front view of Sawing job by FLET workbench

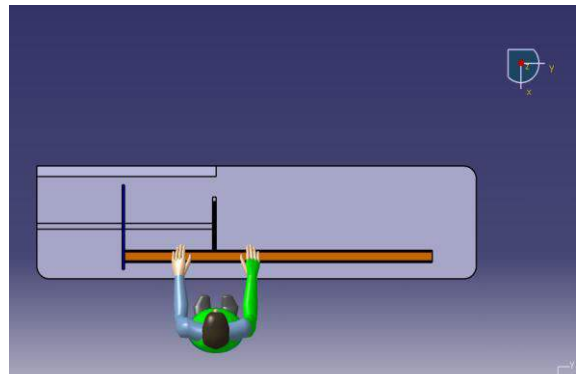


Figure 6. The top view of Sawing job by FLET workbench

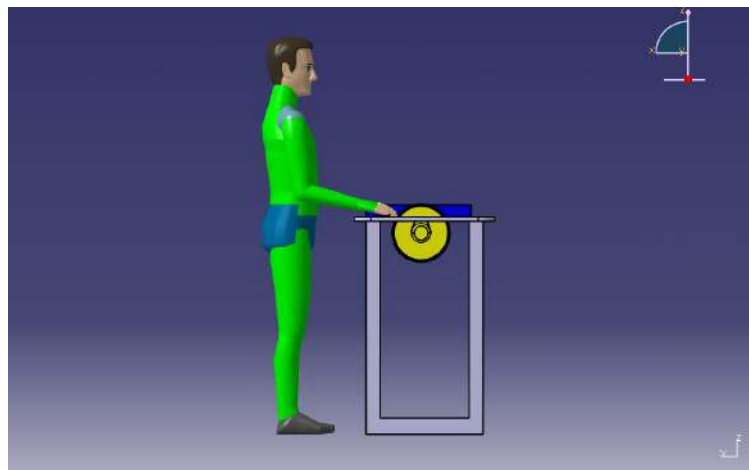


Figure 7. The side view of Sawing job by FLET workbench

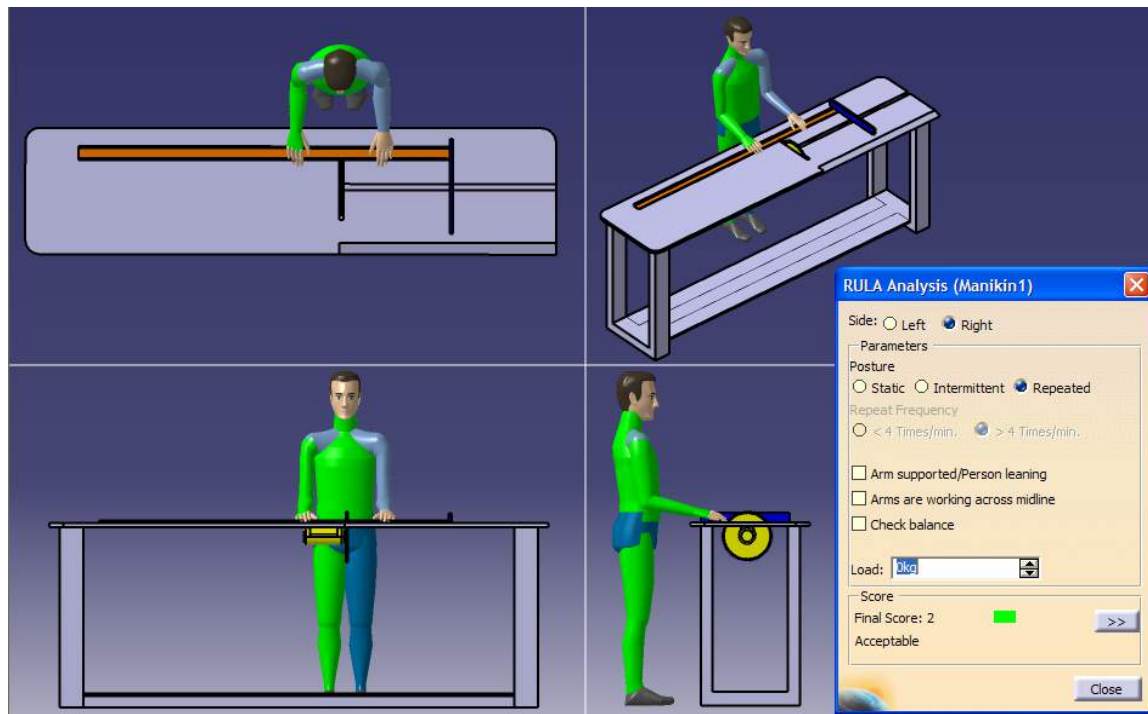


Figure 8. RULA Analysis of the sawing job using FLET workbench

Rula analysis results on the job with a work desk FLET sawing generate a value of 2, meaning that it can be accepted. These results indicate that by changing the workbench, working conditions became more ergonomic.

4. CONCLUSION

The conclusion that can be drawn from this study are as follows:

1. The body parts most complained by workers in Surya Mas Factory when sawing activity is at the waist.
2. Working conditions in Surya Mas Factory is currently using manual chainsaw by a squatting position in the process. While on FLET Work Table, work processes using a cylinder chainsaw and position work in a state of stand up and do by pushing motion.
3. The design workbench FLET is improved design of the work station work squatting position and get an ergonomic working position. It can be seen from the result of analysis that demonstrate the value Rula 1 and 2 on each part of the body, where these values indicates that the table has been ergonomic and design FLET acceptable. While the results of the

analysis Rula when conditions indicate a 6 squatting posture, which means working outside the safe range so it needs to be analyzed and improved.

5. REFERENCES

- (a) Cahyati, Sally. Riyanto, Sugeng, F.X. S. Asep. Yanto, 2005, *CATIA V5 Practical Guide Mechanical designer*, Fakultas Teknologi Industri Universitas Trisakti, Jakarta.
- (b) Ginting, Rosnani, 2010, *Perancangan Produk*, Graha Ilmu, Yogyakarta.
- (c) Nurmianto, Eko, 1996, *Ergonomi: Konsep Dasar dan Aplikasinya*, Guna Widya, Surabaya.
- (d) Philips, Chandler Allen, 2000, *Human Factors Engineering*, John Wiley and Sons, New York.
- (e) Santoso, Gempur, 2000, *Ergonomi, Manusia, Peralatan dan Lingkungan*, Prestasi Pustaka, Jakarta.
- (f) Sriwarno, Andar Bagus, "Efek Ketinggian Permukaan Duduk Terhadap Beban Kerja Dalam Posisi Kerja Jongkok", diakses 19 Oktober 2012.