Vol.7, No.2: 31-12-2021
ISSN Print: 1411 – 951 X, ISSN Online: 2503-1716

Proposed Posture Improvement for Tile Workers Using the REBA Method

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doi: https://doi.org/10.24843/JEI.2021.v07.i02.p08
Article Received: 28 July 2021; Accepted: 2 December 2021.; Published: 31 December 2021

Abstract

Sokka Super Sid Tile SMEs (Small and Medium Enterprises) is one of the SMEs that produce roof tiles in the Godean area. This SMEs has problems regarding workers' body positions that are not ergonomic and are carried out for a long period of time (around 7-8 hours / day) and are repeated for days, resulting in bad effects that are often felt by workers when doing their work such as when bending over, back pain, cramps in muscles and decreased ability to move. This posture issue will cause pain in the joints, muscles and ligaments, and therefore will have an impact on discomfort while working. This study aims to determine body posture in the working position after improvements have been made and provide recommendations for improvements to reduce pain felt by the workers by proposing an ergonomic work tool design. The Rapid Entire Body Assessment (REBA) method is used to determine the risk of injury to the posture of workers at each work station. Data were collected through observation, interviews and taking photo documentation at each work station. Prior to the improvement, activities that have a risk level of 2 are at the work stations of refining, pressing, and drying. Risk level 3 is at the milling, burning, and mixing work stations. Risk level 4 is at the sun-drying work station. Improvements given to the UKM are desk facilities to make their work easier and to reduce the risk of injury to workers' bodies. After improvements are implemented, the results obtained show risk level 1 is at the work station of milling, drying, refining, and burning. Risk level 2 is at the mixing, pressing and sun-drying work stations. It is concluded that the improvement of body posture in drying workers is in accordance with the ideal work posture.

Keywords: Tool Design, Tile Products, Posture, REBA

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Abstrak

UKM Genteng Sokka Super Sid merupakan salah satu UKM yang memproduksi genteng di daerah Godean. UKM ini memiliki permasalahan pada posisi tubuh pekerja yang tidak ergonomis dan dilakukan dalam jangka waktu yang lama sekitar 7-8 jam/hari dan diulang berhari-hari, dampak buruk yang sering dirasakan oleh pekerja saat melakukan pekerjaan nya seperti membungkuk, nyeri punggung, kram pada otot dan penurunand anggota gerak. Hal tersebut akan menimbulkan keluhan pada persendian, otot dan ligamen dengan adanya hal tersebut akan berdampak pada ketidaknyamanan saat bekerja. Penelitian bertujuan mengetahui postur tubuh pada posisi kerja setelah dilakukan perbaikan dan memberikan rekomendasi perbaikan untuk mengurangi keluhan pada pekerja dengan usulan desain alat kerja yang ergonomis. Metode *Rapid Entire Body Assessment* (REBA) digunakan untuk mengetahui resiko cedera pada postur tubuh pekerja di setiap stasiun kerja.

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Pengambilan data dilakukan melalui observasi, wawancara dan mengambil dokumentasi foto di setiap stasiun kerja. Sebelum dilakukan perbaikan aktivitas yang memiliki level resiko 2 yaitu pada stasiun kerja penghalusan, pengepresan, pengeringan. Level resiko 3 yaitu pada stasiun kerja penggilingan, pembakaran, pencampuran. Level resiko 4 yaitu pada stasiun kerja penjemuran. Perbaikan yang diberikan kepada UKM yaitu fasilitas meja untuk mempermudah pekerjaan dan mengurangi terjadinya resiko cedera pada tubuh pekerja. Setelah dilakukan perbaikan diperoleh hasil berupa level resiko 1 yaitu pada stasiun kerja penggilingan, pengeringan, penghalusan, pembakaran. Level resiko 2 yaitu pada stasiun kerja pencampuran, pengepresan, penjemuran. Disimpulkan bahwa perbaikan postur tubuh pada pekerja penjemuran sesuai dengan postur kerja yang ideal.

Kata kunci : Desain Alat, Produk Genteng, Postur Tubuh, REBA.

INTRODUCTION

Transporting and moving materials manually in the production process requires the human resources and it is needed by SMEs (Small and Medium Enterprises) in Indonesia. Traditional material transportation can be done easily and does not require too much handling costs. Some UKMs ignore the consequences of manually transporting material loads, especially at the cost of comfort and health of the workers (Herdiana, 2012).

The way of moving by relying on human power without using a machine is called Manual Material Handling (MMH). One of the effects caused by improper MMH activities is pain that occurs in the musculoskeletal system. Musculoskeletal disorders (MSDs) are disorders that attack the muscles, nerves, tendons, ligaments, joints, cartilage, and spinal nerves. Complaints occurring in the musculoskeletal system are pains in parts of the skeletal muscles that are felt by a person ranging from very mild pain to very painful. If the muscle receives a static load repeatedly and for a long time, it can cause pain in the joints, ligaments and tendons (Rahayu, 2012).

Posture is a geometric arrangement of body parts that are closely related to other body organs. Posture consists of joints, tendons, ligaments and muscles. If the good posture can be used correctly then there is a balance in doing activities (Ristanto & Uswatun Insani, 2014). Work postures that cause complaints or irregularities in body positions include reaching back, turning in the wrong direction, working at a height above the head, bending wrists for too long, kneeling, bending, and squatting. Risks that can occur if incorrect posture is done long-term and unnoticed for some time can cause workers to experience complaints such as pain, numbness, swelling, and stiffness, which can directly affect the productivity of workers (Nur et al., 2016).

The results of the production can be sold at a price that is able to compete in the market. The problem that usually occurs in SMEs is the lack of work facilities that can assist workers in carrying out production activities. The need for training on how to manufacture products must be designed in such a way that workers can better understand and know about the risks that can occur to workers during production activities. Reduction of risks or dangers to workers is carried out by using complete personal protective equipments when doing their work, knowing standard procedures in the event of an emergency and conducting training according to the needs of SMEs.

Sokka Super Sid SMEs is engaged in the production of roof tiles and it is located at Klangkalan I Rt 01 Rw 03 Godean, Sleman, DIY. The number of workers in this study were 7 people and there were 7 work stations, namely mixing, pressing, drying, refining, milling, sun-drying and burning. There are tile SMEs that are still using traditional tools without using automatic machines. All production departments are deemed to be lacking in ergonomics when doing their work. At the mixing work station there is a hoe to mix raw materials, but it is deemed not effective because the handle is too short, and so it forces the worker’s body to

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bend more when using the hoe. The milling work station has a milling tool that is too high so workers would need to stand on tiptoe to pour clay into the milling tool. The pressing work station has a pressing tool by rotation but the tool is too heavy to use. The drying rack used by drying work station is too high so workers would need to stand on tiptoe. The worker at the refining work station uses feet to support the roof tiles in production process. The worker at the drying work station does not use tools when carrying the tiles so that his waist and hands are often under heavy loads. Workers at the burning work station often arrange roof tiles with tilted body positions.

The positions of the workers' body that are not ergonomic and are carried out for a long period of time (around 7-8 hours / day) and repeated for days, can cause bad effects such as hunching back, back pain, muscle cramps and decreased ability to move. This can lead to a decrease in work productivity as a result of complaints associated with Musculoskeletal Disorders felt by workers. An ergonomic approach can increase the effectiveness and efficiency of workers and other activities, as well as improve safety, reduce fatigue and injury, increase comfort and increase job satisfaction.

Problems or impacts on working conditions experienced by workers in tile-producing SMEs certainly involve the need of physical activities that can drain a lot of energy in doing work, particularly if workers do it continuously without sufficient rest time. Workers are only given 1 hour of rest during their work and sometimes they ignore this break in order to meet production targets due to high consumer demand, thus causing pressure felt by workers in doing their work.

High physical activity and irregular rest periods can cause workers to feel tired easily. In addition, almost all workers are dominated by a standing work attitude in addition to lack of concentration. This can cause the workers' posture while doing their job to be susceptible to injury.

Length of work is the amount of time to do a job, which can cause a risk factor the longer that job is being carried out. The length of work can be seen from how many hours worked / day. In tile-producing SMEs the working hours is typically 8 hours per day. Burdens that arise from working can be in the form of physical, mental or social burdens experienced by workers. A worker who physically works hard, such as loading and unloading goods at a port, bears more physical burdens than mental or social burdens. Meanwhile, the workload of an entrepreneur or manager, his responsibility is a mental burden that is relatively larger than the physical burden that is demanded by his job (Utami, 2017).

From information obtained from observations and interviews in trying to identify problems, workers must perform some stages when producing roof tiles, workers lack of understanding of the risks when carrying out production activities, improvements are needed to reduce complaints to workers during the tile production process and suggestions for ergonomic work facilities.

The purpose of this study is to determine body posture in the working position after improvementss were made, to provide recommendations for improvements to reduce the occurrence of complaints to workers and to provide design proposals for ergonomic work facilities. The benefits obtained from this study are: knowing the risk of injury when making roof tiles, providing ergonomic recommendations to reduce injuries or worker complaints, and improving body posture when doing work.

To make improvements, the REBA method is needed to analyze the worker's posture. Some parts of the body can be used in analyzing work postures to reduce the occurrence of joint injuries in the body such as the neck, back, arms, wrists, feet and fingers. So we need a study to make it easier to analyze and find out posture that can cause injury to the joints.

Rapid Entire Body Assessment (REBA) is a method in the field of ergonomics that is used to quickly assess the posture of a worker's neck, back, arms, wrists and legs

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(Middlesworth, 2014). Assessment of upper limbs and lower limbs with muscle function and external loads experienced by the body. The coding system is used to generate a list of actions that indicate the level of intervention needed to reduce the risk of physical injury to the operator (Sulaiman & Sari, 2018).

Solidworks is a design program that is widely used to work on product design, machine design, mold design, construction design or other engineering needs. Solidworks can be equipped with tools that are often used to calculate and analyze design results such as stress and strain, so that they can find out whether the component to be designed is reliable or not (Alejandro Reyes, 2014).

METHOD

The research methodology uses the Rapid Entire Body Assessment (REBA) method. The object of this research is SMEs producing Sokka Super Sid roof tiles located at Klangkalan I Rt 01 Rw 03 Godean, Sleman, DIY. The total population in this study are 7 people. The REBA method is equipped with an external load of work activities, in the REBA method the body parts are divided into two groups, namely group A consisting of the back (torso), neck, and legs, and group B consisting of the upper arms, forearms, and wrists, while group C consists of combined score between group A and group B. The method of collecting data is by means of observation, interviews and documentation (Middlesworth, 2014).

RESULTS AND DISCUSSION

Data was collected by means of observation, interviews and documentation on workers at the Sokka Super Sid Tile SMEs. The production process for making roof tiles consists of several work stations, namely mixing raw materials, grinding soil, pressing, drying, refining, sun-drying and burning. The body posture taken is the largest percentage of complaints from each tile production work station, which can be seen in Table 1.

Table 1. REBA score results for all work stations

NO	Work Station	Neck	Torso	Legs	Upper Arm	Lower Arm	Wrists	REBA Score
1	Refining	1	1	3	1	2	1	4
2	Pressing	2	1	4	3	2	1	6
3	Drying	2	2	3	2	2	2	7
4	Milling	2	1	4	2	2	2	8
5	Burning	3	4	2	2	2	1	9
6	Mixing	1	4	3	3	2	2	10
7	Sun-drying	2	4	3	3	2	2	11

Based on the percentage of the largest complaints experienced by workers, namely the sun-drying work station. Documentation of body posture by tile production workers is then processed using the REBA method as shown in Figure 1.

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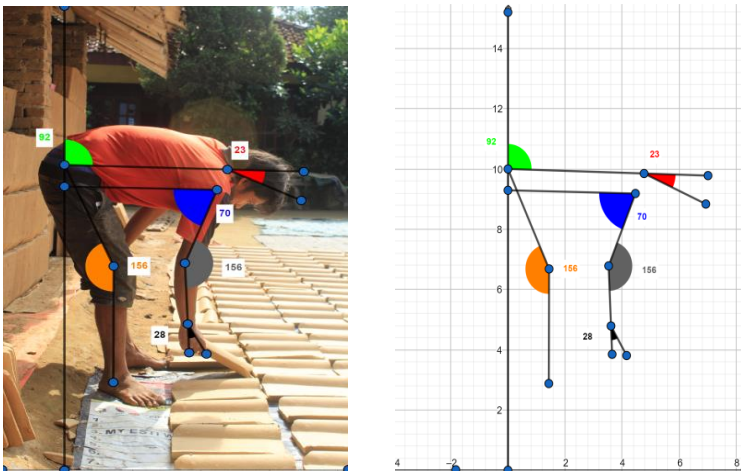

Figure 1. Drying Station Working Position

Worker has body posture as shown in Figure 1. The body posture score of the tile drying process can be seen in Table 2.

Table 2. Body Posture Score of Drying Work Station

Posture	Score	Information	Result
Neck	2	23º forward	2
Torso	4	92º forward	4
Legs	1	Legs are not balanced, +2 because legs are forming 156º angle	3

The posture of the worker in tile production at a drying work station shows that the neck posture is given a score of 2 because the angle is 23º forward, the torso is given a score of 4 because it is 92º forward, and the legs are given a score of 1 because the position of the feet is not balanced and given +2 because the legs form 156º angle as can be seen in table 1, so the final foot score is 4. The results of observations on the posture of the neck, torso and legs when working the score is entered into table A, the score is 7 which can be seen in Table 3.

Table 3. Table A Working Position of Drying Station

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Torso	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

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After obtaining a score in table A, it is continued with scoring in table B. The posture of the tile production worker shows that the upper arm is given a score of 3 because of the large 70^o forward angle, the forearm is given a score of 2 because of the 156^o forward angle, the wrist is given a score of 2 because the angle of 28^o down can be seen in Table 4.

Table 4. Body Posture Score of Drying Work Station

Posture	Score	Information	Result
Upper Arms	3	70^o forward	3
Lower Arms	2	156^o forward	2
Wrists	2	28^o down	2

The score obtained from the results of observing the posture of the upper arm, forearm and wrist while working the score is entered into table B and a score of 5 is obtained and there is no additional grip score, because when working, holding the tool properly can be seen in table 5.

Table 5. Table B Working Position of Drying Station

Table B		Upper Arms					
		1			2		
	Wrists	1	2	3	1	2	3
Upper Arms	1	1	2	2	1	2	3
	2	1	2	3	2	4	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

The results of the analysis showed that the score in table A was 8 while B in table C, so a score of 10 was obtained for the tile production process as seen in Table 6.

Table 6. Table C Working Position of Drying Station

Table A Score	Table B Score											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

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The recapitulation of the body posture score of the tile production process is shown in Table 7.

Table 7. Recapitulation of REBA Scores for Tile Production Process Work Posture

Work Station	Table A Score	Table B Score	Table C Score	REBA Score
Refining	3	1	3	4
Pressing	4	4	5	6
Drying	5	3	6	7
Milling	4	3	7	8
Burning	7	2	8	9
Ingredients Mixing	6	5	9	10
Sun-drying	7	5	10	11

Based on the REBA score, the categorization and corrective actions can be seen in Table 8.

Table 8. Categorization of REBA Scores

Action Level	REBA Score	Risk Level	Improvement Actions
0	1	Can be Ignored	Unnecessary
1	2-3	Low	Might be Necessary
2	4-7	Medium	Necessary
3	8-10	High	Highly Necessary
4	11+	Very High	Extremely Necessary

After knowing the level of risk from the work posture of the tile production process, the results can be categorized according to the REBA score. REBA Score Categorization can be seen in Table 9.

Table 9. Recapitulation of REBA Score Categorization

REBA Score	Risk Level	Improvement Actions	Working Station
4-7	Medium	Necessary	Refining
			Pressing
			Drying
8-10	High	Highly Necessary	Milling
			Burning
			Mixing
11+	Very High	Extremely Necessary	Sun-drying

Based on Table 8, there are 3 postures with a moderate level of risk and need improvement, there are 3 postures with a high risk that need immediate improvement, there is 1 posture with a very high risk and currently need to get an improvement process. The entire body posture of workers in the tile production process in SMEs requires corrective action.

The results of the analysis of body postures at the tile-producing SMEs show many work postures that can pose a risk of injury. This can be seen in the category value of the REBA method. The results of the categorization obtained medium, high and very high categories. A solution to reduce the risk of injury is to improve work postures for all tile

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production processes. After calculating the score, the corrected score can be seen in Table 10.

Table 10. REBA score results after improving all work stations

NO	Working Station	Neck	Torso	Legs	Upper Arms	Lower Arms	Wrists	REBA Score
1	Milling	2	1	1	2	1	2	3
2	Drying	2	1	1	2	1	2	3
3	Refining	1	1	3	1	1	1	3
4	Burning	1	3	1	2	1	1	3
5	Mixing	1	3	1	2	2	1	4
6	Pressing	2	1	1	3	2	1	4
7	Sun-drying	1	1	1	2	2	1	4

The suggestion to improve posture for tile drying workers is because the results of the REBA score before improvements are categorized as very high risk levels, so that body posture improvements can be seen in Figure 2.

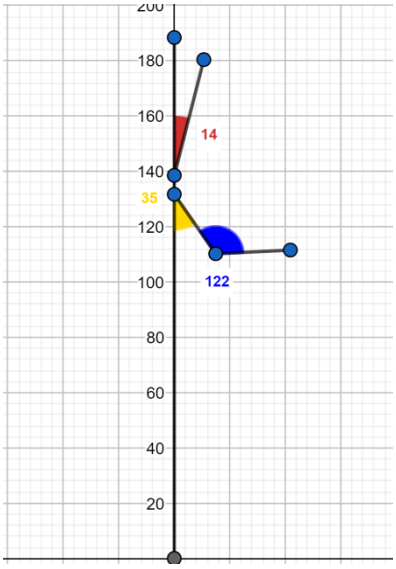

Figure 2. Posture after Improvement at the Drying Work Station

The posture of the workers carried out is as shown in Figure 2. The body posture score of the drying process of the tile can be seen in Table 11.

Table 11. Body Posture Score of Drying Work Station

Posture	Score	Information	Result
Neck	1	14^{o} forward	1
Torso	1	0^{o} balanced	1
Legs	1	0^{o} balanced	1

The posture of the workers in the tile production at the drying work station shows that the neck is given a score of 1 because the angle is 14o forward, the torso is given a score of 1 because it is 0o balanced, and the legs are given a score of 1 balanced leg as seen in table 1, so the final foot score is 1. Results Observing the posture of the neck, torso and legs while

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working, the scores are entered into table A, the score is 1, which can be seen in Table 12.

Table 12. Table A Working Position of Drying Station

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Torso	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

The posture of the tile production workers shows that the upper arm is given a score of 2 because of the large angle of 35º forward, the forearm is given a score of 2 because of the angle of 122º forward, the wrist is given a score of 1 because the angle of 0º down can be seen in Table 13.

Table 13. Body Posture Score of Drying Work Station

Posture	Score	Information	Result
Upper arms	2	35º forward	2
Lower arms	2	122º forward	2
Wrists	1	0º	1

With the scores obtained from the results of observing the posture of the upper arms, forearms and wrists while working, the scores are entered into table B and a score of 2 is obtained and there is no additional grip score, because when working, you are already holding the tool according to Table 14.

Table 14. Table B Drying Station Working Position

Table B		Lower Arms					
		1			2		
	Wrists	1	2	3	1	2	3
Upper Arms	1	1	2	2	1	2	3
	2	1	2	3	2	4	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

After entering the final scores of tables A & B in table C, a score of 3 tile production processes is obtained as seen in Table 15.

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Table 15. Table C Working Position of Drying Station

Table A Score	Table B Score											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

The recapitulation of the body posture score for the tile production process is shown in Table 16.

Table 16. REBA Score Recapitulation of Work Posture in the Tile Production Process

Posture	Table A Score	Table B Score	Table C Score	REBA Score
Milling	1	2	2	3
Drying	1	2	2	3
Refining	2	1	2	3
Burning	2	1	2	3
Mixing	2	2	3	4
Pressing	1	4	3	4
Sun-drying	1	2	3	4

Based on the REBA score, the categorization and corrective actions can be seen in Table 17.

Table 17. REBA Score Categorization

Action Level	REBA Score	Risk Level	Improvement Actions
0	1	Can be Ignored	Unnecessary
1	2-3	Low	Might be Necessary
2	4-7	Medium	Necessary
3	8-10	High	Highly Necessary
4	11+	Very High	Extremely Necessary

After knowing the level of risk from the work posture of the tile production process, the results obtained are in accordance with the REBA Score categorization. REBA Score Categorization can be seen in Table 18.

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Table 18. Recapitulation of REBA Score Categorization

REBA Score	Risk Level	Improvement Actions	Working Station
2-3	Low	Might be Necessary	Milling Drying Refining Burning
4-7	Medium	Necessary	Mixing Pressing Sun-drying

Based on Table 18, there are 3 postures with low risk levels that may need improvement and there are 4 postures with moderate risk that need improvement. The entire body postures of workers in the tile production process in SMEs require a tool design to help their work so that it would be easier and could reduce the risk of injury.

Proposed work tools is also useful for reducing the occurrence of injuries to workers and so it could facilitate work. Tool design was done using Solidworks software. The design of this tool is used to help workers do their jobs easily and reduce the risk of injury. The size of this table is 400 cm long, 200 cm wide, 100 cm high. The reason is because they can put the roof tiles when drying so that workers would not have to bend over. Design can be seen in Figure 3.

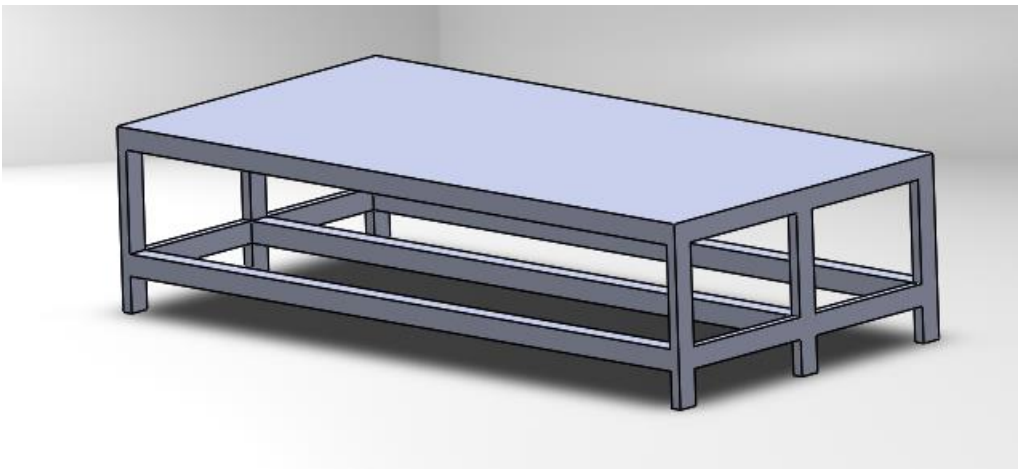

Figure 3. Tool Design at the Drying Work Station

CONCLUSION

The results of the workers' posture scores at the work station and the level of risk using the Rapid Entire Body Assessment (REBA) method before improvements were 4 for smoothing, 6 for pressing, 7 for drying, 8 for grinding, 9 for burning, 10 for mixing, and 11 for sun-drying. The results of the worker's posture score while working and the level of risk using the Rapid Entire Body Assessment (REBA) method after improvements is 3 for grinding, 3 for drying, 3 for refining, 3 for burning, 4 for mixing, 4 for pressing, and 4 for sun-drying.

Proposed improvements are given to help change the worker's body posture according to the ideal posture in order to avoid injury to the body. With the addition of a desk, it can

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help the workers do their jobs easier. The design of the table facility is adjusted to the size of the worker's posture so that workers are more comfortable when using it.

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