

Ergonomic Analysis Using the REBA Method on Worker Posture in the Sorting Section at a Lightweight Brick Company

Iftitah Ruwana¹, Nanta Sigit²

¹ National Institute of Technology, Malang, Indonesia

² Universitas Wisnuwardhana, Malang, Indonesia

Corresponding Author: nantasigit1991@gmail.com

Abstract

Unergonomic work postures in lightweight brick sorting work are one of the things that can cause the risk of musculoskeletal disorders if not corrected. The purpose of this study is to analyze work postures by applying the REBA method which can evaluate the overall work posture of lightweight brick workers so that recommendations can be obtained to avoid injuries to workers. The data used in the study were images of work postures taken through recordings while workers were performing their work activities. Then, the angles of each part of the neck, back, upper arms, forearms, wrists, wrist rotation, and feet were measured, then the weight of the load, coupling factor and activity score were measured. The results of the study showed that the work postures used by workers when sorting lightweight bricks must be immediately corrected because they show a high level of risk for injury with a REBA score of 10, which means it is included in risk level 4 (dangerous conditions). By reducing dangerous angles on the body parts, a better work posture was obtained with a REBA score of 5, which is included in risk level 3 (medium), thereby reducing the risk of injury to workers.

Keyword: Work posture; REBA; Ergonomics; Musculoskeletal disorders

INTRODUCTION

One of the economic factors supporting various parts of the world is industry. Almost all industries now use mass production systems in their production activities, therefore requiring a large amount of equipment, materials, and employees to operate these systems and achieve optimal results (Tee et al., 2017). The era of industrial modernization consistently demands optimal work productivity from all employees (Ramadhani & Prayogo, 2018).

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The increasing development of science can help industries improve their productivity in various ways. One such approach is increasing employee satisfaction through the provision of systems that optimize employee performance (Yazdanirad et al., 2018). Distributed instruments, systems, and procedures to ensure employee comfort and safety are a way to optimize employee performance (Sadeghi Yarandi, 2019).

Employees are a crucial asset for any industry, but they often neglect their needs and interests. Many industries still lack the support of standardized procedures and ergonomic work facilities in their production processes, especially for manual activities (Widodo et al., 2020). Improper manual material handling (MMH) activities cause employee losses and accidents.

One of the consequences of improper MMH activities is musculoskeletal complaints. Musculoskeletal complaints range from minor to severe pain (Souza et al., 2015). When muscles are repeatedly subjected to static loads over long periods, they can cause damage to joints, ligaments, and tendons. To ensure MMH can be performed freely, work system design must consider employee skills and dependencies. Numerous studies have been conducted on analyzing MMH postures, recommending appropriate work spaces and postures to identify complaints and risks, and aligning them with the type of work activity. (Kibria, 2023).

The Rapid Entire Body Assessment (REBA) method analyzes jobs based on body position or tasks requiring full-body movement. The output is a decision category that states the required response requirements. Generally, the procedure involves comparing the subject's body posture angle with the weights listed in the table. The results are expected to inform decisions regarding the company's response to eliminate the likelihood of adverse risks to workers. Measurements were conducted on workers with healthy physical and mental health criteria (Fatemeh et al., 2020).

One common activity that carries a significant potential for adverse risks is the manual movement of objects of varying weight. Fatigue and pain in certain body parts are potential adverse risks. Musculoskeletal disorders (MSDs) are complaints of pain in the body. Conditions that cause impairment of joints, ligaments, muscles, nerves, tendons, and the spine are musculoskeletal disorders. These complaints can be reduced by identifying, evaluating, and improving work equipment and posture (Pałęga et al., 2019).

This research aims to reduce the risk of illness and increase work motivation, while simultaneously increasing productivity in work activities at a workstation. It is recommended to provide work equipment and design facilities that support the sorting process [10]. The REBA method is more effective in analyzing MMH in moving body positions, such as those experienced by manual sorting workers, thus supporting the objectives of this research (Ayyaz et al., 2023).





It is hoped that the results of this study can be a way to improve the health of workers in the sorting section and free from the bad risks they experience. While employees are working, this is the source of data in this study which was obtained directly (Kazemi, 2016).

METHOD

This research begins with planning related to the core problem and the necessary solutions. The results are expected to assist workers in mitigating risks and providing insight into avoiding unwanted risks (Tarakçi et al., 2020). Literature review is the stage where researchers seek information related to the research they intend to conduct and examine the relationship between theory and implementation in the field. Problem identification and formulation: Identifying and formulating the problems experienced by the research object, specifically the potential for workers to experience activities that do not comply with procedures and whether worker injuries are minor or serious (Julianus, 2019).

Data collection in this study included primary data collection. First, workers were recorded using different postures. The images captured on the recordings revealed five work postures, allowing them to distinguish between those that felt heavy and those that felt light. Second, workers were interviewed regarding the sorting process, identifying which positions were considered burdensome for workers prone to injury. Third, body posture was determined, with measurements of the angles of each part of the neck, back, upper arm, forearm, wrist, wrist rotation, and feet. Muscle usage, load weight, force usage, coupling factor, and activity score were also measured (Wibowo & Mawadati, 2021).

Data processing in this study utilized the REBA method to evaluate work postures, resulting in recommendations for reducing dangerous angles to prevent serious worker injury (Tarakçi et al., 2020).

Analysis and discussion analyzed the data processing results, followed by a review of the intended use of these results for practical application.

Conclusions and suggestions drew conclusions from the results. This was followed by the provision of recommendations to both industry and researchers, addressing any gaps in the study.

RESULTS AND DISCUSSION

The lightweight brick sorting process is carried out manually by humans as they exit the production machine. These bricks are sorted into predetermined locations, selecting those of poor and good quality. This is done because the company aims for the best quality, without



defects, while minimizing costs.

To obtain data for analysis, workers' activities were recorded from start to finish during the lightweight brick sorting process. From the recordings, observers obtained two images of body postures that workers found stressful: when they began moving the bricks from the top position and when they moved them to a lower position, as shown in Figures 1 and 2.



Figure 1. Position of the brick above



Figure 2. Position of the brick below

The REBA analysis was conducted in this study to understand whether employee activities pose risks or fall within safe limits. The analysis was performed using AutoCAD or

Imagemeter to determine the angles created during work. The following steps are used to analyze worker posture:

Step 1: Locate neck position.

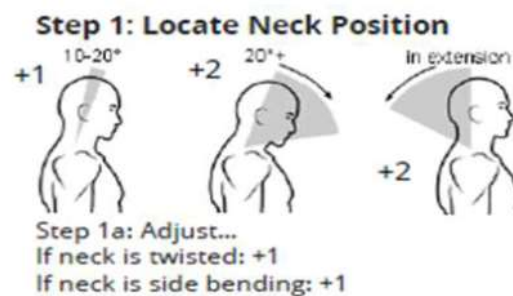


Figure 3. Assessment categories for neck position

The neck position forms an angle of 41.51° to the normal axis of the body. Score: +2

Step 2: Locate the trunk position

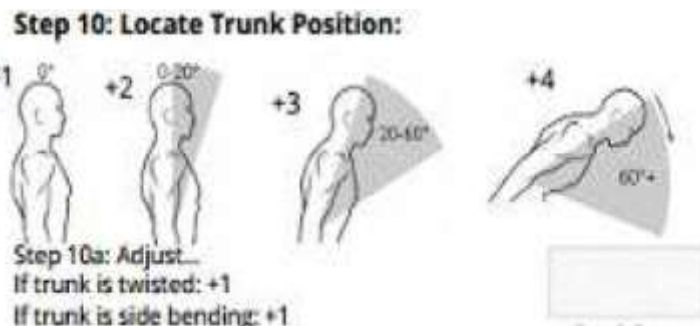


Figure 4. Assessment categories for torso position

The angle formed between the body and the normal axis of the body is 89.60°. Score: +4

Step 3: Legs

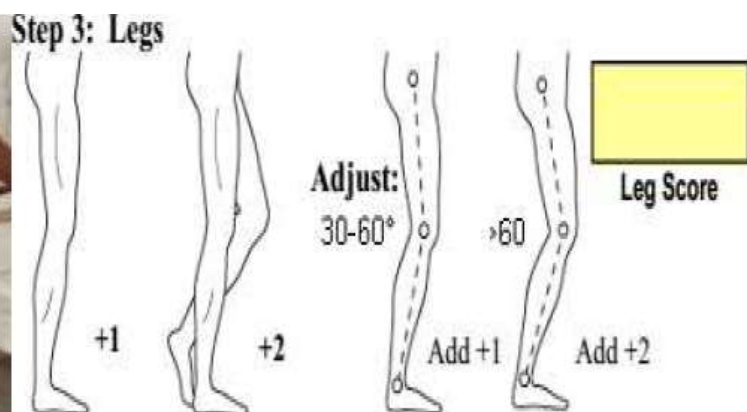


Figure 5. The angle formed and the assessment category for the foot position.

Both workers' feet rest on the base and form 50.16o Score: $1+1 = 2$.

Step 4: Look-up posture score in Table A

Scores

Table A		Neck											
		1				2				3			
	Legs												
		1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	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

Figure 6. REBA Table A, Score: 6

Step 5 – Step 6: Add force/load score; Score A, find row in Table C

Step 4: Look-up Posture Score in Table A

Using values from steps 1-3 above, locate score in Table A

Step 5: Add Force/Load Score

If load < 11 lbs : +0

If load 11 to 22 lbs : +1

If load > 22 lbs: +2

Adjust: If shock or rapid build up of force: add +1

Step 6: Score A, Find Row in Table C

Add values from steps 4 & 5 to obtain Score A.

Find Row in Table C.

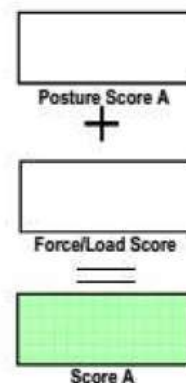


Figure 7. Assessment of table row C

The average load of lightweight bricks is 3 kg, or approximately 6.6 lbs, which is repetitive in the working position. Score: $+0 +1 = +1$.

The row value in Table C is obtained by adding the scores obtained from steps 4 and 5, resulting in a score of $6 + 1 = 7$.

Step 7: Locate upper arm position

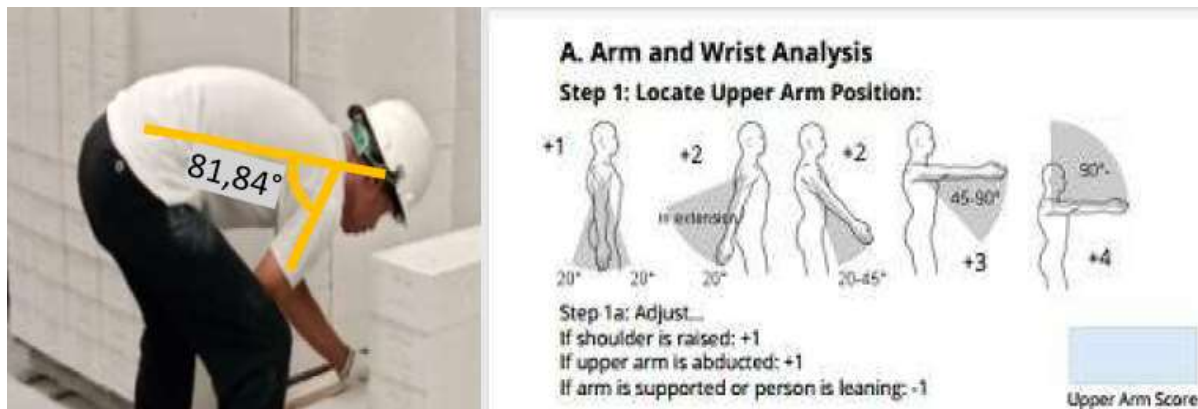


Figure 8. Assessment categories for upper arm position

Figure 8 shows that the position of the upper arm forms an angle of 81.84° to the body axis, where the shoulder is not raised and the upper arm is away from the body axis. The operator also does not lean on an object, so a score of = + 3 is obtained.

Step 8: Locate lower arm position

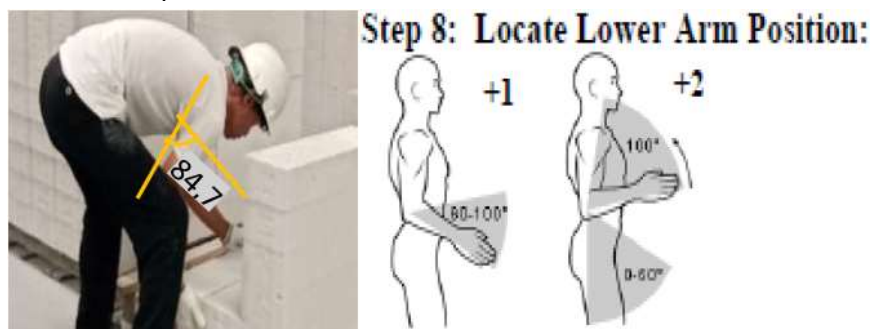


Figure 9. Lower arm position and assessment categories

The posture above shows the forearm forming an 84.71° angle. The arm is neither facing away from nor towards the body. Score: +1

Step 9: Locate the wrist position

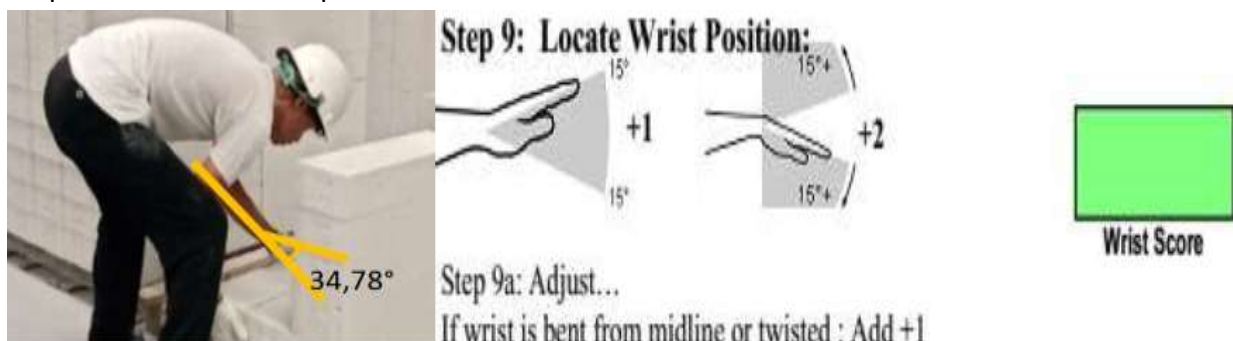


Figure 10. Assessment categories for wrist position

According to Figure 10, it shows that the wrist position forms an angle of 34.78° and there is no bending in this position, so the score is +2.

Step 10: Look-up posture score in Table B

Table B		Lower Arm					
		①			2		
	Wrist	1	②	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	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

Figure 11. REBA Table B, Score: 4

Steps 11 – 12: Add coupling score; Score B, find column in Table C

Step 10: Look-up Posture Score in Table B

Using values from steps 7-9 above, locate score in Table B

Posture Score B

Step 11: Add Coupling Score

Well fitting Handle and mid rang power grip, *good*: +0

Acceptable but not ideal hand hold or coupling

acceptable with another body part, *fair*: +1

Hand hold not acceptable but possible, *poor*: +2

No handles, awkward, unsafe with any body part,

Unacceptable: +3

+

Coupling Score

Step 12: Score B, Find Column in Table C

Add values from steps 10 & 11 to obtain

Score B. Find column in Table C and match with Score A in row from step 6 to obtain Table C Score.

Score B

Figure 12. Assessment for column C of Table C

Figure 12 also shows that the hand grip is still considered good, although not ideal due to the lack of a special handle for holding lightweight bricks, resulting in a score of +1.

The row score in Table C is obtained by adding the scores from steps 10 and 11, resulting in a score of 4 + 1 = 5.

Step 13: Activity score

Step 13: Activity Score

- +1 1 or more body parts are held for longer than 1 minute (static)
- +1 Repeated small range actions (more than 4x per minute)
- +1 Action causes rapid large range changes in postures or unstable base

Figure 13. Assessment criteria for worker activities

Score	Level of MSD Risk
1	negligible risk, no action required
2-3	low risk, change may be needed
4-7	medium risk, further investigation, change soon
8-10	high risk, investigate and implement change
11+	very high risk, implement change

Figure 14. REBA score level

Score A (score from table A +load/force score)	Table C											
	Score B, (table B value +coupling 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	10	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

+

Table C Score

Activity Score

Final REBA Score

Figure 15. REBA Table C

Based on the values obtained from the calculations in steps 6 and 12, the posture score in Table C is 9.

Then, add the Table C score and the activity score to obtain the final result. The activity performed is that the worker changes posture more than four times per minute. Score: +1

Total score: $9 + 1 = 10$

Conclusion: A score of 10 indicates that the worker is working in a position with a high risk of MSDs. Further investigation and improvement are needed, including changes in work posture. Research has been conducted on sorting workers, who frequently experience complaints during this activity, making them less effective. Therefore, a proposed work design is urgently needed to improve worker posture comfort and reduce existing complaints, as shown in Table 1.

Table 1. Suggestions for improving body position

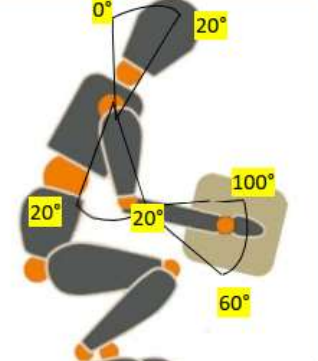
Tabel Score REBA				
	Sebelum Perbaikan		Sesudah Perbaikan	
Neck	2		1	
Trunk	4		2	
Legs	2		3	
Force/Load	1		1	
Upper arm	3		1	
Lower arm	1		1	
Wrist	2		1	
Coupling	1		1	
Activity	1		1	
End Score	10 (Level 4)		5 (Level 3)	

Table 1 shows that the worker's position before the analysis was at level 4 with a score of 10, representing high risk. Consequently, employees experienced problems during the sorting process, including frequent back pain, tingling when squatting, and frequent neck stiffness, all of which were suggested as necessary work equipment designs. Therefore, the researchers implemented the proposed work position improvements, as outlined in Table 1, with a risk reduction level of level 3 with a score of 5, representing medium risk.

In addition to proposing work postures, designing the desired sorting equipment for more effective and comfortable work is also necessary. This proposed work equipment makes worker movements more ergonomic and can reduce complaints.

Below is a work equipment design designed to improve employee posture. The orientation of this design was analyzed based on worker posture and the needs of workers in performing their work.

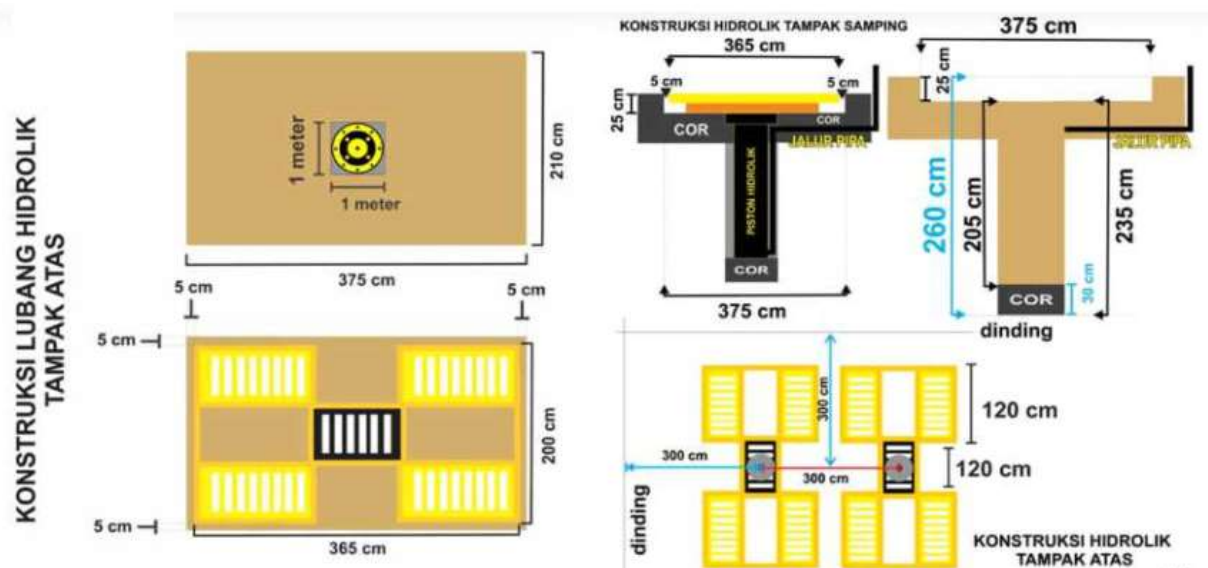


Figure 16. Work facility design

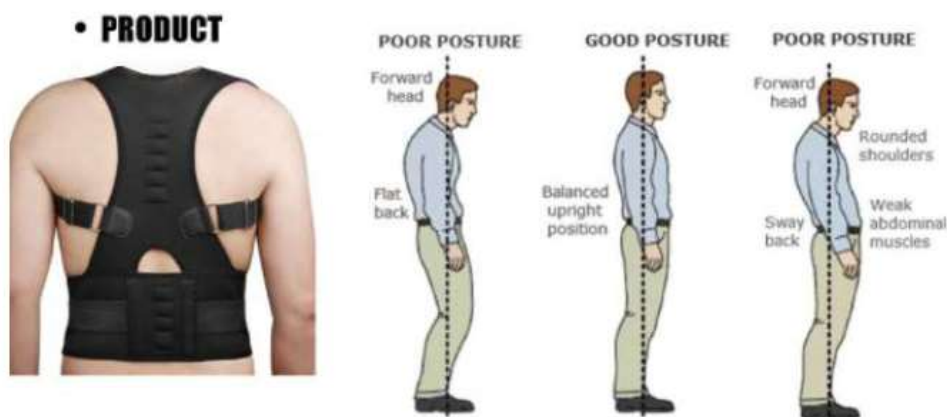


Figure 17. Work aids

The advantage of the facility design in Figure 16 is that it reduces employee complaints during sorting. With a flexible hydraulic concept, the lightweight bricks placed on the hydraulic machine can be raised and lowered to accommodate the worker's height, making the sorting process more effective and comfortable without requiring lowering or bending.

The proposed work aid in Figure 17 can also reduce back complaints by maintaining a firm, upright posture while working, minimizing the risk of muscle injury.



CONCLUSION

In the study, an analysis was carried out regarding the bad risks experienced by lightweight brick sorting workers at PT X. The risks were analyzed through the body posture of workers in carrying out sorting. The method used for manual calculations is the REBA method, because this method is better used when analyzing positions that require movement from the entire body position according to the object being studied. The results of calculations using the REBA method show that this sorting process has a high risk level that must be investigated further and improvements are currently also made with changes in work posture. The final results of the research on sorting workers using the REBA method are obtained, therefore there must be improvements to the methods implemented, namely: Workers must be given back corsets in the work process, so that the worker's posture is more upright and does not bend to reduce complaints in the back and during the sorting process, adequate work facilities should be provided in the proposals that have been made, so that the back position does not bend too much while working which can result in serious injuries.

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