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EVALUATION OF WORK POSITION USING SUBYECTIVITY APPROACH BASED ON RULA METHOD

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ABSTRACT

Workers' activities basically have a positive and negative impact, one of which is the result of a disturbed skeletal and muscular system, which is a decrease in the strength level of body parts which constitutes work productivity when carrying out daily activities. Knowing the danger level of body posture carried out by the welding position, so that it can be given useful input for the company's progress. The method used is the Rapid User Limb Assessment (RULA) method carried out on welding workers and the research method quantitatively and qualitatively then carried out statistical analysis, subjectivity and rula. The results showed that the final score of the posture of squatting, sitting and sitting in a chair had a score of 7, which means a high level of risk and needs immediate improvement. After evaluating the welding position improvement, there is a seat posture with a score of 3 which is a low risk level and requires changes. Same with the welding position sitting on the chair. The squat welding position with a score of 4 which is a low level risk level and sitting work posture has a score of 4 which means a low risk level, but requires a change for the future. From this study it was found that the relationship between Nordic Body Map and RULA was a continuity in squat work postures, which was found that this work posture had the highest risk of danger. Need to improve work posture in certain welding positions in this project or provide counseling about the dangers of work in the work posture if it continues.

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I. INTRODUCTION

RULA was developed by Dr. Lynn Me Attamne and Dr. Nigel Corlett, who is an ergonomics from a university in Nottingham (University's Nottingham Institute of Occupational Ergonomics). It was first explained in the form of an ergonomics application journal in 1993. RULA is intended and used in the field of ergonomics with a broad scope of fields [6]. Ergonomics technology evaluates posture or attitude, strength and muscle activity that cause injury due to repetitive strain injuries. One of the developments in the informal industry is the field of welding. Welding is a local connection between two or more metals using heat energy. The use of welding starts from joining in building construction, automotive assembly and mining. the rapid welding industry has resulted in a higher impact on occupational health risks faced by the workforce. [7]

Observation of the skeletal and muscular system using the human subjectivity approach was carried out on 2 welding section workers with the rula method with position welding squat down. PT AFTA TEHNIK MANDIRI because of the work carried out continuously but if the work method is carried out by the two welding workers the part is not ergonomic as a result will cause pain in certain parts of the body. The hope of this research is to be able to provide recommendations for improvements to work positions and supporting facilities that are used to reduce the potential for complaints and illness that might occur. [1], [2].

Based on the background of the problem, the research objective is to evaluate the ideal work position in carrying out activities, so as to reduce the grievances felt by workers. The research uses subjectivity analysis and RULA method.

II. RESEARCH METHODS

The type of data used is qualitative data and quantitative data. The data source in this study is primary data where the data is obtained from direct field observations and distribution of questionnaires in the form of questions relating to work position complaints that can occur to welding operators.

The method used in this study is the RULA (Rapid User Limb Assessment) method in which there are several parts of the worker's body that can be calculated and measured the level of burden suffered by workers. And the data is taken from the Nordic Body Map questionnaire.

The analysis used in data management research is using statistics and the Rapid User Limb Assessment (RULA) and Nordic body methods

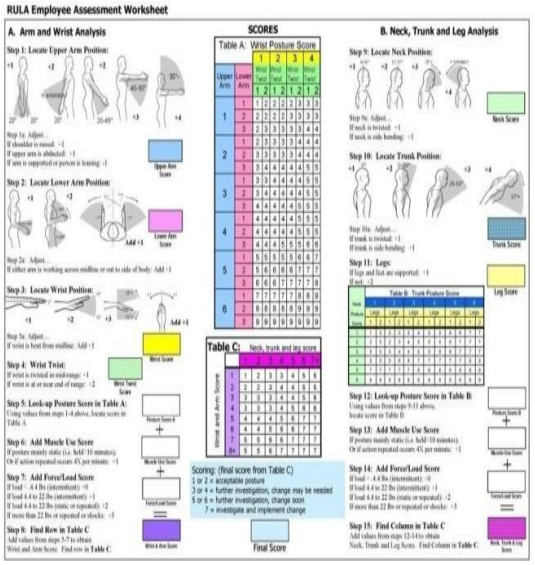


Figure 1. RULA level action table (Dr. Alan Hedge, 1993)

In the RULA level action table, there are several parts of the worker's body that can be calculated and measured the level of burden suffered by the worker. From the results of the overall calculation will be concluded later, whether the work carried out will have an impact on the body of the worker if done continuously - or not. In RULA the movement determines comfort in work that can affect productivity.

III. RESULTS AND DISCUSSION

3.1 RESULTS

1. **Research results after evaluation work position improvement**

From the results of the Nordic body research, it shows that complaints from workers after making improvements to an ergonomic work position, and the results show that the most dominant complaints felt by the operator have changed where the squat welding position shows that the level of complaints felt by workers has changed, namely:

a. Welding position squatting behavior of workers complaints reached 2.7% after an improvement in welding position has now dropped to 1.4% can we see in red-colored chart;

b. The welding position of the chair that had been felt by workers reached 2.2% is now also experiencing a decrease which is marked in green by 1.3%;

c. Sitting welding position which is marked in blue also experienced the same decrease as the squatting position and sitting in the sitting position decreased by 1.3% from 2.1%. So we can see that there is a change in the welding position, there is a comparison of the level of complaints felt by the workers.

3.2 DISCUSSION

The first stage is to assess the work posture of workers on the work station, and analyze the photos from observations. The following are photos of 3 welding position workers, namely:

1. Assessment of the Sitting Operator's posture

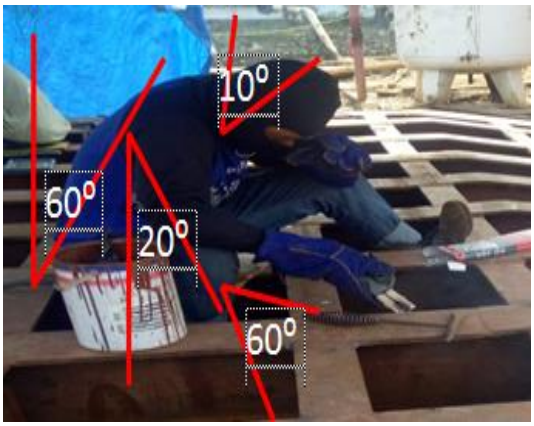


Figure 2 Sitting Work Posture

From Figure 3. The operator does the activity with sitting posture.
a. Group A Posture
- Upper arm posture
The upper arm forms an angle of 60 °, then the score is = 1
- Forearm posture
The torso forms an angle of 90 °, with a score = 1
- Leg posture
Forearms form an angle of 60 ° - 100 °, then the score of the forearm is = 1
- Wrist posture
The wrists form an angle of 15 °, then the score is = 1
- The bushel round
Wrist Round is facing center line with a score = 1

Evaluation of Group A posture can be seen in table 2, the following table is intended:

Table 1. Group A scores for sitting posture

Upper arm	forearm	Wrist							
		1		2		3		4	
		Wrist Rotation		Wrist Rotation		Wrist Rotation		Wrist Rotation	
		1	2	1	2	1	2	1	2
1	1	1	2	2	2	2	3	3	3
	2	2	2	2	3	3	3	3	3
	3	2	2	2	3	3	3	4	4
2	1	2	2	2	3	3	3	4	4
	2	2	2	2	3	3	3	4	4
	3	2	3	3	3	3	4	4	5
3	1	2	3	3	3	4	4	5	5
	2	2	3	3	3	4	4	5	5
	3	2	3	3	4	4	4	5	5
4	1	3	4	4	4	4	4	5	5
	2	3	4	4	4	4	4	5	5
	3	3	4	4	5	5	5	6	6
5	1	5	5	5	5	5	6	6	7
	2	5	6	6	6	6	7	7	7
	3	6	6	6	7	7	7	7	8
6	1	7	7	7	7	7	8	8	9
	2	7	8	8	8	8	9	9	9
	3	9	9	9	9	9	9	9	9

Group A body posture score based on table 1 is = 1
- Activity score
Activity to hold the body, then the score = 1
- Load scores
Loads of 5-10 kg, the score obtained is = 2
Total Score for group A = 1+ (1 + 2) = 4
a. Group B Posture
- Neck posture
The neck forms an angle of 10 °, with a score = 1
- Posture of the torso
The feet are in a stable posture, with a score = 1

Assessment of group B posture can be seen in table 2.

Table 2 Group B scores Form of sitting posture

neck	back											
	1		2		3		4		5		6	
	leg	leg	leg	leg	leg	leg	Leg	leg	leg	leg	leg	leg
	1	2	1	2	1	2	1	2	1	2	1	2
1	1	3	2	3	3	3	4	5	5	6	6	7
2	2	3	2	3	3	4	5	5	5	6	7	7
3	3	3	3	4	4	4	5	5	6	6	7	7
4	5	5	5	6	6	6	7	7	7	7	7	8
5	7	7	7	7	7	7	8	8	8	8	8	8
6	8	8	8	8	8	8	8	8	9	9	9	9

Grub B posture score sitting based on table 2 is = 1

- Activity score

Activity to hold the body, with a score = 1

- Load load scores of 5-10kg, with a score = 2

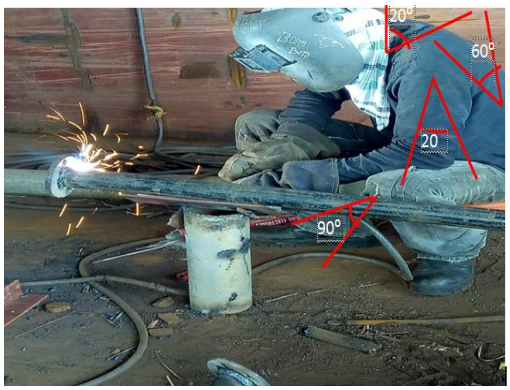
The total score for group B is = 1 + (1 + 2) = 4

Table 3 Group C scores sitting posture

Group score B							
Group score A	1	2	3	4	5	6	7+
1	1	2	2	3	4	5	5
2	2	2	2	4	4	5	5
3	3	3	3	4	4	5	6
4	3	3	3	4	5	6	6
5	4	4	3	5	6	7	7
6	4	4	5	6	6	7	7
7	5	5	6	6	7	7	7
8	5	5	6	7	7	7	7

The final score of the development process with a sitting work posture based on table 4 is 4.

2. Assessment of squatting operator work postures



After obtaining scores from group A and group B, then proceed to determine the scores of group C. Group C itself is the result of the sum of group A scores and group B scores, the following table 3 is the final score of the sitting work posture, the following is table from group C.

Figure 3 Squat welding posture

From Figure 3 it can be seen that the legs of the operator are between 2 steps and the operator's body is slightly bent. Seen from the picture is also the position of the dangerous operator. And the following is a calculation for Figure 4:

a. Group A Posture

- Upper arm posture

The upper arm forms an angle of 20 °, with a score = 1

- Forearm posture

The forearm forms an angle of 60 ° -100 °, with a score = 1

- Wrist body postures

the hand forms an angle of 15 °, with a score = 1

- The bushel round

Wrist rotation is in the middle line with a score = 1

Assessment of group A's posture score for squatting is seen in table 4:

Table 4 Group A scores post squat welding posture

Upper arm	forearm	Wrist							
		1		2		3		4	
		Wrist Rotation		Wrist Rotation		Wrist Rotation		Wrist Rotation	
		1	2	1	2	1	2	1	2
1	1	1	2	2	2	2	3	3	3
	2	2	2	2	3	3	3	3	3
	3	2	2	2	3	3	3	4	4
2	1	2	2	2	3	3	3	4	4
	2	2	2	2	3	3	3	4	4
	3	2	3	3	3	3	4	4	5
3	1	2	3	3	3	4	4	5	5
	2	2	3	3	3	4	4	5	5
	3	2	3	3	4	4	4	5	5
4	1	3	4	4	4	4	4	5	5
	2	3	4	4	4	4	4	5	5
	3	3	4	4	5	5	5	6	6
5	1	5	5	5	5	5	6	6	7
	2	5	6	6	6	6	7	7	7
	3	6	6	6	7	7	7	7	8
6	1	7	7	7	7	7	8	8	9
	2	7	8	8	8	8	9	9	9
	3	9	9	9	9	9	9	9	9

Body posture score based on table = 1
- Activity score
Activity causes movement changes, so the score = 1
- Load scores
Load 5–10kg, with a score = 2
Total group score A = 1+ (1 + 2) = 4
a. Group B Posture
- Neck posture
The neck forms an angle of 20 °, with a score = 1
- Posture of the torso
The torso forms 90 °, with a score = 1
- Leg posture
In the legs are not supported and in a state of weight is not spread, then the score = 1
Assessment of group B posture can be seen from table 5, the following is the table:.

Table 5 Group B scores squatting posture welding

neck	back											
	1		2		3		4		5		6	
	leg	leg	leg	leg	leg	leg	Leg	leg	leg	leg	leg	leg
	1	2	1	2	1	2	1	2	1	2	1	2
1	1	3	2	3	3	3	4	5	5	6	6	7
2	2	3	2	3	3	4	5	5	5	6	7	7
3	3	3	3	4	4	4	5	5	6	6	7	7
4	5	5	5	6	6	6	7	7	7	7	7	8
5	7	7	7	7	7	7	8	8	8	8	8	8
6	8	8	8	8	8	8	8	8	9	9	9	9

Group B posture score based on table 5 is 1

- Activity score

Activity causes movement to change, so score = 1

- Load Scores of 5-10kg, with a score = 2

The total B grub score is = 1 + (1 + 2) = 4.

The final score can be seen in table 6, which is the result of the group postures of A and B that were concluded to form group C posture which is the result of the two groups of body postures. The following is table 6:

Table 6 Group C posture scores

Group score B							
Group score A	1	2	3	4	5	6	7+
1	1	2	2	3	4	5	5
2	2	2	2	4	4	5	5
3	3	3	3	4	4	5	6
4	3	3	3	4	5	6	6
5	4	4	3	5	6	7	7
6	4	4	5	6	6	7	7
7	5	5	6	6	7	7	7
8	5	5	6	7	7	7	7

The final score for welding activities with squat posture based on table 6 is = 4.

3. Posture Work Operator Assessment Seats Chair

Figure 4. Welding Work Posture sitting in a chair

It can be seen that the position of work is carried out sitting on an iron chair as its seat. So the calculation of the score from the posture is done once.

a. Group A Posture

- Upper arm posture

The upper arm forms an angle of 90 °, with a score = 1

- Forearm posture

Forearms form an angle of 60 ° - 100 °, with a score = 1

- 15 ° hand auction, wrists rotating on normal lines, with a score = 1
rotation on the wrist has a score = 1
Assessment of group A's body posture can be seen in table 7, the following is the intended table:

Table 7 Group A scores with sitting postures on chairs

Upper arm	forearm	Wrist							
		1		2		3		4	
		Wrist Rotation		Wrist Rotation		Wrist Rotation		Wrist Rotation	
		1	2	1	2	1	2	1	2
1	1	1	2	2	2	2	3	3	3
	2	2	2	2	3	3	3	3	3
	3	2	2	2	3	3	3	4	4
2	1	2	2	2	3	3	3	4	4
	2	2	2	2	3	3	3	4	4
	3	2	3	3	3	3	4	4	5
3	1	2	3	3	3	4	4	5	5
	2	2	3	3	3	4	4	5	5
	3	2	3	3	4	4	4	5	5
4	1	3	4	4	4	4	4	5	5
	2	3	4	4	4	4	4	5	5
	3	3	4	4	5	5	5	6	6
5	1	5	5	5	5	5	6	6	7
	2	5	6	6	6	6	7	7	7
	3	6	6	6	7	7	7	7	8
6	1	7	7	7	7	7	8	8	9
	2	7	8	8	8	8	9	9	9
	3	9	9	9	9	9	9	9	9

The group A body scores based on Table 7 are 1
- Activity score
Activity to hold body weight, so that a score = 1 is obtained
- Load scores
The load brought by the welder is 5-10 kg, with a score = 2
Thus, the total score for group A posture is = 1 + (1 + 2) = 4

a. Group B Posture
- Neck posture
The neck is at an angle of 10 °, with a score =
- Posture of the torso (back)
The torso is at an angle of 90 °, with a score = 1
- Leg posture
The foot is in a sitting position, then the score = 2
Because the knee is at an angle of 60 °, the score becomes = 2
Assessment of group B posture can be seen in table 8, below is table 8 intended:

Table 8 Group B scores sitting posture on the chair

neck	back											
	1		2		3		4		5		6	
	leg	leg	leg	leg	leg	leg	Leg	leg	leg	leg	leg	leg
	1	2	1	2	1	2	1	2	1	2	1	2
1	1	3	2	3	3	3	4	5	5	6	6	7
2	2	3	2	3	3	4	5	5	5	6	7	7
3	3	3	3	4	4	4	5	5	6	6	7	7
4	5	5	5	6	6	6	7	7	7	7	7	8
5	7	7	7	7	7	7	8	8	8	8	8	8
6	8	8	8	8	8	8	8	8	9	9	9	9

The score of group B sitting posture based on table 8 is 1
- Activity Score

The activity carried out sustains the body weight, so a score = 1 is determined
- Load scores

The burden on this production process is around 5-10 kg, with a score = 2
The total score of group B is = 1 + (1 + 2) = 4
After Adan B group's score has been determined, the search for Group C score can be done. The following is table 9 which is the C group score table:

Table 9 Group C scores sitting posture in the chair

Group score B							
Group score A	1	2	3	4	5	6	7+
1	1	2	2	3	4	5	5
2	2	2	2	4	4	5	5
3	3	3	3	4	4	5	6
4	3	3	3	4	5	6	6
5	4	4	3	5	6	7	7
6	4	4	5	6	6	7	7
7	5	5	6	6	7	7	7
8	5	5	6	7	7	7	7

The final score for welding work in building construction with a sitting posture based on table 9 shows the results of score 3.
Calculation results for the three work postures based on the Rapid Upper Limb Assessment (RULA) method for workers on welding, can be recapitulated in table 10. The following is table 10

Table 10 Recapitulation of posture calculation results constructed using the RULA method

No.	Work Posture	Final Score	Risk Level	Corrective Action
1	Sit	4	Low	Low risk, change is needed
2	Squat Down	4	Low	Low risk, change is needed
3	Sit on the chair	3	Low	Low risk, change is needed

IV CONCLUSION AND ADVICE

4.1 Conclusion

Based on the results of data processing before repairing the welding position with the RULA method, it can be concluded that the assessment of work postures that have the highest risk is the posture of squatting, sitting and sitting in a chair. With the total score reaching a score of 7 which is a high level score. After evaluating the welding position improvement, there is a seat posture with a score of 3 which is the risk level of lace and requires a change. Same with the welding position sitting in the chair. The squat welding position with a score of 4 which is a low level of risk and sitting work posture has a score of 4 which is entered at a low risk level, but requires changes for the future.

4.2. Advice

PT. Afta Tehnik Mandiri is one of the companies engaged in the construction sector, the workforce used does not understand an effective safe and comfortable work system, therefore researchers provide recommendations for improvements to work positions and supporting facilities used to reduce potential complaints and illnesses that may occur

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