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Posture Analysis of Mass Rapid Transit (MRT) Passengers Using the REBA Method in Jakarta, Indonesia

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ABSTRACT

Transit-oriented development (TOD) is one of the sustainable urban development concepts in tackling congestion, environmental degradation, and energy efficiency. To realise transit-oriented development, the government issued a transit-oriented development policy at every rapid mass transit (MRT) station in DKI Jakarta. The Mass Rapid Transit train (MRT) Jakarta has dimensions of 20 meters long, 2.9 meters wide and 3.9 meters high. Dominated by metallic blue and grey, the train body is made of stainless steel with an empty weight per train reaching 31 to 35 tons. PT MRT Jakarta provides 16 train series (one series consists of six trains) so that the carrying capacity of one series reaches 1,950 people per series. The train's interior is equipped with air conditioning, two CCTVs, hand straps, priority seats and a particular wheelchair area. Seats are made of fibre reinforced plastic (FRP) which is fire resistant with a width of 43 cm x 42 cm. This study aims to analyse the passenger posture by the Reba method with the results of measurements obtained in section a, namely 6, section b is 5, and the meeting point between parts a and b is 8. That is, the results of the Reba score have a high level of risk with immediate action needed. From the results of calculations, it is found that the sitting position of the MRT passenger is not ergonomic. Therefore, the authors analysed the posture of the passengers of the Jakarta MRT passenger with the Reba method to provide suggestions for improving posture and seats.

Keywords: Posture analysis, Mass rapid transit (MRT), The REBA method, Jakarta

INTRODUCTION

Ergonomics is also concerned with optimisation, efficiency, health, safety and human comfort at work, home, and recreational areas. Ergonomics requires the study of systems in which humans, work facilities, and their environment interact to adapt the work environment to humans. This adjustment is made to prevent the occurrence of occupational diseases. Occupational diseases caused by mismatches between work equipment and humans are musculoskeletal diseases (Restuputri, 2017).

Musculoskeletal complaints are complaints in the skeletal muscles that a person feels, ranging from mild to pain. If the muscles receive static loads repeatedly and for a long time, it can cause complaints in the form of damage

to joints, ligaments, and tendons. Musculoskeletal complaints can occur in train passengers who sit too long and seats that do not match their posture. Adjusting the centre to the passenger's posture can be measured by one method, namely the REBA method (Restuputri, 2017).

Rapid Entire Body Assessment (REBA) is a method in ergonomics used to quickly assess the posture of a worker's neck, back, arms, wrists and legs. The steps for determining the REBA score are first to calculate the score in table A which consists of the neck (neck), trunk (trunk), and legs (legs). The second step calculates table B, which consists of the upper arm, lower arm and wrist. After obtaining the final scores in tables A and B, they are entered into table C, which determines the category of action (Sari, 2019).

The Jakarta MRT (Mass Rapid Transit) train has dimensions of 20 meters long, 2.9 meters wide and 3.9 meters high. Dominated by metallic blue and grey colours, the train's body is stainless steel with an empty weight of 31 to 35 tons per train. PT MRT Jakarta provides 16 series of trains (one series consists of six trains) so that the carrying capacity of one series reaches 1,950 people per series. The train's interior is equipped with air conditioning, two CCTVs, hand straps, priority seats, and a particular area for wheelchairs. The seat material is made of fire-resistant fibre reinforced plastic (FRP) with a width of 43 cm x 42 cm (Wahabi, 2018).

The results of interviews with MRT passengers about MRT seat satisfaction said that 6 out of 10 passengers did not feel satisfied because the seats on the MRT were uncomfortable when sitting; there was also no notable difference between priority seats and passenger seats in general. The author also analysed the passenger sitting posture that the REBA score was 5, meaning that the level of risk was moderate with immediate action needed.

Based on the introduction above, the authors conducted research on the Posture Analysis of MRT passengers with the REBA method to see the magnitude of the risk and provide input to the highest leadership on this MRT train to evaluate and analyse the MRT passenger seats.

RESEARCH METHODOLOGY

This study uses a survey method with a cross-sectional approach where data regarding variables will be collected simultaneously (Notoatmodjo, 2019).

According to the REBA method, this research was conducted on Jakarta MRT passengers by analysing the passenger sitting posture. They are also conducting interviews with 10 MRT Jakarta passengers to find passenger satisfaction with the seats on the MRT train.

RESULTS

Observation and data collection regarding the sitting posture of MRT passengers using photos of MRT passengers and interviews with MRT passengers conducted on Tuesday, January 7, 2020. The following are the results of the analysis of MRT passengers' sitting postures and interviews with passengers as follows:

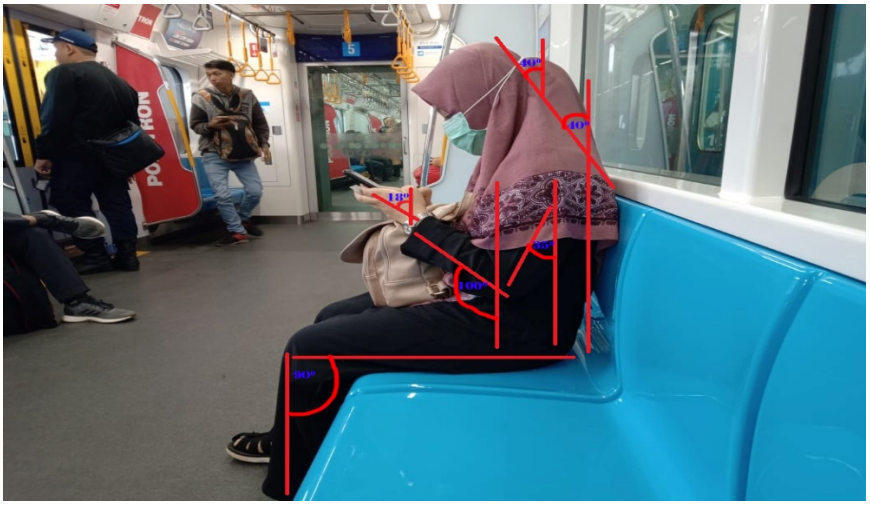

Figure 1: Sitting posture analysis of MRT Jakarta passengers.

Table 1. Back movement score.

Movement	Score	Score Change
Teak / Alamiah	1	+1 If it rotates or tilts to the side
0^o – 20^0 Flexion	2	
0^o – 20^0 Extension		
20^o – 60^0 Flexion	3	
$>20^0$ Extension		
$>60^0$ Flexion	4	

1. Analysis of MRT Passenger Sitting Posture with REBA Method

Posture analysis of MRT passengers = slightly bent back position with an angle of 40^0; neck movement bent at an angle of 40^0, upper arm position 35^0, forearm position 100^0, wrist 18^0, knee bent at 90^0 pitch.

In the calculation of part, A, which consists of the upper back, neck, and legs are, as follows:

a. Back

From Figure 1, it can be seen that the back movement is included in a slightly bent position with an angle of 40^0, with the REBA score for back action being 3.

b. Neck

From Figure 1, it can be seen that the movement of the neck bends at an angle of 40^0 with the REBA score for the direction of the neck bending being 2.

c. Foot

From Figure 1, the sitting position and knees bent at an angle of 90^0 with a REBA score of 2.

Table 2. Neck movement score.

Movement	Score	Score Change
Tegak / Alamiah > 20^0 Flexion Extension	1 2	+1 If it rotates or tilts to the side

Table 3. Foot movement score.

Movement	Score	Score Change
Legs supported, weight evenly distributed, walking or sitting Legs are not endorsed, weight is not evenly distributed / unstable posture	1 2	+1 If the knee is between 30o and 60o flexion +2 if knee > 60o flexion (when not sitting)

Table 4. The REBA scores.

Table A		Neck											
		1				2				3			
Trunk	Leg	1	2	3	4	1	2	3	4	1	2	3	4
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	6	3	4	5	6	7	5	6	7	8
4		3	4	5	7	5	6	7	8	6	7	8	9
5		4	5	7	8	6	7	8	9	7	8	9	9

The REBA Scores for Table A are as Follows:

In The Calculation of Part B, Which Consists of The Upper Arm, Forearm, And Wrist, It Is as Follows:

1) Upper Arm

From Figure 1, the angle of movement of the upper arm forward is 35^0 to the body axis. REBA score is 2 + 1 abducted arm position = 3.

2) Forearm

From Figure 1, it can be seen that the angle of movement of the forearm forms an angle of 100^0. REBA score is 1

3) Wrist

From Figure 1, It Can Be Seen That the Angle of Movement Of The Wrist Forward (Flexion) To The Forearm Is Included In The Movement Of 18^0. Reba's Score Is 2.

The Reba Scores for Table B Are as Follows:

The Results of The Reba Calculation Are the Meeting Between The Reba A Score Of 5 And The Reba B Score Of 4 Being The Reba C Score

Table 5. Upper arm movement score.

Movement	Score	Score Change
20° extension – 20° flexion	1	+1 if arm position:
>20° extension		- Abducted
20° – 45° flexion	2	- Rotated
45° – 90° flexion	3	+1 if the shoulder is elevated
>90° flexion	4	-1 if leaning back, arms weight supported or according to gravity

Table 6. Forearm movement score.

Movement	Score	Score Change
60° – 100° flexion	1	No change in score
<60° flexion	2	
>100° flexion		

Table 7. Wrist movement score.

Movement	Score	Score Change
0° – 15° flexion/extension	1	+1 if wrist deviates or twists
>15° flexion/extension	2	

Table 8. Table of Reba B scores.

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

Based On The Results Of The Reba Calculation, It Was Found That The Mrt Passenger Sitting Posture Score Was 5, Meaning That The Level Of Risk Was Moderate And Immediate Action Was Needed.

2. **Interview Results with MRT Jakarta Passengers.**

   The author interviewed 10 MRT Jakarta passengers on Tuesday, 7 January 2020, about passenger satisfaction with MRT Jakarta seats. The author received information that 6 out of 10 passengers were dissatisfied with the MRT Jakarta seats because the seat material was too hard, the seating area for one person was narrow, the seat backers were less comfortable, and there was no difference between priority seats and passenger seats in general.

Table 9. Table of REBA C scores.

Score A (Score form table A + load force score)	Table C											
	Score B (Score 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	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

Figure 2: General passenger seats and priority passenger seats.

Based On Figure 2, We Can Conclude That There Is No Difference Between the General Passenger Seat and The Priority Passenger Seat. MRT Jakarta Passengers Expect That in The Future Mrt Jakarta Seats Will Be Given Special Cushions To Make Them More Comfortable And Given The Difference In Materials Between Priority Seats And General Passenger Seats. So, Mrt Jakarta Will Be Better.

CONCLUSION

Based on the results of the MRT passenger sitting posture analysis, the authors can conclude that:

1. The seating posture of MRT Jakarta passengers has a REBA score of 5, meaning that the risk level is moderate and immediate action is required.
2. MRT Jakarta passengers feel dissatisfied with the seat material, and there is no difference between general passenger seats and priority passenger seats

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