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Ergonomics Analysis Of Public Seat In The Kudus Town Square

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Abstract. The public seat is one of the public facilities provided by the government as a form of public service to improve better human development. Public seats are in public buildings, public parks, city squares. In the Kudus town square, there are two types of public seats that are widely used by the public. However, the public seats provided do not have a backrest and elbow rest. Therefore ergonomics analysis is needed to determine the comfort level of public seats. Qualitative methods have been used by taking data about the height of users of public seats using random sampling. Then the data is used to calculate anthropometric measurements of chairs based on the comparison of body size to the height from the ASEAN Regional Institute for School Boarding Research. Based on research that has been done, the results obtained in the form of public seats in the Kudus town square designed by not considering aspects of ergonomics.

1. Introduction

Public facilities are facilities and infrastructure provided by the government in community development efforts. Based on Permen PU No.30 / PRT / M / 2006, Chapter I Article 1 point 2, public facilities are all or part of the completeness of infrastructure and facilities in buildings and their environments so that they can be accessed and utilized by all people including those with disabilities and the elderly. One of the public facilities provided by the government is public seats that are provided in public places such as city parks, city squares, etc.

Public seats must be accessible to everyone and provide tangible benefits. Public seat design is made by using various aspects of consideration, starting from the aspect of beauty, aspects of local wisdom, aspects of art, minimalist aspects. Aesthetics and elements related to comfort and relaxation are features that must be considered in designing each chair. The comfort and relaxation elements can be easily distinguished by the chair user. But sometimes it is often to distinguish the ergonomic elements of a chair. For example, there are chairs that meet ergonomic elements, but cannot feel comfort in a chair that is against ergonomic elements [1].

The comfort of a chair is closely related to the design that considers aspects of ergonomics. ergonomics aspects are aspects that provide comfort for its users. In this context the concept of comfort is important. Comfort as a state of "well-being" [2]. It is characterized by "physiological, psychological and physical harmony between humans and their environment" [3]. As a scientific discipline, ergonomics holds the moral high ground, intending to better the human condition [4]. They suggest that this may be a conflict with other aims of improving system effectiveness and efficiency. No one would argue with the aims of



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improved comfort, satisfaction, and well-being, but the drawing of boundaries between the improvements for individuals and improvements for the whole system. One aspect of ergonomics on the seat is the backrest. The dynamics of the sitting position can be more easily described by studying the mechanics of the buffer system and the overall structure of the bones involved in its motion [5]. An ergonomic chair design, the formalization of qualitative criteria with quantitative criteria can lead to various advantages such as reducing developmental lead-time and cost, increasing user's comfort and reliability, etc [6].

Ergonomics or human factors is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data, and methods to design to optimize human well-being and overall system performance [7]. This knowledge is an illustration of innovation and safety factors in implementing a project. Where ergonomics is required to be able to describe and analyze the stages of the design process based on concurrent techniques [8]. In an ergonomic chair research used in a store room, the benefits of the ergonomics chair were designed in the form of increased productivity [9]. Human factors and ergonomic methods are so important and cannot be overstated. Where the structural approach of the ergonomics method is used for the analysis and evaluation of design problems [10].

The Kudus government provides public seats in the Kudus town square. There are two types of public seats in the Kudus town square, namely public seat A (without elbow rest) and public seat B (without backrest). Based on the data in the field, the purpose of this research to analyze the ergonomic aspects of public seats in the Kudus town square to find out which parts of the public seats are designed by considering anthropometric calculations or not. So expect comfort is created when the public seat is used.

2. Research Method

Qualitative methods have been used in this research. Data collection finished by random sampling to determine the number of samples. Then the anthropometric calculation based on the Comparison of Body Size and Altitude tables of the ASEAN Regional Institute for School Boarding Research. To get a comparison of the results of anthropometric calculations of chairs with the results of direct measurements in public seats. The following are the stages of research:

1) Study of literature

Previous research literature studies and research related to chair ergonomics

2) Taking the height data of public seat users by random sampling and ergonomic size data of public seats in the Kudus town square used the Slovin formula [11], the total population of car-free events was 1000 population, so the number of samples taken:

$$\begin{aligned} n &= N / (1 + Ne^2) \\ &= 1000 / (1 + 1000 \times 0.10^2) \\ &= 100 \text{ person} \end{aligned} \quad (1)$$

3) Data processing

The height data for public seat users processed to calculate the anthropometric size of ergonomic chairs based on the Comparison of Body Size tables with Height calculations from the ASEAN Regional Institute for School Boarding Research.

Table 1. Comparison of body dimension with body height

Code	Body dimension	Comparative U.01
U.01	Body height, from the top of the head to toe	1,00 x U.01

U.02	The height of the eye, from the middle of the eye to the sole	¹ 0,92 x U.01
U.03	Shoulder height, from shoulder bulges to soles of the feet	0,81 x U.01
U.04	Scapula height, from the scapula to the sole	0,73 x U.01
U.05	The height of the elbow, from the protrusion of the elbow to the sole	0,63 x U.01
U.06	Hip height, from protrusions hip bone to the sole	0,59 x U.01
U.07	The height of the fingertips, the tip of the fingertip to the sole	0,37 x U.01
U.08	Knee height, from kneecap to soles of the feet	0,27 x U.01
U.09	The distance of the two protrusions on the elbows in position horizontal	0,52 x U.01
U.10	Length range of hand sideways, from the base of the hand to the tip of the middle finger	0,42 x U.01
U.11	Length reach of hands forward, from the base of the hand to the tips of the fingers	0,49 x U.01
U.12	Shoulder width, the distance between the two outer protrusions of the shoulder	0,22 x U.01
U.13	Hip width, the distance between the two protrusions Hip	0,17 x U.01
U.14	Wrist distance (angle of 20 to the floor)	0,56 x U.01
U.15	The distance between the eyes and the field in position sit	0,45 x U.01
U.16	The distance between the bottom corners of the shoulder blades to the seating area in a sitting position	0,26 x U.01
U.17	The distance between the protrusion of the elbow to the area of the chair in a sitting position	0,15 x U.01
U.18	Thigh thickness in a sitting position	0,08 x U.01
U.19	The distance between the knee armpit to the outside hips in a sitting position	0,29 x U.01
U.20	The distance between your feet and the table for activities using tools	0,50 x U.01

4) Result and Discussion

The results of data processing have been discussed to provide an analysis of the ergonomics aspects of public seats in the Kudus town square

5) Closing

The conclusions obtained from the research conducted.

3. Result

3.1. Data On Height Of Public Bodies Using Public Seats

Based on the survey results, we have obtained the data of the height of the public seat user body in the Kudus town square as follows:

Table 2. Height Data For Public Seat Users In Kudus Town Square

Respondent	Height Data Public Seat Users (cm)										Total
1-10	160	159	167	176	160	165	170	165	167	177	1668
11-20	165	156	168	165	166	166	165	173	170	176	1662
21-30	167	171	174	168	170	170	156	178	171	165	1665
31-40	170	168	169	163	171	163	157	165	164	155	1688
41-50	167	173	156	166	179	167	159	164	163	167	1710
51-60	170	156	159	162	177	180	160	167	160	178	1688
61-70	158	160	163	175	176	167	170	176	170	165	1626
71-80	180	170	168	174	165	167	164	175	165	174	1668
81-90	165	175	169	169	167	173	162	150	167	177	1665
91-100	166	174	172	170	179	170	163	155	168	172	1706

The mean can be described as a socialist measure of a central tendency, in other words, the average was the value each participant receives if the amount is shared equally among all group members [12].

The average value of the results of taking data random sampling of public chair users in the Kudus town square has been done by following equation:

$$\bar{x} = \frac{\sum_{i=1}^{n=100} X}{n} = \frac{16746}{100} = 167,5 \text{ cm} \tag{2}$$

3.2. Anthropometric Calculations Of Public Seats

The basis of the calculation to determine the anthropometric size of the chair using a comparison of the dimensions of the human body with height (ASEAN Regional Institute for School Boarding Research), has been done by following equation:

1) Length sitting area

$$\begin{aligned} &= U.12 \pm 4 \text{ cm} \\ &= 0.22 \times U.01 \pm 4 \text{ cm} \\ &= 0.22 \times 167,5 \pm 4 \text{ cm} \\ &= 36.85 \pm 4 \text{ cm} \end{aligned} \tag{3}$$

2) Width sitting area

$$\begin{aligned}
 &= K19 - (U.11 - U.10) \pm 4 \text{ cm} \\
 &= 0,29 \times U.01 - ((0,49 \times U.01) - (0,42 \times U.1)) \pm 4 \text{ cm} \\
 &= 0,29 \times 167,5 - ((0,49 \times 167,5) - (0,42 \times 167,5)) \pm 4 \text{ cm} \\
 &= 48,575 - (82,075 - 70,35) \pm 4 \text{ cm} \\
 &= 48,575 - 11,75 \pm 4 \text{ cm} \\
 &= 36,83 \pm 4 \text{ cm}
 \end{aligned} \tag{4}$$

3) The height of the sitting area from the floor

$$\begin{aligned}
 &= U08 \pm 2 \text{ cm} \\
 &= 0,27 \times U.01 \pm 2 \text{ cm} \\
 &= 0,27 \times 167,5 \pm 2 \text{ cm} \\
 &= 45,23 \pm 2 \text{ cm}
 \end{aligned} \tag{5}$$

4) The height of the seat back from the sitting area

$$\begin{aligned}
 &= K16 \pm 2 \text{ cm} \\
 &= 0,26 \times U.01 \pm 2 \text{ cm} \\
 &= 0,26 \times 167,5 \pm 2 \text{ cm} \\
 &= 43,55 \pm 2 \text{ cm}
 \end{aligned} \tag{6}$$

5) The Height of elbow rest from floor

$$\begin{aligned}
 &= U.05 \pm 2 \text{ cm} \\
 &= 0,63 \times U.01 \pm 2 \text{ cm} \\
 &= 0,63 \times 167,5 \pm 2 \text{ cm} \\
 &= 105,5 \pm 2 \text{ cm}
 \end{aligned} \tag{7}$$

Table 3 shows the results of the anthropometric calculation of the chair. Then table 4 and table 5 which shows the comparison of the size of the anthropometric chair with the size of the public seat in the Kudus town square.

Table 3. Results of Anthropometric Calculation of Chairs

Part of chair	Anthropometric Calculations (cm)
Length sitting area	36,85 ± 4
Width sitting area	36,83 ± 4
The height of the sitting area from the floor	45,23 ± 2
The height of the seat back from the sitting area	43,55 ± 2
The height of elbow rest from floor	105,5 ± 2

Table 4. Comparison of Type A Public Seat Dimension in The Kudus Town Square with Chair Anthropometric Calculation

Part of chair	Anthropometric Calculations (cm)	Public Seat in The Kudus Town Square (cm)
Length sitting area	36,85 ± 4	41
Width sitting area	36,83 ± 4	40

The height of the sitting area from the floor	45,23 ± 2	52
The height of the seat back from the sitting area	43,55 ± 2	24
The height of elbow rest from floor	105,5 ± 2	0

Table 5. Comparison of Type B Public Seat Dimension in The Kudus Town Square with Chair Anthropometric Calculation

Part of chair	Anthropometric Calculations (cm)	Public Seat in The Kudus Town Square (cm)
Length sitting area	36,85 ± 4	41
Width sitting area	36,83 ± 4	40
The height of the sitting area from the floor	45,23 ± 2	52
The height of the seat back from the sitting area	43,55 ± 2	0
The height of elbow rest from floor	105,5 ± 2	70

4. Discussions

The results of comparisons of anthropometric chairs with type A public seat in the Kudus town square only had two-part of seats that meet the criteria for ergonomic aspects, namely the length sitting area and the width sitting area. While the seat height of the sitting area from the floor, the height of the seat back from the sitting area and the height of the elbow rest from the floor did not meet the ergonomic aspects. So that only 40% of Type A public seats meet ergonomic aspects. Figure 1 shows pictures of the type A public seats available in the Kudus town square.

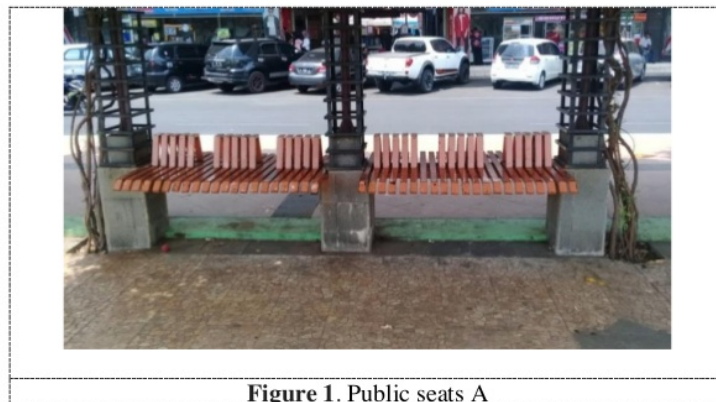
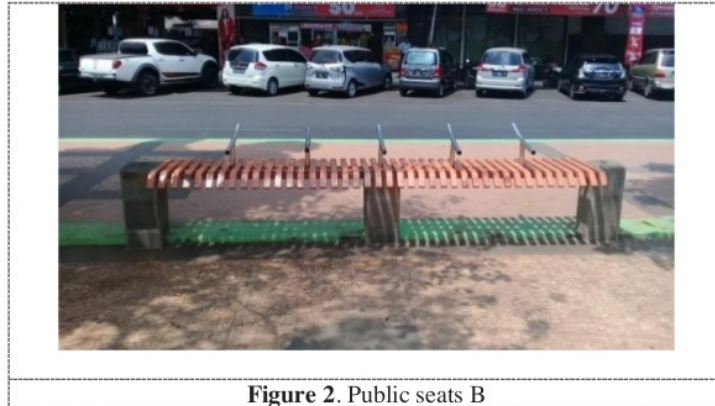


Figure 1. Public seats A

Meanwhile on public seat type B in the Kudus town square also only had two-part of seats that meet the criteria for ergonomic aspects, namely the length sitting area and the width sitting area. While the seat height of the sitting area from the floor, the height of the seat back from the sitting area and the height of the elbow rest from the floor did not meet the ergonomic aspects. So that also only 40% of Type B public seats meet ergonomic aspects. Figure 2 shows pictures of the type A public seats available in the Kudus town square.



Sometimes public seats used not for a long duration. But it was also necessary to design public seats provided to the public must include aspects of ergonomics so that the users of the seat feel comfortable when sitting. Specifically on public seat in the Kudus town square, it needs to be done or redesigned on the seat of the sitting area from the floor, the height of the seat back from the sitting area and the height of the elbow rest from the floor and the addition of foam as a cushion on the height of the seat back from the sitting area and the height of the elbow rest from the floor.

5. Managerial Impact

This research was expected to have an impact on the management of Kudus District government decision making so that it considers the ergonomic aspects of the design of public seats placed in public spaces in the city of Kudus. So people can feel comfortable when sitting in public seats.

6. Conclusions

Public seats available in the Kudus town square were designed with less consideration of ergonomic aspects. Based on the calculation results of ergonomics analysis that there were only two parts of the five-part public seats type A and type B in the Kudus town square that meet the ergonomic aspects, which is 40%. So the comfort felt by the user is not optimal.

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