Implementation of ergonomic on parking management training increases parking user satisfaction in Renon Plaza Denpasar

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Abstract. The indicators of park user satisfaction were in the form of a decrease in workload, a decrease muscle energy usage, increased ease of parking, increased parking convenience and increased parking productivity. An intervention basement used by parking arrangement-based motorcycle ergonomics. Measurements were made before and after repair. Washing out and adaption (WOA) each were conducted for 7 days consisting of one day WO and 6 days of adaptation. Data were analysed descriptively, tested for normality (shapirowilk) and homogeneity (Levene Test). Normally distributed data and is not homogeneous, different test with Friedman Test, different test between periods used the Wilcoxon test. Data were analysed with a significance level of 5 percent. The results showed that the parking space angle 600 a decrease in workload at 27.58 percent (p is less than 0.05), a decrease in muscle energy usage at 30.97 percent (p is less than 0.05), an increase in the ease of parking at 105.80 percent (p is less than 0.05), an increase in the parking convenience at 74.63 percent (p is less than 0.05) and an increase in parking productivity at 166.67 percent (p is less than 0.05).

1. Introduction

Every big city and developing cities that become centers of industrial and economic activities will always be attractive for urbanization which causes an increase in the population. This increase in population requires housing, health, education, recreation facilities including shopping center or mall facilities, this will directly affect the flow of traffic.

Denpasar City is the capital of the province of Bali and of course as a capital city, Denpasar is the center of government and the economy in Bali. The total area of 127.78 km2 has 4 sub-districts with a population of 897.300 people [1]. Increased population and activities have increased the complexity of transportation problems, especially in the city of Denpasar. One of the problems is the need to provide parking in shopping centers that continue to grow. Shopping centers as a place for mass accumulation where buying and selling transactions that have various supporting facilities can attract visitors. The visitors to the shopping center will use the vehicle. So, it takes a parking area to park the vehicle. The parking area as an infrastructure in the transportation system must be able to support the activities that occur because parking problems are closely related to traffic management. On the general problem, the store of Denpasar city has had the problem with the parking area for the shopkeeper or the majority of customer, because the limited access of parking area and the volume of the shop in the area that is not balance with parking area. The shop area biggest than the parking area with the over volume of customer.

As well as the number of employees so it is necessary to take into account the variables that affect the provision of the parking area. For this reason, careful research is needed so that it is expected to produce standard parking requirements that are in accordance with the conditions in the shopping center that will be studied, which can later be used as a comparison with the national parking standard requirements determined by the Director General of Land Transportation.

Parking conditions at the shopping center at Renon Plaza, have their own parking facilities that do not use the road (off street parking). Given the large number of vehicles entering the shopping center and the existing parking area is not able to accommodate vehicles, so vehicles that do not get a parking space are forced to park their vehicles on the street (on street parking) where this will cause losses for other transportation users, the central management shopping needs to provide adequate and well-arranged parking areas to avoid the chaos of parking vehicles, this will provide desirable services for all parties, both employees and consumers who will use the parking lot for a certain period of time in accordance with their interests.

Several studies have been conducted on the analysis of parking requirements in several regions, including: markets, Education [1-2], hospitals and shopping centers [3]. This improvement effort is an ergonomic intervention process so as to produce the best intervention with the least impact. In the ergonomic design of human elements which will later become users, it will certainly become a reference so that it must take into account the natural space and attitude [4].

Based on the problems described above, there is a need for research on the effect of ergonomics-based motorcycle building parking management at Renon Plaza Denpasar. With this study, it is expected to be able to find the effect of ergonomics-based motorcycle parking management on parking user satisfaction.

2. Methodology

This research will be conducted at the Renon Plaza shopping center, located on Jl. Raya Puputan No.210 Timur, South Denpasar, Bali 80239. The research was conducted for 8 months. This time is needed for preparation of research and literature, initial research, data collection before treatment, treatment, data collection after this proposal has been approved.

The scope of the research is in the field of ergonomics-work physiology that is applied in the management of parking at Plaza Renon Mall, type. In this case a total ergonomics approach is applied as a combination of the SHIP approach and Appropriate Technology.

2.1. Population and sample

The population of the target parking attendants of this study were all parking users in the Renon Plaza Denpasar shopping center. While the affordable population is all users park in the Renon Plaza shopping center. From an affordable population determined; Parking user names that will be used as research subjects; and The schedule for using the parking lot according to the research schedule.

2.1.1. Inclusion Criteria. The inclusion criteria considered in this study are. Parking user inclusion criteria. Age ranges from 20 to 50 years. Healthy body as evidenced by a doctor's statement. Gender: Male Minimum high school education.Experience using a parking lot at Renon Plaza at least 2 years. Willing to be involved as a sample in this study which is proven by filling out informed consent.

2.1.2. Drop out criteria. Parking user criteria that are used as considerations do not continue (drop out) as a sample of this study are as follows. Suffering from illness during the study. Resign as a sample, for certain reasons. At the time of the study not entering work.

Thus the number of samples used is the largest number of n which is as much as 8.07 and rounded up to 8 people. To anticipate the selected sample to drop out and not need to be substituted, the minimum sample size is added to 10% [5] so the sample size is added 15% so the total sample becomes: n = 8 + (0.15 x 8) = 9.2 and rounded up to 10 people.

In this study the sample was determined based on the requirements of the inclusion criteria using simple random sampling. The sampling method is done by registering parking users who use the parking basement parking lot, then draws from the existing number to get the number of samples as research subjects as many as 10 people. The sample chosen as the research subject was treated the same, namely the initial conditions were given using the parking lot conditions before repairs with the ergonomic approach, then the samples were treated the same when using the parking place after repairs after repairs with the ergonomic approach.

2.2. Research variable

The variables in this study can be classified as follows:

- The independent variables in this study are: parking arrangement before being based on economy and ergonomics-based parking arrangement.
- Dependent variables are: parking user satisfaction seen from: workload; muscle energy use; c) ease of parking; parking convenience; parking productivity.
- Control variables are: parking users internal factors (age, weight, height, work experience, education and health level).

For more focused the research, it is necessary to set out the operational variables are as follows:

- Ergonomics based motorcycle basement parking arrangement before based ergonomic is basement parking space conditions motorcycle untreated, called Period I.
- Ergonomics based motorcycle basement parking arrangement that intervention with systemic approach, holistic, interdisciplinary and participation, as well as select improvement with consideration of technical aspects, economic, social, cultural, energy efficient and do not damage the environment, including: Arrangement parking basement include: Repair helm daycare; improved parking signs; improved parking markings; Improved lighting; Installation of a room divider wall; Improvements cover the walls in the engine room of the water pump.

Structuring basement parking with different patterns of terraced park, namely: the angle 30^0 is called the Period II (P2), the angle 45^0 is called the Period III (P3), the angle 60^0 is called the Period IV (P4), the angle 90^0 is called the Period V (P5), as shown.

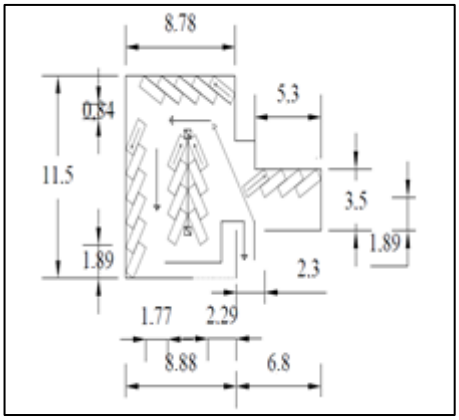

Figure 1. Parking Plot of 30^0.

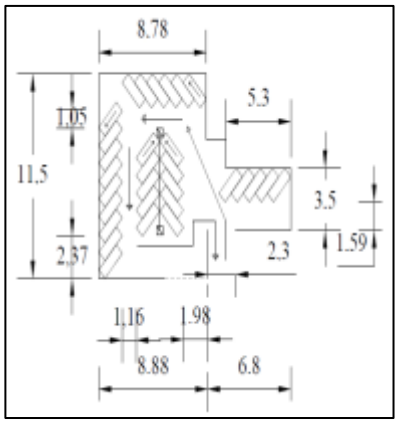

Figure 2. Parking Plot of 45^0.

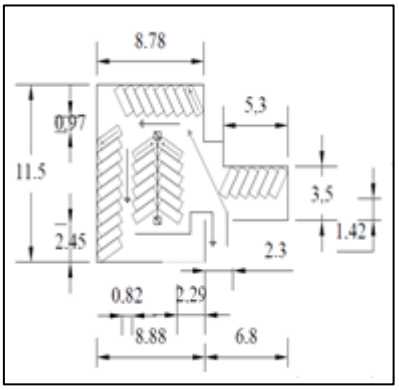

Figure 3. Parking Plot of 60^0.

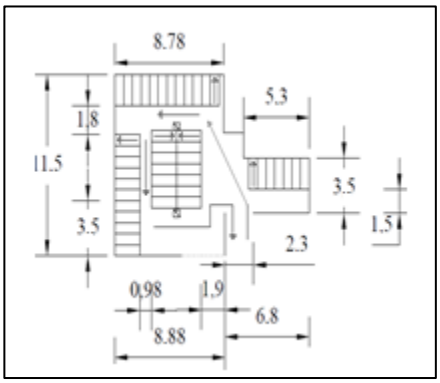

Figure 4. Parking Plot of 90^0.

3. Results and discussion

The total ergonomics approach to the renon parking plaza aims to increase parking user satisfaction. The improvements made in this study are based on the SHIP approach (Systemic, Holistic, Interdisciplinary and Participatory) and assessed through Appropriate Technology Approaches with 6 criteria: Technical, Economical, Ergonomic, Energy Efficient, Socio-Cultural, Environmentally Friendly and Trend. The total ergonomics approach is a form of ergonomic intervention aimed at obtaining a humane, competitive and sustainable work system

The application of the total ergonomics approach to the renon parking plaza starts with the identification of problems consisting of 8 aspects, namely: nutrition and nutrition, utilization of muscle power, work attitudes, environmental conditions, time conditions, information conditions, social conditions and human-machine / tool interactions. Some of the problems that were identified were: a) work attitude in parking vehicles is not natural; b) considerable utilization of muscle power; c) the layout of parking space facilities is less ergonomic; and d) information systems are less informative.

The problem identification is done by solving through the SHIP approach. In the SHIP approach all problems in parking management must be solved through a system approach, studied holistically and through cross-disciplinary methods and using a participatory approach with the intention that all components in the system can be involved starting from the planning, implementation and evaluation stages so that they will know success and failure and jointly seek solutions [5].

The systemic considerations in the parking arrangement design of Renon Plaza Plaza are shapes, sizes, materials, parking operations and costs. Holistically all parties involved must be solved comprehensively by considering the limitations that exist. Interdisciplinary methods require experts from various fields, among others: ergonomics to see the problems of the relationship between humans and their work; transportation techniques determine the technology used in parking, especially regarding parking lot patterns; civil engineering to determine the material requirements and costs needed to repair motorcycle basement parking spaces. Besides that, the architect drawing technique with the Auto Cad program is needed to draw a picture of the condition of the basement parking space and the image of the implementation of the improvements made. To examine this problem, participation of all parking users is needed, because they are the ones who use the parking lot and understand the problems of the parking conditions.

The application of appropriate technology in parking arrangements for Plaza Renon Denpasar with a total ergonomics approach has been discussed through systematic steps based on suggestions and input as well as the participation of all parties involved in the arrangement of motorcycle basement parking spaces. The concept of technology is used in accordance with appropriate technology which is a comprehensive approach in the selection of technology that includes 6 criteria [5-6] that are: Technical, Economical, Ergonomic, Energy Efficient, Socio-cultural and environmentally friendly.

From this description, the parking arrangement of the Plaza Renon Denpasar using the total ergonomics approach is very useful in this study, so that it can increase parking user satisfaction. The

application of this total ergonomics approach has been implemented in several workplaces and industries [7].

3.1. Workload

Large changes in workload (BK) on parking user activities at Renon Denpasar Plaza in this study were measured in Period I and II. This workload is determined by the difference or difference from the resting pulse (DNI) with the working pulse (DNK). Changes in workload in this activity are determined by the activity of the parking user process. The resting pulse in periods 1 and II is taken at 9:00 a.m. while the work pulse is taken at 11:00 a.m.: 1:00 p.m. and 3:00 p.m.

Table 1. Parking user workload research subjects in periods I and II.

Variable	Period I		Period II	
	Average	SD[d]	Average	SD
DNI[a]	74.23	3.43	74.15	3.27
DNK[b]	103.02	1.40	96.57	1.24
BK[c]	28.79	3.27	22.49	2.76

[a] Breaking Pulse
[b] Working Pulse
[c] Workload
[d] Standard Deviation

To find out that changes in workload are not caused by the influence of activities outside the research, normality tests and different resting pulse tests can be carried out before working in Period I and II, while to determine changes in workload for Period I to Period II due to intervention, then the normality test and workload difference test were carried out in Periods I and II. The test results are shown in Table 2.

Table 2. Normality test results and different tests of pulse rate period I and II test and workloads.

Variable	Test	Amount Sample (n)	Average	SD	Different Average	Value of p Normality test (Shapiro-Wilk)	Value of p Different Test (t-paired)
Breaking Pulse	Period I	15	74.24	3.44		0.394	
	Period II	15	74.16	3.28		0.352	
Work Load	Period I	15	28.80	3.28	6.29	0.345	0.000
	Period II	15	22.51	2.77		0.364	

[SD] Standard Deviation

Based on the data in Table 2, it can be stated that the results of the normality test (Shapiro-Wilk) resting pulse in Period I and II are normally distributed (p is more than 0.05) and different tests (t-paired) state that there are no significant differences between the resting pulse Period I and II (p is more than 0.05). The results of the normality test (Shapiro-Wilk) workload in Period I and II are normally distributed (p is more than 0.05) and different tests (t-paired) state that there are significant differences between period I workloads and II (p is less than 0. 05).

The workload determined from the difference in resting pulse with working pulse, which obtained a mean of 28.80 ± 3.28 with a range of 24.20 - 35.71 pulses / minute in Period I and 22.51 ± 2.77 with a

range of 18.51 - 28.39 beats / minute, or a significant decrease in workload of 20.90% from Period I to II. Decreasing workload means parking users are lighter. Decreasing workload theoretically will increase parking user productivity, this is one of the characteristics of an increase in the quality of work so parking users can be healthier and life better.

Viewed from Table2, there has been a change in workload from the moderate category to the light category. This decrease in workload is caused by interventions based on ergonomics studies and mechanical engineering. Ergonomics includes changes in work attitudes and positions that are part of the task, changes in eating breaks and work time which are part of the organization, and changes in the microclimate of the work environment [4].

Parking lot users (parking vehicles and taking vehicles in the parking lot) rely on muscle strength, thus the power to carry out parking activities comes from muscle power. Muscle energy use is the amount of energy needed to complete parking activities. Energy parking activity is the average energy carried out in parking a vehicle and taking a vehicle in the parking lot. The measurement data for muscle energy use is obtained by using the Equation 7. The results of the analysis of muscle energy use can be seen in Table 3.

Table 3. Normality test results and different tests of muscle energy usage period I and II.

Variable	Test	Amount Sample (n)	Average	SD	Different average	Value of p Normality test (Shapiro-Wilk)	Value p Different Test (t-paired)
Work Load	Period I	15	28.80	3.28	6.29	0.45	0.000
	Period II	15	22.51	2.77		0.364	

[SD] Standard Deviation

The results of the normality test (Shapiro-Wilk) workload in Period I and II are normally distributed (p is more than 0.05) and different tests (t-paired) state that there are significant differences between period I workloads and II (p is less than0, 05). The workload determined from the difference in resting pulse with working pulse, which obtained an average of 28.80 ± 3.28 with a range of 24.20 - 35.71 beats / minute in Period I and 22.51 ± 2, 77 with a range of 18.51 - 28.39 beats / minute, or a significant decrease in workload of 21.90% from Period I to II. Decreasing workload means parking users are lighter. Decreasing workload theoretically will increase parking user productivity, this is one of the characteristics of an increase in the quality of work so parking users can be healthier and life better.
Based on the results, Table 3.3 shows that muscle energy use between periods is not significantly different (p is less than0.05). The use of muscle energy in the two periods was significantly different, explaining that the differences in muscle energy use that occur due to the influence of ergonomics-based parking arrangement. Ergonomically based parking arrangement can reduce muscle energy use. While the use of muscle energy between the two periods was not significantly different, explaining that the two periods had no difference in energy use.

Parking and picking up vehicles from parking lots that require movement of the upper and lower skeletal muscle components such as the arm muscles, thigh muscles, calves and soles of the feet are important components in the musculoskeletal system. Parking and taking parking vehicles are a type of activity that has a certain duration. Based on the research conducted, the decrease in muscle energy use was large at 21.06%, so the use of energy for parking activities was at the standard level of energy use for activities i.e. 20-35% of total energy expenditure [10].

Comfort is a comfort that is felt directly by parking users due to a sense of comfort in parking buildings, especially motorcycle vehicles. In this study the measurement of convenience was done by giving questionnaires 12 items of questions. Before the questionnaire was used for data retrieval,

reliability and validation tests were first carried out. After the questionnaire was declared valid, data was collected by providing questionnaires in Period I and II. Data retrieval results are shown in Table 4.

Table 4. Parking user comfort and normality test results and different tests in Periods I and II.

Test	Amount Sample (n)	Average	SD	Different average	Value of p Normality Test (*Shapiro-Wilk*)	Value of p Different Test *(t-paired)*
Period I	15	15.58	1.43		0.107	
				9.22		0.000
Period II	15	24.80	1.85		0.689	

[SD] Standard Deviation

Table 4 shows that there is an increase in the convenience of parking users from Period I to II. The average parking user comfort score in Period I was 15.58 ± 1.43 with a range of 13.67 - 18.33. The average parking user comfort score in Period II was 24.80 ± 1.85 with a range of 22.00 - 29.00 and the average difference in parking user comfort score was 9.22. The results of the normality test (Shapiro-Wilk) on the average comfort in Period I and II were normally distributed (p is more than 0.05) and different tests (t-paired) stated that there was a significant difference between the convenience of Period I and II (p is less than 0.05). This means that in terms of parking convenience, which resulted in an increase in parking convenience the research conducted was 20.90%. Similar opinion also supports the results of research conducted and states that the comfort of the human body depends on three factors, namely temperature, relative humidity and air flow velocity.

4. Conclusions

Based on the results of the research and discussion described in this study, it can be concluded as follows: Implementation of ergonomics in parking management can reduce the parking workload of users at Renon Plaza Denpasar by 14.09%. The implementation of ergonomics in parking management can reduce the energy use of muscle parking users in Renon Plaza Denpasar by 21.05%. The implementation of ergonomics in parking management can increase the convenience of motorcycle parking users in Renon Plaza Denpasar by 20.02%.

5. References

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