

Characteristics of Pedestrian Flow at Traffic Signalised Crossing in Shah Alam

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Abstract: Pedestrians are among the contributors to road traffic accidents and are identified as vulnerable users to accidents. There are a number of factors that cause accidents among pedestrians and road users to be studied, so that the safety of road users especially pedestrians can be improved. The study was conducted to identify pedestrian characteristics in terms of gender, group, and time span in crossing roads. Therefore, a study of pedestrians in the pedestrian crossing area was conducted. In this study, the study area is the main urban road at Shah Alam, Selangor. This study is important to provide an accurate picture of the characteristics of pedestrian flows along the pedestrian crossing in Shah Alam. The study area was selected based on two main focus areas of pedestrian crossing. The first area is at the SACC Mall and the second area at Perdana Apartment near the Shah Alam Stadium. Characteristics of pedestrian flow along pedestrian crossing are identified through observation methods in the study area using video recordings to track pedestrian volumes and group categories. Based on the data obtained, the analysis was performed to achieve the objective of the study to determine the volume of pedestrian, pedestrian gender and pedestrian category by personal, couple or grouping in pedestrian crossing road. In addition, this study was performed to determine the start loss time and clearance time gain of pedestrians. In conclusion, all the factors of pedestrians in making crossing at traffic crossings in terms of gender, crossing method, and the time taken to affect the speed of pedestrians in making a crossing at traffic crossings at peak times and non-peak times. Also, the average for the speed of each class category is very significant in making crossings.

Keywords: Pedestrian, Traffic Light, Crossing

1. Introduction

The road is a convenience to facilitate the movement of vehicles other than sea and air. It is also a medium of communication and one of the basic infrastructure that plays an important role in social and economic development. Pedestrian walkways are an important element in planning and building a road. It was found that almost half of the 1.27 million deaths in road accidents each year are pedestrians, motorcyclists and cyclists [1]. A large number of pedestrians are killed in road accidents every year. Usually, pedestrian accidents are worse than other types of accidents. A survey of pedestrian accident data shows that most accidents occur while pedestrians cross the road. Usually, pedestrian accidents are worse than other types of accidents.

A survey of pedestrian accident data shows that most accidents occur while pedestrians cross the road. Many countries have sought to increase pedestrian activities to reduce the increasing use of vehicles. This method can indirectly reduce traffic congestion and the surrounding areas involved. The characteristics of pedestrian paths are the main focus on the relationship between speed, capacity, flow and the area involved. The influencing factors in this study are human factors such as behavior, age, gender and the load carried. The traffic light system is an important facility needed in areas such as schools, shopping complexes, offices, residential and industrial areas. The system needed is to reduce traffic conflicts between vehicles and pedestrian safety itself.

Pedestrians are an important part of creating a transportation system including cycling and any vehicle that can move things from place to place. Pedestrians often face difficult times in crossing roads, especially on high-speed trails and on wide trails. With the existence of a signalised crossing system, there are still many pedestrians at risk of making crossings due to hesitation because many vehicle owners do not comply with the rules of road safety laws. Through this problem, the researchers chose this topic for the purpose of obtaining data and analysis problem that exists among pedestrians at signalized crossing.

The purpose of this study was to compare the volume of pedestrians at signalised crossings in terms of gender, crossing method, and time. In addition, this study to determine the pedestrian lost time and clearance time gain.

2. Pedestrian Characteristic and Parameters

This section describes the characteristics of signalized pedestrian crossings will be presented as flow, density, pedestrian speed, duration, and the number of vehicles and pedestrians at a time different. The decision-making process to cross is a complex process, in which pedestrians observe and evaluate their environment, make their strategy decisions and adjust accordingly if necessary. According to the pedestrian research, selection of pedestrian crossings at traffic signalized crossings emphasizes on parameter differences when crossing [2].

2.1. Pedestrian safety

Injuries suffered by pedestrians generally can be divided into three types. Primary injury occurs during the first impact of a direct collision with a pedestrian. As a result of the first impact of the collision, the victim will usually be thrown and hit any part of the vehicle. This injury is called a secondary injury. Tertiary injuries resulted from the victim being thrown onto the road surface. In Malaysia, there are several organizations involved to improve the safety of pedestrians namely IKRAM Group Sendirian Berhad, Jabatan Kerja Raya and Malaysia Institute of Road Safety Research. There are a number of important factors to indicate pedestrian safety facilities that include the flow of vehicles and pedestrians, average crossing time (gaps and pedestrian reception) and previous accident reports [3].

2.2. Pedestrian Facilities

This necessary system is to reduce traffic conflicts between vehicles and safety for pedestrians themselves. There are several pedestrian crossing systems practiced in Malaysia which include pelican crossing, overpass crossing, and zebra crossing [4].

2.3. Pedestrian Speed

Walking speed is a measure of distance that involves the total rate of pedestrians over a period of time. Speed is also measured using the 'u' symbol as well as using the 'm / min' unit. Speed is also an important factor in terms of safety, comfort, economy of time and because generally conduct studies to determine the percentage of speed is the speed and distribution of the flow speed of the flow of traffic for free at a certain location [5]. Basically, speed is the sum of distances traveled divided by the travel time taken during traffic analysis.

2.4. Pedestrian Waiting Time

Pedestrian waiting time is interpreted as the period of pedestrians waiting for their arrival by the side of the road until they cross the road. The waiting time for pedestrians depends on the length of the cycle at each intersection and in the area of traffic light crossing. The waiting time for pedestrians should be equal to the duration of the green phase of the traffic signal. Pedestrians have to wait until the red phase to cross the road. There is a belief and consideration that shorter or longer waiting times will affect pedestrian crossing [6]. In terms of waiting time, male pedestrians expect a reasonable waiting time shorter than women [7]. While parents and children are willing to accept reasonable waiting times and longer maximum waiting times than middle-aged people. Other then, when the waiting time increased signaling, pedestrian become impatient and violating the traffic signal [8].

2.5. Pedestrian Loss Time

Pedestrian loss time is the time required for pedestrians to leave the sidewalk or shoulder of the road. If there is a queue due to high pedestrian demand, sufficient departure time should be provided so that all pedestrians waiting on the side of the road or shoulder of the road will have ample opportunity to start crossing. the required discharge time can be a certain fixed mass number of countermeasures for the first pedestrian to start crossing and the waiting time. The situation in making a crossing depends on the traffic situation and the demand rate of the number of pedestrians at one time on the pedestrian traffic signalize crossing.

3. Research and Methods

This process is an importance process in making decision preparation. The methodology of this study to collect and obtain information about the study made and is one of the important parts to make a reference and get accurate analysis results.

3.1. Descriptive Statistical Analysis

This method of analysis provides data in the form of frequency of pedestrian on traffic signalize crossing as well as numerical and graphical methods to determine the pattern of the data set, summarize the information from the data set and present the information collected from the sample in interesting form data taken from the pedestrian that committed the offence is according to the class set obtain other data such as the type of gender and category of pedestrian.

Class 1= Personal

Class 2= Couple

Class 3= Grouping

By conducting an analysis using this method as well as achieving the first objective in this study which is to compare the volume of pedestrians at traffic light crossings in terms of gender, crossing method, and time where the pedestrian crossing data will be taken and collected from a graph to identify which class of pedestrian are more likely to commit the pedestrian crossing.

3.2. Determination of Pedestrian Volume

Volume of pedestrians is the number of pedestrians crossing a point. This method to determine the number of pedestrians at a traffic signalized crossing at a given time and place. Data collection from the study of the volume of pedestrians was used to analyze the types of pedestrian category. There are two basic methods for calculating pedestrian rates which are manual observation and mechanical / automatic recording. The data is collected and analyzed roughly by pedestrians during peak hours and non-peak hours for each section in the study area.

3.3. Determination of Pedestrian Speed

Based on the data of the time period and width of the crossing distance will be taken, the data can identify the speed of pedestrians in making a crossing. To gain speed, the distance traveled by pedestrians is divided by the time period of pedestrians in making crossings.

Where V is crossing speed (meter/second), D is crossing distance (meter), and t is crossing time (second).

$$V = \frac{D}{t} \quad \text{Eq. 1}$$

3.4. Pedestrian Clearance Time

The total of the walk interval and pedestrian clearance time should be sufficient to allow a pedestrian crossing in the crosswalk who left the pedestrian detector. signal indication to travel at a walking speed per second to the far side of the traveled way being crossed or to the median if a two-stage pedestrian crossing sequence is used. Any additional time that is required to satisfy the conditions of this paragraph should be added to the walk interval.

Where W is walking time (second), D is crossing distance (meter), and V is crossing speed (meter/second).

$$W = \frac{D}{v} \quad \text{Eq. 2}$$

4. Results and Discussion

The results of the analysis are discussed based on the data of pedestrian crossing from field observations according to the prescribed method. From the data collection, a total of 50 data were recorded. This data analysis process is important in a study because the results of this study will determine whether the researcher can achieve the goals of the study or not.

4.1. Analysis in Terms of Gender

The data in Table 1 shows pedestrian gender type data observed during peak hours and non-peak hours in two different sections. Where PH is peak hour and NPB is non-peak hour.

Table 1: Gender type rates in two section

	Section 1		Section 2	
	PH	NPH	PH	NPH
Male	16	15	30	35
Female	34	35	20	15

For section 1, the number of female pedestrians is more than the number of male pedestrians during peak hours and non-peak hours. The difference between the two genders is quite significant where at the peak time of female pedestrians is 34 people and only 16 people for male pedestrians. For section 2, the data shows that the number of male pedestrians is more than the female pedestrians where during peak hours there are 30 males and 20 females. At the non-peak time there are 35 male pedestrians while 15 female pedestrians

4.2 Analysis in Terms of Category

For this analysis, pedestrians in the category according to three classes differ in making one crossing. For the first class, pedestrians make the crossing alone. While for the second class, pedestrians make crossings in pairs. For the second class the crossing is done with the same pair of same sex or different gender. Finally, the third class in the category in making crossings in groups. For group crossing is also calculated based on gender mixing.

Table 2 shows the pedestrian rates by class difference in the number of pedestrian categories observed according to classes one, two, and three. For section 1, the total values for peak hours and non-peak hours recorded are in class 2 of 46 crossings. The data recorded in section 1 show that pedestrians are paired higher than doing individual or group crossings at pedestrian crossings with traffic lights. The total pedestrian category for section 2 was recorded during peak hours and non-peak hours showing the highest value in class 1 of 80 crossings. Then for class 2 there are 20 crossings and no data is recorded in class 3. The significant difference factor in each class is due to the study section, where the selected section is the apartment area where the majority of pedestrians are from the apartment population. Different in section 1 which is the shopping mall area. Where class 1 is personal, class 2 is couple, and class 3 is grouping.

Table 2: Pedestrian rates by class

	Section 1			Section 2		
	PH	NPH	Total	PH	NPH	Total
Class 1	18	22	40	41	39	80
Class 2	22	24	46	9	11	20
Class 3	10	4	14	0	0	0

4.3 Speed Analysis

In this section, peak hours are observed at noon (12.00 pm - 2.00 pm) and at non-peak hours in the afternoon (2.00 pm - 4.00 pm).

Table 3 shows the average data of pedestrian speed at traffic light crossings in the two study areas. This study was conducted based on peak hours and non-peak hours. The highest speed was recorded in

section 2 during peak hours while the lowest speed was recorded in section 1 during peak hours. This is because the peak hours in section 1 are recorded on working days where the peak hours involving the majority of pedestrians are public sector employees working in the section 1 area. Where PH is peak hour and NPB is non-peak hour.

Table 3: Average data of pedestrian speed in two section

Pedestrian Speed At Traffic Light Crossing (m/s)				
	Section 1		Section 2	
	PH	NPH	PH	NPH
Average Speed	1.1	1.0	1.3	1.2
Minimum Speed	0.5	0.6	0.9	1.0
Maximum Speed	1.5	1.4	1.9	1.6

4.4 Pedestrian Clearance Time

Table 4 shows during peak hour in section 1 the pedestrian speed more faster then non-peak hour. This factor, because in peak hour section 1 located at near the shopping mall and office area. At this time, the capacity of transport during peak hour will increase on this road, so its give impact to pedestrian to make fast decision to cross the road. For the overall result, in section 1 and section 2 the data shows in two section have quite significant because this two section have different road width of pedestrian crossing. Where section 1 at SACC Mall and section 2 at Perdana Apartment.

Table 4: Average pedestrian clearance time

Average Pedestrian Clearance Time (sec)		
	Section 1	Section 2
Peak Hour	13.6	8.1
Non-Peak hour	15.0	8.7

4.5 Pedestrian Loss Time

This subtopic describes the analysis of pedestrian lost time in Section 1 and Section 2. The pedestrian loss time occurs when the traffic signal changes from red (stop) to green (go). A certain amount of time elapsed between the signal changing from red to green and the first queue vehicle moving through the intersection. Table 5 shows the average of pedestrian loss time. Where section 1 at SACC Mall and section 2 at Perdana Apartment.

Table 5: Average of pedestrian loss time at signalised crossing

Average of Pedestrian Loss Time At Signalised Crossing (second)		
	Section 1	Section 2
Peak Hour	1.3	1.2
Non-Peak Hour	1.5	1.3

5. Conclusion and Recommendation

After all the data have been observed and analyzed at traffic signalize crossing at SACC Mall and Perdana Apartment at the Shah Alam, it shows all the factors of pedestrians in making crossing at traffic crossings in terms of gender, crossing method, and the time taken to affect the speed of pedestrians in making a crossing at traffic crossings. at peak times and non-peak times. Also, the average for the speed of each class category is very significant in making crossings. Class 1 where it is the pedestrians who make the crossings individually produce the highest speed, this shows the single pedestrians are faster than the crossings in groups. The results for volume of the pedestrian increases, so does the speed in making the crossing are decrease. For the pedestrian clearance time the analysis shows that the averages for section 1 and section 2 for non-peak hours are longer than peak hours.

From the results of the study that has been made there are some suggestions that have been identified. In field observations, researchers have identified one of the problems in this study area is that pedestrian traffic lights do not work properly. This has indirectly affected pedestrians in making crossings among which pedestrians have to wait a long time to make crossings. The responsible party needs to maintain the traffic light system. In the study area, pedestrian crossings with traffic lights are located in the main route area. This directly makes pedestrians more at risk because vehicles passing through the pedestrian crossing are speeding. At the pedestrian crossing area with traffic lights is installing pedestrian beacon lights designed to force vehicle users to slow down their vehicles.

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