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A STUDY ON ADVANCE STOP LINE FOR MOTORCYCLISTS AT SIGNALISED INTERSECTION IN MALAYSIA

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Abstract. Urban signalized intersection caters to a high volume of traffic every day and releases traffic in a platoon. Statistic has shown a significant share of accident risk involving motorcyclists at the signalized intersection in most ASEAN countries e.g Malaysia. The mixed interactions of vehicles at signalized intersection creates a traffic conflict among the motorcyclists and other motorists. Advance Stop Line (ASL) is one of the facilities provided at signalized intersection to segregate the motorcycles from other vehicles. This study aim to determine the effectiveness of ASL in reducing traffic conflict at the signalized intersection. The objectives include a) to determine the utilization rate by motorcyclists b) to observe the riding behavior of motorcyclists while stopping at ASL and c) to compare the rate of conflict with and without provision of ASL at the signalized intersection. Result shows that the differences in average of traffic conflicts rate between signalized intersections without and with the implementation of ASL was 71.2%.

Keywords: Motorcycles; signalized intersection; mix interaction; crashes; ASL

Introduction

The signalized intersection area has caused a significant number of vehicle crashes each year especially involving vulnerable road users (VRU). The mixed interaction by different types of vehicles with VRU, e.g. motorcyclist, pedestrian posted more conflict at an intersection. Signalized intersection was designed to eliminate conflicts but, in some cases, it always becomes a challenge typically in ASEAN countries with the percentage of motorcycles is higher. The motorcyclist commonly will squeeze between vehicles and waiting out of the stop lines and between median lines. This situation will lead to conflicts and delay for other vehicles when the signals change its phase at a signalised intersection.

The case is obviously in Malaysia, there were almost 513954 vehicles registered (JPJ, 2010). Figure 1 illustrates the number of registered vehicles in Malaysia, 2009. The highest registration vehicles recorded is private cars among all type of vehicle in Malaysia for 2009 (Borhan et al., 2011). Mohamad and Kiggundu (2007) reported that the influence factors to the rapid growth of private vehicles in Malaysia are due to the income factor, the provision of various motor assembly facilities and the involvement of the Malaysian government into automobile manufacturing (Borhan et al., 2011).

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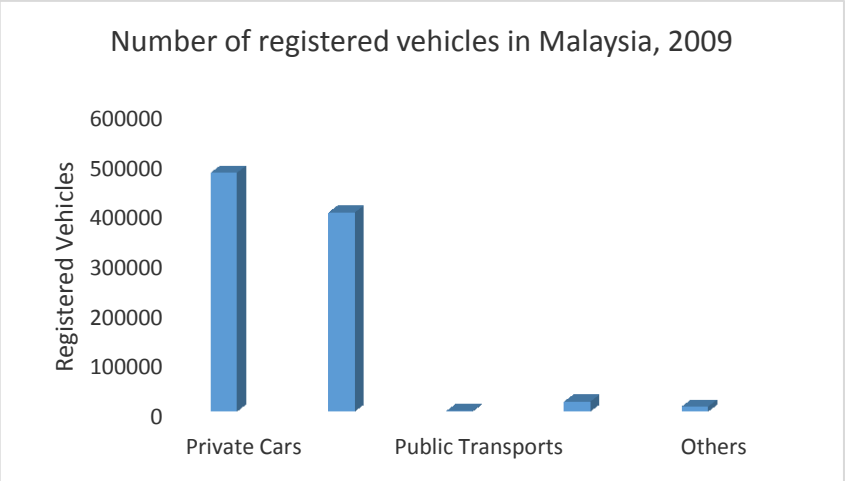

Figure 1: Numbers of registered vehicles in Malaysia, 2009
(Sources: Road Transport Department JPJ, 2010)

According to the Federal Highway Administration (FHWA) report, more than 2.8 million injuries occur each year in the United States of America that related to the intersection. Intersections are the key nodes in the urban road network, where many vehicles intersect with many conflicts (Xia et al., 2019). The contribution of the number of accidents is due to many distinct conflicting patterns at a signalized intersection that causes the vehicle movements (Bhuiyan et al., 2016). The traffic conflict at the signalized intersection has been reduced the motorcyclist's safety.

Malaysia has introduced a dedicated waiting area at the signalized intersection or Advance Stop Line (ASL) or also called as advance stop box. ASL functions to segregate the motorcycles from other vehicles during the red phase. This help lessens the interaction of motorcycle with other vehicles. This solution could decrease the amount of the collision between motorcycle and other vehicles. Most traffic accidents are predictable and can be prevented. Some countries are successful in the implementation of the interventions shows the effectiveness on making a road safer has been corresponding in reductions of road traffic fatality. Rolling out these interventions globally offers huge potential to mitigate future damage and save lives at a global level (WHO, 2015).

Method

The data that was obtained from this study collected via secondary and primary data collection and site observation. There were two (2) cases of signalized intersection take into considerations in this study. Case I for signalized intersection with ASL and Case II for signalized intersection without ASL. The volume of motorcyclists' , traffic conflict and motorcycles behavior data were collected simultaneously using video recording methods during weekdays in the morning (7.30 am – 8.30 am) and afternoon (12.00 pm – 1.00 pm) which is 1-hour duration during peak hours in Malaysia..

The traffic conflict patterns observed includes vehicles applying brakes, swerving or noticeable accelerating or decelerating to avoid a collision. The data for the traffic conflicts were recorded by considering all types of traffic conflicts as Table 1

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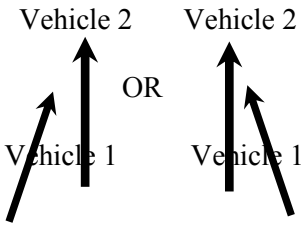
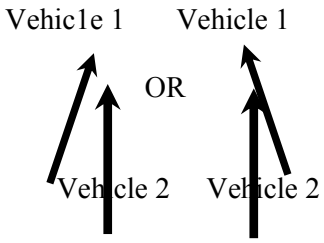
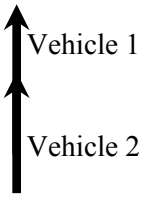
Traffic conflicts (TC)		
TC 1	**TC 2**	**TC 3**
Vehicle 1 is approaching from other lane whether to right or to left lane and must brakes or slow down to avoid collision with vehicle 2 that is moving straight.  	Vehicle 2 moving straight applying brakes or slow down to avoid collision with vehicle 1 that approaching vehicle 2 and moves to other lane whether to right or to the left lane.  	Vehicle 1 moving straight but slow and vehicle 2 at back is fast then need to brakes in order to slow down to avoid collision. 

Table 1: Types of traffic conflicts

The selection of study location for a case I was made based on the availability of ASL at the signalized intersection. The ASL is available at Kuala Lumpur which at Jalan Raja Laut, Jalan Tunku Abdul Rahman and Jalan Tun Perak. However, only two (2) locations were selected which at a signalized intersection along of Jalan Raja Laut. The selection location was at Jalan Raja Laut – Jalan Kucing (Pertama Complex) and Jalan Raja Laut – Jalan Esfahan (SOGO).

For case II, the selection of location was made based on the similarities of characteristics and design of the signalized intersection with ASL. The selection of location for case II was made in Shah Alam area which is at Seksyen 7. The first signalized intersection which located at Persiaran Karangan – Persiaran Permai (KFC) and another one was selected at Persiaran Karangan – Jalan Pintar 1/21A (UiTM). The details of the selected signalized intersection shown in Table 2 below.

Table 2: Details of selected signalized intersection

Location	ID	Signalized Intersection Types
Persiaran Karangan – Persiaran Permai (KFC)	1A	Without ASL
Persiaran Karangan – Jalan Pintar 1/21A (UiTM)	1B	Without ASL
Jalan Raja Laut – Jalan Kucing (Pertama Complex)	2A	With ASL
Jalan Raja Laut – Jalan Esfahan (SOGO)	2B	With ASL

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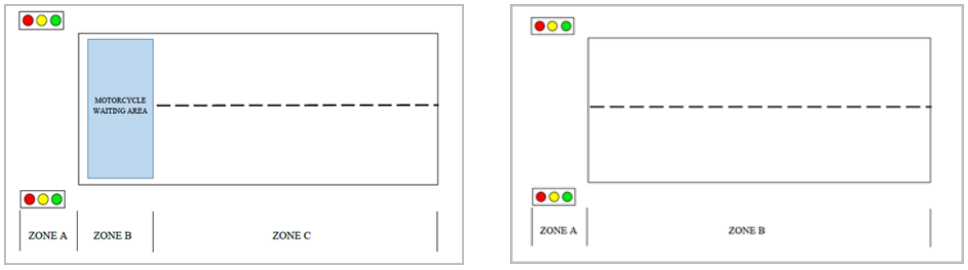

Figure 2: Stop position of signalized intersection a) with ASL b) without ASL

a) *Case I: Signalized intersection with ASL.*
For case I, the observation and video recording were made to observe the motorcycle stop position at the signalized intersection whether the motorcyclists stop at zone A, zone B or zone C. Figure 2 illu

strates the zone dimension that consists of zone A, B and C. Zone A is an area in front of ASL space. At the same time, Zone B is ASL space and Zone C is the area behind the ASL. The number of motorcycles was counted and tabulated.

b) *Case II: Signalized intersection without ASL.*
For case II, the data collection was only considered whether motorcycle (MC) stop at zone A or zone B. As visualize in Figure 2, the zone dimension of zone A is located at out of stop line while zone B is within the stop line. The number of motorcycles was counted and tabulated at each zone.

Result and discussion

a) Data Collection Case I: Signalized intersection with ASL.

Table 3: Data collection for Case I

Location (ID)		Motorcycle stop at Zone A (mc/hr)	Motorcycle stop at Zone B(mc/hr)	Motorcycle stop at Zone C(mc/hr)
2A	am	87	49	3
	pm	71	37	13
2B	am	67	145	21
	pm	60	124	56

b) Data Collection Case II: Signalized intersection without ASL.

Table 4: Data collection form for Case II

Location (ID)		Motorcycle stop at Zone A (mc/hr)	Motorcycle stop at Zone B (mc/hr)
1A	am	225	196
	pm	138	55
1B	am	90	123
	pm	85	92

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c) The comparison between the numbers of motorcycles that stop outside of the stop line with the total number of motorcycles at the signalized intersection.

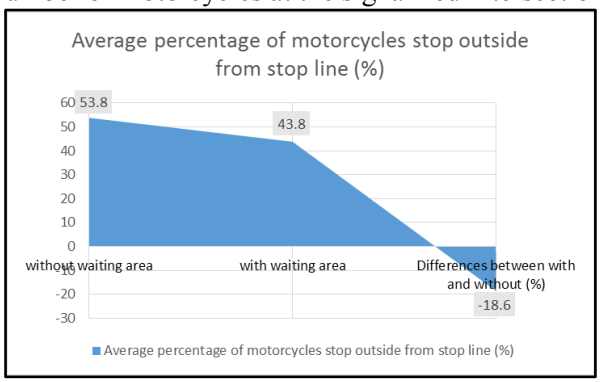

Figure 3: Average percentage of motorcycles stop outside from stop line (%)

Percentage of motorcycles stop outside (%) (1)
= [(number of motorcycle stop outline) / (total number of motorcycle)] × 100%

Differences of motorcycles stop outside between with and without (%) (2)
= [Average motorcycles stop outside (with-without) / Average motorcycles stop outside (without)] × 100%

The total volume of the motorcycle in one hour at both selected locations of a signalized intersection without ASL (1A and 1B) was 634 motorcycles/hr in the morning and 370 motorcycles/hr in the afternoon. While for both selected location of the signalized intersection with ASL (2A and 2B) was 372 motorcycles/hr and 361 motorcycles/hr. From Figure 3, the average on percentage of motorcycles stop outside from the stop line for intersection without ASL was 53.8% and with ASL was 43.8%.

The differences of motorcycles stop outside from the stop line between signalized intersections without and with the implementation of ASL was 18.6%. Hence, these differences show that the implementation of ASL at an intersection will reduce the amount of motorcycles stop outside from the stop line, thus increase the safety among motorcyclists who are known as vulnerable road users.

d) The comparison between the numbers of motorcycles that stop before the stop line or behind of ASL with the total number of motorcycles at a signalized intersection.

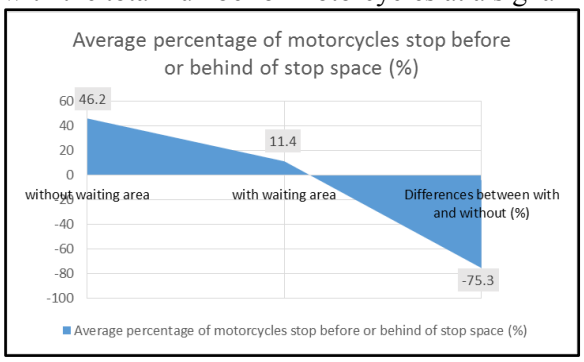

Figure 4: Average percentage of motorcycles stop before or behind of stop space (%)

Percentage of motorcycles stop before stop space (%)
= [number of motorcycle stop before stop space / total number of motorcycle] (3)
×100%

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Differences of motorcycles stop before or behind between with and without (%)= [Average motorcycles stop before stop space (with-without) / Average motorcycles stop before stop space (without)] × 100% (4)

From Figure 4, the average on percentage of motorcycles stop before or behind of stop space for intersection without ASL was 46.2% and with ASL was 11.4%. The differences of motorcycles stop before or behind of stop space between signalized intersections without and with implementation of ASL was 75.3%. Hence, these differences shows that the implementation of ASL at the intersection have reduced the amount of motorcycles stop before or behind of stop space. The mixed interaction between motorcycles with other vehicles have been reduced to 75.3%. The reduced number of motorcycles stop behind of stop space help in reducing accidental risks among motorcyclists and decrease traffic conflicts between motorcycles with other vehicles at the intersection during the green phase especially when vehicles are starting to move.

e) Comparison of traffic conflicts rate between the signalized intersection with and without ASL.

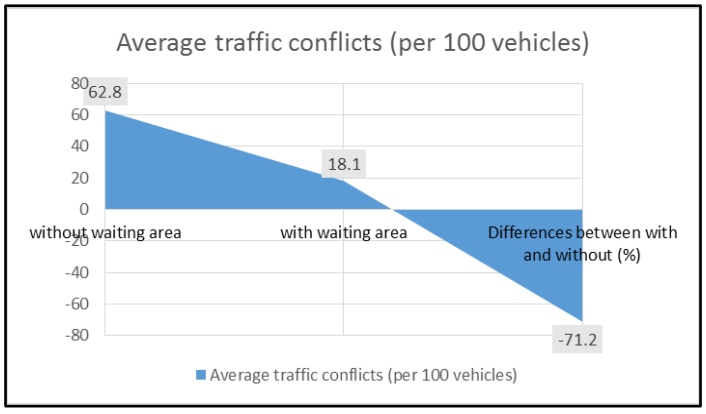

Figure 5: Average traffic conflicts (per 100 vehicles)

Traffic conflict rate = (Total traffic conflicts × 100) / (Traffic volume) (5)

From Figure 5, the average traffic conflict rate at a signalized intersection without ASL was 62.8 per 100 vehicles. While for the average traffic conflict rate at a signalized intersection with ASL was 18.1 per 100 vehicles. The differences in average of traffic conflicts rate between signalized intersections without and with the implementation of ASL was 71.2%. The implementation of ASL shows a huge difference in traffic conflicts rate at the intersection. The existence of ASL at the intersection has provided benefits to motorcyclists as they have their dedicated space and no need to stop in between other vehicles during the red phase. Hence, it reduces the accidental risks among motorcyclists at a signalized intersection and smoothens traffic flows.

Conclusion

In conclusion, from the observation on motorcycles stop position at the signalized intersection with and without ASL at two (2) selected intersection at Kuala Lumpur and Shah Alam, it was proven that the implementation of ASL at the signalized intersection could reduce the traffic conflicts rate among motorcycles and other vehicles. The reduction of the rate of traffic conflicts will help in reducing accidental rates at signalized intersection hence increase the safety among motorcyclists as they are vulnerable road users. The improvement of the infrastructure can be made with an assignment of dedicated traffic light phase for 'Motorcycle

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Only'. Thus is can give the priority to the motorcyclist to clear the intersection first without any conflict with other vehicles while crossing.

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