Contemporary Engineering Sciences, Vol. 3, 2010, no. 3, 149 - 155

The Effect of Pavement Marking on Speed Reduction in Exclusive Motorcycle Lane in Malaysia

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Abstract

A major problem in Malaysia is the high number of motorcycle accidents. The high percentage of motorcycle accidents has proved that motorcycle is a dangerous, unfavourable means of transportation in Malaysia. Given such situation, it is reasonable to pay due attention to this matter. A major factor contributing to the occurrence of accidents is high speed, which in turn increases the probability and severity of accidents. One effective way of improving safety is controlling riding speed. Another efficient way to control riding speed is to inform motorcyclists of the appropriate speed for a particular road. Under some conditions, motorcyclists may not be aware they are riding at a high speed. By influencing the motorcyclist's perception of the traffic situation, the motorcyclists come to a better understanding of the appropriacy of a lower speed. As speed perception depends on cues in the visual environment, road environment could be

changed to improve motorcyclists' perception of speed and thus encourage them to lower their speeds.

For the purpose of this study, a pavement marking pattern was employed and traffic speeds were analysed before and after installation of the pavement markings at four exits in exclusive motorcycle lane in Malaysia. This study concentrates on the effect of pavement marking on speed reduction on exit ways. Moreover, the study attempts to improve the procedures used to select speed-related safety countermeasures and contribute toward safer roads with lower cost solutions. The present study starts with a meticulous review of past studies that were conducted on establishing and proving the relationship between vehicle speed, crash occurrence and speed reduction.

Results demonstrated that markings were effective in reducing speeds of motorcyclist. There was approximately a 4.23 km/h reduction in average speeds, a 5 km/h reduction in median speed, and a 3 km/h reduction in 85th percentile speeds.

Keywords: Exclusive motorcycle lane, Speed reduction, Pavement marking, Exit way

1 Introduction

Pavement markings include lines, words, text, arrows and other markings that are painted on the roadway. Pavement markings are usually installed before the hazardous locations (horizontal curve tangents, roundabout approaches, intersection approaches, construction areas, and off ramps) in order to provide motorists with sufficient reaction time. The Manual on Uniform Traffic Control Devices (MUTCD) describes the two most frequently used types of pavement markings, that is, longitudinal and transverse markings [1]. The longitudinal category typically consists of centre and edge line markings and lane lines. The transverse category typically includes crosswalk lines, intersection stop lines and similar markings.

Pavement markings can have many different meanings. Regardless of their meanings, however, pavement markings are used to inform and warn drivers, pedestrians, and bicyclists of local and federal regulations and potentially hazardous locations. Perhaps, the greatest advantage of using pavement markings is the fact that they give this opportunity to drivers to focus their attention where the hazard is most likely to be located on the roadway[1].

Speeding is one of the most significant factors contributing to fatal collisions [2]. Excessive speeds reduce a driver's ability to react and manoeuvre properly. The severity of accidents, particularly those involving pedestrians, bicyclists, and motorcyclists, increases significantly with the speed of collision. Speeding-related crashes are an issue that can be handled properly with increased efforts in education, engineering, and enforcement. Currently there are many actions that

are being done in the nation and around the world in order to reduce these types of accidents.

Most of the accidents that happen at high speeds result in severe or fatal injuries. Sabey suggested that high driving speed is an important factor that is responsible for about 23% of the accidents in the UK, and that there exists a clear relationship between speed level and the number of accidents[2]. The severity of an accident is in direct relationship with the speed level, since high speeds increase the exposure to dangerous situations, and limit the time needed to respond properly in unexpected situations. When a fast moving vehicle is involved in an accident, the consequences are much worse as compared to the situation in which a vehicle is moving at lower speeds. Several studies [3, 4] show that reducing speed to an average of 2 to 5 km/h can lead to decrease of injuries and fatal accidents, up to 30%. In addition to actual driving speed, the distribution of driving speed plays an important role in accident risk. Studies have shown that there is a statistically significant relationship between speed variance and accident rate[5]. On motorways, the risk of accident occurrence increases as vehicle speed deviates from the average speed limit. Garber argues that speed changes depend on the level of the actual driving speed[6]. This is proved by the fact that the fluctuation of speed on motorways is higher than that on rural roads, although this can partly be accounted for by the differences in driving speed between various kinds of vehicles on motorways. If there are large differences in speed between vehicles in a traffic stream, slower moving traffic may form an obstacle for faster traffic.

Such being the case, the present study intends to examine the effectiveness of pavement markings in reducing speed on exit ways in exclusive motorcycle lane.

2 Background

Pavement markings are often placed with the goal to improve the safety of the roadway at known hazardous locations. Indeed, they are used to supplement the regulations or warnings of other traffic control devices, such as traffic signs or signals. Sometimes they are used alone to convey regulations or warning, which would not be conveyed by other traffic control devices. Moreover, they can be used to encourage drivers to drive at a proper speed without actually exceeding the speed limit. Even though riders know the fact that it is their responsibility to ride at a safe speed, they need to be able to receive cues from the roadway environment as to what that safe speed is.

On the other hand, the increasing number of motorcycles in Malaysia in recent years has become a serious problem in safety issues and traffic system management in urban areas. In fact, motorcycle safety is becoming an increasingly significant concern in Malaysia. Radin showed that motorcyclists contributed more than 60% of the injuries and almost 60% of the fatal accidents that occurred on Malaysian roads. He also maintains that speeding is considered to be a contributing factor in fatal crashes[7]. With the goal to reduce speed on roadway segments where speed is considered to be a safety concern, pavement

marking patterns that give a psychological appearance of decreasing speed have been considered as a relatively cost-effective solution to the problem. Perceptual cues are one potential method of convincing motorists to slow down and hence save lives.

3 Method

3.1 Research Approach

The approach underlying this study is to determine longitudinal and transverse markings that seem to be able to reduce motorcyclists' speed. Four field locations were chosen in which before and after speed data were collected. The markings were then evaluated, based on which a recommendation is made.

3.2 Data Collection

With high proportion and remarkable characteristics of motorcycle, exclusive motorcycle line in Federal Highway F02, SHAH ALAM is a good representative to conduct this research. Four sites were chosen for the installation longitudinal and transverse marking patterns. The markings were designed individually for each site so that a comfortable deceleration could be made to go from the initial speed to the final speed.

The researcher visited the four sites to make sure that there would not be any concern with the sites and then collected before data for a period of eight hours on one typical weekday (Fig. 1). Data collection occurred upstream of the treatment as well as downstream at the end of the treatment area, just prior to entering the exit way. There were two data collection reported in this study. The first was prior to the installation of the markings. The second data collection took place after the installation. It was anticipated to collect data only on clear days where weather is not a major factor on motorcyclist speeds. After the markings were installed, data were collected again to determine the effects of the pavement markings. Additionally, weather data as well as pavement condition were noted and data were only used for periods with dry roadway conditions.

The traffic data collection devices were verified with laser speed gun detector (ULTRA LITE, Lt1 20-20). A laptop computer was used to verify the data as well as to download the data. A before-and-after design with control was employed. Traffic speeds in both down and upstream were measured before and after installation of the pavement markings.

Fig.1. Road Surface after Pavement Marking Installation, F02 Highway, Malaysia

3.3 Data Analysis

Speed data analyses were carried out to determine the effectiveness of the pavement markings. For each speed analysis, the mean, median, variance, and 85th percentile speeds were observed. The total number of motorcyclists was 4800 and total number of motorcyclists that measured speed was 640 and SPSS software was used to process raw data.

Analysis of t-test statistical tests were used with the before and directly after, to determine significance. There were also comparisons between the two treatments for significance as well. The analysis concerned weather, pavement, and other environmental characteristics to try to minimize the chance that any variables other than the marking would influence the results of the study.

4 RESULTS

Table-1 summarizes changes in mean speeds, and 85th percentile speeds. The pavement markings appeared to have affected the speed of motorcyclists when observing the before and after data. Data collection occurred upstream of the treatment as well as downstream at the end of the treatment area. The pattern had a significant effect on both 85th percentile and mean speeds. The effects of the treatments were evaluated in three ways: 1) mean speed, 2) speed variance, and 3) 85th percentile speed. In both the before data and after data, there was approximately a 4.23 km/h reduction in the average speed, a 5 km/h reduction in the median speed, and a 3 km/h reduction in the 85th percentile speed. The

longitudinal and transverse markings have shown to produce significant reductions in all three evaluation ways.

Table 1 Compare before and after pavement marking installation

		Upstream	Downstream
Before	Mean (km/h)	55.36	31.21
	Median (km/h)	54.5	32
	N	640	640
	Std. Deviation	9.56	6.31
	85th Percentile (km/h)	65	36
After	Mean (km/h)	53.74	26.98
	Median (km/h)	54	27
	N	640	640
	Std. Deviation	9.015	4.59
	85th Percentile (km/h)	63	33
Reduction	Mean (km/h)		**4.23**
	Median (km/h)		**5**
	Std. Deviation		**1.72**
	85th Percentile (km/h)		**3**

5 DISCUSSION AND CONCLUSIONS

Speeding is one of the major factors that result in fatal crashes in the Malaysia as well as the rest of the world. This low cost countermeasure is when used appropriately and at critical safety hazard locations have the opportunity to decrease speed and as a result, decrease the number of fatal crashes. Also motorcyclist crashes occur more frequently on exit ways and tend to be more severe than other crashes. Many factors contribute to such crashes. Such factors include driver impairment, fatigue, inattention, visual deficits, and speed. Although most rider factors are not within the control of transportation engineers, it can be seen from the present study that strategically placed pavement markings can influence motorcyclist speed reduction that enter exit roadway sections.

The speed decision made is most probably a factor that is related to the degree of safety that a motorcyclist feels while riding on a particular roadway road. A rider’s perception of his or her environment will influence the speed with which he or she will travel. The objective of this study was to improve the procedures adopted to select speed-related safety countermeasures and contribute to safer roads with low cost effective solutions. The study began with a detailed review of past research related to vehicle that focused on establishing and documenting the relationship between speed and crash occurrence.

Overall, the results of the study showed that there was a significant decrease of speed. As a result, even a small reduction in mean traffic speeds is likely to result in significant safety benefits.

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Received: March, 2010