3D Visual Effect Speed Hump for Urban Road

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Abstract
The speed limit allowed in educational institutions is 30 km/hour and only speed humps are allocated at Politeknik Sultan Haji Ahmad Shah (POLISAS) roadways. Speed hump are well known for roadways in Malaysia, but the effectiveness of 3D visual speed hump is still new and not well explored. The purpose of this study is to design the 3D visual effect speed hump and to evaluate respondents' perceptions towards the development of 3D visual effect speed hump. Spot Speed Study was carried out using radar gun to determine the effectiveness of 3D visual effect speed hump implementation. Survey method using questionnaires were distributed among students, lecturers and road users to evaluate respondents' perceptions. The test was conducted to analyse the speed limit data before and after installation of 3D visual speed hump. The results showed that the speed of the vehicle before the installation is 43 km/h and decreased to 30 km/h after the installation of 3D visual effect speed hump. The survey also proved that the respondents' perceptions for driver's behaviour (41%) is crucial. Therefore, the study confirmed that 3D visual effect speed hump is effective to be implemented in reducing the approaching speed of vehicle.

Keywords: 3D visual effect speed hump, spot speed study, survey

1.0 Introduction

Nowadays, researcher identify better ways to design a speed hump besides the normal one. Speed bumps or traffic calming devices that uses vertical deflection to slow motor-vehicle traffic in order to improve safety conditions (Kamaruddin et al., 2018). Speed bumps are effective in keeping vehicle speeds down, their usage is sometimes controversial. As the purpose to decrease traffic noise, it also can damage vehicles if speeding at the highest speed and slow emergency vehicles. Road users are still speeding eventhough there is a signboard showing the speed limit. In this paper, bumps and humps are interchangeably used. Speed humps have geometric roadways design features with the purpose of slowing down the traffic in neighbourhoods (Ashish G, 2014; Tajudeen et al. 2004). The results of Tajudeen et al. (2004) reveal three importances about road bump, that are bump height, bump width and affective distance between two road bumps. Study by Noor Alyani & Abdul Azeez (2013) found out that the average speed of the vehicles before approaching the road humps was 30 km/h and at the road humps below 10 km/h. The findings showed that the design profiles of the road humps have an impact on the speed of the vehicles and interfere the height and slope.

The researcher had done the study in Taman Setapak, Kuala Lumpur found that with a spacing of 70 m, the 85th percentile speeds recorded 30 m before and after the second hump were 31.88 km/h respectively, thus

suggesting that shorter hump spacing would be more suitable to maintain the 35 km/h speed limit in a Malaysian residential area (Khairun Sarah et al., 2016). However, it should be noted that study was not actively studying the effect of road hump spacing instead it focused on the individual effect of each hump. Siti Syazwani & Abdul Azeez (2016), evaluates the effects of road bumps on speed of vehicles at Taman Setiawangsa. The finding depicts the effectiveness of road humps in reducing speed in relation to the road hump's profiles.

Ting & Che Ros (2016) have studied about performance of different types of road humps at Universiti Teknologi Malaysia (UTM). This study was carried out to check the as-built installation of road humps in UTM with the standard specifications by authorities such as Majlis Bandaraya Johor Bahru (MBJB), Majlis Perbandaran Johor Bahru Tengah (MPJBT), Jabatan Kerja Raya (JKR), Majlis Perbandaran Seberang Perai (MPSP) and Standard and Industrial Research Institute of Malaysia (SIRIM) and to determine the passenger cars speed reduction when passing the different types of road humps in UTM.

Study had done to analyse the effectiveness of road humps as a traffic calming measure in improving the residential living environment (Ashish, 2014 ; Khairun Sarah et al., 2016). The findings show that there are different factor that may affect the effectiveness of road humps that are daily traffic volume and drivers' behaviour. Based on Malaysian Ministry of Road Works (2012), the hump height recommended is 50 mm – 100 mm and hump length is 3.7 m – 4 m. To achieve the speed reduction in areas with 85^{th} percentile speed between 25 km/h – 45 km/h, can result in reduction of speed ranging from 15 km/h – 30 km/h. According to Malaysian Ministry of Road Works (2012), the installation of road humps is based on 3 condition below:

a. Vehicle speed: between 30 km/h to 60 km/h
b. Road Hierarchy: district road, residential road, access road, rural road
c. Road Geometry: 2-way and 2-lane road with no kerbs

Kamarudin et. al., (2018) have conducted a study of temporary traffic calming or called 3D speed hump at 3 different residential locations at Batu Pahat. His findings show that 74% of vehicles were complied to speed limit when approaching intersection compared to 26% who do not do so. The conclusion of their study shows that the effectiveness of road humps in reducing the speed in campus area is not well explored. That is why the 3D speed hump was considered to be applied for urban road along Jalan Mat Kilau, POLISAS. For this objective purpose:

a. To design the 3D visual effect speed hump for Urban Road
b. To evaluate the effectiveness of 3D visual effect speed hump implementation

2.0 Materials and methods

The observation on strategic location selection depends on the goals and objectives to be achieved. This study conducted involved Jalan Mat Kilau, POLISAS to obtain different profiles of analysis for spot speed study and survey. Traffic utilization is used to obtain data and identify the effectiveness of the method used in reducing the speed at the main road of POLISAS.

Jalan Mat Kilau, POLISAS known and categorized as urban road and is the main road for the entrance and exit for students, lecturers and outsiders at POLISAS. The 3D visual speed hump was designed and permanently installed at Jalan Mat Kilau, POLISAS. Director of POLISAS, agreed and approved that Jalan Mat Kilau can be used to install the permanent 3D visual effect speed hump (Appendix 1).

The data collection was conducted using radar gun during peak hour for 6 times before installation of 3D visual speed hump and 6 times after installation. The data then analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0.0. The percentile of reduction of vehicles was taken by the histogram and ogive.

The design of 3D visual effect speed hump included road line paint, EPDM rubber mat and intensity reflective sheeting. The size of hump measuring 3.5m length x 2.6m width is selected and designed with 3 layers of colour that is yellow, white and black (Figure 1). The dimension of 3D speed hump is in compliance to the Malaysian Road Hump Specification (2012). Installation of permanent 3D visual effect speed hump were done on weekend to avoid traffic congestions along Jalan Mat Kilau.

Figure 1: Design of 3D visual effect speed hump

Survey method using questionnaire was distributed to students, lecturers, staff and non-academic staff. The questionnaires are distributed to every department in POLISAS which is Civil Engineering Department, Electrical Engineering Department, Mechanical Engineering Department, Food Technology Department and Commerce Department. Total respondents for this study are 210 people, consisting of 153 females and 57 males. The main respondent is almost 74% from students.

3.0 Result and discussions

This study aims to design the 3D visual effect speed hump for urban road and to evaluate the effectiveness of 3D visual effect speed hump implementation. The design of 3D visual effect speed hump had been designed

and install permanently.

3.1 Analysis of 3D visual effect speed hump implementation

Table 1 shows that average speed data for before and after installation of 3D visual effect speed hump. The result showed the speed for all vehicles passing through Jalan Mat Kilau is 43 km/h before the installation. However, after installation of 3D visual effect speed hump, the speed limit was reduced to 30 km/hour. The speed characteristics of the vehicles at the 3D visual speed hump are analysed using 85th percentile and 95th percentile (Table 2). Before installation of 3D visual effect speed hump, the speed is averagely 40 to 45 km/h. Otherwise, speed totally reduced at 85th percentile travel speeds by about 30km/h after 3D visual effect speed humps were installed. The data was compared to the previous journal by Kamaruddin et al (2018) where the result shows 85% vehicle speed passing the junction with a speed of 46 km/h reduced to 42 km/h.

Table 1: Data of spot speed study for before and after installation of 3D visual effect speed hump

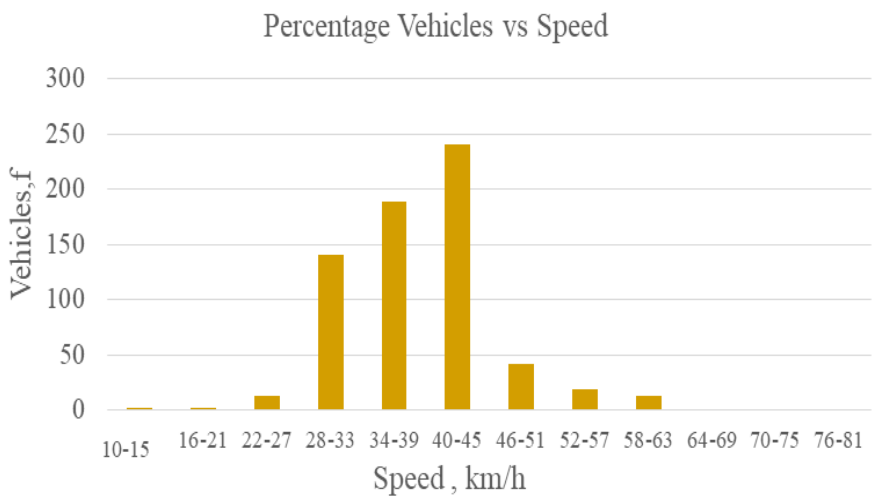
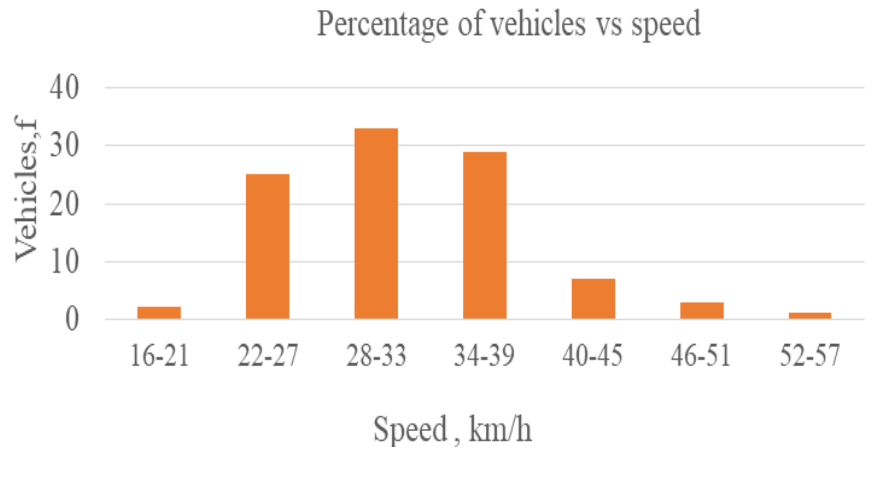
	Data of Spot Speed Study
Before Installation	
After Installation	

Table 2: 85th Percentile and 95th percentile speed at the 3D visual effect speed hump

	30 m Before		At		30 m After	
	85th Percentile (km/h)	95th Percentile (km/h)	85th Percentile (km/h)	95th Percentile (km/h)	85th Percentile (km/h)	95th Percentile (km/h)
Before installation of 3D Visual Effect Speed Hump	45.2	46.5	43.4	45.0	40.6	42.8
After installation of 3D Visual Effect Speed Hump	31.3	32.5	9.5	11.0	29.3	32.1

3.2 Analysis of respondent perception from survey

The survey had been conducted by distributing questionnaires among POLISAS students and staff. It is divided into 2 sections, section A for demography and section B for respondents' perceptions of 3D visual effect speed hump. Road users around POLISAS answered the questions before the 3D visual effect speed hump been installed and after installation. The aims of this survey is to evaluate respondents' perceptions towards the development of 3D visual effect speed hump. The most increment result of 41% is seen on the driver's behaviour (Figure 2). Drivers are looking to slowing down their vehicle over 3D visual effect speed hump and it is comfortable and not noisy.

Section B	Before Installation 3D visual effect speed hump	After Installation 3D visual effect speed hump
Speed	75%	71%
Safety	53%	45%
Vehicle Condition	59%	60%
Driver's Behaviour	60%	41%
Weather	58%	60%

Figure 2: Questionnaire result for 3D visual effect speed hump

4.0 Conclusions

The result showed that 3D visual speed hump was successfully and permanently installed at urban road specifically at Jalan Mat Kilau, POLISAS. The design was approved by the Highway Engineer, JKR Kuantan, in compliance to speed hump specification (2012). The research was carried out for spot speed study showed reduced speed from 43 km/h to 30 km/h. From survey analysis, the evaluation of respondents' perceptions towards the development of 3D visual effect speed humps can help in controlling the speed of vehicles and control of drivers' behaviour especially students and lecturers who used the road. Highway Engineer from JKR Kuantan also suggested this 3D visual effect speed hump to be installed at residential area for next

research . As the conclusion from this 3D visual effect speed humps, it can be located at residential areas for the purpose of reducing the level of vehicles noise and use recycle materials for the design.

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