The Effectiveness of Traffic Calming in Reducing the Speed of Vehicles in University Malaya: Road Humps

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Abstract: According to the Malaysia Ministry of Works (2011), road hump is one of the most frequently deployed traffic calming systems in Malaysia. In order to ensure that the road humps are built to perform their functions successfully, a study must be carried out to determine the efficiency of existing road humps in the University of Malaya campus (UM), Kuala Lumpur. Due to speeding, incorrect and improper placement of road humps, and traffic injuries on campus. This research is being undertaken to examine the feasibility of the construction of road humps to resolve any of these problems on the University Malaya campus.

Keywords: Traffic Calming, Road Humps, Speeding

1. INTRODUCTION

The source of the use of traffic calming measurements started in the late 1960s. The implementation of these measures has begun due to the lives of people being disrupted by the speed of the motorists in their residential area at night (Lines & Castelijn, 1991). People were beginning to build the first road calming measurements for the paved stones on the road to discourage the motorist from speeding up their vehicles. In the 1970s, this idea was recognised by the German planner, introducing this calculation concept to his country, and calling it "Verkehrsberuhigung" which is translated as traffic calming (WeConservePA). Year after year, traffic calming technologies such as pavement stones, road humps, roundabouts and others have been commonly used and embraced by people and many nations, including Malaysia. The implementation of traffic measures such as road humps will naturally force the road users as they are reacting to the physical existence of the road humps. Road humps are also known as speed humps are one of the traffic calming measurements that is installed for purposes of controlling the speed of vehicles within an acceptable speed limit. According to HPU Guidelines (2002), vertical shift such as road humps is the most effective and reliable method for speed reduction. Usually the speed hump is made from asphalt or concrete. However, road hump may be manufactured from other ingredients, such as rubber, metal or recycled plastic. However, the authorities choose asphalt or concrete to ensure the safety of the driver. Nowadays, the target place for the use of road humps is typically used in suburban neighbourhoods, institutional areas, and others. Typically according to the Institute of Transportation Engineer (ITE) as shown in Table 1 locations recommended and should be avoided to be installed are:

Locations recommended to be installed	Locations should be avoided
In the urban areas, it should be installed on the streets with closed drainage or storm sewer and curbs	On arterial roads, roads with through traffic, roads frequently traveled by public transit, trucks or emergency vehicles, and roads with four more lanes (basically highway)
Streets with little through traffic that are not regular public transit, emergency vehicle or trucking routes	In curves or approaches to curves, on roads with a particularly pronounced slope or locations where road humps would not be sufficiently visible or could surprise drivers
Residential streets, school zones and playground zones	Sectors where the 85th percentile speed is above 70 km/h
Sectors where the speed limit is 50 km/h or less	On approaches to intersections
Sectors where low speeds are desired approximately 30 km/h	Before a driveway

Table 1: Locations recommended and to be avoided for road humps installation

Source: Institute of Transportation Engineers (ITE, Washington DC; www.ite.org)

2. THE GUIDELINES OF ROAD HUMP

At the international level, as specified in the Road Humps Regulations 1990 for the Road Hump Guidelines in a developing country like the United Kingdom, there are five types of road Hump which are round top, flat top, raised junction, cushion and 'thump.' The regulations for round top and flat top humps authorise a height of around 50 to 75 millimetres and a length of 3.7 metres for round top humps and a length of 2.5 metres for flat top humps. Then, for raised junction hump, 50 millimetres to 100 millimetres in height and a non-minimum length are specified in the guidelines. Thereafter, the rules specified rulings between 60 and 75 millimetres in length and around 1.9 metres in length should be added to the lane. The estimated height of the 'thump' can be mounted is between 35 and 45 millimetres, and the height is roughly 0.9 metres. The speed reduction imposed by this regulation must be approximately 20 to 30 km/h. (Department for Transport Northern Ireland, 2007)

Meanwhile, according to the Malaysia Ministry of Works (2011), the original road humps regulations have allowed round-top humps dimension featuring 50 millimetres to 100 millimetres and 3.7 meters to 4 meters long to be installed on local roads in Malaysia. Moreover, these regulations approved flat-top hump dimension to be about 75 millimetres to 100 millimetres height and 2.5 meters to 4 meters long applied on the road. Also, this regulation permitted the installation of the curved hump with 75 millimetres to 100 millimetres in height and 3.8 meters to 4 meters long. All these types of road humps installed allowed the drivers to speed their vehicles speed only between 30 km/h. The first experiment of these types of road humps is conducted by Transport Research Laboratory (TRL) in the 1970s' also been carried out to find out whether the road humps were successful in reducing speed or not as the trial humps with 3.7 meters long and 100 millimetres height. After experimenting, the results show that road humps that are less than 3.7 meters long are less effective in controlling vehicle speed. Aside from that, the decision to determine the location of the road hump also should take consideration. Overall, the rules on road humps between the United Kingdom and Malaysia are significantly different. However, all transport planners in these two countries must already take good note of the development of all laws, since they want to ensure that the architecture and regulations specified do not endanger the protection of the city or the driver.

3. THE ISSUES OF ROAD HUMP

Caldwell (1999) stated, "In the final analysis, planning, communication, and cooperation are essential" (Caldwell, p.41, 1999). This statement is corrected, the task of making the operations seamless without facing confrontation will escalate without adequate policy and strong coordination by city planners and engineers. The processes that need to be illuminated if the private manufacturer wants to create road humps; the first step is to construct a proper road hump to ensure the safety of the driver. For example, the manufacturer must conceptualize and develop the Road Hump Plans to be submitted and addressed, in particular, to traffic planners, engineers and officials such as the Traffic Police, the City Hall, municipal councils and the Public Works Department (JKR). First, the manufacturer must apply and receive all licenses and permissions on all sites associated with road construction, such as start-up and earthworks permit, demolition of existing buildings or installations on the road, removal of trees and restrictions for events and temporary works. Until authorization is granted, it is the duty of the authorities to apply a flexible approach to the production of road humps installations on local roads by updating the rules and policies that set out the specific guidelines that must be adopted by manufacturing. If the manufacturer complies with all the standards or requirements set out by the local authorities, they will be given the permit to build road humps as they already intend. This practice extended to all local bodies in Malaysia, including the Petaling Jaya City Council and the Petaling Jaya Public Works Agency. Finally, the contractor will continue to incorporate road humps in the working areas by careful preparation and design for the construction staff to ensure proper service, regularly recorded inspections, and a high degree of maintenance.

The advantages of road humps are including road hump has been proven it is a lasting effect on reducing vehicle speeds. Hence, at the intersection of the roads, a road hump can serve as a raised crosswalk which it can help pedestrians or students to cross the road; it also enhances the appearances of a road, if the road hump itself design and built with a high standard and followed the guidelines; it helps to moderate the cost compared to the other traffic calming measures. (Catherine, 2013, p.6). On the other hand, there also have the disadvantages that relate especially with road humps such as it is not friendly with two-wheel motorized vehicles such as cyclist and motorcyclist which it can give bad effect for the drivers. For instance, there has a risk that the cyclist and motorcyclist alter the trajectory to pass the road humps in the middle of the road. Also, it can cause traffic congestion on the UM campus's road. Other than that, it can give a bad effect on emergency vehicles, for instance, police bikers and cars, ambulance, fire engine and others due to it is increasing response times by up to ten seconds per road hump. (Catherine, 2013, p.6). However, all these disadvantages may be avoided if the application of the road humps itself is properly implemented in the UM campus.

Figure 1 : (A) Situation of police rider when before speeding on road humps, (B) Situation of police rider when after speeding on road humps
Source: Google Images, 2020

4. THE IMPACTS OF ROAD HUMP

4.1 Impacts on Speed

Betthod C. (2011) stated the installation of road humps is an excellent way to reduce vehicle speed yet it also depends on the length and height of the road hump. For instance, Yaacob & Hamsa (2012) remarked that the speed variations were larger in the road humps such as road humps with 60 millimeters height as compared to another hump of 80 millimeters height. This result can conclude the vehicles are more exceeding their speed on road hump with 60 millimeters road hump before and after the vehicles pass the road humps.

4.2 Impacts on Road Safety

According to Laura Jateikiene, she stated there have analysed total and injury accident data on the road sections where the road humps of trapeze shape were placed. This study already does the investigation where the accident happened is not only influenced by road hump but also by other complex traffic calming measures such as separating information shields and others. In other words, road hump is still important to the drivers because if there is no installation of road humps in the UM campus, it can cause the drivers to avoid any stopping or reducing speed and directly will cause fatal accidents on UM campus.

4.3 Impacts on the environment (noise)

Road humps can reduce traffic noise. Refer to the Department of the Environment, Transport, and Regions (DETR) remarkable that most of the traffic calming measures generally can reduce traffic noise. For instance, the vehicle speed from 50 to 30 km/h will reduce 4 to 5 decibels of the sound. However, especially for road humps, it acknowledges can reduce vehicle noise emission but still, it needs to depend on the driving style whether the driver is a calm driver or a passive driver. However, the use of road humps can lead to wider variations in vehicle speeds, with many vehicles slowing to crawl to start negotiating each hump. The natural outcome of a wider speed variation with more velocity and more braking is that too many fuels will be used. If more fuel is used, more pollution can be produced.

4.4 Impacts on the community

The road humps are generally one of the opportunities in improving community lifestyle such as it takes a role to improve accident reduction among the drivers and indirectly can give encouragement to the community such as do the walking, jogging and cycling comfortably on the road by the proper implementation of road humps with the other road facilities such as bicycle lane, jogging track and others. In this way, the road humps scheme can be influencing the acceptance of the road humps scheme by the local community. In other words, road hump is still important for the UM community, particularly for pedestrians who prefer to stroll, jog and do other leisure activities on UM campus without any sense of danger and threaten their safety.

5. METHODOLOGY

Firstly, in this research, the writer has decided to use classic social sciences research tools – questionnaires. All in all, this research was aimed to collect quantitative data which are through questionnaires, the data gave by the Department of Development & Estate Maintenance (JPPHB), University of Malaya, and The Security Office, University of Malaya. Qualitative data will be collected through reconnaissance survey, questionnaires form, and also Google Street Image, 2020.

5.1 Secondary Data

Secondary data is raw data already collected by someone else, either for some general information purpose, such as a government census or another official purpose or for a specific research project. In this study, the data were obtained from the Department of Development & Estate Maintenance (JPPHB) and The Security Office on UM campus. It consists of a complete dataset containing information related to all the road humps, speed limitation, and the case of the accidents on the UM campus.

5.2 Reconnaissance Survey

A reconnaissance survey is a detailed examination of all parts of an area to obtain the data for the existing road humps. It is done to gather initial information regarding road humps which includes maps of the location, type of road humps' design, and pictures. The results can be used to determine whether the design met the specifications outlined by the Highway Planning Unit (HPU) and the Ministry of Works Malaysia. Besides, a reconnaissance survey provides data that enables transport planners or urban planners to study the physical features of a study area which they are conducting. In the finding analysis, a map or plan of the UM campus is used to identify the exact and suitable location for each road humps in UM. Also, the pictures evidence obtains from Google Street Images, 2020 will be the best way in this study which is it could be useful to shows the existing condition of the road humps inside UM campus.

5.3 Online Questionnaires

In survey research, a questionnaire is an instrument that is comprised of a set of questions to be asked to the participants of the survey. In this study, online questionnaires will be distributed to the UM community, which is constituted by the students, lecturers, and non-academic staff

to obtain feedback regarding the effectiveness of the existing road humps. There have four sections that were asked to the respondents which are the demographic profile of the respondent, the frequency of respondents using road humps in UM, the quality level of road humps, and respondents' overview of the effectiveness of using road humps. This survey was attended by 53 respondents.

6. CASE STUDY – UNIVERSITY MALAYA

For purpose of the study, the accident spot is categorized into two which are Inside UM campus and Outside UM campus that is near to the surrounding of UM campus. The frequency of these data stated 26 accidents (96.3%) were recorded inside UM campus while another one (3.7%) was recorded outside UM campus. The crash case-fatality rate was significantly higher inside the UM campus compare to the outside UM campus. In the logistic regression analysis above, this variable is statistically significant. This is to be expected given the inadequate or absence of road humps or road signs which place both drivers and pedestrians at particularly high risk for traffic injuries.

First of all, the existing condition of each road humps on the UM campus has been observed and examine through Google Maps, 2021 due to Pandemic COVID-19. The locations for the survey are determined and the detailed location is provided in Table 1. Overall, the design of the road humps provided in UM campus has two types of design which are rounded hump and flat-topped hump as and their design has been met specification outlined by the Malaysia Ministry of Work (JKR). However, the width of each road humps is different as shown in Table 1.

Table 1: The location, type of design, quantity of the existing road humps

No.	Location	Type of Design	Quantity (unit)	Width(m)
1.	Entrance Gate (Kuala Lumpur)	Round-Top	1	5.0
2.	In front of 1st College Residential	Round-Top	1	5.0
3.	Near to Faculty Built Environment	Round-Top	1	5.0
4.	In front of 6th College Residential	Round-Top	1	7.0
5.	Entrance Gate (Petaling Jaya)	Round-Top	1	11.0
6.	Parking Lots Main Library	Round-Top	1	20.0
7.	In front of Faculty of Economy	Flat-Top	1	5.0
8.	Entrance Gate (Jalan Ilmu)	Round-Top	1	6.5
9.	In front of Geology Department	Round-Top	1	6.3
10.	In front of Faculty of Language and Linguistics	Round-Top	3	11.2
				6.3
				16.0
11.	Entrance Gate (9th College Residential)	Round-Top	1	9.0
12.	Beside ICT Centre	Round-Top	2	6.6
				6.5
13.	In front of 7th College Residential	Round-Top	1	7.0
14.	In front of Computer Science	Round-Top	1	6.5
15.	Entrance Gate (Damansara)	Flat-Top	1	13.0
16.	In front of 11th College Residential	Round-Top	1	5.0
17.	In front of Department of Development & Estate Maintenance (JPPHB)	Round-Top	2	6.0
18.	In front of 5th College Residential	Round-Top	1	8.0
19.	In front of 12th College Residential	Round-Top	1	6.5
20.	In front of Ambang Asuhan Jepun (AAJ)	Round-Top	2	8.0
21.	In front of Varsity Field's Parking Lots	Round-Top	1	7.4

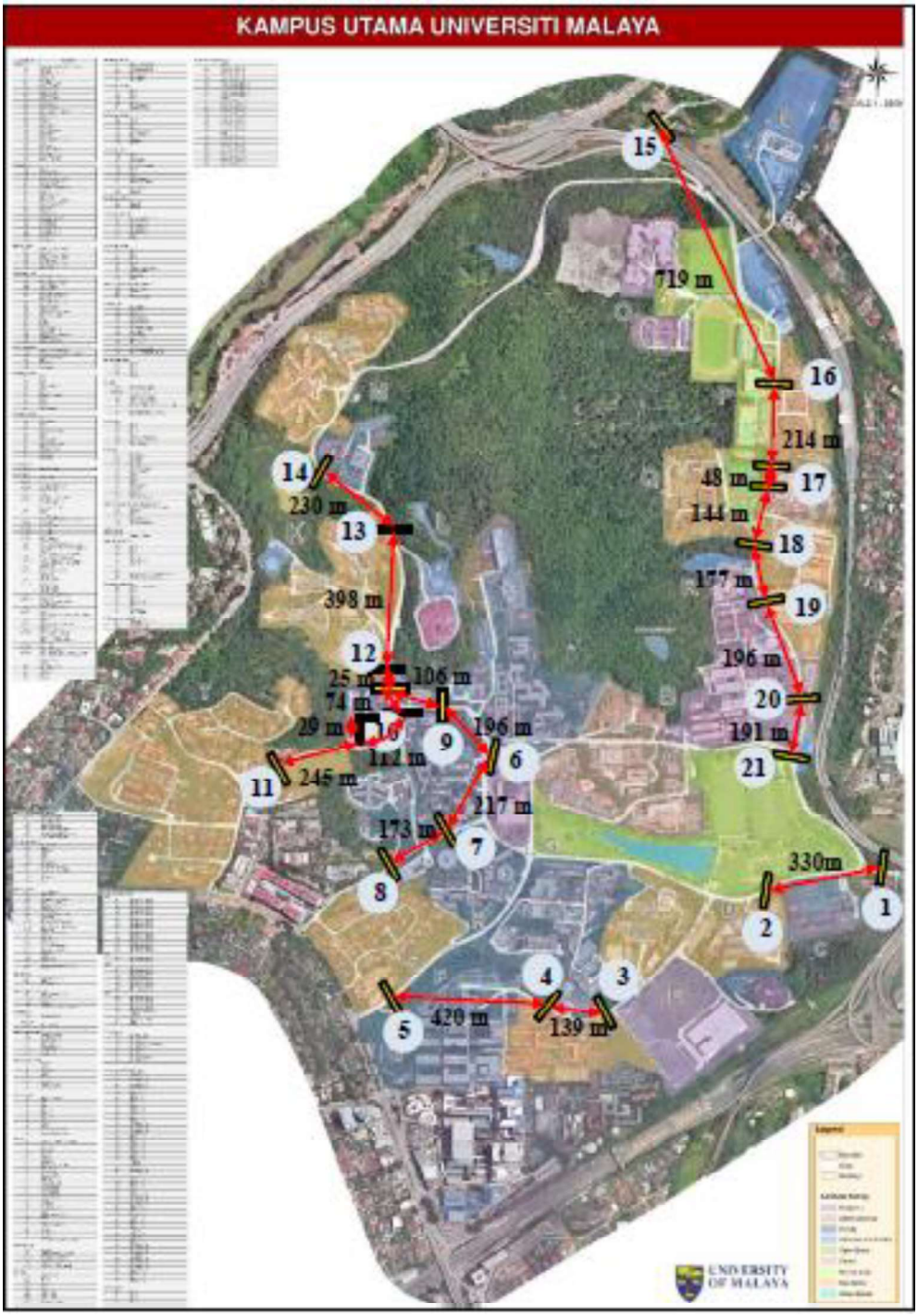

Figure 2: Location of Road Humps in Layout Plan
Source: This map is edited on map owned by University Malaya

Notes: ⟷ Distance of each road humps ▭ Road Hump

1 - 21 Number of the location of each road humps according to Table 1

Figure 2 shows the layout plan of the UM campus obtained from the Department of Development & Estate Maintenance of University Malaya (JPPHB) and also displays the location of each road humps in UM campus and the road humps that being provided which are twenty-one (21) road humps as it has been pinpoint in the figure. The design of the road hump provided in UM campus consists of a rounded hump and a flat-topped hump. The distance of each road hump also being shown in the figure in order to study the distance over speed when vehicles on the road hump and before on the road hump. According to Traffic Calming Guidelines from the South Carolina Department of Transportation, the speed that suitable to prevent any harm or injuries when the vehicles approaching the road hump is within 30 km/h and below 30 km/h and also the suitable distance between the road hump and another road hump is 350 feet or 107 meters. (SCDOT, 2006). Figure 2 shows the distance or space between a road hump to another road hump have more and less than 107 meters. As for the width for each road humps that are provided in UM campus, it can conclude all the road humps have more than 4.25 meters which are already outlined by the Malaysia Ministry of Work (JKR) for both designs whether it is for rounded hump and flat-topped hump.

Based on the online survey answer, the students, most of them tend to use motorcycles and public transport to go to their faculty, residential college, and other places inside UM campus. Motorcycle and walking are the highest percentages (39.53%) compared to the others. Other than that, the staff that is currently working inside UM campus tends to use car due to the cars is more convenient for them to go to the other destination, the percentage of using car among the staffs is the highest (90%) compared to the other transport.

Table 2: Result of respondents' perception towards the effectiveness of road humps.

No.	Quality Statement	Mean (M)	Data Result
1.	The effectiveness of the road hump to reduce the number of accidents	4.42	Very High
2.	Flow of traffic in UM campus before the installation of road hump	3.98	High
3.	Flow of traffic in UM campus after the installation of road hump	2.98	Low
4.	Vehicle speed in UM campus before the installation of road hump	4.26	Very High
5.	Vehicle speed in UM campus after the installation of road hump	2.94	Low

Based on the online survey, the results indicated that in terms of the bicycle is easy to use, the respondents rated it as very good quality as they required for their satisfaction based on the mean of the survey answer. However, the lowest result was the bicycle provided is adequate. Based on the calculated mean, the bicycles provided were not adequate from their perception. To assess the effectiveness of the road hump to reduce the number of accidents, the flow of traffic in UM campus before and after the installation of road hump, and vehicle speed in UM campus before and after the installation of road hump, and the responses were shown in Table 2. According to Table 2, the result stated the effectiveness of road hump on reducing the number of accidents case is rated very high, the respondents rated as very high based on the mean of the survey. Regarding the flow of traffic before the installation of road humps, it is noted that the respondent response resulted in "high flow" based on the meanwhile in terms of the flow of traffic after the installation of road humps, rated as "low flow" based weighted average. These results show the confirmation where the fact of the installation of road humps can reduce the flow rate of traffic.

Then, regarding the vehicle speed before the installation of road humps, it is noted that the respondent response resulted in "very high speed" while in terms of the vehicle's speed after the installation of road humps, it resulted as "low speed". For descriptive analysis, it turned out that the mean decreased from 4.26 to 2.94. Overall, this means that vehicles that are road users drive at high speed can be decreased by the installation of road humps.

7. RECOMMENDATION

This report provides some areas on the UM campus that are comprised of road humps. In this analysis, twenty-one (21) locations with existing road humps were analysed based on the results. In this research paper, all of the data consisting of the width, design, and distance of each road hump was reported and analysed. As for the width of the road bump, however, the advice outlined in the Ministry of Works of Malaysia is not being implemented. There is also a road hump gap to another road hump as corresponding to Figure 2. This is because in the new rules the precise distance regulations from the road hump to another road hump are not given. In Malaysia, the appropriate distance from a road hump to another road hump is set at a speed of 30 km/h between 90 metres and 180 metres apart (Zulkiple, 2009). In the future, it is therefore recommended that the Ministry of Works of Malaysia provide the new guidance that include acceptable distance regulations between the road hump to another road hump (spacing between humps) based on the desired reduction in speed that is 30 km/h in the Road Safety Facilities Manual to minimise the harm to the vehicle and the driver with the impact of inertia that can cause inertia. The result of this recommendation is highly important and will ideally be used in Malaysia to enforce and improve existing guidelines and standards.

Other than that, the location of the accident occurs in UM campus which is collected from The Security Office University Malaya and has been analyses and showing in Figure 2. From the figure, several of the accidents' locations are near the road hump. This case can happen when there is a road hump on a route, there is a possibility of an increase in back-crash accidents as a result of significant velocity changes when approaching a road hump. Another reason could be the road humps are not used correctly such as speeding on humps and the driver could not slow down their vehicles effectively. Both cases could be a risk for the driver's safety. Therefore, it is recommended to all places that are proposed for the installation of road humps must be subject to the 85th percentile speed which does not exceed the 30 km/h speed limit. Besides, it is recommended to study the suitable location to install the road humps such as locating the most proper and safest places for installing these devices before a stopping point and avoid installing the road hump on high-hierarchical and high-speed roads. This recommendation can ensure is the driver to reduce the speed of their vehicle effectively.

Not to forget, from the survey almost all the respondents suggest and preferable to use other traffic calming measurements to reduce vehicle speed and traffic injuries in UM campus such as mini roundabouts, provide more warning signage, traffic lights, streetscapes, road markings, and others. The installation of road humps will also cause a sudden rate of change of speed to the drivers and can result in road accidents especially for roads that generally have high-speed traffic. Thus, other traffic calming measurements as preferable by the respondents can be recommended and considered too. However, the construction of road humps is the last option if other traffic calming measurements are found to be less effective and cost-effective in slowing the velocity of vehicles.

8. CONCLUSION

First of all, road humps are well thought out as feasible and enticing measures to regulate the speed of cars and other vehicles. Based on the literature review, several reports claim that road humps are deemed successful in decreasing vehicle speed in suburban residential areas, institutions, and others. However, the construction of more road humps will also have adverse effects on the atmosphere by increasing pollution levels and noise pollution caused by rapid and regular acceleration and braking from the vehicles. Other than that, it is also a risk of traffic

injuries or accidents that are caused by significant velocity changes when approaching a road hump and could lead to the possibility of back-crash accidents or fatal injuries. In this study, the as-built requirements of existing road humps were evaluated, and it was identified that almost all of the road humps' installation did not conform with the standard guideline. Based on the results, the spacing or distance between road humps and other road humps of different distances and also the width of each road humps does not comply with the guidelines set out by Malaysia's Public Ministry of Public Works. In order to put an end to this issue, it is very important to consider adequate distances between road hump to another road hump to strengthen its role in reducing vehicle speed and traffic accidents without causing unnecessary disturbance to the community on the UM campus. Good results would enhance the living condition in suburban neighbourhoods if the road humps were in good planning, built, installed, and installed at appropriate intervals.

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REFERENCES

Azelin, I. R. (2015). THE EFFECTIVENESS OF TRAFFIC CALMING MEASURES IN THE CAMPUS OF UNIVERSITI TEKNOLOGI PETRONAS: ROAD HUMPS. *Civil Engineering Programme*, 1-50.

Jabatan Kerja Raya Malaysia. (2014). *Manual Fasiliti Keselamatan Jalan.* Kuala Lumpur.: Cawangan Kejuruteraan Jalan & Geoteknik,.

KARIM, M. F. (2012). THE EFFECTIVENESS OF VARIOUS TYPES OF SPEED HUMPS. *Civil Engineering & Earth Resources*, 1-13.

Min, T. H. (n.d.). Performance of Different Types of Road Humps in Universiti Teknologi Malaysia. 360-372.

Robertson, T. (2000). Speed Hump impacts on emergency response times eugene fire and emergency medical services. *Executive Leadership*, 1-46.

South Carolina Department of Transportation. (2006). *Traffic Calming Guidelines.* Columbia: Traffic Engineering.

TRANSPORT RESEARCH LABORATORY. (2000). Traffic calming — literature search on the design and performance of traffic calming measures. *Charging and Local Transport Division,*, 1-35.

Transport Research Laboratory. (2004). Impact of road humps on vehicles and their occupants. *Charging and Local Transport Division*, 1-48.

Transportation Research Procedia. (2017). A theoretical overview of road hump effects on traffic noise in improving residential well-being. *Transportation Research Procedia*, 3388-3401.