SMART BLINKERS SPEED HUMPS USING SOLAR PANEL

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SMART BLINKERS SPEED HUMPS USING SOLAR PANEL

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Thesis submitted in fulfillment of the requirements
for the award of the Degree of
Engineering Technology (Infrastructure Management) with Honors

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ACKNOWLEDGEMENTS

Above all, Alhamdulillah, be beholden to Allah SWT, the Almighty God for the blessing, kindness, strength and inspiration in leading me to achieve my final year project.

I would also like to express the great gratitude for the mentorship and provision of my supervisor ASSOC. Prof. Ir Adnan B. Zulkiple throughout the entire research process. His expertise, understanding, generous guidance, motivation, support and passion made it possible to accomplish my final year project. It was a pleasure working with him and I came to know about so many new things. Next, I am also grateful to Mrs. Mohd Nurulakla B. Mohd Azlan for finding out him time to meet me, for providing me with material, for giving him precious and kind proficiencies and suggestion regarding the topic of my project.

I am highly obligated and very thankful to the technical staffs of the Laboratory of Faculty of Engineering Technology ETIM for given me permission to carry out the project in labs on weekend, for guiding me used the instrument and for providing me with all the apparatus. I am thoroughly grateful to all my lab mates, lab partner for great co-operation, being a source of inspiration, always intense to help with their expertise, encourage me to do better, and the most important part is for sharing beneficial thoughts and advises along the journey.

Finally yet importantly, I would like to voice my deepest appreciation to my family especially my lovely family for love, dream, pray, sacrifice and endless support, which were meaningful for the successful achievement on this study.

ABSTRAK

Sebuah kenderaan memandu laju boleh menjadi menaced kepada pengguna jalan raya yang lain terutamanya di jalan-jalan di mana interaksi antara trafik bermotor dan tidak bermotor adalah tinggi, seperti jalan-jalan kediaman, zon sekolah dan kawasan komuniti. Walaupun tanda-tanda had laju ditempatkan mengikut kehendak piawaian, banyak yang ditinggalkan oleh hati nurani pemandu sama ada mereka harus mematuhinya. Oleh itu, mengawal kelajuan kenderaan adalah isu kritikal dalam pengurusan lalu lintas. Kaedah mengurangkan kelajuan fizikal seperti bonggol kelajuan sering digunakan sebagai salah satu langkah. Pemasangan bonggol kelajuan pada pendekatan sekitar persimpangan akan mengurangkan kelajuan, menenangkan trafik dan akhirnya memberikan keadaan lintasan yang lebih selamat bagi semua pengguna. Sejak bonggol kelajuan dipasang di persimpangan pintu masuk utama ke UMP Kampus Gambag,kebanyakan pemandu tidak kelihatan pada waktu malam, kajian ini berhasrat untuk dilengkapi bonggol kelajuan dengan meletakan lampu iaitu smart blinkers yang akan menjadi solar sebagai sumber tenaga. Ujian perintis menggunakan bonggol kelajuan dengan pengedip pada waktu malam menunjukkan bahawa kelajuan kenderaan dikurangkan berbanding dengan senario tanpa pengedip.

ABSTRACT

A speeding vehicle can be a menaced to other road users particularly on roads where interaction between motorized and non-motorized traffic is high, such as residential streets, school zones and community areas. Although speed limit signs are placed in accordance with the requirements of the standards, much is left to the conscience of the drivers whether they should abide by them. Hence, controlling vehicular speeds is a critical issue in traffic management. Physical speed reducing method such as speed hump is often used as one of the measures. Installation of speed humps at approaches to a junction will reduce speed, calm traffic and eventually provide safer crossing condition for all users. Since speed humps installed at junction of main entrance to UMP Gambang Campus are hardly visible at night, this study intends to equipped the speed humps with blinkers that will be solar powered. Pilot test using the speed humps with blinkers at nights indicated that vehicle speeds were reduced as compare to the scenario without the blinkers.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Introduction

Speed humps are one tools available in the traffic calming toolbox, and have gained acceptance by authorities (domestic and international). However, design and application varies widely between jurisdictions, and speed humps often meet resistance from residents and road users. (Parkhill, Eng, Sooklall, Sc, & Bahar, 2007)

In 1997, according to the Institute of Transportation (ITE), the design of speed humps must be based on the standards recommended and lessons learned through experiences.

The occurrence of two fatal accidents in the vicinity of UMP Gambang Campus main entrance road with the Federal Road 222 (road to LPT Gambang Toll Plaza) had forced the authorities to installed a series of speed humps from both approaches of FR 222. The presence of the speed humps has been effective to reduce vehicle speed, calm traffic and provide safer crossing environment for all road users.

1.2 Problem Statement

Although traffic and warning signages are installed adequately on both approaches, they are hardly visible at nights and instead of slowing down traffic, had posted as obstacle and becoming less effective. Effort should be conceded to increase the visibility of the speed humps at night through installation of blinkers.

1.3 Objectives

The main objective for conducting this project is to enhance the stability of the speed humps using smart blinkers possibly power by solar.

1.4 Scope of Study

The smart blinkers for the speed humps will be installed at the following site plan.

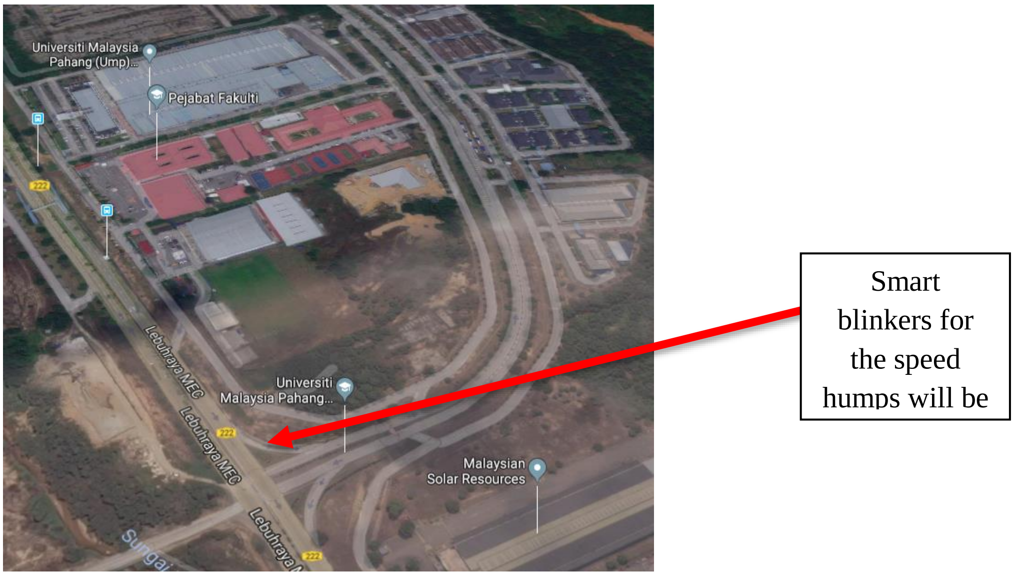

Figure 1-1: Site Plan

1.5 Significant of study

The study is conducted to generate the vest and most suitable speed humps so-called smart blinker by using electrical system which can be seen by the driver easily hence slowing down their speed.

1.6 Expected Outcome

By the end of this project, the smart blinkers speed humps used solar panel system, will be install both side of Federal Road 222 using prototype when the:

- Using the battery and smart blinkers to easy the drivers see at speed humps
- Make the experiment used solar panel to generate power based on the pilot test

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Literature review is a review of studies that has been discussed the related topics which related to this project. In this chapter, it contains the information about the explanation and types of differences speed bumps and speed humps, history, definition of conceptual design speed bumps and speed humps, introduction of road and highway, the planning to upgrade the speed humps used smart blinkers.

2.2 Speed Humps vs. Speed Bumps

A sped hump is a raised area in the roadway pavement surface extending transversely across the travel way. Speed humps are sometimes referred to as “pavement undulations” or “sleeping policemen”. Speed humps a height of 3 to 3.5 inches (79 to 90 mm) and travel length of 12 to 14 (3.7 to 4.3m). Speed humps are generally used on residential local streets.

According the journal from (Parkhill et al., 2007), a speed bump is also a raised pavement area across a roadway. Speed bumps are typically found on private roadways and parking lots do not tend to exhibit consistent design parameters from one installation to another. Generally, have height of 3 to 6 inches (76 to 152 mm) with a travel length of 1 to 3 feet (0.3 to 1 m)

The different of the impact on vehicles is when the vehicle slow to about 20 mph (32km/h) on stress with properly spaced speed humps. A speed bumps, on the other significant driver discomfort at typical residential operational speed ranges and generally results in vehicles slowing to 5 mph or less at each bump.

Some of the speed bumps baes on the varying design have been installed on private roadways and parking lots without the benefits of proper engineering study regarding study their design and placement. Speed humps, other hand, have evolved from extensive and testing and have been designed to achieve a specific result on vehicle operations research and testing and have been designed to achieve a specific result on vehicle operations without imposing unreasonable or unacceptable safety risks. (Parkhill et al., 2007).

2.2.1 Design Speed Humps

The design of a speed hump can be defined by specifying the length of its base, the height of its crown and the shape of its surface profile, as shown in Figure 1. ITE recommended a height of 3-inches for speeds of 20 to 25 mph and 4-inches for speeds of 15 to 20 mph. For length, ITE

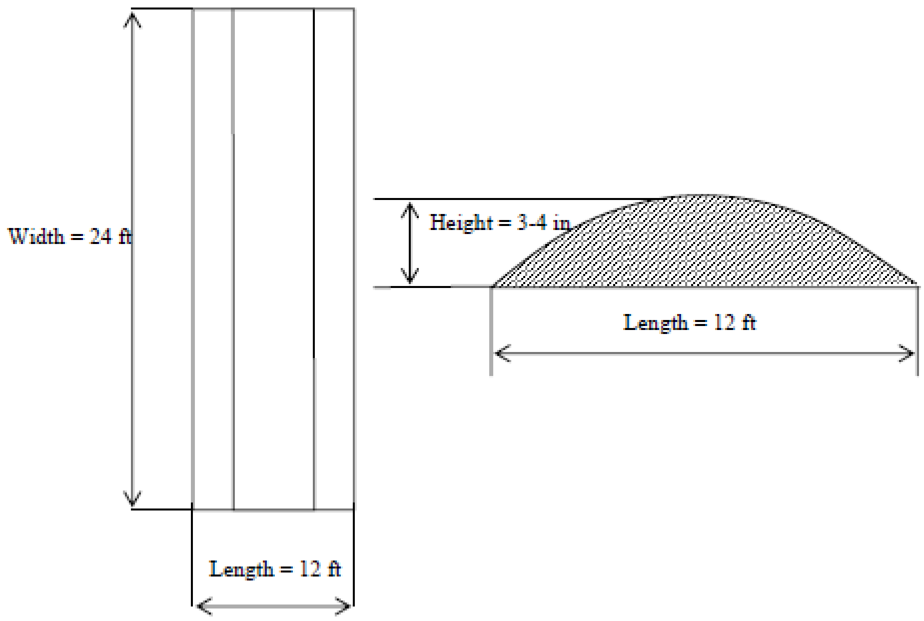

Figure 2-1: Schematic of a Typical Circular Speed Humps

For use on a typical residential street, ITE reported that the most common designs are the circular or parabolic speed hump as shown in Figure 2.2.1.2. An alternative design, the flat-topped design, is also shown in the Figure 2.2.1.2 (Report RP-023A. ITE,1997).

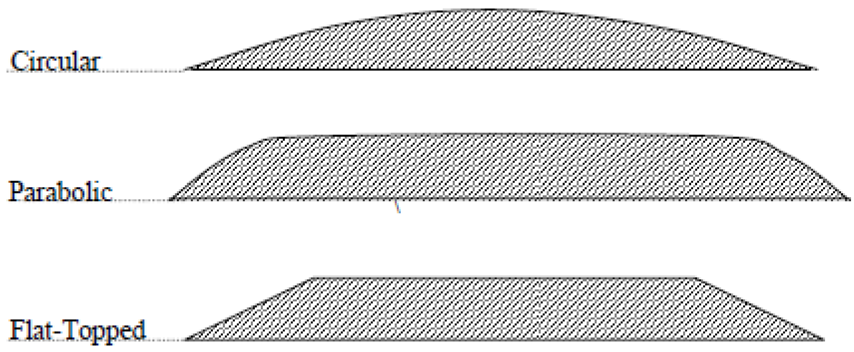

Figure 2.2.1.2: Typical Design Profiles of Speed Humps

2.2.2 Speed Slot and Speed Cushions

Due to concerns that speed humps influence, response times and passenger comfort of emergency response vehicles, modified designs of speed humps were created. Like speed humps, speed slots and speed cushions are both raised areas across the road with the intent of reducing vehicle speed. However, speed slots and cushions were designed to avoid excessive discomfort or damage to emergency vehicles by making separations in the hump. Figure 2-2 compares the typical design of speed humps, slots, and cushions. Speed slots are similar to speed humps in that they extend across the roadway but they have "slots" or tire grooves along each side of the centreline in order to allow emergency response vehicles to avoid of the device by driving through the slots along the middle of the road. Unfortunately, the emergency vehicle must straddle the centreline and travel in both lanes of the roadway, increasing the risk to both the emergency vehicle as well as other vehicles.

Speed cushions are smaller than lane width and are rectangular or square. These characteristics allow an emergency response vehicle to straddle the cushion while remaining in its respective lane. Figure 2.2 shows the typical dimensions and layout of speed humps, slot and cushions.

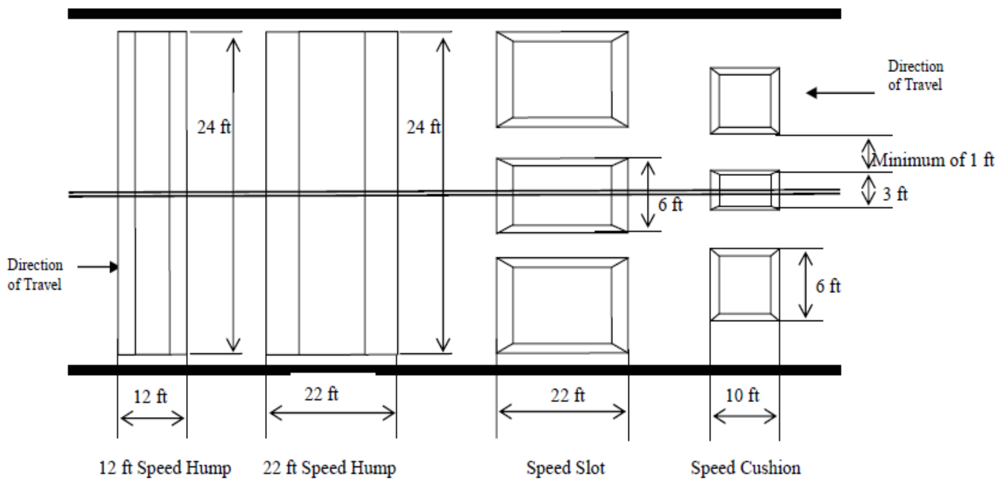

Figure 2-2: Schematic of Speed Hump, Speed Slot and Speed Cushion

2.3 Heights

A speed humps of 4.0m in length and 100mm height is recommend on streets with a traffic volume 1000-5000 vehicles per day. A second hump design of 4.0m in length and 70mm in height is recommended for higher volume streets of 3000-8000 vehicles per day. Speed Humps of 100mm high will result in vehicle crossing speeds of approximately 25km/hr and the 70mm high humps will give vehicle-crossing speeds of approximately 35km/hr.

A for flat topped (height of 70mm or 100mm, and ramp slope 7%) is recommended for use on city streets at crossing locations for pedestrians. The dimensions permitted under the Highways (Road Humps) Regulations 1996 are:

- Maximum and minimum height of 100mm and 25mm respectively
- Minimum length of 900mm
- No vertical face exceeding 6mm in height

2.4 Length

The recommended maximum and minimum length for standard speed humps per the Highway (Road Hump) Regulations 1996 as below. There is no limit imposed on the maximum and minimum lengths for Raised Junctions. For Cushion, a minimum length of 1.90m and a maximum of length of 3.70m are recommended.

2.5 Advantages of Traffic Calming

Base on the domestic and international code shown that speed humps can reduce speeds by approximately 5km/hr. Moreover, that not all people like speed humps and majority of the drivers hate them. The speed hump as a main traffic is likely to gain the greatest benefits in the urban area where there are accidents involving pedestrians particularly children.

The paper by Beckman and Kuch investigated that shown about the effect of road humps vary with speed. Research questions the define their study include could bump be the limiting factor in concerning speed and in an aerodynamic car.

According by smith and Giese the impact of high traffic volumes on the quality of life residential neighbour. Speed Humps are designed or residential roadways that have two lane or less than at the point posted limit of 30 mph or less, and 85^{th} percentile speed of 31-34mph. Roadways that carry traffic volumes of 600-5000 vehicles per day are good candidates for speed hump after installation.

Research base on the Fishman that the introduced the concept of traffic calming employed to improve the conditions on a roadway for pedestrians, bicyclists and neighbour. The traffic calming techniques alter the appurtenance or geometry of a roadway to reduce traffic volume or speed. Other by creating a sense of shared space between the driver and resident make drives want to slow down on local roads.

2.6 Disadvantages of Traffic Calming

We could say that speed humps are relatively cheap and easy to install method of reducing the frequency and severity of injuries by virtue of reducing vehicle speed. But, there also an organization or people who against such measures, where they would say I will delay emergency services, because there is discomfort to drivers and passengers, add to air and noise pollution and even encourage to speed between humps.

For drivers who get used to the effect of speed humps, they may increase their speed and some of them may divert the vehicle movement to alternative routes. Some of them do not think about pedestrian safety, a diversion through traffic to the other people and Parallel Street may be happened. That can show the volume of vehicle may increase due to the high speed of vehicles when they get used and feel the humps. Besides, a potential in increasing the strong noise due to the vehicle breaking and acceleration, and may increase the delay response time of emergency. That because we will make a new design to avoid the increasing the speed near the speed humps to be derived from a perceived increase in safety and liveability due to the lower traffic speed.

Base on the research done by the ITE transport research laboratory dhow that the years after receiving complaints show that increased vehicle emissions, vibrations, excessive noise and significant increase in accidents involving cyclists and motorcyclists. They have conducted emission tests on roads with a 75m hump spacing and found that carbon monoxide increased 70%. From the overall it was confirmed that these problem are likely to become significant where the truck and buses or heavy goods traffic.

In highway (Road Humps Regulations 1990 and the Road Humps and the Road Humps Regulations 1991 resulted in a large number of road humps being installed.

2.7 Spacing between humps and Speed between Humps

The height and length of speed humps, spacing between also must be considered in designing the speed humps and installation of speed humps on street. To minimize the vehicle speed fluxions along streets with speed humps, the best way to do is by spacing the humps between 100m and 150m range. The sitting of the first hump also very important to be considered, where it should be between 50m and 75m from the first intersection or junction. This is recommended in order to minimize the possibility for vehicle to reach higher speed before encountering the speed humps.

In TRL, Project Report 186-Traffic claiming Road Hump Schemes Using 75mm High Humps, the effect on the speed reduction between 75mm and 100mm road humps were studied and compared, summarized as below:

- Installing 75mm humps would reduce the mean and 85^{th} percentile speed between humps by an average of 10mph.

- The overall average mean speed between 75mm high humps with ramp gradients of 1:10 to 1:115 was 20mph.

- Speed humps should not be closer than 20m apart and in excess of 150m, expect for speed cushions at pedestrians crossing where spacing can be as little as 5m.

- Speed humps spacing in excess of 100 meters may increase the between hump speed appreciably.

2.8 Speed Humps Base on the SIRIM- Specification for Materials, Design and Installation

The Malaysia standard of the speed hump under the authority of the Industry Standards Committee on Building, Construction and Civil Engineering. The Working Group on Speed Hump which developed this Malaysian Standard consists of representatives from Kuala Lumpur City Hall, Malaysian Institute of Transport, Universiti Teknologi MARA, Perunding Atur Sdn Bhd, RW Consultancy Sdn Bhd, SIRIM Berhad (Secretariat), the Institution of Engineers Malaysia, Universiti Kebangsaan Malaysia and Universiti Malaysia Pahang.

This thesis will be highlight about the standard, terms and definitions related to speed hump and speed bump, purpose of speed humps installation advantages and bad effect of speed hump.

2.8.1 Scope

This Malaysian Standard serves as the guideline for speed humps as one of the traffic calming measures on roads with legal speed limits of 30 km/hr to 60 km/hr (with upper limit of 80 km/hr for roads under the jurisdiction of the Public Works Department), for the purpose of slowing traffic to approximately 50 % at the road sections before and after the speed humps

2.8.2 Terms and definitions

Speed hump

A raised pavement area across a roadway with a rounded top of 3.70 m to 4.25 m width and vertical rise of 75 mm to 100 mm which can generally slow down vehicles gently to speeds of 15km/h to 30km/h as shown in Figure 2.8.2.1.

Figure 2-3: Speed Hump

A significantly smaller size than speed hump with a rounded top of less than 1 m width and vertical rise of 75 mm to 150 mm which can slow down vehicles abruptly to speeds of 8 km/h to 15 km/h as shown in Figure 2.8.2.2

Figure 2-4: Speed Bump

2.8.3 Purpose about the speed hump and installation

Generally, recent traffic calming measures, which combined, with other physical measures will help to reduce the bad effect of the traffic flow, driver behaviour and enhance the safety for non-motorized street users.

The only thing that concerned by the traffic calming is speed reduction but dost not attempt to restrict vehicular access. It helps to discourage through traffic on certain streets and encourage other means of travel.

2.8.4 Public Participation

According to Ir. Adnan Zukiple, a speed hump constructor, the views of public representatives such as councillors and resident association, the local road safety research institution (Malaysia Institution of Road Safety), should consider the Road Engineering Association of Malaysia and the Institution of Engineers Malaysia.

Proposed locations and details of road humps, road markings and road signs should be clearly shown in drawings and then distributed to the affected proprietors and residents. Briefings and discussions to these parties should be conducted and evaluate the conclusion technically hence incorporated in the construction drawings.

2.8.5 Speed Hump Profile, Physical Characteristics and Material

Shape of speed humps:

The common shapes of the speed hump have 3 shapes are parabolic, circular and sinusoidal:

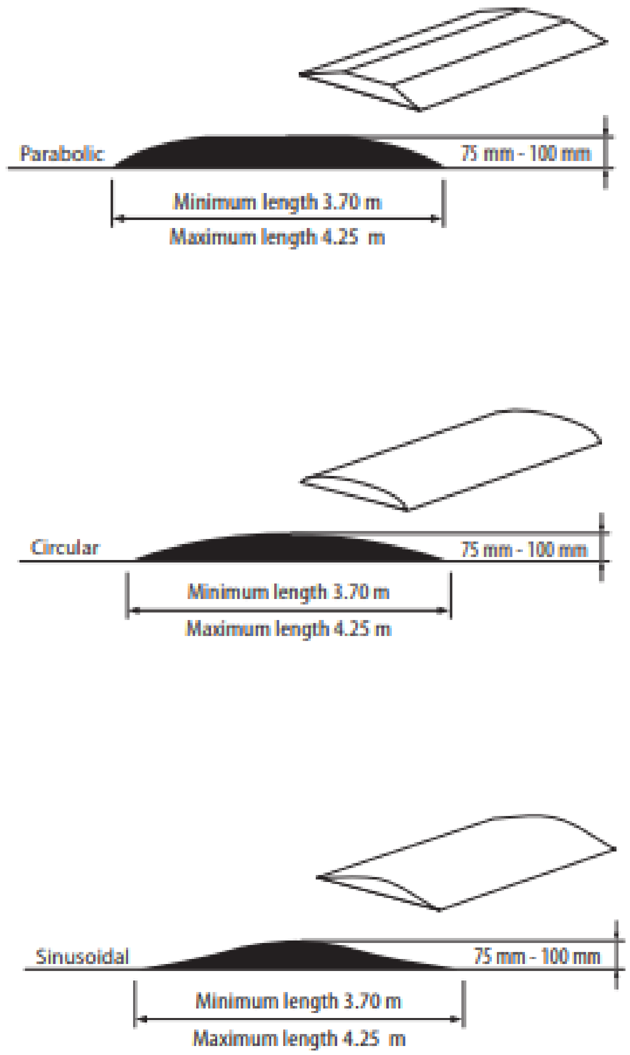

Figure 2-5: Common shapes of speed humps

2.9 Speed hump physical characteristics

The speed at which the traffic will travel over the device is determined by the length and height of speed hump. 85-percentile speed will reduce from 12 km/hr to 15 km/hr when a series of 90 m to 180 m apart is placed.

The physical characteristics of a speed hump are as follows:

- Rounded raised areas of pavement;
- Typically 3.70 to 4.25 m in length and span across the width of the road
- Hump heights range between 75 mm to 100 mm with a construction tolerance of ± 3 mm;
- Common speed hump shapes are parabolic, circular and sinusoidal
- Typically has pavement markings to enhance visibility (suggested being of yellow zebra)
- Tapered to the edge near curbs to allow a gap for drainage; and
- Some have speed advisories for bicyclists and motorcyclists (prefer that it does not cover or cross the bicycle or motorcycle lane)

CHAPTER 3

METHODOLOGY

3.1 Introduction

Research methodology is the steps or the sequence of work involved from the beginning of the study until the completion of the final report. It is essential in guiding the researcher towards achieving the aims and objectives of the study. In this chapter, the methodology used in carrying out this study will be describe in detail. The first step involved is evaluate the effectiveness of existing speed hump. Next, propose an enhancing device to existing speed hump. Nest step about the design and assembly of smart blinkers. Make the Pilot Test to get the result and the collection data would be used for the study are presented. Subsequently the data obtained from the collection were analyze and their inferences are presented. This were follow by the discussions and suggestions and eventually, conclusions are drawn to conclude the study. Lastly the finalize a prototype.

3.2 Methodology

Outlined Methodology is shown as follows:

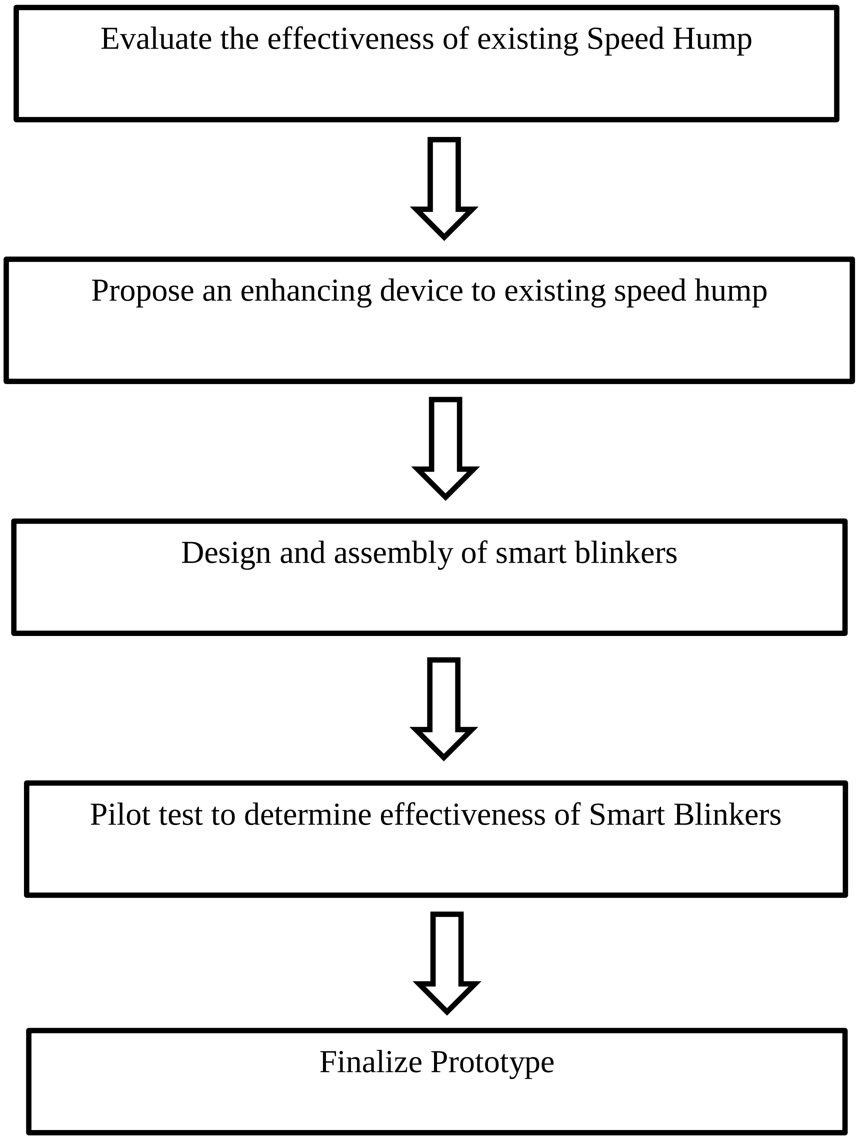

Figure 3-1:Methodology Framework

3.3 Detailed Methodology

3.3.1 Evaluate the effectiveness of existing Speed Hump

The build design about smart blinkers speed humps used solar panel system model in front of the University Malaysia Pahang Gambang. The instrument used to determine the design project have five materials. Solar panel used in this project as a source of generate electricity and as a resource backup for the battery.

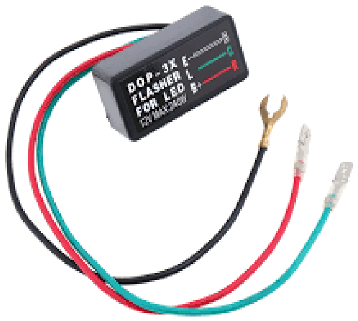

Figure 3-2:DC 12V Waterproof LED Turn Signal Light Flasher Blinker Relay Flash

This material used because easy to install, plug and use. Beside easy to replace LED turn signal indicator for car, motorcycle or other vehicle. The size of this material Flasher relay size 5.6cm x 2.3cm x 2cm/L x W x H.

Figure 3-3:Solar Panel Light Controller Battery Chare

SX 01 multifunction for intelligent control is realized by using microprocessor and dedicated control calculation. Through the computer chips, the controller takes samples from the parameter of storage battery voltage, solar battery, discharge current and environment temperature, and then use the dedicated control mode calculation to control the discharge rate and make it matched with the character of storage battery, realize the high accurate temperature compilation. PWM charge mode and high efficiency control are available for the storage battery. So that storage battery is always in the perfect working state, help prolong the service life. The controller has various has various working modes and built doze lighting effects which can meet customer different requirements.

Application fields: the controller used in maximum solar panel Spec 18V/40W (Maximum open circuit voltage 23V), the maximum load Spec 12V/36W solar LED lights and other types of application systems. Functional Characteristics: 1. More compatibility with a variety of storage batteries such as VRLA battery, gelled electrolyte (GEL) Battery, 3.2V x 2 iron-phosphate-based lithium batteries 3.2V x 4 iron-phosphate-based lithium batteries, 3.7V x 1 iron-phosphate-based lithium battery. 2. Prevent storage battery being overcharged, over discharged and back discharged at night and it also has PWM flatting- charged protection. 3. Automatically turn on floodlight according to the lightness at suet. Regularly turn off floodlight according to the set value or automatically turn off according to the lightness at sunrise.

Figure 3-4:20W Polycrystalline A-Grade Solar Panel

The product details of 20 Watt / 20W Polycrystalline with the diode minimize the power drop by shade. Performance guarantee 90% power output for 12 years and 80% power output for 25 years.

Figure 3-5:Rechargeable Seal Lead Acid Back Up Battery

The detail of this material is maintenance free and backup battery for automatic gate alarm system. General purpose battery up to 3 years in standby service or more than 260 cycle at 100% discharge in cycle service.

Figure 3-6:Pre wired light 12V LD lamp 5mm white Bulb cable

Description:

100% Brand new and high quality

Easy to use and install

High luminous efficiency

Energy saving and environmental friendly

Specification:

Cable length: Approx. 9.84inch/25cm

Height: Approx. 0.20inch/5mm

Colour: White

Voltage: 12V

Power: 0.2W

Lifetime: 50000 hours

3.4 Proposed an enhancing device to existing Speed Hump

In this method, the standard speed hump design and existing the new design was compared. All the advantages and disadvantages for this new design was determined, as for the pedestrian's safety and driver come out from highway. The observation how these speed humps will slow down the vehicle speeds used the smart blinkers, and it will affect to the pedestrian was verified. The best design was decided during this step.

The comparison between the existing speed humps design was compared to the standardized design. These also includes by considering the "before and after" to make the speed humps used smart blinkers for existing speed humps. The best design speed humps that include for driver's safety was choose.

3.5 Pilot test to determine effectiveness of Smart Blinkers

In this project a pilot test study is a one of the standard scientific tool for research that allowing researcher to conduct a preliminary analysis before committing to a full-blown study. Therefore, a good assessment or research strategy can be used to careful planning and a pilot test study will often be a part of this strategy. A pilot study is normally small in comparison with the main research and therefore can provide limited but appropriate information on the sources and magnitude of variation of response measures.

Pilot test are important outcome of the innovation process because they let any organization can suck and see before they take whatever it is to a board base what customer want. There is only one reason to run a pilot: to get learnings about how to operate an innovation before you put it in the hands of customers or end users.

Pilots are about trying the innovation for real and making sure that everything works. They are about preparing to scale up to production. However, a pilot is not a technology experiment to see if people will "like" the service. A pilot is not a proof point that whatever-it-is can be made to work in the first place. Neither is it a sales tool used to help win funding. These are the roles of a prototype, which is a small demonstration of the do ability of a new innovation.

Figure 3-7: In progress Prototype

3.6 Finalize Prototype

The final stage for this study is to finalize the prototype of smart blinkers. This step is following about the reduce the speed of driver analysis data. As we get from the observation, when used the prototype can reduce more speed of vehicle in front of UMP Gambang.

3.6.1 Method of Analysis

The spot o data used in this thesis because to find n analyzed by calculating mean speed, median speed and modal speed. The mean, median and modal is calculated by using the following expressions:

i. Mean Speed,

$$X = \frac{\sum fm}{\sum f}$$

Where

X = arithmetic mean of all recorded cars' speed

$\sum fm$ = Sum of frequency times the middle speed of each class

$\sum f$ = total frequency

ii. Median Speed,

$$\acute{y} = \text{Real Lower Limit (RLL)} + \left[\frac{\sum f\,(0.5) - Cf\,(\text{below})}{f} \right] \times i$$

Where

ý = middle speed in a series of spot speeds that are arranged in ascending order

RLL = the real lower limit of the speed class interval containing the median speed

$\sum f$ = total frequency

Cf(below) = cumulative frequency below the speed class containing the median speed

f = frequency containing median speed

i = interval size

iii.
The calculation of average speed is to interpret the relationship between before smart blinkers installed and the after the smart blinkers installed to compare the speed of cars. These relationships are shown in the form of graphs. A cumulative frequency curve (upper limit speed vs cumulative frequency) was also prepared to determine 85th and 95th percentile speeds. The output from the analysis is expected to ascertain to what extent the provision of road humps reduces the speed of the vehicles along the educational streets.

3.6.2 Limitation of the study

The effect of road humps on speed reduction is mainly applicable to educational areas as the study was administered at educational. The type of vehicles chosen for this study is motorcars because they constitute as the main mode of transportation along of the UMP Gambang streets. The effects of road humps in reducing vehicle speeds in this study are mainly related to motorcars as the other vehicles behave differently in terms of reduction in speed when installed the smart blinker before or after. The selected sample size is another major limitation of this study. Finally, the traffic volume along educational roads is normally low compared to commercial land use because the residents living in the residential areas are the main and frequent users of the residential streets. As a result, the vehicle speeds at residential and commercial areas are different. Even though, the vehicle speeds at these two types of land uses are different, but the design profiles of road humps, if provided with equal dimensions, may alter the driver’s behaviors in terms of vehicle speed insignificantly when approaching road humps.

3.7 Field observation and road inventory survey

In this study, the field observation in front of UMP Gambang was made the collect data on the selection of road and to make new design at the speed humps. The field observation was also made to identify the general issues and problems of the educational area and its immediate surroundings. The selected roads were clearly marked to collect data on geometrical details of the road which includes the width of the carriageway and right of way width. The design profiles and characteristics of the road hump such as shape, length, width were also collected. The field observation was carried out during weekday, which is on Tuesday starting around 10 o'clock and ending in the night at 2 o'clock. The observations on the images of road network and road humps were recorded by using a camera; measurement of design characteristics of road hump and road geometrics by a measurement tape. The weather on the data collection day was rainy and windy. However, in the late night after completing the survey, it has started to drizzle rain.

3.7.1 Spot speed survey to collect data

Systematic sampling procedures were applied to collect data on the spot speed of the vehicles. By systematic sampling method, each element in the population has a known and equal probability of selection. Using the systematic sampling method, every 5th road users (which confine only to the cars) passing the road humps along the selected road at educational area was selected as samples and the procedures was continued until 100 samples were collected. As two different data was collect, before and after were being evaluated, the samples selected at each road hump were 75 samples. The total number of motorcars selected to measure spot speed is 100 at the two selected data were different.

Spot speed survey was administered to understand the users' driving behaviors in terms of reducing speed whenever approaching a road hump. The data on the spot speed was collected when cars are at a distance of 10 meters before the road hump, at the road hump and 10 meters after passing the road hump. The alignment of road selected was a straight road. Road humps were located at few locations along the straight road in the selected residential area. The spot speed data was measured by using a speed measurement device – a hand-held digital known as *Stalker Lidar* and direct timing procedure method. The direct timing procedure method was used because of the lack of radar guns in the laboratory. The direct timing procedure applies the theory of calculating speed which equals to a known distance covered by a vehicle divided by the time taken by the vehicle. The spot speed at location P1 and P3 (Refers to Figure 3.8) was calculated by using direct timing procedure while P2 was measured by using time speed method. Three observation were stationed, one at each location, to measure the spot speeds (Refer to the Figure 3.8).

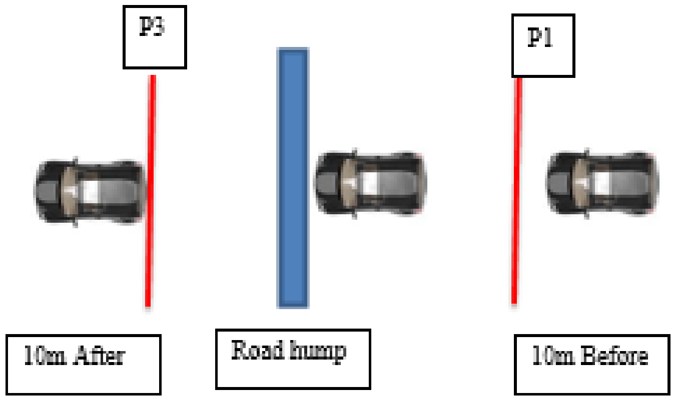

Figure 3-8:Plan view of spot speed survey

3.8 Development of Prototype

The prototype composed of several components including diode light, fuse, waterproof LED turn signal light flasher blinker, relay flash and solar panel. Smart blinker will be working when the UV light from sunlight penetrates to the solar panel controller, making the Signal Light Flasher Blinker Controller stop conducting an electric current to pre wired light 12V. On the other hand, battery will be charged by using UV light immediately. It took 9 hours to charge the battery during the day.

At night, when the solar panel have not receiving any UV light, Signal Light Flasher Blinker Controller will stop the current from charging the battery. Battery is then conducting an electric current to the Pre Weird Light 12V therefore will turns on the LED. Waterproof LED Turns Signal Light Flasher Blinker Relay Flash has been setting with the button manually. All these electronic devices will be kept in a tool box to make it easier for maintenance in further.

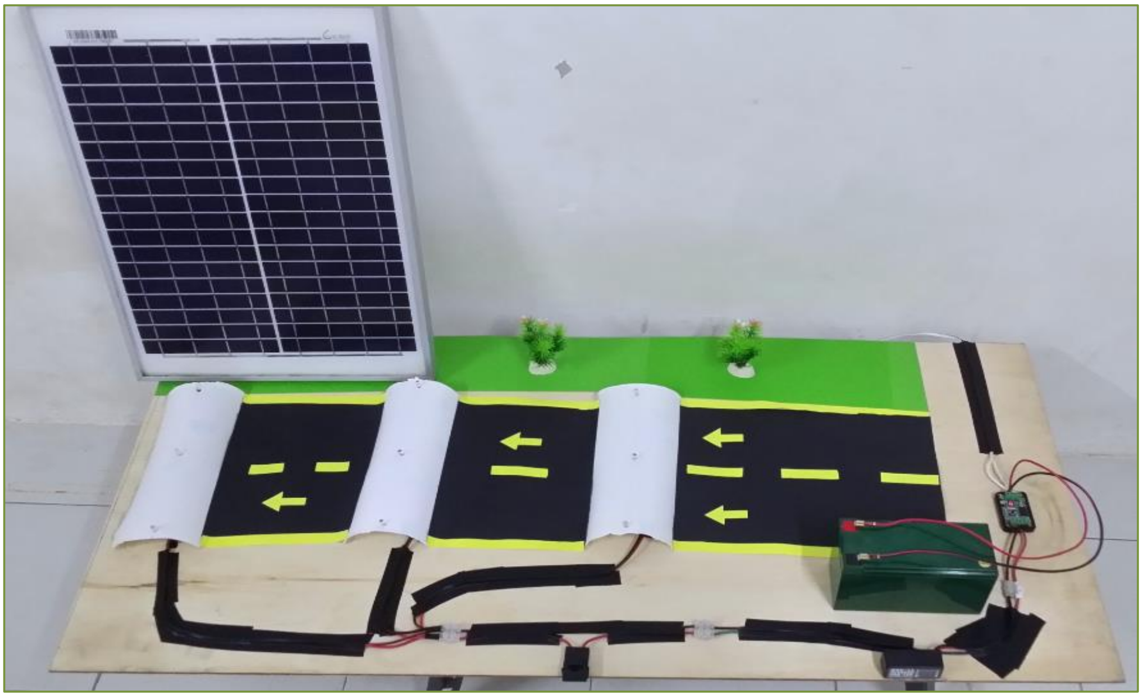

Figure 3-9: Smart Blinkers Design

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

In chapter 3, the methodology that been used in completing this study was explained. In this chapter the process of analyzing the data obtained were discuss. The analyzing process is the most important part in a study and the results obtained will be used to identify weather the objective is achieved or not. Data is being analyzed by using Microsoft Excel in the end of the chapters. The suitable statistic application will have used to support the result that obtained.

4.2 Spot speed analysis (Before)

The findings showed that there exists a wide variation between the speeds of cars. It showed that several drivers drove their vehicles lower than the posted speed limit while others drove higher than the posted speed limit. For instance, the graph shows approximately 11 cars were found speeding (above the speed limit which is 25 km/hr) at 10m before installed the smart blinkers the road hump while the rest are below the posted speed limit (Refer Figure 4.1).

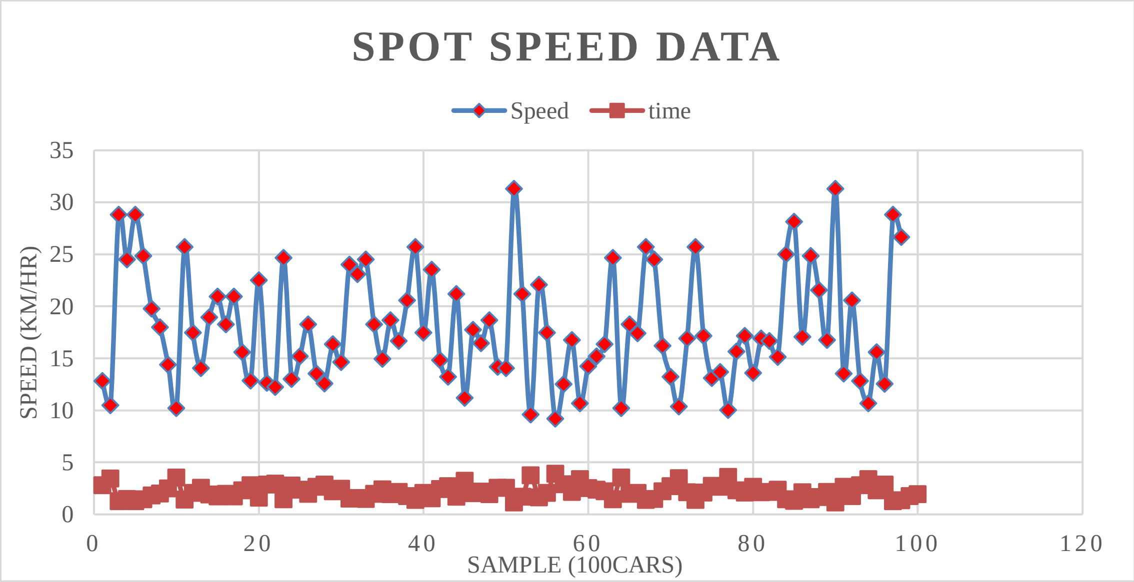

Figure 4-1: Spot Speed variation before

On the other hand, there were also 11 cars recorded speeds above the 25 km/hr at 10 meters before installed the smart blinkers the road humps the first hump. The lowest speed at the road hump was around 3 km/hr and the highest speed was 12 km/hr.

The observation has shown that properly designed and installed at road humps can reduce vehicle speed to 23.4-31.2 km/h when traversing road humps and 39-46.8 km/h in between properly spaced road humps (Farzana Rahman et al, 2007). The interval between the road humps is one of the important factors in reducing the speed of the vehicles. The vehicle speed become around 15 km/h to 20 km/h near or on the road humps but as the interval between road humps increases, the speed of the vehicles increases (Aya Kojima et al, 2011). Based on the observation, it was found that the speeds of the vehicles at the road hump were greatly influenced by the design characteristics of the road hump.

4.3 Spot Speed Analysis (After)

Figure 4.2 shows the speed variations at locations of the after installed the smart blinkers at road hump. There were 7 cars found exceeding the posted speed limit at 10 meters before installed at road hump. The graphs also showed that 9 cars were speeding (above the speed limit) at 30 meters after. The number of vehicles exceeding the speed limit at 10 m before and 10 m after the road hump was slightly higher in the case of the after installed road humps than the first. As the second road hump was provided with gentle slope than the first, it gave an opportunity to the cars to speed above the posted speed limit when approaching the second road hump.

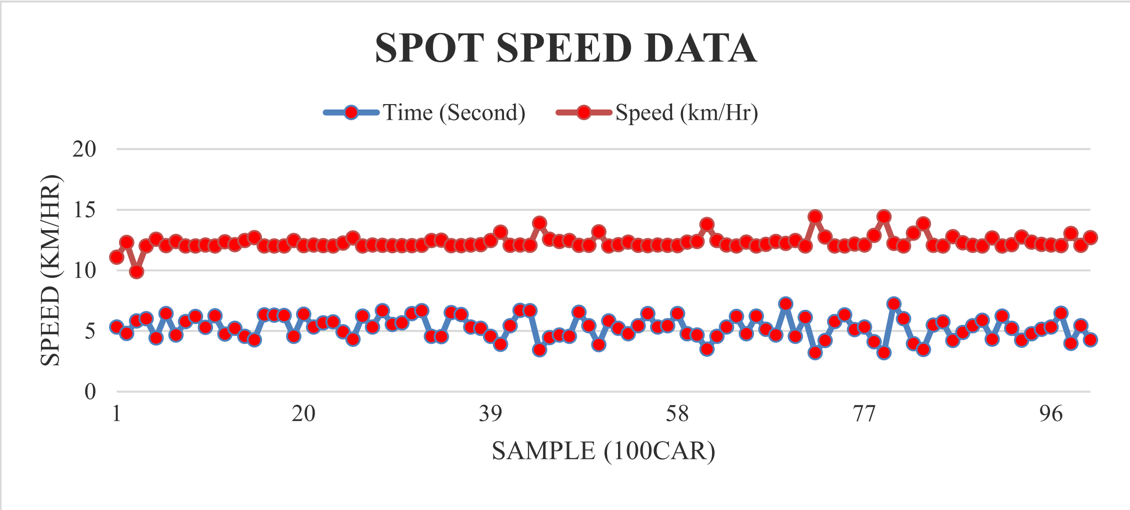

Figure 4-2: Spot speed variation after

The gradient of the road humps can affect speed – the steeper the gradient the larger the speed reducing affect. However, the gradients should not be steeper than 1:10 and side gradients not steeper than 1:4. From this analysis, it shows that the design characteristics of the road hump and the speed reduction of the cars are interrelated, as the drivers tend to speed near the road hump having favorable design characteristics more frequently. In other words, as the design characteristics of the road hump having lesser interference to the vehicles in terms of its dimensions is more prominent, the number of vehicles exceeding the speed limit increases.

4.4 Speed Characteristics

The spot of speed characteristics such as mean, median, modal and percentile speed were calculated and analyzed.

Table 1: Mean and Median speed at the road humps

Before Installed		After Installed	
Mean Speed	Median Speed	Mean Speed	Median Speed
18.0	17.0	7.0	6.8

Table 2: 85th percentile and 95th percentile speed at the road humps

Before Installed		After Installed	
85^{th} Percentile	95^{th} Percentile	85^{th} Percentile	95^{th} Percentile
18.0	17.0	7.0	6.8

Table 3: One-Sample Test

	Test Value = 0.05					
					95% Confidence Interval of the Difference	
	t	Df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Time	32.778	99	.000	2.13800	2.0086	2.2674
Speed	33.343	99	.000	17.90640	16.8408	18.9720

Table 4: One-Sample Test

	Test Value = 0.05					
					95% Confidence Interval of the Difference	
	t	Df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Time	56.634	99	.000	5.23354	5.0502	5.4169
Speed	50.226	99	.000	6.96078	6.6858	7.2358

4.5 Testing the differences in the average speed of the vehicle at the road hump

A t-test was conducted examine whether the differences in the average speed of the vehicles at 10m before installed the smart blinkers on the speed humps was statistically significant. The following subsections show the findings the t-test.

Before install smart blinkers

Table 4 shows the findings of the t-test. It can be seen that the calculated t-value is 32.778 which is higher that the critical t-value with a degree of freedom is 99. The findings show that there exists a clear of differences in the average speed of the vehicle. It shows that the provision of the road hump along the educational area is effective in reducing the speed of the moving car.

After install smart blinkers

The differences in the average speed of the cars after installed was also tested for statistically significance. The calculated t-test value= 56.637 which is found higher than the critical T-test with a 99 degree of freedom. Table 5 shows the findings of the t-test. It can be concluded that the differences in the average speed of the cars showed the effectiveness of road in reducing the speed of the vehicles (cars).

The findings showed that the selected road humps have controlled the drivers' behavior in reducing the speed of the moving vehicles. The design profiles of the road humps have played an important role in reducing the speed of the vehicles

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

A pleasant, harmonious and safe educational area is very important for a better quality of life for student UMP Gambang. The increasing traffic movement especially by private motorcars traveling at speed greater than the stipulated speed limit in the education areas has been posing a greater threat to the living quality of the educational area. Generally, the higher the speed of the vehicles in the educational areas, the greater the noise level and lower the safe living conditions of the educational area. The movement of traffic at speed higher the speed limit has warranted the provision of traffic calming devices including speed hump.

The provision of speed hump in many educational areas has become a common phenomenon to arrest the speed level of the moving vehicles. Studies have shown that properly designed and installed smart blinkers speed humps using solar panel can reduce vehicle speed to 23.4-31.2 km/h when traversing road humps and 39-46.8 km/h. The interval between the road humps is one of the important factors in reducing the speed of the vehicles. The vehicle speed become around 15 km/h to 20 km/h at near or on the road humps but as the interval between road humps increases, the speed of the vehicles increases (Aya Kojima et al, 2011).

The measurement of speed near the road humps along the educational street in front of UMP Gambang has indicated that the most of the motorcars were following the stipulated speed limit. It is also found that the difference in the average speed of the motorcars before install the smart blinkers and at the road hump is statistically significant at both 99% and 95% confidence interval. In other words, there exists a clear difference in the average speed of the motorcars approaching the road hump and at the road hump. This study focuses only on the before install and after install the smart blinkers at the in front of UMP Gambang area. Further studies to evaluate the effects of other road hump types on vehicle speed reduction along the residential areas are required. This is imperative to understand the characteristics and design profiles of other types of road humps in reducing vehicle speeds and thus selecting the new design at speed humps to install the smart blinker for the education areas.

It is evident from the study that road humps along the education street help to reduce not only the speed of the vehicles but also allow vehicles to adhere to the stipulated speed limit. However, the location of road humps at close intervals would increase the noise level of the vehicles especially after passing the road humps.

As a result, it affects the peacefulness, tranquillity and calmness of the community in front of the UMP areas. To arrest this dilemma, it is highly important to identify appropriate spacing between the road humps to enhance its function of reducing vehicle speed without causing unnecessary inconveniences to the community in the residential neighbourhoods. The road humps when planned, designed and located at the appropriate intervals would increase the living environment of the residential neighbourhoods.

5.2 Recommendation

Based on the data collected, the study needs to conduct a set of questionnaire in order to collect more the strong opinion data from the target road and highway educational area. This would like to include further case studies, interviews or face-to-face communication. This could be support the data collection and study currently. I hope that for the next 5 years will becoming the new design used smart blinkers at the speed hump in front of UMP Gambang or in Malaysia.

Although speed humps seem to affect driver behavior to some of the extent, their effectiveness as speed reducing is more to quite far from optimal and thus the choice of local authorities to install the new design at speed humps.

Overall, there are many recommendations that would be suggested in this study but mainly focused on how to install the smart blinker to the speed humps. In order to reduce the speed of vehicles and prevent accident from occur in front of UMP Gambang, installing the Smart Blinker Speed Humps is one of the great idea.

Finally, a study could also be carried out focusing on the effectiveness and the sustainability of the installer the smart blinkers at the speed humps in front of the UMP Gambang using the model solar panel system. This would enhance at speed humps and also making the speed humps it globally known in the world.

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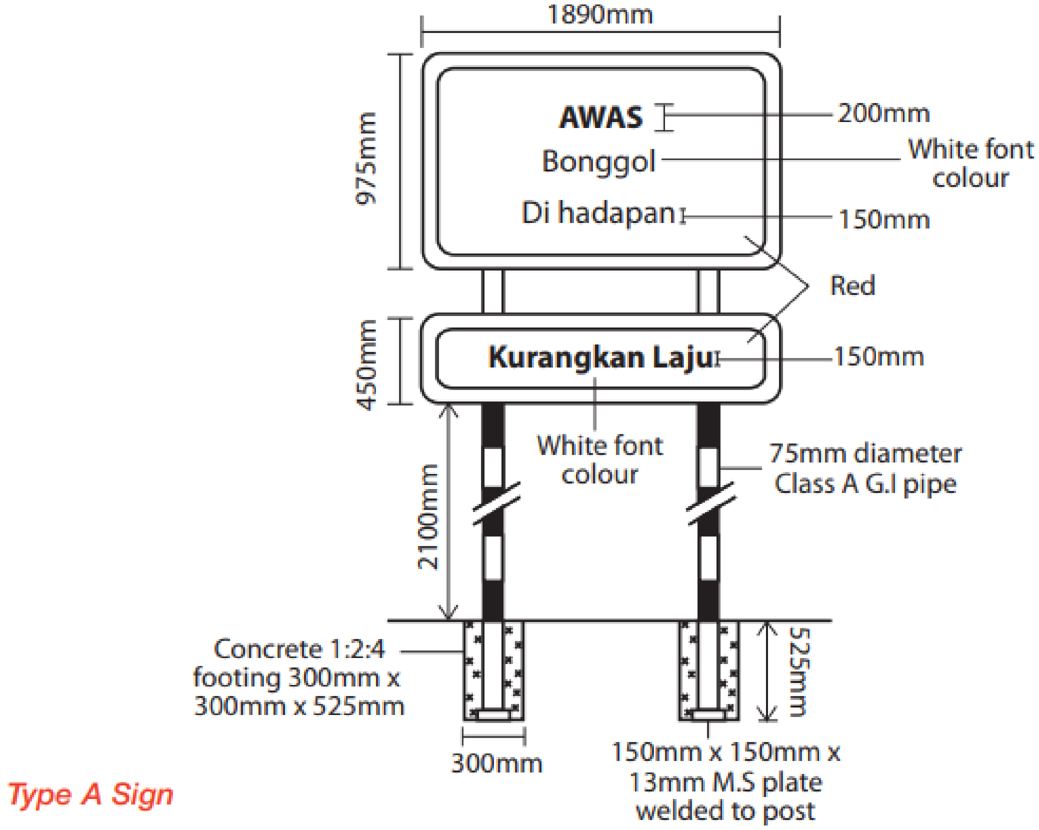
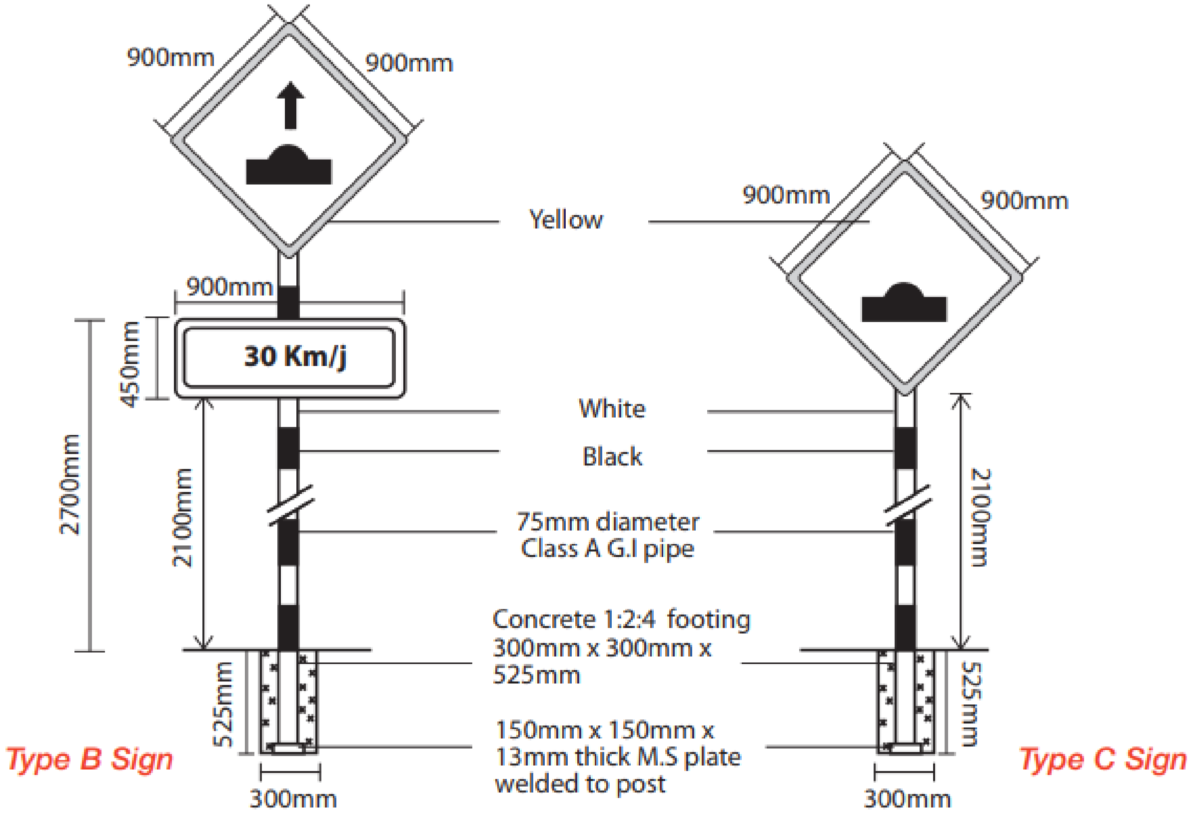
APPENDIX A
SELECTED SITE SPEED DEVICE PROFILE

Site ID	Profile/ Configuration	Height	Length	Width	Gap	Separation	Construction	Markings
1	Parabolic	2.5 in	12-ft	n/a	n/a	Range of 130-383 ft	Asphalt	Zebra
2	Parabolic	3.0 in	12-ft	n/a	n/a	437 & 419 ft	Asphalt	Zebra
3	Parabolic	3.0 in	12-ft	n/a	n/a	600 ft	Asphalt	Chevron
4	Parabolic	3.0 in	22-ft	n/a	n/a	460 ft	Asphalt	Chevron
5	Parabolic	3.5 in	22-ft	n/a	n/a	Range of 430-530 ft	Asphalt	Zebra
6	Flat-top	4.0 in	14-ft	n/a	n/a	150 & 161 ft	rubber	arrow on road prior to hump
7	symmetrical about centerline	3.0 in	22-ft	5 ft & 12-ft	18 in	490-535	Asphalt	Diagonal Lines
8	symmetrical about centerline	3.0 in	22-ft	5 ft & 14-ft	17.5 in	470-575 ft	Asphalt	Diagonal Lines
9	three cushion abreast; symmetrical about centerline	3.0 in	10-ft	7 ft	24 in	505 & 634 ft	Asphalt	Arrow
10	three cushion abreast; middle cushion off set from centerline	3.5 in	10-ft	7 ft	18 in	285 & 470 ft	Asphalt	Arrow

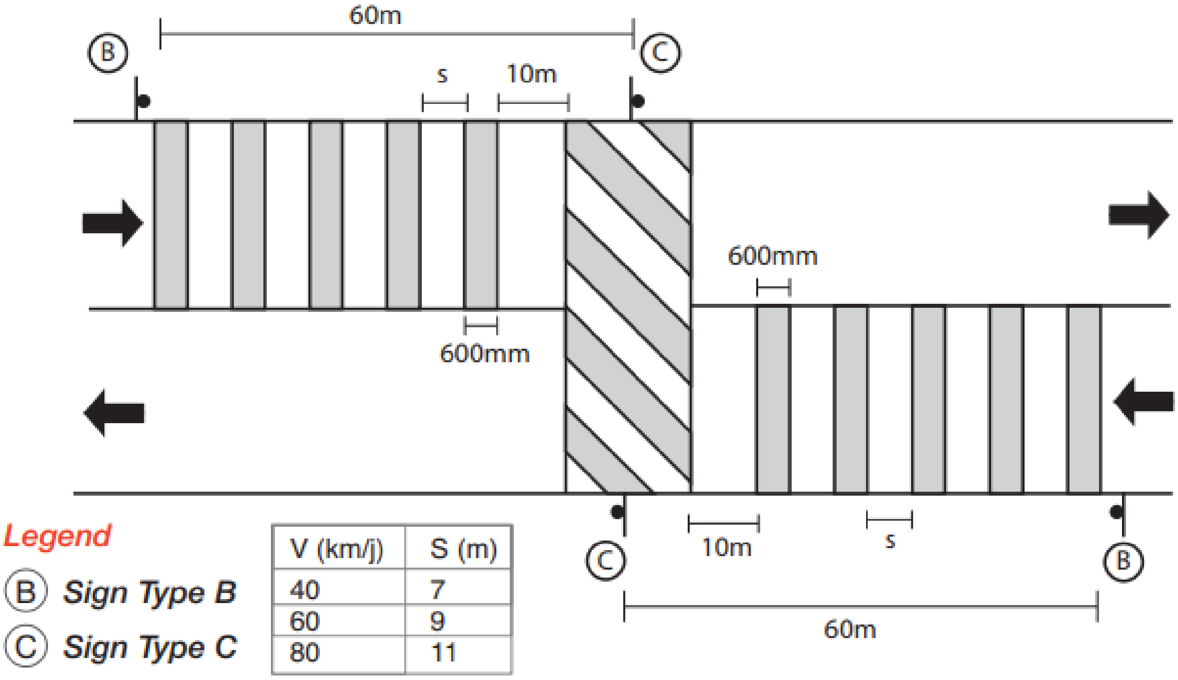
APPENDIX B
WARNING SIGNAGE AND ROAD MARKING



Type A: Speed hump signage design standard for type A



Type B: Speed hump signage design standard for type B and C



V (km/j)	S (m)
40	7
60	9
80	11

Speed hump road making (2-ways traffic flow)