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IMPACT ANALYSIS OF SPEED RESTRICTION MEASURES USING VISSIM 5.40

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ABSTRACT

In this work, the impact of speed restriction measures on road safety and level of service were studied and the real time situation is modeled using micro simulation software VISSIM 5.40. The result shows that the simulated situation resembles the real time situation since the R^2 value ranges between 0.7-0.9 and due to the presence of humps the travel time gets increased and the Level of Service (LOS) gets reduced. Due to the installation of speed breakers there is no significant reduction in the number of accidents in the study stretch. This study also describes a study conducted to establish practical geometric design guidelines of speed control humps for the use of road engineers. A statistical relationship between geometric characteristics of speed control humps and speeds of the automobiles is developed and models have been suggested for the use of practicing engineers. This relationship can be used as a tool for designing hump geometry for a particular hump-crossing speed.

Keywords: Speed humps, Speed, travel time, lost time, VISSIM 5.40

1. INTRODUCTION

Level of service of a road is determined based on travel speed and volume to capacity ratio. In certain conditions it would become necessary to restrict the speed within particular limit due to constraints in road geometry or past accident experience. Imposing speed limit, installation of speed breaker, check barriers, rumble strips, restricting carriageway space etc are commonly adopted speed reduction measures. Though construction of speed breakers on highways is not advisable as per the guidelines of MORTH, the authorities are unsuccessful in curbing this practice because of local resent. Speed breakers cause big discomfort to the motorists and the fellow passengers and can be dangerous if not seen early enough. In such a scenario, it becomes necessary to look at the issue in a scientific manner and evolve

traffic calming techniques that suit both the localities and passengers.

2. SCOPE AND OBJECTIVES OF THE STUDY

The main aim of this study is to evaluate various speed control measures followed in India and its impact on the safety and level of service of the road. The scope of the study will be confined to Vizhinjam- Kaliakavilai road stretch in the Trivandrum district. The paper has the following objectives:

1. To evaluate the effect of speed control measures.
2. To carry out before and after effect accident analysis of the identified road sections where speed control measures are enforced.
3. To model the traffic with and without speed breakers using a micro simulation tool called VISSIM.
4. Suggest appropriate guidelines on speed management measures in Kerala.

3. FINDINGS FROM EARLIER STUDIES

According to IRC: 99-1988 a speed breaker is a hump surface across the roadway having a rounded shape with width greater than the wheel base of most of the vehicles using the road. When there is decreased variation in sensory stimuli and at locations where speed controls are desired, a speed breaker acts as strong stimuli to arouse reaction in the brain. Since the driver reaction times are faster in response to audible and tactile stimuli than to visual stimuli, a driver subconsciously reduces his speed.

Jacqueline Corkle.et.al had prepared a report on investigating the effectiveness of traffic calming strategies on driver behavior, traffic flow and speed and to measure the effectiveness of traffic calming strategies in Minnesota. This study investigated the possibility of using a laboratory driving simulator to measure, as well as predict, the effectiveness of various traffic calming strategies. This was done by simulating roadways 'with and without' various traffic calming devices, and measuring the speeds at which drivers chose to pass through the simulated environments. Sahoo (2010) had done a study on the Geometric Design of Speed Control Humps in Bhubaneswar City. This paper describes a study conducted to establish practical geometric design guidelines of speed control humps for the use of road engineers. A statistical relationship between geometric characteristics of speed control humps and speeds of the automobiles is developed and models have been suggested for the use of practicing engineers. This relationship can be used as a tool for designing hump geometry for a particular hump-crossing speed. One of the important features of the study is the development of a simple procedure for the road hump design.

But there are not many studies done in VISSIM for evaluating the impact of speed restriction measures on road safety and level of service.

4. METHODOLOGY

4.1 Study Corridor

The study corridor is the Vizhinjam- Kaliakavilai road stretch which starts off from Mukkola between Vizhinjam and Balaramapuram road and passes through important coastal settlements and villages on the western side of Trivandrum district. The distance of the stretch is 26.3km. It connects the western parts of Kerala to southern districts of Tamilnadu namely Kanyakumari district.

In the Vizhinjam- Kaliakavilai road, there were 13 speed restriction measures. Out of which 7 rumble strips and 6 speed humps. Other than speed humps and rumble strips reflectors were laid in two or three layers in the road for restricting the speed of vehicles.

4.2 Data Collection

Data collection includes the collection of primary as well as secondary data. The primary data for the study is collected by conducting traffic surveys such as road inventory survey, speed and delay study, vehicle volume count etc and the secondary data such as accident data from various police stations in the selected stretch were collected from Crime Records Bureau.

The 26.3km Vizhinjam- Kaliakavilai road stretch is divided into three sections based on the presence of speed restriction measures deployed in each section. Each section consists of 3 or 4 speed restriction measures such as speed humps and rumble strips.

5. DATA ANALYSIS

5.1 Spot speed analysis

In the analysis of spot speed, the 85th percentile speed and the median speed at each location in the straight section and the speed near hump is calculated and shown in Table 1. The analysis result shows that at all locations the speed near the speed restriction measures is below 20kmph.

TABLE 1
85TH PERCENTILE SPEED AND MEDIAN
SPEED AT VARIOUS LOCATIONS

	Location	85th Percentile speed(Km ph)	Median Speed(Kmp h)
1	Mullur (Straight)	45	32
2	Mullur (Hump)	14	9
3	Checkpost (Straight)	55	41
4	Checkpost (Hump)	19	14
5	Viraly (Straight)	40	32
6	Viraly (Hump)	22	15
7	Cheruvarakonam (Straight)	58	35
8	Cheruvarakonam (Hump)	22	15
9	Kozhivila (Straight)	43	32
10	Kozhivila (Hump)	26	18

Analysis Based On Height To Width Ratio And Area to
width ratio

The procedure for selecting hump width and height can be examined by studying the relationship

between hump crossing speed and H/W of hump.

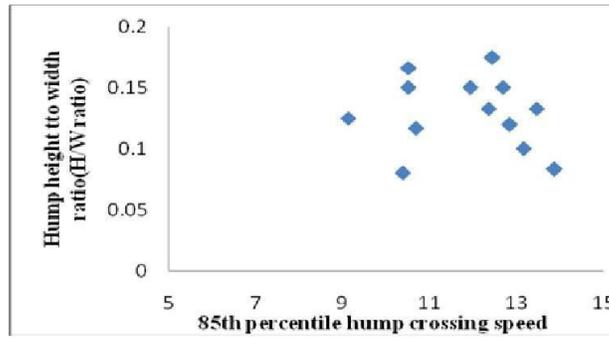


FIGURE.1. RELATIONSHIP BETWEEN HUMPHEIGHT TO WIDTH RATIO AND 85TH PERCENTILE SPEED OF TWO WHEELERS.

No statistically significant relationships could be established between H/ W ratio and the speed measurements, which signify that specifying only the width and height of a hump does not sufficiently enable the design engineers to effectively control the desired hump-crossing speed of traffic. The practice in hump construction of specifying only hump width and height is therefore insufficient in this regard.

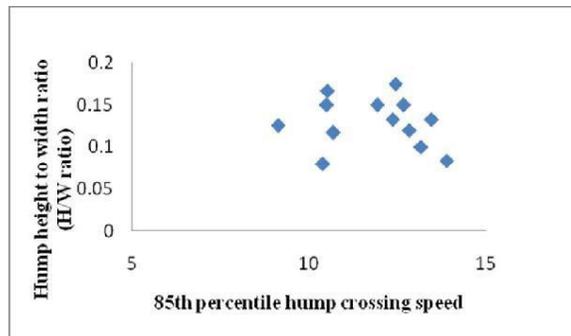


FIGURE 2. RELATIONSHIP BETWEEN HUMP HEIGHT TO WIDTH RATIO AND 85TH PERCENTILE SPEED OF CARS.

An alternative quantitative indicator that can be utilized to characterize hump geometry is the area-to width ratio A/W, which can be seen as a measure of the average height provided over the base of a hump.

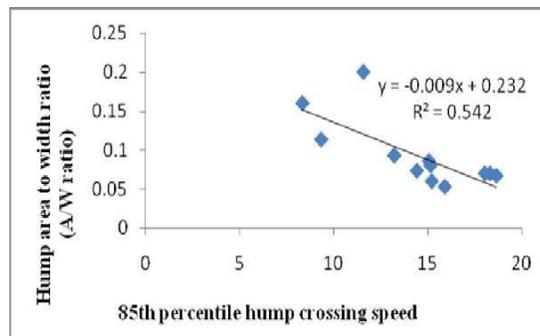


FIGURE.3. RELATIONSHIP BETWEEN HUMP AREA TO WIDTH RATIO AND 85TH PERCENTILE SPEED OF TWO WHEELERS.

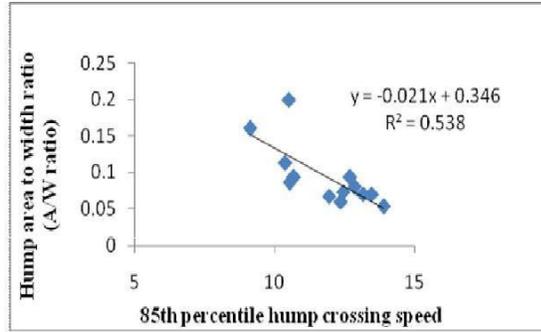


FIGURE.4. RELATIONSHIP BETWEEN HUMP AREA TO WIDTH RATIO AND 85TH PERCENTILE SPEED OF TWO CARS.

In the Fig.3 and Fig 4 85th hump crossing speed data for two wheelers and passenger cars respectively are plotted against the A/W ratio. Statistically significant relationships are now developed between the A/W ratio and the speed measurements. Lower hump-crossing speeds are found to associate with higher A/W ratios.

The following linear regression relationships can be obtained for the 85th percentile (V₈₅) hump-crossing speeds in kilometer per hour.

$$V_{85} \text{ (two wheelers)} = 19.56 - 55.91 A/W$$

$$R^2 = 0.542$$

$$V_{85} \text{ (Cars)} = 14.21 - 25.251 A/W$$

$R^2 = 0.538$, Where A/W is expressed in m; and R^2 = statistical coefficient of simple determination.

6. RESULTS FROM VISSIM 5.40

The simulation is done in VISSIM 5.40 by inputting the data that we collected from the field. The number of vehicles inputted in vehicles/hour and the peak hour traffic is used for the simulation. In the vehicle composition desired speed of different class of vehicles are entered and in VISSIM the speed restriction can be assigned in the form of reduced speed areas and it is possible to assign the desired vehicular speed at the reduced speed areas.

TABLE 2
OBSERVED AND SIMULATED
LOST TIME IN THE SECTION

Time(s)	Observed lost time(s)	Simulated lost time(s)
900	7.42	7.8
1800	6.3	7.6
2700	6.1	6.8
3600	7.09	7.7

7. LOS OBTAINED FROM VISSIM 5.40

The speed gets reduced to 30kmph and 20kmph at the points where speed restriction measures are

installed. The result showing LOS indicates that there is a uniform speed of 40kmph is observed in the section and there is no speed reduction is observed.

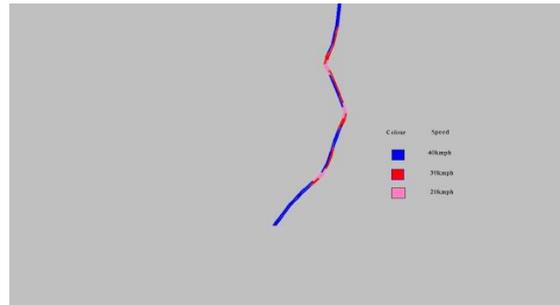


FIGURE.5.LOS IN THE SECTION WITH SPEED RESTRICTION MEASURES

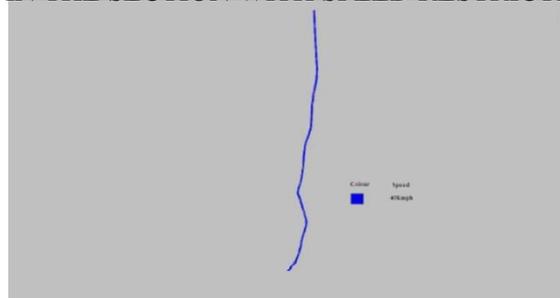


FIGURE.6.LOS IN THE SECTION WITHOUT SPEED RESTRICTION MEASURES

In the figure blue colour indicates a speed of 40kmph, red colour indicates a speed of 30kmph and the pink colour shows a speed of 20kmph.

From the simulation using VISSIM with the section having two wheelers and cars indicate that the average speed of vehicles is 8-10 kmph more than the section with heavy vehicles like truck and buses.

8. CONCLUSION

From the analysis of the impact of speed restriction measures at the Vizhinjam- Kaliakavilai section and from the simulation using VISSIM 5.40 we reach the following conclusions:

1. Based on the field experiments on hump geometry and hump-crossing speeds of two wheelers and passenger cars vehicles this investigation have shown that statistically significant regression relationships could be established between hump-crossing speeds and hump geometry characterized by area to width ratio. These relationships provide a useful tool for field engineers to design hump geometry for speed control.
2. From the volume analysis, the Vizhinjam-Kaliakavilai section experiences LOS B and LOS C. At Attupuram (Checkpoint) the level of service gets reduced due to speed humps and the excise and motor vehicles Checkpost.
3. Average speed of the entire section is 40kmph and the speed gets reduced in the sections having speed restriction measures. Hump has no effect in the reduction of average speed in the entire section.
4. The simulated situation resembles the field conditions and the observed and simulated travel time is almost same.
5. In the sections we have taken for analysis, it is clear that in each section the travel time is 10s to 20s more in the section having speed restriction measures than in the section without speed breakers.
6. The speed at section without speed breakers have 2 to 3kmph more speed than the sections having

speed restriction.

7. In each section the speed gets reduced and the travel time gets increased due to speed restriction measures. The LOS obtained from VISSIM is in the terms of speed and it indicates that if speed restriction is there, the speed gets reduced to 30kmph and 20kmph and there is a uniform speed of 40kmph is experienced if the section have no speed restriction measures.
8. Delay is also more in the sections having speed restrictions.
9. From the accident analysis, it is clear that there is no significant reduction in the number of accidents reported in the section due to the speed breakers. With the improvements taken place in the stretch and due to the congestion in NH-47 (Trivandrum- Kaliakavilai), many through traffic is attracted to this stretch and normally there is no change in the accident rate.
10. From the simulation using VISSIM with the section having two wheelers and cars indicate that the average speed of vehicles is 8-10 kmph more than the section with heavy vehicles like truck and buses.

9. RECOMMENDATIONS

1. Speed restriction measures have to be designed based on the geometric design procedure based on the 85th percentile speed of vehicles and the hump area to width ratio.
2. Speed restriction measures like rumble strips provided in the combination of vertical and horizontal curves cause big discomfort to the passengers as well as the local residents. Hence the rumble strips provided in the curves has to be properly removed and the speed of vehicles on that curves has to be controlled by providing proper GO SLOW signs.

10. FUTURE SCOPE

This study is an initial work and opens the door for several future studies. In the future, further research might explore more strategies, such as impact of speed restriction measures on level of service, could be evaluated using the micro simulation tool. Scenarios with different situations could also be tested in VISSIM 5.40.

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