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A study on Speed Breakers

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Abstract — *The roads are designed for a certain design speed to meet the mobility requirement. However, at some of the locations control of speed may become necessary. For that purpose, traffic calming measures have been used. This paper describes the various traffic calming measures used to reduce accidents/crashes or reduce the severity of accidents. Speed breakers are one of the widely used traffic calming measures such as speed bump, speed hump and speed table. Various types of speed breakers should be discussed along with problems associated with them and suitable remedial measures are also suggested in this study.*

Keywords- road accidents; traffic calming measures; speed breakers; discomfort

I. INTRODUCTION

The roads of different categories are designed for certain design speeds, which the vehicles are required to maintain proper functioning of the roadway system. To ensure that the required speeds are maintained, it is practice to provide certain control measures. These measures can ensure improved traffic movement with better safety and convenience.

Traffic scenario has changed drastically over the past decade. An increase in the number of vehicles has led to increase in the number of the accidents. Scenario of traffic safety is worsening day by day in our country which requires proper attention. Accident data reveals that more than 1.5 lakh people die in road accidents every year which is significantly high as compared to other developed countries.

Analysis of various accidents shows that the main causes of accident are inappropriate speed, lack of road safety awareness, driving under the influence of alcohol and narcotics and violation of traffic rules. To reduce the frequency as well as the severity of accidents various traffic calming measures are used. The most commonly used traffic calming measures are:-

1. Police Enforcement
2. Visual Stimuli (Traffic signs and signals)
3. Tactile Stimuli (Audible and Vibratory attention seeking devices)

There can be various definition of traffic calming measures but the main aim of a traffic calming measure is to reduce the speed and provide a safe environment for non-motorized and motorized traffic. It may be defined as follows:-

“Traffic calming is a set of engineering measures to reduce speeds and volumes of motor vehicles in local area and thereby increasing road safety.”^[1]

The traffic signs and other visual traffic control devices especially the speed control signs are generally found to be less effective when used alone.^[2] However their performance can be significantly improved when used in combination with physical traffic calming measures like speed breakers.

In the present world people spend a great amount of time travelling from one place to another for various purposes. Thus the importance of a comfortable journey without any significant delay have increased manifolds. This requires the traffic calming measures like speed breakers to be designed keeping in view these two factors i.e. comfort and delay. This paper focuses on the problems associated with the speed breakers, suitable measures and measurement of discomfort.

As per the road accident report, 2014 in India a total of 4726 lives were lost due to crashes at speed breakers on National Highways. More life would have been lost on State Highways and on other roads due to speed breakers. So, this is a point of concern to study and need to review the traffic calming measures selection.

II. BASICS OF SPEED BREAKERS

Out of the various traffic calming measures speed breakers are one of the most widely used devices and they are found to be very effective. In India, based on locality, place and other factors, speed breakers are provided on the roads as per 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 road. The various types of speed breakers are:-

1. Speed bump

Speed bumps are the devices that uses the vertical deflection on the road to slow down the moving traffic. They are suitable to reduce speeds of the vehicles to around 40 kmph for roads and/or 8 to 16 kmph for car parking. They are generally 1 to 3 feet long and 7 to 15 cm high as shown in Fig. 1. [3]

The speed bumps reduce speed considerably, avoid accidents and reduces severity of crash. However the provision of bumps may cause significant discomfort to drivers as well as passengers, increased damage to the vehicle, increases response time of emergency services, it requires additional road markings and traffic signs and it causes increase in traffic noise and pollution.



Fig. 1 Speed bump

2. Speed hump

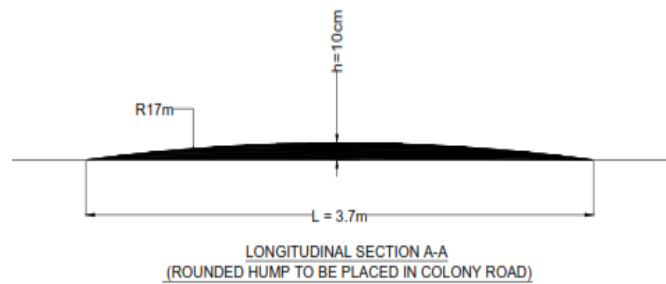


Fig. 2(a) Speed hump

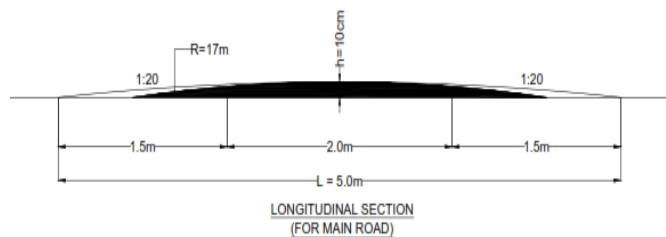


Fig. 2(b) Speed hump

The speed humps are rounded, raised areas placed across the roads. They are generally 10 to 14 feet in length in the direction of travel and are 7 to 10 cm high as shown in Fig. 2(b) [3] thus making them different from the speed bumps. The profile of a speed hump can be circular, parabolic or sinusoidal. They are tapered as they reach the kerb on each end to allow proper drainage.

Speed humps are suitable where low speeds are desired. The speed humps are inexpensive and relatively easy for bicycles to cross if designed properly.

Speed humps cause a rough ride for drivers as well as passengers and can cause severe pain for people with certain skeletal disabilities. They force large vehicles, such as emergency vehicles and those with rigid suspensions, to travel at slower speeds, they may increase noise and air pollution and have questionable aesthetics.

3. Speed table

Speed tables are flat-topped speed humps and are long enough for the entire wheelbase of a passenger car to rest on the flat section. Their long flat fields give speed tables higher design speeds than Speed Humps. They are 22-24 feet long and 7-10 cm high and are good for locations where low speeds are desired with smooth ride for larger vehicles.

If pedestrian markings are used over the flat section it is referred as raised crosswalk. They can be expensive and may increase noise and air pollution. The speed table is shown in Fig. 3.

4. Speed cushion

Speed cushions are a type of speed hump designed to avoid the negative impacts that vertical deflections have on emergency vehicle response times. Speed cushions are made up of several small speed humps installed across the width of the road with spaces between them as show in Fig. 4. They force normal cars to slow down as they ride with one or

both wheels over the humps. Meanwhile, they allow fire engines and other large vehicles with wider axles to straddle the cushions without slowing down. Thus it results in movement of emergency vehicles as well as heavy vehicles with no discomfort to vehicle occupants and no delays.

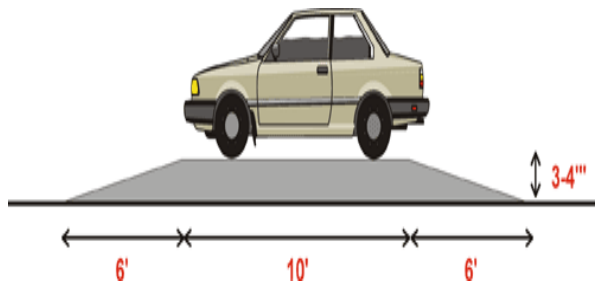


Fig. 3 Speed table



Fig. 4 Speed cushion

III. ANALYSIS OF TRAFFIC CALMING MEASURES

The study is essentially about the effects of speed breakers on traffic performance. There are various effects of speed breakers such as a considerable delay, damage to the vehicles and significant discomfort to vehicle occupants and more fuel consumption due to acceleration and deceleration. Hence, there is a strong need of comprehensive study to analyze the effects of speed breakers.

Recently study conducted at accident spot at Maninagar area of Ahmedabad city, where an accident occurred due to speed hump. A one person fell off from scooter and died. After analysis of that hump it was found that the hump was not as per the standards laid down by IRC. Analysis of various humps across city reveals that a few of the humps provided as traffic calming measures are of improper dimensions and not as per the standards laid down by IRC. This requires serious attention as this ignorance in provision of speed breakers can result in fatal accidents.

Further the analysis shows requirement of a proper planning in locating the speed breakers. For example certain BRTS stations are provided with speed tables near the approaches of the BRTS stations which results in unnecessary delays and discomfort to the passengers. Not only this, it also found that it increases operating and maintenance cost of BRTS too.

Problems associated with the speed breakers:

As discussed above in the introduction the main causes of road accidents include inappropriate speed, absence of safe crossing facilities and violation of traffic rules. Speed breakers are one of the most suitable measures for reducing road accidents and increasing safety of road users. The effectiveness of speed breakers can be determined by nature of the problem, local community involvement and the design. Though speed breakers can be very effective traffic calming measures, there are certain disadvantages which must be kept in mind:

- a) Speed breakers are very effective in reducing the speed of vehicles but people may not accept it readily and can cause a public outcry if public is not consulted in prior.
- b) They are uncomfortable and painful to people who suffering from medical conditions such as back problems.
- c) Road users, especially, the two wheelers try to avoid speed breakers to remove all possible discomfort caused by speed breakers.
- d) Speed humps are a major problem for an emergency vehicles such as ambulances and fire engines. It is found that in USA about 85 people die due to delay of emergency vehicles because of speed breakers.^[4]
- e) Different vehicles respond differently with heavy vehicles like buses, trucks and other public transport vehicles are prone to discomfort unless humps are traversed at very low speeds.
- f) Speed humps have been known to cause accidents and injuries.
- g) Vehicles may get damaged frequently even at normal speed levels. This problem is more severe with older, heavier vehicles and the vehicles with low ground clearance.
- h) Speed breakers cause atmospheric pollution from the acceleration and deceleration of traffic at speed breakers.
- i) Use of speed cushions encourage the use of larger vehicles which are more polluting.
- j) Speed breakers create additional traffic noise. Heavy vehicles generate substantially more noise than before, not only this a heavy vehicle traversing a hump generates a considerable amount of vibration to the adjoining properties.
- k) It is observed that the road surface near the humps shows development of potholes and signs of subsidence which requires a greater road maintenance cost.
- l) Practically provision of speed breakers is not a complete solution to improve road safety or to reduce the accidents. This is because in many of the cases it is found that accidents are caused due to careless driving of the car driver or of other factors that are not solved by the speed breakers.

Remedial Measures:

A few remedial measures for associated with speed breakers are given below:

- a) Speed breakers should be constructed conforming to the standard laid down by IRC-99:1988.^[5]
- b) It should be provided with proper road marking and proper signage and signage should be properly located and maintained.
- c) The speed breakers that have properly designed profile causes a reduction in the discomfort. This encourages the road users to reduce their speed at approaches of speed breakers.
- d) Use of speed cushions should be encouraged. This because it is observed that the vehicles involved in crashes due to over speeding are generally four wheelers having axle width which less than spacing between the cushions. This forces the four wheelers to slow down while allow emergency and heavy vehicles to straddle speed breakers without any discomfort.^{[6][7]}
- e) At signalized intersections, we have observed that speed breakers are provided at many locations. As such intersections signals are being properly followed and also they are manned intersections to enforce the traffic regulation. Thus, these speed breakers are found to be causing unnecessary acceleration and deceleration delays such practices should be discouraged.

Measurement of Discomfort

A few measuring and evaluating methods have been developed to study the comfort in vehicles. The number of factors affecting the comfort of vehicle occupants are temperature, air quality, noise, light and vibration. In the authors also focus the study of vibration while crossing the bump and tried to identify the severity of bump by making various study. A body is considered in vibration when it oscillates relative to a reference position. When studying the effect of vibration in human body, it should be taken into account that it is constituted of different parts with different behaviors when excited by oscillatory movement. Kozawa and Susuki^[8] developed a portable ride comfort meter in 1986 giving an index called Vibration Number (VN) as an objective measure of comfort of passengers. To develop this apparatus, a subjective evaluation test of whole body vibration was carried out using a dual-axis vibration table. The index scale has range between 0 (no vibration) to 100 (maximum vibration). The VN was obtained through multiple regression analysis performed with data from subjective evaluations.^[8]

Ford Motor Company developed a vibration simulator in that the road profiles were reproduced in laboratory. In the vibrator simulator, a set of computer-controlled actuators creates vibrations in the seat as well as in all parts of the car and VN was measured.

In another study, a Society of Automotive Engineers pad was developed to measure the vertical and horizontal acceleration on speed breakers. It is a semi rigid circular pad consisting of an accelerometer that placed between seat and individual. It is of 200 mm diameter plastic pad. The accelerometer was calibrated for the acceleration readings. The peak, root-mean-square (rms) and root-mean-quad (rmq) horizontal and vertical accelerations were determined for the test. Rms values are used to relate the vibration and discomfort. An analytical approach was used to establish the criteria of discomfort for speed breakers.^[9]

IV. SUMMARY

From the study, it is concluded that speed breakers are effective means of controlling speed as well as reducing frequency and severity of accidents. However, they also means of accidents at some locations where no standards are followed and placed at random locations. Speed tables are provided in public transit routes such as in BRTS lanes near the stations where speed of transit vehicles already to be low. It increases operating cost as well as causes significant discomfort to passengers. It is also suggested the effect of the comfort also to be measured after implementation. In India, there will be a strong need for a proper study before and after implementation of speed breakers to check their effectiveness.

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