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Evaluation of Speed Breakers in Pune and Pimpri Chinchwad Municipal Corporation: Case Study

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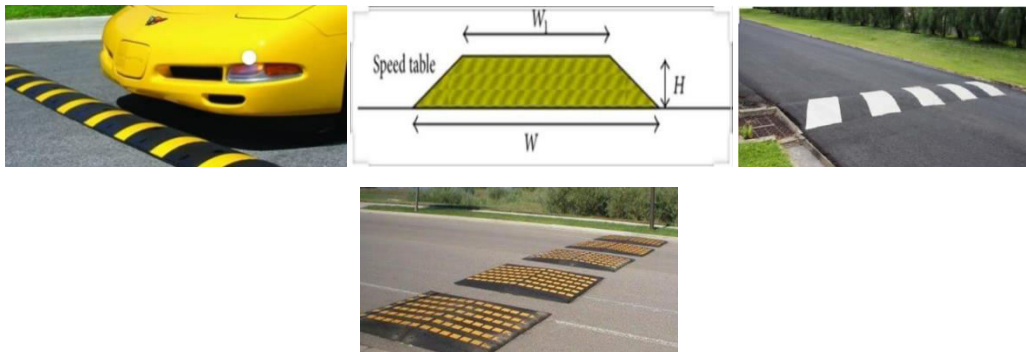
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ABSTRACT: A detailed literature survey indicates that there is a detailed study about various types of speed breaker, Installation of speed breaker, The accident which is happened due to improper size of speed breaker, How the speed humps have reduced the speed of vehicles, Speed humps are known to be effective in reducing the occurrences of accidents that might otherwise be resulted in speeding of vehicles, So we conclude that there will be a strong need for a proper study before and after implementation of speed breakers to check their effectiveness by using Developed Equipment. Also, there exists scope for the development of a portable low-cost equipment.

KEYWORDS: EDM, Road Accidents, Speed Breakers, Road Safety.

I. INTRODUCTION

Traffic calming is defined by the Institute of Traffic Engineers (ITE) as “the combination of mainly physical measures to reduce the negative effects of motor vehicle use, alter driver behavior, and improve conditions for non-motorized street users”. Since speed humps are a very effective means of calming traffic, the main purpose of the installation of speed humps is to reduce the speed and volume of traffic to acceptable limits to enhance safety for pedestrians and motorists. The roads of different categories are designed for certain design speeds, which the vehicles are required to maintain the proper functioning of the roadway system. To ensure that the required speeds are maintained, it is a practice to provide certain control measures. These measures can ensure/improved traffic movement with better safety and convenience. The traffic scenario has changed drastically over the past decade. An increase in the number of vehicles has led to an increase in the number of accidents. The 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 accidents 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 like speed breakers are used.



TYPES OF SPEED BREAKERS:

- **SPEED BUMPS:** Speed bumps are the devices that use vertical deflection on the road to slow down the moving traffic. They are suitable to reduce the speeds of the vehicles to around 40 km/ph for roads and/or 8 to 16 km/ph for car parking. They are generally 1 to 3 feet long and 7 to 15 cm high as shown in The speed bumps reduce speed considerably, avoid accidents and reduce the severity of crashes. However, the provision of bumps may cause significant discomfort to drivers as well as passengers, increased damage to the vehicle, and increased response time of emergency services, it requires additional road markings and traffic signs and it causes an increase in traffic noise and pollution.
- **SPEED HUMPS:** 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 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 curb 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.
- **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 a smooth ride for larger vehicles. If pedestrian markings are used over the flat section it is referred to as a raised crosswalk. They can be expensive and may increase noise and air pollution.
- **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. 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 the movement of emergency vehicles as well as heavy vehicles with no discomfort to vehicle occupants and no delays

II. LITERATURE REVIEW

- Mitul Patel Prof. Dr. P. J. Gundaliya A study of Speed Breakers (March 2017)

This paper presents a review of the existing geometry of the roads and squares and proposes a continuous topological model to solve the existing and upcoming traffic problems. As it is seen that due to discontinuity in traffic flow, public suffers a lot.

After a deep study, it was found that the Discontinuity of spaces exists in this existing model and also it is topologically incorrect.



The Discontinuity of spaces exists due to the reason that all the traffic signals situated on one road are not equidistant and cross roads create a chaotic situation.

Therefore, we introduce a topologically proven model in which we tried to remove discontinuity between spaces and suggested some minor constraints which can be enforced as a part of discipline.

- Chandrasekar Parsuvanathan, Use of speed Humps Near School for an Obstruction- Free Traffic Flow During Holiday.

Speed breakers or speed humps are known to provide road users with increased safety if strategically placed, especially in pedestrian intensive areas. Such traffic calming measures are common in land-uses where streets provide direct access to homes, hospitals, transit stops, and schools.

In cities and towns of developing countries like India, it is common to construct at least two hump-like speed breakers, near the entry and exit gates of every school that provides primary, secondary and higher secondary education. The purpose of such speed breakers is to provide safety for students, staff and parents who access the school.

However, as speed breakers are built as permanent structures, vehicles passing over them during non-operational hours as well as long holidays need to slow down for no reason. Portable speed breakers seem suitable for school areas to allow an obstruction-free traffic flow if and when possible. In this paper, results of a simulation evaluation of such portable speed breakers are presented, with quantification of benefits in terms of travel speed and travel time savings.

- Sayed Shwalya Amal AL-Ayaat, Mohamed Hamed Zakaria, Public Evaluation Of Speed Humps Performance and Effectiveness (2018)

In Egypt, it is believed that speed humps are the cheapest and best solutions to reduce vehicles speed and thus reduce the number of potential accidents. Due to the lack of specifications in Egypt that govern the installation of speed humps, they were spread randomly and with different dimensions without adequate studies. Consequently, this practice can cause adverse effects on the road users and the surrounding environment. For this purpose, a questionnaire was designed to discuss the different effects of using speed humps in Kafr El-Sheikh city as a typical model in the Egyptian cities.

- VSKP Verma, Adarsh Sa, K.L.Ramchandran Binoy B Naira, Real time Detection of speed humps/bumps distance estimation with deep learning using GPU and ZED Stereo camera (ICACC-2018)

Every day, new applications arise relying on the use of high-resolution road maps in both academic and industrial environments. Autonomous vehicles rely on digital maps to navigate when optical sensors cannot be trusted, such as heavy rainfalls, snowy conditions, fog, and others situations.

These situations increase the risks of accidents and disable the potentials of real-time mapping sensors. To tackle those problems, we present a methodology to automatically map anomalies on the road, namely speed bumps in this study, using an off-the-shelf camera (GoPro) and Machine Learning (ML) algorithms.

We acquired data over a series of differently shaped speed bumps and applied three classification techniques: Naive Bayes, Multi-Layer Perceptron, and Random Forest (RF).

- Martins E. Irhebhude, Oladimeji A. Adeyemi, Adeola Kolawole (28 October 2017)

This paper presents a image processing technique for speed breaker, road marking detection and recognition. An Optical Character Recognition (OCR) algorithm was used to recognize traffic signs such as "STOP" markings and a Hough transform was used to detect line markings which serves as a pre-processing stage to determine when the proposed technique does OCR or speed breaker recognition

The stop line inclusion serves as a pre-processing stage that tells the system when to perform stop marking recognition or speed breaker recognition. Image processing techniques was used for the processing of features from



the images. Local Binary Pattern (LBP) was extracted as features and employed to train the Support Vector Machine (SVM) classifier for speed breaker recognition.

- Md. Rokonzaman and Md. Hossam-E-Haider (13 December 2015)

Modern industrialized civilization mostly depends on energy in the form of electricity. It is going to refractory to produce huge amount of energy. Since the population is rising, the environment is going unbalance by pollution, global warming and different kinds of deregulation of energy usage and wastage.

Speed breaker is a newest source of technology to renew the wastage energy of vehicle to electrical energy during the passing time through every speed breaking hump.

This paper investigates and analysis two practically implemented process of electricity generation from speed breaker named roller mechanism and rack-pinion mechanism.

It can be surely effective to reduce the huge power crisis in the near upcoming days for rapidly development of infrastructure especially for developing country like Bangladesh. Where population is thriving dramatically and vehicles are flourishing proportional with the ascending rate of population.

- Dr. Ujjal Chattaraj Study On Speed Profile Across Speed Bumps (8 May 2014)

A speeding vehicle can be a menace 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 an important issue in traffic management. The best way to influence driver speed is through traffic management. One way of controlling speed is to use static speed control devices like bumps which produces discomfort while driver experiences while crossing over it. Road bumps play a crucial role in enforcing speed limits, thereby preventing over speeding of vehicles. It significantly contributes to the overall road safety objective through the prevention of accidents that lead to death of pedestrians and damage of vehicles.

The author of this research investigated how bad drainage on highway structures affects the economics of users, as there are both functional and structural failures as a result of poor drainage.³

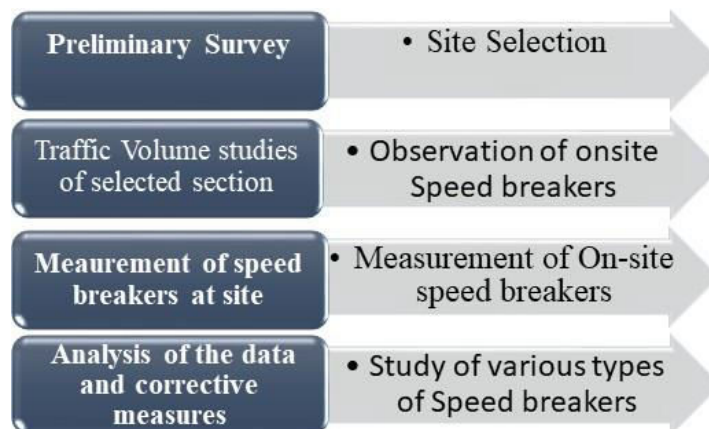
Various tests conducted on 7 kerbs after 3 years of construction are mentioned in this research article. Compressive strength, water absorption, freeze-thaw resistance (resistance to internal cracking), and capillary absorption (internal cracking and surface scaling) were among the tests carried out. Only two of the seven kerbs passed the freezing and de-icing salt resistance tests.⁴

III. OBJECTIVE

- To study and analysis a substitute material which is more economical and eco-friendly for construction of speed breakers.
- To conduct field studies to compare the speed breakers dimensions with the standards mentioned in IRC 99-1988
- Develop a systematic methodology for the construction of accurate speed breakers.

IV. METHODOLOGY

The research methodology for the present study is described below:



- Preliminary Survey- Selection of Proper Site Where Maximum Speed breakers and Variations are Observed.
- Traffic Studies and Demographic of Selected Section-Observation of onsite speed breakers, where the speed breakers are Painted or not, there is any Signboard before Speed breakers or not, There Drainage is Provided or not, etc.
- Measurement of Speed breaker at site-Study of various types of speed breakers means which type of speed breakers is suitable for this road, also the standard size of Speed Bump or Speed hump whichever is installed.
- Analysis of Data and Corrective Measures- Analysis of data and Comparison with IRC 99-1988 Guidelines.
- Traffic Volume studies of selected section- Traffic studies from Ravet Bridge to Aundh and Katraj to Swargate

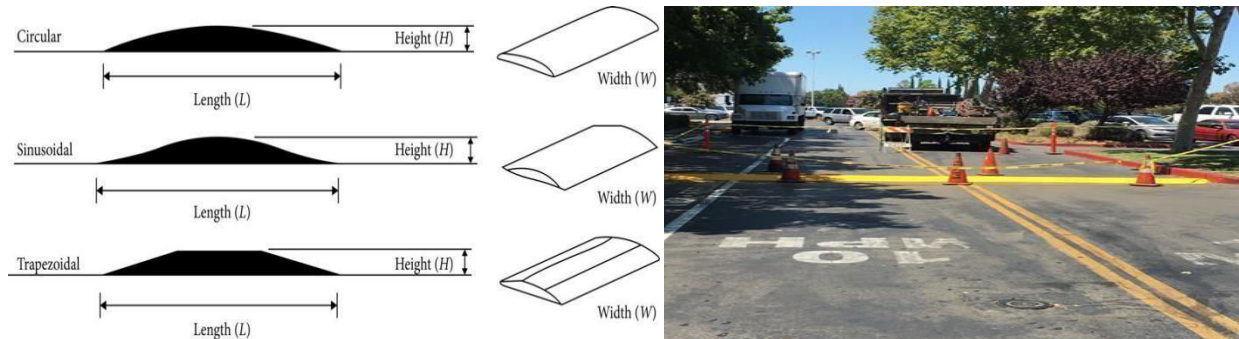
V. CONSTRUCTION PROCESS

Generally, speed-bumps are installed in a parking lot to slow drivers down and protect pedestrians. If possible, speed bumps should be installed between islands so that cars cannot drive around them. When a contractor paves there is a sub-grade, then base rock and asphalt on top. When speed bumps are being installed, they are over layed on existing asphalt and bonded to it with tack oil.”

STEPS FOR CONSTRUCTION PROCESS:

- The crew cleans the area, either blowing off debris or sweeping depending on how dirty it is.
- Then we mark out our dimensions, (depending on how wide the customer wants the speed bumps, usually 2-ft wide is minimum), so we measure and chalk line out the bumpers.
- Next, the existing asphalt is keyed. A notch is made about 2-in. wide around the perimeter of the bump so the speed bump mass has something to tie into the drive surface and won't get displaced by things like plows.
- Once the lines are chalked and the area is notched, we fill the inside of the bumper we marked with ss1 tack oil (bonding between existing asphalt) so the asphalt stays in place.
- The asphalt is then poured into a wheelbarrow for easy transport from the truck, then dumped onto marked areas as needed.
- Once the asphalt is dumped, one of the crew members spreads the asphalt as another crew member uses a rake to form the speed bump.

- While the raker forms the bump, another crew member is sweeping the loose asphalt away from the area while a final fourth crew member uses a vibratory plate to pound the edge of the bump, then up and over the bump.
- When compacting, the crew member is making sure everything is set correctly, we want to make sure there are, no rock pockets (rocks showing/no fines in the mix) and taking outlines.
- Then the crew cleans the area and makes a plan to return in 30 days. Each speed bump takes between half a ton to 1 ton of asphalt, depending on the condition of the existing asphalt.



• INSTRUMENT USED FOR SURVEYING:

EDM - Electronic distance measuring instrument is a surveying instrument for measuring distance electronically between two points through electromagnetic waves.

Electronic distance measurement (EDM) is a method of determining the length between two points, using phase changes, that occur as electromagnetic energy waves travel from one end of the line to the other end. We used the EDM method for measuring the distance. Electronic distance measurement in general is a term used as a method for distance measurement by electronic means. In this method, instruments are used to measure the distance that relies on propagation, reflection, and reception of electromagnetic waves like radio, visible light, or infrared.

Sunlight or artificially generated electromagnetic wave consists of waves of different lengths. Among these waves' microwaves, infrared waves and visible light waves are useful for distance measurement. In EDM instruments these waves are generated, modulated, and then propagated. They are reflected at the point up to which distance is to be measured from the instrument station and again received by the instrument.

The time taken by the wave to travel this 2x distance may be measured and knowing the velocity of the wave, the distance may be calculated. The improved techniques use the phase difference method in which the number of completed waves and an incomplete wave is measured. Knowing the length of the wave, distances are calculated.

Built-up microprocessors provided in the instrument calculate the distances and display them by liquid crystal display (LCD).

• Measurement of distance with EDM and a Reflector:

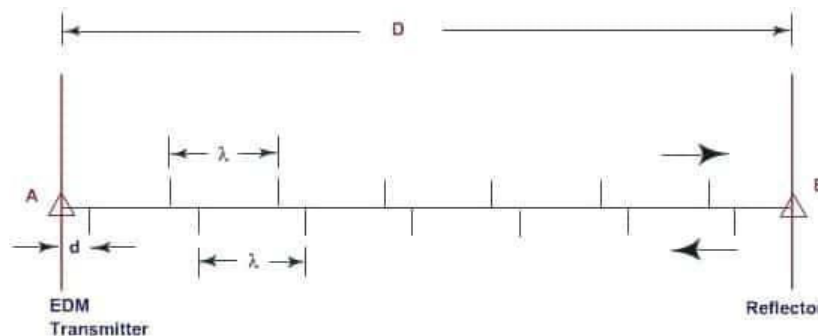
As explained let the waves get transmitted from A and reflected from B. If the received signal is out of phase by a measure of $\nabla\phi$, then the equivalent distance is

$$d = \Delta\phi \frac{\lambda}{360}$$

Thus, the distance is

$$D = \frac{1}{2} \left[n\lambda + \left(\frac{\Delta\phi}{360} \right) \lambda \right]$$

where n is the integral number of wavelengths, in the double path



• PROCEDURE OF SURVEYING:

- For conducting the survey, it was decided to conduct in the morning time slot since there is low traffic on road in the morning.
- The survey Area is Zone D of PCMC (full form). In that Zone, we decided on 1st route (from ravet bridge to Aundh road). And 2nd route (from Katraj to Swargate).
- Electronic Distance meter, Tape, scale, pad, pencil, pen, etc. are the instruments and materials that we used for surveying.
- The survey was started on the first route at 5.30 am. from Tathawade chowk and we have set a meter at 0 km.
- Then the chain age of 0km to 10km was taken. In this chain age following measurements and observations were taken:
 - The number of speed breakers present in this chain age and the distance between two consecutive speed breakers were measured.
 - The dimensions of the speed breakers were measured such as their length, width, radius, etc. with the help of EDM and meter tape
 - Various data was collected such as the location of the speed breaker, drainage line is provided near the speed breaker or not, signboards are provided before the speed breaker or not, the embedded cat eyes are working or not, and also the speed breakers were painted or not was noted down.
- The survey of the 2nd route was conducted in the evening time, from katraj to swargate and the same measurements and observation were taken.
- Then we prepared one chart to fill in the information that we have collected during surveying.
- And at last, after completion of the survey we compared the dimensions of the speed breaker provided with the standard dimensions given by IRC 99-1988

VI. RESULTS

CHAINAGE (KM)	ard Size and Name of Speed breaker	Observed Size and Name of Speed breaker	Remarks
0 to 5	<p>1. SPEED HUMP-</p> <p>Height 10 cm</p> <p>Radius 17 m</p> <p>Length 3.7 m</p> <p>2. SPEED TABLE-</p> <p>Height 10 cm</p> <p>Radius 17 m</p> <p>Length 5 m</p> <p>Slope 1:20</p>	<p>1. SPEED HUMP-</p> <p>Number-8</p> <p>Height-9.2 cm</p> <p>Length-3.27 m</p> <p>2. SPEED TABLE-</p> <p>Number-2</p> <p>Height 8 cm</p> <p>Length 5.26 m</p> <p>Slope-1:3.8</p>	<p>The Speed Breakers are not Design According to a standard size, also they are not painted.</p> <p>Embedded Cat Eyes are not Workable.</p>
5 to 10	<p>1. SPEED HUMP-</p> <p>Height 10 cm</p> <p>Radius 17 m</p> <p>Length 3.7 m</p> <p>2. SPEED TABLE-</p> <p>Height 10 cm</p> <p>Radius 17 m</p> <p>Length 5 m</p> <p>Slope 1:20</p>	<p>2)SPEED TABLE-</p> <p>Number-5</p> <p>Height 8 cm</p> <p>Length -5.6 m</p> <p>Slope-1:3.2</p>	<p>The Speed Breakers are not Design According to a standard size, also they are not painted, Drainage lines Are not provided.</p>

<p>10 to 15</p>	<p>1. SPEED HUMP-</p> <p>Height 10 cm</p> <p>Radius 17 m</p> <p>Length 3.7 m</p> <p>2. SPEED TABLE-</p> <p>Height 10 cm</p> <p>Radius 17 m</p> <p>Length 5 m</p> <p>Slope 1:20</p>	<p>1. SPEED HUMP-</p> <p>Number-3</p> <p>Height 8.5 cm</p> <p>Length 1.9 m</p> <p>2. SPEED TABLE-</p> <p>Number-4</p> <p>Height 12 cm</p> <p>Length 8.5 m</p> <p>Slope-1:4.93</p>	<p>The Speed Breakers are not Design According to a standard size, also the Sign Board is not located before the Speed breakers.</p>
<p>15 to 20</p>	<p>1. SPEED HUMP-</p> <p>Height 10 cm</p> <p>Radius 17 m</p> <p>Length 3.7 m</p> <p>2. SPEED TABLE-</p> <p>Height 10 cm</p> <p>Length 5 m</p> <p>Slope 1:20</p> <p>Radius 17 m</p>	<p>1. SPEED HUMP-</p> <p>Number-2</p> <p>Height 9 cm</p> <p>Length-1.3 m</p> <p>2. SPEED TABLE-</p> <p>Number-2</p> <p>Height 7 cm</p> <p>Length 5.7 m</p> <p>Slope-1:3.84</p>	<p>The Speed Breakers are not Design According to a standard size also they are not painted.</p>

20 to 25	1. SPEED HUMPS- Height 10 cm Radius 17 m Length 3.7 m	1. SPEED HUMPS- Number-2 Height 8 cm Length 2.8 m	The Speed Breakers are not Design According to a standard size, also they are not painted. Embedded Cat Eyes are not Provided.
	2. SPEED TABLE- Height 10 cm Radius 17 m Length 5 m Slope 1:20	2. SPEED TABLE- Number-6 Height 10 cm Length 5.4 m Slope-1:5.7	

VII. CONCLUSION

- The scope of work entails conducting field surveys for measurements of speed breakers installed on the roads and research on developing a methodology to construct speed breakers that will meet the standards prescribed by IRC 99-1988.
- To conduct field studies to compare the speed breakers dimensions with the standards mentioned in IRC 99-1988.
- Develop a systematic methodology for the construction of accurate speed breakers.
- The scope of work entails conducting field surveys for measurements of speed breakers installed on the roads and research on developing a methodology to construct speed breakers that will meet the standards prescribed by IRC 99-1988.

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