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Comparative Overview Between Mechanical Speed Bumps And Speed Bumps Constructed Using Asphalt: A Case Study Of Jalandhar Cantonment.

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ABSTRACT:

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. This paper aims to present the results of a study on the performance of road bumps used in Jalandhar cantonment in reducing vehicle speed. The purpose of this work is to study speed across bumps, like speed at bump, speed reduction, deceleration and acceleration by having a detailed survey of vehicular behaviour near bumps of various heights. The speed profile of vehicles are determined and analysed at various locations along the road prior to the bump, on the bump and after the bump. A critical speed change analysis has been conducted by the help of radar gun and the result presented for various vehicle category and type of bumps at various locations.

KEYWORDS: Traffic Calming, Speed Bumps, Radar gun, Spot Speeds, Speed reduction.

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INTRODUCTION:

Since ancient period for any project with several objectives we, the people are working on one approach which is to find a solution that is safe and economical. Out of these two perspectives safety has always had more priority over economy. When it comes to safety on roads, traffic calming techniques play a vital role in the development and maintenance of a secure environment for road users i.e. vehicle drivers as well as pedestrians. Traffic calming techniques emerged mainly in response to community concern for safety. Traffic calming has been implemented in Western nations in residential areas and neighbourhoods and cities because of the roads and paths between relatively safer cities. It was also agreed by experts that differences and differences in the speed and direction, and / or mass of vehicles usually determine the severity of traffic accidents. In the West, and are classified as very safe roads where driving speeds are relatively higher, but uniform. There is much less difference in direction and mass of the car. In the last twenty years, as well as residential areas and inner cities have become safer because of the 30 regions km / h in residential areas, despite considerable variation in the direction of the block and used vehicles. Traffic calming techniques have played an important role in achieving safety by ensuring that low-speed driving and speed of small differences between different road users. The whole experience of different European countries indicates that the speed limit signs and other visual measures are not sufficient by itself to make drivers always choose the right speed. But when used together with the speed reducing other physical measures, significant effects can be observed. Traffic calming actually change the perception of driver by installation of new physical features or by changing the street alignment, installation of safety barriers for safe and efficient movement of traffic and other public purposes. Speed Humps are good for locations where very low speeds are desired and reasonable, and noise and fumes are not a major concern. For this paper speed control measures (speed bumps) were considered as subject of interest. Need of the Study is aggressive growth in the number of road users is a major concern for traffic engineers and planners. As number of road users increases, the burden on existing transportation system for providing the best Level of Service (LOS) increases and if this system does not perform well, there is a likelihood of occurring accident due to lack of implementation of engineering, enforcement or/and education measures. It is necessary to evaluate the techniques involved in a transportation system to assess the performance of the system at a point of time. Evaluation of traffic calming technique is required to have a check on the fulfilment of the objective with which these were planned, designed and implemented, to say to make streets safe and usable.

LITERATURE REVIEW

Summarised evaluation criteria for traffic calming issues. Issues were evaluated according to criteria which reflect the goals of traffic calming specifically safety and liveability as well as objectives of reducing speed and short-cutting volume, and minimising conflicts between road users. Community support was also considered in the evaluation, as a basis for assigning higher priority to areas with higher levels of community support. Since the number, type and extent of issues will vary from one area to another, it is not possible to use a quantitative means of assigning ratings to each area. Instead, each criterion is evaluated on a subjective basis, on a scale of zero to five, ten or twenty, depending on the relative importance of each criterion. In each case, a higher score represents a more significant issue[2].These findings were confirmed during an investigation conducted in an Italian town. Besides the well known phenomena, such as sudden slow down and acceleration before and after the bump (which is often a source of accidents). It was observed that drivers tend to perform all sorts of maneuvers to reduce their discomfort as much as possible when approaching the undulation. This fact is particularly evident on streets where the speed bumps do not extend over the entire street. This kind of misplacement seems to encourage drivers to perform avoidance maneuvers, such as short deviations into the opposite lanes or parking lanes and bus stops[4, 6]. The study was an attempt to reach a qualitative and quantitative classification of possible alterations in drivers' behaviour due to the presence of the speed bumps. The result of more than 25,000 observations of cars and motorcycles reveal that speed bumps, where not properly installed, induce many drivers (up to 50% for cars and up to 85% for motorcyclists) to avoid the undulation to reduce the level of noise and vibrations perceived inside/on the vehicle. Figure 2.1 shows different type of humps and Figure 2.2 shows speed profile over them[3].

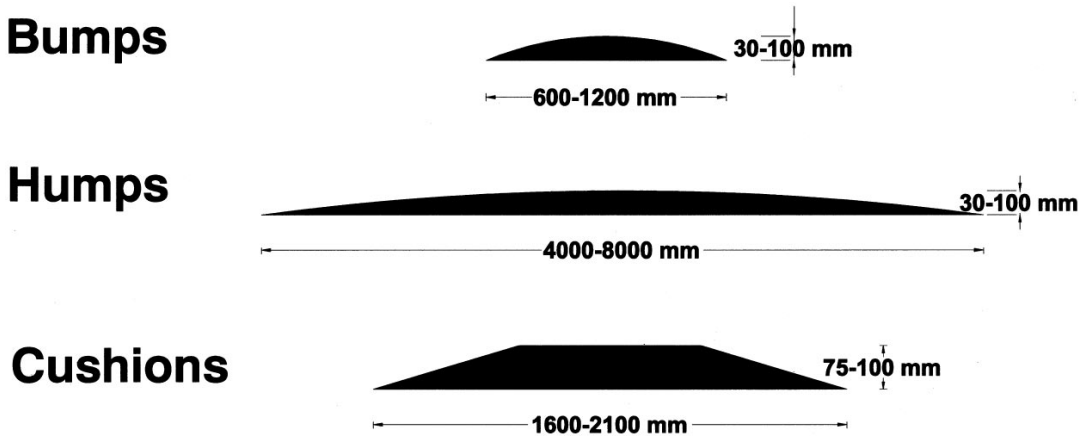


Figure 1: Shows Different Type of Humps.

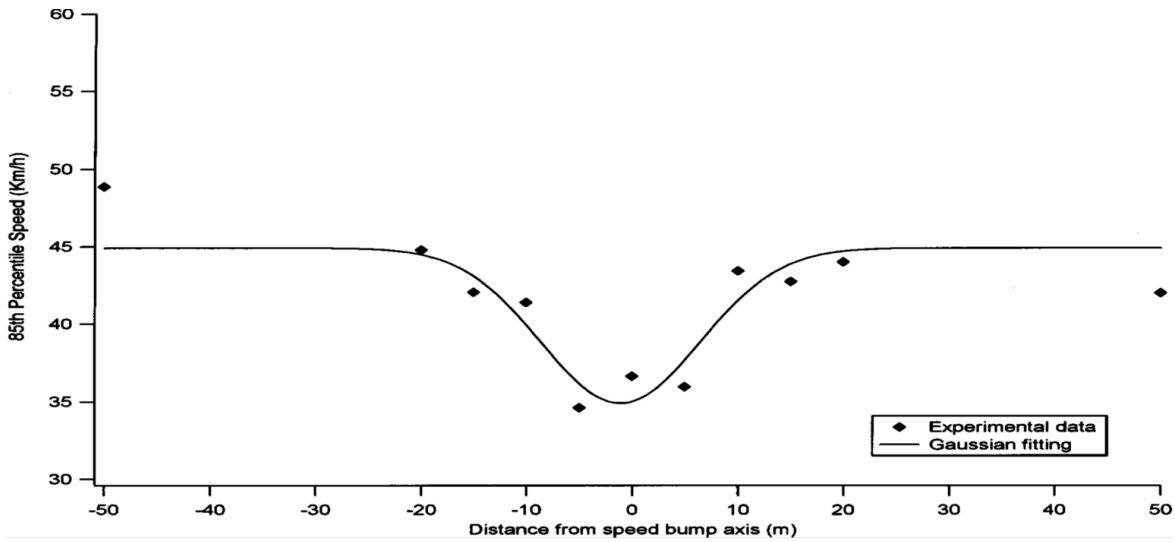


Figure 2: Shows Speed Profile over Bumps.

The influence of traffic calming measures on the speed of unimpeded vehicles has been investigated by evaluating differences in speed profiles obtained from various combinations of traffic calming measures. A case study has been conducted in the City of York focusing on traffic calming measures such as speed humps (flat-topped and round topped)[3], speed cushions and chicanes implemented in sequence. Vehicles' passing times were simultaneously recorded at 16 points along each traffic calmed link. From these data a speed profile for each individual vehicle could be derived[6,7]. An empirical model was developed using multiple regression analysis techniques based on data collected at three calibration sites. Speeds along these links were described as a function of the input speed, the type of measure and the distance between measures[1].

The speed profile model was shown to be a good representation for the data from the calibration sites. It efficiently predicted speeds of unimpeded vehicles over a given combination of traffic calming measures in sequence. The validation process, based on data collected at three validation sites, also indicated that the model provided a good representation of the observed profiles at these sites[9]. The independent variables considered in the model to describe `speed' were as follows:

(i) The entry speed (V_1) is the initial speed in the link which was assumed as the speed measured at the first sensor during data collection (noting that this was taken as indicative of free flow speed) (in km/h);

(ii) Distance to (dt) is the distance to the next measure in the direction of travel (in m);

(iii) Distance from (df) is the distance from the previous measure also measured in the direction of travel (in m);

(iv) Hump (H) is the dummy variable which indicates the presence of a hump (0 or 1);

(v) Table (T) is the dummy variable which indicates the presence of a table (0 or 1);

(vi) Cushion (C) is the dummy variable which indicates the presence of a speed cushion (0 or 1);and

(vii) Chicane (Ch) is the dummy variable which indicates the presence of a chicane (0 or 1).

The recommended speed profile model is given by eqn 2.1 and the speed profile is showing in Figure 2.3.

Speed = - 8.73 + 0.62V_1 + 0.23dt + 0.78df - 0.0012dt^2 - 0.0137df^2 + 8.5E - 05df^3 - 4.48H - 6.71T - 0.86C - 2.01Ch

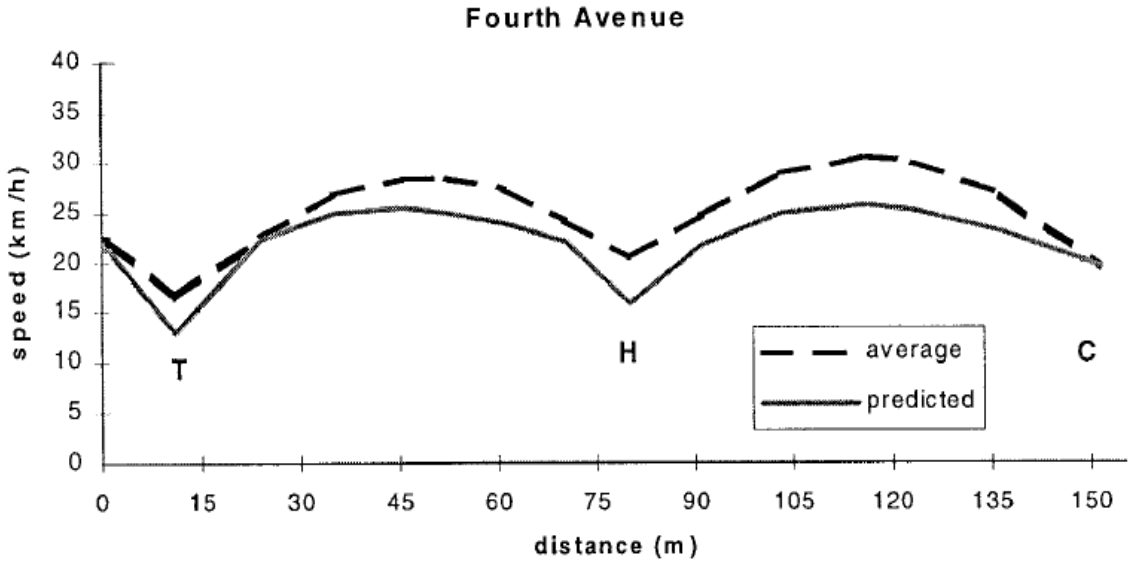


Figure 3: Speed Profiles at Different Distance With Respect To Hump.

The changes in behaviour on the road and reductions in accident rates are the only meaningful criteria for success, if one is truly interested in the promotion of traffic safety[5]. Field study is important to asses these changes. For evaluation of traffic calming technique observations related to significant change in speed of vehicles due to bumps, number of accidents, safety and community support were taken for the study area[7,10].

STUDY AREA

Jalandhar Cantonment was selected as the study area. The following are the locations where speed bumps are constructed or placed in Jalandhar Cantonment (Table 1):

Table 1: Speed bumps in Jalandhar Cantonment.

S. No.	Location	Type	Dimensions (all in mm)	Speed limit on road (kmph)
1	Deep Nagar	Mechanical	340x45	30
2	Dushera Ground.	Mechanical	340x45	30
3	Recruiting Head Quarters	Mechanical	340x55	30
4	Garha Road	Mechanical	340x45	30
5	Officers Colony	Material	2700x30	20
6	Rama Mandi	Material	2700x30	20
7	KV-1	Mechanical	750x60	20
8	Residency quarters 1	Material	1600x75	20
9	Residency quarters 2	Material	1600x80	20
10	Residency quarters 3	Material	1600x75	20
11	Residency quarters	Material	2100x75	20
12	Church lane	Mechanical	750x70	20
13	Church lane	Mechanical	750x70	20
14	Church	Material	2700x75	20

DATA COLLECTION

Radar gun was used to collect speed data. Speed observations were taken on working days during off peak hours so that less interaction between vehicles could be maintained. Impeded vehicles were not of interest as their speeds were affected by lead vehicle rather than by traffic calming measures[1].

Figure 4: Showing Radar Gun.

Success of traffic calming schemes depends, not only on objective empirical measures, but on the overwhelming support of the local community, which in turn depends upon the openness of consultation process[4]. So, an opinion survey was conducted over the performance of speed bumps inside the Jalandhar Cantonment.

ANALYSIS OF RESULTS AND DISCUSSION: After compiling the observations, results are analysed and discussed in this section. Speed impacts of bumps were visible. For different speed bumps, impacts of material and size were also observed. Besides these, public opinion and safety aspect are discussed in the next sections.

SPEED IMPACTS OF BUMPS: The speed of vehicles was observed before and after the bump. The average speeds with standard deviation are given in Table 2 Speed impacts of speed bumps are given in Table.

Table 2: Average speeds at different locations.

(standard deviations in parentheses)

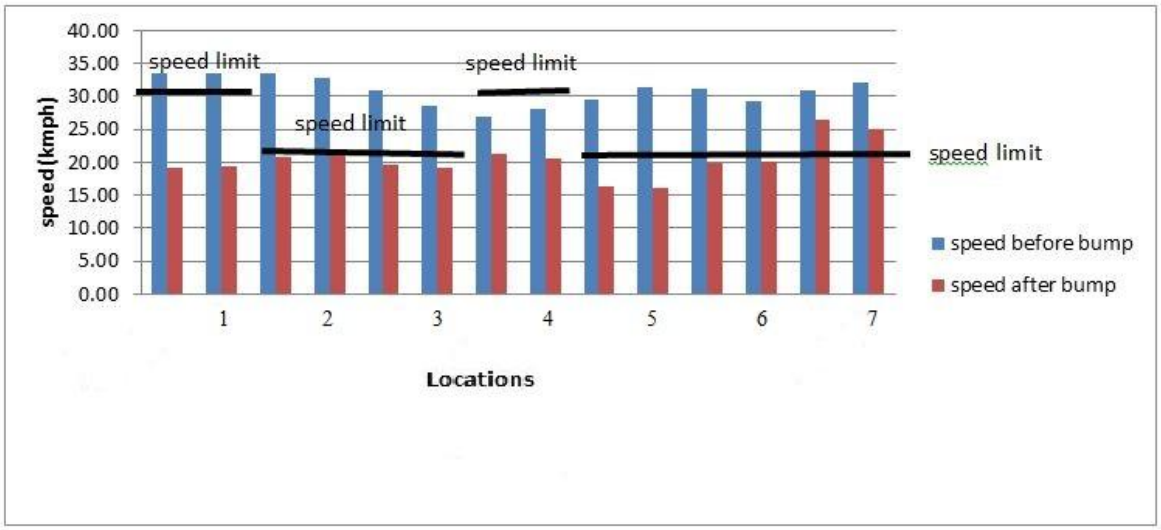
S. No.	Location	Direction	Average speed of 2-W motorised vehicle (kmph)		Average speed of 4-W motorised vehicle (kmph)	
			before bump	After bump	before bump	After bump
1	Deep Nagar	Towards Deep Nagar	33.43 (6.20)	19.26 (4.57)	34.24 (5.24)	18.95 (3.25)
		Towards Dushera Ground	33.42 (5.10)	19.37 (4.78)	39.44 (13.61)	19.22 (2.95)
2	Dushera Ground	Towards main market	33.42 (6.19)	20.86 (4.07)	28.63 (5.50)	16.50 (1.85)
		Towards Sansarpora	32.80 (7.95)	20.94 (8.34)	35.27 (5.37)	18.45 (3.30)
3	Recruiting Head Quaters	Towards market	31.00 (5.51)	19.61 (4.60)	36.00 (7.75)	17.20 (3.77)
		Towards NH1	28.61 (3.95)	19.16 (4.89)	32.67 (6.28)	20.50 (4.37)
4	Garha Road	Towards KV	26.93 (5.31)	21.30 (4.50)	30.75 (4.81)	23.56 (3.48)
		Towards Main Gate	28.00 (5.99)	20.53 (4.09)	30.50 (4.95)	14.00 (0.00)
5	Officers Colony	Towards main market	29.58 (5.37)	16.39 (2.51)	31.57 (6.33)	16.36 (3.71)
		Towards Residential colony	31.47 (5.75)	16.00 (1.45)	34.00 (7.62)	15.86 (1.77)
6	Rama Mandi	Towards NH1	31.08 (5.34)	19.89 (5.13)	34.10 (4.95)	20.80 (6.00)
		Towards Cantonment	29.21 (4.44)	20.02 (5.52)	28.46 (4.22)	20.23 (4.49)
7	Main market cantt	Towards Jalandhar city	30.96 (5.43)	26.39 (5.45)	32.17 (4.06)	26.42 (5.02)
		Towards Cantonment	32.06 (6.98)	25.11 (6.49)	33.33 (1.63)	24.50 (5.54)

Table 3: Impacts of bumps for speed control.

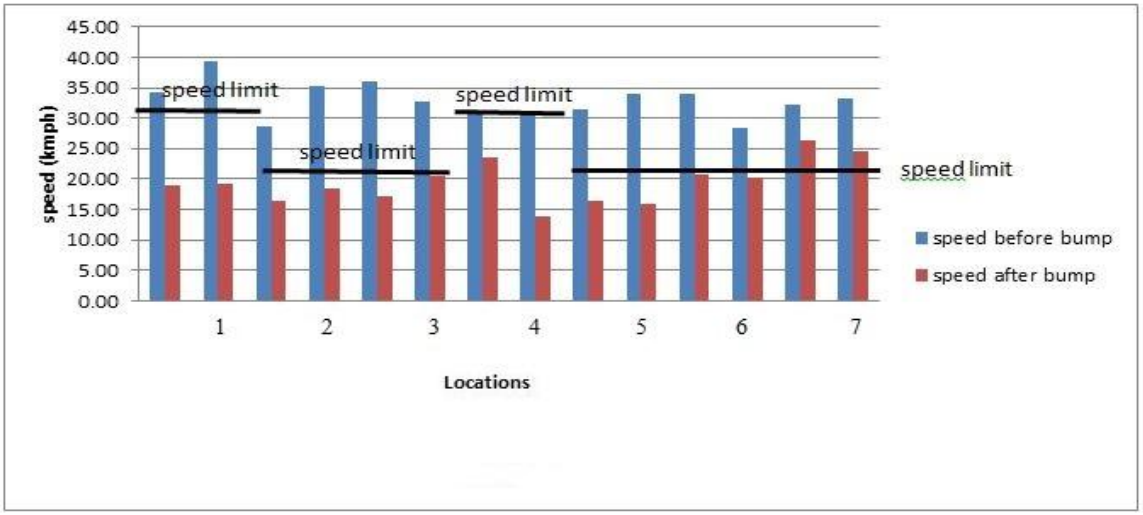
(standard deviations in parentheses)						
S. No.	**Location**	**Direction**	**Average reduction in speed (kmph)**		**Average % reduction in speed**	
			2-W motorised vehicle	**4-W motorised vehicle**	**2-W motorised vehicle**	**4-W motorised vehicle**
1	Deep Nagar	Towards Deep Nagar	14.17 (5.23)	15.29 (5.94)	41.83 (10.89)	43.61 (11.89)
		Towards Dushera Ground	14.05 (5.81)	20.22 (5.91)	41.33 (13.61)	50.54 (9.13)
2	Dushera Ground	Towards main market	12.77 (5.39)	12.13 (5.91)	36.93 (12.09)	40.57 (11.75)
		Towards Pragpora	11.86 (7.71)	16.82 (5.81)	35.20 (18)	46.75 (11.15)
3	Recruiting Head Quarter	Towards market	11.39 (5.53)	18.80 (9.2)	35.80 (14.19)	50.17 (16.13)
		Towards NH1	9.45 (3.38)	12.17 (5.91)	33.40 (11.71)	36.42 (11.96)
4	Garha Road	Towards KV	5.63 (2.85)	7.19 (3.76)	20.53 (8.71)	22.51 (11.09)
		Towards Main Gate	7.47 (3.31)	16.50 (4.95)	26.10 (8.44)	53.49 (7.55)
5	Officers Colony	Towards main market	13.18 (5.06)	15.21 (5.71)	43.25 (10.7)	46.98 (11.83)
		Towards Residential colony	15.47 (5.9)	18.14 (6.87)	47.46 (11.15)	52.14 (7.89)
6	Rama Mandi	Towards NH1	11.19 (4.63)	35.72 (3.72)	11.19 (11.97)	38.48 (12.3)
		Towards Cantonment	9.19 (4.48)	8.23 (4.92)	31.55 (14.55)	28.18 (14.95)
7	Main market cantt	Towards Jalandhar city	4.57 (2.08)	5.75 (2.22)	14.95 (7.41)	18.34 (8.39)
		Towards Cantt	6.94 (3.65)	8.83 (6.27)	21.74 (11.23)	26.14 (17.77)

From Table 2and Table 3it can be noticed that average decrease in speed is more than 22% at most of the locations except two locations; Garha Road (towards Towards KV) andRama Mandi (towards

Cantonment).At Garha Roadmost of the vehicles come from main gate and considering this factor two speed bumps have been provided one at each side of the gate of Garha Road. In front of Rama Mandiroad is at downward slope towards NH1 direction due to which decrease in speed after speed bump is less. Near Main market cantonment, decrease in speed is not much with that cross-drainage structure. Figure 5 depicts the speed impacts of speed bumps in Jalandhar Cantonment. From these bar charts it is clear that motorised vehicles are driving at more than the prescribed speed limit on road.



(a) 2-w motorised vehicles



(b) 4-w motorised vehicles

Figure 5: Speed Impacts of Speed Bumps on Vehicles

IMPACTS OF MATERIAL AND SIZE: If we compare the operational performance of two types of speed bumps, then we find that mechanical speed bumps cause more decrease in speed than the speed bumps which are constructed using material on road. It is given in Table 4 Comparisons of size of bumps for mechanical bumps and bumps constructed using material are given in Table 5 and Table 6 respectively. It was found that for both types of speed bumps, bumps having large size decrease the speed more than those of small size.

Table 4: Showing Comparison between mechanical speed bumps and speed bumps constructed usingmaterial.

Type of vehicle	Average decrease in speed (kmph)		Average % decrease in speed	
	mechanical	material	mechanical	material
2-W motorised vehicle	14.22	9.87	43.47	28.84
4-W motorised vehicle	17.22	15.94	48.32	39.57

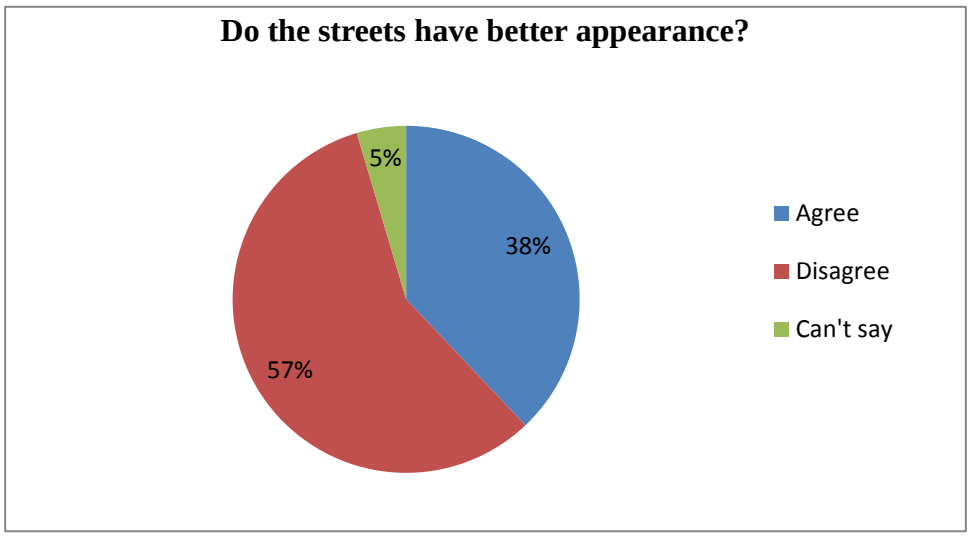
Table 5: Showing Comparison between mechanical speed bumps having different size.

Type of vehicle	Average decrease in speed (kmph)		Average % decrease in speed	
	340 mm x 45 mm	750 mm x 70 mm	340 mm x 45 mm	750 mm x 70 mm
2-W motorised vehicle	14.11	14.32	41.58	45.36
4-W motorised vehicle	17.76	16.68	47.08	49.56

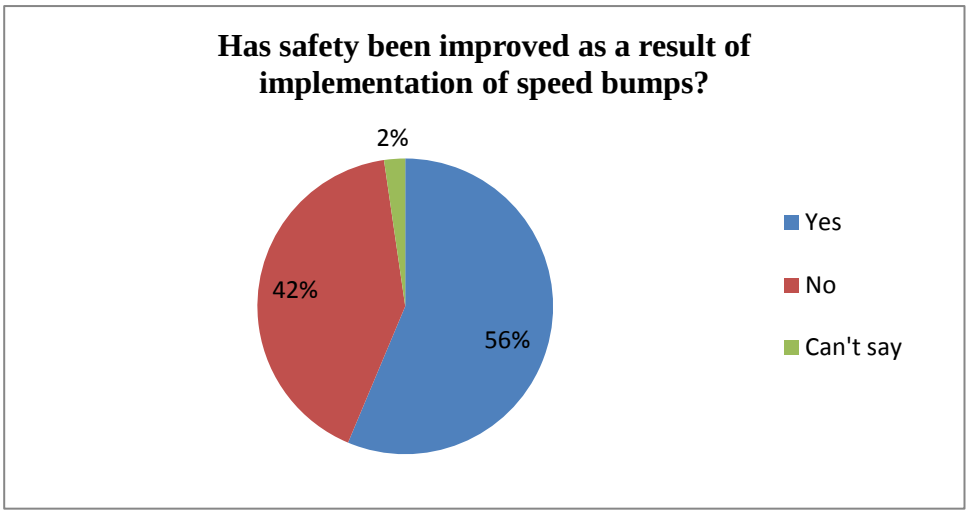
Table 6: Showing Comparison of size of speed bumps constructed using material.

Type of vehicle	Average decrease in speed (kmph)		Average % decrease in speed	
	1600 mm x 75 mm	2700 mm x 30 mm	1600 mm x 75 mm	2700 mm x 30 mm
2-W motorised vehicle	6.55	10.98	23.32	30.68
4-W motorised vehicle	11.84	17.31	38.00	40.10

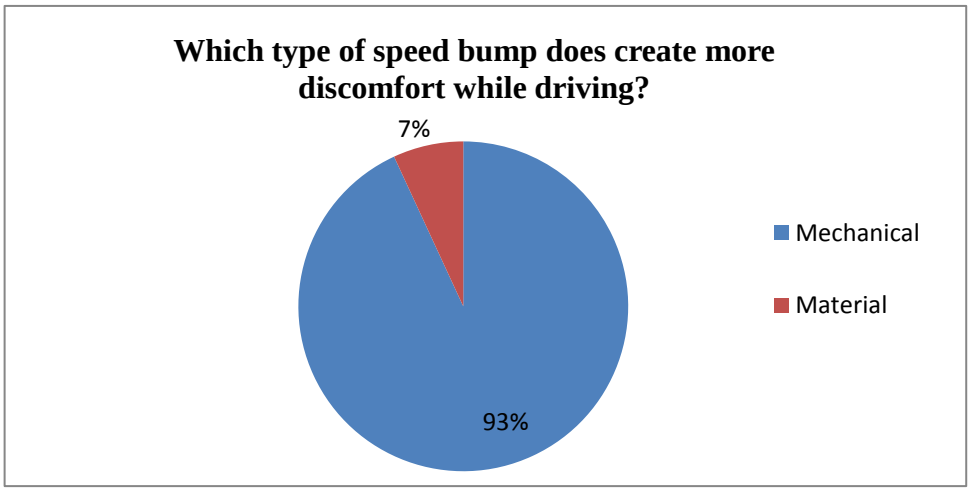
Opinion Survey: To have an eye on what community thinks about the traffic calming scheme which is speed bumps in this project, the opinions of road users have been collected. It was a population of 87 which constituted students, security personnel, cycle rickshaw drivers etc. Results are shown in Figure 6. These pie charts show that there is a need to work on the appearance as the condition of roads is deteriorated due to vehicle movement. On one side, speed bumps are improving the safety of people by forcing the drivers to reduce their vehicle's speed, on the other hand they are not comfortable (as in case of mechanical bumps) for some sections of persons that include children, senior citizens, patients and challenged persons by creating jerks at bump.



(a)



(b)



(c)

Figure 6: Results of opinion survey

CONCLUSIONS

Following conclusions could be drawn from the research paper:

1. Average percentage decrease is more than 22 % at all locations except recruiting headquarters and officers colony.
2. Average percentage decrease in number of accidents from 2010 to 2012 is more than 11 %.
3. Mechanical speed bumps are better in reducing the speed of vehicles than the speed bumps constructed by material.
4. The level of discomfort is lower with the speed bumps constructed by material than that with mechanical speed bumps.
5. Speed bumps of large size are more effective in decreasing the speed of vehicles.
6. Many of the drivers are not following the prescribed speed limits on roads which are 20 kmph and 30 kmph inside the Jalandhar Cantonment.

RECOMMENDATIONS:

On the basis of the conclusions mentioned above, following recommendations can be made:

1. There is a problem of jerk while encountering the mechanical speed bumps. To overcome this, some other alternatives such as speed cushion or speed table can be implemented.
2. Speed bumps should be implemented on entire road width since there is a tendency in some drivers to cross the bumps over the left portion of the road width.
3. For a particular type of speed bumps, bumps having larger size should be used to improve the safety.
4. There is a need to implement some speed control measure again on the road from NH1 immediately.
5. Actions are required to enforce the traffic rules properly and some educational campaigns can be organised to educate people about the same.

A comprehensive study can be done with interest in bicyclists and pedestrians that have the maximum proportion among road users inside Jalandhar cantonment.

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