SPEED REDUCTION AS A ROAD SAFETY MEASURE

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ABSTRACT

The growing number of road accidents is a major national problem in Sri Lanka. By analyzing the police database of past accident records, the causes for the road accidents have been identified as a prominent cause for road traffic accidents.

According to the past accident records from the year 1992 to 1999, there were about 17507 fatal accidents, and 29526 grievous accidents occurred out of the total of 613785 accidents over the last eight years. The annual loss due to road traffic accidents has been evaluated as Rs. 12.9 billion in year 1999.

The research was focused on high speeds at intersections since a higher percentage of accidents occurred close to or at intersections. A feasibility study has been conducted for a speed reduction measure which uses transverse bar markings.

The results before the study and after the study indicated that there is a marginal drop in the speeds due to the presence of transverse strips. Thus, the use of a combination of transverse strips and other measures is suggested at intersections.

INTRODUCTION

Road traffic accidents create a major impact to the Sri Lankan economy. According to the Police reported accidents for the last eight years there were about 17,507 fatal accidents, 29,526 grievous accidents occurred out of the total of 613,785 accidents over the last eight years(Accident database, Police Information Division, 2000).

The overall economic loss due to road accidents could be evaluated as 1% of the GDP of Sri Lanka. The analysis of past accident records, has shown that there are about 48 % of speed related fatal accidents, 45% of speed related grievous accidents and 43% of speed related non grievous accidents. Therefore a detailed research has been carried out to explore the possibilities of speed reduction at accident-prone locations such as intersections, roundabouts, horizontal curves, bridges and bends.

OBJECTIVES

The research work explained in this paper has following objectives:
a) Collection of past accidents recorded from 1992 to 1999.
b) Evaluation of the proportion of speed related accidents.
c) Proposing a speed reduction measure that can be applicable to Sri Lanka.
d) Examine the effectiveness of the proposed speed reduction measure.

METHODOLOGY

a) Accident records have been collected from Police Head Quarters from 1992 to 1999.
b) Analysis of accident records.
c) Identification of major cause for the accidents, and the proportion of speed related accidents in Sri Lanka.
d) Proposing a speed reduction measure that can be applicable to Sri Lanka.
e) Examine the effectiveness of the proposed speed reduction measure by conducting before and after studies.

ANALYSIS OF ACCIDENT DATA

The results obtained from the analysis of fatal, grievous, non-grievous and damage only accidents are presented in Table1, Table2, Table3 and Table 4 respectively.

Table 1: Speed related fatal accidents

Year	Fatal accidents	Speed related	Speed related %	Fatal accidents per (F.a.p.)		Speed related (F.a.p)	
				10,000 vehicles (1)	100 km (2)	10,000 vehicles (1)	100 km (2)
1992	1841	975	53	18	2	10	1
1993	1878	961	51	17	2	9	1
1994	1955	975	50	17	2	8	1
1995	2059	1038	50	17	2	8	1
1996	2015	942	47	15	2	7	1
1997	2597	1074	41	18	3	8	1
1998	2383	1076	45	16	2	7	1
1999	2779	1382	50	17	3	9	1

Table 2: Speed related grievous accidents

Year	Grievous accidents	Speed related	Speed related %	Grievous accidents per (G.a.p.)		Speed related (G.a.p)	
				10,000 vehicles (1)	100 km (2)	10,000 vehicles (1)	100 km (2)
1992	3117	1536	49	31	3	15	2
1993	3439	1668	49	32	3	15	2
1994	3921	1779	45	34	4	15	2
1995	3808	1706	45	31	4	14	2
1996	3348	1440	43	25	3	11	1
1997	3970	1672	42	28	4	12	2
1998	3843	1612	42	25	4	11	2
1999	4080	1971	48	25	4	12	2

Table 3: Speed related non grievous accidents

Year	Non Grievous accidents	Speed related	Speed related %	Non Grievous accidents per (N.G.a.p.)		Speed related (N.G.a.p)	
				10,000 vehicles(1)	100 km (2)	10,000 vehicles(1)	100 km (2)
1992	14791	7074	48	147	15	71	7
1993	16786	7782	46	154	17	72	8
1994	17311	7849	45	149	17	68	8
1995	17161	7690	45	138	17	62	8
1996	15582	6188	40	118	16	47	6
1997	19128	7362	38	136	19	52	7
1998	16800	6696	40	111	17	44	7
1999	17106	7537	44	106	17	47	8

Table 4: Speed related damage only accidents

Year	Damage only accidents	Speed related	Speed related %	Damage only accidents per (D.a.p.)		Speed related (D.a.p)	
				10,000 vehicles(1)	100 km (2)	10,000 vehicles(1)	100 km (2)
1992	41051	16894	41	409	41	168	17
1993	44638	18138	41	411	45	167	18
1994	47968	18415	38	413	48	158	18
1995	53259	20031	38	428	53	161	20
1996	51926	18373	35	392	52	139	18
1997	65617	21992	34	466	66	156	22
1998	61567	20722	34	407	62	137	21
1999	66061	22803	35	409	66	141	23

The total road network of 100,000 Km in Sri Lanka has been considered (Central Bank Report, 1999) and the total vehicle population is given in Table 5(Registration of Motor Vehicles Department)

Table 5: Total vehicle Population (Registration of Motor Vehicles Department)

Year	Total vehicle population
1992	1,003,047
1993	1,086,821
1994	1,162,313
1995	1,244,750
1996	1,324,161
1997	1,407,532
1998	1,511,292
1999	1,614,145

SPEED REDUCTION MEASURES ADOPTED IN OTHER COUNTRIES.

Speed Control Humps

The humps shall be made of concrete or premix material. There are two types of humps. They are short humps and long humps. The short hump shall have a length of 1200mm and a vertical height of 75mm. The long hump shall have a length of 3600mm and a vertical height 100mm. The profiles are shown in Figure 1 and Figure 2.

The humps shall be painted white using road paint, preferably reflectorised road paint (alternate black and white stripes- width-250mm and gap 250mm).

The painting shall be maintained at regular intervals so that the hump is visible at all times. The warning sign, "Road Humps Ahead" shall be provided at a distance of about 45m to 180m from the hump to warn motorists of the existence of the hump.

When humps are provided on roads with raised foot walk, consideration should be given to the drainage of storm water before the hump is constructed.

These are commonly used on private access roads, near schools and near universities in urban situations.

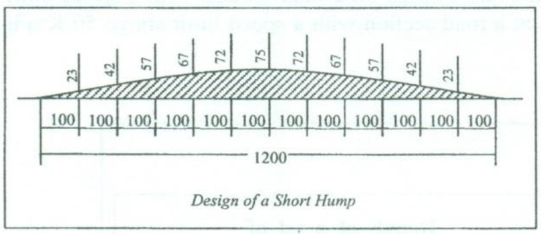

Figure 1: Short hump

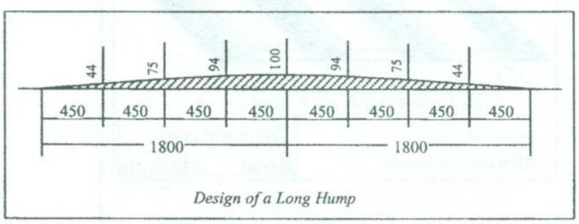

Figure 2: Long hump

Rumble Strips

Speed control humps are sometimes hazardous, inspite of the precautions taken in their safe design and construction. Rumble strips, which are corrugated surfaces, produce noise and a physical sensation on the steering. The driver gets alerted due to these sensations. Otherwise it can consist of sawed grooves on the pavement, or a series of transverse sprayed thermoplastic, asphalt or other suitable material across the lanes of pavement creating the rumble effect and reduce driver's speed when approaching the hazard ahead. Successful applications have been made on sharp curves where an accident problem exists, on approaches to **STOP** signs, and as an outline in taper areas where there is a reduction in pavement width.

When unusual alertness is required from drivers, and standard traffic control devices such as signs and or flashers have apparently not proven to give adequate warning, *rumble strips* have some times been used. Each strip is usually approximately from 75mm to 150 mm wide and 12.5mm to 25mm high.

Typical locations for the use of rumble strips are, approaches to toll gates and to stop signs hidden by horizontal or vertical curves. Proximity of the rumble strips to the hazard is important. If located too close, sufficient reaction time is not given the driver, and if they are located too far away, the driver may not relate the rumble strip to the hazard. The Figure 3 and Figure 4 below indicate the typical arrangements of rumble strips on a road section with a speed limit of 50 Km/h or below and on a road section with a speed limit above 50 Km/h respectively.

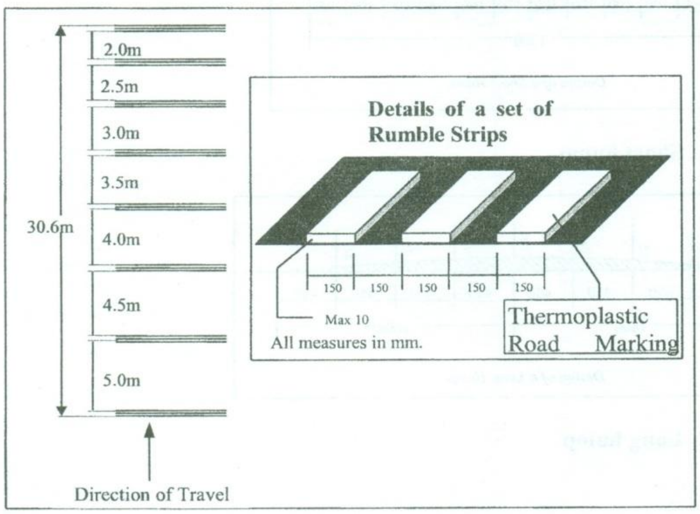

Figure 3: Typical layout of a system of rumble strips on a road section with a speed limit of 50 km/h or less.

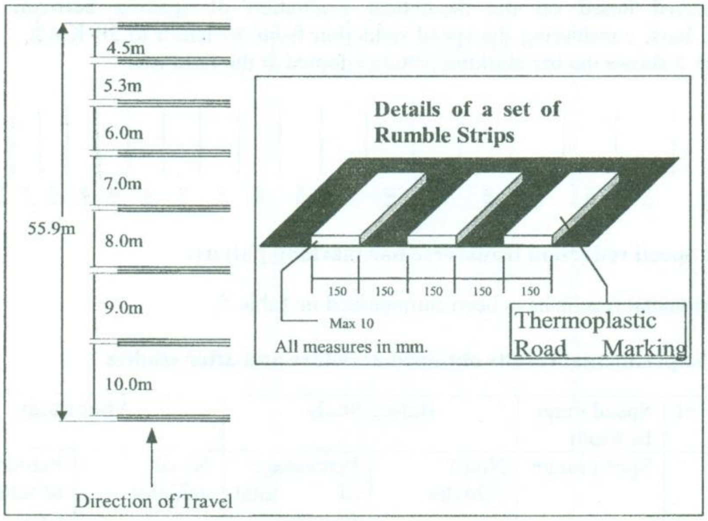

Figure 4: Typical layout of a system of rumble strips on a road section with a speed limit of more than 50 km/h.

Transverse Bar Markings

Structured patterns of transversal strips with decreased spacing and spaced across the road surface are suggested against the speed adaptation phenomenon which can arise after having driven fast for some time. e.g. at motor way exists (Andras.Varhelyi, 1996).

The method for speed influence is based on a deliberate distortion of the environment so that the driver gets the illusion that his speed is increasing. Such strips were introduced first by Denton (1980), who found a significant reduction in average speeds. Experiments with diminishing line spacing (Rutly, 1975) showed a speed reduction of 30% of the 85 percentile and 23% of the mean speeds. Maroney and Dewar (1987), found statistically significant decreases in both mean speed and the percentage of vehicles travelling faster than 80 Km/h. It will also be a solution that could be adopted with a reasonable cost. Both rumble bars and bar markings are most effective on high-speed rural highways. However, the rumble strips, are not in favour of the present modal mix in Sri Lanka, as this can cause safety problems mainly to the cyclists.

EXPERIMENTAL STUDY IN SRI LANKA

With the aim of adopting the transverse bar marks in Sri Lanka, a T- junction has been selected on Katubedda- Kospalana Road on which there is a substantial proportion of vehicles travelling fast. The bar-marking pattern has been selected based on the theoretical evaluation of spacing between transverse bars, considering the speed reduction from 70 Km/h to 20 Km/h . The Figure 5 shows the bar marking pattern adopted at the field trial.

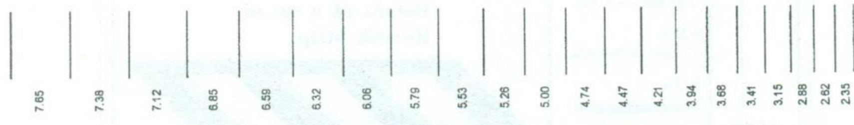

Figure 5: Speed reduction transverse bar marking pattern

The experimental results have been summarized in Table 5.

Table 5: Experimental results obtained at before and after studies

Type of vehicle	Speed range In Km/h	Before Study		After Study	
	Speed range	No.of vehicles	Percentage of total flow(%)	No.of vehicles	Percentage of total flow (%)
Cars and Vans	V<40	86	12.53	56	13.33
	40<V<50	91	22.30	133	31.74
	50<V<60	250	36.44	153	36.51
	V>60	149	21.92	79	18.37
Buses	V<40	51	46.36	28	52.83
	40<V<50	40	36.36	16	30.18
	50<V<60	14	12.27	7	13.20
	V>60	5	4.54	2	3.77
Motor Cycles	V<40	131	44.25	54	34.39
	40<V<50	104	35.13	58	36.94
	50<V<60	44	14.86	36	22.92
	V>60	17	5.74	9	5.73
Three Wheelers	V<40	111	47.84	61	52.58
	40<V<50	103	44.39	46	39.65
	50<V<60	17	7.32	9	7.75
	V>60	1	0.43	0	0
Light and Medium trucks	V<40	67	21.33	51	28.81
	40<V<50	124	39.49	69	38.98
	50<V<60	89	28.34	41	23.16
	V>60	34	10.82	16	9.03

The graphical representation of the results of before and after study has been given in Figure 6 to Figure 10 for various types of vehicles. The Figure 6 shows the variation of percentage of cars and vans flow in before and after study at different speed ranges.

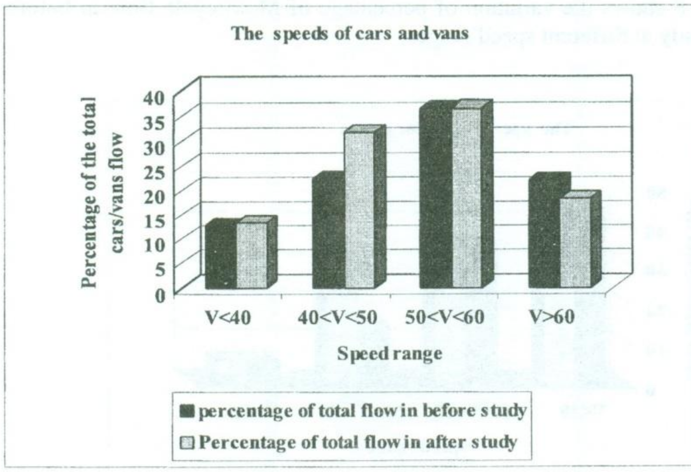

Figure 6: The percentage of cars and vans flow in different speed ranges.

The Figure 7 shows the variation of percentage of bus flow in before and after study at different speed ranges.

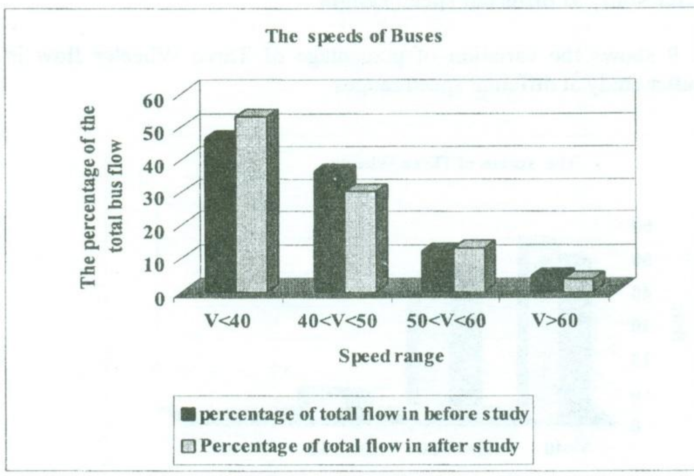

Figure 7: The percentage of bus flow in before and after study at different speed ranges.

The Figure 8 shows the variation of percentage of Motorcycle flow in before and after study at different speed ranges.

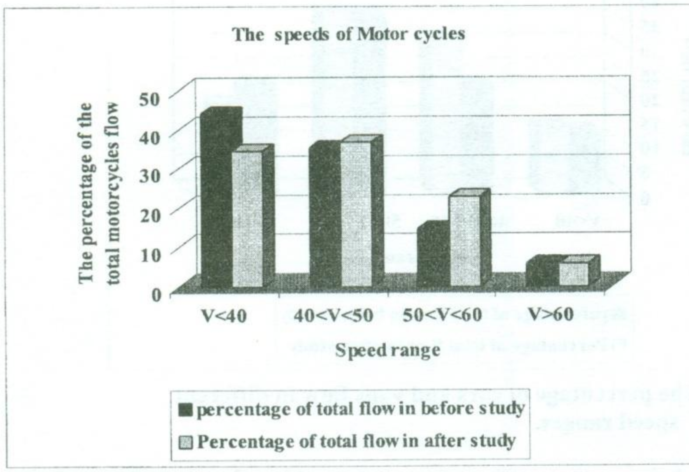

Figure 8: The variation of percentage of motorcycles flow in, before and after study at different speed ranges

The Figure 9 shows the variation of percentage of Three Wheeler flow in before and after study at different speed ranges.

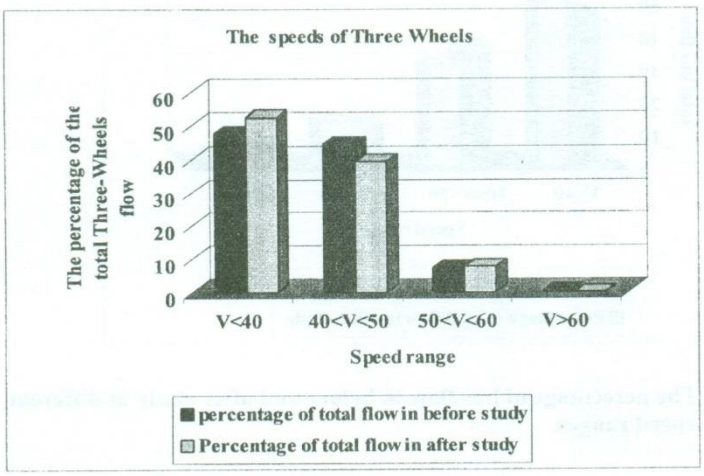

Figure 9: The variation of percentage of three wheelers flow in before and after study at different speed ranges.

The Figure 10 shows the variation of percentage of Light and Medium trucks flow in before and after study at different speed ranges.

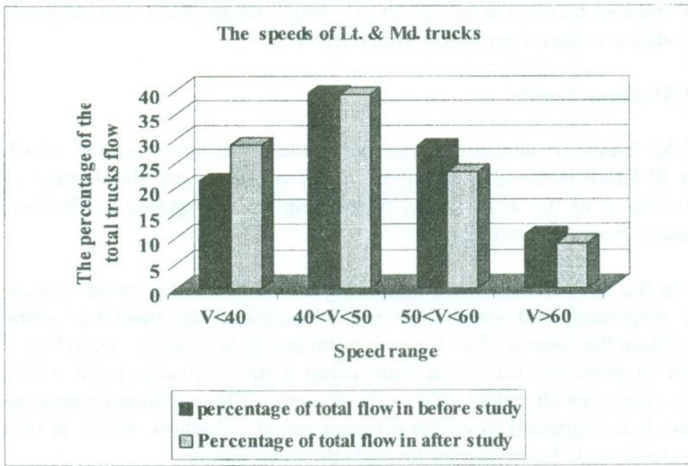

Figure 10: The percentage of light and medium trucks flow in before and after study at different speed ranges.

ANALYSIS OF EXPERIMENTAL RESULTS

According to the experimental results shown in Table 5.0 and Figures 6 to Figure 10 it can be said that the different vehicle types have responded the bar marking pattern in the following manner:

Cars and Vans

The amount of total flow of cars and vans has increased in after studies at the range less than 40 Km/h and between 40 Km/h and 50 Km/h range. Both these speed ranges are below the speed limit of 50 Km/h on this road. Hence increase in percentage of vehicle flow in the lower speed ranges in the after study is a favourable situation. In the speed range of 50 Km/h and 60 Km/h there is hardly any difference in percentage of flow. The high speed vehicles, which are travelling at speeds more than 60 Km/h have responded the bar markings.

Buses

Buses also have increased in number travelling at lower speeds such as less than 40 Km/h. When it comes to higher speed ranges, the response to the bar markings becomes less.

Motor Cyclists

Motor cycles have almost disregarded transverse bar markings.

Three Wheelers

Three wheelers have increased in number, traveled at lower speeds and reduced the number traveled at higher speeds which means there is a response to the bar marking pattern from three wheel drivers.

Light and Medium Trucks

These vehicles basically increased in number in the lower speed ranges, which is less than 40 Km/h in the after study. In higher speed ranges, the number of vehicles decreased in the after study, which implies a response to the bar-marking pattern from the truck drivers.

According to the over all analysis considering all vehicle types, some vehicle types have responded and some have not. Therefore bar markings alone would not reduce the speeds of all types of vehicles, in Sri Lanka. Therefore it is suggested to paint the transverse bars using a thermoplastic paint which introduces a slight rumble effect only to the drivers. When evaluating spacing between bars it is suggested to go for a bigger speed reduction, which in turn will have a closer and closer spacing towards the intersection.

It is also suggested to carry out some field trials by varying the spacing of transverse lines, at different places close to intersections in order to determine the best spacing arrangement for Sri Lanka.

The transverse bar markings can also be combined with adequate warning signs such as "Reduce speed now" and "Slow" together with a proper educational campaign for the drivers over the mass media which highlights the point that when the drivers are approaching the transverse bar markings they have to reduce the speed of the vehicle.

CONCLUSION

According to the past accident records there are 48% average speed related fatal accidents. Based on the above analysis, the transverse bar markings which gives an illusion to reduce speed would not alone give an effective speed reduction for all types of vehicles. Hence a further measures should be combined with the transverse bar markings in order to achieve better results. This could include surface roughening on the transverse bars, proper warning signs ahead of the transverse bars and the use of thermoplastic strips so that the driver will feel the presence of strips. This also could be combined with the proper educational campaign, which highlights the necessity of speed reduction as the driver's approach to this kind of transverse bar markings.

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