A Trial with Rumble Strips as a Means of Alerting Drivers to Hazards at Approaches to Passively Protected Railway Level Crossings on High Speed Western Australian Rural Roads

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Abstract

A trial with rumble strips was conducted at 14 railway level crossings protected by passive signs, of which 11 crossings had Give Way signs and 3 crossings had Stop signs. The crossings were located on high speed rural roads within Wheatbelt regions of Western Australia. The rumble strips were installed at each approach to the crossing. One group of strips was installed at the crossings protected by Give Way signs and four groups of rumble strips were installed at the crossings protected by Stop signs. Changes in vehicle speeds were used as surrogate measures of changes in driver alertness after installation of the rumble strips at the two types of crossing protections.

Two speed surveys were conducted at each of the crossings, before and after the installation of the rumble strips. Comparison of the mean speeds before and after installation of the rumble strips indicated that the strips had a significant effect on driver speed behaviours at the crossings with Stop signs, while the effect was negligible at the crossings with Give Way signs. The installation of rumble strips at the crossings with Stop signs resulted in the mean speed reduction of approximately 5 km/h over the entire section of road of approximately 500 m including the crossing. The effect was strongly associated with the number of groups of rumble strips installed on the pavement at the approach to the crossing.

The study found that a single group of rumble strips installed at the crossing protected by Give Way signs was insufficient to alert the drivers of possible hazards ahead as measured in terms of reduction in speeds at the approach to the railway level crossing. An increased number of rumble strips groups is recommended for the Give Way protected crossings similar to the Stop sign protected crossings. The increase in the number of rumble strips groups is not expected to significantly reduce the vehicle travel speeds, beyond what was observed at the crossings protected by Stop signs, that would increase likelihood of conflicts between vehicles and the train. The increase in driver alertness is expected to minimize possible hazards of conflicts between vehicles and trains at the crossings characterized by extremely low traffic and train volumes.

1. INTRODUCTION

According to Bureau of Transport and Regional Economics (2003), over the period 1997 to 2002, Australia had an average of 37 fatalities per year from railway level crossings crashes, of which 60% were pedestrians.

In Western Australia, over the period between 1994 and 2003 there had been 101 crashes at the railway level crossings involving trains and motorised vehicles, 33% in the Perth metropolitan area and 67% in rural areas. The crash trends for the study period suggests there has been a significant decline in the number of crashes over the period (see Figure 1) with the decline greater in the Perth metropolitan area than in the rural areas. Rural crashes, although small in number, are unacceptable due to the number of fatal crashes that occurred over the observation period, on average 1 crash per year, compared the metropolitan area which has recorded no fatal crashes since 1995. Fifty six percent of the state crashes occurred at the crossings controlled by active protection devices such as boom gates or flashing lights. The remainder of the crashes occurred at the passively protected crossings.

For this period 14% of all railway level crossing crashes were fatal (3 crashes in the metropolitan area and 11 crashes in the rural areas), 15% serious and 20% of personal injury requiring medical treatment. These casualty crashes resulted in 17 deaths, 21 serious injuries and 27 person medical treatments.

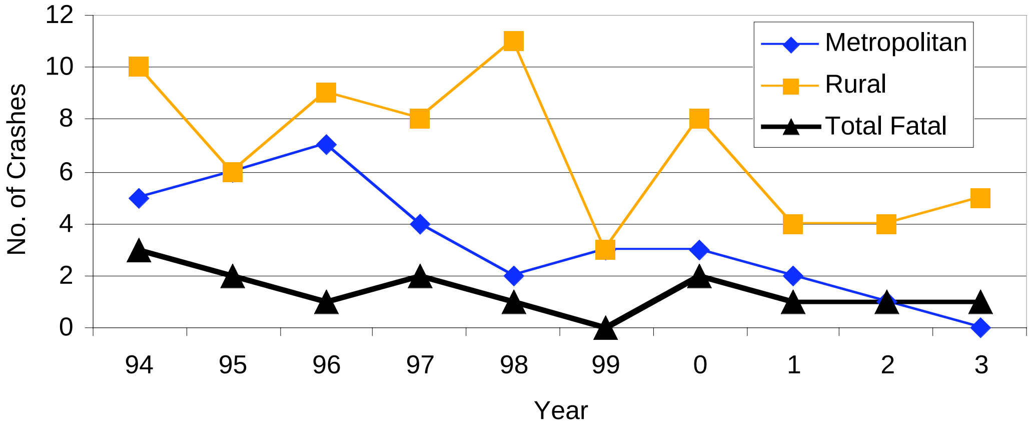

Figure 1. Distribution of number of crashes involving trains by year, Western Australia

Majority of the fatal crashes, 9 out of 14, occurred on the railway level crossings controlled by flashing lights. The crash fatality rate for the rural area was 16% compared to the Perth metropolitan area of 9%. In addition, crash fatality rate at railway level crossings controlled by flashing lights in rural area was 25%.

Twenty nine percent of all railway level crossing crashes and 46% of all fatal crashes occurred on the high 110 km/h speed limit roads. It can be inferred that the fatal rate for the crashes occurring on these high speed roads is approximately 20%, compared to the rate of 10% on the lower than 110 km/h speed limit roads.

Approximately 80% of the crashes at the railway level crossings involved light vehicles whereas 20% involved heavy vehicles (trucks or heavier vehicles). Majority of the fatalities, 16 out of 17, were drivers or passengers of light vehicles.

In WA, over the ten years, there were 44 crashes involving trains at railway level crossings protected by the passive signs. The passive signs were associated with 4 fatal and 7 serious injury crashes, accounting for 35% of all the fatalities at the crossings.

Over 60% of railway level crossings on public roads are protected by passive signs, of which a small number of them are located on high speed rural roads carrying low traffic volume. This traffic is usually associated with local farming population and vehicles travelling between nearby towns, or occasional visitors to the areas. Low traffic volumes on these types of remote area roads and low frequency of train movements do not warrant installation of active protections at the railway level crossings. It is quite possible that due to perceived low likelihood of conflicts between vehicles and trains, accompanied by relatively high open road speeds and possible driver fatigue drivers intentionally or unintentionally overlook the possibility of conflicts between vehicle and train movements, which may result in a vehicle-train crash with serious consequences.

It is hypothesised that some additional stimuli, other than the stimuli provided by railway level crossing warning and control signs, such as rumble strips would possibly increase driver alertness when approaching and passing over the level crossings.

A number of research studies have been conducted on the effectiveness of rumble strips including travel speed reductions (Uber & Barton, 1992), compliance to traffic control signs such as Stop sign (Dravitzki, 1998), and reduction in travel speed at intersections (Webster & Layfield, 1993). These studies were inconclusive in their findings on the magnitude of speed reductions after the installation of rumble strips, however, installation of a rumble strip on an intersection approach generally resulted in a greater number of drivers coming to a full stop. The findings of previous research suggest that installation of rumble strips on the approaches to railway level crossings may have a significant effect on driver speed behaviours and compliance to Stop or Give Way signs. A review of safety at passively controlled railway level crossings that experienced at least one fatal crash (McInerney & Evans, 2000) suggests that the most frequent contributing factors to these crashes were: train not expected, missing or inappropriate advance warning signs, visibility restrictions, prior demands on the driving task, inability to stop (including drink driving), and other reasons.

Since not all factors could be addressed by engineering type of treatments, it was suggested that some of the factors could be alleviated by the installation of rumble strips on the approaches to the crossings in order to increase driver alertness to the downstream hazards associated with a lack of compliance to the signage, Give Way or Stop signs. The installation of rumble strips as a low cost treatment for rural level crossings may be justified when low crash frequencies, traffic and train volumes do not warrant large expenditure on more sophisticated measures such as flashing lights or boom gates.

An earlier study on the effectiveness of rumble strips at railway level crossings conducted by Skinner (1971) showed a significant reduction in crashes and near miss reports on all sites under investigation over a period of 2 to 3 years. Although in recent years rumble strips have been installed at a number of railway level crossings in Victoria, no formal evaluation on their effectiveness have been reported to date.

Recently in WA a number of initiatives have been undertaken to improve safety at railway level crossing ranging from road safety audits to installation of new signs, pavement markings at all passively protected public level crossings, and the implementation of a rumble strips trial at selected passive crossings within Wheatbelt South and Wheatbelt North regions (excluding townsites where speed limits are 60 km/h or less).

The main objective of the rumble strips trial conducted by Main Roads Western Australia (MRWA) is to assess their effectiveness on the approaches to passively protected railway level crossings in rural areas of Western Australia. The effectiveness of rumble strips is measured in terms of reduction in speed indices on the approaches to the crossings, which therefore infers an increase in Stop sign and Give Way compliance. It is hypothesised that reductions in speed indices would be associated with an increase in driver alertness to downstream hazards.

2. METHODOLOGY

In Western Australia, there are approximately 1300 level crossings on public roads, of which, 6% have Half Boom Gates, 24% have Flashing Lights, 33% have Stop Signs, 28% have position signs (Give Way or similar signs with or without advance warning signs) and 9% are designated “unsigned”, having only railway “crossbuck” position signs at the crossings. In addition, there are in excess of 1500 railway level crossings on private land, almost all of which are passively protected.

Apart from four crossings on the Pemberton Tramway, there were only 21 passively protected railway level crossings on sealed, high-speed rural roads on the Government railway network. All other passive crossings are on unsealed roads, or are located in low speed environments in townsites, or near priority road intersections or T-junctions.

2.1 Study Sample

Since the rumble strips may only be installed on sealed roads, the population size from which the sample could be taken consisted of 21 railway level crossings mainly located in Wheatbelt South (7 crossings) and Wheatbelt North (9 crossings) due to practicality and the concentration of the crossings in the two regions, only the crossings within these two regions were considered for inclusion in the trial. Therefore, the sampling frame consisted of 16 railway level crossings on sealed roads where potentially rumble strips could be installed for the trial. After site investigation of each of the crossings, some railway level crossings were found unsuitable for rumble strips by being within close proximity to the townsite with low speed limits or recent realignment or upgrade of the crossings. It was considered that the installation of the rumble strips on the approaches to these crossings would not serve the intended purpose and functions of the strips, therefore, these crossings were excluded from the trial. The final sample size was reduced to 14 crossings, consisting of 7 crossings in each of the two regions. Eleven crossings in the study sample were protected by Give Way signs and three crossings were protected by Stop signs.

2.2 Location of Rumble Strips

In installing the rumble strips on the approaches to the railway level crossings, consideration was given to the design of the rumble strips with respect to the number of strips and the number of groups of strips based on expected responses from the drivers to the types of passive control at the railway level crossings (Give Way or Stop signs).

The MRWA (2005) railway level crossing policy and guidelines and Standards Australian (1993) define the fundamental differences between the required driver behavioural responses to crossings protected by Give Way signs and those protected by Stop signs. These differences are reflected in the different signing regimes. Australian Standards specify that 'RAIL X' pavement legends be marked on the approaches to all railway crossings located on roads, which have separation lines. For roads without separation lines, the pavement legend is optional. Main Roads has traditionally not installed these pavement legends due to high maintenance costs and operational factors. However, as a part of this trial, the 'Rail X' pavement legend was installed at Give Way sign posted railway level crossings regardless of whether or not the road was centre-lined, while these pavement legends were not installed in conjunction with a series of rumble strips as proposed for Stop signs due to the proliferation of markings and the possible confusion to motorists.

In line with the expected driver behavioural responses to the control signs (Give Way and Stop signs), sets of rumble strips groups were installed on the approaches to the crossings on the pavement at specified distances from the crossings. In recognition of the possibility that rumble strips may in themselves be a distraction to drivers observing approaching trains, it was decided that crossings protected by Give Way signs would be limited to a single group of rumble strips positioned before the initial 'train' warning sign.

For crossings protected by Stop signs, it was decided that four groups of rumble strips would be installed at progressively decreasing spacing extending beyond the initial warning signs towards the crossing to accentuate the need for drivers to reduce speed . The first group of strips was placed at the same distance as applied to the Give Way sign crossings, 75 m from the "train" warning sign (B metres). The second group was placed at the "train" warning sign location itself, followed by the third and fourth group of strips at the distance of 0.75B and 0.5B, respectively. The spacing for each of the sites was estimated by taking into consideration the vehicle operating speeds on the open road sections prior to the crossings of approximately 100 km/h.

2.3 Design and Installation of Rumble Strips

A review of literature indicates that various guidelines were used in the design and installation of rumble strips. From the literature research available, it was recommended that each rumble strip group be comprised of seven 150mm wide strips with 400 mm spacings between each rumble strip. The research shows that closer spacings tend to cause vehicles to 'float' over the strips at higher speeds rather than the vehicle tyres hitting the strips individually. This 'floating' effect encourages drivers to maintain higher speeds and would be disconcerting to motorcyclists.

It was suggested the rumble strips be constructed of 6 x 2 mm thick layers (total 12 mm) of yellow thermoplastic sheets with 0.06mm glass beads embedded into the upper surface of the top layer. The strips were installed across the whole carriageway width at all sites to preserve consistency between the crossings and groups of strips within the crossings that might have varying widths over the length of the installation of the groups of rumble strips.

2.4 Study Design

The study hypothesis was that the additional tyre noise and vibration generated by vehicle movement over the rumble strips would alert the driver of change in road environment ahead and as a consequence condition the driver to reduce the travel speed more than would normally be expected in absence of such strips on the pavement. If the rumble strips have an effect on driver speed behaviours, then it is expected the speed differentials between speed measurements taken at an open road section upstream from the warning signs, and various points after the point of the rumble strips would be larger than it would be expected without the rumble strips. Similarly, if all factors remained the same and the rumble strips effect drivers speed behaviours, then the differences between speed indices derived from the data collected before and after the installation of rumble strips at a selected number of points on the section of road between the rumble strips and the crossing would be expected to be significantly different from zero.

In order to test the hypothesis on effects of the rumble strips on driver speed reductions and increased alertness to the possible perceived hazards at the approaches to the railway level crossing, two sets of speed data were taken on the sample crossings, before and after installation of the rumble strips. The speed indices were derived from the data collected on six spots, three spot locations on each side of the crossings in the sample.

2.5 Speed Data Collection Locations

The before and after vehicle speed measurements were taken at three strategic locations along the road sections on each side of the crossing in the direction of vehicle travel, as follows:

- the first location at approximately 375 m from the crossing (150 m prior to the W7-7 sign and 75 m (B metres) away from the first group of rumble strips);

- the second location at 150m (at A) from the crossing (at the distance of 75 m after passing over the first group of rumble strips or just passing over the fourth group of rumble strips on the Stop sign controlled approaches); and
- the third location at the crossing in the proximity of the Give Way/ Stop sign (at Line).

2.6 Data Analysis Methodology

It was proposed that the evaluation of the effectiveness or otherwise of the rumble strips be based on measured differences in vehicle speed before and after installation. For crossings protected by Give Way signs the intention was to determine whether or not a driver has been 'alerted' to the presence of the warning signs by measuring the deceleration response of drivers. It is considered that any reduction in the prevailing speed between the approach to the rumble strips and the approach to the traffic control signs, however marginal, would signify that a driver has at least removed pressure from the vehicle's accelerator pedal, indicating some level of stimulus caused by the audio/tactile effect of the rumble strips that might be reflected in reductions of travel speed indices.

For crossings controlled by Stop signs, speed reductions would be measured between the approach to the first group of rumble strips (on an open road section), at a location immediately after passing the groups of rumble strips, and before and after the railway level crossing. This arrangement would enable measurement of the degree of speed reduction including whether or not a vehicle had in fact stopped or at least passed over the crossing at a very low speed.

The differences between the speed indices at the speed measurement spots determined from the before and after data, and differences between gradients for the speed indices along the observation sections were assessed as an indication of the rumble strips effects.

3. ANALYSIS

Two speed surveys were conducted on the sample of 14 railway level crossings. Each crossing was surveyed at 6 locations, three locations on each approach of the crossing: in the proximity of the crossing, 150 m from the crossing and 375 m from the crossing. The first survey (before survey) was conducted over the period June 2002 to March 2003, followed by the second survey over the period November 2003 to March 2004 (after survey). The "after" survey was conducted approximately six months after the installation of the rumble strips.

Speed data at each of the crossing strategic locations was collected for a minimum period of seven days in both surveys. The average number of vehicles recorded at each of the strategic locations for Give Way sign protected crossings was 6360 in the "before" survey and 5537 in the "after" survey. This corresponds to the average of 578 and 503 vehicles per location per crossing, respectively. The number of vehicles recorded at the locations controlled by Stop signs was 2806 in the "before" survey and 2140 in the "after" survey, corresponding to 935 and 713 vehicles per location per crossing, respectively. It was estimated that average daily traffic for the Give Way roads surveyed was between 60 to 70 vehicles and approximately 100 vehicles for the Stop sign roads.

For the purpose of analysis of speed data on the approach to the railway level crossing and exit from the crossing at each of the strategic locations, it was assumed that there was no significant difference in driver speed behaviours when approaching or leaving the crossing between the two road sections on either side of the crossings. Under this assumption, all directional vehicle speed data was collected at the corresponding locations on each side of the crossings and combined such that the final analysis was performed on three approach points and three exit points with respect to the railway level crossing. The three approach points in the direction of the expected decreasing mean speeds are defined by the distance from the intersection, as follows:

- A + 3B (375m from the crossing);
- A (150m from the crossing); and
- At Line (in the proximity of crossing, at or close to the control sign).

A similar definition was applied to the combined exit points, corresponding to the expected increasing mean speeds as the vehicle leaves the crossing (At Line, at A and at A+3B).

3.1 Driver Speed Behaviours at Railway Level Crossings Controlled by Give Way Signs

An analysis of the mean speeds was conducted for the sample of six strategic locations in the proximity of the railway level crossings: at a point close to the crossing, at distance A from the crossing (150m) and at A + 3B (375m), on each side of the crossing. Distribution of the mean speeds along the observed road section of approximately 750m, 375m on each side of the crossing is presented in Figure 2..

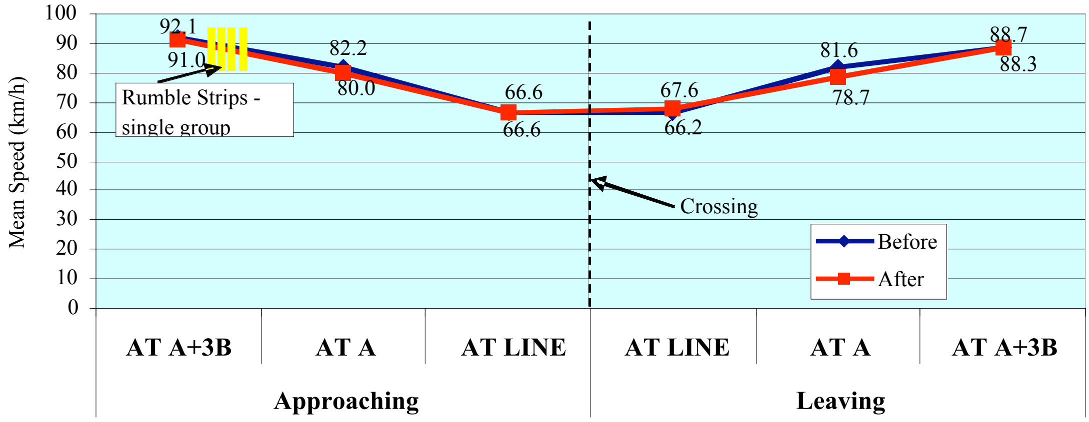

Figure 2. Vehicle mean speeds at strategic locations at the approach to end exit from the railway level crossing controlled by Give Way sign on high speed rural roads

Both surveys, "before" and "after", indicate that vehicle mean speeds gradually reduce as the vehicles approach the crossing. The difference in the mean speed from a pre-defined location on an open road section and a pre-defined location before the crossing is approximately 25 km/h, representing the reduction in the mean vehicle speed from approximately 92 km/h to 67 km/h. As the vehicles pass over the crossing the mean speeds increase to similar but slightly lower in magnitudes at the locations that correspond to the approach locations.

Analysis of the differences in mean speeds at the approach to the strategic locations suggests that, apart from the marginal differences at some locations, the distributions of the mean speeds are very similar for both surveys, before and after installation of the rumble strips. Analysis of variance, survey by location, showed a significant interaction ($p < 0.0001$) between the two factors, indicating that the differences between the survey means varied between the locations. Although the mean speed reduction shown in the "after" survey compared to the “before” survey of 2.2 km/h at the location A (150 m) is twice greater than the mean reduction of 1.1 km/h at the open road section at the location A + 3B, it may not suggest with strong confidence that the rumble strips increased driver “alertness” at the approach to the railway level crossing. On the other hand, it is possible that a small reduction in the mean speed could be a result of the single group of rumble strips which lasts only for a short period of time after which the vehicle speed increases to the “before” speed level at the location in the close proximity of the crossing. It can be argued that the purpose of the strips is not to reduce the speed at the crossing below the level expected without the strips, in which case the mean speeds would not be significantly different between the surveys, as was shown in this trial, but to increase drivers’ alertness as they approach the crossing and pass over it without stopping.

In an ideal trial case the effect of the rumble strips is detected through a substantially large reduction in mean speed at the location A followed by an insignificant change in the mean speed at the crossing. If this can be achieved, it can be concluded with reasonable confidence that the rumble strips have a significant effect on increased driver alertness to possible hazards associated with the movement of trains over the railway level crossing.

3.2 Driver Speed Behaviours at Railway Level Crossings Controlled by Stop Signs

Similar to the sample of the Give Way protected railway level crossings, the effects of the rumble strips on driver speed behaviours at the Stop sign protected crossings were measured in terms of differences in mean speeds at the six strategic locations on the approach and exit from the crossing. If the hypothesis of association between rumble strips and driver reactions to was true then it is quite likely that the magnitude of duration of the driver response would be positively related to the strength and duration of the stimuli, which in turn would be related to the quantity of strips producing the stimuli. In the case of the Stop sign protected crossings in the trial, the stimuli are produced by the four groups of rumble strips installed on the approach to the crossing within the section defined by A and A + 2B from the crossing. The groups of rumble strips were installed at progressively decreasing spacings extending beyond the initial warning signs to accentuate the need for drivers to reduce speed to a level from which the vehicle can be stopped at the crossing.

Analysis of the mean speeds at the strategic location with respect to the groups of rumble strips indicates a positive relationship between the rumble strips and driver response in terms of mean speeds measured at the open road location before the groups of rumble strips and after passing over the strips, at the crossing and beyond after passing over the crossing.

In both instances, at the approaches to the railway level crossings protected by Give Way and Stop signs, at the open road section locations, vehicle mean speeds were 1 km/h lower in the post rumble strips installation survey than the mean speeds in the prior installation survey. However, in contrast to the negligible change in mean speeds at the strategic locations of the Give Way sign protected crossings, the Stop sign controlled crossings resulted in excess of 5 km/h reduction in mean speeds at all of the five observed locations beyond the rumble strips section of the road (see Figure 3). The observed reductions in mean speeds suggest that the four-group rumble strip configuration had a significant effect on driver speed behaviours over the entire section in vicinity of the crossing and most importantly on the behaviour exhibited by the drivers on the approaches to the crossings.

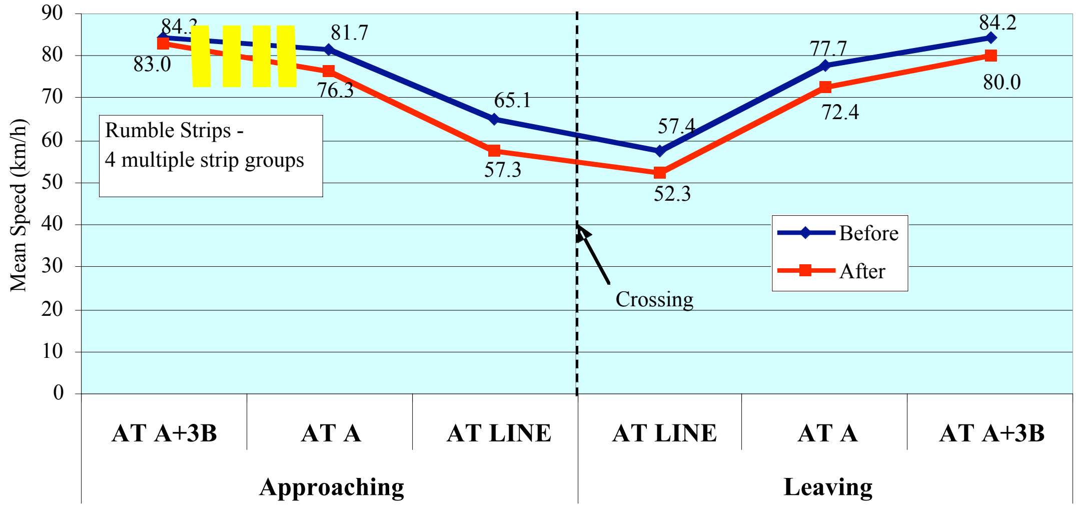

Figure 3. Vehicle mean speeds at strategic locations at the approach to end exit from the railway level crossing controlled by Stop sign on high speed rural roads

The observed reduction in the mean travel speed of 8 km/h in the vicinity of the Stop sign on the approach to the crossing and the reduction in the mean of 5 km/h at the exit from the crossing, strongly supports the inference that the reductions in travel speeds had been associated with an increase in driver alertness to the possible hazards at the crossings with an increased likelihood of stopping at the crossings and observing for possible arrival of a train prior to proceeding their journey over the crossings.

Examination of the 85th percentiles at the strategic locations with respect to the crossing showed a similar pattern in the percentile differences between the "before" and "after" speed surveys. The reductions in the 85th percentiles ranged between 2 and 5 km/h at the approach and exit sides of the crossing, respectively.

The lower mean speed, in excess of 5 km/h, on the exiting side of the crossing compared to the approaching side of the crossing, suggests that the mean vehicle speeds are expected to be lower at some point, most likely at the point of the Stop sign, than the lowest mean recorded at the exiting side of the crossing in both surveys, 57.4 km/h in the "before" survey and 52.3 km/h in the "after" survey. This difference in the mean speed appears to be associated with either the driver stopping at the Stop sign or travelling with lower speeds with caution over the railway level crossing.

3.3 Differences in Driver Speed Behaviours between Give Way Sign and Stop Sign Controlled Railway Level Crossings

Comparison of the means between the two types of controlled crossings, Give Way and Stop sign, indicates that on average drivers travel with higher speeds along the length of the Give Way controlled crossing road section than along the Stop sign controlled crossing road section (refer Figure 4). The differences significantly increased after the installation of the rumble strips, especially at the crossing itself from both sides, that is, at the approach (from 1.5 km/h to 9.3 km/h) and exit (from 8.8 km/h to 15.4 km/h).

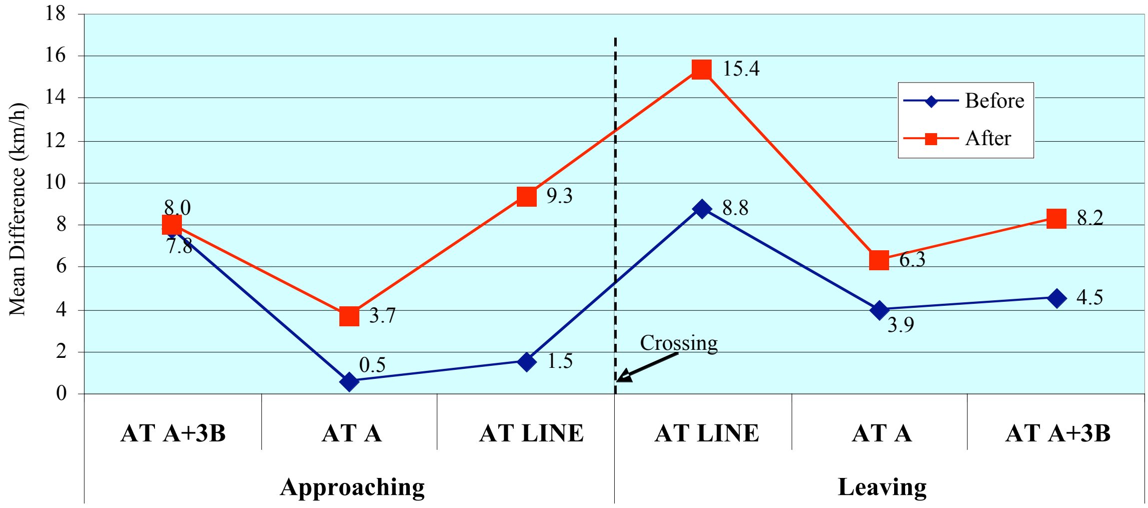

Figure 4. Mean differences between Give Way and Stop sign controlled railway level crossings at strategic locations within +/- 375 from the crossing

The analysis of the means for the strategic locations of both types of crossings indicates that the design of four rumble strips groups used in the trial for the Stop sign controlled crossings has a significantly larger effect on driver speed behaviours than the single group used for the Give Way controlled crossings. This is due to the latter resulting in a negligible change in the travel speed over the entire road section. This negligible change or negligible reduction in mean speeds at the approach to the Give Way protected crossing and at the crossing itself observed in this study may not be associated with an increase in driver alertness to the possible hazards that may arise from conflict with oncoming trains.

4. CONCLUSIONS

The analysis of the speed data collected before and after installation of the rumble strips at the approaches to the railway level crossings protected by passive signs (Give Way and Stop signs) indicates that the rumble strips significantly effect driver speed behaviours at the crossings protected by Stop signs whereas the effect is negligible, if any, at the crossings protected by Give Way signs. It appears the effect is strongly associated with the number of groups of rumble strips installed on the road pavement at the approach to the passively protected railway level crossing. The greater the number of rumble strip groups is the greater the effect is on driver speed behaviours. Although drivers are not expected to stop or significantly reduce the vehicle speed at the crossings protected by Give Way signs, a single group of rumble strips appears to be insufficient to alert drivers of possible hazards ahead as measured in terms of the reduction in speeds along the approach section between the first railway level signs encountered and the crossing itself.

Although the rumble strips were installed on local rural roads predominantly used by drivers who are likely to travel over the crossing on a regular basis and therefore perceive the crossings less hazardous than the drivers who travel through the areas less frequently, the speed indices derived in the trial suggest that the rumble strips at least in the case of Stop sign protected crossings despite the driver familiarity of the hazards play the role of an ‘alerting device’ or a ‘speed lowering device’ .

5. RECOMMENDATIONS

It is recommended that another trial be conducted on a sub-sample of Give Way protected crossings by increasing the number of groups of rumble strips by 2 or 3 groups similar to the Stop sign arrangement in order to estimate the possible optimum reduction in vehicle speeds at the approaches to the crossing to the extent of a magnitude sufficient to make driver more alert than it could be expected without the strips. It is suggested that the optimum number of groups of rumble strips would be the number that would possibly result in a significantly larger reduction in the mean speed at the location "A" when compared to the mean speed at the locations "AT LINE.

Ideally, the changes in driver speed behaviours are desirable only at the section defined by the approach to the railway level signs and the section between the groups of rumble strips and the crossing itself. The only significant reductions in speeds need to be identified at the location just after passing over the groups of rumble strips, expected to be related to driver alertness to the hazard ahead, after which vehicle speeds are expected to increase to the slightly lower magnitude observed before installation of the rumble strips, therefore not resulting in an increase in potential hazards associated with vehicle-train conflicts at the crossing.

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