Department for **Transport**

Traffic Advisory Leaflet 6/96 May 1996



Traffic Calming: traffic and vehicle noise

Introduction

Traffic calming has been shown to be valuable in modifying the speeds at which drivers choose to travel, and thus reducing levels of road accidents. However, there has been some concern that the gains might have been at the expense of the increased traffic noise and other environmental impacts.

The Driver Information and Traffic Management Division (DITM) of the Department of Transport commissioned the Transport Research Laboratory (TRL) to carry out studies of vehicle and traffic noise alongside road humps, to measure the effects.

The research shows that after the installation of road humps and speed cushions, the maximum noise levels from light vehicles (cars) are reduced. So too is the overall traffic noise level when light vehicles form most of the traffic stream. However, the effect of road humps and speed cushions on noise from large vehicle is more complex. Whilst there are some decreases in maximum vehicle noise levels from large commercial vehicles due to reductions in their speeds, this can be offset by increases in noise from the bodywork of such vehicles as they pass over the humps and cushions. The net effect of these vertical deflection measures on overall traffic noise depends on the proportion of large commercial vehicles in the traffic stream, and on the type of road hump installed.

The purpose of this leaflet is to outline the investigations carried out and the results obtained, and to offer advice on limiting adverse noise effects.



Noise Measurements

Noise measurements were made at a variety of sites in Slough and York on roads with road humps, including several types of speed cushion. These were followed up by a controlled trial on the TRL test track at Crowthorne.

The first group of measurements were made, in 1993, at a site in Slough Berkshire, where 75mm high round top asphalt humps had been installed along a residential road.

The second group of noise measurements were made in York, in 1993, on residential roads which formed part of a wider trial of the performance of speed cushions (see TA Leaflet 4/94 - Speed Cushions). Measurements were also made in 1993 and 1994 at another speed cushion site in York, Gale Lane, which was not part of the wider speed cushion trial. The speed cushion designs and layouts on the roads in York were varied: 60 to 80mm in height; 1650 to 1900mm in width, and on/off ramp gradients 1:3.5 to 1:8. Materials used were blocks, red asphalt, and moulded reconstituted rubber (see TRL Project Report 103 for details of all the York sites).

In Slough, "before" and "after" measurements were made of the maximum vehicle noise levels and the overall traffic noise levels, at and between the road humps. Similar measurements were made at and between the speed cushions in York at Gale Lane. At the other cushion sites in York, only "after" measurements of maximum vehicle noise levels were made.

Because of the limited number of large commercial vehicles present at the above sites, a controlled trial was held on the TRL track at Crowthorne in 1995. A variety of large commercial vehicles were used in the trials, selected from types found to be susceptible to body noise. The vehicles traversed two types of road hump (round and flat top), and a variety of speed cushions. For comparison purposes level road surfaces, and a ramp and a trench representing a poorly maintained surface, were used in taking measurements of maximum vehicle noise. Both types of hump were 75mm high: the flat top ones had a 1:12 on/off ramp gradient and a 6m plateau length. The speed cushions ranged from 60mm to 80mm in height and 1500 to 1900mm in width. The cushion on/off ramp gradients were generally 1:8 and side ramp gradients were generally 1:4. For further details see TRL Report 180.

Design Advice

In determining the most appropriate traffic calming measure to limit the possibility of noise nuisance, the composition of the traffic flow needs to be considered.

Where traffic flow consists predominantly of light vehicles, the effect of using road humps, (whether round top, flat top, or speed cushions) should not result in an increase either in overall traffic noise or individual vehicle noise. However, the right spacing between the devices will help ensure that noise variation does not create a nuisance. For speed cushions an ideal spacing for limiting the effects of noise variation has been found to be around 50m. No equivalent information is available for round or flat top humps: from experience it is suggested that spacings in excess of 100m are more likely to encourage drivers to accelerate between humps, thus increasing the likelihood of noise variations.

Where there is a regular flow of large commercial vehicles, and this starts to become a notable component of the overall traffic flow, the sensitivity of an area needs to receive close attention, particularly if the large commercial vehicle flow is likely to occur at unsocial hours.

In residential areas, providing the flow of large commercial vehicles is generally confined to the normal working day, round top humps seem to be the best technique for keeping noise levels to a minimum.

Where round top humps are unacceptable, for example on routes used by the emergency services, narrow cushions (up to 1600mm wide) would be appropriate. Speed cushions are less effective in reducing speeds and so resultant speeds would be higher than if road humps were used.

Where in residential areas or other sensitive locations, the large commercial vehicle content of traffic flows outside normal working hours is high, then even if the overall traffic volume is low, careful consideration needs to be given to the measures to be used. Particular problems occur, for example, where a residential road serves a depot, and large commercial vehicles require access early in the morning or late at night. Flat top humps and wide cushions are not appropriate options for these conditions. Although round top humps seem from the trial to give the most favourable results (see Figure 1), if for any reason the speeds of large commercial vehicles at the humps are likely to exceed 20 km/h then vehicle noise levels will increase significantly (see Figure 2). There is evidence to suggest that vehicles generally are driven faster at night, and without other vehicles present there may be a greater tendency for drivers of large commercial vehicles to

increase their speeds. Because of this, narrow speed cushions may be the most favourable option. Even so some noise increase may arise and this will need to be carefully weighed against the benefits of reduced speed and accidents. Investigations are currently being made into the use of narrow speed cushions on a trunk road through a village, to evaluate the maximum noise levels being generated, and this will provide further information.

It will help limit noise nuisance if speed cushions, whether wide or narrow ones, have on/off ramps no steeper than 1:8.

Results from on-road studies

Vehicle noise

An increase in noise level of 3dB(A) is about a 25% increase in subjective loudness, whilst an increase in noise level of 10dB(A) corresponds to a doubling of subjective loudness. The onroad studies in Slough and York showed that, for light vehicles, maximum vehicle noise levels are mainly determined by vehicle speed. The passage of light vehicles over road humps generated little if any additional noise.

However, it appeared from a limited set of data that the ramp gradients might have some influence on noise levels. The cushions with steep on/off ramps of approximately 1:3, appeared to result in higher noise levels. Since there are other reasons (such as the possible effect on stability of two wheeled vehicles), which mitigate against their use, it may be inadvisable to employ such steep gradients.

Overall traffic noise

The studies showed that, where the vehicle flow predominantly consists of light vehicles, with very few large commercial vehicles, daytime traffic noise levels can be reduced by the introduction of traffic calming measures such as road humps. Day-time traffic noise levels were reduced by about 3 dB(A) alongside the road humps in Slough and by about 4 dB(A) alongside the speed cushions at Gale Lane at York.

The results for night-time traffic noise levels were less clear cut. Night-time traffic noise levels alongside the road humps at the site in Slough were about 2 dB(A) higher than in the same period during the before survey, but were about 2 dB(A) lower alongside the speed cushions at Gale Lane. Night-time changes in traffic noise levels are more susceptible to the influence of noise from non-traffic sources or noise from distant heavier trafficked roads.

Although changes in overall vehicle noise levels are important when considering noise annoyance to residents, an additional factor which may also be important is the variation in noise level. The studies in York showed that, on roads with speed cushions, noise variation was highly correlated to the "speed difference". The term "speed difference" is defined as the difference between the mean speed over the cushions and the mean speed midway between the cushions. The results indicated that the closer the spacing between the cushions, the lower were both the speed difference and the noise variation, with a 50m spacing producing a very low variation in speed and noise.

Results from TRL track trials

Analysis of the results from the TRL track trials indicate that changes in traffic noise levels are related to the proportion of large commercial vehicles in the flow and the type of road hump, eg round top/flat top, or speed cushion.

Figure 1 shows the estimated change in traffic noise levels according to the type of installation. A range of traffic scenarios are included with increasing proportion of large commercial vehicles in the traffic stream. The assumed crossing speeds for each vehicle category are also shown together with the corresponding speeds prior to installation e.g. level road. The estimated change in traffic noise levels shown in Figure 1 also assumes that the total traffic flow before and after installation remains unchanged. It can be seen that the narrower cushions (1500mm -1600mm) have a better acoustic performance than wider cushions (1880mm - 1900mm) as the proportion of large commercial vehicles in the traffic stream increases. The performance of round top humps is notable in that traffic noise levels start to increase only after the proportion of large commercial vehicles exceeds about 20%.

To explain this result Figure 2 shows how the average maximum noise level for large commercial vehicles varies with speed for different road profiles. Relating the noise to the likely speed of a large commercial vehicle passing over the different road profiles showed that for wide cushions (assumed speed 24km/h) and flat top road humps (assumed speed 18km/h) there was a substantial increase of 7.9dB(A) and 6.3dB(A), respectively. For the narrow cushions (assumed speed 34km/h) there was an increase of about 2dB(A). However, for round top road humps (assumed speed of 18km/h) there was a reduction in vehicle noise of about 2dB(A). This led to a better acoustic performance than for other speed control measures, particularly as the proportion of large commercial vehicles increased. If. however, the speed of large commercial vehicles increases above the assumed speed, then as can be seen from Figure 2, the effect on maximum vehicle noise levels and the

subsequent change in acoustic performance with round top road humps would be significant. This may result in an increase rather than a decrease in vehicle noise. Such situations might occur where large commercial vehicle are present outside normal working hours, when traffic flow is light and drivers feel they can drive faster than normal.

Figure 2 also illustrates that the highest maximum noise levels from large commercial vehicles were generated when travelling over the profiles simulating poorly maintained surfaces, e.g. the "trench" and the "ramp".

In the case of buses the trial found that the effect of installing speed cushions would be to increase the individual vehicle noise levels by less than 1dB(A). For round and flat top humps, because speeds would be lower than for speed cushions, there would be a reduction in vehicle noise of about 3dB(A).



Figure 1: Estimated change in traffic noise level after installing different types of speed control measures for a range of traffic scenarios

Figure 2: Comparing average noise levels for commercial vehicles alongside different road profiles



Horizontal deflections

Although the trials referred to in this leaflet only investigated the effects of vertical deflections, the advice given on limiting noise variation along a route will generally be relevant to the situation where a series of horizontal deflections such as chicanes or pinch points are installed.

Professional and Technical Enquiries

Traffic Management Division Department for Transport 2/06 Great Minster House 76 Marsham Street London SW1P 4DR Tel: 020 79442974

References

- TRL Project Report 103 Vehicle and traffic noise surveys alongside speed control cushions in York
- TRL Report 180 Traffic Calming: Vehicle noise emissions alongside speed control cushions and road humps
- TRL Report 174 The environmental assessment of traffic management schemes: A literature review.
- TRL Report 186 Traffic Calming Road hump schemes using 75mm high humps.
- TA Leaflet 2/96 75mm high road humps
- TA Leaflet 4/94 Speed Cushions

Traffic Advisory Leaflets (TAL) are available to download free of charge on the Department for Transport website www.dft.gov.uk

Sign up for a free e-mail alert to receive notification when a new TAL is published by sending an e-mail to tal@dft.gsi.gov.uk with the subject line "subscribe".

To obtain a printed copy of this and/or other TAL's, contact: DfT Publications, PO Box 236, Wetherby, West Yorkshire, LS23 7NB. Telephone 0870 122 6236. Fax 0870 122 6237. E-mail: dft@twoten.press.net

The Department for Transport sponsors a wide range of research into traffic management issues. The results published in TAL's are applicable to England, Wales and Scotland. Attention is drawn to variations in statutory provisions or administrative practices between the countries.

Within England, enquiries should be made to: Traffic Management Division, Department for Transport, 2/07 Great Minster House, 76 Marsham Street, London, SW1P 4DR. Telephone 020 7944 2478. E-mail: tal@dft.gsi.gov.uk