Parliamentary Advisory Council for Transport Safety

**Briefing for debate on the Today Programme, May 2004**

# PACTS Research Briefing

## Road Humps should be dug up: The Case Against

Research into the effectiveness of engineering solutions to reduce vehicle speeds began in the 1970s at the Transport Research Laboratory. Initial research comprised a comprehensive track trial of different hump heights and lengths (in the direction of travel) undertaken by Watts (Watts, 1973). Numerous designs of hump varying from 50mm long by 12mm high to 3.6 metres long by 150mm high were tested. Various types of vehicle, including goods vehicles, a moped and a bus, were driven over the humps at a range of speeds. Both comfort levels of vehicle occupants and peak vertical accelerations were also assessed.

As a result of this research, the initial "standard" design hump was developed. This comprised a circular profile hump, 3.6 meters long by 100mm high. This type of hump was installed in 9 trial sites that were subsequently evaluated (Baguley, 1981).

The history of road humps can be traced through the Regulations governing their dimensions and positioning. Their usage as a speed reduction measure was permitted through an amendment to the Highways Act 1980 contained in the Transport Act 1981. Schedule 10 of the Act allows both highway authorities and the Secretary of State to construct road humps at the public expense and enables the Secretary of State to do the following

> "The Secretary of State may by regulations make such provision in relation to the construction and maintenance of road humps as appears to him to be necessary or expedient in the interests of safety and the free movement of traffic".

A number of sets of Regulations have been made by subsequent Secretaries of State that have created a more flexible approach to the dimensions of humps. The 1990 Regulations, for example, enabled local authorities to install flat-top as well as round-top humps. The current Highways (Road Hump) Regulations 1999 are perhaps the most permissive, allowing local authorities to install humps (including speed cushions) on roads with a speed limit of 30mph or less without the need for special authorisation, providing the humps are between 25 and 100 mm in height, at least 900 mm long and no vertical face is greater than 6 mm. What is important to recognise at all times is that the effectiveness (or otherwise) of road humps is built on the relationship between the height, length and distance between humps.

What may also be useful to note from the outset is the variety of humps that are currently available. The history of the round-top (circular profile) hump has been outlined above. However, this is not the only design in use. *Sinusoidal* humps are of similar dimensions but have a shallower initial rise and are considered to provide a more comfortable ride for cyclists. *Flat-top* humps provide flat crossing places and can be used with zebra or signal controlled pedestrian crossings with tactile paving. If these are used, it is important to consider the gradient of the ramp as this can affect driver or passenger discomfort, with shallower gradients reducing discomfort and allowing higher speeds. In addition, most bus companies prefer longer plateau lengths.

*Raised* junctions are a form of flat-top hump covering an entire junction.

These can also be constructed to 100 mm high to bring them close to the level of adjacent footways thereby benefiting the visually impaired. *"H" and "S"* humps attempt to provide a measure acceptable to both cars and buses. The *"H"* hump has two longer shallower outer profiles to take the tyres of buses and shorter inner steeper profiles to take cars. The *"S"* hump has an alternative ramp design eliminating some of the problems encountered with the *"H"* hump, allowing higher car speeds and being more bus friendly than conventional humps but less so than speed cushions. Finally, *speed cushions* offer an alternative to the full-size road hump, occupying part of the traffic lane and being more easily straddled by large vehicles with wide track widths such as buses and emergency vehicles.

Research into the effectiveness of different types of traffic calming measures is substantial. One of the most significant is Webster and Mackie (1996). This looked at the effect of traffic calming using 20mph zones, of which, at the time of writing, there were 200 schemes installed in the UK. The establishment of 20mph zones was encouraged by the Department of Transport as one measure towards achieving the target for road casualty reduction set for the year 2000. Funding was available at the time from the Department through the Transport Supplementary Grant when zones were being introduced to tackle a casualty problem within a specific locality. It is important to note that at that time authorisation for 20mph zones was required from the Department of Transport. The power to implement such zones has now been passed to local authorities through the Transport Act 2000.

The conclusions from the research were that

- Average annual accident frequency had fallen by about 60%
- Child pedestrian and child cyclist accidents fell by 70 and 48 per cent respectively;
- Speed data showed that average speed 'at a calming measure' was 13.2mph and 'between calming measures' was 17.8mph, with overall vehicle speeds falling by, on average, 9.3mph;
- There was a 6.2% reduction in accidents for each 1mph reduction in vehicle speed;
- Traffic flows were reduced on average by 27% in the zones and there were increases on surrounding roads of approximately 12%;
- Accident migration was not found to be a problem although care should be taken to avoid traffic transferring to unsuitable routes; and
- Overall reactions from residents were generally in favour of the schemes.

Within the zones, a wide variety of measures had been used to enforce the 20mph limit. This is important to remember in any discussion about "humps". As shown above, they come in many guises. In this study, 52% of measures were round-top humps and 30% flat-top humps which were mainly 75 or 100mm high. Raised junctions accounted for 10% and speed cushions for 4% with the remainder of measures including mini-roundabouts, chicanes and rumble strips. One key conclusion is that it is essential for a local authority to think carefully about what measures will be most appropriate in which circumstances.

Mackie (1998) also looked at the effectiveness of different urban speed management methods. The background to this study were the twin pressures on local authorities of increased demand for 20mph zones to improve safety on residential roads and the cost of implementing such schemes more widely. Mackie, therefore, looked at different means to reduce speeds including traffic calming and the use of static signs.

The key conclusion was that of all measures available, speed humps are the most effective in reducing both mean and 85$^{th}$ percentile speeds. The ranking of effectiveness was as follows:

- 20mph zones using speed humps have achieved speed reductions of around 10mph with mean speeds after installation of less than 20mph;
- Speed cameras have reduced speeds by about 5mph on average but the effect has been very localised to the installation;
- Flashing signs (often vehicle-activated) have achieved speed reductions of around 4mph on average;
- Static signs only have a very small effect;
- 20mph zones using signs only showed no reduction in injury accidents, apart from in the city of Graz in Austria where there was a 13% reduction in injury accidents although the installation programme was accompanied by an extensive publicity and enforcement campaign; and
- Traffic calming remains the best option to achieve speeds of around 20mph although in the long term in-vehicle technology to control speeds automatically may be a further option.

This study is an important one for two reasons. First, it confirms the effectiveness of traffic calming measures, however unpopular in certain quarters they may be. Secondly, it points to the need for local authorities to consider the scale of speed reduction that is being sought and to choose the most appropriate way of achieving that. Speed management is not achieved through the use of a single measure that will be equally effective in every set of circumstances.

It could be argued that the initial focus on road humps was the product of needing to deal with high-risk accident sites. The next phase must be to adopt a more strategic approach to traffic management in urban areas, similar to that set out in Urban Safety Management Guidelines (DfT, 2003). This report, co-written with TRL and the Institution of Highways and Transportation, urges local authorities to analyse road type by current and desired function and by accident type. It suggests that a three tier approach should be adopted with roads defined as Main Roads, Local Distributors and Access Roads.

Safety objectives will differ somewhat between the road types. Main roads will aim to improve capacity to take vehicles away from local distributors; safer crossing points will be provided for pedestrians and cyclists; junctions will be improved. Local distributor roads will aim to reduce through traffic, reduce speeds, protect and control parking, and provide safer crossing points and cycle paths. Access roads will be intended for low speed traffic with motor vehicle movements minimised except for residential access. The adoption of a more strategic approach could thus lead to a greater emphasis on road engineering measures to reduce speed on access roads while using different engineering solutions with a far lesser emphasis on speed reduction on main roads.

The implementation of traffic calming schemes as part of speed management policies is primarily the responsibility of the local traffic authority. In carrying out such a policy, the authority will need to take into account any guidance from the Department for Transport contained in Circulars or Traffic Advisory Leaflets.

The advice to local authorities from the Department for Transport contained in Traffic Advisory Leaflet 7/96 is clear: highway authorities need to assess the desired mean "between hump" speed in order to decide what measure to use. The information is contained in the table below.

**Appropriate Road Hump Heights for Approximate "Between Hump" Mean Speeds**

| Road Hump Type | Mean "Between Hump" Speed (approximately) 30mph | Mean "Between Hump" Speed (approximately) 20mph | Suggested maximum on/off ramp gradient |
|---|---|---|---|
| Round Top | 50mm - 75mm | 75mm | N/A |
| Flat Top | 50mm - 75mm | 75mm | 1:10 |
| Raised Junction | 50mm - 100mm | 75mm - 100mm | 1:10 |
| Cushion | 60mm - 75mm | Without other measures may not be appropriate | 1:8 |
| "Thump" | 35mm - 45mm. Up to 50mm heights have been used but may cause unneces- | Not really appropriate where low speeds are required | N/A |

In addition, it is not just the height of the hump that is important but also the spacing between humps. Traffic Advisory Leaflet 2/96 (DoT, 1996) concludes that mean speeds along a road before installation and hump spacings after installation were found to have more effect on mean "after" between-hump speeds than hump type and height (over the height range 75mm to 100mm). The table below shows the estimated spacing requirements.

**Estimated Humps Spacings to Achieve Mean "After" Speeds**

| | **Spacing** | | | | | | |
|---|---|---|---|---|---|---|---|
| | 20 | 40 | 60 | 80 | 100 | 120 | 140 |
| **Mean "Before" Speeds** | **"After" Speeds** | | | | | | |
| 20 | 13 | 14 | 15 | 16 | 18 | 19 | 20 |
| 25 | 15 | 16 | 17 | 18 | 20 | 21 | 22 |
| 30 | 17 | 18 | 19 | 20 | 22 | 23 | 24 |
| 35 | 19 | 20 | 21 | 22 | 24 | 25 | 26 |

The main point to bear in mind is that local authorities have considerable flexibility in the design and placement of road humps. That flexibility is based on a series of field trials, evaluations and research reports. It also reflects the introduction of new ideas and new solutions to local issues. As a result of this evo-

lution in thinking and design and because measures once installed last for at least several years before needing significant maintenance, it is bound to be the case that not all traffic calming measures are ones that would now be seen to be just the right kind in the right place. As with all detailed traffic engineering measures, expenditure on modifications ahead of the need for maintenance has to be justified in competition with other demands on the budget. That said, modifications should be made when the case for them is sufficiently strong.

The Regulations also require local authorities to consult with police, fire and ambulance services as well as organisations or groups representing people who use the road. This last group should include bus operators and residents of streets where humps are to be situated. Rightly, there is a reference to the need to "open up a dialogue with all interested parties to ensure that as far as possible there is consensus in favour of the scheme". However, it should also be noted that consensus often takes a long time to emerge and requires considerable skills on the part of those undertaking the consultation.

It is also important to note that traffic calming is popular with residents. TRL Report 311 reviewed forty UK and five non-UK surveys of public responses to traffic calming measures. Most of the schemes were on roads with 20 or 30 mph speed limits. Sample sizes in most studies were 50 - 500 respondents, with a maximum of 1000. The overall percentage of respondents who approved of the schemes was 65%. Not surprisingly, this varied according to the types of measures in the schemes: it was 72% for schemes including road humps; 53% for schemes including speed cushions; 59% for schemes including horizontal deflections (Webster, 1998).

None of the above is to argue that there are not legitimate criticisms of the use of road humps to reduce vehicle speeds. Local authorities do need to consider the effects on noise and emissions. Where traffic flow consists predominantly of light vehicles, the installation of road humps should reduce noise levels due to reduced speeds although noise levels may increase where there is a regular flow of commercial vehicles.

Further TRL research (Watts, 1997 and Harris, 1999) also assessed the ground-borne vibration levels generated by a range of vehicles crossing a selection of humps and cushions. This concluded that ground-borne vibration was unlikely to cause any superficial damage to buildings. However, air-borne vibration might be experienced or ground-borne vibration amplified in upper floors of buildings. This issue was considered extensively during the recent Greater London Assembly inquiry into road humps. The inquiry concluded that although there was no evidence or research to show that the presence of humps had led to increases in noise levels or structural damage to properties close to humps, there was a need to set up pilot studies across London to measure noise levels and to take photographs of the interior and exterior of houses before and after the implementation of traffic calming measures.

The other issue that is currently under-researched is the impact of traffic calming measures on vehicles. Early concerns about grounding of long wheelbase vehicles or vehicles with low ground clearance have now been resolved by the use of 75mm high humps with ramp gradients of 1:10 or shallower. Advice on avoiding grounding is contained in departmental Advisory Leaflets.

At the same time, there is some anecdotal evidence from bus companies, newspaper reports and emergency services claiming accelerated wear to suspension and tyres because of humps. It has to be said that this is hard to ver-

ify beyond individual localities. It would also be difficult to make an assessment of the effect on a private vehicle because the number of humps crossed by any individual vehicle over its lifetime would be very variable. As a result of concerns, DfT has commissioned further research that should be available shortly. This should be used as the basis of advice to local authorities and to individual road users.

Used sensitively and appropriately, road humps provide an effective way to reduce speed of traffic, whether in 20mph zones or on roads with a speed limit of 30mph. Humps have contributed to the fall in deaths and serious injuries among pedestrians and vulnerable road users. In Hull, the use of 20mph zones has led to a fall in injury accidents of approximately 56%, in fatalities of 90% and child casualties of 70%. In York, at those locations where traffic calming measures have been put in place, there has been on average a 52% reduction in crash injuries and a reduction of 11mph in mean speeds (London Assembly, 2004).

This is not to argue that every road hump in every place is perfectly placed. Rather, it is to conclude that traffic calming has a part to play in the overall management of speed in urban areas to reduce casualties and improve the quality of life for all road users.

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