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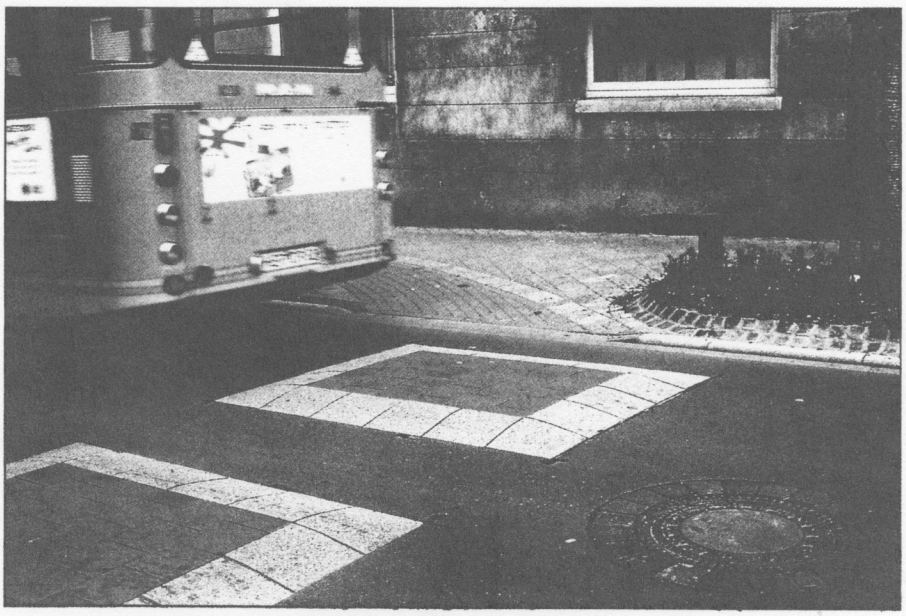
'Bus-friendly' traffic calming techniques

Tim Pharoah examines whether the use of measures for traffic calming can be 'bus-friendly', and describes how effective the 'Berlin cushion' has been in traffic calming in Herne, Germany.



Buses have no difficulty in traffic-calmed Mont Cenis Strasse, Herne; the traffic cushions shown here were built in-situ of granite stones. Note the plant bed located in former carriageway space.

TRAFFIC calming is now widely accepted as a means of achieving environmental and safety benefits in urban areas. Where maximum traffic speeds can be reduced to about 30km/h, major casualty reductions can be expected. The extent of this reduction will depend on the original speeds and accident rates, traffic composition and other factors, but a target reduction of 50% of fatal and serious injuries would be reasonable based on experience of schemes to date.

So far, traffic calming has been applied mainly to residential roads, but to make a serious impact on casualty numbers it will be necessary to moderate driving speeds and behaviour on main roads, which often account for 60-70% of urban casualties. One factor inhibiting the spread of traffic calming has been concern about the effect of speed reduction measures on bus services, which operate mostly on the main traffic routes.

Speed reduction techniques

There are up to a score of techniques which contribute to a reduction of traffic speeds on urban roads. The most effective are those involving a shift in the alignment of the carriageway, either horizontally or vertically.

Horizontal shifts can be effective if carefully designed, but invariably the driving speeds of cars through them will be higher than for buses and other large vehicles, which is the opposite of what is desirable when seeking to give priority to public transport.

Vertical shifts in the carriageway, achieved by the installation of humps or ramped changes of level, are the most effective means of achieving the desired driving speeds because they cannot be counteracted by driving skill or by inconsiderate or illegal manoeuvres. The change of level produces discomfort for vehicle occupants which increases with vehicle speed. Almost all drivers seek to minimise this discomfort and to avoid damage to the vehicle.

The unhindered speed of vehicles negotiating a street where vertical shifts have been installed and the degree of discomfort ('g' force) involved, will depend upon the following factors:

- height of the vertical shift;
- severity of the ramp (gradient/ profile);
- distance between ramps;
- vehicle and suspension design.

Buses and speed reducing ramps

The discomfort factor unfortunately means that buses and other large vehicles must negotiate ramps at speeds lower than those reasonable by cars. For buses there is the added problem that passengers are not strapped in, they may be standing, and they may not always have a firm hold. Consequently, drivers have to be cautious to avoid discomfort and potential danger to passengers. At any given speed, a person riding over a ramp in a luxury car with air suspension will suffer less discomfort than a standing passenger in a conventional bus. So again, in terms of giving buses priority over private transport, the outcome is the opposite of what is desired. Design features can, however, avoid the problems of vertical shifts on bus routes. These include overall layout of the traffic calming scheme, and the design of the vertical shifts themselves.

Scheme layout should take into account that passengers are more likely to tolerate discomfort when they value and identify with the benefits of the traffic calming scheme.

Vertical shifts may therefore be more appropriate at places of passenger concentration such as a shopping street rather than on mid-route or 'line-haul' sections. Vertical shifts also cause few problems when located at compulsory stops where the bus is in any case moving slowly.

Design of the ramps is a critical question. One approach, advocated by the British Department of Transport, is to consider using lower-profile humps, or ▶

less-severe ramps. Whilst this may lessen passenger discomfort, it also reduces the speed reduction effect, and still does not remove the undesirable speed differential between buses and cars.

Two alternative solutions have been developed in Europe, the Danish 'dual-profile hump' and the 'Berlin cushion', both of which exploit the different track width of buses and cars. The 'dual-profile hump' is probably too complex and visually intrusive for general use in urban areas. However, the 'Berlin cushion' satisfies the majority of criteria for traffic calming on bus routes.

Principle of the Berlin cushion

The aim of the speed cushion, developed originally for the Berlin Moabit traffic calming demonstration project in the early 1980s, was to limit traffic speeds without hindering vehicles which are environmentally preferred, namely cycles and buses. The answer was raised portions of carriageway whose width was limited to allow the wheels of cycles and buses to pass either side, but sufficient to ensure that cars (which have a narrower track) would unavoidably have at least two wheels passing over the raised section. In addition, because the cushion is free-standing in the carriageway, it involves no alteration to surface water drainage and so minimises the time and cost of construction.

The design of the original cushion was a raised portion of carriageway 1.8m wide and 2m long whose three-dimensional shape was that of a pyramid stump. The dimensions have been the subject of considerable research and experimentation in Germany, but the basic design has proved to be highly effective and practical, as illustrated by the experience in Herne (see below).

The cushion is a 'bus-friendly' solution because it allows the passage of buses at speeds equal to or even higher than those of cars. The width is engineered so that the front wheels and the outer rear wheels pass either side of the raised area. The inner rear wheels pass over the sloping sides of the cushion. The result is that the bus experiences little vertical movement, and less than that experienced by cars, which must negotiate the full height of the cushion with at least two wheels.

The height of cushions is also an issue. For conventional buses a height of 60 or 70mm is acceptable in terms of full-load chassis clearance. However, where low-floor buses are to be operated, a height of 50mm should be used. The speed reduction effect is maintained by an increased ramp gradient, and increased frequency of cushions in the street.

Cushion is effective

The 'Berlin cushion' has proved to be an effective device for traffic calming on bus routes. It satisfies the following criteria:

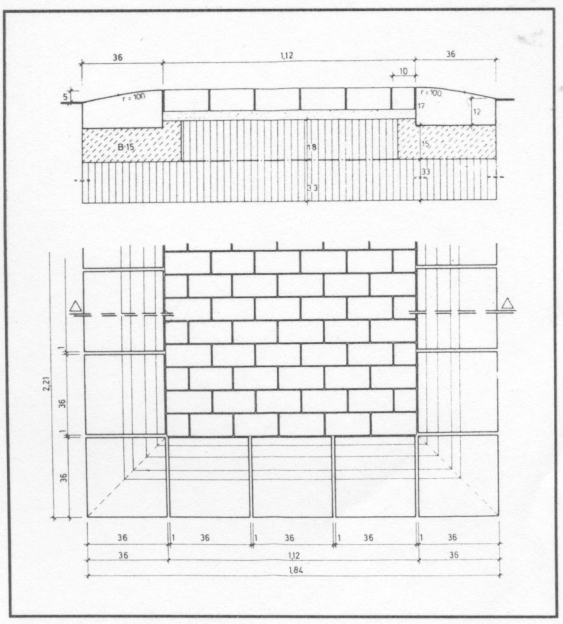
- simplicity of construction;
- self-enforcing speed reduction for car traffic;
- can be built within existing carriageway;
- minimum visual disruption;
- no disruption of surface drainage;
- no inconvenience to cyclists;
- suitable for heavy one- or two-way traffic;
- suitable for frequent repetition (low cost). ■

Tim Pharoah MSc, MRTPI, MCIT, MIHT is a consultant and Senior Lecturer in transport at South Bank Polytechnic, London.

CASE STUDY: Herne, Germany

Herne is a Ruhr town with about 170,000 people where public transport provides 15% of all trips. Mont Cenis Strasse is the main street of the Sodingen district of Herne. Despite the building of a town by-pass road, through traffic continued to use Mont Cenis Strasse as it provided a shorter route. It was decided to 'calm' the street using physical measures to slow traffic speeds, and to enhance the environment. Building started in 1987 and the first phase, including the centre of Sodingen, was completed in 1989. Phase two was completed in 1990.

The solution was to create a 'gateway' effect at either end of the street by the provision of central islands planted with trees and shrubs. Here the carriageway is narrowed to three metres each way, wide enough for buses and heavy lorries which account for 8-10% of the traffic. Greater speed reduction was needed where the street has shopping and other community activities. This has been achieved with the provision of speed cushions. The street is subject to a legal speed limit of 30km/h.



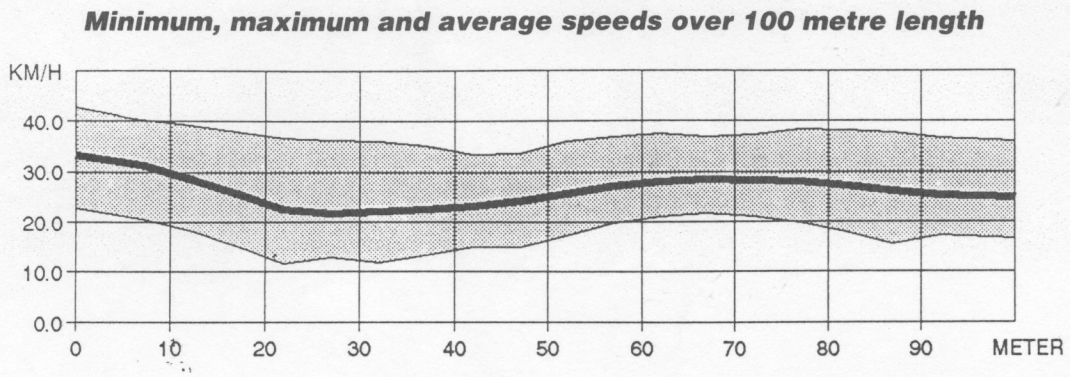
Dimensions and formation of cushions pre-fabricated by Klostermann of Coesfeld, and installed in Herne, Germany. *Courtesy Stadt Herne.*

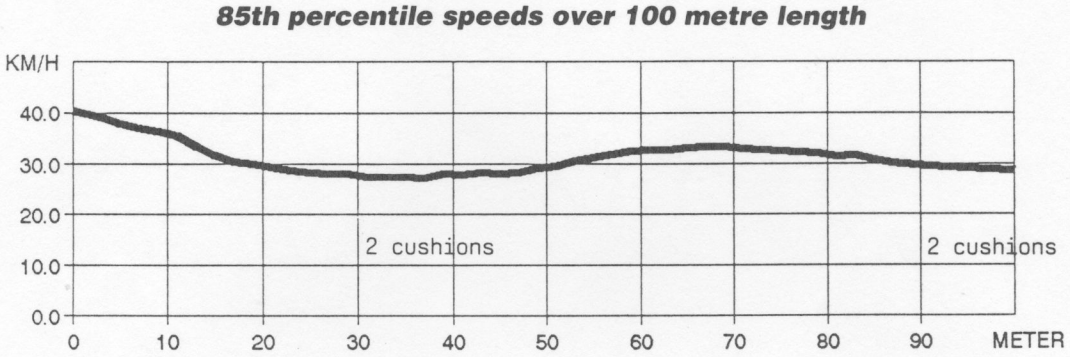
In Phase 1 the cushions were built in-situ of granite setts, but these have not stood up to the pounding by three years of heavy traffic, and the stones have begun to work loose. In Phase 2 the cushions were built from prefabricated ramps and standard concrete tile tops. These are laid on a concrete bed in a standard-depth trench. No bonding mortar is needed.

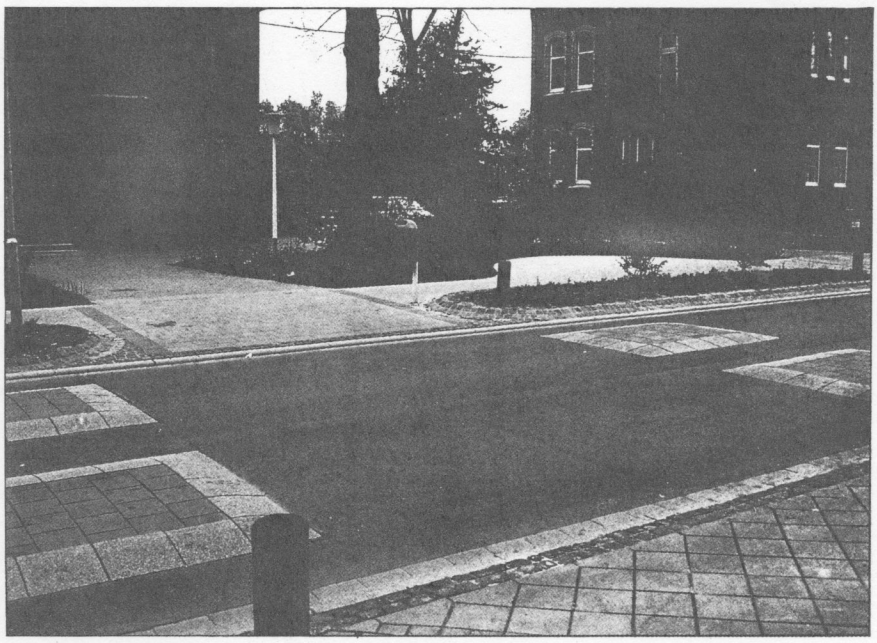
In all there are 36 cushions, arranged in nine sets of four over about half a kilometre of street length. Carriageway width is six metres where the groups of cushions are located, and seven metres where cyclists have no separate path.

Dimensions of 'Berlin cushions' can vary. The catalogue of Klostermann, the manufacturers of the prefabricated cushions in use in Herne, shows cush-

Diagrams showing minimum, maximum and average speeds (top) and speed profile (85th percentile of traffic – bottom) on a 100m section of Mont Cenis Strasse, Herne, Approximate position of cushions is shown. *Courtesy ILS Dortmund.*







Groups of four cushions provide a safe area for pedestrians to cross. Dropped kerbs also help.

ions whose plan form is square, but in Mont Cenis Strasse the cushions are lengthened by one standard stone width, creating a rectangular form with overall dimensions of 1.84 by 2.21 metres. The length needs to be greater still (more than 2.75m) for the wheels of both car axles to be on the cushion at the same time.

To meet the needs of the low floor buses that operate in Herne, the cushions are built 50mm high with speed reduction ensured by increased ramp gradient and frequency of cushions. The prefabricated ramps used in Herne have a gradient of 1:5, and the distance between sets of four cushions is no greater than 60 metres. The resulting speeds are shown in the accompanying diagram. Speeds of buses are not recorded, but they can be driven at the 30km/h speed limit.

The Herne example demonstrates a main road traffic calming scheme that is effective in reducing general traffic speeds without interfering with the operation of bus services. Pedestrians and cyclists have also benefited and the appearance of the street has been enhanced with imaginative paving and planting.

Peak-hour flows along Mont Cenis Strasse have dropped from 1,000 vehicles to 800. Even better results have been achieved with the accident cost rate, which has been reduced by 50% - a benefit largely attributed to speed reduction.

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