Code of Practice (Part 5)
Traffic Calming

IUT

Institute of Urban Transport

Ministry of Urban Development

This document has been prepared by the Transportation Research and Injury Prevention Programme (TRIPP) for the Institute of Urban Transport (IUT), Ministry of Urban Development. The primary purpose of this document is to provide code a of practice for various Urban Road Components. It has been developed in five parts. This is part five of five, which elaborates various norms and standards for traffic calming.

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1. TRAFFIC CALMING

At speeds below 30km/hr pedestrians can co-exist with the motor vehicles in relative safety. Speed management and traffic calming include techniques such as discouraging traffic from entering certain areas and installing physical speed reducing measures, such as road narrowing, roundabouts and road humps. These measures are always backed up by speed limits of 30 km/hr, but they can be designed to achieve various levels of speeds. Management of speed by engineering the road with the purpose to bring the design of the road in accordance with the desired speed is called speed management by design or traffic calming.

Traffic calming is a combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior and improve conditions for non-motorized street users.

Two main principles of for speed reducing measures

1. Visual measure (includes speed limit signs, painted strips ,plants)
2. Physical measure

1.1. AREA OF APPLICATIONS

There are various methods to influence driver and user behavior and achieve traffic calming for motorized vehicles. Each procedure in detail is discussed below:

1.2. LANE NARROWING

It can reduce the speed of cars but its effect is minimal for two wheelers. Also, in the case of bicycle lanes, there are more chances of the lane being encroached upon by the motorized vehicle due to a constricted carriageway. As a suggestion, narrowing should be indicated using lane marking instead of geometric intervention.

1.3. SPEED BREAKERS/ HUMPS

Speed breakers are commonly used to reduce speeds. However, the design and type of the speed breaker is critical. Speed breakers reduce the speed and result in an efficient traffic flow. The advantage of speed breakers is that they can be easily placed at identified locations. The degree of the effect depends upon the profile, height, gradient, length and the material used in the design.

Humps as a speed reducing device work on the basis of the slight inconvenience in the form of a jerk and vertical acceleration, caused to the driver. The driver understands that the greater the speed the higher the inconvenience, thus the general tendency to slow down. Although it is definite that humps contribute in speed reduction, the degree of its effect is known to vary with its profile, height, gradient or slope, length and material used.

The types of humps are:

1.3.1. CIRCULAR HUMPS

The profile of a circular shaped hump is based on the shape of a circular arc with a radius varying from 11m to 113m and a chord length varying from 3.0m to 9.5m to achieve the desired speed of 20km/h to 50 km/h. Circular shaped humps with rises less than the assumed 10 cm will result in higher speeds than those mentioned. Rises that are higher than 10cm may cause damage to the vehicles.

Table 1: Recommended radii and chord lengths, circular and dome shaped humps

Circular Hump			
Desired Speed	Radius	Chord Length	Bus Passage Speed
20 km/hr	11m	3.0 m	5 km/hr
25 km/hr	15m	3.5 m	10 km/hr
30 km/hr	20 m	4.0 m	15 km/hr
35 km/hr	31 m	5.0 m	20 km/hr
40 km/hr	53 m	6.5 m	25 km/hr
45 km/hr	80 m	8.0 m	30 km/hr
50 km/hr	113 m	9.5 m	35 km/hr

1.3.2. TRAPEZOIDAL HUMPS

A hump, which constitutes a 50 to 100 mm, raised, flat section of a carriageway with ramps on both sides is called a trapezoidal hump**.** Trapezoidal humps can be used to good architectural effect, for example, in connection with pedestrian crossings or squares. If designed correctly, the discomfort is moderate for cars, whereas lorries and buses must pass very slowly.

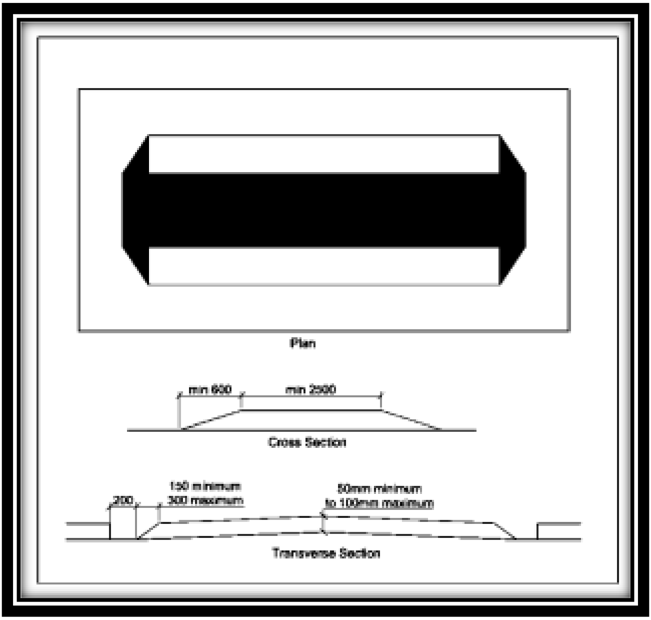


Figure 1: Trapezoidal Hump – Flat top with tapered sides

Table 2: Recommended ramp lengths and gradients for trapezoidal humps

Trapezoidal Humps				
Desired Speed	Radius	Chord Length	Bus Passage	Speed
20 km/hr	0.7 m	14.00%	-	
25 km/hr	0.8 m	12.50%	5 km/h	
30 km/hr	1.0 m	10.00%	10 km/h	
35 km/hr	1.3 m	7.50%	15 km/h	
40 km/hr	1.7 m	6.00%	20 km/h	
45 km/hr	2.0 m	5.00%	25 km/h	
50 km/hr	2.5 m	4.00%	30 km/h	

1.3.3. SINUSOIDAL HUMPS

Sinusoidal humps are circular humps where the transition from the flat surface to the cylinder surface is rounded. They are more comfortable to cross for cyclists, but are difficult to design correctly.

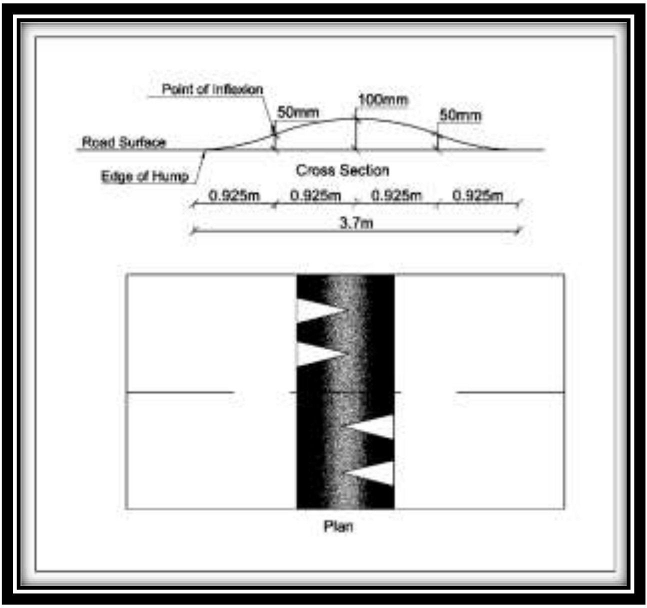


Figure 2: Trapezoidal Hump – Flat top with tapered sides

1.3.4. THUMPS

Road humps formed from thermoplastic with a width of 0.9 to 1.5m and 37mm high having a circular profile are called thumps.

Design guidelines for thumps:

It is a matter for individual authorities to determine whether thumps provide a suitable alternative to road humps in particular circumstances and along particular stretches of road. Where they are judged to be appropriate, it is suggested that the following is used as a basis for design:

Profile:

Circular. 37mm high. Thumps higher than this can be used but there does not appear to be any great advantage, and they may increase the discomfort problem.

Width:

900mm. Widths up to 1500mm are feasible: greater widths will result in lower speed reductions, though they may cause less discomfort to occupants of mini/midi buses.

Thumps need to be combined with additional measures if used in a 20mph zone. They would be ineffective on roads having speed limits greater than 30mph.

Longitudinal spacing:

Approximately 50m should result in 85th percentile speeds around 28mph.

Channel gaps:

Nominal – for drainage purposes only. At a maximum height of 37mm, cyclists and motor-cyclists can negotiate the thumps without great discomfort. With higher thumps consideration could be given to increasing the channel gaps to 750mm so that cyclists can avoid the thumps, provided the channel is not likely to be blocked by parked vehicles.

Color:

Yellow (reflectorised)

1.3.5. COMBI HUMPS

On the roads where – by means of humps – one wants to reduce both car and bus speeds to the same speed and to the same comfort level, the so-called combi-humps may be used.

A combi-hump consists of a circular hump with chord length and radius corresponding to the desired speed (see Table 2).

Combi-humps are normally used in connection with narrowing to one lane. However, they may be used as 2-lane speed reducers where the carriageway is at least 6m wide. Normally, it is not necessary to establish cycle passages in connection with combi-humps. Where it is important to cause as little inconvenience as possible to the bus traffic, combi-humps can be established according to the same principles, but with the two circular humps for buses being omitted and replaced by plane surfaces.

1.3.6. “H” HUMPS

The ‘H’ hump was first developed in Denmark. The hump is called an ‘H’ hump because the plan view of the half carriageway hump resembles the letter ‘H’. There is a practical difficulty in that because of the indentation formed by the ‘H’ it is necessary to provide additional drainage gullies to prevent water ponding. This will add to the overall cost. The ramps on the stems of the ‘H’ will also need careful construction to ensure that any side slopes do not cause difficulties to pedal cyclists or motorcyclists.

Cyclists will normally be expected to utilize the shallower outer profile. However, care will be needed to ensure that any gulley located at the foot of this ramp is placed and constructed so that it does not interfere with the smooth passage of cyclists.

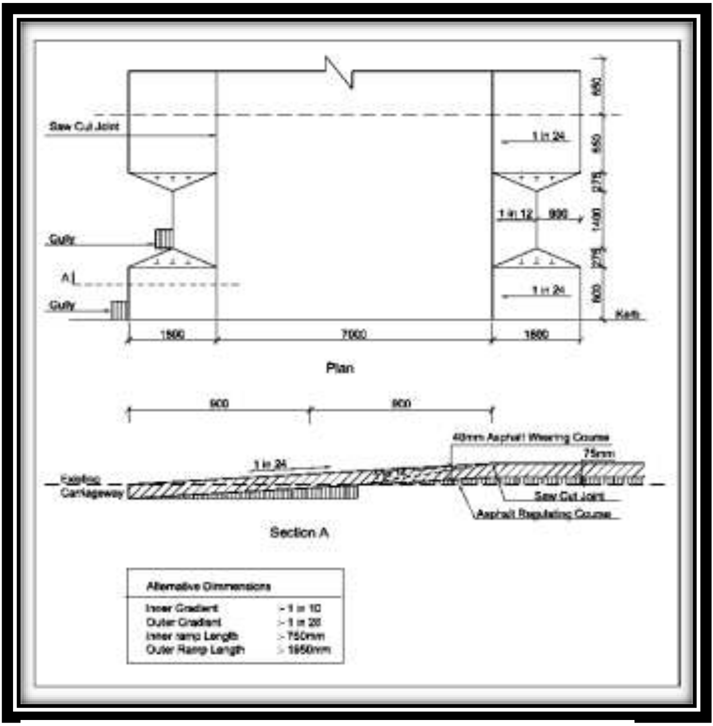


Figure 3: Trapezoidal Hump – Flat top with tapered sides

1.3.7. S HUMPS

This alternative design, because of its plan profile consisting of continuous curves, was referred to as the "S" hump.

Two of the "S" humps were used in combination with Zebra pedestrian crossings, and another in the form of a raised junction. The humps are 75mm high with a plateau length of 7m. They have minimum gradients of 1 in 33 for the outer ramps, and maximum gradients of 1 in 8 for the steep inner ramps. The "S" shape was simply cut out after the final wearing course for the plateau had been laid, the ramps being constructed after this. The base of the ramp, as illustrated in the photographs, forms a straight line across the carriageway, so that the additional drainage gullies as required for the "H" hump are not necessary.

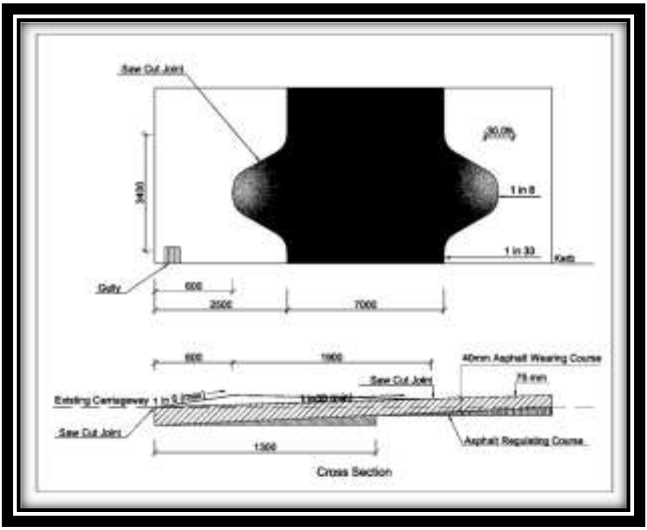


Figure 4: Trapezoidal Hump – Flat top with tapered sides

1.4. SPEED TABLES, RAISED CROSSINGS, RAISED INTERSECTIONS

These are effective methods to bring all users to a common speed limit without affecting the cyclists too much. They can be mainly used on nodes/junctions between access and arterial or access and distributor where the intervention does not affect the movement of through traffic in case of arterial and is done on the access arm.

Raised crossings are standard designs used internationally to resolve conflicts between different kinds of traffic i.e. cars and other motor vehicles, cyclists and pedestrians and are predominantly used at minor junctions, property entrances, entry and exit to service roads; to provide comfort, convenience and safety to all users.

Raised crossings are achieved by raising the motor vehicle lane to the height of the footpath so that the design benefits pedestrians and others with special mobility needs (such as wheelchairs) to walk across unhindered while crossing vehicles slow down and yield to them. Cyclists need to be accommodated to ensure similar quality and level of service as the pedestrian.

The benefits are as follows:

<u>MOTOR VEHICLES</u>

1. Conflict with other traffic is resolved.
2. It makes the car users alert to moving pedestrians and cyclists.

3. Safety is increased.

4. Since property entrances serve as entry and exit for vehicles, introducing raised crossings will also reduce conflict of the exiting vehicles with those on the carriageway.

PEDESTRIANS AND DIFFERENTLY ABLED PERSONS

Every person including those with disabilities and reduced mobility, have the right to a seamless journey from the point of origin to the destination. The pedestrians including differently-abled are the most vulnerable road users. Persons with Disability Act, 1995, provides equal opportunities, protection of rights and full participation to disabled persons; especially non-discrimination in transport and access to the built environment. The benefits of introducing a raised crossing for this category of user are as follows:

1. Since there is no negotiation in change of level, it improves walking and makes it more comfortable and convenient.

2. Makes the pedestrian alert and safe from entering and exiting vehicles.

3. It gives the utmost comfort to people with disability and follows the concept of universal design.

4. Makes the environment '*inclusive*'. Provides a continuous footpath from one intersection to other.

5. Acts as a visual indicator for change in conditions on the pedestrian path.

<u>NON-MOTORISED VEHICLES</u>

1. Like pedestrians, bicyclists are prone to conflicts with turning vehicles at speed. A raised crossing will definitely make a safer crossing because turning vehicles are forced to reduce speed.

2. Since there is a minor change of level, it improves cycling and makes it more comfortable and convenient. The level change is accommodated with a ramp of gradient 1:12-1:20.

3. It alerts the cyclists of unexpected vehicle conflicts.

4. It acts as a tactile and visual indicator for change in conditions on the path of the cyclists.

5. It provides a safer environment to the cyclists.

6. It provides a continuous cycle track from one intersection to other.

OTHER BENEFITS

1. Noise, Air Pollution and Aesthetics

   Traffic calming generally reduces traffic noise[i]. Speed reductions from 50 to 30 km/h typically reduce noise levels by 4-5 decibels[ii] or more in certain circumstances[iii]. Traffic calming can help create more attractive urban environments[iv].

2. It increases neighbourhood interaction and crime prevention.

   Traffic calming helps make public streets lively and friendly, encourages community interaction, and attracts customers to commercial areas[v]. Traffic calming is also used to discourage extreme anti-social behavior[vi]. Neighborhoods that are more difficult to drive through (narrow streets, few straight thoroughfares) have significantly less crime than those that are more permeable.

In the case of arterials and access, they can be classified in two types:

1.4.1. MAJOR CROSSINGS/RAISED PLATFORMS

If the access to the side roads is less frequent (average distance 100m-200m) the crossings can be designed with a change in elevation for the cyclist and the cars to gain a traffic calming effect. Such areas are vary from 6m – 15m in length and it is essential to do a texture change indicative for all users to assess speed reduction and caution. It increases safety for cyclists.

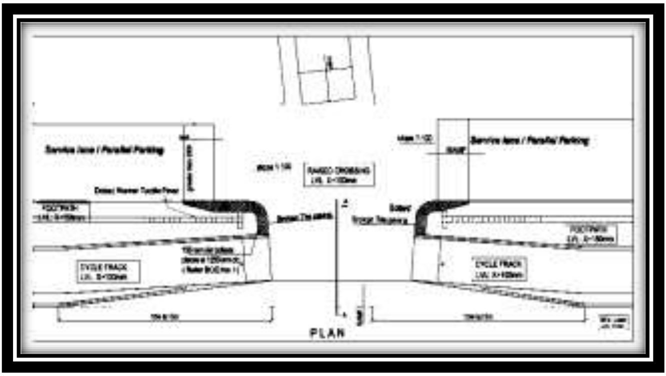
A common level for cycle track and footpath and vehicles access this through a single ramp on each side. Typically this is at the level of the pedestrian path as pedestrian (especially those with special mobility needs) convenience is given a higher priority as they are considered the weakest and the most vulnerable link in the transportation chain.

Since a segregated cycle track exists at + 75mm level from the car lanes, cycle track level is raised to the level of pedestrian path at the crossing using a 1:12 - 1:20 ramp.

The level of footpath is +150mm level from the motor vehicle lanes.

The common area is demarcated with a change in texture (80mm red interlocking tiles) so that the area acts as a visual indicator for the user (cyclist and pedestrians).

Ramps are added on all sides of vehicle access (gradient 1:10) with a surface texture change which bring them down from a speed of 50km/h (for arterial roads) to 30km/hr.



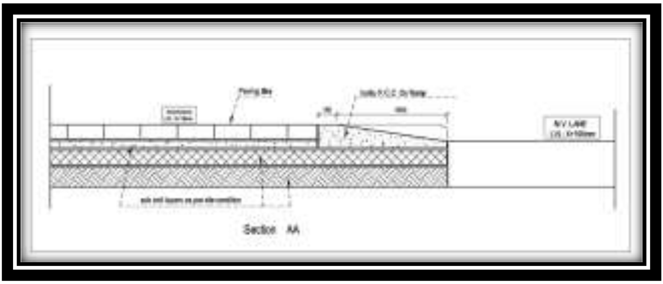


Figure 5: Raised Crossings

1.4.2. MINOR CROSSINGS/SPLIT RAISED CROSSINGS

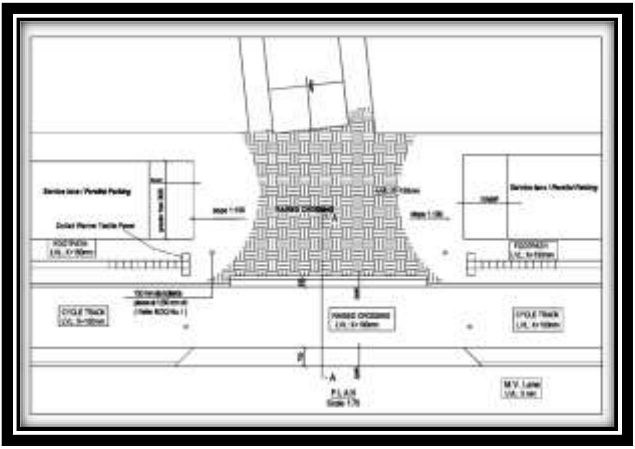
In the cities of Pune and Indore, where the access to side roads is very frequent (average distance 50m), an elevation change every 50m would be uncomfortable and unattractive for cyclists and discourage them from its usage. In such cases, no texture change or elevation change should be incorporated. Since a segregated cycle track exists at + 75mm level from the car lanes but due to frequent punctures, cycle track level is retained.

The level of footpath is +150mm level from the motor vehicle lanes.

The cars will have to enter the road in a staged manner by crossing two ramps i.e. one from the carriageway to the cycle lane and then from the cycle lane to the footpath.

No texture change in pedestrian path. However, it is recommended to give it additional support it by marking materials and signage that inform other users including cyclists to exercise caution.

Depending upon the frequency and the volume of bicyclists the type of crossing, singular or a hybrid can be used along the proposed bicycle route.



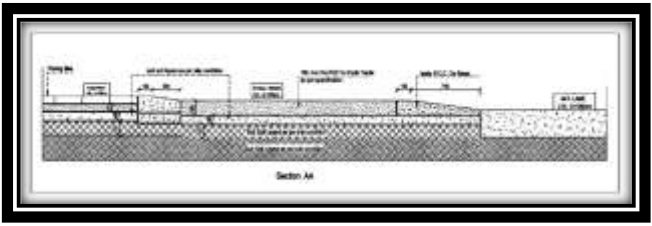


Figure 6: Split Crossings

1.5. TEXTURED PAVEMENTS

Textured pavements are effective for small cars but they need to be combined with other measures to be efficient for buses and other large sized cars. The choice of material should be uncomfortable for cyclists if used for long lengths.

1.6. ROUNDABOUTS

The design and use of roundabouts to resolve conflicts have been discussed in detail in Chapter 9.

1.7. OTHER MEASURES

There are various other measures, which are used internationally like chicanes, chokers, realigned intersections etc. However, their effectiveness on Indian roads is not clear.

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[i] Traffic Calming: Traffic and Vehicle Noise, Department of the Environment, Transport and the Regions (UK; www.roads.detr.gov.uk/roadnetwork/ditm/tal/traffic/06_96/item1.htm), 1996. in Litman T., Benefits and Costs, Evaluating Traffic Calming Benefits, Cost and Equity Impacts, Victoria Transport Policy Institute, 1997-99

[ii] Tim Pharoah and John Russell, Traffic Calming: Policy and Evaluations in Three European Countries, South Bank Polytechnic (London), February 1989. in Litman T., Benefits and Costs, Evaluating Traffic Calming Benefits, Cost and Equity Impacts, Victoria Transport Policy Institute, 1997-99

[iii] Take Back Your Streets, Conservation Law Foundation (Boston; www.clf.org), May 1995, p.27. in Litman T., Benefits and Costs, Evaluating Traffic Calming Benefits, Cost and Equity Impacts, Victoria Transport Policy Institute, 1997-99

[iv] Suzanne Crowhurst Lennard and Henry Lennard, Livable Cities Observed, Gonodolier (Carmel) 1995. in Litman T., Benefits and Costs, Evaluating Traffic Calming Benefits, Cost and Equity Impacts, Victoria Transport Policy Institute, 1997-99

[v] Suzanne Crowhurst Lennard and Henry Lennard, Livable Cities Observed, Gondolier (Carmel) 1995. in Litman T., Benefits and Costs, Evaluating Traffic Calming Benefits, Cost and Equity Impacts, Victoria Transport Policy Institute, 1997-99

[vi] Jones M., and Lowrey K., “Street Barriers in American Cities,” Urban Geography, Vol. 16, No. 2, 1995, pp. 112-122. in Litman T., Benefits and Costs, Evaluating Traffic Calming Benefits, Cost and Equity Impacts, Victoria Transport Policy Institute, 1997-99