REPUBLIC OF GHANA

MINISTRY OF TRANSPORTATION

Ghana Highway Authority
Road Safety and Environment Division

Traffic Calming Measures

Design Guideline

Version 1 / July 2007

0 INTRODUCTION

The main role of a highway is to carry long-distance motorised traffic but the road becomes part of an urban area where it passes through settlements and towns. Highway design must therefore take local traffic into account on such sections, most importantly pedestrian traffic.

The free movement and speed of through-traffic has hitherto had first priority over safety for vulnerable road users in highway design. Speed limit signs are posted but not respected by the road users and the police do not have the capacity to enforce the limits in all settlements. Accident statistics now show the consequences; pedestrians representing the vast majority of road fatalities and most of them occurring where highways pass through settlements.

It is Ghana Highway Authority's objective to improve safety for pedestrians in future road projects. The main problem is high speeds, which increase the number and severity of accidents. This also implies that speed calming can have good impact on safety at these locations.

This manual describes the different traffic calming devices that can be used on roads in Ghana, where they can be used, and how they should be designed.

1 GENERAL RECOMMENDATIONS

Several elements have to be considered when designing a traffic calming project. It should always be considered if it is possible to:

- Minimise the number of intersections / access roads
- Separate turning traffic from through traffic at major junctions.
- Make provision for sidewalks.
- Segregate pedestrians from vehicle traffic where feasible, e.g. with over-/underpasses or in signalized intersections.
- Protect pedestrian crossings with traffic calming measures that are clearly visible to drivers, e.g. by placing zebra crossings on table humps or by protecting the crossings with humps, signals or islands.
- Discourage on-road parking.
- Avoid direct access to premises from the main road by providing local service roads / distributor roads.
- Provide safe and adequate parking and stopping spaces clear of the main carriageway.
- Provide bus-bays at regular intervals.
- Ensure that new developments are well set back from the main road.
- Provide street lights.

The above elements should be considered and planned in detail before a traffic calming project is implemented. Moreover, a road accident data analysis should be carried out based on MAAP or similar software.

However, physical measures are required to encourage or force drivers to slow down to a reasonable speed through populated areas with vulnerable road users.

1.1 Location

Traffic calming devices should be placed so they do not appear unexpectedly in the street scene. Ample distance for prediction and reaction should be ensured allowing drivers to reduce speed sufficiently or, if necessary, to stop.

1.2 Markings and Signs

A speed reducer and its surroundings must be designed so that there is a clear visual difference from the rest of the stretch.

It should be ensured that the carriageway marking and road signs are perceived and observed in due time and, if necessary, pre-warnings should also be provided.

For use of signs and road markings see *"Draft Manual for Signs and Markings, 2007"* (the 1991 Signs and Markings Manual is presently under revision).

1.3 Construction Materials

In this manual some recommendations for use of materials are given. For further recommendations see *"Standard Specifications for Road and Bridge Works, 2006"*.

1.4 Types of Traffic Calming Measures

This manual recommends seven different traffic calming measures based on local experiences to be used on roads in Ghana.

1. Road Humps
2. Rumble Strips
3. Jiggle Bars
4. Raised Islands / Centre Islands
5. Narrowing the road
6. Town Gates
7. Pre-warnings

The seven measures can be divided into three groups of:

1. Vertical deflection (road humps, rumble strips and jiggle bars)
2. Horizontal deflection (raised island and narrowing)
3. Visual deflection (town gates and pre-warnings)

In the following chapters, each of the seven main types is briefly described. The application of the main types is shown in table 1.

Type of traffic calming measure	Road Class / Type				Desired Speed		
	Traffic Road			Local Road	Km/h		
	Motorway	Primary[1]	Secondary[2]		≥ 60	50	≤ 40
1. Road Humps		x	x	x		x	x
2. Rumble Strips		x	x	x		x	x
3. Jiggle Bars	x	x	x	x	x	x	x
4. Road Islands		x	x	x		x	x
5. Narrowing		x	x	x	x	x	x
6. Town Gates		x	x	(x)	x	x	x
7. Pre-Warnings	x	x	x	(x)	x	x	x

Table 1 Application of different traffic calming measures. (x) indicates that it is possible to use the measure, but often it is not necessary.

[1] National roads
[2] Inter regional and regional roads

2 ROAD HUMPS

Road humps are not a new concept in Ghana. They are used on several locations in towns and also successfully used on highways, e.g. the Takoradi - Agona road. Other existing road humps are poorly designed and constructed, often being too short and much too sharp, and they often lack proper prewarnings. Many of these humps can cause damage to tyres and suspensions, and ultimately loss of control. The road surface and the hump itself can also be damaged.

Road humps can be used on highways on approaches to and in settlements if they are well designed, marked, and maintained. Road humps are used on highways (including highways with heavy traffic) in many countries. Some of the western countries with the lowest number of accidents in the world also use road humps on highways. Well designed humps are more costly to construct but they are the most effective to prevent over-speeding.

International experience shows that road humps are one of the most simple and effective traffic calming devices. They can have a tremendous accident reducing effect at low cost if used properly.

Humps should only be used on roads with speed limits of 50 km/h or less, for instance through town/village areas with many pedestrians on highways.

They should only be used in conjunction with other elements which ensure that the road users expect them. Such elements include first and foremost the necessary markings. For instance road humps should be marked with chequer markings. For further information about signs and markings see the *"Draft Manual of Road Signs and Markings, 2007"*.

Road humps must extend over the full width of the carriageway including the hard shoulders to avoid the drivers from by-passing them.

Road humps can be used with different profiles. It is suggested that new humps should be constructed as circular humps or as trapezoidal humps. On roads with heavy bus traffic speed cushions could be used.

It is very important that humps are constructed in strict compliance with the measures listed. The best way of ensuring this is to construct them using a full size template of sawn timber.

2.1 Design of Circular Humps

For circular humps the following radius and chord length for different speed levels should be applied.

Desired Speed	Radius	Chord Length
50 km/h	113 m	9,5 m
40 km/h	53 m	6,5 m
30 km/h	20 m	4,0 m

Table 2 Recommended radii and chord lengths for circular humps.

The recommended crown height for circular humps is 10 cm for all humps. Heights less than the assumed 10 cm will result in higher speeds than those mentioned. Heights above 10 cm may cause damage to vehicles.

Figure 1 Circular Hump for 40 km/h (example from Denmark).

2.1.1 Cross sections for Circular Humps

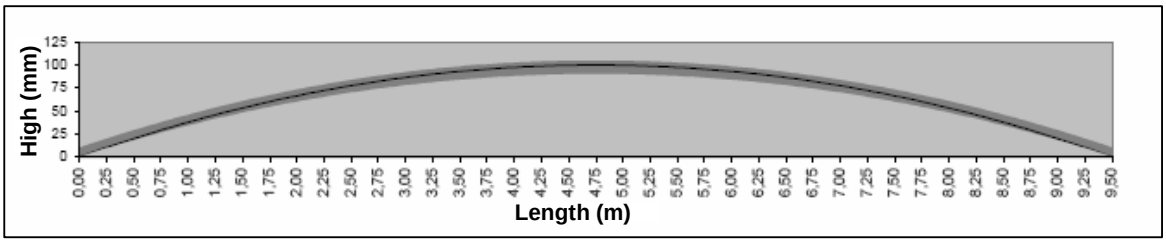


Figure 2 Cross section for circular hump designed for 50 km/h.

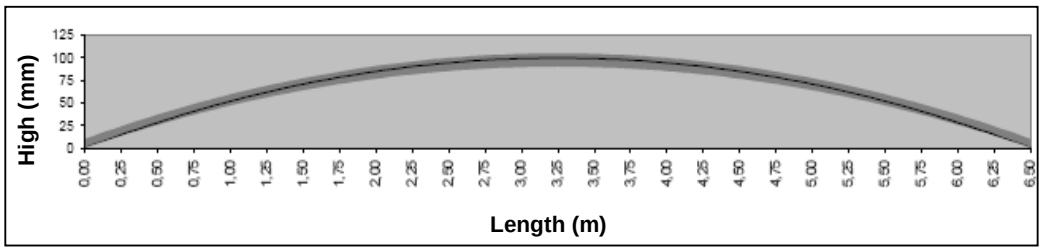


Figure 3 Cross section for circular hump designed for 40 km/h.

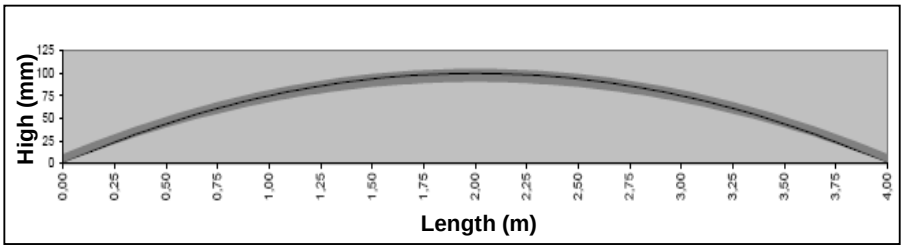


Figure 4 Cross section for circular hump designed for 30 km/h.

With this design, cars have been found to pass the humps at speeds which are 5 km/h lower on average than the desired speed. Passage at this speed will be slightly uncomfortable. Passage at a speed 5 km/h above the desired speed will be uncomfortable.

2.2 Design of Trapezoidal Humps

The basic requirements to a trapezoidal hump are almost the same as for the circular humps but the profile has changed from a circular to a trapezoidal shape, in other words a raised, flat area with two ramps.

For trapezoidal humps the following measures for different speed levels should be used.

Desired speed	Length of ramp	Length of hump[3]	Ramp height	Gradient of slope
50 km/h	1,0 m	12,0 m	7,5 cm	7,5 %
40 km/h	1,7 m	7,4 m	10 cm	6,0 %
30 km/h	1,0 m	6,0 m	10 cm	10,0 %

Figure 5 Recommended design values for trapezoidal humps.

[3] Including ramps

Figure 6 Trapezoidal Hump shaped in concrete. The new draft signs and markings standards allow for white chequer-markings instead of yellow and black markings as shown above.

2.2.1 Cross sections for Trapezoidal Humps

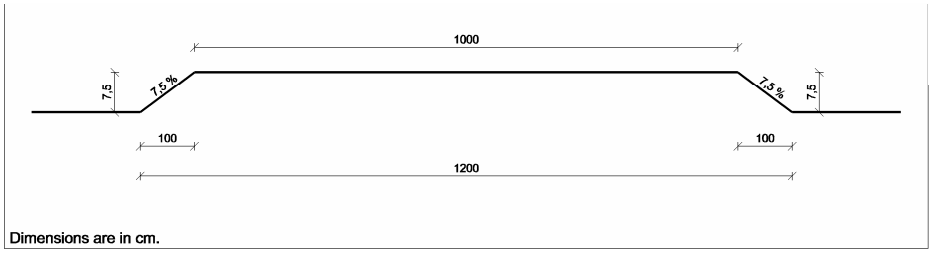


Figure 7 Recommended design for 50 km/h.

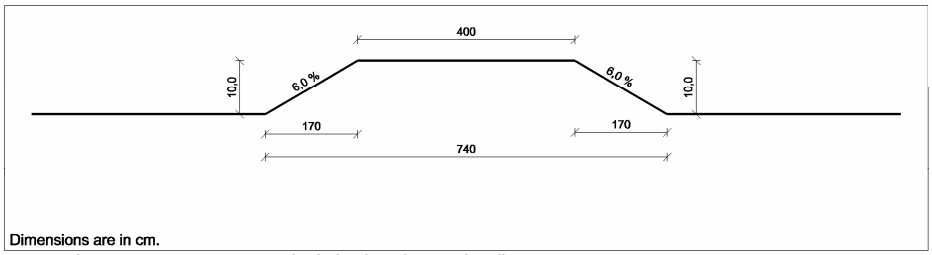


Figure 8 Recommended design for 40 km/h.

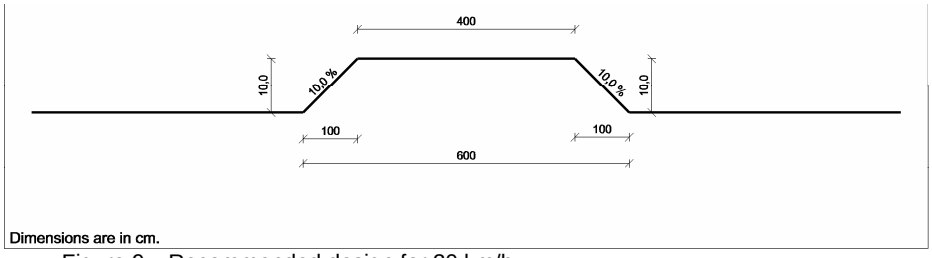


Figure 9 Recommended design for 30 km/h.

2.3 Speed cushion

On roads with bus traffic speed cushions could be installed instead of circular or trapezoidal humps.

Speed cushion causes less interference than ordinary humps to larger vehicles such as buses and trucks but still reduce the speed of cars.

A speed cushion is a form of road hump, occupying part of the traffic lane in which it is installed. The speed cushions are generally located in pairs, arranged transversely across the carriageway. The two humps in a speed cushion are constructed as two circular humps with radii and cord length as shown in table 3. The recommended crown height for circular humps in speed cushions are 10 cm.

Desired speed	Radius	Chord length
50 km/h	113 m	9,5 m
40 km/h	53 m	6,5 m
30 km/h	20 m	4,0 m

Table 3 Recommended radii and chord lengths for circular humps in speed cushions.

The widths of the circular humps and their placement next to each other are shown in figure 10 for a speed cushion designed for 40 km/h.

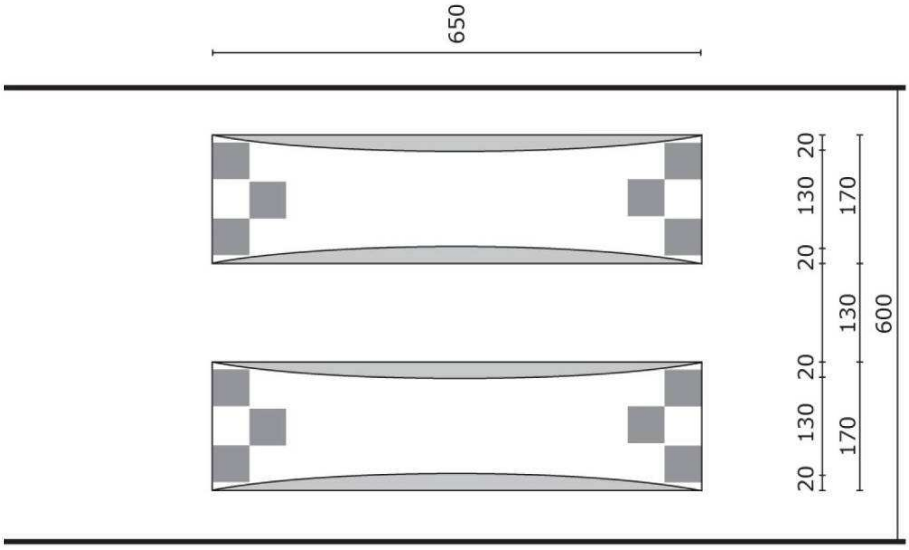


Figure 10 Geometrical design of a speed cushion for 40 km/h. Measures are in centimetres.

Transverse gaps between the base of a cushion and the kerb, as well as between adjacent cushions, should be 65 - 100 cm. To accommodate cyclists and motorcyclists the cushion should not be located adjacent to a gully

To protect motorcyclist and cyclist not to fall in the cushion, the gap between the circular humps and the road surface should be levelled with a gradient of 1:2.

2.4 Distance between humps

If it is necessary to place several humps on a stretch to keep the speed down, it is recommended to place the humps with the distance shown in table 3.

Desired speed	Distance between humps
50 km/h	250 m
40 km/h	100 m
30 km/h	75 m

Table 4 Recommended relationship between desired speed and spacing of humps.

2.5 Humps with zebra crossing

To protect pedestrians in zebra crossings, which are not regulated with traffic signals, the zebra crossing could be placed on top of a trapezoidal hump. The flat–topped speed humps are effective in slowing down vehicles sufficiently to enable pedestrian to use the crossing safely.

When a zebra crossing is placed on top of a speed hump, it is still necessary to pre-warn the vehicles about the zebra crossing and the speed hump. A simple design plan for a zebra crossing on top of a trapezoidal hump is shown below.

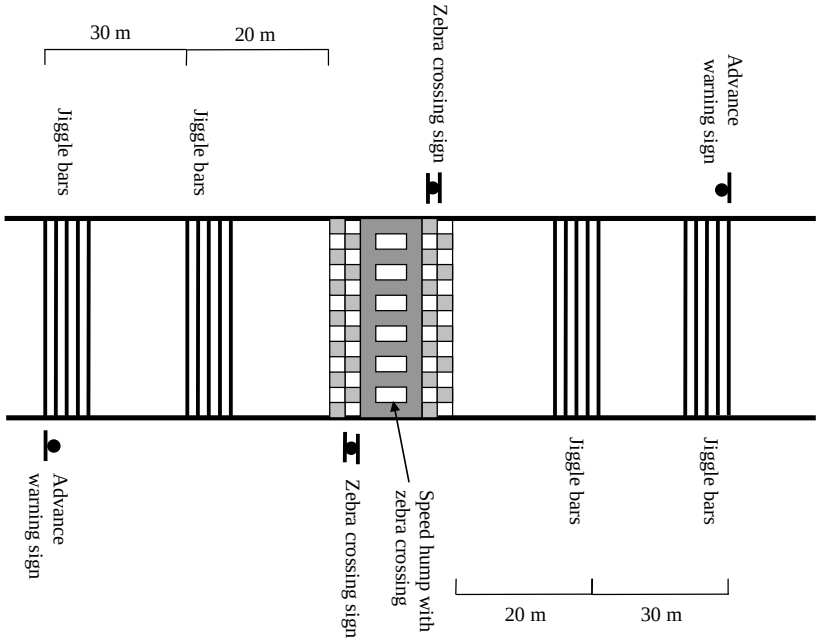


Figure 11 Example of a simple design plan for a zebra crossing on top of a trapezoidal hump.

The following principles can be applied:

- Jiggle bars 50 m before the pedestrian crossing / road hump.
- Warning sign “Road hump”, 50 m before the pedestrian crossing / road hump.
- Jiggle bars 20 m before the pedestrian crossing / road hump.
- Pedestrian crossing / road hump.
- Information sign “Pedestrian crossing” on both sides next to the pedestrian crossing / road hump.

If road humps are used in combination with a pedestrian crossing the location should be lit at night with street lights, solar studs or reflectors.

Figure 12 Zebra crossing placed on top of a trapezoidal hump in Dahwenya.

3 RUMBLE STRIPS

Rumble strips is a transverse treatment designed to cause noise and a bit discomfort when vehicles cross them. Rumble strips alert drivers and create an impression of speed. Rumble strips are unlikely to produce a major reduction in speed. However, they are very effective in combination with road-humps. Rumble strips can typically be used on the approach to villages, trading areas, dangerous intersections or road humps.

The rumble strips must extend over the full width of the road and hard shoulders to avoid the drivers from by-passing the rumble strips.

Rumble strips should be 15 - 25 mm high and made of thermoplastic, line flex, asphalt or concrete. They are usually laid in a pattern – typically 2 or 3 groups of 4 or 5 strips. Sometimes the width of the strips and the spacing (within the groups and between groups) is varied in order to make the “rumple” more noticeable, if the driver does not slow down. The recommended width of rumble strips varies between 30 cm and 50 cm. The space between the rumble strips varies between 50 and 200 cm.

Rumble strips in asphalt.

Rumble strips in thermoplastic.

Figure 13 Two examples of rumble strips.

4 JIGGLE BARS

Jiggle bars is a transverse treatment designed to cause noise when vehicles pass them. The idea is to create an impression of speed for the driver, who in turn slows down. Jiggle bars do not create a major reduction in speed but they are useful to make the driver aware of changes - for instance if the driver is approaching a build-up area, a pedestrian crossings, road humps or other hazards.

Jiggle bars should be 9 - 12 mm high. The bars are very noisy and should only be used outside urban areas. In urban areas rumble strips should be used.

The bars are made of thermoplastic or Line Flex within the following three groups:

1. Type A, which has 5 bars with a width of 100 mm and 100 mm gap.
2. Type B, which has 5 bars with a width of 75 mm and 75 mm gap.
3. Type C, which has 5 bars with a width of 50 mm and 50 mm gap.

Figure 14 Jiggle bars in yellow thermoplastic/Line Flex. White is recommended in future projects.

5 RAISED ISLAND / CENTRE ISLAND

Centre islands in connection with road staggerings and / or narrowings is a speed reducing device. They may also serve for the purpose of separating two-way car traffic and to allow pedestrians to cross the road in two stages. The pedestrians can use the island as a refuge when they cross the road.

Centre islands can be installed in connection with approaches to build-up areas to make it clear for the driver that he / she is approaching a populated area where many pedestrians cross the road.

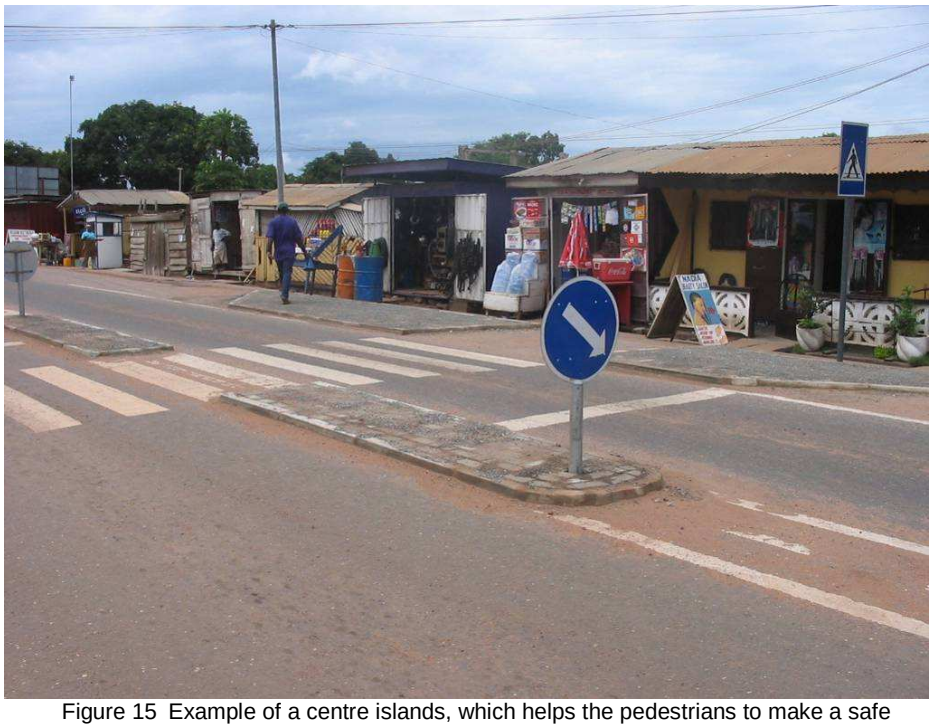


Figure 15 Example of a centre islands, which helps the pedestrians to make a safe crossing.

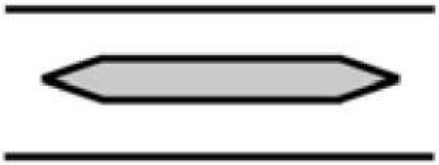
Centre islands should not be used if the speed limit is above 50 km/h.

Centre islands should be delimited by clearly recognisable kerbs to discourage drivers from attempting to cross them. It is important to take into account that there is a risk of material damage and injury if a vehicle hits a kerb with more than 30 km/h. The driver may lose control of the vehicle, either because a tyre explodes at the collision with a sharp edge or because the vehicle bounces off its course on impact. It is therefore advisable to avoid high, sharp kerbs in the design of centre islands if there is a risk of collision at speeds above 30 km/h. In such places the kerb stone should be bevelled and maximum 6 - 8 cm high.

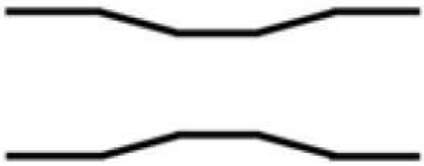
Special attention should be paid to visibility of centre islands to prevent collisions. The island and the surrounding area should be supported with sufficient signs, delineators, road markings, street lights etc. to ensure that drivers see the islands in due time. Centre islands must be pre-warned with signs 50 meters before the island. Centre islands can also be combined with rumble strips and road humps.

6 NARROWING THE ROAD

There are basically two ways of narrowing the road. The first is narrowing the road from the centre of the road; the second is narrowing from the roadside. In both cases the space available for traffic is reduced, which will encourage drivers to slow down. The drivers get a visual signal that he / she must reduce speed to negotiate the narrowing safely.



Narrowing the road from the centre.



Narrowing from the roadside

6.1 2-lane Narrowing's from Road Centre

A narrowing from the road centre is created with a centre island. The centre island should be constructed with a raised area limited with kerbs or with ghost islands limited with delineators.

6.1.1 Centre Island with Kerbs

Reference is made to Section 4 - Raised Islands / Centre Islands.

The width of the central island should be minimum 1 meter if the central island is not used as a refuge for pedestrians. If the central island is also functioning as a refuge for pedestrians, the width of the central island should be minimum 2 meters.

Narrowing the carriageway from the centre-line by construction of kerbed centre islands is mostly used on 2-lane traffic roads an can be used on roads with desired speeds of 50 km/h and less.

6.1.2 Ghost Islands with delineators

Ghost islands can be applied with painted road markings or thermo plastic and should be supported with delineators to discourage drivers from driving on or crossing the islands.

The width of a ghost island should be minimum 0.5 meters.

Ghost islands can normally be used on existing carriageways without extending the cross-section and it can be used at all speed levels. It can for instance be used in smaller settlements where the desired speed level is 70 km/h or in semi urban areas with few crossing pedestrians.

Figure 16 Examples of ghost islands with delineators.

6.2 2-lane Narrowing's from Roadside

Narrowing from roadside can be constructed with kerbs or markings. The construction principles are the same as described under "*2-lane Narrowing's from Road Centre*".

6.3 Lane widths

It is recommended to use the lane widths stated in table 5 when road narrowings are applied. The recommended widths depend on the speed limit.

Speed limit	Lane widths
60 - 80 km/h	3,50 meters
50 km/h	3,25 meters
40 km/h	3,00 meters
30 km/h	2,75 meters

Table 5 Recommended lane widths for 2-lane narrowing's for different speed limits.

7 GATEWAY TREATMENT

Town Gates are normally used on traffic roads to make a clear entrance to an area with a lower speed limit.

First and foremost a gate must function visually by means of signs, centre islands, ghost islands, humps, rumble strips, planting, change of road surface, portals, lighting etc. In addition the carriageway can be slightly narrowed.

“Gateway treatment” using signs with town name on both sides of the carriageway and other features to encourage slower driving on approach to cities, villages and small settlements is a new feature in Ghana. It is now recommended as a standard feature for relevant settlements on highways.

Below is shown an example of a town gate in Apeguso. The gate consists of double signs indicating the town name and the speed limit. Furthermore, the gate is supported by delineators and a ghost island. The drivers are here clearly warned about the settlement ahead and the need to reduce speed.

Figure 17 Example of gate signs supported with delineators.

The following practice is suggested if road humps are used in approaches to settlements:

- Jiggle bars 150 m before the town gate / road hump.
- Warning sign “Road hump”, 150 m before the town gate / road hump.
- Jiggle Bars 50 m before the town gate / road hump.
- Speed sign “50 km/h”, 50 m before the town gate / road hump.
- Road hump and sign with the town name and speed limit (both sides of the carriageway.

- 50 km/h road signs and the road humps should be repeated at regular intervals (every 250 m at 50 km/h desired speed) through the town.

In the figure below the suggested design is illustrated.

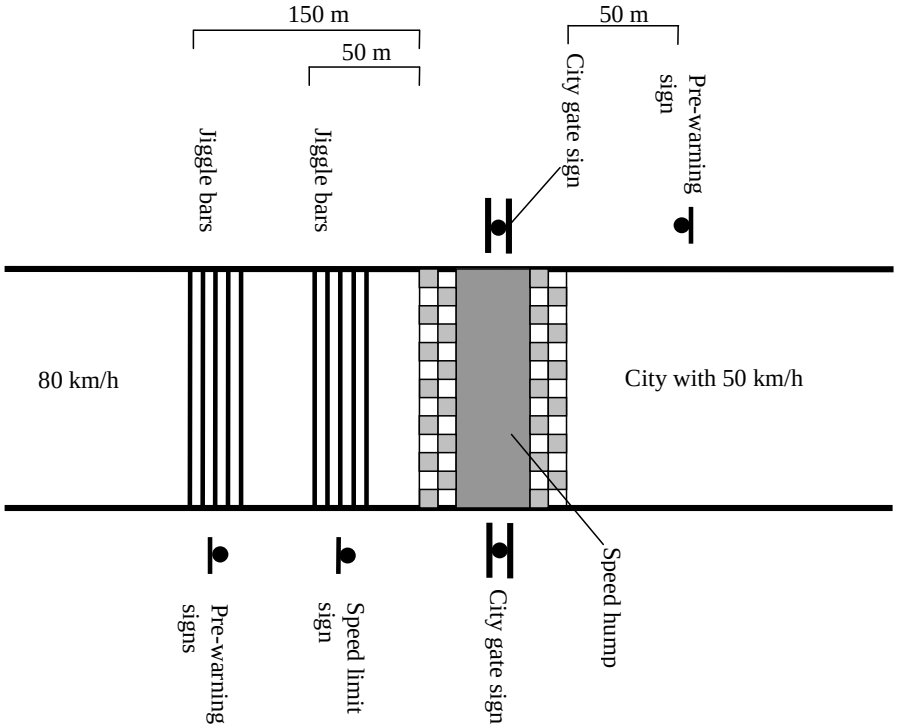


Figure 18 Principles for the use of humps in approaches to settlements.

8 PRE-WARNINGS

The purpose of pre-warnings is to warn drivers about a hazard, settlement or speed limit ahead and ensure that they are aware of the need to slow down.

A pre-warning can simply be a warning sign with the relevant information, as shown below in figure 19.

Figure 19 Prewarnings for road humps ahead (left), and jiggle bars (right).

Pre-warnings can be supplemented with a plate indicating the distance to the hazard. The prewarning for road humps can also supplemented with a plate with the text “5 humps ahead” as required.

The type of pre-warning shown in figure 20 is a new measure that is already used widely on highways. The signboard will be considered in the new version of the Signs and Markings Manual.

Figure 20 Example of a pre-warning

Pre-warnings can also be supplemented with rumble strips to alert drivers.

9 ZEBRA CROSSINGS

Zebra crossings can be placed where considerable amounts of pedestrians cross the road, or where there is a special need for protection of vulnerable road users, for instance outside schools.

Zebra crossing can not be recommended as a stand alone measure. Zebras should always be supported with speed reducers (hump, central islands, narrowing) ore traffic signals.

Pedestrian counts and crossing behaviour should always precede the design of traffic calming projects in order to ensure that speed reducing measures are placed adjacent to places where pedestrians most frequently cross the road.

The combination of zebra crossings and speed reducers should be designed, so that the cars have reduced the speed before they pass the zebra crossing. It is important to ensure that the speed reducer does not distract the driver's attention from the zebra crossing and from the pedestrians using it or approaching it.

Zebra crossings should only be placed on roads where the speed limit is 50 km/h or below and where there are physical measures to ensure that the speed level really is around 50 km/h. When the speed level is above 50 km/h other solutions should be considered, first of all pedestrian over- and underpasses. Signalised intersections, pelican crossings or roundabouts are other options.

Centre islands should be applied where zebra crossings traverse more than two lanes to give pedestrians a refuge.

Requirements for geometrical design of zebra crossings are described in the Signs and Markings manual.

Figure 21 Zebra crossing supported by centre island.