GUIDELINES ON SPEED BREAKER

Maintenance Division
Department of Roads
Ministry of Works and Human Settlement

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FOREWORD

The Department of Roads is pleased to bring out the **"Guidelines on Speed Breaker"** which would provide information and guidance on installation of speed breakers on the roads in the country. This is prepared considering similar standards and specifications in the region with special focus on road safety.

Speeding vehicle can be a menace to road users, particularly on roads where interaction between motorized and non-motorized traffic is high. Traffic calming technique is a self-enforcing traffic management approach that forces motorists to regulate their speed of travel. Such measures would improve safety and livability of a residential neighborhood or critical road stretches as the case may be.

Speed breaker is a raised area of pavement on the roadway surface that extends transversely across the pavement width and is commonly used to reduce speeds which helps in maintaining efficient traffic flow by reducing speed differences among the road users. Considering the relevancy and applicability in context to the roads in Bhutan, the design standards & procedures for the installation is included for speed hump and speed bump.

The Department hopes that this guideline will benefit all relevant agencies in providing proper guidance for the installation of speed breakers on the roads. Valuable comments and suggestions to improve this guideline are solicited. For any clarifications, users are encouraged to contact the Maintenance Division of the Department of Roads at Tel. No. 328203.

(Tenzin)
Director General
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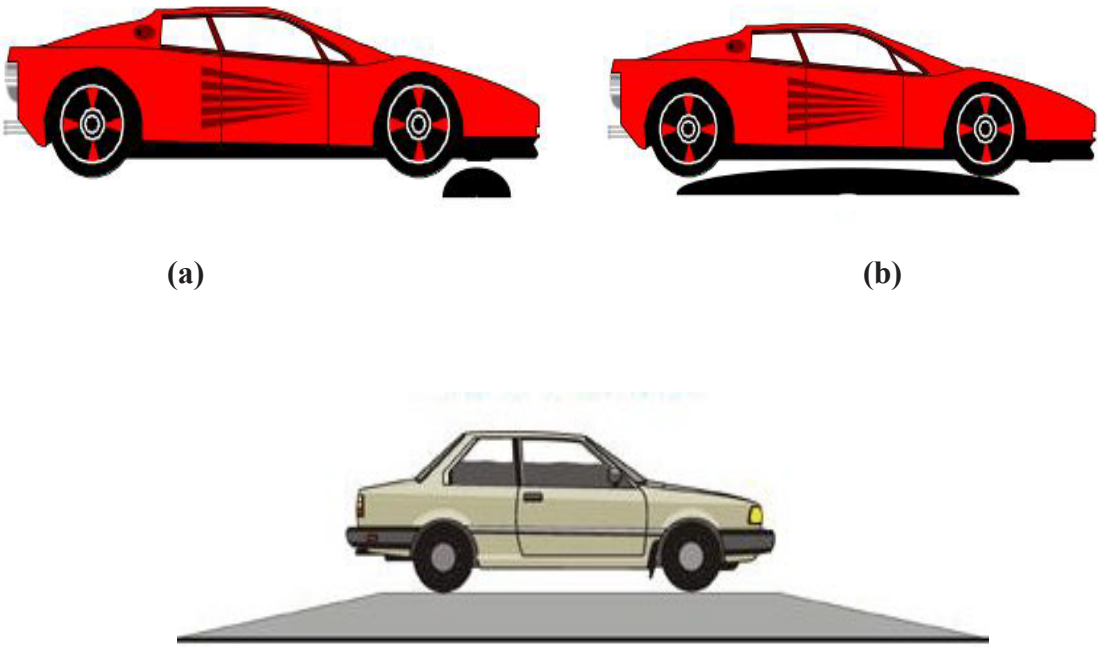
Table of Contents

1. INTRODUCTION

Speed is a significant factor in major proportion of accidents on roads. Over speeding vehicles are major concern for the community that affects neighbourhood safety and liveability due to its potential for personal injury or property damage. Enforcement of the speed limit is the most effective means for reducing speeds through traffic calming techniques. To promote orderly traffic movement and improve safety, control of speed becomes necessary on certain locations where the interactions between the motorized & non-motorized traffic is high. Some of the engineering measures to control vehicular speed includes posting of mandatory speed limit signs, use of flashing beacons to alert drivers, road markings of various types, rumble strips, and the speed breakers.

A speed breaker is a raised area in the roadway pavement surface extending transversely across the roadway which is commonly used to reduce speed in residential areas. The use of speed breaker can reduce the negative effects of motor vehicle use, alter driver behaviour, and improve conditions for pedestrians and roadway users. A speed breaker is a hump surface across the roadway having a rounded shape with width greater than the wheel base of most of the vehicles using the road. An ideally designed speed breaker should cause no damage to the vehicles nor excessive discomfort to the drivers & passengers when passing at the preferred crossing speed.

Design of speed breaker is such that vehicles are slowed down and not virtually stopped to achieve the speed reduction. The design also ensures that the vehicle with low clearance do not become grounded as they cross the speed breaker. Based on the design parameters, speed breakers are of three common types viz: speed bump, speed hump and speed table.



(a) **(b)**

(c)

Fig 1. Schematic difference between speed bump (a), speed hump (b) & speed table (c).

2. SCOPE

The speed breaker shall be used under the following three circumstances:

i. T-intersections of Farm roads with Dzongkhag Roads, characterised by relatively low traffic volumes on Farm Road but very high average operating speed and poor sight distances. Such locations have a high record of fatal accidents and as such a speed breaker on the Farm Road is recommended.
ii. Intersection of Dzongkhag Roads with National Highways, and mid-block sections in urban areas where it is desirable to bring down the speeds.
iii. Selected roads in residential areas, school, hospitals, college/university campuses, etc. Also, in areas where traffic is observed to travel faster than the regulated or safe speed in the area.

Other places where the speed breakers may be used include:

i. Any situation where there is consistent record of accidents primarily attributed to the speed of vehicles (e.g., when hazardous sections follow a long tangent approach)
ii. Approaches to temporary diversions.
iii. Approaches to weak or narrow bridges and culverts requiring speed restrictions for safety.
iv. On the minor arms of uncontrolled junctions.
v. Sharp curves with poor sight distances.
vi. Places of ribbon development, where road passes through built-up areas and vehicles travelling at high speeds are a source of imminent danger to pedestrians.

3. INSTALLATION POLICY

As per the **Road Act 2013**, **Chapter 10** (*Protection against Interference with Roads and Streets*), the installation of road humps shall be abided by the following clauses.

116. A person or any agency of a government shall not construct road humps on any road except with the authority or approval of the Department or the concerned Local Government in accordance with the rules and regulations.

117. A person or an agency of a government to whom an approval for the construction of a road hump is accorded must conform to the road hump standards prescribed by the Department.

118. Without prejudice to the foregoing provisions, if a road hump is proposed to be made by the Department or a Local Government, they shall consult with:

i. The Superintendent of Traffic Police of the area in which the road concerned is situated;

ii. The Road Safety and Transport Authority; and
iii. The Local Government in whose area the road concerned is situated and such other persons or bodies.

119. A road hump conforming to the standards and the regulations shall not be treated as constituting an obstruction to the road but as part of the road.

Further, the **Road Rules and Regulations 2016** elaborates on the proposal & installation pursuant to **Chapter 11** (*Consultation about road hump proposals*) and shall abide by the following clauses:

171. Where a person or agency of a government proposes to construct a road hump, the person or agency shall seek the approval of the Department or Local Government concerned.

172. The Department or Local Government concerned may, subject to rule 174 of these regulations, on its own accord construct a road hump.

173. The Department or Local Government concerned shall, for the purpose of rules 171 and 172 of these regulations, consult the:

i. Superintendent of Traffic Police of the area in which the road is situated;
ii. Road Safety and Transport Authority;
iii. Persons or organizations who are likely to be affected by the road hump as the Department or Local Government concerned deems fit; and
iv. Local Government in whose area the national highway concerned is situated and such other persons or bodies.

174. An approval under rules 171 and 172 of these regulations shall be made, only, if:

i. The road is subject to a speed limit as set by the Road Safety and Transport Authority;
ii. It is required for the safety of residents residing in settlements along or by the side of road or a highway;
iii. It is required for the safety of school children, where schools are located near or by the side of road; or
iv. It is required for the safety of the public or for people attending any educational institutions, or traveling to and fro from hospitals, institutions and government offices, if they located along or on a road.

Further, the Road Rules and Regulations 2016 also mentions about the nature, dimensions and location of road humps as mentioned in the following clauses:

175. The Department shall by order prescribe the standards with regard to the nature, dimension, spacing of road humps and such conditions under which the road humps are to be maintained.

176. The Department shall in stipulating standards bear in mind the road humps should be safe for emergency vehicles on duty.

177. A person or an agency of a government to whom an approval for the construction of a road hump is accorded shall construct the road hump under the supervision of the Department or Local Government concerned and shall conform to the road hump standards prescribed by the Department.

178. A road hump not made in accordance with the prescribed standards shall be immediately rectified to the satisfaction of the Department or Local Government concerned at the cost of the person or agency of a government.

4. DESIGN PARAMETERS:

The geometry of a speed breaker can affect the degree of discomfort experienced by road users and the subsequent speed controlling effect. Smoothing the initial rise of humps and smoothing the return to the road level exit can reduce the dynamic impact on vehicles. It should be stressed that vehicles travelling over road humps at appropriate speeds should not suffer damage, provided the humps conform to the hump regulations. A speed breaker can be fully described using several design parameters like length, height, width and profile.

4.1 Length

Length is the most important geometric design parameter. Effective speed breaker should be at least as long as an automobile wheelbase to isolate the effects of entering and exiting the humps for the vehicles. Longer length exhibits better characteristics for speed reduction and are suitable for the heavy vehicles too.

4.2 Height

Speed breaker heights can influence the magnitudes of vertical accelerations and the maximum levels of perceived discomfort. High height, may cause damage to vehicle and causes discomfort to the drivers & the passengers. Whereas, the low heights can be ineffective. Heights usually range from 50-120mm, with the most common being 75 or 100 mm.

(Note: The provisions outlined in the Road Act 2013 & the Road Rules and Regulations 2016 for road hump shall apply to all types of speed breaker including hump and bump).

4.3 Width

Speed breaker can either span the entire width of a road or taper short of the kerb or road edge. The advantage of the latter approach in an urban setting is that drainage at the kerb and gutter is not affected. As recommended by IRC-99:1988, the speed breaker should be extended through the entire width of shoulder supported on a proper base since some drivers have a tendency to avoid speed breaker using shoulders.

4.4 Profile

Heavy vehicles such as trucks and buses may feel greater inconvenience on passage at speed breakers due to its larger wheelbase. To facilitate appreciable and comfortable passage for larger and heavier vehicles, humps may be modified with 1.5 metres long ramps (1:20) at each edge.

4.5 Spacing

In certain locations speed breakers may have to be repeated over a section to keep speeds low throughout. More speed breakers may be constructed at regular intervals depending on desired speed and acceleration/deceleration and characteristics of vehicles. Research from several countries suggests that speed breaker should be placed between 40-60 m apart to achieve overall speed of 25-30 km/hr and greater spacing up to 100 m can be used for speeds of 50 km/hr.

5. SPEED BREAKER DESIGN

From an operational standpoint, speed bumps and humps have critically different impacts on vehicles. Speed bumps causes significant driver discomfort at typical residential operational speed ranges and generally results in vehicles slowing to about 10 km/hr or less whereas vehicle slows to about 30km/hr for speed hump. Speed table extends over longer length of roads than humps and are mostly used on road section having substantial pedestrian crossing.

5.1 Speed bump

The speed bumps are typically 75-100mm in height and 300-900 mm long. The speed bump produces substantial driver discomfort, damage to the vehicle suspension, and/or loss of control if encountered at too high speed due to its abruptness in design. Speed bumps are normally found in parking lots and or along private roadways.

Wherever if the speed bump is deemed necessary and required installation on Dzongkhag Roads, Farm Roads and the Access Roads, following geometric dimensions of speed bump shall be considered.

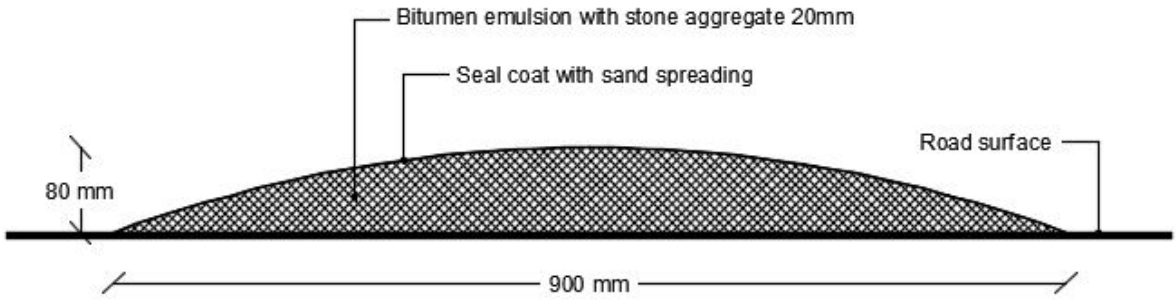


Fig.2 Speed bump dimensions to be adopted on Farm Road & Access Road

5.2 Speed hump

Speed humps are generally wider than the bump and less aggressive in controlling the traffic and are suitable for high traffic areas. Two common types of speed hump are circular hump and trapezoidal hump, where the latter is particularly suitable in providing crossing places for the pedestrians.

5.2.1 Circular speed hump

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

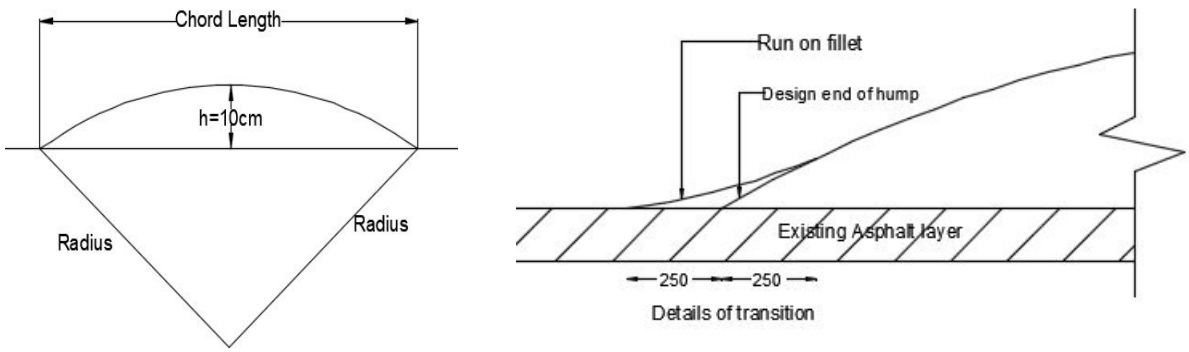


Fig.3 Geometric details of circular hump

IRC-99:2018 recommends different radii and chord length of circular hump based on the desired speed of 20 km/hr to 50 km/hr. However, two types of circular speed hump at desired speed of 20 km/hr and 30 km/hr shall be adopted on highways in Bhutan. In both the cases, the hump rise shall be 100 mm. The former can be used in town areas whereas, the latter can be used on highways where the speed reduction is deemed necessary

- At desired speed of 20 km/hr
  - Chord length: 3 m
  - Radius: 11 m

- At desired speed of 30 km/hr
  - Chord length: 4 m
  - Radius: 20 m

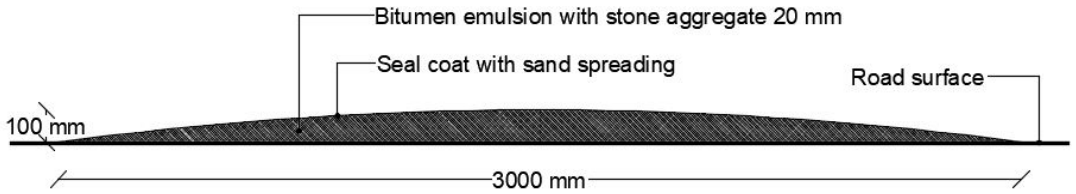


Fig.4 Standard design of circular speed hump at desired speed of 20 km/hr

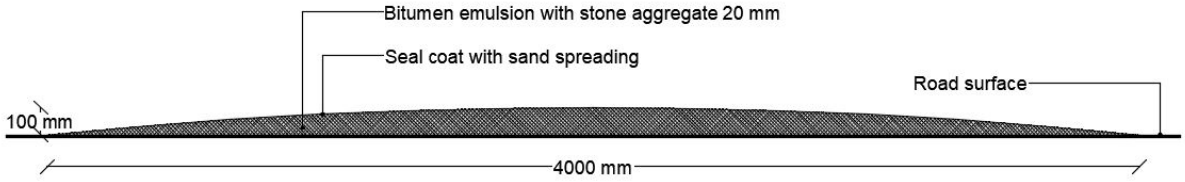


Fig.5 Standard design of circular speed hump at desired speed of 30 km/hr

5.2.2 Trapezoidal speed hump

The trapezoidal humps have a slightly raised flat section of a carriageway with ramps on both sides that can be used for pedestrian crossings. The raised section of trapezoidal hump ranges from 50mm - 100mm with minimum 2.5 m top flat portion for pedestrian crossing. Depending upon the desired speed of 20km/hr to 50km/hr, length of ramp may vary from 0.7 - 2.5 m and accordingly gradient also varies from 14% to 4% respectively.

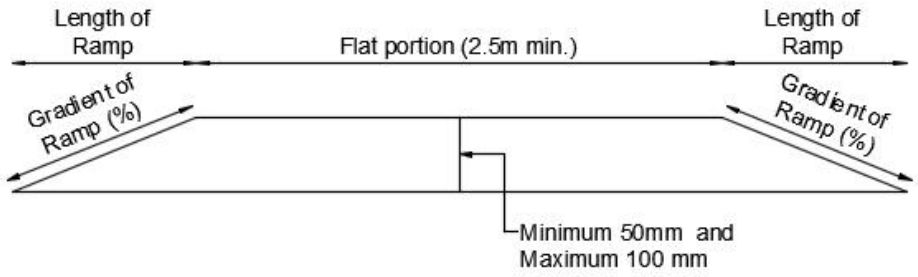


Fig. 6 Geometric details of trapezoidal speed hump

For the installation of trapezoidal speed hump, two types based on the desired speed of 20 km/hr and 30 km/hr shall be adopted. The hump rise considered for both these trapezoidal speed humps is 100 mm.

- At desired speed of 20 km/hr
  - Ramp length: 0.7 m on either side
  - Gradient: 14%

- At desired speed of 30km/hr
  - Ramp length: 1.0 m on either side
  - Gradient: 10%

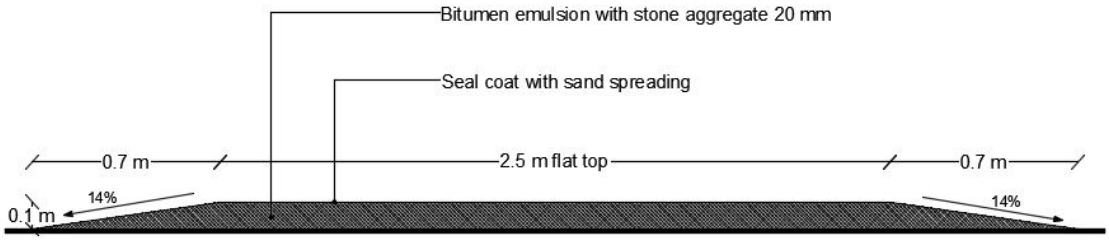


Fig. 7 Standard design of Trapezoidal speed hump at desired speed of 20 km/hr

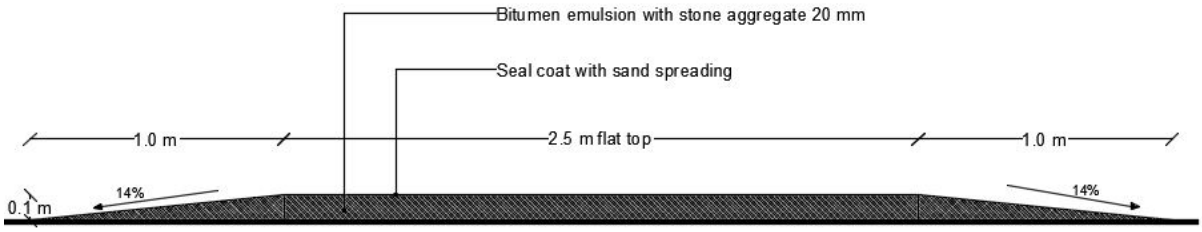


Fig. 8 Standard design of Trapezoidal speed hump at desired speed of 30 km/hr

6. PLACEMENT OF SPEED BREAKERS

The pattern of placement of speed breakers depends upon the location as mentioned below:

i. At T-intersections, speed breakers should be installed on minor roads or perpendicular arms about 10 metres away from the inner edges of major roads. On sharp curves, available sight distances guide the placement and number of speed breakers.
ii. For undivided carriageway, speed breakers should invariably be extended over the entire carriageway width including shoulders.
iii. Speed breakers are normally not provided on bridges. However, where frequent accidents have been reported or the bridges are on curves or they are narrow, either approach must have one speed breaker each.
iv. Speed breakers shall be placed in locations where drivers have adequate sight distance to see vertical deflection on the roadway surface, and avoid conflict with other transportation and utility infrastructures.

7. CONSTRUCTION SPECIFICATION FOR SPEED BREAKERS

The IRC-99:1988 recommends the following procedures for the installation of speed breaker.

i. Speed breakers are laid by first marking the location of hump/bump on the pavement and marking indents in this area for proper bonding.
ii. Surface is then cleared of all dust and loose particles and a tack coat is applied.
iii. Forms of requisite heights, shape and width are then placed, and bituminous material is poured to the required depth and shape.
iv. Forms are then lifted and the surface finished to required shape, and edges rounded by trowel.
v. The premixed material should be well compacted before opening to traffic. Allowance should be made for compaction, and irregularities should be corrected using bituminous materials having fine aggregate or by scrapping, as necessary.
vi. The material is then allowed to cure before opening to traffic. Arrangements for proper drainage of the speed breakers must be made to prevent formation of ponds and puddles.

8. SUITABILITY OF SPEED BREAKER TYPE

The following table shall be referred for the installation of suitable speed breaker type on different categories of road.

Table 1. Suitability of speed breaker on different types of roads.

Type of Speed breaker	Type of Road				
	National Highways	Dzongkhag Roads	Farm Roads	Thromde Roads	Access Roads
Circular Speed hump	✓	✓	✓	✓	✓
Trapezoidal Speed Hump	✓	x	x	✓	x
Speed Bump	x	✓	✓	x	✓

9. MARKINGS ON SPEED BREAKER & SIGNAGE

The markings on speed breakers are necessary to warn driver about the hazard ahead in advance. Speed breakers should be painted with alternate black and white bands to give additional visual warning. For better visibility, it is desirable to use alternate black and yellow bands. To enhance night visibility, the markings shall be made with retro-reflective and reinforced with road studs. The markings on the speed hump comprises two rows of chequer markings consisting of alternate black and white bands of 500 mm width and the triangular markings of 750 mm base width with maximum apex height of 1850 mm for circular speed hump. Speed breaker markings shall be supplemented with advance warning sign which is 40 m in advance of the speed breaker as per IRC-99:1988. The speed limit signage for particular geometric design of speed breaker shall also be posted near that particular speed breaker facing the direction of the traffic (fig.12). For the dimensions of the speed limit signs for different categories of road, following tables shall be referred.

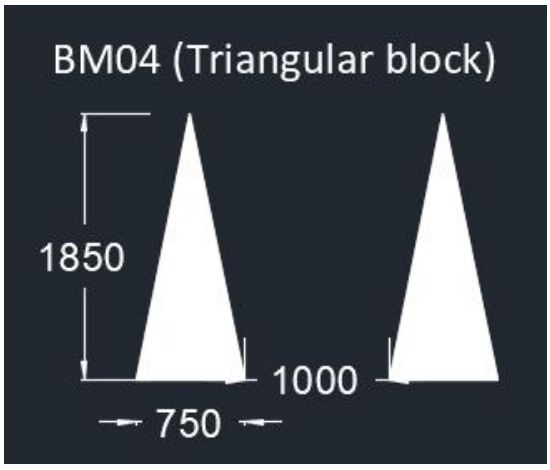
Table 2. Size and dimension of speed limit signs on different types of roads

Types of Roads	Size (Diameter) in mm	Font size (mm)
Asian/National Highways	600	200
Thromde Roads	450	150
Dzongkhag & other roads	300	100

Table 3. Size, dimension & background colour of speed limit signs

Letter/Number	**Size**
SPEED LIMIT	50mm
20	200mm
Km/hr	50mm
Border width	65mm
	Colour
Border	Red
Background	White
Letter/Number	Black

Fig.9 Speed limit sign



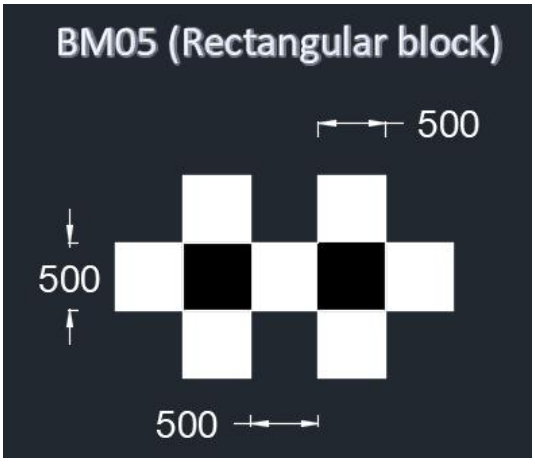


Fig.10 Block Markings (BM) as per IRC-35:2015

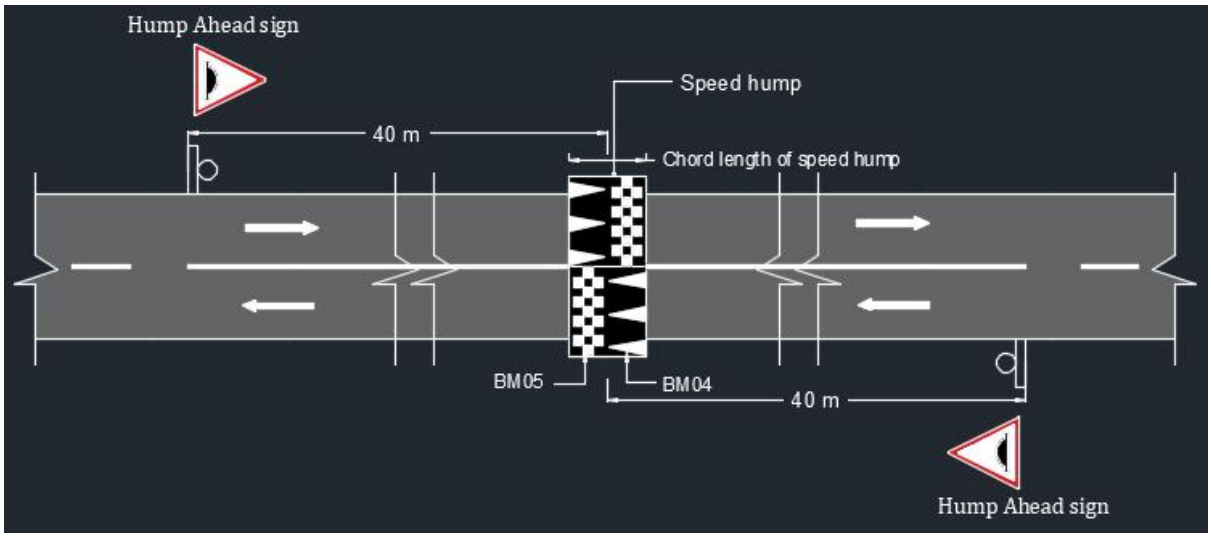


Fig.11 Marking for circular speed hump

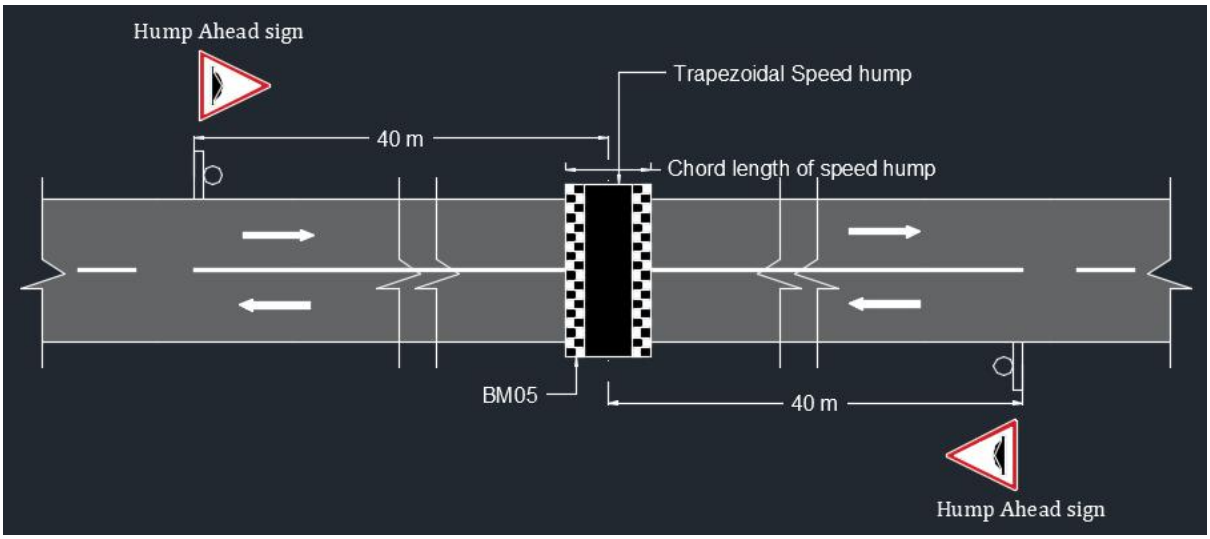


Fig.12 Marking for trapezoidal speed hump

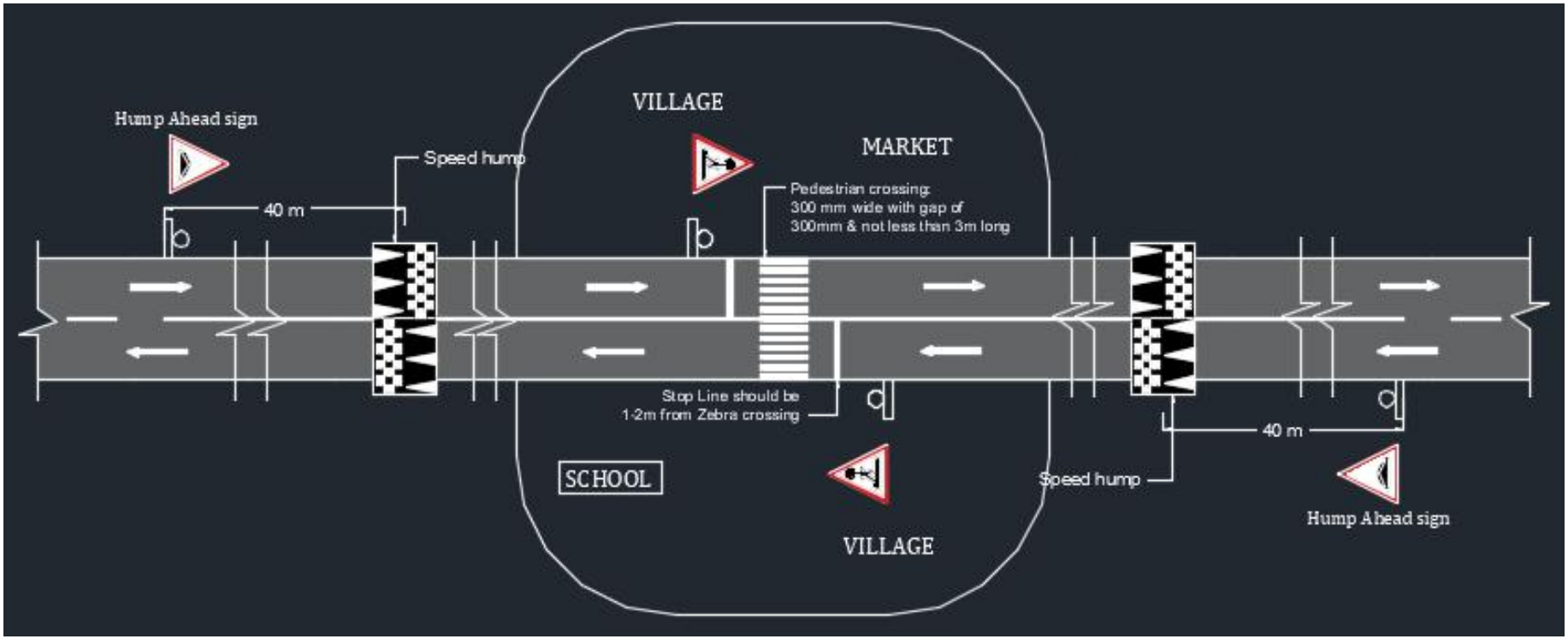


Fig.13 Speed hump along with pedestrian crossing in vulnerable areas

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