Guidelines for urban-rural speed thresholds

RTS 15

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1. Introduction

These Guidelines outline the principles of urban-rural speed thresholds and promote good design practice and consistency.

Thresholds are located at interface between rural and urban areas and consist of physical and optical narrowing of the roadside to form “pinch points”. When designed correctly, thresholds lead to a reduction in vehicle speeds, as drivers perceive a change in the road environment ahead. Given the clearly established correlation between vehicle speeds versus crash severity and the increased exposure to risk, it is desirable to reduce traffic speeds to appropriate levels at the outer fringe of an urban area.

Thresholds are a potential traffic management technique when one or more of the following conditions are present:

- vehicle speeds on the town outskirts or through the urban areas are inappropriately high
- all reported injury crash rates are higher than average or need to be reduced
- when vulnerable road users such as pedestrians and cyclists feature in the crash analysis.

They should only be installed on roads that have a difference in the warranted speed limits of 20km/h or more at the rural/urban interface.

2. Vehicle speeds and crashes

Crash analysis shows that the higher the impact-speed, the greater the likelihood of serious and fatal injury. Research indicates the likelihood of death for car occupants in a crash at an impact speed of 80km/h is 20 times that of an impact speed of 30km/h (IIHS 1987).

Similarly, for pedestrians in crashes:

- 8% of those struck by a vehicle travelling at 30km/h will be killed[1]
- 45% of those struck by a vehicle travelling at 50km/h will be killed[1]
- 90% of those struck by a vehicle travelling at 60km/h will be killed.[1]

Thresholds have been found to reduce vehicle speeds by 2-15 km/h depending on design and location[2]. However, thresholds used in isolation have not always been effective in reducing speeds.

3. Design considerations

3.1 Location

Overseas case studies indicate urban-rural thresholds achieve their greatest speed reductions when used on roads with very high approach speeds before the threshold was installed[3]. Speed reductions are lower[4] when thresholds are located at or near physical features in the road that limit speed, such as a blind bend or summit.

3.1.1 Location relative to a warranted speed limit

Any speed restriction signs in the threshold must be located within 20 metres of the start of the "warranted" speed restriction. RTS 17 *Guidelines for Setting Speed Limits*[5] sets out the warrant details. Road users are more likely to comply with a speed limit if it is consistent with the level of roadside development along the road and the road function. In some cases it may be necessary to carry out speed restriction surveys to ensure the correct speed limit is in force and the signs are located in the correct position.

3.1.2 Location relative to multiple speed limits leading into town

Some locations have progressively reducing speed limits leading into the town centre such as 70km/h at the town outskirts followed by 50km/h. To determine where the threshold will be the most effective relative to these speed restrictions, an analysis of the crash history, the level of exposure of at-risk road users (such as pedestrians or cyclists) and speeds should be undertaken at the start of each speed limit area.

If the problem occurs at the start of the higher speed limit, or at both the higher speed limit and the lower limit, the threshold should be located where the higher limit starts. To ensure that drivers continue to travel at a reduced speed through the urban area, the threshold treatment should be supported by traffic calming measures such as flush medians, selective verge planting, or similar.

If the problem is confined solely to the start of the 50km/h area, the threshold should be located at the start of the 50km/h speed restriction.

3.1.3 Location relative to property accesses and intersections

Locating thresholds at the start of a warranted speed limit also means it will be close to the start of the road frontage development. Care must be taken to ensure the threshold does not interfere with sight lines from nearby properties or interfere with access to properties. The same considerations apply when the threshold is located near an intersection.

3.1.4 Visibility to approaching drivers

Thresholds are effective where approaching drivers can see them in time to adjust their speed to appropriate levels. Thresholds must be visible over at least the stopping sight distance for the 85th percentile of the approach speed**.** Reference should be made to the Austroads 'Rural Road Design' Guide[6] for stopping sight distances.

When thresholds are being located on large radius curves, careful siting is required to ensure they remain within the drivers' cone of vision.

3.2 Roadway narrowing

An effective threshold involves creating a 'pinch point' at the start of the urban area. By the appropriate use of horizontal and vertical elements, the roadway should be narrowed over a length of 10-20 metres. The road width through this pinch point will vary depending on circumstances but must allow all entitled vehicles to pass through it.

If the road is part of a designated overdimension route, a minimum horizontal clearance of 10.5 metres between vertical elements is recommended. If wider loads are to be catered for, the sign mountings can be of a flag type where the entire sign can rotate about a vertical axis when needed. The Overdimension Permit Issuing Agency or the NZ Heavy Haulage Association can be contacted for details of expected load widths.

Figure 1 shows recommended minimum road and lane widths plus lateral clearances through typical threshold pinch points.

3.2.1 Horizontal elements

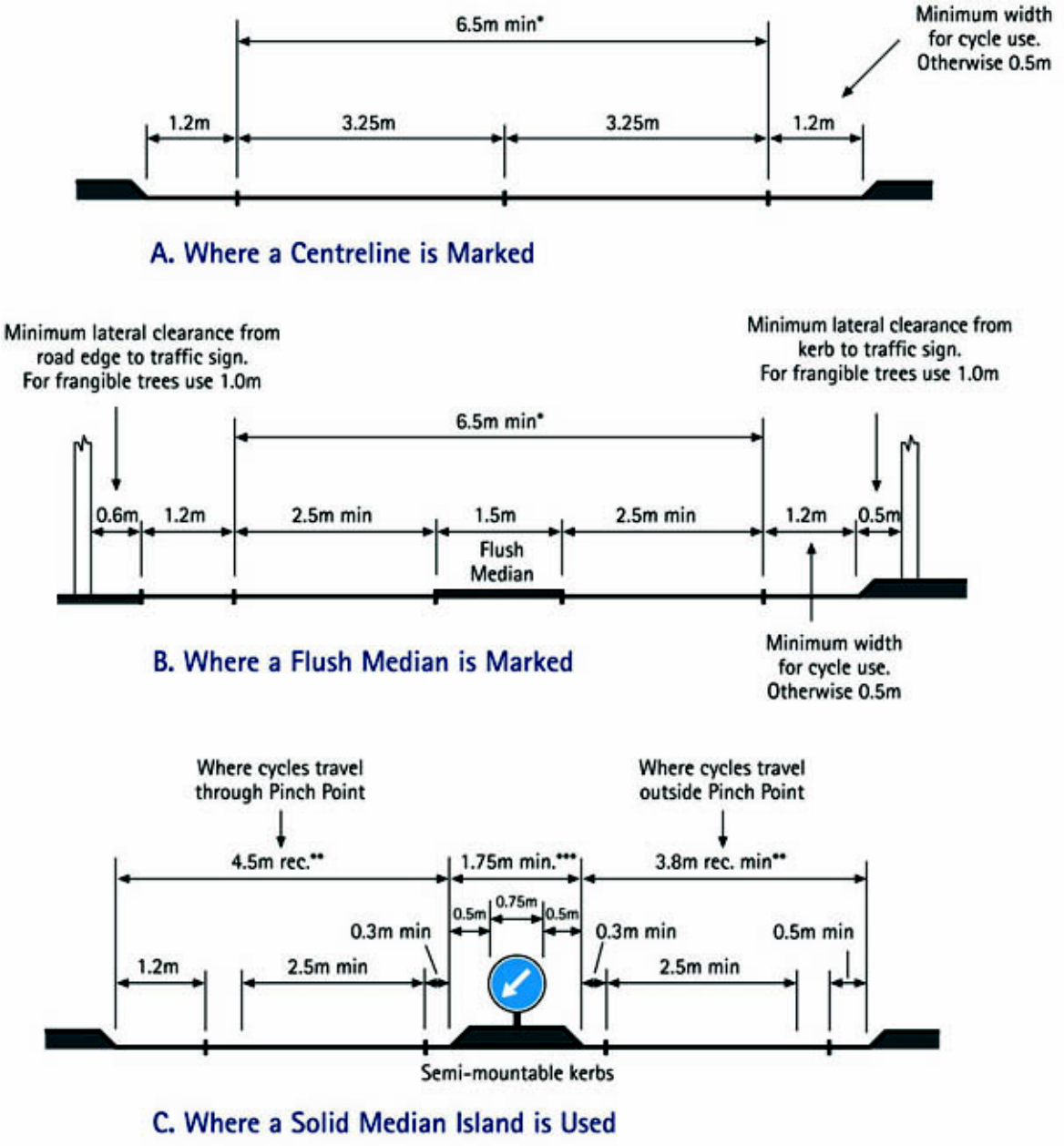
Horizontal design elements are used to reinforce the road narrowing effect at pinch points. Wherever road width permits, the sealed width should be narrowed by installing solid "build-outs" such as kerb, but where this is not possible then pavement markings may be used to create the pinch point effect.

European studies have found median islands (especially those with trees or shrubs) improve the visibility of the thresholds, interrupt the forward view, and reduce the optical width of the carriageway[2].

Solid median islands must be clearly delineated so they are visible both night and day to approaching motorists. Islands that are not clearly visible become a potential hazard, particularly to any overtaking vehicles. Solid median islands should only be used at thresholds located at the start of 50 and 60km/h speed restrictions.

Raised retro-reflective pavement markers (RRPMs) should be used on all transitional approaches to solid build outs or solid median islands in threshold pinch points.

Figure 1: Minimum roadway, lane widths and lateral clearances



NOTES

* A 6.5m minimum combined lane-width provides for two maximum legal width vehicles (2.5m wide body + 0.24m wide wing mirrors) to pass whilst staying within their lane.

** The 4.5m width is recommended where cycles pass through the Pinch Point to allow for clearances (refer Austroads Guide No 14 'Bicycles'[7]). This can be reduced to 3.8m width where cycles have separate lanes outside of the pinch point.

*** Solid median islands should be at least 1.75m wide to allow 0.75m RG 17 signs to be erected with 0.5m lateral clearance each side (refer to MOTSAM Part 1: Traffic Signs[8]).

- Parking should be prohibited within the pinch point areas.
- Traffic Regulations 1976 require a marked lane to be at least 2.5 metres wide.

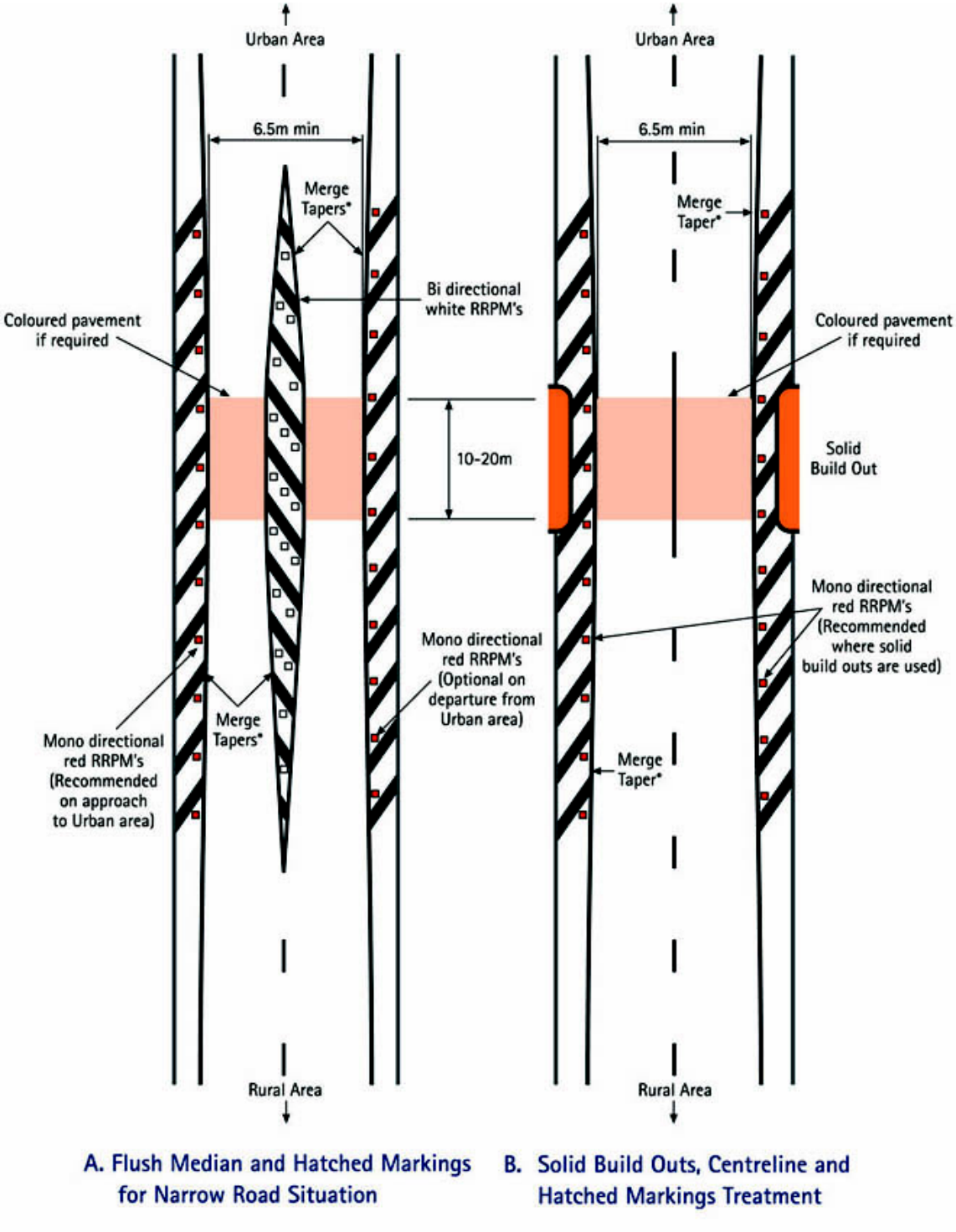
Pavement markings such as diagonal shoulder markings can be used to narrow traffic lanes and also give an optical illusion of a narrow carriageway. Likewise, flush island or median markings can be used in the pinch point areas where lane narrowing is required but a solid median island is not suitable.

RRPMs are recommended as follows:

- Red RRPMs on transition edgelines leading into marked pinch points and on the edgeline through the pinch point itself
- White RRPMs on flush median markings used in threshold pinch points (refer to RTS 4 'Guidelines for Flush Medians[9], for set out details)
- Yellow RRPMs on the tapers leading up to solid median islands

Figures 2 and 3 provide examples of threshold pavement markings.

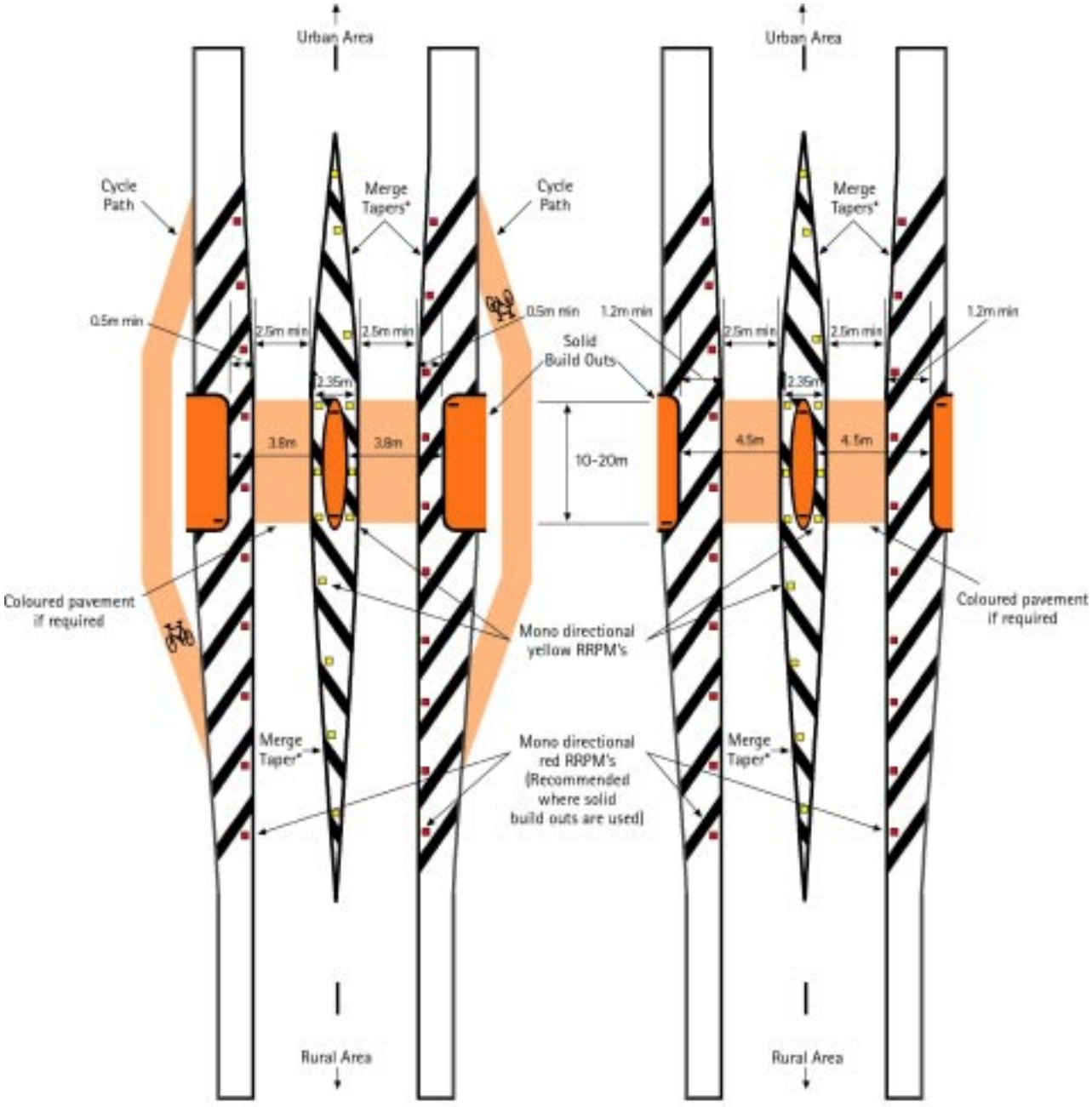
Figure 2: Pavement markings and RRPMs without solid islands



NOTE

* Merge tapers to be set out as shown in MOTSAM Part 2: Markings[10]

Figure 3: Pavement markings and RRPMs with solid islands



NOTE

* Merge tapers to be set out as shown in MOTSAM Part 2: Markings[10]

3.2.2 Vertical elements

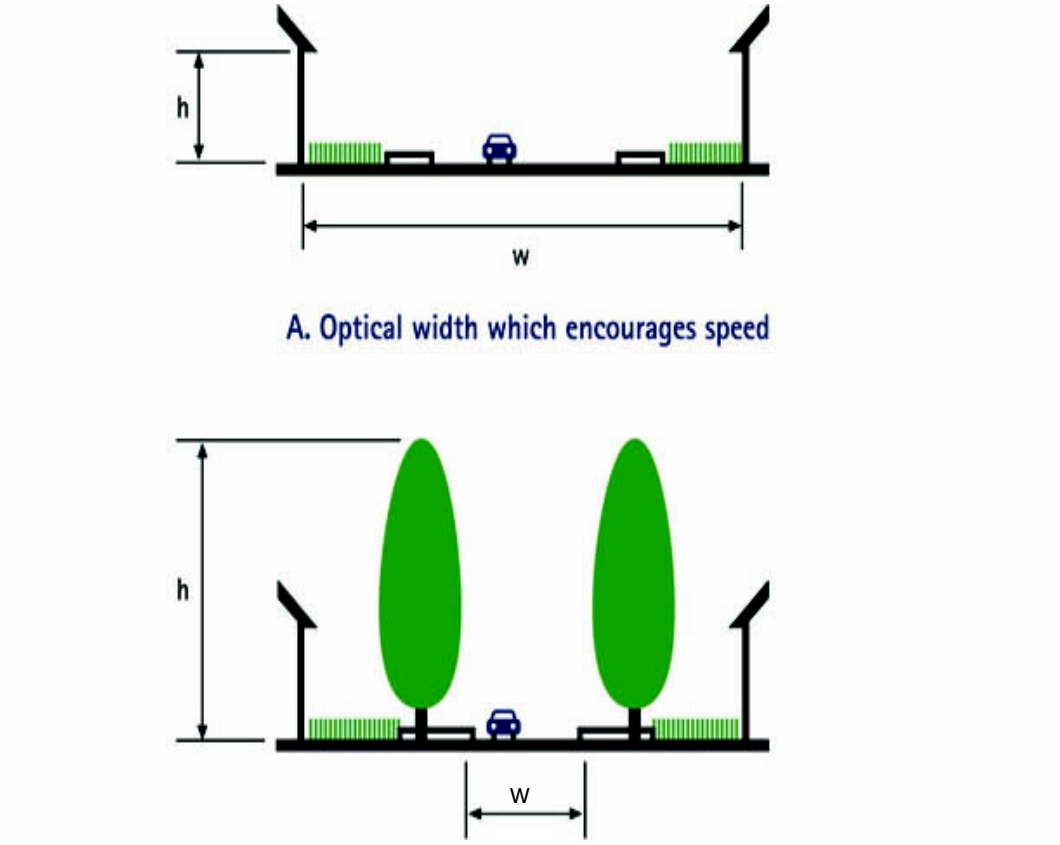
Vertical elements must always be used as they improve the visibility of the threshold to approaching drivers. Examples of vertical elements include trees and shrubs, combined speed restriction and place name signs, and the structure or poles that support these signs. Streetlighting can also be incorporated as a vertical element.

Trees, lighting poles, and poles used to support signs in the threshold area must be frangible. Any trees should have a trunk diameter of less than 100 mm when measured 400 mm above the ground, and should not be hardwoods[11]. Service poles or lighting columns should either be mounted on a "slip base" that breaks on impact or made of energy absorbing materials.

Any unprotected, non-frangible structure within 9 metres of the edge of the carriageway should have hazard markers attached[10].

Research indicates drivers travel at a reduced speed where the height of vertical features is greater than the width of the street. Figure 4 illustrates how the optical width of a road should be less than the optical height.

Figure 4: Optical width (Source: Devon County Council Guidelines[12])



Note: To achieve a good speed reduction effect w≤h.

3.3 Lighting

Street lighting is an important safety element in rural threshold design and:

- Should always be provided where a solid central island is part of the threshold design (either as a continuation of street lighting or isolated flood lighting at the threshold)
- Is desirable where solid build outs are used
- Is optional at thresholds where only pavement markings have been used.

Extending street lighting out to the threshold highlights to road users that they are entering an urban area. The lighting poles themselves are a valuable visual cue of an urban area even in daylight hours.

3.4 Conspicuity

Unless thresholds stand out from the surroundings, road users' may not notice the approaching change of environment and fail to reduce speed as required. In addition to the vertical and horizontal elements described in Section 3.2 above, there are a number of measures that can enhance conspicuity.

3.4.1 Daytime conspicuity

Measures that enhance daytime conspicuity include:

- Bright coloured flowers or shrubs as part of the landscaping
- Trees or shrubs that contrast in colour with the surrounding landscape
- Coloured paving materials through the threshold pinch point (see Section 3.6 below)
- Size and colour of the combined speed limit and place name sign.

3.4.2 Night-time conspicuity

In addition to the use of RRPMs and streetlighting referred to Sections 3.2.1 and 3.3 above, night time conspicuity of the threshold can be enhanced by using reflectorised paint or reflective strips on all kerbs used in build outs or median islands.

3.5 Provision for cyclists or pedestrians

Two methods of catering for cyclists or pedestrians at thresholds are:

- Allowing room for these road-users to travel within the pinch point, or
- Providing a separate path outside of the pinch point.

Catering for cyclists or pedestrians within the pinch point area[7] increases the overall width required and may result in the threshold achieving lesser speed reductions. Measures to address this include increasing the height of the vertical elements to reduce the optical width or installing a median island.

The construction of separate paths outside of the pinch point area would provide greater safety for cyclists and pedestrians and improve the effectiveness of the threshold in reducing speeds. However, the cost of the project is likely to increase.

3.6 Changes in pavement surface

The use of a different pavement surface or texture at the pinch point may be considered as part of the overall threshold design. If a change in surface texture is proposed, care must be taken to ensure that the skid resistance of the carriageway is not compromised.

Surface or texture

Schnull & Lange[2] (1992) noted that changes in road surface to rougher materials led to distinct speed reductions, especially in the higher speed range. However, nearby residents complained about the increase in noise level. Steinbrecher[3] described two alternative design techniques using paving stones at thresholds as a contrast to the normal asphalt road surface. The first used strips of pavement stones at the edges of the threshold to achieve further optical narrowing of the road. The second used pavement stones across the full width of the threshold alerting motorists of the change in environment immediately ahead by an increase in noise level. This design was curtailed after nearby residents found the shift in noise frequencies as vehicles drove over the paving stones to be unpleasant.

Rumble strips

Increases in noise levels of up to 9 decibels have been recorded where rumble strips were installed, and they have not found favour with residents living nearby.

3.7 Vertical carriageway shifts

The use of speed humps or vertical carriageway shifts within rural thresholds is not recommended.

Overseas research[2] indicates that these vertical deflections of the carriageway “could create a safety hazard that would cause many more problems than existed previously”.

3.8 Landscaping and roadside verge treatment

Trees and shrubs planted adjacent to pinch points will often make up a substantial part of the vertical elements used in rural thresholds. These can be complemented either side of the pinch point with low shrubs and ground cover planting to add to the “closing in” effect.

All trees or shrubs planted within 10 metres of the carriageway edgeline must be frangible. Frangible trees require a trunk diameter at maturity of less than 100mm measured 400mm above ground, and should not be hard wood.[11]

The trees or shrubs should not interfere with sight lines between oncoming vehicles and the access points of any nearby properties and intersections or conceal pedestrians. Where it is not possible to position trees without obstructing sight lines, the trunks should be trimmed of branches to a height of 2.5 metres above ground level allowing visibility either side of the trunk of the tree.

Trees and shrubs used as vertical elements in the threshold should be of an evergreen variety as the seasonal loss of leaves can reduce the conspicuity of the threshold and the road narrowing effect.

Care should be taken to ensure trees and shrubs do not cause undue shading of the roadway, especially in areas prone to ice or frost in winter.

4. Traffic signs at thresholds

4.1 Standard speed restriction signs

MOTSAM Part 1: Signs[8] specifies that when the approach speed limit exceeds 50km/h a speed limit sign should:

(a) be visible for at least 120m

(b) on state highways, be duplicated with an additional sign on the right hand side of the road (and at least one of the signs must be visible for at least 120m), and

(c) in terms of the external dimensions of the roundel

- be at least 750mm in diameter, or
- where the road is median divided or operating speeds are very high, be at least 900mm in diameter, or
- for motorways, other high speed roads and at a critical locations where there is a speed limit change, be increased to 1200mm in diameter.

4.2 Combined speed restriction and place name signs

The Traffic Regulations 1976 does not permit any other sign to be erected on the same pole as a speed restriction sign unless approved by the Director of Land Transport Safety. The Director has approved a general form of "threshold" sign and Appendix 1 contains a copy of the NZ Gazette notice which approves and specifies these signs.

Other, similar forms of threshold signs, have been approved by the LTSA with a range of colours, size and, to a limited degree, shape. If an alternative to the standard layout is sought, applications should be sent to the nearest Regional Office of the LTSA for assessment.

4.3 "Speed Limit Ahead" Signs

The treatments described in these guidelines can be relatively expensive and cannot be justified at all rural thresholds. Likewise, the visibility requirements for the speed limit signs may not be readily achievable nor an extension of the speed limit or the creation of progressively reducing speed limits justified. An alternative approach is to install a "Speed Limit Ahead" sign. This sign, recently approved by the LTSA (NZ Gazette 13 December 2001) is similar in form to "STOP Ahead" and "Give Way Ahead". The symbol within the warning diamond reflects the actual speed limit applying ahead.

Experience in New South Wales indicates such a warning sign can achieve reductions in traffic speed of the same order or better than an intermediate speed limit between the open road speed limit and the main urban speed limit. They have the added advantage of clearly indicating the specific nature of the limit ahead to drivers in good time for them to react. "Speed Limit Ahead " signs were erected on a trial basis at a number of sites in Timaru District and Turua in Hauraki District. The trials showed changes in speeds consistent with the NSW experience.

A "speed restriction ahead" sign should be considered only where an intermediate speed limit does not already exist and site restrictions mean sign duplication or increases in sign size cannot be effectively implemented.

4.4 Speed limit sign options for urban-rural thresholds

Where measured entry speeds into an urban area are high compared with similar locations elsewhere and an intermediate speed limit cannot be justified in terms of the normal speed limit policy:

a) ensure the speed limit sign is, or signs are, clearly visible to approaching traffic for at least 120m and desirably 200m or more. ('Clearly visible' means not only can they be seen, but they will be seen - i.e. ensure they are placed within the normal cone of vision for approaching drivers) and

b) the following options should be considered
   - mark the speed value on the road surface (see MOTSAM Part II[10] Section 4.01)
   - if the speed limit sign is not already duplicated, place an additional sign on the right hand side of the road
   - consider increasing the size of the speed limit sign/s. Normally they should be at least 750mm in diameter and may increased to either 900mm or 1200mm
   - where the criteria described in section 4.3 above can be met a speed limit ahead sign may be considered
   - where traffic volumes, speeds and other factors justify installation consider a threshold treatment in accordance with these guidelines.

5. Consultation

During the design stages of a threshold treatment it is important that consultation takes place with all likely road user groups in the area as well as with adjacent landowners and other interested parties. The following check list can be used as a guide:

- adjacent residents, farms, businesses
- Police, ambulance, fire brigade
- NZ Road Transport Forum and NZ Heavy Haulage Association
- NZ Automobile Association
- cycle clubs/groups/associations
- nearby schools, colleges, and rest homes
- iwi and hapu
- network utility operators.

6. Speed measurement

Measurements of speed at urban entry points are necessary to confirm or counteract local perceptions, to provide a database of results to determine expected or achievable speed profiles, and to evaluate the impact of any changes made to signs or the roadside environment.

If the changes have not had the desired effect it may be necessary to introduce other measures or modify the existing design. Not only may the surveys help in determining the need for implementing further options they may assist in implementing or prioritising speed enforcement.

Speed surveys should note the mean and 85th percentile speeds (with standard deviation) for each travel direction. At least three of the four sites below should be surveyed before construction, within two months of completion, and again one year after completion. If only three sites can be measured, site (d) should be excluded.

(a) 200 metres outside of the threshold location

(b) at the threshold

(c) 300 metres inside the threshold

(d) 600 metres inside the threshold

Manual speed surveys are recommended as providing the most accurate and reliable information for before and after comparisons of vehicle speeds. Refer to the Road and Traffic Standards Information Sheet No. 14[13] for details of how to conduct manual speed surveys.

If automatic speed measuring equipment is used, speeds of all vehicles should be recorded for each direction of travel independently for one week.

7. Pictorial examples of the effects of design elements

Figures 5 and 6 illustrate the possible before and after effects at town outskirts.

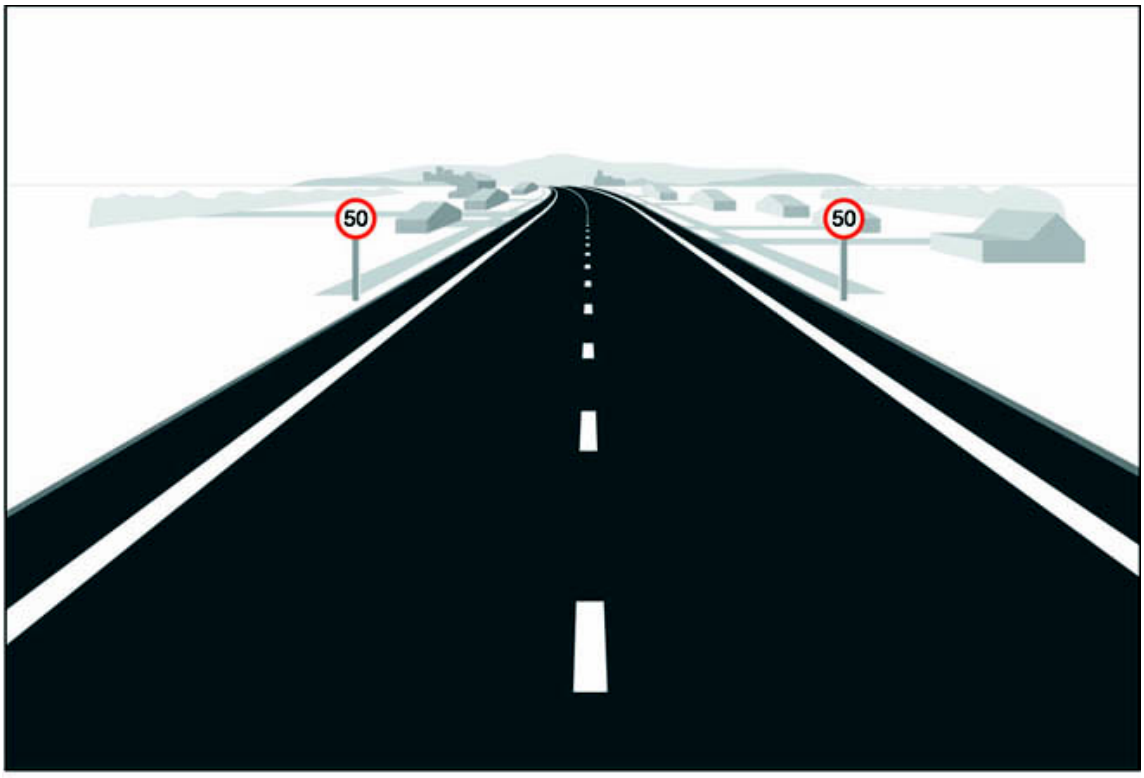


Figure 5: Typical untreated approach to a township

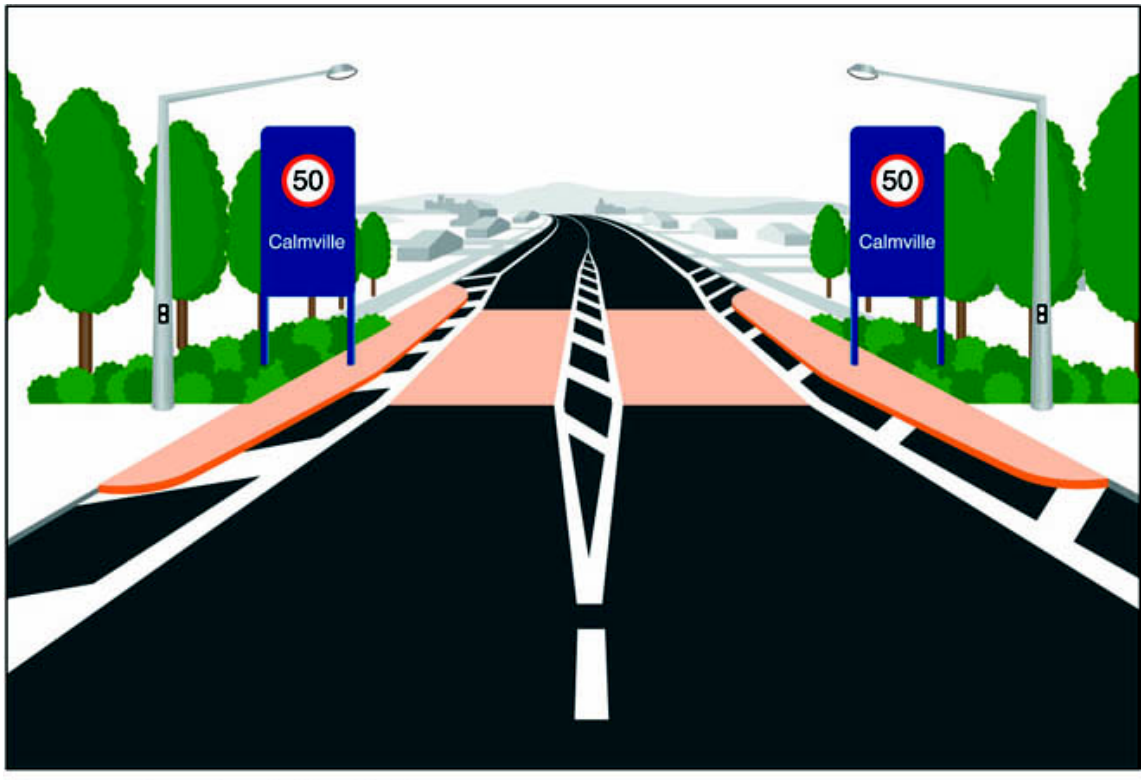


Figure 6: Completed threshold

References

1 European Transport Safety Council (1995) [ETSC] "Reducing Traffic Injuries Resulting from Excess and Inappropriate Speed".

2 Road Traffic Safety Research Council (1994) [RTSRC] "Rural/Urban Threshold Treatment Devices. A Literature Review". Works Consultancy Services.

3 Steinbrecher, J. (1992) "Restructuring of Town Entrances on Roads Classified as Major". VTI Rapport Nr 380A, Part 4, Proceedings of the Conference on Road Safety in Europe, pp 17-31.

4 Wheeler, A. Taylor, M & Payne, A. (1993) "The Effectiveness of Village Gateways in Devon and Gloucestershire". Department of Transport TRL Project Report 35.

5 Land Transport Safety Authority (1995) "RTS 17 Guidelines for Setting Speed Limits".

6 Austroads (1993) "Rural Road Design: Guide to the Geometric Design of Rural Roads".

7 Austroads (1993) "Guide to Traffic Engineering Practice. Part 14 Bicycles".

8 Transit New Zealand/Land Transport Safety Authority (1992) "Manual of Traffic Signs and Markings Part 1: Traffic Signs".

9 Land Transport Safety Authority (1991) "RTS 4 Guidelines for Flush Medians".

10 Transit New Zealand/Land Transport Safety Authority (1994) "Manual of Traffic Signs and Markings Part 2: Markings".

11 Transit New Zealand/Ministry of Transport (1991) "Guidelines for Planting for Road Safety".

12 Devon County Council Engineering and Planning Department (1992) "Traffic Calming Guidelines".

13 Land Transport (LTSA) Road and Traffic Standards (1990) "Information Sheet No. 14 Standard Methodology for Conducting Manual Speed Surveys".

Appendix 1: Threshold sign Gazette notice

Pursuant to section 129(6) of the Traffic Regulations 1976, and pursuant to a subdelegation from the Director of Land Transport Safety by an instrument dated 3rd day of May 1999, I, John Paul Edgar, Manager Safer Roads hereby:

(a) revoke the "Traffic Sign - Speed Limit (Threshold)" notice dated 26th day of May 2000*; and

(b) authorise the erection, installation and maintenance of the Regulatory Traffic Sign described in the Schedule to this notice for the purposes of regulation 128(4) of the Traffic Regulations 1976. The sign may be used in substitution for the sign described as R22(a) Speed Limit (Normal) in Part IV, Fourth Schedule to the Traffic Regulations 1976.

Schedule

Description of traffic sign

The Speed Limit (Threshold) permanent regulatory sign must conform to the layout of the Example Sign depicted in the diagram below and be in accordance with the following.

1. Shape and size
   Rectangular 1900mm wide, 2700mm high

2 Background colour
   White, reflectorised green or reflectorised blue.

3. Border
   Black where the background is white otherwise reflectorised white.

4. Legend

(a) *Speed limit symbol:*
   shape and size - circle 1300mm diameter
   background colour - reflectorised white
   border - reflectorised white
   legend - reflectorised red roundel with 1200mm external diameter enclosing speed limit in kilometres an hour in black lettering 400mm high, stroke width 62mm.

(b) *Place name:*
   shape and size - lettering normally on one line as shown in the example and must be Modified Series E minimum 160mm high upper case and 120mm high lower case.
   colour - reflectorised white

(c) *Greeting message* (optional)*:*
   shape and size - upper case lettering Series D of same size as the lower case lettering of the place name.
   colour - black where the background is white otherwise reflectorised white

Example sign

Dated at Wellington on this 25th day of October, 2000

John Paul Edgar, Manager Safer Roads

* *New Zealand Gazette*, 1 June 2000, No. 59, page 1295.

Road and Traffic Guideline publications

The following Road and Traffic Guidelines are available:

RTS I Guidelines for the implementation of traffic controls at crossroads (1990)

RTS 2 Guidelines for street name signs (1990)

RTS 3 Guidelines for establishing rural selling places (1992)

RTS 4 Guidelines for flush medians (1991)

RTS 5 Guidelines for rural road marking and delineation (1992)

RTS 6 Guidelines for visibility at driveways (1993)

RTS 7 Advertising signs and road safety: design and location guidelines (1993)

RTS 8 Guidelines for safe kerbline protection (1993)

RTS 9 Guidelines for the signing and layout of slip lanes (1994)

RTS 11 Urban roadside barriers and alternative treatments (1995)

RTS 13 Guidelines for service stations (1995)

RTS 14 Guidelines for installing pedestrian facilities for people with visual impairment (1997)

RTS 15 Guidelines for urban-rural speed thresholds (2002)

RTS 17 Guidelines for setting speed limits (1995)

The Guidelines may be purchased from:

Land Transport Safety Authority, Head Office (PO Box 2840, Wellington) or Regional Offices in: Auckland, (Private Bag 92-515), Wellington (PO Box 27-249) and Christchurch (PO Box 13-364).