Guidelines for facilities for blind and vision-impaired pedestrians

RTS 14

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1 Document information

1.1 Purpose

The purpose of this guideline is to provide the best practice design and installation principles for pedestrian facilities that assist blind and vision-impaired people. Standardising pedestrian facilities will give consistent directional and warning messages to blind and vision-impaired people, as well as increasing their safety while crossing roads and throughout the entire walking journey.

1.2 Development

The first edition of RTS 14 was produced following representation by many different organisations including the Royal New Zealand Foundation of the Blind (RNZFB) and a Parliamentary Petition (no. 1993/007) by the New Zealand Association of the Blind and Partially Blind (now the Association of Blind Citizens of New Zealand Inc), which concluded that there was a need for consistency at crossings throughout New Zealand. This guideline was first produced in 1997 and this is the first revision.

Road controlling authorities (RCAs), the RNZFB, the Association of Blind Citizens of New Zealand Inc, and the Disabled Persons Assembly have been consulted in preparation of this document. Their comments and ideas have been incorporated and we thank them for their input.

1.3 Content

This guideline specifies the design, installation and performance standards of pedestrian facilities for blind and vision-impaired people both for new facilities and for those that need to be upgraded. It does not endorse any specific manufacturer or brand of equipment.

There are two features that are installed to assist blind and vision-impaired people on their walking journey.

1.3.1 Tactile ground surface indicators (TGSI)

Tactile ground surface indicators (TGSI) provide pedestrians with visual and sensory information. The two types of TGSI are warning indicators and directional indicators. Warning indicators alert pedestrians to hazards in the continuous accessible path of travel (see Section 4.2.1), indicating that they should stop to determine the nature of the hazard before proceeding further. They do not indicate what the hazard will be. Directional indicators give directional orientation to blind and vision-impaired people and designate the continuous accessible path of travel when other tactile or environmental cues are missing.

When combined with other environmental information, TGSI assist blind and vision-impaired people with their orientation and awareness of impending obstacles, hazards and changes in the direction of the continuous accessible path of travel.

1.3.2 Audible tactile traffic signals (ATTS)

ATTS provide pedestrians with audible and sensory information. The audible features of ATTS help blind and vision-impaired people locate signals and inform them of the status of the crossing phase. The tactile features of ATTS also help blind and vision-impaired people with their orientation. ATTS also has benefits for fully sighted pedestrians, deaf pedestrians and those with cognitive disabilities.

1.4 Status

RTS 14 is a best practice guideline; its use is not mandated by law.

The guide is a mixture of background information, principles, formal requirements and application advice. Formal requirements are indicated by a prominent font. This permits designers to ascertain whether designs comply with the requirements. The use of apparently mandatory terms such as "shall", mean that such matters are necessary to claim a design complies with the requirements of RTS 14. The use of the term "should" indicates that the guide is making a definite recommendation, but engineering judgement may identify sound reasons for departing from the recommendation without prejudicing compliance. In all cases designers and managers of pedestrian facilities are responsible for assessing whether the advice in this guide is appropriate to the situations they encounter.

It is envisaged that road controlling authorities will adopt this guideline as part of their Safety Management Systems, in which case it would become the fundamental document for designing and installing facilities for blind and vision-impaired people. Departures from the guideline would therefore need to be reasoned and documented.

It is intended that the guidance on tactile ground surface indicators be included in the forthcoming 'Pedestrian Network Planning and Facilities Design Guide'.

The audible tactile traffic signal specifications are to be included in the 'National Traffic Signals Specification', which is currently under development by the New Zealand Traffic Signals Committee.

The intention to incorporate these requirements into other documents means any lessons learnt from applying this guideline can be included at that stage. LTSA welcomes helpful suggestions arising from attempts to apply this guide in practice. Comments should be directed to the Standards and Guidelines Engineer, Safer Roads, LTSA, PO Box 2840, Wellington or emailed to info@ltsa.govt.nz.

1.5 Referenced standards

The following Standards are referenced in this guideline:

- AS/NZS 1428.4: 2002 Design for Access and Mobility Part 4: Tactile Indicators.
- AS 2353: 1999 Pedestrian Push Button Assemblies.
- AUSTROADS Guide to Traffic Engineering Practice - Part 7: Traffic Signals - 2003.
- AUSTROADS Guide to Traffic Engineering Practice - Part 13: Pedestrians - 1995.
- NZS 4121: 2001 Design for Access and Mobility – Buildings and Associated Facilities.
- AS/NZS 3661.1: 1993 - Slip Resistance of Pedestrian Surfaces.

Note: This guideline recommends departures from aspects of these standards, which are discussed at the start of Sections 3.5, 4 and 5.

1.6 Glossary of terms

A glossary of terms used in this guideline can be found in Appendix A.

2 Understanding blindness and vision impairment

2.1 Background

The 2001 disability snapshot carried out by Statistics New Zealand estimated that 94,700 people (81,500 adults, 13,200 children) are blind or had a vision limitation that could not be corrected by glasses or contact lenses. Seven thousand and eight hundred (7,800) of the adults are completely blind. Approximately three percent of the total adult population is blind or vision-impaired. Of these vision-impaired people, 33,600 also had hearing disabilities.

At the latest count 12,649 were members of the Royal New Zealand Foundation of the Blind. If, with corrective lenses, a person's visual acuity is 6/24 or less using the better eye, or a field of vision of less than 20 degrees, they are eligible for the services of the RNZFB.

Visual acuity

A person with a visual acuity of 6/24 means that a person has to be as close as 6m to see what a normal sighted person can see at 24m, i.e. four times closer.

A person with a visual acuity of 3/60 means that a person has to be as close as 3m to see what a normal sighted person can see at 60m, i.e. 20 times closer.

To be eligible for an Invalid's Benefit, the visual acuity threshold is 3/60 or field of vision less than five degrees. Ninety-five percent of RNZFB members have some vision, and even some of the remaining five percent can perceive general light and dark.

The vast majority of blind and vision-impaired people are aged over 65 years, with about half over 80, as age-related eye diseases cause most blindness. Table 1 lists the proportions of RNZFB members in various age group bands. It is expected that the proportion of members over 65 will increase as the population ages.

Table 1: Age groups of RNZFB members as at August 2003

Age group	Number of members
0-15	680
16-19	276
20-39	1402
40-64	1952
65-79	2037
80 +	6302

As blind and vision-impaired people are unable to drive a motor vehicle, their independent mobility depends on walking.

2.2 Orientation

2.2.1 General

People rely on visual, audible and sensory (tactile) information from the surrounding environment for their orientation. Most vision-impaired people are able to see in colour; only a small percentage can see nothing at all, but even that group will generally have sensitivity to light and shade. Contrast between the walking surface and surrounding environment is critical for vision-impaired people for orientation, distinguishing the limits of the footpath, recognising hazards and gathering information.

A loss of sight is not accompanied by an increase in the effectiveness of other non-visual senses. However, blind and vision-impaired people generally place more emphasis on information received via other senses, for example the sense of touch. Therefore, pedestrian facilities must have consistent design features that assist blind and vision-impaired people with their orientation.

2.2.2 Walking environment

In order to negotiate the road system, blind and vision-impaired people need to be able to find their way along footpaths and across roads.

Blind and vision-impaired people will move around either independently or with the aid of a sighted person who will act as a guide. Those who move around independently will do so making the most of their residual sight and any mobility aids.

Those people that rely on their residual sight use visual contrast cues for their orientation. Environmental cues include the property line, the edge of the sealed path, the kerb, and consistently placed street furniture e.g. parking meters.

Mobility aids

The most common mobility aid used by pedestrians with poor sight to facilitate their independent mobility is a long white cane. This is used to preview the ground in front of the person to detect hazards.

Previewing takes the form of sweeping the cane in an arc from one side to the other to just beyond the shoulder width. This technique will usually locate potential obstructions such as street furniture, provided that there is some element at ground level, and distinct changes in level such as a kerb upstand or a step.

White cane users are now trained to use a method whereby the cane maintains constant contact with the ground as it is swept. This allows the user to detect the presence of distinct changes in texture underfoot. Once any feature has been located and possibly identified, the pedestrian will decide how to proceed.

Alternatively, blind or vision-impaired people may have guide dogs to assist them with their mobility. A guide dog is trained to lead its owner around obstructions and to stop at distinct changes of level, for example, a kerb upstand, a flight of steps, or a hole in the ground. Guide dogs are generally unable to respond to changes in texture or colour underfoot.

If a guide dog stops at a particular feature, for example a kerb edge, the owner has to decide how and when to proceed.

(The above orientation notes have been adapted from the U.K Department for Transport).

2.2.3 Crossing roads

When attempting to cross a road a blind or vision-impaired pedestrian needs to:

- find the crossing point
- identify when the footpath finishes and roadway is about to be entered

- determine the direction to cross
- determine when it is safe to cross
- maintain orientation while crossing the road
- find the opposite kerb crossing point.

2.2.4 Detection of road crossing points

Crossing roads is the most hazardous activity that blind and vision-impaired people perform in the road environment. The most critical safety need is for the blind or vision-impaired person to detect reliably where the footpath ends and the road is about to be entered.

Kerb upstand

Blind and vision-impaired people walking independent of a mobility aid may only recognise the edge of the footway by stepping off a full height kerb. Overseas research has shown that the full vertical upstand of a kerb is the single most reliable cue for blind and vision-impaired people in detecting roads.

It is now a legal requirement and common design practice in New Zealand to install 'lipless, wheelchair-friendly kerb ramps' at all road crossing points to provide wheelchair and other mobility-impaired users with easy access between the footpath and roadway. However, the absence of any vertical upstand or lip is potentially hazardous to blind and vision-impaired pedestrians who rely on the vertical upstand of the kerb to detect that they have reached the transition from footpath to roadway.

A survey of RNZFB members (March 2003) found that crossing points with 'lipless, wheelchair-friendly kerbs' were difficult to detect and 'blended, same-level kerbs' even harder still.

The majority of blind and vision-impaired people are elderly and they also physically benefit from gentle kerb ramps. So these guidelines are based on the shared use of wheelchair friendly kerb ramps by both mobility-impaired and vision-impaired users.

The blind community have accepted the change to lipless kerb ramp designs on the basis that tactile ground surface indicators would be provided, as outlined in NZS 4121: 2001 section 13.4.5.2. There is however doubt about whether this is mandated by law and many lipless kerb crossings have been installed with no tactile features.

Abrupt change of gradient

The rate of detection of an intersection is also correlated to the abruptness of change in angle between the approaching footpath and the kerb ramp. However for reliable detection of the change of grade, the kerb ramps need to be too steep for the needs of the mobility-impaired. The range of acceptable kerb ramp gradients is described in Section 3.4.1 Kerb ramps.

Tactile ground surface indicators

The survey of RNZFB members found that kerb crossings with TGSI had a higher self-reported detection rate than those with a small vertical upstand, contrary to international literature. The standard warning tiles have a detection rate above 90 percent.

Warning indicators are an essential safety feature for blind and vision-impaired pedestrians and should be provided at all pedestrian kerb ramps.

There should be a clear visual contrast between the footpath and roadway so that vision-impaired people can use their residual vision to define the footpath/roadway boundary.

Tactile ground surface indicators and the mobility-impaired

Overseas research has shown that standard TGSI generally do not adversely affect the progress or stability of the mobility-impaired, though mobility-impaired do complain about discomfort from the rough surface. The combination of the lipless wheelchair friendly crossing with TGSI is a compromise that meets the needs of mobility and blind or vision-impaired people. There is a desire from the wheelchair users for more research to see if effective tactile devices can be developed that are more comfortable for the mobility-impaired.

3 Pedestrian facility design information

3.1 Universal design principles

This document supports the seven universal design principles:

- Equitable use
- Flexibility in use
- Simple and intuitive
- Perceptible information
- Tolerance for error
- Low physical effort
- Size and space for approach and use

Further information on the universal design principles can be found at www.design.ncsu.edu/cud/univ_design/princ_overview.htm

3.2 Key design principles

There are certain key design principles which, when applied, make it easier and safer for blind and vision-impaired pedestrians to move around.

- Simple, logical and consistent layouts enable people to memorise environments that they use regularly and predict and interpret environments that they are encountering for the first time.
- Non-visual features (e.g. audible and tactile devices) convey important information about the environment to blind and vision-impaired users.
- Visual contrast is important to accentuate the presence of certain key features. This will enable many people to use their residual vision to obtain information.

3.3 Continuous accessible path of travel

The continuous accessible path of travel defines the area where the pedestrian route is safe and convenient for people with impaired mobility, along with blind and vision-impaired people. It has even surfaces, gentle slopes and is kept free of permanent and temporary obstacles at all times. The preferred width is 1.8 metres, but wider is beneficial on busy footpaths.

Between intersections the edges of the zone are usually defined by adequate cues. In retail centres the continuous accessible path of travel is normally located next to the building line, which is likely to be the main orientation cue followed by blind and vision-impaired people. Street furniture such as parking metres and rubbish bins are located near the kerb.

In residential streets the edge of the continuous accessible path of travel is usually adequately defined by the edge of the sealed footpath.

At intersections, the continuous accessible path of travel is assumed to continue in a straight line from the mid-block position. If the path deviates to reach a kerb crossing, extra cues such as appropriate street furniture or directional tactile ground surface indicators are used to direct users to the kerb crossing.

3.3.1 Obstacles

Obstacles such as advertising and regulatory signs, seating, rubbish bins, utility poles, post boxes and bus shelters should be kept clear of the continuous accessible path of travel at all times.

Advertising signs on the footpath should be avoided if possible. Where advertising is permitted, signs shall be located away from the continuous accessible path of travel, i.e. on the kerb edge, as shown in Photo 1, and always placed consistently in the same location.

Photo 1: Advertising signs located on the kerb edge, outside the continuous accessible path of travel.

NZS 4121: 2001 - Sections 13.2 and 13.5 provide details on the correct design and placement of street furniture. It requires all obstacles to have a design element within 150mm of the ground, so that they can be detected by use of a long cane.

3.4 Road crossing points

3.4.1 Kerb ramps

NZS 4121: 2001: Design for Access and Mobility

NZS 4121: 2001 Section 13.4 details kerb ramp design practice in New Zealand. The LTSA recommends that the following points better represent good practice in New Zealand and have been incorporated into this guideline. Standards New Zealand will review this standard in due course.

- Warning TGSI shall be installed a minimum of 600mm deep and the full width of the kerb ramp, but need not cover the entire face of the kerb ramp.
- Kerb ramps should generally have a gradient no steeper than 1 in 12. A shallower gradient of 1 in 20 is preferred where there is room as it assists mobility-impaired people. The absolute maximum tolerable gradient is 1 in 8.

  Pedestrians, especially the mobility-impaired, are likely to experience difficulty in negotiating steep kerb ramps. It should be noted that these gradients are relative to horizontal and not the surrounding surface. In hillside areas it may not be possible to achieve these requirements, however due consideration needs to be given to the accessibility needs of mobility-impaired users.
- Adverse lateral crossfall should be minimised (preferably less than 1:50).

  Variation in slope from side to side is inevitable where the kerb ramp intersects a kerb that is not parallel with the crossing direction.

- Haunchings.

  In NZS 4121: 2001, the sloped sides of kerb ramps are shown splayed at 45 degrees, resulting in a similar crossfall to the ramp itself on level ground. This will be appropriate where users are expected to enter and leave the kerb crossing from the side. This may happen where the kerb ramp crosses a straight kerb and the continuous accessible path of travel is next to the kerb.

  Where it is desirable for blind and vision-impaired users to detect that they are entering the kerb ramp from the side, haunchings with an abrupt change of grade steeper than 1:8 but no steeper than 1:6 are appropriate. This will be particularly appropriate where users entering from this direction could inadvertently enter the roadway by bypassing the warning tactile ground surface indicators.

  In most situations it will be desirable for the entry across the haunching at the top of the ramp to be more gentle than near the kerb.

Figure 1 shows a typical kerb ramp design. It shows the maximum slope of haunching of 1:6. If the crossfall on the footpath is one percent, a kerb ramp depth of about 1.4 metres is required to keep the slope below 1:12. For a footpath crossfall of two percent, a kerb ramp depth of about 1.6 metres is necessary.

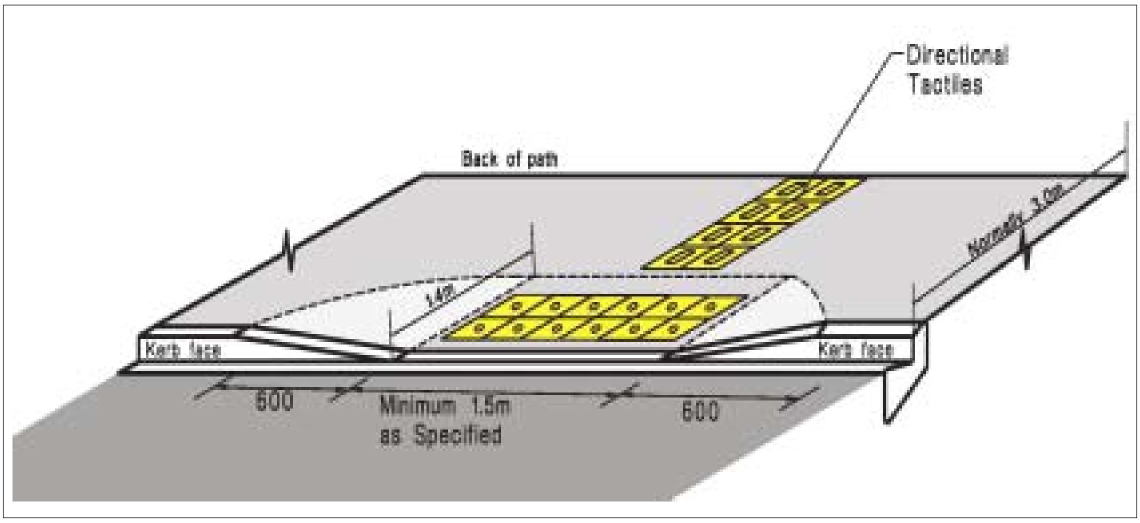


Figure 1: Standard kerb ramp design, assuming a full kerb height of 100mm.

3.4.2 Typical design of kerb ramps

3.4.3 Mid-block crossing points

Mid-block crossing points include: signalised crossings for pedestrians and cyclists only, pedestrian (zebra) crossings, pedestrian median islands, kerb protrusions (with and without a pedestrian median island), school crossing points (kea crossings) and any other places away from an intersection where pedestrian facilities are installed to assist people to cross the road.

All crossing points should be designed to minimise the crossing distance for pedestrians:

- Crossing points should be perpendicular to the direction of the road.
- The roadway should be as narrow at the crossing point as is reasonable taking into account the needs of other road users.

Kerb protrusions have been found to improve substantially the safety of pedestrian crossing points (LTSA monitoring system). At kerb protrusions where a traffic lane is also used by cyclists, a remaining width of 4.2 metres permits cyclists and motor vehicles to travel past side by side in a 50 km/h zone. Refer to the NZ Cycle Design guide.

A good example of a road narrowing at a pedestrian crossing point is shown in Photo 2.

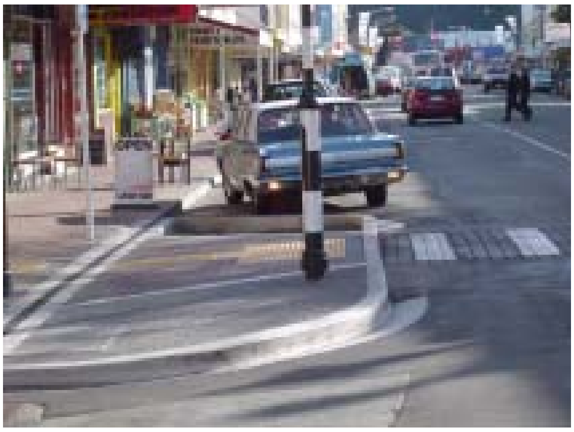


Photo 2: The kerb protrusion at this raised pedestrian crossing reduces the crossing distance for pedestrians. Here a raised crossing slows traffic and eliminates the kerb ramp.

3.4.4 Medians/central islands

Medians are physical islands installed in the roadway to separate vehicles travelling in opposite directions and/or provide a facility for pedestrians crossing the road.

Where medians are cut-through level with the roadway, the sides naturally define the boundaries of the pedestrian path. They also avoid the need for ramps or directional indicators.

Where a median forms part of a crossing point, the crossing should be cut through level with the roadway.

The width of the cut through or kerb ramp in the median shall be at least as wide as the kerb ramp at the footpath/roadway interface.

3.4.5 Crossing points at corners and intersections

As pedestrians are the most vulnerable road users, their safety is a paramount consideration in intersection design. There are a number of competing design objectives.

- There should be separate crossings for each direction at a corner.
- The kerb crossings should be located in the direct line of the continuous accessible travel path. Where this is not possible, environmental or tactile cues should provide guidance to the crossing point.
- The kerb should be aligned so it is crossed perpendicular to the path of travel.
- The location of pedestrians who are about to leave the kerb should be predictable and visible to drivers of conflicting vehicles (particularly those turning left).
- The distance of roadway to be crossed should be as short as practicable.
- Vehicle turning speeds should be slow.

Radius

Large corner kerb radii compromise nearly all of the above objectives.

Corner radii should be minimised.

Kerb corner radii are also set by the needs of the larger vehicles likely to turn at the intersection. The hierarchy of space needs is:

- largest design vehicle, turns left crossing the centreline in one or both streets (appropriate on low volume local roads)
- largest design vehicle turns left without crossing either centreline (CBD, collector and minor arterial roads)
- largest design vehicle turns left from kerbside lane while remaining left of centreline on road being entered (turning left from major road intersection multilane approach), and
- largest design vehicle turns left from kerbside lane into kerbside lane without encroaching on any other lane (intersection between major multilane roads).

Where large kerb radii are required, consider the use of slip lanes separated by islands. However, blind and vision-impaired pedestrians strongly prefer slip lanes to be signalised.

Provided a vehicle can actually fit, the main disadvantage from a small kerb corner radius is inconvenience to waiting traffic. The intersection designer should ensure that the kerb radius is not being designed to an inappropriately high value based simply on occasional motor vehicle convenience.

In the case of large radius kerbs at a corner, it may be possible to use two kerb ramps if the pedestrian crosswalks are moved away from the intersection.

Guidance for situations with various kerb radii is given in section 4.8.

Vertical upstand

Provision of two separate kerb ramps separated by a vertical kerb upstand of at least 1m long is definitely the preferred design for kerb ramps at an intersection. A kerb upstand less than 1m wide between kerb ramps can be difficult for pedestrians to detect, creating a tripping hazard (Photo 3).

A kerb upstand less than 1m in length between kerb ramps should be avoided.

Photo 3: The short kerb upstand between crossing points is a tripping hazard.

4 Tactile ground surface indicators (TGSI)

4.1 AS/NZS 1428.4: 2002

AS/NZS 1428.4:2002 Design for Access and Mobility Part 4: Tactile Indicators was released in November 2002 and consequently its predecessor (NZS/AS 1428.4: 1992) is referenced in NZS 4121: 2001 and RTS 14. While its content with respect to facilities in buildings is unchallenged, its guidance with respect to kerb crossings has not met with support from the New Zealand blind community including the RNZFB and road, footpath and traffic signal designers. Some issues with AS/NZS 1428.4:2002 that have been identified are:

- use of steep kerb ramps where TGSI are omitted
- layout of intersection examples is not typical of NZ intersections
- location of some signal poles is incompatible with NZ practice and regulations, and
- no guidance for kerb ramps entering curved corner kerbs.

RTS 14 is the best practice guideline for installing TGSI in the New Zealand road environment. Where conflict exists between this guideline and referenced standards, this guideline shall be regarded as the more appropriate.

AS/NZS 1428.4: 2002 contains examples of road crossing situations that RTS 14 considers to be inconsistent with good design practice and not readily achievable in the road environment. In particular, Figures C1 (D), C1 (H), C2, C4, C5, C6, C7 and C8 in Appendix C should NOT be implemented.

4.2 Types of TGSI

Only two types of TGSI shall be used in the road environment in New Zealand.

Detailed specifications of these TGSI can be found in AS/NZS 1428.4: 2002 Section 2. For convenience the diagrams are reproduced in Appendix B.

4.2.1 Warning indicators

A warning indicator is a textured surface feature consisting of truncated domes built into or applied to walking surfaces to warn blind and vision-impaired people of a nearby hazard.

Warning indicators are intended to function much like a stop sign. They alert pedestrians who are blind or vision-impaired to hazards in their line of travel, indicating that they should stop to determine the nature of the hazard before proceeding further. They do not indicate what the hazard will be.

Photo 4 shows a typical arrangement of warning indicators.

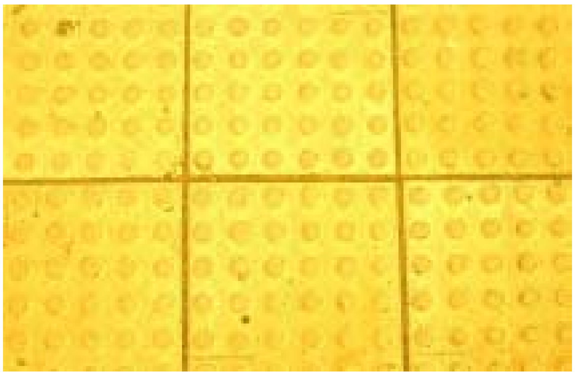


Photo 4: View of warning indicators. Note how the adjoining pavers have been cut and placed in such a way as to maintain equal spacing between domes across the entire warning indicator surface.

4.2.2 Directional indicators

A directional indicator is a textured surface feature consisting of directional grooves built into or applied to walking surfaces to give directional orientation to blind and vision-impaired people.

Directional indicators are used in lieu of other tactile and environmental cues, such as the property line or kerb edge, to:

- give directional orientation in open spaces
- designate the continuous accessible route to be taken to avoid hazards, or
- give directional orientation to a person who must deviate from the continuous accessible path to gain access to a crossing point, public transport access point, or point of entry to a significant public facility e.g. public toilet, information centre.

Photo 5 shows a typical arrangement of directional indicators.

Photo 5: View of directional indicators.

4.2.3 Materials

TGSI should be made from any material that complies with AS/NZS 1428.4: 2002 – Section 2.2.2.

When selecting a material, consideration should be given to the performance characteristics of the material, such as:

- visual contrast (refer Section 4.3)
- slip resistance in wet and dry conditions (refer AS/NZS 3661.1: 1993)
- resistance to impact, i.e. chipping or cracking
- wear resistance, and
- adhesion/bond strength - particularly if immersed in water.

4.3 Visual contrast

Contrasts in the light reflectance value, chromaticity and hue of the walking surface and surrounding environment are critical for vision-impaired people for orientation, distinguishing the limits of the footpath, recognising hazards and gathering information.

TGSI shall provide a high visual contrast to the adjoining walking surface, either light-on-dark, or dark-on-light.

A visual contrast to the immediate adjoining surface of 70 percent should be provided.

Visual contrast in percent is determined by:

Contrast = [(B1 – B2)/B1] x 100

Where: B1 = light reflectance value (LRV) of the lighter area; and

B2 = light reflectance value of the darker area.

A visual contrast to the immediate adjoining surface of 30 percent is acceptable where differences in hue and chromaticity are high.

Increasing the contrast in hue and chromaticity will always help improve visual detection.

Appendix F of AS/NZS 1428.4: 2002 details techniques for laboratory and on-site measurement of LRV (or luminance) contrast.

Safety yellow

Research by Bentzen et al (Accessible Design for the Blind (May 2000)) indicated that the colour "safety yellow" is so salient, even to persons having very low vision, that it is highly visible even when used in association with adjoining surfaces having a LRV differing by as little as 40 percent. Their research found that safety yellow TGSI having a 40 percent contrast from new concrete was subjectively judged to be more detectable than a darker TGSI having an 86 percent contrast with new concrete.

Safety yellow is the preferred standard colour for TGSI.

White coloured warning TGSI should not be used at places where they could be confused with the bar of a pedestrian (zebra) crossing.

4.4 Where are TGSI Installed?

4.4.1 Warning indicators

Warning indicators alert people who are blind or vision-impaired to pending obstacles or hazards on the continuous accessible path that could not reasonably be expected or anticipated using other tactile and environmental cues.

Warning indicators shall be installed to inform blind and vision-impaired people of:

- life threatening hazards where serious falls may occur, such as at railway platforms or wharves
- pedestrian kerb crossings, paths cut through medians, and other places where the footpath is not separated from the roadway by an abrupt change of grade of at least 12.5 percent (or 1:8) or with a vertical kerb more than 70mm high
- approaches to stairways, ramps, escalators and moving walkways (Section 4.13)

- the presence of level railway crossings (Section 4.12), and
- overhead impediments or hazards other than doorways (e.g. wall mounted objects and archway structures), with a clearance of less than 2m from ground level, in an accessible open public space with no clearly defined continuous accessible path of travel.

Warning indicators may also be installed to inform blind and vision-impaired people of:

- vehicle hazards at busy vehicle crossing points such as: shopping centres, bus stations and large public car parks, where other design solutions are not appropriate (Section 4.11), and
- street furniture inappropriately located in the continuous accessible path of travel and not detectable by a vision-impaired person using the aid of a white cane.

It is better to redesign street furniture than to install warning indicators.

4.4.2 Directional indicators

Directional indicators shall be used to provide directional guidance where a person must deviate from the continuous accessible path of travel to gain access to:

- a road crossing point
- public transport access point, or
- significant public facility e.g. public toilets or information centre.

Directional indicators may also be used to provide directional guidance:

- across open space from one point to another, or
- around obstacles in the continuous accessible path of travel (where warning tiles are not sufficient).

It is better to remove obstacles from the continuous accessible path of travel than to install directional indicators.

4.5 Installation principles

4.5.1 Warning indicators

Warning indicators shall be installed:

- Across the full width of all pedestrian kerb crossings, paths cut through medians, stairs and escalators, to ensure that all blind and vision-impaired people using these facilities encounter the warning indicators. In all other situations, warning indicators must have a minimum width of 900mm.

- With the front and back edges perpendicular to the crossing direction to enable blind and vision-impaired people to align themselves correctly (refer to Photo 7 for how NOT to do it).
- So that the domes are aligned with the direct line of travel across the road.
- So that the front edge of the warning indicator is no closer than 300mm from the edge of the hazard, except at railway platforms or wharves where the setback from the hazard must be a minimum of 600mm.
- To a recommended depth of 600mm and up to 900mm where additional warning is considered necessary.

  (This depth is required to prevent a pedestrian from inadvertently stepping over the TGSI.)
- To within 500mm of the base of traffic signals so that pedestrians can stand on the warning indicators when using ATTS.
- So that the base of the warning indicators are flush with the surrounding footpath surface.

In order to maintain a 50mm spacing between dome centres on adjoining tiles, tiles need to be rectangular with length and width dimensions as multiples of 50mm. Tiles with length or width dimensions greater than 300mm can be difficult to place correctly.

Warning distances

The set back distances of warning indicators provide blind and vision-impaired people with a safe tolerance to stop upon encountering the warning indicators without stepping into the hazard or hazard area. Additional set back distance is provided at railway platforms and wharves given the serious fall that could occur at these locations.

Photo 6: The warning indicators at this railway station are 600mm deep and set 600mm back from the platform edge. While these warning indicators look like they provide little contrast, the stainless steel design does comply with visual contrast requirements.

4.5.2 Directional indicators

Directional indicators shall be installed:

- in conjunction with warning indicators where used to provide directional guidance to a road crossing point or access to public transport
- parallel with and along the centreline of the required direction of travel (refer to Photo 7 for how NOT to do it)
- with a minimum depth of 300mm where used to indicate the normal continuous accessible path of travel

- with a minimum depth of 600mm to indicate a change in direction of the continuous accessible path of travel, such as the location of a mid-block road crossing point or access to public transport or where pedestrians will approach it at an angle, and
- with a minimum length of 1000mm so that blind and vision-impaired people can readily orientate themselves.

Directional indicators leading to a kerb crossing need not form a direct continuous path to the warning indicators where there are other tactile cues to assist blind and vision-impaired people once aligned with the warning indicator.

Where used to provide direction guidance all the way to kerb ramps, directional indicators should terminate at the top of the ramp.

Photo 7: Not good practice: The call box, warning and directional indicators are aligned with the kerb instead of the crossing direction. A blind or vision-impaired person could easily lose their orientation at this intersection and walk into a dangerous situation. There is also poor visual contrast between the TGSI and surrounding footpath surface.

4.6 TGSI at road crossing points

4.6.1 Mid-block crossing points

Directional indicators shall be provided at mid-block crossings, except where the crossing point is on the continuous accessible path of travel.

In most cases, the footpath will run parallel to the roadway and thus the crossing point will not be on the continuous accessible path of travel (Photo 8).

Photo 8: These directional indicators intercept all pedestrians on the continuous accessible path of travel. They lead directly to the warning indicators, which are aligned with the centre of the pedestrian crossing.

4.6.2 Median/central islands

Where warning indicators are installed in medians, they shall cover the full width of the median cut through or kerb ramp.

The layout of the TGSI in the median will vary depending on the depth of the median and shape of the island cut through.

Painted medians

Painted medians are not suitable locations for blind and vision-impaired pedestrians to wait in while crossing the road.

TGSI shall NOT be installed within painted medians.

Narrow medians (less than 1.2m deep)

Medians less than 1.2m deep, even those cut through at roadway level (preferred) or with kerb ramps, are not wide enough to cater safely for the needs of blind and vision-impaired people, mobility-impaired people or those people with wheelchairs, mobility scooters, prams or young children.

TGSI shall NOT be installed within medians less than 1.2 metres wide.

Medians (1.2m–1.8m deep)

Where the median is from 1.2 metres to 1.8m deep, warning indicators shall be installed across the full depth, set back at least 300mm from the roadway (photo 9).

Wide medians (more than 1.8 m deep)

Where the median is more than 1.8 m deep, two sets of warning indicators each 600mm deep, shall be installed, set back 300mm from the roadway (photo 10).

Photo 9: Warning indicators correctly installed across the full depth of this pedestrian median island (1.2-1.8m deep). Note: Warning indicators should cover full width of cut through. This one could be bypassed.

Angled medians

Where the cut through of a median is angled, the warning indicators must be installed so that they are aligned with the direct road crossing line (photo 11).

Photo 10: On deep medians two sets of warning indicators are installed. (Note: not quite full width.)

Photo 11: The warning indicators are aligned with the road crossing direction. (Note: not quite full width.)

Median with a staggered crossing

Staggered median crossings are usually installed in deep medians where a large number of people are crossing between staggered crossing points on opposite sides of the roadway.

Staggered median crossings shall have:

- A physical barrier, rail or similar to encourage pedestrians to cross at the cut through or kerb ramps provided. The barrier should provide good visual contrast with the surrounding environment.
- Warning indicators installed 600mm deep, set back 300mm from the roadway at each of the kerb ramps or where the cut through meets the roadway.

Directional indicators should be installed between the warning indicators where there is no kerb to follow between the warning indicators or where there are no other tactile cues.

Figure 2 (overleaf) shows the four types of medians where warning indicators are installed.

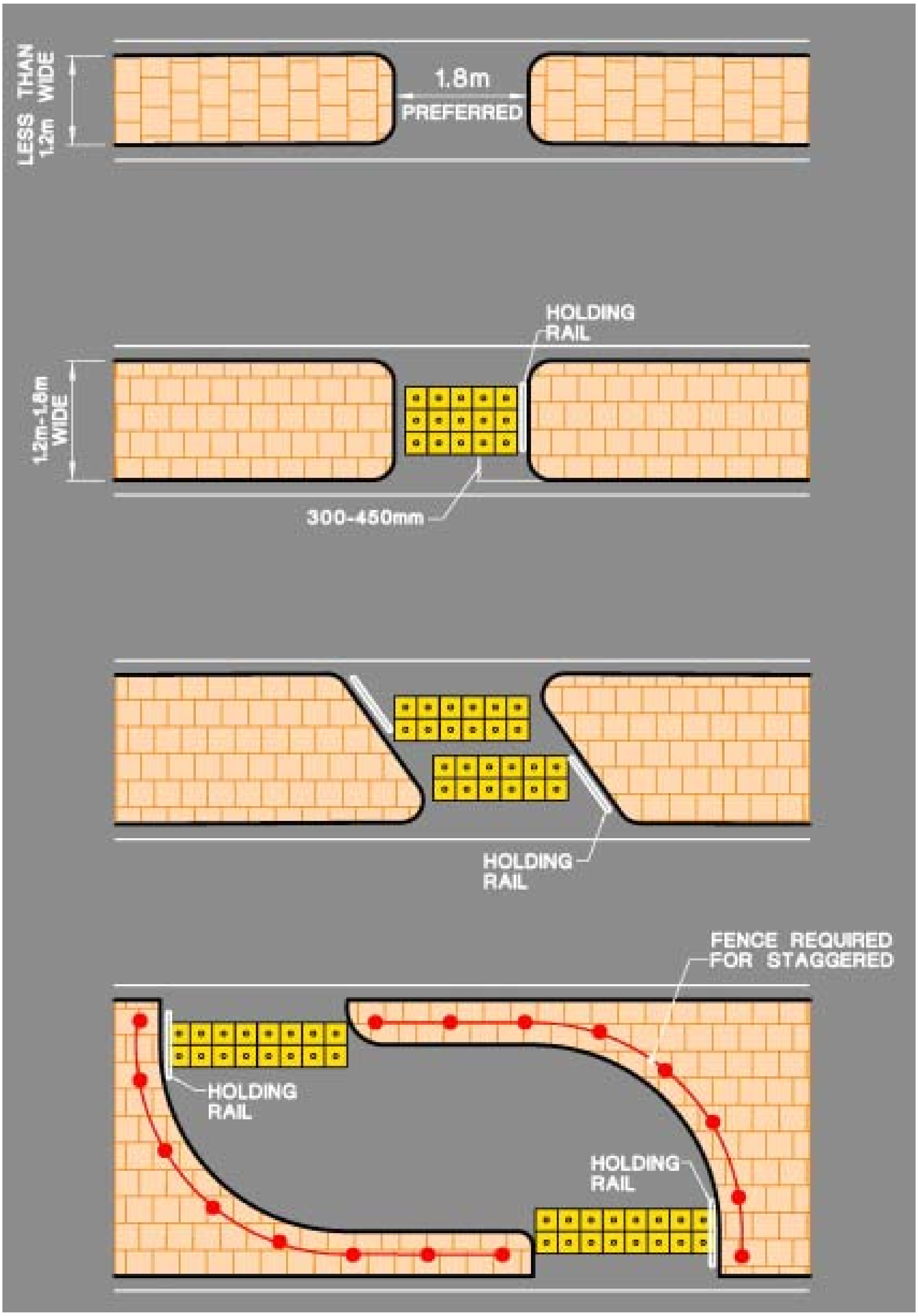


Figure 2: Schematic layout of how warning indicators should be installed in medians.

4.7 TGSI at intersections

4.7.1 Intersections

Intersection crossing points include those at signalised, priority controlled and uncontrolled intersections.

Warning indicators should be installed at all intersection crossing points, irrespective of the type of kerb crossing.

Section 6 recommends a priority order for installing TGSI at existing pedestrian kerb crossings.

Photo 12: Warning indicators should be installed at all intersections, no matter how minor.

Directional indicators should be considered at all intersection crossing points that are:

- offset from the direct line of the continuous accessible path of travel
- more than 3m from the property line and other cues such as well-placed street furniture are insufficient.

In these situations, blind and vision-impaired pedestrians may lose their orientation and have difficulty in locating the crossing point.

Figure 3 (overleaf) illustrates the correct layout of warning indicators at a signalised intersection. The layout dimensions also refer to recommended kerb ramp design (Section 3.4.1) and location of pedestrian push button poles in relation to kerb ramps and crosswalk lines (Section 5.5).

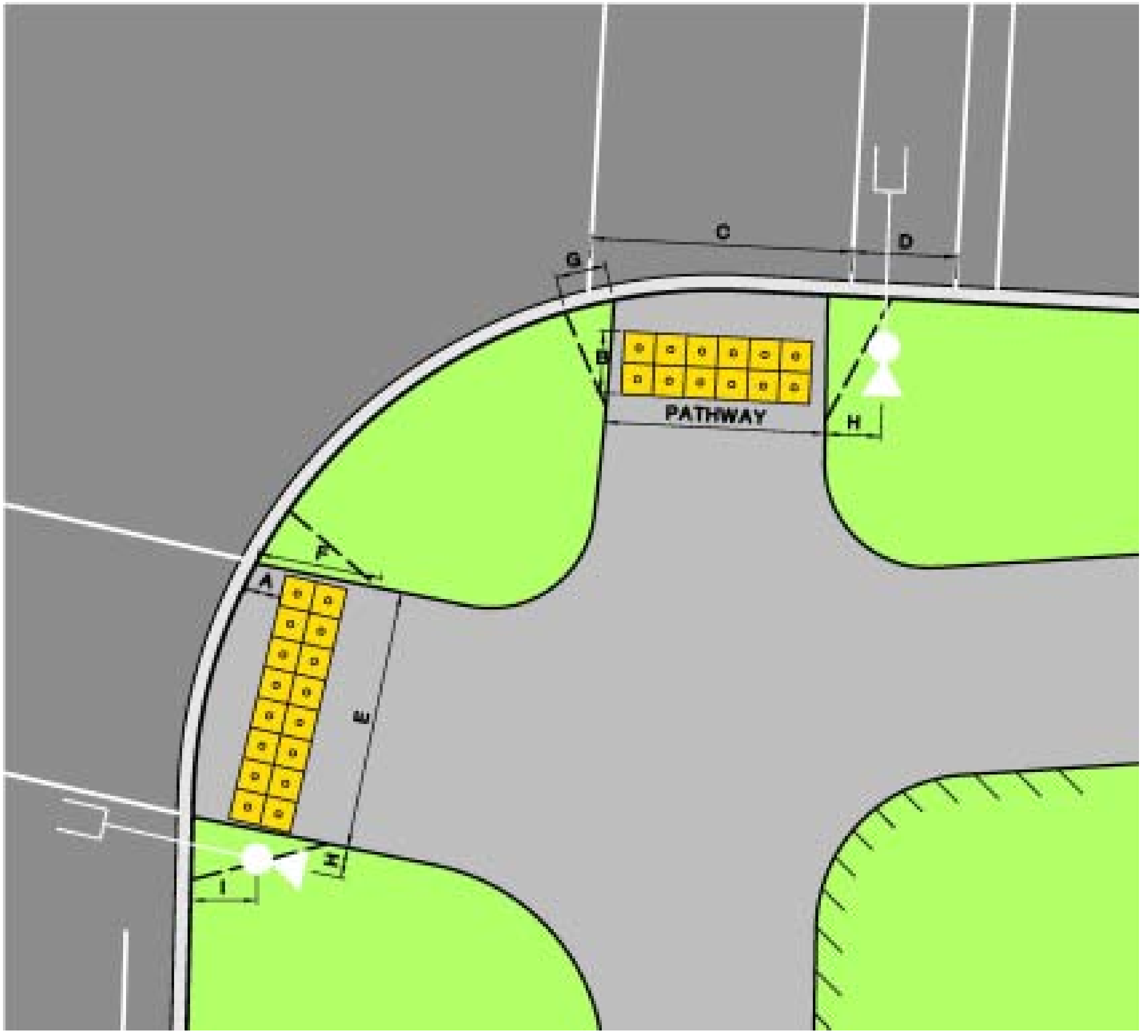


Figure 3: Correct design and orientation of kerb ramps, location of push button pole and installation of warning indicators at a signalised intersection (key below).

Key to Figure 3

ID	Description	Dimension
A	Set back distance of warning indicators to front of kerb*	Minimum 300 mm
B	Depth of warning indicators	Minimum 600 mm
C	Width of pedestrian crosswalk	2.5 m
D	Distance between outside crosswalk line and limit lines	1.0 m
E	Width of kerb ramp	Width of crossing
F	Depth of kerb ramp **	1.4 m minimum
G	Haunching of kerb **	600 mm
H	Pedestrian push button offset from kerb ramp	400 – 600 mm
I	Pedestrian push button set back from kerb	Maximum 1.0 m

Notes:

** Dimension A is measured along the path of pedestrian travel, not perpendicular to the kerb.*

*** Based on a 100 mm full kerb height.*

Photo 13 shows an example of a blended kerb at a wide footpath with large corner radius. Note how the directional indicators link to the building line to intercept the direction of pedestrian movement and lead blind and vision-impaired users to the warning indicators by the call box. This design could be further improved by rotating the call box so that it is mounted perpendicular to the pedestrian path of travel. See figure 5f for a better warning indicator arrangement for the scramble crossing.

Photo 13: Directional and warning indicators installed at a signalised scramble crossing.

4.7.2 Slip lane islands

Slip lane islands separate diverging traffic. The most common type of slip lane island is located at signalised intersections to separate left turning traffic from through and/or right turning traffic.

Where a slip lane island also functions as a place for pedestrians to wait while crossing the road, TGSI should be provided (figure 4).

On most slip lane islands there will be three crossing places: Across the left turn slip lane, across the through and right turning traffic, and across the intersecting road.

On large slip lane islands that are not cut through, directional indicators should be used between the crossing points to provide directional guidance to blind and vision-impaired pedestrians. Where there are three crossing points on the slip island (as in photo 14), directional indicators should lead to a central warning indicator with dimensions of 600 x 600mm to indicate that a choice becomes available.

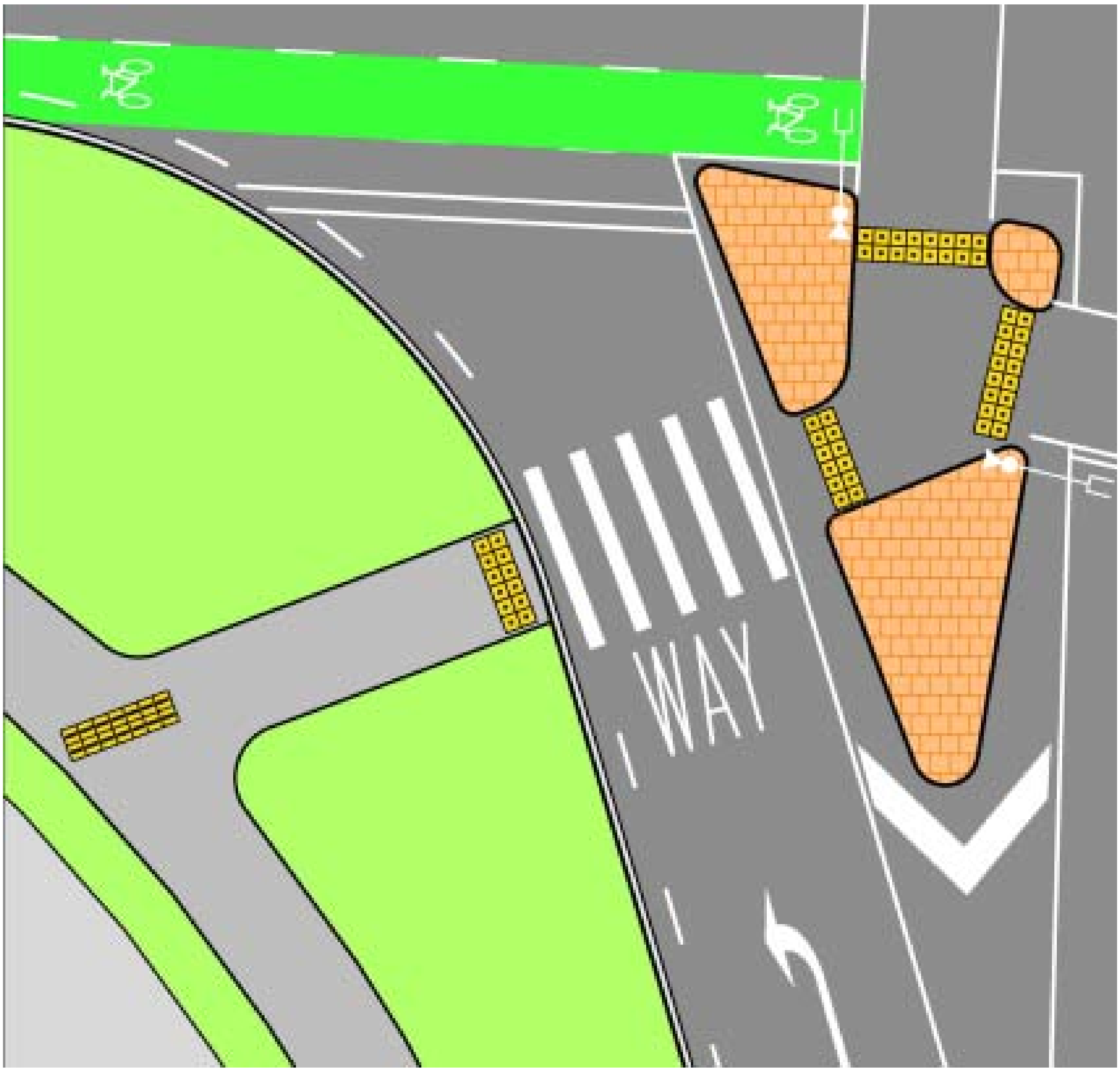


Figure 4: Warning indicators correctly shown in a slip lane island. Note how the warning indicators are orientated perpendicular to the crossing direction.

Photo 14: Warning indicators correctly installed on this slip lane island, in regard to alignment and position. Cutting the island through level with the roadway would improve guidance across the island and accessibility for mobility-impaired people. In the absence of the cut-through directional TGSI should be considered. Also note how exclusive pedestrian push button poles have been provided adjacent to each crossing point (refer Section 5.5 for guidance).

4.8 Application guidance for typical intersections

The design of many existing intersection crossing points in New Zealand makes it difficult to comply with the requirements of this guideline. Some of the more common issues that may be encountered and strategies for mitigating these effects are discussed below.

4.8.1 Intersection curve radius

As outlined in section 3.4.5, pedestrians are best served by small corner kerb radii. Within the range of typical situations, acceptable designs are generally possible where the kerb radius is similar to or smaller than the total footpath width from kerb to property line. In practice many existing intersections have large kerb radii. These result in the continuous accessible path of travel intersecting with a curved kerb which is to be crossed at an angle. The steeper the angle the more difficult it becomes to:

- design kerb ramps that are oriented to the pedestrian crossing path.
- arrange the TGSI to give clear and consistent messages.
- locate kerb crossings in line with the continuous accessible path of travel.

Suggested options in order of pedestrian benefit:

1) Move the kerb: add kerb protrusions or reduce the kerb radius.
2) Move the kerb crossings and associated crosswalks, signal poles etc.
3) Achieve least confusing TGSI arrangement as possible and supplement with appropriate street furniture.

Moving the kerb

Kerb radius considerations are outlined in section 3.4.5. Many intersections perform satisfactorily with kerb corner radii of 3m or less. At 3m, satisfactory kerb crossing layouts can usually be devised. At a kerb corner radius of 5m with the typical berm widths of 3m, designs are significantly compromised but separate kerb crossings are generally possible, requiring the crossing points to be set back at least 2.5m from the prolongation of the kerb lines. Such will not however be perpendicular to the kerb.

The benefits of smaller kerb radii are shown in figures 5a and 5b.

Kerb protrusions provide many operational and safety benefits at intersections, provided all turning movements by design vehicles can be accommodated. They usually provide room for good TGSI arrangements, and allow the ramps to be oriented to the pedestrian route. An example of a kerb protrusion solution is shown in figure 5i.

Moving the kerb ramps

As the kerb ramp is moved away from the intersection, the pedestrian path becomes more perpendicular to the kerb and better TGSI arrangements become possible. On the other hand directional TGSI and other cues may be needed to redirect blind and vision-impaired pedestrians to the crossing points.

At traffic signals, moving the kerb crossings usually means moving the signals poles, crosswalk markings and limit lines as well.

The pedestrian is also moved further from the expected place at the intersection. This does, however, have the advantage that traffic turning will arrive more from the side rather than the rear, giving a pedestrian more opportunity to react to a turning vehicle.

Angled kerb ramps

If a kerb ramp is constructed within a corner curve, but the top and sides of a kerb ramp are kept oriented to the crossing path, one side is longer than the other and the top is not parallel to the bottom and the ramp develops a twist. It is desirable to limit cross-fall on ramps to 1:50. This happens near the bottom of the ramp when one side of the kerb is about 400mm longer than the other side or the angle of the sides to the kerb reaches about 15 degrees from the perpendicular. This effect can be minimised by using a gently sloping landing at the bottom. More work is desirable to optimise the design and determine the limiting angles for angled kerb ramps.

When the desired angle to the kerb becomes too high, it may become necessary to orient the ramp at an angle that is a compromise between the desired pedestrian path and the perpendicular to the kerb.

A number of possible kerb ramp and TGSI arrangements for typical intersections with 5 metre radius corner kerbs, are shown in figures 5c to 5h.

4.8.2 Narrow footpath by kerb

Where a narrow footpath is located by a kerb, kerb crossings with their TGSI intrude into the footpath area. Typically, intersections with such narrow footpaths have the kerb crossing offset from the continuous accessible travel path. Directional TGSI are not likely to fit. Warning TGSI may need to carry out both functions. Ensure the kerb crossings are appropriately located as outlined above. By orienting the warning TGSI to the crossing direction, blind or vision-impaired person encountering the warning TGSI should be able to deduce the location and direction of the kerb crossing.

4.8.3 Single corner kerb crossings

Frequently the corner of an existing intersection will have only one kerb crossing that is shared for all directions. At signals the inside pedestrian crosswalk lines intersect close to the kerb line or within the intersection. It is difficult to give unambiguous orientation messages for two directions at the one kerb crossing in the space that is available.

Recommended strategy

There are two recommended options:

- Redesign the kerbs and/or crossing points as outlined above.
- Provide the least confusing arrangement of TGSI possible, as shown in figure 5d.

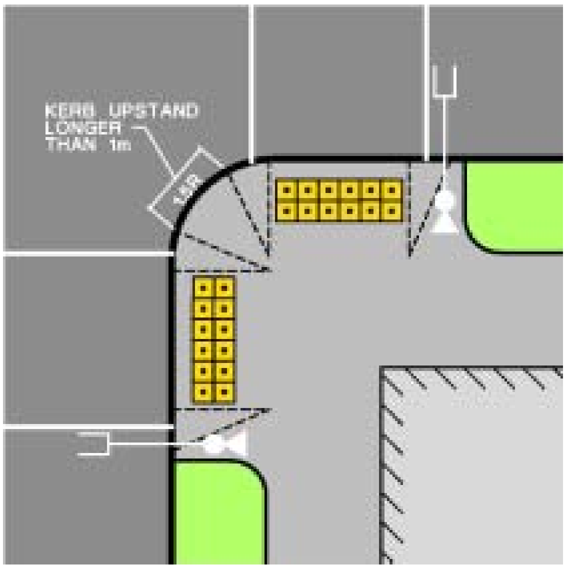


Figure 5a: Two kerb crossings.

Recommended.

With a small kerb radius like 1.5 metres, satisfactory solution.

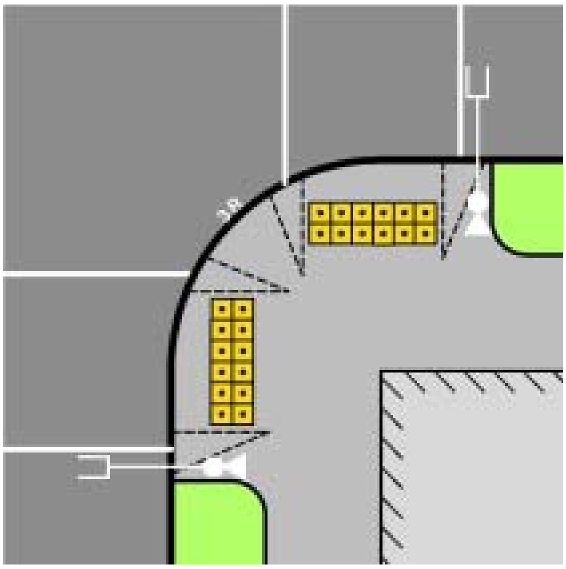


Figure 5b: Two kerb crossings.

Recommended.

Three metre kerb radius, design somewhat compromised.

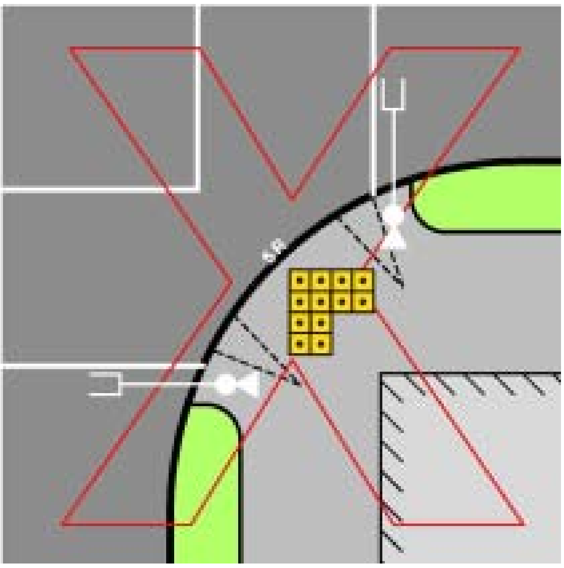


Figure 5c: Single angled crossing.

Kerb ramp design not recommended.
TGSI arrangement not recommended.

The front faces of warning TGSI direct users across the haunchings. TGSI only intercept a small portion of the pedestrian route.

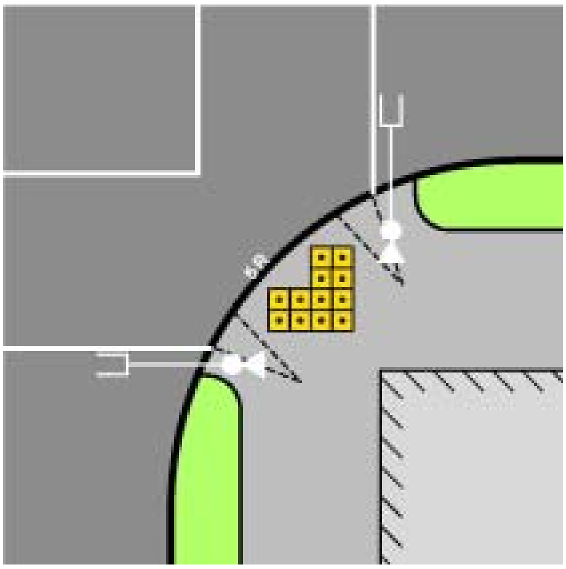


Figure 5d: Single angled crossing.

Kerb ramp design not recommended.
TGSI arrangement acceptable.

This TGSI arrangement gives the least confusing crossing information for this situation, and intercepts a higher proportion of the approach path.

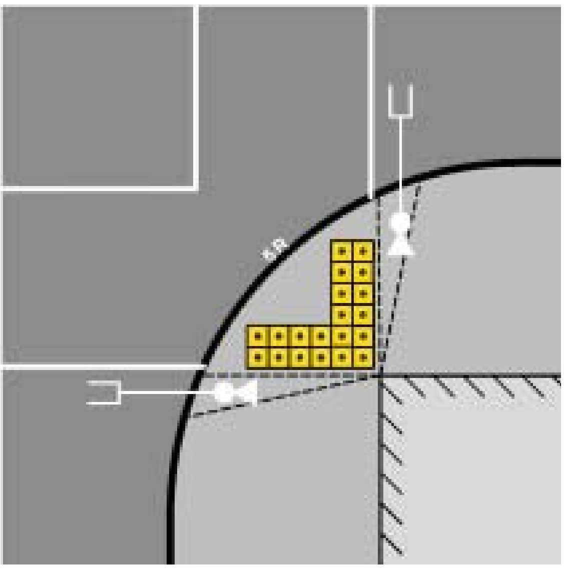


Figure 5e: Full quadrant kerb crossing.

Kerb crossing layout not recommended.
TGSI arrangement acceptable.

Warning TGSI at entry intercept all users, and guide to crossing point. (Warning TGSI only around kerb would confuse. Directional TGSI by themselves would not be sufficient.)

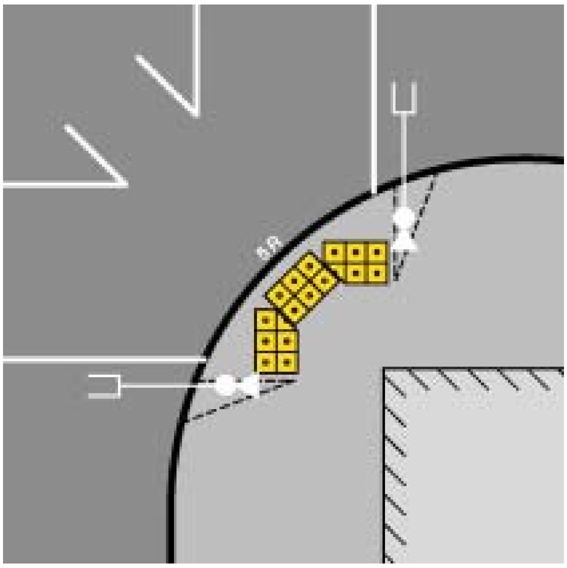


Figure 5f: Full quadrant kerb crossing scramble phase/ Barnes dance.

Recommended.

TGSI intercept full path and provide information for all directions of crossing.

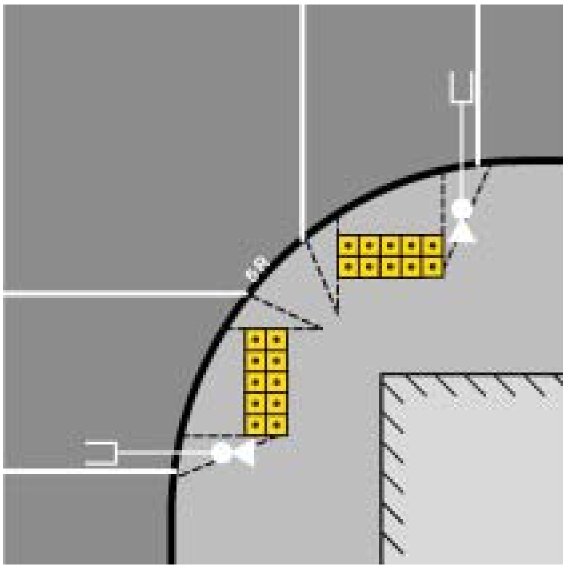


Figure 5g: Two crossings 5m kerb radius.

Acceptable but not recommended.

Minimum separation between kerbs (1m of full height kerb, plus haunchings). Highly angled kerb crossings are offset from the continuous accessible path of travel. TGSI give clear message.

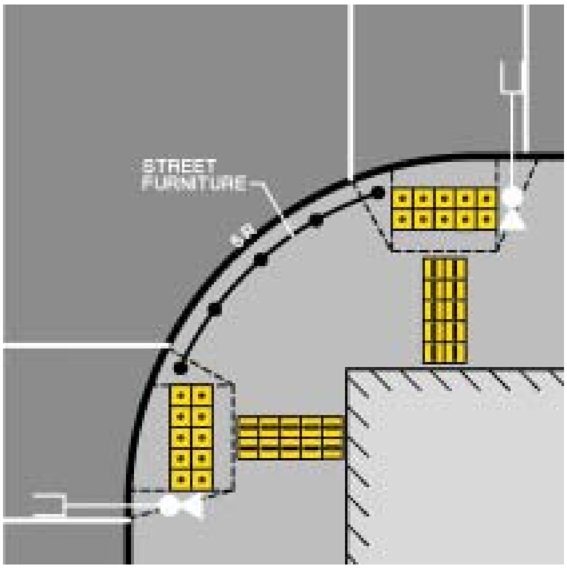


Figure 5h: Two crossings, 5m kerb radius.

Recommended.

Greater separation reduces kerb crossing angles. Kerb and warning TGSI provide more consistent guidance. Crossings are outside continuous accessible path of travel. Directional TGSI desirable.

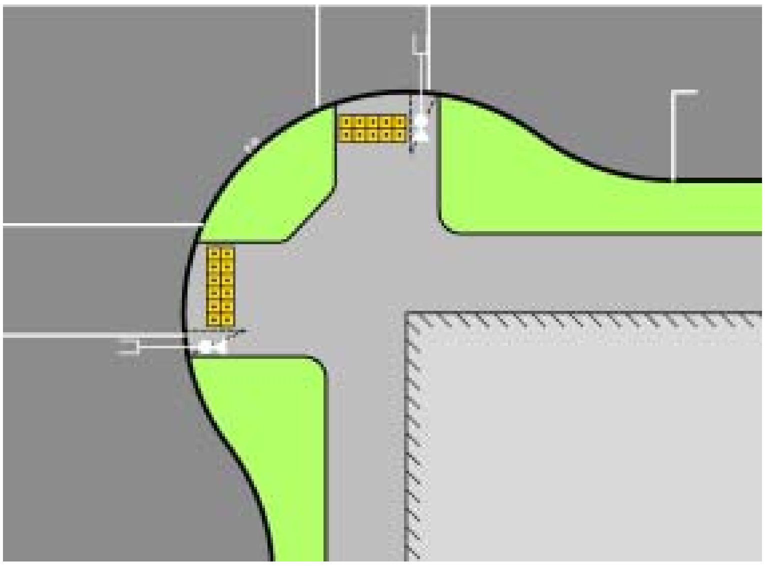


Figure 5i: 2 Two kerb crossings with kerb build-out.

Preferred intersection design.

Kerb crossings and TGSI give accurate crossing information. The kerb build-out reduces crossing distances and allows both kerb ramps to be installed in the continuous accessible path of travel.

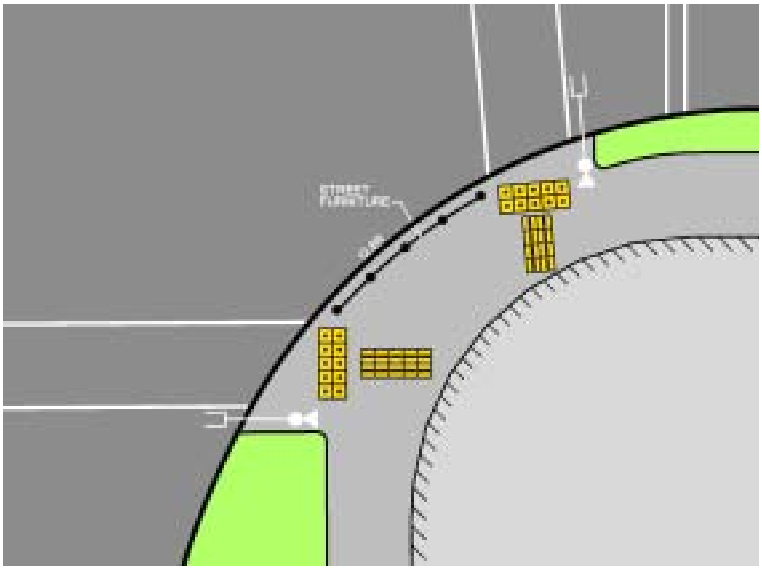


Figure 5j: Large kerb radius.

Acceptable.

Crossings set back to achieve acceptable kerb crossing and TGSI arrangements.

4.8.4 Location of utility services

Public utility services (manholes, lids, valve chambers, etc.) are commonly located at or near the kerb line of the intersection. This can make it difficult to install TGSI.

Recommended strategy

There are four recommended options here:

- install TGSI that can be applied over public utility service covers
- design service covers with a profile consistent with warning indicators
- relocate the services away from the area required to provide tactile surface messages
- extend the kerb (kerb protrusion) to provide more room for tactile surface messages.

Photo 15 shows an attempt at providing TGSI at a corner with utility services, a narrow footpath, and large curve radius.

Photo 15: Although not fully compliant, the TGSI convey warning and directional information to blind and vision-impaired pedestrians that encounter them, but it is quite possible to step past them and miss the warning.

4.8.5 Fitting tiles to kerb crossing points

The requirements for straight front and back edges removes any need to cut tiles in order to follow a curved kerb.

Warning TGSI are however required to be installed across the full width of kerb ramps, median breaks etc. This is to ensure that blind and vision-impaired pedestrians don't inadvertently step past the warning TGSI. As a person's foot is only about 90 mm wide, good design would ensure the tiles come within 50mm of the edge of the pathway. As tiles are typically 300 mm square, the tiles may need to be cut. It may also be necessary to cut warning tiles so they don't extend beyond the top of a kerb ramp.

Where tiles are cut, the edges of the raised circles shall be chamfered at 45 degrees and sharp sides rounded.

4.8.6 Roundabouts

Roundabouts create particular difficulties for blind and vision-impaired pedestrians. It is most difficult to use audible cues to judge whether vehicles are exiting or continuing around the roundabout. The problem is identified in the international literature, but no solutions have been demonstrated. Consideration could be given to providing a crossing facility with a central refuge, at a sufficient distance from the roundabout to permit an audible judgement of approaching traffic. In the absence of any research evidence about this distance, it is suggested that this distance should take into account the time it takes for a pedestrian to cross one half of the roadway, and the time it takes for vehicles exiting the roundabout to reach the crossing point.

4.9 Guidance between kerbs

Consideration should be given to providing blind and vision-impaired pedestrians with guidance between kerbs. Vision-impaired pedestrians may become disorientated by several factors, including long crossing distances and light traffic flows.

Raised crossing platforms and ramps, especially those with a different surface material/texture from the adjoining section of road, can be particularly useful for guiding pedestrians and slowing traffic (photo 16).

Photo 16: This installation shows a textured and raised crossing surface to inform blind and vision-impaired pedestrians of the boundaries of the crossing point. Note also how street furniture (in this case fencing – with a compliant low level horizontal bar) has been used to divert pedestrians to the crossing point away from the trip hazard at the ramp up to the crossing point.

At more heavily trafficked intersections it is unrealistic to provide raised crossing places for pedestrians. In these situations, marking the pedestrian crosswalk lines with thick thermoplastic should be considered. Thermoplastic markings are slightly raised, which allows those with a cane to remain within the crosswalk lines while between kerbs.

Guidance between kerbs should not be limited to the above, and innovation is encouraged. When installing features on the road surface, the negative impacts on all road user groups should be considered e.g. trip hazards for pedestrians or cyclists, capacity reduction for traffic.

4.10 Access to public transport

Blind and vision-impaired pedestrians need to identify areas of access to public transport. TGSI will not solely provide identification of these areas over road crossing points. Other environmental cues such as a person's environmental perception, orientation and awareness will help to determine between particular crossing points and other features, such as areas of access to public transport. For example, most bus stops will not have kerb ramps.

TGSI provided to identify access to public transport shall be installed as follows:

- Warning indicators a minimum of 600 mm wide x 600mm deep installed 300mm back from the front of the kerb edge, adjacent to a bus stop, preferably close to the entry door.
- Warning indicators 600mm from the edge of train platforms and ferry wharf edges.
- Directional indicators 600mm deep, installed where the warning indicators are not located in the direct line of the continuous accessible path of travel, forming a continuous path to the warning indicators.

Photo 17 shows directional and warning indicators installed correctly at a bus stop.

Photo 17: Directional indicators lead to warning indicators at a bus stop. Note the warning indicators are wider than required.

4.11 Vehicle entrances

Busy vehicle crossing points (generally accesses to commercial properties) can be hazardous for blind and vision-impaired pedestrians to cross.

Road controlling authorities will need to exercise their own judgement in conjunction with interested parties when assessing the need for TGSI, but could be justified on footpaths crossing vehicle entrances to:

- shopping centres
- bus stations
- large public car parks
- hospitals.

It should be remembered that pedestrians have the right-of-way where the footpath extends across a vehicle crossing point. Installing TGSI may give vehicles the impression that they have the right-of-way; hence TGSI should only be installed in exceptional circumstances.

It is preferred that the access be formed to intersection standards in situations where confusion may exist over rights-of-way between vehicles and pedestrians and there are heavy vehicle flows.

When installed at vehicle entrances, warning indicators shall:

- have a depth of 600mm and extend across the full width of the footpath, and
- be setback at least 300mm from the expected travel path of a large vehicle turning to enter or leave the vehicle crossing point.

Photo 18: Warning indicators extend across the full width of the footpath outside a car park building.

4.12 Railway level crossings

At railway level crossings, warning indicators shall:

- be located at a safe distance back from the railway crossing
- cover the full width of the footpath
- have a minimum depth of 600mm.

4.13 Stairs and escalators

Stairs can be particularly hazardous for blind and vision-impaired people, given the serious fall or trip that could occur if a pedestrian were inadvertently to step off, or in to, a flight of stairs.

At stairs, warning indicators shall be installed:

- the full width of the path of travel
- 300mm back from the top and bottom steps, and
- at least 600mm deep at the top and bottom of a flight of stairs.

Similarly, moving escalators and travelators are also hazardous for blind and vision-impaired pedestrians.

At escalators and travelators, warning indicators shall be installed:

- the full width of the path of travel
- 300mm back from the moving handrail, and
- at least 600mm deep at both ends of the escalator/travelator.

AS/NZS 1428.4: 2002 Appendix A2, provides examples of stairways and escalators and prescribes the requirements for installing TGSI in these situations.

4.14 Maintenance

4.14.1 TGSI

Specific maintenance regimes should be adopted to monitor the condition of TGSI and to plan for replacement as part of maintenance programmes.

When developing a maintenance regime, consideration should be given to the following factors:

- Soiling of TGSI is inevitable especially in areas of high pedestrian activity and in medians.

  TGSI shall be cleaned free of surface debris to ensure that the visual contrast requirements are maintained. Many of the photos in this document illustrate this need.

- The profile of the tactile surface is crucial to its effectiveness as a warning or directional aid for blind and vision-impaired people.

  TGSI should be replaced if the domes or bars drop in height below 4mm, because the effectiveness of the surface will be reduced and will ultimately become undetectable.

- Changes to the surrounding surface may require changes to the TGSI to ensure that the visual contrast requirements are maintained.

4.14.2 Footpaths

The roughness of footpaths was the most common issue raised during the survey of RNZFB members (March 2003). Uneven footpaths are a tripping hazard for all pedestrians, especially blind and vision-impaired people, mobility-impaired people and older people.

A regime to ensure footpaths are free of tripping hazards should be adopted.

5 Audible tactile traffic signals (ATTS)

5.1 General

ATTS conveys important information to blind and vision-impaired people at signalised intersections. ATTS provides them with:

- assistance in locating signals
- information to assist them with their orientation, and
- information of the status of the pedestrian phase, i.e. cross or do not cross.

ATTS improves the safety and confident mobility for blind and vision-impaired people as well as benefiting fully sighted people with an audible reminder that it is time to cross. ATTS may also increase the safety of people with cognitive disabilities.

5.2 Pedestrian push button assemblies

It is important that ATTS push buttons be of a standard design and installed in a consistent way. Good practice design of the push button assembly is specified in AS 2353: - 1999: Pedestrian push-button assemblies.

Pedestrian push-button assemblies shall provide all the audible and tactile features specified in AS 2353: - 1999: Pedestrian push-button assemblies.

These features are summarised below.

The standard pedestrian push-button assembly layout is shown in Photo 19 and Figure 6. It has an arrow above the push button. The main function of the arrow on the call box is to provide blind and vision-impaired pedestrians with directional orientation.

Photo 19: Pedestrian push-button assembly.

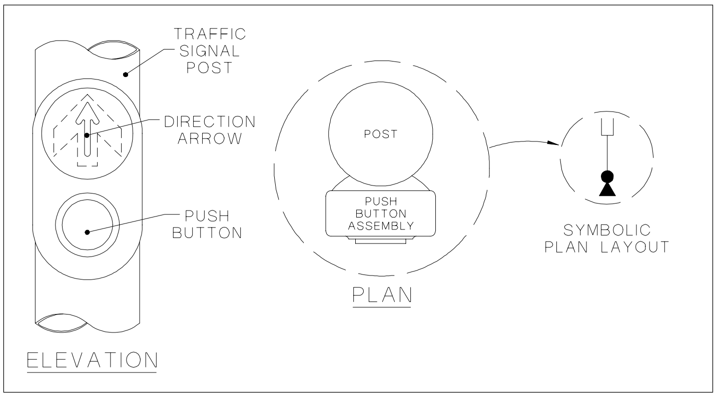


Figure 6: Diagram of pedestrian push-button assembly.

5.3 Design and features of ATTS

There are two types of signals that shall be emitted by ATTS. The "Locating Signal" and the "Crossing Signal" have the following features.

5.3.1 Locating signal

This audible signal consists of a short pip (25 ms of 1000 Hz square wave) repeating every 1.8 seconds. This is associated with a similar length four wavelengths of 145Hz vibrating tactile pulse, which are felt at the centre of the directional arrow above the push button. Both audible and vibrating tactile locating signals operate for the whole time that the "Crossing Signal" is not sounding.

5.3.2 Crossing signal

The audible crossing signal commences with a square wave that descends exponentially in pitch from 3,500Hz to 700 Hz over 115 ms. This is immediately followed by a rapidly pulsing sinusoidal 500Hz signal that decays over 35 ms, before ceasing momentarily and being repeated at 8.5 times a second for the duration of the cross signal. The duration of this signal may be restricted to a maximum time. A vibrating tactile crossing pulse similar to that of the "Locating Signal" is also provided that repeats 8.5 times per second.

Different tones are NOT recommended for the different directions of crossing at an intersection.

The full characteristics of the audible and tactile signals are specified in AS 2353 – 1999: Pedestrian Push Button Assemblies.

A separate unique sound should be provided for exclusive pedestrian phases e.g. Barnes dance/scramble crossings.

The LTSA proposes to develop a standard audible signal for these situations for inclusion in the National Traffic Signal Specification.

5.3.3 Call acknowledge signal

The LTSA proposes to trial traffic signals with a "Call Acknowledge Signal" at intersections during the next year to assess their performance.

A "Call Acknowledge Signal" with the following design features may be provided:

- signal provided within 300ms of the pedestrian button being pressed
- signal consists of a 1250 Hz square wave for 25 ms followed after a 100ms silence by a 1000 ms square wave for 25ms
- signal may be repeated every 1.8 seconds in the place of the "Locating Signal" until the next "Crossing Signal"

- the vibrating tactile call acknowledge signal is a double pulse. It consists of a standard “Locating Signal” pulse followed by a 100 ms gap then another standard “Locating Signal” pulse.

5.3.4 Audible volume

Audible signals shall have a volume control that is automatically responsive to the ambient (background) noise level as specified in AS 2353: - 1999.

This means that a louder tone will be produced when vehicle and other noise at the intersection is high. A quieter sound will be produced during low traffic periods e.g. at night. This is especially useful for signalised intersections in residential areas, so that noise nuisance is kept to a minimum.

While the automatic volume control feature should minimise noise pollution from ATTS, there may still be situations where ATTS annoy neighbours.

If noise pollution proves to be an issue at a site then:

- The “Crossing Signal” feature of the ATTS may be switched off during the hours of 10pm to 7am.
- The “Locating Signal” may also be switched off if the pedestrian push button pole is in a predictable location (refer Section 5.5).
- The vibrating tactile signals must operate at all times.

Note: The ‘Crossing Signal’ is louder than the locating signal so that it is normally loud enough to be heard from the opposite crossing point in the absence of the nearest signal. AS 2353 - 1999 requires the audible ‘Crossing Signal’ to be 14dB louder than the ‘Locating Signal’.

5.3.5 Pedestrian detector pads

Pedestrian detector pads are detectors associated with tactile paving that sense when a pedestrian is standing on the pad. They can be used to call a pedestrian phase or to cancel a pedestrian call if a pedestrian has crossed before the lights changed. They provide no benefit for blind and vision-impaired pedestrians and are therefore not recommended as a facility designed to benefit them.

5.4 Installation

ATTS complying with this section shall be installed wherever new traffic signal installations involve pedestrian signals.

Upgrades to existing systems usually require a separate budget and prioritisation. The prioritisation of ATTS upgrades involves similar criteria to that for TGSI and is discussed in section 6, Installation prioritisation.

5.5 Traffic signal and pedestrian push button location principles

Pedestrian push buttons are usually mounted on traffic signal posts, poles, or mast arm supports.

There are several key principles that should be followed when installing pedestrian push-buttons at signalised intersections.

Pedestrian push buttons should be:

- located consistently in relation to the continuous accessible path of travel and kerb ramps
- placed with the push-button facing the direction of travel, except on medians where the push button is located with the face parallel to the crosswalk
- located in the median where the total road crossing width is more than 36m, or where the pedestrian phasing requires split crossing phases
- located on the traffic pole adjacent to the pedestrian crosswalk
- located less than one metre outside the outside pedestrian crosswalk line and less than one metre from the kerb face
- on the right side of the crossing point when facing the roadway at mid-block crossings
- easily reached by a person waiting on a warning indicator
- within reach of all pedestrians including children and people who use a wheelchair/mobility scooter (400 to 600mm from the kerb ramp and between 800 and 1000mm above the ground surface)
- clearly accessible, with no obstructions such as a raised portion of an island (which may inhibit wheelchair occupants access to the pedestrian push-button with their elbow)
- mounted with its face perpendicular to the direction of the cross walk, so the pedestrian is facing it
- more than 3m from the next nearest pedestrian push button.

An additional pole must be installed for the pedestrian push-button, where there is no pole or the poles are too far from the crosswalk. The additional pole must be correctly positioned so as not to confuse pedestrians. (See photo 14, section 4.7.2.)

Position of push button in relation to ground surface and kerb ramp

If the pedestrian push button is on a signal pole located between the limit lines and pedestrian crosswalk lines, a person on the kerb ramp may not be able to reach the push button. This would require pedestrians to step over the vertical upstand of a kerb or move away from the signal pole, which is not suitable for blind and vision-impaired people or the mobility-impaired. It is recommended that either:

- the width of the kerb ramp be extended so that a person operating the pedestrian push button can do so while standing on the kerb ramp, or
- the pedestrian push button is relocated onto a separate pole closer to the kerb ramp.

Distance between pedestrian push buttons

Poles closer than three metres apart may confuse blind and vision-impaired pedestrians over which direction the audible signal applies. If the poles cannot be located more than 3m apart then consideration should be given to reducing the volume of the signal or turning off the signal altogether. The vibrating tactile signal must never be turned off.

Complex and unusual situations

For complex and unusual situations such as multi-phase and multi-way junctions, consult with Orientation and Mobility Instructors at RNZFB so they can contribute to the design and educate users. Their job is to teach blind and vision-impaired people to understand the traffic flow and safe techniques to cross roads. Appendix C lists the contact details of RNZFB offices throughout New Zealand.

AUSTROADS Part 7 Traffic Signals – A Guide to the Design of Traffic Signal Installations, is the recommended guideline for New Zealand conditions in all other respects.

6 Installation prioritisation

6.1 Compliance

All new pedestrian facilities shall be designed and installed with features detailed in this guideline.

Existing pedestrian facilities need to be reviewed for compliance with this guideline. It is not expected that the facilities prescribed in this guideline comply immediately, as this would be very costly. However, over time we should aim to upgrade all pedestrian facilities so they meet the needs of blind and vision-impaired people.

RCAs should consider adopting a regime that ensures pedestrian facilities for blind and vision-impaired people are upgraded in conjunction with maintenance and upgrade works at these pedestrian facilities, e.g. when the footpath is resurfaced at a signalised intersection the TGSI should be upgraded.

6.2 Tactile ground surface indicators (TGSI)

Existing facilities should be progressively upgraded and prioritised using the factors detailed below.

TGSI should be prioritised for installation in areas of high pedestrian activity and areas where there are a significant number of blind or vision-impaired pedestrians. The risk of a blind or vision-impaired person being injured in the absence of TGSI should be evaluated when prioritising the installation of TGSI.

General situations (not road crossings)

Warning indicators should be installed to inform blind and vision-impaired people of the following hazards (in priority order):

- life threatening hazards where serious falls may occur, such as at railway platforms or wharves
- vehicle hazards on roads where the footpath is not separated from the roadway by an abrupt change of grade (blended same level kerbs)
- approaches to stairways, ramps, escalators and moving walkways, and
- vehicle hazards at busy vehicle crossing points including, but not limited to: shopping centres, bus stations and large car parks.

Directional indicators should be installed in conjunction with warning indicators where directional guidance is necessary (refer Section 4.4.2).

Existing road crossing points

The installation of TGSI at existing road crossing points, should be prioritised based on the following lists:

Intersection location

- Central business district
- Vicinity of shopping centres and malls

- Along arterial roads where substantial pedestrian activity is anticipated, and
- In suburban areas or communities where there is a demand for facilities to assist blind or vision-impaired people.

Road crossing characteristics

- blended same level crossings
- missing visual contrast between footpath and roadway
- complex road crossings situations, and
- lipless wheelchair-friendly crossings.

These are by no means exhaustive lists of factors to be considered when prioritising the upgrade of TGSI. The first step in the process of prioritising TGSI should involve consultation with an Orientation and Mobility Instructor at the RNZFB. Appendix C provides contact details of RNZFB offices throughout New Zealand.

6.3 Audible tactile traffic signals (ATTS)

ATTS shall be installed at all new or upgraded signalised intersections wherever traffic signals include pedestrian signals.

The upgrade of pedestrian signals so that they are fully compliant ATTS systems, should be prioritised after considering the following factors:

- Road crossing distance: Wide streets are more difficult and dangerous for pedestrians to cross because they are exposed to traffic for a longer period of time.
- Pedestrian accident history: Generally speaking, if there have been any pedestrians involved in accidents at the signalised intersection then this could identify the need to improve safety at that intersection.
- Intersection configuration: The geometry of an intersection, including the number of approaches, can cause difficulties for people with visual impairment when they are crossing the intersection. Three leg intersections can pose difficulties for blind and vision-impaired people because they do not always provide adequate audible cues about the traffic phases.
- Vehicle speeds: The higher the vehicle speed, the less time a pedestrian has to get out of the way of an approaching vehicle. In the event of an accident, the higher the speed of the vehicle, the greater the severity of an injury.
- The proximity of public facilities: Determine how many bus stops or access routes there are within one block of the intersection. There may be people with visual impairment in a particular area that rely heavily on public transport. Special attention and consideration should be given to the following issues:

  - frequency and flow of pedestrians
  - proximity to key public facilities, and
  - transfer points between different modes of travel, e.g. train or bus.
- Light traffic flow: It can be difficult for people with visual impairment to determine when it is safe to cross the road because less traffic means fewer audible cues.

This is by no means an exhaustive list of factors to be considered when prioritising the upgrade of ATTS. The first step in the process of prioritising ATTS at signalised intersections should only occur after consultation with an Orientation and Mobility Instructor at the RNZFB. Appendix C provides contact details of RNZFB offices throughout New Zealand.

Appendix A: Glossary of terms

Audible tactile traffic signals (ATTS)

ATTS provide audible and vibrotactile information to pedestrians at signalised pedestrian crossings. The audible signals help blind and vision-impaired people to locate the signals (see Locating Signal) and inform them of the status of the crossing phase (see Crossing Signal). The vibrating tactile pulse assists blind and vision-impaired people with their orientation and also indicates the status of the crossing phase.

Back edge (of warning indicator)

This refers to the edge of the area of warning indicators furthest from the crossing point or hazard.

Blended, same-level kerb

Where the roadway has been raised to the height of the footpath, typically by means of constructing a road platform and hump.

Call acknowledge signal

This is a signal which acknowledges that a demand for the pedestrian phase has been lodged. It is relatively short in duration and has a modified tone of the locating signal used at the crossing.

Chromaticity

The intensity and saturation of a colour.

Continuous accessible path of travel

This is the accessible route intended to provide a safe and convenient path for mobility-impaired, blind and vision-impaired people. This involves even surfaces, gentle grades, a lack of obstacles and smooth transitions between roadways and footpaths.

Crossing point

A crossing point is any formal (e.g. traffic signals, pedestrian crossing) or informal (e.g. priority-controlled intersection, kerb protrusion, raised island) point on the road network, which has been designed to assist the crossing of a roadway by pedestrians.

Crossing signal

This is an audible/vibrating signal that sounds to indicate the start of the crossing phase and continues for the duration of the crossing phase for a preset maximum time (corresponds to the green walking man signal).

Cue

Any object within the environment which can be felt, heard, seen or smelt by a blind or vision-impaired pedestrian. Cues can assist them to establish their direction of travel or location.

Deep (in reference to TGSI and median dimensions)

Measured along the direction of travel when encountering the TGSI. For directional indicators, depth is always measured across the raised bars, not along the direction indicated by the raised bars.

In medians, depth is a measurement of the physical width of the median. To avoid confusion, the term “Width” has been retained for the formalised width of median available to pedestrians.

Directional indicators

These are tactile ground surface indicators that indicate a direction of travel by an elongated raised surface.

Front edge (of warning indicator)

This refers to the edge of the area of warning indicators closest to the roadway.

Haunching

The splayed sloping side of a kerb ramp.

Hue

Hue is a colour or tone. The level of contrast in hue is determined by the proximity of two colours within the colour spectrum. Colours close to each other will contrast less well than those that are further apart.

Kerb ramp

This is a physically constructed change in grade connecting the footpath to the roadway. A kerb ramp lowers the level of a footpath to that of the roadway.

Light reflectance value (LRV)

The proportion of useful light reflected by one surface.

Limit lines

A line marked on the surface of a roadway to indicate the place where a vehicle is required to stop for the purpose of complying with a stop sign, a give way sign or traffic signal.

Lipless, wheelchair-friendly kerb crossing

Where the kerb crossing has gentle gradients and a smooth transition between the footpath and the roadway with no vertical lip.

Locating signal

Signals the location of the pedestrian push button when the audible “Crossing Signal” is not audible/vibrating.

Mobility-impaired

A reduction in the function of legs and feet leading to the use of and dependence on a wheelchair, mobility scooter or artificial aid for walking. In addition to people who are born with a disability, this group includes a large number of people whose condition is caused by age or accidents.

Orientation

Orientation is a person's awareness of where they are in relation to their environment.

Orientation and Mobility (O&M) Instructor

A person who teaches blind and vision-impaired people how to move safely and efficiently within a physical environment, and how to establish where they are by interpreting the surrounding sensory information.

Pedestrian push-button assembly

An enclosure incorporating a push-button switch that is designed for use with a signalised crossing to register a pedestrian demand. It incorporates facilities for the generation of audible and tactile signals.

Pedestrian crosswalk lines

Pedestrian crosswalk lines are provided at signalised intersections and define the area in which pedestrians should walk when crossing the road.

Tactile

Refers to the sense of touch.

Tactile ground surface indicators (TGSI)

These are patterned modules designed to be felt underfoot. This term refers to both directional and tactile warning indicators.

Vision-impaired

This is a general term covering all vision difficulties that cannot be adequately corrected by spectacles or contact lenses. Blindness implies severe impairment including a total or near total loss of the ability to perceive form. To avoid ambiguity, this document generally uses the phrase 'blind and vision-impaired' when talking about the total range of visual impairment. Where the phrase 'vision impaired' is used alone it implies that a person has sufficient residual vision for the user to benefit from the bold, high contrast visual cues recommended in this document.

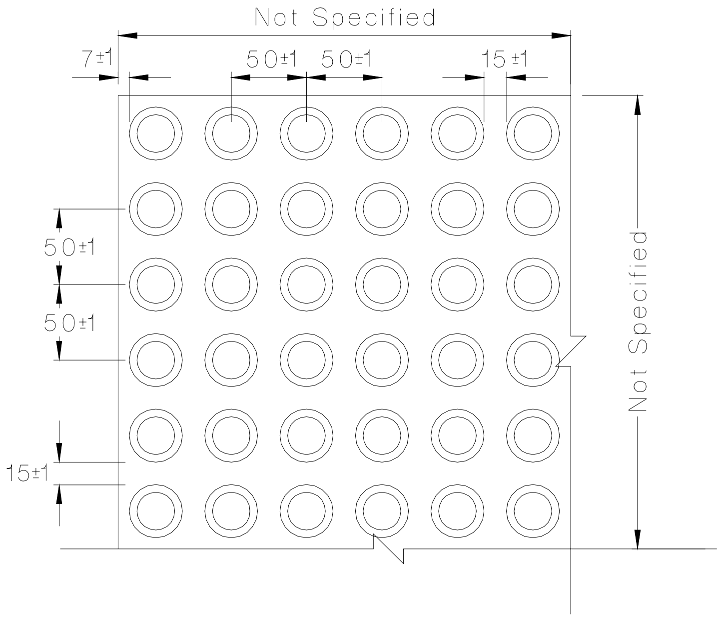
Warning indicators

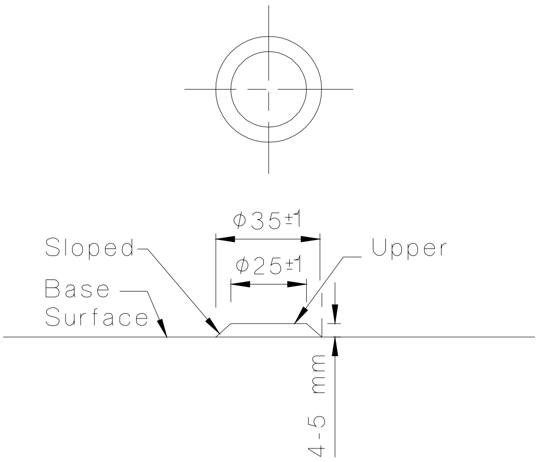
These are tactile ground surface indicators that indicate the presence of potential hazards. They consist of a pattern of truncated domes.

Wide (in reference to TGSI dimensions)

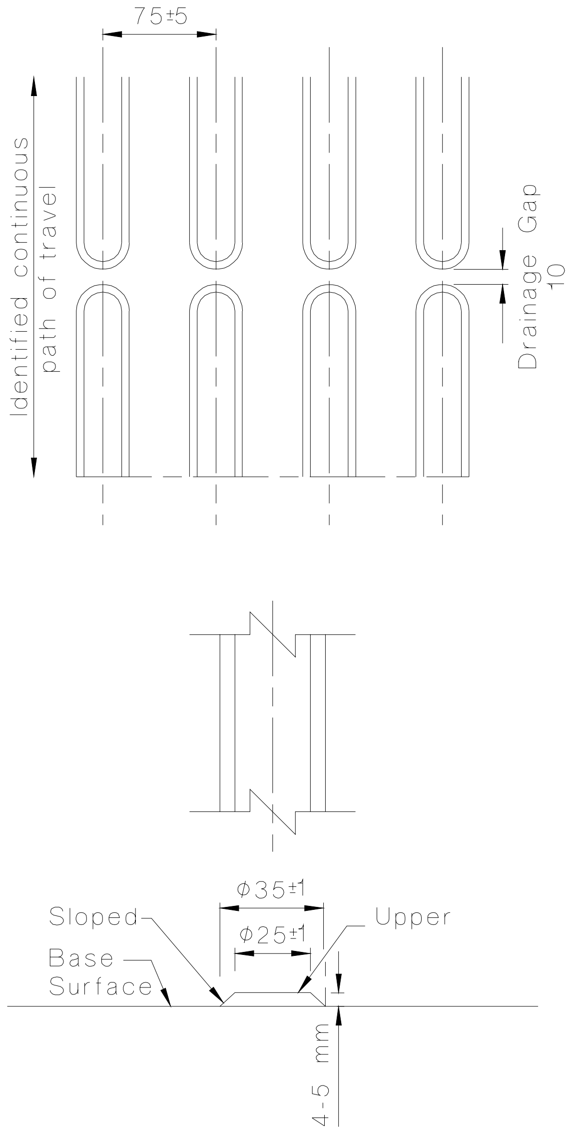
Measured perpendicular to the direction of travel when encountering the TGSI.

Warning indicators (sourced from AS/NZS 1428.4: 2002)





Directional indicators (sourced from AS/NZS 1428.4: 2002)



Appendix C: RNZFB contact details

Orientation and mobility instructors can be contacted at the following RNZFB offices:

Region	Phone	Fax	Address
Whangarei	09 437 1199	09 437 6951	Whangarei Centre for the Blind 277 Kamo Road Kamo PO Box 8139 Kensington Whangarei
Auckland	09 355 6900	09 355 6919	Auckland Locality Office Awhina House 4 Maunsell Road Parnell Private Bag 99941 Newmarket Auckland
Waikato	07 839 2266	07 839 5588	Waikato Locality Office 1st Floor Caro Street Community Building Caro Street PO Box 854 Hamilton
Tauranga	07 578 2376	07 578 8359	Tauranga Centre for the Blind 355 Devonport Road PO Box 15114 Tauranga
Rotorua	07 348 7218	07 347 2007	Rotorua Centre for the Blind Community House 1115 Haupapa Street PO Box 1933 Rotorua
Gisborne	06 867 5529	06 867 9324	Gisborne Centre for the Blind 37 Grey Street PO Box 581 Gisborne
Napier	06 835 3777	06 835 8040	Napier Centre for the Blind 94 Raffles Street PO Box 10 Napier
Palmerston North	06 350 2540	06 356 1790	Palmerston North Centre for the Blind 62 Grey Street PO Box 310 Palmerston North
Taranaki	06 759 1169	06 757 9370	Taranaki Centre for the Blind 131 Vivian Street PO Box 178 New Plymouth
Wanganui	06 348 4401	06 345 9028	Wanganui Centre for the Blind 102 Peat Street Wanganui

Wellington	04 380 2160	04 389 5254	Wellington Regional Office 121 Adelaide Road Newtown PO Box 27 177 Wellington
Nelson	03 547 6616	03 547 6615	Nelson Centre for the Blind 350 Main Road Stoke PO Box 2246 Nelson
Christchurch	03 375 4300	03 355 9151	Christchurch Locality Office 96 Bristol Street St. Albans PO Box 1696 Christchurch
Timaru	03 684 4259	03 684 4259	Timaru Centre for the Blind 63 Grey Road Timaru
Oamaru	03 434 5254	03 433 1141	Oamaru Centre for the Blind 6 Steward Street PO Box 359 Oamaru
Dunedin	03 466 4230	03 455 4319	Dunedin Locality Office Corner Hillside Road and Law Street PO Box 2237 Dunedin
Invercargill	03 218 9189	03 218 9188	Invercargill Centre for the Blind 172 Queens Drive Invercargill

Appendix D: References

The following documents have been used and referred to in the development of this guideline:

Accessible Design for the Blind (1998) *Accessible Pedestrian Signals* Report for U.S. Access Board (website www.access-board.gov).

Accessible Design for the Blind (2000) *Detectable Warnings: Synthesis of US and International Practice* Report for U.S. Access Board (website www.access-board.gov).

AS 2353:1999 *Pedestrian push-button assemblies.*

AS/NZS 1428.4: 2002 *Design for Access and Mobility* 'Part 4: Tactile Indicators'.

AS/NZS 3661.1:1993 *Slip resistance of pedestrian surfaces - Requirements.*

AUSTROADS (1995) *Guide to Traffic Engineering Practice*, 'Part 13 - Pedestrians', Sydney.

AUSTROADS (1997) *Traffic Signals: A Guide to the Design of Traffic Signal Installations*, 'Guide to Traffic Engineering Practice, Part 7', Sydney.

Dunn, R. C. M. and G. W. Main (1988) *Recommended Practice for Pedestrian Crossings*, Road Research Unit, National Roads Board, Technical Recommendation TR11, Wellington.

Hassard, Julie *Considerations for Planning and Modifying Roads for People who are Vision-impaired*, Royal Victorian Institute for the Blind, Melbourne.

NZS 4121: 2001 *Design for Access and Mobility – Buildings and Associated Facilities.*

Royal New Zealand Foundation for the Blind (1995) *Access Working Party Report*, Royal New Zealand Foundation for the Blind, Auckland.

Royal New Zealand Foundation for the Blind website, www.rnzfb.org.nz.

TRAFINZ (1997) *Draft Pedestrian Facilities Guide.*

U.K. Department for Transport *Guidance on the use of tactile paving surfaces*, Integrated Transport website, www.mobility-unit.dft.gov.uk.

U.S. Architectural and Transportation Barriers Compliance Board (1999) *Accessible Rights-of-Way: A Design Guide.*

Appendix E: RTS publications

The following Road and Traffic Standards are available:

RTS 1	Guidelines for the implementation of traffic control 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 facilities for blind and vision-impaired pedestrians (2003)
RTS 17	Guidelines for setting speed limits (1995)

The RTS publications may be purchased from the Land Transport Safety Authority head office (PO Box 2840, Wellington) or the following regional offices:

Auckland	Private Bag 106 602
Hamilton	Private Bag 3081
Palmerston North	PO Box 1947
Napier	215 Hastings Street
Wellington	PO Box 27 249
Christchurch	PO Box 13 364
Dunedin	PO Box 5245