



Road and traffic guidelines

RTS 14

Guidelines for facilities for blind and vision-impaired pedestrians

2nd edition 2007

Consultation document

Comments by Monday 10 December.

Please email them to:

Tim.Hughes@landtransport.govt.nz

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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 second revision.

Road controlling authorities (RCA), 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.

Recently the principles underpinning RTS 14 have been included in a new *Pedestrian planning and design guide* which provides general guidance on providing for pedestrians. RTS 14 now provides detailed guidance in support of this more general guide. This latest revision removes some material that now appears in the guide, removes some ambiguities that became apparent when the guide was being applied and provides application examples for more situations.

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)

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 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 insufficient.

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. The use of this document is not compulsory in New Zealand law at present. It is referenced in the new draft AS/NZS 1428.4 which is awaiting other developments before it can be published.

NZS 4121: 2001 *design for access and mobility – buildings and associated facilities* requires tactile features to be provided at kerb crossings. It is not clear to what extent NZS 4121 must be applied outside its primary scope for buildings and related areas.

RTS 14 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.

RTS 14 is referenced in the *Pedestrian planning and design guide*" and in the *National traffic signals specification* produced by the New Zealand Traffic Signals Committee.

Land Transport NZ welcomes helpful suggestions arising from attempts to apply this guide in practice. Comments should be directed to the Pedestrian and Cyclist Guidelines Engineer, Land Transport NZ, PO Box 13364, Christchurch.

1.5 Referenced documents

The following documents are referenced in this guideline:

- AS/NZS 1428.4: 2002 *design for access and mobility part 4: tactile indicators* (a new draft has been finalised but is awaiting publication).
- AS 2353: 1999 *Pedestrian push button assemblies*.

- AS/NZS 4586: 2004 *slip resistance classification for new pedestrian surface materials*.
- AUSTRROADS *Guide to traffic engineering practice - part 7: traffic signals - 2003*.
- AUSTRROADS *Guide to traffic engineering practice - part 13: pedestrians - 1995*.
- NZS 4121: 2001 *Design for access and mobility – buildings and associated facilities*.
- Land Transport NZ *Pedestrian planning and design guide*.
- New Zealand Traffic Signals Committee *National traffic signals specification*.
- Dept of Building and Housing, 2001, NZ Building Code, *Acceptable solution DS1/AS1 access routes*.
- Department for Transport www.ukdot.gov.uk

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. 7,800 of the adults are completely blind. Approximately 3% of the total adult population is blind or vision-impaired. 33,600 of these vision-impaired people also had hearing disabilities.

At the latest count there were 11,700 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 to the services of the RNZFB. To be eligible for an Invalid's Benefit on the grounds of blindness only, the visual acuity threshold is 3/60 or field of vision less than 5 degrees either side of the point of fixation (10 degrees in total). 95% of RNZFB members have some vision, and even some of the remaining 5% can perceive general light and dark.

Explanatory note: 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 ie, 4 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.

The vast majority of blind and vision-impaired people are aged over 65 years, with slightly more than half aged 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

***Membership breakdown by age
(RNZFB Annual report (05/06))***

<i>Age group</i>	<i>Number of members</i>
<i>Under 20</i>	<i>6.9%</i>
<i>20 – 39</i>	<i>9.2%</i>
<i>40 – 64</i>	<i>15.4%</i>
<i>65 – 79</i>	<i>15.7%</i>
<i>80 +</i>	<i>52.8%</i>

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 tactile and other sensory information from the surrounding environment for their orientation. Most vision-impaired people are able to see in colour, though colour discrimination may be impaired. Some sources report that yellow colours are more salient as vision is lost. Only a small percentage can see nothing at all, but even that group will generally have some 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. They do so with the help of a variety of environmental cues. Environmental cues include, the property line, the edge of the sealed path, the kerb, and consistently placed street furniture e.g. parking meters. Those people that rely on their residual sight use visual contrast cues for their orientation.

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.

Mobility aids

The most common mobility aid used by pedestrians with poor sight to facilitate their independent mobility is a long 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.

One technique that long cane travellers use is the constant contact technique in which the cane tip 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.

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 15.6 of the *Pedestrian planning and design guide*.

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%.

Warning indicators are an essential safety feature for blind and vision-impaired pedestrians and shall be provided at all pedestrian kerb crossings including kerb ramps and blended crossings at the same level.

There should be a clear visual contrast between the footpath and roadway so that vision-impaired people can use their residual vision to identify 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 warning 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. Their main concern arises when crossing directional indicators as the wider spacing of the elements results in more vertical movement of the smaller front wheels. The wider spacing of the strips also means that one side of a shoe may be on the raised strip and the other side 5 mm lower. This modest twisting of the ankle can cause discomfort to pedestrians with arthritic joints.

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 http://www.design.ncsu.edu/cud/about_ud/udprinciples.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 (refer *Pedestrian planning and design guide* Section 14.2 for footpath widths).

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 substantially 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, ie, on the kerb edge, as shown in Photo 1, and always placed consistently in the same location.



Photo 1: While no footpath obstacles would be preferable, these advertising signs are 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. The *Pedestrian planning and design guide* provides more guidance in Section 14.9. Both require all obstacles to have a design element within 150mm of the ground, so that they can be detected by use of a long cane.

Photo 2 below is an example of good practice with seating outside a restaurant that is enclosed by a structure that meets the aforementioned requirements of NZS 4121: 2001. On the other hand, Photo 3 shows seating and signage outside a bar that encroaches on the continuous accessible path of travel with the table in particular being a nasty obstacle for vision-impaired pedestrians.



Photo 2: Good practice – street furniture is located in an enclosed area which can readily be detected by the use of a long cane.



Photo 3: Poor practice – street furniture that sprawls out onto the footpath is a hazard for all pedestrians.

3.4 Kerb crossings at road crossing points

3.4.1 Kerb ramps

Design guidance for kerb crossing points should be sought from *The Pedestrian planning and design guide* (Section 15.6). The key design aspects with respect to vision-impaired pedestrians at kerb crossings and haunchings are summarised below:

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.

Warning TGSI should be arranged so that it is not possible to inadvertently bypass them and enter the roadway.

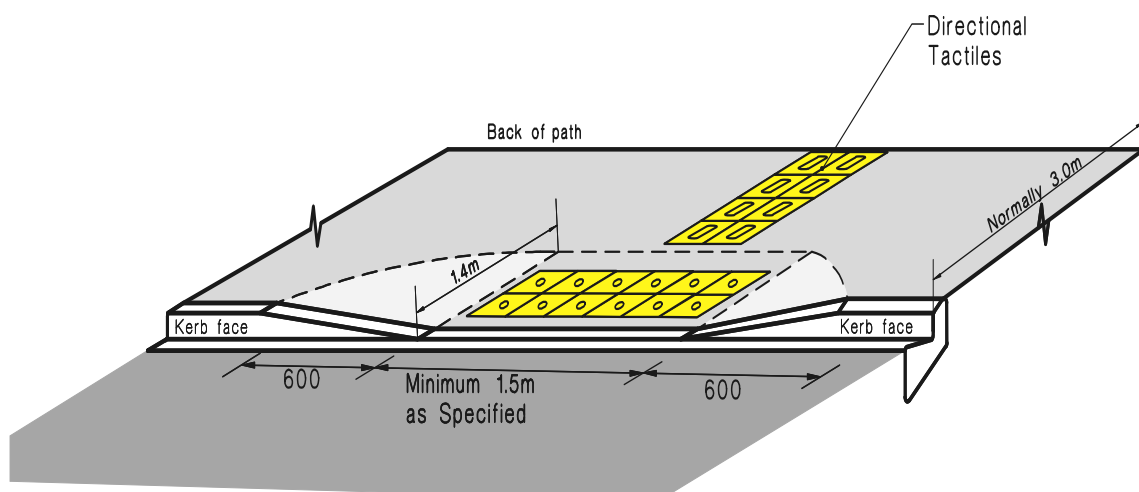
Warning TGSI shall be installed a minimum of 600mm deep (preferably 900mm deep) and the full width of the kerb ramp, but need not cover the entire face of the kerb ramp.

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.

3.4.2 Typical design of kerb ramps

Figure 1 shows a typical kerb ramp design next to a kerb that is 100mm high. It shows the maximum slope of haunching of 1:6. If the crossfall on the footpath is 1%, a kerb ramp depth of at least 1.4 metres is required to keep the slope below 1:12. For a footpath



crossfall of 2%, a kerb ramp depth of at least 1.6 metres would be necessary.

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

3.5 Road crossing points at corners and intersections

As pedestrians are the most vulnerable road users, their safety is a paramount consideration in intersection design. The *Pedestrian and planning design guide* Section 15.15 comprehensively covers design considerations for pedestrians at intersections.

The sub-section that follows is an expansion to the information presented in The *Pedestrian and planning design guide*, with specific emphasis on design measures that should be adopted to enhance road crossing points at corners and intersections for blind and vision-impaired pedestrians.

In general, where difficulties are encountered achieving a satisfaction TGSI arrangement, the problem is usually because the intersection design and kerb crossing location are poorly optimised for pedestrian needs.

3.5.1 Intersection radius

Corner radii should be minimised.

The design of kerb radii at intersections in New Zealand is generally based on the space used by the largest vehicles likely to turn at the intersection.

While this approach is suitable for accommodating large vehicle movements, more often than not this results in a sub-standard crossing point design for pedestrians and also makes it difficult to comply with many of the requirements of this guideline.

Design considerations for minimum kerb radius requirements are in the *Pedestrian planning and design guide* section 15.15. 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.

At intersections where a kerb radius larger than the total footpath width is provided, it is difficult for TGSI to be installed in compliance with this guideline. 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. This results in the continuous accessible path of travel intersecting with a curved kerb. The further the intersecting kerb becomes from right angles with the continuous accessible path of travel 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.

3.5.2 Intersection radius design mitigation measures

To mitigate the impacts to pedestrians, it is recommended that the following measures (in decreasing order of pedestrian benefit) be considered:

- Reduce the kerb radius.
- Move the kerb ramps and associated crosswalks, signal poles etc.
- Provide a bottom landing for the kerb ramps.

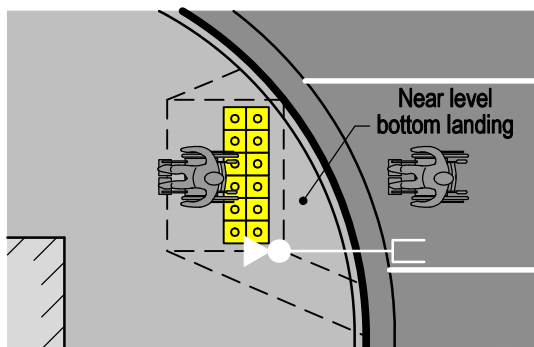


Figure 2. Correct bottom landing arrangement.

Reducing the kerb radius

Most intersections will enable pedestrian crossing points to be provided satisfactorily with kerb corner radii of 3m or less. At 3m, satisfactory kerb crossing layouts can usually be devised with only minor compromise. At a kerb corner radius of 5m with the typical berm widths of 3m, kerb crossing designs are significantly compromised but separate kerb crossings are generally possible, requiring the crossing points to be setback at least 2.5m from the prolongation of the kerb lines. In these circumstances, kerb ramps will not be perpendicular to the kerb and may require bottom landings.

The benefits of smaller kerb radii are demonstrated 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 TGSIs arrangements, and allow the ramps to be oriented in line with 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 further away from an intersection, the pedestrian crossing points become more perpendicular to the kerb, crossing distance reduces, and better TGSIs arrangements become possible. This may move the kerb crossing away from the continuous accessible path of travel. Directional TGSIs and/or other cues may be needed to redirect blind and vision-impaired pedestrians to the crossing points. This does, however, have the advantage that traffic turning will arrive more from the side rather than the rear, giving a pedestrian a little more opportunity to react to a turning vehicle. Moving the crossings too far from the intersection may move pedestrians crossing or about to cross away from a drivers attention.

A separate kerb crossing for each direction should be normally provided. In the case of large radius kerbs at a corner, it may be possible to use two kerb ramps, only if the pedestrian crosswalks are moved away from the intersection. It is important that the distance between

kerb crossings is balanced against the visibility of pedestrians for drivers and the desire line for pedestrians.

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

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. Its content with respect to facilities in buildings is mandatory while its guidance with respect to kerb crossings is advisory and has not met with support from the New Zealand blind community including the RNZFB and those responsible for the management and design of roads, footpaths and traffic signals.

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.

- 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 correct and 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 (E), C1 (G), C1 (H), C2, C4, C5, C6, C7 and C8 in Appendix C should **NOT** be implemented.

A new version of AS 1428.4 has been prepared and is awaiting publication. It advises that RTS 14 should be used for the design and provision of facilities for blind and vision-impaired pedestrians in the road environment in New Zealand.

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 5 shows a typical arrangement of warning indicators.



Photo 5: View of warning indicators. Note how the domes have been located 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 where other tactile and environmental cues, such as the property line or kerb edge are absent or give insufficient guidance. They:

- give directional orientation in open spaces

- designate the continuous accessible route to be taken to avoid hazards

- 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 eg, public toilet, information centre.

Photo 6 shows a typical arrangement of directional indicators.



Photo 6: 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. As a minimum TGSI shall meet either:
 - Class V standard when installed on slopes and Class W when installed on flat terrain (refer AS/NZS 4586: 2004 Table 2), or
 - the requirements of the NZ building code acceptable solutions DS1/AS1 Access routes: 'The walking surface when wet has a coefficient of friction (μ) of no less than: $\mu = 0.4 + 0.0125 S$ where S is the slope of the walking surface expressed as a percentage'
- resistance to impact, ie, chipping or cracking
- wear resistance, and
- adhesion/bond strength - particularly if immersed in water.

4.3 Visual contrast

The visual contrast between the walking surface and surrounding environment are critical for vision-impaired people who are using their limited residual vision for orientation, distinguishing the limits of the footpath, recognising hazards and gathering information. Contrast is especially important in the provision of TGSI to warn users of hazards.

TGSI shall provide a high visual contrast to the adjoining walking surface.

Visual contrast exists in three dimensions – brightness, hue and saturation.

Brightness refers to the amount of light reflected by a surface – perceived as light or dark. Differences in brightness provide the main contrast available to a person with poor colour discrimination. It could be considered as the contrast that would be provided if the surfaces were viewed in black and white. Brightness is easily measured using a luminance meter. Minimum luminance contrast values are specified in Appendix F of AS/NZS 1428.4: 2002 which also details techniques for laboratory and on-site measurement of differences in Light Reflectance Value or luminance contrast. Indicative field measurements can be performed using a photographic spot meter using the method outlined in appendix.

Luminance contrast in percent is determined by:

$$\text{Contrast} = [(B1 - B2)/B1] \times 100$$

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

 B2 = light reflectance value of the darker area.

AS 1428.4 requires the following luminance contrast to the immediately adjoining surface:

- for tiles of uniform colour: 30%

- for individual domes of uniform colour used in warning TGSIs: 45%
- for individual domes with different characteristics on the sides and top of the domes: 60%.

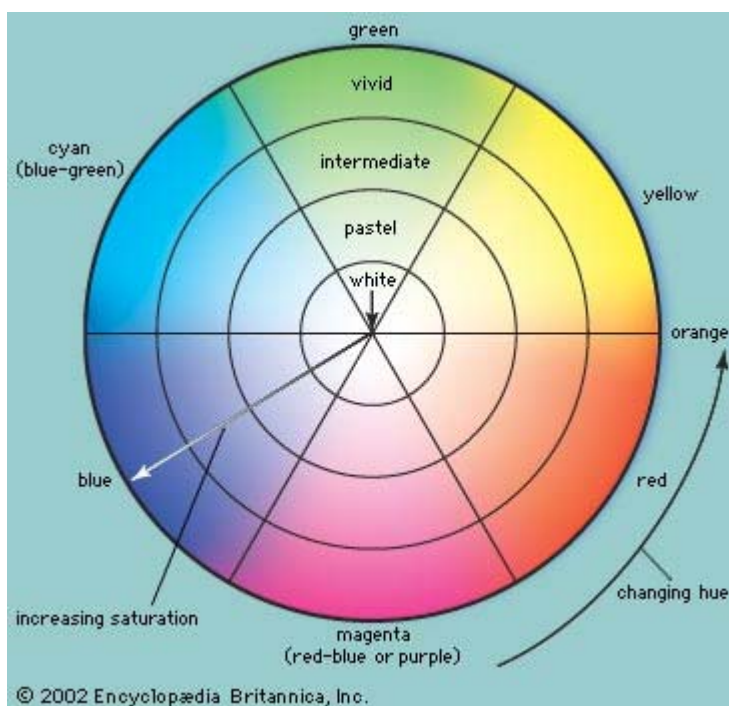
These are minimum values.

Where a high contrast in hue and saturation is not also provided, a luminance contrast of 70% is recommended.

Most NZ paths are surfaced with dark asphalt. On these a luminance contrast of 70% is easily achieved with white or yellow TGIS.

Hue refers to the basic colour reflected by the surface, and can simply be described by the elementary colour names such as red green yellow blue. It is most easily understood by reference to the colour wheels used in paint charts. (see below).

The greatest contrast is provided by colours on opposite sides of the colour wheel.



Avoid using the same or adjacent parts of the colour wheel. If the aesthetics of the design dictate that TGSIs are to be of similar hue to the adjoining footpath surface, then an increase in the contrast should be sought by greater differences in brightness and saturation.

Saturation refers to the purity of colour. Highly saturated colours are pure and vivid. Colours with low saturation are pastel or dull. Red and pink may have the same hue but pink is less saturated. White and black have no saturation.

New Figure to be added like this one –or copyright permission obtained for publication. Colour wheel showing hue and saturation.

More information on providing effective colour contrast can be found at: <http://www.lighthouse.org/accessibility/effective-color-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%. Their research found that safety yellow TGIS having a 40% contrast from new concrete was subjectively judged to be more detectable than a darker TGIS having an 86% contrast with new concrete.

Safety yellow is the recommended standard colour for TGIS. Approval to use an alternative colour should be sought from the local branch of the RNZFB.

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

4.4 Where are TGSIs 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
- all pedestrian kerb crossing points (both formal and informal), 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% (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 4.11)
- overhead impediments or hazards other than doorways (eg, 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 4.12)
- 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 (refer Section 3.3.1 for examples).

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
- significant public facility eg public toilets or information centre.

Where other environmental cues are insufficient, 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 (excluding haunchings), 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.
- 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.
- So that the front edge of the warning indicator is no further than 1000mm from the edge of the hazard, or to a point where a pedestrian could inadvertently bypass the warning indicator and enter the hazard (whichever is closer).
- 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 TGS I.)
- To within 300mm 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 or slightly lower (up to 3mm) than 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.

Explanatory note: 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 7: The warning indicators at this railway station are 600mm deep and set 600mm back from the platform edge. A better photo is to be sourced because the contrast is marginal and not uniform.

4.5.2 Directional indicators

Where required, directional indicators shall be installed:

- In conjunction with warning indicators where a road crossing point is not located in the continuous accessible path of travel and directional guidance is required.
- In conjunction with warning indicators at public transport access points.
- Parallel with and along the centreline of the required direction of travel.
- With a minimum depth of 300mm where used to indicate the normal continuous accessible path of travel.
- Across the full width of the path, 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 (as shown in Photo 8). Directional indicators leading all the way to the ramp often provide greater consistency, guidance and safety for vision-impaired users.



Photo 8: The directional indicators shown in this installation cover the full width of the path while other features, including the planting and a handrail provide tactile cues to the road crossing point.

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

Where directional indicators are used to provide directional guidance to a signalised kerb crossing point, the directional indicators should lead the person to the push-button end of the warning indicators so as to allow the pedestrian to readily find the push-button (refer Figure 5d).

4.6 TGSi at road crossing points

Refer to The *Pedestrian and planning design guide* (Section 15) for information on pedestrian road crossing design.

4.6.1 Mid-block crossing points

Warning Indicators shall be provided at all mid-block crossing points. Directional indicators are almost certainly required at all mid-block crossing points, unless 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 9).



Photo 9: 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 (but unfortunately not the full width of the crossing point).

Where an informal mid-block crossing (e.g. median island) is located close to a controlled crossing point (e.g. traffic signals), it may be safer for a vision-impaired person to cross at the formal crossing point. A decision to omit directional TGSIs should only be made after consulting the local branch of the RNZFB.

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 TGIS 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 10).



Photo 10: 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.

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 11).



Photo 11: On deep medians, two sets of warning indicators are installed. (Note: again not quite full width.)

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 12).



Photo 12: The warning indicators are aligned with the road crossing direction. (Note again: 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 insufficient other cues.



Photo 13: Example of a staggered median crossing with marked pedestrian crossing over the traffic lanes.



Photo 14: The kerb and fencing provides tactile cues within the staggered median to assist vision-impaired pedestrians.

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

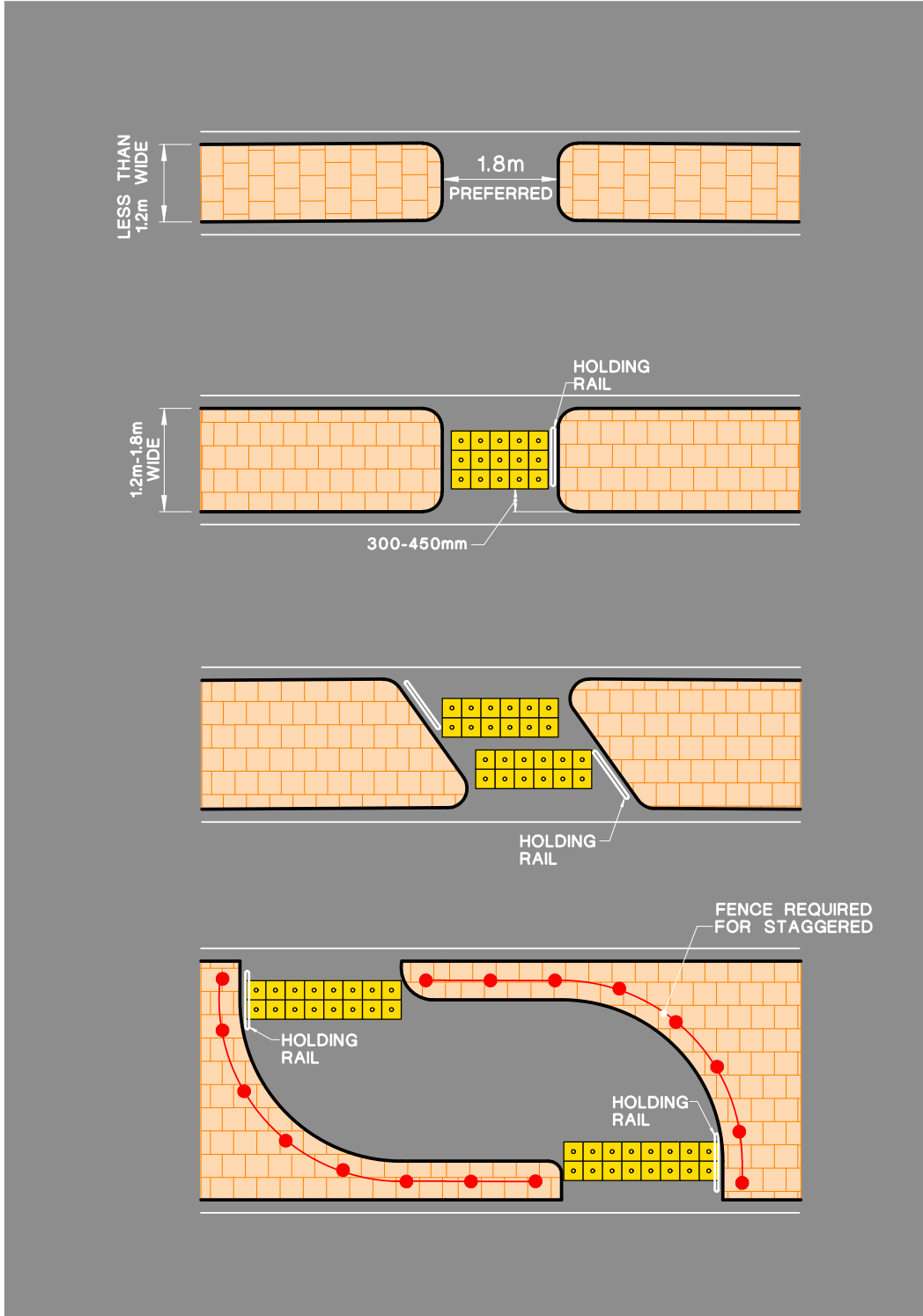


Figure 2: Schematic layout of how warning indicators should be installed in medians.

4.7 TGSi at intersections

4.7.1 All 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 15: 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, or
- 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 otherwise lose their orientation and have difficulty in locating the crossing point.

4.7.2 Signalised intersections

Figure 3 illustrates the correct layout of warning indicators at a signalised intersection. The layout dimensions also refer to recommended kerb ramp design (Section 3.4) and location of pedestrian push button poles in relation to kerb ramps and crosswalk lines (Section 5.5).

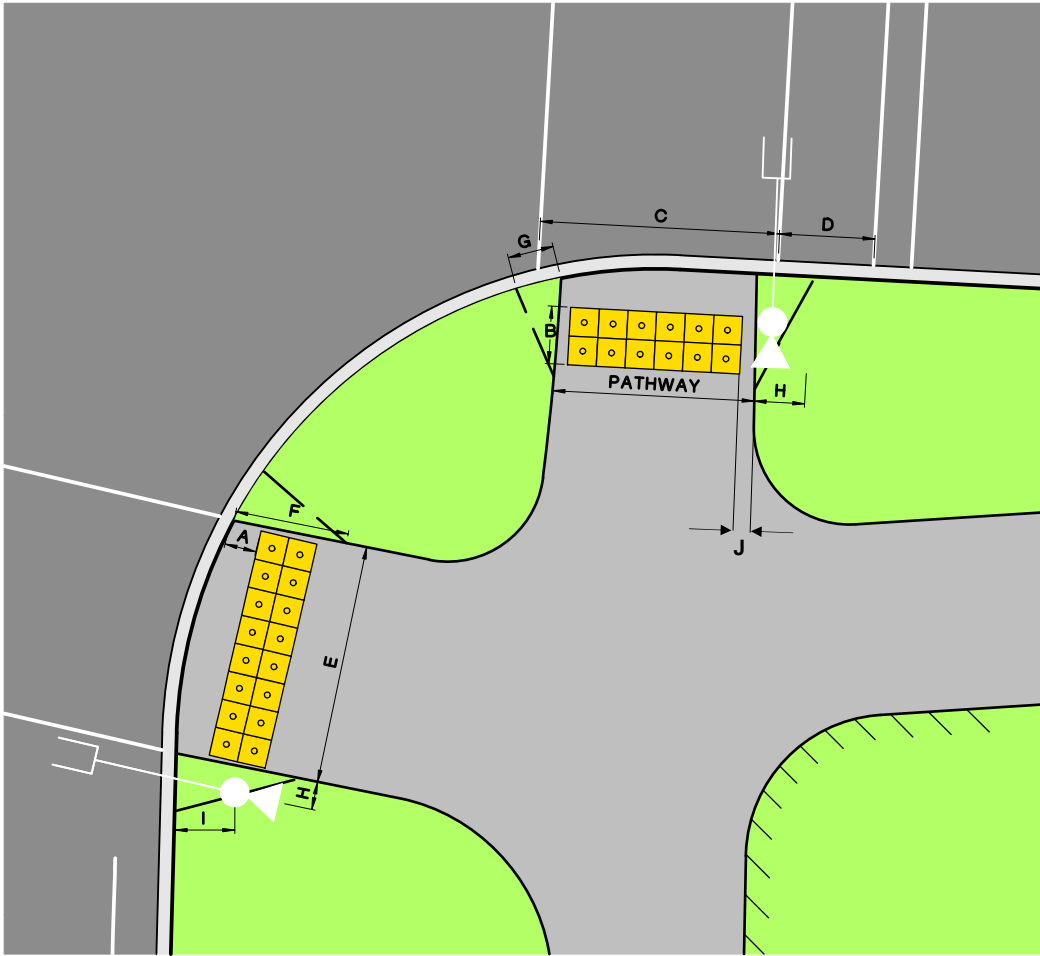


Figure 3: Correct design and orientation of kerb ramps, location of push button pole and installation of warning indicators at a signalised intersection (key below).

ID	Description	Dimension
A *	Set back distance of warning indicators to front of kerb	Minimum 300 mm Maximum 1000 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 or edge of warning TGSi	300 mm
I	Pedestrian push button set back from kerb	Maximum 1.0 m
J	Distance between nearest dome (on warning indicators) to edge of ramp	Maximum 50 mm ***

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

** Where the kerb is not perpendicular with the crossing direction, a suitable TGSi arrangement will result in a variable Dimension A. It is important that Dimension A does not exceed 1m – a staggered TSGi arrangement can overcome this refer Section 4.7.5.

*** Dimension J is required to ensure that a person will receive underfoot tactile warning and not accidentally bypass the warning indicators.

Photo 16 below shows an example of warning TGSi and the pedestrian push-button correctly aligned with the pedestrian crosswalk.



Photo 16. This installation is an example of best practice with the warning TGS and pedestrian call box both aligned with the crossing direction. The gap between the TGS and signal pole is so small that a person cannot inadvertently enter the road without receiving tactile warning.



Photo 17. Actual example of the TGSi layout shown in Figure 4.

4.7.4 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 5).

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.

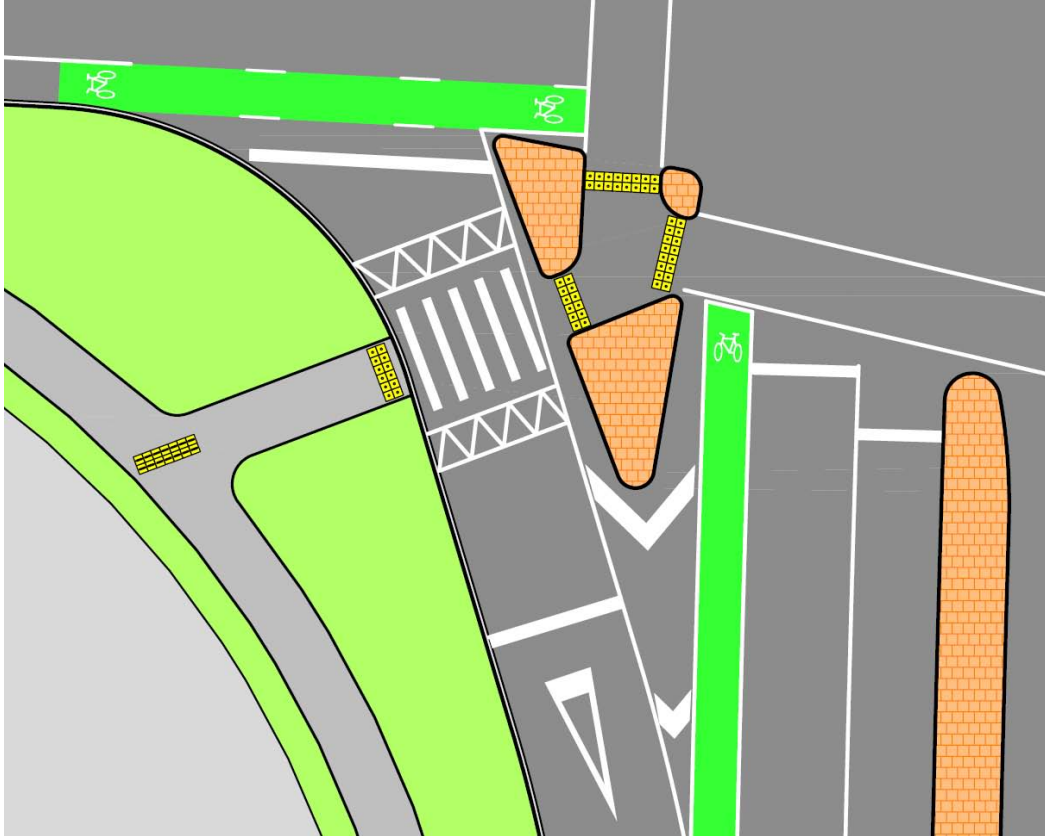


Figure 5: Warning indicators correctly shown in a slip lane island. Note how the warning indicators are orientated perpendicular to the crossing direction.



Photo 18. Actual example of the TGSi layout shown in Figure 5.

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 18), directional indicators should lead to a central warning indicator with dimensions of 600 x 600mm to indicate that a choice becomes available.

4.7.5 Example TGSi installations at intersections

The following diagrams provide pictorial examples of recommended and acceptable TGSi installations at intersections. Although each of the figures is shown at a traffic signal controlled intersection crossing points, the examples can be applied to both controlled and uncontrolled intersection crossing points.

Recommended installations

Recommended installations involve the use of rectangular shaped warning indicator arrangements where both the front and back edges of the warning indicators provide guidance on the crossing direction.

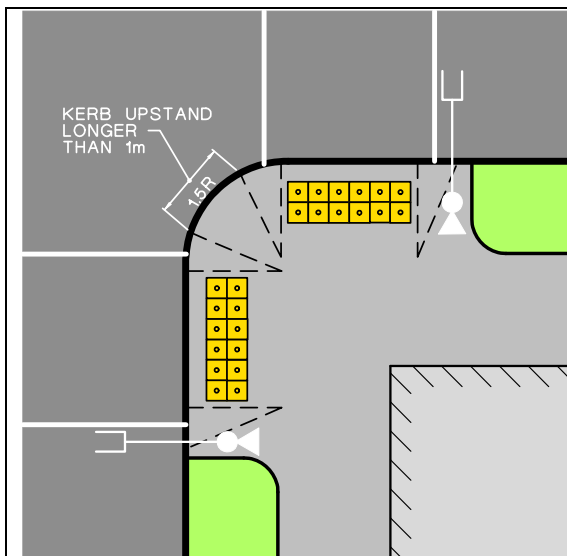


Figure 5a Two kerb crossings

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

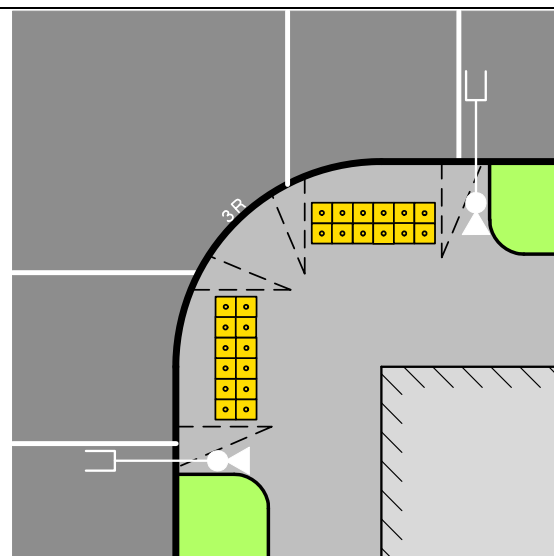


Figure 5b Two kerb crossings

3 metre kerb radius, design somewhat compromised

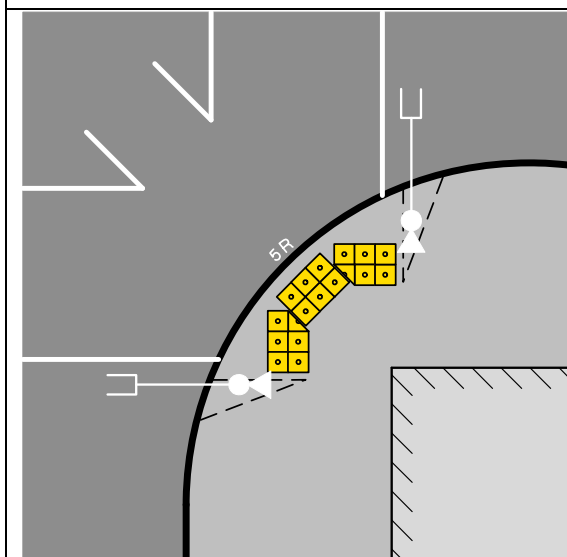


Figure 5c Full quadrant kerb crossing scramble phase/Barnes dance.

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

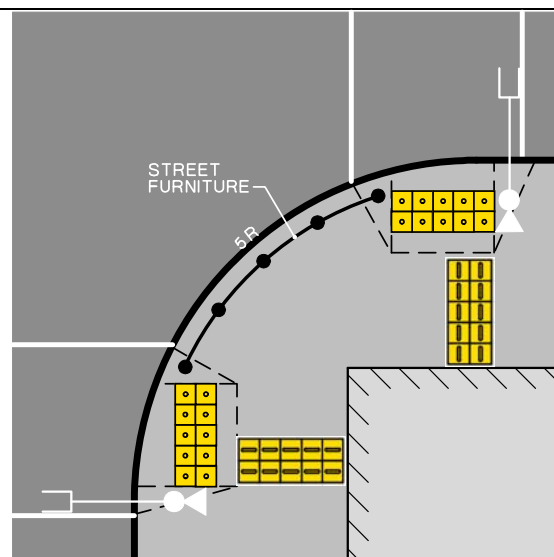


Figure 5d Two crossings, 5m kerb radius

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.

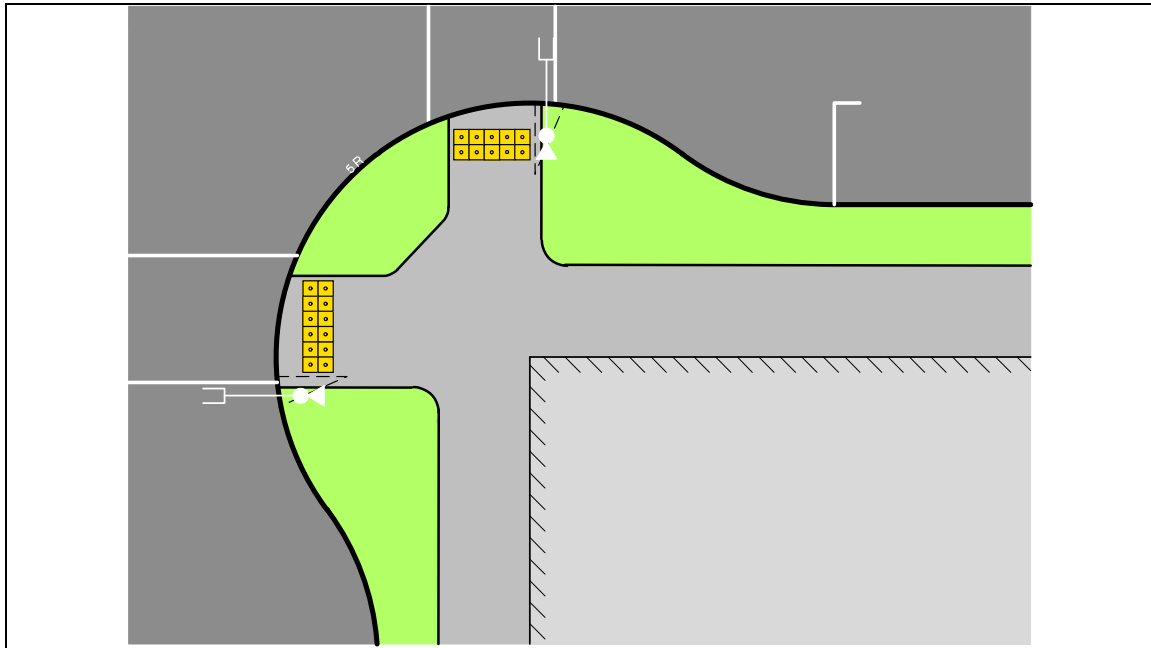


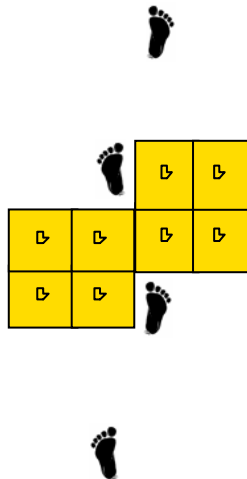
Figure 5e Two kerb crossings with kerb build out

Kerb crossings and TGSIs 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

Acceptable installations

In some instances (particularly where the kerb radius is large) it is not possible for rectangular layouts to be implemented. The next best arrangements are shown below and include the 'Reverse L' and 'Staggered' arrangements.

Staggered layouts of warning indicators are used to intercept vision-impaired pedestrians and are laid out so that the longest straight edges are aligned with the crossing direction. It is important that staggered layouts do not permit accidental overstep by a vision-impaired pedestrian eg



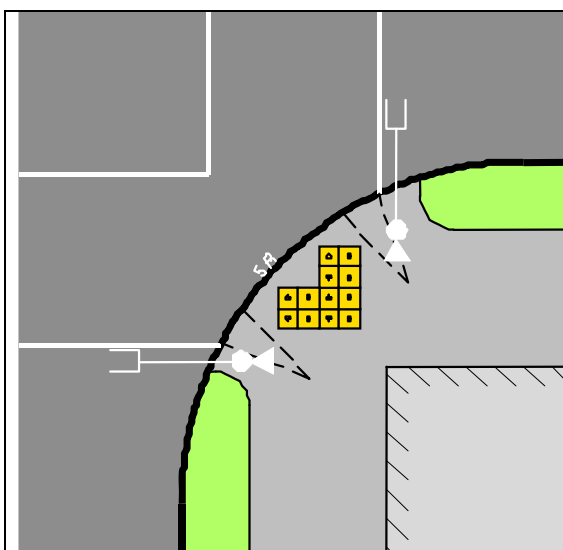


Figure 5f Single angled crossing
Kerb ramp design not recommended
 This TGSIs arrangement gives the least confusing crossing information for this situation, and intercepts a higher proportion of the approach path.

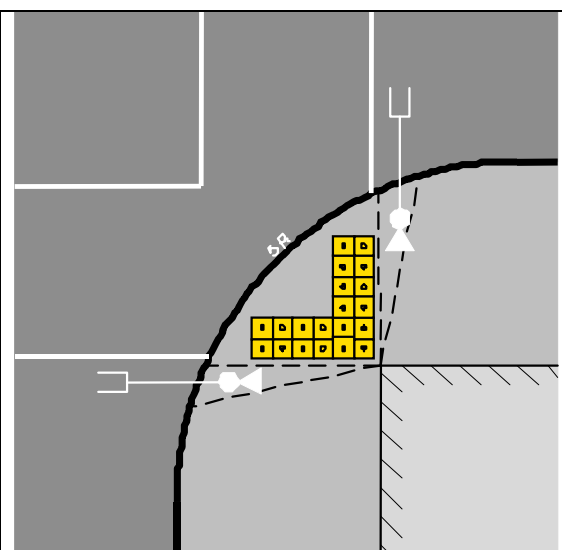


Figure 5g Full quadrant kerb crossing
Kerb crossing layout not recommended
 Warning TGSIs at entry intercept all users, and guide to crossing point.
 (Warning TGSIs only around kerb would confuse).

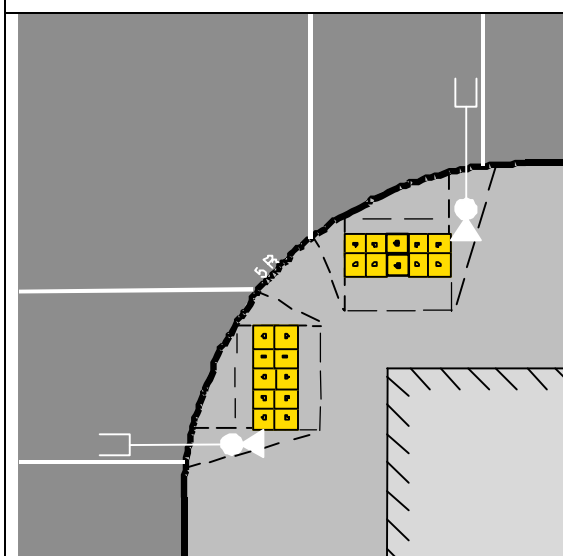


Figure 5h Two crossings 5m kerb radius
 Minimum separation between kerbs (1m of full height kerb, plus haunchings). Highly angled kerb crossings are offset from the continuous accessible path of travel.

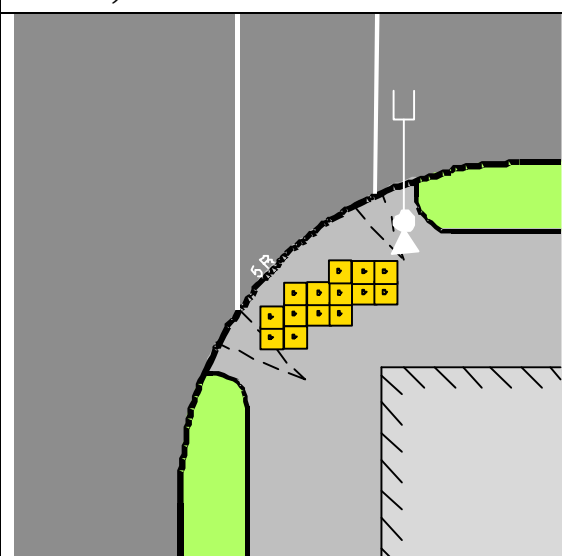
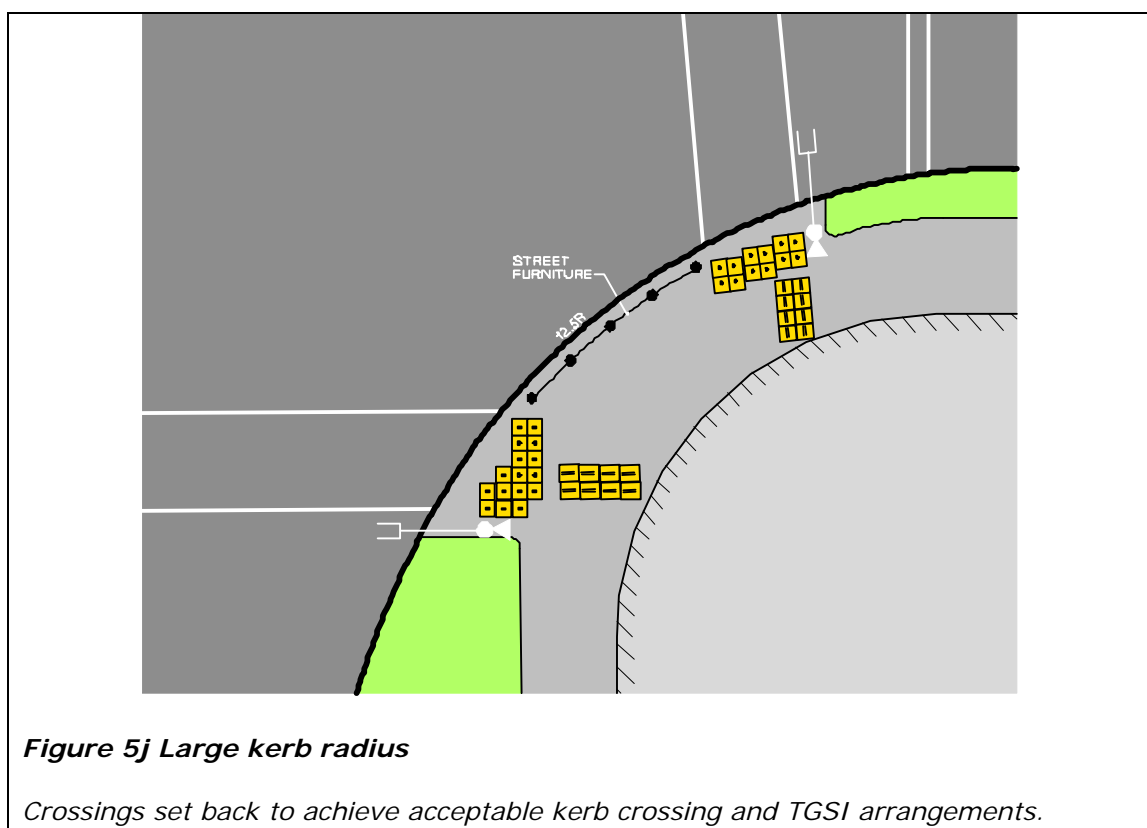


Figure 5i Staggered TGSIs arrangement for single direction kerb crossing
 TGSIs arrangement indicates crossing direction and intercepts all pedestrians.
 Kerb ramp design not recommended.



4.8 TGSi and 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 three recommended options here:

- Install TGSi that can be applied over public utility service covers.
- 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 20: An example of how warning TSGI can be integrated into the design of utility service cover.



Photo 21: An example of how warning TSGI can be integrated into the design of utility service cover.

4.9 Shared signalised crossing facilities

It is becoming increasingly common for crossing facilities at signalised intersections to include provision for both pedestrians and cyclists, where the crossing provides access to an off-road cycle path.

Where pedestrian and/or cycle volumes are high, paint marking can be used to indicate that pedestrians are to use one side of the crossing and cyclists the other to avoid conflict between these users. In such circumstances, **warning indicators shall be installed across the entire width of the shared crossing**, including the area allocated for cyclists. This will ensure that any blind or vision-impaired person that is walking in the area allocated to cyclists will receive a tactile warning prior to entering the road. The inconvenience to cyclists will be minimal.



Photo 22: The TGSI at this signalised pedestrian and cyclist crossing are installed across the pedestrian area only. The TGSI should extend across the entire facility to ensure that a vision-impaired person receives tactile warning if they mistakenly enter the cyclist crossing area.

4.10 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 22).

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.



Photo 22: 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.

4.11 Access to public transport

Blind and vision-impaired pedestrians rely heavily on public transport and therefore need to identify areas of access to public transport.

TGSI alone will not provide identification of public transport access points 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, but do have bus stop information signage.

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 when used adjacent to a bus stop.

- Warning indicators 600mm deep and installed 600mm from the edge when used at train platforms and ferry wharves.
- 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, and
- At bus stops, the directional indicators and warning indicators shall be installed in a position that will be close to the bus entry door.

Photo 23 shows directional and warning indicators installed correctly at a bus stop.



Photo 23: Directional indicators lead to warning indicators at a bus stop.

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.

4.12 Vehicle entrances

Refer to *The Pedestrian and planning design guide* (Section 14.11) for design information about vehicle entrances.

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

It should be remembered that pedestrians have the right-of-way where the footpath extends across a vehicle crossing point.

Installation of TGSIs implies that pedestrians give way. If this is desired, the access should be formed to intersection standards (refer to *The Pedestrian planning and design guide* Section 14.11).

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

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

When installed at vehicle entrances, warning indicators shall;

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



Photo 24: Warning indicators extend across the full width of the footpath outside a car park building.

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 into, 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 Installation and maintenance

4.14.1 TGSi

TGSi must be installed in accordance with manufacturers' instructions. Specific attention should be given to ensuring that the TGSi are installed flush with the surrounding surface so as not to create a trip hazard (refer to the *Pedestrian Planning and Design Guide* Section 3.11).

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. Some 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 (refer to The *Pedestrian planning and design guide* Sections 3.11 and 14.6).

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, ie 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.

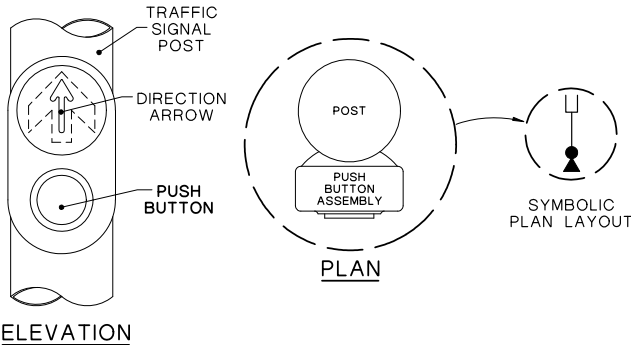


Figure 6: Diagram of pedestrian push-button assembly.

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

Audible component

The audible signal consists of a short pip (25 ms of 1000 Hz square wave) repeating every 1.8 seconds.

Tactile component

The audible signal 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

Audible component

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.

Tactile component

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 eg Barnes Dance/Scramble Crossings.

Land Transport NZ proposes to develop a standard audible signal for these situations for inclusion in the National Traffic Signal Specification.

5.3.3 Call acknowledge signal

A trial of traffic signals with a 'call acknowledge signal' at intersections is desirable 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 eg 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 audible component of the crossing signal feature of the ATTS may be switched off during the hours of 10pm to 7am
- the audible component of 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 components of the ATTS 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 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 guide 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 narrow medians where a single push button for both directions push button is located with the face parallel to the crosswalk
- considered in the median where pedestrians have to cross more than four lanes of traffic, or where the pedestrian phasing requires split crossing phases
- located on the traffic pole adjacent to the pedestrian crosswalk
- located less than 1 metre outside the outside pedestrian crosswalk line and less than 1 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 (300mm 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
- not closer 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.

Position of push button in relation to ground surface, TGS1 and kerb ramp

The maximum distance between warning indicators and the push button is 50 mm. This ensures that a person cannot accidentally bypass the warning indicators by placing their foot between the warning indicators and push button pole.

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.

Drawings

There are numerous examples of installations that have created problems through installations not following the designers' drawings. In some instances, the location of the kerb crossing, signal poles and tactile paving have not been adequately dimensioned with to each other in the drawings, which may have contributed to the poor installations.

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 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 TGSIs should be upgraded.

6.2 Tactile ground surface indicators (TGSIs)

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

TGSIs 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 TGSIs should be evaluated when prioritising the installation of TGSIs.

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.
- 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 TGSIs 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.
- 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.
- 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.
 - Transfer points between different modes of travel, eg 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 TGS and median dimensions)

Measured along the direction of travel when encountering the TGS. 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 (TGSIs)

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

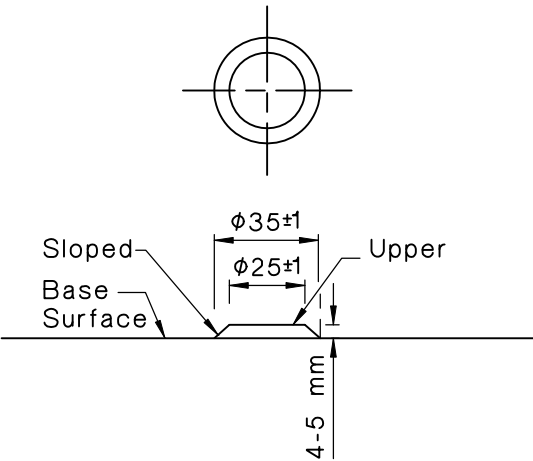
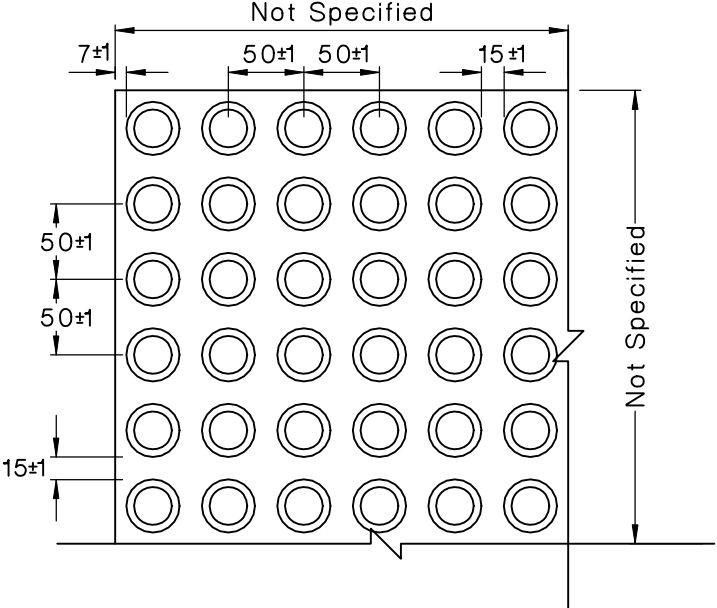
These are tactile ground surface indicators that indicate the presence of potential hazards. They consist of a pattern of truncated domes.

Wide (in reference to TGSI dimensions)

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

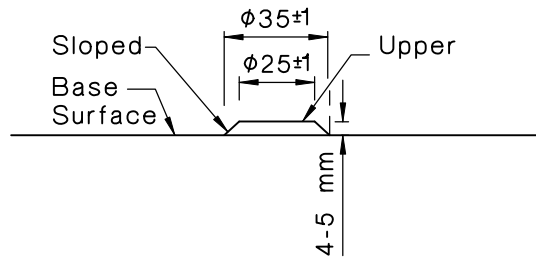
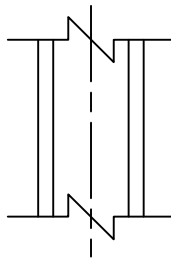
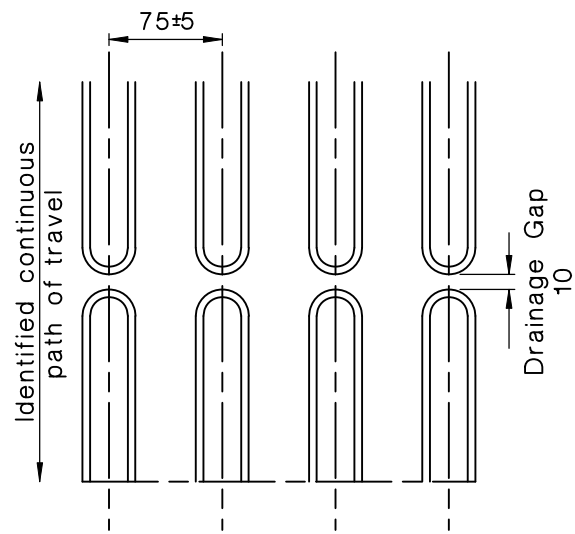
Appendix B: TGSi specifications

Warning indicators



Sourced from AS/NZS 1428.4: 2002

Directional indicators



Sourced from AS/NZS 1428.4: 2002

Appendix C: RNZFB contact details

For information and advice about the RNZFB and its services, please phone toll-free 0800 24 33 33 or visit the website www.rnzfb.org.nz.

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

Auckland

Awhina House,
4 Maunsell Rd, Parnell
Private Bag 99941, Newmarket, Auckland, 1149
Ph: 09 355 6900
Fax: 09 355 6919

Auckland South office

Fale Kotuku, Cnr McVilly & Browns Rd, Gate 1, Manurewa
Private Bag 99941, Newmarket, Auckland, 1149
Ph: 09 264 0107
Fax: 09 264 0106

Christchurch

96 Bristol Street, St. Albans
P O Box 1696, Christchurch, 8140
Ph: 03 375 4300
Fax: 03 355 9151

Dunedin

Cnr Hillside & Law Streets
P O Box 2237, Sth Dunedin, 9044
Ph: 03 466 4230
Fax: 03 455 4319

Gisborne

37 Grey Street
P O Box 581, Gisborne, 4040
Ph: 06 867 5529
Fax: 06 867 9324

Hamilton

1st Floor, Caro Street Community Building, Caro Street
P O Box 854, Hamilton, 3240
Ph: 07 839 2266
Fax: 07 839 5588

Invercargill

172 Queens Drive, Invercargill, 9810
Ph: 03 218 9189
Fax: 03 218 9188

Napier

94 Raffles Street,
P O Box 10, Napier, 4140
Ph: 06 835 3777
Fax: 06 835 8040

Nelson

530 Main Road,
P O Box 2246, Stoke, Nelson, 7041
Ph: 03 547 6616
Fax: 03 547 6615

New Plymouth

129-131 Vivian Street,
P O Box 178, New Plymouth, 4340
Ph: 06 759 1169
Fax: 06 757 9370

Oamaru

6 Steward Street,
P O Box 359, Oamaru, 9444
Ph: 03 433 1140

Palmerston North

43 Walding Street,
P O Box 310, Palmerston North, 4440
Ph: 06 350 2540
Fax: 06 356 1790

Rotorua

Community House,
1115 Haupapa Street, Rotorua, 3010
Ph: 07 348 7218
Fax: 07 347 2007

Tauranga

355 Devonport Road
P O Box 15114, Tauranga, 3144
Ph: 07 578 2376
Fax: 07 578 8359

Timaru

63 Grey Road, Timaru, 7910
Ph: 03 684 4259
Fax: 03 684 9281

Wanganui

102 Peat Street, Wanganui, 4500

Ph: 06 348 4401

Fax: 06 345 9028

Wellington

121 Adelaide Road, Newtown

P O Box 27177, Wellington, 6141

Ph: 04 380 2160

Fax: 04 389 5254

Whangarei

277 Kamo Road, Kamo

P O Box 8139, Kensington, Whangarei, 0145

Ph: 09 437 1199

Fax: 09 437 6951

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 U.S. 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 4586: 2004 *Slip resistance classification for new pedestrian surface materials*.

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*.

NZ Building Code, *Acceptable solution DS1/AS1 access routes*. Dept of Building and Housing, 2001, Wellington.

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Land Transport NZ, *Pedestrian planning and design guide*.

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

Royal New Zealand Foundation of 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: Road and traffic guidelines publications

The following Road and traffic guidelines are available:

RTS 1 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 (1993)

RTS 10 Road signs and markings for railway level crossings (2000)

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

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

RTS 16 Guide to heavy vehicle management (2006).

For copies of the road and traffic guideline series forward your request with a payment of \$10.00 per copy to:

Publications, Land Transport New Zealand, PO Box 2840, Wellington.

Or download from <http://www.landtransport.govt.nz/roads/rts/>