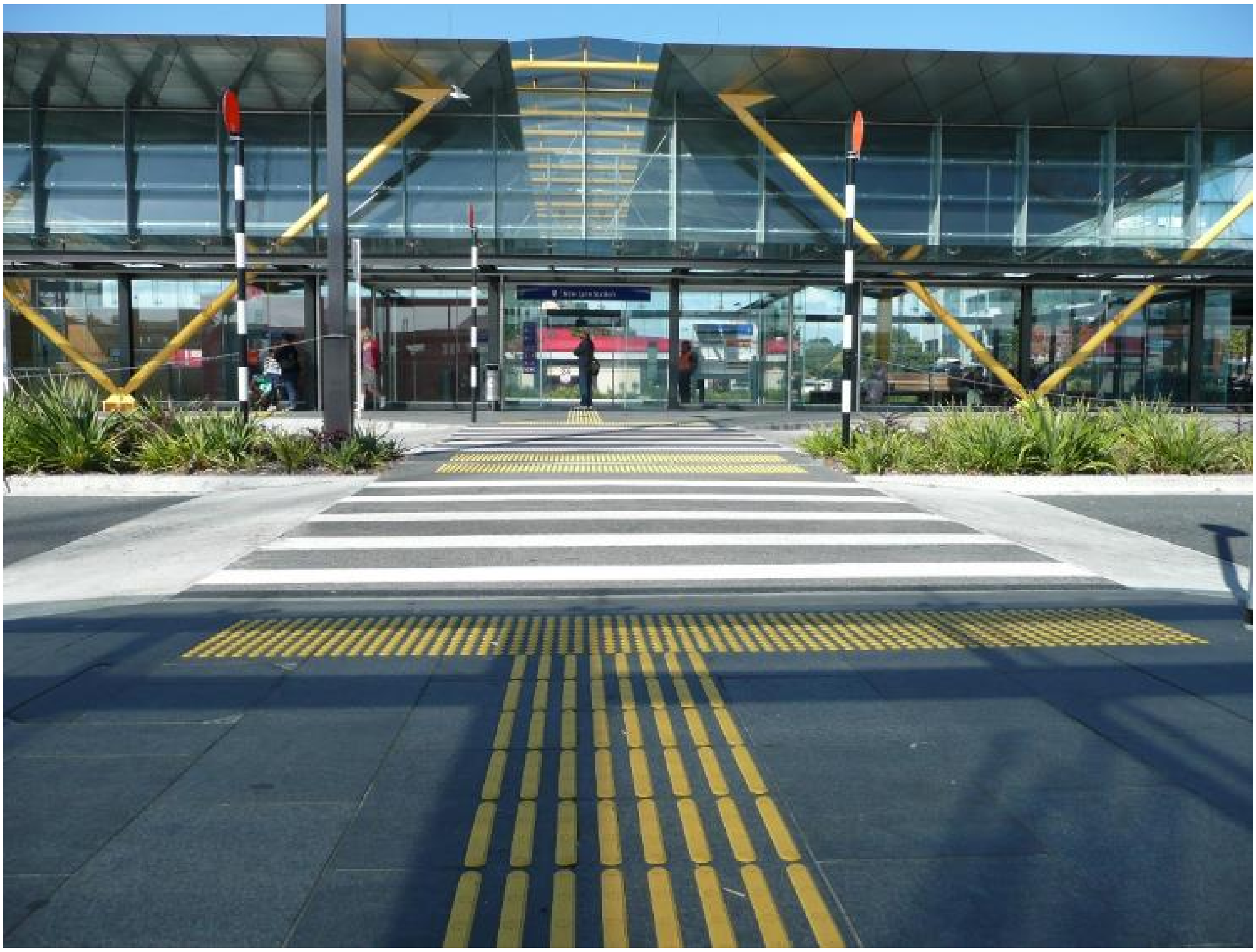
RTS 14 – Guidelines for facilities for blind and vision impaired pedestrians

3rd Edition - May 2015

Road and Traffic Standard Series



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New Zealand Government

More information

NZ Transport Agency
Published May 2015]

ISBN 978-0-478-44512-1 (online)

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1. DOCUMENT INFORMATION

1.1 Purpose

The purpose of this guideline is to provide best practice design and installation principles for pedestrian facilities that assist people who are blind or have low vision. 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. All pedestrians benefit from consistent facilities that also meet the needs of mobility impaired users. This guideline is for provision of facilities in public roads, paths and transport facilities. For guidance on providing for pedestrians who are blind or have low vision in other buildings refer to *AS/NZS 1428.4.1: 2009*, *Design for Access and Mobility Part 4.1: Means to assist the orientation of people with vision impairment, tactile ground surface indicators*

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 (now Blind Foundation) 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 third revision.

Road Controlling Authorities (RCA), the Blind Foundation, 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.

The principles underpinning RTS 14 have been included in the *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 more applied examples.

1.3 Content

This guideline specifies the design, installation and performance standards of pedestrian facilities for people who have disabilities (especially for persons who are blind or have low vision) 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 people who are blind or have low vision on their walking journey.

1.3.1 Tactile Ground Surface Indicators

Tactile ground surface indicators (TGSI) provide pedestrians with visual and sensory information. The two types of TGSI are warning indicators and directional indicators. Warning indicators alert pedestrians to hazards in the continuous accessible path of travel, 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 people who are blind or have low vision and designate the continuous accessible path of travel when other tactile or environmental cues are insufficient.

When combined with other environmental information, TGSI assist people who are blind or have low vision 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)

Audible tactile traffic signals (ATTS) provide pedestrians with audible and tactile information at traffic signals. The audible features of ATTS help people who are blind or have low vision locate the pedestrian push button, and inform them when to cross. The tactile features of ATTS also help those who are blind or have low vision with their orientation. ATTS also has benefits for fully sighted pedestrians

1.4 Status

RTS 14 is a best practice guideline. The use of this document is not compulsory in New Zealand law at present however it is referenced in the new AS/NZS 1428.4.1: 2009 and is a means of compliance within NZS 4121 2001.

NZS 4121: 2001 *Design for Access and Mobility – Buildings and Associated Facilities* requires Tactile Ground Surface Indicators to be provided at kerb crossings. While NZS 4121 states TGSI shall be provided at kerb ramps, 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.

The NZ Transport Agency is required by statute to exhibit a sense of social and environmental responsibility. It has adopted *an environmental and social responsibility policy* which can be found at http://www.nzta.govt.nz/network/operating/environmental/docs/environmental-and-social-responsibility-policy.pdf . RTS 14 has been ratified for use on NZ State Highways, for Transport Agency investment and funding purposes for projects being undertaken by other Road Controlling Authorities, and by the Road Controlling Authorities Forum.

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.

NZ Transport Agency welcomes helpful suggestions arising from attempts to apply this guide in practice. Comments should be directed to the National Safety Engineer, NZ Transport Agency, PO Box 1479, Christchurch.

1.5 Referenced Documents

The following documents are referenced in this guideline:

- AS/NZS 1428.4.1 2009 *Design for Access and Mobility Part 4.1:* Means to assist the orientation of people with vision impairment Tactile ground surface indicators
- AS 2353: 1999 *Pedestrian Push-button Assemblies*.
- AS/NZS 4586: 2004 *Slip Resistance Classification for New Pedestrian Surface Materials*.
- AUSTROADS *Guide to Road Design - Part 4a: Intersections and Crossings General – 2010.*
- NZS 4121: 2001 *Design for Access and Mobility – Buildings and Associated Facilities*
- *NZ Transport Agency, 2009, 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.*
- Auckland Transport, 2014, Auckland Transport Code of Practice (ATCOP) www.auckland transport.govt.nz
- The Centre for Universal Design, Guidelines for Use of the Principles of Universal Design January 29, 1999 / Revised September 9, 2002 www.ncsu.edu/ncsu/design/cud/about_ud/docs/use_guidelines.pdf

1.6 Glossary of Terms

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

2. INSTALLATION PRIORITISATION

2.1 Application & Priority

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 people who are blind or have low vision and vision-impaired people are upgraded in conjunction with maintenance and upgrade works at these pedestrian facilities. For example, when the footpath is resurfaced at a signalised intersection, tactile ground surface indicators should also be upgraded.

2.2 Tactile Ground Surface Indicators (TGSI)

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

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

General Situations (not road crossings)

Warning indicators should be installed to inform people who are blind or have low vision 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, railway crossings and moving walkways
- Vehicle hazards at busy vehicle crossing points including, but not limited to: shopping centres, bus stations and large car parks
- To designate the stopping point of the entry doors at bus stops.

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

Existing Road Crossing Points

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

Intersection Location

- Central business district

- Vicinity of shopping centres and malls
- Along arterial roads where substantial pedestrian activity is anticipated
- In suburban areas or communities where there is a demand for facilities to assist people who are blind or have low vision.

Road Crossing Characteristics

- Blended same level crossings
- Missing visual contrast between footpath and roadway
- Complex road crossings situations
- Lipless wheelchair-friendly crossings.
- Where footpaths shared with cyclists change from shared to separated from cyclists e.g. here the cyclist path leaves or joins from a road.

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 Blind Foundation. Contact the Blind Foundation on 0800 24 33 33 or e-mail GeneralEnquiries@blindfoundation.org.nz

2.3 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 to 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.

- High Pedestrian Flows: Consider the frequency and flow of pedestrians. Where there are sites/routes with high pedestrian usage, upgrading these sites means assistance is likely to be provided to a significant number of blind and visually-impaired people.

- Consultation with Disability Group – local knowledge of sites identified as high priority, or as key destinations, for the people who are blind or have low vision. This can be a useful source of information when considering signal upgrades.

- 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 people who are blind or have low vision 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 who are blind or have low vision in a particular area that rely heavily on public transport. Special attention and consideration should be given to the following issues:
  - Proximity to key public facilities

- – Transfer points between different modes of travel, e.g. train or bus.
- – Transfer points between bus routes

- Light Traffic Flow: It can be difficult for people who are blind or have low vision 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 Blind Foundation. Contact the Blind Foundation on 0800 24 33 33 or e-mail GeneralEnquiries@blindfoundation.org.nz .

3. UNDERSTANDING BLINDNESS AND VISION IMPAIRMENT

3.1 Background

The 2013 disability survey conducted by Statistics NZ estimated that 168,000 people were limited in their daily activities by vision loss that their glasses could not remedy. While overall this represents 4% of the population, an estimated 11% of adults aged over 65 years have such vision loss. 38% of vision impaired people (64,000) also suffer hearing loss.

At the latest count there were 11,572 members of the Blind Foundation. A person is eligible for the services of the blind foundation if; with corrective lenses;

- Their visual acuity is 6/24 or less using the better eye, or
- Their field of vision is less than 20 degrees in the widest diameter.

To be eligible for a supported living allowance from WINZ, a person must be totally blind which is defined by WINZ as:

- The best visual acuity (sharpness), with correcting lenses, does not exceed 3/60 and/or
- The visual field is contracted to a maximum of five degrees on either side of the fixation point.
- 95% of Blind Foundation 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 person with normal sight can see at 24m i.e. 4 times closer.

The majority of blind and vision-impaired people are aged over 65 years, with approximately half aged over 80, as age-related eye diseases cause most blindness. Table 3.1 lists the proportions of Blind Foundation members in various age group bands. It is expected that the proportion of members over 65 will increase as the population ages.

AGE GROUP	NUMBER OF MEMBERS
Under 19	7.0%
20 – 64	28%
65 – 79	14%
80 +	51%

Table 3.1. Membership Breakdown by Age
Blind Foundation Annual Report (12/13)

As people who are blind or have low vision are not permitted to drive a motor vehicle, their independent mobility depends on walking.

3.2 Orientation

3.2.1 General

People rely on visual, audible, tactile and other sensory information from the surrounding environment for their orientation. Most people who have low vision 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 people who have low vision 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, people who are blind or have low vision 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 people who are blind or have low vision with their orientation.

3.2.2 Walking Environment

In order to negotiate the road system people who are blind or have low vision 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.

People who are blind or have low vision will move around either independently or with the aid of another 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 vision loss to facilitate their independent mobility is a long white cane. This is used to preview the ground in front of the person to detect hazards.

Previewing takes the form of moving 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 or within 150mm of the ground (ref: NZS 4121[1]), 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, people who are blind or have low vision may have guide dogs to assist them with their mobility. A guide dog is trained to lead its handler 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 handler has to decide how and when to proceed.

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

[1] *NZS 4121:2001 Design for Access and Mobility – Buildings and Associated Facilities (Cl 13.2.3)*

3.2.3 Crossing Roads

When attempting to cross a road a pedestrian who is blind or has low vision 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.

3.2.4 Detection of Road Crossing Points

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

Kerb Upstand

People who are blind or have low vision may only recognise the edge of the footway by stepping off a full height kerb or detecting the drop off with their cane. Overseas research has shown that the full vertical upstand of a kerb is the single most reliable cue for people who are blind or have low vision 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 pedestrians who are blind or have low vision who rely on the vertical upstand of the kerb to detect that they have reached the transition from footpath to roadway.

A survey of Blind Foundation 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 people who are blind or have low vision 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 those who have mobility impairments and persons who are blind or have low vision

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:

- "A tactile change of surface, whether of concrete or other slip resistant material, shall be used to indicate the full width of the ramp and extended for the full face of the ramp. Such a change in texture should be set on the ramp 300 mm up from the common surface between the kerb line and road edge gutter".(see Figures 46 and 47 of NZS 4121)

Abrupt Change of Gradient

The rate of detection of a kerb crossing is also related 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. Also a sudden change in gradient is a stumble hazard. The range of acceptable kerb ramp gradients is described in Section 15.6 of the *Pedestrian Planning and Design Guide*. A consistent gradient also assists wheelchair users, in particular those in a manual wheelchair.

Tactile Ground Surface Indicators

The survey of Blind Foundation members found that kerb crossings with such indicators 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 pedestrians who are blind or have low vision 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 people who have low vision 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 users 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 impaired people and those who are blind have low vision.

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. The 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.

4. PEDESTRIAN FACILITY DESIGN INFORMATION

4.1 Universal Design Principles

The most common definition of universal design is:

> *The design of products and environments to be useable by all people,*
> *to the greatest extent possible without the need for adaption or specialised design.*

This document supports and takes into account the guidelines of the universal design principles. The principles are outlined below:

- Equitable use – the design is useful and marketable to people with diverse abilities
- Flexibility in use – the design accommodates a wide range of individual preferences and abilities
- Simple and intuitive – use of the design is easy to understand, regardless of the user's experience, knowledge, language skills or current concentration level
- Perceptible information – the design communicates necessary information effectively to the users, regardless of ambient conditions or the user's sensory abilities
- Tolerance for error – the design minimized hazards and the advance consequences of accidental or unintended actions
- Low physical effort – the design can be used efficiently and comfortably and with a minimum of fatigue
- Size and space for approach and use – appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

Further information on the universal design principles can be found at
http://www.design.ncsu.edu/cud/about_ud/udprinciples.htm

Universal design is an integral part of Good Urban Design. For Urban Design guidance refer to the NZ Transport Agency publication: *Bridging the Gap* available for download at.
http://www.nzta.govt.nz/resources/bridging-the-gap/docs/bridging-the-gap.pdf .

4.2 Key Design Principles

The design principles for this guide, when applied, make it easier and safer for pedestrians who are blind or have low vision to move around. The principles are:

- 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 users who are blind or have low vision

- 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

4.3 Continuous Accessible Path of Travel

The continuous accessible path of travel defines the area where the pedestrian route is safe and convenient for everyone, especially people with impaired mobility, and people who are blind or have low vision. 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 (minimum width 1.5 metres), but wider is beneficial on busy footpaths, refer *Pedestrian Planning and Design Guide* Section 14.2 for specific details on 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 people who are blind or have low vision. Street furniture such as parking metres and rubbish bins should be located near the kerb. Where retailers have limited space, well-designed outdoor facilities can be provided directly outside the building. The key element is to maintain an accessible path. See Photo 4.1 for a good practice case. In residential streets the edges of the continuous accessible path of travel are usually adequately defined by the edges 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 should be used to direct users to the kerb crossing.

4.3.1 Obstacles

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

Advertising signs on the footpath should be avoided if possible. Where advertising is permitted, signs shall be located away from the continuous accessible path of travel, i.e. on the kerb edge, as shown in Photo 4.1 and always placed consistently in the same location.

Photo 4.1 While no footpath obstacles would be preferable, these advertising signs are located on the kerb edge, outside the continuous accessible path of travel (Photo: Tim Hughes).

The principle of providing a clear accessible path without hazards also applies to businesses displaying goods outside their premises, on the shop side of the footpath. If deviation (i.e. non-straightness) of accessible routes is unavoidable, a clear and simple transition should be provided.

NZS 4121: 2001 - Sections 13.2 and 13.5 outlines the need for an accessible path clear of hazards and obstructions. Design standards are also included in section 14.9 of the *Pedestrian Planning and Design Guide which* provides more detailed guidance. 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. See Figure 4.1 for the basic design principle.

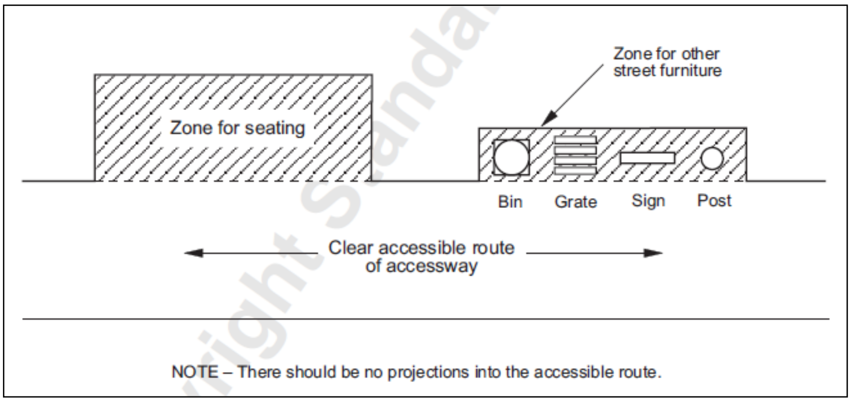


Figure 4.1 Example of street furniture positions. (Source: NZS 4121 2001 Cl 13.5.1 Figure 49)

Photo 4.2 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 Clause 13.5.1 (figure 49) where all street furniture shall be placed clear of the accessible path of travel. On the other hand, Photo 4.3 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 pedestrians who are blind or have low vision.

Photo 4.2 Good Practice – street furniture is located in an enclosed area which can readily be detected by the use of a long cane (Photo: Tim Hughes).

Photo 4.3 Poor Practice – street furniture that sprawls out onto the footpath is a hazard for all pedestrians. Note the umbrella at head height, which also poses a potential hazard (Photo: Tim Hughes).

4.4 Kerb Crossings at Road Crossing Points

4.4.1 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 pedestrians who are blind or have low vision 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, where the ramp length is less than 1500mm.

- Pedestrians, especially those with mobility-impairment are likely to experience difficulty in negotiating steep kerb ramps such as gradients of 1 in 8. 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 TGSIs 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 users who are blind or have low vision, 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.

4.4.2 Typical Design of Kerb Ramps

Figure 4.2 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.

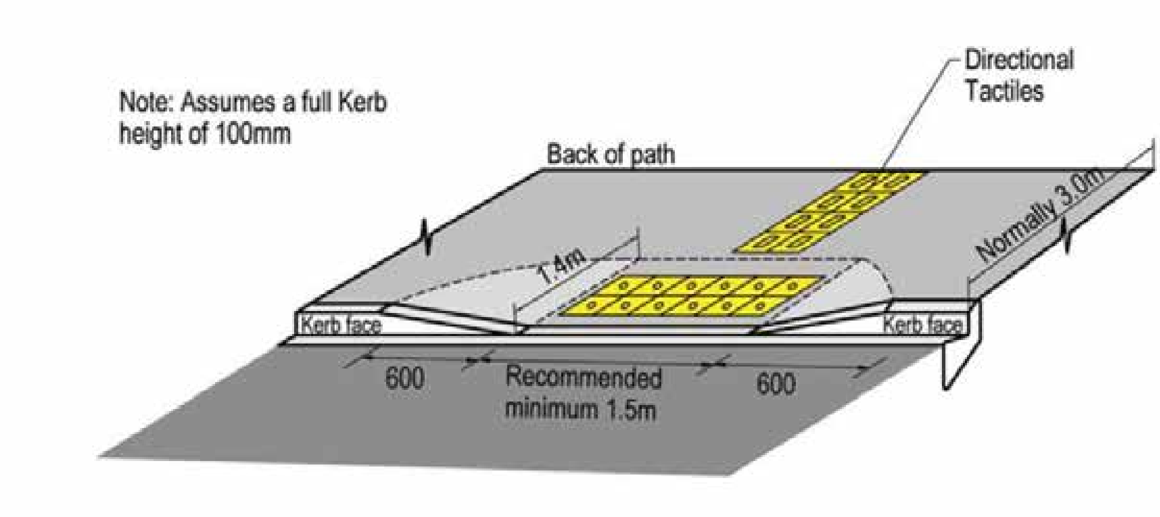


Figure 4.2 Standard kerb ramp design, assuming a full kerb height of 100mm

A gradient of 10% should only be considered for constrained situations where vertical rise is less than 150mm. A gradient of 12% should only be considered in constrained circumstances because the steeper grade is more difficult for mobility-impaired users to negotiate.

The gradient and details of the road surface next to the kerb ramp are also important. The gutter crossing should be smooth with the concrete channel and adjacent surface having a maximum slope of 5 %. Care needs to be taken to avoid a lip forming during reseals. See the *Pedestrian Planning and Design Guide*, Table 15.2.

The various elements of the kerb ramp design can be achieved in a number of ways. Figure 4.3 provides further guidance on how the design can be achieved.

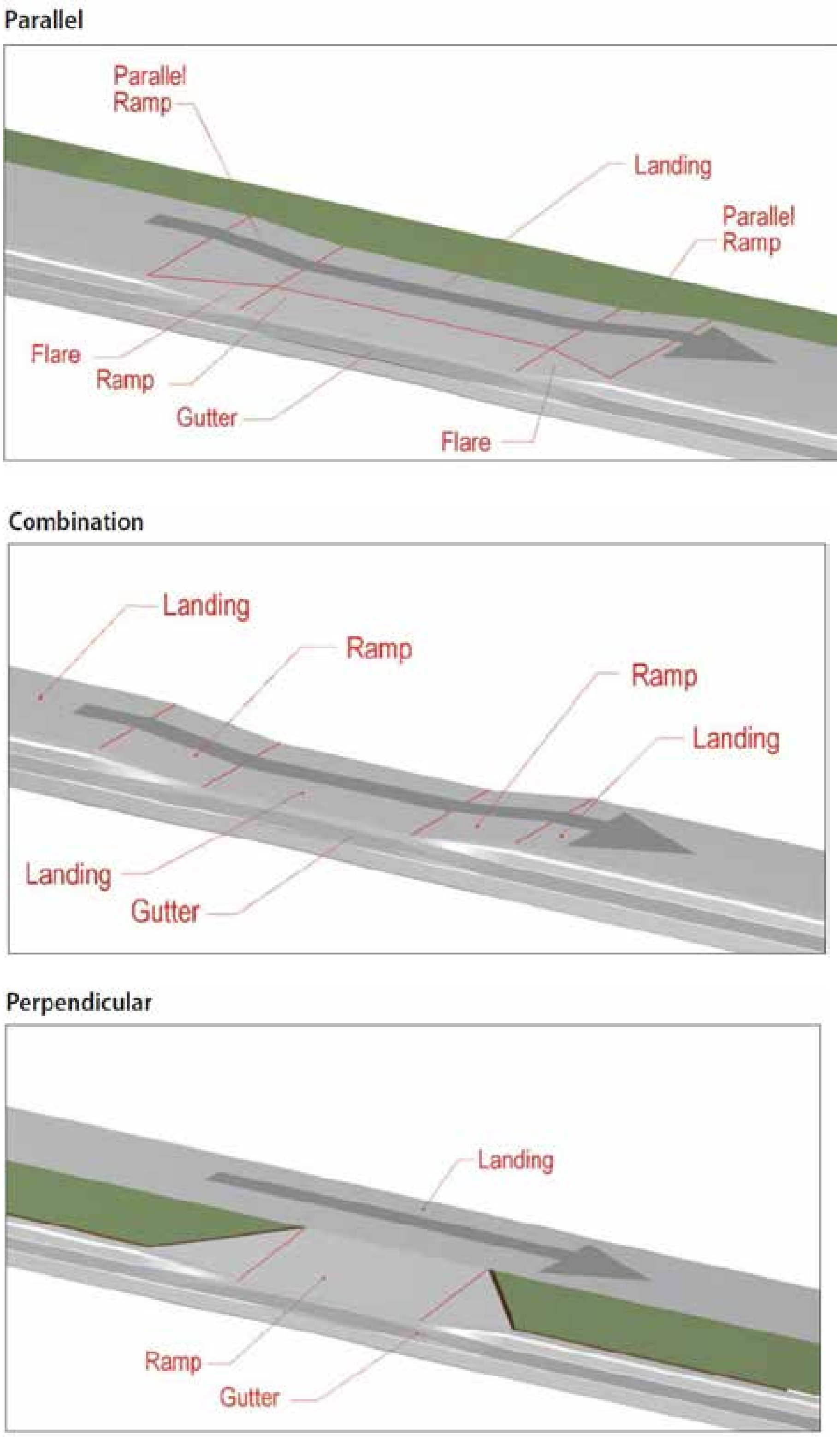


Figure 4.3: Kerb ramp designs – constrained sites (NZTA, 2009)

4.5 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 Planning and 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 Planning and Design Guide, with specific emphasis on design measures that should be adopted to enhance road crossing points at corners and intersections for pedestrians who are blind or have low vision-

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

4.5.1 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 turning 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 meeting with a curved kerb at the crossing point. If the kerb at this point is not at a right angle with the continuous accessible path of travel, it becomes difficult 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.

4.5.2 Intersection Radius Design Mitigation Measures

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

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

When using a bottom landing, development of puddles on the landing may be an issue. Consultation should be undertaken with drainage experts to ensure this does not occur. Figure 4.4 shows the correct landing arrangement.

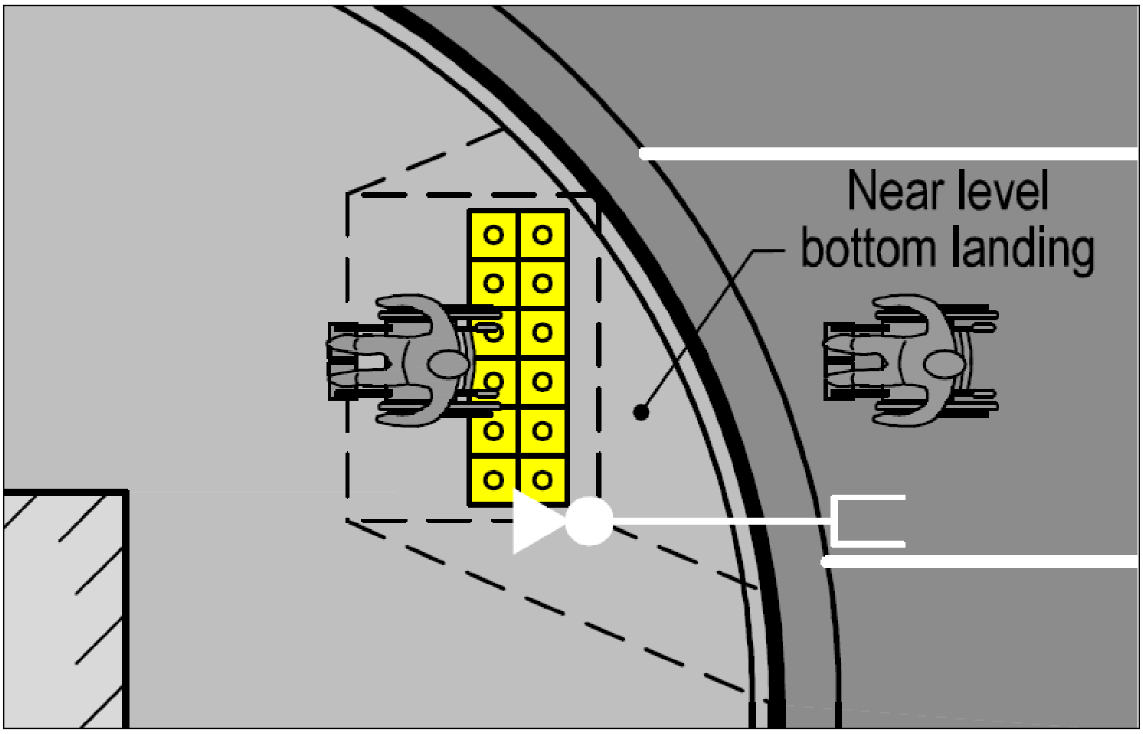


Figure 4.4 Correct bottom landing arrangement.

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 5.5 and 5.6.

Kerb protrusions provide many operational and safety benefits at intersections provided all turning movements by design vehicles can be accommodated. They usually provide room for good TGSI arrangements, and allow the ramps to be oriented in line with the pedestrian route. An example of a kerb protrusion solution is shown in Figure 5.9.

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 TGSI arrangements become possible. This may move the kerb crossing away from the continuous accessible path of travel. However it is important to provide crossing locations that allow the user to hear approaching traffic, which will assist them to determine when it is safe to cross. Directional TGSI and/or other cues may be needed to redirect pedestrians who are blind or have low vision 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 driver's attention and the cars out of the visual field of pedestrians. Where crossings are located away from an intersection, severity of injuries could potentially increase with the conflicts between pedestrian and vehicle, due to increases in vehicle speed on approach.

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 by moving the pedestrian crosswalks away from the intersection without limiting the opportunity for users who are blind or have low vision to hear the approaching traffic to assess when it is safe to cross. 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 usually means moving the signals poles, detector loops, detector tobies, crosswalk markings and limit lines. It also decreases operational efficiency.

5. TACTILE GROUND SURFACE INDICATORS (TGSI)

5.1 AS/NZS 1428.4.1: 2009

AS/NZS 1428. 4.1 :2009 Design for Access and Mobility Part 4: Tactile Indicators was released in November 2009 and consequently its predecessor (NZS/AS 1428.4: 1992) is referenced in NZS 4121: 2001. To comply with AS/NZS 1428.4.1, the requirements with respect to facilities in buildings are 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 Blind Foundation and those responsible for the management and design of roads, footpaths and traffic signals.

Some issues with AS/NZS 1428.4.1 :2009 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.

AS/NZS 1428.4: 2009 contains examples of road crossing situations that are considered in NZ to be inconsistent with good design practice and not readily achievable in the road environment. In particular, the diagrams in Appendix B and C of AS.NZS 1428.4:2009 should **NOT** be implemented in New Zealand.

AS/NZS1428.4.1: 2009 states that RTS 14 should be used for the design and provision of facilities for pedestrians who are blind or have low vision in the road environment in New Zealand.

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.

5.2 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 1428.4:1 2009 Fig 2.1 and 3.1 For convenience the diagrams are reproduced in Appendix B.

5.2.1 Warning Indicators

A warning indicator is a textured surface feature consisting of truncated domes built into or applied to walking surfaces to warn people who are blind or have low vision of a nearby hazard.

Warning indicators are intended to function much like a stop sign. They alert pedestrians who are blind or have low vision 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 5.1 shows a typical arrangement of warning indicators.

Photo 5.1: View of warning indicators. Note how the domes have been located to maintain equal spacing between domes across the entire warning indicator surface. (Photo: Carina Duke)

On installation, the leading edge of the domes should be aligned so that people who are blind or have low vision can identify the location of the hazard more accurately (as mentioned in section 5.5.1).

5.2.2 Directional Indicators

A directional indicator is a textured surface feature consisting of directional grooves built into or bars applied to walking surfaces to give directional orientation to people who are blind or have low vision. **As with any facility, directional indicators should be used appropriately and not overused.** If overused, it can lead to pedestrians who are blind or have low vision being unable to tell the difference between indicators intended for different purposes. Also, directional indicators can sometimes be uncomfortable when being negotiated by wheelchair users, people using other ambulatory devices, prams etc. so other environmental solutions/indicators should be sought e.g. landscaping and visual contrast

Directional indicators should only be used where other tactile and environmental cues, such as the property line or kerb edge, are either absent or give insufficient guidance. They:

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

Photo 5.2: View of directional indicators (Photo: Michael Brown).

An example of other visual and tactile cues can be employed, rather than the use of directional tactiles is shown in Figure 5.3.

Photo 5.3: Example of directional/physical cues (Photo: Michael Brown).

5.2.3 Materials

TGSIs should be made from any material that comply with AS/NZS 1428.4: 2009, – Section 2.3.1 and 3.2.1.

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, i.e. chipping or cracking;

Shall exhibit weathering and UV stability for maintaining high visual colour contrast.

Wear resistance; and

Adhesion/bond strength - particularly if immersed in water

5.3 Visual Contrast

The visual contrast between the walking surface and surrounding environment is critical for people who have low vision. They 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 pedestrians of hazards.

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

High visual contrast must be maintained throughout the products useable life.

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 Section 2.2 of AS/NZS 1428.4.1: 2009 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 by the method outlined in Appendix F.

Luminance contrast in percent is determined by:

Contrast = [(B1 – B2)/B1] x 100

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

B2 = light reflectance value of the darker area.

AS/NZS 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%

The above values from AS1428.4 are minimum values.

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

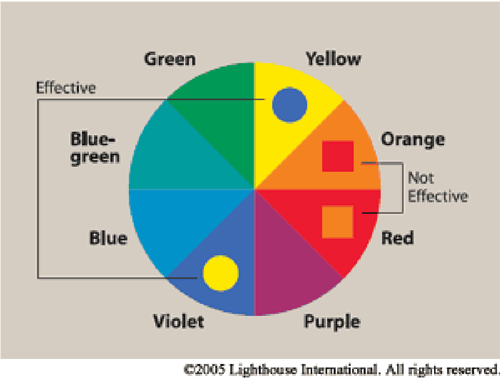
Most NZ paths are surfaced with dark asphalt. On these a luminance contrast of 70% is easily achieved with white or yellow TGSIs.

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. Figure 5.1 outlined the principles for good visual contrast.



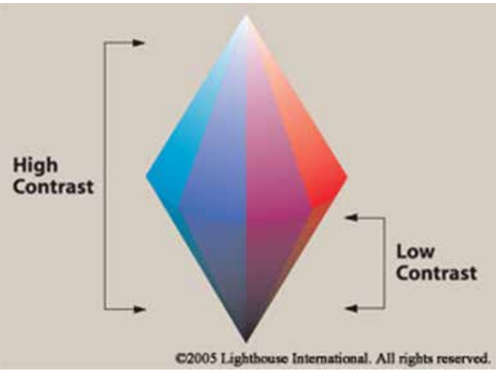


Figure 5.1: Effective Colour Contrast
(Source: www.lighthouse.org/accessibility/design/accessible-print-design/effective-color-contrast)
Adapted from original work by Aries and Knochblauch, 1996

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 TGSI having a 40% contrast from new concrete was subjectively judged to be more detectable than a darker TGSI having an 86% contrast with new concrete.

“Safety Yellow” is the recommended standard colour for TGSI. Provided that contrast requirements are met, other colours may be used. User views should be sought from the Blind Foundation.

White coloured warning TGSI should not be used in a way that could be confused with the bar of a pedestrian (zebra) crossing.

5.4 Where are TGSI Installed?

5.4.1 Warning Indicators

Warning indicators alert people who are blind or have low vision, to pending obstacles or hazards on the continuous accessible path that could not reasonably be expected or anticipated using other tactile and environmental cues. They are also a useful clue to sighted pedestrians.

Warning indicators shall be installed to inform people who are blind or have low vision 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 5.13)**
- **The presence of level railway crossings (Section 5.7.5)**
- **Overhead impediments or hazards other than doorways (e.g. wall mounted objects and archway structures), with a clearance of less than 2m from ground level, in an accessible open public space with no clearly defined continuous accessible path of travel.**
- **Location of bus boarding positions**

Warning indicators may also be installed to inform people who are blind or have low vision- of:

- **Vehicle hazards at busy vehicle crossing points such as at: shopping centres, bus stations and large public car parks, where other design solutions are not appropriate (Section 4.12), and**
- **Street furniture inappropriately located in the continuous accessible path of travel and not detectable by a person who is blind or has low vision 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).

5.4.2 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 e.g. 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**
- **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.

5.5 Installation Principles

5.5.1 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 people who are blind or have lowvision 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 people who are blind or have low vision 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, wharves or similar large vertical fall hazards 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 TGSI.)**
- **Preferably 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.**
- **If adhesive tiles are used the base of the warning indicators should be flush or slightly lower (up to 3mm) than the surrounding footpath surface.**

A 50mm spacing should be maintained between dome centres on adjoining tiles. This means that, for ease of installation, using rectangular tiles with dimensions in multiples of 50 mm is recommended. However if tile dimensions are in excess of 300mm, they can be more difficult to place correctly.

Explanatory Note: Warning Distances

The set-back distances of warning indicators provide people who are blind or have low vision with a safe tolerance to stop upon encountering the warning indicators without stepping into the hazard or hazard area. A greater set-back distance of 600mm is provided at railway platforms and wharves given the serious fall that could occur at these locations. An example of the typical tactile layout arrangement at a train station is shown in Photo 5.4

Photo 5.4: The warning indicators at this railway station are 600mm deep and set 600mm back from the platform edge (Photo: Michael Brown)

5.5.2 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 to identify 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**
- **With a minimum length of 1000mm so that people who are blind or have low vision- can readily orientate themselves.**
- **If adhesive tiles are used the base of the directional indicators should be flush or slightly lower (up to 3mm) than the surrounding footpath surface.**

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 people who are blind or have low vision once aligned with the warning indicator.

Where used to provide direction guidance all the way to kerb ramps, directional indicators should terminate at the top of the ramp. An example of this type of installation is shown in Photo 5.5.

Photo 5.5: The directional indicators shown in this installation cover the full width of the path while other features, including the planting and a handrail provide cues to the road crossing point (Photo: Tim Hughes).

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 (shown in photo 5.6)**.**

5.6 TGSI at Road Crossing Points

Refer to The Pedestrian and Planning Design Guide (Section 15) for information on pedestrian road crossing design.

5.6.1 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 5.6).

Photo 5.6: These directional indicators intercept all pedestrians on the continuous accessible path of travel. They lead directly to the warning indicators, and aligned for the use of the pedestrian push button. (Photo: Carina Duke).

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 person who is blind or has low vision to cross at the formal crossing point. **A decision to omit directional TGSI should only be made after consulting the local branch of the Blind Foundation.**

5.6.2 Median / Central Islands

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

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

Painted Medians

Painted medians are **not** suitable locations for pedestrians who are blind or have low vision to wait in while crossing the road.

TGSI shall <u>NOT</u> 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 people who are blind or have low vision, mobility impaired people or those people with wheelchairs, mobility scooters, prams or young children.

TGSI shall <u>NOT</u> be installed within medians less than 1.2 metres deep.

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 5.7).

Photo 5.7: Warning indicators correctly installed across the full depth of this pedestrian median island (1.2 - 1.8m deep (Photo: Carina Duke).

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 (See Photo 5.8).

Photo 5.8: On deep medians, two sets of warning indicators are installed. (Note: not quite full width.) (Photo: Susan Cambridge)

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 (See Photo 5.9).

Photo 5.9: The warning indicators are aligned with the road crossing direction. (Note: not quite full width) (Photo: Susan Cambridge)

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 5.10: Example of a staggered median crossing with marked pedestrian crossing over the traffic lanes, (note: the barrier contrast could be better) (Photo: Tim Hughes).

Photo 5.11: The kerb and fencing provides tactile cues within the staggered median to assist pedestrians who are blind or have low vision, so there is no need for directional indicators. (Photo: Tim Hughes).

Figure 5.2 shows the four types of medians where warning indicators are installed.

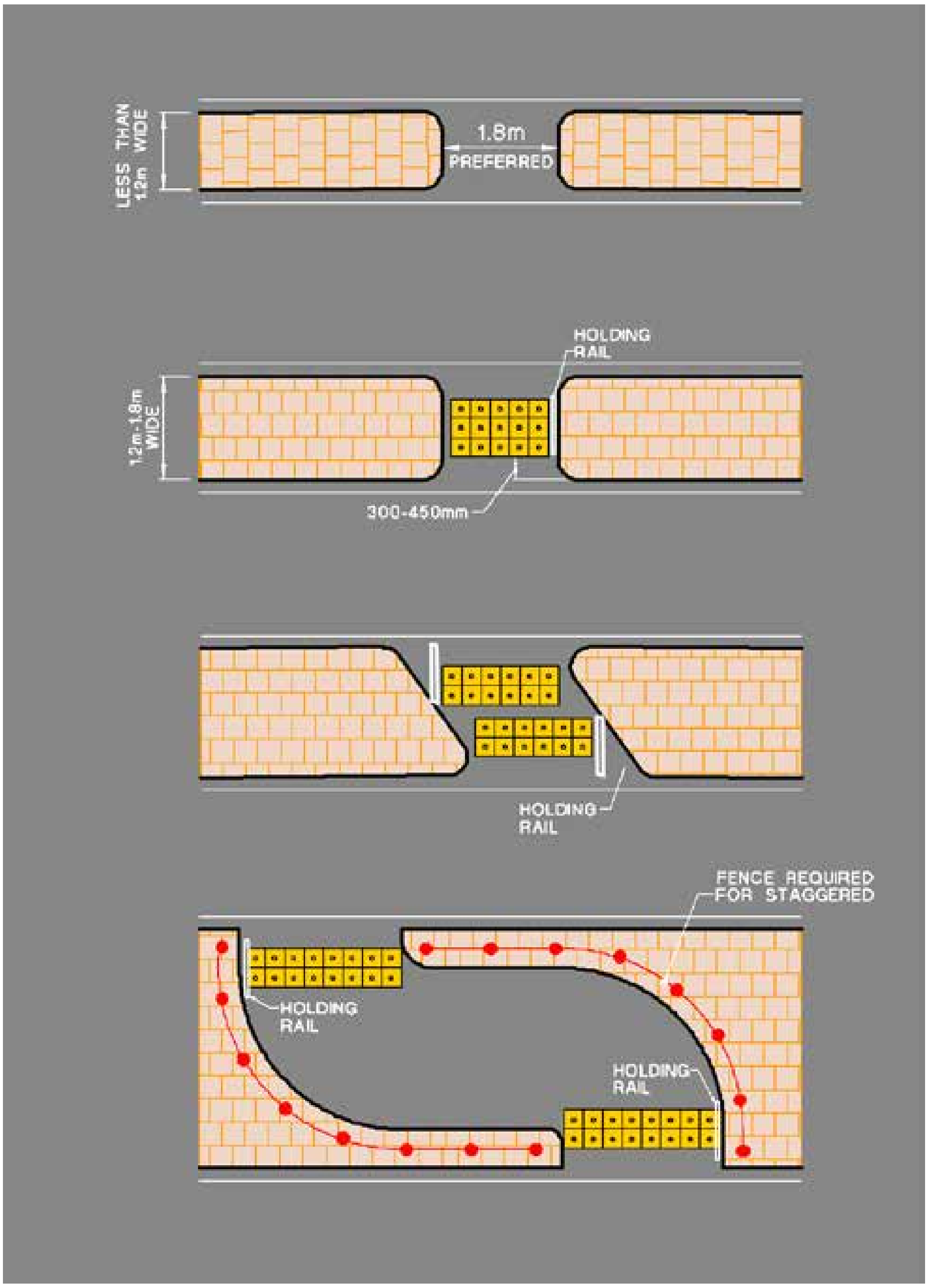


Figure 5.2: Schematic layout of where warning indicators should be installed in medians.

5.7 TGSI at Intersections

All Intersections

Intersections are formed wherever roadways meet. The boundaries of roadways are defined by the kerbs. In NZ pedestrians crossing roadways are required to give way to motor traffic unless they are using a zebra crossing or crossing on a green pedestrian signal. At vehicle entrances to adjoining land the rules are different. Pedestrians need to know that they are at an intersection and not a driveway. . The main way to distinguish that a path is about to cross a roadway at an intersection is the kerb crossing. For pedestrians who are blind or have low vision the kerb crossing is defined by tactile warning indicators.

Warning indicators should be installed at all intersection kerb crossings, irrespective of the type of kerb crossing. They should not normally be used, for driveway crossings, where they may imply (incorrectly) that vehicles have right of way. See section 5.13.

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

Photo 5.12: Example of warning indicators at minor intersections

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, pedestrians who are blind or have low vision may otherwise lose their orientation and have difficulty in locating the crossing point.

5.7.1 Typical Signalised Intersections

Figure 5.3 illustrates the correct layout of warning indicators at a signalised intersection. The layout dimensions also refer to recommended kerb ramp design (section 0) and location of pedestrian push-button poles in relation to kerb ramps and crosswalk lines (section 6.4). An example of good practice is shown in Photo 5.13.

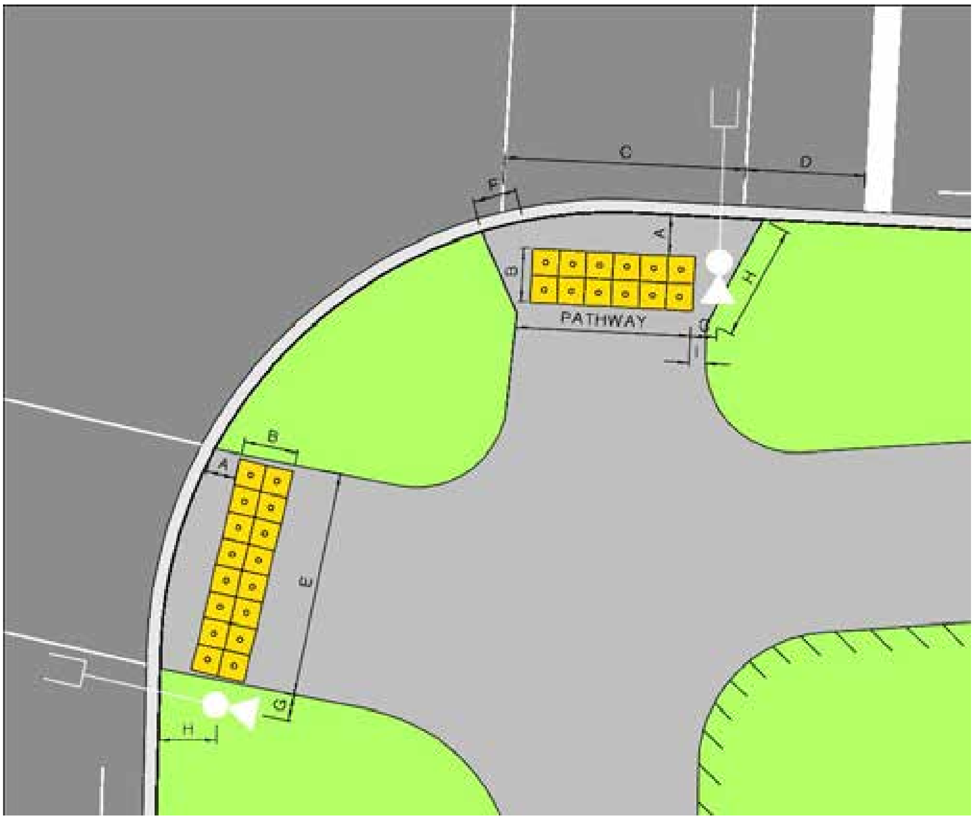


Figure 5.3: Correct design and orientation of kerb ramps, location of push-button pole and installation of warning indicators at a signalised intersection (key below).

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	Recommended 2.5 m (Minimum 2.0 m)
D	Distance between crosswalk line and limit lines	1.0 m
E	Width of kerb ramp	Recommended 1.5m (Minimum 1.0m)
F	Haunching width of kerb located outside the extent of the accessible path (slope 1:6)	600 mm
G	Clearance between push-button pole and edge of kerb ramp	Maximum 300 mm
H	Pedestrian push-button set back from kerb	Minimum 600mm Normally 1.0 m
I	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 to section 5.7.4).*

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

Photo 5.13. This installation is an example of ***"Best Practice"*** *with the warning TGSI and pedestrian call box both aligned with the crossing direction. The gap between the TGSI and signal pole is so small that a person cannot inadvertently enter the road without receiving tactile warning. (Photo: Carina Duke)*

5.7.2 Roundabouts

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

A typical layout is provided in Figure 5.4 with examples of good practice installation in Photos 5.14 and 5.15.

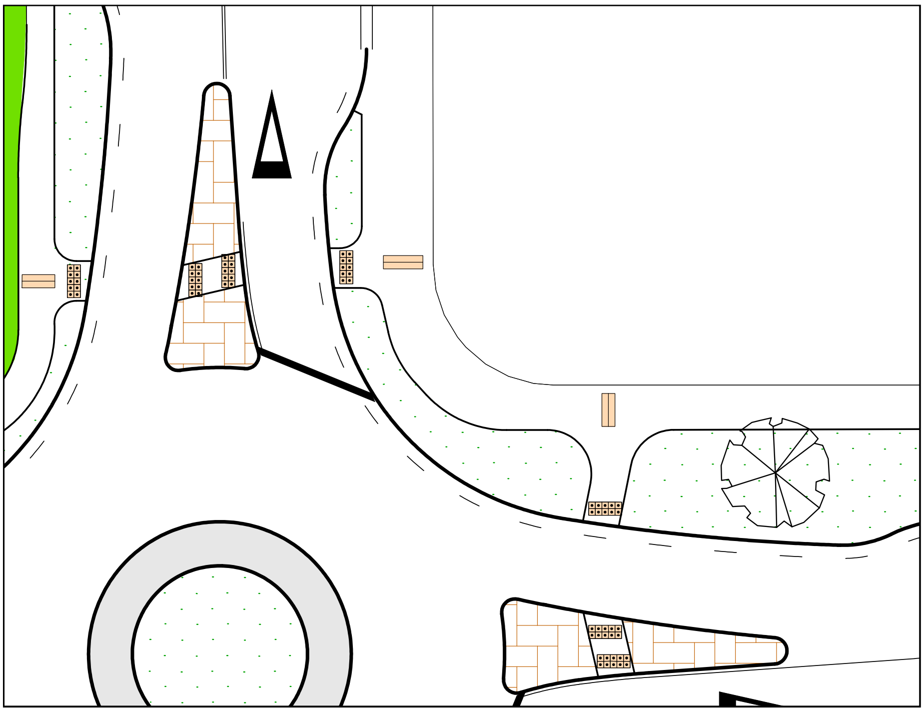


Figure 5.4:. This example shows the recommended layout of warning and directional TGSI at a roundabout

Photo 5.14: Actual example of the TGSI layout shown in Figure 5.13 (Photo: Tim Hughes)

Photo 5.15: Example of the TGSI layout at a roundabout (Photo: Carina Duke)

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5.7.3 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 5.5**).**

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.

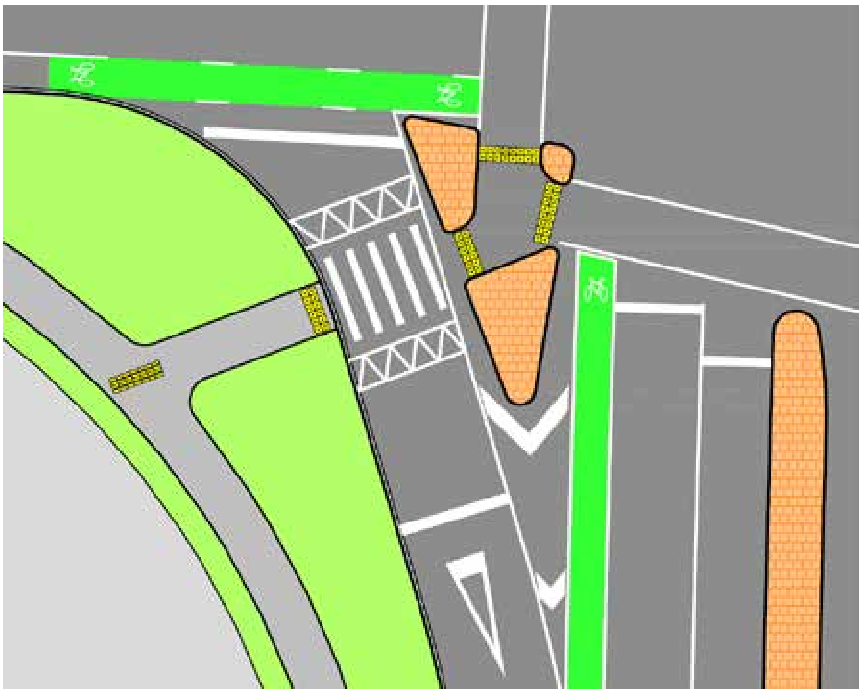


Figure 5.5: Warning indicators correctly shown in a slip lane island. Note how the warning indicators are orientated perpendicular to the crossing direction

Photo 5.16: Actual example of TGSI Layout (Photo, Carina Duke)

On large slip lane islands that are not cut through, directional indicators should be used between the crossing points to provide directional guidance to pedestrians who are blind or have low vision. Where there are three crossing points on a large slip island, directional indicators should lead to a central warning indicator with dimensions of 600 x 600mm to indicate that a choice becomes available.

5.7.4 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.

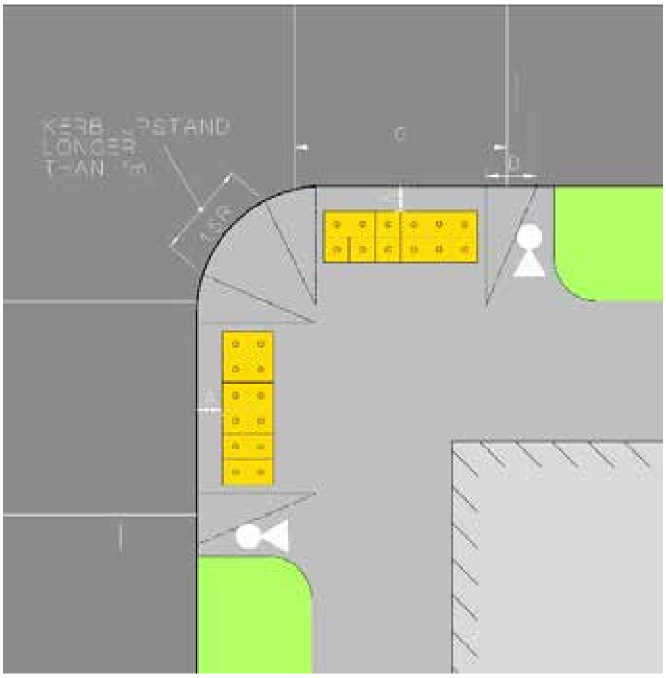


Figure 5.6: Two kerb crossings
With a small kerb radius like 1.5 metres, satisfactory solution.

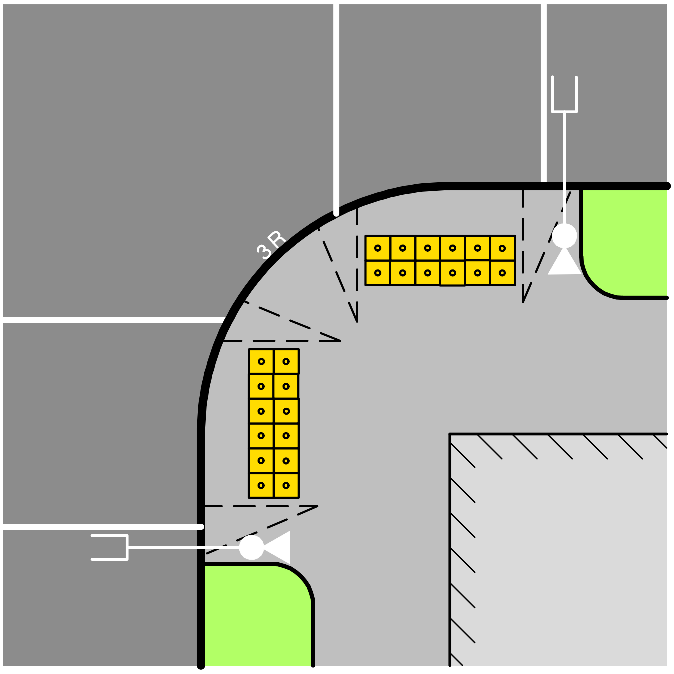


Figure 5.7: Two kerb crossings
3 metre kerb radius, design somewhat compromised.
Gap between ramp hauchings up to 1 metre.

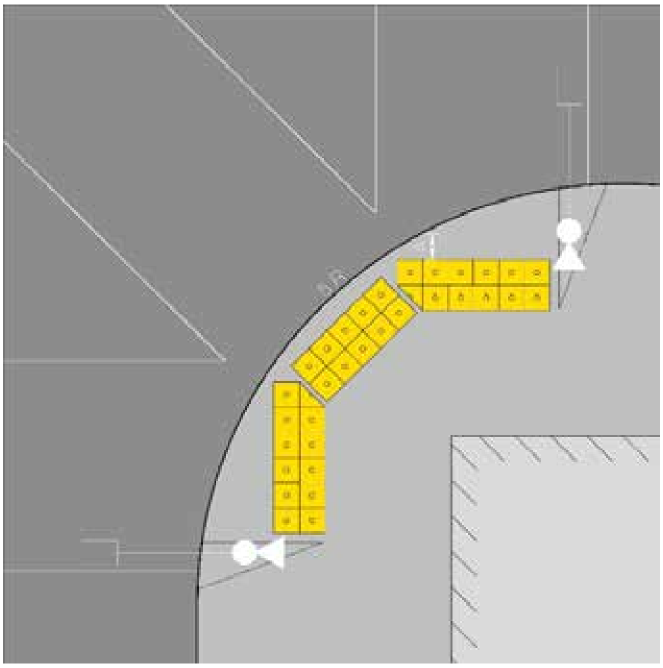


Figure 5.8: Full quadrant kerb crossing scramble phase / Barnes dance.
TGSI intercept full path and provide information for all directions of crossing.

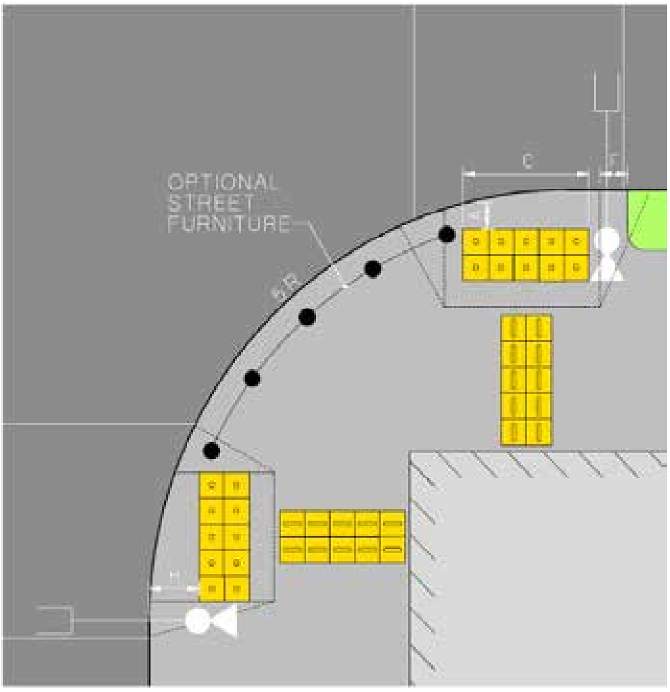


Figure 5.9: Two crossings, 5m kerb radius
Greater separation reduces kerb crossing angles Kerb and warning TGSI provide more consistent guidance. Crossings are outside continuous accessible path of travel. Directional TGSI desirable.

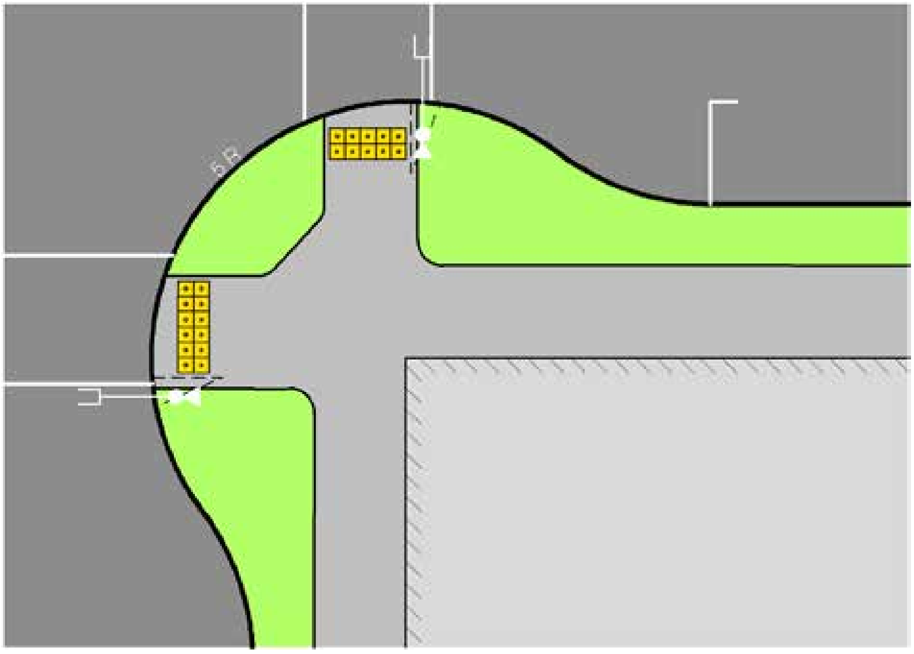


Figure 5.10: Two kerb crossings with kerb extensions
Kerb crossings and TGSI give accurate crossing information. The kerb build out reduces crossing distances and allows both kerb ramps to be installed in the continuous accessible path of travel

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 pedestrians who are blind or have low vision and are laid out so that the longest straight edges are aligned with the crossing direction, and the shorter stagger distance is minimised. It is important that “Staggered” layouts do not permit accidental overstep by a vision-impaired pedestrian. as per Figure 5.11. This should be considered for all likely approach directions.

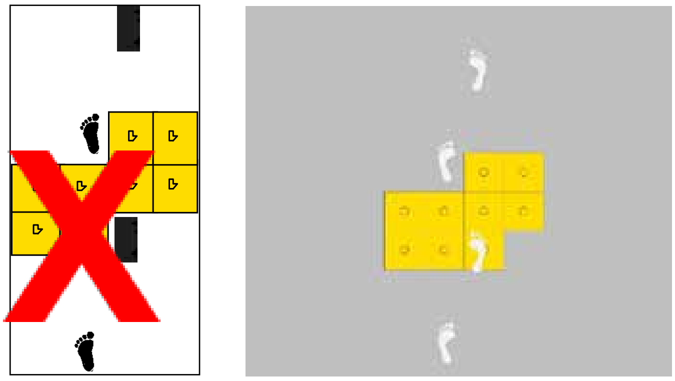


Figure 5.11 Example of overstepping tactile pavers.

An additional tile as shown in the second image above overcomes the problem.

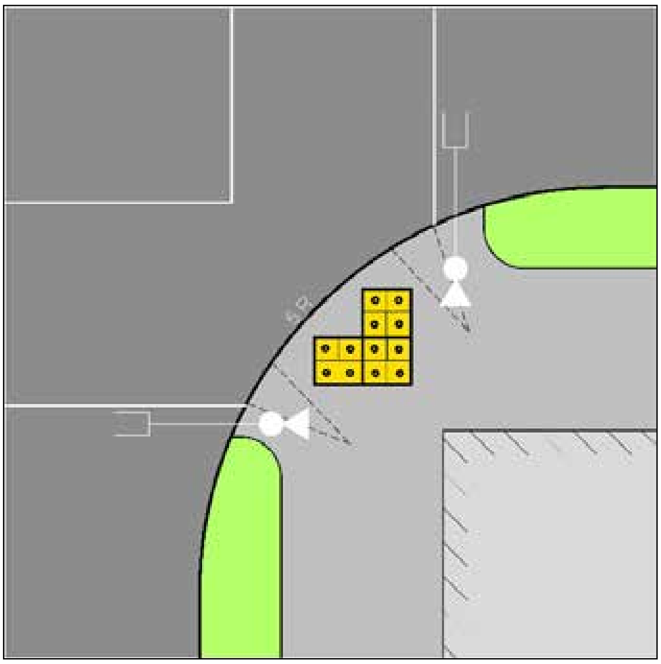


Figure 5.12: Single angled crossing
Kerb crossing design not recommended*. This TGSI arrangement gives the least confusing crossing information for this situation, and intercepts a higher proportion of the approach path.*

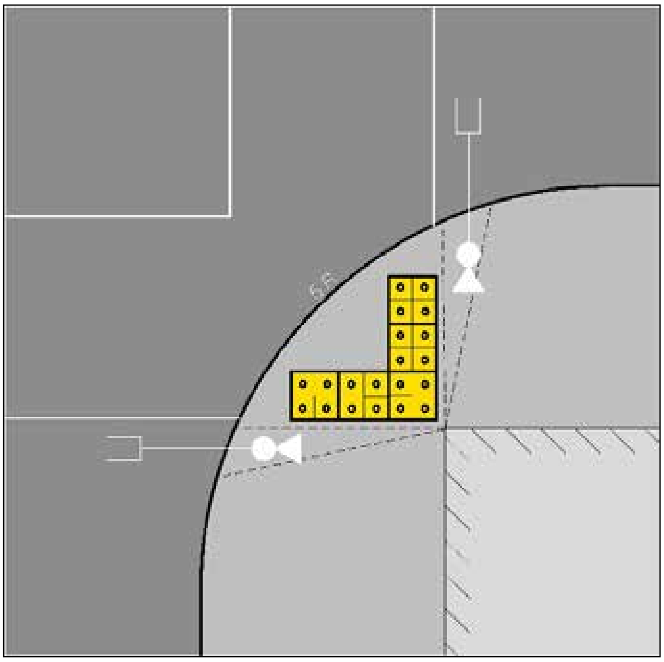


Figure 5.13: Full quadrant kerb crossing
Kerb crossing layout not recommended*. Warning TGSI at entry intercept all users, and guide to crossing point. (Warning TGSI only around kerb would confuse).*

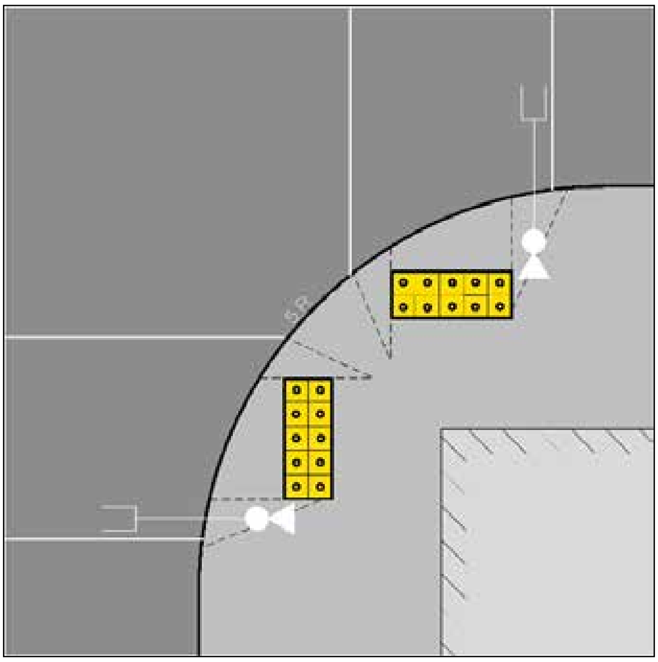


Figure 5.14: Two crossings 5m kerb radius
Minimum separation between kerbs (1m of full height kerb, plus haunchings). Highly angled kerb crossings are partially offset from the continuous accessible path of travel.
Note: Moving the kerb crossing further from the intersection improves the kerb crossing angle.

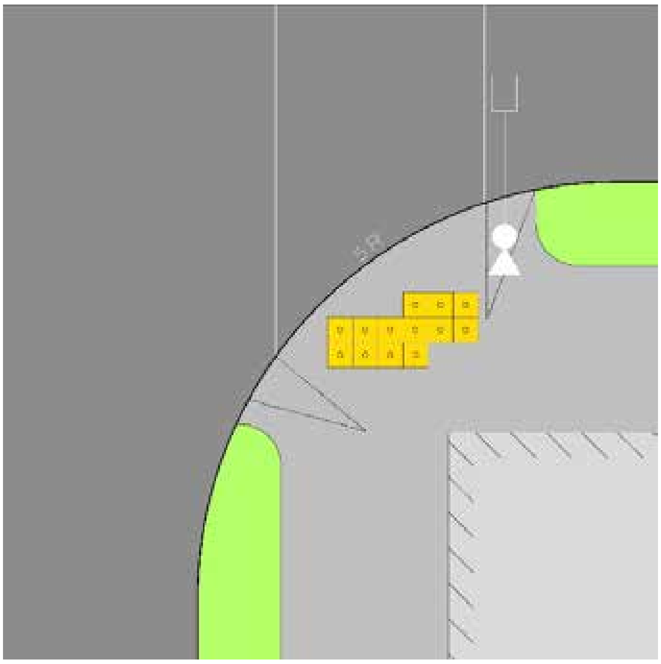


Figure 5.15 Staggered TGSI Arrangement for Single Direction Kerb Crossing
Kerb crossing layout not recommended

Note: The TGSI arrangement aims to indicate crossing direction and intercepts all pedestrians.
Note; The design should aim to minimise any stagger.
Moving the kerb crossing more into the side road would result in a better layout
The stagger can also be reduced by offsetting the TGSIs further from the kerb at the end furthest from the intersection, provided this does not leave a gap that could be bypassed inadvertently. In the above example the signal pole fills that gap.

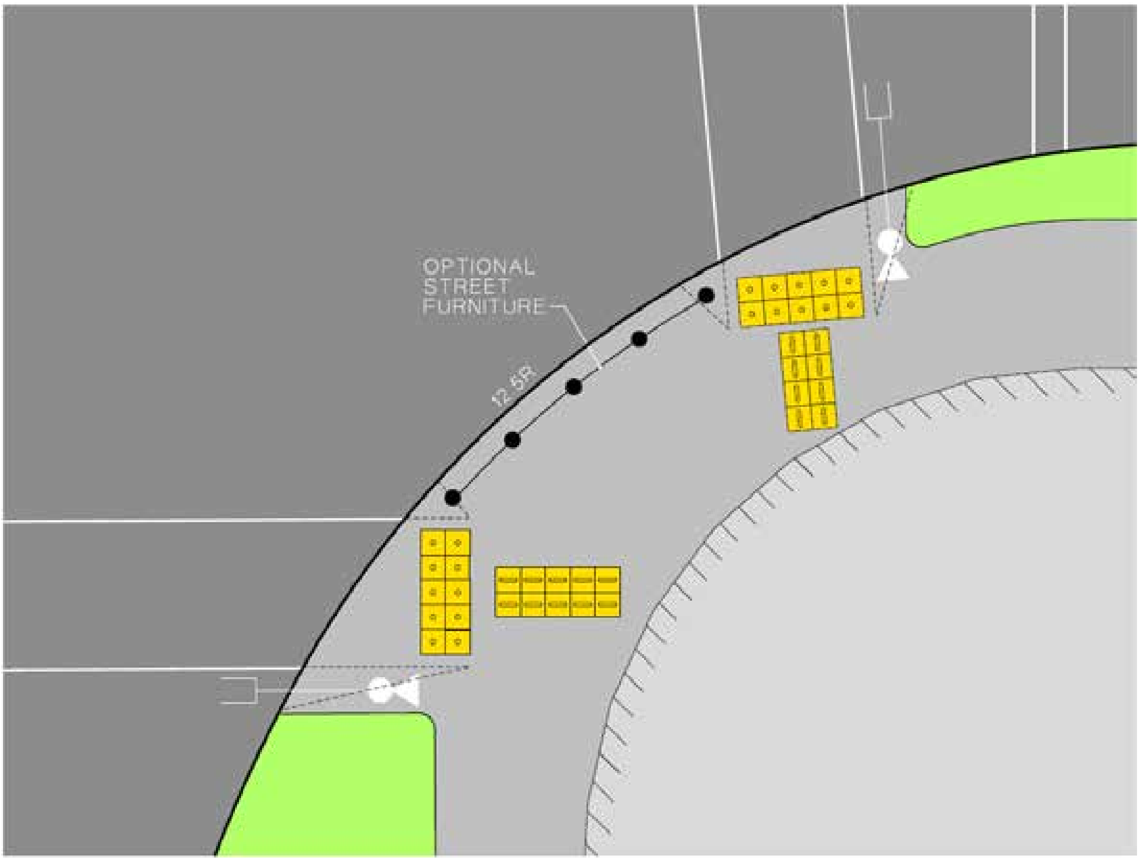


Figure 5.16: Large kerb radius
Crossings set back to achieve acceptable kerb crossing and TGSI arrangements.

There can be issues with the back edge if the ramp encroaches into the through route where the existing path is narrow. Alternatives for narrow footpaths are provided in Table 15.11 of the Pedestrian Planning and Design Guide (“lowered perpendicular” and “projected”).

5.7.5 Railway Crossings

All level railway crossing and maze layouts shall have Warning TGSI installed with safety yellow textured contrasting crosswalk lines.

Level railway crossings can be problematic and further guidance is available in Section 15.19 of the Pedestrian Planning and Design Guide. Photo 5.17 provides an example of the typical layout at rail crossings.

Photo 5.17: Tactile arrangement at a rail crossing (Photo: Michael Brown)

5.8 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.

An example of integrating TGSI with service covers are shown in Photo 5.18

Photo 5.18: An example of how warning TSGI can be integrated into the design of utility service cover (Photo: Michael Brown).

5.9 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 person who is blind or has low vision 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. An example of poor practice is shown in Photo 5.19.

Layouts should lead pedestrians naturally to the side with the pedestrian push button , using directional TGSIs where other cues are insufficient.

Photo 5.19: 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 person who is blind or has low vision receives tactile warning if they mistakenly enter the cyclist crossing area.

A standard layout for the design of shared signalised crossings is shown in Figure 5.17. The warning TGSIs in the cycle space should be a different colour preferably a darker shade of green.

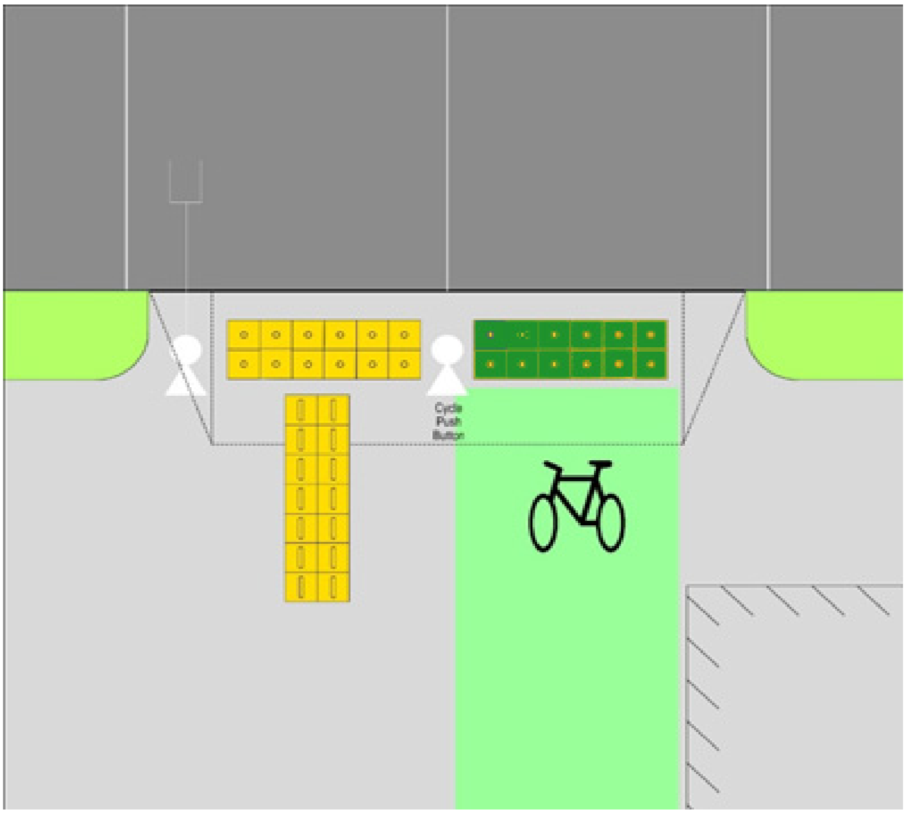


Figure 5.17: Shared Signalised Crossing Standard Detail

5.10Shared Space

A Shared Space is a low speed residential or retail street where the usual kerb is removed that distinguishes the footpath as pedestrian priority space and the roadway as traffic priority space. The ambiguity of a common level and surfacing material leads to caution and lower speeds by vehicles. While this is generally beneficial to most road users, it creates difficulties for pedestrians who are blind or have low vision as the usual orientation cues are often absent and it is difficult for them to sense the subtle cues on the location of the continuous accessible path of travel. (CAPT). The *Pedestrian Planning and Design Guide* section 5.3.3 discusses shared zones.

The development of shared space environments in New Zealand is becoming increasingly popular. When developing these areas consider the following guidance and principles.

- Shared spaces should be signed as shared zones so that pedestrian priority is legally established along with a low speed limit that is compatible with a walking priority environment.
- There should still be a safe pedestrian space designed as a CAPT near one or preferably both sides of the street that is reliably free of traffic and obstacles. The transition to the traffic space must be delineated in manner detectable by users who are blind or have low vision. Well located street furniture, plantings landmarks and similar features are especially useful for orientation in shared spaces, and to provide a natural boundary to the CAPT and buffer to the shared carriageway. In addition a subtle tactile paving delineator has been devised for Auckland CBD (for instance in Fort Street, Auckland). This was developed in conjunction with stakeholders and the rise and fall was agreed upon to prevent it becoming hazardous or not being detectable by cane or foot. The installed width should be a minimum of 600mm. This delineator should not be used in streets that are not classified as shared spaces.
- Consistency of approach is important. Across streetscapes the CAPT should be consistently located –preferably next to the building line, where there is typically also some shelter. It should not be in different positions along the path. It is confusing when the CAPT changes when a person turns a corner, crosses an intersecting road or deviates to go around obstacles.
- Shared spaces often invite adjacent site activities to spill out onto the street. There should be no obstacles in the CAPT such as sandwich boards, café dining, cycle stands, shop displays, or parked vehicles. The extent of approved dining and café areas should be well defined on the ground, with signage, umbrellas, heaters, etc not extending into the CAPT. Formalised barriers with a feature to within 150mm of the ground that can be detected by canes (as per NZ Standard 4121) are preferred. Monitoring and enforcement of encroachment is likely to be necessary.
- Tactile Ground Surface Indicators (TGSI) should only be used where there are hazards or directional changes without adequate cues that a pedestrian who is blind or has low vision needs to be aware of. A TGSI should not normally be used where the pedestrian has priority (unless safety is compromised).
- Generally in shared spaces, crossing takes place everywhere with pedestrians having priority so warning TGSIs are not required in addition to the delineator strip described above. However where street crossing locations are particularly suitable for blind and vision impaired users, and directional TGSIs are used to guide user to these crossing points, warning TGSIS should also delineate the transition to shared traffic space on the line of the directional TGSIs.
- Large vehicles such as buses should not be included as traffic through shared spaces – in particular with stops within the shared space (including tour buses).
- It is preferable that there be no parking within the shared spaces as reversing vehicles are a hazard. Entrances to adjacent parking facilities need to give priority to pedestrians and ensure full visibility for the driver exiting from a stopping point within the footprint of the building.

- The ends of the shared zones should be unambiguously defined. Kerbs and kerb ramps and any other features that normally define the pedestrian and traffic spaces outside the shared zone should be in place and especially used to identify entrance/exit points for vehicles. These provide cues for those travelling parallel and not into the shared space so they are aware that they are crossing a street. Warning TGSI should be installed where the shared space terminates at traffic signals. Cars should not be able to block the shared surface waiting for light changes if there is not a signalized phase and standard crossing point incorporated for pedestrians.

- Plantings adjacent to the CAPT should not have features that can, or will with growth, extend into the CAPT. Garden edges should be straight if they are to be used for orientation along the CAPT.

- Decorative surfaces with strips or patterns of different colours and textural changes should be avoided in the CAPT as they can create confusion within the shared space. Carefully located however they may be an aid to orientation – for instance where they line up with shop entrances and other features. Colours such as yellow that might be confused with TGSIs should be particularly avoided. Colour changes can also be confused by vision impaired users with steps or changes in surface level.

- The whole CAPT surface should be smooth and level with the only textural differences being for the delineator, or necessary TGSIs. Any surface features used in the shared zone and furniture zones, must be able to be easily navigated by those who have mobility issues i.e. they do not catch canes or other mobility aids or trip those who have a shuffling gait.

- Guide dog handlers may have difficulties knowing where they are in space and holding a straight line. An accessible CAPT and logical crossing points that enable directional alignment are important.

- Monitoring the use of the shared spaces is essential. Vehicle speeds and driver behaviours determine the safety and ease of use for pedestrians.

An example of a successful shared space using theses principled is shown in Photo 5.20. Because shared spaces are a new concept and design guidance is still emerging the Blind Foundation should always be consulted on any proposals – contact details in Appendix C.

Photo 5.20: Auckland Shared Space Example

5.11Guidance Between Kerbs

Consideration should be given to providing pedestrians who are blind or have low vision with guidance across the roadway between kerbs. Pedestrians who are blind or have low vision 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 5.21).

Where it is unrealistic to provide raised crossing places for pedestrians, consider marking pedestrian crosswalk lines with thick thermoplastic. Thermoplastic markings are slightly raised, and have a different texture , 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 5.21: This installation shows a textured and raised crossing surface to inform pedestrians who are blind or have low vision of the boundaries of the crossing point. Note the change in texture and colour at the edge of the platform (Photo: Michael Brown).

5.12Access to Public Transport

Pedestrians who are blind or have low vision rely heavily on public transport and therefore need to identify areas of access to public transport.

TGSI alone will not distinguish public transport access points from 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 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 (see Photo 5.4 for an example);**
- **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.**

The Auckland Transport code of practice (ATCOP) published March 2014 provides the latest design guidance for public transport infrastructure. The guidelines can be accessed via the web on the following link.

https://at.govt.nz/about-us/auckland-transport-code-of-practice/

Photo 5.22 shows directional and warning indicators installed correctly at a bus stop.

Photo 5.22: Directional indicators lead to warning indicators at a bus stop (Photo: Michael Brown).

At railway level crossings, warning indicators shall:

- **Be located 3.0m from the track centre line (2.5m minimum)**
- **Cover the full width of the footpath**
- **Have a minimum depth of 900mm.**

For more information on provision at railway crossings refer to the Pedestrian Planning and Design Guide.

5.13 Vehicle Entrances

Refer to The Pedestrian and Planning Design Guide (Section 14.11) for design information about vehicle entrances.

Busy vehicle entrances that cross footpaths (generally accesses to commercial properties) can be hazardous for pedestrians who are blind or have low vision to cross.

It should be remembered that pedestrians have the right-of-way at driveways.

Installation of TGSI 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 TGSI 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**
- **Be setback at least 300mm from the expected travel path of a large vehicle turning to enter or leave the vehicle crossing point (Photo 5.23).**

Photo 5.23: Warning indicators extend across the full width of the footpath outside a busy car park building (Photo: Michael Brown).

5.14Stairs and Escalators

Stairs can be particularly hazardous people who are blind or have low vision, given the serious fall or trip that could occur if a pedestrian were inadvertently to step off, or onto, a flight of stairs. At the top of the stairs a fall could be particularly serious, while the bottom stair presents a trip hazard, and indicates the commencement of the landing.

At stairs, warning indicators shall be installed:

- **The full width of the path of travel**
- **300mm back from the top and bottom steps**
- **at least 600mm deep at the top and bottom of a flight of stairs (Photo 5.24).**

Photo 5.24: Example of TGSI at the top and bottom of stairs (Photo: Michael Brown)

Similarly, moving escalators and travelators are also hazardous for pedestrians who are blind or have low vision

At escalators and travelators, warning indicators shall be installed:

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

Photo 5.25: TGSIs at escalators (Photo: Michael Brown)

AS/NZS 1428.1: 2009 Section 2.4, provides examples of stairways and escalators and prescribes the requirements for installing TGSI in these situations.

5.15 Installation and Maintenance

5.15.1 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 people who are blind or have low vision. 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.**
- **TGSI shall be kept free of weeds and other vegetation likely to reduce the visual contrast or create a trip hazard.**

5.15.2 Footpaths

The roughness of footpaths was the most common issue raised during the survey of Blind Foundation members (March 2003). Uneven footpaths are a tripping hazard for all pedestrians, especially people who are blind or have low vision, mobility-impaired people and older people (refer to The Pedestrian Planning and Design Guide Sections 3.11 and 14.6).

6. AUDIBLE TACTILE TRAFFIC SIGNALS (ATTS)

6.1 General

ATTS convey important information to people who are blind or have low vision at signalised intersections. They provide them with:

- Assistance in locating the pedestrian push button.
- Information to assist them with their orientation
- Information of the status of the pedestrian crossing signals, i.e. cross or do not cross.

ATTS improve the safety and confidence of people who are blind or have low vision 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 impairments.

6.2 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 6.1 and Figure 6.1. It is designed and located to convenient for mobility impaired users in wheelchairs. The assembly contains a transducer that alternately produces both sounds and vibrations that provide cues to people who are blind or have low vision and those who have a hearing impairment. It has a large push button easily used by a person with mobility impairment. There is an arrow above the push-button. The main function of the arrow on the call box is to provide pedestrians who are blind or have low vision with directional orientation, and the centre of the arrow has a an element that vibrating element for tactile sensing when a finger is held against it, that coincides with the audible sounds so that people with both hearing and vision impairment can sense the crossing signal.

Photo 6.1: Pedestrian push-button assembly.

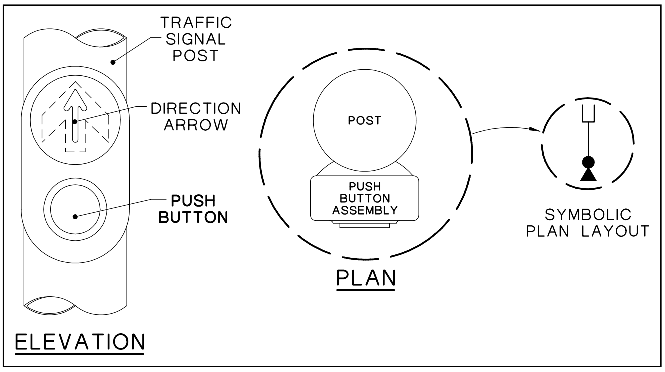


Figure 6.1: Diagram of pedestrian push-button assembly

6.2.1 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:

6.2.2 Locating Signal

The purpose of the locating signal is to assist people who are blind or have low vision to find the pedestrian push button.

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 linked to a vibrating tactile pulse (which vibrates to 145 Hz). This facility is used by touching the directional arrow on the push button unit.

Both audible and vibrating tactile locating signals operate for the whole time that the "Crossing Signal" is not sounding.

6.2.3 Crossing Signal

The purpose of the crossing signal is to indicate that the green pedestrian crossing signal is displayed and the pedestrian may enter the roadway.

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 that is less than the cross signal as vision impaired pedestrians are likely to cross more slowly.

Tactile Component

When the audible crossing signal sounds, the centre of the tactile arrow vibrates at 145 Hz pulsing at 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 may be provided for exclusive pedestrian phases e.g. Barnes Dance / Scramble Crossings, so that users who are blind or have low vision can cross with added confidence knowing that vehicles will not be present during the pedestrian crossing signal.

6.2.4 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 25ms followed after a 100ms silence by a 1000ms 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 acknowledges signal is a double pulse. It consists of a standard "Locating Signal" pulse followed by a 100ms gap then another standard "Locating Signal" pulse.**

6.2.5 Audible Volume

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

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

However, ambient noise microphones may also pick up “noise” generated by wind blowing across the microphone, which increases the level of tones emitted. This may cause the resulting tones to be significantly louder than traffic noise.

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 6.4).**
- **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”.

6.2.6 Pedestrian Detector

Pedestrian detector pads detect when a pedestrian is standing on the warning tiles to sense when a pedestrian is waiting to cross. They can be used to call a pedestrian phase, but their primary purpose is to cancel a pedestrian call if a pedestrian has crossed before the lights changed. They provide no benefit for pedestrians, and are therefore not recommended as a facility designed to benefit blind and vision impaired pedestrians

6.3 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 tactile ground surface indicators, and is discussed in Section 2.3.

6.4 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 may be 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 a two stage pedestrian crossing exists. Care must be taken to avoid confusion between separate phases or sections of a crossing in such circumstances, to ensure pedestrians don't try and cross the full distance when not meant to, or stop in the median when this is not required**
- **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**
- **Not closer than 4m from the next nearest pedestrian push- button (to avoid confusion between audible signals)**
- **Easily accessible by all pedestrians – see following section, Position of Push- Button.**

Where there is no pole or the poles are too far from the crosswalk, an additional pole must be installed. The additional pole must be correctly positioned so as not to confuse pedestrians.

Position of Push-Button in Relation to Ground Surface, Tactile Ground Surface Indicators (TGSI) and Kerb Ramp

To be easily accessible to all pedestrians, the installation should satisfy placement:

- **Within 350mm (Dimension G+I in 3) Figure 5.3 from the end of the TGSI zone (for persons, particularly those who are blind or have low vision, waiting on a warning indicator, and to ensure persons cannot accidentally pass between the warning indicators and push- button pole)**
- **Within 300mm from the top edge of the kerb ramp if its slope is greater than 1:10 (such that wheelchair users do not need to enter steep ramps to activate call- buttons)**
- **Between 800 and 1000mm above the ground surface (for children and wheelchair / mobility scooter users)**
- **Away from obstructions such as a raised portion of an island (which may inhibit wheelchair occupants access to the pedestrian push- button with their elbow).**

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 people who are blind or have low vision- or those who have mobility-impairments. 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**
- **The pedestrian push- button is relocated onto a separate pole closer to the kerb ramp**.

Distance between Pedestrian Push-buttons

Poles closer than four metres apart may confuse pedestrians who are blind or have low vision over which direction the audible signal applies. If the poles cannot be located more than 4m apart then consideration should be given to reducing the volume of the signal. The vibrating tactile signal must never be turned off.

Drawings

There are numerous examples of installations that have created problems through 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 respect 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 the Blind Foundation so they can contribute to the design early in the design process and educate users. Their job is to teach people who are blind or have low vision to understand traffic flow and safe techniques to cross roads. Appendix C lists the contact details of Blind Foundation

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 people who are blind or have low vision 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 people who are blind, vision impaired and hearing impaired people with their orientation and also indicates the status of the crossing phase.

Back Edge (of Warning Indicator)

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

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

The area intended to provide a continuous step-free, safe and convenient route for the use of all pedestrians including those with a mobility-impairment, people who are blind have low vision, or people pushing prams, trolleys etc. This involves even surfaces, gentle grades, a lack of obstacles, and smooth transitions between roadways and footpaths.

Crossing Point

A crossing point is any place designed to assist pedestrians to cross a roadway. It includes formal crossings (e.g. traffic signals, zebra crossings) where pedestrians have extra rights and informal crossings (e.g. priority-controlled intersections, kerb protrusion, raised islands, platforms) where pedestrians are required to give way to traffic.

Crossing Signal

Is an audible/vibrating signal that sounds to indicate the start of the crossing phase and continues for the duration of the crossing phase or for a shorter pre-set maximum time (corresponds to the green walking man signal).

Cue

Any object within the environment which can be perceived by pedestrians and which can assist them in their orientation and navigation tasks. This includes those that can be felt, heard, seen or smelt by a pedestrian who is blind or has low vision. Cues can assist pedestrians to establish their direction of travel, their location or the location of facilities.

Depth (in reference to TGSI and median dimensions)

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

Directional Indicators

These are tactile ground surface indicators that indicate a direction of travel by using a pattern of raised bars, that contrast with surrounding surface. The depth of the bars is always measured across them.

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

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)

A measure of the percentage of visible and useable light that is reflected from a surface when illuminated by a light source. Pure black has a light reflectance value of 0% and absorbs all light. Pure white has a light reflectance value of 100%. The difference in LRV between two adjacent surfaces describes one aspect of contrast which determines how easy it is to tell them apart visually

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

An audible signal that enables someone who is blind or who has a visual impairment to find the pedestrian push button. It operates when the “Crossing Signal” is not audible/vibrating.

Median island

A continuous or short island in the middle of a roadway separating traffic in opposite directions that provides a refuge for pedestrians, permitting them to cross the road in two stages.

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 impairment is caused by age or accidents.

Orientation

A person's awareness of where they are in relation to their environment, the route to, and location of their destination.

Orientation and Mobility (O&M) Instructor

A person who teaches people who are blind or have low vision, techniques and strategies 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

Lines marked on the surface of a roadway at traffic signals, to define the area in which pedestrians should travel when crossing the road.

Tactile

The characteristics of an object that communicates using the sense of touch.

Tactile Ground Surface Indicators (TGSI)

Patterned modules designed to be felt underfoot, to communicate directional information or to warn of hazards.

Vision impairment

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 or vision impaired' when talking about people with 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

Tactile ground surface indicators that warn of the presence of potential hazards. They consist of a pattern of truncated domes that contrast with the surrounding surface.

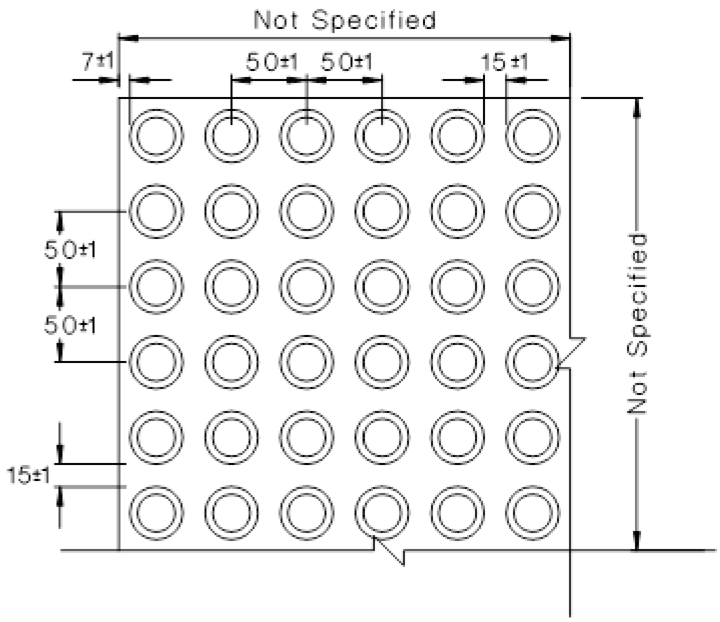
Wide (in reference to TGSI dimensions)

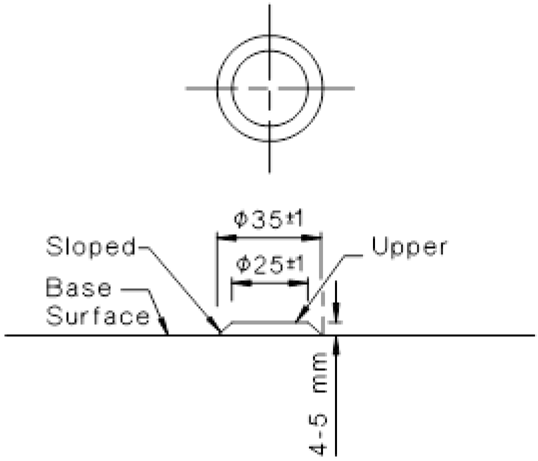
Measured perpendicular to the direction of travel when encountering the TGSI.

APPENDIX B

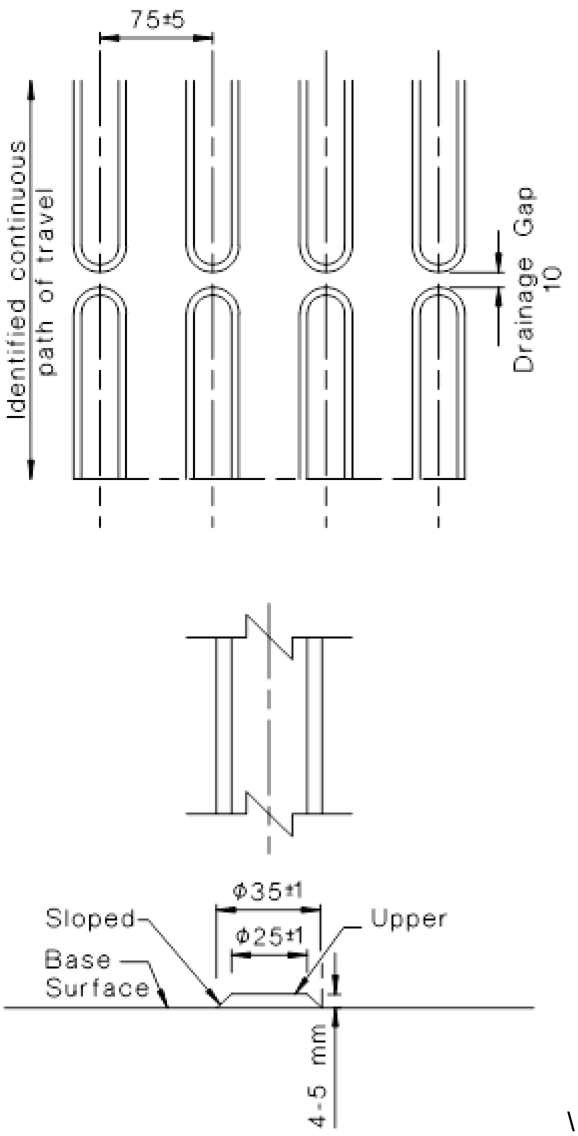
Tactile Ground Surface Indicators (TGSI): Specifications

Warning Indicators





Directional Indicators



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APPENDIX C

Blind Foundation Contact Details

For Information and Advice about the Blind Foundation (BF) and its services, or to contact Orientation and Mobility Instructors please phone toll-free 0800 24 33 33 or visit the website www.blindfoundation.org.nz.

Orientation and mobility instructors are based at the following BF offices:

Auckland

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

Auckland South Office

20 McVilly Road
Manurewa
Private Bag 94002, Manukau 2241
Fax: 09 264 0106

Christchurch

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

Dunedin

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

Hamilton/Waikato

15 Liverpool Street
P O Box 854, Hamilton, 3240
Ph: 07 839 2266
Fax: 07 839 5588

Napier/Gisbourne

P O Box 10, Napier, 4140

Nelson and Marlborough

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

Palmerston North

P O Box 310, Palmerston North, 4440
Fax: 06 356 1790

Tauranga

P O Box 15114, Tauranga, 3144
Fax: 07 578 8359

Timaru

PO Box 7940, Timaru, 7910
Fax: 03 684 9280

Wellington

121 Adelaide Road, Newtown
P O Box 27177, Wellington, 6141
Fax: 04 389 5254

Whangarei

277 Kamo Road, Kamo
P O Box 8139, Kensington, Whangarei, 0145
Fax: 09 437 6951

APPENDIX D

References

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

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

Arditi, Aeries; Knochblau, Kenneth, (1996) Effective Colour Contrast and Low vision in B Rosenthal and R Cole (Eds) Functional Assessment of low Vision. pp 129-135 www.visibilitymetrics.com/sites/visibilitymetrics.com/files/downloads/Effective%20Color%20Contrast%20&%20Low%20Vision%201996.pdf

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Blind Foundation web-site *www.blindfoundation.org.nz*

U.K. Department for Transport. *Guidance on the use of tactile paving surfaces.* https://www.gov.uk/government/publications/guidance-on-the-use-of-tactile-paving-surfaces

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

Arditi, Aeries; Knochblau, Kenneth, (1996) Effective Colour Contrast and Low vision in B Rosenthal and R Cole (Eds) Functional Assessment of low Vision. pp 129-135

www.visibilitymetrics.com/sites/visibilitymetrics.com/files/downloads/Effective%20Color%20Contrast%20&%20Low%20Vision%201996.pdf

NZ traffic signals specification: Signals NZ users group (SNUG), IPENZ Transportation Group.

http://www.ipenz.org.nz/ipenztg/Subgroups/SNUG/Traffic_Signal_Documents/National_Specifications.cfm

Joyce, M, July 2012, Shared Space in Urban Environments – Guidance Document Flow NZ

www.ipenz.org.nz/ipenztg/publications/120706_Shared%20Space%20Guidance%20Note_Issue%203.pdf.

APPENDIX E

Road and Traffic Standards Publications

The following Road and Traffic Standards are available:

These Standards may be downloaded from the NZTA website:
http://www.nzta.govt.nz/resources/road-traffic-standards/rts.html

No.	Title	Issued
RTS 1	Guidelines for the implementation of traffic controls at crossroads (PDF, 86 KB, 22 pages)	Nov 1990
RTS 2	Guidelines for street name signs (PDF, 259 KB, 27 pages)	Nov 1990
RTS 3	Guidelines for establishing rural selling places (PDF, 1.94MB, 37 pages)	1992
RTS 4	Guidelines for flush medians (PDF, 416 KB, 20 pages)	Nov 1991
RTS 5	Guidelines for rural road markings and delineation (PDF, 915 KB, 48 pages)	Oct 1992
RTS 6	Guidelines for visibility at driveways (PDF, 631 KB, 25 pages)	May 1993
RTS 7	Advertising signs and road safety: design and location guidelines (PDF, 754 KB, 48 pages)	Nov 1993
RTS 8	Guidelines for safe kerbline protection (PDF, 155 KB, 20 pages)	Nov 1993
RTS 9	Guidelines for the signing and layout of slip lanes (PDF, 133 KB, 23 pages)	Nov 1993
	Traffic control devices manual, part 9, level crossings. This replaces RTS 10 - Road signs and markings for level crossings.	Dec 2008
RTS 11	Urban roadside barriers and alternative treatments (PDF, 425 KB, 30 pages)	Oct 1995
RTS 13	Guidelines for service stations (PDF, 339 KB, 42 pages)	Mar 1996
RTS 14	Guidelines for facilities for blind and vision-impaired pedestrians - draft (PDF, 1.4MB, 67 pages)	(draft) 2007
RTS 15	Guidelines for urban-rural speed thresholds (PDF, 1.05 MB, 22 pages)	Feb 2002
RTS 16	Guide to heavy vehicle management (PDF, 330 KB, 53 pages)	Jun 2006
	Speed Limits New Zealand. This replaces RTS 17 - Guidelines for setting speed limits and procedures for calculating speed limits.	Feb 2003
RTS 18	New Zealand on-road tracking curves for heavy vehicles provides guidance to road controlling authorities and engineers in the geometric design of roads and intersections, and replaces a similar document *New Zealand on road tracking curves* which was published by the Land Transport Safety Authority in October 1995.	Aug 2007

APPENDIX F

Measuring Light Contrast

Simple field procedure for measuring light contrast

This procedure outlines how to use a photographic spot meter to gain an approximate indication of light contrast. It assumes an adequate light source falling equally on the tactile surface and the immediately adjoining pavement. This procedure is to be read in association with the official onsite measurement method of appendix E of AS /NZS 1428.4.1:2009.

The formula for luminance contrast (%) between two surfaces is:

$$\text{Contrast \%} = \frac{(\text{Brightest surface} - \text{Less bright surface})}{\text{Brightest surface.}}$$

RTS 14 specifies a contrast of 70% which may be reduced to as low as 30% where differences in hue and chromaticity are high. The joint standard calls for 30% for integrated tiles, 45% for individual domes with equal sides and tops, 60% for individual domes with different sides and tops.

A photographic exposure meter uses a unit called EV which is related to the log to base 2 of the luminance (candelas per square meter). A single unit in the EV scale is equivalent to a doubling of luminance. So a difference of one EV unit between surfaces is equivalent to 50% contrast and 2 EV units is equivalent to 75% contrast. The contrast for difference in EV between surfaces is detailed in the table below:

EV DIFFERENCE	CONTRAST
0.1	0.07
0.2	0.13
0.3	0.19
0.4	0.24
0.5	0.29
0.6	0.34
0.7	0.38
0.8	0.43
0.9	0.46
1	0.50
1.1	0.53
1.2	0.56
1.3	0.59
1.4	0.62
1.5	0.65
1.6	0.67
1.7	0.69
1.8	0.71
1.9	0.73
2	0.75

(Multiply contrast by 100 to get %)