Pedestrian planning and design guide

NZ TRANSPORT AGENCY
WAKA KOTAHI

New Zealand Government

On 1 August 2008, Land Transport NZ and Transit NZ became the NZ Transport Agency.

Any references in this document to the previous organisations should now refer to the NZ Transport Agency.

Pedestrian planning and design guide

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A special acknowledgement is owed to the late Mike Gadd, whose work on the Guide to pedestrian crossing facilities for TRAFINZ formed the basis of Chapter 15 and who urged to compilation of this more comprehensive guide.

GLOSSARY

15th percentile speed
The speed at which, or below which, 15 percent of travellers are moving.

85th percentile speed
The speed at which, or below which, 85 percent of travellers are moving.

Arterial road
A main road through an area that carries traffic from one area or suburb to another.

At-grade
Where two or more routes meet at the same vertical level.

Barrier
A physical barrier to prevent vehicles that leave the roadway from entering pedestrian areas.

Benchmarking
Comparing the performance of an organisation, system or network with that of others, using a set of measures (indicators) that are common to each.

Blended crossing
A crossing of the kerb where the roadway and the footpath are at the same level.

Clear zone
An area alongside a roadway, free of potential hazards that are not frangible or breakaway.

Cognitively impaired pedestrian
A pedestrian whose ability to negotiate the walking environment is hampered by a learning difficulty, such as difficulty in reading signs.

Collector road
A non-arterial road that links local roads to the arterial road network, as well as serving neighbouring property.

Community walking plan
A walking strategic plan for improving the walking environment specific to a defined community area, that identifies the area's issues, difficulties and proposed remedial actions.

Crossfall
The slope of the footpath perpendicular to the direction of travel.

Crossing point
Any point on the road network that has been designed to assist pedestrians to cross the roadway.

Crossing sight distance
The distance over which pedestrians must see approaching traffic to be able to judge a safe gap.

Cut-through
A section of a traffic island or raised median where the height has been reduced to the level of the roadway to make an area where pedestrians can wait before crossing another part of the roadway.

Desire line
A straight line between the origin and the destination of a potential pedestrian trip.

Downstream
The direction along a roadway towards which the vehicle flow under consideration is moving.

Driveway
A passageway across the footpath for motor vehicles, which enables drivers to access private property adjacent to the road.

Electric wheelchair
A wheelchair powered by an electric motor that is used by a mobility impaired person.

Fingerpost sign
A thin, directional sign showing the name of, and pointing the way to walk to, a major trip destination.

Footpath
The part of road or other public place built and laid out for pedestrian use.

Frangible
Designed to break away or deform when struck by a motor vehicle, in order to minimise injuries to occupants.

Frontage zone
The part of the footpath that pedestrians tend not to enter, next to adjoining land or on the opposite side to the roadway.

GIS
'Geographic Information System' – a computerised system used for storing, retrieving, manipulating, analysing and producing geographic data, which is referenced by map co-ordinates.

Grade separation
The separation of pedestrians from other road users by a difference in heights, usually by use of an overpass or an underpass.

Gradient
The slope parallel to the direction of travel.

Home zone
See Shared zone.

Indicator
Data collected to measure progress toward a particular goal or objective.

Information board
An upright panel that lists key destinations, with directions showing the way to walk to each one.

Kea crossing
A school pedestrian crossing point that is not marked as a pedestrian zebra crossing, at which a school patrol operates.

Kerb
A raised border of rigid material formed between the roadway and the footpath.

Kerb crossing
A place designed to facilitate convenient pedestrian access between the footpath and roadway, at a kerb ramp or, if at the same level, at a blended kerb crossing.

Kerb extension
A localised widening of the footpath at an intersection or mid-block, which extends the footpath into and across parking lanes to the edge of the traffic lane.

Kerb ramp
A localised area where part of the footpath is lowered to the same level as the roadway next to it to facilitate convenient entry to the roadway.

Kerb zone
The part of the footpath next to the roadway.

Landing
A flat area at the top or bottom of a ramp.

Latent demand
The amount of walking that would happen if conditions were improved, but which is not happening currently.

Living streets
A way to design and allocate road space to give priority to living and community interaction.

Living Streets Aotearoa
An organisation that promotes walking as a healthy, environmentally friendly and universal way of transport and recreation.

Local authority
A regional or territorial authority responsible for local government.

Local road
A road or street used mainly for access to neighbouring properties with little through traffic.

Mall
See Pedestrian precinct.

Manual wheelchair
A chair on wheels used by a mobility impaired person, and propelled by the muscular energy of the user or pushed by another person.

Median
A continuous painted or raised strip along the centre of the roadway.

Mid-block pedestrian signals
Traffic signals that are not at intersections, that stop traffic to permit pedestrians to cross the roadway.

Mobility impaired pedestrian
A pedestrian whose ability to walk is hampered by a temporary or permanent loss of ability. It includes those using mobility aids, those carrying difficult parcels or accompanying small children, and those with temporary conditions such as a broken limb.

Mobility scooter
A powered vehicle designed for use in the pedestrian environment by a person with a physical or neurological impairment.

Mountable kerb
A kerb designed to define the edge of a roadway but which may be mounted or driven across, if the need arises, with little risk of damage to a vehicle.

Natural surveillance
The observation of people and their surrounds by others carrying out their normal activities.

New Zealand Transport Strategy (NZTS)
Document containing the government's position on transport.

Older pedestrian
A pedestrian who may be physically or cognitively less able than others due to aging.

Overhead clearance
The height above the footpath within which there should be no obstructions for pedestrians.

Passing place
A short section of widened footpath to allow one group of pedestrians to pass another easily.

Pedestrian
Any person on foot or who is using a powered wheelchair or mobility scooter or a wheeled means of conveyance propelled by human power, other than a cycle.

Pedestrian advisory group
A defined group of people interested in walking who are consulted as a matter of course about relevant issues.

Pedestrian crossing point
Provision at a particular place to assist pedestrians to cross the roadway.

Pedestrian fence
A fence that channels pedestrian movement. It offers no protection from vehicles that leave the roadway, but provides physical separation from a hazard.

Pedestrian island
A raised area within the roadway that provides a place for pedestrians to wait before crossing the next part of the road.

Pedestrian on small wheels
A pedestrian on a device with small wheels propelled by human power, such as a skateboard, inline-skates or a kick-scooter.

Pedestrian permeability
The extent to which pedestrians can walk by direct routes to their desired destinations.

Pedestrian platform
A raised area of roadway that slows traffic and assists pedestrians to cross the road.

Pedestrian precinct
An area set aside for pedestrians only. Some vehicles may be permitted under specified conditions, such as for deliveries, or cyclists exercising care.

Personalised journey planning plan
A plan developed on a one-to-one basis, according to the individual's specific travel needs, to encourage them to use public transport, walking and cycling.

Personal security
Feeling safe from the risk of injury, attack or accident.

Pram crossing
See Kerb ramp.

RCA
See Road controlling authority.

Rest area
A flat area, part-way through a ramp or steps, at which pedestrians can recover from their exertions.

Road
See Road corridor

Road controlling authority
Organisations that are legally responsible for roads, including every city and district council, unitary authorities and Transit New Zealand.

Road corridor
The whole of the road corridor from one frontage to the other including footpaths. Legally roads include beaches and places to which the public have access whether as of right or not.

Roadway
The part of the road used or reasonably usable by vehicular traffic in general.

Safe routes to school
A programme that aims to improve safety and remove barriers to walking (and cycling) to and from school.

Safety audit
The process of checking a proposed design or existing road to identify features that may result in unsafe conditions.

School patrol
Older children or occasionally adults that use swing signs to stop traffic and permit children to cross free of traffic conflict at pedestrian zebra crossings or kea crossings.

School speed zone
Specially signed temporary speed limits covering the school zone for the time before and after school.

School traffic wardens
Older children or occasionally adults who choose the times at which it is safe for children to cross the road.

School travel plan
A programme that aims to encourage children to walk and cycle to school and reduce the effects of traffic near the school.

School zone
Area in the vicinity of a school where crossing assistance, safety measures and parking provision should be considered.

Segregated shared-use path
A route shared by pedestrians and cyclists where both groups use separate, designated areas of the path.

Sensory-impaired pedestrian
A pedestrian whose ability to walk is hampered by the partial or full loss of a sense, mainly sight or hearing. It may include those who are colour blind.

Severance
Separation of people from facilities and services they wish to use within their community due to obstacles to access such as busy roads.

Shared zone
A residential street that has been designed to slow traffic and signed to give priority to pedestrians. The shared zone sign means that traffic is required to give way to pedestrians but pedestrians must not unreasonably impede traffic.

Shoulder
The part of the road corridor outside the traffic lanes.

Sight distance
The distance, measured along the roadway, between a pedestrian about to enter the roadway and an approaching driver, or between two drivers, or between a driver and an object on the roadway.

Street audit
An audit using a checklist to assess a street's safety, convenience or usability.

Street furniture
Equipment within the footpath such as signal poles, lighting columns, signs, parking meters, seats, landscaping etc.

Street furniture zone
The part of the footpath between the through route and kerb zone primarily used for street furniture.

Tactile paving
A specially profiled footpath surface that can be felt underfoot. It is provided to warn or direct vision impaired people.

Through route
The central part of the footpath designed as the place where pedestrians have a continuous and accessible path of travel.

Traffic calming
Changes to the road environment to reduce driver speeds.

Traffic reduction
Changes to the road environment to reduce the number of vehicles travelling through an area.

Trail signs
Markings (often metal studs, coloured tiles or painted markings) set directly onto the footpath that pedestrians follow to reach their destinations.

Travel plan
A package of measures tailored to particular sites, such as schools or businesses, to promote active and environmentally friendly travel choices and reduce reliance on the private motor car.

Trip destination
The place a journey ends.

Trip origin
The place a journey starts.

Unsegregated shared-use path
A path shared by pedestrians and cyclists where both groups share the same space.

Upstream
The direction along a roadway from which the vehicle flow under consideration has come.

Urban form
The overall design and structure of settlements.

Vision impaired pedestrian
A pedestrian whose vision is reduced and cannot be adequately corrected by spectacles or contact lenses, and who may use tactile, visually contrasting and audible cues when walking.

Vulnerable pedestrian
Pedestrians at greater risk than others of being involved in a crash, or more susceptible to serious injury. It includes older people, impaired people and children.

Walkability
The extent to which the built environment is walking friendly.

Walking
The act of self-propelling along a route, whether on foot or on small wheels, or with aids.

Walking advocate
An individual, or group of individuals, who encourage, support and enable pedestrian activity.

Walking strategic plan
A document setting out a strategy to promote walking and provide a walkable environment, including a programme of actions to achieve this.

Woonerf
Original Dutch name for a shared zone.

Workplace travel plan
A travel plan tailored to a particular business, workplace or group of workplaces sharing a common location, influencing travel choices of staff and visitors.

Young pedestrian
A pedestrian whose physical and cognitive development means their abilities have not reached those of normal adults.

Zebra crossing
A pedestrian crossing point with longitudinal markings, where traffic is required to give way to pedestrians on the crossing. Legally they are called pedestrian crossings.

1 INTRODUCTION

1.1 Purpose of this guide

This guide sets out ways to improve New Zealand's walking environment. It outlines a process for deciding on the type of provision that should be made for pedestrians and provides design advice and standards.

The guide promotes a consistent 'world's best practice' approach to planning, designing, operating and maintaining walking infrastructure and networks. It supports the New Zealand Transport Strategy (NZTS) and the priorities for action in Getting there – on foot, by cycle (the national walking and cycling strategy). In doing so, it encourages walking as a viable mode of transport for short trips in and around our communities, and recognises the important role walking also plays in many car and public transport journeys. It is also a useful tool for those with an active interest in walking, such as community leaders, local councillors and advocacy groups. As New Zealand research into walking trips increases, the guide will be updated and augmented.

Walking mostly takes place within a transport system that must work for a range of road users. This requires effectively integrating walking needs for safety and convenience into the provision for walking along and across roads. Pedestrians also use routes outside road corridors as part of a continuous network. This guide applies to all pedestrian infrastructure, whether it is alongside or across roads, through parks and recreational areas, or on private land where public presence might reasonably be expected. It also applies to new developments, facility changes and existing environments.

Photo 1.1 – Walking environment, Auckland

A broader overview of providing for walking can be found in Easy steps published by Queensland Transport [175]

1.2 Background

Walking is such a basic human activity that it has often been overlooked when planning for transport [46] and has been viewed as a second-class form of travel [103, 122]. Overall, the use of walking for transport in New Zealand is declining. Taking into account population growth, between 1990 and 1998 journeys made solely on foot in New Zealand reduced by around 400,000 per day [112].

Even so, walking remains a key element of a balanced transportation system. Overall, it is still the second most popular form of travel in New Zealand. Nearly one in five of all household trips is made on foot [112]. For the 10 percent of households that have no car, for those in households without car access for much of the day, and for those who cannot, or choose not to drive, walking is an especially vital mode of transport [112].

Photo 1.2 – Pedestrians, Christchurch

Walking is also included in most trips made by other modes. Whatever the main means of travel, walking is usually the first and last mode used, providing an important link between land use and motorised travel [118]. It is also healthy, inexpensive and very environmentally friendly. Although much of the guide focuses on walking for transport, people walk for pleasure on all types of infrastructure. The attractiveness and quality of our streets and public spaces is, therefore, key to getting more people to walk [59].

The approaches to providing for pedestrians and the interventions adopted will depend on the circumstances at each location. With this in mind, the guide does not prescribe a single approach or intervention, but presents a variety, along with their advantages, disadvantages and limitations, and the circumstances when each would be most appropriate. It recognises that financial, technical and political factors may affect what can be achieved at any particular location or time.

1.3 Methodology

The project to develop this guide was managed by Land Transport New Zealand (Land Transport NZ) as one of the Road Safety to 2010 strategy projects. Consultants were employed to develop the drafts and a stakeholder steering group guided its development and gave feedback on the drafts.

The content was guided by a review of international literature on providing and planning for pedestrian facilities and networks. A draft was released for public submissions and, after the final draft was received from the consultants, an international peer review was conducted. Land Transport NZ then undertook some final edits.

1.4 Guide and process outline

Figure 1.1 provides an outline of the sections in this guide.

CONTEXT	Planning and policy context (Ch.2) What is the environment for planning for pedestrians?

PRINCIPLES	Pedestrian characteristics, preferences and activity (Ch.3) How do pedestrians differ, and who walks, where and why?
	Community walkability (Ch.4) What makes walking attractive within communities?
	Approaches to providing for pedestrians (Ch.5) What are the underlying ways to accommodate walking?
	Pedestrian network components (Ch.6) What type of facility can be used to provide for pedestrians?

PROCESS	Planning for pedestrians (Ch.7) Which planning approach should be used?
Community involvement in scheme development (Ch.9) Does the walking environment meet the needs of pedestrians?	Pedestrian planning process (Ch.8) How do we implement the plan?
	Assessing demand for walking (Ch.10) How many pedestrians want to walk and where?
	Measuring walkability (Ch.11) How is walkability assessed?
	Prioritising schemes (Ch.12) Which walking schemes should be done first?
	Implementation (Ch.13) How should the walking schemes be implemented?

DESIGN	Footpaths (Ch.14) How do pedestrians move around?
	Crossings (Ch.15) How do pedestrians cross major obstructions?
	Measures to guide pedestrians (Ch.16) How are pedestrians guided to their desired destination?
	Lighting the pedestrian network (Ch.17) How is the pedestrian network illuminated?
	Maintaining the pedestrian network (Ch.18) How are pedestrian facilities kept in good order?

POST-DESIGN	Monitoring pedestrian activity (Ch.19) Do walking schemes achieve their objectives?
	Making best use of facilities (Ch.20) How can people be encouraged to walk?

APPENDICES
Appendix 1 Characteristics of pedestrians
Appendix 2 Signface design details
Appendix 3 Issues to address in district plans
Appendix 4 References
Appendix 5 Index

Figure 1.1 – Guide outline and process

2 THE PLANNING AND POLICY CONTEXT

PEDESTRIAN PLANNING AND POLICY CONTEXT
The legal framework for providing walking infrastructure
The role of walking in government objectives and strategies
Walking strategic plans

2.1 Introduction

Walking is a form of transport, and in this respect is no different from the private car or public transport. For some groups, it is the primary means of moving around their community independently [30]. The right to walk is a fundamental element in a considerable number of public policies. Although its contribution to transport objectives is often underestimated, its importance must not be ignored [10].

2.2 Transport and the law

'Legislation' includes Acts of Parliament, as well as Rules and Regulations made by people or organisations to whom Parliament has delegated this power (for example, the Minister of Transport for Land Transport Rules). The main pieces of legislation relating to walking are the Local Government Act 2002, the Traffic Control Devices Rule 2004 [111] and the Land Transport (Road User) Rule 2004 [110] where pedestrians are specifically differentiated from 'vehicle traffic'. There are also relevant Rules on the use of land (under the Resource Management Act 1991) in regional and district plans.

'Law' includes not only 'legislation', but also common law, which is understood and accepted by everyone and defined by law court judgments. Common law includes everyone's duty to care for their own safety and to avoid causing harm to others.

Under common law, everyone has the right to travel unimpeded on all public roads, except where there are legal restrictions (such as those prohibiting pedestrians from motorways). Road controlling authorities (RCAs) are obliged to safeguard this right for all lawful road users, including pedestrians. The Local Government Act requires that wheelchair accessible kerb crossings be provided whenever any urban road or footpath is being reconstructed.

2.3 Bylaw powers

Local authorities and RCAs also have the power to enact bylaws for areas within their responsibility. Bylaws can cover activities both on footpaths beside roads and on off-road paths such as through parks. They can also be used for activities on the road that may affect pedestrian safety or mobility, for example vehicle speed limits and parking.

2.4 New Zealand Transport Strategy

The New Zealand Transport Strategy (NZTS) [108] contains the government's position on transport. Its overall vision is: 'by 2010, New Zealand will have an affordable, integrated, safe, responsive and sustainable transport system'. Broader objectives aim to enhance economic, social and environmental well-being through:

- improving access and mobility, including walking and cycling
- protecting and promoting public health
- ensuring environmental sustainability
- assisting safety and personal security
- assisting economic development.

Key principles include:

- creating an integrated mix of transport modes
- taking a long-term sustainable approach
- ensuring high standards of health, safety and security
- responding to the diverse needs of transport users.

GETTING THERE — ON FOOT, BY CYCLE

A strategy to advance walking and cycling in New Zealand transport

OUR VISION

A New Zealand where people from all sectors of the community walk and cycle for transport and enjoyment

SUPPORTED BY THREE GOALS

- Community environments and transport systems that support walking and cycling
- More people choosing to walk and cycle, more often
- Improved safety for pedestrians and cyclists

REQUIRING ACTION ON 10 PRIORITIES, ACROSS FOUR FOCUS AREAS

FOCUS ONE
Strengthening foundations for effective action

Priorities for action

1. Encourage action for walking and cycling within an integrated, sustainable approach to land transport
2. Expand our knowledge and skill base to address walking and cycling
3. Encourage collaboration and co-ordination of efforts for walking and cycling

FOCUS TWO
Providing supportive environments and systems

Priorities for action

4. Encourage land use, planning and design that supports walking and cycling
5. Provide supportive enviroments for walking and cycling in existing communities
6. Improve networks for long-distance cycling

FOCUS THREE
Influencing individual travel choices

Priorities for action

7. Encourage positive attitudes towards and perceptions of walking and cycling as modes of transport
8. Encourage and support individuals in changing their travel choices

FOCUS FOUR
Improving safety and security

Priorities for action

9. Improve road safety for pedestrians and cyclists
10. Address crime and personal security concerns around walking and cycling

INFORMED BY SIX KEY PRINCIPLES

- Walking and cycling face similar issues, but are different modes of transport with different needs
- Providing a transport system that works for pedestrians and cyclists means catering for diversity
- Walking and cycling are important for all communities, but critical in urban areas
- Increasing the use of walking and cycling requires a comprehensive approach
- Safety needs to be integrated with promotion
- The needs of current users must be addressed alongside those of new users

UNDERPINNED BY A NATIONAL FRAMEWORK FOR IMPLEMENTATION

- Central co-ordination process, supported by national advisory groups
- Annual implementation plans for national agencies
- Performance indicators, plus regular monitoring and evaluation
- Informed government investment
- Early emphasis on supporting effective local action

3

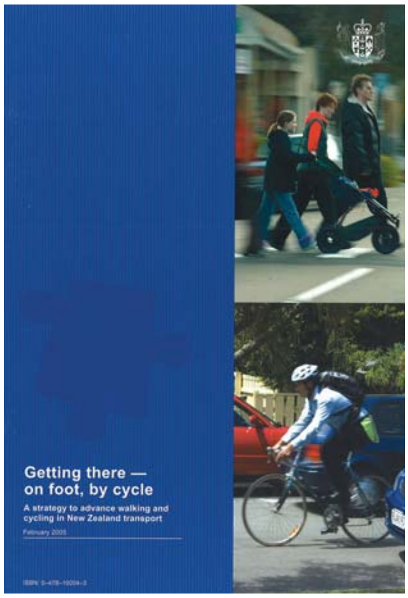
Figure 2.1 – Summary of the vision, priorities, goals, and key principles of *Getting there – on foot, by cycle*, the national walking and cycling strategy

2.5 Integrated transport planning

Integrated transport planning aims to embrace a range of perspectives traditionally addressed separately, including:

- a variety of forms of transport (private and public, motorised and non-motorised)
- the relationships between transport and land use
- transport's contribution to other economic, social, health and environmental objectives.

Integrated transport planning is embodied in Land Transport NZ's objective, which is to allocate resources in a way that contributes to an integrated, safe, responsive and sustainable land transport system [109]. When allocating funds, Land Transport NZ must consider a range of issues including environmental sustainability and public health. Transit New Zealand (Transit NZ), as the RCA for state highways, is to operate the state highway system in a way that contributes to such a system. Walking is an essential part of an integrated transport plan and is an integral part of achieving the government's vision for land transport. As a result, Land Transport NZ invests in a range of walking and cycling activities, such as providing financial help to RCAs for strategic plans and walking (and cycling) projects.



2.6 National walking and cycling strategy

The national walking and cycling strategy [112] *Getting there – on foot, by cycle* expands on the aims of the NZTS. It articulates a vision, goals, priorities and principles as outlined in Figure 2.1. This is accompanied by an implementation plan [178] that sets out a method for achieving the strategy.

2.7 Regional land transport strategies

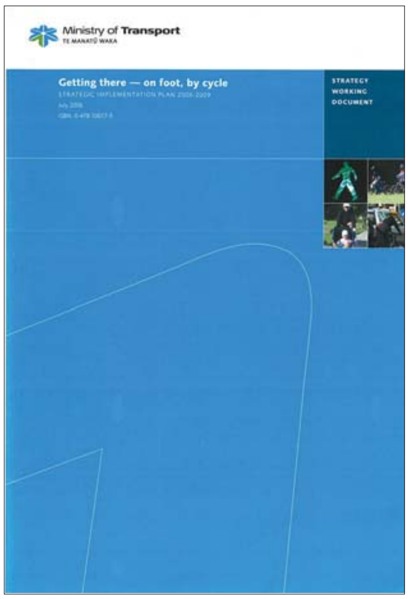
Each regional council is required to develop a regional land transport strategy (RLTS) with help from a regional land transport committee (RLTC). RLTCs are legally required to represent a range of transport perspectives, including walking. Although regional councils do not directly manage the roads, all projects and strategies in their regions must take the RLTS into account, and regional councils may play a variety of roles with regard to walking, such as strategic planning, coordinating schemes and promoting walking. RLTSs also carry weight in Land Transport NZ's decisions on funding RCA projects and packages. They need to be consistent with the NZTS and should reflect the priorities for action in *Getting there – on foot, by cycle*.

2.8 Road controlling authorities

As well as being a local authority, every city and district council is an RCA. While Transit NZ is the RCA for state highways, some local authorities manage their area state highways on its behalf. Organisations such as airport companies, port companies and the Department of Conservation are also RCAs.

RCAs have direct responsibility for the road system. They usually own the roads and public paths, and (often through contractors) build, improve and maintain them. RCAs have powers to regulate road user behaviour, such as by banning parking, creating one-way streets and installing traffic signals.

RCAs are also required by Land Transport NZ to produce strategic plans detailing the projects and packages they intend to carry out. These will contain projects that encourage more people to walk or cycle (see section 2.11).



2.9 Other local council responsibilities

Local councils have other roles, besides that of RCA, that affect walking – they control the planning, design and maintenance of parks and reserves, and produce district or city plans under the Resource Management Act 1991 that provide a framework for managing land use and subdivision within the area. The relevant regional and local strategies and plans in relation to walking are:

Regional:

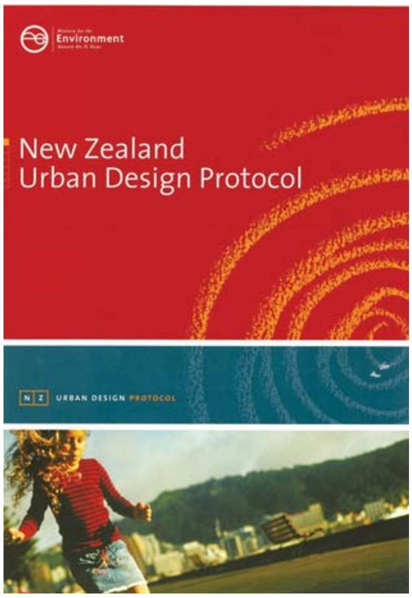
- regional land transport strategy
- regional walking strategy
- regional road safety plan
- regional growth strategy

- regional policy statement
- regional travel demand management strategy (under the regional land transport strategy).

Local:

- local transport strategies
- local walking strategic plans
- neighbourhood accessibility plans
- road safety strategies and plans
- safety management systems
- district and city plans
- long-term council community plans
- asset management plans
- codes of practice
- design guides
- open space access plans
- travel demand management strategies.

2.10 Other non-transport government strategies



Walking plays a role in supporting a wide range of other activity. Actions to provide for or promote walking should take account of, and coordinate with, other non-transport strategies and policies for [30, 103, 130]:

- health
- tourism
- heritage
- environmental protection
- urban design and form
- planning and development
- regeneration
- social inclusion
- recreation
- economic development
- injury prevention.
- disability access.

To ensure effective coordination, more than one agency may be involved. This is a priority in *Getting there – on foot, by cycle*. For example, the Energy Efficiency and Conservation Authority (EECA) and Sport and Recreation New Zealand (SPARC) have sometimes taken the lead in promoting walking (often together with cycling). Similarly, health care professionals may give 'green prescriptions' to patients, advising them to be physically active as part of their health care management. The government's *Sustainable development for New Zealand – programme of action* seeks to make New Zealand cities healthy, safe and attractive places where business, social and cultural life can flourish. This will be achieved through better-integrated decision-making, improved infrastructure and better urban design.

2.11 Local walking strategic plans

Typically, local walking strategic plans aim to increase the number of walking trips, while decreasing the rate and severity of pedestrian injuries. These two goals are not usually mutually exclusive. A greater number of pedestrians should result in increased visibility and act as a reminder to other road users to consider them. The objectives in local walking strategic plans should reflect the objectives in the NZTS and in *Getting there – on foot, by cycle*. A key objective is improving the environment for walking. If RCAs wish to be funded by Land Transport NZ for pedestrian facilities and programmes, they must have a walking strategic plan.

Reducing the speed and volume of other traffic may do as much to help pedestrian safety as providing new infrastructure [43]. Consequently, local walking strategic plans need to be supported by more general traffic, road safety and transport strategies.

Some local walking strategic plans include cycling to make a combined strategy. As cyclists' and pedestrians' needs are different [112], any combined strategies and action plans should reflect these differences.

While each strategic plan should reflect local conditions, there will be common features in them all [29, 36, 103]. Table 2.1 presents these common elements. District and city plans should also reflect the plan's objectives.

Table 2.1 – Common elements in walking strategic plans

Background	**A statement of purpose.** **How the walking strategic plan fits with other national and local strategies.** **The benefits of the walking strategic plan.** **Local information on pedestrian activity and safety.**
The existing walking environment	**Outline of the current local environment for pedestrians (quantitative and qualitative), including personal security issues.** **The local authority's achievements to date.**
Vision	**The authority's broad vision for walking.**
Objectives	**Clear statements of what the walking strategic plan intends to achieve.**
Actions	**A description of the policies to be put in place, and the actions to be taken to meet each objective.**
Funding	**The likely level of overall funding and how it will be allocated (including maintenance work).**
Monitoring performance and targets	**A description of the performance indicators to be used in monitoring the plan's progress in achieving its objectives.** **Methods and timescales for collecting and reporting the information needed to monitor effectiveness.**
Partnership /consultation	**How links will be made with other organisations and communities that can support walking, and how they can provide support for the plan.**

As conditions can vary within areas covered by local authorities, the overarching strategic plan should be complemented by local community walking plans. These describe the particular characteristics and issues of smaller, discrete areas that affect pedestrians, and set out the specific remedial actions required to improve the walking environment [125]. Section 7 of this guide covers the approach for developing community walking plans.

Walking strategies are high-level documents that provide a framework and direction for walking, usually at national and regional levels. A strategic plan is a detailed analysis of projects and packages that encourage more people to walk or cycle at the local level.

3 PEDESTRIAN CHARACTERISTICS, PREFERENCES AND ACTIVITY

PEDESTRIAN CHARACTERISTICS AND PREFERENCES
Pedestrians – diverse characteristics and needs
The who, where and why of walking trips
Why people don't walk more
Pedestrian safety profile
Pedestrians on wheels

3.1 Introduction

Pedestrians are a diverse group of road users, with characteristics reflecting the general population [13]. While many pedestrians are fit and healthy, have satisfactory eyesight and hearing, pay attention and are not physically hindered, this is not the case for all pedestrians [10].

Given the diversity of pedestrians, scheme designs should consider a wide range of user needs, including the needs of children, those with mobility aids and older pedestrians. By 2051, one in four New Zealanders will be 65 years or older compared with the current one in eight [107].

Schemes should, wherever possible, be designed for pedestrians with the lowest level of ability. This removes access barriers for those with special needs, and ensures pleasant, convenient routes that are beneficial for all pedestrians [29, 66].

Photo 3.1 – Pedestrians, Christchurch (Photo: Megan Fowler)

3.2 Definition of terms

A 'pedestrian' is a person on foot, or in or on a contrivance equipped with wheels or revolving runners that is not a vehicle [110]. This can include an able pedestrian, a person pushing a pram, a person on a skateboard, a person in a wheelchair and a number of other users.

For ease of use throughout the guide, pedestrians have been grouped into three categories:

- on foot
- on small wheels
- mobility impaired.

Photo 3.2 – Pedestrian using mobility scooter, Wellington (Photo: Lesley Regan)

Table 3.1 shows the subgroups within each category.

Table 3.1 – Types of pedestrian

Type of pedestrian	Sub groups
On foot	Able pedestrian Runner/jogger Adult pedestrian Young pedestrian Impaired pedestrian Aged pedestrian Pedestrian with a guide dog Sensory impaired pedestrian Pedestrian with a cane
On small wheels	In-line skates Roller skates Skateboards Kick scooters Pedestrian with a pram
Mobility impaired	Mobility scooters Manual wheelchairs Electric wheelchairs Pedestrian with a walking frame

Photo 3.3 – Pedestrians with prams, Auckland (Photo: Megan Fowler)

Photo 3.4 – Wheelchair user, Christchurch (Photo: Glen Koorey)

3.3 Physical space required

Pedestrians require differing spaces within which to manoeuvre. Newer wheelchairs are increasingly wider than their predecessors and this should be considered when designing for pedestrians. Mobility scooters are usually longer but the same width as manual wheelchairs.

Figure 3.1 indicates the physical space required for pedestrians.

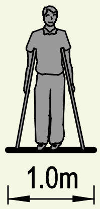
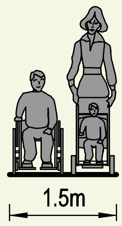
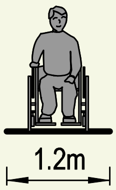
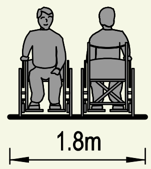
	a) A clear width of 1000 mm is adequate for people with ambulant disabilities. It just allows passage for 80 percent of people who use wheelchairs.		c) A clear width of 1500 mm allows a wheelchair and a pram to pass.
	b) People who use wheelchairs require a clear width of 1.2 metres.		d) To allow two wheelchairs to pass comfortably, a clear width of 1.8 metres is required.

Figure 3.1 – Physical space requirements [10]

3.4 Walking speed

Walking speed is affected by [28]:

- pedestrian characteristics such as age, gender and physical condition
- trip characteristics such as walking purpose, route familiarity, trip length and encumbrances
- route characteristics such as width, gradient, surfacing, shelter, attractiveness, pedestrian density and crossing delays
- environmental characteristics such as weather conditions.

The vast majority of people walk at speeds between 0.8 metres per second (m/s) and 1.8 m/s (2.9 kilometres per hour (km/h) and 6.5 km/h) [139]. A fit, healthy adult will generally travel at a mean speed of 1.5 m/s (15th percentile (15%ile): 1.3 m/s), and the aged and those with mobility impairments travel more slowly, at around 1.2 m/s (15%ile: 1.0 m/s) [70, 104]. Mobility scooters can travel faster than most pedestrians, but may take time to manoeuvre between different road and footpath levels.

3.5 Abilities

Pedestrians vary widely in their physical and cognitive abilities. For example, children's heights and varying cognitive abilities at different ages need to be considered, as do declines in speed of reflexes, hearing and sight among older pedestrians. Abilities can even change during the same walking journey as the pedestrian becomes tired or acquires an encumbrance such as a parcel or a child.

Clusters of pedestrians with similar characteristics may be found at some types of land use, such as children in the vicinity of schools.

Table 3.2 summarises key pedestrian characteristics. Appendix 1 has more details of the typical characteristics of different types of pedestrian.

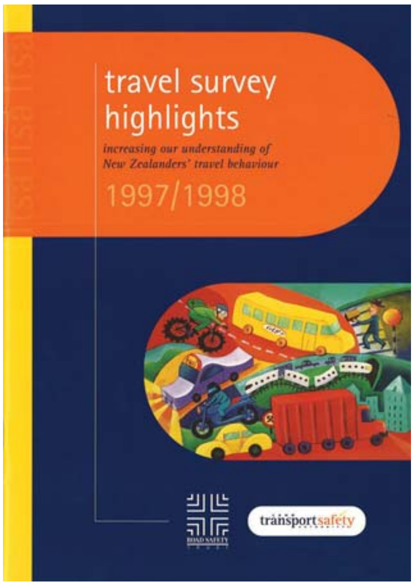
Table 3.2 – Pedestrian physical characteristics		
How pedestrians differ	**Affecting**	**Impacting on**
Height	Ability to see over objects Ability to be seen by others	Sight lines
Speed of reflexes	Inability to avoid dangerous situations quickly	Crossing opportunities
Stamina	Journey distance between rests	Resting places
Visual perception	Ability to scan the environment and tolerate glare	Sign legibility Detecting kerbs and crossing locations Trip hazards Tactile paving Judging traffic
Attention span and cognitive abilities	Time required to make decisions Difficulties in unfamiliar environments Inability to read or comprehend warning signs Difficulty in judging gaps in traffic	Positive direction signage Streetscape 'legibility' Consistency of provision Symbol use Crossing opportunities
Tolerance of adverse temperatures and environments	Preference for sheltered conditions	Route location and exposure Provision of shelter from wind and rain
Balance and stability	Potential for overbalancing	Providing steps and ramps Kerb height Gradients Crossfall Surface condition
Fear for personal safety and security	Willingness to use all or part of a route	Lighting Surveillance Lateral separation from traffic Pedestrian densities Traffic speed and density
Manual dexterity and coordination	Ability to operate complex mechanisms	Pedestrian-activated traffic signals
Accuracy in judging speed and distance	Inopportune crossing movements	Provision of crossing facilities
Difficulty localising the direction of sounds	Audible clues to traffic being missed	Need to reinforce with visual information
Energy expended in movement	Walking speed	Crossing times Journey length Surface quality
[10, 13, 66, 122, 139]		

3.6 Pedestrian activity overview

The *New Zealand travel survey (2000)* [76] showed that of the estimated 6000 million-plus trips [1] made by New Zealand households annually, nearly one in five (18.7 percent) was made by walking. New Zealanders spend 215 million hours annually as pedestrians in the road environment and make around 2400 million road crossings on foot.

Around 70 percent of walking trips in the *New Zealand travel survey (2000)* involved getting from A to B solely on foot. Around 30 percent were undertaken in association with other modes of transport (eg walking from a parked car, or walking to and from public transport) [71].

While there was a small increase in the overall number of walking trips made during the 1990s, this did not keep pace with population growth, and the period saw a three percent drop in the share of household travel where walking was the sole mode of transport. The decline in walking as a mode of transport was most evident amongst those under 20. For example, there was a 10 percent decline (from 36 percent to 26 percent) in school journeys where walking was the sole mode of transport [71].



[1] Research into household travel undertaken for the *New Zealand travel survey*, identifies every leg of a journey as a 'trip'. For example, a trip to the bus stop, followed by a bus ride, followed by a walk at the other end would count as two walking trips and a public transport trip. Similarly a motor vehicle trip to work, with a stop on the way at a dairy, would count as two motor vehicle trips to two separate destinations. By focusing on 'trips', we can better see the multi-modal nature of many of our journeys, enabling us to plan better for all the modes of transport involved.

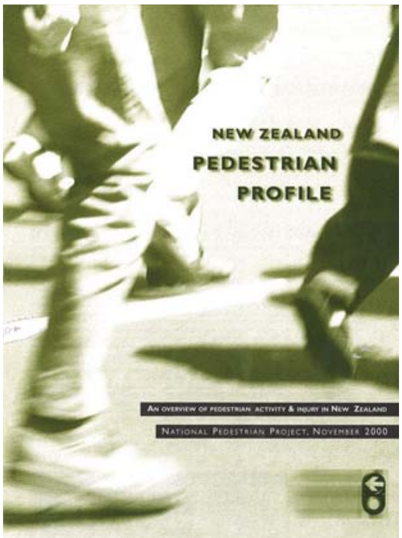
National pedestrian information sources

The *New Zealand pedestrian profile* [71], published in 2000, provides an overview of pedestrian activity and injury in New Zealand. It was the first national document developed to provide such an overview and was based on analysis of New Zealand household travel survey data, crash analysis system data and hospitalisation data.

The New Zealand travel surveys [76] (now being updated annually) provide information on pedestrian activity as part of overall information on household travel in New Zealand. These surveys can sometimes be used to provide regional data, and may, over time, be able to provide some territorial local authority (TLA) level data.

Updated and additional information on pedestrian activity and injury will be available through the Ministry of Transport and Land Transport NZ websites, as part of the implementation of the government's *Getting there – on foot, by cycle* strategy.

A summary of pedestrian trips is in sections 3.7 and 3.8.



3.7 Journey time and distance

Figure 3.2 and Figure 3.3 show the time spent walking on 'walk-only' trips and 'all trips' (ie walk and another mode) in New Zealand. They show that for all trips including a walking element, half of the walking elements are more than five minutes. For walk-only trips, half are more than 10 minutes, 18 percent are more than 20 minutes and nine percent are more than 30 minutes [76]. A typical fit and healthy adult walks about five to six km in an hour. So a simple rule of thumb for undelayed walking is 10 minutes per km.

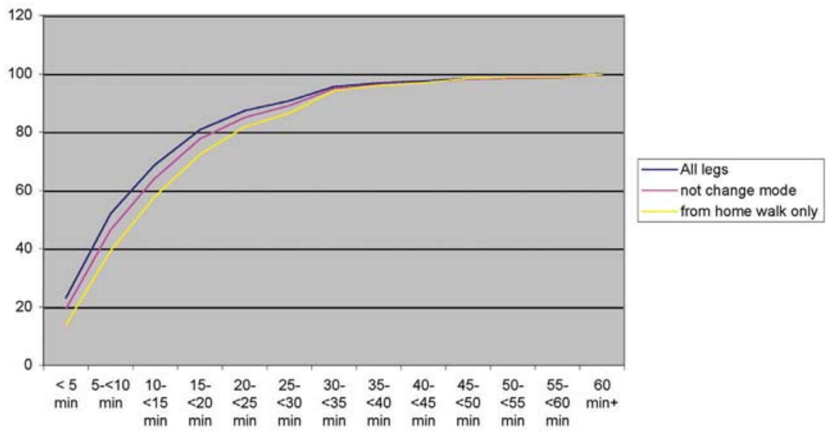


Figure 3.2 – Time spent walking – all trips [76]

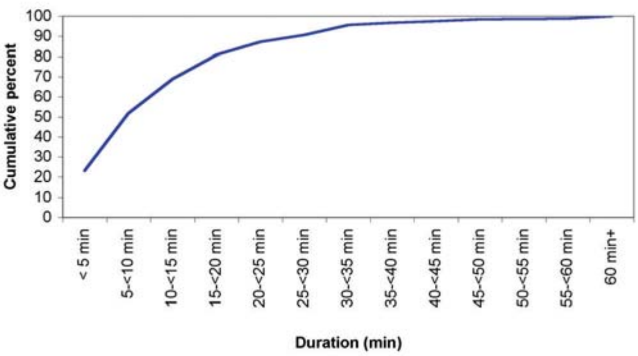


Figure 3.3 – Time spent walking – walk-only trips [76]

3.8 Who walks, where and why

Overall, females, the young, and the aged make the most walking trips [71].

The *New Zealand pedestrian profile* [71] identified that walking trips are made for a wide range of purposes, with social and recreation activities and shopping the most common reasons, followed by work and education related journeys.

Table 3.3 summarises the data from the *New Zealand travel survey (2000)* [76].

Table 3.3 – Purpose of walking trips		
Trip purpose	**Trip purpose as a percentage of all walking trips**	**Walking trips as a percentage of all modes for each trip purpose**
To home*	31.2	16.7
Work (to job)	10.0	16.0
Work (employer's business)	2.2	8.1
Education	7.7	31.8
Shopping	14.2	20.9
Personal business/services	6.1	18.3
Social/recreation	24.5	20.7
Accompanying someone else	4.2	8.3
Total	100.0	-

These results include walking as part of a journey by another mode.

* Includes all trips with a destination that was the respondent's home. This may include returning home from work, education, etc.

Overall, females make 22 percent more walking trips than males but both sexes spend a similar amount of time walking, at around 11 to 12 minutes per trip. Women may be more likely to accompany children on trips to school and may have less access to the family vehicle.

3.9 Why people don't walk

Shortfalls in the physical environment are the most obvious deterrent to walking. Reasons often mentioned include [3, 5, 46, 101, 115, 139, 164, 169]:

- missing footpaths or sections of footpath
- poor-quality (cracked, uneven or slippery) walking surfaces
- obstacles on the footpath, including poorly placed street furniture
- lack of footpath maintenance, including litter, dog fouling and overhanging vegetation
- increased distances imposed by road layouts, barriers, footbridges and subways
- lack of continuous signing to potential destinations
- lack of continuous pedestrian routes
- missing or unsuitable crossing treatments creating severance
- poor-quality lighting
- speeding traffic
- lack of rest areas and seating
- traffic fumes and noise
- lack of shade
- lack of shelter from inclement weather
- lack of interesting features on the route.

Social and perceptual deterrents are also important. Potential deterrents include:

- a perceived lack of time to make journeys
- other modes perceived as more convenient
- a lack of confidence in the walking infrastructure
- confusion about which route to take and how far the destination is
- a perception that pedestrians generally have a low social status, especially in relation to car drivers
- fear of being attacked in isolated or potentially risky areas
- uncertainty about whether a route is fully accessible
- public routes that appear to be private
- a perception that motorists do not properly understand the rights of pedestrians.

Organisational and institutional issues have shaped the environment so that walking is more difficult. These have been compounded by a relative lack (until recently) of a collective voice for pedestrians. Issues include:

- land use planning that has resulted in longer distances between walking trip origins and destinations

- other modes of travel being given a higher priority than walking, resulting in pedestrians not being realistically accommodated within schemes designed for other travel modes
- a lack of knowledge and expertise among infrastructure providers and relevant professions on ways to provide for walking
- restrictive walking practices, where a concern for pedestrian safety results in walking being made less convenient
- considering it is inevitable that volumes and speeds of traffic will increase
- failure to protect or enhance the public realm, which makes walking less attractive
- tolerating obstructions placed on footpaths by third parties, shown by a lack of enforcement of actions such as parking on footpaths
- difficulties in quantifying changes in pedestrian numbers as a result of potential interventions
- difficulties in justifying walking schemes through 'traditional' economic criteria
- businesses paying mileage travel allowances to car drivers for very short trips
- a lack of research into pedestrians and walking journeys
- insufficient resources allocated to walking schemes.

All of the above interact, but addressing individual issues in isolation is unlikely to address all. A holistic view is needed to ensure the maximum benefits.

3.10 Pedestrian motor vehicle crash profile

From 2001 to 2005, pedestrians accounted for about one in 10 (10.5 percent) of all road deaths in New Zealand. In the main urban centres, on roads subject to urban speed limits, about one in three road deaths (32 percent) were pedestrians.

Annually, an average of 45 pedestrians are killed and 1100 are reported injured on New Zealand roads. While the number of pedestrians killed is trending downwards, reported pedestrian injuries have been unchanged for the last 15 years, despite the decline in walking by children who are the biggest group at risk [76].

Figure 3.4 shows the reported number of pedestrians killed and injured per 100,000 population [91].

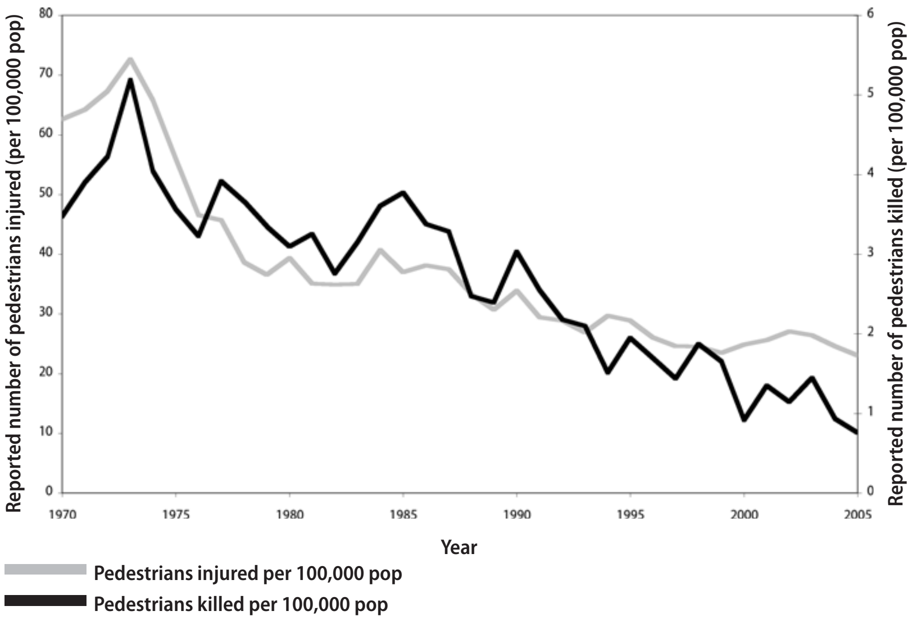


Figure 3.4 – Reported number of pedestrians killed and injured per 100,000 population

At a national level, crashes involving pedestrians occur mainly [71]:

- while pedestrians are crossing roads (around 90 percent)
- in built-up areas (two thirds of pedestrian deaths and 93 percent of injuries)
- within one to two kilometres of the pedestrian's home
- on relatively main roads rather than minor roads (54 percent on roads classified by TLAs as 'arterials', 25 percent on 'distributors/collectors', and only 21 percent on 'local' roads)
- near residential land use (half), commercial land use (one third)

- away from intersections (64 percent)
- away from formal pedestrian crossings (90 percent)
- when pedestrians are most likely to be out and about (eg during daytime, in fine weather, before and after the school day).

Traffic speed is a significant issue for pedestrians. The faster a driver goes, the more difficult it is for them to avoid hitting a pedestrian in their path. The faster the speed at which a pedestrian is hit, the more serious their injuries will be. A pedestrian hit at 30 km/h has a five percent chance of dying, compared with a 40 percent risk of death at 50 km/h. Hit at 70 km/h, 96 percent of pedestrians will die [2]. One in three pedestrian fatalities occurs on roads with a rural speed limit, but only one in 15 pedestrian injuries occurs in these localities [91]. This reflects the fragility of pedestrians when hit by cars at higher speeds. More information on the effect of vehicle speeds on safety is contained in *Down with speed* [2].

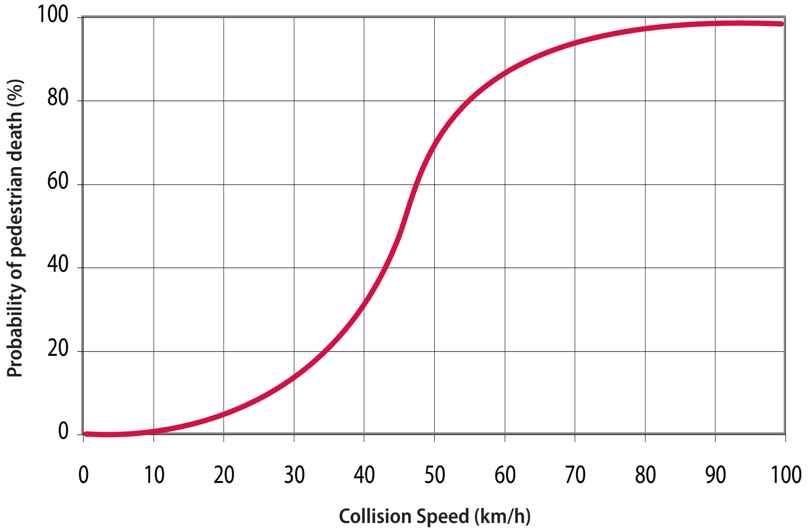


Figure 3.5 – The influence of collision speed on the probability of pedestrian death [2]

Photo 3.5 – Demonstration of the effect of speed on pedestrian accidents, Christchurch (Photo: Tony Francis)

Both older and young pedestrians are at particular risk. Those aged over 75 are involved in 18 percent of pedestrian fatalities, although they represent only six percent of the population [91]. Their likelihood of being struck is also greater than most other age groups [76]. Those aged under 19 represent 46 percent of injuries, yet make up only 30 percent of the population [91].

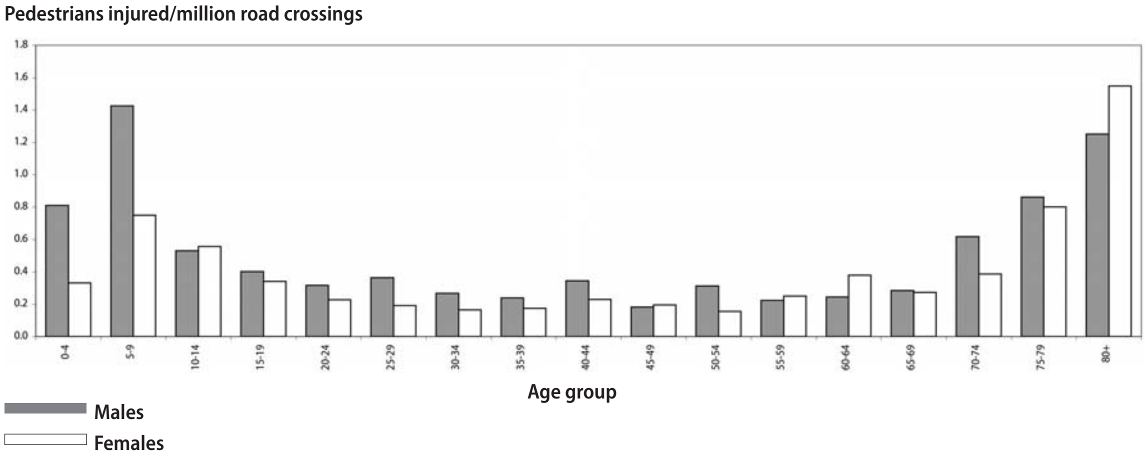


Figure 3.6 – Risk of injury crossing roads by age and gender [76].

While road crash statistics are invaluable in identifying the sites and pedestrian groups with particular road safety issues, they do not provide any qualitative measures such as how safe a pedestrian feels, the risks they take and the reasons for their choice of route [10]. Nor do they indicate which routes are perceived to be so dangerous that pedestrians either completely avoid them or take extra care in them. Moreover, pedestrian crashes and injuries that do not involve a motor vehicle or another road user, or that happen away from the roadway (eg falls due to poorly maintained footpaths) often go unreported.

3.11 Falls – slips, trips and stumbles

Approximately 400 people are admitted to hospital in New Zealand each year due to slips, trips and stumbles on the same level in the road environment. They tend to be elderly as shown in Figure 3.7 and are more likely to be seriously injured if they fall.

Fall on same level from slipping, tripping, and stumbling 2001–2003

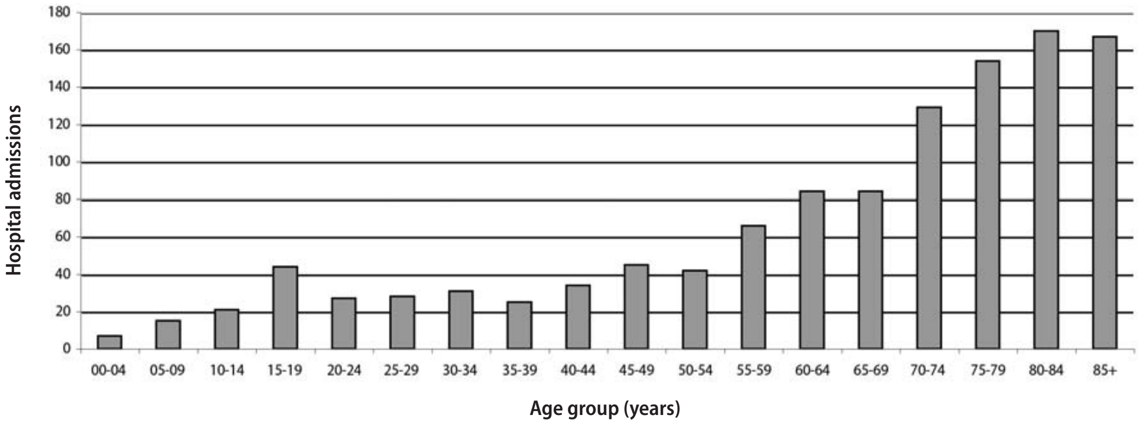


Figure 3.7 – Hospital admissions from falls in the road environment (2001 – 2003).

Slips

Slips are caused by inadequate friction between the foot and the pavement. This can be due to the material and construction of the sole of the shoe, the nature of the pavement surface, the presence of lubricants such as water, any surface treatments such as sealers, and the maintenance of the surface. Polished hard surfaces can become slippery due to the presence of fine dust or grit as well as by water.

A pedestrian's gait also affects the friction required for stability. Running requires more friction than walking. When people know a surface is slippery they can compensate by taking shorter steps and avoiding sudden movements.

Because of the complex nature of friction measurement and performance, international requirements are not uniform. The New Zealand Building

Code DS1/AS1 requires a co-efficient of friction of 0.4 on level surfaces increasing by 0.125 for every percent of gradient. Table 2 of the code provides guidance on the suitability of a variety of materials. Joint Australian/New Zealand standards specify how to measure the friction of new and existing surface materials. For footpath surfaces, the sliding skid resistance of a wet surface is the critical test. This is measured by a pendulum tester using a rubber slider to simulate the sole of a shoe [135, 136].

Because the amount of friction required depends on the context, the joint Australian/New Zealand standards have moved away from a single value of required friction. Official guidance for applying these standards is provided in *An introductory guide to the slip resistance of pedestrian surface materials HB197:1999* and *Slip resistance of pedestrian surfaces–guide to the reduction of slip hazards*. [132, 133].

The only matter under the control of those providing the infrastructure is the specification of the surface material and its treatment and maintenance. It is advisable to provide a safety factor by exceeding the requirements of the standards, thereby catering for activities such as running that require more friction.

Trips

A pedestrian trips when the surface being walked upon has an abrupt increase in height that is large enough to snag the toe of a shoe and cause the pedestrian to lose balance [18]. The study of human gait shows that the toe is generally the lowest part of the swinging foot [18]. However, just before 'initial contact' the foot pivots so that the heel touches first. The toe is the last part of the foot to lift off at the start of the swing and the heel is first to make contact at the end of the swing. Hence it is most often the toe that makes contact with the obstacle.

Gait analysis indicates that the clearance between toe and ground during the 'swing phase' is small. This relates to persons walking on an even surface, where the expectation is to place each foot on a surface of the same level as the previous step, as on paved footpaths and roadways. A study by Murray [116] found toe to ground clearance in the range of 1–38 mm with a mean of 14 mm. Based on this data, a rise in height of 14 mm would represent a trip hazard to 50 percent of the people tested. It is estimated that 10 percent of those tested would trip if the rise was 6 mm. Unfortunately, older pedestrians who are most at risk lift their feet the least, and are least likely to recover if they catch their toe on an obstacle.

The relative probability of catching the toe is shown in figure 3.8

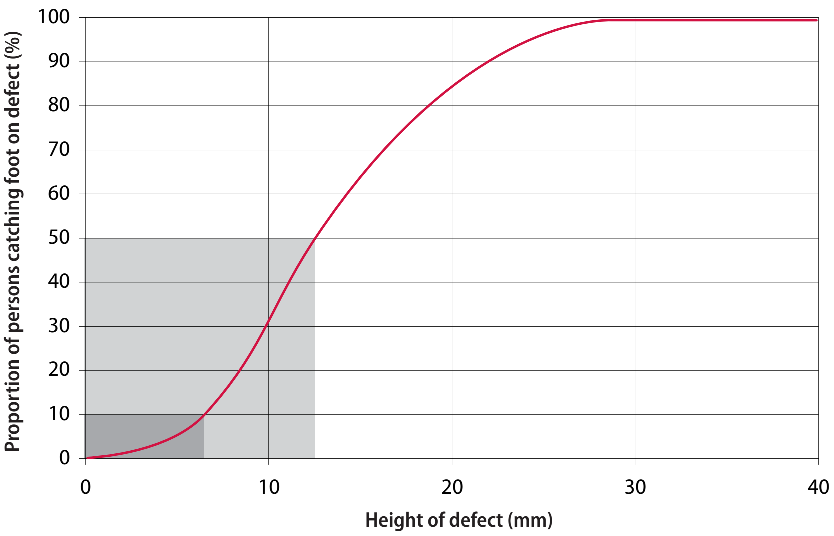


Figure 3.8 – Probability of catching foot on abrupt height change [116].

Based on this analysis, 6 mm is commonly used as the intervention standard for sudden changes in footpath level, but a stricter standard would appear to be justified. This would also explain why tactile paving strips laid on the footpath surface with a rise of only five mm chamfered at 45 degrees have been the subject of complaints from older pedestrians. Depressing tactile paving tiles slightly into the surface would appear to be beneficial.

Trips can also occur when a stair riser is taller than expected, or not noticed. This is particularly likely where there is a single step.

Bird, Sowerby and Atkinson [177] analysed the number of third party insurance claims for accidents on footways with respect to the height of footway defect. The exposure of pedestrians to defects of differing heights was also taken into account. It was found that the probability of an accident occurring increases logarithmically until a defect height of about 40mm, after which the probability remains constant. At higher step heights the defect is more likely to be noticed so the risk does not increase further. This is illustrated in figure 3.9 for varying levels of pedestrian flow.

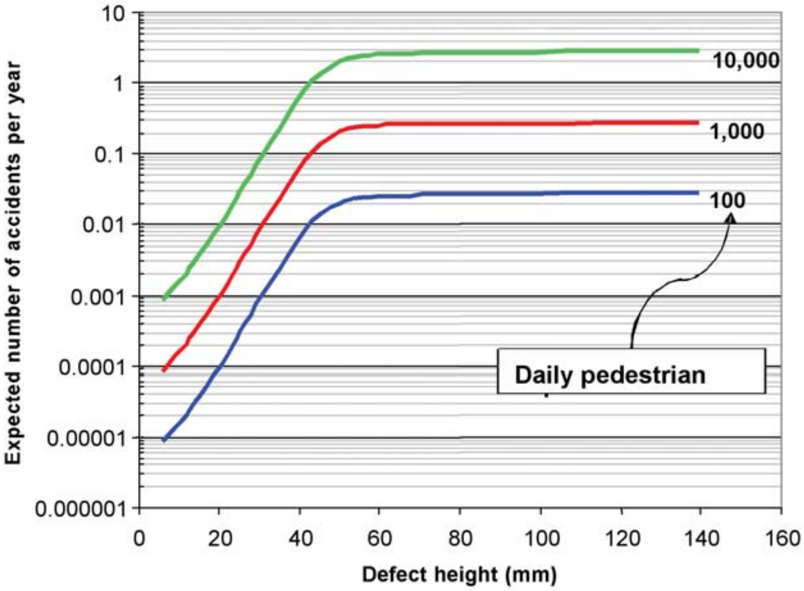


Figure 3.9 – Accident occurence with respect to defect height for different daily pedestrian volumes.

The inclined portion of the curves can be approximated by: $E = 2\times10^{-8}\,Ne^{0.1982d}$

Where: E = the expected number of accidents per year
N = the number of pedestrians passing per day
d = the height of defect

Thus, this equation can be used to develop a maintenance strategy for the timeliness of repair of defects of a given height in various situations, based on an accident rate threshold.

Stumbles

Stumbles happen when the surface is higher or lower than expected. Stumbles become more likely as undulations in the surface rise above 12 mm [18].

3.12 Pedestrians on small wheels

Devices that allow people to travel on small self-propelled wheels, notably skateboards, kick scooters, roller skates and in-line skates have the advantage over walking on foot in that they reduce travel time. They are, therefore, useful for utility travel.

There are concerns associated with these devices as their users travel faster than those on foot but slower than motorised vehicles. Evidence suggests that the risk of serious injury to the user reduces when devices are used on the footpath. However, exposure to risk is difficult to quantify as there is little data on trip numbers and significant under-reporting of minor injuries.

Some overseas evidence suggests that up to 15 percent of all injuries to pedestrians on the footpath occur while they are using skates or skateboards [50]. Many users of these devices are children who are already especially vulnerable. There is little research on the design of infrastructure for them [93].

The Road User Rule [110] currently allows a person using a wheeled recreational device to use either the footpath or the roadway. There does not appear to be a strong case for prohibiting their use on footpaths in New Zealand, as there is no evidence of a high degree of risk to either users or pedestrians, although there may be a perception of danger, especially for older pedestrians. There may, therefore, be a case for banning the use of these devices in specific areas of high pedestrian use, or separating them from pedestrians. In some cases, it may be appropriate to allocate designated routes in areas with a large number of users of wheeled recreational devices.

For design purposes, it may be assumed that skateboarders, kick scooter users, roller skaters, in-line skaters and runners/joggers are walking pedestrians and, therefore, subject to the same design principles as those travelling on foot [93]. However, high quality surface conditions and smooth kerb crossings benefit users of small wheeled devices as well as the mobility impaired.

Photo 3.6 – Skateboarder, Christchurch
(Photo: Susan Cambridge)

Photo 3.7 – Scooters heading off
(Photo: Celia Wade-Brown)

4 COMMUNITY WALKABILITY

COMMUNITY WALKABILITY
Making communities walkable
Urban form
Feeling secure

4.1 Introduction

'Walkability' describes the extent to which the built environment is walking-friendly. It is a useful way to assess the characteristics of an area or a route, although it can be subjective. Section 11 discusses methods for assessing walkability.

4.2 Aspects of walkable communities

Getting there – on foot, by cycle, the national strategy for walking and cycling, states in its key principles that:

'Individuals are more likely to choose to walk or cycle if they see the environment as being walk-and-cycle-friendly – that is, convenient, safe and pleasant, with direct routes that minimise travel time.

'A comprehensive approach that works to maximise the range of destinations within walking or cycling distance, to improve the environment for walking and cycling, and to show individuals how these modes can effectively meet their personal needs will have the best chance of success.'

It takes several important qualities to describe a walkable community. Many ways are used to classify these, but all attempt to describe the same characteristics. The nine primary characteristics shown in Table 4.1 are considered to provide a convenient description of a truly walkable community.

Table 4.1 – Primary characteristics of walkable communities

Characteristic	Definition
Connected	Does the network provide direct access for pedestrians to the places they wish to reach? Do paths connect well to public transport and to surrounding networks?
Legible	Are walking networks clearly signposted and are they published in local maps? Can visitors find their way? Do users intuitively sense how to use the facilities?
Comfortable	Are routes unpolluted by excessive noise and fumes? Are paths wide enough with even surfaces and gentle gradients? Is there shelter from the elements and places to rest?
Convenient	Are routes continuous, efficient, unimpeded by obstacles, and undelayed by other path users and road traffic?
Pleasant	Are the pedestrian spaces enjoyable, interesting, quiet and clean with qualities encouraging lingering and social interaction?
Safe	Are road crossing places and driveway crossings safe from traffic danger and do all surfaces provide a good grip when wet and provide even surfaces free from trip hazards?
Secure	Does the walking environment discourage antisocial and criminal behaviour due to the application of the principles of crime prevention through environmental design?
Universal	Are facilities suitable for mobility and vision-impaired pedestrians through gentle gradients, visual contrast, audible and tactile features?
Accessible	Are popular destinations within easy walking distance.

Three interrelated areas – land use planning, pedestrian infrastructure and the road controlling authority's (RCA) attitude [19] – have a significant impact on walkability. Appendix 3 has more details on pedestrian issues to address in district plans. Table 4.2 summarises the policies affecting walkable communities.

Table 4.2 – Policies affecting walkable communities	
Area	**Characteristic**
Land use planning (in existing areas)	• A wide range of desired destinations is available within walking distance* in town centres, local communities and suburbs. • Town centre destinations provide a range of shops, offices, services, entertainment and public spaces. • In local communities, destinations include a range of business, community and civic services including schools and medical • All dwellings are within walking distance* of a public space (either a community facility or an open area), a convenience store and a frequent public transport service. (* The target walking distances used should be set locally, based on walking times, and decreased as progress is made towards achieving them.)
Land use planning (for new development)	• District plan policies provide a permeable pedestrian network and do not permit layouts that include circuitous routes and cul-de-sacs that have no alternative outlet for pedestrians. • Planning provides for a range of services/destinations relevant to all ages within walking distance. Mixed and/or higher density development is favoured, particularly close to public transport routes, interchanges and the urban core. • Crime prevention through environmental design (CPTED) principles [107] should be applied to all new development. • Provision and charging for parking spaces is carefully managed.
Pedestrian infrastructure	• Pedestrians are considered at an early stage in planning transport infrastructure. Appropriate levels of pedestrian service are established and provided across the roading hierarchy and path network. • Good provision is made for those with mobility and cognitive impairments throughout the entire network. • Motorised traffic speed is managed by design and regulation taking pedestrian needs into account. In areas of high pedestrian importance or density, traffic speed is determined by pedestrians, or alternative pedestrian routes are specifically designed to provide a higher level of safety and convenience. • Pedestrians are generally placed at, or close to, the top of the road user hierarchy, with their needs met by facilities and treatments that provide a high level of safety and access. Section 5.2 explains this further.
RCA approach	• There is a clearly articulated, up-to-date and suitably funded strategy for providing for pedestrians and increasing their number. • There is a suitable budget for maintaining the quality of pedestrian infrastructure. • The RCA has a nominated, well informed person for 'championing' walking, who is consulted on all schemes that could affect pedestrians' interests. • The RCA regularly seeks feedback from pedestrians and other relevant affected parties on all improvement schemes and current/future infrastructure and may benefit from a formal reference group. • Information on pedestrian routes is effectively coordinated and promoted.

Photo 4.1 – Pedestrians top of hierarchy, Christchurch (Photo: Megan Fowler)

Photo 4.2 – Information booth, Christchurch (Photo: Megan Fowler)

4.3 The importance of urban form

'Urban form' relates to how settlements are designed and structured, the type of development that is allowed and where, and how the different areas are connected. Urban form affects the need to travel [63, 106, 163] and the attractiveness (or otherwise) of walking as a practical form of transport [26, 63, 64, 106, 172].

Three interrelated elements affect whether urban form is suitable for pedestrians – pedestrian permeability, connections to transport and strategic planning [5, 103] (see Table 4.3).

Figure 4.1 – Externally distributed network with poor internal connections apart from some narrow paths, Blenheim (Source: Grant Crosswell, Marlborough District Council)

Table 4.3 – Important elements of urban form for pedestrians

Element	Definition	Typical benefits
Pedestrian permeability	The extent to which an accessible environment is provided for pedestrians, free of obstruction and severance.	• There are reduced waiting times at traffic signals and crossings. • Pedestrians having priority at side road crossings. • Pedestrians can continue to use routes that are closed to other traffic. • Traffic-calming, low-speed zones and shared zones are implemented.
Connections to destinations	The extent to which the walking network integrates with likely trip origins and destinations, including the public transport network.	• The pedestrian network links to obvious trip ends, such as schools, shops, supermarkets, parks, public spaces and community services. • Particular attention is paid to the interface between trip ends and the pedestrian network, such as providing shelters, shaded seating and pedestrian signage. • The environment in the immediate vicinity of public transport nodes and interchanges is more intensively developed and pedestrian friendly.
Strategic planning	The extent to which the local policies and strategies encourage walking as a mode of transport.	• There is coordinated land-use and transport planning. • District plan development policies promote walking. • District plan development policies encourage increased housing density around transportation nodes and interchanges. • Traffic demand can be managed. • A regular programme of walkability audits can be implemented. • Local walking strategies reflect the complexity of encouraging walking, for example, linking infrastructure provision with active promotion of walking as a transport mode. • There is coordination between parks and roads for route planning, lighting and signage.

Because pedestrians are the slowest mode, any deviation in their routes will inconvenience them more than other modes. Pedestrians benefit most from finely grained permeable networks. The appropriate spacing of pedestrian network elements relative to other modes can be judged from Table 4.4.

Table 4.4 – Average distance travelled in one minute

Mode	Average Speed	Distance
Walking	5.4 km/h	90 metres
Cycling	20 km/h	330 metres
Car	54 km/h	900 metres

A trend in urban design today is towards compact, 'neo-traditional' patterns that feature an interconnected street network with closely located employment, retail and neighbourhood centres, transport nodes and open spaces [118]. Walking is a viable travel option in these areas owing to the reduced distance between trip origins and destinations [61, 63] and because the road layout helps to reduce severance [118]. Because highly connected grid networks have a poor traffic safety record at intersections, low-speed intersection treatments such as traffic-calming roundabouts will be important. The road network does not need to be as permeable as the pedestrian network.

Off-street pedestrian networks can have a role in neo-traditional areas as they may provide pedestrians with their most enjoyable walking experiences [4]. If well placed they can also reduce the distance travelled by those on foot and alleviate the need to walk beside high-speed roads where there is an increased chance of being hit by a vehicle [118].

Careful urban design can result in drivers, cyclists and pedestrians modifying their behaviour and can reduce the dominance of motorised traffic. Creating a total multi-purpose space when a development is being built eliminates the need later to retrofit a road network with disconnected traffic-calming devices [163]. It becomes safer and easier for people to walk to jobs, shopping, education, leisure and services [163]. Locating high-density residential, retail and other services around public transport interchanges provides options for longer distance trips that do not require a private motor vehicle. This further contributes to enhancing the walking

Figure 4.2 – Traditional grid network, Blenheim
(Source: Grant Crosswell, Marlborough District Council)

environment, and can result in areas deliberately created with fewer cars and greater pedestrian activity [55, 159].

Since many journeys start or end at home, the location of new housing and links to existing transport routes are particularly important. Pedestrians may be given a higher priority than private cars within residential developments [43, 122].

The quality of the street scene is particularly important for pedestrians and is associated with higher walking levels [63]. Pedestrians prefer both close and distant views of features of interest, and landscaping should be provided and maintained while always ensuring personal security. Pedestrians enjoy lively and animated street scenes, so in many situations a modest flow of vehicles is generally acceptable and provides improved natural surveillance. As traffic engineering devices can be ugly, attention to attractive design is important [124].

We need to ensure that our view of a street is more than just functional. Streets and public spaces should be beautiful, engaging and inspiring. Too often they are boring, repetitive and ugly. As a general principle, it is important to promote a quality public environment where impediments to walking are only implemented when they are absolutely essential. For urban design, *People – places – spaces: a design guide for urban New Zealand* [105] provides guidance on urban design principles and how to create better urban design at project level. Urban design also relates to procedures discussed further in *Easy steps* section C2 [175] and *Manual for streets* [176].

Photo 4.3 – Pedestrian precinct, Christchurch (Photo: Susan Cambridge)

4.4 Personal security issues

Personal security issues can be a major barrier to walking and creating walkable communities, especially during hours of darkness and in town centres [36]. People who are concerned about perceived dangers, may modify their travel behaviour by not going out alone after dark or avoiding certain areas or routes. Parents, because of perceived danger, may also modify their children's behaviour by not allowing them to walk without adult supervision. Personal security issues can also create a barrier to accessing public transport services on foot.

Photo 4.4 – Natural surveillance from street activity, Nelson (Photo: Tim Hughes)

Personal security issues should be considered in three general areas [107]:

1. The environment should be legible, with pedestrians able to see and understand their immediate surroundings and those ahead.
2. Pedestrians should be visible to others, particularly other pedestrians.
3. Pedestrians should be provided with alternative routes to avoid potentially threatening situations.

Applying the practices in this guide will address pedestrians' personal security. Additional advice can be found in the *National guidelines for crime prevention through environmental design in New Zealand* [107]. It is particularly important to [107]:

- provide adequate lighting
- ensure pedestrians are able to see and be seen clearly in the surrounding area – and maintain this ability
- avoid designs that create recessed areas and hiding places
- provide pedestrians with the maximum number of route choices
- maximise 'natural surveillance' – the number of people overlooking an area from homes, streets or places of entertainment
- provide suitable signage
- provide an environment that looks 'cared for', eg prompt graffiti removal.

Personal security issues can be best addressed when considering [36]:

- walking strategic plans
- pedestrian audits and walkability surveys
- safe routes to school
- pedestrianisation schemes
- neighbourhood accessibility plans
- walking school buses
- lighting pedestrian amenities
- planting and vegetation maintenance
- maintaining footpaths and adjoining areas
- promotional campaigns for walking (see chapter 20)
- designing building frontages that overlook public spaces.

5 APPROACHES TO PROVIDING FOR PEDESTRIANS

5.1 Introduction

The overwhelming majority of pedestrian routes cross a mixture of land types [13, 139].

A fully comprehensive walking network will encompass:

- the road corridor, enabling pedestrians to travel along and across roads
- routes over land available for public use, such as along coast and river margins and through parks, transport interchanges and car parks
- private land, such as on immediate approaches to and exits from buildings and carparks.

Providing for walking should be at the heart of planning for an area, as faster modes can be more flexibly accommodated. In an integrated approach to planning for new roads or changes to existing roads, identifying, understanding and working to incorporate and balance the needs of all road users at the beginning of the process is critical. This requires an understanding of the general needs of pedestrians in the area for access along and across the road or site of interest.

5.2 Road user hierarchy

RCAs typically use a road hierarchy to manage their road according to the importance of their through traffic function in relation to other needs such as access.

Most roads must accommodate a range of users. Their often conflicting requirements require a balance to be struck in the level of service provided for each user group and the allocation of limited space to each.

To achieve an integrated approach, road controlling authorities (RCAs) internationally are increasingly using a different type of hierarchy called a 'road user hierarchy' which endeavours to:

- bring non-private motor vehicle road users to the heart of the planning process, ensuring the most vulnerable road users are considered early on and appropriately
- identify generally the importance of each travel mode for policies that impact across the various components of the roading hierarchy
- identify more specifically the importance of each travel mode in localised situations based on local understanding and needs. In some cases a user hierarchy could even potentially change at different times of the day (for instance before and after school).

This approach requires an awareness of the impacts and purpose of the wider transport network, along with a strong understanding of the interaction of the different transport modes, and the benefits and costs of different planning decisions or treatments for each road user group.

The first stage in a scheme development, therefore, would be to identify the importance of different road user groups (their relative positions in the hierarchy).

As designs are developed they can then be assessed for their benefits and costs for different road user groups, and in particular for those that have been identified as higher up the established road user hierarchy.

Figure 5.1 shows a potential user hierarchy consistent with promoting walking. It is based on one used in York, United Kingdom [22, 25, 147].

Mobility impaired and wheeled pedestrians	**More important**
Able pedestrians	↑
Cyclists/recreational pedestrians	
Public transport users	
Commercial/business users (including delivery + emergency vehicles)	
Coach-borne shoppers	
Coach-borne visitors	↓
Car-borne commuters + visitors	**Less important**

Figure 5.1 – User hierarchy that supports walking

In this example, a scheme or policy that improves conditions for car-borne commuters while creating difficulties for pedestrians would not be considered favourably, as pedestrians are higher in the hierarchy [147]. One result could be road improvements within an area to provide a continuous pedestrian network at-grade, with vehicles being slowed by platforms and other measures.

5.3 Pedestrian provision outside the road corridor

All land owners should be encouraged to provide a comparable level of service to that on public road corridors. All new and improved developments should be required to have a high-quality pedestrian environment as an integral part of all resource consent applications, unless there is good reason.

When the local authority is the land owner, such as for parks and reserves, it should lead by example by setting a high standard of provision.

Photo 5.1 – Pedestrian facilities in a car park, Nelson (Photo: Tim Hughes)

5.4 Pedestrian provision within the road corridor

A structured process is desirable when pedestrians already walk or wish to walk within a deficient road corridor. A hierarchy for considering solutions (see Figure 5.2) will help in this [147]:

	Consider first
Reducing traffic volumes on the adjacent roadway	↑
Reducing the traffic speed on the adjacent roadway	
Reallocating space in the road corridor to pedestrians	
Providing direct at-grade crossing treatments	
Improving pedestrian routes on existing desire lines	↓
Providing new pedestrian route alignment and grade separation	**Consider last**

Figure 5.2 – Hierarchy for considering solutions

Reducing traffic and speed has the highest priority as it not only benefits pedestrians but can also improve road safety, air quality and noise, enhancing the environment for others in the area. It also contributes to the less quantifiable 'quality' of the streetscape.

New route alignments and grade separation are listed last, as they typically divert pedestrians from their desired path to create a better environment for motor vehicles. They may also be contrary to the road user hierarchy if they provide better access for motor vehicles at the expense of convenience for pedestrians.

In practice, it is unlikely that a scheme will need to consider only one of the six solutions. For example, reallocating road space to pedestrians may deter some drivers and reduce traffic speeds.

5.5 Pedestrian environment concepts

Sections 5.5.1 to 5.5.4 describe four concepts for improving the pedestrian environment. The four concepts are:

1. Living streets
2. Pedestrian precincts
3. Shared zones
4. Sharing the main street

5.5.1 Living streets

Description

The concept of 'living streets' recognises that, as a priority, streets should be designed with living and community interaction [20, 22, 176]. While cars are not excluded, they are designed so drivers are aware they are in an area where pedestrian and other users are important. A living street aims to balance the needs of residents, businesses, pedestrians and cyclists with cars, and thereby encourage a better quality of life and a greater range of community and street activity.

Living streets may incorporate:

- traffic-calming measures
- hard and soft landscaping areas
- places for social activities
- children's play areas
- seating
- lighting improvements
- a better interface between the street and housing
- public art.

The living streets concept can be applied in theory to any road (other than a motorway). There is no one solution; instead, the community is involved in identifying problems for which specific solutions are developed.

Photos 5.2 – Living street culvert feature, Papanui, Christchurch (Photo: Tim Hughes)

Advantages

The living streets concept:

- improves safety and security for pedestrians
- enhances economic vitality
- promotes quality housing
- supports community networks
- creates a sense of place and identity
- promotes cultural activities
- creates a sustainable environment
- maintains ease of access
- creates an aesthetically pleasing environment
- improves social interaction.

Disadvantages

The living streets concept can:

- delay motorised traffic
- be costly.

Recommendations

The living streets approach is recommended. The concept is particularly worth considering for all new roads where good design costs little, and for existing roads that require reconstruction or major alterations for other reasons. The concept is most useful for roads without a predominant through traffic function, but can be applied in part to a minor arterial road.

For more comprehensive guidance refer to *Manual for Streets* [176]. Sections 6.2 and 6.3 cover traffic-calming and traffic-reduction engineering measures which may be incorporated into living streets.

5.5.2 Pedestrian precincts

Description

Most pedestrian-only areas are created by restricting traffic access or closing roads to traffic.

There are four types of pedestrian precinct [66]:

1. Modified street precinct: one block is closed for pedestrian-only use.
2. Plaza: several blocks are closed but the cross-streets stay open to all traffic.
3. Continuous: several blocks and the cross-streets are closed.
4. Displaced: walkways are developed away from the usual roadside footpaths, making use of lanes and alleys.

Advantages

Pedestrian precincts:

- create the best possible conditions for pedestrian freedom of movement and road safety
- have aesthetic and social benefits as well as reducing pedestrian congestion, improving access to retail opportunities, and improving air quality and noise levels [66, 139]
- have economic benefits in shopping areas, as studies have shown that putting pedestrians first in shopping areas can improve retail performance and competitiveness [21].

Disadvantages

They may:

- inconvenience traffic movement
- be difficult to sell to retailers despite their proven benefits
- involve diverting bus routes, which can result in longer travel times; passengers may also be required to walk further to bus stops
- involve closing routes to cyclists
- become deserted during the evenings (this can be overcome with closures during set times, eg during daylight only)
- reduce on-street parking spaces, so convenient parking provision may be needed.

Recommendations

Pedestrian precincts are most beneficial where there is heavy pedestrian activity, retail or mixed development, a high number of pedestrian/vehicle conflicts, and motor traffic can be accommodated elsewhere.

Access must be maintained at all times for emergency services. Delivery vehicles can be allowed access during the early morning or evening, or be prohibited completely as long as servicing arrangements can be maintained. Public transport may also be permitted as long as vehicles operate slowly within a narrow corridor [66], although pedestrians may not favour this. Cyclists can usually be permitted as guests in a pedestrian space. Extra parking areas may be needed to replace on-street spaces lost.

Photos 5.3 – Pedestrian precinct with event space, Brisbane (Photo: Tim Hughes)

5.5.3 Shared zones

Description

A shared zone is a residential or retail street that has been designed to give priority to residents and pedestrians while significantly reducing the dominance of motorised vehicles [46]. In the United Kingdom, shared zones are called home zones and in The Netherlands they are referred to as a woonerf. A woonerf is often of a higher quality and more expensive than a home zone.

Motorised vehicles, including removal vans, refuse and service vehicles, still have access but must give way to pedestrians; and conversely pedestrians should not hinder vehicles. The route is physically constrained for vehicles by landscaping, structures and tight turning radii, with no delineation between the footpath and roadway. This slows vehicles to very low speeds [46].

The result is an 'environment of care' where motorised traffic has a specific reason for travelling through the street. This reduces vehicle numbers and means the drivers of the remaining vehicles take more care. Environmental conditions and road safety also improve to the benefit of residents and shoppers, and streets become open spaces for walking, sitting, playing and talking [65].

Advantages

Shared zones:

- enhance environmental conditions through better air quality, lower noise levels and visual amenity from landscaping
- have fewer crashes and less severely injured casualties
- improve social interaction and provide a greater sense of community when streets are used for walking, playing and talking
- improve security from increased natural surveillance.

Disadvantages

They:

- may be expensive to create as existing roads need to be converted
- may push traffic to adjacent roads
- can cost more to maintain.

Recommendations

Shared zones are most suitable for streets and compact areas with a low demand for through traffic movement. Their maximum size is restricted by the need to maintain response times for emergency services and to limit the extent of roadway that must be negotiated at low speeds by motorists accessing their properties [65]. Parking places should be designated.

Success requires full and active community participation and consensus. The treatment is more costly to fit to existing roads than to new developments [46].

Photo 5.4 – Shared shopping street, Napier (Photo: Celia Wade-Brown)

Photo 5.5 – Home zone, Bristol, United Kingdom (Photo: Tim Hughes)

5.5.4 Sharing the main street

Description

The main streets of rural towns, and minor arterial roads in cities that are straddled by strips of retail, commercial and community activities, have conflicting traffic and pedestrian needs that need to be managed. Pedestrian crashes cluster at such locations. The traffic function is impeded by the activities along the frontage – particularly in areas where there are high levels of parking turnover or many parking manoeuvres, turning movements and crossing pedestrians. The activities along the frontage suffer from the impact of traffic noise and air pollution, access to sites and difficulties for pedestrians who want to cross.

Sharing the main street means adapting it – or a centre along a minor arterial road – to improve the safety and the quality of the road environment for all its users.

People using these areas have a range of needs including:

- pedestrians need to be able to cross safely and conveniently
- visitors need to be able to park
- motorists and cyclists need to be able to move safely through the centre
- businesses need to attract customers
- transport operators need space for loading and unloading
- people with impairments need to be able to use the area safely and comfortably
- the community needs an attractive and safe centre to visit and to meet
- public authorities need to keep costs down.

Advantages

Main street projects:

- reduce conflict between pedestrians, cyclists and vehicles
- increase safety of all road users
- improve the quality of the road environment for all users
- maintain/enhance the economic performance of the commercial functions along the frontage.

Disadvantages

They may:

- be expensive to create as existing roads need to be converted
- create modest delays to traffic when it is slowed through the area.

Recommendations

Main street adaptations are recommended for strip shopping centres alongside existing roads. With respect to pedestrian safety they represent better value for money than residential area traffic calming.

For comprehensive guidance on adapting main streets refer to *Sharing the main street* [170] and *Cities for tomorrow: better practice guide, part C-5* [169].

Photo 5.6 – Main street treatment, Frankton, Hamilton (Photo: Tim Hughes)

Photo 5.7 – Main street treatment, Queenstown (Photo: Tim Hughes)

6 PEDESTRIAN NETWORK COMPONENTS

CHOOSING THE BEST OPTIONS
Reduce and calm traffic
Better paths, ramps, steps, driveways, kerb crossings
Select the best crossing facility
Select the best crossing provision for schools
Select the best combination of components

6.1 Introduction

A variety of components and techniques can be used to improve our networks for pedestrians.

6.2 Traffic-reduction engineering techniques

Description

Road engineering techniques that reduce the amount of traffic include:

- changing the priority at intersections by using Stop and Give Way signs
- using a 'diverter' to prevent some through and/or turning movements at intersections
- partially closing the street by using a kerb extension to block one direction of motor vehicle travel into or out of an intersection
- closing the street to all vehicles by installing a physical barrier.

Advantages

Road engineering traffic reduction techniques can:

- improve the general neighbourhood and walking amenity
- make it easier for pedestrians to cross roads
- create the opportunity to reallocate road space to favour pedestrians
- reduce the likelihood of pedestrian injury
- be low cost compared with other road improvements
- be applied to existing roads. [46, 118, 139]

Disadvantages

They may:

- require additional maintenance
- create problems for bus operators, emergency services and refuse collection
- require detailed consultation with all those affected
- require that vehicles and associated problems move to adjacent routes. [46, 118, 139]

Photo 6.1 – Traffic reduction by heavy vehicle ban and road narrowing, Christchurch (Photo: Susan Cambridge)

Photo 6.2 – Traffic reduction by one-way entry, Christchurch (Photo: Megan Fowler)

Recommendations

Engineering treatments that reduce traffic can be important in terms of the road user hierarchy by creating particular benefits for pedestrians. They work best in combination with traffic calming. To prevent vehicles and existing problems moving to adjacent routes, an area-wide approach that may incorporate a number of low-cost measures is required. As these changes may affect a number of parties, detailed consultation is required.

6.3 Traffic calming

Description

'Traffic calming' covers a range of self-enforcing measures that reduce vehicle speeds [118]. Although it is commonly associated with local roads, some measures can be used on roads higher in the road hierarchy that pose greater difficulties and dangers for pedestrians [33, 37]. The method is essentially a matter of limiting the length of unconstrained street sections so that speeds do not exceed target values.

Traffic calming generally involves measures that slow traffic by making higher speeds feel uncomfortable to drivers. This means physically diverting a moving vehicle either horizontally or vertically, sometimes accompanied by measures that have a psychological effect on drivers and encourage them to reduce their speed voluntarily [12, 146].

All traffic-calming schemes should be designed for local conditions, mixing various devices [46].
However, they generally consist of:

- the traffic-calming elements
- a warning on all approaches that drivers are entering a traffic-calmed area, which may include a lower speed limit
- information for drivers exiting the area that they are leaving the traffic-calmed area.

Possible design elements include:

- limiting total street length
- horizontal curvature that induces continuous slow speeds
- limiting the lengths of straights (by introducing low-speed bends)
- roundabouts
- pedestrian platforms
- mid-block kerb extensions
- intersection kerb extensions
- speed humps
- chicanes
- paving treatments
- gateway/entry treatments.

New developments can use integrated design elements that minimise the need for discrete devices.

Advantages

Traffic calming can:

- increase journey times which will deter drivers from using traffic-calmed streets unless they have business in the area
- decrease vehicle speeds which will result in an improved environment, especially in regard to neighbourhood severance
- give drivers more time to react to unexpected incidents and avoid them
- ensure that any collision between a pedestrian and a vehicle is less severe
- be low cost
- be applied to existing roads.

Disadvantages

Heavy vehicles are slowed more than cars, and may find some manoeuvres more difficult. This may create problems for bus operators, emergency services and refuse collection.

Noise levels and vehicle emissions may increase if traffic speeds up between devices. This is likely when devices are placed too far apart.

Some additional maintenance may be required.

Recommendations

Traffic calming is most appropriate in residential and retail areas.

Consider the effects area-wide and consult with all affected parties.

In new areas use a speed-based design of elements to continuously limit opportunities to speed up.

In existing areas ensure discrete speed-restricting elements are closely placed to ensure traffic does not continually speed up and slow down between them.

For comprehensive guidance on traffic calming for residential areas refer to *Guide to traffic engineering practice, part 10: Local area traffic management* [12].

For comprehensive guidance on traffic calming for main streets refer to *Sharing the main street* [170] and *Cities for tomorrow: better practice guide,* part C-5 [169].

Photo 6.3 – Traffic calming by road narrowing, Christchurch (Photo: Megan Fowler)

Photo 6.4 – Traffic-calmed retail street, central Nelson (Photo: Tim Hughes)

6.4 Network components outside the roadway

6.4.1 Footpaths

Description

A footpath is the part of road or other public place that is laid out or built for pedestrian use [168]. Footpaths may run alongside the road or through parks and other open spaces, and include overbridges and subways [110]. Chapter 14 discusses footpath design and provision in more detail.

Advantages

Well designed footpaths encourage walking and reduce the risk of crashes.

Well designed footpaths can play an important role in social interaction between pedestrians and those living, working or shopping along the route.

Footpaths in the road corridor create space for road user signs and can carry utility cables and pipes.

Footpaths in the road corridor also provide space for those waiting for other modes of travel or wishing to cross the roadway. [46, 63, 66]

Disadvantages

In shared zone situations, providing footpaths in the road corridor can increase vehicle speeds. [46, 63, 66]

Recommendations

Footpaths should provide for all types of pedestrians. By designing for the needs of pedestrians with impaired mobility, a high standard will be provided for all.

Provide footpaths wherever pedestrians might be expected. See section 14.1

In urban areas, always provide footpaths. See section 14.1

In rural areas footpaths are preferred, but where pedestrians can reasonably be expected there should always be, as a minimum, an area reserved for walking that is outside the main traffic lanes, such as a paved shoulder [10]. This is the lowest standard of pedestrian facility and may not be accessible to young or mobility impaired pedestrians.

Photo 6.5 – Footpath, Auckland (Photo: David Croft)

6.4.2 Ramps and steps

Description

Significant gradient changes over relatively short distances present difficulties for all pedestrians, because more energy is required when ascending, and control is more difficult when descending. In most circumstances, ramps and steps are the only practicable way to deal with elevation changes [10, 24].

Advantages

Ramps can overcome major barriers for the mobility impaired (including those encumbered by luggage, shopping or pushchairs) [10, 24].

Disadvantages

Steps are not easily accessible by the mobility impaired or those on small wheels.

Ramps can add additional distance to a route when compared with steps [10, 24].

Photo 6.6 – Steps and zig-zag ramp, Hamilton (Photo: Shane Turner)

Recommendations

Install ramps where possible as they provide greater accessibility and are favoured by all types of pedestrians [10].

Install steps where it is not technically feasible to provide a ramp, or where the additional distance a ramp imposes is so excessive it is unlikely to be used.

Provide both steps and a ramp where these will best suit different users [42].

On rare occasions, use mechanical methods to elevate pedestrians [42]. For example, escalators and elevators are used on a number of New Zealand footpaths, including in Wellington's botanical gardens, between New Plymouth's museum and foreshore, and at Durie Hill in Wanganui. However, they must be well sited and designed to avoid being subjected to considerable abuse and quickly becoming very expensive to maintain.

See section 14.10 for more advice on designing ramps and steps.

6.4.3 Driveways

Description

A driveway is a passageway for motor vehicles that enables them to access private property adjacent to the road [84].

Where they cross footpaths, driveways behave in many respects like intersections, as vehicles can cross pedestrian routes and effectively sever the walking network [66]. Unlike at intersections, however, drivers are required to give way to pedestrians.

Advantages

If traffic volumes using the driveway are very low, pedestrians can use the driveway to access the adjacent property [13, 15, 66].

Disadvantages

Vehicles crossing footpaths conflict with pedestrians using the footpath and are hazardous where visibility is restricted or vehicles are reversing.

Driveways are a common cause of adverse cross gradients on the footpath.

Young children (under four years old) are particularly at risk of serious injury and even death on driveways, especially at their own home. In many cases, the driver of the vehicle involved is a parent or relative who is reversing [13, 15, 66].

Recommendations

Busy driveways should preferably be located to avoid crossing main pedestrian routes.

Driveways should be narrow to minimise the area of conflict with pedestrians.

Driveways should be designed to reflect the law that drivers are required to give way to all other users when entering or leaving the roadway. The footpath should clearly continue across the driveway at-grade.

The driveway should only resemble a roadway where it is so busy it needs to operate as an intersection.

The internal layout of developments should encourage forward entry and exit, and minimise reversing.

Residential driveways where vehicles reverse, should be separated from play areas by internal fencing or similar.

See section 14.11 for design details.

Photo 6.7 – Footpath continues to a high standard across driveway, Tauranga (Photo: Mike Calvert)

6.4.4 Shared-use paths

Description

In a few respects, the characteristics of pedestrians (see section 3) are similar to those of cyclists – so sometimes path-sharing is an appropriate solution for both groups. This can be achieved commonly by creating a widened, purpose-built footpath to accommodate both. This path can be either [11]:

- unsegregated: both pedestrians and cyclists share the same space, or
- segregated: the path is divided into two with one side of the path for pedestrians and the other for cyclists.

Advantages

The advantages of shared-use paths accrue mostly to cyclists unless inclusion of cycling enables a new facility that could not be funded solely for walking.

Shared-use paths:

- provide a motor traffic-free facility
- are generally safer for cyclists between junctions with roads and driveways
- are particularly suitable for novice cyclists and children, and recreational routes
- can provide convenient and attractive links away from roadways.

Disadvantages

The different speeds of pedestrians and cyclists lead to inevitable conflicts.

Some pedestrians, for example older pedestrians, feel insecure walking among faster cyclists.

More space is required than for a footpath due to the need for cyclists to pass pedestrians travelling in the same direction.

The behaviour of children and pets being overtaken by cyclists is unpredictable.

As the volumes of all users increase, conflicts between their needs can significantly affect the quality of provision for both pedestrians and cyclists.

Most cyclists will not divert from a roadway that provides a faster route, so paths rarely completely replace the need for on-road provision.

While segregation by markings or surface treatments reduces these conflicts, users are poor at keeping to their part of the path.

Segregated shared paths require considerably more space.

Recommendations

Shared paths may be considered where the combined flow of pedestrian and cyclists is light. Until further research has been undertaken, British guidance suggests an upper limit of 200 total users per hour. Where the demand for walking or cycling is higher than this, greater width and degree of segregation should be considered.

As shared paths are generally proposed with cyclists in mind, refer to the *Cycle network and route planning guide* [73]. Comprehensive guidance on all the issues for shared paths is found in the toolbox developed for the Australian Bicycle Council: *Pedestrian-cyclist conflict minimisation on shared paths and footpaths* [69].

Section 14.12 has advice on designing shared use and segregated paths.

Photo 6.8 – Unsegregated share path behind beach, Perth (Photo: Tim Hughes)

Photo 6.9 – Segregated path, Auckland (but substandard width)

6.4.5 Kerb crossings

Description

Kerb crossings provide a smooth transition between the footpath and roadway that can be conveniently used by mobility impaired pedestrians. Kerb ramps, also known as 'kerb cut-downs', 'pram crossings' and 'drop kerbs', are a type of kerb crossing where part of the footpath is lowered to the same level as the adjacent roadway. This enables pedestrians to access the roadway without an abrupt change in path level.

Advantages

Kerb crossings are:

- essential for mobility impaired pedestrians, and those with prams
- a natural focus for crossings.

Disadvantages

They can:

- cause difficulties for the mobility impaired if not properly designed
- make it so difficult for blind and vision impaired users to detect when they are leaving the footpath to enter the roadway, that tactile warning indicators are required
- create ponding if drainage is not addressed.

Photo 6.10 – Kerb ramp, Christchurch (Photo: Megan Fowler) (note: missing tactile paving)

Photo 6.11 – Same level kerb crossing, Queenstown (Photo: Tim Hughes)

Recommendations

Kerb crossings should be installed wherever a footpath crosses an intersection and at every pedestrian crossing point. Kerb ramps should be installed at every kerb crossing where the grade changes as pedestrians step onto the roadway [46]. They should guide pedestrians to the safest place to cross.

When retrofitting, priority should be given to areas with the highest pedestrian use, particularly the CBD and near bus stops, schools, parks, shopping areas and medical facilities [13]. The NZ Local Government Act requires them to be installed at every new development or footpath improvement, to a standard suitable for wheelchair use [134].

Tactile paving should be used at kerb crossings so that visually impaired pedestrians are aware of the change from footpath to roadway.

Section 15.6 has design advice on kerb crossings and ramps.

6.4.6 Public transport interface

Recommendations

For effective implementation, the following broad principles for pedestrian access to public transport need to be established [151].

- The location of public transport stops/stations and of pedestrian networks should be developed in relation to each other at both network wide and local levels. Preferably this should be through the medium of a local transport plan.
- The location of the stops/stations should be carefully chosen, preferably at a safe focal point in the area. This requires assessment at a local level with the aim to make the walking element as short, safe and convenient as possible. There may be particular value in locating stops by main pedestrian routes, where these exist. Where they are not obvious, this may point to the need for reviewing pedestrian provision.
- The location and form of pedestrian crossing points should be matched to maximise the convenience of catching a bus (tram, etc). They should be sited in relation to stops and station entrances and designed to ensure that vehicle/pedestrian conflict in such areas is minimised. The passenger should always cross behind the vehicle and, therefore, stops should in principle be located just beyond crossing points. If crossings are not well sited in relation to stops, or pedestrian level of service is poor, there is an incentive, especially to pedestrians in a hurry or impatient, to take risks.
- For local public transport especially, it is important to have adequate comfortable waiting space and facilities, as waiting is linked in the passenger's perception to the walk access. This is particularly so for the local bus stop. Where shelters are provided they should be lit wherever possible. In all cases stops should be lit or sited to take advantage of local street lights.
- New residential estates, shopping and business centres should be designed for the most convenient pedestrian movement and also for effective service by public transport. This approach should also apply to the redevelopment of older areas.
- In town centres and other commercial locations, buses and trams should be able to set down and pick up passengers as close as possible to main destinations.

Description

Walking is involved in all public transport journeys, therefore, providing good pedestrian access is an essential requirement for public transport to become a realistic alternative to car travel [151]. This involves providing good quality pedestrian links to, and good pedestrian facilities at stops, stations and interchanges. Although catering for pedestrians within large stations and interchanges can be considered outside the scope of this guide, smaller stops such as bus shelters are often incorporated into the pedestrian network.

Advantages

By providing attractive and convenient links with public transport, a journey comprising walking and public transport becomes more attractive.

Disadvantages

An interface with a good quality and popular public transport service situated within a sub-standard pedestrian environment may lead to safety issues for pedestrian access, and under-utilisation of the service. To prevent this, particular attention must be paid to the pedestrian network at and around public transport stops.

Photo 6.12 – Bus stop with shelter, Perth, Western Australia (Photo: Tim Hughes)

6.5 Selecting the appropriate crossing facility

In the past, decisions on pedestrian facilities used formal warrants to select a control type based solely on information about traffic and pedestrian flow. Practitioners using these warrants recognised that a more comprehensive and context sensitive approach was required. This would consider a wider range of options and help them choose the best one for the circumstances based on a better understanding of the likely effects on safety and delay to all users.

Research was commissioned to search the literature and develop a better approach. The results [148] were reported in an appendix to the consultation draft of this guide and practitioners were encouraged to trial it. The recommended approach included some complex decision trees and calculations, so Land Transport NZ produced the *Pedestrian crossing facilities calculation spreadsheet* [149] to calculate and compare the level of service and safety improvements likely to be achieved for the options appropriate to the situation. The guidance below on selecting appropriate road crossing facilities follows this approach. Use of the spreadsheet is recommended for all but the most straightforward situations.

There are four main reasons for choosing to improve facilities for pedestrians to cross roads:

1. Level of service: the crossing opportunities available to pedestrians are below the desired level of service.
2. Safety: crash records show that specific pedestrian crashes may be reduced by providing crossing assistance, or that perceptions of poor safety are discouraging walking.
3. Specific access provisions: a particular group (eg young children, vision and mobility impaired people) needs the improvements.
4. Integration: it is part of integrating and reinforcing a wider traffic management plan for the area.

When considering how to best provide for pedestrians, consider the following questions (in this order):

- What is the road environment and the land use context, and who uses it?
- What are the appropriate physical aids to crossing?
- Is the control of the crossing point appropriate?
- How do we design the facility to fit into the environment?

This approach should be followed in all cases when providing crossing assistance for children. Section 6.6 should also be referred to.

6.5.1 Environment and land use context

When considering crossing facilities, refer to the hierarchy for considering solutions in section 5.4 and consider whether it may be appropriate to reduce traffic volumes, calm traffic speeds, or reduce the number of traffic lanes as outlined in Table 6.1.

The issues in Table 6.1 are all relevant when considering the road environment, land use context and the type of user.

Table 6.1 – Environment and land use context considerations

Feature	What to consider
Traffic volume and composition	Traffic volume affects the delays experienced by pedestrians, but with facilities that give priority to pedestrians, there are delays to other road users. Should the volume be reduced? The composition of traffic affects how many heavy vehicles and cyclists use the road. This affects the desirable width of the road at the crossing facility.
Speed of traffic	Speed is critical to pedestrian safety. Higher speeds increase injury severity and make it more difficult for pedestrians to judge safe gaps. Should traffic calming and speed management be used along the route/area?
Road layout	How many traffic lanes are there in each direction? Can road space be reallocated to reduce the number of lanes? Is there room to provide certain types of crossing facility? What other provision is there for pedestrians in the vicinity?
Land use	What is the surrounding land use and how might it affect the types, times and volumes of user? What would users expect in this area? What effect would loss of parking have? How would access to driveways be affected by possible measures?
Pedestrians	Who wants to cross, how many? What are the users' ages and walking purposes? Are some of them school children, elderly, or visually or mobility impaired? Is there suppressed demand for crossing facilities?
Where to cross	Where do pedestrians cross now and where do they want to go or come from? Do they cross in one place or are they spread out along a link, at an intersection? Are they in a hurry?
Road user hierarchy	How does this location fit with the road-user hierarchy? What type of user should be considered the most important?

6.5.2 Types of crossing facility

Often a single facility will address multiple reasons for providing crossing assistance. Facilities (or combinations of facility) are also often implemented at low cost. Crossing facilities generally fall into three categories [10, 126] (see Table 6.2), although it is possible to combine two or more facilities at the same location [58].

Table 6.2 – General types of pedestrian crossing aid

Category of treatment	Objective	Possible treatment
Physical aids	To simplify decisions for drivers and pedestrians by shortening the crossing distance or dividing the crossing movement into two easier crossings.	Kerb extensions Pedestrian islands Splitter islands Medians
Priority/time separated	To give pedestrians priority, or to allot pedestrian-only periods for use of an on-road section, alternating with periods for vehicles.	Zebra crossings School patrols/kea crossings Mid-block signalised crossings Signalised intersections
Spatially separated	To eliminate conflict by putting pedestrians and vehicles in physically different areas.	Underpasses Overpasses

Physical aids

For most urban roads, improvements in safety and level of service for crossing pedestrians can most easily be achieved by physical aids. These reduce the crossing distance and the amount of traffic the pedestrian has to negotiate at each stage. The crossing distance can be reduced through kerb extensions, medians and pedestrian islands. The amount of traffic the pedestrian has to negotiate at each stage can be halved by separating the crossing into two separate crossing manoeuvres (medians and pedestrian islands).

Figures 6.1 and 6.2 are from the *Pedestrian crossing facilities calculation spreadsheet*. They illustrate improvements in the level of service for pedestrians at various traffic volumes, by providing physical aids on a typical two-way, two-lane road with a 50 km/h speed limit. The crossing distance without physical aids assumes a 14 m kerb-to-kerb crossing distance; kerb extensions assume a 9m crossing distance; a median island (for example, pedestrian islands) assumes two 6m crossings; and kerb extensions and a median island assume two 4.5 m crossings.

Mean queuing delay to pedestrians

Note: Chart varies according to inputs entered for flow type, number of lanes, lane widths, pedestrian profile and walk speeds.

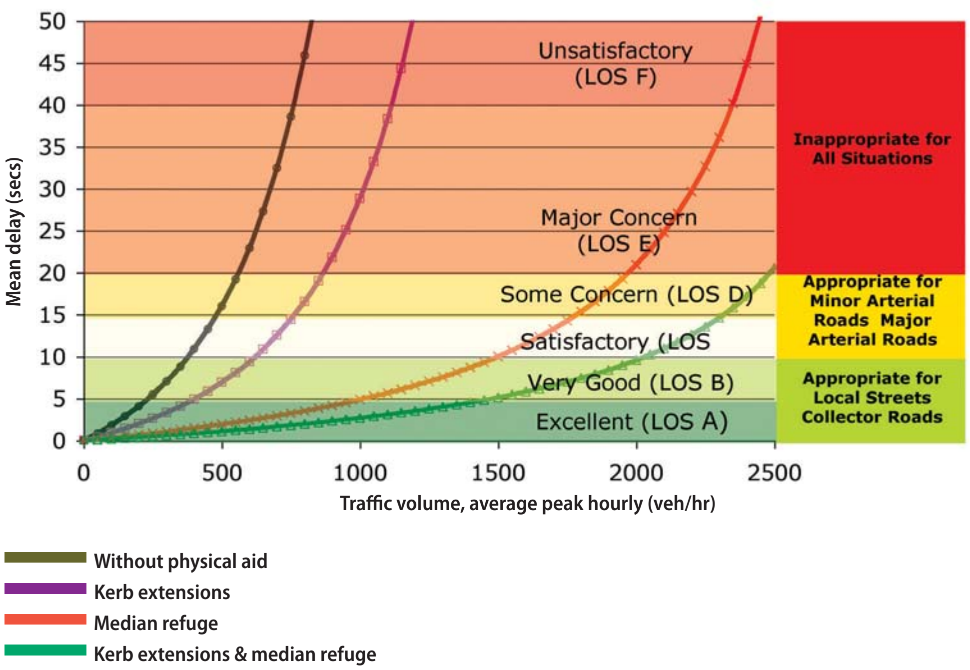


Figure 6.1 – Mean delay for various facilities on a two-lane, two-way urban road (uninterrupted flow)

Mean queuing delay to pedestrians

Note: Chart varies according to inputs entered for flow type, number of lanes, lane widths, pedestrian profile and walk speeds.

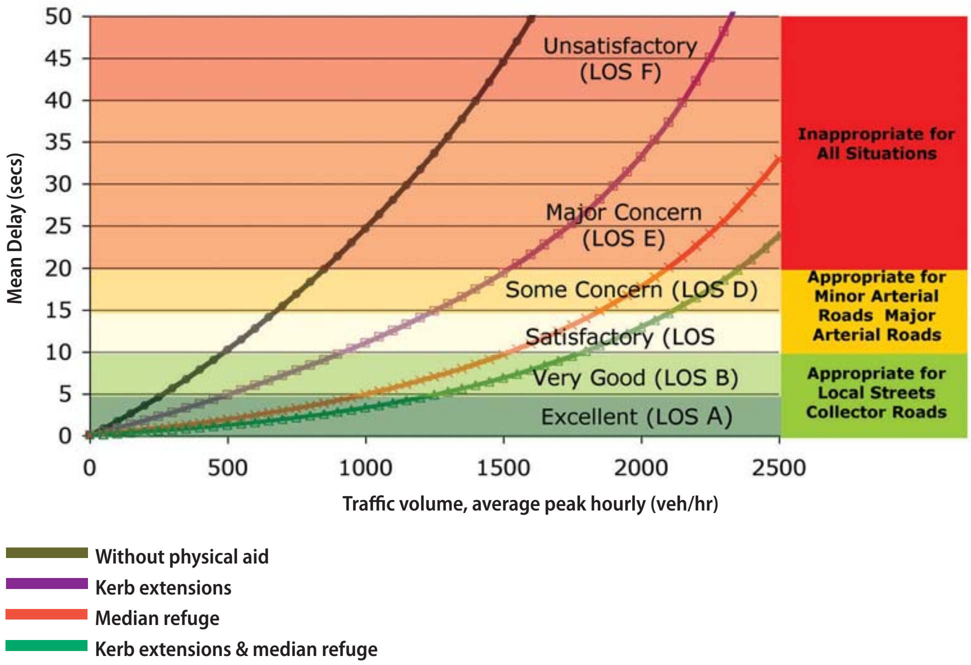


Figure 6.2 – Mean delay for various facilities on a two-lane, two-way urban road (interrupted flow)

Physical aids also improve safety as shown in Table 6.3.

Kerb extensions have superior safety performance so are likely to be preferred on roads carrying up to about 500 vehicles per hour during peak two-way flow.

On busier roads, kerb extensions and a raised median or pedestrian island can provide excellent safety benefits and a satisfactory level of service at flows above 1500 vehicles per hour.

Some of the measures shown in Table 6.3 may not normally provided specifically to address pedestrian safety. They do however provide particular benefits to pedestrians which may exceed the benefits to other road users. An example is cycle lanes. International studies show they provide a modest 10% safety improvement for cyclists, but 30% for pedestrians. This appears to be due to the buffer space provided outside parked cars.

Table 6.3 Physical aids and their typical crash reductions

Measure	Pedestrian crash reduction
Kerb extensions only [79]	36%
Raised median or pedestrian refuge islands [79]	18%
Kerb extensions with raised median islands [79]	32%
Adding kerb extension to existing zebra crossing [145]	44%
Cycle lanes [53]	30%
Roundabouts [79]	48%
Flush medians [79]	30%

Time separated/priority control

Pedestrian priority and signal control should only be considered after providing the best combination of physical aids for the site. Adding the control will provide benefits to pedestrians, but will typically result in a greater total delay to motor vehicle occupants than the total time saved by pedestrians. The road user hierarchy will be most relevant in balancing the needs of the various users. Table 6.4 shows crash reductions for the various time-separated and priority control treatments and enforces the needs for using these treatments in conjunction with physical aids.

Careful thought should be given to using pedestrian zebra crossings, as they do not on their own improve safety, and typically cause greater delays for motor traffic than the delays they reduce for pedestrians. They are not a safe option on roads that cross more than one lane of traffic travelling in the same direction.

Table 6.4 – Time separated and priority control measures and their typical crash reductions

Measure	Pedestrian crash reduction
Zebra crossing on a pedestrian platform [145]	80%
Mid-block traffic signals [145]	45%
Zebra crossings with no physical aids [53]	-28%
School patrol crossing [53]	35%
Intersection traffic signals – parallel pedestrian phase [53]	-8%
Intersection traffic signals – exclusive pedestrian phase [53]	29%

Signals are the only full time at-grade control option for multi-lane roads. They are also appropriate for busy two-lane roads where continuous pedestrian streams create excessive vehicle delays. Where there is a need for special provision for the vision impaired and where a signalised mid-block crossing would get insufficient use, consider signalising a nearby intersection.

Section 6.6 covers crossing assistance for school children.

Spatially separated facilities

Although spatially separated facilities can eliminate conflict with vehicles for pedestrians who use the facility, and minimise crossing delay, they can increase pedestrians' travel time due to the requirement to change level or other detours. This can be overcome depending on the pedestrian's position in the road user hierarchy and could involve keeping pedestrians at-grade, and raising or lowering the road. Section 6.7.7 further describes benefits and potential problems with overpasses and underpasses.

6.6 Crossing assistance for school children

Walking is the most often-used mode of transport to education facilities [76]. However, with their limited abilities and lack of experience, children are among the most vulnerable of pedestrians [91]. Their abilities will also vary according to their age, with children less than eight years old being the most vulnerable.

Crossing assistance for school children may be considered as part of school travel plans and safe routes to school. Near each school the concentration of children walking increases to the extent that formal crossing points are typically provided near school gates. Crossing facilities near schools experience short periods of high pedestrian flows, but may have little use outside these times. Crossing facilities that give full-time priority to pedestrians instead of vehicles may not be the best solution [58]. Even where crossing facilities that give priority to pedestrians are the best solution, they generally require additional devices and help [10, 90].

When considering providing crossing assistance for school children the general process in section 6.5 should be followed. However, crossings mainly used by school children have three major differences from other pedestrian crossings:

Photo 6.13 – Walking to school, Christchurch

1. Flows will be tidal at any one time, towards the school in the morning and away from the school in the afternoon.
2. The average height of those crossing (children) will be lower than that of other users, affecting sight lines and visibility [10].
3. As children will cross in groups, the consequences of a vehicle intruding into the crossing will be more severe.

Although schools often ask for formal crossing facilities [86], they should only be provided where analysis demonstrates they are appropriate, not solely on the basis of the risks perceived by parents and teachers [139]. This ensures that schools with similar issues are treated consistently, and promotes a uniform environment for both pedestrians and drivers [139]. Crossing facilities should be assessed whenever safe routes to school schemes or school travel plans are developed [46].

6.6.1 Types of crossing assistance for school children

Four types of additional crossing assistance can be offered for places where school children are particularly concentrated, and can be supplemented where appropriate by school speed zones. Table 6.5 describes this hierarchy of solutions.

Engineering devices

Engineering devices such as traffic calming and physical crossing aids should be considered first as they provide benefits for all pedestrians. The structured process in section 5.4 should be followed to improve the walking environment. This may lead to considering traffic calming or traffic reduction techniques. Physical crossing aids are discussed in more detail in section 6.5.

Table 6.5 – Types of crossing assistance for school children

Assistance	Descriptions
Engineering devices (not affecting priority)	These are devices that do not change who gives way at crossing points but offer crossing benefits. They include pedestrian islands, raised medians, kerb extensions, pedestrian platforms and traffic calming.
School traffic warden crossing	This involves adults or older children who guide school children on when to cross at: • mid-block crossing points, such as pedestrian islands and mid-block pedestrian signals • crossing points at intersections, including those with give way or stop controls, traffic signals and roundabouts • zebra crossings.
School patrolled zebra crossing or kea crossing	'School Patrol – Stop' signs stop vehicles and allow pedestrians to cross only when it is safe. School patrols operate on zebra crossings and on kea crossings (school crossing points without zebra markings).
Signalised intersections/signalised mid-block crossings	Traffic signals stop vehicles and permit pedestrians to cross when conflicting straight through traffic is stopped. At intersections they either stop any turning traffic or require it to give way to pedestrians.

For all types of school crossings, kerb extensions are generally preferred over central islands because of their safety benefits and because one crossing is easier for wardens and patrols to control than two. Central islands would, however, provide a better level of service for pedestrians at times when the crossing is not patrolled.

Pedestrian platforms should also be considered for school crossings in appropriate environments such as those where approach speeds are no greater than 50 km/h.

School traffic wardens

School traffic wardens are usually older children or adults, typically two per crossing site, who wear the same uniform as school patrols [151]. They have no power to control vehicular traffic other than by calling a pedestrian phase at traffic signals [58]. Wardens decide when it is safe for the assembled children to cross, and tell them to 'cross now', or to 'wait' [58]. Their use should be considered after engineering devices. Traffic wardens are mostly used at places with no traffic control and at traffic signals, but may also be used at zebra crossings where a school patrol is not operating, to guide children when it is safe to cross.

Photo 6.14 – Traffic island installed for safe routes to school, Christchurch (Photo: Tim Hughes)

Traffic wardens are the most appropriate solution at traffic signals, and for straightforward situations where light traffic flows provide ample crossing opportunities, with no need to stop traffic.

Figures 6.1 and 6.2 indicate that when there are kerb extensions that narrow a crossing point to nine metres, wardens can easily find suitable gaps where traffic flows at the rate of 500 vehicles per hour. Because traffic is not expected to stop, wardens provide the safest option for lightly trafficked roads.

School patrolled zebra crossings and kea crossings

School patrols are normally operated by two or three appointed children under adult supervision [79]. On rare occasions adults operate them alone. These patrols must be trained by the New Zealand Police. The appointed patrol members hold or swing out 'School patrol – Stop' signs (RG-28) when they see a safe gap in the traffic. Drivers are obliged to stop. When it is safe to cross, one patrol member calls 'cross now', and releases the children to cross. Thus school patrols, as opposed to school traffic wardens, have the power to control traffic.

When school patrols operate on zebra crossings they are called school patrolled zebra crossings. They can also operate at school crossing points without zebra markings, usually referred to as kea crossings. It is important that both of these incorporate engineering devices to improve their safety. The roadway should be narrowed by kerb extensions. Kea crossings have stricter legal requirements on their layout. Both require permanent signs and markings. Kea crossings also have temporary signs that are only present when the crossing is operational. They are removed when the patrol finishes operation and the site reverts to normal roadway where pedestrians give way to traffic [58, 90]. Kea crossings can be used for crossing two lanes of traffic in one direction, such as on a divided road or one way street – provided a separate 'School patrol – Stop' swing sign can be provided for each lane.

Photo 6.15 – Kea crossing patrol, Christchurch (Photo: Megan Fowler)

School patrols should be considered whenever traffic flows would make it difficult for school traffic wardens to find safe gaps in the traffic. Figures 6.1 and 6.2 give initial guidance, suggesting that with appropriate road widths, school patrols are not needed below 500 vehicles per hour. There is no clear rule about how many children are needed before a school patrol is justified, but as the patrols require a significant commitment of effort, alternative ways of assisting pupils across the road may be considered when there are fewer than 20 pupils.

The provision of a zebra crossing for a school patrol should be made on the basis of the use of the crossing away from school times. If there is little pedestrian use outside school times then a zebra crossing is likely to be dangerous at those times and is not appropriate. A kea crossing should be considered [58, 88, 90].

Photo 6.16 – Kea crossing on pedestrian platform, Christchurch (photo: Paul Cottam)

Sections 15.18.1 and 15.18.2 have design details of school patrols and kea crossings.

Signalised crossings

Signalising an intersection or installing a signalised mid-block crossing may be an appropriate solution in some cases to provide crossing assistance. If the crossing is not likely to be well used outside school hours, signalising an intersection would be the preferred option. Sections 6.7.6 and 6.7.9 further discuss these options.

Traffic signals are the only full time at-grade crossing control option where there are more than two lanes of traffic to be crossed, and the number of lanes cannot be reduced. They should also be considered where traffic flows are very high, making school patrol operation difficult, and where pedestrians need to cross outside school crossing times.

School speed zones

The area of road near a school entrance, where school children are most concentrated, usually has significant activity that results in reduced traffic speeds for the period before and after school. The crossing of children outside a school usually occurs in a supervised environment. Crash statistics show that crossing outside school is the safest part of a walking trip to school. The so-called 'chaos at the school gate' helps to tame traffic speeds and though user behaviour may need some management, care should be taken to ensure it is not managed so well that caution diminishes and traffic speeds increase. Where traffic calming, traffic management and parking management measures are not sufficient to achieve sufficiently slow vehicle speeds outside a school, school speed zones may also be appropriate.

School speed zones are relatively new to New Zealand, but widely used in various forms overseas. Most overseas schemes using fixed signs have proved ineffective. In New Zealand, electronic signs showing a speed limit reduction are programmed to light up only at times when children are coming to and going from school. They are only beneficial where analysis shows they would achieve a real reduction in traffic speeds. *Traffic note 37* [89] has guidelines for introducing school speed zones.

Photo 6.17 – School speed zone, Christchurch (Photo: Megan Fowler)

6.7 Network components on the roadway

This section is based on a comprehensive set of references. To avoid frequent repetition, the references numbers in common are all shown here [6, 10, 12, 13, 46, 53, 58, 66, 72, 118, 126, 139].

6.7.1 Pedestrian islands

Description

Pedestrian islands are elongated, raised portions of pavement within the roadway that provide a place for pedestrians to wait before crossing the next part of the road [56, 70]. Crossing pedestrians only need to find a gap in one stream of traffic, meaning larger and more frequent gaps and significantly reduced crossing times. Pedestrian islands are shorter than raised medians, which continue along sections of road.

Advantages

Pedestrian islands:

- reduce the crossing area where pedestrians are in conflict with traffic
- can considerably reduce delays for pedestrians (by up to 90 percent)
- can be retrofitted to existing roads
- are particularly helpful to pedestrians unable to judge distances accurately or who have slower walking speeds
- can improve safety with an estimated pedestrian crash reduction of 18 percent (or 32 percent when combined with kerb extensions).

Pedestrians on the island are more visible to oncoming drivers, and pedestrians can see oncoming traffic better.

The localised roadway narrowing encourages lower vehicle speeds.

Larger islands may be landscaped.

Disadvantages

They:

- restrict vehicle access to adjacent driveways
- can force cyclists closer to motorised traffic on narrower roads
- can disrupt drainage causing water to pond within the island or adjacent kerb ramps
- need a wide roadway to ensure adequate space after installation
- can be an obstacle which may be struck by motorised traffic if not particularly conspicuous.

The island size is related to the type and number of anticipated pedestrians that will wait on them. This space may not be readily available.

Recommendations

Because the main effect of pedestrian islands is reduction in pedestrian delay, they are most useful where traffic flows exceed 500 vehicles per hour.

Pedestrian islands are nearly always highly cost effective in improving pedestrian safety and reducing delay. They can be incorporated whenever a raised island is created as part of a roading scheme, for example deflection and splitter islands. It is important to ensure they meet at least the minimum criteria and are designed to accommodate the anticipated number of pedestrians for the facility.

Do not install where the lack of remaining road space will create an unsafe pinch point for cyclists.

Pedestrian islands can be combined with kerb extensions and platforms. When used at mid-block traffic signals and zebra crossings the island permits a staggered layout. Flush medians should include regular pedestrian islands to reduce inappropriate motor vehicle use of the medians and to improve pedestrian feelings of security on them. Although they can be retrofitted, they should be considered as a matter of course in all new/improved roading schemes.

See section 15.8 for design advice on pedestrian islands.

Photo 6.18 – Pedestrian island, Christchurch (Photo: Susan Cambridge)

6.7.2 Medians

Description

Medians are areas at, or close to, the centre of the road and provide a place for pedestrians to wait before crossing the next part of the road. They are longer than pedestrian islands and may be raised or flush, continuous or intermittent.

Advantages

Medians:

- have the same advantages as pedestrian islands
- are continuously effective along a road
- improve safety for motor vehicles.

Flush medians:

- allow vehicular access to adjacent driveways
- are very cheap to install.

Raised medians:

- have the same advantages as pedestrian islands
- may be landscaped.

Disadvantages

Medians:

- force cyclists closer to motorised traffic on narrower roads
- require a wide roadway to ensure adequate space after installation.

Flush medians:

- can cause pedestrians to feel vulnerable while waiting on long lengths of flush median.

Raised medians:

- provide an obstacle for mobility impaired pedestrians so the medians can require frequent cut-through treatments
- restrict vehicular access to adjacent driveways, leading to more u-turns at intersections.

Photo 6.19 – Raised median with pedestrian cut-through, Palmerston North (Photo: Shane Turner)
(note: tactile paving is missing)

Photo 6.20 – Flush median, Christchurch (Photo: Aaron Roozenburg)

Recommendations

Medians are particularly appropriate where pedestrian demand is not concentrated at defined locations.

Medians are suited to all classes of road and can be retrofitted as necessary where there is sufficient roadway width.

Do not install where there is insufficient remaining road space for safe cycling.

Raised medians can be combined with kerb extensions, zebra crossings and traffic signals.

Flush medians require pedestrian islands at traffic signals and zebra crossings and should incorporate regular pedestrian islands at other points [85].

Section 15.9 covers design advice on medians.

6.7.3 Kerb extensions

Description

Kerb extensions are created by widening the footpath at intersections or mid-blocks, and extending it into and across parking lanes to the edge of the traffic lane. This improves visibility of pedestrians by traffic and reduces the distance to cross the road.

Advantages

Pedestrian safety is improved by kerb extensions – with an estimated pedestrian crash reduction of 36 percent (twice that of pedestrian islands alone) [78]. This is because pedestrians are more visible to oncoming drivers and pedestrians get a better view of approaching traffic.

Pedestrian delay is reduced due to the shorter crossing distance and, therefore, crossing time which permits pedestrians to select a smaller gap (but to a much lesser extent than pedestrian islands, refer figures 6.1 and 6.2).

They also:

- can be retrofitted to existing roads
- create space for pedestrians to wait without blocking others walking past
- create space for installing kerb ramps
- physically prevent drivers from parking (and blocking) the crossing point
- gain additional space which can be used for landscaping, cycle racks and street furniture (as long as visibility is maintained)
- can help slow vehicle speeds
- ensure that car parking does not obscure visibility for vehicles at intersections.

Signs and traffic signal displays can be located where they are easily seen by approaching traffic.

Disadvantages

They:

- reduce on-street parking
- can force cyclists closer to motorised traffic on narrow roads
- can create drainage problems and rubbish can accumulate
- can create an obstruction that may be struck by cyclists and motorised vehicles.

Recommendations

Kerb extensions have particular safety benefits and also result in less delay for pedestrians. Figures 6.1 and 6.2 suggest they will be most beneficial on roads with flows less than 500 vehicles per hour.

They can be used on any class of road and can be retrofitted as necessary. They are particularly useful when combined with pedestrian platforms, zebra crossings, traffic signals and, where there is sufficient room, pedestrian islands.

Do not use where any part of the extension would protrude into a lane used by moving traffic or leave insufficient room for safe cycling.

See section 15.10 for design advice on kerb extensions.

Photo 6.21 – Kerb extensions, Christchurch (Photo: Tim Hughes)

6.7.4 Pedestrian platforms

Description

Pedestrian platforms are raised and sometimes specially textured areas of roadway that act as a focus for crossings [151]. However, they are part of the roadway and pedestrians have to give way to vehicles unless the platform is also marked as a zebra crossing. (In Australian literature, zebra crossings on platforms are called wombat crossings).

Advantages

Pedestrian platforms:

- emphasise pedestrian movements at the expense of vehicular traffic
- help to focus traffic on pedestrians crossing
- can be aesthetically pleasing
- reinforce the slow speed message to drivers
- are highly effective at reducing vehicle speeds
- eliminate grade changes from the pedestrian route and, therefore, the need for kerb ramps
- lead to more drivers yielding to pedestrians.

Photo 6.22 – Pedestrian platform, Nelson (Photo: Tim Hughes)

(Note: the ramp is well marked – because the design implies pedestrian right of way across the platform, it should be marked as a zebra crossing.)

Photo 6.23 – Pedestrian platform, Palmerston North (Photo: Glenn Connolly)

Disadvantages

They:

- only work effectively when vehicle speeds can be reduced to where drivers are able and prepared to slow or stop
- although still part of the roadway, may cause confusion as to who has the right of way
- can create discomfort for vehicle occupants, especially those in heavy vehicles (while platforms are less suited to bus routes, they can be designed to accommodate buses)
- should preferably not be used in isolation; but form part of a larger (area-wide) scheme
- may increase noise as vehicles brake, slow, pass over them and accelerate (see section 6.3).

Vision impaired pedestrians and children may not be aware they are entering the roadway on a raised platform, so there needs to be clear discrimination between the road and footpath.

Recommendations

Platforms are generally installed on local roads and sometimes on collector roads. They are not installed on arterial roads except in major shopping areas where the need for traffic calming and pedestrian assistance exceeds the arterial function. They can be retrofitted at both intersections and mid-block and are particularly useful in traffic-calmed areas (where they serve the same purpose as road humps). Where motorists need to stop and give way, the platforms should be marked as zebra crossings. In areas where heavy vehicles are part of the traffic, careful design and liaison will be necessary (see section 6.3).

Do not use where traffic approach speeds exceed 50 km/h.

Section 15.11 has design advice on pedestrian platforms.

6.7.5 Pedestrian zebra crossings

Description

A pedestrian zebra crossing is a section of roadway running from kerb to kerb and marked with longitudinal markings. Drivers are required to give way to pedestrians on both sides of all zebra crossings unless the crossing is divided by a raised traffic island.

Advantages

Zebra crossings:

- provide the least delay for pedestrians
- can be retrofitted to existing roads
- create a clear focus for crossings
- if raised (as a platform), slow vehicle speeds and can improve safety.

Recommendations

Zebra crossings are generally unsuitable for roads with higher speeds.

Do not use zebra crossings on roads with speed limits over 50 km/h unless approval is obtained from Land Transport NZ as required by the Traffic Control Devices Rule.

Do not use zebra crossings where there is more than one lane in any direction, as traffic may overtake a vehicle slowing for a pedestrian.

Zebra crossings should be combined with kerb extensions, platforms or islands to reduce the crossing distance and potentially improve safety. Other crossing assistance facilities should be considered before installing zebra crossings (see section 6.5). Flush medians must not be used to interrupt zebra crossings, but should be terminated either side of the crossing, with a pedestrian island installed in the centre [56].

Do not use zebra crossings for locations with fewer than 50 pedestrians per hour.

See section 15.12 for design advice on installing zebra crossings.

Disadvantages

They:

- on their own, do not improve pedestrian safety and may even decrease it
- can lead to an increase in 'nose-to-tail' vehicle accidents.

Pedestrians may feel threatened by vehicles travelling over the part of the crossing they have just used.

Drivers may not stop when pedestrians expect them to.

High pedestrian flows can dominate the crossing and cause severe traffic disruptions.

Wide markings can be slippery when wet for cyclists and motorcyclists.

Pedestrians may step out without checking properly whether approaching vehicles are too close to stop.

Zebra crossings need to be combined with other measures to enhance their safety.

Photo 6.24 – Pedestrian zebra crossing, Hamilton (Photo: Tim Hughes)

Photo 6.25 – Zebra crossing on platform across slip lane, Christchurch (Photo: Tim Hughes)

6.7.6 Mid-block pedestrian signals

Description

Mid-block pedestrian signals are installations that stop traffic so pedestrians can cross unimpeded. The signals are activated by pedestrians, vehicles are stopped, pedestrians cross and then vehicles are allowed to proceed.

Mid-block pedestrian signals can include intelligent features, such as extending the pedestrian phase for slow pedestrians and detecting that pedestrians have already crossed prior to the pedestrian phase being displayed.

Advantages

Mid-block pedestrian signals:

- clearly show when to cross
- balance the delays to pedestrians and traffic
- can reduce community severance
- are very safe for pedestrians when used properly.

Signals take the decision on when it is safe to cross away from the pedestrian.

Pedestrians group together, rather than crossing intermittently.

Photo 6.26 Mid-block pedestrian signals, Palmerston North (Photo: Shane Turner)

Recommendations

Use a traffic signals analysis package to model the expected delays to pedestrians and other users under signal operation. Compare the delay and safety performance with other options calculated using the *Pedestrian crossing facilities calculation spreadsheet*.

Mid-block pedestrian signals are the only option for multi-lane roads and on busy two-lane roads where continuous pedestrian streams can cause problems. They can be combined with kerb extensions, raised medians and islands.

If the number of pedestrians justifies them, consider using mid-block signals for sites with high traffic flows where the environment prevents installation of pedestrian islands or zebra crossings with appropriate physical aids.

Because safe use of pedestrian signals depends on good compliance, ensure signal timings provide a satisfactory pedestrian level of service.

Where there is a need for special provision for the vision impaired and where a signalised mid-block crossing would get insufficient use, signalising a nearby junction and incorporating pedestrian facilities can provide a better safety and traffic management solution.

Section 15.13 has design advice on installing mid-block signalised crossings.

Disadvantages

They:

- delay pedestrians more than zebra crossings
- are more costly to install, operate and maintain than other crossing types
- can be more disruptive to traffic flows than other crossing types apart from zebra crossings
- are more dangerous when crossing near the signals or against the signals.

Slower pedestrians may find it difficult to cross within the allotted time. Intelligent features can assist this.

Signal timings are frequently based on minimising vehicle delays which results in a poor level of service to pedestrians. Pedestrians having to wait for what seems to them an excessive time will take risks and cross against the signals. If all pedestrians have crossed before receiving a green signal, vehicles are required to stop anyway. Intelligent features can reduce this.

6.7.7 Grade separation

Description

Grade separation refers to infrastructure that puts pedestrians and motor vehicles at different heights. This typically means underpasses (tunnels and subways) and overpasses (bridges and elevated walkways).

Disadvantages

Grade separation:

- is costly to construct. It needs to be planned at the earliest possible stage to ensure maximum cost-effectiveness
- may need long ramps or flights of steps, resulting in longer travel times and more effort
- is only effective where pedestrians perceive it is easier and faster to use than crossing at-grade
- can be visually intrusive
- may be subject to vandalism
- may create an increase in the speed of traffic
- may increase the risk for those pedestrians who continue to cross at-grade
- may require the relocation of utilities
- may cause pedestrians to have personal security concerns because of reduced natural surveillance from traffic.

Places where it easiest to construct grade separation are often not on pedestrians' desire lines.

Overpasses:

- are more likely to be open to the weather and the risk of objects falling onto the roadway
- require greater vertical separation than underpasses and, therefore, longer approach ramps and greater travel distance.

Underpasses:

- are perceived as providing less personal security than overpasses due to lower natural surveillance
- can have drainage problems
- can encourage high cycling speeds.

Advantages

Grade separation:

- allows pedestrians to cross the road unhindered by traffic
- can reduce walking travel time
- significantly reduces potential conflicts with motorised vehicles
- minimises severance in communities with heavily used roads
- reduces vehicle delays and increases highway capacity
- can be integrated with existing development (such as air bridges linking buildings).

Overpasses:

- are usually cheaper than an underpass in an existing environment
- can be covered to protect against the weather and to prevent objects falling to the roadway below.

Underpasses:

- can be cost effective when part of a new development.

Recommendations

Grade separation can include under- and overpasses for motor vehicles with the pedestrian route remaining at-grade. This overcomes issues regarding greater travel distances for pedestrians using such facilities. Where the road user hierarchy favours pedestrians this may be the preferred approach.

Where deemed necessary, the grade-separated route must appear more desirable to pedestrians than any other option. This may require restricting other options, for example by installing fencing around dangerous potential at-grade crossing areas, or by improving the convenience and aesthetics of the grade-separated option.

Section 15.14 has design advice on installing grade-separated crossings.

Photo 6.27 – Pedestrian overpass, Auckland (Photo: David Croft)

6.7.8 Give Way, Stop and uncontrolled intersections

Description

Give Way and Stop controlled crossroads and uncontrolled 'T' intersections are most common where there are moderate or low volumes on one or more approaches. They give no priority to pedestrians crossing the intersection. As pedestrians often cross at intersections, they present important opportunities to improve pedestrian safety and convenience.

Advantages

Less busy intersections provide the best opportunities for traffic calming measures and crossing aids.

Photo 6.28 – Priority intersection, Christchurch (Photo: Andy Carr)

Photo 6.29 – Intersection on platform, Auckland (Photo: Brenda Bendall)

Disadvantages

The presence of conflicting and turning traffic movements makes crossing decisions more complex for pedestrians.

The uncontrolled approaches will have faster traffic speeds and be more dangerous to cross. It can be difficult to provide physical crossing aids while maintaining traffic efficiency.

Providing the space necessary for large turning vehicles increases crossing distances and turning speeds of smaller vehicles.

Recommendations

Consider opportunities for traffic calming and physical crossing aids.

Balance the space needs of turning traffic with pedestrian needs.

Consider safer alternatives such as roundabouts.

Combine intersections with kerb extensions, raised medians, pedestrian islands and platforms.

Section 15.15 has general design advice on intersections.

6.7.9 Signalised intersections

Description

In many respects, signal-controlled intersections and mid-block signals have very similar design considerations. At mid-block signals the pedestrian phase is always segregated from vehicles, while at intersections pedestrians may have to share their phase with turning traffic, which must give way to pedestrians [70].

Advantages

Signalised intersections:

- clearly indicate when to cross
- largely take away from the pedestrian the decision on when it is safe to cross
- allow pedestrians to group together, rather than crossing intermittently
- provide clear crossing opportunities where vehicle movements may be very complex
- reduce vehicle conflicts
- can reduce pedestrian crashes if the conflict with turning vehicles is well managed.

An exclusive 'scramble crossing' or 'barnes dance' phase can allow pedestrians to cross safely on the diagonal, minimising their overall travel distance while eliminating vehicle conflicts, but at the expense of extra pedestrian and vehicle delay. The safety benefits will diminish to the extent that extra delays result in non-compliance.

The pedestrian phase can be advanced to give pedestrians an early start (and hence position them where drivers are more likely to notice and give way).

The turning needs of large vehicles can be catered for in a pedestrian friendly way by providing appropriate slip lanes.

Disadvantages

They are:

- more costly to install, operate and maintain than other crossing types
- rarely installed to provide for pedestrian needs but for where vehicular flows warrant signalisation.

Some pedestrians may find it difficult to cross within the allotted time.

The pedestrian phases may require a high proportion of the total cycle time (delaying vehicles), or pedestrians may be delayed to accommodate the vehicles.

If pedestrians have crossed illegally before receiving a green signal, signals will still provide a pedestrian phase, delaying traffic for no apparent reason.

Recommendations

At busy junctions requiring multiple approach lanes, signals are generally preferred over roundabouts.

Consider exclusive phases that permit diagonal crossing where pedestrian needs predominate in the hierarchy of users (such as CBD streets), or where turning conflicts cannot be sufficiently well managed by other means.

Consider providing slip lanes for high volume multi-lane junctions especially where heavy vehicles are present. If not initially provided, reserve the land needed to do so in the future.

Signalised intersections can be combined with kerb extensions, raised medians, pedestrian islands, slip lanes and platforms. If slip lanes are installed, pedestrian platforms should be considered.

Section 15.16 has design advice on installing signalised intersections.

Photo 6.30 – Signals with exclusive pedestrian (scramble) phase, Auckland (Photo: Judith Goodwin)

6.7.10 Roundabouts

Description

Roundabouts give no priority to pedestrians waiting to cross the intersection. However, roundabouts can be designed to benefit pedestrians.

Advantages

Roundabouts can be designed to ensure low vehicle speeds and should have a major role in traffic calming schemes. They generally reduce crashes for pedestrians.

Pedestrian islands can be incorporated into splitter islands dividing the crossing into two movements which will reduce pedestrian delay.

Disadvantages

They:

- can cause problems for the vision impaired due to confusing auditory signals from approaching and circulating vehicles
- can be more difficult to cross when higher volumes of traffic are present

Pedestrians find it particularly difficult to cross the exits of fast multi-lane roundabouts, and drivers exiting these roundabouts may not notice pedestrians crossing if there is not a large pedestrian presence in the area.

Photo 6.31 – Roundabout with zebra crossings on the approaches, Palmerston North CBD (Photo: Shane Turner)

Photo 6.32 – Crossing point near roundabout, Queenstown (Photo: Tim Hughes)

Recommendations

Roundabouts should be designed to ensure low entry and exit speeds.

The splitter islands of roundabouts, should incorporate pedestrian island crossing facilities.

When considering installing multi-lane roundabouts, walking and cycling requirements need to be given full consideration. Consider the use of grade separation of paths, adding signals to the roundabout, or using conventional intersections with traffic signals instead.

Roundabout approaches and departures can be combined with kerb extensions. Pedestrian platforms may be used where approach speeds do not exceed 50 km/h. Zebra crossings can be marked on such platforms where the general requirements for zebra crossings are met, and queues from the crossing will not block the roundabout.

Section 15.17 has design advice on pedestrian aspects of roundabouts.

6.8 Railway crossings

Recommendations

Rail corridor operators seek to minimise the number of level crossings so the need for any additional crossings will have to be discussed with them from the outset to gain their consent.

Level crossings and grade separated crossings should be as convenient as possible for pedestrians and, where possible, follow the natural desire line. There have been cases in New Zealand where pedestrians have found it more convenient to cross the tracks as trespassers, at-grade, putting themselves at risk of being hit by trains. In New Zealand, five to 15 pedestrians are killed each year by trains at places other than level crossings, ie crossing illegally or walking along the tracks [113].

It is important to take into account railway tracks that are close to new developments.

During planning for new areas, locate developments so that pedestrian and other desire lines can utilise natural features such as railway cuttings and embankments to facilitate grade separation.

For significant new developments near existing railway lines, consider how pedestrians will gain access across the railway lines. New railway crossings may be necessary so it is important to involve the rail corridor operator from the outset.

Section 15.19 has design advice on installing at-grade railway crossings.

Photo 6.33 – Pedestrian railway level crossing beside road, Christchurch (Photo: Susan Cambridge)

Note: good separation - but tactile paving needed and ashphalt surface requires regular maintenance.

Photo 6.34 – Automatic pedestrian gates control double track crossing, Fremantle, Western Australia (Photo: Tim Hughes)

Description

Although railway crossings are rare compared with road crossings, pedestrians can feel extremely apprehensive when using them. Trains can travel quickly, are very intimidating and are unable to stop suddenly or swerve to avoid a collision.

There are three types of crossing:

1. Grade separated, with pedestrians travelling under or over the railway
2. Pedestrian level crossings adjacent to vehicular crossings
3. Pedestrian level crossings in isolation from vehicular crossings.

In New Zealand in 2004, four pedestrians died and one was seriously injured after being hit by trains at level crossings [113].

The advantages and disadvantages of grade separated and level crossing facilities are similar to those across roads. See section 6.7.7.

7 PLANNING FOR PEDESTRIANS

CONSIDER WALKING IN RELATION TO OTHER PLANNING PROCESSES AND PROGRAMMES
Integrate walking into neighbourhood planning processes
Determine the appropriate mix of programmes that affect walking
Coordinate with school and workplace travel plans
Review district plan provision for walking and resource consent processes

7.1 Introduction

Once a walking strategy has been developed for a local authority, attention will focus on planning for the needs of pedestrians in each locality. This needs to consider what other planning activities are already happening that affect walking and what combination of these may be appropriate in the circumstances.

There are a variety of approaches that vary in their transport scope and targets. Ideally, planning for an area should be an integrated process considering all community needs and aspirations in a *community development plan*. Traffic calming measures may be considered in a *local area traffic management plan* (LATM). A *neighbourhood accessibility plan* may consider access needs by all modes including cycling, walking and access to public transport stops. Walking needs alone may be addressed in a *community walking plan*. Particular destinations such as schools and businesses may have their own travel plans. All of these planning programmes follow a broadly similar process which is to involve the community to identify problems and potential solutions, collect information, analyse problems, assess options, decide on actions, prioritise them, put them in a programme of funded actions and implement them, as shown in figure 7.1.

Table 7.1 briefly summarises the scale, scope and groups that are targeted by each of these planning programmes. All of them should consider the needs and aspirations of pedestrians for safe walkable conditions and in this respect should generally follow the process outlined in this guide.

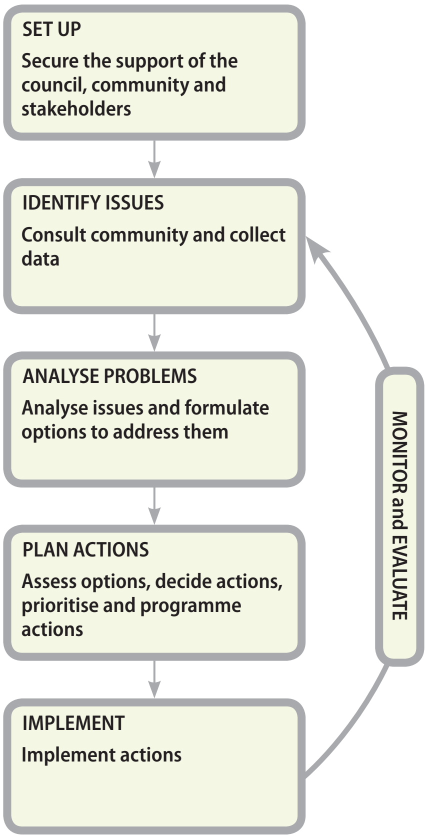


Figure 7.1 Community planning process [74]

Table 7.1 – Nature of community planning programmes

Plan or programme	Scale	Scope	Targets needs of
Community development plans	Whole neighbourhood	All issues	Everyone
Local area traffic management plans	Whole neighbourhood	Traffic	Everyone
Neighbourhood accessibility plans	Whole neighbourhood or defined area	Active modes plus public transport	Everyone
Community walking plans	Whole neighbourhood	Walking	Everyone
Workplace travel plans	Site-based	All modes	Staff/visitors
School travel plans	Site-based	Active modes plus public transport	Children/parents
Safe routes to school	Site-based	Active modes	Children/parents

Some plans focus more on walking than others, with community walking plans focusing solely on walking. Because all these programmes involve related data needs and processes, integration between them is desirable to achieve potential synergies. When planning projects it will be important to use the most appropriate mix of programmes and tailor them to the needs of each community. The approach depends on a number of factors, including the issues in the community concerned, the goals and the target group. It is important to consider carefully the most appropriate approach to achieve the required results.

The Land Transport NZ community-focused programmes activity class provides resources to prepare plans for improving safety and accessibility for walking and cycling.

The different programmes are discussed in more detail below.

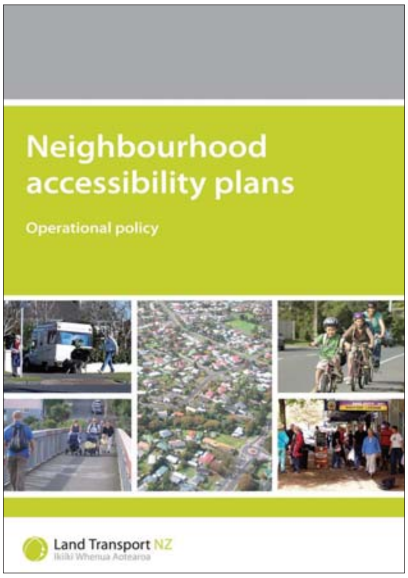
Photo 7.1 – Pedestrian precinct, Christchurch (Photo: Susan Cambridge)

Photo 7.2 – Walking environment, Auckland (Photo: David Croft)

7.2 Neighbourhood-wide plans

While fully integrated community development plans are desirable for each neighbourhood, comprehensive approaches are only common for planning new communities and for run-down areas targeted for urban renewal in neighbourhood improvement plans.

Where the speed and volume of through traffic is creating difficulties, local area traffic management plans (LATMs) detail traffic calming measures. Reducing the volume and speed of traffic is the most effective way of improving the pedestrian environment as outlined in the hierarchy for considering solutions in section 5.4. When developing LATMs, locations where pedestrian desire lines cross roads should receive particular attention.



Neighbourhood accessibility plans

Neighbourhood accessibility plans focus on providing access by walking and cycling to local destinations, bus stops, railway stations and extenal links. Detailed guidance on conducting neighbourhood accessibility planning projects is contained in *Neighbourhood accessibility planning – guidelines for facilitators* [74], currently a draft manual which will be available on the Land Transport NZ website. These guidelines may also be helpful in preparing community walking plans as they have many features in common. Assistance and advice on resolving major safety issues when planning for walking is available from Land Transport NZ regional staff.

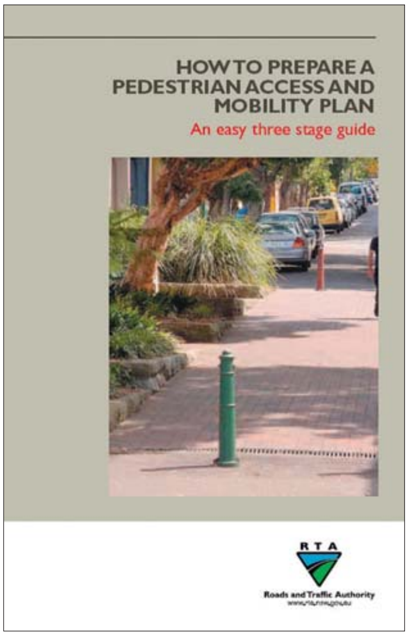
The Land Transport NZ community-focused programmes activity class provides resources to prepare these plans.

Community walking plans

Varying conditions within local authority areas will affect the walking environment. For instance, pedestrians in a small rural settlement will potentially have different trip characteristics from those in a larger city.

Consequently, the general walking strategy for the local authority area should be supplemented by community walking plans that are specific to small areas, setting out details relating to particular issues and difficulties, and remedial actions in those areas [125]. A community walking plan may be part of a broader neighbourhood planning process, provided walking needs and options are dealt with in the same comprehensive way as they would be in a stand-alone walking plan. Community walking plans are described more fully in section 8.

The Land Transport NZ community–focused programmes activity class provides resources to prepare these plans.



7.3 Workplace travel plans

A workplace travel plan is an integrated package of measures specific to an existing or proposed development, site or organisation, which aims to promote alternative travel choices to, and reduce reliance on, single-occupancy private car use [44]. It should consider transport options and information for all trips to and from the site, whether by staff, customers or other visitors. It can be produced:

- to improve access by other transport modes to the site
- as a strategic business tool to minimise parking problems, reduce car park maintenance costs, or enable car parks to be used for other purposes
- to reduce congestion and improve safety in the local area
- to meet road controlling authority (RCA) requirements as part of a resource consent application
- to help in recruiting and retaining employees
- to demonstrate an organisation's environmental credentials
- to encourage employees to follow a healthier lifestyle.

Workplace travel plans vary in complexity and detail, but generally include measures and activities in the workplace to support alternative forms of travel, together with a consideration of improvements required on the wider transport networks. Each plan is also likely to contain clearly stated objectives and measurable targets to ensure real and sustainable improvements in non-car travel.

Walking plays an important part in a business travel plan because short journeys can easily be made on foot and walking is part of accessing other forms of travel, particularly public transport [44].

When preparing a workplace travel plan, it helps to have a good-quality walking environment already provided by the RCA at key locations and on major pedestrian routes in the vicinity of the development, site or organisation. Where this is not the case, one action for the plan may be to lobby for improvements.

The Land Transport NZ community-focused programmes activity class provides resources to prepare these plans.

7.4 School travel plans and safe routes to school

Journeys to school are of key safety importance because:

- younger pedestrians are at greater risk of being involved in a crash [76]
- journeys on foot account for nearly a third of all trips made to and from school [76].

Making pedestrian routes to school safer can also help increase the number of walking trips, which then [129]:

- reduces car-based trips to school, reducing congestion on the wider road network
- reduces congestion at the school entrance
- improves children's health through increased exercise
- equips children with better road safety awareness.

Two programmes have been developed in response to the need to reduce injuries and increase the number of walking trips for school children: *school travel plans* and *safe routes to school*. Both are very similar in their process.

The Land Transport NZ community-focused programmes activity class provides resources to prepare these plans.

The needs of schools vary. At some schools the main issue may be encouraging more walking and cycling to school, less car travel and a reduction in congestion near the school gate. School travel plans were initially conceived with this emphasis. Safety engineering is involved to the extent that perceived dangers are an obstacle to more walking and cycling.

Photo 7.3 – Walking school bus, Christchurch

Photo 7.4 – Safe routes to school crossing point sign, Christchurch (Photo: Tim Hughes)

At other schools the main aim may be to improve the conditions for the majority of children that are already walking or cycling to school. Safety engineering is always a key issue at these schools and travel behaviour change may only be a minor element. This is more typical of lower socio-economic areas. The safe routes to school programme was initially conceived with this emphasis.

As the programmes have developed, each has adopted the key elements of the other.

All school-based programmes aim to improve safety and remove institutional, physical and attitudinal barriers to walking (and cycling) to and from school [129]. They can be highly effective in increasing the number of children walking [63]. From a planning and design perspective, they typically involve improving and/or installing [89, 129]:

- road crossing facilities
- vehicle speed-reduction devices
- pedestrian and cycle paths
- road markings
- signs to warn drivers of the presence of children
- lighting
- traffic management measures.

Measures can be highly targeted, as this is one of the few cases where pedestrian trip origins and destinations can easily be identified (from school records of pupils' addresses), as can associated risks (through reviewing accident records).

However, the approach is more comprehensive than solely providing infrastructure, as maximising walking journeys and overcoming obstacles require behavioural changes from a range of stakeholders [121]. To this end, school-based programmes take a multi-disciplinary approach, allow for joint work across several agencies, and actively involve the wider school community by having:

- teaching staff incorporate road safety within the school curriculum
- children at the school map their own routes, identify physical barriers and suggest ways to solve the problems
- parents who would normally drive their children to school being made aware of their impacts upon those walking and upon the wellbeing of their own children.

7.5 Resource consent applications

Photo 7.5 – Car park, Christchurch (Photo: Megan Fowler)

The resource consent application stage can offer opportunities to make improvements for pedestrians. For example, local authorities can ask for workplace travel plans as part of granting consents.

When assessing resource consent applications, RCAs should ensure that all potential impacts on pedestrians of the development or subdivision have been fully considered, assessed and mitigated by people with appropriate skills [46, 169]. This includes the walking routes within the site (for example through car parks) as well as those external to it, both during and after construction. It also includes pedestrian provision in subdivisions. These policies need to be included in district and city plans.

As a very minimum, no resource consent application should adversely affect conditions for pedestrians. However, developments often create opportunities to provide new walking links and/or increase pedestrian activity. To positively encourage walking, all new infrastructure should be provided to a standard higher than the permissible minimum, and city and district plans should reflect this. Urban developments are more likely to be successful, and to have a higher economic value, if pedestrians are properly catered for [26].

If an application involves apparently unused public land (including road reserves), the RCA should visit the site over a suitable period to check whether pedestrians use the land on a casual basis. If they do, any adverse impacts of the development on walking should be identified and, where possible, mitigated. However, as this may not always be possible, pedestrian interests should be protected by including, in formal planning documents, all routes that are well used or have walking potential.

Proposed residential communities raise unique issues. As they will provide a place for people to live, through traffic should be discouraged and the pedestrian environment be of a high quality. The layout should provide continuous footpaths and direct walking routes to key destinations (including retail centres and bus stops). Traffic-calming techniques should apply to all new residential development (although this does not remove the need for good design in the first place) [114].

Gated residential communities can be a barrier to pedestrian routes. Where one is proposed, pedestrian access through it should be maintained. In the unlikely event that this is not feasible, existing formal or informal pedestrian routes should not be blocked.

Appendix 3 discusses matters that should be addressed in district plans.

8 PEDESTRIAN PLANNING PROCESS

SYSTEMATICALLY PLAN FOR PEDESTRIAN NEEDS IN EACH AREA
Define the scope, the area and who to involve
Research the area and its issues
Develop and assess solutions
Prioritise actions
Implement
Review

8.1 Introduction

This section focuses on the pedestrian planning process for community walking plans. The general process used is common to other planning programmes that consider pedestrian needs, such as workplace travel plans, neighbourhood accessibility plans, and school-based programmes.

8.2 Define objectives

A community walking plan should have clear objectives that can be achieved within a reasonable timescale and be monitored (see section 19). Objectives should always support the community's walkability (see section 4), but may also focus on particular issues such as [125]:

- improving accessibility for all pedestrians
- improving accessibility for particular types of pedestrian
- identifying and resolving pedestrian crash issues
- reducing severance on all pedestrian routes
- improving links to other transport services
- accommodating pedestrians' special event needs
- enhancing road crossing opportunities
- providing a consistent level of walking environment
- providing and improving relevant pedestrian facilities for the prevailing land use(s)
- integrating recreational and road corridor routes
- encouraging behavioural change.

8.3 Select appropriate stakeholders

The most effective community walking plans involve a cross-section of the local authority and community from the outset. Depending on the needs of the area, it may be appropriate to involve:

- planners
- traffic and/or roading engineers
- road safety officer(s)/coordinator(s)
- accessibility officer(s)
- the road controlling authority walking advocate
- walking advocacy groups
- public transport operators

Photo 8.1 – Stakeholders meeting, Mount Manganui (Photo: Megan Fowler)

- New Zealand Police community constables
- representatives from local walking and running clubs
- elected members
- community board representatives
- representatives of local iwi
- business representatives from the area
- community representatives
- a cross-section of individual members of the community
- the local Land Transport NZ area engineer.

Stakeholders should not be selected solely on the basis of whether they have any specialist or technical knowledge of pedestrian-related issues.

8.4 Define the area

Community walking plans should relate to areas that have common elements defined by factors such as:

- geographic area
- land use
- administrative boundaries
- planning designations
- the scale of pedestrian activity
- the types of pedestrian present and/or expected.

Once defined, background information should be gathered to confirm that the proposed area is appropriate, and in particular that there are no adjacent areas that should be included. Where necessary, the original area may need adjusting.

8.5 Research the area

The area's current and likely future characteristics for walking should be identified using a twofold approach, as shown in Table 8.1.

Table 8.1 – Approaches to researching the area

Approach	Purpose	Data to be gathered
National and local policy/strategy documents	To define the overarching framework for community walking plans	• Local and neighbouring walking strategies • Disability and access policies • Land use allocations and zoning • Resource consent applications • Workplace travel plans • Safe routes to school/school travel plans • Neighbourhood improvement plans
Desktop assessment	To identify how the area appears to be used at present	• Pedestrian crash data • Traffic surveys • Pedestrian demand/surveys • Key trip origins and destinations • Likely points of severance • Social/demographic population data • Public transport routes/service frequencies • Land uses • Maintenance records • Existing pedestrian facilities • Letters of complaint • Community satisfaction surveys

Researching the area also involves assessing demand. See section 10 for details on how to do this.

8.6 Site visits

Although the research will collect a substantial amount of information, site visits should always be done to check how the walking networks are used in practice and to observe pedestrian behaviour – at peak-use times and in some cases after dark. Additional data collection exercises can be undertaken if required.

Factors that should be confirmed through site visits and interviews include:

- trip origins and destinations
- community severance locations and extent
- the extent of pedestrian infrastructure provided
- the types of pedestrian present
- public transport stops
- areas of high pedestrian use
- footpath condition
- informal routes used (such as worn paths on grass)
- walking hazards and barriers
- signage (and lack of signage)
- pedestrian behaviour
- opportunities for improving public spaces (art, seating etc)
- anomalies between mapped facilities and actual provision.

8.7 Using technology

Developing a community walking plan involves collecting, managing and analysing a considerable amount of data. Coding it onto a geographical information system (GIS) system as it is gathered will help to:

- preserve data integrity
- minimise the chances of data being accidentally lost
- enable data processing and analysis in future.

8.8 Walkability

It can be useful to determine the area's walkability, and walkability audits should be done on more heavily used routes. See section 11 for details of potential approaches.

8.9 Community involvement

The community should be involved because some hazards may have been overlooked during data collection and site visits. The data may not reflect community perceptions of problems that influence walking behaviour.

Community involvement should involve all parties using the area, including bus and taxi companies, local community services, schools and representatives of people with mobility and sensory impairments.

Section 9 sets out techniques for involving the community.

8.10 Define deficiencies and identify opportunities

After developing an understanding of the area, all data should be assessed and initial views developed about where and how the walking environment is deficient and the opportunities available for improvement. This can be done by examining:

- routes between trip origins and destinations
- apparently hazardous locations
- inconsistencies in infrastructure
- the condition of infrastructure
- informal pedestrian links
- areas where particular types of pedestrian are not properly accommodated.

8.11 Action plan

Once the deficiencies have been identified, the next stage involves developing remedial measures, describing the anticipated benefits of each, and detailing the costs and implications for other road users (if any). If several measures are possible, a more detailed audit of particular areas may be needed to identify the most suitable solution.

In practice, devising remedial measures can lead to the creation of further opportunities and/or additional constraints. This means some iteration between this and the preceding stage.

As resources are likely to be constrained, the measures should be prioritised according to local circumstances. Section 12 covers the many ways this can be done.

8.12 Implementation

The action plan is followed by implementation, during which it is important to understand the role of walking advocacy groups, the community and partnerships. Section 13 covers implementation.

8.13 Monitoring and review

Community walking plans should be monitored and reviewed regularly to check their progress and success. Section 19 covers monitoring techniques.

9 COMMUNITY INVOLVEMENT IN SCHEME DEVELOPMENT

INVOLVE THE COMMUNITY IN SCHEME DEVELOPMENT
Who in the community to involve in scheme development
How to involve them
How much to involve them

9.1 Introduction

The Land Transport Management Act (2002) and Local Government Act (2002) have specific requirements for community consultation. However, as everyone has the potential to be a pedestrian, and walking is an element of nearly every journey, ensuring effective community involvement in scheme development can require considerable effort and resources [48]. The community also needs to be involved in the planning and design of facilities on private land, such as new developments and retail areas.

9.2 Benefits of involving the community

Members of the development team may not have as much in-depth local knowledge or understand local issues as well as the people living close by who regularly walk in the area. By accessing and using this knowledge and experience, the team can ensure they identify the option with the greatest support and develop the most acceptable solution. They are more likely to get it right the first time and be cost effective if the community is involved [139].

Community involvement from the outset can improve the level of community buy-in. Involving the community in certain aspects of implementation (for example carrying out an education initiative) assists with the completion of tasks and can improve uptake of key messages. Community support can also add weight to preferred initiatives and ensure recommendations are better received by councils and other stakeholders.

Photo 9.1 – Community street review, Christchurch (Photo: Glen Koorey)

9.3 Groups to involve

Effective community involvement should focus on the scheme users and those directly affected [146]. These include:

- existing pedestrians
- people not currently walking but who might do so in future, such as those currently specifically excluded from walking, and potential visitors
- people directly affected by the provision for pedestrians, including other road users, those living nearby, and those responsible for managing the pedestrian network in the area
- people indirectly affected, including council officers, retailers and employers, and the emergency services
- people with various types of impairment.

These groups must have the opportunity to make meaningful contributions at all stages of planning and design, using techniques appropriate to the community or area. Consultation should not be a 'bolt-on' separate task [48, 103].

9.4 Techniques for involvement

Table 9.1 illustrates the techniques for involving the public [47, 48, 120, 146].

Table 9.1 – Specific techniques for community involvement

Involvement		Description	When used
Providing information	Using the media	News releases or paid advertisements for radio, television and newspapers.	To provide initial contact for schemes. To gain initial views. To keep the public updated on progress. To thank them for being involved.
Providing information	Posters, leaflets and information sheets	Promotional materials produced to inform the public.	To reach a wide audience while ensuring that information is consistently presented.
Providing information	Public meetings	An 'open' meeting to which the public is invited to hear about the proposal and give their views.	To explain issues and encourage debate. Where no firm data is required. To demonstrate public involvement.
Undertaking consultation	Presentations	A formal presentation, usually given to individuals with a common interest.	To involve a specific audience. To obtain views on final designs for schemes.
Undertaking consultation	Questionnaires/ surveys	Pre-planned questions about a proposal, posed to specific respondent groups.	When 'hard' data is needed. Where a high level of interest is expected. To help define and quantify issues, problems and concerns. To obtain views on final scheme designs.
Undertaking consultation	Exhibitions	Visual displays of the proposal, displayed at a convenient venue.	Where there are specific options to present.
Undertaking consultation	Focus groups	A series of meetings with up to 12 people comprising a cross-section or sub-section of the community, for discussion of the proposal.	To generate a deep understanding of a particular or complex issue by discussion and debate (qualitative data). To better understand the reasons for opinions/beliefs. To generate new ideas.
Facilitating participation	Transport forum/citizens' panel	A 'standing' group of interested individuals, set up on a longer-term basis and meeting regularly.	When informed contributions are required. Where there is a specific issue/question to address.
Facilitating participation	Community participatory events	Full community involvement in a series of informal, two-way workshops or street audits.	Where the involvement of the whole community is desirable. Where the outcome will be implemented. When physical issues are being investigated.
Facilitating participation	New technologies	New technologies are emerging to involve the public, such as using the internet for posting proposals for comment and providing online questionnaires.	When trying to reach members of the community that may not otherwise be involved. To supplement other facilitation measures.

The results of any public involvement technique must be interpreted cautiously, as they may not reflect the opinions of the 'silent majority' [146]. Equally, they may be unduly influenced by dominant personalities. To determine if this is the case, a random survey of those affected may help.

Bias can occur if stakeholders are not treated equitably or if certain groups are unfairly disadvantaged. It should be minimised by [48]:

- using appropriate statistical techniques to calculate sample sizes and confidence levels
- proactively managing the involvement of groups that might otherwise be excluded
- ensuring that, if there is only a small number of respondents, they are able to 'speak' for the majority.

9.5 Extent of community involvement

Community involvement should be planned to ensure it is at the heart of the development process. Ad hoc approaches can be inadequate.

Plans for community involvement will vary according to local circumstances and the scope of the scheme being considered. Consultation plans should be revised and updated as the scheme's development progresses, with the main issues for consideration being [48, 146]:

- defining affected parties
- the geographic area over which each affected group should be consulted
- key stage(s) of the planning/design process when the community should be involved
- the nature, extent and depth of the information required from the community at each of the identified stages
- the potential difficulties in obtaining the required information, including minimising bias, associated costs and impact on timescales
- the type of involvement for each group at each stage
- the ways by which additional groups will be included if necessary.

10 ASSESSING THE DEMAND FOR WALKING

ASSESS DEMAND FOR WALKING
Assess current demand for walking
Assess potential demand for walking
Identify locations where improvements are likely to lead to more walking

10.1 Introduction

It is important to establish pedestrian numbers and characteristics in any given location to ensure an appropriate walking infrastructure [115]. The techniques are useful not only for forecasting walking generation for new developments but also for retrofitting existing roads.

10.2 Key issues in assessing demand

Pedestrians are more likely to be found within and/or around residential areas, retail areas, transport interchanges/nodes, major employers, tourist centres, leisure facilities and education establishments [29, 130, 169]. However, trip origins and destinations change with time, so forecasting walking demand is not a one-off process.

Existing pedestrian activity is a useful starting point. However, it is also important to be able to estimate how many people would walk if the environment were modified, such as through land use changes or removing physical and/or institutional barriers to pedestrian movements. This is known as 'latent demand'.

Photo 10.1 – High demand for use of crossing facilities, Auckland (Photo: Judith Goodwin)

10.3 Methods of assessing current demand

Pedestrian counts are one of the main ways to assess current demand – that is, directly observing the number of people walking in (or using) a particular area. Section 19 covers techniques and considerations for doing this.

The national census is also a useful source of background information, particularly for age groups, and travel to work and car ownership rates in specific areas or communities.

Other approaches can also be used, as shown in Table 10.1. All are useful but should not be used in isolation – a combination will provide a comprehensive understanding of likely existing demand.

Table 10.1 – Ways to assess current demand for walking

Technique	Description	Benefits	Limitations	Application
Crash data	Examine Land Transport NZ crash records to identify where pedestrians have been injured. This identifies areas used by pedestrians.	Simple to use. The data is readily available. The data is needed anyway for improvement measures. Reliable trends.	Does not identify heavily used but safe routes. May not identify unsafe routes avoided by pedestrians. Does not include incidents involving only pedestrians, such as falling. Low reporting rate for pedestrian crashes means some locations will not be identified.	A useful 'first-pass' approach to decide where improvement measures may be required.
Planning information	Using the zoning system for land use to identify areas that are likely to generate or attract walking trips.	Uses readily available information. Very useful to identify common walking trip origins and destinations. Can be used to estimate the relative likelihood of walking trips.	Does not provide information about pedestrian numbers or routes. Can be costly if a high 'grain' of results is required. May require detailed local knowledge.	Obtain information about land use zones, growth areas, major residential subdivisions or commercial or community developments from district plans or local authorities' planning departments. Identify where walking may be expected by plotting significant trip origins and destinations, together with existing facilities (and severance).
Existing provision	Identifying the location of current infrastructure for pedestrians as a proxy for where there are significant pedestrian numbers.	Easy to understand and carry out. Information forms a base inventory that is useful for many other purposes.	Can be costly to collect and manage the information. Assumes previous provision was made in response to need, rather than for other reasons. May reflect locations where pedestrian numbers were significant in the past but not at present.	As the information is needed anyway, it is a useful exercise to undertake.
Ministry of Transport travel surveys	Gathering information on walking trips can be gathered from surveys conducted for other transport planning projects and from Ministry of Transport travel surveys.	Minimal cost of data collection. Ministry of Transport data is regularly updated. Data set may be comprehensive.	The Ministry of Transport survey is national and is sufficient for national and regional analysis, but has insufficient data for local analysis. Data may not identify routes.	Use Ministry of Transport data only where local data is not available. Data should be used with care to prevent misrepresentation.
Census data	Finding information on mode of travel to work and the location of respondents' homes and workplaces.	Minimal cost of data collection. Data set is comprehensive for the working population. Other demographic factors can be included. Can be used to map key destinations.	Does not provide data on non-work trips. Does not identify routes. Costly to process because of extensive amounts of data. 'Snapshot' of one day only, and could be affected by other factors such as the weather. Does not include the elderly and children for whom walking is a key travel mode.	Offers only limited benefits – most of the results can be gained through other techniques.
Local survey	May include questioning as part of resident satisfaction, quality of life and travel perception surveys.	Minimal cost when data is being collected for other purposes.	Costly when data is not being collected for other purposes. Data may not identify routes.	If this data is already available, use it.

10.4 Methods of assessing future demand

There is currently no robust way of forecasting walking trip generation [49], and all current methods have limitations. However, forecasting methods can help identify schemes that have the greatest potential and can estimate improvements that will attract the most new users.

This guide does not consider building infrastructure on an ad hoc or parochial basis. While the approach is well intentioned and can sometimes create benefits for pedestrians, a more focused approach is better as resources are invariably limited and not all improvements can be funded [49].

Table 10.2 sets out some specific approaches [49]. These have not been rigorously tested within New Zealand and further work is required to confirm their validity.

Table 10.2 – Ways to assess future demand for walking

Technique	Description	Benefits	Limitations	Application
Similar conditions study	Carrying out surveys before and after a scheme is installed. The change in pedestrians is assumed to be due to the scheme. The results are then used to predict the trip generation of similar improvements in another location.	Simple. Easy to understand. Easy to apply.	Only provides a rough estimate of demand. Difficult to find comparable sites where all factors are similar (including environmental and social). May reflect changes that are unrelated to the scheme (such as weather or nearby changes to the road).	Before and after surveys are a useful part of monitoring, so the necessary database can be built up over time.
Aggregate behaviour	Developing models/ equations by relating the known characteristics of a population to observed numbers of walking trips. The equations are then applied to other areas to predict walking trips.	Fairly straightforward to apply using spreadsheets. Can be easily updated as new information emerges. Can also be used to identify the factors that most influence walking. Certain data is already collected (population characteristics and land use). Can be used to forecast trips over a wider area.	Wide variety of possible influencing factors may mean some issues are overlooked. Models need to be validated before use. Sufficient data capturing all possible factors may not be readily available. Not suitable to assess the impacts of small-scale schemes. Using aggregate data does not take into account individual factors. May not be transferable to different areas.	Useful for a major area-wide study, but otherwise may be too expensive compared with the cost of the schemes being considered.
Sketch plan	Using regression to predict the number of walking trips as a function of (usually) physical factors such as adjacent land uses and/or other trip generation indicators (parking capacity, public transport patronage, traffic movements). These are then applied to other areas.	Straightforward to understand and apply using spreadsheets. Makes good use of data that already exists or can be easily collected. Can be applied to trips within specific corridors. Can be very accurate, particularly for high-density areas. Can be used to determine the location of improvement schemes and for prioritising. Can be easily updated as new information emerges.	Disregards some issues that affect walking (such as environmental factors). Does not consider latent demand. Validation is required before use as models may be location specific. Using aggregate data does not take into account individual factors.	An easy way to get a rough estimate of potential use. Initial focus on relating the percentage of walking trips to the local population and major trip generators.
Discrete choice	Predicting an individual's decision to walk, and their route choice, as a function of other variables including changes in facilities provided or in policies/ strategies. The model is then applied across the wider population to estimate total trips.	Can be very accurate if based on local data. Very good at isolating the effects of specific factors. Can be used to relate factors (such as whether age affects crossing facility preference). Takes into account individuals' preferences. Models can be used to derive elasticities (the percentage change in walking expected as a result of changing any other factor).	Can require extensive data collection. Requires considerable modelling expertise. Wide variety of possible influencing factors may mean some issues are overlooked. Not easily transferable to different geographic areas.	Very resource intensive. Useful for a major scheme investigation, but otherwise may be too expensive.
Travel models	Employing the 'traditional' four-step travel demand model, using land use conditions and transport network characteristics to predict future walking travel patterns.	Models may already exist and be capable of adaptation. Provides an integrated framework for considering walking. Can be a very powerful tool. Model outputs can become inputs for sketch plans.	Spatial scale of existing models may be too great. May require considerable data collection. Models require specialised software and a high degree of expertise.	Can be effective if existing models exist, or creating a new model as part of a long-term investment in walking. Building new models for only small projects is costly.

11 MEASURING WALKABILITY

MEASURING WALKABILITY
Assess the connectivity of each area for walking
Conduct community street reviews to identify and prioritise importance of issues
Use the results to assess walkability gain of improvement options

11.1 Introduction

Measuring the walkability of an area or route means quantifying pedestrian experiences consistently. It can be done through a 'desktop' analysis of connectivity and as an on-site assessment of the quality of routes. Taken together, they create a good understanding of the ease by which pedestrians can move around an area.

There are no national thresholds for walkability indicators in New Zealand. Road controlling authorities (RCAs) may set a suitable minimum threshold, otherwise it is left to the design team to assess what is acceptable and what is not. However, Land Transport NZ is currently developing walkability assessment systems in New Zealand.

Photo 11.1 – Quality walkable link from car park, Nelson (Photo: Tim Hughes)

11.2 Desktop assessment of walkability

Desktop analysis is appropriate for assessing the connectivity and design adequacy of new facilities that are being built. A major drawback of desktop analysis is that it fails to consider the actual circumstances pedestrians encounter. It disregards issues such as debris, ponding, the sense of personal security, temporary obstructions, inconsistent signing and irregular surfaces, although all may affect pedestrians [100].

The several existing approaches to desktop assessment of walkability [5, 23, 95, 99, 115, 158, 171] can be used in isolation or combination. As some elements of walkability are very difficult to quantify accurately, the connectivity of the pedestrian network is used as a proxy measure, through identifying and assessing the routes between potential walking trip origins and destinations. In some cases, such as for trips from home, it may be impractical to identify every trip origin, so a representative sample should be used. Table 11.1 has some examples of ways to assess connectivity.

Table 11.1 – Ways to assess connectivity

Technique	Indicator
Pair each potential origin with a common destination to identify the mean walking distance.	Walkability reduces as distance increases.
Compare the length of the direct route between the pairs of trip origins and their common destination ('as the crow flies') with the distance that the pedestrian will actually walk, taking into account development patterns.	Walkability reduces as the difference between the direct and actual route increases.
For each trip origin and destination, calculate the number of route choices between them, for a grid network this can be calculated by: $\frac{(A+B)!}{A! \times B!}$ Where 'A' is the number of blocks in an east-west direction, 'B' is the number of blocks in a north-south direction and '!' is the factorial function, ie 4! = 4 x 3 x 2 x 1.	Walkability reduces as the number of route choices diminishes.
For each trip origin and destination pair, calculate a journey time based upon the length of the route and average walking speed, but taking into account obstacles, gradient changes and severance that change walking speed or create delays.	Walkability reduces as the difference between the calculated walking time and that expected if the pedestrian did not change their walk speed increases.
As a variation on the above: Calculate the physical area within a five-minute, 10-minute and 15-minute walking distance, if the pedestrian were to walk as the crow flies from a particular origin and at their ideal speed. Compare this with the area the pedestrian can actually cover taking into account development patterns and obstacles, gradient changes and severance that change walking speed and/or create delays.	Walkability reduces as the difference between the theoretical and actual areas increases.
Assign a value to each type of severance a pedestrian encounters based upon a judgement of the difficulty that it causes the pedestrian, and calculate an 'index' for each trip origin and destination pair.	Walkability reduces as the index increases.

11.3 On-site assessment of walkability

On-site assessments of walkability generally involve the use of:

- consumer tests and ratings
- technical audits and reviews.

Using a technique that is inclusive of both these techniques is recommended. However, any assessment tool needs to be sufficiently easy to use, so that it gets used, yet sufficiently comprehensive to give consistent and meaningful results.

Consumer tests and ratings

These involve assessments of user perceptions and suggestions for improvements. They use numeric ratings of the walking environment so that comparisons with other infrastructure can be made.

Assessments of walkability by pedestrians have the advantage of reflecting 'real world' experience and taking into account environmental and psychological factors. They can also be targeted to particularly vulnerable pedestrian groups [36]. However, they require active local public participation as community contributions are needed to reflect the true views of local pedestrians, and can only be carried out for newly constructed or existing routes [36, 99, 100].

These use checklists and rating systems against which pedestrians compare their own experience as they travel along the route [1, 23, 52, 100, 123, 158, 167]. This means assessments are subjective and results can vary according to individuals' abilities and confidence, and the prevailing conditions.

To minimise any bias, the same route should be assessed using different pedestrians at different times, including during hours of darkness, or using a group and requiring a consensus on each issue. Issuing pedestrians with single-use or digital cameras can also be useful, so that problems can be photographed and easily fed back to the RCA.

The checklist complexity may vary, but should be tailored to match the characteristics of the pedestrians undertaking the assessment. Including more details may generate more comprehensive and focused comments from some pedestrians, but it may be unsuitable for children [52]. Conversely, a shorter checklist may provide only a rudimentary assessment of the route, but is simpler to use.

Checklists must be presented appropriately, which means:

- minimising the use of jargon
- maximising the 'reading ease index'
- using a suitable font size
- using different languages for people whose first language is not English.

The criteria on checklists have several categories such as [1, 23, 52, 96, 100, 123, 158, 167]:

- footpath surfaces and alignments
- obstructions on the footpath (permanent and temporary, including parked cars)
- provision of crossing facilities, including delays
- perceived personal safety
- enjoyment of the journey
- the route directness
- congestion and crowding on the footpath
- provision for different types of pedestrian
- characteristics of adjacent motorised traffic
- characteristics of landscaping and street furniture
- signage.

A simple checklist may ask respondents to rate each of the above on a scale, with the results being weighted and combined to quantify the walkability. More complex checklists use a series of more specific questions within each category, but a correspondingly limited range of responses [52, 100, 123, 158].

Community street review procedures have been developed for New Zealand by a Health Sponsorship Council project [1]. Community street reviews combine the community street audit approach which identifies deficiencies and opportunities for improvements with a user perceptions rating system. The procedure rates the environment with respect to overall walkability (or the extent to which the place was walking friendly), as well as more detailed characteristics:

- safe from traffic – *I felt safe from traffic danger*
- safe from falling – *I felt safe from slips, trips and falls*
- obstacle free – *I was unhindered by physical features*
- secure – *I felt safe from intimidation or physical attack*
- efficient – *I was unimpeded by others*
- pleasant – *I enjoyed being in this place*
- direct – *I did not have to detour to use this crossing point.*

Using this procedure will ensure sites are assessed on a common basis.
The procedures and survey forms are available at a link from the Land Transport NZ website.

Technical audits and reviews

Technical audit and review tools are complementary to consumer tests and ratings. These can include:

- technical deficiency assessments relating to design and maintenance
- a numerical rating system that predicts walkability and pedestrian level of service based on measured technical factors.

A tool that has been used overseas to technically assess walkability is PERS (pedestrian environment review system) [158]. Such tools use checklists similar to those used for consumer tests and ratings, but with a technical focus to evaluate walkability. It is important that if such tools are used they can be shown by research to predict the perceptions of pedestrians. New Zealand pedestrian technical audit and review tools are under development.

Modelling walkability

Research is being conducted in several countries, with Florida, USA having published research on developing models that predict walkability on paths alongside roads and crossing roads at signalised intersections [94]. The models are based on the measurable physical characteristics of some walking environments and comparing them to user ratings of those environments. Land Transport NZ has also begun to develop a database of perception surveys and site characteristics that can be used to develop and validate any prediction models.

Accessibility assessment

Walkability assessment relates to the broader assessment of accessibility which is concerned with how easy it is to access goods and services by different transport modes. Key destinations include shops, schools and medical services. Accessibility assessment for the walking mode measures and maps how easy it is to walk directly to those destinations. It includes walking access to bus stops or rail stations for destinations reached by public transport. In England, accessibility analysis is required in the preparation of all local transport plans. Software has been developed to automate this. Thematic maps are produced showing for example the locations of households within 1 km walking distance of a primary school, or households within 1 hour public transport trip of a public hospital. Land Transport NZ has research projects aiming to develop similar tools for use in New Zealand.

12 PRIORITISING SCHEMES AND MEASURES

DECIDE WHICH SCHEMES SHOULD BE DONE FIRST
Adopt an appropriate prioritisation process
Put projects into priority order

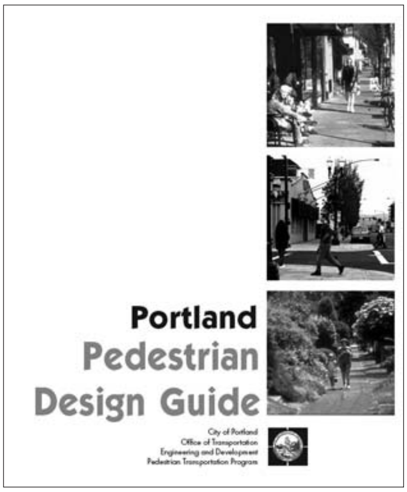
12.1 Introduction

Prioritising improvement schemes and measures involves a significant number of factors – there is no simple assessment process. The situation is further complicated when implementing other roading and cycling projects, as these may create the opportunity to bring forward comparatively low-ranked walking schemes, but in a highly cost-effective way. The approaches here aim to help decide which schemes should be implemented first, once the methods for each have been decided.

12.2 Approaches to prioritising

While several criteria are easily applied, each has drawbacks, so it is a good idea to assess schemes using several approaches, then implementing those that perform well overall [24, 125]. A holistic route treatment is best, as a physical barrier to walking in just one location can result in the whole trip being made by another form of travel. It is better to get a few key routes right to start with than to attempt piecemeal change that is spread too thinly [36]. Table 12.1 presents some prioritisation schemes.

The ultimate approach to prioritising schemes, however, is to select a method based on the expected improvement in walkability received by the greatest number of new and existing pedestrians. This depends on being able to measure and predict levels of walkability and latent demand but shows potential as a prioritising measure in the future.



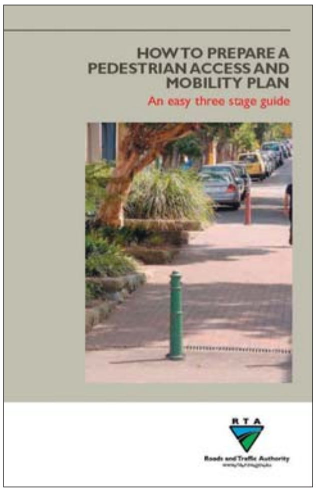


Table 12.1 – Prioritisation schemes to benefit pedestrians [23, 125]

Method	Priority given to	Advantages	Disadvantages
Pedestrian numbers	Schemes on routes with existing high pedestrian use.	Ensures that the greatest number of pedestrians will benefit from the treatment. Can be useful to identify high-profile schemes that help demonstrate a commitment to walking.	Fails to consider areas where flows are suppressed by hazards, physical difficulties or personal safety concerns. Difficulties in comparing pedestrian flows, due to their inherent variability.
Trip linkage	Schemes on routes used for trips between the greatest number of origins and destinations.	Can mean that the greatest number of pedestrians benefit from the treatment. Can be useful to identify high-profile schemes that help demonstrate a commitment to walking. May reflect latent demand.	Does not consider pedestrian numbers. Takes no account of whether there are actual or perceived problems.
Barrier/gap removal	Schemes that remove physical obstacles on routes where the surrounding pedestrian facilities are of high quality.	Creates continuous routes. Straightforward to identify physical barriers. Especially effective in creating the core of the pedestrian network.	Difficult to ascertain perceived barriers without considerable data.
Proximity	Schemes that are geographically closest to a major trip origin or destination.	May benefit the maximum number of pedestrians, as the likelihood of walking declines with increasing distance. May reflect latent demand. Trip origins and destinations are straightforward to identify.	Does not consider pedestrian numbers. Takes no account of whether there are actual or perceived problems.
Land use	Schemes in areas likely to be used by vulnerable pedestrian groups, such as in the vicinity of schools and hospitals.	Can have a major effect on crash rates in the area(s) treated. The type of land use to be treated can easily be changed. Creates a high-quality environment for pedestrians, albeit in a limited area.	Disregards longer-distance routes between origins and destinations. May not support connected networks. May not identify the needs of other pedestrians in areas of different land uses.
Perceived need	Schemes in areas where pedestrians feel there is the greatest need, determined through consultation.	Has the potential to reflect latent demand. Can be useful to demonstrate publicly a commitment to schemes.	Actual need may be different from perceived need. Requires a consultation exercise. Only reflects the views of those consulted.
Crash records	Schemes that generate the greatest potential crash cost savings.	Crash data is easily available. Can result in cost-effective solutions.	Significant under-reporting of pedestrian accidents means not all locations will be identified. May not account fully for places that pedestrians may avoid because of poor perceptions and long delays.
Demonstrable achievement	Schemes that are the cheapest and/or easiest to implement.	Generates the maximum number of schemes on the ground.	Does not consider the perceived pedestrian need for schemes. The cheapest and easiest solutions may not be the most cost effective or appropriate.
Road hierarchy	Schemes on roads that are higher in the roading hierarchy.	Ensures that roads where pedestrians are especially vulnerable are treated. May reflect latent demand. Road hierarchy is widely available.	Does not consider pedestrian numbers or desire lines. Takes no account of whether there are actual or perceived problems.
Combined approach taking into account pedestrians' actual and perceived needs	Schemes that take into account safety factors and exposure for existing and expected future use.	Holistic approach.	

13 IMPLEMENTATION

IMPLEMENT PROJECTS THAT PROVIDE FOR PEDESTRIANS
Establish walking champions and walking advisory groups
Fund walking projects
Provide for walking in other infrastructure projects
Audit all infrastructure projects for effects on pedestrians

13.1 Introduction

Each road controlling authority (RCA) is required to take positive steps to promote and provide facilities for walking. The walking strategy and community action plans create a framework for this, but there are a number of procedural and institutional ways to accomplish it. This section discusses other important stages in the implementation process.

13.2 Walking champions

A walking champion is an individual, or group of individuals working for the RCA, who encourage, support and enable pedestrian activity. The walking champion's role may include:

- representing pedestrian needs and views
- raising awareness of walking as a means of travel
- identifying and promoting best practice
- seeking improved conditions for pedestrians
- lobbying for suitable infrastructure standards
- acting as a coordinator and information disseminator
- connecting, facilitating and engaging different agencies and skills, eg roading, parks, health and planning
- ensuring that personnel across departments have the necessary skills to plan and design for pedestrian needs.

Walking affects a range of disciplines, and consequently all RCA departments or divisions are responsible to differing extents for considering pedestrian needs. To help in this, every RCA should designate one person as a focal point for all enquiries from colleagues and the general public.

The walking champion should have sufficient seniority to ensure their comments carry weight, but should not be so senior that their availability and approachability are hampered [13]. They should be a permanent employee of the RCA to minimise the potential of their specialist knowledge being lost.

The RCA should also establish a pedestrian advisory group, made up of a wide cross-section of people with an interest or expertise in walking. Although it should operate independently of the RCA, the advisory group should be consulted on every strategy or scheme that could affect pedestrian movement [13].

Elected members have a significant role in advocacy, and any walking policy, scheme or strategy must have their support to be effective. All members should be fully briefed on the benefits of walking, and additional time taken as needed to explain matters in full before they make any decisions [103].

The role of pedestrians in advocacy should not be underestimated. Many walking advocacy groups form without any RCA intervention in response to particular circumstances or needs, although the RCA can also help establish them. The RCA should always ensure that such advocacy groups reflect representative views or are otherwise able to speak for the majority.

13.3 Training

Because walking trips are so diverse, it is essential that everyone involved in providing services for the built and natural environment has appropriate knowledge of pedestrians and walking [112].

The extent of each individual's knowledge will depend on their role. For example, those involved in land use and transport planning and infrastructure provision require a detailed understanding, as pedestrians and walking trips should be fully integrated within those disciplines. However, people in other fields may have (and require) no more than a basic understanding. Training may be required for those not directly involved with pedestrian planning and design.

13.4 Community involvement

Section 9 discusses community involvement in schemes in detail, but it is important to stress the need to keep the community informed of progress during implementation.

13.5 Importance of partnerships

Partnerships may be appropriate during implementation. They could be with local councils, businesses, public transport operators, sports trusts, district health boards, individuals and the wider community.

For example, partnerships could be:

- between local workplaces that have few employees on collective travel plan measures (eg a shuttle bus for employees)
- with local organisations or schools, a public transport operator and a local authority with the aim of increasing the service frequency
- between an RCA and a school to deliver improved pedestrian facilities
- between businesses within a retail area to improve the street scene and pedestrian access.

13.6 Funding

Funding and subsidy is available from Land Transport NZ for improvements to pedestrian facilities. The process is set out in Land Transport NZ's *Programme and funding manual* [152]. Projects should be identified in the RCA's walking strategic plan.

When the RCA considers additional or improved pedestrian provision is required because of the effects of a new development, it can ask the developer for a financial contribution to their cost. The policy, mechanism and basis for calculating the contribution will be set out in the city or district plan. It is not unreasonable for the proportion of the infrastructure cost funded by the developer to reflect the percentage increase in pedestrians that the development creates. Long-term council community plans prepared under the Local Government Act may also set out developer contribution policies.

13.7 Pedestrians within other infrastructure projects

Each RCA develops programmes setting out the infrastructure works to be implemented in the future. All projects affect pedestrians, so every project is a walking project. Pedestrian improvement schemes should be integrated with other infrastructure works where they can be incorporated most easily and cost effectively [46].

One way to integrate pedestrian projects within a wider improvements programme is to superimpose the locations of the forward works on a plan of the main routes of the pedestrian network. Work can then focus on locations where the works overlap and/or severely disrupt the network.

All projects that could affect pedestrian movement should routinely be assessed for this and ensure that opportunities for improvement are identified. The planning/design team must also consider involving the wider community at appropriate stages. Such schemes should be assessed by a walking advocate and circulated to the members of the pedestrian advisory group. In areas of high pedestrian use, walkability audits at the pre-opening stage should be considered.

Most major roading schemes undergo either formal safety audits or less formal safety checks to ensure the proposed design does not raise any road safety concerns. These often focus on motorised traffic, but all safety audits or checks should also explicitly consider pedestrians. They should be done at the concept, detailed design and post-construction stages.

13.8 Non-motorised user audit

Safety audits do not currently consider walking convenience and other matters affecting walkability for pedestrians. They also fail to consider similar aspects for cyclists and equestrians. In the United Kingdom a new procedure has been developed called *non-motorised user audit* that provides a process for ensuring the design team fully considers and documents the needs of all non-motorised users related to the project. The project is then audited against these needs at appropriate stages. Land Transport NZ has adapted the UK procedures for New Zealand. The *Non-motorised user project review procedures* [131] can be downloaded from the Land Transport NZ website.

14 FOOTPATHS

PROVIDE FOOTPATHS
Provide footpaths wherever pedestrians will use them
Use footpath dimensions and geometry that provides access for all
Choose surface materials for safety, convenience and aesthetics
Manage design and location of street furniture
Locate and design driveways appropriately
Manage conflict on shared paths by good design and operation
Provide quality connections to public transport

14.1 Where footpaths should be provided

Table 14.1 is a guide to providing footpaths in urban and rural environments [66].

Table 14.1 – When to provide footpaths

<table>
<tr><th rowspan="3">Land use</th><th colspan="4">Footpath provision</th></tr>
<tr><th colspan="2">New roads</th><th colspan="2">Existing roads</th></tr>
<tr><th>Preferred</th><th>Minimum</th><th>Preferred</th><th>Minimum</th></tr>
<tr><td>Commercial and industrial</td><td rowspan="4" colspan="2">Both sides</td><td rowspan="3" colspan="2">Both sides</td></tr>
<tr><td>Residential (on arterials)</td></tr>
<tr><td>Residential (on collector roads)</td></tr>
<tr><td>Residential (on local streets)</td><td>Both sides</td><td>One side</td></tr>
<tr><td>Three to 10 dwellings per hectare</td><td>Both sides</td><td>One side</td><td rowspan="2">One side</td><td rowspan="2">Shoulders on both sides</td></tr>
<tr><td>Fewer than three dwellings per hectare (rural)</td><td>One side</td><td>Shoulders on both sides</td></tr>
</table>

Where only the minimum provision is made, the road controlling authority (RCA) should be able to demonstrate clearly why walking is not expected in that area (although for new or improved developments, this is the developer's responsibility). Retrofitting footpaths is more costly than providing them in the first place, so the preferred standard should be installed for any new or improved development [26, 46, 166], unless:

- it is not accessible to the general public
- the cost of suitable measures is excessive (more than 20 percent of the scheme cost)
- it can be shown to benefit very few pedestrians.

For new developments, project timetables can sometimes mean footpaths are not proposed at the initial stages [46]. In these cases, the RCA can reasonably request a written agreement from the developer to provide footpaths in future, potentially with a bond payment.

14.2 Footpath widths

14.2.1 Footpath zones

Most footpaths within the road reserve lie between the edge of the roadway and the frontage of adjacent private property. There are four distinct zones within this area (see table 14.2) and it is important to distinguish between the total width and the width of the zone likely to be used by pedestrians (the through route) [13, 24, 46].

When determining the width of the frontage or street furniture zone, a 'shy distance' of 0.15 m should apply from any object next to the through route. This area should then be excluded from the through route width as it is unlikely to be used by pedestrians. For example, if a lamp post is near the through route, the shy zone would be the area next to it. This area would then be included in the zone where the lamp post is located and the through-route width would be reduced.

In off-road environments the same principles apply, however, one or more of the zones in table 14.2 may be absent or duplicated on the opposite side of the through route. figure 14.1 illustrates some arrangements for these zones.

Table 14.2 – Zones of the footpath	
Area	**Purpose**
Kerb zone	• Defines the limit of the pedestrian environment. • Prevents roadway water run-off entering the footpath. • Deters vehicles from using the footpath. • Is a major tactile cue for vision impaired pedestrians.
Street furniture zone	• Used for placing features such as signal poles, lighting columns, hatch covers, sandwich boards, seats and parking meters. • Can be used for soft landscaping/vegetation. • Creates a psychological buffer between motorised vehicles and pedestrians. • Reduces passing vehicles splashing pedestrians. • Provides space for driveway gradients.
Through route (or clear width)	• The area where pedestrians normally choose to travel (this should be kept free of obstructions at all times).
Frontage zone	• The area that pedestrians naturally tend not to enter, as it may contain retaining walls, fences, pedestrians emerging from buildings, 'window shoppers' or overhanging vegetation.

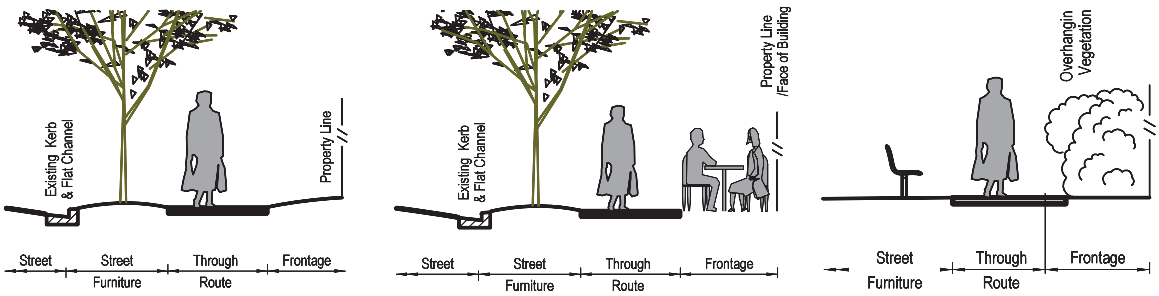


Figure 14.1 – Examples of footpath zones

Photo 14.1 – Kerb zones, Hamilton

Photo 14.2 – Café in street furniture zone, Wellington

14.2.2 Width of zones

The width of the various footpath zones will depend on the environment and those to which the route connects [64, 139]. Table 14.3 has minimum widths that apply to typical pedestrian and vehicle flow conditions [24, 46, 66, 96, 118]. Generally, wider street furniture zones are required in areas with:

- high adjacent vehicle speeds, and/or
- high adjacent vehicle volumes

and wider through-route zones are generally required in areas with:

- high pedestrian volumes, and/or
- a high number of pedestrians stopping on the footpath.

If the flow of pedestrians per minute (p/min) exceeds the maximum in table 14.3, refer to Fruin: *Pedestrian planning and design* [57].

Table 14.3 – Minimum footpath dimensions

Location	Maximum pedestrian flow	Zone				Total
		Kerb	Street furniture #	Through route	Frontage	
Arterial roads in pedestrian districts	80 p/min	0.15 m	1.2m	2.4 m +	0.75 m	4.5 m
CBD						
Alongside parks, schools and other major pedestrian generators						
Local roads in pedestrian districts	60 p/min	0.15 m	1.2 m	1.8 m	0.45 m	3.6 m
Commercial/ industrial areas outside the CBD						
Collector roads	60 p/min	0.15 m	0.9 m	1.8 m	0.15 m	3.0 m
Local roads in residential areas	50 p/min	0.15 m	0.9 m	1.5 m	0.15 m	2.7 m
Absolute minimum*		0.15 m	0.0 m	1.5 m	0.0 m	1.65 m

Consider increasing this distance where vehicle speeds are higher than 55 km/h.

* Only acceptable in existing constrained conditions and where it is not possible to reallocate road space.

All new and improved developments should comply with the above widths. Where footpaths have not been provided to a suitable standard in the past, RCAs should develop works programmes to bring them up to a suitable standard.

When there appears to be not enough space available to install the appropriate footpath width, the step-by-step process in figure 14.2 should be used [139].

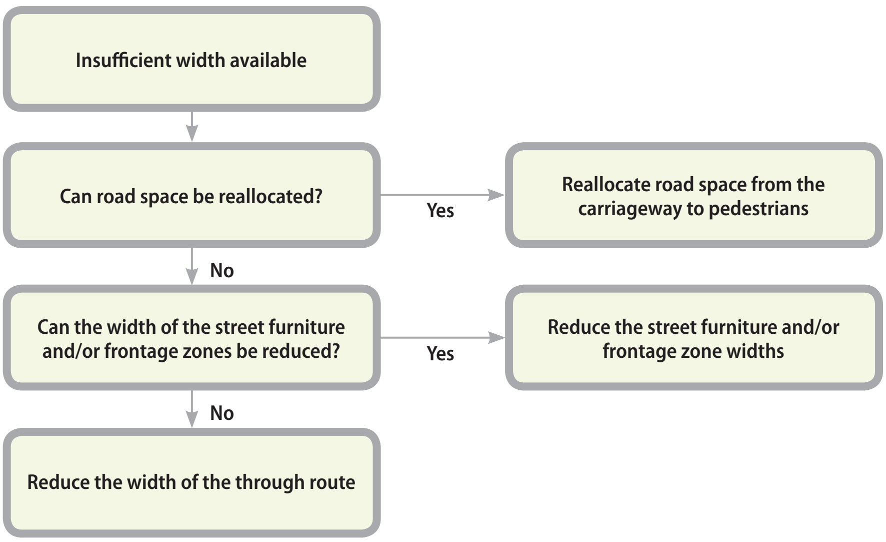


Figure 14.2 – Process for determining footpath provision where width is limited

14.2.3 Passing places

Where through route width is constrained to less than 1.5 metres wide, passing places should be provided – but only where it is not possible to widen the footpath over a longer distance, and never as a low-cost alternative to a full-width footpath. The advantages of passing places are:

- two wheelchairs can pass each other
- walking pedestrians can pass stationary pedestrians, such as those waiting to use a crossing or waiting for public transport.

Table 14.4 outlines passing place dimensions and spacing.

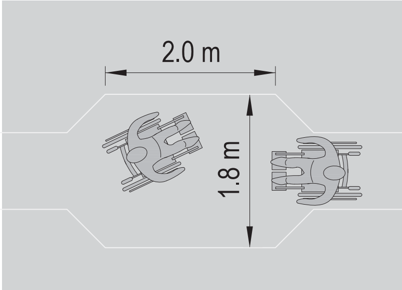


Figure 14.3 – Dimensions of wheelchair passing place

Table 14.4 – Installing passing places

Reason	Passing place dimensions	Location and spacing
Wheelchair users	Minimum through route width 1.8 m. Minimum length 2.0 m (see figure 14.3).	At least every 50 m, and preferably more frequently, where the footpath is less than 1.5 m wide.
Passing pedestrians	Minimum through route width 1.8 m. Minimum length equivalent to the average group of obstructing pedestrians, plus at least 1 m.	As required, according to the RCA's assessment of where pedestrians may wait.
[10, 42]		

14.3 Overhead and protrusion clearances

Overhead clearance

To prevent head injuries to pedestrians, footpaths shall have a vertical (overhead) clearance over their entire width (including the street furniture and frontage zones [10]) that is free of all obstructions, such as vegetation, signs and shop awnings. Table 14.5 shows the minimum overhead clearances.

Table 14.5 – Overhead clearance

Scenario	Clearance
Ideal clearance	2.4 m
Absolute minimum*	2.1 m #
* Only acceptable in constrained existing environments.	
# The clearance shall never be less than this, even for a short distance.	

Photo 14.3 – Overhang, Christchurch

Protrusions

A protrusion is an object projecting into the footpath from the side [13]. Very minor protrusions are acceptable, as long as they are not within the pedestrian through route and comply with the dimensions in table 14.6 [6].

Every item protruding into the footpath shall have an element (which can include any mounting post) within 150 mm of the ground, so that the vision impaired who use canes can detect it [13].

14.4 Gradient

The gradient of a through route is the slope parallel to the direction of travel [13]. Movement becomes more difficult as gradient increases. Table 14.7 shows the three parameters that should be assessed when considering the gradient required [13]. Parameters can be calculated using the procedure outlined at the end of this section.

Through routes in existing developments may have gradients higher than the maximums in table 14.7. Where the mean gradient exceeds the maximum value, the through route should ideally be redesigned as a ramp, which includes rest areas. This allows maximum through-route gradients of up to eight percent while still remaining accessible to wheelchair users [119]. Where this is not possible, and the through route is next to a road, the mean and maximum gradients should be no more than that of the adjacent roadway [46, 166]. Section 14.10 gives advice on designing through routes as ramps.

Generally, through routes in all new developments should be less than the permitted maximums. If they exceed them, the developer should show why this was unavoidable. Section 14.11 advises on situations where footpaths cross driveways.

Table 14.6 – Acceptable protrusions

Mounting	Maximum protrusion into frontage or street furniture ones	Height	Protrusion examples
Attached to walls	100 mm	Between 0.7 m and 2 m	Window sills Business signs Parking meters Public art Benches Post boxes Vegetation Traffic signs Drinking fountains Some litter bins Some sandwich boards
Freestanding or mounted on poles	300 mm		

Table 14.7 – Through-route gradients

Parameter	Definition	Maximum value
Mean gradient	The change in vertical elevation measured between two points.	5%
Maximum gradient	The change in vertical elevation measured at 0.6 m intervals along a route.	8%, over a distance no greater than 9 m. Gradients greater than this are not suitable for wheelchair users.
Rate of change of gradient	The total variation in slope measured at 0.6 m intervals along a route.	13%

The following equations are used to calculate mean and maximum gradient

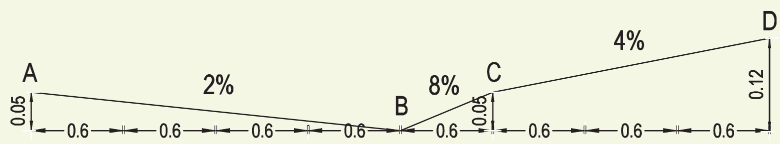
$$\text{Gradient} = \frac{\text{(difference in height)}}{\text{(horizontal distance between points)}} \times 100\%$$

$$\text{Rate of change of gradient}^{*} = \text{(Gradient at point 2)} - \text{(Gradient at point 1)}$$

* Downward slopes are expressed as negative gradients

Example

The following is an example of calculating mean, maximum and rate of change of gradient along the length of the through route:



Parameter	Calculation
Mean gradient (between A and D)	$= \frac{\text{(difference in height)}}{\text{(horizontal distance between points)}} \times 100\%$ $= \frac{(0.12 - 0.05)}{(4.8)} \times 100\%$ $= 1.5\%$
Maximum gradient (between A and D)	= 8% This is the steepest gradient of the three sections between points A and D (ie. between A and B (2%), B and C (8%) and C and D (4%))
Rate of change of gradient (at point B walking from left to right)	= (gradient to right of B) – (gradient to left of B) = 8% – (-2%) = 10%

Figure 14.4 – Example of gradient calculation

Photo 14.4 – Gradient in footpath between two levels, Christchurch (Photo: Andy Carr)

14.5 Crossfall

Crossfall is the slope of the footpath at right angles to the direction of travel. Some crossfall is required for drainage, but excessive crossfall in the through route requires people using wheelchairs and walking frames to use extra energy to resist the sideways forces [6]. As the crossfall is invariably towards the road where footpaths are in the road reserve, anyone losing their balance is directed towards motorised traffic.

Through route crossfalls should always be between one percent and two percent [6, 13, 24, 42, 46, 134]. Where conditions could lead to greater crossfall, the footpath can be raised or lowered over the whole width. Alternatively, steeper crossfalls can be created in the street furniture and/or frontage (Figure 14.5).

Where land next to the footpath's frontage zone has a significant downwards crossfall (greater than 25 percent) or a vertical drop of more than one metre, pedestrians should be prevented from straying from the through path by, for example [42, 166]:

- a 1.2 m-wide strip of a contrasting coloured and/or textured material between the edge of the footpath and the start of the hazard
- a raised mountable kerb at the edge of the footpath, together with a 0.6 m-wide strip of a contrasting coloured and/or textured material between the kerb and the start of the hazard
- a barrier at the edge of the footpath that is at least 1.1 m high.

Photo 14.5 – Footpath with acceptable crossfall, Wellington (Photo: Lesley Regan)

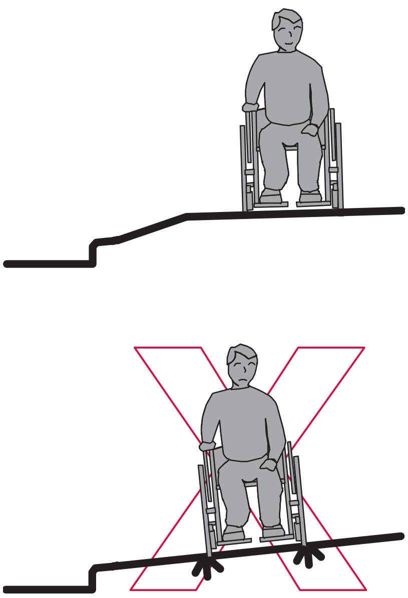


Figure 14.5 – Correct and incorrect provision of crossfall

14.6 Surfaces

General design

All surfaces on which pedestrians walk should be firm, stable and slip resistant even when wet [46, 66, 118, 139]. Slip resistance requirements are discussed in section 3.11. Sudden changes in height on otherwise even surfaces should be less than five mm [18]. To minimise stumbling hazards, undulations in otherwise even surfaces should be less than 12 mm [18]. Both the above are achieved where the maximum deviation of the surface under a 500mm straight edge is less than five mm [10] (figure 14.6). This also prevents puddles from forming. Dished channels for drainage should not be incorporated within the through route [42].

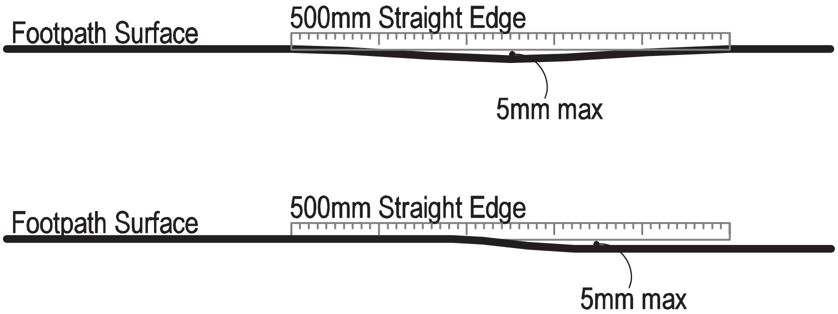


Figure 14.6 – Measuring the maximum deviation of the surface

Short, sudden changes in the surface, such as single steps, should be avoided [134] as they are unexpected and can cause pedestrians to trip or catch the front wheels of wheelchairs and baby carriages.

Where footpaths incorporate structures such as footbridges, refer to the *New Zealand building code handbook* for design and surfacing advice [119].

Decorative surfacing

RCAs are increasingly promoting high-quality and distinctive environments by installing different footpath surfaces, particularly in areas such as the CBD, commercial areas and at tourist attractions. A wide range of material can be used as long as it is firm, stable, even, slip resistant when wet, and does not give misleading signals to the vision impaired. As well as the initial costs, the costs and ease of maintenance, repair, reinstatement and replacement should be considered, along with the drainage properties of different footpath materials.

Vision impaired pedestrians often use differences in texture, contrast and colour as a way-finding cue, so material standardisation and consistency are important [6]. At all times there should be a clear visual and textural contrast between the footpath and the roadway to ensure the vision impaired can define the boundary between the two [92]. For more information on designing for vision impaired pedestrians and providing tactile paving, see the appropriate section of this guide or *Guidelines for facilities for blind and vision-impaired pedestrians* [92]. To avoid excessive changes within an area and promote

Photo 14.6 – Brick-lined asphalt path, Nelson (Photo: Tim Hughes)

Photo 14.7 – Traffic calmed area with contrasting surfaces, Wellington (Photo: Shane Turner)

consistency, RCAs should develop guidelines on when particular surface types should be used.

Materials

Concrete and asphalt are generally considered the most appropriate footpath surfaces, although stone pavers and unglazed brick can also be used [6, 10, 13, 24, 46]. Material combinations are possible, such as a concrete through route edged with unglazed brick to provide visual contrast for vision impaired pedestrians. Table 14.8 gives examples of different materials used for footpaths and their advantages and disadvantages.

Table 14.8 – Footpath surfaces

Surface	Advantages	Disadvantages	Design issues
Concrete and asphalt	Require minimum ongoing maintenance. Any maintenance is inexpensive. Surface can easily be reinstated if removed. Provide longest service life.	Can be aesthetically displeasing. Asphalt can be confusing for pedestrians as it is associated with a 'road' surface. Asphalt can 'sink' and produce protrusions, especially at kerbs.	Texture with a broom finish (perpendicular to the direction of travel) to enhance friction and improve drainage. Concrete shall not be painted. Joints between units shall be less than 13 mm.
Stone pavers and unglazed brick	Highly decorative. Easy to replace if damaged. Easy to reset if displaced.	Small units can move independently and create a trip hazard. Can be difficult to maintain crossfalls. Can cause vibration to users. Some pavers or joints are susceptible to moss.	Consider stamped or stained concrete instead. Joints between units shall be less than 13 mm. Needs a firm base (preferably concrete). Ensure good installation and regular maintenance to prevent moss growth and minimise/reset displaced pavers.
Split-face stone, cobblestones	Highly decorative.	Not easily crossed by the mobility impaired or walking pedestrians wearing some fashion shoes. Prone to moss and weed growth.	Avoid use in the through route. Can be used to delineate places to walk, and within other areas of the footpath.
Loose surfacing, such as exposed aggregate, gravel and bark	Inexpensive to install. Can be aesthetically pleasing. Can fit well in 'rural' environments.	Can cause severe problems for the mobility impaired if not well compacted. Requires significant maintenance commitment. Very prone to weeds.	Avoid use in the through route unless there is an extremely high aesthetic justification (such as in a botanical park). Use to manage vegetation and street trees only (and take measures to prevent materials spilling into the through route)
Tactile paving	Provides a positive tactile way-finding cue for the vision impaired.	Can be aesthetically displeasing.	Should be used in a consistent way and only in specified locations.

14.7 Grates and covers

Whenever possible, covers and grates should be sited within the street furniture zone [24, 42]. If this is not possible, they can be placed at the edge of the through route [10].

To minimise pedestrian hazards, grate openings should be less than 13 mm wide and 150 mm long [10, 42]. Any elongated openings should be placed perpendicular to the main direction of pedestrian movement [10, 42].

Covers should have a rough surface texture, but without regular, large protrusions that could result in the vision impaired mistaking them for a tactile surface [42]. However, they can incorporate attractive designs that can lead to a more interesting streetscape. They should always be flush with the surrounding surface [10, 24, 42] and be slip resistant, even when wet.

Photos 14.8 & 14.9 – Covers in through route, Wellington (Photo: Shane Turner)

14.8 Landscaping

Landscaping can create an attractive visual environment and a 'buffer' between the footpath and the roadway [24]. It creates the appearance of a narrower road and can encourage drivers to travel more slowly [145], as well as possibly providing shade and shelter from wind for pedestrians.

Photo 14.10 – Young trees set back in street furniture zone, Christchurch (Photo: Aaron Roozenburg)

Permanent planting

Permanent planting should be sited within the street furniture zone and consist of trees, flowers, shrubs or grass [24]. Species should be selected with care to ensure they fit in the surrounding area and are appropriate for the environment. It is particularly important that [24, 46, 145]:

- root systems do not damage buried utilities or buckle the footpath surface
- canopies do not interfere with overhead lighting
- plants do not obscure pedestrian or driver visibility when installed or when mature, at any time of the year. This generally requires new trees to be five metres tall at installation
- vegetation and tree limbs do not protrude into the through route or block sight lines when installed or when mature, at any time of the year
- plants are capable of surviving with minimal maintenance and (in drier areas) preferably do not need irrigation
- the landscaping does not create cover for criminal or antisocial activities.

Landscaping also should not create a hazard to vehicles that unintentionally leave the roadway. Outside of traffic-calmed areas (where speeds are greater than 40 km/h), but within urban areas, only collapsible or frangible landscaping should be placed within four metres of the edge of the nearest traffic lane. This distance should be increased on the outside of curves where there is a higher chance of vehicles leaving the roadway. Trees within this area should [87]:

- have a trunk diameter less than 100 mm when mature, measured 400 mm above the ground
- not be hardwood species
- be frangible.

Moveable planters

Moveable planters can be placed in the frontage zone (or street furniture zone in a traffic calmed area) as long as they do not protrude into the through route. For design purposes planters should be considered to be street furniture (see section 14.9).

14.9 Street furniture

The footpath is the main location for street furniture. Some furniture is designed to benefit pedestrians and enhance the walking environment, while other furniture is provided mainly for other road users.

Placement

Furniture can create a visually interesting environment for pedestrians and encourage greater use of the street as a public space. However, it can also create obstructions and trip hazards, obscure visibility and intimidate pedestrians [7, 42, 66, 92, 121, 134, 145].

Every piece and type of street furniture should be easily detectable (and avoidable) by the vision impaired. This means each should [42, 134]:

- be at least one metre high where possible/practical
- have an element within 150 mm of the ground for its entire length parallel to the ground, so that it is detectable by the vision impaired who use a cane
- be placed outside the through route
- be placed in a consistent way within the same environment.

For more advice on catering for the vision impaired, see *Guidelines for facilities for the blind and vision-impaired pedestrians* [92].

Photo 14.11 – Planters in street furniture zone, Christchurch (Photo: Susan Cambridge)

Photo 14.12 – Rubbish bin in street furniture zone, Hamilton (Photo: Shane Turner)

Photo 14.13 – Bollards, Wellington (Photo: Shane Turner)

Photo 14.14 – Public telephones, Hamilton (Photo: Shane Turner)

Outside of traffic calmed areas (where speeds are greater than 40 km/h), but within urban areas only collapsible or frangible street furniture should be placed within four metres of the edge of the nearest traffic lane, so as not to create a hazard for vehicles that leave the roadway. This distance should be increased on the outside of curves where there are higher chances of vehicles leaving the roadway.

Typical characteristics

Street furniture design should be sympathetic to the surrounding environment and, where it is intended for use by pedestrians, should be accessible to all types [42]. There should be a good colour contrast between street furniture and background surfaces to ensure it is conspicuous to the vision impaired [42, 134]. Generally, grey colours should be avoided as they blend into the general background [42].

Table 14.9 shows the typical characteristics and conventional locations of common street furniture for new or improved streets [24, 42, 134].

Photo 14.15 – Bench in frontage zone, Christchurch (Photo: Susan Cambridge)

Table 14.9 – Typical characteristics of street furniture

Furniture	Typical footprint	Typical height	Locations and frequency	Ideally sited	If ideal is not possible, consider
Bench	2.4 m by 0.75 m	0.4-1.0 m	Provide every 50 m in commonly used pedestrian areas, or more frequently on sloping footpaths. Provide also at bus stops and shelters.	Within street furniture zone if zone is more than 0.9 m wide. Within frontage zone if zone is more than 0.9 m wide. At least 0.5 m from the edge of the through route. At right angles to the through route.	Facing the through route.
Bollard	0.3 m diameter	0.6 m to 1.2 m	As required, but no more than 1.4 m apart.	At most 0.3 m from kerb and wholly within street furniture zone.	As per ideal.
Bus stop shelter (see section 14.13)	2.6 m by 1.4 m	2.5 m	As required by bus services.	Where there are large numbers of passengers, within the street furniture zone. The through route width should be maintained which may involve using kerb extensions.	Mostly within street furniture zone but can protrude into the through route as long as the minimum width is maintained.
Cycle locker	2 m by 1.9 m	2.1 m	As determined in consultation with cycle user groups. Provide also at transport interchanges/major stops.	Where there is a manoeuvring depth of 2.7 m at the locker door.	Where there is a manoeuvring depth of 1.8 m at the locker door. This distance may include the through route.
Cycle rack and stand	0.75 m by 50 mm	0.75 m	As determined in consultation with cycle user groups. Provide also at transport interchanges/major stops.	Parallel to the kerb, 0.9 m from it. Retain at least 0.75 m between the rack and the through route. Footpath should be at least 3.6 m wide. At right angles to any severe gradients.	Parallel to the kerb, 0.6 m from it. Retain at least 0.75 m between the rack and the through route. Footpath should be at least 3m wide. At right angles to any severe gradients.
Drinking fountain	0.3 m diameter	0.6 m	As required.	Wholly within street furniture zone.	As per ideal.
Litter bin	0.8 m diameter	1.3 m	As required. Consider for areas where litter may be generated, such as bus stops, transport interchanges and fast-food outlets.	Centred within street furniture zone if zone is more than 0.9 m wide.	Consider using a litter bin with narrower footprint and site wholly within street furniture zone.
Parking meter	0.3 m by 0.15 m	1.5 m	As required by on-street parking.	Centre of supporting post should be 0.8 m from kerb.	Centre of supporting post should be 0.6 m from kerb. If footpath is under 2.7 m wide, install within frontage zone.
Planter	Varies	Varies	As required. More effective if looked down upon.	Within street furniture zone if zone is more than 0.9 m wide. Removable planters are permitted within the frontage zone as long as they do not intrude into the through route.	As per ideal.
Pole – lighting	Up to 0.6 m by 0.6 m	Varies	As required to provide a suitable lighting level.	Centre of supporting post should be 0.75 m from kerb or centred in street furniture zone if it is greater than 1.5 m. Poles should be aligned along the road corridor.	Centre of supporting post should be at least 0.45 m from kerb. Poles should be aligned along the road corridor.
Pole – signal	0.55 m by 0.55 m	Varies	As required under standards for traffic signal installations.	Centre of supporting post should be 0.75 m from kerb or centred in street furniture zone if it is greater than 1.5 m.	Set pole closer to kerb. Place pole within frontage zone.
Pole – utility	0.45 m by 0.45 m	Varies	As required.	Centre of pole should be 0.6 m from kerb.	Centre of pole should be 0.45 m from kerb.
Public art	Varies	Varies	As required.	Centred within street furniture zone.	As per ideal.
Public telephone	Varies	Varies	Not within 1.5 m of a building entrance. Not within 1.2 m of street light or traffic signals pole. No more than one public telephone within 30 m of an intersection. Single telephone or clusters should be at least 60 m apart.	Edge of unit should be 0.6 m from kerb. Minimum footpath width is 3.65 m.	As per ideal.

Furniture	Typical footprint	Typical height	Locations and frequency	Ideally Sited	If ideal is not possible, consider
Sign – public transport	65 mm diameter pole	2.1 m	As required by bus-operating companies.	Use existing signpost or utility pole to place sign. For new posts, centre of pole should be 0.45 m from kerb with the closest edge of the sign 0.3 m from the kerb.	Attached to building face. Place poles within frontage zone.
Sign – parking	65 mm diameter pole	1.5 m	As required by on-street parking.	Use existing posts to place sign where practice and legislation allows. For new posts, centre of pole should be 0.45 m from kerb.	Attach sign to building face. Place poles within frontage zone.
Sign – street name	65 mm diameter pole	2.1 m	As required (see *Guidelines for street name signs* [75]).	Within street furniture zone if zone is more than 0.9 m wide.	Some signs may be attached to building face. Place poles within frontage zone.
Sign – traffic	65 mm diameter pole	2.1 m	As required by traffic control devices rule [111].	Within street furniture zone if zone is more than 0.9 m wide, with the closest edge of the sign 0.3 m from the kerb.	Locate pole closer to the kerb. Place poles within frontage zone. Some signs may be attached to building face.
Signal controller box	0.75 m by 0.6 m	Up to 1.75 m	At traffic signal installations.	Centred within street furniture zone if zone is more than 0.9 m wide. Parallel to kerb.	Mostly within street furniture zone but can protrude into the through route as long as the maximum width possible is maintained (at least 1.5 m). Perpendicular to kerb.
Street tree	As per tree grates	5 m tall when installed	Varies	Centred within street furniture zone. Minimum footpath width is 2.75 m. Leaves should be above pedestrian eye-line.	As per ideal.
Tree grate	1.2 m by 1.2 m	Flush	See 'Street tree'.	See 'Street tree'.	See 'Street tree'.
Utility vault	Varies	Flush	As required by utility companies.	Centred within street furniture zone if zone is more than 0.9 m wide.	Locate within private property.

Café furniture/advertising signs

There are currently no New Zealand guidelines for placing café furniture (tables and chairs). However, whatever placement is adopted (either frontage zone or street furniture zone), it is important to keep it consistent within the RCA – noting that there are advantages to placing café furniture in the street furniture zone as some vision impaired people use shop frontages as a cue to follow. It is important that café furniture placement should not reduce the through-route width below the appropriate minimum (see section 14.2).

Some RCAs allow footpaths to be used for displaying shop stock or displaying advertising signs and boards. In this case, there should be no interference, obstruction or hazard for pedestrians. Any items should only be placed in the frontage or street furniture zone and no part should be sited on, or extend into, the through route. Placement of hazardous items should be banned, and rules on these items enforced.

Photo 14.6 – Brass plate on footpath delineates permitted trading area, Perth (Photo: Tim Hughes)

Constrained environments

In very constrained environments, there may not be enough space in the street furniture or frontage zones for even street furniture or equipment that is necessary for the street to be safe and function efficiently. Figure 14.7 shows the approach for determining the location of such items [24, 42].

The last option should be chosen rarely; if it is used, it is important to:

- maintain the maximum possible clear through route at all times
- keep the length over which the through route is restricted to less than six metres [42]
- ensure that the through route width is at least 1.5 m and preferably 1.8 m [10]
- ensure that the colour of the obstruction contrasts with its surrounding environment [42].

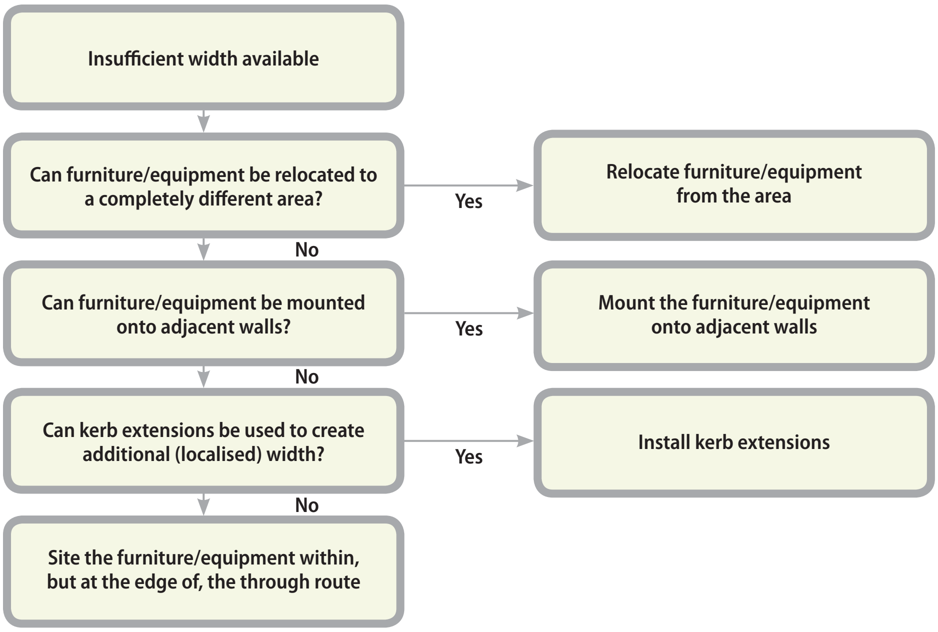


Figure 14.7 – Approach to determining location of necessary equipment

14.10 Ramps and steps

A through route should be treated as a ramp if the mean gradient is greater than five percent. Note rest areas are required where the mean gradient exceeds three percent (see figure 14.8) [134].

Table 14.10 has key design features common to both ramps and steps [10, 24, 42, 134].

Photo 14.17 – Choice of ramps or steps, Queenstown (Photo: Tim Hughes)

Photo 14.18 – Steps, Wellington (Photo: Shane Turner)

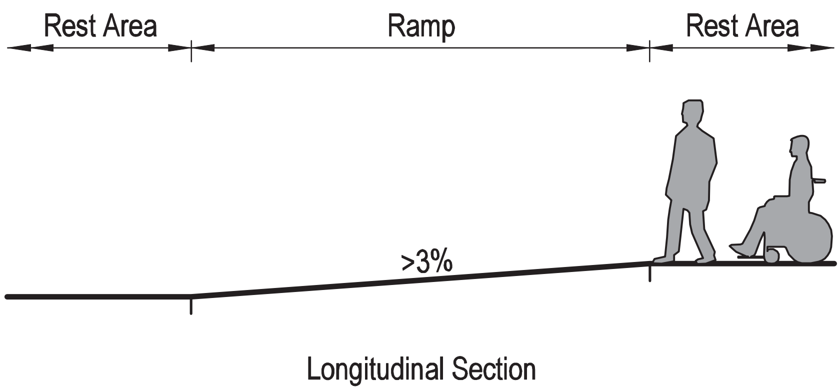


Figure 14.8 – Rest areas in ramp (for ramp lengths see Table 14.10)

Table 14.10 – Design features common to both ramps and steps

Feature	Purpose	Location	Design issues
Landing	Accommodates changes of direction after the ascent/ descent is completed. Ensures that pedestrians emerging from the ramp/steps are clearly visible to others.	Top and bottom of every ramp or flight of steps.	At least 1.2 m long, 1.8 m preferred. Extends over the full width of the ramp/steps. Kept clear of all obstructions. Gradient should be less than 2%.
High contrast material	To enable people to detect the top and bottom of the ramp/ steps.	Edge of the landings, adjacent to the ramp/steps. On the edge of each step.	Should cover the full width of the steps/ramp. On steps, it should be 55 mm deep.
Tactile paving	To help vision impaired people to detect the top and bottom of the steps or steep ramps.	Edge of the landings, adjacent to the ramp/steps.	Install tactile ground surface indicators coloured 'safety yellow', as described in *Guidelines for facilities for blind and vision-impaired pedestrians* [92].
Signing	To inform pedestrians of the impending change in levels. To provide directions to an alternative route where available.	Top and bottom of every ramp or flight of steps.	No additional requirements to normal pedestrian signage.
Handrails	To provide a means of support, balance and guidance. To provide a means of propulsion for some types of pedestrian.	Continuous over the whole route. Provided on both sides.	Handrails should be 30 mm to 45 mm in diameter. Sited at least 50 mm from any surface. They should extend by at least 0.3 m into the top and bottom landings, and return to the ground or a wall, or be turned down by 0.1 m. Sited 0.8 m to 1.1 m above the step pitch line or ramp surface. Secondary handrails may be considered at a height of 0.55 m to 0.65 m. Colour should contrast with the background.
Rest areas	To allow pedestrians to recover from their exertions. To make changing direction much easier.	Frequency depends on the height gained (or lost). A rest area is required every 0.75 m change in height for the ramp to remain accessible to wheelchair users. For ramps, rest areas are required: **Gradient**: 4% – 19 m; 5% – 15 m; 6% – 13 m; 7% – 11 m; 8% – 9 m (Rest area frequency)	At least 1.2 m long, 1.5 m preferred. Covers the full width of the ramp/steps. Gradient should be less than 2%.

Gradient	4%	5%	6%	7%	8%
Rest area frequency	19 m	15 m	13 m	11 m	9 m

Flights of steps and ramps should be straight, with corners where necessary [42 134]. Curved ramps and flights of steps are not recommended because [6]:

- they are harder for the mobility impaired to negotiate
- for ramps, the gradients between the inner and outer edges are different
- for steps, the tread length on the inner edge is always smaller than that on the outer
- it is much harder to provide rest areas of a suitable size.

It is important to minimise the risk of pedestrians colliding with the underside of freestanding stairs or ramps by ensuring they are positively directed around the obstacle [42].

Table 14.11 details design parameters for ramps [10, 42, 134].

Table 14.11 – Design features specific to ramps

Parameter	Range/value
Surface	Should comply with the same best practice as other footpath surfaces.
Width	1.2 m absolute minimum, preferably 1.8 m (between handrails). If more than 2 m, a central handrail should be provided.
Maximum length	Preferably less than 50 m. Absolute maximum length of 130 m.
Maximum crossfall	2% (but no crossfall normally required).
Mean gradient	No greater than 8%.
Maximum gradient	Generally no greater than 8%. In highly constrained conditions, greater gradients are tolerated but only over short distances: • a gradient of 10% is permitted over a length of 1.5 m • a gradient of 12% is permitted over a length of 0.75 m • a gradient of 16% is permitted over a length of 0.6 m.
Rate of change of gradient	No greater than 13%.

Table 14.12 details design parameters for steps [10, 24, 42, 134].

Table 14.12 – Design features specific to steps

Parameter	Range/value
Surface	Should comply with the same best practice as other footpath surfaces.
Width	0.9 m absolute minimum, preferably 1.2 m (between handrails). If more than 2.1 m, an additional handrail may be provided. This can be located to create a route on which the mobility impaired can hold a rail on either side.
Maximum crossfall	2%.
Tread	Depth no less than 0.31 m and consistent for the entire flight. No overhang at the edge of the tread. Nose of the step should be slightly rounded.
Riser	Height of between 0.1 m and 0.18 m and consistent for the entire flight. Solid risers are required.
Flight	A maximum rise of 2.5 m is permitted before a rest area should be provided. A minimum of three steps is required to avoid a tripping hazard. Long-tread, low-riser steps can be very helpful for the mobility impaired.

14.11 Driveways

Location

The following principles apply when locating driveways [10, 46]:

- Driveways should be located where the expected pedestrian activity is low.
- High-volume driveways and pedestrian accesses should be separated.
- The number of driveways should be reduced through pairing/combining accesses to several properties, and not having separate low volume entrances and exits.
- Driveways should be located as far from street intersections as possible to avoid confusion and conflict.

General design

When designing driveways the following principles apply [24, 46]:

- Turning radii should be minimised to ensure slow vehicle speeds.
- The driveway width at both edges of the through route should not be significantly greater than at the property boundary.
- The driveway width should be minimised to slow vehicle speeds.
- The give way obligations of drivers and pedestrian should be clear.
- The road user rule states 'a driver entering or exiting a driveway must give way to a road user on a footpath'.
- If it is desired that pedestrians give way at a high-volume access way to a development, the entrance should be designed as an intersection.

Photo 14.19 – Driveway with normal pedestrian path crossfall maintained, Queenstown (Photo: Tim Hughes)

When deciding whether to design a high volume entrance as an intersection consider:

- Is the driveway busy enough? – at least above 500 vehicles per day?
- Is the driveway traffic volume substantially greater than pedestrian path volume?
- Is the strategic function of the pedestrian path less important than the traffic access function?

Drivers and pedestrians should be provided with clear cues that they are at either a driveway or an intersection.

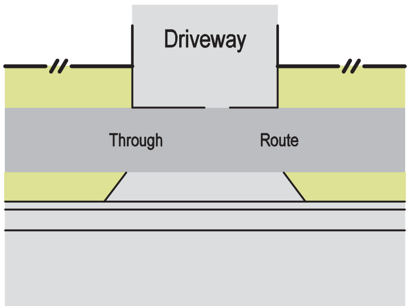
Driveway cues include:

- The pedestrian path is continuous in grade, crossfall, colour and texture across the driveway, with no tactile warning tiles.
- The driveway changes grade to cross the kerb at a kerb ramp, and preferably changes in colour and texture to cross the pedestrian through path.
- The roadway kerb is continuous and cuts down to a concrete gutter crossing running straight across the driveway ramp – it does not return into the driveway.

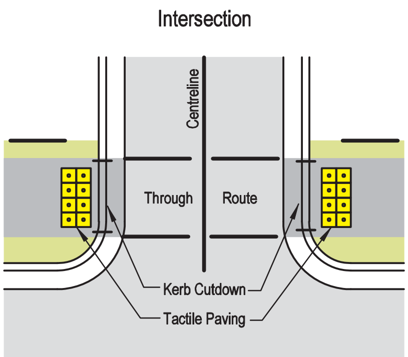
Intersection cues include:

- Between the footpath and the side road there is a change in colour and texture, tactile paving, and preferably a kerb ramp at a kerb crossing.
- The vehicle path is kerbed and continuous with the road surface with no change in colour and texture.
- There is no kerb crossing or ramp to enter the roadway.
- The road kerb does not continue across but returns to follow the side road.

These design differences are shown in figure 14.9



Driveway

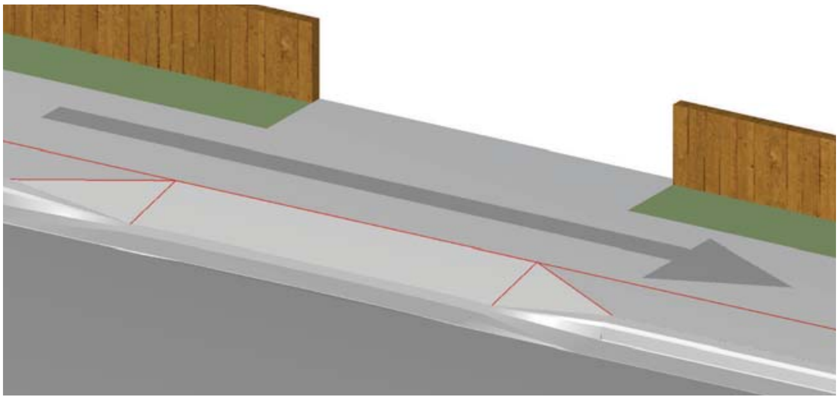


Low-volume intersection (high-volume access way)

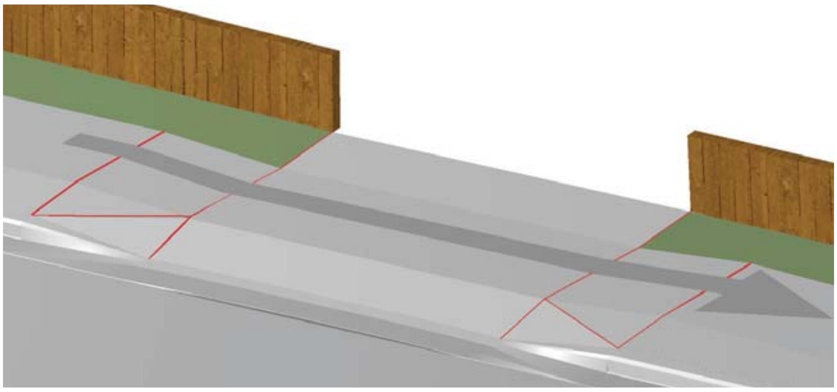
Figure 14.9 – Comparison between driveway and higher-volume access way

Driveways should have a level landing at the top (similar to a kerb ramp), and be at least 1.2 m wide across the through path. The crossfall should be less than two percent, with the gradient differing from the adjacent through path by less than two percent [6, 24]. To achieve this, the sloped part of the driveway should be within the street furniture zone and/or the adjacent private property. It may be necessary to lower the footpath (see figure 14.10) [24].

Perpendicular



Combination



Parallel (To be used only in existing constrained circumstances)

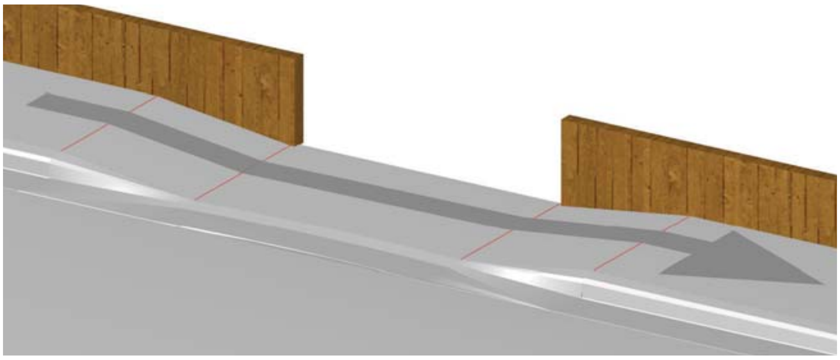


Figure 14.10 – Interface between driveways and footpaths

Visibility

Footpaths on either side of the driveway should be kept clear of all obstructions [10, 84]. A five metre by two metre 'visibility splay' (see figure 14.11) should be installed in areas with high pedestrian flows and more than 200 expected daily vehicle access manoeuvres [84].

Boundary treatments next to driveways should not obscure pedestrians – avoid tall, close-boarded fencing, solid structures and dense vegetation. They should also not adversely affect any formal visibility splay. If visibility splays cannot be provided in very constrained situations, install convex mirrors at the access way and/or visual and audio warnings to pedestrians.

Vertical visibility is also an issue for driveways that descend quickly from the footpath – ascending drivers may not be able to see pedestrians clearly on the through route, especially children. To prevent this a near level platform at the top of the driveway next to the through route can be provided (see figure 14.12). At higher-volume access ways (200 vehicle access manoeuvres per day) where constrained circumstances do not allow such a platform, provide convex mirrors.

Driveways (especially residential driveways) should be carefully designed to minimise the risk to young children, especially those less than four years old. Where possible, physical barriers should be installed between homes and driveways, using features such as fences and self-closing gates [15]. Internal driveway layout should also encourage drivers to enter and exit the site in a forward direction if possible.

Signage for drivers should be provided at more heavily used driveways, such as those for servicing retail and industrial developments. This warns drivers of the presence of pedestrians and encourages a low vehicle speed [10].

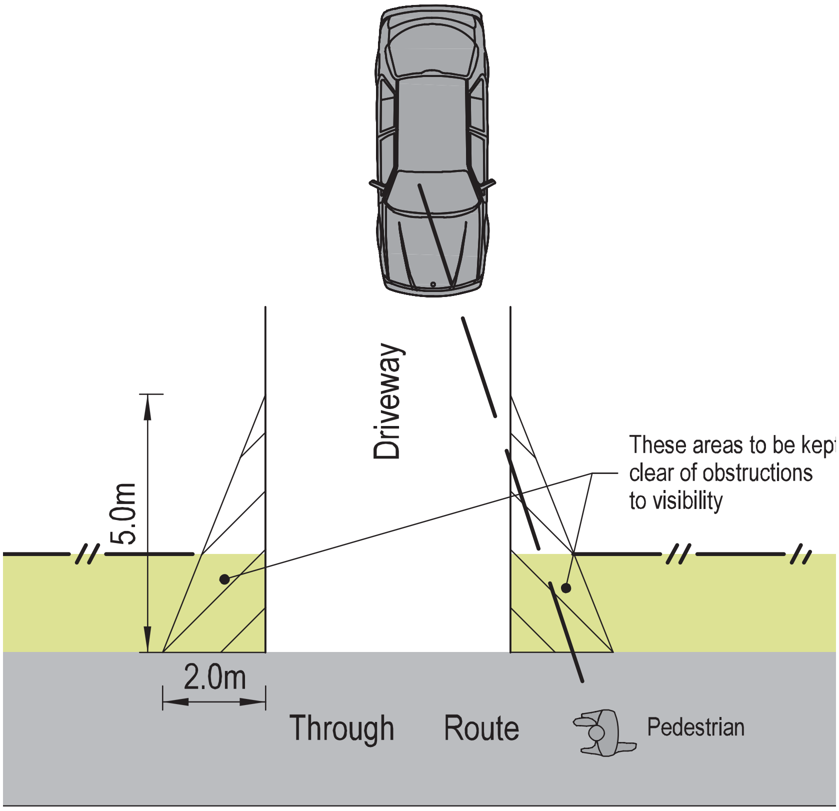


Figure 14.11 – Driveway visibility splays for high-volume driveways

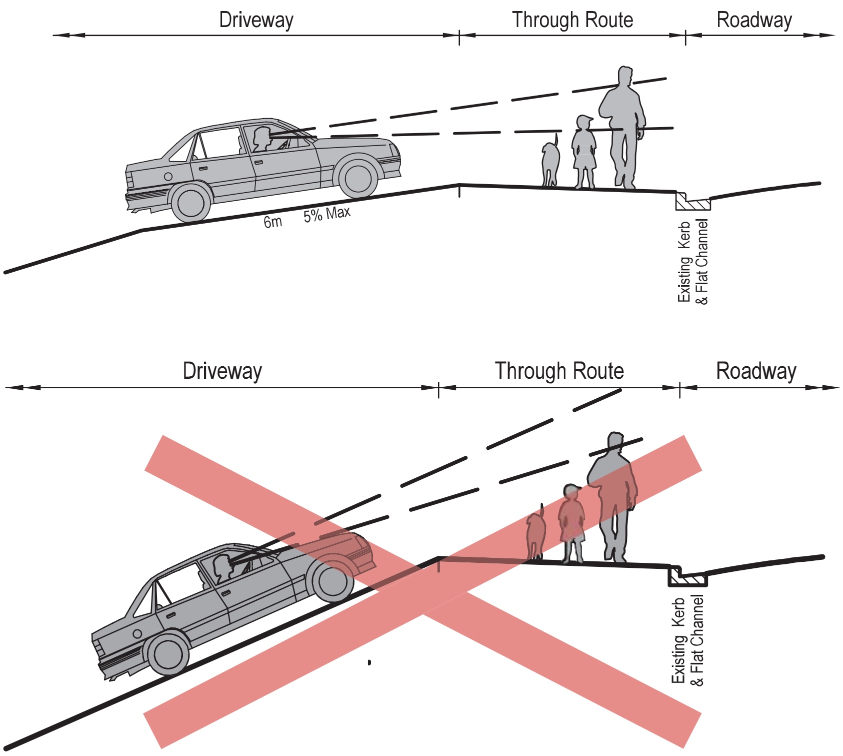


Figure 14.12 – Steep driveway with a vertical visibility problem and one where the approach is closer to level

14.12 Shared-use paths

For both unsegregated and segregated paths, particular care needs to be taken:

- where cyclists join the shared route to ensure they can do so safely and without conflict with pedestrians
- where the shared routes ends, to ensure that cyclists do not continue to use a route intended for pedestrians only
- where one route crosses another pedestrian, cyclist or shared-use route
- to ensure adequate forward visibility for cyclists, who are generally moving more quickly than pedestrians
- to provide adequate signing to indicate the presence of pedestrians and cyclists.

In both cases [121] it is important to:

- leave a lateral clearance distance of one metre on both sides of the path to allow for recovery by cyclists after a loss of control or swerving
- maintain an overhead clearance of 2.4 m over the path and the lateral clearance distance
- ideally, keep a 1.5 m separation between the path and any adjacent roadway
- ensure the gradient and crossfall comply with the most stringent best practice for pedestrians and cyclists.

Table 14.13 shows the typical widths of the through route for unsegregated shared paths [11].

Segregated paths require pedestrians and cyclists to use separate areas of the path, delineated by contrasting surfaces or markings. To ensure the vision impaired do not stray into cyclists' paths, the pedestrian and cyclist areas should be separated by:

- a raised mountable kerb
- a white thermoplastic line
- a median strip of a different surface, at least one metre wide
- a landscape barrier
- raising the pedestrian area by at least 75 mm.

Table 14.14 shows typical through-route widths for segregated paths [11].

Austroads [11] and the New Zealand supplement to Austroads: Part 14: Bicycles [153] have more design details for shared routes. Comprehensive guidance on all the issues for shared paths is found in the toolbox developed for the Australian Bicycle Council: *Pedestrian-cyclist conflict minimisation on shared paths and footpaths* [69].

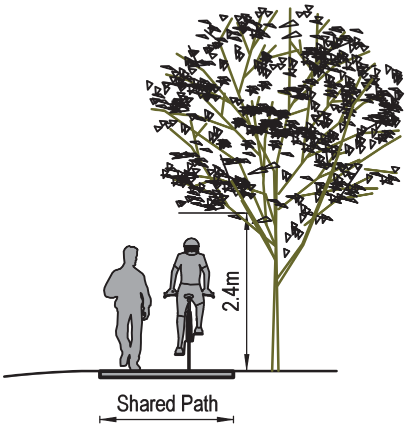


Figure 14.13 – Minimum overhead clearance for shared-use path

Photo 14.20 – Shared bridge markings, Brisbane (Photo: Tim Hughes)

Photo 14.21 – Shared bridge signs, Brisbane (Photo: Tim Hughes)

Photo 14.22 – Landscape barrier separates pedestrians and cyclists, Subiaco, Perth (Photo: Tim Hughes)

Table 14.13 – Widths of unsegregated shared-use paths

	Likely main use of path *		
	Local access only	Commuters	Recreational or mixed use
Desirable path width	2.5 m	3 m	3.5 m
Path width range	2 m to 2.5 m	2 m to 3.5 m	3 m to 4 m

* Where the use is uncertain, provide a width of 3 m [121].

Table 14.14 – Widths of segregated shared-use paths

	Area for cycles	Area for pedestrians	Total
Desirable path width	2.5 m	2 m	4.5 m
Path width range	2 m to 3 m	At least 1.5 m	At least 3.5 m

Shared areas

Cyclists are often excluded from pedestrian-only areas, such as malls. There can be little justification for this, as collisions between pedestrians and cyclists are comparatively rare [32]. Nevertheless, some pedestrians do perceive a danger from cyclists due to their speed and quietness [32], and may feel intimidated by them. The elderly feel especially vulnerable when encountering cyclists in their walking space. As a result, a physically segregated route might be appropriate for cyclists in pedestrian-only areas [143]. Signs outlining cyclists' obligations in pedestrian-only areas should be provided if cycling is allowed. Such examples of signs may be 'Cyclists: Walking Speed Only' or 'Cyclists: Give Way to Pedestrians'.

Photo 14.23 – Unsegregated shared-use path, Nelson (Photo: Susan Cambridge)

14.13 Public transport interface

Well designed public transport stops and their interface with the pedestrian network are essential to a usable system. In designing public transport interfaces, other sections of this guide are relevant, such as those covering crossfall, footpath width and materials. Good practice for designing stops includes [10, 151]:

- making bus stops clearly visible, to avoid passengers missing their stop
- naming stops and shelters with locally recognisable names, to reduce confusion between passenger and driver, and to promote a sense in which the service is part of the local community
- ensuring that the stop or shelter is well lit, or located in an area that is generally well lit
- ensuring that stops and shelters remain unobscured by overgrown trees and foliage, or by other traffic signage
- ensuring the boarding point is laid at right angles to the through route for clarity, with clear details of its location provided by signage and tactile cues
- ensuring that boarding points are kept clear of street furniture and signage
- minimising changes in level between the waiting and boarding areas
- displaying a route map, timetable and real-time bus information at the stop
- minimising changes in level from footpaths to buses (kerb ramps should not be provided at the boarding point and the stop should be oriented so that buses can extend their entrance ramp (if fitted) to the footpath).


Photo 14.24 – Tactile paving at a boarding point, Christchurch (Photo: Paul Durdin)

Photo 14.25 – Bus stop, with tactile pavment arrangement, Subiaco, Perth, Western Australia (Photo: Tim Hughes)

Vision impaired pedestrians need to identify public transport access areas. This can be done by environmental cues, but tactile paving can also be provided. Tactile paving should comprise directional indicators that intercept the through route and lead to warning indicators close to the entry door. Tactile warning indicators should also be provided 600 mm from the edges of train platforms and ferry wharfs. For more guidance, see *Guidelines for facilities for blind and vision-impaired pedestrians* [92].

Footpath width needs to be considered carefully at public transport stops where a large number of pedestrians are expected to board or exit, such as at railway stations. Table 14.3 covers the maximum pedestrian volumes for different through-route widths that result in a level of service B. Where expected pedestrian volumes at public transport stops exceed those in the table for a given through-route width, refer to Fruin: *Pedestrian planning and design* [57].

Shelters

To maintain an unobstructed through route the likely number of passengers using a bus stop needs to be considered. At very busy bus stops and interchanges, shelters should be provided in a widened street furniture zone. To achieve this, kerb extensions may be required. Alternatively, shelters should be in the frontage zone.

Bus shelters should be designed so that:

- approaching traffic can see them clearly
- there is adequate lighting for security
- they have adequate seating
- they are protected from the weather
- they are resistant to vandalism
- there is adequate security (such as with multiple exits at enclosed shelters, and transparent walls)
- they are located near existing land uses that provide passive security.
- they are visually distinct from surroundings to aid visually impaired pedestrians [134].

Photo 14.26 – Bus shelter in street furniture zone (through route behind shelter), Christchurch (Photo: Aaron Roozenburg)

Photo 14.27 – Train station, Papakura (Photo: Megan Fowler)

Photo 14.28 – Tactile paving treatment at railway station, Fremantle, Western Australia (Photo: Tim Hughes)

15 CROSSINGS

CROSSING FACILITIES FOR PEDESTRIANS
Designing crossing facilities at, and away from intersections
Pedestrians' crossing requirements
Drivers' crossing requirements
Different crossing types and specifications

15.1 Introduction

Pedestrians cross the road an average of two to three times on every walking trip [476] and may also need to cross railways, waterways or other natural features. Their perceptions of the walking experience largely focus on difficulties crossing roads [169] and any problems with this can cause delays and create a sense of insecurity. Therefore, correctly designing, building and signing appropriate crossing facilities should be a major consideration when developing pedestrian routes. This applies not only to facilities in the road reserve, but also to off-road environments shared with cars, such as car parks.

Photo 15.1 – Pedestrians crossing, Christchurch (Photo: Megan Fowler)

15.2 General design considerations for pedestrian crossing points

As an integral part of the pedestrian network, crossings should meet the same minimum standards as through routes on the footpath, especially in:

- the maximum permissible crossfall
- maintaining adequate overhead clearances and protrusions
- the surface standard (stable and firm, and slip resistant even when wet)
- not containing grates and covers.

All crossing points should be designed to minimise pedestrians' crossing distance, which means ensuring [92]:

- they are at right angles to the direction of the road
- the roadway is as narrow at the crossing point as possible.

Where possible, crossings should be located on the pedestrian desire line. Where this is not possible or unsafe, use environmental and/or tactile cues to guide pedestrians to the crossing point [92]. Other road users should be able to predict the route of pedestrians who are about to leave the kerbs [92].

Street furniture that may obscure visibility should be located well away from the crossing, and vegetation should be regularly trimmed [46, 66]. Parking should be prohibited for at least 15 m either side of the crossing point (although this can be six metres if there is a kerb extension at least two metres deep). To ensure compliance, this may need enforcing every now and then, or additional infrastructure could be installed [139].

Some crossings are raised to the same level as the footpath, while others require pedestrians to change grade. In both cases, it is important to ensure that all types of pedestrian can make the transition between the footpath and the crossing safely and easily (see section 3). Later parts of this section cover specific issues for each type of crossing.

All pedestrian crossing points must be monitored so they continue to be appropriate for the location while operating safely and efficiently [86,139, 173]. They may need removing if pedestrian numbers have declined substantially and are unlikely to increase, or upgrading if pedestrian numbers have increased [173].

Crossing point design includes considering the cost and ease of maintenance, repair, reinstatement and replacement, especially in the materials used. It also includes considering the implications of maintenance for pedestrians and other road users.

Overdimension load transport is also an issue in designing pedestrian crossing points, especially on routes commonly used for this purpose. These routes require a 'design envelope' 11m wide and six metres high. Islands should have mountable kerbs and load bearing surfaces, with signs, poles and rails conveniently removed or folded at ground level. Where the road edge protrudes into the 'design envelope' such as at kerb protrusions, road furniture, signs, poles and other objects should be less than one metre high or be conveniently removed or folded over.

15.3 Crossing sight distance

At most crossing points pedestrians need to choose gaps in the traffic stream to cross safely, so they must be able to see the approaching traffic in good time. This distance, known as the 'crossing sight distance' [10], is a critical element in ensuring pedestrians can cross the road safely. It is calculated as [10]:

$$\text{Crossing sight distance (m)} = \frac{\text{crossing distance (m)}}{\text{walking speed (m/s)}} \times \frac{\text{85th percentile vehicle speeds (km/h)}}{3.6}$$

Crossing sight distance should be calculated carefully to take account of conditions at the site. For example:

- the pedestrian line of sight may be blocked by permanent or temporary obstructions
- walking speed can vary owing to factors such as pedestrian ages and physical condition, route gradients, pedestrian densities and environmental conditions [145]
- some pedestrians may take additional time to start crossing, because of mobility or visual impairments, uncertainty or double-checking that it is safe [13]
- the signed speed limit in the area should not be used as an indication of actual vehicle speeds. Actual speeds are usually faster than posted limits.

As walking speeds can vary, the one assumed at a crossing point should generally be biased towards slower pedestrians [13].

Where required crossing sight distances cannot be provided, they can be reduced with devices such as kerb extensions or refuges, or the traffic speed can be slowed. If neither is possible, provision of any facility that would encourage pedestrians to cross at that point should not be installed.

15.4 Design considerations for drivers

Drivers should be able to see all crossings easily so they can adjust their speed and be aware of the potential for pedestrians to step into the roadway [10]. They should be able to see the crossing over at least the appropriate 'approach sight distance' (see table 15.1), although an extra safety factor is recommended.

Table 15.1 – Minimum approach sight distances [10]			
Speed (km/h)	Approach sight distance (m)		
	Rural		Urban
	Normal R=2.5s	Alerted R=2s	R=1.5s
10	-	6	5
20		14	11
30		23	19
40		35	30
50		45	40
60		65	55
70		85	70
80	115	105	95
R = driver's reaction speed.			

The figures in table 15.1 presume emergency braking and adequate skid resistance. It is important to assess the skid resistance of the roadway upstream of a pedestrian crossing point, to help drivers avoid a crash if a pedestrian steps out unexpectedly. Treatment is justified if the skid resistance (sideways force coefficient) is less than 0.55 [157].

Advance road signing [154] and more intense lighting [68] may be required to make crossings more conspicuous.

15.5 Landscaping at pedestrian crossing points

Some pedestrian crossing points, such as kerb extensions and pedestrian islands, create opportunities for landscaping or public art. While this can provide an amenity value for pedestrians, it must not obscure visibility for pedestrians or drivers, particularly on the upstream side, at any time of the year. The crossing point must also continue to operate effectively during any landscaping maintenance, which means ensuring:

- drivers are not distracted by maintenance work or vehicles
- maintenance work or vehicles do not obscure pedestrian or driver visibility
- maintenance work or vehicles do not wholly or partially block pedestrian routes and force those on foot to change direction
- loose material is not spilled into the pedestrian route
- auditory cues (important to vision impaired pedestrians) are not obscured.

Photo 15.2 – Landscaping, Christchurch (Photo: Andy Carr)

15.6 Kerb crossings

Kerb crossings are an integral part of every crossing facility, whether mid-block or at intersections. Kerb crossings are of two types, kerb ramps and blended crossings.

15.6.1 Kerb ramps

When designing kerb ramps, it is important to ensure that:

- if there is a kerb ramp on one side of the roadway, there is also one on the other to prevent pedestrians being 'stranded' on the roadway itself
- there are no low points in the gutter where water can collect [13, 139]
- if installed at a pedestrian crossing point, the whole kerb ramp is contained within the crossing markings [118].

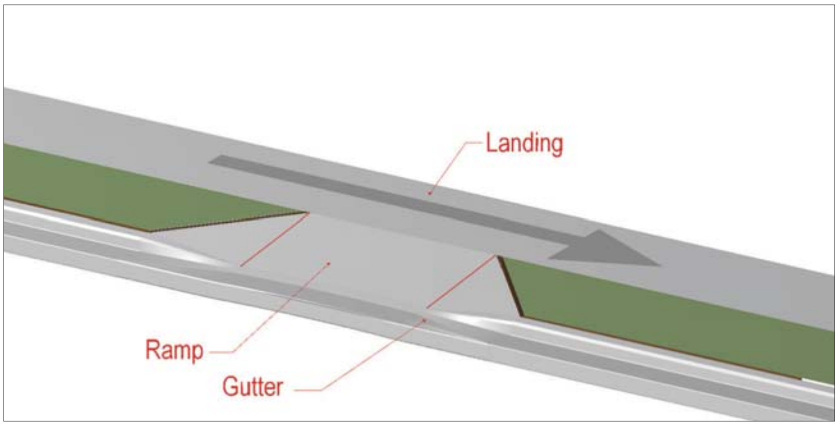
Every kerb ramp comprises [13, 46, 66, 139]:

- the ramp, which is the area pedestrians cross to change their grade
- the top landing, which is where pedestrians move between the ramp and the footpath
- the approach, which is the section of footpath next to the top landing
- the gutter, which is the drainage trough at the roadway edge.

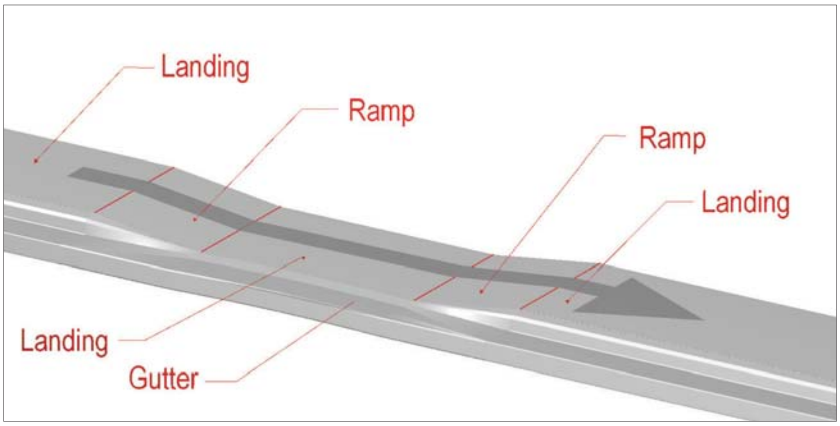
Many kerb ramps also have flared sides, which are sloping areas next to the ramp, to prevent pedestrians tripping on the ramp edges [13]. Some ramps also have a bottom landing. Return kerbs can be used instead if the kerb ramp is carefully located within the street furniture zone or at a kerb extension [13].

The various elements of kerb ramps can be combined in a number of ways, as shown in figure 15.1 [13, 46, 66, 139].

Perpendicular



Combination



Parallel

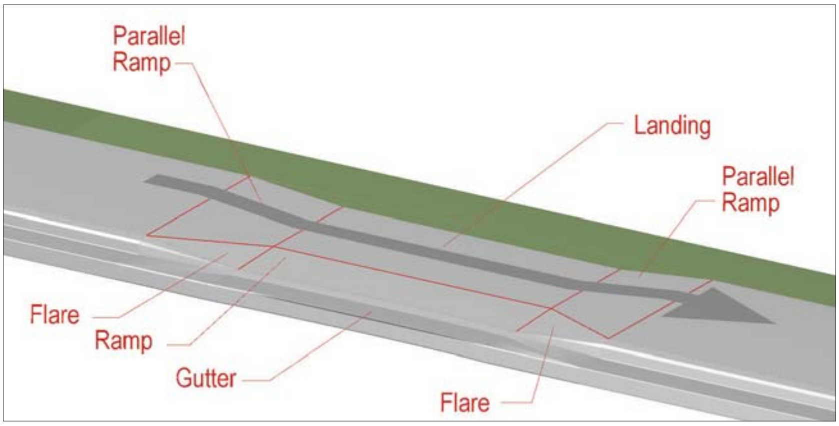


Figure 15.1 – Examples of kerb ramps

Table 15.2 covers the key design issues for the elements within kerb ramps [6, 13, 42, 92, 134, 139].

Table 15.2 – Design elements of kerb ramps

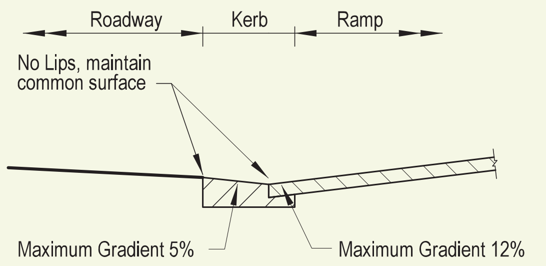
Element	Key issues	Additional information
Ramp	Normal maximum gradient 8% (1:12) Maximum gradient 12% (1:8)	A gradient of 10% should only be considered for constrained situations where the vertical rise is less than 150 mm. A gradient of 12% should only be considered for constrained situations where the vertical rise is less than 75 mm. Slopes more than 12% are very difficult for the mobility impaired to negotiate. To avoid using these steeper gradients, lower the footpath as shown in figure 15.1
	Maximum crossfall 2% (1:50)	Should be consistent across the whole ramp – avoid twist.
	Minimum width 1 m	1.5 m is recommended.
	Maximum width: equal to the width of the approaching footpath	Wider ramps are difficult for the vision impaired to detect.
	Tactile paving	For more advice, see *Guidelines for facilities for blind and vision-impaired pedestrians* [92].
Gutter	Maximum gradient 5% (1:20)	Anything greater can cause wheelchair users to lose their balance at the transition.
	Transition between gutter and ramp	Should be smooth with no vertical face. Ensure that this does not inadvertently happen when the roadway has been resurfaced [13].  **Figure 15.2 – Typical gutter design**
Landing	Maximum gradient 2% (1:50)	To prevent wheelchair users overbalancing, or accidentally rolling, and to provide a rest area.
	Maximum crossfall 2% (1:50)	
	Width: equal to that of the ramp	
	Minimum depth 1.2 m (top landing)	A depth of 1.5 m is preferred.
Flare	Maximum gradient 16% (1:6)	Use the steeper value if a vision impaired person could inadvertently enter and leave the kerb ramp from the side and bypass the tactile paving.
	Maximum gradient: as per the ramp section	Use these gentler values if mobility impaired people are expected to enter and leave the kerb ramp from the side due to the top platform being too small. For a kerb ramp perpendicular to a straight kerb this results in a splay angle of 45°.

Figure 15.3 shows a typical kerb ramp design for a footpath with a kerb height of 100 mm that incorporates these dimensions.

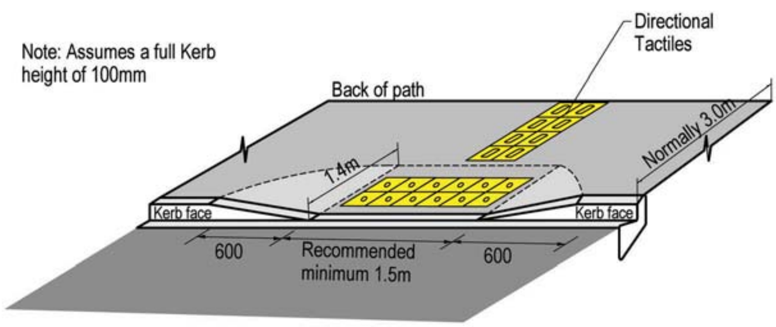


Figure 15.3 – Typical kerb ramp design

Mobility impaired people should not have to change direction while on the ramp [4]. This means curved kerbs require kerb ramps with bottom landings (see figure 15.4).

Kerb ramps create particular problems for the vision impaired. This is because they often use the kerb face as a tactile cue for the footpath edge [6, 13] and kerb ramps can increase the risk of their inadvertently walking out into the roadway. To avoid this, all kerb ramps should incorporate appropriate tactile ground surface indicators. Refer to *Guidelines for facilities for blind and vision-impaired pedestrians* [92].

Section 14.15 has advice on kerb ramps at intersections.

15.6.2 Blended kerb crossings

Blended kerb crossings are where the footpath and roadway meet at the same level. This can occur at a number of locations, particularly at pedestrian platforms. The design advice on demarcation and surfacing of pedestrian platforms should be referred to for all blended crossings (see section 15.11).

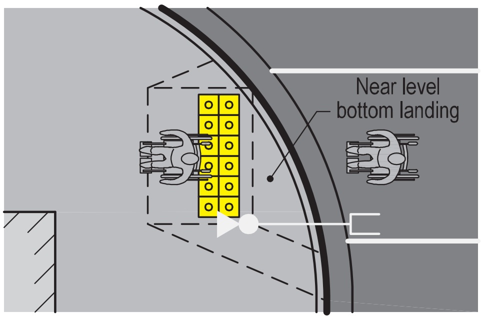


Figure 15.4 – Correct bottom landing arrangement

Photo 15.3 – Kerb ramp, Featherston St, Wellington (Photo: Tim Hughes)

Photo 15.4 – Kerb ramp, near bus stop, SH 1, Russley Rd, Christchurch (Photo: Tim Hughes)

Photo 15.5 – Blended kerb crossing at platform, Taupo (Photo: Else Tutert)

15.7 Selecting the appropriate crossing facility

The choice of crossing facilities should always be appropriate for the prevailing environment. Section 6.5 covers crossing facility selection.

15.8 Pedestrian islands

Pedestrian islands should be built as kerbed islands (0.15 m to 0.18 m above the road's surface) and be a different colour from the road. If they are large enough, low plants that do not obscure children or signage may be planted [58]. Figure 15.5 shows the three pedestrian island layouts commonly used [58].

Of these, the diagonal style is favoured for a 'stand-alone' pedestrian island because [24, 58, 72]:

- pedestrians are turned to face oncoming traffic (a 45° angle strikes an appropriate balance between turning pedestrians and extending their route)
- there are some installation and maintenance benefits.

The chicane design is also useful as it offers space for handrails and can hold more pedestrians on narrow roads [58, 72]. The 'stagger' between entry and exit is also helpful in preventing pedestrians trying to cross the whole road in one movement [72]. The island should have resting rails. A fence is desirable on chicane layouts. Both of these encourage pedestrians to cross at the cut-through or kerb ramps.

Kerb crossings (built according to section 15.6) on the adjacent footpaths must be used where pedestrian islands are provided.

Straight

Diagonal

Chicane

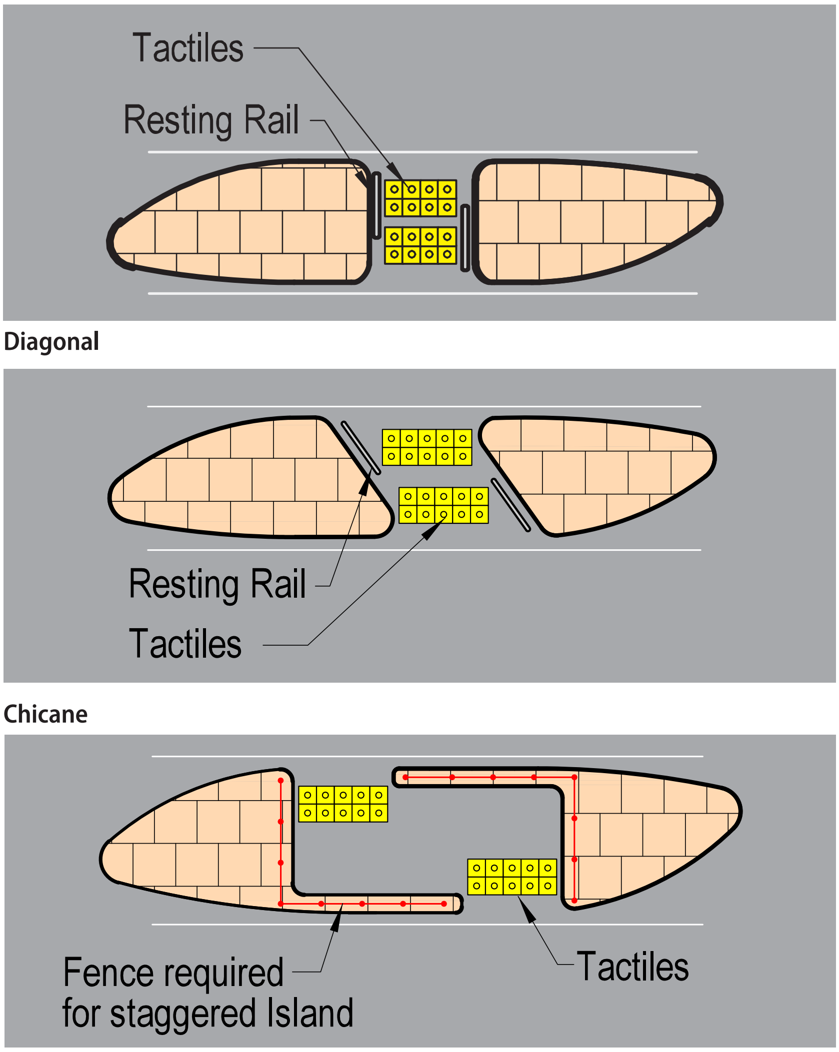


Figure 15.5 – Pedestrian island layouts

Table 15.3 covers the key design issues for pedestrian islands, while figure 15.6 is an example of a compliant pedestrian island [6, 10, 42, 46, 58, 68, 92, 126, 139, 154].

Table 15.3 – Design elements of pedestrian islands

Key issues	Requirement	Additional information
Islands	Length at least 8 m	Site specific according to: • the road type (larger islands on busier, wider roads) • the potential number of pedestrians waiting on the island • possible vehicles turning into adjacent accesses.
	Approach nosing taper 10%	In accordance with the *Manual of traffic signs and markings* (MOTSAM) [154].
	Approach nosing radius 0.6 m	In accordance with MOTSAM [154].
Island depth	At least 1.8 m, preferably 2 m	This is required so that waiting pedestrians and/or their belongings do not protrude into adjacent traffic lanes. In constrained situations, the 'depth' can be measured parallel to the waiting area. Where the roadway has a constrained width, the desirable width can be achieved by narrowing the traffic lanes.
Width of route through island	At least 1.5 m or the width of the adjacent kerb ramps (whichever is greatest)	The actual width should be based on the potential number of pedestrians waiting on the island, so it is also affected by the island's depth.
Ramps within the island	If provided, there must be a level area between ramps of at least 1.2 m	It is preferable to not change grade within the island and use a cut-through instead. If used, they must comply fully with the kerb ramp design criteria.
Resting rails	1 m high At least 0.35 m from the kerb face at the edge of adjacent traffic lane(s)	Rails should be frangible to avoid injury to drivers whose vehicles leave the roadway, and built of iron pipe or some other such material (figure 15.7). They should be conspicuous and painted in a contrasting colour to their surroundings. They should not reduce the route width to below the minimum and should have a bar near ground level that the vision impaired can detect.
Fences	See section 16.8	These are required when using a chicane layout to avoid creating a trip hazard.
Lighting	In accordance with AS/NZS 1158.3.1: 1999 [88]	Some RCAs have used a white globe (similar to a Belisha beacon) mounted on a 4 m high white pole within the island. Floodlighting (as used for zebra crossings) has also been used. Lighting poles on islands must fold down for overdimension loads.
Island kerbing	Mountable splay kerbs	Other kerbs are only acceptable if the traffic lanes more than 3.2 m wide **and** the island is wider than 2 m. It is advisable to paint the island kerbs with white or reflective paint.
Signs	RG-17 or RG17.1 ('keep left')	Installed as close to the island ends as possible and facing oncoming vehicles. No more than 0.15 m between the bottom of the sign and the island surface.
Roadway markings	Merge/diverge tapers on approaches	In accordance with MOTSAM [154].
Overdimension loads	Maintain 11 metre wide envelope	Refer section 15.2

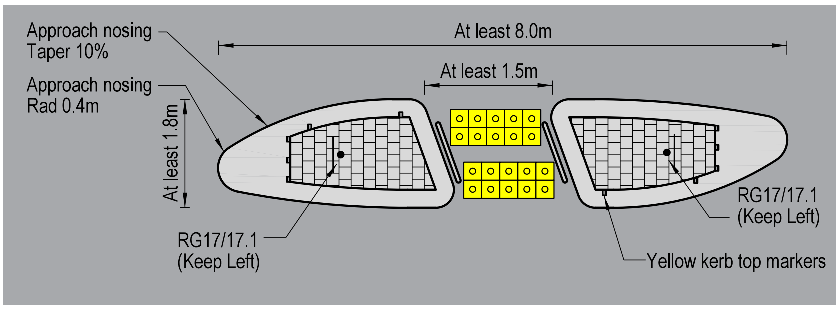


Figure 15.6 – Example of a compliant pedestrian island

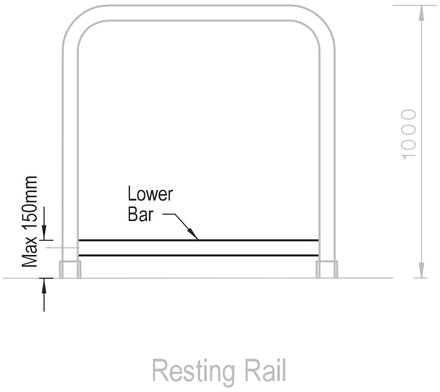


Figure 15.7 – Resting rail – recommended design

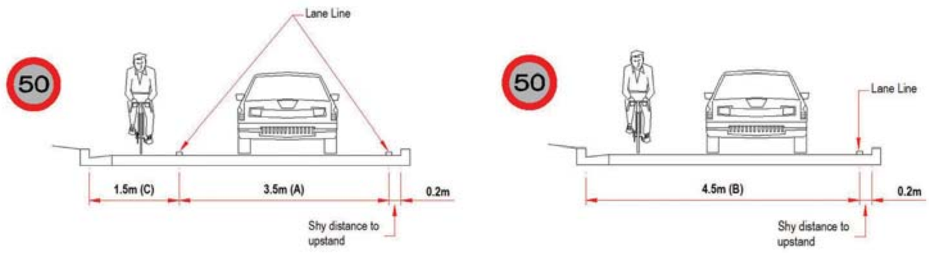
Photo 15.6 – Pedestrian island lighting column and globe, Hamilton (Photo: Shaun Peterson)

If there is another pedestrian island nearby, consider linking the two with a continuous raised or flush median [58, 139]. If a flush median is already there, it should be smoothly widened if necessary to enclose the raised island [58]. Traffic lanes should never terminate immediately before an island [46].

Photo 15.7 – Pedestrian island, Highsted Rd, Christchurch (Photo: Tim Hughes)

Roadway width

When providing pedestrian islands, or any device that narrows the roadway, it is important to maintain enough width for cyclists and vehicles to pass each other. In the absence of a cycle lane, there should normally be at least 4.5 m, and no more than five metres width for each direction of travel. If a cycle lane is provided, there should normally be five metres width for each direction of travel. Where the width is less than this, the vehicular lane, not the cycle lane, should be narrowed. Figure 15.8 illustrates these dimensions.



With cycle lane **Without cycle lane**

(A) May be reduced to a minimum of 3 m if heavy vehicles are rare and next to mountable kerb.

(B) May be reduced to a minimum of 4 m if heavy vehicles are rare and next to mountable kerb.

(B & C) Increase by 0.5m for 70 km/h speed limits.

Figure 15.8 – Desirable minimum roadway widths for cyclists

The appropriate width must also be maintained along all approaches and departures, so in constrained situations this may mean removing car parking. Figure 15.9 shows two good practice examples of this.

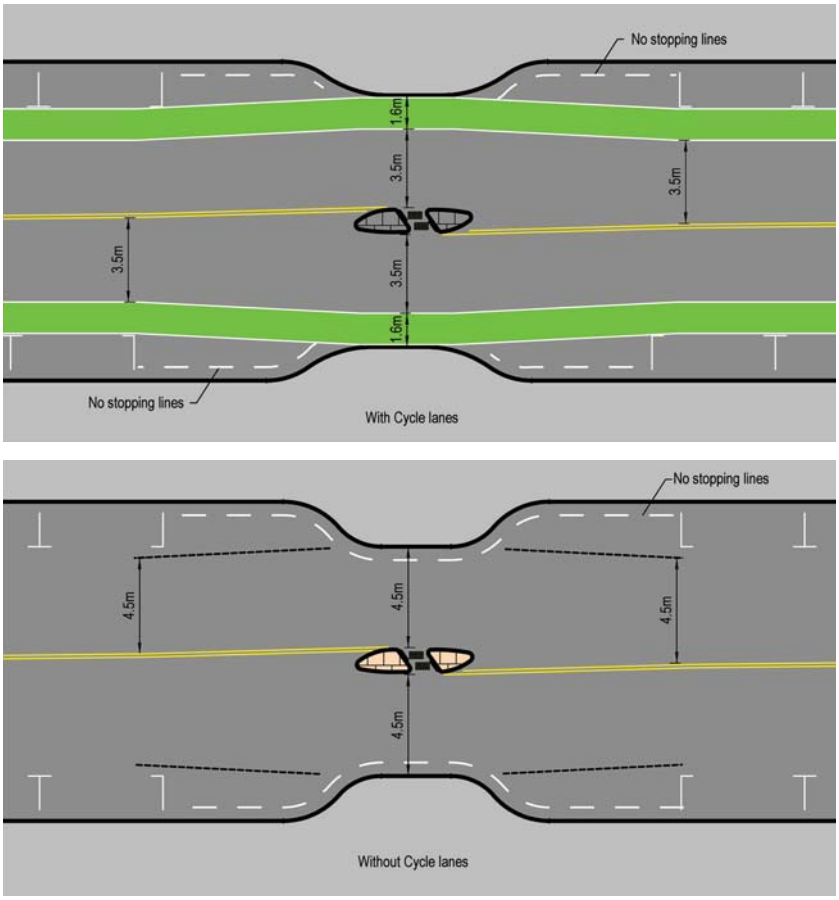


Figure 15.9 – Good practice examples of pedestrian island layout

15.9 Medians

Medians may be flush or raised. Raised medians are similar to pedestrian islands in many respects.

Flush medians enable pedestrians to cross the road in many locations. However, care is required to ensure kerb ramps are at suitable locations for the mobility impaired to cross the road. Raised medians require cut-throughs (or kerb ramps) at the crossing locations, which should be consistent with pedestrian islands (see section 15.8). Table 15.4 details other median design considerations.

Photo 15.8 – Median with path cut through island, SH 74 Main Nth Rd, Christchurch (Photo: Susan Cambridge)

Table 15.4 – Design elements of medians			
Key issues		**Requirement**	**Additional information**
Median depth		At least 1.8 m, preferably 2.0 m	This is required so that waiting pedestrians or their belongings (prams, wheel chairs etc) do not protrude into the adjacent traffic lanes. In constrained locations, the desirable width may be achieved by narrowing the traffic lanes.
Lighting		In accordance with AS/NZS 1158.3.1: 1999 [68].	
Raised medians only	Width of the path through a raised median	At least 1.5 m or the width of the adjacent kerb ramps (whichever is greatest)	The width should be based on the potential number of pedestrians waiting on the median to cross, so this is also affected by the median depth.
Raised medians only	Ramps within raised medians	If provided, there must be a level area between ramps of at least 1.2 m	It is preferable to maintain the grade within the raised median and use a cut-through instead. If used, they must comply fully with kerb ramp design criteria.
Raised medians only	Resting rails	1 m high At least 0.35 m from kerb face at edge of adjacent traffic lane(s)	As for section 15.8
Raised medians only	Barriers	See section 16.8	These should not reduce the route width to below the minimum.

15.10 Kerb extensions

Kerb extensions should be designed on a case-by-case basis. In each case, access to the crossing point should be facilitated by kerb ramps installed partly or wholly within the kerb extensions, to the standard in section 15.6.

Extensions installed at intersections should enable large vehicles to turn safely and without mounting the kerb. Section 15.15 has advice on designing intersections for pedestrians.

When providing kerb extensions it is important to keep enough width for cyclists and vehicles to pass each other through the crossing. Section 15.8 covers adequate widths.

Kerb extensions should comply with the general dimensions in table 15.5. Figure 15.10 is an example of a mid-block kerb extension.

Table 15.5 – General dimensions for kerb extensions		
Key issues	**Requirement**	**Additional information**
Extension depth	0 m to 7 m, typically 2 m to 4 m	This is determined by the width of the nearside lane, keeping an adjacent lane width of at least 4.5 m if the adjacent lane has no cycle lane or 5 m if it has. See figure 15.8
Extension length	At least 3 m	The length should be based on the potential number of pedestrians waiting to cross, so it is also affected by the extension depth.
Approach length	2 m to 5 m	
Departure length	2 m to 8 m	
Curve radii	0.5 m to 6.5 m, typically above 5 m (concave) 0.5 m to 5 m, typically above 2 m (convex)	Above 5 m facilitates mechanical street sweeping.
Lighting	In accordance with AS/NZS 1158.3.1: 1999 [68]	
Signs and roadway markings	Bridge end markers on upstream approaches	It is advisable to paint the kerbs with white or reflective paint.
Overdimension loads	Maintain 11 metres wide envelope	Refer section 15.2

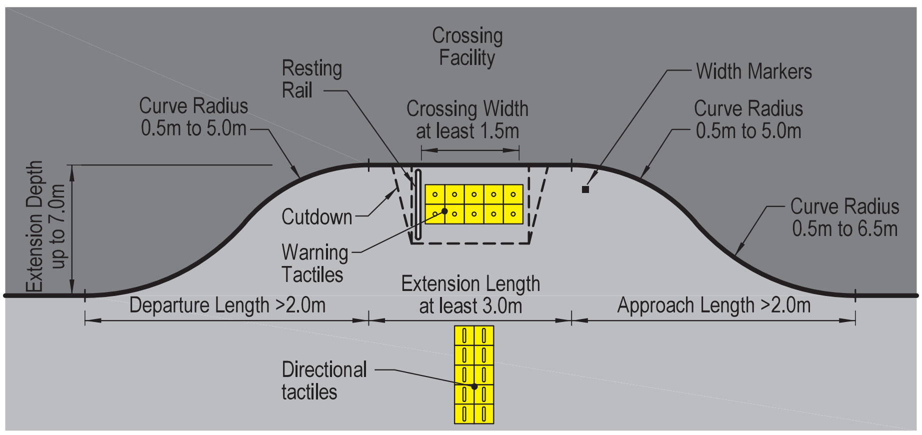


Figure 15.10 – Example of mid-block kerb extension

15.11 Pedestrian platforms

Pedestrian platforms are raised above the level of the surrounding road. Platforms on their own do not affect give-way priority unless they are also marked as a zebra crossing. Their exact design depends on [58]:

- the number of (crossing) pedestrians
- the number of vehicles
- the street function
- the street width
- whether the crossing is controlled or uncontrolled
- landscape/streetscape factors
- the types of vehicles
- vehicle speed
- the roadway surface slope and drainage.

Photo 15.9 – Platform with good footpath to road contrast, Kilbirnie, Wellington (Photo: Tim Hughes)

Generally, pedestrian platforms should comply with the criteria in table 15.6 [12, 31, 34, 35, 39, 46, 58, 66, 68, 81, 118, 139, 145]. Figure 15.11 shows their typical dimensions.

Table 15.6 – Design issues for raised pedestrian platforms

Element	Key issues	Additional information
Vehicle approach ramp	Maximum gradient 10%	Greater values are more effective in slowing vehicle speeds.
	Minimum gradient 5%	
	The ramp leading edge should be flush with the road surface.	
	Ramp faces should be clearly marked (see below).	
Platform dimensions	Maximum height 0.10 m	The platform should be high enough to encourage vehicles to reduce their speed, and can tie in to the height of the adjacent kerb.
	Minimum height 0.075 m	
	Maximum length 6 m	Use longer platforms where there are higher numbers of large vehicles or pedestrians.
	Minimum length 2 m	
Siting	Not on sharp bend.	
	Roadway width should be no more than two live lanes of traffic, one in each direction.	
	Set back 5 m or more from junction mouths.	
	Should be preceded by a feature that causes vehicles to slow (such as yielding the right of way).	
	Speed limit: 50 km/h or less.	
	These are only suitable for local roads and possibly collector roads. They are not for arterials except in major shopping areas where this function exceeds the arterial function.	

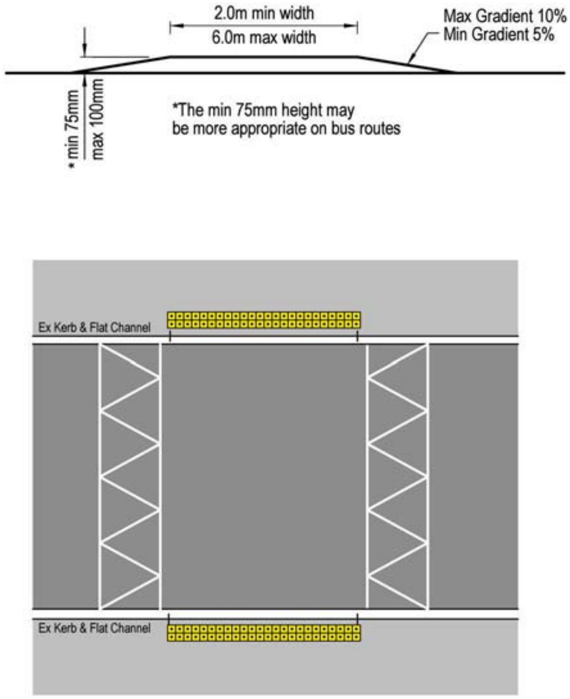


Figure 15.11 – Typical dimensions of a pedestrian platform

Photo 15.10 – Sign on bollard delineates edge of roadway, Palmerston North (Photo: Tim Hughes)

It is important that pedestrians do not falsely perceive the platform as a continuation of the footpath. This especially applies where there are concentrations of pedestrians who may lack experience or understanding, such as children or the elderly [80, 81].

To avoid misunderstanding:

- the material on top of the platform should be significantly different in colour and/or texture from the paved footpath
- there should be a clear demarcation between the platform and the footpath.

There are a number of ways to follow these design criteria and indicate who has priority. These include [58]:

- using different surfacing materials
- maintaining a significant height difference between the top of the platform and the footpath
- using a white concrete beam between the edge of the platform and the footpath
- using colour contrasted tactile warning indicator paving along the footpath at the boundary with the platform
- using bollards or other street furniture.

This should reduce the need for any signage, although some road controlling authorities (RCAs) have installed signs on platforms, such as 'Pedestrians watch for vehicles' or 'Pause'.

A wide variety of different surfacing materials can be used. They must [58]:

- be highly durable
- be able to withstand the impact of moving traffic
- retain their colour, texture and/or contrast well
- have a high skid resistance, with a sideways force coefficient higher than 0.55 [157]
- bond well with road marking material
- be compatible with underlying or adjacent material
- minimise the effects of glare, bright-sky reflection and wet roads at night.

Pedestrian platforms can be combined with other types of pedestrian crossing, as long as the latter are appropriate. The overall design must comply with all relevant requirements, including all signing and roadway marking regulations.

Drivers must be made aware of a pedestrian platform in good time so they can reduce their speed. An approved warning sign (PW-39) is available for this [80]. Markings are also required on the approach ramps as the drivers' view of the top of the platform is restricted. A 'zigzag' marking in white reflective paint, such as that in figure 15.12, should be installed across the full width of the approach ramp.

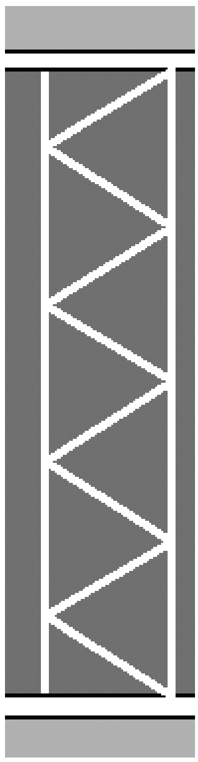


Figure 15.12 – Reflective 'zigzag' marking on platform approach, lines 150mm wide

15.12 Zebra crossings

Zebra crossings should not normally be sited [58, 146]:

- within 100 m of:
  - any other pedestrian crossing point on the same route
  - a major intersection unless located at the intersection
  - a signalised pedestrian crossing
- near speed humps, unless they are combined with the speed hump (as a platform)
- where the speed limit exceeds 50 km/h, without specific approval from Land Transport NZ.

Table 15.7 highlights locations where zebra crossings are not normally suitable [58, 66].

Photo 15.11 – Zebra crossing, Marine Parade, New Brighton. Christchurch (Photo: Basil Pettigrew)

Table 15.7 – Unsuitable locations for zebra crossings

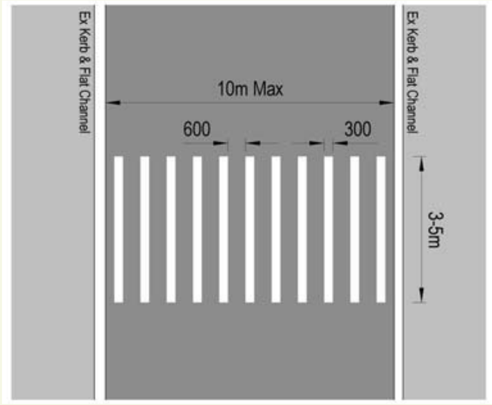
Unsuitable location	Difficulties	Solution
Multi-lane or divided roads	Stationary vehicles can obscure pedestrians. Some drivers will overtake a car stopped in another lane.	Consider pedestrian islands. Consider mid-block pedestrian signals. In the rare cases where a zebra crossing is justified, it should be made more conspicuous through extra signing and other measures.
Close to junctions	Drivers focus on the junction rather than the crossing. Forward visibility of the crossing may be less than desirable.	Consider pedestrian islands. Consider signalising the junction and including a pedestrian phase.

Kerb ramps on the adjacent footpaths (installed to the standards in section 15.6) provide access to zebra crossings.

In urban areas, pedestrian desire lines for zebra crossings may be very close to, or at, a lightly used driveway. Locating them here is not a safety hazard [58], although pedestrians may find their route blocked or become confused by a turning vehicle [58]. However, the transition between the footpath and the crossing must be carefully considered, as a standard driveway cut-down will not meet the minimum standards for a kerb ramp [58].

Table 15.8 summarises the key features of zebra crossings. Further details can be found in MOTSAM [154].

Table 15.8 – Design elements of zebra crossings

Sign/marking		Dimension and location
Roadway markings	Bar markings	Transverse bars must be painted reflectorised white, at least 2 m long (3 m or more desirable) and 0.3 m wide with a 0.6 m gap between. 
	Diamond	An advance warning diamond can be located at least 50 m in advance of the crossing on each approach. However, if the 85%ile speed is consistently and significantly less than 50 km/h, the diamond should be at the safe stopping distance plus 5 m.
	Centrelines	If a centreline is marked on the roadway, a single white line 50 m long (rural) or 30 m long (urban) should be marked, terminating at the hold line on both approaches. The centreline should not pass through the crossing.
	Hold lines	A single white limit line 300 mm wide must be installed 5 m back from the bar markings.
	Edge lines	These should be stopped short of the crossing at the hold lines.
	No stopping lines	At least 6 m (preferably 8 m to 15 m) of broken yellow line on the upstream approach to the crossing.
Other signs and markings	Crossing poles	Black and white (preferably reflectorised) striped poles, at least 2 m high and 75 mm wide, located within 2 m and upstream of each end of the crossing including any traffic islands.
	Lighting	Crossings must be illuminated at night. If the RCA is of the opinion that the crossing will not be used at night it must still be illuminated by street lighting.
	Belisha beacons/fluorescent orange discs	An internally lit flashing amber beacon, or fluorescent orange disc, at least 300 mm in diameter, mounted on the crossing poles.
	PW-30 warning signs	These must be used on both approaches in advance of the crossing.

Although zebra crossings may be legally up to 15 m long, none should be longer than 10 m [58, 146]. Where a longer distance is likely, kerb extensions should be used to reduce the distance travelled in one crossing movement [58]. If kerb extensions cannot be used, pedestrian islands may be installed instead. Islands should be at least two metres wide [58] and be of the chicane or diagonal type so that pedestrians are turned to face oncoming vehicles. In traffic-calmed environments (where speeds are less than 50 km/h) zebra crossings can be installed on pedestrian platforms, as long as they use zebra crossing signs and markings. The bar markings on the platform must be reflectorised white material.

Figures 15.13, 15.14 and 15.15 show the signs and markings for zebra crossings on platforms, with kerb extensions and with a pedestrian island. For other situations, see MOTSAM [154].

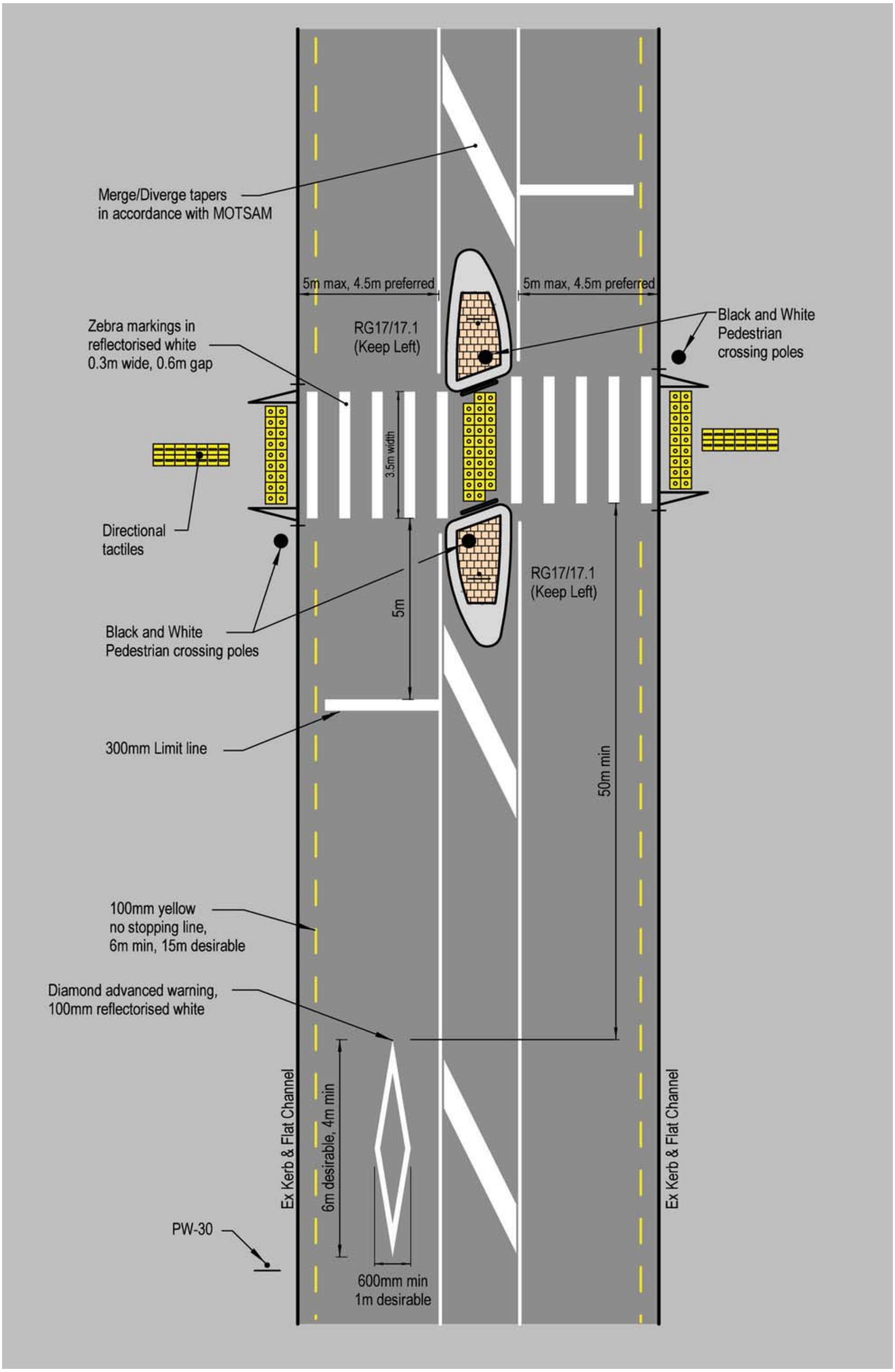


Figure 15.13 – Markings for zebra crossing with island

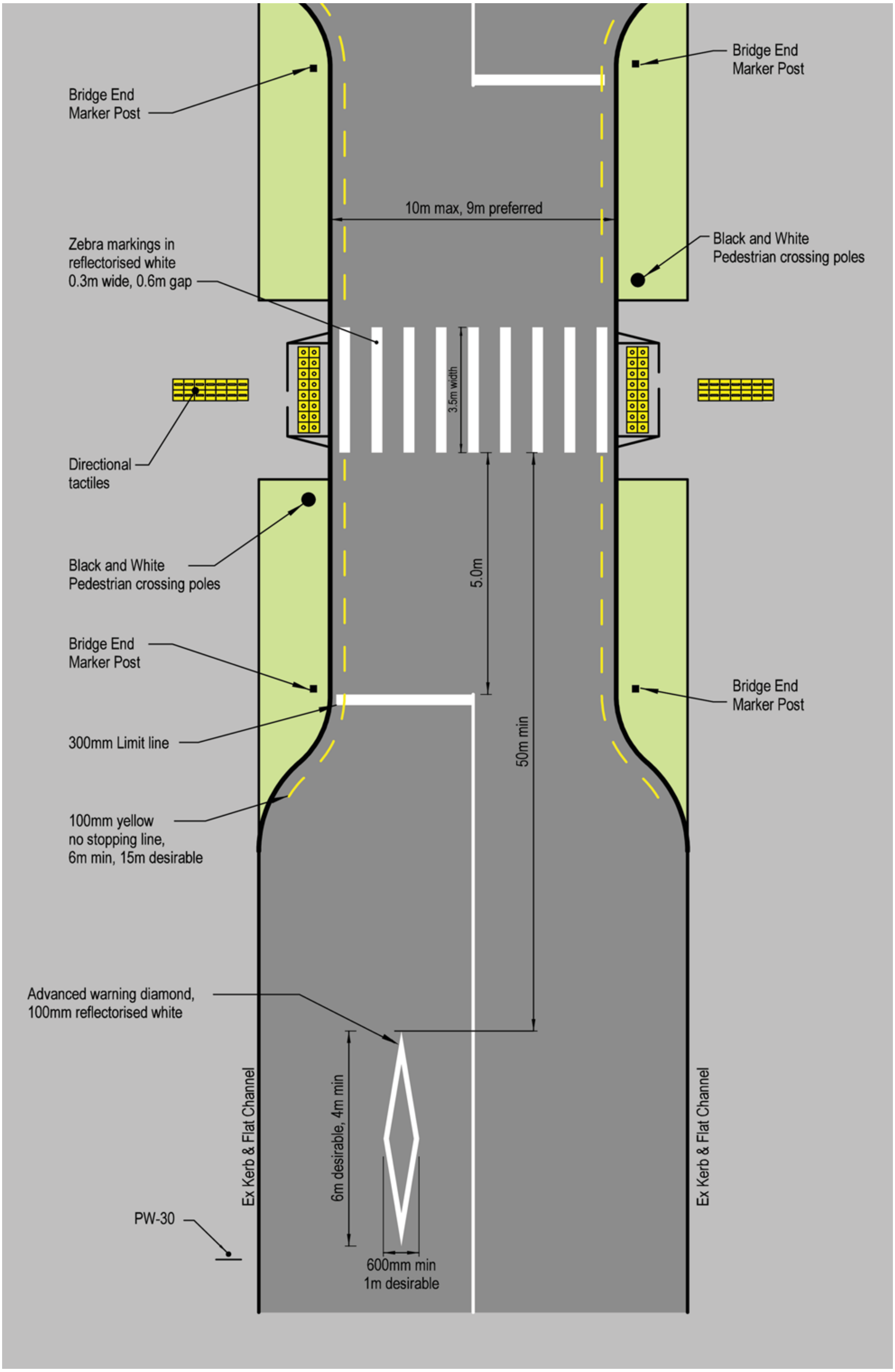


Figure 15.14 – Markings for zebra crossing with kerb extensions

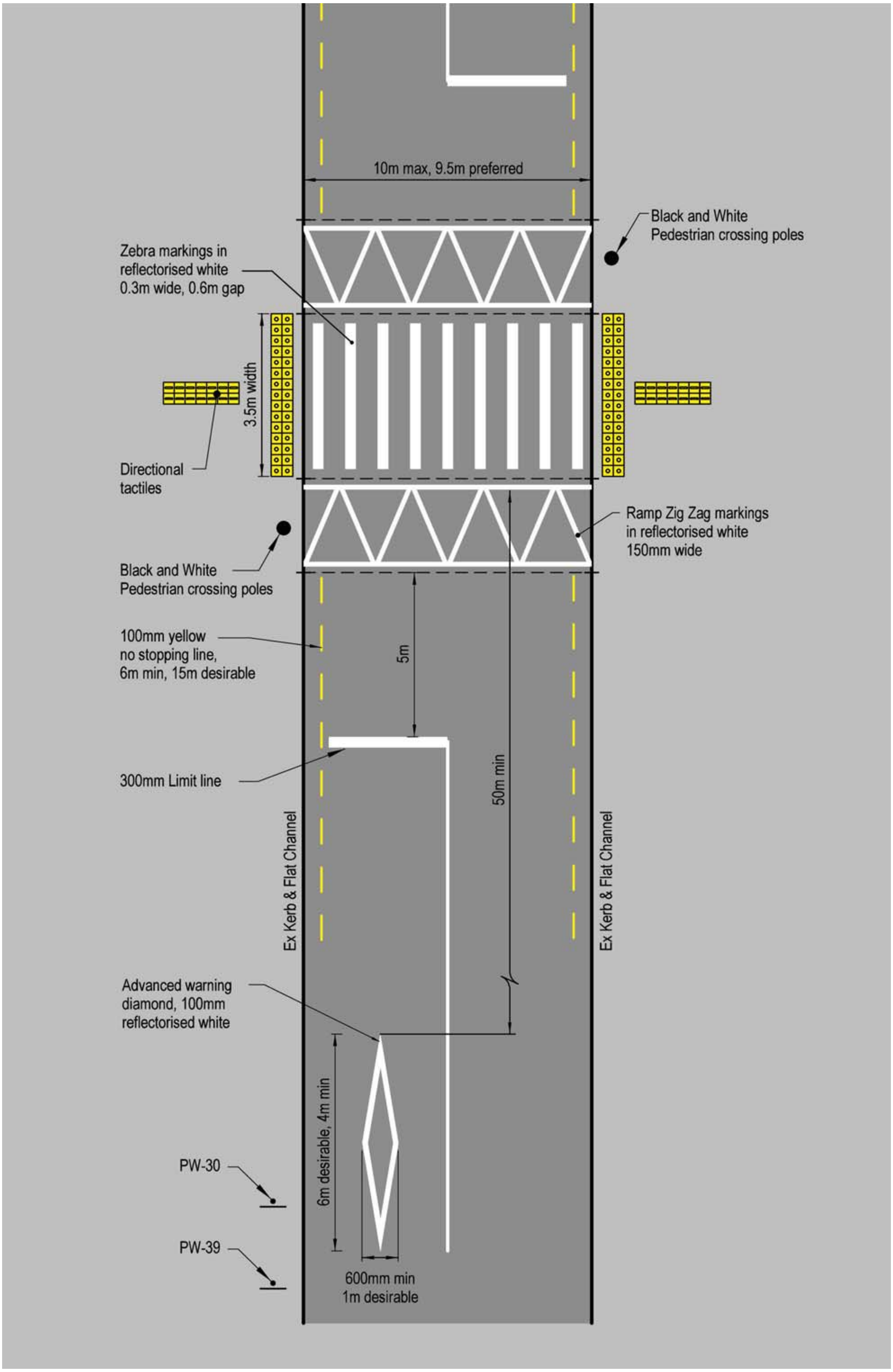


Figure 15.15 – Markings for zebra crossing on platform

15.13 Mid-block pedestrian signals

Pedestrian signals are usually installed only where there are enough pedestrians to ensure the signals are activated regularly. If the signals are not activated regularly, drivers can develop the expectation that pedestrians will not be crossing, leading to safety issues. The alternative may be to signalise a nearby intersection.

Timings

Safe operation of signals requires high levels of pedestrian compliance so the signals should respond promptly to pedestrian demand. This needs to be considered in relation to system coordination needs for efficient traffic flow [66]. There are two ways of improving signal responsiveness to pedestrians:

- Exclude the mid-block pedestrian signals from the coordinated system and rely on the system to correct the delays.
- Consider the wider area and determine if the system reflects the road user hierarchy. Shorten the system cycle times accordingly.

The signal timings should allow for the maximum practical crossing time for pedestrians. Table 15.9 summarises ideal pedestrian timings.

Table 15.9 – Symbols of pedestrian signal heads

Symbol		Meaning	Ideal timings	Minimum timings
	Steady red pedestrian figure	Do not step out on to the road. Wait by the kerb.	The green walking pedestrian symbol should be displayed as soon as practicable after the call button is pressed.	The longest average waiting time should be 30 seconds to avoid pedestrians choosing their own gap and trying to cross.
	Green walking pedestrian figure	After checking it is safe to do so, walk across the road.	Provide sufficient time for all waiting pedestrians to enter the crossing. This depends on depth of waiting space occupied and agility of users.	Five seconds (six seconds preferred). At shorter intervals, some pedestrians may start to cross and then turn back.
	Flashing red pedestrian figure	Do not step out on to the road, but finish crossing if already in the road.	A pedestrian who has just entered the roadway and is travelling at the 15th percentile speed (default 15 m/s) on the longest valid crossing route, should be able to reach the opposite kerb before the steady red pedestrian figure appears.	

[41, 46, 66, 111,139]

Walking speeds should always be estimated conservatively (see section 3.4), with additional allowances where needed for [139]:

- some pedestrians, notably the elderly, who can take up to 1.5 seconds longer to start crossing
- people at the back of a large group of pedestrians, who will take some time to enter the crossing
- if the crossing is narrow, obstructions and delays between pedestrians walking in opposite directions.

Pedestrians should be able to see the signal heads whenever they are waiting and crossing [66, 139, 146]. The heads should be at least 2.1 m above the footpath to ensure they do not create a hazard.

Photo 15.12 – Pedestrian call button with explanation (Photo: Tim Hughes)

Detection

Pedestrians are usually detected when they press a push-button. These push-buttons should have all the audible and tactile features specified in 'AS 2353: 1999: Pedestrian push-button assemblies' (see figure 15.16). For more details, see *Guidelines for facilities for blind and vision-impaired pedestrians* [92].

Pressure-sensitive mats or infrared detection are also used – most often to cancel a phase because the pedestrian has departed [24, 58]. They should always be accompanied by a push-button system. Their use to cancel a phase is not recommended until the technology more reliably detects that the pedestrian has really departed.

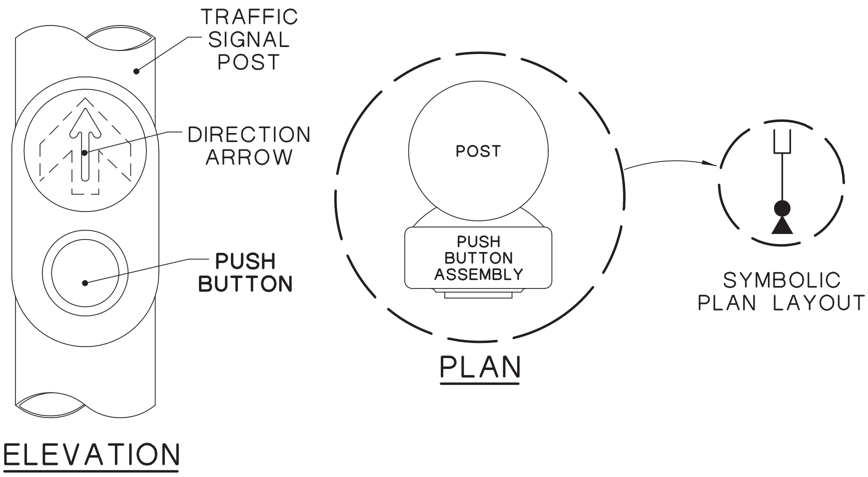


Figure 15.16 – Pedestrian push-button assembly

Detected pedestrians should have their presence acknowledged so they know the signals are working and they will receive a crossing signal [139]. This may be by:

- an indicator light near the push-button
- an audible sound
- the opposite pedestrian signal head lighting up.

Pedestrian push-buttons should be [92]:

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

If there is no pole for the push-button, or the poles are too far from the crossing, an additional pole shall be installed and positioned so that it does not confuse pedestrians.

Crossing design

Kerb ramps on the adjacent footpaths (installed to the standard in section 15.6) provide access to the crossing point.

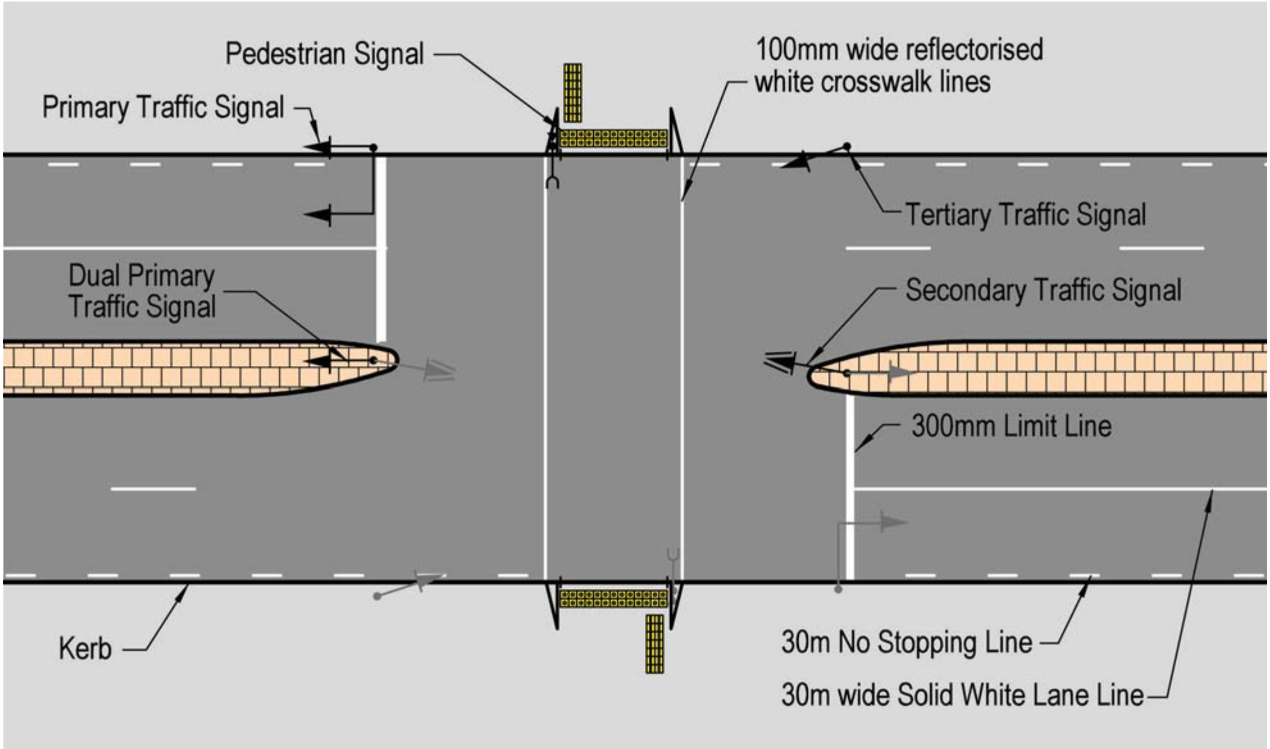
Vision impaired people must be made aware of the crossing opportunity and be able to use it safely. This means [13, 46, 58, 92]:

- installing tactile paving in accordance with *Guidelines for facilities for blind and vision-impaired pedestrians* [92]
- providing audible tactile devices at all new and upgraded installations.

When using audible tactile devices, ensure that locations are treated consistently. More details are available in *Guidelines for facilities for blind and vision-impaired pedestrians* [92]. If they are being installed at unusual or complex locations, designers should also consult potential users or their representatives (such as the Orientation and Mobility instructors from the Royal New Zealand Foundation of the Blind).

MOTSAM [154] covers the appropriate layout for mid-block signals, and figure 15.17 has an example. Drivers must be able to see the signal heads over the whole approach sight distance [146].

Photo 15.13 – Mid-block signals, Riccarton, Christchurch (Photo: Basil Pettigrew)



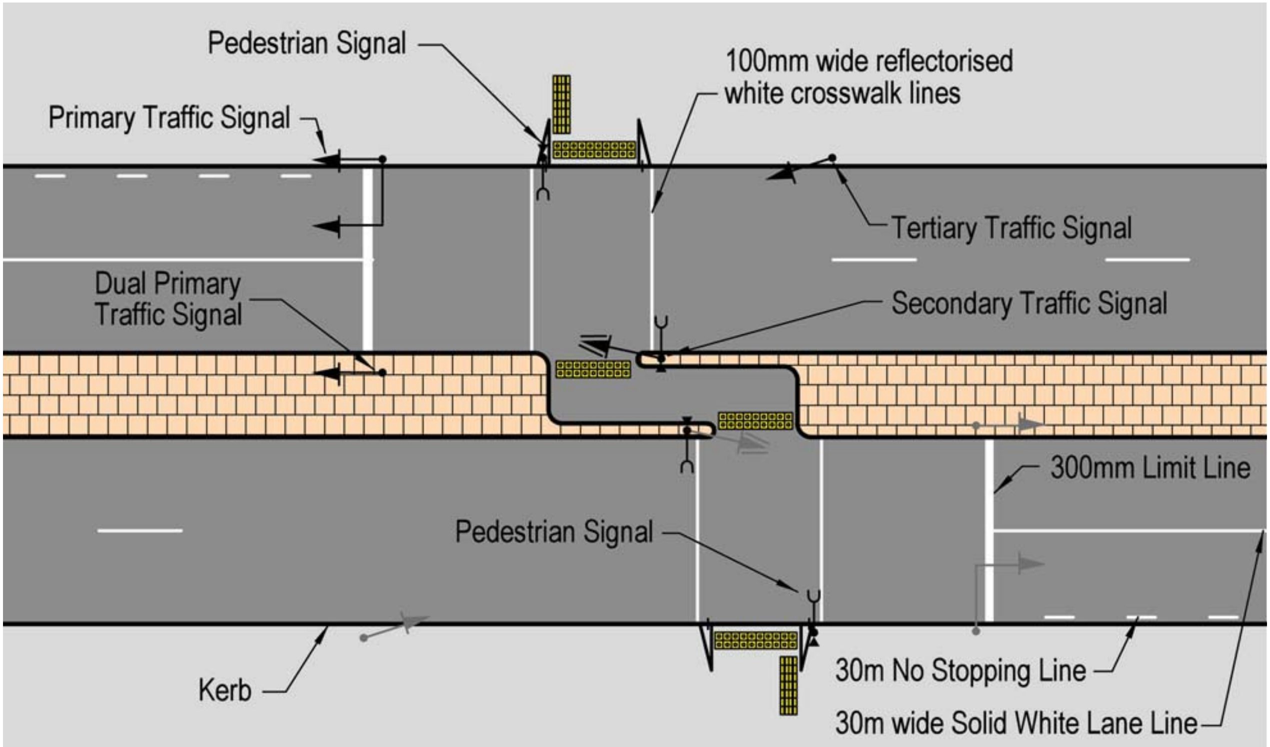


Figure 15.17 – Examples of signalised mid-block pedestrian signals

To shorten the crossing distance, mid-block signals can be combined with kerb extensions. However, where kerb extensions are not possible and the crossing distance is more than 15 m, pedestrian islands and raised medians can be considered [58]. In this case [13, 42, 139, 146]:

- pedestrian detection can be installed to help slower pedestrians who cannot cross in time, or a call-button could be installed to reactivate the pedestrian phase
- a chicane arrangement can be used so that pedestrians are turned to face oncoming vehicles. This also means crossings on either side of the island/median can be activated at different times (staged crossings)
- if using staged crossings, visors should be installed on each set of pedestrian signal heads so that pedestrians do not mistake one set for another.

15.14 Grade separation

Overpasses and underpasses are fundamentally different in their grade changes. However, they do share some common features, notably that they are most effective when pedestrians believe they are easier to use than at-grade crossings [13].

Pedestrians should ideally stay at the same grade when crossing, or have only a minor change in level – if necessary, the road should be elevated or sunk [6, 66, 118, 139, 146]. In planning for new areas where a grade-separated crossing is required, it may be possible to utilise the terrain to achieve this. If this is not possible, ramps and steps that comply with best practice are required (see section 14.10).

Both over- and underpasses usually result in longer walking journeys than at-grade crossings – and they are unlikely to be used where the walking distance is more than 50 percent greater than the at-grade distance [66]. Even when less than this, some pedestrians will try to take the shortest route, so fences may be appropriate [10, 58, 139]. These should be continuous, unclimbable and long enough to prevent people walking around the ends [59].

Many dimensions for over- and underpasses are determined by specific site conditions. Table 15.10 shows some general dimensions [10, 13, 118, 146].

Table 15.10 – Dimensions of width and height

Parameter	Value	Additional information
Width	At least 2.4 m	It should be greater where the route is shared with other road user types.
Overhead clearance	At least 2.1 m	Greater clearance can help make the overpass/underpass feel more 'open'.
Grade change	No more than 6.5 m	For overpasses only.
	No more than 3.5 m	For underpasses only.
Roadway clearance	At least 4.9 m (6 m on over-dimension routes)	For overpasses only.

Pedestrians can be concerned for their personal security at both under- and overpasses [118], particularly if they are not well used [139].
To overcome this [13, 66, 118, 139, 146]:

- structures should be well lit, potentially on a continuous basis
- skylights should be provided in underpasses
- pedestrians should always be able to see their whole route without any obstructions or recesses, and (where possible) from a public place some distance away
- the route should include direction signs
- closed circuit television installations may be used
- each entry/exit should have 'natural surveillance' from adjacent buildings.

Photo 15.14 – Underpass, Pukete, Hamilton (Photo: Tim Hughes)

15.15 General design considerations at intersections

Pedestrian safety is paramount for intersection-based crossings. However, there are a number of competing design objectives [92], such as:

- there should be separate crossings for each direction at a corner
- the kerb crossings should be in the direct line of the pedestrian through route. Where this is not possible, environmental or tactile cues should guide people to the crossing point
- the kerb should be perpendicular to the pedestrian through route
- drivers (particularly those turning left) should be able to predict the location of pedestrians who are about to leave the kerb
- vehicle turning speeds should be slow.

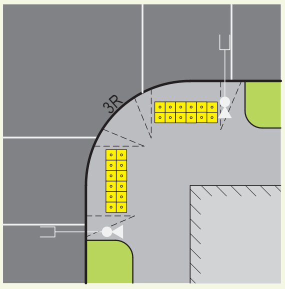
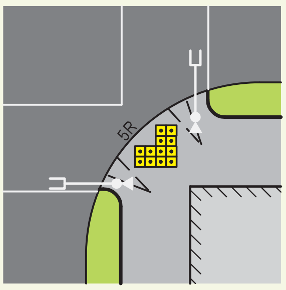
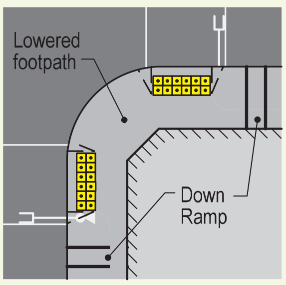
Large corner radii should be minimised, as they compromise nearly all these objectives. Kerb corner radii are also dictated by the needs of larger vehicles likely to turn at the intersection. The hierarchy of space needs is [92]:

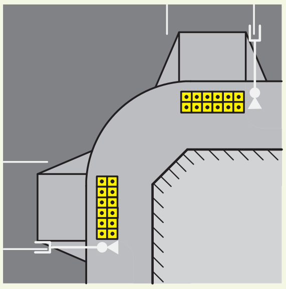
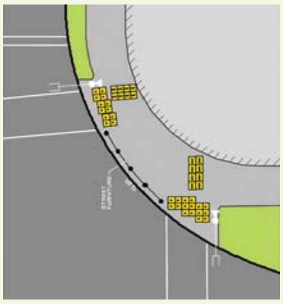
- the largest design vehicle turns left, crossing the centreline in one or both streets (appropriate on low-volume local roads)
- the largest design vehicle turns left without crossing either centreline (appropriate for CBD, collector and minor arterial roads)
- the largest design vehicle turns left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

Slip lanes separated by islands should be considered if large kerb radii are required.

Section 15.6 covers kerb ramps and design details. Kerb ramp installations at intersections will depend on the location, the type of street and other design constraints [6, 13, 24, 118]. Table 15.11 shows the options.

Table 15.11 – Installing kerb ramps

Kerb ramp arrangement	Diagram	Design issues
Perpendicular		**Requires a suitable top landing for mobility impaired pedestrians.** **It is not suitable for narrow footpaths unless a kerb extension is provided.** **Install kerb ramps in pairs at street corners.** ***Preferred arrangement.***
Diagonal		**This forces mobility impaired pedestrians to change direction within the ramp or roadway.** **It is more difficult to provide unambiguous directional guidance for vision impaired users.** **Audible signals from push-button assemblies are closer together, so more likely to confuse.** **It is cheaper to install than two perpendicular kerb ramps.** ***Not recommended: prefer perpendicular instead.***
Lowered perpendicular		**This is similar to a perpendicular kerb ramp but the entire footpath is lowered near the intersection.** **It is suitable for narrow footpaths as the kerb ramp length is reduced owing to the lower kerb height.** **Attention is required to drainage.** **Install in pairs at street corners.** ***Preferred arrangement for narrow footpaths.***

Kerb ramp arrangement	Diagram	Design issues
Projected		This ramp: • can be installed on narrow footpaths • creates a hazard for passing traffic and cyclists • creates maintenance problems • can create drainage problems • can encourage pedestrians to walk into the roadway too soon. ***Not recommended: use as a last resort for very narrow footpaths.***
Wide radii		This can be installed at intersections where large kerb radii are unavoidable and slip lanes are not provided. The crosswalks are set back to improve the angle that the kerb is crossed and reduce the crossing distance. Angled kerb ramps require bottom landings. Street furniture is required. ***Not preferred: where crosswalks cannot be set back diagonal may be better.***

The preferred option is individual kerb ramps separated by a vertical upstand kerb for each of the possible pedestrian directions of travel. There should be at least one metre of full kerb upstand between the ramps to minimise a tripping hazard.

Photo 15.15 – Use of kerb extensions maintains straight continuous accessible path, Featherston St, Wellington (Photo: Tim Hughes)

Photo 15.16 – Short kerb between crossing points is a tripping hazard, Christchurch (Photo: Paul Durdin)

15.16 Signalised intersections

Section 15.13 covers general design considerations for pedestrians at traffic signals, including timings, signal heads and pedestrian call buttons. Section 15.15 covers general intersection design for pedestrians. This section provides additional advice specific to signalised intersections.

Where a signalised intersection has a pedestrian phase, provision should be made for crossing on each junction arm. Without this [66]:

- walking distances can increase
- it can take longer to cross the intersection
- pedestrians will try to cross arms where there is no provision.

Table 15.12 shows the two general pedestrian phase types for signalised intersections [46, 66, 139]. Shorter cycle times are better for both, as this minimises pedestrian waiting times [46].

Table 15.12 – Potential signal phasings

Phasing	Definition	Design issues
Exclusive (dedicated/ Barnes dance)	All vehicles stop and pedestrians can walk in all directions, including across the diagonal.	It is beneficial where there are high pedestrian numbers. It is safer for pedestrians than concurrent phasings. There is greater delay to vehicles. Pedestrian have to wait longer to cross. Those walking on the diagonal have further to travel and may not be able to see the signal heads.
Concurrent (parallel)	Vehicles yield the right of way to pedestrians crossing the road into which they are turning.	Pedestrians normally have a shorter wait. There is less delay to vehicles. Pedestrians may feel intimidated by turning vehicles. A high number of pedestrians can prevent turning vehicles from completing their manoeuvre. Heavy vehicles have blind spots to the side. When turning, drivers may be unable to see pedestrian crossing from alongside.

With concurrent phasing, pedestrians and parallel drivers set off at the same time, and this can lead to conflict with turning vehicles. Fortunately turning traffic speeds are generally low so collision consequences are usually minor unless they involve a heavy vehicle. Heavy vehicles have blind spots to the side. It may not be possible for a driver to see a pedestrian arriving from behind the heavy vehicle.

The likelihood of conflicts between pedestrians and turning traffic and especially heavy vehicles should be assessed and design and phasing options considered that minimise the risks. Arrows can be used to stop turning traffic during the entire pedestrian phase or to hold back the turning traffic until pedestrians are well in view.

Left turn slip lanes manage this heavy vehicle conflict well, increase intersection safety and efficiency for all users. In designing slip lanes it is important to have a high entry angle to reduce traffic speeds and thereby reduce the risk to pedestrians.

At left turn slip lanes, use the approach in section 6.5 to choose the most appropriate crossing facility. As there is only one lane to cross, opportunities to cross will be frequent unless traffic flows are very high, so kerb crossings alone will often be sufficient. If pedestrian priority is desired, consider using a zebra crossing on a platform. Where continuous streams of pedestrian are unduly interrupting left turning traffic, controlling the left turn slip lane with signals may be considered but at the expense of pedestrian delay and compliance. Vision impaired pedestrians prefer signals. Figure 15.18 is an example of appropriate slip lane treatment.

Photo 15.17 – Platform pedestrian crossing free turn, Northlands mall exit, Christchurch (Photo: Tim Hughes)

Pedestrian push-buttons should be located close to the side furthest from the intersection [58] and preferably more than three metres apart to ensure there is no confusion about which button to push or audible signal to monitor [92].

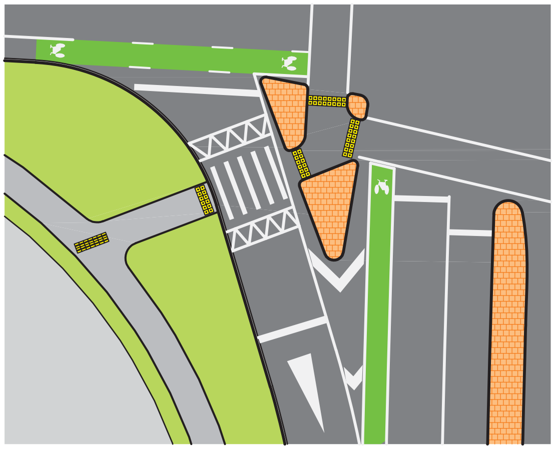


Figure 15.18 – Example of slip-lane treatment

15.17 Roundabouts

When providing pedestrian facilities at roundabouts [9]:

- vehicle speeds should be kept low by providing adequate vehicle deflection, and ensuring that on each approach, vehicle intervisibility to the right is not excessive
- splitter islands should be as large as the site allows, with cut-throughs (designed similar to pedestrian islands) one or two car lengths back from the limit lines
- pedestrians must have an adequate sight distance, which may mean banning parking
- street lighting must illuminate the circulating roadway and the approaches
- signs and vegetation must not obscure small children.

Some vision impaired people find roundabouts particularly difficult to negotiate owing to confusing audible information from cars approaching and exiting the roundabout. This means some vision impaired pedestrians prefer to cross mid-block away from the roundabout – so if there are a number of vision impaired people in the area, install additional mid-block crossing facilities upstream of the roundabout approaches.

Photo 15.18 – Crossing point by roundabout, St Albans, Christchurch (Photo: Tim Hughes)

15.18 Crossing assistance for school children

Section 6.6 discusses planning for, and the advantages and disadvantages of, different crossing assistance schemes and devices for school children. Carefully consider both sections 6.5 and 6.6 first. The two facilities exclusive to school children, school patrol crossings and kea crossings, are forms of control that should be considered after other factors and may not be the most appropriate solution.

For all school crossings, visibility distances must meet or exceed the relevant crossing sight distance [8, 126] detailed in section 15.3 and must exceed the approach sight distance detailed in section 15.4.

15.18.1 School patrol crossings

The zebra crossing that the school patrol operates on should be designed as set out in section 15.12, and may include kerb extensions, pedestrian platforms and pedestrian islands. In addition to the usual signage and markings and any bans of, or controls on, parked vehicles necessary for safety, a PW-33 'SCHOOL' sign should be fitted below the PW-30 sign [154]. The word SCHOOL can also be painted on the approach lane between the standard diamond and the crossing itself.

15.18.2 Kea crossings

Kea crossings must meet the same site, location and design layout requirements as school patrol crossings, except those for signs and markings detailed below. As discussed in section 6.6, a kea crossing operates in the same way as a school patrol zebra crossing, but when it is not operating, the crossing point reverts to a section of road where pedestrians select a safe gap in the traffic. Table 15.13 outlines the elements of a kea crossing.

Photo 15.19 – School patrol, Shirley Road, Christchurch (Photo: Basil Pettigrew)

Table 15.13 – Elements of kea crossings

	Sign/marking	Dimension and location	
Permanent signs and markings	‘School’ warning signs (PW-31 and PW-32)	One per approach, installed 65 m ahead of the crossing.	
	White reflectorised L-shaped ‘limit’ lines	One per approach, installed 5 m ahead of the crossing point edge, with a solid centreline on each approach at least 30 m long and a limit line 300 mm wide.	See figure 15.19
	Two pedestrian holding lines on each side of the crossing	1.5 m to 3 m apart, starting 0.75 m behind the kerb face on each side of the crossing or yellow tactile warning indicators across full kerb crossing width.	See figure 15.19
Temporary signs and markings	Fluorescent orange ‘children’ flag signs (PW-31)	One per approach, mounted on a 2 m white post permanently installed on the footpath within 0.3 m of the vehicle limit lines. The signs should be visible to approaching traffic for at least 60 m.	
	Staff-mounted ‘School Patrol – Stop’ signs (RG-28)	One per approach on a ‘swing-out’ mounting, within 0.3 m of both the crossing point definition lines and the kerb face.	

Figure 15.18 shows the road markings, including the elements in Table 15.13.

The roadway width at a kea crossing should be kept to a minimum. However, it is important to consider the needs of cyclists passing through the crossing and provide them with an adequate width. Advice on crossing widths for different situations is provided in section 15.8. To minimise width, the use of kerb extensions and pedestrian islands may be required.

Only an RCA can mark out or maintain a kea crossing [111]. However, approval from Land Transport NZ is not required as long as the speed limit is 50 km/h or less and the crossing fully complies with the specifications in the traffic control devices rule [111].

Photo 15.20 – Kea crossing on platform, St Albans, Christchurch (Photo: Basil Pettigrew)

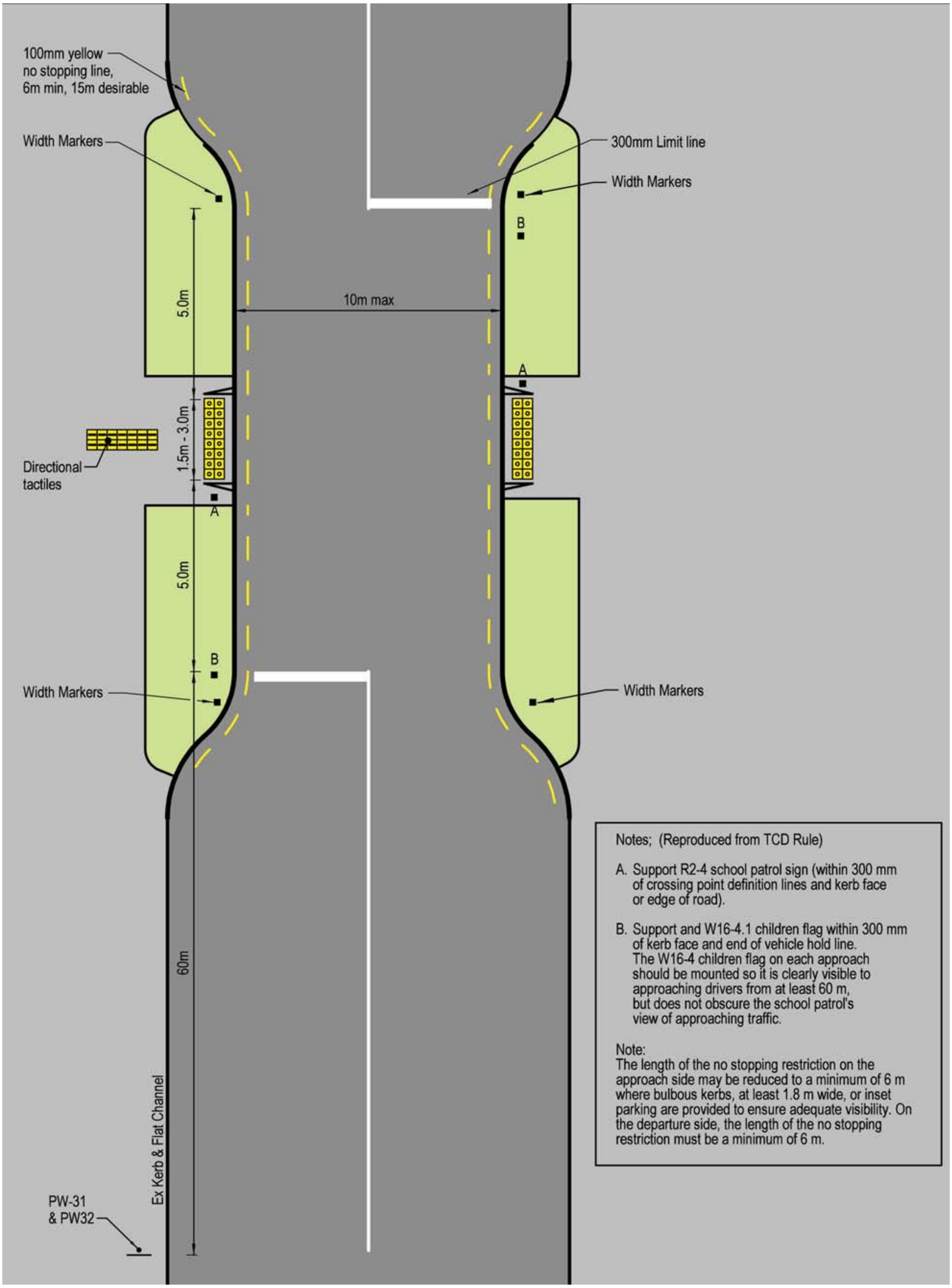


Figure 15.19 – Layout of a kea crossing

15.19 Railway crossings

There are several design issues to address for locations where pedestrians cross a railway line at-grade.

To avoid pedestrians tripping on the rails, the footpath across the railway lines should be at the same level as the top of the rails [10]. If the pedestrian crossing point is adjacent to a vehicle crossing point this can be easily achieved by widening the roadway. The flange gap (the gap between the rails and the pavement, as shown in figure 15.20) should be no greater than 63mm and have a strong edge. This is to minimise the risk of trapping the wheels of a wheelchair.

Railway crossings must be accessible for all types of pedestrian, including those using walking aids. Warning must be given to show pedestrians they are entering a hazardous area. Tactile warning indicators should be provided with the nearest edge no closer than 3m from the track centre line and at right angles to the pedestrian direction of travel. Exposure is minimised by ensuring that crossings are perpendicular to the railway lines.

No single treatment will completely solve all safety issues [138] and it is particularly difficult to prevent pedestrians from deliberately crossing when it is unsafe to do so [161]. Thus supplementary signage and physical guidance measures leading up to the crossing point are also required. When pedestrian flows are heavy or trains are frequent [10,138,161]:

- install fencing along the approach footpaths and along the rail reserve near the crossing, to ensure pedestrians use the designated route, as shown in photo 15.22
- if there is an automatic barrier for vehicular traffic, extend it across, or install separate barriers for the pedestrian route, as shown in photo 15.23
- use a maze to deviate the pedestrian route left and right in the immediate approach to the crossing. This encourages pedestrians to look for trains in both directions, as shown in photo 15.24 . A sample design of a pedestrian maze is shown in figure 15.21
- automatic pedestrian gates can be installed to prevent entry by unobservant pedestrians as shown in photo 15.25. Note that when the gate closes an exit maze is opened so pedestrian already on the crossing can escape
- provide notices on how to cross safely, as shown in photo 15.26
- use a higher surface standard for the pedestrian route than for the vehicular crossing, as illustrated by the rubber pad system in photo 15.27. The use of rubber or similarly designed concrete pads also act as a bridge that automatically adjusts to track movement, thereby maintaining a quality surface that does not quickly degrade or go out of alignment
- if the noise of bells is a problem at night time, use quieter bells rather than switching the bells off altogether
- provide advance warning systems to help slower moving pedestrians decide when to cross

These measures must be used in conjunction with each other as they will not be effective enough if used individually. For example, it is not enough to rely solely on bells as a warning system. Bells are especially unsuitable on their own in double-tracked areas where trains may be on either track [62]. Both physical and visual warnings are also necessary in such cases.

It is important to ensure that pedestrians use only the designated crossing points. Areas adjacent to railway lines that could be seen by pedestrians as attractive crossing points, such as open grassy spaces, should be fenced off to avoid any unsafe and unexpected crossings being made [62] as already shown above in photo 15.22, where the shared pedestrian and cycle track adjacent to the railway is well fenced.

As for any pedestrian facility, once at-grade railway crossings are installed, they must be maintained and checked regularly to ensure they meet pedestrians' needs. Note that all works on or immediately next to a railway line require approval from the appropriate rail access provider.

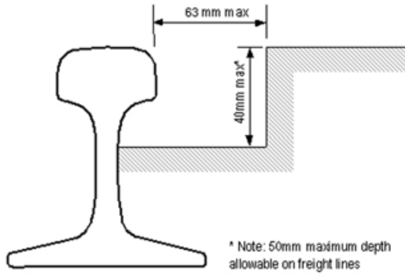


Figure 15.20 – Flange gap requirements

Photo 15.21 – Warning systems, Papakura (Photo: David Croft)

Photo 15.22 – Fence between rail and pedestrian area, Christchurch (Photo: Axel Wilke)

Photo 15.23 – Full automatic barriers, Hull, U.K. (Photo: Tim Hughes)

Photo 15.24 – Pedestrian rail crossing maze, Upper Hutt (Photo: Roy Percival)

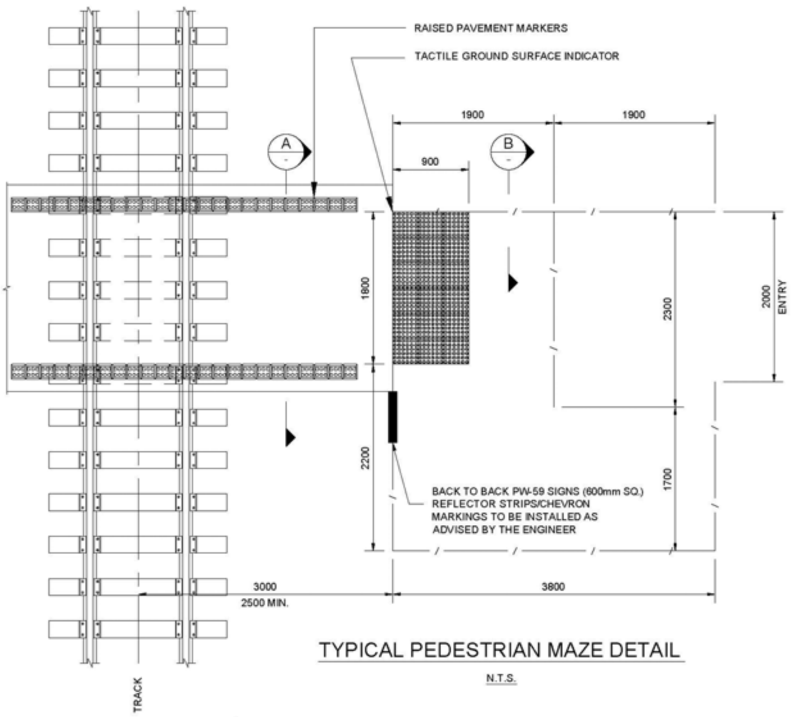


Figure 15.21 – Pedestrian rail crossing maze layout.

Photo 15.25 – Automatic pedestrian gate, Upper Hutt (Photo: Roy Percival)

Photo 15.26 – Safe crossing notice, Papatoetoe (Photo: David Croft)

Photo 15.27 – Rubber crossing surface, Tauranga (Photo: Greg Hackett)

16 MEASURES TO GUIDE PEDESTRIANS

MEASURES TO GUIDE PEDESTRIANS
Types of pedestrian signage and design
Other methods to guide or channel pedestrians

16.1 Introduction

All road users need helpful guidance and direction to inform and warn them of the environment ahead [46]. As pedestrians have different characteristics and routes from other road users, the following four specific measures are required [10, 117]:

- providing directional information to pedestrians
- channelling pedestrian flows
- informing other road users of the presence of pedestrians
- indicating to pedestrians and other road users who has priority at crossing points.

16.2 Pedestrian signage strategies

A planned and cohesive strategy for pedestrian signage usually reduces the number of signs and locations and minimises maintenance costs, clutter/obstruction and visual blight [46]. Signage strategies should be based on locating signs at the following specific 'decision points' on the pedestrian network [16, 144]:

- Likely trip origins, that is, places where people join the pedestrian network such as transport interchanges/stops, car parks and key city approaches.
- Likely trip destinations, as when visits to these location are over they become trip origins. Examples include tourist attractions, community facilities and retail areas.
- Locations with possible route ambiguity, including major junctions and open areas.
- On long routes where pedestrians may be uncertain that they have chosen the correct direction and need confirmation.

The strategy should include all major destinations for pedestrians. Once a destination appears on a sign, it must continue to be signed at every subsequent decision point until the destination is reached [45]. Choosing destinations can be contentious, so community involvement in the process is strongly recommended.

Photo 16.1 – Lyttelton heritage pole, Lyttelton (Photo: Wendy Everingham)

Signs should only be installed where they fulfil a need based on pedestrians' expectations. They may be located outside the roadway owing to pedestrian route flexibility and diversity.

16.3 Pedestrian signage

16.3.1 Pedestrian specific signage

There are no standard directional signs for pedestrians, therefore, a variety of non-standard versions have been developed.

Non-standard pedestrian signs include:

Fingerpost

Photo 16.2 – Fingerpost, Lyttelton (Photo: Wendy Everingham)

A thin, directional sign showing the name of, and pointing the way to walk to, a major trip destination. It is distinct in design from street name signs.

- Fingerposts to different destinations can be grouped together.
- New destinations can be added easily.
- They provide helpful directions.
- They are intuitive for users.
- They can be seen over 360°.
- Confirmatory signs can be identical.

Information board

Photo 16.3 – Information board (Photo: Tim Hughes)

Upright display panels listing key destinations, with arrows showing the way to walk to each one.

- The greater physical area allows for more destinations and symbols.
- Information can be displayed at head height, in the 'natural' line of vision.
- They are more vandal resistant.
- They can incorporate 'real time' information.
- They are easily lit.

Map

Figure 16.1 – Lyttelton map (Wendy Everingham)

An 'overhead' view of the immediate area showing pedestrian location and possible destinations.

- Maps provide the greatest amount of information.
- They can be combined with information boards and fingerposts.
- They can be either upright or flat.
- Paper maps behind transparent protection can be updated quickly, easily and cheaply.
- Key destinations and landmarks can be shown graphically, helping with direction-finding.
- Maps can be oriented according to the pedestrian's location [16].

Trail signs

Photo 16.4 – Trail sign

Markings (such as metal studs, coloured tiles or painted markings) set directly onto the footpath that pedestrians follow to reach their destination.

Trail signs:

- are intuitive to follow
- can be used to show 'walks' around an area, not just destinations
- are easily understood by most pedestrians
- are quick to install
- are less prone to being vandalised
- can be installed temporarily (for short-term routes to a destination, such as an event).

There is considerable design flexibility. However, as they can affect significantly the quality of public space, they should be designed and located sympathetically, taking into account their environment [45] and future maintenance issues.

A pedestrian seeing one type of sign is likely to seek signs of a similar style at other points on their journey. Road controlling authorities should consider a consistent theme for signface designs, colours and mounting height. This approach also helps minimise maintenance and replacement costs.

16.3.2 Outdoor recreation symbols

NZS 8603:2005: *Design and application of outdoor recreation symbols* [137] is a standard for signs with symbols and pictures that can help pedestrians to:

- locate areas, facilities, services, features and attractions
- identify safety requirements and learn about dangers
- find out about regulations that apply.

Symbols are commonly used and many people are familiar with them, so they can apply to a variety of situations to convey a message quickly and clearly. To further explain the sign, text can be included – or a circle with a line through the symbol can identify prohibited activities. The standard sets out details of symbols, legends and layouts (see figure 16.1 for some examples).

Figure 16.1 – Examples of standard recreational signs

16.3.3 Roadway signage

Signs and markings in road transport corridors are governed by the *Traffic Control Devices Rule* [111] and detailed in MOTSAM [154]. This details symbols, legends and layouts, and sign size and location/positioning.

MOTSAM [154] includes signs that inform and warn other road users of the possible presence of pedestrians, as well as signs designating pedestrian-only and no-pedestrian routes. It also has details of temporary direction signing for pedestrians. However, it does not include any permanent pedestrian direction or way-finding signs, although it does incorporate information signs.

Figure 16.2 – Examples of symbols used in a MOTSAM motorist service sign

No cycling beyond the sign

Warns drivers – pedestrians ahead

Warns drivers – pedestrian crossing ahead

No pedestrians beyond the sign

Warns drivers – children ahead

Pedestrians must use the route indicated to proceed beyond the sign

Figure 16.3 – Examples of MOTSAM regulatory and warning signs. Note: supplementary plates: school, kindergarten and aged may be used with the warning signs.

16.4 Locating signs

Signfaces should be located within the normal field of vision of their proposed users. To be most appropriate for people seated and standing, signs intended for viewing close up should be mounted on walls or other structures 0.9 m to 1.5 m above the ground [10]. Figure 16.3 shows fields of vision for different users.

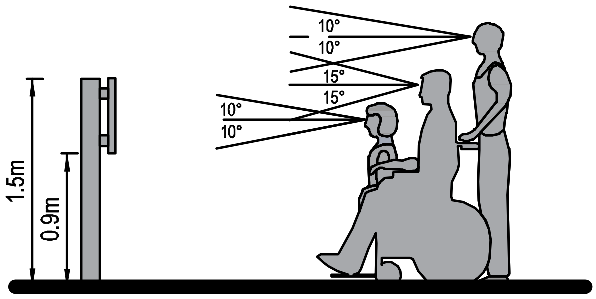


Figure 16.4 – Fields of vision of different users

If signs at such heights are not possible or practical, put them 2.4 m above the ground. Assume that the sign will be viewed from some distance away, and tailor the information accordingly.

When siting signs, it is also important to remember that:

- signfaces are most easily read when they are perpendicular to the direction of travel. Where this is not possible, the approach angle should be within 30° [10]
- the immediate area around each sign should be level, even, well lit and accessible for the mobility impaired
- signs should not be an obstacle or hazard for pedestrians (see section 14.3)
- free-standing signs should not be placed in the through route
- pedestrians reading signs should not obstruct other pedestrians, or inadvertently put themselves or other road users in danger.

A regular maintenance programme is needed to ensure signs stay in good condition, free from graffiti and unobscured by vegetation, and continue to serve a purpose [46].

16.5 Signface design

Signface legibility is affected by [7]:

- apparent character height, which relates to the distance at which the sign will be viewed [10]
- the relative height and width of characters
- character spacing
- colour contrast
- font.

These are described in more detail in Appendix 2.

It is always preferable to use recognised symbols rather than words, as this makes signfaces more accessible to the vision impaired, children and those whose first language is not English.

16.6 Signing temporary works

Section 18 covers signage for temporary works.

16.7 Additional measures to guide the vision impaired

Audible, visual and tactile cues can help in providing additional information to guide the vision impaired [20]. These are covered in more depth in *Guidelines for facilities for blind and vision-impaired pedestrians* [92].

16.8 Measures to channel pedestrian movements

Pedestrians exposed to a serious safety hazard may need channelling to areas where they are at less risk [10, 24, 72]. As signage is generally ineffective [66], pedestrian fences should be considered, particularly in the instances in table 16.1 [10, 24, 72].

Table 16.1 – Places where pedestrian fences should be considered

Safety issue	Examples
Where it is especially dangerous for pedestrians to cross the road, because:	• there are high vehicle speeds and/or flows • visibility is obstructed and the obstruction cannot be removed • there are complex vehicle movement patterns • there are adjacent pedestrian crossing points where pedestrians can cross more safely and conveniently • drivers would not normally be expecting pedestrians.
Where there is a severe change of gradient next to the footpath, due to:	• the edge of a bridge • large open drains/ditches • a gradient higher than 25% • a vertical drop of more than 1 m • an excavation.
Where there are other hazards, such as:	• next to a railway • next to a watercourse or deep water.

Pedestrian fences are usually not robust enough to stop vehicles that leave the roadway from entering the footpath. Vehicle barriers perform this task and can also restrain pedestrians from crossing the roadway if modified.

Pedestrian fences are appropriate in very limited circumstances – they should only be installed if it is not possible to modify the arrangement so it is safer for pedestrians [66]. This is because pedestrian fences have a number of disadvantages [66, 72, 126, 146, 147]. They:

- may make pedestrian routes longer
- may be contrary to road user hierarchies that have pedestrians towards the top
- diminish the streetscape quality
- if installed on footpaths, reduce the available width
- create feelings of confinement for pedestrians
- are perceived to be 'anti-pedestrian'
- impose additional maintenance costs
- if rear servicing is not possible, can cause problems for shop deliveries
- reduce on-street parking
- create a hazard for errant vehicles.
- may increase traffic speed.

There are no warrants for installing pedestrian fences, so the design team is responsible for assessing whether they are required [66]. As a general rule:

- short fences should not be used as pedestrians will walk around the ends, and they create a hazard for other road users
- where a fence is installed on one side of a roadway, another should be installed on the opposite side to prevent pedestrians crossing and then being unable to regain the footpath.

As fences can result in pedestrians deviating from their desired route, signage should be provided to direct them towards key destinations [24].

All pedestrian fences must be maintained. As well as undergoing inspection and preventive maintenance, they should be repaired or replaced as soon as possible after being damaged [66].

All pedestrian fences should comply with the following criteria [10, 58, 66, 72, 115, 126, 146]:

- They should be continuous, with no breaks that a pedestrian could pass through.
- A small child should not be able to squeeze through any gap between the bottom of the fence and the ground.
- They should be at least 1.2 m high, and higher if pedestrians may try to climb over or otherwise be in danger.

- If they are not solid, gaps between elements should be less than 100 mm to prevent small children squeezing through.
- If they are not solid, a continuous horizontal element within 150 mm of the ground will help vision impaired people using a cane to detect them.
- There should be no sharp edges or protrusions.
- They should not obscure visibility for other road users.

Photo 16.5 – Pedestrian fence, Hamilton (Photo: Shane Turner)

If a pedestrian fence is required solely between pedestrians and static hazards (such as a bridge parapet or a steep gradient), it does not have to maintain pedestrian viewing qualities. This means it can be built of concrete, brick, timber or other fabricated material [10]. However, pedestrians may enjoy a better experience if they can still see views and objects of interest beyond the fence. Natural surveillance may also be improved with such fences.

Photo 16.6 – Fence and drop, Hamilton (Photo: Shane Turner)

Chain link or welded mesh pedestrian fences can be used to stop pedestrians crossing motorways or entering rail reserves [10]. However, if there are no convenient crossing facilities and there is strong crossing demand, more robust fences may be required to limit pedestrians' ability to climb over or break through them.

Footpath fences between pedestrians and moving vehicles should be built in metal and coated to contrast with the surroundings [42].

They should be 1.2 m high and comprise vertical rails with two horizontal rails top and bottom [42, 72]. Post and chain arrangements should not be used. The barrier must not restrict visibility between pedestrians and drivers [10, 42, 58], so vertical bars should be offset [126].

Table 16.2 – Siting footpath fences	
Location	**Siting**
In a median, including at a pedestrian island	The closest part of the barrier must be at least 0.6 m from the kerb face.
At the edge of a footpath	The closest part of the barrier must be at least 0.2 m from the kerb face.

Fences between a roadway and pedestrian route are a risk to both vehicle occupants and passing pedestrians if the fences are struck by a vehicle. It is important to ensure sufficient distance so this is less likely (see table 16.2) [126].

If fences are beside a roadway, they must be collapsible or break away without causing injury to vehicle occupants [87]. No horizontal components should be able to be dislodged and project into a vehicle if they are struck [10].

Photo 16.7 – Pedestrian fence, Christchurch

Photo 16.8 – Fencing by signals, Palmerston North (Photo: Shane Turner)

Photo 16.9 – Pedestrian railway crossing, Silverstream Station (Photo: Roy Percival)

17 LIGHTING THE PEDESTRIAN NETWORK

LIGHTING THE PEDESTRIAN NETWORK
The need for lighting
Lighting scheme design

17.1 Introduction

Lighting has several purposes for pedestrians [10, 46, 139]. It:

- illuminates potential hazards so pedestrians can avoid them
- enables pedestrians to read signs and orient themselves
- affects feelings of personal security and comfort
- enables drivers to see pedestrians and thereby improves their safety
- can enhance the walking environment
- makes the pedestrian network continuously available, not just during daylight hours
- can encourage pedestrians to use some routes rather than others.

Street lighting is not always adequate for pedestrians on footpaths within road reserves [166] – walking conditions can change and the initial scheme may have been inadequate.

17.2 The need for lighting

Pedestrian lighting should be specifically assessed and additional lighting provided where [10, 46, 139]:

- there is potential for conflicts with motorised vehicles, such as at road crossings
- there may not be enough natural light, such as in areas enclosed by high buildings
- there are large numbers of vision impaired people, who are less able to adapt to differing levels of ambient light
- pedestrians are likely to congregate at night, such as at bus stops, car parks and leisure activity locations
- levels change, such as at steps, ramps, overbridges and underpasses/subways
- specific hazards may be difficult to identify in low light, including temporary works
- a cluster of pedestrian crashes occur during hours of darkness
- there is not enough natural surveillance (see section 4.4).

Visits to sites during the hours of darkness are important as they can establish the pedestrian environment, such as vehicle speeds, pedestrian levels, lighting from other sources (such as shops), and vegetation that may cast shadows.

17.3 Lighting scheme design

Generally, the overall lighting level and the absence of glare are important for pedestrians [10]. This means [10, 46, 68, 139]:

- most lamps should be shielded to ensure light is mainly directed downwards, to both improve energy efficiency and minimise light pollution. The exception to this is in pedestrian precincts where there is no conflict of glare to motorised traffic and light can be emitted horizontally
- there should be an element of 'redundancy', so that if one lamp fails, another will continue to provide at least some light in the affected area
- where footpaths are within road reserves, placing lights along both sides of the road is better for pedestrians than putting them within the roadway median.

Photo 17.1 – Low mounted lighting in wall by ramp, Queenstown (Photo: Tim Hughes)

'AS/NZS 1158.3.1: 1999 [68]' is the standard for lighting; it applies to pedestrian-only areas and those with a mix of pedestrians, vehicles and cyclists. The standard also covers the lighting required at pedestrian islands and traffic-calming measures. A specialist road lighting engineer should be consulted owing to lighting source complexity and interrelationships [146].

Generally, along the road corridor, if lighting is provided at the level needed for motorised traffic to move safely, then in most circumstances this should be sufficient to light the adjoining footpaths. However, as roads become less busy, the potential for pedestrian movements and vehicle conflict declines and the requirement for continuous, equal lighting is reduced [139]. In these areas, spot or 'highlight' lighting may be appropriate.

Some rural residents may not want any lighting at all to preserve the environment. Their wishes must be balanced with those of passing pedestrians and visitors, especially at important pedestrian flow areas such as transport stops, key intersections and leisure activity locations [139].

17.4 Locating lighting

Lamp post location is determined by the illumination level provided, so spacings are calculated case by case [68]. Even then, it is not possible to achieve an exact spacing every time because of intersections, driveways, trees and other utilities. It may be possible to locate lamps on existing power poles, as long as the spacing is adequate.

Lights mounted on tall columns in high-use pedestrian areas reduce the intimacy of a public place. Lights mounted close to the ground may encourage vandalism or introduce glare within the normal pedestrian field of vision. Nevertheless, ground-level lighting can be useful in less heavily used pedestrian areas.

Lamp posts create an obstruction for pedestrians and cyclists, so should be sited with care.

Photo 17.2 – Medium height lighting column, Christchurch

17.5 Lighting hue

Studies have shown that pedestrians in intensively used areas prefer lighting to mimic daylight [46, 139]. Unless required for a particular reason, avoid using low-pressure sodium lights, as the yellow light they produce has a high level of colour distortion [46, 139].

17.6 Maintenance

Pedestrian lighting should be fully integrated within road controlling authority (RCA) road lighting maintenance processes and asset management systems.

17.7 Lighting at new developments

Lighting requirements of all new and improved developments should be assessed as a matter of course. The developer is responsible for demonstrating that pedestrian lighting has been assessed and all relevant standards met.

17.8 Lighting at pedestrian crossing points

Pedestrian crossing points need more intense lighting than footpaths to ensure they are conspicuous to pedestrians and that approaching drivers can see pedestrians clearly [10, 146]. The lighting standard 'AS/NZS 1158.3.1: 1999 [68]' particularly considers:

- steps and stairways, ramps and footbridges
- underpasses including associated ramps and steps
- pedestrian islands.

For other pedestrian crossing points, RCAs should place floodlights on the approach side(s) to better illuminate pedestrians using the crossing [82]. This should be done by:

- identifying the pedestrian crossing points that are used at night
- identifying the risks to pedestrians at each location
- identifying the current lighting levels at each location
- ranking locations by these three criteria and improving the sites with the greatest need.

Lighting in underpasses requires specific attention owing to pedestrians' personal safety concerns [10, 146]. Lighting on the approaches and within the underpass should appear bright while avoiding glare and shadows. This can be done by carefully selecting surface textures and colours [146].

When the ratio of underpass length to height exceeds 10:1, lighting should operate continuously [139, 146]. Otherwise, lights next to the entrance and exit should provide enough illumination [139].

During the day, underpass lighting should be bright enough to allow pedestrians to see into the underpass [10, 139, 146]. At night, it should be less bright so that pedestrians in the underpass can see the areas surrounding the exit. This can be done by reducing the lighting intensity at the underpass entrance and exit [146].

Avoid using recessed lamps that create pools of light [146]. As underpass lamps will be at a relatively low level, they should be made of polycarbonate or be otherwise resistant to vandalism [139, 146]. Consider installing an emergency lighting system to ensure illumination if the main power supply fails.

Photo 17.3 – Crossing point lit from beacon pole, Hamilton (Photo: Shaun Peterson)

Photo 17.4 – Pedestrian crossing floodlit from lantern on black and white pole, in advance of crossing, Christchurch (Photo: Tim Hughes)

18 MAINTAINING THE PEDESTRIAN NETWORK

MAINTAINING THE PEDESTRIAN NETWORK
Maintenance in the short and long term
Planning for pedestrians during maintenance works

18.1 Introduction

Both pedestrian-related and other infrastructure-related maintenance can affect pedestrian movements. It is important to manage it correctly to avoid it having major effects on the pedestrian network.

18.2 Maintaining pedestrian-related infrastructure

All pedestrian facilities need adequate maintenance. Without it, facilities that initially encouraged walking can become hazards or obstructions to pedestrian movement [118] and a deterrent to walking trips.

The impact on pedestrians is not necessarily related to the physical size of the problem – a three metre damaged surface can create as much difficulty as one of 30 m [13]. Seemingly minor issues, such as a small vertical face or minor ponding, can also cause difficulties for some pedestrians [13]. Table 18.1 outlines treatments for differences in vertical levels.

Table 18.1 – Treatments for localised changes in vertical levels

Difference in vertical level	Treatment
Below 6 mm	No action required.
6 mm to 13 mm	Provide a bevel between surfaces or remove and reinstate.
More than 13 mm	Remove and reinstate one of the surfaces, or treat the area as a ramp.

Pedestrian infrastructure should be fully integrated within road controlling authority (RCA) road asset management systems, along with accurate records of where maintenance has been carried out, the actions taken and the timeframes within which problems were addressed [27]. This also helps identify high-maintenance locations and potential underlying problems.

18.3 Problems arising in the long term

Table18.2 shows some common issues that arise over time [13, 102, 118, 130, 139].

Table 18.2 – Problems that arise over the long term

Problem	Possible causes
Heave	Expanding the footpath section. Tree root penetration. Seismic activity. Vehicles parking or driving on the footpath.
Settlement	Rainwater penetration washing away the footpath base. Vehicles parking or driving on the footpath.
Obscured visibility	Vegetation intruding both from the sides and from above. Dirt and debris from vehicles.

An ongoing 'rolling' programme of planned preventive maintenance will address these issues. It should include a timeframe within which every footpath and other pedestrian facility in the RCA's area will be inspected and assessed [27, 118, 139].

Each section of infrastructure should be assessed as being:

- life-expired or significantly damaged, causing a significant barrier for pedestrians and requiring immediate attention, or
- worn but with residual life or slightly damaged, causing inconvenience for pedestrians, which should be addressed within a given timeframe, or
- satisfactory, requiring no attention.

Since the types of damage are fairly limited, 'pro forma' guidance for appropriate corrective actions and timeframes will help streamline the process. The RCA should determine the thresholds for remedial actions and the nature of those actions and timings, and provide adequate funding for the identified maintenance.

It is usually cost effective to group sites with similar problems and undertake the remedial actions at the same time. Some could also be done as part of an adjacent roading scheme. However, there may be safety implications in delaying works, and it is important to ensure the condition does not get significantly worse.

18.4 Problems arising in the short term

Some problems appear more suddenly, although the planned preventive maintenance programme will go some way to addressing them. Table 18.3 covers some of the issues [13, 118, 130, 139].

Complaints by members of the public often alert RCAs to problems. They should respond quickly [6] and arrange for a competent person to visit the site within a specified timeframe appropriate to the problem [13].

The person visiting the site should assess the extent of the problem and identify likely causes, with remedial actions prioritised and programmed using criteria similar to those in section 18.3. The problem can sometimes be solved quickly and with minimal cost, such as through street sweeping, relocating the item(s), or enforcement.

18.5 Winter maintenance

Footpaths and crossings should stay open at all times. In colder areas, a winter maintenance programme will help keep pedestrian routes free from frost and ice. The programme should respond to local conditions, and focus on how to improve footpath traction for pedestrians and clear pedestrian crossing points [118].

Photo 18.1 – Competition for footpath space suggests need for education and enforcement (Photo: Victoria Lawson)

Photo 18.2 – Vegetation narrows path (Photo: Victoria Lawson)

Table 18.3 – Problems that arise in the short term

Problem	Possible causes
Slippery surfaces	Loose debris (such as leaves and oil). Ice, frost or snow.
Obstructions and barriers	Shop advertising signs/boards. Shop stock. Café tables and chairs.
Faults in other infrastructure	Drainage failure, leading to ponding after inclement weather. Traffic signal failure.
Inconsiderate use by other road users	Vehicles parked on the footpath. Dog fouling. Dropped rubbish. Broken glass. Other accidental damage, vandalism and graffiti. Street vendors. Vagrants.

When keeping the main road open, problems should not be moved onto footpaths, pedestrian islands and medians. For example, some techniques for clearing snow from the roadway result in it being heaped onto the footpath. These should be discouraged [118].

18.6 Maintaining non-pedestrian infrastructure

Pedestrian infrastructure is often used as part of maintaining other facilities, plant and equipment. This means access may be temporarily restricted or some of the footpath may need to be removed. In all cases pedestrian needs must be fully considered and alternative arrangements made [6, 118]. The *Code of practice for temporary traffic management measures* [155] sets out details of how this is accomplished.

Whenever a roadway is resurfaced, crossing points must continue to comply with best practice [13, 118]. This will avoid problems such as:

- an upstand or 'lip' being created between the gutter and the roadway, creating problems for the mobility impaired using kerb ramps
- an increase in the gradient created for pedestrians as a result of the roadway crossfall becoming more severe.

18.7 Planning for pedestrians at temporary works

The *Code of practice for temporary traffic management measures* [155] details how to accommodate pedestrians at temporary works. Layouts E2.22 and E2.23 in that code show potential pedestrian diversion routes.

It is important to advertise any potential disruptions for pedestrians well before the works start. This can be done through paid advertisements in the local printed media, but displaying notices at the site is less expensive and better targets those most likely to be affected.

The temporary traffic management plan for the works [155] must consider how pedestrians will be affected, how their exposure to risk will change, and how they may be accommodated. For example, the route affected may have especially high pedestrian volumes or be used by high proportions of the mobility or vision impaired, the elderly, or the young (including a safe routes to school programme or walking school bus).

Photo 18.3 – Litter collection, Birmingham, UK (Photo: Tim Hughes)

Photo 18.4 – Weeds growing around tactile paving (Photo: Tim Hughes)

Photo 18.5 – Pedestrian diversion, Christchurch (Photo: Andy Carr)

The diversion route should comply with the *Code of practice for temporary traffic management* [155] by separating pedestrians from the work site and from motorised traffic. At the same time, it should minimise any extra walking distance, accommodate all groups of pedestrians at all times (including the mobility impaired), and be logical for the vision impaired to follow. If the route crosses the road, the crossing facility must be safe.

The initial pedestrian diversion should take place away from the immediate work site. This will avoid localised pedestrian congestion and prevent risky movements such as stepping into, or crossing the road next to, the work site where visibility may be restricted. Suitable temporary directional signing will be required, and it may also be necessary to physically barricade the original route [155].

If pedestrians have to walk alongside the site and on the roadway itself, the route should be clearly marked to discourage them from straying into the road. A 'buffer' zone will separate them from the adjacent 'live' traffic lane.

As figure 18.2 illustrates, reflectorised tape, plastic chain and rope do not provide a continuous edge for the vision impaired [6, 51] and should not be used. Wooden or metal barriers should also be avoided, as if struck they can create hazards for both pedestrians and vehicle occupants [6].

A temporary fence is one method of delineation, but concrete barriers should be used if there is a serious risk of vehicles intruding into the pedestrian route [4]. Whatever the method used, it should be consistent throughout the diversion route [155] and be between one metre and 1.2 m high [42].

Any on-road route should replicate, as far as possible, the conditions of the footpath on either side of the work site. It should be as wide as the footpath to avoid pedestrian congestion or, if this is not possible, at least 1.2 m. The surface must be of good quality, without steep grades, free of significant cracks and holes, and of a suitable texture.

The points at which pedestrians step into the roadway and regain the footpath must be suitable for all pedestrian types. Temporary ramps should be fixed firmly in place and covered with a suitable slip-resistant material. Drainage channels should be maintained to eliminate ponding [6, 51].

The pedestrian route must be kept clear of all obstructions, including plant and other equipment, at all times. A clear

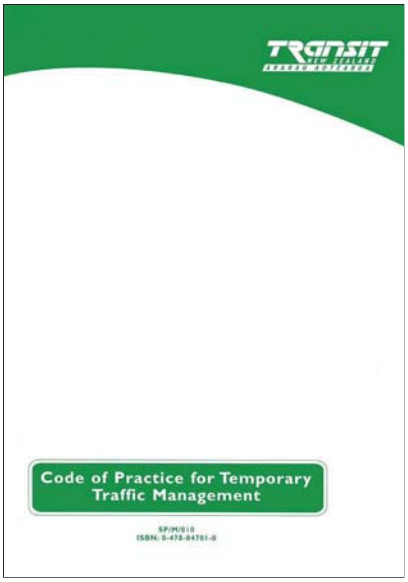


Figure 18.1 – Examples of temporary pedestrian warning signage

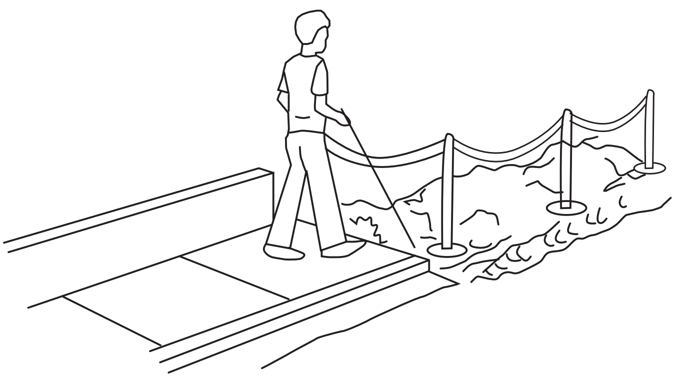


Figure 18.2 – Tape does not provide a continuous edge for the vision impaired

height of 2.4 m should be maintained [10] and there must be no intrusions into the route either from the side or from above. Canopies and boarding should be used if there is a risk of this [42].

Moving pedestrians to the opposite footpath is an alternative to providing an adjacent route. However, pedestrians must be able to cross the road safely – it is better to divert them to a nearby existing crossing point than create a temporary new one.

Finally, once works are complete, the affected pedestrian area must be reinstated to at least its original condition.

Photo 18.6 – Footpath diverted onto protected roadway with temporary kerb crossing and rail (Photo: Tim Hughes)

18.8 Maintaining the temporary route

Any temporary pedestrian route should be regularly assessed to ensure it remains adequate and no equipment has been accidentally damaged, vandalised or removed. The names and contact details of companies undertaking works should be clearly displayed so the public can report any problems immediately [42].

For longer-term works, a maintenance programme may be required to keep the route free of debris. The RCA can undertake on-the-spot inspections to ensure pedestrians are adequately accommodated [51].

19 MONITORING PEDESTRIAN ACTIVITY

MEASURE PROGRESS TOWARDS WALKING OBJECTIVES
Choose monitoring techniques
Set up pedestrian counting programme
Collect data for walking indicators
Share information to benchmark performance

19.1 Introduction

Every scheme or strategy to help pedestrians should have a clear set of objectives – and a plan for effective monitoring to track progress in achieving those objectives, to establish trends and to determine if the facilities provided are adequate [97].

19.2 Monitoring methods

The appropriate monitoring method(s) should be chosen at the earliest stages of the scheme or strategy. It must be cost effective, easily repeatable and collect accurate data [98]. The survey duration is also a factor, as longer periods increase costs but generally provide more accurate and useful information.

The approaches are usually limited and depend on the objective being monitored. Table 19.1 shows some common techniques [38]:

Table 19.1 – Monitoring techniques

Technique		Characteristics
Interviews and questionnaires	On-street surveys	• Can collect origin and destination data that enable trip length and route to be determined, as well as demonstrating how walking relates to other modes. • Can also be used to gather information on perceptions of the walking environment by those actually using the facilities.
	Household surveys	Useful to obtain general and background information on walking trips.
	Travel diaries	
Pedestrian counts	Manual pedestrian counts	Collect a range of data for pedestrian flows, such as: • pedestrian ages • group size • mobility impairments • conflicts with vehicles or other pedestrians • crossing location • delays experienced • path taken across the road • uncertainty in crossing (abortive crossing attempts). Need to have enough staff to cope with anticipated pedestrian numbers and avoid fatigue/loss of accuracy. Surveys can be videotaped and reviewed later, but this increases costs.
	Automatic video imaging	• Walking activity is videotaped and subsequently processed using computer software. • Can provide good data when extended monitoring is required. • Generally less flexible and more expensive than manual methods.
	Infrared sensors (through-beam or retro-reflective)	• Create an invisible beam that pedestrians break as they walk past. • Pedestrians have to be in single file, which occurs infrequently. • Can provide good data when extended monitoring is required. • Generally more expensive than manual methods.
	Infrared sensors (diffuse-reflective)	• Capture pedestrian targets and trace their path. • Very flexible and can produce data on walking speed, routes and sudden deviations (indicating conflicts). • Can provide good data when extended monitoring is required. • Generally more expensive than manual methods.

19.3 Survey locations

Pedestrian surveys should take place where the scheme's effects are likely to be the most significant, bearing in mind that walking trips are generally short. Pedestrians can also be highly flexible in their choice of route, so for some monitoring activities a number of surveys carried out simultaneously in different locations can offer more reliable and useful data than a single survey at just one location [38]. These approaches are known as 'site-specific' for surveys in the scheme's immediate vicinity and 'area-wide' for those on the immediate approach to, or within, the area.

Table 19.3 – Potential walking indicators

	Quantitative	Qualitative
Walkability	• Total length of road that has been subject to a walkability audit, per 100,000 population. • Percentage of households within 1 km of major destinations (such as local shopping areas or schools). • Percentage of streets where the 85th percentile speed is greater than 40 km/h. • Percentage of roads that include footpaths on both sides. • Average number of formal crossing facilities provided per km of road. • Percentage of pedestrian crossing points with facilities for mobility or vision impaired. • Percentage of reported pedestrian problems that are corrected within one week. • Percentage of residential streets having street lights that meet or exceed the minimum standard. • Percentage of crossing facilities more than 10 m long with no refuge.	• Percentage of pedestrians who feel the streetscape has improved in quality. • Percentage of pedestrians who consider it easy to cross the road. • Percentage of the public who are satisfied with footpath conditions. • Percentage of pedestrians who feel they have to wait too long at signalised crossings.
Modal share	• Annual increase in pedestrian numbers at key cordons. • Percentage of trips under 1 km made by walking. • Percentage of population walking to work. • Percentage of children walking to school. • Number of children's independent journeys, per 10,000 children.	• Percentage of the public who feel more inclined to walk.
Safety	• Number of pedestrian casualties per 100,000 population. • Number of crimes where a pedestrian is a victim per 100,000 population.	• Percentage of pedestrians who feel safe while out walking. • Percentage of pedestrians who feel safe while crossing the road. • Percentage of school children who consider it is safe to walk to school.
Other	• Percentage of transportation funds spent on pedestrian facilities. • Percentage of schools that have a safe routes to school or school travel plan scheme. • Percentage of schools that have a walking school bus scheme. • Percentage of resource consent applications specifically consider pedestrians.	• Percentage of pedestrians who know how to complain about footpath condition.

19.4 Survey timing

The ideal time to monitor walking is when flows are high but unaffected by short-term, special events – this usually means the summer months. It is good practice to collect data at the same time each year, as long as weather conditions are comparable [38].

Pedestrian flows can fluctuate significantly owing to inclement weather, school/public holidays, sporting events and seasonal factors such as daylight hours and tourism activities. All factors that may influence the results should be noted when the survey is carried out and included when interpreting historic data. For this reason, short-term counts are unlikely to be statistically reliable [146].

19.5 Pedestrian counts within other surveys

Pedestrian counts and surveys can sometimes be easily included within other RCA surveys, such as manual classified vehicle counts. While this is a straightforward and cost-effective way of gathering information, it does have drawbacks, such as:

- the survey locations and timing may not be appropriate for observing representative pedestrian flows and patterns
- the surveys may only identify the main mode of travel, rather than all modes
- the surveys may be targeted at groups that do not have typical walking behaviour
- when surveyors get busy they tend to miss pedestrians.

As a result, this technique should only be used in addition to, not in place of, properly arranged and programmed pedestrian counts.

19.6 Indicators

There are no standard indicators for assessing the pedestrian environment. The *Getting there – on foot, by cycle* implementation plan [178] proposes to develop indicators for New Zealand. Section 19.7 of the implementation plan has a selection of examples from around the world; however, local authorities should also develop local indicators [150, 25, 97].

19.7 Benchmarking

Benchmarking compares the performance of one organisation or geographic area with others, using a set of common indicators. It can identify significant differences in indicator values, enabling organisations to identify ways to improve performance [160]. It should be an ongoing process.

There is no limit to the number of organisations or geographic areas that can be involved in benchmarking, but all should use the same indicators and collect data in identical ways. Those organisations performing strongly should be prepared to help those that have not performed as well on any given indicator [38].

Benchmarking can start at any stage of the monitoring process, but there are advantages to starting as early as possible, such as [160]:

- common indicators are developed before any data is collected
- the potential for generating incompatible data sets is removed
- it helps in establishing relationships and creating a comparative environment where ideas can be exchanged
- relevant data is collected prior to scheme implementation.

Walking indicators can be both quantitative and qualitative.

20 MAKING BEST USE OF FACILITIES

PROMOTE WALKING AND PEDESTRIAN FACILITIES
Increase the profile of walking
Promote facilities
Produce walking maps

20.1 Introduction

For facilities to be fully effective, people must know that a high-quality walking environment is available and be encouraged to use it [29]. Many of the techniques in this guide go some way to accomplishing this, but there are other opportunities too.

Table 20.1 – Ways of promoting walking

Technique	Overview	Key considerations
Media releases	A short statement to the local media about some issue to do with walking.	• Minimal cost to issue, and can cover a wide range of media types. • Can only provide limited information. • Limited control over whether the media release is picked up. • Media may put their own 'spin' on the information.
Paid advertisements	A message placed in the local media, paid for at commercial rates.	• Total control over the message presented. • Can be expensive. • Very useful to communicate simple messages. • Readership of publication must be carefully considered.
Leaflets	Small flyers or other handouts that provide some information on walking.	• Needs to be kept simple, and use graphics rather than text. Should 'whet the appetite' of the reader rather than provide copious amounts of information. • Distribution is key – consider using community and health facilities. • Can be expensive to copy or print the leaflets.
Posters	Large displays providing information on walking.	• Can be eye-catching and reinforce a message effectively. • Very limited information can be provided. • Only a limited number of places where they can be displayed (mainly community and health facilities) without considerable cost.
Maps	A simplified street pattern, over which is superimposed key trip origins and destinations and the pedestrian network itself.	• Routes on which there are more significant barriers or obstructions should not be explicitly promoted. • Maps are commonly printed and distributed freely at trip origins (such as community facilities) but can also be distributed via other means. • Further details are set out below.
Personal travel plans	Individuals are given a personalised travel plan showing the most suitable route between their home and key destinations. Typical travel times (by all modes of travel) can be shown, as well as the real cost of using a car for the same journey, or anticipated fitness gains through walking the route regularly.	• Considers people's individual environments as well as their characteristics. • Improves any misperceptions of walking as a viable mode of travel. • Proactive help to identify how to make trips by alternative means. • Can be expensive to implement, as each plan is different.
[17, 54, 60, 165, 162, 67, 16]		

20.2 General considerations

The most important consideration in any promotional activity is ensuring the message reaches the intended audience at the right time. For walking, this has two implications [17, 122]:

- The intended audience of pedestrians is a diverse group and should be treated accordingly. Information should be carefully tailored to trip purposes, geographic locations, ages and/or ability. For example, walking maps could be produced specifically for visitors to an area (showing locations of interest), or for the vision impaired (using a larger print size).

- The choice between walking and using another travel mode is made at an early stage in the journey planning process. So the right time for providing information to travellers is the earliest opportunity. For instance, while maps at community facilities are useful, providing information directly into people's homes is better.

Promoting the walking environment should be an ongoing exercise, with different emphases at different times. Combining both long-term information provision and short-term campaigns helps increase the profile of walking [17]. The two approaches should be coordinated and complementary.

The internet is becoming increasingly important as a way of promoting walking, as it allows potential pedestrians to access information easily from remote locations, and can be updated frequently.

Few planners, engineers and designers have the full range of technical skills and abilities required for promoting walking effectively. Involving suitably qualified professionals is strongly recommended. At best, poorly implemented promotion will be ineffective, but at worst it can be costly, embarrassing and undermine the intended objectives. These professionals should, therefore, work alongside first-line consultation partners, such as schools, mobility impaired groups and advocacy groups who know and understand their local area and community.

Table 20.1 has several techniques for providing information.

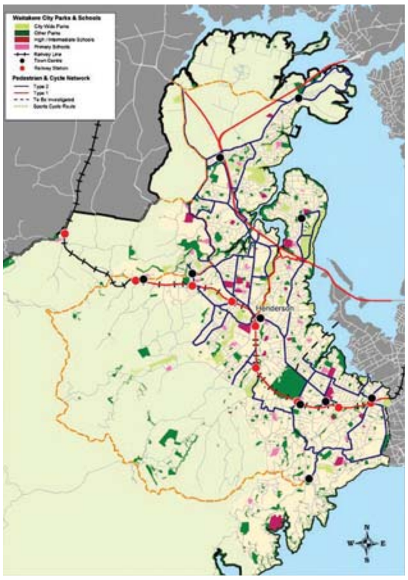


Figure 20.1 – Waitakere walking map

20.3 Maps

Maps for pedestrians need to contain different information from those designed for other road user types. In particular, pedestrians of all abilities should be able to understand the information on the maps and use it to decide if it is feasible to make their journey by walking, and which is the best route for their abilities and skills.

Table 20.2 shows the information that should be included on a walking map.

Table 20.2 – Information to be included on pedestrian maps

General type of information		Details
Essential	Background information	The date of publication.
		Contact details for any errors on the map.
		Contact details for any other problems (usually the local authority).
		Contact details for local pedestrian associations and/or advocates.
	Information for interpreting the map	A scale (walking time may be more meaningful than distance).
		The direction of north.
		A key.
	Way-finding information	The location of major destinations (for example malls, libraries, educational facilities, recreational facilities).
		The location of steps and steep slopes.
		The location of visitor/tourist information centres.
		The location of toilets.
		The location of interconnecting lanes and walkways.
		The location of car parking facilities.
		The name of all streets, house numbers on long streets and street numbers within the CBD.
		Routes that are fully accessible to the mobility impaired (which should be specifically highlighted).
		Route lengths (either time or distance).
		Distinctions should be drawn between off-road and on-road routes, and between open spaces and built-up areas, by using different colours or shading.
Desirable (if space is available)	Background information	Contact details for any obstructions, damage or problems encountered during the walking trip.
	Wayfinding information	Key destinations and landmarks, represented as pictograms.
		Names of parks.
		Heritage trails (if any).
		The location of short-cuts through buildings and the times they are available.
	Links to other forms of transport	Location of bus routes.
		Location of transport interchanges.
		Location of railway stations.
	Services	Accessibility of toilets and times they are closed.
		Location of public telephones.
		Location of post boxes.

APPENDIX 1 PEDESTRIAN CHARACTERISTICS

A1.1 Older pedestrians

The ageing process generally causes people's physical, cognitive and sensory abilities to deteriorate, and more than 50 percent of the over-65s in New Zealand consider themselves to have some form of impairment [142]. Regular walking is an especially valuable form of exercise for this age group, but as age increases so does the severity of the consequences of traffic crashes [46, 76, 122].

Characteristics of older pedestrians

Characteristic	Resulting in	Impacting on
Reduced range of joint motion	Slower walking speed.	• Crossing times. • Mean journey length.
Vision problems, such as reduced acuity and poor central vision	Reduced ability to scan the environment.	• Ability to detect and avoid objects. • Sign legibility. • Kerb detection. • Crossing locations. • Trip hazards. • Maps.
Limited attention span, memory and cognitive abilities	Needing more time to make decisions, difficulties in unfamiliar environments, lack of understanding of traffic signals.	• Positive direction signage. • 'Legibility' of streetscape. • Consistency of provision.
Reduced tolerance for adverse temperature and environments	Preference for sheltered conditions.	• Route location and exposure.
Decreased agility, balance and stability	Difficulties in changing level.	• Provision of steps/ramps. • Kerb height. • Gradients. • Handrails. • Surface quality.
Increased fear for personal safety and security	Fear of using all or part of a route.	• Lighting. • Surveillance. • Lateral separation from cars. • Provision of footpath. • Traffic speed and density.
Slower reflexes	Inability to avoid dangerous situations quickly.	• Crossing opportunities.
Reduced stamina	Shorter journeys between rests.	• Resting places. • Shelter.
Reduced manual dexterity and co-ordination	Reduced ability to operate complex mechanisms.	• Pedestrian-activated traffic signals.
[10, 13, 66, 122, 127, 139]		

A1.2 Child pedestrians

Children are a major road user group and face specific challenges when walking.

They have significantly different characteristics from adults, not only in physical build but also in developmental maturity. As non-drivers, they may rely more on walking trips for independent travel in their community, including to public transport. However, their restricted abilities and lack of experience mean they are at increased risk of injury. They tend also to trust that others will protect them, and can be overconfident in many circumstances [13].

Characteristics of child pedestrians		
Characteristic	Resulting in	Impacting on
Shorter height	Reduced ability to see over the tops of objects.	• Sight lines and visibilities.
Reduced peripheral vision	Reduced ability to scan the environment.	• Sign legibility. • Kerb detection. • Crossing locations. • Trip hazards.
Limited attention span and cognitive abilities	Inability to read or understand warning signs and traffic signals.	• Positive direction signage. • 'Legibility' of streetscape. • Use of symbols.
Less accuracy in judging speed and distance	Inopportune crossing movements.	• Provision of crossing facilities.
Difficulty localising the direction of sounds	Missing audible clues to traffic.	• Need to reinforce visual information.
Unpredictable or impulsive actions	Poor selection of routes and crossings.	• Lateral separation from cars. • Provision of footpath. • Traffic speed and density. • Barriers.
Lack of familiarity with traffic patterns and expectations	Lack of understanding of what is expected of them.	• Complexity of possible schemes.
[10, 13, 66, 127, 139]		

A1.3 Mobility-impaired pedestrians

Mobility-impaired pedestrians are commonly thought of as using devices to help them to walk, ranging from canes, sticks and crutches to wheelchairs, walkers and prosthetic limbs. However, a significant proportion of those with mobility impairments do not use any visually identifiable device [13].

Characteristics of mobility-impaired pedestrians		
Characteristic	Resulting in	Impacting on
Extra energy expended in movement	Slower walking speed.	• Crossing times. • Journey length. • Surface quality.
Use of mobility aids	Increased physical space and good surface quality needed.	• Footpath width. • Footpath condition. • Obstructions. • Step depth. • Gaps/grates.
Decreased agility, balance and stability	Difficulties in changing level.	• Provision of steps/ramps. • Kerb height. • Gradients. • Handrails. • Surface quality.
Reduced stamina	Shorter journeys between rests.	• Resting places. • Shelter.
Reduced manual dexterity and coordination	Reduced ability to operate complex mechanisms.	• Pedestrian-activated traffic signals.
[10, 13, 66, 122, 139]		

A1.4 Sensory-impaired pedestrians

Sensory impairment is often mistaken as being a complete loss of at least one sense, but a partial loss is far more common [66]. Vision impairment mainly affects pedestrians' abilities, although to some extent hearing and proprioception (the ability to sense the location of parts of the body) can have an effect [13].

Characteristics of sensory-impaired pedestrians

Characteristic	Resulting in	Impacting on
Reduction in hearing ability	Missing audible clues to traffic.	• Need to reinforce visual information.
Lack of contrast resolution	Reduced ability to distinguish objects.	• Sign legibility. • Small changes in level.
Reduced vision	Reduced ability to scan the environment.	• Kerb detection. • Crossing locations. • Trip hazards. • Consistency of streetscape.
Severe vision impairment	Use of mobility aid, guide dog and/or tactile feedback to navigate.	• Streetscape legibility. • Tactile paving use.
[10, 13, 66, 122, 139]		

A1.5 Wheeled pedestrians

Wheelchair and mobility scooter users can legitimately use the pedestrian network, but in many ways their characteristics are very different from those of walking pedestrians. This means the network has to function differently when taking these users into account.

Characteristics of wheeled pedestrians

Characteristic	Resulting in	Impacting on
More susceptible to effects of gravity	Slower speeds travelling uphill, faster speeds travelling on level surfaces or downhill.	• Route gradients. • Interaction with walking pedestrians.
Chair/scooter width effectively increases the width of the pedestrian	Greater width required to use a route or pass others.	• Route widths (including across roads). • Street furniture placement. • Passing places on narrow routes.
Reduced agility	Increased turning radius (and turning circle).	• Places to turn around. • Horizontal alignments. • Surface quality.
Reduced stability	Greater potential for overbalancing.	• Upstands/sudden changes in gradient. • Crossfall. • Maximum forwards and sideways reach to pedestrian-activated traffic signals.
User is seated	Eye level lower.	• Location of pedestrian-activated traffic signals. • Position of signs.
[10, 13, 66, 122, 139]		

APPENDIX 2 SIGNFACE DESIGN DETAILS

Design issue	Appropriate standard
Design issue	**Appropriate standard**
Letter height	**Equivalent to at least 1% of the distance from which the message will usually be read, subject to a minimum letter height of 22 mm.**
Width to height ratio of characters	**Between 3:5 and 1:1.**
Stroke width to height ratio	**Between 1:5 and 1:10, preferably in the band 1:6 to 1:8.**
Horizontal spacing between characters	**Between 25% and 50% of the characters' width.**
Horizontal spacing between words	**Between 75% and 100% of the characters' width.**
Vertical spacing between lines	**At least 50% of character height.**
Font	**Preferred fonts are Arial, Times New Roman and Helvetica Medium.** **Title case lettering should be used (upper case letter at the start, followed by lower case letters), with Arabic numerals where necessary.**
Wording used	**Use clear and concise language.** **Keep punctuation to a minimum.** **Walking times to destinations should be included.**
Use of symbols	**Any symbols should be nationally or internationally recognised and used consistently.** **Routes suitable for the mobility impaired should be marked using the international disabled access symbol.**
Alignment	**For directions to the left or straight ahead, words should be aligned to the left.** **Text should only be aligned to the right where the direction indicated is also to the right.**
Contrast	**Use light-coloured characters or symbols on a dark background.** **A matt [42] or eggshell finish [7] must be used.** **There must be a high contrast between the sign and its mounting (if any).**
Lighting	**Signs should be evenly lit over their entire surface.** **All characters should be embossed rather than engraved.**
[7, 10, 42, 128, 134]	

APPENDIX 3 ISSUES TO ADDRESS IN DISTRICT PLANS

The followings issues should be considered in district plan policies:

Issue	Comments
Environmental design	The seven basic requirements for walkable communities (connected, legible comfortable, convenient, pleasant, safe and secure–see section 4.2) should be incorporated into district plan policies. The underlying principle is that pedestrians should not be delayed, diverted or placed in danger. Crime Prevention Through Environmental Design (CPTED) principles [107] should also be applied to all new development.
Development type and density	Mixed and/or higher density development should be favoured in policies, particularly close to public transport routes, interchanges and the urban core.
Development of unused land	If an application for a new development involves apparently unused land (including road reserves), the site should be checked over a suitable period to check whether pedestrians use the land on a casual basis. If they do, any adverse impacts of the development on walking should be identified and, where possible, mitigated..
Connected pedestrian routes	Every new development should form part of a connected pedestrian network. It should link obvious trip ends, such as residential with shops, supermarkets, public spaces and community services. District plan policies should not permit layouts that include circuitous routes and cul-de-sacs that have no alternative outlet for pedestrians.
Footpath provision	District plans should specify the circumstances where footpaths are required, along with any design standards for footpaths.
Driveways	Driveways should be located as far from street intersections as possible to avoid confusion for pedestrians over the intended path of drivers. The number of driveways crossing footpaths should be minimised and sharing of driveway access between properties encouraged.
Internal layout	Internal site layouts should encourage vehicles to exit sites in a forward direction. They should minimise interaction between pedestrian access and vehicle movement.
Design standard	District plans should positively encourage walking, and all new pedestrian infrastructure should be provided to a standard higher than the permissible minimum.
Public Transport	District plans should allow for more intensive development around public transport nodes and interchanges, and encourage pedestrian friendly access routes. For new developments, ensure route layouts permit public transport to efficiently serve the area and provide shelters, seating and pedestrian signage.
Parking	District plan policies should provide guidance on providing and managing parking spaces.
Workplace travel plans	District plan policies should require workplace travel plans to be developed for all new developments that are major traffic generators. These should promote alternative travel choices to, and reduce reliance on, single-occupancy private car use.
Gated communities	Gated residential communities can be a barrier to pedestrian routes and should be discouraged. Where one is proposed, pedestrian access through it should be maintained. In the unlikely event that this is not feasible, existing formal or informal pedestrian routes should not be blocked.
Monitoring pedestrian activity	Every scheme or strategy to help pedestrians should have a clear set of objectives, set out in district plans. Effective monitoring is necessary to track progress in meeting those objectives and to establish trends.
Maintaining a pedestrian envelope	District plans should require facility standards to be maintained including clearing public and private vegetation to maintain the pedestrian envelope, the visibility of signage and the visibility of vehicles at crossing points.

APPENDIX 4 REFERENCES

1	Abley, Steve. 2007. *Community street review procedures*. New Zealand: Health Sponsorship Council. www.levelofservice.com (October 2007) – to be published on www.landtransport.govt.nz
2	Accident Compensation Corporation and Land Transport Safety Authority. 2000. *Down with speed: A review of the literature, and the impact of speed on New Zealanders*. http://www.acc.co.nz/DIS_EXT_CSMP/groups/external_ip/documents/internet/wcm000021.pdf (October 2007).
3	Alan Baxter and Associates and EDAW. 2002. *Paving the way: How we achieve clean, safe and attractive streets*. London: Commission for Architecture and the Built Environment.
4	Alexander, C. 1977. *A pattern language, towns-buildings-construction*. New York: Oxford University Press.
5	Allan, A. 2001. Walking as a local transport modal choice in Adelaide. Australia: *Walking the 21st Century*, 20 to 22 February 2001: 122–134.
6	Architectural and Transportation Compliance Board. 1999. *Accessible rights of way: A design guide*. United States: Architectural and Transportation Compliance Board.
7	Architectural and Transportation Compliance Board. 2002. ADA *Accessibility guidelines for buildings and facilities* (ADAAG). United States: Architectural and Transportation Compliance Board.
8	Austroads. 1991. *Guide to traffic engineering practice: Part 5: Intersections at grad*e. Australia/New Zealand: Austroads.
9	Austroads. 1993. *Guide to traffic engineering practice: Part 6: Roundabouts*. Australia/New Zealand: Austroads.
10	Austroads. 1995. *Guide to traffic engineering practice: Part 13: Pedestrians*. Australia/New Zealand: Austroads.
11	Austroads. 1999. *Guide to traffic engineering practice: Part 14: Bicycles*. Australia/New Zealand: Austroads.
12	Austroads. 2004. *Guide to traffic engineering practice: Part 10: Local area traffic management*. Australia/New Zealand: Austroads.
13	Axelson, P. W., D. A. Chesney, D. V. Galvan, J. B. Kirschbaum, P. E. Longmuir, C. Lyons, and K. M. Wong. 1999. *Designing sidewalks and trails for access. Part 1 of 2: Review of existing guidelines and practices*. United States: Department of Transportation.
14	Bass, Wade and Wigmore. 2004. *School journey safety – A comparative study of engineering devices*. Wellington. Land Transport New Zealand.
15	Beasley, S. 2002. Why our children are not as safe as we think they are. *Journal of the New Zealand Medical Association* 115, no. 1160.
16	Bristol City Council. 2004. Bristol legible city. www.bristollegiblecity.info (October 2007).
17	British Heart Foundation. 2004. Marketing and promoting 'Walking for Health' schemes: Advice note 3. from publications page of http://www.whi.org.uk (October 2007).
18	Brown Andrew and Brown Alan. Information sheets – *Trip hazards, human gait and misstep hazards*. http://www.cnf.com.au/forensic.shtml (October 2007).
19	Burden, D. 2004. *How can I find and help build a walkable community?* www.walkable.org/article3.htm (October 2007).
20	Burden Paul. 2003. *Living streets – creating a better balance*. Walk 21 Conference Portland USA http://viastrada.co.nz/sites/viastrada/files/Burden-Living-Streets.pdf (October 2007)
21	Cairns, Sally. 2000. Rethinking transport and the economy. *Town and country planning* 69, no. 1 (January): 6–7 United Kingdom.
22	Christchurch City Council. Living streets: *Creating a better balance*. Christchurch: Christchurch City Council. Also http://archived.ccc.govt.nz/programmes/livingstreets/ (October 2007)
23	City of Kansas City Council. 2003. *Kansas City walkability plan*. City of Kansas City Council.
24	City of Portland Office of Transportation. 1998. *Portland pedestrian design guide*. City of Portland. http://www.portlandonline.com/transportation/index.cfm?c=dejff (October 2007)
25	City of York Council. 2001. *Local transport plan*. City of York Council.
26	Commission for Architecture and the Built Environment. 2001. *House of Commons Select Committee Inquiry into Walking in Towns and Cities: Memorandum of Evidence*. United Kingdom. www.cabe.org.uk/AssetLibrary/2380.pdf (October 2007).
27	Corrs, Chambers and Westgarth. *Footpath maintenance*. http://www.corrs.com.au/corrs/website/web.nsf/Content/Pub_LIT_130804_TGIF_Special_Friday_13_Double_Edition_Trip_and_Fall_Claims_Fall_Over (September 2007)
28	Daaman, W. and S. P. Hoogendoorn. 2003. Experimental research of pedestrian walking behaviour. www.ltrc.lsu.edu/TRB_82/TRB2003-001113.pdf (October 2007).
29	Department for the Environment, Transport and the Regions. 2000. *Encouraging walking: Advice to local authorities*. United Kingdom: Department for the Environment, Transport and the Regions. http://www.dft.gov.uk/pgr/sustainable/walking/encouragingwalkingadvicetolo5793 (October 2007)

30	Department for Transport. 2003. Walking: *The way ahead*. United Kingdom: Department for Transport. www.dft.gov.uk/consultations/archive/2003/omf/walkingthewayahead (October 2007)
31	Department for Transport. 1991. *Traffic advisory leaflet 03/91: Speed control humps*. United Kingdom: Department for Transport.
32	Department for Transport. 1993. *Traffic advisory leaflet 09/93: Cycling in pedestrian areas*. United Kingdom: Department for Transport. http://www.dft.gov.uk/stellent/groups/dft_roads/documents/page/dft_roads_504728.hcsp (October 2007)
33	Department for Transport. 1994. *Traffic advisory leaflet 01/94: Village speed control work group – A summary*. United Kingdom: Department for Transport. http://www.dft.gov.uk/pgr/roads/tpm/tal/trafficmanagement/vispvillagespeedcontrolworkg4135 (October 2007)
34	Department for Transport. 1994. *Traffic advisory leaflet 03/94: Fire and ambulance services, traffic calming: A code of practice*. United Kingdom: Department for Transport. http://www.dft.gov.uk/pgr/roads/tpm/tal/trafficmanagement/fireandambulanceservicestraf4110 (October 2007)
35	Department for Transport. 1994. *Traffic advisory leaflet 04/94: Speed cushion*s. United Kingdom: Department for Transport. http://www.dft.gov.uk/stellent/groups/dft_roads/documents/page/dft_roads_504786.hcsp (October 2007)
36	Department for Transport. 1999. *Personal security issues in pedestrian journeys*. United Kingdom: Department for Transport. http://www.dft.gov.uk/pgr/crime/ps/personalsecurityissuesinpede3005 (October 2007)
37	Department for Transport. 1999. *Traffic advisory leaflet 14/99: Traffic calming on major roads*. United Kingdom: Department for Transport. http://www.dft.gov.uk/pgr/roads/tpm/tal/trafficmanagement/trafficcalmingonmajorroads (October 2007)
38	Department for Transport. 2000. *Traffic advisory leaflet 06/00: Monitoring walking*. United Kingdom: Department for Transport. http://www.dft.gov.uk/stellent/groups/dft_roads/documents/page/dft_roads_504819.hcsp (October 2007)
39	Department for Transport. 2000. *Traffic advisory leaflet 10/00: Road humps – discomfort, noise and ground-borne vibration*. United Kingdom: Department for Transport. http://www.dft.gov.uk/pgr/roads/tpm/tal/trafficmanagement/roadhumpsdiscomfortnoiseandg4115 (October 2007)
40	Department for Transport. 2001. *Traffic advisory leaflet 10/01: Home zones – Planning and design*. United Kingdom: Department for Transport. http://www.dft.gov.uk/stellent/groups/dft_roads/documents/page/dft_roads_504804.hcsp (October 2007)
41	Department for Transport. 2001. *Traffic advisory leaflet 01/01: Puffin pedestrian crossings*. United Kingdom: Department for Transport. http://www.dft.gov.uk/stellent/groups/dft_roads/documents/page/dft_roads_504816.hcsp (September 2007)
42	Department for Transport. 2002. *Traffic advisory leaflet 06/0:2 Inclusive mobility: a guide to best practice on access to pedestrian and transport infrastructure*. United Kingdom: Department for Transport. http://www.dft.gov.uk/transportforyou/access/tipws/inclusivemobility (October 2007)
43	Department for Transport. 2004. *Local Transport Note 01/04: Policy, planning and design for walking and cycling*. United Kingdom: Department for Transport. http://www.dft.gov.uk/consultations/archive/2004/ltnwc/ltn104policyplanninganddesig1691 (October 2007)
44	Department for Transport. *A travel plan resource pack for employers*. United kingdom. http://www.travelwiseni.com/dft_travel_plan_resource_pack_ (October 2007).
45	Department for Transport. *Guidance for tourist signing – general introduction*. United Kingdom. www.dft.gov.uk/stellent/groups/dft_roads/documents/pdf/dft_roads_pdf_505108.pdf (June 2004).
46	Department of Transportation Federal Highway Administration. 2002. *Pedestrian facilities users' guide*. United States: Department of Transportation Federal Highway Administration. http://drusilla.hsrc.unc.edu/cms/downloads/PedFacility_UserGuide2002.pdf (October 2007)
47	Department of Transportation Federal Highway Administration. 1994. *Innovations in public involvement for transportation planning*. United States: Department of Transportation Federal Highway Administration.
48	Department of Transportation Federal Highway Administration. 1996. *Public involvement techniques for transportation decision-making*. United States: Department of Transportation Federal Highway Administration.
49	Department of Transportation Federal Highway Administration. 1999. *Guidebook on measures to estimate non-motorized travel*. United States: Department of Transportation Federal Highway Administration.
50	Department of Transportation Federal Highway Administration. 1999. *Injuries to pedestrians and bicyclists: An analysis based on hospital emergency department data*. United States: Department of Transportation Federal Highway Administration.
51	Department of Transportation Federal Highway Administration. 2003. *Manual of uniform traffic control devices*. United States: Department of Transportation Federal Highway Administration.
52	Department of Transportation National Highway Traffic Safety Administration. *How walkable is your community*? www.nhtsa.dot.gov/people/injury/pedbimot/ped/walk1.html (October 2007)
53	Elvik, R., and T. Vaa. 2004. *The handbook of road safety measures*. Norway: Elsevier.

54	Energy Efficiency Best Practice Programme. *Good practice guide 314 – A guide on how to set up and run travel plan networks*. United Kingdom.
55	Faure, A. 2003. *Walking, urban sprawl and innovative measures*. In: Proceedings of Walk 21 IV Conference. America Walks. http://www.americawalks.org/PDF_PAPE/Faure.pdf (October 2007)
56	Fox, J., M. Good, and P. Joubert. 1979. *Collisions with utility poles*. Australia: Department of Transport, Office of Road Safety.
57	Fruin, J. 1987. *Pedestrian planning and design*. New York. Metropolitan Association of Urban Designers and Environmental Planners.
58	Gadd, M. 2001. *Guide to pedestrian crossing facilities*. Christchurch: Trafinz.
59	Gehl Architects. 2004. *City to waterfront – Wellington October 2004. Public spaces and public life study*. Wellington: Wellington City Council.
60	Greater Manchester Local Authorities. *Travel plan resource pack*. www.travelplans.org.uk/frameset.php?page=http://www.travelplans.org.uk/16trav_resource_pack.htm (October 2007).
61	Greenwald, M. J. and M. G. Boarnet. 2001. Built environment as a determinant of walking behaviour. *Transportation Research Record* 1780.
62	Guest, W. 2004. *Rail corridor safety in New Zealand – issues and observations*. Presented at the IPENZ Transportation Group Conference 2004. Wellington.
63	Handy, S. 2004. *Community design and physical activity: What do we know?* In: Obesity and the built environment (Post conference information), 24–26 May 2004. http://www.niehs.nih.gov/news/events/pastmtg/2004/built/ (October 2007).
64	Hess, P., A. V. Moudon, M. C. Snyder, and K. Stanilov. 1999. Site design and pedestrian travel. *Transportation Research Record* 1674: 9–19.
65	Institute of Highway Incorporated Engineers. 2002. *Home zones design guidelines*. United Kingdom: Institute of Highway Incorporated Engineers.
66	ITE Traffic Engineering Council Committee. 1998. *Design and safety of pedestrian facilities – A recommended practice of the Institute of Transportation Engineers*. United States: Institute of Transportation Engineers.
67	John, G. *The effectiveness of the travelsmart individualised marketing program for increasing walking trips in Perth*. http://www.dpi.wa.gov.au/mediaFiles/tsmart_walk21century.pdf (October 2007)
68	Joint Technical Committee LG/2 Road Lighting. 1999. AS/NZS 1158.3.1: 1999, *Road lighting – pedestrian area (Category P) lighting – Performance and installation design requirements*. Australian/New Zealand Standards.
69	Ker, Ian, A. Hubard, G. Veith and J. Taylor. Australia. 2007. *Pedestrian-cyclist conflict minimisation on shared paths and footpaths*. Australian Bicycle Council. http://www.austroads.com.au/documents/Ped-cyclist_conflict_minimisation_on_shared_paths.pdf (October 2007)
70	Knoblauch, R. L, M. T. Pietrucha, and M. Nitzburg. 1996. Field studies of pedestrian walking speed and start-up time. *Transportation Research Record* 1538.
71	Kokotailo, R. 2000. *New Zealand pedestrian profile*. http://www.landtransport.govt.nz/research/documents/pedestrian.pdf (October 2007)
72	Lalani, N., and The ITE Pedestrian and Bicycle Task Force. 2001. *Alternative treatments for at-grade pedestrian crossings*. Washington D. C.: Criterion Press.
73	Land Transport New Zealand. 2004. *Cycle network and route planning guide*. Wellington: Land Transport New Zealand. http://www.landtransport.govt.nz/road-user-safety/walking-and-cycling/cycle-network/ (October 2007)
74	Land Transport New Zealand. 2007. *Neighbourhood accessibility planning – Guidelines for facilitator*. Wellington: Land Transport New Zealand.
75	Land Transport Safety Authority. 1990. RTS02: *Guidelines for street name signs*. Wellington: Land Transport Safety Authority. http://www.landtransport.govt.nz/roads/rts/rts-02.pdf (October 2007)
76	Land Transport Safety Authority. 1998. *The New Zealand travel survey 1997/98*. Wellington: Land Transport Safety Authority. http://www.transport.govt.nz/travel-survey-highlights-1997-98-index/ (October 2007)
77	Land Transport Safety Authority. 1993. RTS09: *Guidelines for the signing and layout of slip lanes*. Wellington: Land Transport Safety Authority. http://www.landtransport.govt.nz/roads/rts/rts-09.pdf (October 2007)
78	Land Transport Safety Authority. 1994. *School traffic safety team manual*. Wellington: Land Transport Safety Authority. http://www.landtransport.govt.nz/road-user-safety/schools/stst-manual/index.html (October 2007)
79	Land Transport Safety Authority. 1994. *Crash reduction monitoring reports – Install pedestrian refuge and/or bulbous kerbs*. http://www.landtransport.govt.nz/roads/crash/docs/ped-refuge-bulbous-kerbs2.pdf (October 2007)
80	Land Transport Safety Authority. 1998. *Traffic Note 2: Platforms as crossing points – Guidelines*. Wellington: Land Transport Safety Authority. http://www.landtransport.govt.nz/roads/traffic-notes/traffic-note-02-rev1.pdf (October 2007)
81	Land Transport Safety Authority. (1999). *RSS11: Pedestrian platforms*. Wellington: Land Transport Safety Authority. http://www.landtransport.govt.nz/roads/rss/rss-11.html (October 2007)

82	Land Transport Safety Authority. 1999. *RSS12: Floodlighting pedestrian crossings*. Wellington: Land Transport Safety Authority. http://www.landtransport.govt.nz/roads/rss/rss-12.html (October 2007)
83	Land Transport Safety Authority. 2000. RTS10: *Road signs and markings for railway level crossings*. Wellington: Land Transport Safety Authority. http://www.ltsa.govt.nz/roads/rts/rts-10.pdf (October 2007)
84	Land Transport Safety Authority. 2001. RTS06: *Guidelines for visibility at driveways*. Wellington: Land Transport Safety Authority. http://www.landtransport.govt.nz/roads/rts/rts-06.pdf (October 2007)
85	Land Transport Safety Authority. 2002 (revised 2007). *Factsheet 52: Flush medians*. Wellington: Land Transport Safety Authority. http://www.landtransport.govt.nz/factsheets/52.html (October 2007)
86	Land Transport Safety Authority. 2002. *RSS17: School crossing facilities*. Wellington: Land Transport Safety Authority. http://www.landtransport.govt.nz/roads/rss/rss-17.pdf (October 2007)
87	Land Transport Safety Authority. 2002. *RTS15: Guidelines for urban-rural thresholds*. Wellington: Land Transport Safety Authority. http://www.landtransport.govt.nz/roads/rts/rts-15.pdf (October 2007)
88	Land Transport Safety Authority. 2002. *Traffic Note 29 revision 1: School crossing points*. Wellington: Land Transport Safety Authority. http://www.landtransport.govt.nz/roads/traffic-notes/traffic-note-29-rev2.pdf (October 2007)
89	Land Transport Safety Authority. 2002. *Traffic Note 37: 40 km/h school zones*. Wellington: Land Transport Safety Authority. http://www.landtransport.govt.nz/roads/traffic-notes/traffic-note-37-rev1.pdf (October 2007)
90	Land Transport Safety Authority. 2003. *Factsheet 26: Kea crossings*. Wellington: Land Transport Safety Authority. http://www.landtransport.govt.nz/factsheets/26.html (October 2007)
91	Land Transport Safety Authority. 2003. *Motor vehicle crashes in New Zealand*. Wellington: Land Transport Safety Authority.
92	Land Transport Safety Authority. 2003. *RTS14: Guidelines for facilities for blind and vision-impaired pedestrians*. Wellington: Land Transport Safety Authority. http://www.landtransport.govt.nz/roads/rts/rts-14-2003.pdf (October 2007)
93	Land Transport Safety Authority. Road User Rule consultation paper: Recreational devices, motorised mobility scooters and wheelchairs.
94	Landis, Bruce W., V. R. Vattikuti, R. M. Ottenerg, D. S. McLeod, and M. Guttenplan. 2000. *Modelling the roadside walking environment: A pedestrian level of service*. United States: Florida Department of Transportation.
95	Leyden, K. M. 2003. Social capital and the built environment: The importance of walkable neighbourhoods. *American Journal of Public Health* 93, no. 9: 1546–1550.
96	Lillis, J., and S. Sourmoradian. 2001. *PEDSAFE – Development of a new pedestrian auditing method*. Order from: http://civil.eng.monash.edu.au/its/caitrhome/prevcaitrproceedings/caitr2001 (October 2007).
97	Litman, T., 2005. Well measured: *developing indicators for comprehensive and sustainable transport planning*. Canada: Victoria Transport Policy Institute. http://www.vtpi.org/wellmeas.pdf (October 2007)
98	Litman, T., and D. Burwell. 2007. *Issues in sustainable transportation. Int. J. Global Environmental Issues*, Vol. 6, No. 4, pp.331–347. http://www.vtpi.org/sus_iss.pdf (October 2007)
99	Livi, A. D., and K. J. Clifton. 2004. *Issues and methods in capturing pedestrian behaviours, attitudes and perceptions: Experiences with a community-based walkability survey*. http://www.enhancements.org/download/trb/trb2004/TRB2004-001417.pdf (October 2007).
100	Living Streets. 2002. *DIY community street audits*. United Kingdom: Living Streets.
101	Local Government Commission Centre for Liveable Communities. *Why people don't walk and what city planners can do about it*. www.lgc.org/freepub/PDF/Land_Use/focus/plan_to_walk.pdf (October 2007).
102	London Borough of Islington Parking Services. *Footway parking*. www.islington.gov.uk/pdf/environment/parkingfootway.pdf (June 2004).
103	Lumsden, L., and R. Tolley. 1999. Techniques for planning local networks: Developing a walking strategy. *World Transport Policy & Practice* 5, no. 1: 17–23.
104	Milazzo, J. S., N. M. Rouphail, J. E. Hummer, and D. P. Allen. 1999. *Quality of service for uninterrupted pedestrian facilities in the 2000 highways capacity manual*. http://www.itre.ncsu.edu/HWY/products/publications/uninterrupted.pdf (October 2007)
105	Ministry for the Environment. 2002. *People, places, spaces: A design guide for urban New Zealand*. http://www.mfe.govt.nz/publications/rma/people-places-spaces-mar02/index.html (October 2007)
106	Ministry for the Environment. 2005. *New Zealand urban design protocol*. http://www.mfe.govt.nz/issues/urban/design-protocol/index.html (October 2007)
107	Ministry of Justice. 2005. *National guidelines for crime prevention through environmental design in New Zealand*. http://www.justice.govt.nz/pubs/reports/2005/cpted-part-1/index.html http://www.justice.govt.nz/pubs/reports/2005/cpted-part-2/index.html (October 2007)
108	Ministry of Transport. 2002. *New Zealand transport strategy*. Wellington. Ministry of Transport. http://www.beehive.govt.nz/nzts/downloads.cfm (October 2007)
109	Ministry of Transport. 2003. *Land Transport Management Act*. Wellington. Ministry of Transport.

110	Ministry of Transport. 2004. *Land Transport (Road User) Rule 2004*. http://www.landtransport.govt.nz/rules/docs/road-user-rule-2004.pdf (October 2007)
111	Ministry of Transport. 2004. *Land Transport Rule: Traffic Control Devices 2004*. http://www.landtransport.govt.nz/rules/docs/traffic-control-devices-2004.pdf (October 2007)
112	Ministry of Transport. 2005. *Getting there – on foot by cycle*. Wellington: Ministry of Transport. http://www.transport.govt.nz/assets/NewPDFs/getting-there.pdf (October 2007).
113	Ministry of Transport. *Rail incident data base*. Wellington: Ministry of Transport.
114	Moscovich, J. L. 2003. Designing transportation systems for active communities: Planning, design and system performance considerations. In: *ITE Journal* (June).
115	Moudon, A. V., P. M. Hess, J. M. Matlick, and N. Pergakes. 2002. *Pedestrian location identification tools. Transportation research record* 1818: 94–101. United States
116	Murray, M.P. 1967. Gait as a total pattern of movement. *American Journal of Physical Medicine* 46: 290–333.
117	National Center for Bicycling and Walking. *Pedestrian facilities reference guide*. www.bikewalk.org/walking/design_guide/pedestrian_design_guide_index.htm (May 2004).
118	New Jersey Department of Transportation. 1999. *Pedestrian compatible planning and design guidelines*. United States: New Jersey Department of Transportation.
119	New Zealand Building Industry Authority. 2005. *New Zealand building code handbook and approved documents*. Wellington: Scenario Communications. (available on CD-ROM).
120	Oldham Metropolitan Borough Council. *Summary of consultation methods*. www.oldham.gov.uk/ace/documents/methods.pdf (October 2007).
121	Oregon Department of Transportation. 1995. *Oregon bicycle pedestrian plan*. United States: Oregon Department of Transportation.
122	Organisation for Economic Co-operation and Development. 2001. *Ageing and transport: Mobility needs and safety issues*. Paris: Organisation for Economic Co-operation and Development.
123	Pedestrian and Bicycle Information Center. *How walkable is your community?* www.walkinginfo.org/pdf/walkingchecklist.pdf (October 2007).
124	Planning South Australia. 2000. *Transport choice and urban design: Design issues for accessible neighbourhoods*. Australia: Department for Transport.
125	Roads and Traffic Authority New South Wales. 2002. *How to prepare a pedestrian access and mobility plan – An easy three stage guide*. Australia. Roads and Traffic Authority New South Wales.
126	Roads and Traffic Authority New South Wales. 2004. *Pedestrian facilities* (draft). Australia: Roads and Traffic Authority New South Wales.
127	Roads and Traffic Authority New South Wales. *Vulnerable pedestrians*. http://www.rta.nsw.gov.au/roadsafety/pedestrians/pedestriansafety/vulnerablepedestrians/index.html (October 2007).
128	Royal National Institute for the Blind. 2000. *Sign design guide*. United Kingdom: Royal National Institute for the Blind.
129	Safekids New Zealand. *Safe routes to school*. www.safekids.org.nz/index.php/pi_pageid/56 (October 2007).
130	Scottish Executive United Kingdom. 2004. *A walking strategy for Scotland* (consultation draft). Edinburgh: Scottish Executive.
131	Selby, Tim, Tiffany Lester. 2007. *Non-motorised user project review procedures*. Wellington: Land Transport New Zealand. – to be published on www.landtransport.govt.nz .
132	Standards Australia and CSIRO. 1*999. HB 197:1999 An introductory guide to the slip resistance of pedestrian surface materials*. Australia: Standards Australia.
133	Standards New Zealand. 1994. *AS/NZS 3661.2:1994 Slip resistance of pedestrian surfaces – guide to the reduction of slip hazards*. Wellington: Standards New Zealand.
134	Standards New Zealand. 2001. *NZS 4121:2001* Design for access and mobility – buildings and associated facilities. Wellington: Standards New Zealand.
135	Standards New Zealand. 2004. *AS/NZS 4586:2004 Slip resistance classification of new pedestrian surface materials*. Wellington: Standards New Zealand
136	Standards New Zealand. 2004. *AS/NZS 4663:2004 Slip resistance measurement of existing pedestrian surfaces*. Wellington: Standards New Zealand.
137	Standards New Zealand. 2005. *NZS 8603:2005 Design and application of outdoor recreation symbols*. Wellington: Standards New Zealand.
138	State Government of Victoria Department of Infrastructure. *Disability access at railway crossings report*. http://www.doi.vic.gov.au/Doi/Internet/transport.nsf/7df5312841bde42a4a2563730019cf4d/8e25d8f5179e8f1aca256d5e0007975d?OpenDocument (October 2007)

139	State of Florida Department of Transportation. 1999. *Florida pedestrian planning and design handbook*. Florida Department of Transportation.
140	Statistics New Zealand. *New Zealand population 1951–2051, Projection series 5*. www.stats.govt.nz/popn-monitor/future-popn/default.htm (April 2004).
141	Statistics New Zealand. *National population estimates tables*. www.stats.govt.nz/domino/external/web/prod_serv.nsf/htmldocs/National+Population+Estimates+Tables (April 2004).
142	Statistics New Zealand. *New Zealand disability survey snapshot 1 key facts*. www.stats.govt.nz/domino/external/pasfull/pasfull.nsf/web/Media+Release+2001+Disability+Survey+Snapshot+1+Key+Facts?open (July 2004).
143	Sustrans. 2002. *Information sheet FF04: Shared use paths*. United Kingdom: Sustrans.
144	Sustrans. 2004. *Information sheet FF26: Direction signing on the national cycle route network*. United Kingdom: Sustrans.
145	Tate, Fergus. 2007. *Guidelines for the Selection of Pedestrian Facilities*. Wellington: Land Transport New Zealand. – to be published on www.landtransport.govt.nz .
146	Tate, Fergus and Gina F Waibl. 2007. *Pedestrian crossing selection calculation spreadsheet*. Wellington: Land Transport New Zealand. – to be published on www.landtransport.govt.nz
147	The City of Oakland. 2002. *Pedestrian master plan – The City of Oakland*. United States: The City of Oakland.
148	The Institution of Highways and Transportation. 1997. *Transport in the urban environment*. United Kingdom: The Institution of Highways and Transportation.
149	The Institution of Highways and Transportation. 2000. *Providing for journeys on foot*. United Kingdom: The Institution of Highways and Transportation.
150	The Mayor of London and Transport for London. 2004. *Making London a walkable city: The walking plan for London*. United Kingdom: Transport for London.
151	Tolley, R. 2003. *Providing for pedestrians: Principles and guidelines for improving pedestrian access to destinations and urban spaces*. Victoria: Department of Infrastructure.
152	Transfund New Zealand. 2004. *Programme and funding manual, PFM1, second edition*. http://www.landtransport.govt.nz/funding/programme-and-funding-manual/index.html
153	Transit New Zealand. 2005. *New Zealand supplement to the Austroads guide to traffic engineering practice, Part 14: Bicycles* (provisional). http://www.transit.govt.nz/technical/manuals.jsp
154	Transit New Zealand. 1997. *Manual of traffic signs and markings*. Wellington: Transit New Zealand.
155	Transit New Zealand. 1999. *Code of practice for temporary traffic management*. Wellington: Transit New Zealand.
156	Transit New Zealand. 2002. *State highway geometric design manual section 6: Cross section*. Wellington: Transit New Zealand.
157	Transit New Zealand. 2002. *TNZ T10:2002 Specification for skid resistance investigation and treatment selection*. Wellington: Transit New Zealand.
158	Transport Research Laboratory. *Pedestrian environment review software*. United Kingdom. www.trlsoftware.co.uk/index.asp?Section=Products&Item=PERS (October 2007).
159	Tumlin, J. and A. Millard-Bell. 2003. How to make transit-orientated development work. *Planning* (May).
160	Urban Transport Benchmarking Initiative. *What is benchmarking?* http://www.transportbenchmarks.org/benchmarking/what-is-benchmarking.html (October 2007).
161	Van der Horst, R. and P. Bakker. *Safety measures at railway level crossings for pedestrians and cyclists*. www.ictct.org/workshops/03-Vancouver/vanderhorst.pdf (October 2007).
162	Victoria Transport Policy Institute. *Walking and cycling encouragement: Strategies that encourage people to use non-motorized transportation*. Canada. www.vtpi.org/tdm/tdm3.htm (October 2007).
163	Victoria Transport Policy Institute. *New urbanism: Clustered, mixed-use, multi-modal neighbourhood design. Canada*. www.vtpi.org/tdm/tdm24.htm (October 2007).
164	Walk 21. 2004. *Best practice*. www.walk21.com/bestpractice/ (April 2004).
165	Walking Bus Dot Com. *What is a walking bus?* United Kingdom. www.walkingbus.com/ (October 2007).
166	Washington State Department of Transportation. 2001. *Design manual*. Washington. Washington State Department of Transportation.
167	Wellington City Council. *Community safety audit*. Wellington. Wellington City Council.
168	Wellington City Council. *Wellington consolidated bylaw*. Wellington. www.wcc.govt.nz/plans/bylaws/ (October 2007).
169	Westerman, Hans L. 1999. *Cities for tomorrow*. Sydney: Austroads.
170	Westerman, Hans L 2000. *Sharing the main street*. Roads & Traffic Authority of NSW, Sydney Australia
171	Western Australian Planning Commission. *Liveable Neighbourhoods- Edition 3 – Appendix 3*. Australia. http://www.wapc.wa.gov.au/Publications/26.aspx (October 2007).
172	Zacharias, J. 1994. Planning for pedestrian networks in North American downtowns. *Journal of advanced transportation* 28 no. 2: 141–156.

173	Zegeer, C.V., J. R. Stewart, H. Huang, and P. Lagerwey. 2002. *Safety effects of marked vs unmarked crosswalks at uncontrolled locations*. United States. Federal Highway Administration (Report No FHWA-RD-01-075).
175	Queensland Transport 2005, *Easy Steps – A toolkit for planning, designing and promoting safe walking*. Queensland Transport, Brisbane. http://www.transport.qld.gov.au/Home/Safety/Road/Pedestrians/Pedestrian_easy_steps (October 2007)
176	Department for Transport 2007. *Manual for Streets*. United Kingdom, Department for Transport. http://www.dft.gov.uk/pgr/sustainable/manforstreets/ (October 2007)
177	Bird, S., C.R. Sowerby, and V.M. Aitkinson. 2007. *Development of a Risk Analysis Model for Footways and Cycletracks*. England. TRL Limited (Report No PPR171).
178	Ministry of Transport 2008. *Getting there implementation plan*. http://www.transport.govt.nz/assets/NewPDFs/GettingThereA4.pdf

APPENDIX 5 INDEX