GUIDE TO ROAD DESIGN

Part 6A: Pedestrian and Cyclist Paths
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Summary

The Guide to Road Design – Part 6A: Pedestrian and Cyclist Paths provides guidance for road designers and other practitioners on the design of paths for safe and efficient walking and cycling. The guide provides a brief introduction to planning and the need for a path, describes the types of path and covers the requirements of path users. However, the main focus of Part 6A is the geometric design of paths and related facilities such as intersections between paths, and terminal treatments. Detailed guidance is provided on path location, alignment, width, clearances, crossfall, drainage and sight distance requirements.

The location and design of paths may be influenced by a range of aspects that need to be considered and facilities that need to be accommodated within roadsides. In particular, designers should refer to the Guide to Road Design:

- Part 6: Roadside Design, Safety and Barriers
- Part 6B: Roadside Environment.

The design of pedestrian and cyclist paths may also be influenced by design considerations and requirements covered in other parts of the Guide to Road Design. In addition, road designers should also refer to relevant parts of the Austroads Guide to Traffic Management in relation to traffic management devices and requirements that may need to be accommodated within a roadside or may otherwise influence the design.

Keywords

Planning, footpaths, bicycle paths, shared paths, separated paths, path user requirements, operating space, location of paths, alignment, horizontal curvature, gradient, width, clearance, intersections, fences, terminal treatments, bridges, culverts, bicycle safety audits

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Guide to Road Design
Part 6A: Pedestrian and Cyclist Paths

Austroads
Sydney 2009
Austroads profile

Austroads purpose is to contribute to improved Australian and New Zealand transport outcomes by:

- providing expert advice to SCOT and ATC on road and road transport issues
- facilitating collaboration between road agencies
- promoting harmonisation, consistency and uniformity in road and related operations
- undertaking strategic research on behalf of road agencies and communicating outcomes
- promoting improved and consistent practice by road agencies.

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Austroads membership comprises the six state and two territory road transport and traffic authorities, the Commonwealth Department of Infrastructure, Transport, Regional Development and Local Government in Australia, the Australian Local Government Association, and New Zealand Transport Agency. It is governed by a council consisting of the chief executive officer (or an alternative senior executive officer) of each of its 11 member organisations:

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- Roads Corporation Victoria
- Department of Transport and Main Roads Queensland
- Main Roads Western Australia
- Department for Transport, Energy and Infrastructure South Australia
- Department of Infrastructure, Energy and Resources Tasmania
- Department of Planning and Infrastructure Northern Territory
- Department of Territory and Municipal Services Australian Capital Territory
- Department of Infrastructure, Transport, Regional Development and Local Government
- Australian Local Government Association
- New Zealand Transport Agency.

The success of Austroads is derived from the collaboration of member organisations and others in the road industry. It aims to be the Australasian leader in providing high quality information, advice and fostering research in the road sector.
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1 INTRODUCTION

1.1 Purpose

Austroads Guide to Road Design seeks to capture the contemporary road design practice of member organisations; refer to the Guide to Road Design – Part 1: Introduction to Road Design (Austroads 2006a). In doing so, it provides valuable guidance to designers in the production of safe, economical and efficient road designs.

The purpose of Part 6 of the Guide to Road Design is to provide guidance on the design of all features and facilities that have to be accommodated and coordinated within the road reservation outside of the road pavement. The guide comprises three parts:

- Part 6: Roadside Design, Safety and Barriers
- Part 6A: Pedestrian and Cycling Paths
- Part 6B: Roadside Environment.

Part 6 provides an introduction to roadside design and also provides detailed guidance on roadside safety (e.g. hazard identification, mitigation and treatment) and the use and design of safety barriers. Part 6A covers the geometric design of all types of pedestrian and cycling paths and the design of associated facilities, while Part 6B provides guidance on all other roadside features and facilities (Figure 1.1).

Paths are provided to meet the transportation and recreational needs of pedestrians and cyclists. They may be situated in road reserves, through parkland reserves, or beside rivers or coastal areas to provide safe and convenient routes and facilities for these road users. The Guide to Road Design – Part 6A: Pedestrian and Cycling Paths therefore provides guidelines for the design of paths generally and not only for the integration of paths into road designs.

Figure 1.1 shows that Part 6 is one of eight guides that comprise the Austroads Guide to Road Design. Collectively these parts provide information on a range of disciplines including geometric design, drainage, roadside design and geotechnical design, all of which may influence the location and design of paths within road reservations.

![Flow chart of the Guide to Road Design](https://example.com/flow-chart)
1.2 Scope of this Part

Part 6A describes the types of paths and their location within the road reservation, provides guidance on alignment, width and other geometric requirements, and information on the design of treatments such as path intersections and terminals. In addition to the *Guide to Road Design*, there are nine other subject areas spanning the range of Austroads publications that may also be relevant to the design of the roadside (www.austroads.com.au).

Part 6A, when used in conjunction with other relevant parts of the *Guide to Road Design* and the *Guide to Traffic Management*, provides the information and guidance necessary for a road designer to prepare detailed geometric design drawings that are adequate to facilitate the construction of paths. Of particular relevance is the *Guide to Traffic Management – Part 5: Road Management* (Section 3.3, Table 3.1 and Table 3.2) (Austroads 2008a) and Section 8 of the *Guide to Traffic Management – Part 6: Intersections, Interchanges and Crossings* (Austroads 2007). In some situations bicycle paths may also interface with bicycle lanes on the road in which case reference should be made to the *Guide to Road Design – Part 3: Geometric Design* (Austroads 2009a).

The scope of Part 6A is therefore to provide guidelines for the geometric design of paths and not to provide guidance on planning matters related to cycling including the development of bicycle and/or pedestrian networks as this relates to network planning. However, designers should understand that the design standard adopted for a particular facility should relate to the transportation role it has in the bicycle or pedestrian network. Some bicycle paths and shared paths are designed to perform an arterial function whilst others have an access function. For example, a veloway is a very high standard bicycle path (in terms of width, alignment, clearances, access etc.) that provides a major arterial link for cyclists and this type of facility should be designed for high operating speeds (e.g. the 7 km long Adelaide Southern Veloway alongside the Southern Expressway in South Australia).

1.3 Safe System Approach

Adopting a Safe System approach to road safety recognises that humans, as road users are fallible and will continue to make mistakes, and that the community should not penalise people with death or serious injury when they do make mistakes. In a Safe System, therefore, roads (and vehicles) should be designed to reduce the incidence and severity of crashes when they occur.

The Safe System approach requires, in part (Australian Transport Council 2006):

- Designing, constructing and maintaining a road system (roads, vehicles and operating requirements) so that forces on the human body generated in crashes are generally less than those resulting in fatal or debilitating injury.
- Improving roads and roadsides to reduce the risk of crashes and minimise harm: measures for higher speed roads including dividing traffic, designing ‘forgiving’ roadsides, and providing clear driver guidance. In areas with large numbers of vulnerable road users or substantial collision risk, speed management supplemented by road and roadside treatments is a key strategy for limiting crashes.
- Managing speeds, taking into account the risks on different parts of the road system.

In New Zealand, practical steps have been taken to give effect to similar guiding principles through a Safety Management Systems (SMS) approach.
Road designers should be aware of and through the design process actively support the philosophy and road safety objectives covered in the *Guide to Road Safety* (Austroads 2006 – 2009). The philosophy and objectives are as relevant to pedestrian and cyclists paths as they are to roads in general.
2 PLANNING AND NEED FOR A PATH

2.1 Planning

Cycling and walking have significant roles in transport systems throughout Australia and New Zealand and are expected to make an important contribution to the well-being and transportation of people in future.

The *Australian National Cycling Strategy 2005-2010* acknowledges that Australia currently faces a multitude of transport, health and environmental challenges and that there is a need to:

- provide for the safe, affordable and enjoyable movement of people and goods
- reduce the environmental and health impacts of transport, for instance by reducing motor vehicle tailpipe (including greenhouse gas) and noise emissions
- increase physical activity by Australian people
- combat rising traffic congestion, which is increasing travel times and industry costs.

The strategy recognises that in order to meet these needs society needs to:

- reduce dependence on the private motor vehicle
- increase the use of ‘active transport’ (walking, cycling and public transport)
- provide a transport system that offers attractive choices for travel other than by the private vehicle – including cycling.

The national strategy in New Zealand is *Getting there – on foot, by bicycle: A strategy to advance walking and cycling in New Zealand Transport*. This strategy aims to ensure that supportive walking and cycling environments are provided in New Zealand communities, that safety is improved for pedestrians and cyclists, and that people walk and cycle more as part of their day-to-day transport mix.

The development of walking and cycling is integral to achieving the five key objectives of the New Zealand Transport Strategy, which comprise:

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

When planning or designing a path in a road, rail, river or coastal reservation it is important that road designers have a broad view of the transport network and identify connections to other paths and facilities that should be provided as part of the design or accommodated in plans for the future.

It is important also to recognise the broad range of performance and skill that exists among pedestrians and cyclists due to factors such as to age, experience, physical ability, cognitive skill and vision, and the need to provide paths to satisfy the needs of various users and demands. Further information is provided in Commentary 1.
Bicycle paths and facilities are generally designed for a normal bicycle. However, it is important to understand that there are other forms of human powered vehicles that have a broad range of performance characteristics that may have to be considered. For example, tandem bicycles are generally the least maneuverable human powered vehicle, which may have implications for path terminal design.

Planners and designers should establish early in the process whether the path is likely to carry a significant number of human powered vehicles other than bicycles so that paths and facilities are designed to safely accommodate the appropriate design vehicle. Commentary 2 provides operational characteristics for examples of human powered vehicles and this information may assist designers in providing for them where necessary.

Designers should be aware of local pedestrian or cycling planning and design guides. These guides generally provide the policy and network planning context in which pedestrian facilities are provided within a jurisdiction. With respect to pedestrians examples of these guides include:

- How to Prepare a Pedestrian and Mobility Plan – An easy three stage guide (RTA 2002)
- *Easy Steps* (Queensland Transport 2005)
- Pedestrian Planning and Design Guide (Land Transport NZ 2007a).

Traffic management aspects and road user considerations in relation to pedestrian and cycling paths are provided in Austroads (2008a) and Austroads (2007).

### 2.2 Need for a Path

#### 2.2.1 General

The provision of coherent networks of pedestrian and bicycle paths is important to governments, businesses and individuals because they:

- encourage exercise which improves public health and reduces the strain on health services and hospital systems
- can assist in causing a shift from car to other forms of transport (walking, cycling and public transport) thereby reducing air pollution, greenhouse emissions and other forms of environmental pollution, as well as assisting in the management of traffic congestion
- benefit businesses through healthier employees who enjoy a better quality of life.

Road designers have a role in achieving these important outcomes by ensuring that paths and associated facilities are appropriately located and designed.

#### 2.2.2 Pedestrian Paths

The most common type of pedestrian path is a footpath for use by pedestrians and young cyclists (depending on local road rules). The general principles relating to provision of footpaths include:

- In general, all roads should have some type of walking facility out of the vehicle path. An exception may be categories of road that have a very low volume and low operating speed (i.e. < 40 km/h) such as minor access roads.
- Footpath installation warrants based solely on pedestrian demand are not practical, except in the central business districts of cities and at event locations.
The need for footpaths should also be related to the pedestrian network functional requirements. For example, the presence of pedestrians on many rural roads is a rare event and the provision of paths is not economically justified. In this situation the provision of shoulders will provide space for a pedestrian who happens to use the road. On the other hand, all roads that have a moderate to high speed (i.e. ≥ 40 km/h) and significant pedestrian activity should be provided with footpaths because of the high risk of serious injury should a pedestrian be struck by a vehicle.

Additional factors that may influence a decision to provide a path are described in Commentary 3.

Table 2.1 is an example of when footpaths may be required based on the general abutting land use, and illustrates the way in which the principles are applied in New Zealand.

<table>
<thead>
<tr>
<th>Land use</th>
<th>Footpath provision</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>New roads</td>
<td>Existing roads</td>
</tr>
<tr>
<td></td>
<td>Preferred</td>
<td>Minimum</td>
</tr>
<tr>
<td>Commercial and industrial</td>
<td>Both sides</td>
<td>Both sides</td>
</tr>
<tr>
<td>Residential (on arterial roads)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential (on collector roads)</td>
<td>Both sides</td>
<td>One side</td>
</tr>
<tr>
<td>Residential (on local streets)</td>
<td>Both sides</td>
<td>One side</td>
</tr>
<tr>
<td>Three to ten dwellings per hectare</td>
<td>Both sides</td>
<td>Shoulders on both sides</td>
</tr>
<tr>
<td>Fewer than three dwellings per hectare</td>
<td>One side</td>
<td>Shoulders on both sides</td>
</tr>
</tbody>
</table>


### 2.2.3 Paths for Cycling

The flow chart in Figure 2.1 is a basic guide to assist designers to choose an appropriate type of path treatment. The flow chart only considers the primary factors needed to determine the type of treatment required. Prior to this chart being applied a decision will have been taken as to whether an on-road lane or an off-road path, or both, are required. Also, there may be other issues, constraints and practices that will have a bearing on the decision making process.
Strategic bicycle route path
or
Path to suit local conditions e.g.:
• for connections to strategic routes
• for connectivity in general
• as an option for cyclists at ‘squeeze points’
• to achieve a shorter route for cyclists
• to avoid one or several road intersections
• for recreation (e.g. a connection in a reservation
• to achieve safe access to schools
• as an alternative route for child, recreational or inexperienced cyclists, where no satisfactory on-road solution exists
• to achieve convenient access to community facilities such as sporting centres and shopping centres
• where no viable on-road solution exists
• to assist cyclists to avoid steep or lengthy grades

Is the bicycle demand low 1, 2?

Is the pedestrian demand low 1, 2?

Is there an alternative path or route available?

Are bicycle speeds low (e.g. <20 km/h)?

Yes

Yes

Yes

Exclusive bicycle path

Shared use path

Separated path

Notes:
1. The level of demand can be assessed generally on the basis of the peak periods of a typical day as follows:
   a. Low demand: Infrequent use of path (say less than 10 users per hour)
   b. High demand: Regular use in both directions of travel (say more than 50 users per hour).
2. These path volumes are suggested in order to limit the incidence of conflict between users, and are significantly lower than the capacity of the principal path types.
   Source: Austroads (1999)

Figure 2.1: Guide to the choice of path treatment for cyclists
3 TYPES OF PATH

3.1 General

The types of path are:
- pedestrian path (i.e. footpath)
- bicycle path (i.e. exclusive use)
- shared use path
- separated path.

3.2 Footpaths

Footpaths within road reservations provide an important part of the transport network either for trips undertaken entirely by walking, or as the first or last link in a trip that utilises other types of transport. Often footpaths simply comprise a wearing surface but in many other cases urban roadsides have to provide for a number of other uses. There are four distinct zones within the area between the edge of the road and the frontage of adjacent property and it is important to distinguish between the total width and the width of the zone likely to be used by pedestrians who are walking through the area (Section 14, Land Transport NZ, 2007a). Table 3.1 describes the zones and Figure 3.1 illustrates them.

The same principles apply in off-road environments except that one or more of the zones in Table 3.1 may be absent or duplicated on the opposite side of the through route for pedestrians.

<table>
<thead>
<tr>
<th>Area</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerb zone</td>
<td>Defines the limit of the pedestrian environment.</td>
</tr>
<tr>
<td></td>
<td>Prevents roadway water run-off entering the footpath.</td>
</tr>
<tr>
<td></td>
<td>Deters vehicles from using the footpath.</td>
</tr>
<tr>
<td></td>
<td>Is a major tactile cue for vision-impaired pedestrians.</td>
</tr>
<tr>
<td>Street furniture zone</td>
<td>Used for placing features such as signal poles, lighting columns, hatch covers, sandwich boards, seats and parking meters.</td>
</tr>
<tr>
<td></td>
<td>Can be used for soft landscaping/vegetation.</td>
</tr>
<tr>
<td></td>
<td>Creates a psychological buffer between motorised vehicles and pedestrians.</td>
</tr>
<tr>
<td></td>
<td>Reduces passing vehicles splashing pedestrians.</td>
</tr>
<tr>
<td></td>
<td>Provides space for driveway gradients.</td>
</tr>
<tr>
<td>Through route (or clear width)</td>
<td>The area where pedestrians normally choose to travel (this should be kept free of obstructions at all times).</td>
</tr>
<tr>
<td>Frontage zone</td>
<td>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.</td>
</tr>
</tbody>
</table>


Examples of footpath zones are shown in Figure 3.1.
3.3 Bicycle Paths

Bicycle paths (i.e. for the exclusive use of cyclists) are most appropriate where:

- there is a significant cycling demand and very few pedestrians desire to use the path or a separate footpath is provided
- there is very limited motor vehicle access across the path
- it is possible to achieve an alignment that generally allows cyclists uninterrupted and safe travel at a relatively high constant speed (say 30 km/h).
Cyclists will prefer riding on the exclusive off-road bicycle paths to on-road lanes and shared paths where the level of service is similar. Commuting cyclists may choose on-road lanes over bicycle paths where the commuting time and distance is reduced. However, the provision of suitable off-road bicycle paths often cannot be achieved due to physical and monetary constraints.

Figure 3.2 shows a typical bicycle path within a road reservation. Special attention must be given to the path design in the vicinity of bus and tram stops, and preventative measures may have to be taken to avoid illegal parking of cars and the placement of garbage bins on the paths.

![Figure 3.2: Bicycle path in a road reservation](image)

Note: May also be used for shared paths and two-lane two-way roads.

Source: Adapted from RTA (2005).

Further information on bicycle paths is provided in Commentary 4.

### 3.4 Shared Use Paths

A shared use path may be appropriate where:

- demand exists for both a pedestrian path and a bicycle path but where the intensity of use is not expected to be sufficiently great to provide separate facilities
- an existing low-use footpath can be modified to provide for cyclists by satisfying legal requirements and as necessary upgrading the surface, width and kerb ramps
• there is an existing road nearby which caters well for faster cyclists (e.g. has on-road bicycle lanes), to limit the extent of user conflict on the shared path.

Shared paths can be used for a variety of purposes including recreation, local access and providing links between higher speed on-road paths or bicycle paths.

Shared use paths that utilise existing footpaths may be satisfactory where they provide a:

• Convenient and safe option for inexperienced cyclists and young cyclists. Because footpaths usually have driveway crossings or side streets intersecting at frequent intervals they are only suitable for low cycling speeds (less than 15 km/h).

• Safer option for cyclists at squeeze points such as narrow, heavily trafficked sections of road, bridges, underpasses or railway level crossings. In such cases it may be appropriate that the connections between the footpath and the road be properly designed so that cyclists can leave and enter the general traffic stream safely and conveniently. This can be achieved utilising existing kerb ramps or driveway crossings that have a smooth invert or by constructing special ramps for the purpose. It should be noted that this use should be limited to sections of paths that are:
  — relatively remote from properties that are likely to generate significant volumes of pedestrians onto the path
  — unlikely to be used by persons with a vision impairment
  — unlikely to have obstructions such as garbage bins or sandwich boards.

The ramps should be designed so that they do not encourage unintentional use by people who have disabilities.

Figure 3.3 shows a typical shared path within a road reservation.

A significant issue associated with shared use paths is the variety of users who display various characteristics that can lead to conflict between them. These characteristics include differences in speed, space requirements, age, user expectation (as some users expect exclusive or priority use) and predictability (e.g. cyclists, pedestrians walking dogs, roller bladers, and skateboard riders). Austroads (2006b) describes the key conflict issues between pedestrians and cyclists on shared paths and footpaths and provides guidance on key conflict minimisation strategies and key options. Some additional information on shared use paths is provided in Commentary 5.
3.5 Separated Paths

A separated path may be appropriate where there is a significant volume of both cyclists and pedestrians such that shared use would lead to safety and operational problems. These situations typically arise in areas that attract high pedestrian and cyclist recreational or commuting movements (e.g. foreshore promenades and major inner city bridges). However, separated paths should not be provided in busy shopping centres where large numbers of pedestrians are expected to cross the path in conflict with cyclists.
Because separated paths are rare, public understanding of the correct use of them is not good. Consequently, careful design, prominent signing and pavement symbols at close spacing are required. Differing pavement surfaces or colours can also be used to delineate the pedestrian and bicycle lanes (e.g. concrete slabs for pedestrians and smooth asphalt for cyclists). In addition, it may be appropriate to have the pedestrian path and bicycle path at different levels, separated by a semi-mountable kerb or a small grass dividing strip. It is also desirable that the bicycle path be designed so that cyclists have priority at intersecting side streets (refer to Section 7 of the Guide to Road Design – Part 4: Intersections and Crossings – General (Austroads 2009c) that provides guidance on treatments that provide priority for cyclists and pedestrians at side roads (e.g. ‘bent-out’ and ‘bent-in’ treatments). Separated paths may provide for two-way or one-way cyclist movement (refer to Figure 3.4).

Separated paths are generally designed as two-way facilities, catering for cyclists and pedestrians requiring access in both directions but may provide for one-way movement of cyclists on both sides of a road. Where adequate space exists a separated path may provide cyclists with an alternative to sharing a narrow kerbside lane with motorists at squeeze points. Other than in a one-way street, a separated one-way path treatment should provide for cyclists’ travel in the same direction as the adjacent traffic lane. However, designers should confirm the suitability of the treatment with respect to local regulations.

The accommodation of any path in a road reservation requires consideration of access for maintenance personnel and equipment and the placement of road furniture (signs, signals, barriers, bus/tram stops) and other items (refer to Section 4.2), which may adversely affect operation of the path. This can be problematic with separated paths that require considerable space in order to ensure appropriate use.

Further information on separated paths and their use is provided in Commentary 6.
(a) Separated with one-way pair of bicycle paths

(b) Separated with two-way bicycle path

Note: Kerb outstands may be considered in the side street in order to reduce the crossing distance for pedestrians and cyclists.


Figure 3.4: Separated path in a road reservation
4 PATH USER REQUIREMENTS

4.1 Pedestrians

4.1.1 Principles

In order to develop appropriate and practical design solutions road designers should have a sound understanding of what is required to ensure that pedestrian networks and facilities offer a high level of mobility and safety.

Walking is regarded as having significant benefits to the community (see Section 2.2.1). The key attributes of an environment required to encourage walking, referred to as the 5 Cs (DETR 2000), are that it should be:

- connected – are there walking networks to give good access to key destinations?
- comfortable – do local facilities meet design standards for footpath width, walking surfaces and planning for people with impairments?
- convenient – can streets be crossed easily, safely and without delay?
- convivial – are routes interesting, clean and free from threat?
- conspicuous – are walking routes clearly signposted and are they published in local maps?

Considerations in relation to the 5 Cs are listed below (DETR 2000).

Connected

A well-connected walking environment should:

- INTEGRATE walking networks with public transport and ensure short distances to stops from the area severed.
- Have continuous pedestrian routes to key destinations without barriers that are difficult to cross (e.g. major roads, railways).
- Provide good access to key destinations.
- Locate pedestrian crossings on pedestrian desire lines where people want to cross to get to public transport interchanges.
- Give important pedestrian routes a sufficiently high priority (e.g. short waiting times at signalised crossings on routes to bus and rail interchanges). Where pedestrian flows are very high and consistent (e.g. inner-city routes) consideration should be given to prioritising and wherever practicable coordinating traffic signals to improve the level of service for pedestrians.

Comfortable

In order to provide an appropriate level of comfort the walking environment should:

- meet design standards with respect to footpath widths and gradients, provide good quality walking surfaces and appropriate facilities for impaired people
- ensure that parking does not create a problem (e.g. act as a barrier, impede sight distance at roads)
- ensure that cyclists do not conflict with pedestrians
- provide a walking surface that is clear of obstructions and is well maintained (e.g. no broken paving)
include crossings that are appropriate for the traffic volume and traffic speed environment

- ensure that manhole covers and gratings are not placed in major pedestrian walkways wherever practicable

- ensure that walkways are set back an adequate distance from the roadway

- ensure that surface water does not pond on roads and result in splashing of pedestrians from passing vehicles

- provide adequate lighting to ensure that pedestrians feel safe when using paths at night and do not walk on the edge of the road instead of a path.

Convenient

A convenient walking environment for pedestrians should:

- be as continuous as practicable (e.g. raise road crossings to footpath level)

- ensure that streets can be crossed easily and safely

- minimise delays to pedestrians at all existing facilities

- include efficient pedestrian signals or phases at signalised intersections

- provide adequate lighting to ensure that pedestrians feel safe when using paths at night and do not have to deviate to less direct routes

- provide adequate and safe storage areas for waiting pedestrians such that the flow of other pedestrians is not impeded.

Convivial

To be convivial, a walking environment should:

- have a high standard of urban design so that it is attractive to pedestrians

- include interesting pedestrian routes

- ensure that footpaths are substantially free from litter, debris and other deposits

- have a safe environment free from crime and fear of crime.

Conspicuous

Important aspects of a conspicuous walking environment include:

- clear signposting (direction signs and distances to key destinations)

- a coherent layout and design where it is obvious how to get to various facilities (e.g. shops, leisure centre, bus stops)

- readily available supporting information (e.g. published local maps, information boards, tourist information)

- local walking schemes such as Safe Routes to School

- clearly visible street names and sufficient repeater street signs and place name plates.
4.1.2 Pedestrian Operating Space and Clearances

General

Whilst it is not possible to identify all design situations in this guide, basic reach and geometric parameters, and operating envelopes may be established that assist in the appropriate design of all components of the street system and facilities provided for or used by pedestrians. This section provides information regarding maximum limits of reach, vision and minimum dimensions necessary to accommodate most people with disabilities. However, designers should not simply design for these maximum limits and minimum dimensions but should ensure the design provides the highest level of service to pedestrians that is practicable.

As it may be necessary to accommodate a variety of uses in pedestrian areas, design envelopes should include the type of pedestrian activity and local considerations that impact on placement of street furniture or capacity. For example:

- proximity to shops – additional area/width required for people carrying shopping bags
- climate – sub-tropical locations could incorporate umbrellas and similar furniture that requires greater widths and clearances
- commuters – design envelope should allow for backpacks, briefcases and other devices used by pedestrians and which would affect storage capacity generally and on traffic islands in particular
- proximity to retirement centres – additional width and storage length to accommodate personal mobility devices.

Pedestrian space

Body depth and shoulder width are the primary human measurements used by designers of pedestrian spaces and facilities, where shoulder breadth is the factor affecting the practical capacity. The plan view of the average adult male human body occupies an area (the body ellipse) of about 0.14 m². However, a 460 mm by 610 mm body ellipse (Figure 4.1) equivalent to an area of 0.21 m² is used to determine practical standing capacity, allowing for the fact that many pedestrians carry personal articles, natural psychological preferences to avoid bodily contact with others and body sway.

With respect to normal path operation where pedestrians and cyclists are moving at speed and sharing space it is considered that a 1 m width should be used as the basis of design to allow adequate operating space and clearances for pedestrians.


Figure 4.1: Plan view of pedestrian body ellipse
Reach

Whilst there is a wide variation in the size of people and their reach, basic limits that should be adopted for the purposes of design are shown in (Figure 4.2). It can be seen that the overlap between the heights is easily accessible by wheelchair users and people with mobility difficulties. This means that anything that must be reached by both groups should lie between approximately 600 mm and 1.57 m above the ground. Things in this range are generally also accessible by people of short stature. Wheelchair users are also constrained in the limits of their horizontal reach, as shown in Figure 4.2.

Visual

General limits to the field of view are shown in Figure 4.3. Such limits dictate the placement of signs, street furniture and other components of the street system and pedestrian facilities that either provide information or must be visible to the pedestrian.

Wheelchair dimensions

Dimensions of the design wheelchair (wheelchairs vary in size) and reach limits are shown in Figure 4.4 and Figure 4.5, which also shows space requirements for an A80 wheelchair to be turned. Wheelchair users generally require more space than other people to move around. The A80 wheelchair was developed in 1983 as an ‘average’ wheelchair to cover the mid-range of manual and mechanical wheelchairs then in use. The top and bottom 10% of wheelchairs (largest and smallest respectively) were omitted in developing the A80, as very few were in use.

The A80 was developed as a measure of the 80th percentile wheelchair. However, wheelchairs vary in width and many people may require wider chairs or prefer powered scooters. In addition, there is some evidence (Hunter 2003) that using the A80 may no longer be appropriate for all situations. Therefore, designers should consider whether a larger size wheelchair should be used in the design of specific facilities or treatments and may also have to establish the appropriate design vehicle for particular situations within a jurisdiction. This may involve consultation with local community organisations. In considering the minimum width required for a wheelchair, designers should also refer to AS 1428.1 – 2001 regarding minimum widths for accessways, walkways, ramps, landings and doorways.

General spatial requirements

Figure 4.2 also shows the radius of turn for a wheelchair when wheels are moved in opposite directions and when pivoting about a locked wheel. The radii represent the actual swept path of the wheelchair and therefore it is essential for designers to allow sufficient clearance from the swept path to fixed objects to allow for variance in the location at which the rider chooses to commence the turn, and to provide comfortable and safe operating conditions. This clearance is necessary to avoid the risk of damage to the wheelchair, damage to street infrastructure and injury to the wheelchair rider.

Users of the design wheelchair need 1.2 m of clear space for comfortable movement whilst people using crutches have a similar requirement. In contrast most walkers require 900 mm of clear space.

More room is required for people to pass each other. Two wheelchair users can pass each other in a space 1.8 m wide. This is also enough room for a user to turn a wheelchair around.
1. Includes clearance for knuckles of hands.

2. Radius is the swept path of the wheelchair; clearance between path and objects (e.g. walls, poles) must be provided.


Figure 4.2: Design dimensions for mobility impaired people
Figure 4.3: Limits to the field of view

Figure 4.4: Side view of A80 wheelchair
4.2 Cyclists

4.2.1 Principles

In relation to path and road engineering all cyclists have six basic requirements whenever they ride:

- space to ride
- a smooth surface, free of debris
- speed maintenance
- appropriate sight lines to path surface
- connectivity
- information.

These requirements apply equally on roads and on paths. By implication the important objective of a safe environment for cyclists must exist, given the provision of space to ride, a smooth surface and the ability of cyclists to maintain their speed, objectives which are reflected in the principles of the path user requirements for pedestrians (see Section 4.1).

Space to ride

Where data is available (e.g. census information and jurisdictional surveys) the space required for new major bicycle paths should be based on an estimation of the likely demand for cycling on the proposed facility. However, where such information is not available the bicycle design envelope and clearances shown in Figure 4.6 provide the basis for the design of the bicycle facilities described in this guide. It is important for designers to understand the basis of the design, including clearance requirements, so that they can make appropriate judgements in constrained situations where knowledge of minimum cyclist space requirements is needed. The envelope is relevant to the design of lanes on roads, off-road paths and bicycle parking facilities (refer to AS 2890.3).
The 1.0 m wide envelope allows for the width of a bicycle and for variations in tracking. Not all bicycle riders can steer a straight line and when riding uphill experienced riders work the bicycle from side to side whilst the inexperienced may wobble. Bicycle riders also need adequate clearances to fixed objects and to passing vehicles in addition to the 1.0 m envelope.

In some situations it may be appropriate to provide for alternative forms of pedal cycles in the design of facilities. For example, it may be appropriate on heavily utilised recreational paths to allow for the space (e.g. width, length, swept path) required by a bicycle trailer that is commonly used by parents to tow young children.

**Smooth surface**

Surface quality and trip length are of equal importance, and both are twice as important to cyclists as traffic volumes and the availability of bicycle facilities, in cyclists’ route choice (Bovy and Bradley 1985).

Many bicycles have narrow tyres inflated to high pressure to reduce drag and have no suspension system. A smooth (albeit skid resistant) surface is therefore desirable for bicycles to be used effectively, comfortably and safely. Surfaces used for cycling should desirably be smoother than those acceptable for motor vehicles and persons responsible for path construction and maintenance should be made aware of this requirement. Some guidance on surface tolerances is provided in Section 4.2.3.

It is also important that the design restricts debris from accumulating on paths. Surface water should not be shed across the path in situations where soil, mulch or other debris could be carried onto the path. It is generally preferable that water is collected and piped under the path. Similarly, a maintenance regime should be in place to enable the removal of any debris that could inconvenience cyclists or create hazardous conditions by placing a solid object in the path of cyclists or causing the surface to become slippery (e.g. broken glass, rocks, mud after inundation, loose leaves or berries etc.).

**Speed maintenance**

For bicycles to be most effective as a means of transport cyclists must be able to maintain speed without having to slow or stop often. Whilst many cyclists typically travel at speeds between 20 km/h and 30 km/h, a significant number of cyclists can travel at speeds in excess of 35 to 40 km/h on the flat and may reach speeds in excess of 50 km/h on down hill gradients. Once slowed or stopped it takes considerable time and effort to regain the desired operating speed.

Bicycle routes, especially off-road, should be designed for continuous riding, minimising the need to slow or stop for any reason including steep gradients, rough surfaces, sharp corners, obscured sight lines, intersections, or to give way to other people because the width available is too narrow.

**Sight lines**

It is important that appropriate sight lines are provided between a cyclist’s eye height and pedestrians to assist in minimising conflict, and between a cyclist’s eye height and the path surface so that cyclists can stop in the event that a hazard exists on the path (e.g. mud deposited during inundation, potholes due to washouts, broken glass, and fallen tree limbs).

Designers should therefore resist the temptation to provide curves that are smaller than necessary (e.g. to create an artificially winding path for aesthetics or urban design reasons). It is much better for the safety of path users if larger curves with greater sight distance are provided. Sight distance for cyclists is covered in Section 7.8.
Connectivity

Connectivity is that quality of a bicycle route or route network, describing the continuous nature of facilities or of the continuous nature of desired conditions.

Cyclists need to be able to undertake and complete meaningful trips by bicycle. For recreation it may be from a residential area to a picnic spot, for a specific purpose trip from home to work or the shops. Bicycle routes comprising roads and paths should combine to form an effective, convenient and safe network.

Connectivity is an important aspect of the construction of effective bicycle routes. Before a route is constructed the purpose of the route should be identified as well as the routes which cyclists are likely to use in travelling to and from the paths, bicycle lanes and roads forming the network.

A route for cyclists which starts and ends abruptly is undesirable and may be hazardous as it may lure inexperienced cyclists to a point where they are at risk, perhaps having to ride along or across busy roads to complete their intended trip.

Information

Bicycle routes should be signposted to indicate both destinations and the distances to them. The principles to be applied to the signposting of bicycle routes are similar to those applied to the road system. Apart from the necessary regulatory and warning signs, cyclists require advance direction, intersection direction and reassurance signs in order to conveniently and safely negotiate bicycle networks (refer to Austroads Guide to Traffic Management – Part 10: Traffic Control and Communication Devices (Austroads 2009b), AS 1742.9 and MOTSAM (Transit NZ 2007).

Maps should be available showing the route, facilities and points of interest along it, its relationship to the surrounding road system, and its relationship to relevant community facilities. The map and the signposting should be consistent in terms of destination names and other information.

4.2.2 Cyclist Operating Space and Clearances

The concept of a cyclist operating envelope (Figure 4.6) and clearances (Figure 4.7) may be used to construct the appropriate width of facility required for cyclists under various conditions. The envelope is assumed to be consistent over the range of operating conditions and allowance for higher speeds is provided through larger clearances to both other cyclists and fixed objects beside the path. Appendix A provides guidance on how the envelope and clearances are applied to particular situations in order to determine satisfactory operating widths.
4.2.3 Surface Tolerances

The new pavement surface of a bicycle lane or bicycle path should be shaped to match existing features such as pit covers, edgings or driveways, to within 5 mm. It is desirable that the finished surface of a new bicycle lane or path does not:

- deviate from a 3 m straight edge by more than 5 mm at any point
- have a rate of change in deviation in excess of 1 mm in 240 mm.

Figure 4.6: Bicycle operating space

Figure 4.7: Clearances between cyclist envelope and potential path hazards

Source: Austroads (1999).

1. Refer to Section 7.7.1 for guidance on clearances.
2. Refer to Section 7.7.2 for guidance on batters and the need for fences.

Source: Based on Austroads (1999).
Also, due to the high pressure in many bicycle tyres it is desirable that sprayed sealed surfaces have a stone size less than 14 mm in order to provide a comfortable ride for cyclists.

Existing bicycle paths often develop surface imperfections over their operational life such as:

- pavement deformation that results in undulating pavements with relatively smooth bumps
- tree roots creating sharp bumps
- service trenches that subside to create grooves or steps.

In addition, the hazards associated with such surface imperfections can be compounded by other features beside the path, such as an edge drop-off or fixed objects (e.g. trees, poles, rocks).

The surface of an existing bicycle lane or a path for cyclists should - desirably - not exceed the tolerances nominated in Table 4.1. The figures in the table are applicable to discontinuities in the surface of concrete and other sealed pavements, at the pavement/gutter interface, at interfaces between the pavement surface and service covers, at failures and at subsidence and the like. However, the values in the table may be used as a guide for the other surface imperfections described previously.

The table requirements may be difficult to achieve where a pavement abuts an unsealed surface. However, authorities should make every effort to limit the height of steps in these locations as the effect on cyclists travelling along or across a step can be severe.

Whilst, no dimension is provided in relation to a groove perpendicular to the direction of travel, this circumstance should be treated as two steps if greater than 100 mm wide.

Grooves or steps with dimensions in excess of the figures listed in Table 4.1 are potentially hazardous to cyclists.

### Table 4.1: Existing surface tolerances

<table>
<thead>
<tr>
<th></th>
<th>Not to exceed (mm):</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Width of groove&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Parallel to direction of travel</td>
<td>12</td>
</tr>
<tr>
<td>Perpendicular to direction of travel</td>
<td>-</td>
</tr>
</tbody>
</table>

<sup>a</sup> A narrow slot in the surface that could catch a bicycle wheel, such as a gap between two concrete slabs.

<sup>b</sup> A ridge in the pavement, such as that which might exist between the pavement and a concrete gutter or manhole cover; or that might exist between two pavement blankets when the top level does not extend to the edge of the roadway.

Note: It is suggested that a height of 20 mm, as suggested by the Californian Department of Transportation (2006), may be excessive for many modern bicycles that have narrow high-pressure tyres. This value should be considered as a maximum intervention level for an existing facility rather than a design or construction tolerance. It is suggested that individual jurisdictions should consider a lower intervention level (e.g. 10 mm for perpendicular to direction of travel) depending on local circumstances and the importance of the path within the bicycle path network. Designs and specifications should require smooth flat surfaces.

Source: Californian Department of Transportation (2006).
5 LOCATION OF PATHS

5.1 General

Paths are often constructed through reserves, and thus offer pleasant and the least stressful of conditions for cycling. As such they play a critical role in recreational cycling. Paths in this situation present the ideal environment for children, adult ‘learners’ and others to improve their cycling.

Conversely, paths can have a critical transportation role where, for instance, they form part of a strategic bicycle or pedestrian route, or are used to avoid limitations caused by discontinuous access along roads, excessive gradients or undesirable traffic conditions. Paths can offer a safe functional design suitable for use by a variety of pedestrian and cyclist categories and trip purposes. To achieve this objective a designer should have:

- a professional approach to planning and implementation
- an understanding of the objectives for the proposed path
- an appreciation of the need for appropriate geometric design and layout
- recognition of the dynamic nature of cycling.

Paths may be located:

- in the reservations of major new or existing access-controlled arterial roads or freeways
- along river frontages
- on foreshores
- through parkland
- along railway reservations
- abutting bridges or across exclusive bridge facilities
- within the reservations of streets which have direct access to abutting property.

Paths may either have very limited motor vehicle access across them or they may have driveways crossing at frequent intervals. Where paths have very limited motor vehicle access across them bicycle speeds are likely to be relatively high (greater than 30 km/h) and it is most important to provide a high design standard with respect to width, surface condition, drainage, gradient and alignment. In many cases (e.g. freeway reservations) there will be ample space available to achieve a high standard whereas other situations may be constrained.

5.2 Factors of Influence – Path Location

Factors that influence the location of paths are:

- The need to:
  - Achieve the best alignment possible, within reason, to allow cyclists to travel safely at their chosen speed. Cost may be a factor in the choice of alignment but in general the design speed of paths should satisfy the advice provided in Section 7.2.
  - Avoid sharp horizontal curves and intersections, particularly at the bottom of steep downgrades.
  - Achieve adequate sight distance across the inside of curves.
  - Optimise the personal security of users of paths located in relatively isolated areas.
Provide access for emergency service vehicles and maintenance vehicles at path entrances or other strategic points.

Landscaping and planting considerations including vegetation removal (especially vegetation that has thorns that may puncture tyres), planting sizes at maturity and maintaining adequate sight distances and accumulation of debris.

Owners of private property abutting the reservation, who may be concerned that provision of a path will adversely affect privacy or the security of their property.

The possible advantages that can be derived from incidental lighting from fixed sources or motor vehicles.

The choice of aesthetically pleasing locations (to increase the likelihood of patronage).

Constraints such as environmentally sensitive areas, areas of indigenous significance etc.

5.3 Factors Influencing Roadside Alignment

Where a path is located in a road reserve and abutting development results in driveways at frequent intervals, a choice may exist between locating the path:

- adjacent to the property boundary
- adjacent to the kerb
- at an intermediate point, say 1.5 m behind the kerb.

However, in many cases the road reservation will be too narrow to allow a choice in the location of a path.

The overriding consideration should be the safety of the path users. For this reason it is recommended that where practicable paths in urban arterial road reservations are located with adequate clearance from both road traffic and the property line so that adequate sight distance is achieved for vehicles and pedestrians leaving driveways and gateways (refer to Figure 5.1). A related consideration is that a path too far from the adjacent carriageway may decrease the likelihood of path users being seen because they are outside the peripheral vision of turning drivers. Wider clearances or physical barriers (including low profile landscaping) may be appropriate where:

- the kerbside lane is heavily trafficked
- high speed limits exist (e.g. 80 km/h and above)
- children on bicycles or inexperienced cyclists regularly use the path.

In addition, it is necessary for the path to be located a sufficient distance from the kerb that enables driveways to be formed without adversely affecting the profile of the path, necessary road furniture to be located near the kerb and errant cyclists to recover without encroaching onto the road. However, where the only option is for the path to be located close to the kerb, consideration should be given to extending the path to the roadside as a sealed shoulder in order to avoid maintenance where it is difficult to access with machinery.

It will often be necessary for a path alignment to shift between the road reserve boundary and the kerb in order to retain vegetation, avoid obstacles, utilise bridges or connect to pedestrian crossings of the road. Figure 5.2 illustrates the way in which such a shift should be achieved.

Factors that influence the choice of alignment are summarised in Table 5.1.
1.8 m
0.8 m
0.2 m (minimum)
1.0 m
1.0 m
Varies from zero.
Desirable to have minimum of 1.5 m where boundary fence is high and driveways exist.
Provides essential clearance to parked and moving vehicles. Path avoids kerb returns at driveways.

Figure 5.1: Location of path in road reserve

Source: Based on Austroads (1999).

Figure 5.2: Integrating a shared path with existing trees and obstacles

Table 5.1: Factors considered in the choice of path alignment in road reservations

<table>
<thead>
<tr>
<th>Path location</th>
<th>Factors for consideration</th>
</tr>
</thead>
</table>
| Close to kerb         | ▪ In many cases is the only option because of the road reserve width available.  
▪ Offers the best visibility of path users to drivers reversing out of their properties, particularly where high screen walls exist at the boundaries.  
▪ Will be used in two directions and allows cyclists to run off the path and ride against the flow of motor traffic on the road pavement. Overseas experience has shown wrong-way movements to be a major problem (Cross and Fisher 1977).  
▪ May result in parked cars being a hazard to cyclists due to the opening of vehicle doors into the path.  
▪ May result in persons entering and exiting parked cars being put at risk due to the proximity of bicycle movements to the cars.  
▪ Follows the longitudinal profile of the kerb and is therefore generally cheaper to construct because of reduced earthworks.  
▪ May be preferred by abutting landowners in terms of privacy and nature strip disruption.  
▪ May result in the effective path width being reduced by kerb returns (however, the use of AS 1428.1 style side ramps (see Figure 8 in AS 1428.1) would be of some assistance at driveways or the path profile being adversely affected at the cross over.  
▪ If wide, may be viewed as detracting from the appearance of the streetscape and may imply a higher speed environment.  
▪ Is less pleasant for cyclists because of traffic noise, fumes and speed, and perhaps the splashing of water from gutters.  
▪ May be relatively unaffected by the presence of fences varying in height and type, or having sharp or exposed edges or protrusions. |
| Near property boundary| ▪ Provides a more pleasant cycling environment and is perceived to be safer for inexperienced or young cyclists.  
▪ May limit visibility of path users to drivers reversing out of driveways, or to drivers turning left from the abutting carriageway, where path users are beyond the driver’s peripheral vision.  
▪ Does not necessarily follow the kerb profile and may result in steeper gradients for cyclists or be more costly to construct.  
▪ May be viewed as having a lower negative visual impact on the street than a kerbside path.  
▪ May be unacceptable to abutting land owners.  
▪ Is more efficient for the mail service, if the nature strip is very wide.  
▪ Should preferably be deviated to a location at least one car length back from road intersections, adjacent to which the path crosses, to facilitate passage behind a queued car).  
▪ Allows space for garbage (e.g. wheelie) bins to be accommodated clear of path and for pit lids for utilities to be located outside of the path surface. Pit lids should not be located within paths as they can create an uncomfortable ride and constitute a trip hazard for pedestrians. |

Cyclists using paths that cross driveways have right of way over vehicles entering and leaving the driveway. Where there is an issue of vehicles failing to give way to cyclists or blocking the path it may be necessary to reinforce the priority by erecting a give way sign and/or ensuring that paths appear to continue across driveways, preferably by continuing the path surfacing (to provide a contrast with the driveway surface) or alternatively through the use of appropriate pavement markings.

5.4 Paths in Medians

Paths for cycling are not usually located in central medians. A disadvantage of median paths is that motorists do not expect cyclists at median openings and therefore cyclists may be put at risk at these crossings. However, it may be acceptable to locate a path in an existing median where:

▪ the median is wide and the outer verges narrow
▪ the spacing of intersections is large
▪ the speed environment of the road is low
• motor vehicles are required to give way or stop for path users
• safe crossings of the carriageways and intersections can be made (e.g. traffic volumes low to moderate, major intersections controlled by traffic signals).

Similarly, it may also be acceptable to locate a path for cycling in an outer separator of a major road, which may be the most appropriate option depending on site conditions and traffic conditions. However, this should only be done where there are few entries and exits from the service road and cyclist crossings at these locations can be designed to ensure that they are safe by:
• physically controlling vehicle ingress and egress speeds
• providing good sight distance
• making the priority clear to both cyclists and motorists.

Alternatively, it may be appropriate to have cyclists move onto the road and cross the outer separator openings in a bicycle lane, the interface between the path and road being designed to provide some physical protection for entering cyclists.
6 DESIGN CRITERIA FOR PEDESTRIAN PATHS

6.1 Alignment
The location of footpaths is covered in Section 5 but in urban areas they are generally either located adjacent to the roadway or separated from it by the nature strip.

6.2 Clear Width and Height

6.2.1 Width
The width of the footpath is dependent on its location, purpose and the anticipated demand on the facility. Width requirements for footpaths, including provisions for people with disabilities such as vision impairment, are shown in Table 6.1. The operating space required for impaired pedestrians is illustrated in Figure 6.1 and whilst personal mobility devices (e.g. scooters) are not included in the figure it is considered that most scooters could be accommodated within the widths shown (refer to product suppliers websites). As a guide, the desirable minimum width of a footpath that has a very low demand is 1.2 m with an absolute minimum of 1.0 m. These widths should be increased at locations where:

- high pedestrian volumes are anticipated
- a footpath is adjacent to a traffic or parking lane
- a footpath is combined with bicycle facilities
- the footpath is to cater for people with disabilities.

The roadside often has to accommodate many features including paths. It is therefore important that enough space is provided to ensure that all features can be accommodated and pedestrians have a clear space in which to operate. In some cases the relevant road authority may desire to implement an urban design solution within the roadside. Commentary 7 provides additional information on the requirements of pedestrians using footpaths.

The crossfall of a paved footpath may vary from flat (but achieving an adequately drained surface) to 2.5%. Provided that drainage is satisfactory, a lower crossfall is preferred (i.e. 1.0%) as a higher crossfall may cause problems for some people.

<table>
<thead>
<tr>
<th>Situation</th>
<th>Desired width (m)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>General low demand</td>
<td>1.2 to 1.0 (absolute minimum)</td>
<td>General minimum is 1.2 m for most roads and streets.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clear width required for one wheelchair.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not adequate for commercial or shopping environments.</td>
</tr>
<tr>
<td>High pedestrian volumes</td>
<td>2.4 m (or higher based on demand)</td>
<td>Generally commercial and shopping areas.</td>
</tr>
<tr>
<td>For wheelchairs to pass</td>
<td>1.8 to 1.5 (desired minimum)</td>
<td>Allow for two wheelchairs to pass (1.8 m comfortable, 1.5 m minimum)</td>
</tr>
<tr>
<td>For people with other disabilities</td>
<td>1.8 to 1.0</td>
<td>Narrower width (1.2 m) can be tolerated for short distances.</td>
</tr>
</tbody>
</table>

Notes:
- Whilst the minimum width may be used where demand is low it is generally desirable to provide a path that will accommodate two pedestrians side by side.
- Wider than the minimum width (e.g. up to 5 m) may also be necessary at locations where pedestrian flows are high or where pedestrians gather such as in the vicinity of schools and associated road crossings, at recreation facilities and at important bus stops.
- Where demand is significant it may be necessary to provide adequate congregation areas clear of the path required for through movement of pedestrians.
In some instances pedestrian demand will be very high and require a width corresponding to or greater than those suggested in Table 6.1 for high pedestrian volumes. In most cases road designers should be able to adopt a footpath width in accordance with jurisdictional planning requirements. The planning process may involve estimation of pedestrian demands and the application of capacity analysis to ensure that the path will provide an appropriate level of service (Fruin 1971; Land Transport NZ 2007a).

(a) A clear width of 1000 mm is adequate for people with ambulant disabilities, just allows passage for 80 per cent of people who use wheelchairs, and is in accordance with AS 1428.1

(b) People who use wheelchairs require a clear width of 1200 mm

(c) A clear width of 1500 mm allows a wheelchair and a pram to pass

(d) To allow two wheelchairs to pass comfortably, a clear width of 1800 mm is required


Figure 6.1: Footpath width requirements for various users
Constrained widths should be avoided or treated (e.g. removal of obstacles) wherever practicable. However, where it is not possible to remove the obstacle an absolute minimum width can be used over a very short length at an obstruction (Figure 6.2), and if a narrow footpath cannot be avoided over a greater length passing areas should be provided wherever possible (Figure 6.3).

It is also important that the edges of paths do not have a drop-off that may cause a pedestrian to slip or trip, or cause a wheelchair to overturn, such as along the back of a kerb. This consideration is critical where minimum path widths are used. In addition, any obstruction within the path should be highlighted (e.g. bright contrasting colour) to reduce the likelihood that pedestrians will collide with it, and have any aspects removed that could cause path users to be ‘snagged’ by it.

Source: Based on Austroads (1999).

Figure 6.2: Minimum footpath widths

Source: Based on AS 1428.2 (1992).

Figure 6.3: Passing areas in constrained locations

Note: Refer to AS 1428.2 for alternative design.
Source: Based on AS 1428.2 (1992).
6.2.2 Height
An adequate vertical clearance should be provided over the full width of the footpath, completely free of overhanging projections and obstructions, as illustrated in Figure 6.4. Clause D2.3.5 of AS 1742.2 – 2009 requires that the vertical clearance to a sign that overhangs a footway or bicycle path is no less than 2.5 m.

For urban areas AS 1742.2 – 2009 (Clause D2.3.5) requires a minimum vertical clearance to a sign of 2.0 m above the top of the kerb to prevent obstruction to an occasional pedestrian. It is considered that this should be interpreted to mean a sign that is located outside of the limits of the path and recommended clearances. It should be noted that AS 1428.2 – 1992 also requires a minimum vertical clearance of 2.0 m to fixtures and fittings to buildings (e.g. lights, awnings, opening windows) and that this is a minimum provision. For example, some municipalities require trees overhanging footpaths to be trimmed to a clearance of 3.0 m.

Furthermore, it is noted that the height of the cyclist design envelope (Figure 4.7) is 2.2 m and that the height of the pedestrian population is increasing. The designer should therefore obtain the agreement of the relevant authority where it is absolutely necessary to the use of the minimum clearance (e.g. at sites where space is constrained and the achievement of a greater clearance would have significant implications regarding the cost of a facility or impacts on other infrastructure).

![Figure 6.4: Envelope of minimum width and height requirements](image)

Note:
The vertical clearance to an obstruction (e.g. sign), shown as 2500 mm, is required by AS 1742.2 – 2009.
Source: Based on Austroads (1995).

6.3 Changes in Level
Changes in level within roadsides have to be designed to allow all pedestrians to move safely and efficiently around the road network. Factors relating to changes in level for pedestrians and treatments are summarised in Table 6.2.
Wherever practicable, a high level of service should be provided for pedestrians with respect to convenience and safety. As a general principle the dominant flow should claim priority and maintain a level surface. In situations where the volume of pedestrians and vehicles is high and the speed environment is relatively low it may be appropriate to allow pedestrians to have priority and cross the road without a change in level (i.e. not have to use ramps). This will not only reduce trip hazards for pedestrians but will also reduce vehicular speeds at the conflict points. However, where this type of treatment is installed it will require the use of formal crossings (e.g. pedestrian crossing with regulatory signs, pedestrian signalised crossing) to establish priority for pedestrians.

It may also be appropriate to eliminate a change in level for pedestrians where pedestrian footpaths cross low volume side streets adjacent to intersections in built-up urban areas (e.g. laneways and roads with infrequent vehicular access). In such cases the side street traffic has to slow down or stop in order to give way to the major road traffic. The level of conflict in these situations would not justify pedestrians being given right of way and formal pedestrian crossings are not justified. The benefit of the treatment in this situation is to remove the need for pedestrians (particularly persons with a disability with respect to mobility) to change level. However, in this case it is important to delineate priority through the surface colour and texture (i.e. footpath surface material should not continue across the road. Further information is provided in Commentary 8.

6.4 Surface Treatments

Surface treatments should be stable, firm, even, relatively smooth but slip resistant. The choice of surface treatment depends on:

- the grade of the surface and the coefficient of friction required
- whether the surface is also to provide guidance regarding use of the path or priority (i.e. maintaining contrast with the intersecting road surface)
- the physical environment, climate and demands placed on the surface.

It is important for many people that surfaces be flat. This is particularly so for people in wheelchairs, on crutches or who are unsteady on their feet as small ridges and protrusions as small as 6 mm can cause these people to stumble and fall. Surfaces should not deviate more than 5 mm from a 500 mm long straight-edge laid anywhere on the surface.

Wherever possible pits for utilities or other purposes should not be located in paths as the covers can be hazardous for pedestrians (e.g. misaligned or broken covers form a trip hazard), particularly for physically impaired persons, people on crutches or using other walking aids. Additionally, metal manhole covers can become slippery, particularly when wet.

Another significant disadvantage of locating pit covers in paths is that the path is unable to be used when works are required to maintain the underground service that passes through the pit.
The use of some common paving materials is discussed in Commentary 9.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Consideration</th>
</tr>
</thead>
</table>
| Kerbing and kerb ramps                  | ▪ Level differences between a roadway and an adjacent footpath pose difficulties for pedestrians, particularly those with mobility and vision impairments.  
▪ Provide kerb ramps with a smooth change in the level between the footpath and road pavement to allow safe and easy access for pedestrians including people in personal mobility devices and those with a mobility impairment.  
▪ Align kerb ramps in the direction of travel to guide pedestrians who are blind or have vision impairment directly across the road and not out into the intersection.  
▪ A typical kerb ramp is illustrated in Figure 8.6 of the Guide to Road Design – Part 4: Intersections and Crossings – General (Austroads 2009c).  
▪ A minimum footpath width of 1330 mm should be provided beyond the top of the ramp.  
▪ A gradient of 1:10 should not be exceeded if possible as wheelchairs may tip backwards when being wheeled up steep ramps. Note that this gradient is less than the maximum of 1:8 quoted in AS 1428.1- 1993, which should be considered as an absolute maximum ramp gradient and only be used in extenuating circumstances.  
▪ A vertical lip should not be provided at the edge of the drainage channel as it inhibits the free movement of wheelchairs.  
▪ Design surface drainage to avoid low points and the accumulation of water where pedestrian crosswalks are to be located. For example, on-road drainage inlets should be placed immediately upstream of ramps to minimise the water that passes through the channel at ramp crossings.  
▪ Refer also to the AS 1428.1 – 2001 that provides guidance regarding the design of kerb ramps.                                                                                                                                                                                                 |
| Steps, stairs and ramps                 | ▪ An abrupt change in level can be a problem for pedestrians particularly for those who have vision impairments and need to be warned of the presence of a kerb, a flight of stairs or a ramp.  
▪ Ramps should be provided where possible as an alternative or in addition to steps or stairs that are a barrier to people with disabilities and necessary for people in wheelchairs or with prams. On the other hand some people with impaired mobility cannot use ramps and need shallow steps (refer to AS 1428.2 – 1992).  
▪ Rest areas (i.e. flat sections) should be provided at each change in direction and at intermediate points along ramps to break up long flights. AS 1428.2 suggests that the spacing of rest areas range from 9 m for ramp grades of 1:14 to 15 m for grades of 1:20. This is a most important consideration in the design of overpasses and underpasses.  
▪ Provide handrails to assist pedestrians, including those in wheelchairs:  
  — on both sides of a set of stairs, or steps, or a ramp  
  — wherever people may need support (e.g. continuously around rest areas and changes of direction). Generally, two rails at different levels will be required to meet the need of both wheelchair users and other groups.  
▪ Ensure inter-visibility between the end of stairs or ramps and intersecting footpaths (e.g. sight distance not obscured by a wall) and an area at the foot of the stairs to minimise the risk of collision.  
▪ Provide in all areas used by pedestrians (i.e. above stairs or ramps) a vertical clearance (i.e. headroom) no less than 2.5 m unless significant constraints exist (refer to Section 6.2.2).  
▪ Ramp surfaces and treads of stairs should be stable, even and slip resistant.  
▪ Tactile ground surface indicators (TGSIs) should be provided at the top of stairs and foot of stairs to indicate these hazards.  
▪ The provision of seating clear of the walking space should be considered on long ramps. Other features such as observation decks should be considered if the path provides tourist/social opportunities.  
▪ Recommended maximum crossfall is 1:40 (refer to AS 1428.1).                                                                                                                                                                                                 |
| Gradients                               | ▪ Australian Standard AS 1428.1 - 2001 lists requirements for the design of sloped footpaths.  
▪ Where the gradient is 1:33 level rest areas 1.2 m long should be provided at not greater than 25 m intervals whereas at 1:20 the interval should not exceed 15 m. Between gradients of 1:33 and 1:20 the interval should be interpolated. Landings are not required on gradients less than 1:33. Paths with a gradient steeper than 1:20 are to be considered as ramps for design purposes.  
▪ Adjacent ground for all footpaths should be within 25 mm of the level of the footpath.  
▪ If the adjacent ground has a steep slope, a kerb between 65 mm and 75 mm high should be provided to protect prams and wheelchairs and to guide those people with impaired vision. Handrails may also be provided.  
▪ The provision of seating clear of the walking space should be considered on long gradients. Other features such as observation decks should be considered if the path provides tourist/social opportunities.  
▪ Consideration should be given to the provision of an alternative shorter route via a staircase if such an alternative can be identified.                                                                                                                                                                                                 |

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### 6.5 Pedestrian Path Lighting

The primary objectives of lighting pedestrian paths are:

- to enable pedestrians to perceive hazards such as unusual or uneven surfaces or obstacles such as steps or street furniture, and to enable them to orientate themselves and find their way about
- to enhance the personal security of pedestrians by enabling them to recognise potential threats from other people in time to take appropriate action.

These objectives are particularly important for elderly people and people with impaired vision who may be more vulnerable to trip hazards or feel insecure or uncomfortable in poorly lit environments.

Where a pedestrian path is located adjacent to a road, the road lighting should also cater for pedestrians (Austroads 2009g, AS/NZS 1158.1.1: 2005, AS/NZS 1158.1.3: 1997). Designers should consider all aspects of the design that may influence the effectiveness of the lighting, such as the presence of overhanging trees and low-profile hedges that may create significant shadowing and which, when combined with adjacent headlights (from the roadway), could make the silhouettes of pedestrians extremely difficult to see. Lighting may also be needed on major shared paths that are part of an arterial path network provided for commuting by cyclists and/or recreational riding (refer to Section 7.9).

Areas associated with pedestrian paths that may require a relatively high level of lighting are at-grade road crossings, because of the potential for conflict with motor vehicles and pedestrian underpasses that are often perceived to be unsafe in terms of personal security.

Designers should consult with the relevant authority regarding the need to light specific pedestrian paths and refer to any relevant jurisdictional design guidelines. However, where it is decided to light a path the lighting should be designed in accordance with AS/NZS 1158.3.1:2005, Pedestrian area (Category P) lighting—Performance and design requirements.
7 PATH DESIGN CRITERIA FOR BICYCLES

7.1 General

The principles of designing a path for bicycles are similar to those used in designing roads in that it is essential that the path has an alignment and cross-section to suit the function of the path and the speed and volume of traffic, drainage that prevents inundation and debris from washing onto the surface, and adjacent areas that are forgiving to errant bicycles that leave the path.

The vertical and horizontal alignment (and combinations of these), width of path and clearances adopted are vital to the safe operation of a path. Paths attract a variety of users from experienced commuter cyclists to young children (refer to Table C1 1 in Commentary 1) and hence it is desirable to consider the characteristics of all likely users and to design the path to suit the needs of the type of user for which it is intended.

The geometric standard adopted for a path will depend on its role within the bicycle network. Paths may perform an arterial function for a specific user group (e.g. veloway), have a mixed-use function for cyclists, pedestrians and other types of use (e.g. roller blades) or have a local access function.

A veloway is a high-standard exclusive bicycle path catering for high-volume and /or high-speed arterial movement. There are few veloways in Australia. This guide does not provide guidelines that are specific to the design of veloways. Whilst the information in this section may assist in the design of veloways the values adopted for design elements will depend on local circumstances and should be determined by the responsible authority.

7.2 Bicycle Operating Speeds

Bicycle operating speeds on paths are influenced by a combination of human and other factors, including:

- the type of bicycle
- purpose of the trip (e.g. commuting, riding to gain fitness including group riding)
- age, confidence and level of fitness of the cyclist
- condition of surface
- alignment standard of the facility
- gradients
- widths
- path user volumes
- prevailing weather conditions.

It is important to recognise that under appropriate conditions many fit cyclists can maintain relatively high speeds. Speeds in excess of 35 km/h can be maintained on the flat whilst speeds of over 50 km/h can be attained on moderate gradients.
It is recommended that paths be designed for a speed of at least 30 km/h (Shepherd, 1994) wherever possible and desirable given the purpose of the path, and in other cases for the anticipated operating speeds. However, it should be recognised that it may be necessary to adopt higher or lower design speeds in specific circumstances. For example, it is desirable to provide a high standard curve at the bottom of a steep downgrade but designers may be forced to adopt tight curves in providing a path down the face of an escarpment. In such circumstances the potential hazard should be appropriately highlighted (e.g. adequate sight distance, delineation and warning signs).

7.3 Horizontal Curvature

Where a path location or alignment is not constrained by topography or other physical features, a generous alignment consisting of straights and large radius curves is desirable. Such an alignment will provide good sight lines that are essential for safety as well as a pleasant riding experience for cyclists.

While the anticipated type of use is a factor for consideration, the fact that a path is provided primarily for recreational use does not remove the need for a good alignment; nor should it encourage designers to provide tight curves to achieve what they consider to be a visually pleasing alignment. Many recreational cyclists travel at relatively high speeds and the radii of curves should be chosen to cater for the expected operating speed on the particular section of path. In addition, tight curves should not be provided to improve visual amenity because:

- pedestrians and cyclists are likely to cut across the verge on the inside of the curve leading to unsightly bare patches, possible erosion and safety issues
- there will be a subsequent requirement to treat the area on the inside of curves at additional cost in order to constrain cyclists and pedestrians to travel along the inadequate alignment.

The minimum horizontal radii shown in Table 7.1 should be used where a flat surface is used and it is not possible or desirable to provide superelevation. Table 7.2 shows the minimum radii that should be used in combination with superelevation. However, AS 1428.1 requires that the crossfall on a path used by pedestrians should not exceed 2.5% (i.e. 1 in 40). Therefore, it follows that the minimum radii used on shared paths should be no less than those shown in Table 7.2, corresponding to a superelevation of 2.5%. It also follows that the values from Table 7.2 for a superelevation greater than or equal to 3% should only be used on exclusive bicycle paths. From a cyclists perspective curves should generally have positive superelevation so that they can be comfortably negotiated.

Where practicable designers should not design for the minimum radius as tight curves can result in sight distance restrictions, a poor level of service and some cyclists choosing an informal alternative path to avoid the restriction. Exceptions include locations where the alignment is severely constrained (e.g. steeply sloping land) and smaller radii cannot be avoided. However, isolated tight bends that do not have preparatory approach geometry should be avoided as at night, in an unlit environment, curve warning signage may not be visible with bike lights.

It is acknowledged that a curvilinear alignment is often preferred to achieve a visually pleasing path for cyclists. However, minimum radius or sharp curves should not be used to achieve landscaping objectives to the detriment of the level of service and social safety for cyclists on any path that has a commuter, major recreational or utility function.
Table 7.1: Minimum radii of horizontal curves without superelevation

<table>
<thead>
<tr>
<th>Design speed (km/h)</th>
<th>Minimum radius (metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>50</td>
<td>94</td>
</tr>
</tbody>
</table>

Note: Based on zero superelevation and friction factors of 0.31, 0.28, 0.25 and 0.21 for speeds of 20, 30, 40 and 50 km/h respectively.

Table 7.2: Minimum radius of horizontal curves that have superelevation

<table>
<thead>
<tr>
<th>Superelevation (%)</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed (km/h)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>10</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>30</td>
<td>24</td>
<td>23</td>
<td>22</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>40</td>
<td>47</td>
<td>45</td>
<td>43</td>
<td>42</td>
<td>41</td>
</tr>
<tr>
<td>50</td>
<td>86</td>
<td>82</td>
<td>79</td>
<td>76</td>
<td>73</td>
</tr>
</tbody>
</table>

Source: Californian Department of Transportation (2006).

7.4 Gradient

As a general principle longitudinal gradients on paths for cycling should be as flat as possible. The potential hazard for cyclists due to high speeds on steep downgrades is as important as the difficulty of riding up the grade when determining maximum gradients on two-way paths.

In many cases there may not be any demand for wheelchair use on shared paths beside freeways (e.g. remote locations) in which case landings may not be required. However, the gradients in AS 1428.1 requiring landings are of the order of 3% to 5% and it is therefore suggested that where there is any likelihood that disabled persons will use a shared path, the preferred approach is to provide the flattest practicable gradient (e.g. 2%).

AS 1428.1 and AS 1428.2 have specific requirements for pedestrians and require level rest areas at a specific spacing (refer to Table 6.2). Whilst these standards were developed for buildings there is a need to consider the same issue with respect to the design of shared paths.

Designers should consult any jurisdictional guidelines; however, in the absence of such guides it is suggested that the following approach be considered:

- Where a path is proposed for a relatively short transverse pedestrian/cyclist overpass (e.g. across a road, creek or railway) it may be appropriate for it to be a shared path. For a shared path, the ramps should be provided with landings at a spacing that complies with AS 1428.1. However, because these landings result in a reduction in cyclist comfort and convenience they may only be acceptable to cyclists if used over a relatively short length.

- Where a gradient that requires landings under AS 1428.1 is proposed on a path (including a longitudinal path on a road bridge) that has to provide for ramps greater than 200 m in length, the provision of standard landings may present an inconvenience or hazard for cyclists, particularly those travelling downhill. If there is a need for pedestrian landings in this situation they should be provided on a separated facility or outside the shared path, on both sides.
7.4.1 Ease of Uphill Travel

Figure 7.1 shows the maximum lengths of uphill gradient acceptable to cyclists. The figure is based on a review of the ease of uphill travel (Andrew O’Brien & Associates 1996).

In using the figure designers should understand that:

- Above 3% the acceptable length reduces rapidly and it is considered this is the desirable maximum gradient for use on paths. However, in practice there are cases where it is not feasible to achieve a 3% maximum and the designer has no choice but to adopt a steeper gradient.

- In cases where 3% cannot be achieved consideration should be given to limiting gradient to a maximum of about 5% and providing short flatter sections (say 20 m long) at regular intervals to give cyclists travelling both uphill and downhill some relief from the gradient.

It is sometimes difficult to achieve these gradients where a path follows a river and a connection between paths must be achieved in the vicinity of a steep escarpment. It should also be noted that a long, uphill grade preceded by a downgrade is more acceptable than one preceded by a flat or slightly rising grade.

Notes:

- Gradients and the associated length would normally be based on the distance between the tangent points for an isolated steep section. However, where there are consecutive grades of varying steepness (all uphill) or large radius vertical curves, these should be calculated based on the intersection points of the respective vertical curves.

- In general, the ‘acceptable’ line in the figure would be satisfactory for paths with a high proportion of regular or physically fit cyclists, which in most instances would include commuter and sporting cyclists. Otherwise, the ‘desirable’ line in the figure is recommended.


Figure 7.1: Desirable uphill gradients for ease of cycling
7.4.2 Safety and Downhill Travel on Paths

Gradients steeper than 5% should not be provided unless it is unavoidable. It is most important that sharp horizontal curves or fixed objects do not exist near the bottom of hills, particularly where the approach gradient is steep (greater than 5%) and relatively straight. If a curve must be provided at the bottom of a steep grade then consideration should be given to providing additional path width, and a clear escape route or recovery area adjacent to the outside of the curve.

Many cases where gradients are in excess of 5% occur on the approaches to grade-separated facilities (e.g. underpasses) and in these situations the provision of widened paths or clear escape routes is not practicable. In these cases adequate sight distance should be provided together with appropriate delineation and warning signs.

Intersecting paths, underpass access points and other circumstances that may result in conflict for cyclists should not be provided at the bottom of steep grades, except where there is no alternative. If an intersection must be provided then it is important that adequate sight distances are provided on all approaches. Commentary 10 provides additional information with respect to cyclists and downhill gradients.

7.5 Width of Paths

7.5.1 General

The width of paths is an important factor given construction costs and operational considerations. It can also have a significant bearing on the level of convenience and conflict between users and potentially on path safety as well.

The path width required depends on the envelope (i.e. space) occupied by pedestrians and/or cyclists using the path together with appropriate clearances. The clearances are required between path users travelling in the same direction or opposite directions, and also between path users and the edge of the path. Some allowance for the ability of cyclists to ride in a consistent wheel path (i.e. tracking of the bicycle within the envelope) is provided. Pedestrian and cyclist envelopes and examples of their application to determine the widths presented in Table 7.3 and Table 7.4 are contained in Appendix A.

While path width can be developed from cyclist and pedestrian envelopes and required clearances, the choice of a width in many situations is subjective because data is not usually available on the level of use and type of use that could be expected. Some jurisdictions systematically collect traffic data on existing path networks and some investigation has been done on the development of models to estimate the traffic flow on proposed paths (Land Transport NZ 2007b). However, in the absence of a relationship between path width and traffic parameters (e.g. speed, volume, mix of pedestrians and bicycles) practitioners should consider a number of factors, such as the:

- level of pedestrian and cyclist use
- the types of cyclists likely to be attracted to the path
- objectives of the path (e.g. provide a major link for cyclists including school children)
- speed of cyclists
- traffic regime
- available clearances
- user envelopes.
In many cases there will be more than one type of user that has to be accommodated and their requirements may differ. For example, where a path follows a scenic route but also is intended to attract cyclists from an alternative high speed road environment, it will be necessary to provide a good experience for the recreational cyclists whilst ensuring that commuter cyclists are provided with an alignment and other conditions that result in a satisfactory travel time. Commentary 11 provides a summary of factors that may be considered in the determination of an appropriate width for a path.

Table 7.3 and Table 7.4 should be used as a guide to the width required for paths. The terms major path, commuter path and recreational path are intended to suggest that these paths are the most important in a bicycle network and have an arterial function in terms of traffic movement (i.e. higher volumes and or speeds). The term local access path is intended to suggest a length of path that has the function of transporting cyclists either to local centres or to the arterial paths within the bicycle network.

In reality, some new major, commuter, and recreational paths will not initially carry large volumes of cyclists, although the volume may become significant throughout their operational lives. However, these paths should be able to safely transport cyclists at reasonably high speeds and therefore require an adequate width for this purpose. On the other hand, some local access paths may carry relatively high volumes of cyclists and a high operating speed may or may not be required or desirable. Therefore, while the desirable values in Table 7.3 and Table 7.4 are likely to be suitable in most cases, designers should determine whether there are local circumstances that justify a different width.

In general, a width less than lowest value of the acceptable range shown in the tables should not be adopted. An exception is the local access path that is provided to connect a local area to a community facility (e.g. shopping centre) and it is expected that the volume of cyclists and operating speeds will remain low throughout the life of the path. In such cases a width no less than 2.0 m may be considered. A width greater than the upper value of the acceptable range may be required where a very high number of cyclists are expected to use the path. However, a very wide path could lead to operational and safety issues and is likely to require traffic management devices (e.g. signs and markings).

### 7.5.2 Bicycle Paths

Table 7.3 shows desirable widths and acceptable ranges of width for bicycle paths (i.e. exclusive use). The upper limit of the acceptable range in the table should not discourage designers from providing a greater width where it is needed (e.g. very high demand that may also result in overtaking in both directions).

<table>
<thead>
<tr>
<th>Path width (m)</th>
<th>Local access path</th>
<th>Major path</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desirable minimum width</td>
<td>2.5</td>
<td>3.0</td>
</tr>
<tr>
<td>Minimum width – typical maximum</td>
<td>2.5(^1) – 3.0(^2)</td>
<td>2.5(^1) – 4.0(^2)</td>
</tr>
</tbody>
</table>

1. A lesser width should only to be adopted where cyclist volumes and operational speeds will remain low.
2. A greater width may be required where the number of cyclists is very high.
7.5.3 **Shared Paths**

Table 7.4 shows desirable widths and acceptable ranges of width for shared use paths. As for bicycle paths, the upper limit of the acceptable range in the table should not discourage designers from providing a greater width where it is needed (e.g. very high demand that may also result in overtaking in both directions).

<table>
<thead>
<tr>
<th>Path width (m)</th>
<th>Local access path</th>
<th>Commuter path</th>
<th>Recreational path</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desirable minimum width</td>
<td>2.5</td>
<td>3.0</td>
<td>3.5</td>
</tr>
<tr>
<td>Minimum width – typical maximum</td>
<td>2.5 – 3.0²</td>
<td>2.5 – 4.0²</td>
<td>3.0¹ – 4.0²</td>
</tr>
</tbody>
</table>

1. A lesser width should only to be adopted where cyclist volumes and operational speeds will remain low.
2. A greater width may be required where the numbers of cyclists and pedestrians are very high or there is a high probability of conflict between users (e.g. people walking dogs, roller bladders and skaters etc.).

7.5.4 **Separated Paths**

Table 7.5 and Table 7.6 show desirable widths and acceptable ranges of width for two-way and one-way separated paths respectively. However, where it is appropriate (e.g. high traffic demand) designers may provide a greater width than the typical maximum shown in the tables.

**Table 7.5: Separated two-way path widths**

<table>
<thead>
<tr>
<th>Path width (m)</th>
<th>Bicycle path</th>
<th>Footpath</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desirable minimum width</td>
<td>2.5</td>
<td>2.0</td>
<td>4.5</td>
</tr>
<tr>
<td>Minimum width – typical maximum</td>
<td>2.0 – 3.0</td>
<td>≥ 1.5</td>
<td>≥ 4.5</td>
</tr>
</tbody>
</table>

**Table 7.6: Separated one-way path widths**

<table>
<thead>
<tr>
<th>Path width (m)</th>
<th>Bicycle path</th>
<th>Footpath</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desirable minimum width</td>
<td>1.5</td>
<td>1.5</td>
<td>3.0</td>
</tr>
<tr>
<td>Minimum width – typical maximum</td>
<td>1.2 – 2.0</td>
<td>≥ 1.2</td>
<td>≥ 3.4</td>
</tr>
</tbody>
</table>

Ways of achieving separation are shown in Figure 7.2. Physical, horizontal or vertical separation of the bicycle path and pedestrian path is preferred to line marking. Should line marking be used to separate bicycles from pedestrians then tactile markings are recommended. In assessing the need for physical separation, factors such as the speed of cyclists as well as the potential for children to run into the paths of cyclists should be considered.

In contrast to separated two-way paths, a barrier separating the bicycle and pedestrian path sections is not usually required for separated one-way paths. However, it should be used in situations such as where path conditions are congested or where unsafe conditions exist due to the path users.

A common minimum width for footpaths is 1.2 m. In the event that a barrier is used to separate the bicycle and pedestrian path sections, then a wider footpath section may be required to allow passing manoeuvres on that section of the path, amongst other reasons (e.g. pedestrian volumes).
Notes:
Separation line should be a painted broken line, not raised or supplemented with raised retroreflective pavement markers.
The horizontal clearances to physical (vertical) separation devices shown in the figure are essential. The clearances should be sufficient to ensure that cyclists do not shy away from hitting the handlebars on fences or pedals on kerbs and thus reducing the effective width of the path.
Source: Based on Austroads (1999).

Figure 7.2: Typical ways of separating paths

7.6 Crossfalls and Drainage

7.6.1 Crossfall
Water ponding on paths has a significant impact on the level of service provided to cyclists as spray leads to grit on both bicycle and rider. On straight sections crowning of the pavement is preferable as it results in less accumulation of debris. On sealed surfaces a crossfall of 2%-4% should be adequate to effectively dispose of surface water whereas unsealed surfaces may require 5% to prevent puddles of water from developing.

Section 7.3 provides information on the horizontal radius of curves and the corresponding superelevation that is required.

Where paths are for shared use, the needs of other path users (e.g. impaired pedestrians) should be considered. In particular, AS 1428.1 specifies that a path crossfall should not exceed 2.5% (1 in 40) to cater for people who have a disability. However, a crossfall of 2.5% should be adopted in order to ensure that the path will shed water and to avoid ponding.

With reference to Table 7.2 there is limited value in using higher rates of superelevation, and as such it is generally preferable to use a low path crossfall and thereby accommodate the needs of a range of path users.
7.6.2 Drainage

Paths for cycling should be constructed so that water does not pond on the surface and debris does not wash onto the path during heavy rain. The path should therefore have adequate crossfall and catch drains to collect water and prevent water and litter from flowing onto the path. In flat terrain it may be adequate to simply elevate the path above the adjacent land, but designers should ensure that the path shoulders are matched to the path surface level and graded with a suitable crossfall (preferably on a slope flatter than 1 in 8).

Catch drains will often be required on the inside of curves and pipes will often be needed to carry water under the path. On large radius curves (100 m say) an adverse superelevation of 2% may be provided to avoid the need for the catch drain and pipes. However, this should only be done where the catchment area above the path is relatively small and has a surface stable enough that debris is unlikely to wash over the path. Figure 7.3 shows typical cross-sections and drainage requirements of paths for cycling.

Major commuting and recreational paths should be designed for an equivalent flood immunity as that adopted for local roads unless suitable safe alternative routes can be easily accessed from the path. Major recreational paths that follow watercourses will have to satisfy the requirements of the responsible authority. For most major paths adjacent to freeways and arterial roads an average recurrence interval of at least five years should be adopted whereas a two-year average recurrence interval should be satisfactory for paths that have a lesser function and/or have readily accessible alternative routes. In addition, to meet a low hazard criterion during flooding of shared paths the product of water depth (m) and water velocity (m/s) should be less than 0.35.

Where sections of a path are likely to be subjected to inundation (e.g. along a linear trail adjacent to a watercourse, less important routes) it is important that signs should be erected to warn users of any risk (e.g. flooding, slippery surface after inundation, accumulation of debris on the path) and that maintenance measures are in place to assist cyclists and pedestrians (e.g. well-signed detours, barricades). In such situations the drains should be designed to minimise the likelihood of blockages and the consequent ponding of water at low points in the alignment.

Where paths have to pass under the abutments of structures and headroom is limited, necessitating the level of the path being below the flood level, it may be possible to construct a flood wall between the path and the river to hold back water during minor flood events. In extreme conditions the water can overtop the wall and flow along the path.

Designers should also:

- check to ensure that water follows minimal flow-path distances on the path surface
- consider potential problems of water flowing either from the path or other sources, through landscaped areas, to deposit debris over the path surface
- consider the use of fencing or other treatment details that trap debris so that it accumulates clear of path edge
- ensure that drains are of an adequate size to avoid them being blocked by roadside litter.

The same principles that are applied in the design of road cross-sections should be used in the design of path cross-sections, namely the need to prevent water from flowing across the path, flooding the path or causing damage to the pavement. Figure 7.3 shows four typical cross-sections that are used on major paths and that illustrate the principles, namely:

- Example A shows a path in flat terrain where the pavement is elevated above the natural surface and water is shed into the flat areas beside the path where it can flow to an outlet.
Example B shows a case where a path is located on a cross-slope with the pavement cut into the high side so that the surface is coincident with the natural surface. This approach is not generally satisfactory as water and possibly debris would be shed across the path and water could seep into and cause damage to a flexible pavement on the high side. Consequently, this option should only be used where the upper ‘non-eroding surface’ has a porous, free-draining sub-surface such that run-off (regardless of the extent of debris) does not encroach onto the path; otherwise Example C should be used.

Example C illustrates the provision of an open drain on the high side of the path to cut off water and carry it to a discharge point, possibly via pits and lateral pipes. In this case water from the path is shed to the low side.

Example D again shows a path on a cross-slope but with the path on a curve and superelevated toward the high side. In this case the open drain collects water from the path and the high side of the path.

Source: Based on Austroads (1999).

Figure 7.3: Drainage and crossfall requirements
7.7 Clearances, Batters and Need for Fences

7.7.1 Clearances

It is important for safe operation that adequate clearance is provided between bicycle operating spaces for cyclists travelling in opposite directions and between the cyclist operating spaces and potential hazards beside paths (e.g. fixed objects, vertical drops, steep batters).

The clearance between cyclist operating spaces varies according to the type of use and operating speeds as follows:

- on paths designed for commuting and major recreational activity a minimum lateral clearance of 1.0 m is required between opposing bicycle operating spaces because of the high relative speed which exists when cyclists approach one another from opposite directions at speeds of 30 km/h or more (i.e. closing speed of 60 km/h)
- on recreational paths where the speeds of cyclists are not likely to exceed 20 km/h a minimum lateral clearance of 0.4 m is necessary between opposing bicycle operating spaces.

Consideration should be given to the provision of a centreline on all two-way paths that have a minimal clearance between opposing flows in order to provide guidance and certainty regarding the opposing travel path.

The following guidelines should be applied for clearances between the cyclist operating spaces and potential hazards beside paths:

- Where both the areas beside the path and the path alignment are both relatively flat a lateral clearance of at least 1.0 m (0.5 m absolute minimum) should be provided between the edge of any path for cycling and any obstacle, which if struck may result in cyclists losing control or being injured. However, on high-speed paths it is most desirable to have a clearance considerably greater than 1.0 m.
- Where it is considered that a hazard beside the path has attributes that could cause serious injury to cyclists (e.g. sharp surfaces such as the rear side of the posts and rails of steel W-beam road safety barrier), designers should assess the risk of cyclists losing control on the particular section of path, and consider either increasing the lateral clearance or shielding cyclists from the hazard. Depending on the situation a rub rail behind the posts or a cyclist fence near the edge of the path could be provided.
- Where a vertical drop or a steep batter exists or must be provided adjacent to the path the guidance in Section 7.7.2 should be applied.

Obstacles beside paths include bushes, culvert end walls, trees and large rocks used in landscaping. Provided the design and end treatments are appropriate, or where extenuating circumstances exist, a lesser clearance may be acceptable for fences and other obstacles that have smooth features and are aligned parallel to the path (0.3 m absolute minimum).

These horizontal clearances are partially illustrated in Appendix A.

The minimum vertical clearance required by cyclists is 2.5 m, measured above the riding surface (also shown in Appendix A). This applies to tree branches, underpasses, doorways, sign structures and any other overhead structure.
7.7.2 Batters and Fences

General

The installation of a fence at the side of a path used by cyclists is desirable where:

- there is a steep batter or large vertical drop located in close proximity to the path
- the path is adjacent to an arterial road and it is necessary to restrict cyclist access to the road
- a bridge or culvert exists on a path
- a hazard exists adjacent to a particular bicycle facility
- cyclists are likely to be ‘blazing a separate trail’ at an intersection between paths or around a path terminal.

Steep batter or vertical drop

Figure 7.4 provides a specific recommendation for the provision of a fence on a path in close proximity to a steep batter or vertical drop. In addition to those referred to in the figure, other circumstances may exist where it may be desirable to erect fences even if provision is not required by the figure (e.g. a curving path alignment, located in the vicinity of batters or a drop-off, bridges).

A fence barrier may be appropriate where a path is located adjacent to a watercourse or lake. A full barrier fence would be appropriate where a vertical fall to water occurs within 5 m of a path.

Figure 7.4 highlights the circumstances in which either a partial barrier fence (refer to Figure 7.5), or a full barrier fence (refer to Figure 7.6) or equivalent form of protection should be used. These barriers are intended to prevent access to a slope or to a fall away from a path or other riding surface, where injury might otherwise be expected in the event of a cyclist riding inadvertently off the line of a path. Examples of these fences are provided in the Guide to Road Design – Part 6B: Roadside Environment (Austroads 2009g).

The recommended height for fences (desirable 1.4 m and minimum 1.2 m) is illustrated in Figure 7.5 and Figure 7.6. The minimum height of 1.2 m should be used only where the severity of the hazard is considered to be low. A higher fence (e.g. 1.6 m) may be considered where the fence is protecting path users from a very severe hazard (e.g. high vertical drop from a structure to a body of water or rocks). Similar or even more stringent measures may be required adjacent to roads. Where a batter or fall is located in close proximity to a road, designers should have regard for the requirements of Figure 7.4, particularly where no kerb exists at the edge of a road. However, the actual measures required should be decided upon with consideration of all road users and of the particular circumstances.
Figure 7.4: Requirement for fence barriers at batters and vertical drops

Source: Austroads (1999).
Note: Desirable fence height is generally 1.4 m. Minimum of 1.2 m may be used where severity of hazard is considered to be low.
Source: Based Austroads (1999).

**Figure 7.5: Example of a partial barrier fence details**

Note: Desirable fence height is generally 1.4 m. Minimum of 1.2 m may be used where severity of hazard is considered to be low.
Source: Austroads (1999).

**Figure 7.6: Example of a full barrier fence details**

### 7.8 Sight Distance

For safe travel cyclists must be able to see across the inside of horizontal curves, under overhead obstructions in sag curves (e.g. where a path passes under a road) and over vertical crest curves a sufficient distance to enable them to stop or take evasive action if necessary in order to avoid another cyclist, a pedestrian or an obstacle in their path.

Figure 7.7 shows the stopping sight distances that should be provided to enable a cyclist to stop for various combinations of bicycle operating speeds and gradients. The figure is based on a coefficient of friction of 0.25 and a perception/reaction time of 2.5 seconds. The eye height of the cyclist is assumed to be 1.4 m and the object height is assumed to be zero to recognise that impediments to bicycle travel exist at pavement level (e.g. potholes or stones).

Paths should be designed and constructed to provide the greatest sight distance possible at any given location.
The stopping sight distance to be used in the geometric design of paths should be at least equal to that shown in Figure 7.7, and should be used:

- for intersection design
- in setting out the alignment of paths
- in relation to the positioning of terminals and handrails
- at entries to underpasses
- locate landscaping in the field
- otherwise as required to ensure the safety of path users.

All two-way bicycle paths should be designed to provide a sight distance between opposing cyclists (i.e. as shown across a horizontal curve in Figure 7.8) at least equivalent to twice the stopping sight distance given by Figure 7.7. This is to ensure that cyclists who are overtaking can avoid a head-on collision.

Path sight distances can be drastically reduced by the growth of vegetation and hence the location and maintenance of vegetation is critical to safe path operation.

![Figure 7.7: Minimum stopping sight distance for cyclists](image)

Figure 7.7 illustrates the relationship between stopping sight distance, radius of the curve and the lateral clearance to significant visibility obstructions such as extensive vegetation or an earth embankment. Isolated features including trees do not necessarily constitute a significant obstruction if cyclists can see most of the curve beyond them.

Whilst the graph is provided for use by designers, it is suggested that it (or a simple tabular representation) should be supplied to works staff to be used in construction and routine maintenance operations.
Where an existing path is narrow, the level of use of the path is high (such that cyclists may be expected to travel in both directions at the same time i.e. ‘non-tidal’ flow) and widening is not feasible (because of physical or financial constraints), it is recommended vegetation should be set back as shown in Figure 7.8. This set back is to prevent the possibility of head-on crashes. If such a set back is not possible then consideration should be given to any one or a combination of:

- local widening of the path around the curve
- warning signs
- tactile lines.

A vertical curve should join all changes of grade. Crest vertical curves must be of sufficient length to give the cyclist the stopping sight distance shown in Figure 7.7. Where practicable, sag curves should be the same length as equivalent crest curves to ensure comfort and an aesthetically pleasing path alignment. Figure 7.9 shows the minimum length of vertical curve for various changes of gradient and design speeds.
7.9 Bicycle Path Lighting

The objectives, discussion and issues relating to the lighting of pedestrian paths (Section 6.5) also apply to paths used by cyclists who need to be able to detect hazards such as rough surfaces and obstacles on paths, and also have a sense of personal security.

Where bicycle paths or shared paths carry a substantial number of cyclists during periods of darkness (i.e. dawn, dusk and at night) consideration should be given to the provision of path lighting. The decision to provide lighting is a matter for the relevant authority.

A path considered for lighting will usually form part of an arterial bicycle route or a principal bicycle network where cyclists desire to travel at relatively high speeds for commuting or recreation because under these circumstances:

- cyclists require greater sight distance in order to avoid conflict with other cyclists or pedestrians and the severity of such a crash is often severe
- bicycle head lamps may enable a cyclist to be seen but some not illuminate the path surface sufficiently to enable cyclists to avoid hazards (rough surface, debris, obstacles)
- lighting assists in delineating the alignment of the path.

If it is decided to light a bicycle path or shared path the lighting should be designed in accordance with AS/NZS 1158.3.1:2005, Pedestrian area (Category P) lighting—Performance and design requirements (e.g. lighting level P2 or higher depending on the jurisdiction, location and the circumstances).
A level of lighting higher than that provided generally along a bicycle path or shared path should be considered for locations where cyclists are likely to conflict with other path users or motor vehicles, or have greater concern for personal security, for example:

- path/path intersections on major paths
- path/road intersections
- road crossings and refuges
- path terminal treatments
- cyclist/pedestrian underpasses
- tight curves.

As is the case with road lighting, the design objectives of Category P lighting are achieved by specifying luminaire optics, lamp type, lamp wattage, lumen output, mounting height, spacing of poles, setback from the edge of path or edge of kerbed path, overhang length and other physical parameters to satisfy the lighting requirements for the pathway.

### 7.10 Underground Services

The location and design of paths should be coordinated with the many other features and infrastructure that need to be accommodated within road reservations and which are covered in the *Guide to Road Design – Part 6B: Roadside Environment*.

Above ground utility services that have to be located near paths should be placed so that they do not constitute a hazard for pedestrians and cyclists using the path. However, aside from the permanent fixtures located near the path it is important to ensure that underground services do adversely influence the design of the path or the future operation of the path. For example, future operation could be significantly impeded if:

- utility pits are located within the path as maintenance staff and vehicles would be required to work on the path
- the path is ripped up to access services
- maintenance vehicles associated with the utility provider drive or park along the path.
8     INTERSECTIONS OF PATHS WITH ROADS

8.1     General

Off-road paths must be readily accessible in order to be well utilised by the community. Access should always be provided where paths cross local streets and arterial roads. Accessibility should be improved further by connections to quiet local roads or cul-de-sac.

Where a path is located on one side of a road, kerb ramps should be provided opposite every side street to enable access for local users. They should preferably provide an attractive setting that enhances the streetscape. All connections and crossings should be designed and constructed so as to encourage safe and correct use by cyclists.


8.2     Ancillary Treatments and Features

These comprise the treatments and features associated with the design of path terminals, including kerb ramps, holding rails and any other devices used to warn and control path traffic. Details are provided in Section 10.
9 PATHS REMOTE FROM ROADS

9.1 General

Many paths are not directly associated with or influenced by roads. These paths may be located within reservations that accommodate watercourses, railways, major water supplies, parkland, freeways and motorways. They attract both commuter cyclists and a broad range of recreational cyclists and pedestrians varying in age, experience and ability.

In many cities major off-road paths form part of a large network that provides for trips to work and recreation from which significant benefits are derived such as improved community health and reduced vehicle emissions. Many of these paths are not the responsibility of a road authority. Nevertheless, road authorities have a responsibility wherever these paths intersect with roads and may have broader responsibilities to governments regarding path design standards and safety.

Paths that are not directly associated with roads should also be designed in accordance with the design criteria discussed in Section 7. It is also very important that all paths have adequate signing to destinations, at junctions, and at points of discontinuity along the route (refer to Section 4.2.1).

9.2 Path Function

9.2.1 Utility and Commuter Use

Commuters will want to travel as fast as conditions allow. It is important, therefore, that paths provided for long distance commuting have the best possible alignment and are designed to cater for the anticipated speed of cyclists (refer to Section 7.2).

Such paths should:
- lead to useful destinations
- allow safe travel at a constant speed appropriate to the use
- achieve a specific purpose such as providing a short cut or a by-pass of a busy section of road.

9.2.2 Recreational Use

A recreational path is a path that may be located along the coastline, a river foreshore, or along a linear public open space corridor. These locations attract recreational users due to their scenic nature and because they can have generally flat grades. Although provided mainly for recreational use, such paths often attract commuters during some periods of the week.

A path designed for recreation should:
- offer an attractive and enjoyable ride of at least 10 minutes duration or a walk of 30 minutes
- where possible, generally have flat gradients to better provide for children and novice adult cyclists
- have few road crossings
- be readily accessible
- include such facilities as toilets, water fountains for drinking, car and bicycle parking.

The characteristics of successful paths for commuting and utility cycling and also for recreational cycling are illustrated in Appendix A.
9.3 Intersections of Paths with Paths

Intersections between bicycle paths and shared paths are relatively simple arrangements as shown in Figure 9.1. In general, the intersections of paths should be constructed and controlled in accordance with the established principles of codes of practice for roads. For instance, at path junctions, the controls and layout should favour the predominant flow on the major through route and meet geometric requirements such as sight distance and gradients. Also, designers must ensure that the construction and controls are consistent with local regulations.

At these intersections:

- a staggered T arrangement should be adopted to prevent high crossing speeds
- the intersection angle should not be less than 70° to achieve acceptable observation angles and angles of conflict
- pavement markings should include centre lines and give-way holding lines
- pavement splays in the corners should have a minimum radius of 2.5 m.

Cross intersections should not be provided between intersecting bicycle paths or shared use paths because they allow high-speed conflicts to occur. The designer or responsible person will have to nominate which path is to have priority at intersections between paths. Priority should normally be given to the path that has the highest daily volume of cyclists and pedestrians. Where path volumes are low or similar on both paths the choice should be made on the basis of function within the network or priority should be given to the traffic stream that will be most disadvantaged through having to stop and accelerate to speed (e.g. one path may have a steep upgrade on the departure).

![Figure 9.1: Intersections of paths with paths](image)

Source: Based on Austroads (1999).
A similar approach can be applied to the determination of priority where a bicycle path or shared path intersects with a footpath (which cyclists are not allowed to use or infrequently use) except that a cross-intersection arrangement may be appropriate.

Considering that cycling and walking are two sustainable forms of transport the priority should depend on which mode is impacted to the greater extent by having to give way. As a general rule, where volumes are low to moderate, cyclists will be disadvantaged more than pedestrians because of the effort required to brake and accelerate up to operating speed. However, at higher volumes some pedestrians (e.g. elderly or mobility impaired) may have difficulty in crossing the shared path or bicycle paths due to the speed of cyclists in which case priority may be given to the footpath.

To ensure priority requirements are emphasised consideration should be given to the construction of additional controls at the intersections of exclusive paths or segregated paths with footpaths, where:

- paths are well used
- the footpath is used regularly by people who have a vision impairment
- sight distance constraints exist.

Figure 9.2 and Figure 9.3 show four arrangements where a bicycle path or shared path intersects with a footpath and priority is reinforced through delineation and traffic control devices. Figure 9.2 illustrates cases where cyclists have priority and respectively show how pedestrian ramps or contrasting surface material on the footpath can be used to provide an interface between the paths. Figure 9.3(a) and Figure 9.3(b) are cases where pedestrians have priority at an intersection with a shared path and a separated path respectively and show the use of give-way signs to control cyclists and contrasting surfaces to emphasise that pedestrians have priority.

Other factors that should be considered in relation to intersections of shared paths are:

- T-Junctions in busy locations should be widened to allow for through cyclists to pass a turning cyclist as the extra space reduces the number and intensity of conflicts. Where hold rails are used in the side path the width should cater for turning cyclist envelopes plus additional lean allowance.
- The area around path intersections should be kept clear of hazardous obstacles, such as log barriers, to provide cyclists with a recovery zone. Any landscaping or planting should be low and ‘soft’. However, landscaping is useful where cyclists may attempt to travel the shortest path between path junctions or at sharp curves, which inevitably results in maintenance problems.
- Care should also be exercised in the location of intersections on paths adjacent to watercourses so that water holes and steep embankments do not present a hazard to cyclists. The treatment at the sides of paths should provide a forgiving environment in terms of cyclist safety.
Contrasting surface desirable
Flare entry where appropriate
Barrier / kerb etc.

(a) Bicycle path and footpath
(b) Shared path and footpath

Source: Based on Austroads (1999).

Figure 9.2: Intersection of bicycle path and footpath where cyclists have priority

Contrasting surface desirable
Barrier / kerb etc.
Flare entry where appropriate

(a) Shared path and footpath
(b) Separated path and footpath

Source: Based on Austroads (1999).

Figure 9.3: Intersection of a separated path and footpath (cyclists give way)
10 PATH TERMINAL TREATMENTS

10.1 General

A path terminal treatment may be required where a shared path or bicycle path intersects with a road and applies to recreational and commuter paths that cross a road from a reservation, or to paths that follow a major road and cross side streets.

Path terminal treatments for off-road, shared-user paths and bicycle paths are generally provided to:

- restrict illegal access by drivers of motor vehicles to road reserves and parkland to prevent damage to paths and other assets and prevent rubbish from being dumped illegally
- advise cyclists that there is a road ahead and slow cyclists down before they cross the road.

The prevention of illegal vehicle access is critical to prevent damage to path structures particularly when they have been designed only for bicycle and pedestrian use. Often physical methods are required in order to prevent vehicles from entering paths or driving over lightweight bridge structures (RTA 2005).

However, there is some evidence these devices are a hazard to cyclists and as such they generally should not be installed unless:

- there is clear evidence of unauthorised and undesirable motor vehicle access
- the device is effective at excluding such vehicles and not readily circumvented.

Where installed, terminal treatments should be designed and installed in such a way that they serve their intended purpose and do not cause an unacceptable hazard to cyclists. Cyclists must be able to:

- negotiate path entrances with ease
- concentrate on other traffic, pedestrians, pavements and ramps
- not be distracted by overly restrictive barriers.

In most instances it is unnecessary to use restrictive devices to slow cyclists down before they cross a road. However, it is important that cyclists travelling along off-road paths are provided with sufficient visual and/or physical cues to advise them that they are approaching a road crossing. Cyclists will then be able to assess the situation and slow to an appropriate speed or stop if necessary.

One of the basic requirements for cyclists is that they are able to maintain speed because, having stopped or slowed down to a very low speed, it requires considerable effort for cyclists to accelerate to their preferred operating speed. Therefore cyclists attempt to keep moving unless there is a good reason for them to stop. Very few cyclists will ever dismount and walk. Once on the bicycle they prefer to keep moving, even slowly, and hence maintain some momentum rather than having to stop completely.

For these reasons overly restrictive path terminal devices (e.g. chicanes) are usually ineffective because cyclists may travel around them, sometimes performing dangerous manoeuvres.
In some situations chicanes or other restrictive devices are unavoidable because cyclists have to be slowed down for their own safety. Where this is the case designers should ensure that:

- the device is no more restrictive than is necessary
- the fencing is light in colour to increase its conspicuity at night
- street lighting is adequate
- the fencing has no sharp protrusions.

In general, crossings should allow cyclists to move straight across the intersecting roadway, any slowing of cyclists preferably being achieved by relatively sharp curves on the path in advance of the intersection.

### 10.2 Terminal Design Principles

If local authorities choose to use or develop terminal devices that are not illustrated or described in this guide, the designs should comply with the requirements with respect to access, geometry, safety and delineation set out in Sections 10.2.1 to 10.2.4

#### 10.2.1 Access

The design should:

- Seek to enhance the safety of cyclists accounting for factors such as gradients, the proximity of roads and the approach alignment of the path, and in particular the anticipated categories of cyclists.
- Be accessible to a range of path users including pedestrians and people with physical disabilities. In relation to bicycles, they should accommodate the common bicycle types as well as tandem bicycles, bicycles with trailers, and other human powered vehicles.
- Be constructed so that small passenger cars cannot pass easily through or under horizontal rail sections where a primary objective of the terminal is to restrict access for motor vehicles. It should be noted that it is generally impractical to restrict motorcycles and to do so may result in a hazard for cyclists.
- Not be easily circumvented by unauthorised vehicles, such that either the device is rendered ineffective, or that alternative paths of access are created in adjacent reserve areas resulting in higher maintenance demands.
- Accommodate emergency or maintenance vehicle access where this is not available elsewhere in the vicinity of the terminal (in the event that the path will be relied upon by such vehicles). Note that wherever terminal device elements are removable the connections (or sockets) should be flush at the connecting surface and not present a hazard to path users.

#### 10.2.2 Geometry

The terminal treatment should:

- be located with regard to other design features in the immediate section of path (e.g. in general it would be inappropriate to locate terminals at or near curves, within a distance of less than 5 m of kerb ramps or within a manoeuvring zone of cyclists
- not be located too close to an intersection (e.g. 5-10 m) to enable storage and final braking to occur beyond the device where cyclists may wait for other path users to pass through the terminal device
- be located with at least 1.4 m clearance to adjacent fixtures and so that cyclists can pass conveniently

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have clearances at the terminal device and parallel roads that are sufficient in the event of cyclists failing to properly negotiate the device

- if consisting of a ‘frame’ be
  - at least 1.0 m high above the riding surface
  - shaped so that on the approach side of the frame, the minimum radius of the frame is 250 mm
  - constructed of individual frame elements that are rounded, without sharp edges, and having a minimum diameter of 100 mm

- if consisting of isolated vertical poles (e.g. bollards)
  - be at least 1.0 m high above the riding surface
  - have a minimum diameter of 300 mm.

10.2.3 Safety

With respect to safety the treatment should:

- Not present a hazardous feature for any pedestrian group (e.g. visually disabled pedestrians).

- Include adequate protection where the sides grade away from the path at a steep angle or where obstructions exist.

- Have regard for other (conflicting) paths, other paths of access and for sight lines. Terminals should be located in such a way that existing paths are not obstructed in any way. Similarly sight lines should not be restricted due to the terminal device or to users (as a result of the terminal device).

- Not be located at mid-block locations where speeds are likely to exceed 20 km/h.

10.2.4 Delineation

In order to operate safely under all light conditions it is important that terminal treatments and devices should:

- Be painted in a contrasting colour (white or yellow) and be fitted with quality reflective tape on horizontal and vertical elements to ensure it is visible from all directions. Barriers etc., on both sides of paths should be painted and delineated in this manner. Similarly, reflective tape should be fully wrapped around the elements to which it is attached to ensure that it is clearly visible from all directions.

- Be illuminated in accordance with AS/NZS1158, or with the lighting requirements of this guide, as appropriate.

- Where necessary, include signs or pavement markings, generally on the path approach to the device, warning of the presence of devices.

- That may present additional risk (e.g. single-lane devices or those with narrow central bollards).

- Due to conditions associated with increased risk (e.g. where gradients are significant, stopping sight distance to the device is limited, where group rides occur regularly or where paths are heavily trafficked).

- Be preceded by tactile line marking, or a tactile path surface and a painted unbroken line, where cyclists need to deviate from their line of approach. Similarly, as a further means of warning to approaching cyclists, it is desirable for the device to be visible to one cyclist whilst following immediately behind another.
There are numerous reports of collisions of cyclists on group rides with isolated vertical poles (e.g. bollards) located within paths. Therefore, it may be appropriate to consider the use of poles that are not less than 1.8 m high where narrow poles (minimum 100 mm diameter) are used, to increase the likelihood of observation of poles above the form of a leading cyclist.

10.3 Terminal Device Opening Width

In most instances a minimum opening width of 1.4 m is appropriate to encourage slower speeds by cyclists or where restriction of motor vehicle access is warranted. Terminal devices should have sufficient capacity to accommodate the anticipated path traffic.

Due to concerns regarding injuries to cyclists resulting from the use of overly restrictive terminal devices, there is some support for wider openings (up to 1.6 m), on the basis that the terminal devices will still discourage the majority of drivers of cars illegally attempting to gain access to reserves and the like.

10.4 Terminal Treatments

The purpose of a terminal treatment is to restrict unauthorised vehicles from entering a path. Therefore, if there is no need for such a restriction then a terminal treatment should not be required at all, the path leading directly to an appropriate road crossing with adequate signs and delineation to warn cyclists and clearly define priority. Only where there is good reason to do so (e.g. history of ride-out incidents, near misses or crashes) a terminal treatment can be used to physically slow cyclists. Where a treatment is required it should be based on the type of treatments described below.

Treatments that do not cause cyclists to substantially deviate are preferred because they do not unduly inconvenience cyclists. Therefore, the staggered fence and offset path treatments discussed in Sections 10.4.3 and 10.4.4 respectively should only be used in exceptional circumstances as they have the same issues associated with them as the overly restrictive devices and chicanes discussed in Section 10.1. If used they should also be well designed and delineated to meet the requirements listed in Section 10.1.

10.4.1 Separate Entry and Exit Treatment

The preferred terminal treatment to restrict access and warn cyclists to slow down is shown in Figure 10.1. This treatment is the bicycle path equivalent of providing a median island at a road intersection with similar benefits with respect to warning cyclists and channelising traffic movements. It provides sufficient advice to cyclists that they are approaching a road and does not place an obstacle (such as a bollard) in the path of cyclists.

In order to restrict unauthorised access it is critical that the fence extends to the edge of the path. If access is required for authorised vehicles removable posts may be placed within the fence line.
10.4.2 Bollards and U-rails

A common method of restricting access to paths is to install a bollard in the centre of the path. This type of treatment can create an unacceptable risk to cyclists and should only be used where provision of the preferred treatments is not practicable. While opinions vary, there is considerable concern (and growing evidence in the form of injury compensation claims by cyclists) that the construction of these devices in the centre of paths is hazardous to cyclists.

If bollards are to be used on paths they must be used in conjunction with a feature on the sides of the path to provide openings of no more than 1.6 m wide. They should also be conspicuous to cyclists and include line marking to direct cyclists away from the bollard. Figure 10.2 illustrates the layout of a bollard treatment while Figure 10.3 shows an installation.
Figure 10.2: Preferred layout for the use of a central bollard
For paths that are 4 m wide or more, consideration could be given to the installation of a U-rail instead of a bollard. This arrangement shown in Figure 10.4 includes a hazard marker that provides a larger surface area and hence greater conspicuity for the treatment.

Details of bollards and U-rails are provided in Figure 10.5.

Many instances exist where bollards are located in the centre of paths and no feature exists at the sides of the paths that would prevent access by motor vehicles and as such the devices serve no particular purpose. Where authorities are determined to maintain or construct central fixtures in the centre of paths the need must be justified in every instance; they should be effective in meeting their purpose, and should be provided with a high level of delineation. In particular, the locating of bollards and other fixtures centrally on paths is considered to be inappropriate at or near curves, or at intersections in the manoeuvring area of cyclists.
10.4.3 Staggered Fence Treatment

A treatment that should only be used where there is a very good reason (e.g. history of ride-out incidents, near misses or crashes) to slow cyclists down involves the installation of two sections of mesh fence as shown in Figure 10.6. It is important that the treatment has adequate lighting and is constructed of materials that are inherently conspicuous (i.e. all posts and mesh colours should contrast with the surrounding environment as viewed by the approaching cyclists) as total reliance on fitted delineation devices poses a risk to safety if the device is vandalised or poorly maintained.
However, the materials that are suitable for these treatments are generally not retroreflective and hence the treatment should be delineated, for example, with a hazard board on each fence section facing approaching cyclists.

Some road authorities do not favour this device because of concern that these treatments may:

- distract cyclists from concentrating on the task of processing more important information relating to surrounding traffic conditions
- create unnecessary conflict points and hazards for path users.

This type of treatment is particularly suitable for slowing cyclists down as it narrows the paths and requires cyclists to slow down to negotiate their way through the treatment. The key requirement with the treatment is to ensure that there is sufficient distance between the two fences so that cyclists are not forced to stop and dismount, or slow to the point where they become unstable during the manoeuvre. A minimum of 3 m is suggested.

Source: G. Veith.

**Figure 10.6: Staggered fence treatment**

**10.4.4 Offset Path Treatment**

An alternative to the staggered fence treatment, which is based on a similar principle, is to provide an offset path treatment as shown in Figure 10.7. The discussion and concerns relating to staggered fencing (Section 10.4.3) also apply to the offset path treatment.
Because the cognitive skills of primary school children are not fully developed, facilities provided specifically for this group or used frequently by this group may require more restrictive controls. The devices used should be kept as simple as possible and as well as slowing the cyclist to walking pace, should direct the cyclist so that the nearest conflicting traffic stream is readily seen.

### 10.5 Holding Rails

A holding rail is a U-shaped rail that is similar to the U-rail but placed in close proximity to both the edge of a path on the approach to an intersection with a road or another path. Its purpose is to provide a support for cyclists to hold onto whilst they await an acceptable gap in the conflicting traffic stream. Holding rails may also be provided in central refuges and medians. They therefore may be provided as part of the terminal treatment. An example of a holding rail is shown in Figure 10.8.

Holding rails should only be provided where there is a reasonable likelihood that cyclists will have to stop at intersections with roadways or paths. For example, they should not be provided at the intersections of paths with local streets and other paths where it is unlikely cyclists will have to stop and wait. In some jurisdictions holding rails also serve as a support for pedestrians who have a mobility impairment (including aged pedestrians) and use the rails to rest upon while waiting to cross roads.


**Figure 10.7: Offset path treatment**
The rails must be placed within easy reach of cyclists, on the left hand side of the path, to ensure that they:

- are conveniently located, enabling cyclists to stop without having to dismount or remove shoes from toe clips
- encourage cyclists to stop when appropriate
- assist the cyclists as they move off, reducing the time spent travelling through an intersection and aiding balance, thus improving safety
- in addition to other clues, provide a useful warning of the existence of an intersection.

To enable a holding rail to be most effective it is important that it is placed so that the cyclists using it can easily see approaching traffic and safely cross or enter the intersecting carriageway. If possible, holding rails should be located about 600 mm from the kerb line or edge of the intersecting roadway, and 300 mm from paths.

A sign-post extension on a holding rail has benefit in that it helps to minimise the number of posts near terminals. The sign should be located with a sufficient clearance to the intersecting road and high enough that it is not hazardous for cyclists.

To avoid the unnecessary proliferation of holding rails, they should not be installed at the traffic islands or approaches to signalised intersections unless specifically sought by users. Furthermore, holding rails should not be constructed centrally on paths due to the narrow section tubing used for rails and hence their less than obvious nature of the rails. In addition, holding rails should not be installed where it is required for cyclists to dismount because:

- regulatory stop signs are erected to face cyclists
- of the risk associated with the types of users and traffic conditions.
11 PROVISION FOR CYCLISTS AT STRUCTURES

11.1 General

The design of structures is very important to cyclists. Existing road bridges are often narrower than the road on the approaches thus creating a squeeze point for cyclists. Because of the high relative cost of new bridges there is an understandable tendency for designers to be as economical as possible in the widths provided for the various users. It is important, however, that road managers look for ways to better cater for cyclists at all existing structures and that designers and planners ensure that cyclists are adequately provided for in the design of all new structures.

The structures may cross rivers, railway lines or busy roads. They may be overpasses or underpasses that cater for motor traffic, small bridges or underpasses specifically for cyclists and pedestrians, large drainage culverts that also accommodate cyclists or a bicycle structure attached to a road bridge.

The primary requirements of cyclists using bridges and underpasses are that:

- adequate path width and horizontal clearances to objects (walls, safety barriers, kerbs, fences, poles, street furniture etc.) is provided
- adequate vertical clearance is provided, particularly in underpasses
- good sight lines are provided into and through structures
- the surface is smooth and not slippery under any conditions; a particular issue can arise with expansion joints that can provide a rough ride and be slippery when wet and designers should seek better methods and materials to address this issue.

11.2 Road Bridges

Where a bicycle facility is provided on the approach to a road bridge it is important that a similar facility be continued across (or under) the structure. This should always be possible in the case of new structures. In the case of existing structures it will not always be possible but in brownfield situations consideration should be given to implementing measures that will improve the situation for cyclists (e.g. reduce width of motor traffic lanes to make space available for cyclists; utilise footpaths as shared use paths).

The characteristics of pedestrians and cyclists at a site may require that an on-road bicycle lane is provided for commuter cyclists and a shared path is provided for other cyclists and pedestrians.

On-road facilities are discussed in the Guide to Road Design – Part 3: Geometric Design (Austroads 2009a). Paths at structures may involve:

- use of an existing footpath by pedestrians and all cyclists, or only young riders
- provision of a bicycle path, shared path or separated path of adequate width, the choice depending on the characteristics of users and demand.

Figure 11.1 shows a shared path on a long freeway bridge with a road barrier and 1.6 m high pedestrian barrier.
11.2.1 Use of Footpaths on Narrow Bridges

The footpaths on bridges should be available for use by young and inexperienced cyclists. If the width between kerbs on a two-lane two-way bridge is less than 7.4 m and footpaths exist on both sides of the bridge then ramps should be provided on both sides of the bridge so that experienced commuter cyclists can also use the footpath to avoid the squeeze point. Where a footpath exists on only one side of the bridge it may be possible to the path for one direction and provide a wide kerbside lane in the opposite direction.

The absolute minimum footpath width for one-way operation by pedestrians and cyclists is 1.5 m although a greater width (say 2.0 m) is desirable. Where there is a high number of users, and in the case of new construction, consideration should be given to the establishment of a separated one-way path.

11.2.2 Two-way Shared Use Paths Structures

Where a two-way shared use path is to be provided along a route, all bridges on the route should be designed to accommodate a two-way shared path of the same width. If both sides of an arterial road have extensive residential development it may be necessary to provide a two-way shared path on both sides of the structures on the road.

Where an existing bridge has a footpath only on one side and the traffic operating conditions, type of cyclist and bridge widths would preclude the provision of on-road bicycle facilities, consideration should be given to converting the footpath to a two-way shared path.

Where a two-way shared path is to be provided on only one side of a road, safe access to the path should be provided via appropriate at-grade crossings or by providing paths beneath any bridges near the abutments as illustrated in Figure 11.2. An example of a similar crossing is shown in Figure 11.3.
It is desirable that the width of two-way shared paths on one side of a bridge accord with Section 6.2. If a width of less than 2.0 m is available then it may be necessary to erect warning signs advising cyclists not to overtake or pass on the footpath.
If a two-way path for cycling is provided on a road structure the path on the approaches should be at least 1.2 m from the edge of the traffic lane and concrete kerb installed along the length of the structure and on the immediate approach. Pedestrian fencing having a height of 1.4 m (Figure 7.6), preferably set back at least 450 mm from the line of kerb, should be considered for installation on the footpath of the bridge to separate the cyclists from the motor vehicles in the adjacent traffic lane. The same treatment should be installed where for network reasons two-way shared paths, which are of adequate width and used by child cyclists, are installed on structures along very busy roads. However, such fences should not be installed where they are located on the inside of horizontal curves and would impede the required stopping sight distance for motorists.

Where it is considered that cyclists and pedestrians would be at an unacceptable level of risk due to the speed of traffic, alignment of the road and any other contributing factors, consideration should be given to the installation of a safety barrier to shield path users.

### 11.3 Grade Separated Crossings

#### 11.3.1 General

Grade separated crossings such as bicycle bridges, underpasses and overpasses may be provided to achieve a safe crossing of roads, rivers or railways. General guidance on the use of grade separations for use by pedestrians and cyclists is provided in the Guide to Traffic Management – Part 6: Intersections, Interchanges and Crossings (Austroads 2007).

Although often provided as part of a shared path network grade separations may be provided as a safe alternative adjacent to narrow road bridges or through the fill behind a bridge abutment. In difficult terrain a structure may be used to continue a shared path along the bank of a river.

#### 11.3.2 Use of Existing Culverts

The desirable vertical clearance within an underpass is 2.5 m. However, this height is problematic in that a standard height of 2.4 m has been used in many existing drainage culverts constructed with crown units and is adequate. In relation to severely constrained sites, culverts with a vertical clearance of only 2.0 m have been successfully utilised to accommodate paths for cycling under roads and this is considered to be acceptable when utilising existing structures.

The relative advantages and disadvantages of using a culvert with limited clearance rather than an at-grade crossing should be evaluated. If it is decided to use a culvert of limited height, signs should be erected to warn cyclists of the reduced headroom. Other steps should also be considered including some form of external (to the culvert) roof transition (from a height of 2.5 m to the height of the culvert roof) to negate the chance of a cyclist colliding with the abrupt low roof face of a culvert. Where a square corner cannot be avoided on the culvert ceiling at the entrance to the culvert some form of cushioning should be provided on the headwall to minimise injury to cyclists who may impact their head against it.

A drainage culvert should not cater for cyclist/pedestrian use unless it satisfies the recommendations in Section 7.6.2 for drainage, whilst providing adequate vertical clearance. Appropriate warning signs should be installed advising of alternative crossing points for use during higher water flows. A connecting path between the recreational path and the road is always provided to facilitate access to the path and is generally suitable for use as a bypass during high water flows. It is essential that good sight distance is provided to the culvert entrances so that cyclists have adequate warning and can see any debris, silt, etc. that may have built up around and in the culvert during and after these conditions.
If an underpass is used the alignment of the path on the approach should be designed such that users can see through the culvert. Vandal-proof lighting should also be provided in underpasses for shared paths.

Underpasses of roads should be constructed with minimal cover between the top of the underpass and the road. Whilst this may necessitate the relocation of services it has the advantage that shorter approach ramps can be used requiring less overall space. Also better opportunities for the provision of adequate sight lines may be possible in order to enhance personal security.

The gradients on approach ramps to shared path overpasses and underpasses should be in accordance with the requirements of AS 1428.1, which are summarised in Section 7.4 and Table 6.2. Where the facility is an exclusive bicycle path a steeper gradient is permissible in accordance with Figure 7.1.

On existing structures that incorporate right angle landings in the alignment of the approach ramps, or where adequate sight distance cannot be provided, warning signs advising cyclists and other users of the hazards should be erected.

11.4 Bicycle Wheeling Ramps

Where it is not possible to locate a path for cycling so that an acceptable gradient is achieved a bicycle wheeling ramp (Figure 11.4) may be provided to accommodate a significant change in level over a short distance.


Figure 11.4: Bicycle wheeling ramp (Yarra Path Vic.)
Wheeling ramps should be used as a last resort and should not necessarily be regarded as a treatment that serves the needs of cyclists well. They can be as unsatisfactory to recreational cyclists (i.e. carrying children) as for commuters (due to inconvenience). They are generally regarded as inappropriate where used in association with new path facilities if alternative path access is possible.

Existing stairs can often be readily modified to provide for cyclists by the addition of a ramp formed by concrete infill or steel plate. Ramps may be either on the sides or within a median of the stairs.

Also:
- Wheeling ramps should be provided on both sides of stairways where significant bicycle volumes exist.
- CROW (1993) recommends that the gradient of ramps should not exceed about 25°.
- Narrow channels (75 mm to 150 mm wide) or channels that are rounded at the base should be used to improve the ease of wheeling for cyclists. A channel designed to accommodate what is on average the widest bicycle tyre (i.e. that of a mountain bike) would be ideal.
- The channel should be constructed approximately 0.4 m from a fence or wall, or so as to avoid the catching of pedals or handle bars.
- Handrails should be constructed as close as practical to the fence or wall, when erected adjacent to a wheeling ramp.
- Wheeling ramps should be constructed with a smooth transition onto and off of the ramp.
- It may be desirable to construct the ramp with a kerb (Figure 11.5) to limit the possibility of pedestrians inadvertently stepping onto the ramp section.
- It would be prudent to construct the ramp so as to minimise the possibility that it may be cycled on.

Source: Adapted from Austroads (1999).

**Figure 11.5: Bicycle wheeling ramp key dimensions**
12 CONSTRUCTION AND MAINTENANCE CONSIDERATIONS FOR PATHS

12.1 General

If bicycle paths are not adequately constructed and maintained, cyclists are not likely to use them, or may swerve in order to avoid surface irregularities thus creating a hazardous situation.

Smooth, debris free surfaces are a fundamental requirement for riding bicycles in safety on paths. As cyclists ride at speeds up to 50 km/h on downhill grades, a rough surface or pothole can cause a cyclist to fall, leave the path and crash or come into conflict with other path users. Most bicycles have no suspension or shock absorbers and many bicycles have relatively thin tyres inflated to high pressures. Consequently, when a cyclist hits a pothole at speed it is most uncomfortable, difficult to maintain control and potentially hazardous for the cyclist.

In order to gain an appreciation of the problems faced by cyclists with respect to maintenance it is suggested that road maintenance supervisors should ride a bicycle over sections of path used by cyclists. This enables a more detailed examination of the surface to be made including problems that are easily missed from a patrol motor vehicle.

A substantial capital investment is often made in providing bicycle paths and jurisdictions authorities should also have an effective management regime to define responsibilities and to ensure that these facilities are adequately maintained.

Reference should also be made to Appendix B regarding construction and maintenance considerations.

12.2 Bicycle Safety Audits

Section B.5 of Appendix B presents the concept of a bicycle safety audit as part of a quality system. Bicycle safety audits are as important as safety audits that relate to other road users and should also comply with guidelines presented in the Guide to Road Safety – Part 6: Road Safety Audit (Austroads 2009).

Bicycle safety audits should be applied to both on-road and off-road facilities, existing and proposed facilities, and all stages of the development of proposals from feasibility studies to pre-opening of the facility. An example of a bicycle safety checklist is provided in Appendix C. Such lists should be used in conjunction with Austroads lists that relate to road design, transportation and traffic in general.
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APPENDIX A APPLICATION OF ENVELOPES AND CLEARANCES TO DETERMINE THE WIDTHS OF PATHS

Various common path operational scenarios are shown in Figure A 1, Figure A 2 and Figure A 3. These form the basis of the widths provided for paths in Section 6 of the guide. Designers should review the likely operational characteristics of paths during the design process to determine the appropriate path width.

A.1 Bicycle Paths

With reference to bicycle paths and Figure A 1.

- 3.0 m is the desirable width for a path where high speeds (i.e. \( \geq 35 \) km/h) are possible.
- 2.5 m is the acceptable minimum path width for paths with a predominant purpose of commuting, during periods of peak use.
- 2.0 m is the absolute minimum path width where paths experience very low use at all times and on all days or where significant constraints exist limiting the construction of a wider path, and may be acceptable for a commuting path where the path user flows are tidal in nature.

Whilst unlikely, it is technically possible that situations exist where wider paths may be justified i.e. where there are high speeds, and where high 'concurrent' bicycle volumes exist for both directions, such that passing within the lane in each direction is necessary.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Overall width of path</th>
<th>Predominant path purpose</th>
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<tbody>
<tr>
<td>A</td>
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<td>Local access</td>
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<td></td>
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<td>• Constrained conditions</td>
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<td>• 'Tidal flow'</td>
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<td></td>
<td></td>
<td>• Low use</td>
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<tr>
<td>B</td>
<td>2.5 m</td>
<td>Commuting and local access</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Regular use</td>
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<tr>
<td></td>
<td></td>
<td>• 20 km/h</td>
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<tr>
<td>C</td>
<td>3.0 m</td>
<td>Commuting</td>
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<td></td>
<td></td>
<td>• Frequent and concurrent use in both directions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 30 km/h+</td>
</tr>
</tbody>
</table>

Source: Austroads (1999).

Figure A 1: Bicycle path operation
A.2 Shared Paths

Although recreational paths attract individual cyclists and pedestrians who use paths for pleasure and to improve health and fitness, it also attracts many people who ride or walk in pairs or groups as a social outing. An essential aspect of this group activity is to share the experience and converse with other cyclists en-route, and for cyclists this requires them to ride two abreast. When this occurs on paths that are not quite wide enough the result is that cyclists encroach into the travel path of cyclists approaching from the opposite direction with the risk that collisions may occur. In response to this type of recreational activity there is a growing acknowledgement that a width of 3.0 m is not adequate for major recreational paths.

With reference to shared use paths and Figure A 2:

- Major recreational paths should be 4.0 m wide to permit the cyclist groups/couples to pass pedestrian couples or other cyclist groups, or to permit cyclists travelling in opposite directions to pass pedestrians with convenience and safety. However, it should be noted that in some jurisdictions cyclists may be prohibited from riding side-by-side on shared paths.
- Shared use paths often experience a mix of simultaneous commuting and recreational use and in these circumstances should have a minimum width of 3.5 m.
- 2.5 and 3.0 m are the absolute minimum widths for paths having a predominant purpose of commuting and recreation respectively, during periods of peak use.
- 2.0 m is an acceptable path width where paths experience very low use at all times and on all days, where significant constraints exist limiting the construction of a wider path, and may be acceptable for a commuting path where the path user flows are highly tidal in nature.
- 3.0 m is the minimum path width for a path where high speeds (i.e. 30 km/h +) occur.

A.3 Separated Paths

In most instances a separated path is preferred where a combination of user volumes, clearances and other factors indicate that the path should be constructed with a width in excess of 4.0 m. This is to maximise the efficient use of the path, and to make user movements more predictable in what may otherwise be a wide ‘undefined’ pavement area.

Figure A 3 illustrates the operation of a one-way separated path. With reference to one-way separated paths and Figure A 3:

- 1.5 m is the desirable width for this treatment and is appropriate for paths used by commuter cyclists, and where relatively high cyclist speeds (30 km/h+) exist.
- 1.2 m is the absolute minimum path width and should only be used for local access paths (where commuters and other higher speed cyclists are a small proportion of all users), where cyclist speeds are relatively low, and where the path abuts an adjoining footpath not less than 1.2 m wide.

Also, 2.0 m is the maximum width that would normally be required where passing within the cyclists’ path section occurs or where it is desirable that passing manoeuvres by cyclists occur outside of the footpath section of the facility.

In contrast to separated two-way paths, a barrier separating the bicycle and pedestrian path sections is not usually required for separated one-way paths. However, physical separation should be considered in situations such as where path conditions are congested or where unsafe conditions exist due to the path users.
In the event that a barrier is used to separate the bicycle and pedestrian path sections, then a wider footpath section may be required to allow passing manoeuvres on that section of the path, amongst other reasons (e.g. pedestrian volumes).

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Overall width of path</th>
<th>Predominant path purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2.0 m</td>
<td>Local access</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Typical circumstances of use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Constrained conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tidal flow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Low use</td>
</tr>
<tr>
<td>B</td>
<td>2.5 m</td>
<td>Commuting and local access</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Regular use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• &lt;20 km/h</td>
</tr>
<tr>
<td>C</td>
<td>3.0 m</td>
<td>Commuting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Frequent and concurrent use in both directions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• &lt;30 km/h</td>
</tr>
<tr>
<td>D</td>
<td>3.0 m</td>
<td>Recreation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Regular use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• &lt;20 km/h</td>
</tr>
<tr>
<td>E</td>
<td>3.5 m</td>
<td>Commuting and recreation (concurrent)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Frequent and concurrent use in both directions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• &lt;30 km/h</td>
</tr>
<tr>
<td>F</td>
<td>4.0 m</td>
<td>Major recreational path</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• &lt;20 km/h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Heavy and concurrent use in both directions</td>
</tr>
<tr>
<td>G</td>
<td>4.0 m</td>
<td>Major recreational path</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Regular group rides</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Heavy and concurrent use in both directions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Generally low speed due to congestion</td>
</tr>
</tbody>
</table>

Source: Austroads (1999).

Figure A 2: Shared use path operation
### Table 1: Path Width and Purpose for Separated One-Way Path Operation

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Overall width of path</th>
<th>Predominant path purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2.5 m</td>
<td>Commuting and local access</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ Typical circumstances of use</td>
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<tr>
<td></td>
<td></td>
<td>+ Constrained conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ 20 km/h</td>
</tr>
<tr>
<td>B</td>
<td>3.0 m</td>
<td>Commuting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ Frequent and concurrent use in both path sections</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ 30 km/h+</td>
</tr>
</tbody>
</table>

Source: Austroads (1999).

**Figure A 3:** Separated one-way path operation
APPENDIX B PATH CONSTRUCTION AND MAINTENANCE

B.1 General Requirements

Careful location, design and construction of paths for cycling can reduce future maintenance requirements. Careful attention to drainage, the location of vegetation and the type of vegetation planted can assist in minimising maintenance. A large amount of maintenance can be prevented if debris is not washed onto paths, if the roots of inappropriate plant species do not cause pavement damage and trimming of overhead branches is not required.

The path alignment and cross-section should be designed to minimise the amount of debris, which can wash onto the path surface. Paths adjacent to watercourses should be located so that the likelihood of inundation and the resulting slippery surface is reduced.

Bushes that will not grow tall enough to obstruct sight distance should be planted on the inside of curves. Trees should be chosen and planted away from the edge of paths so as to minimise the likelihood of roots causing deformation and cracking of the path surface.

Most authorities would be aware of the financial implications of failing to maintain roads, and yet it is not uncommon for paths to be substantially neglected after construction. Paths for bicycles should be included in asset management programs in a similar manner to roads, to ensure a safe and useable riding surface and also to avoid the increasing cost of maintenance or reconstruction as a result of the asset degradation.

It is essential for effective maintenance operations that all aspects of the design allow for ease of access for all necessary maintenance plant (i.e. truck, backhoe, mowers), not only to the path but abutting reservations that do not have alternate access. As the construction may not be performed by the authority performing the maintenance, consultation should be undertaken throughout the design process in order to determine maintenance requirements.

B.2 Path Maintenance Requirements

Regular maintenance activities on paths should include:

- filling of cracks (Figure B 1)
- trimming or removal of grass so that it does not intrude into the path (Figure B 2)
- sweeping of paths to remove debris such as broken glass and fine gravel (including that arising from construction and maintenance activities such as crack sealing)
- re-painting of pavement markings
- cleaning of signs
- trimming of trees and shrubs to maintain safe clearances and sight distances.
B.3 Provision at Works

B.3.1 General

When construction and maintenance work is carried out involving trenching or other construction work across roads and paths, access for cyclists (and pedestrians in the case of shared paths) should be maintained, and to a satisfactory quality to avoid the use of alternative routes which may be hazardous or inconvenient for cyclists (and pedestrians).

Construction and maintenance works should be undertaken in such a way that these activities do not place cyclists at risk during the works period. This is particularly important, for instance, where a sealed shoulder is closed for maintenance on freeways or other high speed roads where cyclists may be permitted.

Also, whilst different standards are sometimes applied to paths, it is worth noting that an open trench in a road is potentially no less hazardous than one that is adjacent to a well-used path.
B.3.2 Signing and Delineation at Work Sites on or Adjacent to Paths

The signing and delineation of construction and maintenance works on roads and footpaths should be performed in accordance with AS 1742.3 and any relevant local codes of practice and regulations. In general, provision for works on paths should be made in accordance with the principles of these standards. Additional consideration of cyclists should be made in accordance with the details set out below.

As a principal objective of provision for cyclists adjacent to the works site, the riding surface should be maintained in a clean and smooth state. This may necessitate sweeping of the riding surface on at least a daily basis.

Figure B 3, Figure B 4 and Figure B 5 highlight the desired level of provision required in the vicinity of works, depending on the circumstances. The actual provisions to be made are dependent on the conditions that exist, including:

- presence of a traffic controller
- existing level of bicycle use, and also of pedestrian use in the case of shared use path diversions
- available opportunities to provide for cyclists
- road or path alignment
- traffic speeds and volumes
- duration of work
- surface material and condition
- environmental impacts.

Provision for cyclists on roads should be made in the following circumstances:

- where bicycle lanes exist
- arterial roads
- collector roads, with an AADT in excess of 3000 vehicles per day
- strategic and other significant bicycle routes.

Safety barriers should be provided where required by AS 1742.3, and are generally appropriate where cyclists or pedestrians are detoured onto roads. Temporary (lower) speed limits may also be appropriate in this circumstance.

With reference to Figure B 3 where adequate provision for cyclists is not possible on a road, access along a path in the area of the roadside verge may be appropriate. Provided adequate separation from the work area can be maintained, it is generally acceptable to initiate and terminate the roadside verge bicycle access within the road lane transition zones either side of the work area.

For paths, reference should be made to Section 3 (in relation to paths located away from road reserves) and to Section 3.5 (separated paths) where temporary roadside verge access is required. The controls highlighted in these sections are applicable to temporary paths.
Containment fences should be provided in accordance with the requirements of AS 1742.3, and otherwise as required by the *Guide to Road Design – Part 6B: Roadside Environment* (Austroads 2009g). These may be appropriate to separate pedestrians and cyclists where a footpath is to be used for access by cyclists, and where:

- significant pedestrian or bicycle volumes exist
- safety issues may arise due to the unexpected use of a footpath by cyclists.

Examples of provisions for paths located adjacent roads and in reserves are shown in Figure B 4 and Figure B 5 respectively.

Temporary paths should be sealed. Whilst dependent on circumstances, such as bicycle volumes, safety and the extent of inconvenience to cyclists, this may be unnecessary where:

- the works are carried out over a short period (e.g. less than 2 or 3 weeks duration)
- the temporary path surface is firm, smooth and free of thorns
- the works are carried out during dry weather conditions
- path traffic is minimal.

However, it is very desirable that temporary paths are sealed and delineated where works are carried out over longer periods. Separated paths should be suitably delineated regardless of the period of construction.

Where works on paths are carried out for a period exceeding one day, the works should be made sufficiently visible for night-time path travel, so that path users are able to observe conditions under low ambient light conditions including temporary access paths, and take appropriate action. In addition, as a general principle, lighting on temporary access paths should not be less than the existing level on the original path.

Specific consideration may need to be given to the intersections of paths and roads. The measures taken to protect traffic should be balanced with consideration to all of the potential users and movements at such locations.

Where containment fences are used, to avoid catching the pedals of cyclists the fence should be set back from paths used by cyclists by at least 0.3 m. In the case of flexible mesh fencing particular care is needed to ensure it remains tightly stretched and that it is supported regularly along its length.

Surface tolerances for bicycle riding surfaces are provided in Section 4.2.3

Where steel road plates are used to cover excavated or damaged pavement surfaces, appropriate steps should be taken to ensure that any steps and grooves are within the permissible tolerances.
Suitable kerb ramp
(at least 2 m long)

Refer section 6.2.1 for width

Temporary path access where suitable on road provision not possible

Containment fence

Cyclists’ route

Refer AS 1742.3 for road signing and delineation provision

Source: Based on Austroads (1999).

Figure B 3: Works on roads – exclusive bicycle path diversion

Source: Based on Austroads (1999).

Figure B 4: Works on paths adjacent roads – shared use path diversion
B.4 Pavements for Cycling

B.4.1 Pavements for Bicycle Paths

The pavement of paths for cycling must be designed and constructed to a standard that ensures a satisfactory level of service for cyclists throughout the life of the facility.

The maintenance activities discussed previously require the use of a truck and other substantial machinery. If paths are not designed to carry the live loads imparted by this equipment then pavements will suffer structural damage, which will affect use of the facility, and be expensive to repair. All paths should therefore be designed to withstand at least a fully laden small truck.

Most paths should have a hard weatherproof surface. Primarily they can be constructed as a flexible pavement of crushed rock surfaced with asphalt or a bituminous seal, or as a rigid concrete pavement.

It is vital that the sub-grades of both flexible and rigid pavements are compacted to a satisfactory standard and soft areas are treated. It may be necessary in some cases to assess sub-grade conditions along the line of the proposed path.

Typical cross-sections of flexible and rigid pavements are shown in Figure B 6. Individual state and local government authorities will have a preference for particular types of pavement based on experience using local materials that should result in economical pavements. Appropriate pavement design advice should be sought in every instance.

Where paths are located on river banks and likely to become inundated they should be constructed of concrete to provide greater resistance to scour by flood water.

Coloured pavement surfaces are used in some instances (refer to the Guide to Traffic Management – Part 10: Traffic Control and Communication Devices (Austroads 2009b)).

B.4.2 Bituminous Surface Pavements

Flexible pavements (Figure B 6) have in the past been favoured in some jurisdictions because they are usually cheaper to construct than concrete and have in general provided superior riding qualities.
A recent innovation has been the use of geofabric reinforced bituminous concrete and double spray seal pavements. In addition to a typical flexible pavement design, examples of geofabric reinforced pavements and concrete pavements are shown in Figure B 7. The spray seal version has been used as an economical solution where significant sub-grade movement was expected.

Asphalt mixes should be similar to those used for lightly trafficked streets. The aggregates used for asphalt should not exceed 10 mm nominal size. In the case of sprayed seals, the aggregate size should not exceed 7 mm. Larger aggregates result in an unacceptably rough surface.

Source: Austroads (1999).

Figure B 6: Asphalt path (Croydon Park, NSW)
B.4.3 Concrete Pavements

The use of concrete paths can be beneficial on the basis of whole of life costs, but only where appropriate construction methods are employed. In general, concrete paths have a longer life and are relatively unaffected by:

- inundation and should therefore be preferred for paths close to watercourses
- the deleterious effects of vegetation either at cracks or along the path edges
- low levels of maintenance
- the absence of motor traffic (important to the condition of bituminous pavements)
- poor sub-grade conditions in some instances

Figure B 7: Typical pavements for paths

For construction purposes road authorities should have detailed requirements and specifications for pavements on bicycle paths and shared paths. An example from New South Wales (RTA 2005) is provided in the Commentary 12.
occasional heavy traffic (in the case of reinforced paths).

Concrete paths should be of sufficient strength to resist cracking and differential vertical movement. A skid-resistant surface finish should be provided by transverse brooming of the wet concrete. Similar attention should be given to the smoothness of path sections both at joints and in between.

The development of advanced concrete path construction techniques and products has resulted in significant improvements in rider comfort. It is critical that such techniques (C&CAA 1996, 1998) are employed. They include:

- Preformed or saw-cut contraction joints. As a consequence bull floating, trowelling and broom finishing can be extended right up to the joints resulting in a considerably improved riding surface. In particular, wet formed contraction joints made using a grooving tool, should be avoided. The sealing of contraction joints may be important to minimise the ingress of dirt and to limit weed growth amongst other benefits.

- The use of extended bull floats (up to 4 m wide) to avoid long wave corrugations that affect cyclists travelling at speed.

- Narrower and fewer joints.

It is sometimes perceived that the contrast between the colour of lines and concrete surfaces is insufficient. Conversely, concrete paths are thought to offer a high standard of delineation for cycling in dark conditions. As for other path surface types, it is important that pavement markings are maintained on concrete paths to a high standard, as illustrated by Figure B 8.
B.4.4 Unsealed Paths

Consideration may be given to the provision of a stabilised unsealed surface as the first stage of development where:

- it is necessary to reduce construction costs
- the path is unlikely to flood to the extent that excessive damage to an unsealed path or excessive maintenance costs will result
- where the volume of cyclists initially using the path is expected to be low
- flat gradients exist (e.g. less than 3%)
- to reduce costs
- where the environmental amenity of an area will be reduced by a sealed path.

The second stage would be the provision of an asphalt, or bituminous surface, or possibly of a concrete surface.

Care should be taken in the selection of the (unsealed) surface material to ensure that the riding surface is smooth and well bound, as cyclists will not be attracted to a path that has a poor surface. Well graded river gravels are most suitable. Materials that result in loose surfacing should not be used under any circumstances. Good drainage is also an important factor in the success of gravel paths.

B.4.5 Timber Surfaces

Gaps between longitudinal planks in timber decks (Figure B 9) can trap bicycle wheels and cause serious injuries to cyclists. Consideration should therefore be given to remedial treatment of existing timber bridges such as through an asphalt overlay of the outer 1.0 m sections of deck to provide a smooth, safe ride for cyclists. At the very least warning signs should be provided on the approaches to bridges that have longitudinal gaps in the deck.

On new timber bridges the planks should be placed perpendicular to the direction of travel of cyclists. In constructing and maintaining bridges it is important to ensure that the deck joints at abutments and piers provide a smooth and hence safe passage for cyclists.

Drainage should not be a problem when one considers the number of gaps in the decks of timber bridges. However, individual planks have the potential to warp and collect small, localised pools of water. Timber surfaces can be slippery in wet or shady conditions. Where these circumstances are common the application of a non-slip finish is also desirable, regardless of the alignment of planks.
B.5 Quality Systems

B.5.1 General

Quality systems should ensure that when a road or path has to be ‘opened’ or repaired, it is restored to the correct standards of compaction and surface quality so that the patch does not subside with the passing of time, and the surfacing of the patch does not have an abrupt edge. Subsidence of backfill and pavement at trenches across roads and paths is particularly concerning because cyclists are unable to avoid a trench as they might avoid an isolated pothole.

B.5.2 Bicycle Safety Audits

It is important to focus on the needs of cyclists, as for other road users in relation to the planning, design, maintenance and construction of road and path infrastructure. The implementation of a system of auditing in relation to cycling facilities, either integrated with a similar process for roads, or otherwise, is recognised as the most appropriate means of assessment for roads and paths used for cycling.

Detailed guidance on auditing processes is provided in Austroads (2009g). A broad listing of various issues of concern in relation to cycling facilities is provided in Appendix C to assist in the preparation of structured bicycle safety audit checklists.
APPENDIX C  BICYCLE SAFETY AUDIT CHECKLIST

C.1  Introduction

In accordance with the Austroads road safety audit process (Austroads 2009); it is appropriate that audits of bicycle routes and other facilities are conducted at various stages from planning through to construction, and in relation to existing infrastructure.

The lists of items in the sections below represent the possible contents of a checklist to assist the identification of relevant safety issues or concerns associated with bicycle facilities. It is unlikely that they include all of the issues that are of relevance or concern to cyclists, particularly given the wide variation in construction and design practice, and the conditions that exist.

It is therefore essential that personnel conducting audits of bicycle facilities are experienced in and knowledgeable about the provision of bicycle facilities.

Individual items provided in the lists may be applicable during several audit stages or may only relate to existing infrastructure.

Where existing infrastructure is to be audited, it is important that to some degree the audit is performed on a bicycle and on foot. The type of bicycle used should be representative of the most common type in the region of the audit, but should not have a suspension system or tyres thicker than 32 mm.

Similarly, it is important that safety audit personnel ride at speeds typical of most users – which may be in excess of 25 km/h. Riding at slower speeds may not reveal potential problems such as geometric limitations or pavement surface defects.

Section C.2 is generally applicable to roads, paths and intersections. The requirements that relate mainly to either paths or roads are provided in Section C.9 and Section C.10 respectively.

In so far as roads are concerned, it is assumed that general road safety auditing processes exist, and hence the lists below represent additional considerations for bicycles.

C.2  General Requirements for Roads and Paths

- Are the designated crossing points and routes appropriate and acceptable to meet the required cyclist demand?
- Are the characteristic bicycle use patterns accommodated (i.e. categories of cyclists, volumes, times of travel)?
- Do the proposals account for surrounding bicycle network deficiencies and opportunities?
- Do consistent and suitable provisions exist for the respective categories of cyclists anticipated along the route, or can they be achieved; for instance, is a path required for children and inexperienced cyclists?
- Are grade separated or controlled crossings required?
- Are traffic calming or local area traffic management measures required? (refer to the Guide to Traffic Management: Part 8 – Local Area Traffic Management) (Austroads 2008b).
- Are the requirements of local codes of practice met?
C.3 Alignment and Cross-section

- Does the cross-section of the lane/path facility safely accommodate the anticipated cyclists?
- Are stopping sight distances adequate for all traffic, accounting for paths, roads, driveways, railways etc.?
- Are sight lines applicable to the operation of cyclists obscured by obstacles such as signs, trees, pedestrian fences and parked cars?
- Is the horizontal and vertical alignment suitable? If not, are warning signs installed?
- Are there any sections of riding surface which may cause confusion for users, e.g.:
  - Is alignment of the riding surface clearly defined, particularly at unexpected bends or for dark conditions?
  - Have disused pavement sections been removed or treated?
- Is sufficient route information or guidance provided?
- Does the design avoid or minimise the need for cyclists to slow or stop?
- Do hazardous conditions (e.g. concealed intersecting paths, curves) exist at the bottom of steep gradients?

C.4 Signs, Delineation and Lighting

- Are all necessary pavement markings provided?
- Are there any redundant pavement markings? Have redundant pavement markings been properly removed?
- Are all necessary regulatory, warning and direction signs provided and located appropriately? Are they conspicuous and clear in their intent? Are they at a safe distance/height with respect to the riding surface?
- Are signs in good condition and of an appropriate standard?
- Are there any redundant signs?
- Are fixed objects close to or on the path (trees, fences, holding rails, etc.) treated to ensure visibility at night (e.g. painted white and fitted with reflectors or reflective tape)?
- Are pavement markings clearly visible and effective for all likely conditions (e.g. day, night, rain, fog, rising or setting sun, oncoming headlights, light coloured pavement surface, poor lighting)?
- Are user movements obvious or delineated through intersections?
- Is public lighting of facilities required? Is the lighting design satisfactory, particularly at tunnels, underpasses and areas of high pedestrian activity? Is it operating satisfactorily?
- Are raised pavement markers recessed flushed with the surface or located outside of the paths of travel of cyclists, or outside of bicycle lanes?
- Are thermoplastic markings chamfered?

C.5 Riding Surface

- Is the riding surface suitable for cycling?
- Is the riding surface and edges smooth and free of defects (e.g. grooves, ruts or steps) which could affect the stability of cyclists or cause wheel damage?
• Is the pavement design/construction of a satisfactory standard?
• Can utility service covers, grates, drainage pits etc., be safely negotiated by cyclists?
• Are smooth and flat gutters/channels provided at stormwater drainage pit inlets?
• Is the riding surface free of loose materials (e.g. sand, gravel, broken glass, concrete spills)?
• Is there suitable protection to prevent sand or other debris from depositing on the riding surface?
• Does the riding surface have adequate skid resistance, particularly at curves, intersections, bridge expansion joints and railway crossings?
• Is the riding surface generally free of areas where ponding or flow of water may occur?
• Is special protection required to prevent cyclists from running off the riding surface?

C.6 Vegetation, Maintenance and Construction

• Is suitable access for cycling available during maintenance and construction activities? (refer to Appendix B).
• Are all locations free of construction or maintenance equipment?
• In the absence of an appropriate and regular maintenance program:
  — Is there a possibility of the encroachment of grasses into bituminous riding surfaces (e.g. kikuyu) or similar circumstances that could result in poor edge conditions or pavement degradation?
  — Do thorn-bearing grasses (e.g. caltrop) exist, or are they likely to be introduced adjacent to the riding surface?
  — Are channels, kerb slots or similar treatments over which cyclists ride, located under deciduous trees etc., or otherwise likely to experience a build up of debris due to poor drainage conditions?
• Will crack sealing processes or the application of spray seals result in the presence of loose/granular material/sand on the riding surface?
• Does landscaping allow adequate clearances, sight distance etc, and will these be maintained given mature plant growth?
• Could personal security of path users be adversely affected due to the position of bushes and other landscape features?
• Is landscaping required as a wind break?
• Will the positioning of trees and the species used contribute to the degradation of the pavement (e.g. through undermining or moisture variation)?

C.7 Traffic Signals

• Are separate pedestrian and/or bicycle phases provided where necessary?
• Do traffic signals operate correctly? Are signal displays located appropriately for all users?
• Does the design of the signals prevent conflicting motor vehicle movements during crossing phases for pedestrians and cyclists?
• Where a permanent demand for individual phases does not exist, have suitable detection facilities been provided for cyclists? Are these operating satisfactorily?
• Are inductive detector loops provided for bicycle users, are they located appropriately, of a suitable design and do they operate correctly for bicycles in the various stopping positions?
• If push-button actuators have been provided, are they located to allow convenient and legal operation from the normal stopping position (e.g. on the left of riding surface or kerb ramp, behind stop line)? Do they operate correctly?
• Are phasing and phase times acceptable? Are suitable warning signs or guidance for cyclists erected where intersection crossing times are insufficient?

C.8 Physical Objects
• Are fences, safety barrier or other objects located within 1.0 m of the path(s) of cyclists:
  — free of sharp edges, exposed elements or corners so as to minimise the risk of injury to cyclists in the event of the feature/object being struck by a bicycle?
  — designed to minimise the potential for bicycle handle bars or pedals to become caught in the feature should an errant bicycle collide with it.
• If there are any obstructions located adjacent to the paths of cyclists, are they adequately delineated?
• Are clearances to the operating space of cyclists acceptable?

C.9 Paths
This section should be read in conjunction with Section C.2.

C.9.1 General
• Are automatic reticulation systems timed to avoid periods of significant path use? Do sprinklers spray away from the path (rather than across it)?
• Do irrigation hoses need to be placed across path surfaces?
• Are provisions for car parking in the vicinity of the path satisfactory in relation to the operation and safety of path users?
• Are there any potential problems of conflict between the various path users (e.g. pedestrians and cyclists)?
• Is the path subject to flooding? If so, are warning signs provided and located appropriately?

C.9.2 Alignment and Cross-section
• Where paths are located adjacent to roads, is there sufficient separation and/or protection from the carriageway?
• Are adequate overtaking opportunities provided?
• Is the path width, at structures or otherwise, adequate for the likely usage levels of pedestrians and cyclists?
• Is the geometric alignment and gradient satisfactory?
• Is the design speed appropriate?
• Is path crossfall suitable for the anticipated path users?
• Is the crossfall steep enough to adequately drain the path and prevent ponding on the surface, while being flat enough to be comfortable for pedestrians?
C.9.3 Intersections

- If justified, is path priority assigned to path users at road crossings?
- At intersections with busy roads, are appropriate facilities provided, e.g. traffic signals, underpass, overpass or median refuge, to allow path users to safely cross? Are the intersection controls satisfactory?
- Is the location of road/path or path/path intersections satisfactory and obvious with respect to horizontal and vertical alignment?
- Is the presence of intersections obvious to road/path users?
- Is a refuge required at road crossings? Would it adversely affect (e.g. squeeze) cyclists travelling along the road?
- In relation to path entry controls:
  - Are terminal devices required? If so, does the device design meet the requirements of this guide?
  - If central holding rails or bollards exist, is there a legitimate reason why they are needed, and if so is there sufficient pavement width either side?
- Are kerb ramps adequate and suitable for all users (width, slope, flush surface)? Are turning radii adequate?
- Are holding rails provided? Are they positioned so as to not unduly interfere with access for cyclists and other users (consider tandem bicycles, bicycles with trailers etc.)?
- Are the controls associated with path/path intersections satisfactory?

C.10 Roads

Whilst this guide relates to paths it is often the case that road and path treatments interface therefore this section contains some information relating to roads that may impact on path users.

C.10.1 General

- Are bicycle lanes required?
- Are bicycle lane widths or the left traffic lane widths adequate to accommodate cyclists?
- Can sufficient space be obtained? Are there any squeeze points for cyclists?
- Does the construction of the lane facility conform to this guide and other relevant standards?
- Are special provisions required along curving roads?
- Are road markings for cyclists suitable and adequate, and do they meet relevant standards?
- On controlled access roads, is a commuter path required within the reservation?
- Are local area traffic management treatments appropriate for bicycles?
- Are drainage pit covers flush with the surface or are there level differences that could be hazardous to cyclists and pedestrians?
- Is the positioning of bicycle pavement symbols potentially hazardous to motorcyclists?
- Are sealed shoulders at least as smooth as traffic lanes?
C.10.2 Intersections

- Are the intersection treatments appropriate?
- Are there any common cyclist movements (legal or otherwise) that differ from typical traffic movements? Are these likely to be anticipated by other traffic? Can these movements be made safely and if not what remedial measures are required?
- Are ‘head start’ storage areas required due to conflicting manoeuvres of bicycles and other traffic, or due to high cyclist volumes?
- Are special provisions for cyclists required at roundabouts?
- Are there continuity lines marked where appropriate?
- Are grated drainage pits that are potentially hazardous to cyclists and pedestrians located within the road/path intersection or within the turning path of cyclists (i.e. radii in the corners of the intersection)?
- Are grated pits on paths or in close proximity to paths properly designed so that they cannot trap bicycle wheels?
COMMENTARY 1

Where sufficient demand exists, separate paths should be provided for the exclusive use of cyclists and pedestrians. Separated paths may reduce the potential for conflict and allow the bicycle path section to operate at a reasonable speed.

An indication of the extent of other users normally found on shared use paths is shown in Table C1 1.

Table C1 1: Categories of users of shared paths

<table>
<thead>
<tr>
<th>Category of user</th>
<th>Specific users within category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrians</td>
<td>children, elderly, people pushing prams &amp; strollers, family groups, dog walkers, joggers</td>
</tr>
<tr>
<td>Cyclists</td>
<td>children, families, adults, individuals &amp; groups, power assisted bicycles</td>
</tr>
<tr>
<td>Users with disabilities (vision, hearing mobility, &amp; cognitively impaired users)</td>
<td>pedestrians, sporting users, manual wheelchair users, electric wheelchair/scooter users</td>
</tr>
<tr>
<td>Small-wheeled vehicle users</td>
<td>children's pedal/motorised/electric cars, in-line skaters, skateboarders, roller skaters, foot scooters</td>
</tr>
<tr>
<td>Others</td>
<td>organised events, maintenance workers, horse riders, anglers</td>
</tr>
</tbody>
</table>

If the facility is intended for use by commuter cyclists then it should follow a direct route to a popular destination, be wide and have a horizontal and vertical alignment which allows safe, high speed bicycle travel. Rail reserves and river banks can offer an opportunity to provide a high quality commuter path. Provision of an exclusive bicycle path can often, but not always, mean that a separate parallel facility has to be provided to meet the demands of pedestrians and other potential users.

Because cyclist demand is often relatively low, the cost of paths significant and many paths provide useful and attractive links for pedestrians, there has been a tendency for shared-use paths to be provided rather than exclusive bicycle paths. Whilst this enables the maximum benefit to be derived from these facilities, conflict does occur between cyclists and other users, particularly pedestrians, and this has become an issue on some busy paths. For this reason a separated path which divides the operating space for each use, or where completely separate facilities are provided, may be appropriate where both cyclist and pedestrian (or other user) demands are heavy.
In some jurisdictions cyclists are permitted to ride on footpaths whereas in others footpaths must be signed as shared use paths before cyclists are able to use them legally. The issue of footpath cycling is one that must be addressed by the individual authorities responsible for traffic regulation.

Although they can be designed for high speeds, many paths are not used by inter-suburb distance commuter cyclists. This is mainly due to cyclists inability to travel constantly at the relatively high speed attainable on the road system, and because paths often do not lead to useful destinations. Indirect paths bring cyclists into conflict with other users, and cause them to have to yield at side streets.

These factors can result in speeds being low and overall travel times being relatively long, and unattractive to commuter cyclists. Thus paths should not be regarded as a substitute for adequately designing roads for travel by bicycle.

In designing an off-carriageway facility for bicycles, the designer should first determine the purpose of the cycling path. The purpose of a path is best assessed through consideration of the potential, likely and desired use of the path amongst the various categories of cyclists. Predominantly, a path for cycling may either lead to specific destinations (a commuter path) or offer a pleasant ride (a recreational path). Therefore the detailed designs of commuter and recreational paths can be quite different.

Crashes and even fatalities occur on paths and may be the result of high-density use or as a result of the mixed use by leisure and commuting traffic. Careful consideration of separated paths for differing user needs may be required to minimise risk within limited budgets.

**COMMENTARY 2**

Although the bicycle is the standard vehicle for the design of facilities, the use of other human powered (HPVs) such as tandem bicycles, tricycles and other ‘pedal powered vehicles’ may be popular in some areas and an allowance for these vehicles may be appropriate in the design of some facilities.

There is limited information available on the needs and operating characteristics of these vehicles, and in particular on their performance from the perspective of road and path design, or in relation to traffic management and safety. Therefore, designers should make their own assessment of the required measures that need to be taken to account for the used of these vehicles.

The consideration of the issues in Table C2 1 relating to HPVs and elderly or impaired cyclists may be relevant to the design of bicycle facilities that have significant use by these vehicles and path users.
Table C2 1: Human powered vehicles – facility design considerations

<table>
<thead>
<tr>
<th>Issue</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sight distance</td>
<td>Consider low cyclist eye height (as low as 0.7 m above riding surface in some instances.</td>
</tr>
<tr>
<td>Braking performance</td>
<td>Due to factors such as the low centre of gravity and braking system, performance of a recumbent tricycle can be significantly more effective than a standard bicycle. Conversely, a tandem bicycle may have a lesser performance.</td>
</tr>
<tr>
<td>Medians or refuge width</td>
<td>The additional length of some HPVs may necessitate special consideration.</td>
</tr>
<tr>
<td>Turning paths</td>
<td>Refer to Table C2 2</td>
</tr>
<tr>
<td>Width of road and path</td>
<td>Use a vehicle design envelope equal to the difference in inner and outer turning path radii, plus 0.3 m (0.4 m for tandem bicycle). If this is greater than the standard bicycle envelope width then increase path space in road or path treatments accordingly.</td>
</tr>
<tr>
<td>facilities</td>
<td></td>
</tr>
<tr>
<td>Path terminals</td>
<td>Give due consideration and allowance for lesser turning capabilities and in particular avoid chicanes.</td>
</tr>
<tr>
<td>Speed</td>
<td>May be relatively high for tandem bicycles. May be lower for elderly cyclists or cyclists who have impairments.</td>
</tr>
<tr>
<td>Gradients</td>
<td>Path gradients may have to be flatter for elderly cyclists, or cyclists who have impairments.</td>
</tr>
<tr>
<td>Education</td>
<td>Make relevant advice available (e.g. conspicuity of low HPVs)</td>
</tr>
</tbody>
</table>

Source: Adapted from Austroads (1999).

Operating dimensions of specific HPVs that may be of assistance to designers are shown in Table C2 2. Photographic examples of HPVs are shown in Figure C2 1, Figure C2 2 and Figure C2 3.

Table C2 2: Examples of HPV dimensions

<table>
<thead>
<tr>
<th>Examples of human powered vehicles (HPVs)</th>
<th>Overall vehicle width (m)</th>
<th>Inner turning path radius (m)</th>
<th>Outer turning path radius (m)</th>
<th>Length (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recumbent touring tricycle (Greenspeed)</td>
<td>0.9</td>
<td>1.4</td>
<td>2.3</td>
<td>1.95</td>
</tr>
<tr>
<td>Tandem recumbent touring tricycle (Greenspeed)</td>
<td>1.0</td>
<td>3.1</td>
<td>4.1</td>
<td>3.5</td>
</tr>
<tr>
<td>Tandem Bicycle (Cannondale)</td>
<td>0.76</td>
<td>1.85</td>
<td>2.55</td>
<td>2.45</td>
</tr>
<tr>
<td>Bicycle with two wheel trailer (Coolstop)</td>
<td>0.82</td>
<td>0.7</td>
<td>1.85</td>
<td>2.67</td>
</tr>
<tr>
<td>Bicycle with BOB trailer (i.e. baby on board)</td>
<td>0.56</td>
<td>0.9</td>
<td>1.6</td>
<td>2.8</td>
</tr>
<tr>
<td>Bicycle with hitch-bike (Thorogood)</td>
<td>0.56</td>
<td>1.7</td>
<td>2.55</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Source: Austroads (1999).

Figure C2 1: Examples of recumbent tricycles
Source: Austroads (1999).

Figure C2 2: Example of tandem bicycle

Source: Austroads (1999).

Figure C2 3: Example of bicycle with a hitch-bike attached
COMMENTARY 3

General principles relating to the provision of footpaths include the following:

- Although a separate walkway is preferable, a roadway shoulder can also provide safer pedestrian accommodation than walking in the traffic lanes. The presence of these facilities encourages segregation of pedestrian and vehicular traffic and reduces the potential for pedestrian related accidents.

Where it is not possible, necessary or practicable to provide a separate path adjacent to rural roads, shoulders should be provided that will provide lateral support for the pavement and also provide some separation of vehicles from occasional pedestrian movements. However, it should be noted that the use of shoulders by pedestrians is accompanied by significant risk, particularly where traffic lanes are narrow and heavy vehicles regularly use the road.

- Footpath installation warrants based solely on pedestrian volume are not practical, partially because individuals tend to walk where there are footpaths and footpaths tend to be built where people walk. In addition, pedestrian volumes are not regularly collected by most agencies and cannot be easily forecast. Development density can be used as a surrogate for pedestrian usage in determining the need for footpaths.

- A higher road functional classification in urban areas generally means higher traffic speeds and volumes, and hence a need to provide for pedestrian mobility and safety. However, some roads classified as local streets also function as traffic routes and have similar needs.

Collector and arterial roads in the vicinity of schools should be provided with footpaths and desirably off-road cycle paths, shared or segregated footpaths, to increase safety for children travelling to and from school. Safe routes to school can also reduce reliance of car travel for school trips and have health and environmental benefits.

Many people with disabilities undertake much of their travel either on foot, in wheelchairs or on personal mobility devices (e.g. scooters) and so the development of a network of adequate footpaths is important for their mobility. The provision of footpaths that meet recommended dimensions, surface requirements, and which are free of obstructions is important to ensure that they do not represent a hazards for people who have difficulty in detecting or manoeuvring around obstacles.

The use of electric powered scooters has emerged as an alternative means of transport for people with mobility impairment or other health issues and is likely to grow as the population ages. It is therefore important that paths and associated facilities can accommodate this type of use. The characteristics of these vehicles can be obtained from specifications on suppliers web sites. Dimensions for width, length and turning radii vary depending on model (e.g. length is often in the range 1.2 m to 1.6 m). Designers should source typical dimensions for products used in Australia and New Zealand and ensure that they can be accommodated within path and facility designs.

For example scooters should be able to:

- use kerb ramps and cross channels without the device becoming unstable or the undercarriage impacting the path or road pavement
- turn within intersections and pass through chicanes and other devices in a continuous forward motion
- store safely within refuges without overhanging into the adjacent traffic lane.
COMMENTARY 4

A bicycle path is a path set aside for exclusive use by cyclists. For this facility to be established, legally appropriate signing is required.

An exclusive bicycle path permits fast bicycle travel and is the most desirable of the off-carriageway alternatives, particularly for commuter routes although it will also serve many local destinations along the way. The most desirable facility would have full grade separation at road intersections and a path lighting system to improve safety for users, amongst other features.

Routes are ideally developed along suburban railway and freeway reserves. These corridors can link separate areas that have a high population density or provide links to regional centres and other areas with high employment densities. Such links will allow commuter bicycle use to develop to its full potential.

Importantly, exclusive bicycle paths may also provide for shorter trips to destinations such as schools along the way, and enhance access to rail stations and bus interchanges for those wishing to combine cycling and public transport for longer journeys.

The use of exclusive bicycle paths is rare because few situations exist where a path that is popular with cyclists is not equally popular with pedestrians. It will therefore be an expensive alternative as in many instances a parallel exclusive pedestrian path will also be required to avoid the tendency of pedestrians to use the path.

COMMENTARY 5

Shared use paths are the most common type of facility due to the cost to construct separated path facilities, the limitations of space and because of their versatility in providing a facility for cyclists, pedestrians and all the other possible users listed in Commentary 1. The provision of a shared use path acknowledges that there is additional benefit to the community in allowing other users access to the path and also the impracticability of restricting users other than cyclists.

However, there is potential for conflict between the various users of a shared use path. To minimise this, a shared use path design should be to a high standard which provides adequate sight distance between cyclists and other users. It should desirably also provide a clear zone adjacent to the path to enable cyclists to safely run off the path to escape an incident (e.g. potential head-on collision with another cyclist; entanglement with a dog leash or evasive action to avoid a dog that is off the leash).

The report by Kerr et al. (Austroads 2006b) identified and described key conflict issues between pedestrians and cyclists on shared paths and footpaths under the following categories:

- Users and usage
  - footpath users
  - people with disabilities
  - young and inexperienced users
  - user behaviour: operational
  - speed.
Footpath and shared path planning
- shared strategy and planning
- network continuity
- path location.

Path design
- design standards
- path capacity
- path access and continuity
- path geometry
- path quality
- signage and information
- path safety.

Path maintenance.

The report concluded that a number of strategies can be applied in both the short term and long term to minimise conflict between cyclists and pedestrians. These were identified and discussed in a working paper, based on a literature review as well as input from the initial stakeholder surveys and stakeholder workshops held in a number of locations throughout Australia. The key conflict minimisation strategies addressed by the study are:

- integrated policy, strategy and planning
- urban design
- infrastructure planning
- infrastructure design
- infrastructure construction and maintenance
- information
- regulation
- enforcement
- education and awareness-raising
- travel behaviour change.

The report also concludes that a combination of initiatives is likely to be required and that the packaging of issues will need to be situation-specific, and that it is more likely that a suitable package can be found for specific situations if each issue is addressed by a number of options. The extent to which this is so is indicated in Table C5 1.
### Table C5 1: Summary of relationship of issues and options

<table>
<thead>
<tr>
<th>Issue</th>
<th>Urban Design and Placemaking</th>
<th>Integrated Policy, Strategy and Planning</th>
<th>Infrastructure Planning</th>
<th>Infrastructure Design</th>
<th>Urban Design and Design Standards</th>
<th>Construction and Maintenance</th>
<th>Information</th>
<th>Regulation</th>
<th>Enforcement</th>
<th>Education and Awareness-raising</th>
<th>Travel Behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Footpath Users</td>
<td>✓</td>
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<td></td>
</tr>
<tr>
<td>People with Disabilities</td>
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<td>Young/Inexperienced</td>
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<td>User Awareness</td>
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<td>User Operational</td>
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<td>Speed</td>
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<td>Path Location</td>
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<td>Design Standards</td>
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<td>Path Capacity</td>
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<td>Access and Continuity</td>
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<td>Path Quality</td>
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<tr>
<td>Signage and Information</td>
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<td>Path Safety</td>
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<tr>
<td>Path Maintenance</td>
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<td>✓</td>
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</tr>
</tbody>
</table>

Source: Austroads (2006b).

### COMMENTARY 6

#### C6.1 General

A separated path is a path on which cyclists and pedestrians are required to use separate designated areas of the path. These designated areas are created by the use of pavement markings, contrasting surfaces, and the erection of regulatory signs.

#### C6.2 Separated One-way Path

Where wide nature strips exist and bicycle lanes along the road carriageway are not possible, consideration can be given to the construction of separated one-way paths. These paths enable bicycles to travel on the side of the road, in the verge area, in one direction, with bicycle movement in the opposite direction provided on the other side of the road.

The treatment can be advantageous when:

- used contiguously with other traditional bicycle lane treatments located on roads, in order to maintain continuous access for cyclists past squeeze points
- other constraints exist to the construction of bicycle lanes in the carriageway
- a safety problem exists for cyclists in the road carriageway
- there is a high proportion of child cyclists.
The treatment is most appropriate where:

- there is a limited number of driveway crossings (preferably less than one per 100 m);
- adequate sight lines exist, to significant road and pedestrian path access points
- a suitable separation/barrier exists between the path and the road carriageway.

**COMMENTARY 7**

Urban road reservations have to accommodate a variety of infrastructure and uses and this requires competition for space and allocation of space. In addition, communities often have a desire to improve the amenity and visual appearance of city streets. Consequently, urban design solutions are sometimes developed for streets where pedestrian and cyclist access is also important. In these situations urban designers and architects should not lose sight of the need for the street to be functional for pedestrians and cyclists as well as other activities. A collaborative approach between all disciplines and stakeholders is important in developing the best outcomes for communities.

Any piece of street furniture on or near the footpath is a potential obstruction to free movement and should wherever possible be located to preserve an obstacle-free footpath width. People with physical and visual disabilities have particular difficulty in avoiding and moving around obstacles in their path. Street furniture of concern to pedestrians includes temporary or permanent structures or pieces of equipment located within a pedestrian environment. In general, obstructions should be kept clear of footpaths, and overhanging objects (including trees) should not be lower than 2.5 m above the footpath. The basis for this is covered in Section 6.2.2.

Examples of street furniture include trees, signposts, traffic signals and light poles, parking meters, rubbish bins, seats, telephones, advertising signs and vending machines. In pedestrian areas, street furniture should be carefully located (and preferably grouped) away from commonly used pedestrian routes. In general, potential obstacles that are required to be placed in or near walkways should not be placed adjacent to the building line, which is a major reference point for visually impaired pedestrians.

Placing manhole covers and gratings in major pedestrian walkways should be avoided. However, this is not always practicable and where it is necessary to locate them in the footpath area, they should be of a non-slip surface, laid flush with the footpath. In the case of drainage grates, the openings should not be more than 13 mm wide and not more than 150 mm long (AS 1428.2) with the longer dimension arranged perpendicular to the direction of pedestrian movement to prevent wheelchair wheels and canes from becoming trapped in the gratings.

The setback distance of the footpath from the roadway is an important safety and design factor. Footpaths too close to high-speed traffic discourage pedestrian travel due to the high noise level and perception of hazard. Wider setbacks will add to the convenience and perceived safety of travel and should be used whenever possible.
COMMENTARY 8

Pedestrians encounter level changes whenever they move about on the transport network. The differences in level may be small (e.g. as between the footpath and roadway at a kerb), they may be gradual (e.g. a small slope or grade), or they may be large and require special structures such as steps, ramps or lifts to enable pedestrians to conveniently move from one level to the other. However, while large differences in level on a footpath are always recognised by designers and treated, many small level differences are left untreated and these can be a significant source of concern to some pedestrians (e.g. those with mobility or visual impairments).

COMMENTARY 9

C9.1 Concrete and Asphalt

Hard surfaces, such as concrete and asphalt, are generally the most functionally appropriate. They are preferred where the footpath is on a gradient, especially where it can become wet. Concrete and other light coloured surfaces are preferred in hot climates as they radiate less heat. However, a disadvantage of concrete surfaces can be increased glare for pedestrians who may congregate adjacent to the path (e.g. footpath cafes, general seating, and bus stops).

In order to provide a safer facility for cyclists and pedestrians, expansion/contraction joints should be no wider than 13 mm and the concrete surfaces should be finished to provide a non-slip surface (e.g. wooden floated or sponged finish may be satisfactory). Brushed or broomed finishes can have a disadvantage in that they cause increased abrasions for cyclists in the event of a fall, but may be necessary to enhance traction on steep grades. In some jurisdictions, there is a preference for saw-cut expansion joints.

C9.2 Pavers and Bricks

Glazed surfaces can become very slippery when wet and so pavers and bricks used on footpaths in external areas should not be glazed. Joints should be as flush as possible and should not be wider than 13 mm. Unless they are laid on a firm base, small paving units tend to move independently and form an uneven surface. The provision of a firm, well-compacted base, or preferably a concrete base is essential where this type of paving is to be used for pedestrian paths.

Bluestone pitchers are sometimes used as pavers in threshold local area traffic management treatments. They often fail the flatness test noted above and are difficult to negotiate for people in wheelchairs and some others. Bluestone pitchers should therefore not be used on pedestrian routes or footpaths. People with sight impairments frequently use differences in pavement colour as a means of guidance. They can find the variation of colour that occurs in surfaces composed of pavers confusing.

C9.3 Loose Surface Materials

Avoid the use of exposed aggregate, gravel, soil, sand, grass and tanbark surfacing on pedestrian routes, other than recreational routes. Even though they can be less expensive, and more aesthetic, some people find them difficult to walk on and they can impose severe difficulties for people in wheelchairs.
Where unsealed surfaces are used adequate crossfall should be provided to ensure that good drainage occurs. Unsealed surfaces may require an increase in crossfall (up to 5%) to prevent puddles of water from developing, though AS 1428.1 specifies that a path crossfall should not exceed 2.5% to cater for people who have a disability.

**COMMENTARY 10**

For uphill gradients consideration should be given to:

- cyclists’ speeds on approach to an uphill section
- exposure to wind
- width of path – where the recommended gradient cannot be achieved it may be desirable to widen the path to cater for the sideways displacement of bicycles being ridden uphill, or to allow for cyclists walking side by side.

There has been limited comprehensive research to determine what constitutes the maximum downhill grade in terms of cyclist safety. However, it is known that cyclists have been seriously injured because they have lost control of bicycles on steep downgrades and run off paths and into obstacles.

It has been suggested (State Bicycle Committee of Victoria 1987) that ‘many existing bicycle facilities have gradients which require riding skills beyond those of most recreational and child cyclists when they are riding down the grade. As a guide, a gradient greater than 10% over 50 m with horizontal curves or a gradient of 12% over 50 m on a straight path is considered to be extremely hazardous.’

It should also be noted that grades of 10% or greater are difficult for cyclists to ascend and may be avoided by recreational and novice riders.

**COMMENTARY 11**

The factors and issues summarised below are a guide only. Other local issues and constraints may also exist and may need to be considered and a specific assessment should be made in each case. In general the stated issues have been considered in the development of the path treatment widths listed in this guide.

Separate consideration should be given to the varying circumstances of the use of paths on weekends and weekdays. For instance, lower bicycle speeds are conceivable during weekends along paths having recreational value, which are used for commuting on weekdays.

1. Level of pedestrian and bicycle use.

Paths can experience significant use:

- where they are located within urban areas, near schools or other major bicycle or pedestrian trip generators
- where they provide an opportunity for recreation and exercise
- due to visual and other attractions
- where they provide useful connections within a comprehensive bicycle network.
However, the capacity of even a common 3 m wide path is significant and rarely exceeded due to path traffic volumes alone and therefore in most instances detailed consideration of path traffic volumes is not required.

2. Speed of cyclists

Higher bicycle speeds (30 km/h +) are likely where paths:
- are direct between significant employment destinations
- are used for intense exercise e.g. circuit training
- have a high standard of geometric alignment
- have gradients.

Lower bicycle speeds are likely where paths:
- experience high use
- have a circuitous or indirect alignment
- have regular sharp curves
- are located where only recreational use is likely.

3. Traffic regime

In some instances it is important to determine if a path is likely to be subject to tidal flows or to concurrent travel in both directions. Given the relatively low use of paths, tidal flows are a consideration only where they are narrow, or in the case of very heavily used paths. Alternatively, for example, it is important to know whether the path is likely to be used by service vehicles.

4. Clearances

Clearances represent a critical consideration in the assessment of path width requirements. However, for the purpose of determining path widths, it is reasonable for some clearance allowances (e.g. between users) to be ignored where paths are subject to low use or where path traffic flows are tidal. This is reasonable on the basis that path users meet infrequently and therefore the potential for conflict is limited.

5. User envelopes

These envelopes include the operating width of cyclists, pedestrians and others. It should be noted that the presence of couples walking side by side is a common occurrence along paths used for recreation, and one that is commonly associated with the highest demand for path width. For the purpose of determining path widths, the design envelope can be taken as 1.0 m wide for pedestrians and 1.5 m wide for a pedestrian couple.
COMMENTARY 12

Some road authorities have detailed specifications for the construction of bicycle path and shared path pavements. Figure C12.1 shows an example from the RTA of New South Wales, including different pavement types and transverse joint types for concrete pavements.

![Diagram of bicycle path pavement types](image)

**Figure C12.1: Details of bicycle path pavements**

Source: Adapted from RTA (2005).