NOTE:
This VicRoads Supplement must be read in conjunction with the Austroads Guide to Road Design.
Reference to any VicRoads or other documentation refers to the latest version as publicly available on the VicRoads website or other external source.
VicRoads Supplement to the Austroads Guide to Road Design
Updates Record

Part 6A – Pedestrian and Cyclist Paths

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This VicRoads Supplement has been developed by VicRoads Technical Services and authorised by the Executive Director – Policy and Programs.

The VicRoads Supplement to the Austroads Guide to Road Design provides additional information, clarification or jurisdiction specific design information and procedures which may be used on works financed wholly or in part by funds from VicRoads beyond that outlined in the Austroads Guide to Road Design guides.

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References

AGRD – Austroads Guide to Road Design
AGRS – Austroads Guide to Road Safety
AGTM – Austroads Guide to Traffic Management
GTEP – Guide to Traffic Engineering Practice (superseded)
VRD/RDG – VicRoads Road Design Guidelines (superseded)

VicRoads (latest). Road Design Note 06-05: Accepted DDA Products.
VicRoads (latest). Road Design Note 06-06: Guidelines for the Placement of Ground Surface Indicators.

Web sites

Thinking Transport http://www.thinkingtransport.org.au/
1.0 Introduction
VicRoads has no supplementary comments for this section.

2.0 Planning and Need for a Path

2.1 Planning
Refer to Austroads Guide to Traffic Management (AGTM) Part 4 and AGTM Part 6 for further information on planning for pedestrians and cyclists.

2.2 Need for a Path
Refer to VicRoads Bicycle Facilities as Part of Road Projects Policy (VicRoads, 2010) to determine if bicycle facilities should be provided as part of a road project.

3.0 Types of Path
VicRoads has no supplementary comments for this section.

4.0 Path User Requirements

4.1 Pedestrians

4.1.1 Principles

Additional information
Implications for Pedestrian Design (from GTEP Part 13, Section 1.3)
Pedestrian devices are often designed to cater for the 'average' or 'normal' pedestrian. It is generally assumed that the pedestrian has satisfactory eyesight and hearing, is paying attention and is not physically hindered in any way. By virtue of these implicit assumptions, pedestrians under 12 and over 50 years old are misrepresented, as also are intoxicated persons, the vision and hearing impaired and possibly, people with prams or in wheelchairs. These pedestrians will all potentially experience difficulty and inconvenience with access. For these reasons, many people with mobility disabilities do not use the street system at all.

It is interesting to note that it is those groups who are most dependent on walking and who often do not have the option of driving a car are most impeded by some current accessibility design practices. The following is a description of some of the factors which need to be considered in planning works to reflect the needs of all pedestrians.

Additional information
People with Disabilities
Disabilities result in some form of functional loss or mobility impairment. People with disabilities, range from those who have the ability to walk, but have difficulty in doing so, (especially in negotiating steps and changes of grade), to those who require assistance to maintain balance and interpret directions, those that have impaired vision and those who require a mobility aid such as a wheelchair.

An Australian Bureau of Statistics survey, conducted in 1988 of people with disabilities in Australia (McLennan, 1990) concluded that 2,543,100 Australians – or 16 per cent of the population are impaired in some way. A person may have more than one disabling condition, however the most frequently reported group of conditions related to “diseases of the musculo-skeletal system and connective tissue”, followed by "loss of hearing" and then "circulatory diseases".

Some commonly stated problems in moving about the street system are summarised below:

- People with impaired vision have difficulty in using visual cues; consequently, strong contrast/delineation is required between the road and pedestrian areas, usually in a form of physical guidance (e.g. kerbs, strips of textured paving). Vision impaired pedestrians have trouble with obstructions in their path, therefore sign posts and other street furniture can be the cause of annoyance and confusion, particularly at signals or other crossing points.

- People with hearing impairments may be unable to hear oncoming vehicles early enough and therefore have to rely more on seeing vehicles in order to cross a road safely. Therefore, a clear view from the side of the road becomes more critical.

- Wheelchair users have difficulty in using uneven, discontinuous, soft or loose surfaces. They need a ramp to change levels. In order to cross a road, an appropriately designed kerb edge is required which can be mounted and which will not cause a wheelchair to tip over.

Additional information
Young Children
A child’s physical size limits their ability to be seen and to see from the kerb. This is particularly so when there are parked cars or plantations along the verge of the road. It is important to recognise however that there are additional factors which significantly
contribute to the vulnerability of children in the road environment.

Children have been considered by some designers to be ‘miniature adults’ in terms of traffic engineering design. This is an inappropriate assumption as, in addition to their physical size, their intellectual, psychological and sensory capacities are limited by virtue of their age and stage of development. Hoffman (1978) has shown experimentally that children do not reach an adult level of performance in traffic, i.e. do not have the perceptual and cognitive capacity to make sound judgements about traffic safety, until about 12 years of age.

Several studies in the United States have shown that understanding and integrating traffic information is a basic problem for children. Even the protection offered by signalised crossings is undermined, (which is also common to the elderly), where a false sense of confidence and security contributes to the lack of attention and higher risk taking at these points.

Traffic devices and treatments therefore need to be reviewed from the child’s perspective and appropriate measures taken to ensure their applicability in some situations. In order to maximise their safety, primary school age children generally need to be supervised.

Additional information

Elderly Pedestrians

Changes in physical factors associated with ageing affect the ability of elderly to function on the traffic environment. Their deteriorating eyesight and balance affect their walking speed and reaction times and this is not always adequately accounted for in the design of traffic facilities. The 1990 Western Australian study of senior pedestrians identified the mean walking speeds and those which only the slowest 10% of pedestrians over 65 years cannot manage, as shown in Table V4.1.

Table V4.1: Walking Speeds for Senior Pedestrians
(from GTEP PART 13, Table 1.1)

<table>
<thead>
<tr>
<th>Walking Pace</th>
<th>Mean Speed</th>
<th>10th Percentile Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>1.13 m/s</td>
<td>0.8 m/s</td>
</tr>
<tr>
<td>Hurried</td>
<td>1.41 m/s</td>
<td>1.0 m/s</td>
</tr>
<tr>
<td>Rushing to catch a bus</td>
<td>1.71 m/s</td>
<td>1.0 m/s</td>
</tr>
</tbody>
</table>

Source: Main Roads (1990)

In contrast to younger pedestrians, elderly people are aware of their limitations and will compensate for these. Consequently, the elderly pedestrian will wait longer before leaving the kerb to cross a road, knowing it takes longer to react to danger should they misjudge a situation. Grayson (1975) found kerb delays of 3–4 seconds were apparent in seniors over 60 years.

4.1.2 Pedestrian Operating Space and Clearances

Additional information

Walking Speed
(from GTEP Part 13, Section 1.2.2)

Walking speeds vary over a wide range, generally determined by crowd density and other traffic impediments. The distribution of free-flowing walking speeds varies as follows:

- Minimum walking speed: 0.74 m/s
- Maximum walking speed: 2.39 m/s
- Average unimpeded free-flowing walking speed: 1.35 m/s

The deviation from the mean has been shown to correlate not only with physical characteristics such as gender, age and physical condition, but also with additional external factors such as time of day, weather conditions and trip purpose. Over the lengths encountered by normal pedestrian movements, grades of up to 5% generally do not affect speeds.

Calculation of the duration of the green walk phase at traffic signals which is generally based on an ‘average’ pedestrian walking speed of 1.2 m/s, does not always ensure a safe and comfortable crossing for all pedestrians. For example, a study of the walking speeds of seniors in Western Australia (Main Roads, 1990) reported that 25% of the senior population would not be able to walk at this pace, even in a hurry. At busy intersections where crowding would reduce crossing speeds, or where elderly or physically impaired persons cross, the design speed should be reduced to 1.0 m/s.

4.1.2 Pedestrian Operating Space and Clearances – Pedestrian Space

Additional information

Pedestrian Capacity
(from GTEP Part 13, Section 1.6)

The pedestrian transportation network consists of a number of elements including:

- footways
- elevated walkways/subways
• stairs
• ramps
• escalators
• travelators.

For each of these elements, capacities may be defined to aid the analysis of operations and the selection of an appropriate pedestrian network and facilities to suit demand. In considering network capacity or the capacity of individual facilities, the concept of Level of Service becomes important and provides a useful model which can be applied to the design of pedestrian spaces, such as footpaths, stairs, entrances and queuing areas.

Fruin (1971) developed the classical theoretical work in the area of pedestrian traffic flow, modelling pedestrian flow from traffic flow relationships. Pedestrian service standards are based on the freedom to select normal travel speed, the ability to bypass slow moving pedestrians, and the relative ease of cross and reverse flow movements at various pedestrian traffic concentrations.

Six levels of service based on service volumes and qualitative evaluation of user convenience have been defined. These are depicted in Figure V4.1 and are described below as follows:

**Level of Service A** provides space for a free flow condition, which allows the bypass of slower pedestrians and avoids crossing conflicts with others.

**Level of Service B** provides space which permits the selection of normal walking speeds and the bypass of other pedestrians in primarily one-directional flows. For a situation of bi-directional or crossing flows, minor conflict will occur, resulting in slightly lower mean pedestrian speeds and potential volumes.

**Level of Service C** is a condition restrictive in the freedom to select individual walking speeds and to freely pass other pedestrians. With reverse and crossing flows, frequent adjustment of speed and direction would be required.

**Level of Service D** walkway conditions would have the majority of pedestrians with restricted and reduced normal walking speeds, due to the difficulties experienced in bypassing others and therefore avoiding conflicts. Reverse and crossing flows would be severely restricted due to frequent conflicts with others.

**Level of Service E** approaches the maximum attainable flow volume (capacity) of the walkway. Frequent stoppages and interruptions to the flow would be experienced by virtually all persons, due to insufficient area available to bypass others. Reverse and cross flow movements would be extremely difficult.

**Level of Service F** conditions would result in frequent, unavoidable contact with other pedestrians, and reverse and crossing movements would be virtually impossible. Walking speeds are extremely restricted with forward progress reduced to a shuffle.

As one measure of the level of service, Fruin uses a variable of pedestrian module size, which relate to an individual’s buffer zone. This is consistent with buffer zones around an individual, which is maintained in particular social contexts and situations, and where violation of this buffer results in a lowering of the level of service. Given the pedestrian

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Figure V4.1: Illustration of Walkway Levels of Service
(from GTEP Part 13, Figure 1.5)
area module, \( M (m^2/ped) \), an expression of flow rate is derived, similar to the form of the traffic flow equation.

\[ i.e. \quad P = \frac{S}{M} \]

where:

- \( P \) is the flow rate in pedestrians per metre width per minute (ped/m/min)
- \( S \) is the mean horizontal space speed (m/min).

The six levels of service of pedestrian flow were derived and the results are summarised in Table V4.2. These show that as crowding increase, walking speed falls, while flow rate increase up to a critical point at which speeds become slow that movement virtually ceases.

Fruin (1971) suggests that Level of Service standards provide a useful means of determining the environmental quality of a pedestrian space, but they are no substitute for judgement. All elements of pedestrian way design must be examined, including such traffic characteristics as the magnitude and duration of peaks, surging of platooning caused by traffic signal cycles or public transport arrivals, and all the economic ramifications of space utilisation. When designing for extreme peak demands of short duration, a lower level of service may apply in order to obtain a more economical design. This in effect accepts that some ‘backing up’ of pedestrians will occur at critical bottlenecks.

Delay to pedestrians in crossing the road and pedestrian safety are additional measures of the level of service provided and the impacts of traffic on the pedestrian environment.

Details of calculation of delay and exposure are given in Appendix VA. When the design requires that maximum capacity volumes be used, such as in sports stadium design, the adequacy of holding areas at the approaches to the critical section must be examined. In such situations, pedestrians waiting and system clearance times should form the basis for the qualitative evaluation of the design. Consideration needs to be given to emergency evacuation situations as well as ‘normal’ design loads for these facilities and the presence of elderly people and people with disabilities.

The potential pedestrian capacity of the urban footpath is significantly reduced by the intrusion of various footpath impediments. Refuse bins, fire hydrants, fire alarm boxes, parking meters, traffic signals and poles, news stands, telephone booths, kiosks, mail boxes, planters, sewer and ventilation gratings and similar devices reduce footpath capacity. Care needs to be exercised regarding the location of these items, in particular at corners of intersections. In many cases a balance will need to be made between the needs of pedestrians for an unobstructed footpath and the need to achieve adequate clearance to adjacent traffic lanes to meet safety objectives.

### Table V4.2: Levels of Service for Horizontal Pedestrian Movement
(from GTEP Part 13, Table 1.3)

<table>
<thead>
<tr>
<th>Level of Service</th>
<th>Module Size ( M (m^2/ped.) )</th>
<th>Flow Rate ( (ped/m/min) )</th>
<th>Sample Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&gt; 3.3</td>
<td>23</td>
<td>Public buildings or plazas without severe peaking fit this level.</td>
</tr>
<tr>
<td>B</td>
<td>2.3 – 3.3</td>
<td>23 – 33</td>
<td>Suitable for transport terminals or buildings with recurrent but not severe peaks.</td>
</tr>
<tr>
<td>C</td>
<td>1.4 – 2.3</td>
<td>33 – 49</td>
<td>Recommended design level for heavily – used transport terminals, public buildings or open space where severe peaking and space restrictions limit design feasibility.</td>
</tr>
<tr>
<td>D</td>
<td>0.9 – 1.4</td>
<td>49 – 66</td>
<td>Found in crowded public spaces where continual alteration of walking speed and directions required to maintain reasonable forward progress.</td>
</tr>
<tr>
<td>E</td>
<td>0.5 – 0.9</td>
<td>66 – 82</td>
<td>To be used only where peaks are very short (e.g. sports stadia or on a railway platform as passengers disembark.) A need exists for holding areas for pedestrians to seek refuge from the flow.</td>
</tr>
<tr>
<td>F</td>
<td>0.5</td>
<td>Variable up to 82</td>
<td>The flow becomes a moving queue, and this is not suitable for design purposed.</td>
</tr>
</tbody>
</table>

Source: Fruin (1971)
Additional information

**Obstruction Free Path**
*(from GTEP Part 13, Section 2.1.3)*
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 2.0 m. Refer to Austroads Guide to Road Design (AGRD) – Part 6A, Section 6.2.2 and Figure 6.4 for minimum envelope requirements.

Examples of street furniture include trees, signposts, traffic signals and light poles, parking meters, rubbish bins, seats, telephones, advertising signs and vending machines. In pedestrianised areas, street furniture should be carefully located (and preferably grouped) away from commonly used pedestrian routes.

**Covers and Gratings**
*(from GTEP Part 13, Section 2.1.4)*
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 footway. In the case of drainage grates, the openings should not be more than 13mm wide and not more than 150mm long (AS1428, 1992) and arranged perpendicular to the direction of pedestrian movement to prevent wheelchair wheels and canes from becoming trapped in the gratings.

**Setback Distance**
*(from GTEP Part 13, Section 2.1.5)*
The setback distance of the footpath from the roadway is an important safety and design factor. Footpaths located 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.

**4.2 Cyclists**
Refer also to VicRoads and Austroads web sites for further information on bicycles:
VicRoads  
Australian Bicycle Council  

**4.2.1 Principles**
Surveys to establish likely user demand should be used to assist in determining the space required for new major bicycle paths.

**5.0 Location of Paths**

**5.1 General**
VicRoads has no supplementary comments for this section.

**5.2 Factors of Influence – Path Location**
VicRoads has no supplementary comments for this section.

**5.3 Factors Influencing Roadside Alignment**

Additional information

**Driveways Across Footpaths**
*(from GTEP Part 13, Section 2.4)*
Driveway location will be determined by factors other than pedestrian activity, however, off-street developments and car-parking facilities should be designed so that pedestrian entrances/exits are separate from vehicular entrances/exits. Circulation roadways and access driveways should be located where there is minimum conflict with heavy pedestrian movements between car parks, public transport stations and associated shopping facilities, etc. Splays, clear of obstructions, are required at the property line to ensure adequate visibility between vehicles on a driveway and pedestrians on the footpath, as shown in Figure V5.1. Suitable information or warning signs may need to be provided in order to control the speed of traffic and warn of the presence of pedestrians. Vehicle drivers exiting buildings and off-street car parks should be encouraged to give pedestrians an audible warning where sight distance is severely restricted.

**5.4 Paths in Medians**
VicRoads has no supplementary comments for this section.
6.0 Design Criteria for Pedestrian Paths

6.1 Alignment

VicRoads has no supplementary comments for this section.

6.2 Clear Width and Height

6.2.1 Width

Provision of pedestrian paths need to comply with the objectives of an urban design strategy or existing Municipal standards.

Any requirements should be clarified prior to the commencement of design.

6.2.2 Height

VicRoads or Municipal agreement, as appropriate, should be obtained before using the minimum clearance.

6.3 Changes in Level

Additional information

Walkways, ramps and landings (from AS1428.1, Clause 10).

Changes in the vertical level that paths may need to negotiate will require compliance with AS1428: Design for Access and Mobility. Table V6.1 summarises the maximum gradients allowable and the landing spacing where required.

Typical road gradients will generally result in grades flatter than 3% and hence landings are not usually provided. Where a road is constructed on a steeper grade as part of an overpass or similar, consideration must be given to the gradient that an adjacent path will follow. Should the requirements of Table V6.1 be incorporated, independent grading of the path will most likely be required and will result in a level difference between the path and the road.

Where there is difficulty meeting the requirements of AS1428, the Disability Discrimination Act (Cth.) requires proponents to show why provision of the standard will result in undue hardship.

6.4 Surface Treatments

Refer to VicRoads Cycle Notes and Traffic Engineering Manual (TEM) Volume 1 for guidance on surface treatments for shared users.
Table V6.1: Summary Clause 10, AS1428.1

<table>
<thead>
<tr>
<th>Walkways - gradient</th>
<th>Landing Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 in 33</td>
<td>N/A</td>
</tr>
<tr>
<td>1 in 33 (3%)</td>
<td>25m maximum</td>
</tr>
<tr>
<td>1 in 20 (5%)</td>
<td>15m maximum</td>
</tr>
<tr>
<td>Between 1 in 33 and 1 in 20</td>
<td>Linear interpolation</td>
</tr>
<tr>
<td>4%</td>
<td>20m</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ramp - gradient</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 in 14 (7%)</td>
<td>9m maximum</td>
</tr>
<tr>
<td>1 in 20 (5%)</td>
<td>15m maximum</td>
</tr>
<tr>
<td>Between 1 in 14 and 1 in 20</td>
<td>Linear interpolation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Landing Length</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No change in direction = no less than 1200mm</td>
<td></td>
</tr>
<tr>
<td>Change in direction &lt;900 = no less than 1500mm</td>
<td></td>
</tr>
<tr>
<td>1800 turn = at least 2000mm x 1540mm</td>
<td></td>
</tr>
<tr>
<td>The intervals specified above may be increased by 30% where at least one side of a walkway is bounded by:</td>
<td></td>
</tr>
<tr>
<td>(a) a kerb or kerb rail and a handrail</td>
<td></td>
</tr>
<tr>
<td>(b) a wall or handrail</td>
<td></td>
</tr>
</tbody>
</table>

6.5 Pedestrian Path Lighting

VicRoads Guidelines for Road Lighting Design TCG006-2-2010 (VicRoads, 2010) provides guidance on the design of new road lighting schemes on freeways and arterial roads.

7.0 Path Design Criteria for Bicycles

7.1 General

Refer to VicRoads for specific design requirements for veloways.

7.2 Bicycle Operating Speeds

VicRoads has no supplementary comments for this section.

7.3 Horizontal Curvature

Clarification

A minimum radius of at least 30 metres is generally preferred for paths not constrained by topography or other physical features.

Curves with a radius less than 15 metres are generally considered to be ‘sharp’ and should not be used to achieve landscaping objectives to the detriment of the path operation for cyclists.

A small radius may be appropriate on the approach to intersections (e.g. 5.0 metres) and at ‘hairpin’ bends (e.g. 2.5 metres min.) of paths traversing steeply sloping land.

7.4 Gradient

VicRoads has no supplementary comments for this section.

7.5 Widths of Paths

7.5.1 General

Additional information

Capacity of Paths

(from GTEP Part 14, Section 6.3.3)

The capacity of a 1.5 metre wide path in one direction is in the order of 150 cyclists per hour. In general this width is sufficient for the passage of a single stream of cyclists.

Generally it is impractical to design for the peak annual or lifetime use of a path. For many paths the nature of use varies over the period of a day or week. In considering the suitability of a path to handle the anticipated number of cyclists, and pedestrians if appropriate, it is recommended that path volumes be assessed in the basis of the highest demand over the period of 2 separate hours of a typical day (weekday or weekend).

In the case of shared use paths, the volume of pedestrians can be added to that of cyclists. Opportunities for passing would be required either through the provision of additional path width (minimum width of 1.8 – 2.0 metres in each direction), or through passing on the side of the path with opposing flow provided sufficient opportunities exist.

7.5.2 Bicycle Paths

Clarification

New grade separated crossings should not have a width less than 3.0 metres, with a minimum of 2.5 metres between handrails. The geometry of the approaches to the overpass should reduce the speed of cyclists.

7.6 Crossfall and Drainage

7.6.2 Drainage

Additional information

All works associated with a shared use path design and construction shall be undertaken in accordance with AGRD and the VicRoads Supplement. Where the path may traverse a floodway or overland flow path, the shared user path should meet Melbourne’s Water’s Low Hazard criterion for a 100 year ARI flood where the product of water depth (metre) and water velocity (metres per second) shall be less than 0.35, i.e. $v_{avg}d_{avg} \leq 0.35$ m$^2$/s along footpath/cycle path alignments.

Refer to Melbourne Water’s Shared Pathways Guidelines (Melbourne Water, 2009) for further guidance on the design of pathways along waterways.
7.7 Clearances, Batters and Need for Fences

7.7.2 Batters and Fences
Fences constructed in close proximity to bicycle lanes or paths should be designed to prevent injury to cyclists who may brush against it at speed, or get caught. Refer to AGRD Part 6A, Appendix C – Bicycle Safety Audit Checklist for further information.

Where it is proposed to use fences or similar structures in association with bicycle lanes or path facilities, the following factors should also be considered:

- The various fence elements (posts, railings, etc) should be designed to minimise the possibility of cyclists snagging their handlebars or pedals;
- Care needs to be exercised in the choice of fences to avoid those that would give rise to spearing injuries if struck (by any vehicle);
- The ends of fences should be at least 1 metre away from the riding surface, but may taper closer to the edge of the path if necessary (refer to Figure V7.1). They should also be appropriately delineated by signs and reflective tape, and preferably be of a light colour;
- The width of paths and lanes should account for the presences of fences (see AGRD Part 6A, Section 7.7.1 for further details on clearances).

7.8 Sight Distances
VicRoads has no supplementary comments for this section.

7.9 Bicycle Path Lighting
Refer to VicRoads Guidelines for Road Lighting Design TCG006-2-2010 (VicRoads, 2010) for guidance on the design of new road lighting schemes on freeways and arterial roads.

7.10 Underground Services
VicRoads has no supplementary comments for this section.

8.0 Intersections of Paths and Roads
Refer to AGRD Part 4, Section 9 – Cyclist Crossings.

8.1 General

Pedestrian Crossings
Refer to VicRoads TEM Volume 1, Section 4.

8.2 Ancillary Treatments and Features
VicRoads has no supplementary comments for this section.

9.0 Paths Remote from Roads
Refer to The Bicycle Parking Handbook (Bicycle Victoria, 2004) and Bicycle Parking – providing bicycle parking facilities (Bicycle Victoria, 2000) for further information on the provision of parking facilities.

Figure V7.1: Fence Construction Details
(from GTEP Part 14, Figure 7.18)
10.0 Path Terminal Treatments

10.1 General
VicRoads has no supplementary comments for this section.

10.2 Terminal Design Principles
VicRoads has no supplementary comments for this section.

10.3 Terminal Device Operating Width
VicRoads has no supplementary comments for this section.

10.4 Terminal Treatments
Refer to VicRoads Cycle Notes regarding guidance on terminal treatments.

10.5 Holding Rails
Additional Information
Holdings rails (AGRD Part 6A, Figure 10.8) 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 where it is unlikely cyclists will have to stop and wait.

To avoid the unnecessary proliferation of holding rails, they should not be installed at traffic islands or approaches to signalised intersections unless demand has been identified.

A sign extension (AGRD Part 6A, Figure 10.8) should not be used in close proximity to road carriageways or where cyclists would turn in close proximity to the sign extension.

Figure V10.1 shows VicRoads preferred kerb ramp and holding rail layout details.

11.0 Provision for Cyclists at Structures

11.2.1 Use of Footpaths on narrow Bridges
Full Integration of Cyclists
Where it is not possible to meet the criteria identified in AGRD Part 6A it may be necessary for commuter cyclists to share narrow traffic lanes with motor vehicles. Integration of all cyclists with motor vehicles is only appropriate on roads having an Annual Average Daily Traffic (AADT) of less than 3000 vehicles per day, and where a low speed traffic environment exists, particularly where the proportion of young and inexperienced cyclists is significant. Bicycle access should be maintained, but the route should not be signed as part of the local bicycle route network. If the bicycle demand is significant (e.g. in excess of 200 bicycles per day) then the provision of specific bridge facilities for cyclists should be considered.

Figure V10.1: Kerb Ramp & Holding Rail Layout Details
(from GTEP Part 14, Figure 6.44)


11.2 Road Bridges

Additional information

11.2.3 Exclusive Bicycle Lanes
If an exclusive bicycle lane exists on the approach to the bridge it is desirable that the same width be carried across the bridge. However, if this is not possible the desirable bicycle lane width of 1.5 metres or absolute minimum bicycle lane width of 1.2 metres should be provided (AGRD Part 6A, Section 7.5). Additional width is required if the kerb on the bridge is high, e.g. greater than 150mm.

On roads where motor vehicle speeds are above 75 km/h, the volume of commercial vehicles is greater than 400 vehicles per day, or the gradient on the bridge is greater than 5% it is desirable that the bicycle lane be at least 2.0 metres wide.

In many cases, particularly in rural and outer urban areas, a sealed shoulder on the bridge and approaches will provide the same level of service to cyclists as an exclusive bicycle lane without the costs of signs associated with the latter.

11.2.4 Wide Kerbside Lanes
If 7.4 metres to 9.0 metres exists between kerbs on a two lane two way bridge then the road should be marked only with a centreline to provide wide kerbside lanes in each direction.

11.2 Grade Separated Crossings

11.3.2 Use of existing Culverts
The critical considerations for the use of underpass/culvert structures are width, gradient, height and stopping sight lines.

11.3.4 Road Tunnels
VicRoads does not allow cyclists to enter road tunnels and therefore does not provide facilities.

11.4 Bicycle Wheeling Ramps
VicRoads has no supplementary comments for this section.

12.0 Construction and Maintenance Considerations for Paths

12.1 General
Effective management and maintenance regime should be established and in place when providing bicycle paths.

12.2 Bicycle Safety Audits
VicRoads has no supplementary comments for this section.

References
VicRoads has no supplementary comments for this section.

Appendices

Appendix B.1 Path Construction and Maintenance – General Requirements
An effective management and maintenance regime should be in place when providing bicycle paths.

Appendix B.4.1 Pavements for Cycling Paths
Refer to VicRoads Cycle Note No. 14 – Coloured Surface Treatments for Bicycle Lanes.

Refer to VicRoads Cycle Note No. 18 – Providing a Smooth Surface for Cyclists.

Refer to VicRoads TEM Volume 1, Section 5 – Bicycle Facilities.

Appendix B.5.2 Bicycle Safety Audits

Commentaries

Commentary 1 Use of paths
Refer to VicRoads Cycle Notes for further details regarding shared use paths.

Commentary 9.1 Concrete and Asphalt
VicRoads prefer the use of saw-cut expansion joints in concrete shared use paths or exclusive bicycle paths.

Tables
VicRoads has no supplementary comments for this section.

Figures
VicRoads has no supplementary comments for this section.
Appendix VA
(from GTEP Part 13 Appendix E)

Appendix E
Pedestrian Delay And Exposure

E1 DELAY TO PEDESTRIANS CROSSING THE ROAD

Considerable research effort has been expended in developing methods of predicting the proportion of pedestrians likely to be delayed and their average delay for a variety of road crossing situations. In the case of an uncontrolled crossing situation on a road having a low degree of platooning, the proportion delayed may be calculated using traditional gap acceptance theory:

\[ Pr = 1 - (1 - t_m q) e^{-\lambda (t_c - t_m)} \]

where

- \( Pr \) is the probability of a pedestrian being delayed
- \( q \) is the vehicle flow on the road to be crossed (veh/s)
- \( t_m \) is the average headway between bunched vehicles. Use 2 divided by the number of lanes.
- \( t_c \) is the critical acceptance gap required by pedestrians to cross the road (s). This is dependant upon the assumed walking speed of pedestrians.

\( \lambda \) is the delay constant given by

\[ \lambda = \frac{(1 - \theta)q}{1 - t_m q} \]

\( \theta \) is the proportion of bunched vehicles. A good estimate of the proportion of bunched vehicles is given in the AUSTRORADS GTEP Part 6 (Roundabouts) for circulating flow. Recommended values are between

\[ 1 - e^{-2.5t_mq} \quad \text{and} \quad 1 - e^{-3.0t_mq} \]

The average delay to all pedestrians is given by:

\[ d = \frac{e^{-\lambda (t_c - t_m)} - t_c - \frac{1}{\lambda} + \frac{\lambda t_m^2 - 2t_m \theta}{(1 - \theta)q}}{2(\lambda t_m - 1 - \theta)} \]

The average delay to those pedestrians who are delayed is given by the following equation:

\[ d_{d>0} = \frac{d}{Pr} \]

However, when platooning of the flow exists (as it does on most urban arterial roads), or where the crossing occurs at a 'controlled traffic' facility, the relationships become somewhat more complex and the data input requirements increase. Models for the latter have been developed in the UK (by Compton and Goldschmidt). No similar pedestrian related research has been undertaken in Australia although the work done by Troutbeck (1990a), (1990b) and Akcekil and Troutbeck (1991), in taking account of 'traffic bunching' in the analysis of traffic operation at roundabouts and other unsignalised intersections, could be applied to the analysis of delay to pedestrians crossing heavily trafficked urban roads.

E2 PEDESTRIAN SAFETY: EXPOSURE AND CONFLICT

Any street in which space is intermittently shared by pedestrians and vehicles places pedestrians at "risk". Whilst it is not easy to predict this "risk" directly, positive correlations have been found between levels of pedestrian activity and vehicular traffic volumes.
Hence in streets where pedestrian activity is high, acceptable traffic volumes may be determined by consideration of conflict between pedestrians and vehicles as well as by consideration of the delay caused to pedestrians when crossing the road. The approach to defining pedestrian/vehicle conflict standards may be based on two measures of pedestrian activity: pedestrian volumes crossing the road and pedestrian densities on the footpaths.

These two measures reflect different types of pedestrian activity; in the case of pedestrian travel through an area from, say, home to shops or to school, pedestrian crossing volumes will be appropriate criterion, as these pedestrian flows will tend to be concentrated at intersections. Where the pedestrian movements are directly associated with an activity, such as "window shopping" or waiting at a bus stop, the pedestrian density on the footpath will be the criterion. In this situation, crossings of the road (when conflict may occur) are likely to occur randomly at places along the road rather than at intersections or other specific locations at which pedestrian flow can be channelised and controlled.

Work in the UK (Compton and Gilbert, 1976) has shown that both measures are positively correlated with pedestrian accident rates and vehicular flow, with the relationships being of the following form:

**Pedestrian Crossing Volumes**

\[ P_c V^2 \propto \text{accident rates} \]

where \( P_c = \text{pedestrian crossing/hour/100m of road} \)

\( V = \text{traffic volume (vehicle/hour)} \)

**Pedestrian Density**

\[ P_d V^2 \propto \text{accident rates} \]

where \( P_d = \text{pedestrian density on both footpaths/100m of road} \)

\( V = \text{traffic volume (vehicle/hour)} \)

The United Kingdom Department of the Environment has stated that a case for a pedestrian crossing facility exists when the average value of the product \( P_c V^2 \) exceeds \( 1 \times 10^6 \) during the four "peak" hours of the day (United Kingdom Department of the Environment, 1973). With a \( P_c \) value of 200 pedestrians/hour/100m, this yields an acceptable traffic volume of 700 vehicles/hour. This may be compared with the Australian standards in which a \( P_c V^2 \) product value of \( 9 \times 10^4 \) is recommended.