Background Paper 2

Path Alignment and Surfaces

VICTORIA State Government | Department of Transport

Contents

Other elements of the project can be found at: https://www.vicroads.vic.gov.au/safety-and-road-rules/vehicle-safety/construction-trucks-and-community-safety

Any photos, figures or illustrations where a source is not provided should be assumed to be produced by the combined authors and organisations acknowledged below.

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1. Path Location and Alignment

1.1 Introduction

This paper forms one of a series of background papers relating to issues around the safety and provision for pedestrians and cyclists at roadworks. It provides additional details and information for use by practitioners. Through the background research undertaken as part of this work it was identified that little consideration is given to how pedestrians and cyclists will navigate around or through temporary roadworks, or their requirements in terms of size and scale of pathways, and the quality of routes and surfacing. Often pedestrians and cyclists are left to their own devices with little consideration of the suitability of controls. Poorly conceived routing and paths can lead to unsafe behaviour by pedestrians and cyclists and a proactive approach can considering the needs of these users can improve outcomes for all. There are also issues with how pedestrians and cyclists interact with worksites and accesses with particular problems and conflicts with trucks.

This document provides more detailed information and guidance on how to improve consideration of routings and design consideration to improve the experience for pedestrians and cyclists and improve safety.

This document was developed to support the "Safety Essentials: Accommodating Pedestrians and Bicycle Riders at Temporary Road Works" summary document. This project was undertaken for the Construction Truck and Vulnerable Road Safety project.

1.2 Path Location and Alignment: Requirements

Standard	Content
Road Management Act 2004, Worksite Safety – Traffic Management Clause 51 (1) (3)	• *Special provision should be made for pedestrians (including people with disabilities) and cyclists if they are expected to pass through, past or around the worksite. The path to be taken should be located as far as is reasonably practicable from the roadway, be smooth and free from obstructions, be of adequate width (e.g. 1.5 metres for pedestrian paths and 2.0 metres for shared paths), be well delineated and constructed to prevent pedestrians from walking through the work area, and provide clear guidance where the path changes direction.* • *If the works make it necessary for pedestrians or cyclists to cross the road within the worksite, particular attention should be paid to the crossing point to ensure that the pedestrians or cyclists are visible to both the approaching traffic and the operators of roadworks plant and equipment on the worksite.*

1.3 Pedestrians: Objective and Function

AGRD 6A: (2017), section 3, recommends that the key characteristics of an environment required to encourage walking are as follows:

- Safe
- Connected
- Legible
- Comfortable
- Convenient
- Universal
- Pleasant

Whilst these attributes are intended for permanent conditions, it is encouraged that they be upheld on temporary footpaths and diversions, especially if works are for long term or semi-permanent periods. The upkeep of these attributes around worksites is the following section.

It should be noted that these recommendations also apply to cycle routes.

1.4 Pedestrians: Best Practice

The following provides information on the seven characteristics set out in AGRD 6A (2017), that encourage walking environments.

1.4.1 Safe

Alternative travel paths should provide a safe environment for users and be designed to minimise any threats. A safe walking environment should:

- provide good quality surfaces, clear of obstructions and well maintained
- Cater for urban design and follow CPTED principles
- provide adequate lighting to ensure users feel safe.
- minimise conflicts between path users
- provide adequate information signage reminding users of appropriate user behaviour

Regarding personal safety, the implementation of Crime Prevention through Environmental Design (CPTED) is recommended. CPTED is a multi-disciplinary approach to deterring criminal behaviour through environmental design creating safer environments.

CPTED is most commonly used for permanent built environments. However, practices applied for permanent measures are recommended for temporary sites, especially where works are to be carried out for extensive periods of time.

Personal security of pedestrians, and cyclists, particularly at night should be considered.

Blind spots and long tunnels pose particular safety concerns with increased risk of assault. Figure 1 provides an example of poor path visibility along hoarding. Figure 2 shows an example of convex mirror used to enable pedestrians to see around a blind corner.

Where hoardings, gantries and scaffolding are used, personal security should be considered at all times along the temporary infrastructure.

As a general principle, where possible, the use of pedestrian (and cyclists) tunnels, bridges, or other physical objects which limit surveillance and response options should be avoided (Queensland Government, 2007).

Examples of recommended CPTED strategies include:

- **Natural surveillance**: through lighting design, use of least sight-limiting fence etc.
- **Natural access control**: through clearly identifying entry and exit points, eliminate design features that provide access to higher levels, use of locked gates to worksites etc.
- **Natural territorial reinforcement**: through display of security systems signage at access points, maintain premises and landscaping, to alert active presence of space etc.

FIGURE 1: EXAMPLE OF HOARDING WITH POOR FORWARD VISIBILITY

FIGURE 2: EXAMPLE OF CONVEX MIRROR USED TO FACILITATE VIEW AROUND BLIND CORNER

Beyond the implementation of CPTED, the XYX Lab – Monash University Space Gender Communication Lab, which explores gender-sensitive design practices and theory, have conducted research on using design-based methods and techniques, such as mapping, diagramming and modelling in three dimensions, the experiences of women and girls in public spaces to alleviate issue's underlying causes. One of their research pieces looked at spaces on the Melbourne map where women felt and unsafe and provided some of the reasons for the sentiments. The research provided some key insights and findings on elements that made individuals surveyed feel safe or unsafe. This research highlights the importance of consulting different perspectives when designing safe spaces, for the temporary and permanent, to provide environments in which all users feel safe. Further information on conducted research can be found here: https://www.monash.edu/mada/research/labs/xyx-lab-monash-space-gender-communication-lab

1.4.2 Connected

Part of providing adequate footpaths in certain environments is ensuring they are connected, making sure access to abutting facilities are maintained. Austroads Guide to Road Design (AGRD) Part 6A: Paths for Walking and Cycling (2017), recommends the following is to be ensured:

- Walking networks are integrated with public transport to ensure short distances to stops from the area severed
- Pedestrian routes to key destinations are continuous and as short as possible without barriers that are difficult to cross (e.g. major roads, railways)
- Paths provide good access to key destinations
- Pedestrian crossings are located at locations that are difficult to cross
- Important pedestrian routes are given 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, such as inner-city routes, consideration should be given to prioritising and wherever practicable coordinating traffic signals to improve the level of service for pedestrians.

It is recommended that volumes of individuals using the area prior to any works commencing should be established to determine a road user hierarchy and subsequent priority of modes.

1.4.3 Legible

Part of providing adequate walking environments is ensuring they are legible, so that users can easily navigate their way along them. To fulfil this attribute, the following should be achieved

- 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)
- Clearly visible street names and place names and sufficient repeater signs.

During construction, it is important to ensure permanent signage such as street and place names are not obstructed through the works. Where this is the case, temporary replacement signs should be installed.

Figure 3 shows an example of the provision of wayfinding on the built form (hoarding), by the Metro Tunnel Project as part of their Urban Design Strategy. Ease of wayfinding is provided by creating well-structured paths and clear sightlines to make navigating around the site intuitive and minimise reliance on direction signage.

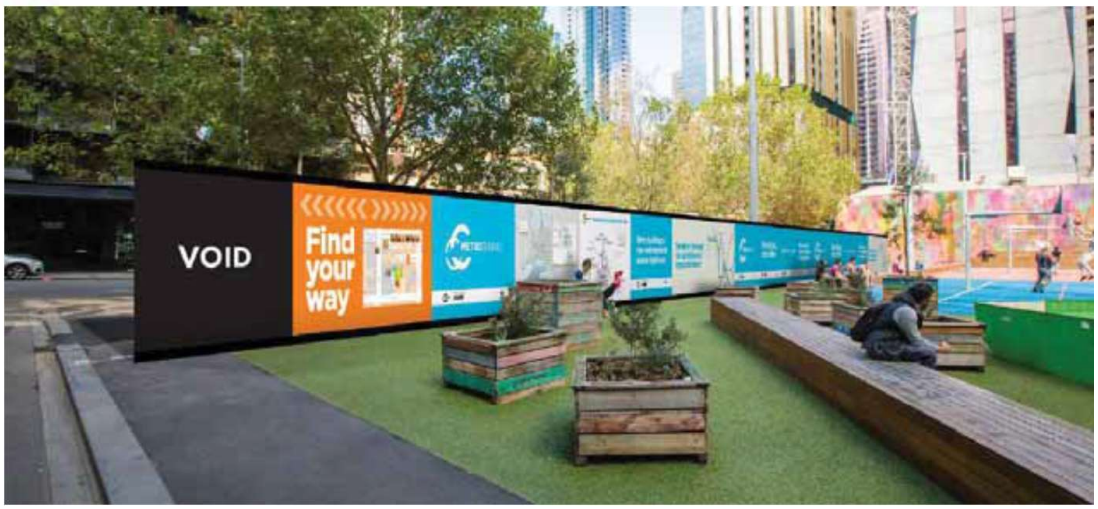


FIGURE 3: METRO TUNNEL PROJECT WAYFINDING ON HOARDING

1.4.4 Comfortable

Pedestrians and people with disabilities should be able to utilise alternative paths around construction works without difficulty. Paths should meet the following to satisfy this attribute:

- Meet design standards with respect to footpath widths and desired Level of Service (LOS).
- Provide adequate and safe storage areas.
- Ensure that cyclists do not conflict with pedestrians
- Provide a walking surface that is clear of obstructions and is well maintained. For example, broken paving can present a trip hazard to pedestrians
- Ensure that walkways are set back an adequate distance from the roadway
- Ensure that surface water does not pool 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.
- Ensure that parking (vehicle and motorcycle) does not create a problem around construction sites, acting as a barrier by obstructing routes and access points or impeding sight distances at road crossings

1.4.5 Convenient

The length and time required for pedestrians to travel along alternative footpaths around construction sites should be kept to a minimum. This falls under the attribute of providing a convenient walking environment. To achieve such an environment, paths should:

- forewarn about diversions ahead
- be as continuous as practicable
- ensure that streets can be crossed easily and safely

For diversion routes the number of crossing points for pedestrians should be minimised, especially signalised intersections, as these delay travel times. However, where crossing of roads cannot be avoided, those located as near as practicable to established pedestrian routes should be utilised and have the same level of function as the crossing they replace (Department of Transport and Main Roads Queensland, 2016).

- minimise delays to pedestrians at all existing facilities

For temporary footpaths, it is recommended that their use should not increase the travel time for pedestrians compared to the permanent paths by a factor of 1.2 or a maximum of 5 minutes.

Additional distance to be travelled should be avoided by keeping the diversion routes as close to the existing routes as possible.

- include efficient pedestrian signals or phases at signalised intersections; which may include retiming existing provision
-

Figure 4 and Figure 5 provide examples of preferred pedestrian diversion route treatments around construction sites, where the footpath is obstructed by the works. Here, the former option of closing a traffic lane to uphold the pedestrian path in proximity to the existing location is preferred over diverting path users to the other side of the road.

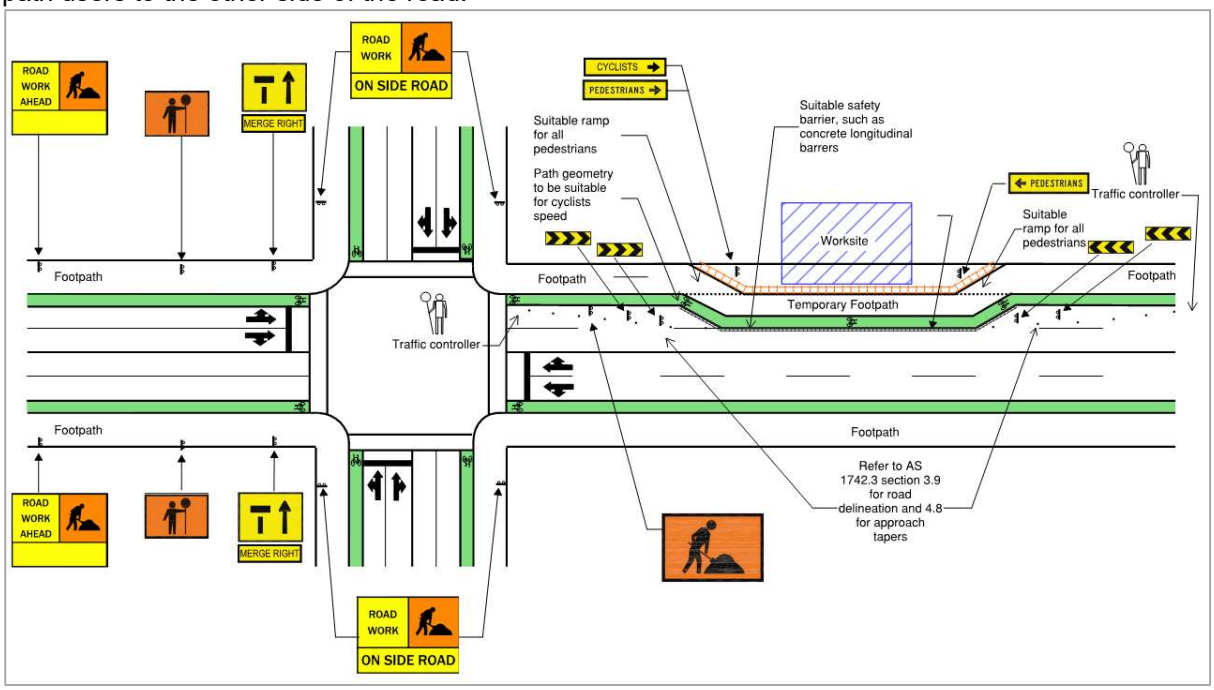


FIGURE 3: OPTION 1 WORKS ON FOOTPATH: ON-ROAD PEDESTRIAN DIVERSION

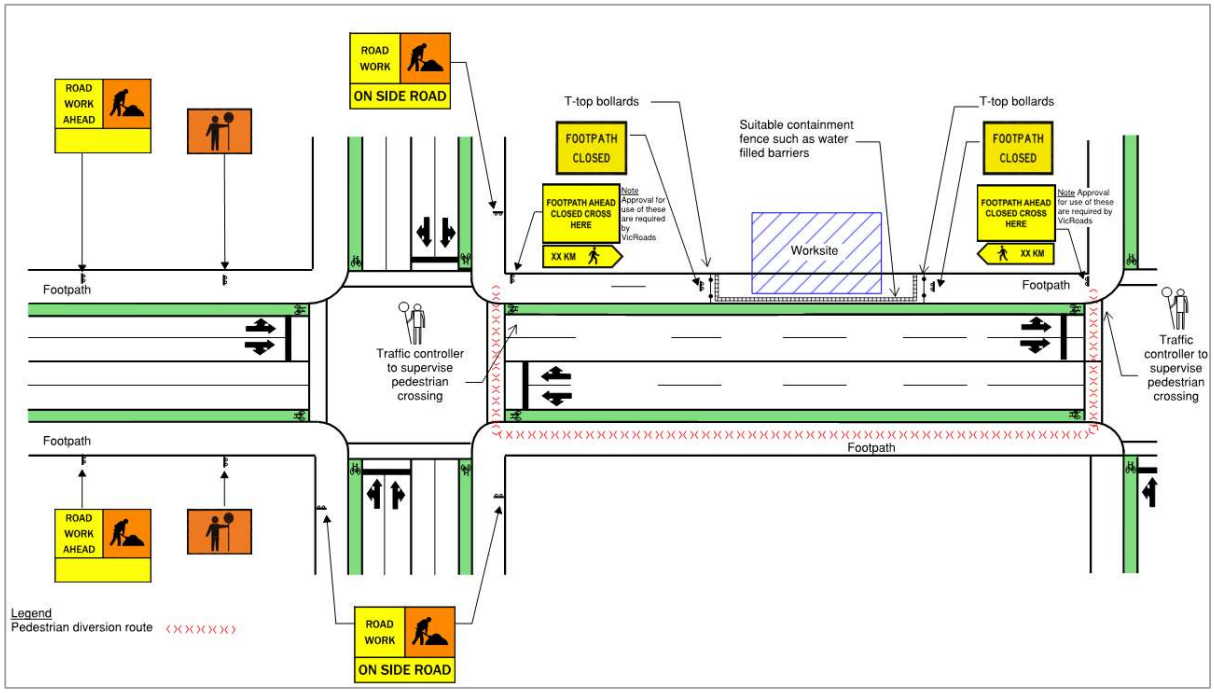


FIGURE 4: OPTION 2 WORKS ON FOOTPATH: OFF-ROAD PEDESTRIAN DIVERSIONS

Notes for Figure 4 and Figure 5.

1) Drawings not to scale

2) Potential traffic speed alterations have not been considered in the traffic signage. Refer VicRoads TEM Vol 2, Part 23 for further information on associated signage. For more guidance on speed alterations, refer to Background Paer on Speed

3) Where temporary signs are located in the footpath, an effective path width of 2.0m should be upheld where practicable, 1.8m at a minimum. Where this can't be achieved, signs should be mounted.

4) It is acknowledged that the treatments shown may not be practicable for short term works. However, these or similar treatments are expected for long term and semi-permanent works.

There are two methods that should be used to measure a diversion route:

- Distance; and
- Journey time

For both, the existing route length and time taken to travel along the route should be compared to the proposed.

Consideration should be given to diverting pedestrians well in advance of the worksite at a suitable route choice decision point which could lead to a reduction in the total journey distance.

Suitable signs with information on the detour route distance/ time should be placed at these decision point locations.

To determine the 'journey time', measured in seconds, the default walking speed of 1.2m/s is generally adopted. The journey time should also include any delay time waiting at crossings (controlled and uncontrolled) and can be determined on site by recording the time spent at the crossings.

This would involve several "runs" to obtain an average delay time. Alternatively, mobile phone apps that record journey time using GPS could also be used.

The delay at a signalised crossing can be calculated based upon knowing the total cycle time and the allocation of time for the pedestrian phase.

$$Expected\ Delay = (Cycle\ Time - Green\ Time + 1) / 2$$

For unsignalised crossing a value should be determined based on the ease of crossing that considers vehicle flows, number of lanes and suitable gaps. A minimum value of 5 seconds should be used to account for the time checking if the crossing is clear.

Figure 6 provides an example of applying the above principles to calculate the pedestrian travel time when using the existing route and proposed diversion route. Taking into account the added travel distance and delay time at signals, the travel time of the diversion route under this example increases 4-fold, suggesting the need to consider whether the proposed diversion routes are reasonable.

This may identify a need to speak to the agency controlling signal timings to adjust timings to reduce delays or identify options to prevent the need for pedestrians to cross the road.

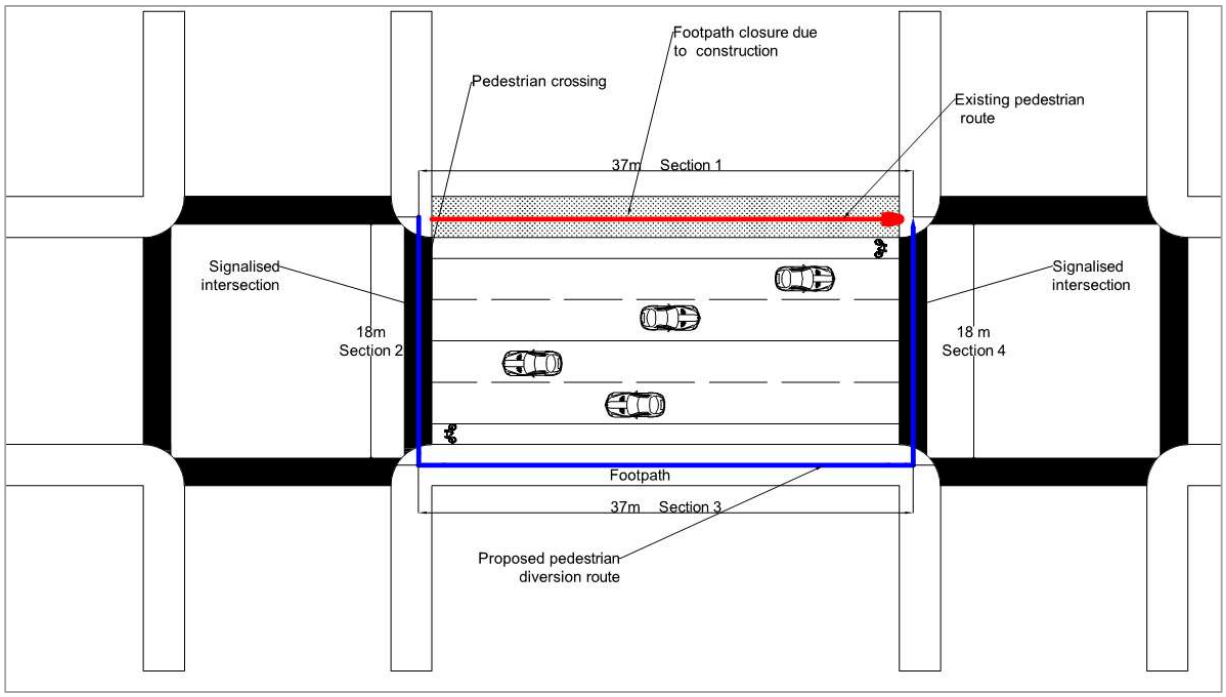


FIGURE 5: EXAMPLE OF PEDESTRIAN TRAVEL TIME FOR EXISTING ROUTE AND DIVERSION ROUTE

Figure 6

Assumptions:

Pedestrian travel speed: 1.2 m/s

Approximate expected delay time at the signalised crossings: 35 s

Existing pedestrian route:

Travel time section 1 = 37 m / 1.2 m/s = 31 s

Diversion route:

Travel time section 2 = 18 m / 1.2 m/s + 35s = 50s

Travel time section 3 = 37 m / 1.2 m/s = 31s

Travel time section 4 = 18 m/1.2 m/s + 35s = 50s

Total pedestrian diversion route approx. travel time: 31 s + 50 s + 50 s = 131 s

→ 1 min 40 sec increase in travel time

1.4.6 Universal

Paths should cater for all users by:

- Having gradients that cater for mobility users where practicable
- Having contrasted coloured pavement surfaces to highlight demarcated areas of paths
- Having tactile treatments and physical features

It is important to ensure that individuals with vision impairments are able to easily and safely navigate around construction sites.

Audible devices placed strategically can assist in guiding the visually impaired, especially for works that are long term. Placed strategically at the start, finish and corners of detours they can help wayfinding.

1.4.7 Pleasant

Wherever possible, temporary paths should be located to maximise the local amenities.

1.4.8 Additional Considerations

The following provide additional advice on path locations and alignment around construction sites in addition to the guidance developed from AGRD 6A (2017).

1.5 Managed Interface with Construction Traffic

Where high construction vehicle or pedestrian volumes are expected around sites, a coordinated approach is required to manage the interface between the modes.

The use of manual or remote-controlled barriers that can be operated by onsite traffic controllers can be used to provide suitable regulation. This allows safe management of pedestrian paths crossing construction vehicles access routes and coordination between pedestrian diversion and vehicle routes. Figure 7 and Figure 8 show examples of use of pedestrian barriers at existing construction sites and Figure 9 shows an alternate barrier type that could be considered.

FIGURE 6: EXAMPLE OF THE USE OF PEDESTRIAN BARRIERS AROUND THE WORKSITE

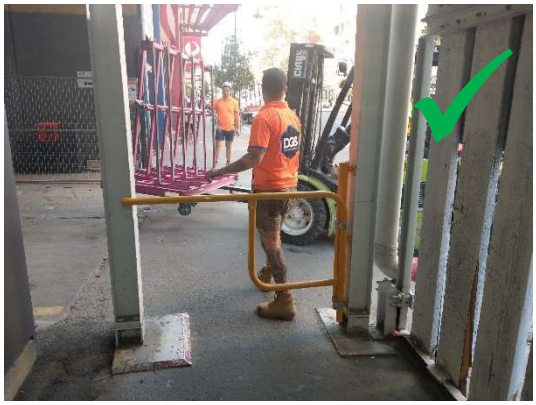


FIGURE 7: EXAMPLE OF THE USE OF PEDESTRIAN BARRIER AROUND WORKSITE

FIGURE 8: EXAMPLE OF AN ALTERNATE PEDESTRIAN BARRIER FOR WORKSITES[1]

[1] Reference

1.6 Agile Path Locations

Where feasible, moveable barriers and fencing should be drawn upon to ensure pedestrian routes are kept open during changeable construction conditions. They can further be drawn upon to free up construction loading zone space. Figure 10 and Figure 11 show scenarios for the potential use of the barriers, whilst Figure 12, Figure 13 and Figure 14 show examples of their onsite application, where unloading and craning into a construction site is being carried out whilst keeping the footpath operational.

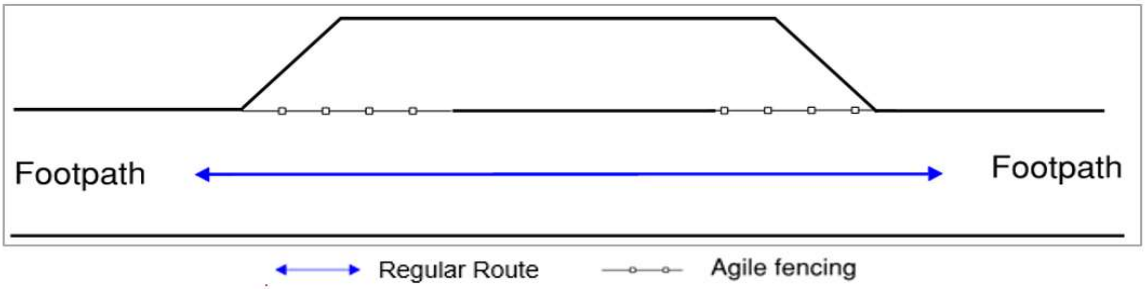


FIGURE 9: SCENARIO 1: AGILE FENCE CORDONING CONSTRUCTION ACTIVITY[2]

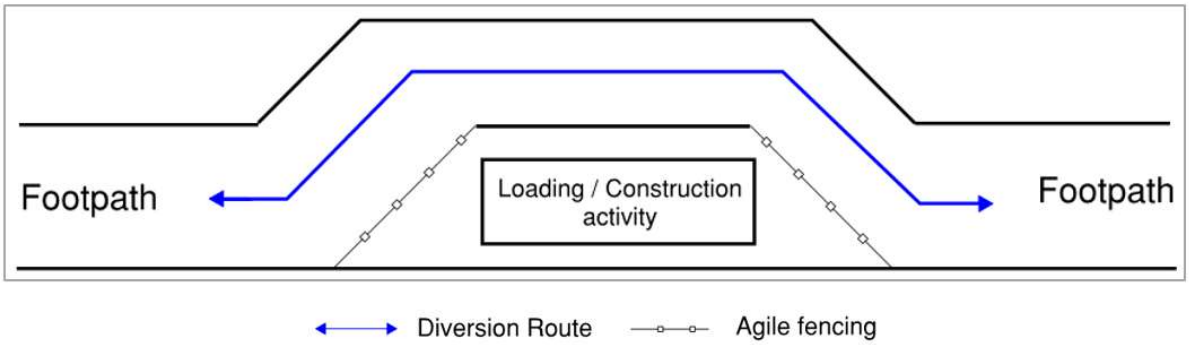


FIGURE 10: SCENARIO 2: AGILE FENCING REDIRECTING PEDESTRIANS

FIGURE 11 & FIGURE 12: EXAMPLE OF AGILE DIVERSION ROUTE USING MOVEABLE BARRIERS AND FENCING

1.7 Cyclists

[2] Reference

1.7.1 Cyclists: Objectives and Function

AGRD 6A (2017) states that as a general principle, all cyclists have the following four basic requirements whenever they ride:

- Space to ride
- A smooth surface, free of debris.
- Wherever safe and possible to do so, ensure cyclists can maintain their speeds as under permanent conditions
- Appropriate sight lines to path surface

Whilst the guidance under ARDG 6A primarily relates to provisions of permanent cycling facilities, it is recommended that the same principles are upheld for temporary cycle paths and cycle lanes.

1.7.2 Cyclists: Things to Avoid

The following should be avoided, where possible, when providing for a continuous cycle path:

- Steep gradients
- Rough and slippery surfaces and sharp corners
- Obscured sight lines
- Intersections
- Requirements to give way due to narrow cycle paths.

Steep Cycle Diversion Routes and Sharp Horizontal Curves

AGRD 6A (2017) section 5.3 provides guidance on the minimum radii of horizontal curves based on design speeds and should be satisfied on temporary paths and diversion routes.

Steep diversion routes should be discouraged, and where possible gradients should be less than 3% but never exceeds 5%. Above a 3% grade, the ease of uphill travel decreases rapidly, increasing the likelihood of cyclists taking alternate routes around sites that are less steep but potentially more dangerous. Additionally, gradients steeper than 5% present safety issues for downhill travel paths, especially where there are sharp horizontal curves or fixed objects and should therefore be avoided. When assessing the gradients of diversion routes, the gradient of the existing route must be taken into consideration, and where possible not worsened under temporary conditions.

For shared user paths, the gradient is determined by the gradient required for pedestrian paths, set out in AS 1428.1, ensuring that people with disabilities can safely transverse the path. Where gradients are between 3% to 5%, landings are required. The preferred approach is to provide the flattest practicable gradient generally below 3% so landings can be avoided.

Slippery Surfaces

When diverting cyclists, the surface quality of the path, in terms of smoothness and skid resistance, should be taken into consideration. Temporary surfaces such as metal road plates, plastic ramps or similar surfaces can have low skid resistance values and therefore present dangers to cyclists. Bikes can slip from under riders on these surfaces leading to injuries.

1.8 Cyclists: Best Practice

1.8.1 Minimisation of Travel Path Length

In line with pedestrian path design, travel times around construction sites for cyclists should also be kept to a minimum and should consider the difference between the existing and the proposed. If this is too high then users may ignore the diversions.

1.8.2 Space to Ride and Cycle Path Treatments

Whilst there are minimum design envelopes for cyclist that inform on the width required for cycle paths, AGRD 6A (2017) recommends that the likely demand of the cycle path should be taken into consideration to inform on actual space requirements. Where the likely demand is not available, required clearances need to be considered on top of the design envelopes, as shown in Figure 14.

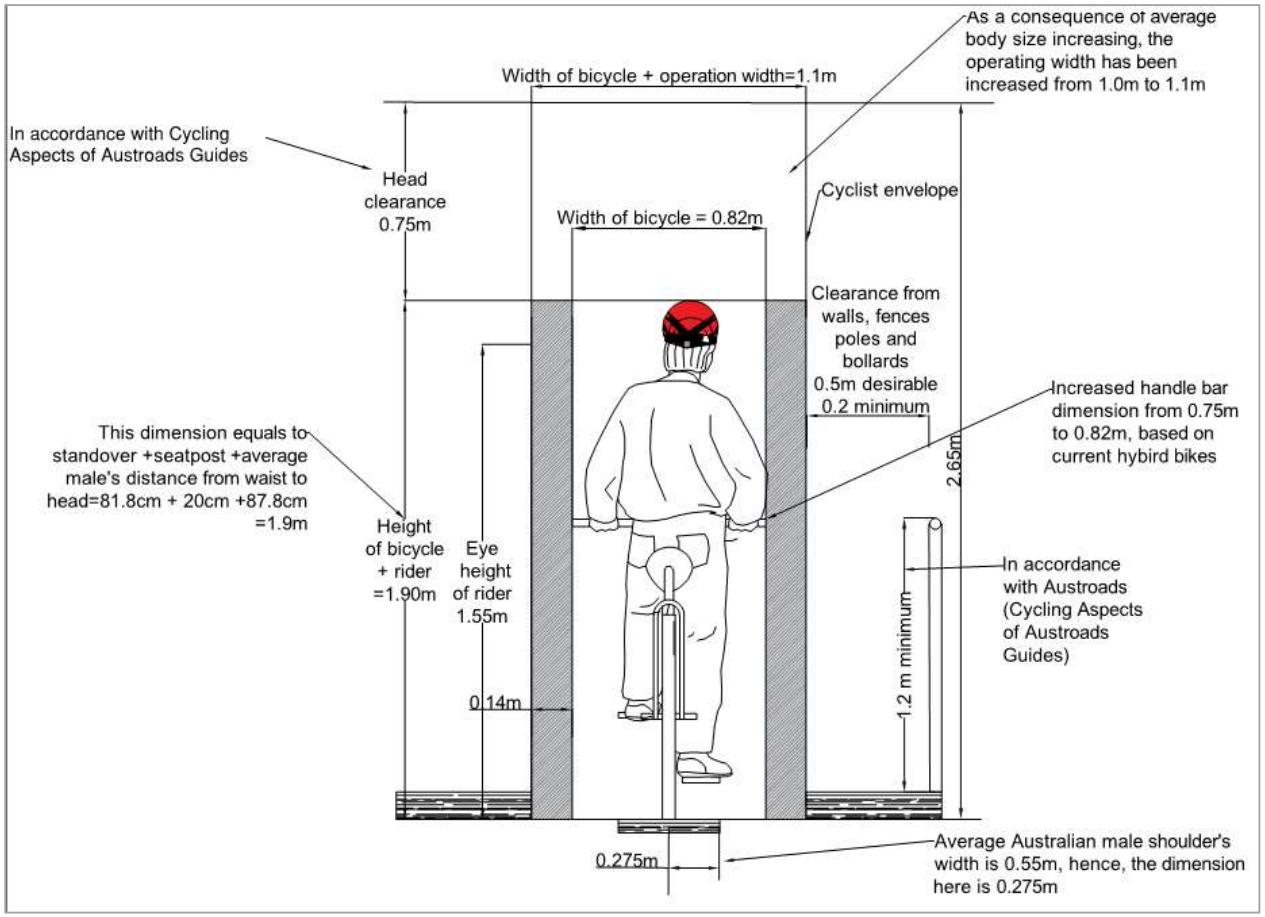


FIGURE 13: BICYCLE OPERATING SPACE[3]

Space to ride and consequent cycle path treatments are further dependent on vehicle volumes. The thresholds listed in the following, adopted by the Roads and Traffic Authority (RTA) (2010) in New South Wales (NSW), are suggested in determining appropriate cycle path treatments around worksites.

- On roads with ADT (Average Daily Traffic) less than 3,000 vehicles, motor vehicles and cyclists can be expected to share the available road space through worksites.
- For works affecting a cycle route and/or a road with ADT more than 3,000 vehicles, temporary arrangements will be necessary for cyclists.

Whilst the RTA states that with the presence of a Traffic Controller, cyclists may share the traffic lane and no further special provision is needed, this does not necessarily make it safer for cyclists and segregation is still recommended.

[3]Image created by AJM, source material ARGTTM Part 3 (2017) and AGRD 6A (2017)

1.8.3 Provisions for Suitable Diversion Routes

AGRD 6A: (2017) section C.5 Provision at Works, states that provisions for cyclists on roads should be made under the following circumstances:

- Where bicycle lanes exist
- Arterial roads
- Collector roads, with an Annual Average Daily Traffic (AADT) in excess of 3000 vehicles per day
- Strategic and other significant bicycle routes.

Austroads (2017) acknowledges that where provision for cyclists on the road is not possible due to construction works, the adjacent roadside verge may be used. Examples of these are shown in Figure 15, Figure 16 and Figure 17, all from AGRD 6A (2017).

If cyclists cannot be separated from pedestrians, and as a result, cyclists are to be diverted onto the footpath as a last resort, then the designer needs to check that the remaining footpath width can accommodate the pedestrian usage to the agreed service level. Local Council approval will be required

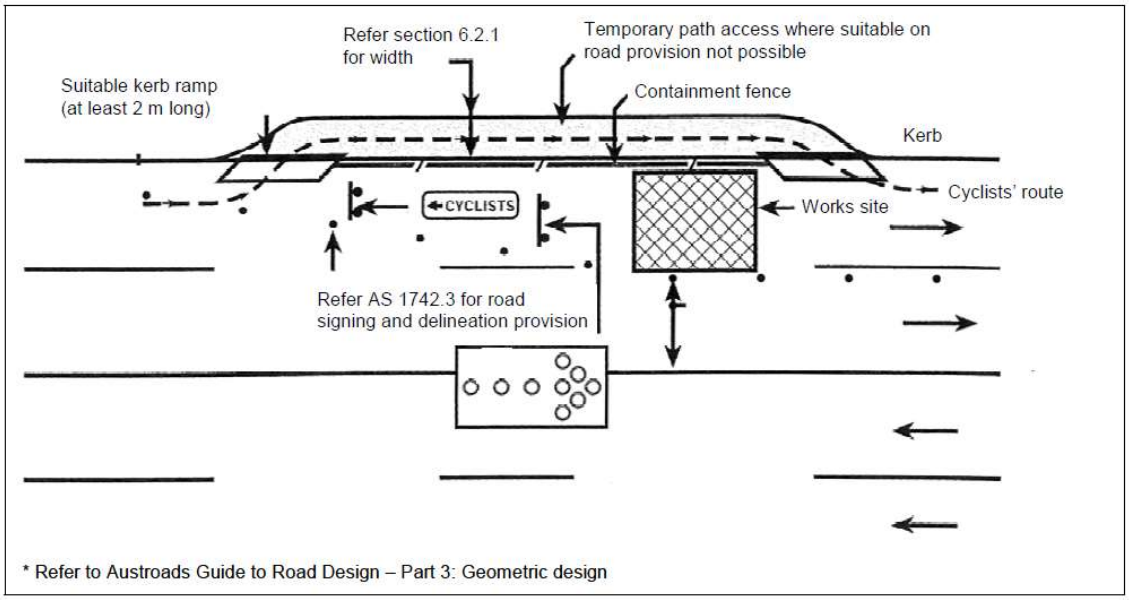


FIGURE 14: WORKS ON ROADS – EXCLUSIVE BICYCLE PATH DIVERSION

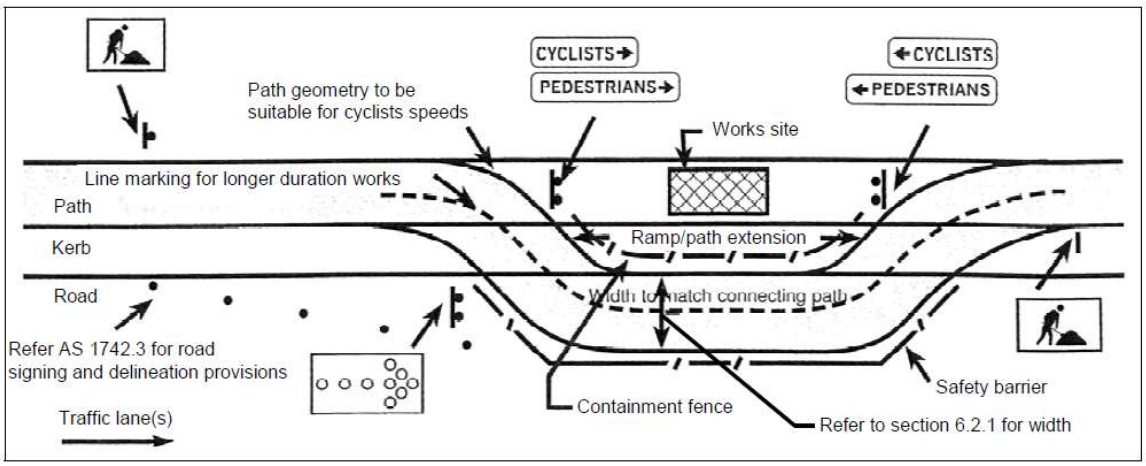


FIGURE 15: WORKS ON PATHS ADJACENT ROADS – SHARED USE PATH DIVERSION

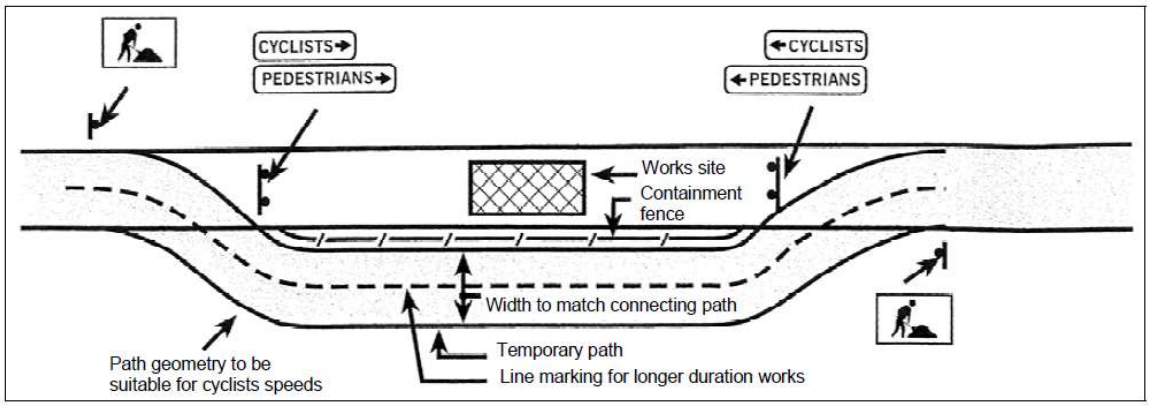


FIGURE 16: WORKS ON PATHS – SHARED USE PATH DIVERSION

1.8.4 Manoeuvres to be Avoided

To avoid putting cyclists in dangerous situations along diversion routes, the following manoeuvres should be avoided where possible:

- Cyclists turning right at busy intersections
- Left turning vehicles crossing the travel path of cyclists riding ahead

Suitable measures should be provided to enhance cyclist safety, where these movements may occur.

Where right turns are required, cyclist hook turn facilities or advance stop lines should be considered to ensure vehicle drivers are able to see turning cyclists and provide them with a head start.

Where vehicles turning left are required to cross the cycle paths or cycle lanes, it is advised that suitable delineation of cycle paths is provided to enhance their presence to vehicle drivers. Figure 18 below provides an example of such temporary delineation with the left turning manoeuvre (shown in red) being an illegal movement.

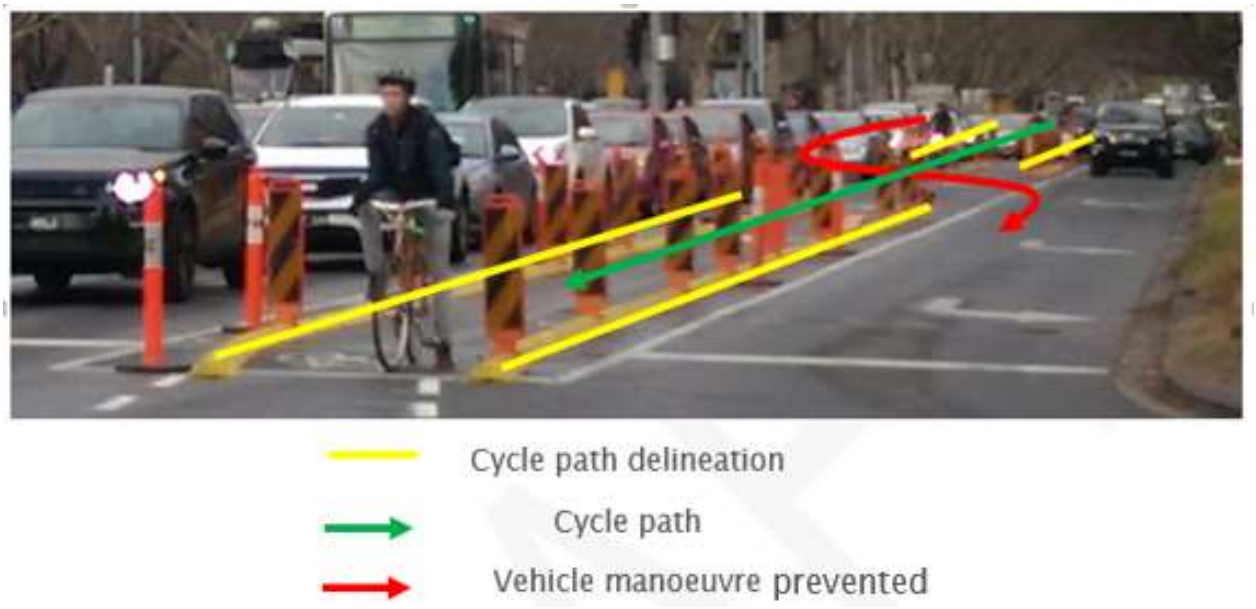


FIGURE 17: ST KILDA ROAD, METRO TUNNEL SITE PROVISION FOR CYCLISTS AROUND LEFT TURN VEHICLE MANOEUVRE

1.8.5 Speed Maintenance

AGRD 6A (2017) sets out the following with regards to cycle speeds:

"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 (..) Once slowed or stopped it takes considerable time and effort to regain the desired operating speed."

Whilst around construction sites cyclists may be required to ride with caution and reduce their speed, TMPs should, where possible, provide continuous riding and avoid situations requiring cyclists to dismount.

Average cycle speeds along many routes in Victoria are available from VicRoads. As an example, Figure 19, which is extracted from VicRoads Power BI database, shows the average daily speed on St Kilda Road by time and direction. Here, the cycle speeds are seen to reach over 25 km/h in the AM peak.

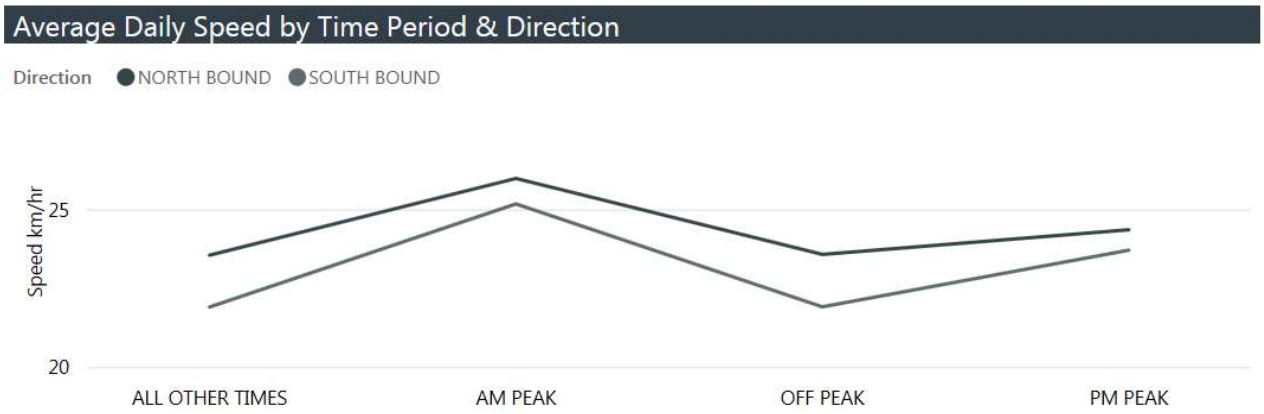


FIGURE 18: EXAMPLE OF AVERAGE DAILY CYCLE SPEED BY TIME AND DIRECTION ON ST KILDA ROAD

If shared paths must be used, cyclists should be encouraged to cycle at a speed that feels safe for pedestrians. Preference would be for separated paths where possible, as they are safer and provide improved amenities for both modes.

1.8.6 Sight Distance

The sight distance of temporary paths should, where practicable be the same as under permanent conditions.

Bicycle path stopping sight distance is calculated by the following formula provided in section 5.7.1 of AGRD 6A (2017):

$$S = \frac{V^2}{254 \times (f \pm G)} + \frac{V}{1.4}$$

Where:

S = stopping sight distance (m)

V = speed (km/h)

f = coefficient of friction (typically 0.16 for a bicycle in wet conditions)

G = grade of path (+ for uphill and – for downhill)

It is important to ensure the sight distance is not obstructed by vegetation or temporary works and where this cannot be avoided, suitable diversion routes should be sought, or warning signs put in place.

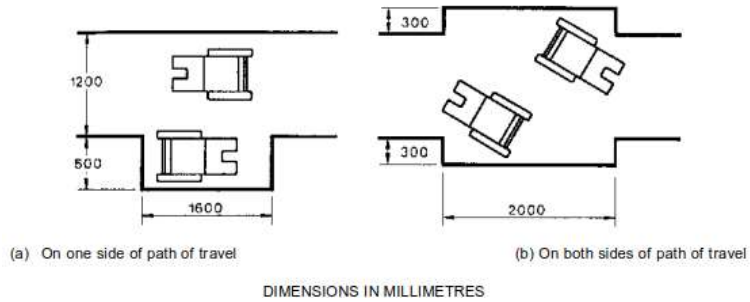
1.8.7 Managed Interface with Construction Traffic

Where high construction vehicle volumes are expected around sites, a coordinated approach is required with cyclists, especially where bike paths cross site access points. Under such circumstances, the use of remote controlled or other barriers that can be operated by onsite traffic controllers is recommended. An example are shown in Figure 20.

FIGURE 19: REMOTE CONTROLLED BARRIER THAT DROPS TO HORIZONTAL FOR THE CONTROL AND COORDINATION OF CYCLISTS

2. Path Width

2.1 Path Width: Requirements

Standard	Content
AS 1428.2 (1992) **Section 6.5***	Footpath widths The minimum width of space required for two wheelchairs to pass each other shall be 1800 mm. Where a path of travel is less than 1800 mm wide, passing spaces at intervals of not more than 6 m shall be provided as follows: (i) On one side of the path of travel—the path of travel shall be not less than 1600 mm long and 1800 mm wide. (ii) With the space distributed equally on both sides of the path of travel—the path of travel shall be not less than 2000 mm long and 1800 mm wide.  FIGURE 21: SPACE REQUIRED FOR WHEELCHAIRS TO PASS EACH OTHER
Road Management Act 2004, Worksite Safety – Traffic Management **Clause 51 (1)**	Quality of diversion routes Special provision should be made for pedestrians (including people with disabilities) and cyclists if they are expected to pass through, past or around the worksite. The path to be taken should be located as far as is reasonably practicable from the roadway, be smooth and free from obstructions, be of adequate width (e.g. 1.5 metres for pedestrian paths and 2.0 metres for shared paths), be well delineated and constructed to prevent pedestrians from walking through the work area, and provide clear guidance where the path changes direction.

2.2 Things to Avoid

2.2.1 Obstructing the Footpath Through Street Furniture

Footpaths are frequently seen to be compromised in width around construction sites through the placement of construction signage, including VMS, and street furniture such as poles, columns, stanchions, and bollards.

Overall it must be ensured that the effective width of paths is free of any obstructions as per AS1428.2 (1992) Clause 6.4. Figure 22 and Figure 23 show some common examples of bad practices associated with the placement of VMS and obstruction through permanent street furniture.

FIGURE 22: FOOTPATH BLOCKED BY VMS SIGN

FIGURE 23: FOOTPATH NARROWED THROUGH CONSTRUCTION WORKS WITH NO CLEAR ROUTE FOR PEDESTRIANS

2.2.2 Narrow Footpaths Surrounded by Hoarding

Around construction sites footpaths are often enclosed by fencing or hoardings on each side, creating tunnel like routes of travel. Narrow hoarded footpaths provide pedestrians and people with disabilities less manoeuvre space than open paths, as the enclosure does not allow movement outside of the path footprint. Pedestrians will shy away from physical edges of paths with hoarding/barriers, reducing the effective path widths by up to 0.3m.

Hoarded footpaths over long distances also present safety issues for path users, especially at night when lighting can be poor.

FIGURE 24: PEDESTRIANS SHYING AWAY FROM HOARDING

FIGURE 25: EXAMPLE OF NARROW FOOTPATH, PARTIALLY ENCLOSED

2.3 Path Width Guidelines

Standard	Content
AGTTM Part 3	Providing for mobility impaired users
3.10,4.10,5.13	Desirably, if footpaths or pedestrian crossings have been partially closed or temporarily relocated, a temporary footpath should be provided with minimum width of 1.8 m to allow for all pedestrians including those with mobility aids or on the same scale and to the same width as any facilities for pedestrian that existed prior to the works. This width should also be applied to any temporary ramps (e.g. kerb ramps).

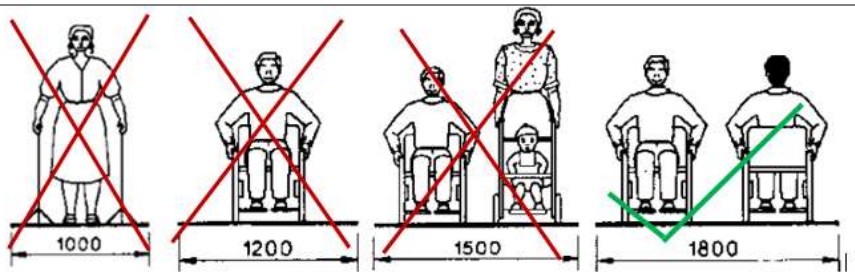


FIGURE 26: DESIRABLE FOOTPATH WIDTH[4]

AGTTM Part 3 3.10,4.10,5.13	Warning of cycle lane closures If there is insufficient width for a temporary bicycle path (same width as the existing bicycle lane), merge cyclists into an existing traffic lane or shoulder. This should include: • appropriate approval as required by the Road Infrastructure Manager • appropriate delineation • additional signage should be placed to alert road users of merging cyclists. This signage shall be placed at the relevant stopping distance in advance of the closed section of the bicycle lane. • consideration of differing speeds and behaviours between cyclists and other road users. Cyclists tend to move slower and in a different manner to other road users. • separating cyclists from other road users by time, if the existing traffic lane is narrow or rough, by allowing other road users to manoeuvre past the worksite first and cyclists second. Traffic controllers shall be provided to ensure that no other road users follow behind cyclists until they have cleared the area. Multiple traffic controllers will be required, one for traffic and one for cyclists. • a temporary speed limit for road users applied to provide safe entry of cyclists into traffic lanes.

2.4 Best Practice

Principles	Description
Recommended path width, including effective path width and obstructions	Overall, it must be ensured that the effective width of paths is free of any obstructions as per AS1428.2 (1992) Clause 6.4. It is recommended that around construction sites, effective footpath widths of 1.8m or wider are provided to allow two wheelchair users to pass each other comfortably. (AGRD 6A (2017)) The application of a 0.4 m buffer should be added to the minimum recommended 1.8m effective footpath width, resulting in an overall minimum clear width of 2.2m. (AGRD 6A (2017)) This primarily concerns narrow hoarded footpaths, bordering walls and paths that border next to active traffic lanes. This provides pedestrians and people with disabilities less manoeuvre

[4] Annotated from AS 1742- (1992), Section 6.5

space than open paths, as the enclosure does not allow movement outside of the path footprint. Pedestrians will shy away from physical edges of paths with hoarding/barriers. (Transport for London's Pedestrian Comfort Guidance (2010))

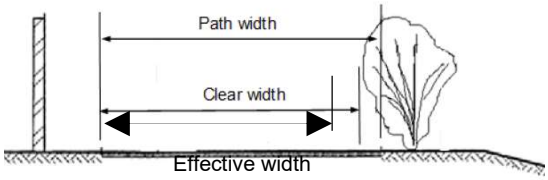


FIGURE 27: EXAMPLE OF CLEAR WIDTH FROM AGRD 6A 2017 [5]

Demand based approach

Consideration should be given to providing space for pedestrians based upon demand requirements. Fruin Levels of Service (LoS) can be used to ensure adequate is provided. LoS A-C are ideal.[6]

Walking		Queueing		Stairs	
LOS A	35 sq ft (3.3 m^2) per person or greater	LOS A	13 sq ft (1.2 m^2) per person or greater	LOS A	20 sq ft (1.9 m^2) per person or greater
LOS B	25 sq ft (2.3 m^2)-35 sq ft per person	LOS B	10-13 sq ft per person	LOS B	15-20 sq ft per person
LOS C	15 sq ft (1.4 m^2)-25 sq ft per person	LOS C	07-10 sq ft per person	LOS C	10-15 sq ft. per person
LOS D	10 sq ft (0.93 m^2)-15 sq ft per person	LOS D	3-7 sq ft. per person	LOS D	7-10 sq ft per person
LOS E	5 sq ft (0.46 m^2)-10 sq ft per person	LOS E	2-3 sq ft per person	LOS E	4-7 sq ft per person
LOS F	5 sq ft (0.46 m^2) per person or less	LOS F	2 sq ft (0.19 m^2) per person or less	LOS F	4 sq ft (0.37 m^2) per person or less

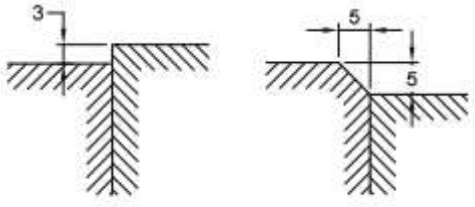
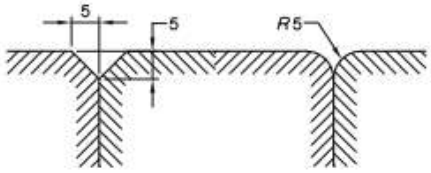
LoS measure for pedestrians based on crowd DENSITY

3. Path Surfaces

3.1 Path Surface: Requirements

Standard	Content
AS 1428.1 (2009)	Surface type
Section 7.1	A continuous accessible path of travel and any circulation spaces shall have a slip-resistant surface. The texture of the surface shall be traversable by people who use a wheelchair and those with an ambulant or sensory disability.
AS 1428.1 (2009)	Transitions
Section 7.2	Abutment of surfaces shall have a smooth transition. Design transition shall be 0 mm. Construction tolerances shall be as follows:

[5] Austroads, 2017
[6] Fruin, J. J. (1971). Pedestrian planning and design (No. 206 pp).

	0 ± 3 mm vertical, as shown in the figure below (a)  (a) Change in level 0 ±5 mm, provided the edges have a bevelled or rounded edge to reduce the likelihood of tripping, as shown in the figure below (b)  (b) Continuous paving units—flush-jointed with level surfaces DIMENSIONS IN MILLIMETRES AND ARE MAXIMUM
AS 1428.1 (2009) Road Management Act 2004, Worksite Safety – Traffic Management **Clause 51 (1)**	Providing for pedestrians and cyclists Special provision should be made for pedestrians (including people with disabilities) and cyclists if they are expected to pass through, past or around the worksite. The path to be taken should be located as far as is reasonably practicable from the roadway, be smooth and free from obstructions, be of adequate width (e.g. 1.5 metres for pedestrian paths and 2.0 metres for shared paths), be well delineated and constructed to prevent pedestrians from walking through the work area, and provide clear guidance where the path changes direction.
AS 1428.1 (2009) **Section 7.5**	Grates Grates shall comply with the following: • Circular openings shall be not greater than 13 mm in diameter. • Slotted openings shall be not greater than 13 mm wide and be oriented so that the long dimension is transverse to the dominant direction of travel. NOTE: Where slotted openings are less than 8 mm, the length of the slots may continue across the width of paths of travel.
AS 1428.1 (2009) **Section 10.2-2, 10.7**	Walkways, Ramps and Kerb ramps Requirements on the following items can be found in Background Paper B: • Walkways (landings, gradients) • Ramps (landings, gradients, change in directions, at intersections, handrail, kerbs and kerb rails). • Kerb ramps (alignment, profile)
AS 1428.4.1: (2009)	Tactile Ground Surface Indicators (TGSIs) shall be installed in accordance with AS/NZS 1428.4.1: (2009)

	Warning and directional tactile ground surface indicators are required to achieve the following slip resistance ratings per AS 4586 (2013) 'Slip resistance classification of new pedestrian surface materials':
Road Management Act 2004, Worksite Safety – Traffic Management **Clause 29 (6)**	Consideration should be given to the needs of pedestrians (including people with disabilities) and cyclists if they are expected to pass through the worksite. The path should be smooth and clear of obstructions.

3.2 Things to Avoid

Steps

Ramps should be provided in addition or in replacement of steps / stairs, so that people with disabilities, in wheelchairs or with prams are able to access the area. Where people with disabilities can't access ramps, the suitability of steps should be looked at on a case-by-case basis.

Uneven Surfaces and Grass

Uneven surfaces as well as grass or similar areas should be avoided, as they are difficult for wheelchair users to manoeuvre and can also pose difficulties for people with vision impairments who use canes to help navigate. Unsealed surfaces are not acceptable for semi-permanent or long-term works.

Where VRUs are directed onto grass or unmade surface signage indicating such should be provided. Rain and other weather conditions can also make such surface unsuitable for pedestrian use and create a trip or slip hazard.

Grates and Pits

Placing manhole covers and gratings in major pedestrian walkways should be avoided (VicRoads, 2012). Wherever possible, grates and pits should be located outside of pedestrian paths of travel within construction areas.

If grates within the pedestrian path cannot be avoided, they should be arranged perpendicular to the direction of pedestrian movement to prevent wheelchair wheels and canes from becoming trapped in the gratings (VicRoads, 2012), see Figure 28.

FIGURE 28: SERVICE GRATE WITH SIZE OF OPENINGS GREATER THAN 13MM (LEFT) CREATES ENTRAPMENT HAZARD FOR WHEELS[7]

GRATE WITH SUITABLY SIZED OPENINGS (RIGHT)

Diversion over metal plates should consider skid resistance as such surfaces can be a slip hazard.

Crossfall

Under permanent conditions, AGRD 6A (2017) states

"The crossfall of a paved pedestrian path 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."

Paths of travel with steeper crossfalls are extremely difficult and tiring for many VRUs with a mobility disability to traverse and contribute to trips and falls.

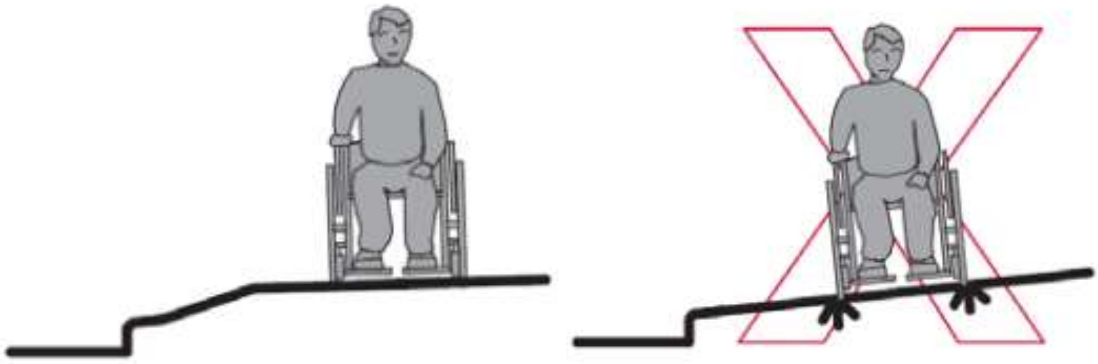


FIGURE 29: CORRECT AND INCORRECT FOOTPATH CROSSFALL[8]

This should be considered when building any temporary ramps and walkways around construction sites. Around construction sites, temporary paths are frequently unsurfaced. AGRD 6A (2017) notes that:

"Unsealed surfaces may require an increase in crossfall (up to 5%) to prevent puddles of water from developing, though AS 1428.1:2009 specifies that a path crossfall should not exceed 2.5% to cater for people who have a disability."

Rough or Slippery Boardwalks and Timber Surfaces

Around some construction sites, the path may need to be relocated and or elevated due to the works with timber paths, boardwalks or ramps being implemented as part of their traffic management.

Surfaces that are rough or slippery are considered especially hazardous on a curve or slope where a rider must change direction or brake (Bicycle Network, 2017). Serious crashes can occur when riders slip or hit broken elements as they fall off the side of the boardwalk or into a fence barrier.

Bicycle Network (2017) has identified the following risks to path users on boardwalks and bridges:

- Not seeing other path users or obstacles due to low visibility or short sight distances and crashing into them
- Hitting obstacles, including fencing, on the side of the path and crashing
- Slipping on, or being unable to stop, due to a rough or slippery path surface, and crashing

Bicycle Network (2017) noted that wooden surfaces (e.g. as shown in Figure 30) tend to be slippery, especially in the wet, and usually require an additional non-slip surface treatment to prevent cycle

[7] VicRoads, 2017
[8] VicRoads, 2017

tyres sliding. It noted that chicken wire fencing tacked to the surface of timber boardwalks is not effective as a non-slip surface. That is, the chicken wire may become loose over time and is not significantly less slippery than wood.

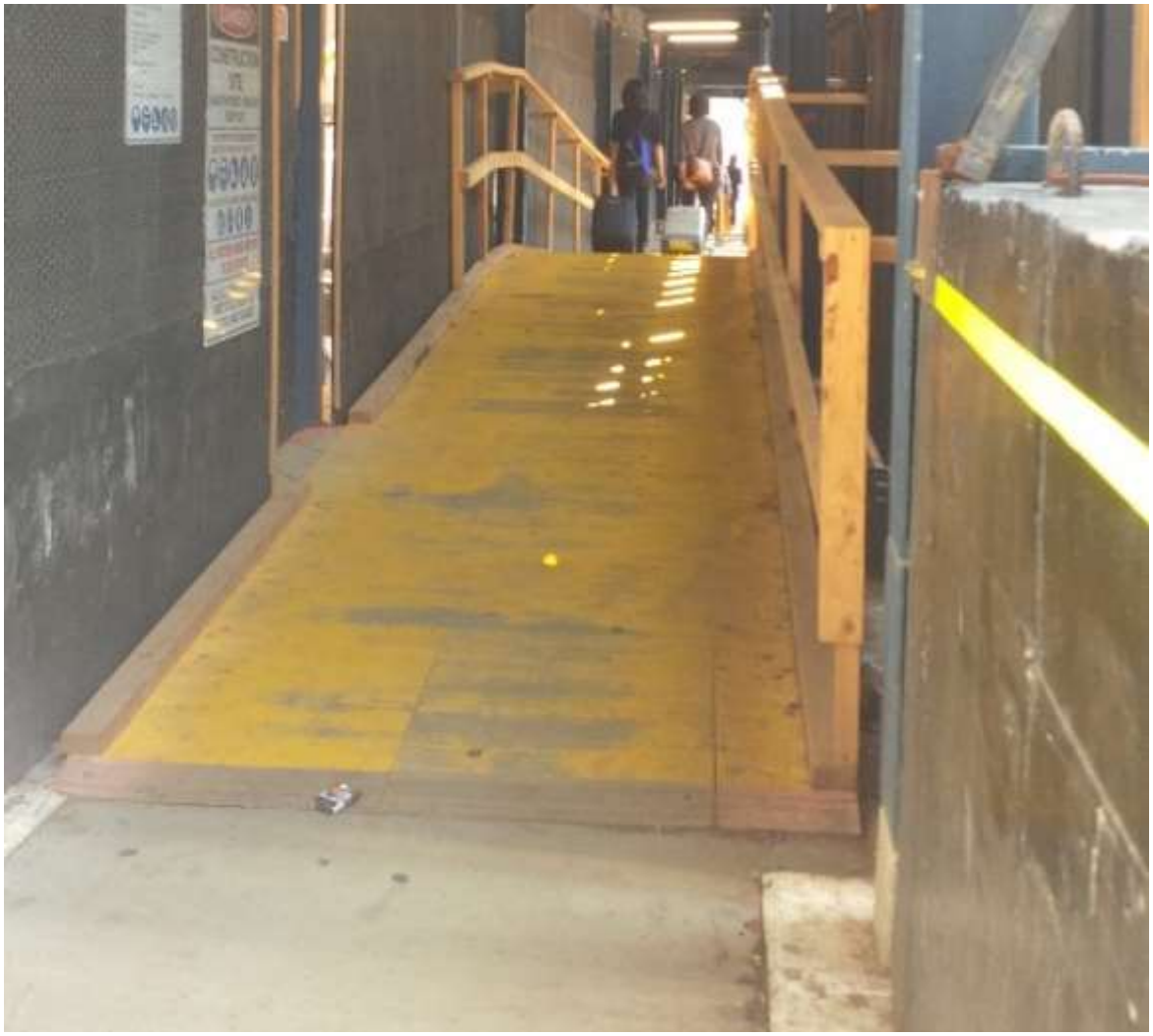


FIGURE 30: EXAMPLE OF COMMON USE OF TIMBER BOARDWALK

Bicycle Network (2017) has recommended that if wooden boards are to be used, they should be installed perpendicular to the direction of cyclist travel. This prevents bicycle tyres becoming caught or deflected by the gaps between the boards that are parallel to the travel direction (Figure 31).

FIGURE 31: LONGITUDINAL LAYING AND GAPS DEMONSTRATING POOR PRACTICE[9]

Similar to pedestrians, diversion onto grass or other surfaces needs to consider the potential impact on cycle movements. Such surfaces can be slip hazards in the wet or create the potential for punctures or damage to wheels which are potential dangers in themselves.

3.3 Best Practice

Ramp Gradient

In line with the recommendations from AGRD 6A (2017), gradients on kerb ramps are recommended to not exceed 1:10, as wheelchairs may tip backwards when being wheeled up steep ramps. This is less than the maximum grade of 1:8 as stated in AS 1428.1 (2009).

Handrails

Handrails should be provided along temporary ramps or stairs wherever people may need support but particularly at rest areas and changes in direction.

Two rails at different heights should be provided to aid people in wheelchairs and other pedestrians.

Tactile Ground Surface Indicators (TGSIs)

TGSIs are defined by AS 1428.1 (2009) as:

“Truncated cones and/or bars installed on the ground or floor surface, designed to provide pedestrians who are blind or vision-impaired with warning or directional orientation information.”

The provision of TGSIs would assist VRUs who are blind or have low vision in identifying hazards and wayfinding around construction sites.

TGSIs come in two forms:

- Warning TGSIs: raised blips to warn people of a hazard ahead, such as a vehicular roadway, stairway, ramp, etc.
- Directional TGSIs: raised bars to assist VRUs in wayfinding, where sufficient environment cues are not provided.

AS 1428.4.1 (2009) sections 2 and 3 provide further guidance on the application and placement of warning and directional TGSI respectively.

Where practicable the same principles should be adopted around construction sites, particularly for those of long duration. It is further recommended that TGSIs be installed with maximum luminance contrast for VRUs.

This also benefits VRUs as a visual warning for change in conditions around construction sites.

The easy availability of stick down TGSI mean any long-term works should include these as a minimum provision. Wayfinding for the visually impaired around construction sites should be further improved through the provision of sound emitting devices, where the works are long term.

[9] Improving Timber Bridge Deck Safety in Knox City Council (Slide 10), Downer EDI 2015

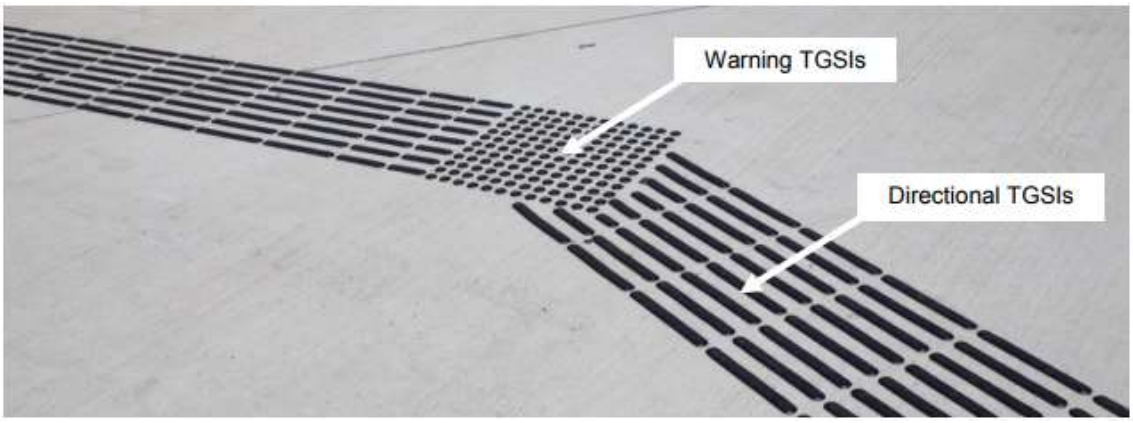


FIGURE 32: WARNING AND DIRECTION TGSIS

Edge protection

The edge of the pedestrian path around or through construction sites should have some form of edge protection where paths have an adjoining hazard and does not abut a property boundary or kerb. (VicRoads, 2017)

This ensures VRUs do not trip on the edge or fall off the edge of the path (especially wheelchair users). Acceptable forms of edge protection include:

- a 150 mm high kerb rail
- a compliant kerb rail and handrail
- a wall of not less than 450 mm in height

Permanent Path Standard

Temporary cycle paths should be provided to the same standard as permanent paths, as recommended by AGRD 6A (2017). The surface should be smooth and slip resistant and should not deviate from a 3 m straight edge by more than 5 mm at any point

The surface should where practicable not exceed the tolerances nominated in the table below.

	Not to exceed (mm)	
	Width of groove	Height of step
Parallel to direction of travel	12	10
Perpendicular to direction of travel	-	20

Maintenance of Riding Surface

All temporary paths associated with the works should be well maintained, including sweeping of the path on a regular basis.

Provisions of Ramps

Where the cycle lane is to be diverted from the road carriageway and onto a path, a ramp linking the road and the verge may be required. Where this is the case, the ramp should adopt the following design requirements (in line with permanent guidelines as set out in Cycling Aspects of Austroads Guides (2017)):

- The exit ramp from the road should be orientated to enable the cyclists to leave the road at a speed appropriate to the abutting development and the level of pedestrian usage of the path
- The ramp for re-entering the traffic stream should be placed at an angle that enables cyclists to conveniently view traffic approaching in the left-hand lane

- Consideration should also be given to providing a kerb extension to shelter the reintroduction of a bicycle lane
- The gradient of ramps to and from raised path sections should be constructed to avoid an abrupt change of grade (in excess of 5%) and in general should not be steeper than 15:1 where high bicycle speeds are likely
- The surface of ramps should have a suitable skid resistance so that cyclists don't slip

Figure 33 provides guidance on low and high-speed exit and entry ramps that should be adopted where practicable.

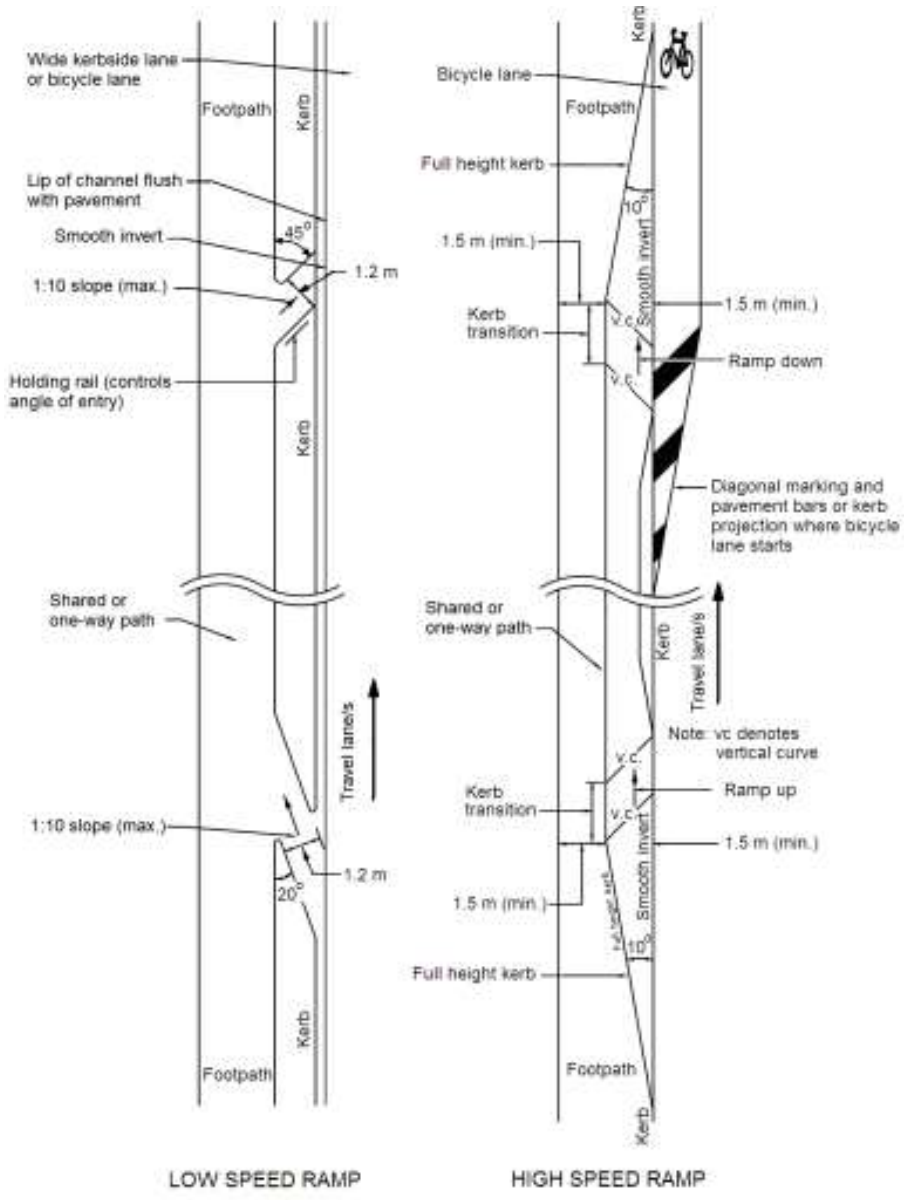


FIGURE 33: GUIDELINES ON LOW AND HIGH-SPEED RAMP EXITS[10]

[10] Section 4.6 (Austroads, 2017)

4. Conclusion

This paper has provided collated information relating to the routing and paths for pedestrians and cyclists around and through temporary roadworks. It has identified a range of considerations that should be made in thinking how those users interact with worksites and considerations of routes, flows, surfaces, widths and safety and security. Lack of consideration in planning can lead to unsafe behaviour and safety issues and fail to meet the required standards and advice in the Australian Standards and AustRoads.

5. References

Road Management Act 2004, Worksite Safety – Traffic Management

Austroads, Guide to Road Design Part 6A Paths for Walking and Cycling (2017)

https://www.monash.edu/mada/research/labs/xyx-lab-monash-space-gender-communication-lab

Australian Standards AS 1428.1 (2009) - Design for access and mobility, Part 1: General requirements for access - New building work

Australian Standards AS1428.2 (1992) – Design for Access and Mobility

Austroads, Guide to Temporary Traffic Management, Part 3 Static Worksites (2019)

Department of Transport, 1 Spring Street Melbourne Victoria 3000