Technical Note 130

Speed management on shared paths

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1 Purpose and scope

The purpose of this technical note is to provide operational and best practice guidance on speed management techniques for shared paths in order to minimise potential conflict between users. Design guidance is provided in the Transport and Main Roads *Road Planning and Design Manual* Volume 3, Part 6A.

Currently there is no technical guidance available on the management of excessive speeds on shared paths in Queensland. This lack of guidance has resulted in speed limits being introduced and applied to facilities with no consideration to more appropriate design treatments or the high likelihood of non-compliance.

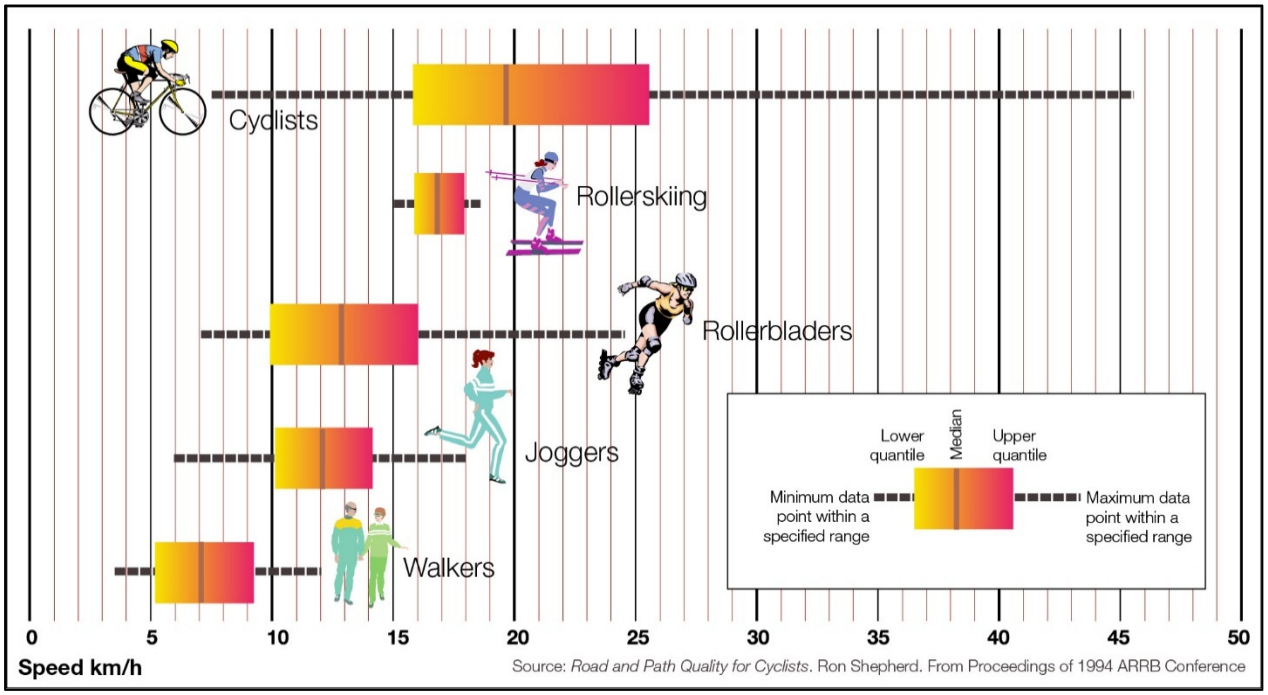
1.1 Introduction and background

Austroads Guide to Road Design Part 6A: Pedestrian and Cycle Paths (2009) describes shared paths as a type of off-road cycling facility which is accessible by pedestrians and cyclists. Shared paths are the most common type of facility due to the cost of constructing separated paths, limitations in the physical area available for a path and the versatility of a shared path, being accessible by all users.

Austroads also recommends that shared paths should be used in situations where there is demand for both a cycling and a pedestrian facility, but where the demand is not expected to be sufficiently great to provide separated facilities. However, as cycling increases greater pressure is being placed on shared paths which in turn have led to increased conflict between cyclists and pedestrians. Where separated facilities cannot be provided and an increasing number of cyclists and pedestrians are expected to use the same space there is growing need for management to mitigate potential conflict.

Of particular concern to both path users and path managers (asset managers) is the speed of cyclists. The wide difference in operating speeds between the modes is shown in Figure 1.

Figure 1: Operating speeds of the different types of shared path users (indicative)



Since bicycles are not required to have a speed-measuring device (and most do not have one), mandatory speed limits are not a viable option, even if they could be enforced. However, advisory speed signing and warning signage on paths where there are large numbers of slower users can be effective when used selectively at appropriate locations, and in accordance with the prevailing conditions.[1]

A review of national and international literature has demonstrated that speed limits for cyclists are not used or recommended as a safety device, with the exception of the rule which states that the speed limit of the adjacent roadway shall apply to any road related area.

1.2 Related documents

This technical note should be read in conjunction with the following guidelines:

- Austroads project NS1018 report and resources toolkit: *Pedestrian-Cyclist Conflict Minimisation on Shared Paths and Footpaths* (Austroads 2006)
- *Austroads Guide to Road Design Part 6A: Pedestrian and Cyclist Paths*. (Austroads 2009)
- Transport and Main Roads *Road Planning and Design Manual* Volume 3, Part 6A
- *Austroads Cycling Aspects of the Austroads Guides*, Section 7.5.8 Sight Distance.(Austroads 2011)
- *Manual of Uniform Traffic Control Devices* – Part 9: Bicycle Facilities (based on AS/NZS 1742.9) Department of Transport and Main Roads (MUTCD 2013)
- *NSW Bicycle Guidelines* Roads and Maritime Services NSW. (RMS 2005).

Figure 2: Inappropriate speed limit signage application

Though the path on the right in this photo has been linemarked as a bicycle path, the modified R8-2 regulatory sign declares it as a shared path with an 8 km/h speed limit. The adjacent path on the left is designed and signed for pedestrian-only use. Cairns, QLD.

[1] Austroads 2006

Figure 3: Effective use of pavement markings to manage speeds

The speeds cyclists can comfortably operate at are much higher than that of pedestrians. Poorly designed facilities can produce conflicts between the users due to insufficient operating space, poor surface or a lack of path definition and linemarking. This well-designed path is smooth and well defined with centrelining. The path markings warn users to slow for a sharp bend in the path. Bicentennial Bikeway, Brisbane, QLD.

2 Bicycle operating requirements

A rider balances their bicycle in an upright position mainly due to the forward-motion forces they exert on their machine. Without this forward-motion the bicycle loses stability and falls over. The speed of this forward motion at which cyclists chose to travel is influenced by a combination of human and other factors.

At slow speeds a rider stays upright by continually adjusting the steering and shifting their body weight in response to the motion of the bicycle. At higher speeds, the forces set up by the rotating wheels make front wheel steering difficult, so a rider steers by leaning in the intended travel direction.

On well-designed paths and in good conditions cyclists can comfortably travel at speeds of between 15 and 25 km/h with minimum risk or decrease in amenity to pedestrians.

An analysis by Transport and Main Roads of its permanent bicycle counters in the SEQ region found that cyclists travel, on average, at a speed of 20 km/h[2]. As is the case in on-road situations, the small percentage of riders travelling at excessive speeds (not appropriate to the prevailing conditions) presents the largest concern to the safe operation of shared paths.

Studies of bicycle operational stability during the last century have shown that a bicycle can become unstable at speeds below 11 km/h. The degree of stability depends on a number of factors: the skill of the rider; the design of the bicycle; and, environmental factors such as path surface and slope[3].

[2] Rees 2011. Speed Setting on Shared Paths. Griffith University study commissioned by Transport and Main Roads.
[3] Wilson, Papadopoulos (2004). *Bicycling Science* (Third ed.). The MIT Press. pp. 263–390.
Whipple (1899). *Quarterly Journal of Pure and Applied Mathematics* 30, pp 312-385.

Requiring cyclists to travel at speeds which may detrimentally affect their stability (and hence safety), on inadequately designed paths, shared with other users insensitive to their operational needs, is not an equitable or safe path management strategy.

Any regulatory device which instructs a cyclist to undertake a behaviour that will compromise their safety cannot be expected to be complied with and damages the credibility of the device.

2.1 Speed setting on shared paths

In situations where a speed limit has been pursued, it has proven high cost for little benefit as it is problematic to enforce for the following reasons:

- technological limitations in measuring the speed of a cyclist from a standing position
- the required expectation of the cyclist themselves to monitor their specific speed
- few bicycles are equipped with a speedometer (or similarly accurate speed measuring instrument).

Research into speed limit setting issues on shared paths was undertaken for Transport and Main Roads in 2011 (see footnote 2). The study surveyed user behaviour on a number of popular paths in Brisbane and reviewed current research including accident data and current practice. The key findings of this study were:

- From an analysis of a range of available data, it was observed that the frequency of crashes between pedestrians and cyclists on footpaths and bikeways is extremely low, with an average of 4.7 crashes per year on off-road facilities across the state of Queensland. In the 17 year period analysed, only two fatalities were recorded, and in both circumstances the crash occurred on the nearby road.
- Data sourced from traffic counters installed on shared paths in Brisbane suggested that at periods of higher volume there is more consistent speed on the paths, whereas when the path is unoccupied cyclists will travel freely at a broad range of speeds. Counter data shows that the average speed of each facility at peak times approximates a reasonable design speed for each location. It is therefore posed that the cycling community is able to self-moderate speeds that are appropriate to the location.
- There is no defensible justification for imposing regulatory speed limits on shared paths. A more constructive approach would be to provide clear instructions to cyclists of appropriate cycling speed and behaviour in relation to other path users through effective path design and traffic control devices.
- The feedback received from cyclists surveyed suggested decisively that the cycling community was opposed to the introduction of regulatory speed limits on shared paths. There was agreement however that there is a safety issue in some locations that needs to be addressed. A number of alternative treatment measures were discussed to address safety issues in place of a speed limit.
- A review of literature has demonstrated that speed limits are not used or recommended as a safety measure for paths.

- Alternative treatment methods to speed limiting may be as, or more, effective as safety devices for path management thus avoiding the negative connotations associated with regulation. If a speed limit is to be imposed it is recommended that advisory speed signs be used in place of regulatory speed limits. It is further recommended that only sections of path that are below current design standards or have a localised safety hazard be assessed for speed limits.

Speed management guidelines for paths cannot be viewed in isolation. Implementing a path speed limit may increase the number of cyclists choosing to use an on-road alternative. If the road does not positively provide for cyclists this could be potentially counter-productive for cyclist safety. The likely consequences and risk of non-compliance must be considered.

Figure 4: Speed signs in current use

The two signs on the left are regulatory (enforceable) speed signs which apply to both the road and the road-related area (adjacent paths). The centre right sign is an (unenforceable) advisory speed sign. This type of sign is preferred for indicating advisory speeds (photo right). Where a regulatory speed limit is not signed the default speed limits apply – 50 km/h in built-up areas and 100 km/h outside built-up areas.

It should always be recognised that there are always spatial issues when different transport modes mix. In the case of mixed street traffic, cyclists feel that it is essential that they be given at least one metre separation space to motor vehicles. This has been recognised in recent changes to the Queensland Road Rules, specifying a 'minimum overtaking distance' when passing a cyclist. Likewise pedestrians regularly voice the need for similar separation between themselves and cyclists on shared paths and footpaths. These issues should be addressed through carefully considered facility design and targeted behavioural interventions. The following sections provide advice and guidelines on the implementation of such measures.

3 Designing paths to account for speed

There are a range of treatment measures available for use on shared paths to address the safety concerns of users. However, when operational safety issues arise on existing paths, it is seldom a single design category which needs to be addressed. Practitioners are advised to take a holistic approach to path design by taking into account all the following categories and carefully studying path user behaviour (where possible consulting with actual path users) before implementing remedial measures.

The impact of the treatment in terms of the likely compliance by cyclists must also be carefully considered. If there is a high likelihood of non-compliance then an alternative treatment should be used. It is also essential to determine if the treatment is 'solving' the problem or just 'relocating' it.

Common design and management issues affecting the operation of a path are:

- path design speed
- path widths and user volumes
- path gradient, surface, alignment and sightlines
- physical devices
- advisory devices.

3.1 Path design speed[4]

Austroads 2011 recommends that shared *paths be built to a design speed of at least 30 km/h 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*.

Design speed should not be confused with operating speed or preferred operating speed which are related more to the driver rather than the path's design.

All path and road users have a legal obligation to travel at safe speeds according to the prevailing conditions. It is also a legal obligation of all road and path users to travel with all due-care and attention to avoid a collision with other road/path users. A travel speed appropriate to the prevailing conditions may well be below a posted speed limit.

In instances where shared paths or short sections of these paths have not been adequately designed for the desired operating speed specific site measures may need to be implemented as an interim measure prior to a path upgrade.

[4] Design speed is the selected speed used to determine the various geometric factors of a shared path e.g: curve radii, cross slope, grade, sight distance, path width. Once the design speed has been selected all pertinent path features should be related to it to achieve a balanced design. See Figure 5 for example of the various design elements.

Figure 5: Design parameters for off-road paths (updated from Table 6.2 NSW Bicycle Guidelines)

Design element	Coverage in Austroads *Guide to Road Design - Part 6A Pedestrian and Cyclist Paths*	Example values for 30 km/h design speed
Operating speed	7.2 Bicycle operating speed	30km/h
Horizontal curvature	7.3 Horizontal curvature Tables 7.1 and 7.2	25m minimum path radius without superelevation
Bicycle path width	7.5 Width of bicycle paths 7.5.2 Table 7.3	2.5m local access, 3.0m major path
Shared path width	7.5 Width of shared paths 7.5.3 Table 7.4	2.5m local access, 3.0m major path
Separated path width	7.5 Width of separated paths 7.5.4 Table 7.5 and 7.6	Two-way 2.5m bikepath, 2.0m footpath One-way 1.5m bikepath, 1.5m footpath
Clearances	7.7 Clearances Figure 7.4, 7.5, 7.6 and 7.8	0.5 - 1.0m to walls and fences
Gradient	7.4 Gradient Figure 7.1	5% maximum
Sight and stopping distance	7.8 Sight distance Figures 7.7, 7.8 and 7.9 for vertical	35-40m 8m sight clearance on min 25m radius curves
Crossfall and drainage	7.6 Crossfalls and drainage Figure 7.3	2% for minimum radius of 25m

Also refer to the Transport and Main Roads *Road Planning and Design Manual* Volume 3, Part 6A.

Figure 6: Use of segregation and pavement markings to minimise conflict

During morning and evening peak periods this path is heavily used by cyclists and pedestrians. To minimise conflicts and improve user amenity the path has been widened into separate bicycle and pedestrian paths. Bicentennial Bikeway, Brisbane QLD.

3.2 Path widths and path user volumes

In urban situations where paths carry high volumes of both types of users; cyclists and pedestrians, the width of the facility is a critical factor in its safe operation and user amenity. The departmental *Road Planning and Design Manual* Volume 3, Part 6A provides design guidance, and the departmental technical note Guidance on the Widths of Shared Paths and Separated Bicycle Paths provides operational guidance, to practitioners on suitable path widths relative to path use. In

instances where path volumes are excessive, the physical separation of cyclists and pedestrians onto separate but parallel paths may be the most desirable option.

3.3 Path gradient, surface, alignment and sightlines

Bicycles are very manoeuvrable but this manoeuvrability has limits when the forward movement of the bicycle becomes insufficient to comfortably maintain an upright position. While people can travel slowly on a bicycle at times, they can also travel relatively fast. As bicycles are vehicles of momentum, riders will commonly coast quickly down hills using the momentum built up from prior physical effort to travel further with minimal effort.

Figure 7: Path safety issues due to broader design issues exacerbated by speed

Left: This path is built on a downhill slope with a significant pedestrian crossing movement across the path to the ferry wharf. The crossing point is marked with warning signage and highlighted pavement colour. The sign assembly is top to bottom – TC9785, W8-23 and TC1952-2. Right: This merge point for separated pedestrian, and cyclist merges into a shared path section which is signed (in the opposite direction) with warning signage and different pavement material. Kangaroo Point, QLD.

These factors relating to the operating characteristics of the vehicle are not widely recognised by path designers. This can result in excessively steep grades, insufficient warning of path curves or sudden path narrowing obscured by poor sightlines. Adequate warning signage of upcoming potential hazards and the maintenance of good sightlines are factors that can in themselves moderate excessive path speeds. For further design criteria please refer to the department's *Road Planning and Design Manual* Volume 3, Part 6A.

3.4 Physical devices

Refer to the department's *Road Planning and Design Manual* Volume 3, Part 6A for path design criteria for physical devices and path speed limiting devices.

Crash data analysis suggested that the frequency of crashes between pedestrians and cyclists on footpaths and bikeways is extremely low (compared with road crashes). Data analysis showed that the average speed of each (shared use path) facility at peak times approximates a reasonable design speed for each location. It is therefore posed that the cycling community is able to self-moderate speeds that are appropriate to the location. (see footnote 2).

The following section demonstrates some examples of 'best practice' speed management, utilising the path speed limiting devices listed in the department's *Road Planning and Design Manual* Volume 3, Part 6A.

3.5 Pavement markings and segregation

The use of line marking and signage (Section 3.6 Advisory devices) on pathways has an impact on user behaviour. The over-use of centre line pavement markings and advisory signage, can result in shared paths looking like 'roads'. In these instances it is highly likely that cyclist will treat the facility as if it were in fact a 'road' – a dedicated right-of-way, travelling at higher speeds. The alternative is to use an uncluttered 'shared space' look with minimal or zero demarcation of user space, allowing for slower speed 'mixing' of users.

Practitioner experience has found that placing pedestrians on the 'view' side of the path (for example, the riverside) and the cyclists on the 'non-view' side will minimise conflicts and encourage the 'through' movement of cyclists, whilst allowing pedestrians to enjoy the amenity/scenery.

It should be noted that, particularly in Queensland, pedestrians will naturally tend to use facilities with shade. For example: a 'bicycle only' path with shade from overhanging tree branches may have significant pedestrian usage if the adjoining footpath has none.

The following section demonstrates some examples of 'best practice' speed management, utilising the path speed limiting devices listed in the department's *Road Planning and Design Manual* Volume 3, Part 6A.

Figure 8: A shared path adjacent to Perth central railway station

This particular section of path is crossed by pedestrians and traversed by cyclists and service vehicles. The flush brick paving makes the area look like a pedestrian plaza (i.e. not like a road) thus encouraging drivers and cyclists to be alert and respectful when traversing this area. To assist cyclists (this is a major cycling network route) and to provide clear definition of the facility, edgelining and centrelining has been installed. The bollards have been installed to physically prevent parking at the curve.

Figure 9: Pavement markings use on a sight restricted corner to manage approach speed

Distinctive pavement markings have been added to the pavement of this curving shared path as it enters an underpass on a downhill slope. Normanby Pedestrian Cyclist Link, Brisbane, QLD.

Figure 10: Shared path slow point treatment at railway station access point

City West Station, Perth, WA.

3.6 Advisory devices

Advising cyclists and pedestrians that they are on a designated shared path and additional care needs to be taken is best done through the provision of clear sightlines and the use of traditional warning devices, such as signs and pavement markings. In most instances the use of a R8-2 shared path in

conjunction with pavement markings (centrelining – solid in the case of tight curves and constrained widths, edgelining particularly in low light locations and, bicycle/pedestrian pavement symbols) will communicate a strong regulatory/safety message to cyclists and pedestrians.

Additional departmental warning signage is also available for shared path use: TC1952-2 “Slow down watch for pedestrians, TC6605 Steep downhill, W4-3 Path (road) narrows.

Figure 11: Warning advisory signage recommended for use on paths in Queensland

Left to right: W4-3 Path narrows (also W4-3 Narrow bridge); TC9605 Steep descent – W4 signs and TC9605 to be 450mm square; TC1608 (300mm wide) Slow down – used in conjunction with other diamond shape warning signs); TC1592-2 Slow down watch for pedestrians.

3.6.1 Path behavioural signage

A properly designed path may still experience major safety issues if the type of usage changes from that for which it was designed. Similarly, a narrow path (less than 2.5 m width) may not operate safely if, over time, the volume of pedestrians or cyclists exceeds its design capacity[5].

In place of a costly full upgrade, path management measures will need to be implemented to reduce risk to users. These in themselves may be unpopular with the path users as they may reduce the level of service of the path and require changes in behaviour. Balancing safety with path amenity and level of service for the users should always be given careful consideration and any introduced physical measures communicated to the path users.

Repeated instances of poor path user behaviour can be address by the installation of the path behaviour signage which is designed to remind path users of four key behaviour messages.

[5] Technical Note 133 Guidance on the widths of shared paths and separated bicycle paths.

Figure 12 (right): Path behavioural sign (similar to ACT sign DS13-15-1)

Details on additional path advisory signs can be found in the departmental publication *A Guide to Signing Cycle Networks* – Page 17, Figure 5 available for download from the department's website.

4 Behavioural interventions to mitigate excessive path speeds

4.1 Path behaviour interventions – a case history

On paths with high volumes of users where, due to site limitations, path authorities have resorted to targeted interventions to educate users and to develop site-specific micro improvements to reduce path user conflicts.

One such intervention was carried out in 2009 by the City of Sydney Council on a section of harbourside shared path at Glebe Point in Sydney's Inner West. This path was heavily used by walkers, cyclists, dog owners and their pets. During the campaign Council staff and contractors were stationed along a problematic section of path to interact with the users.

Improved behaviour and respect between the user groups was achieved by the campaign. Physical design issues were also addressed on a critical narrow section of shared path. Cyclists were diverted from this short section of path and provided with an alternative bypass route (of similar length and path type).

Figure 13: Example of a constrained mixed speed environment, prior to treatment

Left – a section of the path at Glebe Point prior to the Council intervention. This path is heavily used and has seating designed into the retaining wall to the right. To the left the bank falls away steeply to the waters of harbour. The bypass path for cyclists now takes them to the right of the fig tree. Right – Campaign poster showing the blue advisory pavement pictograms and key messages for shared path behaviour.

For further information on this technical note, please contact:

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5 References

The document listed below have been referenced in this technical note but are not listed in Section 1.2 Related Documents.

Rees 2011 *Speed Limit Setting on Shared Paths*. Unpublished Griffith University study commissioned by the Department of Transport and Main Roads Brisbane, Queensland.