ACT Government

Design Guide

Best practices for intersections and other active travel infrastructure in the ACT

Transport Canberra and City Services

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1. Introduction

Purpose and overview

Walking, rolling, riding and other forms of active travel are at the centre of the ACT Government's plans to make Canberra an even more liveable and sustainable city. In order to achieve this, we need to ensure that the design principles are in place that reflect best practice to encourage active travel. This Design Guide sets the design vision for creating safe, people-friendly streets across the ACT.

This guidance fills the gap between the high-level aspiration for creating a complete street network that is safe and accessible as outlined in the *Active Travel Plan* using the comprehensive best-practice technical information of the MIS 05 (active travel) and its associated standard drawings and other planning guidance including *Planning for active Travel in the ACT*. This guide represents the shift away from technical compliance to an outcomes-based approach consistent with the ACT Government's new Planning System.

The goal is to improve active travel safety, accessibility and priority at intersections as these are the locations where most crashes occur and where people who walk and ride experience the most delays. Conceptual examples of best practice are provided with supporting design principles that demonstrate how different design responses can be applied to improve intersection operation for people walking and riding.

The guide focuses on the design principles and approaches that can be applied at the early stage of design. This allows all parties to focus on the **purpose** and **context** of intersections before overlaying constraints. As such, this Design Guide is deliberately non-technical, although some specific technical information is included where necessary. The intention is that further sources such as the Municipal Infrastructure Standards (MIS), the associated standard drawing series and other requirements would be brought to bear as concepts are developed.

The intersection treatments provided in **Section 5: Intersection Design Treatment Examples and Guidance** are consistent with the Municipal Infrastructure Standards and demonstrate how different intersection designs might look in a range of settings with different movement and place characteristics. They show the full context of street-life, different users, their activities and their interactions with the built environment. Several of these examples are represented as busier, inner urban intersections, but could equally apply in suburban contexts. Understanding how the design objectives have been achieved in each design response can inform other settings.

Each example includes an overview of the **design objectives** and **recommended treatments**, that have been chosen based on the **context** of these common settings. They outline the considerations that inform the choice of treatments. In every project there are many alternatives to achieve the same outcome, and these examples are only representative some of those possibilities.

To achieve the best outcomes, practitioners and stakeholders will consider **treatments** following a **design process** that first explores the **unique context and direct user needs**. Technical requirements and project constraints should follow this more holistic analysis and problem solving. For interested members of the community, the guide provides an introductory reference and a common language to participate in that holistic design process.

Who is this Design Guide for?

The Design Guide supports a range of people to work together to meet the active needs of the community in urban contexts. It provides a common language for different disciplines and people with different priorities to work together including:

- ACT Government staff, and private contractors involved in project planning, design, approval and construction of active travel facilities;
- Development and infrastructure professionals seeking approval for private development projects that interact with, and contribute to, the active travel network; and
- General public and advocates, it serves as a starting point for their participation in design processes.

How to use this guide

The Design Guide takes you from high-level policy and design context through to the specific intersection design responses and treatments.

Users are encouraged to refer to the broader design approach and considerations that has informed these treatments, which is covered in Sections 3 and 4, before jumping to the specific design response examples in Section 5. This will enable users to apply the design approach to situations that are not covered by the specific examples included in this Guide.

The appendices include seven thematic sections, which can assist by providing further context and implementation ideas while reading the Design Guide:

- Quick-build separator treatments
- Intersection geometry
- Intersection elements
- Path cross sections
- Cycling and micromobility cross-sections
- Signalisation: operations and features
- Signalised intersection arrangements

There are other tools and guides that practitioners can use to address the issues that are out of scope of this guide. As each intersection ultimately integrates into a network, every project offers practical opportunities that can improve the whole-of-journey experience.

Section	Content Overview
1 Introduction	Outlines the purpose and context of the guide and how to use it.
2 Policy setting	Provides a high-level overview of the policy context that governs active travel provision in the ACT, including the strategic transport setting and design approvals process.
3 Design approaches and considerations for active travel	This section looks at user-centered design principles, noting the need to mediate the requirements of different users to improve their safety and comfort. It also looks at some safety considerations and the safety needs of the different modalities of walking, cycling and using micromobility. This section also explores the design principles to ensure that roads and streets are consistent with Safe Systems to meet the needs of path users.
4 Intersection design considerations for active travel	Building on the previous section, Section 4. includes an analysis of the design principles and requirements that are essential to achieving safer prioritised intersection treatments for active travel. This section also provides an overview of the broader network operating environment that shapes, and is shaped by, each intersection project.
5 Intersection design treatment examples and guidance	Illustrative examples of applied design principles. These illustrations are stylised showing the full range of users, buildings, street-life and vegetation. These examples include treatments and a vision for what better practice could look like in the ACT, based on typical situations in the ACT road environment. These images are largely consistent with the technical specifications of standard drawings of the MIS, noting that some regulatory markings and signage have not been included.
Appendices	The Appendices provide a range of additional technical and contextual details that provides further information on the examples covered throughout the Design Guide.

The importance of context and collaboration

Success depends on how effectively a design response contextually addresses an issue. Across the Design Guide, the context is both how standalone projects address a localised, project-specific brief, while also ensuring that each project responds to the broader network considerations to improve active travel more generally. Tacit understanding and local perspectives will inform how to best apply the design principles in this Design Guide in individual projects, and how each project, once complete, will integrate with the existing network.

Engage early, engage often

Proactive and early engagement with the community is strongly encouraged to better understand how design will impact overall functionality. Early engagement also helps to determine the varied user needs, and perceptions of safety and comfort in specific locations. Practitioners need to be mindful of how individual projects can enhance and inhibit the overall active travel network. All design solutions involve trade-offs, and early design thinking that reflects on how different users will be impacted will lead to better outcomes about how these trade-offs are weighted.

It is crucial that practitioners observe and collaborate with users and other practitioners before and during the design phases – community participation in preliminary design stages, combined with consistent engagement with technical and operational requirements, will mitigate the need to adjust project planning in later stages of implementation. *Engaging Canberrans: A Guide to community engagement* offers guidance on the ACT Government's community engagement approach.

Context is everything

The design and infrastructure treatments deployed in one location may not work in another. The context, such as traffic volumes, the role an intersection plays within the network, and the varying user types, as well as other considerations, all affect the types of treatments that can or should be considered. Particular attention needs to be paid to ensuring that different path users and demographics are represented as part of this design stage.

Keep it simple

Sometimes simplifying an intersection can be better than overcomplicating it with separation. This can also significantly reduce project cost or highlight the need for more general Local Area Traffic Management. While this will typically be beyond the scope an individual project, those considerations are important for the longer-term planning and improvement of the active travel network and may inform future priorities and approaches. When these choices are canvassed earlier in the design and planning process, it reduces the risk of having to adapt projects to include active travel at advanced stages of delivery – which can present costly delays and changes.

Key terms and definitions

Each discipline has its own technical language. This guide cuts across legal, engineering, and urban planning technical policy and standards. Generally, all terms here should be considered inclusionary rather than exclusionary. For example, 'active travel' has a broad meaning to include anyone not in a motor vehicle. Some terms are used interchangeably (path, foot path, shared path, bicycle path). The context indicates whether it is a concept or an outcome consistent with a standard or regulation. For example, a cycleway or roadway indicated a space, whereas a collector road or a bicycle-only path, indicates a specific infrastructure classification according to the MIS. A glossary is provided at (**Section 6**).

Implementation

This Design Guide provides guidance and examples to help practitioners aspire to best practice in a specific context, with a focus on outcomes. Each project represents an opportunity to improve overall network operations to improve outcomes for active travel. To successfully implement these design aspirations, practitioners will need to synthesise these design principles with applicable technical requirements.

Operational constraints in implementation can have a significant impact on active travel network functionality. Strict technical compliance and the application of network signal prioritisation should be complementary to, and informed by, best practice principles at the project level, informed by context.

For every project, early and ongoing reference to technical documents will help pre-empt and resolve practical issues to ensure that even ambitious projects can align with technical safety, accessibility, and design requirements. Standards reflect generic requirements that are often challenged or conflict with complex real-world situations and sometimes with other standards. Rigid application can sometimes lead to over-engineering and counter-productive outcomes.

That said, as some treatment and real-world examples demonstrate, it is sometimes necessary to implement treatments that deviate from, or are not captured by current standards to achieve a desired outcome. These cases need to be documented and they may need a safety assessment. They may also inform future applications or changes to the standards.

The ACT Government will continue to develop guidance on other considerations for the active travel network. Implementation, including the development of additional guidance and training for infrastructure practitioners where relevant, as well as considering the development of implementation and project delivery process measurement guidance to evaluate whether these principles have been successfully applied.

ACT-specific approval process, design documents and standards manuals have been included in **Section 2: Policy Setting**.

Acknowledgement

The *Auckland Urban Street and Road Design Guide* (Auckland Guide) is widely regarded as a current Australasian best practice for active travel design and forms the background for this Design Guide. Many sections and illustrations have been generously provided and adopted directly from it. Other guidance documents have also been informative: The ACT Government acknowledges and thanks the Te Kaunihera o Tāmaki Makaurau Auckland Council for allowing us to reuse this work.

The Auckland Guide is part of a suite of well researched guidance and policy instruments that broadly fit with the ACT policy and guidance framework. In particular, this Design Guide closely aligns with the frameworks and principles of Movement and Place and Safe Systems, currently under development by the ACT Government.

Other guides have also been used in the preparation of this Design Guide:

- Austroads – *Integrating Safe System with Movement and Place for Vulnerable Road Users*
- Transport for NSW – *Cycleway Design Toolbox*
- World Resources Institute – *Global Street Design Guide*
- Waka Kotahi New Zealand Transport Agency – *Handbook for Tactical Urbanism in Aotearoa*

The ACT Government acknowledges and thanks all of those organisations for generously allowing us to benefit from their work.

We also acknowledge the knowledge sharing and collaboration between jurisdictions, professional practitioners and not-for-profit organisations through the Design Innovations Working Group established by Cycling and Walking Australia New Zealand (CWANZ) who have been reviewing these materials on an ongoing basis.

We are grateful for the feedback and technical guidance from members of our advisory group and the many submissions received from the community:

- Living Streets Canberra
- Pedal Power
- The Heart Foundation ACT
- Auscycling ACT
- Amy Gillett Foundation
- Design professionals: Barros van den Dool and Civilscope Consult
- Community submissions through the Yoursay

2. Policy setting

Provides a high-level overview of the policy context that governs active travel provision in the ACT, including the strategic transport setting and design approvals process.

Policy context

This Design Guide has been developed to deliver the ACT Government commitment in the ACT Transport Strategy 2020 and Active Travel Plan 2024, to develop best practice active travel design guidance for intersections. It is aligned with the Movement and Place, Vision Zero and Safe Systems policy frameworks.

Safety is a key element under the ACT Transport Strategy 2020 and the ACT Road Safety Strategy 2020-25. Safety is used to assess current and future performance of roads, streets, corridors and precincts. Death and serious injury for active travel modes are disproportionately high compared to other road users. Protection and separation for people who use active travel is fundamental to achieving Vision Zero.

Vision Zero and the Safe Systems Approach

Figure 1 Safe Systems (Source: ACT Road Safety Action Plan 2024–25).

Applying vision Vision Zero to our active travel networks, as we do for our roads, recognises that all deaths are preventable. Vision Zero is about safety for all modes, no matter their priority. The pathway to Vision Zero follows the Safe Systems approach – integrating safe people, safe vehicles, safe roads and safe speeds (Figure 1). Figure 2 shows the relationship between evidence and science and the systematic approaches that we take when we design, build and operate a transport network that protects and improves conditions for walking, cycling and public transport. These improved conditions also make for a more vibrant and healthier city. This Guide focusses on the how intersections can be designed based on these safe system concepts.

Figure 2 Evidence and systematic approaches underpin Vision Zero (Source: *Urban Street and Road Design Guide*, Auckland Transport)

Movement and Place

The Movement and Place Framework (Figure 3) is one of a series of policy frameworks developed under the *ACT Planning Strategy 2018*. Once a street is classified according to its movement, and separately, place functions, it makes it easier to identify appropriate treatments (such as intersections) that support the existing functions of a street, or move it toward more desirable functions.

The ACT Transport Strategy 2020 subsequently applied the concept to further integrating land use and transport planning for our future transport network. A Movement and Place decision-making tool is being developed and is currently being tested on a number of ACT Government projects and in the development of a multi-modal network plan.

Figure 3 Movement and Place framework

Street types

To guide future developments and road, street or placemaking projects, the *ACT Transport Strategy 2020* contains a set of street types that classify roads and streets based on the adjacent land uses (place) and transport function (movement) using the Movement and Place Framework (Figure 4). These street types can be enhanced with design solutions that meet the aim of the street. Section 5 of the guide shows how this vision can be translated into design solutions that meet the aim of the street.

In addition to these policy frameworks, the Design Guide supports the fulfilment of the Active Travel Plan, ACT Road Safety Strategy 2020–25 and the ACT Road Safety Action Plan 2024–25, which set the strategic road safety objectives and priorities for the ACT.

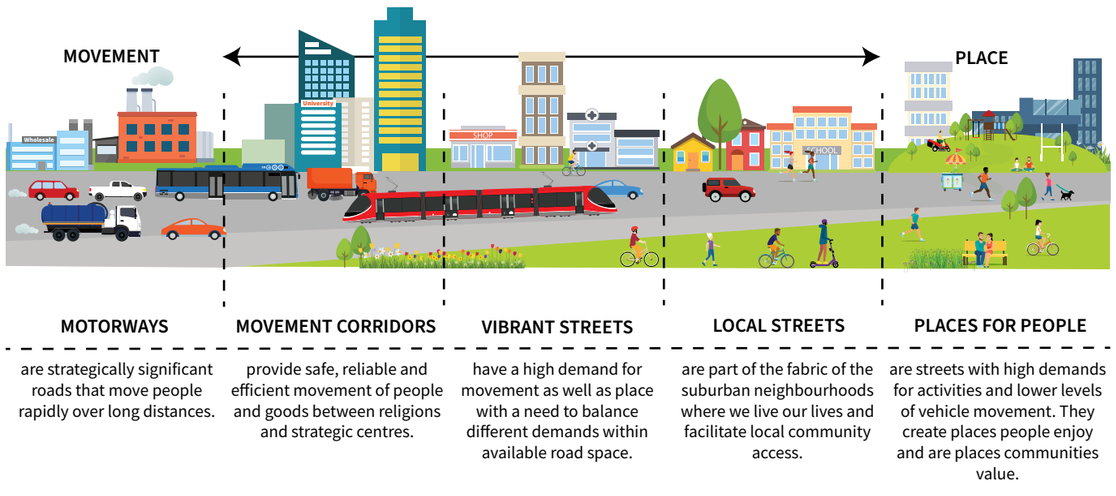


Figure 4 Street types according to Movement and Place classifications

Urban street zones

In urban environments (no matter what the movement and place or road/ path classification), the cross-section of all street types can be segmented into different zones (Figure 5) to allow conceptual thinking for design, prior to applying technical details. From the property boundary, these include:

1. Frontage zone – the space adjacent to the building edge where ground-floor uses spill out onto the public realm, such as outdoor dining. It can be an extension of the active land uses found along a street. The frontage zone is where the features found along the edge of a street interact with the street use.
2. Clear footway zone – provides a movement zone for people on foot, using mobility devices (including prams) to travel side by side and pass each other in either direction, that is clear of any obstacles. This facilitates through access for people walking or riding along a street, regardless of age and abilities. Frequent safe crossings provide continuity for people on foot.
3. Street furniture zone – the designated area for a variety of features, not limited to street furniture. It provides space for signs, light and signal poles, street trees, public transport stops, rubbish bins, and any additional underground infrastructure.
4. Kerbside zone – sitting between the street furniture zone and the roadway, this area offers opportunities for flexible use of the urban realm including walking improvements (such as kerb build-outs), patios and parklets, cycleways, parking for cars, bikes and micromobility, loading zones, taxi stands, pick-up/ drop-off zones and public transport stops.
5. Roadway – provides space for through movement for motor vehicles, public transport and for the delivery of goods. In off-peak hours, this space may be partially used for parking and loading. On occasions, access to vehicles might be restricted to provide space for events and festivals.

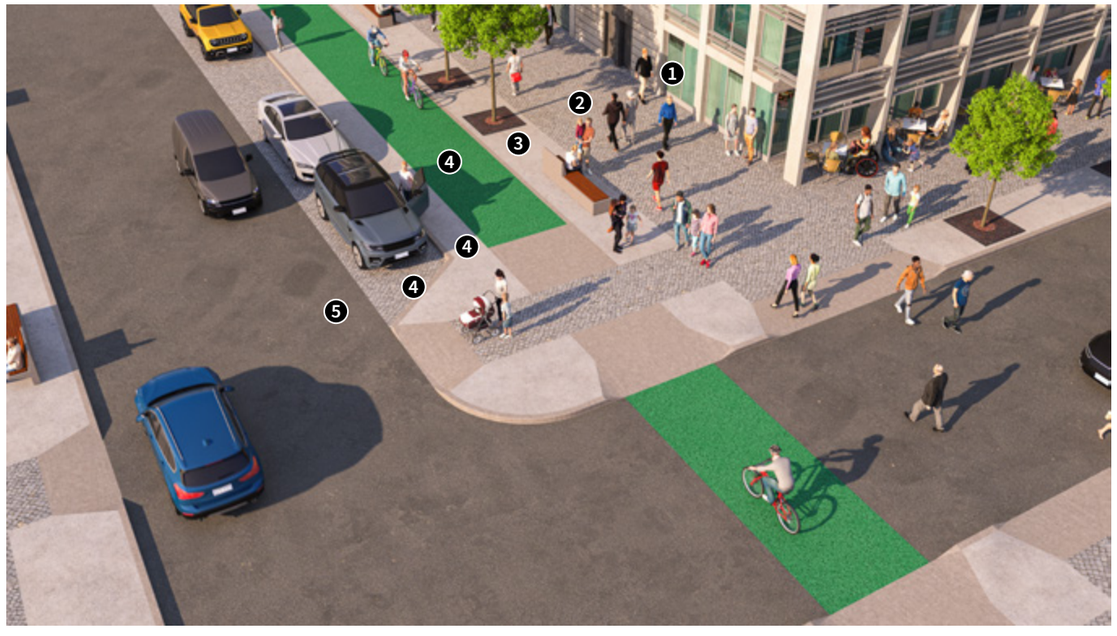


Figure 5 Urban street zones [adapted from the Urban Streets and Road Design Guide (Auckland 2022)]

National Capital Authority land and other areas

Some areas of Canberra are outside of the ACT Government's direct planning and development control, including the Parliamentary Triangle (National Capital Authority) Commonwealth Department of Defence land, the Australian National University and Canberra Airport.

In these areas, the ACT Government is committed to ensuring that the path and road network meet the current expectations for active travel design, and will continue to work with those stakeholders to ensure that the Design Guide's design principles can be achieved, including when it integrates with the broader network.

The National Capital Authority (NCA) has responsibility for planning policy and works approval in certain areas, with the design choices based on adherence to the National Capital Plan. Certain treatments are required for 'Designated Areas' under the National Capital Plan, which are outside the scope of the Design Guide.

Consistency and legibility of infrastructure treatments is important for safety and functionality across the entire network. It is crucial that while design details may vary, design choices do not compromise safety and functionality. Alignment with the design principles and approaches articulated here is strongly encouraged to minimise these impacts.

The ACT Government will continue to work closely with the National Capital Authority and other significant land managers to ensure accessibility and safety outcomes are consistently implemented across the entire active travel network.

The Designated Areas include:

- Lake Burley Griffin and its foreshores
- The National Triangle (or Parliamentary Triangle); and
- The road reservations of identified Main Avenues and Approach Routes.

Road and path user rules that inform design in the ACT

Unless designated, all paths are shared and people can use them for walking, cycling, scooting and riding other devices, including mobility aids. People riding can use zebra crossings at low speed (10km/hr). Drivers of motor vehicles must give way to people walking or riding over marked crossings, or at signalised intersections when the lights are green. Drivers must also give way to people walking or riding when those people are crossing a driveway leaving a private property. Some of these rules are poorly understood by the general community which highlights the importance of design treatments that clearly indicate priority.

As the most vulnerable users, pedestrians (people walking or using devices to assist in pedestrian activity, such as wheelchairs or other mobility aids) have priority in the path environment over people riding bikes or personal mobility devices (PMDs – e-scooter and other e-rideable devices as well as non-motorised devices such as skateboards or rollerblades). The ACT has a significant network of footpaths, on-road bicycle only lanes, and shared paths designed to support more efficient, longer trips for cycling and micromobility.

Since 2019, PMDs have been legal to use on paths, which has increased demand in the path network. We have seen a significant uptake of privately-owned devices, and the e-scooter share scheme was rolled out to all regions of Canberra at the end of 2022.

Canberra streets commonly have footpaths on both sides of residential streets, although some only have them on one side and some have none. Streets in newer suburbs were better designed for lower speeds.

Unless otherwise signposted, the default speed limit on residential streets is 50km/ hour. Major collector streets are generally 60km/hr. Both can be modified by localised treatments such as, but not limited to, school zones and high pedestrian areas in the town centres that are limited to 40km/hr.

Design approvals in the ACT

The Transport Canberra and City Services Directorate (TCCS) is the approval authority for road and path design, construction and acceptance of these assets if delivered by third parties. Road and path projects are typically designed and led across a number of agencies, with TCCS engagement, including:

- Suburban Land Agency (greenfield developments);
- Environment Planning and Sustainable Development (Territory planning and master planning)
- Major Projects Canberra (major infrastructure projects including Light Rail Stage 2);
- City Renewal Authority (activation projects across central Canberra).

Planning for active travel in the ACT (Interim guide) (2019) outlines in detail how planning through to asset acceptance operates in the ACT.

Policy and technical guidance for intersection design for the ACT

This below list provides the first layer of technical documentation that relates to the conceptual design process envisaged by this guide. This is not an exhaustive list of the technical requirements and guidance available for intersection design (see **Bibliography**). Other requirements and guidance are elaborated further in the Municipal Infrastructure Standards.

Compliance

- Municipal Infrastructure Standards (and related standard drawings):
    - 01 (street planning and design)
    - 05 (active travel) and associated standard drawings.
    - 13 (traffic control devices)
- Disability Discrimination Act 1992 (with reference to Australian Standard AS 1428 for buildings as far as they apply to access)
- Disability Standards for Accessible Public Transport 2002
- ACT Road Rules (having regard to how they apply to intersection design)

Guidance

- Planning for Active Travel in the ACT (interim guide) (2019)
- Other ACT Standard Drawings (that complement the MIS)
- City Centre Urban Design Guide (CRA)
- Urban Design guide (new ACT planning system)
- Gender Sensitive Urban Design Guidelines
- Traffic management and safety: A practical guide for schools

Tools

- Active Travel Infrastructure Practitioners Tool

3. Design approaches and considerations for active travel

This section looks at user-centered design principles, noting the need to mediate the requirements of different users to improve their safety and comfort. It also looks at some safety considerations and the safety needs of the different modalities of walking, cycling and using micromobility.

This section also explores the design principles to ensure that roads and streets are consistent with Safe Systems to meet the needs of path users.

User-centred design

This guide recognises that active travel networks and intersections are used by a broad range of people who may travel for similar reasons (for example to work and education in the morning and afternoon peaks), or for a range of reasons at other times (for example shopping, recreation, business, and work).

The movement hierarchy adopted in the *Urban Design Guide* (Figure 6) is a simple concept that shows the importance of the most efficient use of space and resources for transportation planning. It also recognises the need to prioritise safety and equity for the most vulnerable road and path users.

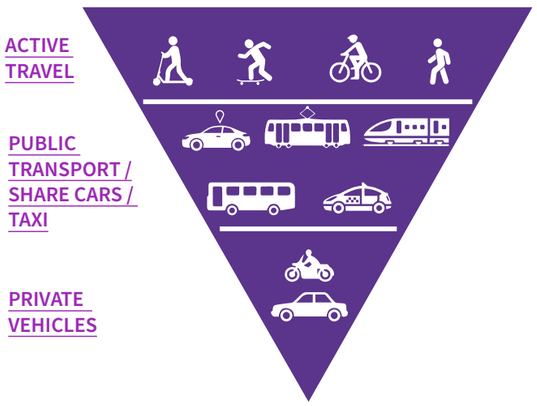


Figure 6 Movement hierarchy (Source: ACT Urban Design Guide 2023)

Vulnerable road and path users

The first level of people in the movement hierarchy who use active travel are diverse in their needs and preferences:

- almost every person walks, even if that is from the car or to the bus stop
- people may use a single device or a range of devices
- people have varying levels of ability, skills and fitness
- people travel and move for different reasons
- people may travel at different speeds
- people require different amounts of space, including to manoeuvre and stop, and
- people are more and less predictable or responsive in their behaviour.

Intersections need to accommodate users of all ages and abilities. If users with the highest level of need such as the young and the elderly and people with disabilities can use them confidently and independently then all other users will be able to do the same.

In addition, in meeting the higher levels of need, another group of users who move faster (bicycles as well as micromobility devices) is growing. The potential consequences of a collision for vulnerable path users, particularly the elderly, is high and can deter them from walking (even if the actual risk is low).

By identifying and acknowledging diverse needs, we are better placed to prioritise them in the design process.

Motor vehicle (road) users

The complexity of interactions in the path environment is increased at intersections with the roadway where active travel users mix with a range of motor vehicle drivers who may be:

- professional drivers in public transport (buses and light rail)
- emergency workers in a range of specialised vehicles (cars, trucks, ambulances)
- services provided by specialised vehicles (waste removal, mowers, tractors)
- commercial drivers for delivery (small and large cars and trucks)
- travel between work sites to do their work (i.e.: builders, community services workers)
- commercial cars (ride share) and
- private travel (privately owned cars and motorbikes).

Traditionally, intersection design has disproportionately prioritised the efficiency of motor-vehicle users over people who are more vulnerable (with the aspiration to keep them safe – but with the consequence of restricting their movements), either because the more vulnerable have not been afforded adequate separation or because they often encourage non-compliant behaviours: by active travel users who have not been given adequate priority, and subsequently by motor vehicle users because they assume priority (for example not slowing down early and sufficiently to stop at zebra crossings).

Mediating the needs of all users

The design challenge is to understand, respond to and mediate the needs and behaviours of all users to increase the mode share of people who walk and ride by making sure intersections operate efficiently and safely for the benefit of all. The application of the Movement and Place framework helps to prioritise the different functions of a street and then a user overlay helps to modify that.

There are always design trade-offs, leading a process of 'averaging' against some users in every project. Balancing design choices is contingent on understanding the needs and behaviours of different user groups (which may be informed by their experiences, values and perceptions).

Contextual awareness of the range of users will determine how to balance the trade-off between efficiency and separation. Treatments will necessarily vary across the network in order to appropriately provide for the diversity of active travel users in different environments. For example, the intersection of a principal community route/ arterial intersection at the periphery of a town centre primarily used by adult commuters will require a different approach to a suburban school crossing over a local street. The town centre is also more likely to accommodate large vehicles as regular hourly users, whereas the local intersection may only see a few buses and service vehicles a day. Understanding and documenting the needs of all users will help inform and justify later design trade-offs, balanced with the critical requirements to achieved useful infrastructure.

Walking

Walking is the most accessible, affordable and equitable form of transport. Within the movement hierarchy and street types, people on foot are prioritised in the design of Vibrant Streets, Local Streets and Places for People. Walking is the most intense experience of streets due to the slow speeds and short distances at which people move when on foot or using pedestrian devices. Enriching that sensory experience and making it safe and more comfortable will make it more attractive. A person walking with crutches, a person in a wheelchair and a young parent with a pram all have an equal right to reach any destination accessed by public streets in a city. Priority should be given to designing for the most vulnerable users in mind, such as the elderly, the young and people with mobility impairments. Every street must be accessible by people of any age and ability.

Walkable cities are places that are easily and safely navigable on foot and offer a sense of equity and independence. Walking has the capacity to promote equality and reduce social exclusion.

Walking is good for health both physically and by creating social connections that benefit psychological health. Street design should enable many trips, especially shorter ones, up to 10 or 20 minutes, to be made by walking rather than motor vehicle.

A street environment that encourages walking should:

- enable comfortable flow
- promote social interaction
- provide a sense of safety
- improve accessibility for people with limited mobility
- move large numbers of people efficiently (Vibrant Streets and Places for People), and
- enhance the liveability and sustainability of the city.

Cycling and micromobility

Riding a bike is an affordable, low emissions, healthy mode of transport. The use of cycling facilities is expanding to include scooters, skateboards and other forms of active travel, as well as electrically powered versions of these devices. Safe and attractive cycling infrastructure may also be more appealing for people using mobility scooters.

This section should be used to design according to the intensity of cycling and micromobility use predicted for the life of the infrastructure. In all options, cyclist movements are protected from vehicle movements by a built kerb height separator or buffer area.

In every project, the aim should be to maximise space, including preferring the separation rather than integration of different movement types. The primary design aim is to first provide enough space – without adequate space, conflict and safety issues will arise, particularly in busier areas. All options, including the repurposing of road space, need to be considered in initial designs to ensure that active travel movements are appropriately provided for. This is particularly relevant when the minimum width requirements are unable to be met within the existing path provision area.

Steps in user-centred design thinking

As discussed above, designing intersections for active travel requires **a user-centred approach** to ensure the safety, convenience, and comfort of people walking and riding. Far too often we jump straight to solutions that meet the needs of road users (even placing cycling traffic above pedestrians) without considering the needs of all users, particularly where there are competing needs. For example we often think of the time delay for motor vehicles as having economic impacts, but we do not think the same about people walking and riding. Depending on the place (and movement) characteristics of the intersection we can also make these places more pleasant.

The following is an extensive set of steps that can inform a user-centred design process, together or with some modification depending on the scale of the project. The different steps highlight the range of disciplines/ stakeholders that can be involved rather than a process to be followed. If the project scale or scope does not allow for a fulsome design process, think of ways to adapt these steps to ensure that all user needs are considered.

1. **Define goals and objectives:**
   - Identify the primary goals of the intersection design, such as improving safety, promoting accessibility and efficiency, and enhancing the overall experience for active travelers balanced with the needs of other road users.
   - Establish specific objectives, considering factors like reducing conflict points, minimising travel times, and enhancing visibility.
   - Set a strong vision for how the intersection should perform and for whom., that can be monitored and validated post-implementation.
2. **User research:**
   - Conduct thorough user research to understand the needs, behaviours, and preferences of pedestrians, cyclists, and other active travelers in the specific context.
   - Gather data on peak usage times, demographics, common routes, and any existing challenges or safety concerns.
   - Document gathering places, destinations (schools, bus and light rail stops and interchanges), landmarks, and other relevant activity.
   - The NSW Walking Space Guide provides valuable procedures to balance pedestrian space against space required for the movement of general traffic.
3. **Stakeholder engagement:**
   - Involve key stakeholders, including local residents, community groups, transportation authorities, and advocacy organisations.
   - Collect input and feedback from these stakeholders to ensure a comprehensive understanding of the diverse needs of the community.
4. **Site analysis:**
   - Conduct a detailed analysis of the intersection site, considering factors such as existing infrastructure, traffic patterns, land use, network function and potential environmental impacts.
   - Identify any physical constraints or opportunities that may influence the design.
   - Calculate the volume of people (not just vehicles), and by what modes, that may move through the intersection.
   - Note desire lines and where people linger. Where do informal crossings occur? Use land, use plans, census data and employment data to assess future demand.
   - Identify specific challenges or issues that may need to additional consideration such as mobility aids, children and older people.
   - Is the intersection used differently at different times or on different days.
   - Analyse crash history and assess safety of existing user conflict points – this includes an analysis of the crash history at similar intersection types.
   - Acquire signal plans (SCATS data) from Transport Canberra and City Services.
5. **Develop personas:**
   - Create personas representing different user groups, such as children, elderly individuals, people with disabilities, regular commuters, delivery riders etc.
   - Use these personas to guide decision-making and ensure that the intersection design caters to a diverse range of users.
6. **Design workshops and prototyping of functional concepts for the intersection:**
   - Organise design workshops involving both designers and end-users to brainstorm ideas and generate creative solutions.
   - Develop low-fidelity prototypes or simulations of intersections to test and refine design concepts before implementation using sophisticated software or using toys and paper.
   - Map and understand the turning movements required of the intersection. Overlaying vehicle volumes gives perspective on the relative importance of that link in the network.
7. **Accessibility considerations:**
   - Prioritise accessibility using universal design principles, ensuring that the intersection is usable by people of all abilities.
   - Consider features such as Tactile Ground Surface Indicators (TGSIs), paving, audible signals, and markings.
8. **Refine concepts through sketch plan stages:**
   - Include specific safety features such as well-defined markings, dedicated bike lanes, and traffic-calming measures to minimise the risk of accidents.
   - Incorporate advanced signaling systems to enhance the predictability of traffic movements.
9. **User testing:**
   - Conduct usability testing with representative users to gather real-world feedback on the design.
   - Analyse the results to identify any issues or areas for improvement.
10. **Iterative design:**
    - Based on user feedback and testing results, iterate on the design to address any identified shortcomings.
    - Continue to refine the design through multiple iterations until it meets the needs of all user groups.
11. **Implementation and monitoring:**
    - Plan for rapid implementation and evaluation of the finalised design.
    - Monitor the intersection post-implementation to assess its impact on active travel and address any emerging issues.
    - Identify whether other system changes may be needed such as regulatory change or public education.
12. **Public education and outreach:**
    - Consider the level of local or city-wide communications that may be required at all stages to inform the public about the new intersection design and how to navigate it safely.
    - Conduct outreach programs to raise awareness and promote positive user behaviour.

Principles of safe design to meet the needs of path users

One of the principles of the Safe Systems Framework is Safe Roads. This guide provides five design principles to ensure that roads and streets are consistent with Safe Systems:

- **Network functional hierarchy**
- **Speed of the path or road environment**
- **Forgiveness**
- **State of awareness of road users**
- **Self-explaining environments**

Network functional hierarchy

A network functional hierarchy is used to determine priority at junctions and intersections of both roads and paths, and the design elements reinforce this hierarchy. This includes consideration of the overall active travel network.

Within the Movement and Place Framework, there are functional hierarchies for walking, cycling and road traffic. The design of intersections and junctions between different road classifications should clearly show change from one function to another.

Table 1 Street and path classifications in the ACT

Movement class and facilities	Functional hierarchy
Roads	Arterial/Collector Access/ local
Cycling facilities (path and road)	Principal Main Local
Walking areas (path, road, open space)	Central High intensity Low intensity

Speed of the path or road environment

Achieving safe speeds is a critical component of safe street and intersection design. Road and path environments are complex, with an increasing diversity of vehicle types, often with competing needs, preferences and uses. Effectively managing the speed differential between different road and path users is a key part of ensuring overall safety for everyone.

Where people who are walking, cycling and driving share road space without protection, the road or street environment should be designed to achieve equitable travel speeds (30km/h or less). If equitable travel speeds are not achievable, then separate facilities should be provided.

At intersections, people driving yield more frequently to people walking and riding when speeds are low, making it safer for path users to pass in front of turning cars. Lower speeds give drivers more time to stop if needed and reduce the severity of collisions when they occur. Other design considerations that can reduce driver speed are smaller turn radii, centreline hardening, turn speed bumps, and raised crossings for paths.

Speed also needs to be considered in path environments where there are faster moving bikes and micromobility devices, and people walking and lingering. Generally, potential conflict can be mitigated by providing more space and dedicated separation between users in busier areas. Depending on the movement and place classification separated facilities, or other design considerations to reduce the speed differential between path users in shared environments, may be required. For faster cycling movements, in some situation grade separation may be necessary.

Forgiveness

Road and path users make mistakes, but mistakes should not result in serious injury or death. We can limit injuries through a forgiving road environment and anticipation of road user behaviour.

Path facilities should be designed to eliminate path-side hazards such as bollards, railings, poles, fences, overhanging vegetation, drainage grates, slippery or longitudinally grooved surfaces, ramp lips above 100mm, and inadequate clearances from moving traffic.

Table 2 Forgiveness responses

Response	Application in street and path design
On new or rebuilt roads and streets, design for safe and appropriate speeds where vulnerable road users are regular users.	Design speeds: • Residential (local access) streets should be designed for slower speeds that allow people to move freely and equitably when walking and cycling, including crossing informally without priority crossings. • On-road shared environments (active travel streets and shared streets are designed to achieve equitable travel speeds between `modes. • The Road Rules currently provide for 10,20 and 40km/hr posted speed limits in the ACT depending on the design. • Local community facilities (schools, shops, sports grounds) are often located on collector streets where higher speeds may be signposted. The approaches to these facilities should be designed to reduce speeds, so that people can access these facilities easily from multiple directions, on foot or when riding.
Manage existing roads and streets to encourage safe and appropriate speeds where vulnerable road users are present	Management of residential streets in existing suburbs is guided by the safe systems ambition for safe and appropriate speeds. Existing streets need to be assessed on an individual basis and require traffic calming if current speeds exceed survivable speeds.

State of awareness of road users

The state of awareness of road and path users refers to their ability to process information from the road/path environment and adapt their responses to suit.

Predictable and consistently designed infrastructure provides users with a clear indication on travel behaviour and direction.

Table 3 State of awareness of road users reponses

Response	Application in street and path design
Compact intersections	Use signalisation instead of slip lanes and high-speed roundabouts to minimise intersection footprint, pedestrian crossing times and distances as well as conflict points. Minimum number of lanes and lane width. On non-orbital corridors, a lower level of service for motor vehicles may be acceptable in order to achieve a more compact footprint.
Visibility of people walking, cycling and other forms of active travel	Design should aim to provide good lines of sight without encouraging higher speeds of vehicles. Setting back bikeway crossings, installing recessed stop lines for motor vehicles, and building raised bikeway crossings all make it easier for drivers to see people using the bikeway.
Crossing points	Safe crossing points (zebra crossing, school crossings, median refuges) provide safety and convenience for people walking. They should be assessed on a balance of factors, which include but are not limited to, warrants based on walking and motor vehicle volumes.

Self-explaining environments

Ability of the road user to process information from the road/path environment and adapt their responses to suit. Part of this is ensuring legibility and consistency between different contexts so that all users can understand the rules and expectations.

Walking, cycling and other forms of active travel have differing needs and require different infrastructure solutions. Cycleways should be separated from footpaths where feasible particularly in busy areas.

People on bikes crossing busy intersections need clear priority over the turning movements by motor vehicles. Yielding behaviour can be improved by implementing bike-friendly signal strategies.

Table 4 Self-explaining environment responses

Response	Application in street and path design
Path widths	Shared path designs should consider the volume and speeds of waking and cycling, with mode separation provided in high volume locations. Path widths in Primary walking areas should be wider to accommodate larger volumes of people accessing destinations or public transport.
Integrate of space and time	Signalisation of intersections allows them to be altered instantly and temporarily. This means the same space can be opened up to some users, while access is restricted to others, alleviating the need to widen the intersection to address delays and congestion concerns.
Flexible designs to accommodate changes over time	Use pop-up treatments to test new designs. Provide separation for painted on-road cycle lanes and shortened crossing distances particularly at conflict points to provide direct connections for people on bikes. Consider as part of upgrades or new works. This could utilise surface mounted kerbs, painted buffers or a ‘road diet’ where road space is reduced and reallocated for other uses (traffic calming and walking and cycling). Temporal application of speed zones could be considered, for example special events.

4. Intersection design considerations for active travel

Building on the previous section, Section 4. includes an analysis of the design principles and requirements that are essential to achieving safer prioritised intersection treatments for active travel.

This section also provides an overview of the broader network operating environment that shapes, and is shaped by, each intersection project.

The role of intersections and crossings

Most conflicts and crashes occur at intersections and crossings because this is where different users come together.

Intersections and crossings must be designed in a way that ensures they can be seamlessly and intuitively navigated, safely and easily, and are predictable to all users passing through. This is a result of a holistic approach where the design is uniform and consistent. Safe intersections allow all users to make eye contact with one another, and are places where people who are walking, riding and driving are aware of each other. They encourage people to approach with care and at safe speeds, so that any collisions caused by user errors are survivable.

Equally important to intersections being places where people pass through, is that intersections are also public places where people meet and linger or conduct business. A well designed intersection has the potential to unlock a city's economic and civic potential and revive under-utilised areas with street life.

In urban contexts, intersections become the most complex and challenging part of street design. As pinch points in the road network, they are often overbuilt and tend to prioritise vehicle traffic and throughput, making them difficult to negotiate for people who are walking and riding. To guarantee safety for all users, a number of principles should be considered when designing intersections, not only to make them convenient to navigate, but to also to ensure they work well as public places. These principles do not always align, requiring considered approaches to every context.

Special provisions for people walking

Pedestrian crossing points, both formal (designated) and informal, are a key component of urban streets. Busier streets with high volumes or speeds over 30 km/h require multiple design treatments to provide safe and effective crossing facilities. Streets designed for lower vehicle speeds require less intervention and can support more opportunities for informal crossing.

Determining which type of crossing to use for a particular intersection or mid-block crossing depends on a variety of factors. These include traffic speed, average daily traffic , anticipated pedestrian volumes, and street geometry. Crossing locations should enable the desired land use activity of the street type and support wider transport access (e.g. bus stops) and walking and cycling networks. Frequent signalised or zebra crossings are vital to a safe and busy centre.

Special provisions for people cycling and using micromobility

Intersections can be highly stressful for people riding bikes, forming one of the main barriers to cycling for the wider population. By far the most collisions in urban environments involving people riding bikes occur at intersections. ACT Police data shows that up to 53% of collisions occur within intersections (NRMA ACT Road Safety Trust, 2012). Getting the design of cycling facilities at intersections right, and creating a safe cycling environment, is therefore of critical importance to increasing cycling uptake.

Observing how people who are riding bikes use the street can provide useful cues to intersection design. Also consider the wider network in intersection design. Sometimes, solutions for the wider cycling network may be better achieved by relocating the crossing point to an adjacent intersection or at a nearby midblock location. In general, greater separation between people riding bikes and other modes reduces the risk of crashes and increases the cyclists' level of comfort.

Intersection principles

Make intersections safe for all users

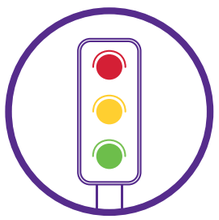
Intersections are safer when users can see each other, are aware of each other, and are able to anticipate and respond to each other's actions and movements. The goal of the intersection should be to not strictly reduce the number of conflicts, but to ensure a space where street users are visible and predictable in their actions. Where users' paths cross, they should do so at safe, survivable speeds and with separation in time and space if needed. A Safe System Assessment must be used in the design.

Design for context

The design of intersections should account for both the existing and the future land use of the surrounding area. Land use is a key determinant of walking, cycling, public transport and vehicle volumes. Medium/high-density, mixed-use areas will generate more trips than lower-density single-use areas. Walking generators (schools, shops, workplaces, public transport stops etc) located in the area should inform the decisions that are made in intersection design and are as important as matters such as vehicle throughput.

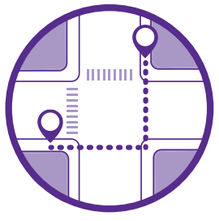
Part of a multi-modal network

Intersections cannot be designed in isolation. It is possible to achieve a balance of a road network's role in providing traffic capacity and an intersection's role in providing a safe and comfortable crossing for people on foot and by bike. To support a multi-modal network, intersection design should balance and prioritise spatially efficient modes with vehicular traffic.



Integrate time and space using signals

The use of an intersection may be altered instantly and temporarily through signalisation. This allows for the same space to be opened up to some users, while access is restricted to others, alleviating the need to widen the intersection to address delays and congestion concerns. Signalisation allows regulation of the time taken to enter and cross the intersection, and the capacity of each movement for all users. It is still necessary to ensure survivable approach speeds in case of user mistakes.



As compact as possible

Compact intersections reduce exposure, slow traffic where crashes are mostly likely to occur, and increase visibility for all users. Complicated and over-sized intersections deter people who are walking and riding, because of the distance and time that is needed to cross, as well as the number of potential conflicts. Oversized intersections take up valuable land, and compromise land economics and street life. Over-sized intersections may leave pedestrians stranded midway, without adequate protection (or worse) with poorly designed refuges that promise protection and do not deliver.

Protect public transport crossings and stops

All users are vulnerable where they interact with public transport vehicles. Rail and bus vehicles are heavy, fast and quiet, and cannot stop quickly. Within the movement hierarchy, the objective is to provide a high level of service for walking, cycling and public transport at light rail and rapid bus stops as well as crossings of principal and main cycle routes. In this context, consideration should be given to default green for people walking and cycling. Canberra light rail already receives priority as they approach intersections to ensure consistent travel times and improved passenger comfort.

Reducing the number of intersections

Due to the importance of intersections in making walking and cycling safer, intersection improvements for people who walk or cycle may be justified, or even independent of, wider corridor improvements. By reducing traffic routes for motor vehicles we can focus on improving a smaller number of intersections with only a few complex ones (Figure 7).

Reducing the number of intersections to be managed

Step 1. Reduce the general traffic routes (and intersections)

Step 2. Identify walking and cycling routes through a precinct

Step 3. Develop excellent crossing facilities at a smaller number of intersections

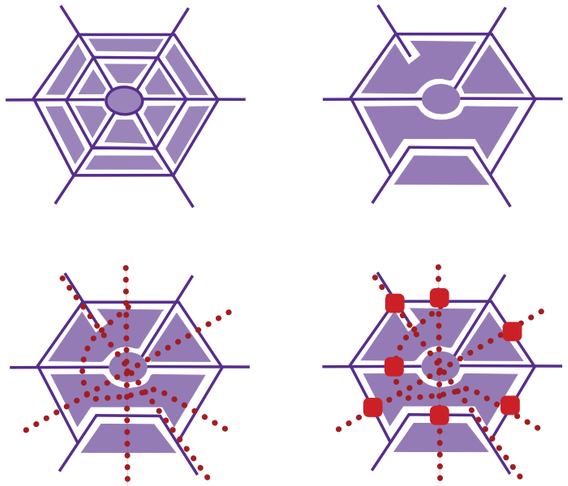


Figure 7 **Simplify traffic routes to focus on improving a small number of intersections (Source: submission to the Vulnerable Road User inquiry, ACT Legislative Assembly 2013)**

Speed, observation and decision-making

The geometry of an intersection affects the speed at which users will choose to pass through it. A safe system requires that any mistake by a user should not result in death or serious injury, so where user paths conflict at an intersection, it is vital that each point of conflict should be approached at a speed suitable for a safe encounter. Mistakes can include misjudgement, distraction, or inattention. They may result in failing to give way to other users, including not complying with red signals.

Lower speeds require a shorter distance of observation for decisions. This makes judgment easier and safer. A clearly visible curved path will encourage choice of a suitable slow speed, as at a roundabout, or other speed reduction elements may be used on the approach.

Points of conflict should be designed to occur where vehicle speeds are lowest. Observation of other users is critical to safe encounters, and to efficiency of the intersection.

The geometry can aid this by presenting a user with only a limited range of observation to be able to decide to proceed safely. Turning to look in several directions, and looking for an opportunity to go, while also needing to look for people on foot or by bike, pose a complex task that may lead to mistakes. Separating out these decisions in time into a sequence can reduce the risk of a mistake. Roundabouts are well suited to allowing this kind of decision sequencing.

Separation or integration

There are two alternative design approaches for intersections (Figure 8):

- Separating cycle and motor traffic streams – generally appropriate at intersections along main roads when protected bike lanes or shared paths are provided on the approaches.
- Integrating cycle and motor traffic streams – generally appropriate where motor traffic speeds and flows are low enough for people on bikes to share the roadway.

Where cycle lanes are used on the approaches to intersections, designers will need to consider carefully which design approach is appropriate.

A combination of design approaches may be used at a single intersection. For example, cycling in mixed traffic may be appropriate on a very lightly trafficked arm of a signal-controlled intersection which operates in its own stage.

Separating walk/cycle and motor traffic streams will increase the number of potential conflict points to be considered and managed, which may increase the overall time delay at an intersection.

Integrating traffic streams reduces the number of conflicts but mixes cycle and motor traffic. This is less likely to be appropriate at busier locations or where speeds are higher.

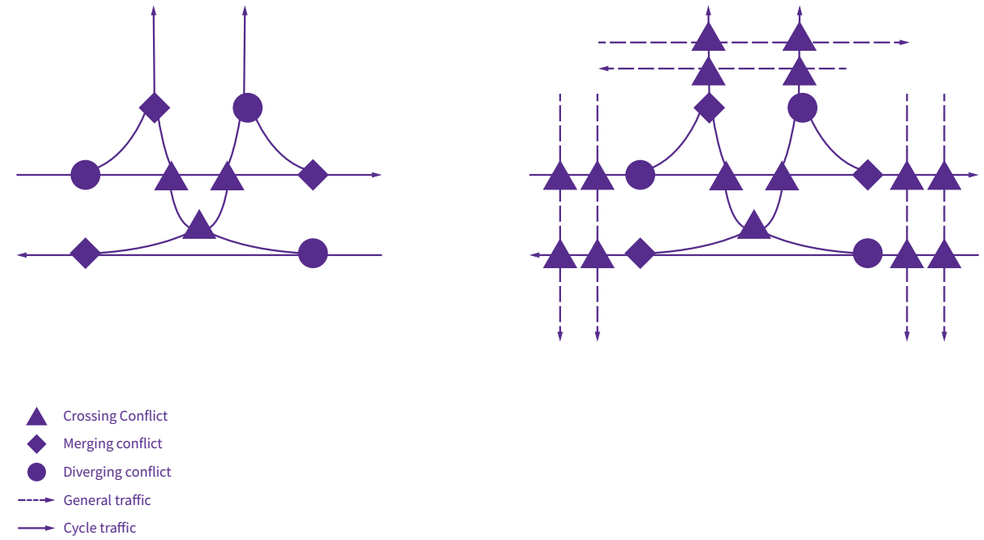
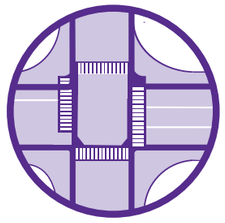


Figure 8 **Illustration of conflict points at a T-junction without separation and with separation (Source: DfT, 2020)**

Active travel intersection principles



Minimise exposure to conflicts

Intersections with bicycle facilities should be designed to minimise the area of potential conflict points between people riding bikes and other vulnerable users and vehicles.

This can be achieved by separating cyclists and other vulnerable users from road users with higher speeds and higher mass, particularly at intersections with high traffic volumes. Intersection design should provide clearly marked places for people riding bikes to traverse the intersection. This both guides cyclists along the intersection and informs them where to ride, and at times, provides them with enhanced visibility.

Communicate who has priority

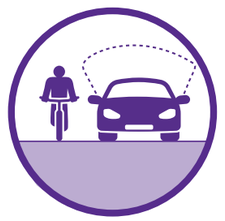
Communicating clearly who needs to give way and who can take priority removes ambiguity and confusion that can lead to crashes even with clear sight lines. Designs should reinforce normal rules of the road where turning traffic from the main street has to give way because turning traffic gives way to through traffic. Markings (traffic control devices), warning signs, and physical features (e.g. raised crossings) should reinforce the desired user behaviour. These signs and markings may need special authorisation.

Reduce Speeds at Conflict Points

Lower speeds allow drivers to be more observant and aware of their immediate environment, and reduce the severity of crashes when they do occur. Tightening an intersection's geometry through the use of kerb build-outs, sharp kerb radii, narrow lanes, and limiting the number of lanes all contribute to lower speeds. Roundabouts reduce speeds and give time to observe each conflict in turn. Raised table crossings and raised intersections slow vehicles at priority crossings. Design speeds may differ from regulated speeds.

Maximise Safety & Comfort

Design measures include not only the array of safety-enhancing features, but also measures to increase cyclist comfort, such as handrails and automated detection of people on bikes at intersections. When cycling facilities are both safe and offer a degree of comfort, cycling becomes an attractive mode of transport.



Provide Adequate Sight Distance

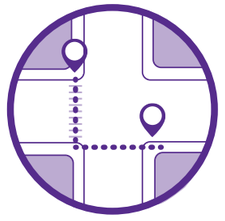
Providing an appropriate sight distance is fundamental in making intersections safe. At a minimum, oncoming road users must be able to see others who are approaching the intersection and who are already at the intersection.

Priority and simplicity in crossings

Concentrating people movements requires good attention to desire lines. Crossings can be wider than the minimum or be made into a shared zone if the concentration is not natural due to the place characteristics. Crossing the street is made simple and convenient for path users in a clearly visible location.

Raise Awareness

Visual cues such as a green surfaced lane across the intersection and additional signage can aid in managing drivers' awareness of where to expect people riding bikes.



Formalise and legitimise crossing

There are two types of formal controlled crossings: zebras, requiring vehicles to give way; and signals, requiring vehicles to stop. These should be used whenever safety of people crossing the street requires formal control, being mindful of how different users have varying space and timing requirements.

Adapted directly from:

Auckland Transport (2020), *Urban Street and Road Design Guide* (Auckland)

Department for Transport (2020). *Cycle Infrastructure Design*. Local Transport Note 1/20. July 2020

Unsignalised intersections

Figure 9 Raised priority/ zebra crossing with clear priority for walking and riding (note the green treatment indicates a cycleway adjacent to a footpath)

Avoiding conflicts at unsignalised intersections depends on the intersection geometry to encourage safe interactions between people using different modes. The behaviour of street users can be guided by visual and tactile cues, including changes in level and road markings through the selection of intersection elements. Intersection geometry and elements are discussed further in Appendices 2 and 3).

Raised crossings

Raised crossings are a preferred solution wherever paths cross minor side streets at T- and cross-intersections, as well as at driveways and entry lanes. In terms of priority, these operate legally in the same way as road level intersections.

They can be used on approaches to roundabouts. They can be stand-alone raised cycleways, or form part of a raised table that accommodates both walking and cycling traffic across the side street, and act as a speed hump for cars turning into the side street. At the same time, raised tables function as a clearly defined entry point to a street type that is different than the intersecting street, thus acting as a spatial threshold that informs drivers that they are entering a street that expects different speeds and behaviour.

Communicating the right of way for people walking and cycling on side streets

The ACT Road Rules require that vehicles must give way to people crossing a side street, when turning into side streets, the design treatment of raised tables can be such that good give way practice is implied. Where it is necessary, the raised table can be slightly set back from the intersection, to allow vehicles to wait before crossing the raised table just outside the intersection, ahead of the raised table. While this causes modest deflection the desired line of travel of the person walking or riding, it provides an area where vehicles can queue and wait while giving way to people who are crossing, outside the heavy flow of traffic along some major and medium streets. It also improves visibility to see people on foot or bike as they approach. For compact intersections and mini roundabouts, the whole intersection can be raised, provided vehicles cannot gain too much speed once they have entered the intersection before reaching a cycleway crossing their exit lane.

Signalised intersections – protected

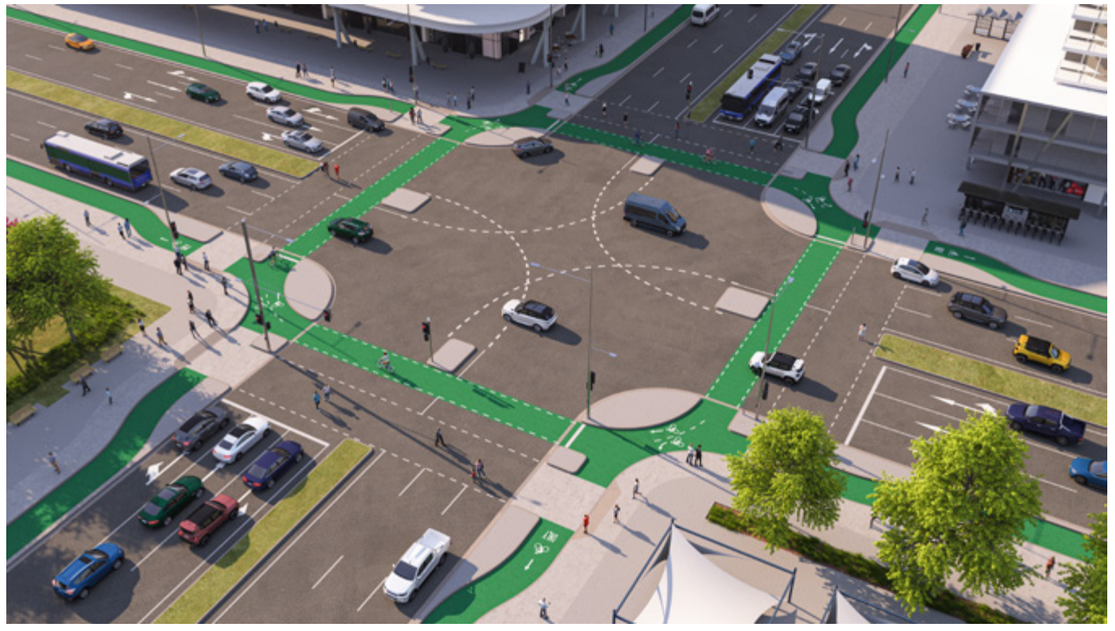


Figure 10 Signalised intersection. The principles set out in this diagram have been generally adopted in ACT Standard Drawing ACTSD-0561 and are discussed further in Section 5 [adapted from the *Urban Street and Road Design Guide* (Auckland, 2022)].

Both protected and unprotected cycleways at intersections must consider signal operations and features to avoid conflicts between turning vehicles, bikes and people on foot. This is a technical area of operations that should be discussed at the design phase as it is a costly addition to retrofit with suitable equipment after construction. Appendix 5 provides some non-exhaustive technical considerations and constraints in signal operation (in lay- language) to facilitate early discussion.

Corner safety islands

The protected intersection design with corner safety islands emerged in The Netherlands and other northern European countries as an approach to define traffic movements at the intersection of streets with separated bicycle paths. The central design element is the corner safety island. They are used to tighten the turning radius for cars to decrease their speeds and slowly negotiate the turning movement. Additionally, they are required in order to design the bicycle path slightly set back from the intersection. Situating cycle tracks behind the corner safety island enables left-turning cyclists to turn without having to mix with traffic. The space behind the corner safety island allows people on bikes to wait to cross the intersection.

The corner safety island also provides a queue space for a single vehicle to wait while giving way to crossing cycle traffic immediately after having made a turn. Vehicles will have significantly slowed down before they begin to cross the bicycle path. This facilitates vehicles coming to a standstill when they need to give way. It also places people who don't have the size or the protection of a motor vehicle, who are crossing the road, firmly within the driver's view.

Forward stop lines

A forward stop line is situated on the bicycle path right before the crossing, between the corner safety island and the pedestrian safety island. The space at this line serves as a waiting area for people who are riding and waiting to cross. This allows left-turning bike traffic to proceed freely, unimpeded by other bikes that are waiting to cross the intersection.

Pedestrian crossings are situated behind the cycle

crossing. Path users crossing the intersection first cross the bicycle path (or a shared zone), where people on bikes must give way to them. Pedestrian safety islands are provided between the bicycle path and the roadway, which are preferably accessed using zebra crossings (or a shared zone treatment).

Using signals to give priority to path users

To ensure that bicycle crossings at protected intersections work properly and remain safe, people crossing on bikes must be given priority by drivers. This can be achieved by signalising the intersection and allocating a dedicated signal phase to crossing cyclists, separate to pedestrians. Separate bicycle signal lanterns installed at intersections with cycle facilities, especially at intersections with higher traffic volumes can improve safety and priority significantly. Older intersections may be constrained by equipment, but where it is possible to provide cycle priority, it should be considered. This treatment may have impacts on motor vehicle flows that turn across the cycleway. This provides a choice in programming that should be resolved at the design stage using context specific data. It is important to separate the two conflicting outcomes of achieving cycling safety that creates an unacceptable delay to prioritise motor traffic flows.

Alternatively, on intersections with low traffic volumes, a policy of giving way to people crossing on bikes can be chosen. However, this only works where speeds are low (30 km/h) so that eye contact becomes possible. Traffic volumes must be low enough that an occupied queue area does not cause backed-up traffic.

The protected intersection provides opportunities to safely cross the intersection in any direction, facilitating left and right turns as well as through movements.

5. Intersection design treatment examples and guidance

This section includes illustrative examples of applied design principles. These illustrations are stylised showing the full range of users, buildings, street-life and vegetation.

These examples include treatments and a vision for what better practice could look like in the ACT, based on typical situations in the ACT road environment.

These images are largely consistent with the technical specifications of standard drawings of the MIS, noting that some regulatory markings and signage have not been included.

Note 1

The sketches in the following sections show ‘one-way pairs’ only. These are the generally preferred design strategy to reduce the number of conflict points as illustrated at Figure 8.

Two-way paths have similar design parameters but they add complexity for road and path users. Not all design options are suitable for all environments.

Note 2

Not all combinations of major and minor roads at intersections are covered, but the design considerations will allow other combinations to be understood.

Different land use contexts will require adaptation of the examples to other contexts. Many of the examples are depicted in inner urban settings. These could also be applied in suburban settings.

For each example, the **Context**, desired outcome (**Design Objectives**) and a list of **Recommended Treatments** are provided. High level information about the elements used in these treatments are contained in the Appendices. More detail is provided in the Municipal Infrastructure Standards which also refer to standard drawings, Australian Standards, Austroads guidance and the ACT Road Rules to ensure compliance.

These examples in this section are not exhaustive. They should be used as conversation starters. A well-considered design process should take advantage of the rapid innovation that is taking place in Australia and all over the world at this time.

Laneway or driveway

Figure 11 Priority crossing over driveways [adapted from the *Urban Street and Road Design Guide* (Auckland, 2022)].

Context

Laneways, driveways and off-street parking entry points treatments can drastically improve amenity for people on city streets and in suburban settings. Here the dominant movement to be provisioned is people using the footway. The lesser movement is vehicles accessing a minor street. Simple design measures can ensure that the pedestrian safety and priority is maintained with both laneways and driveways such as the laneways entering Bunda Street in the City Centre. Setback and visibility are key considerations – when sightlines are restricted, ensure that traffic is slowed down at these points.

Design Objectives

- Safety – slow speeds as lines of sight for path and road users may be compromised by buildings.
- Service the dominant movement of pedestrians.
- Emphasise priority for people in the footway.

Recommended treatments

- Install steep ramp profiles that slow down vehicles.
- Use driveway-style transitions rather than kerb radii.
- Continuous verges use materials that reinforce the continuity of the footway, distinct from the roadway material. This helps to enforce proper yielding behaviour by people driving motor vehicles.
- Ensure that the footway treatment is level and uninterrupted across the intersection.
- Consider a holding line or speed hump or cushion at the exit of the laneway or driveway, before the footpath (not pictured).
- Overall laneway width is minimised by allowing vehicles to share adjacent lanes, or (preferably) by limiting vehicles to one direction.
- Ensure that the driveway ramps are minimised and do not extend into the clear pedestrian travel zone.
- Overall design treatment should ensure that these intersections between main roads and laneways or driveways are clear entry points or transitions into a different type of environment.

Local access network intersection – community path

Figure 12 Local path network intersection with a local street, prioritising walking and cycling movements .

Context

Principal Community Routes should have priority crossings to provide minimal interruption that intersect with streets with signposted speeds of 50km/hr or below in suburban and inner urban areas. Local routes may also require priority crossings to access community facilities such as schools and shops. In the ACT, principal and main community routes should provide priority to ensure continuous safe movement for path users to key destinations.

Design objectives

- Safety – slow speeds and ensure lines of sight for path and road users.
- Connectivity – provide dedicated crossing points for people walking and cycling at regular intervals and along desire lines.
- Environment – incorporate trees and landscaping and contribute to urban green spaces.

Responses

- Main design principle: reduce speed of vehicles and raise awareness of potential conflict points.
- Flat top speed humps (i.e., raised road platforms) with gentle ramp gradients that incorporate either a pedestrian crossing or kerb build-out.
- Narrow roadway designed to reduce speed of motorised traffic.
- Design features that provide visual cues to road users including changed surface pavement, clearly distinguishable by colour, texture and/or materials.
- Additional features to slow traffic may be incorporated such as chicanes and speed cushions.

Local to local – mini roundabout

Figure 13 Local to local streets support local activities using short trips and therefore should prioritise active travel [adapted from the *Urban Street and Road Design Guide* (Auckland, 2022)].

Context

Local to local intersections make up the bulk of intersections in the ACT. They can be the quiet intersections between the local streets that make up the fabric of the ACT's suburban areas or vibrant streets in inner urban areas where there is significant local active travel as well as access traffic for motor vehicles. Whether they are situated in residential, commercial, industrial or mixed-use districts, local streets tend to be characterised by comparatively low volumes of vehicular traffic. In higher density settings, they are the places where people live, work and socialise. In suburban areas they are busiest in the morning and afternoon peaks when children need to get to school.

Design objectives

The primary functions of local streets are to support daily activities such as walking to school and nearby destinations, encouraging social interaction among neighbours and creating a pleasant living environment. In some cases, these intersections support important local services such as cafes and shops.

Where these intersections are retrofitted, they may be defined by using existing verge space for non-traffic purposes. as illustrated here and in Figure 16. In greenfield developments, the verge space near intersections may host more diverse functions to modify the intersection.

Creating a safer environment for all street users at local-to-local intersections is achieved by the following conditions:

- Slow down midblock traffic speeds (with a maximum of 30 km/h for local streets).
- Slow down turning vehicles (with a maximum turning speed 15 km/h).
- Enable eye contact between users where mixing occurs.
- Shorten pedestrian crossing distances.
- Accommodate pedestrian desire lines. This is particularly critical at pedestrian crossings. Detours should be avoided and pedestrian crossings should be kept as close to the intersection as possible.
- Re-allocate roadway space to public space or green infrastructure. Currently, the roadways on local streets tend to provide far more space than is required for regular vehicle operations.
- Consider strategies across the wider network (traffic calming, local paths). Interventions across a network of streets might work together to bring speeds down across neighbourhoods, and to make communities more liveable.
- Manage traffic volume and speed so that people by bike can travel safely with other vehicles.

Recommended treatments

- Square the intersection by removing oversized kerb radii.
- Consider adding traffic calming elements that provide vertical deflection, to effectively slow traffic. These could be either raised platforms that span the intersection, or individual speed bumps on each of the approaches to the intersection.
- Excess roadway space can be repurposed as public space, or as green infrastructure such as rain gardens, bioswales, street trees, or berm gardening.
- Shorten pedestrian crossings with kerb build-outs.
- Introduce mini-roundabouts where appropriate (best introduced at regular intervals to help keep speeds low throughout the street network).
- Remove pedestrian splitter islands where these exist, and instead shorten crossing distances by narrowing the street's geometry.
- Add missing footpaths where deficiencies exist in the footpath network. Where it is possible, footpaths must be provided on both sides of the street.
- Remove road markings except holding lines at side streets. Drivers become more observant of their surroundings, and will begin to slow down, as their desired position on the roadway is less clear. Limit markings to the minimum required for safe intersection control.
- Placing the holding line at a slight distance from the pedestrian crossing is recommended to improve visibility of path users. Removing on-street parking along the roads leading up to the intersection is advised as well, as it frees up further space to keep crossing distances short.
- At T-intersections, align the side street and ongoing street to intersect at a 90-degree angle.
- Provide pedestrian facilities along desire lines. These can be distinguished using a different form of pavement material for the pedestrian crossing.
- Consider street trees and water-sensitive-urban-design where opportunities exist to provide shade and cooling. Street trees also provide vertical elements that create visual narrowing and speed reduction.

Collector to local access – bent-out

Figure 14 Bent out path where a local road meets a collector road [adapted from Cycleway Design Toolbox. Designing for cycling and micromobility (Transport for NSW, 2020)].

Context

These intersections represent the transition between streets that support stronger motor vehicle traffic (collectors) and local (access) streets where walking and cycling needs to be more strongly encouraged and supported. The collector street may experience higher volumes of motor traffic. A bend out provides a storage area for turning traffic to pause and bring both path and road users into the others' line of sight to ensure that the turning vehicle yields to the path users.

The preferred treatment for an intersection where a facility interacts with a side street is continuous footway and cycleways (in this illustration a bicycle-only path, but could also be a bicycle lane or they may all be shared paths). Priority is given to people walking and cycling to provide high level of service and improved safety.

Where there is a greater mixing and complex movements between bike and foot traffic, shared zones (zebra and pavements) are preferred to show pedestrian priority. Hybrid solutions may be required to reduce conflict, but these should be achieved on the path rather than adding greater complexity to the intersection within the roadway.

The interaction between people walking and cycling requires careful consideration. Any bend-outs should be as smooth as possible to allow for ease of manoeuvring and provide waiting space for vehicles a safe distance from the roadway. As much as possible, vehicle movements that cross the bicycle path (i.e. side streets, driveways, car parks, laneways) should be minimised. Where conflict zones are unavoidable, the infrastructure should be designed to reduce the speed of motorised traffic and adequate sight lines preserved where possible to allow for reciprocal visibility.

Objectives

- Provide a high level of service to people walking and riding.
- Reinforce priority people for people walking and riding over traffic that is turning into the local access street.
- Reduce speed of intersecting traffic.
- Bring motor vehicles (and path users) into the others' line of sight.
- Mediate high volumes and potential conflict between people walking and cycling.

Recommended treatments

- Raised intersection and clear road marking to indicate to all road users that path users have priority over turning vehicles.
- Zebras over the bicycle only path (on the collector street) indicate pedestrian priority on one side of the collector street. However bikes transition into a shared zone on the other side of the street as it is an area where there are many different movements.
- Smooth bend out to avoid uncomfortable manoeuvring for people cycling.
- Bend-out to store waiting vehicle outside roadway, and perpendicular crossing of bicycle path.
- No high objects (>1.0m) between the bicycle path and the road, to allow for reciprocal visibility.
- Prioritised pedestrian crossing and bicycle path where facilities are separated, or clear shared zone when they are not.
- Kerb build outs to narrow intersection to reduce vehicle turning speeds and increase reciprocal visibility.
- Provide a storage area (if needed) for one vehicle entering and leaving the local access street.
- At smaller intersections, there may be insufficient space to incorporate bend-outs in the design of the bicycle path. Several alternative treatments may be appropriate. For example, the bicycle path could be kept close to the road, and turning vehicles required to wait on-road before turning.

Collector to local access – raised, straight

Figure 15 Priority path over laneways and local access streets in a busy inner-urban area [adapted from the *Urban Street and Road Design Guide* (Auckland, 2022)].

Context

This scenario is similar to the previous one (Figure 14), with a local access street intersecting with a collector street. Speeds and volume of traffic are lower. Walking and riding movements are high along the collector street and with more informal crossing due to the high density of attractor destinations on either side of the street (i.e. a High Street situation). The collector street may include a significant cycle route (main or principal), also with a higher volume of cycle traffic.

There is a significant change in activity between the continuing collector street and the local side street in terms of prevailing speeds, traffic volumes, land uses, public transport service and pedestrian amenity.

In these situations, because of the volume and diversity of movements, conflict between users can increase.

Design objectives

- Prioritise comfort and safety for the high pedestrian and cycling movements along the collector street.
- Clearly reflect the appropriate user hierarchy for crossing.
- Signify a strong transition into local access street.
- Slow vehicle speeds on the collector street.
- The intersection must be designed for the comfort of the most frequent motor vehicles, but also be able to accommodate less frequent users (such as large trucks).
- Turning speeds from collector into the local access street should be slow.

Recommended treatments

- A raised crossing (continuous verge) in line with pedestrian desire lines. The raised platform reinforces path user priority and encourages slow speeds for turning vehicles. Platform ramp slope is designed to achieve the desired turning speed.
- Traffic lanes are reduced in size to reinforce slower traffic speed.
- On-street parking may be reclaimed for other uses, or reduced and balanced with other kerbside functions.
- Provide protected cycleways. Bicycle-only paths (pictured) or protected bicycle lanes provide a buffer between the footway and furniture zone (including outdoor seating areas) and the roadway and may help accommodate occasional larger vehicle turns made by the control vehicle, as they enlarge the effective turning radius.
- Provide a threshold to the different street type.
- Introduce kerb extensions in order to reduce pedestrian crossing distance.
- Remove splitter islands where these are present.
- Keep kerb radii small to slow down turning vehicles.
- In light of this, it is important to slow speeds on local streets to no more than 30 km/h (with 40 km/h being the advised top speed for the collector street).

Local to local – shared street intersection

Figure 16 Local shared street environment where all users can mix [Adapted from the World Resources Institute (2022)].

Context

Shared streets may be appropriate in commercial areas with high pedestrian volumes, where pedestrians make random crossings, or on neighbourhood streets with low motor vehicle volumes to create more flexible space for children's play and other activities.

Designs may not look like traditional streets making cars the guest, rather than the priority user.

Shared streets are common in old city streets that are too narrow for a travel lane and footpath. They can be used to make better use of space in small residential estates.

They have high 'place' value in the movement and place framework and present a great opportunity for creativity and community input as well as flexibility in how they are used at different times of the year and for special events.

Design objectives

- Support and prioritise a diverse range of human scale activities (not just movement).
- Reduce and/ or discourage vehicle movements.
- Communicate to drivers that they must give way to all non-motorised activity.
- Increase the place function of a street.
- Encourage very low motor vehicle speeds and volumes with a design and target speed of 10 km/h.

Recommended treatments

- The gateway or transition to a shared street should slow motor vehicle speeds and clearly communicate the entrance to the shared street from conventional streets. This can be achieved through changes in surface texture and colour raised pedestrian crossings, raised intersections, and vertical elements that aid in the visual narrowing of the street.
- Avoid elements that suggest motor vehicle priority or segregation of modes, such as kerbs, pavement markings, signs, etc.
- Include design elements that suggest priority for people and the function of the street as a place for social, economic, and cultural exchange, such as street furnishings, gathering areas, lighting, etc.
- Placing the holding line at a slight distance from the pedestrian crossing is recommended to improve visibility of path users. Removing on-street parking along the roads leading up to the intersection is advised as well, as it frees up further space to keep crossing distances short.
- Address and carefully consider the navigational needs of people with disabilities.
- Provide a way for people with mobility impairments to access buildings.
- Include appropriate drainage designs for shared streets that do not have kerbs to channel rainwater.

Local network intersection – cross intersection (modal filter)

Figure 17 Treatment to reduce the number of intersections for cars and retain permeability for walking and cycling [adapted from the *Urban Street and Road Design Guide* (Auckland, 2022)]

Context

Local streets should support access, rather than through traffic for people in motor vehicles. Local network intersections, sometimes referred to as 'modal filters' or diverters, are intersections that are only available to people walking and cycling, to 'filter' through to access the next street. The above diagonal diverter is one example of many types of local network intersections (similar treatments can be used at midblock and T-intersection filters (see Figure 18). This one is a retrofit of a traditional t-intersection.

Objectives

- Increase local active travel routes that can use roadway facilities with low traffic volumes and speeds that feel safer for people walking and cycling.
- Support suburbs and other areas to reduce through traffic of motor vehicles on selected streets which provide local access while still allowing movement of bicycles or other modes.
- Slow down traffic.
- Reduce the number of intersections requiring more intensive treatments.
- Assists to meet whole of area planning.

Recommended treatments

- This treatment is recommended in areas with sufficient access options in the street network.
- No parking should be allowed around the central diverter.
- Use reflective pavement markings and signage to increase visibility at night.
- Gaps between bollards should be around 1.5 m to provide for bicycles, but not motorised vehicles.
- Sharrow markings may be used for wayfinding and warning purposes.
- Consider pavement treatments to create shared zones around the modal filter (not-shown).
- Consider alternate emergency response routes.
- These intersections can provide an opportunity for landscaping; native and low-maintenance plants are recommended. Planting should not obstruct visibility and should be <1.0 m high.

Local network intersection – T-intersection retrofit (modal filter)

Figure 18 Modified T-intersection to restrict motor vehicle traffic and allow walking and cycling to filter through [adapted from Cycleway Design Toolbox. Designing for cycling and micromobility (Transport for NSW, 2020)].

Context

Local network intersections are often part of a series of streets and intersections that form a network of quiet streets with high-quality mixed traffic treatments. In the ACT, the term 'active travel street' is used. These are similar to 'bike boulevards' or 'quiet ways' used in other jurisdictions.

Local network intersections can be retrofit solutions (in this case a previous t-intersection) to reduce the number of conflict points in the network between cars and other users.

Design objectives

- Reduce and slow motorised traffic volumes.
- Prevent through traffic of motor vehicles.
- Maintain connectivity for people walking or cycling by providing full access.
- Create a more attractive environment for walking and cycling.

Recommended treatments – raised intersection (right)

- Raised platforms with gentle ramp gradients.
- Narrow traffic lanes designed to reduce speed and discourage overtaking by motorised traffic.
- Design features that provide visual cues to road users including changed surface pavement, clearly distinguishable by colour, texture and/or materials.
- Consider shared environments or active travel streets (lower posted speed limits).

Recommended treatments – modal filter (left)

- Differing pavement texture and colour designed to increase awareness and adjust behaviour of all road users, with consideration given to green pavement to indicate priority to people cycling.
- Full road closure for motorised traffic.
- Turning loop.
- Connections for people walking and cycling.
- Landscaping elements and a median to prevent motor vehicles from cutting through.

Collector to collector – signalised, single bicycle route

Figure 19 This collector to collector design is applied in a higher density setting. As such detailed road markings would be used. In a lower density residential setting, minimal road markings would be applied. In this setting protected lanes are only facilitated

Context

Collector to collector intersections are common in the ACT and exist wherever the city's main streets, mixed-use and neighbourhood collectors intersect. Collector streets provide access to neighbourhoods and residential streets, and connect to the wider urban area. In inner-urban areas they are focal points of neighbourhood activity and retail. They are often the most intensively used by people on foot, both as places to pass through and destinations. As the backbone of the city's walking network, it is important to create safe and efficient facilities at these intersections.

Design objectives

The primary function of collector to collector intersections is to support an exchange of traffic flows where two main streets intersect. Traffic flows include and should prioritise walking, cycling and public transport traffic. In most cases, these intersections support a wide variety of retail stores.

Providing a safe environment for all street users at these intersections is achieved by the following conditions:

- Shortened pedestrian crossing distances.
- Accommodated desire lines.
- Footpath widths that are appropriate for retails centres.
- Safe facilities for people walking, riding and connecting with public transport.
- Slow down traffic movements between intersections (target 30 km/h for local streets, 40 km/h for neighbourhood collectors).
- Slow down turning vehicles (design turning speed 15 km/h).
- Public space or green infrastructure.
- Signal phasing that minimises non-compliance by prioritising people walking and cycling.

Recommended treatments

- Tightening the kerb radii will enforce lower speeds as vehicles turn.
- Placing the stop line at a slight distance from the pedestrian crossing is recommended to improve the visibility of people crossing the street. Removing on-street parking along the roads leading up to the intersection is advised as well, as it frees up further space to keep crossing distances short.
- Where capacity allows, reducing the number of single-movement lanes (and having multi-purpose lanes instead) can support a narrower geometry. In addition, understanding the number of through and turning vehicles in each lane is important, to optimise allocation of lanes and avoid sudden lane change.
- Narrowing lanes is also highly recommended; many medium streets have excessively wide lanes and some of these are widened even further at intersections. Narrower lanes do not only save space, they also visually narrow the roadway, slowing traffic down.
- Provide protected, yet concurrent turn controls to allow cycle and pedestrian through movement priority (see Appendix 5).
- Ramps or raised platforms on approaches slow down vehicles, allowing safe speeds if drivers fail to stop, and protecting people on crossings.
- Consider hook turn storage boxes to facilitate right turns from the cycleways.

Collector to collector – signalised, dual bicycle routes

Figure 20 Collector to collector intersection where bicycle routes are present in both directions, [adapted from Cycleway Design Toolbox. Designing for cycling and micromobility (Transport for NSW, 2020)].

Context

Collector to collector intersections service the main movements within a neighbourhood and that are feeding in and out of the arterial network. They experience distinct peaks at the beginning and end of the weekday. They are more likely to be signalised in built up areas, or where they need to provide protection to pedestrian and cycling movements and guarantee travel times for public transport.

Space may be constrained. There may be dual carriage way in one or both directions (not pictured).

Design Objectives

- Provide protection and priority for people walking and riding to ensure efficient movement.
- Slow down turning vehicles (design turning speed 15 km/h).
- Signal phasing that minimises non-compliance by prioritising people walking and cycling.
- Reduce conflict between path users.

Recommended treatments

- Crossing facilities for people walking and cycling on all legs.
- Reduced waiting times for people walking and cycling through adjusted traffic signal controls.
- Barriers to protect riders from turning vehicles. May need to be narrow if space is constrained.
- Buffer areas for right turning riders.
- Signal lead phase and dedicated green time for bicycle movements to remove signal conflicts.
- Automatic loop detectors for bicycles, reducing wait time.

Collector to collector – roundabout

Figure 21 Tightened kerb radii slows turning traffic and increases visibility between road and path users (adapted from *Cycleway Design Toolbox. Designing for cycling and micromobility* [Transport for NSW, 2020)].

Context

As above, collector to collector intersections service the main movements within a neighbourhood and that are feeding in and out of the arterial network. They experience distinct peaks at the beginning and end of the weekday. Pedestrian and cycling movements at this time will include children travelling to school. People walking and cycling may be separated in busy areas or where cycling facilities have been retrofitted to provide networks in older suburbs, otherwise the zebra crossings would be shared.

Design objectives

- Provide high level of service to people walking and cycling, prioritising their movements at intersections for local active travel within neighbourhoods.
- Reduce the speed of traffic that intersects first with cycling traffic where it is separated (pictured) or with all path traffic where it is shared.
- Recommended treatments
- Prioritised and continuous bicycle paths around the roundabout and pedestrian crossings on all legs.
- Raised crossing platforms and clear road marking.
- Narrow all approaches to the roundabout and apply deflection angle for motorised traffic to reduce speed.
- Raised island in the centre for use by wide-turning vehicles (e.g. trucks and buses).

Arterial to arterial – signalised

Figure 22 Arterial to arterial intersection with priority to active users [adapted from the Urban Street and Road Design Guide (Auckland, 2022)]

Context

Arterial to arterial intersections provide access are where intertown arterials meet main street arterials. Their main purpose is servicing through movement. They are often the most intensively used by people in motor vehicles as places to pass through with active travel facilities in the same corridor.

As the backbone of the city's street network, it is important to create facilities for people who are walking and riding. This is especially important given that large intersections provide opportunity for motor vehicles to accelerate as they cross them.

There is also a unique positive opportunity to redesign these arterial streets, which presently are mostly traffic-dominated places, back into the urban fabric by supporting the adjacent land uses and minimising the number of lanes, transforming them into better places. They can be destinations in their own right,, by virtue of the land uses at the adjacent corners.

Design objectives

The primary function of arterial to arterial intersections is to support an exchange of traffic flows where two arterial streets intersect. Traffic flows include and should prioritise walking, cycling and public transport vehicles, with a focus on accessibility if it is in a high use area.

These intersections tend to support retail activity, because of the great accessibility and visibility of the location.

Providing a safe environment for all street users at these intersections is achieved by the following conditions:

- Shortened pedestrian crossing distances.
- Accommodated desire lines.
- Footpath widths that are appropriate for retail centres.
- Safe and attractive facilities for cycling and public transport.
- Slow down traffic movements between intersections (40 km/h for urban areas).
- Slow down turning vehicles (target turning speed 15 km/h).
- Slow down vehicles through intersections to survivable speeds <30 km/h.
- Public space or green infrastructure.
- Line of sight on left turn (immediate crossing and the next one).

Recommended treatments

It is best to apply design treatments that naturally slow down vehicles and provide safe methods for people to cross:

- Tightening the kerb radii will enforces lower speeds as vehicles are making a turn and provide more walking space.
- Placing the stop line at a slight distance from the intersection is recommended to ensure that people crossing can be seen.
- Remove slip lanes and add signalised turn lanes for vehicles turning across oncoming traffic.
- Corner safety islands prevent cars from turning into the path of people riding and provide more visibility for people on foot.
- Reducing the number of single-purpose lanes (and having multi-purpose lanes instead) can support a narrower geometry.
- Narrower lanes can save space and visually narrow the roadway, slowing traffic down.
- Bicycle paths should lead up to the intersection from each direction.
- Cycle lanterns
- Pedestrian refuge to allow path users to focus on one direction of traffic at a time as they cross the street and to reduce crossing times.
- Direct and visible pedestrian and cyclist crossings that follow desire lines
- Ramps or raised platforms on approaches slow down vehicles, allowing safe speeds if drivers fail to stop, and protecting people on crossings.

6. Glossary

This glossary notes that some definitions are similar, but subtly different between the following sources. In most cases the guide adopts the language of the Municipal Infrastructure Standards and notes other common usage terms.

- References to **RRR** mean the *Road Transport (Road Rules) Regulation 2017* (ACT) which also reflect the Australian Road Rules.
- References to **DG** mean this *Design Guide*.
- References to **MIS** refer to the Municipal Infrastructure Standards (01 and 05)

Access Streets (often referred to as local and residential streets) – (MIS 01) a road typology used where the residential environment is dominant, traffic is subservient, speed and volumes are low and pedestrian and cycle movements are facilitated.

Active travel – Inclusive of walking and riding bikes and other micromobility technologies defined as Personal Mobility Devices **(PMDs)**, as well as other mobility aids and pedestrian devices such as wheelchairs and mobility scooters and rollerblades and skateboards. It also includes horse-riding (defined in Draft Active Travel Plan, p. 6).

Active Travel Network – The collective description for all existing facilities associated with active travel. Facilities include Community Routes, On-road Routes, Accessible Pedestrian Routes and Recreational Routes. (ACT Government – Building an Integrated Transport Network: Active Travel 2015).

Active Travel Streets – MIS05 outlines low-speed (below 30km/h by design), low-volume, traffic calmed streets optimised for bicycle travel on-road with improved adjacent path provision for pedestrians. They have potential to extend the cycling network considerably while also reducing path conflict between faster and slower users.

Arterial Road – A road typology that is strategically significant catering for high vehicle volumes travelling over large distances. They do not interact with the places that the road passes through. (MIS 01)

Bicycle lane (also onroad-cycle lane) – A special purpose on-road traffic lane for the exclusive use of cyclists marked in accordance with Australian Road Rule 153 and as described in AS 1742.9 and AGRD03 Section 4.6.7. Commonly separated by road markings. Bicycle lanes may be of varying widths depending on the road speed environment and their use is defined by the Australian Road Rules for cyclists and other road users.

Bicycle-only path – A grade-separated facility designated for the exclusive use of cyclists by signage or pavement marking as detailed in Australian Road Rule 239.Usually in combination with a **separated footpath** for pedestrians where conflict is significant.

Continuous verge/ path – A raised verge and path across a minor side street to improve pedestrian access and amenity. Under the road rules, a verge is a road related area. When entering, or crossing, a road related area from a road, drivers must give way to any pedestrian or other road users on the road related area. The introduction of a continuous verge treatment reinforces the road rules.

Checking vehicle – The largest maneuverable vehicle that is ever planned to use a street, but on an occasional basis. need to use, very low speeds, multipoint turns , or mount the kerb (see also **Design vehicle**).

Corner safety islands – A treatment that provides protection for people who are turning the corner in line with motor vehicles.

Crossing distance – The distance for a person walking or riding from one kerb to another over a roadway.

Cycleway – A general term, like **footway**, or **roadway** that suggests a space used for a particular user, without being specific about the facilities.

Cycling network (also strategic cycling network) – The network of routes with facilities most suitable for cycling and micromobility, in particular longer, distance trips (**Principal** and **Main Community routes**).

Default speed limit – As defined in *RRR* section 25. 50km/h for built up areas, otherwise 100km/h.

Design objectives – Refer to the specific goals and criteria that a design process aims to achieve. These objectives guide the decision-making and implementation of the final design. These will be determined by context, but must include safety, functionality and attractiveness (which includes comfort, efficiency) at a minimum.

Design speeds – A speed fixed for the design and correlation of those geometric features of a roadway that influence vehicle operation (defined in MIS 05, MIS01).

Design vehicle – A concept to test the preferred geometry of an intersection, using the most appropriate vehicle. The design vehicle is therefore the largest vehicle likely to regularly perform a movement at an intersection rather than the largest of the vehicles that may operate at that location (see also **Checking vehicle**).

Designated Areas – As defined in Part 4 of the National Capital Plan, exercising powers provided under section 10 of *The Australian Capital Territory (Planning and Land Management) Act 1988* (Cth).

Desire lines – Alignment chosen by the majority of pedestrians or cyclists irrespective of the presence of a path or other facility, usually because it is more direct or otherwise attractive.

Driveway – Vehicle access across the verge to the block from the edge of the roadway to the property line (defined in MIS).

Footpath – A non-specific term to refer to a minor path. In the ACT a path may be designated for pedestrians only if it conforms to the requirements of the Australian Road Rule 239 to become a **separated footpath** and signed accordingly. Usually delivered with a **Bicycle-only path**.

Footway – A general term, like **cycleway**, or **roadway** that suggests a space used for a particular user type, without being specific about the facilities.

Forgiveness – Refers to the Forgiving Roads system under the Safe Systems framework, which seeks to minimize consequences of errors. Has its roots from the 1960s “Forgiving Highways” concept. Contrast with self-explaining concept.

Functional road classifications – Are based on traffic volumes and land uses. The hierarchical road network aims to maximise road safety, priority for pedestrians and cyclists, residential amenity and legibility. Place making is not explicitly considered. Other overlapping terms may be used to describe the character of the place in relation to the road typology.

Grade separation – Refers to the physical separation of different transport zones such as roads and paths, at different vertical levels to avoid conflicts at the same grade or level.

Healthy Streets – (also Living Streets, Streets for People or Complete Streets) – Frameworks that all seek to increase human-scale activity and liveability in street planning and design.

High pedestrian area – Commonly town and group centres, public transport interchanges and other areas where destinations of interest are close together resulting in high pedestrian movements.

Hold line – Road marking indicating the point where vehicles must stop before an intersection.

Human scale – Generally refers to the comfortable, convenient and safe experience of the human, physically and psychologically in relation to their surroundings. In active travel this means facilities and environments that make walking and riding welcoming.

Informal crossing – Crossing a street away from a marked formal controlled crossing.

Inner urban areas – Are considered to be those areas defined in the Territory Plan for medium and high density residential development, commercial or industrial land and community facility zones (RZ3, RZ4, RZ5, CZ1-CZ6, IZ1, IZ2 & CF). See also **Suburban areas**.

Level of service – Usually defined in terms of the convenience of travel and safety performance.

Line of sight (also sight distance) – The distance, measured along the roadway, over which visibility occurs between a driver and an object (single vehicle sight distance) or between two drivers at specific heights above the roadway in their lane of travel (as defined by Queensland Government - Road Planning and Design Manual, Chapter 9, 2002).

Major Collector road – A road typology that collect and distribute traffic between the primary (**arterial** and sub-arterial) road network and the user destinations in neighbourhoods. (MIS 01).

Major collector street – A road typology in neighbourhoods that collect and distribute traffic between the primary (arterial and sub-arterial) road network and the user destination (defined in MIS). (MIS 01).

Micromobility – Generally in this guide it refers to powered devices that can be used on paths (including, e-bikes and **PMDs**). More broadly, it is a term that emerged in the 2010s to describe the disruptive potential for movements made using small powered and manual devices (up to 500kg, with smaller batteries than cars, that travel at low speeds and possibly with connectivity to communications networks). It encompasses technologies that are present today and that are rapidly evolving. In particular, lending themselves to new commercial models (sharing and leasing). Designers should have regard to this potential disruption when future-proofing infrastructure.

Minor Collector – A road typology that distribute traffic from **Access Streets** to **Major Collector** or **Arterial roads**. A reasonable level of residential amenity and safety is maintained by restricting vehicle speeds by means of street alignment, intersection design or by speed control measures.

Mode separation – Provision of physically separated facilities for people walking and/or cycling and/or driving. In the path environment this might be where there is a higher risk of conflict.

National Capital Authority – The authority established under section 5 of *The Australian Capital Territory (Planning and Land Management) Act 1988* (Cth) with its functions defined in section 6.

Path – A paved off-road facility of varying width and surfacing, for shared use by people walking, riding and using other mobility devices, including horses. (defined in MIS). By law, all paths in the ACT can be used by all people walking and using devices that are legal for use on paths.

Pedestrian – Is inclusive of people walking, using mobility devices such as wheelchairs and mobility scooters as well as pedestrian devices such as roller blades and **PMDs**. Pedestrians can have widely different needs. Also defined in *RRR* section 18.

Pedestrian crossing – Is used as a general term in this document. It is not used to describe an infrastructure type as priority crossings can be used by all path users. As defined in *RRR* section 81(3). See also **zebra crossing** and **priority crossing**.

Personal mobility device (PMD) – Defined by *RRR* section 18A. The definition captures devices such as e-scooters and e-skateboards and other emergent technologies. The definition is designed to reduce risk in the path environment. It means a device:

- propelled by an electric motor; and
- designed for use by only 1 person; and
- weighing not more than 60kg unladen; and
- with 1 or more wheels; and
- with a brake system; and
- that cannot travel faster than 25km/h on level ground; and
- with dimensions not more than –
- 1250mm in length; and
- 700mm in width; and
- 1350mm in height.

Posted speeds – The maximum legal speed on a road.

Priority crossing – A general term used in this guide to describe crossing types that give priority to pedestrians and cyclists over motor vehicles and includes Bicycle-Only Priority Crossings (Give Way or Stop sign controlled), **Zebra crossings**, and Children's crossings. Crossing types are discussed further in MIS05, Section 4.7.

Quick build treatment – Using temporary materials to change the operation of streets, usually to provide bike lanes, create pedestrian areas, reduce traffic speeds and movements. Often undertaken as a trial prior to permanent installation to test demand for facilities as well as traffic impacts.

Raised crossing – See also **raised pavement platform**.

Raised pavement platform – Defined in MIS05 as a treatment used to highlight pedestrian and cyclist priority and slow approach speeds by cars and in some cases bicycles. Using zebra crossings, materials or continuous verges to reduce motor vehicle priority (ie Bunda Street intersections).

Rear Lane (also laneways) – Are narrow and short streets which have the primary function of providing vehicular access to the rear of blocks.

Road – A designated facility forming a route between two places for vehicular traffic and services. Roads include verge space, carriageways and associated public areas and may also provide vehicular access to properties (by contrast see Street).

Road diet – The space allocated for the roadway is reduced and reallocated for other uses (traffic calming, walking and cycling), often resulting in slower traffic.

Roadway – A general term, like footway, or cycleway that suggests a space used for a particular user, without being specific about the facilities.

Safe Systems – Refers to Towards Zero Foundation's 'Safe System Approach to Road Safety' framework, with four main principles: human fallibility, human vulnerability, shared responsibility, and building a safe and forgiving road system.

Self-explaining – Intuitive and easy to navigate facilities that don't rely heavily on traditional signage or external guidance. The goal is to design streets and paths in a way that their layout and features naturally communicate to users, making it easy for them to understand how to navigate and use the space.

Separated footpath – A section of path designated for the exclusive use of pedestrians by signage or pavement marking as detailed in Australian Road Rule 239.

Shared path – Refers to both paths that are shared, and a particular facility type that is designed for use by wheeled devices, usually by reference to width and materials. A shared path is a type of facility used in other jurisdictions where legal sharing of other paths is not permitted. As defined in *RRR* section 242(2).

Shared streets/ spaces/ zones – MIS 05 distinguishes between shared spaces and zones for low speed environments that prioritise pedestrian movement but allow motor vehicle access and depending on whether they have the physical infrastructure of a road or a or not. This guide uses 'shared streets' as a design concept so that practitioners consider the desired function of the space first and then apply relevant treatments to achieve it.

Signalised intersection – An intersection with traffic lights to mediate priority between road and path users in busy and/ or higher speed environments.

State of awareness – Refers to the level of attention, vigilance, and understanding that individuals have while navigating roadways. This concept encompasses various factors, including a person's attentiveness to their surroundings, adherence to traffic rules, awareness of other road users, and the ability to respond to changing conditions.

Storage boxes (also, advance stop boxes, hook turn storage boxes bicycle boxes) – Give priority to bicycles at some signalised intersections making them more visible to other vehicles and to move them away from direct exhaust fumes.

Street – In this guide, the street is emphasised as a fundamental component of the public realm and a space for people, in the range of activities they undertake, not just motor vehicles. Streets encompass a number of zones including building frontages, paths, verges, street furniture and vegetation as well as the roadway (by contrast see **Road**).

Suburban areas – Are those areas identified for low density residential development (RZ1 & RZ2). The full details of the urban context is described in MIS05. See also **Inner urban areas**.

Street types – In the Movement and Place framework, street types are classified based on the adjacent land uses (place) and transport function (movement).

Traffic calming – Physical interventions that reduce speeds and volumes of motor traffic including, but not limited to narrow lanes, chicanes created by kerbs and planting beds, reduced road markings, surface treatments, raised platforms and mini roundabouts.

Transport corridor (central/ orbital) – Reserves for movement that may allow for multiple modes. A corridor can transition between different movement and place classifications depending on the adjacent land uses. Orbital corridors are more likely to have higher movement functions.

Urban – (adjective) a general term meaning, of the city, inclusive of **suburban** and **inner-urban areas**.

User-centred – Having regard to the needs of users as distinct from operational or system needs. Most often used in design thinking to convey a process of analysing the (often diverse and sometimes competing) needs of users as a fundamental consideration in the design of facilities and services.

Vision Zero – Refers to the goal to achieve a roadway system with no fatalities or serious injuries involving road traffic. First implemented by Sweden in 1997, adopted by the ACT and other governments

Zebra crossing – Used in the ACT in common usage instead of **Pedestrian Crossing** as they may be used by all path users. Marked with white stripes on the road surface according to the specification in MIS05, Section 4.7. See also **Priority crossing**.

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8. Appendices

These appendices provide more detail and other information to support some of the topics and examples provided in the body of the Design Guide. This should not be read as a substitute for the relevant standards and guidance.

Appendices Contents

Appendix 1. Quick-build separator treatments

Quick build protected bike lanes

Many people do not feel safe using on-road cycle lanes where motorised traffic is busy or fast moving. Quick-build separator treatments are a cost effective and efficient method for providing physical separation between people on bikes and people in cars. They can also be used to quickly enclose pre-existing on-road lanes or to test demand on roads where no current provision exists, prior to installing permanent infrastructure. They are an opportunity to test designs for functionality and usage before larger investment decisions are made. Prototyping and trialing pop-up infrastructure can also be undertaken during road closures and other network changes to test the feasibility and demand for separated infrastructure. Some examples of the types of treatments are listed below.

Tactical urbanism for placemaking and walkability

These treatments can also be used for placemaking and to make places more walkable. The range of possible treatments and options are endless and generally determined through a co-design process with local stakeholders. See the resources below for more details.

Bollards only with line marking

A very quick and inexpensive installation that provides visual separation.

They don't provide physical protection.

An ideal solution for a short-term pilot in urban settings to quickly test demand and the impact on traffic.

Separator and bollards (Type 1)

Separator bollards provide strong visual separation, combined with a kerb, and deter vehicles from straying into the bike lane.

They can be installed quickly to provide a short term solution.

Separator and bollards (Type 2)

A more robust installation with more robust bollards for medium term trials for the conversion of existing on-road lanes.

Separator buffers with line marking

Provide significant protection, suitable for situations where a lane is continuous and there is little pedestrian activity or where pedestrian activity should be directed to controlled crossings, such as arterial roads connecting regions and town centres

Can be purchased as pre-fabricated units.

Separator buffers only

Provide significant protection as well as an intermediate pedestrian refuge. Can be built to a range of widths and used as a buffer between a cycle lane and kerbside parking zone or where pedestrian permeability is high.

Can be purchased as pre-fabricated units.

Planters and other barriers

Suitable for low speed, low volume environments over short distances

Suitable for temporary placemaking and special events, particularly community delivered and managed installations.

Could use repurposed materials (car tyres, pallets etc.)

Potential WHS issues as they require a high level of maintenance.

More information:

The NSW *Cycleway Design Toolbox* (2020) is an extensive resource which also includes guidance on quick build considerations.

The Vic Roads websites displays a range of treatments to support pop up and quick build cycling facilities https://www.vicroads.vic.gov.au/traffic-and-road-use/ cycling/suite-of-treatments.

The *Tactical Urbanist's Guide to getting it done* (2016) provides information about materials and installations as well as case studies from the US. http://tacticalurbanismguide.com/

Appendix 2. Intersection geometry

The geometry of an intersection can be enhanced by considering a number of design treatments. The most important concepts are discussed below.

A central consideration is that of the 'Design vehicle' which considers the largest vehicle that will use the intersection regularly. Larger vehicles will also need to be accommodated, but should not dominate the design at the cost of safety and amenity of people who also use the intersection when walking and riding on a daily basis. The largest vehicle likely to use the intersection is the 'checking vehicle'.

Kerb radii

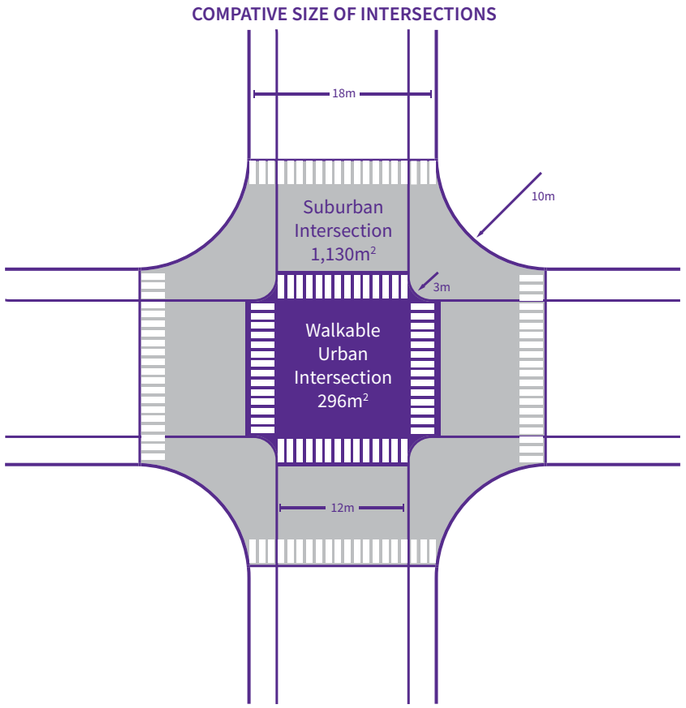


Figure 23 Kerb radii

The geometry of a kerb radius (or corner radius) significantly affects the overall operation and safety of an intersection. The shape and dimensions of kerb radii vary based on street type and transport context. Kerb radii should be designed to **maximise pedestrian space and shorten pedestrian crossing distance**. The smallest possible kerb radius should be used, while providing for the appropriate design vehicle.

Minimising kerb radii has multiple benefits for both people walking and cycling. It **reduces the crossing distance** (thereby decreasing exposure to conflicts), **enhances the visibility** of the person on foot, **slows turning vehicles down significantly**, and brings priority crossings closer to the intersection.

Because traffic is slowed by tighter kerb radii, it becomes easier for people using the intersection to see one another and adequately respond to each other's movements and actions. Tighter kerb radii also benefit people riding bikes, as speeds of turning vehicles are reduced, thus reducing the risk of a turning driver turning left across the path of a person cycling going straight across the intersection.

An appropriate kerb radii should be designed for every corner of an intersection, based on the range of vehicles that are expected to use the intersection. It is difficult to design for each and every type of vehicle that is expected to use the intersection, and the occasional difficult turning movement is acceptable. For instance, kerb radii at local neighbourhood streets can accommodate infrequent users like large removalist trucks, but not prioritise their movements. Recessed hold lines allow for the larger checking vehicle to turn using the right side of the street to make their turn. Appropriate design vehicles must be chosen and their needs balanced against the needs of people walking and cycling.

Effective turning radius

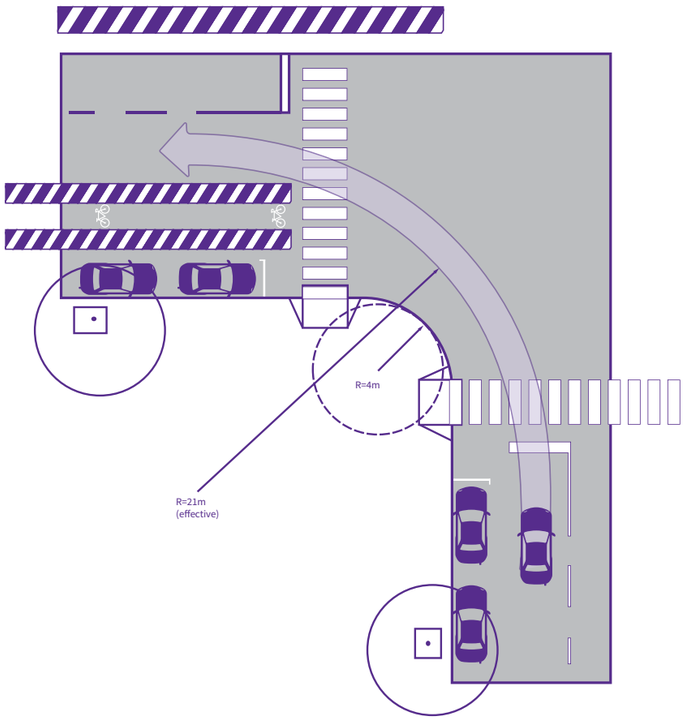


Figure 24 Effective turning radius

When designing intersections, it is critical to consider the elements that create the effective turning radius.

The effective radius is the curve that vehicles follow when turning. The effective radius is influenced by kerb extensions, parking, cycle lanes, medians and receiving lanes.

Many drivers will turn into the centre-most lane to minimise centrifugal force. In order to create the desired conditions of a street type, e.g. slow turning speeds, the effective turning radius must be considered when establishing the actual kerb radius.

The effective turning radius is also a key tool for designing for streets with regular large vehicle movements. The receiving and the kerbside elements (parking, cycle lanes) defines the effective turning radius that needs to be balanced with the desire to keep the actual kerb radius and intersection as small as possible. Where the effective turning radius for cars exceeds the preferred maximum radius, over-run paved areas can be used for large vehicles turning to manage speed and user conflicts.

Rare large-vehicle movements on neighbourhood and narrow streets can be accommodated by using the entire roadway, including adjacent and oncoming lanes. This should be assessed based on risk and in accordance with relevant standards.

Lane matching

Lane matching ensures that lanes are allocated in a manner intuitive for users and that supports the priorities of the street type. The number of entering lanes entering an intersection should align with the number of receiving lanes.

The introduction of additional, short vehicle lanes (e.g. auxiliary lanes) at intersection approaches introduces turbulence (unconfined, unpredictable vehicle movements), rewards aggressive drivers and compromises the objectives of designing a compact, multi-modal intersection.

Exclusive right turn lanes generally should be introduced to the right of the centre most through-moving vehicle lane. Through-moving lanes that become right turning lanes introduce unnecessary complexity and traffic turbulence and force people driving to make abrupt, unpredictable lane changes.

Adapted directly from:

Auckland Transport (2020), *Urban Street and Road Design Guide* (Auckland)

More information:

Austroads (2023), Design vehicles and turning path templates AP-G34-23 (Canberra)

NACTO (2020), Urban Street Design Guide, Design Vehicle

Appendix 3. Intersection elements

A combination of hard elements can be used to shape the behaviours of drivers and to make intersections work better for path users. The desired function and the context of the intersection will determine the selection of elements. MIS05 and the accompanying standard drawings provide more detail on these elements.

Raised platforms

Figure 25 Kingston pedestrian crossing

Raised platforms are effectively speed humps for intersections. They reduce speeds on all intersection approaches and through the intersection. They were first introduced in Australia's early traffic calming schemes in the early 1980's. They are most effective when combined with kerb extensions to reduce crossing distances. They can be used for discrete pedestrian crossings, or to create an 'ambiguous' environment for cars signalling that they are visitors in a pedestrian space. MIS 05 and ACTSD-3532 provide more detail on the application of raised platforms.

Kerb extensions

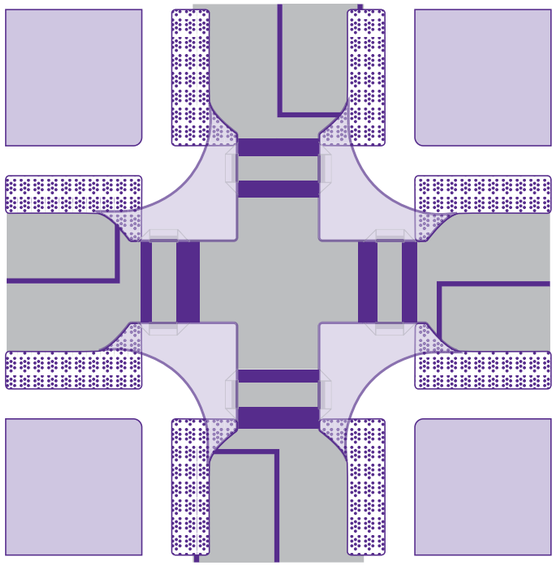


Figure 26 Kerb extensions

Kerb extensions physically and visually narrow down the roadway, increase general driver awareness, and are useful in reducing vehicle speeds. They are a commonly used tool to enhance priority crossings, as they shorten the crossing distance and make people waiting to cross more visible, and allow path users to see oncoming traffic. When applied at both ends of a street, they act as effective traffic calming devices. Kerb extensions are generally most appropriate for streets with on-street parking.

Priority crossings

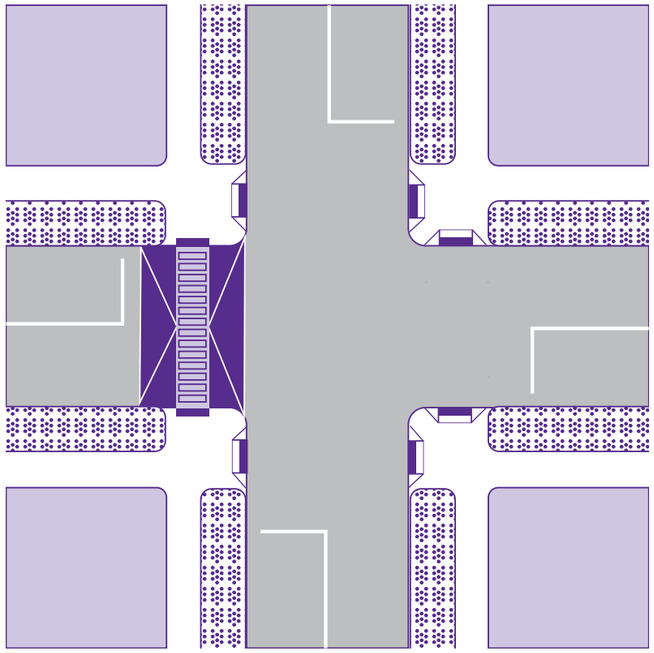


Figure 27 Priority crossings

Priority crossings (zebras) are a common crossing facility in the ACT. The zebra crossing consists of striped roadway markings running from kerb to kerb. Drivers are required to give way to path users on both sides of all zebra crossings, unless the crossing is divided by a raised traffic island.

Zebra crossings are not recommended on streets with traffic speed over 50 km/h or where there is more than one lane in any direction, as the path user may not be able to determine the appropriate time to cross and drivers to respond, due to the higher speed and/or traffic volume of the road.

Traffic signals should be used in these locations. Raised tables should be used to ensure survivable speed at the crossing.

Consider zebra crossings at intersections or across side roads to increase accessibility and safety.

Continuous verges

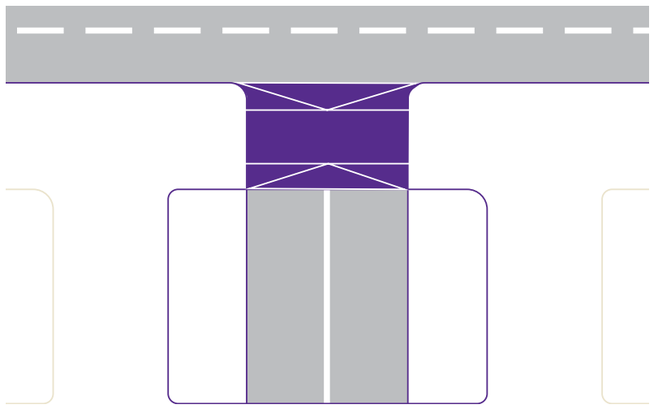


Figure 28 Continuous verges

A continuous verge extends the path across the intersections and creates a ramp to slow down crossing vehicles. This design solution makes it easier for path users to cross and slows vehicle movements. Importantly, as the title infers, it changes the priority in favour of all path users over road users (which could include people on bikes travelling in the roadway).

Continuous verges are appropriate in town centre contexts with high pedestrian volumes and at local or collector street intersections. They can be used at a speed zone threshold. They can also be marked with a zebra crossing or used with signal-controlled crossings.

Recessed holding lines

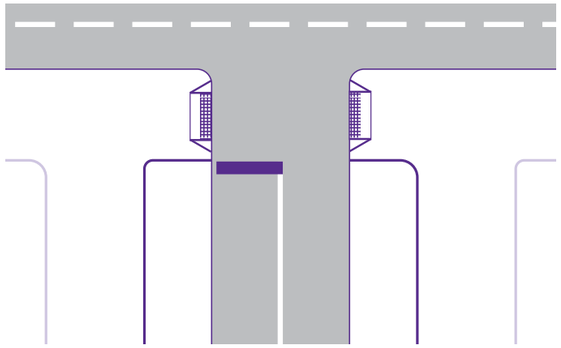


Figure 29 Recessed holding lines

To ensure priority for people walking and cycling across side roads, there is an opportunity to provide a simple, low-cost solution for these crossings, across most T-intersections. However this would require a change to the road rules. In combination with kerb extensions and smaller corner geometry to slow left turning vehicles, the holding line can be recessed before the pedestrian crossing point, creating a de facto priority crossing at every intersection. This can be further supplemented by materials or colour to enhance the priority crossing zone. This design has the added benefit of accommodating rare large vehicle movements, while maintaining a short crossing distance for path users. Visibility from the holding line must be considered, and how vehicles may move forward from it and possibly stop again before the main road.

Kerb ramps

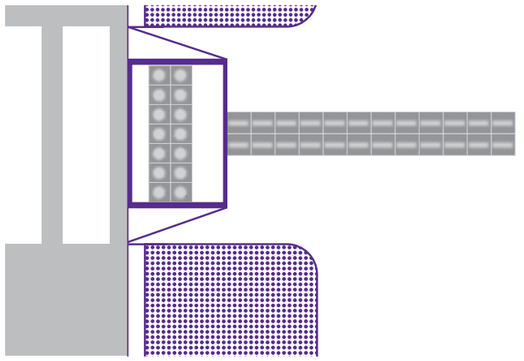


Figure 30 Kerb ramps

Kerb ramps are gently sloping ramps that mediate the transition from the footpath to the roadway at pedestrian crossing points. They are especially critical for people in wheelchairs and people pushing prams or shopping carts. At midblock locations, they should be placed at a 90-degree angle to the direction of the crossing and have a gentle enough grade to ease the transition between path and the road. At intersections, they should be placed at an angle parallel to the road they are following. MIS05 provides extensive guidance on kerb ramps with links to standard drawings in Section 4.7.2.

Guidance for vision impairment

Placed along footpaths, at kerb ramps and platform edges at public transport stations, tactile paving strips Tactile Ground Surface Indicators (TGSIs) guide people with visual impairments along pedestrian connections and other urban environments, in designated areas. They have a different texture from the surrounding paving and have highly visible colouring. The requirements are determined by the Disability Standards for Accessible Public Transport 2002. Section 5 of MIS05 provides more guidance on the application of TGSIs.

Adapted directly from:

Auckland Transport (2020), *Urban Street and Road Design Guide* (Auckland)

More information:

The Disability Standards for Accessible Public Transport 2002 have specific requirements for tactile treatments on paths that may also apply to intersections. These requirements are covered in the ACT Municipal Infrastructure Standards and relevant Australian Standards.

The Centre for Universal Design has collated resources to assist in planning for accessibility in the built environment. https://universaldesignaustralia.net.au/category/practice-guidelines-for-built-environment/

Municipal Infrastructure Standard 05 (Section 5).

Appendix 4. Path cross sections

These cross sections have been included to provide detail of the connections to the intersection.

Walking cross-sections

This appendix provides a quick reference for the path connections to intersections, according to movement and place classifications. MIS 05 provides further guidance depending on the path hierarchy and whether the context is greenfield or brownfield.

Local streets –low and medium activity (M1/P1)

- Verges and footpaths in residential neighbourhoods vary in width, depending on their context.
- Designing for low activity, this is appropriate where people walking are unlikely to pass people coming the other way.
- This layout is appropriate for low-activity areas only– it does not enable people to pass each other coming the other way or walk side-by-side.
- A clearance of 1m between the footpath and property boundary is recommended.

Local streets – medium activity (M1-2/P1-2)

- Designing the walking environment on local streets for medium activity is appropriate where people walking are more than likely to pass people coming the other way.
- 2m wide footpaths support two people walking side-by-side, and passing when people are walking single file.
- 2m – 3m wide footpaths support two people walking abreast, or two people walking together past another person.

Local streets – residential, low activity (M1/P1-2) shared street option

- Local streets with low traffic volumes should be low speed to allow the space to be shared by all users, particularly where there are no footpaths.
- Traffic calming measures are typically necessary to achieve safe speeds.

Vibrant streets – medium activity (M2/P2)

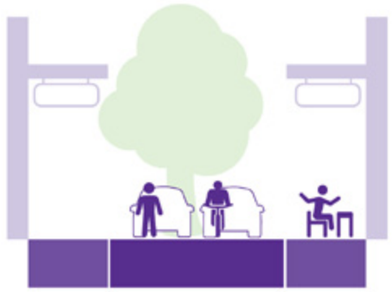
- People walking are almost certain to pass people coming the other way.
- Paths should support two people walking next to each other without having to walk in single file when passing others.
- For neighbourhood main streets, various configurations are possible depending on the circumstances:
    - Where the clear path sits directly adjacent to the building edge, a width of at least 2.4 m is ideal.
    - Commercial activity (such as outdoor seating) is likely to need about 2.1 metres of this space, so additional width may be required.
- On narrower streets, where it might not be possible to provide tree pits, the buffer strip adjacent to the kerb might be used to provide planters or other landscaping features and should be at least 1 metre wide.
- Where the clear path is not situated directly adjacent to the building's edge, a small zone (1.5 metre) of commercial activity might be situated directly in front of the building.
- On busier neighbourhood main streets, a clear path width of at least 3 m is suggested, as are street trees to provide a buffer between higher pedestrian volumes and traffic.
- A furniture zone of 2.4 m would provide for bus stops and other uses.

Vibrant streets – high activity (M2-3/P2-3)

- Busy commercial streets need multiple zones to provide for on-street commercial activities, a clear path or footway and a distinct buffer between people walking and cycling and motor vehicles.
- Commercial activity that transitions out from the building line onto the footpath in a dedicated area requires about 3.0m.
    - Depending on the total width of the footpath and the street, a clear path of 3.0 to 4.2m for higher volume pedestrian paths is appropriate for city and town centres.
- A buffer from traffic of 1.5 to 1.8m is suggested to cater for tree pits, public transport stops and street furniture (such as benches and planters) in the buffer between the clear path and the kerb.

Places for people – medium to high activity (M1/P3) shared zone option

- Within shared zones, the entire realm between buildings on both sides of the street effectively becomes the footpath, as it is level throughout.
- People on foot have priority and can walk freely anywhere on the street, only needing to circumnavigate street furniture and street trees.
- The geometry depends greatly on the total width of the street and these environments should be designed on a case-by-case basis.
- However, in all cases the clear footway zone still exists and it is important to provide a clear and accessible path of travel that is safe and protected from vehicles.



More information:

Section 3 of the Urban Street and Road Design Guide (Auckland, 2022) provides more detail about the general needs of people walking, including different walking users (wheelchairs, prams etc), and design features for different street types.

The NSW Guide to Walkable Public Spaces (NSW, 2022) identifies 10 characteristics that support places to be more walkable in safety, scale, comfort and interest. https://www.movementandplace.nsw.gov.au/design-principles/guides-and-tools/nsw-guide-walkable-public-space

Appendix 5. Cycling and micromobility cross-sections

One-way versus. two-way operation

Options for one-way and two-way facilities are provided. Typically, one-way facilities are preferred in urban environments where all users are moving in the same direction as adjacent motor vehicle traffic. The benefit is less complexity of traffic signal operation, greater predictability of movements and less delay.

Two-way facilities may be used where signalised intersections can be avoided (or complexity/delays minimised) or when changing from two-way to one- way operation would be indirect or inconvenient for users.

Figure 31 One-way versus two-way

One-way protected cycleway at roadway level

Refer to MIS-05 Bicycle-only path (one-way pair)

The cycleway width should be more generous than on-road cycle lanes, or off-road paths at kerb level, to allow clearances from vertical elements.

A cycleway width of 2.0m – 2.5m is desirable and allows overtaking or riding side by side. The minimum width is 2m. If they are narrower it becomes difficult to manoeuvre different configurations such as cargo bikes and trailers.

Two-way protected cycleway at roadway level

Refer to MIS-05 Bicycle-only path (two-way)

The cycleway width should be more generous than on-road cycle lanes, or off-road paths at kerb level, to allow clearances from vertical elements.

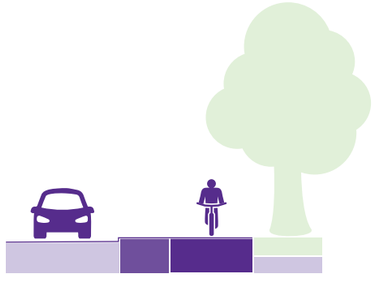
A cycleway width of 2.5m – 3m is desirable and allows overtaking or riding side by side, with a minimum width of 2.5m.

Buffers should be a minimum 0.4m in retrofit situations and 1.0m in estate developments. The height of the buffer will be determined by the environment to avoid pedal strike and damage to motor vehicles where there is a tight turning radius. Bevelled profiles may help to address this issue.

Protected cycleway at verge level

Refer to MIS-05 Bicycle-only path (one-way pair)

A cycleway width of 2.0m – 2.5m is desirable and allows overtaking or riding side by side. Constrained retrofit situations may consider further reductions, on a case-by-case basis.

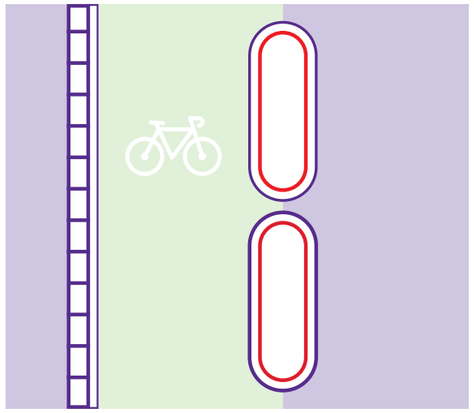


Separator and buffer dimensions

The design of the buffer area, on the verge between the cycle path and the roadway, should consider whether it will be used by people walking to cross the roadway or cycleway.

A width of 0.6m or more is desirable, which allows it to be used by pedestrians to pause when crossing the road and cycleway. A wider width of 0.8m – 1.0m should be used where on street parking or loading is present. In these instances, the separator will allow vehicle passengers to alight while minimising the risk of having the door of a parked car opened in the path of a person riding a bike. At a minimum, separator kerbing should be no less than 0.4m wide, or 0.3m for pop-up kerb-and-bollard separators.

Buffers used between parked cars may be castellated and positioned so that passengers alighting from a car do not step onto the buffer, but between blocks.



Appendix 6. Signalisation: operations and features

Signalisation is the highest level of intervention to mediate conflicting movements and to separate vulnerable road users from motor vehicles. With the acute vulnerability of people walking and riding, signalisation has commonly been used to restrict their movements unequally, which increases risky, non-compliant behaviours.

Based on a thorough analysis, each signalised intersection will have its own unique context. The pros and cons of the options below (as well as future options) should be discussed at the design stage to ensure that outcomes are actively determined based on analysis of the context and constraints. Where compromises are made these should be documented.

The ACT operates an adaptive urban traffic control system which is configured to optimise intersection phase splits and cycle time on an ongoing basis. Through dedicated programming, adaptive systems have the potential for more efficient outcomes for people walking and riding in the future. Some of the treatments at the end of this appendix may not be possible to implement in an adaptive system.

Design Goals to Improve Pedestrian Safety and Comfort

- Reduce vehicle speeds
- Minimise crossing distance
- Minimise wait for WALK indication
- Minimise conflicts with turning vehicles
- Provide sufficient signal time to cross the street.

Lead-Pedestrian Interval

Where concurrent pedestrian phases are allowed, left turns should be held by a red arrow aspect rather than relying on 'Give way to pedestrians crossing' signs. This reduces pedestrian-vehicle conflicts that otherwise might arise when vehicles start to infringe on the pedestrian crossing when pedestrians are crossing.

Countdown pedestrian displays

Countdown pedestrian displays inform path users of the amount of time in seconds that is available to safely cross (or clear the intersection), or when the next green phase is expected. Pedestrian countdown timers have greatest application in areas with high pedestrian volumes and can encourage greater safety through compliance. Where pedestrians perceive a long wait time, they are more likely to behave in a way that is non-compliant and unsafe.

Countdown displays for remaining clearance time may not be suitable for two stage crossings if the count is separate for each stage, but could be perceived to apply to both stages.

Countdown displays (to the next green phase) are generally not compatible with intersections in the ACT that are part of the adaptive system as these intersections are continuously re-calibrating cycle times.

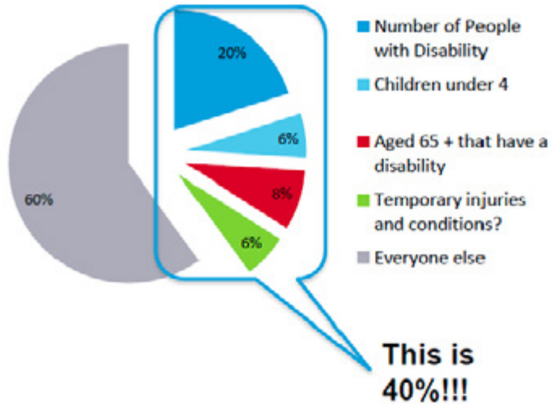
Signal timing

Signal timing for path users is provided using pedestrian and cycling signal lanterns. Pedestrian signal lanterns should be provided on all approaches at all signalised intersections. As a general design aim, operations should maximise the total clearance time for active travel movements. However, signals operations are complex and this design choice ultimately is balanced by network operations design trade-offs.

The ACT road rules already require turning vehicles to give way to people walking and riding. However, these rules are poorly understood, often leading to conflicts. Additional signage and pedestrian and cycling lanterns can help to reinforce this priority.

The pedestrian clearance time is marked by a flashing red phase, equivalent to the time it takes for a pedestrian to clear the intersection if they leave at the onset of the flashing red DON'T WALK signal.

Pedestrian clearance times are commonly calculated using a pedestrian walking speed of 1.2-1.49 meters per second. Recent Austroads research, indicates this speed is too fast for many user groups such as the young, the aged and people with disabilities.



Recent research by Transport for NSW indicates the proportion of people who are walking slower than commonly accepted clearance times may be as high as 40%.

Pedestrian signals should allocate enough time for people of all abilities to safely cross the roadway.

Exclusive vs concurrent

Exclusive

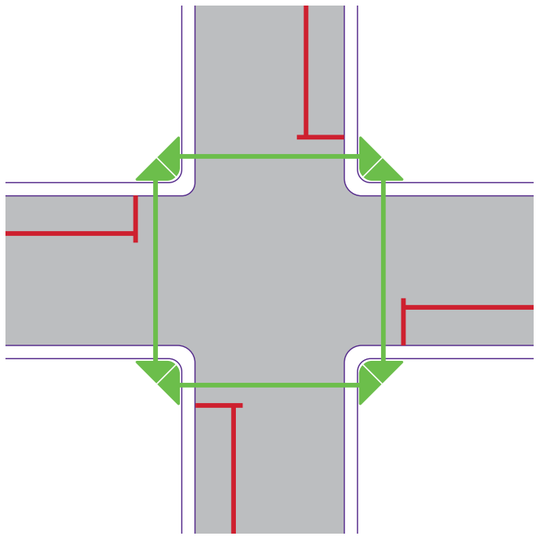


Figure 32 Exclusive phasing

Exclusive pedestrian phasing (sometimes referred to as 'scramble' or 'Barnes Dance') is when path users are able to cross when there are no conflicting movements. Exclusive phasing is theoretically safer because it removes all conflicts. However, evidence for safety is mixed due to path user non-compliance (i.e. crossing against the 'don't walk' signal). They are most successful in the busiest pedestrian precincts in very large cities, near public transport hubs.

The green pedestrian walk indication is typically short, usually requiring a path user to activate the pedestrian call button and to be waiting. It is common for programming to require up to 90 seconds for motor vehicle traffic cycles before allowing the path user to cross. The long wait time is potentially unsafe, as it incentivises crossing against the signals, or mid-block before the intersection. Long wait times are a significant disincentive to walking, in particular when the destination is the diagonal corner. Pedestrian wait times in busy urban environments should be no longer than 30 seconds.

Due to road user rules and prevailing engineering practice, it is difficult to provide comprehensive signal phasing and timing guidance. User-centred design approaches will assist in getting outcomes that work for people, helping to distinguish between technical constraints and operational choices.

To provide a high level of service to people walking and cycling, provide crossings on all intersection legs wherever possible so they don't have to make unnecessary crossings to get to their destination. Vehicular movements should be analysed at every intersection in order to utilise non-conflicting phases to implement walk intervals. For example:

1. Where one-way streets approach intersections, path users can always cross while traffic is stopped.
2. Introduce concurrent pedestrian phases within signal cycles that also include an all-pedestrian phase.
3. Introduce concurrent pedestrian phases at intersections with slip lanes and an all-pedestrian phase.
4. Use double-phase 'Scramble' phasing (two pedestrian only phases each cycle) where long cycles cause excessive delays for pedestrians.

Concurrent

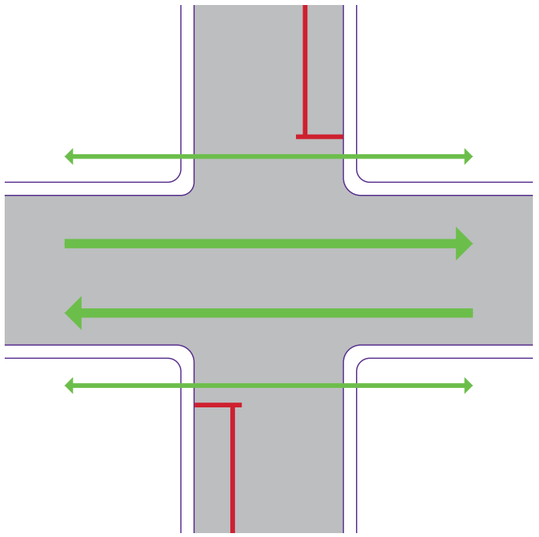


Figure 33 Concurrent

A concurrent pedestrian phase is when path users are able to cross while parallel and non-conflicting vehicular traffic is also moving. Concurrent phasing is often accompanied by signage, such as turning vehicles must give way to path users to reinforce the road rules.

A combination left turn arrow – green disc (straight through) phase communicates to drivers an 'all clear' turning movement. This practice should be used with caution to ensure that turning vehicles take care and look for vulnerable road users, in particular where people on bikes may be expected to pass to the left of turning vehicles.

Protected, yet concurrent signal phase is preferred

The conflict between left-turning vehicles and people on bikes is a critical design consideration at intersections. An all-pedestrian phase, or an exclusive bicycle phase provides the most protection, however the overall green-to-green time increases substantially for each modality. This is because an additional signal phase is introduced. As vehicle phases have longer red times, queues grow longer and, in turn, need more time to clear and increase waiting times for path users. For this reason, all-pedestrian phases or exclusive bicycle phases may limit an intersection's capacity.

Dangerous situations might also arise from path user non-compliance, with path users refusing to wait for their phase and crossing with parallel traffic, or mid-block, avoiding the intersection, leading to unanticipated conflicts. All-pedestrian/all-bicycle phases are virtually non-existent in The Netherlands.

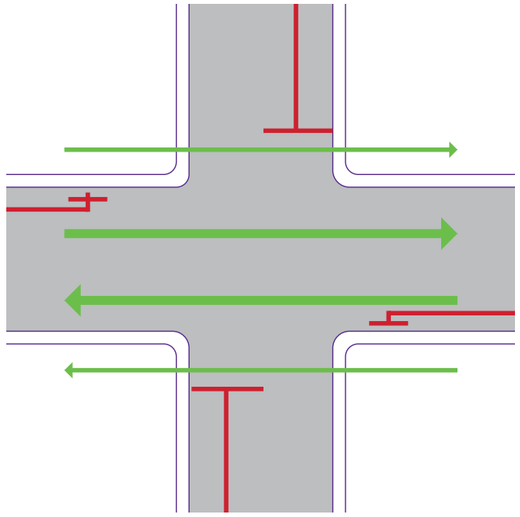


Figure 34 Protected concurrent phasing

One alternative is to permit conflicting vehicle turning movements, using permitted phasing. This should be considered acceptable for priority crossings only on two conditions:

1. the geometry (turning radius) must force the turning movement to be made at a low speed; and
2. the volume of turning vehicles must be low.

One rule of thumb uses 250 turning vehicles per hour as the maximum for allowing permitted phasing. Due to the added traffic stress for people and the lack of opportunity to respond, wherever conflicts with turning traffic exist, this conflict should be removed to the greatest extent possible. The protected, yet concurrent configuration should always be considered before any other treatments.

Additional provisions at signals for people riding include:

- The **Green Wave** of lights embedded in the pavement (as discussed above) syncronised at an average of 20km/hr demonstrates visible support for cycling.
- A short **bypass** allows riders to avoid a signalised T-intersection where people turn left on a dedicated path, or where they can proceed straight through an intersection at the head of the T if there are no conflicting pedestrian movements.

Protected, yet concurrent phases are preferred. Protected phasing ensures conflicting walking-riding movements are not allowed to run concurrently. Left-turning vehicle traffic is allocated its own phase, usually in its own lane, directed by turn arrows. The cyclist (and pedestrian) crossing phase runs concurrently with parallel through traffic, eliminating left-turning vehicles is eliminated. The crossing phase might begin later or earlier, to allow additional time for the conflicting left turn phase. Adding an additional lagging phase allows more people on bikes through an intersection. A protected, yet concurrent phasing uses both time and space efficiently. Protected, yet concurrent phasing requires fewer lanes to serve traffic, keeping intersection geometry tight.

The protected, yet concurrent phases are normally used at signalised intersections with bicycle facilities in the ACT following common practice in The Netherlands and in North America.

Figure 35 Give way to cyclists sign

Adapted directly from:

Auckland Transport (2020), *Urban Street and Road Design Guide* (Auckland)

Signal coordination and other strategies

The practice of synchronising a series of signals that are in close proximity, is called coordinated signal timing or signal coordination (also a 'green wave'). Traffic signals are planned to allow vehicles, traveling steadily at the desired speed, to progress with little delay along a corridor by obtaining a sequence of green lights at signalised intersections. Traffic moves through signals with ease and delays are minimised, while mid-block speeding is discouraged simultaneously.

When used, signal coordination must be optimised to consider the needs of all road users. Delays for people who are walking and riding and for public transport vehicles need to be minimised. Furthermore, bicycle speeds should be considered when planning signal coordination along bicycle routes. Ideally, signal coordination would allow both bikes and motorised traffic to travel through a series of intersections without stopping noting that people riding travel at different speeds to each other, whereas motor vehicle in an urban environment can be quite uniform.

Signal coordination can also be used as a tool to provide safe transitions between high-speed roads and urban streets. This is done by stopping all vehicles before they enter urban environments with red lights and platooning vehicles slowly as a group. A similar strategy can be utilised where the signals are held in a default red phase unless triggered by vehicles. This should be considered in very busy urban environments, in particular during late hours of the night, where vehicle speeds need to respond to the presence of vulnerable road users.

Slow signal progressions have multiple benefits, providing a green wave for bikes and buses, while slowing speeds for private vehicles.

Placement of bus stops needs to be considered along with phasing.

Low speed signal progressions create amenable environments for both bicycle green waves and bus or light rail priority streets (Figure 36).

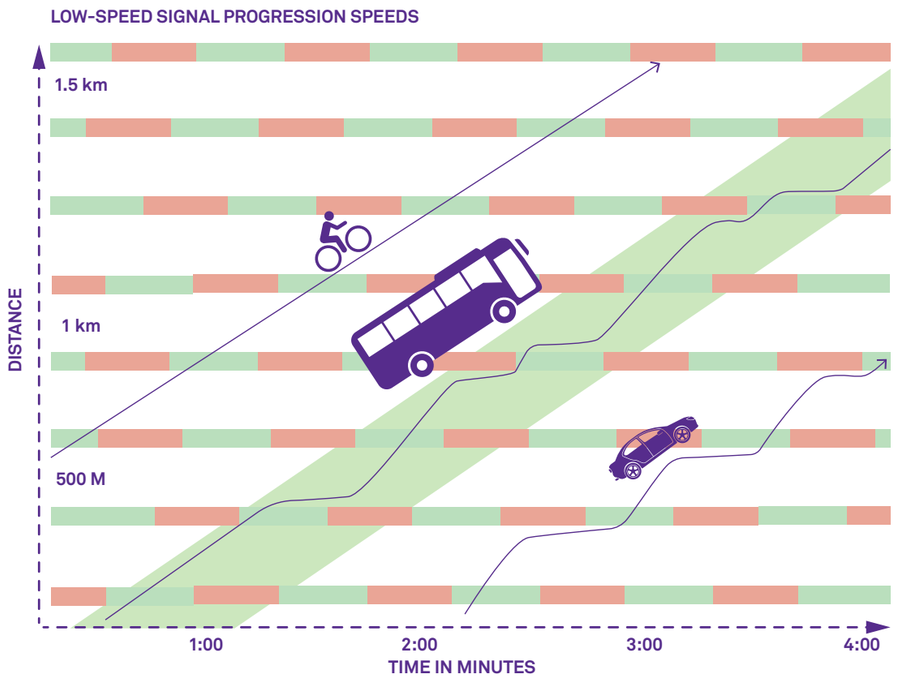


Figure 36 Low speed signal progression speeds

Actuated -vs- automated signals

Active travel phases can be programmed to be automated at each cycle, or to be actuated by using push buttons within an adaptive system. Generally, automated pedestrian phases are preferred, particularly in areas where higher volumes of path users create a need for a pedestrian phase during every cycle as was programmed during the COVID19 pandemic. Vehicles are detected automatically at signalised intersections; path users should be provided with the same service. As a principle, active travel movements signals should be automated and consistent for users in busy pedestrian environments and during peak periods.

Push buttons are most fitting for intersections with infrequent pedestrian use and intersections designed to operate only with vehicle detection. It is important that actuated buttons are conveniently placed for users.

Where signal phases require a person to press the button, it is critical to consider how people on bikes will be affected when the pedestrian phase is not activated. Independent cycling detectors or cycling push buttons may be necessary to remove conflicts with left turning vehicles, particularly where facilities are separated.

Mobile phone technology to call the pedestrian phase for low-vision people already exists. Mobile phone Bluetooth technology can allow people to trigger the pedestrian phase without having to detour off a straight walking route to find the button. This allows a vision-impaired person to stay on the intended travel path up to the kerb crossing, and across the intersection without having to reassess the direction of travel after finding the button, so that crossing the intersection at the right place in the right direction is more likely. This is very useful where people cross concurrently with traffic, as it is easy to get a bit turned around and step towards the flow of traffic.

Signal design plays an integral role in making intersections safe and convenient for people who are walking or riding. Signals are used to separate users by time, and to help reduce or remove conflict from intersections for all modes. There are many opportunities to improve signal design to make intersections work better for people walking and cycling.

These include phasing strategies, advance green lights, and minimising delays across corridors.

Adapted directly from:

Auckland Transport (2020), *Urban Street and Road Design Guide* (Auckland).

Further advice is available from the former Australian Bicycle Council – Traffic Signal Features for Bicycles (2017).

Appendix 7. Signalised intersection arrangements

An intersection's look and feel often mirrors that of the intersecting streets. When two busy urban arterials meet, the intersection will experience high volumes of traffic, and will often need signalisation to guide traffic through and avoid collisions. Similarly, in the ACT, new crossings installed on roads with signposted speeds of 50km/ hr or above should be signalised, including midblock crossings.

Signalisation is an expensive intersection treatment that has network-wide implications, so it is only used where neccesary. In any new project or retrofit, reducing the number of intersections that require signalisation, can be a way to reduce this cost.

Note: the following diagrams are indicative and not to scale.

Protected crossings

Protected priority crossings should be designed to offer as much comfort and protection as possible.

Prominent road markings should be used for signalised crossings according to the standards and associated standard drawings. These are more visible to people who are driving a motor vehicle. Australian priority crossing designs should evolve to become more in line with international best practice. An interim solution may be to make the typical priority crossing stripe much wider, as was past practice in some Australian jurisdictions.

Mark the crossing to be at least as wide as the footpath it extends to. The crossing path should be aligned as closely to the pedestrian desire line as possible.

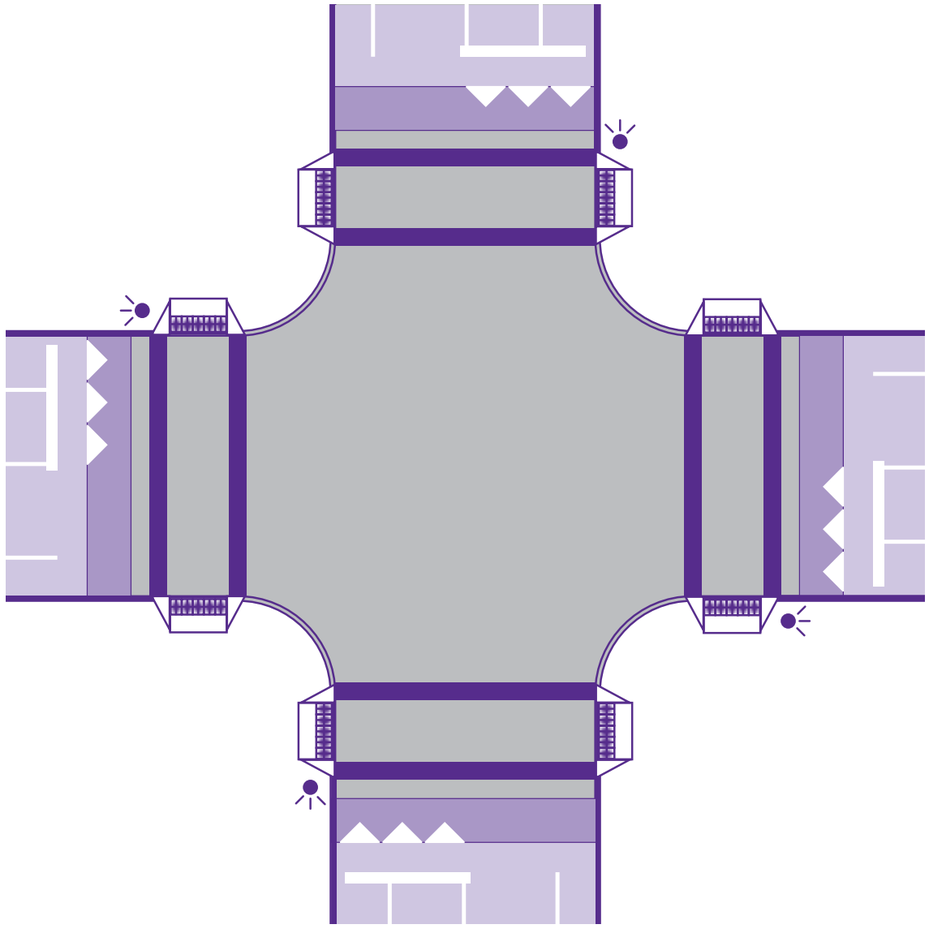


Figure 37 Protected crossings

Crossings with kerb ramps should preferably be located at every leg of the intersection to provide safe and direct crossing opportunities.

An advance vehicle holding line should be placed at least 2.4 m in advance of the priority crossing. If the street has an on-road bicycle lane or a separated bike path, or high levels of bike traffic, the holding line should be recessed even further (7.0 m before the priority crossing).

Mid-block crossings

Mid-block pedestrian signals are installations that stop traffic so path users can cross safely and unimpeded. The signals are activated by path users. Mid-block signals are important features on busy urban arterials with higher speeds. They improve safety, accessibility and permeability of the walking network in town centres.

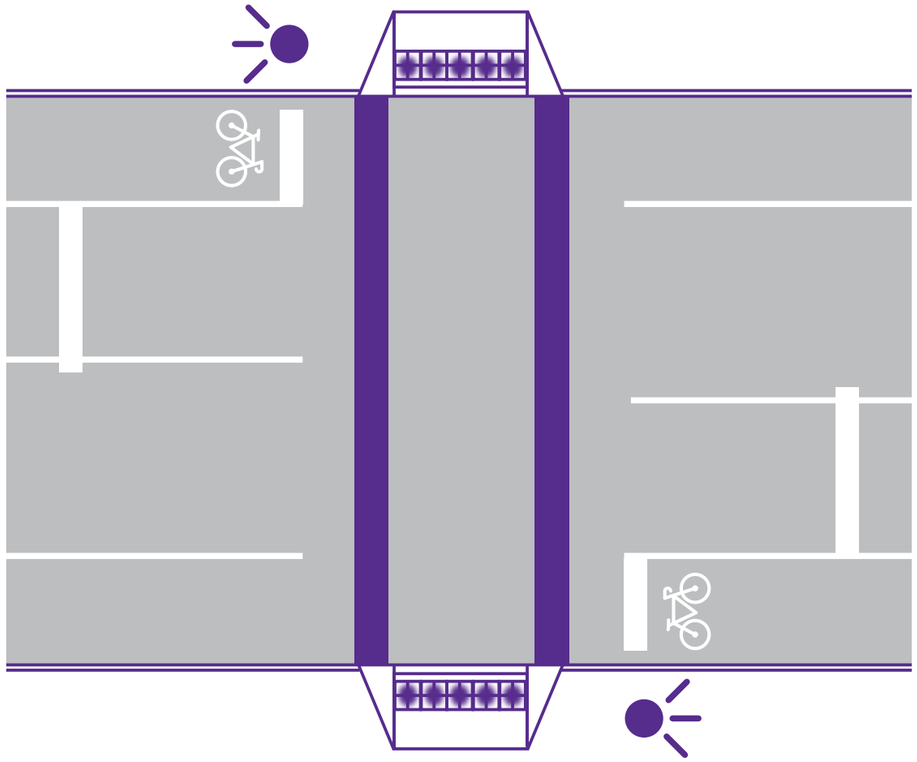


Figure 38 Mid-block crossings

Raised intersection entries with corner safety islands

Operation of traffic signals does not entirely prevent mistakes that lead to conflicts within the controlled intersection. It may be possible to reduce vehicle operating speed on all approaches to a signalised intersection, but often this is not feasible. It is then necessary to ensure that vehicles enter the intersection at a speed that is survivable in the event of a collision. One method is to provide a raised intersection table, or provide raised crossings on the approach arms. These should be designed to achieve a safe speed through to the last conflict point on the vehicle's path, which may be the crossing used by people walking and riding on the exit side. Where there are crossings, the safe speed is 30 km/h or less. For conflicts with other vehicles, the angle of incidence determines the acceptable collision speed.

The choice of raised platform intersection, raised crossing tables or approach-only (Swedish) ramps depends on local factors, including drainage.

Additional measures on approaches may be needed to ensure that vehicles do not approach a raised intersection entry at an unsafe speed for the ramp height and gradient.

In this intersection treatment, both the pedestrian and cycle traffic would have a protected phase, however providing a longer clearance time for cyclists prevents unnecessary delays and ensures that the storage area behind the corner safety island does not become congested. Unnecessary delays encourage non-compliance and preventable road trauma. Cycle lanterns can be used to provide a separate phase. Older intersections may need additional capacity to provide this function.

The design should aim to encourage a steady speed through the intersection on a green light phase, not high acceleration, or deceleration, for both safety and efficiency. Any design should be evaluated with the Safe System Assessment Framework. Alternative treatments may be closing intersection arms, grade separation, roundabout or fully managed low-speed approaches.

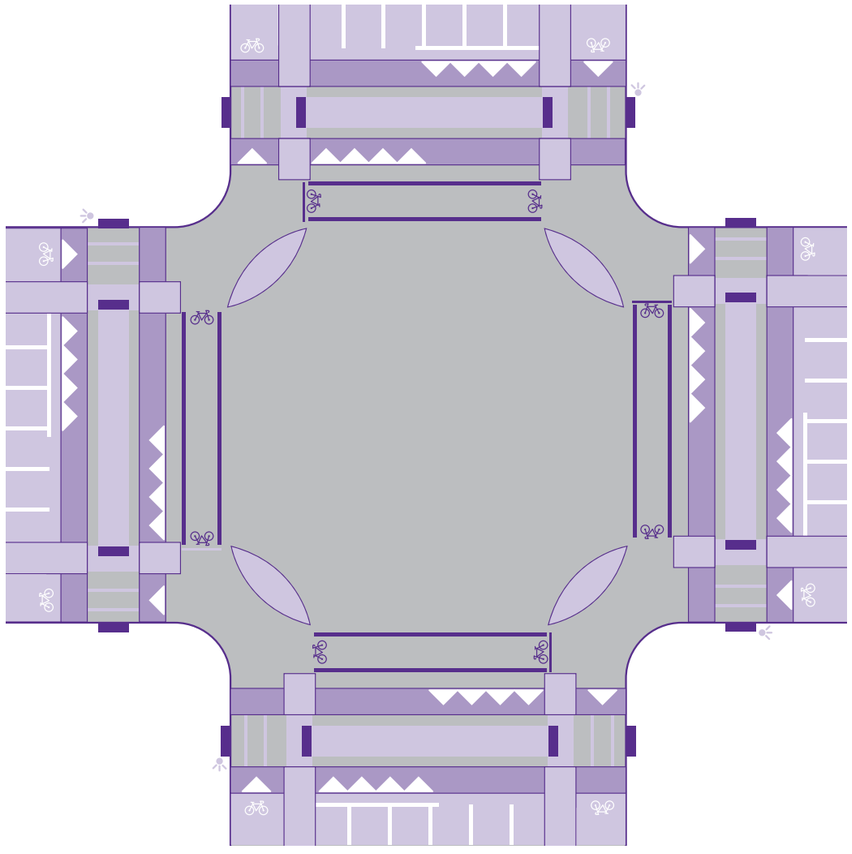


Figure 39 Raised intersection entries

Signal priority for public transport

Signal priority

Widely used at prioritised busways in many cities, public transport signal priority allows public transport vehicles to extend a green phase or shorten a red phase, without interfering with the phase sequencing or overall signal timing. The time difference is made up for in the subsequent cycle when the bus or light rail vehicle has passed. All other signal operations remain intact. Using an in-vehicle transponder, public transport vehicle drivers can trigger a signal change on their approach to an intersection, ensuring that they have a green light. This minimises waiting times at the intersection, or eliminates it altogether. This reduction of delays allows public transport to stay on schedule and it minimises bunching. Signal priority is currently applied to the light rail corridor in the ACT.

Signal timing

Public transport prioritisation at intersections can contribute to a more reliable, more efficient public transport service. It also makes it less polluting, as it leads to less queuing, and stopping and starting. Public transport prioritisation encompasses signal coordination, signal priority, dedicated public transport-only lanes, as well as queue jumps or bypass lanes.

Signal coordination and priority strategies are typically used in conjunction with dedicated public transport-only lanes and queue jumps. Where signal priority and queue jumps are provided, the impact on overall signal cycle lengths as well as the impacts to delay for other users should be considered.

Bus head-starts and bypasses can be an effective strategy to allocate road space across constrained corridors.

Adapted directly from:

Auckland Transport (2020), *Urban Street and Road Design Guide* (Auckland).