Intersections

Guide to Traffic Management Part 6

Guide to Road Design Part 4 and 4A

6 November 2017

Austroads

Today’s moderator

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About Austroads

The peak organisation of Australasian road transport and traffic agencies

- Roads and Maritime Services New South Wales
- Roads Corporation Victoria
- Department of Transport and Main Roads Queensland
- Main Roads Western Australia
- Department of Planning, Transport and Infrastructure South Australia
- Department of State Growth Tasmania
- Department of Transport Northern Territory
- Transport Canberra and City Services Directorate, Australian Capital Territory
- Commonwealth Department of Infrastructure and Regional Development
- Australian Local Government Association
- New Zealand Transport Agency

Housekeeping

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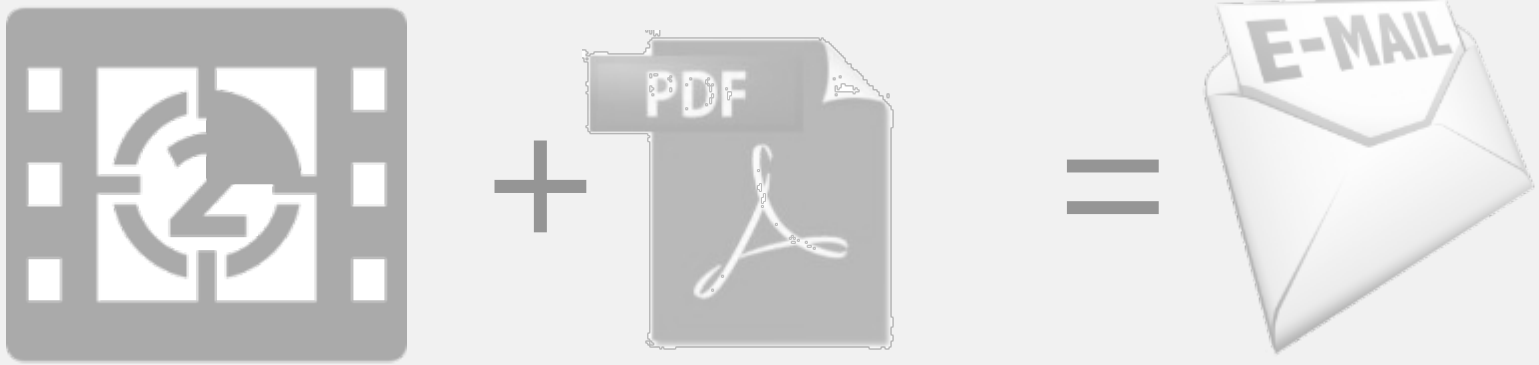
Webinar = 55 mins

Question time = 15 mins



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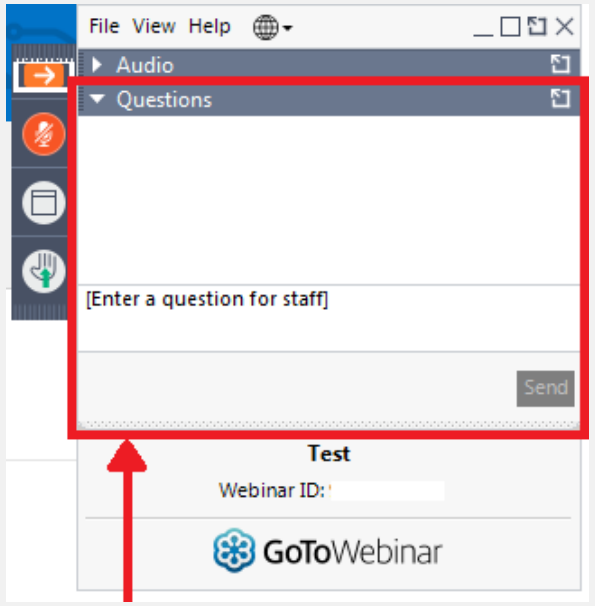

Please type your questions here

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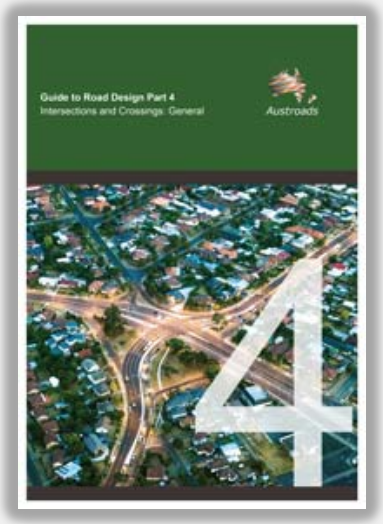

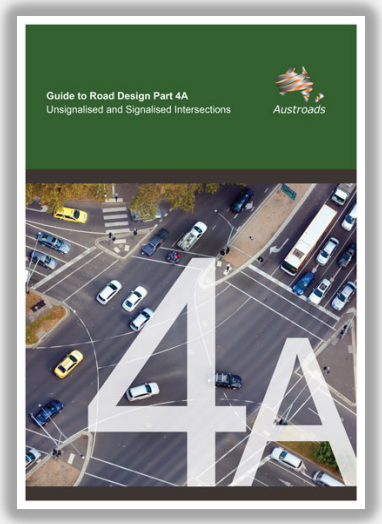

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Today’s presenters

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Agenda

Topic	Presenter
Introduction	Peter Aumann
Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings	Lisa Steinmetz
Guide to Road Design Part 4: Intersections and Crossings – General	Peter Aumann
Guide to Road Design Part 4A: Unsignalised and Signalised Intersections	Peter Aumann
Q&A	All presenters

Introduction

Peter Aumann

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Guide Relationships

See General

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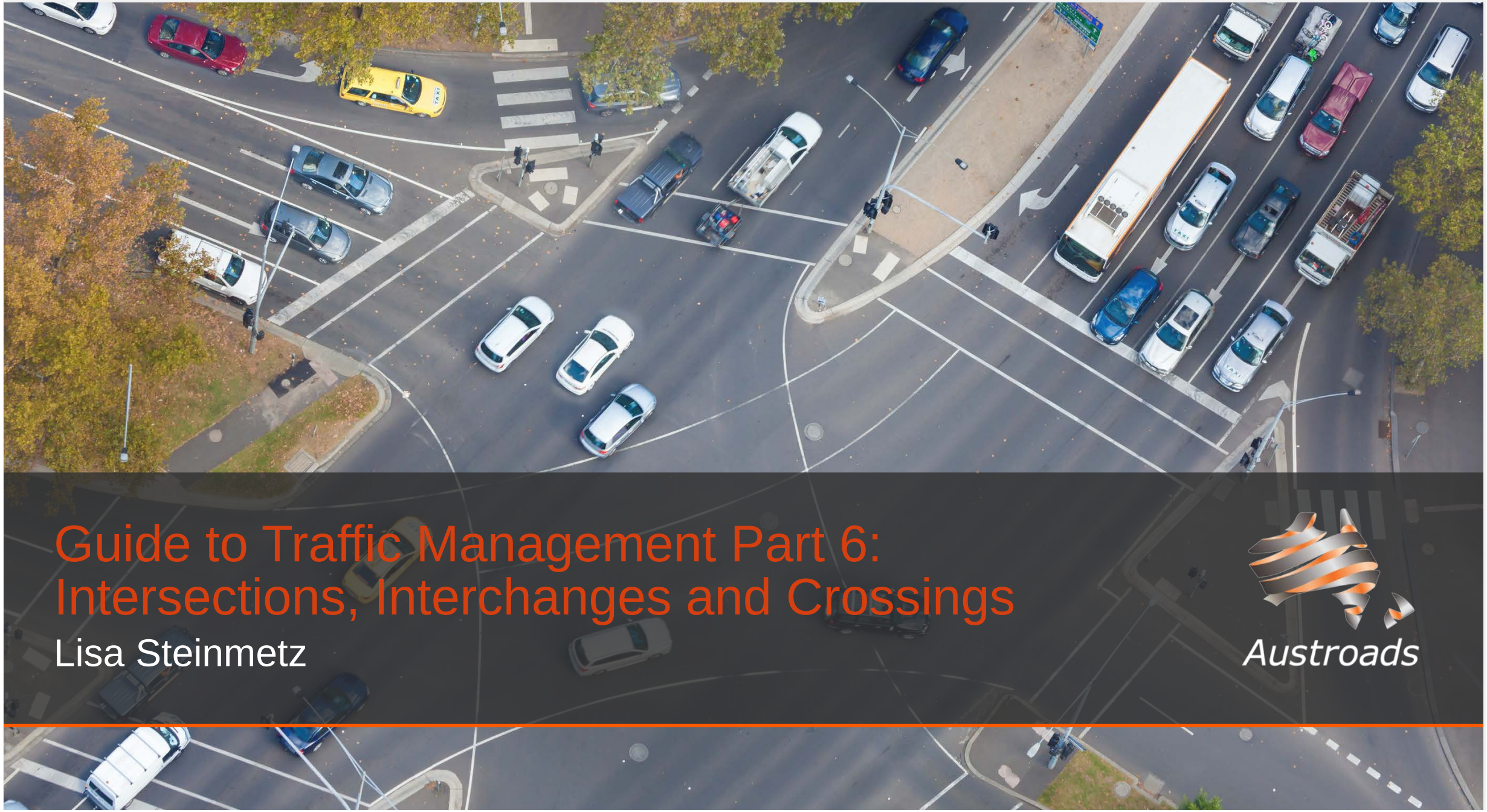
- *Guide to Road Design Parts 4, 4A, 4B* and *4C* provide guidance relating to design parameters for intersections and crossings together with typical layouts of various intersections, interchanges and crossings and other relevant facilities.
- *Part 6* of the *Guide to Traffic Management* provides guidance on traffic management aspects, including the selection of intersection type, including considerations for various road user types



Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings

Lisa Steinmetz

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Process

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Review Team

Austroads Project Working Group

Austroads Traffic Management Working Group

Stakeholders- Road and Traffic Authorities

Austroads Network Taskforce

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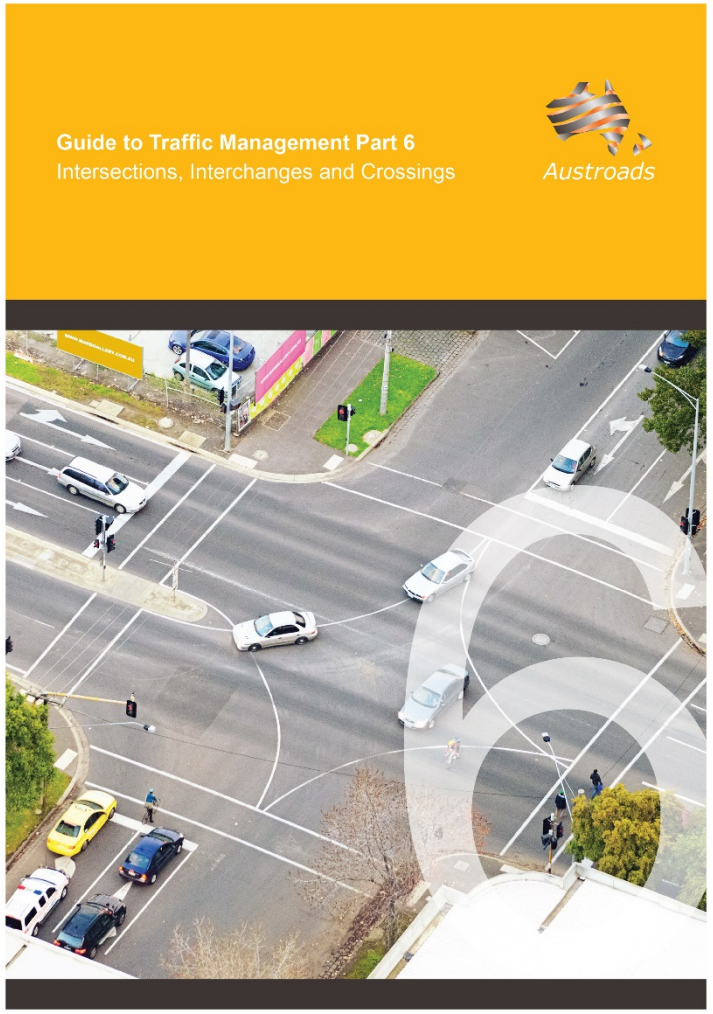
Purpose

- Focuses on traffic management and treatments
- Describes the use and design of:
  - various intersection types
  - techniques to be applied for efficient and safe intersections



Structure

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1. Introduction
2. Selection of Intersection Types
3. Roundabouts
4. Signalised Intersections
5. Unsignalised Intersections
6. Road Interchanges
7. Rail Crossings
8. Pedestrian and Cyclist Crossings

Key Updates

See General

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Safety Systems principles

Network Operations objectives

AGTM Part 6: Intersections, Interchanges and Crossings

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Types of Intersections

See Section 2.2.4

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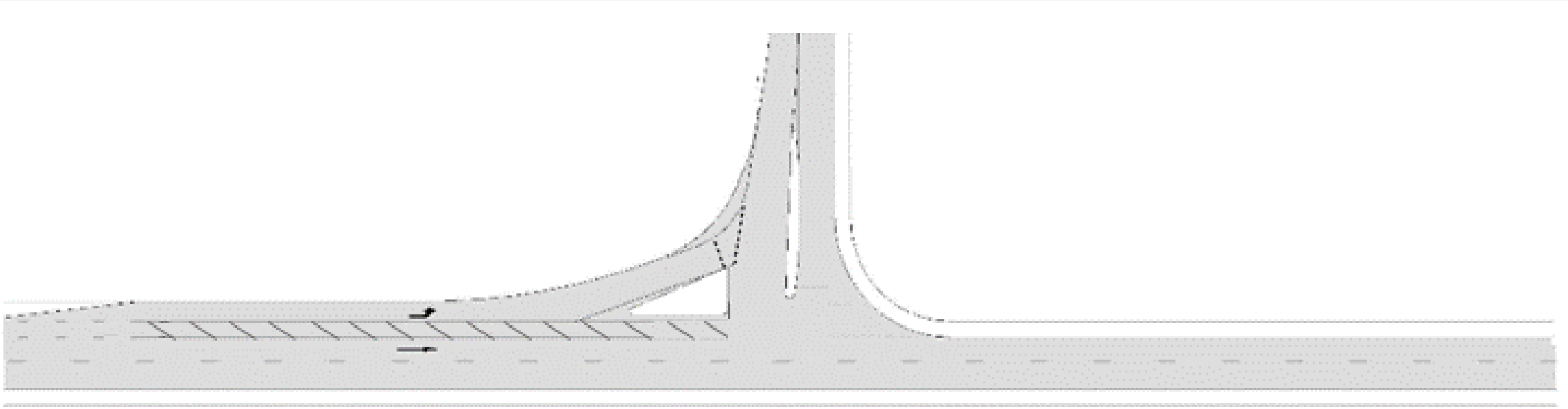
Rural channelised turn treatments

- Increased separation



Channelised Left Turn (CHL)
on the Major Road

Types of Intersections

See Section 2.2.4

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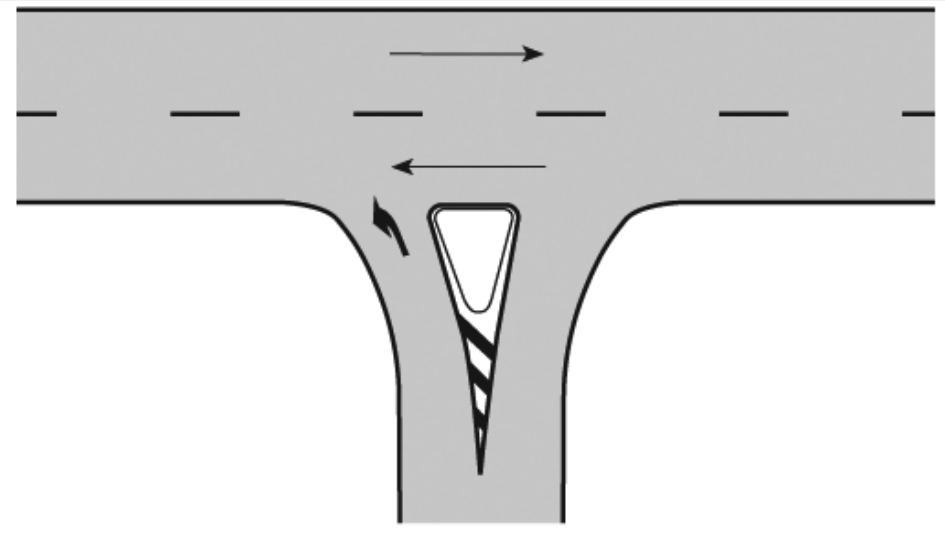
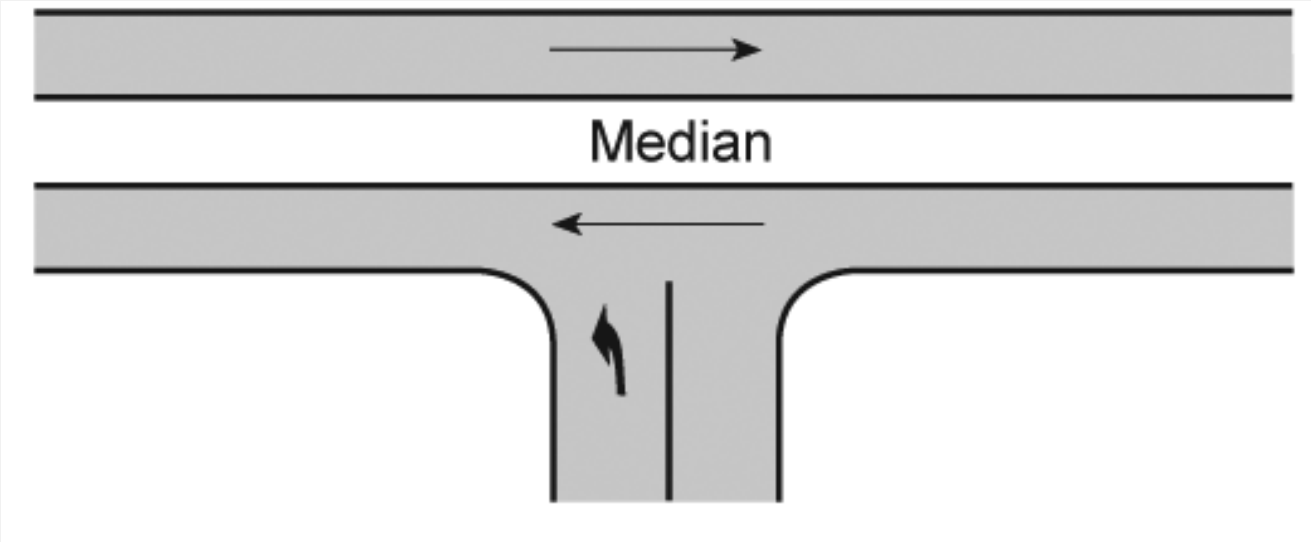
Left in/left out (LILO)

- Channelised left turn treatment added





Types of Intersections

See Section 2.2.7

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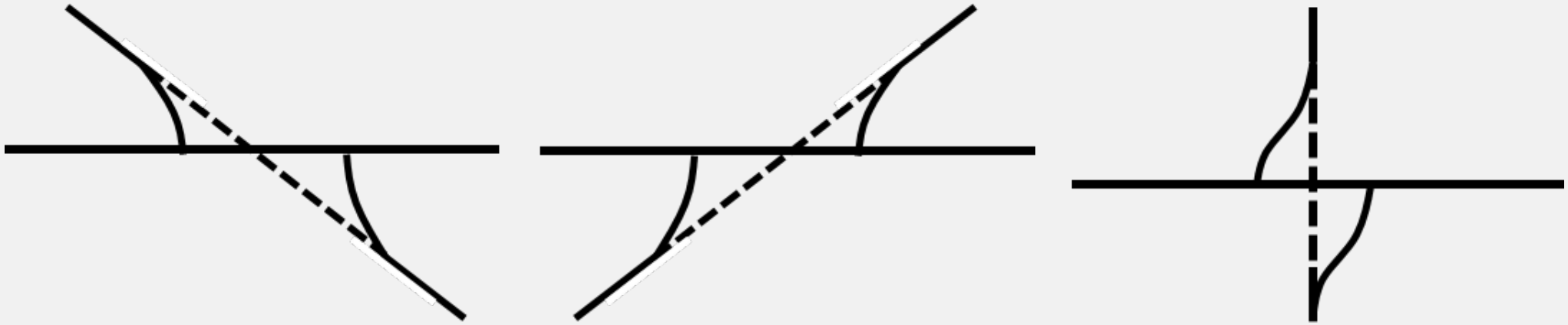
Staggered T-intersections

- Additional content on left-right (preferred configuration), although direction of stagger may also be influenced by existing site conditions, traffic volumes, and road alignment.



(a) Left-right (L-R) (b) Right-left (R-L) (c) Left-right (L-R)

Intersection Selection

See Section 2.3.2

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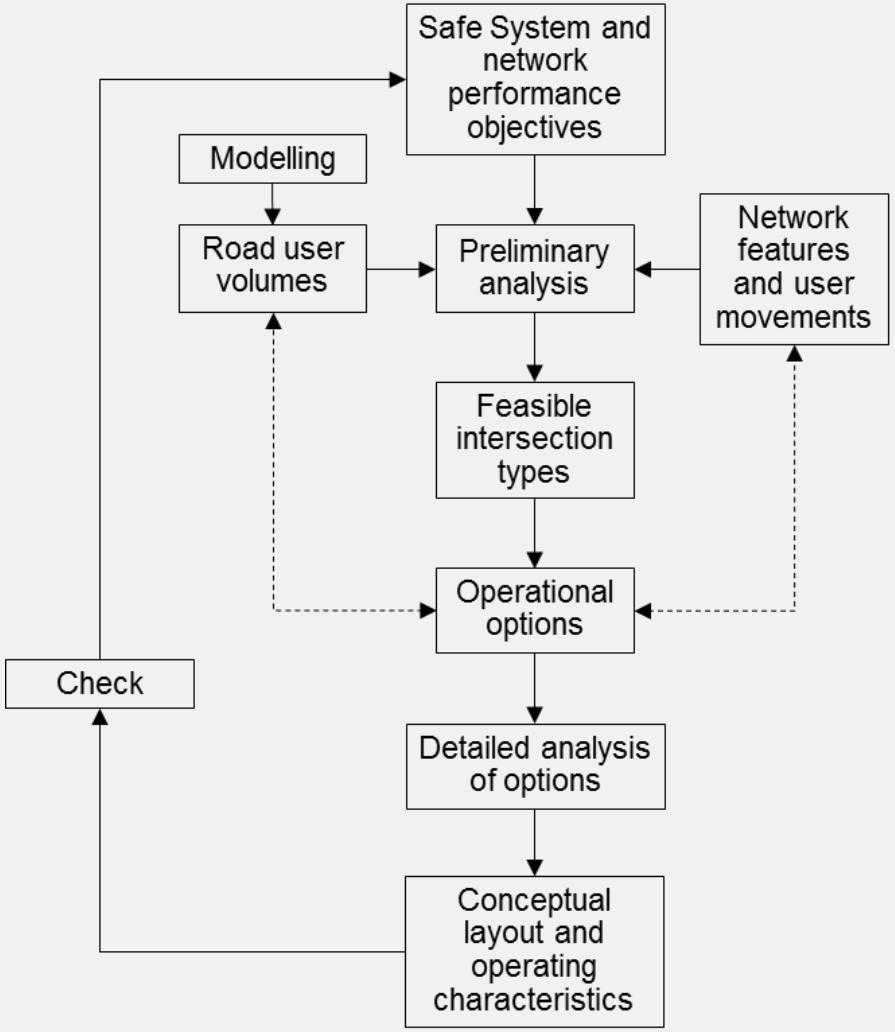
Selection process

- Safe System and network performance objectives



Intersection Selection

See Section 2.3.2

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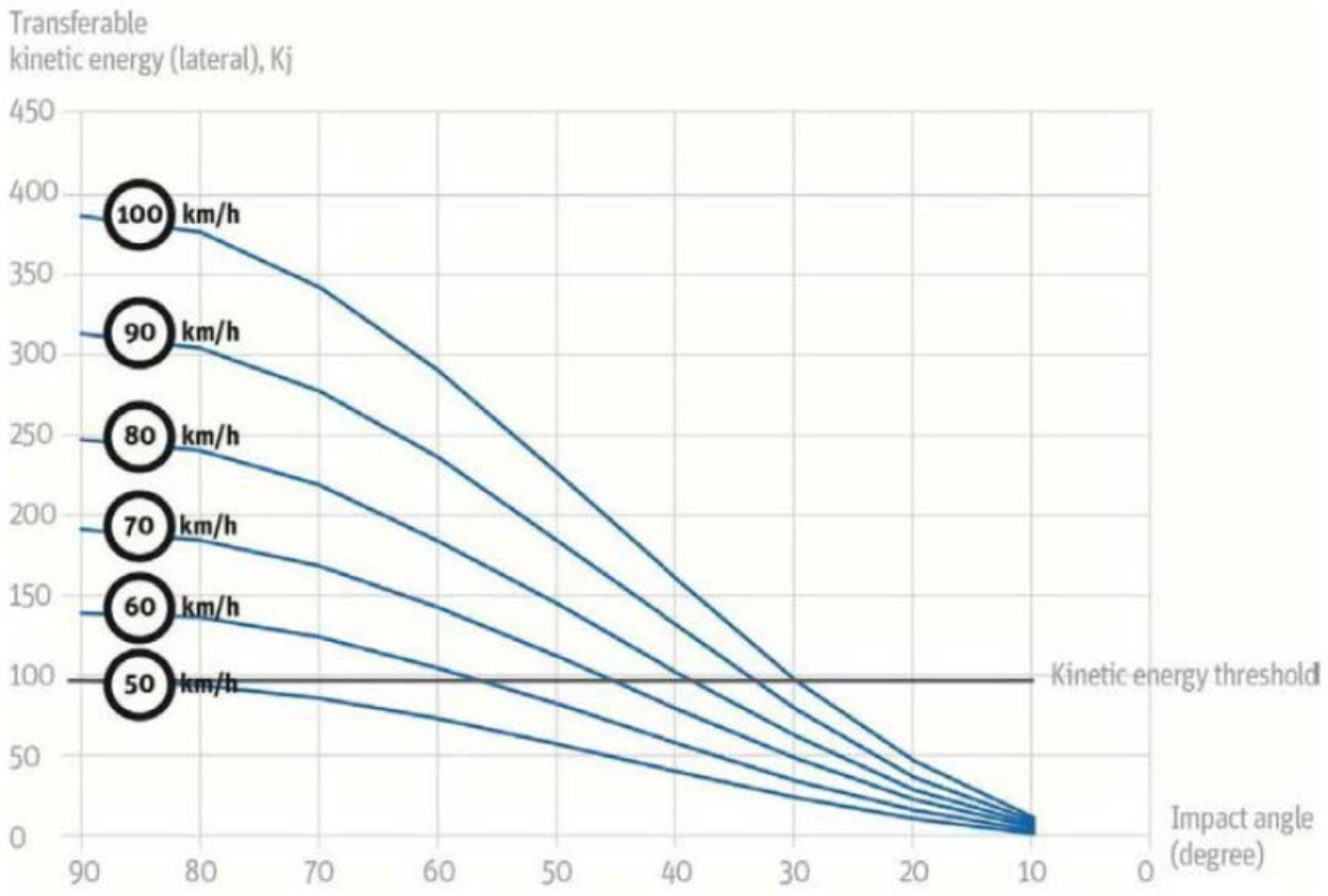
- Intersection safety performance predominantly influenced by approach speed, impact angle and opportunity for conflict



Source: ITF (2016), based on Candappa et al. (2015).

Intersection Selection

See Section 2.3.2

Austroads

- Safe System Assessment Framework

Stages	Summary
1. Assess objectives	The first step is to identify and document the objective of the assessment in terms of purpose, scale and depth.
2. Project context	Consider: • What is the reason for the project? • What is the function of the road? • What is the speed environment? • What road users are present? • What is the vehicle composition?
3. Safe System Matrix	In order to ensure that Safe System elements are considered, or to measure how well a given project (e.g. an intersection, road length, area, treatment type etc.) aligns with Safe System principles, the Framework provides a Safe System matrix. The matrix helps the assessment of different major crash types against the exposure to that crash risk, the likelihood of it occurring and the severity of the crash should it occur.
4. Treatment hierarchy	Finally the Framework outlines a Safe System-based hierarchy of solutions for common high severity crash types: • run-off-road • head-on • intersection • pedestrian • bicyclist • motorcyclist • other. The guidance on Safe System treatment hierarchy can inform decisions regarding the appropriate treatments that might be used to address crash risks identified by the assessment matrix.

Intersection Selection

See Section 2.3.2

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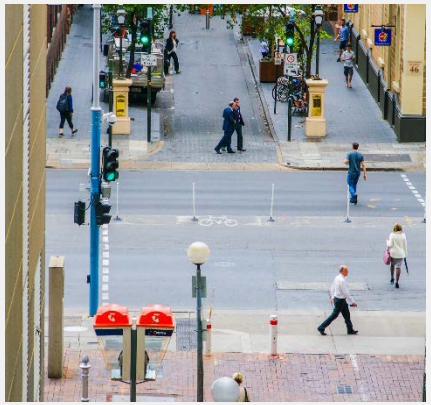
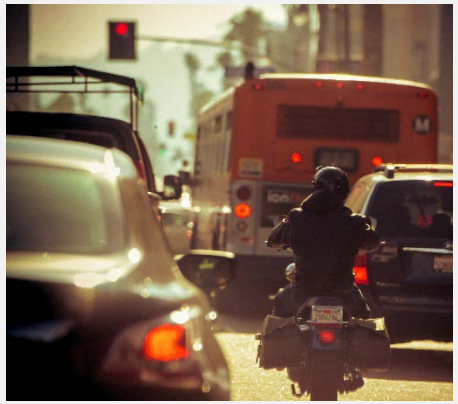
- Network operation
  - Consider road user needs
  - Priority for certain road user groups or balancing priorities for multiple groups





Intersection Selection

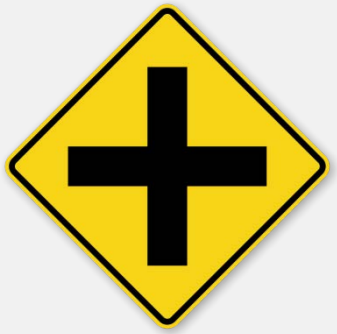
See Section 2.3.3

Austroads

Assessment of Intersection Control Options

- Traffic control selection to optimise safety and operational performance
- Safe System intersection hierarchy of control:
  1. roundabouts
  2. signalised intersections
  3. unsignalised (stop or give way preferred to road rules only).





Intersection Selection

See Section 2.3.3

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Suitability of types of traffic control to different intersection layouts

Intersection layout	Roundabout	Signals	Stop or give way	Road rules only
T-intersections	All forms of control generally work well.			
Four-way intersection	Generally work well.	Generally work well.	A staggered T-intersection is preferred(1).	
Y-junction	Generally work well.	Generally work well.	Not recommended due to poor observation angle on the minor road.	Not recommended due to poor observation angle on the minor road. Also confusion regarding who has right-of-way.
Multileg intersection (more than four legs)	Single lane roundabouts generally work well. Multileg, multilane roundabouts cause significant driver confusion in terms of the appropriate lane choice for the intended movement.	Can experience high crash rates. Can result in inadequate sighting of lanterns. Can produce a high proportion of inter-green time.	Can cause confusion as to who has right-of-way.	

Intersection Selection

See Section 2.3.6

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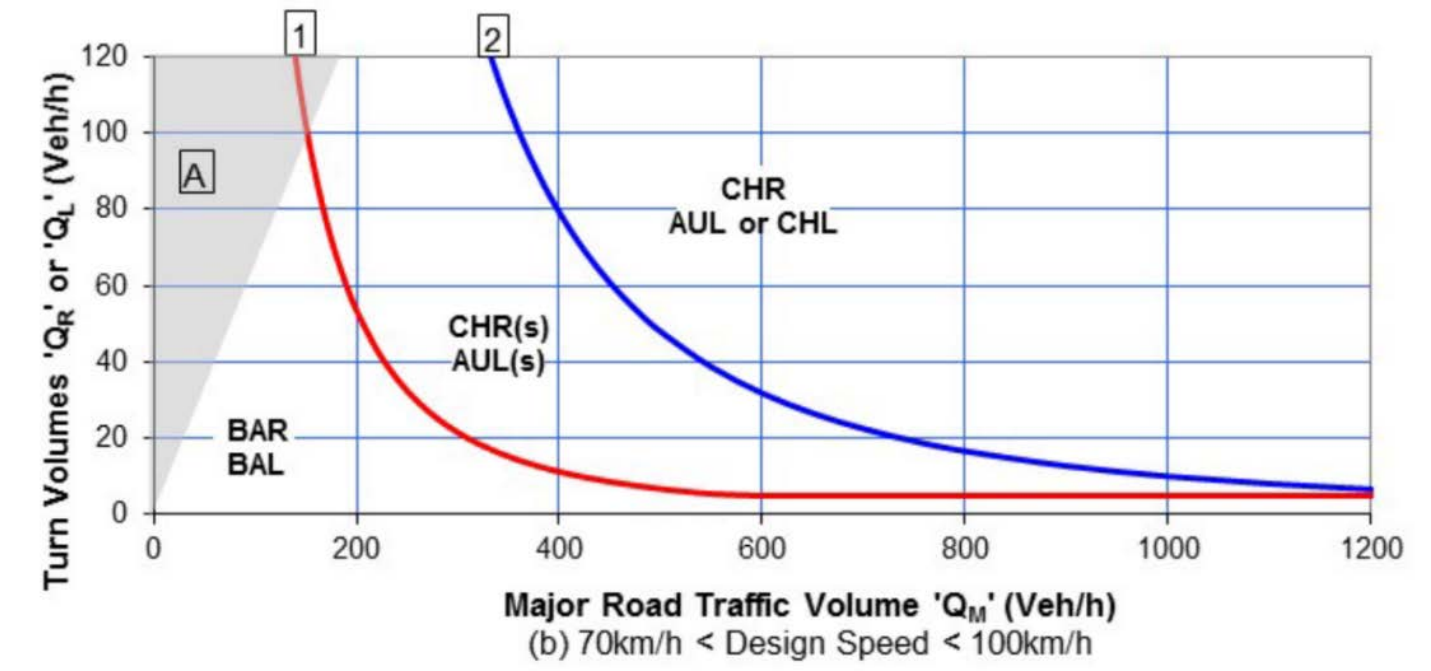
Warrants for BA, AU and CH Turn Treatments

- New curves for 70-100 km/h and <70 km/h
- Calculation of the major road traffic volume now includes road types:
  - Two-lane two-way
  - Four-lane two-way
  - Six-lane two-way



Road User Considerations

See Section 2.4

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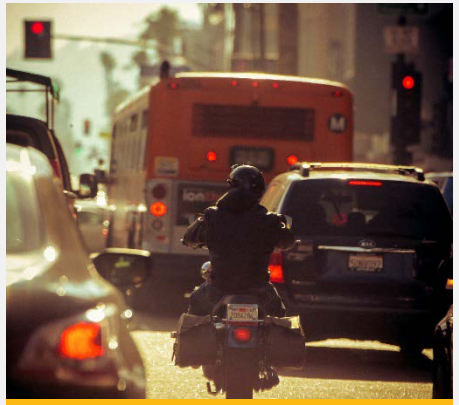
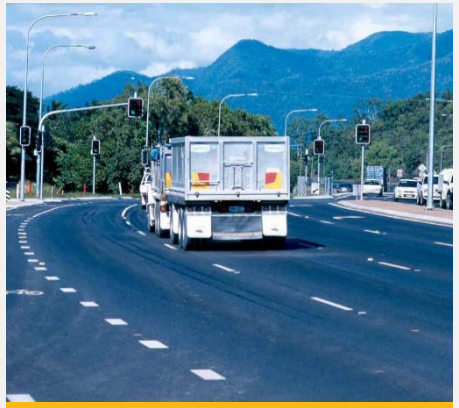
Pedestrians
Age, ability
Safe System

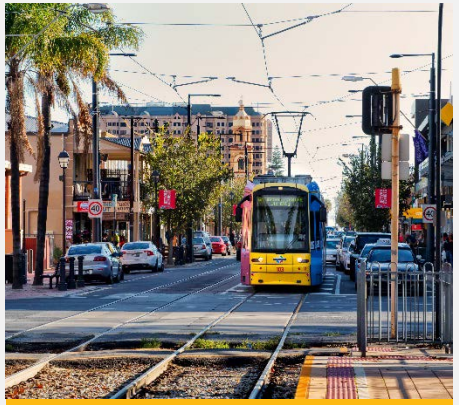
Cyclists
Types, ability, level of service, type of facility



Motorcyclists
Unique needs, susceptible to crashes at intersections



Trucks
Negotiate intersections with adequate clearance



Public transport
Vehicles and needs of users

Intersection Performance

See Section 2.5

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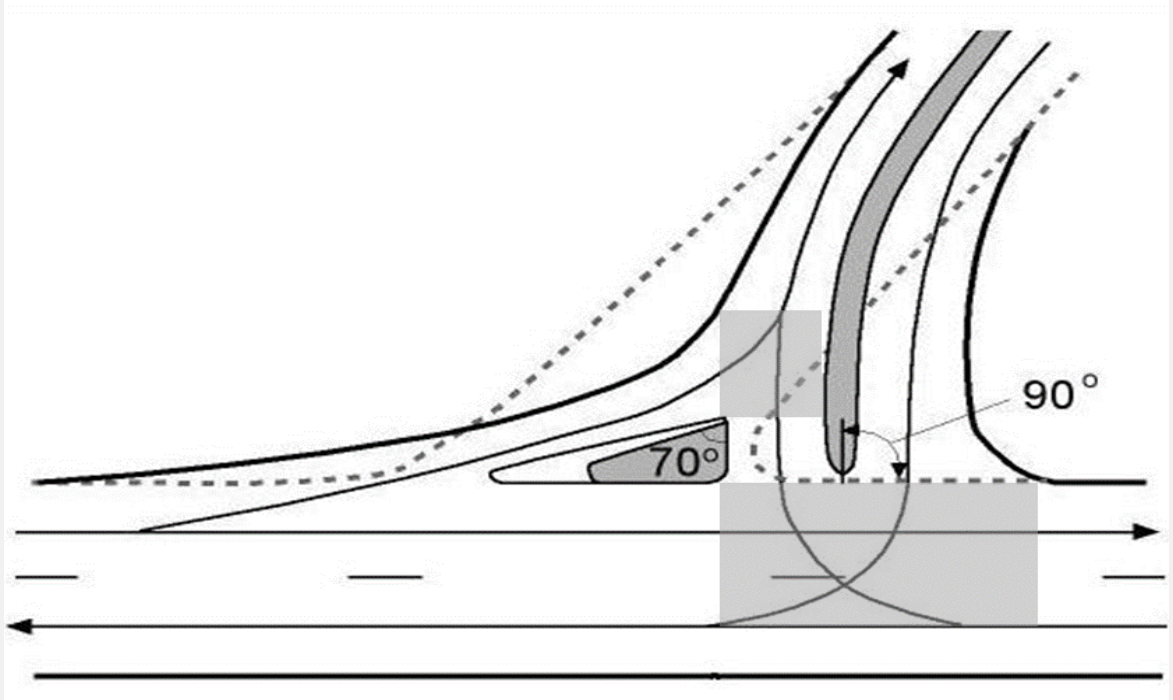
Safety performance: Section 2.5.1

- ensuring adequate visibility
- minimising potential for conflict
- managing priority movements
- managing speeds
- clear and easy to understand design and layout



AGTM Part 6: Intersections, Interchanges and Crossings

Austroads

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Roundabouts

See Section 3

Austroads

- Safe System considerations — Section 3.3.1
- Expected crash reductions
- Concerns and considerations for motorcyclists, cyclists and pedestrians — Section 3.4
- Potential speed reduction treatments for approaches — Section 3.5.4
- Signalised roundabouts — Section 3.6

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Signalised Intersections

See Section 4.1

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Contribution of signal management to meeting road user needs

Road user need	Contribution of signal management
Mobility	• Adjust signal timings and phasing to reduce delay at individual intersections, for priority road users/movements at certain times of the day. • Improve coordination of signals along a corridor to maximise throughput and progress priority uses/movements at certain times of the day. • Implement network-wide congestion management strategies (e.g. pre-emption/gating of general traffic to address recurrent congestion problems in an area. • Support control of access to the network and dissipation of traffic to assist incident management in reducing non-recurrent congestion. • Actively discourage vehicle movements in locations with good level of service for other modes, to encourage modal shift and reduce traffic on the network. • Support public transport and freight movements where intended.
Safety	• Prevent unsafe conflict of movements. • Provide protection to vulnerable road users such as pedestrians and cyclists.
Access	• Improve level of service for all road users. • Assist in improving equity for side/local road access to key arterials during off-peak periods. • Provide priority for emergency vehicles where possible.

Signalised Intersections

See Section 4

Austroads

- Table 4.2 Factors affecting signalised intersection capacity and safety
- Table 4.3 Road user requirements for arterial road signalised approaches
- Table 4.4 Road user requirements for local road signalised approaches
- Table 4.5 Lane management at signalised intersections

Signalised Intersections

See Section 4.5

Austroads

Elements of traffic signal operation

- Provides a summary and directs readers to GTM Part 9 for more information.

Traffic signal operation	Description
Signal phasing	A signal phase is a state of the signals during which one or more movements (streams of vehicles) receive right-of-way subject to resolution of any vehicle or pedestrian conflicts by priority rules. A phase is identified by at least one movement gaining right-of-way at the start of it and at least one movement losing right-of-way at the end of it. Needs of different road user groups, for example motorcyclists, should be taken into consideration when design of the signal phasing is undertaken.
Signal timings	Signal timing at a signalised intersection, including the allocation of appropriate green times to competing traffic movements, requires consideration of: • safety • adequate capacity • efficient traffic operation • equity in levels of service for different movements • priority for different road users.
Coordination of traffic signals	Coordination of traffic signals is implemented to improve the level of service of a road or a network of roads.
Traffic detection	The effectiveness of traffic signal systems and hence signalised intersections depends on the ability to detect traffic on intersection approaches and respond with appropriate changes of phase and timing requirements. Pedestrian demands are usually recorded when a pedestrian presses a push button mounted on the side of the signal post, although other (often automated) sensors may be used. Detection of bicycles and light motorcycles is more difficult, but may be achieved by attention to the design of detection loops.

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Unsignalised Intersections

See Section 5

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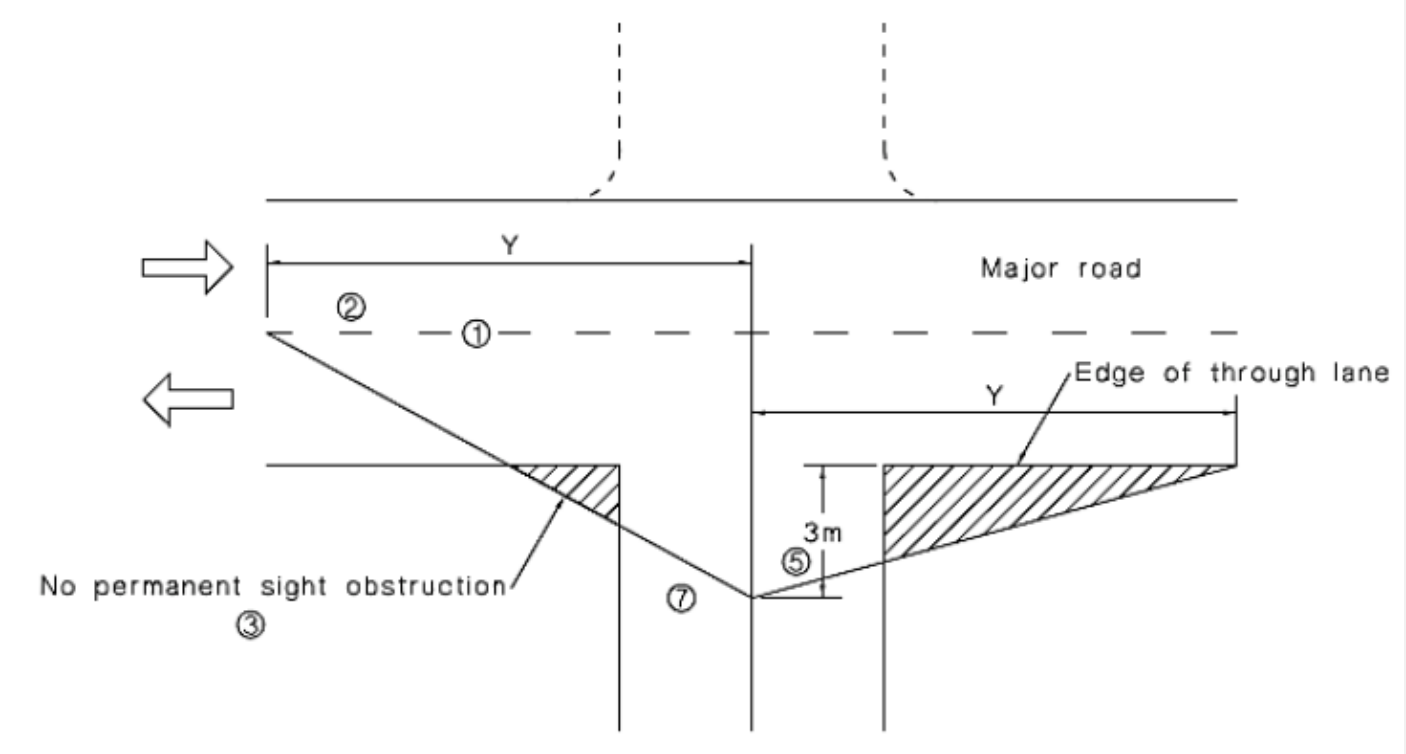
Amended **Traffic controls**

Section 5.2.2

- Sight distance requirements for Stop signs, drivers eye height changed to 1.10 m
- Acknowledge New Zealand stipulation that Stop signs to be erected at a blind intersection



AGTM Part 6: Intersections, Interchanges and Crossings

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Interchanges

See Section 6

- Spacing of interchanges — Section 6.3.1
- Ramp metering — Section 6.9

AGTM Part 6: Intersections, Interchanges and Crossings

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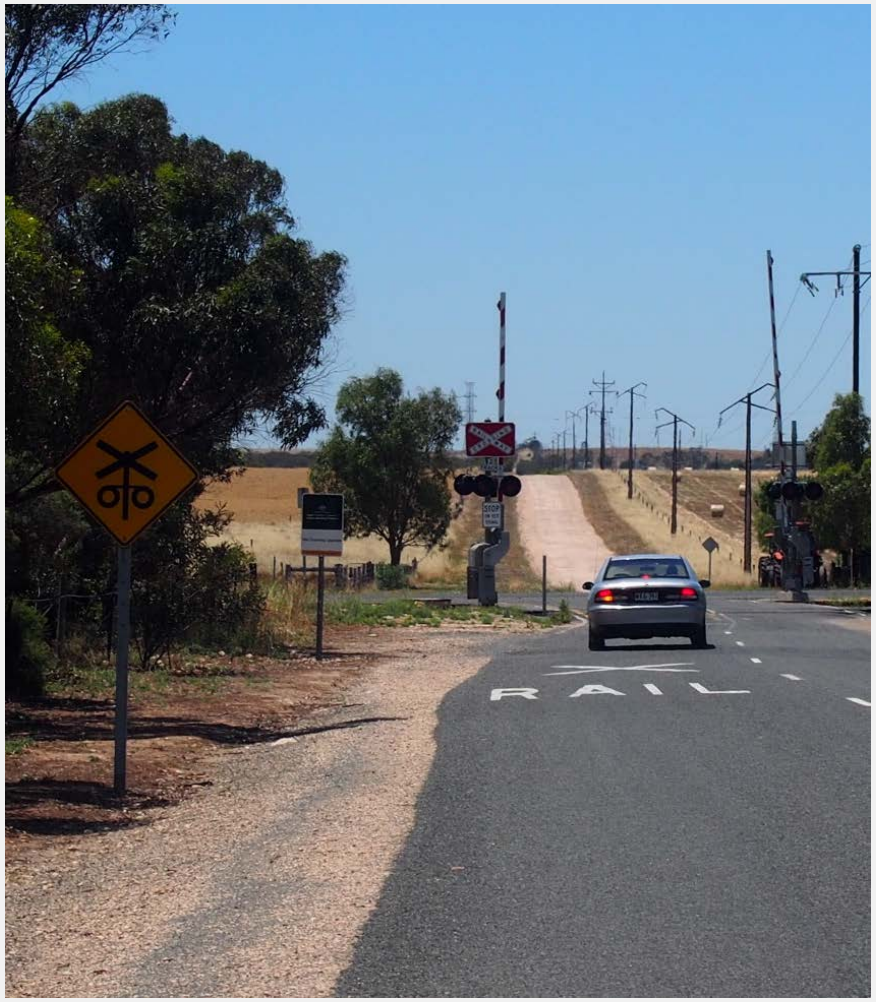
Rail crossings

See Section 7

Austroads

- Safety at Rural Rail Crossings — Section 7.3.3
- Level crossing treatments — Section 7.3.4
  - Rumble strips
  - Speed limit signs
  - Yellow box marking in addition to the queue relocation and passive signs
  - Provision of additional storage or an escape lane
  - ‘Upgrade protection’ amended to include ‘passive to active protection’ and ‘improve active protection elements
- Selection of treatment (ALCAM) — Section 7.6



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Pedestrian and cyclist crossings

See Section 8

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- Bicycle path terminal treatments at road crossings Section 8.2.2
- Crossings at signalised facilities Section 8.2.3
  - Pedestrian countdown timers
- Bicycle treatments at intersections Section 8.3

Unconventional & Innovative Designs

See Commentary 6

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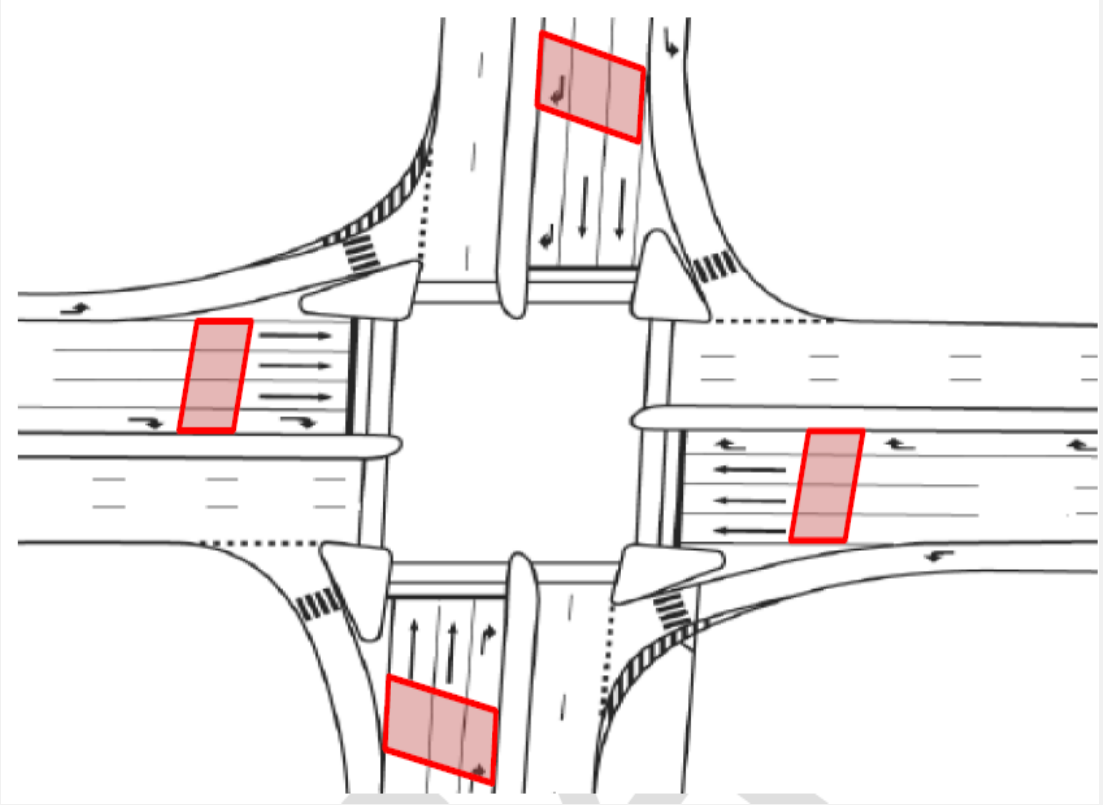
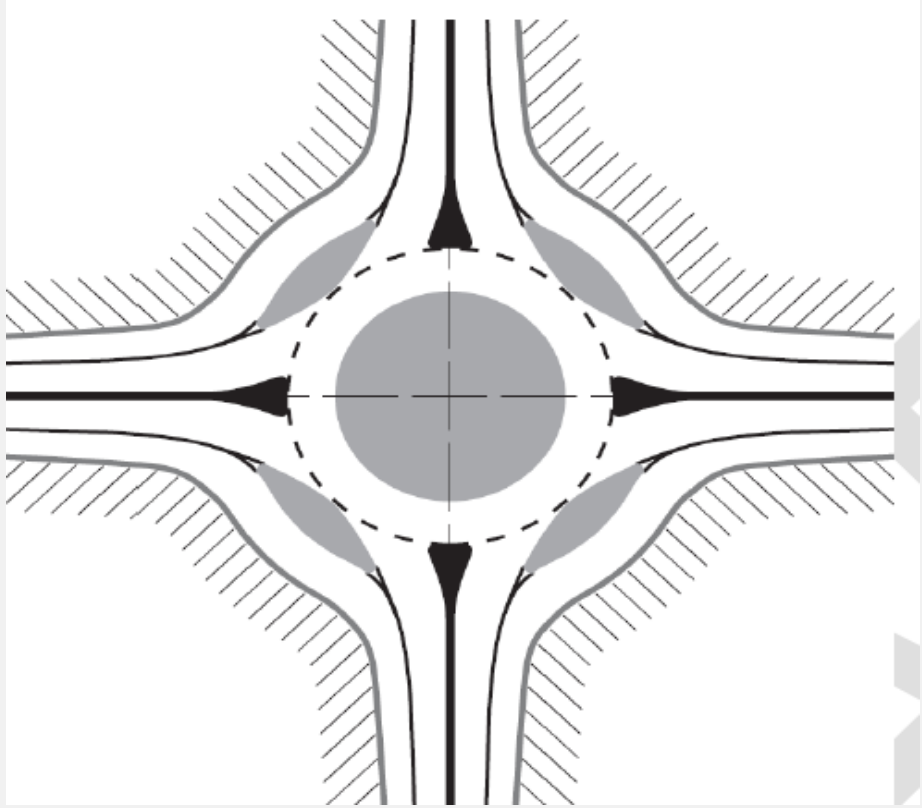


Vertical deflections at/on approaches



Flower roundabout

Guide to Road Design Part 4: Intersections and Crossings - General

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Stakeholders- Road and Traffic Authorities

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AGRD Part 4 and 4A Update: Project Team

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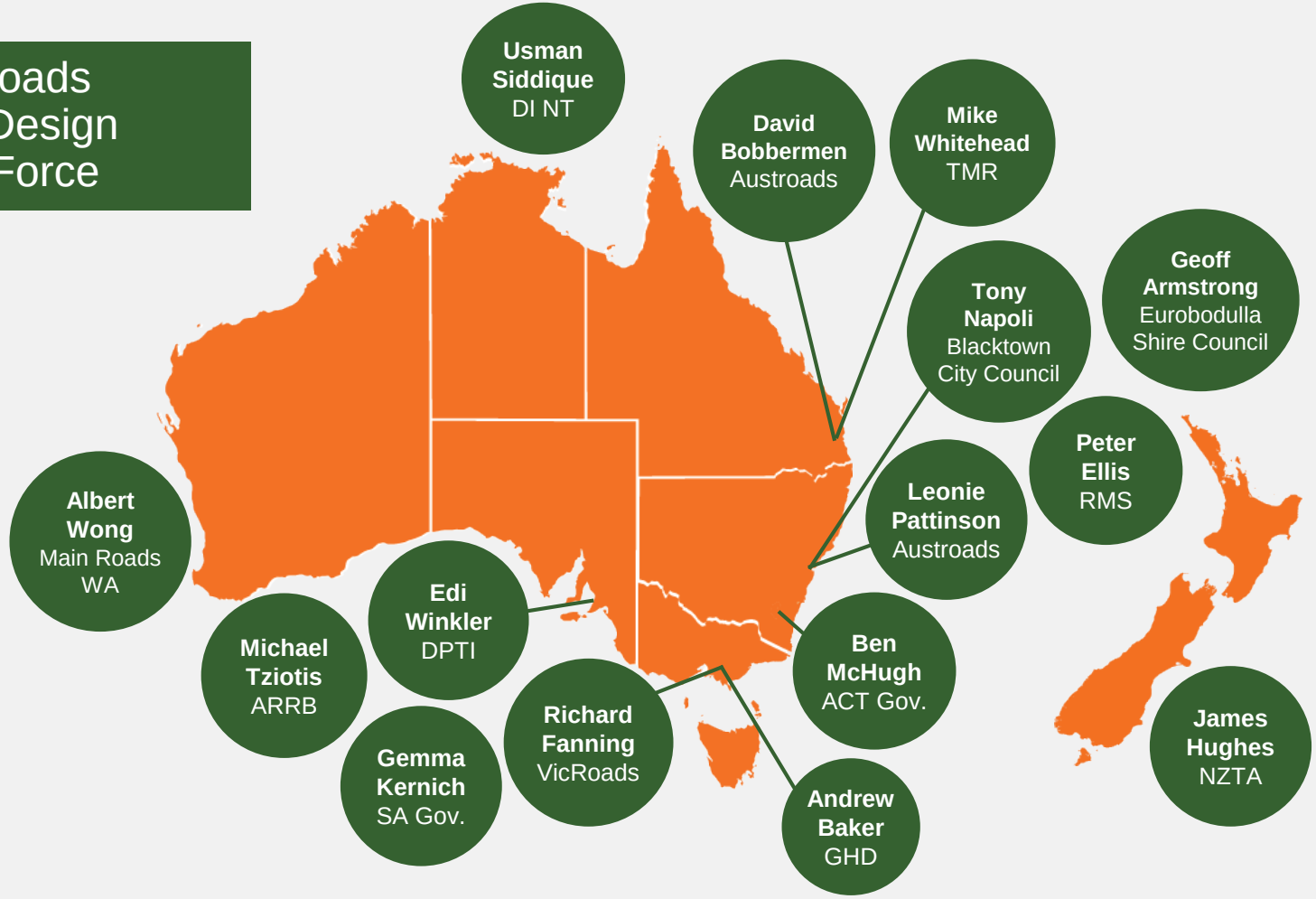

Part 4 Purpose

See General

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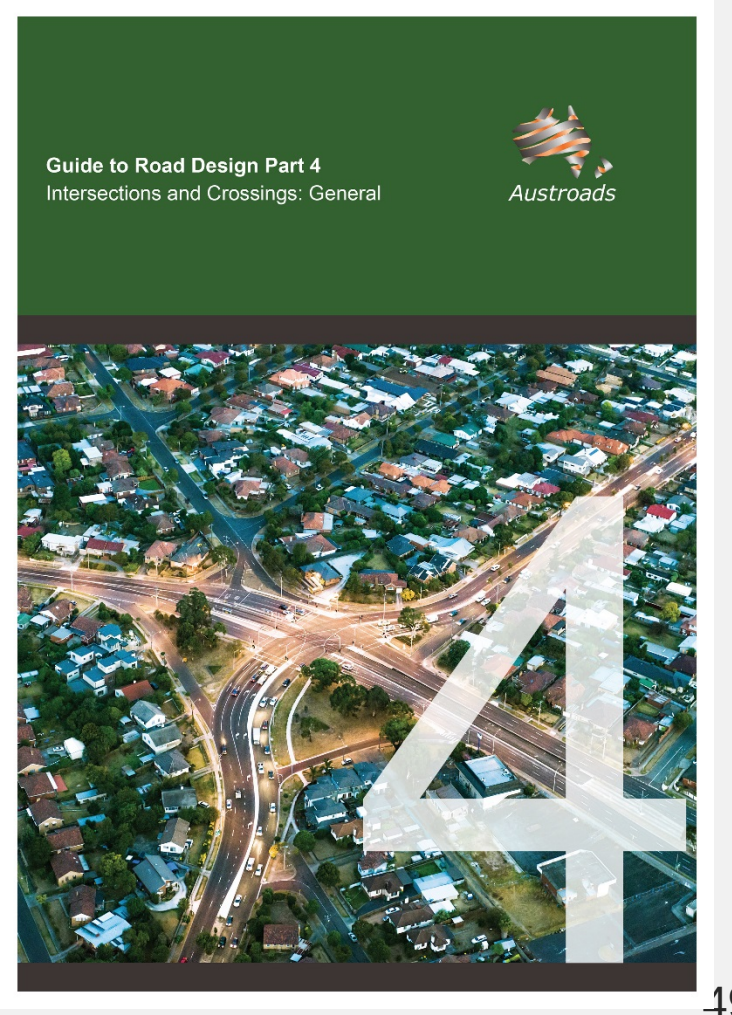
Part 4 Intersections and Crossings- General provides:

- information for the geometric design of at-grade intersections.
- some information on the types of intersections,
- design considerations for intersections and the
- design process for the development of an intersection layout.



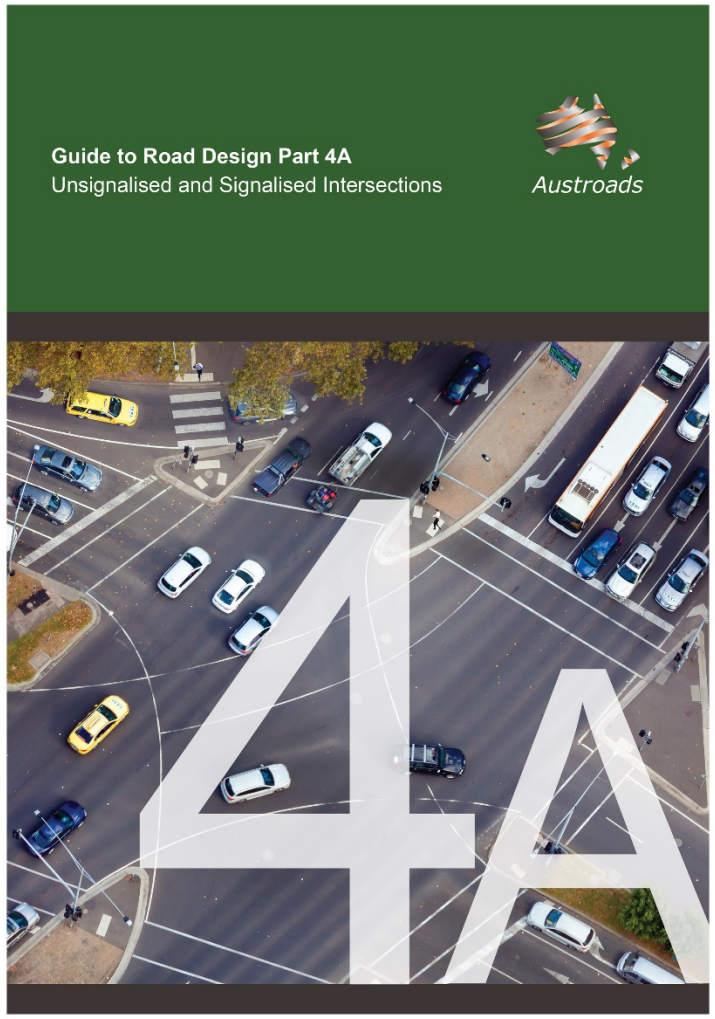
Part 4A Purpose

See General

Austroads

Part 4A: Signalised and Unsignalised Intersections provides:

- guidance for the geometric design of at-grade intersections (excluding roundabouts).
- intersection sight distances
- turn treatments
- auxiliary lanes at intersections
- size of traffic islands.



Key moves from Part 4A to Part 4

See Summary

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Section	Information
Section 4.3-4.14	Types of intersections, selection, turn treatments, warrants
Section 5.2	Need for auxiliary lanes
Section 6.1	General
Section 7.1-7.5	Types of treatment and selection, rural channelised left turn, cyclists at rural free flow left turn lanes on bicycle routes, left turn treatments
Section 8	All presenters
Section 9	U-turn treatments
Section 10	Signalised intersections, urban roads, rural roads

AGRD Part 4: Intersections and Crossings - General

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1. Introduction	2. Types of Intersections	3. Road Design Considerations for Intersections	4. Design Process	5. Design Vehicle
6. Public Transport at Intersections	7. Property Access and Median Openings	8. Pedestrian Crossings	9. Cyclist Crossings	10. Rail Crossings

Introduction

See Section 1

Austroads

Section 1.3.1: Providing for a Safe System

- Emphasis to understand the interaction between road elements and the likely crashes
- More information is referenced to Guide to Road Design Part 1: Introduction to Road Design

Section 1.3.3: Progressive Safety Updates

- Innovative and emerging treatments – need for assessment and translation to local conditions, assessing risk, safety, operation, whole of life costs

Section 1.5: Other Considerations moved to **Section 3.7**

AGRD Part 4: Intersections and Crossings - General

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Types of Intersections

See Section 2

Austroads

- Key reference made to GTM Part 6: Intersections, Interchanges and Crossings
- Emphasis design principles for an intersection:
  - are the same irrespective of the type of control
  - in urban areas, need to consider parking on approaches, cyclists and pedestrians
- Basic Forms of intersection moved to Appendix A

AGRD Part 4: Intersections and Crossings - General

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Design Considerations

See Section 3.1

Austroads

- Emphasis to consider all road users, particularly pedestrian and cyclists
- Road users are not:
  - surprised by the location of the intersection or the layout
  - not severely disadvantaged for making.

Source: Australian Road Research Board

AGRD Part 4: Intersections and Crossings - General

Austroads

1. Introduction	2. Types of Intersections	3. Road Design Considerations for Intersections	4. Design Process	5. Design Vehicle
6. Public Transport at Intersections	7. Property Access and Median Openings	8. Pedestrian Crossings	9. Cyclist Crossings	10. Rail Crossings

Design Process

See Section 4.1 and 4.3

Austroads

Table 4.1: Factors regarding function

- Emphasis on identifying:
  1. All possible conflict points
  2. Movement priority based on function and classification.

Section 4.3: Locations of Intersections

- Emphasising that design is an iterative process and layouts may need to change through the course of the design development.

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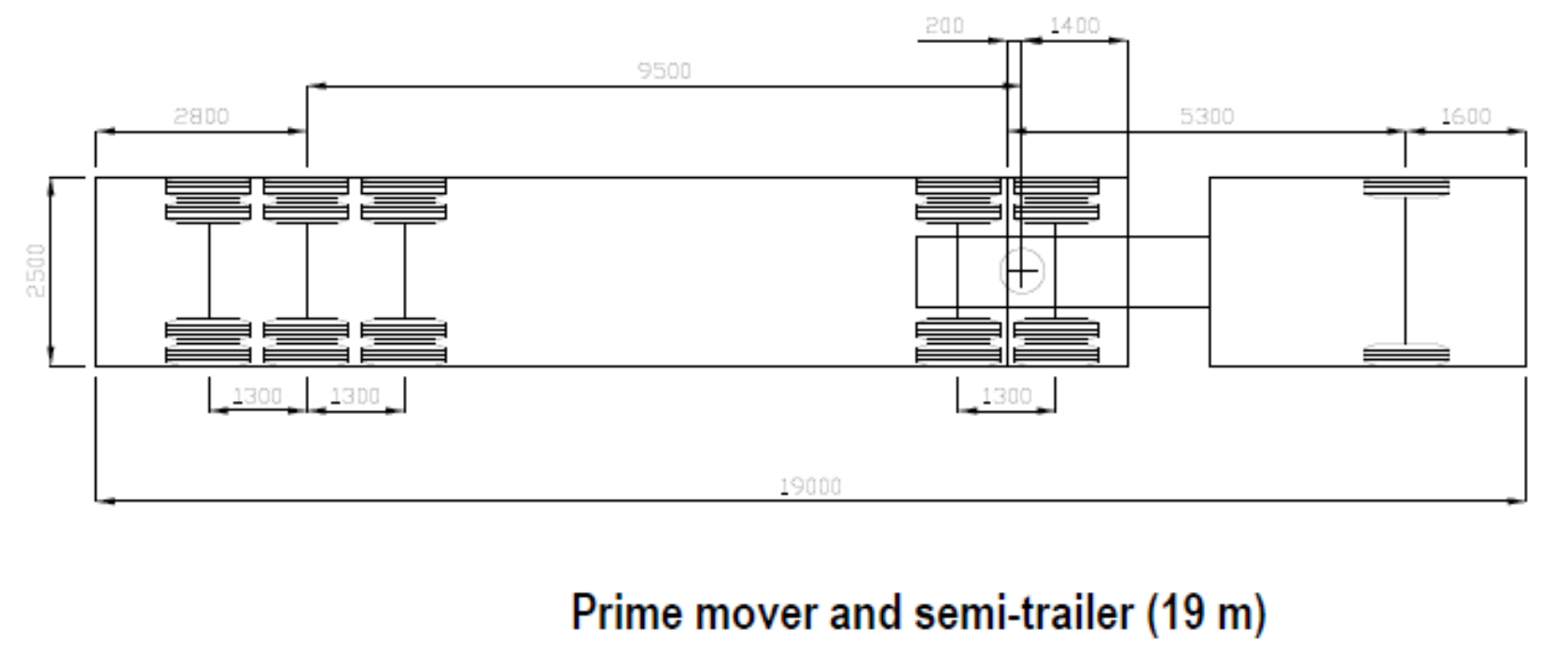
Design Vehicles

See Section 5

Austroads

Table 5.1: Selection of design and checking vehicles

- Updated to align with Design Vehicles and Turning Path Templates Guide (AP-G34-13)



Source: Austroads Design Vehicles and Turning Path Templates (2013)

AGRD Part 4: Intersections and Crossings - General

Austroads

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Public Transport

See Section 6.3.2

Austroads

Providing for Buses and Bicycles

- Emphasising the need to consider cyclists, in particular commuter cyclists, even if there is an off-road bicycle path

Source: Australian Road Research Board

AGRD Part 4: Intersections and Crossings - General

Austroads

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Property Access

See Section 7.2.1

Austroads

Access Spacing and Proximity of Driveways to Intersections

- Section transferred from Appendix A5 and including Table (7.1): Examples of upstream functional intersection distances

Figure 7.1: Upstream functional intersection area (based on right-turning vehicles

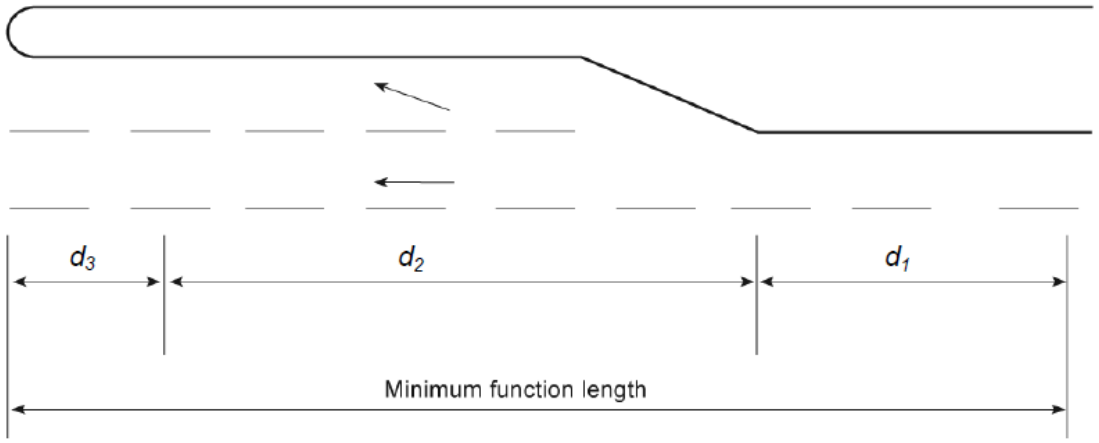

Table 7.1: Examples of upstream functional intersection distances

Location	Speed (km/h)	$d_1 + d_2$ (m)	Storage: d_3 (m)	Upstream functional distance (m)
Rural	80	185	25(1)	210
	100	250	25(1)	275
	110	310	25(1)	335

Median Openings

See Section 7.2.1

Austroads

Additional guidance for high-speed divided roads

- The U-turn facility should be based on a network wide strategy (i.e. U-turn facility spacing
- If a facility cannot be provided within 3 km, consideration providing a channelised right-turn treatment (CHR) of adequate truck storage length (Appendix A.7.1)

Unsignalised and Signalised Intersections: Guide to Road Design Part 4A

Peter Aumann

Austroads

AGRD Part 4A: Unsignalised & Signalised Intersections

Austroads

1. Introduction
2. Layout Design Process
3. Sight Distance
4. Types of Intersection and their Selection
5. Auxiliary Lanes
6. Traffic Islands and Medians
7. Right-turn Treatments
8. Left-turn Treatments
9. Signalised Intersections

Introduction

See Section 1

Austroads

Safe System approach

Additional information relating to the considerations for motorcyclists:

- Visibility between vehicles
- Layout recognition, particularly for motorcyclists
- Travel paths and clear of areas where debris may build up
- Skid resistant pavement markings

AGRD Part 4A: Unsignalised & Signalised Intersections

Austroads

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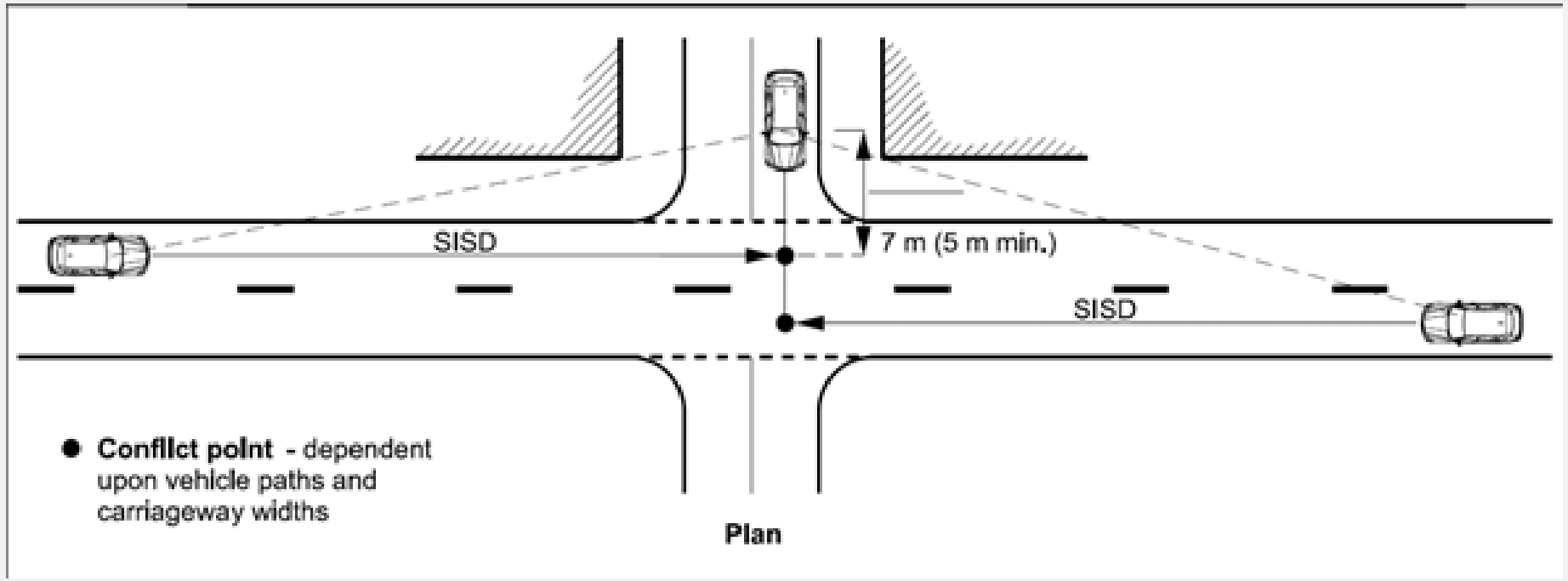
7. Right-turn Treatments
8. Left-turn Treatments
9. Signalised Intersections

Sight Distance

See Section 3.2.2

Austroads

Setbacks for sightlines



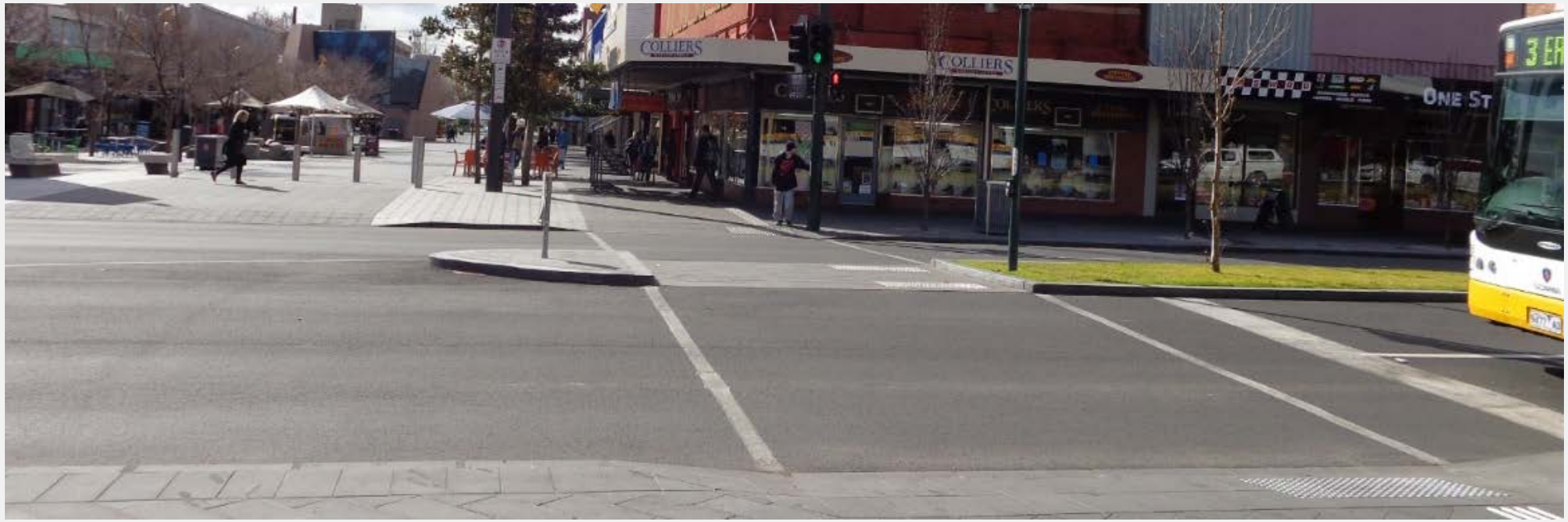
Pedestrian Sight Distance

See Section 3.3

Austroads

Variable t_c in Equation 3 corrected to read:

critical safe gap = crossing length/walking speed



AGRD Part 4A: Unsignalised & Signalised Intersections

Austroads

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Auxiliary Lanes

See Section 5.3.2

Austroads

Acceleration distance (lane lengths): New Table 5.5 (previously Table 5.4)

- distance for 4 secs of travel time
- merge taper length

Table 5.5: Length of acceleration lanes for cars on level grade

Design speed of road entered[1]	Length of acceleration lane *A* (m) (including length of merge taper)								4 sec travel (m)	Merge T_m (m)	Min. desirable length 4 sec + T_m[3]
	Design speed of entry curve (km/h)										
(km/h)	0(2)	20	30	40	50	60	70	80			
50	70	55	45	30	–	–	–	–	55	50	105
60	110	95	85	70	40	–	–	–	65	60	125
70	165	150	140	125	95	55	–	–	80	70	150
80	235	220	210	195	165	125	75	–	90	80	170
90	330	315	305	290	260	220	170	95	100	90	190
100	450	435	425	410	380	340	290	220	110	100	210
110	610	595	585	570	540	500	450	320	120	110	230

Questions?

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Topic	Date
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Register at http://www.austroads.com.au/event

Thank you for participating