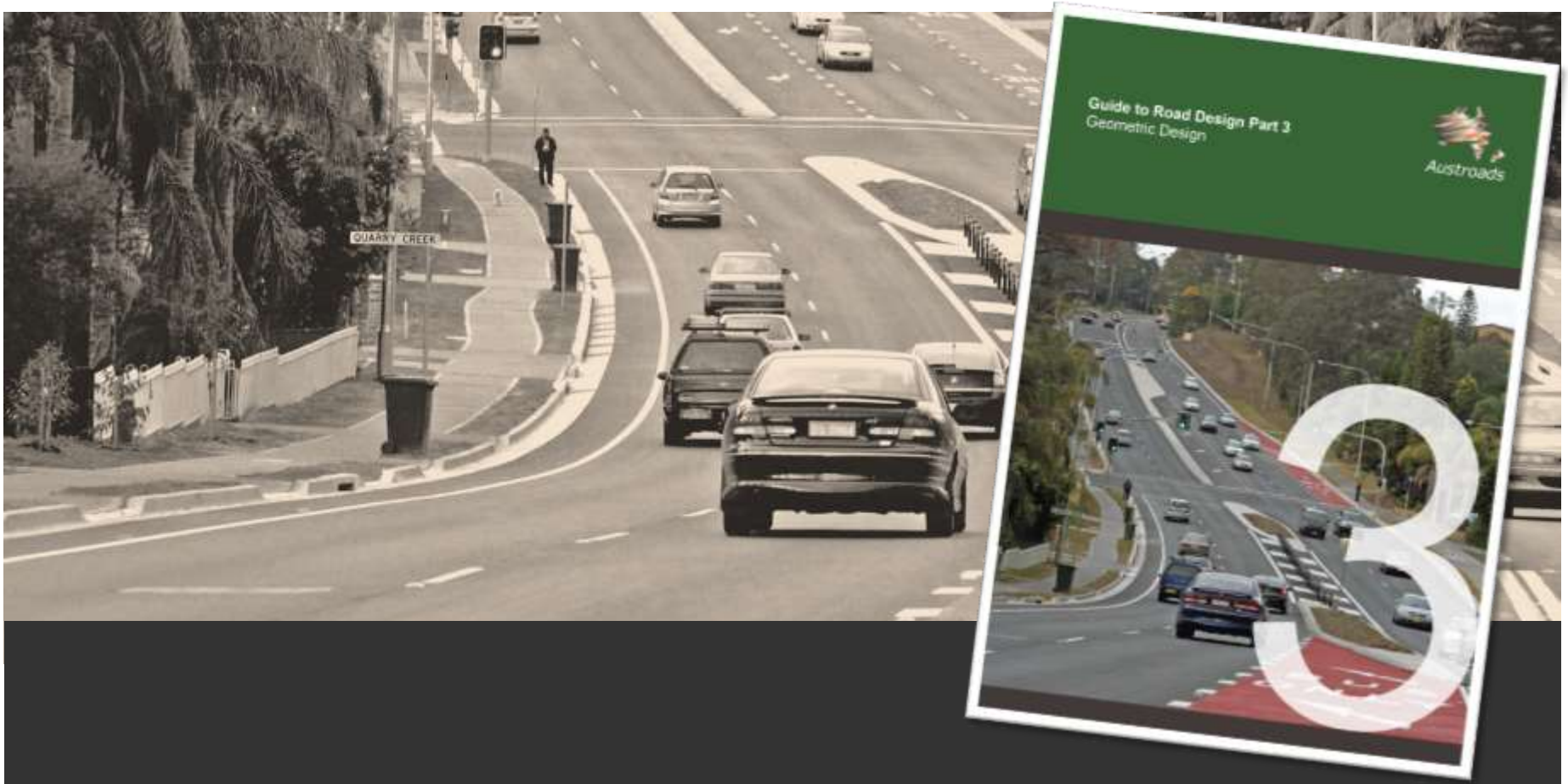

Guide to Road Design Part 3: Geometric Design

Session I – 18 October 2016

Austroads

Today’s moderator

Angela Racz
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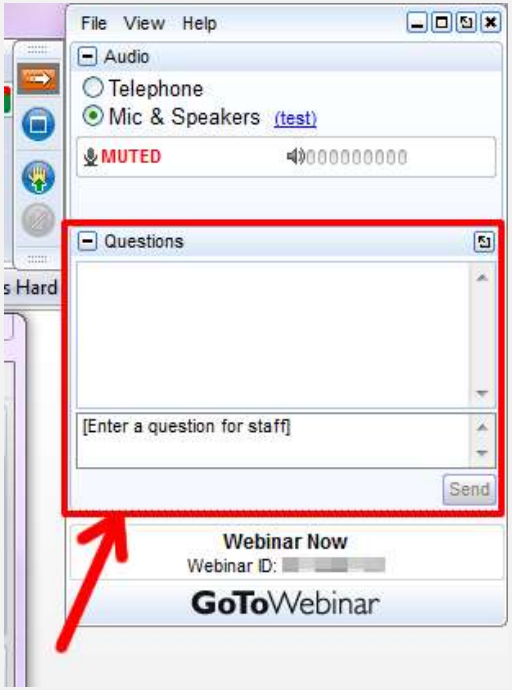
Housekeeping

Webinar = 60 mins

Question time = included

GoToWebinar functions



Please type your questions here

Today’s presenter

Peter Aumann
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Introduction

Guide to Road Design Part 3 : Geometric Design

Reviewed and updated

Focus on updated or new information

Introduction

Guide to Road Design Part 3 : Geometric Design

Available at

https://www.onlinepublications.austroads.com.au/items/AGRD03-16

Note
Free PDF downloads for Australian and New Zealand road agencies including councils. Email austroads@austroads.com.au for log-in.

Webinar – two sessions

Session 1 – Design objectives, Speeds, Cross-section

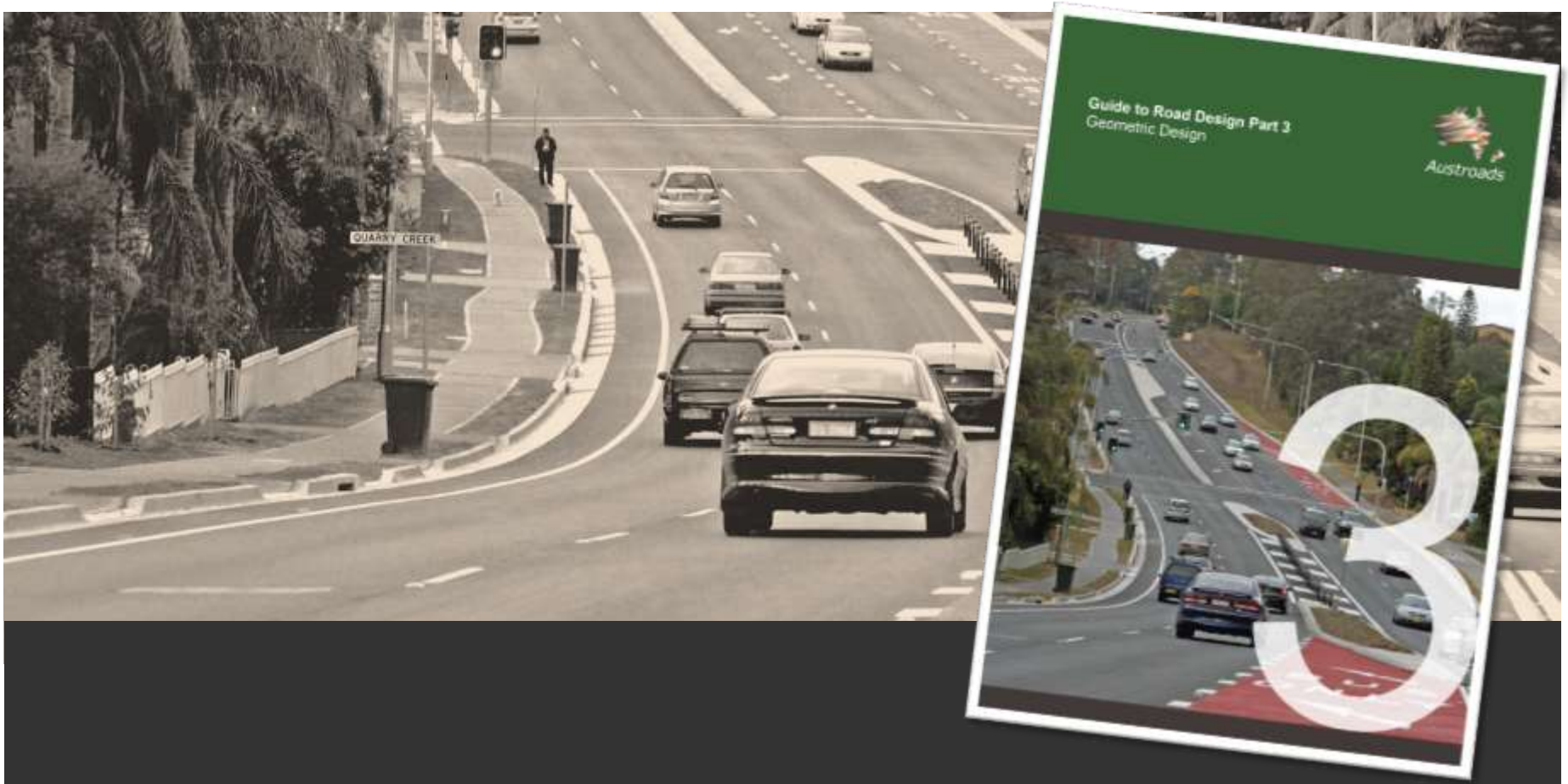
Session 2 – Horizontal and Vertical Alignment, Superelevation

Content

Design objectives

Speeds

Cross-section



Design Objectives

Austroads

Design objectives contents

General

Vulnerable road users

Motorcyclists

Emergency runway strips

Design objectives (1.4)

Maximise safety

Maximise operational efficiency

Maintain uniformity

Development of economically efficient designs

Design objectives (1.4)

Maximise the benefit of available funds

Provide for future traffic growth

Cater for all road user groups

Minimise environmental impacts

Community views

Design objectives

Vulnerable Road Users (2.2.4) (new)

Safe and efficient movement of cars and trucks, and pedestrians, cyclists and motorcyclists

Design objectives

Motorcyclists (2.2.4)

New Table 2.1: Issues and good practice relating to motorcyclists

Issue	General good practice for all road users and most important in catering for the special needs of motorcyclists
Visibility	More critical for motorcyclists to reduce the incidence of hard braking. Achieve and maintain sight distance standards. Clear vegetation from sight lines on inside of curves.
Recognition of layout and clear definition of vehicle paths	Avoid surprises or dangerous combinations of geometric elements. Maintain a high standard of delineation and pavement markings. Do not use kerbing colours which blend in, especially on islands and protrusions.
Adverse crossfall	Avoid it as much as possible. Where unavoidable keep within limits of design guidelines.
Compound curves	Avoid using them (warning signs will not overcome the problem).
Skid resistance	Provide adequate skid resistance especially in areas where braking and manoeuvring are frequently required. Provide a surface which maintains traction in front of barriers. Design intersections and driveways so that drainage water does not wash gravel and debris onto the road surface.

Design objectives

Motorcyclists (2.2.4)

Layout recognition

- Avoid surprises or dangerous combinations of geometric elements.
- Maintain a high standard of delineation and pavement markings.
- Do not use kerbing colours which blend in, especially on islands and protrusions.

Design objectives

Motorcyclists (2.2.4)

Curves

- Avoid compound curves (workload)
- Lane widen on curves (motorcyclists lean into curves)
- Shoulders provide area for correction

Design objectives

Motorcyclists (2.2.4)

Shoulders

- provide area for correction

Pavements

- shape to drain water quickly off the surface to minimise potential for aquaplaning
- at intersections and driveways - drainage water does not wash gravel and debris onto the road surface

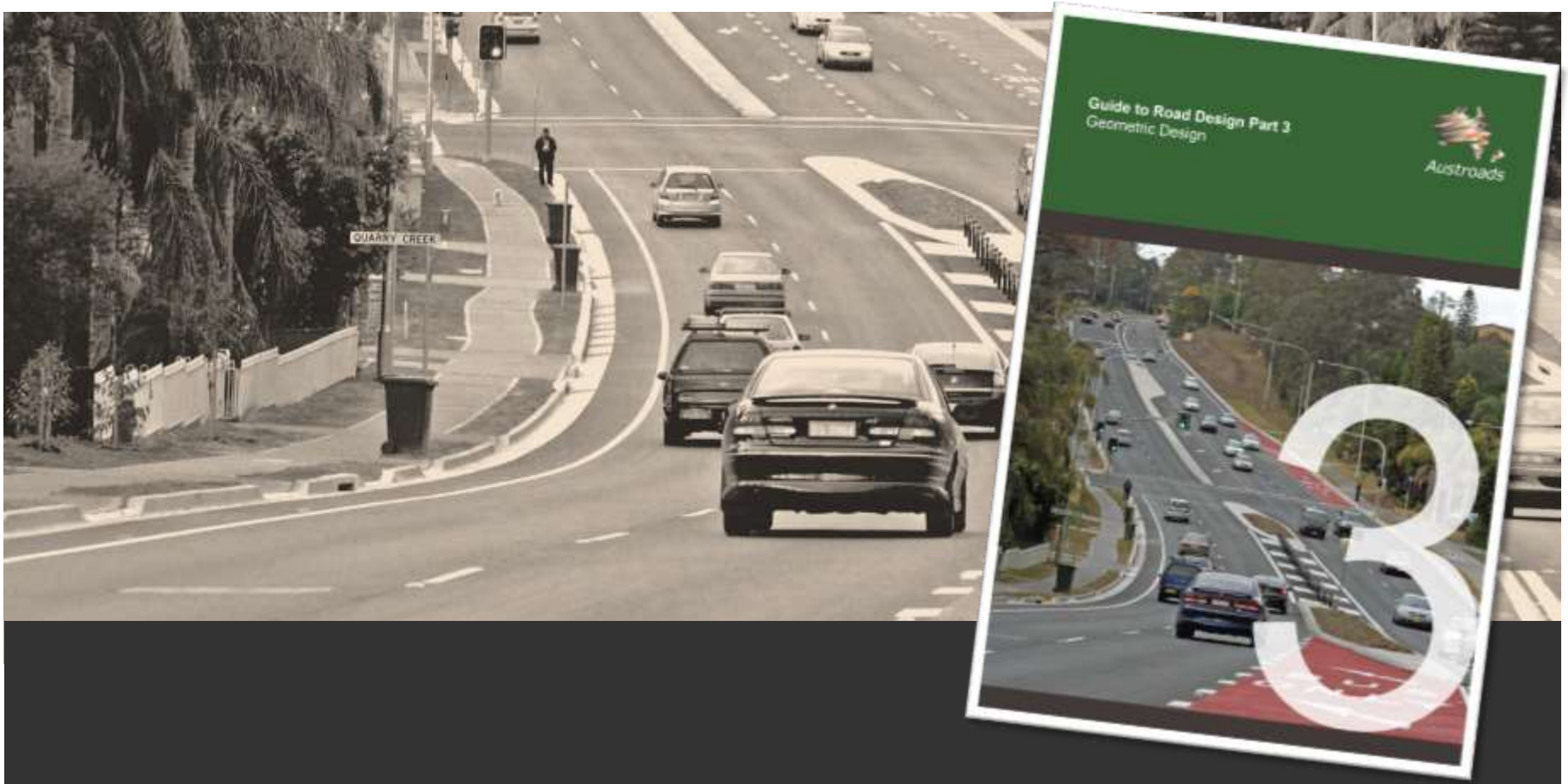
Design objectives

Emergency runway strips (2.2.8, Appendix B) (new)

Remote areas where runway strip not provided and road access may not be available (eg flooded road)

Should have

- minimum vertical design speed of 130 km/h
- minimum seal width of 10 m
- minimum runway length of 1200 m.



Speeds

Austroads

Speeds contents

Speeds general

Terminology

Desired speeds

Speeds

Speeds General (3.1)

Geometric consistency

Speeds

Speeds General (3.1)

Driver expectations

High speed rural

Low speed rural

Speeds

Speeds terminology (3.2)

Desired speed - adopted by drivers on less constrained elements

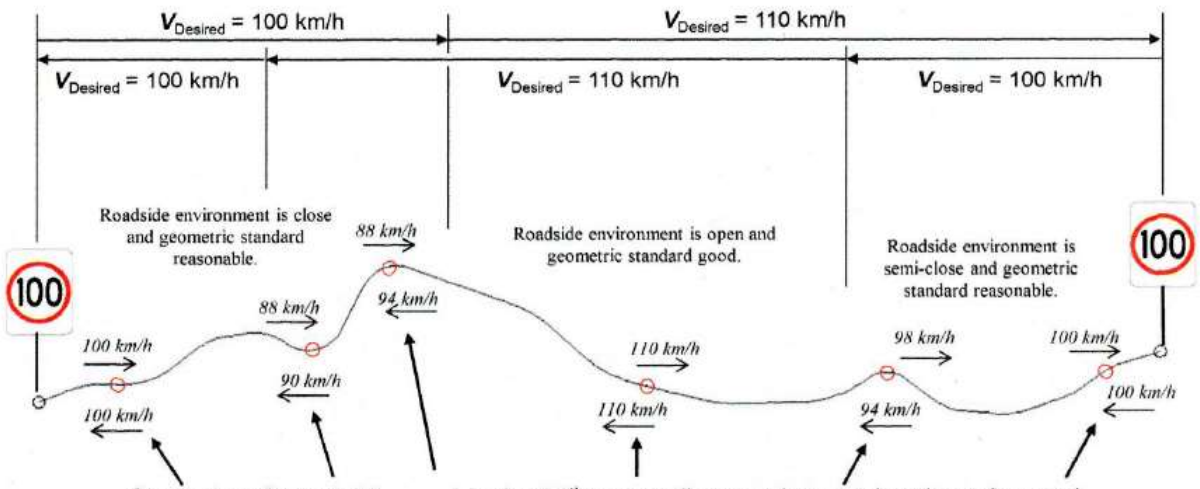
Operating speed - 85th percentile speed at which drivers will travel at under free flowing conditions

Design speed - the speed adopted for the design of each element of the road

Speeds

Speed relationship (3.2.4)

Desired Speed ($V_{Desired}$) is the speed drivers will adopt or operate at on the less constrained alignment elements of a reasonably uniform section of the road (in free flow conditions).



Operating Speed ($V_{Operating}$) is the 85th percentile speed at a point along the road.

Design Speed (V_{Design}) is equal to or greater than the Operating Speed for the particular horizontal geometric element and used for the calculation of various geometric design parameters.

$V_{Design} \geq [V_{Operating} = 85^{th}$ **Percentile Speed** $(V_{85})]$.

Speeds

Determining Desired Speed (3.5.1)

Existing rural roads

85th percentile on straights or large radius curves where there is sufficient length to maintain constant speed, lengths typically needed

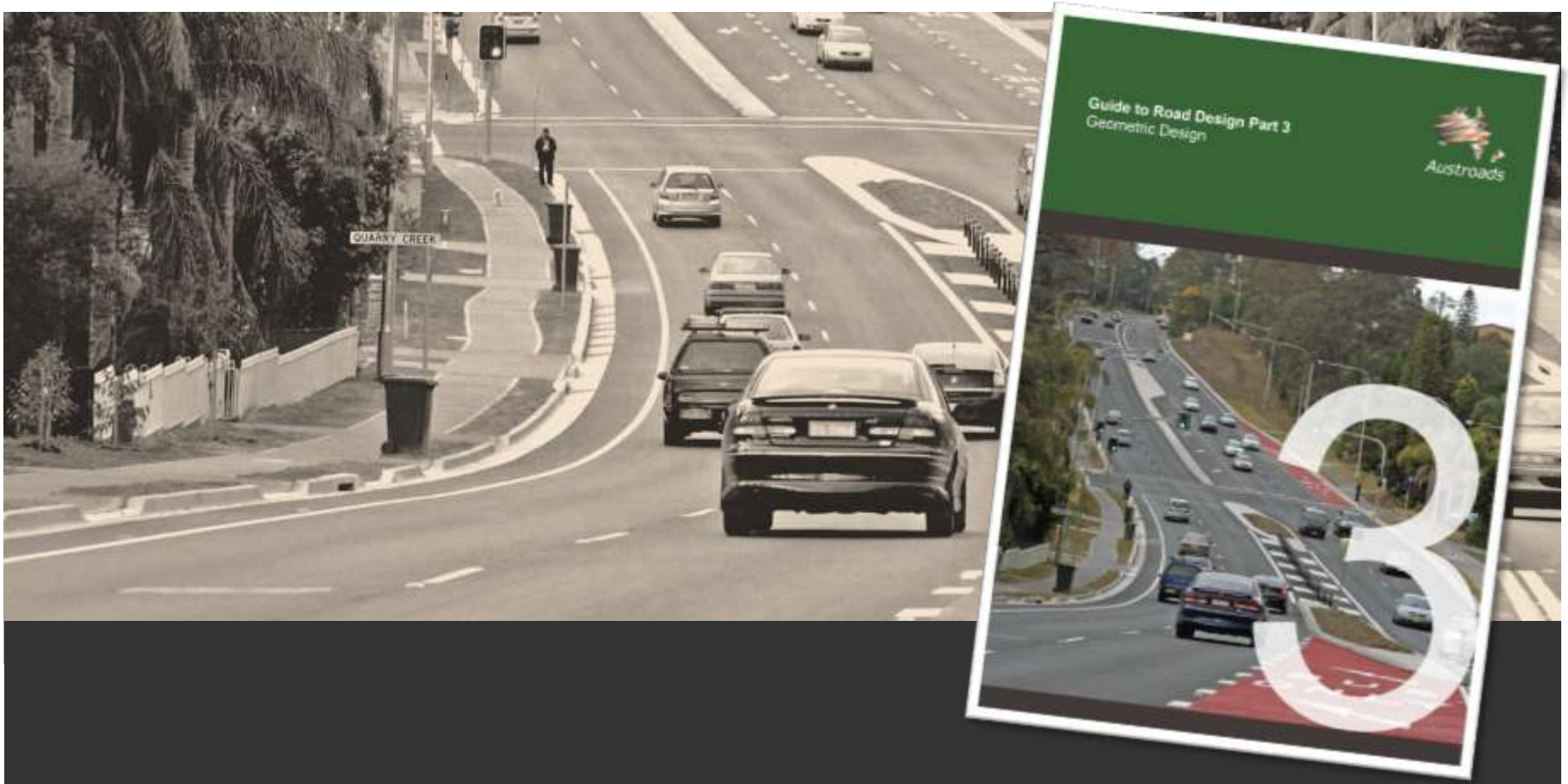
- 70 km/h - 300 m
- 90 km/h - 450 m
- 110 km/h - 600 m

Speeds

Desired Speed (3.5.2)

New roads, Table 3.2 (new table) provides a guide

Road type	Proposed speed limit (km/h)	Typical desired speed and design speed (km/h)(1)	Typical minimum radius (m) that will not reduce desired speed(2)
Motorways	80	90	450
	100	110	600
	110	120	800
High speed rural roads	100	110	600
	110	120	800
Urban arterial and sub-arterial roads	60	70	200
	70	80	275
	80	90	300



Cross-Section

Austroads

Cross-section contents

Shoulders

Verges slopes

Batter slopes

Bunds or mounds

Drainage

Medians

Wide centreline treatments

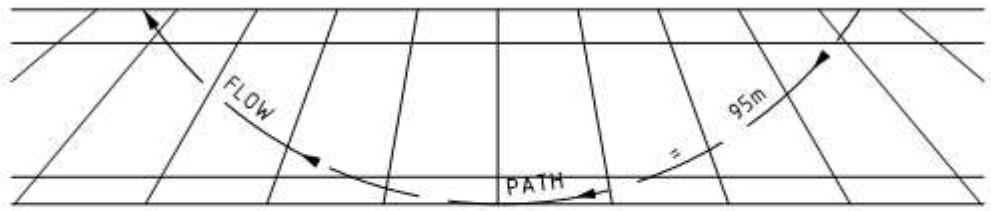
Bicycle treatments

Cross-section

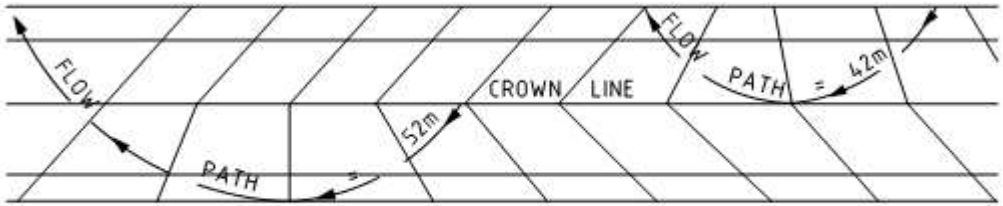
Crown lines (4.2.3)

Crown lines introduce a destabilising opportunity - care is needed

Drainage purposes



FLOW PATH 95m WITHOUT CROWN

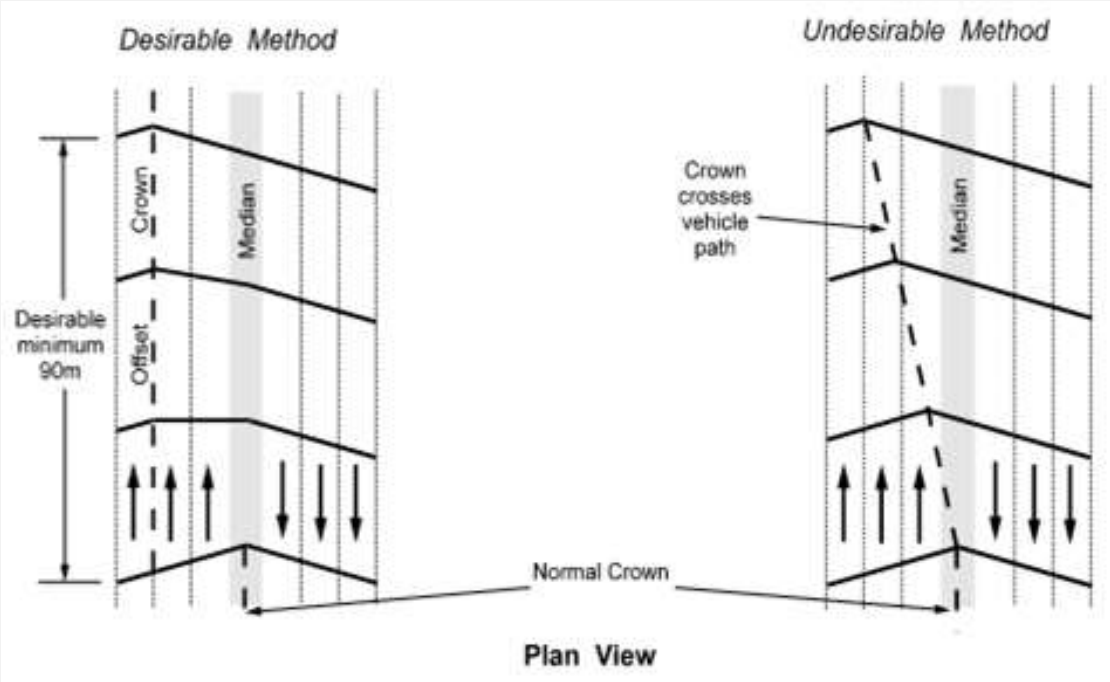


FLOW PATH 52m WITH CROWN

Cross-section

Crown lines (4.2.3)

Method of developing offset crowns (example Fig 4.5, multilane divided road)



Cross-section

Medians

Road widths – divided carriageways (additional information)

Undivided – casualty crash rates

1.6 times higher that divided

Cross-section

Shoulders (4.3.3)

Sealing benefits

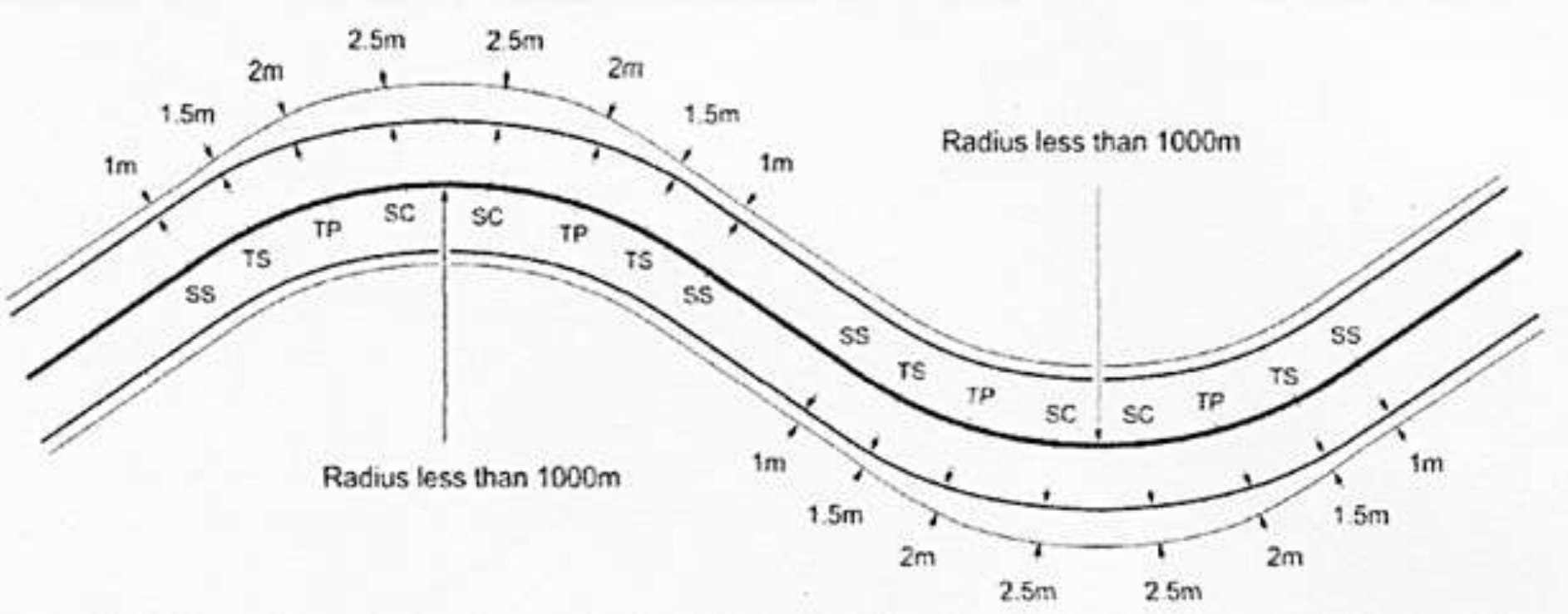
Reduction in run-off-road crashes achieved by a shoulder seal width of 0.5 to 1.5 m

Safety does not improve significantly for shoulder widths over 1.5 to 2.0 m

High speed/high volume roads may justify a continuous 2.5 to 3.0 m wide shoulder

Cross-section

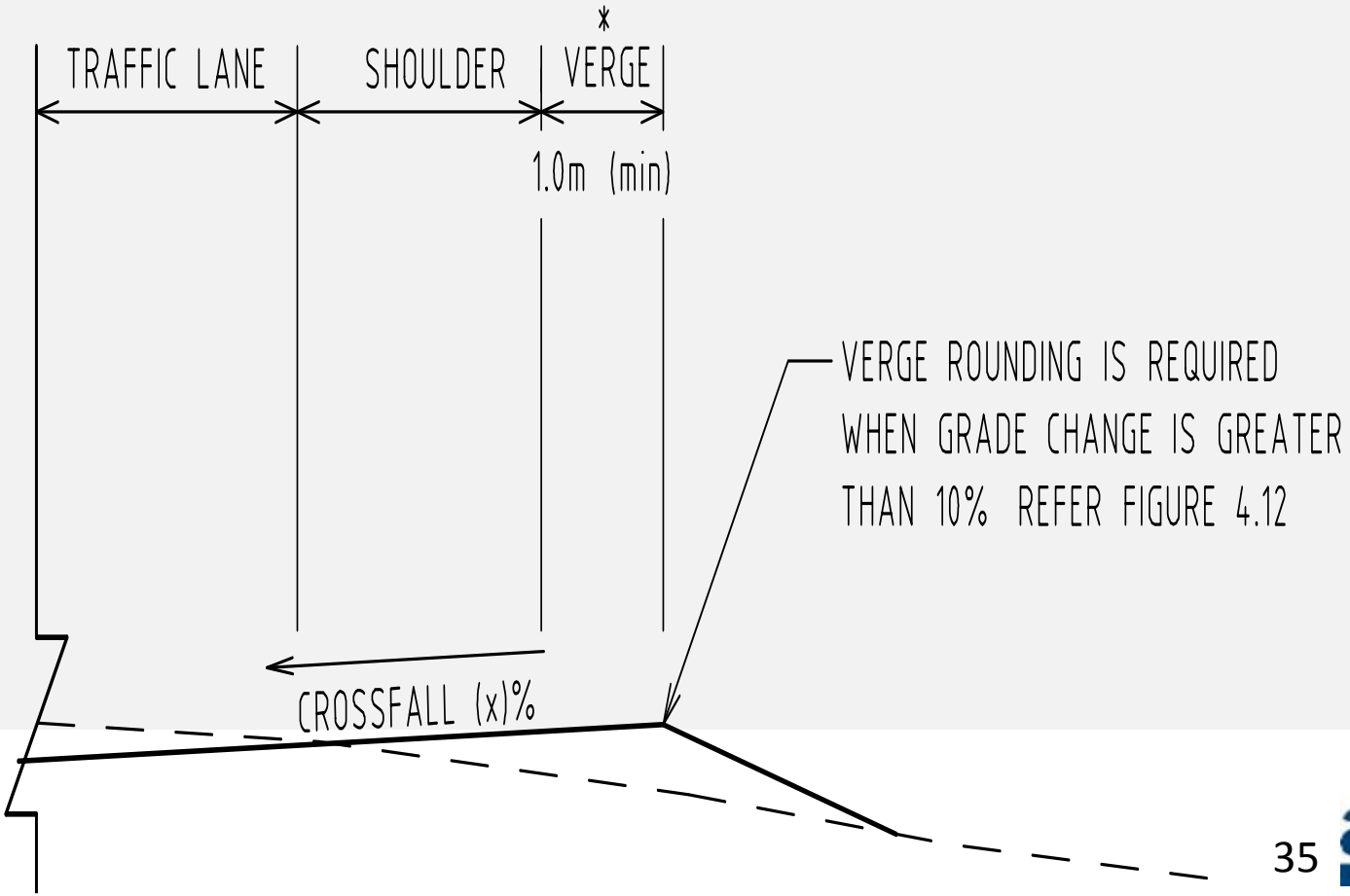
Shoulders (4.3.4) widen shoulders on outside of curves



Source: Levett (2007)

Cross-section

Verges slopes (4.4)



Cross-section

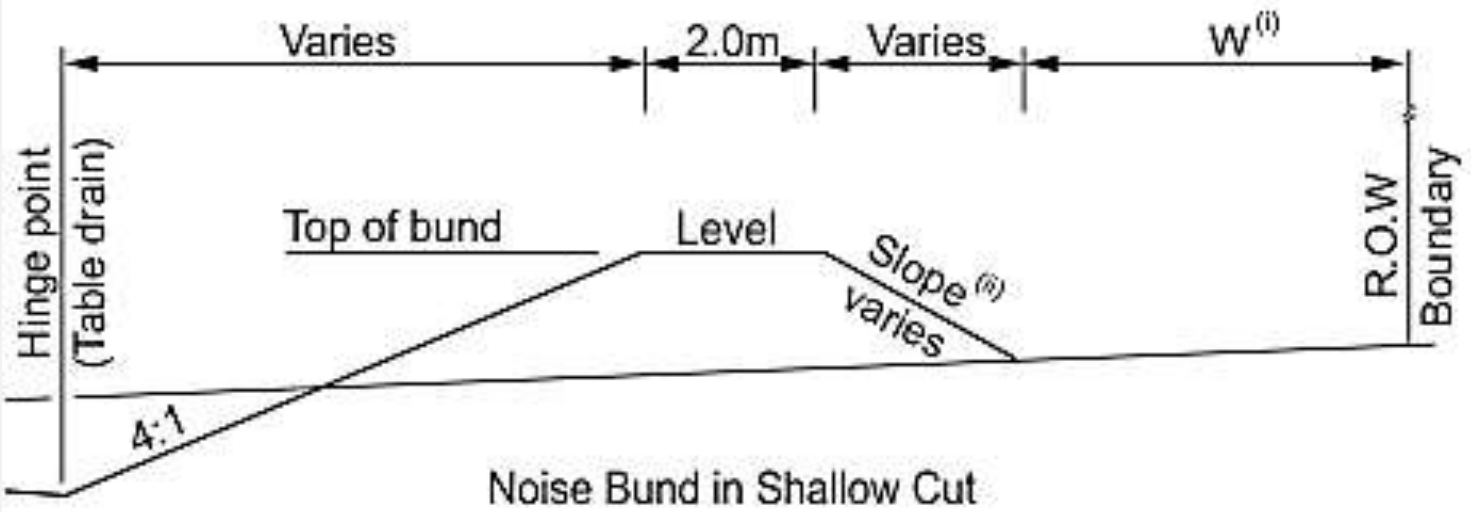
Batter slopes (4.5)

For earth cut batters, earth fill batters and rock fill batters

- Undertake a slope stability analysis, check for potential for sliding, toppling and wedge failure
- May need structural treatments

Cross-section

Bunds or mounds (4.5.3)



(i) 3.0 desirable minimum. 1.0m absolute minimum
(ii) Maximum batter slope to be 3:1 for landscaping purposes

Cross-section

Drainage (4.6)

Factors to be considered

Alignment	-	land-use, topography
Longitudinal invert slope	-	flow velocities
Cross-section slope	-	flow/depth, traversability, maintenance
Lining material	-	appearance
Flow characteristics	-	supercritical or sub-critical flows
Access	-	maintenance

Cross-section

Drainage (4.6)

Image source: www.lgam.info

Cross-section

Drainage (4.6)

Slope away from pavement

Figure 4.16: Typical table drain shape and location

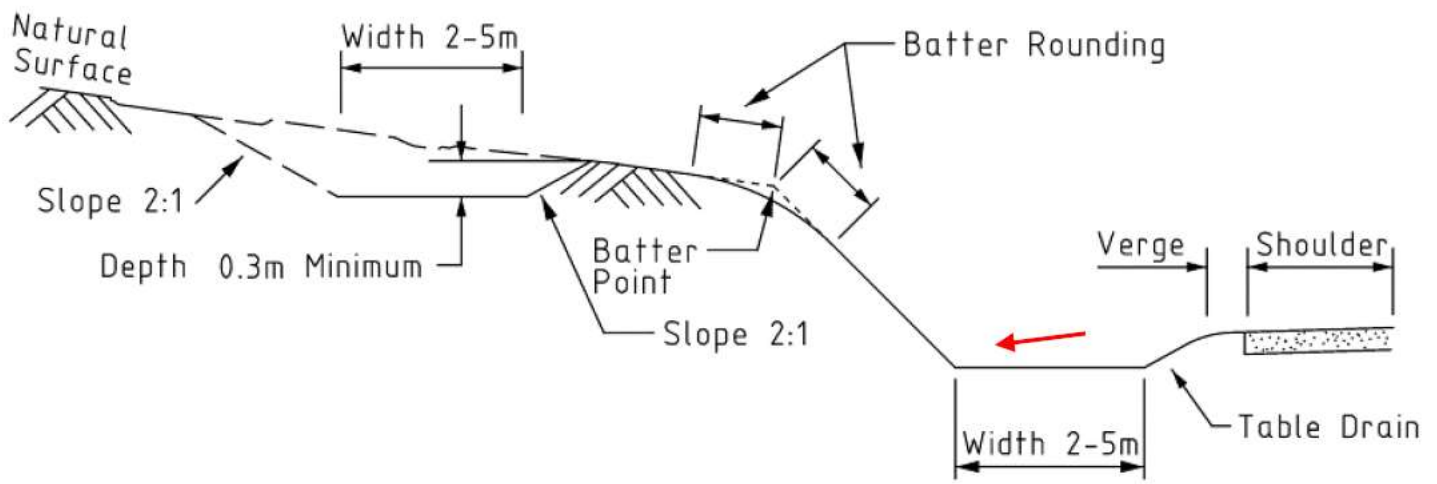


Image source: www.lgam.info

Cross-section

Urban median clearances (4.7.1)

Design speeds ≤80 km/h

Lit area - no lateral clearance required from the edge of the travel lane to a raised median.

Unlit areas - 0.5 m lateral clearance is required to a raised median. The channel, if provided, is outside the lane.

Cross-section

Urban median clearances (4.7.1)

Design speeds >80 km/h

- Unlit areas a lateral clearance of 1.0 m is required, measured from the edge of the lane to the bottom face of the kerb.
- Lit area, this distance can be reduced to 0.5 m.

Cross-section

Median width recovery area (4.7.1)

Cross-median crashes common on medians wider than 15 m

Reduction in crashes on roads with median widths of up to 20 m

No further reductions are achieved at widths of 20 m or more.

Table 4.15 recovery area nominated at 20 m increase from 15 m

Cross-section

Medians (4.7.1)

Narrow medians with wire rope safety barrier (WRSB).

New Appendix E provides some information on narrow medians with WRSB

Cross-section

Narrow medians with wire rope safety barrier (4.7.1 and Appendix E)

Considerations

- minimum length at full height (e.g. 24 m)
- minimum vertical curvature (e.g. greater than 3000 m radius)
- minimum horizontal curvature (e.g. >200 m radius)
- adequate space behind barrier for deflection (under impact)
- maintenance practices

Cross-section

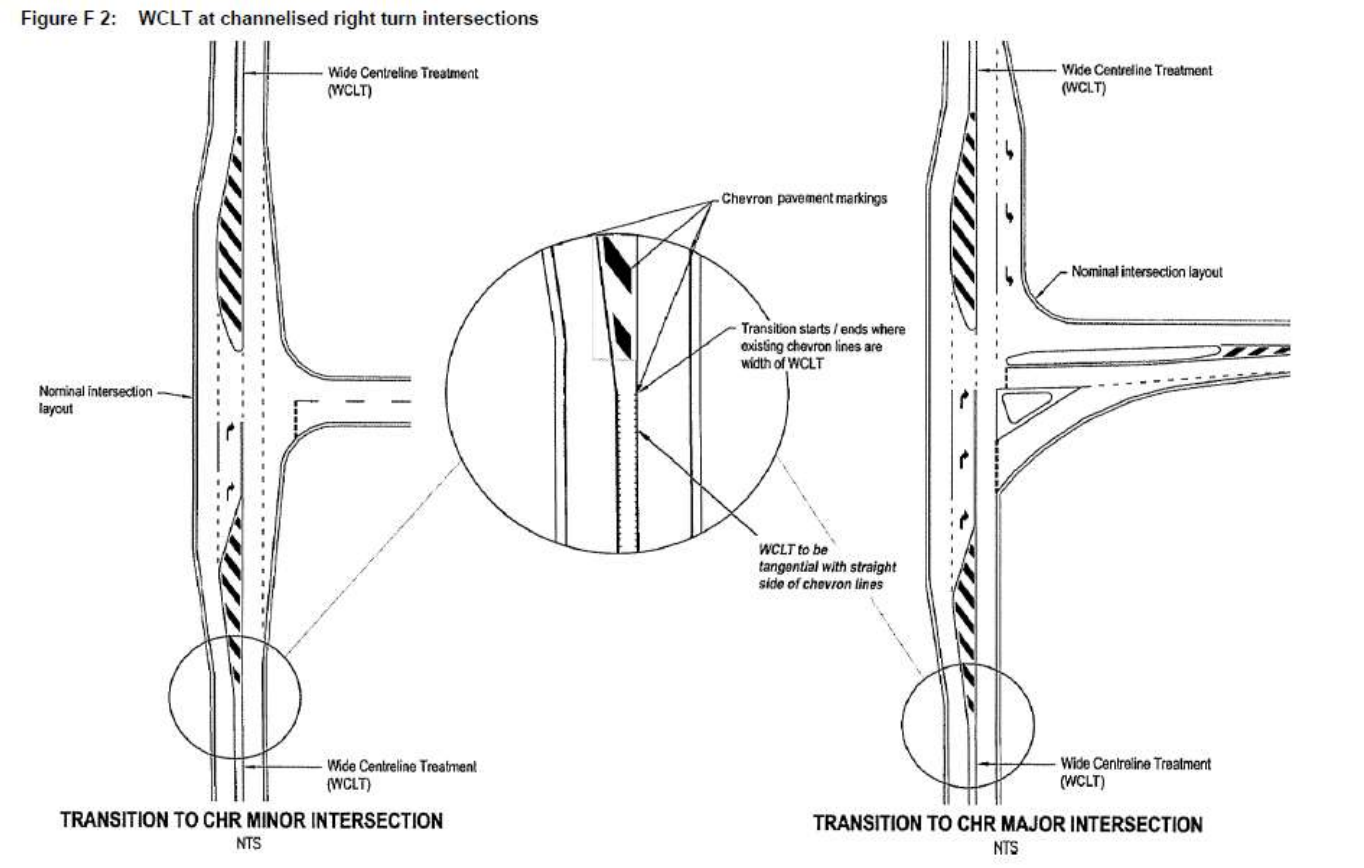
Medians – Wide Centreline treatment (WCLT)

Example (NDD)

Table F 1: Normal design domain cross-section for WCLT – two lane, two way roads

Design AADT	Vehicle routes	Sealed shoulder[(2)(3)] (m)	Lane width[(1)] (m)	WCLT (m)	Total seal width (m)
2000–4000	All vehicles up to B-double[(5)]	1.75	3.25	1.0	11.0
	Type 1 Road Train	1.50	3.50	1.0	
	Type 2 Road Train	1.25	3.75	1.0	

Cross-section



Cross-section

Medians (4.7.1)

Head-on crashes on two-lane two-way roads, narrow medians have been installed with enhanced delineation called a Wide Centre Line Treatment (WCLT) (new Appendix F)

Cross-section

Wide Centreline treatment (4.7.1, Appendix F)

A dividing line, incl audio tactile line marking 1 m wide

How are we travelling?

Cross-section

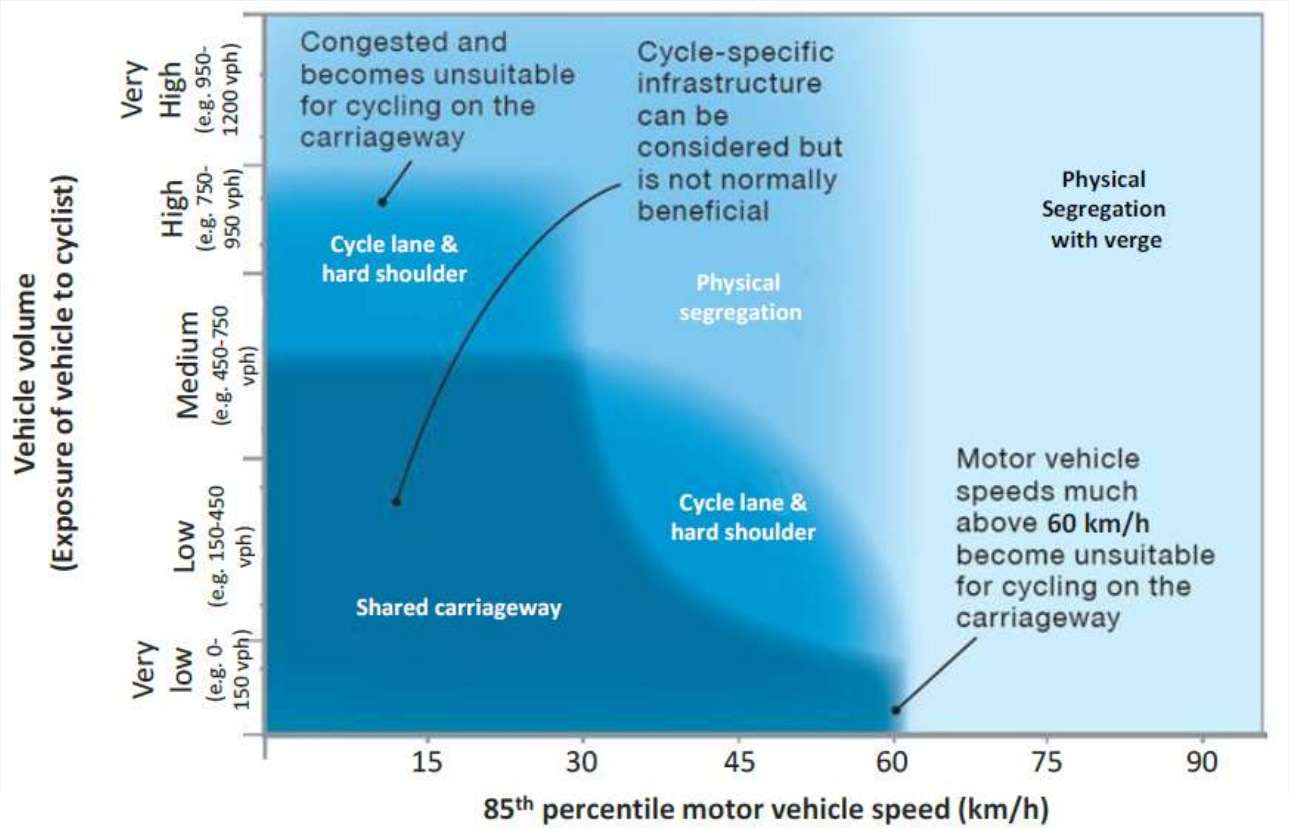
Bicycle lanes (4.8)

Provision for cyclists on roads should be considered in all aspects of road management, including

- choice of cross-section for all roads during the design process
- development of traffic management programs
- maintenance programs where opportunities exist to provide space for cyclists by altering lane markings.

Cross-section

Reference to GTM Part 4 (2016)



Cross-section

Bicycle lanes (4.8)

Separation between motor vehicles and cyclists to improve safety

Separation achieved through

- linemarking
- painted separator strips and delineators
- providing raised islands or facilities behind a kerb

Cross-section

Separated bicycle lanes

Example of a separated bicycle lane with physical separation of parking

Cross-section

Contra flow bicycle lanes (4.8.6)

Cross-section

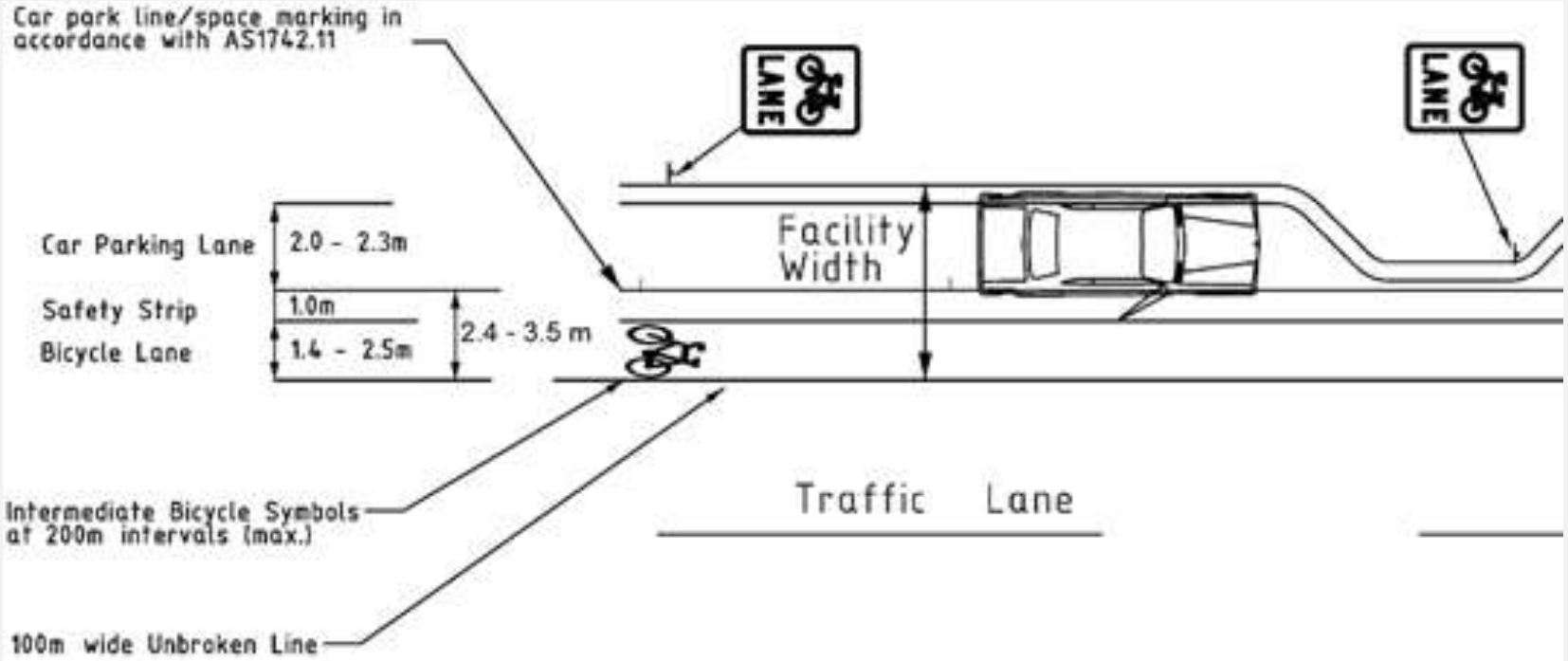
Contra flow bicycle lanes (4.8.6)

>50 km/h, physical separation from motor traffic should be provided by a raised traffic island or a safety strip that should desirably be 1.0 m wide (0.6 m minimum)

Green surfacing in bicycle lanes is used with road agency policy and at sites where there is a higher probability of conflict eg approaches to intersections or through intersections

Cross-section

Bicycle/car parking lanes (4.8.10)



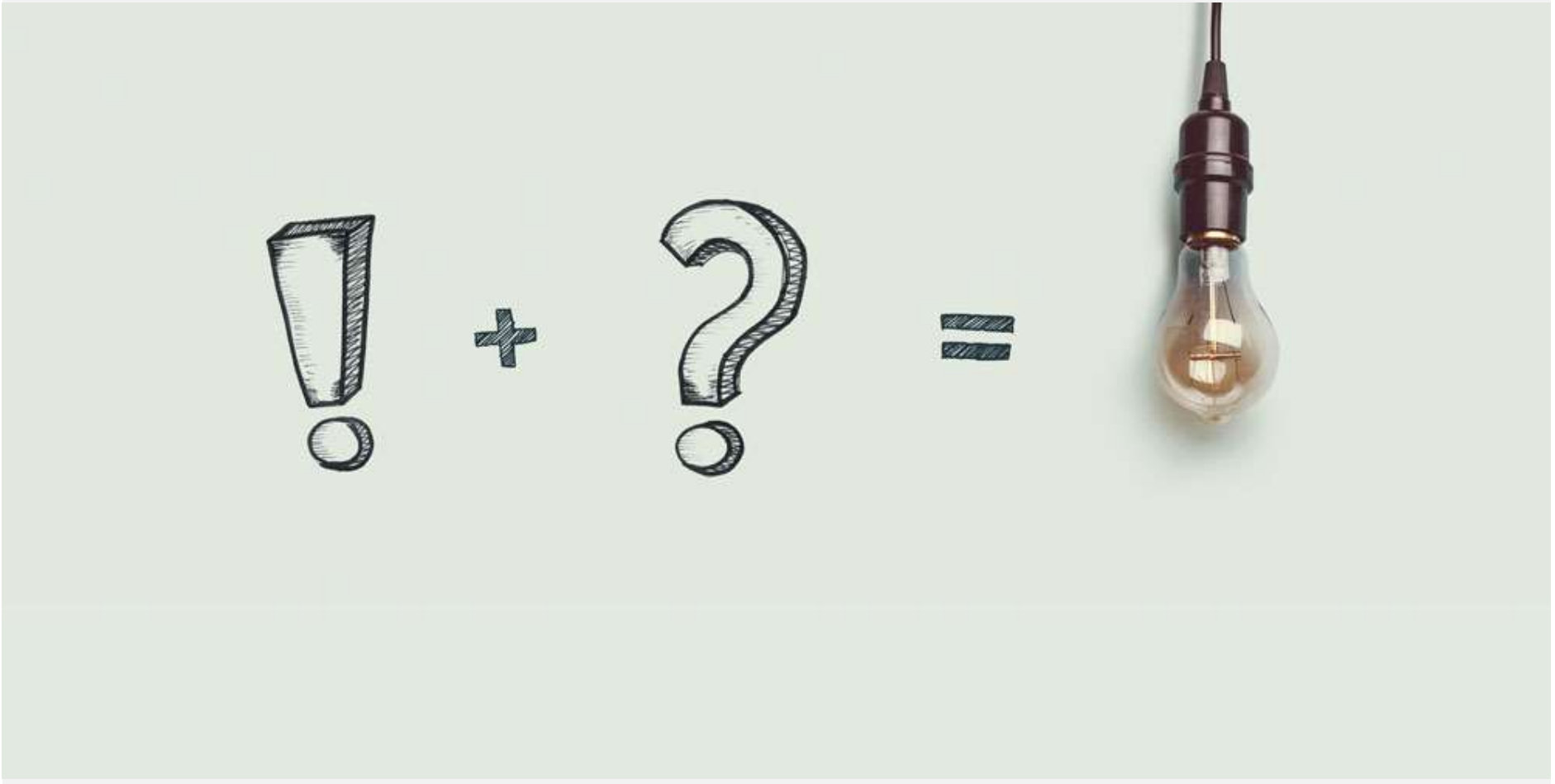
Cross-section

Bicycles supplementary treatments (Section 4.8.12)

When assessing the need for protective treatments

- radii of curves
- sight distance from drivers to cyclists (around curves/over crests)
- traffic speed and volume
- numbers of trucks and buses
- kerbside motor traffic lane width
- degree of encroachment of traffic into existing bicycle lanes

Questions?



Thank you for participating

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