Guide to Road Design Part 3: Geometric Design
Session I – 18 October 2016
Today’s moderator

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Housekeeping

Webinar = 60 mins
Question time = included
GoToWebinar functions

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Today’s presenter

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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


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
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

<table>
<thead>
<tr>
<th>Issue</th>
<th>General good practice for all road users and most important in catering for the special needs of motorcyclists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visibility</td>
<td>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.</td>
</tr>
<tr>
<td>Recognition of layout and clear definition of vehicle paths</td>
<td>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.</td>
</tr>
<tr>
<td>Adverse crossfall</td>
<td>Avoid it as much as possible. Where unavoidable keep within limits of design guidelines.</td>
</tr>
<tr>
<td>Compound curves</td>
<td>Avoid using them (warning signs will not overcome the problem).</td>
</tr>
<tr>
<td>Skid resistance</td>
<td>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.</td>
</tr>
</tbody>
</table>
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 (e.g., 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
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 ($V_{\text{Desired}}$) 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 ($V_{\text{Operating}}$) is the 85th percentile speed at a point along the road.

Design Speed ($V_{\text{Design}}$) 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.

$$V_{\text{Design}} \geq [V_{\text{Operating}} = 85^{\text{th}} \text{ Percentile Speed (V85)}].$$
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

<table>
<thead>
<tr>
<th>Road type</th>
<th>Proposed speed limit (km/h)</th>
<th>Typical desired speed and design speed (km/h)&lt;sup&gt;(1)&lt;/sup&gt;</th>
<th>Typical minimum radius (m) that will not reduce desired speed&lt;sup&gt;(2)&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motorways</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>90</td>
<td>450</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>110</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>120</td>
<td>800</td>
<td></td>
</tr>
<tr>
<td><strong>High speed rural roads</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>110</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>120</td>
<td>800</td>
<td></td>
</tr>
<tr>
<td><strong>Urban arterial and sub-arterial roads</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>70</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>80</td>
<td>275</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>90</td>
<td>300</td>
<td></td>
</tr>
</tbody>
</table>
Cross-Section
Cross-section contents

- Shoulders
- Verges slopes
- Batter slopes
- Bunds or mounds
- Drainage
- Medians
- Wide centreline treatments
- Bicycle treatments
Crown lines (4.2.3)
Crown lines introduce a destabilising opportunity - care is needed

Drainage purposes
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 than 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)

VERGE Rounding is required when grade change is greater than 10%. Refer Figure 4.12
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

- Natural Surface
- Width 2-5m
- Depth 0.3m Minimum
- Batter Point
- Batter Rounding
- Slope 2:1
- Verge
- Shoulder
- Width 2-5m
- Table Drain

Image source: www.lgam.info
Urban median clearances (4.7.1)

Design speeds $\leq 80$ 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.
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>
<thead>
<tr>
<th>Design AADT</th>
<th>Vehicle routes</th>
<th>Sealed shoulder(^{(2)(3)}) (m)</th>
<th>Lane width(^{(1)}) (m)</th>
<th>WCLT (m)</th>
<th>Total seal width (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000–4000</td>
<td>All vehicles up to B-double(^{(5)})</td>
<td>1.75</td>
<td>3.25</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type 1 Road Train</td>
<td>1.50</td>
<td>3.50</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type 2 Road Train</td>
<td>1.25</td>
<td>3.75</td>
<td>1.0</td>
<td>11.0</td>
</tr>
</tbody>
</table>
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?
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)
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)
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)
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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