TRUNK ROAD INFRASTRUCTURE STANDARD No. 06

PAVEMENT DESIGN

Supplement to Austroads Guide: Pavement Technology

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PREFACE

The Austroads series of Guides for provision and management of road and transport infrastructure provides a level of consistency across all jurisdictions in Australia and New Zealand. All road authorities have agreed to adopt the Austroads Guides as the primary technical reference, together with the relevant Australian and New Zealand Standards.

The Australian Capital Territory has adopted the Austroads Guides, and has issued a revised series of documents to reflect this development in standards and specifications for practice in the ACT. This present document is part of the ACT Trunk Road Infrastructure Standard (TRIS) series spanning the broad scope of road infrastructure development in the ACT:

- TRIS 01 – Road Planning
- TRIS 02 – Road Design
- TRIS 03 – Traffic Management
- TRIS 04 – Road Safety
- TRIS 05 – Asset Management
- TRIS 06 – Pavement Design
- TRIS 07 – Bridges and Structures
- TRIS 08 – Road Tunnels
- TRIS 09 – Project Delivery
- TRIS 10 – Project Evaluation.
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Each of the TRIS documents indicates adoption of the relevant Austroads Guide, sets out specific requirements for implementation in ACT, and calls up more detailed Specifications.

This ACT Trunk Road Infrastructure Standard No. 06 – PAVEMENT DESIGN constitutes a supplement to the

AUSTROADS GUIDE TO PAVEMENT TECHNOLOGY

The Territory and Municipal Services Directorate accepts the principles and general guidance in the Guide to Pavement Structural Design. This Trunk Road Infrastructure Standard is issued to clarify any exceptions or additional requirements for implementation in the ACT, and to identify relevant complementary documents.

The planning, design and management of pavements in the ACT must be implemented in general accordance with the Austroads Guide above, and in accordance with specific provisions of this Trunk Road Infrastructure Standard.

Where any differences in practice exist between the Austroads Guide and this Trunk Road Infrastructure Standard, the latter will prevail.

CONTENTS

1. GENERAL

Austroads has released the Guide to Pavement Technology and all state road agencies in Australia have agreed to adopt the Austroads guides to provide a level of consistency and harmonisation across jurisdictions. Consequently the Austroads guides and the Australian Standards referenced in them will become the primary technical references for use within the managing authorities.

The Austroads Guide to Pavement Technology comprises 10 Parts issued in 21 volumes (see Section 3.1). Part 2 contains the guide to pavement structural design, which is the focus of the present document. The other Parts of the Guide provide complementary and background information representing up to date knowledge and practice relevant to pavement design and construction.

This present document, the Trunk Road Infrastructure Standard for Pavement Design, is issued to clarify, add to or modify the Austroads Guide to Pavement Technology, with particular reference to the pavement design guidance contained in Part 2 of that Guide.

2. GENERAL PRINCIPLES

The ACT Government accepts the principles contained in the Austroads Guide to Pavement Technology with variations documented in this supplement. The general principles and guidelines of the Austroads documents are to be followed wherever appropriate.

The Roads and Maritime Service (RMS-formerly RTA) of NSW issued a series of supplements to the Austroads Guides to complement the general topics with local experience and practices. The RMS Supplement to Austroads Guide to Pavement Technology Part 2 (referred to here as the RMS Supplement) contains local (RMS NSW) requirements and practices based on the RMS experience.

As a general approach, this RMS Supplement and its provisions are to be adopted in ACT. The RMS Supplement takes precedence over the Guide when the two differ from each other.

The design of pavements relies – among other matters - on the knowledge of materials. Material properties and construction standards are detailed in the relevant ACT Standard Specifications as listed.

For any differences in practice between this ACT Supplement and other ACT complementary materials, the ACT Supplement will apply.

3. REFERENCE DOCUMENTS

Details for all reference documents are given in the Section 5 Reference List.

3.1 GUIDELINES

The following documents contain relevant information regarding to ACT Trunk Road Infrastructure Standard No. 6 - Pavement Design.

Austroads Guide to Pavement Technology

Part 1:	Introduction to Pavement Technology
Part 2:	Pavement Structural Design
Part 3:	Pavement Surfacings
Part 4:	Pavement Materials
Part 4A:	Granular Base and subbase
Part 4B:	Asphalt
Part 4C:	Materials for concrete road pavements
Part D:	Stabilised materials
Part 4F:	Bituminous binders
Part 4G:	Geotextiles and geogrids
Part 4H:	Test Methods
Part 4I:	Earthworks materials
Part 4J:	Aggregate and source rock
Part 4K:	Seals

Part 4L:	Stabilising binders
Part 5:	Pavement Evaluation and Treatment Design
Part 6:	Unsealed pavements
Part 7:	Pavement maintenance
Part 8:	Pavement Construction Assurance
Part 9:	Pavement work practices
Part 10:	Surface drainage

RMS Pub. 11.050	RMS Austroads Guide Supplements – Supplement to the Austroads Guide to Pavement Guide to Pavement Technology Part 2: Pavement Structural Design Austroads Glossary of Terms

The Austroads Guide to Pavement Technology contains references to Australian and New Zealand Standards. These are listed in the relevant documents.

3.2 RELATED TECHNICAL SPECIFICATIONS

Detailed requirements for materials, processes, or procedures specific to pavement design in the ACT are prescribed in the following specifications:

ACT Trunk Road Infrastructure Technical Specification No.02 - Earthworks
ACT Trunk Road Infrastructure Technical Specification No. 04 - Flexible Pavements
ACT Trunk Road Infrastructure Technical Specification No.05 - Rigid Pavements
ACT Trunk Road Infrastructure Technical Specification No.06 - Concrete Kerbs and Footpaths
ACT Trunk Road Infrastructure Technical Specification No.07 - Segmental Paving
ACT Trunk Road Infrastructure Technical Specification No. 08 - Incidental Works

Implementation of pavement designs must be undertaken in accordance with these Specifications.

3.3 LEGISLATIVE DOCUMENTS

4. SUPPLEMENTARY MATERIAL

Specific local conditions require adjustments or complementary information to the reference documents listed in Section 3.1. These are summarised in the following tables, which indicate any qualifications applying to the adoption of the Guide in ACT.

Tables are presented for Parts 1 to 4 only of the Guide, since these are the Parts most directly relevant to pavement structural design issues. The remaining Parts 5 to 10 provide substantial information and advice on other areas of pavement technology and management. They are to be adopted fully, with no exceptions in principle, as guidance for road pavements in ACT.

SUPPLEMENT TO THE AUSTROADS GUIDE TO PAVEMENT TECHNOLOGY PART 1: INTRODUCTION TO PAVEMENT TECHNOLOGY PUBLICATION DATE: 2009		
Discusses the purpose and structure of the Guide to Pavement Technology. It was not intended as a reference document on its own but gives an overview and guidance to the Guide. It provides definitions and terminology for the further parts of the Guide.		
Reference Section	**ACT Practice, Complementary Material, or Departures**	**Date**
General	Part 1 of the Guide is adopted with no exceptions in principle for the practice in ACT	
	There are no 'local roads' covered specifically in the Guide. However, the Guide is generally relevant to local road pavements and should be applied as such.	
	Segmental pavements are not addressed in the Guide. Refer to ACT Trunk Road Infrastructure Technical Specification No.07 - Segmental Paving.	

SUPPLEMENT TO THE AUSTROADS GUIDE TO PAVEMENT TECHNOLOGY PART 2: PAVEMENT STRUCTURAL DESIGN PUBLICATION DATE: 2012

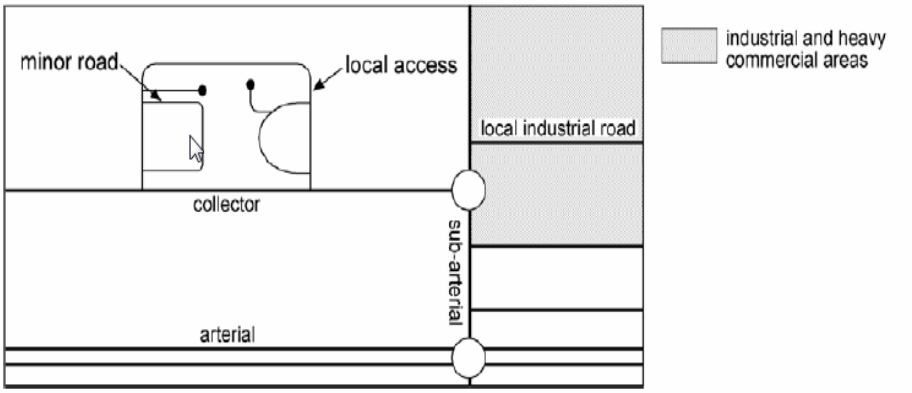
Provides detailed design procedures for the structural design of flexible and rigid pavements. Part 2 includes design principles, concepts accompanied by examples.

<table>
<tr><th>Reference Section</th><th>ACT Practice, Complementary Material, or Departures</th><th>Date</th></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>General</td><td>Part 2 of the Guide is adopted with no exceptions in principle for the practice in ACT</td><td></td></tr>
<tr><td></td><td>The Guide addresses the design of flexible and rigid pavements for lightly and heavily trafficked roads.</td><td></td></tr>
<tr><td></td><td>Pavement design for lightly trafficked roads (local roads) is discussed in section 12 of this Part of the Guide.</td><td></td></tr>
<tr><td></td><td>The Guide does not cover special pavements, such as industrial and clay segmental pavements. However, Appendix I of the Guide provides information regarding pavement damage due to specialised vehicles.</td><td></td></tr>
<tr><td></td><td>The RMS Supplement to the Austroads Guide to Pavement Technology Part 2 has several supplementary or modified requirements. These take precedence over the requirements stated in the Guide.</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>1</td><td>Introduction</td><td></td></tr>
<tr><td>1.1</td><td>See RMS Supplement</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>2</td><td>Pavement Design Systems</td><td></td></tr>
<tr><td>2.1</td><td>See RMS Supplement</td><td></td></tr>
<tr><td>2.2.1</td><td>Input variables</td><td></td></tr>
<tr><td></td><td>See RMS Supplement.
The typical design traffic and project reliability is given in the following table:

<table>
<tr><th>ACT road categories</th><th>Austroads Guide</th><th>Typical design traffic (ESA) (20 years)</th><th>project reliability</th></tr>
<tr><td>Access streets</td><td>Minor road</td><td>$1x10^4$</td><td>80%</td></tr>
<tr><td>Minor collector roads (no buses)</td><td>Local access road</td><td>$1x10^5$</td><td>85%</td></tr>
<tr><td>Major collector roads (with buses)</td><td>Collector road</td><td>$1x10^6$</td><td>90%</td></tr>
<tr><td>Sub-arterial</td><td>Sub-arterial</td><td>$5x10^6$</td><td>90%</td></tr>
<tr><td>Arterial road</td><td>Arterial Road</td><td>$1x10^7$</td><td>95%</td></tr>
<tr><td>Parkway</td><td>Freeway, motorway or parkway</td><td>$>1x10^7$</td><td>95%</td></tr>
</table>

The project reliability levels provided here are to be considered as the minimum requirement.

The typical hierarchy of road types is illustrated in the following figure (Source: Figure 12.1 in AGPT02/08).</td><td></td></tr>
</table>

		
	The feasibility and cost efficiency of a perpetual pavement alternative should be explored when designing a new pavement.	
3	**Construction and maintenance considerations**	
3.1	See RMS Supplement	
	For arterial roads SMA wearing course must be used with PMB.	
	Arterial roads with AADT>= 107 ESA must have a pavement structure other than thin asphalt overlay on granular base.	
	Roundabouts must have suitable pavements to resist shear loading	
3.2	Bituminous pavement layers must not be laid directly on sand or sandy materials.	
3.2.2	See RMS Supplement	
	Pavement drainage should be provided (a) on un-kerbed roads, by sub-soil drains installed at the edge of the shoulder as shown on the Standard Drawings and (b) on kerbed roads, by sub-soil drains installed in front of the kerb or the gutter lip, with depth minimum 1.0 m below the finished surface level and longitudinal grade of minimum 1%. In some cases the combination of a table drain and a sub-soil drain could be appropriate. The sub-soil drain should extend up to the bottom of the base course, i.e.: • for granular pavements to the bottom of the fine crushed rock material • for stabilised pavements to the bottom of the lowest stabilised layer • for deep lift AC pavements to the bottom of the lowest asphalt layer • for concrete pavements to the bottom of the base concrete. If a sub-soil drain is located in the wheel path, consideration should be given to using a 75mm thick no fines concrete capping to the sub-soil drain.	
3.14.1	See RMS Supplement p10 for more details	
3.17	See RMS Supplement	
4	**Environment**	
4.1	See RMS Supplement	
5	**Subgrade evaluation**	
5.3.3	See RMS Supplement	
5.3.5	Moisture changes during service life – see RMS Supplement p15-18	
5.3.6	See RMS Supplement	
5.5.3	See RMS Supplement	
	Benkelman Beam testing for the determination of in situ CBR is applicable only to unbound granular pavements with thin bituminous surfacing. Detailed method and recommended parameters are provided in the RMS Supplement. Results obtained with DCP or deflection testing must be verified by other means of investigation.	
5.6	See RMS Supplement	
5.6.2	See RMS Supplement Typical moisture content for laboratory CBR testing has to be according to the RMS Supplement Table 5.C;	
5.7	Presumptive CBR values - See RMS Supplement	

	Presumptive values given in Table 5.D of the RMS Supplement may be used where other information is not available.	
6	**Pavement materials**	
6.2	Unbound materials	
6.2.1	See RMS Supplement; Material characteristics and requirements are defined in RMS QA specification 3051; construction requirements are detailed in RMS R71. The design requirements must be adjusted accordingly. The details are given in the RMS Supplement.	
6.2.3	*Modulus of Unbound Granular Materials*	
	The maximum presumptive vales for unbound granular materials in thin bituminous surfacings are given in Table 6.A in the RMS Supplement.	
	A presumptive value of 450 MPa may be used for DGB (HD) materials at 100% compaction. (RMS Supplement p 22)	
6.4	Cemented materials See RMS Supplement	
6.4.3	See RMS Supplement The presumptive values for post cracking condition are to be taken into account according to Table 6.B of the RMS Supplement.	
6.5	*Asphalt*	
6.5.2	See RMS Supplement	
6.5.3	Determination of asphalt modulus	
	See RMS Supplement When the Shell nomographs are used to estimate the asphalt modulus, the input parameters (speed limits) given in Table 6.C of the RMS Supplement must be used. The same speed limits are to be used for the design of full depth asphalt pavements.	
	The modulus of a thin asphalt layer (up to 50 mm) over a cementitious base is limited to a maximum of 1000MPa.	
	AC moduli of asphalt produced in the ACT are in the order of 2,800 – 5,000 MPa. When no other information on the asphalt modulus is available, for thin pavements over granular base the higher asphalt modulus should be used, whilst for full depth asphalt pavements the lower end of the historical range should be used.	
6.5.7	**Permanent deformation of asphalt**	
	See RMS Supplement Wheel tracking test requirements are given in Table 6.D of the RMS Supplement for intersections and other places where traffic slows down.	
	For intersections and roundabouts where the design AADT > 3000 PMB must be used in the asphalt layers. The preferred wearing course is PMB SMA at intersections and roundabouts. For these locations the project reliability level must be 97.5%.	
6.5.8	*Recycled asphalt*	
	See RMS Supplement for additional requirements.	
	Warm asphalt	
	Warm asphalt has been introduced successfully since the release of the Guide. Where warm asphalt is proposed or intended to be used, the designer must specify the expected properties, such as modulus, binder viscosity of the end product of the asphalt.	
6.6	*Concrete*	
6.6.2	See RMS Supplement for additional requirements.	
	Cementitious layers must be primed and sealed with 7mm or 10mm PMB SAMI prior to laying asphalt.	
7	**Design traffic**	
7.2	See RMS Supplement	
7.4	See RMS Supplement	

7.4.4	Design traffic for lightly trafficked roads (access and minor roads) is to be calculated according to section 12.7 of this Part of the Guide.	
7.5	See RMS Supplement	
7.6.3	See RMS Supplement	
8	**Design of new flexible pavements**	
8.2	See RMS Supplement	
8.2.2	See RMS Supplement	
8.2.4	See RMS Supplement	
8.2.5	Thin bituminous surfacing on granular base must not be designed for arterial or other roads with traffic exceeding 107 ESA. The design of granular pavements with thin surfacing must include a PMB seal under the thin asphalt wearing course.	
8.3.1	See RMS Supplement	
9	**Design of Rigid Pavements**	
9.1	See RMS Supplement	
9.2	*Pavement Types*	
9.2.1	See RMS Supplement	
9.2.2	See RMS Supplement	
9.2.3	See RMS Supplement	
9.3.1	See RMS Supplement	
9.3.3	See RMS Supplement	
9.3.5	See RMS Supplement	
9.4.1	See RMS Supplement	
9.4.2	See RMS Supplement	
9.4.3	See RMS Supplement	
9.4.5	See RMS Supplement	
9.5.3	See RMS Supplement	
9.5.4	See RMS Supplement	
10	**Comparison of designs**	
10.2	See RMS Supplement	
10.3	The designer should include the additional costs related to different pavement solutions, such as modifications to kerb, drainage etc.	
10.5	See RMS Supplement	
10.6	See RMS Supplement	
10.7	See RMS Supplement	
10.8	See RMS Supplement	
12	**Design of lightly trafficked pavements**	
	Cycle and footpath pavement should be designed according to Section 12 of this Part of the Guide.	

SUPPLEMENT TO THE AUSTROADS GUIDE TO PAVEMENT TECHNOLOGY PART 3 PAVEMENT SURFACING PUBLICATION DATE: 2009		
Part 3 of the Guide addresses the selection of the most appropriate pavement surfacing. It identifies the significant factors that need to be considered in the selection of the most appropriate surfacing, their inter-relationship and the rationale for assessing the surfacing options available. User requirements may vary with speed, environment, traffic. The Guide does not reduce the need for experienced engineering judgement.		
Reference Section	**ACT Practice, Complementary Material, or Departures**	**Date**
General	Part 3 of the Guide is adopted with no exceptions in principle for the practice in ACT.	

SUPPLEMENT TO THE AUSTROADS GUIDE TO PAVEMENT TECHNOLOGY PART 4: PAVEMENT MATERIALS PUBLICATION DATE: 2007		
Part 4 is a collection of publications covering the major pavement and road making material groups. The individual sub-parts (4A-4L) provide extensive information on the relevant materials, their behaviour and design parameters.		
Reference Section	**ACT Practice, Complementary Material, or Departures**	**Date**
General	Part 4 of the Guide is adopted with no exceptions in principle for the practice in ACT.	
	Sub-parts 4A to 4L (see titles in Section 3.1) are adopted without exception as relevant technical advice and guidance on pavement materials.	
Note:	PI is required in the 2-8% range for base layers.	

5. REFERENCE LIST

Austroads 2009, *Guide to Pavement Technology Part 9: Pavement Work practices*, by Rebbechi, J, Austroads, Sydney, NSW.

NSW Roads and Traffic Authority 2011, RTA Austroads guide supplements: Austroads guide to pavement technology Part 2: pavement structural design, RTA, Sydney, NSW.

Roads and Maritime Services 2010, *QA Specification R71: Unbound and modified pavement course*, RMS, Sydney, NSW.

Roads and Maritime Services 2011, *QA Specification 3051: Granular based and subbase materials for surfaced road pavements*, RMS, Sydney, NSW.