



DEVELOPMENT DESIGN
SPECIFICATION

D2

PAVEMENT DESIGN

Amendment Record for this Specification Part

This Specification is Council's edition of the AUS-SPEC generic specification part and includes Council's primary amendments.

Details are provided below outlining the clauses amended from the Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirement clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
1	IPWEA Mid North Coast Working Party Review of D2 15/9/2000	D2	AMO	HC	16/1/01

PAVEMENT DESIGN

GENERAL

D2.01 SCOPE

1. The work to be executed under this Specification consists of the design of the road pavement to meet the required design life, based on the subgrade strength, traffic loading and environmental factors, and including the selection of appropriate materials for select subgrade, subbase, base and wearing surface. *Design Criteria*
2. The Specification contains procedures for the design of the following forms of surfaced road pavement construction: *Surfaced Pavement Types*
 - (a) flexible pavements consisting of unbound granular materials;
 - (b) flexible pavements that contain one or more bound layers, including pavements containing asphalt layers other than thin asphalt wearing surfaces;
 - (c) rigid pavements (ie. cement concrete pavements);
3. Consideration to the design of unsealed (gravel) pavements will only be given for minor rural subdivisions/developments in isolated rural areas where the access to the subdivision is via an existing unsealed road. *Unsealed Pavements*

D2.02 OBJECTIVES

1. The objective in the design of the road pavement is to select appropriate pavement and surfacing materials, types, layer thicknesses and configurations to ensure that the pavement performs adequately and requires minimal maintenance under the anticipated traffic loading for the design life adopted. *Pavement Performance*

D2.03 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specifications

D1	-	Geometric Road Design
D4	-	Subsurface Drainage Design
C242	-	Flexible Pavements
C244	-	Sprayed Bituminous Surfacing
C245	-	Asphaltic Concrete
C247	-	Mass Concrete Subbase
C248	-	Plain or Reinforced Concrete Base
C254	-	Segmental Paving
C255	-	Bituminous Microsurfacing

(b) State Authorities

Roads and Traffic Authority, NSW - Sprayed Sealing Guide, 1992.

EPA – NSW Traffic Noise Policy 1999

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(c) Other

- AUSTROADS - Pavement Design, A Guide to the Structural Design of Road Pavements, 1992.
- AUSTROADS - Guide to Control of Moisture in Roads.
- APRG21 - A Guide to the Design of New Pavements for Light Traffic
- CCA – T33 - Cement and Concrete Association, T33 - Concrete Street and Parking Area Pavement Design, 1984.

- CCA – T51 - 1997 Concrete Pavement Design for Residential Streets
- CCA – TN52 - Cement and Concrete Association, TN52 - Single-Lane Concrete Bus Bays, 1984.

- RTA - Standard Test Methods.

- AS 1141 Methods for Sampling and Testing Aggregates
- AS 1289 Methods of Testing Soils for Engineering Purposes

- AS 1726 Geotechnical Site Investigations

PAVEMENT DESIGN CRITERIA

D2.04 DESIGN VARIABLES

1. Regardless of the type of road pavement proposed, the design of the pavement shall involve consideration of the following five input variables: **Design Variables**
 - (a) Design Traffic
 - (b) Subgrade Evaluation
 - (c) Environment
 - (d) Pavement and Surfacing Materials
 - (e) Construction and Maintenance Considerations

D2.05 DESIGN TRAFFIC

1. The design traffic shall be calculated based on a minimum pavement design life of 100 years . **Minimum Pavement Design Life**

2. Design traffic shall be calculated in equivalent standard axles (ESAs) for the applicable design life of the pavement, taking into account present and predicted commercial traffic volumes, axle loadings and configurations, commercial traffic growth and street capacity. For new subdivisions, the design traffic shall take account of both the construction traffic associated with development and the in-service traffic. **Design Traffic**

3. The pavement design shall include all traffic data and/or assumptions made in the calculation of the design traffic. Not with standing, the minimum traffic for pavement **Traffic Data**

design shall be as per Table D1.5 (Geometric Road Design).

4. In general, reference should be made to APRG21 for the calculation of design traffic volumes up to 5×10^5 ESAs for flexible pavements and 5×10^6 CVAG's for rigid pavements and AUSTRROADS Pavement Design elsewhere.

Design Traffic Volumes

D2.06 SUBGRADE EVALUATION

1. Evaluation of subgrade conditions shall be in accordance with APRG21 Section 13.5 or Austroads Pavement Design Section 5.
2. Except where a mechanistic design approach is employed using AUSTRROADS Pavement Design, the measure of subgrade support shall be the California Bearing Ratio (CBR). Where a mechanistic design approach using linear elastic theory is employed for flexible pavements, the measure of subgrade support shall be in terms of the elastic parameters (modulus, Poisson's ratio).
3. The following factors must be considered in determining the design strength/stiffness of the subgrade:
- Sequence of earthworks construction
 - The compaction moisture content and field density specified for construction
 - Moisture changes during service life
 - Subgrade variability
 - The presence or otherwise of weak layers below the design subgrade level.
4. The road pavement design shall be divided into "subgrade areas" of similar traffic loading, subgrade material, moisture conditions and subgrade support. Pavement design shall be carried out for each subgrade area.

California Bearing Ratio

Design Considerations

Subgrade Areas

The calculation of the Design CBR shall be based on a minimum of three 4 day soaked CBR laboratory samples for each subgrade area, compacted to the relative density specified for construction, and corrected to allow for the effects of subsurface drainage (or lack of), climatic zone, and soil type if appropriate to give an estimated equilibrium in-situ CBR. The Design CBR for each subgrade area is computed by using the appropriate formulae as follows.

Design CBR

The Design CBR for each **subgrade area** is computed by using the appropriate formulae as follows: Design CBR

Design CBR = Least of estimated equilibrium CBRs, for less than five results

OR

Design CBR = 10th percentile of all estimated equilibrium CBRs, for five or more results

= $C - 1.3S$

Where C is the mean of all estimated equilibrium CBRs, and

S is the standard deviation of all values.

Field Confirmation

Where practicable, the Design CBR obtained from laboratory testing should be confirmed by testing performed on existing road pavements near to the job site

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under equivalent conditions and displaying similar subgrades.

5. Where soft and/or wet subgrades occur and the insitu density is less than minimum subgrade compaction requirements specified in construction standards, the subgrade support adopted for pavement design shall be determined at the insitu density or a higher density, not exceeding minimum compaction requirements in C213 that may reasonably be achieved in construction. **Soft Subgrade**

7. Subgrade Separation

Where any of the following conditions occur, a separation membrane shall be provided:

Subgrade Separation

- Soft subgrade – CBR 3 or less
- Water table – less than 300mm below subgrade level
- Dispersible clay subgrade

A separation membrane shall consist of a non woven geotextile, 140 glm² or approved alternative permeable membrane.

8. The pavement design shall include a summary of all laboratory and field test results and assumptions and/or calculations made in the assessment of Design CBR. **Summary of Results**

D2.07 ENVIRONMENT

1. The environmental factors that which significantly affect pavement performance are moisture and temperature. Both of these factors must be considered at the design stage of the pavement. Reference should be made to Austroads Pavement Design Guide, APRG21- Guide to Design of New Pavements for Light Traffic & Austroads – Guide to Control of Moisture in Roads.

D2.08 PAVEMENT AND SURFACING MATERIALS

1. Pavement materials can be classified into essentially four categories according to their fundamental behaviour under the effects of applied loadings: **Pavement Classification**

- (a) Unbound granular materials, including modified granular materials
- (b) Bound (cemented) granular materials
- (c) Asphaltic Concrete
- (d) Cement Concrete

2. Surfacing materials can also be classified into essentially three categories or types:- **Surfacing Classification**

- (a) Sprayed bituminous seals (flush seals)
- (b) Asphaltic concrete and bituminous microsurfacing (cold overlay)
- (c) Cement Concrete

3. Unbound granular materials, including modified granular materials, shall satisfy the requirements of the Construction Specification for C242 FLEXIBLE PAVEMENTS.

4. Bound (cemented) granular materials shall satisfy the requirements of the Construction Specification for C242 FLEXIBLE PAVEMENTS.

5. Asphaltic concrete shall satisfy the requirements of the Construction Specification for C245 ASPHALTIC CONCRETE.
6. Cement concrete shall satisfy the requirements of the Construction Specifications for C248 CONCRETE BASE.
7. Sprayed bituminous seals shall satisfy the requirements of the Construction Specification for C244 SPRAYED BITUMINOUS SURFACING.
8. Concrete, clay segmental pavers and stencil concrete shall not be used on roads.
9. Bituminous microsurfacing (cold overlay) shall not be used for new road construction and other applications where approved by Council shall satisfy the requirements of the Construction Specification for C255 BITUMINOUS MICROSURFACING.

D2.09 CONSTRUCTION AND MAINTENANCE CONSIDERATIONS

1. The type of pavement, choice of base and subbase materials, and the type of surfacing adopted should involve consideration of various construction and maintenance factors as follows:
 - (a) Extent and type of drainage, stormwater and subsoil
 - (b) Use of boxed or full width construction
 - (c) Traffic characteristics including traffic volumes, heavy vehicles and turning movements
 - (d) Use of stabilisation
 - (e) Aesthetic, environmental and safety requirements including noise
 - (f) Social considerations
 - (g) Construction constraints including vibration limitations and construction under traffic
 - (h) Use of staged construction
 - (i) Ongoing and long-term maintenance costs

These factors are further discussed in AUSTRROADS Pavement Design.

PAVEMENT THICKNESS DESIGN

D2.10 PAVEMENT STRUCTURE – GENERAL

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. The minimum overall pavement thickness shall be 300 mm. Asphaltic Concrete surfacing less than 30mm shall not be included in the overall pavement thickness. | <p><i>Minimum
Pavement
Thickness</i></p> |
| <ol style="list-style-type: none"> 2. The subbase layer shall extend a minimum of 150mm behind the rear face of any kerbing and/or guttering and shall be a minimum of 150 mm in depth under the kerbing and/or guttering. | <p><i>Subbase
Extent</i></p> |
| <ol style="list-style-type: none"> 3. The base and surfacing shall extend to the face of any kerbing and/or guttering. Where the top surface of the subbase layer is below the level of the underside of the kerbing and/or guttering, the base layer shall also extend a minimum of 150mm behind the rear face of the kerbing and/or guttering. | <p><i>Base Extent</i></p> |

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4. For unkerbed roads, the subbase and base layers shall extend at least to the nominated width of shoulder. Where subsoil drainage is not provided, the subbase and base layers shall extend the full width of formation or to the table drain unless it is demonstrated that the subgrade is sufficiently well drained to permit boxed construction.

D2.11 UNBOUND GRANULAR FLEXIBLE PAVEMENTS (BITUMINOUS SURFACED)

1. Unbound and modified granular flexible pavements with thin bituminous surfacing with design traffic up to 5×10^5 ESAs shall be designed in accordance with APRG21, using Figure 13.8.2(A) (95% confidence limit curves).
2. For design traffic above 10^6 ESAs, the design shall be in accordance with AUSTRROADS Pavement Design.
3. The minimum thickness of unbound layers shall be 100mm.

D2.12 FLEXIBLE PAVEMENTS CONTAINING BOUND LAYERS (BITUMINOUS SURFACED)

1. Flexible pavements containing one or more bound layers, including cement stabilised layers or asphaltic concrete layers other than thin asphalt surfacings, shall be designed in accordance with AUSTRROADS Pavement Design.

2. Bound layers designed as a single layer are required to be placed and compacted as a single layer and notation shall be included on the drawings to this effect.

Bound Layer Design

Consideration to compaction requirements shall be given to deep lift bound layers. Deep lift layers shall not be included in designs for built up areas due to vibration effects during construction.

Deep Lift Compaction

Bound layers to be constructed as two or more layers shall be designed as separate debonded layers with corresponding reduction in design strength from single layer construction.

3. The minimum thickness of bound layers shall be 150mm.

The thickness of bound layers is critical to achieving design life and small reductions in thickness can result in significant reductions in pavement life. A tolerance of 20mm shall be added to the design pavement thickness of bound pavement layers to allow for construction tolerances.

Bound Layer Thickness

D2.13 RIGID PAVEMENTS

1. Rigid (concrete) pavements, with design traffic up to 10^6 ESAs shall be designed in accordance with either CACA -T33 or AUSTRROADS Pavement Design.
2. Rigid (concrete) pavements for design traffic above 10^6 ESAs, the design shall be in accordance with AUSTRROADS Pavement Design.
3. Single lane concrete bus bays adjacent to a flexible pavement shall be designed in accordance with CCA -TN52.

Rigid (Concrete)

D2.14 RESERVED

D2.15 RESERVED

SURFACING DESIGN

D2.16 CHOICE OF SURFACE TYPE

1. Shall be as follows:-

(a) Urban Residential streets (Refer table D1.5 – Geometric Road Design)

- two coat flush seal
- asphaltic concrete

or

- concrete

(b) Rural and Rural Residential streets

- two coat flush seal

(c) Commercial and Industrial streets:

- asphaltic concrete

or

- concrete

(d) Distributor and Arterial roads:

- asphaltic concrete

or

- concrete

However a two coat flush seal may be accepted if it is demonstrated that noise and surface life will meet required service level

(e) Roundabouts, traffic lights:

- minimum 100mm thick Asphaltic Concrete, consisting of 50mm AC10 base layer and 50mm AC10 Polymer Modified Bitumen (PMB) Surface Layer.

or

- concrete

3. Variations to these requirements may be approved by Council in special circumstances. **Variations**

D2.17 SPRAYED BITUMINOUS SEALS (FLUSH SEALS)

1. The design of sprayed bituminous (flush) seals, including primer seals, shall be in accordance with the RTA Sprayed Sealing Guide. **Seal Design**
2. Two-coat flush seals shall be double-double seals, comprising a minimum of two coats binder and two coats of aggregate, 1st coat 14 mm and 2nd coat 7 mm. **Two-Coat Flush Seals**

D2.18 BITUMINOUS MICROSURFACING (COLD OVERLAY)

1. Bituminous microsurfacing, also referred to as "cold overlay", where approved shall be designed to provide a nominal compacted thickness of not less than 8mm. **Minimum Thickness**
2. As a minimum, a 7mm primer seal and a single coat flush seal (14 or 10mm) shall be indicated on the Drawings below the bituminous microsurfacing. **Primer Seal and Single Coat Seal**

D2.19 ASPHALTIC CONCRETE

1. In light to medium trafficked residential, rural or commercial streets (design traffic up to approximately 3×10^5 ESAs), the asphalt mix design shall be either a 'high-bitumen content' mix or the ARRB Gap-graded mix in accordance with APRG21 and the Construction Specification C245 ASPHALTIC CONCRETE. **Light to Medium Traffic**
2. In medium to heavily trafficked residential, rural or commercial roads and in all industrial and classified roads, the asphalt mix design shall be a dense graded mix in accordance with the Construction Specification for C245 ASPHALTIC CONCRETE. **Medium to Heavy Traffic**
3. Asphaltic concrete surfacings shall be designed to provide a nominal compacted layer thickness of not less than specified in Table D1.5. **Minimum Thickness**
4. As a minimum, a 7mm primer seal shall be indicated on the Drawings below the asphaltic concrete surfacing. **Primer Seal**

D2.20 RESERVED

DOCUMENTATION

D2.21 DESIGN CRITERIA AND CALCULATIONS

1. As a minimum, a Geotechnical Report indicating considerations, assumptions, subgrade test locations & results, and calculations shall be submitted with the pavement design for approval by Council.
2. The Drawings shall clearly indicate the structure, material types and layer thicknesses of the proposed pavement and surfacing. The drawings shall also state the minimum subgrade CBR to be achieved and the corresponding DCP/PSPT requirement in blows/150mm.
3. Pavement design details required to be submitted to Council under this specification shall be certified by an approved Geotechnical or Civil Engineer.

**Submission
Details**

Drawings

SPECIAL REQUIREMENTS

D2.22 NOISE POLICY

Road surfacing choices shall give consideration to the requirements of the NSW Traffic Noise Policy 1999. Choice of road surfacing materials shall be made in conjunction with other design options for mitigation of traffic noise where required by the policy.

D2.23 GEOTEXTILES

Geotextiles including geofabrics and geogrids can provide options for design problems such as construction over poor subgrades and reinforcement of soft spots. Where geotextiles are included in the design, the design shall:

- be in accordance with design and construction requirements provided by the manufacture
- have sufficient overlaps to provide for development length for stresses
- include documentation of the design including manufacturer's design details shall be submitted to Council with the pavement design

D2.24 SUBSOIL DRAINAGE

Subsoil drainage shall be provided as per D04 – Subsoil Drainage..

D2.25 DEFINITIONS

Modified material – small addition of stabilising material (binder) to improve performance in properties such as wet strength. Typically modified gravels may contain up to 2% cement or lime by mass. Modified materials have an unconfined compressive strength (UCS) less than 1mpa. Modified pavements are designed as per flexible pavements.

Bound material – are produced by the addition of cement, lime or other binders sufficient to produce significant tensile strength. Lightly bound materials have UCS between 1-4mpa and bound materials have a UCS greater than 4mpa. Bound pavements are typically designed to limit strains in pavement layers to pre-determined criteria. Design procedures are included in Austroads Pavement Design.

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