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.

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

2. The Specification contains procedures for the design of the following forms of surfaced road pavement construction:

(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.

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.

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


EPA – NSW Traffic Noise Policy 1999
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:

   (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.

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.

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

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 AUSTROADS 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:
   (a) Sequence of earthworks construction
   (b) The compaction moisture content and field density specified for construction
   (c) Moisture changes during service life
   (d) Subgrade variability
   (e) 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.

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.

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

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.

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

7. Subgrade Separation

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

- 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.

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:

   (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:

   (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 MICRO SURFACING.

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 AUSTROADS Pavement Design.

PAVEMENT THICKNESS DESIGN

D2.10 PAVEMENT STRUCTURE – GENERAL

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.

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.

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.
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 $5 \times 10^5$ 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 AUSTROADS 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 AUSTROADS 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.

   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.

   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.

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 AUSTROADS Pavement Design.

2. Rigid (concrete) pavements for design traffic above $10^6$ ESAs, the design shall be in accordance with AUSTROADS Pavement Design.

3. Single lane concrete bus bays adjacent to a flexible pavement shall be designed in accordance with CCA -TN52.

D2.14 RESERVED
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
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 x 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.

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.
# CONTENTS

<table>
<thead>
<tr>
<th>CLAUSE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENERAL</td>
<td>1</td>
</tr>
<tr>
<td>D2.01 SCOPE</td>
<td>1</td>
</tr>
<tr>
<td>D2.02 OBJECTIVES</td>
<td>1</td>
</tr>
<tr>
<td>D2.03 REFERENCE AND SOURCE DOCUMENTS</td>
<td>1</td>
</tr>
<tr>
<td>D2.04 DESIGN VARIABLES</td>
<td>2</td>
</tr>
<tr>
<td>D2.05 DESIGN TRAFFIC</td>
<td>2</td>
</tr>
<tr>
<td>D2.06 SUBGRADE EVALUATION</td>
<td>3</td>
</tr>
<tr>
<td>D2.07 ENVIRONMENT</td>
<td>4</td>
</tr>
<tr>
<td>D2.08 PAVEMENT AND SURFACING MATERIALS</td>
<td>4</td>
</tr>
<tr>
<td>D2.09 CONSTRUCTION AND MAINTENANCE CONSIDERATIONS</td>
<td>5</td>
</tr>
<tr>
<td>PAVEMENT THICKNESS DESIGN</td>
<td>5</td>
</tr>
<tr>
<td>D2.10 PAVEMENT STRUCTURE – GENERAL</td>
<td>5</td>
</tr>
<tr>
<td>D2.11 UNBOUND GRANULAR FLEXIBLE PAVEMENTS (BITUMINOUS SURFACED)</td>
<td>6</td>
</tr>
<tr>
<td>D2.12 FLEXIBLE PAVEMENTS CONTAINING BOUND LAYERS (BITUMINOUS SURFACED)</td>
<td>6</td>
</tr>
<tr>
<td>D2.13 RIGID PAVEMENTS</td>
<td>6</td>
</tr>
<tr>
<td>D2.14 RESERVED</td>
<td>6</td>
</tr>
<tr>
<td>D2.15 RESERVED</td>
<td>7</td>
</tr>
<tr>
<td>SURFACING DESIGN</td>
<td>7</td>
</tr>
<tr>
<td>D2.16 CHOICE OF SURFACE TYPE</td>
<td>7</td>
</tr>
<tr>
<td>D2.17 SPRAYED BITUMINOUS SEALS (FLUSH SEALS)</td>
<td>8</td>
</tr>
<tr>
<td>D2.18 BITUMINOUS MICROSURFACING (COLD OVERLAY)</td>
<td>8</td>
</tr>
<tr>
<td>D2.19 ASPHALTIC CONCRETE</td>
<td>8</td>
</tr>
<tr>
<td>D2.20 RESERVED</td>
<td>8</td>
</tr>
<tr>
<td>DOCUMENTATION</td>
<td>9</td>
</tr>
<tr>
<td>D2.21 DESIGN CRITERIA AND CALCULATIONS</td>
<td>9</td>
</tr>
<tr>
<td>SPECIAL REQUIREMENTS</td>
<td>9</td>
</tr>
<tr>
<td>Section</td>
<td>Title</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>D2.22</td>
<td>NOISE POLICY</td>
</tr>
<tr>
<td>D2.23</td>
<td>GEOTEXTILES</td>
</tr>
<tr>
<td>D2.24</td>
<td>SUBSOIL DRAINAGE</td>
</tr>
<tr>
<td>D2.25</td>
<td>DEFINITIONS</td>
</tr>
</tbody>
</table>