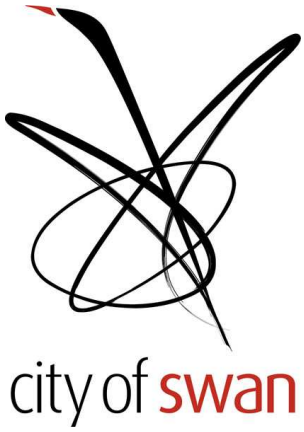

WESTERN AUSTRALIA

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 requirements 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	*Minimum Pavement Thickness*	*D2.10.1* *D2.10.2*	*A*	*YKW*	*January 2008*
2	*Clay segmental pavers*	*D2.20.2*	*M*	*YKW*	*July 2009*
3	*Seal Design*	*D2.17.1*	*M*	*YKW*	*July 2009*
4	*Referenced and Sourced Documents*	*D2.03*	*M,A*	*RMS*	*September 2019*
5	*Design Traffic*	*D2.05.1* *D2.05.2* *D2.05.4* *D2.05.5*	*A,0,M*	*RMS*	*September 2019*
6	*Subgrade Evaluation*	*D2.06.1* *D2.06.4*	*M*	*RMS*	*September 2019*
7	*Environment*	*D2.07.1*	*M*	*RMS*	*September 2019*
8	*Pavement and Surfacing Material*	*D2.08.2* *D2.08.9yg*	*O*	*RMS*	*September 2019*
9	*Construction and Maintenance Considerations*	*D2.09.1*	*M*	*RMS*	*September 2019*
10	*Pavement Thickness Design*	*D2.10.2* *D2.10.3* *D2.10.4*	*A,O,M*	*RMS*	*September 2019*
11	*Unbound Granular Flexible Pavements*	*D2.11.1* *D2.11.2*	*O,M*	*RMS*	*September 2019*
12	*Flexible Pavement Containing Bound Layers*	*D2.12.1* *D2.12.2*	*O,M*	*RMS*	*September 2019*
13	*Rigid Pavements*	*D2.13.1* *D2.13.2*	*O,M*	*RMS*	*September 2019*
14	*Concrete Segmental Pavers*	*D2.14.1* *D2.14.2*	*O,M*	*RMS*	*September 2019*

15	*Choice of Surface*	*D2.15.1*	*M*	*RMS*	*September 2019*
16	*Sprayed Bituminous Seals*	*D2.16.1* *D2.16.2* *D2.17.3*	*O,M*	*RMS*	*September 2019*
17	*Bituminous Microsurfacing (Cold Overlay)*	*D2.18.1* *D2.15.2*	*O*	*RMS*	*September 2019*
18	*Asphaltic Concrete*	*D2.17.1* *D2.17.3*	*M*	*RMS*	*September 2019*
19	*Segmental Pavers*	*D2.18.2*	*O*	*RMS*	*September 2019*

CONTENTS

PAVEMENT DESIGN

GENERAL

D2.01 SCOPE

Design Criteria

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.

Surfaced Pavement Types

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);

(d) concrete or clay segmental pavements.

Unsealed 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

Pavement Performance

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) Other

AUSTROADS - Guide to Pavement Technology Part 2: Pavement Structural Design, 2017.

AUSTROADS - Guide to Pavement Technology Part 4K: Selection and Design of Sprayed Seals

AUSTROADS - Guide to Pavement Technology Part 4B: Asphalt

Concrete Masonry Association of Australia.
CMAA – P01 - Concrete Segmental Pavements – Detailing Guide, 2014
CMAA – P02 - Concrete Segmental Pavements - Design Guide for Residential Access Ways and Roads, 2014
CMAA – P03 - Concrete Segmental Pavements – Specifying Guide, 2014

Institute of Public Works Australasia
IPWEA - Local Government Guidelines for Subdivisional Development, 2017

PAVEMENT DESIGN CRITERIA

D2.04 DESIGN VARIABLES

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

Minimum Pavement Design Life

1. The design traffic shall be calculated based on the following minimum design lives of pavement:-

(a) Flexible, Unbound Granular - 40 years

(b) Flexible, Containing one or more bound layers - 40 years

(c) Rigid (Concrete) - 40 years

(d) Segmental - 40 years

Equivalent Standard Axles

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 the subdivision development and the in-service traffic for the subdivision and for any future developments linked to that subdivision.

Traffic Data

3. The pavement design shall include all traffic data and/or assumptions made in the calculation of the design traffic.

4. Reference should be made to AUSTROADS Guide to Pavement Technology Part 2: Pavement Structural Design for all design traffic volumes. ***Design Traffic Volumes***

5. In the absence of other traffic data, the following traffic values may be taken as a guide to the design traffic, but shall be subject to variation depending on the circumstances for the particular development. ***Design ESAs***

ROAD TYPE	TRAFFIC AADT	% HVs	GROWTH %	Av. HV AXLE GROUP	ESAs/HV AG
INTEGRATOR A	15,000	5	2	2.3	0.8
INTEGRATOR B	10,000	5	2	2.2	0.7
NEIGHBOURHOOD CONNECTOR A	7,000	5	1	2.2	0.6
NEIGHBOURHOOD CONNECTOR B	3,000	5	0	2.2	0.6
ACCESS STREET A	APPROX. OR LESS THAN 1.00E+05 ESAs				
ACCESS STREET B					
ACCESS STREET C					
ACCESS STREET D					
LANEWAY					

D2.06 SUBGRADE EVALUATION

1. Except where a mechanistic design approach is employed using AUSTROADS Guide to Pavement Technology Part 2, 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). ***California Bearing Ratio***

2. The following factors must be considered in determining the design strength/stiffness of the subgrade: ***Design Considerations***

(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.

3. The subgrade Design CBR adopted for the pavement design must consider the effect of moisture changes in the pavement and subgrade during the service life, and hence consideration must be given to the provision of subsurface drainage in the estimation of equilibrium in-situ CBRs, and hence in the design of the pavement structure. Warrants for the provision of subsurface drainage are given in Specification for SUBSURFACE DRAINAGE DESIGN. If subsurface drainage is not provided, then the Design CBR adopted must allow for a greater variability in subgrade moisture content during the service life of the pavement, and hence a Design Moisture Content above the Optimum Moisture Content.

Design CBR

4. 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 (as per the guidelines in AUSTROADS Guide to Pavement Technology Part 2) to give an estimated equilibrium in-situ CBR. The Design CBR for each subgrade area is computed by using the appropriate formulae as follows:

Calculation of Design CBR

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

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

= C - 1.3S

Where C is the mean of all estimated CBRs, and
S is the standard deviation of all values.

5. Where practicable, the Design CBR obtained from laboratory testing should be confirmed by testing performed on existing road pavements near to the job site under equivalent conditions and displaying similar subgrades.

Field Confirmation

6. 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 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 Guide to Pavement Technology Part 2.

Reference

2. The following factors relating to moisture environment must be considered in determining the design subgrade strength/stiffness and in the choice of pavement and surfacing materials:

(a) Rainfall/evaporation pattern
(b) Permeability of wearing surface
(c) Depth of water table and salinity problems
(d) Relative permeability of pavement layers
(e) Whether shoulders are sealed or not
(f) Pavement type (boxed or full width)

3. The effect of changes in moisture content on the strength/stiffness of the subgrade shall be taken into account by evaluating the design subgrade strength

Evaluate Design CBR

parameters (ie. CBR or modulus) at the highest moisture content likely to occur during the design life, ie the Design Moisture Content. The provision of subsurface drainage may, under certain circumstances, allow a lower Design Moisture Content, and hence generally higher Design CBR.

Temperature Change

4. The effect of changes in temperature environment must be considered in the design of pavements with asphalt wearing surfaces, particularly if traffic loading occurs at night when temperatures are low, thus causing a potential reduction in the fatigue life of thin asphalt surfacing. The effect of changes in temperature environment should also be considered for bound or concrete layers.

5. The pavement design shall include all considerations for environmental factors, and any assumptions made that would reduce or increase design subgrade strength, or affect the choice of pavement and surfacing materials.

D2.08 PAVEMENT AND SURFACING MATERIALS

Pavement Classification

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

Surfacing Classification

2. Surfacing materials can also be classified into essentially five categories or types:-

(a) Sprayed bituminous seals (flush seals)

(b) Asphaltic concrete

(c) Cement Concrete

(d) Concrete Segmental Pavers

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

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

5. Asphaltic concrete shall satisfy the requirements of the Construction Specification for ASPHALTIC CONCRETE.

6. Cement concrete shall satisfy the requirements of the Construction Specifications for MASS CONCRETE SUBBASE or PLAIN OR REINFORCED CONCRETE BASE, as appropriate. (Clause not applicable within City of Swan)

7. Sprayed bituminous seals shall satisfy the requirements of the Construction Specification for SPRAYED BITUMINOUS SURFACING.

8. Concrete segmental pavers shall satisfy the requirements of the Construction Specification for SEGMENTAL PAVING.

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
(b) Use of boxed or full width construction
(c) Available equipment of the Contractor
(d) Use of stabilisation
(e) Aesthetic, environmental and safety requirements
(f) Social considerations
(g) Construction under traffic
(h) Use of staged construction
(i) Ongoing and long-term maintenance costs

These factors are further discussed in AUSTROADS.

PAVEMENT THICKNESS DESIGN

D2.10 PAVEMENT STRUCTURE - GENERAL

Minimum Pavement Thickness

1. The pavement thickness, including the thickness of surfacing, shall be determined in concurrence with City of Swan Standard drawing STD 200-2s. This drawing indicates minimum thicknesses based upon road hierarchy.

2. Notwithstanding subgrade testing and subsequent pavement thickness design, on sand subgrade, the thickness of subbase and base layers shall not be less than the following:-

(a) Flexible pavement : Refer to STD 200-2s
(b) Rigid pavement: Design is required

Subbase Extent

3. The subbase layer shall extend a minimum of 300mm behind the rear face of any kerbing (or 6omm beyond the edge of seal).

Base Extent

4. The base and surfacing shall extend to the face of any kerbing. Where the top surface of the subbase layer is below the level of the underside of the kerbing, the base layer shall also extend a minimum of 300mm behind the rear face of the kerbing.

5. For unkerbed roads, the subbase and base layers shall extend at least to the nominated width of shoulder.

Carparks

6. The pavement designer shall make specific allowance for traffic load concentrations within carpark areas (eg. entrances/exits).

Drainage

7. The pavement designer shall make provision for pavement layer drainage on the assumption that during the service life of the pavement ingress of water will occur.

D2.11 UNBOUND GRANULAR FLEXIBLE PAVEMENTS (BITUMINOUS SURFACED)

1. Unbound granular flexible pavements with thin bituminous surfacing's, including those with cement or lime modified granular materials, shall be designed in accordance with AUSTROADS Guide to Pavement Technology Part 2

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 surfacing's, shall be designed in accordance with AUSTROADS Guide to Pavement Technology Part 2.

D2.13 RIGID PAVEMENTS

Rigid (Concrete)

1. Rigid (concrete) pavements shall be designed in accordance with AUSTROADS Guide to Pavement Technology Part 2.

D2.14 CONCRETE SEGMENTAL PAVEMENTS

Concrete Segmental

1. Concrete segmental pavements shall be designed in accordance with CMAA – PO2 and AUSTROADS Guide to Pavement Technology Part 2.

SURFACING DESIGN

D2.15 CHOICE OF SURFACE TYPE

Bitumen Wearing Surface

1. Except where the pavement is designed for concrete or segmental block surfacing, the wearing surface shall be a bituminous wearing surface as follows:-

(a) Urban Residential streets - Access Places and Ways, and Rural Residential streets:

- primer seal plus two coat flush seal (rural roads only)

  or

- primer seal, plus asphalt.

(b) Urban Residential streets - Local Distributor and District Distributor (B):

- primer seal plus two coat flush seal (rural roads only)

  or

- primer seal, plus asphalt

(c) Commercial and Industrial streets:

- primer seal, plus asphalt

Braking and Turning Zones

2. At intersection approaches and cul-de-sac turning circles on residential streets with flush seals asphalt surfacing shall be provided within the vehicle braking and turning zones.

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

D2.16 SPRAYED BITUMINOUS SEALS (FLUSH SEALS)

1. The design of sprayed bituminous (flush) seals, including primer seals, shall be in accordance with the AUSTROADS Guide to Pavement Technology Part 4K: Selection and Design of Sprayed Seals. ***Seal Design***

2. 7mm primer seals shall be indicated on the Drawings below all flush seals, and asphalt surfacings. Where a 7mm primer seal is impractical, a 10mm primer seal shall be indicated in lieu. ***Primer Seal***

3. Single coat flush seal shall be one coat of binder and one coat of aggregates (14mm diorite). ***Single Coat Flush Seal***

D2.17 ASPHALTIC CONCRETE

1. In urban residential access and ways, rural or light trafficked commercial streets (design traffic up to approximately 10^5 ESAs), the asphalt mix designed in accordance with AUSTROADS Guide to Pavement Technology Part 4B: Asphalt. ***Light to Medium Traffic***

2. In urban residential local distributor and district distributor(B) roads, medium to heavily trafficked commercial streets and in all industrial roads, the asphalt mix design shall be a dense graded mix in accordance with the Construction Specification for ASPHALTIC CONCRETE. ***Medium to Heavy Traffic***

3. Asphaltic concrete surfacings shall be designed to provide a nominal compacted layer thickness of not less than 30mm on light to medium trafficked residential, rural and commercial streets, and 30mm on medium to heavily trafficked residential, rural or commercial roads and on all industrial and classified roads. ***Minimum Thickness***

4. As a minimum, a 7mm or 10mm primer seal shall be indicated on the Drawings below the asphalt surfacing. ***Primer Seal***

D2.18 SEGMENTAL PAVERS

1. Concrete segmental pavers shall be 80mm thick, shape Type A, interlocking and designed to be paved in a herringbone pattern. ***Size and Shape***

3. The edges of all paving shall be designed to be constrained by either kerbing or by concrete edge strips. ***Edge Constraint***

DOCUMENTATION

D2.19 DESIGN CRITERIA AND CALCULATIONS

1. All considerations, assumptions, subgrade test results, and calculations shall be submitted with the pavement design for approval by Council. ***Submission Details***

2. The Drawings shall clearly indicate the structure, material types and layer thicknesses of the proposed pavement and surfacing. ***Drawings***

SPECIAL REQUIREMENTS

D2.20 RESERVED

D2.22 RESERVED

D2.23 RESERVED

D2.24 RESERVED