Muswellbrook Shire Council

DEVELOPMENT DESIGN SPECIFICATION

AUS-SPEC (Cot 09)

0042 Pavement Design

Rev 2_2013

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
0	Customisation for Muswellbrook Council Local Government Area	all	AMOP		24/10/2011
1	*SURFACE TYPE*	4.1	AMO	SK	05/12/2013

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0042 PAVEMENT DESIGN

1 GENERAL

1.1 RESPONSIBILITIES

Objective

General: Select appropriate pavement and surfacing materials, types, layer thicknesses and configurations to ensure that the pavement performs to its design functions and requires minimal maintenance under the anticipated traffic loading for the design life adopted.

Criteria: This worksection covers the design of road pavement to meet the required design life, based on the subgrade strength, traffic loading, climatic conditions, environmental factors, and includes the selection of appropriate materials for subgrade, subbase, base and wearing surface.

1.2 CROSS REFERENCES

General

Requirement: Conform to the following:

- *0160 Quality (Design).*
- *0043 Subsurface drainage (Design).*
- *1131 Rolled concrete subbase.*
- *1132 Mass concrete subbase.*
- *1133 Plain or reinforced concrete base.*
- *1134 Steel fibre reinforced concrete base.*
- *1135 Continuously reinforced concrete base.*
- *1141 Flexible pavements.*
- *1143 Sprayed bituminous surfacing.*
- *1144 Asphaltic concrete (Roadways).*
- *1145 Segmental paving.*
- *1146 Bituminous slurry surfacing.*

Related worksections: The following worksection is related to this worksection:

- *0041 Geometric road layout.*

1.3 REFERENCED DOCUMENTS

Other publications

The following documents are incorporated into this worksection by reference:

- AUSTROADS
  - . AGRD01: 2006 Guide to Road Design Part1: Introduction to Road Design.
  - . AGRD02: 2006 Guide to Road Design Part 2: Design considerations.
  - . AP-T68: 2006 Update of the Austroads sprayed seal design method.
  - . AGPT02-2008 Pavement structural design.
- Cement and Concrete Association of Australia: C&CAA—T51: 2004 Guide to Residential Streets and Paths.
- Concrete Masonry Association of Australia:
  - . CMAA—T44: 1997 Concrete segmental pavements—Guide to specifying.
  - . CMAA—T45: 1997 Concrete Segmental Pavements—Design guide for residential access ways and roads.
- Clay Brick and Paver Institute: Design Manual 1Clay paving design and construction 2003.
- Clay Brick and Paver Institute: Techniques 15-1995 – Design Considerations for Clay Paved Roadways.

- Department of Environment and Climate Change, NSW: Specification for supply of recycled materials for pavements, earthworks and drainage, 2003.

1.4 STANDARDS

General

Standard: Road design To Austroads AGRD01 and AGRD02.

Design considerations: To AGRD02 Table 3.1.

Pavement structural design: To AGPT02.

2 DESIGN CRITERIA

2.1 PAVEMENT

Design variables

All proposed road pavements: Consider the following input variables for Urban and rural roads:

- Design traffic.
- Subgrade evaluation.
- Climatic conditions (For climatic zones see www.bom.gov.au).
- Environment – surface noise considerations (To AGPT02 Section 4).
- Pavement and surfacing materials – note any exclusions of local aggregates commonly available.
- Construction and maintenance considerations (To AGPT02 Section 3).

2.2 TRAFFIC

Standards

General: To AGPT02 Section 7 covers detailed considerations of traffic design parameters and Section 12 covers additional requirements for lightly trafficked pavements. Design traffic shall be calculated by fallowing the flow diagram shown in Figure 7.2: Procedure for determining design traffic AGPT02.

Minimum pavement design life

General: Select the design life to suit the design traffic conditions based on the following minimum design lives of pavement. Alternatively calculate the 'whole of life' costs and adopt an appropriate 'first cost' to select the pavement:

- Flexible, unbound granular: 25 years.
- Flexible, containing one or more bound layers: 25 years.
- Rigid (concrete): 40 years.
- Segmental block: 25 years.

Equivalent standard axles (ESA)

General: Calculate design traffic 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. AGPT02 Table 7.4 provides the values of cumulative growth factor for a range of annual growth rates and design period.

Interlocking concrete segmental pavements: The simplification of replacing ESA's with the number of commercial vehicles exceeding 3 tonne gross contained in CMAA—T45 is acceptable up to a design traffic of 10^6. Beyond this, calculate ESAs.

Traffic data

Pavement design: Include all traffic data and/or assumptions made in the calculation of the design traffic. Consider the width of structural pavement beyond the trafficked lanes to suit edge conditions and traffic movements. Any assumption made shall be clearly stated to council for approval.

Design traffic volumes

Calculation of design traffic volumes for lightly trafficked roads: To AGPT02 Section 12.7.

Calculation of design traffic volumes approaching or exceeding 10^6 ESAs: To AGPT02 *Pavement structural design.*

Guide to design ESAs

Traffic values (in ESAs): To AGPT02 Table 12.2 for lightly trafficked urban streets and to **Design ESA's 25 year design life table** subject to variation depending on the circumstances for the particular project. This is a guide line only, it may be used in the absence of traffic data and Designer shall consult and confirm these values with council for any particular project.

Council shall establish a higher ESA with the consideration of strategic planning in the local road network.

Design ESA's 25 year design life table

Street type	Design ESA's—25 year design life
Urban Residential - Access Street - Local Street - Collector Street Local Sub-Arterial	 6×10^4 3×10^5 1×10^6 2×10^6
Rural Residential	3×10^5
Commercial and Industrial	5×10^6

2.3 SUBGRADE EVALUATION

Design considerations

Design strength/stiffness of the subgrade: Consider the following factors:

- Sequence of earthworks construction.
- The compaction moisture content and field density specified for construction.
- Moisture changes during service life.
- Susceptibility to flooding.
- Subgrade variability.
- The presence or otherwise of weak layers below the design subgrade level.
- Stabilisation requirements.
- Dispersive soils.
- Plasticity parameters.
- Swell characteristics.
- Salinity.

California Bearing Ratio (CBR)

Except where a mechanistic design approach is employed using AUSTROADS AGPT02 *Pavement structural design* (or software designed for this purpose), as the measure of subgrade support, use the California Bearing Ratio (CBR).

Where a mechanistic design approach using linear elastic theory is employed for flexible pavements, the measure of subgrade support is in terms of the elastic parameters (modulus, Poisson's ratio).

Design CBR considerations

Adopted subgrade Design CBR: Consider the effect of moisture changes in the pavement and subgrade during the service life involving the following:

- Provision of subsurface drainage in the estimation of equilibrium in-situ CBRs.
- Design of the pavement structure.

Subsurface drainage: Refer to *0043 Subsurface drainage (Design)*. If subsurface drainage is not proposed, the Design CBR must allow for a greater variability in subgrade moisture content during the service life of the pavement with a design moisture content above the optimum moisture content.

Calculation of design CBR

Criteria: Conform to the following:

- Field determination of subgrade CBR (To AGPT02 Section 5.5)
  - . In situ CBR test.
  - . Cone penetrometers (it provides approximate CBR result)
- Laboratory determination of CBR and elastic parameters (To AGPT02 Section 5.6)
- Presumptive values for lightly trafficked roads. (To AGPT02 Section 5.7, Table 5.4)

Field confirmation

Testing: Confirm the Design CBR obtained from laboratory testing by site testing performed on existing road pavements near to the job site under equivalent conditions and displaying similar subgrades. Consider the use of dynamic cone penetrometer (DCP) in test pits within the subgrade for use in conjunction with CBR testing.

Summary of results
Pavement design: Include a summary of all laboratory and field test results and assumptions and/or calculations made in the assessment of Design CBR.

2.4 ENVIRONMENT

Environmental factors
Pavement design: 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.

Moisture and temperature
General: Consider moisture and temperature at the design stage of the pavement. Refer to AGPT02 Section 4.

Moisture considerations
Significant factors: Consider the following factors relating to moisture environment in determining the design subgrade strength/stiffness and in the choice of pavement and surfacing materials:

- Rainfall/evaporation pattern.
- Permeability of wearing surface.
- Depth of water table and salinity problems.
- Relative permeability of pavement layers.
- Whether shoulders are sealed or not.
- Pavement type (boxed or full width).

Design moisture content
Changes in moisture content: Evaluate the design subgrade strength parameters (i.e., CBR or modulus) at the highest moisture content likely to occur during the design life, i.e., the design moisture content.

Temperature changes
Asphalt wearing surfaces and bound or concrete layers: Consider the effect of maximum/minimum seasonal variations in temperature in the design of pavements, particularly if traffic loading occurs at night when temperatures are low and cause a potential reduction in the fatigue life of thin asphalt surfacing.

Specific location effects
In selection of pavement, consider the following:

- Freezing.
- Snow/ice removal (use of chemicals/salt).
- Mine subsidence.
- Bushfire heat.
- Extreme temperatures.
- Industrial traffic spills.

2.5 PAVEMENT AND SURFACING MATERIALS

Pavement classification
Pavement materials: Adopted classification according to their fundamental behaviour under the effects of applied loadings:

- Unbound granular materials, including modified granular materials.
- Bound (cemented) granular materials.
- Asphaltic Concrete.
- Cement Concrete.

Surfacing classification
Surfacing materials: Adopted classification:

- Sprayed bituminous seals (flush seals).
- Asphaltic concrete and bituminous slurry surfacing (cold overlay).
- Cement concrete.

- Concrete segmental pavers.
- Clay segmental pavers.

Materials

Pavement materials: To AGPT02 Table 6.1 for pavement material categories and characteristics.

Unbound granular materials including modified granular materials: To 1141 *Flexible pavements*.

Bound (cemented) granular materials: To 1141 *Flexible pavements*.

Asphaltic concrete: To 1144 *Asphaltic concrete (Roadways)*.

Cement concrete: To 1131 *Rolled concrete subbase*, 1132 *Mass concrete subbase*, 1133 *Plain or reinforced concrete bas*e, 1134 *Steel fibre reinforced concrete* or 1135 *Continuously reinforced concrete bas*e, as appropriate.

Sprayed bituminous seals: To 1143 *Sprayed bituminous surfacing*.

Concrete and clay segmental pavers: To 1145 *Segmental paving*.

Bituminous slurry surfacing (cold overlay): To 1146 *Bituminous slurry surfacing.*

2.6 CONSTRUCTION AND MAINTENANCE

Considerations

Construction and maintenance factors: Consider the following for the type of pavement, choice of base and subbase materials, and the type of surfacing adopted:

- Documentation of joints incorporated in the design.
- Extent and type of drainage.
- Use of boxed or full width construction.
- Available equipment of the Contractor.
- Use of stabilisation.
- Aesthetic, environmental and safety requirements.
- Social considerations.
- Construction under traffic.
- Use of staged construction.
- Ongoing and long-term maintenance costs.

3 PAVEMENT THICKNESS DESIGN

3.1 PAVEMENT STRUCTURE

Minimum pavement thickness

Pavement thickness, including the thickness of surfacings:

- Roads with kerb and channel (gutter): 250 mm.
- Unkerbed roads: 200 mm.
- Carparks: 150 mm.

Final thickness of subbase and base layers:

- Flexible pavement: Subbase 100 mm, base 100 mm
- Rigid pavement: Subbase 100 mm, base 150 mm

Subbase extent

Subbase layer: Minimum of 150 mm behind the rear face of any kerb and/or channel (gutter).

Base extent

Base and surfacing: To the face of any kerbing and/or channel (gutter).

Kerb conditions: If the top surface of the subbase layer is below the level of the underside of the kerb channel (gutter), extend the base layer a minimum of 150 mm behind the rear face of the kerb and/or channel (gutter).

Unkerbed roads: Extend the subbase and base layers at least to the nominated width of shoulder.

Carparks

Concentrations: Allow for traffic load concentrations within carpark areas (e.g. entrances/exits).

Drainage

Precautions: Make provision for pavement layer drainage on the assumption that during the service life of the pavement ingress of water will occur.

3.2 PAVEMENT DESIGN

Unbound granular flexible pavements – Bituminous surfaced

Criteria: Design unbound granular flexible pavements with thin bituminous surfacings, including those with cement or lime modified granular materials, with design traffic up to 10^6 ESAs to AGPT02 Figure 12.2.

For design traffic above 10^6 ESAs, use AGPT02 Figure 8.4 (or software designed for this purpose).

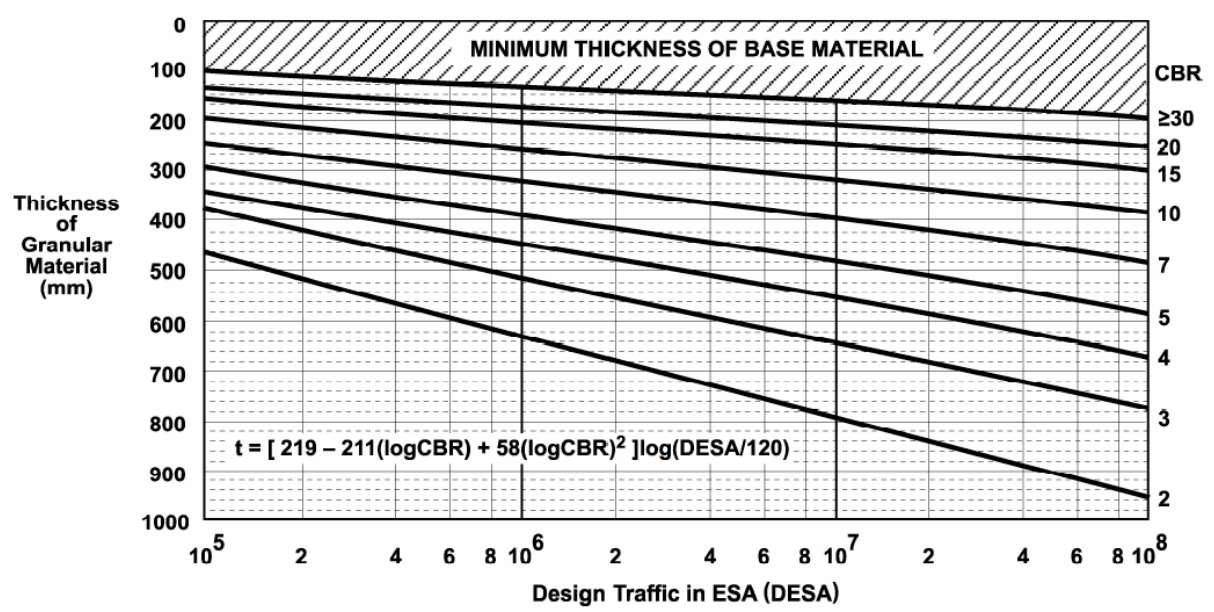
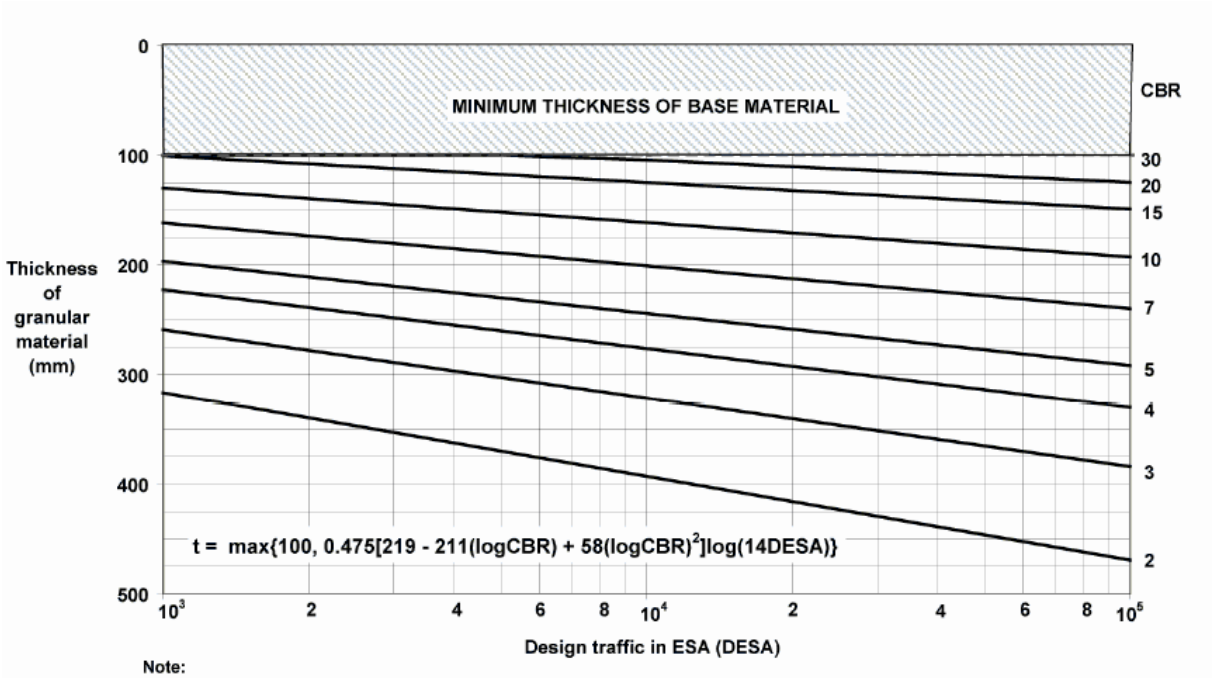


Figure 8.4: Design chart for granular pavements with thin bituminous surfacing



Note:
1. Appropriate local conditions, environmental and drainage issues must be considered in using these design curves.
2. Thin asphalt surfacings may be included in total granular thickness. However, the minimum thickness of the granular base is 100 mm.

Figure 12.2: Example design chart for lightly-trafficked granular pavements with thin bituminous surfacings

Source: Part 2 Pavement Structural Design - AGPT02-10 Figure 12.2 and Figure 8.4

Flexible pavements containing bound layers—Bituminous surfaced

Criteria: Design flexible pavements containing one or more bound layers, including cement stabilised layers or asphaltic concrete layers other than thin asphalt surfacings, to AGPT02 Section 8.4 (or software designed for this purpose).

Alternatively for design traffic up to 10^6 ESAs: Assume bound layers to be equivalent to unbound layers of the same thickness, and design the pavement to AGPT02 Section 12.8.3.

Rigid pavements

Criteria: Design rigid (concrete) pavements, with design traffic up to 10^6 ESAs to either CCAA-T51 *Guide to residential streets and paths* or AGPT02 Section 12.9 (or software designed for this purpose).

Criteria: Design rigid (concrete) pavements for design traffic above 10^6 ESAs to AGPT02 Section 9 (or software designed for this purpose).

Concrete segmental pavements

Criteria: Design concrete segmental pavements with design traffic up to 10^6 estimated commercial vehicles exceeding 3 T gross to CMAA-T45.

Clay segmental pavements

Criteria: Design clay segmental pavements with design traffic up to 10^6 ESAs to *CBPI Design Manual 1 – Clay paving design and construction* and CBPI Techniques 15 - Design Considerations for Clay Paved Roadways.

4 SURFACING DESIGN

4.1 SURFACE TYPE

Streets

Wearing surface specifications: Bituminous wearing surface as follows except where the pavement is designed for concrete or segmental block surfacing or Braking and turning zones:

Urban/rural residential streets: Access street and local street, alternatives:

- primer seal plus two coat flush seal, or
- primer seal, plus one coat flush seal, plus bituminous slurry surfacing; or
- primer seal, plus asphalt.

Urban/rural residential streets: Collector and local sub-arterial, alternatives:

- primer seal, plus one coat flush seal, plus bituminous slurry surfacing; or
- primer seal, plus asphalt.

Commercial and industrial streets:

- primer seal, plus asphalt.

Braking and turning zones

On residential streets with flush seals, provide asphalt surfacing with suitable binders within the vehicle braking and turning zones at:

- Culs-de-sac turning circles;
- Turning heads;
- Roundabouts; and
- Where otherwise specified in the approved plans.

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4.2 SURFACE TYPE PROPERTIES

Sprayed bituminous seals (flush seals)

Criteria: Sprayed bituminous (flush) seals, including primer seals to *AUSTROADS AP-T68 Sprayed seal design – 2003/04: Summary* or to the relevant State Road Authorities' Bituminous Surfacing Manual.

Primer seal: Indicate on the Drawings 7 mm primer seals below all flush seals, bituminous slurry surfacing, and asphalt surfacings. Conform to the following:

- Use size 5-7 mm aggregate < 200 v/l/d.
- Use 7-10 mm size aggregate > 200 v/l/d.
- If the conditions are either very hot and/or wet, and the traffic is in excess of 600 v/l/d, use size 10 mm aggregate.

Two-coat flush seals: Double-double seals, comprising a minimum of two coats binder and two coats of aggregate as follows:

- 1st coat—14 mm.
- 2nd coat—7 mm.

Single coat flush seal: If bituminous slurry surfacing (or asphaltic concrete) is to be applied as the finished surface, provide single coat flush seals either 14 mm or 10 mm thick.

Provide a copy of seals design to the council for the approval and documentation.

Bituminous slurry surfacing (cold overlay)

Minimum thickness: 8 mm nominal compacted thickness.

Primer seal and single coat seal: Indicate on the Drawings a 7 mm primer seal and a single coat flush seal on the drawings below the bituminous slurry surfacing.

Asphaltic concrete

Light to medium traffic: In urban residential access and local streets, rural or light trafficked commercial streets (design traffic up to approximately 3×10^5 ESAs), design the asphalt mix as either a 'high-bitumen content' mix or a mix to AGPT02 Section 6.5 and 1144 *Asphaltic concrete (Roadways).*

Medium to heavy traffic: In urban residential collector and sub-arterial roads, medium to heavily trafficked rural and commercial streets and in all industrial roads, design the asphalt mix as a dense graded mix to 1144 *Asphaltic concrete (Roadways).*

Minimum thickness: Design asphaltic concrete surfacings to provide a nominal compacted layer thickness:

- On light to medium trafficked residential rural and commercial streets: > 40 mm
- On medium to heavily trafficked residential, rural or commercial roads: 40 mm.

Primer seal: Indicate a 7 mm or 10 mm primer seal on the drawings below the asphalt surfacing.

Segmental pavers

Size and shape: Conform to the following:

- Concrete segmental pavers: 80 mm thick, shape Type A, and designed to be paved in a herringbone pattern.
- Clay segmental pavers: 65 mm thick, Class 4, and designed to be paved in a herringbone pattern.

Edge restraint: Design the edges of all paving to be constrained by either kerbing and/or guttering, or by concrete edge strips.

5 DOCUMENTATION

5.1 SUBMISSIONS

Design criteria and calculations

Documents: Submit all considerations, assumptions, subgrade test results, and calculations with the pavement design for approval by Council.

Drawings: Clearly indicate the structure, material types and layer thicknesses of the proposed pavement and surfacing.