FNQROC DEVELOPMENT MANUAL

OPERATIONAL WORKS

DESIGN GUIDELINES

D3

ROAD PAVEMENTS

Version No. 01/09

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GENERAL

D3.01 SCOPE

1. This section sets out the Guidelines for 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 Guideline contains procedures for the design of the following forms of road pavement construction:

   (a) Flexible pavements

   (b) Rigid pavements (ie. concrete pavements);

3. Generally flexible pavements designed in accordance with this guideline are preferred for road pavement construction in Far North Queensland. Council may examine pavement designs for rigid pavements subject to detailed engineering submissions of any such proposals. Council reserves the right to refuse any alternate proposal for pavement design.

D3.02 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.

D3.03 REFERENCE DOCUMENTS

Note: Where *Acts* or reference documents are updated, reference should be made to the current version.

Department of Main Roads

- Pavement Design Manual.

Australian Asphalt Pavement Association (AAPA)

- National Asphalt Specification

AUSTROADS / ARRB Publications

- Design of Sprayed Seals.
- Pavement Design, A Guide to the Structural Design of Road Pavements.
- Guide to Control of Moisture in Roads.
- ARRB-SR35 - Special Report No. 35 - Subsurface Drainage of Road Structures.
- APRG 21 - Report No. 21 - A guide to the design of new pavements for light traffic

Cement and Concrete Association of Australia.

- T51 Concrete Pavement Design for Residential Streets.

Concrete Masonry Association of Australia.

- T44 Concrete Segmental Pavements - Guide to Specifying.
- T45 Concrete Segmental Pavements - Design Guide for Residential Access Ways and Roads.
- T46 Concrete Segmental Pavements - Detailing Guide.

PAVEMENT DESIGN CRITERIA

D3.04 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 Factors

   (d) Pavement and Surfacing Materials

   (e) Construction and Maintenance Considerations

D3.05 DESIGN TRAFFIC

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

   (a) Flexible, - 20 years

   (b) Rigid (Concrete) - 40 years

   (c) Segmental Block - 25 years

2. Unless determined otherwise by the Council, the minimum number of design Equivalent Standard Axles (ESA's ie, 80 kN axle load passes) for the various road categories shall be as calculated in accordance with the requirements of the AUSTRODS publications “Pavement Design - A Guide to the Structural Design of Road Pavements” and “APRG Report 21 - A guide to the design of new pavements for light traffic”. For design traffic volumes approaching or exceeding 5×10^5 ESA’s (Trunk Collector Street), Main Roads Pavement Design Manual shall be used.

3. Design traffic shall be calculated 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, the in-service traffic, proposed and potential public Transport routes and connection to adjacent development.

4. For 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 5×10^5.

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

6. In the absence of other traffic data, the traffic values provided in Table D3.1 may be taken as a guide to the minimum design traffic, but shall be subject to variation depending on the circumstances for the particular development.

Table D3.1 Minimum Traffic Loadings

Street Type	%CV [1]	%ESA/CV	Minimum ESA's
Urban			
Access Place	3.6	1.0	5×10^4
Access Street	5	1.0	1×10^5
Minor Collector Street	7	1.0	5×10^5
Major Collector Street	10	1.0	1×10^6
Sub Arterial	10	1.0	1×10^6
Rural			
<250vpd	5	1.0	1×10^5
>250vpd	9	1.0	1×10^6
Industrial	To be determined by specific design data		5×10^5
Business / Commercial	To be determined by specific design data		5×10^5

Note

1. Consider potential for bus routes

D3.06 SUBGRADE EVALUATION

1. Subgrade evaluation shall be carried out by a NATA registered materials test authority on each different natural sub-grade material evident and shall be by the conduct of soaked 4 day CBR laboratory testing.

2. Design CBR for each subgrade area shall be determined in accordance with the method outlined in AUSTROADS publications “Pavement Design - A Guide to the Structural Design of Road Pavements” and “ARRG Report 21 - A guide to the design of new pavements for light traffic”.

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 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.

5. If the insitu subgrade test results in a CBR of 3 or less, the pavement is to be designed with input from geotechnical engineer experienced in the design of road pavements.

D3.07 ENVIRONMENT FACTORS

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 publications "Guide to Control of Moisture in Roads" and "Special Report No. 35 Subsurface Drainage of Road Structures".

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

   (d) Relative permeability of pavement layers

   (e) Whether shoulders are sealed or not

   (f) Pavement type (boxed or full width)

   (g) Subject to flooding (eg. Causeways and Floodways).

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 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.

4. 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.

D3.08 MATERIALS TESTING

1. All materials testing shall be carried out by a NATA registered materials testing authority using the procedures described in the manuals or codes of practice as appropriate to the following authorities:

   - Department of Main Roads
   - Standards Association of Australia

PAVEMENT THICKNESS DESIGN

D3.09 PAVEMENT STRUCTURE – GENERAL

1. The minimum pavement provided shall be as detailed in Table D3.2.

Table D3.2 Minimum Pavement Design Criteria

Street Type	Minimum Pavement (mm) [1]	Surface Treatment	Minimum Base Course CBR	Minimum Subbase Course CBR
Access Place / Access Street / Residential Street	200	minimum 30mm AC [3]	60	45
Collector Streets				
- Minor	250	minimum 30mm AC [3]	60	45
- Major	250	minimum 30mm AC [3]	80	60
Sub Arterial	300	50mm AC	80	60
Low Density Residential	200	Minimum 30mm AC	60	45
Rural & Rural Residential				
• < 100 vpd	150	2 coat seal	60	
• 100 – 999 vpd	200	2 coat seal	60	45
• > 1,000 vpd	200	2 coat seal	80	60
Industrial	250	50mm AC	80	60

Notes:

1. Minimum pavement thickness does not include the depth of surfacing.
2. All cul-de-sac heads and intersection turnouts in Rural and Rural Residential developments are required to have a 30mm asphalt surface treatment with a single coat seal.
3. In Cairns Regional Council, AC thickness to be increased to 50mm at intersections and roundabouts

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

   (a) Flexible pavement: Subbase 100mm, Base 100mm
   (b) Rigid pavement: Subbase 100mm, Base 150mm

3. The subbase layer shall extend a minimum of 150mm behind the rear face of any kerbing.

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 and/or guttering, the base layer shall also extend a minimum of 150mm behind the rear face of the kerbing. Regardless of pavement design, all kerbing to be constructed on a minimum of 100mm pavement material.

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

6. A change of pavement types may be considered for intersection thresholds and traffic control features.

D3.10 FLEXIBLE PAVEMENTS

1. Flexible pavements with a design traffic up to 5 x 10^5 ESA's shall be designed in accordance with AUSTROADS publications “Pavement Design - A Guide to the Structural Design of Road Pavements” and “ARRG Report 21 - A guide to the design of new pavements for light traffic”.

2. Flexible pavement with a design traffic above 5 x 10^5 ESA's shall be designed in accordance with Main Roads Pavement Design Manual.

3. In areas of high water table (within 300mm of subgrade level). Base course should be cement modified (1% by weight)

4. Concrete segmental pavements with design traffic up to 5 x 10^5 and estimated commercial vehicles exceeding 3T gross shall be designed in accordance with CMAA-T45.

5. For design traffic above 5 x 10^5 estimated commercial vehicles exceeding 3T gross the design shall be in accordance with AUSTROADS Pavement Design, with the calculation of design traffic in terms of ESA’s.

D3.11 RIGID PAVEMENTS

1. Rigid (concrete) pavements, with design traffic up to 5 x 10^5 ESA’s shall be designed in accordance with either CCAA -T51 or AUSTROADS Pavement Design.

2. Rigid (concrete) pavements for design traffic above 5 x 10^5 ESA’s, the design shall be in accordance with AUSTROADS Pavement Design.

SURFACING DESIGN

D3.12 BITUMEN WEARING SURFACE

1. Except where the pavement is designed for asphaltic concrete or segmental paver surfacing or where a gravel pavement is permitted, the wearing surface shall be a bituminous as follows:

(a) Urban Residential, Low Density Residential	-	Primer, plus 2 coat sprayed bitumen Seal (14mm / 7mm Aggregate).
(b) Rural & Rural Residential	-	Primer, plus 2 coat sprayed bitumen Seal (16mm / 10mm Aggregate).

D3.13 SEGMENTAL PAVERS

1. Segmental pavers shall be concrete segmental pavers 80mm thick, shape Type A, and designed to be paved in a herringbone pattern unless otherwise approved by Council. Concrete segmental pavements are only to be used for pathways and local pavement 'highlight' features (eg. 'threshold' treatments). The use of clay pavers on road wearing surfaces is not permitted.

2. The edges of all paving shall be constrained by either kerbing and/or guttering, or by concrete edge strips.

3. Sand bedding layers are to be provided with adequate drainage.

D3.14 ASPHALTIC CONCRETE [TRC, CRC]

1. All roadworks shall be surfaced with an appropriate thickness of Asphaltic Concrete in accordance with Table D3.2.

2. Council requires the use of dense graded asphalt on all roads.

3. All roads greater than 10% shall have a 10mm primer seal or other Council approved measure applied to the base course prior to the placement of the AC.

4. Asphalt Surfacing

    a. Where asphalt surfacing is required to be between 30mm and 50mm, it is considered to function as a wearing surface only

    b. Asphalt 40mm or thicker is required to be a dense graded asphalt (DG14) in accordance with Main Road's "Standard Specifications Roadworks"

    c. Asphalt of 30 – 40 mm thickness must be a dense graded asphalt (AC10) in accordance with the Australian Asphalt Pavement Association (AAPA's) "National Asphalt Specification"

    d. A light prime is to be applied over the pavement material prior to the asphalt being laid

SUBSURFACE DRAINAGE

D3.15 SUBSOIL DRAINS

1. Subsoil or sub-pavement drains shall be provided on both sides of the formation in the following locations, unless the geotechnical report indicates the absence of subsurface moisture at the time of investigation and the likelihood that changes in the subsurface moisture environment will not occur within the design life of the pavement and/or the pavement has been specifically designed to allow for likely variations in subgrade and pavement moisture contents:

   (a) Cut formations where the depth to finished subgrade level is equal to or greater than 400mm below the natural surface level.

   (b) Locations of known hillside seepage, high water table or isolated springs.

   (c) Irrigated, flood-prone or other poorly drained areas.

   (d) Subgrades, which are highly susceptible to moisture, (ie. commonly displaying high plasticity or low soaked CBRs).

   (e) Pavement materials, which are susceptible to moisture.

   (f) Existing pavements displaying signs of distress due to excess subsurface moisture.

   (g) At cut to fill transitions.

2. Subsoil drains shall always be installed to all grassed/landscaped central medians and islands, unless otherwise approved by council.

3. Where only one side of the formation is in cut, and the other side in fill, it may be sufficient to provide subsoil or sub-pavement drains only along the edge of the formation in cut.

4. In some circumstances it may be necessary to note on the engineering design the need for additional subsoil and sub-pavement drains that may become apparent during the construction process, due to changes in site moisture conditions or to areas of poorer subgrade being uncovered that were not identified in the geotechnical investigation.

5. The requirements for subsoil drains should be assessed and designed by a registered geotechnical engineer or specialist pavement engineer.

6. In kerbed roads, the preferred location for the line of the trench is directly behind the kerb.

7. In unkerbed roads, subsoil and sub-pavement drains shall be located within the shoulder, preferably at the edge of the pavement layers.

8. At the time of sub-soil drainage installation tree root barriers are to be installed in the appropriate locations and the kerb suitably marked (temporarily) to indicate where the tree is to be planted

9. The minimum desirable longitudinal design grade shall be 1.0 - 1.5%. (Absolute minimum grade of 0.5%).

10. Trench widths shall be a minimum of 300mm, with a minimum depth below finished subgrade level of 300mm in earth and 200mm in rock. All subsoil drain trenches shall be wrapped in an appropriate geotextile fabric.

11. Outlets shall be spaced at maximum intervals of 150 metres. Where possible, subsoil and sub-pavement drainage pipes shall discharge into gully pits or other stormwater drainage structures. Where not possible, outlets shall be provided through fill batters.

12. Flushing Points are to be provided at the commencement of each run of drain, and at intervals not exceeding 50 metres. Flushing points shall generally be located directly at the rear of kerb or at the edge of shoulder, as applicable.

13. Flushing Points and Outlets shall be constructed in accordance with Standard Drawing S1095**.**

D3.16 DRAINAGE MAT (BLANKETS)

1. Drainage mats are designed where there is a need to ensure continuity of a sheet flow of water under fills, to intercept and control seepage water and springs in the floors of cuttings, to intercept water which would otherwise enter pavements by capillary action or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water.

2. In embankments drainage mats are constructed after the site has been cleared and grubbed and before commencement of embankment construction.

3. In excavations drainage mats are constructed after completion of the subgrade construction and before construction of the pavement.

4. The minimum thickness of compacted filter material shall be 300mm plus an allowance for the expected consolidation or 500mm if the amount of consolidation of embankment foundation is not known.

5. The requirements for and design of drainage mats shall be undertaken by a geotechnical engineer experienced in the design of road pavements.

6. All drainage mats shall be wrapped in appropriate geotextile.