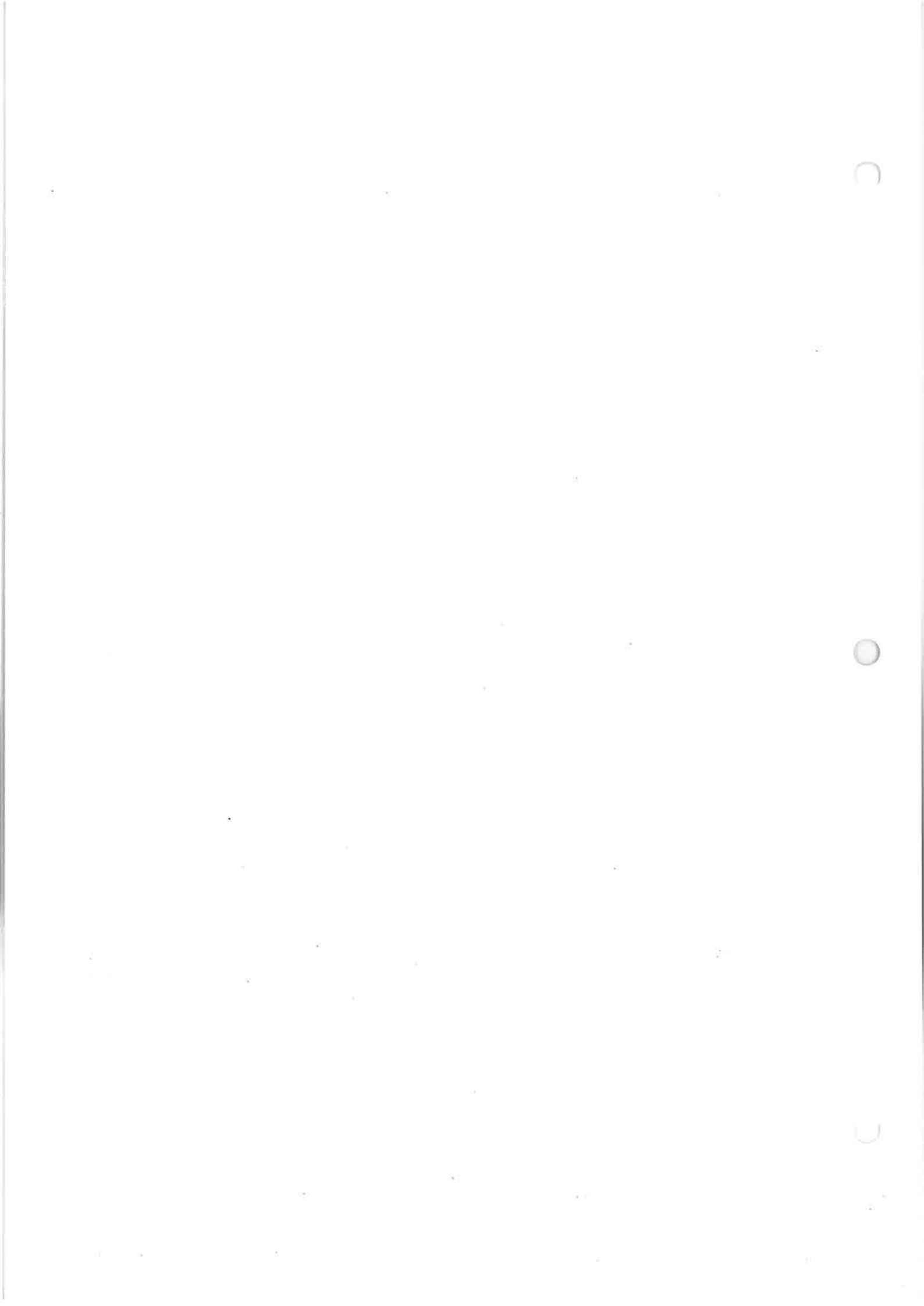


DEVELOPMENT DESIGN
SPECIFICATION

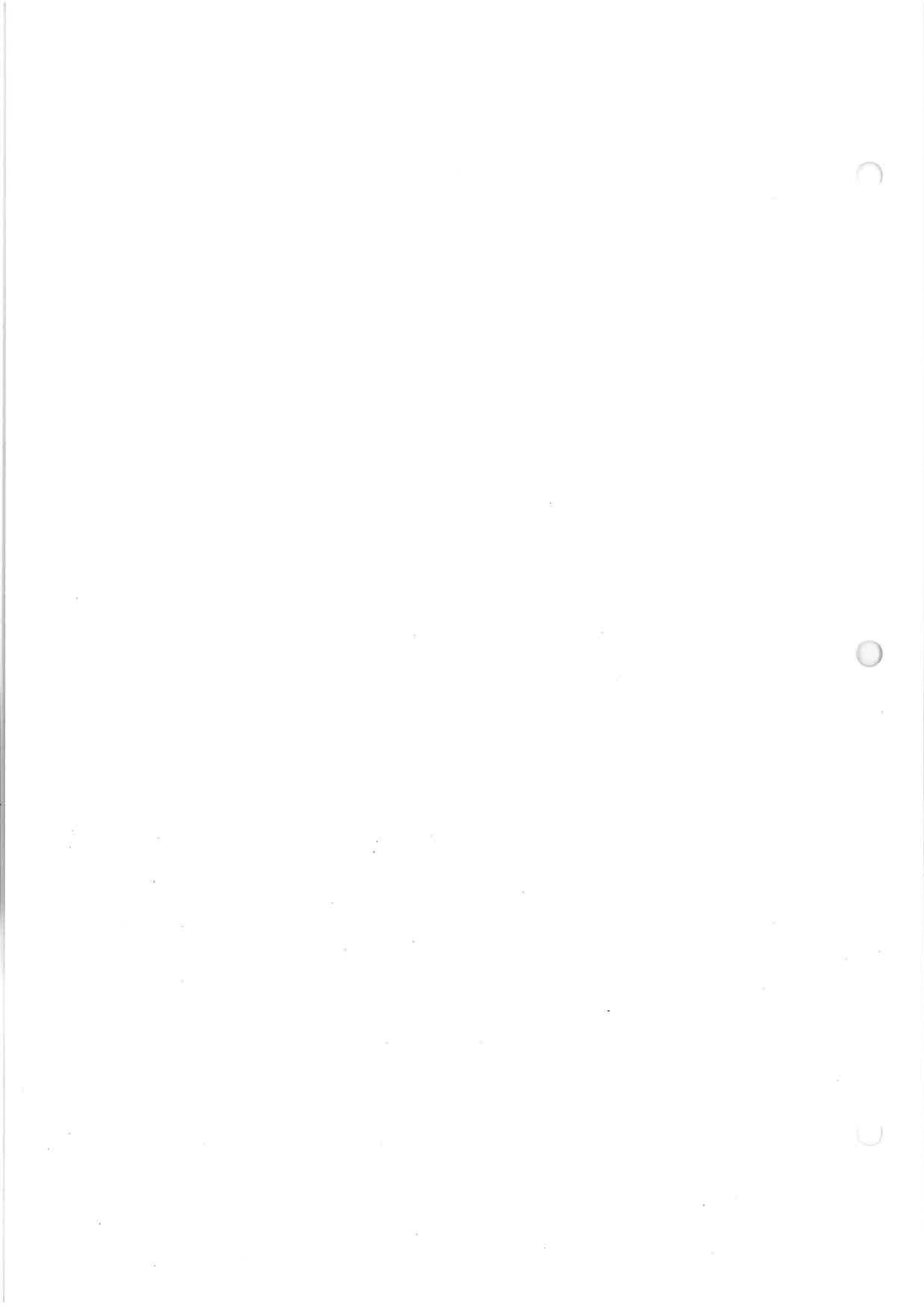
D4

**SUBSURFACE
DRAINAGE DESIGN**



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DEVELOPMENT DESIGN SPECIFICATION D4 SUBSURFACE DRAINAGE DESIGN

GENERAL

D4.01 SCOPE

1. The work to be executed under this Specification consists of the design of the subsurface drainage system for the road pavement and/or subgrade.
2. This specification contains procedures for the design of subsurface drainage, including:
 - (a) Subsoil and Foundation Drains
 - (b) Sub-Pavement Drains
 - (c) Drainage Mats, including Type A and Type B Mats.
3. Reference guidelines for the application and design of subsurface drainage include ARRB Special Reports 35 and 41, and the AUSTRROADS publication - Guide to the Control of Moisture in Roads. The full titles of these guidelines are given below.

D4.02 OBJECTIVES

- | | |
|--|--|
| 1. The objective for the design of the subsurface drainage system is to control moisture content fluctuations in the pavement and/or subgrade to within the limits assumed in the pavement design. | <i>Control
Moisture
Content</i> |
|--|--|

D4.03 TERMINOLOGY

- | | |
|---|--|
| 1. Subsoil drains are intended for the drainage of ground water or seepage from the subgrade and/or the subbase in cuttings. | <i>Subsoil Drains</i> |
| 2. Foundation drains are intended for the drainage of seepage, springs and wet areas within and adjacent to the foundations of the road formation. | <i>Foundation
Drains</i> |
| 3. Sub-pavement drains are intended for the drainage of the base and subbase pavement layers in flexible pavements. They may also function to drain seepage or groundwater from the subgrade. | <i>Sub-pavement
Drains</i> |
| 4. Type A drainage mats are intended to ensure continuity of a sheet flow of water under fills, to collect seepage from a wet seepage area, or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water. | <i>Type A
Drainage Mats</i> |
| 5. Type B drainage mats are constructed to intercept water, which would otherwise enter pavements by capillary action or by other means on fills, and to intercept and control seepage water and springs in the floors of cuttings. | <i>Type B
Drainage Mats</i> |

D4.04 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specification

- C230 - Subsurface Drainage - General
- C231 - Subsoil and Foundation Drains
- C232 - Pavement Drains
- C233 - Drainage Mats

(b) Australian Standards

- AS2439.1 - Perforated drainage pipe and associated fittings

(c) RTA Specifications

- MR Form 1160 - Supply and Delivery of Seamless Tubular Filter Fabric.
- 3555 - Slotted Fibre Reinforced Concrete Pipe for Subsurface Drainage

(d) Other

- AUSTROADS - Guide to the Control of Moisture in Roads, 1983
- ARRB-SR35 - Australian Road Research Board, Special Report No. 35 - Subsurface Drainage of Road Structures, Gerke R.J., 1987.
- ARRB-SR41 - Australian Road Research Board, Special Report No. 41 - A structural Design Guide for Flexible Residential Street Pavements, Mulholland P.J., 1989.

SUBSOIL AND SUB-PAVEMENT DRAINS

D4.05 WARRANTS FOR USE

1. Subsoil drains are designed to drain groundwater or seepage from the subgrade and/or subbase in cuttings. **Subsoil Drains**
2. Sub-pavement drains are designed to drain water from base and subbase pavement layers in flexible pavements, and to drain seepage or groundwater from the subgrade. **Sub-pavement Drains**
3. 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 content, subsoil or sub-pavement drains shall be provided on both sides of the formation in the following locations: **Geotechnical Survey**
 - (a) Cut formations where the depth to finished subgrade level is equal to or greater than 400mm below the natural surface level. **Locations**
 - (b) Locations of known hillside seepage, high water table or isolated springs.
 - (c) Irrigated, flood-prone or other poorly drained areas.

- (d) Highly moisture susceptible subgrades, ie commonly displaying high plasticity or low soaked CBRs.
- (e) Use of moisture susceptible pavement materials.
- (f) Existing pavements with similar subgrade conditions displaying distress due to excess subsurface moisture.
- (g) At cut to fill transitions.

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. The need for subsoil and sub-pavement drains may otherwise 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. The Design Drawings shall be suitably annotated to indicate the potential need for subsoil or sub-pavement drains in addition to those shown on the Drawings.

During Construction

D4.06 LAYOUT, ALIGNMENT AND GRADE

1. Typical cross sections of subsoil and sub-pavement drains are shown below in Figures D4.1 and D4.2. As indicated in these figures, subsoil drain trenches are excavated to below subgrade level, while sub-pavement drains extend into or adjacent to the pavement layers to facilitate drainage of the pavement layers in addition to the subgrade.

Typical Cross Sections

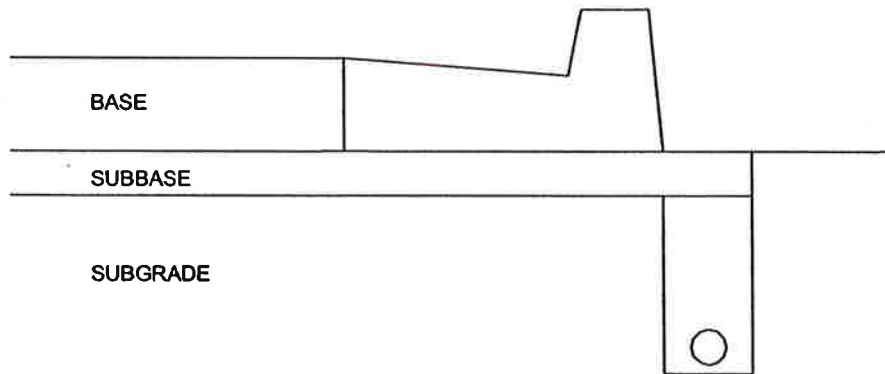


Figure D4.1 - Typical Subsoil Drain

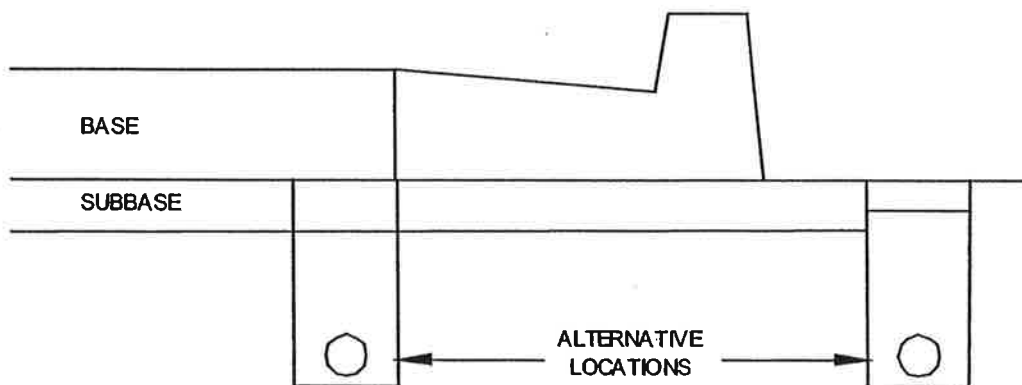


Figure D4.2 - Typical Sub-pavement Drain

SUBSURFACE DRAINAGE DESIGN

- | | | |
|----|--|--------------------------|
| 2. | In kerbed roads, the two acceptable alternative locations for the line of the trench are directly behind the kerb line. Pavement layers must extend to at least the line of the rear of the trench. | <i>Kerbed Roads</i> |
| 3. | In unkerbed roads, subsoil and sub-pavement drains shall be located within the shoulder, preferably at the edge of the pavement layers as shown in Figure D4.2. | <i>Unkerbed Roads</i> |
| 4. | The minimum desirable longitudinal design grade of drains shall be 1.0-1.5%. For non-corrugated pipes, an absolute minimum grade of 0.5% is acceptable. | <i>Grade</i> |
| 5. | Trench widths shall be a minimum of 300mm, with a minimum depth below finished subgrade level of 600mm in earth and 450mm in rock, and the pipe shall be below the invert level of any service crossings. | <i>Trench Dimensions</i> |
| 6. | Outlets shall be spaced at maximum intervals of 50 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. | <i>Outlets</i> |
| 7. | Cleanouts are to be provided at the commencement of each run of drain, and at intervals not exceeding 50 metres. Cleanouts shall generally be located directly at the rear of kerb or at the edge of shoulder, as applicable, and clearly marked either by inscribing on the kerb or a painted marking on an adjacent guidepost. | <i>Cleanouts</i> |

FOUNDATION DRAINS

D4.07 WARRANTS FOR USE

- | | | |
|----|--|--|
| 1. | Foundation drains are designed to drain excessive ground water areas within the foundation of an embankment or the base of cutting, or to intercept water from entering these areas. | <i>Foundation Drains</i> |
| 2. | The need to provide foundation drains may be apparent from the results of the geotechnical survey along the proposed road formation alignment, and in this case the location shall be shown on the plans. However, more commonly, the need to provide foundation drains is determined during construction, and hence in this situation requirements and locations cannot be ascertained at the design stage. | <i>Geotechnical Survey During Construction</i> |
| 3. | Where the road formation traverses known swampy, flood-prone, or water charged strata, the design Drawings shall be suitable annotated with the potential need for foundation drains at various locations, in addition to those shown on the Drawings. | |

D4.08 LAYOUT, ALIGNMENT AND GRADE

- | | | |
|----|---|------------------------------|
| 1. | Typical cross-sections of foundation drains are shown below in Figure D4.3. | <i>Typical Cross Section</i> |
|----|---|------------------------------|

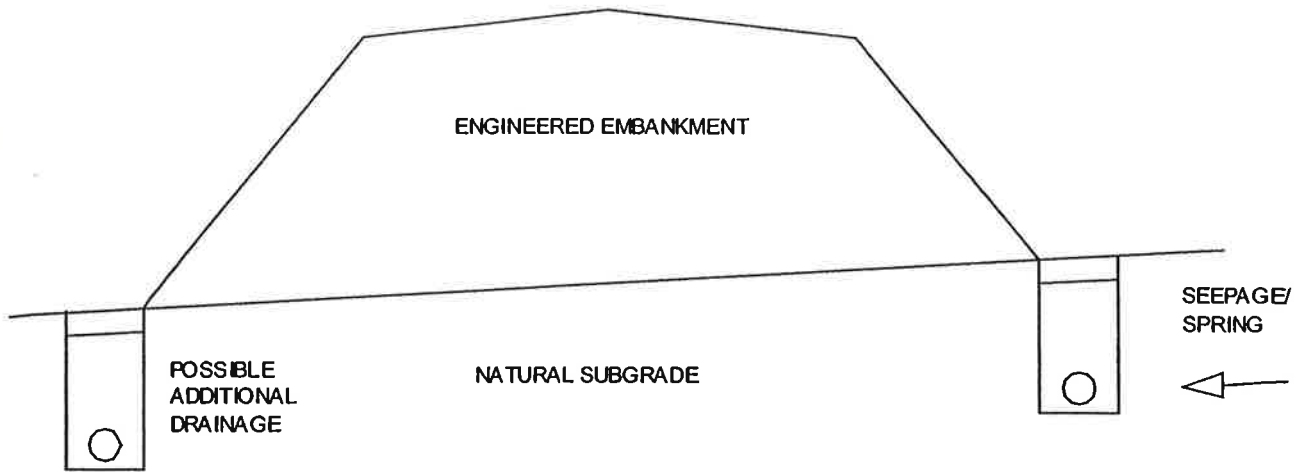


Figure D4.3 - Foundation Drains

- | | |
|---|---------------------------------|
| <p>2. The minimum desirable design grade shall be 1.0-1.5%. For non-corrugated pipes an absolute minimum grade of 0.5% is acceptable.</p> | <p>Grade</p> |
| <p>3. Foundation drains shall be a minimum trench width of 300mm, with a variable trench depth to suit the application and ground conditions on site.</p> | <p>Trench Dimensions</p> |
| <p>4. Outlets shall be spaced at maximum intervals of 80 metres.</p> | <p>Outlets</p> |
| <p>5. Where practicable, cleanouts are to be provided at the commencement of each run of foundation drain. Cleanouts shall be clearly marked either by inscribing on the kerb or a painted marking on an adjacent guidepost</p> | <p>Cleanouts</p> |

DRAINAGE MATS (BLANKETS)

D4.09 WARRANTS FOR USE

- | | |
|---|-----------------------------------|
| <p>1. Type A drainage mats are designed where there is a need to ensure continuity of a sheet flow of water under fills, to collect surface seepage from a wet seepage area, or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water. Type A drainage mats are constructed after the site has been cleared and grubbed and before commencement of embankment construction.</p> | <p>Type A Mats</p> |
| <p>2. Type B drainage mats are designed where there is a need to intercept water which would otherwise enter pavements by capillary action or by other means on fills, and to intercept and control seepage water and springs in the floors of cuttings. Type B drainage mats shall be constructed after completion of the subgrade construction and before construction of the pavement.</p> | <p>Type B Mats</p> |
| <p>3. The need to design for the provision of drainage mats should be apparent from the result of the geotechnical survey along the proposed road formation alignment.</p> | <p>Geotechnical Survey</p> |

MATERIALS

D4.10 SUBSOIL AND SUB-PAVEMENT DRAIN PIPE

1. Pipes designated for subsoil, foundation and sub-pavement drains shall be 100mm dia. slotted pipe.
2. Corrugated plastic pipe shall be Class 1000 conforming to the requirements of AS2439.1. Joints, couplings, elbows, tees and caps shall also comply with AS2439.1.
3. Slotted fibre reinforced cement pipe shall be designated type "100 DMR" meeting the requirements of RTA Specification No. 3555.
4. Slotted rigid UPVC pipe shall be of a type and class approved by Council.
5. All pipe shall be slotted, and fitted with seamless tubular filter fabric complying with MR Form 1160, except for cleanouts and outlets through fill batters which shall be un-slotted pipe.

D4.11 INTRA PAVEMENT DRAIN PIPE

1. Pipes for use in Type B Drainage Mats shall be 100mm diameter slotted fibre reinforced cement, type 100 DMR pipe, meeting the requirements of RTA Specification 3555. The pipe shall be designated for use in intra pavement drains where crushed rock subbase layer thicknesses are greater than 200mm, for edge drains where any part of the shoulder consists of material other than concrete, and for use in Type B Drainage Mats.

D4.12 FILTER MATERIAL

1. The types of filter material covered by this Specification shall include:
 - (a) Type A filter material for use in subsoil, foundation and sub-pavement (trench) drains and for Type B drainage mats.
 - (b) Type B filter material for use in subsoil, foundation and sub-pavement (trench) drains.
2. Material requirements and gradings for each type of filter material are included in the Development Construction Specification (C230), SUBSURFACE DRAINAGE GENERAL.
3. The type of filter material specified to backfill the sub-surface drainage trenches (subsoil, foundation and sub-pavement drains) shall depend on the permeability of the pavement layers and/or subgrade and the expected flow rate. Generally, Type A filter material is used for the drainage of highly permeable subgrade or pavement layers such as crushed rock or coarse sands, while Type B filter material is used for the drainage of subgrade and pavement layers of lower permeability such as clays, silts or dense graded gravels. Further guidance to the selection of appropriate filter material is contained in ARRB Special Report 35.

D4.13 GEOTEXTILE

1. Geotextile shall be designated to encapsulate the filter material. The Geotextile shall comply with the requirements included in the construction specification C230 SUBSURFACE DRAINAGE GENERAL.
2. Geotextile shall be designated for both Type A and Type B Drainage Mats.

DOCUMENTATION

D4.14 DESIGN DRAWINGS AND CALCULATIONS

1. The proposed location of all subsurface drains shall be clearly indicated on the Design Drawings, including the nominal depth and width of the trench, and the location with respect to the line of the kerb/gutter or edge of pavement. Where practicable, the location of outlets and cleanouts shall also be indicated on the Drawings.

2. Assumptions and/or calculations made in the determination of the need or otherwise for subsurface drainage in special circumstances or as a variation to the requirements of this specification shall be submitted to Council for approval with the Design Drawings.

