

DEVELOPMENT DESIGN SPECIFICATION

D4

SUBSURFACE DRAINAGE DESIGN

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 Report 35, Pavement Design for Light Traffic- A Supplement to Austroads Pavement Design Guide and the AUSTROADS publication - Guide Road Design – Part 5A: Drainage. The full titles of these guidelines are given below.

D4.02 OBJECTIVES

1. The objective in 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. ***Control Moisture Content***

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. ***Subsoil Drains***
2. Foundation drains are intended for the drainage of seepage, springs and wet areas within and adjacent to the foundations of the road formation. ***Foundation Drains***
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. ***Sub-pavement Drains***
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. ***Type A Drainage Mats***
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. ***Type B Drainage Mats***

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) RMS 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 Road Design – Part 5A: Drainage
- ARRB-SR35 - Australian Road Research Board, Special Report No. 35 - Subsurface Drainage of Road Structures, Gerke R.J., 1987.
- AUSTROADS - Pavement Design for Light Traffic – A Supplement to Austroads Pavement Design Guide

SUBSOIL AND SUB-PAVEMENT DRAINS

D4.05 APPLICATION

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. Subsoil or sub-pavement drains shall be provided on both sides of the formation in the following locations, unless otherwise justified by a geotechnical report:

Geotechnical Survey

- (a) Formations where the depth to finished subgrade level is equal to or greater than 400mm below the natural surface level.
- (b) Locations of known and/or potential hillside seepage, high water table or isolated springs.
- (c) Irrigated, flood-prone or other poorly drained areas.
- (d) Highly moisture susceptible sub-grades, i.e. commonly displaying high plasticity or low soaked CBRs.
- (e) Use of moisture susceptible pavement materials.
- (f) Existing pavements with similar sub-grade conditions displaying distress due to excess subsurface moisture.

Locations

- (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 the effect that subsoil or sub-pavement drains in addition to those shown on the Drawings shall be installed where and as directed by Council.

During Construction

D4.06 LAYOUT, ALIGNMENT AND GRADE

1. Typical cross sections of subsoil and sub-pavement drains are shown below in Figure D4.1. As indicated, 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 sub-grade.

Typical Cross Sections

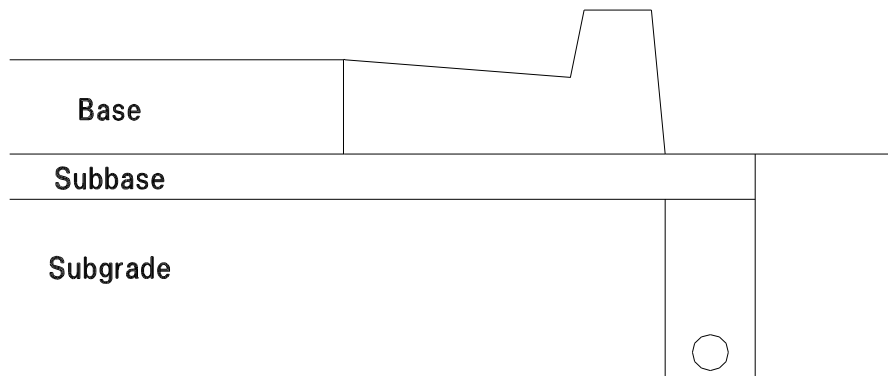


Figure D4.1 - Typical Subsoil Drain

2. In kerbed roads, the acceptable location for the trench is directly behind the rear of kerb as indicated in Figure D4.1. Pavement layers must extend to at least the line of the rear of the trench.

Kerbed Roads

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

Unkerbed Roads

4. The minimum longitudinal design grade shall be 0.5%.

Grade

5. Trench widths shall be a minimum of 300mm, with a minimum depth below finished subgrade level of 300mm in rock, 600mm in OTR and in all cases shall be below the invert level of any service crossings.

Trench Dimensions

6. Outlets shall be spaced at maximum intervals of 80 metres. Where possible, subsoil and sub-pavement drainage pipes shall discharge into stormwater pits or other stormwater drainage structures.

Outlets

FOUNDATION DRAINS

D4.07 APPLICATION

1. Foundation drains are designed to drain excessive ground water areas within the

Foundation

SUBSURFACE DRAINAGE DESIGN

foundation of an embankment or the base of cutting, or to intercept water from entering these areas.

Drains

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.

Geotechnical Survey During Construction

3. The Design Drawings shall be suitably annotated to the effect that foundation drains in addition to those shown on the Drawings shall be installed where and as directed by Council.

D4.08 LAYOUT, ALIGNMENT AND GRADE

1. Typical cross-sections of foundation drains are shown below in Figure D4.3.

Typical Cross Section

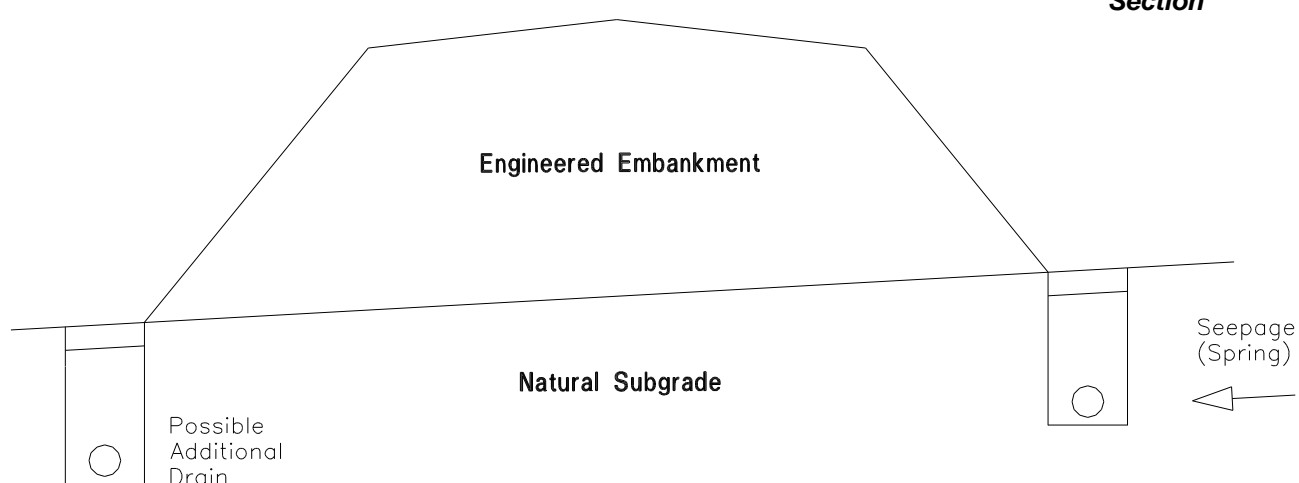


Figure D4.3 - Foundation Drains

2. The minimum acceptable design grade shall be 0.5%.

Grade

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.

Trench Dimensions

4. Outlets shall be spaced at maximum intervals of 80 metres.

Outlets

DRAINAGE MATS (BLANKETS)

D4.09 APPLICATION

1. Type A drainage mats are required 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.

Type A Mats

2. Type B drainage mats are required where there is a need to intercept water which

Type B Mats

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.

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.

***Geotechnical
Survey***

MATERIALS

D4.10 SUBSOIL AND SUB-PAVEMENT DRAIN PIPE

1. Pipes designated for subsoil, foundation and sub-pavement drains shall be minimum 100mm dia. slotted pipe.
2. Corrugated plastic pipe shall be Class 1000 conforming to the requirements of AS 2439.1. Joints, couplings, elbows, tees and caps shall also comply with AS 2439.1.
3. Slotted rigid UPVC pipe shall be of a type and class approved by Council.
4. All pipes shall be slotted, and fitted with seamless tubular filter. Outlets through fill batters shall be unslotted pipe.

D4.11 INTRA PAVEMENT DRAIN PIPE

1. Pipes for use in Type B Drainage Mats shall be designated 100mm diameter slotted fibre reinforced cement pipe, (designated type 100 DMR pipe) meeting the requirements of RMS Specification 3555. These pipes shall be designated for:
 - 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. Reserved
2. Material requirements and gradings for the filter material are included in the Construction Specification, SUBSURFACE DRAINAGE GENERAL.
3. The type of filter material specified to backfill the sub-surface drainage trenches (subsoil, foundation and sub-pavement drains) may depend on the permeability of the pavement layers and/or sub-grade and the expected flow rate. Guidance to the selection of appropriate filter material is contained in ARRB Special Report 35.

D4.13 GEOTEXTILE

1. Where necessary to provide separation (i.e. prevent infiltration of fines) between the filter material in the trench and the sub-grade or pavement material, geotextile shall be specified to encapsulate the filter material. The geotextile shall comply with the requirements included in the Construction Specification, SUBSURFACE DRAINAGE GENERAL.
2. Geotextile shall also be specified 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. The location of outlets shall also be indicated on the Drawings.

CONTENTS

CLAUSE	PAGE
GENERAL	1
D4.01 SCOPE	1
D4.02 OBJECTIVES	1
D4.03 TERMINOLOGY	1
D4.04 REFERENCE AND SOURCE DOCUMENTS	2
SUBSOIL AND SUB-PAVEMENT DRAINS	2
D4.05 WARRANTS FOR USE	2
D4.06 LAYOUT, ALIGNMENT AND GRADE	3
FOUNDATION DRAINS	3
D4.07 WARRANTS FOR USE	3
D4.08 LAYOUT, ALIGNMENT AND GRADE	4
DRAINAGE MATS (BLANKETS)	4
D4.09 WARRANTS FOR USE	4
MATERIALS	5
D4.10 SUBSOIL AND SUB-PAVEMENT DRAIN PIPE	5
D4.11 INTRA PAVEMENT DRAIN PIPE	5
D4.12 FILTER MATERIAL	5
D4.13 GEOTEXTILE	5
DOCUMENTATION	6
D4.14 DESIGN DRAWINGS AND CALCULATIONS	6