SECTION 705 - DRAINAGE PITS AND COVERS

##This section cross-references Sections 175, 610, 611, 689, 701 and 703.

If any of the above sections are relevant, they should be included in the specification.

If any of the above sections are not included in the specification, all references to those sections should be struck out, ensuring that the remaining text is still coherent:

705.01 GENERAL

This section specifies the requirements for the supply of materials and construction of drainage pits including the associated excavation, backfilling, culvert connections and supply and fitting of covers and associated components.

The design and construction of drainage pits and covers shall also comply with the Department of Transport and Planning (DTP) Bridge Technical Note BTN 033 – Structural Requirements of Reinforced Concrete Drainage Pits and Austroads Guide to Road Design Part 5: Drainage – General and Hydrology Considerations.

DTP was formerly known as Department of Transport (DoT) and VicRoads. DTP documents include relevant DoT and VicRoads documents which must also be complied with.

705.02 STANDARDS

Documents referred to in this Standard Section are listed in Table 705.02. Section 175 details the relevant references to these documents.

**Table 705.02: Referenced Documents**

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| Australian Standards, ASTM International |
| AS 1657 | Fixed platforms, walkways, stairways and ladders – Design, construction and installation |
| AS/NZS 3679.1 | Structural steel – Hot rolled bars and sections |
| AS 3996 | Access covers and grates |
| AS/NZS 4058 | Precast concrete pipes (pressure and non-pressure) |
| AS/NZS 4671 | Steel reinforcing materials |
| AS/NZS 4680 | Hot-dip galvanized (zinc) coatings on fabricated ferrous articles |
| AS 5100  | Bridge Design Set |
| ASTM C1116 | Standard Specification for Fiber-Reinforced Concrete |
| ASTM C1609 | Standard Test Method for Flexural Performance of Fiber-Reinforced Concrete (Using Beam With Third-Point Loading) |
| ASTM C1399 | Standard Test Method for Obtaining Average Residual-Strength of Fiber-Reinforced Concrete |
| ASTM D792 | Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement |
| ASTM D3822  | Standard Test Method for Tensile Properties of Single Textile Fibers |
| ASTM A820 | Standard Specification for Steel Fibres for Fibre-Reinforced Concrete |
| **Department of Transport & Planning** |
| BTN 033 | Determination of the Fibre Content of Fresh Concrete (Wash-out Method) |
| RC 377.01 | Structural Requirements of Reinforced Concrete Drainage Pits |

705.03 DEFINITIONS

**Drainage pit:** A reinforced concrete chamber constructed or installed below ground, which is designed to receive water from the surface and from connected upstream underground stormwater drain(s) and facilitate its discharge into a connected downstream stormwater drain.

**Fibre reinforced concrete (FRC):** A concrete mixture containing uniformly dispersed and randomly oriented fibres.

**Prototype testing:** Load testing of the first type of unit(s) from a specific design and production.

**Step Iron:** A structure comprising of a rung on which a person may stand on, step on or support off when ascending or descending inside a drainage pit.

**Stile:** A member that supports the treads or rungs of a ladder or stairway. The terms ‘side rail’ or ‘stringer’ are often used and are synonymous with ‘stile’.

**Ladders:** A structure comprising stiles and treads on which a person may stand on or step on when ascending or descending inside a drainage pit.

**Batch:** One truckload of a transit concrete agitator

705.04 MATERIALS AND COMPONENTS

1. Concrete

 (i) Portland Cement-based Concrete

 All concrete shall be manufactured to a DTP registered concrete mix design and comply with the requirements of Section 610. The concrete grades shall comply with Table 705.041.

**Table 705.041**

|  |  |
| --- | --- |
| **Minimum Concrete Grade** | **Used for:** |
| VR450/50 | Steel reinforced drainage pits |
|  | Fibre reinforced drainage pits |

 (ii) Geopolymer Concrete

 Geopolymer concrete as defined in Section 703 may be used for the construction of drainage pits provided the supply of geopolymer concrete and construction comply with the requirements of Section 610 and satisfy the concrete grade requirements of Table 705.041.

For precast drainage pits, the base units (or any other riser units to which incoming drainage pipes will be joined) shall be manufactured to suit the design configuration of the particular pit with pre-formed knockouts only in the walls that require them to be in accordance with BTN 033.

(b) Covers, Grates, Lids and Lintels

Covers, grates, lids and lintels shall be as shown on the drawings.

Metal access covers, grates and frames shall comply with AS 3996. Covers and grates shall not dislodge or rock in their frame when subjected to traffic loading. Covers and grates shall be of the lift out type, unless otherwise specified or shown on the drawings.

**HP A complying test Certificate shall be provided to the Superintendent at least 5 days prior to installation, certifying that pit access covers have been tested and certified by a NATA accredited laboratory as complying with the requirements of AS 3996 and DTP.**

For Class C pit access cover requirements, light weight material shall be used for drainage pit access covers. A maintenance safety lock shall be provided on the access cover for access security.

(c) Step Irons and Ladders

Step irons and ladders shall be manufactured from either cast iron, steel, aluminium or other material in accordance with the requirements of AS 1657. If step irons and ladders are fabricated from steel, they shall be made from AS/NZS 3679.1 Grade 250, or AS/NZS 4671 Grade N500 and after fabrication shall be prepared, pre-treated and hot dip galvanized in accordance with the requirements of AS/NZS 4680 with a minimum average coating thickness equivalent to 600 g/m2.

Alternatively, step irons may be manufactured from 13 mm diameter steel bar covered with polypropylene plastic to a design and sample approved by the Superintendent.

(d) Reinforcement

Steel reinforcement shall comply with the requirements of Section 611.

(e) Fibres

When relevant to the registered concrete mix, fibres shall comply with the requirements of ASTM C1116 and shall be supported with documentary evidence confirming their long term resistance to deterioration when in contact with the moisture and alkalis present in cementitious paste or the substances present in chemical admixtures.

Fibres shall be tested to the requirements of ASTM C1609 (flexural toughness) and ASTM C1399 (average residual strength of fibre reinforced concrete) to ensure compliance of the fibre reinforced concrete with the requirements of AS 5100.

1. Synthetic Fibres

Synthetic fibres shall be in the form of fine micro and macro virgin copolymer or polypropylene, consisting of twisted bundle non-fibrillated monofilament and fibrillated network fibre.

The synthetic fibre shall be capable of absorbing maximum energy without breakage and shall be designed to retain its cross sectional shape and avoid brittle failure.

1. Properties of synthetic fibre

The synthetic fibres shall possess the following properties:

* Tensile strength (ASTM D3822) > 550 MPa
* Modulus of elasticity (ASTM D3822) > 5.0 GPa
* Specific gravity (fibre density) (ASTM D792) > 0.91g/cm³
* Aspect ratio (length divided by the equivalent diameter of the fibre) between 70 and 170
1. Properties of synthetic fibre reinforced concrete

Synthetic fibre reinforced concrete shall possess the following properties:

* Average residual strength (ASTM C1399) > 1.0 MPa
* Flexural toughness (ASTM C1609) > 4.5 MPa
* Re3(Flexural toughness factor) (ASTM C1609) > 40%

Note: Re3 - % of flexural strength at 3 mm deflection of standard beam test.

1. Steel Fibres

Steel fibres shall comply with the requirements of ASTM A820 for Type I, cold drawn wire, or Type II, cut sheet.

All fibres shall be deformed and have a minimum tensile strength of 800 MPa and an aspect ratio between 40 and 70.

705.05 EXCAVATION

1. General

 Excavation shall be to the depth indicated on the drawings or as necessary to secure a satisfactory foundation. Backfill material conforming to the requirements of Section 701 shall be supplied, placed and compacted in accordance with clause 705.18.

1. Precast Pits

 For precast pits the excavation shall provide a clearance from all external faces of the pit to each face of the excavation of not less than 400 mm. Bedding conforming to the requirements of Section 701 shall be supplied, placed and compacted to a thickness not less than 80 mm on a clay foundation or 150 mm on a rock foundation.

705.06 CAST IN PLACE DRAINAGE PITS

Cast in place drainage pits shall be constructed at the locations and to the dimensions shown on the drawings.

Cast in place drainage pits shall be constructed in accordance with the requirements of this Section and BTN 033.

Cast in place drainage pits shall not be constructed with fibre reinforced concrete (FRC).

705.07 PRECAST STEEL REINFORCED CONCRETE DRAINAGE PITS

Precast steel reinforced concrete drainage pits shall be manufactured, supplied and installed in accordance with the requirements of this Section, BTN 033, Section 610 and 611.

**Where precast steel reinforced concrete drainage pits do not conform to DTP requirements, they shall be rejected.**

705.08 PRECAST FIBRE REINFORCED CONCRETE DRAINAGE PITS

1. General

Precast FRC drainage pits shall be manufactured, supplied and installed in accordance with the requirements of all relevant Australian Standards listed in Clause 705.02.

Precast FRC drainage pits shall be subject to the following conditions:

1. The design of FRC drainage pits shall comply with the requirements of AS 5100 and the loading requirements of BTN 033.
2. The design of the FRC drainage pits shall be supported by detailed drawings and design computations carried out by a prequalified consultant and proof engineered by a Proof Engineer who is prequalified in accordance with the DTP scheme for prequalification.
3. FRC drainage pits shall not be located under or adjacent to traffic lanes or shoulders of roads.
4. Concrete used for the construction of FRC drainage pits shall comply with the requirements of clause 705.04 and Section 610.

(b) Prototype Testing

A sample of two prototype FRC drainage pits shall be load tested in accordance with the requirements of AS 5100.5 Appendix A to demonstrate that FRC drainage pits manufactured under the same conditions, and to the same design, satisfy the requirements of this Section.

Where a new design or a significant departure from an accepted design is proposed, prototype testing, appropriate to the design or design change, shall be carried out in accordance with the requirements of this Section.

(c) Fibres

Fibres used in the manufacture of precast FRC drainage pits shall comply with the requirements of clause 705.04(f).

Fibres shall be added to the concrete in such a manner to ensure that they are uniformly distributed, balling does not occur, and the concrete mix remains workable and cohesive without any segregation.

(d) Fibre Content

The fibre content of fresh concrete shall be determined in accordance with the DTP fibre wash-out test method RC 377.01 as described in the DTP Code of Practice RC 500.16.

**The worksheet and/or report for determination of fibre content shall be submitted for review to the Superintendent.**

(e) Sampling and Testing for Fibre Content

Further to the requirements of clause 610.16(a) for sampling and testing of concrete, the fibre content shall be determined by sampling at a frequency of one test per five batches (truckloads) of concrete.

The concrete represented by the sample shall be deemed to comply if the fibre content as determined is within 1% of the fibre content in the approved mix design.

705.09 ADDITIONAL REQUIREMENTS FOR PRECAST CONCRETE DRAINAGE PITS

(a) General

Precast drainage pits shall be installed at the locations and to the dimensions shown on the drawings.

Precast concrete Circular Punch Out drainage pits shall comply with the requirements of AS/NZS 4058.

(b) Provision for Stormwater and Subsurface Drainage Connections

Provision shall be made for the connection of all stormwater drainage, culverts and subsurface drains as shown on the drawings.

Holes for subsurface drains shall be 150 mm diameter. Subsurface drain holes shall be sealed if not used.

50 mm diameter weep holes shall be provided in the walls which have openings for pipes and shall be placed halfway between the top of the drainage pit and the centre of the opening for the pipe.

The weep holes shall be encapsulated by a non-woven geotextile, minimum size of 300 mm x 300 mm, securely attached to the external face of the drainage pit wall.

(c) Segments

If a precast drainage pit is cast in segments, each section of the drainage pit shall be rebated to ensure correct alignment and to prevent horizontal movement. A minimum rebate of 15 mm shall be used.

(d) Completion on Site

Where precast drainage pits are to be completed on site, the provision of cut outs and protruding reinforcement shall be as specified or in accordance with the drawings.

(e) Modification to Existing Drainage Pits

Where existing drainage pits are to be modified, the pits must be assessed and designed in accordance with BTN 033.

705.10 TRENCH DRAINS

Trench drains shall withstand the load classes as defined by AS 3996. The materials used in the manufacture and supply of covers and grates for trench drains shall comply with the requirements of AS 3996.

705.11 STORMWATER DRAINAGE CONNECTIONS

All stormwater drainage connections to drainage pits shall be neatly made, and where necessary the ends of all drains shall be trimmed off and finished with cementitious mortar as stated in clause 705.15.

Openings into drainage pit walls to facilitate stormwater drainage connections shall be neatly saw cut to the required size.

Weep holes or holes installed on site shall be cut. Breaking out of holes is not permitted. Drainage pits shall be replaced if circumferential or longitudinal cracking occurs as a result of installing holes or if the hole exceeds the pipe diameter by more than 50 mm.

Reinforcement exposed by the cutting of holes shall be coated with an approved epoxy treatment to prevent corrosion prior to application of a repair mortar around the pipes in accordance with Section 689.

705.12 STEP IRONS AND LADDERS

Drainage pits greater than 1.0 m deep shall be fitted with step irons or ladders in accordance with AS 1657 and this Section.

Where drainage pits are extended in height from the lowest pit, step irons shall be located such that an equidistant spacing between step irons is maintained.

Proprietary step irons shall be installed in accordance with the manufacturer's instructions.

Where step irons are installed after the concrete pit wall has been cast and set, they shall be epoxy mortared into drilled holes using an epoxy material and method approved by the Superintendent. The joints between the step irons and the shafts shall be completely filled and neatly pointed so that the step irons are held rigid and the joints are watertight.

Ladders shall be located so that they do not obstruct openings and that water does not discharge onto them.

Ladder rungs shall be located directly below the opening in the cover and set into a wall which has no openings, or beside an opening, or across a corner of the pit. Ladder rungs shall have circular or rounded edges.

Ladders fabricated from steel shall be hot-dip galvanised in accordance with AS/NZS 4680 after fabrication.

705.13 SHAPING OF FLOOR

Drainage pit floors shall be smoothly shaped from the inlets to the outlet for a height of one‑third of the diameter of the outlet pipe with cementitious mortar, to provide a profile that will ensure smooth flow conditions between inlet and outlet pipes and prevent any snagging of debris. The cementitious mortar shall comply with the requirements of clause 610.33.

705.14 SURFACE FINISH

The method of construction and the materials used in the concrete and formwork shall remain consistent and shall comply with the requirements of this Section for surface finish.

Surfaces shall be finished uniform in appearance with a Class 2 surface finish in accordance with the requirements of Section 610.

705.15 JOINTING

The ends of components shall be free of any foreign matter at the time of jointing and shall be arranged to give best fit.

The joints between various components such as drainage pits, access chambers and pipes shall be made watertight using a cementitious mortar in accordance with the requirements of clause 610.33. The joint areas shall be thoroughly cleaned and wetted just prior to filling. The cementitious mortar shall be used within its allowable application time and shall not be retempered.

The joints shall be finished to provide smooth surfaces, uniform with the inner surfaces of drainage pits and access chambers.

Mortared joints and recesses shall be cured for a period of not less than 48 hours. Backfilling operations against end structures shall not be carried out during the curing period.

705.16 CONCRETE REPAIRS

The method of repair of minor surface imperfections including porous spots, shallow honeycombing, rough areas and blow holes not conforming to the class of surface finish as specified in clause 705.14.

The cementitious patch repair of other concrete defects shall be in accordance with Section 689.

Epoxy materials shall not be used for the patch repair of concrete.

The exposed surface of the repaired area shall be similar in texture and colour to the surrounding concrete.

705.17 FITTING OF COVERS

Frames for drainage pit covers shall be cast into the top of the drainage pit or bedded on fresh mortar, 5 mm thick, consisting of two parts of sand, one part of cement and sufficient water to produce a mix of suitable consistency.

The level at every point of the perimeter shall be within 10 mm of the design level for that point, and the line of the cover shall be within 10 mm of the design kerb line.

705.18 BACKFILLING AROUND DRAINAGE PITS

Backfilling around drainage pits shall be placed in layers not exceeding 300 mm loose thickness and compacted to refusal using handheld mechanical equipment.

705.19 TOLERANCES

The tolerances listed in Clause 610.47 are the allowable deviations of the finished product from the dimensions shown on the drawings. These tolerances will be a basis for acceptance of the work.