

Technical Specification

Transport and Main Roads Specifications MRTS26 Manufacture of Fibre Reinforced Concrete Drainage Pipes

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1 Introduction

This Technical Specification applies to the design, supply, and manufacture of fibre reinforced concrete drainage pipes used for the conveyance of stormwater in applications where the pipe is not subject to internal pressure.

Installation of pipes is to be in accordance with MRTS03 *Drainage, Retaining Structures and Protective Treatments*, by either trench or embankment conditions as defined by AS/NZS 3725.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements* and other Technical Specifications as appropriate.

This Technical Specification forms part of the Transport and Main Roads Specifications Manual.

2 Administrative requirements

Fibre reinforced concrete drainage pipes shall be manufactured only by a Transport and Main Roads registered supplier. The requirements for registration are outlined in the document *Registered suppliers manual*

For a copy of this document refer to the departmental webpage <http://www.tmr.qld.gov.au/business-industry/Business-with-us/Approved-products-and-suppliers/Bridges-and-other-structures-approved-products-and-suppliers>

To be eligible for registration as a registered supplier for the manufacture of fibre reinforced concrete pipes, a manufacturer shall:

- a) operate a Quality Management System certified to a minimum of AS/NZS ISO 9001 by a JAS/ANZ accredited certifier
- b) have established procedures for the manufacture of fibre reinforced concrete pipes, and
- c) have an inspection and test plan including Hold Points acceptable to the department for manufacturing fibre reinforced concrete pipes which demonstrates compliance with this specification (the inspection and test plan shall address supply of materials).

Registration as a registered supplier of fibre reinforced concrete pipes shall be reviewed at intervals varying from six months to three years depending on registration level, or earlier if unsatisfactory performance is reported.

For information on registered suppliers refer to the departmental website www.tmr.qld.gov.au

3 Referenced documents

Table 3 lists documents referenced in this Technical Specification.

Table 3 – Referenced documents

Reference	Title
AS 1726-1993	<i>Geotechnical Site Investigations</i>
AS 4139-2003	<i>Fibre Reinforced Concrete Pipes and Fittings</i>
AS 5100 Set-2007	<i>Bridge Design</i>
AS/NZS 3725:2007	<i>Design for Installation of Buried Concrete Pipes</i>
AS/NZS ISO 9001	<i>Quality Management Systems - Requirements</i>
MRTS01	<i>Introduction to Technical Specifications</i>
MRTS03	<i>Drainage, Retaining Structures and Protective Treatments</i>
MRTS50	<i>Specific Quality System Requirements</i>
MRTS70	<i>Concrete</i>
SMP-PC01	<i>Registration Scheme: Suppliers and Products for Bridges and Other Structures</i>

4 Quality system requirements

4.1 Hold Points, Witness Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are specified in Clause 5.2 of MRTS01 *Introduction to Technical Specifications*.

The Hold Points, Witness Points and Milestones applicable to this Technical Specification are summarised in Table 4.1.

Table 4.1 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
5.2	1. Approval of alternative design diameter		Submission of drawings or tabulations for alternative design diameter.
7(b)		1. Load testing for non standard pipes manufactured to order for a specific project.	
8.2	2. Supply of information prior to delivery of pipes to site.		Supply of information.
8.3	3. Supply of monthly conformance reports.		
9		2. Inspection of manufactured pipes.	

5 Design

Design of fibre reinforced concrete drainage pipes shall comply with the requirements of this Technical Specification and AS 4139 with the hierarchy of documents as listed in this Clause.

5.1 Design life

The design life of fibre reinforced concrete drainage pipes shall be 100 years. The design life means that 95% of the production shall remain in a serviceable condition with negligible maintenance for 100 years.

5.2 Design internal diameter

The design internal diameter as defined in AS 4139 shall not be less than 95% of the nominal internal diameter specified on the drawings for all classes of pipes. Where the design internal diameter does not meet these requirements, an alternative design internal diameter may be submitted to the Administrator for approval. Drawings showing the alternative design internal diameter shall be submitted not less than three weeks before supply of pipes is due to commence **Milestone**. No pipes of an alternative design internal diameter shall be supplied until written approval is granted by the Administrator **Hold Point 1**.

The design internal diameter is critical for the hydraulic performance of the pipe. Consideration of alternative smaller design internal diameters for pipes shall take into consideration the reduction in hydraulic performance. The external diameter of the pipe may also vary from standard designs. In this case compatibility with other elements such as pits and headwalls may need to be considered. In addition compatibility with existing installed pipes may also need to be considered.

5.3 Pipe joints

Joints between pipe lengths shall be flexible elastomeric double V ring joints as defined in Appendix M Figure (b) of AS 4139.

5.4 Durability and exposure conditions

The following definitions are applicable for exposure conditions for fibre reinforced concrete pipes:

- a) freshwater – chloride content less than 2000 ppm
- b) brackish water – 2000 to 8000 ppm
- c) saltwater – 8000 ppm or higher and or seawater.

Pipes supplied and manufactured in accordance with this Technical Specification shall be suitable for following underground and above ground environments:

- a) non aggressive soil, freshwater and brackish water conditions
- b) aggressive soil conditions as per Table 5.4, and
- c) all salt water conditions with the exception of above ground environments where the pipe is exposed to wave action or wind driven salt borne spray.

For potential and acid sulphate soil environments (PASS / ASS) exposure classifications shall be as defined in Table 5.4. Fibre reinforced concrete pipes manufactured in accordance with this Specification will require No Additional Protection (NAP) for exposure conditions identified as NAP in Table 5.4. Pipes to be installed in exposure conditions denoted Protection Required (PR) environments will require full protection or isolation from the environment as specified by the designer.

or pipe supplier, and as approved by the Director - Bridge Construction Maintenance and Asset Management.

Table 5.4 – Exposure conditions for FRC pipes in (PASS / ASS)

Acidity (pH)	Soil Classification	SO₄ in Groundwater (mg/l or ppm)			
		≤ 1500	> 1500 to ≤ 3000	> 3000 to ≤ 6000	> 6000
> 5.5	All Soil Types	NAP	NAP	NAP	PR
≤ 5.5 to > 5.0	All Soil Types	NAP	NAP	NAP	PR
≤ 5.0 to > 4.5	All Soil Types	NAP	NAP	NAP	PR
≤ 4.5 to > 3.5	Clay / Stagnant and Medium	NAP	NAP	NAP	PR
	Sandy/Flowing	PR	PR	PR	PR
≤ 3.5	All soil Types	PR	PR	PR	PR

Soil Type Definitions are as follows:

1. Clay / Stagnant = practically impervious for example homogeneous clays.
2. Medium – poorly draining soils for example fine sands, organic and inorganic silt, mixtures of silt, sand and clay, glacial till, and stratified clay.
3. Sandy / Flowing – well drained soils such as clean gravel, sands, and mixtures of sand and gravels.

In relation to soil types, further guidance may be found in or AS 1726 if required.

Approval of options for Protection Required (Applications) is the responsibility of the Director - Bridge Construction Maintenance and Asset Management and approval shall be project specific with correspondence through the Administrator.

When considering protective coatings, the combination of the coating and the fibre reinforced concrete pipe, must provide a 100 year design life in accordance with this Technical Specification. For PASS / ASS soil applications the coating would need to be acid resistant.

Sleeving the pipe through an inert pipe material with the gap between the pipe and the sleeve grouted or sealed would also be considered.

5.5 Design for installation

Fibre reinforced concrete pipes shall be designed for installation in accordance with AS/NZS 3725 with the following exceptions:

Clause 6.5 of AS/NZS 3725 shall be deleted and replaced by:

- a) the effects of superimposed live loads shall be calculated in accordance with AS 5100
- b) distribution of live loads shall be in accordance with AS 5100
- c) dynamic load allowance shall be as follows:
 - i. a value of 0.4 for zero fill height
 - ii. a value of 0.1 for fill heights of 2 m or higher

- iii. a linear interpolation between 0.4 and 0.1 for depths between zero and 2 m respectively.

Superimposed live loads shall be considered as detailed in Clauses 5.5.1 and 5.5.2 of this Technical Specification. These loads apply to both construction and service loads.

The effects of superimposed live loads are specified to be calculated in accordance with AS 5100 to be consistent with the design of all Transport and Main Roads infrastructure.

5.5.1 Construction loads

The following mandatory minimum construction load cases shall be considered in addition to loads associated with compaction of fill.

- a) Truck and dog trailer with a minimum height of compacted fill of 0.5 m over the top of the pipe. Load is defined in Figure 5.5.1(a).
- b) 25.9 tonne excavator and 580 mm compaction wheel acting separately with a minimum height of compacted fill of 1.0 m over the top of the pipe. Load is defined in Figure 5.5.1(b).

Where additional load cases other than those listed above are required as part of the construction sequence, these cases shall be designed and listed in Annexure MRTS26.1.

If the actual construction sequence results in lower fill heights, and or heavier equipment than those specified, then the pipe installation shall be redesigned with a higher load class of pipe, or different installation conditions.

Figure 5.5.1(a) – Design load truck and dog trailer

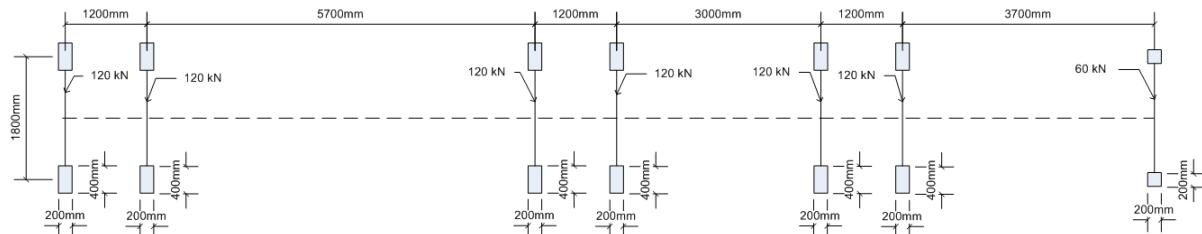
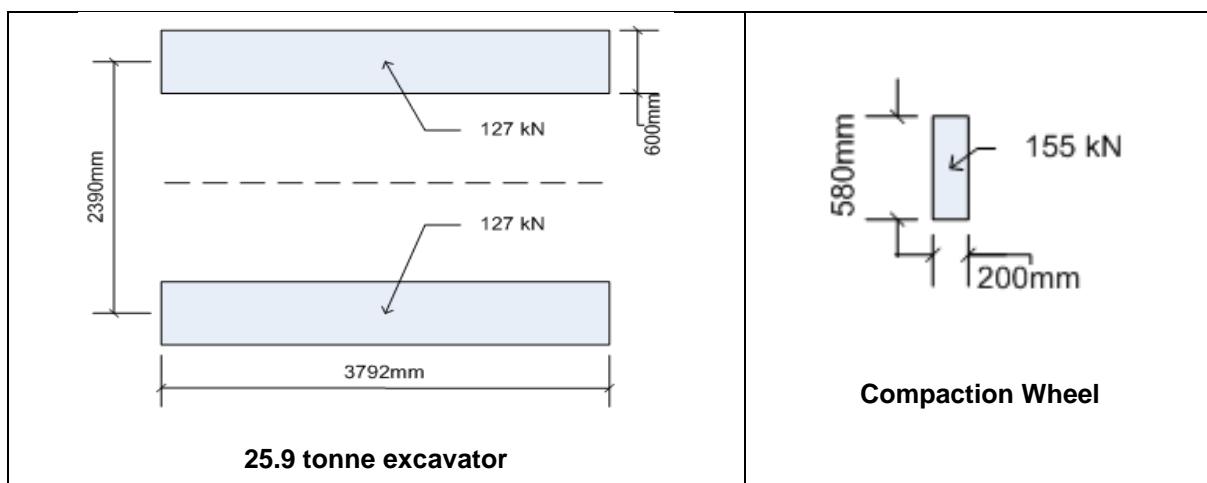


Figure 5.5.1(b) – Design load 25.9 t excavator and 580 mm wide compaction wheel



Design of the pipe and installation for construction load cases is critical, including consideration of loading during placement and compaction of fill around the pipe.

In addition to loads associated with the compaction of fill around the pipe, MRTS26 nominates two construction load cases which must be considered by designers.

To aid the designer Appendix A, Figure A1 shows the relationship between fill height and pipe load class for the truck and dog trailer (T54) construction load case for the following conditions:

- a) the embankment installation condition with positive projection
- b) soil type wet clay
- c) support types H1, H2/HS1 and HS2.

The installation conditions and support types are as defined in AS/NZS 3725. Load cases and or installation conditions that are not covered by this information must be considered separately by the designer. Typically the embankment installation condition with positive projection is the installation condition which provides the highest load on the pipe.

Likewise as a design aid only, Appendix A, Figure A2 shows the relationship between fill height and pipe load class for the same installation conditions for the 25.9 tonne excavator and 580 mm wide compaction wheel acting separately. Again load cases that are not covered by this information must be considered separately by the designer.

It is critical for both the designer and the construction team to note that if load cases outside of these two minimum specified load cases are required during the construction sequence, then these cases must be considered separately and the pipe load class and or installation conditions modified to suit. Details of these alternative cases must be listed in Annexure MRTS26.1.

5.5.2 Road vehicle loads

W80, A160, SM1600 and HLP400 as defined in AS 5100 for the completed fill height.

Maximum live load pressures due to the design road vehicle load distributed in accordance with AS 5100 are as listed in Table 5.5.2.

Table 5.5.2 - Live load pressure for AS 5100 road vehicle loads

Depth (m)	Wheel Load Pressure (kPa)	Depth (m)	Wheel Load Pressure (kPa)
0.40	246	2.80	19
0.60	129	3.00	18
0.80	78	3.20	17
1.00	52	3.40	17
1.20	37	3.60	16
1.40	27	3.80	16
1.60	24	4.00	15

Depth (m)	Wheel Load Pressure (kPa)	Depth (m)	Wheel Load Pressure (kPa)
1.80	23	4.20	15
2.00	22	4.40	14
2.20	21	4.60	14
2.40	20	4.80	13
2.60	19	5.00	13

5.6 Strength requirements

All pipes manufactured in accordance with this Technical Specification shall comply with the rigid pipe strength requirements of Clause 11.1(a) of AS 4139, with the load regression factor (R) determined in a manner consistent with the design life of 100 years as defined by Clause 5.1 of this Technical Specification.

6 Material

Material used in the manufacture of fibre reinforced concrete drainage pipes shall comply with AS 4139. In addition cement, supplementary cementitious materials, and aggregates shall comply with MRTS70 Concrete and be supplied in accordance with MRTS70.

7 Manufacture

Fibre reinforced concrete drainage pipes shall be manufactured in accordance with AS 4139 with the following exceptions:

- a) Long term design loads shall be as per Table 1 of AS 4139 for Load Classes 1 to 4. For higher load classes check availability and appropriateness with the manufacturer.
- b) One pipe per 100 pipes or part thereof of each size and class shall be load tested in accordance with Clause 11.1 of AS 4139. Load testing of non standard pipes ordered for specific projects shall be a **Witness Point 1**
- c) One pipe per 50 pipes or part thereof each size and class shall be tested for internal diameter, wall thickness, pipe length, squareness of ends, and straightness in accordance with the dimension and tolerance requirements of Clause 10 of AS 4139.

Testing for restrictions on chemical content as described in Section 6.1.7 of AS 4139 shall be at six monthly intervals.

The manufacturer's stated value for water absorption shall not exceed 25.

8 Supply

8.1 General

The Contractor shall provide to the Administrator the information specified in Clauses 8.2 and 8.3, obtained from the fibre reinforced concrete pipe manufacturer and included in the quality records, in accordance with the times specified.

8.2 Prior to delivery of pipes to the site

The following information shall be provided to the Administrator three weeks before any pipes are delivered to the Site. **Milestone** No pipes shall be delivered to the site until written acceptance has been obtained from the administrator. **Hold Point 2**:

- a) the type of fibre used in the pipe
- b) the test methods and values used to control the properties of the fibre
- c) drawings or tabulations showing critical dimensions of the pipes and joints including wall thickness for different classes of pipe
- d) the methods of manufacture and testing
- e) the type of cement used
- f) the water absorption value, and
- g) the values of C and R, as defined by AS 4139 and amended loads, with test data (not more than two years old and for the current material formulation) establishing these values and the results of any screening evaluation performed.

8.3 With the delivery of each batch of pipes

With each batch of pipes delivered to the Site a delivery docket shall be supplied that provides traceability to a conformance report for the batch. The delivery docket shall also state that the pipes conform to the requirements of AS 4139 and this Technical Specification.

At no less than monthly intervals, the Contractor shall provide a conformance report issued by the fibre reinforced concrete pipe manufacturer, confirming that the pipes supplied comply with the requirements of AS 4139 and this Technical Specification along with copies of test results as described in Clause 7 (b) and (c) for the pipes supplied. Final acceptance of pipes shall be subject to receipt and acceptance of this report by the Administrator **Hold Point 3**

9 Inspection and Delivery

Fibre reinforced concrete pipes shall remain available for inspection either at the place of manufacture, or on site before installation, for a minimum of seven days after notification to the Administrator. **Witness Point 2**

It is generally expected that the most practical method will be for the Administrator to inspect the pipes on site prior to installation.

10 Product marking

In addition to the requirements in AS 4139, all pipes manufactured in accordance with this Technical Specification will be marked "MRTS26" or other agreed identification acceptable to Transport and Main Roads, Director - Bridge Construction, Maintenance and Asset Management.

11 Installation

Pipes shall be installed as specified in MRTS03 *Drainage, Retaining Structures and Protective Treatments*. Pipes shall not be installed until all test results as described in Clause 7 (b) and (c) have been provided and are conforming for the batch of pipes supplied.

The maximum angle of deflection of joints is two degrees.

Pipes shall be installed in accordance MRTS03 *Drainage, Retaining Structures and Protective Treatments*, the nominated loading and installation conditions in Clause 5.5 of this Technical Specification, and as detailed in Annexure MRTS26.1.

Appendix A – Design guide for construction loads

Figure A1 - Fill height and pipe load class for various installation conditions for truck and dog trailer

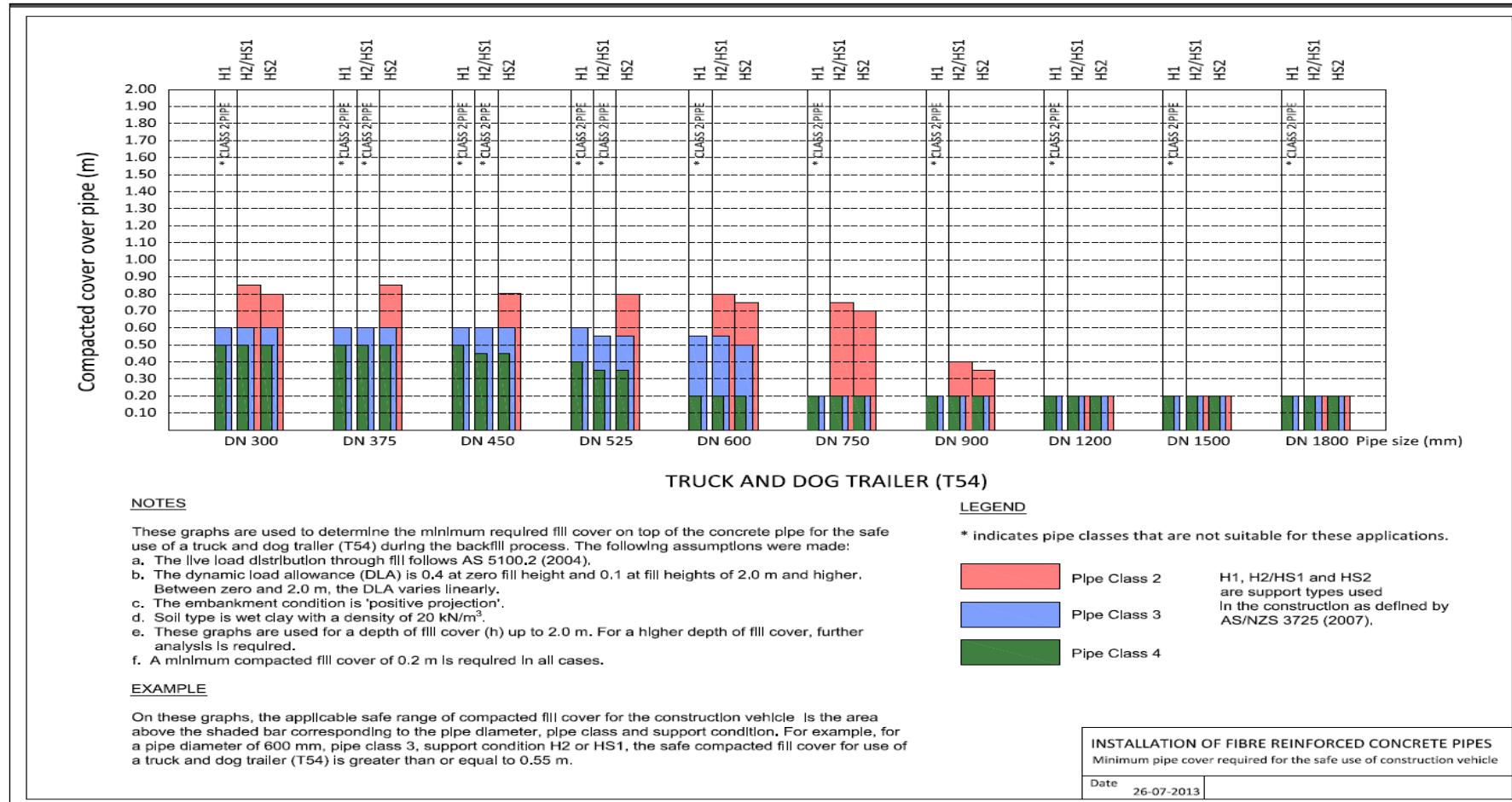


Figure A2 - Fill height and pipe load class for various installation conditions for 25.9 tonne excavator and 580 mm wide compaction wheel