Technical Note 23

Design Criteria for Precast Drainage Pits

April 2017
1 Purpose

The purpose of this technical note is to address the design criteria for precast drainage pits to departmental requirements.

2 Referenced documents

The table below lists referenced documents in this technical document.

Table 2 – Referenced documents

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<th>Title</th>
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<tr>
<td>AS/NZS 1597.2</td>
<td>Precast Reinforced Concrete Box Culverts Part 2: Large Culverts (from 1500 mm span and up to and including 4200 mm span and 4200 mm Height)</td>
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<tr>
<td>AS1657</td>
<td>Fixed platforms, walkways, stairways and ladders - Design, construction and installation.</td>
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<td>AS3600</td>
<td>Concrete structures</td>
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<td>AS3996</td>
<td>Access cover and grates</td>
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<td>MRTS70</td>
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<td>MRTS71</td>
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<td>MRTS72</td>
<td>Manufacture of Precast Concrete Elements</td>
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3 Design life

The design life means that 95% of the production shall remain in a serviceable condition with negligible maintenance for the specified design life.

- For pits up to 5.0 m deep – 50 years.
- For pits deeper than 5.0 m – 100 years.

4 Design loads

4.1 Vertical traffic loads

Design shall allow for the worst effect of W80, A160, SM1600 and HLP 400 in accordance with AS 5100.2.

Live load factors and dynamic load allowance shall be as defined in AS 5100.2.

4.2 Horizontal earth pressure

Horizontal earth pressure due to compacted fill shall be calculated to Clause 3.2.1.3 of AS 1597.2 with Ko equal to 0.5. ULS load factor for earth pressure is 1.5.

4.3 Surcharge loads from road traffic loads

Live load surcharge shall be determined in accordance with Clause 13.2 of AS 5100.2. Earth pressure coefficients shall be calculated similar to Clause 4.2 of this document.
4.4 **Water pressure on pit walls**

All pits shall be designed for external hydrostatic pressure on pit walls for minimum water level 1.0 m below the finish surface of the fill and pit is in empty condition.

4.5 **Access covers and grates**

Access covers and grates shall be in accordance with AS 3996. Covers and Grates shall be designed for load classification in accordance with AS 3996 and appropriate for the application. The minimum load classification for pits under road traffic shall be Class D.

4.6 **Load Combinations**

Load combinations shall be in accordance with AS 5100.2.

5 **Materials**

5.1 **Concrete**

- Concrete to be in accordance with MRTS70 *Concrete*.
- The minimum concrete strength shall be in accordance with MRTS72 *Manufacture of Precast Concrete Elements* for the relevant exposure classification.
- Exposure classifications and cover to reinforcement for pits up to 5.0 m deep (50 years design life) shall be as defined in AS 3600. The minimum exposure classification shall be B1.
- Exposure classification for pits deeper than 5.0 m (100 year design life), shall be in accordance with AS 5100.5 with a minimum exposure classification of B2. Cover to reinforcement is as defined in AS 5100.5.
- Higher exposure classification to be determined in accordance with MRTS72 *Manufacture of Precast Concrete Elements* and AS 5100 or AS 3600 as appropriate.

5.2 **Reinforcement**

Reinforcement shall be in accordance with MRTS71 *Reinforcing Steel* and AS/NZS 4671. If ductility Class L reinforcement is used, reduced strength reduction factors to Table 2.2.2 of AS 3600 shall be used. If Class L reinforcement together with Class N reinforcement is used, the maximum value for capacity reduction factor for member design strength calculation shall be taken as 0.64.

6 **Structural design**

6.1 **General**

- Structural designs for drainage pits shall be to AS 3600 and criteria stated in this technical note.
- Notes shall include all design criteria, relevant Australian Standards, Transport and Main Roads Technical Specifications, materials standard and manufacture requirements.
- Structural analysis shall be carried out using relevant structural analysis software to determine the necessary structural actions.
- The design shall be certified by a RPEQ (Structures).
6.2 Ultimate limit state design

The following criteria is applicable for all drainage pit sizes.

- Ultimate flexural design shall be to Section 9 of AS 3600.
- Ultimate shear strength check shall be to Section 9 of AS 3600.
- Pit walls and the base shall be designed for the worst load effect of vertical traffic loads and horizontal loads on the pit walls as stated in Clause 4 of this document. The appropriate load factors and the load combinations as stated in Clause 4 of this document shall be used.
- The load cases where the traffic wheel load on one wall and distributed to all walls shall be considered to obtain the maximum design base pressure and structural action (bending moment and shear force) on the base.
- Where there is a Cover or Grate associated with the pit, Covers and Grates shall be designed for the load classification appropriate for the application in accordance with AS 3996. The minimum load classification for pits under road traffic shall be Class D. The Cover and Grate design loads are only for Cover and Grate design. The pit structure shall be designed for AS 5100.2 loads referred to in Clause 4 of this document.

6.3 Serviceability limit state design

Serviceability design shall be in accordance with Section 9 of AS 3600.

6.4 Crack control for shrinkage and temperature effects

6.4.1 Base slab

Primary Direction:

As per Clause 9.4.3.2 of AS 3600

Secondary Direction:

1. For Square slabs, the slab shall be considered as a partially restrained slab to Clause 9.4.3.5 of AS 3600 but reinforcement shall not be greater than the reinforcement provided in primary direction.

2. For Rectangular slabs where length/width ratio is equal or greater than 2, slabs shall be considered as a partially restrained slab to Clause 9.4.3.5. Average of reinforcement area required for Clause 9.4.3.3 and Clause 9.4.3.4(c) of AS 3600 shall be provided.

6.4.2 Pit walls

Primary Direction:

As per Clause 9.4.3.2 of AS 3600.

Secondary Direction:

Minimum reinforcement to Clause 9.4.3.3 of AS 3600 considering an unrestrained slab to full height shall be provided.
6.4.3 Penetration for drainage pipes

- All penetrations on pit walls for drainage pipes are preferably above the base slab. The lowest outlet penetration shall be placed on the top of the base slab. The depth of base slab shall be increased to match the invert level of the lowest outlet pipe to achieve a smooth flow inside the pit. Alternatively, the invert level of the lowest pipe penetration may be kept within the minimum required base slab thickness provided the designer has calculated the structural adequacy of the reduced base slab thickness at the penetration, using a Finite Element analysis or other appropriate methods.

- Local stresses at penetrations for drainage pipes shall be taken into consideration in structural design. Adequate trimmer bars shall be provided at the penetration to control cracking around the periphery of the penetration.

6.4.4 Bearing pressure under base

Load cases for full and empty pit with W80 wheel loading on the roof and 100% impact shall be considered to determine the bearing pressure under the base slab. The design bearing pressure shall be stated in the design documentation.

7 Manufacturing requirements

- Manufacture of precast concrete elements shall be in accordance with MRTS72 *Manufacture of Precast Concrete Elements*.

- Lifting points shall be designed and RPEQ certified in accordance with MRTS72 *Manufacture of Precast Concrete Elements*. The lifting points shall be shown in the design documentation.

8 Access to pit

Safe access to inside the pit for inspection and maintenance shall be considered in the pit design. Permanent access shall comply with AS 1657 “Fixed platforms, walkways, stairways and ladders—Design, construction and installation”.

9 Proprietary precast pit designs

Proprietary pit designs shall be in accordance with this technical note and shall be submitted to the following email for review and approval by the Director (Structural Design Standards):

Email: tmr.techdocs@tmr.qld.gov.au

If the submission is not suitable for emailing, please mail to Director (Structural Design Standards) for review and approval:

Department of Transport and Main Roads
Engineering & Technology
Director, (Structural Design Standards)
GPO Box 1412
Brisbane City Qld 4000