

# Main Roads Technical Standard

## **MRTS63A**

### **Piles for Ancillary Structures**

**October 10**

 **Queensland** Government



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# Piles for Ancillary Structures

## 1 INTRODUCTION

This Technical Standard applies to the construction of cast-in-place/bored reinforced concrete piles with high moment and low axial loads extending to competent rock such as Sign Gantries, Retaining Walls, Road Barriers, Pad Footings, Light Poles, Masts, Hoardings, Advertising Boards and other ancillary structures.

This Technical Standard shall be read in conjunction with MRTS01 *Introduction to Technical Standards* and other Technical Standards as appropriate (refer Clause 6.1).

This Technical Standard forms part of the Main Roads Specifications and Technical Standards Manual.

The intention of this technical standard is that the piles are cast in dry conditions. Wet holes are only permitted when all methods (for example, extend length of liner) to have a dry hole have been unsuccessful.

Cast-in-place piles not covered by this technical standard include –

- a) piles consisting of driven, closed-end tubes which are later filled with concrete;
- b) piles utilising enlarged bases formed by extruding a concrete plug from the toe of a liner using an internal drop hammer;
- c) piles with bentonite or polymer slurry; and
- d) piles using temporary liners that are removed.

## 2 DEFINITION OF TERMS

The terms used in this Standard shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Standards*.

## 3 REFERENCED DOCUMENTS

Table 3 lists documents referenced in this Technical Standard.

**Table 3 – Referenced Documents**

Reference	Title
AS 1379	Specification and supply of concrete
AS/NZS 1554.1	Structural steel welding - Welding of steel structures
AS/NZS 3678	Structural steel-Hot-rolled plates, floorplates and slabs
AS/NZS 4058	Precast concrete pipes (pressure and non-pressure)
AS 5100.3	Bridge design – Foundations and soil supporting structures

## 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 Standards*.

The Hold Points and Milestone applicable to this Technical Standard are summarised in Table 4.1. There are no Witness Points defined.

**Table 4.1 – Hold Points and Milestones**

Clause	Hold Point	Milestone
6.2	1. Pile construction.	Submit procedure for construction of pile (28 day notice period).
10.1	2. Construction of pile base	
11.2	3. Geotechnical certification of socket and pile base	
13.1	4. Placement of concrete with a tremie	

#### **4.2 Construction Procedures**

Construction procedures which are required to be submitted by the Contractor to the Administrator in accordance with Clause 5 of MRTS50 *Specific Quality System Requirements* are listed in Table 4.2.

**Table 4.2 – Construction Procedures**

Clause	Procedure
6.2	Construction of piles including cleaning, inspection and certification

#### **4.3 Conformance Requirements**

The conformance requirements which apply to each pile for work covered by this Technical Standard are summarised in Table 4.3.

**Table 4.3 – Conformance Requirements**

Clause	Procedure
9	Location and tolerances
10	Size of pile base/socket
MRTS70	Concrete conformance

#### **4.4 Lot Size for Testing**

The minimum lot size for work covered by this Technical Standard is each pile.

### **5 ASSESSMENT OF FOUNDATION INFORMATION**

The Contractor shall be deemed to have inspected any borehole drilling logs, cores and reports based thereon, made available by the Principal at time of tender, and shall be deemed to have acknowledged that –

- a) such data represents subsurface information at a specific location only;
- b) information on strata between boreholes is the subject of interpretation and also of the inherent variability of soil and rock strata; and
- c) departures from the strata conditions indicated by the borehole information are inevitable.

### **6 MATERIALS AND PROCESSES**

#### **6.1 General**

Materials and processes shall conform to the following standards –

- a) Steel for liners As stated on the drawings but not less than AS/NZS 3678 Grade 250;
- b) Concrete pipe liners AS/NZS 4058 and MRTS25;
- c) Concrete MRTS70 *Concrete* together with Clause 13 herein;

- d) Reinforcing steel MRTS71 *Reinforcing Steel*; and
- e) Structural steel welding AS/NZS 1554.1

All reinforcing steel shall be sourced from suppliers certified by ACRS (Australian Certification Authority for Reinforcing Steel).

## 6.2 Construction Procedures

The Contractor shall submit a procedure for construction of the piles. The procedure shall give details of the method of sinking the pile shaft, the method of socket construction, the method of maintaining stability of the walls, the equipment to be employed for this operation and the method of sealing the base of the pile against the ingress of water.

The Contractor shall make an assessment with regard to the anticipated stability of the socket walls and shall make allowance for any necessary measures required to maintain the stability of the socket during construction. If temporary liners are to be utilised, full details of installation and removal of liners shall be included in the procedure.

The completed procedure shall be submitted to the Administrator at least 28 days prior to the date for sinking of pile shafts **Milestone**. Work shall not commence until approval from the Administrator has been received in writing. **Hold Point 1**

## 7 FABRICATION OF LINERS

### 7.1 Permanent Steel Liners

Steel liners shall conform to the dimensions and thicknesses shown on the Drawings. The inside diameter of the liner shall not be less than the nominal diameter shown on the Drawings, nor shall the out-of-round tolerance exceed 5% of diameter of liner.

Welding shall be carried out in accordance with the provisions of AS/NZS 1554.1.

All longitudinal and transverse welds shall be made with full penetration butt welds. Segments shall be rotated 90 degrees to each other so that longitudinal welds along the liner are staggered.

Liners shall be supplied to the Site in the longest lengths possible, commensurate with the overall length of the pile and the transport facilities available.

Field joints between lengths shall employ full penetration butt welding to the details shown on the Drawings.

The leading edge of the liners shall be reinforced by providing a stiffening band to the details shown on the Drawings.

Liners shall be stored and transported in such a manner as to prevent damage. Damaged liners shall be repaired or replaced by the Contractor at no additional cost to the Principal.

### 7.2 Concrete Pipe Liners

Concrete pipe liners shall conform to AS/ANZ 4058 and be the length, thickness and class shown on the Drawings. Where required, pipe joints shall be made in place to the details shown on the Drawings. Pipes shall be stored and transported in such a manner as to prevent damage. Damaged pipes shall be repaired or replaced by the Contractor at no additional cost to the Principal. **Nonconformance**

## 8 PILE LINERS AND BORED HOLES

### 8.1 General

The founding levels shown on the Drawings are provisional levels and have been determined using foundation information available prior to construction. Actual foundation levels shall be determined by the Contractor using a qualified Geotechnical Assessor following inspection and assessment during construction.

The sinking of pile liners shall be effected from firm ground, from temporary supports, from a spudded barge or from a fixed platform.

Whatever the method used, it shall provide sufficient rigidity to ensure accuracy of sinking under all conditions of tide, stream flow, and/or hammer blow.

Any liner or bored hole which is incorrectly located, or damaged, or which shows partial collapse to an extent which materially decreases the load carrying capacity of the pile, shall be rejected or repaired. **Nonconformance** Remedial measures shall be determined by the Contractor and submitted to the Administrator for consideration and approval to proceed. Replacement of any rejected pile or other remedial work shall be at no cost to the Principal.

### **8.2 Bored Holes without Liners**

Boring of uncased holes shall be permitted only where the walls of the shaft consist of material which is self-supporting. Special precautions should be taken in the event of boring through material exhibiting excessive water absorption properties.

The diameter of the bored hole shall be not less than that shown of the Drawings except for small local variations which shall not exceed 5% of the diameter at any location. In places where the diameter is less than that specified, the cover requirement to the reinforcement shall be maintained.

Boring shall be carried out using rotary or percussion type equipment. Where percussion equipment is used, the level of energy per blow at the drilling bit shall be kept to a minimum, consistent with effective boring, so as to minimise vibration and avoid damage to adjacent piles, structures or services. The Contractor shall take all measures necessary to prevent water from entering the hole.

If it is elected to optimize proposed construction procedure by increasing input energy over and above that necessary to drive liners as detailed on the drawings, then a heavier liner is to be used to sustain the application of such increased driving energy. Any change to the nominated liner design to be approved by the Administrator and no additional cost will be borne by the Principal as a consequence of this change to liner thickness.

Boring shall continue to the level shown on the Drawings or, to such lower founding level as is capable of sustaining the design pressure shown on the Drawings.

No additional payment will be made by the Principal for pre-bored holes.

### **8.3 Liners Driven by Oscillation or Vibration**

Liners may be driven using an appropriate rig which oscillates the liner in a horizontal plane, or by a rig which vibrates the liner vertically. Either method shall employ a vertical load applied simultaneously with the oscillations or vibrations.

The toe of the liner shall be kept far enough ahead of the excavation inside the liner to prevent material entering the cavity. At the terminal level, the liner shall penetrate sufficiently deep into firm stratum to form an effective seal against the entry of material and water into the final excavation.

### **8.4 Liners in Pre-Bored Holes**

Placing a liner in an oversized prebored hole reduces lateral stiffness and restraint of the pile to be constructed. Preboring shall only be used under the conditions stated as follows:

The diameter of a pre-bored hole shall be of a minimum size to facilitate insertion of the liner. A concrete liner shall be driven or sunk into firm stratum at its base to prevent the entry of water and other material prior to concreting. A steel liner shall be driven for a minimum of 3 m below the prebore into firm strata to achieve a seal and lateral stability at the base.

The space between liner and hole shall be backfilled using flowable fill or other approved material, using a method that fills the void around the liner completely. Flowable fill shall be piped to the base of the prebored hole and the gap filled from the base upwards. Fill shall be inserted at a minimum of 3 points equally spaced around the liner circumference.

Pre-bored holes may be used to facilitate installation of reinforced concrete pipe liners or steel liners provided that –

- a) prior agreement of the Administrator and designer has been obtained in writing [**refer to Hold Point 1**];
- b) the material in situ is of a consistency, cohesion and strength such that the hole shall be self-supporting until such time as the liner is inserted, and it is safe to work around the top of the unlined hole. Preboring is not allowed in strata with sand or gravel layers; and

- c) the diameter of a pre-bored hole shall be of a minimum size to facilitate insertion of the liner and the liner is driven or sunk into firm stratum at its base to prevent the entry of water and other material prior to concreting; and

### **8.5 Concrete Pipe Liners**

Where concrete pipe liners are used, they shall be supported vertically at the toe at all times.

At any stage during the excavation, the Administrator may restrict the extent to which the excavation is carried out below the toe of the liner.

Concrete pipe liners shall only be flush joined and shall only be used for relatively shallow piles less than 10 m deep.

Concrete pipe liners shall conform to AS/NZS 4058 and be the length, thickness and class shown on the Drawings. Where required, pipe joints shall be made in place to the details shown on the Drawings. Pipes shall be stored and transported in such a manner as to prevent damage. Damaged pipes shall be repaired or replaced by the Contractor at no additional cost to the Principal. **Non-conformance**

### **8.6 Construction Limitations**

No pile which is located within 2.5 metres clear distance from a newly concreted pile shall be bored or driven until 18 hours after completion of concreting.

No pile which is located between 2.5 metres and 9 metres clear distance from a newly concreted pile shall be driven in the period between initial set and 12 hours after casting is completed.

The top of a newly concreted pile shall not be in contact with the driving platform while another pile is being pre-bored or driven from that platform.

## **9 TOLERANCES**

Completed piles shall be located as shown on the Drawings within the following tolerances –

- |                                   |  |
|-----------------------------------|--|
| a) Top of pile                    | 75 mm in any direction;                      |
| b) Variation from vertical        | 20 mm per metre or designated batter;        |
| c) Bow of pile                    | 1% of length of pile in any direction; and   |
| d) Diameter of unlined bored hole | 0, + 5% of nominal diameter at any position. |

Any piles which are outside these tolerances shall be corrected by the Contractor to the satisfaction of the Administrator at no additional cost to the Administrator. **Nonconformance**

## **10 CONSTRUCTION OF PILE BASE**

### **10.1 General**

All piles shall be excavated to rock or hard stratum as adequate to sustain the imposed loading pressures shown on the Drawings and shall penetrate the founding strata not less than the distance shown on the Drawings. The pile base shall be clean and free of loose material. **Hold Point 2**

When the liner is at its anticipated terminal level and the strata immediately below are considered by the Contractor to be self-supporting and not liable to water inflow, then the excavation of an unlined hole may proceed to the approved founding level. If, during this operation, there is an influx of water and/or material into the excavation, which prevents work continuing, the liner shall be re-driven until a new seal is formed at no additional cost to the Principal.

After completion of the excavation, the pile shall be dewatered, the bearing surface thoroughly cleaned of all foreign and loose material, and the surface dressed to level. Pockets or seams of inferior material shall be removed. **[refer to Hold Point 3]**.

Temporary safety shields shall be used where manual work is carried out in unlined holes and sockets as required by the Workplace Health and Safety Act or when considered necessary for safety.

## 10.2 Belling

Actual foundation levels and bell dimensions shall be determined by the Contractor subject to the minimum requirements shown on the drawings.

Foundations shall be logged, inspected and certified by a Geotechnical Assessor prior to casting of concrete. The Geotechnical Assessor shall certify that the factored geotechnical strength is greater than the design loads shown on the drawings in accordance with AS 5100.3 and the bell complies with the minimum requirements shown on the drawings.

Geotechnical Assessor certification of the pile base prior to concreting is a hold point (refer to Hold Point 3).

As constructed records of all bells, including the rock classification, shall be maintained and forwarded to the Administrator.

## 10.3 Pile Sockets

Where pile sockets are detailed, the applied load is to be carried by a combination of socket wall friction and base resistance. The length and diameter of socket shall be in accordance with the details shown on the Drawings.

Sockets shall be logged, inspected and certified by a Geotechnical Assessor prior to casting of concrete. The Geotechnical Assessor shall certify that the factored geotechnical strength is greater than the design loads shown on the drawings in accordance with AS 5100.3 and the socket complies with the minimum requirements shown on the drawings.

Geotechnical Assessor certification of the socket prior to concreting is a hold point [refer to Hold Point 3].

As-constructed records of all sockets, including the rock classification, shall be maintained and forwarded to the Administrator.

At any pile position, where it is suspected that the rock below founding level may not be consistent with that at founding level, a test hole 24 mm minimum diameter shall be drilled to a depth of at least 2.4 metres below the bottom of the excavation to ensure that suitable material persists to that level (refer to Hold Point 2).

## 10.4 Geotechnical Assessor

Unless stated otherwise in Clause 1 of Annexure MRTS63.1, the Geotechnical Assessor shall be a geotechnical engineer and shall be an RPEQ. Where stated in Clause 1 of Annexure MRTS63.1, the Geotechnical Assessor may be an engineering geologist with at least 10 years experience in heavy civil engineering foundation design and assessment procedures.

The name and qualifications of the Geotechnical Assessor shall be submitted to the Administrator at least 28 days prior to commencing pile construction [Refer to Hold Point 1].

# 11 GEOTECHNICAL CERTIFICATION

## 11.1 Foundation Inspection

### 11.1.1 General

Prior to inspecting the pile foundation, the Contractor shall undertake a safety and hazard assessment to ensure that the procedures are in accordance with the *Workplace Health and Safety Act*.

Cast-in-place pile foundations shall be inspected by either physical inspection down the pile, by cameras or by a combination of both methods.

If the pile excavation contains water, it shall be dewatered and the foundation properly cleaned immediately prior to inspection.

### 11.1.2 Physical Inspection

The Contractor shall provide sufficient equipment and safe transport within the pile for the Contractor's qualified Geotechnical Assessor and the Administrator during inspection.

The Contractor shall install a safety shield in all unlined sockets greater than 1.5 metres long during periods of inspection. Inspection openings shall be provided at regular intervals to facilitate inspection of socket walls.

### 11.1.3 Camera for inspecting end bearing cast-in-place piles

To obtain adequate information, the camera used for pile hole inspections shall have at least the following features –

- a) Robust, high resolution and water resistant colour video camera controlled by a display monitor at the surface with the capacity to record data for QA records (Pile identifier, date, time, operator's name, pile depth and so on);
- b) Equipped with variable-intensity light source that can be adjusted to give true colour images of the foundation material; and
- c) Able to be moved to view horizontally (sockets) and vertically (base) by means of a telescopic or articulated pole or push rod or some other controlling device..

In addition to the above requirements, the camera should preferably incorporate an off-set light source so that shadows can give a perception of depth and surface texture can be determined.

The camera shall be operated by an experienced person who can obtain a clear stable image with high definition.

The camera shall be available on site at least two (2) weeks before the first pile inspection and the Contractor shall demonstrate its compliance to the Administrator before it is used in pile assessment.

### 11.2 Geotechnical Assessment

Following inspection and assessment of the actual ground conditions during construction, a strength classification of the observed rock profile is to be undertaken to ensure that the required friction and base capacities have been achieved.

Geotechnical assessment shall ensure that –

- The design requirements of the foundation have been achieved. Design considerations are axial compression, axial tension (if applicable), bending moment, scour, moment fixity and lateral shear;
- The minimum strength classification of the pile base has been achieved;
- the minimum socket length and diameter have been achieved;
- the socket walls are clean and free of smear material;
- the classification of the rock into both lithological and weathering type has been undertaken;
- the defect spacing and orientations has been examined and recorded;
- bands of weak rock, intrusions, shear planes and fault lines have been examined and recorded;
- macro weathering profile in 3D has been undertaken; and
- water seepage, if any has been recorded.

Inspection and/or geotechnical assessment of cuttings from the length of the liner or socket shall not be accepted as the sole means of logging.

Geotechnical Assessor certification of the socket and pile base prior to concreting is a hold point  
**Hold Point 3**

## 12 STEEL REINFORCING

Steel reinforcing shall be supplied and placed in accordance with the requirements of MRTS71 *Reinforcing Steel*. Steel reinforcing shall be assembled as detailed on the Drawings to form a rigid cage capable of being lowered into the excavation without any disintegration occurring.

Cover to steel reinforcing shall be maintained using approved spacers or stainless steel nibs welded to the longitudinal reinforcement. The spacers shall be located on the periphery of the pile cage 90 degrees apart at a maximum of 2.5 m centres axially, as shown on the Drawings.

Prior to lowering the reinforcing cage, the pile excavation shall be cleaned of all loose material.

## 13 CONCRETING

### 13.1 General

After excavation has been completed in accordance with Clause 10 and the reinforcement inserted, concreting operations shall commence without delay. The foundation shall be rechecked immediately prior to placement of concrete to ensure that no deterioration has occurred in any intervening period.

Where there has been a delay of more than 24 hours between completed of excavation in accordance with Clause 10 and when the Contractor is ready to start concreting, or when the foundation has been observed to deteriorate significantly, the foundation shall be cleaned if required and reinspected and recertified.

All concrete shall be placed in accordance with MRTS70 *Concrete* except as otherwise specified in Clauses 13.2 and 13.3 herein. The Contractor shall observe all relevant milestones and hold points stated in MRTS70 *Concrete*.

The placing of concrete shall be a continuous operation from the base level to the top of pile unless circumstances dictate otherwise. The use of a concrete pump with a tremie shall only be permitted if the Contractor has a procedure that has a continuous operation. **Hold Point 4**

### 13.2 Slump of Concrete

The slump of concrete shall be in the range 100 mm to 150 mm.

### 13.3 Placement and Compaction

Concrete shall be placed in dry conditions.

To ensure compaction by hydrostatic head, the rate of placing the concrete shall not be less than 6 metres (length of pile) per hour irrespective of the method of placement.

Concrete vibrators shall be used in the top 3 metres of each pile.