Chapter 16 Amendments

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16 Piles and Footings

16.1 Glossary of terms
For a complete glossary of terms refer Chapter 1 – Introduction.

16.2 Figures and examples shown in this volume
The figures and examples shown in this volume are for presentation purposes only, and may contain some details that are now superseded. These details have been included for ease of reference, to illustrate typical solutions, and to show the required standard of drafting presentation. The details are not to be used without an engineering check and certification by a Structural RPEQ to confirm that the details are appropriate for the specific project.

16.3 General
The most common types of foundations used in bridge construction are as follows:

- Driven Piles
- Cast in place piles
- Spread footings.

Driven piles most commonly used in bridge design are as follows:

- Precast Prestressed Concrete (PSC) Piles
- Precast Prestressed Concrete (PSC) Spliced Piles.

Other types of driven piles may be used, if approved on a project specific basis, by the Department of Transport and Main Roads:

- Reinforced Concrete (RC) Piles
- Composite Piles (a combination of PSC and RC piles)
- Steel Piles.

Piles and footings shall be set out on the Abutment and Pier drawings and also on the Pile Identification and Setting Out Diagram which is shown on the General Arrangement drawings. Refer Chapter 11 – General Arrangements, Figure 11.7.3 – Pile Identification and Setting Out Diagram.

16.4 Precast Prestressed Concrete Piles
PSC piles are the most commonly used pile type. They are octagonal in cross section, measure 550 mm across opposite faces, and can be manufactured up to 28 m in length.

450 mm and 500 mm PSC piles were once commonplace, however, they shall no longer be used because most casting yards are not set up to produce them.

Pile drawings require a Schedule. Details to be supplied in the Schedule may include, but are not limited to:

- Pile location
- Pile length
- Numbers of each pile type
• Headbar diameter, length and number per pile
• Total mass of piles

Refer Appendix A Example PSC Pile Drawing.

16.5 Precast Prestressed Concrete Spliced Piles

Typically, casting yards are only set up to make piles up to 28 m in length. When piles longer than 28 m are required, two segments of the same profile are joined together with a mechanical splice. The splice shall be placed in the lower half of the pile where the bending moment is reduced. The department intends to produce a new standard drawing for spliced piles.

Refer Appendix B Example PSC Spliced Pile Drawings.

16.6 Reinforced Concrete Piles

RC piles are square in cross section and are not prestressed. Their use is not permitted for bridge foundations. Any Designer who believes the use of such piles is cost effective and will achieve the strength and durability required, may prepare a written submission for consideration by the Deputy Chief Engineer (Structures). Delays in assessing such submissions, and any consequent costs are entirely the responsibility of the Designer.

16.7 Composite Piles

The most common form of composite pile used in bridge design is a PSC pile and a RC pile joined by a mechanical splice. However, their use is not permitted for bridge foundations. Any Designer who believes the use of such piles is cost effective and will achieve the strength and durability required, may prepare a written submission for consideration by the Deputy Chief Engineer (Structures). Delays in assessing such submissions, and any consequent costs are entirely the responsibility of the Designer. Refer Appendix C Example Composite Pile Drawing.

16.8 PSC Pile Rock Shoe

When the ground is too hard to drive PSC piles fitted with a standard cast iron pile shoe, the shoe may be substituted with a steel rock shoe. The hardened steel pin on the shoe is designed to break through rock. Refer Appendix D Example PSC Pile Rock Shoe Drawing.

16.9 Steel Piles

Steel Universal Columns (UC) may sometimes be used for the following reasons:

• to save on transport costs when the bridge is in a dry, remote area
• they may be permitted in overflow bridges (not the main channel) where there is no permanent water in the stream
• the ground is too hard for PSC piles.

The use of steel piles must be approved by the Director (Bridge and Marine Engineering).

Fabrication details shall be shown on the drawings as necessary. Details may include, but are not limited to:

• Layout of piles about the Bridge Control
• Type and size of pile
• Orientation of pile
• Height of pile tip
• Height of soffit of pilecap or headstock
• Rake of pile if not vertical
• Ultimate Pile Capacity
• Pile tip details.

Steel piles may be used in conjunction with precast abutment and pier headstocks that are precast off site. These are typically used in remote areas where the procurement of large quantities of fresh concrete is impractical, or when a quick construction period is required. Refer Appendix F Example Steel Pile and Precast Headstock Drawing.

16.10 Cast in Place Piles

Cast in place piles in bridge structures consist of a reinforced concrete column contained in either a concrete pipe liner or a steel liner. The liner is founded on suitable hard strata using a socketed base. Bellied bases are not permitted. Bored piles (constructed on site without a liner) are not permitted for bridge foundations.

Details of cast in place piles to be shown on the abutment and pier drawings may include, but are not limited to:

• Layout of piles about the Bridge Control
• Size, grade and type of liner
• Height of soffit of pilecap/headstock
• Height of toe of liner
• Provisional Height of bottom of socket/bell
• A note clarifying the fixity requirements of the socket/bell into rock
• Details of the size and shape of the socket/bell
• Design Foundation Bearing Pressure
• Rock anchors
• Cover to steel reinforcing details. The size of the stainless steel nib depends on the reinforcement cover requirements. Refer Figure 16.10-1 Example Stainless Steel Nib
• Cathodic protection details. Note that stainless steel nibs cannot be used with cathodic protection. An alternate such as ceramic spacers will be required.
• Stiffening band details at the toe of the steel liner, including transition liner details if required. Refer Figure 16.10-2 Example Stiffening Band. The thickness of the stiffening band, transition liner and the main pile liner may vary depending on the ground conditions and the diameter and length of the liner.

Refer Appendix G Example CIP Pile Drawing.
**Figure 16.10-1 Example Stainless Steel Nib**

1 set of 4 stainless steel nubs (equally spaced around the circumference of the cage) to be welded securely to main steel at intervals of 4000 maximum on welded cages and 2500 maximum on unwelded cages. There must be at least 2 sets of stainless steel nubs per cage. Stainless steel nubs shall be placed approximately in line and straddle the ligature/spiral as shown.

**Figure 16.10-2 Example Stiffening Band**

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16.11 **Spread Footings**

Spread footings are used when strata capable of carrying the design loads is found close to the ground surface.

Details of spread footings to be shown on the abutment and pier drawings may include, but are not limited to:

- Layout of footings about the Bridge Control
- Dimensions of footing
- Reinforcement details
- Height of soffit of footing
- Rock anchors
- Blinding concrete
- Design Foundation Bearing Pressures.

Refer *Appendix H Example Spread Footing Drawings.*
Appendix A – Example PSC Pile Drawing

Appendix A – Example PSC Pile Drawing
Appendix B – Example PSC Spliced Pile Drawings

Appendix B – Example PSC Spliced Pile Drawings – Sheet 1
Appendix C – Example Composite Pile Drawing

![Composite Pile Drawing](image-url)
Appendix D – Example PSC Pile Rock Shoe Drawing
Appendix E – Example Steel Pile and Cast In Situ Headstock Drawing

Notes:
1. Concrete class to be 20MPa/70.
2. Bars to reinforcing steel to be 45mm unless stated otherwise.
3. Exposed reinforcement to be painted with primer.
4. Bars to be cut to lengths of 1m and 2m.
5. Bars to be cut to lengths of 1m and 2m.
6. All exposed edges to have 25 x 25 chamfer unless stated otherwise.
7. bolts for seismic purposes to be a minimum of M20, M24, M30.
Appendix F – Example Steel Pile and Precast Headstock Drawing

CONSTRUCTION SEQUENCE – ERECTING PIER HEADSTOCK

A1. Fabricate headstock support frame.
A2. Seal the gap around K2 piles with closure welds.
B. Placing the Precast Headstock:
B1. Lift and lower the headstock to the first position.
B2. When the headstock is about 25mm above the final position, remove the gap above the headstock support frame. Adjust the alignment of headstock, if set required by the final position.
B3. Generally place the headstock in position on the headstock support frame, ensuring the contact into all supports. Fill the voids with concrete.
B4. Insulation support frame not to be removed until 3 days (min) after commissioning.
B5. Seal details are not to be erected onto headstock until a minimum strength of concrete of 20MPa is reached and a minimum of 7 days after placing of concrete units.

NOTES
1. CONCRETE core to be 250/30 except as follows
2. EXPOSED EDGES to be 15 x 15 chamfered unless shown otherwise.
3. STEEL ENHANCED to be used in conjunction with Standard Drawings 1040 and 1044
4. BRIDGE TYPES to be selected from 2D plan
5. Non-heeted areas to be 15 x 15, 25 x 25 unless shown otherwise.
6. 200 REDUCES for installation purposes to AS/NZS 1554.2 Class 3.0.1 and 3.3.5.
7. Welding consumables to be ER70S-6, E4910 or E6010.
Appendix G – Example CIP Pile Drawing

TABLE OF HEIGHTS – PILES

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Notes:

1. Piles should be driven until refusal, final blow to be recorded. Buckling and deviation from vertical to be assessed.

2. Pile caps should be designed to carry the dead and live loads from the superstructure.

3. Pile grouting to be carried out by the contractor to ensure a sound connection between pile and cap.

4. Pile caps should be designed to carry the dead and live loads from the superstructure.

5. Pile grouting to be carried out by the contractor to ensure a sound connection between pile and cap.