

**Drafting and Design Presentation Standards  
Volume 3: Structural Drafting Standards**

**Chapter 16: Piles and Footings**

**May 2013**

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**Chapter 16 Amendments****Revision register**

<b>Issue/Rev No.</b>	<b>Reference Section</b>	<b>Description of Revision</b>	<b>Authorised by</b>	<b>Date</b>
1	–	First Issue.	Manager (Structural Drafting)	March 2011
2	–	Document name change.	Manager (Structural Drafting)	Nov 2011
	16.4	450 and 500 mm piles shall not be used.		
3	16.10	Cast in Place pile wording details revised. Figure 16.10-1 amended.	Team Leader (Structural Drafting)	May 2013
	–	Appendix G – new drawing added.		

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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figures and examples shown in this volume are for presentation purposes only, and may contain some details that are now superseded.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**

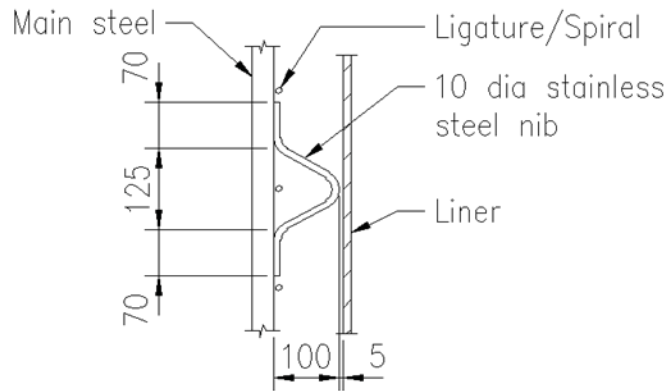
Cast in place piles in bridge structures consist of a reinforced concrete column contained in either a concrete pipe liner or a steel liner. The liner is founded on suitable hard strata using a socketed base. Belled bases are not permitted. Bored piles (constructed on site without a liner) are not permitted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

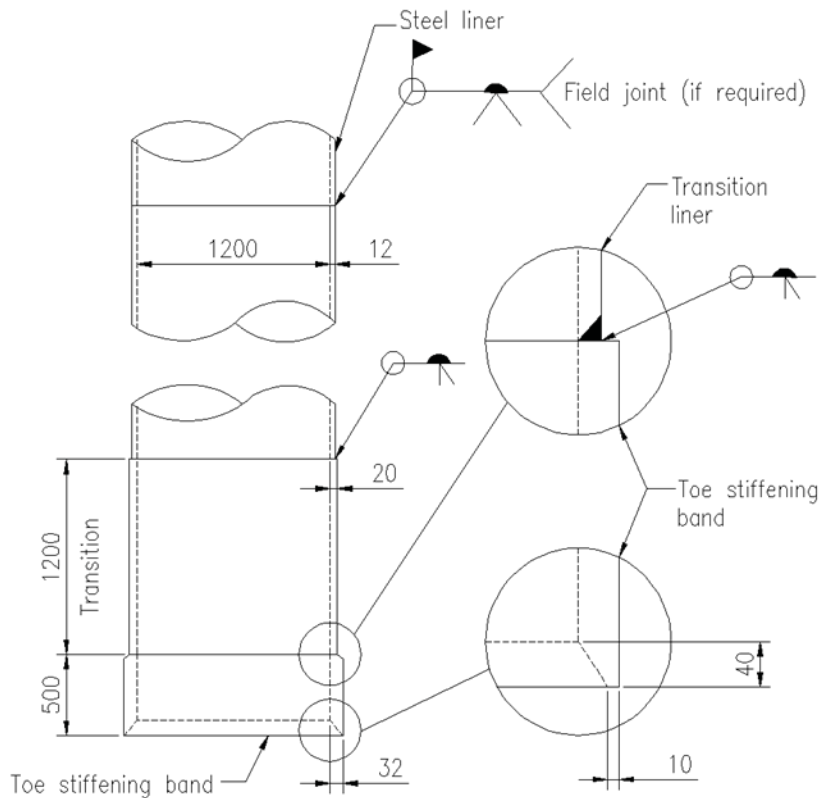
**Figure 16.10-1 Example Stainless Steel Nib**



1 set of 4 stainless steel nibs (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 nibs per cage. Stainless steel nibs shall be placed approximately in line and straddle the ligature/spiral as shown

SPACER DETAIL  
NTS

**Figure 16.10-2 Example Stiffening Band**





### ***16.11 Spread Footings***

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

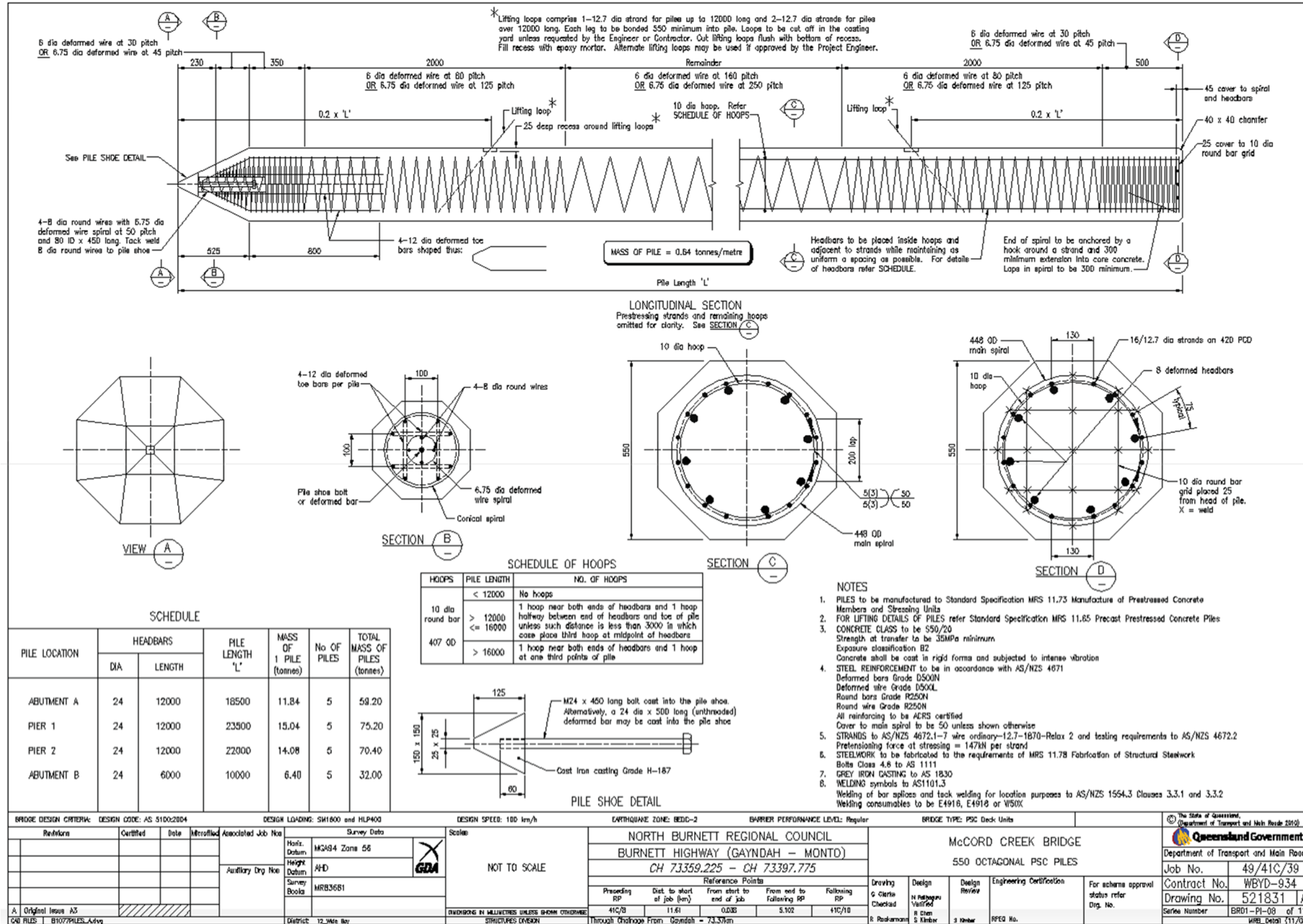
Details of spread footings to be shown on the abutment and pier drawings may include, but are not limited to:

- 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

**PSC SPLICED PILE ASSEMBLY**  
Scale A

**VIEW A**  
550

**SPLICED PILE DETAIL**  
Scale B

**HOOP LOCATION DIAGRAM – TOP SECTION**  
NTS

**HOOP LOCATION DIAGRAM – BOTTOM SECTIONS**  
NTS

**SECTIONAL ELEVATION SPLICED CONNECTION DETAIL**  
Scale B

**PILE SHOE DETAIL**  
Scale C

**ERECTOR PROCEDURE FOR SPLICED PILES**

- Place Splice Sleeves on Bottom Section of pile.
- Insert Top Section of pile to ensure full penetration to full depth of Splice Sleeve and true alignment with the Bottom Section of pile. Remove Top Section.
- Seal lower edge of Splice Sleeve against pile.
- Check that Splice Sleeve, pile ends, formed holes and dowel bars are clean and dry.
- Fill sleeve and holes with epoxy resin so that when Top Section is inserted, excess resin flows out over the top of the Splice Sleeve.
- While curing, hold pile rigidly in position in true line relative to the Bottom Section of pile.
- Spliced piles shall not be driven until the epoxy has reached a strength of 80MPa.
- Epoxy for piles shall be suitable for high impact loads.

**NOTES**

- PILES to be manufactured to Standard Specification MRS 11.73 Manufacture of Prestressed Concrete Members and Stressing Units.
- FOR LIFTING DETAILS OF PILES refer Standard Specification MRS 11.85 Precast Prestressed Concrete Piles.
- CONCRETE CLASS to be S60/20. Strength at transfer to be 35MPa minimum. Exposure classification B2. Concrete shall be cast in rigid forms and subjected to intense vibration.
- STEEL REINFORCEMENT to be in accordance with AS/NZS 4671. Deformed bars Grade D500N. Deformed wire Grade D500L. Round bars Grade R250N. Round wire Grade R250N. All reinforcing steel to be ACRS certified. Cover to main spiral to be 50 unless shown otherwise.
- STRANDS to AS/NZS 4672.1 – 7 wire ordinary-12.7-1870-Relax 2 and test requirements to AS/NZS 4672.2. Pretensioning force at stressing = 147kN per strand.
- STEELWORK to be fabricated to the requirements of MRS 11.78 Fabrication of Structural Steelwork. Steel plate to AS/NZS 3678. Stainless Steel dowel bars to ASTM A276. Bolts Class 4.6 to AS 1111. All steelwork to be hot dip galvanised to AS/NZS 4680 unless shown otherwise. Prior to galvanising all weld splatter and welding slag is to be removed.
- GREY IRON CASTING to AS 1830.
- WELDING symbols to AS 1101.3. **Structural Steel** All welding to AS/NZS 1564.1. All welds, except location tack welds, to be SP category. Welding consumables to be controlled hydrogen type E490X or W50X unless shown otherwise. **Reinforcing Steel** Tack welds for location purposes to AS/NZS 1564.3 Clauses 3.3.1 and 3.3.2. Welding consumables to be E491B, E491B or W50X.

**MASS OF PILE = 0.64 tonnes/metre**

**PILE DESIGN IS BASED ON THE SPLICED SECTION OF THE PILE BEING DRIVEN TO WITHIN A RANGE OF H'S. REFER TO PILE DRIVING NOTES ON DRG NOS 453894 & 453895**

**SCHEDULE**

PILE LOCATION	TOP SECTION		BOTTOM SECTION			TOTAL SPLICED PILE LENGTH	No OFF	
	HEADBARS		DRIVING BARS					
	DIA	LENGTH	'L1'	DIA	LENGTH			'L2'
PIER 3 (3/7 TO 3/9 & 3/16 TO 3/18)	24	17 000	18 000	24	6 000	12 000	30 000	6
ABUT B	24	19 000	20 000	24	6 000	17 000	37 000	9

**BRIDGE DESIGN CRITERIA:** DESIGN CODE AS 5100:2004 DESIGN LOADS: SW1600 and HLP400 DESIGN SPEED: 110 km/h EARTHQUAKE ZONE: BEDO-1 BARRIER PERFORMANCE LEVEL: Medium BRIDGE TYPE: R0 Deck on PSC Girders BIS No: 41715 © The State of Qld, (Old Main Road 2010)

**Revisions**

Revisions	Certified	Date	Microfilm	Associated Job No

**Survey Data**

Survey Data	Survey Book
Horiz. Datum: MGA 94 Zone 55	FB 838-87883
Height Datum: AHD (D)	

**Scale**

A 0 250 500mm  
B 0 200 400mm  
C 0 100 200mm

**TOWNSVILLE CITY**  
**BRUCE HIGHWAY (TOWNSVILLE – INGHAM)**  
**CH 4841.723 – CH 5095.723**

**ROSS RIVER BRIDGE DUPLICATION**  
**550 OCTAGONAL PSC SPLICED PILES – SHEET 1**

**Reference Points**

Preceding RP	Dist. to start of Job (km)	From start to end of Job	From end to Following RP	Following RP
10M/1C	9.283	0.281	2.304	10M/2A

**Dimensions in millimetres unless shown otherwise.**

**Through Chords from Intersection of 10M/10L/144 – 13,240m**

**Drawing**  
R Gibson Checked  
J Shelton Verified  
N Holden

**Design**  
R Pizzano

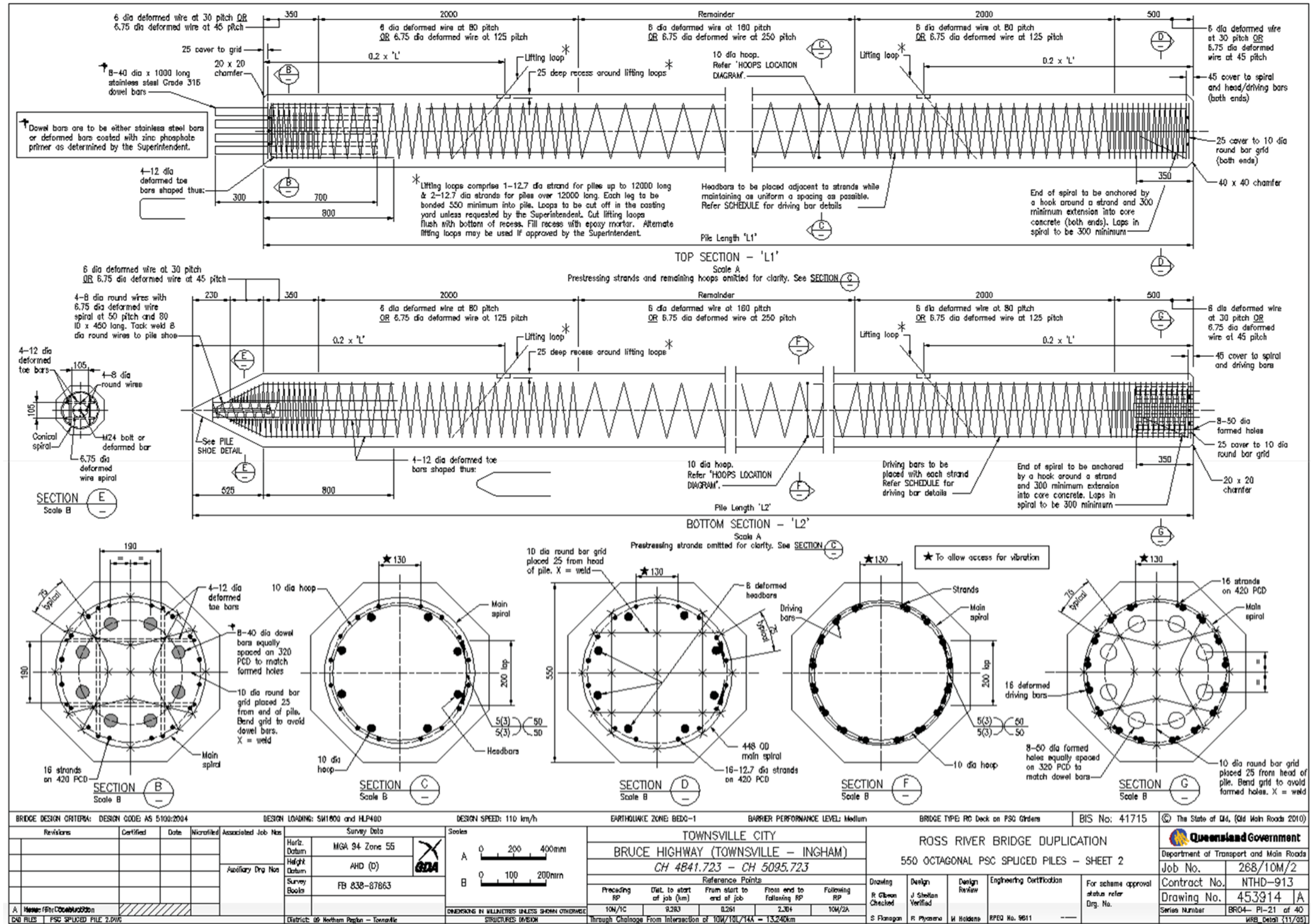
**Design Review**  
N Holden

**Engineering Certification**  
RFD No. 9511

**For scheme approval status refer**  
Drg. No.

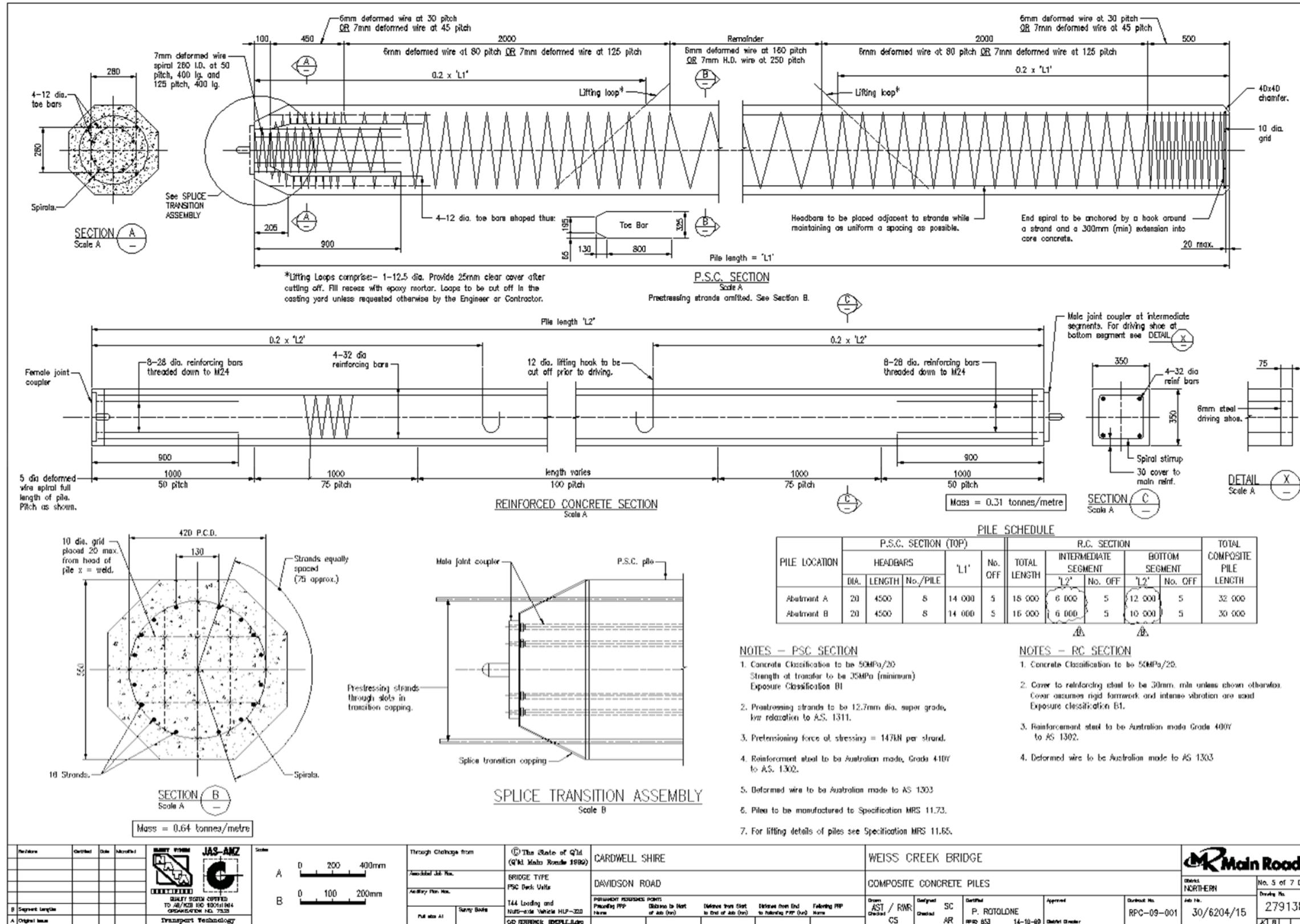
**Queensland Government**  
Department of Transport and Main Roads  
Job No. 258/10M/2  
Contract No. NTHD-913  
Drawing No. 453913 A  
Series Number BR04-PI-20 of 40  
NRS\_Deck [11/09]

Appendix B – Example PSC Spliced Pile Drawings – Sheet 2



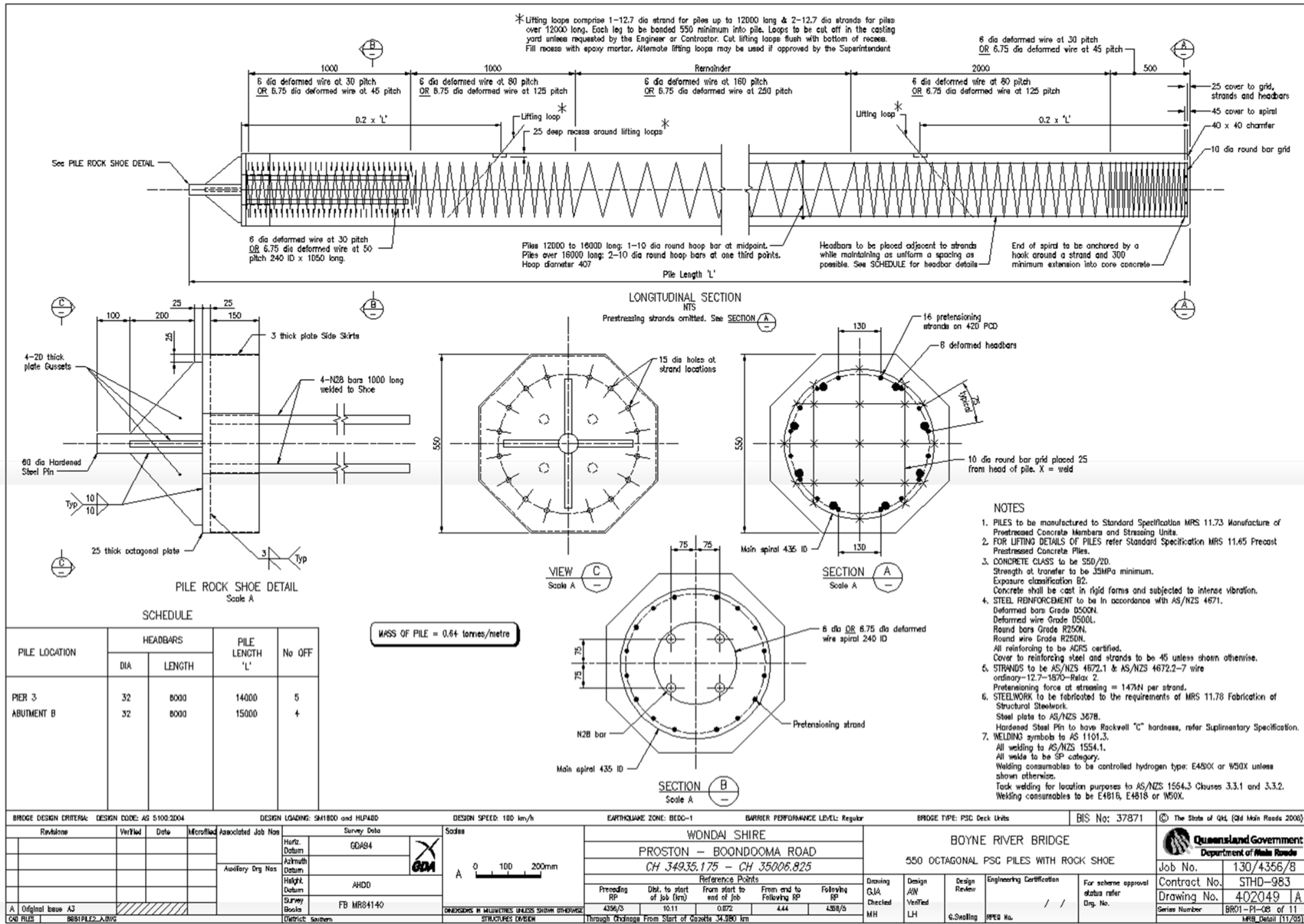
Appendix C – Example Composite Pile Drawing

Appendix C – Example Composite Pile Drawing



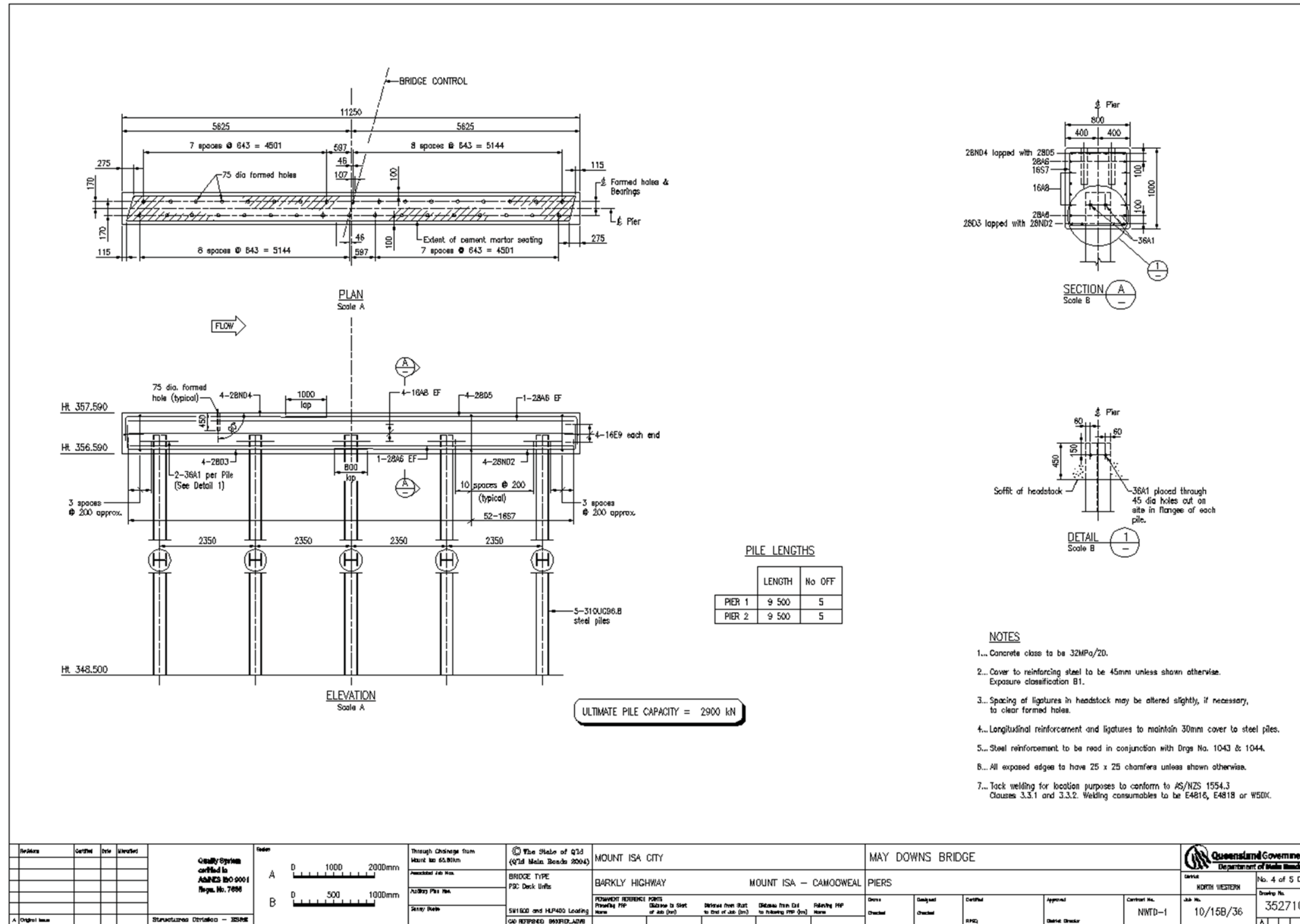
Appendix D – Example PSC Pile Rock Shoe Drawing

Appendix D – Example PSC Pile Rock Shoe Drawing



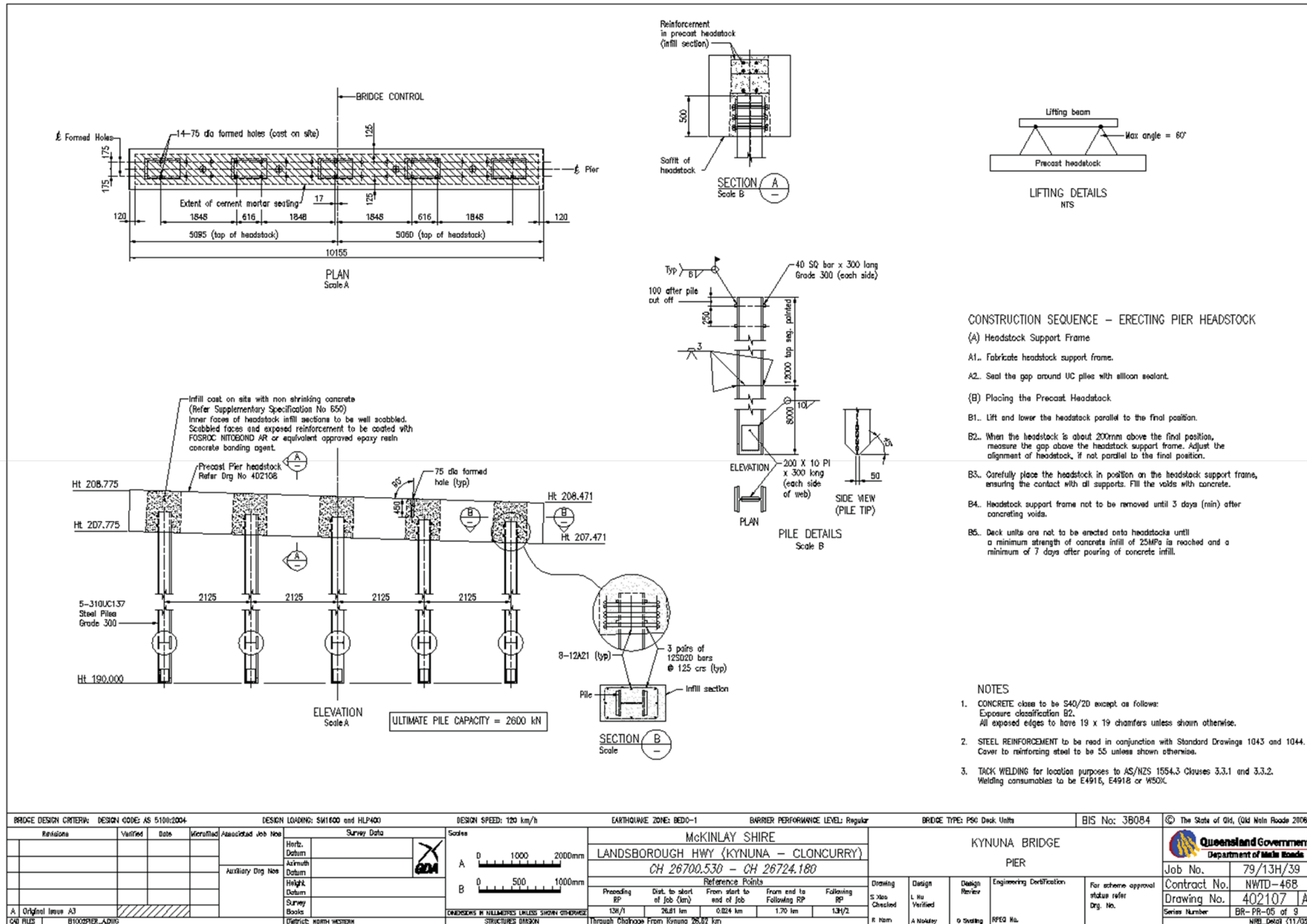
Appendix E – Example Steel Pile and Cast Insitu Headstock Drawing

Appendix E – Example Steel Pile and Cast Insitu Headstock Drawing



Appendix F – Example Steel Pile and Precast Headstock Drawing

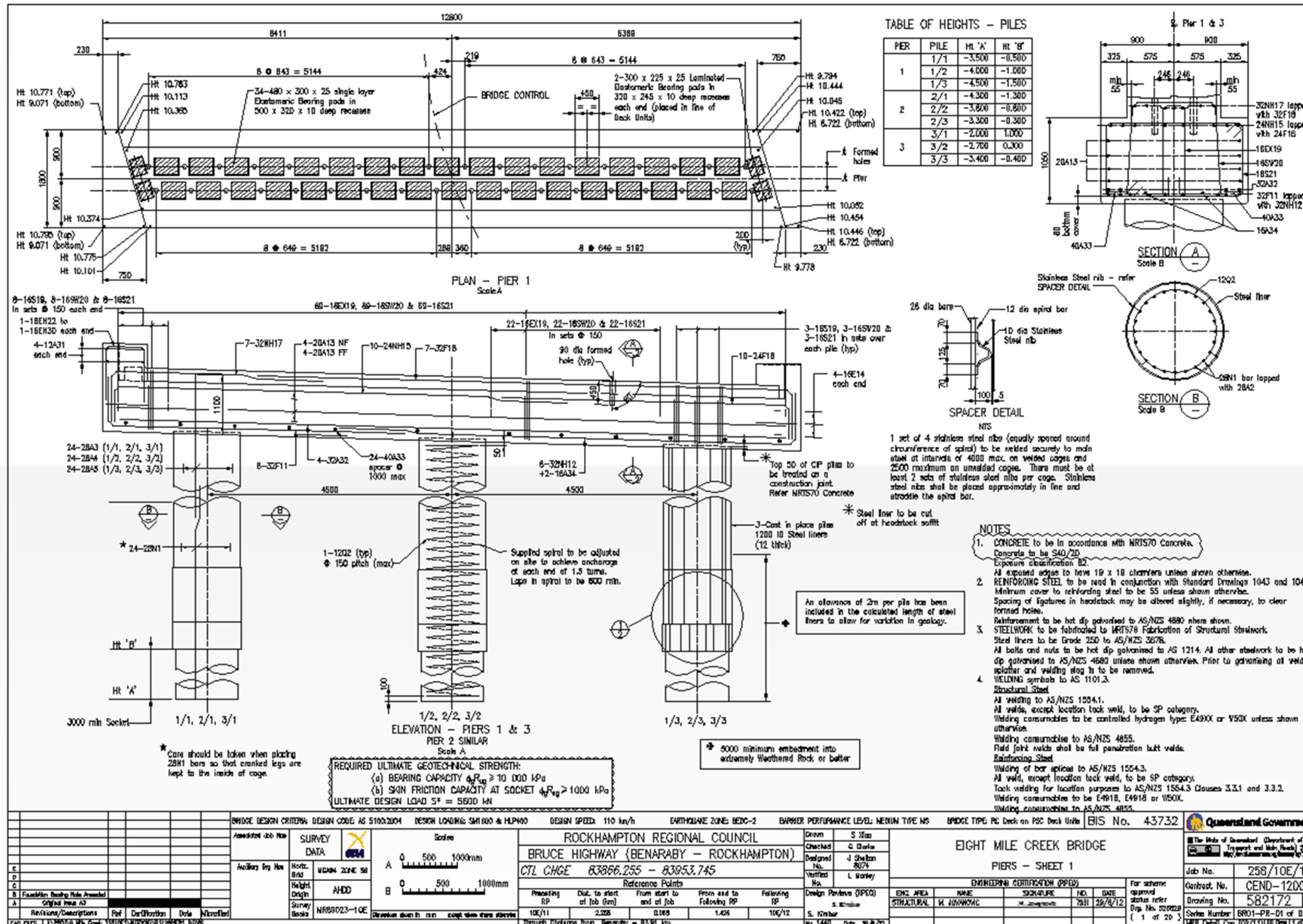
Appendix F – Example Steel Pile and Precast Headstock Drawing





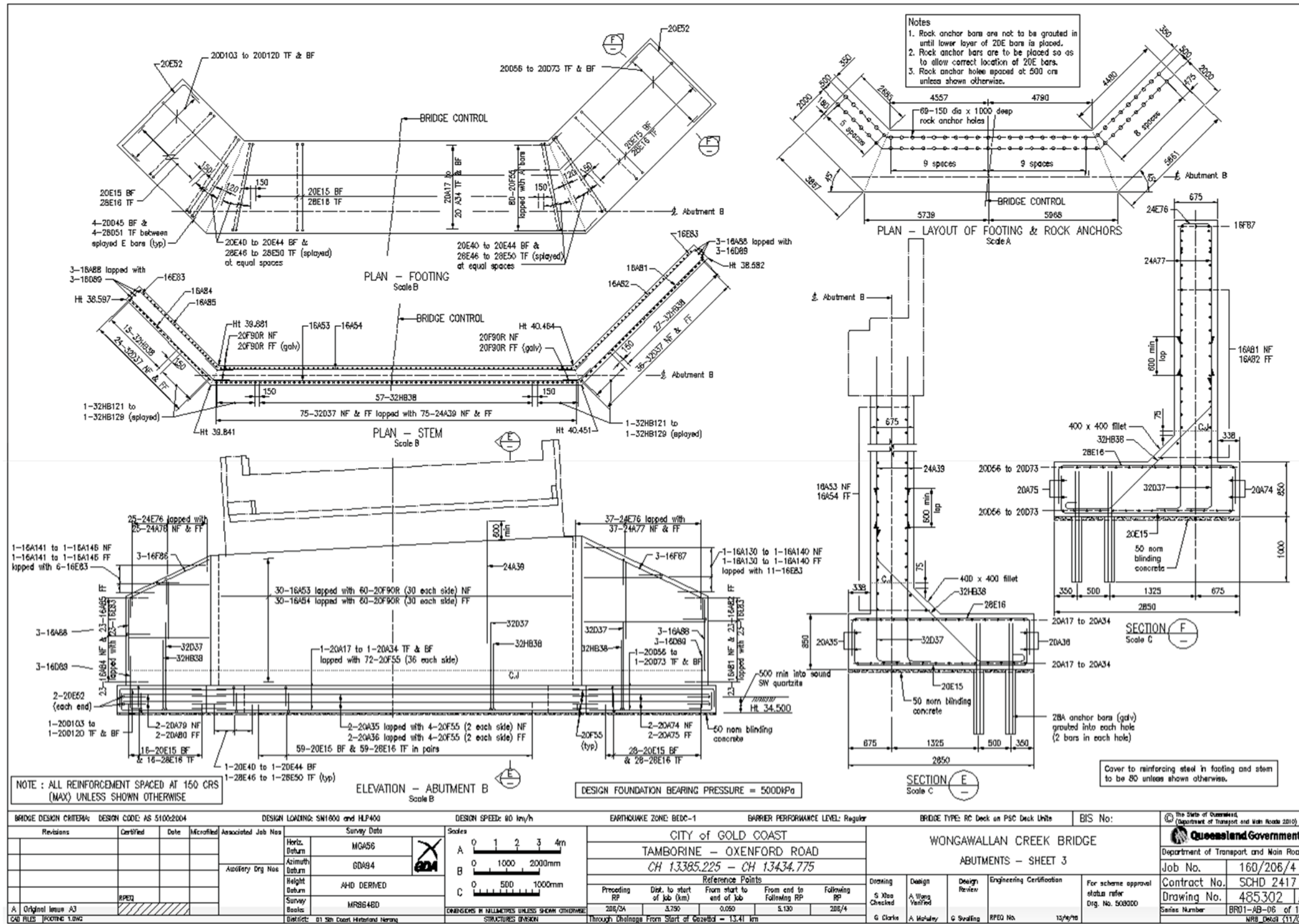
Appendix G – Example CIP Pile Drawing

Appendix G – Example CIP Pile Drawing



Appendix H – Example Spread Footing Drawings

Appendix H – Example Spread Footing Drawings – Sheet 1



Appendix H – Example Spread Footing Drawings – Sheet 2

