Master Specification
Part ST-PI-C2

Cast-in-Place Concrete Piles

September 2024

Government of South Australia
Department for Infrastructure and Transport

Build.
Move.
Connect.

Document Information

Document Information	
K Net Number:	13523414
Document Version:	1
Document Date:	30/09/2024

Document Amendment Record

Version	Change Description	Date
0	Initial issue	31/08/2023
1	Updated cover page	30/09/2024

Document Management

Contents

ST-PI-C2 Cast-in-Place Concrete Piles

1 General

a) This Master Specification Part specifies the requirements for the installation of drilled, cast in place, reinforced concrete piles, which do not use permanent casing, including:

i) the documentation requirements, as set out in section 2;

ii) the material requirements, as set out in section 3;

iii) the pile construction requirements, as set out in section 4;

iv) the tolerance requirements, as set out in section 5;

v) the pile testing requirements, as set out in section 6; and

vi) the Hold Point requirements, as set out in section 7.

b) This Master Specification Part does not cover requirements for continuous flight auger piles, which is covered in ST-PI-C3 “Continuous Flight Auger (CFA) Piles”.

c) Cast in place concrete piles must comply with the Reference Documents, including:

i) AS 2159 Piling - Design and installation; and

ii) AS 5100.3 Bridge design, Part 3: Foundations and soil-supporting structures.

d) The Contractor is responsible for:

i) providing the design of the piles to achieve the specified design geotechnical strength (unless a design has been provided by the Principal);

ii) the installation of piles that achieve the design geotechnical strength and design durability; and

iii) verifying that the design geotechnical strength has been achieved in practice.

2 Documentation

2.1 Construction Documentation

In addition to the requirements of PC-CN3 “Construction Management”, the Construction Documentation must include the following documents, procedures, and instructions relating to cast in place concrete piles:

a) the concrete mix designs, including test results for mix designs, verifying the ability to achieve specified requirements;

b) details of proposed boring equipment to be used and evidence of its capacity to carry out the work;

c) proposed recording forms to be used during construction and testing;

d) methodology to ensure pile location and verticality tolerances are met;

e) methodology for boring and verifying the ground conditions as per the design assumptions;

f) safety requirements to ensure that fall protection is in place whenever an open excavation exists;

g) where appropriate, the type of drilling mud, and the means of maintaining head levels;

h) methodology to monitor and prevent contamination by ingress of loose material, ground water, or mud during pile construction;

i) methodology for placing shaft concrete;

j) method of cutting and breaking back of piles; and

k) details of the proposed test methods, including:

i) the name and qualifications of the independent specialist Subcontractors nominated in section 6.2;

ii) a method statement of how the test will be carried out;

iii) details of the record sheets proposed for monitoring results; and

iv) details of the software to be used for the analysis of testing, where the Contractor proposes to use software other than CAPWAP or TNOWAVE, in accordance with section 6.4a)v).

2.2 Quality Management Records

a) In addition to the requirements of PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable), the Quality Management Records must include continuous records for each cast in place concrete pile, including the following data:

i) in relation to the installation of the piles:

A. diameter, length, location, type of pile, and date and time of boring and concreting;

B. verification that the ground profile does not vary from the design soil profile;

C. concrete batch details, properties and slump;

D. hardened concrete test results (in accordance with ST-SC-S7 “Supply of Concrete”);

E. all information regarding obstructions, delays and other interruptions to the sequence of work; and

F. data recorded during installation of piles as specified in the Construction Documentation; and

ii) in relation to testing of the piles:

A. integrity testing results, in accordance with section 6.3;

B. load test results, in accordance with section 6.4;

C. where applicable, static load testing results, in accordance with section 6.5; and

D. 2 copies of a report showing the measured field parameters and the results of analysis to determine pile capacity, in accordance with section 6.4a)vii).

b) Records for the installation of each cast in place concrete pile must be made available as part of the Quality Management Records within 12 hours of completion of the pile (or group of piles).

3 Materials

The following requirements apply to materials used for cast in place concrete piles:

a) concrete must be in accordance with ST-SC-S7 “Supply of Concrete”;

b) reinforcement must be in accordance with ST-SC-S6 “Steel Reinforcement”; and

c) reinforcement cages must be supplied in full lengths with the number of splices minimised.

4 Pile construction

4.1 General

a) Cast in place concrete piles must be constructed in accordance with the methods specified in:

   i) AS 2159 Piling - Design and installation; and

   ii) AS 5100.3 Bridge design, Part 3: Foundations and soil-supporting structures.

b) A suitably qualified and experienced civil/geotechnical engineer or engineering geologist, fully conversant with piling operations, must be present to supervise all piling works.

4.2 Excavation

a) The Contractor must ensure that the method of construction prevents collapse, ingress of contaminants and material falling in from the surface. If temporary steel casing is used, any holes bored prior to placing the casing in position must be drilled with a bit not more than 25 mm larger than the outside diameter of the casing.

b) Utility Services or adjacent structures must not be damaged by the piling operations. Where percussion equipment is used, the level of energy per blow of the drilling bit must be kept to the minimum consistent with effective boring, so as to minimise vibration, and avoid damage to adjacent piles, structures or services.

c) After excavation and immediately prior to placing concrete, a **Hold Point** will apply. Placing of concrete must not commence until the Hold Point has been released.

4.3 Protection of adjacent piles

a) The Contractor must ensure that the pile construction process does not result in damage to adjacent newly cast piles due to ground vibration or ground disturbance.

b) Pile construction must not be commenced within 2.5 m clear distance of a newly cast pile until the concrete in the newly cast pile has attained a strength of 15 MPa.

c) Piles more than 2.5 m clear distance from a newly cast pile may be installed by boring at any time providing there is no likelihood of damage to the newly cast piles.

d) Installation of piles by methods which involve driven temporary casing or result in significant vibration must not be carried out within the distance 2.5 m to 9.0 m until the concrete in the pile has set for 24 hours.

4.4 Concrete placement

a) Piles must be concreted within 24 hours of completion of the pile excavation.

b) In the event that the requirement of section 4.4a) is not achieved, the Contractor must ream the walls and the base of the pile to remove not less than 25 mm thickness of material and any other foundation material which has softened in that time prior to concreting the pile.

c) Concreting must be a continuous process from the toe level of the pile to the top of the pile such that no voids or debris are left in the shaft and the required concrete compaction is achieved without segregation of aggregate or ingress of contaminants. The concrete must be in intimate contact with the surrounding ground.

d) The reinforcement must be firmly positioned so that it does not move during concrete placement and is fully surrounded by the specified cover of sound concrete.

e) If temporary casing is being used and concrete is being placed below the water table, the minimum height of concrete within the casing must be adjusted to ensure that water is not permitted to enter from outside the casing. The soil pressure at the toe of the casing must be balanced by the mass of the concrete within the casing. The free surface of the concrete must be at least 1.5 m above the bottom of the casing.

f) A minimum of 400 mm of sound concrete must be constructed above the final top level of the pile. The space between the top of the cast concrete and the ground surface (if any) must be filled with sand within 30 minutes of placing the shaft concrete. Piles must not be broken back or trimmed earlier than 24 hours after casting the concrete.

g) For concrete piles acting primarily as laterally loaded piles, with large, embedded steel elements, the requirements of section 4.4f) do not apply.

h) Inspection of pile set-out and reinforcement cages will constitute a **Hold Point**. Placing of concrete must not commence until the Hold Point has been released.

5 Tolerances

All cast in place concrete piles must be constructed in accordance with the tolerances specified in AS 2159 Piling - Design and installation, except that:

a) the pile head must finish within 75 mm of the specified plan position;

b) variation from vertical must not be more than 1 in 50; and

c) minimum cover to reinforcement must be 75 mm.

6 Testing of piles

6.1 General

The results of the testing of cast in place concrete piles required in sections 6.3 and 6.4, and where applicable, section 6.5, must be submitted as part of the Quality Management Records. The submission of the test results will constitute a **Hold Point.** Breakback of the pile and any construction work on the pile cap or abutment, must not occur until this Hold Point has been released.

6.2 Independent specialist Subcontractor

a) Testing of cast in place concrete piles must be carried out by an independent specialist Subcontractor approved by the Principal.

b) The Contractor must nominate the independent specialist Subcontractor which will constitute a **Hold Point**. Testing of the piles must not occur until this Hold Point has been released.

6.3 Integrity testing

a) Integrity testing for cast in place concrete piles must be carried out:

   i) by the independent specialist Subcontractor nominated in section 6.2;

   ii) on all piles; and

   iii) in accordance with integrity test methods specified in AS 2159 Piling - Design and installation.

b) Integrity testing equipment must be capable of checking cross-sectional irregularities in cast in place concrete piles and identifying the location and characteristics of any significant anomalies, such as voids or contaminants, throughout the full length of the pile.

c) Acceptance criteria, supervision and reporting of integrity testing must be in accordance with the requirements of AS 2159 Piling - Design and installation.

6.4 Dynamic load testing

a) Subject to section 6.4b), the following requirements apply to load testing for cast in place concrete piles:

   i) dynamic load testing of piles must be carried out by an independent specialist Subcontractor as nominated in section 6.2;

ii) where requested by the Principal, the Contractor must provide the raw data, collected from the testing in accordance with this section 6.4, to the Principal within 1 day of such request, which may be used for independent review by a third party;

iii) the Contractor must carry out dynamic load testing of piles to confirm that design pile capacity has been achieved, including:

A. at least one dynamic load test at each bridge abutment and pier location; and

B. at least 10% of the total number of piles;

iv) if a test pile has been constructed, additional dynamic load testing (in addition to section 6.4a)iii)) must be carried out on piles where the toe level varies by more than 2 m from the test pile toe level;

v) testing must be carried out by use of a pile driving analyser and the data obtained from each pile must be analysed using CAPWAP, TNOWAVE or equivalent software as nominated in the Construction Documentation;

vi) the test procedures and test reports must conform to the requirements of AS 2159 Piling - Design and installation;

vii) 2 copies of a report showing the measured field parameters and the results of analysis to determine pile capacity must be provided as part of the Quality Management Records; and

viii) the measured ultimate capacity of test piles must be equal to or greater than the pile test load.

b) Dynamic load testing is not required for cast in place concrete piles where the primary load effect on the pile is from lateral loading and which have no vertical load capacity requirement.

6.5 Static load testing

a) Where nominated in the Contract Documents or on the Design Documentation, static load testing for cast in place concrete piles must be carried out:

i) by the independent specialist Subcontractor nominated in section 6.2;

ii) on the nominated piles;

iii) where requested by the Principal, the Contractor must provide the raw data, collected from the testing in accordance with this section 6, to the Principal within 1 day of such request, which may be used for independent review by a third party; and

iv) in accordance with static load test methods specified in AS 2159 Piling - Design and installation.

b) Acceptance criteria, supervision, and reporting of static load testing must be in accordance with the requirements of AS 2159 Piling - Design and installation.

7 Hold Points

Table ST-PI-C2 7-1 details the review period or notification period, and type (documentation or construction quality) for each Hold Point referred to in this Master Specification Part.

Table ST-PI-C2 7-1 Hold Points

Section reference	Hold Point	Documentation or construction quality	Review period or notification period
4.2c)	At the completion of excavation	Construction quality	1 hour notification
4.4h)	Inspection of pile set-out and reinforcement cages	Construction quality	24 hours notification
6.1	Submission of test results	Documentation	5 Business Days review
6.2b)	Details of the independent specialist Subcontractor	Documentation	10 Business Days review