

TRANSPORT FOR NSW (TfNSW)

QA SPECIFICATION B63

CONTINUOUS FLIGHT AUGER (CFA) PILES

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REVISION REGISTER

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 1/Rev 0		First issue.	GM, IC	19.11.08
Ed 1/Rev 1	1.3 3.3 Annex M	Definitions of “you” and “your” added. Added: NPER registration as equivalent to CPEng, Engrs Aust, for certification purposes Referenced documents updated.	GM, IC (Bernie Chell’worth)	15.01.10
Ed 2/Rev 0	Global Guide Notes 1.1 1.2.1 1.2.5 1.3 2.1 2.2 2.3	Specification title changed. Clauses rearranged and reworded to improve clarity. Guide notes added. Clause reworded. Statement on pile installation tolerances moved to clause 5.6 and amended. Changed to “Not Used”. Clause on reduction of minimum frequency of testing deleted. New definitions added. Previously clause 2. Statement on submission of concrete mix for approval deleted, as requirement is covered by other clauses. New clause on concrete requirements, including use of self-compacting concrete and high workability concrete. New clause on steel reinforcement incorporating parts of previous clause 3.4.4. Requirement added that spacers to be of smaller size than nominal cover.	DCS	07.09.18

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 2/Rev 0 (cont'd)	3.1	New clause on submission of weekly program.		
	3.2	New clause on Piling Supervisor and attending Geotechnical Engineer.		
	3.3.1	New sub-clause on piling equipment capacity and auger length added.		
	3.3.2	New sub-clause on piling rig instrumentation added.		
	3.4	New clause on WHS.		
	3.4.1	Previously part of clause 3.3.		
	3.4.2	Previously part of clause 3.3. Requirement to check concreting line for leakages added.		
	3.5	New clause on environmental requirements added.		
	3.6	Previously clause 3.2, but with new requirements. Requirement on checking position and verticality moved to sub-clause 5.1.2.		
	4.1	New clause on additional site investigation.		
	4.2	New clause on trial piles.		
	5.1	New clause on checks and other preparatory measures prior to augering, incorporating clause 3.2 and parts of previous sub-clause 3.4.1. New Hold Point on augering of first pile in pile group, and Witness Point on piling added.		
	5.2.1	New sub-clause on sequence and timing, incorporating parts of previous clause 3.4.2. Pile spacing between adjacent piles cast during previous 24 hours in unfavourable ground conditions specified as 7 times pile diameter.		
	5.2.2	New sub-clause on augering depth.		
	5.2.3	New sub-clause on control and monitoring during augering.		
	5.3	New clause incorporating parts of previous sub-clause 3.4.3. Headings added to form new sub-clauses 5.3.1 to 5.3.5. Clauses on disconnection/breaking of auger during augering removed.		

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 2/Rev 0 (cont'd)	5.3.2	Minimum concrete oversupply factor specified.		
		Requirement added to check concrete volumes after concreting each pile.		
	5.3.4	Requirement for uninterrupted supply of concrete added.		
		During auger extraction, redrilling required only if concrete pressure becomes negative.		
	5.4	New sub-clause on process to be followed in event of auger plug failure, incorporating part of previous sub-clause 3.4.3.		
	5.5	Previously sub-clause 3.4.4.		
		Use of vibrator to assist installation of reinforcement cage deleted.		
	5.6	New clause on installation tolerances, incorporating part of previous clause 1.1, except that tolerance for deviation from verticality increased to 2%.		
	5.7	New clause on installation records, incorporating part of previous clause 3.1.		
		Requirement to provide a copy of the pile monitoring records added.		
	6	Previously clause 4.		
	6.1	New clause on pile integrity testing, incorporating part of previous clause 4.1.		
		New Hold Point added.		
	6.2	Incorporating parts of previous clause 3.1.		
	6.3	Previously clause 4.2.		
	6.3.1, Annex E	List of approved dynamic pile testing systems previously in Annex E replaced by link to “Lists of RMS Approved Bridge Components and Systems”.		
	Annex A	Table in Annex A removed, and heading title changed to “Not Used”.		
	Annex B	New Pay Items on additional site investigation, attendance of geotechnical engineer and trial piles added.		
Annex C1	Schedule of Hold Points and Witness Points added.			
Annex C2	Schedule of Identified Records updated.			
Annex D	Planning Documents updated.			
Annex L	Frequency of testing updated.			
Annex M	Referenced Documents updated.			

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 2/Rev 1	1.2.5	Standard clause on frequency of testing updated.	MCQ	15.01.19
Ed 2/Rev 2	Global	References to “Roads and Maritime Services” or “RMS” changed to “Transport for NSW” or “TfNSW”.	DCS	22.06.20

GUIDE NOTES

(Not Part of Contract Document)

USE AND LIMITATIONS OF CFA PILES FOR BRIDGES

CFA piles:

- (a) can be constructed with diameters up to a maximum of 1200 mm.
- (b) can be founded in cohesive and non-cohesive soils and soft rock.
- (c) are suitable for use in:
 - (i) uniform soil profiles;
 - (ii) cohesive soil formations;
 - (iii) cohesive soil formations overlying granular soil formations;
 - (iv) granular soil formations where the soil density index of the soil layers generally increases with depth.
- (d) are not suitable for use in complex soil profiles with:
 - (i) cohesive soil formations inter-bedded with granular layers;
 - (ii) hard layers overlain by soft layers;because the relatively small penetration of the auger per revolution into hard layers can result in excessive “draw-in” of surrounding granular material or soft layers causing decompression of the pile hole and/or subsidence of the ground.

The length of sockets into rock that can be achieved using CFA piling depends on the torque of the piling rig, the strength of the rock and the nature of the overlying soils. Reasonable socket lengths can be achieved in very low to medium strength rock (UCS < 10 MPa) overlain by cohesive soils.

However, only short rock sockets are possible where medium to high strength rock is overlain by granular soils, due to excessive draw-in.

CFA piles must only be installed vertically, and must not be used as end bearing piles where the toe of the pile is located on top of bedrock with a slope steeper than 1 vertical to 4 horizontal.

COMMENTS ON PARTICULAR CLAUSES

Clause 3.3 – Piling Plant and Equipment

At the tender stage, it is recommended that details of the proposed CFA piling rig and equipment be submitted prior to award of the contract.

The TfNSW Project Manager must ensure that the proposed piling rig is capable of augering the full length of the pile and any additional length as specified in Clause 3.3.1 without stopping.

Clause 4.1 – Additional Site Investigation

Where the distance from the borehole shown on the Drawings for each pile group to any of the CFA piles within the group exceeds four metres, additional boreholes should be taken in accordance with Clause 4.1 of this Specification.

Additional boreholes may be required where ground conditions are complex.



CONTINUOUS FLIGHT AUGER (CFA) PILES

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VERSION FOR: DATE:

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FOREWORD

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REVISIONS TO PREVIOUS VERSION

This document has been revised from Specification TfNSW B63 Edition 2 Revision 1.

All revisions to the previous version (other than minor editorial and project specific changes) are indicated by a vertical line in the margin as shown here, except when it is a new edition and the text has been extensively rewritten.

PROJECT SPECIFIC CHANGES

Any project specific changes are indicated in the following manner:

- (a) Text which is additional to the base document and which is included in the Specification is shown in bold italics e.g. *Additional Text*.
- (b) Text which has been deleted from the base document and which is not included in the Specification is shown struck out e.g. ~~Deleted Text~~.

TfNSW QA SPECIFICATION B63

CONTINUOUS FLIGHT AUGER (CFA) PILES

1 GENERAL

1.1 SCOPE

This Specification sets out the requirements for the construction of reinforced cast-in-place concrete injected piles using continuous flight augers (CFA).

Materials and construction must conform to AS 5100.3 and this Specification.

1.2 STRUCTURE OF THE SPECIFICATION

This Specification includes a series of annexures that detail additional requirements.

1.2.1 (Not Used)

1.2.2 Measurement and Payment

The method of measurement and payment is detailed in Annexure B63/B.

1.2.3 Schedules of HOLD POINTS, WITNESS POINTS and Identified Records

The schedules in Annexure B63/C list the **HOLD POINTS** and **WITNESS POINTS** that must be observed. Refer to Specification TfNSW Q for definitions of **HOLD POINTS** and **WITNESS POINTS**.

The records listed in Annexure B63/C are **Identified Records** for the purposes of TfNSW Q Annexure Q/E.

1.2.4 Planning Documents

The PROJECT QUALITY PLAN must include each of the documents and requirements listed in Annexure B63/D and must be implemented.

1.2.5 Frequency of Testing

The Inspection and Test Plan must nominate the proposed frequency of testing to verify conformity of the item, which must not be less than the frequency specified in Annexure B63/L. Where a minimum frequency is not specified, nominate an appropriate frequency. Frequency of testing must conform to the requirements of TfNSW Q.

You may propose to the Principal a reduced minimum frequency of testing. The proposal must be supported by a statistical analysis verifying consistent process capability and product characteristics. The Principal may vary or restore the specified minimum frequency of testing, either provisionally or permanently, at any time.

1.2.6 Referenced Documents

Unless otherwise specified, the applicable issue of a referenced document, other than a TfNSW Specification, is the issue current at the date one week before the closing date for tenders, or where no issue is current at that date, the most recent issue.

Standards, specifications and test methods are referred to in abbreviated form (e.g. AS 1234). For convenience, the full titles are given in Annexure B63/M.

1.3 DEFINITIONS

The terms “you” and “your” mean “the Contractor” and “the Contractor’s” respectively.

The term “auger” refers to a hollow stem continuous flight auger.

The following definitions apply to this Specification:

Contract Level	Reduced level (RL) of the pile toe shown on the Drawings.
Dynamic Analysis	A Wave Equation Analysis of a specific blow using force and velocity measured in Dynamic Testing together with measured pile/soil parameters to replicate the measured traces of force and velocity and subsequently determine pile resistance, distribution of resistance and pile integrity (e.g. CAPWAP, TNOWAVE).
Dynamic Data	The force and velocity near the head of the pile and estimates of pile resistance, net energy, pile integrity and stresses in the pile, determined immediately using electronic equipment (e.g. PDA) during pile testing.
Dynamic Testing	The measuring and recording of Dynamic Data for a specific blow and subsequent Dynamic Analysis. The term is the same as the High-Strain Dynamic Testing of AS 2159.
Integrity Testing	A non-destructive test carried out on a concrete pile after its installation/construction to verify the quality of the concrete pile shaft in terms of its continuity, density, shape and length.
Pile Design Load	The design ultimate axial load shown on the Drawings for the pile.
Piling Supervisor	Your employee responsible for supervision and control of the piling operations.
Trial Pile	Pile completed for the purpose of trialling the construction method for the site ground conditions, and must not be part of the permanent works.
Wave Equation Analysis	A predictive computer analysis of pile driving, which can use hammer, pile and soil characteristics measured during Dynamic Testing for the determination of pile resistance.

2 MATERIALS

2.1 GENERAL

Concrete and reinforcement must conform to Specification TfNSW B80 and any additional requirements necessitated by the CFA pile construction method.

2.2 CONCRETE

Use self-compacting concrete or high workability concrete conforming to Annexure B80/G of TfNSW B80.

Select the concrete mix such that all loads of concrete remain workable throughout the time required to complete the pile construction including reinforcement cage insertion, allowing for delays and other unforeseen circumstances. Verify by calculation that the time to complete the pile is within the mix reversion time.

2.3 STEEL REINFORCEMENT

Reinforcement must extend over the full length of the piles.

Supply and fix reinforcement cages in conformity to TfNSW B80.

Tying or welding of reinforcement cages must be sufficient to enable their placement in the correct position and to the full pile length.

Attach spacers with a minimum contact width of 35 mm to the reinforcement cage at locations and intervals not exceeding 3 m for the full length of the cage. Spacer depth (measured along the pile diameter) must be 25 mm less than the nominal cover specified on the Drawings to facilitate insertion of the cage in the concreted pile hole.

3 CONSTRUCTION – GENERAL REQUIREMENTS

3.1 WEEKLY PROGRAM

Submit to the Principal each week a program showing your daily scheduled pile construction work for the week.

3.2 SUPERVISION

3.2.1 Piling Supervisor

Your Piling Supervisor must supervise and control the piling operations at all times.

3.2.2 Attending Geotechnical Engineer

During augering and concreting of the first pile of each pile group, a Geotechnical Engineer, engaged by you, must be in attendance.

For uniform or non-complex ground conditions, the attending Geotechnical Engineer must direct the Piling Supervisor to the single required depth that all piles within the pile group must reach.

For non-uniform or complex ground conditions, the attending Geotechnical Engineer must direct the Piling Supervisor to the specific depths that each individual pile must reach.

The attending Geotechnical Engineer must be a Chartered Professional Engineer with membership of Engineers Australia practising in the field of geotechnical engineering (or equivalent) and experienced in the geotechnical assessment of pile excavations. Submit for acceptance details of the qualifications and experience of the attending Geotechnical Engineer.

An equivalent to membership of Engineers Australia would be an Engineer registered on the National Engineering Register (NER) in the general area of practice of Civil Engineering and experienced in the geotechnical assessment of pile excavations.

3.3 PILING PLANT AND EQUIPMENT

HOLD POINT

Process Held:	Delivery of piling plant and equipment to the Site.
Submission Details:	(a) Details of the proposed piling equipment together with certification, including calculations by a Chartered Professional Engineer, that the proposed piling equipment and working platforms or supports, complies with Clauses 3.3.1 and 3.4.1; (b) Calibration records for piling rig monitoring instruments in accordance with Clause 3.3.2; at least 5 working days before delivery of piling plant.
Release of Hold Point:	The Principal will consider the submitted information prior to authorising the release of the Hold Point.

3.3.1 Capacity and Auger Length

The piling equipment must have the capacity to excavate the pile shaft and socket (where applicable) in the founding material to the diameter and depth shown on the Drawings, and the capacity to excavate an additional 20% of the design pile length.

The auger length must also exceed the design pile length by at least an additional 20%, to allow continuous augering without breaking or unscrewing the auger in the event that the pile length need to be increased by an additional 20%.

3.3.2 Piling Rig Instrumentation

Fit the CFA piling rig with on-board instruments to monitor the piling operations in real-time. The on-board instruments must be capable of accurately measuring the parameters listed in Clause 5.7.

Provide evidence verifying that the piling rig monitoring instruments have been calibrated within the six months before the date of pile construction.

3.4 WORK HEALTH AND SAFETY REQUIREMENTS

3.4.1 General

Without limiting the requirements of Specification TfNSW G22, prior to bringing any piling equipment or plant to the site, provide drawings and calculations certified by a Chartered Professional Engineer with membership of Engineers Australia practising in the field of geotechnical engineering (or equivalent), verifying that under the proposed set up and site conditions, the proposed piling equipment and working platforms or supports will operate safely.

3.4.2 Daily Checks

Prior to the commencement of each day's piling, carry out a safety check on the piling equipment to ensure safe working conditions.

Check the entire concreting line for leakages.

3.5 ENVIRONMENTAL REQUIREMENTS

Remove all excavated material, excess concrete and waste from the site, unless otherwise specified.

Collect, treat and dispose of the water resulting from your piling operations in accordance with Specification TfNSW G36.

3.6 SET OUT

Set out the site with adequate recovery pegs and survey markers so that the drilling rig can be set up accurately on the pile locations and be aligned correctly.

4 ADDITIONAL SITE INVESTIGATION AND TRIAL PILES

4.1 ADDITIONAL SITE INVESTIGATION

4.1.1 General

When directed by the Principal, and as required by site conditions, take additional boreholes and/or cores prior to augering the pile holes to confirm the adequacy of the ground conditions for the pile shaft and the depth of the pile base.

4.1.2 Standard Penetration Test

When taking boreholes, carry out Standard Penetration Test (SPT) to AS 1289.6.3.1 at 1.5 m intervals starting from one metre below the ground level to the pile toe level.

4.1.3 Cores

For piles founded on rock, take 50 mm diameter core samples commencing at one metre above the top of the rock socket shown on the Drawings to a depth that is at least 3 m or 3 pile diameters, whichever is the greater, below Contract Level.

4.1.4 Logging

Log the boreholes and/or cores in conformity to AS 1726. Place the cores in suitable core boxes and make them available for inspection by the Principal as required.

4.1.5 Backfilling Boreholes

Fill all boreholes upon completion using flowable cement-stabilised sand.

4.2 TRIAL PILES

Where specified on the Drawings or directed by the Principal, construct trial piles in conformity to Clauses 5.2 to 5.5.

Submit installation records as specified in Clause 5.7.

Carry out and submit results of integrity and load testing on every trial pile in conformity to Clauses 6.1 and 6.3, respectively, prior to the construction of the piles represented by that trial pile.

5 CONSTRUCTION – CFA PILING

5.1 PRIOR TO AUGERING

HOLD POINT

Process Held:	Augering and concreting of the first pile in each pile group.
Submission Details:	Certification of pile location set out (refer to Clause 3.6) and, where required, additional site investigation (refer to Clause 4.1) and trial piles test results (refer to Clause 4.2), at least one working day before commencing.
Release of Hold Point:	The Principal will consider the details and certification submitted, prior to authorising the release of the Hold Point.

WITNESS POINT

Process to be Witnessed:	Augering, concreting and placing of reinforcement cage for each pile.
Submission Details:	Notification of the time and location of the augering of each pile at least one working day prior to commencing.

5.1.1 Calibration of Concrete Volume Measuring System

Determine the calibration factor for concrete pump efficiency, based on the make, model and previous experience with the specific concrete pump.

Prior to commencement of piling on site, confirm or adjust the calibration factor to suit the concrete mix and pump. The calibration factor is calculated as the ratio of the concrete volume delivered to the pump to the actual corresponding volume discharged. Enter that factor into the on-board monitoring instrument.

5.1.2 Other Checks and Preparatory Measures

Clearly mark the drilling frame at 0.5 m intervals for independent visual verification of the auger depth in addition to the automated depth monitoring unless a secondary depth recorder is present.

Check the depth sensors to ensure accurate measurements.

Prior to augering of the first pile of the day, prime the concrete supply line with a cement/water mix or equivalent and pump concrete through the full length of the line.

Keep the concrete hose length to a minimum to facilitate pumping.

Prior to augering of each pile, use an end cap or temporary plug to close off the auger tip and prevent soil and water ingress into the hollow shaft of the auger during augering. Clean and grease the plug prior to sealing the auger.

Check the position and verticality of the auger prior to the commencement of augering of each pile.

5.2 AUGERING

5.2.1 Sequence and Timing

Carry out the pile construction in such a sequence that the integrity of previously constructed piles is not compromised.

Do not construct piles within a centre-to-centre distance of less than 3 times the pile diameters from adjacent piles cast within the previous 24 hours, unless approved by the Principal. If required because of unfavourable ground conditions, such as in saturated granular soils or soft clays, increase this minimum distance to 7 times the pile diameter unless otherwise approved by the Principal.

Prevent delays during augering. Do not leave pile holes partially drilled.

5.2.2 Depth

Auger to the Contract Level unless otherwise directed by the attending Geotechnical Engineer and approved by the Principal.

5.2.3 Control and Monitoring

Control the auger drilling rate against the penetration rate to minimise “draw-in” of surrounding ground. Do not allow the auger stem to rotate without penetration or extraction. Do not lift the auger stem during augering.

Monitor the penetration rate, the drilling rate and the torque over the full length of the piles.

5.3 CONCRETING AND AUGER EXTRACTION

5.3.1 General

Commence concreting immediately after completion of augering and proceed with injecting the concrete without delays.

Verify from the concrete delivery docket prior to the discharge from the agitator that the specified concrete mix has been delivered. Visually check the concrete mix and carry out testing in conformity to Specification TfNSW B80.

5.3.2 Concrete Oversupply

The actual volume of concrete placed in the pile shaft must not be less than the nominal volume multiplied by the concrete oversupply factor.

The concrete oversupply factor varies for different ground conditions, but must not be less than 105% except for pile sockets in rock where the factor may be reduced to 100%.

The oversupply factor must replicate values derived from trial piles where used.

5.3.3 Prior to Auger Extraction

Prior to auger extraction, pre-charge the concreting line and the auger stem with concrete under pressure.

Should the plug closing off the auger tip not open immediately following commencement of extraction, raise the auger 200 mm and blow the plug free. Re-auger to the original depth and recommence extraction.

Use a multi-pass drilling technique in the base of the pile hole to ensure that the concrete is not contaminated. Withdraw the auger 500 mm while discharging concrete and then drill back down to toe of the pile to pick up any contaminated concrete before re-commencing concreting of the pile. The auger depth in the second or subsequent pass must not be less than the depth of the previous pass by more than 50 mm.

Verify the use of the multi-pass drilling technique from the pile monitoring records.

5.3.4 Auger Extraction and Concrete Pumping

During extraction, provide an uninterrupted supply of concrete for each pile to produce a monolithically concreted pile with the specified dimensions and that is free of entrapped air and debris.

Extract the auger smoothly, without jerks. Where required, the auger stem may rotate slowly on extraction to facilitate the auger cleaning. Care must be taken to ensure soil draw-in will not occur.

Maintain positive concrete pressure during extraction over the length of the pile. If the concrete pressure becomes negative at a certain depth, redrill to 500 mm below that depth and resume extraction and concreting. Ensure that the auger tip remains embedded in concrete at all times during extraction by injecting sufficient concrete oversupply.

During extraction, clean the auger of all rising ground materials. Progressively remove spoil accumulating around the top of the pile hole.

5.3.5 Completion of Concrete Placement

Continue concrete pumping until the auger tip rises to 300 mm above the ground level. Remove all spoil from around the pile hole.

On completion of concrete placement, and removal of spoil around the top of the pile hole, clean the top of the pile manually. Where necessitated by the site conditions, insert a temporary form in the pile top and remove contaminated concrete at the top and replace with good concrete as required.

5.4 PLUG FAILURE

If the plug opens prematurely during drilling, or if all attempts to blow out the plug after completion of drilling are unsuccessful, wind out the auger in conformity to the manufacturer's recommendations and clean and refit the end plug. Then redrill the same pile hole to the specified depth or to an increased depth as directed by the Principal.

If redrilling the pile at the same position cannot be achieved, seek the Principal's direction. The Principal may accept drilling the pile at a new position which is within a short distance from the original pile position.

5.5 PLACEMENT OF REINFORCEMENT CAGE

Prior to placement, ensure that the reinforcement cage is clean and straight.

Place the reinforcement cage into the centre of the concreted pile hole immediately after concreting and while the concrete is still fluid. Keep the cage vertical during insertion. Prior to lowering the reinforcement cage, adjust the cage orientation to avoid clashing with the pile cap reinforcement.

Secure the reinforcement cage in place to obtain the specified projection above final pile cut-off level.

If the reinforcement cage cannot be placed to the specified depth, withdraw the cage and clean it thoroughly before re-augering and re-concreting the pile prior to re-inserting the cage.

5.6 INSTALLATION TOLERANCES

Tolerances on pile installation must conform to Section 7 of AS 2159 except that the inclination tolerance for vertical piles must be 2%.

Demonstrate that the inclination tolerance has been achieved.

5.7 INSTALLATION RECORDS

Monitor and record the following parameters in real-time over the full length of each pile to verify conformity of the pile installation:

- (a) penetration rate (m/min) during augering;
- (b) drilling rate (rev/mm) during augering;
- (c) drilling torque (% of maximum available) during augering;
- (d) extraction rate of auger (m/min) during concreting;
- (e) concreting pressure (bar); and
- (f) amount of concrete oversupply (% above nominal) recorded at half metre intervals of the pile depth).

Provide to the Principal a copy of the pile monitoring records, signed by the Piling Supervisor, demonstrating that the pile position, size, depth, verticality and other design parameters shown on the Drawings, or in conformity to the directions of the attending Geotechnical Engineer and approved by

the Principal, have been achieved within 24 hours of the completion of the pile where mobile phone reception is available at the site, and within 48 hours otherwise.

6 TESTING

6.1 PILE INTEGRITY TESTING

Unless specified otherwise on the Drawings, carry out integrity testing of all piles in conformity to AS 2159. Testing must not result in the allowable concrete stresses being exceeded.

The integrity testing must confirm that the pile is sound over its full length.

HOLD POINT

Process Held:	Integrity testing of all piles.
Submission Details:	Method of integrity testing and personnel proposed for the testing.
Release of Hold Point:	The Principal will consider the submitted information prior to authorising the release of the Hold Point.

6.2 PILE LOAD TESTING - GENERAL

Carry out load testing to the piles designated on the Drawings (such as for trial piles if applicable) or directed by the Principal, to the test load specified on the Drawings or directed by the Principal.

Unless specified otherwise by the Principal, perform static or high-strain dynamic testing in conformity to AS 2159 and Clause 6.3 as applicable.

You may use other types of pile load testing in conformity to AS 2159, where approved by the Principal.

6.3 HIGH-STRAIN DYNAMIC TESTING

6.3.1 General

Where high-strain dynamic pile testing is to be carried out, prepare the pile as required to allow the attachment of transducers or similar testing instruments.

Carry out high-strain dynamic testing in conformity to AS 2159 and this Clause using an approved organisation with approved equipment using an approved dynamic testing system, with subsequent wave equation analysis or signal matching carried out using an approved computer program, all as listed in the “Lists of TfNSW Approved Bridge Components and Systems” at:

<http://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/tenders-contracts/listofapprovedbridgecomponentssystems.pdf>

Testing must not result in the allowable concrete stresses being exceeded.

6.3.2 Testing Procedure

Use the following procedure for the testing:

- (a) Attach at least four bolt-on transducers below the head of the pile.
- (b) Connect the transducers to the analyzer and strike the pile with sufficient energy to verify the required resistance.

6.3.3 Dynamic Analysis

Analyse the dynamic data for each pile tested. Analyses must include full Dynamic Analysis using measured field parameters of the test data (e.g. CAPWAP).

6.3.4 Report

Provide to the Principal a report for each pile tested, including the following:

- (a) Complete PDA (or approved equivalent) output for all blows.
- (b) CAPWAP (or approved equivalent) analyses for selected blows.
- (c) Certification that the pile has been dynamically tested in conformity to this Specification. If it is not possible for this certification to be provided due to nonconformities in the testing or the pile tested, provide instead an itemised nonconformity report together with the proposed disposition.

ANNEXURE B63/A – (NOT USED)

ANNEXURE B63/B – PAYMENT

Refer to Clause 1.2.2.

In the Schedule of Prices accompanying the Lump Sum Tender, the cost of piles is divided into the following items or sub-items (separately provide similar items or sub-items for each diameter of pile):

Pay Item B63P1 – Additional Site Investigation – Provisional Quantity

Pay Item B63P1.1 – Boreholes

The unit of measurement is the “lineal metre” of drilling. The rate covers all costs associated with drilling, sampling and logging the borehole to the pile toe level for piles that are not socketed in rock, or to the top of rock level prior to coring (refer Pay Item B63P1.2), and carrying out SPT testing every 1.5 m during drilling.

Pay Item B63P1.2 – Coring in Rock

The unit of measurement is the “lineal metre” of coring. The rate covers all costs associated with coring, sampling, logging and placing the cores in core boxes (refer to Clause 4.1).

Drilling in soil prior to coring in rock is paid under Pay Item B63P1.1.

Pay Item B63P2 – Attendance of Professional Geotechnical Engineer during Pile Augering and Concreting

The unit of measurement is the “hour” of attendance on site in accordance with Clause 3.3.2.

Pay Item B63P3 – Augering and Concreting of Pile

(a) To Contract Level

The unit of measurement is the “lineal metre” of pile constructed.

The rate covers all costs associated with augering, and supply and placement of concrete to Contract Level, including removal and disposal of excavated material from the Site, and cutting off to suit the pile cap or abutment construction.

(b) Below Contract Level – Provisional Quantity

The unit of measurement is the “lineal metre” of pile constructed below Contract Level.

The rate covers all costs associated with augering, and supply and placement of concrete below Contract Level, including the removal and disposal of excavated material from the Site.

Pay Item B63P4 – Supply and Placement of Reinforcement

(a) To Specified Depth

The unit of measurement is the “tonne” of reinforcement placed to Contract Level.

(b) Below Specified Depth – Provisional Quantity.

The unit of measurement is the “tonne” of reinforcement placed below Contract Level.

Pay Item B63P5 – Pile Integrity Testing

The unit of measurement is “each” pile tested.

The rate covers all costs associated with undertaking pile integrity testing in accordance with Clause 6.1, including construction and removal of any temporary measures required for the testing.

Pay Item B63P6 – Pile Load Testing – Provisional Quantity

Pay Item B63P6.1 – Static Load Testing

The unit of measurement is “each” pile tested.

The rate covers all costs associated with undertaking static pile load testing in accordance with Clause 6.2, including construction and removal of any temporary measures (including excavation and backfilling) required to undertake the testing, and preparation and submission of the test reports.

Pay Item B63P6.2 – Dynamic Load Testing

(a) Site Establishment

The unit of measurement is “each” establishment of the testing equipment at a bridge location.

The rate covers all costs associated with mobilising to, and subsequent removal from each bridge location, of the testing equipment. No additional payment will be made for movement of the testing equipment within a particular bridge location.

(b) Testing

The unit of measurement is “each” pile tested.

The rate covers all costs associated with undertaking dynamic pile load testing in accordance with Clause 6.3 when testing is instructed by the Principal to verify design strength, including construction and removal of any temporary measures (including excavation and backfilling) required to undertake the testing, and preparation and submission of the test reports.

Pay Item B63P7 – Extra over for Trial Piles

The unit of measurement is “each” trial pile constructed.

The rate covers all additional costs associated with construction of trial piles shown on the Drawings, including equipment mobilisation, but does not cover augering, concreting, reinforcement and testing which are paid under Pay Items B63P2 to B63P6.

ANNEXURE B63/C – SCHEDULES OF HOLD POINTS, WITNESS POINTS AND IDENTIFIED RECORDS

Refer to Clause 1.2.3.

C1 SCHEDULE OF HOLD POINTS AND WITNESS POINTS

Clause	Type	Description
3.3	Hold	Submission of details of piling plant and equipment before delivery to Site
5.1	Hold	Submission of pile set out, and site investigation and trial pile test results, for each pile group
5.1	Witness	Augering, concreting and placing of the reinforcement for each pile
6.1	Hold	Proposed method of pile integrity testing and personnel to carry out the testing

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
3.2.2	Qualifications and experience of Geotechnical Engineer
3.3.2	Calibration records for drilling monitoring instruments
4.1	Borehole logs and SPT results from additional site investigation
5.7	Certified installation records for each pile
6.1	Integrity test report for each pile tested
6.3.4	Load test report for each load tested pile

ANNEXURE B63/D – PLANNING DOCUMENTS

Refer to Clause 1.2.4.

The following documents are a summary of documents that must be included in the PROJECT QUALITY PLAN. Review the requirements of this Specification and other contract documents to determine any additional documentation requirements.

Clause	Description of Document
2.2	Details of approved nominated concrete mix
3.3.2	Details of proposed CFA piling rig and on-board monitoring instruments together with recent calibration records
5.1.1	Evidence that on-board monitoring instruments accurately measure the concrete volume discharged
5.2 & 5.3	Procedures for auguring, auger extraction and concreting
5.5	Procedure for placing reinforcement cage
6.1	Procedure for Integrity Testing
6.3	Procedures for load testing and details of proposed approved dynamic testing organisation and system and testing personnel

ANNEXURES B63/E TO B63/K – (NOT USED)**ANNEXURE B63/L – FREQUENCY OF TESTING**

Refer to Clause 1.2.5.

Clause	Characteristic Analysed	Minimum Frequency of Testing
2.2 & 5.3	Concrete for piles	As specified in TfNSW B80
2.3	Reinforcement for piles	As specified in TfNSW B80
5.6	Pile position and verticality	Each pile
6.1	Pile Integrity Testing	All piles
6.3	Pile Load Testing	Piles specified on Drawings or by Principal

ANNEXURE B63/M – REFERENCED DOCUMENTS

Refer to Clause 1.2.6.

TfNSW Specifications

TfNSW B80	Concrete Work for Bridges
TfNSW G22	Work Health and Safety (Construction Work)
TfNSW G36	Environmental Protection
TfNSW Q	Quality Management System

Australian Standards

AS 1289.6.3.1	Methods of testing soils for engineering purposes – Soil strength and consolidation tests – Determination of the penetration resistance of a soil - Standard penetration test (SPT)
AS 1726	Geotechnical site investigations
AS 2159	Piling – Design and installation
AS 5100.3	Bridge design. Part 3: Foundations and soil-supporting structures