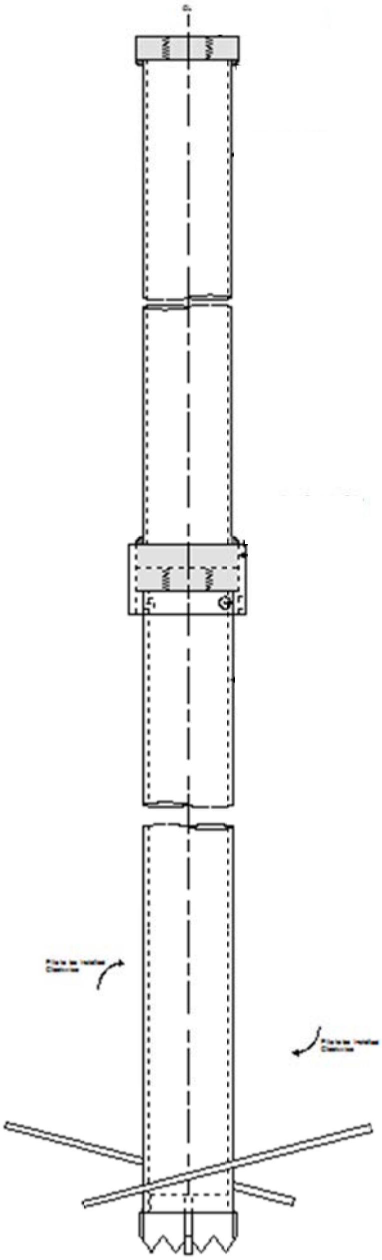
KATANA BLADE PILE – 80kN SWL



SPECIFICATION

TUBULAR STEEL – KATANA PILES

Prepared by Patented Foundations Pty Ltd

Please note this document has been prepared by Patented Foundations Pty Ltd. Its use is intended as a guide only for checking and inclusion by a practising consulting engineer in their project documentation. This specification outlines a minimum set of standards and procedures for the supply and installation of the Katana Blade Pile in accordance with the relevant Australian Standards.

ISSUE 2.0
DATE: November 2013

CONTENTS

Clause Page

TUBULAR STEEL - KATANA PILE

GENERAL

1 SCOPE

The work to be executed under this Specification consists of:-

- Supply of steel Katana piles
- Installation of steel Katana piles
- Design and certification of Katana piles.

2 REFERENCES

Australian Standards

AS 1579	Arc Welded Steel Pipes and Fittings for Water and Waste Water
AS 2159	Piling Design and Installation
AS 2177	Non Destructive Testing – Radiography of Welded Butt Joints in Metal
AS 2203.1	Cored Electrodes for Arc-Welding
AS 2207	Non Destructive Testing – Ultrasonic Testing of Fusion Welded Joints in Carbon & Low Alloy Steel
AS 1163	Structural steel hollow sections
AS 4100	Steel structures

Australian/New Zealand Standards

AS/NZS 1553.1	Low Carbon Steel Electrodes for Manual Metal-arc Welding of Carbon Steels & Carbon – Manganese Steels
AS/NZS 1554.1	Welding of Steel Structures
AS/NZS 3678	Structural Steel - Hot-rolled Plates, Floor plates and Slabs

Supporting Documentation

Appendix A	Weld Specifications
Appendix B	Corrosion
Appendix C	Geotechnical Test Results
Appendix D	Bracing Plate (Optional)

MATERIALS

3 STEEL KATANA PILES

STEEL BLADE PILES REQUIREMENTS for the 80kN KATANA BLADE PILE

a) The steel Katana pile shaft shall be made from “Orrocon Steel” circular hollow section structural steel with a yield strength of 463MPa and a tensile strength of 490MPa, to AS 1163 manufactured in accordance with AS/NZS 1554.1

b) The steel Katana Pile bearing plates shall be made from structural steel Grade 400 or higher to AS/NZS and manufactured in accordance with AS/NZS 1554.1

c) Certification of materials - Test certificates shall be issued with the Katana piles for the steel used in the manufacture of in accordance with AS/NZS 3679.1 relating to tests performed by the manufacturer to establish compliance with the Standard.

d) Dimensions and Tolerances – The steel hollow sections shall conform to the manufacturing tolerances specified in AS 1163-1991.

e) Weld specifications are to comply with report by e3K Global *A division of Gilmore Engineers Pty Ltd, research and development. Attached (Appendix A)

f) The use of unidentified or second hand steel is not to be used. All steel shall comply with AS 4100.

g) Once manufactured Katana piles are to be visually inspected and approved.

CORROSION PROTECTION TO BLADE PILES

Steel Katana piles to be designed in accordance with AS 2159 Section 6.3 with an allowance for sectional loss based on the site corrosion classification and design life. Refer “Katana Blade Pile” corrosion manual by e3k Global *A division of Gilmore Engineers Pty Ltd, research and development. Attached (Appendix B)

DESIGN

4. DESIGN OF STEEL BLADE PILES

a) The Katana piles when incorporated within a foundation system must be designed by a practising professional structural engineer with previous experience in the use and design of steel blade piles.

b) The steel Katana piles shall be designed in accordance with AS 4100 and AS 2159 to carry 80kN safe working load, along with any additional loads due to installation misalignment, soil movement or pile settlement if applicable. Suitable geotechnical information will be supplied and used for design purposes.

c) Katana pile design calculations shall be supplied to project engineers for their approval prior to the manufacture of the Katana piles.

d) Katana pile design calculations shall include a load eccentricity of 25mm and a realistic allowance for effective length for the particular soil conditions

e) The maximum settlement of the Katana piles under design working load shall be as detailed in AS 2159 Table 8.2 unless noted otherwise on the engineered drawings.

f) The Katana pile connection to the footing or structure over shall be part of the design process undertaken by the design engineer.

INSTALLATION

5. KATANA PILE INSTALLATION

KATANA PILES INSTALLATION REQUIREMENTS

a) The Katana piles shall be installed using specialised equipment correctly calibrated to allow torque reading to be monitored and recorded during installation.

b) The Katana piles shall be installed by an experienced accredited "Katana Pile" contractor.

c) Details of the proposed Katana pile installation equipment and operator proficiency shall be submitted to the project engineers for approval.

d) During the storage, transportation, lifting and installation the Katana piles shall be correctly supported. Any steel Katana piles damaged or distorted in excess of the specified tolerances in AS 1163-1991 shall be replaced at the sole expense of the Contractor.

e) The piling contractor shall submit for approval a record of the initial "Rapid Load Test" verification with installation torques and pile depths achieved. The engineer is required to sign off on the install prior to the concrete foundation being completed.

Note: Installers are required to be accredited by "Stoddart Foundations". An install manual is available on request.

KATANA PILE INSTALLATION TOLERANCES

f) The maximum variation shall be no more than ± 25mm from the plan position as shown on the drawings.

g) The Katana pile shaft shall be installed vertically with a variation of not more than 4% from the vertical.

h) The maximum variation of the cut-off level shall be ± 25mm from that shown on the drawings.

CERTIFICATION

6 KATANA PILE CERTIFICATION

a) At the completion of the Katana piling works the piling contractor shall issue the following certification to the project engineer or principle contractor.

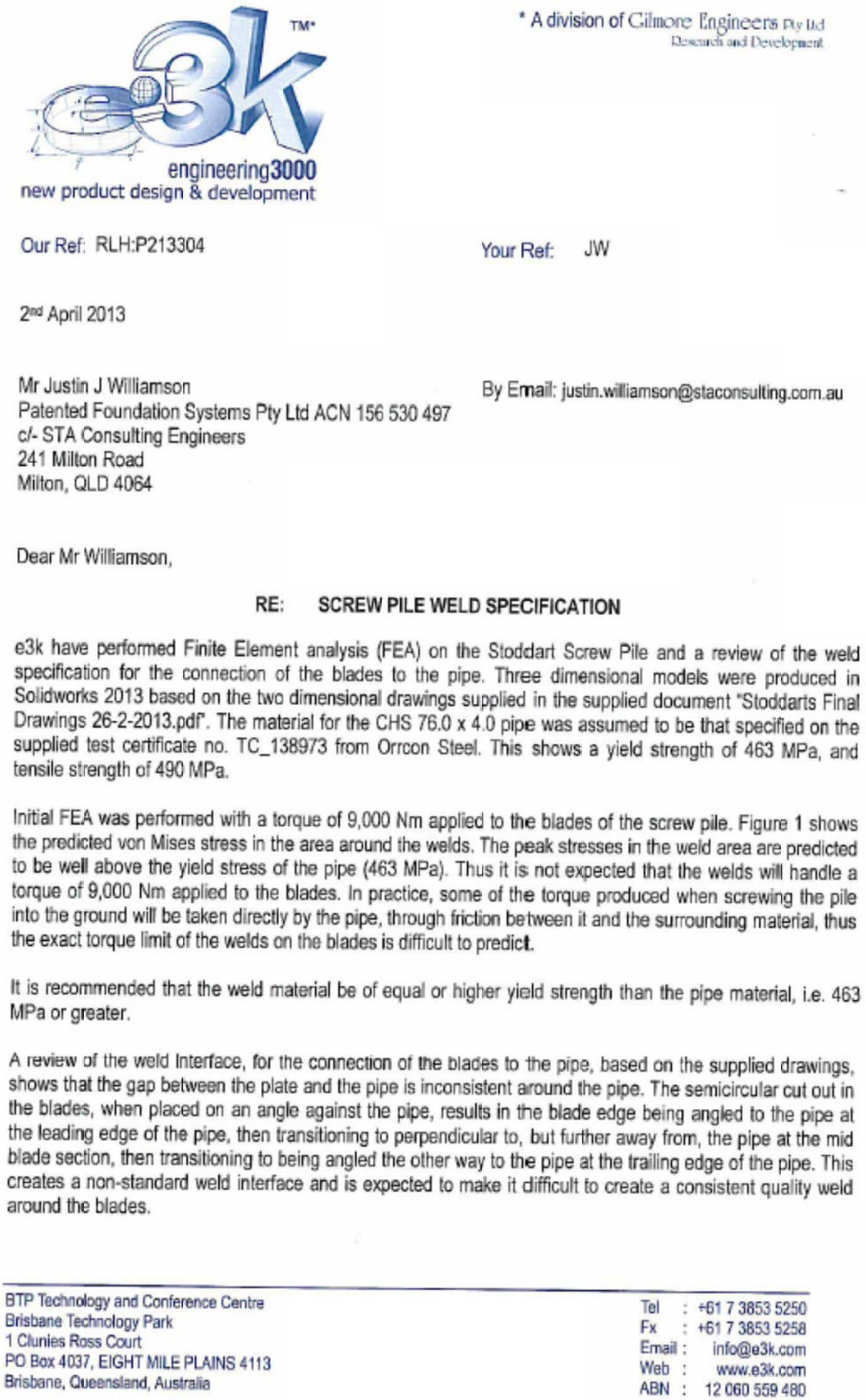
- ✓ Katana piles have been designed to carry the design loads as shown on the Drawings.
- ✓ Katana piles have been installed in accordance with the engineered design.
- ✓ Katana piles satisfy all the requirements of AS 4100 and AS 2159

b) Design certification is to be issued by a practising professional structural / geotechnical engineer as defined by the building code of Australia and is competent and experienced in Katana pile design and approved by the project engineers prior to the installation of the Katana piles.

Appendix A

Weld Specifications

- Katana Pile Specification



e3k™*
engineering3000
new product design & development

* A division of Gilmore Engineers Pty Ltd
Research and Development

Our Ref: RLH:P213304

Your Ref: JW

2nd April 2013

Mr Justin J Williamson
Patented Foundation Systems Pty Ltd ACN 156 530 497
c/- STA Consulting Engineers
241 Milton Road
Milton, QLD 4064

By Email: justin.williamson@staconsulting.com.au

Dear Mr Williamson,

RE: SCREW PILE WELD SPECIFICATION

e3k have performed Finite Element analysis (FEA) on the Stoddart Screw Pile and a review of the weld specification for the connection of the blades to the pipe. Three dimensional models were produced in Solidworks 2013 based on the two dimensional drawings supplied in the supplied document "Stoddarts Final Drawings 26-2-2013.pdf". The material for the CHS 76.0 x 4.0 pipe was assumed to be that specified on the supplied test certificate no. TC_138973 from Orrcon Steel. This shows a yield strength of 463 MPa, and tensile strength of 490 MPa.

Initial FEA was performed with a torque of 9,000 Nm applied to the blades of the screw pile. Figure 1 shows the predicted von Mises stress in the area around the welds. The peak stresses in the weld area are predicted to be well above the yield stress of the pipe (463 MPa). Thus it is not expected that the welds will handle a torque of 9,000 Nm applied to the blades. In practice, some of the torque produced when screwing the pile into the ground will be taken directly by the pipe, through friction between it and the surrounding material, thus the exact torque limit of the welds on the blades is difficult to predict.

It is recommended that the weld material be of equal or higher yield strength than the pipe material, i.e. 463 MPa or greater.

A review of the weld Interface, for the connection of the blades to the pipe, based on the supplied drawings, shows that the gap between the plate and the pipe is inconsistent around the pipe. The semicircular cut out in the blades, when placed on an angle against the pipe, results in the blade edge being angled to the pipe at the leading edge of the pipe, then transitioning to perpendicular to, but further away from, the pipe at the mid blade section, then transitioning to being angled the other way to the pipe at the trailing edge of the pipe. This creates a non-standard weld interface and is expected to make it difficult to create a consistent quality weld around the blades.

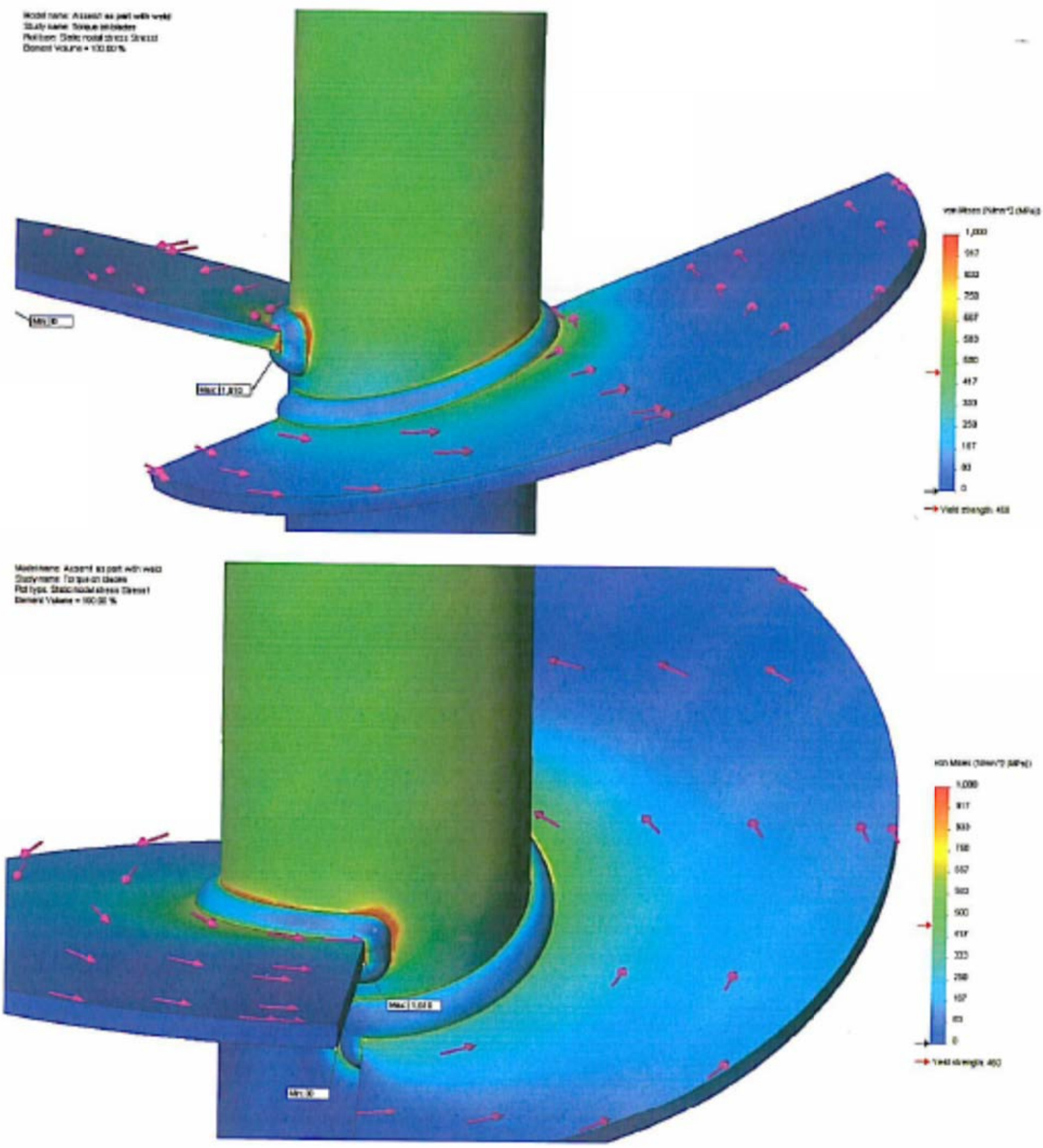


Figure 1. Predicted von Mises stress with a torque of 9000 Nm applied to the blades of the screw pile.

To maintain an equal distance between the blades and the pipe, it is recommended that the semicircular cut out in the blades be changed to an elliptical cut out, to match the angle the blade is to be placed on the pipe. Figure 2 shows dimensions for an elliptical cut to match a 15° angle on the pipe with a one millimetre clearance around the pipe.

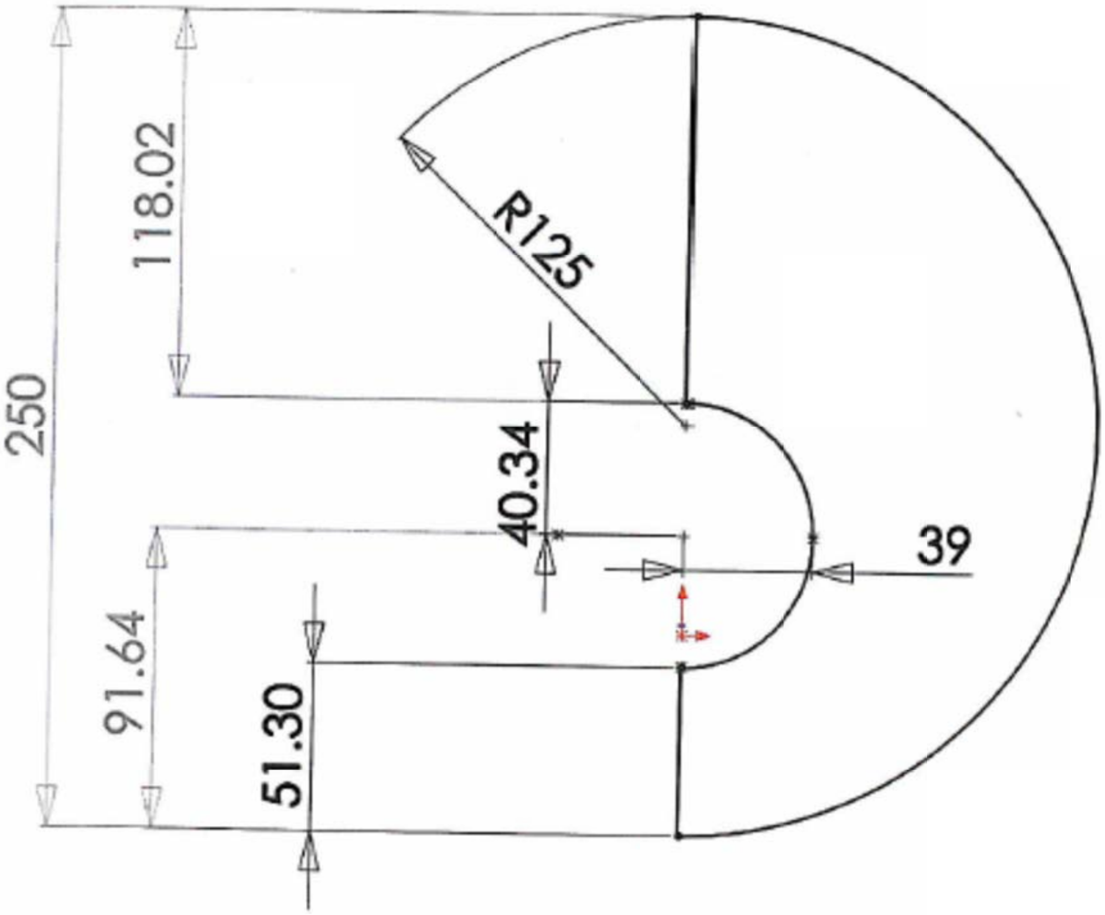


Figure 2. Dimensions for an elliptical cut to match a 15° angle on the pipe, with a one millimetre clearance around the pipe.

To provide a more consistent weld interface around the blade it is recommended that the edges of the elliptical cut out be ground back at 45° on each side (see Figure 3).

The recommended weld is "equal 6mm fillet welds superimposed on complete penetration bevel welds" as shown in Figure 3.

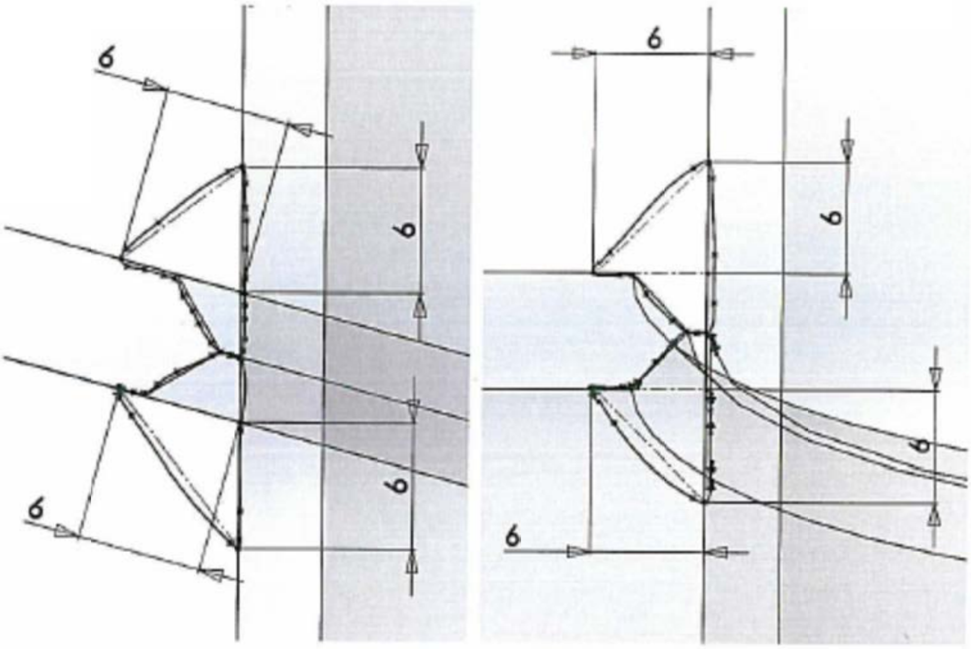


Figure 3. Equal 6mm fillet welds superimposed on complete penetration bevel welds. The left figure shows the weld interface at the leading edge of the blades, and the right figure shows the weld interface at the mid blade section.

Yours sincerely,
e3k

Ray Hope

Dr Raymond L Hope
Vice President e3k Global

Appendix B

Corrosion

- Product Corrosion Report

Appendix C

Pile Testing

- Product Geotechnical Testing Report

  a. Pile Static Load Test
  b. Pile Uplift Test
  c. Lateral Load Test

INTRODUCTION

A series of ten compressive tests, six lateral tests and six pull out (tension) tests were undertaken to present a report of results in accordance with static pile load tests, AS 2159-2009 specifications requirements. These tests have three primary objectives:

- To establish load-deflection relationships in the pile-soil system,
- To determine capacity of the pile-soil system, and
- To determine load distribution in the pile-soil system.

These tests will confirm design assumptions or provide information to allow those assumptions and the pile design to be modified.

These tests relates, but is not limited to, a load capacity test for the footings of buildings, and more particularly, to the load capacity of screw piles supporting the footings.

PILE TEST LOADS AND LOAD APPLICATION SYSTEMS

1) REACTION FRAME

Install two or more reaction piles for the reaction frame after the installation of the test pile. Locate these reaction piles not less than 3.0m from the test pile. These distances are measured between the axis of the test pile and reaction piles.
Apply the load to the pile by one or more hydraulic jack.
Design the reaction frame and reaction piles to resist four times the pile design load indicated in the contract documents without undergoing a magnitude of deflection exceeding 75 percent of maximum travel of the jack.

2) LOAD APPLICATION SYSTEM

Apply load with the jack(s), having a capacity of at least four times the pile design load indicated in the contract documents. Use jacks with a minimum travel of 150 mm, but not less than 25 percent of the test pile's maximum cross-section dimension. Equip the jack(s) with spherical bearing plates, to bear firmly and concentrically against the pile load transfer plate. Use an automatic load-maintaining pump with manual supplement to control load application. Use a pressure-gage for the jack so that the pressure reading corresponding to the pile design load indicated in the contract documents is between one-fourth and one-third of maximum gage pressure. Place a load cell (either electric or hydraulic, unless one or the other is specified in the contract documents) to measure strains for load monitoring during the load test. Load cell shall be accurate to within 2% of the indicated load and of stable construction.

Arrange and construct the elements of the load-application system as follows:

1. Provide a level load transfer plate perpendicular to the pile axis.
2. To distribute load over the pile’s entire cross-section, place a solid steel plate of sufficient thickness (16 mm minimum) to prevent bending as a bearing plate between the capped pile and the jack base. The size of the solid steel plate shall be not less than the size of the pile butt or less than the area covered by the jack base.
3. Place the load application system (including hydraulic jack, spherical bearing and load cell) between the bearing plate on the pile and the centre of the underside of the load beam.
4. Construct the system so that all components are centred along the pile's longitudinal axis, to ensure application of a concentric axial load.

5. Immediately before starting a load test, verify that at least 25 mm of clear space exists between the load transfer plate and load beam .The details of the reaction frame, test pile and apparatus for testing the load-bearing capacity of the test screw pile are illustrated in figure 1. below

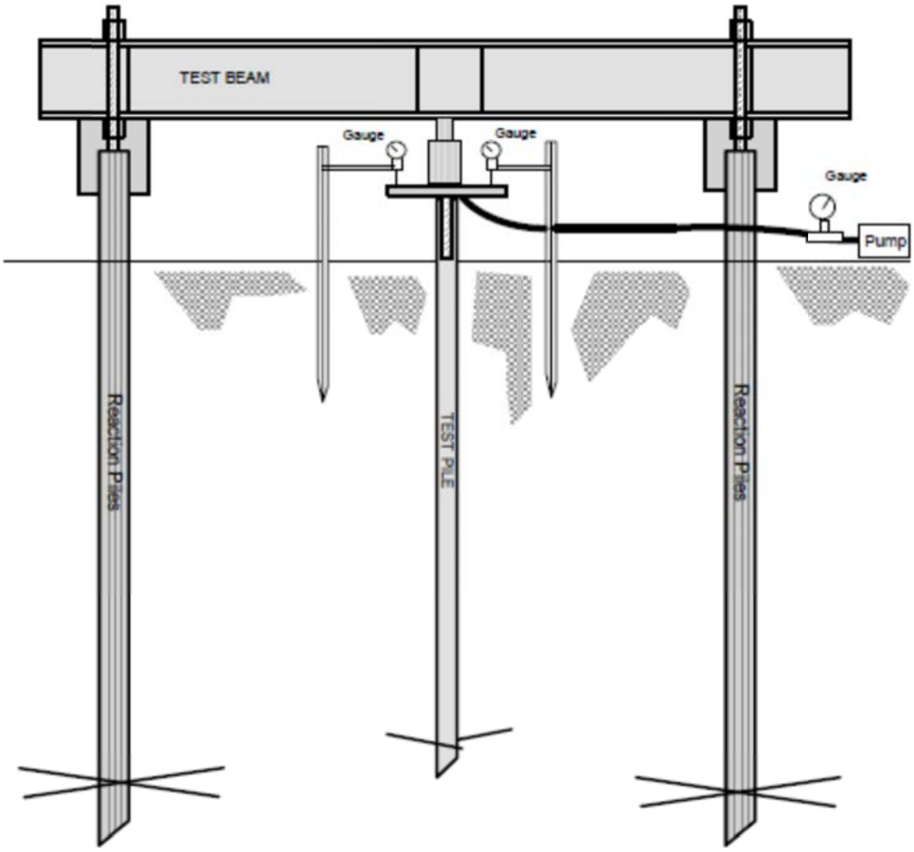


Figure 1.

PREPARATION AND MAINTENANCE OF TEST AREA

- Clear the area surrounding the test pile,
- Provide a properly designed level platform of sufficient plan dimensions to support the testing equipment safely and with suitable access for operatives,
- Construction plant that may be operating elsewhere on site must be excluded from
- the test area during the course of the pile test so that the test pile's performance can
- be accurately monitored in a safe environment,
- Any excavations within the exclusion zone are prohibited,
- Provide complete protection at all times for the pile supports and reference beam from wind, heavy rains, direct sunlight, frost action, and other disturbances. Also maintain a temperature of not less than 10° C and not more than 40° C throughout the duration of the test and provide a thermometer to monitor temperature,
- Provide adequate lighting for the duration of the test.

COMPRESSION TEST

Load and unload the test pile incrementally in two cycles, unless an alternative procedure is specified in the contract documents. Apply each load increment to the pile in as short a period as physically possible. The maximum load applied is at least 150% the pile design load indicated in the contract documents. The required load increments are expressed as a percentage of the pile design load. Magnitude and sequence of load increments for the two loading cycles are as follows:

Cycle	Percent of Maximum Design Load
1	10,20,30,40,50,60,70,80,90,100
2	10,20,30,40,50,60,70,80,90,100,110,120,130,140,150

Maintain each load increment until the deflection rate under the applied load, or rate of rebound from the previous load increment, is less than 0.05 mm in 10 minutes. The minimum period for maintaining a load increment, however, is 30 minutes and an increment may be removed after having been maintained for 2 hours, regardless of rate of deflection or rebound. When 150 percent of the design load has been applied during Cycle 2, provided the pile has not failed, leave this load in place for 24 hours. When the pile has rebounded to zero load at the end of Cycle 2, maintain zero load at least 1 hour.

If the pile fails before application of the 150-percent load, rebound it to zero load. The pile designer and the piling contractor should investigate the causes and undertake appropriate remedial action, if any.

TENSION LOAD TEST

This test has been developed to calibrate individual sites soil properties to actual performance load capacity tests. The Katana pile is installed to a set depth, with torque reading obtained. The Katana pile is then tested to determine whether it has maintained the nominated load bearing capacity, as specified by the engineer.

METHODOLOGY

The On Site Rapid Load Test consisted of a test pile installed at a minimum depth of 2.0 metres below ground surface. The pile top was 100 mm clear of ground surface enabling Rapid Load Test Device to be positioned over the top of the test pile. The threaded pull rod was screwed into the top of the test pile ensuring full embedment of thread then locked off with an M36 locking nut. Load was then applied to the pile in increments using a 20 tonne hydraulic jack. Load was maintained at each loading increment for a minimum of 3 minutes ensuring pressure remained consistent for this period of time. The load was increased on each test until such time load/ pressure could no longer be maintained at which point is considered the failure point of the test.

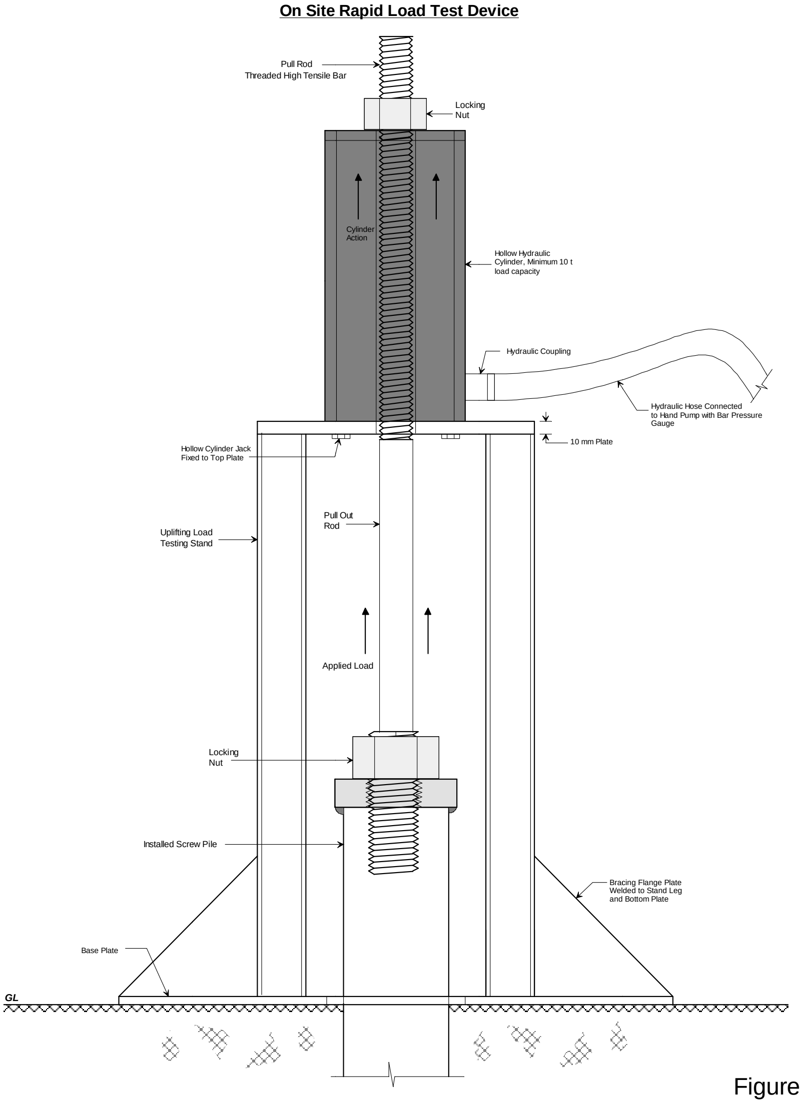


Figure 2.

PROCEDURE

1. Install the first Katana Pile to the minimum target depth as nominated within the foundation design report.
2. Record the bar pressure achieved on the machine used for installation when at the required target depth.
3. Place the Rapid Load Testing Device over the Katana Pile, ensuring a level firm base under the test unit. Note - Test is not suitable on piles installed at less than 2.0 metres.
4. Screw in the connecting threaded rod to the full depth of the threaded slug in the top of the pile. Fix in place with locking nut as shown in fig.1 below.
5. Connect the hand pump unit with a calibrated bar pressure gauge.
6. Jack ram, pre loading the test device allowing for potential settlement at base of the testing unit. This may vary depending on the extent of soils beneath test unit. All persons should be located a minimum of 3 metres clear of the testing unit prior to jacking.
7. Once pre loading is completed, that is no further settlement can be observed within testing unit. Continue jacking ram until such time the required pier capacity as nominated by the engineer has been achieved. Typically the measured uplifting load is ~ 100 % of the calculated load-bearing capacity of the pile.
8. Maintain minimum constant pressure on pile at load capacity requirement for a minimum of 5 minutes ensuring pile does not displace.
9. Record bar pressures achieved on the supplied record sheets (refer appendix) and document using photographs and video evidence.
10. Where the tested pile continues to hold the required load capacity with no displacement for the minimum time specified, it can be confirmed the screw has passed the load requirements nominated.

ACCEPTANCE CRITERIA

The “Rapid Load Capacity Test” enables the engineer / installer to satisfy themselves, that the Katana piles load capacity has been met. It must also be noted that the pull out test, under the “Piling Code” AS2159, has a 1.3 factor of safety. In other words the pull out capacity in the nominated soil strata, is 70% of the end bearing capacity.

LATERAL LOAD TEST

This test has been developed to determine the lateral capacity of the Katana Pile. The lateral capacity of vertical single piles has been determined from the least of the values calculated on the basis of soil failure, structural capacity of the pile and deflection of the pile head.

METHODOLOGY

The lateral load test setup seen in figure 3. below consisted of a test pile installed approximately 2.0 metres away from a reaction pile. The reaction pile was installed a minimum of 1.0 metre below the final depth of the test pile. Pile tops were maintained approximately 100 mm above ground level, where applied loads were imposed using a 5 tonne winch in line with a calibrated 5 tonne scale measuring the applied loads as the winch was retracted. The winch acted by pulling the test pile head towards the reaction pile. Lateral movements were monitored at two points at the test pile top at a distance of 100 mm above the ground surface to measure lateral deflections at the point of load application. The lateral movement was measured using dial gauges with 0.01 mm accuracy and 150 mm travel. All dial gauge readings were recorded at the same time at each point additional load was applied.

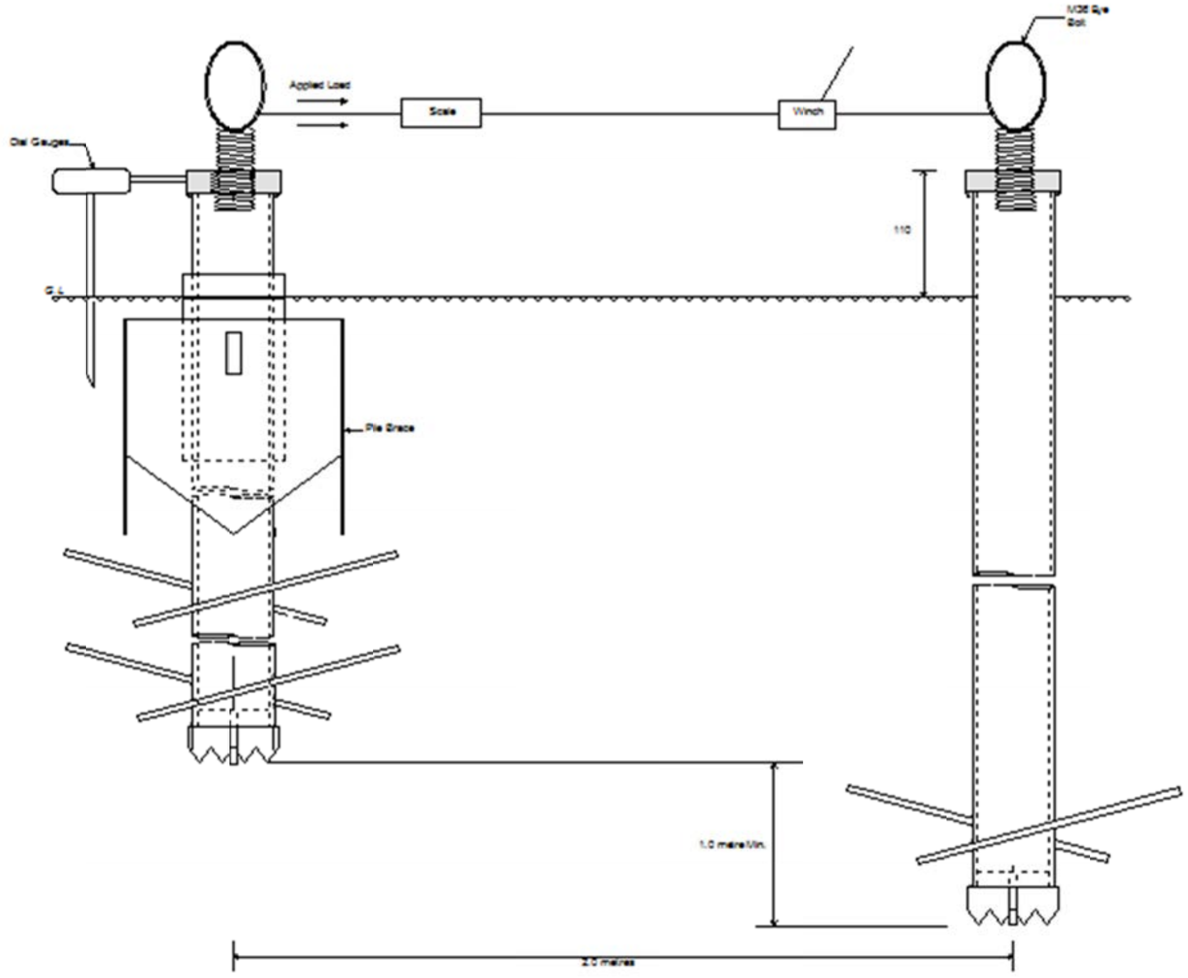


Figure 3

PROCEDURE

1. Install test pile to required target depth.
2. Record torque reading and document at final depth installed.
3. Install a single reaction pile after the installation of the test pile. Locate the reaction piles not less than 2.0m from the test pile. These distances are measured between the axis of the test pile and reaction piles.
4. Screw in high capacity eye bolts to top of test pile and reaction pile.
5. Mount in line scale and winch to pile tops between test pile and reaction pile.
6. Install dial gauges at base of test pile, with gauges measuring the deflection at the point of load application.
7. Begin to apply load by retracting winch, documenting the applied load on the in line scale. Maintain each applied load until stable, recording deflection on dial gauges throughout test duration.
8. Where required applied loads have been reached, release pressure from winch removing all applied load from test pile.
9. Record rebound of test pile on dial gauge after applied load removed.
10. Results of the lateral load test are to be presented in the form of a load deflection curve as presented in the following field test results.

ACCEPTANCE CRITERIA

The engineer must satisfy themselves, that the bracing requirements of the intended construction do not exceed the lateral loading capacity of the installed screw piles. Where this is the case a review of bracing measures must be undertaken.

SUMMARY OF TEST RESULTS

Test results for Compression and Tensile give a “Ultimate Geotechnical Load Capacity”. Lateral loads are nominated at a point where we had a 20mm deflection within the pipe. The 20mm mark was the point where we still achieve total rebound when load was released.

Table 1A

Test No.	**Location**	**Pile Depth**	**Compression**	**Lateral**	**Tension**
	Suburb	(m)	kN	kN	kN
1	Jimboomba	2	140	3.2	
2	“	2	140		102
3	Browns Plains	2	140	3.3	
4	“	2	128		89
5	Flinders View	2	76		51
6	“	3	153		115
7	Second Site	2	102	2.9	
8	‘	3	140	3.5	
9	Redbank	2	115	3.8	76
10		3	169	4.8	115

Note: Test No.5 & 9, did not achieve require “Ultimate Compressive Load” of 120kN. The “Tension Test” then verified the geotechnical failure of the screw pile at a depth of 2 metres. In a real world setting a one metre extension would have been installed achieving and overall embedment of 3 metres, which tested up to the required load, or better.

LIMITATIONS

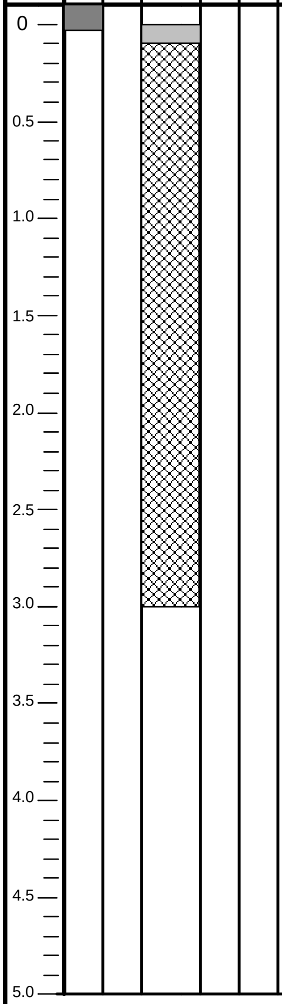
STA Consulting Engineers (STA) has prepared this report in accordance with the usual care and thoroughness of the consulting professional for the use of the Stoddart Foundation Systems Pty Ltd screw pile. It is based on generally accepted practices and standards at the time it was prepared. No other warranty expresses or implied, is made as to the professional advice included in this report.

Bore Log Sheet

Test Location # 1 - Pile # 1

Project Job No. Testing
Client: Stoddart Screw Pile

Date Drilled: 13th November, 2012
Drill Method: Power Auger



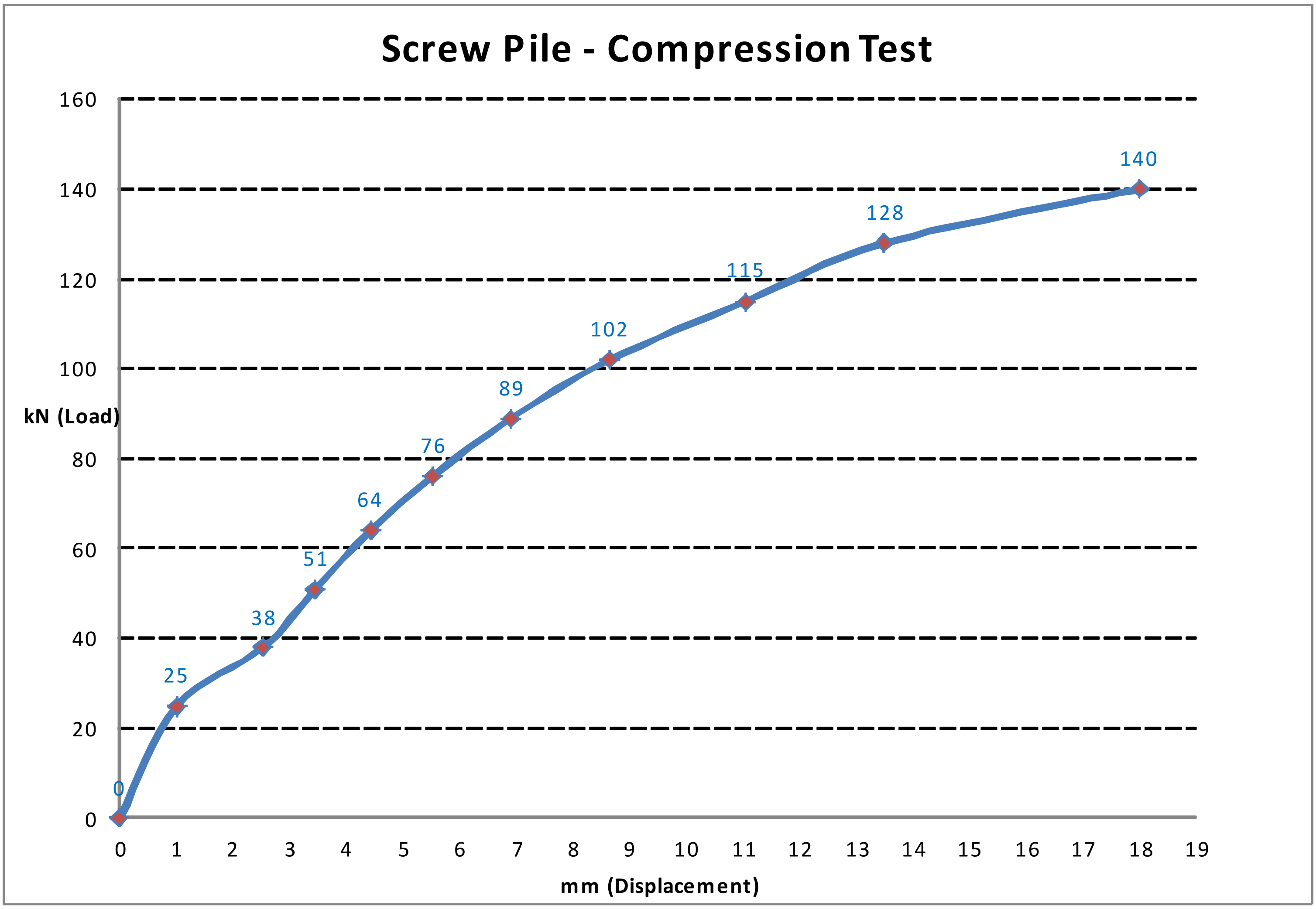
SOIL DESCRIPTION	PP Value	D.C.P blows / 100 mm	N'q (kPa)
SANDY SILT (ML) (Grey Brown)			
SANDY SILTY CLAY (Light Grey/Grey) Just Moist & Stiff to Very Stiff Friable	300+		
(Grey/ Yellow Brown) Moist & Very Stiff	280		
SILTY CLAY (Grey/ Yellow Brown) Moist & Very Stiff to Hard Fine Sands			
SILTY CLAY (CH) (Grey Mottled Yellow) Just Moist & Very Stiff	300+		
SANDY SILTY CLAY (CI) (Brown/ Grey) Dry to Moist & Very Stiff	300+		
SILTY SANDY CLAY (Grey/ Yellow) Dry to Moist & Very Stiff			
	300+		
END			

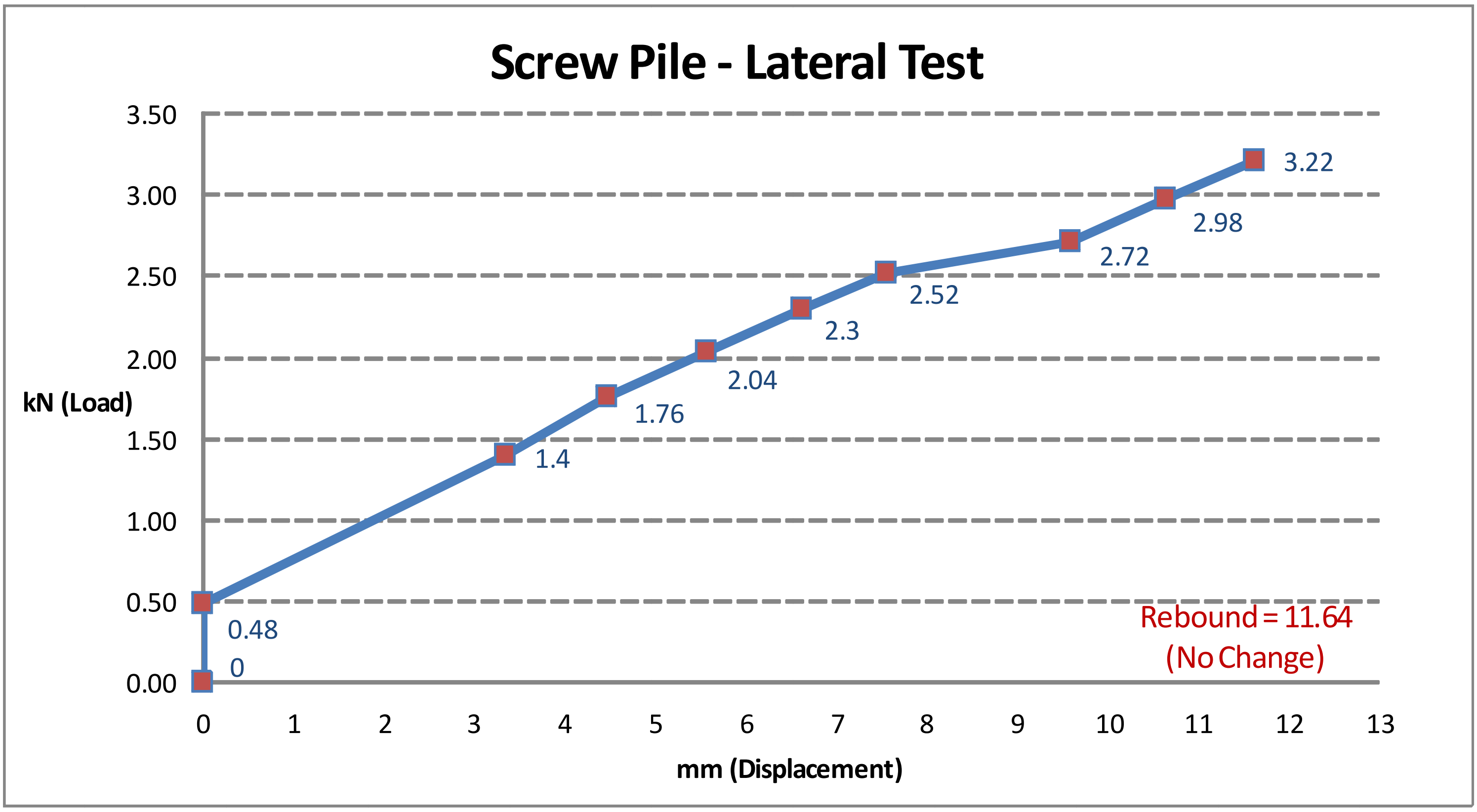
Bore Hole Terminated - 3.0m

Terms :-

D.C.P.:-	Dynamic Cone Penetrometer
N'q:-	Allowable Bearing Capacity (kPa)
PP:-	Pocket Penetrometer Strength (kPa)
U.T.P:-	Unable to Penetrate
⟶	Slope Direction

Note : kPa value is allowable bearing pressure caculated in accordance with paper 'Determination of allowable bearing pressure under small structures' by M.J Stockwell (June 1977)


Screw Pile - Compression Test
kN (Load)
mm (Displacement)
0
20
40
60
80
100
120
140
160
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
0
25
38
51
64
76
89
102
115
128
140

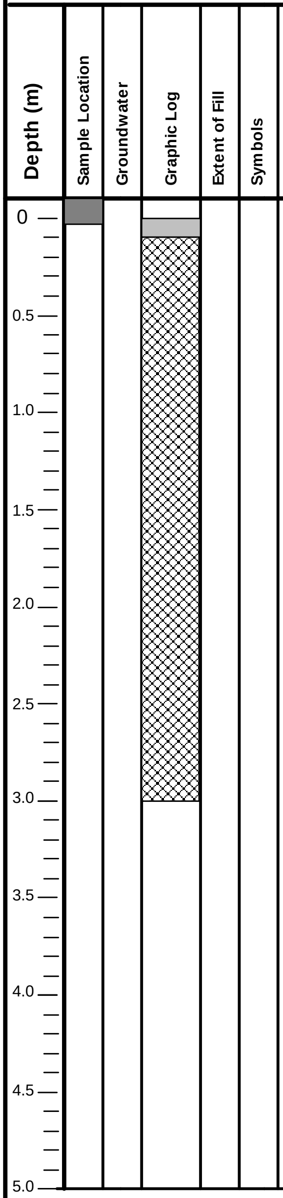

Screw Pile - Lateral Test
kN (Load)
mm (Displacement)
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
0
1
2
3
4
5
6
7
8
9
10
11
12
13
0
0.48
1.4
1.76
2.04
2.3
2.52
2.72
2.98
3.22
Rebound = 11.64
(No Change)

Bore Log Sheet

Test Location # 1 - Pile # 2

Project Job No. Testing
Client: Stoddart Screw Pile

Date Drilled: 13th November, 2012
Drill Method: Power Auger



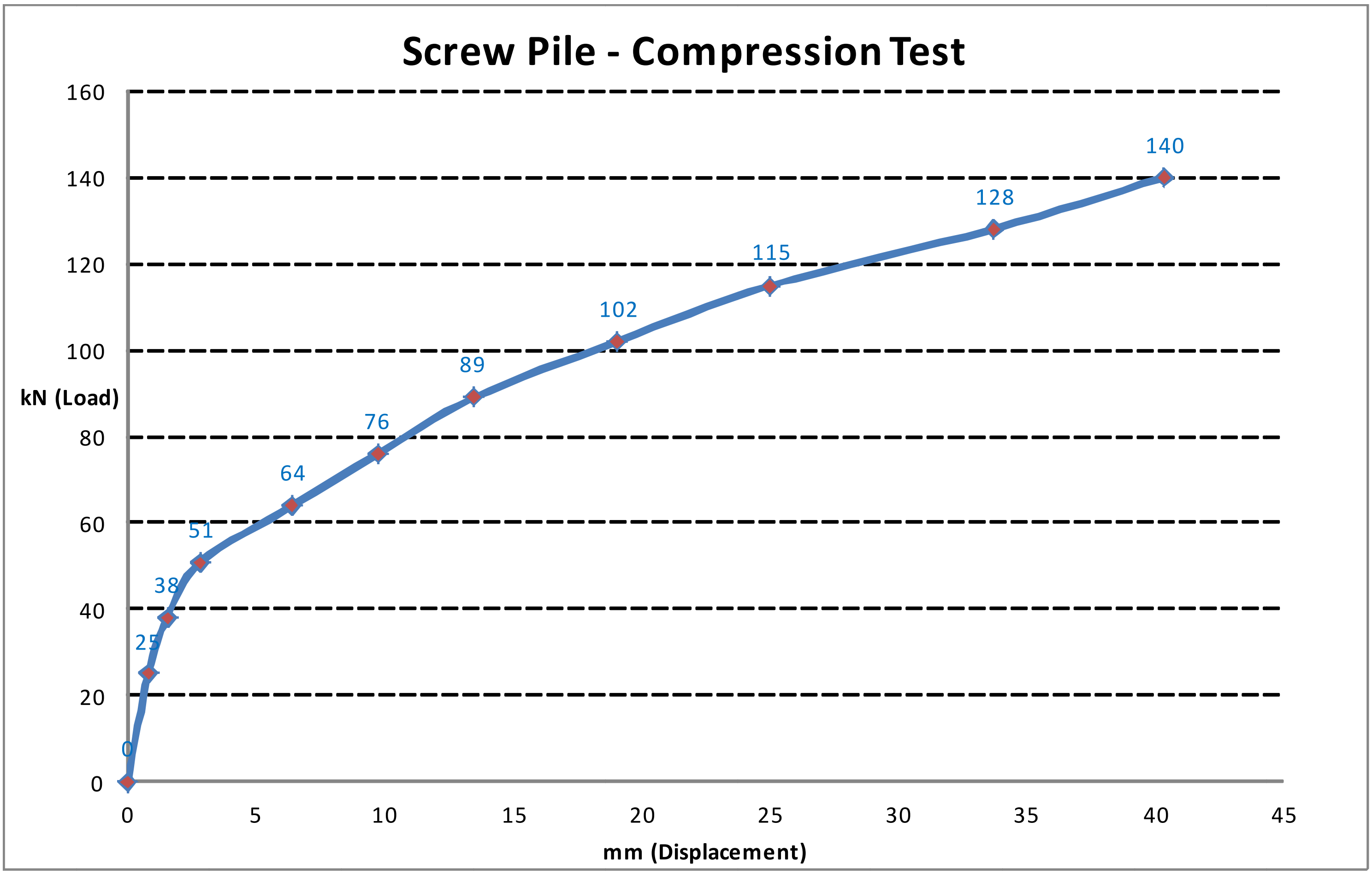
SOIL DESCRIPTION	PP Value	D.C.P blows/ 100 mm	N'q (kPa)
SANDY SILT (ML) (Grey Brown)			
SANDY SILTY CLAY (Light Grey/Grey) Just Moist & Stiff to Very Stiff Friable	300+		
(Grey/ Yellow Brown) Moist & Very Stiff	280		
SILTY CLAY (Grey/ Yellow Brown) Moist & Very Stiff to Hard Fine Sands			
SILTY CLAY (CH) (Grey Mottled Yellow) Just Moist & Very Stiff	300+		
SANDY SILTY CLAY (CI) (Brown/ Grey) Dry to Moist & Very Stiff	300+		
SILTY SANDY CLAY (Grey/ Yellow) Dry to Moist & Very Stiff			
	300+		
END			

Bore Hole Terminated - 3.0m

Terms :-

D.C.P.:-	Dynamic Cone Penetrometer
N'q:-	Allowable Bearing Capacity (kPa)
PP:-	Pocket Penetrometer Strength (kPa)
U.T.P:-	Unable to Penetrate
⟶	Slope Direction

Note : kPa value is allowable bearing pressure caculated in accordance with paper 'Determination of allowable bearing pressure under small structures' by M.J Stockwell (June 1977)



Tension Test	
kN	Hold
25	Yes
38	Yes
51	Yes
64	Yes
76	Yes
89	Yes
102	Yes
115	No

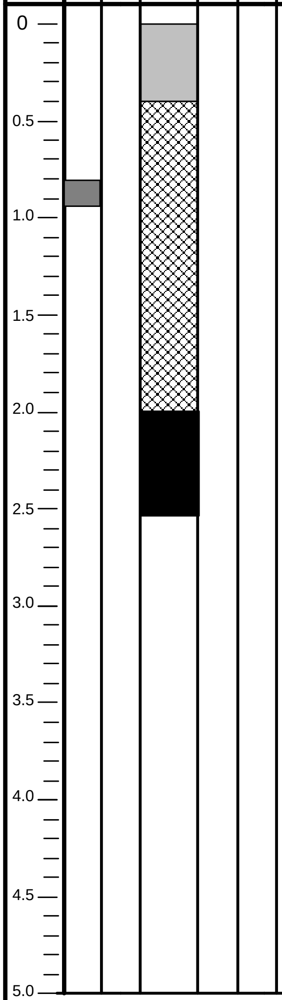
Bore Log Sheet

Test Location # 2 - Pile # 3

Project Job No. Testing
Client: Stoddart Screw Pile

Date Drilled: 13th November, 2012
Drill Method: Power Auger

Depth (m)	Sample Location	Groundwater	Graphic Log	Extent of Fill	Symbols	SOIL DESCRIPTION	PP Value	D.C.P blows/ 100 mm	N'q (kPa)



SANDY SILT (Yellow/ Brown Grey)
Moist and Medium Dense
Fine to Medium Sands Some Clay Fines

SANDY SILTY CLAY
(Yellow Brown/ Red Grey)
Moist and stiff Some fine to medium gravels throughout

Moist and stiff

Dry to Moist and stiff to Very Stiff

EXTREMELY WEATHERED ROCK
(Yellow/ Light Brown) Dry to Moist and Weak to Moderately Strong

END

PP Value: 180, 220, 220

D.C.P blows/ 100 mm: 3, 3, 3, 4, 4, 5, 4, 3, 4, 4, 3, 4, 5, 4, 4, 5, 4

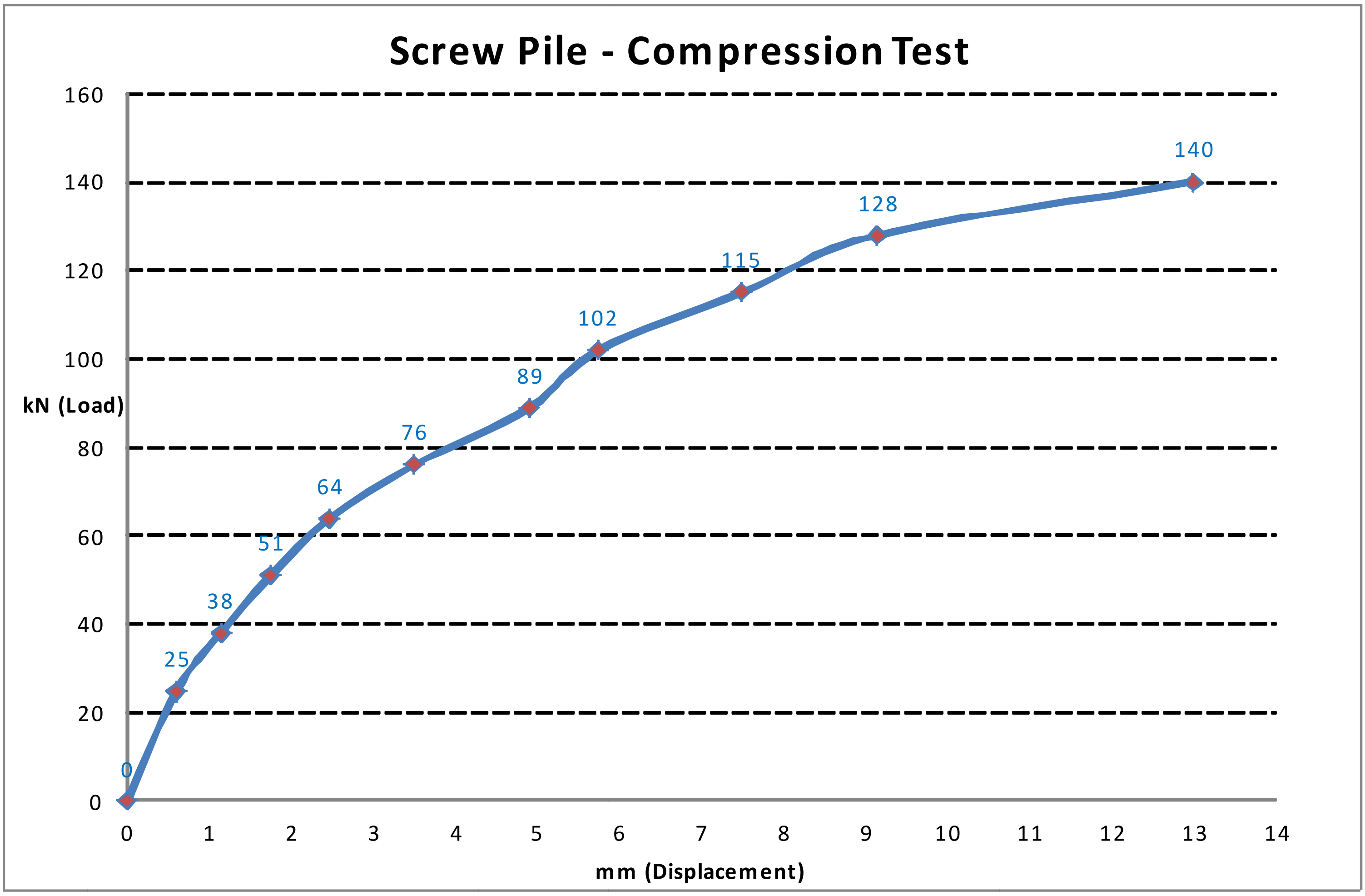
N'q (kPa): 90, 120, 100, 100, 110

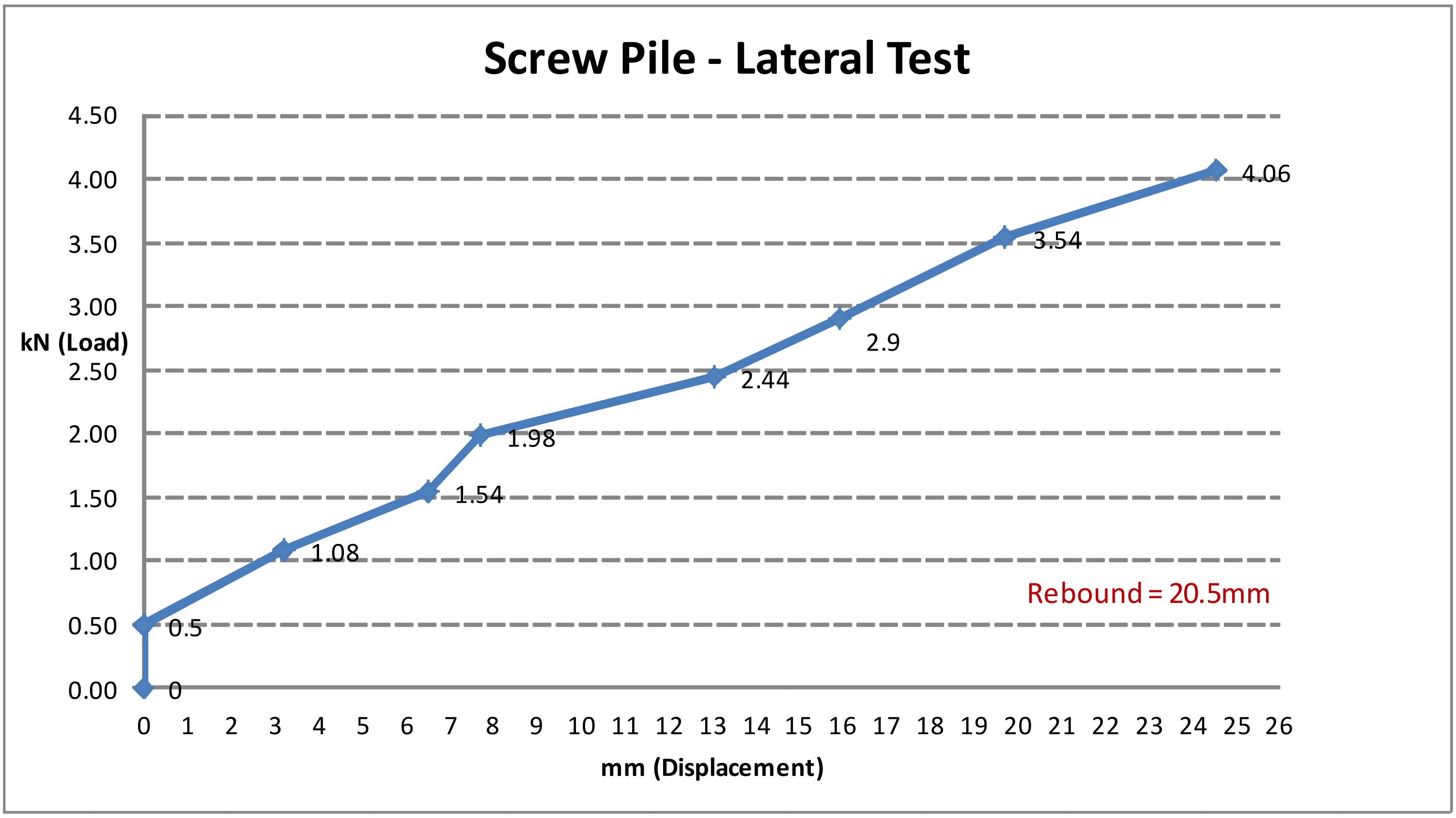
Bore Hole Terminated - 2.0m

Terms :-

D.C.P.:-	Dynamic Cone Penetrometer
N'q:-	Allowable Bearing Capacity (kPa)
PP:-	Pocket Penetrometer Strength (kPa)
U.T.P:-	Unable to Penetrate
⟶	Slope Direction

Note : kPa value is allowable bearing pressure caculated in accordance with paper 'Determination of allowable bearing pressure under small structures' by M.J Stockwell (June 1977)


Screw Pile - Compression Test
kN (Load)
mm (Displacement)
0
20
40
60
80
100
120
140
160
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
0
25
38
51
64
76
89
102
115
128
140

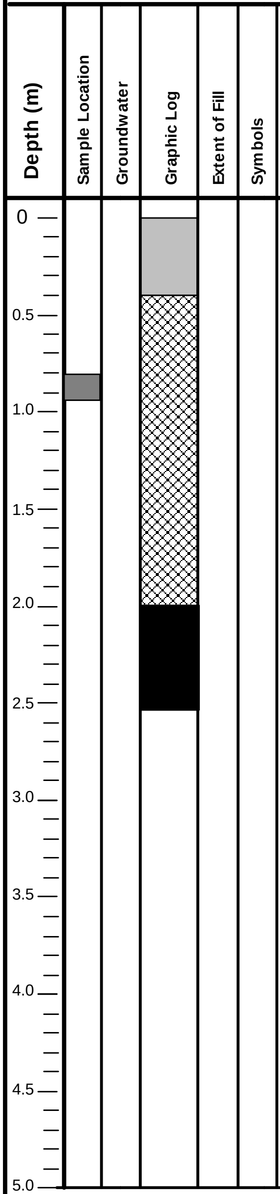

Screw Pile - Lateral Test
kN (Load)
mm (Displacement)
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
0
0.5
1.08
1.54
1.98
2.44
2.9
3.54
4.06
Rebound = 20.5mm

Bore Log Sheet

Test Location # 2 - Pile # 4

Project Job No. Testing
Client: Stoddart Screw Pile

Date Drilled: 13th November, 2012
Drill Method: Power Auger



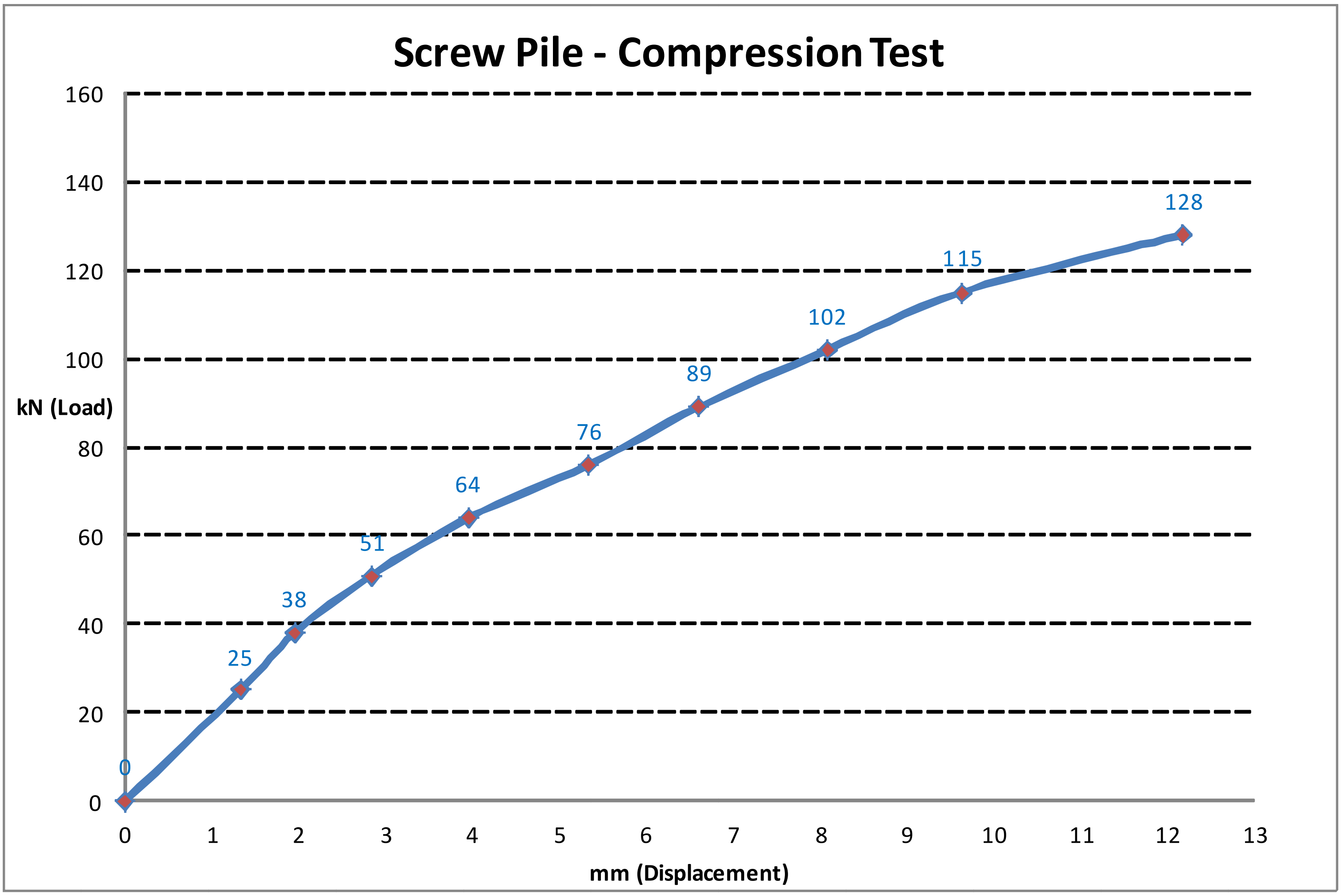
SOIL DESCRIPTION	PP Value	D.C.P blows/ 100 mm	N'q (kPa)
SANDY SILT (Yellow/ Brown Grey) Moist and Medium Dense Fine to Medium Sands Some Clay Fines		3 3 3	90
SANDY SILTY CLAY (Yellow Brown/ Red Grey) Moist and stiff Some fine to medium gravels throughout	180	4 4 5 4 3 4 4	120 100
Moist and stiff	220	3 4 5 4	100
Dry to Moist and stiff to Very Stiff	220	4 5 4	110
EXTREMELY WEATHERED ROCK (Yellow/ Light Brown) Dry to Moist and Weak to Moderately Strong			
END			

Bore Hole Terminated - 2.0m

Terms :-

D.C.P.:-	Dynamic Cone Penetrometer
N'q:-	Allowable Bearing Capacity (kPa)
PP:-	Pocket Penetrometer Strength (kPa)
U.T.P:-	Unable to Penetrate
⟶	Slope Direction

Note : kPa value is allowable bearing pressure caculated in accordance with paper 'Determination of allowable bearing pressure under small structures' by M.J Stockwell (June 1977)



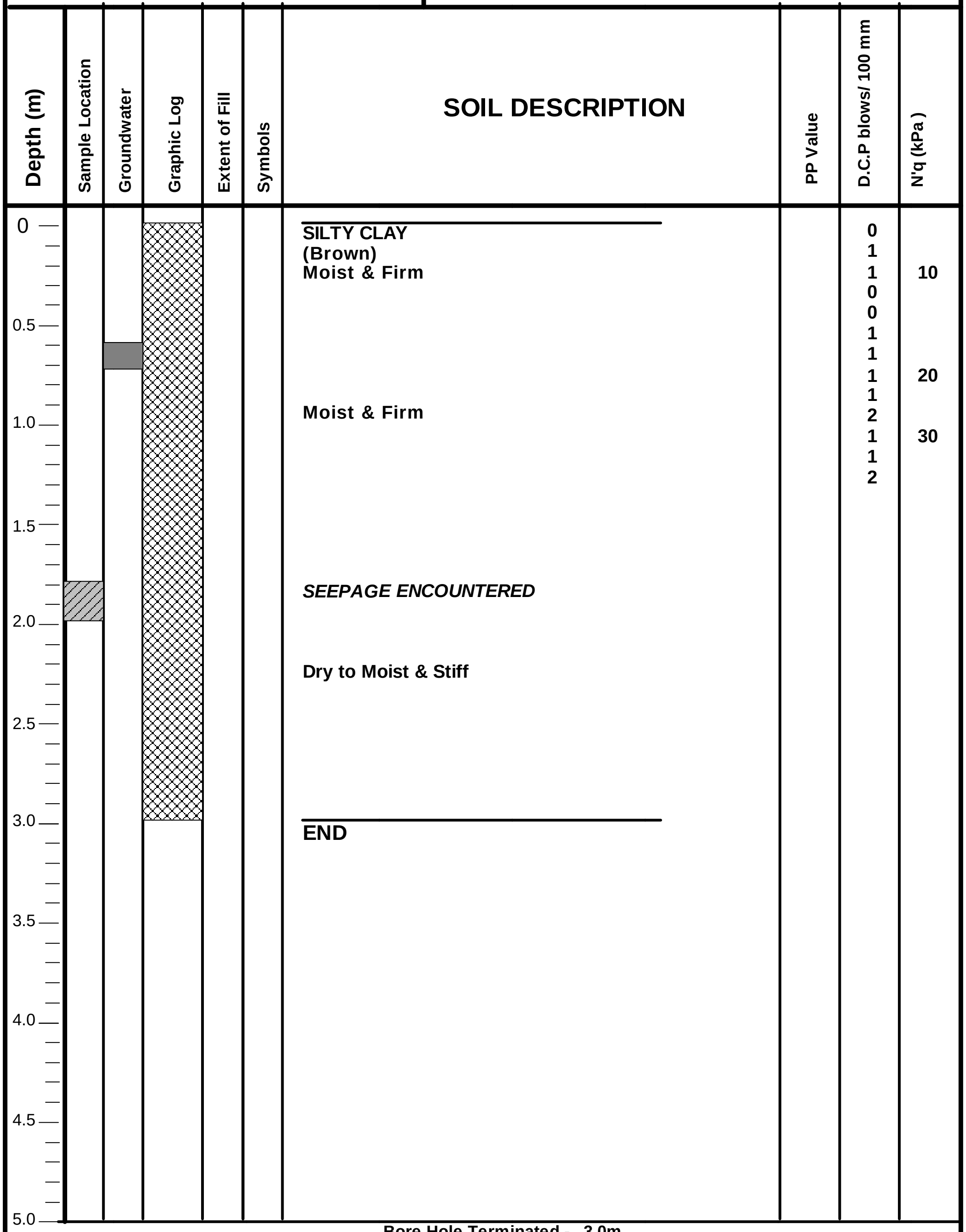
Tension Test	
kN	Hold
25	Yes
38	Yes
51	Yes
64	Yes
76	Yes
89	Yes
102	No

Bore Log Sheet

Test Location # 3 - Test Pilse # 5 & #6

Project Job No. Testing
Client: Stoddart Screw Pile

Date Drilled: 13th November, 2012
Drill Method: Power Auger



SILTY CLAY
(Brown)
Moist & Firm

Moist & Firm

SEEPAGE ENCOUNTERED

Dry to Moist & Stiff

END

0
1
1
0
0
1
1
1
1
2
1
1
2

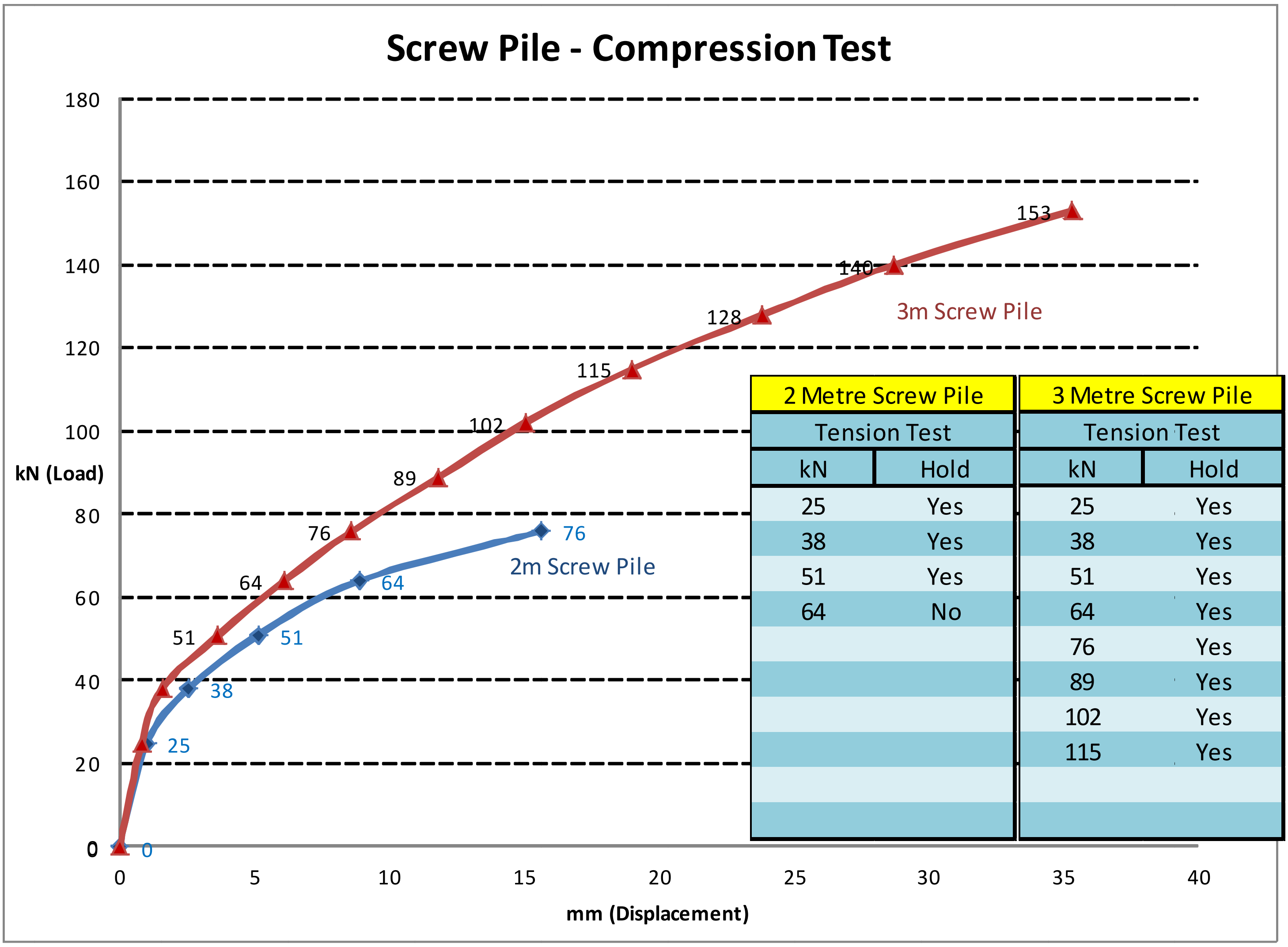
10
20
30

Bore Hole Terminated - 3.0m

Terms :-

D.C.P.:-	Dynamic Cone Penetrometer
N'q:-	Allowable Bearing Capacity (kPa)
PP:-	Pocket Penetrometer Strength (kPa)
U.T.P:-	Unable to Penetrate
⟶	Slope Direction

Note : kPa value is allowable bearing pressure caculated in accordance with paper 'Determination of allowable bearing pressure under small structures' by M.J Stockwell (June 1977)



2 Metre Screw Pile	
Tension Test	
kN	Hold
25	Yes
38	Yes
51	Yes
64	No

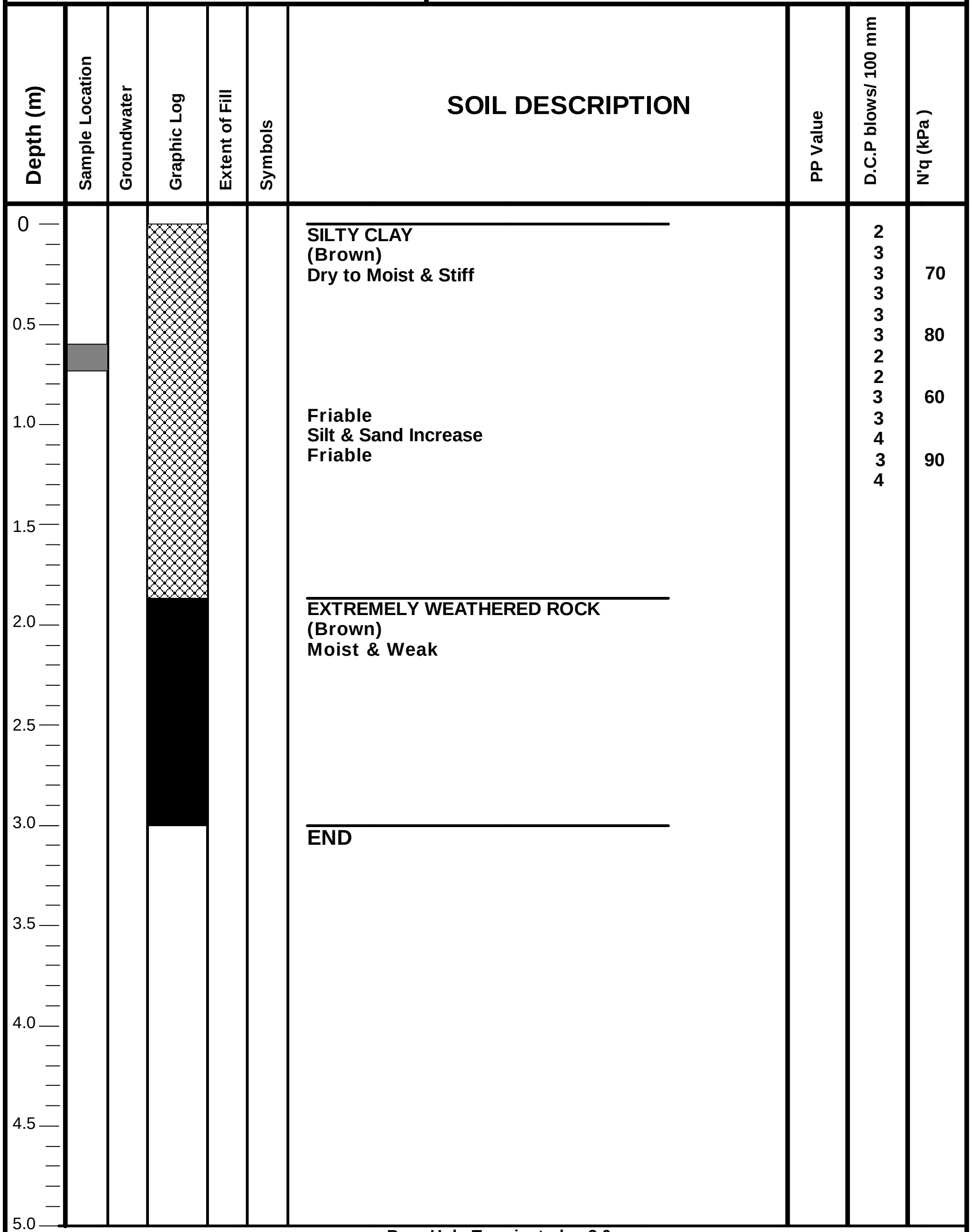
3 Metre Screw Pile	
Tension Test	
kN	Hold
25	Yes
38	Yes
51	Yes
64	Yes
76	Yes
89	Yes
102	Yes
115	Yes

Bore Log Sheet

Test Location # 4 - Test Piles # 7 & # 8

Project Job No. Testing
Client: Stoddart Screw Pile

Date Drilled: 13th November, 2012
Drill Method: Power Auger



SOIL DESCRIPTION

SILTY CLAY
(Brown)
Dry to Moist & Stiff

Friable
Silt & Sand Increase
Friable

EXTREMELY WEATHERED ROCK
(Brown)
Moist & Weak

END

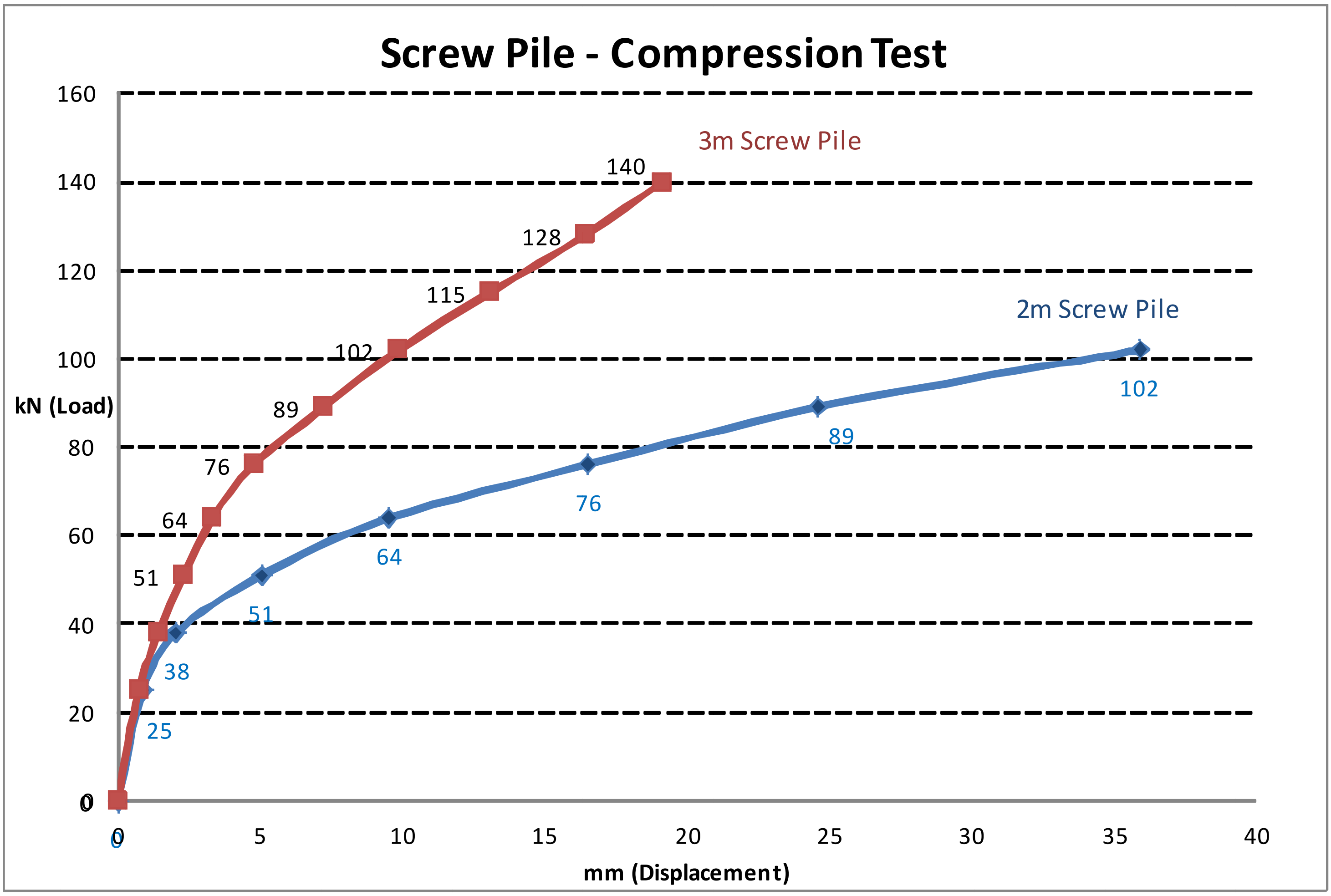
D.C.P blows/ 100 mm	N'q (kPa)
2	
3	
3	70
3	
3	
3	80
2	
2	
3	60
3	
4	
3	90
4	

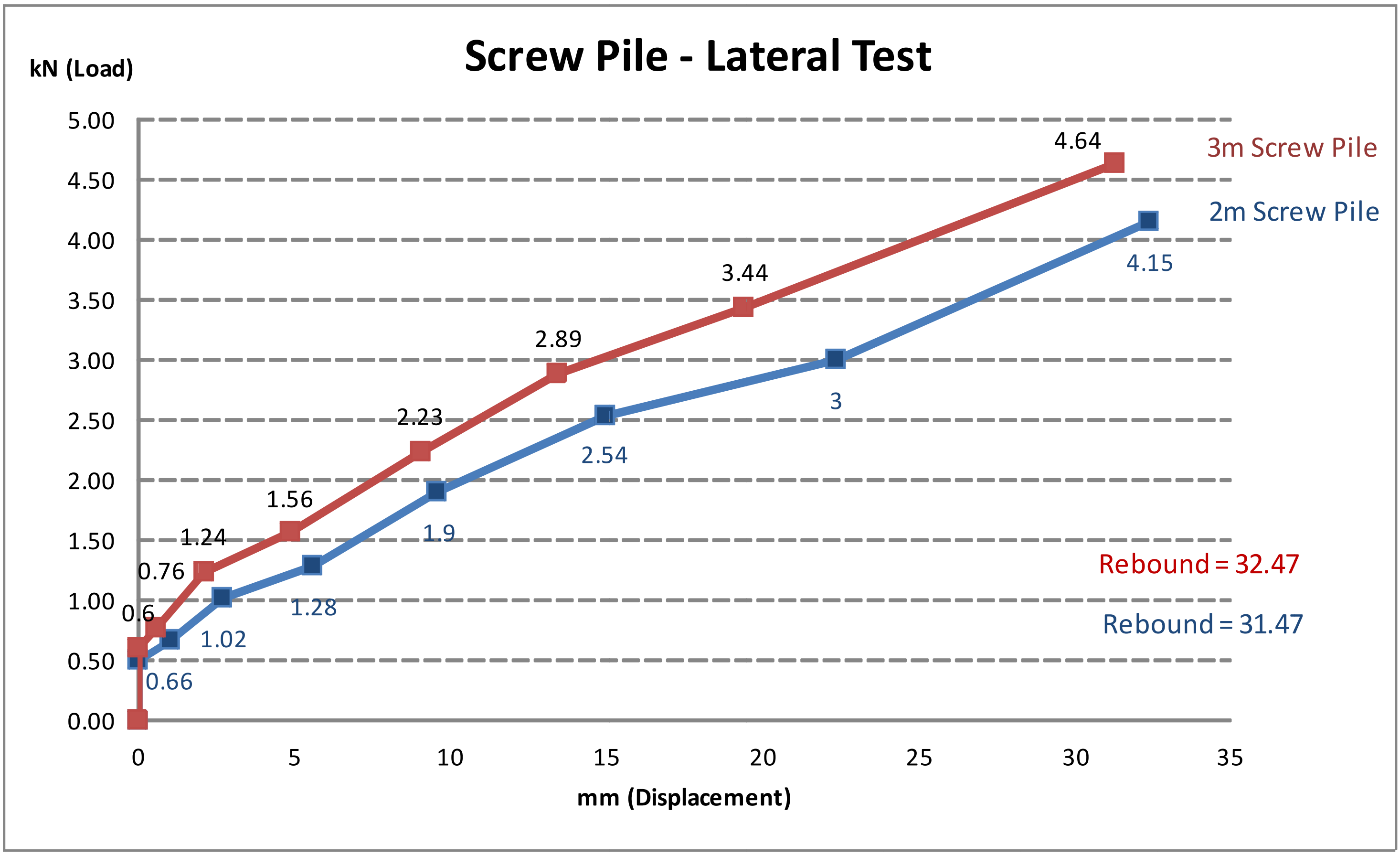
Bore Hole Terminated - 3.0m

Terms :-

D.C.P.:-	Dynamic Cone Penetrometer
N'q:-	Allowable Bearing Capacity (kPa)
PP:-	Pocket Penetrometer Strength (kPa)
U.T.P:-	Unable to Penetrate
⟶	Slope Direction

Note : kPa value is allowable bearing pressure caculated in accordance with paper 'Determination of allowable bearing pressure under small structures' by M.J Stockwell (June 1977)


Screw Pile - Compression Test
kN (Load)
160
140
120
100
80
60
40
20
0
0
5
10
15
20
25
30
35
40
mm (Displacement)
3m Screw Pile
2m Screw Pile
140
128
115
102
89
76
64
51
38
0
102
89
76
64
51
38
25
0


Screw Pile - Lateral Test
kN (Load)
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0
5
10
15
20
25
30
35
mm (Displacement)
3m Screw Pile
2m Screw Pile
4.64
3.44
2.89
2.23
1.56
1.24
0.76
0.6
4.15
3
2.54
1.9
1.28
1.02
0.66
Rebound = 32.47
Rebound = 31.47

Bore Log Sheet

Test Location # 5 - Test Pile # 9 & # 10

Project Job No. Testing
Client: Stoddart Screw Pile

Date Drilled: 13th November, 2012
Drill Method: Power Auger

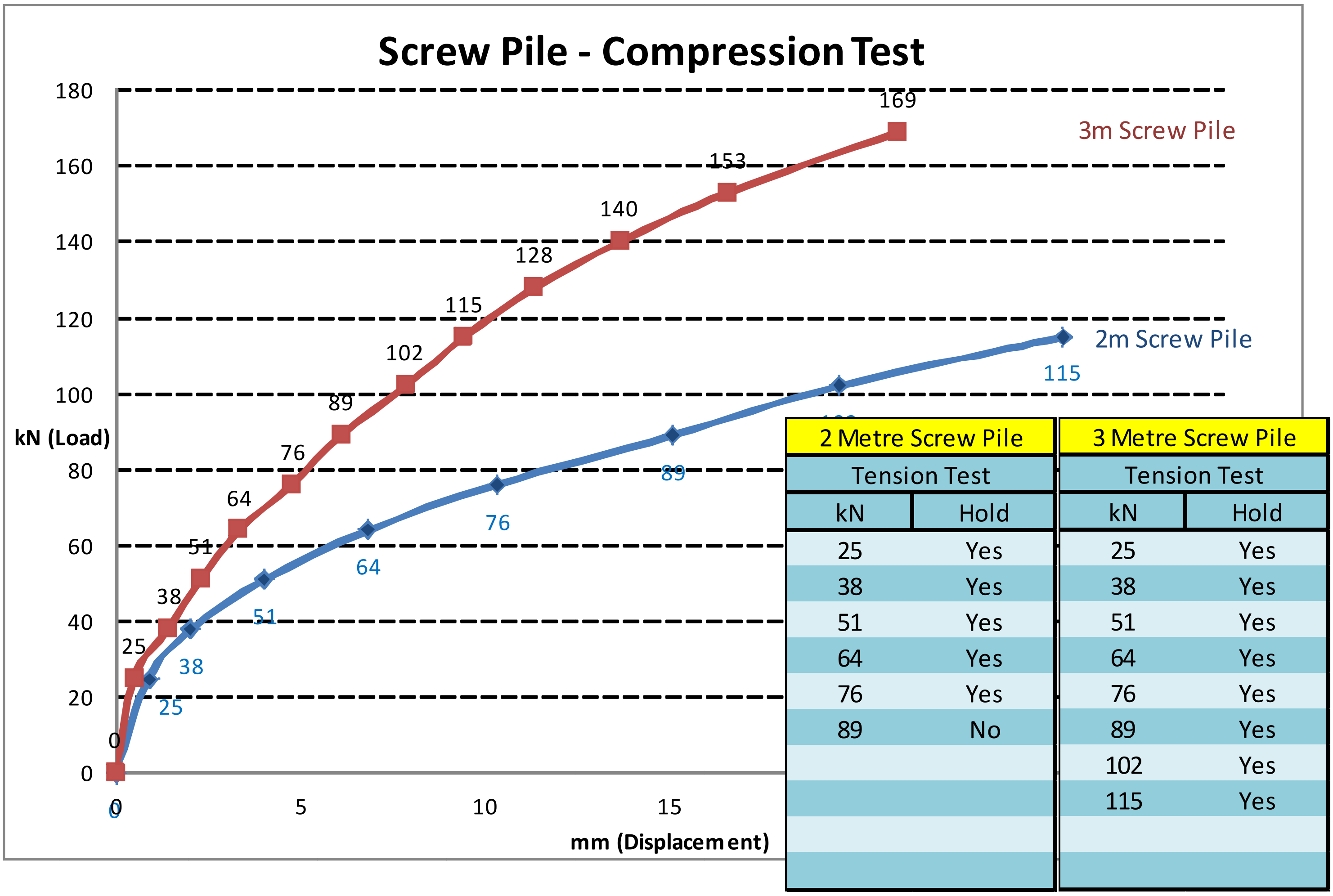
Depth (m)	Sample Location	Groundwater	Graphic Log	Extent of Fill	Symbols	SOIL DESCRIPTION	PP Value	D.C.P blows/ 100 mm	N'q (kPa)
0			▨			**SILTY CLAY**		2	
						(Brown)		3	
						Dry to Moist & Stiff		4	80
								3	
								3	
0.5								4	90
								3	
	■							2	
								3	70
1.0						**Silt & Sand Increase**		4	
								4	
								3	100
								4	
1.5									
						Friable			
2.0									
			■			**EXTREMELY WEATHERED ROCK** **(Brown)** **Moist & Weak**			
2.5									
3.0						**END**			
3.5									
4.0									
4.5									
5.0									

Bore Hole Terminated - 3.0m

Terms :-

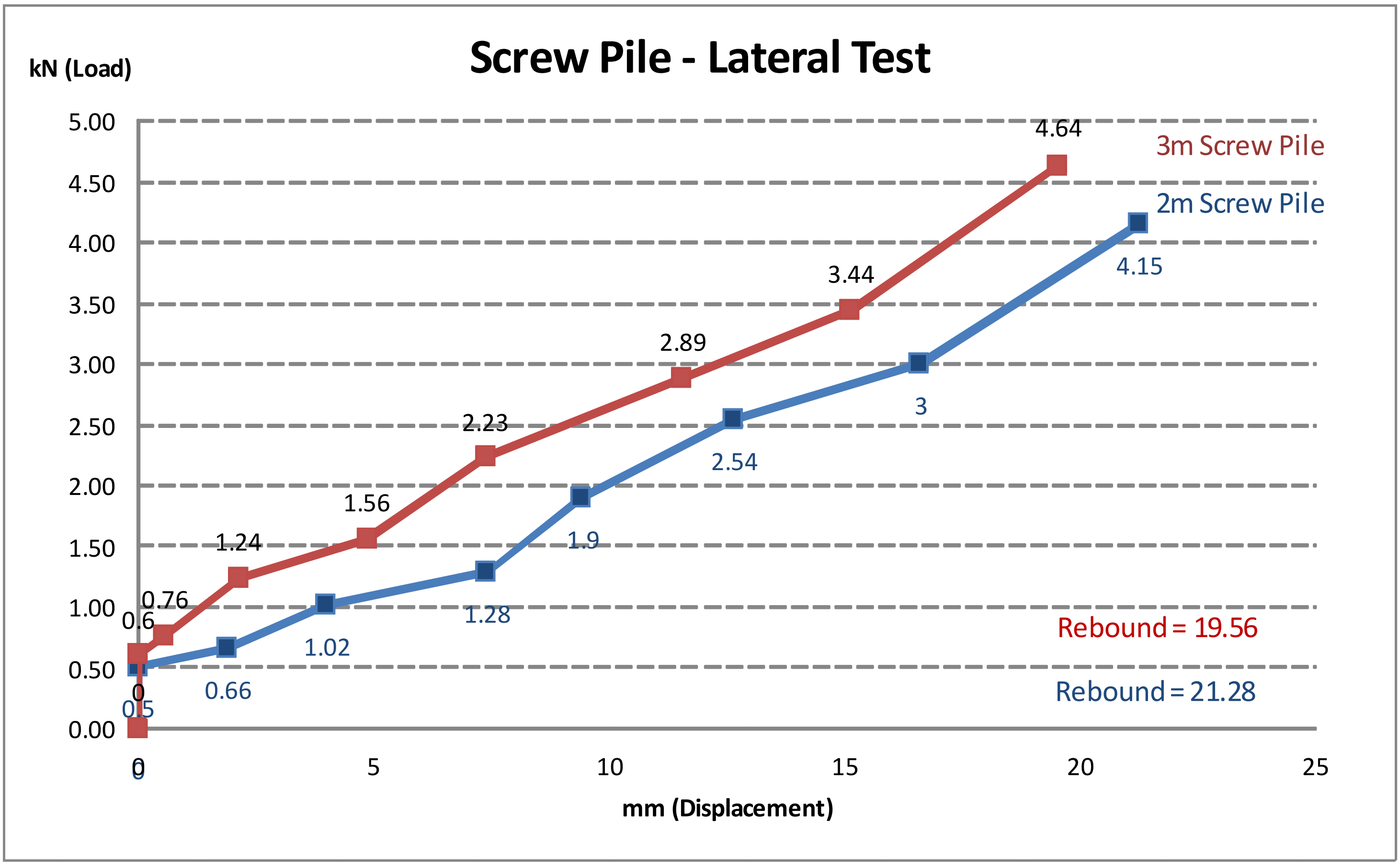
D.C.P.:-	Dynamic Cone Penetrometer
N'q:-	Allowable Bearing Capacity (kPa)
PP:-	Pocket Penetrometer Strength (kPa)
U.T.P:-	Unable to Penetrate
⟶	Slope Direction

Note : kPa value is allowable bearing pressure caculated in accordance with paper 'Determination of allowable bearing pressure under small structures' by M.J Stockwell (June 1977)



2 Metre Screw Pile	
Tension Test	
kN	Hold
25	Yes
38	Yes
51	Yes
64	Yes
76	Yes
89	No

3 Metre Screw Pile	
Tension Test	
kN	Hold
25	Yes
38	Yes
51	Yes
64	Yes
76	Yes
89	Yes
102	Yes
115	Yes



Appendix D

Bracing Plate (Optional)

- Lateral Load Testing with Bracing Plate

INTRODUCTION

A series of two lateral tests were undertaken to present a report of results in accordance with, AS 2159-2009 specifications requirements. The test objectives where:

To determine capacity of the bracing pile.

These tests relates to the lateral load capacity of the bracing Katana pile supporting the footings.

LATERAL LOAD TEST

This test has been developed to determine the lateral capacity of the Katana Pile. The lateral capacity of vertical single piles has been determined from the least of the values calculated on the basis of soil failure, structural capacity of the pile and deflection of the pile head.

METHODOLOGY

The lateral load test setup seen in figure 3. below consisted of a test pile installed approximately 2.0 metres away from a reaction pile. The reaction pile was installed a minimum of 1.0 metre below the final depth of the test pile. Pile tops were maintained approximately 100 mm above ground level, where applied loads were imposed using a 5 tonne winch in line with a calibrated 5 tonne scale measuring the applied loads as the winch was retracted. The winch acted by pulling the test pile head towards the reaction pile. Lateral movements were monitored at two points at the test pile top at a distance of 100 mm above the ground surface to measure lateral deflections at the point of load application. The lateral movement was measured using dial gauges with 0.01 mm accuracy and 150 mm travel. All dial gauge readings were recorded at the same time at each point additional load was applied.

PROCEDURE

1. Install test pile to required target depth.
2. Record torque reading and document at final depth installed.
3. Install a single reaction pile after the installation of the test pile. Locate the reaction piles not less than 2.0m from the test pile. These distances are measured between the axis of the test pile and reaction piles.
4. Screw in high capacity eye bolts to top of test pile and reaction pile.
5. Mount in line scale and winch to pile tops between test pile and reaction pile.
6. Install dial gauges at base of test pile, with gauges measuring the deflection at the point of load application.
7. Begin to apply load by retracting winch, documenting the applied load on the in line scale. Maintain each applied load until stable, recording deflection on dial gauges throughout test duration.
8. Where required applied loads have been reached, release pressure from winch removing all applied load from test pile.
9. Record rebound of test pile on dial gauge after applied load removed.
10. Results of the lateral load test are to be presented in the form of a load deflection curve as presented in the following field test results.

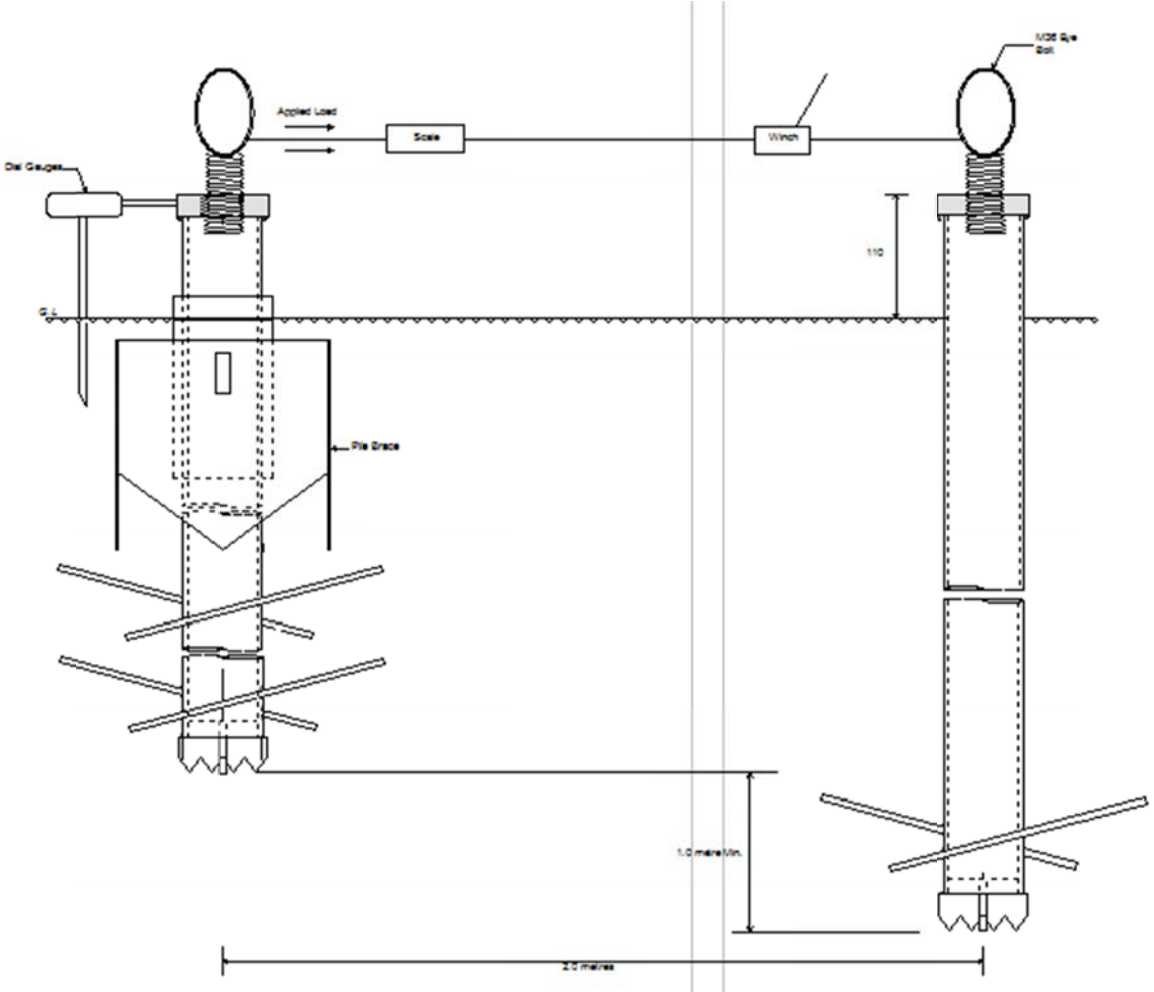


Figure 3

ACCEPTANCE CRITERIA

The engineer must satisfy themselves, that the bracing requirements of the intended construction do not exceed the lateral loading capacity of the installed screw piles. Where this is the case a review of bracing measures must be undertaken.

SUMMARY OF TEST RESULTS

Test results for Compression and Tensile give a “Ultimate Geotechnical Load Capacity”. Laterial loads are nominated at a point where we had a 20mm deflection within the pipe. The 20mm mark was the point where we still achieve total rebound when load was released.

Table 1A

Test No.	Location	Pile Depth	Lateral
	Suburb	(m)	kN
1	Browns Plains	2	8.35
2	“	2	8.61

LIMITATIONS

STA Consulting Engineers (STA) has prepared this report in accordance with the usual care and thoroughness of the consulting professional for the use of the Stoddart Foundation Systems Pty Ltd and Katana Pile. It is based on generally accepted practices and standards at the time it was prepared. No other warranty expresses or implied, is made as to the professional advice included in this report.

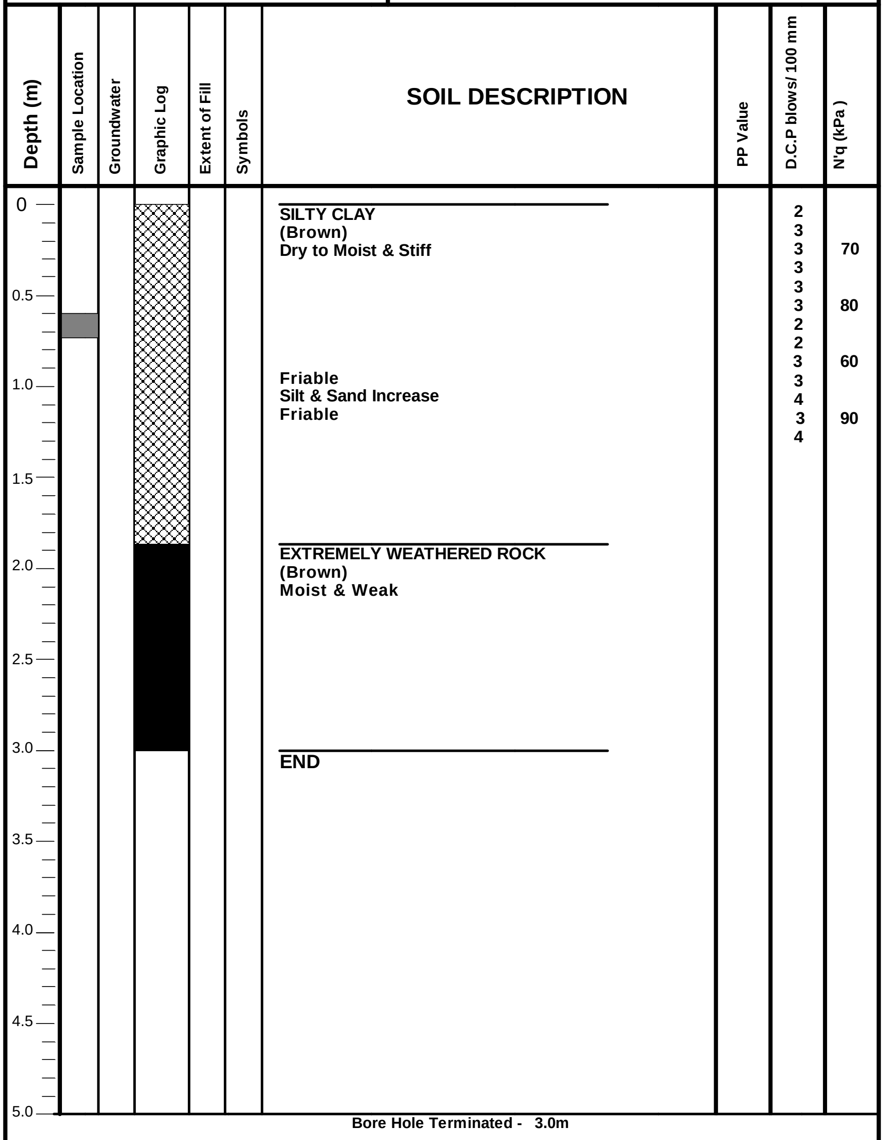
Section 3 - Bore Logs

Bore Log Sheet

Test Location # 1 - Test Piles # 1 & # 2

Project Job No. Testing
Client: Stoddart Screw Pile

Date Drilled: 13th November, 2012
Drill Method: Power Auger



Bore Hole Terminated - 3.0m

Terms :-

D.C.P.:-	Dynamic Cone Penetrometer
N'q:-	Allowable Bearing Capacity (kPa)
PP:-	Pocket Penetrometer Strength (kPa)
U.T.P:-	Unable to Penetrate
⟶	Slope Direction

Note : kPa value is allowable bearing pressure caculated in accordance with paper 'Determination of allowable bearing pressure under small structures' by M.J Stockwell (June 1977)

Test Results

Lateral Loading - Test Location # 1 - Test Piles # 1 & # 2

Load (kN)	**Displacement (mm)** **WITH BRACING PLATE**	**Load (kN)**	**Displacement (mm)** **WITH BRACING PLATE**
0.82	-	0.34	-
1.46	1.96	1.02	0.00
2.08	4.07	1.3	0.00
2.66	6.44	1.6	1.18
3.76	9.2	1.92	2.40
4.82	11.84	2.24	3.63
6.06	14.81	2.66	4.91
7.12	17.55	3.04	6.25
8.35	20.18	3.54	7.60
-	-	3.98	8.98
-	-	4.62	10.38
-	-	5.14	11.77
-	-	5.68	13.22
-	-	6.36	14.64
-	-	6.88	16.00
-	-	7.42	17.28
-	-	7.91	18.52
		8.61	19.57
Total Displacement	20.18	**Total Displacement**	19.57
Total Rebound	No Rebound observed	**Total Rebound**	No Rebound observed

Appendix E

Lateral Capacities

- Product Lateral Capacities

a) Clay
b) Sand

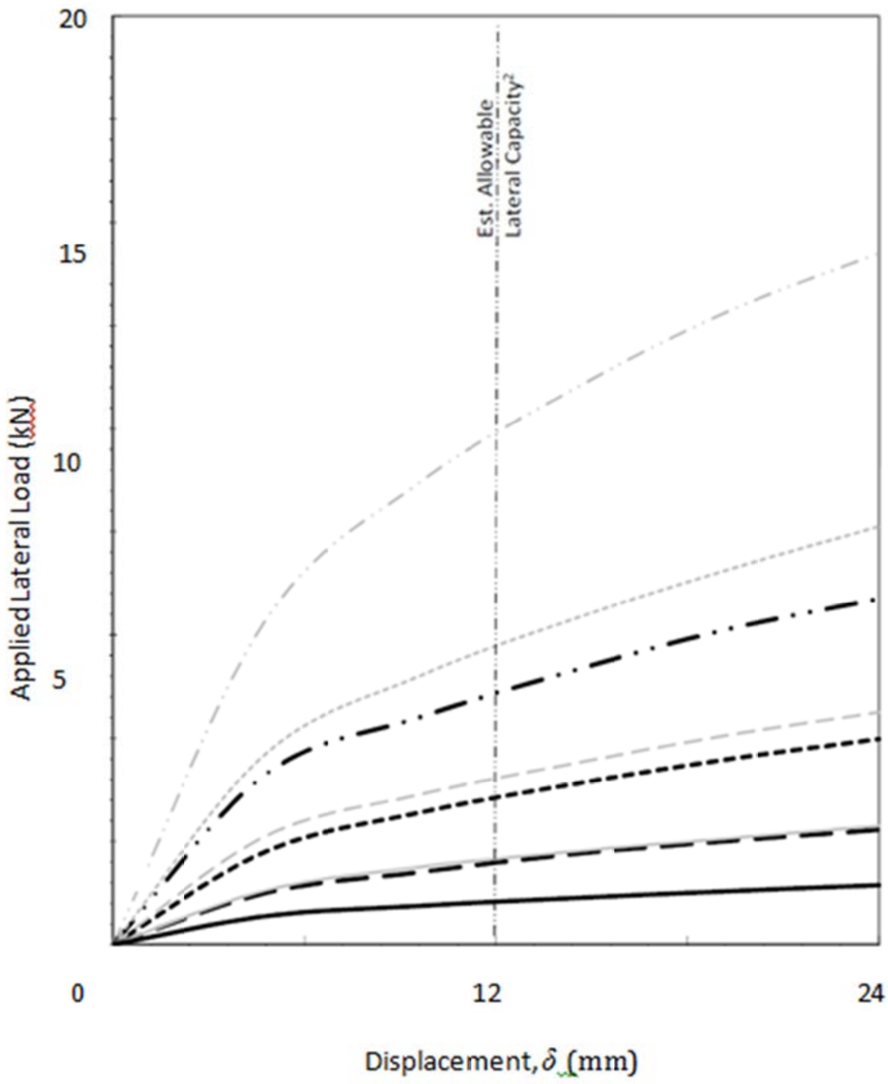
Katana Pile - 80kN

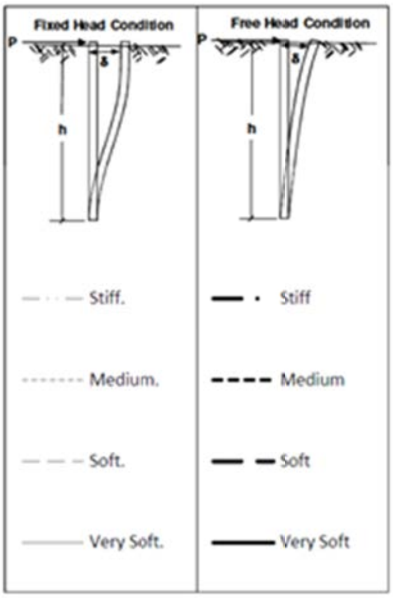
Lateral Performance in Clay

Pile Properties	
Pipe Diameter (mm)	76
Wall Thickness (mm)	4.0
Steel Grade (f's)	400
Pile Base Dia. (mm)	250

Soil Properties		
Soil Type	Angle of Friction (deg)	Cohesion Cu
Stiff	0	100
Medium	0	60
Soft	0	30

Minimum Pile Depth, h		
Soil Type	Fixed Head	Free Head
Stiff	40d	34d
Medium	30d	28d
Soft	28d	24d





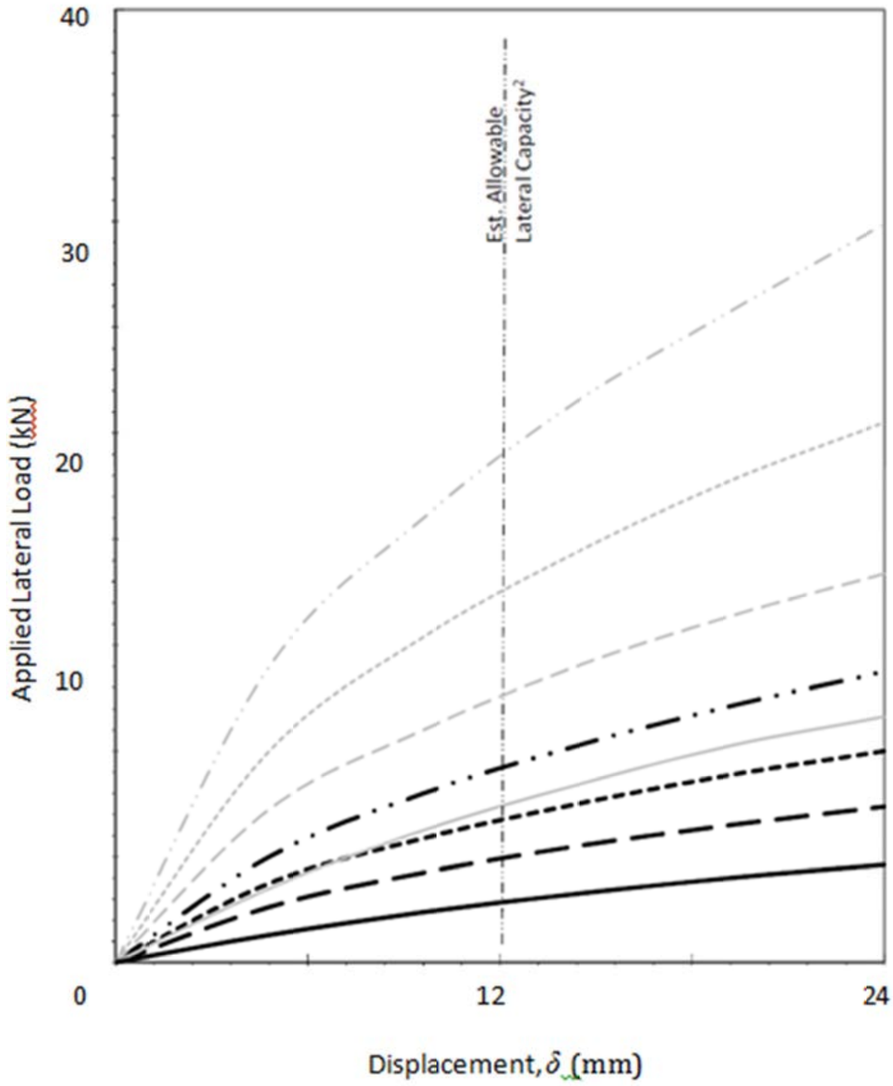
These charts are for Katana Piles only as lateral performance is highly dependent on the connections rigidity and shaft properties. It is Katana's opinion that these graphs represent a reasonable approximation of the average performance of the Katana Pile in the indexed soils. Using the average performance is reasonable for multiple redundant structures (e.g. buildings, bridges, marina piers, etc.)

AS2159 - 2009, states that the allowable lateral capacity of a pile is half load causing a 25mm of displacement. Many practitioners take this to be nearly the same as the lateral load predicated at 12mm displacement. The graph presented here can be used to evaluate capacity for either condition as well as to judge lateral performance under other displacement criteria and codes. The design allowable displacement is the responsibility of the design engineer.

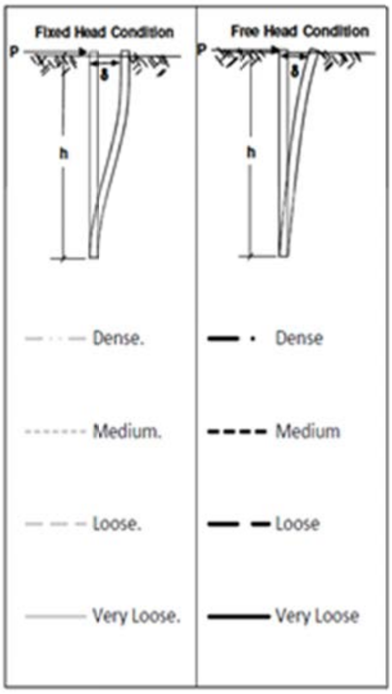
Katana Pile - 80kN
Lateral Performance in Sand

Pile Properties	
Pipe Diameter (mm)	76
Wall Thickness (mm)	4.0
Steel Grade (f's)	400
Pile Base Dia. (mm)	250

Soil Properties		
Soil Type	Angle of Friction (deg)	Cohesion Cu
Dense	25	0
Medium	29	0
Loose	33	0



Minimum Pile Depth, h		
Soil Type	Fixed Head	Free Head
Dense	40d	34d
Medium	30d	28d
Loose	28d	24d



These charts are for Katana Piles only as lateral performance is highly dependent on the connections rigidity and shaft properties. It is Katana's opinion that these graphs represent a reasonable approximation of the average performance of the Katana Pile in the indexed soils. Using the average performance is reasonable for multiple redundant structures (e.g. buildings, bridges, marina piers, etc.)

AS2159 - 2009, states that the allowable lateral capacity of a pile is half load causing a 25mm of displacement. Many practitioners take this to be nearly the same as the lateral load predicated at 12mm displacement. The graph presented here can be used to evaluate capacity for either condition as well as to judge lateral performance under other displacement criteria and codes. The design allowable displacement is the responsibility of the design engineer.