Technical Presentation – Site Specific Pile Design to Australian Standards

A superior ‘screw in pile’ or an alternative for bored piers, driven piles or grout piles.

- Rapid & precise installation.
- Measures soil strength during installation.
- Superior capacity, when compared to bored piers or screw piles.
- Fully compliant to all Australian standards, including AS2159 & AS2870.
Blades vs. Helix Testing

4 Cutting points create an ‘active pulse’ that vibrates the Blade Pile head for easier installation, when penetrating heavy gravels or rock/cobble type layers.

A pair of 250mm Blades provides a diagonal length of 350mm. Blades are also designed with more bearing plate area over an equivalent size screw pile helix.

The extended area radiates out and into an enlarged pressure wave for improved load capacity, compared to a circular 250 mm diameter Helix.

Testing confirms the Twin Blade design has less soil ‘bulking out’ during installation, for less geotechnical disturbance and improved load bearing capacity.

© Blade Pile Group Pty Ltd 2015
Screw piles have one leading edge. A curved pitched helix that augers the soil during install. The single edge induces out of round forces. The trailing edge follows into disturbed material.

Through soil settlement, over time bearing capacity will slowly ‘grow’ back into place around the helix area (shaded Orange in diagram).

Twin Blade Piles counter balance each other for improved verticality. The Blades ‘sliver’ into the soil with less disturbance for improved ‘end bearing’ compression & tension load capacity.

Blade Piles are manufactured from 350 Grade high tensile steel (Average 450 Mpa yield) for a higher torsional install capacity and structural strength.

Blade Piles provide a level of installed verticality & positioning for finite tolerance structures, that is simply unattainable with screw piles.
Combined with the Blade pile & a raft slab design, the 'Pile Cap Slab System' is created.

The Blade Pile & Slip Joint Cap is deemed to comply as a ‘Bored Pier’ substitute, maintaining AS2870 compliance as an ‘isolated pier’.
Blade Piles suspend slab and maintain 'as constructed' RL during soil shrinkage

Ys point @ shrinkage

Heave/Shrink Zone (Hs)

Patented – Isolated 'Slip Joint' Pile Caps

As Constructed – Ys RL

50mm

100mm

Pile Cap Slab System, Shrinking Clay – Raft Slab, Blade Piles & Slip Joint Pile Cap
Blade Piles maintain ‘as constructed’ RL during periods of clay heave.
Bored Piers are engaged in friction within the reactive Clay zone, forcing the pier to follow the same path & level of heave & shrink movement.

To better manage movement within the Hs zone, the design engineer should consider founding depths relative to allowable slab deflection.
‘0.75 Hs’ Bored Piers in Heaving Clay Soil – ‘In Friction’ Pushed Up & Rotated Inward by Clay

Bored Piers are engaged in friction within the reactive Clay zone, forcing the pier to follow the same path & level of heave & shrink movement.

To better manage movement within the Hs zone, the design engineer should consider founding depths relative to allowable slab deflection.
Bored Pier Failure in Shrinking Clay Soil – Single Level Dwelling, Booval, Ipswich QLD, 2014

Significant separation between bored pier & raft slab from soil shrinkage.

Soil shrinkage & pier separation was visible around entire property.

Top of the Bored Pier visibly ‘leaning out’ from the underside of raft slab.

Pier support loss to slab during shrinkage leads to ‘Hogging’, confirmed by internal inspection of dwelling.

50 Cent Coin placed between bored pier & underside of slab perimeter beam.

Hand excavation & flushing with water used to expose top of Bored Pier.
Bored Pier vs. Blade Pile & Pile Cap – How Blade Piles offer a superior alternative

Bored Pier vs Blade Pile in Homogeneous Very Stiff Clay (Hs = 3.0m and Cu = 200kPa)

Bored Pier – Reduction Factor to AS2870 (2011) - Cl 1.4.2
Blade Pile – Reduction Factor to AS2159 (2009) - Ø g %

Design Geotechnical Capacity [kN]

Pile/Pier Depth into Very Stiff Clay [m]

© Blade Pile Group Pty Ltd 2015
The Bracing Pile is a rapid piling system that is used to support lateral load requirements. The steel pile and its unique ‘Wing Assembly’ are embedded into the ground, providing support for all types of above ground.

The Bracing Pile generates very high levels of lateral load capacity to obtain the optimum structure to pile, to soil interface.

The Bracing Piles are truly unique in their design because they can include any type of fixed, fused or adjustable connection/support system, to facilitate easy on site installation, using less time and resources than traditional methods.

• Carries all types of structural load applications.
• Flexible top plate designs allow shim or thread lock adjustment after installation.
• Can Incorporate cable slots for electrical power supply.
• The steel Bracing Pile can be uninstalled and relocated as required.
Lateral Load Piling – Certified, Fast, Adjustable & Cost Efficient
World Leading Technology – A Geodynamic Design for Every Need

* Solar Blade Piles supporting the Moree Solar Farm
* Bracing Blade Piles for the Caribbean Pirates Movie
* Solar Blade Piles installation, the Moree Solar Farm
* Bracing Blade Piles supporting Pirate Ship on slipway
Pile Connection Innovation – A Solution Designed & Fabricated for All Needs
3.

Pile Performance

Blade Piles being installed into the Brisbane River, for the Kingsford Smith Drive freeway widening, for the City to Airport Link
Moree Solar Farm (MSF) – NSW

- Australia’s largest ever ‘screw in’ steel piling contract – **32,000** Solar Blade Piles
- **6,400** tons of steel Solar Blade Piles, supplied & installed on time & on budget
- Made possible by the patented Solar Blade Pile, created by the Blade Pile Group
Blade Pile Analysis – Ensures ULS is met, with optimum design for site conditions

**Structural Load**

(dead g + live q) Factored for required - ULS

**Pile Capacity (Shaft)**

Factored 50 Year life for Corrosion - ULS

**Ultimate Geotechnical Capacity**

(φg Rd,ug) Determines Blade Pile sizes - ULS

**Site Condition Filter – Blade Sizes & Types**

Blades ‘tuned’ to site specific conditions
### AS1170 - STRUCTURAL LOAD

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### AS1163 & AS4100 - PILE CAPACITY

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### AS2159 - ULTIMATE GEOTECHNICAL CAPACITY

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### VERY STIFF CLAY - 200 kPa (Cu)

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<td>ULS</td>
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Pile Testing For Deflections – Optimising end bearing ‘pressure bulb’

Note: End bearing ‘pressure bulb’ restrained by overburden pressure of surrounding soil (VSC)…… to a limit point

$\Omega_g 0.65 = 90 \text{ kN ULS}$

$\Omega_g 0.65 = 136 \text{ kN ULS}$

$\Omega_g 0.65 = 182 \text{ kN ULS}$

$\Omega_g 0.65 = 0 \text{ ULS}$

$\Omega_g 0.65 = 90 \text{ kN ULS}$

$\Omega_g 0.65 = 136 \text{ kN ULS}$

$\Omega_g 0.65 = 182 \text{ kN ULS}$
Reduced pile spacing’s can enable smaller pile groups to share much larger loads in critical high load areas of the structural design. Often representing the lowest cost solution for increased loads or weaker soil.

Higher load capacities can be achieved with smaller CHS tube piles, by attaching larger blades for larger load bearing pressure bulbs.

Dual bladed piles create a 'hybrid' Blade Pile, that achieves load from both end bearing & skin friction.

The standard range of Blade Piles provides a variety of different sizes and configurations to achieve loads from 50 kN to 1,000 kN.
Current subsidence policies for residential site investigations (AS2870) are insufficient for AS2159. Bore logs need to identify natural material with adequate soil strength data.

Accurate SLS or ULS loads for each pile location is essential, for design calculations.

Generic engineering load specifications simply forces Blade Pile to over-design with larger, deeper and more expensive piles.
Geotech Reporting Issue – Low Cost AS2870 Geotech reporting is high risk & high cost

---

**PENETROMETER (D.C.P)**

<table>
<thead>
<tr>
<th>No. OF BLOWS</th>
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<th>HOLE 2</th>
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<td>2800 - 3000</td>
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---

**BORE LOGS**

- **HOLE 1**
  - **300 m:** Sandy Clay (CI) with Yellow, Brown, Moist, Stiff.
  - **1400 m:** Light Grey, Brown, Moist, M-Dense.

- **HOLE 2**
  - **300 m:** Sandy Clay (CI) with Yellow, Brown, Moist, Stiff.
  - **1400 m:** Light Grey, Brown, Moist, M-Dense.

---

**M/Dense Sand**

- **To 4.5 Metres**

---

**BOREHOLE 1**

- **3400 mm:** Water Table

---

**BOREHOLE 2**

- **3000 m:** Sandy Clay (CI) with Yellow, Brown, Moist, Stiff.
  - **1700 m:** With Sandy Clay (CI) Bands.

---

**NOTE:**

All dimensions shown are approximate only.

---

**SITE SKETCH (N.T.S.)**

- **'NEAR LEVEL':**
  - **4 m**
  - **3 m**

---

**MORALLA AVENUE**

- **BH 1:**
  - **3 m**
- **BH 2:**
  - **4 m**
- **BH 3:**
  - **3 m**

---

**NOTE:**

Trees within limits outlined in AS2870 were noted at the time of this soil test. If existing trees of potential influence are to remain engineering assessment will be required to ascertain if additional slab strengthening or piers are required in accordance with AS2870-2011 Appendix (CH). Alternatively, removal of influential trees must occur prior to construction.
## SITE INVESTIGATION & CLASSIFICATION REPORT

**CLIENT:** Blade Pile QLD Pty Ltd  
13 Alex Fisher Drive  
BURLEIGH HEADS QLD 4220

**JOB NUMBER:** 43237-15RS (Revision A)

**SITE ADDRESS:** Lot 25 - RP205543  
186 Morley Avenue, Runaway Bay

**DATE:** 12 January 2016

**SITE CLASSIFICATION:**
- Class P – due to trees (refer note)
- Class P – due to fill (Class S properties, excluding trees)
Note: house removal, refer note

---

### Site Sketch

To 7.0 Metres

**To 7.0 Metres**

Front of site

**Middle of site**

Back of site

---

### Terms

- **DCP:** Dynamic cone penetrometer (blows/100mm)
- **Hs:** AS2870 Depth of design soil suction change (mm), or HEDTRA/QBCC update 2015.
- **Hp:** Depth of cracking (mm)
- **w:** Estimated Shrink-swell index (%/pF)
- **l:** Shrink-swell index (%/pF)
- **PP:** Pocket penetrometer bearing pressure (kPa)
- **UBT:** Unstable bearing pressure (kPa)
- **HWR:** Highly weathered rock
- **γc:** Characteristic surface movement (mm)
- **γp:** Potential additional surface movement due to trees (mm)

### Laboratory test results

- **Hs (mm):** 1700
- **Hp (mm):** 850
- **Sample:** A
- **l (%/pF):** 0.1
- **γc (mm):** 0 to 5
- **γp (mm):** 0

---

**SITE CLASSIFICATION:**
- **FILL:** %Silty%SAND%
- **Light$Yellow$/Light$Grey,$Moist
- **Brown/Grey,$Moist
- **M/Dense Sand
- **Loose Sand
- **Dark$Grey,$Wet
- **Dark$Brown$/Dark$Grey,$Wet
- **Silty%SAND%
- **With$Gravel,$Brown/Grey/Yellow,$Moist

---

**Geotech Reporting Solution** – Deep and precise Geotech reduces risk & cost
Pile Loads Issue – More effort is needed to get it right for the client

Providing the wrong pile loads for each location, means the client pays more for piles they don’t need.
Calculating the correct pile load for each location, means the right piles at the right cost for the client.
This Technical Design Manual (TDM) has been created for use in the determination, application and design of Blade Piles, Slip Joint Pile Caps, Piled Slab Systems, Lateral Bracing Piles and connections for Residential, Commercial, Industrial and Civil Construction projects.

Design information, methodologies, calculations and recommendations documented within this TDM are in accordance with the relevant Australian Standards, to ensure that proper compliance & certification can be achieved for the mandatory requirements of those standards.
5.

Slab Systems

The Blade Pile Group and its associate company Airformer, have invented & patented the following.

Blade Pile Group - Pile Cap Slab System (For both Waffle or conventional slabs)

And Coming Soon!

Airformer - Air Slab System – Air Pod, Mesh Chairs & Pod Lock Bar Chairs

Airformer - Blade Slab System – Blade Pod & Blade Plates.
Pile Cap Slab System – Waffle Raft Slab, Blade Piles & Slip Joint Pile Cap

REINFORCEMENT FOR WIDENED BEAMS:

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NOTE:
- WIDER BEAMS COV. 200MM, FOOTING REINFORCEMENT STEEL OR ANY STEEL WHERE CONCRETE IS Poured TO EXIST TO HAVE 50MM COVER MIN.
- SLAB REINFORCEMENT:
  - TOP FACE: REFER FOOTING AND SLAB PLAN
  - STEM FACE 50MM COVER MIN. AND SLAB REINFORCEMENT
  - WET AREA SET-DOWNS:
  - PLACE LAY BAR MIN. 200MM LONG AT ALL REPEATED CORNERS OF WET AREAS.
- TILED AREAS:
  - AREA OF CERAMIC TILES GREATER THAN 2.5M2, MIN. SLAB REINFORCEMENT OF SLAB (MIN.) OVER THE TILED AREA, ALTERNATIVELY IF A PERIOD OF THREE MONTHS IS ALLOWED TO ELAPSE BEFORE PLACEMENT CERAMIC TILES MAY BE PLACED ON A RUBBER BASED ADHESIVE WITHOUT THE NEED FOR ADDITIONAL SLAB REINFORCEMENT.
- DAMP PROOF COURSE:
  - DAMP PROOF COURSES AND FLASHING SHOULD BE INSTALLED IN ACCORDANCE WITH CLAIRE HALL OF ASHTON, DESIGN AND NATIONAL CONSTRUCTION CODE NCC.
Pile Cap Slab System – Conventional Raft Slab, Blade Piles & Slip Joint Pile Cap

LEGEND:
- INDICATES SLAB THICKNESS
- EDGE BEAM
- INTERNAL BEAM
- STRIP FOOTING
- SLAB THICKENING
- BLADE PILES BY OTHERS, WITH SWL OF 70 KN IN COMPRESSION, FOUND IN NATURAL GROUND.
- 3.440 THINNER BARS, 2.0m LONG, LAY BELOW MAIN SLAB MATT

BLADE PILE NOTES:
- BLADE PILE MINIMUM CAPACITY UNO: 70 KN
- 1. TEST BLADE PILES ARE TO BE CONDUCTED prior to the confirmation of the blade pile design by the engineer.
- 2. THE TREATMENT OF THE BLADE PILES SHALL BE AS PER AS 2165 OR EQUIVALENT.
- 3. ALL BLADE PILES ARE TO BE 350 GRADE UNO.
- 4. ALL BLADE PILES MUST HAVE A MINIMUM DEPTH OF 2m.

SITE CLASSIFICATION: E Class

SOIL TEST BY: Structerre WSA Pty Ltd
16/03/13

CONCRETE GRADE: 20MPa
SLUMP: 100mm
AGG: 20mm

ALL CONCRETE IS TO BE MECHANICALLY VIBRATED DURING CONCRETE PLacing.

RECOMMENDED FOUNDING MATERIAL:
- NATURAL SOIL, STRATIFIED CLAY.

THE CUT/FILL LINE SHOWN IS APPROXIMATE ONLY. IF VARIES PLEASE CONSULT ENGINEER FOR FURTHER ADVICE.

ENSURE STIRRUP, PENETRATING AND SLAB THICKENGS ARE INSTALLED IN ACCORDANCE WITH THE ARCHITECTURAL PLANS.

THE CONTRACTOR SHALL CONFIRM THE LOCATION OF ALL EXISTING SERVICES, ON AND EXTERIORS TO THE SITE INCLUDING WATERMANS, SEWERMANS, TELECOMMUNICATION CABLES, ELECTRICAL CABLES, GAS PIPES AND STORMWATER MAINS. ANY DAMAGE TO EXISTING SERVICES SHALL BE REPAIRED AT THE CONTRACTORS EXPENSE.

DO NOT SCALE OFF ENGINEERING DRAWINGS.

---

Footing & Slab Plan
Scale 1:100

SL92 Mesh with 40 Top Cover Over Blade Piles

'SEEP FOOTING TO EXTEND 15 CM INTO FOOTING TYP.'
Pile Cap Slab System – Conventional Raft Slab, Blade Piles & Slip Joint Pile Cap

NOTE:
REINFORCEMENT COVER:
FOOTING REINFORCEMENT STEEL OR ANY STEEL WHERE CONCRETE IS POURED TO EARTH TO HAVE SOME COVER MIN.
SLAB REINFORCEMENT:
TOP FACE NEEDS REINFORCING AND SLAB PLAIN ETM FACE; SOME COVER MIN. NOU ALL STEEL IS TO BE SUPPORTED ON BAR CHAIRS AT 50MM CENTRES BOTH WAYS.
REINFORCEMENT LAYS LUD.
TRENCH WBEAM AND BARS
UP TO 150mm DIA. 500mm LAY MIN. BARS UP TO 150mm DIA. 600mm LAY MIN.
SLAB WBEAM 2 BAR LAY MIN.
WET AREA SET-DOWNS:
PLACE DA0 150mm LONG AT ALL HIGH-WATER CVERGIES OF TELEPH ARAS.
TILES AREAS:
AREAS OF TILES CEMENT LARGER THAN 872x727mm MAY BE REQUIRED AND CONCRETE LAYERER LAYMENT ON AN ADDITIONAL TOP LAYER OF 12.7MM SILL MING OVER THE TLED AREA. ALTERNATIVELY, IF A PERIOD OF THREE MONTHS IS ALLOWED TO ELAPSE BEFORE PAVING, CEMENT TILES MAY BE PLACED ON A BURIED RISER CONCRETE WITHOUT THE NEED FOR ADDITIONAL SLAB REINFORCEMENT.
DAMP PROOF COURSES:
DAMP PROOF COURSES AND FLASHING SHALL BE INSTALLED IN ACCORDANCE WITH CLAIRE PLAN DED OF AS1550-2001 AND NATIONAL CONSTRUCTION CODE (NCC).
22 November 2011
Project No. 214714

Trista Technology Pty Ltd
Level 2/389 Scottsdale Drive
Robina Qld 4226

Attention: Kym Plotkin, CEO

Dear Sir,

Subject: Pile Cap Slab Footing System

We confirm that we have examined the Pile Cap Slab System and have successfully carried out designs of residential footings using this method of footing construction.

The Pile Cap Slab Footing System comprises several elements as follows:

1. A 350 grade high tensile steel shaft with a high tensile twin blade at the base which has a cutting edge at 45° (Plate A). This blade pile falls under the classification of a "steel screw pile" by AS 2159-2009 “Piling – design and installation”, Section 1.3.32. It is an alternative method of piling to the conventional steel screw pile with a helical circular base, a timber pile, and a bored and cast-in-situ concrete pile. Plate B shows the installation of a Blade Pile.

2. A pile cap made of high density PVC which provides an enlarged support to the surface footing (Plate C). The pile cap has a slip joint that accommodates soil heave. The pile cap also provides a compression only connection to the surface footing.

3. A surface footing which is either a conventional stiffened slab system (such a waffle raft, such as shown in Plate D) designed for the reactive soil movement for the site, or alternatively a suspended reinforced concrete slab supported on the blade piles and pile caps, and cast on void forms comprising collapsible polystyrene “Star Pods”. For the former system, the blade pile and pile cap minimises the development of edge settlement of the stiffened shallow footing. For the latter system, the blade pile and pile cap enables the floor slab to be suspended above the reactive soil movements.

The design of the Pile Cap Slab System will follow the intention of AS2870-2011 “Residential Slabs and Footings” Section 4.6, i.e. the design is to be in accordance with engineering principles.

Informative design procedures are given in AS2870-2011 Section G6.

In particular, the Pile Cap Slab System can be designed to meet the following design requirements:

- The pile must have an adequate compressive structural and geotechnical strength,
- The pile must have adequate tensile structural and geotechnical strength,
- The pile must have adequate flexural (bending) structural strength,
- The pile cap can be designed to accommodate the expected soil swell for the site,
- The pile cap can be designed to carry the compressive load from the surface footing,
- The pile must be adequately anchored in the soil. In the case of reactive sites, the pile must be founded in the stable zone below the depth of reactive soil movements,
- When the Pile Cap Slab System is used to suspend the floor slab above the reactive soil, the footing must be isolated from the reactive soil, and
- There must be isolation and flexibility of the services connecting to the structure supported on the Pile Cap Slab System.

With the above design requirements being met, we have found the Pile Cap Slab System to be a very effective method of footing construction.

Yours sincerely,
Aurecon Australia Pty Ltd

Dr. Peter W. Mitchell
Technical Leader Ground Engineering
Blade Pile Group and its associated companies understand the importance of ongoing independent structural & geotechnical testing of foundation products and are now able to assist other parties in acquiring expert pile testing services.

Independent verification and certification of Blade Pile Group products continues to be carried out by some of Australia’s leading engineers, testing laboratories and consulting engineering companies.

Some of the parties that have worked with Blade Pile to provide testing include Structerre Consulting Engineers, GHD Consulting Engineers WA, Aurecon SA, Prompt Certification WA, URS SA, University of South Australia, Griffith University QLD, ALS Group, Foundations Specialist Group, Alfa Labs QLD and Dr. Peter Mitchell.

The Blade Pile Group and its associated companies have now established pile testing services for other parties. Our group works directly with certifying engineers in Australia and overseas, to ensure independent, accurate & reliable certification services that meet all Standards, Building Codes and regulatory requirements.
**Test Stage:** 1  
**Test Number:** 45  
**Date:** 20.08.15  
**Site Address:** MSF Solar Farm project, Moree NSW

**Client/Project Details:** GLC

**Test Pile Position:** PS01N3T12P07

### Geotechnical Displacement for given Test Load

<table>
<thead>
<tr>
<th>Each No.</th>
<th>Test Load (kN)</th>
<th>Displacement (NGL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2</td>
<td>3.12</td>
<td>0.09</td>
</tr>
<tr>
<td>3</td>
<td>4.16</td>
<td>0.13</td>
</tr>
<tr>
<td>4</td>
<td>5.20</td>
<td>0.13</td>
</tr>
<tr>
<td>5</td>
<td>6.24</td>
<td>0.16</td>
</tr>
<tr>
<td>6</td>
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<td>8.32</td>
<td>0.18</td>
</tr>
<tr>
<td>8</td>
<td>9.36</td>
<td>0.22</td>
</tr>
<tr>
<td>9</td>
<td>10.40</td>
<td>0.30</td>
</tr>
<tr>
<td>10</td>
<td>8.32</td>
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</tr>
<tr>
<td>11</td>
<td>6.24</td>
<td>0.21</td>
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<td>4.16</td>
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<td>2.08</td>
<td>0.07</td>
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<td>0.00</td>
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<td>15</td>
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</table>

![Graph Image](image-url)
## BLADE PILE TEST GRAPH - Compression Test - vs.22.07.15

### Test Details

- **Test Stage:** 3
- **Test Number:** 131 OM
- **Date:** 24.09.15
- **Pile Type:** OM
- **Site Address:** MSF Solar Farm project, Moree NSW
- **Install Torque:**
- **Client/Project Details:** Catcon & For GLC
- **Test Pile Position:** OM Building

### Test Load vs. Geotechnical Displacement

<table>
<thead>
<tr>
<th>No.</th>
<th>Test Load (kN)</th>
<th>Geotechnical Displacement (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1</td>
<td>33.90</td>
<td>1.51</td>
</tr>
<tr>
<td>2</td>
<td>45.20</td>
<td>1.87</td>
</tr>
<tr>
<td>3</td>
<td>56.50</td>
<td>2.14</td>
</tr>
<tr>
<td>4</td>
<td>67.80</td>
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<td>5</td>
<td>79.10</td>
<td>2.78</td>
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<td>6</td>
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<td>3.40</td>
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<td>8</td>
<td>113.00</td>
<td>3.74</td>
</tr>
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<td>90.40</td>
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<td>67.80</td>
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<td>45.20</td>
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<td></td>
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</tr>
<tr>
<td>15</td>
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<td></td>
</tr>
</tbody>
</table>

### Graph Details

- **Test Load (%)** vs. **Geotechnical Displacement (%)**
- **Test Load (kN)**
- **Geotechnical Displacement (mm)**

![Graph Image]
### Geotechnical Displacement (bottom) for given Test Load

<table>
<thead>
<tr>
<th>Test Load No.</th>
<th>kN</th>
<th>Bottom (mm)</th>
<th>Top (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>50%SLS</td>
<td>1.57</td>
<td>1.80</td>
<td>7.00</td>
</tr>
<tr>
<td>Rebound</td>
<td>0.00</td>
<td>0.28</td>
<td></td>
</tr>
<tr>
<td>75%SLS</td>
<td>2.35</td>
<td>3.75</td>
<td>15.00</td>
</tr>
<tr>
<td>Rebound</td>
<td>0.00</td>
<td>0.38</td>
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</tr>
<tr>
<td>100% SLS</td>
<td>3.14</td>
<td>5.62</td>
<td>21.00</td>
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<tr>
<td>Rebound</td>
<td>0.00</td>
<td>0.46</td>
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</tr>
<tr>
<td>125% SLS</td>
<td>3.92</td>
<td>6.52</td>
<td>24.00</td>
</tr>
<tr>
<td>Rebound</td>
<td>0.00</td>
<td>0.49</td>
<td></td>
</tr>
<tr>
<td>150% SLS</td>
<td>4.71</td>
<td>7.79</td>
<td>29.00</td>
</tr>
<tr>
<td>Rebound</td>
<td>0.00</td>
<td>0.55</td>
<td></td>
</tr>
</tbody>
</table>

### Deflection at top of pier for given Test Load

- Start: 1.57 mm
- 50%SLS: 2.35 mm
- 75%SLS: 3.14 mm
- 100%SLS: 3.92 mm
- 125%SLS: 4.71 mm

**Summary Notes:**
- Lateral 'Side Push'
Blade Piles are continually tested beyond their limit, to verify and certify the Blade design, fusion welded connections and there relationship with a given CHS pipe.

All these elements are designed to perform equally to there limit, with ZERO allowable tolerance for weld failure, to ensure the best possible performance in all Geotechnical environments.
7. Certification

- Many piering/piling companies provide certification for foundation works that may not be compliant if they design outside the relevant Australian Standard or, not verified that completed works comply with the Engineers design & specification.

- A certificate that only states works were completed & compliant to a given standard, without a Pile Design Summary Report with calculations to support their pier/pile design, is incomplete and therefore not acceptable for AS2159 certification.
Thank You For Your Time