
ISM Micropile Test
Instrumentation

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ISM Micropile – Our Scope

1. Design two engineered fills – with 10 kPa and 20 kPa shear. (Thanks - Wing)

2. Set-up instrumentation to monitor – load, displacement and bending in real-time (Thanks to Ivan and Gabriel, Measurand).

3. Set-Up video and data feed between the two locations (Thanks to Lewko).

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1. Engineered Fills

- Literature search and discussions plastic slurry wall and cement-bentonite specialists.
- Feedback and previous experience gave us a starting point plus warnings about predictability and repeatability.
- Starting point - grouts consisting of 6.5% bentonite slurries mixed with percentages by weight of cement, ranging from 2% to 12%.

1. Engineered Fills

- Shear testing - ASTM standard test method for laboratory miniature vane shear test (ASTM D 4648-05).

- Initial results lower than expected.

1. Engineered Fills

- Additional mixes of 14%, 16%, 18% and 20% cement mixes were batched to extend the data set to greater shear strengths.
- Two distinct curves from each data set?
- A smaller mixer and half batches for the first set of tests and larger mixer and full batches for the second set of tests.

Grout Shear Strength

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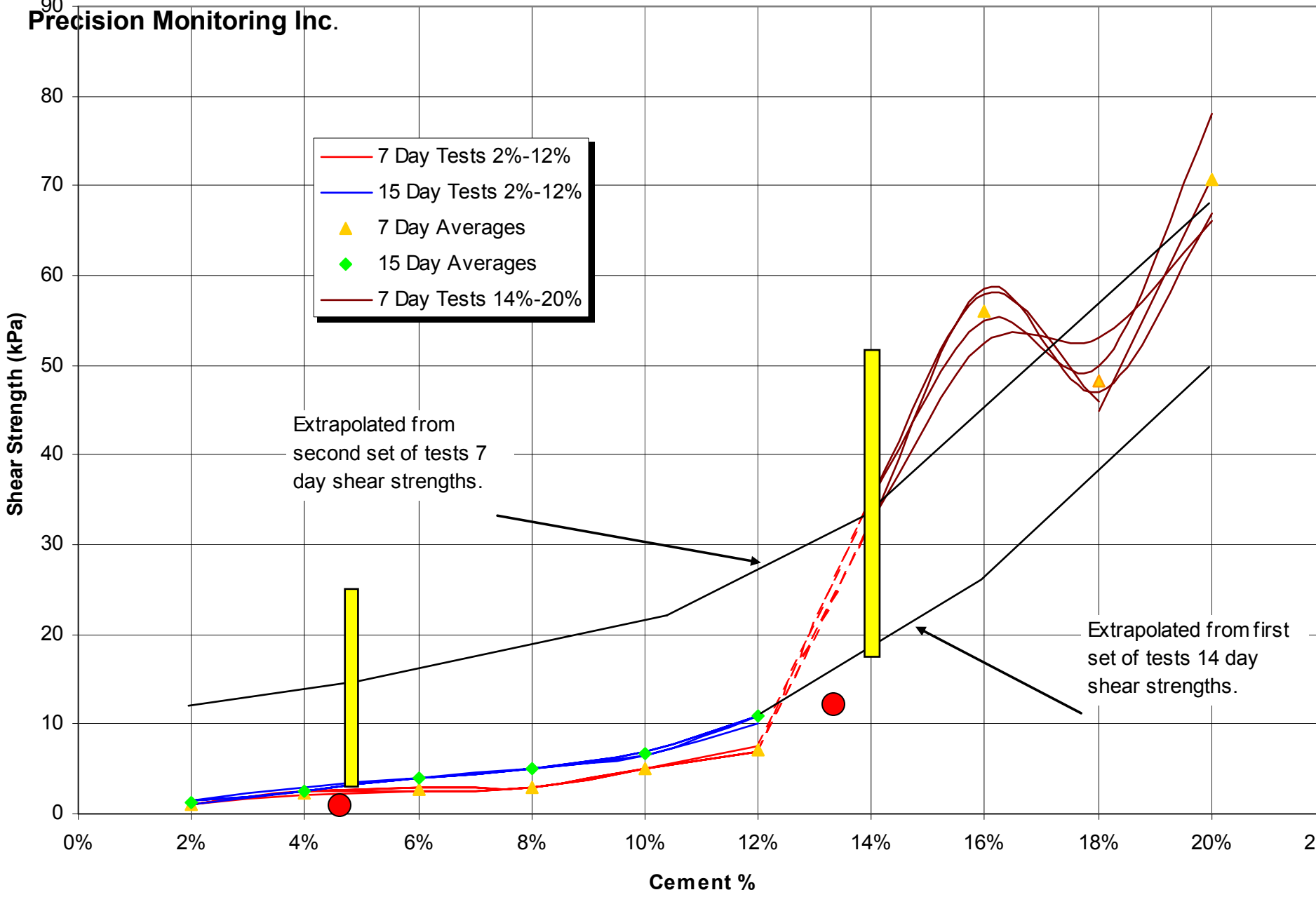

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2. Real-Time Instrumentation:

- Cap displacement in relation to the applied load
- Displacement vs. load in plotted on screen in real-time
- Bending or buckling of the bar.
- Movement of the reaction piles.
- Archive data

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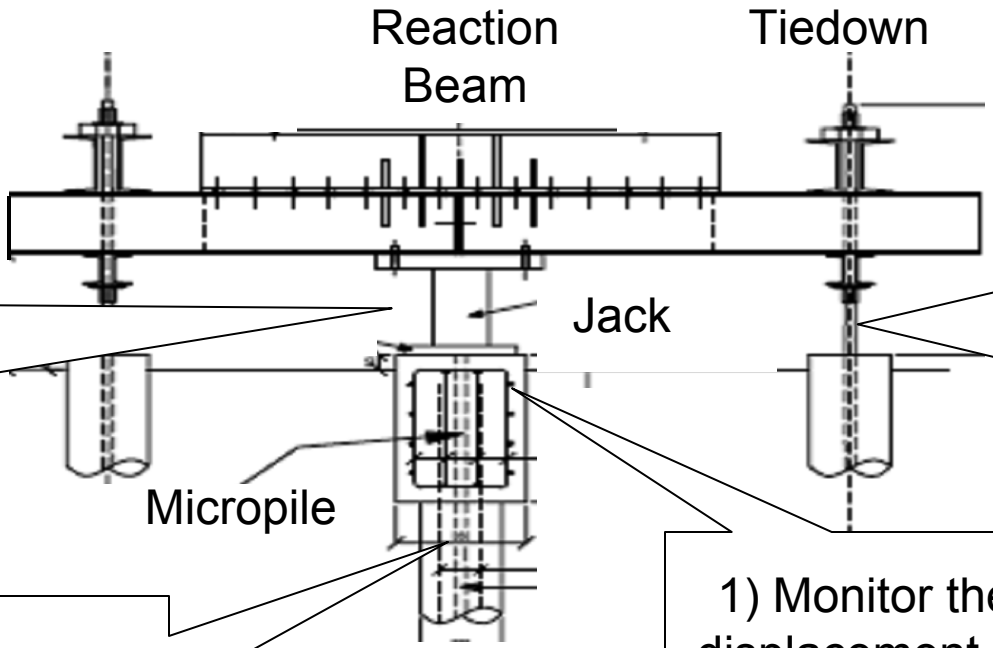
The Set up



2) Measure the pressure applied by the jack

4) As a safety precaution, see the pullout motion on reaction piles

3) Observe any bending or buckling of the micropile

1) Monitor the displacement of the cap

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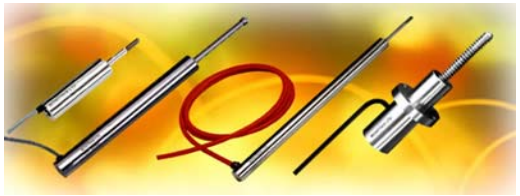
LVDT's

- Linear Variable differential Transformer

  -- Instruments similar in function to electronic dial gauges.
  – Accurate and precise as dial gauges and infinity resolution.
  – More suitable for rugged site conditions, and unlike dial gauges, interface easily with computers.



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Pressure Transducer

- This sensor transforms pressure into an analogue electrical signal.
- Easily connected to a datalogger or a computer.

Measurand ShapeAccelArray

- Measurand ShapeAccelArray
  - A series of sensor (accelerometers) linked together (MEMS Technology).
  - It produces a 3D representation of the borehole, bar, etc.
  - Better resolution that a series of in-place inclinometers.

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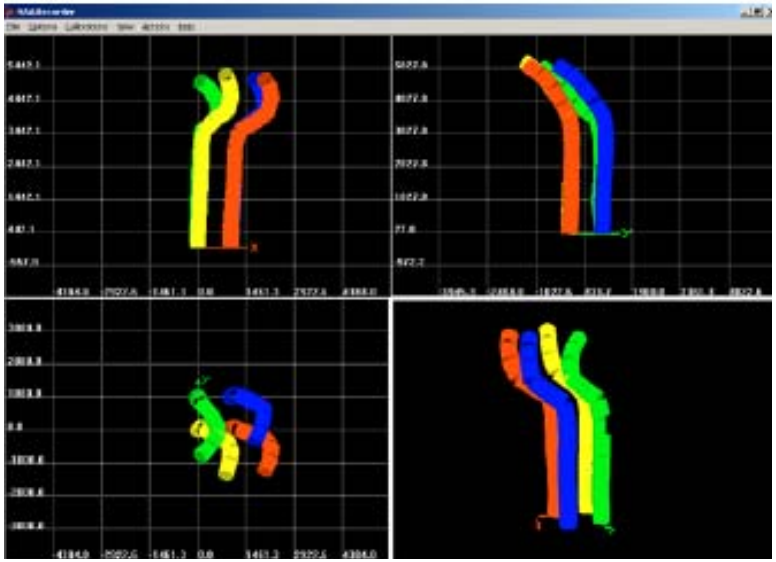

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The method used:

- To see the vertical movement of the cap, four LVDT's were placed on the cap.
- The pressure transducer was attached to the hydraulic jack.
- Each tie-down also had a LVDT for any possible pull-out during the test.
- A ShapeAccelArray was inserted inside the micropile to see any bending during the compression.

- All LVDT's and the pressure transducer were connected to a datalogger that collected readings every second.
- A graph showing the Displacement vs. Load was produced in real time.
- Using Measurand SAArecorder software, the bending of the bar was monitored as the bar was loaded.


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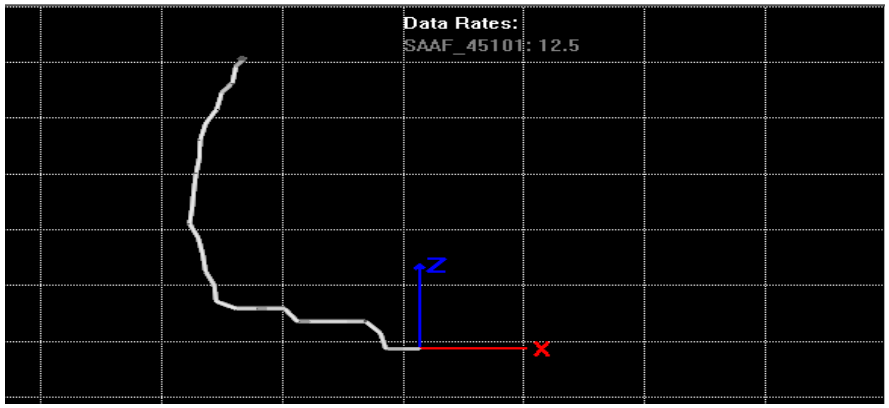
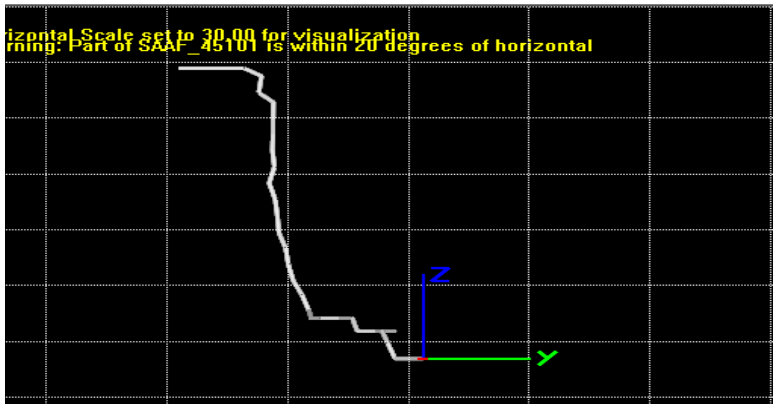
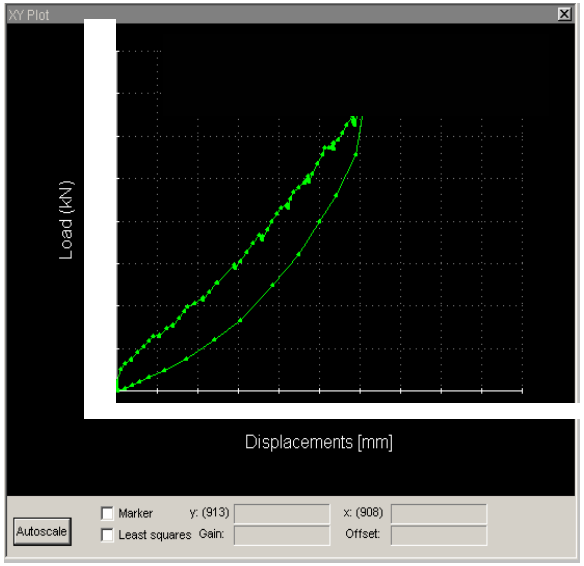
ShapeAccelArray Screen shot







Hewlett Packard
Displacement vs. Load
graph

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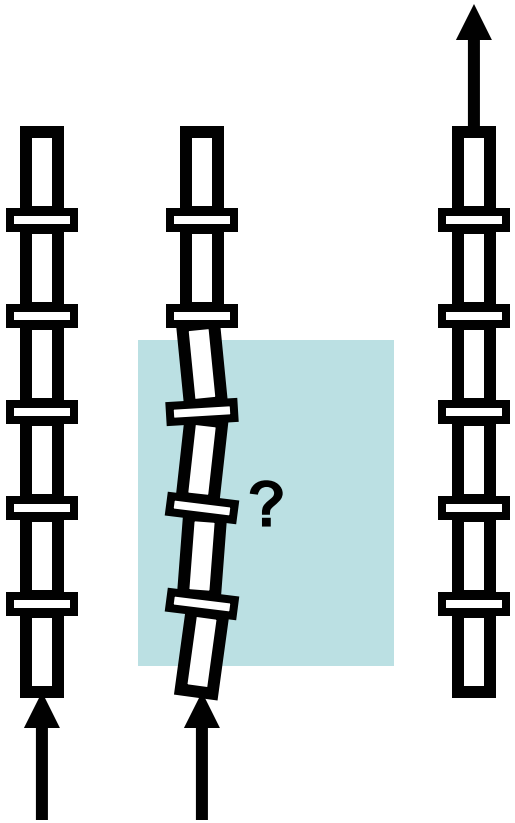
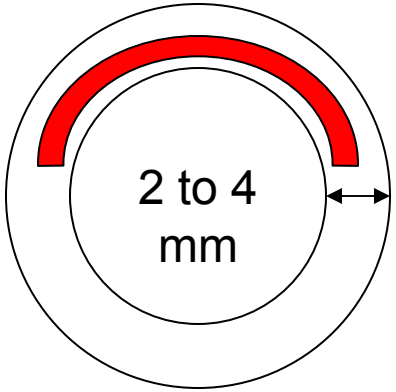
Lessons Learned

- SAA – installation details



1. annulus webbing or no webbing



2. supported on bottom / hung from top

Conclusions

- Engineered fill shear values lower than design targets:
  15 kPa and **2 to 3 kPa**
- The LVDT's, pressure transducers, datalogger and related software worked as expected.
- ShapeAccelArray and Measurand's software worked well. We gained experience regarding installation details and using the instrument as a real-time monitoring instrument.
- All the instrumentation performed as it was designed to: providing accurate measurements and allowing further analysis after the test.
- Video and Data Feed – See it later today.