

# Pile Loading Tests of Titan Injection Bored Micropiles

ISM Workshop May 10-13, 2009

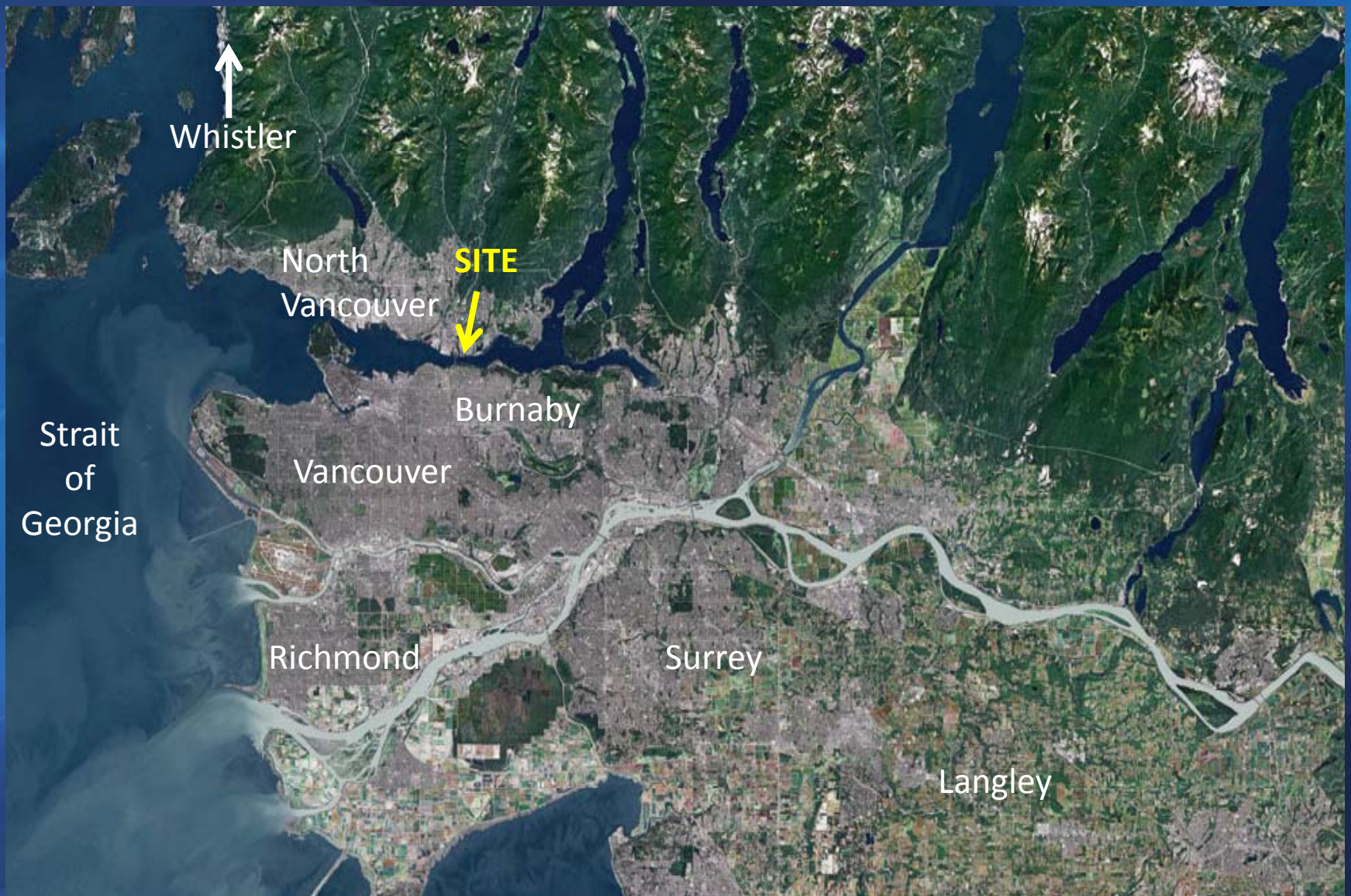
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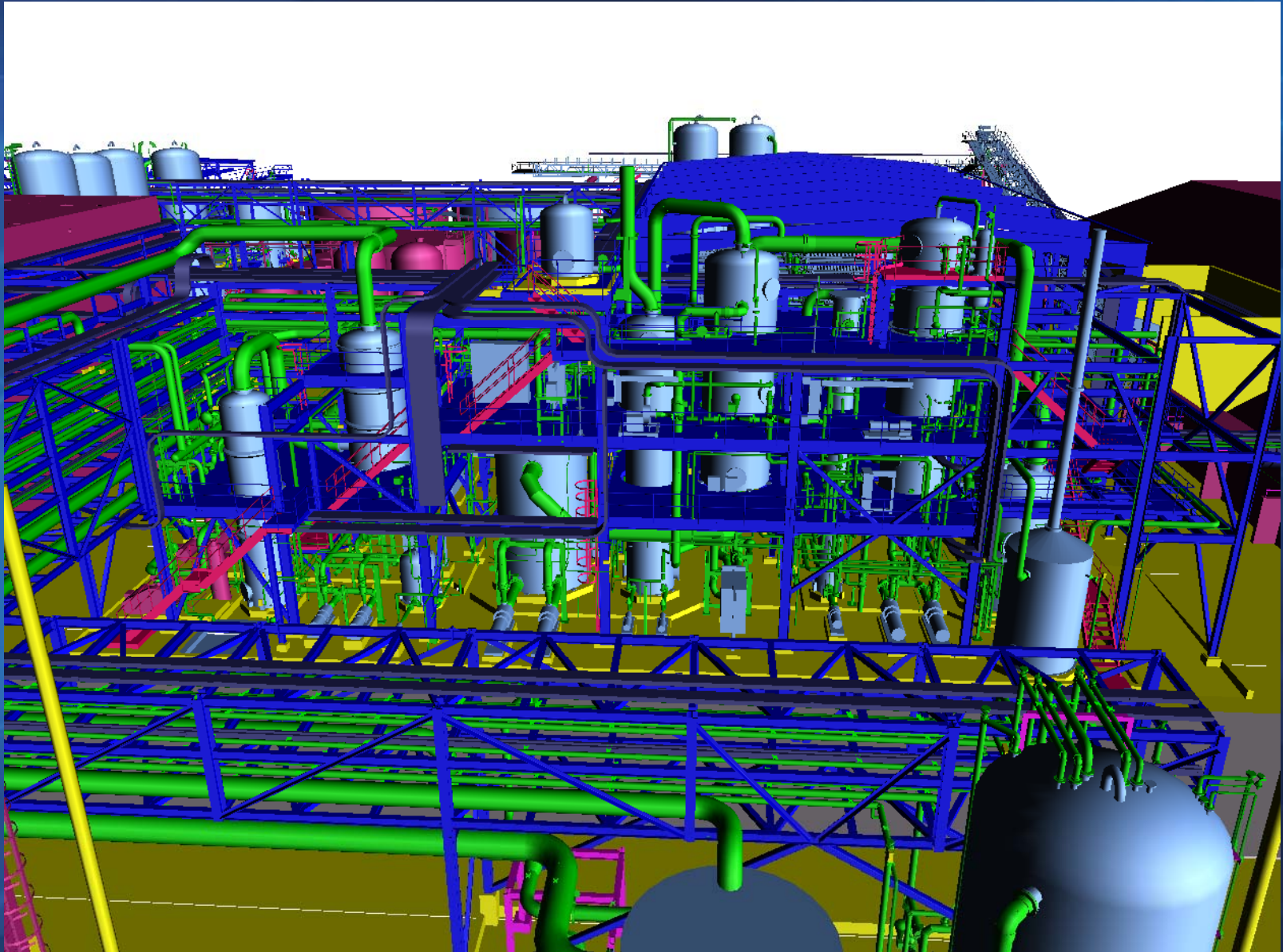
Vancouver, British Columbia  
Canada



# Site Location



# Plant Buildings



# Outline

- Local Use of Micropiles
- Design Methodology
- Regional Geology/Soil Profile
- Installation Method
- Pile Loading Tests
- Quality Control
- Installation Problems
- Conclusions



# Local Use of Micropiles

- Seismic upgrading
- Underpinning of buildings
- Casing drilled piles – DCP GEWI-Pile
- Injection anchors used primarily for shoring

# Design Methodology

- Estimate the soil/grout bond capacity
- Determine a suitable pile length
- Corrosion protection requirements
- Limit state design
- Establish load testing and quality control requirements

# Why Titan Micropiles Used





# Regional Geology

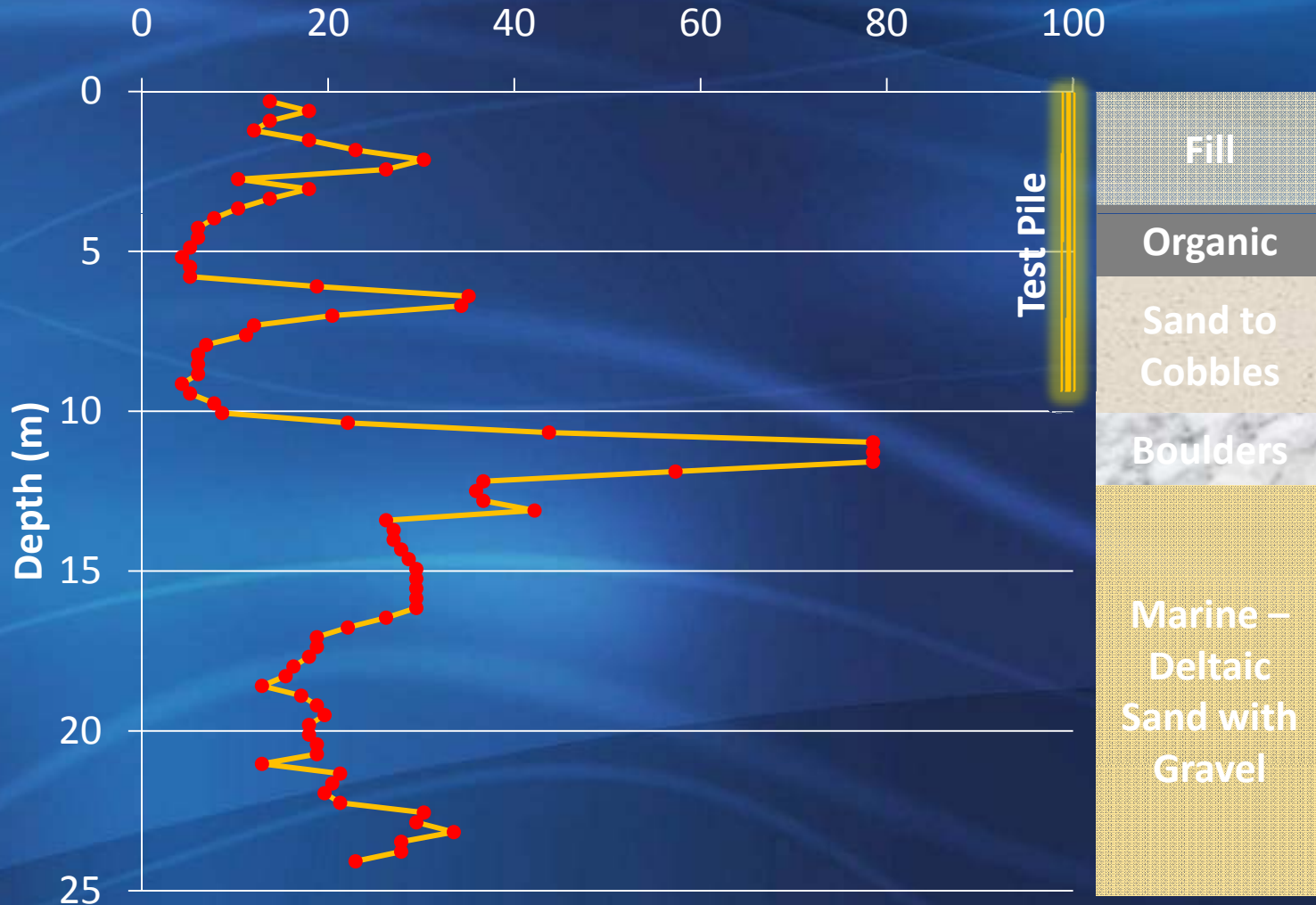
- Located 1 km from the mountains
- Mountain stream – marine deltaic coarse sand and gravel
- Glacial till at 90 metres
- Tertiary bedrock within 120 metres



5 m Excavation in  
Dredged Fills

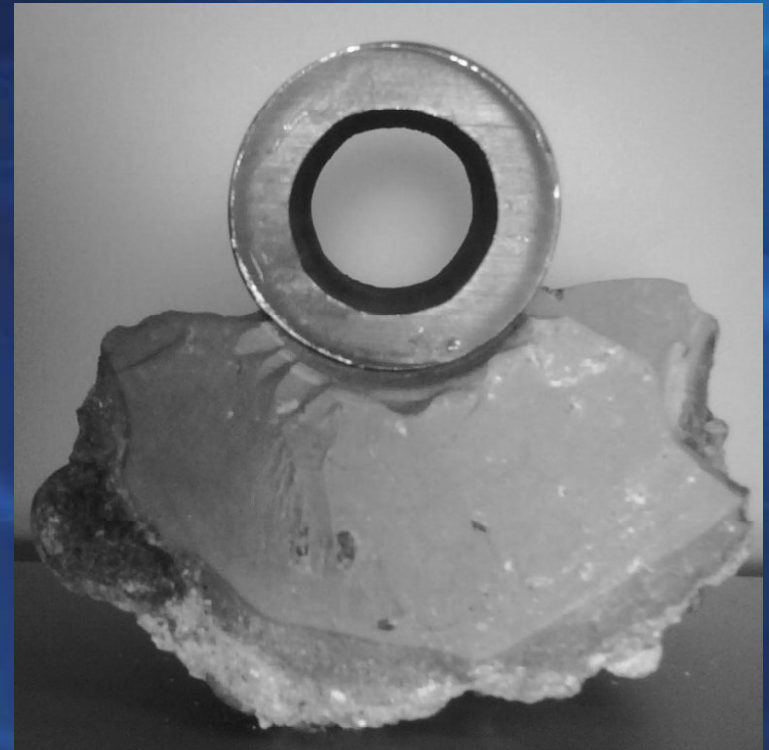
# Soil Profile

Becker Penetration Test  
SPT N60 (blows/0.3m)



# Installation Method

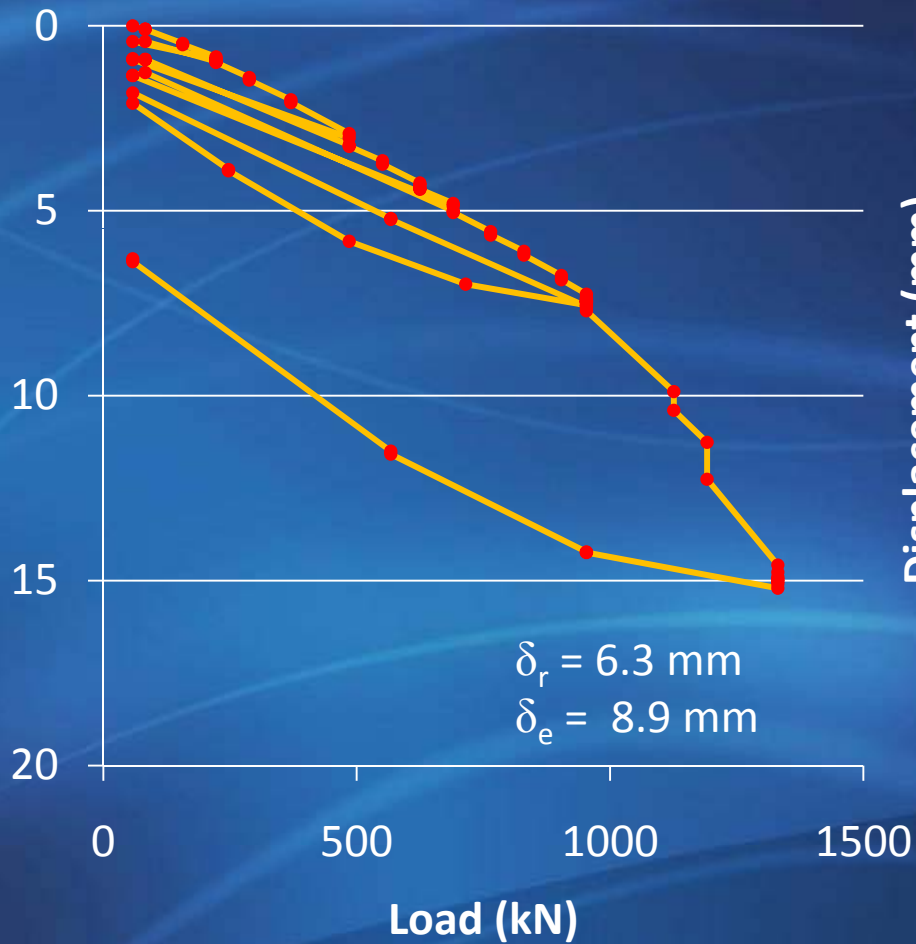
- Rotary top hammer drill
- Continuous grout flush with a W/C ratio of 0.7 to 0.9
- Final W/C of 0.5 for the production piles



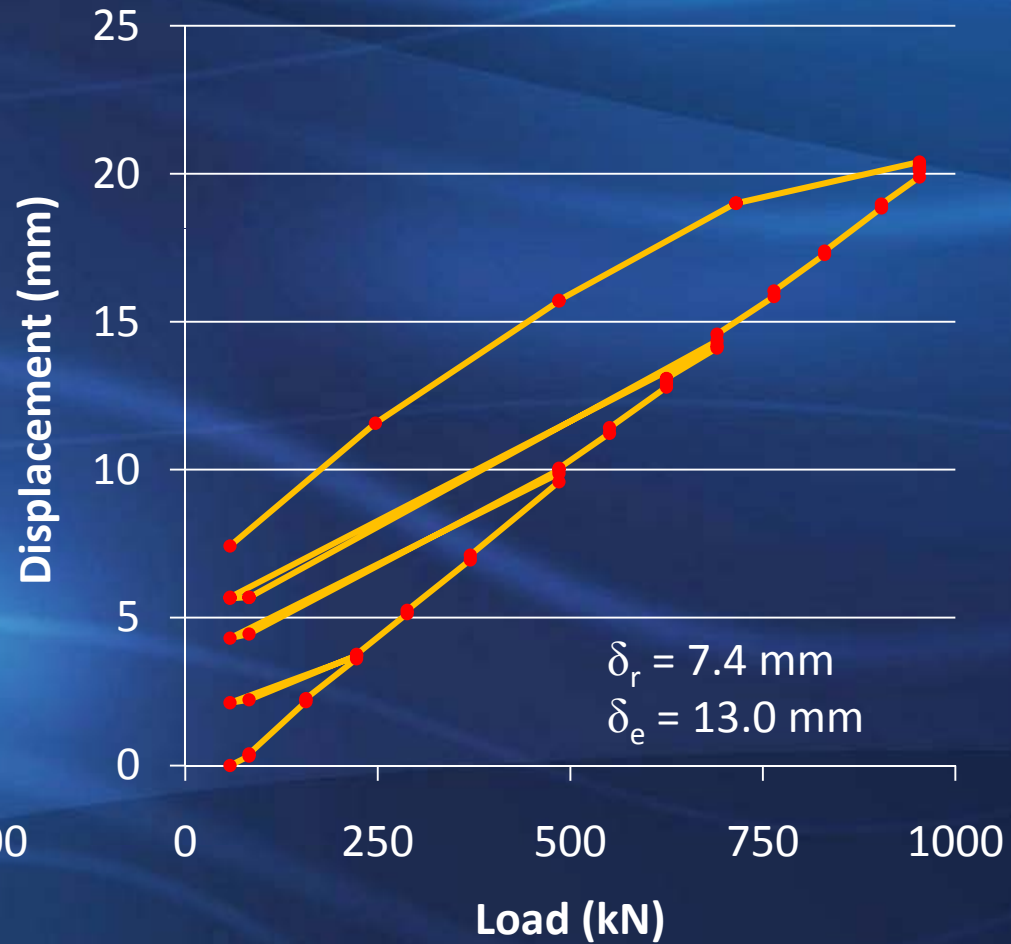
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# Pile Loading Tests

## Compression Test



## Tension Test



# Quality Control

- Production piles quality control
- Full time supervision
- 5% pile testing frequency
- Grout testing



Tension Test Setup  
On Inclined Pile

# Installation Problems

- Uniform gravels
- Used DCP for some of the micropiles
- Slow installation and 5 times slower production rate

# Conclusions

- Capable of supporting high compression and tensile loads
- Low pile head movements
- FHWA micropile design method recommended
- Tested bond strengths in the sand and gravel deposit correlate with the FHWA ultimate bond strengths

# Thank you

