Structural Testing of Micropile Threaded Connections

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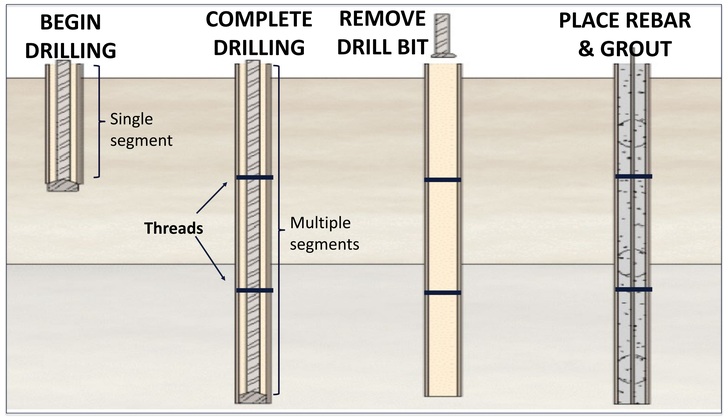
Steel Casing Micropiles

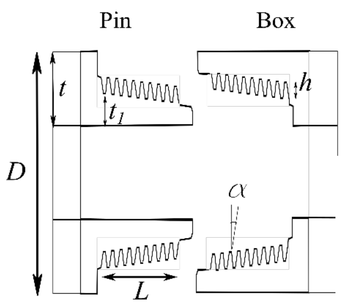
Permanent steel casings micropiles are an advantageous foundation system:

- High geotechnical capacities.
- Suitable for challenging subsurface conditions.
- Suitable at sites with limited access.
- **Segmental installation** for situations with low head clearance.

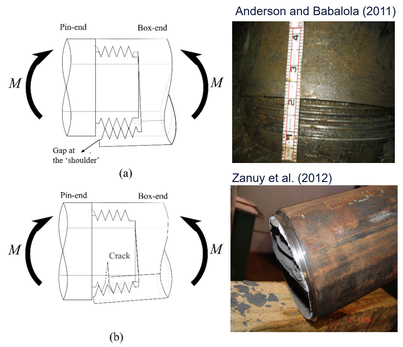


Typical micropile installation. Modified from FHWA (2005)

Threads are the 'Achilles Heel'



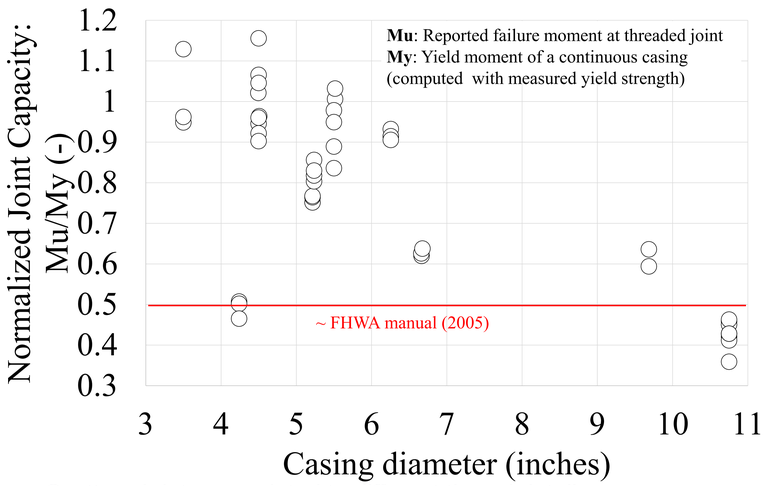
Typical thread geometry. (NTS)



Joint failure modes: (a) Jump-out; and (b) Rupture. (Diagrams are schematic only)

Flexural Capacity at the Joint

Laboratory four-point bending tests reported in the literature



- Scattered data associated to different thread details.
- Design manuals and provisions are specific for API sections
- **DO NOT INCLUDES REINFORCING BAR**.
- **DO NOT INCLUDES COMBINED LOADING**.
- **Lack of understanding**: No universally accepted methodology for estimating joint flexural capacity based on thread details.

Testing Program at UMaine

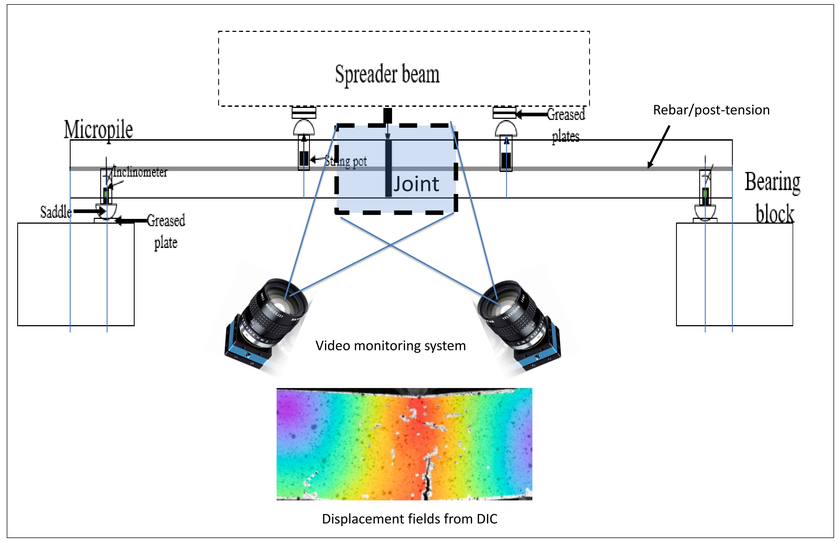
A total of 63 micropiles will be tested at the facilities of the Advance Structures and Composites Center. The specimens can be grouped in 20 different test with varying thread details, with and with/out reinforcement, and considering combined loads (bending+compression).

Micropile specimens prepared for UMaine study.

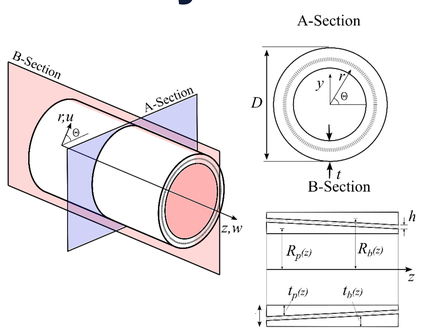
Approach

Micropiles will be tested in bending by means of a four-point bending test:

- String-pots and inclinometers to monitor local displacements and rotations.
- Digital image correlation (DIC) to monitor detailed displacement field near the joint location (mid-span).
- Combined loading by applying a compressive load through a post-tensioning system.



Analytical Model



$$u = u(z,\theta) \qquad w = w(z,\theta)$$

$$\varepsilon_\theta = \frac{u}{R} \qquad \varepsilon_z = \frac{\partial w}{\partial z} \qquad \gamma_{\theta z} = \frac{1}{R}\frac{\partial w}{\partial \theta}$$

$$\sigma_z = F(\varepsilon_\theta, \varepsilon_z, \gamma_{\theta z}) \longrightarrow M = -\int \sigma_z \, y dA$$

Best fit to measured data

$$u_b = \chi(\theta, t_p, t_b, R_p, R_b, h)\lambda(z, L)$$

$$w_b = \zeta(\theta, t_p, t_b, R_p, R_b, h)\eta(z, L)$$

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