African Meetinghouse
“ACCESSING HISTORY”

Richard Pizzi, P.E.

Special Thanks to
Rick Wilhelmsen

HAYWARD BAKER
Geotechnical Construction

GEOTECHNICAL
CONSULTANTS, INC
SOIL NAIL WALL CONSTRUCTION
SOIL NAIL WALL CONSTRUCTION
SOIL NAIL WALL CONSTRUCTION
SOIL NAIL WALL CONSTRUCTION
SOIL NAIL WALL CONSTRUCTION

NAIL INDIRECTLY LOADED IN TENSION ACROSS BOUNDARY.

CRITICAL SHEAR PLANE.
FOR WALL HEIGHT ~ 20

NAIL LENGTH ~ 15’ ea.
12 NAILS x 15’ = 180’ OF DRILLING

OR A NAIL DENSITY OF
~ 10’ OF DRILLING PER L.F. OF WALL
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GEOTECHNICAL CONSULTANTS, INC
African Meetinghouse
8 Smith Court  •  Boston
Built in 1806
(Cost $7,500)

Oldest Black Church
Still Standing in the United States
2006 Restored to 1855 Appearance
(Completed 2012)

Cost $9.5 Million
Frederick Douglass

- Escaped Slave
- Leader in Abolitionist Movement
- Dazzling Orator – 1860 Speech
MICROPILES  TYPE 1  (>99%)

• Deep Foundation Elements
• Structural Elements
• Installed by Drilling (usually)
• Small Diameter (<= 12-inch Diameter)
• Directly Loaded
• Load Applied Near Ground Surface
• Penetrate Weak Strata
• Transfer Load to (deep) Bearing Strata
MICROPILE INSTALLATION

WEAK STRATA

- Urban Fill
- Organic Soil
- Peat
- Very loose Sand
- Soft Silt or Clay

BEARING STRATA

- Sand
- Sand & Gravel
- Glacial Till
- Stiff/Hard Clay
- Bedrock
MICROPILE INSTALLATION

WEAK STRATA

- Urban Fill
- Organic Soil
- Peat
- Very loose Sand
- Soft Silt or Clay

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BEARING STRATA

- Sand
- Sand & Gravel
- Glacial Till
- Stiff/Hard Clay
- Bedrock
MICROPILE DESIGN

CASED SECTION

$A_{\text{cased}} \rightarrow \text{Casing} + \text{Core} + \text{Grout}$

UNCASED SECTION

$A_{\text{bond}} \rightarrow \text{Core} + \text{Grout}$
MICROPILE DESIGN

Cased Section:
- $A_{cased} \rightarrow$ Casing + Core + Grout

Uncased Section:
- $A_{bond} \rightarrow$ Core + Grout

Casing + Core + Grout

Core

Casing

GROUT

CORE

GROUT

CORE

MICROPILE DESIGN
\[
\frac{P}{A_{\text{cased}}} \leq F_{c \text{ allowable}}
\]

where: \( A_{\text{cased}} \rightarrow \text{Casing + Core + Grout} \)

\[
\frac{P}{A_{\text{bond}}} \leq F_{b \text{ allowable}}
\]

where: \( A_{\text{bond}} \rightarrow \text{Core + Grout} \)
\[ P_{all} \leq A_{cased} \times F_{c \text{ allowable}} \]

\[ A_{cased} \rightarrow \text{Casing + Core + Grout} \]

\[ P_{all} \leq A_{bond} \times F_{b \text{ allowable}} \]

\[ A_{bond} \rightarrow \text{Core + Grout} \]
CODE BASED DESIGN – Most are ASD

**CASED SECTION**

\[ P \leq 0.33(f'_{c\text{ grout}} \times A_{\text{grout}}) + 0.4(F_y \text{ casing} \times A_{\text{casing}} + F_y \text{ core} \times A_{\text{core}}) \]

**UNCASED (a.k.a BOND LENGTH or EMBEDMENT LENGTH)**

\[ P \leq 0.33(f'_{c\text{ grout}} \times A_{\text{grout}}) \times 0.4(F_y \text{ core} \times A_{\text{core}}) \]

\[ F_{y\text{ steel}} \text{ is the smaller of: } 0.4F_y \text{ casing} \]
\[ 0.4F_y \text{ core} \]
\[ 30,000 \text{ psi} \]

Massachusetts State and New York City Codes

\[ 0.33f'_{c\text{ grout}} \leq 1,600 \text{ psi} \]
FHWA - *Micropile Design and Construction Reference Manual*  
(Also ASD)

**CASED SECTION**

\[ P \leq 0.4(f_{c\text{\_grout}} \times A_{\text{grout}}) \times 0.47F_{y\text{\_steel}}(A_{\text{casing}} + A_{\text{core}}) \]

- \( F_{y\text{\_steel}} \) is the smaller of:  
  - \( F_{y\text{\_casing}} \)  
  - \( F_{y\text{\_core}} \)  
  - 87,000 psi  

(Strain Compatibility)

**UNCASED LENGTH**

\[ P \leq 0.4(f_{c\text{\_grout}} \times A_{\text{grout}}) \times 0.47(F_{y\text{\_steel}} \times A_{\text{core}}) \]
AASHTO — Design Specifications (LRFD)

CASED SECTION

\[ \phi P \leq 0.85 \phi [(0.85 f'_{c, grout} \times A_{grout}) + F_{y, steel} (A_{casing} + A_{core})] \]

*\( F_{y, steel} \) is the smaller of:
  * \( F_{y, casing} \)
  * \( F_{y, core} \)
  * 87,000 psi

*\( \Phi = 0.7 \) for compression

UNCASED LENGTH

\[ \phi P \leq 0.85 \phi [(0.85 f'_{c, grout} \times A_{grout}) + (F_{y, steel} \times A_{core})] \]
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GEOTEchnical CONSultants, Inc
Reticulate / Reticulated?

Adjective - *Re-tic-u-late [Ri-tik-yuh-lit]*

1. Netted; Covered With a Network.
2. Netlike.

Verb - *Re-tic-u-lat-ed [Ri-tik-yuh-leyt]*
(Used with an object)

3. To Form Into a Network.
Pali Radicé  [Italian trans. “Root Piles”]

Reticulated Root Piles: a network of micropiles
NETWORKED MICROPILES: TYPE 2 (<1%)  
(Reticulated Root Piles)
VERTICAL CROSS-SECTION

P.C.

AREA TO BE EXCAVATED

BOTTOM OF THE EXCAVATION

~20 ft.

Sand/gravels formation with boulders and old masonries.
FOR HEIGHT ~ 20

NAIL LENGTH ~ 15’ ea.
12 NAILS x 15’ = 180’ OF DRILLING

OR A NAIL DENSITY OF
~ 10’ OF DRILLING PER LF. OF WALL
PILE LENGTH ~25’ ea.
42 PILES x 25’ = 1050’ OF DRILLING

PILE DENSITY ~50’ OF DRILLING PER L.F. OF WALL

NAIL LENGTH ~15’ ea.
12 NAILS x 15’ = 180’ OF DRILLING

NAIL DENSITY: ~10’ DRILLING PER L.F. OF WALL

20’ HIGH SOIL NAIL WALL

~20’ ft.

~21 ft. Long

VERTICAL CROSS-SECTION

A-Row  B-Row  C-Row  D-Row

WALL

End 4
2006 Restored to 1855 Appearance (Completed 2012)

Cost $9.5 Million
SECANT PILES

NOTE: REFER TO NOTE A.4 FOR FURTHER DETAILS

PLAN NOT TO SCALE
African Meetinghouse

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FUTURE OF TYPE 2 NETWORKED MICROPILES??
(Reticulated Root Piles)

- DESIGN BASED ON PREVIOUS PROJECTS
- PILE DENSITY TOO GREAT-TOO COSTLY
- NO ACCEPTED DESIGN METHOD
- NO STANDARDS OF ANY KIND
- 3-D FINITE ELEMENT ANALYSIS???
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