



Design and Construction of Micropiles Supporting Taxiway Bridge

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I-5110, R-2413A and R-2413B I-73 Design Build Greensboro, North Carolina



PROJECT LOCATION



The I-73 Project Consists of:

- Approximately 10 miles of roadway
- (1) Water Crossing Bridge Structure (Designed By NCDOT)
- (10) Grade Crossing Bridge Structures
- (6) Box Culverts
- **(1) Taxiway Bridge over I-73**

TAXIWAY BRIDGE



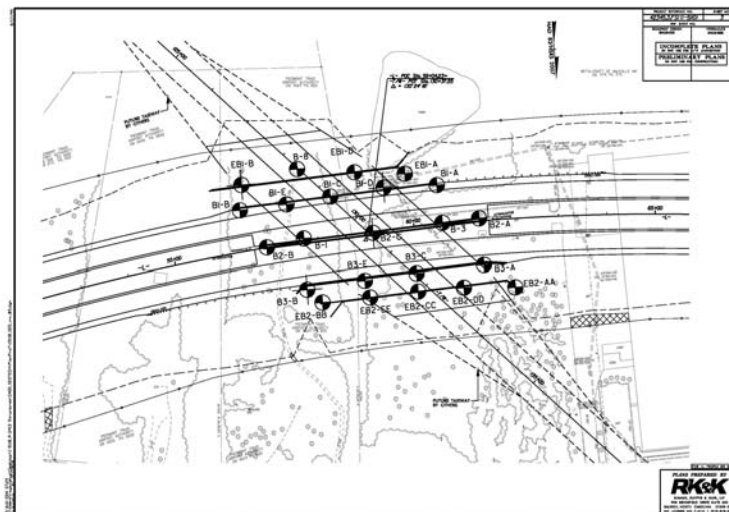
TAXIWAY BRIDGE



Taxiway Bridge Information

- Four Span Bridge
- Concrete Girders
- Skew angle of Bents
130°30'.00"
- Bents Approx. 400 feet Long.
- Bridge Will Cross Approx.
50 Feet of Cut.
- I-73 Elev. = Approx. 860 Ft.
- Bottom of Pile Cap = Approx.
856 Ft
- Aircraft Live Load of Approx.
1.25 million pounds.
- Braking Forces 70 Percent of
Live Load

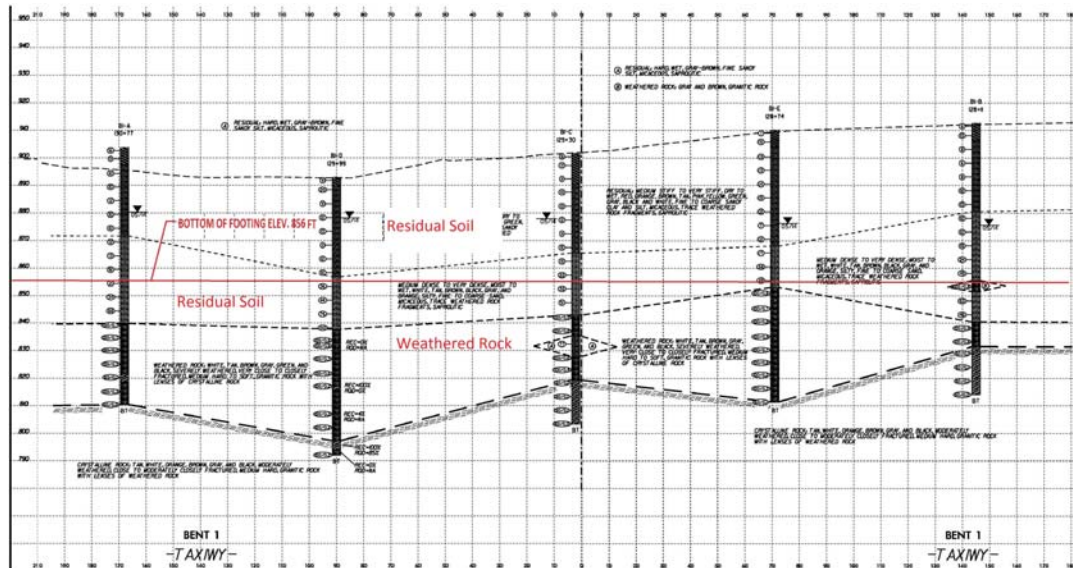
Boring Location Plan



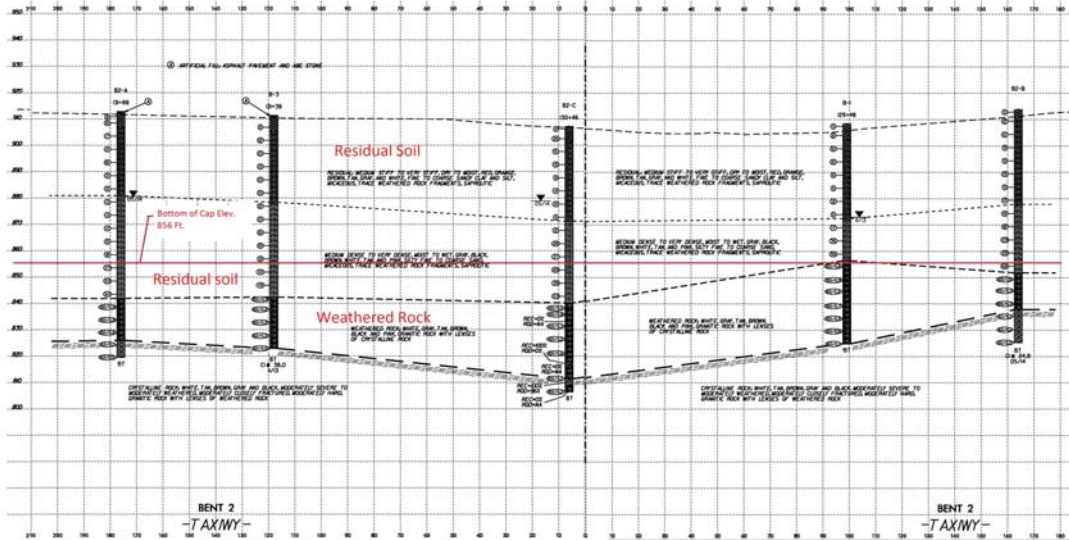
Summary of General Subsurface Conditions

- Subsurface Exploration by Amec Foster Wheeler
- Summary
 - Deeply weathered soil profile
 - Up to 50 to 70 feet of residual micaceous sandy silts and silty sands
 - Weathered Granite
 - Crystalline Rock: Granite

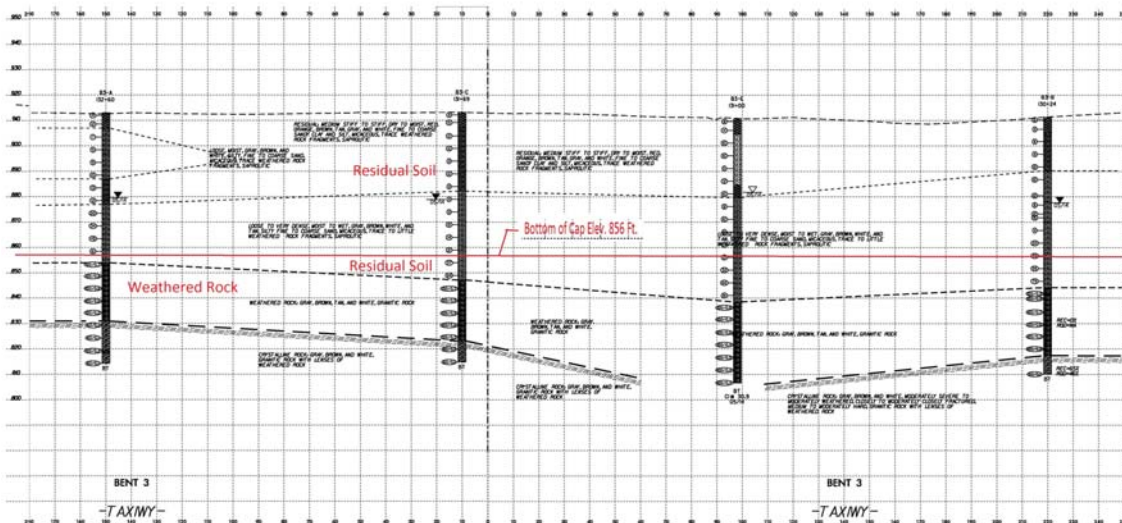
Soil Profile At Bent No. 1



Soil Profile At Bent No. 2



Soil Profile At Bent No. 3



Foundation Type Considerations

- Factors to consider for foundation selection
 1. Structural Loads have compression, tension and lateral loads
 2. Weathered rock near bottom of pile cap elevation
 3. Design Groundwater close to finished grade
 4. Significant number of piles required due to heavy aircraft loads
- Possible Foundation Types
 1. Driven Piles
 2. Drilled Piers
 3. Micropiles

Final Foundation Type

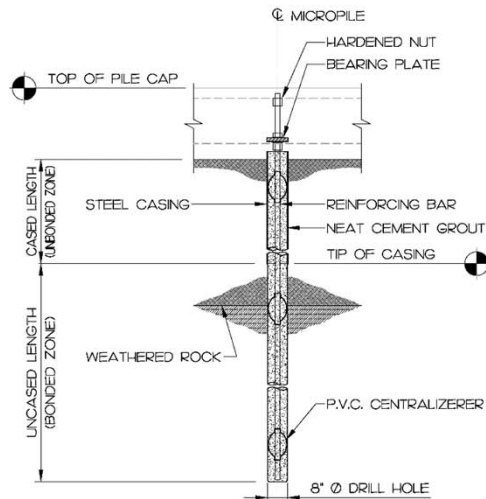
- End Bents – Driven Steel HP 14x73 Piles
 - Lateral & Uplift loads resisted by battered piles & straps attached to bent cap.
- Interior Bents – Micropiles
 - Selected due to:
 - Minimal soil thickness above weathered rock
 - Ability to resist significant uplift
 - Cost effectiveness

Amec Foster Wheeler

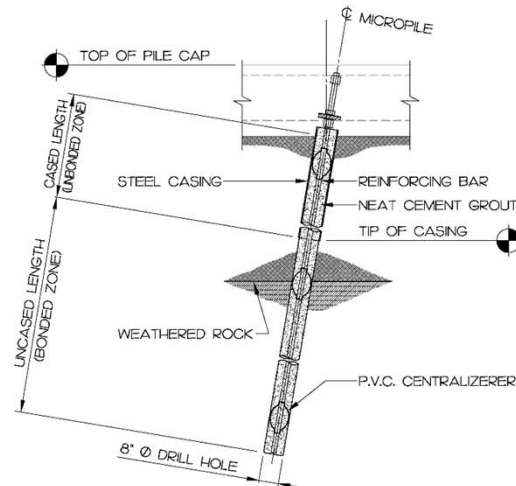
- Received design reactions at the top of pile cap from Structural Engineer (RK&K)
- Performed Pile Group Analysis to determine Micropile Design Loads:
 - Axial (compression and uplift)
 - Shear
 - Moment
- Provided Project Special Provisions to Micropile Designer



MICROPILE DETAILS



PLUMB MICROPILE DETAIL



BATTERED MICROPILE DETAIL

MICROPILE DESIGN

QUANTITIES:

- (3) INTERIOR BENTS 1, 2 & 3: (734) MICROPILES
 - BENT 1 & 3: (293) MICROPILES / BENT
 - 'FACTORED' DESIGN LOADS:
 - COMPRESSION (P_{UC}): 283 K
 - TENSION (P_{UT}): 137 K
 - MOMENT (M_U): 420 IN-K @ 3.67' BELOW BOTT. OF CAP
 - BENT 2: (148) MICROPILES
 - 'FACTORED' DESIGN LOADS:
 - COMPRESSION (P_{UC}): 272 K
 - TENSION (P_{UT}): 0 K
 - MOMENT (M_U): 420 IN-K @ 3.67' BELOW BOTT. OF CAP

MICROPILE DESIGN

CRITERIA:

- AASHTO PART II, 6TH EDITION, 2012 SECTION 10.9 – MICROPILES (LRFD)
 - STRUCTURAL – FACTORED RESISTANCE
 - COMPRESSION (UNCASED):
 - $R_{CU} = 0.75(0.85[f'_g A_g + f_y A_b])$ 10.9.3.10.2b-1
 - TENSION (UNCASED):
 - $R_{TU} = 0.80(f_y A_b)$ 10.9.3.10.3b-1
 - FLEXURAL (CASED):
 - $M_{R(UNJOINTED)} = 1.0(F_y S_{(UNJOINTED)})$ 6.5.4.2
 - GEOTECHNICAL – FACTORED RESISTANCE
 - $R_s = \phi_{qs} \pi d_b \alpha L_b$ 10.9.3.5.1-1

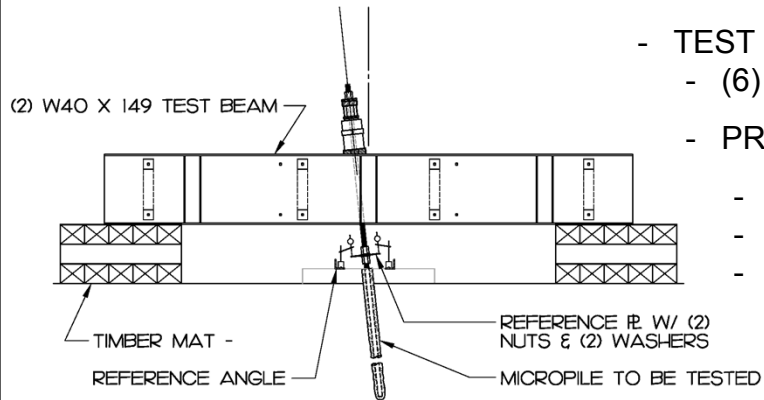
MICROPILE INSTALLATION



EQUIPMENT:

- DRILL RIGS
 - COMMACHIO MC-1200 (32' MAST)
 - COMMACHIO MC-F04.1 (24' MAST)
- AIR COMPRESSORS
 - ATLAS COPCO – 1350 CFM, 350 PSI
- DRILL TOOLING
 - DRILL RODS: 4" ϕ W/ 3-1/2" API
 - MINCON SD6 DOWN HOLE HAMMER
 - DRILL BIT: 8" DTH 'CONVEX FACE'
- GROUT PLANT
 - AD1011 HD COLLOIDAL GROUT MIXER

MICROPILE TESTING



TYPICAL TESTING SETUP

- CRITERIA:
 - ASTM D3689-07 (QUICK TEST)
- TEST QUANTITY:
 - (6) VERIFICATION TEST - 2 / BENT
 - PROOF TEST 5% OF MICROPILES
 - BENT 1 – (13) PROOF TESTS
 - BENT 2 – (12) PROOF TESTS
 - BENT 3 – (12) PROOF TESTS

MICROPILE TESTING



TEST BEAM SETUP



DIAL GAUGE SETUP

