

May 19, 2022

GENERAL REQUIREMENTS FOR MICROPILE TESTING
Smithsonian Institution Building

I. DESCRIPTION OF PROJECT

**Structural
Engineers**

1053 31st Street NW
Washington, DC 20007
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The proposed Revitalize Historic Core (RHC) project for the South Campus of the Smithsonian Institution will include a renovation to the Smithsonian Institution Building (SIB) and the construction of a below-grade structure between SIB and the existing below grade structure to the south of SIB, called the Quad. At SIB, the proposed work involves lowering the existing basement level and adding an additional below-grade level within the footprint of the building. This lower level will align with the new below-grade structure to the south of SIB, known as the SIB Extension. Another primary part of SIB's renovation scope is the installation of a base isolation system just below the new lowered basement level. The installation of this system requires the construction of a moat around SIB where the building interfaces with landscaping and a seismic joint where SIB will interface with the SIB Extension. The moat and seismic joint will allow SIB to move independently of the adjacent landscaping and structure.

To install the additional below-grade level, the seismic moat, and the SIB Extension, an immense amount of foundation work will be required. Due to stringent settlement requirements to protect the historic fabric of the SIB, the geotechnical engineer has recommended that SIB be re-supported on micropile foundations, and the SIB Extension should be constructed on micropile foundations as well. Moreover, at the existing masonry walls and piers at SIB, the micropiles will be used in the temporary condition to provide temporary support of the masonry structure: additional framing will be added at micropile groups to create braced towers that will support the existing structure until the new below-grade structure is installed. In the final condition, the micropiles at SIB will be trimmed down to the top of the pile caps. For both SIB and the SIB Extension, the micropiles will only support gravity loads and will not require any lateral capacity. In some instances, tension loads will be imparted on the micropiles.

Approximately 1200 micropiles will be required for the project: 300 in the SIB Extension and 900 at SIB. Based on the Schematic Design Phase Geotechnical Design Recommendations (dated December 2021) prepared by Haley & Aldrich, the project's geotechnical engineer, the preliminary micropile capacities are the following for a 273 mm (10.75 inch) nominal diameter micropile:

- In compression: 236 kN (53 kips) for a 3.0-meter (10 ft) socket to 712 kN (160 kips) for a 9.1-meter (30 ft) socket
- In tension: 156 kN (35 kips) for a 3.0-meter (10 ft) socket to 476 kN (107 kips) for a 9.1-meter (30 ft) socket in tension.

- To control settlement, the maximum socket length required will be 9.1-meter (30 ft). It should be noted that the total micropile length will be up to 27.4 meter (90 ft) due to the top portion of the micropile being used in the temporary wall support. Ultimately, the top approximately 6.1-meter (20 ft) will be cut down, which will leave the proposed 9.1-meter (30 ft) socket depth plus required embedment to reach the top of the socket (approximately 12.2 m (40 ft) for the 9.1 m (30 ft) socket length and approximately 16.8 m (55 ft) for the 10 3.0 m (10 ft) socket length). Pre-jacking loads into the piles has also been listed as an option to reduce settlements and reduce micropile lengths.
- An outer 305 mm Ø (12"Ø) casing shall be installed from the ground surface to the planned cut-off elevation of the production piles to isolate the upper portion of the micropile from the adjacent overburden soil. The test pile shall then be installed from the ground surface, through the upper casing, to the specified pile tip elevation.

II. EXTENT OF WORK: PRECONSTRUCTION TESTING

A. Preconstruction Testing

1. General: Static pile tests are used to verify installation criteria and pile lengths and to confirm allowable load of piles.
 - a) Furnish 273 mm Ø (10.75 inch Ø) test piles for testing. Perform one test for each proposed socket length: 3.0 m (10 ft), 6.1 m (20 ft), and 9.1 m (30 ft).
 - b) Determination of actual length of piles is based on results of static pile tests.
 - c) Pile tests may require a grouping of three (3) or more piles to test a single pile, depending on testing apparatus and requirements.
2. Pile Tests: Arrange and perform the following pile tests:
 - a) Axial Compressive Static Load Test: ASTM D1143/D1143M, Procedure B, Maintained Test and the following Procedures:
 - (1) Procedure G, Cyclic Loading Test.
 - b) Axial Tension Static Load Test: ASTM D3689
3. Equip each test pile with telltales, strain gauges, or an alternative measure as proposed by the contractor to measure load transferred to the bond zone. At least 200% of the design load should be transferred to the bond zone during the load test.
4. Provide pile reaction frame, anchor piles, equipment, and instrumentation with enough reaction capacity to perform tests. Notify Architect at least 48 hours in advance of performing tests. On completion of testing, remove

testing structure, anchor piles (if possible; otherwise, cut down), equipment, and instrumentation.

- a) Pile testing shall not begin until concrete design compressive strength has been achieved. Confirm concrete design compressive strength through testing.
 - b) Number of Test Piles: Three piles (see below for reference to “Micropile Testing Plan”, which shows recommended locations).
5. Drill test piles at locations indicated to the minimum tip elevation indicated. Use test piles identical to those required for Project and drill with appropriate pile-drilling equipment to be used in installing permanent piles.
- a) Pile Design Load: shall be approximately 200% of the maximum pile design load:
 - (1) 3.0 m (10 ft) Socket Length Pile Design Load: 471 kN (106 kips)
 - (2) 6.1 m (20 ft) Socket Length Pile Design Load: 947 kN (213 kips)
 - (3) 9.1 m (30 ft) Socket Length Pile Design Load: 1423 kN (320 kips)
6. Approval Criteria: Allowable load shall be the load acting on the test pile when the lesser of the following criteria are met, divided by a factor of safety of 2:
- a) Net settlement, after deducting rebound, of not more than 0.5 inch.
 - b) Total settlement exceeds the pile elastic compression by 0.15 inch (4 mm), plus 1.0 percent of the tip diagonal dimension.
 - c) A plunging failure or sharp break in the load settlement curve.
7. Test Pile-Installation Records: Prepare installation records for each test pile, compiled and attested to by a qualified professional engineer. Include same data as required for installation records of permanent piles.
8. Test piles that comply with requirements, including location tolerances, may be used on Project.

B. Extent of Exploration

1. The “Micropile Testing Plan” (attached) together with the items under this heading is to be taken as the suggested scope of tests required. Coordinate final, exact location of borings with site conditions (existing buildings, underground utilities, etc.) and notify EOR of any location changes if required. Note: the locations shown are schematic and may be adjusted according to owner or contractor comments.

III. PERFORMANCE OF WORK

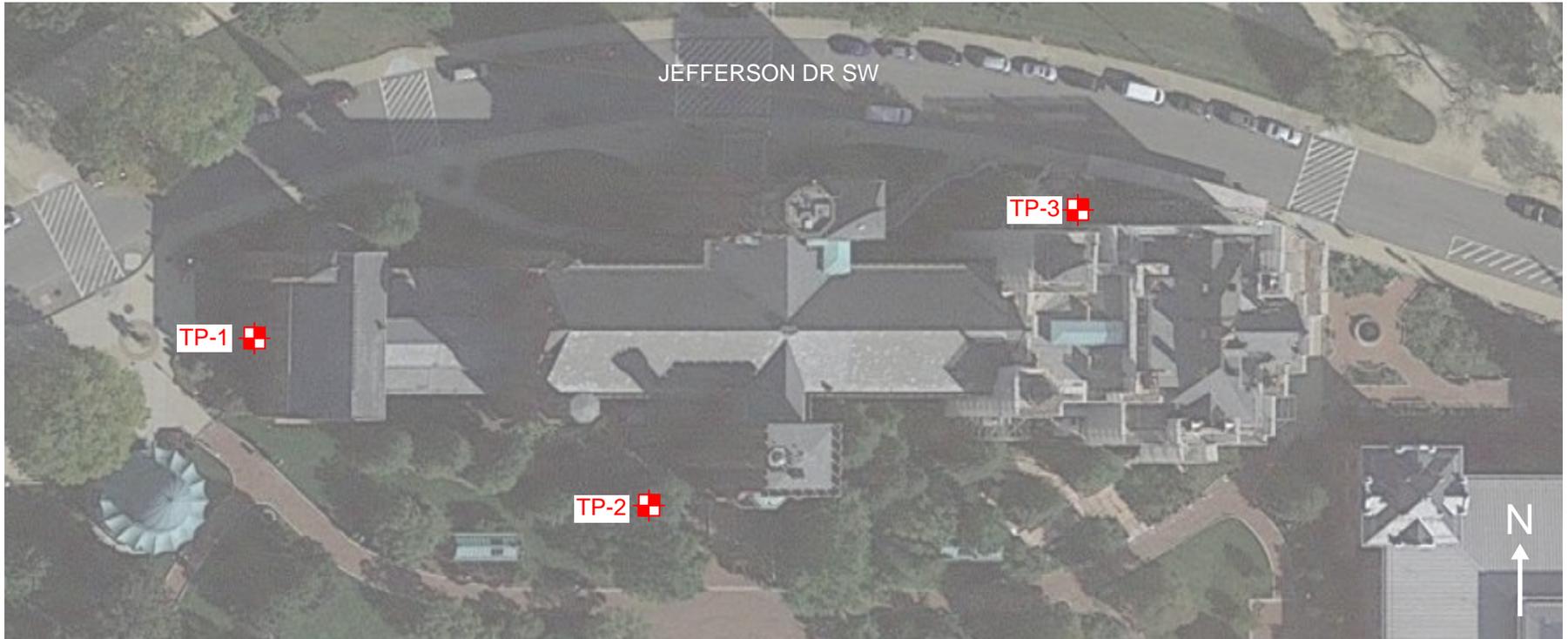
- A. The Contractor shall perform the work in a professional and expeditious manner and shall submit the required reports by [DATE] or provide an alternate schedule with the proposal. The Consultant shall coordinate its work with all existing site restraints, such as buildings, utilities, underground construction, governing agencies etc. All testing shall be according to ASTM Standards. Obtain owners approval for access to the site.
- B. The Contractor shall maintain professional liability insurance, general liability insurance, and workmen's compensation insurance in amounts satisfactory to the owner. A certificate indicating insurance carrier and limits shall accompany the cost proposal.

IV. COST PROPOSALS

- A. Provide a "maximum not to exceed cost" to include the cost of all testing, supervision, analyses, and complete report containing all required information. Unit prices shall be provided for each item of testing and inspection and the actual final cost will be based on the actual units used up to the not to exceed limit.

V. SUBMITTALS

- A. Submit an electronic copy of an engineering report prepared by a registered Professional Engineer, with brief but conclusive statements and recommendations covering all the items specified under Paragraph II, "EXTENT OF WORK." The report shall also include:
 - 1. Description of micropile testing, a plot showing the actual locations of the testing, photographs and section details of test micropiles.
 - 2. Refined recommendations for the micropiles based on testing, to be considered in design and construction.
 - 3. Information of Test Piles Including:
 - a) Pile location.
 - b) Pile dimensions.
 - c) Ground elevation.
 - d) Elevation of tips after drilling.
 - e) Final tip and cutoff elevations of piles after drilling pile group.
 - f) Elevation of splices.
 - g) Type, make, and model of drill rig.
 - h) Pile-drilling start and finish times, and total driving time.
 - i) Time, pile-tip elevation, and reason for interruptions.
 - j) Pile deviations from location and plumb.
 - k) Unusual occurrences during pile drilling.



NOTES:

1. PILE TESTING LOCATIONS SHOWN ABOVE ARE SCHEMATIC AND MAY BE ADJUSTED. NOTIFY EOR IF LOCATIONS NEED TO CHANGE.
2. TP-2 SHALL BE LOCATED TO AVOID ALL BELOW-GRADE STRUCTURES.
3. TP-1: TEST 3.0 M (10.0 FT) SOCKET LENGTH
4. TP-2: TEST 6.1 M (20.0 FT) SOCKET LENGTH
5. TP-3: TEST 9.1 M (30.0 FT) SOCKET LENGTH
6. SEE SHEET 02 FOR SCHEMATIC SHOWING DIFFERENT SOCKET LENGTH PILES.
7. INFORMATION SHOWN IS IN COORDINATION WITH THE REQUIREMENTS OUTLINED BY THE GEOTECHNICAL ENGINEER OF RECORD.

Date: 5/19/2022	Title: MICROPILE TESTING PLAN	
Scale: NTS		
Reference: GOOGLE MAPS	Job Number: W3769	 <p>1053 31st Street NW, Washington, DC 20007 202 333 6230</p>
01	Job Title: REVITALIZE HISTORIC CORE	

EXISTING GRADE
8.93 m (29'-4")

305 MM Ø (12"Ø) CASING TO ISOLATE PILE FROM SOIL ABOVE ELEVATION AT WHICH THE PILES WILL ULTIMATELY BE CUT DOWN

B1 LEVEL
2.67 m (8'-9-1/4")

PILES WILL ULTIMATELY BE CUT DOWN TO THIS LEVEL (FOR FINAL CONDITION)

T.O. 30-FT SOCKET LENGTH
8.84 m (-29'-0")

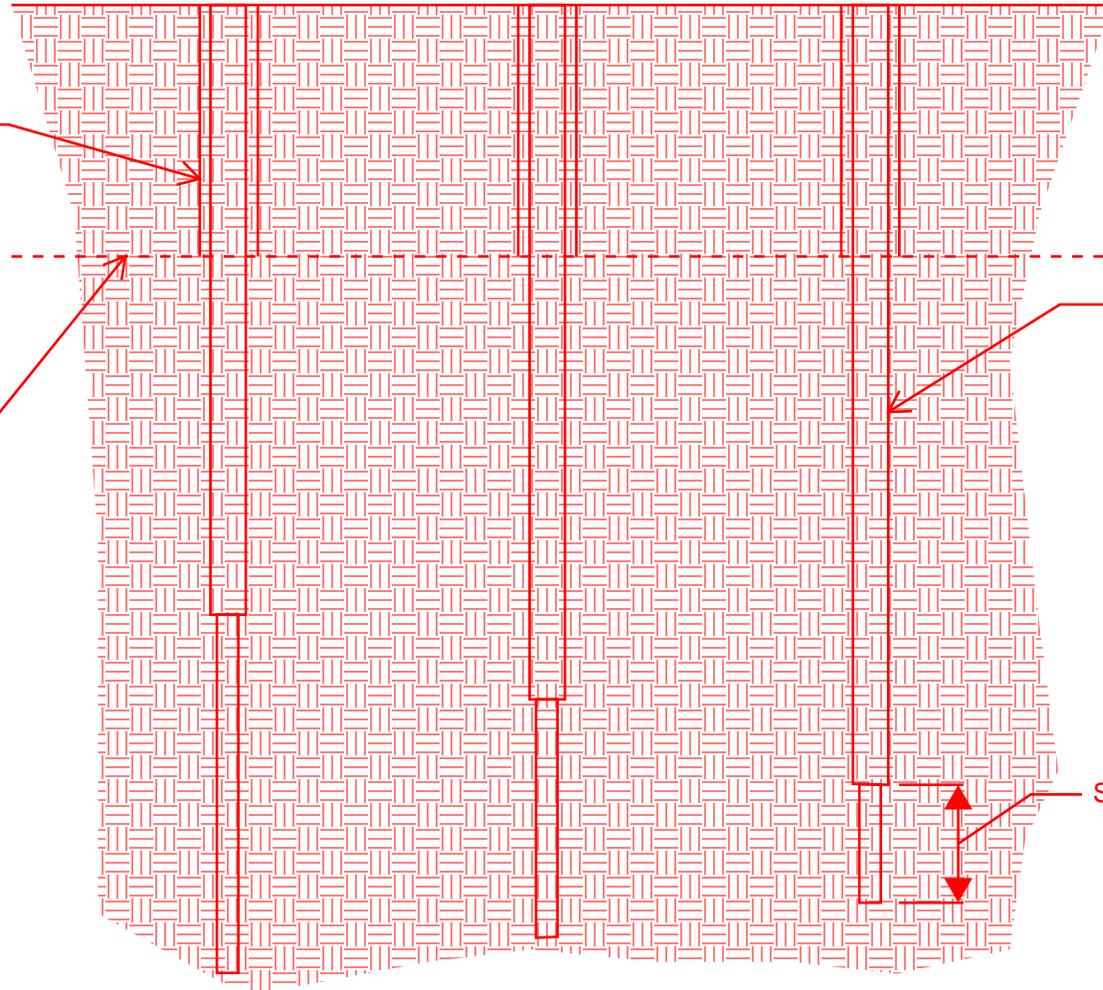
T.O. 20-FT SOCKET LENGTH
11.00 m (-36'-0")

T.O. 10-FT SOCKET LENGTH
13.11 m (-43'-0")

B.O. 10-FT SOCKET LENGTH
16.15 m (-53'-0")

B.O. 20-FT SOCKET LENGTH
17.10 m (-56'-0")

B.O. 30-FT SOCKET LENGTH
18.00 m (-59'-0")



NOTE: INFORMATION SHOWN IS IN COORDINATION WITH THE REQUIREMENTS OUTLINED BY THE GEOTECHNICAL ENGINEER OF RECORD.

Date: 5/19/2022

Scale: NTS

Reference: N/A

Title:

SCHEMATIC SECTION OF PILE LENGTHS

Job Number: W3769

Job Title:

REVITALIZE HISTORIC CORE

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