COMMONWEALTH OF KENTUCKY
TRANSPORTATION CABINET
Frankfort, Kentucky 40622
www.transportation.ky.gov/

Matthew G. Bevin
Governor

Greg Thomas
Secretary

July 23, 2019

CALL NO. 105
CONTRACT ID NO. 191041
ADDENDUM # 2

Subject: MASON COUNTY, STP BRO 5462(028)
Letting July 26, 2019

(1) Revised – Cover Page – Page 1 of 105
(2) Revised – Page 4 of 105
(3) Revised - Special Notes – Pages 21-32(a) of 105
(4) Revised – Proposal Bid Items – Pages 104-105 of 105
(5) Added - Geotechnical Engineering Structure Foundation Report Addendum – Pages 1-73 of 73
(6) Revised – Plan Sheets – S1, S21, S22, and S23

Proposal revisions are available at http://transportation.ky.gov/Construction-Procurement/.

If you have any questions, please contact us at 502-564-3500.

Sincerely,

Rachel Mills

Rachel Mills, P.E.
Director
Division of Construction Procurement

RM:mr
Enclosures

CALL NO. 105

CONTRACT ID. 191041

MASON COUNTY

FED/STATE PROJECT NUMBER STP BRO 5462(028)

DESCRIPTION US-68

WORK TYPE BRIDGE REPLACEMENT

PRIMARY COMPLETION DATE 05/31/2021

LETTING DATE: July 26,2019

Sealed Bids will be received electronically through the Bid Express bidding service until 10:00 AM EASTERN DAYLIGHT TIME July 26,2019. Bids will be publicly announced at 10:00 AM EASTERN DAYLIGHT TIME.

PLANS AVAILABLE FOR THIS PROJECT.

DBE CERTIFICATION REQUIRED - 0%

REQUIRED BID PROPOSAL GUARANTY: Not less than 5% of the total bid.

ADMINISTRATIVE DISTRICT - 09

CONTRACT ID - 191041

STP BRO 5462(028)

COUNTY - MASON

PCN - DE08100681941
STP BRO 5462(028)

US-68 REPLACE BRIDGE ON US-68 OVER LAWRENCE CREEK 0.13 MILE SOUTHWEST OF KY-3056, A DISTANCE OF 0.15 MILES.BRIDGE REPLACEMENT SYP NO. 09-01095.00.

GEOGRAPHIC COORDINATES LATITUDE 38:40:18.00 LONGITUDE 83:47:56.00

COMPLETION DATE(S):

COMPLETED BY 05/31/2021 APPLIES TO ENTIRE CONTRACT

SPECIAL NOTE FOR MICROPILES
US 68 BRIDGE OVER LAWRENCE CREEK
MASON COUNTY ITEM NO. 9-1095.00

1.0 DESCRIPTION. This work shall consist of constructing micropiles as shown on the Plans, accepted working drawings and approved shop drawings and as specified herein. The micropile specialty Contractor is responsible for furnishing all required working\shop drawings, materials, products, accessories, tools, equipment, services, transportation, labor and supervision, and manufacturing techniques required for installation and testing of micropiles and pile top attachments for this project. The micropile load capacities shall be verified by verification and proof load testing as required and must meet the test acceptance criteria specified herein. Section references herein are to the Department's 2019 Standard Specifications for Road and Bridge Construction.

2.0 MATERIALS.

2.1 Admixtures for Grout. Conform to Section 802. Admixtures that control bleed, improve flowability, reduce water content, and retard set may be used in the grout, subject to the review and acceptance of the Engineer. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer's recommendations. Accelerators are not permitted.

2.2 Cement. Conform to Section 801. Use types I, II, III or V

2.3 Centralizers and Spacers. Centralizers and spacers shall be fabricated from schedule 40 PVC pipe or tube, steel, or material non-detrimental to the reinforcing steel. Wood shall not be used.

2.4 Epoxy Coating. Conform to subsection 811.10. Bend test requirements are waived. Bearing plates and nuts encased in the pile concrete footing need not be epoxy coated unless the footing reinforcement is epoxy coated.

2.5 Fine Aggregate. If sand / cement grout is used, sand shall conform to Section 804.

2.6 Grout. Neat cement or sand / cement mixture with a minimum 28-day compressive strength of 5,000 psi per AASHTO T106/ASTM C109, unless shown otherwise on the Plans.

2.7 Permanent Casing. Permanent steel casing / pipe shall have the diameter and at least minimum wall thickness shown on the Plans. The permanent steel casing / pipe:

1) shall meet the Tensile Requirements of ASTM A252, Grade 3, except the yield strength shall be a minimum of 80 ksi, unless shown otherwise on the plans.
2) may be new "Structural Grade" (a.k.a. "Mill Secondary") steel pipe meeting above but without Mill Certification, free from defects (dents, cracks, tears) and with two coupon tests per truckload delivered to the fabricator.

For permanent casing / pipe that will be welded for structural purposes, the following material conditions apply:

1) The carbon equivalency (CE) as defined in AWS D1.1, Section X15.1, shall not exceed 0.45, as demonstrated by mill certifications.
2) The sulfur content shall not exceed 0.05%, as demonstrated by mill certifications.

For permanent casing / pipe that will be shop or field welded, the following fabrication or construction conditions apply:

1) The steel pipe shall not be joined by welded lap splicing.
2) Welded seams and splices shall be complete penetration welds.
3) Partial penetration welds may be restored in conformance with AWS D1.1.
4) The proposed welding procedure certified by a welding specialist shall be submitted for approval.

Where allowed on the Plans, flush threaded casing joints shall be completely shouldered with no stripped threads.

2.8 Plates and Shapes. Structural steel plates and shapes for pile top attachments shall conform to ASTM A709/AASHTO M270, Grade 50.

2.9 Reinforcing Bars. Reinforcing steel shall be deformed bars in accordance with ASTM A615/AASHTO M31, Grade 60 or Grade 75 or ASTM A722/AASHTO M275, Grade 150, as shown on the plans. When a bearing plate and nut are required to be threaded onto the top end of reinforcing bars for the pile top to footing anchorage, the threading may be continuous spiral deformed ribbing provided by the bar deformations (e.g., Dywidag or Williams continuous threadbars) or may be cut into a reinforcing bar. If threads are cut into a reinforcing bar, the next larger bar number designation from that shown on the Plans shall be provided, at no additional cost.

Bar couplers, if required, shall develop the ultimate tensile strength of the bars without evidence of any failure.

2.10 Water. Conform to Section 803.

3.0 CONSTRUCTION.

3.1 Preconstruction.

3.1.1 Experience Requirements. The micropile Contractor shall be experienced in the construction and load testing of micropiles and have successfully constructed at least 5 projects in the last 5 years involving construction totaling at least 100 micropiles of similar size and capacity to those required in these plans and specifications.

The Contractor shall have previous micropile drilling and grouting experience in soil / rock similar to project conditions. The Contractor shall submit construction details, structural details and load test results for at least three previous successful micropile load tests from different projects of similar scope to this project.

The Contractor shall assign an Engineer to supervise the work with experience on at least 3 projects of similar scope to this project completed over the past 5 years. The Contractor shall not use consultants or manufacturers' representatives to satisfy the supervising Engineer requirements of this section. The on-site foremen and drill rig operators shall also have experience on at least 3 projects over the past 5 years installing micropiles of equal or greater capacity than required in these plans and specifications.

At least 45 calendar days before the planned start of micropile construction, the Contractor shall submit electronically in PDF format the completed project reference list and a personnel list. The project reference list shall include a brief project description with the owner's name and current phone number and load test reports. The personnel list shall identify the supervising project Engineer, drill rig operators, and on-site foremen to be assigned to the project. The personnel list shall contain a summary of each individual's experience and be complete enough for the Engineer to determine whether each individual satisfies the required qualifications.

Work shall not be started, nor materials ordered, until the Engineer's written

approval of the Contractor's experience qualifications is given. The Engineer may suspend the Work if the Contractor uses non-approved personnel.

3.1.2 Construction Site Survey. Before bidding the Work, the Contractor shall review the available subsurface information and visit the site to assess the site geometry, equipment access conditions, and location of existing structures and above ground facilities.

The Contractor is responsible for field locating and verifying the location of all utilities shown on the plans prior to starting the Work. Maintain uninterrupted service for those utilities designated to remain in service throughout the Work. Notify the Engineer of any utility locations different from shown on the plans that may require micropile relocations or structure design modification.

Prior to start of any micropile construction activity, the Contractor and Engineer shall jointly inspect the site to observe and document the pre-construction condition of the site, existing structures and facilities.

3.1.3 Construction Submittals. At least 21 calendar days before the planned start of micropile construction, submit to the Engineer, for review and approval, electronically in PDF format the following for the micropile system or systems to be constructed:

1) Detailed step-by-step description of the proposed micropile construction and testing procedures in sufficient detail to allow the Engineer to monitor the construction and quality of the micropiles.
2) Proposed start date and time schedule and micropile installation schedule.
3) Working drawings for micropiles including items that are either not shown on the contract plans or deviations due to specific installation equipment/methods such as final bond zone drill hole diameters; splice types and locations; and reinforcing centralizers and spacers.
4) Shop drawings for all structural steel elements used in the micropiles, including the top bearing plate.
5) If welding of casing is proposed, submit the proposed welding procedure, by a qualified welding specialist.
6) Information on headroom and space requirements for installation equipment that verify the proposed equipment can perform at the site.
7) Sample micropile installation log to be used per Section 3.2.9.
8) Plan describing how surface water, drill flush, and excess waste grout will be controlled and disposed.
9) Method for measuring and determining vertical and horizontal alignment during construction. Some form of hole telemetry shall be used to measure the vertical alignment of each micropile.
10) Certified mill test reports for the reinforcing steel or coupon test results for permanent casing without mill certification. The ultimate strength, yield strength, elongation, and material properties composition shall be included. For API N-80 pipe casing, coupon test results may be submitted in lieu of mill certification.
11) Proposed Grouting Plan. The grouting plan shall include complete descriptions, details, and supporting calculations for the following:
    a) Grout mix design and type of materials to be used in the grout, including certified test data and trial batch reports.
    b) Methods and equipment for accurately monitoring and recording the grout depth, grout volume and grout pressure as the grout is being placed.

c) Grouting rate calculations, when requested by the Engineer. The calculations shall be based on the initial pump pressures or static head on the grout and losses throughout the placing system, including anticipated head of drilling fluid (if applicable) to be displaced.
d) Estimated curing time for grout to achieve specified strength. Previous test results for the proposed grout mix completed within one year of the start of grouting may be submitted for initial verification and acceptance and start of production work. During production, grout shall be tested in accordance with Section 3.2.8.
e) Procedure and equipment for Contractor monitoring of grout quality.

12) Detailed plans for the proposed micropile load testing method. This shall include all drawings, details, and structural design calculations necessary to clearly describe the proposed test method, reaction load system capacity and equipment setup, types and accuracy of apparatus to be used for applying and measuring the test loads and pile top movements in accordance with Section 3.3, Pile Load Tests.
13) Calibration reports and data for each test jack, pressure gauge and master pressure gauge and electronic load cell to be used. The calibration tests shall have been performed by an independent testing laboratory, and tests shall have been performed within 90 calendar days of the date submitted. Testing shall not commence until the Engineer has reviewed and accepted the jack, pressure gauge, master pressure gauge and electronic load cell calibration data.

All drawings and calculations shall be signed and sealed by the Contractor's Professional Engineer licensed in the State of Kentucky.

Work shall not begin until the construction submittals have been received, reviewed, and accepted in writing by the Engineer. Changes or deviations from the approved submittals must be re-submitted for approval.

3.1.4 Micropile Pre-Construction Meeting. A micropile pre-construction meeting will be scheduled by the Engineer and held prior to the start of micropile construction. The Engineer, prime Contractor, micropile specialty Contractor, and excavation contractor shall attend the meeting. Attendance is mandatory. The pre-construction meeting will be conducted to clarify the construction requirements for the work, to coordinate the construction schedule and activities, and to identify contractual relationships and delineation of responsibilities amongst the prime Contractor and the various Subcontractors—specifically those pertaining to excavation for micropile structures, anticipated subsurface conditions, micropile installation and testing, micropile structure survey control and site drainage control.

3.2 General Construction.

3.2.1 Site Drainage Control. The Contractor shall control and properly dispose of drill flush and construction related waste, including excess grout, in accordance with the standard specifications and all applicable local codes and regulations. Provide positive control and discharge of all surface water that will affect construction of the micropile installation.

3.2.2 Excavation. Coordinate the work and the excavation so the micropiles are safely constructed. Perform the micropile construction and related excavation in accordance with the Plans and approved submittals. No excavations steeper than those specified herein or shown on the Plans will be made above or below the micropile

structure locations without written approval of the Engineer.

3.2.3 Micropile Allowable Construction Tolerances. Centerline of piling shall not be more than 3 inches from indicated plan location. Pile shall be plumb within 1 percent of total-length plan alignment. Top elevation of pile shall be plus 1 inch or minus 2 inches maximum from vertical elevation indicated. Centerline of reinforcing steel shall not be more than 3/4 inch from indicated location.

3.2.4 Micropile Installation. Unless shown otherwise on the Plans, the micropile Contractor shall propose the drilling method, the grouting procedure, and the grouting pressure used for the installation of the micropiles, subject to approval by the Engineer. Final approval of this proposed method is contingent upon the satisfactory results of the verification load tests. The micropile Contractor shall also determine the final bond zone drill hole diameter for the selected drilling equipment, and central reinforcing sizing for test piles. The final drill hole diameter shall not be less than that shown on the Plans. The micropile Contractor is also responsible for estimating the grout take. There will be no extra payment for grout overruns.

3.2.5 Drilling. The drilling equipment and methods shall be suitable for drilling through the conditions to be encountered, without causing damage to any overlying or adjacent structures or services. Upon drilling completion ensure drill cuttings and/or other loose debris is removed from the bottom of the hole. The drill hole must be open along its full length to at least the design minimum drill hole diameter prior to placing grout and reinforcement. Develop methods of stabilizing borehole that do not have a deleterious effect on the grout-to-ground bond development. All installation techniques shall be determined and scheduled such that there will be no interconnection or damage to piles in which grout has not achieved final set. Use of drilling fluid containing bentonite is not allowed.

3.2.6 Hole Telemetry. Upon advancing the micropile to the bedrock surface and prior to advancing the micropile into the bond zone, the Contractor shall measure the vertical alignment of the cased section of each micropile using a method of hole telemetry that is approved by the Department. Where the micropile is determined to be out of tolerance, the out-of-tolerance hole shall be grouted and the micropile redrilled. There will be no extra payment for grouting and redrilling out-of-tolerance micropiles, except if the existing H-piles cause the micropile to deviate from the acceptable vertical tolerances.

3.2.7 Pipe Casing and Reinforcing Bar Placement and Splicing. Reinforcement shall be placed into the drill hole prior to grouting. Reinforcement surface shall be free of deleterious substances, such as soil, mud, grease or oil that might contaminate the grout or coat the reinforcement and impair bond.

The Contractor shall check pile top elevations and adjust all installed micropiles to the planned elevations.

Centralizers and spacers shall be provided at 10-foot centers maximum spacing. The upper and lower most centralizer shall be located a maximum of 2 feet from the top and bottom of the micropile. Centralizers and spacers shall permit the free flow of grout without misalignment of the reinforcing bar(s) and permanent casing. The central reinforcement bars with centralizers shall be lowered into the stabilized drillhole and set. The reinforcing steel shall be inserted into the drill hole to the desired depth without difficulty. Partially inserted reinforcing bars shall not be driven or forced into the hole.

Contractor shall redrill and reinsert reinforcing steel when necessary to facilitate insertion.

Lengths of casing and reinforcing bars to be spliced shall be secured in proper alignment and in a manner to avoid eccentricity or angle between the axes of the two lengths to be spliced. Splices and threaded joints shall meet the requirements of Materials Section 2.0. Threaded pipe casing joints shall be located at least two casing diameters (OD) from a splice in any reinforcing bar. When multiple bars are used, the bar splices shall be staggered at least 1 foot.

3.2.8 Grouting. Micropiles shall be fully grouted the same day the load transfer bond length is drilled. The grouting equipment used shall produce a grout free of lumps and undispersed cement. The Contractor shall have means and methods of measuring the grout quantity and pumping pressure during the grouting operations. The grout pump shall be equipped with a pressure gauge to monitor grout pressures. A second pressure gauge shall be placed at the point of injection into the pile top. The pressure gauges shall be capable of measuring pressures of at least 150 psi or twice the actual grout pressures used, whichever is greater. The grout shall be kept in constant agitation prior to pumping. Grout shall be placed within one hour of mixing. The grouting equipment shall be sized to enable each pile to be grouted in one continuous operation.

Tremie grout from the lowest point of the drill hole until uncontaminated grout flows from the top of the pile. The grout may be pumped through grout tubes, casing, hollow-stem augers, or drill rods. All grouting operations, including tremie grout pumping, casing extraction and subsequent pressure grouting operations, must ensure complete continuity of the grout column. The grout pressures and grout takes shall be controlled to prevent excessive heave or fracturing of rock or soil formations. Upon completion of grouting, the grout tube may remain in the hole, but must be filled with grout.

Grout within the micropiles shall be allowed to attain the required design strength prior to being loaded.

If the Contractor elects to use a post-grouting system, Working Drawings and details shall be submitted to the Engineer for review in accordance with Section 3.1.3, Construction Submittals.

3.2.9 Grout Testing. Grout within the micropile verification and proof test piles shall attain the required minimum 28-day compressive strength shown on the Plans prior to load testing. Previous test results for the proposed grout mix completed within one year of the start of work may be submitted for initial verification of the required compressive strengths for installation of pre-production verification test piles. During production, micropile grout shall be tested by the Contractor for compressive strength in accordance with AASHTO T106/ASTM C109 at a frequency of no less than one set of three 2-inch grout cubes from each grout plant each day of operation or per every 10 piles, whichever occurs more frequently. At a minimum, compressive strength tests shall be taken at 3, 7 and 28 days after grouting. For each time interval, the compressive strength shall be the average of the set of 3 cubes tested.

Grout consistency, as measured by grout density, shall be determined by the Contractor per ASTM C188/AASHTO T133 or API RP-13B-1 at a frequency of at least one test per pile, conducted just prior to start of pile grouting. The Baroid Mud Balance used in accordance with API RP-13B-1 is an approved device for determining the grout density of neat cement grout.

Grout samples shall be taken directly from the grout plant. Provide grout cube compressive strength and grout density test results to the Engineer within 24 hours of

testing.

3.2.10 Micropile Installation Records. Contractor shall prepare and submit to the Engineer full-length installation records for each micropile installed. The records shall be submitted within one work shift after that pile installation is completed. The records shall include the following minimum information:

1) Reference number of micropile
2) Date and time begun and completed for both drilling and grouting
3) Equipment used and operator
4) Factored Design load (compression and/or tension)
5) Micropile drilling logs indicating:
    a) penetration rates (feet depth per minute)
    b) downpressure
    c) materials encountered, including flush return description
    d) elevation of obstructions, if any
    e) elevation of karst, solutions features or voids, if any
    f) ground elevation
    g) elevation of groundwater or seepage encountered
    h) final tip elevation
    i) casing length above and below bottom of footing
    j) plunge length
    k) bond length
    l) total micropile length
    m) description of unusual installation behavior or conditions
6) grouting rates (cubic yards per feet depth)
7) grouting pressures (pounds per square inch per feet depth)
8) total grout quantities (cubic yards)
9) casing materials and dimensions
10) reinforcing material, size and lengths, and
11) compliance with tolerances.

The data shall be recorded on a micropile installation log. A separate log shall be provided for each micropile.

3.3 Pile Load Tests. Perform verification and proof testing of piles at the locations specified herein or designated by the Engineer based on the design axial load(s) as shown in the Plans. Perform tension load testing in accordance with ASTM D3689, except as modified herein. The load test shall be performed in tension regardless of load direction.

3.3.1 Testing Equipment and Data Recording. Testing equipment shall include dial gauges, dial gauge support, jack and pressure gauge, electronic load cell, and a reaction frame. The load cell is required only for the creep test portion of the verification test. The contractor shall provide a description of test setup and jack, pressure gauge and load cell calibration curves in accordance with the Submittals Section.

Design the testing reaction frame to be sufficiently rigid and of adequate dimensions such that excessive deformation of the testing equipment does not occur. Align the jack, bearing plates, and stressing anchorage such that unloading and repositioning of the equipment will not be required during the test.

Apply and measure the test load with a hydraulic jack and pressure gauge, or load cell when present. The jack and pressure gauge shall have a pressure range not exceeding twice the anticipated maximum test pressure. Jack ram travel shall be sufficient to allow

the test to be done without resetting the equipment. Monitor the creep test load hold during verification tests with both the pressure gauge and the electronic load cell. Use the load cell to accurately maintain a constant load hold during the creep test load hold increment of the verification test.

Measure the pile top movement with a dial gauge capable of measuring to 0.001 inch. The dial gauge shall have a travel sufficient to allow the test to be done without having to reset the gauge. Visually align the gauge to be parallel with the axis of the micropile and support the gauge independently from the jack, pile or reaction frame. Use a minimum of two dial gauges when the test setup requires reaction against the ground or single reaction piles on each side of the test pile.

Production piles may be utilized as reaction piles for proof tests. The Contractor is responsible for any modifications to the production piles to facilitate testing. No additional payment will be made to repair or replace damaged production piles utilized as reaction piles. Production piles may not be utilized as reaction piles for verification tests.

3.3.2 Verification Tests. Perform pre-production verification pile load testing on sacrificial (non-production) test piles, unless noted otherwise in the Plans, to verify the design of the pile system and the construction methods proposed prior to installing any production piles. Sacrificial verification test piles shall be constructed in conformance with the Plans and the accepted Working Drawings. The number and approximate locations of verification test piles shall be as shown on the Plans.

Verification load tests shall be performed to verify that the Contractor installed micropiles will meet the required compression and tension load capacities and load test acceptance criteria and to verify that the length of the micropile bond zone is adequate. Provide the Engineer a written report confirming micropile geometry, construction, testing details, and verification test results within 7 working days following completion of the pre-production verification load tests. The micropile verification load test results must verify the design and installation methods,and be reviewed and accepted by the Engineer prior to beginning installation of production micropiles.

The drilling-and-grouting method, casing length and outside diameter, reinforcing bar lengths, and depth of embedment for the verification test pile(s) shall be identical to those specified for the production piles at the given locations. The verification test micropile structural steel sections and reinforcing shall be sized to safely resist the maximum test load.

The maximum verification and proof test loads applied to the micropile shall not exceed 80 percent of the structural capacity of the micropile structural elements, to include steel yield in tension, steel yield or buckling in compression, or grout crushing in compression. Any required increase in strength of the verification test pile elements above the strength required for the production piles shall be provided for in the contractor’s bid price.

The jack shall be positioned at the beginning of the test such that unloading and repositioning during the test will not be required.

3.3.3 Verification Test Loading Schedule. Test verification piles designated for tension load testing to a maximum test load equal to the required nominal geotechnical resistance, or Nominal Resistance (NR) shown on the Plans. NR is typically calculated by dividing the Factored Design Load (FDL) for the micropile by the Geotechnical Resistance Factor (Φ).

The verification pile load tests shall be made by incrementally loading the micropile in accordance with the following cyclic load schedule:

VERIFICATION TEST LOADING SCHEDULE			
STEP	**LOADING**	**APPLIED LOAD**	**HOLD TIME (Min.)**
1	Apply AL		2.5
2	Cycle 1	0.10 NR	2.5
		0.20 NR	2.5
		0.30 NR	2.5
		AL	1
3	Cycle 2	0.10 NR	1
		0.20 NR	1
		0.30 NR	1
		0.40 NR	2.5
		0.50 NR	2.5
		AL	1
4*	Cycle 3*	0.10 NR	1
		0.50 NR	1
		0.60 NR	2.5
		0.70 NR	60 minutes (Creep Test)
		0.80 NR	2.5
		AL	1
5	Cycle 4	0.10 NR	1
		0.80 NR	1
		0.90 NR	2.5
		1.00 NR	10
		0.75 NR	5
		0.50 NR	5
		0.25 NR	5
		AL	5
AL = Alignment Load not to exceed 0.05 NR NR = Nominal Geotechnical Resistance (As Shown on Plans) *Loading Cycle 3 shall be repeated 5 times. During the initial 4 times of performing Loading Cycle 3, each applied load only needs to be held for 1 minute. During the fifth instance of repeating Load Cycle 5, the applied loads shall be held for the times indicated in the above schedule.			

To reduce the contribution of the overburden soils on the resistance, Loading Cycle 3 of the Verification Test Loading Schedule in the project-specific "Special Note for Micropiles" shall be repeated 5 times between Loading Cycles 2 and 4. During the initial 4 times of performing Loading Cycle 3, each applied load only needs to be held for 1 minute. During the fifth instance of repeating Load Cycle 5, the applied loads shall be held for the times indicated in the referenced schedule.

Pile top movement shall be measured at each load increment relative to a fixed reference. The load-hold period shall start as soon as each test load increment is applied. The verification test pile shall be monitored for creep at the 0.70 Nominal Resistance (NR). Pile movement during the creep test shall be measured and recorded at 1, 2, 3, 4, 5, 6, 10, 20, 30, 50 and 60 minutes. The alignment load shall not exceed 5 percent of the NR load. Dial gauges shall be reset to zero after the initial AL is applied.

The acceptance criteria for micropile verification load tests are:

1) The pile shall sustain the first 0.50 NR test load (compression or tension) with

no more than 1/2" total vertical movement at the top of the pile, relative to the position of the top of the pile prior to testing.

2) At the end of the 0.70 NR creep test load increment, test piles shall have a creep rate not exceeding 0.040 inch/log cycle time (1 to 10 minutes) or 0.080 inch/log cycle time (6 to 60 minutes or the last log cycle if held longer). The creep rate shall be linear or decreasing throughout the creep load hold period.
3) Failure does not occur at the NR maximum test load. Failure is defined as load where the slope of the load versus head settlement curve first exceeds 0.025 inch/kip.

3.3.4 Verification Test Pile Rejection. If the micropile verification test fails to meet the acceptance criteria, establish the cause(s) and provide modifications to the design, the construction procedures, or both. Retest the new system, as directed by the Engineer. These modifications include, but are not limited to, installing replacement test micropiles, modifying the installation methods, increasing the bond length, regrouting via pre-placed re-grout tubes, or changing the micropile type. Any modification which requires changes to the structure must have prior review and acceptance of the Engineer through submittals. Determine the cause for any modifications of design or construction procedures to appropriately determine any additional cost implications.

3.3.5 Proof Load Tests. Unless shown otherwise on the Plans, perform proof tests on 5 percent of the production piles with a minimum of 1 pile per substructure unit. The proof test piles or locations shall be as shown on the Plans or as directed by the Engineer. Provide the Engineer a written report confirming micropile geometry, construction, testing details, and proof test results within 7 working days following completion of the production pile proof load tests.

3.3.6 Proof Test Loading Schedule. Test piles designated for proof load testing to a maximum test load of the Factored Design Load (FDL) shown on the Plans or Working Drawings. Proof tests shall be made by incrementally loading the micropile in accordance with the following schedule:

PROOF TEST LOADING SCHEDULE			
STEP	**LOADING**	**APPLIED LOAD**	**HOLD TIME (Min.)**
1	Apply AL		2.5
2	Load Cycle	0.10 FDL	2.5
		0.20 FDL	2.5
		0.30 FDL	2.5
		0.40 FDL	2.5
		0.50 FDL	2.5
		0.60 FDL	2.5
		0.70 FDL	2.5
		0.80 FDL	10 to 60 minutes (Creep Test)
		0.90 FDL	2.5
		1.00 FDL	2.5
3	Unload Cycle	0.75 FDL	4
		0.50 FDL	4
		0.25 FDL	4
		AL	4
AL = Alignment Load not to exceed 0.05 FDL FDL = Factored Design Load (As Shown on Plans)			

Depending on performance, either a 10-minute or 60-minute creep test shall be performed at the 0.80 FDL Test Load. Where the pile top movement between 1 and 10 minutes exceeds 0.040 inch, the test load shall be maintained an additional 50 minutes. Movements shall be recorded at 1, 2, 3, 5, 6, 10, 20, 30, 50 and 60 minutes. The alignment load shall not exceed 5 percent of FDL. Dial gauges shall be reset to zero after the initial AL is applied.

The acceptance criteria for micropile proof load tests are:

1) The pile shall sustain a 0.70 FDL test load (compression or tension) with no more than 1/2" total vertical movement at the top of the pile, relative to the position of the top of the pile prior to testing.
2) At the end of the 0.80 FDL creep test load increment, test piles shall have a creep rate not exceeding 0.040 inch/log cycle time (1 to 10 minutes) or 0.080 inch/log cycle time (6 to 60 minutes). The creep rate shall be linear or decreasing throughout the creep load hold period.
3) Failure does not occur at the FDL maximum test load. Failure is defined as load where the slope of the load versus head settlement curve first exceeds 0.025 inch/kip.

3.3.7 Proof Test Pile Rejection. If a proof-tested micropile fails to meet the acceptance criteria, proof test another micropile in the immediate vicinity. For failed piles and further construction of other piles, modify the design, the construction procedure, or both. These modifications include, but are not limited to, installing replacement micropiles, incorporating piles of reduced load capacities, modifying the installation methods, increasing the bond length, or changing the micropile type. Any modification which requires changes to the structure must have prior review and acceptance of the Engineer through submittals. Determine the cause for any modifications of design or construction procedures to appropriately determine any additional cost implications.

3.4 Abandoned Holes. In the event a micropile cannot be advanced to the design tip elevation due to interference from the existing H-piles below grade (i.e., the bottom of pile cap elevation), the micropile location shall be abandoned, the permanent casing shall be extracted and reused (if possible), and the hole shall be grouted. The hole may be tremie grouted with flowable fill or an approved mixture of grout with a minimum compressive strength of 250 psi at 28 days. The grout mixture shall consider the effects of the rather porous in-situ pile core and shot-rock fill materials. There will be no extra payment for grout or flowable fill overruns.

4.0 MEASUREMENT.

4.1 Micropile. The Department will not measure for payment any non-production trial piles, failed test piles or reaction piles. No distinction in measurement is made between cased or uncased piling. The contractor is responsible for estimating the grout take. There will be no extra payment for grout overruns or special installation materials, procedures or equipment to prevent or reduce grout overruns. Where piles are out of vertical tolerance, there will be no extra payment for replacement piles, or for grouting and redrilling piles to achieve the required tolerance, unless the pile is interfered by the existing H-piles (see Pay Items for Abandoned Micropile Hole and for Damaged Casing from H-Pile Interference).

4.1.1 Micropile, Common. The Department will measure the length, in linear feet, of installed and complete production micropiles from the cut-off elevation to the approved top of competent, relatively unweathered bedrock elevation, minus any additional length installed at the contractor's option such as, but not limited to, facilitating the use of whole casing segments. This item also includes advancing the minimum plunge length, including the casing, through the competent unweathered bedrock, per the plans.

4.1.2 Micropile, Rock Socket. The Department will measure each installed and complete production micropile~~s~~ rock socket/bond zone length in the competent unweathered bedrock per the plans.

~~**4.1.3 Micropile, Bond Zone.** The Department will measure the quantity by each for each installed and complete production pile bond zone length.~~

4.2 Micropile Verification Test. For each verification test micropile installed according to the plans and is tested and accepted, the Department will measure the quantity by "each." The unit price will include the sacrificial pile as well as the reaction system, ancillaries, and any other materials and labor required to perform the test. Additional verification test micropiles installed to verify alternative micropile installation methods proposed by the Contractor will not be measured for payment.

4.3 Micropile Proof Test. The Department will measure the quantity by each for each test performed on a production micropile that is accepted and incorporated into the completed structure.

4.4 Abandoned Micropile Hole. The Department will measure the length, in linear feet, of abandoned micropile holes, resulting from unforeseen interferences with the existing H-piles. The unit price will include the drilling of the hole to the depth at which the casing was advanced and the placement of the grout. The cost of damaged casing is not included in

this pay item.

4.5 Damaged Casing from H-Pile Interference. The Department will measure the length, in linear feet, of casing that is damaged or unable to be extracted from abandoned micropile holes, resulting from unforeseen interferences with the existing H-piles. The unit price will include the length of casing that is unable to be extracted or the length of damaged (nonreusable) casing segments that are able to be extracted.

4.6 Vertical Tolerance Measurements of Micropiles Using Hole Telemetry. The Department will measure the quantity by each production pile that is determined to be within the acceptable vertical tolerance using hole telemetry and incorporated into the completed structure. When piles are determined to be out of tolerance, requiring replacement piles or grouting and redrilling, the Contractor will not be paid for the out of tolerance piles.

5.0 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Pay Item	Pay Unit
Micropile, 9 5/8 “, Common	Linear Foot
Abutment Micropile, Rock Socket	Each
Pier Micropile, Rock Socket	Each
~~Micropile, Bond Zone~~	~~Each~~
Micropile Verification Test	Each
Micropile Proof Test	Each
Abandoned Micropile Holes	Linear Foot
Damaged Casing from H-Pile Interference	Linear Foot
Vertical Tolerance Measurements of Micropiles Using Hole Telemetry	Each

The Department will consider payment as full compensation for all work required in this note.

191041

PROPOSAL BID ITEMS

Report Date 7/23/19

Section: 0001 - ROADWAY

LINE	BID CODE	ALT	DESCRIPTION	QUANTITY	UNIT	UNIT PRIC	FP	AMOUNT
0010	00212		CL2 ASPH BASE 1.00D PG64-22	175.00	TON		$	
0020	00301		CL2 ASPH SURF 0.38D PG64-22	27.00	TON		$	
0030	00356		ASPHALT MATERIAL FOR TACK	1.00	TON		$	
0040	02014		BARRICADE-TYPE III	4.00	EACH		$	
0050	02223		GRANULAR EMBANKMENT	900.00	CUYD		$	
0060	02351		GUARDRAIL-STEEL W BEAM-S FACE	200.00	LF		$	
0070	02363		GUARDRAIL CONNECTOR TO BRIDGE END TY A	4.00	EACH		$	
0080	02562		TEMPORARY SIGNS	209.00	SQFT		$	
0090	02650		MAINTAIN & CONTROL TRAFFIC	1.00	LS		$	
0100	02671		PORTABLE CHANGEABLE MESSAGE SIGN	4.00	EACH		$	
0110	03171		CONCRETE BARRIER WALL TYPE 9T	880.00	LF		$	
0115	21415ND		EROSION CONTROL (ADDED: 7-23-19)	1.00	LS		$	

Section: 0002 - BRIDGE

LINE	BID CODE	ALT	DESCRIPTION	QUANTITY	UNIT	UNIT PRIC	FP	AMOUNT
0120	00001		DGA BASE	183.00	TON		$	
0130	02091		REMOVE PAVEMENT	420.00	SQYD		$	
0140	02231		STRUCTURE GRANULAR BACKFILL	1,670.00	CUYD		$	
0150	02599		FABRIC-GEOTEXTILE TYPE IV	1,488.00	SQYD		$	
0160	02726		STAKING	1.00	LS		$	
0170	02731		REMOVE STRUCTURE	1.00	LS		$	
0180	02775		ARROW PANEL	1.00	EACH		$	
0190	02998		MASONRY COATING	344.00	SQYD		$	
0200	03299		ARMORED EDGE FOR CONCRETE	128.00	LF		$	
0210	08003		FOUNDATION PREPARATION	1.00	LS		$	
0220	08100		CONCRETE-CLASS A	714.00	CUYD		$	
0230	08104		CONCRETE-CLASS AA	256.00	CUYD		$	
0240	08131		MECHANICAL REINF COUPLER #6	20.00	EACH		$	
0250	08134		MECHANICAL REINF COUPLER #9	48.00	EACH		$	
0260	08150		STEEL REINFORCEMENT	101,940.00	LB		$	
0270	08151		STEEL REINFORCEMENT-EPOXY COATED	22,840.00	LB		$	
0280	08820		DRAIN PIPE-6 IN	1,340.00	LF		$	
0290	21532ED		RAIL SYSTEM TYPE III	46.00	LF		$	
0300	22056NN		TEMPORARY SUPPORT	4.00	EACH		$	
0310	22585NN		MICROPILE PROOF TEST	12.00	EACH		$	
0320	22861EN		HIGH STRENGTH GEOTEXTILE FABRIC TY V	5,630.00	SQYD		$	
0330	23744EC		EPOXY INJECTION CRACK REPAIR	186.00	LF		$	
0340	24002EC		MICROPILES-9 5/8 IN (REVISED: 7-23-19)	16,752.00	LF		$	
0350	24006EC		MICROPILE VERIFICATION TEST (REVISED: 7-23-19)	2.00	EACH		$	
0360	24007EC		PIER MICROPILE-ROCK SOCKET	116.00	EACH		$	
0370	24008EC		ABUTMENT MICROPILE-ROCK SOCKET	98.00	EACH		$	

191041

PROPOSAL BID ITEMS

Report Date 7/23/19

LINE	BID CODE	ALT	DESCRIPTION	QUANTITY	UNIT	UNIT PRIC	FP	AMOUNT
0380	24595EN		ELASTICIZED EPS MASON	225.00	SQYD		$	
0400	25035ED		ABANDONED MICROPILE HOLES	214.00	LF		$	
0410	25036ED		DAMAGED CASING FROM H-PILE INTERFERENCE	600.00	LF		$	
0420	25037ED		VERT TOLERANCE MEASURE OF MICROPILES	600.00	EACH		$	
0430	40101		CONCRETE PATCHING	117.00	SQFT		$	

Section: 0003 - MOBILIZATION AND/OR DEMOBILIZATION

LINE	BID CODE	ALT	DESCRIPTION	QUANTITY	UNIT	UNIT PRIC	FP	AMOUNT
0440	02568		MOBILIZATION	1.00	LS		$	
0450	02569		DEMOBILIZATION	1.00	LS		$	

SA-013-2019 (Consultant)

M E M O R A N D U M

TO: Bart Asher, P.E., P.L.S.
Director, Division of Structural Design

FROM: Michael Carpenter, P.E.
TEBM, Geotechnical Branch
Division of Structural Design

BY: Daryl J. Greer, P.E.
Geotechnical Branch

DATE: June 17, 2019

SUBJECT: **Mason County**
JL03 103 0377 000-016 D
MARS No. 9201301D
US 68, Bridge over Lawrence Creek
Stations 178+00 to 187+00
Item No. 9-1095.00
Geotechnical Engineering Structure Foundation Report Addendum

Geotechnology, Inc. completed a geotechnical engineering report addendum for this structure. We have reviewed and concur with the recommendations as presented in this report.

This addendum addresses revisions to the batter pile analyses at Piers 2 and 5, pile drivability analyses for driven H-piles at the temporary supports for Abutments 1 and 6, and revisions to the micropile plan notes and project-specific micropile special note. This addendum is supplemental to and is to be used in conjunction with the original geotechnical report (S-057-2017).

A copy of the report is attached. If you have any questions, please contact this office at 502-564-2374.

Attachments

cc: J. Van Zee
C. Van Zee
D. Eldridge (D-9)
R. Stull (D-9)
P. Perry
K. Stewart
R. Thomas
D. McElmurray
J. Hauber (Geotechnology)
C. Klusman (AECOM)

GEOTECHNOLOGY INC
FROM THE GROUND UP

STRUCTURE GEOTECHNICAL ADDENDUM REPORT 1
US 68 BRIDGE OVER LAWRENCE CREEK
MASON COUNTY, KENTUCKY

STATIONS 178+00 TO 187+00
ITEM NO. 9-1095.00
MARS NO. 9201301D
SA-013-2019

Prepared for:

AECOM
LOUISVILLE, KENTUCKY

Prepared by:

GEOTECHNOLOGY, INC.
ERLANGER, KENTUCKY

Date:

JUNE 17, 2019

Geotechnology Project No.:

J028501.01

SAFETY
QUALITY
INTEGRITY
PARTNERSHIP
OPPORTUNITY
RESPONSIVENESS

GEOTECHNOLOGY INC
FROM THE GROUND UP

June 17, 2019

Mr. Craig Klusman, PE
AECOM
500 West Jefferson Street
Suite 1600
Louisville, Kentucky 40202

Re: Structure Geotechnical Addendum Report 1
US 68 Bridge Over Lawrence Creek
Mason County, Kentucky
Stations 178+00 to 187+00
Item No. 9-1095.00
Mars No. 9201301D
SA-013-2019
Geotechnology Project No. J028501.01

Dear Mr. Klusman:

Geotechnology, Inc. is pleased to present with this letter the Structure Geotechnical Addendum Report for the US 68 Bridge over Lawrence Creek in Mason County, Kentucky. This is an addendum to the Structure Geotechnical Report (S-057-2017) for this project, which was dated March 8, 2019. This addendum includes revisions to the batter pile analyses at Piers 2 and 5, pile driveability analyses for driven H-piles at the temporary supports for Abutments 1 and 6, and revisions to the micropile plan notes and project-specific micropile special note.

We appreciate the opportunity to provide the geotechnical services for this project. If you have any questions regarding this report, or if we may be of any additional service to you, please do not hesitate to contact us.

Respectfully submitted,
GEOTECHNOLOGY, INC.

Joseph D. Hauber, PE
Senior Project Manager

Lee J. Czor, PE
Principal Engineer/Office Leader

JDH/LJC:jdh

Copies submitted: AECOM (email)
KYTC Geotechnical Branch (email)

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GEOTECHNOLOGY INC
FROM THE GROUND UP

STRUCTURE GEOTECHNICAL ADDENDUM REPORT 1
US 68 BRIDGE OVER LAWRENCE CREEK
MASON COUNTY, KENTUCKY

Stations 178+00 to 187+00
Item No. 9-1095.00 | Mars No. 9201301D | SA-013-2019
June 17, 2019 | Geotechnology Project No. J028501.01

1.0 INTRODUCTION

The Structure Geotechnical Report (S-057-2017) for the US 68 Bridge over Lawrence Creek in Mason County, Kentucky, was dated March 8, 2019. This addendum includes revisions to the batter pile analyses at Piers 2 and 5, pile driveability analyses for driven H-piles at the temporary supports for Abutments 1 and 6, and revisions to the micropile plan notes and project-specific special note.

This addendum is supplemental to, and is to be used in conjunction with the referenced Structure Geotechnical Report; therefore, project information, analyses, appendices, etc., from this report are not reproduced in this addendum.

2.0 ANALYSES

2.1 Batter Pile Analyses

In Section 10.3 of the Structure Geotechnical Report, we recommend that the existing batter piles be disconnected from the pile caps at Piers 2 and 5. Since the submittal of this report, the following concerns have been raised:

1. The ability of the existing vertical piles to temporarily support the piers during construction in the timeframe between disconnecting the batter piles and installing and connecting the proposed micropile foundations; and

2. The feasibility of disconnecting the batter piles if this is completed after the micropiles are installed and connected to the pile cap.

Consequently, we reevaluated the scenario of leaving the existing batter piles connected and evaluated the forces that the batter piles would transmit to the pile caps due to continued settlement of the shale fill embankments over the 75-year design life for the repaired bridge.

The revised batter pile analyses were completed using the empirical LPILE method per Behling et al (2012) that was discussed in Section 9.3.2 of the Structure Geotechnical Report. The analyses were completed using normal soil movement profiles that were generated from the settlement profiles predicted by the Hopkins and Beckham equation presented in Section 9.2.1 of

the Structure Geotechnical Report for both *t* = 23 years (present) and *t* = 100 years (end of the 75-year design life for the repaired bridge). Additionally, the analyses were completed for modulus of subgrade reactions of both 60 and 90 pounds per cubic inch (pci), and for both pinned- and fixed-head connections to the pile caps. One sixteenth inch of corrosion was also assumed around the perimeter of the HP14x73 piles.

The maximum (unfactored) moments and shears for the LPILE analyses at Pier 2 are provided in Table 1 while Table 2 summarizes these values for Pier 5. The graphical outputs from the LPILE analyses are provided in Appendix A.

Table 1. LPILE results on batter piles at Pier 2.

Analysis for Pier 2	Pile Head Condition	Max Shear/Pile Head Shear (k)	Max Moment (k-in)	FS for Moment[a]
P2-002 (k = 60 pci, t = 23 years)	Pinned	31	1,780	1.47
	Fixed	71	4,130	0.63
P2-003 (k = 90 pci, t = 23 years)	Pinned	31	1,800	1.45
	Fixed	72	***4,150***	0.63
P2-1002 (k = 60 pci, t = 100 years)	Pinned	41	2,580	1.01
	Fixed	93	5,710	0.46
P2-1003 (k = 90 pci, t = 100 years)	Pinned	41	2,600	1.00
	Fixed	93	***5,730***	0.46

[a] Factor of safety (FS) values assume 1/16 inch of corrosion around perimeter of HP14x73 piles and a steel yield strength (F_y) of 36 ksi, which corresponds to a nominal moment capacity of 2,612 k-in.

Table 2. LPILE results on batter piles at Pier 5.

Analysis for Pier 5	Pile Head Condition	Max Shear/Pile Head Shear (k)	Max Moment (k-in)	FS for Moment[a]
P5-002 (k = 60 pci, t = 23 years)	Pinned	45	3,000	0.87
	Fixed	109	7,330	0.36
P5-003 (k = 90 pci, t = 23 years)	Pinned	46	3,020	0.86
	Fixed	110	***7,350***	0.36
P5-1002 (k = 60 pci, t = 100 years)	Pinned	58	4,270	0.61
	Fixed	139	9,960	0.26
P5-1003 (k = 90 pci, t = 100 years)	Pinned	58	4,300	0.61
	Fixed	139	***9,990***	0.26

[a] Factor of safety (FS) values assume 1/16 inch of corrosion around perimeter of HP14x73 piles and a steel yield strength (F_y) of 36 ksi, which corresponds to a nominal moment capacity of 2,612 k-in.

Based on discussions with AECOM, the current batter pile embedment into the pile caps at Piers 2 and 5 would behave as a pinned-head connection (i.e., the *t* = 23 years models), and the design

condition over the 75-year design life post-repair would behave more as a fixed-head connection due to the increased concrete embedment (i.e., the *t* = 100 years models).

In reality, the models where *t* = 100 years assumes that the pile head has been fixed the entire time from *t* = 0 to *t* = 100 years. To account for the pile behaving as a pinned-head pile to date, the design moment acting at the pile head was considered to be the net moment increase from the fixed-head models from *t* = 23 years to *t* = 100 years, as the pile has already deflected from *t* = 0 to *t* = 23 years without being fixed. So the net moments at the pile heads would be as follows:

- Pier 2: 5,730 – 4,150 = 1,580 k-in./batter pile
- Pier 5: 9,990 – 7,350 = 2,640 k-in./batter pile

Included in Appendix B are figures of the pile caps at Piers 2 and 5 illustrating the unfactored shears and moments acting at the pile heads (on a per pile basis) for *t* = 23 years (existing condition) and *t* = 100 years (design condition). The shear loads in these figures are oriented perpendicular to the longitudinal axis of the batter piles and, therefore, have vertical and horizontal components acting on the pile caps.

It should be noted that the flexural factors of safety provided in Table 1 and Table 2 generally indicate that the existing HP14x73 piles will yield before the piles would be able to transmit the theoretical moments to the pile caps (except for the pinned head models on Pier 2). Therefore, the pile cap analyses should be conservative when applying these moments to the pile cap design.

Additionally, it should be noted that, while the batter piles are no longer being disconnected from the pile caps at Piers 2 and 5, their contribution to provide foundation resistance to loads is being ignored.

2.2 Pile Driveability

As an industry standard, the maximum compressive and tension stress applied to piles during driving should not exceed 90 percent of the steel yield strength (i.e., 0.9 F_y) or 45 kips per square inch (ksi) for Grade 50 steel.

Static pile analysis using the program APILE Version 2015.7.8 produced by ENSOFT, Inc., was performed to estimate the ultimate driving resistance that HP14x117 piles would experience during the installation process. Driveability analyses were performed at Abutments 1 and 6 using the program GRLWEAP Version 2010 produced by Pile Dynamics, Inc. of Cleveland, Ohio. An 80 percent pile hammer efficiency and a 20 percent side friction loss were used in the analysis. The driveability analyses also accounted for predrilling down to the potential conflict points with the existing batter piles and backfilling with sand or pea gravel prior to driving the piles.

The driveability analyses at the abutments resulted in minimum and maximum rated hammer energies of 47.1 and 80.3 foot-kips, respectively, to drive the HP14x117 piles to practical refusal and achieve the factored load/resistance while remaining within allowable driving stresses.

3.0 CONCLUSIONS AND RECOMMENDATIONS

Based on our engineering reconnaissance of the site, the borings, visual examination of the recovered samples, the laboratory test results, our understanding of the construction of the fill embankments and bridge, the field instrumentation readings, our engineering analyses, several meetings with KYTC and AECOM, review of the different versions of the project plans prepared by AECOM, and our experience as Consulting Soil and Foundation Engineers in Kentucky, we have reached the following conclusions and make the following recommendations.

3.1 Settlement and Batter Piles

The recommendations provided in Section 10.3 of the Structure Geotechnical Report regarding the batter piles at Piers 2 and 5 should be revised as follows:

- At Piers 2 and 5, we recommend that the existing batter piles be considered insufficient for long-term support of these piers and that any resistance that the batter piles provide be ignored.

- The unfactored pile head shears and moments on the existing batter piles discussed in Section 2.1 of this addendum should be applied to the pile cap in addition to the other loads acting on the pile cap (e.g., the superstructure loads). See the figures in Appendix B for these unfactored loads on a per pile basis.

3.2 Temporary Support System for Bridge Girders

As indicated on the plans prepared by AECOM, a temporary support system will be provided at Abutments 1 and 6 to support the bridge girders while the abutments are reconstructed. Driven HP14x117 piles will be used as the deep foundations for the temporary support system.

Except for the predrilling recommendations, the recommendations from Section 8.2.1 of the Structure Geotechnical Report are applicable to these piles.

With regards to predrilling, the pile locations for the temporary shoring system should be predrilled to beyond the potential conflict points with the existing batter piles at Abutments 1 and 6. The predrilled holes will require temporary casing to prevent collapse of the holes from the existing select pile core material. The first length of the temporary pile should then be driven into the in-situ soils at the base of the predrilled, cased hole. Prior to splicing on the second length of pile, the predrilled hole should be backfilled with sand or pea gravel and the temporary casing should be extracted as the hole is backfilled. The pile should then be driven to practical refusal into the bedrock.

3.2.1.1 Driven Pile Axial Capacity

We recommend that piles for the temporary support at Abutments 1 and 6 be driven to practical refusal in the underlying bedrock. In accordance with Article 10.7.3.2.3 from AASHTO (2017), the nominal bearing resistance shall not exceed the nominal structural capacity of the pile, which is assumed to be the yield strength of the pile for point bearing piles where pile penetration into the rock formation is minimal. Therefore, an HP14x117 pile has a nominal bearing resistance of 1,720 kips.

Given the subsurface encountered in the borings and the regional geology discussed in Section 3.0 of the Structure Geotechnical Report, we recommend that a strength limit state resistance factor (ϕ_c) of 0.5 be applied to the nominal bearing resistance for axial resistance of piles in compression and subject to severe driving conditions where use of a pile tip is necessary. The estimated factored axial resistance of HP14x117 piles driven to practical refusal is 860 kips. Furthermore, we recommend that the combined strength limit state axial and flexural resistance factors for design be 0.7 (ϕ_c) and 1.0 (ϕ_f) as noted in Section 6.5.4.2 of AASHTO (2017).

3.2.1.2 Pile Driveability

As mentioned in Section 2.2 of this addendum, wave equation driveability analyses have been performed estimating that a hammer with a rated energy between 47.1 and 80.3 foot-kips will be required to drive the HP14x117 piles at Abutments 1 and 6 to practical refusal and achieve the factored resistance while maintaining allowable driving stresses. Note that these driveability analyses accounted for predrilling down to the potential conflict points with the existing batter piles and backfilling with sand or pea gravel prior to driving the piles to practical refusal.

The results of the wave equation analyses rely on the accuracy of the input data and the validity of the mathematical models to predict the performance and dynamic response of the hammer, pile, and soil systems.

4.0 PLAN NOTES

4.1 Temporary Steel H-pile Foundations

Add the following plan notes at the appropriate locations in the plans for the steel H-Pile foundations for the temporary support systems at Abutments 1 and 6:

- **PRACTICAL REFUSAL**: Drive point bearing piles to practical refusal. For this project minimum blow count requirements are reached after total penetration becomes ½ inch or less for 10 consecutive blows, and practical refusal is obtained after the pile is struck an additional 10 blows with total penetration of ½ inch or less. Advance production piling to the driving resistance specified above and to depths determined by test pile(s) and available subsurface information. Immediately cease driving operations if the pile visibly yields or becomes damaged during driving. If hard driving is encountered because of dense strata or an obstruction, such as a boulder, before the pile is advanced to the depth anticipated, the Engineer will determine if more blows than the average driving resistance

specified for practical refusal is required to further advance the pile. Drive additional production and test piles if directed by the Engineer.

- **HAMMER ENERGY:** At the End Bent locations, a diesel pile driving hammer with a rated energy between 47.1 foot-kips and 80.3 foot-kips will be required to drive the HP14x117 steel piles to practical refusal without encountering excessive blow counts or damaging the piles. The Contractor shall submit the proposed pile driving system to the Engineer for approval prior to the installation of the first test pile. Approval of the pile driving system by the Engineer will be subject to satisfactory field performance of the pile driving procedures.

- **PRE-DRILLING**: Holes shall be drilled beyond the conflict point with the existing batter piles. A temporary casing will be required to prevent collapse of the hole. The first length of the pile (estimated to be 60 feet or less) shall be driven into the in-situ soils at the base of the pre-drilled, cased hole. Prior to splicing on the second length of pile, backfill the predrilled hole around the first length of pile with sand or pea gravel. The temporary casing shall be extracted as the hole is backfilled. Drive the remainder of the pile to practical refusal into the bedrock. Include the cost of all materials, labor, and equipment needed to pre-drill, advance and pull temporary casing, backfill the holes, and drive piles to refusal in the price per linear foot for “Temporary Support.”

4.2 Permanent Micropile Foundations

Revise the following plan notes for Permanent Micropile Foundations from the Structure Geotechnical Report as follows (deletions are struck out and additions are bolded):

- Micropiles shall be constructed and tested in accordance with the project-specific “Special Note for Micropiles” and these plans. The Micropile Contractor shall be prepared to encounter boulders in the existing shot-rock fill. ~~Holes shall be drilled and casing advanced using duplex drilling techniques.~~ External flush or open hole drilling is not allowed. Permanent casing is required in the overburden and to the depths shown in the plans. As the primary lateral load resisting element of the micropile, the casing may not be modified without written approval of the designer.

- **REINFORCING:** Micropile reinforcing shall be ASTM A615/AASHTO M31 Grade 75, all-thread bars**, unless noted otherwise**.

5.0 SPECIAL NOTES

The project-specific “Special Note for Micropiles” that was included in Appendix N of the Structure Geotechnical Report should be replaced with the revised version of this special note that is included in Appendix C of this addendum.

Additionally, it should be noted that the Kentucky Transportation Cabinet (KYTC) is revising the “Special Note for Treatment of End Bent or Abutment Backfills Using Geotextile Reinforcement”

to match the 2019 Edition of the *Standard Specifications for Road and Bridge Construction* that are published by KYTC. This revised special note will be provided at a later date.

REFERENCES

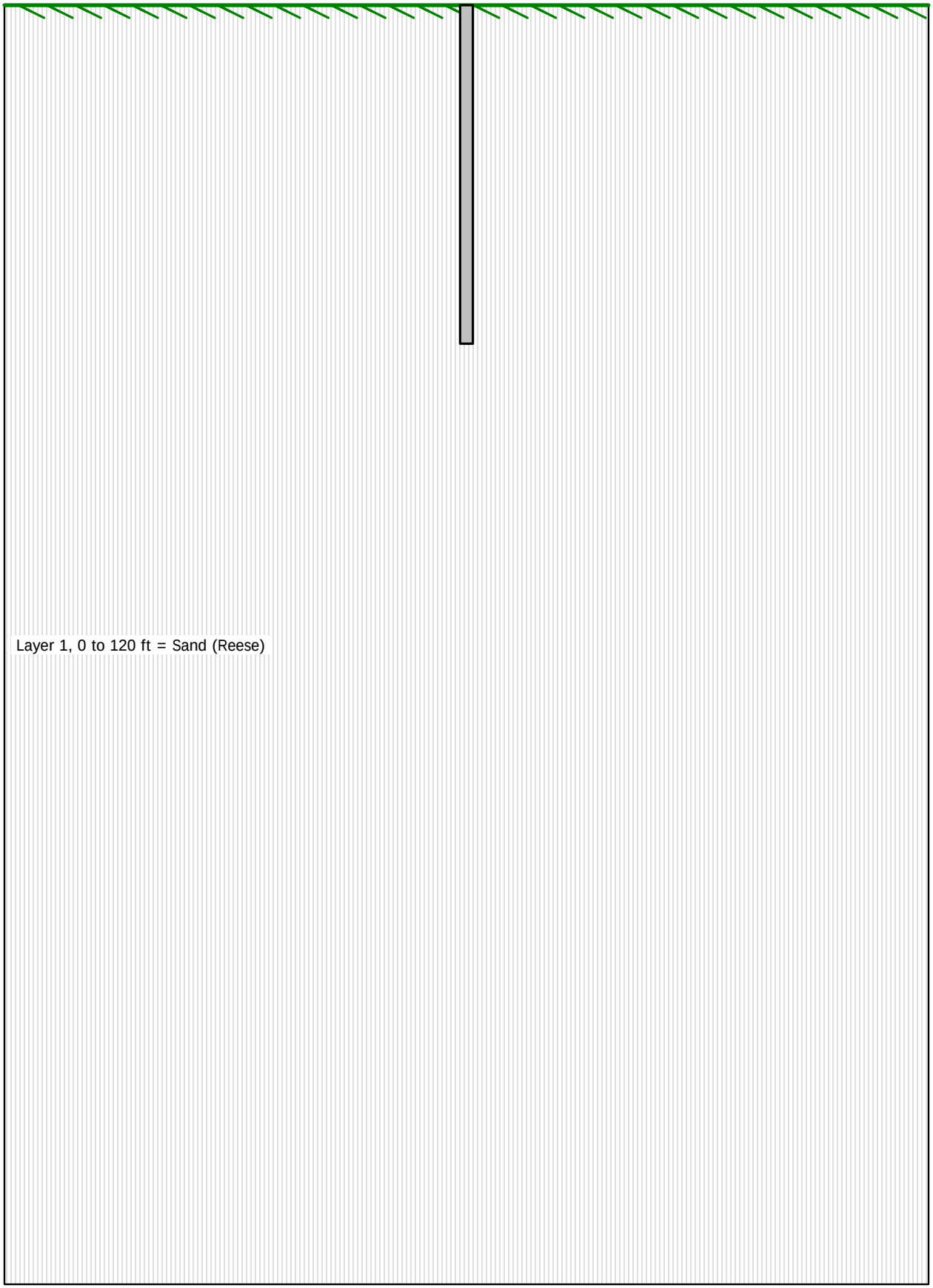
AASHTO (2017). *AASHTO LRFD Bridge Design Specifications, 8th Edition*, American Association of State Highway and Transportation Officials, Washington, DC

Behling, C., Chiu, S., Hokens, K., Navin, M., and Schwanz, N. (2012). *Interim Guidance, Revised "LPILE Method" to Calculate Bending Moments in Battered Piles for T-Walls Subject to Downdrag*, USACE Contract No. W912P8-07-D-0062.

APPENDIX A – LPILE GRAPHICAL OUTPUTS FOR BATTER PILE ANALYSES

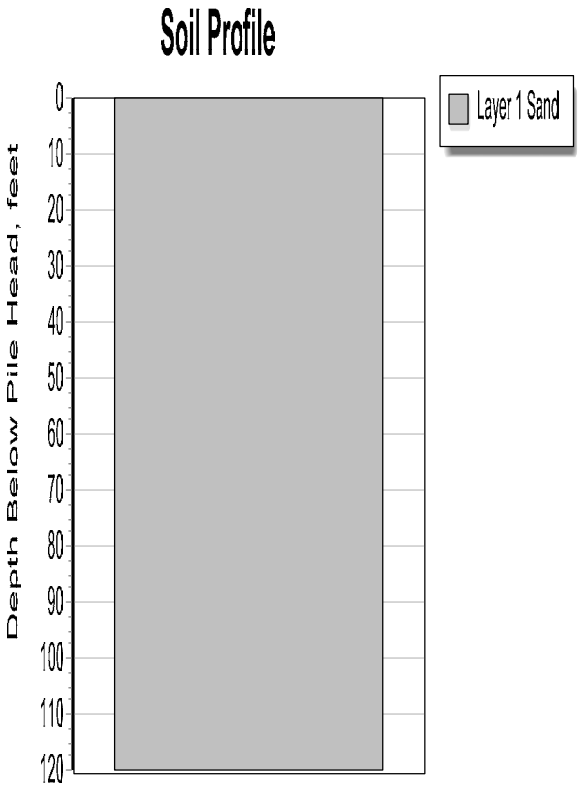
Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

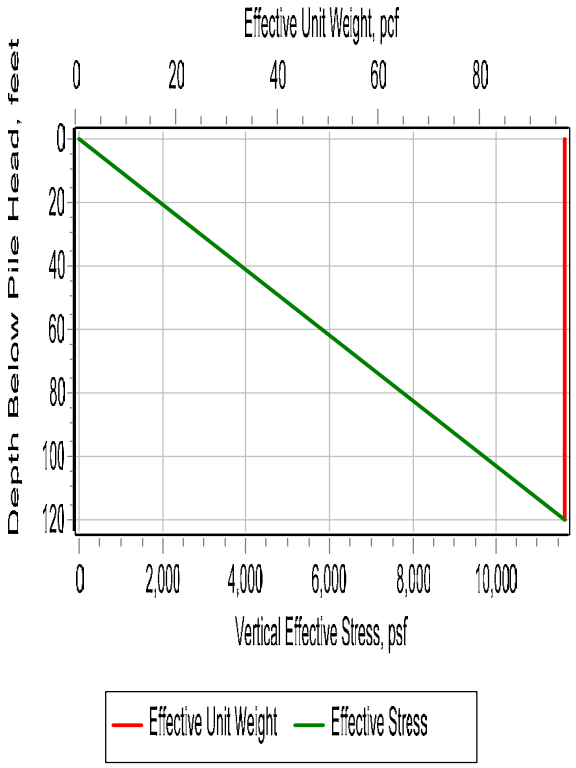
LPILE Analysis P2-002
Pier 2 - HP14x73
With 1/16" Corrosion & k = 60 pci

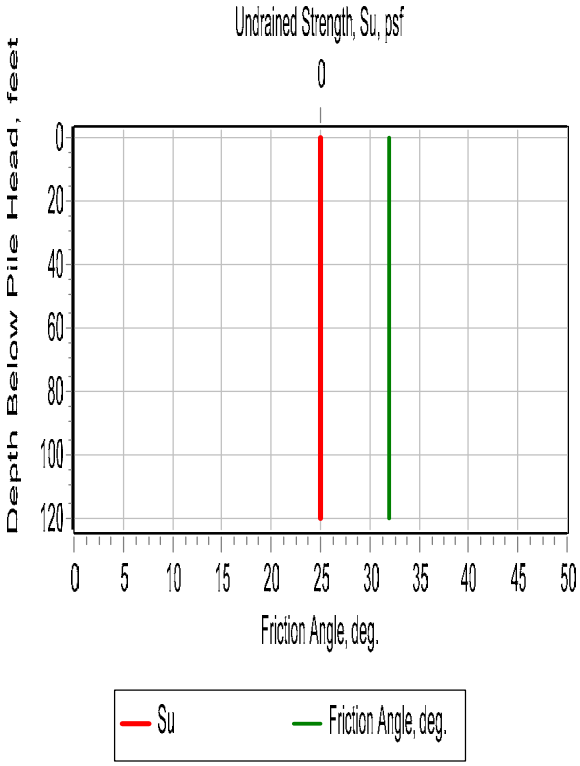


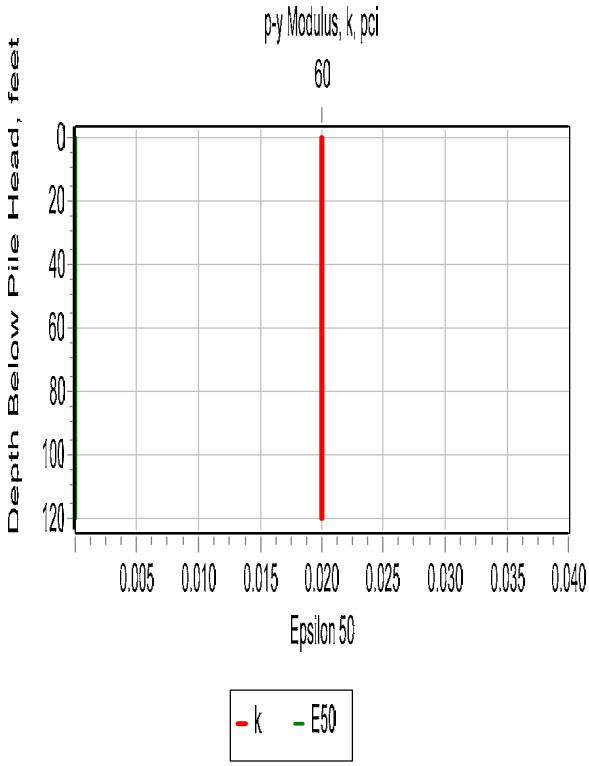
Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

LPILE Analysis P2-002
Pier 2 - HP14x73
With 1/16" Corrosion & k = 60 pci



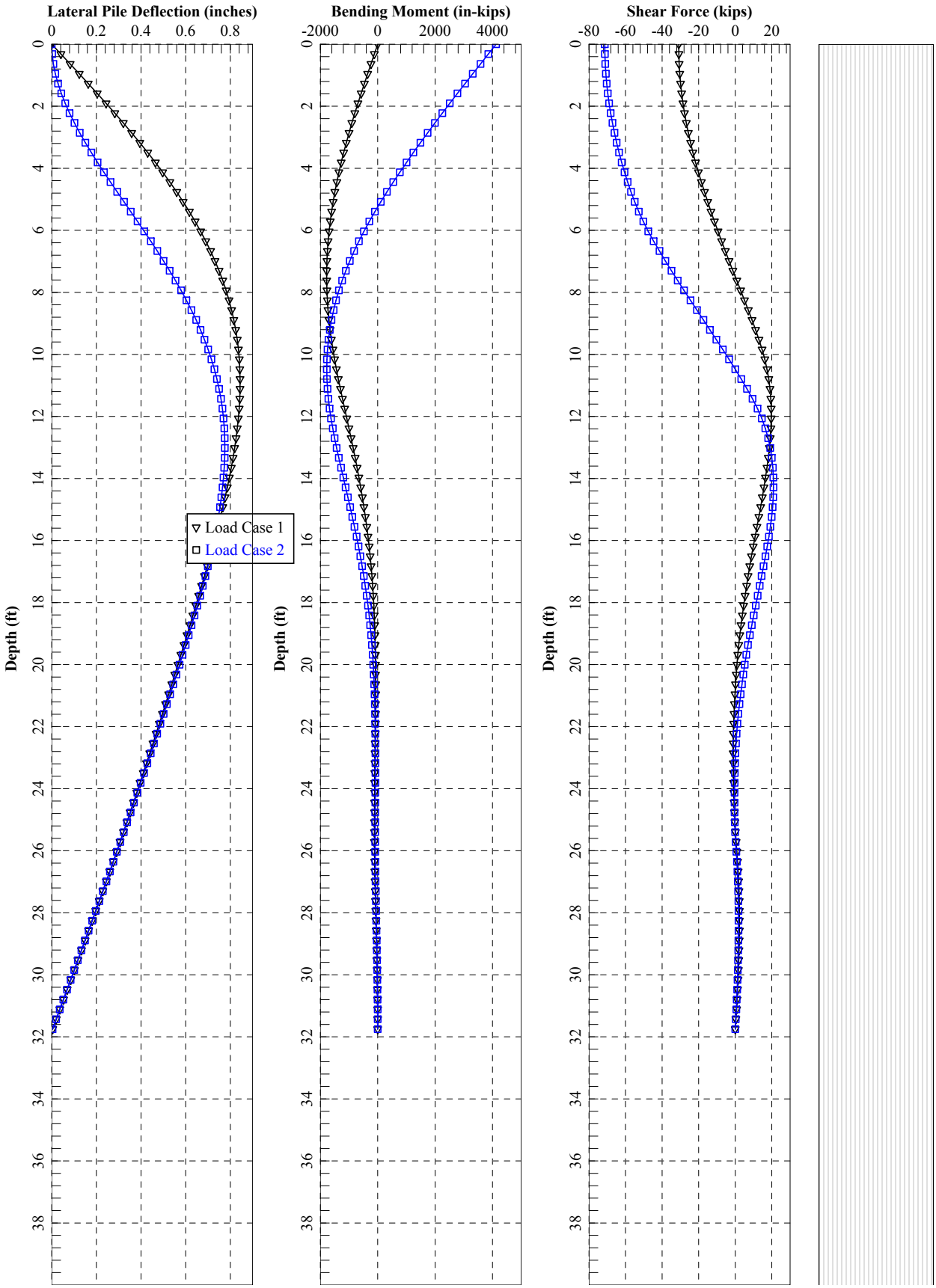






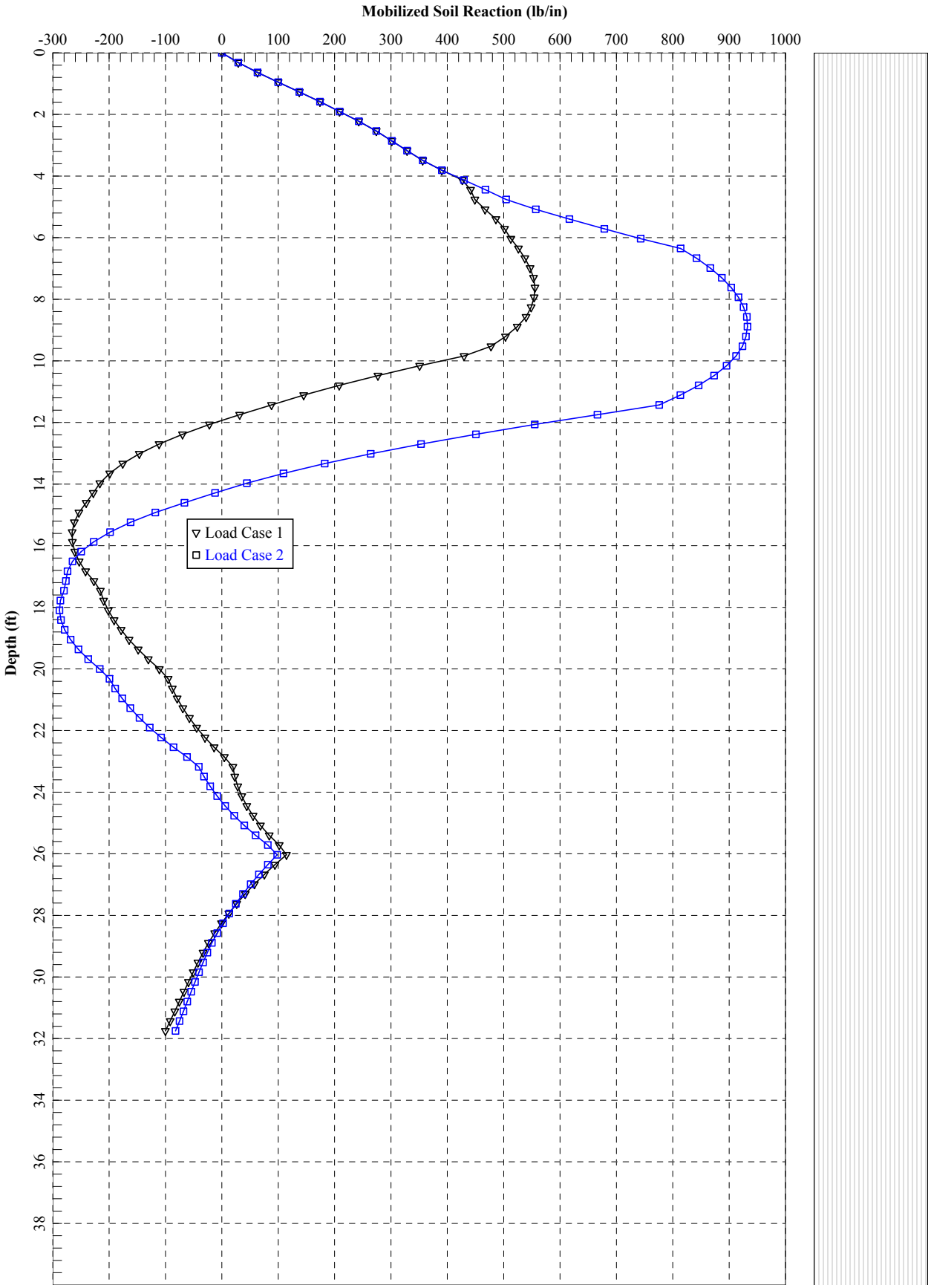
Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

LPILE Analysis P2-002
Pier 2 - HP14x73
With 1/16" Corrosion & k = 60 pci



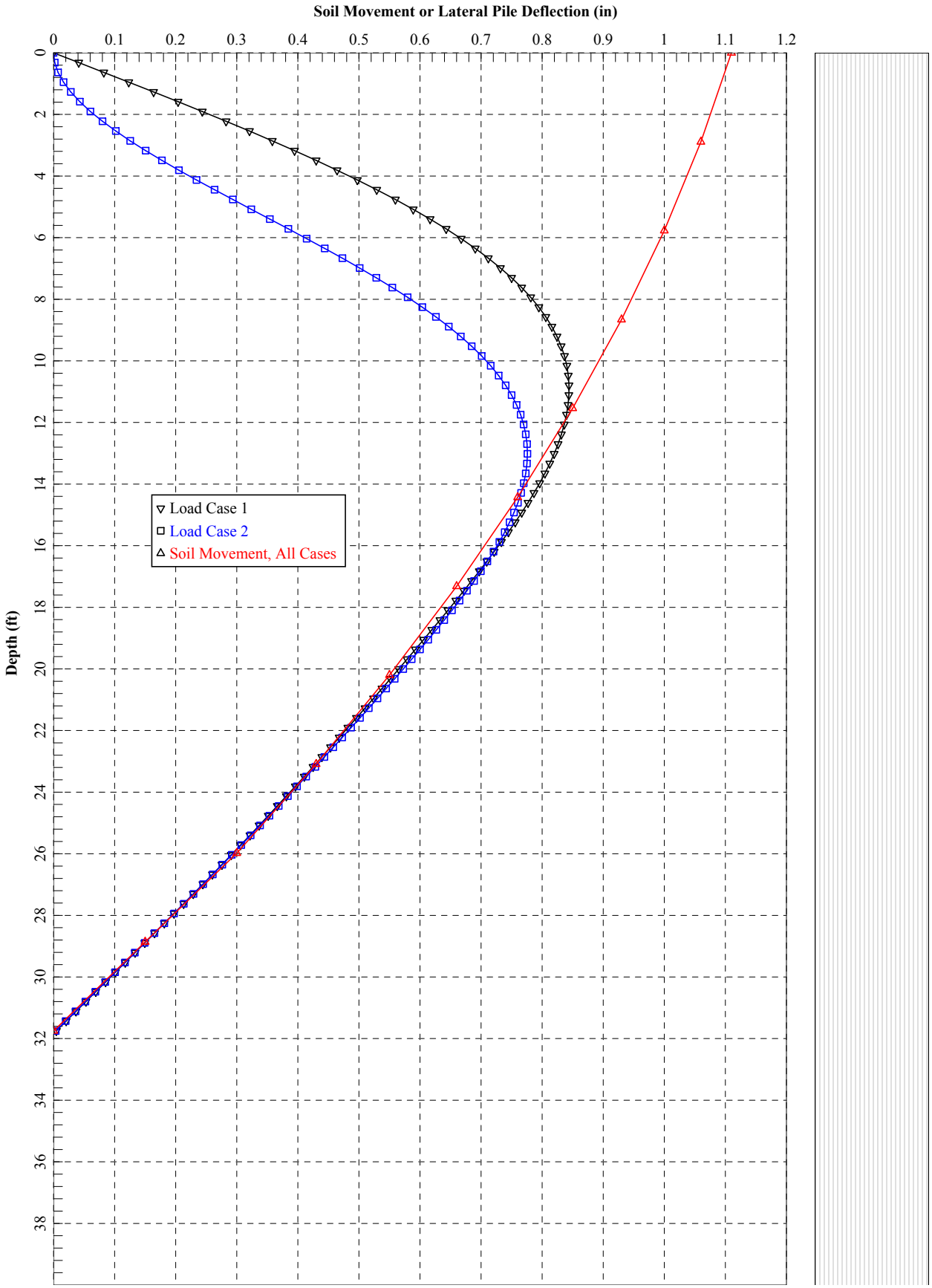
Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

LPILE Analysis P2-002
Pier 2 - HP14x73
With 1/16" Corrosion & k = 60 pci



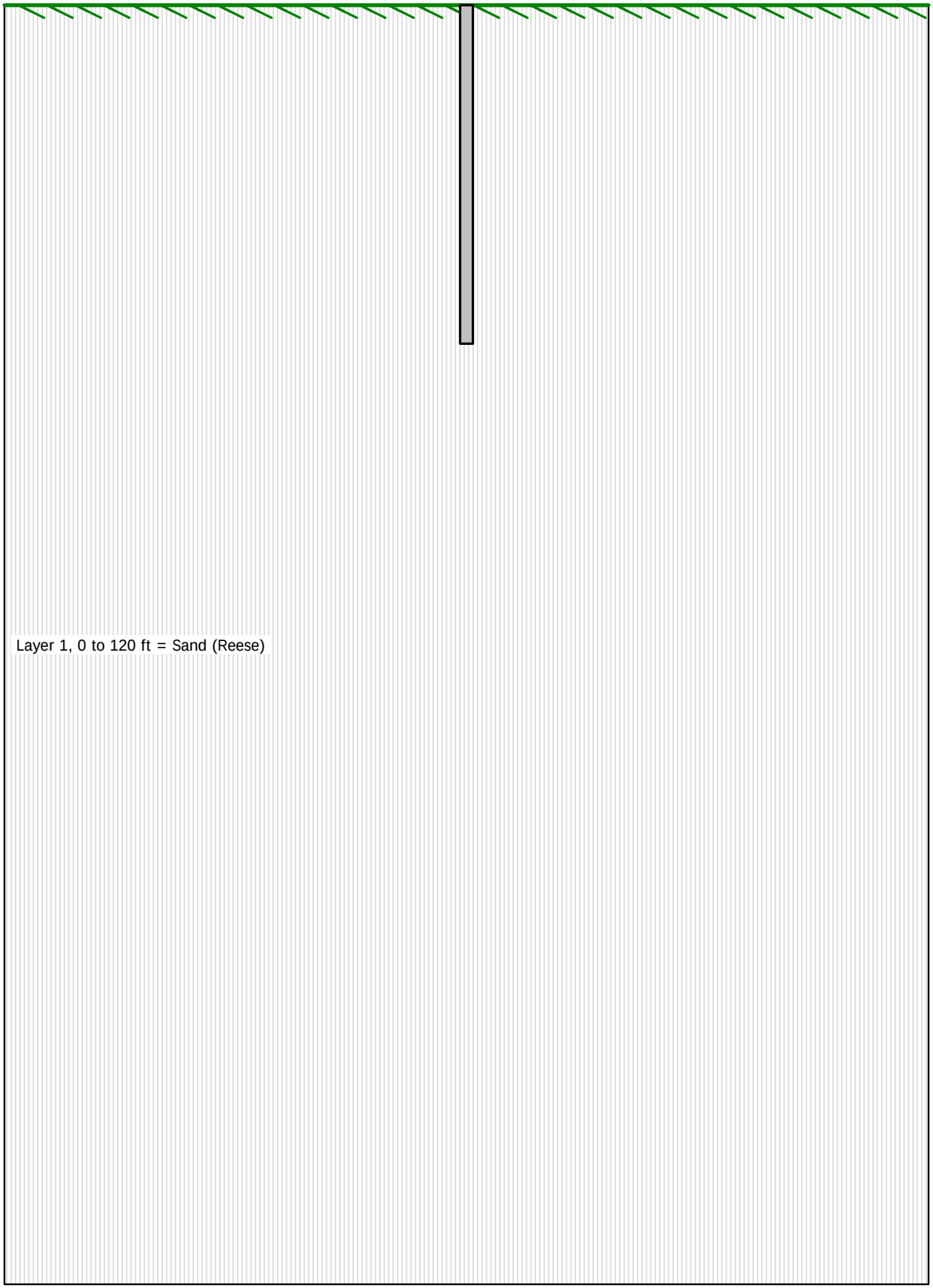
Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

LPILE Analysis P2-002
Pier 2 - HP14x73
With 1/16" Corrosion & k = 60 pci



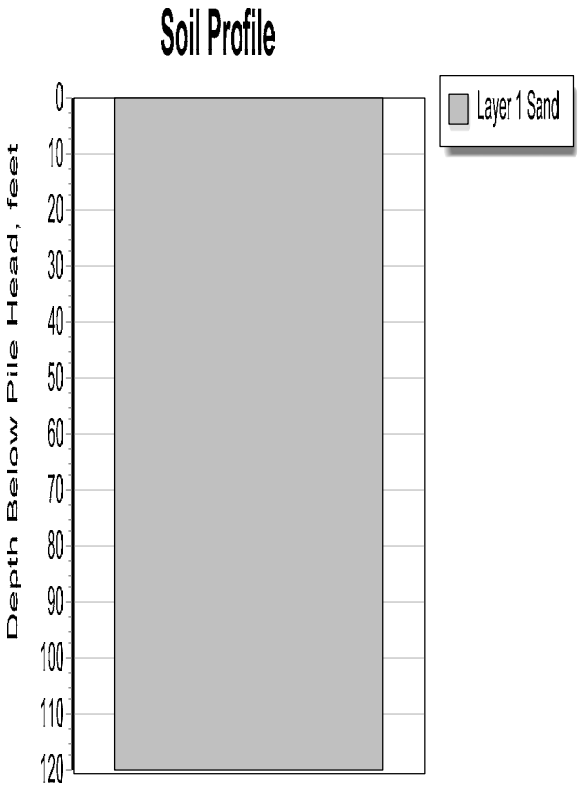
Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

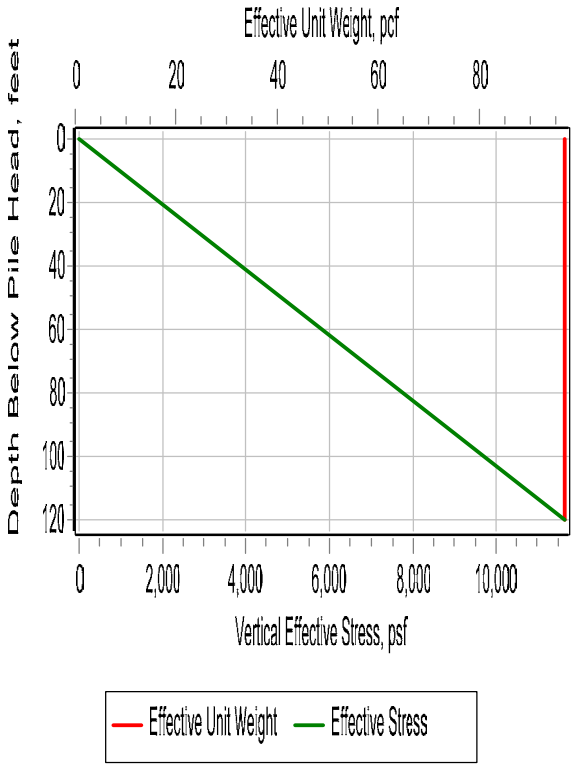
LPILE Analysis P2-003
Pier 2 - HP14x73
With 1/16" Corrosion & k = 90 pci

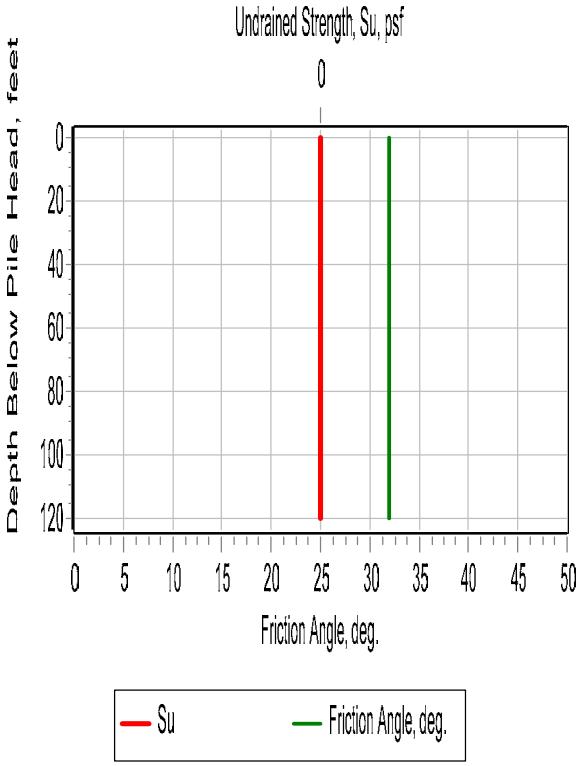


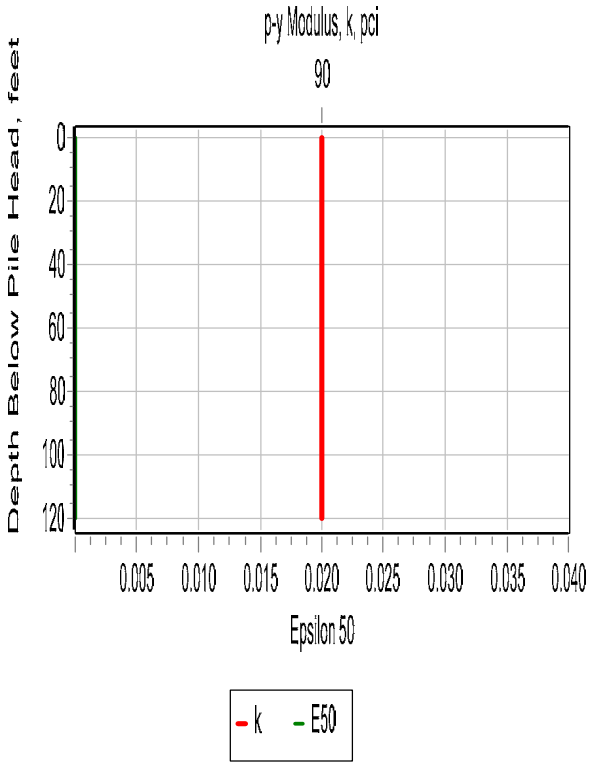
Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

LPILE Analysis P2-003
Pier 2 - HP14x73
With 1/16" Corrosion & k = 90 pci









Project No.: J028501.01
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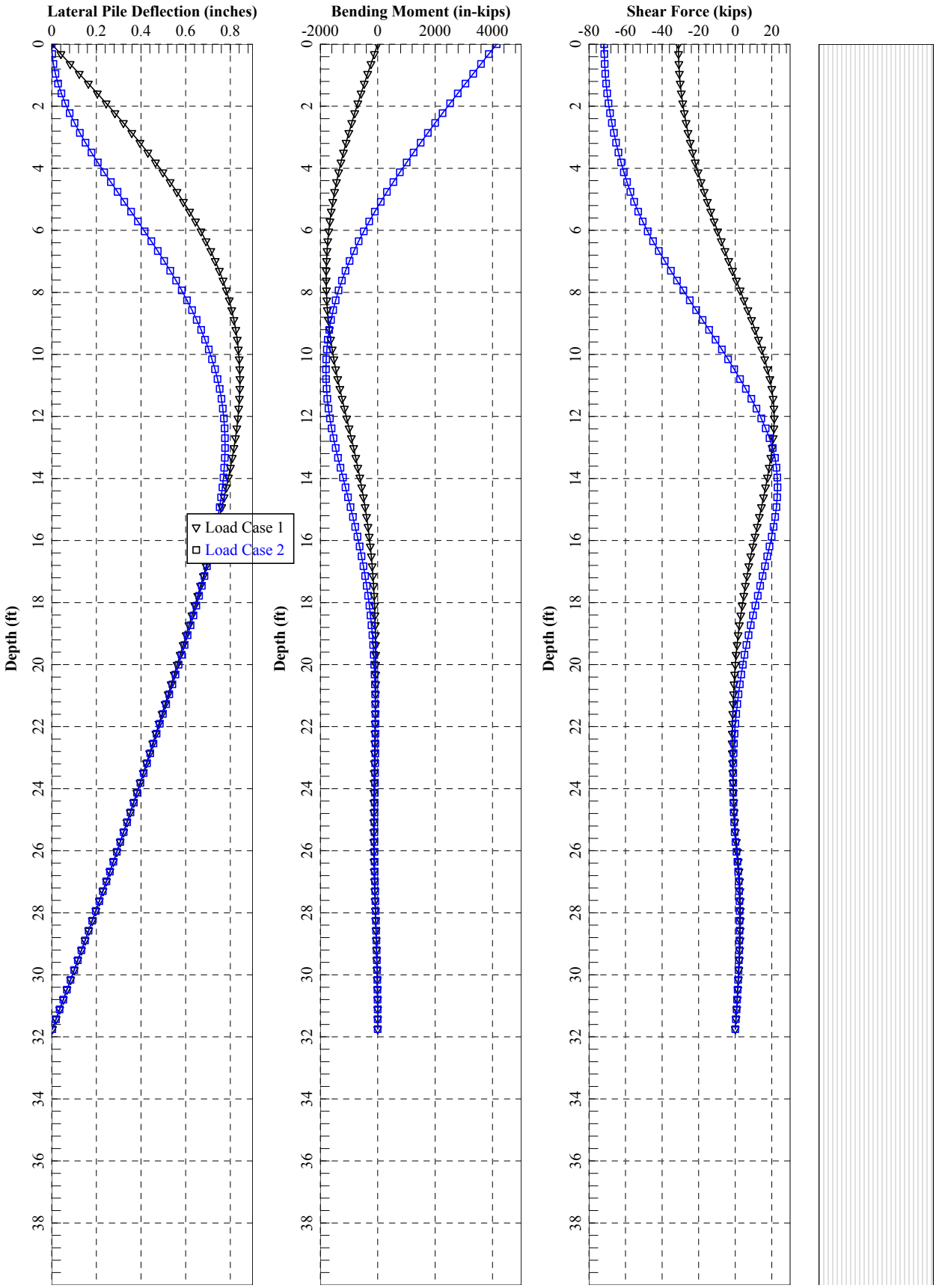
LPILE Analysis P2-003
Pier 2 - HP14x73
With 1/16" Corrosion & k = 90 pci



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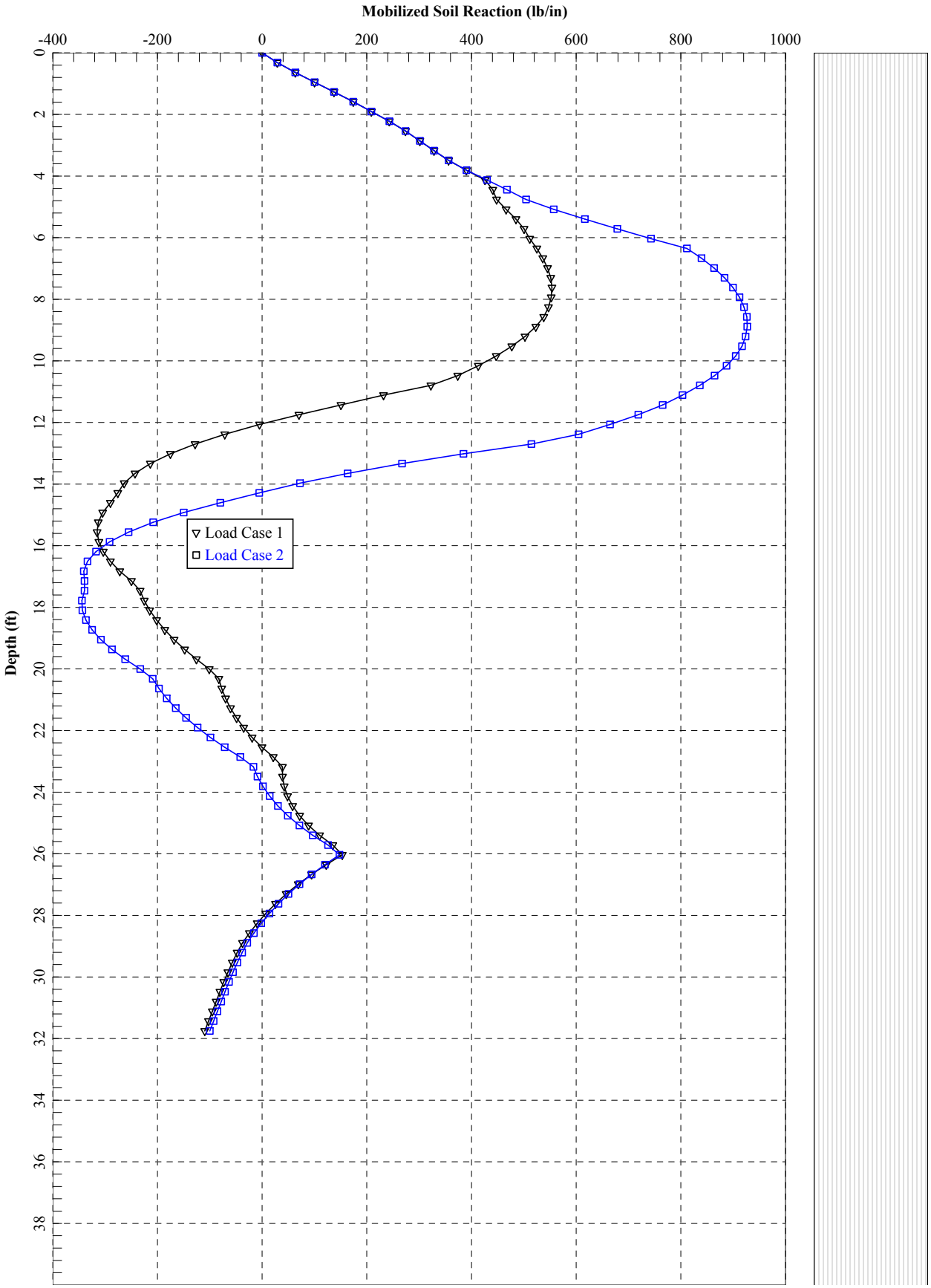
LPILE Analysis P2-003
Pier 2 - HP14x73
With 1/16" Corrosion & k = 90 pci



Project No.: J028501.01
Client: AECOM
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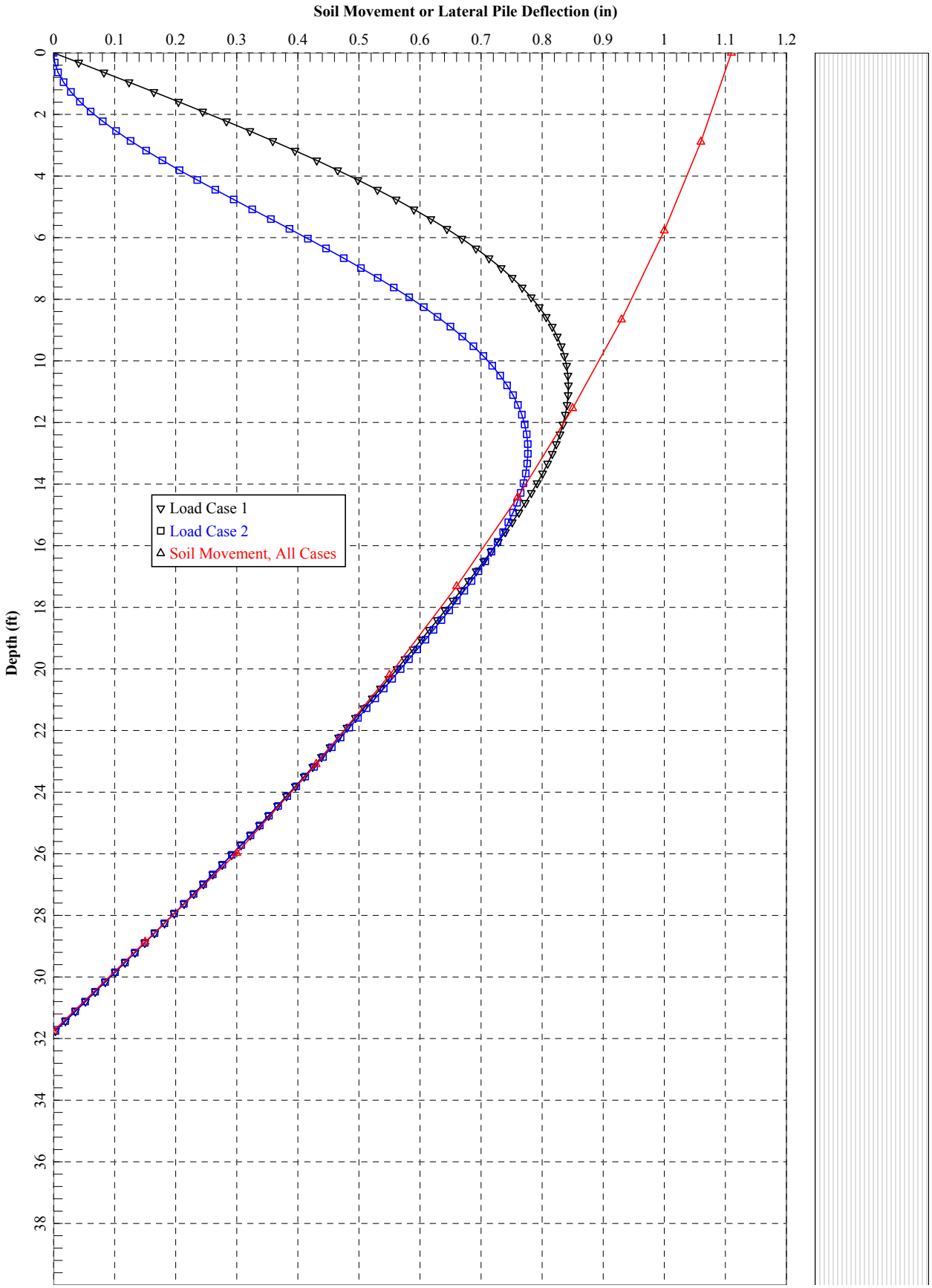
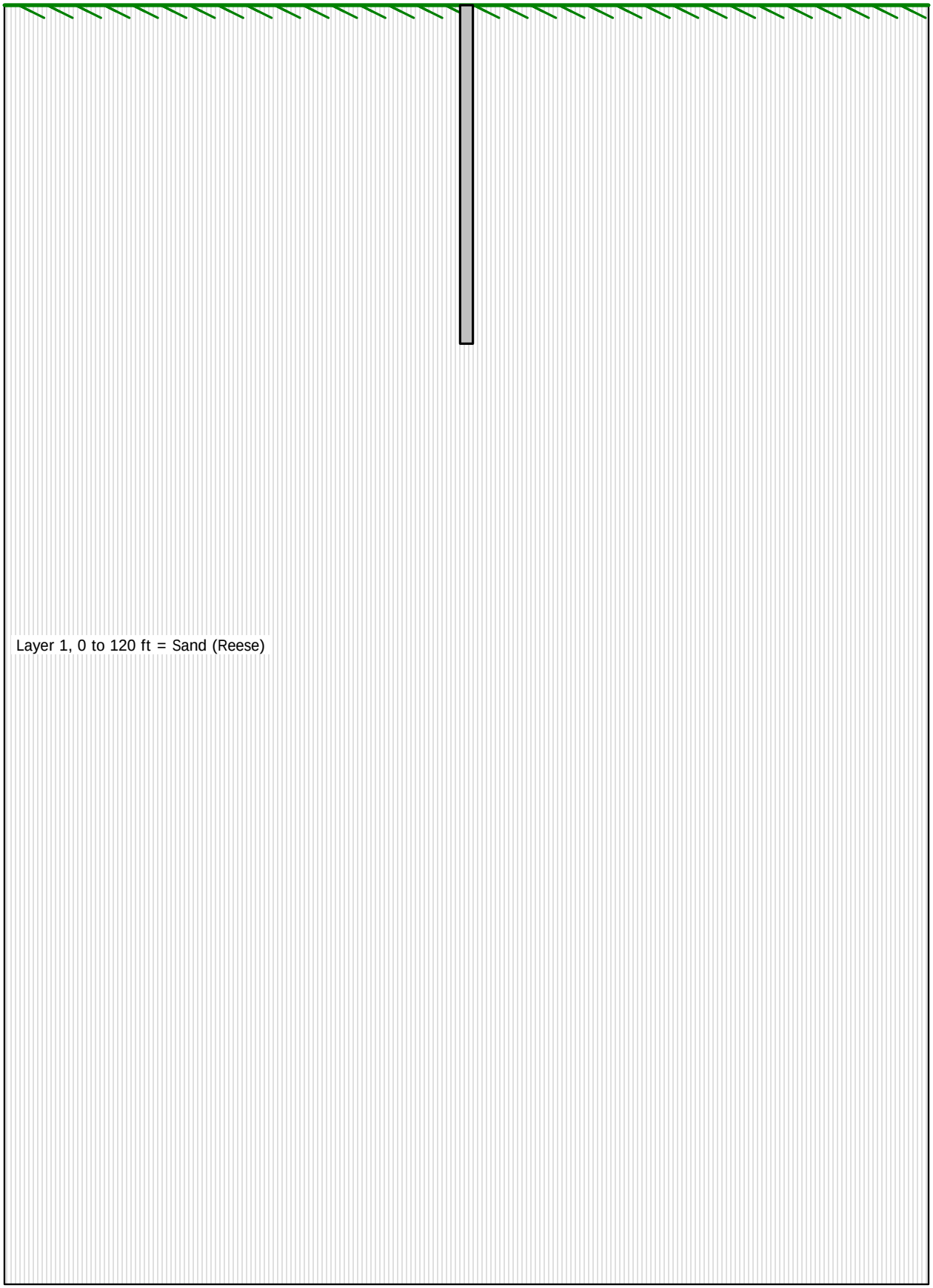
LPILE Analysis P2-003
Pier 2 - HP14x73
With 1/16" Corrosion & k = 90 pci



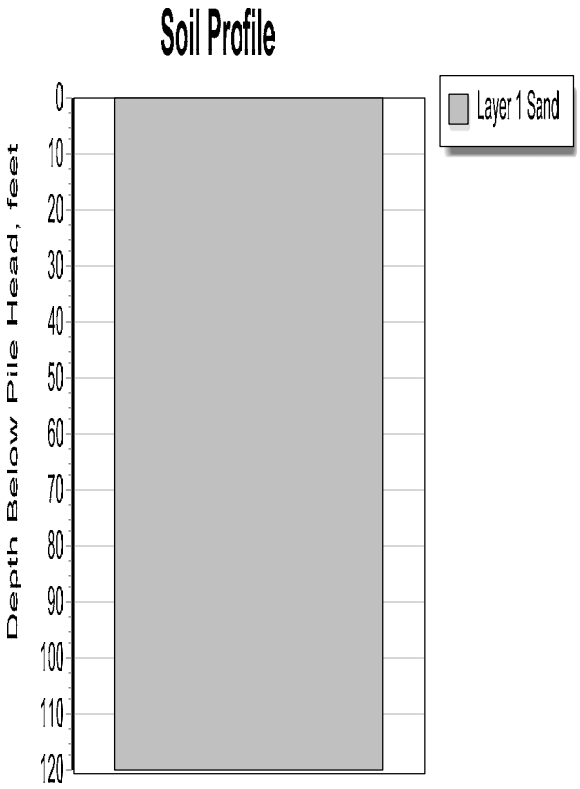
Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

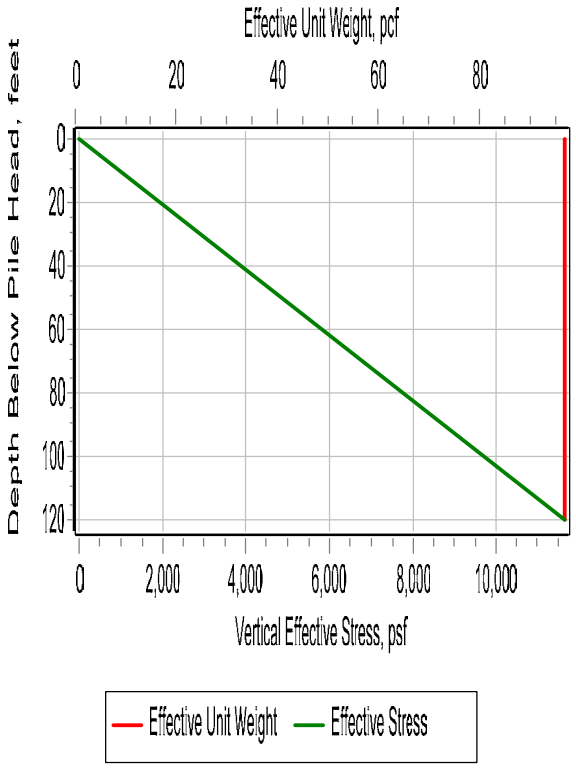
LPILE Analysis P2-1002
Pier 2 - HP14x73 at t=75 yrs. Post Repair
With 1/16" Corrosion & k = 60 pci

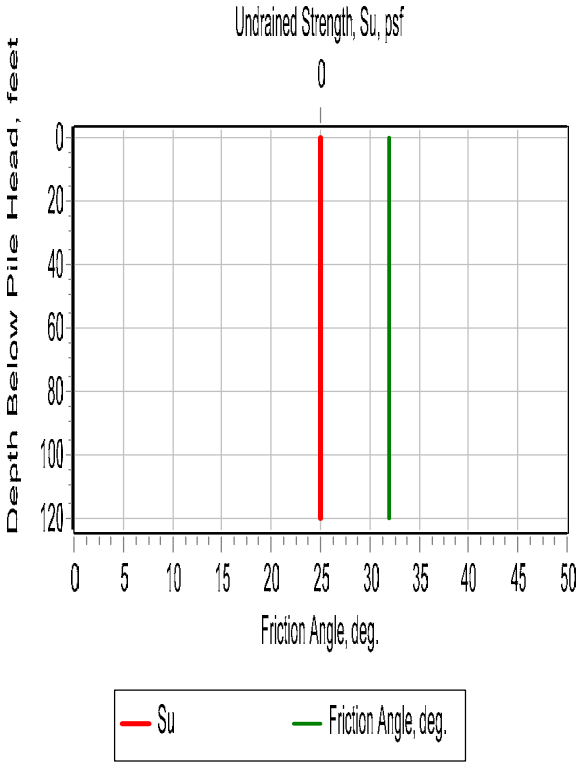


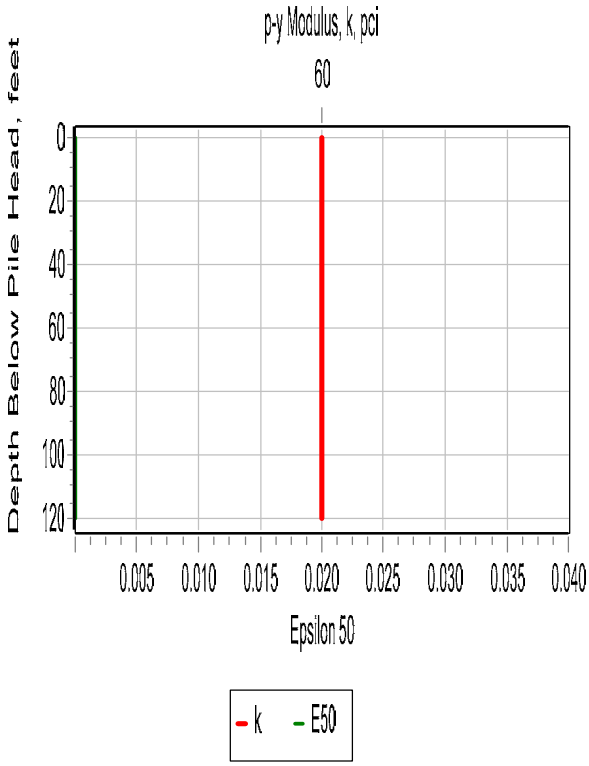
Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

LPILE Analysis P2-1002
Pier 2 - HP14x73 at t=75 yrs. Post Repair
With 1/16" Corrosion & k = 60 pci









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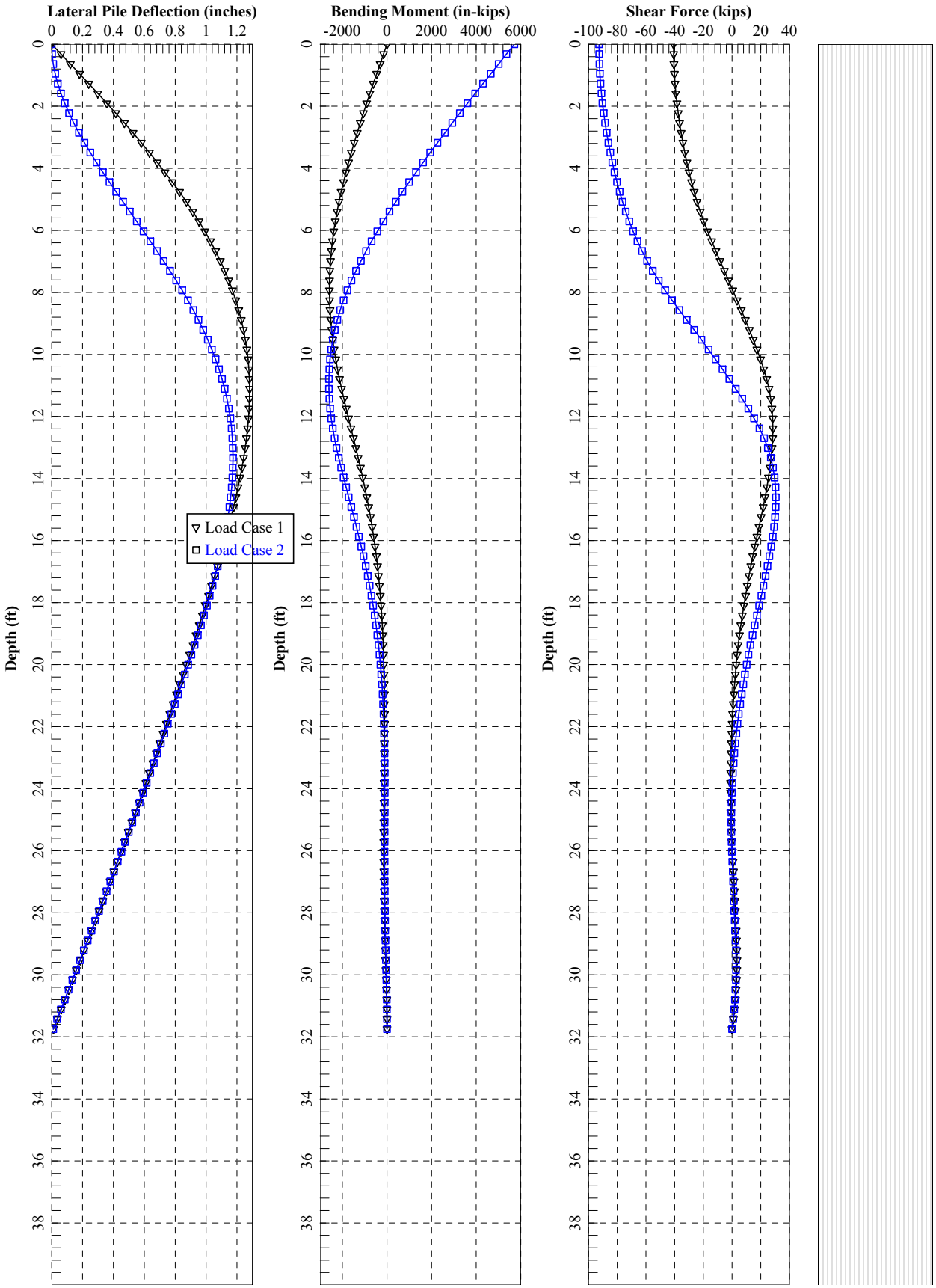
LPILE Analysis P2-1002
Pier 2 - HP14x73 at t=75 yrs. Post Repair
With 1/16" Corrosion & k = 60 pci



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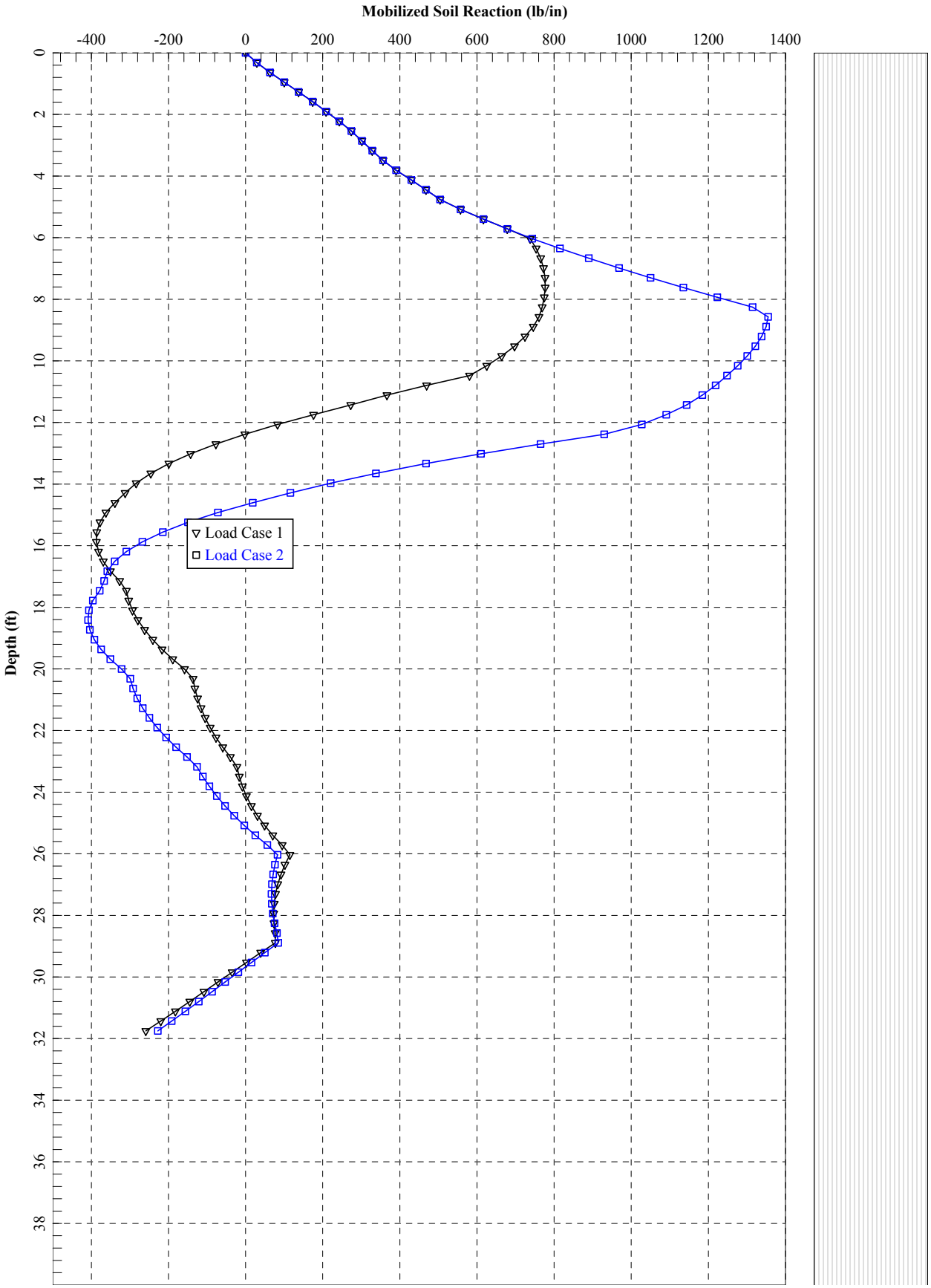
LPILE Analysis P2-1002
Pier 2 - HP14x73 at t=75 yrs. Post Repair
With 1/16" Corrosion & k = 60 pci



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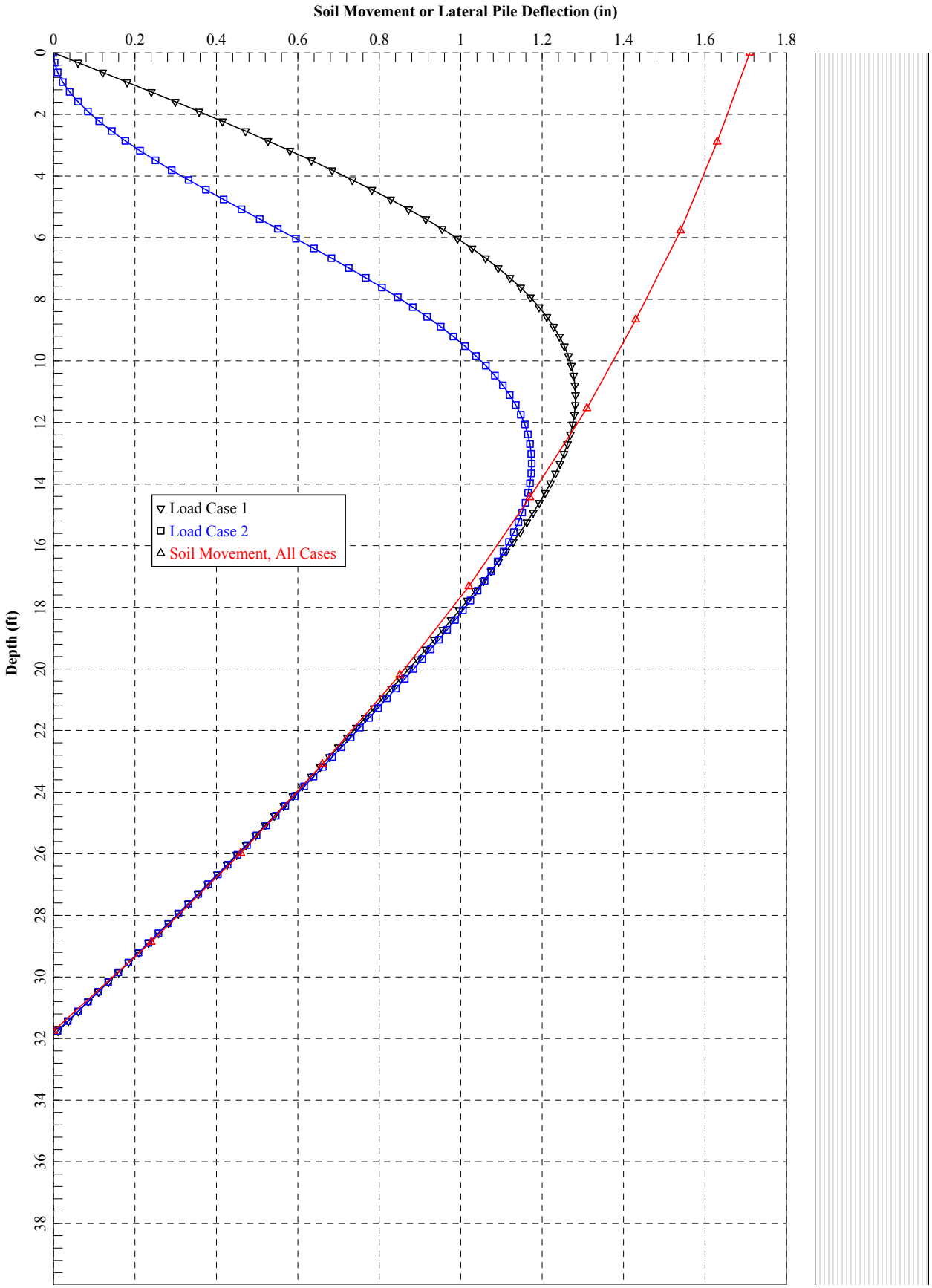
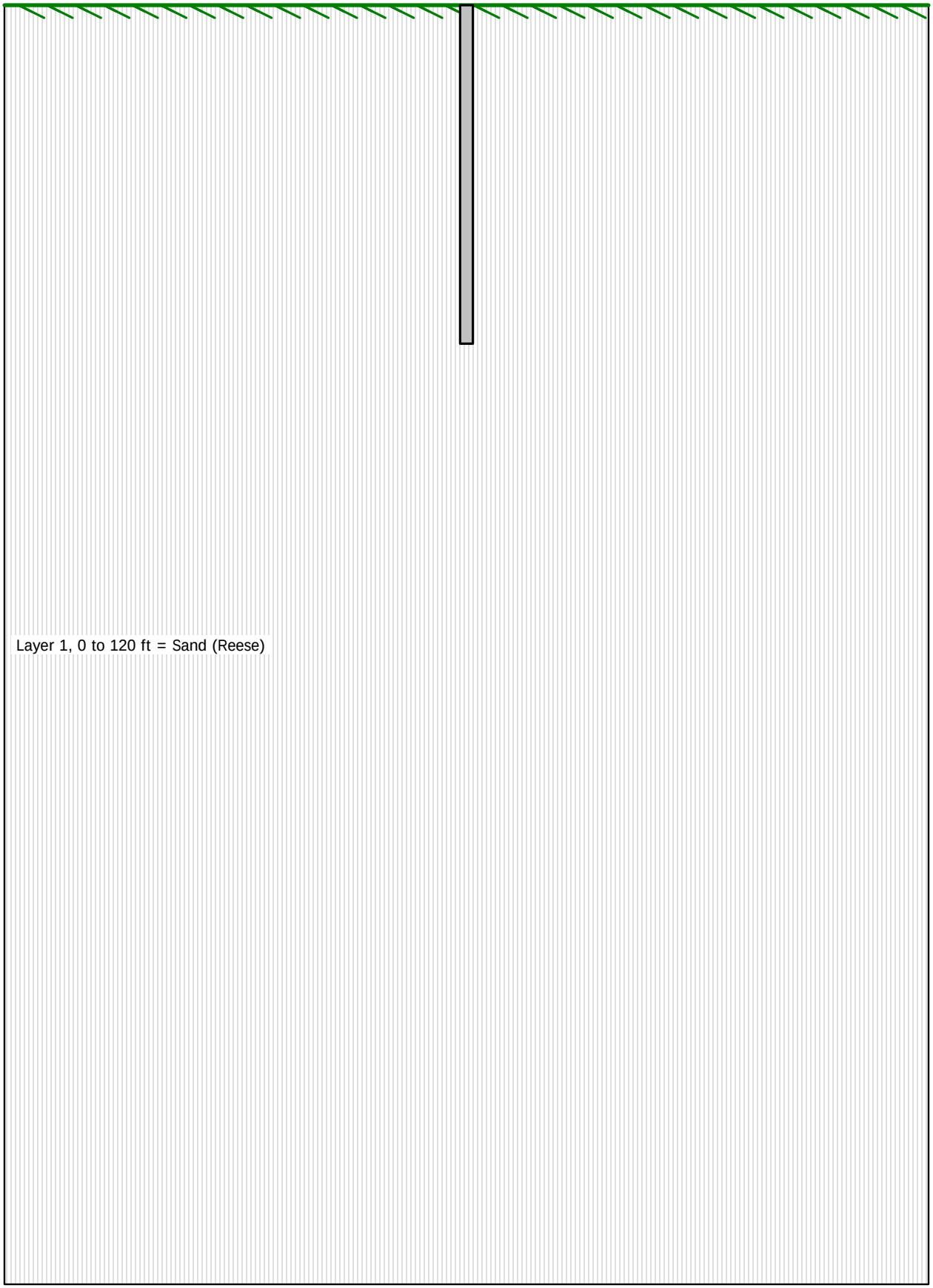
LPILE Analysis P2-1002
Pier 2 - HP14x73 at t=75 yrs. Post Repair
With 1/16" Corrosion & k = 60 pci



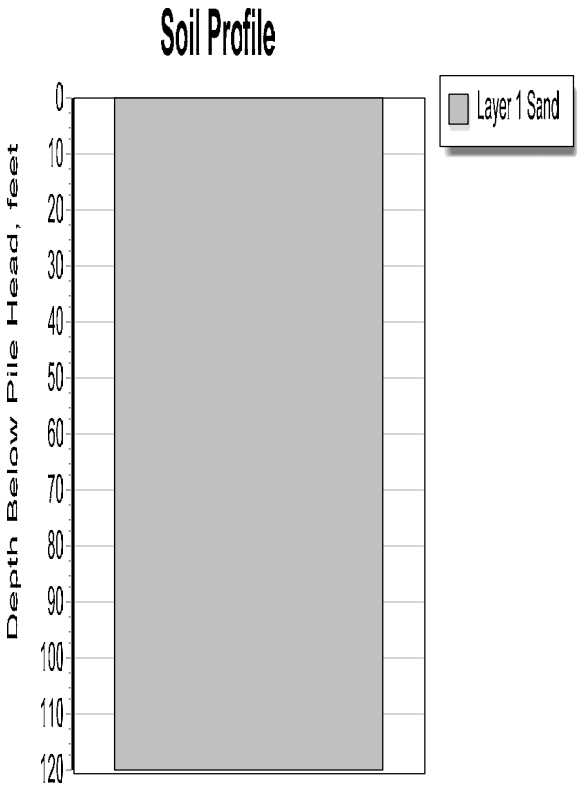
Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

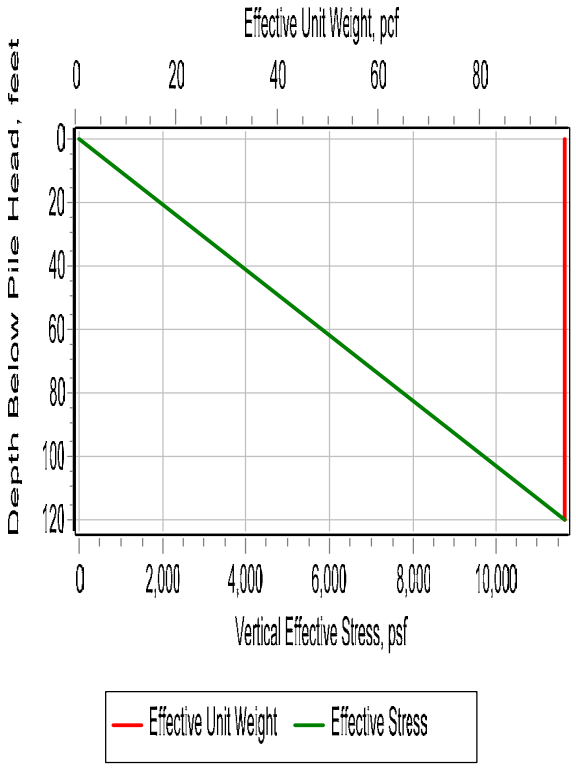
LPILE Analysis P2-1003
Pier 2 - HP14x73 at t=75 yrs. Post Repair
With 1/16" Corrosion & k = 90 pci

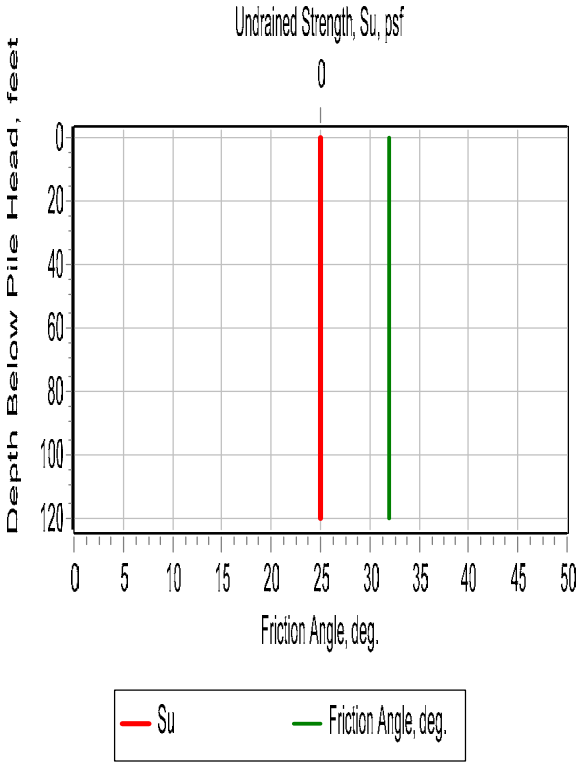


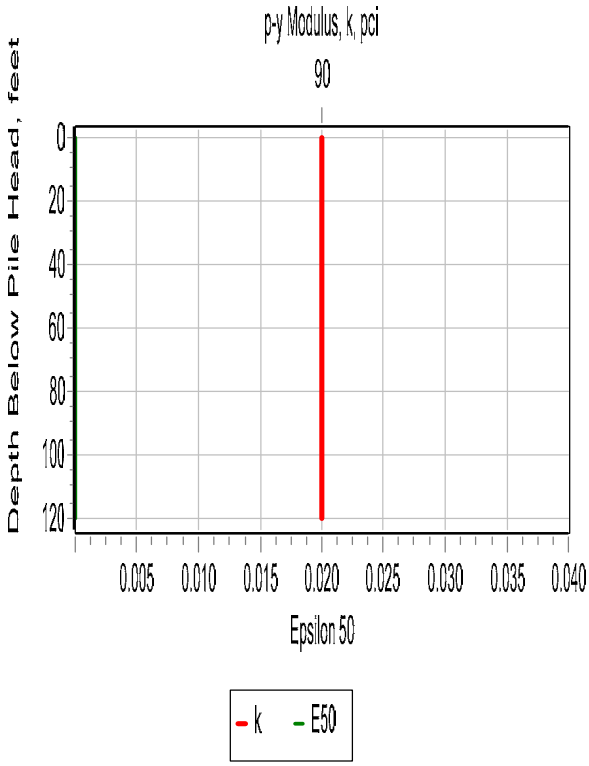
Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

LPILE Analysis P2-1003
Pier 2 - HP14x73 at t=75 yrs. Post Repair
With 1/16" Corrosion & k = 90 pci









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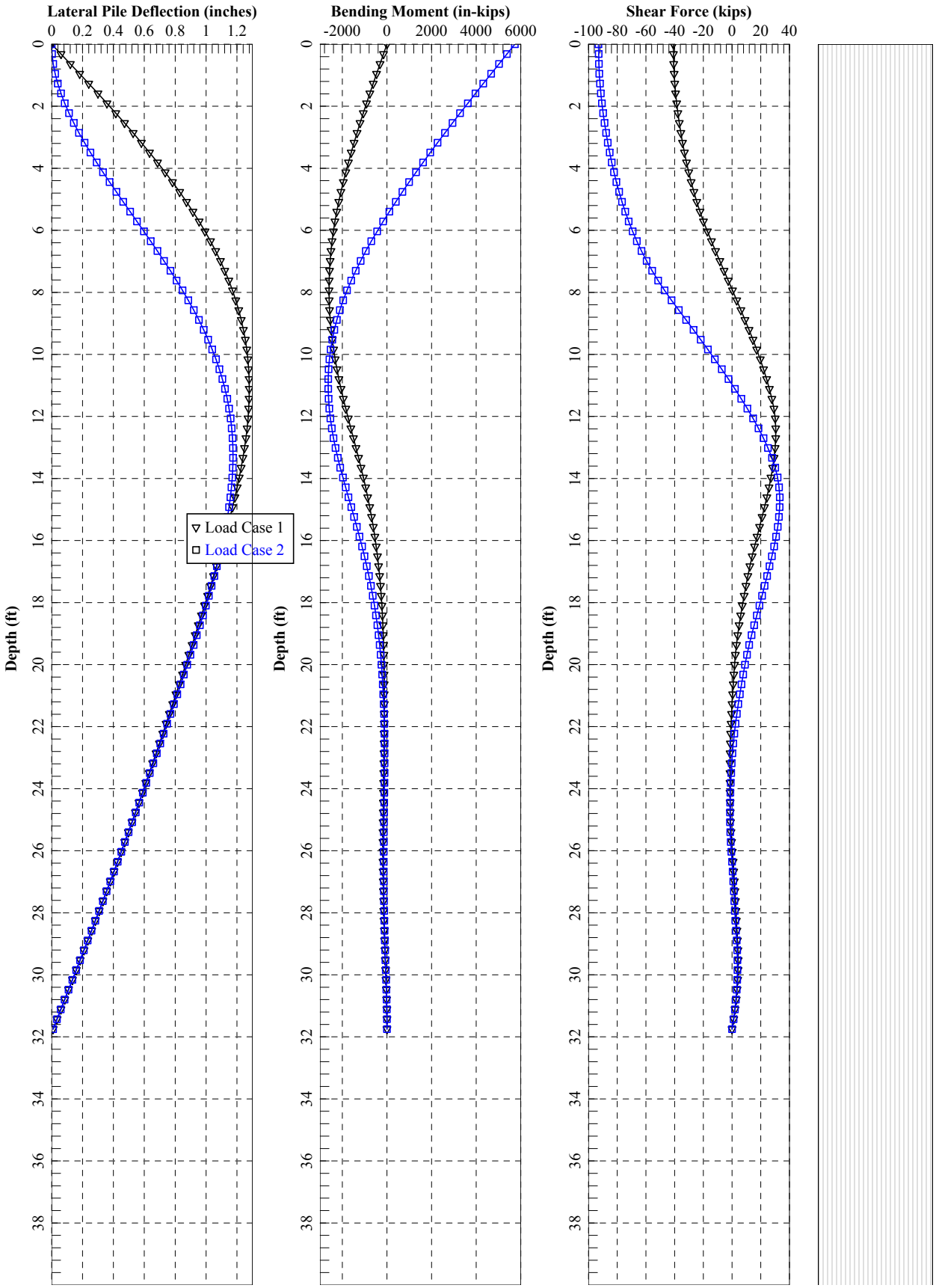
LPILE Analysis P2-1003
Pier 2 - HP14x73 at t=75 yrs. Post Repair
With 1/16" Corrosion & k = 90 pci



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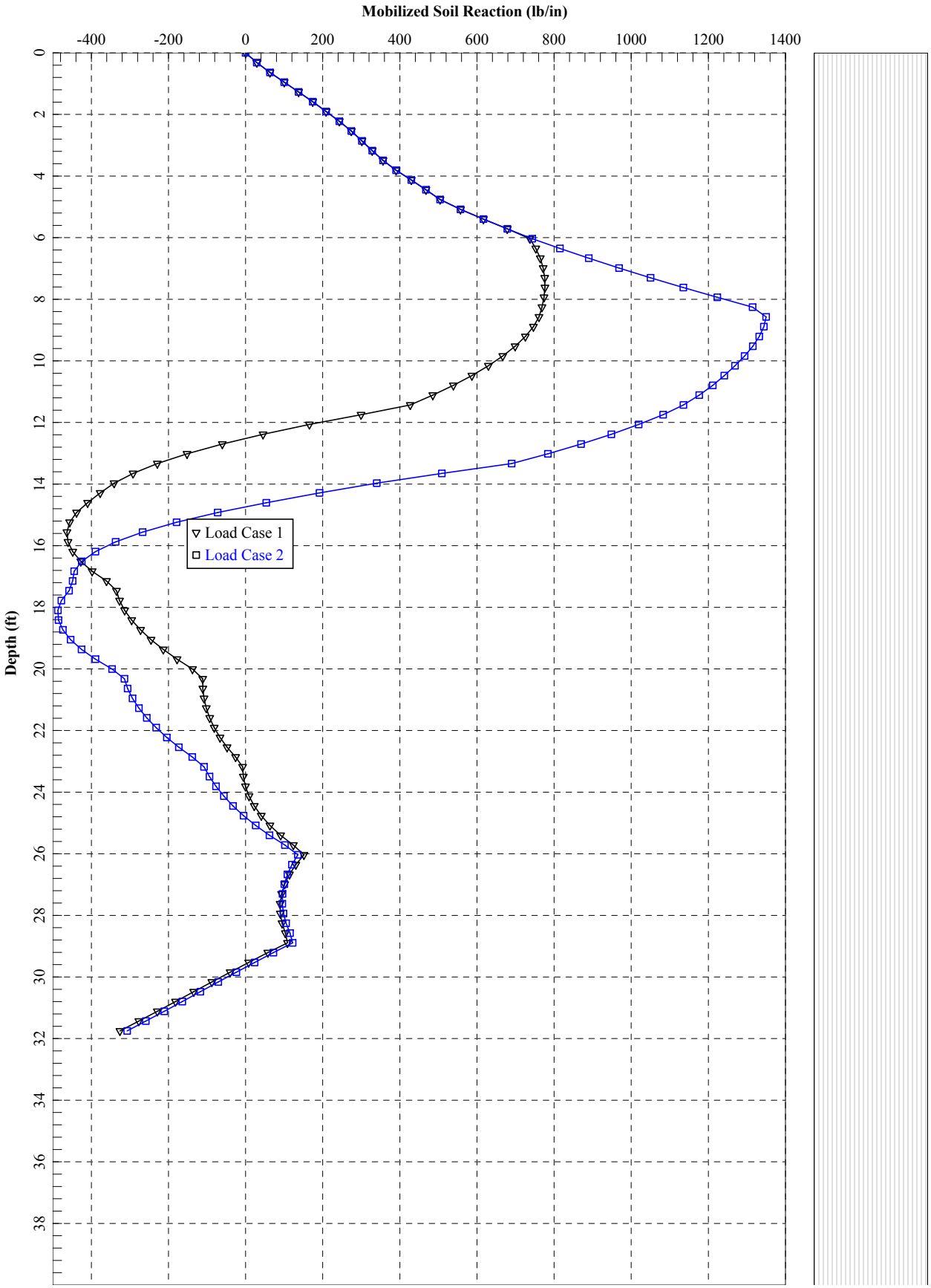
LPILE Analysis P2-1003
Pier 2 - HP14x73 at t=75 yrs. Post Repair
With 1/16" Corrosion & k = 90 pci



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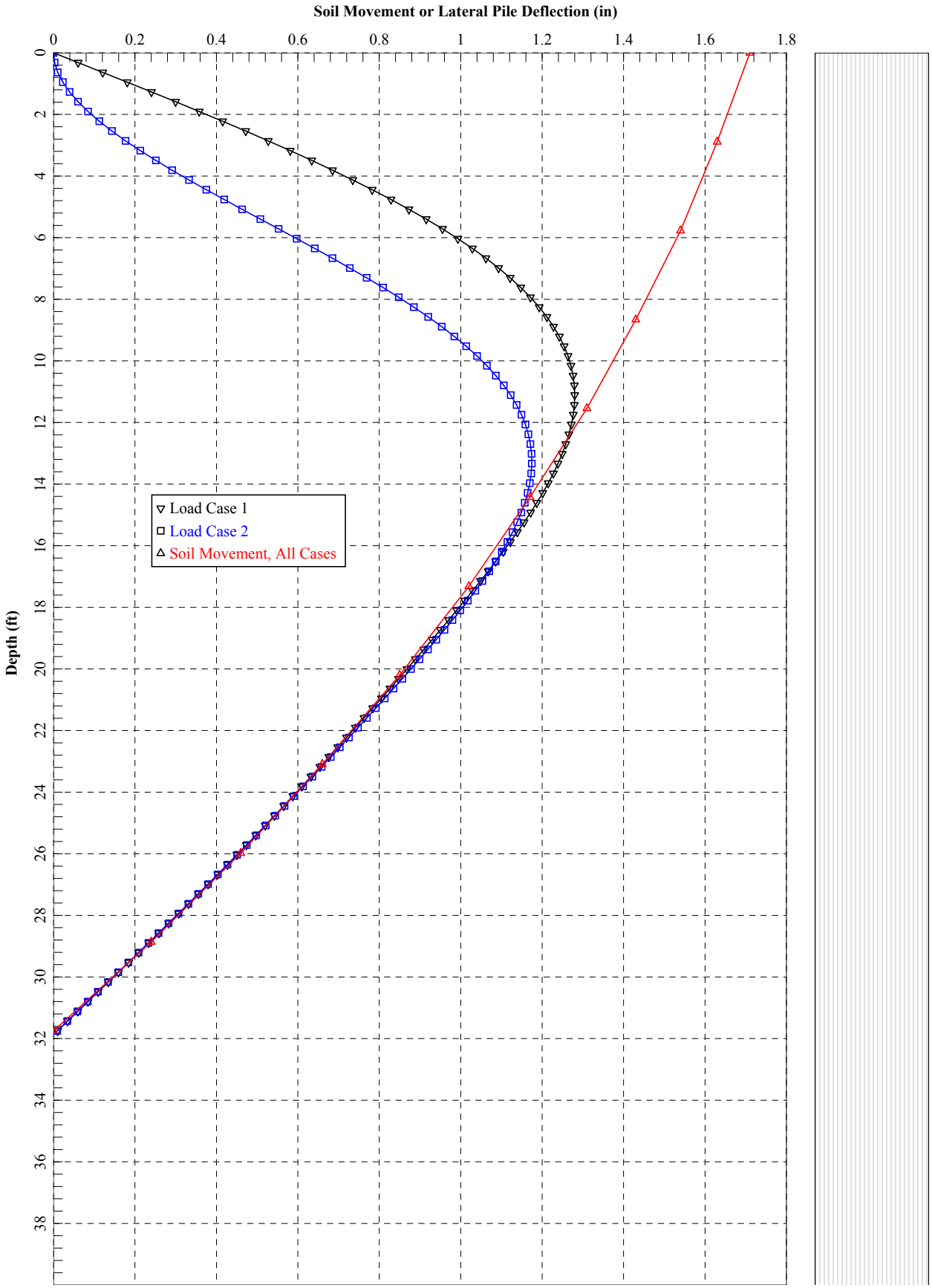
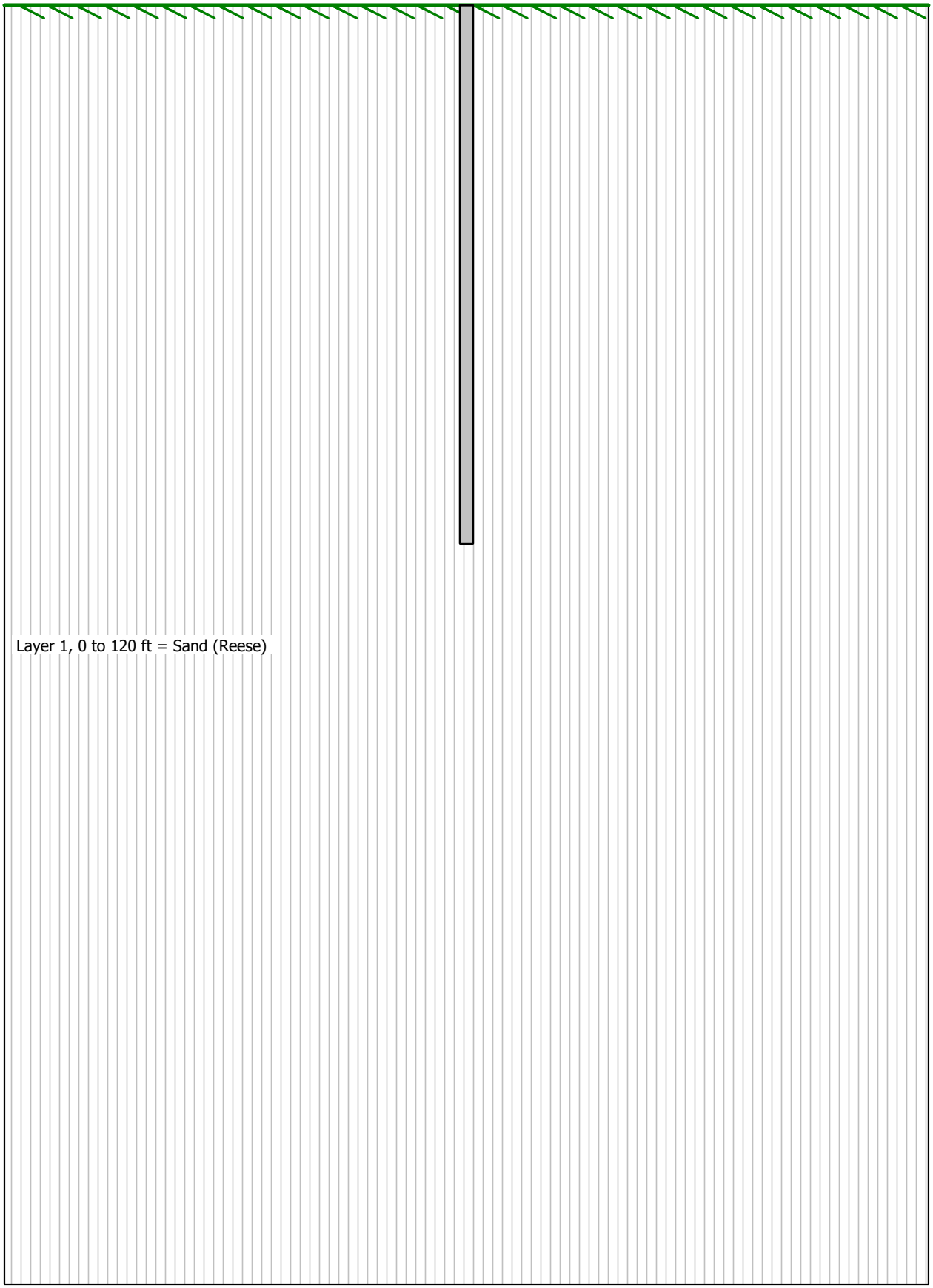
Project: US 68 Bridge over Lawrence Creek

LPILE Analysis P2-1003
Pier 2 - HP14x73 at t=75 yrs. Post Repair
With 1/16" Corrosion & k = 90 pci



Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

LPILE Analysis P5-002
Pier 5 - HP14x73
With 1/16" Corrosion & k = 60 pci



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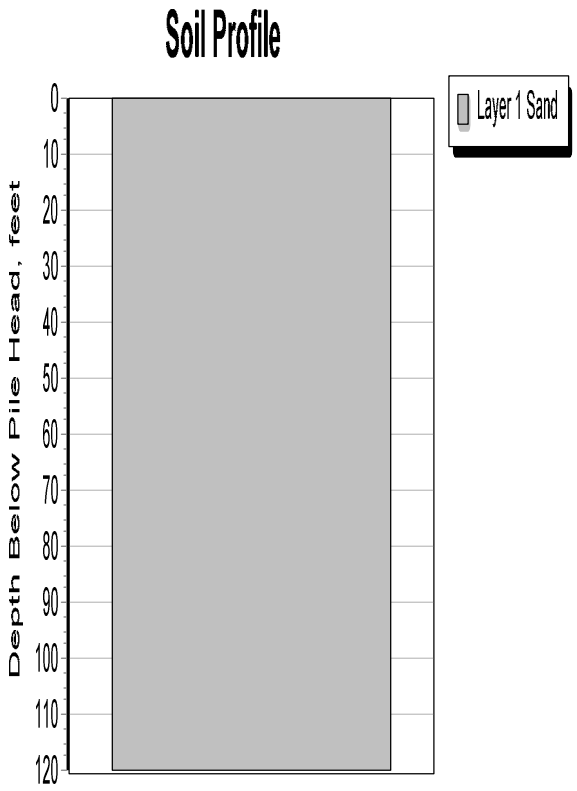
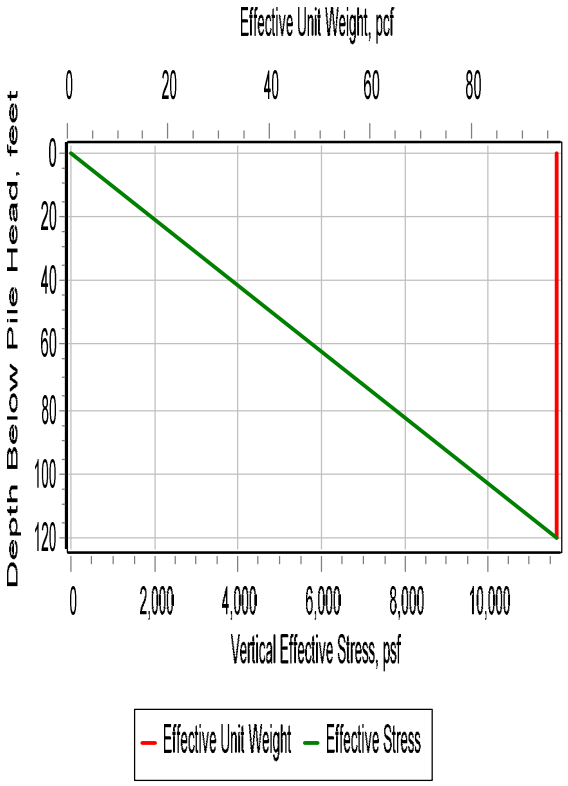
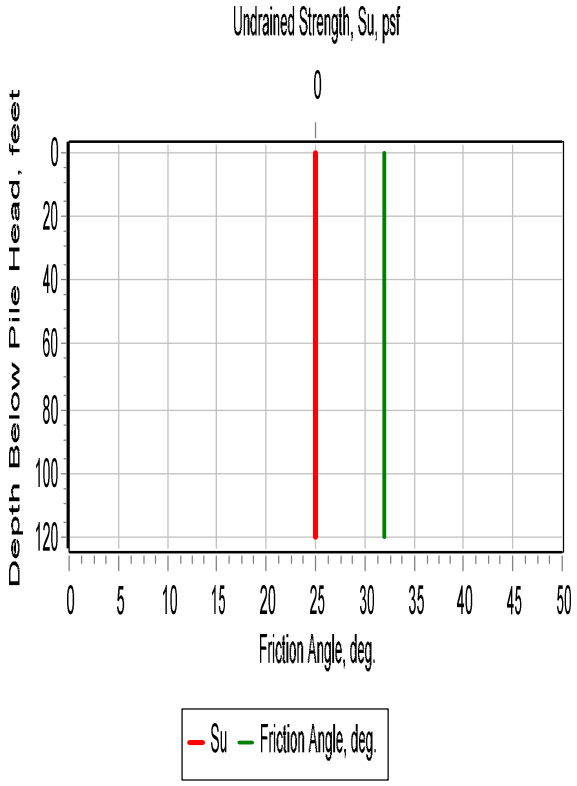
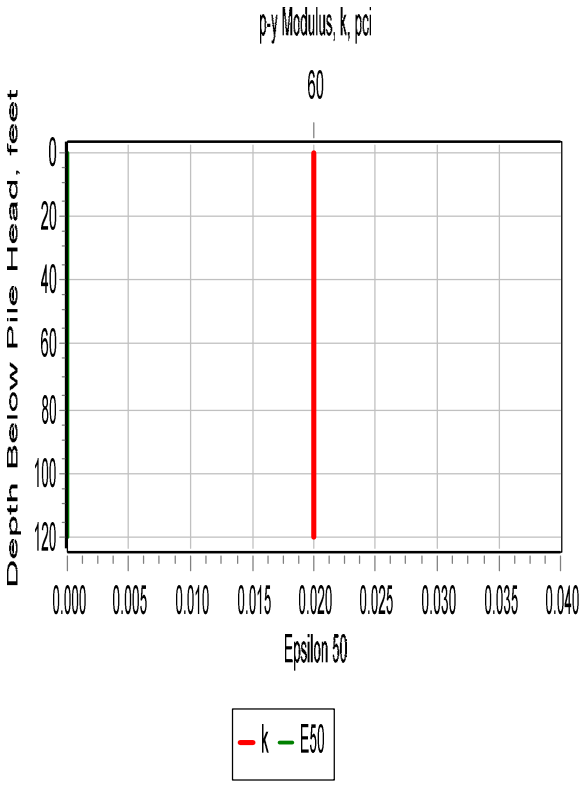
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

LPILE Analysis P5-002
Pier 5 - HP14x73
With 1/16" Corrosion & k = 60 pci









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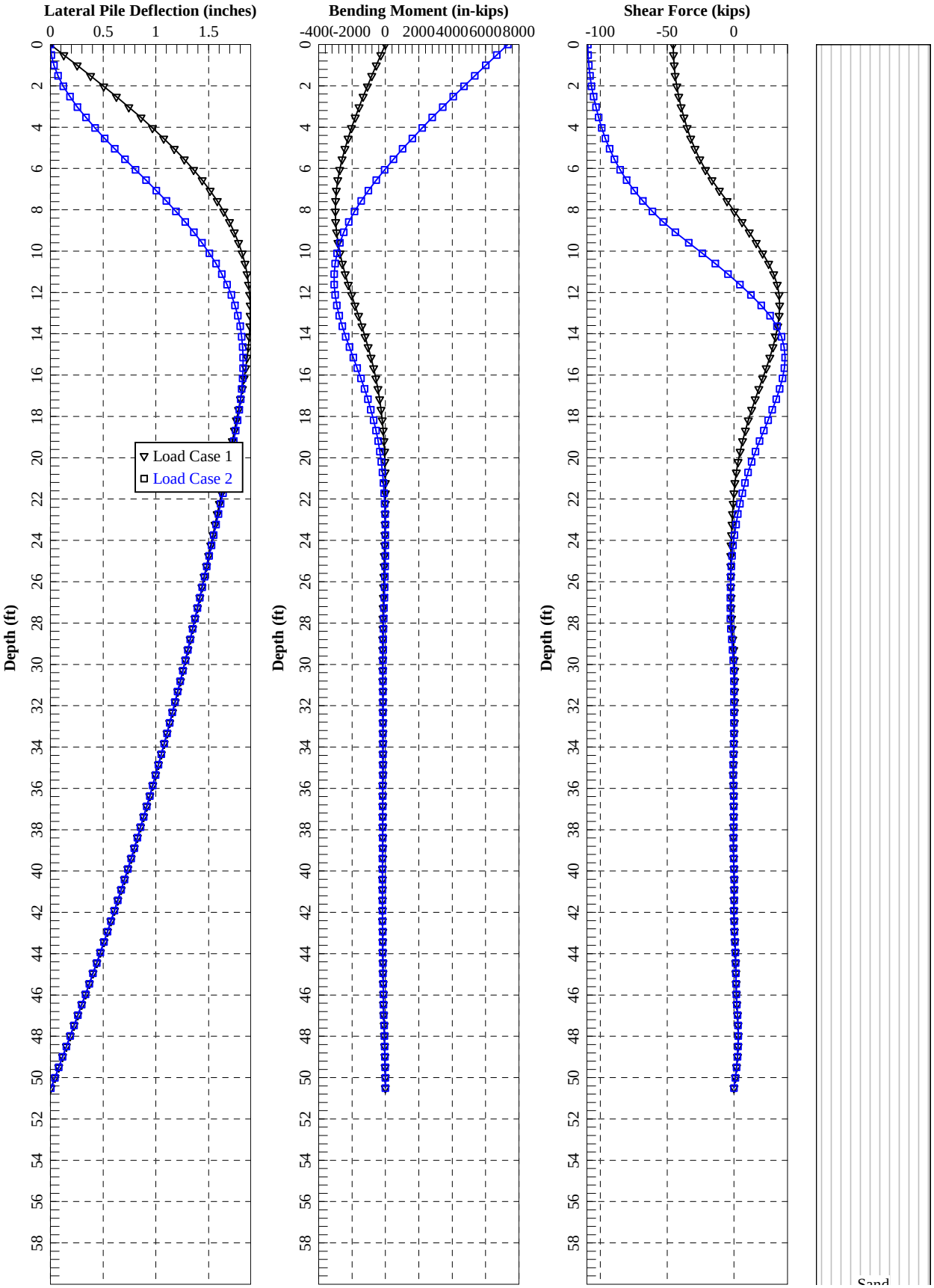
LPILE Analysis P5-002
Pier 5 - HP14x73
With 1/16" Corrosion & k = 60 pci



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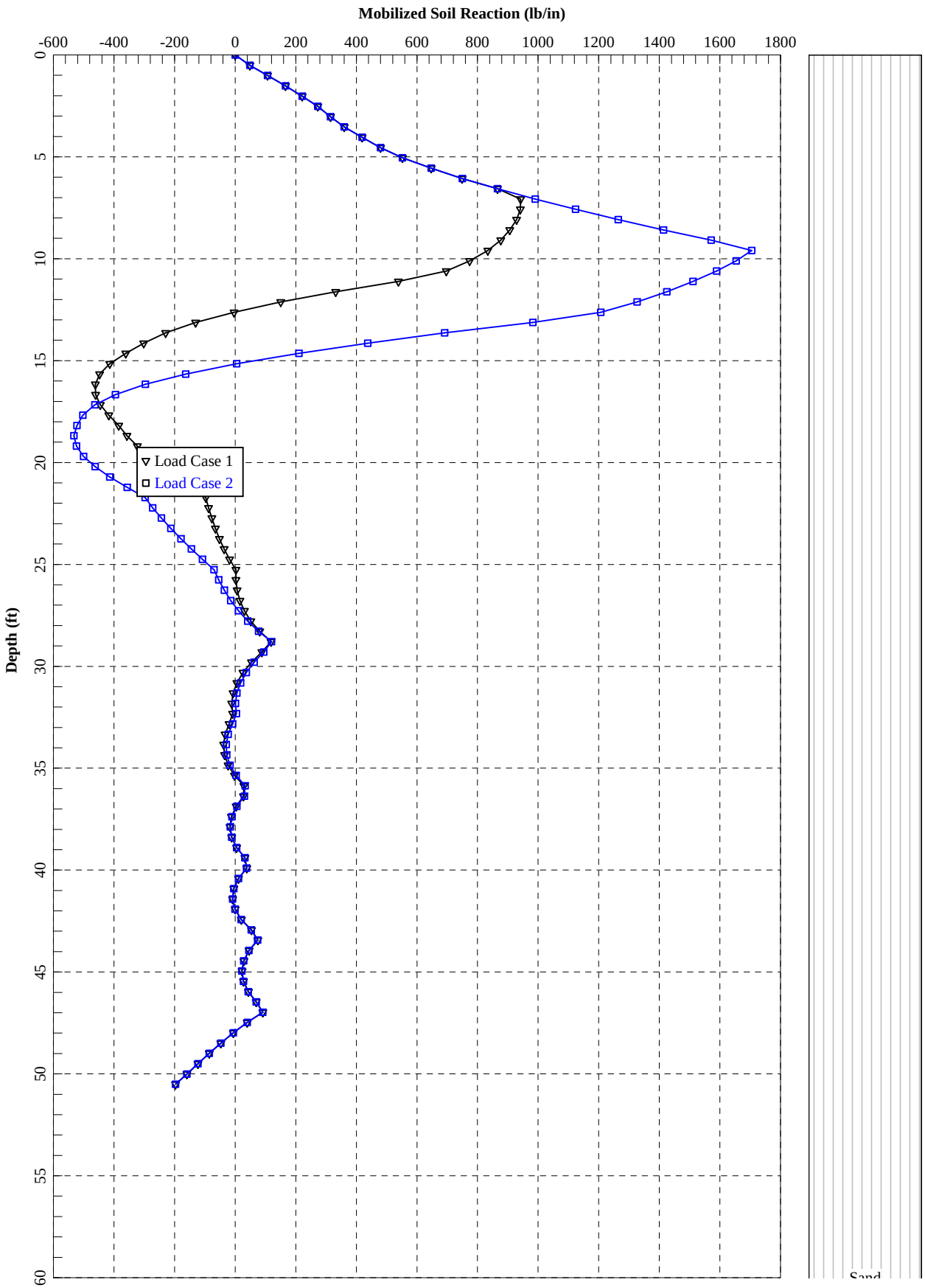
LPILE Analysis P5-002
Pier 5 - HP14x73
With 1/16" Corrosion & k = 60 pci



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LPILE Analysis P5-002
Pier 5 - HP14x73
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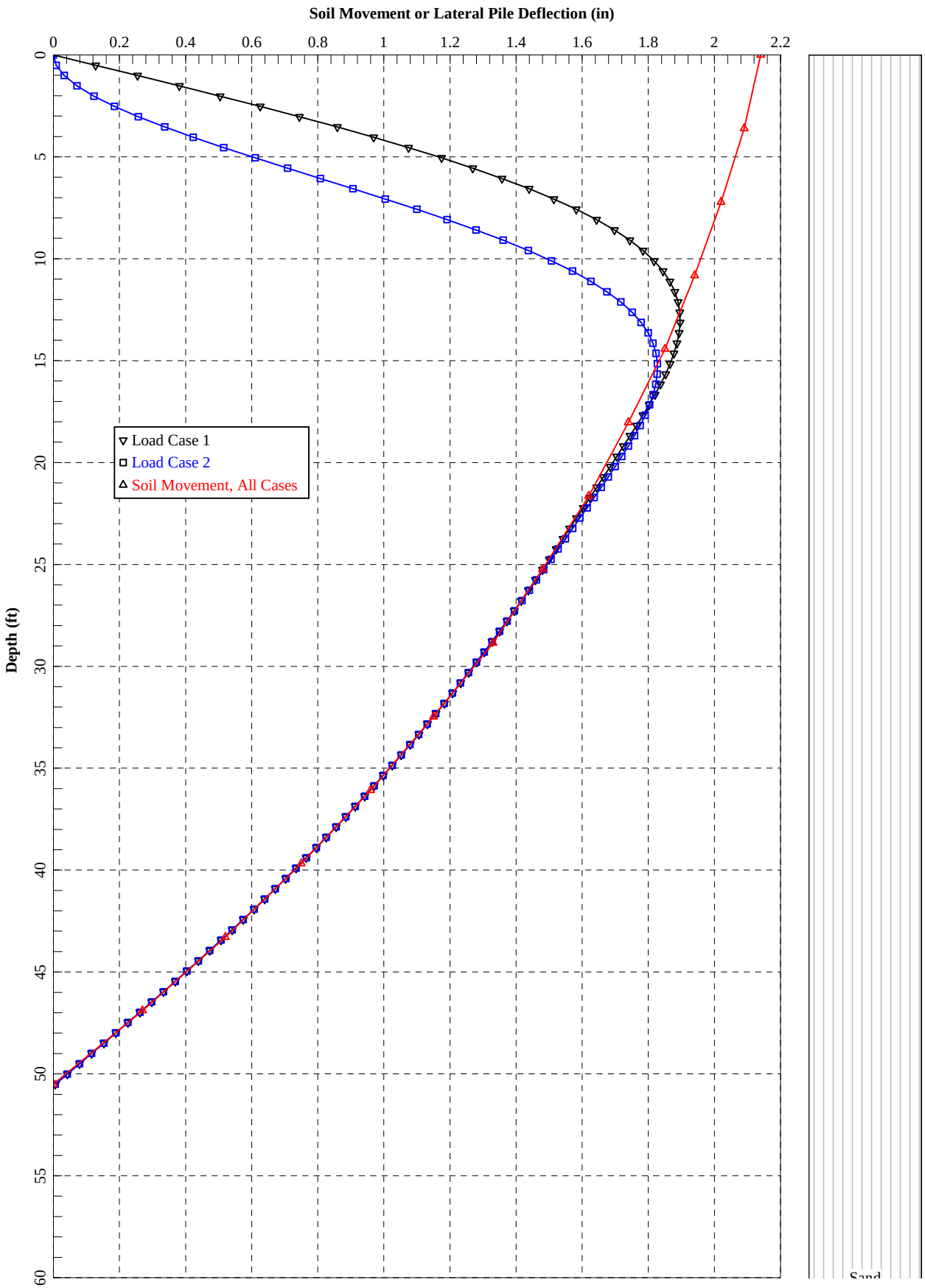

Project No.: J028501.01
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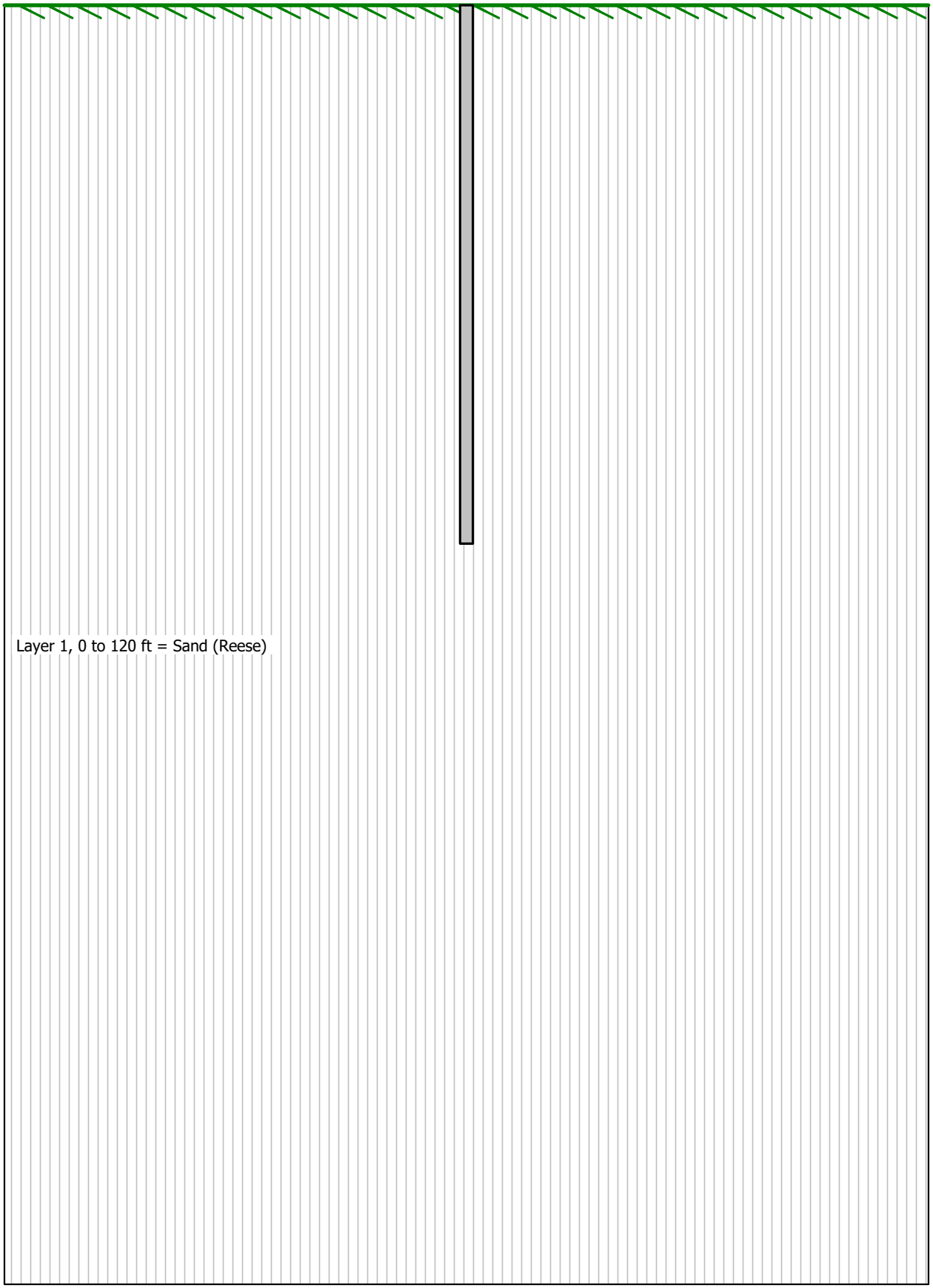
LPILE Analysis P5-003
Pier 5 - HP14x73
With 1/16" Corrosion & k = 90 pci



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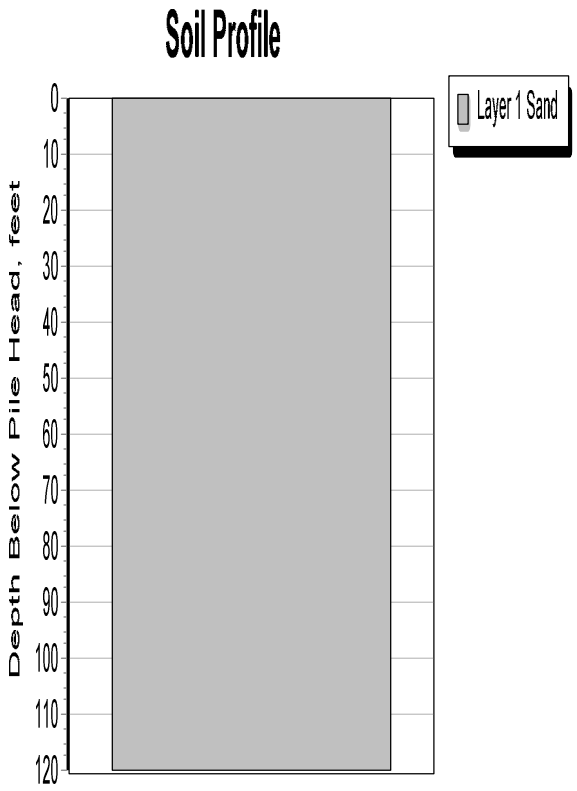
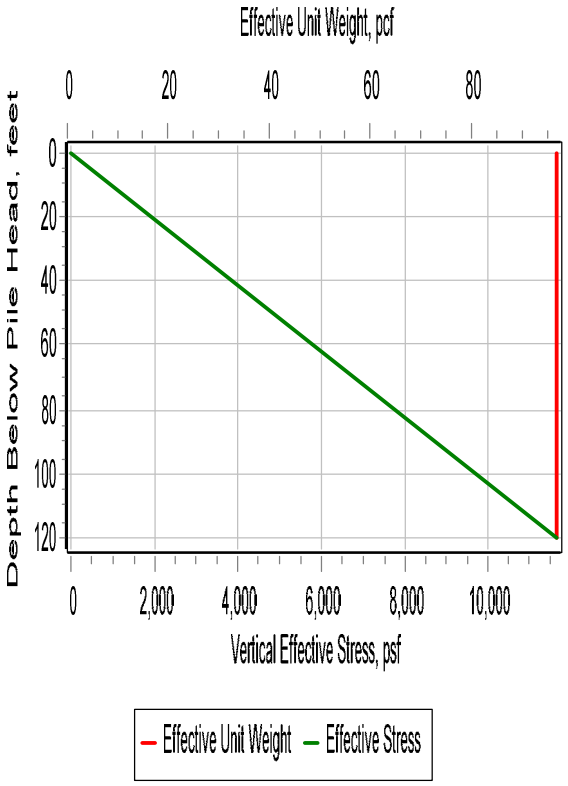
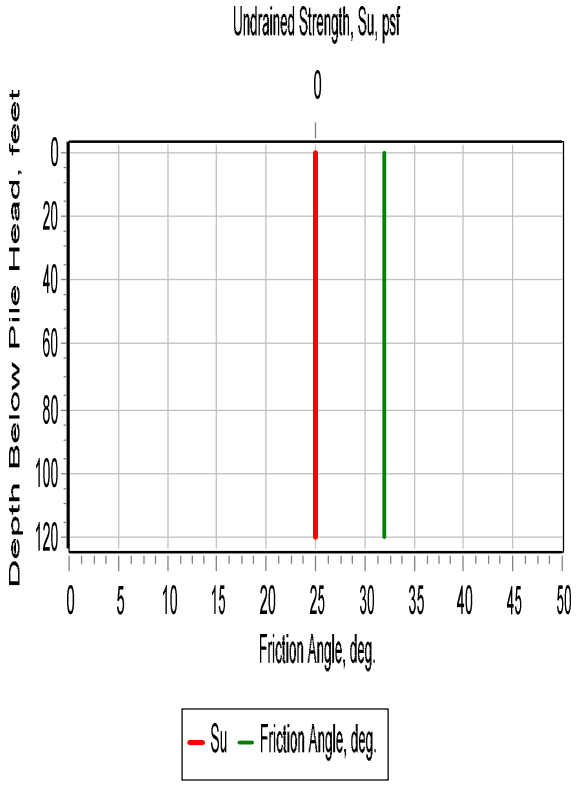
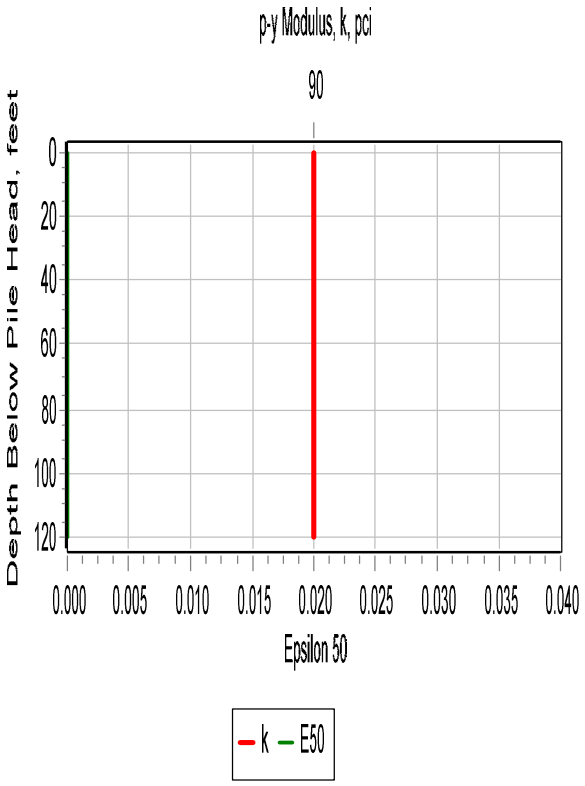
LPILE Analysis P5-003
Pier 5 - HP14x73
With 1/16" Corrosion & k = 90 pci









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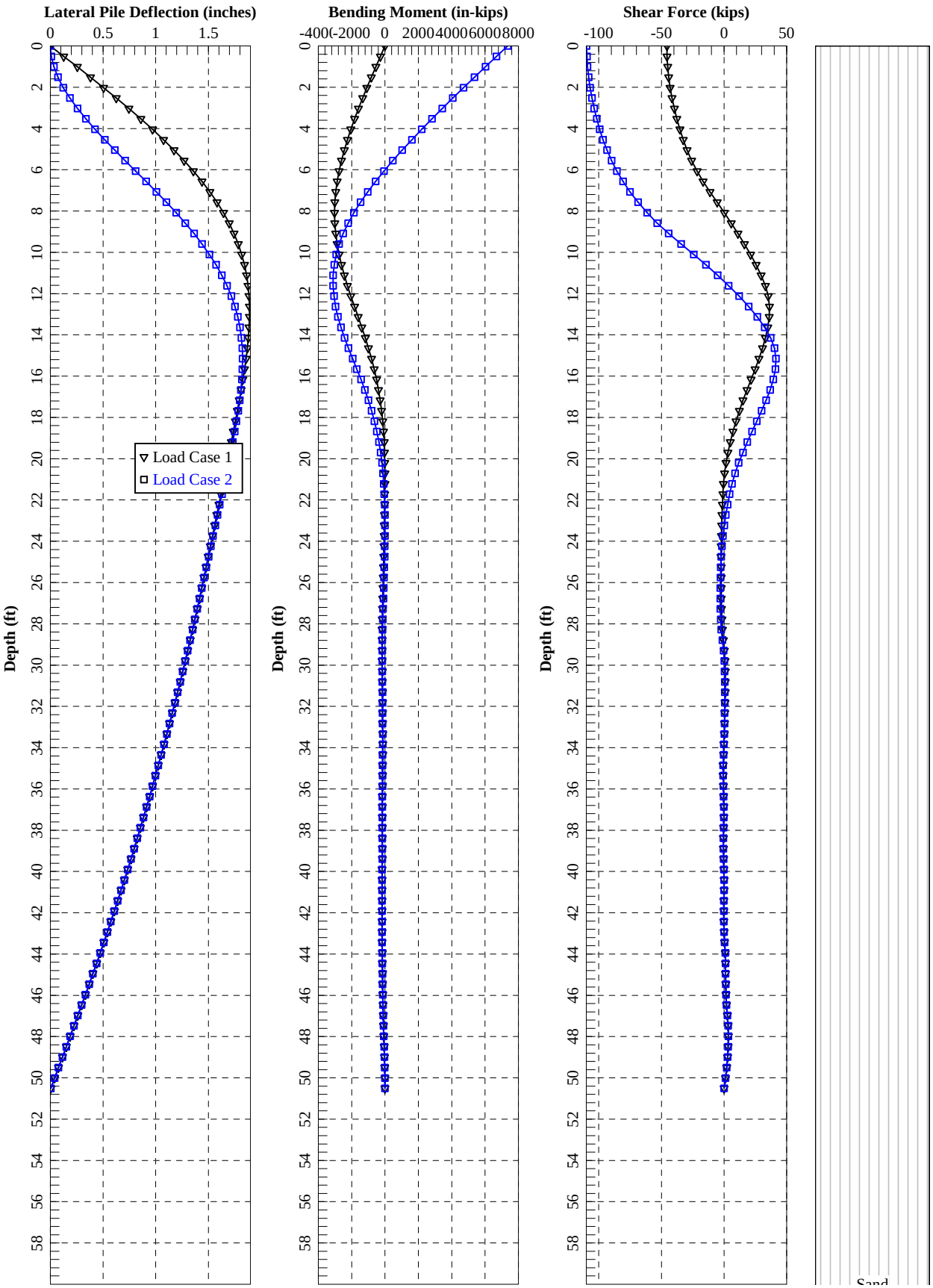
LPILE Analysis P5-003
Pier 5 - HP14x73
With 1/16" Corrosion & k = 90 pci



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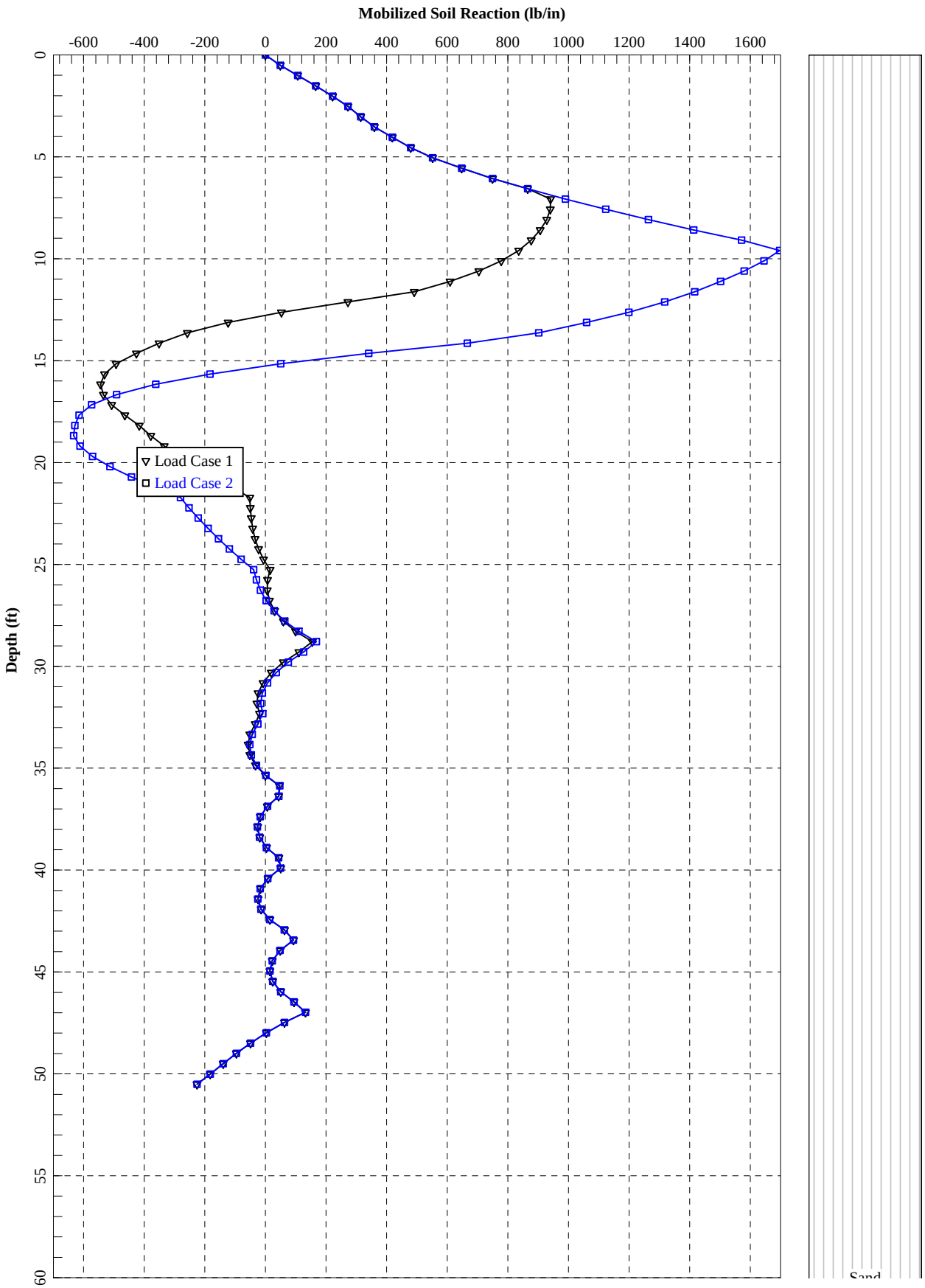
LPILE Analysis P5-003
Pier 5 - HP14x73
With 1/16" Corrosion & k = 90 pci



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LPILE Analysis P5-003
Pier 5 - HP14x73
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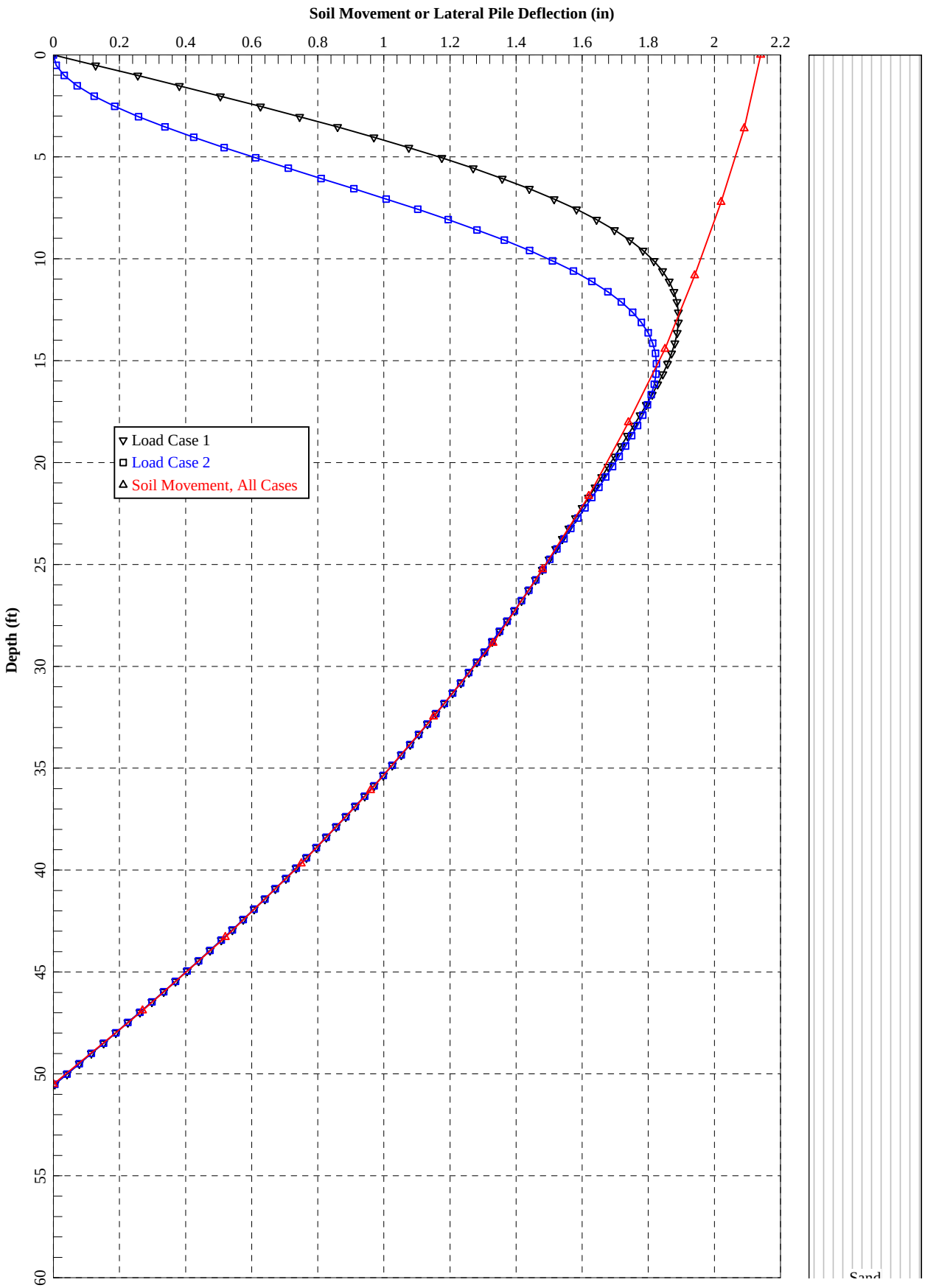

Project No.: J028501.01
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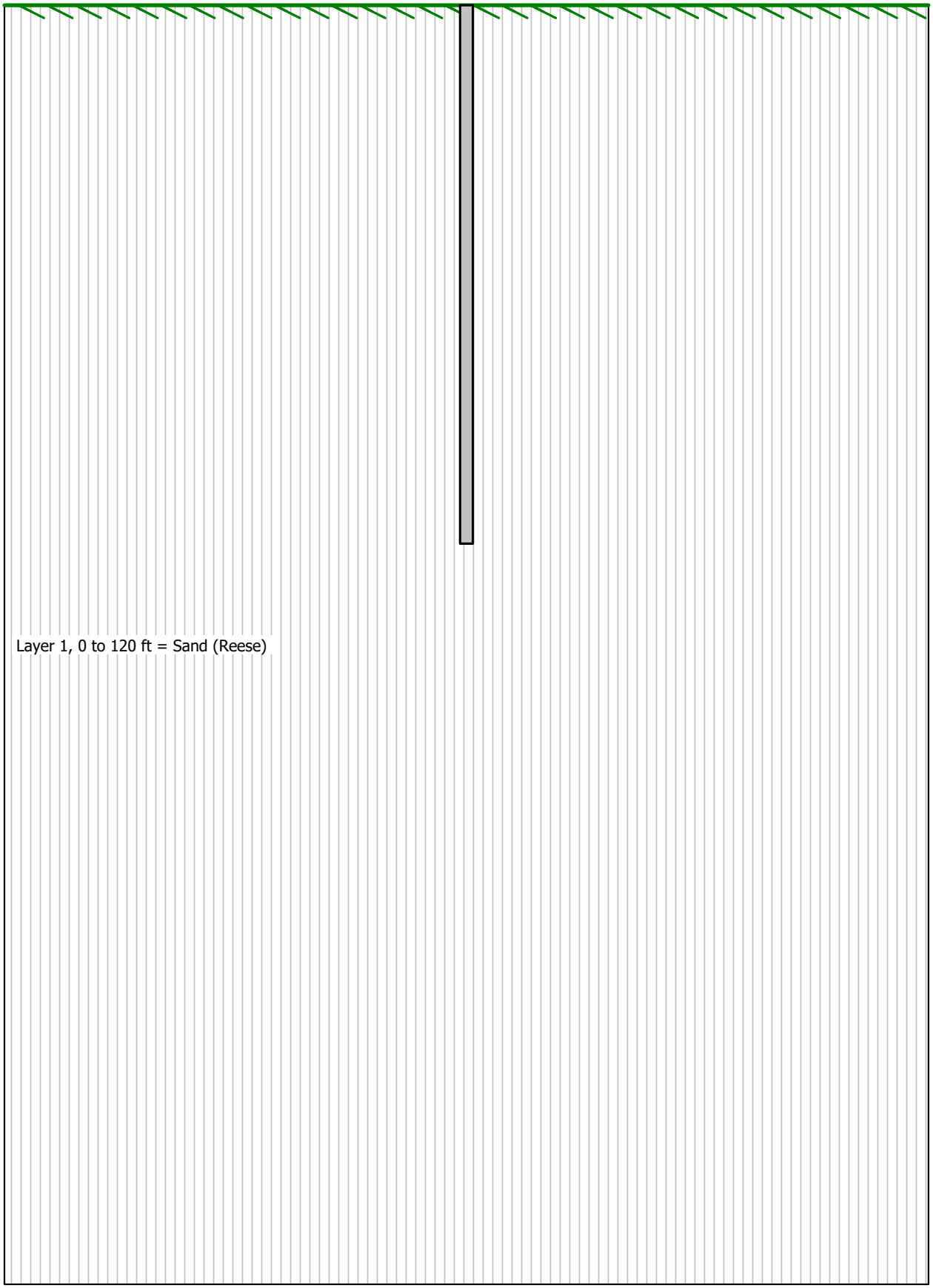
LPILE Analysis P5-1002
Pier 5 - HP14x73 at t =75 yrs. Post Repair
With 1/16" Corrosion & k = 60 pci



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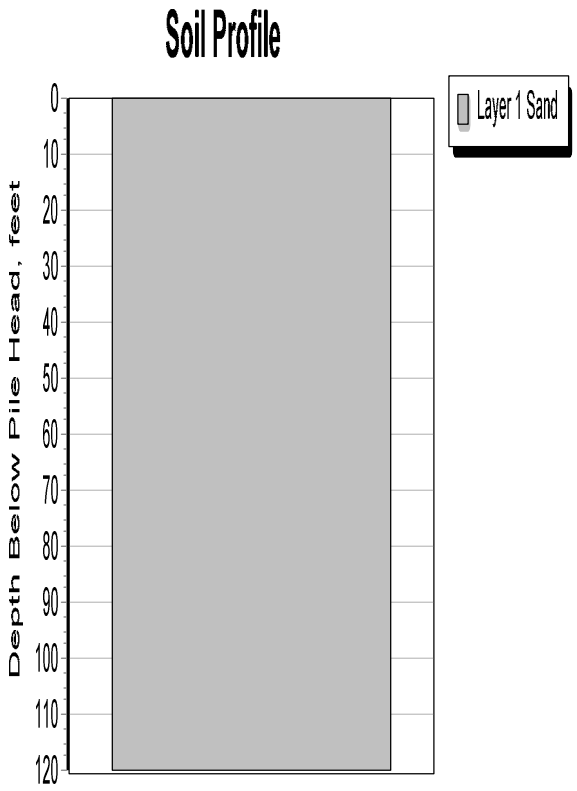
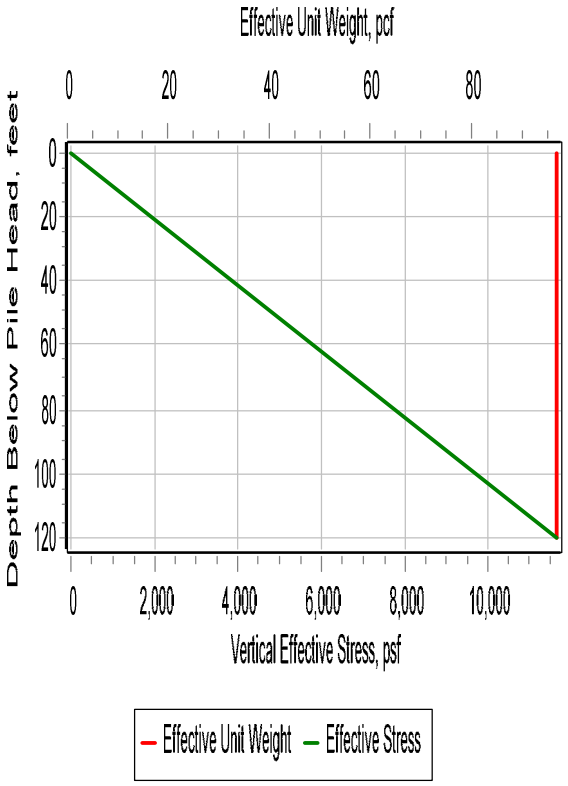
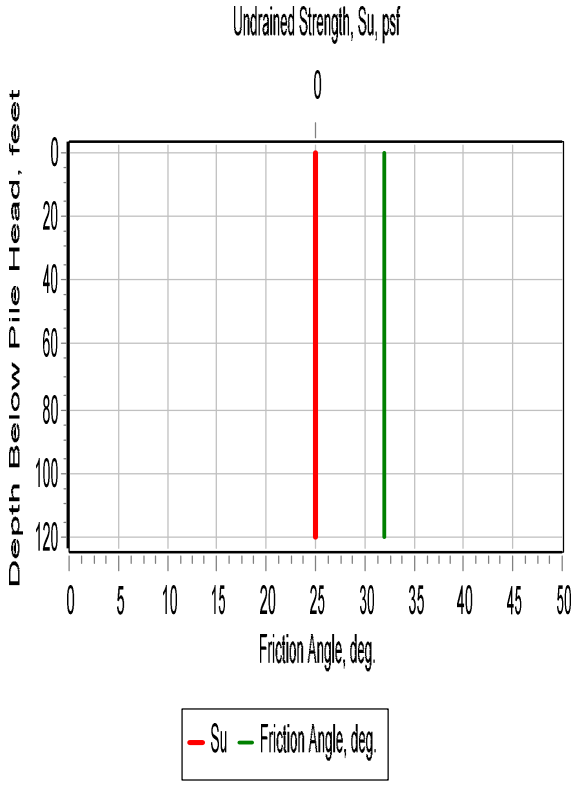
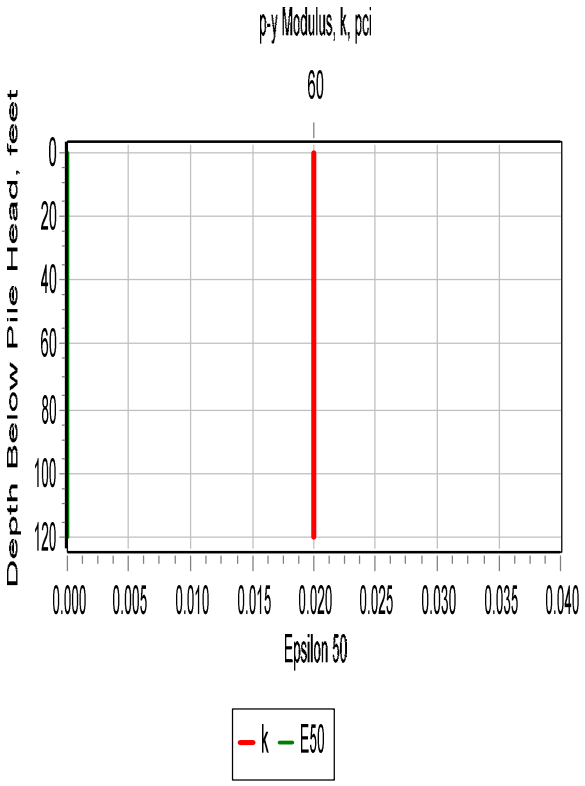
LPILE Analysis P5-1002
Pier 5 - HP14x73 at t =75 yrs. Post Repair
With 1/16" Corrosion & k = 60 pci



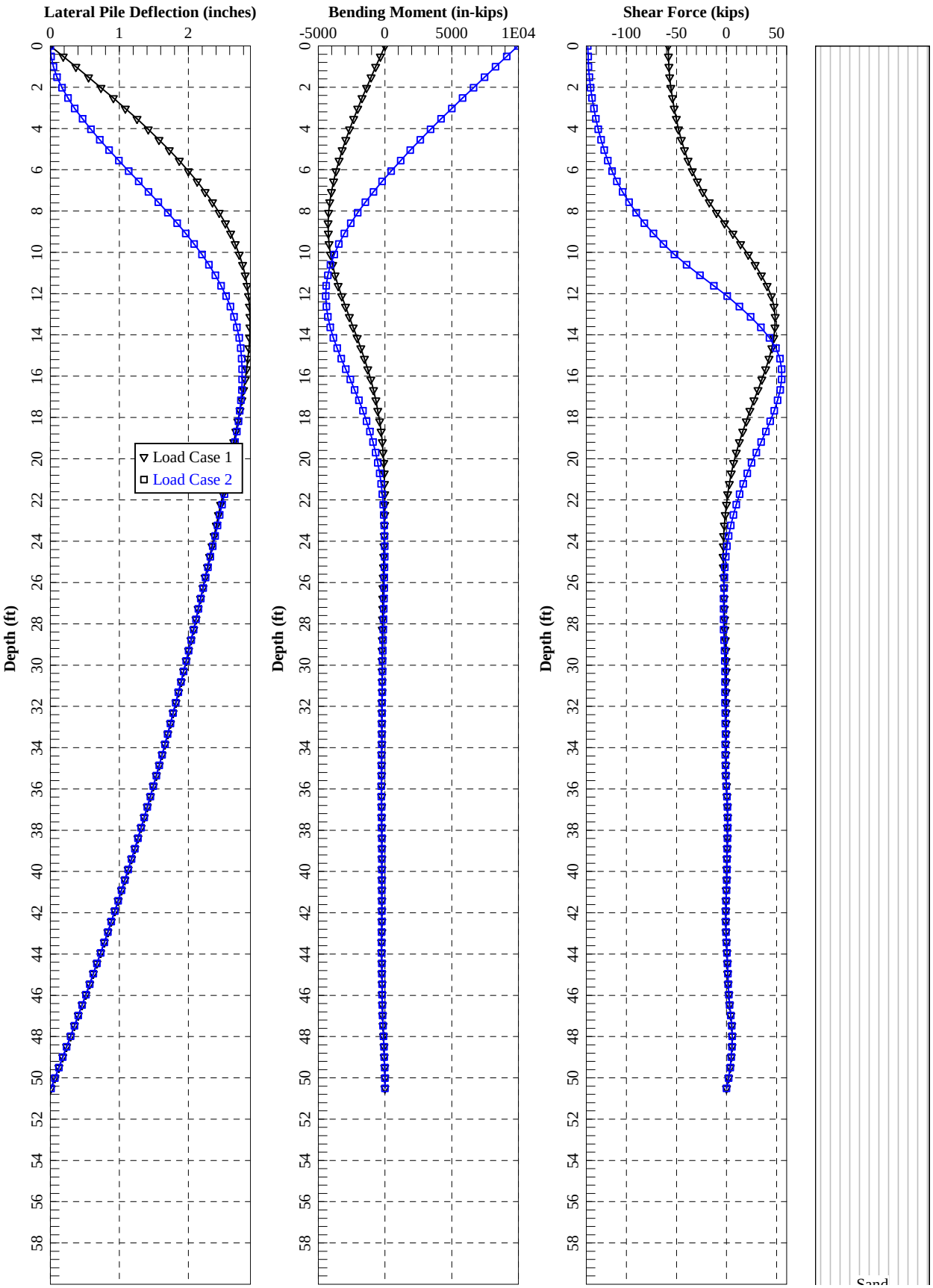






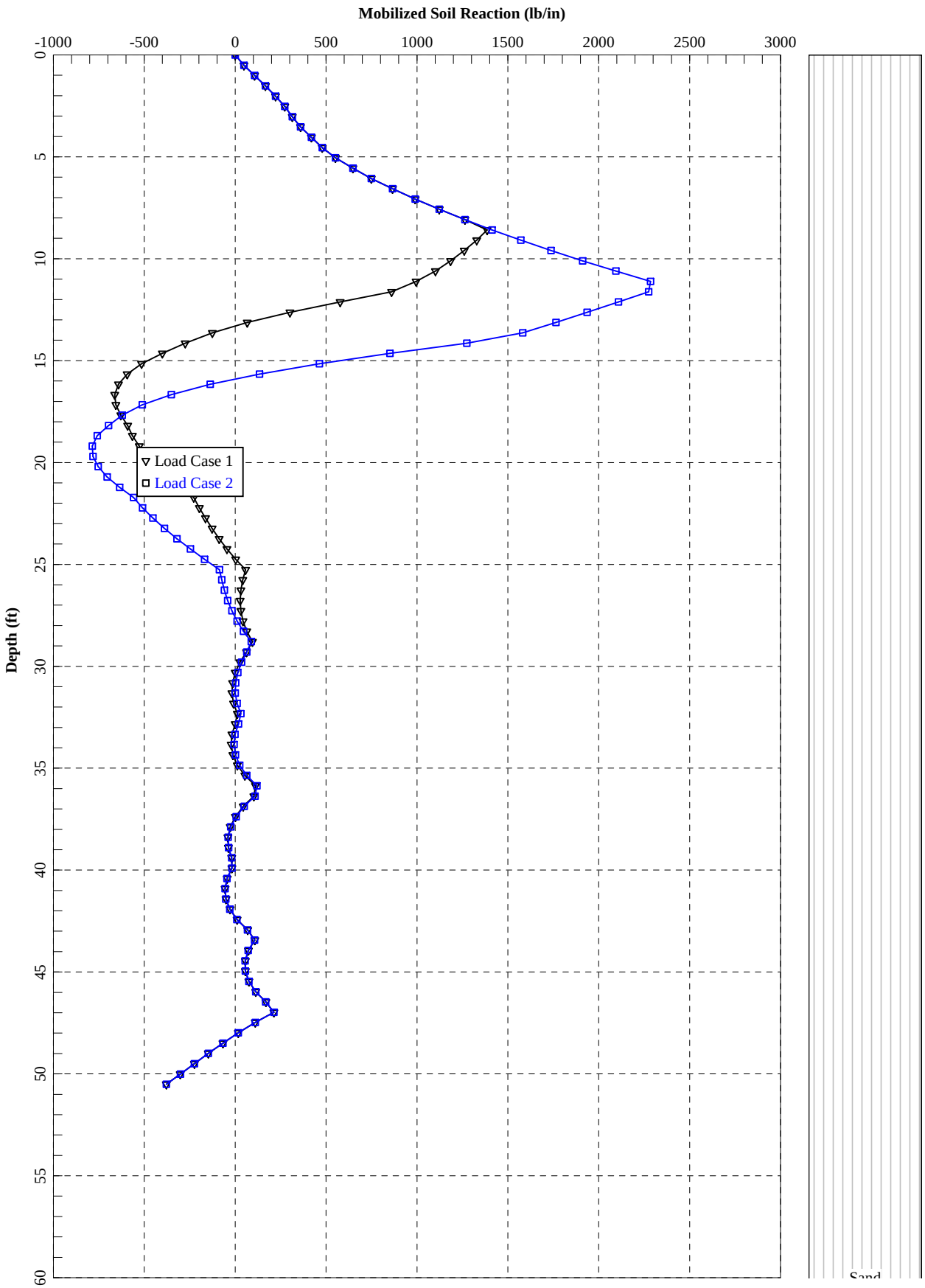
Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

LPILE Analysis P5-1002
Pier 5 - HP14x73 at t =75 yrs. Post Repair
With 1/16" Corrosion & k = 60 pci



Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

LPILE Analysis P5-1002
Pier 5 - HP14x73 at t =75 yrs. Post Repair
With 1/16" Corrosion & k = 60 pci



Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

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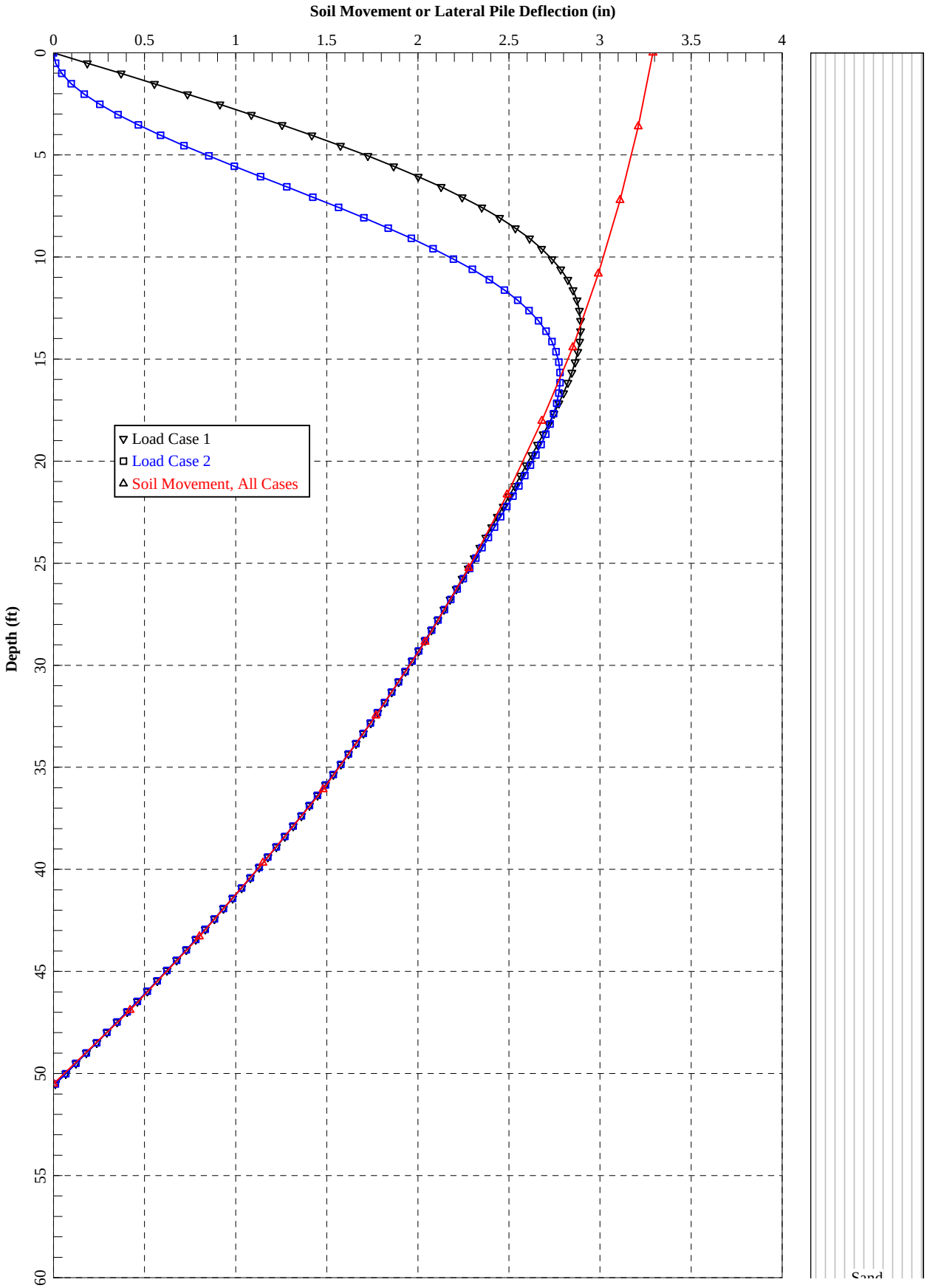
Pier 5 - HP14x73 at t =75 yrs. Post Repair
With 1/16" Corrosion & k = 60 pci



Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

LPILE Analysis P5-1003
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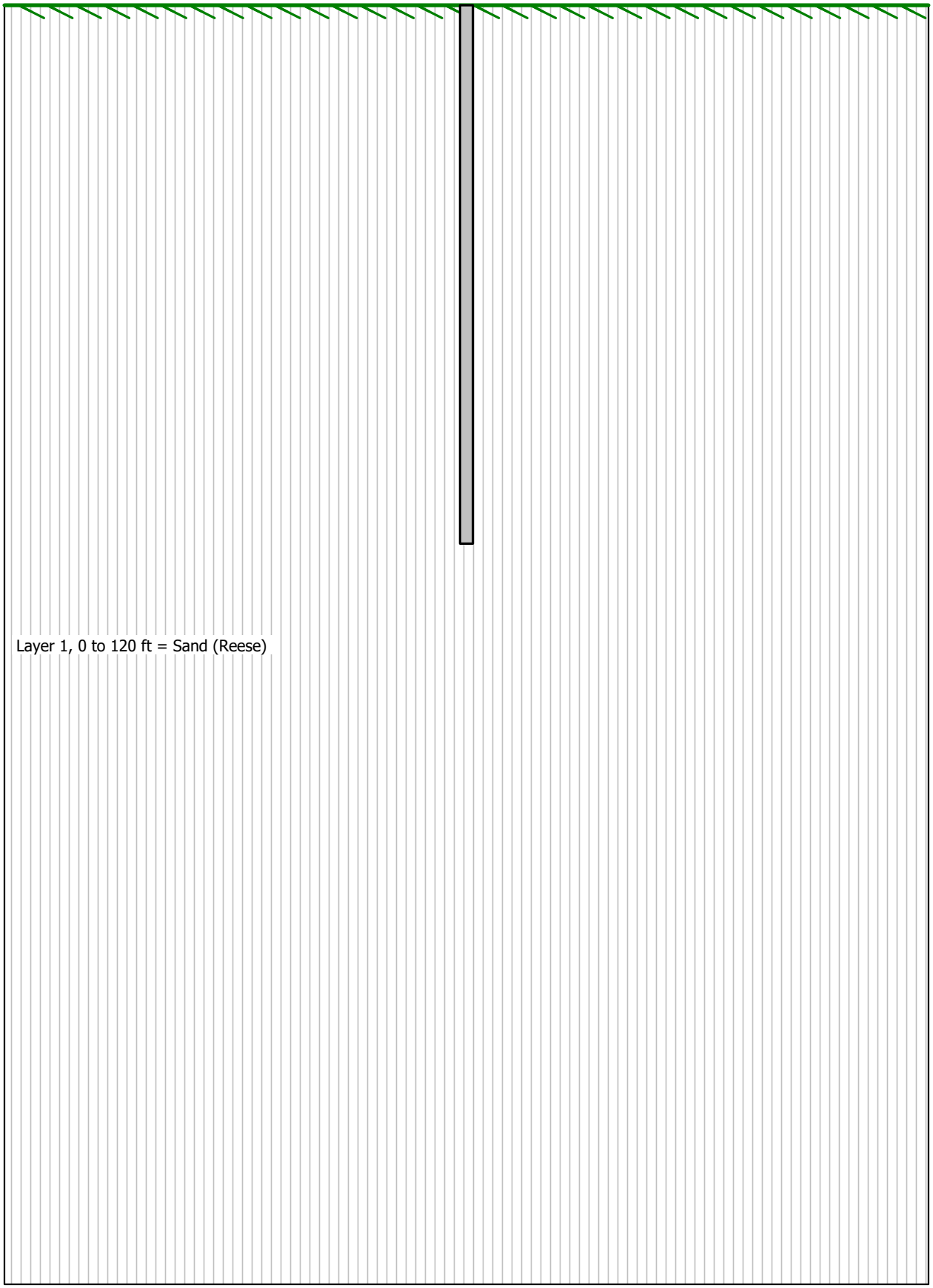
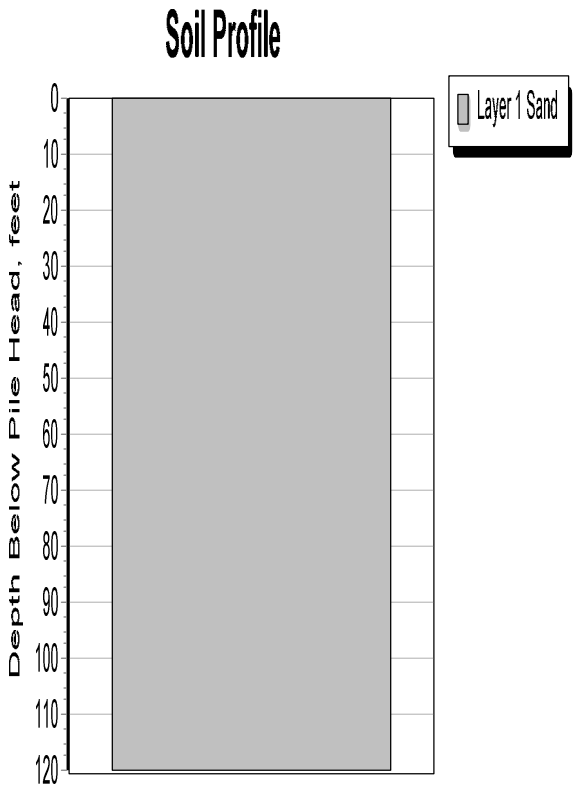
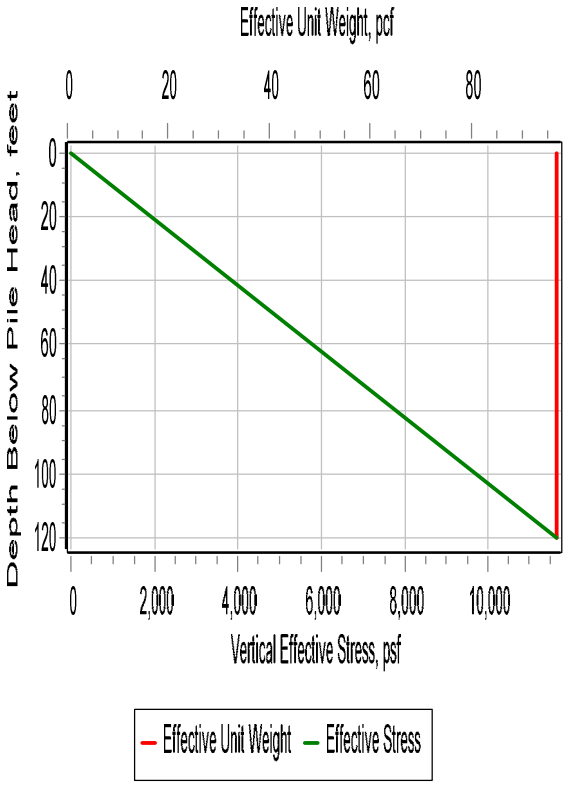
With 1/16" Corrosion & k = 90 pci

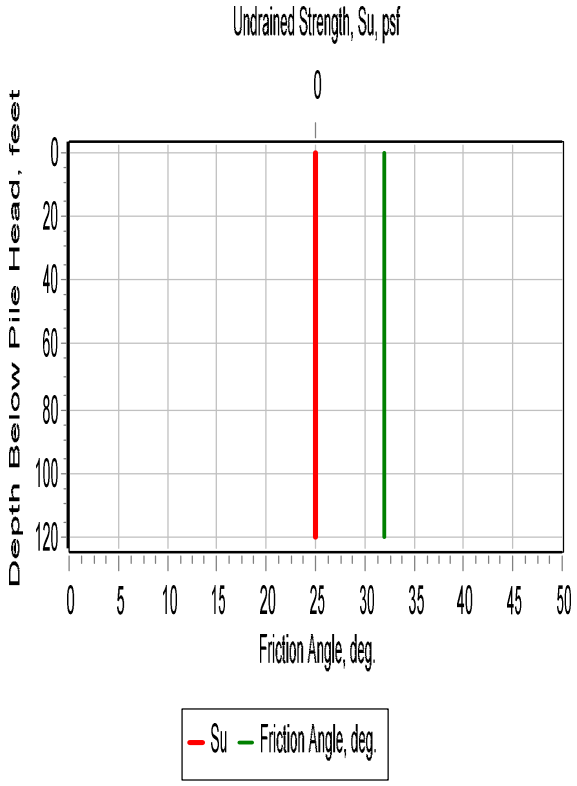


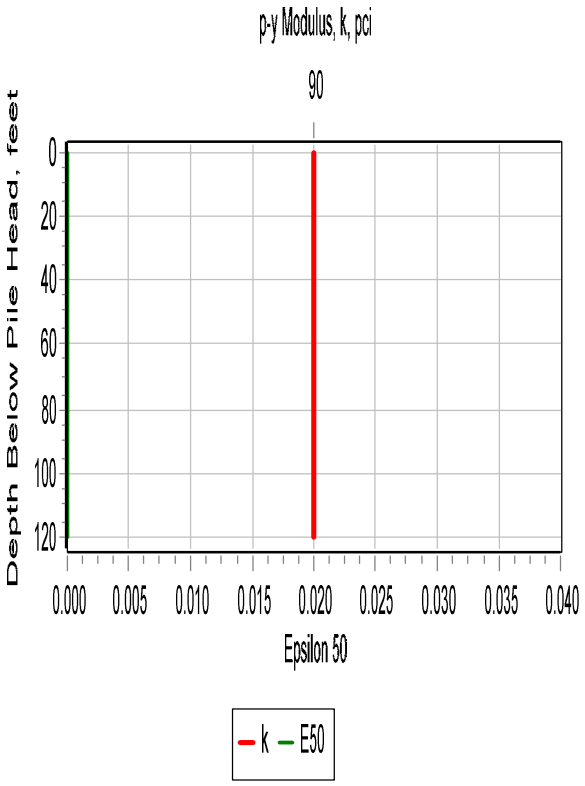
Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

LPILE Analysis P5-1003
Pier 5 - HP14x73 at t =75 yrs. Post Repair
With 1/16" Corrosion & k = 90 pci



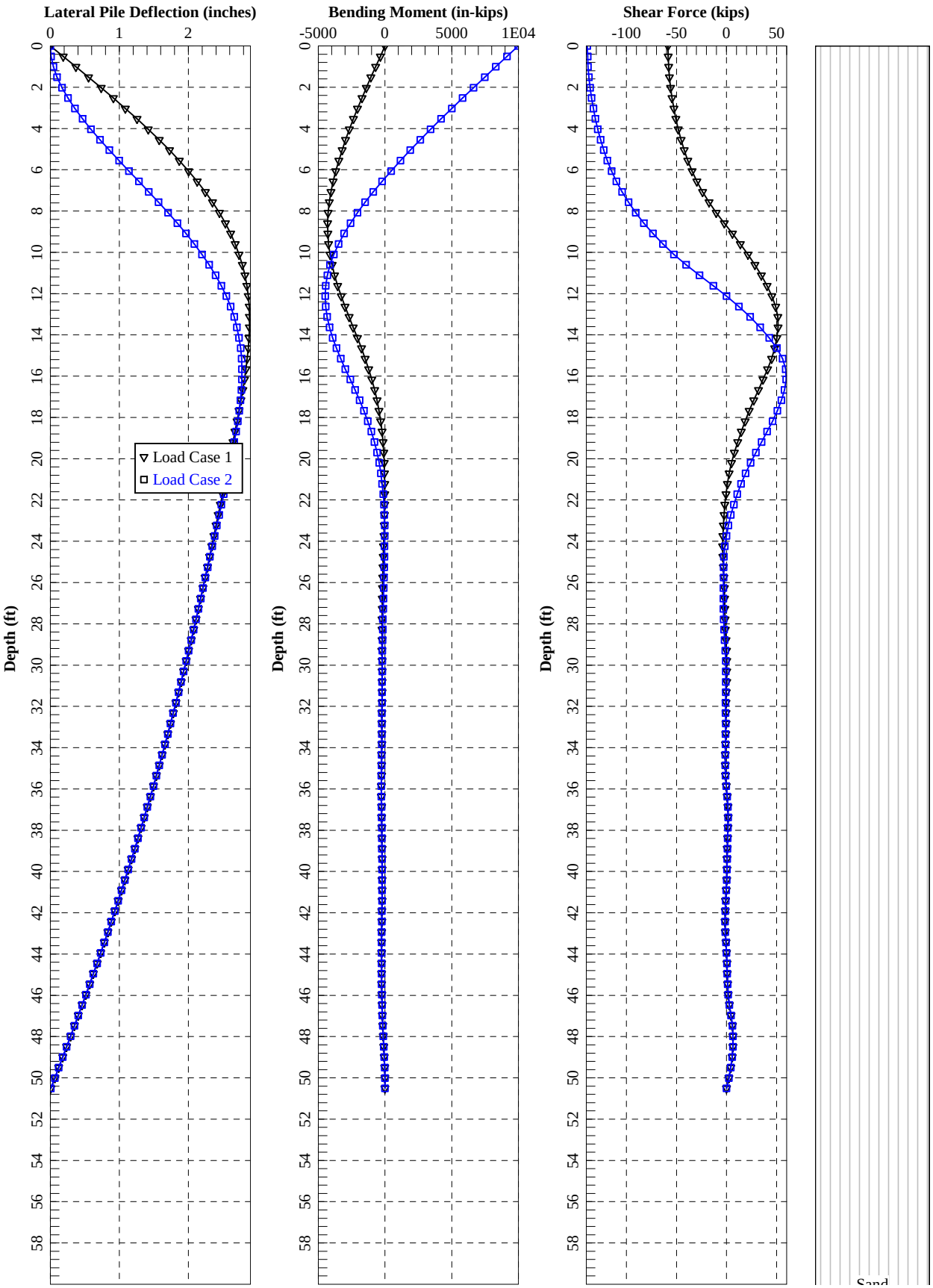






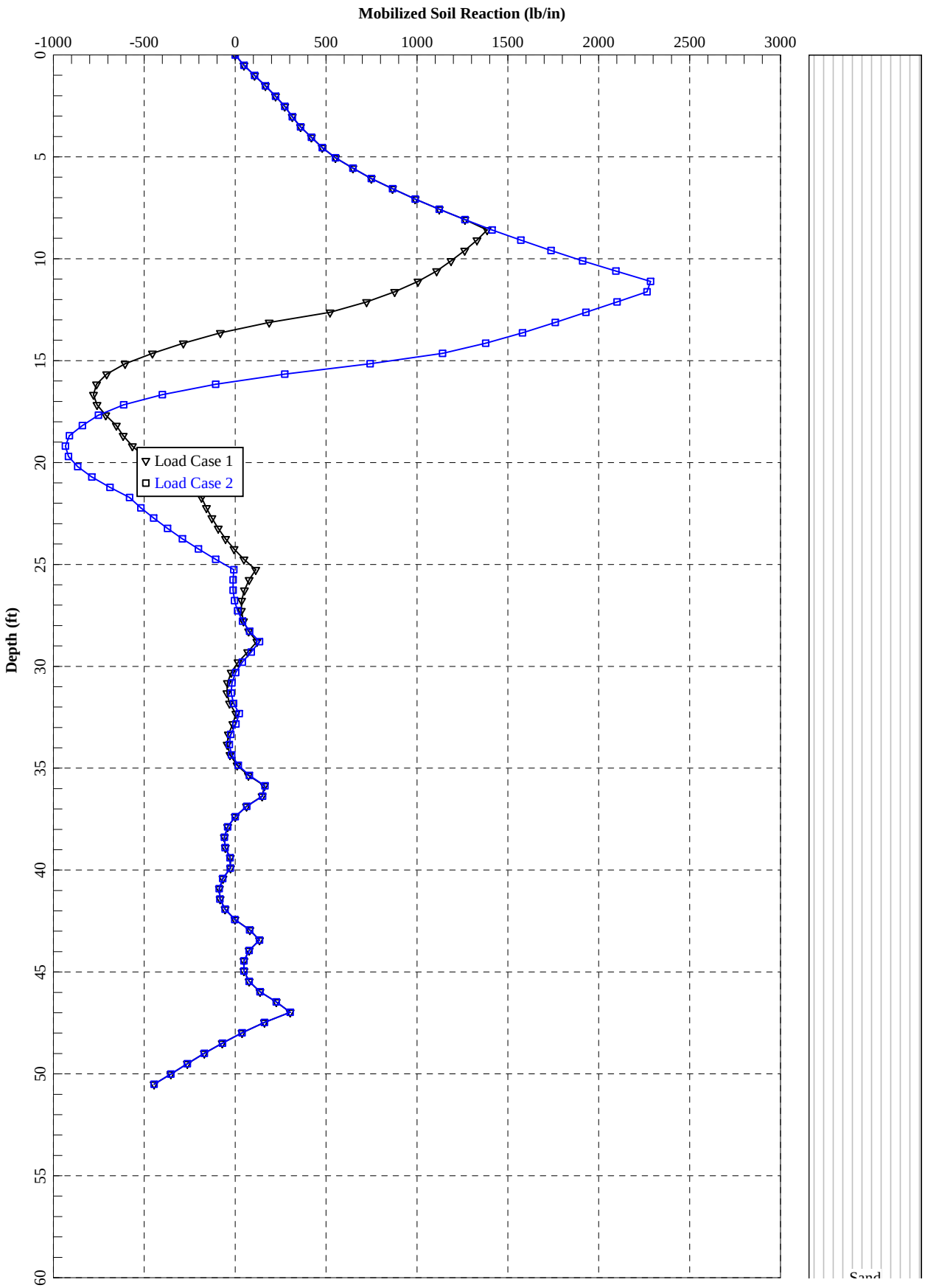
Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

LPILE Analysis P5-1003
Pier 5 - HP14x73 at t =75 yrs. Post Repair
With 1/16" Corrosion & k = 90 pci



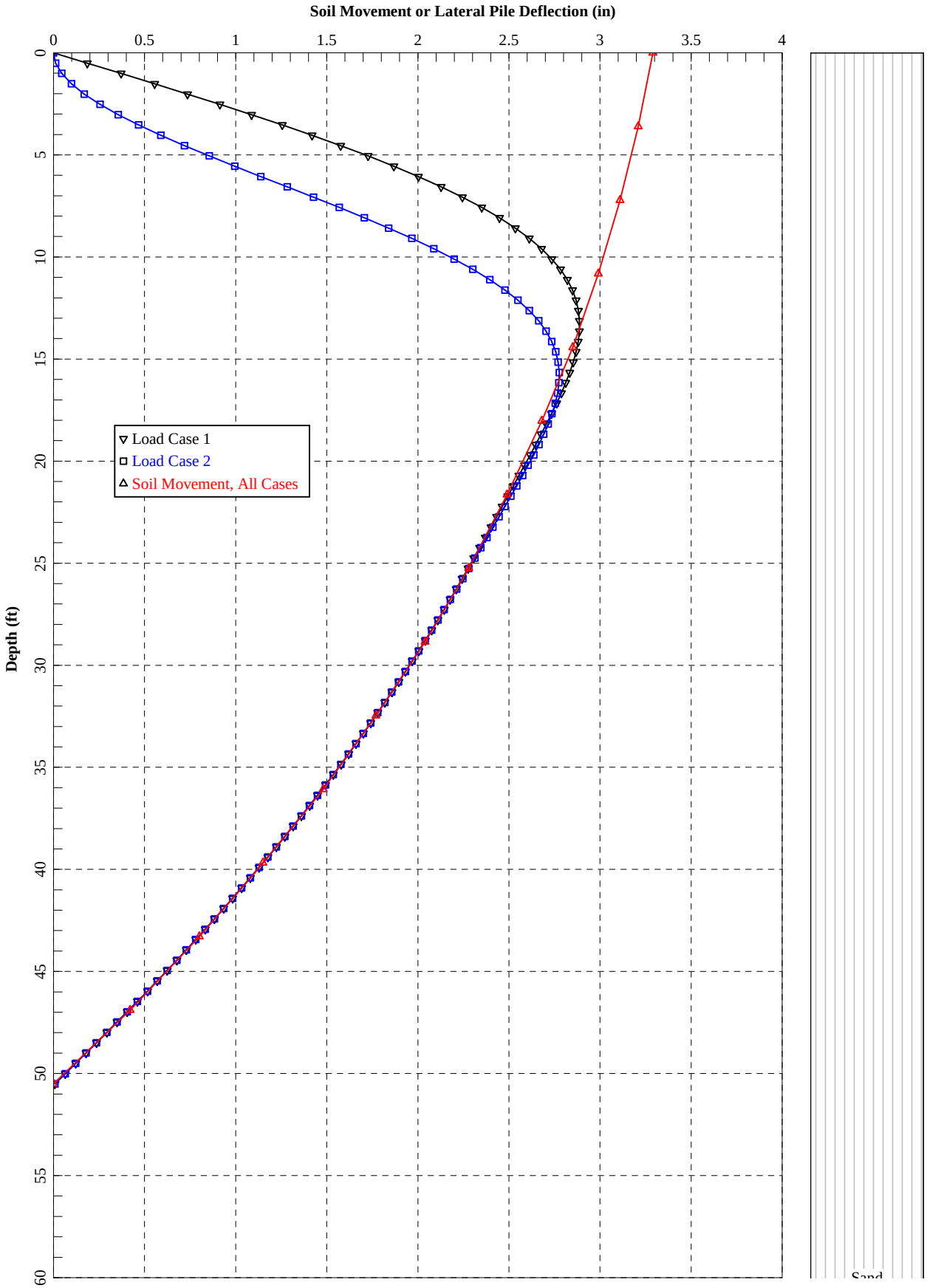
Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

LPILE Analysis P5-1003
Pier 5 - HP14x73 at t =75 yrs. Post Repair
With 1/16" Corrosion & k = 90 pci



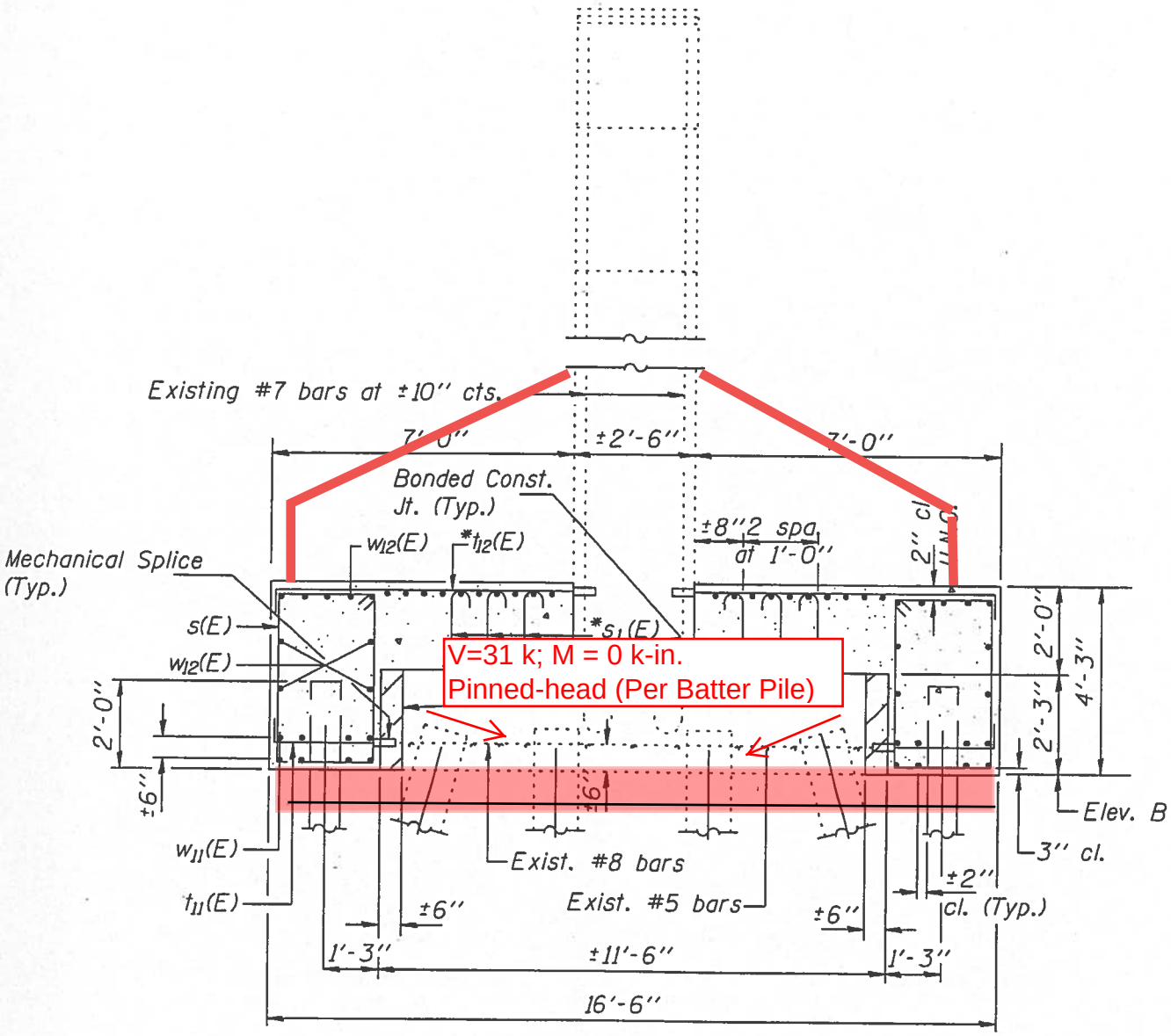
Project No.: J028501.01
Client: AECOM
Project: US 68 Bridge over Lawrence Creek

LPILE Analysis P5-1003
Pier 5 - HP14x73 at t =75 yrs. Post Repair
With 1/16" Corrosion & k = 90 pci

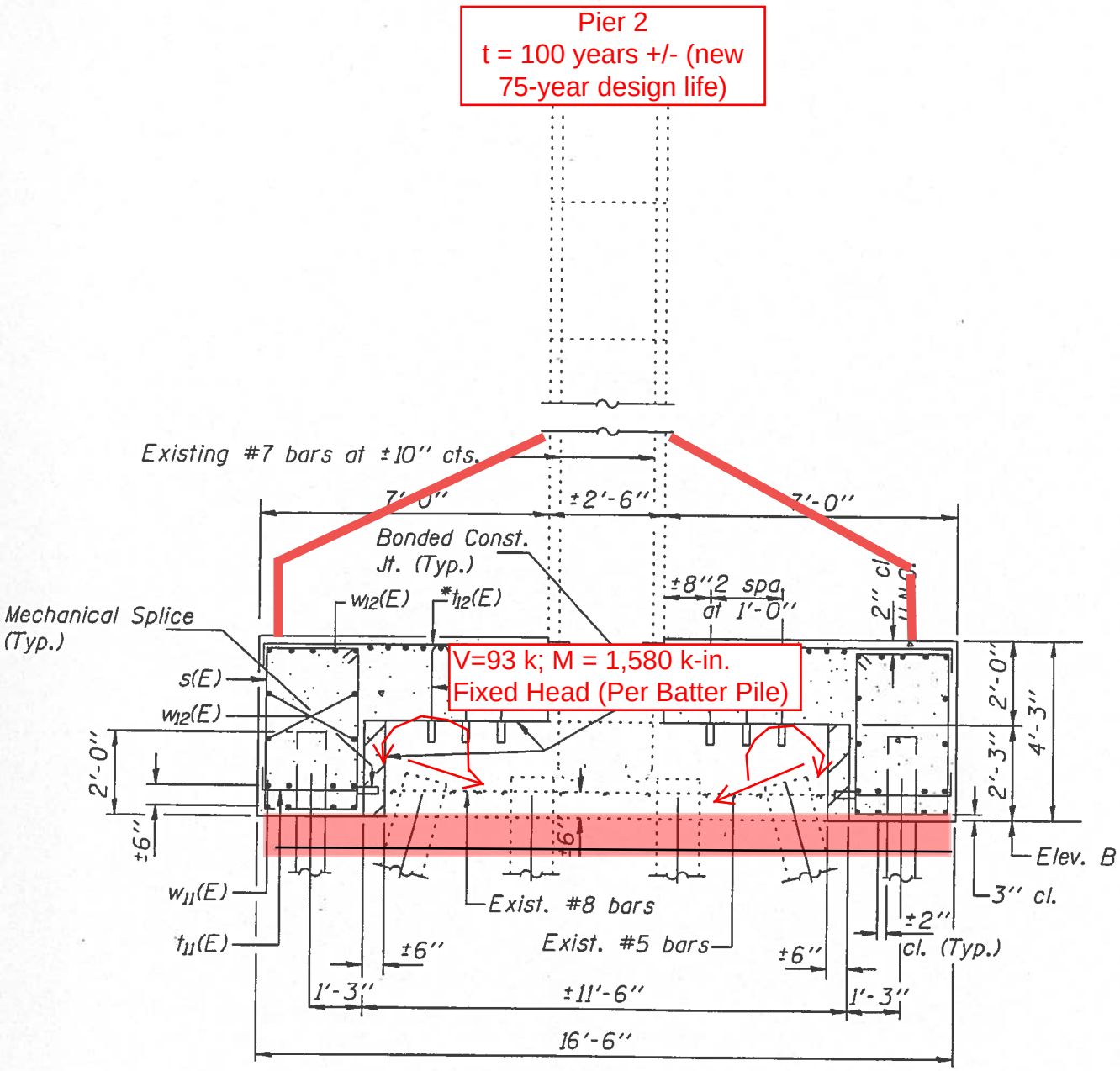


APPENDIX B – PILE HEAD LOADS FOR BATTER PILES AT PIERS 2 & 5 FROM DOWNDRAG LOADS

Pier 2
t = 23 years +/- (now)

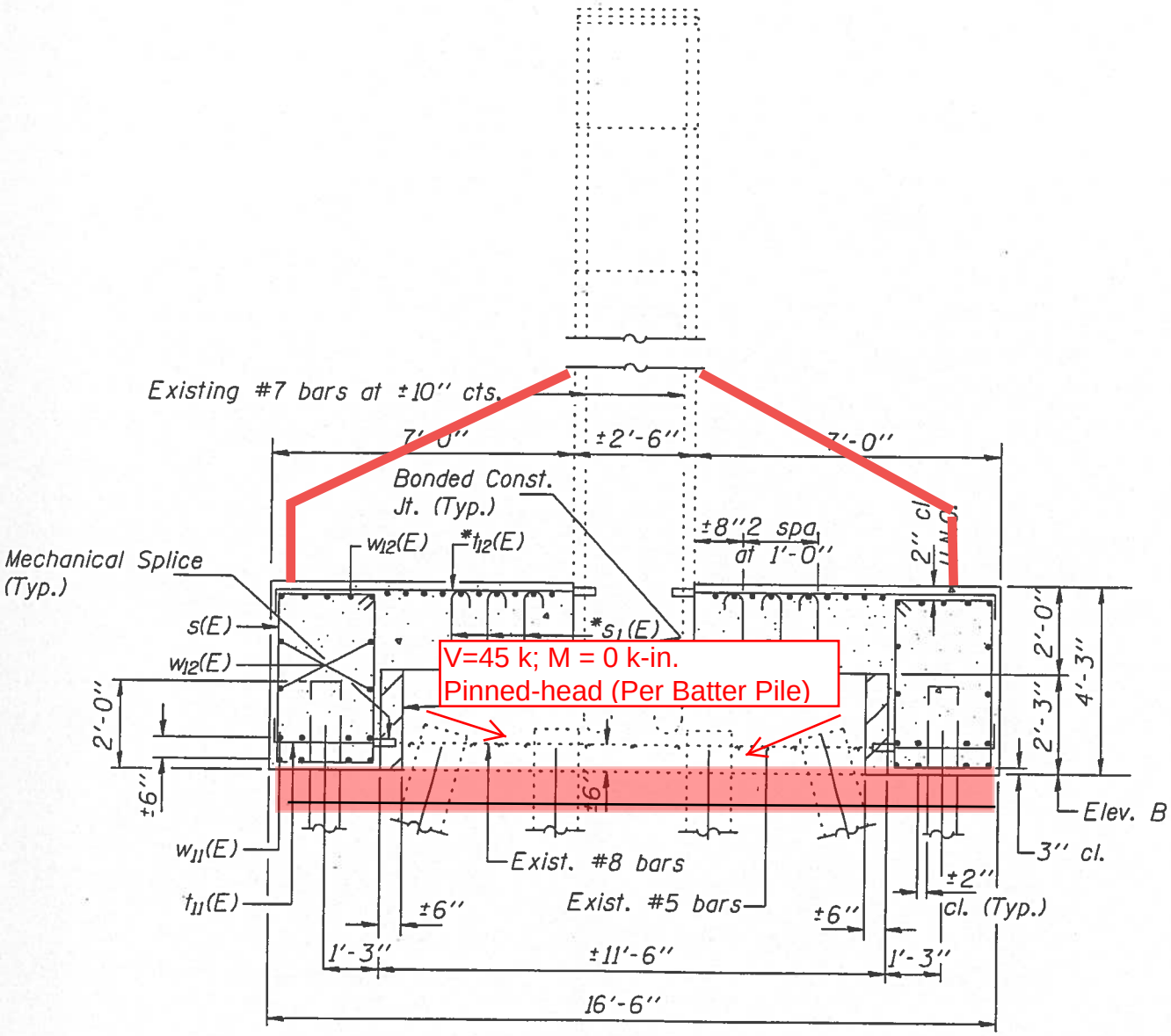


PIER SECTION



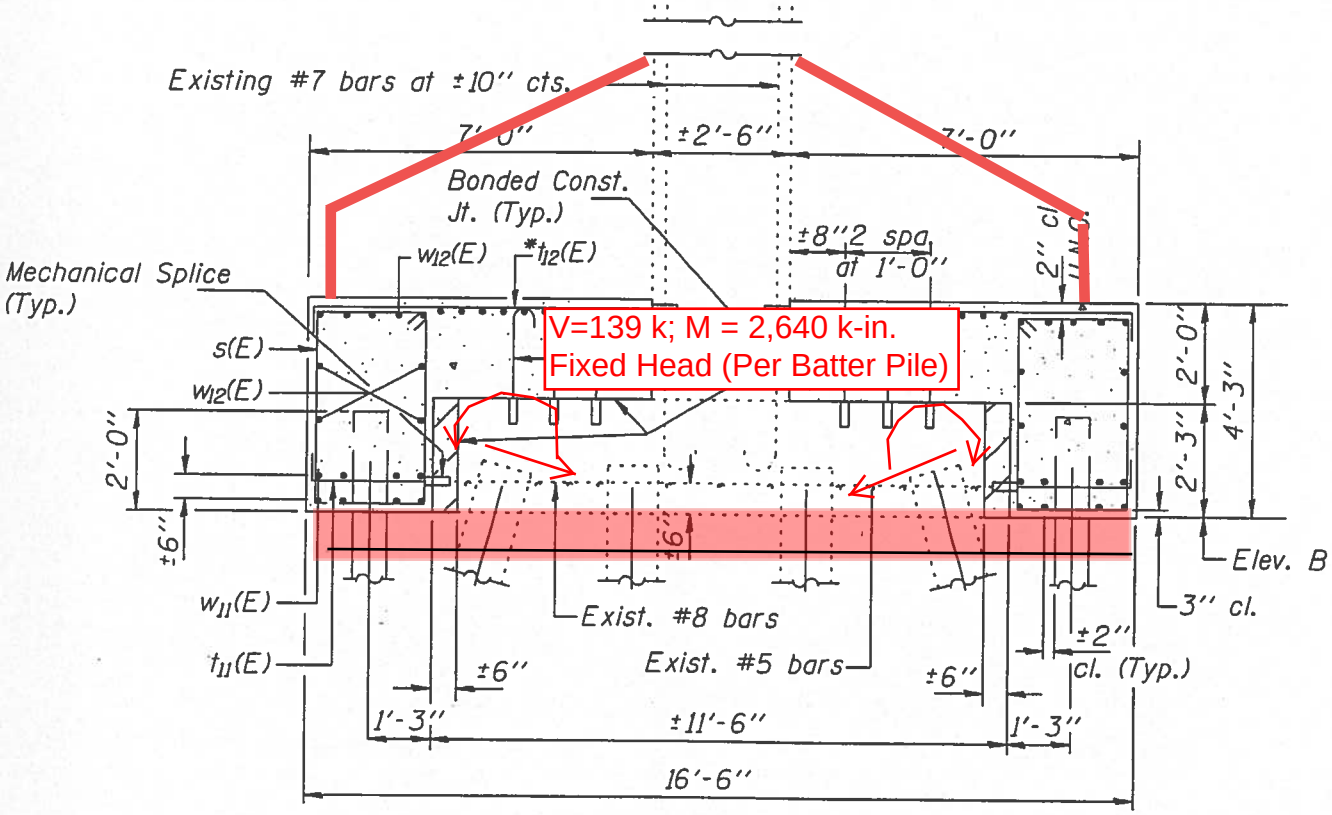
PIER SECTION

Pier 5
t = 23 years +/- (now)



PIER SECTION

Pier 5
t = 100 years +/- (new 75-year design life)



PIER SECTION

APPENDIX C – SPECIAL NOTES

Revised Special Note for Micropiles

SPECIAL NOTE FOR MICROPILES
FOR US 68 BRIDGE OVER LAWRENCE CREEK (ITEM NO. 9-1095.00)

1.0 DESCRIPTION. This work shall consist of constructing micropiles as shown on the Plans, accepted working drawings and approved shop drawings and as specified herein. The micropile specialty Contractor is responsible for furnishing all required working\shop drawings, materials, products, accessories, tools, equipment, services, transportation, labor and supervision, and manufacturing techniques required for installation and testing of micropiles and pile top attachments for this project. The micropile load capacities shall be verified by verification and proof load testing as required and must meet the test acceptance criteria specified herein. Section references herein are to the Department's 2019 Standard Specifications for Road and Bridge Construction.

2.0 MATERIALS.

2.1 Admixtures for Grout. Conform to Section 802. Admixtures that control bleed, improve flowability, reduce water content, and retard set may be used in the grout, subject to the review and acceptance of the Engineer. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer's recommendations. Accelerators are not permitted.

2.2 Cement. Conform to Section 801. Use types I, II, III or V

2.3 Centralizers and Spacers. Centralizers and spacers shall be fabricated from schedule 40 PVC pipe or tube, steel, or material non-detrimental to the reinforcing steel. Wood shall not be used.

2.4 Epoxy Coating. Conform to subsection 811.10. Bend test requirements are waived. Bearing plates and nuts encased in the pile concrete footing need not be epoxy coated unless the footing reinforcement is epoxy coated.

2.5 Fine Aggregate. If sand / cement grout is used, sand shall conform to Section 804.

2.6 Grout. Neat cement or sand / cement mixture with a minimum 28-day compressive strength of 5,000 psi per AASHTO T106/ASTM C109, unless shown otherwise on the Plans.

2.7 Permanent Casing. Permanent steel casing / pipe shall have the diameter and at least minimum wall thickness shown on the Plans. The permanent steel casing / pipe:

1) shall meet the Tensile Requirements of ASTM A252, Grade 3, except the yield strength shall be a minimum of 80 ksi, unless shown otherwise on the plans.
2) may be new "Structural Grade" (a.k.a. "Mill Secondary") steel pipe meeting above but without Mill Certification, free from defects (dents, cracks, tears) and with two coupon tests per truckload delivered to the fabricator.

For permanent casing / pipe that will be welded for structural purposes, the following material conditions apply:

1) The carbon equivalency (CE) as defined in AWS D1.1, Section X15.1, shall not exceed 0.45, as demonstrated by mill certifications.
2) The sulfur content shall not exceed 0.05%, as demonstrated by mill certifications.

For permanent casing / pipe that will be shop or field welded, the following fabrication or construction conditions apply:

1) The steel pipe shall not be joined by welded lap splicing.

2) Welded seams and splices shall be complete penetration welds.
3) Partial penetration welds may be restored in conformance with AWS D1.1.
4) The proposed welding procedure certified by a welding specialist shall be submitted for approval.

Where allowed on the Plans, flush threaded casing joints shall be completely shouldered with no stripped threads.

2.8 Plates and Shapes. Structural steel plates and shapes for pile top attachments shall conform to ASTM A709/AASHTO M270, Grade 50.

2.9 Reinforcing Bars. Reinforcing steel shall be deformed bars in accordance with ASTM A615/AASHTO M31, Grade 60 or Grade 75 or ASTM A722/AASHTO M275, Grade 150, as shown on the plans. When a bearing plate and nut are required to be threaded onto the top end of reinforcing bars for the pile top to footing anchorage, the threading may be continuous spiral deformed ribbing provided by the bar deformations (e.g., Dywidag or Williams continuous threadbars) or may be cut into a reinforcing bar. If threads are cut into a reinforcing bar, the next larger bar number designation from that shown on the Plans shall be provided, at no additional cost.

Bar couplers, if required, shall develop the ultimate tensile strength of the bars without evidence of any failure.

2.10 Water. Conform to Section 803.

3.0 CONSTRUCTION.

3.1 Preconstruction.

3.1.1 Experience Requirements. The micropile Contractor shall be experienced in the construction and load testing of micropiles and have successfully constructed at least 5 projects in the last 5 years involving construction totaling at least 100 micropiles of similar size and capacity to those required in these plans and specifications.

The Contractor shall have previous micropile drilling and grouting experience in soil / rock similar to project conditions. The Contractor shall submit construction details, structural details and load test results for at least three previous successful micropile load tests from different projects of similar scope to this project.

The Contractor shall assign an Engineer to supervise the work with experience on at least 3 projects of similar scope to this project completed over the past 5 years. The Contractor shall not use consultants or manufacturers' representatives to satisfy the supervising Engineer requirements of this section. The on-site foremen and drill rig operators shall also have experience on at least 3 projects over the past 5 years installing micropiles of equal or greater capacity than required in these plans and specifications.

At least 45 calendar days before the planned start of micropile construction, the Contractor shall submit electronically in PDF format the completed project reference list and a personnel list. The project reference list shall include a brief project description with the owner's name and current phone number and load test reports. The personnel list shall identify the supervising project Engineer, drill rig operators, and on-site foremen to be assigned to the project. The personnel list shall contain a summary of each individual's experience and be complete enough for the Engineer to determine whether each individual satisfies the required qualifications.

Work shall not be started, nor materials ordered, until the Engineer's written approval of the Contractor's experience qualifications is given. The Engineer may

suspend the Work if the Contractor uses non-approved personnel.

3.1.2 Construction Site Survey. Before bidding the Work, the Contractor shall review the available subsurface information and visit the site to assess the site geometry, equipment access conditions, and location of existing structures and above ground facilities.

The Contractor is responsible for field locating and verifying the location of all utilities shown on the plans prior to starting the Work. Maintain uninterrupted service for those utilities designated to remain in service throughout the Work. Notify the Engineer of any utility locations different from shown on the plans that may require micropile relocations or structure design modification.

Prior to start of any micropile construction activity, the Contractor and Engineer shall jointly inspect the site to observe and document the pre-construction condition of the site, existing structures and facilities.

3.1.3 Construction Submittals. At least 21 calendar days before the planned start of micropile construction, submit to the Engineer, for review and approval, electronically in PDF format the following for the micropile system or systems to be constructed:

1) Detailed step-by-step description of the proposed micropile construction and testing procedures in sufficient detail to allow the Engineer to monitor the construction and quality of the micropiles.
2) Proposed start date and time schedule and micropile installation schedule.
3) Working drawings for micropiles including items that are either not shown on the contract plans or deviations due to specific installation equipment/methods such as final bond zone drill hole diameters; splice types and locations; and reinforcing centralizers and spacers.
4) Shop drawings for all structural steel elements used in the micropiles, including the top bearing plate.
5) If welding of casing is proposed, submit the proposed welding procedure, by a qualified welding specialist.
6) Information on headroom and space requirements for installation equipment that verify the proposed equipment can perform at the site.
7) Sample micropile installation log to be used per Section 3.2.9.
8) Plan describing how surface water, drill flush, and excess waste grout will be controlled and disposed.
9) Method for measuring and determining vertical and horizontal alignment during construction. Some form of hole telemetry shall be used to measure the vertical alignment of each micropile.
10) Certified mill test reports for the reinforcing steel or coupon test results for permanent casing without mill certification. The ultimate strength, yield strength, elongation, and material properties composition shall be included. For API N-80 pipe casing, coupon test results may be submitted in lieu of mill certification.
11) Proposed Grouting Plan. The grouting plan shall include complete descriptions, details, and supporting calculations for the following:
    a) Grout mix design and type of materials to be used in the grout, including certified test data and trial batch reports.
    b) Methods and equipment for accurately monitoring and recording the grout depth, grout volume and grout pressure as the grout is being placed.
    c) Grouting rate calculations, when requested by the Engineer. The

calculations shall be based on the initial pump pressures or static head on the grout and losses throughout the placing system, including anticipated head of drilling fluid (if applicable) to be displaced.

d) Estimated curing time for grout to achieve specified strength. Previous test results for the proposed grout mix completed within one year of the start of grouting may be submitted for initial verification and acceptance and start of production work. During production, grout shall be tested in accordance with Section 3.2.8.

e) Procedure and equipment for Contractor monitoring of grout quality.

12) Detailed plans for the proposed micropile load testing method. This shall include all drawings, details, and structural design calculations necessary to clearly describe the proposed test method, reaction load system capacity and equipment setup, types and accuracy of apparatus to be used for applying and measuring the test loads and pile top movements in accordance with Section 3.3, Pile Load Tests.

13) Calibration reports and data for each test jack, pressure gauge and master pressure gauge and electronic load cell to be used. The calibration tests shall have been performed by an independent testing laboratory, and tests shall have been performed within 90 calendar days of the date submitted. Testing shall not commence until the Engineer has reviewed and accepted the jack, pressure gauge, master pressure gauge and electronic load cell calibration data.

All drawings and calculations shall be signed and sealed by the Contractor's Professional Engineer licensed in the State of Kentucky.

Work shall not begin until the construction submittals have been received, reviewed, and accepted in writing by the Engineer. Changes or deviations from the approved submittals must be re-submitted for approval.

3.1.4 Micropile Pre-Construction Meeting. A micropile pre-construction meeting will be scheduled by the Engineer and held prior to the start of micropile construction. The Engineer, prime Contractor, micropile specialty Contractor, and excavation contractor shall attend the meeting. Attendance is mandatory. The pre-construction meeting will be conducted to clarify the construction requirements for the work, to coordinate the construction schedule and activities, and to identify contractual relationships and delineation of responsibilities amongst the prime Contractor and the various Subcontractors—specifically those pertaining to excavation for micropile structures, anticipated subsurface conditions, micropile installation and testing, micropile structure survey control and site drainage control.

3.2 General Construction.

3.2.1 Site Drainage Control. The Contractor shall control and properly dispose of drill flush and construction related waste, including excess grout, in accordance with the standard specifications and all applicable local codes and regulations. Provide positive control and discharge of all surface water that will affect construction of the micropile installation.

3.2.2 Excavation. Coordinate the work and the excavation so the micropiles are safely constructed. Perform the micropile construction and related excavation in accordance with the Plans and approved submittals. No excavations steeper than those specified herein or shown on the Plans will be made above or below the micropile structure locations without written approval of the Engineer.

3.2.3 Micropile Allowable Construction Tolerances. Centerline of piling shall not be more than 3 inches from indicated plan location. Pile shall be plumb within 1 percent of total-length plan alignment. Top elevation of pile shall be plus 1 inch or minus 2 inches maximum from vertical elevation indicated. Centerline of reinforcing steel shall not be more than 3/4 inch from indicated location.

3.2.4 Micropile Installation. Unless shown otherwise on the Plans, the micropile Contractor shall propose the drilling method, the grouting procedure, and the grouting pressure used for the installation of the micropiles, subject to approval by the Engineer. Final approval of this proposed method is contingent upon the satisfactory results of the verification load tests. The micropile Contractor shall also determine the final bond zone drill hole diameter for the selected drilling equipment, and central reinforcing sizing for test piles. The final drill hole diameter shall not be less than that shown on the Plans. The micropile Contractor is also responsible for estimating the grout take. There will be no extra payment for grout overruns.

3.2.5 Drilling. The drilling equipment and methods shall be suitable for drilling through the conditions to be encountered, without causing damage to any overlying or adjacent structures or services. Upon drilling completion ensure drill cuttings and/or other loose debris is removed from the bottom of the hole. The drill hole must be open along its full length to at least the design minimum drill hole diameter prior to placing grout and reinforcement. Develop methods of stabilizing borehole that do not have a deleterious effect on the grout-to-ground bond development. All installation techniques shall be determined and scheduled such that there will be no interconnection or damage to piles in which grout has not achieved final set. Use of drilling fluid containing bentonite is not allowed.

3.2.6 Hole Telemetry. Upon advancing the micropile to the bedrock surface and prior to advancing the micropile into the bond zone, the Contractor shall measure the vertical alignment of the cased section of each micropile using a method of hole telemetry that is approved by the Department. Where the micropile is determined to be out of tolerance, the out-of-tolerance hole shall be grouted and the micropile redrilled. There will be no extra payment for grouting and redrilling out-of-tolerance micropiles, except if the existing H-piles cause the micropile to deviate from the acceptable vertical tolerances.

3.2.7 Pipe Casing and Reinforcing Bar Placement and Splicing. Reinforcement shall be placed into the drill hole prior to grouting. Reinforcement surface shall be free of deleterious substances, such as soil, mud, grease or oil that might contaminate the grout or coat the reinforcement and impair bond.

The Contractor shall check pile top elevations and adjust all installed micropiles to the planned elevations.

Centralizers and spacers shall be provided at 10-foot centers maximum spacing. The upper and lower most centralizer shall be located a maximum of 2 feet from the top and bottom of the micropile. Centralizers and spacers shall permit the free flow of grout without misalignment of the reinforcing bar(s) and permanent casing. The central reinforcement bars with centralizers shall be lowered into the stabilized drillhole and set. The reinforcing steel shall be inserted into the drill hole to the desired depth without difficulty. Partially inserted reinforcing bars shall not be driven or forced into the hole. Contractor shall redrill and reinsert reinforcing steel when necessary to facilitate

insertion.

Lengths of casing and reinforcing bars to be spliced shall be secured in proper alignment and in a manner to avoid eccentricity or angle between the axes of the two lengths to be spliced. Splices and threaded joints shall meet the requirements of Materials Section 2.0. Threaded pipe casing joints shall be located at least two casing diameters (OD) from a splice in any reinforcing bar. When multiple bars are used, the bar splices shall be staggered at least 1 foot.

3.2.8 Grouting. Micropiles shall be fully grouted the same day the load transfer bond length is drilled. The grouting equipment used shall produce a grout free of lumps and undispersed cement. The Contractor shall have means and methods of measuring the grout quantity and pumping pressure during the grouting operations. The grout pump shall be equipped with a pressure gauge to monitor grout pressures. A second pressure gauge shall be placed at the point of injection into the pile top. The pressure gauges shall be capable of measuring pressures of at least 150 psi or twice the actual grout pressures used, whichever is greater. The grout shall be kept in constant agitation prior to pumping. Grout shall be placed within one hour of mixing. The grouting equipment shall be sized to enable each pile to be grouted in one continuous operation.

Tremie grout from the lowest point of the drill hole until uncontaminated grout flows from the top of the pile. The grout may be pumped through grout tubes, casing, hollow-stem augers, or drill rods. All grouting operations, including tremie grout pumping, casing extraction and subsequent pressure grouting operations, must ensure complete continuity of the grout column. The grout pressures and grout takes shall be controlled to prevent excessive heave or fracturing of rock or soil formations. Upon completion of grouting, the grout tube may remain in the hole, but must be filled with grout.

Grout within the micropiles shall be allowed to attain the required design strength prior to being loaded.

If the Contractor elects to use a post-grouting system, Working Drawings and details shall be submitted to the Engineer for review in accordance with Section 3.1.3, Construction Submittals.

3.2.9 Grout Testing. Grout within the micropile verification and proof test piles shall attain the required minimum 28-day compressive strength shown on the Plans prior to load testing. Previous test results for the proposed grout mix completed within one year of the start of work may be submitted for initial verification of the required compressive strengths for installation of pre-production verification test piles. During production, micropile grout shall be tested by the Contractor for compressive strength in accordance with AASHTO T106/ASTM C109 at a frequency of no less than one set of three 2-inch grout cubes from each grout plant each day of operation or per every 10 piles, whichever occurs more frequently. At a minimum, compressive strength tests shall be taken at 3, 7 and 28 days after grouting. For each time interval, the compressive strength shall be the average of the set of 3 cubes tested.

Grout consistency, as measured by grout density, shall be determined by the Contractor per ASTM C188/AASHTO T133 or API RP-13B-1 at a frequency of at least one test per pile, conducted just prior to start of pile grouting. The Baroid Mud Balance used in accordance with API RP-13B-1 is an approved device for determining the grout density of neat cement grout.

Grout samples shall be taken directly from the grout plant. Provide grout cube compressive strength and grout density test results to the Engineer within 24 hours of testing.

3.2.10 Micropile Installation Records. Contractor shall prepare and submit to the Engineer full-length installation records for each micropile installed. The records shall be submitted within one work shift after that pile installation is completed. The records shall include the following minimum information:

1) Reference number of micropile
2) Date and time begun and completed for both drilling and grouting
3) Equipment used and operator
4) Factored Design load (compression and/or tension)
5) Micropile drilling logs indicating:
    a) penetration rates (feet depth per minute)
    b) downpressure
    c) materials encountered, including flush return description
    d) elevation of obstructions, if any
    e) elevation of karst, solutions features or voids, if any
    f) ground elevation
    g) elevation of groundwater or seepage encountered
    h) final tip elevation
    i) casing length above and below bottom of footing
    j) plunge length
    k) bond length
    l) total micropile length
    m) description of unusual installation behavior or conditions
6) grouting rates (cubic yards per feet depth)
7) grouting pressures (pounds per square inch per feet depth)
8) total grout quantities (cubic yards)
9) casing materials and dimensions
10) reinforcing material, size and lengths, and
11) compliance with tolerances.

The data shall be recorded on a micropile installation log. A separate log shall be provided for each micropile.

3.3 Pile Load Tests. Perform verification and proof testing of piles at the locations specified herein or designated by the Engineer based on the design axial load(s) as shown in the Plans. Perform tension load testing in accordance with ASTM D3689, except as modified herein. The load test shall be performed in tension regardless of load direction.

3.3.1 Testing Equipment and Data Recording. Testing equipment shall include dial gauges, dial gauge support, jack and pressure gauge, electronic load cell, and a reaction frame. The load cell is required only for the creep test portion of the verification test. The contractor shall provide a description of test setup and jack, pressure gauge and load cell calibration curves in accordance with the Submittals Section.

Design the testing reaction frame to be sufficiently rigid and of adequate dimensions such that excessive deformation of the testing equipment does not occur. Align the jack, bearing plates, and stressing anchorage such that unloading and repositioning of the equipment will not be required during the test.

Apply and measure the test load with a hydraulic jack and pressure gauge, or load cell when present. The jack and pressure gauge shall have a pressure range not exceeding twice the anticipated maximum test pressure. Jack ram travel shall be sufficient to allow the test to be done without resetting the equipment. Monitor the creep test load hold

during verification tests with both the pressure gauge and the electronic load cell. Use the load cell to accurately maintain a constant load hold during the creep test load hold increment of the verification test.

Measure the pile top movement with a dial gauge capable of measuring to 0.001 inch. The dial gauge shall have a travel sufficient to allow the test to be done without having to reset the gauge. Visually align the gauge to be parallel with the axis of the micropile and support the gauge independently from the jack, pile or reaction frame. Use a minimum of two dial gauges when the test setup requires reaction against the ground or single reaction piles on each side of the test pile.

Production piles may be utilized as reaction piles for proof tests. The Contractor is responsible for any modifications to the production piles to facilitate testing. No additional payment will be made to repair or replace damaged production piles utilized as reaction piles. Production piles may not be utilized as reaction piles for verification tests.

3.3.2 Verification Tests. Perform pre-production verification pile load testing on sacrificial (non-production) test piles, unless noted otherwise in the Plans, to verify the design of the pile system and the construction methods proposed prior to installing any production piles. Sacrificial verification test piles shall be constructed in conformance with the Plans and the accepted Working Drawings. The number and approximate locations of verification test piles shall be as shown on the Plans.

Verification load tests shall be performed to verify that the Contractor installed micropiles will meet the required compression and tension load capacities and load test acceptance criteria and to verify that the length of the micropile bond zone is adequate. Provide the Engineer a written report confirming micropile geometry, construction, testing details, and verification test results within 7 working days following completion of the pre-production verification load tests. The micropile verification load test results must verify the design and installation methods, and be reviewed and accepted by the Engineer prior to beginning installation of production micropiles.

The drilling-and-grouting method, casing length and outside diameter, reinforcing bar lengths, and depth of embedment for the verification test pile(s) shall be identical to those specified for the production piles at the given locations. The verification test micropile structural steel sections and reinforcing shall be sized to safely resist the maximum test load.

The maximum verification and proof test loads applied to the micropile shall not exceed 80 percent of the structural capacity of the micropile structural elements, to include steel yield in tension, steel yield or buckling in compression, or grout crushing in compression. Any required increase in strength of the verification test pile elements above the strength required for the production piles shall be provided for in the contractor's bid price.

The jack shall be positioned at the beginning of the test such that unloading and repositioning during the test will not be required.

3.3.3 Verification Test Loading Schedule. Test verification piles designated for tension load testing to a maximum test load equal to the required nominal geotechnical resistance, or Nominal Resistance (NR) shown on the Plans. NR is typically calculated by dividing the Factored Design Load (FDL) for the micropile by the Geotechnical Resistance Factor (Φ).

The verification pile load tests shall be made by incrementally loading the micropile in accordance with the following cyclic load schedule:

VERIFICATION TEST LOADING SCHEDULE			
STEP	**LOADING**	**APPLIED LOAD**	**HOLD TIME (Min.)**
1	Apply AL		2.5
2	Cycle 1	0.10 NR	2.5
		0.20 NR	2.5
		0.30 NR	2.5
		AL	1
3	Cycle 2	0.10 NR	1
		0.20 NR	1
		0.30 NR	1
		0.40 NR	2.5
		0.50 NR	2.5
		AL	1
4*	Cycle 3*	0.10 NR	1
		0.50 NR	1
		0.60 NR	2.5
		0.70 NR	60 minutes (Creep Test)
		0.80 NR	2.5
		AL	1
5	Cycle 4	0.10 NR	1
		0.80 NR	1
		0.90 NR	2.5
		1.00 NR	10
		0.75 NR	5
		0.50 NR	5
		0.25 NR	5
		AL	5
AL = Alignment Load not to exceed 0.05 NR NR = Nominal Geotechnical Resistance (As Shown on Plans) *Loading Cycle 3 shall be repeated 5 times. During the initial 4 times of performing Loading Cycle 3, each applied load only needs to be held for 1 minute. During the fifth instance of repeating Load Cycle 5, the applied loads shall be held for the times indicated in the above schedule.			

To reduce the contribution of the overburden soils on the resistance, Loading Cycle 3 of the Verification Test Loading Schedule in the project-specific "Special Note for Micropiles" shall be repeated 5 times between Loading Cycles 2 and 4. During the initial 4 times of performing Loading Cycle 3, each applied load only needs to be held for 1 minute. During the fifth instance of repeating Load Cycle 5, the applied loads shall be held for the times indicated in the referenced schedule.

Pile top movement shall be measured at each load increment relative to a fixed reference. The load-hold period shall start as soon as each test load increment is applied. The verification test pile shall be monitored for creep at the 0.70 Nominal Resistance (NR). Pile movement during the creep test shall be measured and recorded at 1, 2, 3, 4, 5, 6, 10, 20, 30, 50 and 60 minutes. The alignment load shall not exceed 5 percent of the NR load. Dial gauges shall be reset to zero after the initial AL is applied.

The acceptance criteria for micropile verification load tests are:

1) The pile shall sustain the first 0.50 NR test load (compression or tension) with no more than 1/2" total vertical movement at the top of the pile, relative to the

position of the top of the pile prior to testing.

2) At the end of the 0.70 NR creep test load increment, test piles shall have a creep rate not exceeding 0.040 inch/log cycle time (1 to 10 minutes) or 0.080 inch/log cycle time (6 to 60 minutes or the last log cycle if held longer). The creep rate shall be linear or decreasing throughout the creep load hold period.
3) Failure does not occur at the NR maximum test load. Failure is defined as load where the slope of the load versus head settlement curve first exceeds 0.025 inch/kip.

3.3.4 Verification Test Pile Rejection. If the micropile verification test fails to meet the acceptance criteria, establish the cause(s) and provide modifications to the design, the construction procedures, or both. Retest the new system, as directed by the Engineer. These modifications include, but are not limited to, installing replacement test micropiles, modifying the installation methods, increasing the bond length, regrouting via pre-placed re-grout tubes, or changing the micropile type. Any modification which requires changes to the structure must have prior review and acceptance of the Engineer through submittals. Determine the cause for any modifications of design or construction procedures to appropriately determine any additional cost implications.

3.3.5 Proof Load Tests. Unless shown otherwise on the Plans, perform proof tests on 5 percent of the production piles with a minimum of 1 pile per substructure unit. The proof test piles or locations shall be as shown on the Plans or as directed by the Engineer. Provide the Engineer a written report confirming micropile geometry, construction, testing details, and proof test results within 7 working days following completion of the production pile proof load tests.

3.3.6 Proof Test Loading Schedule. Test piles designated for proof load testing to a maximum test load of the Factored Design Load (FDL) shown on the Plans or Working Drawings. Proof tests shall be made by incrementally loading the micropile in accordance with the following schedule:

PROOF TEST LOADING SCHEDULE			
STEP	**LOADING**	**APPLIED LOAD**	**HOLD TIME (Min.)**
1	Apply AL		2.5
2	Load Cycle	0.10 FDL	2.5
		0.20 FDL	2.5
		0.30 FDL	2.5
		0.40 FDL	2.5
		0.50 FDL	2.5
		0.60 FDL	2.5
		0.70 FDL	2.5
		0.80 FDL	10 to 60 minutes (Creep Test)
		0.90 FDL	2.5
		1.00 FDL	2.5
3	Unload Cycle	0.75 FDL	4
		0.50 FDL	4
		0.25 FDL	4
		AL	4
AL = Alignment Load not to exceed 0.05 FDL FDL = Factored Design Load (As Shown on Plans)			

Depending on performance, either a 10-minute or 60-minute creep test shall be performed at the 0.80 FDL Test Load. Where the pile top movement between 1 and 10 minutes exceeds 0.040 inch, the test load shall be maintained an additional 50 minutes. Movements shall be recorded at 1, 2, 3, 5, 6, 10, 20, 30, 50 and 60 minutes. The alignment load shall not exceed 5 percent of FDL. Dial gauges shall be reset to zero after the initial AL is applied.

The acceptance criteria for micropile proof load tests are:

1) The pile shall sustain a 0.70 FDL test load (compression or tension) with no more than 1/2" total vertical movement at the top of the pile, relative to the position of the top of the pile prior to testing.
2) At the end of the 0.80 FDL creep test load increment, test piles shall have a creep rate not exceeding 0.040 inch/log cycle time (1 to 10 minutes) or 0.080 inch/log cycle time (6 to 60 minutes). The creep rate shall be linear or decreasing throughout the creep load hold period.
3) Failure does not occur at the FDL maximum test load. Failure is defined as load where the slope of the load versus head settlement curve first exceeds 0.025 inch/kip.

3.3.7 Proof Test Pile Rejection. If a proof-tested micropile fails to meet the acceptance criteria, proof test another micropile in the immediate vicinity. For failed piles and further construction of other piles, modify the design, the construction procedure, or both. These modifications include, but are not limited to, installing replacement micropiles, incorporating piles of reduced load capacities, modifying the installation methods, increasing the bond length, or changing the micropile type. Any modification which requires changes to the structure must have prior review and acceptance of the Engineer through submittals. Determine the cause for any modifications of design or construction procedures to appropriately determine any additional cost implications.

3.4 Abandoned Holes. In the event a micropile cannot be advanced to the design tip

elevation due to interference from the existing H-piles below grade (i.e., the bottom of pile cap elevation), the micropile location shall be abandoned, the permanent casing shall be extracted and reused (if possible), and the hole shall be grouted. The hole may be tremie grouted with flowable fill or an approved mixture of grout with a minimum compressive strength of 250 psi at 28 days. The grout mixture shall consider the effects of the rather porous in-situ pile core and shot-rock fill materials. There will be no extra payment for grout or flowable fill overruns.

4.0 MEASUREMENT.

4.1 Micropile. The Department will not measure for payment any non-production trial piles, failed test piles or reaction piles. No distinction in measurement is made between cased or uncased piling. The contractor is responsible for estimating the grout take. There will be no extra payment for grout overruns or special installation materials, procedures or equipment to prevent or reduce grout overruns. Where piles are out of vertical tolerance, there will be no extra payment for replacement piles, or for grouting and redrilling piles to achieve the required tolerance, unless the pile is interfered by the existing H-piles (see Pay Items for Abandoned Micropile Hole and for Damaged Casing from H-Pile Interference).

4.1.1 Micropile, Common. The Department will measure the length, in linear feet, of installed and complete production micropiles from the cut-off elevation to the approved top of rock elevation, minus any additional length installed at the contractor's option such as, but not limited to, facilitating the use of whole casing segments.

4.1.2 Micropile, Solid Rock. The Department will measure the length, in linear feet, of installed and complete production micropiles from the top of rock elevation to the approved top of bond zone elevation, minus any additional length installed at the contractor's option such as, but not limited to, facilitating the use of whole casing segments.

4.1.3 Micropile, Bond Zone. The Department will measure the quantity by each for each installed and complete production pile bond zone length.

4.2 Micropile Verification Test. For each verification test micropile installed according to the plans and is tested and accepted, the Department will measure the quantity by "each." The unit price will include the sacrificial pile as well as the reaction system, ancillaries, and any other materials and labor required to perform the test. Additional verification test micropiles installed to verify alternative micropile installation methods proposed by the Contractor will not be measured for payment.

4.3 Micropile Proof Test. The Department will measure the quantity by each for each test performed on a production micropile that is accepted and incorporated into the completed structure.

4.4 Abandoned Micropile Hole. The Department will measure the length, in linear feet, of abandoned micropile holes, resulting from unforeseen interferences with the existing H-piles. The unit price will include the drilling of the hole to the depth at which the casing was advanced and the placement of the grout. The cost of damaged casing is not included in this pay item.

4.5 Damaged Casing from H-Pile Interference. The Department will measure the length, in linear feet, of casing that is damaged or unable to be extracted from abandoned micropile holes, resulting from unforeseen interferences with the existing H-piles. The unit price will include the length of casing that is unable to be extracted or the length of damaged (nonreusable) casing segments that are able to be extracted.

4.6 Vertical Tolerance Measurements of Micropiles Using Hole Telemetry. The Department will measure the quantity by each production pile that is determined to be within the acceptable vertical tolerance using hole telemetry and incorporated into the completed structure. When piles are determined to be out of tolerance, requiring replacement piles or grouting and redrilling, the Contractor will not be paid for the out of tolerance piles.

5.0 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Pay Item	Pay Unit
Micropile, Diameter*, Common	Linear Foot
Micropile, Diameter*, Solid Rock	Linear Foot
Micropile, Bond Zone	Each
Micropile Verification Test	Each
Micropile Proof Test	Each
Abandoned Micropile Holes	Linear Foot
Damaged Casing from H-Pile Interference	Linear Foot
Vertical Tolerance Measurements of Micropiles Using Hole Telemetry	Each

* *See Plan Sheets for sizes of micropiles*.

The Department will consider payment as full compensation for all work required in this note.

TRANSPORTATION CABINET
DEPARTMENT OF HIGHWAYS
BRIDGE REPAIR PLANS FOR
MASON COUNTY
U.S. 68 OVER LAWRENCE CREEK
STPBRO5462028 081 0068 016-018

CONSTRUCTION PROJECT NO.

LETTING DATE

FILE NAME: G:\LOUISVILLE\DCS\PROJECTS\KY\KYTC\60537897 KYTC MASON COUNTY US 68\500 - DELIVERABLES\2019-07-19 ADDENDUMS\S28058_001.DGN

USER: Kimberly.Kutner
DATE PLOTTED: July 23, 2019

E-SHEET NAME:

MicroStation v8.11.7.443

ESTIMATE OF QUANTITIES

BID ITEM CODE		00001	00212	00301	02014	02091	02223	02231	02351	02363	02562	02599	02650	02671	02731	02775	02998	03171	03299	40101	08003	08100	08104	08131	08134	08150	08151	08820
BID ITEM		DGA Base	Class 2 Asphalt Base 1.00D PG 64-22	Class 2 Asphalt Surface 0.38D PG 64-22	Barricade–Type III	Remove Pavement	Granular Embankment	Structure Granular Backfill	Guardrail–Steel W Beam S Face	Guardrail Conn. To Bridge End Type A	Temporary Signs	Fabric Geotextile Type IV	Maintain and Control Traffic	Portable Changeable Message Sign	Remove Structure	Arrow Panel	Masonry Coating	Concrete Barrier Wall Type 9T	Armored Edge for Concrete	Concrete Patching	Foundation Preparation	Concrete Class "A"	Concrete Class "AA"	Mechanical Reinforced Coupler #6	Mechanical Reinforced Coupler #9	Steel Reinforcement	Steel Reinforcement, Epoxy Coated	Drain Pipe – 6 in.
UNIT		TON	TON	TON	EACH	S.Y.	C.Y.	C.Y.	L.F.	EACH	S.F.	S.Y.	L.S.	EACH	L.S.	EACH	S.Y.	L.F.	L.F.	S.F.	L.S.	C.Y.	C.Y.	EACH	EACH	LBS.	LBS.	L.F.
Substructure	End Bent 1						450	835				744					140					145	109	10	24	11,980	5,530	700
	Pier 2																7			62		212				39,380		
	Pier 3																2			17								
	Pier 4																2			16								
	Pier 5																2			12		212				39,380		
	End Bent 6						450	835				744					139					145	109	10	24	11,200	5,530	640
Superstructure															1		52		128	10	1		38				11,780	
Roadway		183	175	27	4	420			200	4	209		1	4		1		880										
BRIDGE TOTALS		183	175	27	4	420	900	1,670	200	4	209	1488	1	4	1	1	344	880	128	117	1	714	256	20	48	101,940	22,840	1,340

BID ITEM CODE		21415ND	22056NN	22585NN	22861EN	23744EC	24002EC	24006EC	24007EC	24008EC	24595EN	21532ED	25037ED	25036ED	25035ED	02726
BID ITEM		Erosion Control	Temporary Support	Micropile, Proof Test	High Strength Geotextile Fabric Type V	Epoxy Injection Crack Repair	Micropile, 9 5/8" Dia. – Common	Micropile, Verification Test	Pier Micropile – Rock Socket	Abutment Micropile – Rock Socket	Elasticized EPS (20")	Rail System Type III	Abandoned Micropile Holes	Damaged Casing From H-pile Interference	Vert. Tolerence Measurement of Micropiles	Staking
UNIT		L.S.	EACH	EACH	S.Y.	L.F.	L.F.	EACH	EACH	EACH	S.Y.	L.F.	LF	LF	EACH	L.S.
Substructure	End Bent 1		2	3	2815		5,390			49	113		150	150	49	
	Pier 2			3			2,194		58				150	150	58	
	Pier 3							1								
	Pier 4							1								
	Pier 5			3			3,876		58				150	150	58	
	End Bent 6		2	3	2815		5,292			49	112		150	150	49	
Superstructure						186						46				1
Roadway																
BRIDGE TOTALS		1	4	12	5630	186	16,752	2	116	98	225	46	600	600	214	1

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SPECIAL NOTES

Treatment of End Bent Backfills Using Wrapped Geotextile Reinforcement & Elastic Inclusion

Special Note for Micropiles

Special Notes for Erosion Prevention & Sediment Control

Concrete Patching & Repair

Epoxy Injection Crack Repair

Special Note for Pre-Bid Conference

SPECIAL PROVISIONS

69 Embankment at Bridge End Bent Structures

STANDARD DRAWINGS

BBP-001-12	Elastomeric Bearing Pads for Prestressed Beams
BBP-002-04	Bearing Details
BGX-006-10	Stencils for Structures
BGX-012-02	Geotechnical Legend
BJE-001-12	Neoprene Expansion Dams and Armored Edges
RDP-010-09	Perforated Pipe Headwalls
RBC-006	Guardrail Connector To Bridge End Type A
RBR-001-12	Steel Beam Guardrail "W" Beam
RBM-115-10	Concrete Barrier Wall Type 9T (Temporary)
RBM-020-09	Delineators for Concrete Barriers
RBR-005-11	Guardrail Components
RBR-015-05	Steel Guardrail Posts
RDX-210-03	Temporary Silt Fence
RDX-220-05	Silt Trap Type A
RDX-225-01	Silt Trap Type B

SPECIFICATIONS

2019 Standard Specifications for Road and Bridge Construction.

2002 Standard Specifications for Highway Bridges 17th Edition

Plans Prepared By
AECOM

STATE OF KENTUCKY
CRAIG RAYMOND KLUSMAN
22558
LICENSED PROFESSIONAL ENGINEER

Craig Raymond Klusman, PE
KY. No. 22558

ITEM NUMBER
09-1095

REVISION	DATE

DATE: 06/06/2019	CHECKED BY
DESIGNED BY: A. VASUDEVAN	A. BHATT
DETAILED BY: A. VASUDEVAN	C. KLUSMAN

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY
MASON

ROUTE
US 68

CROSSING
LAWRENCE CREEK

TITLE SHEET

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SHEET NO.
S1

DRAWING NO.
28058

CONSTRUCTION PROJECT NO.

LETTING DATE

TRANSPORTATION CABINET
DEPARTMENT OF HIGHWAYS
BRIDGE REPAIR PLANS FOR
MASON COUNTY
U.S. 68 OVER LAWRENCE CREEK
STPBRO5462028 081 0068 016-018

ESTIMATE OF QUANTITIES

BID ITEM CODE	00001	00212	00301	02014	02091	02223	02231	02351	02363	02562	02599	02650	02671	02731	02775	02998	03171	03299	40101	08003	08100	08104	08131	08134	08150	08151	08820
BID ITEM	DGA Base	Class 2 Asphalt Base 1.00D PG 64-22	Class 2 Asphalt Surface 0.38D PG 64-22	Barricade–Type III	Remove Pavement	Granular Embankment	Structure Granular Backfill	Guardrail–Steel W Beam S Face	Guardrail Conn. To Bridge End Type A	Temporary Signs	Fabric Geotextile Type IV	Maintain and Control Traffic	Portable Changeable Message Sign	Remove Structure	Arrow Panel	Masonry Coating	Concrete Barrier Wall Type 9T	Armored Edge for Concrete	Concrete Patching	Foundation Preparation	Concrete Class "A"	Concrete Class "AA"	Mechanical Reinforced Coupler #6	Mechanical Reinforced Coupler #9	Steel Reinforcement	Steel Reinforcement, Epoxy Coated	Drain Pipe – 6 in.
UNIT	TON	TON	TON	EACH	S.Y.	C.Y.	C.Y.	L.F.	EACH	S.F.	S.Y.	L.S.	EACH	L.S.	EACH	S.Y.	L.F.	L.F.	S.F.	L.S.	C.Y.	C.Y.	EACH	EACH	LBS.	LBS.	L.F.
Substructure: End Bent 1						450	835				744					140					145	109	10	24	11,980	5,530	700
Substructure: Pier 2																7			62		212				39,380		
Substructure: Pier 3																2			17								
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Substructure: Pier 5																2			12		212				39,380		
Substructure: End Bent 6						450	835				744					139					145	109	10	24	11,200	5,530	640
Superstructure														1		52		128	10	1		38				11,780	
Roadway	183	175	27	4	420			200	4	209		1	4		1		880										
BRIDGE TOTALS	183	175	27	4	420	900	1,670	200	4	209	1488	1	4	1	1	344	880	128	117	1	714	256	20	48	101,940	22,840	1,340

BID ITEM CODE	21415ND	22056NN	22585NN	22861EN	23744EC	24002EC	24006EC	24007EC	24008EC	24595EN	21532ED	25037ED	25036ED	25035ED	02726
BID ITEM	Erosion Control	Temporary Support	Micropile, Proof Test	High Strength Geotextile Fabric Type V	Epoxy Injection Crack Repair	Micropile, 9 5/8" Dia. – Common	Micropile, Verification Test	Pier Micropile – Rock Socket	Abutment Micropile – Rock Socket	Elasticized EPS (20")	Rail System Type III	Abandoned Micropile Holes	Damaged Casing From H-pile Interference	Vert. Tolerence Measurement of Micropiles	Staking
UNIT	L.S.	EACH	EACH	S.Y.	L.F.	L.F.	EACH	EACH	EACH	S.Y.	L.F.	LF	LF	EACH	L.S.
Substructure: End Bent 1		2	3	2815		5,390			49	113		150	150	49	
Substructure: Pier 2			3			2,194		58				150	150	58	
Substructure: Pier 3							1								
Substructure: Pier 4							1								
Substructure: Pier 5			3			3,876		58				150	150	58	
Substructure: End Bent 6		2	3	2815		5,292			49	112		150	150	49	
Superstructure					186						46				1
Roadway															
BRIDGE TOTALS	1	4	12	5630	186	16,752	2	116	98	225	46	600	600	214	1

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Plans Prepared By
AECOM

Craig Raymond Klusman, PE
KY. No. 22558

ITEM NUMBER
09–1095

REVISION	DATE

DATE: 06/06/2019	CHECKED BY
DESIGNED BY: A. VASUDEVAN	A. BHATT
DETAILED BY: A. VASUDEVAN	C. KLUSMAN

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY
MASON

ROUTE
US 68

CROSSING
LAWRENCE CREEK

TITLE SHEET

PREPARED BY
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Louisville, KY 40202–4251
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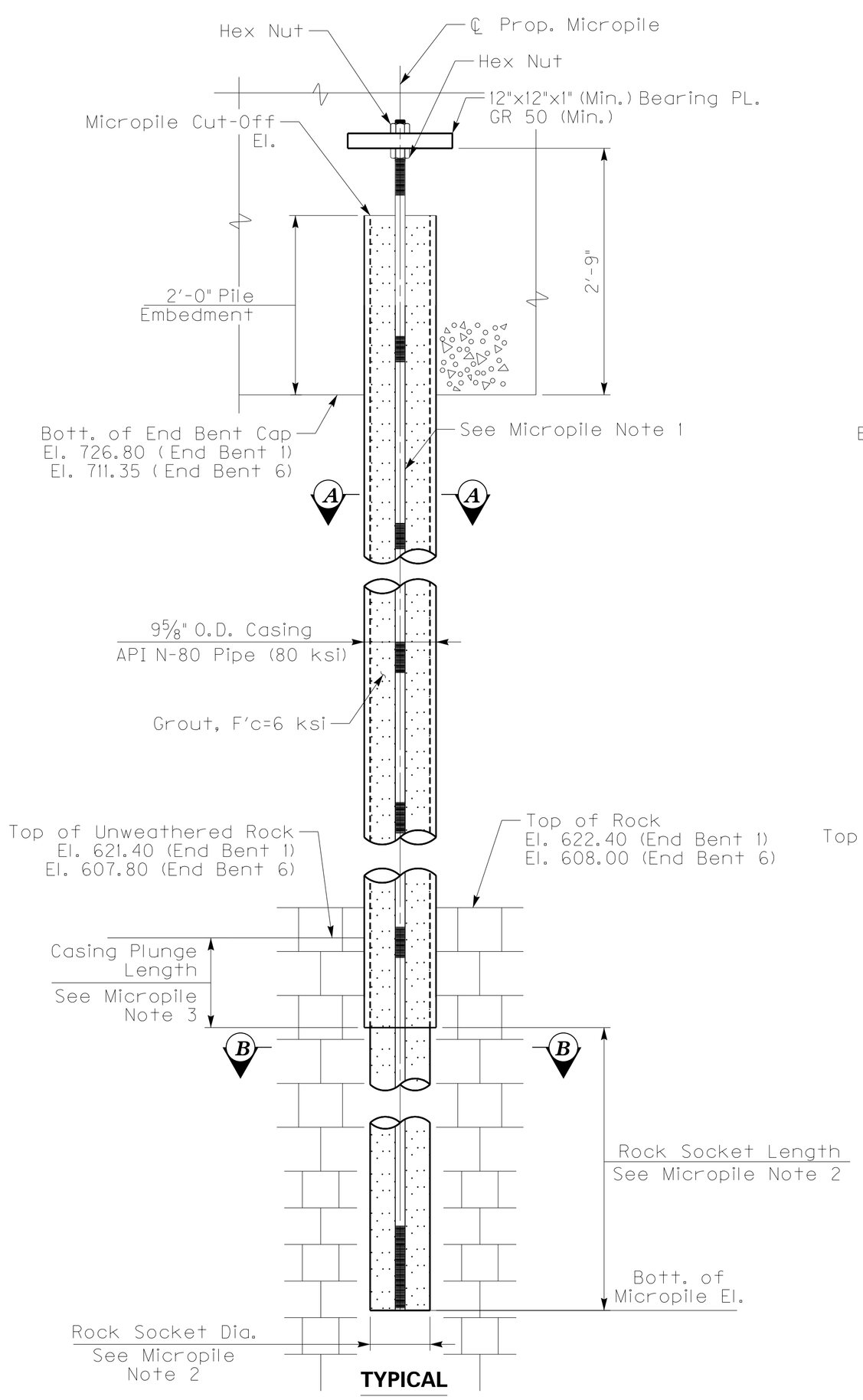
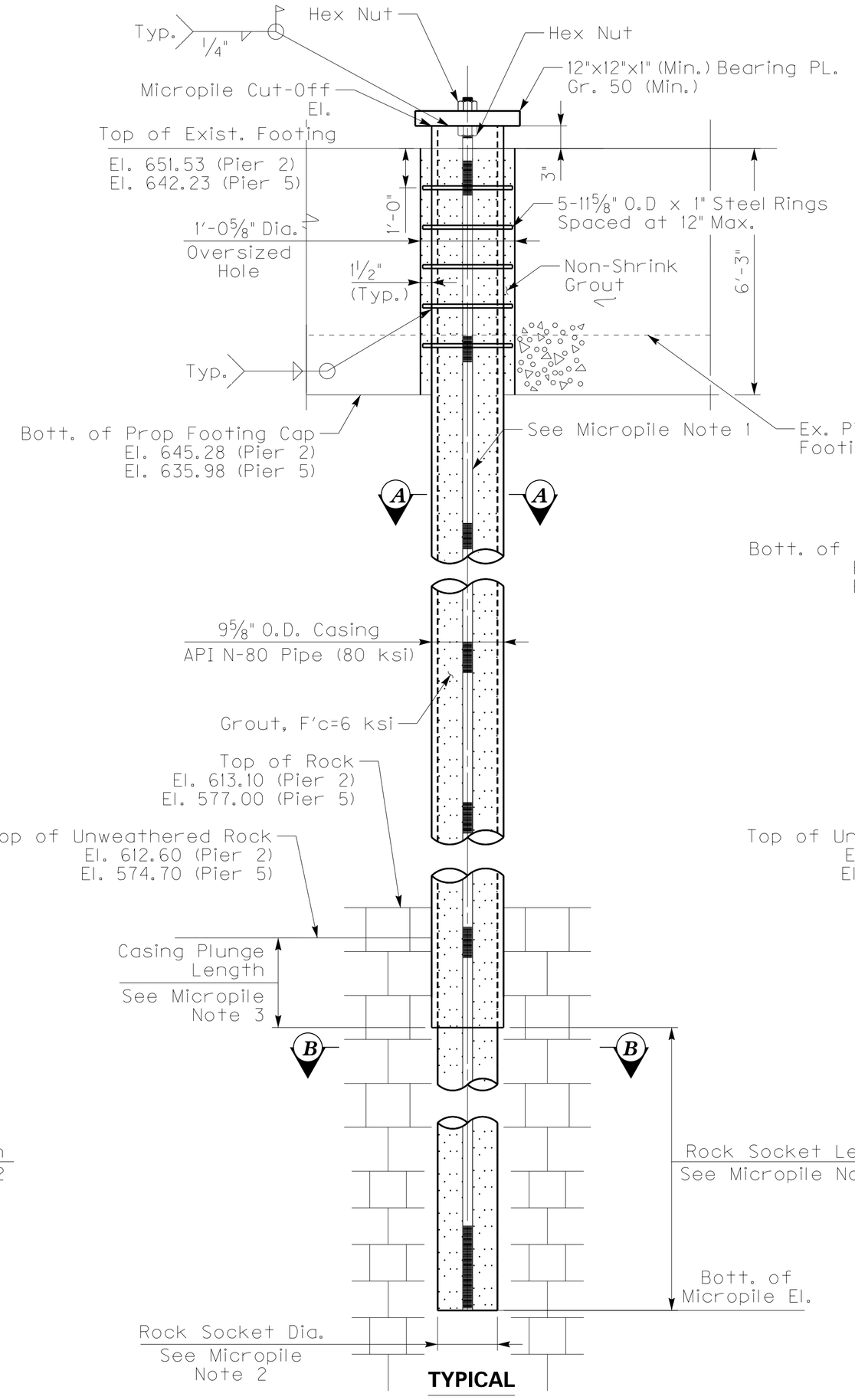
SHEET NO.
S1

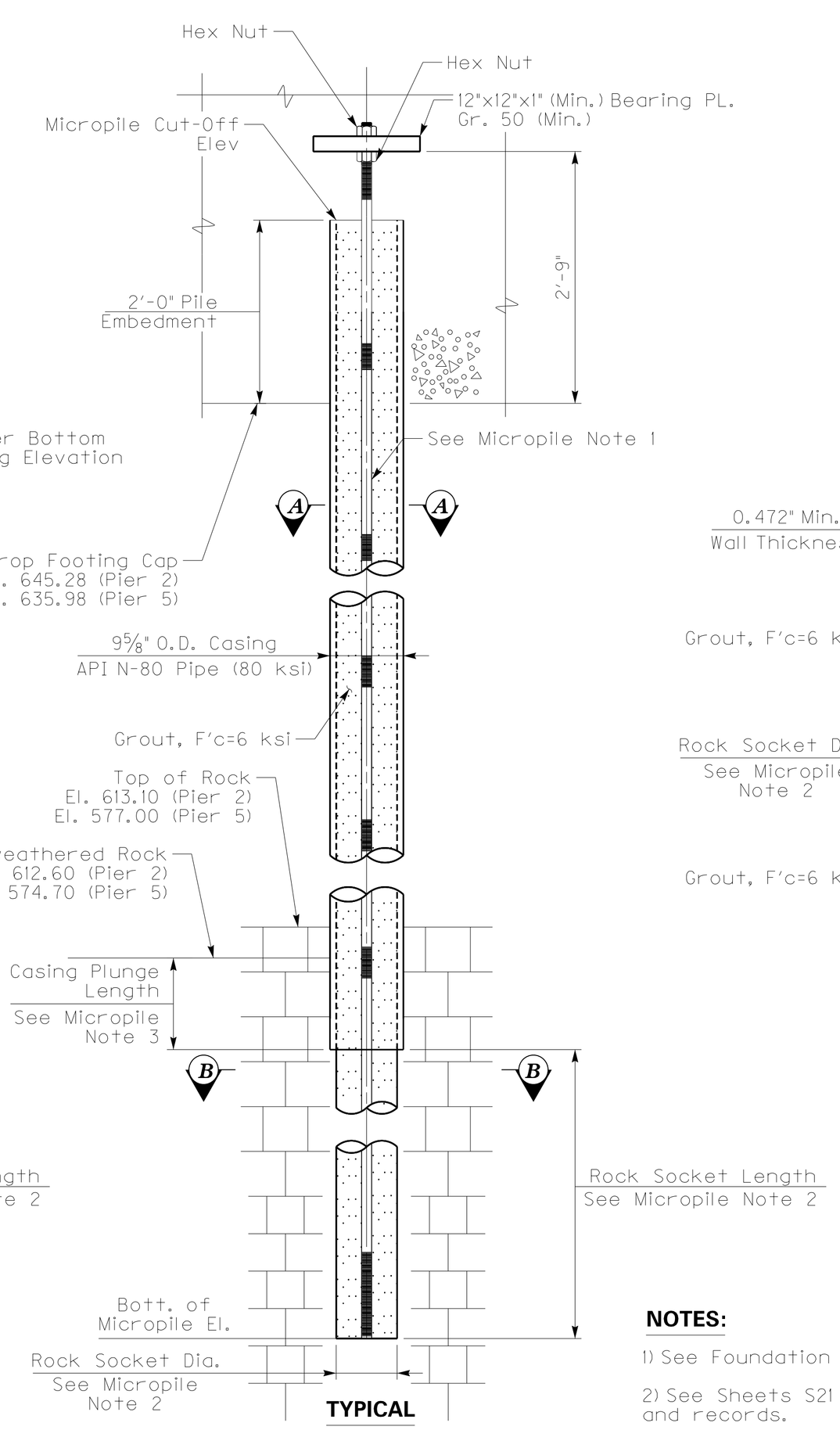
DRAWING NO.
28058



END BENT MICROPILE ELEVATION



MICROPILE ELEVATION DRILLED THRU EXISTING PIER FOOTING



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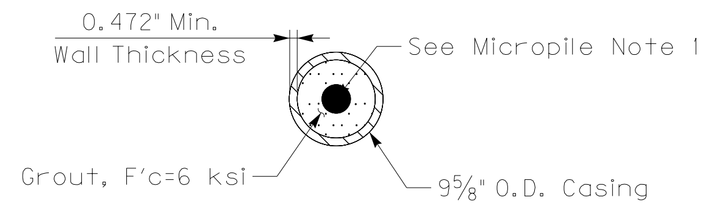
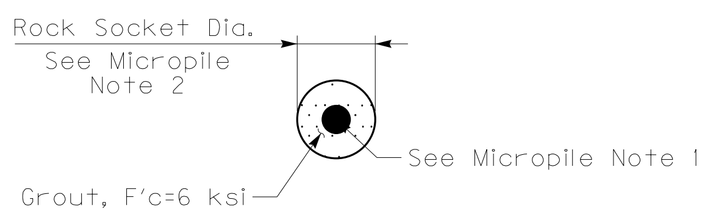


SECTION A–A



SECTION B–B

NOTES:

1) See Foundation Layout for micropile locations.

2) See Sheets S21 thru S25 for micropile notes and records.

MICROPILE NOTES:

1) #28 All-Thread Rebar (Grade 75) for all Production Micropiles. 3" Diameter All-Thread Rebar (Grade 150) for Proof Load Testing micropiles & Load/Verification Piles.

2) The rock socket/bond zone shall be located within the competent, relatively unweathered shale and limestone bedrock. Contractor shall have the option of using rock socket diameters as described below,

End Bents 1 & 6
8" Diameter Rock Socket with 45'-6" Rock Socket Length. Larger rock socket diameters may be considered that provide at least 95 sq. ft. of periphery surface area in the rock socket.

Pier 2
8" Diameter Rock Socket with 32'-0" Rock Socket Length. Larger rock socket diameters may be considered that provide at least 67 sq. ft. of periphery surface area in the rock socket.

Pier 5
8" Diameter Rock Socket with 40'-0" Rock Socket Length. Larger rock socket diameters may be considered that provide at least 84 sq. ft. of periphery surface area in the rock socket.

MICROPILE NOTES (Contd.)

3) Casing Plunge Length shall be a minimum of 2'-0".

4) This work shall consist of constructing micropiles as shown on the Plans, accepted working drawings and approved shop drawings and as specified herein. The micropile specialty Contractor is responsible for furnishing all required working shop drawings, materials, products, accessories, tools, equipment, services, transportation, labor and supervision, and manufacturing techniques required for installation and testing of micropiles and pile top attachments for this project. The micropile load capacities shall be verified by verification and proof load testing as required and must meet the test acceptance criteria specified herein. Section references herein are to the Department's Standard Specifications for Road and Bridge Construction.

5) Use a 1/4" minimum fillet weld, unless noted otherwise. All welds shall be SMAW process or better.

REVISION	DATE

DATE: 06/06/2019	CHECKED BY
DESIGNED BY: A. ZEIN	L. LIN
DETAILED BY: A. VASUDEVAN	C. KLUSMAN

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY
MASON

ROUTE
US 68

CROSSING
LAWRENCE CREEK

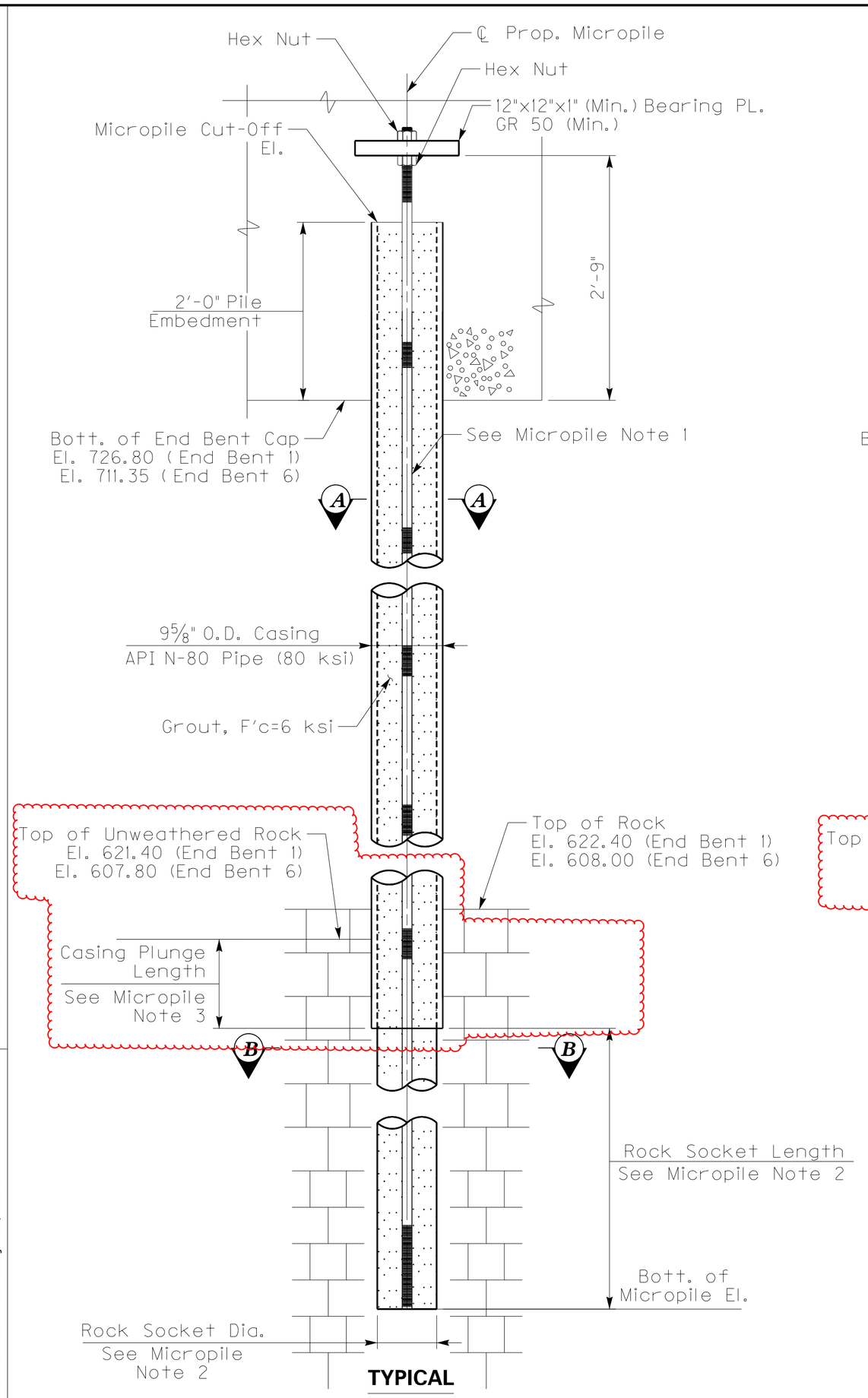
MICROPILE RECORD & DETAILS – 1

ITEM NUMBER
09–1095

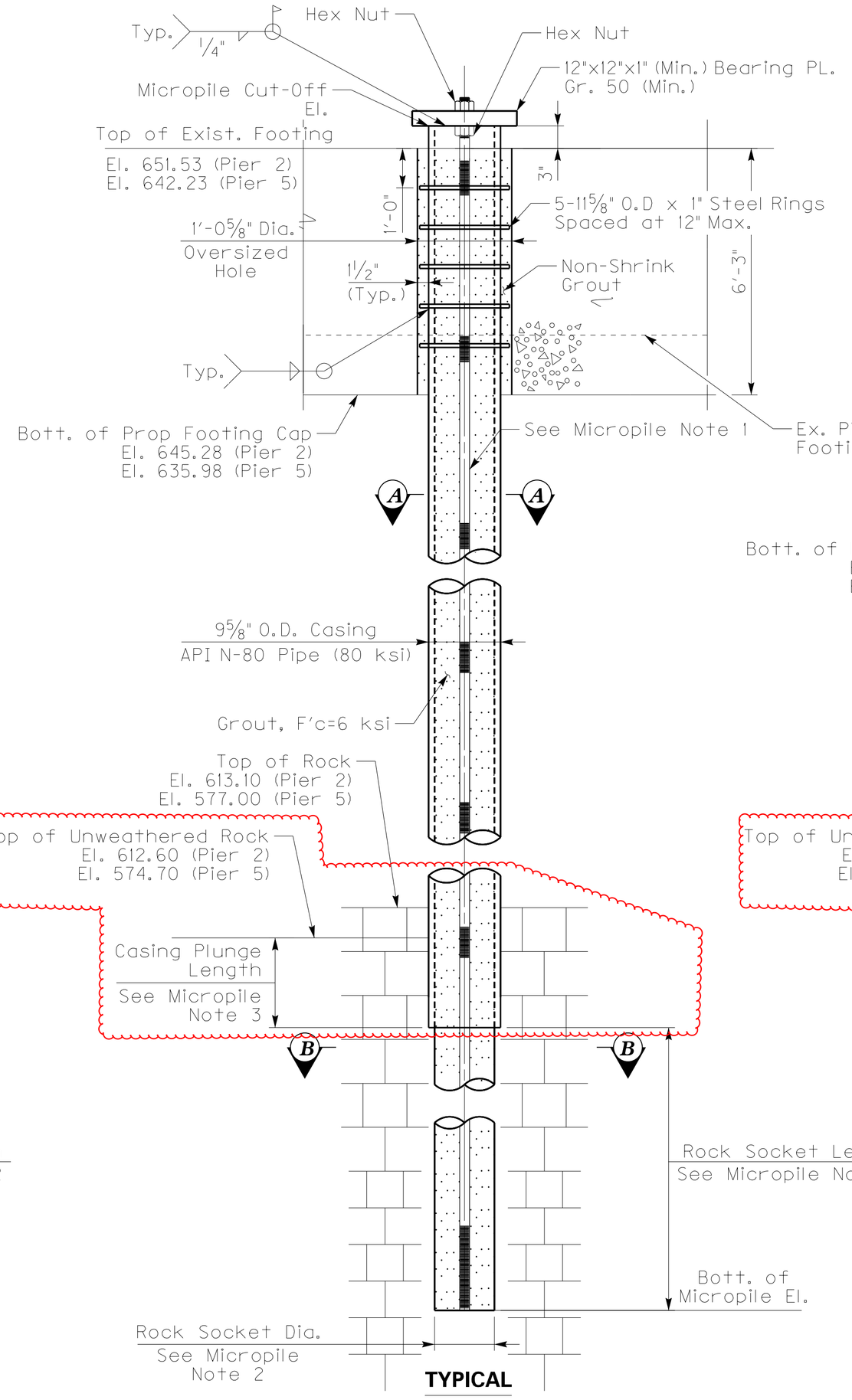
PREPARED BY
AECOM
500 West Jefferson Street
Suite 1600
Louisville, KY 40202-4251
www.aecom.com

SHEET NO.
S21

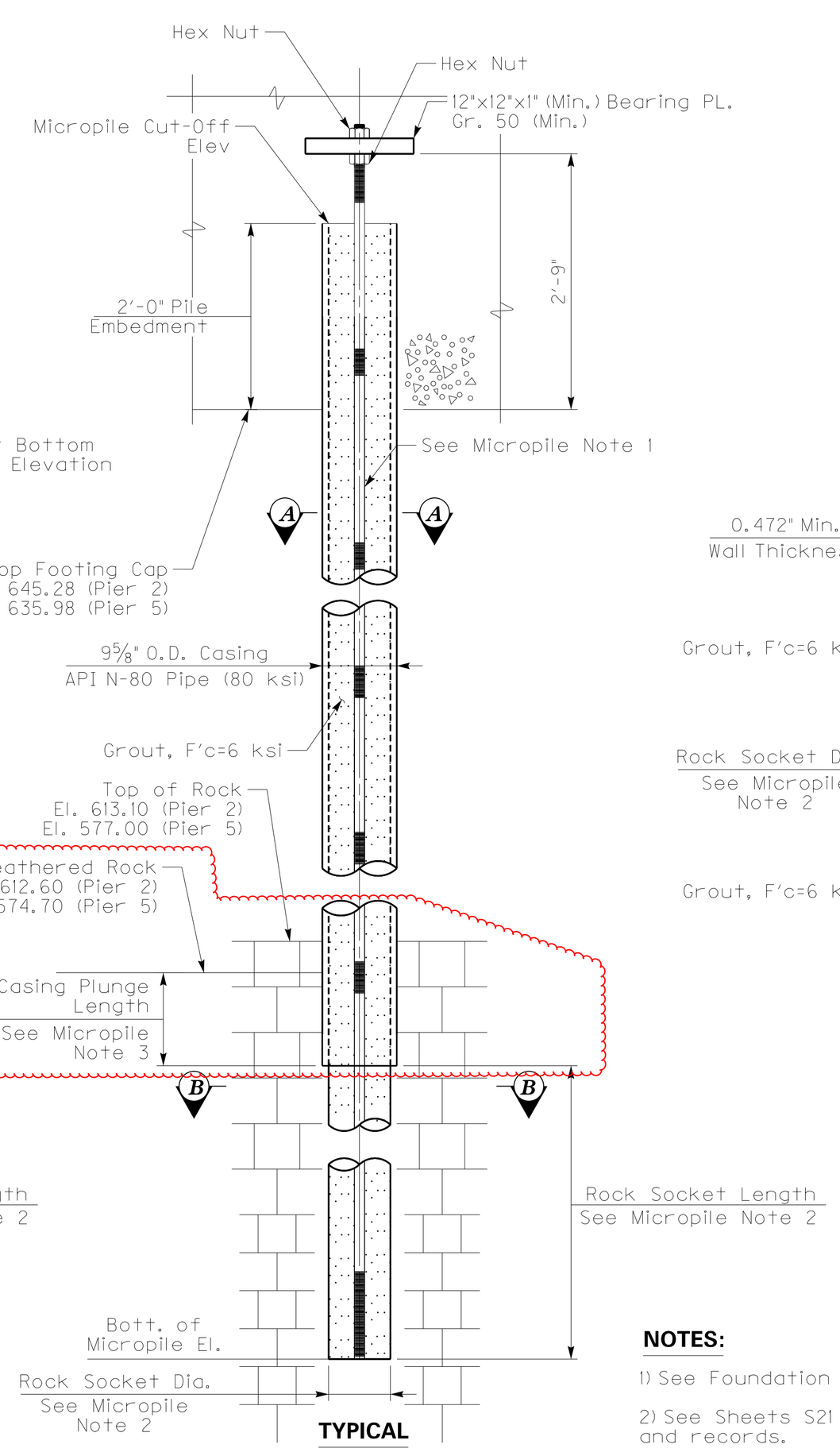
DRAWING NO.
28058



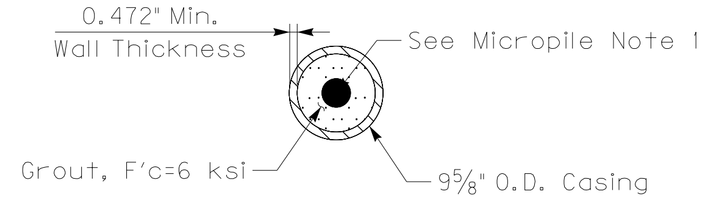
END BENT MICROPILE ELEVATION



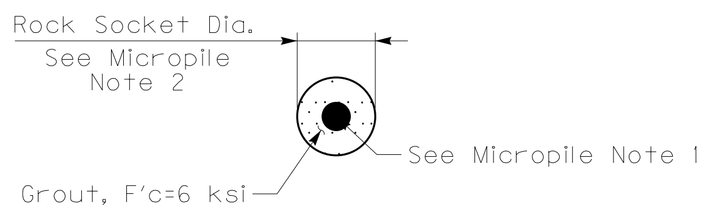
MICROPILE ELEVATION DRILLED THRU EXISTING PIER FOOTING



MICROPILE ELEVATION IN PROPOSED PIER FOOTING



SECTION A–A



SECTION B–B

NOTES:

1) See Foundation Layout for micropile locations.

2) See Sheets S21 thru S25 for micropile notes and records.

MICROPILE NOTES:

1) #28 All-Thread Rebar (Grade 75) for all Production Micropiles. 3" Diameter All-Thread Rebar (Grade 150) for Proof Load Testing micropiles & Load/Verification Piles.

2) The rock socket/bond zone shall be located within the competent, relatively unweathered shale and limestone bedrock. Contractor shall have the option of using rock socket diameters as described below.

End Bents 1 & 6
8" Diameter Rock Socket with 45'-6" Rock Socket Length. Larger rock socket diameters may be considered that provide at least 95 sq. ft. of periphery surface area in the rock socket.

Pier 2
8" Diameter Rock Socket with 32'-0" Rock Socket Length. Larger rock socket diameters may be considered that provide at least 67 sq. ft. of periphery surface area in the rock socket.

Pier 5
8" Diameter Rock Socket with 40'-0" Rock Socket Length. Larger rock socket diameters may be considered that provide at least 84 sq. ft. of periphery surface area in the rock socket.

MICROPILE NOTES (Contd.)

3) Casing Plunge Length shall be a minimum of 2'-0".

4) This work shall consist of constructing micropiles as shown on the Plans, accepted working drawings and approved shop drawings and as specified herein. The micropile specialty Contractor is responsible for furnishing all required working shop drawings, materials, products, accessories, tools, equipment, services, transportation, labor and supervision, and manufacturing techniques required for installation and testing of micropiles and pile top attachments for this project. The micropile load capacities shall be verified by verification and proof load testing as required and must meet the test acceptance criteria specified herein. Section references herein are to the Department's Standard Specifications for Road and Bridge Construction.

5) Use a ¼" minimum fillet weld, unless noted otherwise. All welds shall be SMAW process or better.

REVISION	DATE

DATE: 06/06/2019	CHECKED BY
DESIGNED BY: A. ZEIN	L. LIN
DETAILED BY: A. VASUDEVAN	C. KLUSMAN

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY
MASON

ROUTE	CROSSING
US 68	LAWRENCE CREEK

MICROPILE RECORD & DETAILS – 1

ITEM NUMBER
09–1095

PREPARED BY
AECOM
500 West Jefferson Street
Suite 1600
Louisville, KY 40202-4251
www.aecom.com

SHEET NO. S21
DRAWING NO. 28058

MICROPILE RECORD (END BENT 1)

AS SHOWN ON PLANS						AS CONSTRUCTED		
Micropile No.	Design Axial Load (kips)	Micropile Cut-Off Elev.	Approx. Top of Unweathered Berock Elev.	Approx. Length of Micropile (ft.) *	Approx. Bott. of Micropile Elev.(8" Dia. Rock Socket)	Bott. of Micropile Elev.	Length of Micropile (ft.)	Rock Socket Length (ft.)
A1	478	728.803	621.40	110	574.90			
A2	478	728.803	621.40	110	574.90			
A3	478	728.803	621.40	110	574.90			
A4	478	728.803	621.40	110	574.90			
A5	478	728.803	621.40	110	574.90			
A6	478	728.803	621.40	110	574.90			
A7	478	728.803	621.40	110	574.90			
A8	478	728.803	621.40	110	574.90			
A9	478	728.803	621.40	110	574.90			
A10	478	728.803	621.40	110	574.90			
A11	478	728.803	621.40	110	574.90			
A12	478	728.803	621.40	110	574.90			
A13	478	728.803	621.40	110	574.90			
A14	478	728.803	621.40	110	574.90			
A15	478	728.803	621.40	110	574.90			
A16	478	728.803	621.40	110	574.90			
A17	478	728.803	621.40	110	574.90			
A18	478	728.803	621.40	110	574.90			
A19	478	728.803	621.40	110	574.90			
A20	478	728.803	621.40	110	574.90			
A21	478	728.803	621.40	110	574.90			
A22	478	728.803	621.40	110	574.90			
A23	478	728.803	621.40	110	574.90			
A24	478	728.803	621.40	110	574.90			
A25	478	728.803	621.40	110	574.90			
A26	478	728.803	621.40	110	574.90			
A27	478	728.803	621.40	110	574.90			
A28	478	728.803	621.40	110	574.90			
A29	478	728.803	621.40	110	574.90			
A30	478	728.803	621.40	110	574.90			
A31	478	728.803	621.40	110	574.90			
A32	478	728.803	621.40	110	574.90			
A33	478	728.803	621.40	110	574.90			
A34	478	728.803	621.40	110	574.90			
A35	478	728.803	621.40	110	574.90			
A36	478	728.803	621.40	110	574.90			
A37	478	728.803	621.40	110	574.90			
A38	478	728.803	621.40	110	574.90			
A39	478	728.803	621.40	110	574.90			
A40	478	728.803	621.40	110	574.90			
A41	478	728.803	621.40	110	574.90			
A42	478	728.803	621.40	110	574.90			
A43	478	728.803	621.40	110	574.90			
A44	478	728.803	621.40	110	574.90			
A45	478	728.803	621.40	110	574.90			
A46	38	728.803	621.40	110	574.90			
A47	38	728.803	621.40	110	574.90			
A48	38	728.803	621.40	110	574.90			
A49	38	728.803	621.40	110	574.90			

*Includes casing plunge length

MICROPILE RECORD (END BENT 6)

AS SHOWN ON PLANS						AS CONSTRUCTED		
Micropile No.	Design Axial Load (kips)	Micropile Cut-Off Elev.	Approx. Top of Unweathered Berock Elev.	Approx. Length of Micropile (ft.) *	Approx. Bott. of Micropile Elev.(8" Dia. Rock Socket)	Bott. of Micropile Elev.	Length of Micropile (ft.)	Rock Socket Length (ft.)
D1	478	713.353	607.8	108	560.50			
D2	478	713.353	607.8	108	560.50			
D3	478	713.353	607.8	108	560.50			
D4	478	713.353	607.8	108	560.50			
D5	478	713.353	607.8	108	560.50			
D6	478	713.353	607.8	108	560.50			
D7	478	713.353	607.8	108	560.50			
D8	478	713.353	607.8	108	560.50			
D9	478	713.353	607.8	108	560.50			
D10	478	713.353	607.8	108	560.50			
D11	478	713.353	607.8	108	560.50			
D12	478	713.353	607.8	108	560.50			
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D14	478	713.353	607.8	108	560.50			
D15	478	713.353	607.8	108	560.50			
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D17	478	713.353	607.8	108	560.50			
D18	478	713.353	607.8	108	560.50			
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D21	478	713.353	607.8	108	560.50			
D22	478	713.353	607.8	108	560.50			
D23	478	713.353	607.8	108	560.50			
D24	478	713.353	607.8	108	560.50			
D25	478	713.353	607.8	108	560.50			
D26	478	713.353	607.8	108	560.50			
D27	478	713.353	607.8	108	560.50			
D28	478	713.353	607.8	108	560.50			
D29	478	713.353	607.8	108	560.50			
D30	478	713.353	607.8	108	560.50			
D31	478	713.353	607.8	108	560.50			
D32	478	713.353	607.8	108	560.50			
D33	478	713.353	607.8	108	560.50			
D34	478	713.353	607.8	108	560.50			
D35	478	713.353	607.8	108	560.50			
D36	478	713.353	607.8	108	560.50			
D37	478	713.353	607.8	108	560.50			
D38	478	713.353	607.8	108	560.50			
D39	478	713.353	607.8	108	560.50			
D40	478	713.353	607.8	108	560.50			
D41	478	713.353	607.8	108	560.50			
D42	478	713.353	607.8	108	560.50			
D43	478	713.353	607.8	108	560.50			
D44	478	713.353	607.8	108	560.50			
D45	478	713.353	607.8	108	560.50			
D46	38	713.353	607.8	108	560.50			
D47	38	713.353	607.8	108	560.50			
D48	38	713.353	607.8	108	560.50			
D49	38	713.353	607.8	108	560.50			

*Includes casing plunge length

MICROPILE NOTES

Micropiles shall be constructed and tested in accordance with the project-specific "Special Note for Micropiles" and these plans. The Micropile Contractor shall be prepared to encounter boulders in the existing shot-rock fill. External flush or open hole drilling is not allowed. Permanent casing is required in the overburden and to the depths shown in the plans. As the primary lateral load resisting element of the micropile, the casing may not be modified without written approval of the designer.

DESIGN METHOD: Micropiles are designed in accordance with the current AASHTO LRFD Bridge Design Specifications, supplemented by the FHWA Micropile Design and Construction Reference Manual, Publication No. FHWA NHI-05-039, assuming a Type A micropile.

PERMANENT CASING: Permanent steel casing pipe shall be API N-80. Casing pipe shall meet the tensile requirements of ASTM A252, Grade 3, except the yield strength shall be a minimum of 80 ksi, and the minimum elongation shall be 15 percent. Flush threaded joints are permissible, except for in the top 8 feet of casing where the casing shall be continuous. The Contractor shall evaluate overhead clearance when determining casing segment lengths.

BEARING PLATE: Structural steel for micropile bearing plates shall conform to ASTM A709/AASHTO M270, Grade 50.

REINFORCING: Micropile reinforcing shall be ASTM A615/AASHTO M31 Grade 75, all-thread bars (unless noted otherwise).

GROUT: Micropile grout shall be either a neat cement or a sand/cement mixture with a minimum 28-day compressive strength of 6,000 psi.

PLUNGE LENGTH: The purpose of the plunge length is solely to transfer lateral loads in the micropile into the rock stratum. Any contribution to the axial bond capacity has been neglected in the design.

BOND ZONE: Bond zone lengths and diameters are based on a grout-to-ground bond nominal resistance of 50 psi and a 0.70 resistance factor. The Contractor may increase, but not decrease, the diameter and/or the length of the bond zone based on the selected drilling equipment without any additional payment.

VERIFICATION TESTS: Regardless of required load direction (i.e., compression or tension), install and perform a verification load test to a maximum tension test load equal to the Nominal Geotechnical Resistance (NR) for End bents 1 and 6 on sacrificial micropiles located near Piers 3 and 4 (2 total one at each pier). The test micropiles shall be located in close proximity to Holes 1007 and 1008 (as shown on the Subsurface Data Sheets) by these two piers to reduce the impacts of the overburden soils on the measured capacity of the test micropiles, as the overburden soils are thinner near these locations.

The test micropiles shall be installed with bedrock sockets equivalent to those planned for End bents 1 and 6, and the tension test loads shall be based on the NR required at the abutments, which shall account for the factored design downdrag loads on the micropiles. To reduce the contribution of the overburden soils on the resistance, Loading Cycle 3 of the Verification Test Loading Schedule in the project-specific "Special Note for Micropiles" shall be repeated 5 times between Loading Cycles 2 and 4. During the initial 4 times of performing Loading Cycle 3, each applied load only needs to be held for 1 minute. During the fifth instance of repeating Load Cycle 5, the applied loads should be held for the times indicated in the referenced schedule. The Contractor shall not install any production micropiles until the Engineer has received, reviewed, and accepted the verification test report.

PROOF TESTS: Regardless of required load direction (i.e., compression or tension), perform a proof load test to a maximum tension test load equal to the Factored Design Load (FDL) on 5 percent of the production micropiles at each abutment and each pier, and at least one proof test per substructure.
FDL = Factored Design Load (C = Compression, T = Tension)
Phi = Geotechnical Resistance Factor = 0.70
NR = Required Nominal Geotechnical Resistance (C = Compression, T = Tension) = FDL/ Phi

ABANDONED MICROPILE HOLES: Where micropiles are unable to be advanced to the design bedrock socket lengths due to unforeseen conflicts with the existing H-piles, the design locations shall be abandoned, and the Contractor shall notify the Engineer for direction on where to relocate the micropile. At the abandoned location, the micropile casing shall be extracted, if possible, and the hole shall be backfilled with flowable fill or an approved grout mixture that has a minimum 28-day compressive strength of 250 psi and an appropriate viscosity to account for the relatively porous structure of the in-situ pile core and shot-rock fill materials.

GROUTING & REDRILLING OUT-OF-TOLERANCE PILES: After advancing the micropile to the bedrock surface and prior drilling the bond zone, micropiles shall be measured for tolerance relative to the verticality/plumbness tolerance in the project-specific "Special Note for Micropiles".

The Contractor shall submit for review and approval the method for measuring the verticality/plumbness of the micropiles. Where micropiles are measured to be out of tolerance, the micropile casing shall be extracted, and the hole shall be grouted with an approved grout mixture that has a minimum 28-day compressive strength of 250 psi and an appropriate viscosity to account for the relatively porous structure of the in-situ pile core and shot-rock fill materials. The micropile shall be redrilled to the specified tolerance with no adjustment for payment. If the micropile was out of tolerance due to unforeseen conflicts with the existing H-piles, the micropile shall be abandoned and grouted in accordance with the note for "Abandoned Micropile Holes".

REVISION	DATE

DATE: 06/06/2019	CHECKED BY
DESIGNED BY: A. ZEIN	L. LIN
DETAILED BY: A. VASUDEVAN	C. KLUSMAN

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY
MASON

ROUTE
US 68

CROSSING
LAWRENCE CREEK

MICROPILE RECORDS & DETAILS-2

ITEM NUMBER
09-1095

PREPARED BY
AECOM
500 West Jefferson Street
Suite 1600
Louisville, KY 40202-4251
www.aecom.com

SHEET NO.
S22

DRAWING NO.
28058

MICROPILE RECORD (END BENT 1)

AS SHOWN ON PLANS						AS CONSTRUCTED		
Micropile No.	Design Axial Load (kips)	Micropile Cut-Off Elev.	Approx. Top of Unweathered Berock Elev.	Approx. Length of Micropile (ft.) *	Approx. Bott. of Micropile Elev.(8" Dia. Rock Socket)	Bott. of Micropile Elev.	Length of Micropile (ft.)	Rock Socket Length (ft.)
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A7	478	728.803	621.40	110	574.90			
A8	478	728.803	621.40	110	574.90			
A9	478	728.803	621.40	110	574.90			
A10	478	728.803	621.40	110	574.90			
A11	478	728.803	621.40	110	574.90			
A12	478	728.803	621.40	110	574.90			
A13	478	728.803	621.40	110	574.90			
A14	478	728.803	621.40	110	574.90			
A15	478	728.803	621.40	110	574.90			
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A17	478	728.803	621.40	110	574.90			
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A48	38	728.803	621.40	110	574.90			
A49	38	728.803	621.40	110	574.90			

*Includes casing plunge length

MICROPILE RECORD (END BENT 6)

AS SHOWN ON PLANS						AS CONSTRUCTED		
Micropile No.	Design Axial Load (kips)	Micropile Cut-Off Elev.	Approx. Top of Unweathered Berock Elev.	Approx. Length of Micropile (ft.) *	Approx. Bott. of Micropile Elev.(8" Dia. Rock Socket)	Bott. of Micropile Elev.	Length of Micropile (ft.)	Rock Socket Length (ft.)
D1	478	713.353	607.8	108	560.50			
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D4	478	713.353	607.8	108	560.50			
D5	478	713.353	607.8	108	560.50			
D6	478	713.353	607.8	108	560.50			
D7	478	713.353	607.8	108	560.50			
D8	478	713.353	607.8	108	560.50			
D9	478	713.353	607.8	108	560.50			
D10	478	713.353	607.8	108	560.50			
D11	478	713.353	607.8	108	560.50			
D12	478	713.353	607.8	108	560.50			
D13	478	713.353	607.8	108	560.50			
D14	478	713.353	607.8	108	560.50			
D15	478	713.353	607.8	108	560.50			
D16	478	713.353	607.8	108	560.50			
D17	478	713.353	607.8	108	560.50			
D18	478	713.353	607.8	108	560.50			
D19	478	713.353	607.8	108	560.50			
D20	478	713.353	607.8	108	560.50			
D21	478	713.353	607.8	108	560.50			
D22	478	713.353	607.8	108	560.50			
D23	478	713.353	607.8	108	560.50			
D24	478	713.353	607.8	108	560.50			
D25	478	713.353	607.8	108	560.50			
D26	478	713.353	607.8	108	560.50			
D27	478	713.353	607.8	108	560.50			
D28	478	713.353	607.8	108	560.50			
D29	478	713.353	607.8	108	560.50			
D30	478	713.353	607.8	108	560.50			
D31	478	713.353	607.8	108	560.50			
D32	478	713.353	607.8	108	560.50			
D33	478	713.353	607.8	108	560.50			
D34	478	713.353	607.8	108	560.50			
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D36	478	713.353	607.8	108	560.50			
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D43	478	713.353	607.8	108	560.50			
D44	478	713.353	607.8	108	560.50			
D45	478	713.353	607.8	108	560.50			
D46	38	713.353	607.8	108	560.50			
D47	38	713.353	607.8	108	560.50			
D48	38	713.353	607.8	108	560.50			
D49	38	713.353	607.8	108	560.50			

*Includes casing plunge length

MICROPILE NOTES

Micropiles shall be constructed and tested in accordance with the project-specific "Special Note for Micropiles" and these plans. The Micropile Contractor shall be prepared to encounter boulders in the existing shot-rock fill. External flush or open hole drilling is not allowed. Permanent casing is required in the overburden and to the depths shown in the plans. As the primary lateral load resisting element of the micropile, the casing may not be modified without written approval of the designer.

DESIGN METHOD: Micropiles are designed in accordance with the current AASHTO LRFD Bridge Design Specifications, supplemented by the FHWA Micropile Design and Construction Reference Manual, Publication No. FHWA NHI-05-039, assuming a Type A micropile.

PERMANENT CASING: Permanent steel casing pipe shall be API N-80. Casing pipe shall meet the tensile requirements of ASTM A252, Grade 3, except the yield strength shall be a minimum of 80 ksi, and the minimum elongation shall be 15 percent. Flush threaded joints are permissible, except for in the top 8 feet of casing where the casing shall be continuous. The Contractor shall evaluate overhead clearance when determining casing segment lengths.

BEARING PLATE: Structural steel for micropile bearing plates shall conform to ASTM A709/AASHTO M270, Grade 50.

REINFORCING: Micropile reinforcing shall be ASTM A615/AASHTO M31 Grade 75, all-thread bars (unless noted otherwise).

GROUT: Micropile grout shall be either a neat cement or a sand/cement mixture with a minimum 28-day compressive strength of 6,000 psi.

PLUNGE LENGTH: The purpose of the plunge length is solely to transfer lateral loads in the micropile into the rock stratum. Any contribution to the axial bond capacity has been neglected in the design.

BOND ZONE: Bond zone lengths and diameters are based on a grout-to-ground bond nominal resistance of 50 psi and a 0.70 resistance factor. The Contractor may increase, but not decrease, the diameter and/or the length of the bond zone based on the selected drilling equipment without any additional payment.

VERIFICATION TESTS: Regardless of required load direction (i.e., compression or tension), install and perform a verification load test to a maximum tension test load equal to the Nominal Geotechnical Resistance (NR) for End bents 1 and 6 on sacrificial micropiles located near Piers 3 and 4 (2 total one at each pier). The test micropiles shall be located in close proximity to Holes 1007 and 1008 (as shown on the Subsurface Data Sheets) by these two piers to reduce the impacts of the overburden soils on the measured capacity of the test micropiles, as the overburden soils are thinner near these locations.

The test micropiles shall be installed with bedrock sockets equivalent to those planned for End bents 1 and 6, and the tension test loads shall be based on the NR required at the abutments, which shall account for the factored design downdrag loads on the micropiles. To reduce the contribution of the overburden soils on the resistance, Loading Cycle 3 of the Verification Test Loading Schedule in the project-specific "Special Note for Micropiles" shall be repeated 5 times between Loading Cycles 2 and 4. During the initial 4 times of performing Loading Cycle 3, each applied load only needs to be held for 1 minute. During the fifth instance of repeating Load Cycle 5, the applied loads should be held for the times indicated in the referenced schedule. The Contractor shall not install any production micropiles until the Engineer has received, reviewed, and accepted the verification test report.

PROOF TESTS: Regardless of required load direction (i.e., compression or tension), perform a proof load test to a maximum tension test load equal to the Factored Design Load (FDL) on 5 percent of the production micropiles at each abutment and each pier, and at least one proof test per substructure.
FDL = Factored Design Load (C = Compression, T = Tension)
Phi = Geotechnical Resistance Factor = 0.70
NR = Required Nominal Geotechnical Resistance (C = Compression, T = Tension) = FDL/ Phi

ABANDONED MICROPILE HOLES: Where micropiles are unable to be advanced to the design bedrock socket lengths due to unforeseen conflicts with the existing H-piles, the design locations shall be abandoned, and the Contractor shall notify the Engineer for direction on where to relocate the micropile. At the abandoned location, the micropile casing shall be extracted, if possible, and the hole shall be backfilled with flowable fill or an approved grout mixture that has a minimum 28-day compressive strength of 250 psi and an appropriate viscosity to account for the relatively porous structure of the in-situ pile core and shot-rock fill materials.

GROUTING & REDRILLING OUT-OF-TOLERANCE PILES: After advancing the micropile to the bedrock surface and prior drilling the bond zone, micropiles shall be measured for tolerance relative to the verticality/plumbness tolerance in the project-specific "Special Note for Micropiles".

The Contractor shall submit for review and approval the method for measuring the verticality/plumbness of the micropiles. Where micropiles are measured to be out of tolerance, the micropile casing shall be extracted, and the hole shall be grouted with an approved grout mixture that has a minimum 28-day compressive strength of 250 psi and an appropriate viscosity to account for the relatively porous structure of the in-situ pile core and shot-rock fill materials. The micropile shall be redrilled to the specified tolerance with no adjustment for payment. If the micropile was out of tolerance due to unforeseen conflicts with the existing H-piles, the micropile shall be abandoned and grouted in accordance with the note for "Abandoned Micropile Holes".

REVISION	DATE

DATE: 06/06/2019	CHECKED BY
DESIGNED BY: A. ZEIN	L. LIN
DETAILED BY: A. VASUDEVAN	C. KLUSMAN

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY
MASON

ROUTE
US 68

CROSSING
LAWRENCE CREEK

MICROPILE RECORDS & DETAILS-2

ITEM NUMBER
09-1095

PREPARED BY
AECOM
500 West Jefferson Street
Suite 1600
Louisville, KY 40202-4251
www.aecom.com

SHEET NO.
S22

DRAWING NO.
28058

MICROPILE RECORD (PIER 2)								
AS SHOWN ON PLANS						AS CONSTRUCTED		
Micropile No.	Design Axial Load (kips)	Micropile Cut-Off Elev.	Approx. Top of Unweathered Berock Elev.	Approx. Length of Micropile (ft.) *	Approx. Bott. of Micropile Elev.(8" Dia. Rock Socket)	Bott. of Micropile Elev.	Length of Micropile (ft.)	Rock Socket Length (ft.)
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B13	342	647.28	612.60	37	579.10			
B14	342	647.28	612.60	37	579.10			
B15	342	647.28	612.60	37	579.10			
B16	342	647.28	612.60	37	579.10			
B17	342	647.28	612.60	37	579.10			
B18	342	647.28	612.60	37	579.10			
B19	342	651.78	612.60	41	579.10			
B20	342	651.78	612.60	41	579.10			
B21	342	651.78	612.60	41	579.10			
B22	342	647.28	612.60	37	579.10			
B23	342	647.28	612.60	37	579.10			
B24	342	647.28	612.60	37	579.10			
B25	342	647.28	612.60	37	579.10			
B26	342	647.28	612.60	37	579.10			
B27	342	647.28	612.60	37	579.10			
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B34	342	647.28	612.60	37	579.10			
B35	342	647.28	612.60	37	579.10			
B36	342	647.28	612.60	37	579.10			
B37	342	647.28	612.60	37	579.10			
B38	342	651.78	612.60	41	579.10			
B39	342	651.78	612.60	41	579.10			
B40	342	651.78	612.60	41	579.10			
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B42	342	647.28	612.60	37	579.10			
B43	342	647.28	612.60	37	579.10			
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B45	342	647.28	612.60	37	579.10			
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B49	342	651.78	612.60	41	579.10			
B50	342	651.78	612.60	41	579.10			
B51	342	647.28	612.60	37	579.10			
B52	342	647.28	612.60	37	579.10			
B53	342	647.28	612.60	37	579.10			
B54	342	647.28	612.60	37	579.10			
B55	342	647.28	612.60	37	579.10			
B56	342	647.28	612.60	37	579.10			
B57	342	647.28	612.60	37	579.10			
B58	342	647.28	612.60	37	579.10			

MICROPILE RECORD (PIER 5)								
AS SHOWN ON PLANS						AS CONSTRUCTED		
Micropile No.	Design Axial Load (kips)	Micropile Cut-Off Elev.	Approx. Top of Unweathered Berock Elev.	Approx. Length of Micropile (ft.) *	Approx. Bott. of Micropile Elev.(8" Dia. Rock Socket)	Bott. of Micropile Elev.	Length of Micropile (ft.)	Rock Socket Length (ft.)
C1	425	637.98	574.70	66	535.00			
C2	425	637.98	574.70	66	535.00			
C3	425	637.98	574.70	66	535.00			
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C49	425	642.48	574.70	70	535.00			
C50	425	642.48	574.70	70	535.00			
C51	425	637.98	574.70	66	535.00			
C52	425	637.98	574.70	66	535.00			
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MICROPILE RECORD NOTES

1. Design loads are based on factored strength limit state loadings.

2. Elevations for the Top of Rock and Bott. of Micropiles shall be confirmed in the field by the Resident Engineer to assure the Minimum Rock Socket Length. Top of Rock and Bott. of Micropile Elevations are based on borings. Field elevations may vary from these values.

3. As constructed Bott. of Micropile Elevations shall be at or below the Bott. of Micropile Elevations shown on the plans.

4. Adjustment to Bott. of Micropile elevations shall be made as required, based on field conditions. In no event, however, the Micropile Rock Socket Length be reduced from the minimum dimensions specified in the plans.

5. After completing the drilling operations, the Resident Engineer shall complete the Micropile Record. One copy of the completed record shall be forwarded to:

Kentucky Transportation Cabinet
Director, Division of Structural Design
3rd Floor East
200 Mero Street
Frankfort, KY40622

This Micropile record does not replace micropile installation log and documentation required.
See micropile construction notes for micropile construction requirements and records.

* Includes casing plunge length

REVISION	DATE

DATE: 06/06/2019	CHECKED BY
DESIGNED BY: A. ZEIN	L. LIN
DETAILED BY: A. VASUDEVAN	C. KLUSMAN

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY: **MASON**

ROUTE: **US 68** | CROSSING: **LAWRENCE CREEK**

MICROPILE RECORDS & DETAILS-2

ITEM NUMBER: **09-1095**

PREPARED BY:
AECOM
500 West Jefferson Street
Suite 1600
Louisville, KY 40202-4251
www.aecom.com

SHEET NO.: S23

DRAWING NO.: **28058**

MicroStation v8.11.7.443
E-SHEET NAME:
USER: Kimberly.Kutner
DATE PLOTTED: July 22, 2019
FILE NAME: G:\LOUISVILLE\DCS\PROJECTS\KY\KYTC\60537897 KYTC MASON COUNTY US 68\500 - DELIVERABLES\2019-07-19 ADDENDUMS\S28058_023.DGN

MICROPILE RECORD (PIER 2)

AS SHOWN ON PLANS						AS CONSTRUCTED		
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MICROPILE RECORD (PIER 5)

AS SHOWN ON PLANS						AS CONSTRUCTED		
Micropile No.	Design Axial Load (kips)	Micropile Cut-Off Elev.	Approx. Top of Unweathered Berock Elev.	Approx. Length of Micropile (ft.) *	Approx. Bott. of Micropile Elev.(8" Dia. Rock Socket)	Bott. of Micropile Elev.	Length of Micropile (ft.)	Rock Socket Length (ft.)
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MICROPILE RECORD NOTES

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Kentucky Transportation Cabinet
Director, Division of Structural Design
3rd Floor East
200 Mero Street
Frankfort, KY40622

This Micropile record does not replace micropile installation log and documentation required.
See micropile construction notes for micropile construction requirements and records.

* Includes casing plunge length

REVISION	DATE

DATE: 06/06/2019	CHECKED BY
DESIGNED BY: A. ZEIN	L. LIN
DETAILED BY: A. VASUDEVAN	C. KLUSMAN

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY
MASON

ROUTE
US 68

CROSSING
LAWRENCE CREEK

MICROPILE RECORDS & DETAILS–2

ITEM NUMBER
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PREPARED BY
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