Structural Geotechnical Report

Leavitt Street Over I-290 & CTA Bridge Replacement
SN: 016-2079
IDOT PTB 201-012
FAI 290 at Leavitt Street
Cook County, Illinois

Prepared for

Illinois Department of Transportation
Project Number: P-91-424-13

Project Design Engineer Team
Ciorba Group, Inc.

Geotechnical Consultant:
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Structural Geotechnical Report
Proposed Bridge Carrying Leavitt Street over I-290
Cook County, IL
IDOT PTB 201-012

Dear Mr. Sauter:

Attached is a copy of the Structural Geotechnical Report for the above-referenced project. The report provides a description of the site investigation, site conditions, and foundation and construction recommendations. The overall site investigation for the proposed bridge replacement included advancing two (2) soil borings for the proposed new abutments, to depths ranging from 90 to 92 feet where auger refusal was encountered on bedrock.

Should you have any questions or require additional information, please call us at 630-994-2600.

Sincerely,

Daniel DiMaggio

Daniel DiMaggio, E.I.T.
Project Engineer

Ala E Sassila, Ph.D., P.E.
Principal

TABLE OF CONTENTS

Exhibits

Tables

Appendices

Structural Geotechnical Report
Leavitt Street Over I-290 Bridge Replacement
SN: 016-2079
Cook County, Illinois
IDOT PTB 201-012

1.0 INTRODUCTION

GSG Consultants, Inc. (GSG) completed a geotechnical investigation for the Phase II design of the proposed Leavitt Street over I-290 bridge replacement in the Near West Side neighborhood of Chicago in Cook County, Illinois. The purpose of the investigation was to explore the subsurface conditions, to determine engineering properties of the subsurface soil, and develop design and construction recommendations for the proposed bridge. **Exhibit 1** shows the general project location.

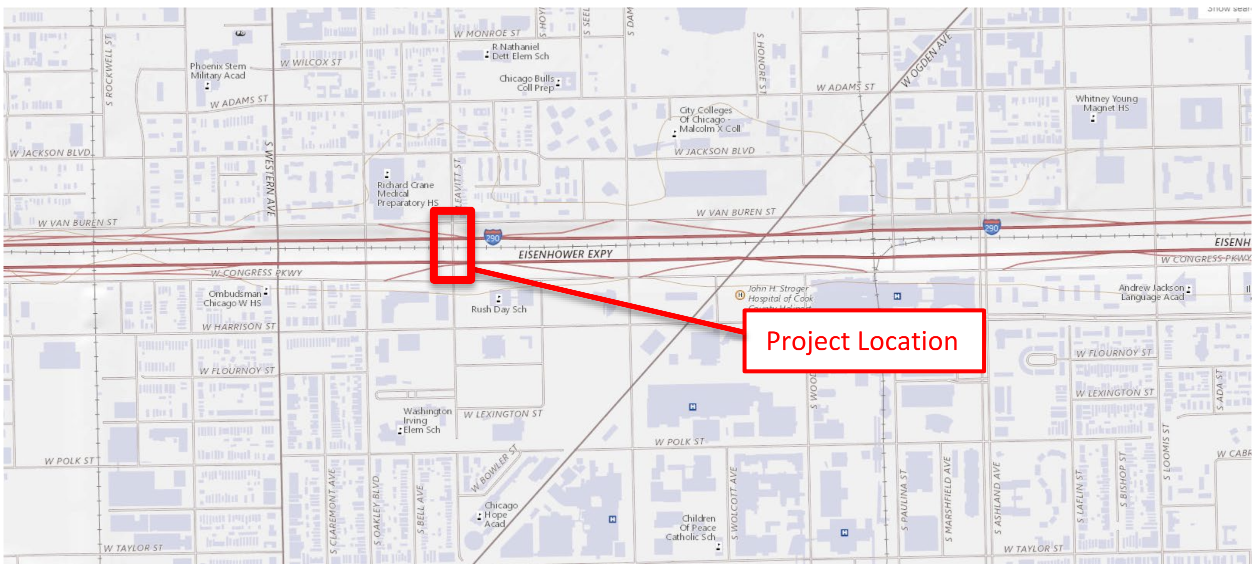


Exhibit 1 – Project Location Map
(Source: USGS Topographic Maps, usgs.gov)

The general scope of the overall project is to replace the Leavitt Street bridge. The new bridge will have a longer span with similar width based on the Type, Size, and Location (TSL) plan provided by the Ciorba Group, Inc (Ciorba), the design section engineer.

1.1 Existing Bridge Information

IDOT Structure No. 016-2079 currently supports Leavitt Street over I-290. The existing bridge was constructed in 1953, with rehabilitation and repairs completed in 1983. The structure consists of a 3-span continuous non-composite wide flange steel beam bridge with concrete closed wall abutments and two reinforced concrete multi-column piers supported on metal shell cast in place concrete piles. The bridge carries two lanes of traffic and sidewalk in each direction. The bridge is supported on two piers and two abutments. The bridge is about 262.8 feet long from back-to-back of the abutments with an out-to-out deck width of 62.3 feet. The sides of the existing embankments are sloped, with some vegetated areas. **Exhibits 2a and 2b** generally show the existing site conditions at the existing bridge structure.

Exhibit 2a – Existing Leavitt Street Bridge, Looking North along Leavitt Street

Exhibit 2b – Existing Leavitt Street Bridge, Looking East along I-290

1.2 Proposed Bridge Information

Based on information provided by Ciorba (TSL dated 7/3/24), the SN 016-2079 bridge, carrying Leavitt Street over I-290 will be replaced to increase the vertical clearance and to widen I-290 below the bridge. The new bridge will be supported upon the existing central piers and new closed abutments. The new abutments will be constructed behind the existing abutments to provide additional lanes on I-290. This will require approximately 25.5 feet of new engineered fill where the vaulted abutments are removed. The proposed bridge will have an out-to-out deck width of 62.3 feet. The proposed bridge will be a 3-span structure and will be about 274.4 feet in length, back-to-back between the abutments. The vertical clearance above I-290 will be about 15'-1". Leavitt Street will be closed during construction. Based on the TSL plan, the new bridge superstructure will be supported on cast in place cantilever wall abutments with piles for the new abutment foundations.

2.0 SITE SUBSURFACE CONDITIONS

This section describes the subsurface exploration program and laboratory testing program completed as part of this project. The proposed locations and depths of the soil borings were selected in accordance with IDOT requirements and reviewed with Ciorba. The borings were completed in the field based on field conditions and accessibility.

2.1 Subsurface Exploration and Laboratory Testing

The site subsurface exploration for the proposed bridge was conducted between March 7 and March 20, 2024. The investigation included advancing two (2) borings to depths of 90 and 92 feet where auger refusal was encountered on limestone bedrock. The locations of these soil borings were adjusted in the field as necessary based on utilities and site access. The elevations and as-drilled locations for the borings were gathered by GSG's field crew using GPS surveying equipment. The approximate as-drilled locations of the soil borings are shown on the Soil Boring Location Plan & Subsurface Profiles **(Appendix B)**. **Table 1** presents a summary of the borings used for the analyses.

Table 1 – Summary of Subsurface Exploration Borings

Associated Structure	Boring ID	Station*	Offset (ft) / Direction	Depth (ft)	Surface Elevation (ft) CCD / NAD 83
North Abutment	BSB-01	104+83.48	20.80 LT	92.0	13.52/593.4
South Abutment	BSB-02	100+89.09	19.44 LT	90.0	14.72/594.6

*Based on proposed Leavitt Street stationing

The soil borings were drilled using a truck mounted CME-75 (hammer efficiency 79.8%) drill rig, equipped with 3¼-inch I.D. hollow stem augers and an automatic hammer. Soil sampling was performed according to AASHTO T 206, "Penetration Test and Split Barrel Sampling of Soils." Soil samples were obtained at 2.5-foot intervals to a depth of 30 feet, then at 5-foot intervals until encountering auger refusal on apparent bedrock. Water level measurements were made in each boring when evidence of free groundwater was detected on the drill rods or in the samples. The boreholes were also checked for free water immediately after auger removal, and before filling the open boreholes with soil cuttings and surface patching with asphalt where necessary to match the existing pavement. Copies of the Soil Boring Logs are provided in **Appendix C**.

GSG's field representative inspected, visually classified and logged the soil samples during the subsurface exploration activities and performed unconfined compressive strength tests on cohesive soil samples using a calibrated Rimac compression tester and a calibrated hand penetrometer in accordance with IDOT procedures and requirements. Representative soil samples were collected from each sample interval and were placed in jars and returned to the laboratory for further testing and evaluation.

2.2 Laboratory Testing Program

All samples were inspected in the laboratory to verify the field classifications. A laboratory testing program was undertaken to characterize and determine engineering properties of the subsurface soils encountered in the area of the proposed bridge. Moisture content tests (ASTM D2216 / AASHTO T-265) were performed on representative soil samples.

The laboratory tests were performed in accordance with test procedures outlined in the most current IDOT Geotechnical Manual, and per ASTM and AASHTO requirements. Based on the laboratory test results, the soils encountered were classified according to the AASHTO and the Illinois Division of Highways (IDH) classification systems. The results of the laboratory testing program are shown on the **Soil Boring Logs (Appendix C)**.

2.3 Subsurface Soil Conditions

This section provides a brief description of the soils encountered in the borings performed in the vicinity of the proposed bridge. Variations in the general subsurface soil profile were noted during the drilling activities. Detailed descriptions of the subsurface soils are provided in the soil boring logs and are shown graphically in the Soil Boring Location Plan & Subsurface Profiles. The soil boring logs provide specific conditions encountered at each boring location and include soil descriptions, stratifications, penetration resistance, elevations, location of the samples, and laboratory test data. Unless otherwise noted, soil descriptions indicated on boring logs are visual identifications. The stratifications shown on the boring logs represent the conditions only at the actual boring locations and represent the approximate boundary between subsurface materials; however, the actual transition may be gradual.

The borings were drilled through the roadway along S. Leavitt Street and initially encountered 1 to 4 inches of asphalt, followed by 8 to 11 inches of concrete, and 7 to 10 inches of aggregate base. The surface elevations ranged between 14.72 and 13.56 CCD / 594.6 and 593.4 feet.

Below the pavement materials, the borings encountered brown and dark brown sandy fill materials to depths of 6 feet (El. 8.72 to 7.52 CCD / 588.6 to 587.4 feet). Beneath the sandy fill materials, boring BSB-01 encountered dark brown silty clay fill to a depth of 8.5 feet (El. 5.02 CCD / 584.9 feet).

Beneath the fill materials, the borings encountered native dark brown and gray stiff to very stiff silty clay to depths of 11 feet (El. 3.72 to 2.52 CCD / 583.6 to 582.4 CCD), followed by gray very soft to medium stiff silty clay to depths of 38.5 to 43.5 feet (El. -23.78 to -29.98 CCD / 556.1 to 539.9 feet), followed by gray stiff to hard silty clay to depths of 53.5 feet (El. -38.78 to -39.98 / 541.1 to 539.9). The borings then encountered gray dense to very dense silty loam to depths of 63.5 to 73.5 feet (El. -49.98 to -58.78 CCD / 539.9 to 521.1 feet), followed by gray hard to very hard silty clay to depths of 78.5 to 83.5 feet (El. -63.78 to -69.98 CCD / 516.1 feet to 509.9 feet), and then a layer of gray extremely dense gravel before encountering auger refusal on limestone bedrock at depths of 90 to 92 feet (El. -75.28 to -78.48 CCD / 504.6 to 501.4 feet). Boring BSB-02 noted a gravel seam at 39 feet and a sand seam at 59.5 feet and encountered a layer of gray very dense to extremely dense sandy loam between depths of 78.5 and 88.5 (between El. -63.78 and -73.78 CCD / 516.1 and 506.1 feet). Cobbles were noted at a depth of 8.5 feet in boring BSB-02. Silt seams were noted in boring BSB-01 at a depth of 79 feet and in boring BSB-02 at depths of 22 and 26.5 feet.

The unconfined compressive strength of the dark brown and gray stiff to very stiff silty clay ranged between 1.7 and 2.5 tons per square foot (tsf), with an average strength of 2.1 tsf. The unconfined compressive strength of the gray very soft to medium stiff silty clay ranged from less than 0.2 tsf to 0.6 tsf, with an average strength of 0.2 tsf. The gray stiff to hard silty clay layer beneath the very soft to medium stiff silty clay layer had unconfined compressive strength values ranging from 1.0 to 7.7 tsf, with most values being greater than 4.0 tsf, and with an average strength of 4.6 tsf. The gray dense to very dense silty loam had SPT blow count ‘N’ values ranging from 30 to 57 blows per foot (bpf), with an average value of 40 bpf. The gray hard to very hard silty clay had unconfined compressive strength values ranging from 6.3 to 15.6 tsf, with an average value of 9.8 tsf. The gray extremely dense gravel had SPT blow count 'N' values ranging from 50 blows per 6 inches to 50 blows per 3 inches. The gray very dense to extremely dense sandy loam had SPT blow count 'N' values ranging from 58 bpf to 50 blows per 4 inches.

2.4 Groundwater Conditions

Water levels were checked in each boring to determine the general groundwater conditions present at the site and were measured while drilling and after each boring was completed. Groundwater was not observed during or immediately after completion of drilling at either of the boring locations. None of the borings were left open after leaving the site due to safety concerns.

Based on the observed water levels and soil color change from brown to gray, it is anticipated that the long-term groundwater level is approximately 20 feet below existing grade. Perched water may also be present within the fill materials or confined granular layers observed in the borings. Water level readings were made in the boreholes at times and under conditions shown on the boring logs and stated in the text of this report. However, it should be noted that fluctuations in groundwater level may occur due to variations in the rainfall, other climatic conditions, or other factors not evident at the time measurements were made and reported herein.

3.0 GEOTECHNICAL ANALYSES

This section provides GSG's geotechnical analysis and recommendations for the design of the proposed bridge abutments based on the results of the field exploration, laboratory testing, and geotechnical analysis. Subsurface conditions between borings may vary from those encountered at the boring locations. If structure locations, loadings, or elevations are changed, we request that GSG be contacted so that we may re-evaluate our recommendations.

3.1 Scour

The bridge structure carrying Leavitt Street over I-290 has no waterways in the vicinity; therefore, scour will not be a concern for this project.

3.2 Settlement

It is anticipated that up to 25.5 feet of fill will be required to build the new bridge abutments and replace the existing vaulted abutments. For the section of the newly constructed abutment where there will be fill placed over the abutment wall foundations, there will be minimal settlement since the load of the embankment will be transferred to the pile foundations below. However, for the section of the new embankment behind the abutment wall, where the existing abutment will be removed and replaced, there will be some additional load added due to the addition of new fill (approximately 5 feet) near the top of the embankment. Assuming construction of the new abutments will be completed immediately after the removal of the existing abutments, the anticipated settlement was calculated at each of the abutment locations. The results are summarized in **Table 2**. The new fill height was estimated based on the proposed TS&L provided by Ciorba (dated 07/03/2024).

Table 2 – Anticipated Embankment Settlement

Structure Name	Structure Station*	New Fill Height (ft)	Anticipated Settlement (inches)
North Abutment	Sta. 104+22	25.3	<1.0
South Abutment	Sta. 101+48	25.5	<1.0

*Based on proposed Leavitt Street Stationing

**With removal of soft clay soils beneath the bottom of the embankments and with placement of structural clay fill.

3.3 Seismic Parameters

The seismic hazard for the site was evaluated per the IDOT Geotechnical Manual, IDOT Bridge Design Manual, and AASHTO LRFD Bridge Design Specifications. The Seismic Soil Site Class was determined per the requirements of All Geotechnical Manual Users (AGMU) Memo 9.1, Design Guide for Seismic Site Class Determination, and the "Seismic Site Class Determination" Excel spreadsheet provided by IDOT. A global Site Class Definition was determined for this project, and was found to be Soil Site Class D. The Seismic Performance Zone (SPZ) was determined using Figure 2.3.10-2 in the IDOT Bridge Manual and was found to be Seismic Performance Zone 1.

The AASHTO Seismic Design Parameters program was used to determine the peak ground acceleration coefficient (PGA), and the short (S_{DS}) and long (S_{D1}) period design spectral acceleration coefficients for the proposed structure. For this section of the project, the S_{DS} and the S_{D1} were determined using 2020 AASHTO Guide Specifications as shown in **Table 3**. Given the site location and materials encountered, the potential for liquefaction is minimal.

Table 3 – Seismic Parameters

Building Code Reference	PGA	S_{DS}	S_{D1}
2020 AASHTO Guide for LRFD Seismic Bridge Design	0.042g	0.145g	0.086g

4.0 GEOTECHNICAL BRIDGE DESIGN RECOMMENDATIONS

The foundations for the proposed bridge must provide sufficient support to resist the dead and live loads, as well as seismic loading. The foundation design recommendations presented within this section were completed per the AASHTO LRFD 9th Edition (2020). The anticipated total loads provided by Ciorba for the proposed bridge abutments are 2,106 kips for the Service I case and 2,709 kips for the Strength I case.

4.1 Bridge Foundation Recommendations

Based on information provided by Ciorba, GSG understands that cast in place cantilever wall abutments supported on driven piles will be used for the abutment foundations. GSG evaluated this type of deep foundation system for the proposed bridge. The results of the evaluation are presented below.

4.2 Driven Pile Foundation Design Recommendations

Driven piles will be used to support the bridge abutments. Steel H-piles and metal shell pipe piles are considered to be feasible for this project. Concrete piles are not recommended for this site because the pile lengths cannot be readily adjusted to accommodate variability in soil conditions. H-piles are a feasible option for the construction of the abutments for the proposed bridge structure.

Based on the TSL, there will be little to no grade change at the new abutment locations, and no new fill will be placed. Therefore, capacity reductions for downdrag induced by fill placement do not apply for the pile design at this site.

4.3 Pile Design

The Modified IDOT static method-excel spreadsheet was used to estimate the pile lengths at various axial geotechnical resistances for driven piles per IDOT AGMU Memo 10.2. The factored resistance includes a reduction of 0.55 for the geotechnical resistance for the pile installation. No geotechnical losses due to scour or liquefaction were included in the axial pile resistance calculations.

Tables 4a and 4b summarize the estimated maximum pile lengths for representative pile sections along with the factored resistance available for several pile types which could be feasible for the proposed substructures. The complete IDOT Pile Design Tables for each substructure, including factored resistance available (R_F) and nominal required bearing (R_N), are included in **Appendix D**.

The estimated pile lengths shown in **Table 4a and 4b** and in **Appendix D** are based on the pile cut off elevations noted below each table. The actual pile length and resistance should be evaluated based on test piles installed in accordance with the specifications provided in Section 512.15 of IDOT Standard Specifications for Road and Bridge Construction. Per section 3.10.1.11 of the IDOT Bridge Manual, the minimum pile spacing should be 3 pile diameters.

Table 4a – North Abutment Pile Design (BSB-01)

Pile Section	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (FT)
Metal Shell 14'' Φ w/0.25'' walls (Max. R_N = 459 Kips)	432	237	56
	459	252	57
Metal Shell 14'' Φ w/0.312'' walls (Max. R_N = 570 Kips)	512	282	61
	570	313	62
Metal Shell 16'' Φ w/0.312'' walls (Max. R_N = 654 Kips)	623	343	61
	654	359	62
HP10x42 (Max. R_N = 335 Kips)	316	174	71
	335	184	72
HP12x53 (Max. R_N = 418 Kips)	379	208	71
	418	230	72
HP14x73 (Max. R_N = 578 Kips)	460	253	71
	578	318	72

*Pile cut off elevation = 572.21 feet (TS&L dated 07/03/2024)
Ground surface elevation against pile during driving = 571.21 feet (TS&L dated 07/04/2024)

Table 4b – South Abutment Pile Design (BSB-02)

Pile Section	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (FT)
Metal Shell 14'' Φ w/0.25'' walls (Max. R_N = 459 Kips)	374	206	31
	459	252	32
Metal Shell 14'' Φ w/0.312'' walls (Max. R_N = 570 Kips)	465	256	45
	570	313	46
Metal Shell 16'' Φ w/0.312'' walls (Max. R_N = 654 Kips)	561	308	45
	654	359	46
HP10x42 (Max. R_N = 335 Kips)	232	128	68
	335	184	69
HP12x53 (Max. R_N = 418 Kips)	278	153	68
	418	230	69
HP14x73 (Max. R_N = 578 Kips)	339	187	68
	578	318	70

*Pile cut off elevation = 572.21 feet (TS&L dated 07/04/2024)
Ground surface elevation against pile during driving = 571.21 feet (TS&L dated 07/04/2024)

Based on information provided by Ciorba, due to the presence of a large siphon sewer with inlet and outlet junction chambers located east of the bridge, there are concerns of damage occurring to the sewer structures during pile driving activities. It is anticipated that pre-coring the piles down to an elevation below the bottoms of the chamber structures may be necessary to avoid causing damage to the siphon sewer structures. The bottom of chamber structure elevations are estimated to be approximately 5 feet below the proposed abutment footing foundations.

Tables 5a and 5b summarize the estimated maximum pile lengths for representative pile sections along with the factored resistance available for the piles that are feasible for the proposed substructures when pre-coring is included. The complete IDOT Pile Design Tables, including factored resistance available (RF) and nominal required bearing (R_N), are included in **Appendix E**.

Table 5a – North Abutment Pile Design with Pre-Coring (BSB-01)

Pile Section	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (FT)
Metal Shell 14'' Φ w/0.25'' walls (Max. R_N = 459 Kips)	427	235	56
	459	252	57
Metal Shell 14'' Φ w/0.312'' walls (Max. R_N = 570 Kips)	508	279	61
	570	313	62
Metal Shell 16'' Φ w/0.312'' walls (Max. R_N = 654 Kips)	618	340	61
	654	359	62
HP10x42 (Max. R_N = 335 Kips)	313	172	71
	335	184	72
HP12x53 (Max. R_N = 418 Kips)	375	206	71
	418	230	72
HP14x73 (Max. R_N = 578 Kips)	455	250	71
	578	318	72

*Pile cut off elevation = 572.21 feet (TS&L dated 07/03/2024)
Ground surface elevation against pile during driving = 571.21 feet (TS&L dated 07/04/2024)
Bottom of pre-coring elevation = 566.21 feet

Table 5b – South Abutment Pile Design with Pre-Coring (BSB-02)

Pile Section	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (FT)
Metal Shell 14'' Φ w/0.25'' walls (Max. R_N = 459 Kips)	371	204	31
	459	240	32
Metal Shell 14'' Φ w/0.312'' walls (Max. R_N = 570 Kips)	461	254	45
	570	268	46
Metal Shell 16'' Φ w/0.312'' walls (Max. R_N = 654 Kips)	557	306	45
	654	359	46
HP10x42 (Max. R_N = 335 Kips)	229	126	68
	335	184	69
HP12x53 (Max. R_N = 418 Kips)	274	151	68
	418	230	69
HP14x73 (Max. R_N = 578 Kips)	335	184	68
	578	318	70

*Pile cut off elevation = 572.21 feet (TS&L dated 07/04/2024)
Ground surface elevation against pile during driving = 571.21 feet (TS&L dated 07/04/2024)
Bottom of pre-coring elevation = 566.21 feet

Although all of the above pile types are considerable options for foundation support, the structural engineer is responsible to determine what pile best suits the design. Some of the pile options may not be suitable alternatives due to spacing requirements or constructability concerns.

IDOT standard practice includes driving one (1) indicator pile for each sub structural element to determine the actual pile length. A test pile shall be performed at each abutment prior to production driving so that actual, on-site, field data can be gathered to determine pile driving requirements for the project. Driving shoes or conical tips, depending on the selected piles, in accordance with Section 1006.05 (e) of the IDOT Standard Specifications for Road and Bridge Construction (SSRBC), should be considered to protect piles from damage during driving.

4.4 Lateral Earth Pressure on Abutment Walls

The lateral earth pressures on retaining walls depend on the type of wall (i.e., restrained or unrestrained), the type and method of placement of backfill against the wall, and the magnitude of surcharge weight on the ground surface adjacent to the wall. In general, the static lateral earth pressure acting on the bridge abutment walls consists of two components: static active earth pressure and static active surcharge pressure. The backfill behind the abutment walls shall be free-draining aggregate in accordance with IDOT standard details. Heavy compaction equipment should not be allowed closer than five (5) feet to the retaining wall to prevent inducing high lateral earth pressures and causing wall yielding and/or other damage. Cantilever-type abutments shall be designed as unrestrained retaining walls. This means that these walls are free to rotate at the top in an active state of earth pressure. Abutment and wing walls that behave as a pinned support at the top, not allowing movement or rotation, should use the at-rest state of earth pressure for their design. **Table F1: Summary of Soil Parameters, Appendix F,** presents the design soil properties for the existing soils.

The recommended soil parameters listed in **Table F1** should be used to determine earth pressures acting on the retaining walls. It should be used for the retained soil and applied as a triangular load beginning at the base of the wall. The static active earth pressure (Pa) should be applied at ⅓ H from the bottom of the pressure distribution, where H is the height of the wall. The abutment wall should be designed for surcharge loading due to surface loads within the zone of the proposed backfill. At a minimum, a uniform vertical pressure of 250 psf should be considered in the design. This shall be multiplied by the appropriate earth pressure coefficient to determine the resulting horizontal pressure on the abutment wall. The lateral load will act uniformly along the face of the wall. Other loads should also be evaluated using the procedures of AASHTO LRFD Section 3.11.6 on a case-by-case basis for the abutment walls. The abutment and retaining walls should be backfilled with a minimum of 4 feet (measured from the back of the wall) of free draining materials in accordance with IDOT standard construction specifications.

4.5 Lateral load Resistance

Lateral loadings applied to deep foundations are typically resisted by the soil/structure interaction, pile flexure, or a combination of these factors. Section 3.10.1.10 of the 2023 IDOT Bridge Manual requires performing detailed structure interaction analysis if the factored lateral loading per pile exceeds 3 kips. The analysis shall determine actual pile moment and deflection to determine the selected pile adequacy for the existing loadings. **Table 6 and Table F-1 (Appendix F)** provide generalized soil parameters for the site and include recommended lateral soil modulus and soil strain parameters that can be used for deep foundation analysis via the p-y curve method based on the encountered subsurface conditions.

Table 6 – Lateral Load Resistance Soil Parameters

Depth / Elevation Range (feet) (CCD / NAD 83)	Soil Description	Lateral Modulus of Subgrade Reaction (pci)	Soil Strain (ε_{50})
	New Engineered Clay Fill	100	0.01
	New Engineered Granular Fill	90	N/A
1.0 to 6.0 (13.12-8.12) (593-588)	Brown and Dark Brown Sand Fill	25	N/A
6.0 to 11.0 (8.12-3.12) (588-583)	Dark Brown and Gray Stiff to Very Stiff Silty Clay	1,000	0.005
11.0 to 43.5 (3.12 - (-29.38)) (583-550.5)	Gray Very Soft to Medium Stiff Silty Clay	30	0.02
43.5 to 53.5 (-29.38 - (-39.38)) (550.5-540.5)	Gray Stiff to Hard Silty Clay	2,000	0.004
53.5 to 63.5 (-39.38 - (-49.38)) (540.5-530.5)	Gray Dense to Very Dense Silty Loam	125	N/A
63.5 to 83.5 (-49.38 - (-69.38)) (530.5-510.5)	Gray Hard to Very Hard Silty Clay	2,000	0.004
83.5 to 91.0 (-69.38 - (-76.88)) (510.5-503)	Gray Extremely Dense Gravel	125	N/A
6.0 to 8.5 (8.12-5.62) (588-585.5) ***BSB-01 Only**	Black Silty Clay Fill	30	0.02

Depth / Elevation Range (feet) (CCD / NAD 83)	Soil Description	Lateral Modulus of Subgrade Reaction (pci)	Soil Strain (ε_{50})
78.5 to 88.5 (-64.38 - (-74.38)) (515.5-505.5) ***BSB-02 Only**	Gray Very Dense to Extremely Dense Sandy Loam	125	N/A

*The initial p-y modulus, E_{py} , varies linearly with depth. To obtain E_{py} use the equation $E_{py} = k_{py} * z$, where k_{py} is the subgrade modulus given in the table and z is the distance from the surface to the center point of the layer in inches.

5.0 CONSTRUCTION CONSIDERATIONS

All work performed for the proposed project should conform to the requirements in the IDOT Standard Specifications for Road and Bridge Construction (2022). Any deviation from the requirements in the manuals above should be approved by the design engineer.

5.1 Existing Utilities and Structures

Based on the existing site conditions, utilities exist along the project corridor. Before proceeding with construction, all existing underground utility lines or structures that will interfere with construction should be completely relocated from the proposed construction areas. Where possible, existing utility lines that are to be abandoned in place should be removed and/or plugged with cement grout. All excavations resulting from underground utilities or structure removal activities should be cleaned of loose and disturbed materials, including all previously placed backfill, and backfilled with suitable fill materials in accordance with the requirements of this section. During the clearing and stripping operations, positive surface drainage should be maintained to prevent the accumulation of water.

5.2 Site Excavation

If borrow material is to be used for onsite construction, it should conform to Section 204 "Borrow and Furnished Excavation" of the IDOT Construction Manual (2021). The fill material should be free of organic matter and debris. Earth-moving operations should be avoided during excessively cold or wet weather to avoid freezing of softening subgrade soils.

Structural fill shall be placed in accordance with the recommendations provided in the IDOT Standard Specifications for Road and Bridge Construction (2022).

Should fill be placed during cool, wet seasons, the use of granular fill may be necessary since weather conditions will make compaction of cohesive soils more difficult. If water seepage while excavating and backfilling procedures, or where wet conditions are encountered such that the water cannot be removed with conventional sump and pump procedures, GSG recommends placing open grade stone similar to IDOT CA-7 to stabilize the bottom of the excavation. The CA-7 stone should be placed 12 inches above the water level, in 12-inch lifts, and should be compacted with the use of a heavy smooth drum roller or heavy vibratory plate compactor until stable. The remaining portion of the excavation should be backfilled using approved engineered fill.

GSG recommends that foundation excavations, subgrade preparation, and structural fill placement and compaction be inspected by a GSG geotechnical engineer to verify the type and strength of soil materials present at the site and their conformance with the geotechnical recommendations in this report.

5.3 Groundwater Management

It is anticipated that the long-term groundwater level is below approximately 20 feet below existing grade. Perched water may also be present within the fill materials or confined granular layers. If rainwater run-off or groundwater is accumulated at the base of excavations, the contractor should remove accumulated water using conventional sump pit and pump procedures and maintain a dry and stable excavation. The location of the sump should be determined by the contractor based on field conditions. During earthmoving activities at the site, grading should be performed to ensure that drainage is maintained throughout the construction period. Water should not be allowed to accumulate in the foundation area either during or after construction. Undercut and excavated areas should be sloped toward one corner to facilitate removal of any collected rainwater or surface run-off. Grades should be sloped away from the excavations to minimize runoff from entering.

If water seepage occurs during excavations or where wet conditions are encountered such that the water cannot be removed with conventional sumping, we recommend placing open grade stone similar to IDOT CA-7 to stabilize the bottom of the excavation below the water table. The CA-7 stone should be placed 12 inches above the water table, in 12-inch lifts, and should be compacted with the use of a heavy smooth drum roller or heavy vibratory plate compactor until stable. The remaining portion of the excavation beneath the foundations should be backfilled using approved structural fill.

5.4 Temporary Earth Structure Lateral Earth Pressures

A temporary soil retention system (TSRS) is anticipated to be necessary for the construction of the new abutments. The IDOT temporary sheet piling design charts are not feasible for this project as the average unconfined compressive strengths of the clay are below the minimum value of 1.0 tsf for the estimated retained height of 18 feet. A Temporary Soil Retention System will be required. The Temporary Soil Retention System shall be designed by an Illinois licensed structural engineer in accordance with the IDOT Bridge Design Manual. The design of the Temporary Soil Retention System is the responsibility of the contractor. The contractor should submit the TSRS plans to the structural design team for review prior to commencing construction of the TSRS.

6.0 LIMITATIONS

This report has been prepared for the exclusive use of the Illinois Department of Transportation (IDOT) and its Design Section Engineer consultant. The recommendations provided in the report are specific to the project described herein and are based on the information obtained at the soil boring locations within the proposed bridge area. The analyses have been performed and the recommendations provided in this report are based on subsurface conditions determined at the locations of the borings. This report may not reflect all variations that may occur between boring locations or at some other time, the nature and extent of which may not become evident until during the time of construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and review the recommendations presented herein.

APPENDIX A

GENERAL PLAN, ELEVATION & DETAILS

Bench Mark: Chiseled "□" on west side of traffic signal foundation at southeast corner of Leavitt St and Van Buren St. Elev. 594.77.

Existing Structure: Structure Number 016-2079, built in 1953 as FA Route 131, Sections 3-B-8 and 3-F-8. The north approach slab was constructed in 1958 as FAI Route 1, Section 2527-108.1. In 1983, under IDOT Contract C-91-059-80 (FAI Rte I-290, Section 042BR), the overlay was replaced, the approach sidewalks, curb, and gutter were replaced, the expansion joints were replaced, shim plates were added beneath the bearings and the handrails were replaced. The structure is a three span non-composite continuous wide flange steel beam bridge with concrete closed wall abutments and two reinforced concrete multi-column piers supported on metal shell cast in place concrete piles. The existing bridge measures 262'-10" from back to back abutments, 62'-4" out to out, with no skew. New abutments are going to be constructed and the new bridge will measure 274'-5" from back to back abutments.

Traffic Control: Leavitt Street to be closed during construction.

No Salvage.

DESIGN SPECIFICATIONS

(New Construction)
2020 AASHTO LRFD Bridge Design Specifications, 9th Edition

SCOPE OF WORK

1. Temporary support existing utilities during construction.
2. Remove existing superstucture and vault spans.
3. Remove abutments.
4. Construct new closed abutments at new locations.
5. Repair existing piers and remove graffiti.
6. Construct proposed pier extensions.
7. Construct proposed superstructure and reattach utilities.
8. Construct proposed approach slabs.

SEIMIC DATA

Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec (SD1) = 0.086g
Design Spectral Acceleration at 0.2 sec (SDS) = 0.145g
Soil Site CLass = D

LOADING HL-93

Allow 25#/sq. ft. for future wearing surface

DESIGN STRESSES

FIELD UNITS

f'c = 3,500 psi
f'c = 4,000 psi (Superstructure Concrete)
fy = 60,000 psi (Reinforcement)
fy = 50,000 psi (M270 Grade 50, Metalized)

EXISTING UNITS

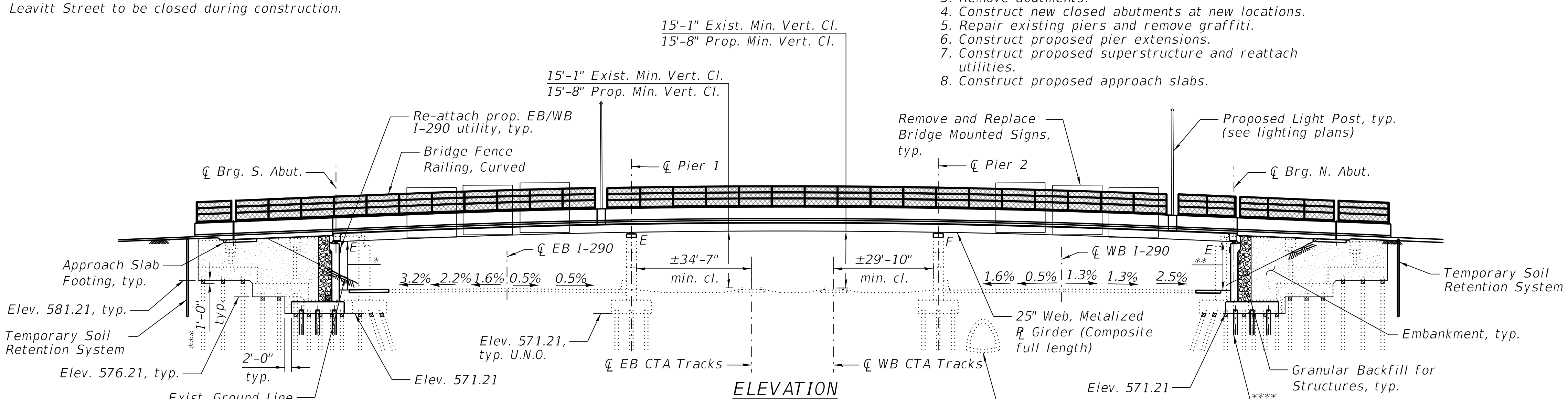
f'c = 3,500 psi
fy = 40,000 psi

HIGHWAY CLASSIFICATION

Leavitt Street
Functional Class: Local
ADT: 1,350 (2022); 1,313 (2046)
ADTT: 41 (2022); 40 (2040)
DHV: 135 (2021); 131 (2046)
Design Speed: 30 m.p.h.
Posted Speed: 30 m.p.h.
Two-Way Traffic
Directional Distribution: 50:50

F.A.I. Rte. 290 WB
Functional Class: Interstate
ADT: 71,730 (2021); 75,300 (2040)
ADTT: 3,230 (2021); 3,400 (2040)
DHV: 5,740 (2021); 6,100 (2040)
Design Speed: 60 m.p.h.
Posted Speed: 55 m.p.h.
One-Way Traffic
Directional Distribution: 100%

F.A.I. Rte. 290 EB
Functional Class: Interstate
ADT: 87,670 (2021); 92,100 (2040)
ADTT: 3,950 (2021); 4,100 (2040)
DHV: 7,010 (2021); 7,400 (2040)
Design Speed: 60 m.p.h.
Posted Speed: 55 m.p.h.
One-Way Traffic
Directional Distribution: 100%



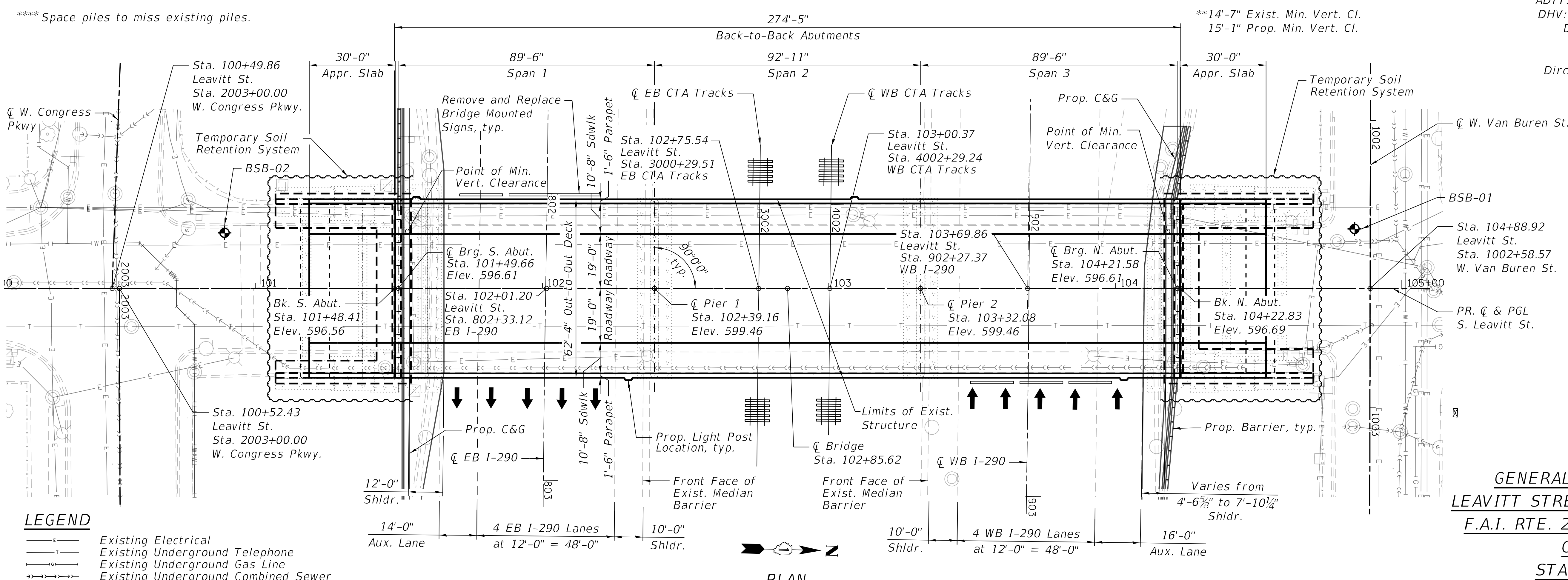
ELEVATION

*** Remove 1'-0" of existing concrete piles and abandon below.

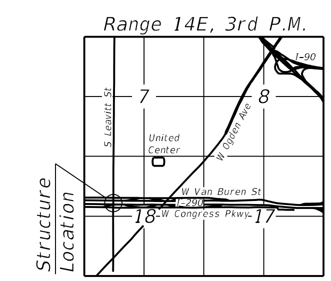
**** Space piles to miss existing piles.

*14'-7" Exist. Min. Vert. Cl.
15'-1" Prop. Min. Vert. Cl.

**14'-7" Exist. Min. Vert. Cl.
15'-1" Prop. Min. Vert. Cl.



PLAN



LOCATION SKETCH

LEGEND

- Existing Electrical
- Existing Underground Telephone
- Existing Underground Gas Line
- Existing Underground Combined Sewer
- Existing Underground Water Line
- Boring

GENERAL PLAN & ELEVATION
LEAVITT STREET OVER I-290 AND CTA
F.A.I. RTE. 290 - SEC. 2021-120-BR
COOK COUNTY
STATION 102+85.62
STRUCTURE NO. 016-2079

APPENDIX B

SOIL BORING LOCATION PLAN

& SUBSURFACE PROFILES

MODEL: Default
FILE NAME: T:\Illinois DOT\Ciorba 201-012\Geotechnical\Exhibits\DGN\IDOT PTB 201-012 Leavitt Street over I-290 & CTA -PL- 01.dgn

GSG CONSULTANTS, INC.
735 E. REMINGTON RD, SCHAUMBURG, IL 60173
TEL: +1630.994.2600 | WWW.GSG-CONSULTANTS.COM

USER NAME = nnano	DESIGNED - DD	REVISED -
	DRAWN - NN	REVISED -
PLOT SCALE = 1200.0000 ' / ft.	CHECKED - DE	REVISED -
PLOT DATE = 3/27/2024	DATE - 03/22/2024	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

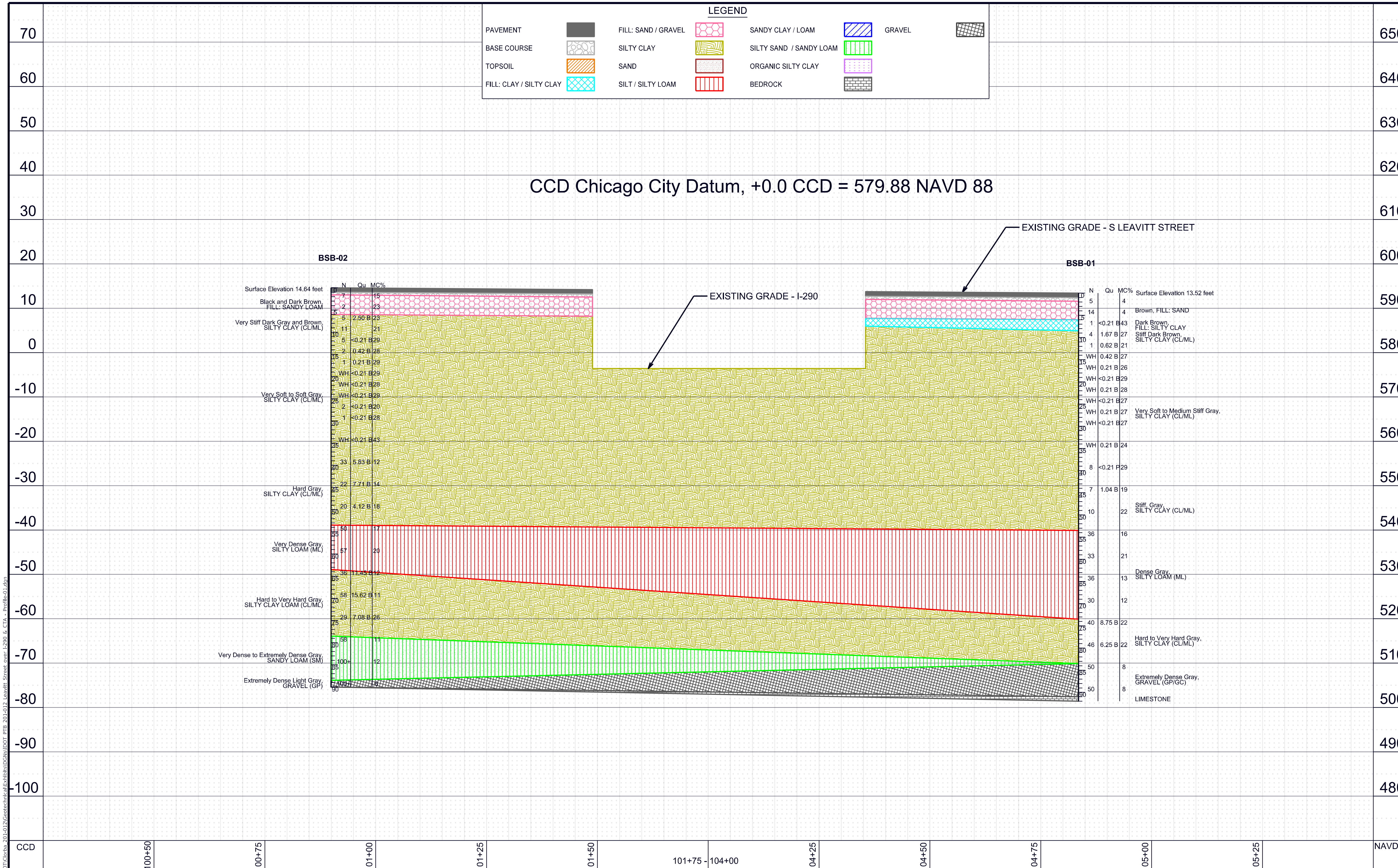
IDOT PTB 201–012
PROPOSED BRIDGE LEAVITT STREET OVER I–290 & CTA
BORING LOCATION PLAN

SCALE: 1:50 | SHEET 1 OF 1 SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		COOK	2	1

CONTRACT NO. PTB 201-012

ILLINOIS | FED. AID PROJECT



GSG CONSULTANTS, INC.
735 E. REMINGTON RD, SCHAUMBURG, IL 60173
TEL: +1630.994.2600 | WWW.GSG-CONSULTANTS.COM

USER NAME = nnano	DESIGNED - DD	REVISED -	
	DRAWN - NN	REVISED -	
PLOT SCALE = 240.0000 ' / ft.	CHECKED - DE	REVISED -	
PLOT DATE = 3/26/2024	DATE - 03/22/2024	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IDOT PTB 201-012
PROPOSED BRIDGE LEAVITT STREET OVER I-290 & CTA
BORING PROFILE

SCALE: AS NOTED | SHEET 1 OF 1 SHEETS | STA. 100+50 TO STA. 105+25

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		COOK	2	2
		CONTRACT NO. PTB 201-012		
	ILLINOIS	FED. AID PROJECT		

MODEL: Default
FILE NAME: ...\Leavitt Street over I-290 & CTA - Profile-01.dgn

APPENDIX C

SOIL BORING LOGS

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 3/20/24

ROUTE FAI 290 (I-290) **DESCRIPTION** Bridge Boring **LOGGED BY** DV

SECTION 2021-120-BR **LOCATION** , **SEC.** 18, **TWP.** 39N, **RNG.** 14E, **Latitude** 41.8761186, **Longitude** -87.6814759

COUNTY COOK **DRILLING RIG** CME 75 **HAMMER TYPE** AUTO
DRILLING METHOD MUD ROTARY **HAMMER EFF (%)** 79.8

STRUCT. NO. 016-2079
Station N/A

BORING NO. BSB-01
Station 104+83.48
Offset 20.80ft LT
Ground Surface Elev. 593.40 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
4 inches of Asphalt	593.07				
11 inches of Concrete					
7 inches of Aggregate Base	592.15		3		
	591.57		3 2		4
Brown, Dry FILL: SAND, trace gravel, concrete fragments			2 9 5		4
		-5			
	587.40				
Dark Brown, Very Moist FILL: SILTY CLAY, trace organics, gravel			WH WH 1	<0.21 B	43
	584.90				
Stiff Dark Brown, Very Moist SILTY CLAY, trace gravel (CL/ML)			1 1 3	1.7 B	27
		-10			
	582.40				
Very Soft to Soft Gray, Moist to Very Moist SILTY CLAY, trace gravel (CL/ML)			WH WH 1	0.6 B	21
			WH WH WH	0.4 B	27
		-15			
			WH WH WH	0.2 B	26
			WH WH WH	<0.21 B	29
		-20			

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very Soft to Soft Gray, Moist to Very Moist SILTY CLAY, trace gravel (CL/ML) *(continued)*		WH WH WH	0.2 B	28
		WH WH WH	<0.21 B	27
	-25			
		WH WH WH	0.2 B	27
		WH WH WH	<0.21 B	27
	-30			
		WH WH WH	0.2 B	24
	-35			
		WH 4 4	<0.21 P	29
	-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 3/20/24

ROUTE FAI 290 (I-290) **DESCRIPTION** Bridge Boring **LOGGED BY** DV

SECTION 2021-120-BR **LOCATION** , **SEC.** 18, **TWP.** 39N, **RNG.** 14E, **Latitude** 41.8761186, **Longitude** -87.6814759

COUNTY COOK **DRILLING RIG** CME 75 **HAMMER TYPE** AUTO
DRILLING METHOD MUD ROTARY **HAMMER EFF (%)** 79.8

STRUCT. NO. 016-2079
Station N/A

BORING NO. BSB-01
Station 104+83.48
Offset 20.80ft LT
Ground Surface Elev. 593.40 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very Soft to Soft Gray, Moist to Very Moist SILTY CLAY, trace gravel (CL/ML) *(continued)*				
549.90				
Stiff, Gray, Moist SILTY CLAY, with sand, trace gravel (CL/ML)	-45	2 2 5	1.0 B	19
	-50	1 5 5		22
539.90				
Dense Gray, Moist to Very Moist SILTY LOAM (ML)	-55	14 15 21		16
	-60	11 15 18		21
Dense Gray, Moist to Very Moist SILTY LOAM (ML) *(continued)*	-65	11 19 17		13
	-70	9 10 20		12
519.90				
Hard to Very Hard Gray, Moist SILTY CLAY (CL/ML)	-75	11 17 23	8.8 B	22
8 inch Silt Seam at 79 feet	-80	9 26 20	6.3 B	22

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 3/20/24

ROUTE FAI 290 (I-290) **DESCRIPTION** Bridge Boring **LOGGED BY** DV

SECTION 2021-120-BR **LOCATION** , **SEC.** 18, **TWP.** 39N, **RNG.** 14E,
Latitude 41.8761186, **Longitude** -87.6814759

COUNTY COOK **DRILLING RIG** CME 75 **HAMMER TYPE** AUTO
DRILLING METHOD MUD ROTARY **HAMMER EFF (%)** 79.8

STRUCT. NO. 016-2079
Station N/A

BORING NO. BSB-01
Station 104+83.48
Offset 20.80ft LT
Ground Surface Elev. 593.40 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Hard to Very Hard Gray, Moist SILTY CLAY (CL/ML) *(continued)*	509.90				
Extremely Dense Gray, Moist GRAVEL, with clay, sand (GP/GC)			39		
			50		8
		-85			
			50		
					8
		-90			
	502.40				
WEATHERED LIMESTONE	501.40				
Auger Refusal at 92 feet End of Boring					
		-95			
		-100			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 3/7/24

ROUTE FAI 290 (I-290) **DESCRIPTION** Bridge Boring **LOGGED BY** DF

SECTION 2021-120-BR **LOCATION** , **SEC.** 18, **TWP.** 39N, **RNG.** 14E,
Latitude 41.8750366, **Longitude** -87.6814429

COUNTY COOK **DRILLING RIG** CME 75 **HAMMER TYPE** AUTO
DRILLING METHOD MUD ROTARY **HAMMER EFF (%)** 79.8

STRUCT. NO. 016-2079
Station N/A

BORING NO. BSB-02
Station 100+89.09
Offset 19.44ft LT
Ground Surface Elev. 594.60 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
1 inch of Asphalt	594.52				
8 inches of Concrete	593.85				
10 inches of Aggregate Base	593.02		6		
Black and Dark Brown, Moist FILL: SANDY LOAM, trace gravel			4		15
			3		
			3		
			1		23
		-5	1		
	588.60				
Very Stiff Dark Gray and Brown, Moist SILTY CLAY, trace gravel (CL/ML)			2		
			2	2.5	23
			3	B	
Cobbles at 8.5 feet			4		
			5		21
		-10	6		
	583.60				
Very Soft to Soft Gray, Very Moist SILTY CLAY, trace gravel (CL/ML)			2		
			2	<0.21	29
			3	B	
			WH		
			1	0.4	28
		-15	1	B	
			WH		
			WH	0.2	29
			1	B	
			WH		
			WH	<0.21	29
		-20	WH	B	

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very Soft to Soft Gray, Very Moist SILTY CLAY, trace gravel (CL/ML) *(continued)*			WH		
			WH	<0.21	28
Silt seam at 22 feet			WH	B	
			WH		
			WH	<0.21	29
		-25	WH	B	
			3		
Silt seam at 26.5 feet			1	<0.21	20
			1	B	
			WH		
			WH	<0.21	28
		-30	1	B	
			WH		
			WH	<0.21	43
		-35	WH	B	
	556.10		10		
Gravel seam 39 feet			16	5.8	12
		-40	17	B	

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 3/7/24

ROUTE FAI 290 (I-290) **DESCRIPTION** Bridge Boring **LOGGED BY** DF

SECTION 2021-120-BR **LOCATION** , **SEC.** 18, **TWP.** 39N, **RNG.** 14E, **Latitude** 41.8750366, **Longitude** -87.6814429

COUNTY COOK **DRILLING RIG** CME 75 **HAMMER TYPE** AUTO
DRILLING METHOD MUD ROTARY **HAMMER EFF (%)** 79.8

STRUCT. NO. 016-2079
Station N/A

BORING NO. BSB-02
Station 100+89.09
Offset 19.44ft LT
Ground Surface Elev. 594.60 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Hard Gray, Moist SILTY CLAY, trace gravel (CL/ML) *(continued)*				
		7		
		9	7.7	14
	-45	13	B	
		5		
		6	4.1	18
	-50	14	B	
541.10				
Very Dense Gray, Moist SILTY LOAM (ML)		18		
		26		17
	-55	24		
		14		
		28		20
Sand seam at 59.5 feet	-60	29		

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very Dense Gray, Moist SILTY LOAM (ML) *(continued)*				
531.10				
Hard to Very Hard Gray, Moist SILTY CLAY LOAM, trace gravel (CL/ML)		12		
		15	11.5	12
	-65	21	B	
		15		
		24	15.6	11
	-70	34	B	
		8		
		11	7.1	26
	-75	18	B	
516.10				
Very Dense to Extremely Dense Gray, Moist SANDY LOAM, trace gravel (SM)		21		
		28		11
	-80	30		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 3/7/24

ROUTE FAI 290 (I-290) **DESCRIPTION** Bridge Boring **LOGGED BY** DF

SECTION 2021-120-BR **LOCATION** , **SEC.** 18, **TWP.** 39N, **RNG.** 14E, **Latitude** 41.8750366, **Longitude** -87.6814429

COUNTY COOK **DRILLING RIG** CME 75 **HAMMER TYPE** AUTO
DRILLING METHOD MUD ROTARY **HAMMER EFF (%)** 79.8

STRUCT. NO. 016-2079
Station N/A

BORING NO. BSB-02
Station 100+89.09
Offset 19.44ft LT
Ground Surface Elev. 594.60 **ft**

Surface Water Elev. N/A **ft**
Stream Bed Elev. N/A **ft**

Groundwater Elev.:
First Encounter None **ft**
Upon Completion N/A **ft**
After N/A **Hrs.** N/A **ft**

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Very Dense to Extremely Dense Gray, Moist SANDY LOAM, trace gravel (SM) *(continued)*			50/4"		12
		-85			
	506.10				
Extremely Dense Light Gray, Moist GRAVEL (GP)			50/3"		6
	504.60	-90			
Auger Refusal at 90 feet End of Boring					
		-95			
		-100			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, form 137 (Rev. 8-99)

APPENDIX D

IDOT PILE DESIGN TABLES

WITH NO PRE-CORE

Pile Design Table for North Abutment - Wall utilizing Boring #BSB-01

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.25" walls			
	41	22	27
	183	101	32
	204	112	37
	244	134	42
	253	139	47
	316	174	52
	375	206	57
Metal Shell 14"Φ w/.25" walls			
	49	27	27
	240	132	32
	262	144	37
	310	171	42
	317	174	47
	398	219	52
Metal Shell 14"Φ w/.312" walls			
	49	27	27
	240	132	32
	262	144	37
	310	171	42
	317	174	47
	398	219	52
	470	259	57
Metal Shell 16"Φ w/.312" walls			
	58	32	27
	304	167	32
	326	179	37
	384	211	42
	387	213	47
	487	268	52
	576	317	57
Metal Shell 16"Φ w/.375" walls			
	58	32	27
	304	167	32
	326	179	37
	384	211	42
	387	213	47
	487	268	52
	576	317	57
Steel HP 8 X 36			
	74	41	52
	84	46	57
	104	57	62
	198	109	67
	214	118	70
	255	140	71
	286	157	72

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42			
	73	40	42
	82	45	47
	92	50	52
	104	57	57
	129	71	62
	258	142	67
	277	153	70
	316	174	71
	335	184	72
Steel HP 10 X 57			
	76	42	42
	84	46	47
	94	52	52
	107	59	57
	136	75	62
	265	146	67
	285	157	70
	326	179	71
	454	250	73
Steel HP 12 X 53			
	77	42	37
	88	48	42
	98	54	47
	110	60	52
	124	68	57
	155	85	62
	318	175	67
	352	194	70
	379	208	71
	418	230	72
Steel HP 12 X 63			
	79	44	37
	90	50	42
	101	55	47
	113	62	52
	128	70	57
	162	89	62
	325	179	67
	358	197	70
	389	214	71
	497	273	72
Steel HP 12 X 74			
	70	38	32
	81	44	37
	92	51	42
	103	56	47
	115	63	52
	130	72	57
	167	92	62
	329	181	67

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 84			
	72	39	32
	82	45	37
	94	52	42
	104	57	47
	117	64	52
	133	73	57
	172	95	62
	333	183	67
	368	202	70
	403	222	71
	664	365	73
Steel HP 14 X 73			
	48	26	27
	80	44	32
	94	51	37
	107	59	42
	119	66	47
	133	73	52
	151	83	57
	191	105	62
	385	212	67
	426	234	70
	460	253	71
	578	318	72
Steel HP 14 X 89			
	49	27	27
	83	46	32
	96	53	37
	110	61	42
	122	67	47
	137	75	52
	155	85	57
	199	110	62
	392	216	67
	433	238	70
	472	260	71
	705	388	73
Steel HP 14 X 102			
	49	27	27
	85	47	32
	98	54	37
	112	62	42
	124	68	47
	139	77	52
	158	87	57
	206	113	62
	397	218	67
	438	241	70
	480	264	71
	810	445	73

Pile Design Table for North Abutment - Wall utilizing Boring #BSB-01

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
					364	200	70	**Steel HP 14 X 117**			
					396	218	71		50	27	27
					589	324	73		88	48	32
									101	55	37
									115	63	42
									127	70	47
									143	78	52
									162	89	57
									214	118	62
									404	222	67
									445	245	70
									492	270	71
									929	511	74
								Precast 14"x 14"			
									63	35	27

Pile Design Table for South Abutment - Wall utilizing Boring #BSB-02

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.25" walls			
	7	4	11
	92	51	26
	290	159	31
	351	193	41
Metal Shell 14"Φ w/.25" walls			
	9	5	11
	114	63	26
	374	206	31
Metal Shell 14"Φ w/.312" walls			
	9	5	11
	114	63	26
	374	206	31
	435	239	41
Metal Shell 16"Φ w/.312" walls			
	11	6	11
	139	76	26
	469	258	31
	527	290	41
Metal Shell 16"Φ w/.375" walls			
	11	6	11
	139	76	26
	469	258	31
	527	290	41
	609	335	51
Steel HP 8 X 36			
	77	42	36
	89	49	41
	99	55	51
	122	67	56
	137	75	61
	164	90	66
	187	103	68
	286	157	70

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42			
	79	43	31
	95	52	36
	111	61	41
	124	68	46
	128	71	51
	152	83	56
	179	98	61
	204	112	66
	232	128	68
	335	184	69
Steel HP 10 X 57			
	31	17	26
	82	45	31
	99	54	36
	114	62	41
	128	70	46
	132	72	51
	156	86	56
	183	100	61
	209	115	66
	241	132	68
	454	250	70
Steel HP 12 X 53			
	34	19	26
	94	52	31
	114	63	36
	133	73	41
	149	82	46
	163	90	51
	181	100	56
	214	118	61
	244	134	66
	278	153	68
	418	230	69
Steel HP 12 X 63			
	36	20	26
	97	54	31
	118	65	36
	136	75	41
	153	84	46
	165	91	51
	186	102	56
	219	120	61
	250	138	66
	287	158	68
	497	273	70
Steel HP 12 X 74			
	38	21	26
	100	55	31
	121	66	36
	138	76	41
	156	86	46

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 84			
	39	21	26
	102	56	31
	123	68	36
	140	77	41
	159	87	46
	170	94	51
	192	106	56
	225	124	61
	258	142	66
	300	165	68
	664	365	71
Steel HP 14 X 73			
	43	23	26
	115	63	31
	139	77	36
	161	89	41
	181	100	46
	201	111	51
	220	121	56
	259	143	61
	296	163	66
	339	187	68
	578	318	70
Steel HP 14 X 89			
	45	25	26
	119	66	31
	144	79	36
	164	90	41
	186	102	46
	205	113	51
	226	124	56
	264	145	61
	303	166	66
	350	192	68
	705	388	71
Steel HP 14 X 102			
	46	26	26
	122	67	31
	147	81	36
	167	92	41
	190	104	46
	207	114	51
	229	126	56
	268	147	61
	307	169	66
	358	197	68
	810	445	71
Steel HP 14 X 117			
	48	27	26
	126	69	31
	152	83	36
	170	94	41

Pile Design Table for South Abutment - Wall utilizing Boring #BSB-02

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)			Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)			Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
						168	92	51			194	107	46
						189	104	56			210	116	51
						222	122	61			234	129	56
						254	140	66			273	150	61
						294	162	68			313	172	66
						589	324	71			368	202	68
											929	511	72
										Precast 14"x 14"			
											11	6	11
											146	80	26

APPENDIX E

IDOT PILE DESIGN TABLES

WITH PRE-CORE

Pile Design Table for North Abutment - Wall with Pre-Core to El. 566.2 feet utilizing Boring #BSB-01

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.25" walls			
	37	21	27
	180	99	32
	200	110	37
	240	132	42
	250	137	47
	313	172	52
	342	188	56
	371	204	57
Metal Shell 14"Φ w/.25" walls			
	45	25	27
	236	130	32
	257	142	37
	306	168	42
	313	172	47
	393	216	52
	427	235	56
Metal Shell 14"Φ w/.312" walls			
	45	25	27
	236	130	32
	257	142	37
	306	168	42
	313	172	47
	393	216	52
	427	235	56
	466	256	57
	508	279	61
Metal Shell 16"Φ w/.312" walls			
	54	29	27
	299	164	32
	321	177	37
	379	209	42
	382	210	47
	483	265	52
	522	287	56
	571	314	57
	618	340	61
Metal Shell 16"Φ w/.375" walls			
	54	29	27
	299	164	32
	321	177	37
	379	209	42
	382	210	47
	483	265	52
	522	287	56
	571	314	57
	618	340	61
Steel HP 8 X 36			
	78	43	56
	81	44	57
	89	49	61
	102	56	62
	196	108	67

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42			
	79	43	47
	88	48	52
	97	53	56
	100	55	57
	111	61	61
	126	69	62
	256	141	67
	275	151	70
	313	172	71
	335	184	72
Steel HP 10 X 57			
	72	40	42
	81	44	47
	91	50	52
	100	55	56
	103	57	57
	114	63	61
	133	73	62
	263	144	67
	282	155	70
	322	177	71
	454	250	73
Steel HP 12 X 53			
	73	40	37
	84	46	42
	94	52	47
	106	58	52
	116	64	56
	120	66	57
	133	73	61
	151	83	62
	314	173	67
	348	191	70
	375	206	71
	418	230	72
Steel HP 12 X 63			
	75	41	37
	86	47	42
	97	53	47
	108	60	52
	119	66	56
	123	68	57
	137	75	61
	157	87	62
	321	176	67
	355	195	70
	385	212	71
	497	273	72
Steel HP 12 X 74			
	77	42	37
	88	48	42
	98	54	47

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 84			
	78	43	37
	90	49	42
	100	55	47
	113	62	52
	124	68	56
	128	71	57
	142	78	61
	168	92	62
	329	181	67
	364	200	70
	399	219	71
	664	365	73
Steel HP 14 X 73			
	75	41	32
	89	49	37
	102	56	42
	114	63	47
	128	71	52
	141	78	56
	146	80	57
	162	89	61
	186	102	62
	380	209	67
	421	231	70
	455	250	71
	578	318	72
Steel HP 14 X 89			
	78	43	32
	91	50	37
	105	58	42
	117	64	47
	132	73	52
	145	80	56
	150	83	57
	166	91	61
	194	107	62
	387	213	67
	428	235	70
	467	257	71
	705	388	73
Steel HP 14 X 102			
	44	24	27
	80	44	32
	93	51	37
	107	59	42
	119	65	47
	134	74	52
	147	81	56
	153	84	57
	169	93	61
	201	110	62
	392	215	67

Pile Design Table for North Abutment - Wall with Pre-Core to El. 566.2 feet utilizing Boring #BSB-01

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
	212	117	70		111	61	52		433	238	70
	252	138	71		122	67	56		475	261	71
	286	157	72		126	69	57		810	445	73
					139	77	61	**Steel HP 14 X 117**			
					163	90	62		45	25	27
					325	179	67		83	46	32
					360	198	70		96	53	37
					392	216	71		110	60	42
					589	324	73		122	67	47
									138	76	52
									151	83	56
									157	86	57
									173	95	61
									209	115	62
									399	219	67
									440	242	70
									486	268	71
									929	511	74
								Precast 14"x 14"			
									58	32	27

Pile Design Table for South Abutment - Wall with Pre-Core to El. 566.2 feet utilizing Boring #BSB-02

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.25" walls			
	4	2	11
	89	49	26
	287	158	31
	348	191	41
	373	205	45
Metal Shell 14"Φ w/.25" walls			
	5	3	11
	111	61	26
	371	204	31
Metal Shell 14"Φ w/.312" walls			
	5	3	11
	111	61	26
	371	204	31
	432	237	41
	461	254	45
Metal Shell 16"Φ w/.312" walls			
	6	4	11
	135	74	26
	465	256	31
	523	288	41
	557	306	45
Metal Shell 16"Φ w/.375" walls			
	6	4	11
	135	74	26
	465	256	31
	523	288	41
	557	306	45
	605	333	51
Steel HP 8 X 36			
	74	41	36
	87	48	41
	92	50	45
	98	54	51
	119	66	56
	136	75	61
	162	89	66
	184	101	68
	286	157	70

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42			
	76	42	31
	92	51	36
	108	59	41
	116	64	45
	121	67	46
	126	69	51
	149	82	56
	176	97	61
	201	111	66
	229	126	68
	335	184	69
Steel HP 10 X 57			
	79	43	31
	96	53	36
	111	61	41
	118	65	45
	125	69	46
	129	71	51
	153	84	56
	180	99	61
	206	113	66
	238	131	68
	454	250	70
Steel HP 12 X 53			
	31	17	26
	91	50	31
	111	61	36
	129	71	41
	138	76	45
	145	80	46
	161	88	51
	178	98	56
	211	116	61
	241	132	66
	274	151	68
	418	230	69
Steel HP 12 X 63			
	32	18	26
	94	52	31
	114	63	36
	132	73	41
	142	78	45
	149	82	46
	162	89	51
	182	100	56
	215	118	61
	246	136	66
	283	156	68
	497	273	70
Steel HP 12 X 74			
	34	19	26
	96	53	31

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 84			
	35	19	26
	99	54	31
	120	66	36
	136	75	41
	146	80	45
	155	85	46
	168	92	51
	189	104	56
	221	122	61
	254	140	66
	296	163	68
	664	365	71
Steel HP 14 X 73			
	38	21	26
	111	61	31
	135	74	36
	157	86	41
	168	92	45
	177	97	46
	197	108	51
	216	119	56
	255	140	61
	292	161	66
	335	184	68
	578	318	70
Steel HP 14 X 89			
	40	22	26
	115	63	31
	140	77	36
	160	88	41
	171	94	45
	182	100	46
	200	110	51
	221	122	56
	260	143	61
	298	164	66
	345	190	68
	705	388	71
Steel HP 14 X 102			
	42	23	26
	118	65	31
	143	79	36
	162	89	41
	174	96	45
	185	102	46
	202	111	51
	225	124	56
	263	145	61
	303	166	66
	353	194	68
	810	445	71
Steel HP 14 X 117			

Pile Design Table for South Abutment - Wall with Pre-Core to El. 566.2 feet utilizing Boring #BSB-02

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
					117	64	36		44	24	26
					134	74	41		121	67	31
					144	79	45		147	81	36
					152	84	46		166	91	41
					165	91	51		177	97	45
					186	102	56		190	104	46
					218	120	61		206	113	51
					250	138	66		230	126	56
					290	159	68		268	148	61
					589	324	71		309	170	66
									363	200	68
									929	511	72
								Precast 14"x 14"			
									7	4	11
									141	78	26

APPENDIX F

SOIL DESIGN PARAMETERS

Table F1: Summary of Soil Parameters

Depth / Elevation Range CCD / NAVD	Soil Description	In situ Unit Weight (pcf)	Undrained		Drained		Active Earth Pressure Coefficient (K_a)	Passive Earth Pressure Coefficient (K_p)	At Rest Earth Pressure Coefficient (K_o)	Lateral Modulus of Subgrade Reaction (pci)	Soil Strain ($_{50}$)	Soil Type
			Cohesion c (psf)	Friction Angle (°)	Cohesion c (psf)	Friction Angle (°)						
	New Engineered Clay Fill	125	1,000	0	100	25	0.41	2.46	0.58	100	0.01	Stiff Clay w/o free water (Reese)
	New Engineered Granular Fill	125	0	32	0	32	0.33	3.00	0.50	90	N/A	Sand (Reese)
1.0 to 6.0 (13.12-8.12) (593-588)	Brown and Dark Brown Sand Fill	120	0	34	0	34	0.28	3.54	0.44	25	N/A	Sand (Reese)
6.0 to 11.0 (8.12-3.12) (588-583)	Dark Brown and Gray Stiff to Very Stiff Silty Clay	138	2,100	0	210	28	0.36	2.77	0.53	1,000	0.005	Stiff Clay w/o free water (Reese)
11.0 to 43.5 (3.12 - (-29.38)) (583-550.5)	Gray Very Soft to Medium Stiff Silty Clay	111	200	0	20	25	0.41	2.46	0.58	30	0.02	Stiff Clay w/o free water (Reese)
43.5 to 53.5 (-29.38 - (-39.38)) (550.5-540.5)	Gray Stiff to Hard Silty Clay	138	4,600	0	460	28	0.36	2.77	0.53	2,000	0.004	Stiff Clay w/o free water (Reese)
53.5 to 63.5 (-39.38 - (-49.38)) (540.5-530.5)	Gray Dense to Very Dense Silty Loam	134	0	42	0	42	0.20	5.04	0.33	125	N/A	Silt
63.5 to 83.5 (-49.38 - (-69.38)) (530.5-510.5)	Gray Hard to Very Hard Silty Clay	138	9,800	0	980	28	0.36	2.77	0.53	2,000	0.004	Stiff Clay w/o free water (Reese)

83.5 to 91.0 (-69.38 - (-76.88)) (510.5-503)	Gray Extremely Dense Gravel	138	0	42	0	42	0.20	5.04	0.33	125	N/A	Sand (Reese)
6.0 to 8.5 (8.12-5.62) (588-585.5) ***BSB-01 Only**	Black Silty Clay Fill	111	200	0	20	25	0.41	2.46	0.58	30	0.02	Stiff Clay w/o free water (Reese)
78.5 to 88.5 (-64.38 - (-74.38)) (515.5-505.5) ***BSB-02 Only**	Gray Very Dense to Extremely Dense Sandy Loam	138	0	40	0	40	0.22	4.60	0.36	125	N/A	Sand (Reese)

APPENDIX G

SEISMIC SITE CLASS

DETERMINATION CALCULATIONS

Illinois Department of Transportation

SEISMIC SITE CLASS DETERMINATION

PROJECT TITLE===== Leavitt St over I-290

Substructure 1

Base of Substruct. Elev. (or ground surf for bents)	571.2	ft.
Pile or Shaft Dia.	12	inches
Boring Number	BSB-1	
Top of Boring Elev.	593.4	ft.

Approximate Fixity Elev. 565.2 ft.

Individual Site Class Definition:

N (bar):	5	(Blows/ft.)	Soil Site Class E
N_{ch} (bar):	50	(Blows/ft.)	Soil Site Class D
s_u (bar):	1.42	(ksf)	Soil Site Class D <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	587.4	6.00	9		B
17.8	547.4	40.00	1	0.43	B
42.8	522.4	25.00	29		B
52.8	512.4	10.00	43	5.00	B
62.8	502.4	10.00	69	5.00	B
100.0	465.2	37.20	100	5.00	R

Substructure 2

Base of Substruct. Elev. (or ground surf for bents)	571.2	ft.
Pile or Shaft Dia.	12	inches
Boring Number	BSB-2	
Top of Boring Elev.	594.6	ft.

Approximate Fixity Elev. 565.2 ft.

Individual Site Class Definition:

N (bar):	12	(Blows/ft.)	Soil Site Class E
N_{ch} (bar):	74	(Blows/ft.)	Soil Site Class C
s_u (bar):	1.71	(ksf)	Soil Site Class D <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary
	588.6	6.00	4		B
	583.6	5.00	8	2.50	B
6.6	558.6	25.00	1	0.22	B
21.6	543.6	15.00	25	4.70	B
31.6	533.6	10.00	53		B
46.6	518.6	15.00	41	5.00	B
61.6	503.6	15.00	52		B
100.0	465.2	38.40	100	5.00	R

Substructure 3

Base of Substruct. Elev. (or ground surf for bents)		ft.
Pile or Shaft Dia.		inches
Boring Number		
Top of Boring Elev.		ft.

Approximate Fixity Elev. ft.

Individual Site Class Definition:

N (bar):		(Blows/ft.)	NA
N_{ch} (bar):		(Blows/ft.)	NA
s_u (bar):		(ksf)	NA

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary

Substructure 4

Base of Substruct. Elev. (or ground surf for bents)		ft.
Pile or Shaft Dia.		inches
Boring Number		
Top of Boring Elev.		ft.

Approximate Fixity Elev. ft.

Individual Site Class Definition:

N (bar):		(Blows/ft.)	NA
N_{ch} (bar):		(Blows/ft.)	NA
s_u (bar):		(ksf)	NA

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary

Global Site Class Definition: Substructures 1 through 2

N (bar):	9	(Blows/ft.)	Soil Site Class E
N_{ch} (bar):	62	(Blows/ft.)	Soil Site Class C
s_u (bar):	1.57	(ksf)	Soil Site Class D <----Controls

Method B - N (bar): 5 (Blows/ft.) ---------------> Soil Site Class E

Method C - N_{ch} (bar): 50 (Blows/ft.) ---------------> Soil Site Class D

Method C - s_u (bar): 1.42 (ksf) ------- ---------------> Soil Site Class D <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary #		Method B - N (bar)			Method C - N_{ch} (bar)			Method C - s_u (bar)		
							N_i (Blows/ft.)	d_i (ft.)	d_i / N_i (ft.^{2} / Blows)	N_{chi} (Blows/ft.)	d_i (ft.)	d_i / N_{chi} (ft.^{2} / Blows)	s_{ui} (ksf)	d_i (ft.)	d_i / s_{ui} (ft.^{3} / kip)
					1	B									
17.80	547.40	17.80	1	0.43	2	B	1	17.8	17.80				0.43	17.8	41.40
42.80	522.40	25.00	29		3	B	29	25	0.86	29	25	0.86			
52.80	512.40	10.00	43	5.00	4	B	43	10	0.23				5.00	10	2.00
62.80	502.40	10.00	69	5.00	5	B	69	10	0.14				5.00	10	2.00
100.00	465.20	37.20	100	5.00	6	R	100	37.2	0.37	100	37.2	0.37	5.00	37.2	7.44
								100.0	19.41		62.2	1.23		75	52.84
								=	=		=	=		=	=
								$\Sigma\ d_i$	$\Sigma\ (d_i / N_i)$		d_s	$\Sigma\ (d_i / N_{chi})$		d_c	$\Sigma\ (d_i / s_{ui})$

Substructure 2 Site Class Definition Calculations

Method B - N (bar):	12	(Blows/ft.)	--------------->	Soil Site Class E	
Method C - N_{ch} (bar):	74	(Blows/ft.)	--------------->	Soil Site Class C	
Method C - s_u (bar):	1.71	(ksf)	------ --------------->	Soil Site Class D	<----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation	Sample Thick. (ft.)	N	Qu (tsf)	Layer Description Boundary #		Method B - N (bar) N_i (Blows/ft.)	d_i (ft.)	d_i / N_i (ft.^{2} / Blows)	Method C - N_{ch} (bar) N_{chi} (Blows/ft.)	d_i (ft.)	d_i / N_{chi} (ft.^{2} / Blows)	Method C - s_u (bar) s_{ui} (ksf)	d_i (ft.)	d_i / s_{ui} (ft.^{3} / kip)
					1	B									
					2	B									
6.60	558.60	6.60	1	0.22	3	B	1	6.6	6.60				0.22	6.6	30.00
21.60	543.60	15.00	25	4.70	4	B	25	15	0.60				4.70	15	3.19
31.60	533.60	10.00	53		5	B	53	10	0.19	53	10	0.19			
46.60	518.60	15.00	41	5.00	6	B	41	15	0.37				5.00	15	3.00
61.60	503.60	15.00	52		7	B	52	15	0.29	52	15	0.29			
100.00	465.20	38.40	100	5.00	8	R	100	38.4	0.38	100	38.4	0.38	5.00	38.4	7.68
								100.0	8.43		63.4	0.86		75	43.87
								=	=		=	=		=	=
								$\Sigma\, d_i$	$\Sigma\, (d_i / N_i)$		d_s	$\Sigma\, (d_i / N_{chi})$		d_c	$\Sigma\, (d_i / s_{ui})$

Global Site Class Definition Calculations

Method B - N (bar):	9	(Blows/ft.)	-----------------> Soil Site Class E	
Method C - N_{ch} (bar):	62	(Blows/ft.)	-----------------> Soil Site Class C	
Method C - s_u (bar):	1.57	(ksf)	-----------------> Soil Site Class D	<----Controls

Location	N_{ch} (bar) d_s (soil only) (ft.)	s_u (bar) d_c (soil only) (ft.)
Substructure 1	25	37.8
Substructure 2	25	36.6
Substructure 3		
Substructure 4		
Substructure 5		
Substructure 6		
Substructure 7		
Substructure 8		
	50	74.4
	=	=
	Σ d_s (soil only)	Σ d_c (soil only)

<---- Consider ds & dc

Location	Method B N (bar)	Method C - N_{ch} (bar)			Method C - s_u (bar)		
		d_s (ft.)	N_{ch} (bar) (Blows/ft.)	d_s * N_{ch} (bar)	d_c (ft.)	s_u (bar) (ksf)	d_c * s_u (bar)
Substructure 1	5	62.2	50	3110	75	1.42	106.50
Substructure 2	12	63.4	74	4691.6	75	1.71	128.25
Substructure 3							
Substructure 4							
Substructure 5							
Substructure 6							
Substructure 7							
Substructure 8							
	9			62			1.57
	=			=			=
	Avg. N (bar)			Wt.'d Avg. N_{ch} (bar)			Wt.'d Avg. s_u (bar)