STRUCTURE GEOTECHNICAL REPORT
CIRCLE INTERCHANGE RECONSTRUCTION
RETAINING WALL 22A (PROPOSED SN 016-1813)
NB C-D ROAD
F.A.I ROUTE 90/94, (KENNEDY EXPRESSWAY)
IDOT D-91-227-13/ PTB 163-001
COOK COUNTY, ILLINOIS

For

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11. Abstract

To facilitate the widening and reconstruction of Circle Interchange, Retaining Wall 22A will be constructed along NB C-D Road. The proposed 220-foot long Retaining Wall 22A will have a maximum retained height of 20.8 feet. This report provides geotechnical recommendations for the design and construction of the proposed retaining wall.

Beneath the pavement or topsoil, the subsurface soils consists of up to 13 feet of fill materials, up to 5 feet medium stiff to very stiff clay crust, up to 41 feet of very soft to medium stiff silty clay, 25 feet of stiff to hard clay loam, and up to 30 feet of very dense silt to silty loam and sand to gravelly sand extending to the boring termination depths or weathered bedrock. Sound bedrock was encountered at an elevation of about 490 feet. Although groundwater was not encountered within the fill layer, the groundwater should be anticipated between elevations of 592 and 585 feet. Under pressure water-bearing layers are expected at deeper levels.

Given that the location and geometry, the proposed MSE wall is feasible with the use of Class II LCCF or combined MSE wall fill materials with Class II LCCF for bottom and regular fill material for top 3 feet. The soil will have a maximum factored bearing resistance of 2,000 psf using a geotechnical resistance factor of 0.65.

If there are other considerations and MSE wall is not feasible, the drilled shaft and/or drilled pile walls could be considered. For these walls, geotechnical parameters for design are presented in this report.

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1.0 INTRODUCTION

This report presents the results of our subsurface investigation, laboratory testing, geotechnical engineering evaluations and recommendations for a new retaining wall, designated as SN 016-1813 (Retaining Wall 22A) proposed along the NB C-D Road in connection with the Circle Interchange Reconstruction project in the City of Chicago, Cook County, Illinois. A *Site Location Map* is presented as Exhibit 1.

The purpose of Wang Engineering, Inc. (Wang) investigation was to characterize the site soil and groundwater conditions, perform geotechnical engineering analyses, and provide recommendations for the design and construction of the new wall structure.

1.1 Project Description

The Circle Interchange is over 50 years old and has significant congestion and safety problems. The project is aiming to improve safety and mobility as well as upgrade the mainline and interchange facilities. The project will also improve other modes of transportation such as transit, pedestrians and bicyclists within the same corridor.

The Circle Interchange Reconstruction project is along Interstate 90/94 (I-90/94) from south of Roosevelt Road to north of Lake Street, along Interstate 290 (I-290) from Loomis Street to the Circle Interchange; and along Congress Parkway from the Circle Interchange to Canal Street/Old Post Office. The routes typically have three lanes of traffic in each direction with mostly one lane ramp at interchanges. Locally, the north leg is known as the Kennedy Expressway, the south leg as the Dan

Ryan Expressway and the west leg as the Eisenhower Expressway. Within the project area, there are several cross street bridges over I-90/94 and I-290 considered for reconstruction. Along I-90/94, from south to north, the cross street overpasses include Taylor Street, Van Buren Street, Jackson Boulevard, and Adams Street. Along I-290, from west to east, the cross street overpasses include Morgan Street, Peoria Street, and Halsted Street.

The proposed improvements include additional through lanes in each direction on I-90/94. The horizontal alignment and vertical profiles throughout the interchange will be improved. A new two-lane flyover, Ramp NW (Flyover) will be constructed for I-90/94 northbound to I-290 westbound traffic. Cross street bridges, Morgan Street, Harrison Street, Halsted Street, Peoria Street, Taylor Street, Adams Street, Jackson Boulevard, and Van Buren Street will be reconstructed. Various existing ramps will be reconstructed and more than fifty new retaining walls will be constructed.

1.2 Proposed Structure

Retaining wall 22A (SN 016-1813) is proposed along the NB C-D Road. Based on the Type, Size, and Location (TSL) plan dated January 31, 2018 provided by TranSystems Corporation (TranSystems), the 220-foot long wall is proposed to be a mechanically stabilized earth (MSE) wall. Wall 22A starts at Station 6324+44.49 at Harrison Street Bridge east abutment and ends at Station 6326+66.22 (NB C-D Road alignment). The proposed MSE wall will have a maximum retained height of 20.8 feet. There will be a minimum of 4.5-foot tall concrete parapet on top of the MSE wall. The TSL plan is included in the Appendix D.

1.3 Existing Structure

The TSL plan shows existing temporary soil retention system (TSRS) to be removed. There is an existing CTA building at the south end of proposed wall near the Harrison Street Bridge east abutment and will be removed. There is also an existing abandoned 6-foot diameter tunnel near Station 6325+00 that is proposed to be filled.

2.0 SITE CONDITIONS AND GEOLOGICAL SETTING

The site is located within the City of Chicago at the I-90/94 and I-290 Circle Interchange. On the USGS *Chicago Loop 7.5 Minute Series* map, the wall is located in the NW¼ of Section 16, Tier 39 N, Range 14 E of the Third Principal Meridian.

The following review of published geologic data, with emphasis on factors that might influence the design and construction of the proposed engineering works, is meant to place the project area within a geological framework and confirm the dependability and consistency of the present subsurface investigation results. For the study of the regional geologic framework, Wang considered northeastern Illinois in general and Cook County in particular. Exhibit 2 illustrates the *Site and Regional Geology*.

2.1 Physiography

The wall is situated within the Chicago Lake Plain Physiographic Subsection. The area is characterized by a flat surface that slopes gently toward the lake, largely made of groundmoraine till covered by thin and discontinuous lacustrine silt and clay. The ground elevation along the wall ranges from 590 feet at the north end to 594 feet at the south end.

2.2 Surficial Cover

The project area was shaped during the Wisconsinan-age glaciation, and more than 75-foot thick drift covers the bedrock (Leetaru et al. 2004). The glacial cover is made up of clay and silt of the Equality Formation of the Mason Group and diamictons of the Wadsworth and Lemont Formations of the Wedron Group (Hansel and Johnson 1996). The Equality Formation is made up of bedded silt and clay, locally laminated, with lenses and/or thin beds of sand and gravel. The Wadsworth Formation consists of relatively homogenous, massive, gray till with clay to silty clay matrix, with dolostone and shale clasts and occasional lenses of sorted and stratified silt. The Wadsworth Formation is underlain by the pebbly silty clay loam to silty loam diamicton of the Yorkville Member of the Lemont Formation, known informally as the Chicago “hardpan.”

From a geotechnical viewpoint, the Equality Formation is characterized by low strength, medium to high plasticity, and medium to high moisture content, whereas the Wadsworth Formation is characterized by low plasticity, medium to low moisture content, medium to very stiff consistency, poor permeability, and low compressibility. The Yorkville Member (hardpan) is characterized by low plasticity, high blow counts, and low moisture content (Bauer et al. 1991; Peck and Reed 1954).

2.3 Bedrock

In the project area, the glacigenic deposits unconformably rest over approximately 350-foot thick Silurian-age dolostone (Leetaru et al 2004). The top of bedrock may be encountered at 475 to 500 feet elevation or 75 to 100 feet below ground surface (bgs) or more. The Silurian dolostone dips gently

eastward at a pace of 15 feet per mile. Only inactive faults are known in the area, and the seismic risk is minimal (Leetaru et al. 2004; Willman 1971). There are no records of mining activity in the area, but deep tunnel excavations are known to exist.

Our subsurface investigation results fit into the local geologic context. The borings drilled in the project area revealed the native sediments consist of clay to silty clay diamicton of the Wadsworth Formation resting on top of more competent silty clay loam diamicton (hardpan) of the Lemont Formation, which in turn is underlain by bedrock. Sound dolostone bedrock was sampled at nearby boring at a depth of 105 feet bgs, corresponding to 490.6 feet elevation, within the range predicted based on published geological data.

3.0 METHODS OF INVESTIGATION

The following sections outline the subsurface and laboratory investigations. All elevations in this report are based on NAVD 1988.

3.1 Subsurface Investigation

Wang drilled one structure boring, designated as 22-RWB-01 in March 2014. Wang has also referenced six nearby structure borings, designated as 21-RWB-01, 21-RWB-03, 1710-B-03, 1710-B-02, 1705-B-05, and 1705-B-05A drilled between July and October 2013. The as-drilled boring locations were surveyed by Dynasty Group, Inc. and station and offset information for each boring were provided by AECOM. Boring location data are presented in the *Boring Logs* (Appendix A). The as-drilled boring locations are shown in the *Boring Location Plan* (Exhibit 3).

We also considered the Piezometer 1703-PZ-01 located about 350 feet north of Wall 22A. The piezometer was installed in accordance with ASTM D5092, "*Standard Practice for Design and Installation of Groundwater Monitoring Wells in Aquifers*."

A truck-mounted drilling rig equipped with hollow stem augers, was used to advance and maintain an open borehole to 10 to 15 feet depths after that mud rotary was used to boring termination depths. Soil sampling was performed according to AASHTO T 206, "*Penetration Test and Split Barrel Sampling of Soils*." The soil was sampled at 2.5-foot intervals to 30 feet bgs and at 5-foot intervals to boring termination depths. Soil samples collected from each sampling interval were placed in sealed

jars and transported to Wang Geotechnical Laboratory in Lombard, Illinois for further examination and laboratory testing.

Field boring logs, prepared and maintained by a Wang engineer or geologist, include lithological descriptions, visual-manual soil/rock classifications, results of Rimac and pocket penetrometer unconfined compressive strength tests, results of Standard Penetration Tests (SPT) recorded as blows per 6 inches of penetration. The SPT-N value, shown on the soil profile, is the sum of the second and third blows per 6 inches. The soils were described and classified according to Illinois Division of Highways (IDH) Textural Classification system. The field logs were finalized by an experienced engineering geologist after verifying the field visual classifications and laboratory test results.

Groundwater observations were made during drilling to depths of 10 feet before using mud rotary drilling method. Due to safety considerations, boreholes were backfilled with grout immediately upon completion. Groundwater levels in the piezometer were recorded autonomously at defined intervals by digital pressure loggers suspended within the water column. Barometric affects were compensated by a second in-air pressure logger installed in the riser pipe. Data retrieved from loggers periodically were downloaded to a computer for analysis.

3.2 Vane Shear Tests

Wang performed vane shear tests in Boring VST-06. Boring VST-06 is located 300 feet north of Wall 22A. Vane shear tests were performed using calibrated RocTest vane shear equipment in undisturbed and remolded conditions. The sensitivity shown on the boring logs is the ratio of shear strength in undisturbed and remolded conditions. In general, the vane shear strength values for soft clays were significantly higher than the corresponding values from unconfined compressive strength tests using the RIMAC apparatus. Vane shear test results were used on our analyses.

3.3 Laboratory Testing

The soil samples were tested in the laboratory for moisture content (AASHTO T265). Atterberg limits (AASHTO T 89/T 90) and particle size analyses (AASHTO T 88) tests were performed on selected soil samples representing the main soil layers encountered during the investigation. Shelby tube samples were tested for one-dimensional consolidation (AASHTO T 216) and unconsolidated-undrained triaxial (AASHTO T 296) strength. Field visual descriptions of the soil samples were verified in the laboratory. Laboratory test results are shown in the *Boring Logs* (Appendix A), in the *Soil Profile* (Exhibit 4), and in the *Laboratory Test Results* (Appendix B).

4.0 RESULTS OF FIELD AND LABORATORY INVESTIGATIONS

Detailed descriptions of the soil conditions encountered during our subsurface investigation are presented in the attached *Boring Logs* (Appendix A) and in the *Soil Profile* (Exhibit 4). Please note that strata contact lines represent approximate boundaries between soil types. The actual transition between soil types in the field may be gradual in horizontal and vertical directions.

4.1 Soil Conditions

Borings drilled from the I-290 Ramp and Harrison Street encountered 12 inches of asphalt and 2.5 inches of asphalt over 9.5 inches of concrete, respectively followed by sandy gravel. Borings drilled on the grassy area along the wall encountered 10 to 12 inches of silty clay loam topsoil. In descending order, the general lithologic succession encountered beneath the pavement structure or topsoil includes: 1) man-made ground (fill); 2) medium stiff to very stiff silty clay to silty clay loam; 3) very soft to medium stiff clay to silty clay; 4) stiff to hard silty clay to silty clay loam; 5) medium dense to very dense silt to silty loam and sand to gravelly sand; and 6) weathered to sound dolostone.

1) Man-made ground (fill)

Underneath topsoil or pavement structure, the borings encountered 3 to 13 feet of fill materials. Granular fill consists of loose to medium dense, dark brown to gray gravelly loam to sandy gravel. Cohesive fill includes stiff to hard, brown to gray silty clay loam. The granular fill layer has N-values of 8 to 19 blows per foot and moisture content values of 4 to 17%. The cohesive fill layer has unconfined compressive strength (Q_u) values ranging from 1.0 to 7.8 tsf and moisture content values of 11 to 21%.

2) Medium stiff to very stiff silty clay to silty clay loam

Beneath the fill, at elevations of 581 to 585 feet (3 to 13 feet bgs), the borings encountered 3 to 5 feet of medium stiff to very stiff, brown to gray silty clay to silty loam. This layer has Q_u values ranging from 1.7 to 3.6 tsf and moisture content values between 19 and 26%. This layer is commonly known as the “crust.”

3) Very soft to medium stiff clay to silty clay

At elevations of 577 to 584 feet (6 to 16 feet bgs), the borings revealed up to 41 feet of very soft to medium stiff, gray clay to silty clay with Rimac Qu values of 0.16 to 0.66 tsf and moisture content values of 20 to 28%. This layer is commonly known as the “*Chicago Blue Clay*.”

Laboratory index testing on samples from this layer showed liquid limit (L_L) values of 31 to 34% and plastic limit (P_L) values of 17 to 19%. The UU triaxial test on Shelby tube sample from an elevation of 569.2 feet shows an undrained cohesion of 439 psf. The long-term consolidation properties of the silty clay at an elevation of 554.2 feet were obtained from one-dimensional oedometer testing. The consolidation testing soil parameters are summarized in Table 1 and the laboratory sheets are attached in Appendix B.

Table 1: Summary of Consolidation Testing

Boring ID	Test Depth (feet)	Test Elevation (feet)	C_C	C_S	e_O	OCR/ P´c	Moisture Content (%)	L_L/P_L
1705-B-05A	25 to 27	554.2	0.223	0.045	0.738	1.2 / 2886	26	33/17

C_C : Compression index; C_S : Swelling index ; e_O : Initial void ratio; OCR: Over consolidation ratio; and P´c: Preconsolidation pressure.

As discussed in Section 3.2, undrained shear strength values from vane shear tests are generally higher than Rimac tests. In-situ undisturbed vane shear strengths obtained in Boring VST-06 between elevations 575 and 542 feet ranged from 580 to 980 psf.

4) Stiff to hard silty clay to silty clay loam

At elevations of 539 to 550 feet (47 to 57 feet bgs), the borings encountered up to 25 feet of stiff to hard silty clay to silty clay loam. The silty clay to silty clay loam has Q_u values of 1.2 to 8.7 tsf and moisture content values of 12 to 24%.

(5) Medium dense to very dense silt to silty loam and sand to gravelly sand

At elevations of 515 to 530 feet (57 to 82 feet bgs), the borings encountered medium dense to very dense silt to silty loam and sand to gravelly sand. This layer has N values of 12 to over 50 blows per foot.

(6) Weathered to sound bedrock

At elevations of 485 to 492 feet (102 to 104 feet bgs) Borings 1710-B-03, 21-RWB-03, and 22-RWB-01 revealed about 2 feet of weathered bedrock. Boring 22-RWB-01 cored strong bedrock at an elevation of 490.6 feet.

4.2 Groundwater Conditions

The groundwater was not observed after drilling in borings due to the mud rotary drilling from 10 to 15 feet bgs.

A Piezometer 1703-PZ-01 was installed about 350 feet north of the proposed Retaining Wall 22A on November 12, 2014. The screen was placed with the top and bottom elevations at 507.2 and 487.2 feet (75 to 95 feet bgs), respectively. A summary of the monitoring data between November 2014 and March 2017 is shown in Figure 1.

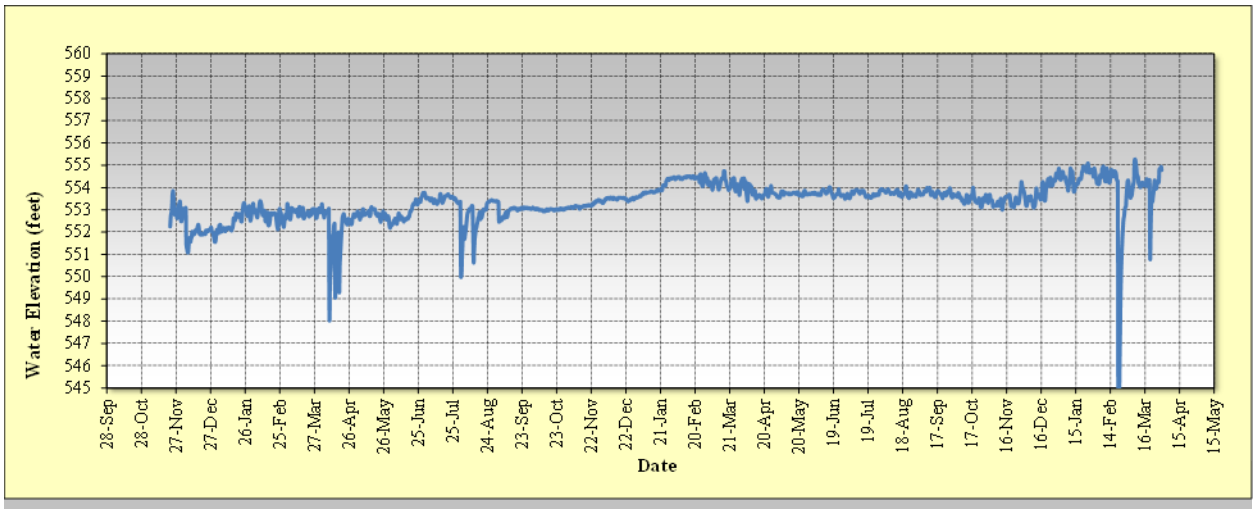


Figure 1: Summary of Groundwater Monitoring Data

The data shows groundwater is under hydrostatic pressure head. The average hydrostatic elevation within the aquifer is about 553 feet.

Although the groundwater was not encountered within the granular fill, the design and construction of the wall should consider the perched ground water between 592 and 585 feet elevations. The design and construction of the drilled shaft and drilled soldier pile walls should consider the deeper granular soils (**layer 5**) as water bearing and under hydrostatic pressure.

4.3 Seismic Design Considerations

The retaining wall is located in Seismic Performance Zone (SPZ) 1 and is not required to be designed for seismic forces as per 2012 IDOT *Bridge Manual* (IDOT 2012).

5.0 ANALYSIS AND RECOMMENDATIONS

5.1 Retaining Wall Type Evaluation

Based on the TSL plan and the cross-section drawings, the proposed Retaining Wall 22A is primarily a cut wall along the proposed NB C-D Road. The new 220-foot long Retaining Wall 22A begins at Harrison Street east abutment at Station 6324+44.49 and ends at Station 6326+66.22 (NB C-D Road alignment). The wall will have a maximum retained height of 20.8 feet near the Harrison Street Bridge.

In general, the applicable wall types for a cut section include drilled shaft and/or drilled soldier pile and lagging walls. Driven soldier pile or permanent sheet piling walls are not feasible due to noise and vibration. However, TranSystems proposed an MSE wall due to the close proximity to the Ramps NE and NW piers, the available right of way, and the existing TSRS that will need to be removed.

The following sections present the results of our geotechnical engineering analyses and recommendations for the MSE wall and drilled shaft and lagging wall design and construction.

5.2 MSE Wall

For frost protection, the MSE retaining wall base should be established at a minimum of 3.5 feet below the finished grade at the front face of the wall.

5.2.1 Bearing Resistance and External Stability Analyses

Based on the TSL Plan and cross-section drawings (Appendix E), the MSE wall's base elevations vary from 574.73 to 578.60 feet. Based on our boring data, the foundation soils at the MSE wall base elevations includes up to 36 feet of soft to medium stiff clay to silty clay. We estimate the foundation soils will have a nominal bearing resistance of 3,100 psf and a factored bearing resistance of 2,000 psf based on a geotechnical resistance factor of 0.65 (AASHTO 2017).

We analyzed the following options to satisfy the factored bearing resistance available, external stability, and settlement.

1. Using regular fill material of unit weight of 125 pcf of the MSE wall reinforced and backfill zones for temporary excavation with slope of 1:2 (V:H);

2. Using IDOT District One Class II Lightweight Cellular Concrete Fill (LCCF) of unit weight of 30 pcf for MSE wall reinforced and backfill zones for temporary excavation with slope of 1:2 (V:H); and
3. Using regular fill material for upper 3 feet of MSE wall zone and backfill zone for temporary excavation with slope of 1:2 (V:H) and Class II LCCF for remaining portion of MSE wall zone and backfill zone for temporary excavation with slope of 1:2 (V:H).

For Option 1 with regular fill, at the highest portion of the wall near Station 6324+44.49, considering reinforcement width of 0.7 times the total height of the wall, the wall (0.7 H) will apply a maximum factored equivalent bearing pressure of 6,400 psf with a regular MSE wall fill material that exceeds the factored soil bearing resistance available.

For Option 2 with Class II LCCF, at the highest portion of the wall near Station 6324+44.49 considering reinforcement width of 0.7 H, the wall will apply a maximum equivalent factored bearing pressure of 1,800 psf, thus the foundation soils will have sufficient bearing resistance to support the wall.

In Option 3 with combined fill of regular fill for upper 3 feet and Class II LCCF for remaining portion, at the highest portion of the wall near Station 6324+44.29 considering reinforcement width of 0.7 H, the wall will apply a maximum equivalent factored bearing pressure of 2,200 psf, which exceeds the factored soil resistance available. Therefore, we have considered reinforcement width of 0.9 times the total height (0.9 H). With the reinforcement width of 0.9 H, the wall will apply a maximum equivalent factored bearing pressure of 2,000 psf, thus the foundation soils will have sufficient bearing resistance to support the wall.

We conclude that the Option 2 with reinforcement zone width of 0.7 H and Option 3 with combined fill and reinforcement zone width of 0.9 H are feasible. In addition, it should be noted that the excavation slope for the wall should be kept at a slope of 1:2 (V:H) to reduce lateral pressure on the MSE wall.

The estimated friction angle between an MSE wall base and underlying cohesive soil is 30º, and the corresponding friction coefficient is 0.58. The MSE retaining walls should be designed based on a geotechnical sliding resistance factor of 1.0 for soil-on-soil contact (AASHTO 2017).

5.2.2 Settlement Analyses

Due to the unloading of existing fill and reloading with Class II LCCF (Option 2) or combined fill materials (Option 3) for MSE wall reinforcement zone and backfill materials, the net service pressure created by MSE wall construction will be less than existing pressures. Therefore, we do not anticipate any settlement concerns.

5.2.3 Global Stability Analyses

Global stability analysis was performed near Station 6324+44.49 for both short-term (undrained) and long-term (drained) soil conditions. The computer program, SLIDE Version 6.0, was used to calculate the FOS. The minimum required FOS against global instability according to IDOT is 1.5 for both conditions. We estimate the MSE wall section has a short-term FOS of 1.9 (Appendix C-1) and a long-term FOS of 1.7 (Appendix C-2), therefore satisfying the minimum IDOT FOS requirements.

5.3 Drilled Shaft or Drilled Soldier Pile Walls

As an alternative to MSE wall, we recommend drilled shaft or drilled soldier pile walls. These walls should be designed for both lateral earth pressure and lateral deformation. The embedment depth in moment equilibrium for the wall section should be designed in accordance with the LRFD guidelines (AASHTO 2017). Generally, overconsolidated clayey soils, such as the stiff to very stiff clays and very dense silty loam will exhibit lower overall shear strength in the long-term condition; however, normally-consolidated clayey soils such as the very soft to medium stiff clay to silty clay (Chicago blue clay) will likely exhibit significantly lower shear strength in the short-term condition. Therefore, the lateral earth pressure analysis should be performed for walls in both the short-term (undrained) and long-term (drained) condition using the soil parameters shown in Tables 2 and 3.

The undrained shear strength properties of the soft to medium stiff silty clay were taken from the vane shear test results shown in Boring VST-06. The earth pressure coefficients were calculated based on horizontal slopes behind and in front of the wall as per cross-section drawings. In addition, the results of unconfined compressive test results and undrained shear strength (cohesion) results from triaxial UU tests for the Circle Interchange project were also considered in the development of soil parameters. Drained friction angles of the soft to medium stiff clay layer were estimated from the consolidated-undrained (CU) triaxial tests performed on this stratum within the Circle Interchange project.

The design of the wall should ignore 3 feet of soil in front of the wall measured from the finished ground surface elevation in providing passive pressure due to excavation required for installation of

concrete facing, drainage system and frost-heave condition. In developing the design lateral pressure, the lateral pressure due to construction equipment surcharge load should be added to the lateral earth pressure. Drainage behind the wall and underdrain should be as per 2012 IDOT *Bridge Manual* (IDOT 2012). The water pressure should be added to the earth pressure if drainage is not provided.

The potential pressure from any planned facilities must be considered in design. The design of drilled shafts should consider the existing abandoned tunnel near Station 6325+50 and electrical and AT & T ductbanks near Station 6325+00.

Table 2: Short-term (Undrained) Geotechnical Parameters for Design of Drilled Shaft Wall
(Ref. Borings: 22-RWB-01, 21-RWB-03, 1710-B-02, 1710-B-03, 1705-B-05, 1705-B-05A, and VST-06)

Soil Description (Layer)	Unit Weight, γ (pcf)	Undrained Shear Strength Properties		Earth Pressure Coefficients	
		Cohesion (psf)	Friction Angle (°)	Active Pressure	Passive Pressure
V Stiff to Hard SILTY CLAY to CLAY LOAM FILL Ground Surface to EL 592 feet	125	3000	0	1.00	--
M Stiff to Stiff SILTY CLAY FILL El 592 to 588 feet	120	1100	0	1.00	--
M Dense GRAVELLY LOAM FILL El 588 to 585 feet	120	0	30	0.33	3.00 / 1.61[(1)]
Stiff to V Stiff SILTY CLAY EL 585 to 578 feet	120	1800	0	1.00	1.00
Soft to M Stiff CLAY to SILTY CLAY EL 578 to 566 feet	115	550	0	1.00	1.00
Soft to M Stiff CLAY to SILTY CLAY EL 566 to 556 feet	115	640	0	1.00	1.00
M Stiff CLAY to SILTY CLAY EL 556 to 550 feet	115	750	0	1.00	1.00
M Stiff CLAY to SILTY CLAY EL 550 to 539 feet	115	950	0	1.00	1.00
Hard SILTY CLAY LOAM EL 539 to 519 feet	125	5500	0	1.00	1.00

Soil Description (Layer)	Unit Weight, γ (pcf)	Undrained Shear Strength Properties		Earth Pressure Coefficients	
		Cohesion (psf)	Friction Angle (°)	Active Pressure	Passive Pressure
M Dense SILT EL 519 to 514 feet	58(2)	0	30	0.33	3.00
V Dense SILTY LOAM EL 514 to 499 feet	63(2)	0	35	0.27	3.69
V Dense GRAVELLY SANDY LOAM to SILTY LOAM EL 499 to 492 feet	68(2)	0	36	0.26	3.85
V Dense WEATHERED BEDROCK EL 492 to 490 feet	73(2)	0	37	0.25	4.02

(1) 1:3(V:H) front slope; (2) Submerged unit weight.

Table 3: Long-term (Drained) Geotechnical Parameters for Design of Drilled Shaft Wall
(Ref. Borings: 22-RWB-01, 21-RWB-03, 1710-B-02, 1710-B-03, 1705-B-05, 1705-B-05A, and VST-06)

Soil Description (Layer)	Unit Weight, γ (pcf)	Drained Shear Strength Properties		Earth Pressure Coefficients	
		Cohesion (psf)	Friction Angle (°)	Active Pressure	Passive Pressure
V Stiff to Hard SILTY CLAY to CLAY LOAM FILL Ground Surface to EL 592 feet	125	100	30	0.33	--
M Stiff to Stiff SILTY CLAY FILL El 592 to 588 feet	120	100	30	0.33	--
M Dense GRAVELLY LOAM FILL El 588 to 585 feet	120	0	30	0.33	3.00 / 1.61(1)
Stiff to V Stiff SILTY CLAY EL 585 to 578 feet	120	100	30	0.33	3.00 / 1.61(1)
Soft to M Stiff CLAY to SILTY CLAY EL 578 to 566 feet	115	0	27	0.38	2.66
Soft to M Stiff CLAY to SILTY CLAY EL 566 to 556 feet	115	0	27	0.38	2.66

Soil Description (Layer)	Unit Weight, γ (pcf)	Drained Shear Strength Properties		Earth Pressure Coefficients	
		Cohesion (psf)	Friction Angle (°)	Active Pressure	Passive Pressure
M Stiff CLAY to SILTY CLAY EL 556 to 550 feet	115	0	27	0.38	2.66
M Stiff CLAY to SILTY CLAY EL 550 to 539 feet	115	80	29	0.33	3.00
Hard SILTY CLAY LOAM EL 539 to 519 feet	125	100	30	0.33	3.00
M Dense SILT EL 519 to 514 feet	58(2)	0	30	0.33	3.00
V Dense SILTY LOAM EL 514 to 499 feet	63(2)	0	35	0.27	3.69
V Dense GRAVELLY SANDY LOAM to SILTY LOAM EL 499 to 492 feet	68(2)	0	36	0.26	3.85
V Dense WEATHERED BEDROCK EL 492 to 490 feet	73(2)	0	37	0.25	4.02

(1) 1:3 (V:H) front slope; (2) Submerged unit weight.

Design considerations should include deflection control at the top of the wall. The lateral deformation of the wall should be designed using the parameters shown in Table 4 using the p-y curve (COMP624) method.

Table 4: Recommended Parameters for Lateral Load Analysis of Drilled Shaft Wall
(Ref. Borings: 22-RWB-01, 21-RWB-03, 1710-B-02, 1710-B-03, 1705-B-05, 1705-B-05A, and VST-06)

Soil Type (Layer)	Unit Weight, γ (pcf)	Undrained Shear Strength, c_u (psf)	Estimated Friction Angle, Φ (°)	Estimated Lateral Soil Modulus Parameter, k (pci)	Estimated Soil Strain Parameter, ε_{50} (%)
V Stiff to Hard SILTY CLAY to CLAY LOAM FILL Ground Surface to EL 592 feet	125	3000	0	1000	0.5
M Stiff to Stiff SILTY CLAY FILL El 592 to 588 feet	120	1100	0	500	0.7
M Dense GRAVELLY LOAM FILL El 588 to 585 feet	120	0	30	60	--
Stiff to V Stiff SILTY CLAY EL 585 to 578 feet	120	1800	0	500	0.7
Soft to M Stiff CLAY to SILTY CLAY EL 578 to 566 feet	115	550	0	60	1.0
Soft to M Stiff CLAY to SILTY CLAY EL 566 to 556 feet	115	640	0	70	1.0
M Stiff CLAY to SILTY CLAY EL 556 to 550 feet	115	750	0	80	1.0
M Stiff CLAY to SILTY CLAY EL 550 to 539 feet	115	950	0	100	0.7
Hard SILTY CLAY LOAM EL 539 to 519 feet	125	5500	0	2000	0.4
M Dense SILT EL 519 to 514 feet	58(1)	0	30	60	--
V Dense SILTY LOAM EL 514 to 499 feet	63(1)	0	35	120	--
V Dense GRAVELLY SANDY LOAM to SILTY LOAM EL 499 to 492 feet	68(1)	0	36	125	--
V Dense WEATHERED BEDROCK EL 492 to 490 feet	73(1)	0	37	125	--

(1) Submerged unit weight.

5.3.1 Settlement Analyses

Since the Wall 22A is a purely cut wall, we do not anticipate any settlement concerns. However, we anticipate surface settlement due to the drilled soldier pile deflection. Ground surface settlement is discussed in Section 5.4.

5.3.2 Global Stability

For global stability considerations, the drilled solider pile wall should not terminate above an elevation of 539 feet due to the presence of soft to medium stiff clay to silty clay.

5.4 Ground Movement Evaluations

The construction of Wall 22A's ground surface settlement was determined at Station 6325+25 considering IDOT wall deflection criteria. The IDOT's wall deflection criteria states that the project limitations are set for a maximum allowable wall deflection of up to 1.0% of the exposed wall height (which is about 2.04 inches), if the wall is not supporting sensitive structures or facilities. For walls supporting sensitive structures, the maximum allowable wall deflection should be limited to 0.5% of the exposed wall height (which is about 1.02 inches), or less as required, to prevent detrimental effects on adjacent structures or facilities.

Using empirical data compiled from various research papers, Wang estimates the ground movement adjacent to the building induced by the maximum lateral wall deflection of 1% inch is about 0.8 inch. Ground movement estimates including method used are included in Appendix F. The potential impact of the wall deflection inducing ground movements on other existing buried utilities must be considered on the final design to ensure specific deformation limits are not exceeded. We recommend that deflection of the wall should be limited to avoid damage to the nearby utilities.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Excavation

Any required excavations should be performed in accordance with local, state, and federal regulations including current OSHA regulations. The potential effect of ground movements upon nearby structures and utilities should be considered during construction. Any open excavation to a depth of 4 feet should have a slope of 1:2 (V:H) for cohesive soils and 1:2.5 (V:H) for granular soils or flatter.

Based on the TSL Plan, we understand the existing CTA Bus turnaround will be closed during Wall 22A construction. We performed global slope stability analysis for a temporary excavation slope of 1:2 (V:H) and a live load surcharge of 250 psf. Our analyses indicate the FOS of about 1.7. Slugging of the slope surface should be expected due to the presence of the granular fill. A temporary soil retention system (TSRS) should be considered.

6.2 Filling and Backfilling

All fill and backfill materials shall be as per IDOT *Standard Specification for Road and Bridge Construction* (IDOT 2016).

6.3 Drilled Shaft Encasement

Although groundwater was not encountered within the fill layer and the groundwater should be anticipated during drilling of the drilled shafts excavations. In addition, the installation of drilled shafts and drilled soldier piles extending into the medium dense to very dense silt to silty loam and sand (**Layer 5**) will encounter groundwater that will present challenges in maintaining an open borehole. Temporary or permanent casings should be used when the groundwater is encountered. Failure to anticipate the challenges posed by the groundwater at this location will result in caving or heaving sand and weakening of the foundation soils.

The soft soil layer with Qu less than 0.5 tsf (500 psf cohesion) is prone to squeeze if left open for long period of time. Therefore, to minimize the squeeze potential, casing should be provided. Due to high squeeze potential, the following note should appear on the final plans:

'Due to the squeeze potential of the clay soils, the use of temporary casing will be required to properly construct the shafts. Casing may be pulled or remain in place, as determined by the Contractor at no cost to the Department.'

6.4 Wall Construction

The wall should be constructed as per IDOT *Standard Specification for Road and Bridge Construction* (IDOT 2016).

6.5 Construction Monitoring

Given the proximity of structures, roads, and utilities, Wang recommends special precautions should be taken during the construction not to undermine the existing foundations, pavements and utilities.

7.0 QUALIFICATIONS

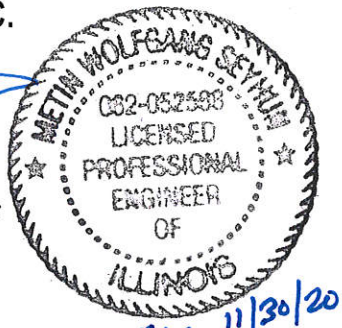
The analysis and recommendations submitted in this report are based upon the data obtained from the borings drilled at the locations shown on the boring logs and in Exhibit 3. This report does not reflect any variations that may occur between the borings or elsewhere on the site, variations whose nature and extent may not become evident until the course of construction. In the event that any changes in the design and/or location of Retaining Wall 22A (SN016-1813) are planned, we should be timely informed so that our recommendations can be adjusted accordingly.

It has been a pleasure to assist AECOM and the Illinois Department of Transportation on this project. Please call if there are any questions, or if we can be of further service.

Respectfully Submitted,

WANG ENGINEERING, INC.

Metin W. Seyhun, P.E.
Senior Geotechnical Engineer



Corina T. Farez, P.E., P.G.
Vice President

Nesam S. Balakumaran
Project Geotechnical Engineer

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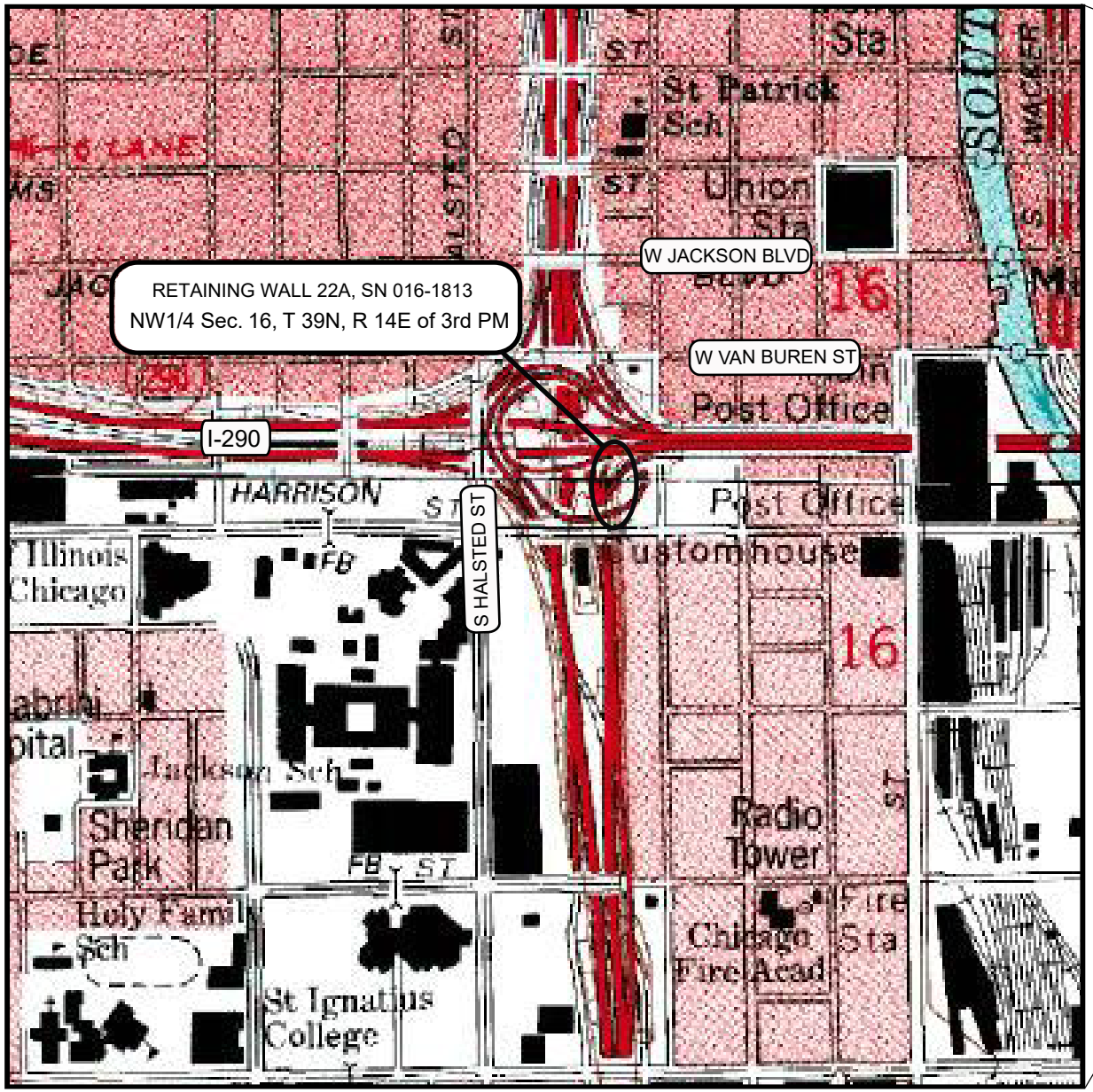
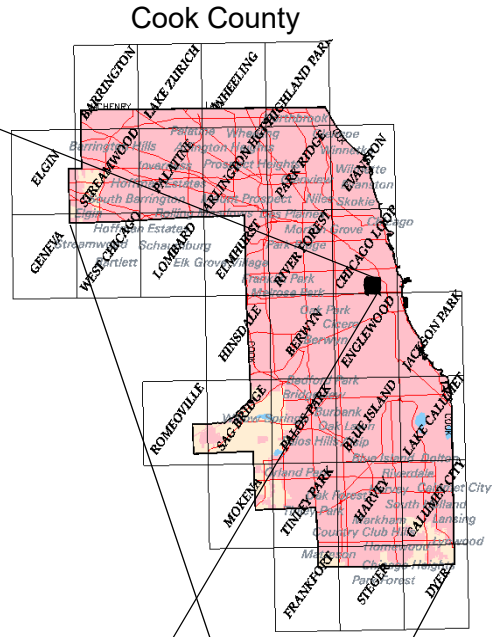
PECK, R.B., and REED, W.C., 1954, *Engineering Properties of Chicago Subsoils*: University of Illinois Engineering Experiment Station Bulletin No. 423: Urbana, University of Illinois, 62 p.

EXHIBITS





0 0.25 0.5 Mile

SITE LOCATION MAP: CIRCLE INTERCHANGE RECONSTRUCTION, RETAINING WALL 22A, SN 016-1813, COOK COUNTY, IL

SCALE: GRAPHICAL	EXHIBIT 1	DRAWN BY: NSB CHECKED BY: MWS

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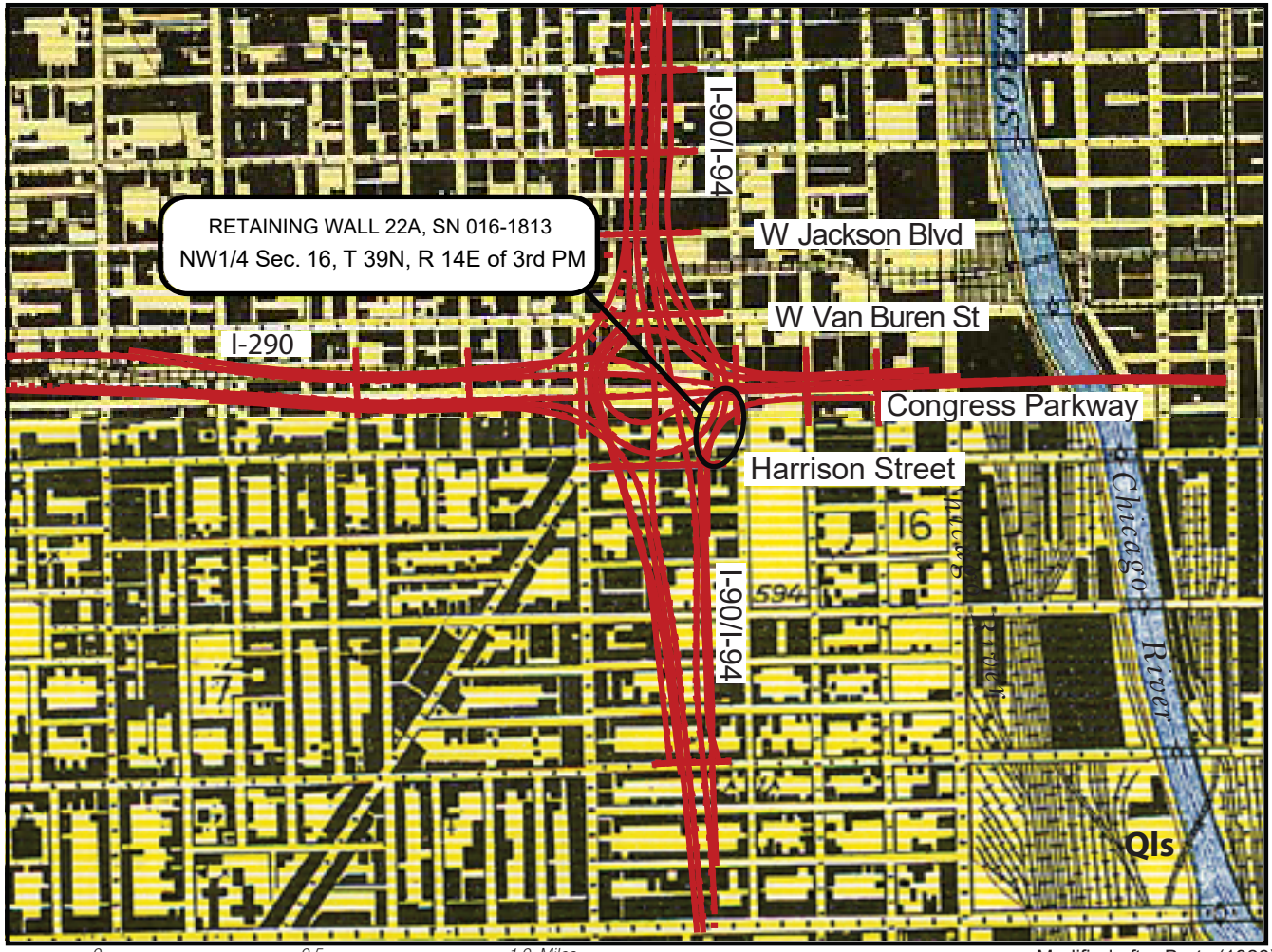
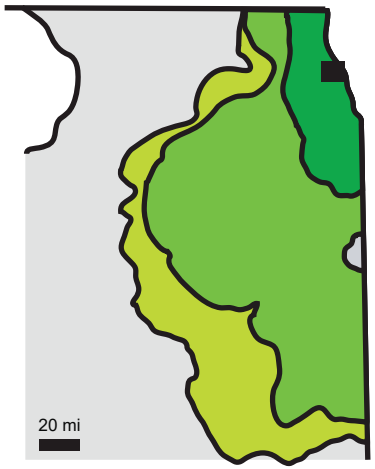


Modified after Bretz (1926)

REGIONAL GEOLOGY



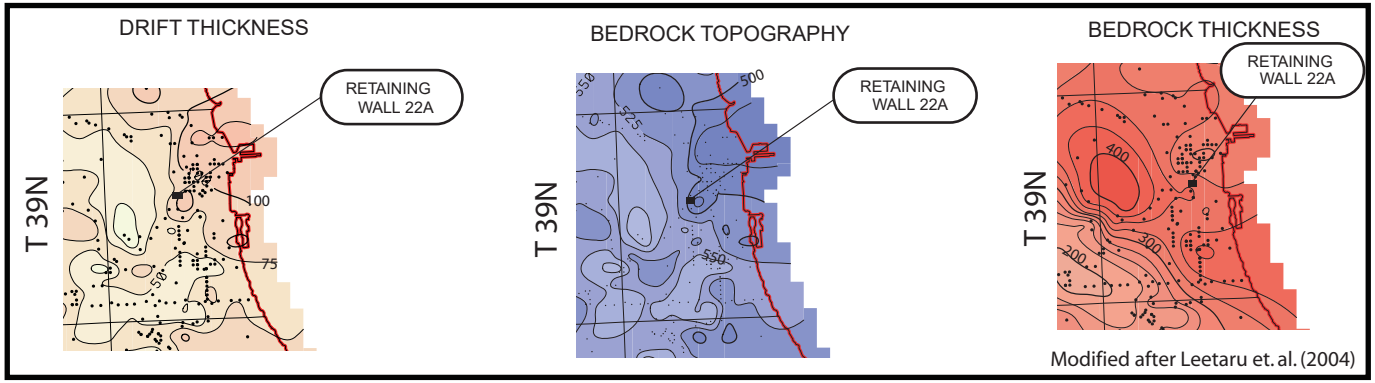
Wedron Group

- Wadsworth Formation
- Lemont Formation
- Tiskilwa Formation

Modified after Hansel and Johnson (1996)

Legend

Qls — Glacial lake bottom
(Covered by lacustrine deposits)



Modified after Leetaru et. al. (2004)

SITE AND REGIONAL GEOLOGY: CIRCLE INTERCHANGE RECONSTRUCTION, RETAINING WALL 22A, SN 016-1813, COOK COUNTY, IL		
SCALE: GRAPHICAL	EXHIBIT 2	DRAWN BY: NSB CHECKED BY: MWS
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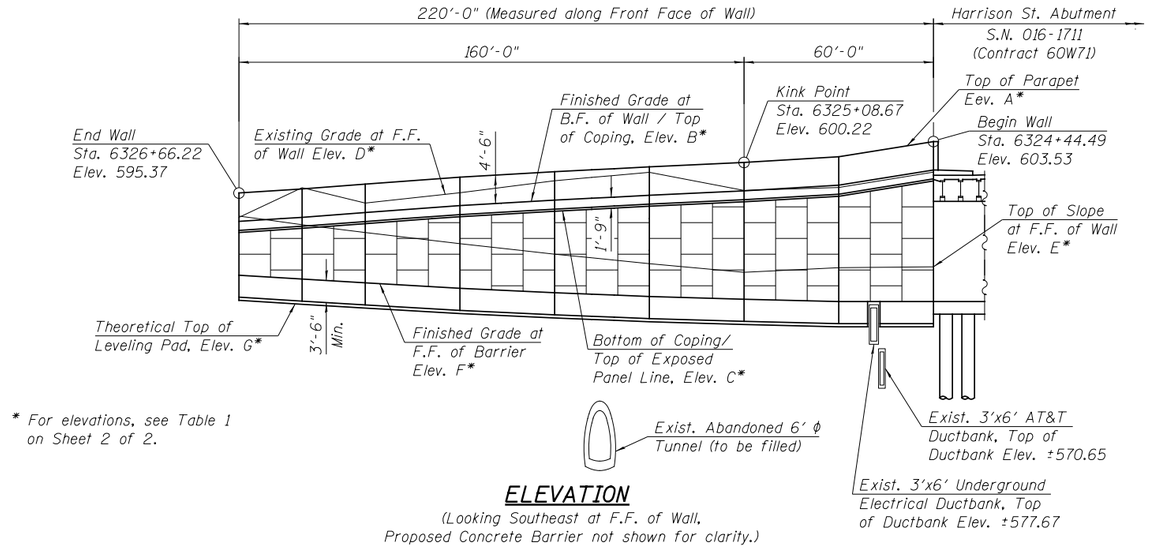
FOR AECOM		1100-04-01

Bench Mark: Chisel "X" on chain bolt of fire hydrant in front of 555 W. Harrison St. Elev. 594.46

Existing Structure: None.

Traffic on I-90/94, Desplaines Street, and Harrison Street will be maintained with stage construction.

No Salvage.



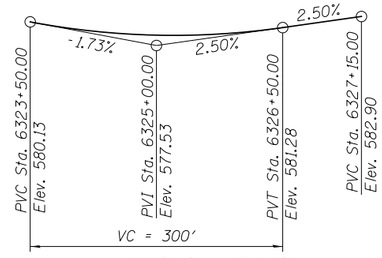
* For elevations, see Table 1 on Sheet 2 of 2.

ELEVATION

(Looking Southeast at F.F. of Wall. Proposed Concrete Barrier not shown for clarity.)

Notes:

1.) Wall offsets are measured from the ℄ of Proposed NB C-D Road to the front face of precast panels.
2.) F.F. denotes Front Face.
3.) B.F. denotes Back Face.
4.) Proposed drainage information shown is conceptual and will be determined during final design.



PROFILE GRADE

(℄ NB C-D Road)

CURVE DATA

(NB C-D Road)
Prop. Curve P-NCD-NX-3
P.I. Sta. = 6324+41.27
Δ = 20° 56' 44" (RT)
D = 17° 21' 44"
R = 330.00'
T = 61.00'
L = 120.64'
E = 5.59'
e = 5.80%
T.R. = NA
S.E. Run = 105'
P.C. Sta. = 6323+80.27
P.T. Sta. = 6325+00.91

(NB C-D Road)
Prop. Curve P-NCD-NX-4
P.I. Sta. = 6328+76.78
Δ = 59° 05' 41" (LT)
D = 14° 08' 50"
R = 405.00'
T = 229.58'
L = 417.72'
E = 60.54'
e = 5.40%
T.R. = 36'
S.E. Run = 98'
P.C. Sta. = 6326+47.20
P.T. Sta. = 6330+64.91

HIGHWAY CLASSIFICATION

NB C-D Road
Functional Class: Interstate
ADT: NA (2012); 17,000 (2040)
ADTT: NA (2012); 440 (2040)
DHV: 1,680 (2040)
Design Speed: 30 m.p.h.
Posted Speed: 30 m.p.h.
One-Way Traffic
Directional Distribution: 100%

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge Design Specifications 8th Edition

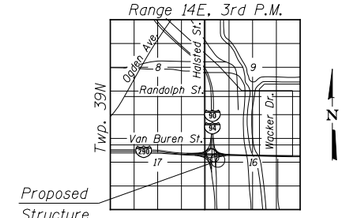
DESIGN STRESSES

FIELD UNITS

f'c = 3,500 psi
fy = 60,000 psi (Reinforcement)

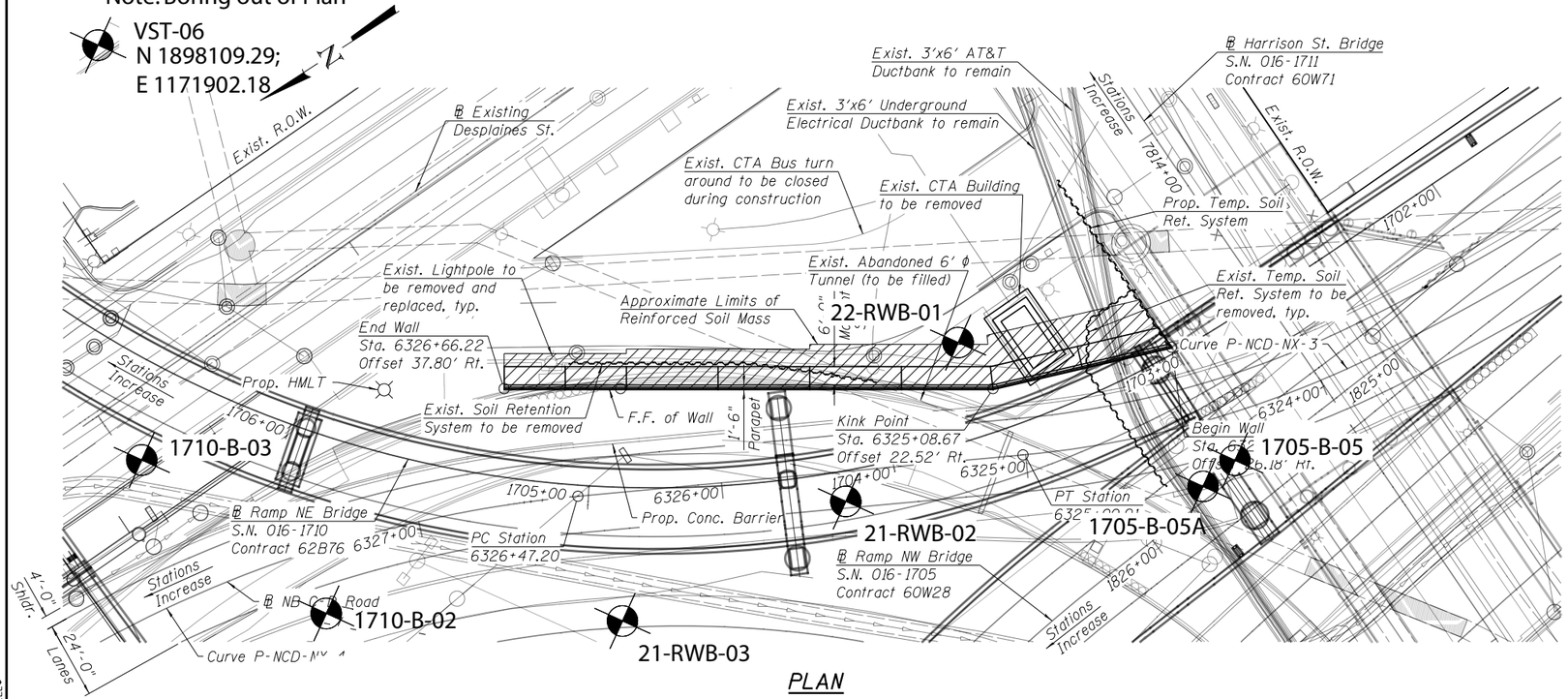
PRECAST UNITS

f'c = 4,500 psi



LOCATION SKETCH

Note: Boring out of Plan
VST-06
N 1898109.29;
E 1171902.18



PLAN

GENERAL PLAN
RETAINING WALL 22A ALONG NB C-D ROAD
F.A.I. RTE. 90/94 (KENNEDY EXPRESSWAY)
SECTION 2014-005R&B
COOK COUNTY
STATION 6324+44.49 TO STATION 6326+66.22
STRUCTURE NO. 016-1813

BORING LOCATION PLAN: CICRCLE INTERCHANGE RECONSTRUCTION, RETAINING WALL 22A, SN. 016-1813, COOK COUNTY, ILLINOIS

SCALE: GRAPHICAL | EXHIBIT 3 | DRAWN BY: NSB CHECKED BY: MWS

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TranSystems

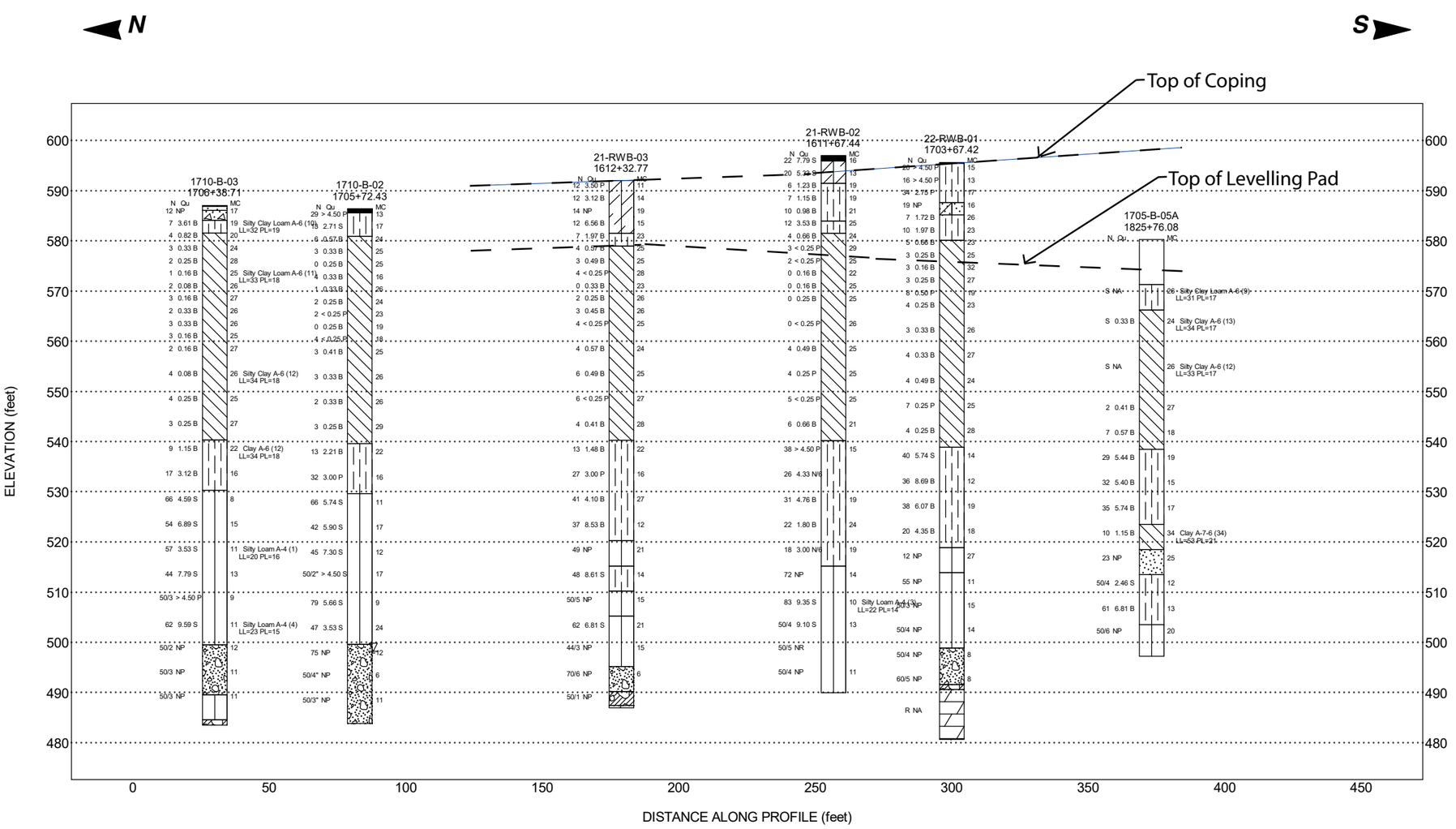
USER NAME = $USER$	DESIGNED - WJC	REVISED -
	CHECKED - JM/MDS	REVISED -
PLOT SCALE = $SCALE$	DRAWN - WJC	REVISED -
PLOT DATE = $DATE$	CHECKED - JM/MDS	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 1 OF 2 SHEETS

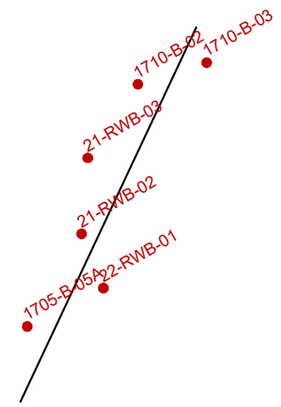
F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94	2014-005R&B	COOK	2	1
		CONTRACT NO. 60X79		
		ILLINOIS FED. AID PROJECT		

$TIME$ - $FILE$



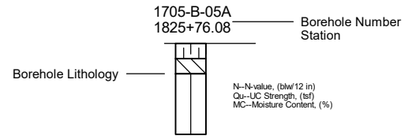
Lithology Graphics

- IDH Silty Clay, Silty Clay Loam
- IDH Clay
- IDH Sand, Sandy Loam
- IDH Silt, Silty Loam
- Topsoil
- Gravelly sand, sandy gravel
- Pavement
- Concrete
- Crushed stone
- Weathered bedrock
- IDH Clay Loam
- Dolomite or Dolomitic Limestone
- IDH Loam



Site Map Scale 1 inch equals 165 feet

Explanation:



- Water Level Reading at time of drilling.
- Water Level Reading 24-hr after drilling or at end of drilling

0 45

Horizontal Scale (feet)

Vertical Exaggeration: 2x

Wang Engineering, Inc.
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Lombard/IL/60148

Subsurface Data Profile
Retaining Wall 22A, SN 016-1813

WEI SINCE 1982

Circle Interchange Reconstruction
Section 17, T39N, R14E of 3rd PM

JOB NUMBER	PLATE NUMBER
1100-04-01	EXHIBIT 4

APPENDIX A

Wang Engineering
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Fax: (630) 953-9938

BORING LOG 1703-PZ-01

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 582.49 ft
North: 1898127.96 ft
East: 1171807.47 ft
Station: 1104+74.81
Offset: 3.30157 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--Drilled without sampling--	5					
			10					
			15					
			20					

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		Piezometer Data: *--Installed in Nov. 12, 2014* *--Bentonite Seal 70 to 72 feet* *--Top of Sand Pack at 72 feet* *--Top of Screen at 75.3 feet* *--Screen Length 20 feet* *--Bottom of Screen at 95.3 feet*	25					
			30					
		--piezometer stabilized water level reading -- --reading during well development (11/20/2014) = 32.00 feet bgs-- --reading date: 12/05/2014 = 31.10 feet bgs--	35					
			40					

GENERAL NOTES

Begin Drilling: **11-10-2014** Complete Drilling: **11-12-2014**
Drilling Contractor: **Wang Testing Services** Drill Rig: **B-57 TMR [100%]**
Driller: **P&P** Logger: **S. Woods** Checked by: **C. Marin**
Drilling Method: **4.25" HSA, monitoring water well**

WATER LEVEL DATA

While Drilling: **78.00 ft**
At Completion of Drilling: **NA**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

WANGENGINC 11000401.GPJ WANGENG.GDT 1/29/18

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Lombard, IL 60148
Telephone: (630) 953-9928
Fax: (630) 953-9938

BORING LOG 1703-PZ-01

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 582.49 ft
North: 1898127.96 ft
East: 1171807.47 ft
Station: 1104+74.81
Offset: 3.30157 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
			45					
			50					
			55					
			60					

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		Piezometer Data: *--Installed in Nov. 12, 2014* *--Bentonite Seal 70 to 72 feet* *--Top of Sand Pack at 72 feet* *--Top of Screen at 75.3 feet* *--Screen Length 20 feet* *--Bottom of Screen at 95.3 feet*	65					
			70					
			75					
			80					

GENERAL NOTES

Begin Drilling: **11-10-2014** Complete Drilling: **11-12-2014**
Drilling Contractor: **Wang Testing Services** Drill Rig: **B-57 TMR [100%]**
Driller: **P&P** Logger: **S. Woods** Checked by: **C. Marin**
Drilling Method: **4.25" HSA, monitoring water well**

WATER LEVEL DATA

While Drilling: **78.00 ft**
At Completion of Drilling: **NA**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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1145 N Main Street
Lombard, IL 60148
Telephone: (630) 953-9928
Fax: (630) 953-9938

BORING LOG 1703-PZ-01

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 582.49 ft
North: 1898127.96 ft
East: 1171807.47 ft
Station: 1104+74.81
Offset: 3.30157 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
			85					
		Very dense, gray SILTY LOAM, trace gravel --Dry--	90		1	40 42 18/3	NP	13
			95		2	10 23 50/3	NP	20
		--Dolostone fragments--			3	15 30/2	NP	14
	482.5	Boring terminated at 100.00 ft	100					

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)

GENERAL NOTES

Begin Drilling: **11-10-2014** Complete Drilling: **11-12-2014**
Drilling Contractor: **Wang Testing Services** Drill Rig: **B-57 TMR [100%]**
Driller: **P&P** Logger: **S. Woods** Checked by: **C. Marin**
Drilling Method: **4.25" HSA, monitoring water well**

WATER LEVEL DATA

While Drilling: **78.00 ft**
At Completion of Drilling: **NA**
Time After Drilling: **NA**
Depth to Water: **NA**

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BORING LOG 1705-B-05

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 579.65 ft
North: 1897590.86 ft
East: 1171794.26 ft
Station: 1220+07.86
Offset: 44.3373 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		12-inch thick ASPHALT --PAVEMENT--						
	578.6	Loose, gray SANDY GRAVEL --FILL--			1	5 3 4	NP	4
	576.6	Very soft to soft, gray CLAY to SILTY CLAY LOAM, trace gravel			2	0 0 0	< 0.25 P	18
			5		3	0 0 1	0.41 B	20
			10		4	0 0 0	0.25 B	21
					5	0 0 0	0.25 B	24
			15		6	0 3 2	0.33 B	23
		--L_L(%)=35, P_L(%)=15-- --%Gravel=5.8-- --%Sand=17.8-- --%Silt=48.3-- --%Clay=28.1-- --A-6 (14)--			7	0 0 1	0.41 B	24
	561.6	Very loose, gray LOAM			8	0 0 0	NP	28
			20					
	559.1	Very soft to soft, gray CLAY to SILTY CLAY, trace gravel			9	0 0 0	0.25 B	25
			25		10	1 1 2	0.41 B	25
					11	0 2 2	< 0.25 P	27
			30		12	0 0 1	0.41 B	25
	547.1	--Obstruction at 32.5 ft-- Boring terminated at 32.50 ft						
			35					
			40					

GENERAL NOTES

Begin Drilling: **07-22-2013** Complete Drilling: **07-22-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR [78%]**
Driller: **R&N** Logger: **A. Happel** Checked by: **C. Marin**
Drilling Method: **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **mud in the borehole**
Time After Drilling: **NA**
Depth to Water: **NA**

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BORING LOG 1705-B-05A

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 580.24 ft
North: 1897604.27 ft
East: 1171792.75 ft
Station: 1825+76.08
Offset: 3.9157 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--Blind drilled--						
	571.2	SILTY CLAY LOAM --L_L(%)=31, P_L(%)=17-- --%Gravel=4.4-- --%Sand=18.7-- --%Silt=48.3-- --%Clay=28.6-- --A-6 (9)--	10		1	PUSH		26
	566.2	Soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel --L_L(%)=34, P_L(%)=17-- --%Gravel=4.2-- --%Sand=13.9-- --%Silt=49.8-- --%Clay=32.1-- --A-6 (13)-- --L_L(%)=32, P_L(%)=17-- --%Gravel=2.9-- --%Sand=14.3-- --%Silt=50.9-- --%Clay=31.9-- --A-6 (11)--	15 20		2	PUSH	0.33 B	24
		--L_L(%)=33, P_L(%)=17-- --%Gravel=2.9-- --%Sand=13.8-- --%Silt=49.3-- --%Clay=33.9-- --A-6 (12)--	25		3	PUSH		26
			30					
			35		13	0 0 2	0.41 B	27
			40		14	0 2 5	0.57 B	18

GENERAL NOTES

Begin Drilling: **07-23-2013** Complete Drilling: **07-24-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR [78%]**
Driller: **R&N** Logger: **A. Happel** Checked by: **C. Marin**
Drilling Method: **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **mud in the borehole**
Time After Drilling: **NA**
Depth to Water: **NA**

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BORING LOG 1705-B-05A

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 580.24 ft
North: 1897604.27 ft
East: 1171792.75 ft
Station: 1825+76.08
Offset: 3.9157 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	538.5							
		Hard, gray SILTY CLAY, trace gravel						
			45		15	7 12 17	5.44 B	19
			50		16	8 12 20	5.40 B	15
			55		17	7 15 20	5.74 B	17
	523.5							
		Stiff, gray CLAY						
		--L_L(%)=53, P_L(%)=21-- --%Gravel=0.5-- --%Sand=2.9-- --%Silt=34.0-- --%Clay=62.6-- --A-7-6 (34)--	60		18	5 5 5	1.15 B	34

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	518.5							
		Medium dense, gray SANDY LOAM						
		--possible groundwater bearing--	65		19	8 10 13	NP	25
	513.5							
		Very stiff to hard, gray SILTY CLAY LOAM, trace gravel						
			70		20	10 48 50/4	2.46 S	12
			75		21	21 30 31	6.81 B	13
	503.5							
		Very dense, gray SILTY LOAM, trace gravel						
		--possible groundwater bearing--	80		22	50/6	NP	20

GENERAL NOTES

Begin Drilling: **07-23-2013** Complete Drilling: **07-24-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR [78%]**
Driller: **R&N** Logger: **A. Happel** Checked by: **C. Marin**
Drilling Method: **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **mud in the borehole**
Time After Drilling: **NA**
Depth to Water: **NA**

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BORING LOG 1705-B-05A

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 580.24 ft
North: 1897604.27 ft
East: 1171792.75 ft
Station: 1825+76.08
Offset: 3.9157 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	497.2	--AUGER REFUSAL--						
		Boring terminated at 83.00 ft						
			85					
			90					
			95					
			100					

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)

GENERAL NOTES

Begin Drilling: **07-23-2013** Complete Drilling: **07-24-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR [78%]**
Driller: **R&N** Logger: **A. Happel** Checked by: **C. Marin**
Drilling Method: **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **mud in the borehole**
Time After Drilling: **NA**
Depth to Water: **NA**

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BORING LOG 1710-B-02

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 586.37 ft
North: 1897868.08 ft
East: 1171913.23 ft
Station: 1705+72.43
Offset: 55.5596 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	585.5	10-inch thick, brown SILTY LOAM --TOPSOIL--						
		Hard, brown, SILTY CLAY LOAM, little gravel, wood and brick fragments --FILL--			1	22 18 11	> 4.50 P	13
			5		2	5 6 7	2.71 S	17
	580.9	Very soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel			3	2 3 3	0.57 B	24
			10		4	0 1 2	0.33 B	25
					5	0 0 0	0.25 B	25
			15		6	0 2 2	0.33 B	16
					7	0 0 1	0.33 B	26
			20		8	1 1 1	0.25 B	24
					9	0 1 1	< 0.25 P	23
			25		10	0 0 0	0.25 B	19
					11	0 2 2	< 0.25 P	18
			30		12	0 1 2	0.41 B	25
			35		13	1 1 2	0.33 B	26
			40		14	0 1 1	0.33 B	26

GENERAL NOTES

Begin Drilling: **10-01-2013** Complete Drilling: **10-01-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR [78%]**
Driller: **R&R** Logger: **B. Wilson** Checked by: **L. Iordache**
Drilling Method: **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **88.50 ft**
At Completion of Drilling: **mud in the borehole**
Time After Drilling: **NA**
Depth to Water: **NA**

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BORING LOG 1710-B-02

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 586.37 ft
North: 1897868.08 ft
East: 1171913.23 ft
Station: 1705+72.43
Offset: 55.5596 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
			45		15	0 1 2	0.25 B	29
	539.6							
		Very stiff, gray SILTY CLAY LOAM, trace gravel	50		16	3 5 8	2.21 B	22
			55		17	8 10 22	3.00 P	16
	529.6							
		Very stiff to hard, gray SILTY LOAM to SILTY CLAY LOAM, trace gravel	60		18	23 33 33	5.74 S	11
			65		19	11 18 24	5.90 S	17
			70		20	11 19 26	7.30 S	12
			75		21	50/2"	> 4.50 S	17
			80		22	30 36 43	5.66 S	9

GENERAL NOTES

Begin Drilling: **10-01-2013** Complete Drilling: **10-01-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR [78%]**
Driller: **R&R** Logger: **B. Wilson** Checked by: **L. Iordache**
Drilling Method: **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **88.50 ft**
At Completion of Drilling: **mud in the borehole**
Time After Drilling: **NA**
Depth to Water: **NA**

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BORING LOG 1710-B-02

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 586.37 ft
North: 1897868.08 ft
East: 1171913.23 ft
Station: 1705+72.43
Offset: 55.5596 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--Cobble at 83.5'-84'--	85		23	13 21 26	3.53 S	24
	499.6	Very dense, gray GRAVELLY SAND						
		--possible underpressure groundwater bearing--	90		24	22 32 43	NP	12
		--HARD DRILLING-- *--Possible Cobbles--*						
			95		25	50/4"	NP	6
		--HARD DRILLING-- *--Possible Cobbles--*						
			100		26	50/3"	NP	11
		--HARD DRILLING-- *--Possible Cobbles--*	105					
	483.9	--ROLLER BIT REFUSAL-- Boring terminated at 102.50 ft						
			110					
			115					
			120					

GENERAL NOTES

Begin Drilling: **10-01-2013** Complete Drilling: **10-01-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **D-50 TMR [78%]**
Driller: **R&R** Logger: **B. Wilson** Checked by: **L. Iordache**
Drilling Method: **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **88.50 ft**
At Completion of Drilling: **mud in the borehole**
Time After Drilling: **NA**
Depth to Water: **NA**

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BORING LOG 1710-B-03

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 587.04 ft
North: 1897891.66 ft
East: 1171988.13 ft
Station: 1706+38.71
Offset: 29.9313 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	586.8	2.5-inch thick ASPHALT over 9.5-inch thick CONCRETE						
	586.0	--PAVEMENT--						
		Medium dense, white CRUSHED STONE aggregate			1	6 5 7	NP	17
		--FILL--						
	584.0							
		Very stiff, gray SILTY CLAY LOAM, trace gravel						
		--L_L(%)=32, P_L(%)=19--						
		--%Gravel=2.0--						
		--%Sand=16.6--	5		2	3 3 4	3.61 B	19
	581.5	--%Silt=52.1--						
		--%Clay=29.3--						
		--A-6(10)--						
		Very soft to medium stiff, gray CLAY to SILTY CLAY LOAM, trace gravel			3	2 2 2	0.82 B	20
			10		4	2 2 1	0.33 B	24
					5	0 1 1	0.25 B	28
		--L_L(%)=33, P_L(%)=18--						
		--%Gravel=3.1--						
		--%Sand=17.5--						
		--%Silt=50.4--	15		6	0 0 1	0.16 B	25
		--%Clay=29.0--						
		--A-6(11)--						
					7	0 0 2	0.08 B	26
			20		8	0 1 2	0.16 B	27
			25		9	0 0 2	0.33 B	26
					10	0 2 1	0.33 B	26
					11	0 2 1	0.16 B	25
			30		12	0 1 1	0.16 B	27
		--L_L(%)=34, P_L(%)=18--						
		--%Gravel=5.2--						
		--%Sand=14.6--						
		--%Silt=48.4--	35		13	0 2 2	0.08 B	26
		--%Clay=31.9--						
		--A-6(12)--						
			40		14	2 1 3	0.25 B	25

GENERAL NOTES

Begin Drilling: **10-14-2013** Complete Drilling: **10-14-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR [85%]**
Driller: **R&J** Logger: **A. Tomaras** Checked by: **L. Iordache**
Drilling Method: **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **mud in the borehole**
Time After Drilling: **NA**
Depth to Water: **NA**

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BORING LOG 1710-B-03

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 587.04 ft
North: 1897891.66 ft
East: 1171988.13 ft
Station: 1706+38.71
Offset: 29.9313 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
			45		15	2 1 2	0.25 B	27
	540.3	Stiff to very stiff, gray CLAY to SILTY CLAY, trace gravel						
		--L_L(%)=34, P_L(%)=18-- --%Gravel=4.0-- --%Sand=12.6-- --%Silt=47.9-- --%Clay=35.5-- --A-6(12)--	50		16	4 3 6	1.15 B	22
			55		17	5 7 10	3.12 B	16
	530.3	Hard, gray SILTY LOAM, trace gravel						
			60		18	22 32 34	4.59 S	8
			65		19	18 26 28	6.89 S	15
		--L_L(%)=20 P_L(%)=16-- --%Gravel=1.6-- --%Sand=15.1-- --%Silt=71.3-- --%Clay=11.9-- --A-4(1)--	70		20	19 25 32	3.53 S	11
			75		21	15 18 26	7.79 S	13
		--HARD DRILLING-- *--Possible Cobbles--*						
			80		22	50 50/3	> 4.50 P	9

GENERAL NOTES

Begin Drilling: **10-14-2013** Complete Drilling: **10-14-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR [85%]**
Driller: **R&J** Logger: **A. Tomaras** Checked by: **L. Iordache**
Drilling Method: **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **mud in the borehole**
Time After Drilling: **NA**
Depth to Water: **NA**

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BORING LOG 1710-B-03

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 587.04 ft
North: 1897891.66 ft
East: 1171988.13 ft
Station: 1706+38.71
Offset: 29.9313 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--L_L(%)=23, P_L(%)=15--						
		--%Gravel=5.2--						
		--%Sand=16.7--						
		--%Silt=62.3--	85		23	25 30 32	9.59 S	11
		--%Clay=15.7--						
		--A-4(4)--						
		--HARD DRILLING--						
	499.5							
		Very dense, gray GRAVELLY SAND, trace cobbles						
		--possible underpressure groundwater bearing--			24	50 50/2	NP	12
			90					
					25	50/3	NP	11
			95					
		--HARD DRILLING--						
		--Possible Cobbles--						
	489.5							
		Very dense, gray SILTY LOAM, little gravel						
					26	50/3	NP	11
			100					

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--HARD DRILLING--						
		--Possible Cobbles--						
	484.5							
		--WEATHERED BEDROCK--						
		--ROLLER BIT REFUSAL--						
	483.5							
		Boring terminated at 103.50 ft						
			105					
			110					
			115					
			120					

GENERAL NOTES

Begin Drilling: **10-14-2013** Complete Drilling: **10-14-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR [85%]**
Driller: **R&J** Logger: **A. Tomaras** Checked by: **L. Iordache**
Drilling Method: **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **mud in the borehole**
Time After Drilling: **NA**
Depth to Water: **NA**

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BORING LOG 21-RWB-02

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 596.95 ft
North: 1897705.23 ft
East: 1171851.95 ft
Station: 1611+67.44
Offset: 53.9743 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	596.0	12-inch thick, brown LOAM, trace gravel						
		--TOPSOIL--						
		Hard, gray CLAY LOAM, trace gravel			1	13 11 11	7.79 S	16
		--FILL--			2	5 9 11	5.33 S	13
			5					
	591.5	Stiff to medium stiff, gray and brown, SILTY CLAY, trace gravel, slag, brick and wood			3	2 2 4	1.23 B	19
		--FILL--			4	2 3 4	1.15 B	19
			10					
					5	3 5 5	0.98 B	21
	584.0	Very stiff, brown and gray SILTY CLAY, trace gravel			6	3 5 7	3.53 B	25
			15					
	581.5	Very soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel			7	0 2 2	0.66 B	24
					8	1 1 2	< 0.25 P	29
			20					
			25		9	1 1 1	< 0.25 P	25
					10	0 0 0	0.16 B	22
					11	0 0 0	0.16 B	25
			30		12	0 0 0	0.25 B	25
			35		13	0 0 0	< 0.25 P	26
			40		14	0 1 3	0.49 B	25

GENERAL NOTES

Begin Drilling: **09-25-2013** Complete Drilling: **09-30-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR [85%]**
Driller: **R&J** Logger: **A. Tomaras** Checked by: **L. Iordache**
Drilling Method: **2.25" HSA, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **mud in the borehole**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG 21-RWB-02

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 596.95 ft
North: 1897705.23 ft
East: 1171851.95 ft
Station: 1611+67.44
Offset: 53.9743 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	540.2	Stiff to hard, gray SILTY CLAY LOAM, trace gravel	45		15	2 2 2	0.25 P	25
			50		16	1 2 3	< 0.25 P	25
			55		17	1 3 3	0.66 B	21
			60		18	15 17 21	> 4.50 P	15
			65		19	11 10 16	4.33 N/6	
			70		20	10 12 19	4.76 B	19
			75		21	6 10 12	1.80 B	24
			80		22	6 8 10	3.00 N/6	19

GENERAL NOTES

Begin Drilling: **09-25-2013** Complete Drilling: **09-30-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR [85%]**
Driller: **R&J** Logger: **A. Tomaras** Checked by: **L. Iordache**
Drilling Method: **2.25" HSA, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **mud in the borehole**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG 21-RWB-02

WEI Job No.: 1100-04-01

Client **AECOM**
Project **Circle Interchange Reconstruction**
Location **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 596.95 ft
North: 1897705.23 ft
East: 1171851.95 ft
Station: 1611+67.44
Offset: 53.9743 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	515.2	Very dense, gray SILTY LOAM, little to some gravel and cobbles						
			85		23	13 31 41	NP	14
			90		24	18 35 48	9.35 S	10
			95		25	20 36 50/4	9.10 S	13
		--HARD DRILLING-- *--Possible Cobbles--*						
			100		26	50/5	NR	
		--HARD DRILLING-- *--Possible Cobbles--*	105		27	50/4	NP	11
	490.0	--ROLLER BIT REFUSAL-- Boring terminated at 107.00 ft	110					
			115					
			120					

GENERAL NOTES

Begin Drilling **09-25-2013** Complete Drilling **09-30-2013**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR [85%]**
Driller **R&J** Logger **A. Tomaras** Checked by **L. Iordache**
Drilling Method **2.25" HSA, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **mud in the borehole**
Time After Drilling **NA**
Depth to Water ▼ **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG 21-RWB-03

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 591.97 ft
North: 1897787.89 ft
East: 1171858.64 ft
Station: 1612+32.77
Offset: 11.8407 RT

Depth (ft)	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
0		Very stiff to hard, brown CLAY LOAM, trace brick fragments --FILL--		1	3 4 8	3.50 P	11
5				2	5 5 7	3.12 B	14
		--3-inch thick, red, crushed Brick--		3	13 8 6	NP	19
10				4	5 5 7	6.56 B	15
	581.5	Stiff, gray SILTY CLAY, trace gravel		5	2 3 4	1.97 B	23
	579.0	Very soft to medium stiff, gray CLAY, trace gravel		6	2 1 3	0.57 B	25
15				7	2 1 2	0.49 B	25
20				8	2 2 2	< 0.25 P	28
25				9	0 0 0	0.33 B	23
				10	0 0 2	0.25 B	26
				11	0 1 2	0.45 B	26
30				12	2 2 2	< 0.25 P	25
35				13	1 2 2	0.57 B	24
40				14	2 3 3	0.49 B	25

GENERAL NOTES

Begin Drilling: **09-23-2013** Complete Drilling: **09-23-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR [85%]**
Driller: **R&J** Logger: **A. Tomaras** Checked by: **L. Iordache**
Drilling Method: **3.25" HSA, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **mud in the borehole**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG 21-RWB-03

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 591.97 ft
North: 1897787.89 ft
East: 1171858.64 ft
Station: 1612+32.77
Offset: 11.8407 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
			45		15	2 3 3	< 0.25 P	27
			50		16	0 2 2	0.41 B	28
	540.2	Very stiff to hard, SILTY CLAY to SILTY CLAY LOAM, trace gravel	55		17	4 5 8	1.48 B	22
			60		18	14 12 15	3.00 P	16
	520.2	Dense, gray SILT	65		19	15 17 24	4.10 B	27
			70		20	16 17 20	8.53 B	12
			75		21	20 26 23	NP	21
	515.2	Hard, gray SILTY CLAY LOAM, trace gravel	80		22	19 20 28	8.61 S	14

GENERAL NOTES

Begin Drilling: **09-23-2013** Complete Drilling: **09-23-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR [85%]**
Driller: **R&J** Logger: **A. Tomaras** Checked by: **L. Iordache**
Drilling Method: **3.25" HSA, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **mud in the borehole**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG 21-RWB-03

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 591.97 ft
North: 1897787.89 ft
East: 1171858.64 ft
Station: 1612+32.77
Offset: 11.8407 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	510.2	Very dense, gray SILT --HARD DRILLING--						
					23	31 32 50/5	NP	15
			85					
	505.2	Very dense, gray SILTY LOAM, trace gravel						
					24	23 33 29	6.81 S	21
			90					
					25	66/6 44/3	NP	15
			95					
	495.2	--HARD DRILLING-- Very dense, brown SANDY GRAVEL --possibly underpressure groundwater bearing--						
					26	30 70/6	NP	6
			100					

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	490.2	Very dense, weathered DOLOSTONE fragments --WEATHERED BEDROCK--						
					27	50/1	NP	
	487.5	--ROLLER BIT REFUSAL--						
	487.0	--BEDROCK--	105					
		Boring terminated at 104.50 ft						
			110					
			115					
			120					

GENERAL NOTES

Begin Drilling: **09-23-2013** Complete Drilling: **09-23-2013**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR [85%]**
Driller: **R&J** Logger: **A. Tomaras** Checked by: **L. Iordache**
Drilling Method: **3.25" HSA, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **mud in the borehole**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG 22-RWB-01

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 595.62 ft
North: 1897646.18 ft
East: 1171875.74 ft
Station: 1703+67.42
Offset: 31.6147 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	595.4	2-inch thick CRUSHED STONE						
		Very stiff to hard, brown and gray SILTY CLAY LOAM, trace gravel and brick fragments --FILL--			1	7 10 10	> 4.50 P	15
			5		2	4 7 9	> 4.50 P	13
					3	3 22 12	2.75 P	17
	587.6							
		Medium dense, dark brown GRAVELLY LOAM; wet --FILL--	10		4	19 9 10	NP	16
	585.1							
		Stiff, gray SILTY CLAY, trace gravel			5	3 3 4	1.72 B	26
			15		6	2 4 6	1.97 B	23
	580.1							
		Very soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel			7	1 2 3	0.66 B	23
			20		8	1 1 2	0.25 B	25
			25		9	0 1 2	0.16 B	32
					10	0 1 2	0.25 B	27
					11	1 4 4	0.50 P	19
			30		12	2 2 2	0.25 B	23
			35		13	0 1 2	0.33 B	26
			40		14	1 2 2	0.33 B	27

GENERAL NOTES

Begin Drilling: **03-13-2014** Complete Drilling: **03-16-2014**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR [85%]**
Driller: **R&N** Logger: **F. Bozga** Checked by: **C. Marin**
Drilling Method: **2.25" SSA to 15', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **mud in the borehole**
Time After Drilling: **NA**
Depth to Water: **NA**

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BORING LOG 22-RWB-01

WEI Job No.: 1100-04-01

Client **AECOM**
Project **Circle Interchange Reconstruction**
Location **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 595.62 ft
North: 1897646.18 ft
East: 1171875.74 ft
Station: 1703+67.42
Offset: 31.6147 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
			45		15	0 2 2	0.49 B	24
			50		16	1 3 4	0.25 P	25
			55		17	1 2 2	0.25 B	28
	538.9	Hard, gray SILTY CLAY LOAM, trace gravel	60		18	7 17 23	5.74 S	14
			65		19	10 16 20	8.69 B	12
			70		20	7 14 24	6.07 B	19
			75		21	6 8 12	4.35 B	18
	518.9	Medium dense, gray SILT; wet --possible groundwater bearing--	80		22	3 5 7	NP	27

GENERAL NOTES

Begin Drilling **03-13-2014** Complete Drilling **03-16-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR [85%]**
Driller **R&N** Logger **F. Bozga** Checked by **C. Marin**
Drilling Method **2.25" SSA to 15', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **mud in the borehole**
Time After Drilling **NA**
Depth to Water ▼ **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG 22-RWB-01

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 595.62 ft
North: 1897646.18 ft
East: 1171875.74 ft
Station: 1703+67.42
Offset: 31.6147 RT

Depth (ft)	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	513.9	Very dense, gray SILTY LOAM, trace gravel					
				23	13 25 30	NP	11
85							
				24	30 45 50/3	NP	15
90							
				25	23 50/4	NP	14
95							
	498.9	--HARD DRILLING-- *--Possible Cobbles--* Very dense, gray GRAVELLY SANDY LOAM to SILTY LOAM --possible groundwater bearing--					
				26	50 50/4	NP	8
100							

Depth (ft)	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--HARD DRILLING-- *--Possible Cobbles--*					
	491.6	--WEATHERED BEDROCK--		27	60/5	NP	8
105	490.6	Strong, light gray, fair rock mass quality, bedded fresh DOLOSTONE, up to 18-inch beds, 10-inch joints spacing, horizontal joints with none to more than 0.2-inch greenish gray argillaceous infilling, hard joint wall, with stylolitic surfaces, and moderately vuggy porosity --Run 1 - RECOVERY=96%-- --RQD=75%--			C O R E		
110				1			
115	480.6	Boring terminated at 115.00 ft					
120							

GENERAL NOTES

Begin Drilling: **03-13-2014** Complete Drilling: **03-16-2014**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR [85%]**
Driller: **R&N** Logger: **F. Bozga** Checked by: **C. Marin**
Drilling Method: **2.25" SSA to 15', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **mud in the borehole**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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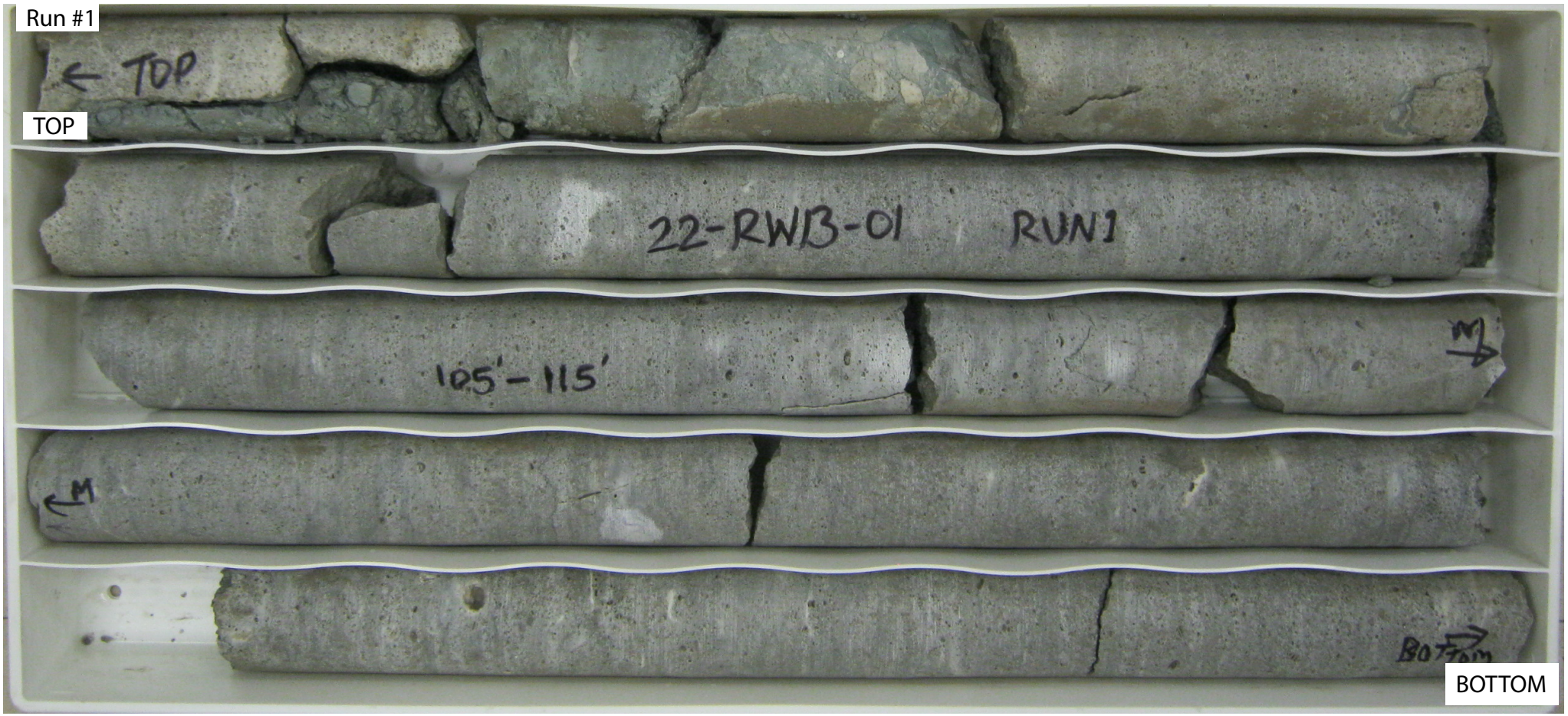

0 3 6 9 12 inch

Boring 22-RWB-01:
Run #1, 105' to 115', RECOVERY = 96% , RQD = 75%

BEDROCK CORE: CIRCLE INTERCHANGE RECONSTRUCTION, RETAINING WALL 22, SN 016-1813, CHICAGO, IL

SCALE : GRAPHIC	22-RWB-01	DRAWN BY: H. Bista CHECKED BY: M. Seyhun

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FOR AECOM	1100-04-01

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BORING LOG VST-06

WEI Job No.: 1100-04-01

Client: **AECOM**
Project: **Circle Interchange Reconstruction**
Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 585.69 ft
North: 1898109.29 ft
East: 1171902.18 ft
Station: 1103+77.81
Offset: 27.3835 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		Hard, brown SILTY CLAY LOAM, trace gravel --FILL--						
			5		1	7 6 6	> 4.50 P	16
	580.2							
		Soft, gray SILTY CLAY LOAM			2	1 2 3	0.41 B	23
	576.7							
			10					
		--In-Situ Vane Shear, 10.5 feet-- --$S_{u\ undis}$ = 972.0 psf-- --$S_{u\ remold}$ = 611.6 psf-- --Sensitivity = 1.6--			1	VS		
		--In-Situ Vane Shear, 13.0 feet-- --$S_{u\ undis}$ = 982.9 psf-- --$S_{u\ remold}$ = 589.7 psf-- --Sensitivity = 1.7--	15		2	VS		
		--In-Situ Vane Shear, 15.5 feet-- --$S_{u\ undis}$ = 873.7 psf-- --$S_{u\ remold}$ = 513.3 psf-- --Sensitivity = 1.7--			3	VS		
		--In-Situ Vane Shear, 18.0 feet-- --$S_{u\ undis}$ = 928.3 psf-- --$S_{u\ remold}$ = 360.4 psf-- --Sensitivity = 2.6--	20		4	VS		
		--In-Situ Vane Shear, 20.5 feet-- --$S_{u\ undis}$ = 775.4 psf-- --$S_{u\ remold}$ = 360.4 psf-- --Sensitivity = 2.2--			5	VS		
		--In-Situ Vane Shear, 23.0 feet-- --$S_{u\ undis}$ = 600.6 psf-- --$S_{u\ remold}$ = 305.8 psf-- --Sensitivity = 2.0--	25		6	VS		
		--In-Situ Vane Shear, 25.5 feet-- --$S_{u\ undis}$ = 578.8 psf-- --$S_{u\ remold}$ = 316.7 psf-- --Sensitivity = 1.8--			7	VS		
		--In-Situ Vane Shear, 28.0 feet-- --$S_{u\ undis}$ = 611.6 psf-- --$S_{u\ remold}$ = 338.5 psf-- --Sensitivity = 1.8--	30		8	VS		
		--In-Situ Vane Shear, 30.5 feet-- --$S_{u\ undis}$ = 786.3 psf-- --$S_{u\ remold}$ = 382.2 psf-- --Sensitivity = 2.1--			9	VS		
		--In-Situ Vane Shear, 33.0 feet-- --$S_{u\ undis}$ = 698.9 psf-- --$S_{u\ remold}$ = 404.1 psf-- --Sensitivity = 1.7--	35		10	VS		
		--In-Situ Vane Shear, 35.5 feet-- --$S_{u\ undis}$ = 808.1 psf-- --$S_{u\ remold}$ = 502.4 psf-- --Sensitivity = 1.6--			11	VS		
		--In-Situ Vane Shear, 38.0 feet-- --$S_{u\ undis}$ = 982.9 psf-- --$S_{u\ remold}$ = 546.0 psf-- --Sensitivity = 1.8--	40		12	VS		

GENERAL NOTES

Begin Drilling: **12-09-2015** Complete Drilling: **12-14-2015**
Drilling Contractor: **Wang Testing Services** Drill Rig: **CME-55 TMR [85%]**
Driller: **R&N** Logger: **F. Bozga** Checked by: **A. Kurnia**
Drilling Method: **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **Rotary wash**
At Completion of Drilling: **mud in the borehole**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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BORING LOG VST-06

WEI Job No.: 1100-04-01

Client **AECOM**
Project **Circle Interchange Reconstruction**
Location **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
Elevation: 585.69 ft
North: 1898109.29 ft
East: 1171902.18 ft
Station: 1103+77.81
Offset: 27.3835 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--In-Situ Vane Shear, 40.5 feet--			13	VS		
		--$S_{u\ undis}$ = 906.4 psf--						
		--$S_{u\ remold}$ = 524.2 psf--						
		--Sensitivity = 1.7--						
		--In-Situ Vane Shear, 43.0 feet--			14	VS		
	542.2	--$S_{u\ undis}$ = 677.1 psf--						
		--$S_{u\ remold}$ = 393.1 psf--						
		--Sensitivity = 1.7--						
		Boring terminated at 43.50 ft	45					
			50					
			55					
			60					

GENERAL NOTES

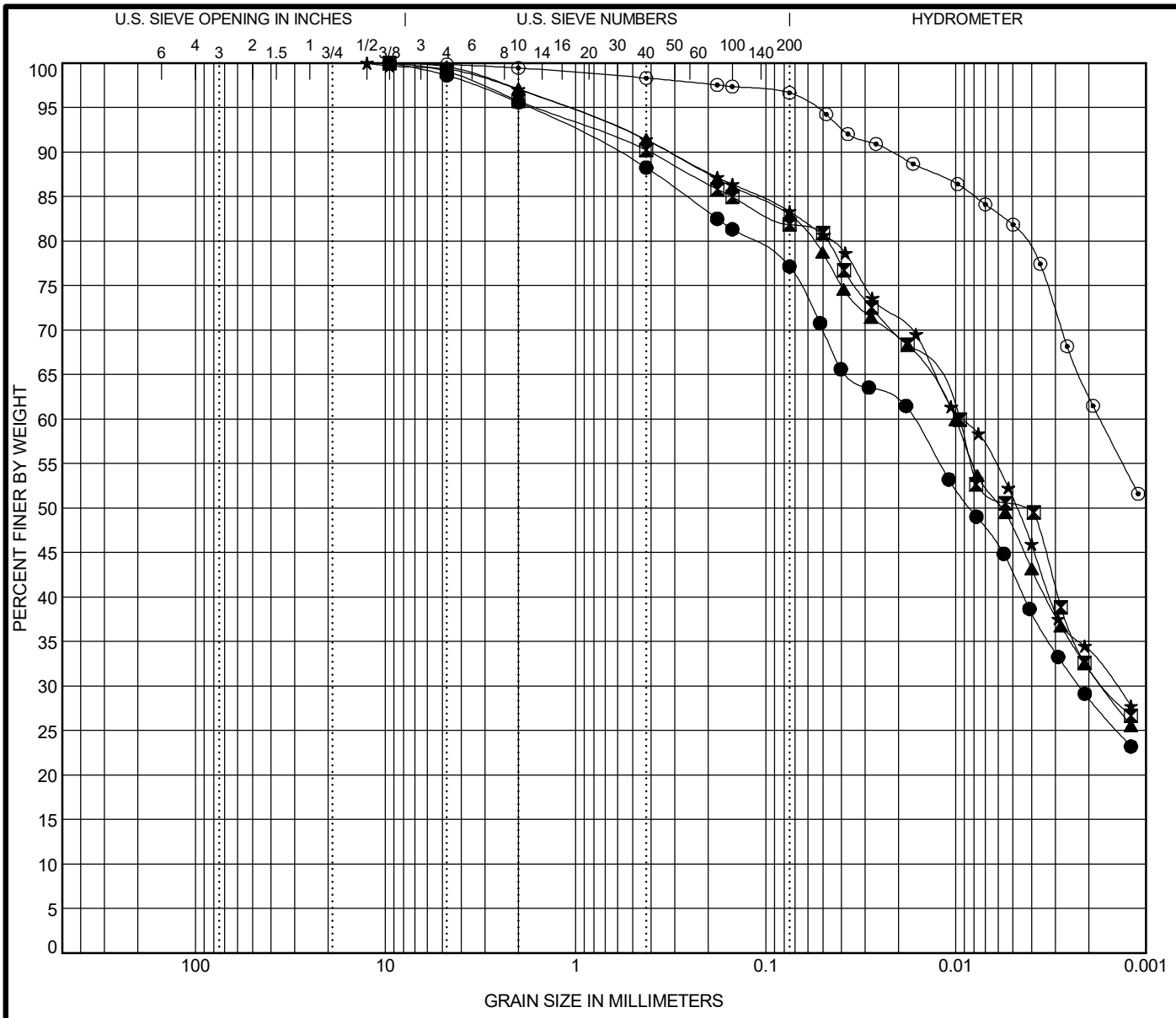
Begin Drilling **12-09-2015** Complete Drilling **12-14-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR [85%]**
Driller **R&N** Logger **F. Bozga** Checked by **A. Kurnia**
Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **Rotary wash**
At Completion of Drilling ▼ **mud in the borehole**
Time After Drilling **NA**
Depth to Water ▼ **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

APPENDIX B



COBBLES	GRAVEL	SAND		SILT AND CLAY
		coarse	fine	

Specimen Identification		IDH Classification	LL	PL	PI	Cc	Cu
● 1705-B-05A#1	10.0 ft	**Silty Clay Loam**	**31**	**17**	**14**		
⊠ 1705-B-05A#2	16.0 ft	**Silty Clay**	**34**	**17**	**17**		
▲ 1705-B-05A#	16.5 ft	**Silty Clay**	**32**	**17**	**15**		
★ 1705-B-05A#3	25.0 ft	**Silty Clay**	**33**	**17**	**16**		
⊙ 1705-B-05A#18	58.5 ft	**Clay**	**53**	**21**	**32**		

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 1705-B-05A#1	10.0 ft	**9.5**	**0.017**	**0.002**		**4.4**	**18.7**	**48.3**	**28.6**
⊠ 1705-B-05A#2	16.0 ft	**9.5**	**0.01**	**0.002**		**4.2**	**13.9**	**49.8**	**32.1**
▲ 1705-B-05A#	16.5 ft	**9.5**	**0.01**	**0.002**		**2.9**	**14.3**	**50.9**	**31.9**
★ 1705-B-05A#3	25.0 ft	**12.5**	**0.009**	**0.001**		**2.9**	**13.8**	**49.3**	**33.9**
⊙ 1705-B-05A#18	58.5 ft	**9.5**	**0.002**			**0.5**	**2.9**	**34.0**	**62.6**

WEI SINCE 1982
Wang Engineering, Inc.
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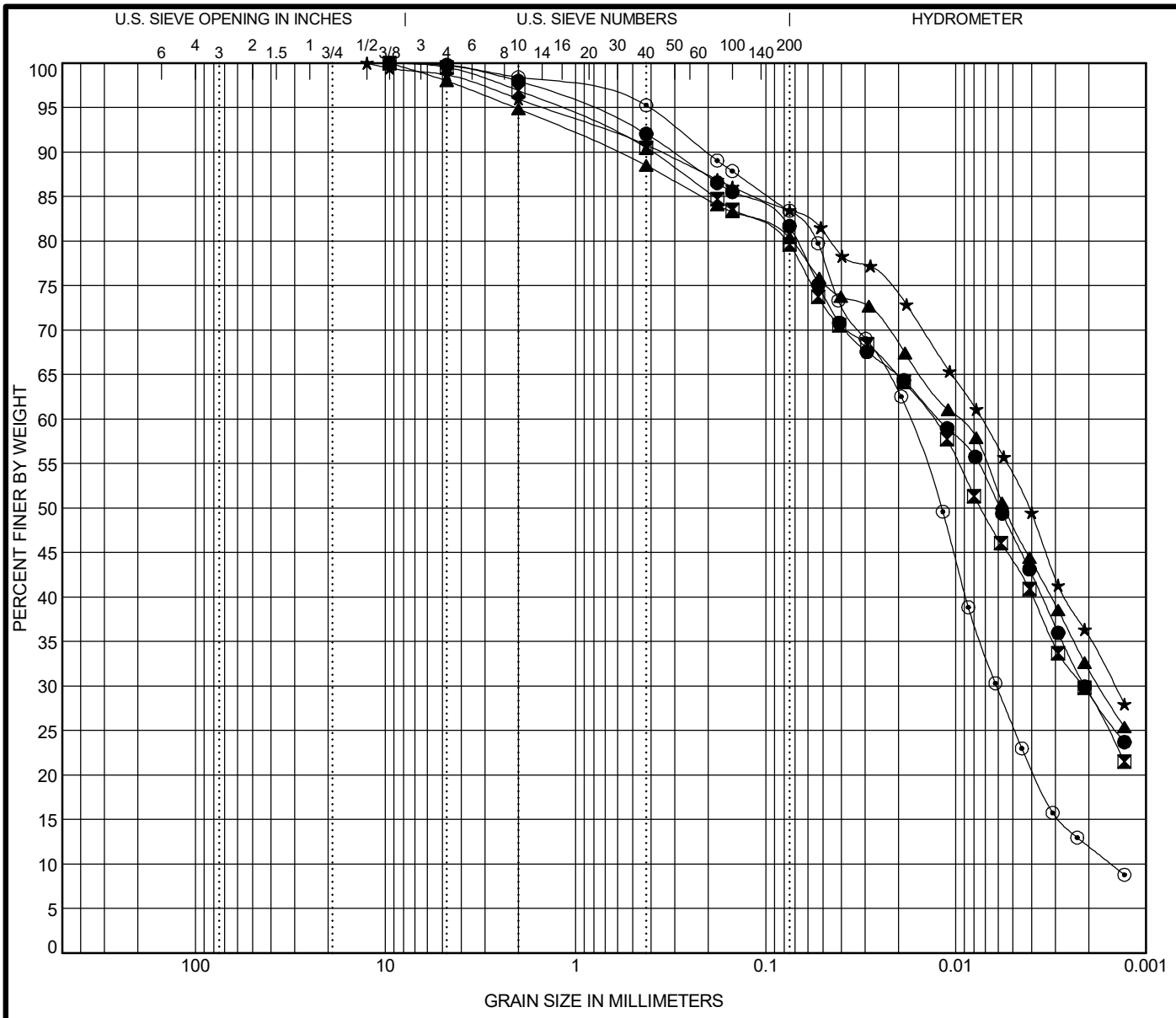
Lombard/IL/60148
Telephone: 6309539928
Fax: 6309539938

GRAIN SIZE DISTRIBUTION

Project: Circle Interchange Reconstruction

Location: Section 17, T39N, R14E of 3rd PM

Number: 1100-04-01



COBBLES	GRAVEL	SAND		SILT AND CLAY
		coarse	fine	

Specimen Identification		IDH Classification	LL	PL	PI	Cc	Cu
● 1710-B-03#2	3.5 ft	**Silty Clay Loam**	**32**	**19**	**13**		
⊠ 1710-B-03#6	13.5 ft	**Silty Clay Loam**	**33**	**18**	**15**		
▲ 1710-B-03#13	33.5 ft	**Silty Clay**	**34**	**18**	**16**		
★ 1710-B-03#16	48.5 ft	**Clay**	**34**	**18**	**16**		
⊙ 1710-B-03#20	68.5 ft	**Silty Loam**	**20**	**16**	**4**	**1.39**	**11.46**

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 1710-B-03#2	3.5 ft	**9.5**	**0.012**	**0.002**		**2.0**	**16.6**	**52.1**	**29.3**
⊠ 1710-B-03#6	13.5 ft	**9.5**	**0.013**	**0.002**		**3.1**	**17.5**	**50.4**	**29.0**
▲ 1710-B-03#13	33.5 ft	**9.5**	**0.01**	**0.002**		**5.2**	**14.6**	**48.4**	**31.9**
★ 1710-B-03#16	48.5 ft	**12.5**	**0.007**	**0.001**		**4.0**	**12.6**	**47.9**	**35.5**
⊙ 1710-B-03#20	68.5 ft	**9.5**	**0.018**	**0.006**	**0.002**	**1.6**	**15.1**	**71.3**	**11.9**

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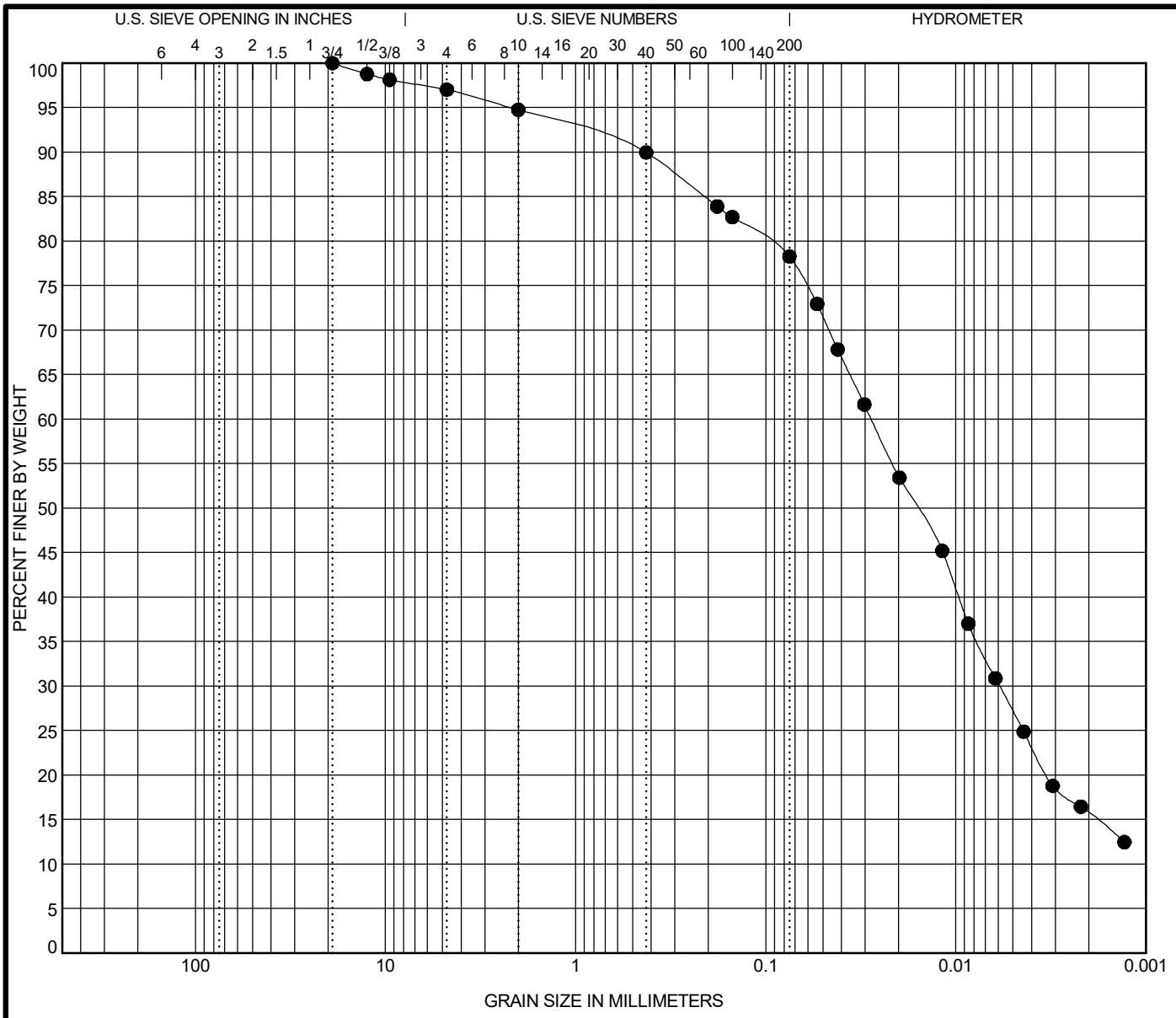
GRAIN SIZE DISTRIBUTION

Project: Circle Interchange Reconstruction

Location: Section 17, T39N, R14E of 3rd PM

Number: 1100-04-01



COBBLES	GRAVEL	SAND		SILT AND CLAY
		coarse	fine	

Specimen Identification	IDH Classification	LL	PL	PI	Cc	Cu
● 1710-B-03#23 83.5 ft	**Silty Loam**	**23**	**15**	**8**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 1710-B-03#23 83.5 ft	**19**	**0.028**	**0.006**		**5.2**	**16.7**	**62.3**	**15.7**

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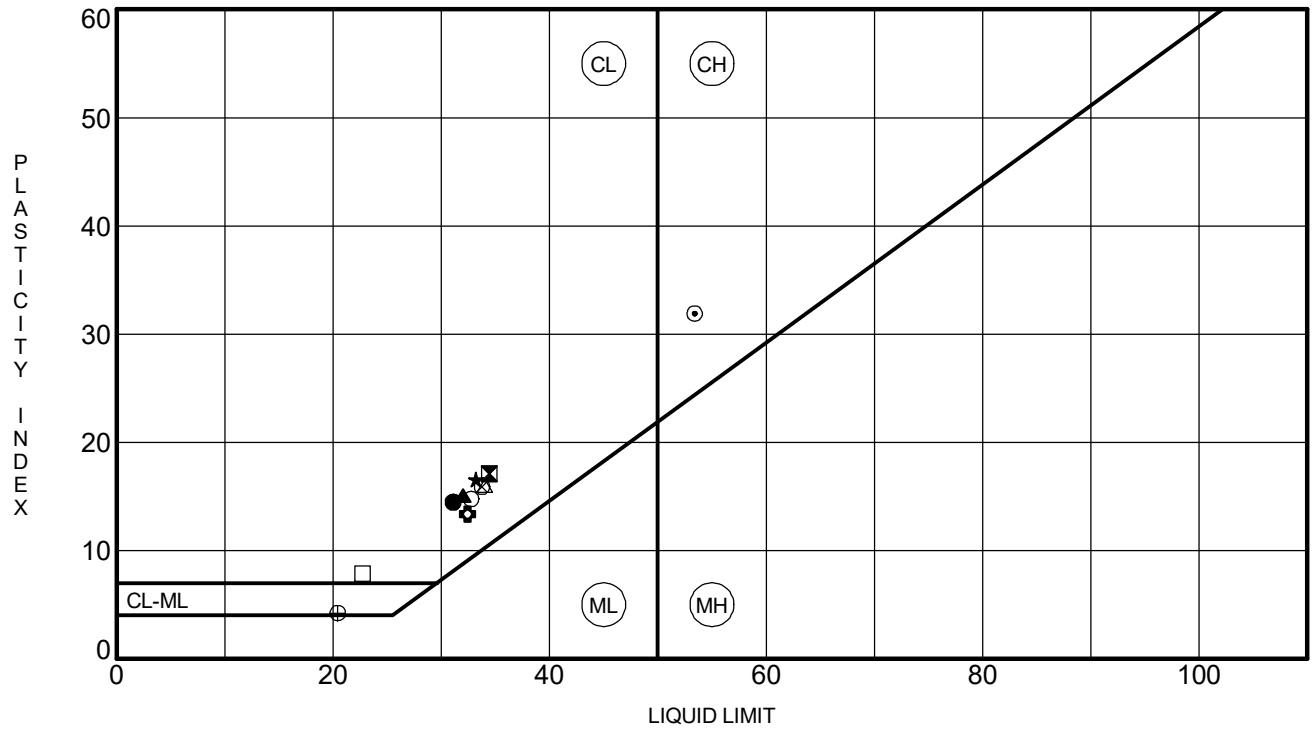
GRAIN SIZE DISTRIBUTION

Project: Circle Interchange Reconstruction

Location: Section 17, T39N, R14E of 3rd PM

Number: 1100-04-01



Specimen Identification			LL	PL	PI	Fines	IDH Classification
●	1705-B-05A#1	10.0 ft	31	17	14	77	Silty Clay Loam
⊠	1705-B-05A#2	16.0 ft	34	17	17	82	Silty Clay
▲	1705-B-05A#	16.5 ft	32	17	15	83	Silty Clay
★	1705-B-05A#3	25.0 ft	33	17	16	83	Silty Clay
⊙	1705-B-05A#18	58.5 ft	53	21	32	97	Clay
✿	1710-B-03#2	3.5 ft	32	19	13	82	Silty Clay Loam
○	1710-B-03#6	13.5 ft	33	18	15	80	Silty Clay Loam
△	1710-B-03#13	33.5 ft	34	18	16	80	Silty Clay
⊗	1710-B-03#16	48.5 ft	34	18	16	83	Clay
⊕	1710-B-03#20	68.5 ft	20	16	4	83	Silty Loam
□	1710-B-03#23	83.5 ft	23	15	8	78	Silty Loam

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ATTERBERG LIMITS' RESULTS

Project: Circle Interchange Reconstruction

Location: Section 17, T39N, R14E of 3rd PM

Number: 1100-04-01

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UNCONFINED COMPRESSIVE STRENGTH of COHESIVE SOIL

(AASHTO T 208 / ASTM D 2166)

Project: Circle Interchange
Client: AECOM
WEI Job No.: 1100-04-01
Soil Sample ID: 1705-B-05A, (16.0-18.0ft) Middle
Type/Condition: ST / Undisturbed
Liquid Limit (%): 32
Plastic Limit (%): 17

Analyst name: A. Mohammed
Date received: 7/23/2013
Test date: 8/6/2013
Sample description: Gray Silty Clay

Sand(%): 14.3
Silt(%): 50.9
Clay(%): 31.9

Average initial height h_0 =	5.76	in
Average initial diameter d_0 =	2.80	in
Height to diameter ratio=	2.05	
Mass of wet sample and tare M_i =	1247.70	g
Mass of dry sample and tare M_d =	1007.38	g
Mass of tare M_t =	0.00	g
Mass of sample Ms=	1247.70	g
Estimated specific gravity G_s =	2.78	

Initial water content w =	23.86%	(cuttings)
Initial unit weight g =	133.67	pcf
Initial dry unit weight g_d =	107.93	pcf
Initial void ratio e_0 =	0.61	
Initial degree of saturation S_r =	100%	
Average Rate of Strain=	1%/min	
Unconfined compressive strength q_u =	0.33	tsf
Shear Strength=	0.16	tsf

Displacement (in) Δh	Force (lbs) F	Strain (%) e	Stress (tsf) s
0.00	0.00	0.00	0.00
0.03	2.07	0.52	0.02
0.06	4.15	1.04	0.05
0.09	6.22	1.56	0.07
0.12	8.30	2.08	0.09
0.15	10.37	2.60	0.12
0.18	12.44	3.13	0.14
0.21	14.52	3.65	0.16
0.24	15.56	4.17	0.17
0.27	16.59	4.69	0.18
0.30	18.67	5.21	0.21
0.35	20.74	6.08	0.23
0.40	22.81	6.95	0.25
0.45	24.89	7.81	0.27
0.50	25.93	8.68	0.28
0.55	26.96	9.55	0.28
0.60	29.04	10.42	0.30
0.65	29.04	11.29	0.30
0.70	30.07	12.15	0.31
0.80	31.11	13.89	0.31
0.90	33.18	15.63	0.33

NOTES:

Prepared by: _____ Date: 8/8/13

Checked by: _____ Date: 8/30/13

AASHTO R18

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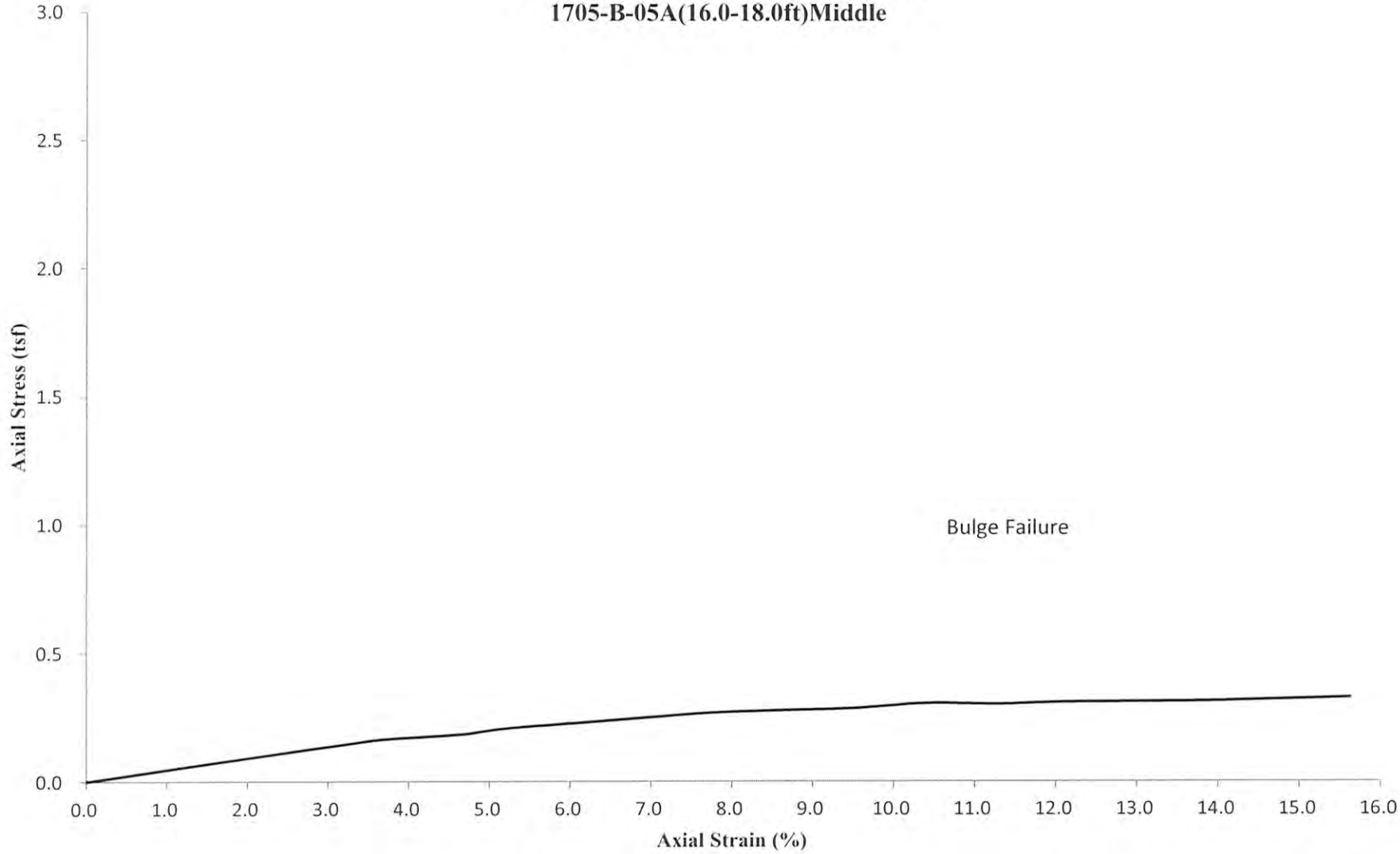
Unconfined Axial Stress v. Axial Strain
1705-B-05A(16.0-18.0ft)Middle



AAR AASHTO R18

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Phone (630) 953-9928
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UNCONFINED COMPRESSIVE STRENGTH of COHESIVE SOIL

(AASHTO T 208 / ASTM D 2166)

Project: Circle Interchange
Client: AECOM
WEI Job No.: 1100-04-01
Soil Sample ID: 1705-B-05A, (16.0-18.0ft) Bottom
Type/Condition: ST / Undisturbed
Liquid Limit (%): 34
Plastic Limit (%): 17

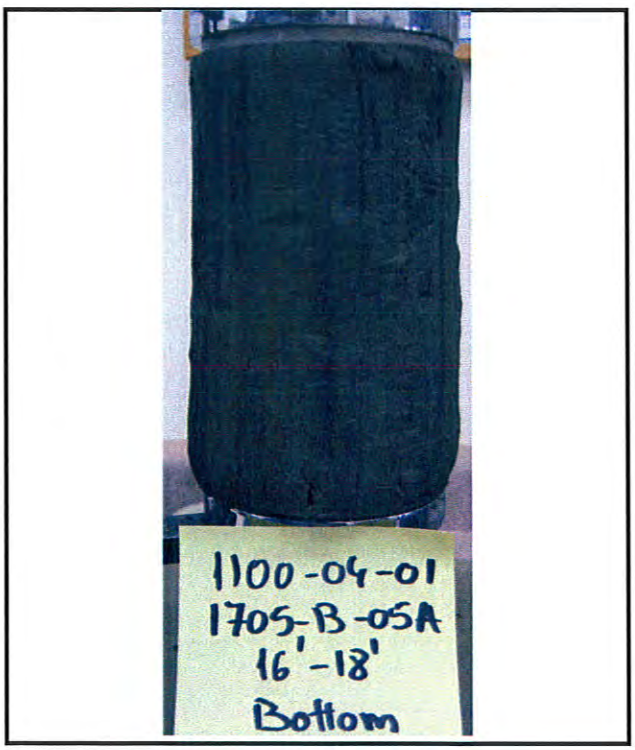
Analyst name: A. Mohammed
Date received: 7/23/2013
Test date: 8/6/2013
Sample description: Gray Silty Clay

Sand(%): 13.9
Silt(%): 49.8
Clay(%): 32.1

Average initial height h_0 =	6.17	in
Average initial diameter d_0 =	2.81	in
Height to diameter ratio=	2.20	
Mass of wet sample and tare M_i =	1331.60	g
Mass of dry sample and tare M_d =	1073.07	g
Mass of tare M_t =	0.00	g
Mass of sample Ms=	1331.60	g
Estimated specific gravity G_s =	2.78	

Initial water content w =	24.09%	(cuttings)
Initial unit weight g =	132.54	pcf
Initial dry unit weight g_d =	106.81	pcf
Initial void ratio e_0 =	0.62	
Initial degree of saturation S_r =	100%	
Average Rate of Strain=	1%/min	
Unconfined compressive strength q_u =	0.39	tsf
Shear Strength=	0.20	tsf

Displacement (in) Δh	Force (lbs) F	Strain (%) e	Stress (tsf) s
0.00	0.00	0.00	0.00
0.03	2.07	0.49	0.02
0.06	4.15	0.97	0.05
0.09	7.26	1.46	0.08
0.12	8.30	1.94	0.09
0.15	12.44	2.43	0.14
0.18	14.52	2.92	0.16
0.21	16.59	3.40	0.19
0.24	18.67	3.89	0.21
0.27	19.70	4.37	0.22
0.30	20.74	4.86	0.23
0.35	22.81	5.67	0.25
0.40	24.89	6.48	0.27
0.45	26.96	7.29	0.29
0.50	29.04	8.10	0.31
0.55	32.15	8.91	0.34
0.60	33.18	9.72	0.35
0.65	33.18	10.53	0.34
0.70	35.26	11.34	0.36
0.80	36.30	12.96	0.37
0.90	39.41	14.58	0.39



NOTES:

Prepared by: _____ Date: 8/6/13

Checked by: _____ Date: 8/30/13

AASHTO R18

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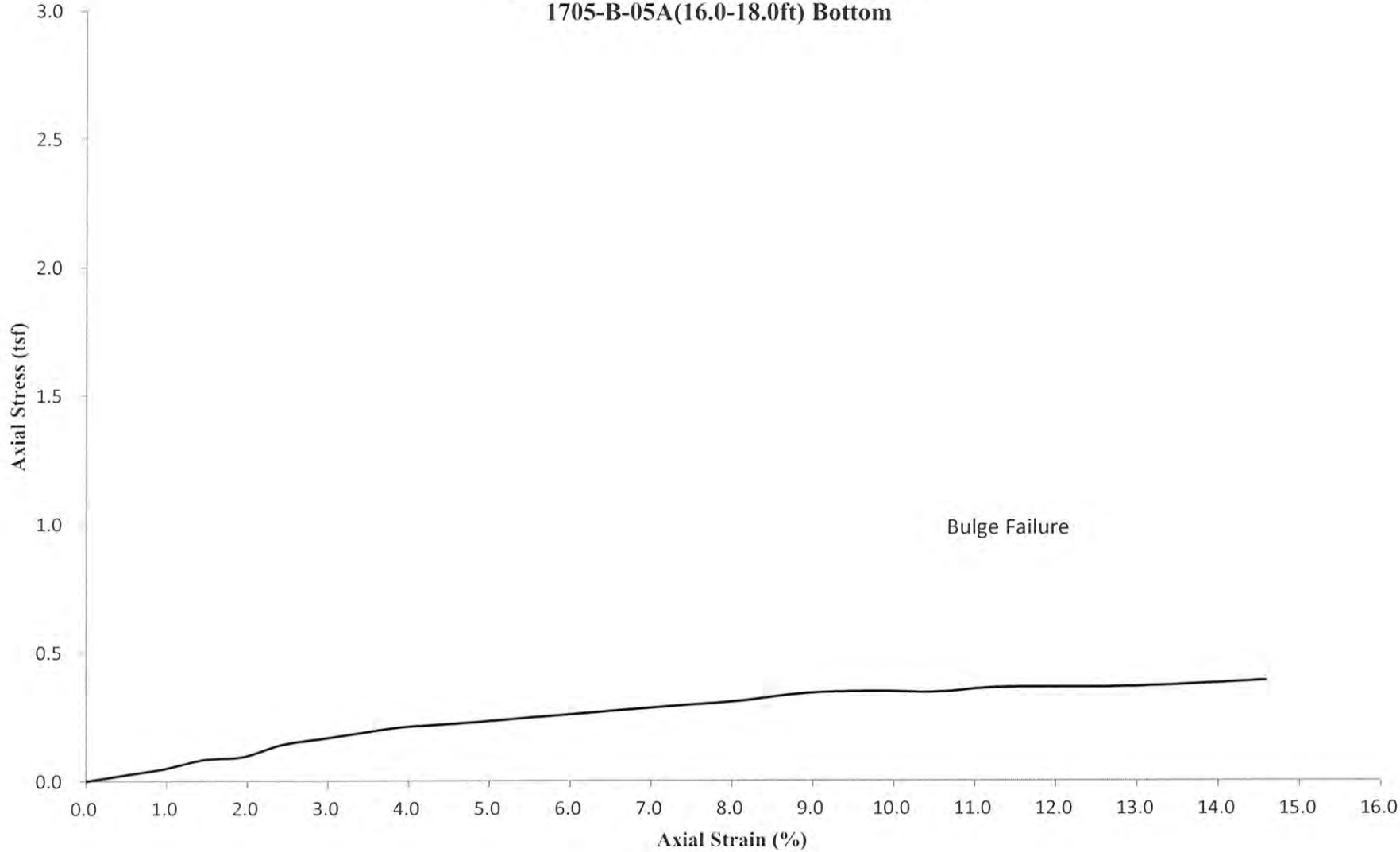
Unconfined Axial Stress v. Axial Strain
1705-B-05A(16.0-18.0ft) Bottom



AASHTO R18

UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

AASHTO T 296 / ASTM D 2850

Project: Circle Interchange Reconstruction
Sample ID: Boring 1705-B05A, ST#1, 10' to 12'
Sample description: Gray SILTY CLAY LOAM w/trace gravel
Triaxial Cell No.: 1

Tested by: M. Snider
Prepared by: *M. Snider*
Test date: August 6, 2013
WEI Job No.: 1100-04-01

Initial sample height:	6.08	in	Tare mass:	13.28 g
Initial sample diameter:	2.83	in	Measured sample mass w/out Tare:	1283.90 g
Initial sample mass:	1283.90	g	Tare and dry sample mass:	1036.10 g
Soil specific gravity:	2.78	(estimated)		
Dry sample mass:	1022.82	g		
Initial water content:	25.53%	(specimen)	Rate of loading:	1.000 %/min
Initial unit weight:	127.51	pcf		
Initial dry unit weight:	101.58	pcf		
Initial void ratio:	0.708			
Initial saturation:	100.0%			
Liquid Limit, %:	31			
Plastic Limit, %:	17			
% Sand:	18.7			
% Silt:	48.3		Confining stress:	10.0 psi
% Clay:	28.6		Shear modulus:	150.69 psi

Axial displacement (Δh)	Axial force (F)	Axial strain (eps)	Deviator stress	Total vertical stress	Shear stress, q=q'	Total spherical stress, p
in	pound	%	psi	psi	psi	psi
0.00	0.000	0.00	0.0	10.0	0.00	10.00
0.01	7.031	0.09	1.1	11.1	0.56	10.56
0.01	10.283	0.18	1.6	11.6	0.81	10.81
0.02	11.735	0.28	1.9	11.9	0.93	10.93
0.02	12.703	0.37	2.0	12.0	1.00	11.00
0.03	13.413	0.47	2.1	12.1	1.06	11.06
0.03	14.063	0.57	2.2	12.2	1.11	11.11
0.04	14.699	0.67	2.3	12.3	1.16	11.16
0.05	15.243	0.78	2.4	12.4	1.20	11.20
0.05	15.787	0.88	2.5	12.5	1.24	11.24
0.06	16.574	0.99	2.6	12.6	1.30	11.30
0.12	21.413	1.97	3.3	13.3	1.66	11.66
0.18	25.525	2.94	3.9	13.9	1.96	11.96
0.24	28.475	3.89	4.3	14.3	2.17	12.17
0.30	31.498	4.88	4.8	14.8	2.38	12.38
0.36	34.764	5.84	5.2	15.2	2.60	12.60
0.41	36.172	6.79	5.3	15.3	2.67	12.67
0.47	38.318	7.79	5.6	15.6	2.80	12.80
0.54	40.647	8.84	5.9	15.9	2.94	12.94
0.60	41.222	9.83	5.9	15.9	2.95	12.95
0.66	42.991	10.82	6.1	16.1	3.04	13.04
0.72	44.397	11.81	6.2	16.2	3.10	13.10
0.78	45.184	12.78	6.3	16.3	3.13	13.13
0.84	45.728	13.74	6.3	16.3	3.13	13.13
0.90	46.650	14.72	6.3	16.3	3.15	13.15

Notes:
$p=\sigma_1+\sigma_3/2$ $q=\sigma_1-\sigma_3/2$
$p'=\sigma_1'+\sigma_3'/2$ $q'=\sigma_1'-\sigma_3'/2$

Prepared by: _____ Date: 8/28/13
Checked by: _____ Date: 8/30/13

UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

AASHTO T 296 / ASTM D 2850

Project: Circle Interchange Reconstruction
Sample ID: Boring 1705-B05A, ST#1, 10' to 12'
Sample description: Gray SILTY CLAY LOAM w/trace gravel
Triaxial Cell No.: 2
Initial sample height: 5.97 in
Initial sample diameter: 2.85 in
Initial sample mass: 1318.50 g
Soil specific gravity: 2.78 (estimated)
Dry sample mass: 1079.80 g

Initial water content: 22.11% (specimen)
Initial unit weight: 132.34 pcf
Initial dry unit weight: 108.38 pcf
Initial void ratio: 0.601
Initial saturation: 100.0%

Liquid Limit, %: 31
Plastic Limit, %: 17
% Sand: 18.7
% Silt: 48.3
% Clay: 28.6

Tested by: M. Snider
Prepared by: *M. Snider*
Test date: August 6, 2013
WEI Job No.: 1100-04-01
Tare mass: 13.50 g
Measured sample mass w/out Tare: 1318.50 g
Tare and dry sample mass: 1093.30 g

Rate of loading: 1.000 %/min

Confining stress: 20.0 psi
Shear modulus: 118.91 psi

Axial displacement (Δh)	Axial force (F)	Axial strain (eps)	Deviator stress	Total vertical stress	Shear stress, q=q'	Total spherical stress, p
in	pound	%	psi	psi	psi	psi
0.00	0.000	0.00	0.0	20.0	0.00	20.00
0.00	5.625	0.08	0.9	20.9	0.44	20.44
0.01	8.029	0.17	1.3	21.3	0.63	20.63
0.02	9.889	0.27	1.6	21.6	0.78	20.78
0.02	11.281	0.36	1.8	21.8	0.88	20.88
0.03	12.415	0.45	1.9	21.9	0.97	20.97
0.03	13.368	0.55	2.1	22.1	1.05	21.05
0.04	14.169	0.65	2.2	22.2	1.11	21.11
0.05	14.955	0.76	2.3	22.3	1.17	21.17
0.05	15.772	0.86	2.5	22.5	1.23	21.23
0.06	16.453	0.96	2.6	22.6	1.28	21.28
0.12	22.682	1.95	3.5	23.5	1.75	21.75
0.17	27.673	2.92	4.2	24.2	2.11	22.11
0.23	31.604	3.90	4.8	24.8	2.39	22.39
0.30	35.324	4.96	5.3	25.3	2.64	22.64
0.36	38.591	5.97	5.7	25.7	2.85	22.85
0.41	41.161	6.95	6.0	26.0	3.01	23.01
0.48	43.732	7.96	6.3	26.3	3.17	23.17
0.54	46.000	9.00	6.6	26.6	3.29	23.29
0.59	47.860	9.96	6.8	26.8	3.39	23.39
0.65	49.690	10.95	7.0	27.0	3.48	23.48
0.71	51.111	11.96	7.1	27.1	3.54	23.54
0.77	52.502	12.94	7.2	27.2	3.59	23.59
0.83	53.621	13.94	7.3	27.3	3.63	23.63
0.89	54.710	14.99	7.3	27.3	3.66	23.66

Notes:
$p=\sigma_1+\sigma_3/2$ $q=\sigma_1-\sigma_3/2$
$p'=\sigma_1'+\sigma_3'/2$ $q'=\sigma_1'-\sigma_3'/2$

Prepared by: _____ Date: 8/28/13
Checked by: _____ Date: 8/30/13

UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

AASHTO T 296 / ASTM D 2850

Project: Circle Interchange Reconstruction
Sample ID: Boring 1705-B05A, ST#1, 10' to 12'
Sample description: Gray SILTY CLAY LOAM w/trace gravel
Triaxial Cell No.: 3
Initial sample height: 6.11 in
Initial sample diameter: 2.85 in
Initial sample mass: 1333.10 g
Soil specific gravity: 2.78 (estimated)
Dry sample mass: 1075.59 g

Initial water content: 23.94% (specimen)
Initial unit weight: 130.06 pcf
Initial dry unit weight: 104.94 pcf
Initial void ratio: 0.653
Initial saturation: 100.0%

Liquid Limit, %: 31
Plastic Limit, %: 17
% Sand: 18.7
% Silt: 48.3
% Clay: 28.6

Tested by: M. Snider
Prepared by: *M. Snider*
Test date: August 6, 2013
WEI Job No.: 1100-04-01
Tare mass: 13.61 g
Measured sample mass w/out Tare: 1333.10 g
Tare and dry sample mass: 1089.20 g

Rate of loading: 1.000 %/min

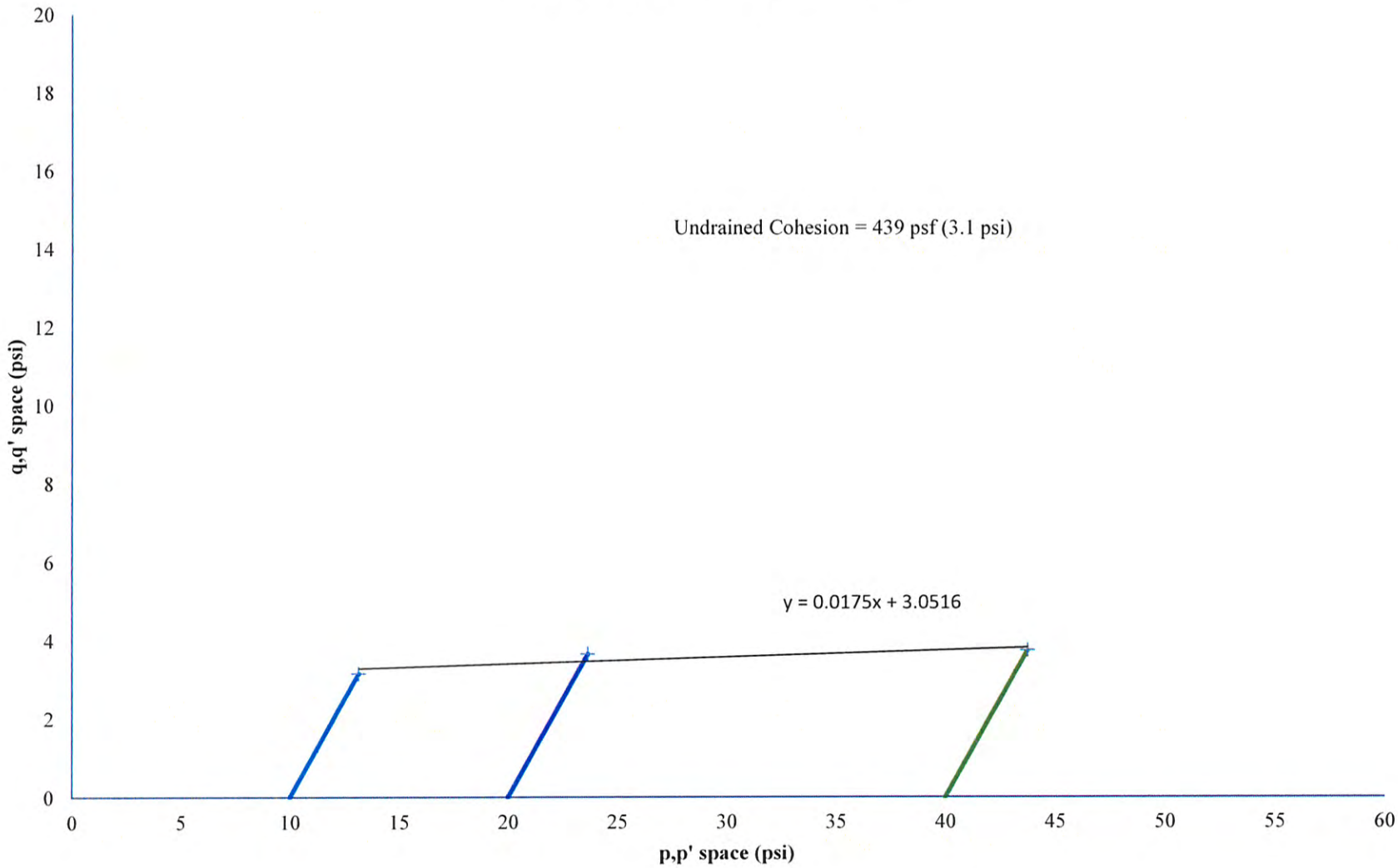
Confining stress: 40.0 psi
Shear modulus: 52.09 psi

Axial displacement (Δh)	Axial force (F)	Axial strain (eps)	Deviator stress	Total vertical stress	Shear stress, q=q'	Total spherical stress, p
in	pound	%	psi	psi	psi	psi
0.00	0.000	0.00	0.0	40.0	0.00	40.00
0.01	2.858	0.08	0.4	40.4	0.22	40.22
0.01	3.704	0.18	0.6	40.6	0.29	40.29
0.02	4.098	0.28	0.6	40.6	0.32	40.32
0.02	6.094	0.38	0.9	40.9	0.47	40.47
0.03	7.560	0.48	1.2	41.2	0.59	40.59
0.04	8.800	0.58	1.4	41.4	0.68	40.68
0.04	9.693	0.68	1.5	41.5	0.75	40.75
0.05	10.494	0.78	1.6	41.6	0.81	40.81
0.05	11.416	0.89	1.8	41.8	0.88	40.88
0.06	12.535	0.99	1.9	41.9	0.97	40.97
0.12	20.520	1.99	3.1	43.1	1.57	41.57
0.18	26.886	2.95	4.1	44.1	2.04	42.04
0.24	31.256	3.92	4.7	44.7	2.35	42.35
0.30	35.414	4.92	5.3	45.3	2.63	42.63
0.36	39.785	5.88	5.9	45.9	2.93	42.93
0.42	41.676	6.85	6.1	46.1	3.04	43.04
0.48	44.412	7.87	6.4	46.4	3.20	43.20
0.55	47.738	8.93	6.8	46.8	3.40	43.40
0.61	47.951	9.92	6.8	46.8	3.38	43.38
0.67	51.504	10.90	7.2	47.2	3.59	43.59
0.73	53.561	11.92	7.4	47.4	3.69	43.69
0.79	53.455	12.89	7.3	47.3	3.64	43.64
0.85	54.725	13.86	7.4	47.4	3.69	43.69
0.91	56.313	14.85	7.5	47.5	3.75	43.75

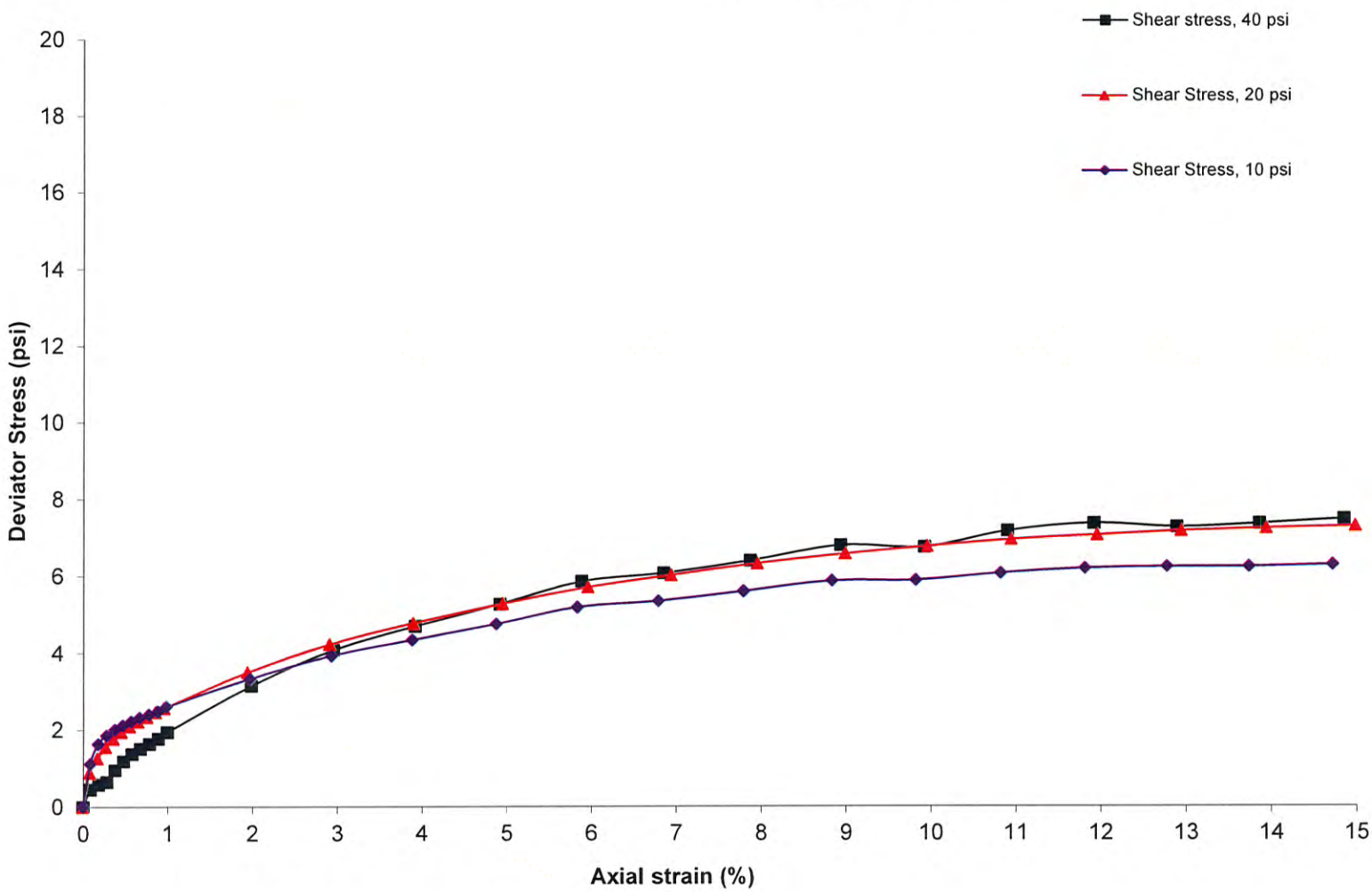
Notes:
$p=\sigma_1+\sigma_3/2$ $q=\sigma_1-\sigma_3/2$
$p'=\sigma_1'+\sigma_3'/2$ $q'=\sigma_1'-\sigma_3'/2$

Prepared by: Jay Date: 8/28/13
Checked by: [signature] Date: 8/30/13

Total Stress Paths (p-q Space)
Boring 1705-B05A, ST#1, 10' to 12'



Boring 1705-B05A, ST#1, 10' to 12': Stress v. Axial Strain Curve
All Confining Pressures



P:\1210201\LWS_Wang_MLS_CombinedUU_11000401_1705B05A_130814

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ONE-DIMENSIONAL CONSOLIDATION TEST
AASHTO T 216 / ASTM D 2435

Project: Circle Interchange
Client: AECOM
Soil Sample ID: Boring 1705-B05A, ST#3, 25' to 27'
Sample Description: Gray LEAN CLAY with trace gravel (CL)

Tested by: M. Snider
Prepared by: M. Snider
Test date: 7/30/2013
WEI: 1100-04-01

Initial sample height =	0.997 in	Ring diameter =	2.496 in
Initial sample mass =	160.54 g	Ring mass =	109.55 g
Initial water content =	25.63%	Initial sample and ring mass =	270.09 g
Initial dry unit weight =	99.81 pcf	Tare mass =	13.58 g
Initial void ratio =	0.738	Final ring and sample mass =	262.68 g
Initial degree of saturation =	96.54%	Mass of wet sample and tare =	166.60 g
		Mass of dry sample and tare =	141.37 g
Final sample mass =	153.02 g	Initial dial reading =	0.01000 in
Final dry sample mass =	127.79 g	Final dial reading =	0.12368 in
Final water content =	19.74%	LL=	33 %
Final dry unit weight =	112.66 pcf	PL=	17 %
Final void ratio =	0.540	% Sand=	13.8 %
Final degree of saturation =	100.00%	% Silt=	49.3 %
Estimated specific gravity =	2.78	% Clay=	33.9 %
		In-Situ Vertical Effective Stress =	2500 psf

Compression and Swelling Indices

Compression index C_c =	0.192	**Preconsolidation pressure,s_C**	
Field corrected C_c =	0.223	Casagrande Method =	2886 psf
Swelling index C_s =	0.045	**Over-Consolidation Ratio (OCR) =**	1.15

Load number	Vertical stress	Dial reading	System deflection	Vertical strain	Void ratio	C_v	Cae	Elapsed time
	psf	in	in	%		ft^2/day	%	min
1	100.0	0.01019	0.00010	0.03	0.738	N/A	N/A	1440
2	200.0	0.01167	0.00023	0.19	0.735	0.1311	0.06	1140
3	500.0	0.01742	0.00058	0.80	0.724	0.1012	0.07	1440
4	1000.0	0.02494	0.00090	1.59	0.710	0.1030	0.09	1380
5	2000.0	0.03802	0.00135	2.95	0.687	0.1213	0.18	1350
6	4000.0	0.06526	0.00193	5.74	0.638	0.1031	0.37	960
7	8000.0	0.09293	0.00253	8.57	0.589	0.1018	0.36	1440
8	16000.0	0.12371	0.00324	11.73	0.534	0.1184	0.38	1440
9	32000.0	0.15605	0.00413	15.06	0.476	0.1519	0.39	1440
10	8000.0	0.15508	0.00295	14.85	0.480	N/A	N/A	480
11	2000.0	0.14033	0.00198	13.27	0.507	N/A	N/A	2820
11	500.0	0.12566	0.00123	11.72	0.534	N/A	N/A	1440

Prepared by: _____ Date: 8/28/13

Checked by: _____ Date: 8/30/13

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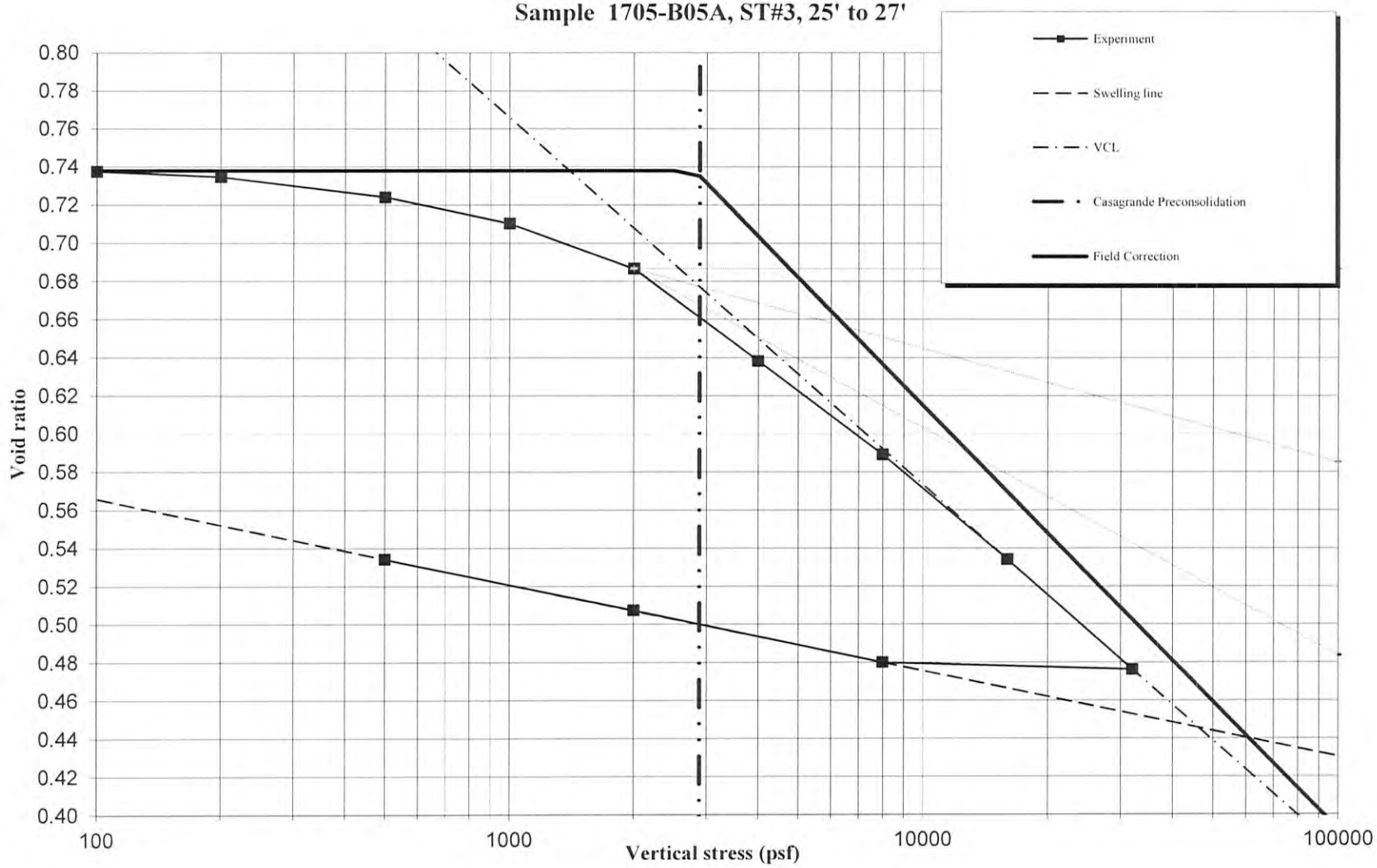
CONSOLIDATION CURVE

Sample 1705-B05A, ST#3, 25' to 27'



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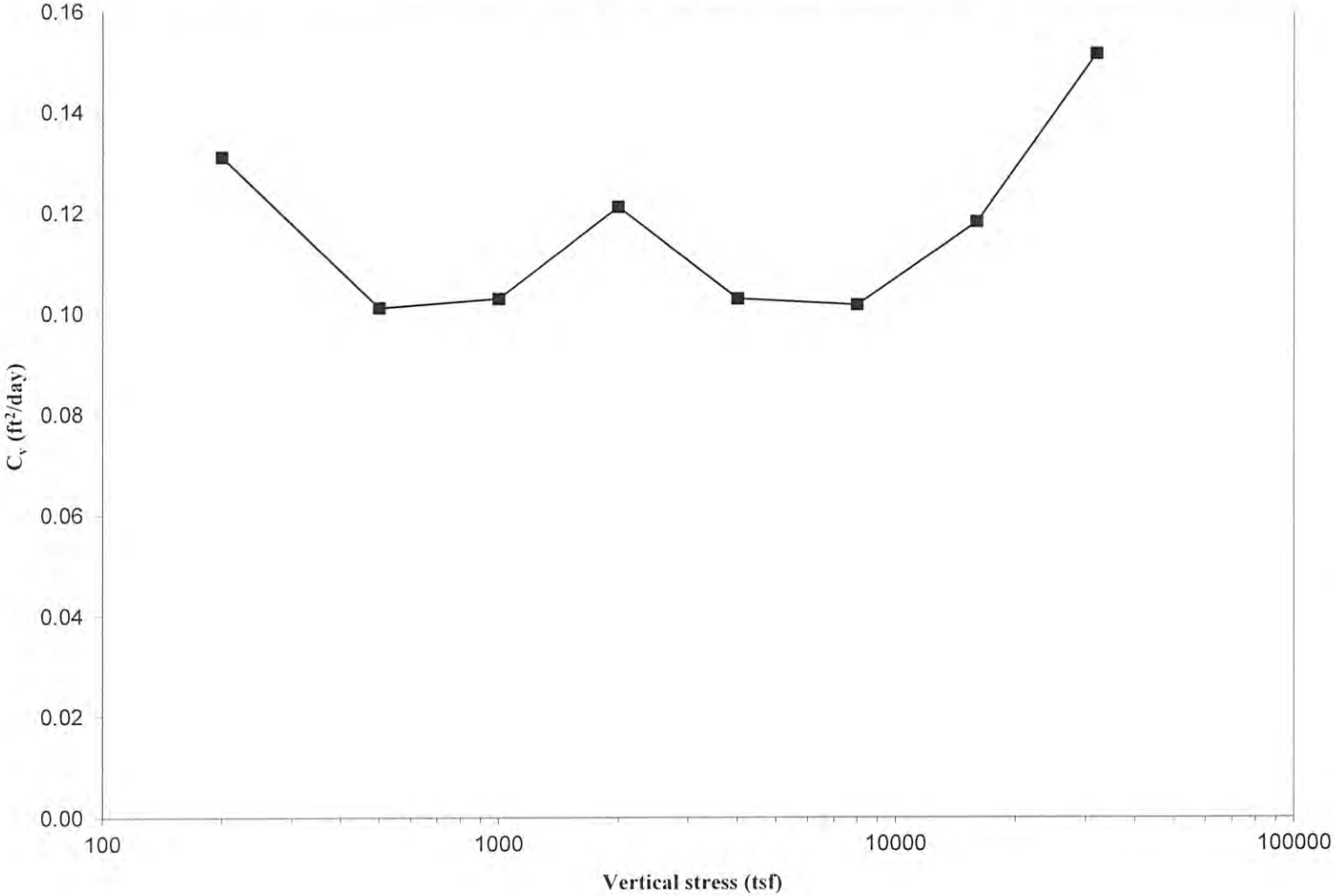
CONSOLIDATION COEFFICIENT (C_v) vs. VERTICAL STRESS

Sample 1705-B05A, ST#3, 25' to 27'



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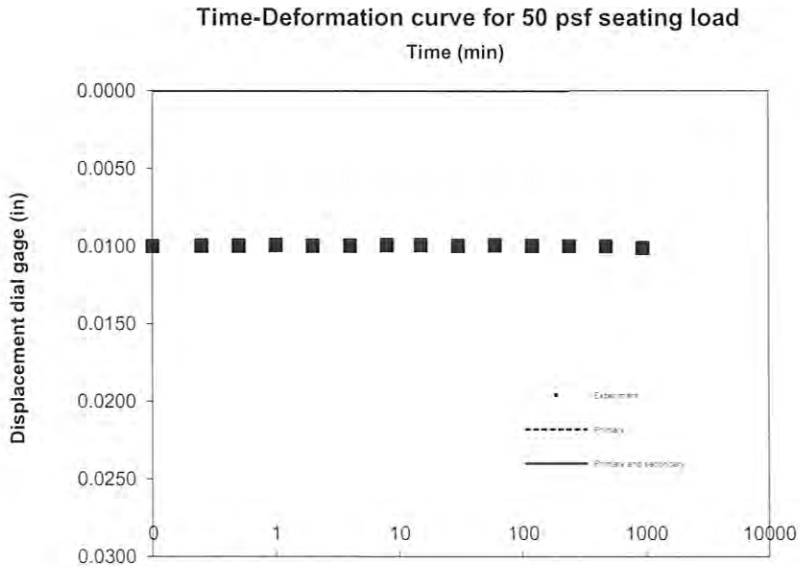
Applied stress	Elapsed time	Dial	Fitted Primary	Fitted Primary and Secondary
psf	min	in	in	in
50.0	*0.00*	0.01000	#VALUE!	#VALUE!
	0.10	0.01001	#VALUE!	#VALUE!
	0.25	0.00996	#VALUE!	#VALUE!
	0.50	0.00996	#VALUE!	#VALUE!
	1.00	0.00994	#VALUE!	#VALUE!
	2.00	0.00996	#VALUE!	#VALUE!
	4.00	0.00998	#VALUE!	#VALUE!
	8.00	0.00994	#VALUE!	#VALUE!
	15.00	0.00994	#VALUE!	#VALUE!
	30.00	0.00998	#VALUE!	#VALUE!
	60.00	0.00994	#VALUE!	#VALUE!
	120.00	0.00998	#VALUE!	#VALUE!
	240.00	0.01001	#VALUE!	#VALUE!
	480.00	0.01001	#VALUE!	#VALUE!
	945.00	0.01011	#VALUE!	#VALUE!

h_0 = 0.99700 in
U_s = 99%
t_s = #VALUE! min
d_s = #VALUE! in
d_0 = #VALUE! in
d_{100} = #VALUE! in
d = #VALUE! in
C_v = #VALUE! in^2/min
r_i = #VALUE!
r_p = #VALUE!
r_s = #VALUE!
Slope = 0.0002
Intercept = 0.0096
h_c = #VALUE! in
t_c = #VALUE! min
C_{ae} = #VALUE!



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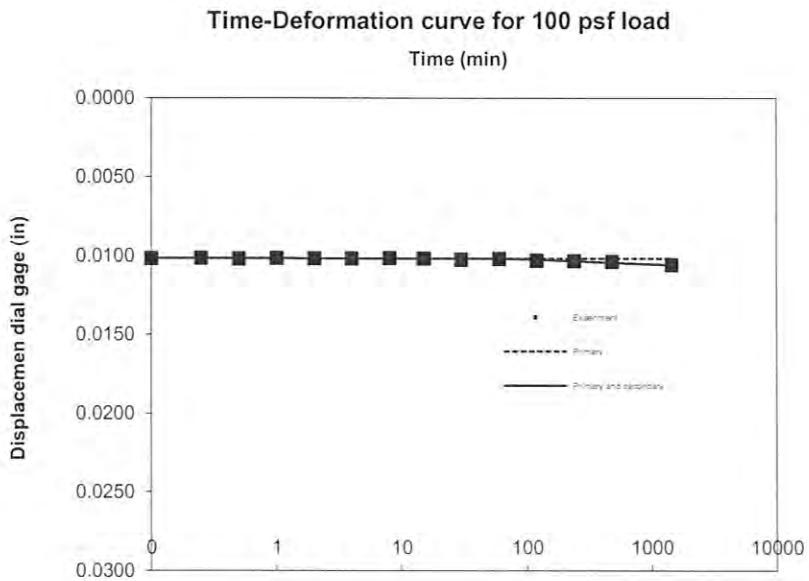
Applied stress	Elapsed time	Dial	Fitted Primary	Fitted Primary and Secondary
psf	min	in	in	in
100.0	*0.00*	0.01017	0.01016	0.01016
	0.10	0.01018	0.01016	0.01016
	0.25	0.01017	0.01017	0.01017
	0.50	0.01020	0.01017	0.01017
	1.00	0.01017	0.01017	0.01017
	2.00	0.01018	0.01018	0.01018
	4.00	0.01018	0.01018	0.01018
	8.00	0.01017	0.01019	0.01019
	15.00	0.01018	0.01019	0.01019
	30.00	0.01025	0.01019	0.01019
	60.00	0.01020	0.01019	0.01019
	120.00	0.01031	0.01019	0.01025
	240.00	0.01036	0.01019	0.01034
	480.00	0.01040	0.01019	0.01043
	1440.00	0.01059	0.01019	0.01058

h_0 =	0.99683	in
U_s =	99%	
t_s =	16.71	min
d_s =	0.01019	in
d_0 =	0.01016	in
d_{100} =	0.01019	in
d =	0.49841	in
C_v =	0.0265	in^2/min
r_i =	-2.0%	
r_p =	7.2%	
r_s =	94.8%	
Slope =	0.0003	
Intercept =	0.0096	
h_c =	0.9968	in
t_c =	77.28	min
C_{ae} =	0.030%	



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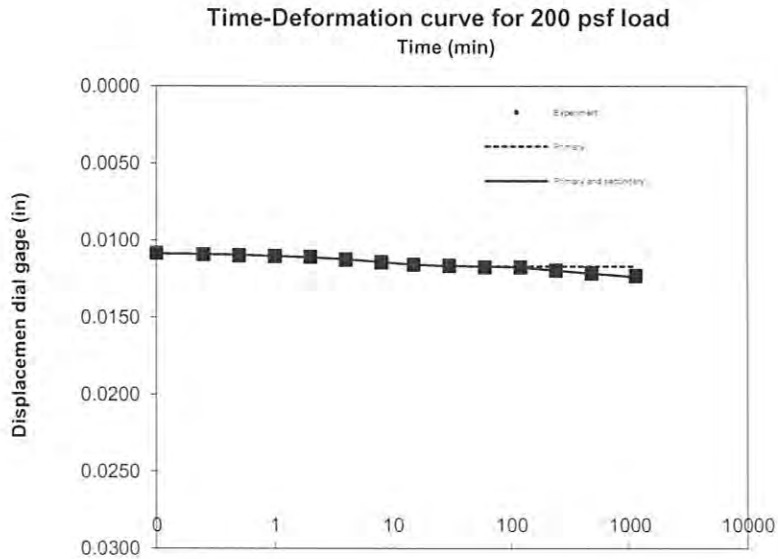
Applied stress	Elapsed time	Dial	Fitted Primary	Fitted Primary and Secondary
psf	min	in	in	in
200.0	*0.00*	0.01078	0.01078	0.01078
	0.10	0.01084	0.01085	0.01085
	0.25	0.01091	0.01089	0.01089
	0.50	0.01099	0.01094	0.01094
	1.00	0.01102	0.01101	0.01101
	2.00	0.01108	0.01110	0.01110
	4.00	0.01125	0.01124	0.01124
	8.00	0.01143	0.01142	0.01142
	15.00	0.01157	0.01157	0.01157
	30.00	0.01165	0.01166	0.01166
	60.00	0.01176	0.01167	0.01167
	120.00	0.01176	0.01167	0.01176
	240.00	0.01196	0.01167	0.01195
	480.00	0.01213	0.01167	0.01213
	1140.00	0.01231	0.01167	0.01237

h_0 =	0.99622	in
U_s =	99%	
t_s =	33.68	min
d_s =	0.01166	in
d_0 =	0.01078	in
d_{100} =	0.01167	in
d =	0.49789	in
C_v =	0.0131	in^2/min
r_i =	-0.3%	
r_p =	58.6%	
r_s =	41.7%	
Slope =	0.0006	
Intercept =	0.0105	
h_c =	0.9953	in
t_c =	85.95	min
C_{ae} =	0.062%	



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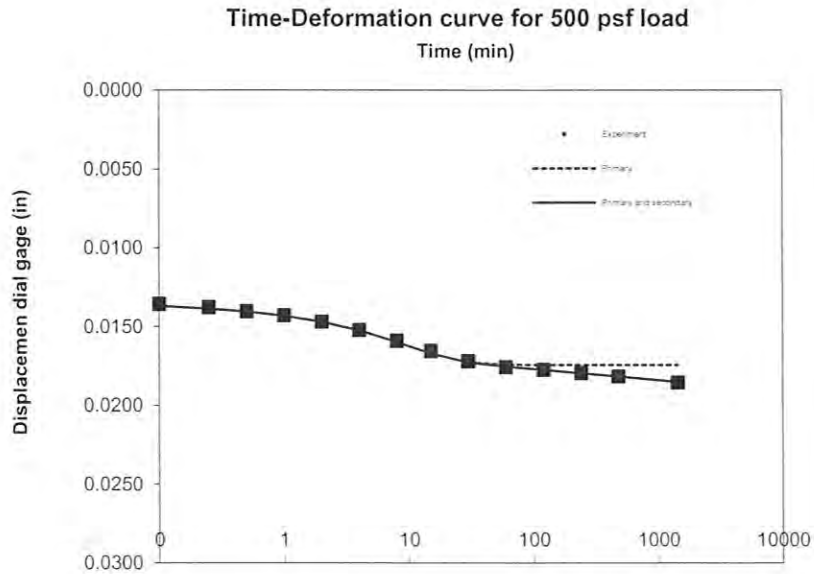
Applied stress	Elapsed time	Dial	Fitted Primary	Fitted Primary and Secondary
psf	min	in	in	in
500.0	*0.00*	0.01301	0.01339	0.01339
	0.10	0.01357	0.01368	0.01368
	0.25	0.01377	0.01385	0.01385
	0.50	0.01404	0.01404	0.01404
	1.00	0.01430	0.01431	0.01431
	2.00	0.01471	0.01470	0.01470
	4.00	0.01523	0.01524	0.01524
	8.00	0.01590	0.01597	0.01597
	15.00	0.01656	0.01671	0.01671
	30.00	0.01720	0.01727	0.01727
	60.00	0.01757	0.01741	0.01753
	120.00	0.01774	0.01742	0.01774
	240.00	0.01796	0.01742	0.01795
	480.00	0.01816	0.01742	0.01816
	1440.00	0.01856	0.01742	0.01850

h_0 =	0.99399	in
U_s =	99%	
t_s =	43.28	min
d_s =	0.01738	in
d_0 =	0.01339	in
d_{100} =	0.01742	in
d =	0.49580	in
C_v =	0.0101	in^2/min
r_i =	6.9%	
r_p =	72.6%	
r_s =	20.5%	
Slope =	0.0007	
Intercept =	0.0163	
h_c =	0.9896	in
t_c =	41.58	min
C_{ae} =	0.071%	



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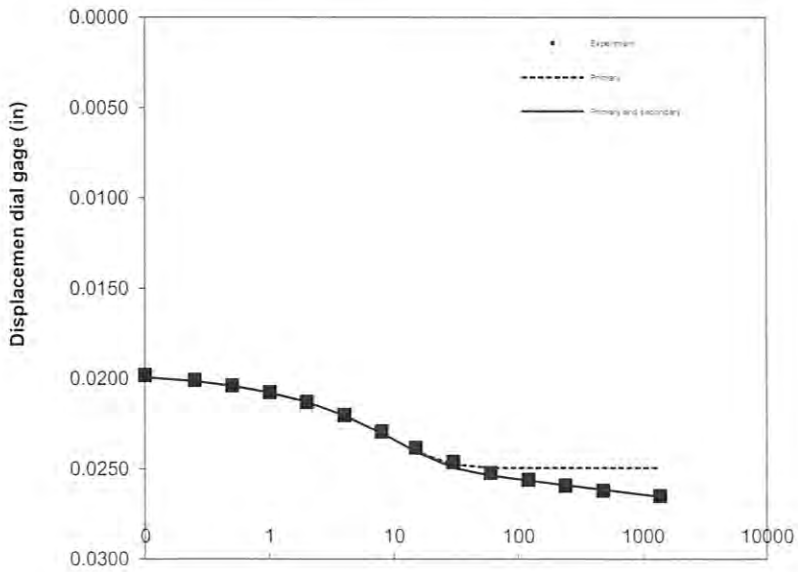
Applied stress	Elapsed time	Dial	Fitted Primary	Fitted Primary and Secondary
psf	min	in	in	in
1000.0	*0.00*	0.01915	0.01951	0.01951
	0.10	0.01981	0.01991	0.01991
	0.25	0.02009	0.02014	0.02014
	0.50	0.02040	0.02040	0.02040
	1.00	0.02077	0.02077	0.02077
	2.00	0.02130	0.02130	0.02130
	4.00	0.02203	0.02203	0.02203
	8.00	0.02293	0.02304	0.02304
	15.00	0.02381	0.02402	0.02402
	30.00	0.02462	0.02475	0.02493
	60.00	0.02522	0.02493	0.02536
	120.00	0.02559	0.02494	0.02563
	240.00	0.02592	0.02494	0.02589
	480.00	0.02619	0.02494	0.02615
	1380.00	0.02650	0.02494	0.02654

h_0 =	0.98785	in
U_s =	99%	
t_s =	41.93	min
d_s =	0.02488	in
d_0 =	0.01951	in
d_{100} =	0.02494	in
d =	0.49239	in
C_v =	0.0103	in^2/min
r_i =	4.9%	
r_p =	73.7%	
r_s =	21.3%	
Slope =	0.0009	
Intercept =	0.0239	
h_c =	0.9821	in
t_c =	18.53	min
C_{ae} =	0.087%	

Time-Deformation curve for 1000 psf load



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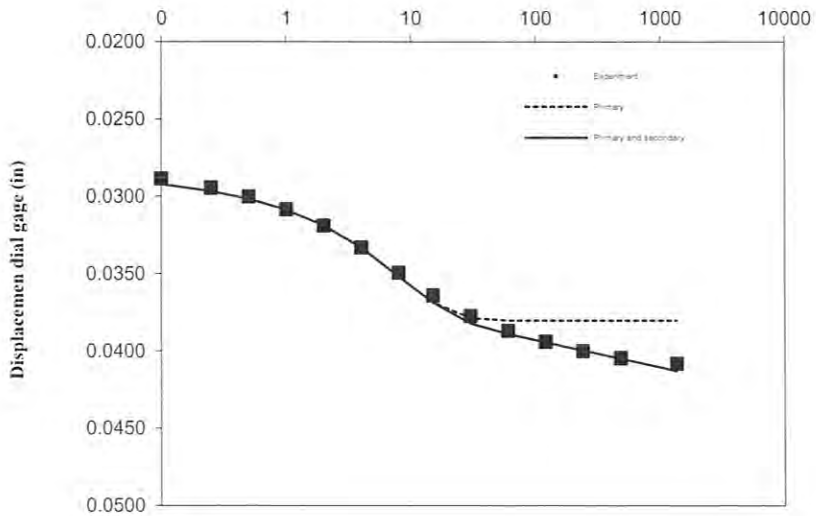
Applied stress	Elapsed time	Dial	Fitted Primary	Fitted Primary and Secondary
psf	min	in	in	in
2000.0	*0.00*	0.02757	0.02843	0.02843
	0.10	0.02887	0.02920	0.02920
	0.25	0.02946	0.02965	0.02965
	0.50	0.03003	0.03016	0.03016
	1.00	0.03086	0.03087	0.03087
	2.00	0.03191	0.03189	0.03189
	4.00	0.03331	0.03332	0.03332
	8.00	0.03494	0.03518	0.03518
	15.00	0.03641	0.03684	0.03684
	30.00	0.03774	0.03784	0.03819
	60.00	0.03868	0.03801	0.03889
	120.00	0.03940	0.03802	0.03943
	240.00	0.04000	0.03802	0.03996
	480.00	0.04046	0.03802	0.04049
	1350.00	0.04081	0.03802	0.04127

h_0 =	0.97943	in
U_s =	99%	
t_s =	34.82	min
d_s =	0.03792	in
d_0 =	0.02843	in
d_{100} =	0.03802	in
d =	0.48689	in
C_v =	0.0121	in^2/min
r_i =	6.4%	
r_p =	72.5%	
r_s =	21.1%	
Slope =	0.0018	
Intercept =	0.0358	
h_c =	0.9690	in
t_c =	18.86	min
C_{ae} =	0.181%	

Time-Deformation curve for 2000 psf load



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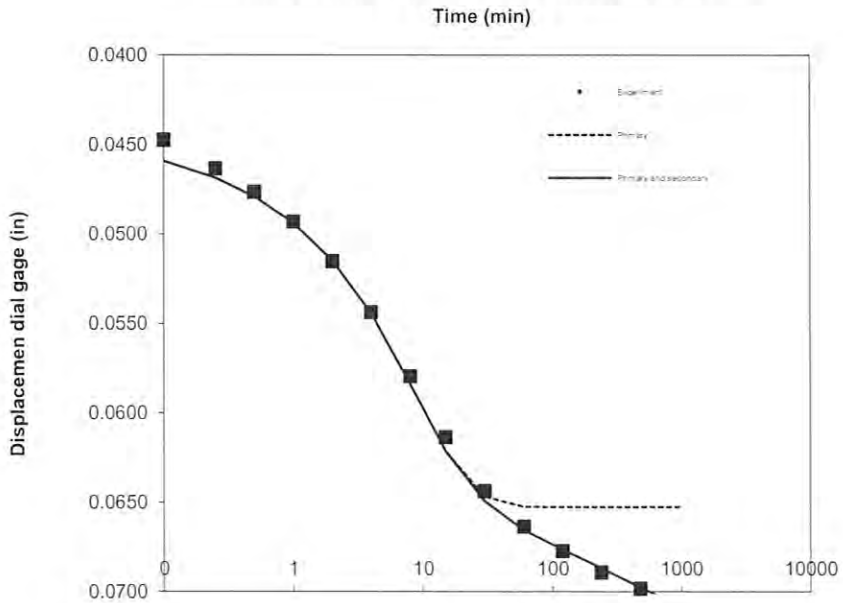
Applied stress	Elapsed time	Dial	Fitted Primary	Fitted Primary and Secondary
psf	min	in	in	in
4000.0	0.00	0.04085	0.04433	0.04433
	0.10	0.04475	0.04592	0.04592
	0.25	0.04634	0.04684	0.04684
	0.50	0.04765	0.04789	0.04789
	1.00	0.04932	0.04936	0.04936
	2.00	0.05152	0.05145	0.05145
	4.00	0.05437	0.05440	0.05440
	8.00	0.05795	0.05834	0.05834
	15.00	0.06135	0.06211	0.06211
	30.00	0.06437	0.06467	0.06491
	60.00	0.06634	0.06524	0.06654
	120.00	0.06772	0.06526	0.06762
	240.00	0.06891	0.06526	0.06868
	480.00	0.06982	0.06526	0.06974
	960.00	0.07060	0.06526	0.07080

h_0 =	0.96615	in
U_s =	99%	
t_s =	39.17	min
d_s =	0.06505	in
d_0 =	0.04433	in
d_{100} =	0.06526	in
d =	0.47610	in
C_v =	0.0103	in^2/min
r_i =	11.7%	
r_p =	70.4%	
r_s =	17.9%	
Slope =	0.0035	
Intercept =	0.0603	
h_c =	0.9417	in
t_c =	25.66	min
C_{ae} =	0.374%	

Time-Deformation curve for 4000 psf load



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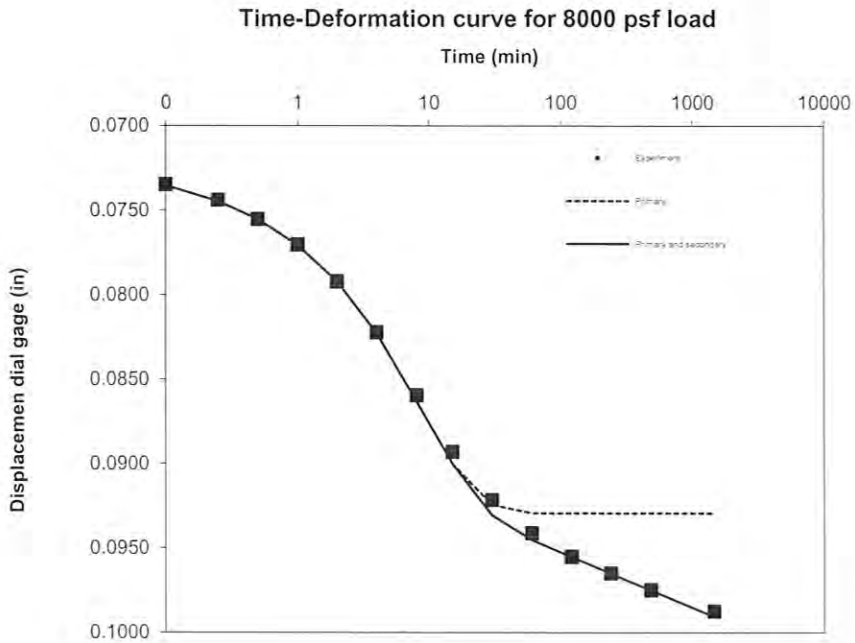
Applied stress	Elapsed time	Dial	Fitted Primary	Fitted Primary and Secondary
psf	min	in	in	in
8000.0	0.00	0.07180	0.07187	0.07187
	0.10	0.07348	0.07351	0.07351
	0.25	0.07440	0.07446	0.07446
	0.50	0.07554	0.07554	0.07554
	1.00	0.07704	0.07706	0.07706
	2.00	0.07923	0.07920	0.07920
	4.00	0.08223	0.08224	0.08224
	8.00	0.08596	0.08627	0.08627
	15.00	0.08933	0.09001	0.09001
	30.00	0.09218	0.09243	0.09307
	60.00	0.09412	0.09292	0.09453
	120.00	0.09553	0.09293	0.09553
	240.00	0.09650	0.09293	0.09651
	480.00	0.09749	0.09293	0.09749
	1440.00	0.09876	0.09293	0.09904

h_0 =	0.93520	in
U_s =	99%	
t_s =	37.38	min
d_s =	0.09272	in
d_0 =	0.07187	in
d_{100} =	0.09293	in
d =	0.46230	in
C_v =	0.0102	in^2/min
r_i =	0.2%	
r_p =	78.1%	
r_s =	21.6%	
Slope =	0.0033	
Intercept =	0.0888	
h_c =	0.9141	in
t_c =	19.14	min
C_{ae} =	0.356%	



AASHTO R18

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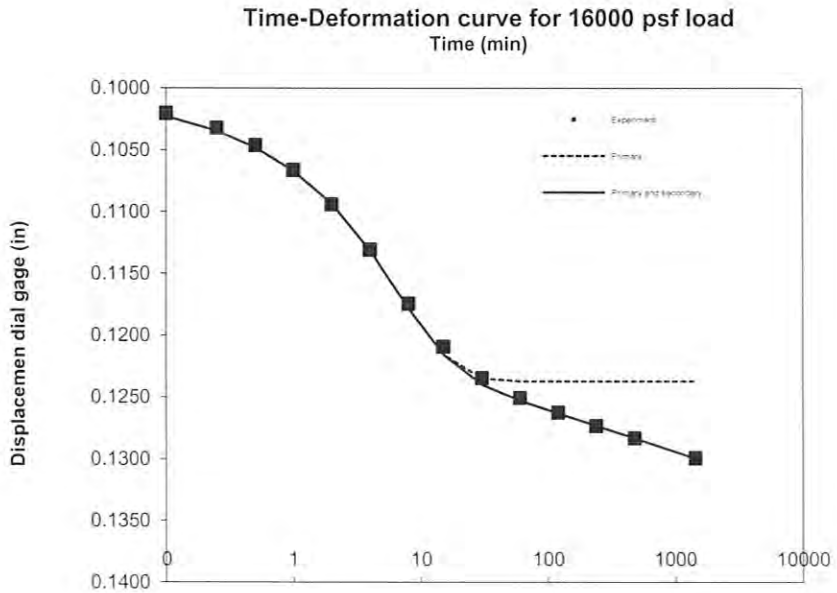
Applied stress	Elapsed time	Dial	Fitted Primary	Fitted Primary and Secondary
psf	min	in	in	in
16000.0	*0.00*	0.10017	0.10023	0.10023
	0.10	0.10204	0.10226	0.10226
	0.25	0.10323	0.10345	0.10345
	0.50	0.10463	0.10478	0.10478
	1.00	0.10662	0.10667	0.10667
	2.00	0.10941	0.10934	0.10934
	4.00	0.11308	0.11311	0.11311
	8.00	0.11746	0.11778	0.11778
	15.00	0.12092	0.12157	0.12157
	30.00	0.12347	0.12347	0.12400
	60.00	0.12508	0.12371	0.12526
	120.00	0.12627	0.12371	0.12629
	240.00	0.12734	0.12371	0.12731
	480.00	0.12835	0.12371	0.12834
	1440.00	0.12995	0.12371	0.12996

h_0 =	0.90683	in
U_s =	99%	
t_s =	30.13	min
d_s =	0.12347	in
d_0 =	0.10023	in
d_{100} =	0.12371	in
d =	0.44752	in
C_v =	0.0118	in^2/min
r_i =	0.2%	
r_p =	78.9%	
r_s =	20.9%	
Slope =	0.0034	
Intercept =	0.1192	
h_c =	0.8833	in
t_c =	20.91	min
C_{ae} =	0.385%	



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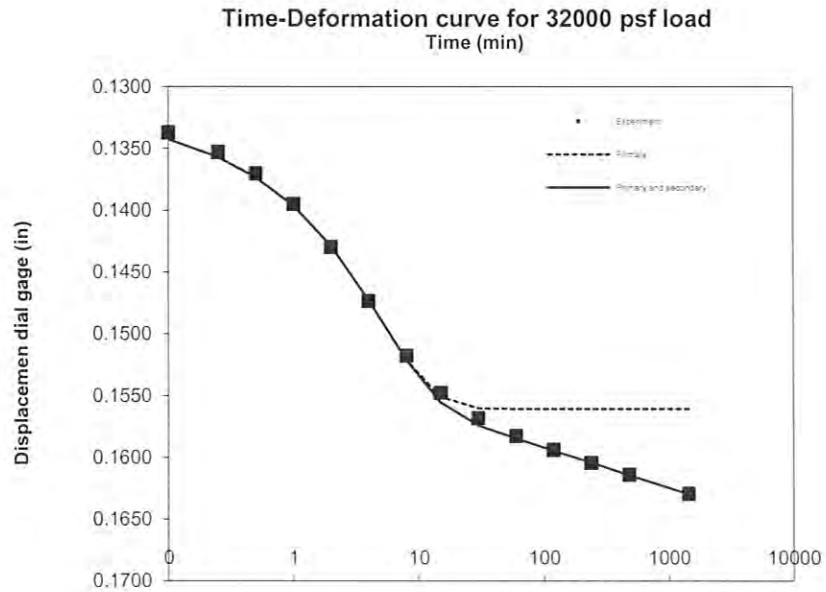
Applied stress	Elapsed time	Dial	Fitted Primary	Fitted Primary and Secondary
psf	min	in	in	in
32000.0	*0.00*	0.13128	0.13177	0.13177
	0.10	0.13372	0.13424	0.13424
	0.25	0.13529	0.13568	0.13568
	0.50	0.13703	0.13730	0.13730
	1.00	0.13950	0.13959	0.13959
	2.00	0.14299	0.14283	0.14283
	4.00	0.14735	0.14725	0.14725
	8.00	0.15178	0.15211	0.15211
	15.00	0.15478	0.15509	0.15550
	30.00	0.15684	0.15600	0.15740
	60.00	0.15828	0.15605	0.15843
	120.00	0.15940	0.15605	0.15942
	240.00	0.16043	0.15605	0.16041
	480.00	0.16142	0.15605	0.16140
	1440.00	0.16294	0.15605	0.16296

h_0 =	0.87572	in
U_s =	99%	
t_s =	21.84	min
d_s =	0.15581	in
d_0 =	0.13177	in
d_{100} =	0.15605	in
d =	0.43155	in
C_v =	0.0152	in^2/min
r_i =	1.5%	
r_p =	76.7%	
r_s =	21.8%	
Slope =	0.0033	
Intercept =	0.1526	
h_c =	0.8510	in
t_c =	11.24	min
C_{ae} =	0.385%	



AASHTO R18

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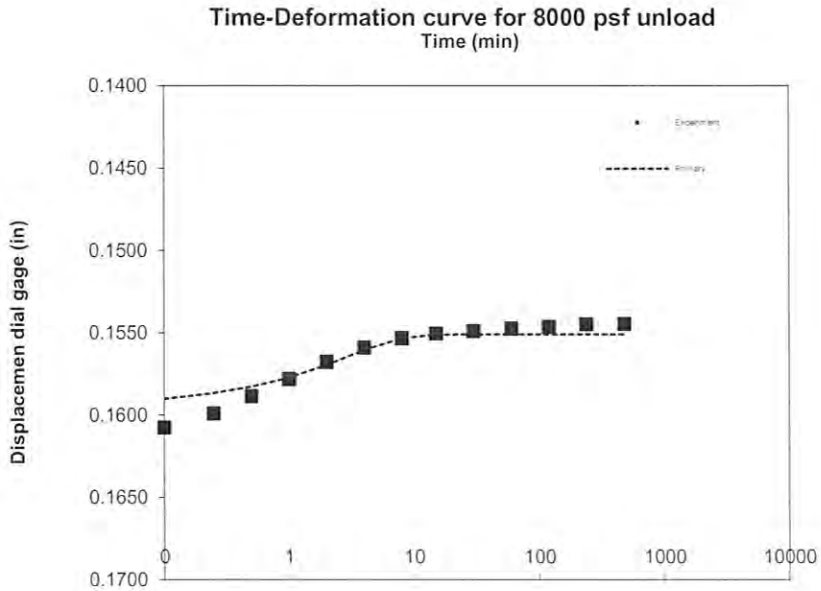
Applied stress	Elapsed time	Dial	Fitted Primary	Fitted Primary and Secondary
psf	min	in	in	in
8000.0	*0.00*	0.16219	0.15962	0.15962
	0.10	0.16076	0.15902	0.15902
	0.25	0.15991	0.15867	0.15867
	0.50	0.15887	0.15828	0.15828
	1.00	0.15782	0.15772	0.15772
	2.00	0.15676	0.15694	0.15694
	4.00	0.15590	0.15603	0.15603
	8.00	0.15533	0.15533	0.15533
	15.00	0.15506	0.15511	0.15519
	30.00	0.15489	0.15508	0.15529
	60.00	0.15476	0.15508	0.15541
	120.00	0.15464	0.15508	0.15553
	240.00	0.15448	0.15508	0.15565
	480.00	0.15447	0.15508	0.15577

h_0 =	0.84481	in
U_s =	99%	
t_s =	12.98	min
d_s =	0.15513	in
d_0 =	0.15962	in
d_{100} =	0.15508	in
d =	0.42483	in
C_v =	0.0248	in^2/min
r_i =	33.3%	
r_p =	58.7%	
r_s =	8.0%	
Slope =	-0.0004	
Intercept =	0.1555	
h_c =	0.8519	in
t_c =	9.13	min
C_{ae} =	0.047%	



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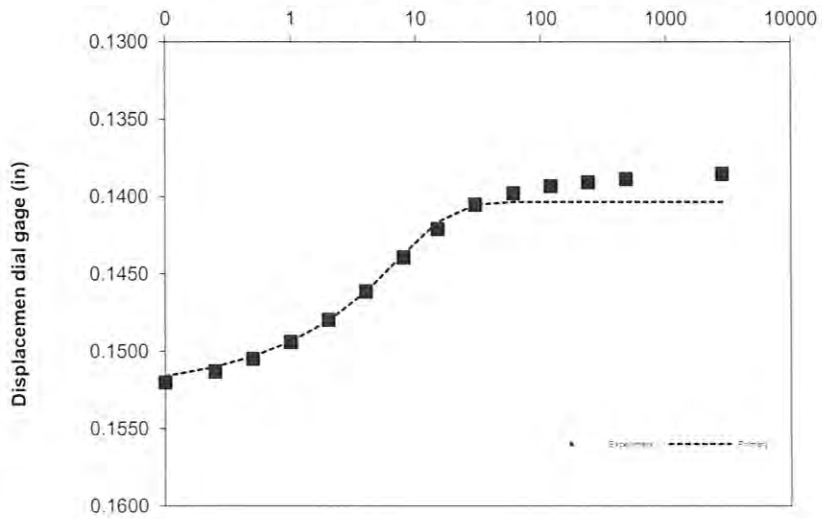
Applied stress	Elapsed time	Dial	Fitted Primary	Fitted Primary and Secondary
psf	min	in	in	in
2000.0	*0.00*	0.15392	0.15264	0.15264
	0.10	0.15203	0.15161	0.15161
	0.25	0.15131	0.15101	0.15101
	0.50	0.15049	0.15033	0.15044
	1.00	0.14941	0.14938	0.14962
	2.00	0.14798	0.14803	0.14840
	4.00	0.14614	0.14612	0.14663
	8.00	0.14394	0.14369	0.14434
	15.00	0.14210	0.14163	0.14240
	30.00	0.14052	0.14050	0.14141
	60.00	0.13978	0.14034	0.14138
	120.00	0.13933	0.14033	0.14152
	240.00	0.13908	0.14033	0.14165
	480.00	0.13888	0.14033	0.14179
	2820.00	0.13853	0.14033	0.14214

h_0 =	0.85308	in
U_s =	99%	
t_s =	32.29	min
d_s =	0.14046	in
d_0 =	0.15264	in
d_{100} =	0.14033	in
d =	0.43026	in
C_v =	0.0102	in^2/min
r_i =	8.3%	
r_p =	80.0%	
r_s =	11.7%	
Slope =	-0.0005	
Intercept =	0.1401	
h_c =	0.8667	in
t_c =	0.29	min
C_{ae} =	0.052%	

Time-Deformation curve for 2000 psf unload



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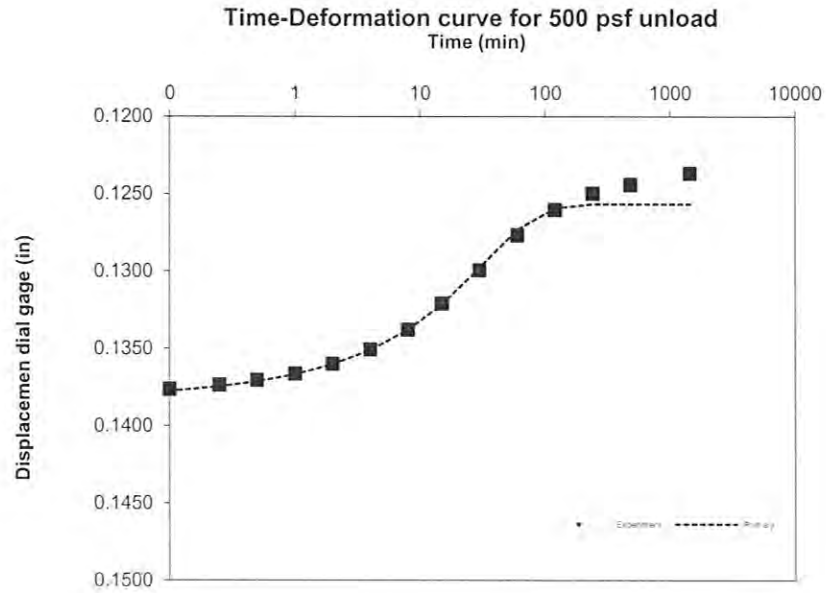
Applied stress	Elapsed time	Dial	Fitted Primary	Fitted Primary and Secondary
psf	min	in	in	in
500.0	*0.00*	0.13826	0.13824	0.13824
	0.10	0.13765	0.13774	0.13774
	0.25	0.13737	0.13745	0.13745
	0.50	0.13706	0.13713	0.13713
	1.00	0.13664	0.13667	0.13667
	2.00	0.13602	0.13601	0.13601
	4.00	0.13509	0.13509	0.13509
	8.00	0.13379	0.13379	0.13379
	15.00	0.13211	0.13215	0.13215
	30.00	0.12996	0.12977	0.12977
	60.00	0.12769	0.12732	0.12732
	120.00	0.12604	0.12593	0.12593
	240.00	0.12499	0.12567	0.12634
	480.00	0.12442	0.12566	0.12738
	1440.00	0.12368	0.12566	0.12903

h_0 =	0.86874	in
U_s =	99%	
t_s =	145.11	min
d_s =	0.12579	in
d_0 =	0.13824	in
d_{100} =	0.12566	in
d =	0.43753	in
C_v =	0.0023	in^2/min
r_i =	0.2%	
r_p =	86.2%	
r_s =	13.6%	
Slope =	-0.0035	
Intercept =	0.1333	
h_c =	0.8813	in
t_c =	154.10	min
C_{ae} =	0.394%	



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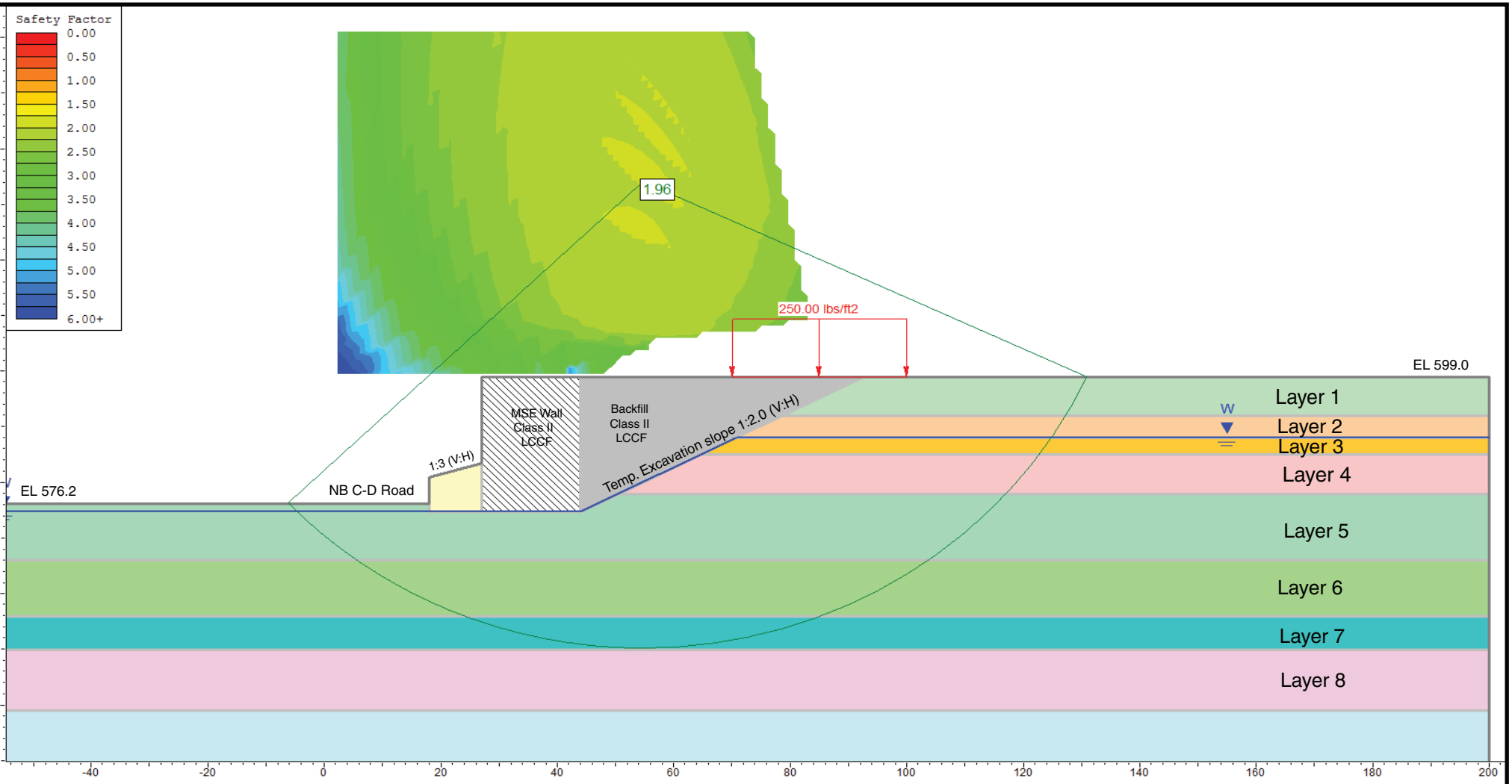
APPENDIX C



Undrained Analysis, Station 6324+44.49, Ref Borings 22-RWB-01 and VST-06

Layer ID	Description	Unit Weight (pcf)	Undrained Cohesion (psf)	Undrained Friction Angle (degrees)
1	V Stiff to Hard SILTY CLAY LOAM FILL	125	3000	0
2	M Stiff to Hard SILTY CLAY FILL	120	1100	0
3	Medium Dense GRAVELLY LOAM FILL	120	0	30
4	Stiff to V Stiff SILTY CLAY	120	1800	0
5	Soft to M Stiff CLAY to SILTY CLAY	115	550	0
6	Soft to M Stiff CLAY to SILTY CLAY	115	640	0
7	Soft to M Stiff CLAY to SILTY CLAY	115	750	0
8	Soft to M Stiff CLAY to SILTY CLAY	115	950	0

GLOBAL STABILITY ANALYSIS: CIRCLE INTERCHANGE RECONSTRUCTION
RETAINING WALL 22A, SN 016-1813, COOK COUNTY, ILLINOIS

SCALE: GRAPHICAL	APPENDIX C-1	DRAWN BY: NSB CHECKED BY: MWS

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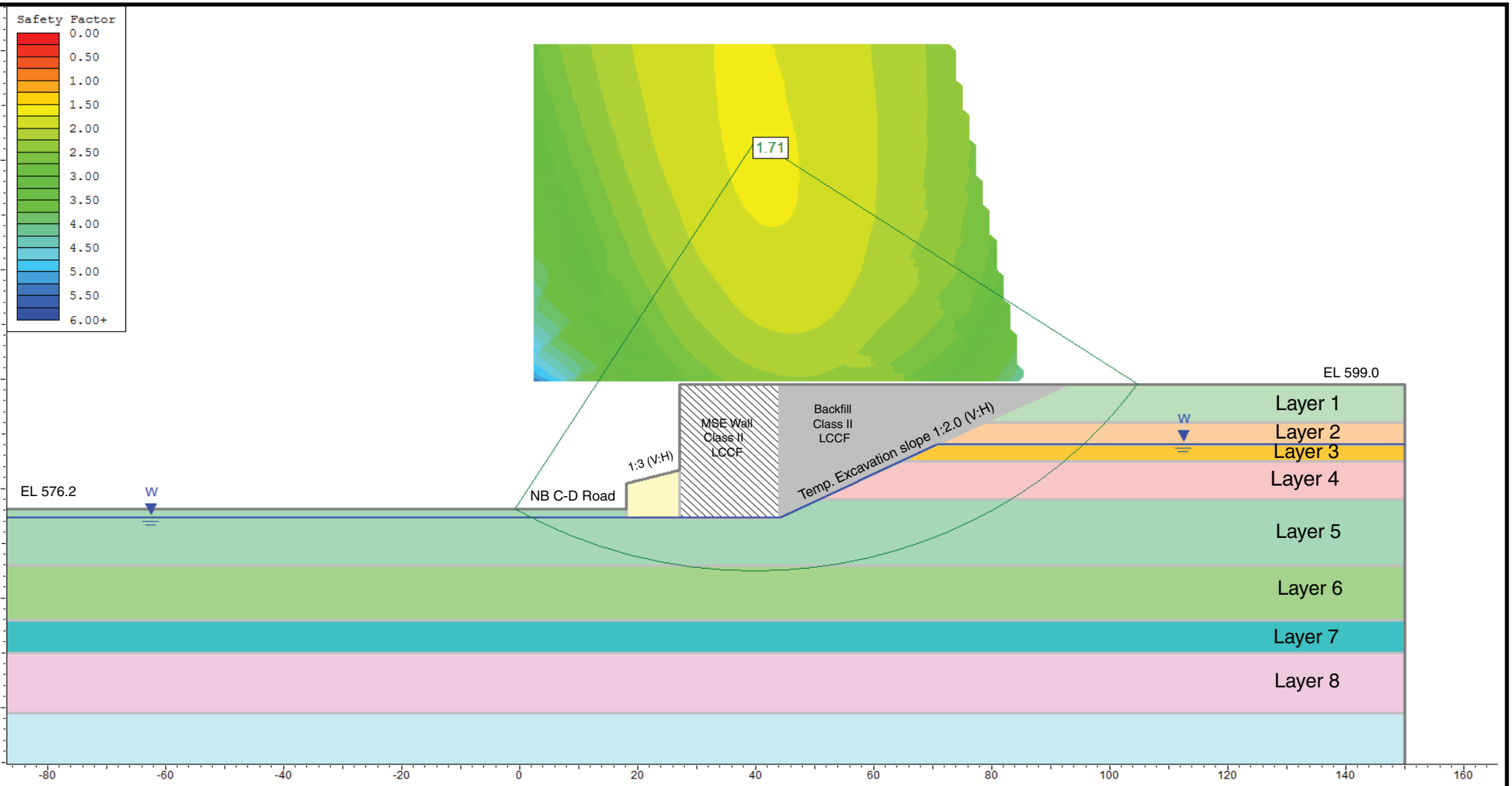
FOR AECOM | 1100-04-01



Drained Analysis, Station 6324+44.49, Ref Borings 22-RWB-01 and VST-06

Layer ID	Description	Unit Weight (pcf)	Drained Cohesion (psf)	Drained Friction Angle (degrees)
1	V Stiff to Hard SILTY CLAY LOAM FILL	125	100	30
2	M Stiff to Hard SILTY CLAY FILL	120	100	30
3	Medium Dense GRAVELLY LOAM FILL	120	0	30
4	Stiff to V Stiff SILTY CLAY	120	100	30
5	Soft to M Stiff CLAY to SILTY CLAY	115	0	27
6	Soft to M Stiff CLAY to SILTY CLAY	115	0	27
7	Soft to M Stiff CLAY to SILTY CLAY	115	0	27
8	Soft to M Stiff CLAY to SILTY CLAY	115	80	29

GLOBAL STABILITY ANALYSIS: CIRCLE INTERCHANGE RECONSTRUCTION
RETAINING WALL 22A, SN 016-1813, COOK COUNTY, ILLINOIS

SCALE: GRAPHICAL | APPENDIX C-2 | DRAWN BY: NSB | CHECKED BY: MWS

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FOR AECOM | 1100-04-01

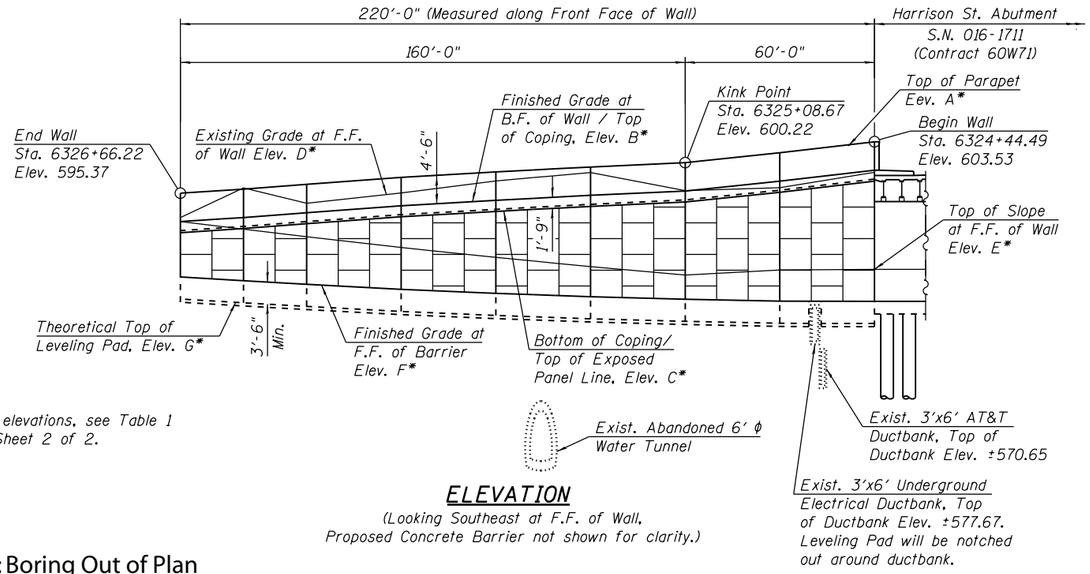
APPENDIX D

Bench Mark: Chisel "X" on chain bolt of fire hydrant in front of 555 W. Harrison St. Elev. 594.46

Existing Structure: Existing Sheet Pile Wall along Existing Ramp EN.

Traffic on Ramp NE, Des Plaines Street, and Harrison Street will be maintained with stage construction. The Existing CTA Bus turn around will be closed during construction.

No Salvage.

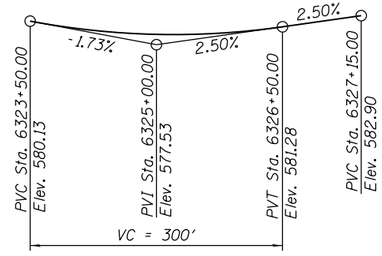


* For elevations, see Table 1 on Sheet 2 of 2.

ELEVATION

(Looking Southeast at F.F. of Wall. Proposed Concrete Barrier not shown for clarity.)

Notes:
1.) Wall offsets are measured from the ℄ of Proposed NB C-D Road to the front face of precast panels.
2.) F.F. denotes Front Face.
3.) B.F. denotes Back Face.
4.) Proposed drainage information shown is conceptual and will be determined during final design.



PROFILE GRADE

(℄ NB C-D Road)

CURVE DATA

(NB C-D Road)
Prop. Curve P-NCD-NX-3
P.I. Sta. = 6324+41.27
Δ = 20° 56' 44" (RT)
D = 17° 21' 44"
R = 330.00'
T = 61.00'
L = 120.64'
E = 5.59'
e = 5.80%
T.R. = NA
S.E. Run = 105'
P.C. Sta. = 6323+80.27
P.T. Sta. = 6325+00.91

(NB C-D Road)
Prop. Curve P-NCD-NX-4
P.I. Sta. = 6328+76.78
Δ = 59° 05' 41" (LT)
D = 14° 08' 50"
R = 405.00'
T = 229.58'
L = 417.72'
E = 60.54'
e = 5.40%
T.R. = 36'
S.E. Run = 98'
P.C. Sta. = 6326+47.20
P.T. Sta. = 6330+64.91

HIGHWAY CLASSIFICATION

NB C-D Road
Functional Class: Interstate
ADT: NA (2012): 17,000 (2040)
ADTT: NA (2012): 440 (2040)
DHV: 1,680 (2040)
Design Speed: 30 m.p.h.
Posted Speed: 30 m.p.h.
One-Way Traffic
Directional Distribution: 100%

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge Design Specifications 8th Edition

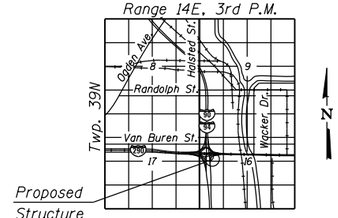
DESIGN STRESSES

FIELD UNITS

f'c = 3,500 psi
fy = 60,000 psi (Reinforcement)

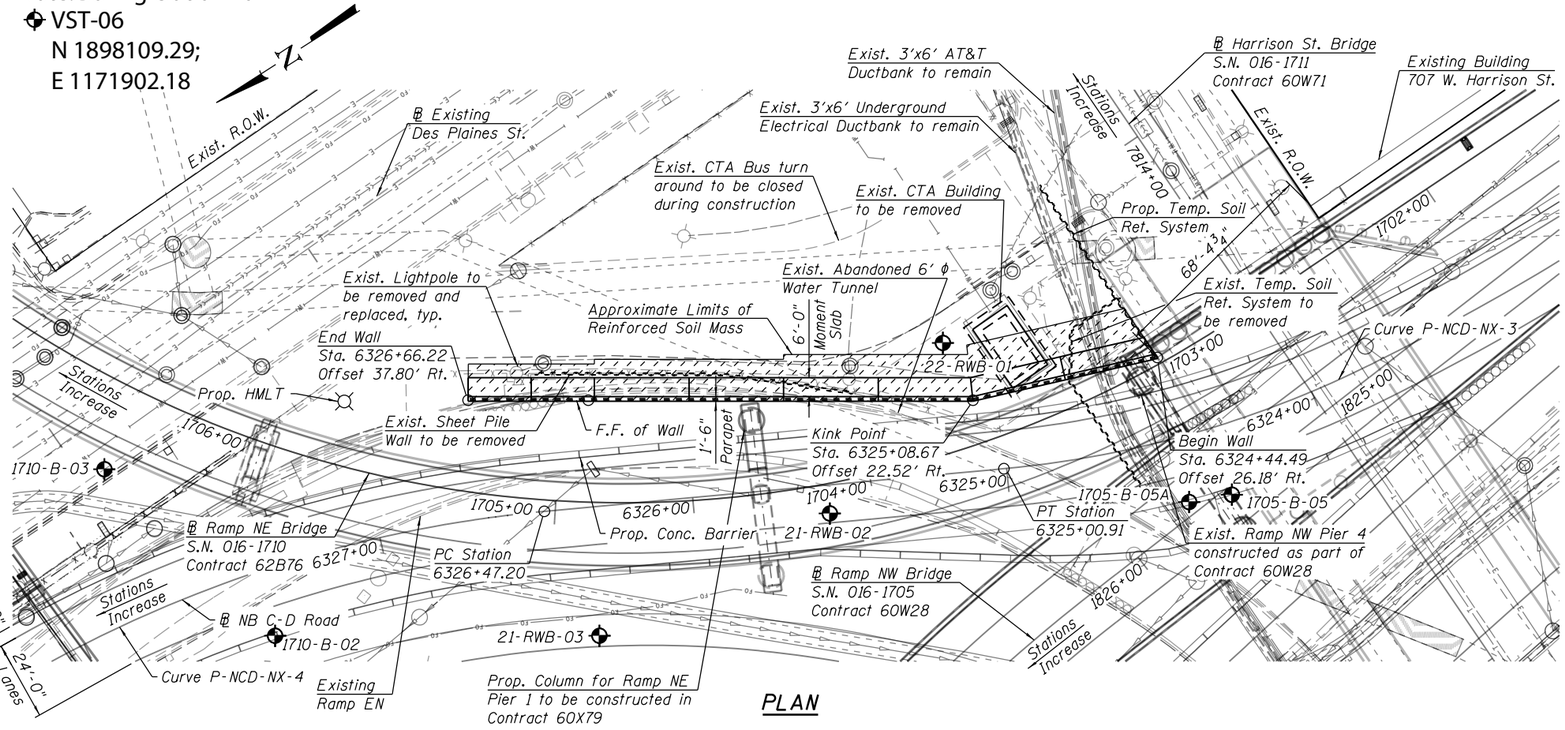
PRECAST UNITS

f'c = 4,500 psi



LOCATION SKETCH

Note: Boring Out of Plan
VST-06
N 1898109.29;
E 1171902.18



PLAN

LEGEND:

Ex. Chain Link Fence	— x — x — x —	Soil Boring	⊕
Combined Sewer	→→→→→→→→→→	Existing Catch Basin	○
Electric	—E—E—	Proposed Catch Basin	●
Ex. Storm Sewer	—▷—▷—▷—	Existing Manhole	◎
Prop. Storm Sewer	—▷—▷—▷—	Proposed Manhole	◉
Ex. ITS Cable	— — — — — —	Proposed Inlet	▬
Ex. Gas Line	—G—	Limits of Soil Reinforcement	▨
Ex. Fiber Optic	—fo—fo—		
Ex. AT&T Line	—T—T—		

GENERAL PLAN
RETAINING WALL 22A ALONG NB C-D ROAD
F.A.I. RTE. 90/94 (KENNEDY EXPRESSWAY)
SECTION 2014-005R&B
COOK COUNTY
STATION 6324+44.49 TO STATION 6326+66.22
STRUCTURE NO. 016-1813

TranSystems

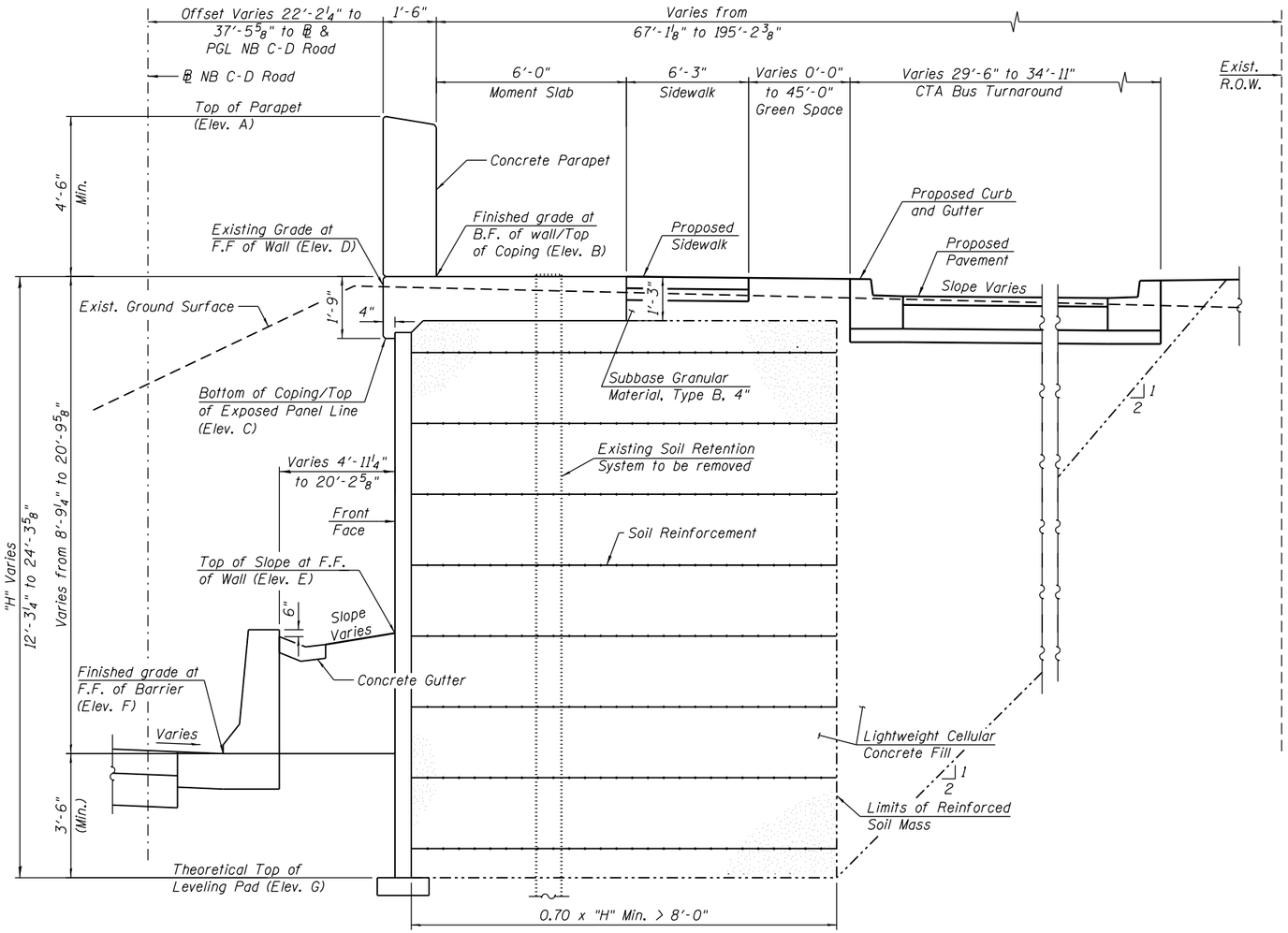
USER NAME = wjcolletti	DESIGNED - WJC	REVISED -	
	CHECKED - JM/MDS	REVISED -	
PLOT SCALE = 48.00 '/ in.	DRAWN - WJC	REVISED -	
PLOT DATE = 1/31/2018	CHECKED - JM/MDS	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 1 OF 2 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94	2014-005R&B	COOK	2	1
		CONTRACT NO. 60X79		
	ILLINOIS FED. AID PROJECT			

5/2/18 PM - pw:\\6if479-PWINT.oecomonline.local:AECOM_DS02.NA\Documents\01Americas\Transportation\60269938 Circle\Phase_IN\000_CAD\008.Structural\Structure.016-1813\TSL\Sheets\016813-60X79-SHT-TSL-001



TYPICAL CROSS SECTION

(Looking Upstation)

TABLE 1 - WALL ELEVATIONS

Station	Offset	Elevation A	Elevation B	Elevation C	Elevation D	Elevation E	Elevation F	Elevation G
6324+44.49	26.18' Rt.	603.53	599.03	597.28	598.68	583.30	578.23	574.73
6324+77.06	25.77' Rt.	601.78	597.28	595.53	596.25	583.19	578.25	574.75
6325+08.67	22.52' Rt.	600.22	595.72	593.97	595.77	582.42	578.57	575.07
6325+38.54	25.29' Rt.	599.53	595.03	593.28	598.66	583.75	578.97	575.47
6325+68.41	28.07' Rt.	598.74	594.24	592.49	597.32	585.20	579.49	575.99
6325+98.29	30.84' Rt.	597.88	593.38	591.63	595.41	586.78	580.15	576.65
6326+28.16	33.61' Rt.	596.78	592.28	590.53	593.77	588.48	580.93	577.43
6326+48.00	35.46' Rt.	596.03	591.53	589.78	596.21	589.68	581.52	578.02
6326+66.22	37.80' Rt.	595.37	590.87	589.12	591.51	590.87	582.10	578.60

Elevation A- Top of Parapet
Elevation B- Finished Grade at Back Face of Wall / Top of Coping
Elevation C- Bottom of Coping / Top of Exposed Panel Line
Elevation D- Existing Grade at Front Face of Wall
Elevation E- Top of Slope at Front Face of Wall
Elevation F- Finished Grade at Front Face of Barrier
Elevation G- Theoretical Top of Leveling Pad

CROSS SECTIONS AND DETAILS
RETAINING WALL 22A ALONG NB C-D ROAD
F.A.I. RTE. 90/94 (KENNEDY EXPRESSWAY)
SECTION 2014-005R&B
COOK COUNTY
STATION 6324+44.49 TO STATION 6326+66.22
STRUCTURE NO. 016-1813

TranSystems

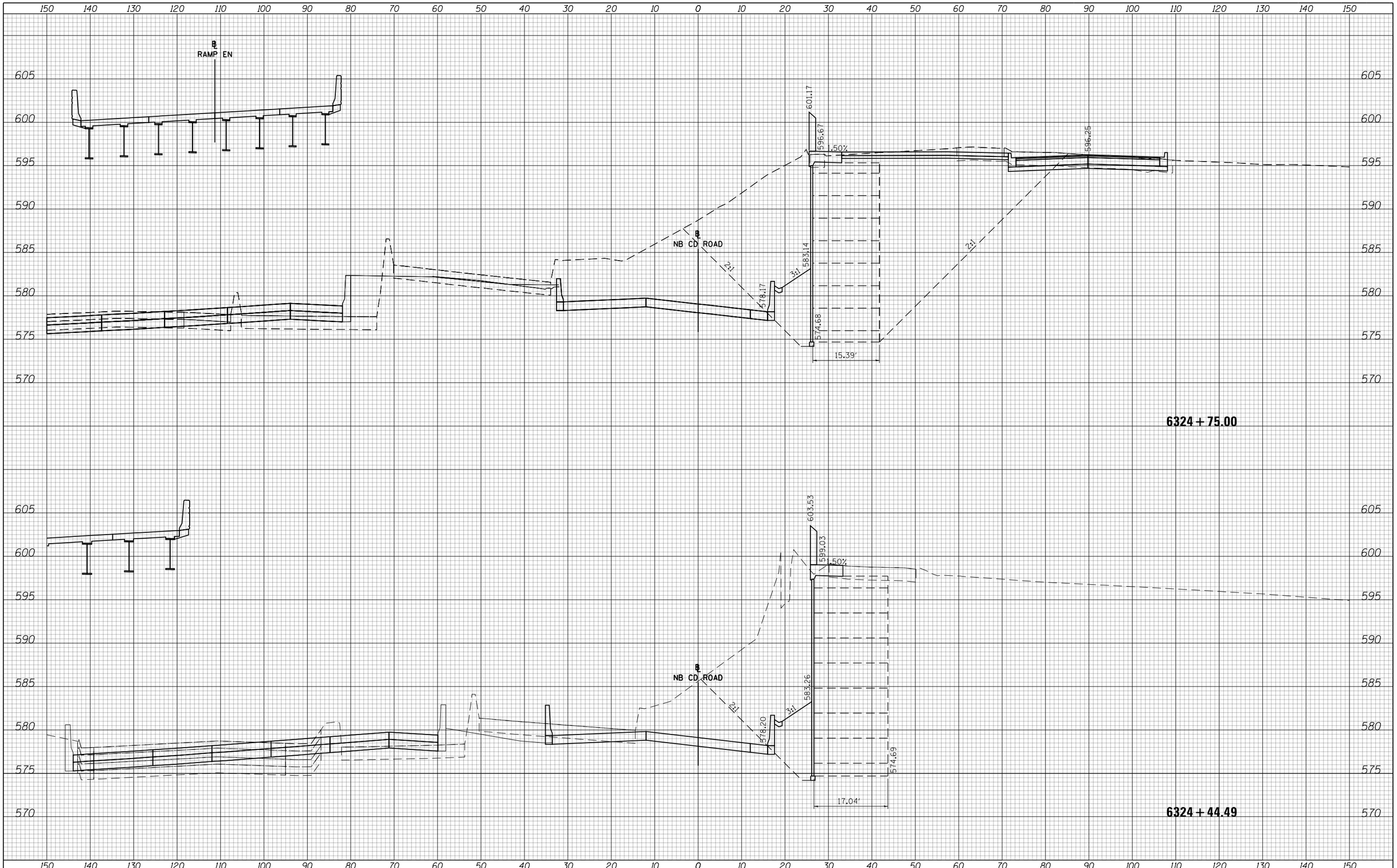
USER NAME = wjcolletti	DESIGNED - WJC	REVISED -
	CHECKED - JM/MDS	REVISED -
PLOT SCALE = 0.17 ' / in.	DRAWN - WJC	REVISED -
PLOT DATE = 1/31/2018	CHECKED - JM/MDS	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 2 OF 2 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94	2014-005R&B	COOK	2	2
		CONTRACT NO. 60X79		
	ILLINOIS FED. AID PROJECT			

APPENDIX E



FINAL SURVEY

NOTE BOOK

NO.

SURVEYED

PLOTTED

TEMPLATE

AREAS

AREAS CHECKED

BY

DATE

ORIGINAL SURVEY

NOTE BOOK

NO.

SURVEYED

PLOTTED

TEMPLATE

AREAS

AREAS CHECKED

BY

DATE

TranSystems

D160X79-XS-WALL22A.dgn	DESIGNED - MKW	REVISED -
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PLOT SCALE = 19.9999 ' / in.	CHECKED - JMG	REVISED -
PLOT DATE = 1/17/2018	DATE - 8/20/2014	REVISED -

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DEPARTMENT OF TRANSPORTATION

CROSS SECTIONS
PROPOSED RETAINING WALL 22A

SCALE: 10:H 5:V | SHEET OF SHEETS | STA. | TO STA.

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
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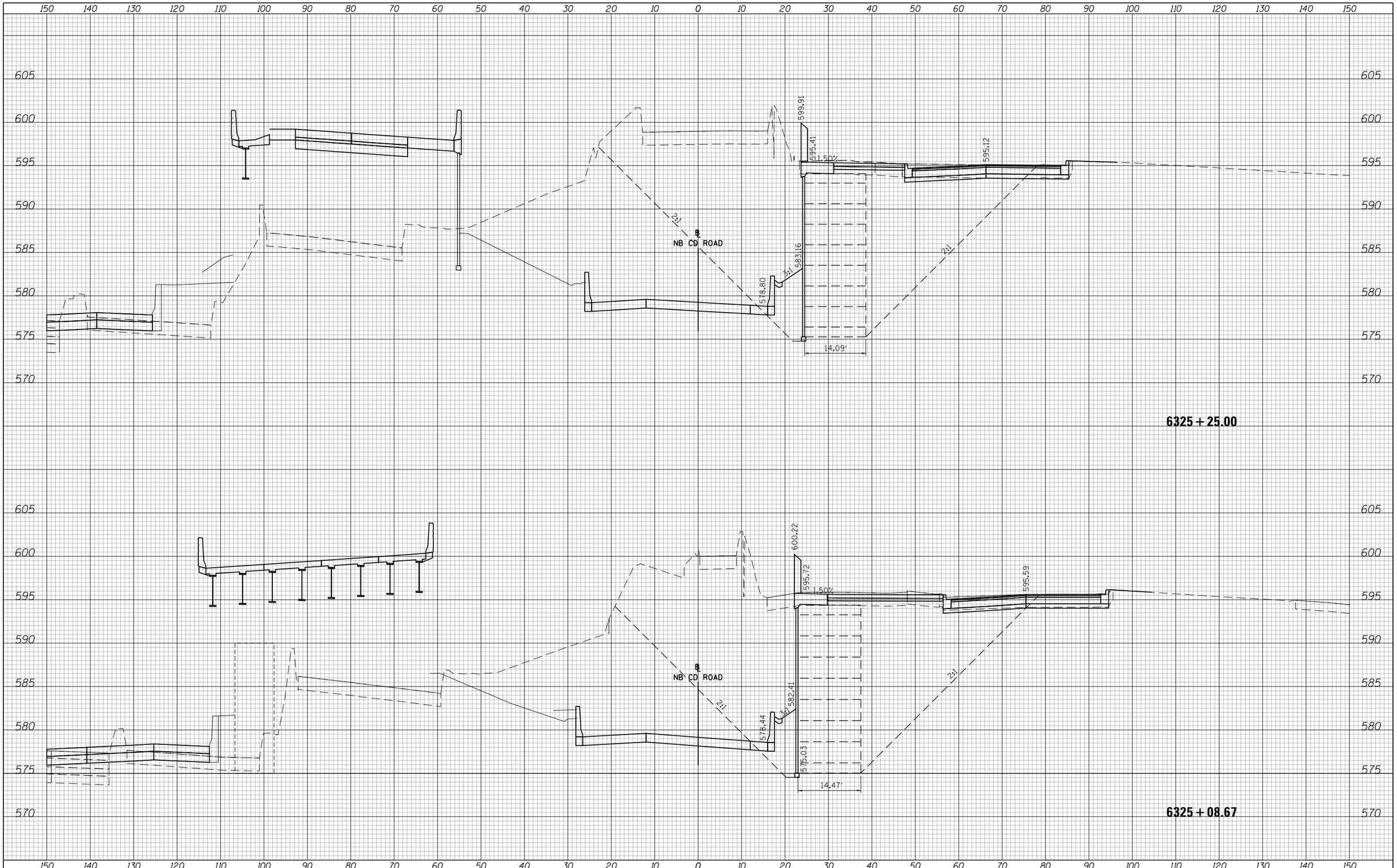
	ILLINOIS	FED. AID PROJECT		



FINAL SURVEY

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NO.	PLOTTED	DATE
	TEMPLATE	
	AREAS	
	AREAS CHECKED	

ORIGINAL SURVEY

NOTE BOOK	SURVEYED	BY
NO.	PLOTTED	DATE
	TEMPLATE	
	AREAS	
	AREAS CHECKED	

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STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CROSS SECTIONS
PROPOSED RETAINING WALL 22A

SCALE: 10:H 5:V | SHEET OF SHEETS | STA. | TO STA.

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
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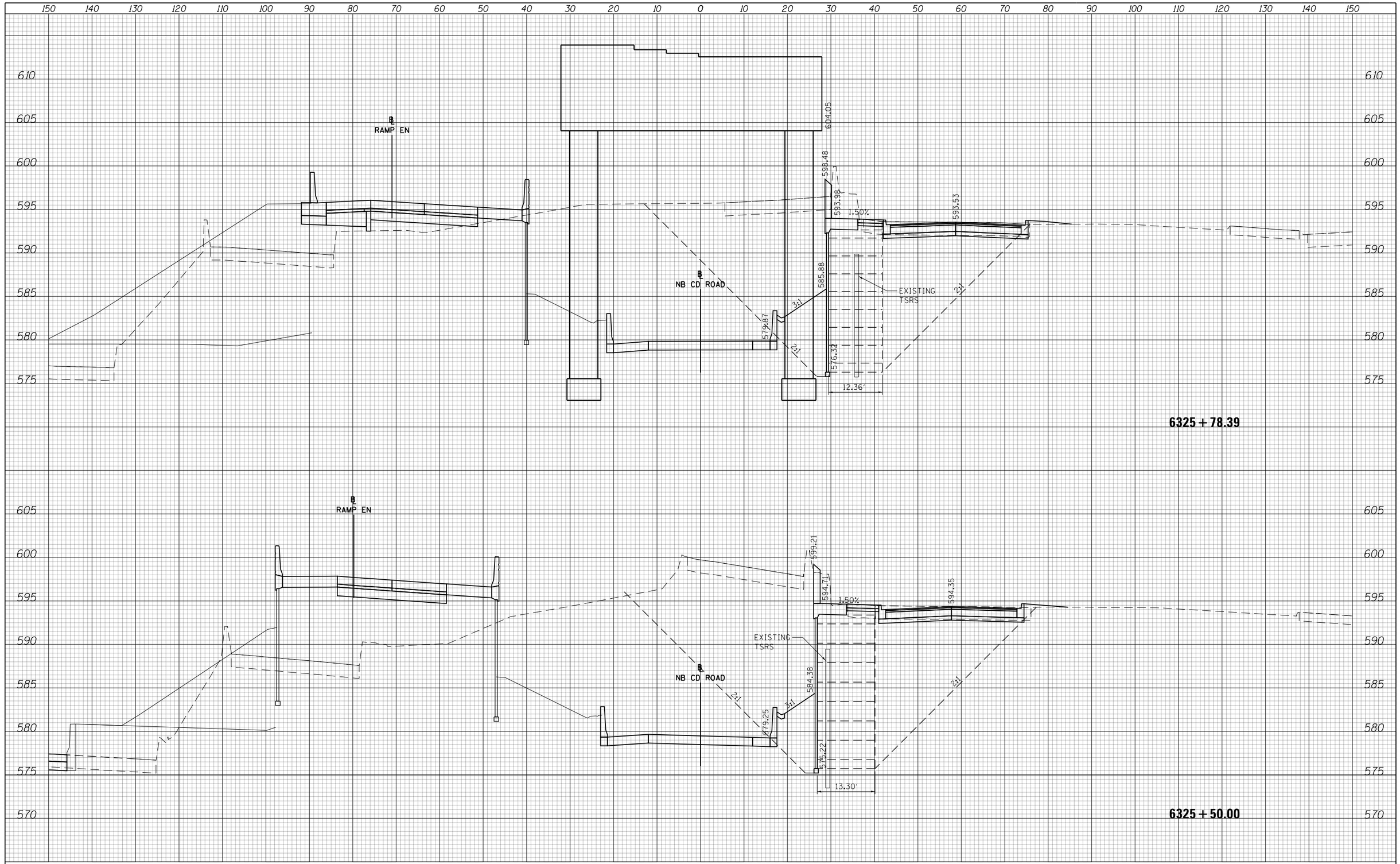

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ORIGINAL SURVEY

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CROSS SECTIONS
PROPOSED RETAINING WALL 22A

SCALE: 10:H 5:V | SHEET OF SHEETS | STA. | TO STA.

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		ILLINOIS FED. AID PROJECT		

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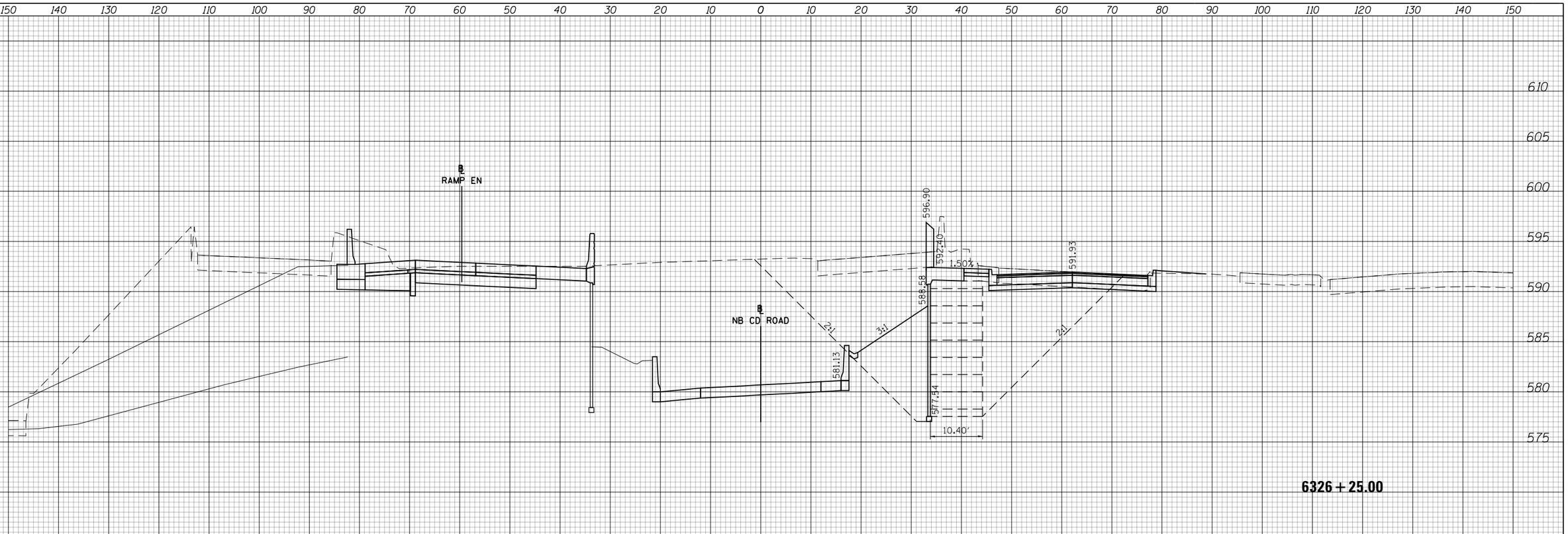

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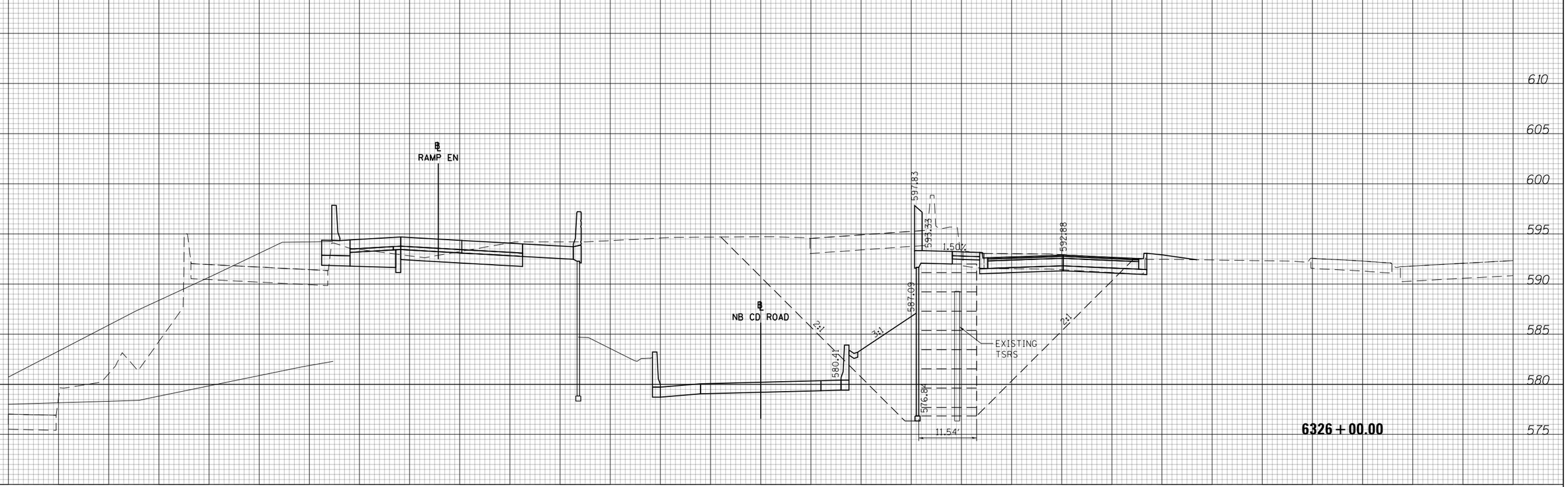

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CROSS SECTIONS
PROPOSED RETAINING WALL 22A

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F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
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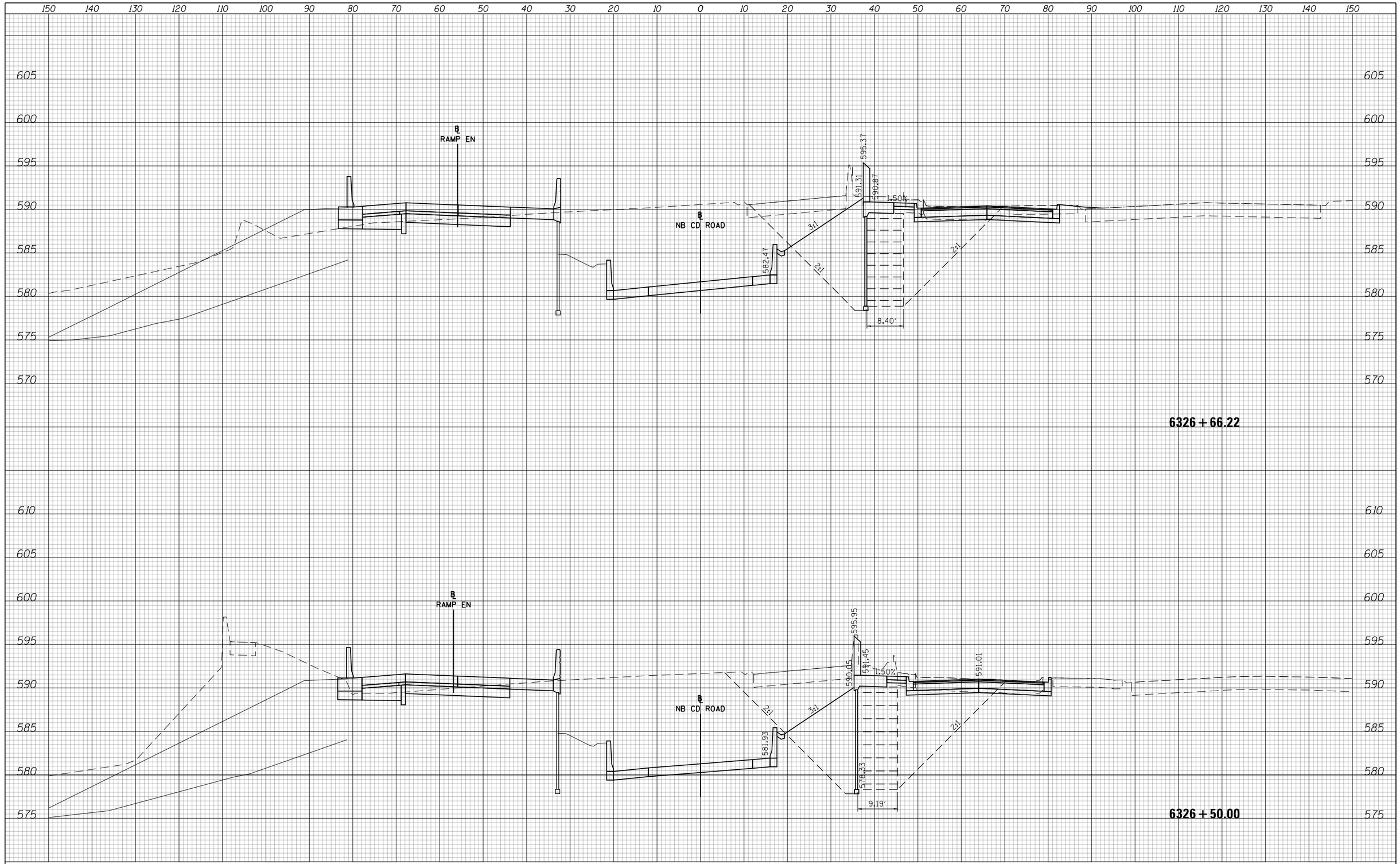

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ORIGINAL SURVEY — NOTE BOOK — NO.

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90/94/290	2014-017B	COOK	5	5
		CONTRACT NO. 60X79		
		ILLINOIS FED. AID PROJECT		

APPENDIX F

Wang Engineering
1145 North Main Street
Lombard, Illinois 60148
Phone: (630)-953-9928

Date: 01/30/2018 Sheet: 1 of 6
Calculation By: N. Balakumaran Approved By: M. Saghafi
Project Number: 1100-04-01 Client Name: AECOM
Project Name: Circle Interchange Project

Retaining Wall 22A
(SN 016-1813)

Ground Movement Estimates

Purpose: To estimate the surface ground movement along CTA bus turn around induced by the movement of proposed Wall 22A Construction.

Reference:
1) Clough, W and O Rourke T (1990) Construction induced movement of in-sim Sail walls
2) Ou, C.y, H Sieh, PT, and Chow D (1993). "Charcterihics of ground surface settlemants during excavation" Canadian Geotechnical Journel V.30, P. 758 - 767
3) Wang J.H, Xu Z.H, and Wang W.D (2010) Wall and Groundmovements due to Deep excavations in Shangai Soft Soils" Journel of Geotech a Geoenviromental Engineering P 985 - 994

Wang Engineering

1145 North Main Street
Lombard, Illinois 60148
Phone: (630)-953-9928

Date: 01/30/2018 Sheet: 2 of 6
Calculation By: N. Balakumaran Approved By: M. Seyhan
Project Number: 1100-04-01 Client Name: AECOM
Project Name: Circle Interchange Project
Retaining Wall 22A
(SN 016-18131

Assumptions: (1) CTA bus turn around is about 15 to 45' away from wall.

(2) Consider Sta. 6325+25 Maximum retained height of wall 17' and CTA Bus turn around 25' away from wall

(3) There is no existing wall behind the wall 22A

Notations: S_{hm} = Maximum lateral displacement of wall

S_v = ground surface Settlement

S_{vm} = Max. ground surface Settlement.

Design Criteria: Max S_{hm} is 1% of wall height = 2.04 inches.

Max S_{hm} is 1 inch.

Evaluations: From figure 6.14 Using a ratio $\frac{S_{vm}}{S_{hm}} = 1.0$

Obtain S_{vm} = 2.04 inches.

S_{vm} = 1 inch (1 inch)

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Then from Figure 11

for $d/H = \frac{25}{17} = 1.47$

Method 1 (Clough and O'Rourke (1990))

Obtain $\frac{\delta_v}{\delta_{hm}} = 0.4$

$\delta_v = 0.8$ inches (1% deflection Criteria)

$\delta_v = 0.4$ inches (1 inches deflection Criteria)

Method 2: (Kung et al (2007))

Obtain $\frac{\delta_v}{\delta_{hm}} = 0.4$

$\delta_v = 0.8$ inches (1% deflection Criteria)

$\delta_v = 0.4$ inches (1 inches deflection Criteria)

Conclusions: Based on our evaluations the ground settlement along CTA Bus turnaround is 0.8 inches for 1% deflection Criteria.

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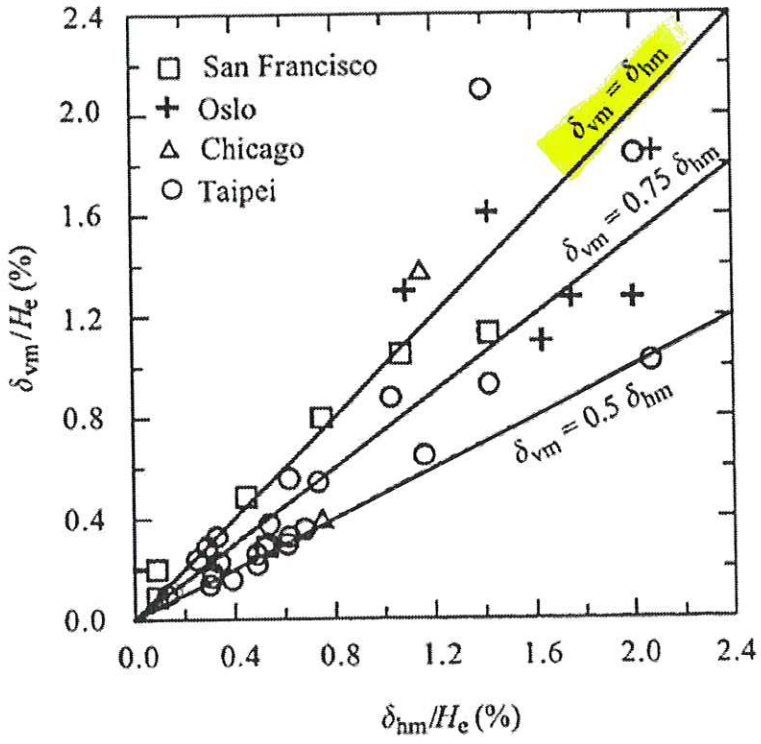


Figure 6.14 Maximum ground surface settlement and lateral wall deflection (Ou *et al.*, 1993).

OU, C.-Y., HSIEH, P.-G., AND CHIOU, D.-C., 1993, Characteristics of ground surface settlement during excavation: Canadian Geotechnical Journal, v. 30, p. 758-767.

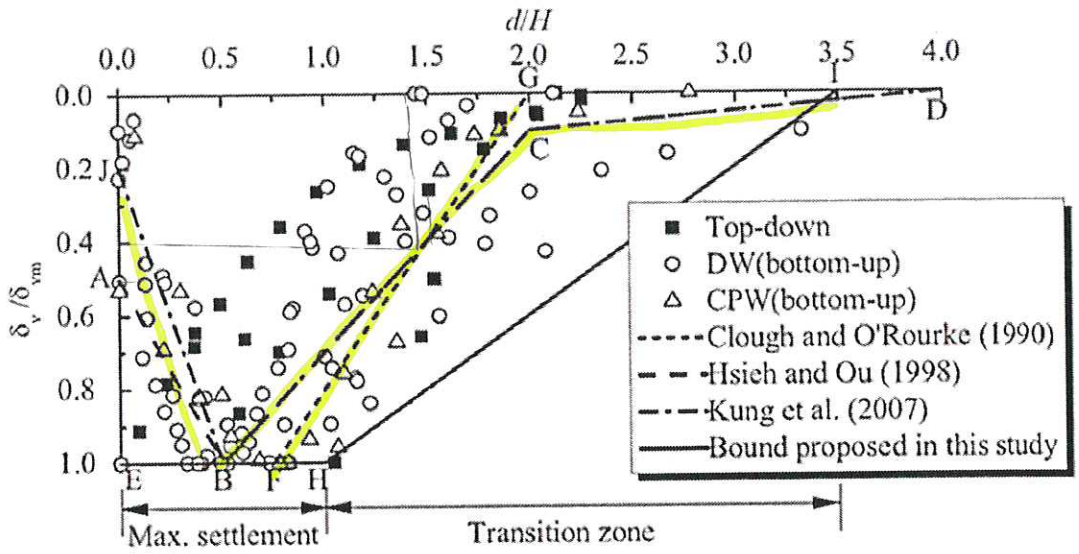
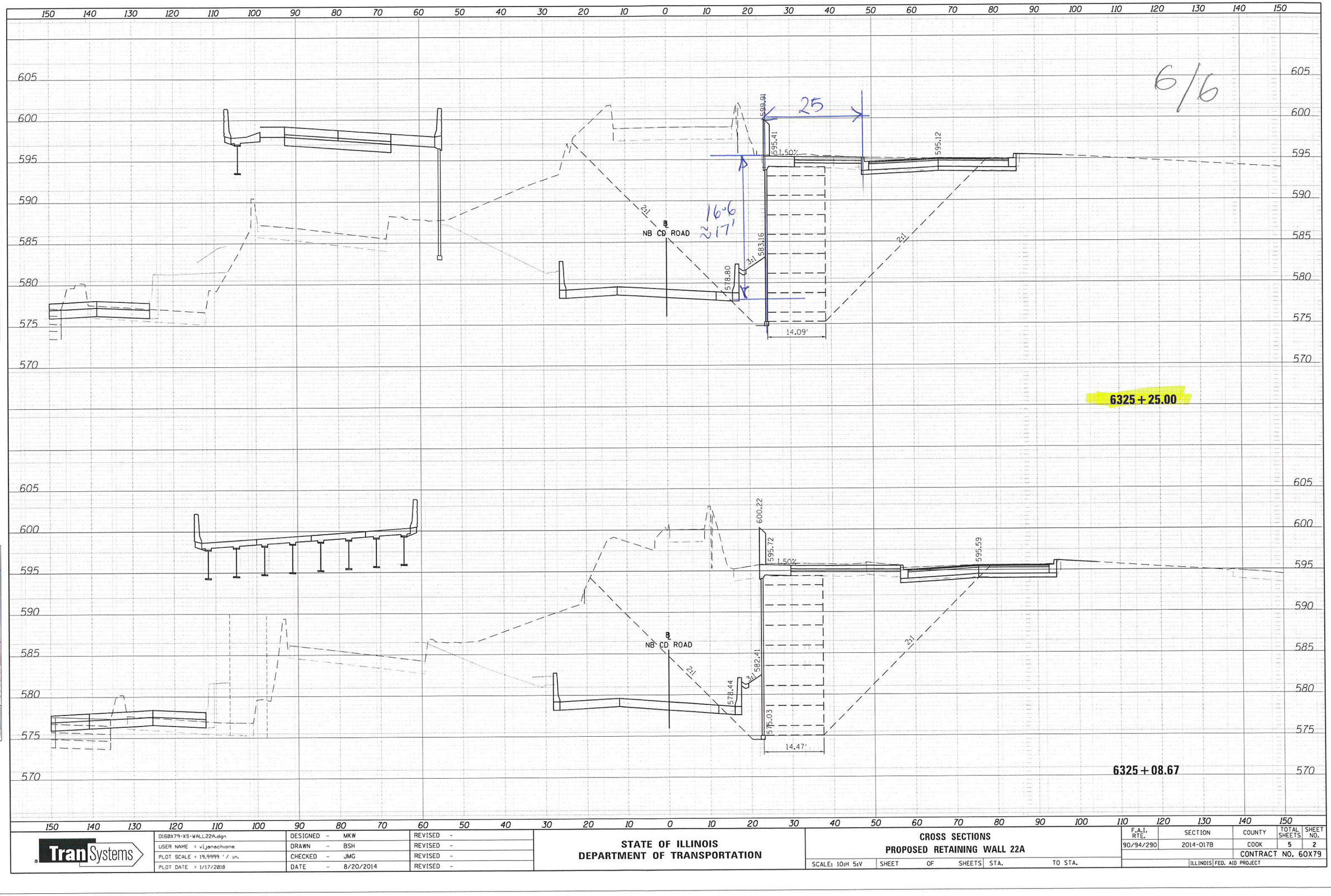


Fig. 11. Relationship between ground settlement normalized by maximum settlement and normalized distance from wall

WANG, J., XU, Z., AND WANG, W., 2009, Wall and ground movements due to deep excavations in Shanghai soft soils Journal of Geotechnical and Geoenvironmental Engineering, v. 136, p. 985-994.



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PROPOSED RETAINING WALL 22A

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