NOTE

Subject: EPA Comments on Ameren UE, Meramec Power Station, St. Louis, MO
Round 7 Draft Assessment Report

To: File
From: Jana Englander, OSWER, US EPA

Date: January 6, 2011

1. On p. 29, the report states that Pond 9 and Pond 10 are filled to capacity and closed, however, on p. 17 the report states that Pond 9 and Pond 10, are deactivated and are currently supporting plant structures and activity. Please clarify.

2. On p. 26 the report states that the plant is regulated under the State Operating Permit No. MO-0000361 and that this permit was effective on May 19, 2000 and expired on May 18, 2005. Has there been activity to renew the permit, please clarify status.

Ameren Services

March 2, 2011

Mr. Stephen Hoffman
US Environmental Protection Agency (5304P)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Re: Ameren Missouri
Meramec Power Station
Dewberry & Davis, LLC Coal Combustion Waste Impoundment
Round 7 – Dam Assessment Report

Dear Mr. Hoffman:

Below are Ameren Missouri's responses to the Dewberry & Davis, LLC draft dam safety assessment of the coal combustion waste (CCW) impoundments at the Meramec Power Station. The draft report was received by Ameren Missouri from the U.S. EPA on February 4, 2011. We have also enclosed a copy of our recently completed stability analysis of the Meramec CCW impoundments as requested by your consultant. Please note that we have recently revised the designation for our Company from AmerenUE to Ameren Missouri.

Recommendations from the Dewberry & Davis, LLC report are presented in **bold faced** type and our responses are provided in regular type.

1.2.1 Recommendations Regarding the Structural Stability: None appear warranted at this time to satisfy a critical need. An embankment stability analysis is being conducted and will be available at the end of year of 2010. A copy of this analysis is requested.

Response: The subsurface investigation and stability analysis for the Meramec Power Station mentioned in the assessment has been completed and a copy of the report is enclosed with this letter for the EPA's review. Ameren has initiated a project to be implemented in 2011 which will flatten the existing slopes on the downstream side of Pond 489, Pond 493, and the Retention Pond. This project will increase the embankment cross-sectional area and improve the factor of safety of the perimeter levee in these sections. Based on the implementation of this project and engineering data and evaluation provided in this report, we request the overall condition ratings for the ponds be reevaluated prior to issuing the final report.

1.2.2 Recommendations Regarding the Hydrologic/Hydraulic Safety: It is recommended that Ameren Missouri review and document the design flood for the CCW basins. It is also recommended that Ameren Missouri review and document the effects of the 100-year frequency rainfall event with the Mississippi River flood elevation on the plant.

Response: A Hydraulic evaluation of the Meramec Plant was completed as part of the Phase I Report by Reitz & Jens, Inc. dated August 31, 2007. The hydraulic evaluation performed by Reitz & Jens documents the effects of the 100-year, 24-hour rainfall event. This report shows that the ponds have sufficient storage for the 100-year 24-hour storm when the starting pool elevation is at or below normal. This report also states when the Mississippi River is at the 100-year flood elevation reported by FEMA, the Retention Pond and Pond 495 will be inundated. A copy of this report was sent to your consultants (Dewberry & Davis, LLC) with the "Request for Data" letter dated October 6, 2010.

1.2.3 Recommendations Regarding the Supporting Technical Documentation: Provide documentation as recommended above in Subsections 1.21 and 1.22

Response: See the above responses for 1.2.1 &1.2.2.

1.2.4 Recommendations Regarding the Description of the Management Unit(s): Documented descriptions of the CCW ponds and operational procedures were not provided. It is recommended that the purpose and processes within the CCW ponds be summarized in an operational manual.

Response: Currently Ameren Missouri does not have a formal Operation & Maintenance procedure for the Meramec Power Station. Ameren plans to develop an Operation & Maintenance manual for the Meramec Power Station in 2011.

1.2.5 Recommendations Regarding the Field Observations: None appear warranted at this time.

Response: No action required.

1.2.6 Recommendations Regarding the Maintenance and Methods of Operation. The recommendations include the following:

- **It is recommended that woody vegetation be removed from embankment slopes and groin areas, and embankment slopes and toe areas be mowed at least twice annually**
- **It is recommended that the seepage area observed at the outside of Pond 4 continue to be monitored for changed conditions.**
- **It is recommended that the inside slope and retaining wall of Pond 1 be monitored and maintained.**

Response: The individual bullet items are discussed below in order.

- Woody vegetation was removed from the perimeter levee in October 2009. Routine maintenance of the slopes will be performed to ensure woody vegetation is controlled.
- The seepage area outside Pond 4 is monitored by plant staff during weekly inspections, and annually by Dam Safety. Changed conditions will be evaluated and addressed accordingly.
- The inside slope and retaining wall of Pond 1 is monitored by plant staff during weekly inspections, and annually by Dam Safety. Maintenance will be performed as required.

1.2.7, Recommendations Regarding the Surveillance and Monitoring Program: It is recommended that internal inspection of the outlet structures be performed at a frequency of at least once every 5 years and be documented with a written report.

Response: A thorough inspection of the outlet structures is performed annually by Dam Safety and plant personnel. A written report is generated with each annual inspection.

1.2.8, Recommendations Regarding Continued Safe and Reliable Operation: No additional recommendations for continued safe and reliable operation appear warranted at this time.

Response: No action required.

Business Confidentiality Claim

We request the Draft Dam Safety Assessment Report for the Meramec Power Station prepared by Dewberry & Davis, LLC, as well as our responses to this report remain confidential. We also request the attached Meramec Ash Pond Dam Stability Analysis Report be kept confidential. This request is made in accordance with the procedures described in 40 CFR, Part 2, Subpart B.

When initially submitting support documents to Dewberry & Davis, LLC for preparation of their report we also designated the following materials as confidential:

- Plans of the embankment
- EIP
- Dam Safety Program for AmerenUE Non-Hydro Facilities
- AmerenUE Dam Inventory Inspection Program
- August 31, 2007 Phase I Report
- EPA Questionnaire
- February 26, 2008 Ash Pond #494 Drilling and Piezometer installation
- 2008 and 2009 Annual Inspection Reports
- Weekly Inspection Reports

If you need further information, please feel free to contact me at 314-554-2388.

Sincerely,

Paul R. Pike
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Environmental Services
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Enclosures

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November 16, 2010

CONFIDENTIAL

Mr. Matt Frerking
Managing Supervisor – Dam Safety
Ameren Missouri
3700 South Lindberg, MC F-604
Sunset Hills, Missouri 63127

RE: Ash Pond Dam Stability Analysis
Meramec Power Station

Dear Mr. Frerking:

This report presents our findings and recommendations from the geotechnical field investigations, laboratory testing, land survey, and slope stability analyses of the dams impounding the ash ponds at the Meramec Power Station. The investigation, testing and analyses was done in general accordance with our proposal dated January 29, 2010, and Ameren Missouri's request for proposal dated December 9, 2009. The purpose of this project is to evaluate the stability of the ash pond dams and conduct the necessary land surveys, subsurface explorations, and laboratory testing to define the critical section at each location. The slope stability analysis conducted was for the load cases required by the Missouri Department of Natural Resources (MDNR). The results of the slope stability analysis were compared to the required safety factors for the type and assumed hazard classification of each dam.

In 2007, Reitz & Jens (RJ) completed the Phase I: AmerenUE Dam Inventory and Inspection Program project. This project was a preliminary study and consisted of determining the existing condition and classification status of the dams at Rush Island, Meramec, Labadie and Sioux Power Stations and developing a site specific inspection program at each power station. The project involved field inspections, surveys, site reconnaissance, research of current registration requirements, and pertinent computations. Site specific recommendations for future inspections were developed which include inspection templates, frequency of monitoring and maintenance recommendations. The study reported that the height of the Meramec dam was approximately 24.7 feet, and that the dams did not fall under the current MDNR regulation that requires all dams 35 feet or more in height to be regulated. The report also found no dwellings downstream of the dams and if regulation were necessary the dams would be categorized within Environmental Site Class III. The MDNR dam safety regulations have not changed since the 2007 report.

SURVEY

A land survey was conducted to determine the elevation profile along the crest of the dam. The extents of the survey were chosen to include the areas with the greatest elevation difference between the crest and the downstream toe and the segments impounding water or unconsolidated sediment. Cross-sections were also surveyed at multiple locations at each plant to determine the slope heights and geometry. Zahner and Associates, Inc. conducted the survey, as a subcontractor to RJ. At the Meramec Power Station an elevation survey of the crest was conducted over approximately 4,600 lineal feet. Elevation profile measurements were taken at 100 foot intervals. The extents of the elevation profile are shown in Figure 1 and a plot of the measured elevations is presented in Appendix B. A total of five cross-sections were surveyed, one adjacent to Pond 489, two adjacent to Pond 494 and two on the Retention Pond and Pond 498. Plots of the cross-sections are shown in Appendix A. From the cross-section surveys, the approximate maximum height of the Meramec dam is 24 feet at cross-section 3. The dam height surveyed during this project is in close agreement with that found during the Phase I: AmerenUE Dam Inventory and Inspection Program project. Due to high river levels during most of this project, the survey was not extended far enough to capture the creek running along the north side of the dam. Based on the preliminary findings from the Phase I project, the height of the dam may be increased with additional survey data from this area.

GEOTECHNICAL FIELD INVESTIGATION AND LAB TESTING

Geotechnical field investigations were conducted using rotary drilling and cone penetrometer test (CPT) soundings. The quantity of borings and soundings, and the approximate locations at the power station are shown in Figure 1. The boring locations were selected by RJ based on previous experience at these locations, to fill in gaps were there was no subsurface data, slope geometry and to provide soil profiles representative of as much of the embankment as possible. The elevations of the ground surface at the boring locations were measured by Zahner and Associates, Inc. The borings were made by Terra Drill, Inc. of Dupo, Illinois, as a subcontractor to Reitz & Jens. The borings were advanced through the soil using 4.25-in. I.D. hollow-stem augers. Mud rotary drilling was not necessary in either of the auger drilling locations. Holes were backfilled with cement grout, which was tremmied from the bottom to the top.

The CPT soundings were also made by Terra Drill, Inc. using a Geo-probe rig, under a subcontract with Reitz & Jens. The cone penetrometer consists of a 1.5-inch diameter, 100 MPa capacity, electronic piezocone (CPTu), which records tip pressure, sleeve friction and porewater pressure as it is hydraulically pushed into the ground. The testing was carried out according to ASTM D5778. The holes were backfilled the same day with Bentonite pellets.

The field investigation was done under the direction of a Reitz & Jens' geological engineer or geotechnical technician, who determined the sampling intervals and the termination depths, operated the CPT equipment, and logged the borings. The boring logs for the Meramec Power Station are presented in Figures 2-1 to 2-2. Logs of CPT soundings are presented in Figures 3-1 to 3-8. The keys and notes for the boring logs and CPT soundings are shown in Figures 2-0 and 3-0, in that order.

Samples of subsurface materials were obtained using rotary drilling methods at about 2.5-foot intervals for the first 10 feet, at 5-foot intervals below 10 feet. Two types of samplers were used: 1) a hydraulically pushed, 3-in. O.D., thin-walled Shelby tube sampler (ASTM D-1587); and 2) a 2-in. O.D., split-spoon sampler driven by an automatic hammer in conjunction with a Standard Penetration Test (ASTM D-1586). Published tests have shown that the blow counts from a Standard Penetration Test (SPT) using an automatic hammer are about 75% of the blow counts obtained using a manual 140-lbs. drop hammer, rope and cathead. Manual SPT hammers have been used to develop correlations between SPTs and soil properties, therefore, the blow counts, or N-values, from an automatic hammer should be increased by about one-third in order to use such correlations. The uncorrected blow counts are shown on the boring logs. The disturbed split-spoon samples obtained were visually classified in the field and sealed in glass jars to prevent loss of moisture, for later testing in the laboratory. The relatively undisturbed Shelby tube samples were sealed in the tubes and were extruded from the tubes immediately prior to testing in the lab.

All of the recovered samples were visually described in our laboratory in general accordance with the Unified Soil Classification System and the Standard Test Method for Classification, Description, and Identification of Soils (ASTM D-2487 and D-2488). Index tests were also performed and included: water content and dry unit weight tests (ASTM D-2216). The results of these index tests appear on the individual boring logs. Unconsolidated undrained (UU) triaxial compression tests (ASTM D2850) and consolidated undrained (CU) triaxial compression tests (ASTM D-4767) with pore pressure measurement were performed on selected Shelby tube samples of the fine grained samples, to obtain better measurements of the *in situ* total and effective shear strength properties. The results of the UU and CU triaxial shear strength tests are presented with the boring logs in Figures 2-3 and 2-4.

The field data from the CPT soundings were analyzed in the office using the program CPT-pro, Ver. 5.49 by Geosoft. The program automatically applies corrections for depth, and post/pre-data collection baseline readings. These corrected field data are plotted in the CPT logs, which are field tip resistance (q_c), sleeve friction (f_s) and pore water pressure (u2). Soil type was determined based upon the Robertson (1986) method[1]. Undrained shear strength (s_u) was calculated for cohesive materials based upon the Lunne (1997) method[2]. Equivalent Standard Penetration Test (SPT) N_{60} values were calculated using procedures recommended by Robertson (1986)[1]. The equivalent N_{60} values were used to verify the computed internal friction angle (ϕ) in sands and s_u in fine-grain soils. The estimate of ϕ in coarse soils was based upon the measured q_c values using Bowles (1996).[3] The computed parameters N_{60}, s_u and ϕ are also plotted in the CPT logs.

PIEZOMETER INSTALLATION AND MONITORING

A temporary piezometer was installed to help define the line of seepage through the dam. The piezometer was located at the upstream crest, with the tip located in the lower most embankment fill above the native soils. The location of the piezometer is shown in Figure 1, and a description of the tip elevation is noted in the boring log. PZ-1 was located along the north side of the dam near the Retention Pond.

The piezometer was constructed using 1-inch inside diameter Schedule 40 PVC pipe, 0.010-inch factory machine-slotted screen and was capped with an above grade well protector. The bottom 10 feet of the piezometer was screened and backfilled with filter sand.

Readings were obtained from the piezometer and compared to the pool elevation. A table containing the piezometer readings is shown below. The temporary piezometer was removed after several readings

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[1] Robertson, P.K., et al. (1986), "Use of Piezometer Cone Data," *Proceedings of the ASCE Specialty Conference In Situ 86: Use of In Situ Tests in Geotechnical Engineering*, ASCE.
[2] Lunne, T., Robertson, P.K. and Powell, J.J.M. (1997). *Cone Penetration Testing in Geotechnical Practice.* Published by Blackie Academic * Professional.
[3] Bowles, Joseph E. (1996). *Foundation Analysis and Design.* 5th ed., McGraw-Hill, page 180.

were obtained and the hole was grouted closed with cement grout. Additional readings were obtained from existing piezometers at the plant. The existing piezometers are generally located on the east side of Pond 494. Existing piezometer PZ-1 is located near cross-section 4 and existing piezometer PZ-3 is located near CPT sounding P-5. Readings from the existing piezometers are presented in the following table.

Meramec Power Station

Date	Piezometer	Reading	Groundwater Elevation (ft)	Ground Surface Elevation (ft)	Tip Elevation (ft)	Pond Elevation (ft)
8/31/2010	PZ-1 (RJ)	17.9	398.6	413.6	386.6	-
9/7/2010	PZ-1 (RJ)	18.8	397.7	413.6	386.6	-
10/8/2010	PZ-1 (RJ)	16.3	400.2	413.6	386.6	-
8/31/2010	PZ-1*	17.7	398.6	413.3	371.8	-
9/7/2010	PZ-1*	18.6	397.7	413.3	371.8	-
8/31/2010	PZ-3*	27.4	390.0	414.3	369.3	-
9/7/2010	PZ-3*	28.6	388.7	414.3	369.3	-

*Existing permanent piezometer

MERAMEC POWER STATION

The Meramec Power Station is located at the southern most point in St. Louis County, Missouri near the confluence of the Meramec and Mississippi Rivers. The plant is located south of the City of Oakville and east of the City of Arnold. The Meramec River is adjacent to the plant on the west. To the east is the Mississippi River. The confluence of these two rivers is directly south of the plant. To the north of the plant is a small creek, wooded uplands and Meramec River floodplain.

The Meramec Dam is a single stage industrial dam. The dam impounds an area of approximately 138-acres for coal combustion ash sedimentation and water treatment purposes. The impoundment area was estimated from an aerial photo. The perimeter of the dam has a length of approximately 6,400-lineal-feet (lf). This dam forms the perimeter of several smaller impoundments. These impoundments include the Retention Pond, the New Ash Pond, Pond 489, Ponds 490-496 and Pond 498. All or portions of ponds 490, 491, 494, 495 and 498 have been filled to capacity with coal combustion ash, and are now supporting plant equipment.

An elevation profile was run on the Meramec Dam from the southwest corner of Pond 489 to the railroad track crossing near Pond 493. The total distance of the profile was approximately 4,600 feet and the minimum and maximum crest elevation was 413.3 and 419.5, in that order. A plot of the elevation profile is shown in Appendix C. Five cross-sections were also surveyed and the approximate locations and drawings depicting the sections are shown in Appendix B. The downstream slope angles for the various sections varied from 1.7 (H) to 2.5 (H) on 1 (V). One section was adjacent to Pond 498, 2 were adjacent to Pond 494, and 2 were adjacent to the Retention Pond and Pond 498.

Pond 489

Cross-section 3 was measured near the outfall for Pond 489. The survey showed that the upstream slopes were approximately 3 (H) to 1 (V) and the downstream slopes were approximately 1.9 (H) to 1 (V). The embankment height at this section is approximately 24.5 feet.

At this section an auger boring was drilled at the centerline of the crown and a CPT sounding was conducted at the toe. The drilling revealed that the dam fill generally consists of fly ash, bottom ash, silty clay, and high plastic clay. The coarse grain fill was typically medium dense and the fine grained fill was stiff. A UU test was conducted on a specimen of high plastic clay which was sampled from the fill. The measured s_u of the material was approximately 1900 psf. For modeling purposes we estimated that the ϕ of the fill is approximately 29°.

The top 18 feet of the foundation soil consisted of silty and moderate to high plasticity clay soils. The stiffness was soft to firm in the top 9 feet and became slightly stiffer from 9 to 18 feet. Based on correlations for N-values in clay and CPT soundings, we estimate that the top 9 feet of the foundation soil has a ϕ of 23° and from 9 to 18 feet the ϕ is 24°. Beneath the clay and to a depth of approximately 43 feet, clay, silt and sand were observed. The soil is generally soft or loose and CPT soundings indicated ϕ values ranging from 22.5° to 25°.

Pond 494

Cross-sections 2 and 4 were measured adjacent to Pond 494. At section 2 the upstream slopes were very steep in the top half of the dam and were sloped at 1.6 (H) to 1 (V) and became less steep in the lower half of the dam at 2.4 (H) to 1 (V). The approximate height of the dam at this location was 15.3 feet. Cross-section 4 was located to the north of section 2. The slopes at section 4 varied from approximately 1.9 (H) to 2.5 (H) on 1 (V). The height of the dam at this location was approximately 20.8 feet.

Five CPT soundings were conducted near the locations of these sections. Two were located at the crest of the dam and three were located at the toe. The data obtained from the soundings was averaged to come up with a profile representative of both sections. The embankment fill generally consisted of clay, although thin silty clay and clayey silt layers were observed near the top of the embankment. Based on data obtained from the CPT soundings we modeled the embankment fill in these locations with a ϕ of 23° and an effective cohesion of 200 psf.

The top 6 feet of the foundation soil consisted of soft clay. Using the data obtained from the CPT soundings we estimated the ϕ of the clay to be 23°. Underlying the clay was stiff clay and silty clay. Using the shear strengths obtained from a CU test in the silty clay foundation soil, we modeled this stratum with a ϕ of 27° and an effective cohesion of 100 psf. At a depth of approximately 22 feet into the foundation, sand and silt was encountered. The CPT soundings show that the ϕ of these strata are approximately 30°.

Retention Pond and Pond 498

Cross-sections 1 and 5 were measured near the Retention Pond and Pond 498. The upstream slopes at sections 1 and 5 were 2 (H) on 1 (V) and 1.7 (H) on 1 (V), respectively. Section 1 has a height of approximately 18 feet and the height of section 5 is roughly 19.5 feet. Due to floodwater, the cross-section surveys were stopped prior to reaching the creek which runs adjacent to the ponds on the north. For modeling purposes, survey data from the Phase I project was used to approximate the location, slope angels and elevations of the top of bank and bottom of the creek. The survey data from the Phase I project increases the height of the cross-section to approximately 25 feet.

One auger boring and one CPT sounding were conducted in the crown, and one CPT sounding was conducted at the toe, near these sections. A piezometer was installed at the location of the auger boring. The embankment fill consisted of sandy silt, clayey silt and silty clay. Fly and bottom ash were also observed in the samples obtained from the auger boring. The embankment fill was modeled with a ϕ of 26° based on the N-values and CPT soundings.

The top 12 feet of the foundation soil was silty clay. A CU test was run on a specimen obtained in this stratum. The test data showed that the stratum had a ϕ of 27° and an effective cohesion of 100 psf. Beneath the silty clay 5 feet of stiff clay was observed. Based on the CPT soundings we estimate the ϕ of the clay to be 26°. Clayey silt, silty clay, and sandy silt were observed at a depth of 17 feet in the foundation to the boring termination depth. The coarse grained strata were generally loose to medium dense and the cohesive strata were soft to firm, and using the CPT soundings a ϕ of 25° was used for modeling purposes.

Slope Stability Analysis Results

The stability of each cross-section was analyzed for the steady seepage and seismic load cases. The steady seepage case was analyzed using piezometric data obtained from the piezometer installed during this project and from existing piezometers installed adjacent to Pond 494. It was assumed that the piezometric levels will not vary widely because most of the impounded area is filled with ash. Each piezometer was located at the upstream crest of the dam. For Pond 489 no seepage was assumed to occur from the pond because it is lined with high-density polyethylene (HDPE).

For the seismic load case a horizontal acceleration of 0.0575 g or 0.25 of the probable maximum acceleration (PMA) was added to the steady state seepage model. The seismic load was taken from 10 CSR 22-3 for St. Louis County (Zone D) and for an environmental site class III dam.

The analysis show for the steady seepage load case the calculated factor of safety is less than the required factor of safety by the MDNR. This analysis limited the search for critical failure surfaces to those that significantly impact the dam. The factor of safety is lower for shallow slope failures. For the seismic load case the factor of safety exceeded that required by the MDNR.

Meramec Power Station

Load Case	Required Factor of Safety	Factor of Safety				
		Cross-Section 1	Cross-Section 2	Cross-Section 3	Cross-Section 4	Cross-Section 5
Steady Seepage	1.5	1.3	1.4	1.3	1.4	1.2
Earthquake, Steady Seepage	1.0	1.1	1.2	1.1	1.2	1.1

CONCLUSIONS

The stability of the Meramec Dam was analyzed for steady seepage and seismic load cases. For the seismic load case the calculated factor of safety was greater than the minimum required by MDNR for an environmental site class III dam, but for the steady seepage load case the factor of safety for all five cross-sections is below the minimum required. The low factor of safeties for the steady seepage case is primarily due to the steep downstream slope angles, which generally are steeper than 2 (H) on 1 (V). In addition, the upper most strata of the foundation soil generally consist of soft clay.

The impounded area of the ponds is generally filled to capacity with coal combustion ash. As a result the line of seepage from the impounded area is relatively low within the embankment. This was confirmed with the piezometric levels measured during this project. Positive drainage should be maintained within the impounded area. Should the line of seepage rise within the embankment, the stability of the slopes and the factor of safety will be less.

Please let us know if you have any questions regarding this report or any aspects of the project. We appreciate this opportunity to continue our working relationship with Ameren Missouri.

Sincerely,
REITZ & JENS, Inc.

Donald S. Eskridge, P.E.
Principal

Jeff Bertel, P.E.
Project Engineer

The following figures are attached and complete this report:

Figure 1	Boring Location Map
Figure 2-0	Key to Boring Logs
Figures 2-1 to 2-2	Logs of Borings
Figures 2-3 to 2-4	Graphs of CU and UU tests
Figure 3-0	Key to CPT Soundings
Figure 3-1 to 3-8	Logs of CPT Soundings
Appendix A	Cross-sections
Appendix B	Elevation Profile
	Graphical Depictions of Slope Stability Models

Copies submitted: 5

Elevation Profile Survey Limits
Locations of Cross-sections and Borings

REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure 1

KEY TO BORING LOGS

Symbol	Description
KEY TO SOIL SYMBOLS	
	Crushed Limestone
	Miscellaneous FILL
	Medium to high plastic CLAY
	Low plastic Silty CLAY (CL)
MISCELLANEOUS SYMBOLS	
	Water table during drilling
●	Moisture content (%)
▲	N-value from Standard Penetration Test, ASTM D-1586 (blows/ft)
■	Shear strength from Pocket Penetrometer (tsf)
SOIL SAMPLERS	
	2-in. O.D. Split-Spoon
	3-in. O.D. Shelby Tube

Notes:

1. Details of the drilling and sampling program are presented in the general introduction of the report.

2. Stratification lines shown on the logs represent approximate soil boundaries; actual changes in strata may be gradual or occur between samples.

Figure 2-0

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG

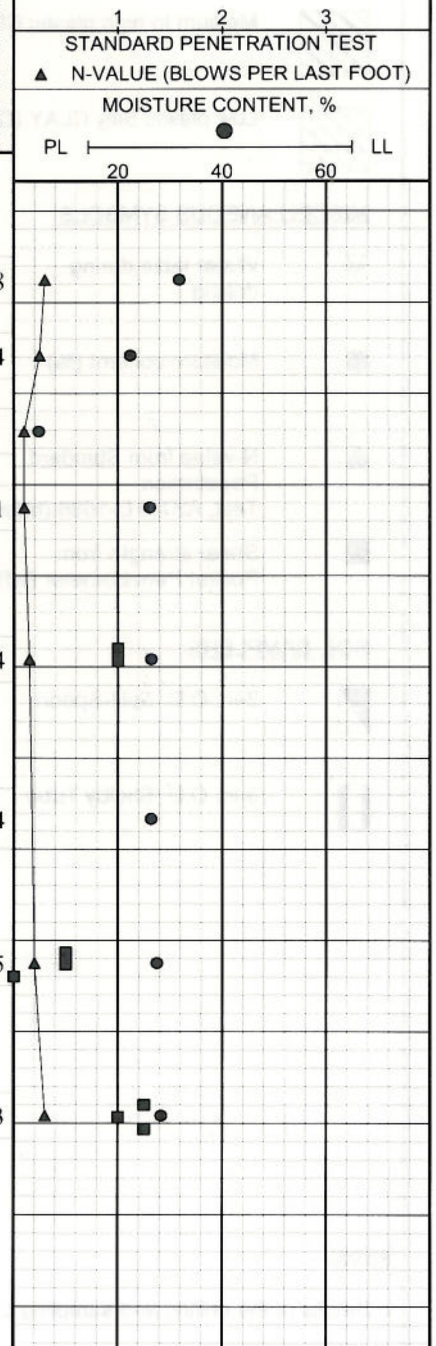
PROJECT: Ash Pond Stability
Meramec Power Plant
CLIENT: Ameren Missouri

DATE DRILLED: 08-09-10

BORING NUMBER: **PZ-1**
LOCATION:
COORD. N 937323.42 E 864991.49
ELEVATION: 413.6 DATUM: NAVD88
FIGURE: 2-1 SHEET 1 OF 1

DEPTH (FEET)	ELEVATION	Water Table	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0				FILL, gray with trace dark gray, firm, very silty clay to clayey silt, with trace limonite and fly ash		
			100		3-3-3	31.8
			100		1-2-3	22.4
6	408					
			6	Becoming very loose, and silty sand to sandy silt, gray, with fine sand, and trace fly ash and cinders	1-1-1	4.8
			100	Becoming soft, and silty clay to clayey silt, dark gray and brown, with fly ash	0-1-1	26.1
12	402					
			100	Becoming silty clay to very silty clay, with decayed roots and wood	1-1-2	26.4
				PZ-1, screened interval from 17' to 27'		
18	396					
			79	Becoming firm, silty clay, gray to brownish gray, with pockets of very silty clay and high plastic clay, and trace rock	96.8	26.4
24	390					
			100	Silty CLAY (CL), gray to brownish gray, firm, with trace lignite	1-2-2	27.5
		▽ (29')				
30	384		100	Becoming moderately plastic, and silty to slightly silty, with trace limonite and iron stains	1-2-4	28.3
				Boring terminated at 30'6"		
36	378					

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇TV
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
MOISTURE CONTENT, %
PL ● LL



THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Terra Drill
METHOD: HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

WATER LEVELS: DURING DRILLING 29 FEET
_____ BORING DRY AT COMPLETION OF DRILLING
AT _____ FEET AFTER _____ HOURS
AT _____ FEET AFTER _____ HOURS
PIEZOMETER: INSTALLED AT _____ FEET

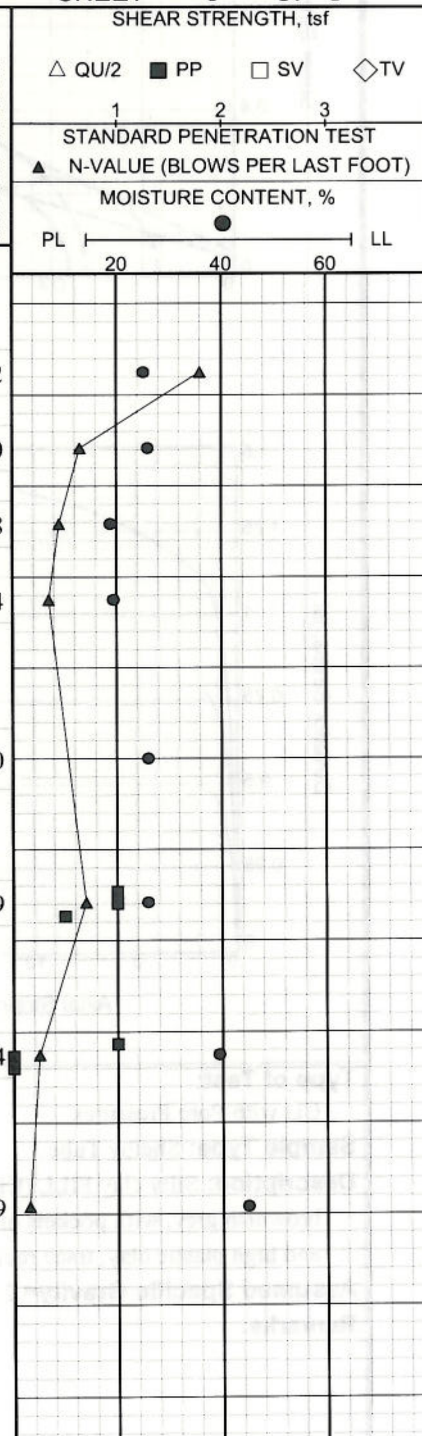
File:

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG

PROJECT: Ash Pond Stability	BORING NUMBER: **B-2**
Meramec Power Plant	LOCATION:
CLIENT: Ameren Missouri	COORD. N 934544.23 E 864910.61
	ELEVATION: 414.0 DATUM: NAVD88
DATE DRILLED: 08-09-10	FIGURE: 2-2 SHEET 1 OF 1

DEPTH (FEET)	ELEVATION	Water Table	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES / RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	414				3" Crushed Aggregate Pavement		
				100	FILL, gray to dark gray, fly ash, dense	8-17-19	25.2
				100	Becoming medium dense, with bottom ash and trace fine sand	4-7-6	26.0
6	408			56	With some brown silty clay, and crushed limestone gravel up to 1" diameter	1-4-5	18.8
				100		1-3-4	19.4
12	402						
				83	Becoming high plastic clay, gray and dark gray, stiff, with trace organics	97.1	26.0
18	396						
				100	Becoming slightly silty, moderate to high plasticity, and dark gray-brown, with trace fine sand and crushed limestone	3-7-7	25.9
24	390	▽		100	Silty CLAY (CL-CH), grayish brown, firm, moist, moderate to high plasticity	1-2-3	39.4
30	384			100	Becoming gray and brownish gray, with decayed roots	0-1-2	44.9
					Boring terminated at 30'6"		
36	378						



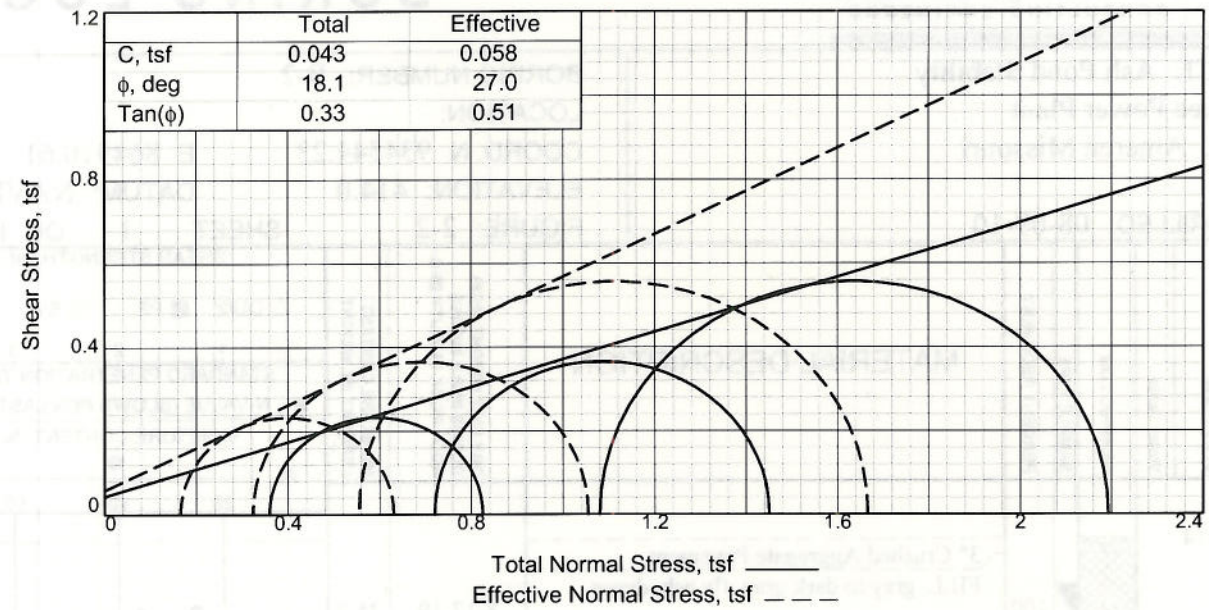
THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Terra Drill
METHOD: HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): ____
LOGGED BY: J. Pruett

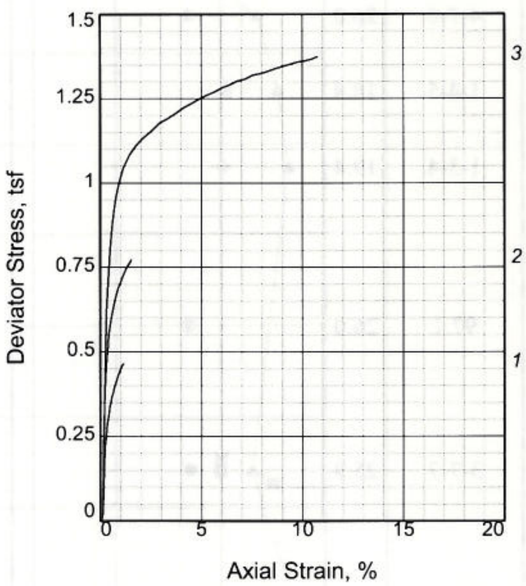
WATER LEVELS: DURING DRILLING 24 FEET
____ BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ____ FEET

File:



	Total	Effective
C, tsf	0.043	0.058
ϕ, deg	18.1	27.0
Tan(ϕ)	0.33	0.51



Sample No.		1	2	3
Initial	Water Content,	26.4	26.4	26.4
	Dry Density, pcf	96.8	96.8	96.8
	Saturation,	98.6	98.6	98.6
	Void Ratio	0.7098	0.7098	0.7098
	Diameter, in.	2.84	2.84	2.84
	Height, in.	5.81	5.81	5.81
At Test	Water Content,	26.0	25.4	25.1
	Dry Density, pcf	98.0	98.8	99.4
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.6878	0.6736	0.6647
	Diameter, in.	2.83	2.84	2.86
	Height, in.	5.78	5.70	5.60
Strain rate, %/min.		0.01	0.01	0.01
Back Pressure, tsf		3.96	4.32	5.04
Cell Pressure, tsf		4.32	5.04	6.12
Fail. Stress, tsf		0.46	0.73	1.11
Total Pore Pr., tsf		4.15	4.72	5.57
Ult. Stress, tsf				1.37
Total Pore Pr., tsf				5.48
σ_1 Failure, tsf		0.63	1.05	1.67
σ_3 Failure, tsf		0.17	0.32	0.55

Type of Test:
CU with Pore Pressures

Sample Type: Shelby Tube

Description: Silty clay FILL (CL), grey and brownish grey, with pockets of very silty clay and high plastic clay, trace rock

Assumed Specific Gravity= 2.65

Remarks:

Figure 2-3

Client: Ameren Missouri

Project: Ash Pond Stability

Source of Sample: PZ-1 **Depth:** 19

Sample Number: ST-6

Proj. No.: 2010012488 **Date:** 8/9/10

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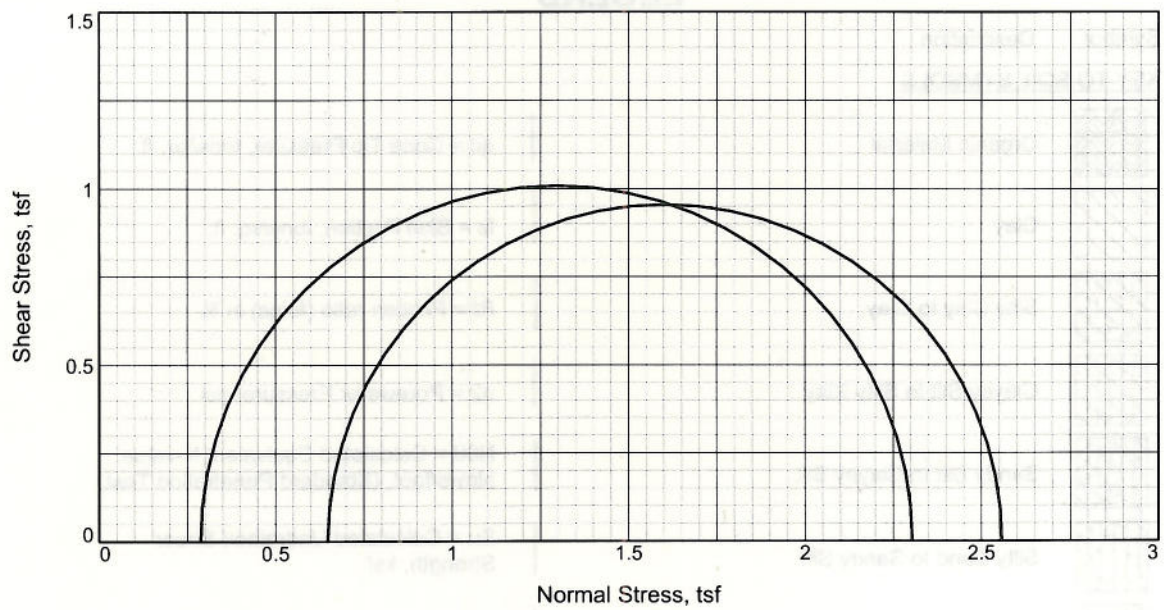
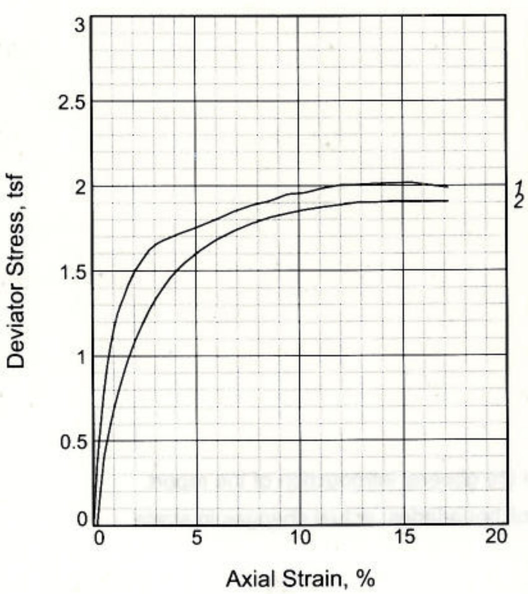
CONSULTING ENGINEERS

Tested By: K. Kocher **Checked By:** J. Bertel





	Sample No.	1	2
Initial	Water Content,	23.5	26.9
	Dry Density, pcf	99.2	96.2
	Saturation,	91.7	97.6
	Void Ratio	0.6870	0.7385
	Diameter, in.	2.85	2.85
	Height, in.	5.82	5.82
At Test	Water Content,	23.5	26.9
	Dry Density, pcf	99.2	96.2
	Saturation,	91.7	97.6
	Void Ratio	0.6870	0.7385
	Diameter, in.	2.85	2.85
	Height, in.	5.82	5.82
	Strain rate, %/min.	0.83	0.83
	Back Pressure, tsf	0.00	0.00
	Cell Pressure, tsf	0.29	0.65
	Fail. Stress, tsf	2.02	1.91
	Ult. Stress, tsf		
	σ_1 Failure, tsf	2.30	2.56
	σ_3 Failure, tsf	0.29	0.65

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: Clay Fill (CH), mottled gray and dark gray, with trace organics, high plasticity

Assumed Specific Gravity= 2.68

Remarks:

Figure 2-4

Client: Ameren Missouri

Project: Ash Pond Stability

Source of Sample: B-2 **Depth:** 14

Sample Number: ST-5

Proj. No.: 2010012488 **Date:** 08-11-10

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: J. David/J. Pruett **Checked By:** J. Bertel

LEGEND

Symbol Description

KEY TO SOIL SYMBOLS

- Organic Material
- Clay
- Silty Clay to Clay
- Clayey Silt to Silty Clay
- Sandy Silt to Clayey Silt
- Silty Sand to Sandy Silt
- Sand to Silty Sand
- Sand
- Gravelly Sand to Sand

- qc = Cone Tip Pressure, tons/sq. ft.
- fs = Skin Friction, tons/sq. ft.
- Rf = Friction ratio (fs/qc) in %
- u2 = Porewater Pressure, psi
- N60 = Calculated Equivalent N-value, blows/foot, (Standard Penetration Test)
- Su = Calculated Undrained Shear Strength, ksf
- Phi = Friction Angle, degrees

Notes:

1. Details of the drilling and sampling program are presented in the general introduction of the report.
2. Stratification lines shown on the log represent approximate soil boundaries; actual changes in strata may be gradual.

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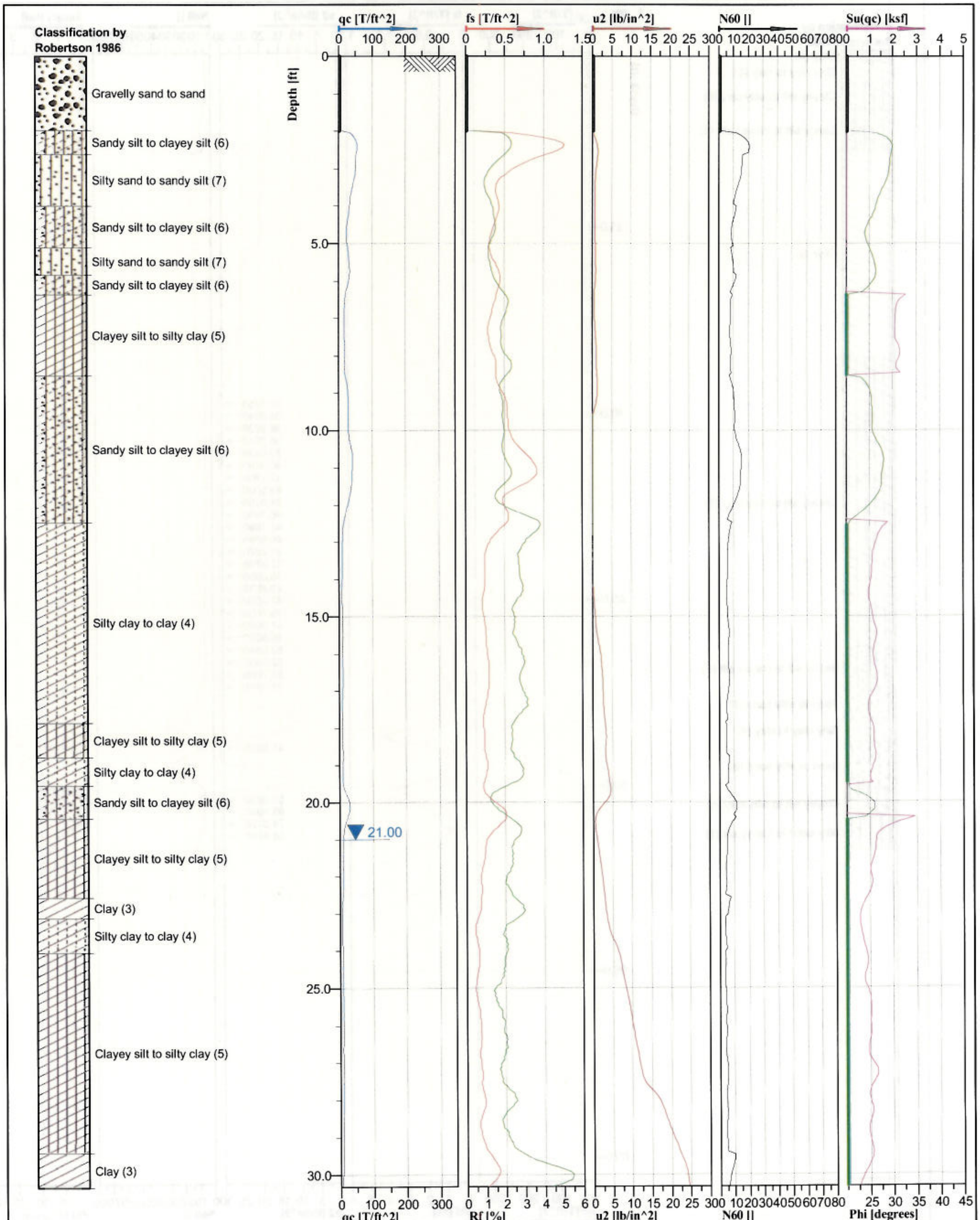
[1] Robertson et al. (1986) *Use of piezometer cone data.* Proceedings of the ASCE Specialty Conference: In Situ 86: Use of In Situ Tests in Geotechnical Engineering. ASCE 1986

[2] Lunne, T. Robertson, P.K. and Powell, J.J.M. (1997) Cone Penetration Testing in Geotechnical Practice, Published by Blackie Academic & Professional.

[3] Bowles, Joseph E. (1996) Foundation Analysis and Design. McGraw-Hill. 5th ed. Page 180.

Figure 3-0



Location: Meramec Power Plant	Position: X: 937555.35 ft, Y: 865357.78 ft	Ground level: 417.49	Test no: P-1
Project ID: 2010012488	Client: Ameren Missouri	Date: 10/7/2010	Scale: 1 : 42
Project: Ameren: Meramec Ash Pond Stability Analysis		Page: 1/2	Fig: 3-1
		File: Meramec P-1.cpd	

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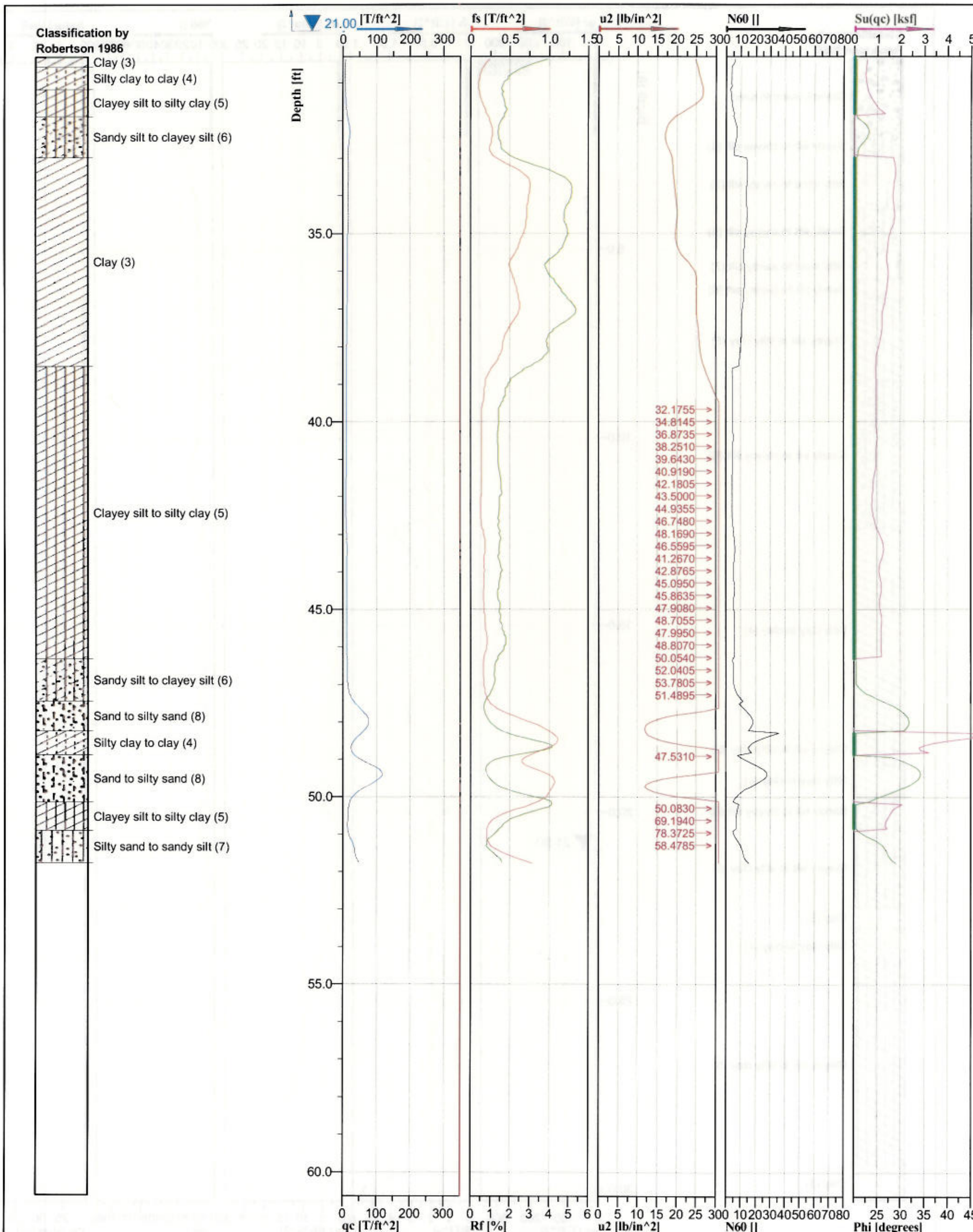
Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150



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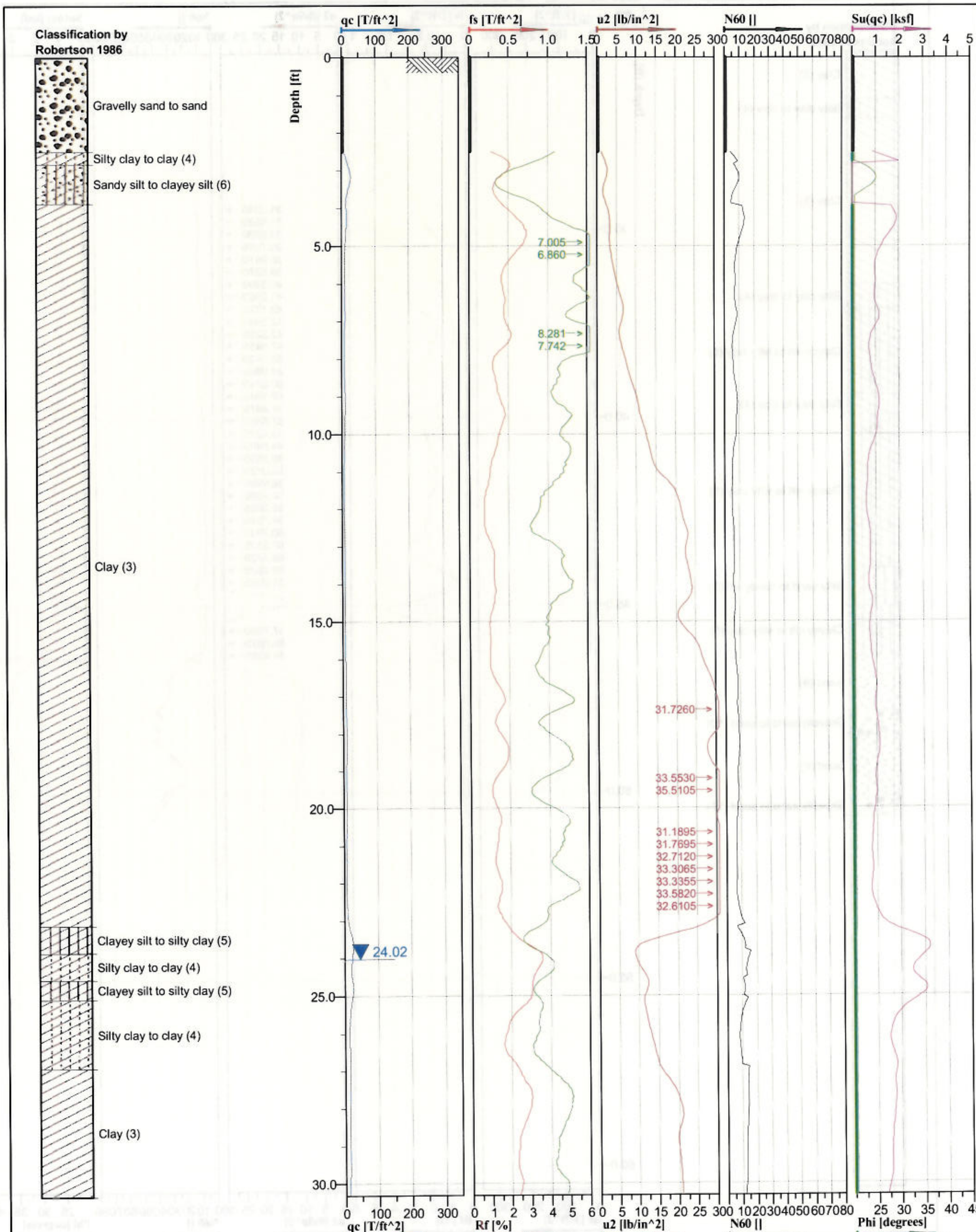
CONSULTING ENGINEERS

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Power Plant	Position: X: 937555.35 ft, Y: 865357.78 ft	Ground level: 417.49	Test no: P-1
Project ID: 2010012488	Client: Ameren Missouri	Date: 10/7/2010	Scale: 1 : 42
Project: Ameren: Meramec Ash Pond Stability Analysis		Page: 2/2	Fig: 3-1
		File: Meramec P-1.cpd	

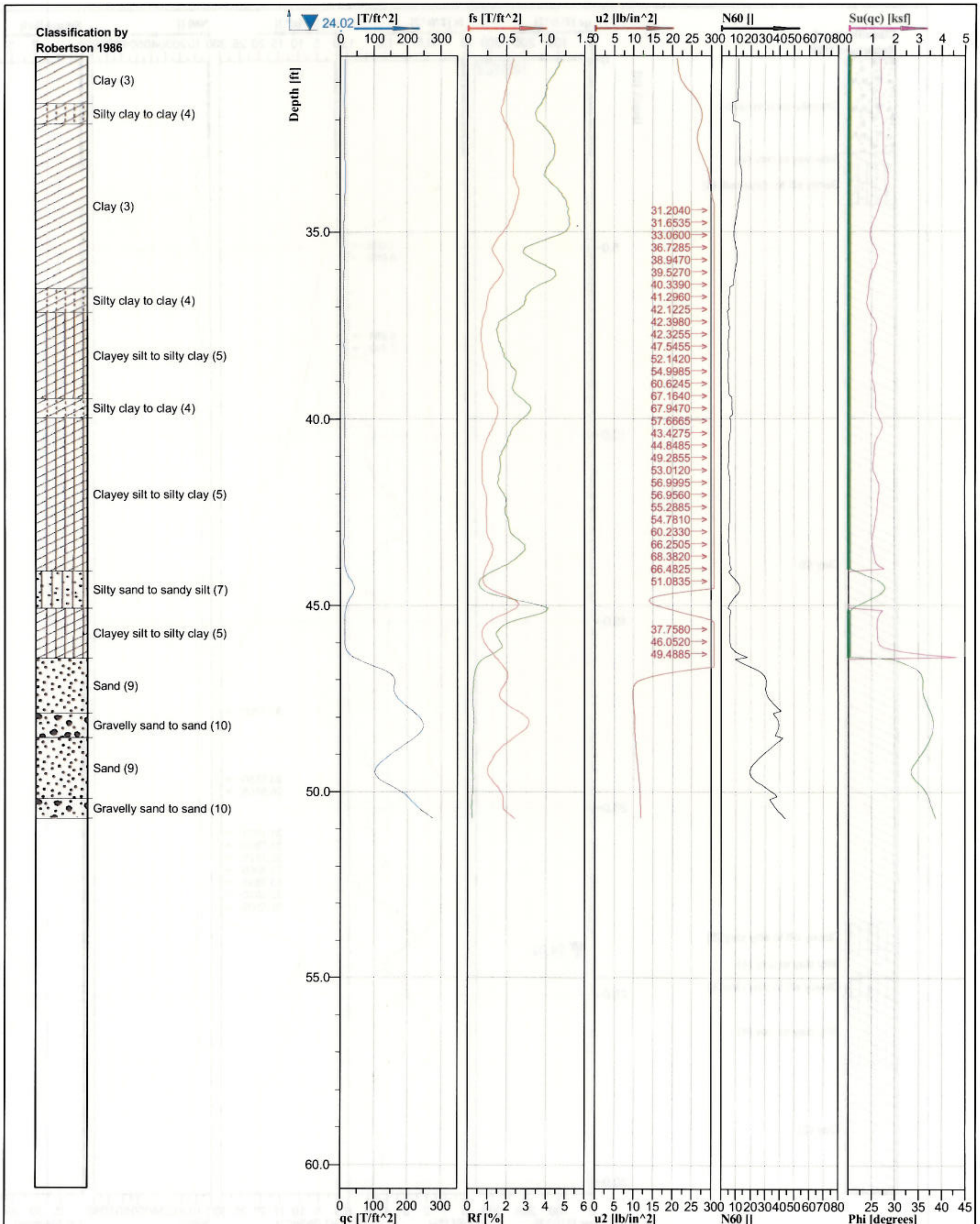


RJ
Reitz & Jens, Inc.
Consulting Engineers

U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Power Plant	Position: X: 936802.95 ft, Y: 864543.54 ft	Ground level: 414.57	Test no: P-2
Project ID: 2010012488	Client: Ameren Missouri	Date: 10/7/2010	Scale: 1 : 42
Project: Ameren: Meramec Ash Pond Stability Analysis		Page: 1/2	Fig: 3-2
		File: Meramec P-2.cpd	



U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Power Plant	Position: X: 936802.95 ft, Y: 864543.54 ft	Ground level: 414.57	Test no: P-2
Project ID: 2010012488	Client: Ameren Missouri	Date: 10/7/2010	Scale: 1 : 42
Project: Ameren: Meramec Ash Pond Stability Analysis		Page: 2/2	Fig: 3-2
		File: Meramec P-2.cpd	

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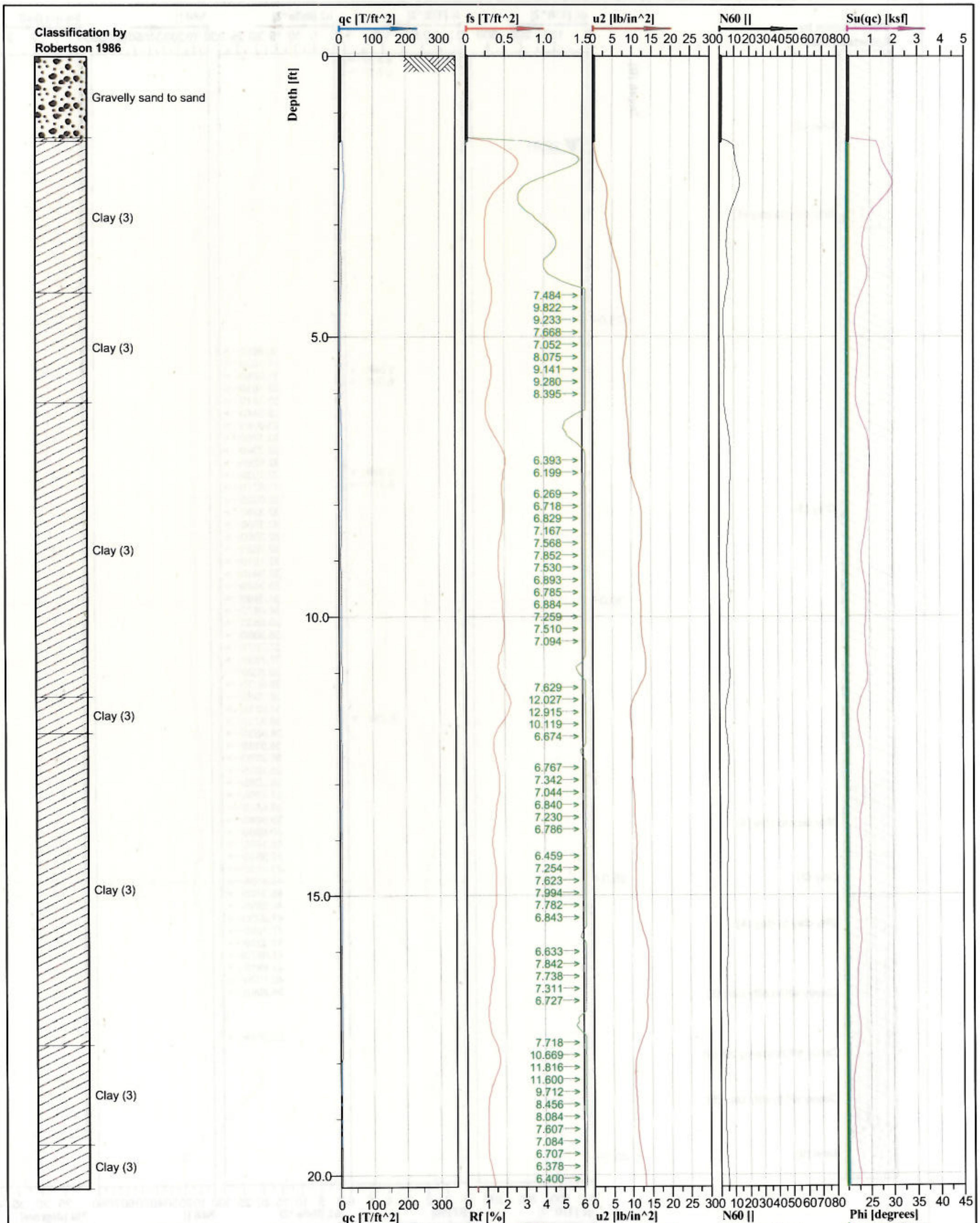

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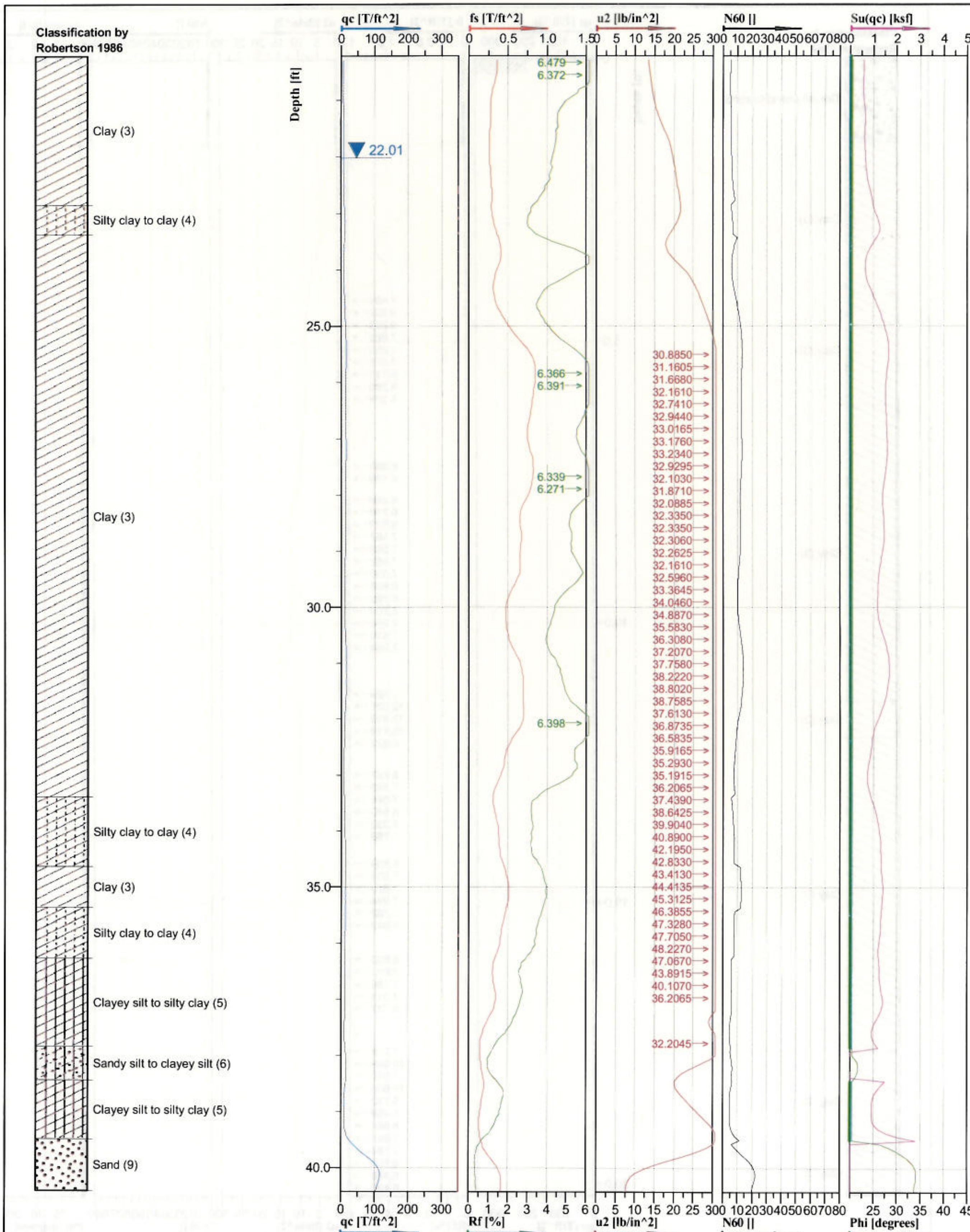
CONSULTING ENGINEERS

U2
22.01

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Power Plant	Position: X: 864515.12 ft, Y: 936305.48 ft	Ground level: 413.25	Test no: P-3
Project ID: 2010012488	Client: Ameren Missouri	Date: 10/7/2010	Scale: 1 : 28
Project: Ameren: Meramec Ash Pond Stability Analysis		Page: 1/3	Fig: 3-3
		File: Meramec PZ-2.cpd	

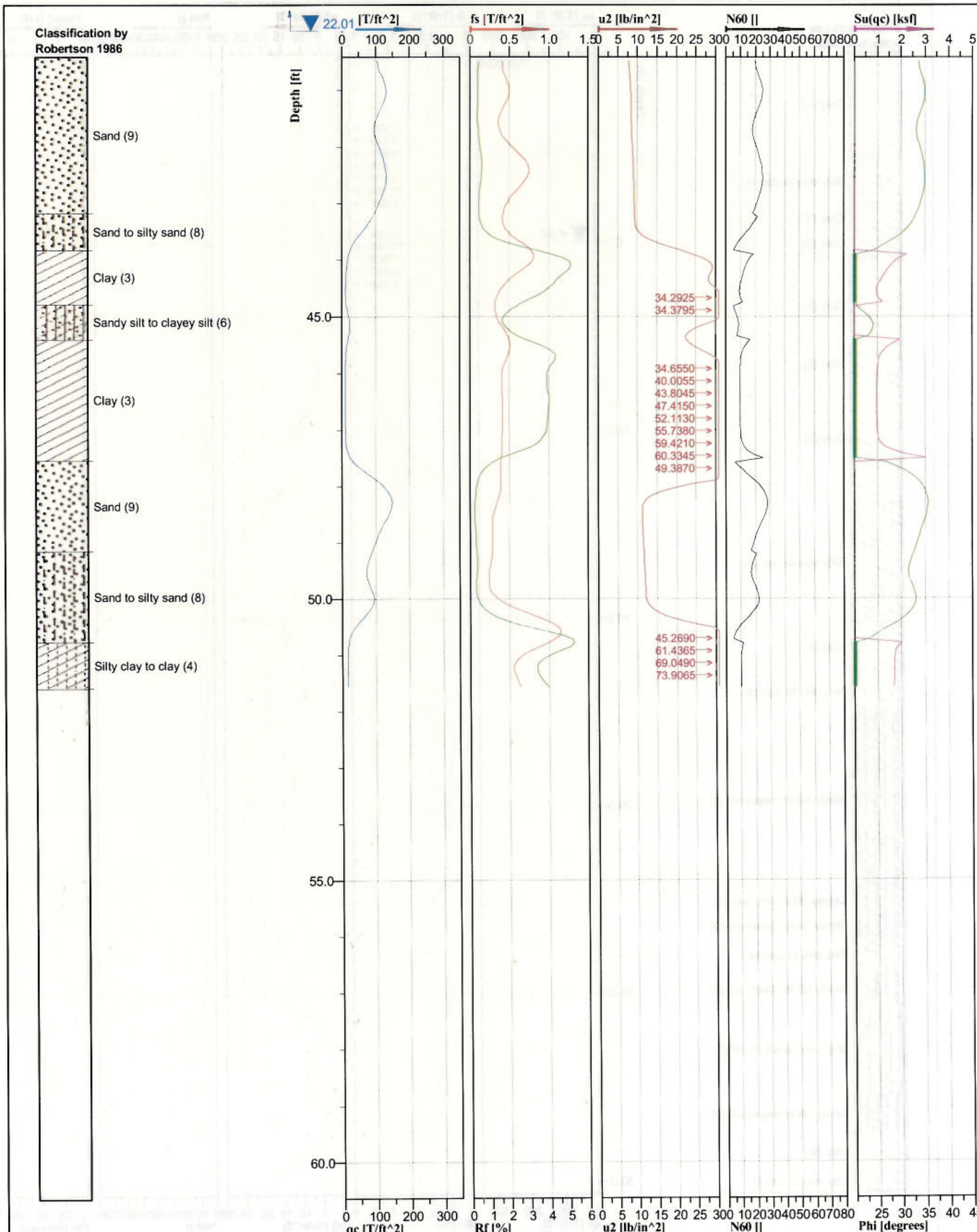


REITZ & JENS, INC.
CONSULTING ENGINEERS

U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

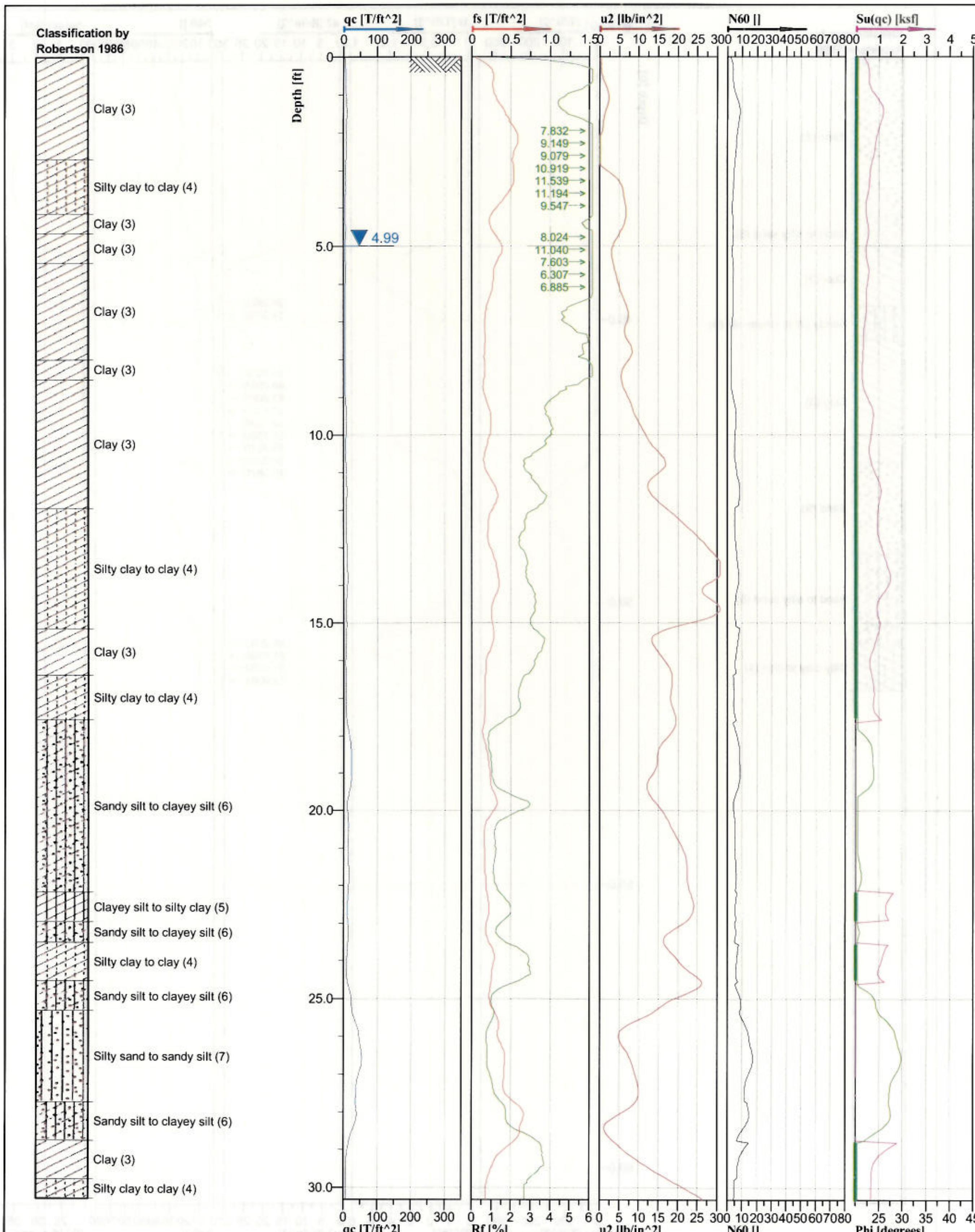
Location: Meramec Power Plant	Position: X: 864515.12 ft, Y: 936305.48 ft	Ground level: 413.25	Test no: P-3
Project ID: 2010012488	Client: Ameren Missouri	Date: 10/7/2010	Scale: 1 : 28
Project: Ameren: Meramec Ash Pond Stability Analysis		Page: 2/3	Fig: 3-3
		File: Meramec PZ-2.cpd	



Location: Meramec Power Plant	Position: X: 864515.12 ft, Y: 936305.48 ft	Ground level: 413.25	Test no: P-3
Project ID: 2010012488	Client: Ameren Missouri	Date: 10/7/2010	Scale: 1 : 28
Project: Ameren: Meramec Ash Pond Stability Analysis		Page: 3/3	Fig: 3-3
		File: Meramec PZ-2.cpd	

Reitz & Jens, Inc.
Consulting Engineers

U2
Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150



Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Power Plant	Position: X: 864848.16 ft, Y: 934529.04 ft	Ground level: 394.26	Test no: P-4
Project ID: 2010012488	Client: Ameren Missouri	Date: 10/7/10	Scale: 1 : 42
Project: Ameren: Meramec Ash Pond Stability Analysis		Page: 1/2	Fig: 3-4
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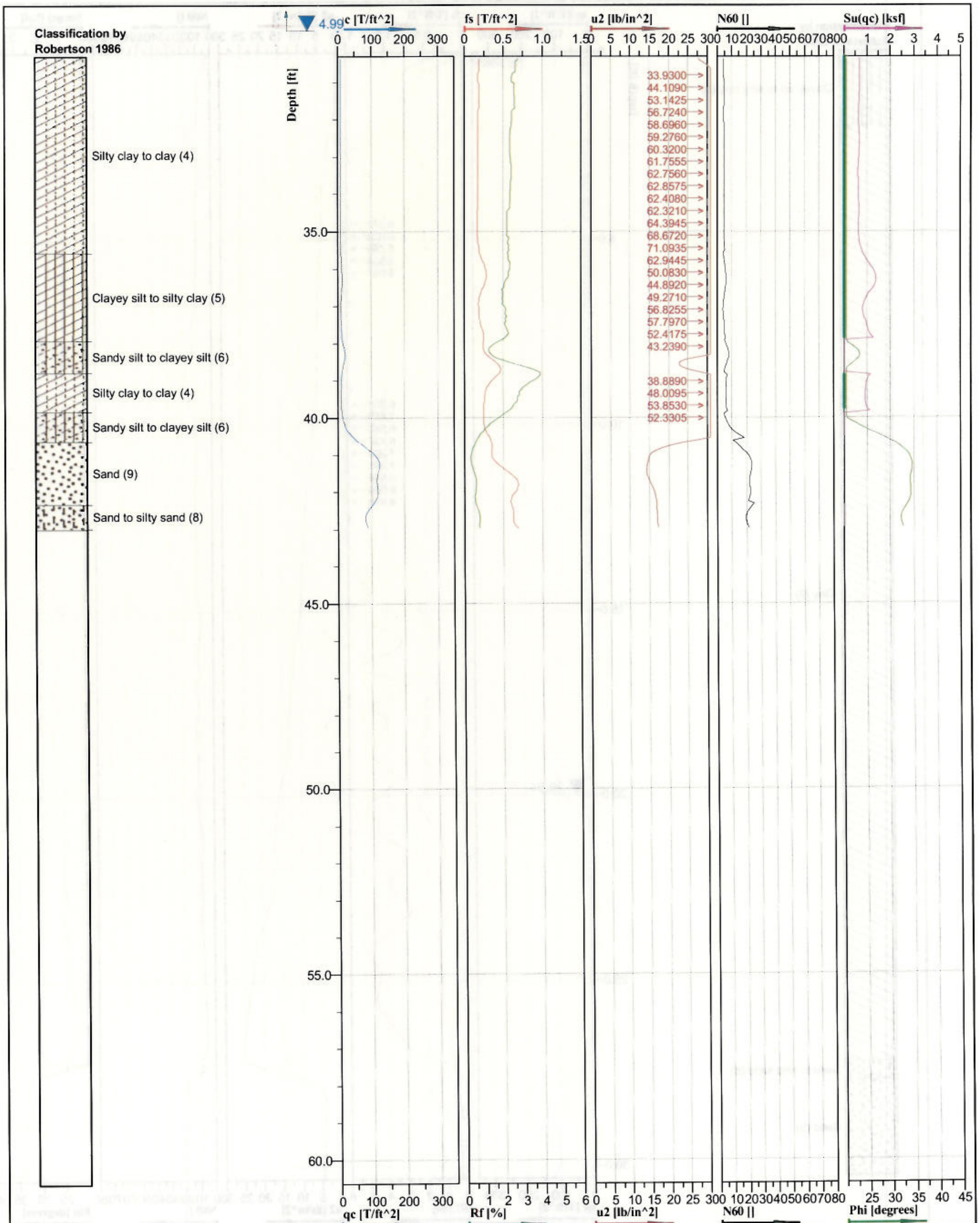
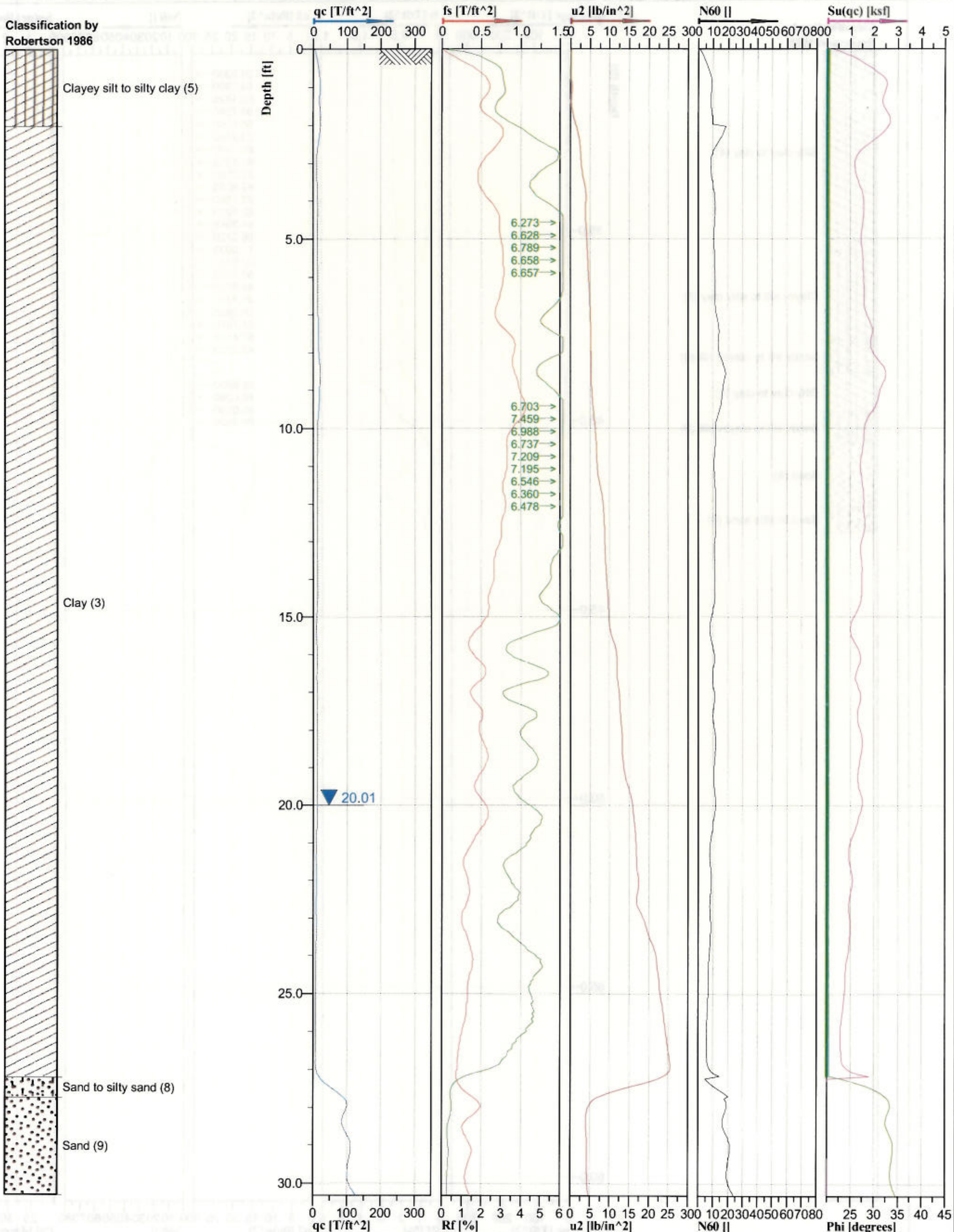


U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

REITZ & JENS, INC.
CONSULTING ENGINEERS

Location: Meramec Power Plant	Position: X: 864848.16 ft, Y: 934529.04 ft	Ground level: 394.26	Test no: P-4
Project ID: 2010012488	Client: Ameren Missouri	Date: 10/7/10	Scale: 1 : 42
Project: Ameren: Meramec Ash Pond Stability Analysis		Page: 2/2	Fig: 3-4
		File: Meramec P-4.cpd	



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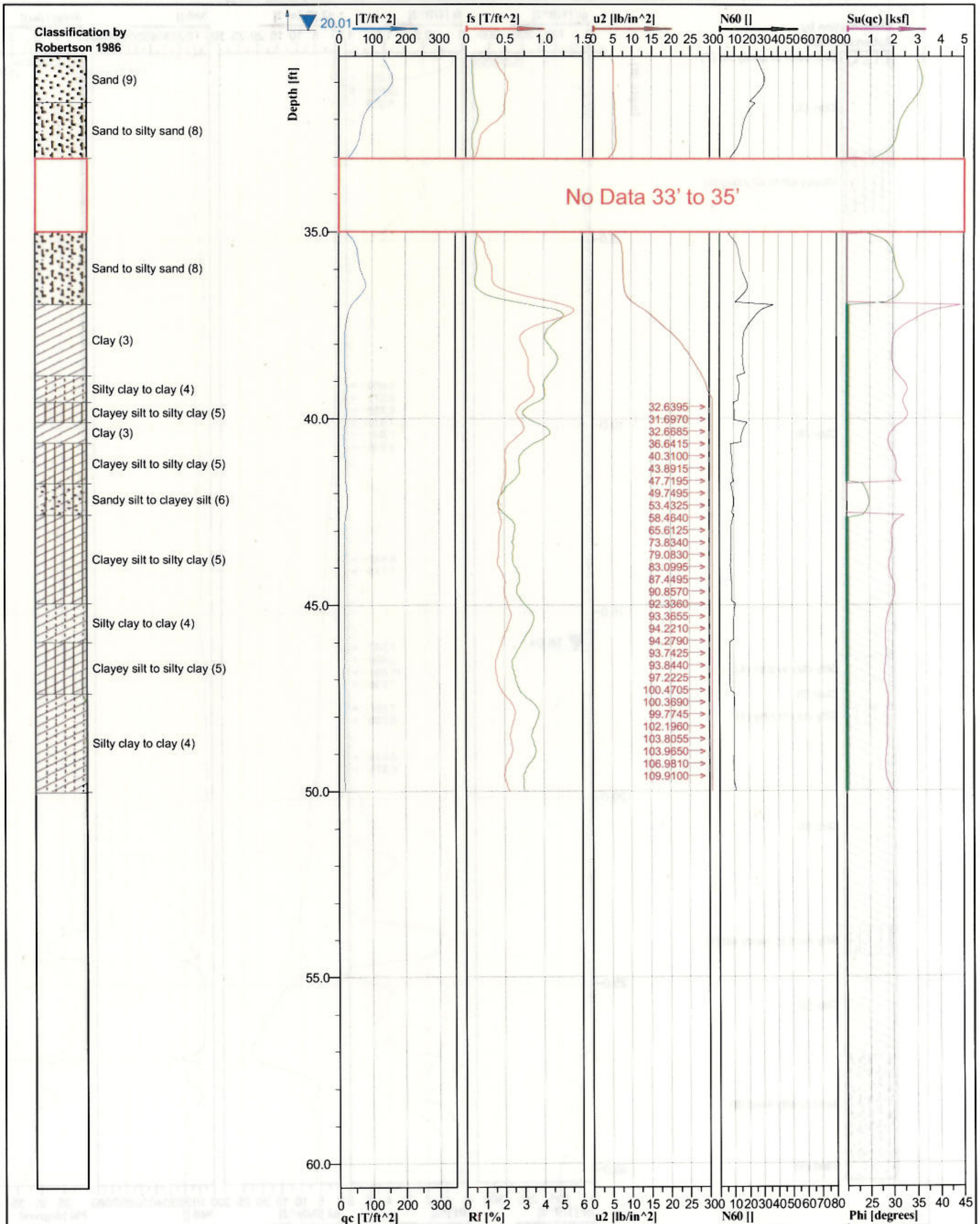
Location: Meramec Ash Ponds	Position: X: 864538.12 ft, Y: 936033.50 ft	Ground level: 398.00	Test no: P-5
Project ID: 2010012488	Client: Ameren Missouri	Date: 11/2/2010	Scale: 1 : 42
Project: Ameren: Ash Pond Stability Analyses		Page: 1/2	Fig: 3-5
No data 33' to 35'		File: meramec p-5.cpd	

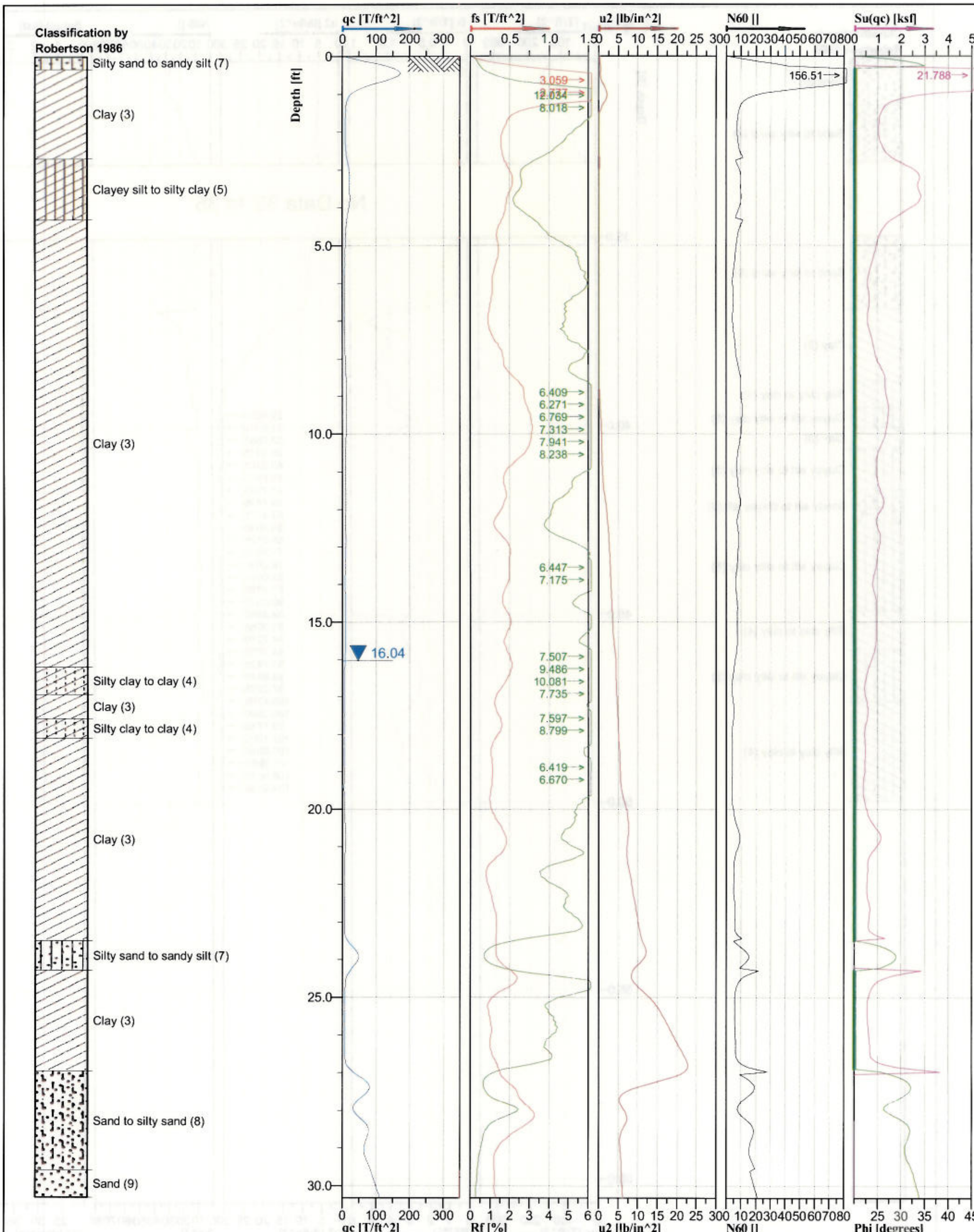


REITZ & JENS, INC.
CONSULTING ENGINEERS

U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Ash Ponds	Position: X: 864538.12 ft, Y: 936033.50 ft	Ground level: 398.00	Test no: P-5
Project ID: 2010012488	Client: Ameren Missouri	Date: 11/2/2010	Scale: 1 : 42
Project: Ameren: Ash Pond Stability Analyses		Page: 2/2	Fig: 3-5
No data 33' to 35'		File: meramec p-5.cpd	



U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

REITZ & JENS, INC.
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Location: Meramec Ash Ponds	Position: X: 864498.59 ft, Y: 936885.56 ft	Ground level: 396.69	Test no: P-6
Project ID: 2010012488	Client: Ameren Missouri	Date: 11/2/2010	Scale: 1 : 42
Project: Ameren: Ash Pond Stability Analyses		Page: 1/2	Fig: 3-6
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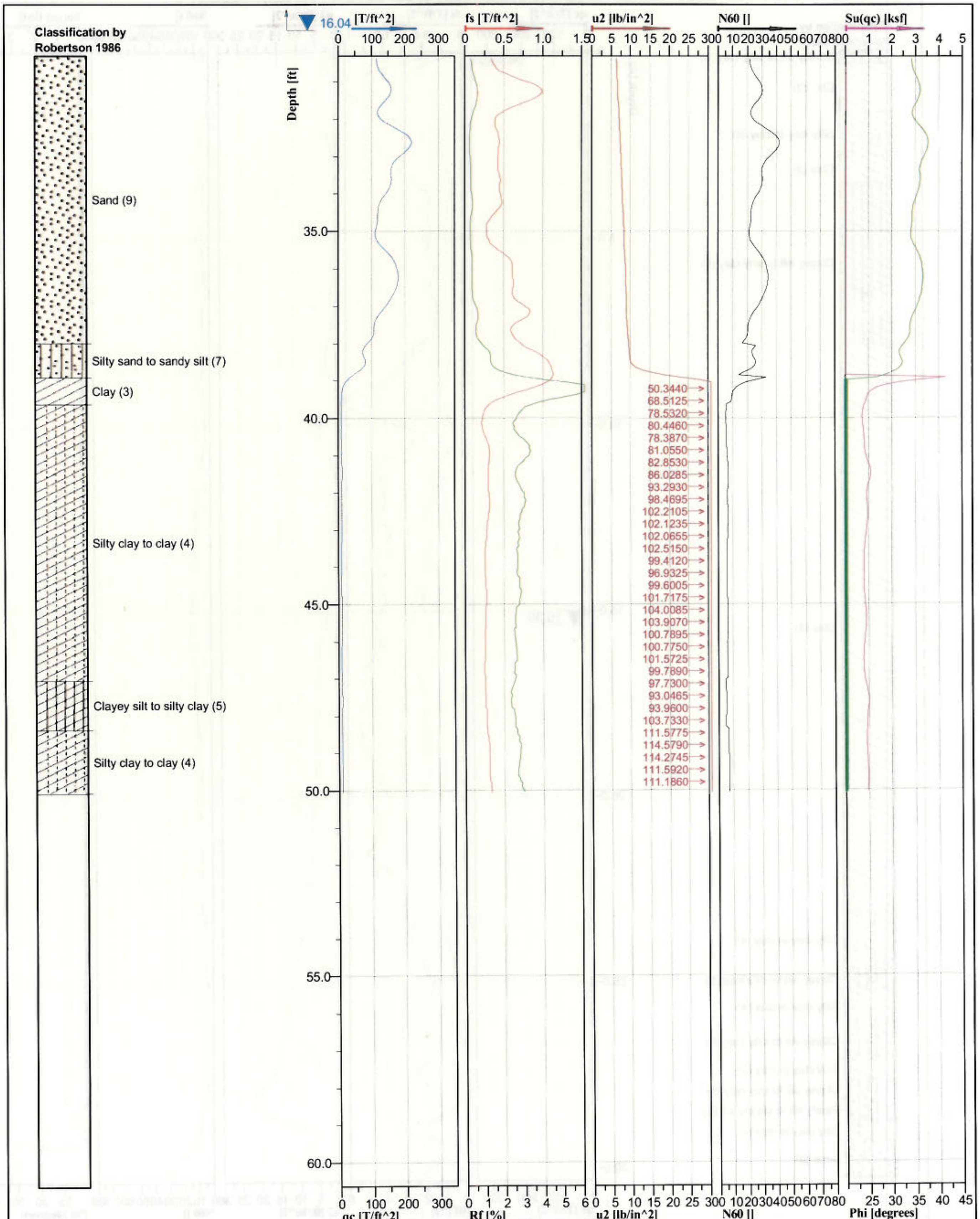
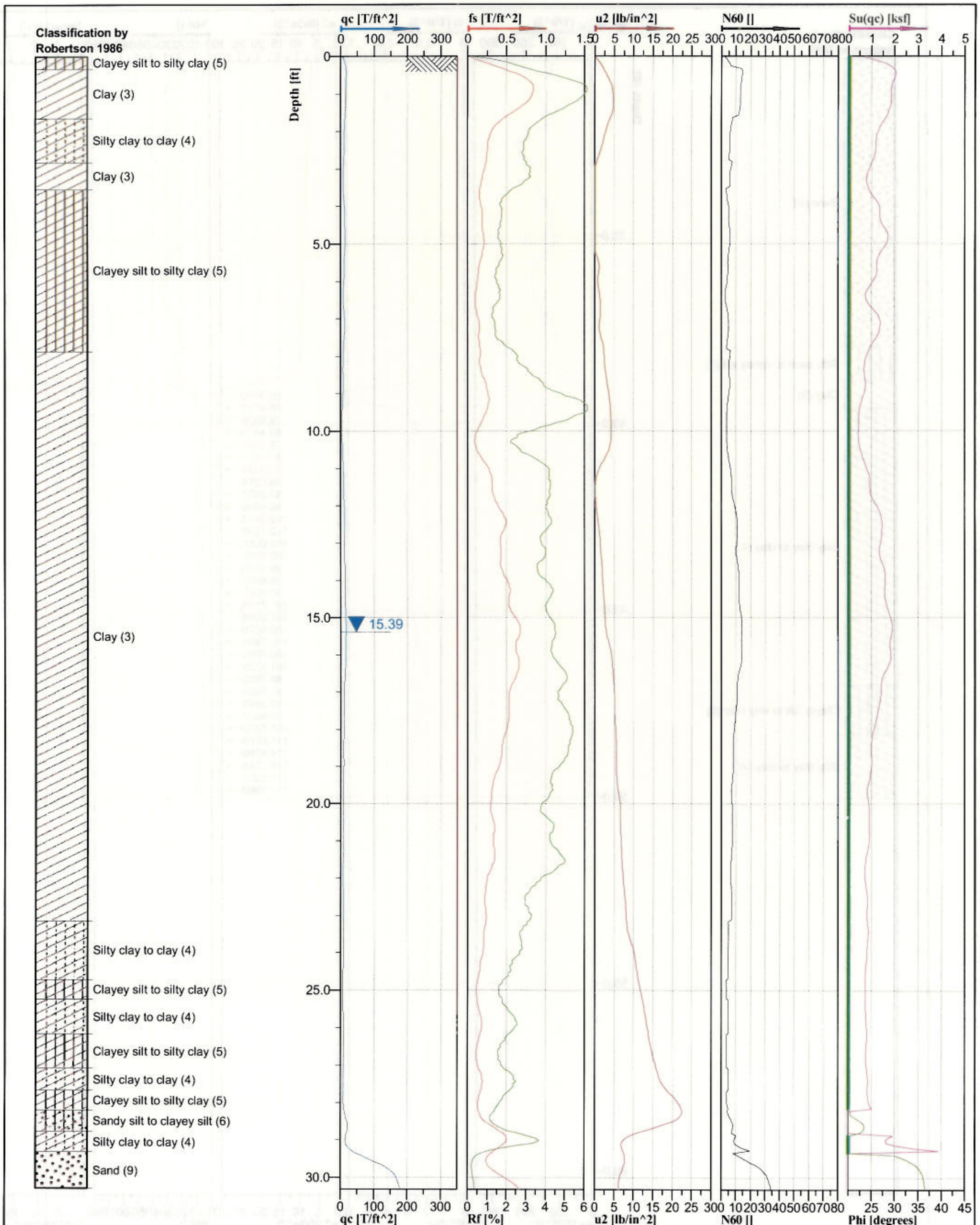


REITZ & JENS, INC.
CONSULTING ENGINEERS

U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Ash Ponds	Position: X: 864498.59 ft, Y: 936885.56 ft	Ground level: 396.69	Test no: P-6
Project ID: 2010012488	Client: Ameren Missouri	Date: 11/2/2010	Scale: 1 : 42
Project: Ameren: Ash Pond Stability Analyses		Page: 2/2	Fig: 3-6
		File: meramec p-6.cpd	



Location: Meramec Ash Ponds	Position: X: 864861.25 ft, Y: 937323.69 ft	Ground level: 397.60	Test no: P-7
Project ID: 2010012488	Client: Ameren Missouri	Date: 11/2/2010	Scale: 1 : 42
Project: Ameren: Ash Pond Stability Analyses		Page: 1/2	Fig: 3-7
		File: meramec b-1.cpd	

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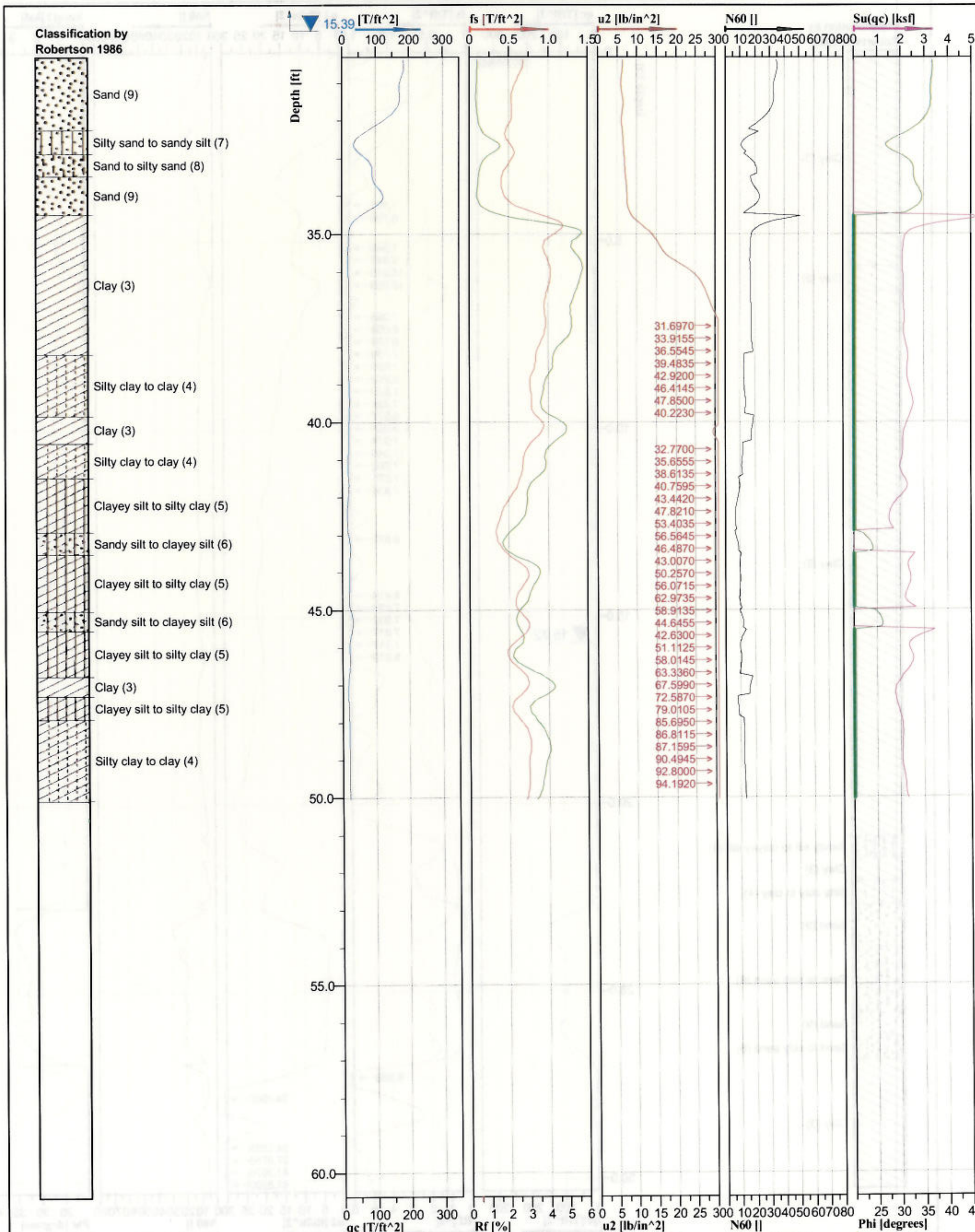
U2
Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150



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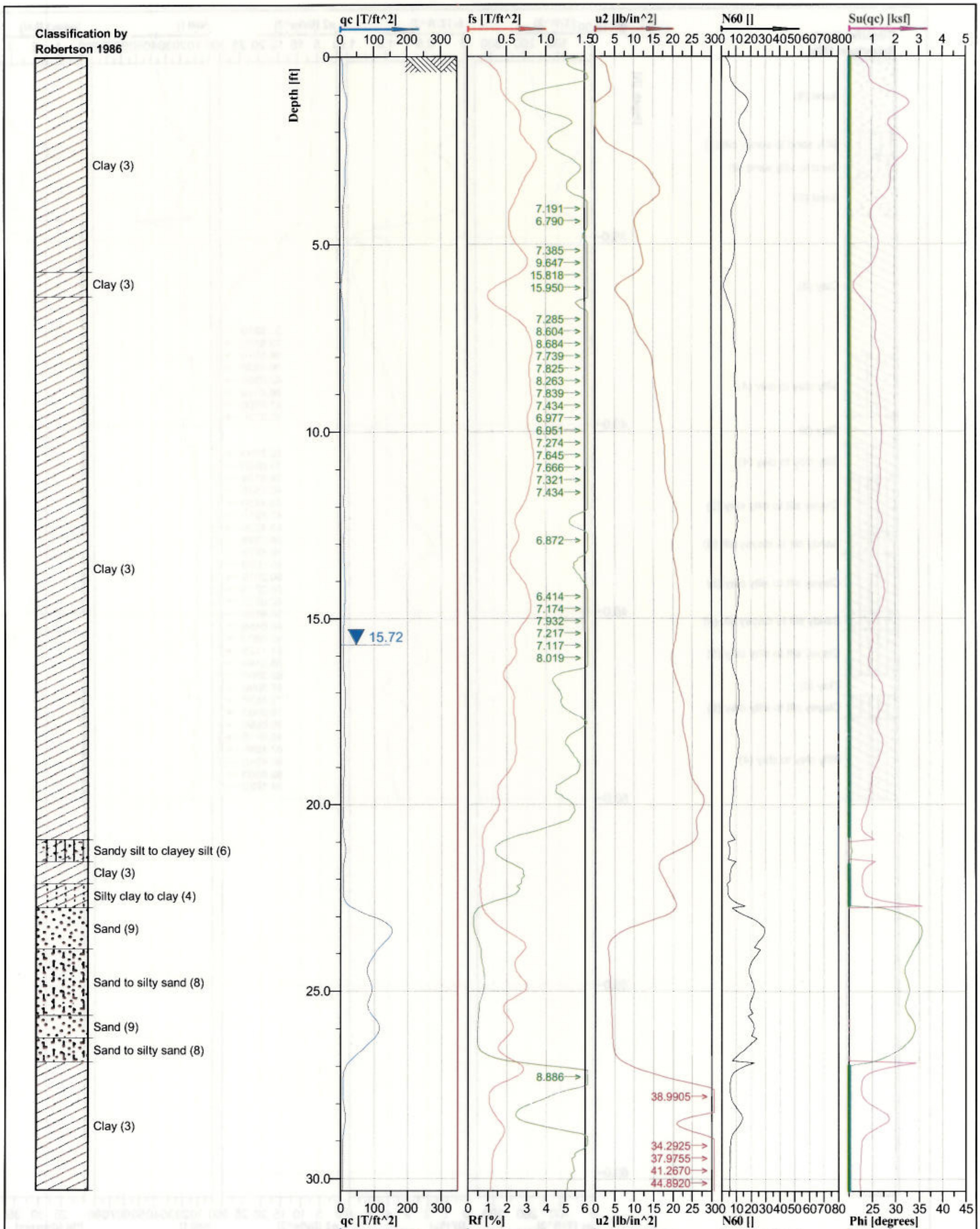
Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Ash Ponds	Position: X: 864861.25 ft, Y: 937323.69 ft	Ground level: 397.60	Test no: P-7
Project ID: 2010012488	Client: Ameren Missouri	Date: 11/2/2010	Scale: 1 : 42
Project: Ameren: Ash Pond Stability Analyses		Page: 2/2	Fig: 3-7
		File: meramec b-1.cpd	



Location: Meramec Ash Ponds	Position: X: 864459.06 ft, Y: 936289.47 ft	Ground level: 398.00	Test no: P-8
Project ID: 2010012488	Client: Ameren Missouri	Date: 11/2/2010	Scale: 1 : 42
Project: Ameren: Ash Pond Stability Analyses		Page: 1/2	Fig: 3-8
		File: meramec b-2.cpd	

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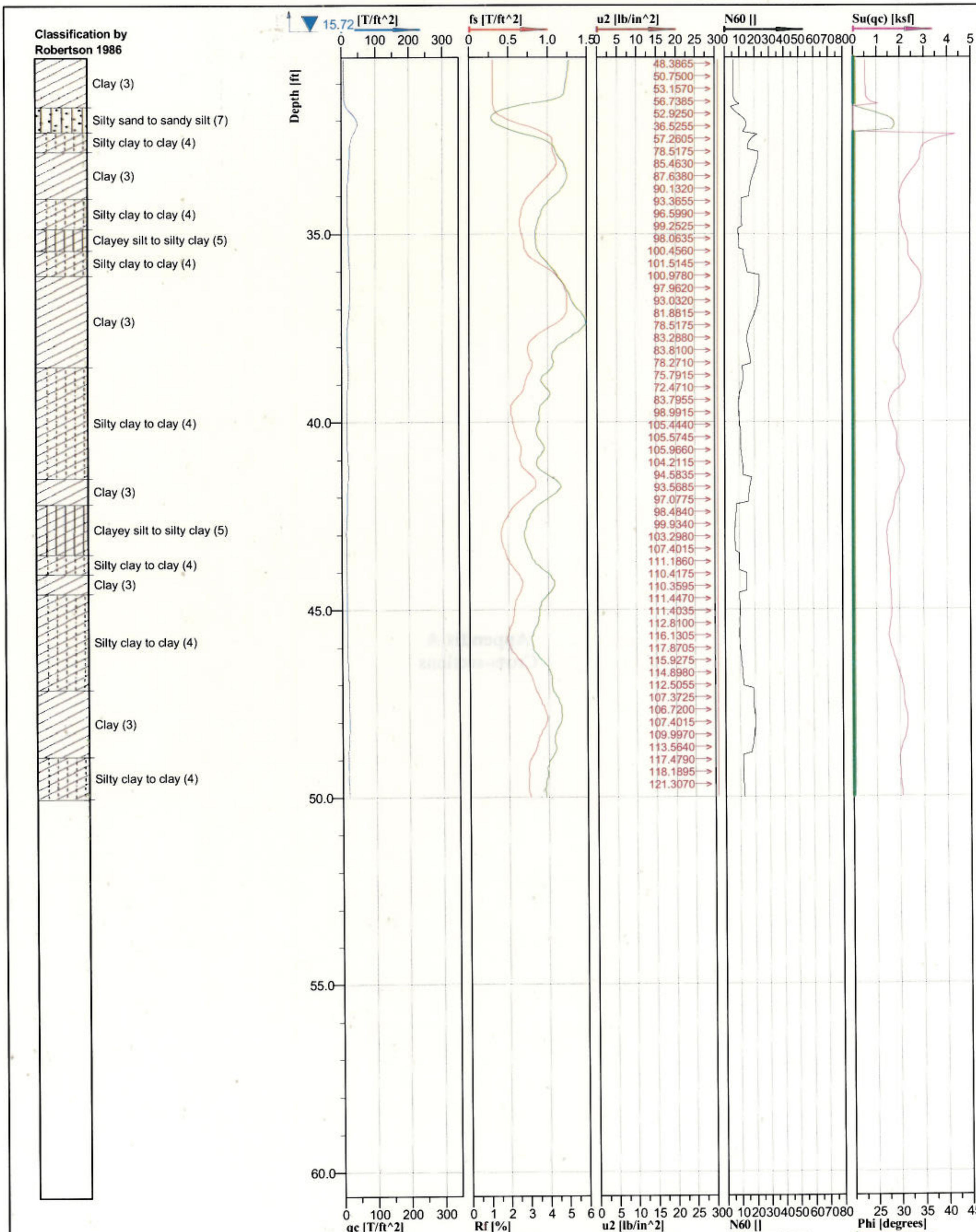
Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150



U2

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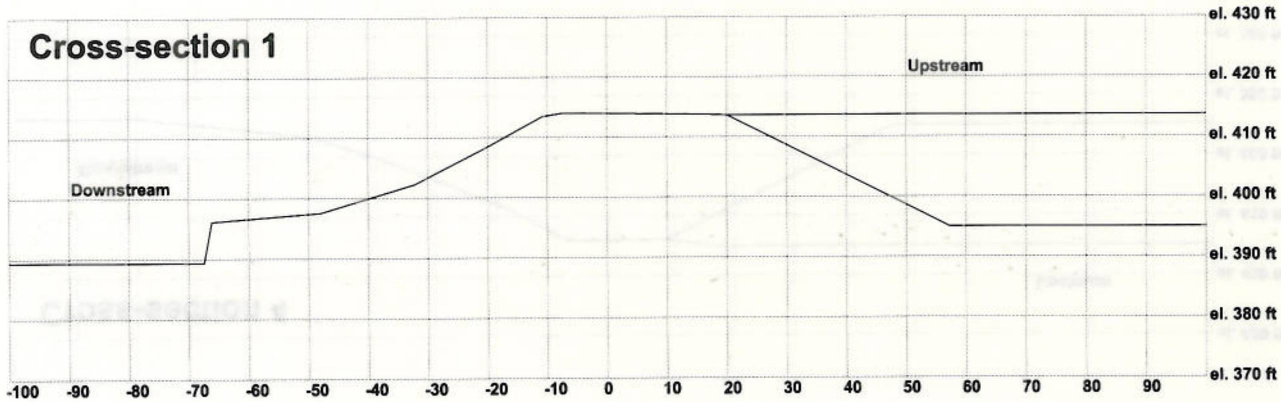
Consulting Engineers

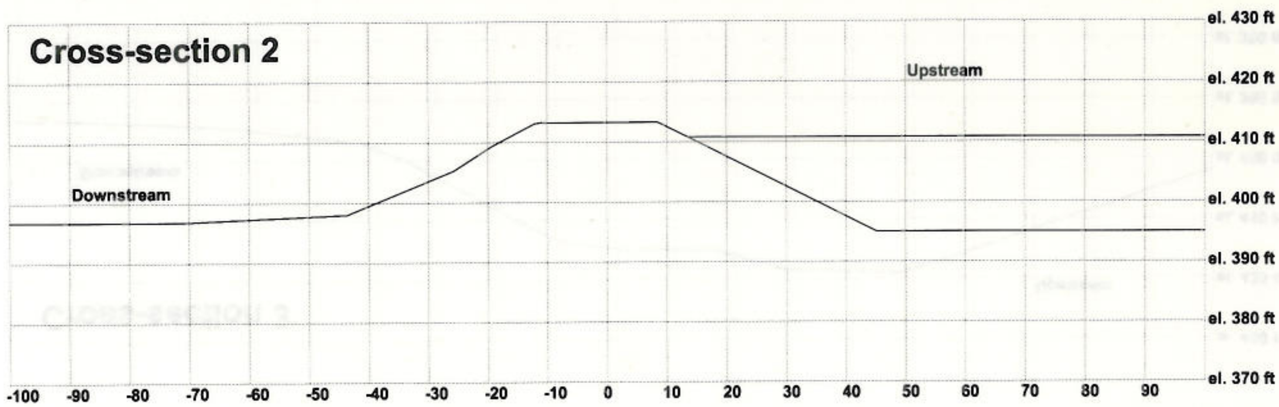
Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Ash Ponds	Position: X: 864459.06 ft, Y: 936289.47 ft	Ground level: 398.00	Test no: P-8
Project ID: 2010012488	Client: Ameren Missouri	Date: 11/2/2010	Scale: 1 : 42
Project: Ameren: Ash Pond Stability Analyses		Page: 2/2	Fig: 3-8
		File: meramec b-2.cpd	

Appendix A
Cross-sections

Meramec Power Station





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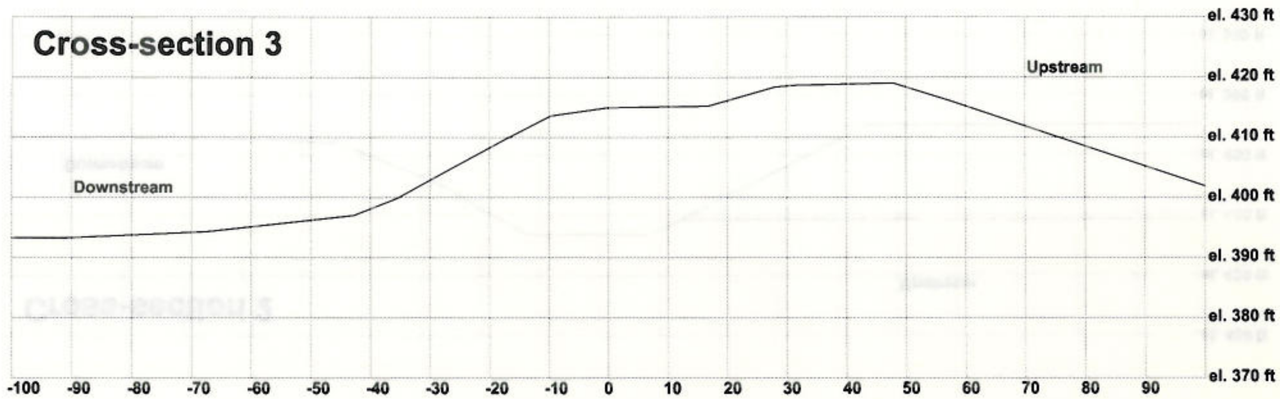
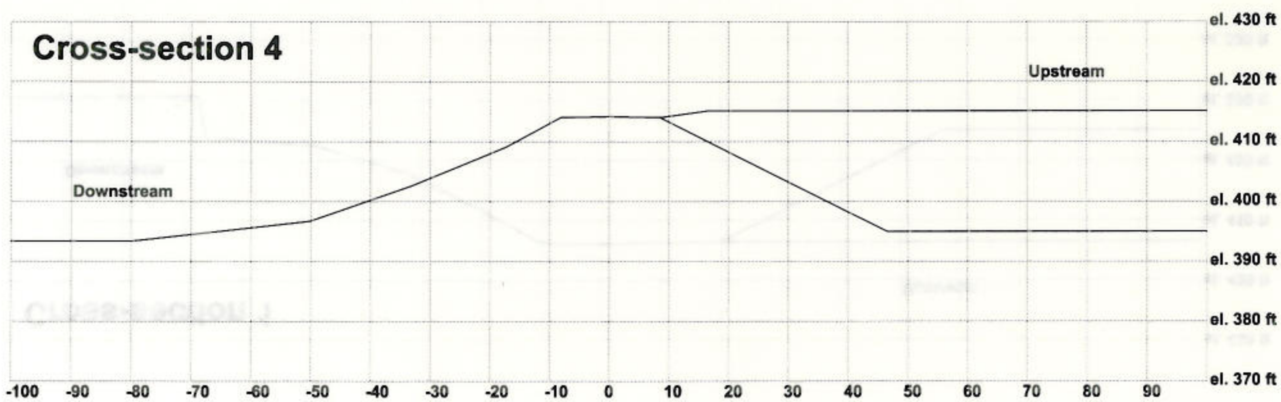
1055 Corporate Square Drive
St. Louis, Missouri 63132

Figure A-1

Meramec Power Station





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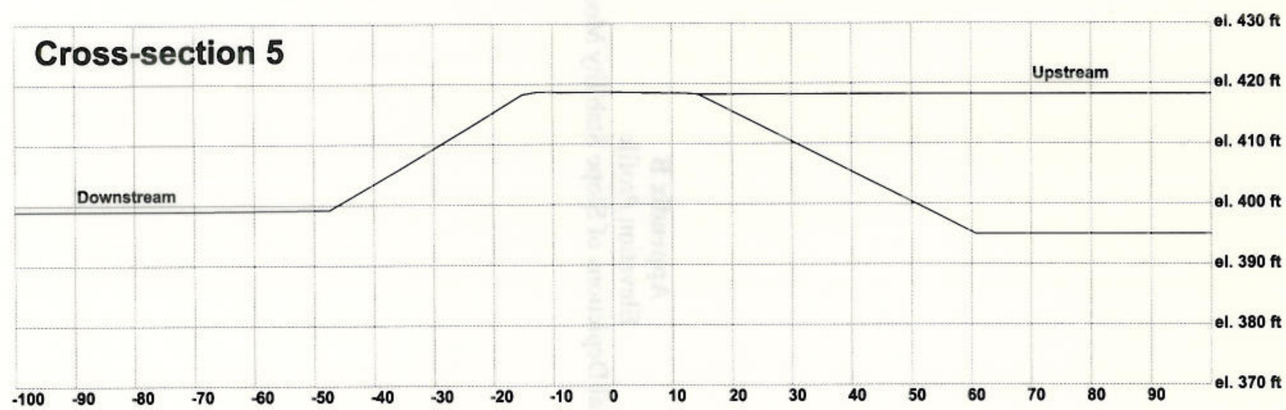
1055 Corporate Square Drive
St. Louis, Missouri 63132

Figure A-2

Meramec Power Station



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1055 Corporate Square Drive
St. Louis, Missouri 63132

Figure A-3

Appendix B

Elevation Profile

Graphical Depictions of Slope Stability Models

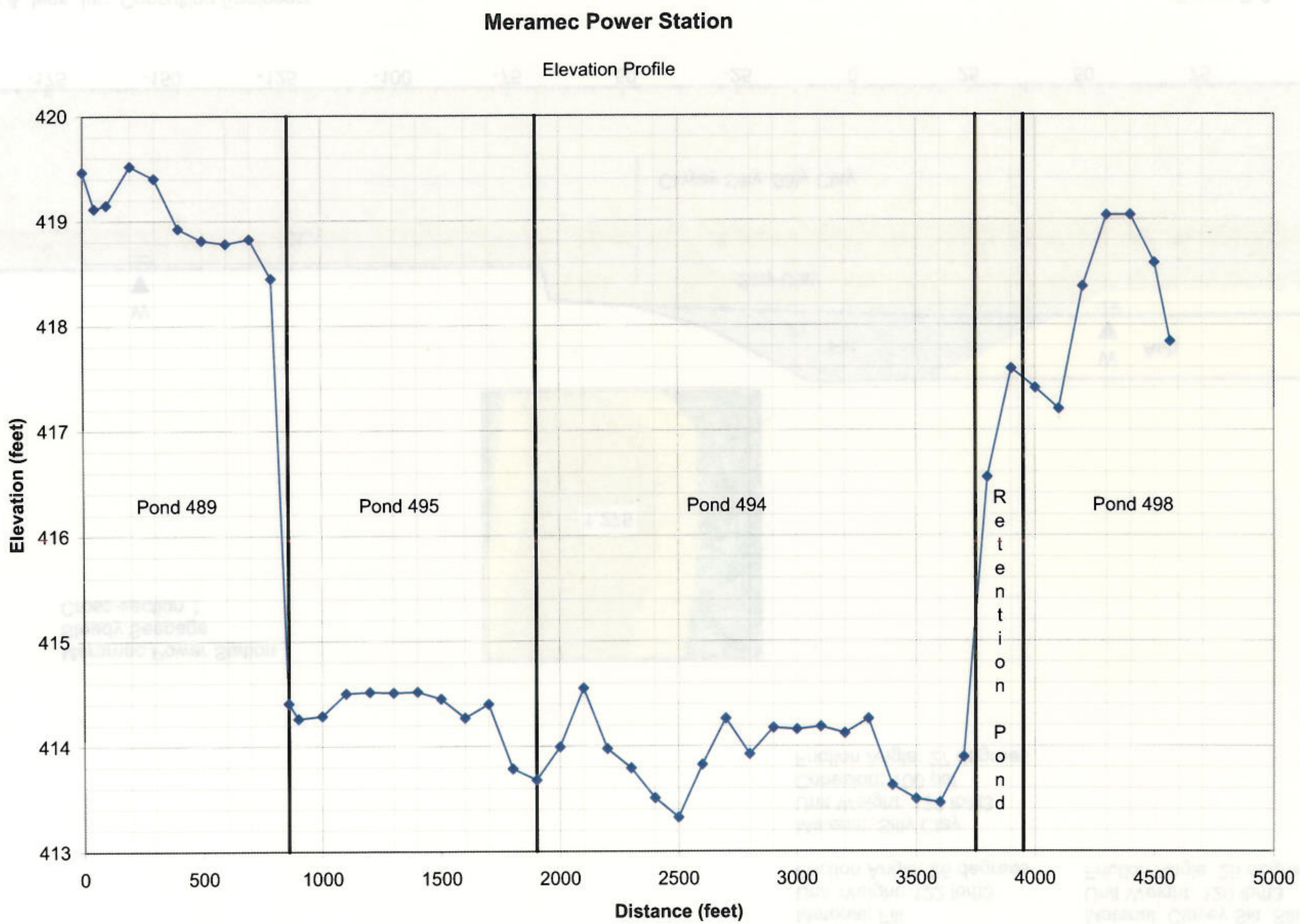

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Figure B-1

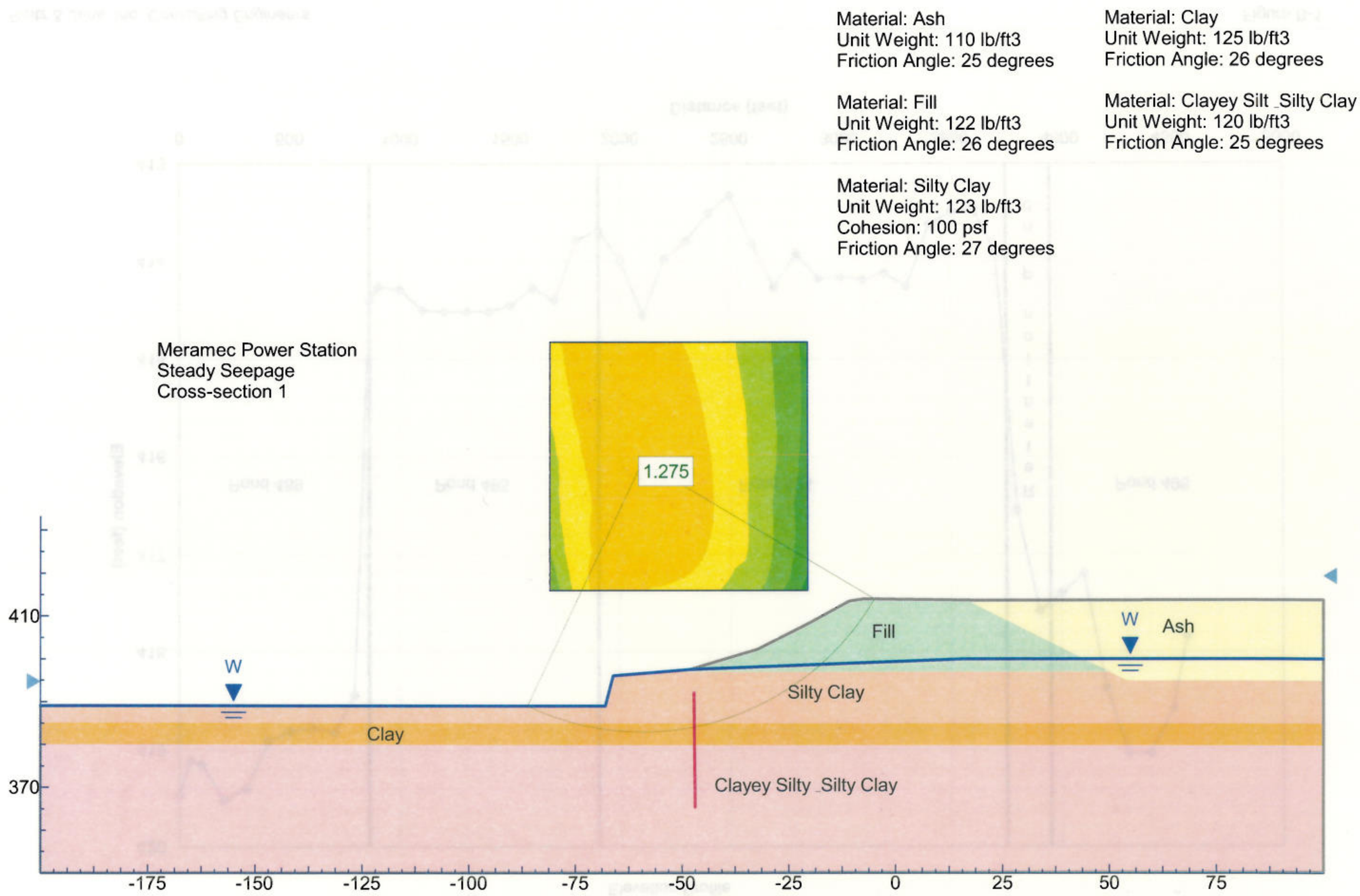

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Figure B-2

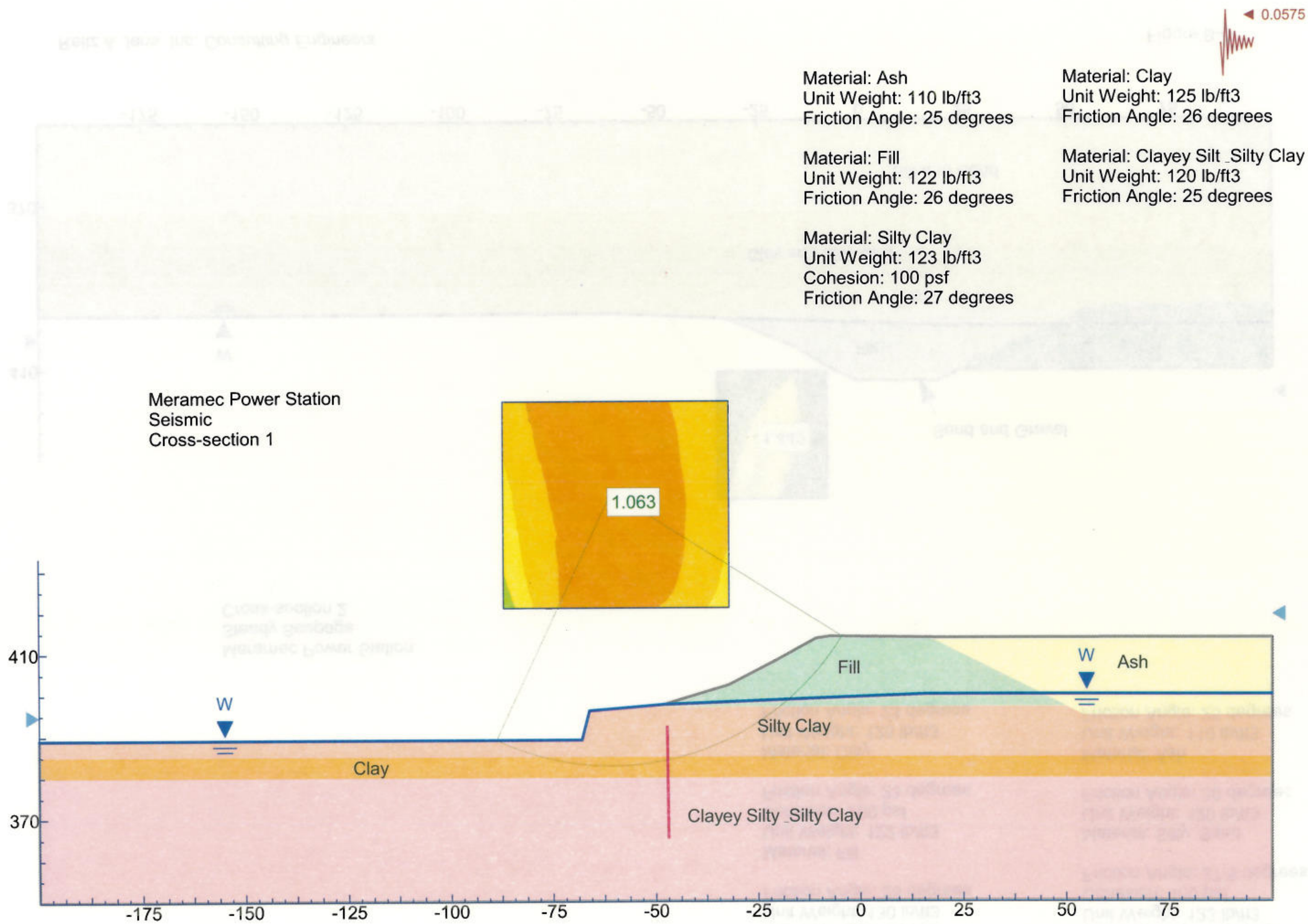

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Figure B-3

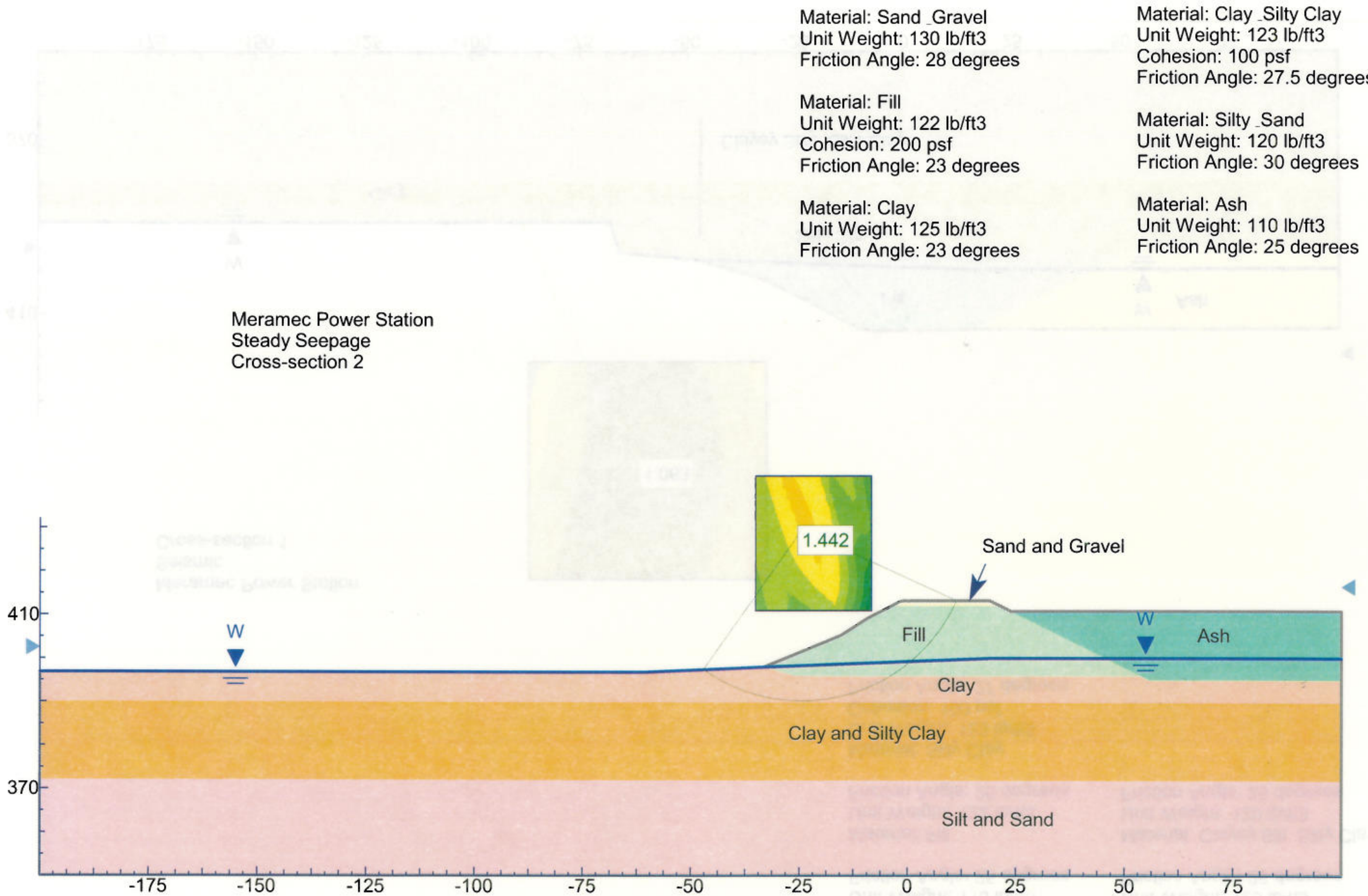

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Figure B-4

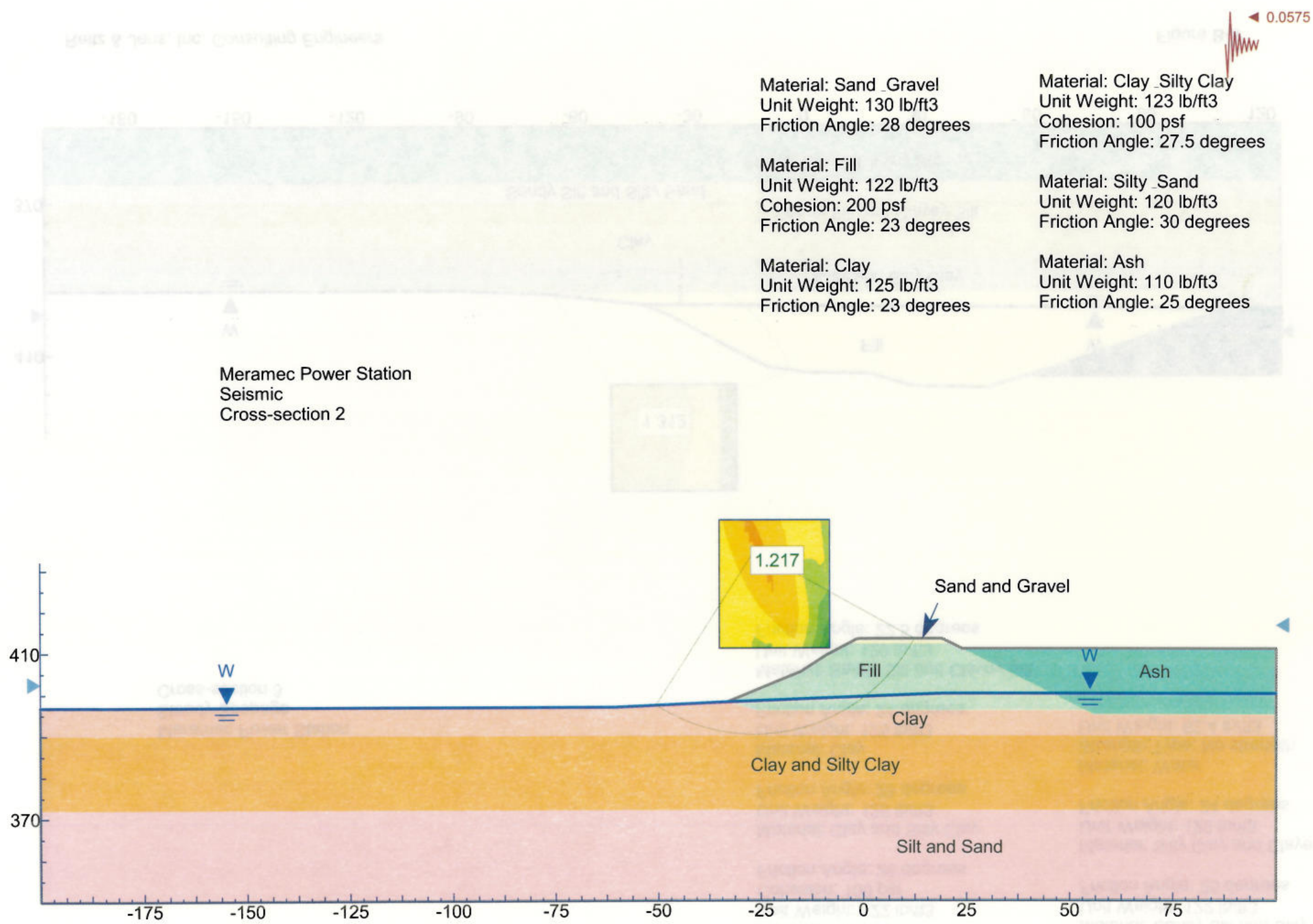

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Figure B-5

Meramec Power Station
Steady Seepage
Cross-section 3

Material: Fill
Unit Weight: 122 lb/ft3
Cohesion: 100 psf
Friction Angle: 26 degrees

Material: Clay and Silty Clay
Unit Weight: 125 lb/ft3
Friction Angle: 23 degrees

Material: Clay
Unit Weight: 125 lb/ft3
Friction Angle: 24 degrees

Material: Sandy Silt and Clayey Silt
Unit Weight: 120 lb/ft3
Friction Angle: 22.5 degrees

Material: Sandy Silt and Silty Sand
Unit Weight: 122 lb/ft3
Friction Angle: 25 degrees

Material: Silty Clay and Clayey Silt
Unit Weight: 120 lb/ft3
Friction Angle: 24 degrees

Material: Water
Strength Type: No strength
Unit Weight: 62.4 lb/ft3

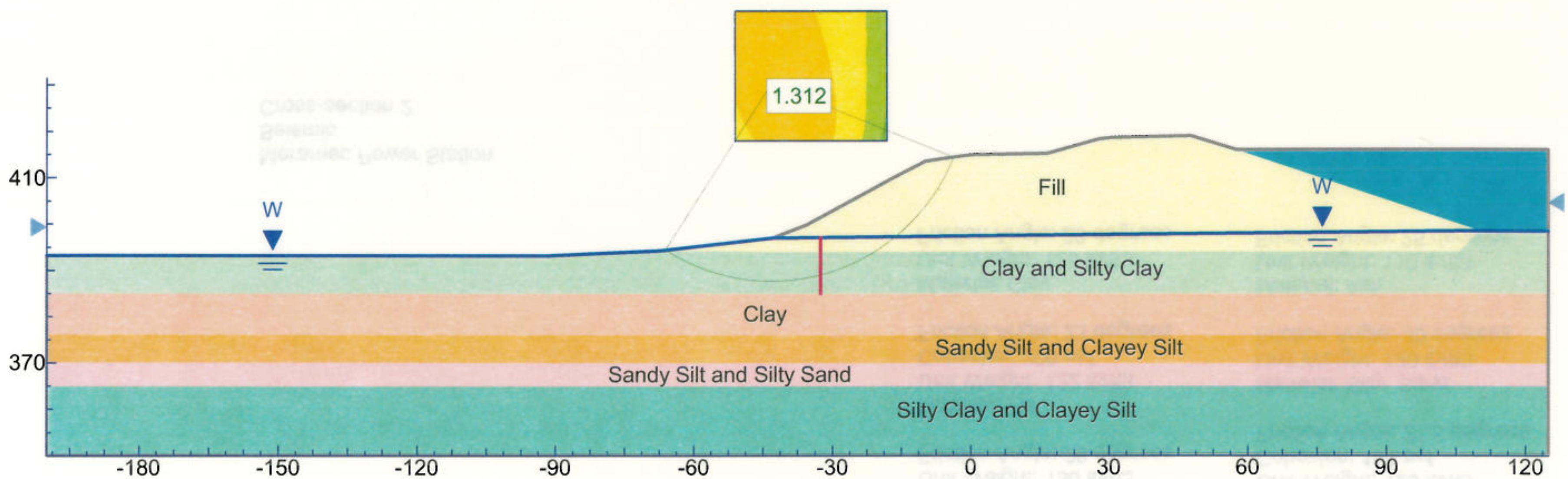

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Figure B-6

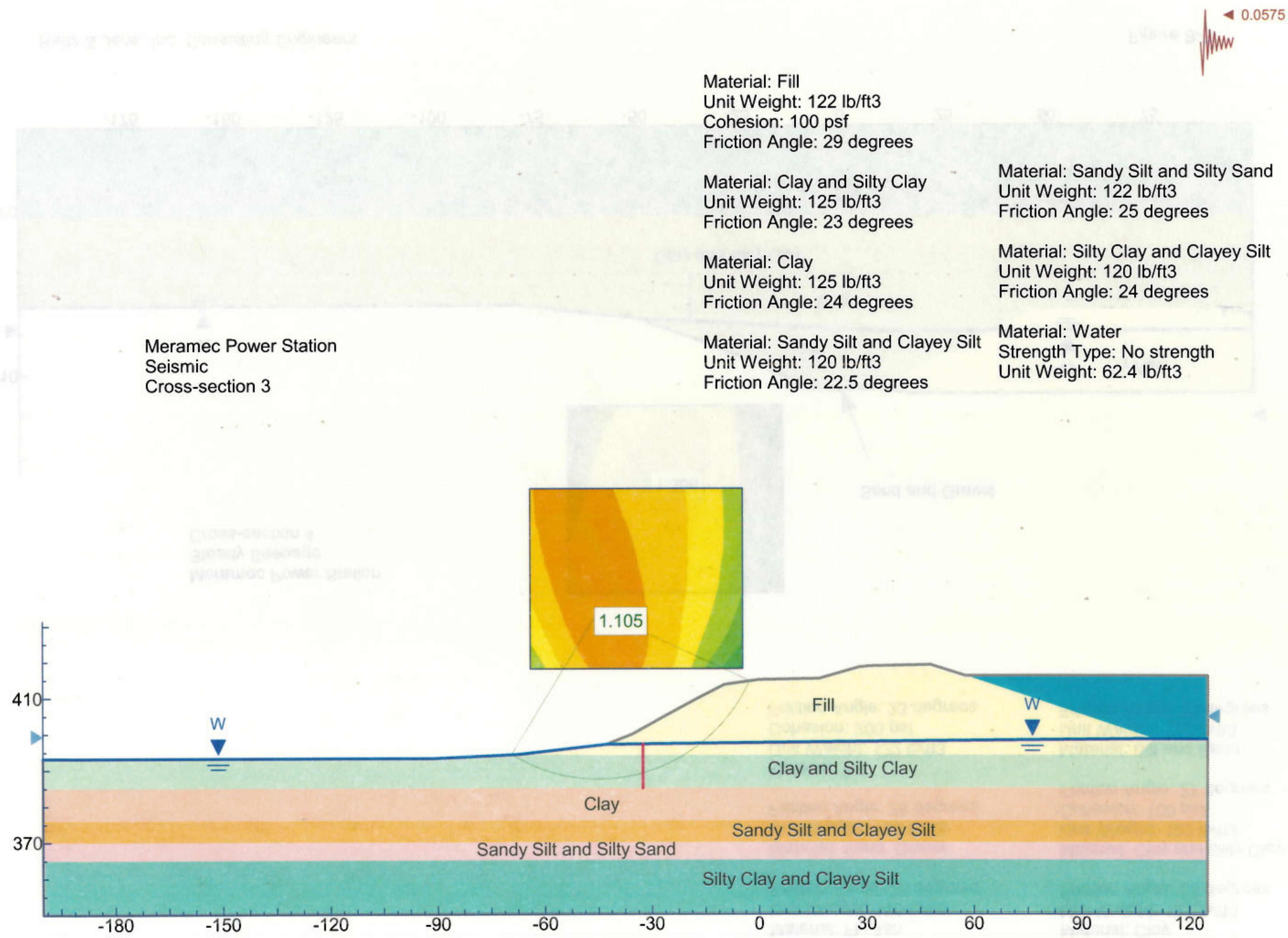

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Figure B-7

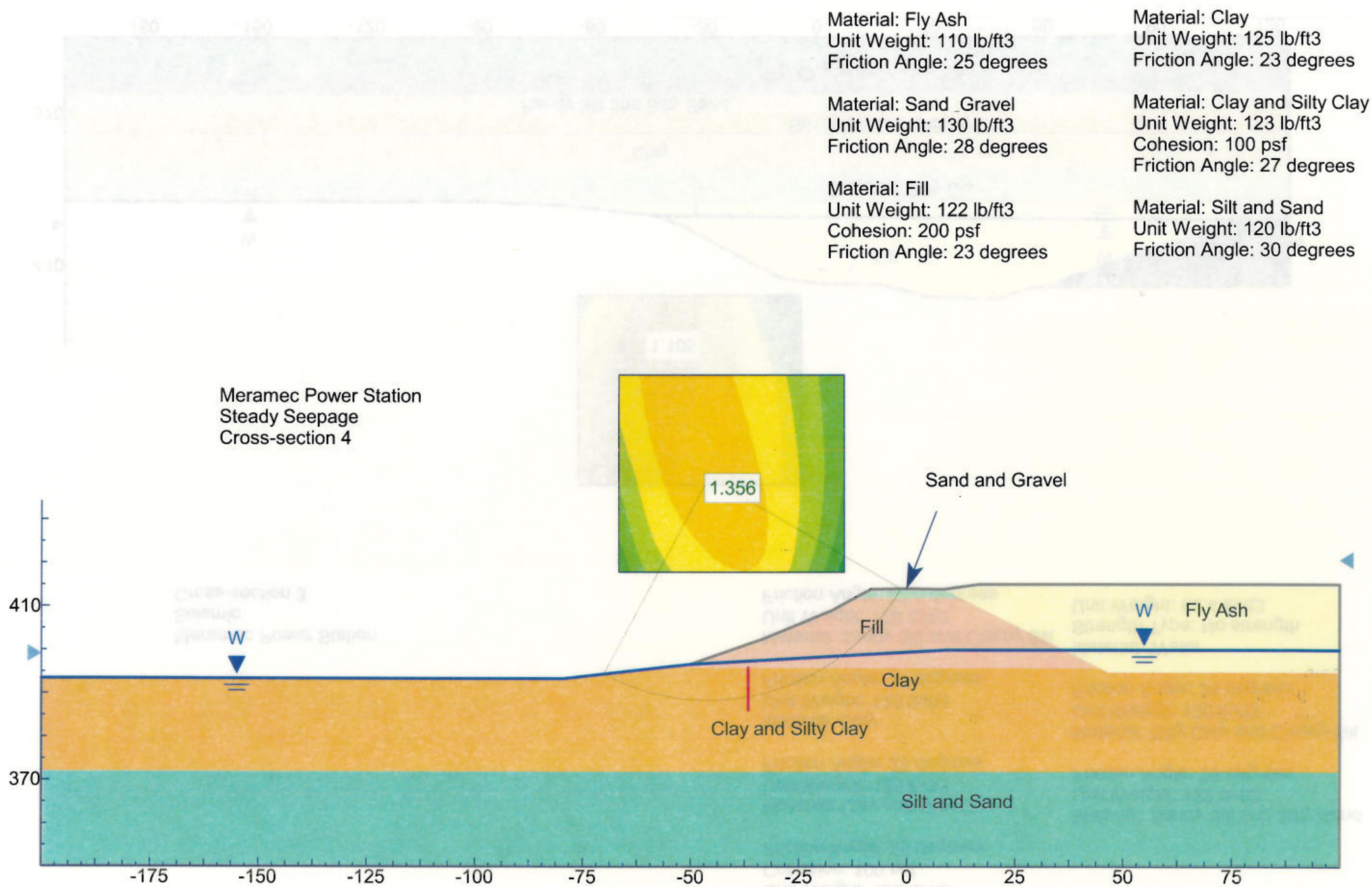

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Figure B-8

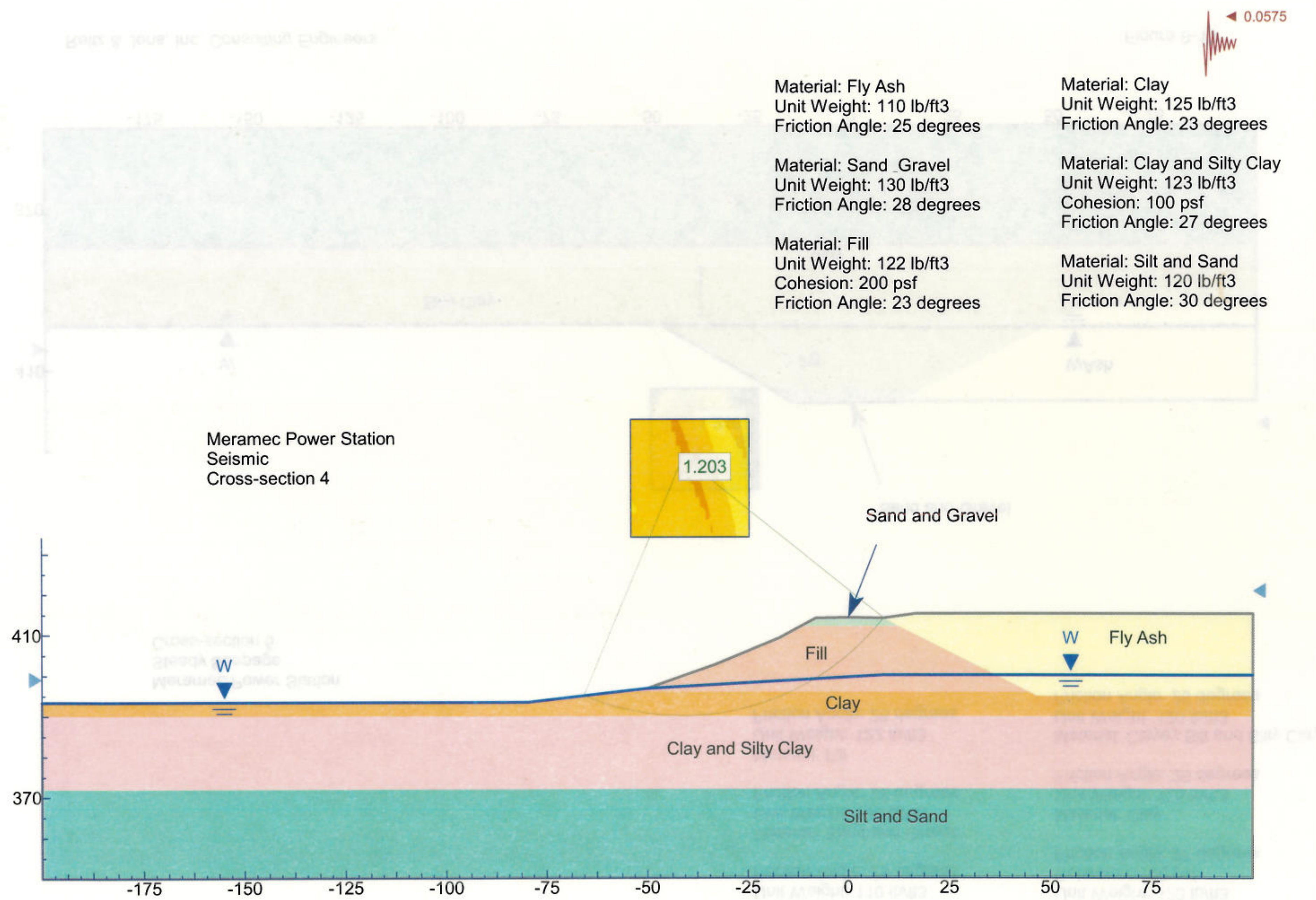

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Figure B-9

Meramec Power Station
Steady Seepage
Cross-section 5

Material: Ash
Unit Weight: 110 lb/ft3
Friction Angle: 25 degrees

Material: Sand and Gravel
Unit Weight: 130 lb/ft3
Friction Angle: 28 degrees

Material: Fill
Unit Weight: 122 lb/ft3
Friction Angle: 26 degrees

Material: Silty Clay
Unit Weight: 123 lb/ft3
Cohesion: 100 psf
Friction Angle: 27 degrees

Material: Clay
Unit Weight: 125 lb/ft3
Friction Angle: 26 degrees

Material: Clayey Silt and Silty Clay
Unit Weight: 120 lb/ft3
Friction Angle: 25 degrees

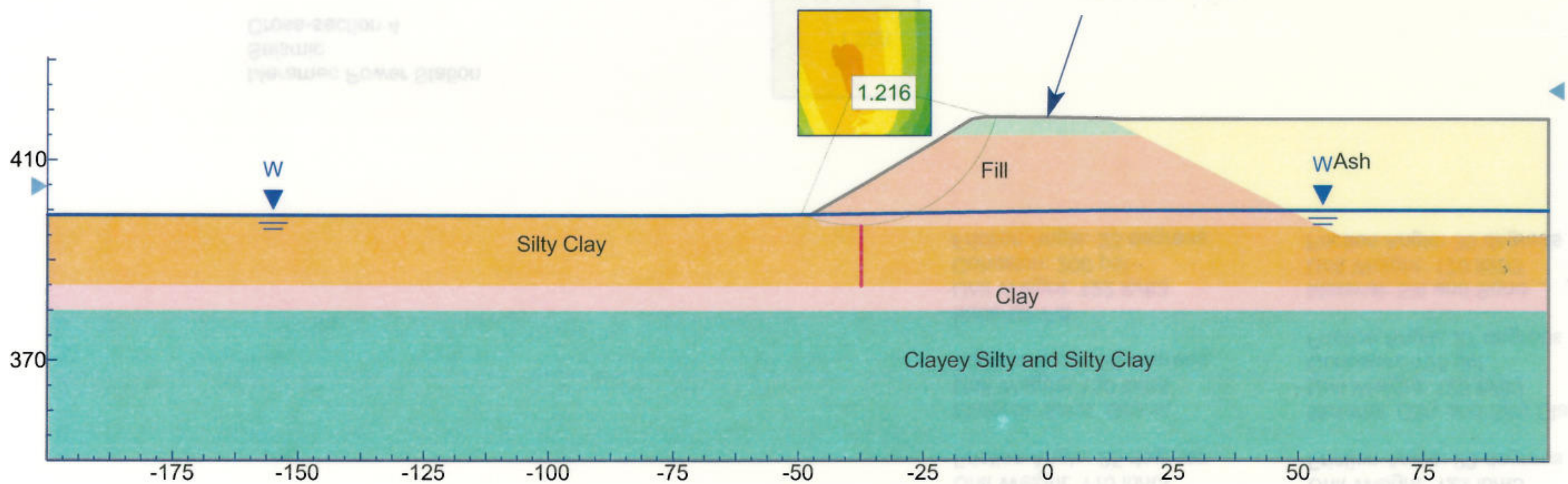

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Figure B-10

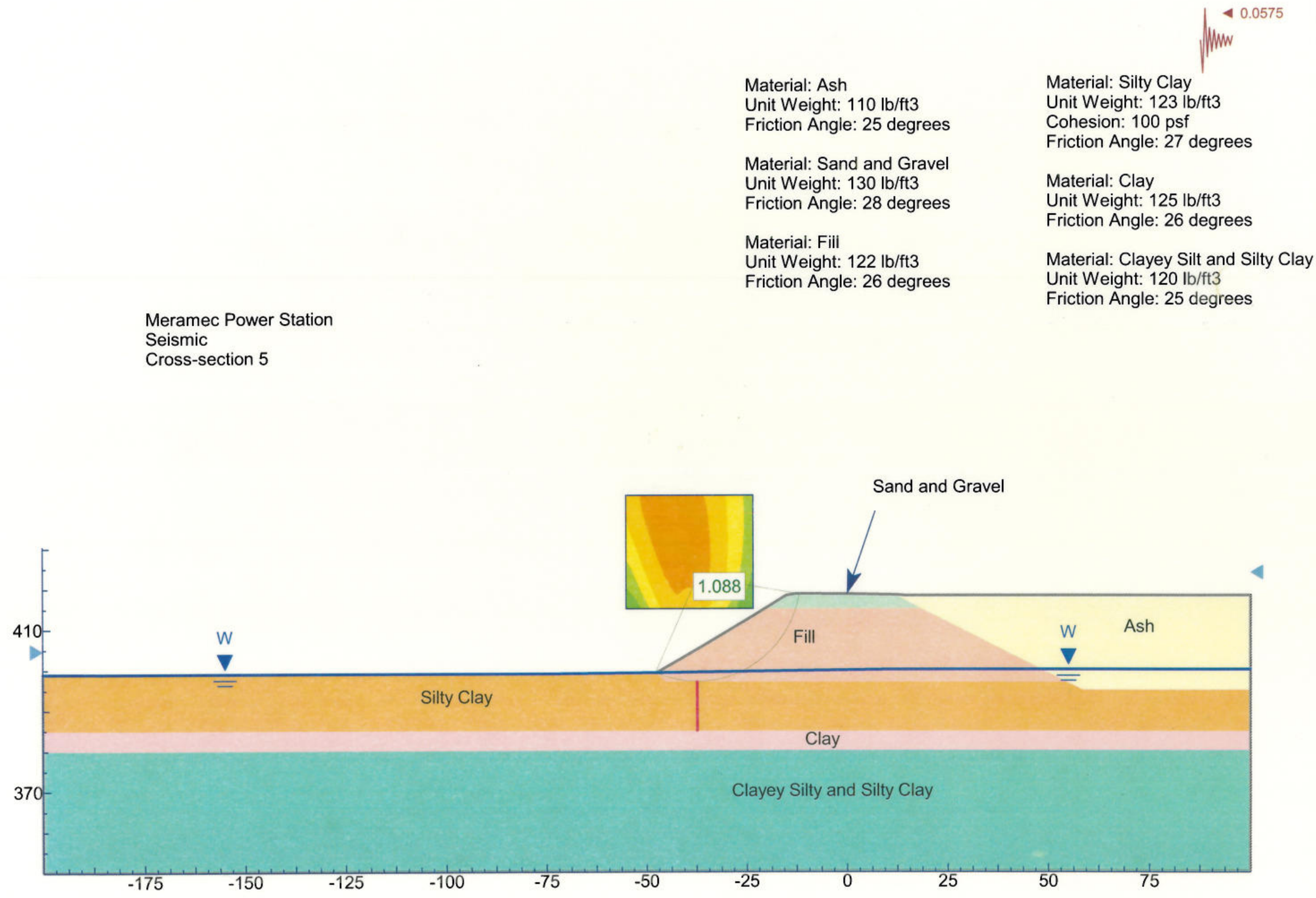

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Figure B-11