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Paul C. Rizzo Associates, Inc.
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SUPPLEMENTAL FIELD INVESTIGATION DATA REPORT

TURKEY POINT NUCLEAR POWER PLANT UNITS 6 & 7

REVISION 2

Engineering & Construction Management
Hydro-Nuclear-Fossil
Geotechnical Engineering
Seismic & Structural Engineering
Hydrological & Hydraulic Engineering
Tunnel Engineering
Environmental Engineering & Permitting

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SUPPLEMENTAL FIELD INVESTIGATION DATA REPORT TURKEY POINT NUCLEAR POWER PLANT UNITS 6 & 7

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0	January 23, 2014	Initial Draft Submittal
1	January 31, 2014	Updated Appendix in-text citations. Added Section 2.2.1 Continuously Sampled Borings. Minor corrections to Tables 2 and 3. Re-ordered samples by depth in Table 4. Pore Pressure Dissipation Test results added to Appendix E.
2	April 15, 2014	Removed references to proprietary RIZZO procedures. Minor corrections to Table 2. Changes made in Revision 2 do not impact any subsequent reports, RAIs, or calculations.

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SUPPLEMENTAL FIELD INVESTIGATION DATA REPORT TURKEY POINT NUCLEAR POWER PLANT UNITS 6 & 7

1.0 INTRODUCTION

This Supplemental Field Investigation Data Report describes the supplementary geological, geotechnical, and geophysical field investigation that was performed by Paul C. Rizzo Associates, Inc. (RIZZO) at the Turkey Point Nuclear Power Plant (PTN) Units 6 & 7 Site between July 30, 2013 and October 21, 2013.

The overall objective of the additional geological, geotechnical, and geophysical field investigation is to supplement characterization of the subsurface conditions at the PTN Units 6 & 7 footprints. The supplemental field investigation and subsequent laboratory testing was performed in general accordance with Regulatory Guide (RG) 1.132, "Site Investigations for Foundations of Nuclear Power Plants" and RG 1.138, "Laboratory Investigation of Soils and Rocks for Engineering Analysis and Design of Nuclear Power Plants."

1.1 GEOLOGIC PROFILE

The upper 600 feet (ft) of the Turkey Point Units 6 & 7 Site subsurface consists of eight soil and rock formations. These formations include: a surficial muck layer, Miami Limestone, Key Largo Limestone, the Fort Thompson Formation, the Upper Tamiami Formation, the Lower Tamiami Formation, the Peace River Formation, and the Arcadia Formation. Muck is a soft surficial soil layer. Miami Limestone, Key Largo Limestone, and the Fort Thompson formations are relatively porous limestone rock layers. Underneath these rock layers are the Upper Tamiami, the Lower Tamiami, and the Peace River formations that are composed of quartzitic sands, silts, and clays deposited as a result of carbonate and clastic processes during the Neogene period. Due to their geotechnical properties, the Tamiami and Peace River formations are referred as soil formations, hereafter. Underneath the Tamiami and Peace River formations, lies the Arcadia Formation, a limestone layer with occasional dolostone and thin silty-sand layers near the top of this unit.

2.0 FIELD AND LABORATORY INVESTIGATION

2.1 OVERVIEW

Field work consisted of soil sampling and drilling through Standard Penetration Test (SPT) and rock coring, pressuremeter testing, cone penetration testing (CPTu), and geophysical surveying including high resolution acoustic televiewer and compressional (P) and shear (S) wave velocity survey using P-S Suspension logging. In addition, undisturbed soil samples and special care rock samples were collected. Inclined coring was used to identify potential vertical fractures. Destructive drilling was used in combination with CPTu and pressuremeter testing.

For at least one boring at each unit, sampling in soil and rock layers was performed continuously. In soil layers, split spoon (SPT) samples and Shelby tubes samples were taken. In rock layers, rock coring was performed continuously.

Additionally, RIZZO has collected muck deposits (soft, surficial soil, and sediment layers) near the anticipated PTN Units 6 & 7 Site. Data from these Holocene-age muck deposits will be used to provide additional information related to the recent geologic history at the Site. Surficial muck collection activities, data, and results will be presented in a separate report.

All work was performed in accordance with USNRC 10 CFR 50 Appendix B, USNRC 10 CFR 21, and ASME NQA-1-1994.

RIZZO Staff (one geologist/engineer for each rig location) was on-site full-time to perform geotechnical field logging and drill inspection duties during all of the drilling operations and data acquisition. One RIZZO staff member independent from the rig geologists/geotechnical engineers was also on site to ensure that all local quality, health, safety, and environmental requirements are met.

The RIZZO Subcontractors for this Scope of Work and the QA program each subcontractor worked under are presented in ***Table 1***.

Boring logs prepared by RIZZO are provided in ***Appendix A***.

Kleinfelder laboratory testing results (resonant column torsional shear (RCTS) testing) are provided in ***Appendix B.*** Geotechnics laboratory testing results (index testing, triaxial testing, consolidation testing, and chemical testing) are provided in ***Appendix C.***

The GRL final report (SPT Energy Measurement) is provided in ***Appendix D.*** The ConeTec final report (CPTu) is provided in ***Appendix E***. The In-Situ Engineering final report (pressuremeter testing) is provided in ***Appendix F.*** The GEOVision final report (geophysical testing) is provided in ***Appendix G***.

Figure 1 shows the as-built boring and testing locations. Surveying of the final boring and testing locations was performed by Ford, Armenteros, and Fernandez, Inc. located in Doral, Florida. The final survey report is provided in ***Appendix H***. ***Table 2*** shows a summary of the drilling and testing program.

2.2 GEOTECHNICAL DRILLING AND CORING

Geotechnical drilling and coring was performed as listed in ***Table 2***. Geotechnical drilling was performed by Huss Drilling. Soil boreholes were advanced using wash rotary methods with 5 inch side-discharge bits, in accordance with ASTM D 1586-11, "Standard Test Method for SPT and Split-Barrel Sampling of Soils." Testing was conducted on a DR-16 "Failing 1500" truck-mounted drilling rig and an NWJ rod. The hammer had a 0.1406 kip ram weight. The SPT system utilized a cathead-rope safety type hammer. The operator used an indentation on the hammer rod as a guide to control the hammer height of 30 inches. SPT was performed advancing the split barrel sampler in four successive 0.5 ft increments. RIZZO boring logs (***Appendix A***) show the SPT N-values (N1) and additionally the sum of the number of blows required for the third and fourth 0.5 ft increments of penetration (N2).

Calibration of the SPT rig hammer to determine the energy transferred by the SPT hammer (Method B) to the SPT rod was performed on all drill rigs that performed SPT sampling by direct energy measurements according to the Commercial Grade Dedication (CGD) plan. The energy transferred by the SPT hammer system was measured in accordance with ASTM D 4633-10, "Standard Test Method for Energy Measurement for Dynamic Penetrometers." Energy measurements were performed by GRL Engineers and Pile Dynamics, Inc., of Orlando, Florida, and Cleveland, Ohio, respectively. The energy measurement report is provided in ***Appendix D***. The average energy transfer ratio was 62.1 percent, corresponding to an average energy ratio correction of 1.035.

All samples were logged in general accordance with ASTM D 6032-08, ASTM D 4220-95(2007), ASTM D 5079-08, ASTM D 5434-12, ASTM D 2488-09a, and applicable RIZZO field procedures.

Undisturbed soil samples were collected using a thin-wall tube (Shelby tube) (ASTM D 1587-08(2012) e1, "Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes"). Shelby tube samples were collected primarily using a pitcher barrel sampler. In some cases, where the pitcher barrel sampler yielded no recovery in the Shelby tube, a second attempt was made using the Osterberg sampler to push the Shelby tube.

Rock and over-consolidated soil coring were advanced using diamond-tipped rock core tools, in accordance with ASTM D 2113-08, "Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation." Rock coring through Miami, Key Largo and Fort Thompson layers up to the approximate depth of 115 ft was conducted using PQ size coring equipment with a triple barrel and split inner barrel for continuous sampling. The drilling rate, mud thickness, and core run length was adjusted by the RIZZO geologist/engineer to aim at least 80 percent recovery.

Temporary casing was occasionally used to prevent caving and to keep a clean boring. In saturated soils, drill rods were withdrawn slowly to prevent sloughing into the hole. The holes were re-cleaned to the bottom if the split-barrel sampler did not rest on the bottom prior to sampling.

For Boring R-6-1b, PQ-coring was conducted in the shallow limestone layers to a depth of 120.5 ft, and SPT testing and SPT/Shelby Tube sampling was conducted in the Tamiami and Peace River formations to a depth of 464.1 ft For Boring R-7-1, PQ-coring was performed in shallow limestone layers to a depth of 118.7 ft, and SPT testing and SPT/Shelby Tube sampling was conducted in the Tamiami and Peace River formations to a depth of 459.4 ft Borings R-6-1a, R-6-1a-A, and R-7-4, inclined PQ-coring was performed in the shallow limestone layers to a depth of approximately 115 ft For Borings R-6-2 and R-7-2, destructive drilling and NWD4-coring were conducted to a depth of approximately 365 ft to allow for subsequent pressuremeter testing. For Borings R-6-3 and R-7-3, destructive drilling was used to a depth of 125 ft to allow for CPTu testing in the Tamiami and Peace River formations.

2.2.1 Continuously Sampled Borings

A vertical Boring, R-6-1b, included core drilling of the limestone layers, followed by continuous sampling through the underlying soil layers. Continuous sampling was in the form of either split spoon SPT sampling or Shelby tube sampling. At Boring R-6-1b, the frequency of SPT testing was not less than every 6 ft for the depth interval of 115 to 215 ft, and every 9 ft for the depth interval of 215 to 450 ft.

2.2.2 Inclined Borings

The inclined borings were performed as listed in ***Table 2***. They were drilled with a BK Dutch 51 model track mounted rig utilizing a PQ triple barrel mud rotary assembly. All inclined borings were performed in lithified rock units performing rock core sampling in accordance with ASTM D 2113-08 to investigate the presence of vertical or near-vertical fractures.

The inclined borings were advanced into the shallow limestone units of the Miami, Key Largo, and Fort Thompson formations. They were terminated when the Upper Tamiami formation was reached. Each boring was drilled with an targeted deviation of 15-16 degrees from vertical. Boring R-6-1a and R-7-4 were the only two original inclined borings planned. However, there was poor recovery between the depths of approximately 70 and 110 ft in Boring R-6-1a due to mechanical issues with the core barrel. Therefore, an adjacent boring, R-6-1a-A, was drilled to obtain core of the depths of poor recovery after the mechanical issues were rectified.

The inclined borings were intended to intersect zones of suspected fractures due to surface features, such as drains and vegetated depressions. No fractures were observed in the previous investigations because of the sub-vertical nature of the fracture orientations and because none of the borings were in the location of the drains and vegetated depressions. R-6-1a and R-6-1a-A were drilled across a drain and R-7-4 was drilled across a vegetated depression. The borings were successful in encountering these discontinuities within the subsurface below the drain and vegetated depression. The depth and physical characteristics of the discontinuities were recorded in the boring logs.

2.2.3 Pressuremeter Testing

In-Situ Engineering performed pressuremeter testing (PMT) in three boreholes at the Site: R-6-2, R-6-1b, and R-7-2. The main objective of the PMT program was to obtain large strain shear modulus for the sub-surface materials of the Key Largo, Fort Thompson, Upper Tamiami, Lower Tamiami, and Peace River formations. Drilling activities for pressuremeter testing were performed by Huss Drilling of Dade City, Florida using a “Failing 1500” truck-mounted mud rotary drilling rig. Both mud rotary destructive drilling and coring were used. The field work was carried out between August 12, 2013 and September 23, 2013. Pressuremeter testing was performed in accordance with the testing procedures if In-Situ Engineering of Snohomish Washington:

- Technical Procedure TP-01, Collection of Borehole Pressuremeter Data in Soil and Rock, Version TP-01-06, August 20, 2013.
- Technical Procedure TP-02, Standard Technical Procedure for Correcting Pressuremeter Data for Membrane Effects, Version TP-02-03, August 20, 2013.
- Technical Procedure TP-03, Standard Technical Procedure for Calibrating Electronic Pressuremeter Instruments Manufactured by In-Situ Engineering, Version TP-03-02, August 20, 2013.

The instrument used for this investigation is a Cambridge style pre-bored high pressure pressuremeter (PBPM). The pressuremeter is of the monocell type, with a testing range of 2,000 pounds per square inch (psi) and 18 percent strain. It has three electronic displacement sensors spaced 120 degrees apart and located at the center of a flexible membrane, and a pressure cell. The flexible membrane is placed over the sensors, clamped at each end. The membrane is covered by a protective sheet of stainless steel strips. The unit is pressurized using compressed air to expand the membrane and deform the adjacent material. The electronic signals from displacement sensors and the pressure sensor are transmitted by cable to the surface.

In the pressuremeter test, the membrane is expanded by controlling the flow of compressed gas into the pressuremeter, increasing the pressure smoothly until the membrane starts to expand against the borehole wall. During the test, the average expansion versus pressure is displayed on a computer screen. Once the instrument has deformed the borehole sidewall and the response curve appears to be deforming intact material, the pressure is reduced to no more than 40 percent

of the highest applied pressure, then increased again to form an unload-reload loop. The resulting unload-reload loop can be used to evaluate the elastic behavior of the material.

The test pocket is the actual location within the borehole where a pressuremeter test is performed. The quality of the test pocket is most important in the PMT program. RIZZO's Geotechnical Engineer coordinated the effort of fine-tuning the drilling techniques that worked best for different materials encountered on Site. Two drilling techniques were used which were successful in creating the test pockets for the different formations, as described below.

For the Key Largo and Fort Thompson test pockets, the driller used a 4-inch diameter tricone bit to destructively advance the hole from the surface to the top of the first test pocket and to advance the hole between test pockets. An NWD4 sized core barrel was used to create a 5 foot long test pocket into which the pressuremeter instrument was inserted.

For the Upper Tamiami, Lower Tamiami, and Peace River formations mud rotary drilling was used. The hole was advanced with the 4-inch tricone bit and the test pockets were drilled using a 2 15/16 inch diameter tricone bit. After the 2 15/16 bit was removed from the hole, the instrument was lowered into the pocket for testing. After the testing was complete, the instrument was removed and the hole was advanced to the top of the next test pocket with the larger diameter drill bit. Two improvements were made along the course of the investigation that resulted in increased success in the soil layers. One was to advance casing to a few feet above the test pocket to stabilize the hole and prevent caving. Another improvement was to increase the bentonite content in the drilling mud, resulting in a heavier mud and the formation of a mud cake in the walls of the hole.

The measures taken to achieve a test pocket of high quality, namely the coring technique in the limestone layers and the casing advancement and thicker drill mud in the soil layers, had the effect of forming smooth test pockets (limestone tests) and shortening the duration of drilling, thus minimizing the disturbance of the hole walls (soil tests).

A total of 96 pressuremeter tests were attempted in the investigation; 48 tests were conducted in borehole R-6-2; 6 tests were conducted in borehole R-6-1b, and 42 tests were conducted in borehole R-7-2. Approximately 2/3 of the test attempts were successful and produced useful data for stiffness characterization. The remaining tests resulted in oversized test pockets due to the combination of drilling conditions and the deformation limit of the apparatus, which has a 6.35mm radial displacement range.

2.2.4 Cone Penetration Testing

CPTu testing was performed as listed in ***Table 2***. CPTu testing was performed by ConeTec, Inc. A CPTu cone cannot advance into the shallow limestone formations, Miami, Key Largo, and Fort Thompson formations. Pre-drilling, using 2-7/8 and 2-15/16 inch diameter bits, was necessary within these formations, so that the CPTu test could be initiated within the Tamiami and Peace River formations underneath the Fort Thompson Formation. The CPTu data was collected in the Tamiami and Peace River formations until the refusal depth was reached (i.e., the pushing capacity of the CPTu truck).

The cone penetrometer tests were carried out using an integrated electronic seismic piezocone. The piezocone used was a compression model cone penetrometer with a 15 centimeter (cm^2) tip and a 225 cm^2 friction sleeve. The cone is designed with an equal end area friction sleeve and a tip end area ratio of 0.80. The piezocone dimensions and the operating procedure were in accordance with ASTM Standard D 5778-12.

The cone was advanced using a 25-ton truck cone penetration rig. The tip resistance, sleeve friction, and dynamic pore pressure were recorded every 5 cm as the cone was advanced into the ground.

Baseline readings for the cone were taken before and after each sounding, and the shift in the baseline reading was compared against the requirements per ASTM D 5778-12. The baseline shift from sounding to sounding was small, typically less than 0.1percent of full scale.

2.2.5 Geophysical Surveying

Borehole geophysics measurements were collected in two cased and two uncased borings by GEOVision, of Corona, California. The final GEOVision Report is provided in ***Appendix G***.

2.2.5.1 P-S Suspension Velocity Logging Surveys

In-situ P- and S-wave velocities were measured in borings R-6-1b and R-7-1 at 1.6 ft intervals with the OYO/Robertson Suspension P-S Logging System as listed in ***Table 2***. As an industry standard for nuclear power plant site characterization, the P-S logging method directly determines the average P-wave and S- wave velocity of a 3.3-ft (1.0 meter [m]) segment of the

soil/rock column surrounding the boring using a downhole source. During P-S logging, seismic velocities calculated between each receiver and source (i.e., receiver to receiver and source to receiver) enables an independent check of measured velocities.

Procedures outlined in the "Procedure for OYO P-S Suspension Seismic Velocity Logging," were followed.

2.2.5.2 Acoustic Televiewer and Deviation (Verticality) Survey

Acoustic televiewer imaging was performed in two borings, R-6-1b and R-7-1, as indicated in ***Table 2***. When performing acoustic televiewer imaging, the borehole was uncased and fluid filled. The logging procedures for acoustic televiewer imaging conformed to ASTM D 5753-05(2010), "Standard Guide for Planning and Conducting Borehole Geophysical Logging."

Vertical deviation surveys were performed at all borings where P-S Suspension logging surveys were conducted, as well as for Borings R-6-1a-A and R-7-4. Geophysical logging began after all drilling tools were removed from the borehole. The geophysical testing procedures followed ASTM D 4428/D 4428M-07, Section 7.2.1.

2.3 BOREHOLE ABANDONMENT

A cement-bentonite grout was used to abandon the above referenced boreholes. Boreholes were backfilled using the tremie pipe method, always from bottom depth to top. Borings were grouted immediately after completion unless left open for geophysical testing. This mixture was a maximum of 7 gallons of water per 94-pound bag of Portland cement. No more than 5 percent by weight of bentonite powder was added to reduce shrinkage of backfill grout.

There were significant amounts of grout take during the abandonment of the boreholes. Large quantities (up to 40 gals) were being pumped into the borehole with no raise in the grout level, so the decision was made to add additives (e.g. "hole Plug") and let the grout set in steps, in order to help plugging and clogging the open spaces that were causing the loss of grout into the formations. When let set, the grout was leveling only in the formation contacts, or even raising up to 10 ft overnight, meaning that part of the grout already pumped into the formations was returning to the borehole. The intervals, at which the grout level showed no change, were observed between: Upper Tamiami and Fort Thompson formations, at the base of the Key Largo Formation, and between Miami Limestone and Key Largo formations.

2.4 SAMPLE HANDLING AND STORAGE

Samples were stored on Site in a temperature controlled facility monitored by electronic temperature data loggers. Samples were transported in a manner to avoid excessive shock or freezing that may damage the samples. Sample crates included shock indicators and minimum/maximum thermometers to indicate disturbance during transport. Minimum/maximum thermometer data indicates that no samples experienced freezing or temperatures greater than 125^{0}F. The shock indicator for Sample R-7-1 ST-15 was tripped during placement of a sample crate at Geotechnics, Inc. This sample was not tested.

Sample handling, preservation, storage, and transport were in accordance with ASTM D 4220-95 (2007) and applicable RIZZO Procedures.

2.5 SURVEYING

Surveying services were provided by Ford, Armenteros & Fernandez, Inc., a registered land surveyor in Florida. The surveyor performed two functions in the course of the investigation: the initial layout of the investigation points, followed, eventually, by their final as-built locations after all installations were completed. The results of the as-built survey are provided in ***Appendix H***.

Horizontal and vertical control was performed with conventional (optical) surveying techniques for geodetic control, using the data in the NAVD 1988 (vertical) and North American Datum (NAD) 1983 (horizontal) coordinate systems.

Survey equipment consisted of a “Total Station” (i.e., an electronic theodolite [transit]) integrated with an electronic distance meter or level. Global Positioning Systems (GPS) were not used.

2.6 LABORATORY TESTING

The laboratory testing performed by Geotechnics, Inc., located in Pittsburgh, Pennsylvania and Kleinfelder Laboratory located in Albuquerque, New Mexico, focused on testing soil and rock samples through index testing, triaxial testing, consolidation testing, chemical testing, and RCTS

testing. ***Table 3*** shows a summary of the laboratory testing program. ***Table 4*** shows a summary of the laboratory testing results.

2.6.1 Unit Weight

Unit weight testing was used to determine the unit weight of soil and rock samples. Unit weight testing was performed by Geotechnics, Inc., according to ASTM D 2937-10 and ASTM D 7263-09. Unit weights are also determined during the RCTS testing performed by Kleinfelder Laboratory. Unit weight testing was performed on 46 soil samples and 4 rock samples.

2.6.2 Sieve and Hydrometer Analysis

Sieve and hydrometer analysis were used to determine the distribution of particle sizes. Sieve and hydrometer testing was performed by Geotechnics, Inc., according to ASTM D 422-63 (2007). Sieve and hydrometer analysis was performed on 41 soil samples.

2.6.3 Atterberg Limits

Atterberg limit testing was used to determine the plasticity of samples. Atterberg limit testing was performed by Geotechnics, Inc., according to ASTM D 4318-10. Atterberg limit testing was performed on 41 soil samples.

2.6.4 Moisture Content

Moisture content testing was used to determine the moisture content of soil and rock samples. Moisture content testing was performed by Geotechnics, Inc., according to ASTM D 2216-10. Moisture contents were also determined during RCTS testing performed by Kleinfelder Laboratory. Moisture content testing was performed on 46 soil samples and 4 rock samples.

2.6.5 Specific Gravity

Specific gravity testing was used to determine the specific gravity of soil samples. Specific gravity testing was performed by Geotechnics, Inc., according to ASTM D 854-10. Specific gravity testing was performed on 49 soil samples.

2.6.6 Consolidated Undrained (CU) Triaxial Test

Triaxial testing was used to determine the static strength and stiffness of soil samples. Triaxial testing was performed by Geotechnics, Inc., according to ASTM D 4767-11. Triaxial testing was performed on 20 soil samples.

2.6.7 One Dimensional Consolidation

Consolidation testing was used to determine the consolidation properties of soil samples. Consolidation testing was performed by Geotechnics, Inc., according to ASTM D 2435/ D 2435M-11. Consolidation testing was performed on 16 soil samples.

2.6.8 Chemical Testing

Chemical testing was used to determine the pH, chloride content, and sulfate content of rock samples. Chemical testing was performed by Geotechnics, Inc., according to AASHTO T-290-95, AASHTO T-291-94, and ASTM D 4972-01. Chemical testing was performed on 8 rock samples.

2.6.9 Resonant Column Torsional Shear (RCTS) Testing

RCTS testing was used to determine the dynamic properties of soil and rock samples. RCTS testing was performed by Kleinfelder Laboratory according to the Kleinfelder procedure 50051.LAB-ALB12OP010. RCTS testing was performed on 3 soil samples and 4 rock samples. Three of the RCTS rock samples tested were obtained from the previous investigation in 2008 (***Figure 1***).

3.0 SUMMARY/FUTURE WORK

This Supplemental Field Investigation Data Report describes the supplementary geological, geotechnical, and geophysical field investigation that was performed by RIZZO at the PTN Units 6 & 7 Site. Based on this information and information collected by others, RIZZO will revise the PTN Final Safety Analysis Report (FSAR) Section 2.5.4 and respond to associated Requests for Additional Information (RAI) from the United States Nuclear Regulatory Commission (NRC).

REFERENCES

AASHTO T-290-95, “Standard Method of Test for Determining Water-Soluble Sulfate Ion Content in Soil,” American Association of State Highway and Transportation Officials, Washington, DC, 2003.

AASHTO T-291-94, “Standard Method of Test for Determining Water-Soluble Chloride Ion Content in Soil,” American Association of State Highway and Transportation Officials, Washington, DC, 2004.

ASME NQA-1-1994, “Quality Assurance Program for Nuclear Facilities,” American Society of Mechanical Engineers, 1994.

ASTM Standard D 422-63, 2007, “Standard Test Method for Particle-Size Analysis of Soils,” DOI: 10.1520/D0422-63R07, ASTM International, West Conshohocken, PA, 2007.

ASTM Standard D 854-10, 2010, “Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer,” DOI: 10.1520/D0854-10, ASTM International, West Conshohocken, PA, 2010.

ASTM Standard D 1586-11, 2011, “Standard Test Method for Standard Penetration Test (SPT), and Split-Barrel Sampling of Soils,” DOI: 10.1520/D1586-11, ASTM International, West Conshohocken, PA, 2011.

ASTM Standard D 1587-08(2012) e1, 2012, “Standard Test Method for Thin-Wall Tube Sampling of Soils,” DOI: 10.1520/D1587-08R12E01, ASTM International, West Conshohocken, PA, 2012.

ASTM Standard D 2113-08, 2008, “Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation,” DOI: 10.1520/D 2113-08, ASTM International, West Conshohocken, PA, 2008.

ASTM Standard D 2216-10, 2010, “Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass,” DOI: 10.1520/D2216-10, ASTM International, West Conshohocken, PA, 2010.

ASTM Standard D 2435/D 2435 M-11, 2011, “Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading,” DOI: 10.1520/D2435_D2435M-11, ASTM International, West Conshohocken, PA, 2011.

ASTM Standard D 2488-09a, 2009, “Standard Practice for Description and Identification of Soils (Visual-Manual Procedure),” DOI: 10.1520/D 2488-09A, ASTM International, West Conshohocken, PA, 2009.

ASTM Standard D 2937-10, 2010, “Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method,” DOI: 10.1520/D2937-10, ASTM International, West Conshohocken, PA, 2010.

ASTM Standard D 2974-07a, 2007, “Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils,” DOI: 10.1520/D2974-07A, ASTM International, West Conshohocken, PA, 2007.

ASTM Standard D 4220-95, 2007, “Standard Practice for Preserving and Transporting Soil Samples,” DOI: 10.1520/D 4220-95R07, ASTM International, West Conshohocken, PA, 2007.

ASTM Standard D 4318-10, 2010, “Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils,” DOI: 10.1520/D4318-10, ASTM International, West Conshohocken, PA, 2010.

ASTM Standard D 4428/D 4428M-074, 2007, “Standard Test Methods for Crosshole Seismic Testing,” DOI: 10.1520/D 4428/ 4428M-07, ASTM International, West Conshohocken, PA, 2007.

ASTM Standard D 4633-10, 2010, “Standard Test Method for Energy Measurement for Dynamic Penetrometers,” DOI: 10.1520/D4633-10, ASTM International, West Conshohocken, PA, 2010.

ASTM Standard D 4719-07, 2007, “Standard Test Method for Prebored Pressuremeter Testing in Soils,” DOI: 10.1520/D 4719-07, ASTM International, West Conshohocken, PA, 2007.

ASTM Standard D 4767-11, 2011, “Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils,” DOI: 10.1520/D4767-11, ASTM International, West Conshohocken, PA, 2011.

ASTM Standard D 4972-01, 2007, “Standard Test Method for pH of Soils,” DOI: 10.1520/D4972-01R07, ASTM International, West Conshohocken, PA, 2007.

ASTM Standard D 5079-08, 2008, “Standard Practices for Preserving and Transporting Rock Core Samples,” DOI: 10.1520/D 5079-08, ASTM International, West Conshohocken, PA, 2008.

ASTM Standard D 5434-12, 2012, “Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock,” ASTM International, DOI: 10.1520/D 5434-12, 2012.

ASTM Standard D 5753-05, 2010, “Standard Guide for Planning and Conducting Borehole Geophysical Logging,” DOI: 10.1520/D 5753-05, ASTM International, West Conshohocken, PA, 2010.

ASTM Standard D 5778-12, 2012, “Standard Test Method for Electric Friction Cone and Piezocone Penetration Testing,” DOI: 10.1520/D 5778-12, ASTM International, West Conshohocken, PA, 2012.

ASTM Standard D 6032-08, 2008, “Standard Test Method for Determining Rock Quality Designation of Rock Core,” DOI: 10.1520/D 6032-08, ASTM International, West Conshohocken, PA, 2008.

ASTM Standard D 7263-09, 2009, “Standard Test Methods for Laboratory Determination of Density (Unit Weight) of Soil Specimens,” DOI: 10.1520/D7263-09, ASTM International, West Conshohocken, PA, 2009.

ConeTec, Inc., 2013, “Presentation of In-Situ Testing Program Results, Turkey Point NPP Units 6 & 7, Job#13-5054,” Revision 2, January 20, 2014.

Ford, Armenteros & Fernandez, Inc., “PNT 6 & 7 – Turkey Point, Specific Purpose Survey, Sketch of Survey and Surveyor’s Notes,” Revision 2, October 30, 2013.

Geotechnics, 2013, “Laboratory Test Results, Turkey Point Nuclear Power Plant Units 6 & 7, Project Number #13-5054,” Revision 2, January 21, 2014.

GEOVision, 2010, “Procedure for OYO P-S Suspension Seismic Velocity Logging,” Revision 1.5, October 7, 2010.

GEOVision, 2013, “Turkey Point NPP Borehole Geophysics, Borings R-6-1a-A, R-6-1b, R-7-1, and R-7-4, Report 13331-01,” Revision 1, January 17, 2014.

GRL Engineers, Inc., 2013, “Report of SPT Energy Measurements, Boring R-6-1b, Turkey Point Nuclear Power Plant Units 6 and 7,” Revision 1, January 16, 2014.

In-Situ Engineering, 2013a, “Report of In-Situ Pressuremeter Testing, Turkey Point Nuclear Power Plant Site Units 6 & 7,” January 14, 2014.

In-Situ Engineering, 2013b, “Technical Procedure TP-01 Collection of Borehole Pressuremeter Data in Soil and Rock,” Version TP-01-06, August 20, 2013.

In-Situ Engineering, 2013c, “Technical Procedure TP-02 Standard Technical Procedure for Correcting Electronic Pressuremeter Data for Membrane Effects,” Version TP-02-03, August 20, 2013.

In-Situ Engineering, 2013d, “Technical Procedure TP-03 Standard Technical Procedure for Calibrating Electronic Pressuremeter Instruments Manufactured by In-Situ Engineering,” Version TP-03-02, August 20, 2013.

Kleinfelder, 2012, “Measurement of Soil and Rock Dynamic Properties by the Resonant Column and Torsional Shear (RCTS) Method,” 50051.LAB-ALB12OP010, Revision 4, May 30, 2012.

Kleinfelder, 2014, “Laboratory Data Report, Resonant Column and Torsional Shear (RCTS) Testing, Turkey Point Units 6 & 7 Site, Miami-Dade County, FL, Kleinfelder Project No. 136473,” Revision 1, February 5, 2014.

Nuclear Regulatory Commission (NRC), 2003a, “Site Investigations for Foundations of Power Plants,” Revision 2, Regulatory Guide 1.132, NRC, Washington, DC, October 2003.

Nuclear Regulatory Commission (NRC), 2003b, “Laboratory Investigations of Soils and Rocks for Engineering Analysis and Design of Power Plants,” Revision 2, Regulatory Guide 1.138, NRC, Washington, DC, December 2003

Paul C. Rizzo Associates, Inc. (RIZZO), 2013a, “Work Plan, Supplemental Geological, Geotechnical, and Geophysical Field Investigation Program, Turkey Point Nuclear Power Plant Units 6 and 7,” current revision, RIZZO, Pittsburgh, PA, 2013.

Paul C. Rizzo Associates, Inc. (RIZZO), 2013b, “Quality Assurance Project Plan, Supplemental Geological, Geotechnical, and Geophysical Field Investigation Program, Turkey Point Nuclear Power Plant Units 6 and 7,” current revision, RIZZO, Pittsburgh, PA, 2013.

Paul C. Rizzo Associates, Inc. (RIZZO), 2013c, “Work Plan, Collection, In-Field Evaluation, and Sampling of Surficial Muck Deposits, Turkey Point Nuclear Power Plant Units 6 and 7,” current revision, RIZZO, Pittsburgh, PA, 2013.

TABLES

TABLE 1
RIZZO'S SUBCONTRACTORS PROVIDING SAFETY RELATED ACTIVITIES
FOR FPL TURKEY POINT UNITS 6 & 7

SUBCONTRACTOR	LOCATION	ACTIVITY	SAFETY RELATED	QA PROGRAM
Huss Drilling	Dade City, FL	Drilling	Yes	RIZZO QA Program
ConeTec, Inc.	Charles City, VA	CPTu testing	Yes	RIZZO QA Program
		CPTu calibration	Yes	Commercial Grade Dedication (CGD)
In-Situ Engineering	Snohomish, WA	Pressuremeter testing	Yes	RIZZO QA Program
GEOVision Geophysical Services	Corona, CA	Geophysical testing	Yes	RIZZO QA Program
Geotechnics, Inc.	Pittsburgh, PA	Laboratory testing	Yes	Geotechnics QA Program [(1)]
Kleinfelder Laboratory	Albuquerque, NM	Dynamic testing	Yes	Kleinfelder QA Program [(1)]
Ford, Armenteros, & Fernandez, Inc.	Doral, FL	Survey: locate borings	Yes	CGD
GRL Engineers and Pile Dynamics, Inc. (PDI)	Orlando, FL and Cleveland, OH	Energy ratio of Standard Penetration Test (SPT) hammer	Yes	CGD

NOTE:

(1) Approved by RIZZO QA Program in compliance with NQA-1:1994, 10CFR50 App B, 10CFR21

TABLE 2
SUMMARY OF THE BOREHOLE DRILLING AND TESTING PROGRAM

Boring No.	Activity	Description	Depth Range	No. of Samples/Tests
R-6-1a	Destructive Drilling	Destructive Drilling	0-3 ft. (1)	N/A
	Coring	Inclined PQ-coring in shallow limestone	3-122 ft.(1)	5 Special Care Samples
R-6-1a-A	Destructive Drilling	Destructive Drilling	0-2 ft. (1)	N/A
	Coring	Inclined PQ-coring in shallow limestone	2-112 ft.(1)	3 Special Care Samples
	Testing	Borehole Deviation	3-106 ft. (1)	0.04 ft. intervals
R-6-1b	Destructive Drilling	Destructive Drilling	0-3 ft.	N/A
	Testing	Acoustic televiewer	3-464 ft.	0.04 ft intervals (down) and 0.004 ft intervals (up)
		P-S Suspension	7-449 ft.	1.64 ft. intervals
		Pressuremeter testing	33-156 ft.	6 Pressuremeter tests
		Borehole deviation	3-464 ft.	0.04 ft intervals (down) and 0.004 ft intervals (up)
	Testing/Sampling	SPT/undisturbed sampling in soil	3-15 ft.	6 SPT Samples
			120-464 ft.	45 SPT and 102 Shelby Tube and 6, 3-inch Split Spoon Samples
	Coring	PQ-coring in shallow limestone	15-120 ft.	6 Special Care Samples
R-6-2	Testing/Sampling	SPT/undisturbed sampling in soil	2-8 ft.	2 SPT Samples
	Destructive Drilling	Destructive Drilling	0-2 ft. 8-46 ft. 66-70 ft. 75-80 ft. 85-100 ft. 112-360 ft.	N/A
	Coring	NWD4 Coring	46-66 ft. 70-75 ft. 80-85 ft. 100-112 ft.	Continuous Sampling
	Testing	Pressuremeter testing	29-328 ft.	48 Pressuremeter tests

TABLE 2
SUMMARY OF THE BOREHOLE DRILLING AND TESTING PROGRAM
(CONTINUED)

Boring No.	Activity	Description	Depth Range	No. of Samples/Tests
R-6-3	Destructive Drilling	Destructive drilling through limestone	0-125 ft.	N/A
	Testing	CPTu testing in soil	125-289 ft.	Continuous data collection
R-7-1	Destructive Drilling	Destructive Drilling	0-5 ft.	N/A
	Coring	PQ-coring in shallow limestone	5-120 ft.	9 Special Care Samples
		NWD4 Coring	453-458 ft.	No Recovery
	Testing/Sampling	SPT/undisturbed sampling in soil	120-453 ft. 458-459 ft.	37 SPT & 30 Shelby Tube Samples
	Testing	Acoustic televiewer	3-454 ft.	0.04 ft intervals (down) and 0.004 ft intervals (up)
		P-S Suspension	7-441 ft.	1.64 ft. intervals
		Borehole Deviation	3-454 ft.	0.04 ft intervals (down) and 0.004 ft intervals (up)
R-7-2	Destructive Drilling	Destructive drilling	0-27 ft. 58-65 ft. 78-90 ft. 95-370 ft.	N/A
	Coring	NWD4 Coring	27-58 ft. 65-78 ft. 90-95 ft.	Continuous Sampling
	Testing	Pressuremeter testing	31-304 ft.	42 Pressuremeter tests
R-7-3	Destructive Drilling	Destructive drilling	0-20 ft. 120-125 ft.	N/A
	Coring	NWD4 Coring	20-120 ft.	Continuous Sampling
	Testing	CPTu testing in soil	125-288 ft.	Continuous data collection
R-7-4	Destructive Drilling	Destructive Drilling	0-2 ft. [1]	N/A
	Coring	Inclined PQ-coring in shallow limestone	2-126 ft.[1]	4 Special Care Samples
	Testing	Borehole Deviation	4-122 ft.[1]	0.04 ft intervals (down) and 0.004 ft intervals (up)

NOTE:

(1) Indicates measured depth in boring. The angle of borings R-6-1a and R-6-1a-A is15 degrees from vertical, and the angle of R-7-4 is 16 degrees from vertical.

TABLE 3
SUMMARY OF LABORATORY TESTING PROGRAM

TEST	LABORATORY	TEST STANDARD	PURPOSE OF TEST	TEST QUANTITY[1]
Unit Weight	Geotechnics	ASTM D 7263-09 ASTM D 2937-10	To measure unit weight of samples	43
Sieve Analysis	Geotechnics	ASTM D 422-63 (2007)	To determine the distribution of particle sizes	41
Hydrometer Analysis	Geotechnics	ASTM D 422-63 (2007)	To determine the distribution of particle sizes	41
Atterberg Limits	Geotechnics	ASTM D 4318-10	For general classification and soil index	41
Moisture Content	Geotechnics	ASTM D 2216-10	For moisture content, saturation, void ratio, porosity	43
Specific Gravity of Soil Solids	Geotechnics	ASTM D 854-10	To determine the specific gravity of soil samples	35
Consolidated Undrained (CU) Triaxial Test	Geotechnics	ASTM D 4767-11	To determine the static strength and stiffness of soil and rock samples	20
One Dimensional Consolidation	Geotechnics	ASTM D 2435/ D 2435M-11	To determine consolidation properties of soil samples	16
Resonant Column Torsional Shear Test	Kleinfelder	Kleinfelder: 50051.LAB-ALB12OP010, Rev. 4, May 30, 2012	To determine dynamic properties of soil and rock samples	7
Chemical Tests	Geotechnics	AASHTO T-290-95, AASHTO T-291-94, ASTM D4972-01	To determine the chemical properties of rock samples	8

NOTE:

(1) Quantity of tests is based on number of samples, not number of sections tested. Quantity of unit weight and moisture content tests do not include unit weight and moisture content determined during RCTS testing.

TABLE 4
SUMMARY OF THE LABORATORY TESTING RESULTS

BORING	SAMPLE	DEPTH (ft)	BOTTOM DEPTH (ft)	GRAVEL (%)	SAND (%)	FINES (%)	LL	PL	PI	w (%)	DRY UNIT WEIGHT γ (pcf)	BULK UNIT WEIGHT (pcf)	SPECIFIC GRAVITY	USCS SYMBOL	c' (psi)	φ' (^{0})	pH	CHLORIDE (mg/kg)	SULFATE (mg/kg)	RCTS	C_c	C_r
B-714	714-CS-01	29.4	29.9							9	119.4	129.8								X		
B-615	615-CS-01	32.6	33.1							10	126.3	138.4								X		
R-6-1a	SC-1	33	33.7														8.73	3111	259			
R-7-1	SC-2	37.5	37.9														8.85	1960	257			
R-7-1	SC-4	46.9	47.7														8.72	2991	364			
R-6-1b	SC-3	47.6	48.1							4	146.5	151.8								X		
R-7-4	SC-2	48.2	49														8.86	2766	252			
B-728	728-CS-04	53.7	54.2							8	134	144.3								X		
R-6-1a-A	SC-1	72.6	73.5														8.24	1974	198			
R-7-1	SC-6	74.3	75														8.98	1863	399			
R-6-1b	SC-4A	81	81.7														8.84	1833	315			
R-6-1a	SC-5	114.7	115														8.75	3404	457			
R-6-1b	ST-1	136	136.5							27	94.6	119.9		SM						X		
R-7-1	ST-1 (3)	137.9	138.1								106.3	127.9										
R-7-1	ST-1 (2)	138.1	138.6	7	57	36	NP	NP	0				2.64	SM								
R-7-1	ST-1 (1)	138.6	138.7							20												
R-6-1b	ST-3 (4)	148.2	148.7	5	63	32	NP	NP	0		89.5	116.1	2.63	SM	0	34.65						
R-6-1b	ST-3 (3)	148.7	149.2								89.7	116.7			0	34.65						
R-6-1b	ST-3 (2)	149.2	149.7								89.5	116.1			0	34.65						
R-6-1b	ST-3 (1)	149.7	149.8							30												
R-7-1	ST-2	159.6	160.7	0	36	64	NP	NP	0	33			2.64	ML								
R-6-1b	ST-5 (5)	163.4	163.6																		0.263	0.002
R-6-1b	ST-5 (4)	163.6	164.1								90.8	117.9			1.71	32.93						
R-6-1b	ST-5 (3)	164.1	164.6								91.3	118.6			1.71	32.93						
R-6-1b	ST-5 (2)	164.6	165.1	0	38	62	NP	NP	0		90.4	117.3	2.66	ML	1.71	32.93						
R-6-1b	ST-5 (1)	165.1	165.2							30												
R-6-1b	ST-7	171.7	172.2							29	93	119.9								X		
R-6-1b	ST-9 (3)	179.2	179.7	0	36	64	NP	NP	0		87.4	114.8	2.65	ML								
R-6-1b	ST-9 (2)	179.7	179.9							31	88.3	116.1									0.306	0.003
R-6-1b	ST-9 (1)	179.9	180							32												

TABLE 4
SUMMARY OF THE LABORATORY TESTING RESULTS
(CONTINUED)

BORING	SAMPLE	DEPTH (ft)	BOTTOM DEPTH (ft)	GRAVEL (%)	SAND (%)	FINES (%)	LL	PL	PI	w (%)	DRY UNIT WEIGHT γ (pcf)	BULK UNIT WEIGHT (pcf)	SPECIFIC GRAVITY	USCS SYMBOL	c' (psi)	φ' (^{0})	pH	CHLORIDE (mg/kg)	SULFATE (mg/kg)	RCTS	C_c	C_r
R-6-1b	ST-11 (5)	185.7	185.8							34												
R-6-1b	ST-11 (4)	185.8	186.3								86.2	115.4			3.17	31.37						
R-6-1b	ST-11 (3)	186.3	186.8	0	43	57	NP	NP	0		87.8	116.7	2.62	ML	3.17	31.37						
R-6-1b	ST-11 (2)	186.8	187.3								87.4	116.1			3.17	31.37						
R-6-1b	ST-11 (1)	187.3	187.4							33												
R-7-1	ST-4 (5)	188.9	189.4								86	114.8			2.56	30.6						
R-7-1	ST-4 (4)	189.4	189.6							34	85.7	114.8									0.251	0.004
R-7-1	ST-4 (3)	189.6	190.1	0	39	61	NP	NP	0		87.7	115.4	2.63	ML	2.56	30.6						
R-7-1	ST-4 (2)	190.1	190.6								88.9	116.7			2.56	30.6						
R-7-1	ST-4 (1)	190.6	190.7							32												
R-6-1b	ST-13 (2)	194.1	194.6	0	39	61					89.6	116.7	2.64	ML								
R-6-1b	ST-13 (1)	194.6	194.8				NP	NP	0	30												
R-6-1b	ST-15 (5)	200.5	200.6							33												
R-6-1b	ST-15 (4)	200.6	201.1								98.2	117.9			6.86	28.79						
R-6-1b	ST-15 (3)	201.1	201.6								99.5	119.2			6.86	28.79						
R-6-1b	ST-15 (2)	201.6	202.1	0	33	67	NP	NP	0		100.1	119.8		ML	6.86	28.79						
R-6-1b	ST-15 (1)	202.1	202.2							20												
R-7-1	ST-5	207.9	208.4							32	89.6	118.2		SM						X		
R-6-1b	ST-17 (3)	208.7	209.2	0	22	78	NP	NP	0		86.5	114.8	2.64	ML								
R-6-1b	ST-17 (2)	209.2	209.4							33	88.1	116.7									0.397	0.004
R-6-1b	ST-17 (1)	209.4	209.6							33												
R-7-1	ST-6 (2)	223.1	223.6	6	60	34	NP	NP	0		102.8	123.6	2.7	SM								
R-7-1	ST-6 (1)	223.6	223.7							20												
R-6-1b	ST-22 (4)	225	225.2							19											0.169	0.005
R-6-1b	ST-22 (3)	225.2	225.7	0	73	28	NP	NP	0		103.5	126.7	2.64	SM	4.82	35.19						
R-6-1b	ST-22 (2)	225.7	226.2								102	124.8			4.82	35.19						
R-6-1b	ST-22 (1)	226.2	226.3							22												
R-7-1	ST-7 (5)	233	233.1							31												
R-7-1	ST-7 (4)	233.1	233.6								100.2	119.8			5.78	31.51						
R-7-1	ST-7 (3)	233.6	234.1	0	60	40	NP	NP	0		101.4	121.7	2.65	SM	5.78	31.51						
R-7-1	ST-7 (2)	234.1	234.6								101.8	121.7			5.78	31.51						

TABLE 4
SUMMARY OF THE LABORATORY TESTING RESULTS
(CONTINUED)

BORING	SAMPLE	DEPTH (ft)	BOTTOM DEPTH (ft)	GRAVEL (%)	SAND (%)	FINES (%)	LL	PL	PI	w (%)	DRY UNIT WEIGHT γ (pcf)	BULK UNIT WEIGHT (pcf)	SPECIFIC GRAVITY	USCS SYMBOL	c' (psi)	φ' (^{0})	pH	CHLORIDE (mg/kg)	SULFATE (mg/kg)	RCTS	C_c	C_r
R-7-1	ST-7 (1)	234.6	234.7							20												
R-6-1b	ST-25 (2)	234.7	235.2	0	61	39	NP	NP	0		93	119.2	2.66	SM								
R-6-1b	ST-25 (1)	235.2	235.4							28												
R-7-1	ST-8 (3)	245.5	246	0	78	22	NP	NP	0	23	101.1	124.2	2.63	SM								
R-7-1	ST-8 (2)	246	246.3							23	100.1	122.9									0.087	0.004
R-7-1	ST-8 (1)	246.3	246.5							23												
R-6-1b	ST-31 (4)	251.7	252.2								104.4	125.4			0.55	33.49						
R-6-1b	ST-31 (3)	252.2	252.7	0	72	28	NP	NP	0		102.8	123.6	2.65	SM	0.55	33.49						
R-6-1b	ST-31 (2)	252.7	253.2								104.6	126.0			0.55	33.49						
R-6-1b	ST-31 (1)	253.2	253.3							20												
R-7-1	ST-9 (4)	255.9	256.4								96.3	120.4			7.72	26.52						
R-7-1	ST-9 (3)	256.4	256.9	0	74	26	NP	NP	0		97.4	122.3	2.64	SM	7.72	26.52						
R-7-1	ST-9 (2)	256.9	257.4								95.9	120.4			7.72	26.52						
R-7-1	ST-9 (1)	257.4	257.5							25												
R-6-1b	ST-33 (3)	259.7	260.1	0	74	26	NP	NP	0		95.8	119.8	2.64	SM								
R-6-1b	ST-33 (2)	260.1	260.3							25	96	120.4									0.137	0.002
R-6-1b	ST-33 (1)	260.3	260.5							26												
R-7-1	ST-10 (5)	266.9	267.1							28											0.268	0.004
R-7-1	ST-10 (4)	267.1	267.6								93.9	119.8			26.77	19.85						
R-7-1	ST-10 (3)	267.6	268.1	0	63	37	NP	NP	0		90.3	114.8	2.67	SM	26.77	19.85						
R-7-1	ST-10 (2)	268.1	268.6								94.1	119.8			26.77	19.85						
R-7-1	ST-10 (1)	268.6	268.7							27												
R-6-1b	ST-37 (2)	271.8	272.3	0	50	50	NP	NP	0		97.5	120.4		SM								
R-6-1b	ST-37 (1)	272.3	272.5							23												
R-7-1	ST-11 (5)	277.9	278.1							30											0.163	0.005
R-7-1	ST-11 (4)	278.1	278.6	0	45	55	31	25	6		90.8	118.6	2.63	ML	6.5	30.56						
R-7-1	ST-11 (3)	278.6	279.1								90.8	118.6			6.5	30.56						
R-7-1	ST-11 (2)	279.1	279.6								91	118.6			6.5	30.56						
R-7-1	ST-11 (1)	279.6	279.7							31												
R-6-1b	ST-40 (5)	280.7	280.9							31											0.213	0.005
R-6-1b	ST-40 (4)	280.9	281.4	0	54	46	30	20	10		91.3	118.6	2.65	SC	5.7	30.36						

TABLE 4
SUMMARY OF THE LABORATORY TESTING RESULTS
(CONTINUED)

Boring	Sample	Depth (ft)	Bottom Depth (ft)	Gravel (%)	Sand (%)	Fines (%)	LL	PL	PI	w (%)	Dry Unit Weight γ (pcf)	Bulk Unit Weight (pcf)	Specific Gravity	USCS Symbol	c' (psi)	φ' (^{0})	pH	Chloride (mg/kg)	Sulfate (mg/kg)	RCTS	C_c	C_r
R-6-1b	ST-40 (3)	281.4	281.9								91.5	118.6			5.7	30.36						
R-6-1b	ST-40 (2)	281.9	282.4								91.4	118.6			5.7	30.36						
R-6-1b	ST-40 (1)	282.4	282.5							30												
R-7-1	ST-12 (5)	288.7	288.9										2.66									
R-7-1	ST-12 (4)	288.9	289.1	0	76	24								SM								
R-7-1	ST-12 (3)	289.1	289.6				NP	NP	0													
R-7-1	ST-12 (2)	289.6	290							24	96.2	119.2									0.124	0.003
R-7-1	ST-12 (1)	290	290.2							25												
R-7-1	ST-13 (7)	298.2	298.3							27												
R-7-1	ST-13 (6)	298.3	298.7								96.2	122.3			5.69	32.01						
R-7-1	ST-13 (5)	298.7	299.2								98.8	125.4			5.69	32.01						
R-7-1	ST-13 (4)	299.2	299.7								98.2	124.8			5.69	32.01						
R-7-1	ST-13 (3)	299.7	300.3	0	84	16	NP	NP	0		97.2	121.1	2.66	SM								
R-7-1	ST-13 (2)	300.3	300.5							25	96.8	121.1									0.134	0.003
R-7-1	ST-13 (1)	300.5	300.7							26												
R-6-1b	ST-46 (4)	300.7	301.2	0	89	11	NP	NP	0		109.8	127.3	2.61	SW-SM	2.67	32.55						
R-6-1b	ST-46 (3)	301.2	301.7								108.7	126.0			2.67	32.55						
R-6-1b	ST-46 (2)	301.7	302.2								111.8	129.8			2.67	32.55						
R-6-1b	ST-46 (1)	302.2	302.3							16												
R-7-1	ST-14 (2)	310.5	311	0	88	12	NP	NP	0		91.7	116.7	2.62	SM								
R-7-1	ST-14 (1)	311	311.2							27												
R-6-1b	ST-52 (3)	319	319.5	0	94	6	NP	NP	0		95.4	119.2	2.62	SP-SM								
R-6-1b	ST-52 (2)	319.5	319.7							25												
R-7-1	ST-16 (5)	320.3	320.5	3	88	10								SP-SM								
R-7-1	ST-16 (4)	320.5	321								96.9	120.4			56.97	26.7						
R-7-1	ST-16 (3)	321	321.5								98.4	122.3			56.97	26.7						
R-7-1	ST-16 (2)	321.5	322				NP	NP	0		100.3	124.8	2.61		56.97	26.7						
R-7-1	ST-16 (1)	322	322.2							24												
R-6-1b	ST-55 (4)	326.4	326.9								93.8	115.4			26.54	32.84						
R-6-1b	ST-55 (3)	326.9	327.4								99.6	122.9			26.54	32.84						
R-6-1b	ST-55 (2)	327.4	327.9								99.3	122.3			26.54	32.84						

TABLE 4
SUMMARY OF THE LABORATORY TESTING RESULTS
(CONTINUED)

Boring	Sample	Depth (ft)	Bottom Depth (ft)	Gravel (%)	Sand (%)	Fines (%)	LL	PL	PI	w (%)	Dry Unit Weight γ (pcf)	Bulk Unit Weight (pcf)	Specific Gravity	USCS Symbol	c' (psi)	φ' (^{0})	pH	Chloride (mg/kg)	Sulfate (mg/kg)	RCTS	C_c	C_r
R-6-1b	ST-55 (1)	327.9	328							23												
R-7-1	ST-17 (2)	329.7	330.2	0	95	5	NP	NP	0		96.6	121.7		SP-SM								
R-7-1	ST-17 (1)	330.2	330.4							26												
R-7-1	ST-18 (4)	338	338.2										2.63									
R-7-1	ST-18 (3)	338.2	338.7	0	95	5	NP	NP	0		93.3	115.4		SP								
R-7-1	ST-18 (2)	338.7	338.9							24											0.031	0.001
R-7-1	ST-18 (1)	338.9	339							25												
R-6-1b	ST-61 (2)	343.5	344	0	94	7	NP	NP	0		94.2	121.7		SP-SM								
R-6-1b	ST-61 (1)	344	344.2							29												
R-7-1	ST-19 (2)	346.3	346.8	0	95	5	NP	NP	0		95	119.2		SP-SM								
R-7-1	ST-19 (1)	346.8	347							26												
R-7-1	ST-20 (4)	354.4	354.9								119.4	119.2			1.02	34.74						
R-7-1	ST-20 (3)	354.9	355.4	0	90	10	NP	NP	0		121.7	121.7	2.61	SP-SM	1.02	34.74						
R-7-1	ST-20 (2)	355.4	355.9								121.5	121.7			1.02	34.74						
R-7-1	ST-20 (1)	355.9	356							25												
R-6-1b	ST-66 (5)	356.8	357							26	93.9	118.6									0.057	0.001
R-6-1b	ST-66 (4)	357	357.5								94.4	119.2	2.62		7.76	32.54						
R-6-1b	ST-66 (3)	357.5	358								95.9	121.1			7.76	32.54						
R-6-1b	ST-66 (2)	358	358.5								95.9	121.1			7.76	32.54						
R-6-1b	ST-66 (1)	358.5	358.6							26												
R-6-1b	ST-67 (2)	360.6	361.1	0	93	7	NP	NP	0		95	119.8	2.62	SP-SM								
R-6-1b	ST-67 (1)	361.1	361.3							26												
R-7-1	ST-22 (2)	373.8	374.3	0	93	7	NP	NP	0		94	118.6		SP-SM								
R-7-1	ST-22 (1)	374.3	374.5							26												
R-6-1b	ST-75 (2)	383.4	383.9	0	90	10	NP	NP	0		87.9	117.3	2.61	SP-SM								
R-6-1b	ST-75 (1)	383.9	384.1							33												
R-7-1	ST-23 (4)	390.7	390.9								97	122.9			0	36.72						
R-7-1	ST-23 (5)	390.7	390.9																		0.047	0.003
R-7-1	ST-23 (3)	391.4	391.9								95.3	121.1			0	36.72						
R-7-1	ST-23 (2)	391.9	392.4	0	86	14	NP	NP	0		91.5	116.1	2.6	SM	0	36.72						
R-7-1	ST-23 (1)	392.4	392.5							27												

TABLE 4
SUMMARY OF THE LABORATORY TESTING RESULTS
(CONTINUED)

BORING	SAMPLE	DEPTH (ft)	BOTTOM DEPTH (ft)	GRAVEL (%)	SAND (%)	FINES (%)	LL	PL	PI	w (%)	DRY UNIT WEIGHT γ (pcf)	BULK UNIT WEIGHT (pcf)	SPECIFIC GRAVITY	USCS SYMBOL	c' (psi)	φ' (^{0})	pH	CHLORIDE (mg/kg)	SULFATE (mg/kg)	RCTS	C_c	C_r
R-6-1b	ST-82 (5)	402.8	403							20	84.8	102.3									0.058	0.002
R-6-1b	ST-82 (4)	403	403.5	0	86	14	NP	NP	0		90.1	115.4	2.6	SM	0	34.46						
R-6-1b	ST-82 (3)	403.5	404								94.6	121.1			0	34.46						
R-6-1b	ST-82 (2)	404	404.5								91.8	117.9			0	34.46						
R-6-1b	ST-82 (1)	404.5	404.6							28												
R-6-1b	ST-88 (2)	421.5	422	0	95	5	NP	NP	0		96.5	121.1		SP-SM								
R-6-1b	ST-88 (1)	422	422.2							26												
R-7-1	ST-25 (2)	436.8	437.3	0	91	9	NP	NP	0		88.9	117.3	2.61	SP-SM								
R-7-1	ST-25 (1)	437.3	437.5							32												
R-6-1b	ST-97 (2)	447.9	448.4	0	85	15	NP	NP	0		92.6	117.9	2.62	SM								
R-6-1b	ST-97 (1)	448.4	448.6							27												

ABBREVIATIONS:

LL – Liquid Limit
PL – Plastic Limit
PI – Plasticity Index
W (%) – Moisture Content
USCS – United Soil Classification System

C' – Effective cohesion
φ' – Effective internal friction angle
RCTS – Resonant Column Torsional Shear
C_c – Compression index
C_r – Recompression index

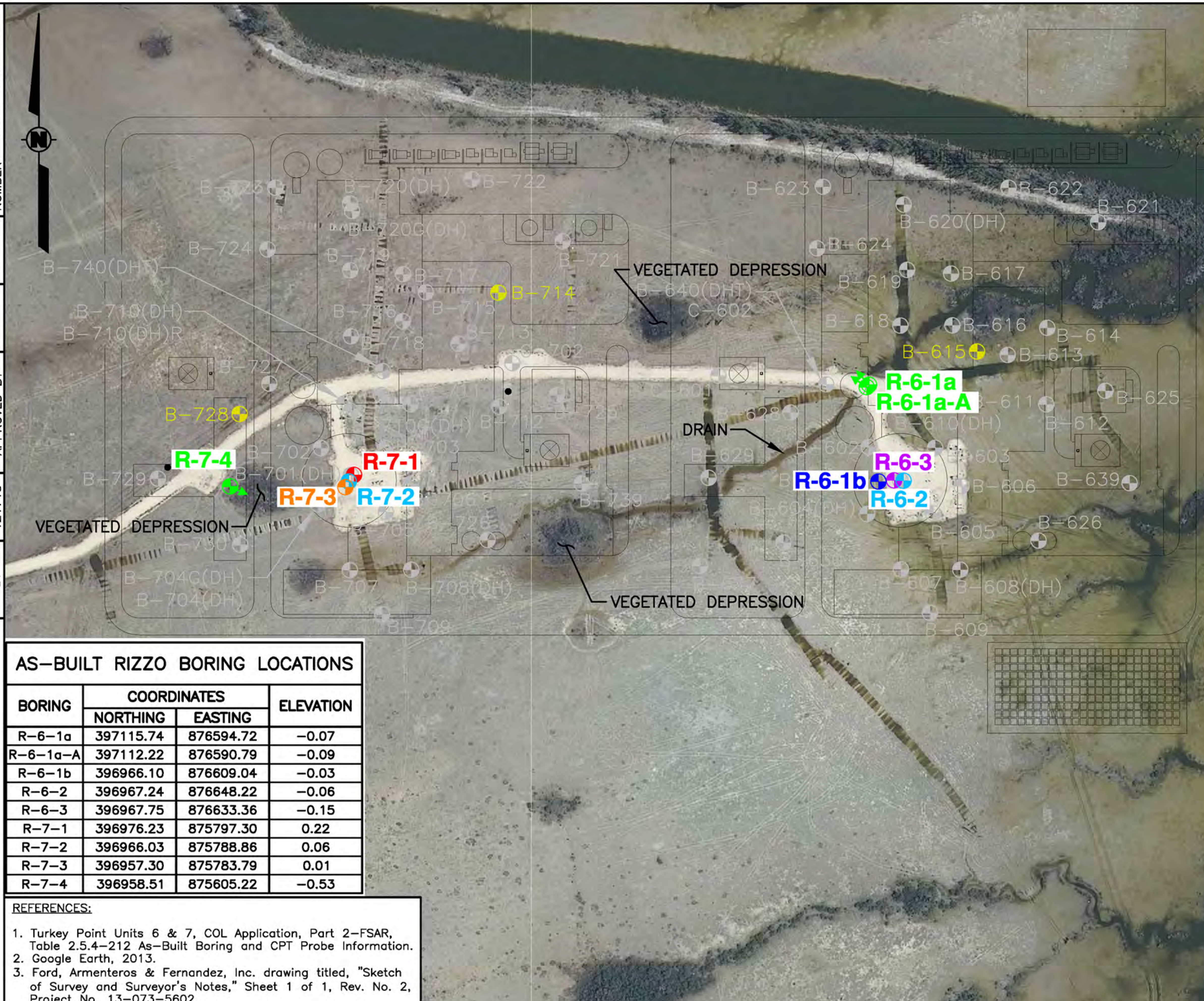
ML – Silt
SC – Clayey sand
SM – Silty sand
SP – Poorly graded sand
SW – Well graded sand

FIGURE

CAD FILE NUMBER 13-5054-B5

CHECKED BY / APPROVED BY: J.S.S. 121713

DRAWN BY



AS-BUILT RIZZO BORING LOCATIONS

BORING	COORDINATES NORTHING	COORDINATES EASTING	ELEVATION
R-6-1a	397115.74	876594.72	-0.07
R-6-1a-A	397112.22	876590.79	-0.09
R-6-1b	396966.10	876609.04	-0.03
R-6-2	396967.24	876648.22	-0.06
R-6-3	396967.75	876633.36	-0.15
R-7-1	396976.23	875797.30	0.22
R-7-2	396966.03	875788.86	0.06
R-7-3	396957.30	875783.79	0.01
R-7-4	396958.51	875605.22	-0.53

REFERENCES:

1. Turkey Point Units 6 & 7, COL Application, Part 2-FSAR, Table 2.5.4-212 As-Built Boring and CPT Probe Information.
2. Google Earth, 2013.
3. Ford, Armenteros & Fernandez, Inc. drawing titled, "Sketch of Survey and Surveyor's Notes," Sheet 1 of 1, Rev. No. 2, Project No. 13-073-5602.

LEGEND:

- R-7-1 — RIZZO SPT BORING AND LIMESTONE ROCK CORING (CONTINUOUS SAMPLING) WITH ACOUSTIC TELEVIEWER AND P-S SUSPENSION LOGGING
- R-6-2, R-7-2 — RIZZO DESTRUCTIVELY DRILLED BORING (INTERMITTENT LIMESTONE ROCK CORING) WITH PRESSUREMETER TESTING
- R-6-3 — RIZZO CPT BORING
- R-7-3 — RIZZO CPT BORING WITH INTERMITTENT LIMESTONE ROCK CORING
- R-6-1a, R-6-1a-A, R-7-4 — RIZZO INCLINED BORING – LIMESTONE ROCK CORING
- R-6-1b — RIZZO SPT BORING AND LIMESTONE ROCK CORING (CONTINUOUS SAMPLING) WITH ACOUSTIC TELEVIEWER AND P-S SUSPENSION LOGGING AND PRESSUREMETER TESTING
- AS-BUILT BORING AND CPT PROBE FROM PREVIOUS INVESTIGATION
- RCTS TESTING – B-615, B-714 & B-728 AS-BUILT BORING FROM PREVIOUS INVESTIGATION

NOTES:

1. SITE COORDINATE SYSTEM IS NAD83, FLORIDA STATE PLANE, U.S. FOOT, EAST ZONE.
2. NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88, FEET).

SCALE

150 0 150 FEET

FIGURE 1

AS-BUILT BORING LOCATIONS

TURKEY POINT UNITS 6 & 7 SITE

PREPARED FOR

FLORIDA POWER & LIGHT
MIAMI-DADE COUNTY, FLORIDA

Paul C. Rizzo Associates, Inc.
ENGINEERS / CONSULTANTS / CM

APPENDICES

APPENDIX A

BORING LOGS

KEY TO SYMBOLS

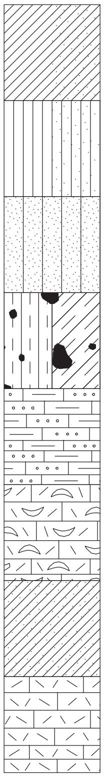
CLIENT FPL

PROJECT NUMBER 13-5054

PROJECT NAME Turkey Point Units 6 and 7 Site

PROJECT LOCATION Homestead, Florida

LITHOLOGIC SYMBOLS



(CL)-S: Lean Clay with Sand

(ML)-S: Silt with Sand

(SM): Silty Sand

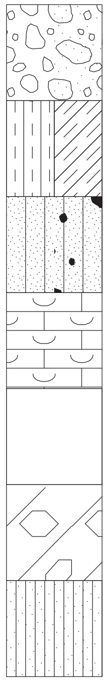
G(OL/OH): Gravelly Organic Soil

MUDSTONE: mudstone

PACKSTONE: Packstone

S(CL): Sandy Lean Clay

WACKESTONE: Crystaline Limestone



(GW)-S: Well-graded Gravel with Sand

(OL/OH): Organic Soil

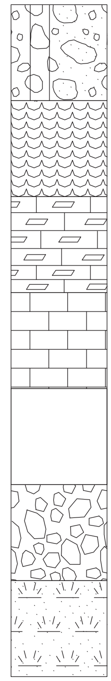
(SM)-G: Silty Sand with Gravel

GRAINSTONE: Grainstone

NO RECOVERY: No Recovery

ROADBASE: Roadbase

S(ML): Sandy Silt



(GW-GM)-S: Well-graded Gravel with Silt and Sand

(PT): Peat

BOUNDSTONE: Boundstone

LIMESTONE: Limestone bedrock

NO SAMPLE: No Sample Taken

ROCKFILL

TOPSOIL: Topsoil

Abbreviations and Acronyms

%REC	Percent recovery of sample collected.
%RQD	Percent of Rock Quality Designation value.
(10Y 6/2) Pale Olive	Munsell Color Chart Designations.
CPT	Cone Penetration Testing.
in.	Inches.
FD-1	Fracture Density.
ft.	Feet.
HCl	Hydrochloric acid.
N1/N2	(N) Value, represents the sum of blow counts over a specified interval during SPT sampling.
NWD4	Drill bit size (outside diameter of 2.980 inches) used for conventional coring.
PQ	Drill bit size (outside diameter of 4.827 inches) used for wireline coring.
R.D.	Relative Dip.
R-1	Core run identification number.
S-1	SPT sample identification number.
SC-1	Special Care Sample identification number.
SPT	Standard Penetration Testing.
ST-1	Shelby Tube sample identification number.
USCS Symbol	Unified Soil Classification System Symbol as per ASTM D-2487: lower case - Field description. UPPER CASE - Result of Laboratory Analysis.
(W5) Moderately Weathered	Weathering Descriptor.
WOR	Weight of Rod.

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500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
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Boring R-6-1a

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 397115.74 ft E. 876594.72 ft
GROUND SURFACE ELEVATION: -0.07 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	DESCRIPTION	USCS SYMBOL	REMARKS
-0.0 to -3.0	0.0-3.0				0.0-3.0 ft Road base layer.		0 - 3 ft. boring was destructively drilled with 5 inch mud rotary bit. Measured water level varied within one foot of ground surface. Core loss due to soft sandy loose zones. 3.0 - 121.8 ft., PQ Wireline Coring.
	3.0-4.6	R-1	74% (53%)		3.0-4.6 ft Sandy organic soil, dusky yellowish brown (10YR 2/2) and pale brown (5YR 5/2), organic odor, wet, Spongy consistency, with Plant material, (Peat/Muck)	ol/oh	
	4.6-11.8	R-2	35% (12%)	FD0	4.6-11.8 ft GRAINSTONE, calcareous, hard to moderately soft, slightly to moderately weathered, fine sand to very coarse sand particles, vuggy to pitted, max size: 1 in., very pale orange (10YR 8/2) and light bluish gray (5B 7/1), massive bedded, strong reaction to HCl, moist, lower contact is conformable and gradational, Zones of loose sandy limestone in competent hard sandy limestone. Some shells and shell fragments. [Miami Limestone]		
	11.8-27.5	R-3	96% (8%)		11.8-27.5 ft PACKSTONE, calcareous, hard to moderately soft, slightly to moderately weathered, clay to very coarse sand particles, vuggy to pitted, max size: 1.5 in., white (N9) and light bluish gray (5B 7/1), massive bedded, R.D. = 30°, strong reaction to HCl, moist, lower contact is conformable and gradational, Zones of loose sandy limestone in competent hard micrite packstone. gray (N4) angular micritic limestone clasts in wackestone matrix (breccia) from 18.3-18.7 ft. [Miami Limestone]		Abundant voids allow for common breakage of brittle core to rubble and small segments. Possible fractures.
		R-4	88% (10%)	FD2			

Elevation scale: -1.0, -2.0, -3.0, -4.0, -5.0, -6.0, -7.0, -8.0, -9.0, -10.0, -11.0, -12.0, -13.0, -14.0, -15.0, -16.0, -17.0, -18.0, -19.0
Depth scale: 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 14.0, 15.0, 16.0, 17.0, 18.0, 19.0

DATE STARTED: 8/26/13
DATE FINISHED: 8/29/13
FIELD GEOLOGIST: Doug Raszewski
CHECKED BY: Rolando Benitez
DRILLING METHOD: Mud Rotary, PQ
DRILLING CO. Huss Drilling
NOTES: Boring is angled 15 degrees toward bearing 318. Depth on log is measured depth in boring.
APPROVED BY: EOT
DRILLER: Anthony Hudson
DRILL RIG: DR-5
HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

Paul C. Rizzo Associates, Inc
500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
www.rizzoassoc.com

Boring R-6-1a

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 397115.74 ft E. 876594.72 ft
GROUND SURFACE ELEVATION: -0.07 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY
-20.0	21.0	R-4	88% (10%)	
-21.0	22.0			
-22.0	23.0			
-23.0	24.0	R-5	48% (0%)	
-24.0	25.0			
-25.0	26.0			
-26.0	27.0			
-27.0	28.0			
-28.0	29.0	R-6	94% (58%)	FD2
-29.0	30.0			
-30.0	31.0			
-31.0	32.0			
-32.0	33.0			
-33.0	34.0	R-7	90% (38%)	
-34.0	35.0			
-35.0	36.0			
-36.0	37.0			
-37.0	38.0	R-8	98% (44%)	
-38.0	39.0			FD6

DESCRIPTION

19.9-20.1 ft Joint, R.D. = 30°, very closely to widely spaced, slightly open; filling: not healed, fresh; surface: moderately rough, planar, fresh, hard. Fracture set #1.

11.8-27.5 ft PACKSTONE, calcareous, hard to moderately soft, slightly to moderately weathered, clay to very coarse sand particles, vuggy to pitted, max size: 1.5 in., white (N9) and light bluish gray (5B 7/1), massive bedded, R.D. = 30°, strong reaction to HCl, moist, lower contact is conformable and gradational, Zones of loose sandy limestone in competent hard micrite packstone. gray (N4) angular micritic limestone clasts in wackestone matrix (breccia) from 18.3-18.7 ft. [Miami Limestone]
20.8-21 ft Joint, R.D. = 30°, very closely to widely spaced, slightly open; filling: not healed, fresh; surface: moderately rough, planar, fresh, hard.

27.3-27.7 ft Joint, R.D. = 60°, very closely to widely spaced, slightly open; filling: not healed, fresh; surface: moderately rough, planar, fresh, hard. Fracture set #1.

27.5-48.6 ft WACKESTONE, calcareous, interbedded, hard to moderately hard, fresh to moderately weathered, clay to fine sand particles, vuggy to cavities, max size: 4.0 in., white (N9) to light gray (N7), moderately to thickly bedded, closely to widely fractured, weak reaction to HCl, moist, lower contact is conformable and gradational, 1-4 inch voids present. Occasional shells/fossils and moldic porosity. Voids are coated with calcite crystal overgrowth below about 35 feet. Subvertical curved solution cavity. [Key Largo Limestone]
interbedded with BOUNDSTONE, calcareous, moderately soft to hard, fresh to slightly weathered, pitted to cavities, max size: 3.6 in., white (N9) to light gray (N7), thinly to moderately bedded, closely to widely fractured, R.D. = 30° to 45°, weak reaction to HCl, moist, lower contact is conformable and gradational, Calcite overgrowth filling fractures and voids below 42.0 ft. [Key Largo Limestone]

28.9-34.3 ft Abundant voids allows for much mechanical breakage of core. Possible fractures.
33.5-34.1 ft Joint, R.D. = 45°, very closely to widely spaced, moderately open; filling: not healed, slightly weathered; surface: rough, planar, slightly weathered, hard.

37.7-38.1 ft Joint, R.D. = 35°, moderately to widely spaced, slightly open; filling: not healed, fresh; surface: rough, planar, fresh, hard.

REMARKS

R-5 is mostly rubble. lost loose sand. Driller reports many soft sandy pockets.

Many vugs and vesicles 28.7-31.0 ft.

SC-1: 33.0-33.7 ft.

Calcite crystals coating void surfaces below ~35.0 ft.
Lost circulation.

DATE STARTED: 8/26/13
DATE FINISHED: 8/29/13
FIELD GEOLOGIST: Doug Raszewski
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ
DRILLING CO. Huss Drilling
DRILLER: Anthony Hudson

NOTES: Boring is angled 15 degrees toward bearing 318. Depth on log is measured depth in boring.
DRILL RIG: DR-5
HAMMER ID:

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Boring R-6-1a

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 397115.74 ft E. 876594.72 ft
GROUND SURFACE ELEVATION: -0.07 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-39.0						39.7-40 ft Joint, R.D. = 45°, moderately to widely spaced, slightly open; filling: not healed, fresh; surface: rough, planar, fresh, hard.		
-40.0	41.0	R-8	98% (44%)	FD6		27.5-48.6 ft WACKESTONE, calcareous, interbedded, hard to moderately hard, fresh to moderately weathered, clay to fine sand particles, vuggy to cavities, max size: 4.0 in., white (N9) to light gray (N7), moderately to thickly bedded, closely to widely fractured, weak reaction to HCl, moist, lower contact is conformable and gradational, 1-4 inch voids present. Occasional shells/fossils and moldic porosity. Voids are coated with calcite crystal overgrowth below about 35 feet. Subvertical curved solution cavity. [Key Largo Limestone] interbedded with BOUNDSTONE, calcareous, moderately soft to hard, fresh to slightly weathered, pitted to cavities, max size: 3.6 in., white (N9) to light gray (N7), thinly to moderately bedded, closely to widely fractured, R.D. = 30° to 45°, weak reaction to HCl, moist, lower contact is conformable and gradational, Calcite overgrowth filling fractures and voids below 42.0 ft. [Key Largo Limestone]		
-41.0	42.0					40.4-40.8 ft Joint, R.D. = 55°, moderately to widely spaced, slightly open; filling: not healed, fresh; surface: rough, planar, fresh, hard.		
-42.0	43.0					42.1-42.4 ft Joint, R.D. = 40°, closely to widely spaced, open; filling: moderately healed, moderately thick calcite, fresh, moderately hard; surface: rough, planar, fresh to slightly weathered, hard; In boundstone bed.		Abundant porosity and vugs in boundstone (calcite coated voids). 44 - 48ft, abundant calcite coated voids.
-43.0	44.0	R-9	94% (32%)	FD0		42.5-43 ft Joint, R.D. = 45°, closely to widely spaced, open; filling: partly healed, thin calcite, fresh, moderately hard; surface: rough, planar, fresh to slightly weathered, hard; In boundstone bed.		
-44.0	45.0					42.7-43.1 ft Joint, R.D. = 45°, closely to widely spaced, open; filling: partly healed, thin calcite, fresh, moderately hard; surface: rough, planar, fresh to slightly weathered, hard; In boundstone bed.		
-45.0	46.0							
-46.0	47.0							SC-2: 47.0-47.6 ft.
-47.0	48.0							
-48.0	49.0	R-10	96% (46%)			48.6-50.9 ft WACKESTONE, calcareous, hard to very hard, fresh to slightly weathered, clay to fine sand particles, vuggy to pitted, max size: 0.5 in., medium gray (N5) to light gray (N7), thickly bedded, strong reaction to HCl, moist, lower contact is conformable and gradational, this layer is the transition to the Fort Thompson Formation. Larger voids coated with calcite. Common shell molds. [Key Largo Limestone]		
-49.0	50.0					49.4-49.5 ft Joint, R.D. = 10°; filling: not healed, hard (H3); surface: moderately rough, planar.		SC-3: 50.0-50.6 ft.
-50.0	51.0			FD7		50.6-51.5 ft Fracture zone, R.D. = 30°, very closely spaced; filling: totally healed, moderately thin calcite, fresh to slightly weathered, moderately soft; surface: rough, planar, fresh to slightly weathered, hard.		
-51.0	52.0					50.9-119.8 ft GRAINSTONE, calcareous, hard to very soft, fresh to moderately weathered, very coarse sand to silt particles, pitted to vuggy, max size: 1.0 in., white (N9) to very light gray (N8), massive, strong reaction to HCl, moist, shells and shell fragments. Most vugs are moldic porosity. From 51.9 - 52.5 ft, core broken with loose sand. From 54.7 - 59.4 ft, common shell molds. From 62.9 - 73.0, Abundant soft sandy zones (potentially unidentified fractures). Very soft pockets become present from approximately 64.0- 80.0 ft. From 87.3 - 91.8 ft, abundant shell molds. Below 112.3 ft, small to medium (1/16 - 1/2") shell molds common in core recovered. [Fort Thompson Formation] with layers of PACKSTONE, calcareous, moderately soft to hard, fresh to slightly weathered, clay to granule particles, cavities to pitted, max size: 2.0 in., white (N9) to very light gray (N8), very thickly to thickly bedded, strong reaction to HCl, moist, lower contact is conformable and gradational, [Fort Thompson Formation]		
-52.0	53.0							
-53.0	54.0	R-11	100% (92%)					
-54.0	55.0							
-55.0	56.0			FD0				
-56.0	57.0							
-57.0	58.0	R-12	100% (88%)					SC-4: 58.3-59.4 ft.
	59.0							

DATE STARTED: 8/26/13
DATE FINISHED: 8/29/13
FIELD GEOLOGIST: Doug Raszewski
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ
DRILLING CO. Huss Drilling
DRILLER: Anthony Hudson

NOTES: Boring is angled 15 degrees toward bearing 318. Depth on log is measured depth in boring.

DRILL RIG: DR-5
HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

Paul C. Rizzo Associates, Inc
500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
www.rizzoassoc.com

Boring R-6-1a

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 397115.74 ft E. 876594.72 ft
GROUND SURFACE ELEVATION: -0.07 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-59.0	61.0	R-12	100% (88%)			50.9-119.8 ft GRAINSTONE, calcareous, hard to very soft, fresh to moderately weathered, very coarse sand to silt particles, pitted to vuggy, max size: 1.0 in., white (N9) to very light gray (N8), massive, strong reaction to HCl, moist, shells and shell fragments. Most vugs are moldic porosity. From 51.9 - 52.5 ft, core broken with loose sand. From 54.7 - 59.4 ft, common shell molds. From 62.9 - 73.0, Abundant soft sandy zones (potentially unidentified fractures). Very soft pockets become present from approximately 64.0- 80.0 ft. From 87.3 - 91.8 ft, abundant shell molds. Below 112.3 ft, small to medium (1/16 - 1/2") shell molds common in core recovered. [Fort Thompson Formation] with layers of PACKSTONE, calcareous, moderately soft to hard, fresh to slightly weathered, clay to granule particles, cavities to pitted, max size: 2.0 in., white (N9) to very light gray (N8), very thickly to thickly bedded, strong reaction to HCl, moist, lower contact is conformable and gradational, [Fort Thompson Formation]		
-60.0	62.0							
-61.0	63.0							
-62.0	64.0	R-13	64% (36%)					
-63.0	65.0							Mechanical breakage of core at weak zones.
-64.0	66.0			FD0				
-65.0	67.0							Core Run R-14 yielded no recovery; Driller states that pressure gague never moved and felt like a void. Extremly low recovery from 66.5 - 111.8 ft due to problems with inner barrel.
-66.0	68.0							
-67.0	69.0	R-14	0% (0%)					
-68.0	70.0							Could not get inner barrel down to depth due to loose material from R-14. sandy material on core catcher. air lifting and flush out could not get packed material loose below ~69 ft.
-69.0	71.0							
-70.0	72.0							71.5 - 73.0 ft: unsampled.
-71.0	73.0							Ultimately had to drill out packed sand with 2 3/8" tricone. drilled to 73.0 ft.
-72.0	74.0			FD3				Drilling with only polymer in drilling mud.
-73.0	75.0	R-15	84% (16%)			75.2-75.5 ft Joint, R.D. = 40°, very widely spaced, slightly open; filling: not healed, fresh; surface: rough, planar, fresh, hard.		
-74.0	76.0							
-75.0	77.0							
-76.0	78.0	R-16	40% (0%)	FD3				
-77.0	79.0							Loose sand pocket

DATE STARTED: 8/26/13
DATE FINISHED: 8/29/13
FIELD GEOLOGIST: Doug Raszewski
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ
DRILLING CO. Huss Drilling
DRILLER: Anthony Hudson

NOTES: Boring is angled 15 degrees toward bearing 318. Depth on log is measured depth in boring.
DRILL RIG: DR-5
HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

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500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
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Boring R-6-1a

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES

N. 397115.74 ft E. 876594.72 ft

GROUND SURFACE ELEVATION: -0.07 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
								~79.5-81.5 ft. no recovery.
-78.0	81.0	R-16	40% (0%)			50.9-119.8 ft GRAINSTONE, calcareous, hard to very soft, fresh to moderately weathered, very coarse sand to silt particles, pitted to vuggy, max size: 1.0 in., white (N9) to very light gray (N8), massive, strong reaction to HCl, moist, shells and shell fragments. Most vugs are moldic porosity. From 51.9 - 52.5 ft, core broken with loose sand. From 54.7 - 59.4 ft, common shell molds. From 62.9 - 73.0, Abundant soft sandy zones (potentially unidentified fractures). Very soft pockets become present from approximately 64.0- 80.0 ft. From 87.3 - 91.8 ft, abundant shell molds. Below 112.3 ft, small to medium (1/16 - 1/2") shell molds common in core recovered. [Fort Thompson Formation] with layers of PACKSTONE, calcareous, moderately soft to hard, fresh to slightly weathered, clay to granule particles, cavities to pitted, max size: 2.0 in., white (N9) to very light gray (N8), very thickly to thickly bedded, strong reaction to HCl, moist, lower contact is conformable and gradational, [Fort Thompson Formation]		
-79.0	82.0							
-80.0	83.0							
-81.0	84.0	R-17	26% (0%)					
-82.0	85.0							
-83.0	86.0							
-84.0	87.0							
-85.0	88.0					87.3-91.8 ft Abundant shell molds.		
-86.0	89.0	R-18	34% (26%)					
-87.0	90.0			FD3				
-88.0	91.0							
-89.0	92.0							
-90.0	93.0	R-19	0% (0%)					
-91.0	94.0							
-92.0	95.0							Barrel gets locked up. Begin adding quick-gel to drilling fluid to bring up loose material.
-93.0	96.0	R-20	0% (0%)					
-94.0	97.0							
-95.0	98.0	R-21	0% (0%)					
-96.0	99.0							

DATE STARTED: 8/26/13
DATE FINISHED: 8/29/13
FIELD GEOLOGIST: Doug Raszewski
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ
DRILLING CO. Huss Drilling
DRILLER: Anthony Hudson

NOTES: Boring is angled 15 degrees toward bearing 318. Depth on log is measured depth in boring.

DRILL RIG: DR-5
HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

Paul C. Rizzo Associates, Inc
500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
www.rizzoassoc.com

Boring R-6-1a

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 397115.74 ft E. 876594.72 ft
GROUND SURFACE ELEVATION: -0.07 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-97.0								
	101.0	R-21	0% (0%)			50.9-119.8 ft GRAINSTONE, calcareous, hard to very soft, fresh to moderately weathered, very coarse sand to silt particles, pitted to vuggy, max size: 1.0 in., white (N9) to very light gray (N8), massive, strong reaction to HCl, moist, shells and shell fragments. Most vugs are moldic porosity. From 51.9 - 52.5 ft, core broken with loose sand. From 54.7 - 59.4 ft, common shell molds. From 62.9 - 73.0, Abundant soft sandy zones (potentially unidentified fractures). Very soft pockets become present from approximately 64.0- 80.0 ft. From 87.3 - 91.8 ft, abundant shell molds. Below 112.3 ft, small to medium (1/16 - 1/2") shell molds common in core recovered. [Fort Thompson Formation] with layers of PACKSTONE, calcareous, moderately soft to hard, fresh to slightly weathered, clay to granule particles, cavities to pitted, max size: 2.0 in., white (N9) to very light gray (N8), very thickly to thickly bedded, strong reaction to HCl, moist, lower contact is conformable and gradational, [Fort Thompson Formation]		Drilling only with polymer again.
-98.0								
	102.0							
-99.0								
	103.0							
-100.0								
	104.0							
-101.0		R-22	6% (0%)					
	105.0							
-102.0								
	106.0			FD3				
-103.0								
	107.0							
-104.0								
	108.0							
-105.0								
	109.0							
-106.0		R-23	2% (0%)					
	110.0							Core breakage due to soft sand zones.
-107.0								
	111.0							
-108.0								
	112.0							111.8 - 112.3 ft took SPT to sample lost material. Shows that material is rock and recovery problem is with core barrel.
-109.0								
	113.0							
-110.0								
	114.0							
		R-24	87% (76%)					SC-5: 114.7-115.0 ft.
-111.0	115.0					114.7-115 ft Joint, R.D. = 50°, discontinuous, one end visible; filling: totally healed, moderately thin calcite, fresh, moderately soft; surface: smooth, planar, fresh, soft; Does not completely cross the core.		
-112.0	116.0			FD1				
-113.0	117.0							
-114.0	118.0	R-25	100% (40%)					
-115.0	119.0							Bottom 1.0 ft. of Fort Thompson Formation is mostly soft sand.

DATE STARTED: 8/26/13
DATE FINISHED: 8/29/13
FIELD GEOLOGIST: Doug Raszewski
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ
DRILLING CO. Huss Drilling
DRILLER: Anthony Hudson

NOTES: Boring is angled 15 degrees toward bearing 318. Depth on log is measured depth in boring.
DRILL RIG: DR-5
HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

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500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
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Boring R-6-1a

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 397115.74 ft E. 876594.72 ft
GROUND SURFACE ELEVATION: -0.07 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-117.0	121.0					119.8-121.8 ft Not recovered. Upper Tamiami Formation.		Bottom of Fort Thompson Formation is at 119.8 ft. The bottom 2.0 ft of R-25 was extremley soft, indicating top of Upper Tamiami Formation. This material was not recovered.
						---- Bottom of Boring at 121.80 ft.----		

DATE STARTED: 8/26/13
DATE FINISHED: 8/29/13
FIELD GEOLOGIST: Doug Raszewski
CHECKED BY: Rolando Benitez
DRILLING METHOD: Mud Rotary, PQ
DRILLING CO. Huss Drilling
NOTES: Boring is angled 15 degrees toward bearing 318. Depth on log is measured depth in boring.

APPROVED BY: EOT
DRILLER: Anthony Hudson
DRILL RIG: DR-5
HAMMER ID:

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ENGINEERS/CONSULTANTS/CM

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500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
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Boring R-6-1a-A

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 397112.22 ft E. 876590.79 ft
GROUND SURFACE ELEVATION: -0.09 ft

SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	DESCRIPTION	USCS SYMBOL	REMARKS
			0.0-3.0 ft Crushed stone (Road base Layer). Lost recovery of material from 1.7 - 3.0ft.		Measured water level varied within one foot of ground surface. 0 - 1.7ft was destructively drilled with 5 inch mud rotary bit. 1.7 - 111.9 ft., PQ wireline coring.
R-1	62% (27%)		3.0-5.0 ft Peat, blackish red (5R 2/2) to grayish red (10R 4/2), organic odor, moist, strong HCl reaction, Plastic to Spongy consistency, some celulose, (Peat/Muck)	ol/oh	
R-2	94% (76%)	FD0	5.0-11.9 ft GRAINSTONE, calcareous, hard to very soft (H7), slightly to moderately weathered, fine sand to very coarse sand particles, vuggy to pitted, max size: 1 in., very pale orange (10YR 8/2) and very light gray (N8), massive bedded, strong reaction to HCl, moist, lower contact is conformable and gradational, Zones of loose sandy limestone in competent hard sandy limestone. Some shells and shell fragments. From 7.6 - 8.9 and 10.4 - 11.9ft, very soft and crumbley material. [Miami Limestone]		
R-3	98% (54%)		11.9-29.5 ft PACKSTONE, calcareous, hard to moderately soft, slightly to moderately weathered, clay to very coarse sand particles, vuggy to pitted, max size: 1.5 in., white (N9) and light bluish gray (5B 7/1), massive bedded, strong reaction to HCl, moist, lower contact is conformable and gradational, Zones of loose sandy limestone in competent hard micrite packstone. gray (N4) angular micritic limestone clasts present in wackestone from 18.2-20.0 ft. From 22.0 - 25.0 ft, soft loose sandy zones. Zones of high void density break mechanically into rubble with ease. From 13.0 - 18.5 ft, very broken and brittle material due to abundant voids. [Miami Limestone]		
R-4	94% (86%)	FD4	19.5- ft Random fracture, R.D. = 20°, slightly open; filling: not healed,		

Elevation (Feet): -1.0, -2.0, -3.0, -4.0, -5.0, -6.0, -7.0, -8.0, -9.0, -10.0, -11.0, -12.0, -13.0, -14.0, -15.0, -16.0, -17.0, -18.0, -19.0
Depth (Feet): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 14.0, 15.0, 16.0, 17.0, 18.0, 19.0

DATE STARTED: 8/29/13
DATE FINISHED: 9/3/13
FIELD GEOLOGIST: Doug Raszewski
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ
DRILLING CO. Huss Drilling
DRILLER: Anthony Hudson

NOTES: Boring is angled 15 degrees toward bearing 305. Depth is measured depth in boring.
DRILL RIG: DR-5
HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

Paul C. Rizzo Associates, Inc
500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
www.rizzoassoc.com

Boring R-6-1a-A

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 397112.22 ft E. 876590.79 ft
GROUND SURFACE ELEVATION: -0.09 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY
-20.0	21.0	R-4	94% (86%)	
-21.0	22.0			
-22.0	23.0			
-23.0	24.0			
-24.0	25.0	R-5	54% (22%)	
-25.0	26.0			
-26.0	27.0			FD4
-27.0	28.0			
-28.0	29.0			
-29.0	30.0	R-6	88% (68%)	
-30.0	31.0			
-31.0	32.0			
-32.0	33.0			
-33.0	34.0	R-7	100% (100%)	
-34.0	35.0			
-35.0	36.0			
-36.0	37.0			FD0
-37.0	38.0	R-8	94% (88%)	
-38.0	39.0			

DESCRIPTION

slightly weathered; surface: rough, undulating, slightly weathered, hard.

11.9-29.5 ft PACKSTONE, calcareous, hard to moderately soft, slightly to moderately weathered, clay to very coarse sand particles, vuggy to pitted, max size: 1.5 in., white (N9) and light bluish gray (5B 7/1), massive bedded, strong reaction to HCl, moist, lower contact is conformable and gradational, Zones of loose sandy limestone in competent hard micrite packstone. gray (N4) angular micritic limestone clasts present in wackestone from 18.2-20.0 ft. From 22.0 - 25.0 ft, soft loose sandy zones. Zones of high void density break mechanically into rubble with ease. From 13.0 - 18.5 ft, very broken and brittle material due to abundant voids. [Miami Limestone]
20.1-20.2 ft Random fracture, R.D. = 20°, slightly open; filling: not healed, slightly weathered; surface: rough, undulating, slightly weathered, hard.
23.4-24.4 ft R.D. = 60°, tight; filling: very thin; surface: rough, planar.

25.0-28.0 ft Multiple voids.

29.5-49.3 ft WACKESTONE, calcareous, interbedded, moderately hard to hard, fresh to moderately weathered, clay to fine sand particles, vuggy to cavities, typical diameter: 0.4 in., max size: 6.0 in., white (N9) to light gray (N7), moderately to thickly bedded, strong reaction to HCl, wet, lower contact is conformable and gradational, Wackstone to boundstone (coral). 1-4 inch voids present. Occasional shells/fossils and moldic porosity. Voids are coated with calcite crystals below about 35 feet. From 30 - 36, 39 - 41 and 45 - 47ft, high void density. Minor clay coatings above 35.0ft. [Key Largo Limestone]
interbedded with BOUNDSTONE, calcareous, moderately soft to hard, fresh to slightly weathered, pitted to cavities, max size: 6.0 in., white (N9) to light gray (N7), thinly to moderately bedded, weak reaction to HCl, moist, lower contact is conformable and gradational, Calcite filling fractures and voids below 42.0 ft. Much mechanical breakage of core in zones of high void density. [Key Largo Limestone]
33.1-33.2 ft Joint, R.D. = 0°, moderately to widely spaced; filling: not healed, moderately thin recrystalized calcite, slightly weathered, moderately soft; surface: rough, undulating, slightly weathered.
34.2-34.3 ft Joint, R.D. = 0-10°, moderately spaced, slightly open; filling: not healed, calcite, fresh, moderately soft; surface: rough, planar, fresh; Recrystalized calcite coated.
34.5-35 ft Joint, R.D. = 45°, moderately spaced, slightly open; filling: not healed, moderately thin recrystalized calcite, fresh, moderately soft; surface: rough, planar, fresh.
35.5-35.6 ft Joint, tight; filling: partly healed, calcite; surface: moderately rough; curved.

USCS SYMBOL

REMARKS

DATE STARTED: 8/29/13
DATE FINISHED: 9/3/13
FIELD GEOLOGIST: Doug Raszewski
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ
DRILLING CO. Huss Drilling
DRILLER: Anthony Hudson

NOTES: Boring is angled 15 degrees toward bearing 305. Depth is measured depth in boring.
DRILL RIG: DR-5
HAMMER ID:

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ENGINEERS/CONSULTANTS/CM

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500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
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Boring R-6-1a-A

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES

N. 397112.22 ft E. 876590.79 ft

GROUND SURFACE ELEVATION: -0.09 ft

ELEVATION (Feet)	DEPTH (Feet)
-39.0	
	41.0
-40.0	
	42.0
-41.0	
	43.0
-42.0	
	44.0
-43.0	
	45.0
-44.0	
	46.0
-45.0	
	47.0
-46.0	
	48.0
-47.0	
	49.0
-48.0	
	50.0
-49.0	
	51.0
-50.0	
	52.0
-51.0	
	53.0
-52.0	
	54.0
-53.0	
	55.0
-54.0	
	56.0
-55.0	
	57.0
-56.0	
	58.0
-57.0	
	59.0

SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)
R-8	94% (88%)
R-9	96% (96%)
R-10	86% (86%)
R-11	96% (96%)
R-12	96% (78%)

FRACTURE DENSITY: FD0; FD4; FD0

DESCRIPTION

29.5-49.3 ft WACKESTONE, calcareous, interbedded, moderately hard to hard, fresh to moderately weathered, clay to fine sand particles, vuggy to cavities, typical diameter: 0.4 in., max size: 6.0 in., white (N9) to light gray (N7), moderately to thickly bedded, strong reaction to HCl, wet, lower contact is conformable and gradational, Wackstone to boundstone (coral). 1-4 inch voids present. Occasional shells/fossils and moldic porosity. Voids are coated with calcite crystals below about 35 feet. From 30 - 36, 39 - 41 and 45 - 47ft, high void density. Minor clay coatings above 35.0ft. [Key Largo Limestone]
interbedded with BOUNDSTONE, calcareous, moderately soft to hard, fresh to slightly weathered, pitted to cavities, max size: 6.0 in., white (N9) to light gray (N7), thinly to moderately bedded, weak reaction to HCl, moist, lower contact is conformable and gradational, Calcite filling fractures and voids below 42.0 ft. Much mechanical breakage of core in zones of high void density. [Key Largo Limestone]

48.4-48.7 ft R.D. = 50°, moderately spaced; filling: partly healed, calcite; surface: rough, planar, moderately hard.
49.1-49.3 ft R.D. = 45°, widely spaced, slightly open; filling: moderately healed, thin calcite, moderately soft; surface: rough, undulating.

49.3-52.9 ft GRAINSTONE, calcareous, moderately hard to moderately soft, fresh to moderately weathered, very coarse sand to silt particles, pitted to vuggy, max size: 1.0 in., white (N9) to very light gray (N8), massive, strong reaction to HCl, wet, Shells are mostly dissolved. Most vugs are moldic porosity. From 52.6 - 52.9, abundant shell molds. [Fort Thompson Formation]
51.6- ft R.D. = 0°, moderately spaced; filling: not healed, very thin calcite, soft; surface: smooth, planar, moderately hard.

52.9-65.5 ft WACKESTONE, calcareous, moderately hard (H4), moderately to slightly weathered, silt to very fine sand particles, pitted, typical diameter: 0.2 in., max size: 1.0 in., white (N9) to very light gray (N8), massive, strong reaction to HCl, wet, Shells are mostly dissolved. Most vugs are moldic porosity. Lower contact is gradual. [Fort Thompson Formation]

USCS SYMBOL

REMARKS

Mechanical breaks at soft zones in core.

DATE STARTED: 8/29/13
DATE FINISHED: 9/3/13
FIELD GEOLOGIST: Doug Raszewski
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ
DRILLING CO. Huss Drilling
DRILLER: Anthony Hudson

NOTES: Boring is angled 15 degrees toward bearing 305. Depth is measured depth in boring.

DRILL RIG: DR-5
HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

Paul C. Rizzo Associates, Inc
500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
www.rizzoassoc.com

Boring R-6-1a-A

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES

N. 397112.22 ft E. 876590.79 ft

GROUND SURFACE ELEVATION: -0.09 ft

ELEVATION (Feet)	DEPTH (Feet)
-59.0	61.0
-60.0	62.0
-61.0	63.0
-62.0	64.0
-63.0	65.0
-64.0	66.0
-65.0	67.0
-66.0	68.0
-67.0	69.0
-68.0	70.0
-69.0	71.0
-70.0	72.0
-71.0	73.0
-72.0	74.0
-73.0	75.0
-74.0	76.0
-75.0	77.0
-76.0	78.0
-77.0	79.0

SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY
R-12	96% (78%)	
R-13	100% (90%)	
R-14	14% (0%)	FD1
R-15	86% (58%)	
R-16	90% (70%)	

DESCRIPTION

52.9-65.5 ft WACKESTONE, calcareous, moderately hard (H4), moderately to slightly weathered, silt to very fine sand particles, pitted, typical diameter: 0.2 in., max size: 1.0 in., white (N9) to very light gray (N8), massive, strong reaction to HCl, wet, Shells are mostly dissolved. Most vugs are moldic porosity. Lower contact is gradual. [Fort Thompson Formation]
60.7-61.1 ft Joint.

65.5-111.9 ft GRAINSTONE, calcareous, hard to soft, fresh to slightly weathered, very coarse sand to silt particles, pitted to cavities, max size: 5.0 in., white (N9) to very light gray (N8), massive bedded, strong reaction to HCl, wet, lower contact is gradational, Shells are mostly dissolved. Most vugs are moldic porosity. Voids up to 2 inches big from 91.9-94.0 ft. with remnants of sand filling. Pits and vugs aid in mechanical breakage of core. From 81.9 - 83.1, high void density, broken. From 85.8 - 87.9 and 96.0 - 103.0ft, abundant shell molds. [Fort Thompson Formation]
with layers of PACKSTONE, calcareous, moderately soft to hard, fresh to slightly weathered, clay to granule particles, vuggy to pitted, max size: 2.0 in., white (N9) to very light gray (N8), very thickly to thickly bedded, strong reaction to HCl, moist, lower contact is conformable and gradational, [Fort Thompson Formation]

75.0 ft Soft sandy pockets from 75 - 77ft (likely fractured).
75.2-75.5 ft Joint, R.D. = 40°, moderately open; filling: not healed; surface: rough, planar, slightly weathered, moderately hard to hard; Core mechanically broken within interpreted fractured interval.

78.0 ft Very broken, loose sand present from 78.0 - 79.4 ft..

USCS SYMBOL

REMARKS

R-14: Low recovery due to loose sand from ~67-71.5 ft. run only took ~2 minutes. Zero resistance from 66.9 - 71.9 ft.

SC-1: 72.6-73.5 ft.

DATE STARTED: 8/29/13
DATE FINISHED: 9/3/13
FIELD GEOLOGIST: Doug Raszewski
CHECKED BY: Rolando Benitez
DRILLING METHOD: Mud Rotary, PQ
DRILLING CO. Huss Drilling
NOTES: Boring is angled 15 degrees toward bearing 305. Depth is measured depth in boring.
APPROVED BY: EOT
DRILLER: Anthony Hudson
DRILL RIG: DR-5
HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

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500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
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Boring R-6-1a-A

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 397112.22 ft E. 876590.79 ft
GROUND SURFACE ELEVATION: -0.09 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-78.0	81.0	R-16	90% (70%)	FD1		65.5-111.9 ft GRAINSTONE, calcareous, hard to soft, fresh to slightly weathered, very coarse sand to silt particles, pitted to cavities, max size: 5.0 in., white (N9) to very light gray (N8), massive bedded, strong reaction to HCl, wet, lower contact is gradational, Shells are mostly dissolved. Most vugs are moldic porosity. Voids up to 2 inches big from 91.9-94.0 ft. with remnants of sand filling. Pits and vugs aid in mechanical breakage of core. From 81.9 - 83.1, high void density, broken. From 85.8 - 87.9 and 96.0 - 103.0ft, abundant shell molds. [Fort Thompson Formation] with layers of PACKSTONE, calcareous, moderately soft to hard, fresh to slightly weathered, clay to granule particles, vuggy to pitted, max size: 2.0 in., white (N9) to very light gray (N8), very thickly to thickly bedded, strong reaction to HCl, moist, lower contact is conformable and gradational, [Fort Thompson Formation]		
-79.0	82.0					80.5-80.7 ft Joint, R.D. = 25°, moderately open; filling: not healed; surface: rough, planar, slightly weathered, moderately hard to hard; Core mechanically broken within interpreted fractured interval.		
-80.0	83.0					83.1-83.3 ft Joint, R.D. = 40°, slightly open; filling: partly healed, moderately thin sandy mud, slightly weathered, soft; surface: rough, planar, slightly to slightly weathered, moderately hard to hard; Core mechanically broken within interpreted fractured interval.		
-81.0	84.0	R-17	96% (78%)					
-82.0	85.0							
-83.0	86.0							
-84.0	87.0			FD5				
-85.0	88.0					87.9-88.2 ft Joint, R.D. = 40°, slightly open; filling: partly healed, moderately thin sandy mud, slightly weathered, soft; surface: rough, planar, slightly to slightly weathered, moderately hard to hard; Core mechanically broken within interpreted fractured interval.		From 87.9 - 90.0 ft, Core very broken (mechanically) due to fractures and soft zones.
-86.0	89.0	R-18	90% (50%)			88.7- ft Joint, R.D. = 35°, moderately open; filling: not healed; surface: rough, planar, slightly weathered, moderately hard to hard; Core mechanically broken within interpreted fractured interval. 89- ft Joint, R.D. = 35°, moderately open; filling: not healed; surface: rough, planar, slightly weathered, moderately hard to hard; Core mechanically broken within interpreted fractured interval.		
-87.0	90.0			FD0		90.0 ft Abundant large vugs (1 - 2 inches) with remnant sand coating, often broken from 90.0 - 96.0 ft.		
-88.0	91.0							
-89.0	92.0							
-90.0	93.0							
-91.0	94.0	R-19	94% (82%)					
-92.0	95.0			FD4		94.9-95.2 ft Joint, R.D. = 30°, slightly open; filling: not healed; surface: rough, undulating, slightly weathered, moderately hard to hard; Core mechanically broken within interpreted fractured interval. 95.6-95.8 ft Joint, R.D. = 30°, slightly open; filling: not healed; surface: rough, undulating, slightly weathered, moderately hard to hard; Core mechanically broken within interpreted fractured interval.		SC-2: 95.7-96.5 ft.
-93.0	96.0							
-94.0	97.0					97.7-97.9 ft Joint, R.D. = 45°, one end visible, slightly open; filling: not healed; surface: rough, planar, slightly weathered, moderately hard to hard; terminates at large shell mold.		
-95.0	98.0	R-20	100% (100%)	FD0				
-96.0	99.0							

DATE STARTED: 8/29/13
DATE FINISHED: 9/3/13
FIELD GEOLOGIST: Doug Raszewski
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ
DRILLING CO. Huss Drilling
DRILLER: Anthony Hudson

NOTES: Boring is angled 15 degrees toward bearing 305. Depth is measured depth in boring.
DRILL RIG: DR-5
HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

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500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
www.rizzoassoc.com

Boring R-6-1a-A

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 397112.22 ft E. 876590.79 ft
GROUND SURFACE ELEVATION: -0.09 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-97.0								
	101.0	R-20	100% (100%)			65.5-111.9 ft GRAINSTONE, calcareous, hard to soft, fresh to slightly weathered, very coarse sand to silt particles, pitted to cavities, max size: 5.0 in., white (N9) to very light gray (N8), massive bedded, strong reaction to HCl, wet, lower contact is gradational, Shells are mostly dissolved. Most vugs are moldic porosity. Voids up to 2 inches big from 91.9-94.0 ft. with remnants of sand filling. Pits and vugs aid in mechanical breakage of core. From 81.9 - 83.1, high void density, broken. From 85.8 - 87.9 and 96.0 - 103.0ft, abundant shell molds. [Fort Thompson Formation] with layers of PACKSTONE, calcareous, moderately soft to hard, fresh to slightly weathered, clay to granule particles, vuggy to pitted, max size: 2.0 in., white (N9) to very light gray (N8), very thickly to thickly bedded, strong reaction to HCl, moist, lower contact is conformable and gradational, [Fort Thompson Formation]		
-98.0								
	102.0							
-99.0								
	103.0							
-100.0								
	104.0							Large shell (up to 4") moldic porosity from 103.3 - 105.0ft.
-101.0		R-21	90% (90%)					
	105.0							
-102.0								
	106.0			FD0				
-103.0								From 106.5 - 111.9ft, Abundant small-med moldic porosity.
	107.0							
-104.0								
	108.0							
-105.0								SC-3: 108.6-109.7 ft.
	109.0							
-106.0		R-22	100% (100%)					
	110.0							
-107.0								
	111.0							
-108.0						---- Bottom of Boring at 111.90 ft.----		

DATE STARTED: 8/29/13
DATE FINISHED: 9/3/13
FIELD GEOLOGIST: Doug Raszewski
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ
DRILLING CO. Huss Drilling
DRILLER: Anthony Hudson

NOTES: Boring is angled 15 degrees toward bearing 305. Depth is measured depth in boring.
DRILL RIG: DR-5
HAMMER ID:

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Paul C. Rizzo Associates, Inc
500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
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Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	DESCRIPTION	USCS SYMBOL	REMARKS
-1.0 to -2.0	0.0–2.5				0.0-2.5 ft Road base layer.		0 - 2.5 ft, boring was destructively drilled using 5 inch mud rotary bit. 2.5 - 14.5 ft SPT sampling. Measured water level varied within one foot of ground surface. S-1: No blow counts, reached two ft interval by weight of rods (WOR) only.
-3.0 to -5.0	2.5–5.3	S-1	0 0%		2.5-5.3 ft Gravelly organic soil, 60% fines, low plasticity; 40% gravel, fine to coarse, subrounded, medium hardness; maximum grain size = 2.5 in., wet, strong HCl reaction, Spongy consistency, weak cementation, with organics, with Wood, (Peat/Muck layer).	ol/oh	
		S-2	7-10-18-17 N1(28) N2(35) 70%				
-6.0 to -12.0	5.3–12.5	S-3	3-8-10-7 N1(18) N2(17) 60%		5.3-12.5 ft LIMESTONE, calcareous, soft to moderately hard, moderately (W5) weathered to intensely (W7) weathered, clay to fine sand particles, very light gray (N8) to white (N9), strong reaction to HCl, Limestone with weakly cemented silt matrix, mostly washed out during drilling. [Miami Limestone]		
		S-4	3-5-1-7 N1(6) N2(8) 30%				
		S-5	2-7-5-5 N1(12) N2(10) 50%				
-13.0 to -19.0	12.5–26.6	S-6	25-24-27-21 N1(51) N2(48) 70%	FD0	12.5-26.6 ft GRAINSTONE, calcareous, moderately soft to moderately hard, moderately (W5) weathered to intensely (W7) weathered, clay to fine sand particles, pitted to vuggy, max size: 1.5 in., very light gray (N8) to white (N9), strong reaction to HCl, lower contact is gradational, From 25.0 - 26.5ft, high intensity of voids. [Miami Limestone]		14.5 - 120 ft. PQ wireline coring.
		R-1	100% (85%)				
		R-2	37% (31%)				

DATE STARTED: 9/11/13
DATE FINISHED: 10/4/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-16
HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

Paul C. Rizzo Associates, Inc
500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
www.rizzoassoc.com

Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-21.0	21.0	R-3	35% (0%)			12.5-26.6 ft GRAINSTONE, calcareous, moderately soft to moderately hard, moderately (W5) weathered to intensely (W7) weathered, clay to fine sand particles, pitted to vuggy, max size: 1.5 in., very light gray (N8) to white (N9), strong reaction to HCl, lower contact is gradational, From 25.0 - 26.5ft, high intensity of voids. [Miami Limestone]		
-22.0	22.0	R-4	100% (0%)					
-23.0	23.0							
-24.0	24.0	R-5	100% (100%)					SC-1a: 23.7-24.3ft. SC-1b: 24.3-25.2ft.
-25.0	25.0							
-26.0	26.0							
-27.0	27.0	R-6	94% (86%)			26.6-47.6 ft PACKSTONE, calcareous, moderately hard, slightly weathered, silt to fine sand particles, pitted to cavities, max size: 2.0 in., light gray (N7) with very light gray (N8), weak reaction to HCl, lower contact is gradational, Grades from Miami Limestone to Key Largo Limestone, 26.3-26.9ft. Cavity: 37.0 - 37.5ft. [Key Largo Limestone]		
-28.0	28.0							SC-2: 28.15-29.2ft.
-29.0	29.0							Lost circulation at 29ft.
-30.0	30.0			FD0				Drilled from 30.0-35.0ft with NWD4 conventional core barrel. Followed by pressuremeter testing in this interval, and then overdrilled with PQ core barrel.
-31.0	31.0							
-32.0	32.0	R-7	54% (26%)					
-33.0	33.0							
-34.0	34.0							
-35.0	35.0							
-36.0	36.0							
-37.0	37.0	R-8	84% (76%)					
-38.0	38.0							
-39.0	39.0							

DATE STARTED: 9/11/13
DATE FINISHED: 10/4/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-16
HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

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500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
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Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-41.0	41.0					26.6-47.6 ft PACKSTONE, calcareous, moderately hard, slightly weathered, silt to fine sand particles, pitted to cavities, max size: 2.0 in., light gray (N7) with very light gray (N8), weak reaction to HCl, lower contact is gradational, Grades from Miami Limestone to Key Largo Limestone, 26.3-26.9ft. Cavity: 37.0 - 37.5ft. [Key Largo Limestone]		From 40.0-45.0ft, NWD4 conventional coring used for pressuremeter testing interval. Overdrilled with PQ barrel.
-42.0	42.0	R-9	36% (28%)					
-43.0	43.0							Lost circulation at 43.0 ft.
-44.0	44.0							
-45.0	45.0							
-46.0	46.0							
-47.0	47.0	R-10	96% (62%)					
-48.0	48.0					47.6-49.1 ft PACKSTONE, calcareous, moderately soft to moderately hard, slightly weathered, clay to fine sand particles, vuggy, max size: 0.5 in., light gray (N7), weak reaction to HCl, Grades to Fort Thompson Formation 47.2-49.1ft. [Fort Thompson Formation]		SC-3: 47.2 - 48.6ft.
-49.0	49.0							
-50.0	50.0			FD0		49.1-58.6 ft PACKSTONE, calcareous, moderately soft, slightly weathered, clay to very fine sand particles, vuggy, max size: 0.5 in., very light gray (N8) to white (N9), From 49.1 - 51.0ft, interval of high void density. [Fort Thompson Formation]		
-51.0	51.0	R-11	100% (100%)					
-52.0	52.0							
-53.0	53.0	R-12	100% (100%)					
-54.0	54.0							
-55.0	55.0							
-56.0	56.0							
-57.0	57.0	R-13	92% (92%)					
-58.0	58.0							
-59.0	59.0							

DATE STARTED: 9/11/13
DATE FINISHED: 10/4/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-16
HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

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Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
						58.6-63.0 ft GRAINSTONE, calcareous, moderately soft, slightly (W3) weathered, very fine sand to fine sand particles, pitted, very light gray (N8), [Fort Thompson Formation] with layers of PACKSTONE, moderately soft, slightly to moderately weathered, very fine sand to fine sand particles, [Fort Thompson Formation]		
-61.0	61.0							
-62.0	62.0	R-14	86% (44%)					
-63.0	63.0			FD0		63.0-98.1 ft GRAINSTONE, calcareous, moderately soft, slightly to moderately weathered, silt to medium sand particles, vuggy to pitted, max size: 3.0 in., very light gray (N8), weak reaction to HCl, lower contact is gradational, Contains intervals of loose sand, 85-87ft. Sections of core recovered as gravel fragments. From 83.2 - 83.8ft, void spaces contain calcite overgrowth. Moldic porosity. [Fort Thompson Formation]		
-64.0	64.0							
-65.0	65.0							
-66.0	66.0					66-68 ft Joint, R.D. = 90°; filling: totally healed, thick calcite, slightly weathered, moderately soft; surface: slightly rough, planar, slightly weathered; Near vertical.		Soft zone, 66 - 66.7ft.
-67.0	67.0	R-15	54% (32%)	FD1				
-68.0	68.0							Soft zone, 68 - 70ft.
-69.0	69.0							
-70.0	70.0							
-71.0	71.0	R-16	70% (0%)					
-72.0	72.0							
-73.0	73.0	R-17	100% (60%)					
-74.0	74.0			FD0				
-75.0	75.0	R-18	100% (0%)					
-76.0	76.0							
-77.0	77.0							Tool drop: 77.0 - 78.0ft.
-78.0	78.0	R-19	57% (24%)					
-79.0	79.0							

DATE STARTED: 9/11/13
DATE FINISHED: 10/4/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:
DRILL RIG: DR-16
HAMMER ID:

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Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		R-20	100% (60%)			63.0-98.1 ft GRAINSTONE, calcareous, moderately soft, slightly to moderately weathered, silt to medium sand particles, vuggy to pitted, max size: 3.0 in., very light gray (N8), weak reaction to HCl, lower contact is gradational, Contains intervals of loose sand, 85-87ft. Sections of core recovered as gravel fragments. From 83.2 - 83.8ft, void spaces contain calcite overgrowth. Moldic porosity. [Fort Thompson Formation]		
-81.0	81.0							SC-4a: 81.0 - 81.7ft.
-82.0	82.0							SC-4b: 81.7 - 82.3ft.
-83.0	83.0	R-21	100% (100%)					
-84.0	84.0							
-85.0	85.0							Soft zone from 85 - 87ft depth. Grab sample collected.
-86.0	86.0							
-87.0	87.0	R-22	82% (32%)					
-88.0	88.0							
-89.0	89.0							
-90.0	90.0	R-23	100% (90%)	FD0				
-91.0	91.0							
-92.0	92.0	R-24	80% (20%)					
-93.0	93.0							
-94.0	94.0	R-25	100% (100%)					
-95.0	95.0							
-96.0	96.0							
-97.0	97.0							
-98.0	98.0	R-26	100% (100%)					
-99.0	99.0							

DATE STARTED: 9/11/13
DATE FINISHED: 10/4/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-16
HAMMER ID:

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ENGINEERS/CONSULTANTS/CM

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500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
www.rizzoassoc.com

Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	DESCRIPTION	USCS SYMBOL	REMARKS
		R-26			98.1-100.8 ft PACKSTONE, calcareous, moderately soft (H5), moderately (W5) weathered, silt to medium sand particles, pitted to vuggy, light gray (N7) to very light gray (N8), weak reaction to HCl, Sections of core recovered as gravel sized fragments. Moldic Porosity. [Fort Thompson Formation]		
-101.0	101.0						
-102.0	102.0				100.8-111.0 ft GRAINSTONE, calcareous, moderately soft (H5), moderately (W5) weathered, silt to medium sand particles, pitted to vuggy, light gray (N7) to very light gray (N8), weak reaction to HCl, Moldic Porosity. [Fort Thompson Formation]		
-103.0	103.0	R-27	100% (100%)				
-104.0	104.0						
-105.0	105.0						
-106.0	106.0						
-107.0	107.0						
-108.0	108.0	R-28	84% (84%)				
-109.0	109.0						
-110.0	110.0			FD0			
-111.0	111.0				111.0-120.5 ft PACKSTONE, calcareous, moderately soft (H5), moderately (W5) weathered to intensely (W7) weathered, silt to medium sand particles, pitted to vuggy, light gray (N7) to white (N9), weak reaction to HCl, Moldic Porosity. Grades to Upper Tamiami Formation from 116.5 to 117.5ft depth. [Fort Thompson Formation]		
-112.0	112.0						
-113.0	113.0	R-29	78% (70%)				
-114.0	114.0						
-115.0	115.0						
-116.0	116.0						
-117.0	117.0						
-118.0	118.0	R-30	58% (40%)				Softer material at 117.5 ft, contact with Upper Tamiami Formation.
-119.0	119.0						

DATE STARTED: 9/11/13
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DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

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Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY
				FD0
-121.0	121.0	S-7	19-18-33-35 N1(51) N2(68) 85%	
-122.0	122.0			
-123.0	123.0	S-8	9-10-9-14 N1(19) N2(23) 95%	
-124.0	124.0			
-125.0	125.0	S-9	7-9-19-13 N1(28) N2(32) 70%	
-126.0	126.0			
-127.0	127.0	S-10	10-5-9-7 N1(14) N2(16) 93%	
-128.0	128.0			
-129.0	129.0	S-11	8-8-9-13 N1(17) N2(22) 93%	
-130.0	130.0			
-131.0	131.0	S-12	4-5-10-15 N1(15) N2(25) 95%	
-132.0	132.0			
-133.0	133.0	S-13	10-15-10-12 N1(25) N2(22) 85%	
-134.0	134.0			
-135.0	135.0	ST-1	74%	
-136.0	136.0			
-137.0	137.0			
-138.0	138.0	S-1(3inch)	55%	
-139.0	139.0	S-2(3inch)	55%	

DESCRIPTION

120.5-122.5 ft Silty sand, 70% sand, fine, subrounded; 25% fines, low plasticity, slow dilatancy, low toughness; 5% gravel, fine to medium, subangular, flat and elongated, medium hardness; very light gray (N8) with light gray (N7), moist, weak HCl reaction, weak cementation, [Upper Tamiami Formation] — USCS SYMBOL: sm

122.5-128.0 ft Silty sand, 50% sand, fine, subrounded; 45% fines, low plasticity, slow dilatancy, low toughness; 5% gravel, fine to medium, subangular, flat and elongated, medium hardness; very light gray (N8), moist, weak HCl reaction, weak cementation, [Upper Tamiami Formation] — USCS SYMBOL: sm

128.0-140.0 ft Sandy silt, 60% fines, medium plasticity, slow dilatancy, low toughness; 40% sand, fine, subrounded; pale olive (10Y 6/2), peices of organic material seen in sample., soft consistency, weak cementation, [Upper Tamiami Formation] — USCS SYMBOL: ml

REMARKS

From 120 ft. to total depth, a combination of ST and SPT sampling, and destructive over-drilling using a 5 inch mud rotary bit were used to advance the boring.
Intervals sampled by SPT were destructively over-drilled, with 5 inch mud rotary bit, to ream out the boring in preparation for ST sampling.
At 121 ft, (N) values may be affected by the presence of coarse gravel in the samples collected by SPT sampling.

A 3-inch split spoon was used to create pockets for Pressuremeter testing at various intervals as noted.

DATE STARTED: 9/11/13
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APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

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Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		S-2(3inch)				140.0-156.0 ft SILTY SAND, 60% sand, fine, subrounded; 30% fines, low plasticity, slow dilatancy, medium toughness; 10% gravel, fine to medium, subrounded, medium hardness; pale olive (10Y 6/2), moist, strong HCl reaction, weak cementation, with shells, Shell fragments and gravel throughout. [Upper Tamiami Formation] with layers of silt with sand, 80% fines, medium plasticity, slow dilatancy, low toughness; 15% sand, fine, subrounded; 5% gravel; pale olive (10Y 6/2), moist, strong HCl reaction, weak cementation, shells, Sandy silt. [Upper Tamiami Formation]	SM	
-141.0	141.0							
-142.0	142.0	S-3(3inch)	65%					
-143.0	143.0							
-144.0	144.0	S-14	16-17-17-22 N1(34) N2(39) 80%					
-145.0	145.0							
-146.0	146.0	ST-2	41%					
-147.0	147.0							
-148.0	148.0							
-149.0	149.0	ST-3	71%					
-150.0	150.0							
-151.0	151.0	S-15	10-16-23-41 N1(39) N2(64) 100%					
-152.0	152.0							From 151.8 -157.8 ft, a 3-inch diameter split spoon was used to create a pocket for pressure meter testing.
-153.0	153.0	S-4(3inch)	90%					
-154.0	154.0							
-155.0	155.0	S-5(3inch)	90%					
-156.0	156.0					156.0-218.3 ft SANDY SILT, 70% fines, medium plasticity, slow dilatancy, medium toughness; 30% sand, fine, subrounded; pale olive (10Y 6/2), moist, strong HCl reaction, medium stiff to stiff consistency, weak cementation, trace shells, Sand/silt ratio varies from 10/90 to 30/70 throughout. At 200 - 218.3ft depth, sand/silt ratio is 30/70. [Lower Tamiami Formation]	ML	
-157.0	157.0	S-6(3inch)	90%					
-158.0	158.0							
-159.0	159.0	S-16	8-14-24-47 N1(38) N2(71) 100%					
		ST-4						

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APPROVED BY: EOT

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DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-16
HAMMER ID:

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Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-161.0	161.0	ST-4	85%			156.0-218.3 ft SANDY SILT, 70% fines, medium plasticity, slow dilatancy, medium toughness; 30% sand, fine, subrounded; pale olive (10Y 6/2), moist, strong HCl reaction, medium stiff to stiff consistency, weak cementation, trace shells, Sand/silt ratio varies from 10/90 to 30/70 throughout. At 200 - 218.3ft depth, sand/silt ratio is 30/70. [Lower Tamiami Formation]		
-162.0	162.0							
-163.0	163.0							
-164.0	164.0	ST-5	89%					
-165.0	165.0							
-166.0	166.0	S-17	5-9-17-38 N1(26) N2(55) 100%					
-167.0	167.0							
-168.0	168.0							
-169.0	169.0	ST-6	93%					
-170.0	170.0						ML	
-171.0	171.0	ST-7	56%					
-172.0	172.0							
-173.0	173.0							
-174.0	174.0	S-18	8-12-21-44 N1(33) N2(65) 100%					
-175.0	175.0							
-176.0	176.0	ST-8	96%					
-177.0	177.0							
-178.0	178.0							
-179.0	179.0	ST-9	96%					

DATE STARTED: 9/11/13
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Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-181.0	181.0	S-19	2-5-15-37 N1(20) N2(52) 100%			156.0-218.3 ft SANDY SILT, 70% fines, medium plasticity, slow dilatancy, medium toughness; 30% sand, fine, subrounded; pale olive (10Y 6/2), moist, strong HCl reaction, medium stiff to stiff consistency, weak cementation, trace shells, Sand/silt ratio varies from 10/90 to 30/70 throughout. At 200 - 218.3ft depth, sand/silt ratio is 30/70. [Lower Tamiami Formation]	ML	
-182.0	182.0							
-183.0	183.0	ST-10	78%					
-184.0	184.0							
-185.0	185.0							
-186.0	186.0	ST-11	100%					
-187.0	187.0							
-188.0	188.0	S-20	2-9-19-45 N1(28) N2(64) 100%					
-189.0	189.0							
-190.0	190.0							
-191.0	191.0	ST-12	81%					
-192.0	192.0							
-193.0	193.0	ST-13	100%					
-194.0	194.0							
-195.0	195.0							
-196.0	196.0	S-21	4-13-32-50 N1(45) N2(82) 100%					
-197.0	197.0							
-198.0	198.0	ST-14	96%					
-199.0	199.0							
		ST-15						

DATE STARTED: 9/11/13
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DRILLING CO. Huss Drilling
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Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
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COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-201.0	201.0	ST-15	85%			156.0-218.3 ft SANDY SILT, 70% fines, medium plasticity, slow dilatancy, medium toughness; 30% sand, fine, subrounded; pale olive (10Y 6/2), moist, strong HCl reaction, medium stiff to stiff consistency, weak cementation, trace shells, Sand/silt ratio varies from 10/90 to 30/70 throughout. At 200 - 218.3ft depth, sand/silt ratio is 30/70. [Lower Tamiami Formation]	ML	
-202.0	202.0							
-203.0	203.0	S-22	3-6-20-49 N1(26) N2(69) 100%					
-204.0	204.0							
-205.0	205.0							
-206.0	206.0	ST-16	100%					
-207.0	207.0							
-208.0	208.0	ST-17	100%					
-209.0	209.0							
-210.0	210.0	S-23	6-13-31-50 N1(44) N2(81) 100%					
-211.0	211.0							
-212.0	212.0							
-213.0	213.0	ST-18	85%					
-214.0	214.0							
-215.0	215.0							
-216.0	216.0	ST-19	96%					
-217.0	217.0							
-218.0	218.0	S-24	6-11-33-50/4 N1(44) N2(50/4) 100%					
-219.0	219.0	ST-20	78%				SM	

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COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-221.0	221.0	ST-20	78%			218.3-243.7 ft SILTY SAND, fine to medium, soft hardness; 60% sand, fine, subrounded; 40% fines, low plasticity, medium toughness; maximum grain size = 0.2 in., pale olive (10Y 6/2), dry, strong HCl reaction, medium dense to dense consistency, moderate cementation, trace shells, Trace gravel clasts (shell fragments). Material from 224 - 232.7ft is more dense than the surrounding layers. [Peace River Formation] with layers of poorly graded sand, 90% sand, fine to medium, subrounded; 10% gravel, fine, subangular, flat and elongated; maximum grain size = 0.3 in., moist, strong HCl reaction, loose to medium dense consistency, weak cementation, trace shells, [Peace River Formation]	SM	
-222.0	222.0							
-223.0	223.0	ST-21	81%					
-224.0	224.0							
-225.0	225.0	ST-22	76%					
-226.0	226.0							
-227.0	227.0	S-25	8-11-23-50/5 N1(34) N2(50/5) 100%					
-228.0	228.0							
-229.0	229.0							
-230.0	230.0	ST-23	78%					
-231.0	231.0							
-232.0	232.0	ST-24	94%					
-233.0	233.0							
-234.0	234.0	ST-25	89%					
-235.0	235.0							
-236.0	236.0	S-26	18-22-29-50/5 N1(51) N2(50/5) 100%					
-237.0	237.0							
-238.0	238.0							
-239.0	239.0	ST-26	68%					
		ST-27						

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COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-241.0	241.0	ST-27	80%			218.3-243.7 ft SILTY SAND, fine to medium, soft hardness; 60% sand, fine, subrounded; 40% fines, low plasticity, medium toughness; maximum grain size = 0.2 in., pale olive (10Y 6/2), dry, strong HCl reaction, medium dense to dense consistency, moderate cementation, trace shells, Trace gravel clasts (shell fragments). Material from 224 - 232.7ft is more dense than the surrounding layers. [Peace River Formation] with layers of poorly graded sand, 90% sand, fine to medium, subrounded; 10% gravel, fine, subangular, flat and elongated; maximum grain size = 0.3 in., moist, strong HCl reaction, loose to medium dense consistency, weak cementation, trace shells, [Peace River Formation]	SM	
-242.0	242.0							
-243.0	243.0	ST-28	96%					
-244.0	244.0							
-245.0	245.0					243.7-248.0 ft Silty sand, 70% sand, fine to medium, subangular, flat and elongated; 30% fines, non plastic, low toughness; maximum grain size = 0.2 in., light gray (N7) with very light gray (N8), moist, medium dense consistency, weak cementation, trace shells, [Peace River Formation]	sm	
-246.0	246.0	S-27	12-20-27-28 N1(47) N2(55) 100%					
-247.0	247.0							
-248.0	248.0	ST-29	89%			248.0-272.5 ft SILTY SAND, 70% sand, fine, subrounded; 20% fines, low plasticity, medium toughness; 10% gravel, fine to medium, soft hardness; maximum grain size = 0.2 in., pale olive (10Y 6/2), dry, strong HCl reaction, medium dense to dense consistency, moderate cementation, with shells, Gravel clasts are shells. [Peace River Formation] with layers of poorly graded sand, 90% sand, fine to medium, subrounded; 10% gravel, fine, subangular, flat and elongated; maximum grain size = 0.3 in., moist, strong HCl reaction, loose to medium dense consistency, weak cementation, some shells, [Peace River Formation]	SM	
-249.0	249.0							
-250.0	250.0	ST-30	70%					
-251.0	251.0							
-252.0	252.0	ST-31	67%					
-253.0	253.0							
-254.0	254.0	S-28	13-16-29-50/4 N1(45) N2(50/4) 100%					
-255.0	255.0							
-256.0	256.0	ST-32	93%					
-257.0	257.0							
-258.0	258.0							
-259.0	259.0	ST-33	85%					

DATE STARTED: 9/11/13
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DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

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Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		ST-33						
-261.0	261.0					248.0-272.5 ft SILTY SAND, 70% sand, fine, subrounded; 20% fines, low plasticity, medium toughness; 10% gravel, fine to medium, soft hardness; maximum grain size = 0.2 in., pale olive (10Y 6/2), dry, strong HCl reaction, medium dense to dense consistency, moderate cementation, with shells, Gravel clasts are shells. [Peace River Formation] with layers of poorly graded sand, 90% sand, fine to medium, subrounded; 10% gravel, fine, subangular, flat and elongated; maximum grain size = 0.3 in., moist, strong HCl reaction, loose to medium dense consistency, weak cementation, some shells, [Peace River Formation]	SM	
-262.0	262.0	ST-34	79%					
-263.0	263.0							
-264.0	264.0	S-29	21-23-38-50/5 N1(61) N2(50/5) 100%					
-265.0	265.0							
-266.0	266.0	ST-35	68%					
-267.0	267.0							
-268.0	268.0							
-269.0	269.0	ST-36	88%					
-270.0	270.0							
-271.0	271.0	ST-37	78%					
-272.0	272.0							
-273.0	273.0					272.5-291.0 ft Silt with sand, 80% fines, low plasticity; 20% sand, fine; pale olive (10Y 6/2), strong HCl reaction, medium dense to dense consistency, [Peace River Formation]	ml	
-274.0	274.0	S-30	11-25-40-50/5 N1(65) N2(50/5) 100%					
-275.0	275.0							
-276.0	276.0	ST-38	100%					
-277.0	277.0							
-278.0	278.0							
-279.0	279.0	ST-39	100%					
		ST-40						

DATE STARTED: 9/11/13
DATE FINISHED: 10/4/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:
DRILL RIG: DR-16
HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

Paul C. Rizzo Associates, Inc
500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
www.rizzoassoc.com

Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-281.0	281.0	ST-40	100%			272.5-291.0 ft Silt with sand, 80% fines, low plasticity; 20% sand, fine; pale olive (10Y 6/2), strong HCl reaction, medium dense to dense consistency, [Peace River Formation]	SC	
-282.0	282.0							
-283.0	283.0	S-31	5-16-41-50/4 N1(57) N2(50/4) 100%					
-284.0	284.0							
-285.0	285.0	ST-41	93%				ml	
-286.0	286.0							
-287.0	287.0							
-288.0	288.0	ST-42	96%					
-289.0	289.0							
-290.0	290.0							
-291.0	291.0	ST-43	85%			291.0-313.0 ft Silty sand, 70% sand, fine; 30% fines, low plasticity; pale olive (10Y 6/2), strong HCl reaction, medium dense to dense consistency, [Peace River Formation]		
-292.0	292.0							
-293.0	293.0	S-32	16-27-47-50/4 N1(74) N2(50/4) 100%					
-294.0	294.0							
-295.0	295.0	ST-44	74%				sm	
-296.0	296.0							
-297.0	297.0							
-298.0	298.0	ST-45	81%					
-299.0	299.0							
		ST-46						

DATE STARTED: 9/11/13
DATE FINISHED: 10/4/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
NOTES:
APPROVED BY: EOT
DRILLER: Eddie Palmer
DRILL RIG: DR-16
HAMMER ID:

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Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-301.0	301.0	ST-46	74%			291.0-313.0 ft Silty sand, 70% sand, fine; 30% fines, low plasticity; pale olive (10Y 6/2), strong HCl reaction, medium dense to dense consistency, [Peace River Formation]	SW-SM	
-302.0	302.0							
-303.0	303.0	S-33	24-25-38-50/4 N1(63) N2(50/4) 100%					
-304.0	304.0							
-305.0	305.0	ST-47	78%					
-306.0	306.0							
-307.0	307.0						sm	
-308.0	308.0	ST-48	70%					
-309.0	309.0							
-310.0	310.0	ST-49	84%					
-311.0	311.0							
-312.0	312.0	S-34	21-27-33-50/5 N1(60) N2(50/5) 100%					
-313.0	313.0					313.0-346.0 ft Silty sand, 70% sand, fine to medium; 30% fines, low plasticity, medium toughness; pale olive (10Y 6/2) with light gray (N7), strong HCl reaction, Sand/silt ratio varies from 70/30 to 60/40. [Peace River Formation] with layers of lean clay with sand/silt with sand, 90% fines, medium plasticity, slow dilatancy, low toughness; 10% sand, fine; strong HCl reaction, medium stiff to stiff consistency, Exist as lenses, average thickness is 1 inch. [Peace River Formation]		
-314.0	314.0	ST-50	75%					
-315.0	315.0							
-316.0	316.0	ST-51	71%					
-317.0	317.0						sm	
-318.0	318.0							
-319.0	319.0	ST-52	81%				SP-SM	

DATE STARTED: 9/11/13
DATE FINISHED: 10/4/13
FIELD GEOLOGIST: Jason Lee
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DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
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Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		S-35 S-35	40-50/5 N1(50/5) 100%			313.0-346.0 ft Silty sand, 70% sand, fine to medium; 30% fines, low plasticity, medium toughness; pale olive (10Y 6/2) with light gray (N7), strong HCl reaction, Sand/silt ratio varies from 70/30 to 60/40. [Peace River Formation] with layers of lean clay with sand/silt with sand, 90% fines, medium plasticity, slow dilatancy, low toughness; 10% sand, fine; strong HCl reaction, medium stiff to stiff consistency, Exist as lenses, average thickness is 1 inch. [Peace River Formation]		
-321.0	321.0							
-322.0	322.0	ST-53	75%					
-323.0	323.0							
-324.0	324.0							
		ST-54	59%					
-325.0	325.0							
-326.0	326.0							
-327.0	327.0	ST-55	81%				SM	
-328.0	328.0	S-36	50/5 N1(50/5) 0%					
-329.0	329.0							
		ST-56	67%					
-330.0	330.0						sm	
-331.0	331.0							
		ST-57	68%					
-332.0	332.0							
-333.0	333.0							
-334.0	334.0	ST-58	85%					
-335.0	335.0							
		S-37	36-50/2 N1(50/2) 100%					
-336.0	336.0							
-337.0	337.0							
		ST-59	44%					
-338.0	338.0							
-339.0	339.0							
		ST-60	70%					

DATE STARTED: 9/11/13
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DRILLING CO. Huss Drilling
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Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-341.0	341.0	ST-60	70%			313.0-346.0 ft Silty sand, 70% sand, fine to medium; 30% fines, low plasticity, medium toughness; pale olive (10Y 6/2) with light gray (N7), strong HCl reaction, Sand/silt ratio varies from 70/30 to 60/40. [Peace River Formation] with layers of lean clay with sand/silt with sand, 90% fines, medium plasticity, slow dilatancy, low toughness; 10% sand, fine; strong HCl reaction, medium stiff to stiff consistency, Exist as lenses, average thickness is 1 inch. [Peace River Formation]	SP-SM sm	
-342.0	342.0							
-343.0	343.0	ST-61	67%					
-344.0	344.0	S-38	50/5 N1(50/5) 100%					
-345.0	345.0							
-346.0	346.0	ST-62	63%			346.0-348.8 ft Sandy lean clay, 70% fines, medium plasticity, low toughness; 30% sand, fine; pale olive (10Y 6/2) with light gray (N7), moist, strong HCl reaction, stiff consistency, [Peace River Formation]	cl	
-347.0	347.0							
-348.0	348.0							
-349.0	349.0	ST-63	59%			348.8-377.0 ft Silty sand, 70% sand, fine to medium, subrounded; 30% fines, low plasticity, low toughness; pale olive (10Y 6/2) with very light gray (N8), moist, strong HCl reaction, weak cementation, [Peace River Formation] with layers of lean clay with sand/silt with sand, 80% fines, medium plasticity; 20% sand, fine; 0% gravel; medium stiff to stiff consistency, Clay layers exist as lenses. [Peace River Formation]		Layer change based on recovery seen in bottom of shelby tube samples ST-62 and ST-63, top and bottom depths of this layer are estimated to be at the midpoint of both samples.
-350.0	350.0							
-351.0	351.0							
-352.0	352.0	ST-64	56%					
-353.0	353.0	S-39	50/5 N1(50/5) 100%					
-354.0	354.0							
-355.0	355.0	ST-65	56%				sm	
-356.0	356.0							
-357.0	357.0						SM	
-358.0	358.0	ST-66	70%					
-359.0	359.0	ST-67	59%				SP-SM	

DATE STARTED: 9/11/13
DATE FINISHED: 10/4/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:
DRILL RIG: DR-16
HAMMER ID:

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Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		ST-67	59%			348.8-377.0 ft Silty sand, 70% sand, fine to medium, subrounded; 30% fines, low plasticity, low toughness; pale olive (10Y 6/2) with very light gray (N8), moist, strong HCl reaction, weak cementation, [Peace River Formation] with layers of lean clay with sand/silt with sand, 80% fines, medium plasticity; 20% sand, fine; 0% gravel; medium stiff to stiff consistency, Clay layers exist as lenses. [Peace River Formation]	SP-SM	
-361.0	361.0							
		S-40	50/5 N1(50/5) 100%					
-362.0	362.0							
-363.0	363.0	ST-68	59%					
-364.0	364.0							
-365.0	365.0							
-366.0	366.0	ST-69	81%					
-367.0	367.0							
-368.0	368.0							
-369.0	369.0	ST-70	78%				sm	
-370.0	370.0	S-41	50/5 N1(50/5) 100%					
-371.0	371.0							
-372.0	372.0	ST-71	56%					
-373.0	373.0							
-374.0	374.0	ST-72	63%					
-375.0	375.0							
-376.0	376.0							
-377.0	377.0	ST-73	81%			377.0-415.5 ft Silty sand, 70% sand, fine to medium, subrounded; 30% fines, low plasticity, low toughness; pale olive (10Y 6/2) and very light gray (N8), moist, strong HCl reaction, weak cementation, Sand/silt ratio varies from 80/20 to 60/40. [Peace River Formation] with layers of lean clay with sand/silt with sand, 80% fines, medium plasticity; 20% sand, fine; 0% gravel; medium stiff to stiff consistency, Clay layers exist as lenses. [Peace River Formation]		
-378.0	378.0	S-42	50/5 N1(50/5) 100%				sm	
-379.0	379.0	ST-74	63%					

DATE STARTED: 9/11/13
DATE FINISHED: 10/4/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:
DRILL RIG: DR-16
HAMMER ID:

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Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		ST-74	63%			377.0-415.5 ft Silty sand, 70% sand, fine to medium, subrounded; 30% fines, low plasticity, low toughness; pale olive (10Y 6/2) and very light gray (N8), moist, strong HCl reaction, weak cementation, Sand/silt ratio varies from 80/20 to 60/40. [Peace River Formation] with layers of lean clay with sand/silt with sand, 80% fines, medium plasticity; 20% sand, fine; 0% gravel; medium stiff to stiff consistency, Clay layers exist as lenses. [Peace River Formation]	SP-SM	
-381.0	381.0							
-382.0	382.0							
-383.0	383.0	ST-75	81%					
-384.0	384.0							
-385.0	385.0							
-386.0	386.0	ST-76	56%					
-387.0	387.0	S-43	45-50/2 N1(50/2) 100%					
-388.0	388.0							
-389.0	389.0	ST-77	63%					
-390.0	390.0						sm	
-391.0	391.0							
-392.0	392.0	ST-78	56%					
-393.0	393.0							
-394.0	394.0	ST-79	89%					
-395.0	395.0							
-396.0	396.0	S-44	25-50/5 N1(50/5) 89%					
-397.0	397.0							
-398.0	398.0	ST-80	81%					
-399.0	399.0							
		ST-81	52%					

DATE STARTED: 9/11/13
DATE FINISHED: 10/4/13
FIELD GEOLOGIST: Jason Lee
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DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
NOTES:

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COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-401.0	401.0	ST-81	52%			377.0-415.5 ft Silty sand, 70% sand, fine to medium, subrounded; 30% fines, low plasticity, low toughness; pale olive (10Y 6/2) and very light gray (N8), moist, strong HCl reaction, weak cementation, Sand/silt ratio varies from 80/20 to 60/40. [Peace River Formation] with layers of lean clay with sand/silt with sand, 80% fines, medium plasticity; 20% sand, fine; 0% gravel; medium stiff to stiff consistency, Clay layers exist as lenses. [Peace River Formation]	SM	
-402.0	402.0							
-403.0	403.0	ST-82	70%					
-404.0	404.0							
-405.0	405.0	S-45	50/5 N1(50/5) 100%					
-406.0	406.0							
-407.0	407.0	ST-83	74%					
-408.0	408.0						sm	
-409.0	409.0	ST-84	85%					
-410.0	410.0							
-411.0	411.0							
-412.0	412.0	ST-85	78%					
-413.0	413.0							
-414.0	414.0	S-46	21-50/5 N1(50/5) 100%					
-415.0	415.0							
-416.0	416.0	ST-86	93%			415.5-458.0 ft Silty sand, 70% sand, fine to medium, subrounded; 30% fines, low plasticity, low toughness; light olive gray (5Y 5/2) and very light gray (N8), moist, strong HCl reaction, weak cementation, Sand/silt ratio varies from 80/20 to 70/30. [Peace River Formation] with layers of lean clay with sand/silt with sand, 80% fines, medium plasticity; 20% sand, fine; 0% gravel; medium stiff to stiff consistency, Clay layers exist as lenses. [Peace River Formation]		
-417.0	417.0							
-418.0	418.0	ST-87	85%				sm	
-419.0	419.0							
		ST-88						

DATE STARTED: 9/11/13
DATE FINISHED: 10/4/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
NOTES:
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DRILLER: Eddie Palmer
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Boring R-6-1b

PROJECT: Turkey Point Units 6 and 7 Site
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COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-421.0	421.0	ST-88	93%			415.5-458.0 ft Silty sand, 70% sand, fine to medium, subrounded; 30% fines, low plasticity, low toughness; light olive gray (5Y 5/2) and very light gray (N8), moist, strong HCl reaction, weak cementation, Sand/silt ratio varies from 80/20 to 70/30. [Peace River Formation] with layers of lean clay with sand/silt with sand, 80% fines, medium plasticity; 20% sand, fine; 0% gravel; medium stiff to stiff consistency, Clay layers exist as lenses. [Peace River Formation]	SP-SM	
-422.0	422.0	S-47	44-50/4 N1(50/4) 88%					
-423.0	423.0							
-424.0	424.0	ST-89	89%					
-425.0	425.0							
-426.0	426.0							
-427.0	427.0	ST-90	96%					
-428.0	428.0							
-429.0	429.0	ST-91	96%					
-430.0	430.0						sm	
-431.0	431.0	S-48	32-50/4 N1(50/4) 88%					
-432.0	432.0							
-433.0	433.0	ST-92	63%					
-434.0	434.0							
-435.0	435.0							
-436.0	436.0	ST-93	85%					
-437.0	437.0							
-438.0	438.0							
-439.0	439.0	ST-94	89%					

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COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		S-49	50 100%			415.5-458.0 ft Silty sand, 70% sand, fine to medium, subrounded; 30% fines, low plasticity, low toughness; light olive gray (5Y 5/2) and very light gray (N8), moist, strong HCl reaction, weak cementation, Sand/silt ratio varies from 80/20 to 70/30. [Peace River Formation] with layers of lean clay with sand/silt with sand, 80% fines, medium plasticity; 20% sand, fine; 0% gravel; medium stiff to stiff consistency, Clay layers exist as lenses. [Peace River Formation]		
-441.0	441.0							
-442.0	442.0	ST-95	100%					
-443.0	443.0							
-444.0	444.0							
-445.0	445.0	ST-96	81%					
-446.0	446.0							
-447.0	447.0	ST-97	78%				SM	
-448.0	448.0							
-449.0	449.0	S-50	16-40-50/5 N1(50/5) 100%				sm	
-450.0	450.0							
-451.0	451.0	ST-98	52%					
-452.0	452.0							
-453.0	453.0							
-454.0	454.0	ST-99	89%					
-455.0	455.0							
-456.0	456.0							
-457.0	457.0	ST-100	70%			457.0-458.0 ft Grades to Dolomitic starting at approximately 457.0ft depth.		
-458.0	458.0							
-459.0	459.0	S-51	20-32-44-50/5 N1(76) N2(50/5) 89%				sm	

DATE STARTED: 9/11/13
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DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
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PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.10 ft E. 876609.04 ft
GROUND SURFACE ELEVATION: -0.03 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-461.0	461.0	ST-101	52%			458.0-461.3 ft Silty sand, 70% sand, fine to medium, subrounded; 30% fines, low plasticity, low toughness; pale olive (10Y 6/2) with very light gray (N8), moist, weak HCl reaction, weak cementation, Dolomitic. [Arcadia Formation]	sm	
-462.0	462.0					with layers of lean clay with sand/silt with sand, 80% fines, medium plasticity; 20% sand, fine; 0% gravel; medium stiff to stiff consistency, Clay layers exist as lenses.	sm	
-463.0	463.0	ST-102	93%			461.3-463.4 ft Silty sand with gravel, 60% sand, fine to coarse; 30% fines, low plasticity; 10% gravel, fine, subrounded, hard hardness; greenish black (5GY 2/1), weak HCl reaction, weak cementation, [Arcadia Formation]		
-464.0	464.0					463.4-464.1 ft GRAINSTONE, dolomitic, moderately hard (H4) to moderately soft (H5), moderately (W5) weathered, clay to very fine sand particles, brownish gray (5YR 4/1), weak reaction to HCl, HCL reaction is delayed. Moldic porosity. Layer contains clay lenses/nodules with medium plasticity, low toughness, dry. Color is light olive gray (5Y 5/2). Contains trace amount of fine grained sand. [Arcadia Formation]		

---- Bottom of Boring at 464.10 ft.----

DATE STARTED: 9/11/13
DATE FINISHED: 10/4/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-16
HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

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500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
www.rizzoassoc.com

Boring R-6-2

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396967.24 ft E. 876648.22 ft
GROUND SURFACE ELEVATION: -0.06 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-1.0 to -2.0	0.0-2.17					0.0-2.17 ft Road base layer.		0 - 2.17 ft, destructively drilled using (2 7/8 inch and 2 15/16 inch) mud rotary bits. Measured water level varied within one foot of ground surface. 2.17 - 8.17 ft., SPT sampling.
-3.0 to -4.0	2.17-4.17		1-1-0-1 N1(1) N2(1) 0%			2.17-4.17 ft Very soft consistency, (MUCK) Sample not recovered.		
-5.0	4.17-5.8	S-1	1-1-2-4 N1(3) N2(6) 55%			4.17-5.8 ft Silty sand with gravel, 60% sand, fine to coarse, angular, spherical, soft; 25% fines, non plastic, low dry strength; 15% gravel, fine, angular, spherical, soft hardness; maximum grain size = 0.75 in., very pale orange (10YR 8/2) to yellowish gray (5Y 7/2), no odor, wet, strong HCl reaction, very loose consistency, trace roots	sm	
-6.0	5.8-6.17					5.8-6.17 ft Organic soil, 95% fines, medium plasticity; 5% sand, fine; grayish brown (5YR 3/2) to very dusky red (10R 2/2), organic odor, wet, strong HCl reaction, plasic consistency, peat is more spongy than fibrous, trace amount of very fine sand.	ol/oh	
-7.0	6.17-7.17	S-2	7-7-8-7 N1(15) N2(15) 75%			6.17-7.17 ft Silty sand with gravel, 50% sand, fine to coarse, angular, spherical, medium; 25% gravel, fine to medium, angular, spherical, medium hardness; 25% fines, non plastic, no dry strength; maximum grain size = 1.0 in., very pale orange (10YR 8/2) to yellowish gray (5Y 7/2), no odor, wet, strong HCl reaction, medium dense consistency, trace roots, [Miami Limestone]	sm	
-8.0	7.17-8.17					7.17-8.17 ft Silty sand with gravel, 45% sand, fine to coarse, angular, spherical, medium; 30% gravel, fine to medium, angular, spherical, soft hardness; 25% fines, non plastic; maximum grain size = 1.25 in., very pale orange (10YR 8/2), no odor, wet, strong HCl reaction, medium dense consistency, trace roots, [Miami Limestone]	sm	
-9.0 to -19.0	8.17-46.0					8.17-46.0 ft No Sample Recovered.		8.17 - 46.0 ft, destructively drilled using (2 7/8 inch and 2 15/16 inch) mud rotary bits.

Depth scale: 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 14.0, 15.0, 16.0, 17.0, 18.0, 19.0
Elevation scale: -1.0, -2.0, -3.0, -4.0, -5.0, -6.0, -7.0, -8.0, -9.0, -10.0, -11.0, -12.0, -13.0, -14.0, -15.0, -16.0, -17.0, -18.0, -19.0

DATE STARTED: 8/13/13
DATE FINISHED: 9/10/13
FIELD GEOLOGIST: Rolando Benitez
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-18
HAMMER ID:

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Boring R-6-2

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396967.24 ft E. 876648.22 ft
GROUND SURFACE ELEVATION: -0.06 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
						8.17-46.0 ft No Sample Recovered.		
-21.0	21.0							
-22.0	22.0							
-23.0	23.0							
-24.0	24.0							
-25.0	25.0							From 25.0 - 27.0 ft, loss of circulation.
-26.0	26.0							
-27.0	27.0							
-28.0	28.0							
-29.0	29.0							
-30.0	30.0							
-31.0	31.0							
-32.0	32.0							
-33.0	33.0							
-34.0	34.0							
-35.0	35.0							
-36.0	36.0							
-37.0	37.0							
-38.0	38.0							
-39.0	39.0							

DATE STARTED: 8/13/13
DATE FINISHED: 9/10/13
FIELD GEOLOGIST: Rolando Benitez
CHECKED BY: Rolando Benitez
DRILLING METHOD: Mud Rotary, PQ, SPT, NWD4
DRILLING CO. Huss Drilling
NOTES:
APPROVED BY: EOT
DRILLER: Eddie Palmer
DRILL RIG: DR-18
HAMMER ID:

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Boring R-6-2

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396967.24 ft E. 876648.22 ft
GROUND SURFACE ELEVATION: -0.06 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-41.0 to -46.0	41.0 to 46.0					8.17-46.0 ft No Sample Recovered.		
-46.0 to -48.0	46.0 to 48.0	R-1	76% (66%)	FD1		46.0-48.0 ft BOUNDSTONE, clastic, moderately hard, moderately weathered, very fine sand to silt particles, vuggy to pitted, typical diameter: 0.25 in., max size: 1.0 in., very light gray (N8) to light gray (N7), strong reaction to HCl, wet, Calcareous. [Key Largo Limestone]		46.0 - 112.0 ft., A combination of destructive drilling using (2 7/8 inch and 2 15/16 inch) mud rotary bits and NWD4 conventional coring were used to create pockets for pressuremeter testing.
-48.0 to -51.0	48.0 to 51.0					48.0-51.0 ft GRAINSTONE, fossiliferous, moderately hard to hard, moderately weathered, fine sand to silt particles, pitted, typical diameter: 0.20 in., max size: 0.5 in., very light gray (N8) to light gray (N7), very widely fractured, R.D. = 0° to 45°, strong reaction to HCl, wet, Calcareous, abundant moldic porosity. Fractures are healed. [Fort Thompson Formation]		
-51.0 to -56.0	51.0 to 56.0	R-2	86% (76%)			51.0-61.5 ft GRAINSTONE, fossiliferous, moderately soft to moderately hard, moderately to intensely weathered, fine sand to silt particles, pitted, typical diameter: 0.20 in., max size: 0.4 in., white (N9) to very light gray (N8), strong reaction to HCl, wet, Calcareous, abundant moldic porosity. [Fort Thompson Formation]		
-56.0 to -59.0	56.0 to 59.0	R-3	66% (38%)					Tool drop from 56.5 to 57.0 ft.

DATE STARTED: 8/13/13
DATE FINISHED: 9/10/13
FIELD GEOLOGIST: Rolando Benitez
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DRILLING METHOD: Mud Rotary, PQ, SPT, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

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Boring R-6-2

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396967.24 ft E. 876648.22 ft
GROUND SURFACE ELEVATION: -0.06 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		R-3						
-61.0	61.0							Softer material throughout core run R-4 (61 - 66 ft).
-62.0 to -66.0	62.0 to 66.0	R-4	38% (0%)			61.5-66.0 ft GRAINSTONE, fossiliferous, moderately soft, moderately to intensely weathered, fine sand to silt particles, pitted, typical diameter: 0.1 in., max size: 0.5 in., white (N9) to very light gray (N8), strong reaction to HCl, wet, Calcareous, abundant moldic porosity. Softer than upper layer; recovered mostly as loose medium gravel fragments. [Fort Thompson Formation]		
-66.0 to -70.0	66.0 to 70.0					66.0-70.0 ft No Sample Recovered.		
-70.0 to -75.0	70.0 to 75.0	R-5	30% (14%)			70.0-75.0 ft GRAINSTONE, fossiliferous, moderately soft, moderately to intensely weathered, fine sand to silt particles, pitted, typical diameter: 0.2 in., max size: 0.5 in., white (N9) to very light gray (N8), strong reaction to HCl, wet, Calcareous, abundant moldic porosity. Recovered mostly as short pieces of core and loose medium gravel fragments [Fort Thompson Formation]		
-75.0 to -79.0	75.0 to 79.0					75.0-80.0 ft No Sample Recovered.		

DATE STARTED: 8/13/13
DATE FINISHED: 9/10/13
FIELD GEOLOGIST: Rolando Benitez
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DRILLING METHOD: Mud Rotary, PQ, SPT, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:
DRILL RIG: DR-18
HAMMER ID:

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Boring R-6-2

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396967.24 ft E. 876648.22 ft
GROUND SURFACE ELEVATION: -0.06 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-81.0	81.0					80.0-85.0 ft GRAINSTONE, fossiliferous, moderately soft, moderately to intensely weathered, medium sand to very fine sand particles, pitted, typical diameter: 0.1 in., max size: 0.4 in., white (N9) to very light gray (N8), strong reaction to HCl, wet, Calcareous, abundant moldic porosity. Recovered mostly as medium gravel fragments [Fort Thompson Formation]		
-82.0	82.0	R-6	8% (0%)					
-83.0	83.0							
-84.0	84.0							
-85.0	85.0					85.0-100.0 ft No Sample Recovered.		
-86.0	86.0							
-87.0	87.0							
-88.0	88.0							
-89.0	89.0							
-90.0	90.0							
-91.0	91.0							
-92.0	92.0							
-93.0	93.0							
-94.0	94.0							
-95.0	95.0							
-96.0	96.0							
-97.0	97.0							
-98.0	98.0							
-99.0	99.0							

DATE STARTED: 8/13/13
DATE FINISHED: 9/10/13
FIELD GEOLOGIST: Rolando Benitez
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-18
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Boring R-6-2

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396967.24 ft E. 876648.22 ft
GROUND SURFACE ELEVATION: -0.06 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
						100.0-112.0 ft GRAINSTONE, fossiliferous, moderately soft, moderately to intensely weathered, medium sand to very fine sand particles, pitted, typical diameter: 0.1 in., max size: 0.4 in., white (N9) to very light gray (N8), strong reaction to HCl, wet, Calcareous, abundant moldic porosity. [Fort Thompson Formation]		
-101.0	101.0							
-102.0	102.0							
-103.0	103.0							
-104.0	104.0							
-105.0	105.0	R-7	17% (4%)					
-106.0	106.0							
-107.0	107.0							
-108.0	108.0							
-109.0	109.0							
-110.0	110.0							Bottom of coring at 112.0ft. Boring continues to 360.0ft, and was destructively drilled alternating between (2 7/8 inch and 2 15/16 inch) mud rotary bits to accomodate pressuremeter testing pocket drilling.
-111.0	111.0	R-8	0% (0%)					
-112.0	112.0					---- Bottom of Boring at 112.00 ft.----		

DATE STARTED: 8/13/13
DATE FINISHED: 9/10/13
FIELD GEOLOGIST: Rolando Benitez
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-18
HAMMER ID:

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500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
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Boring R-7-1

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396976.23 ft E. 875797.30 ft
GROUND SURFACE ELEVATION: 0.22 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	DESCRIPTION	USCS SYMBOL	REMARKS
0.0 to -1.3	0.0-1.5				0.0-1.5 ft Road base layer.		Measured water level varied within one foot of ground surface. Boring was destructively drilled using a 5 inch mud rotary bit from 0 - 5 ft.
-1.3 to -5.8	1.5-6.0				1.5-6.0 ft Muck (Soft zone to 6ft depth).		5.0 - 120.2 ft., PQ wireline coring.
		R-1	75% (39%)	FD0	6.0-30.5 ft PACKSTONE, sandy, moderately soft to soft, moderately weathered, fine sand to cobble particles, pitted to vuggy, max size: 1 in., yellowish gray (5Y 8/1) with medium gray (N5), weak reaction to HCl, lower contact is gradational, Interval from 17.0 - 18.5ft contains higher void density. Grades to Key Largo Limestone from 25.7 to 30.5ft. Grain supported. Intervals with pockets of sand. [Miami Limestone]		
		R-2	100% (43%)				
		R-3	59% (0%)				Lost circulation at 13.0 ft, increased approximately 70% return after drilling a few more feet.
		R-4	100% (100%)				(Special care sample) SC-1: 13.7-14.3ft.
		R-5	88% (66%)				

DATE STARTED: 8/20/13
DATE FINISHED: 9/6/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-16
HAMMER ID:

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Boring R-7-1

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396976.23 ft E. 875797.30 ft
GROUND SURFACE ELEVATION: 0.22 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-20.0								
-21.0	21.0					6.0-30.5 ft PACKSTONE, sandy, moderately soft to soft, moderately weathered, fine sand to cobble particles, pitted to vuggy, max size: 1 in., yellowish gray (5Y 8/1) with medium gray (N5), weak reaction to HCl, lower contact is gradational, Interval from 17.0 - 18.5ft contains higher void density. Grades to Key Largo Limestone from 25.7 to 30.5ft. Grain supported. Intervals with pockets of sand. [Miami Limestone]		
-22.0	22.0	R-6	0% (0%)					
-23.0	23.0							
-24.0	24.0			FD0				
-25.0	25.0	R-7	100% (0%)					Lost circulation 25.5 - 28ft.
-26.0	26.0	R-8	60% (0%)					
-27.0	27.0							
-28.0	28.0	R-9	100% (40%)	FD1		28.2-29.2 ft Joint, R.D. = 90°; filling: totally healed, slightly weathered, moderately soft; surface: moderately rough, undulating, slightly weathered.		
-29.0	29.0							
-30.0	30.0	R-10	95% (20%)					
-31.0	31.0					30.5-37.9 ft BOUNDSTONE, moderately hard, moderately weathered, pitted to vuggy, max size: 2 in., yellowish gray (5Y 8/1) with medium dark gray (N4), strong reaction to HCl, Coral clasts, upper contact is gradational, void surfaces covered by recrystallized calcite. [Key Largo Limestone]		
-32.0	32.0							
-33.0	33.0	R-11	88% (63%)					
-34.0	34.0			FD0				
-35.0	35.0							
-36.0	36.0							
-37.0	37.0	R-12	90% (50%)					SC-2: 37.5-37.9ft.
-38.0	38.0							
-39.0	39.0							

DATE STARTED: 8/20/13
DATE FINISHED: 9/6/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:
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Boring R-7-1

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396976.23 ft E. 875797.30 ft
GROUND SURFACE ELEVATION: 0.22 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-40.0 to -47.9	40.2 to 48.1	R-13	100% (98%)			37.9-47.7 ft PACKSTONE, calcareous, moderately hard to hard, slightly (W3) weathered to moderately (W5) weathered, pitted to vuggy, typical diameter: 0.4 in., yellowish gray (5Y 8/1) with moderate yellow (5Y 7/6), strong reaction to HCl, Void surfaces covered by recrystallized calcite. Sandy,soft interval from 47.4 to 49.0ft, core mostly recovered as gravel fragments due to mechanical breakage during drilling. [Key Largo Limestone]		SC-3: 40.1 - 41.0ft.
		R-14	97% (80%)					SC-4: 46.9 to 47.7ft. Softer material, 47.4-47.9ft.
-47.9 to -57.9	48.1 to 58.1	R-15	100% (60%)	FD0		47.7-57.7 ft PACKSTONE, calcareous, moderately hard, slightly weathered, pitted to vuggy, max size: 0.7 in., white (N9) to light gray (N7), weak reaction to HCl, At 56ft, oolitic fossils seen in core. Interval from 50.5 - 51.6ft is Grainstone. [Fort Thompson Formation]		
		R-16	100% (100%)					SC-5: 53.7-55.0ft.
		R-17	100% (100%)					
		R-18						

Elevation scale: -40.0, -41.0, -42.0, -43.0, -44.0, -45.0, -46.0, -47.0, -48.0, -49.0, -50.0, -51.0, -52.0, -53.0, -54.0, -55.0, -56.0, -57.0, -58.0, -59.0
Depth scale: 41.0, 42.0, 43.0, 44.0, 45.0, 46.0, 47.0, 48.0, 49.0, 50.0, 51.0, 52.0, 53.0, 54.0, 55.0, 56.0, 57.0, 58.0, 59.0

DATE STARTED: 8/20/13
DATE FINISHED: 9/6/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
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Boring R-7-1

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396976.23 ft E. 875797.30 ft
GROUND SURFACE ELEVATION: 0.22 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-60.0 to -66.5	60.2–66.5	R-18	100% (96%)			57.7-66.5 ft GRAINSTONE, calcareous, moderately hard to hard, slightly weathered, very fine sand particles, vuggy, light gray (N7), weak reaction to HCl, Angular quartz grains present, approximately 40% [Fort Thompson Formation] interbedded with GRAINSTONE, calcareous, moderately hard to moderately soft, moderately weathered, light gray (N7), weak reaction to HCl, [Fort Thompson Formation]		
		R-19	97% (97%)					
-66.5 to -79.0	66.5–79.0	R-20	52% (30%)	FD0		66.5-79.0 ft PACKSTONE, calcareous, moderately soft, slightly to moderately weathered, fine sand particles, pitted to vuggy, white (N9), strong reaction to HCl, [Fort Thompson Formation] interbedded with GRAINSTONE, calcareous, soft, moderately weathered, white (N9), weak reaction to HCl, Some core intervals are recovered as gravel sized fragments from mechanical breakage during drilling. [Fort Thompson Formation]		
		R-21	70% (45%)					
		R-22	100% (90%)					
		R-23	100% (63%)					
		R-24	100% (92%)					SC-6: 74.3-75.0ft.
		R-25	100% (100%)					
		R-26	100%					

DATE STARTED: 8/20/13
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FIELD GEOLOGIST: Jason Lee
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DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
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Boring R-7-1

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396976.23 ft E. 875797.30 ft
GROUND SURFACE ELEVATION: 0.22 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-80.0			(87%)					
-81.0	81.0	R-26	100% (87%)			79.0-83.3 ft GRAINSTONE, calcareous, moderately soft, moderately weathered, very fine sand to fine sand particles, pitted to vuggy, light gray (N7) to very light gray (N8), strong reaction to HCl, Average shell clast size decreases compared to above layers [Fort Thompson Formation]		
-82.0	82.0							
-83.0	83.0	R-27	87% (73%)					
-84.0	84.0					83.3-93.0 ft PACKSTONE, calcareous, moderately soft to moderately hard, slightly to moderately weathered, very fine sand to fine sand particles, vuggy, light gray (N7) to very light gray (N8), strong reaction to HCl, [Fort Thompson Formation] with layers of GRAINSTONE, calcareous, moderately soft to soft, moderately weathered, very fine sand to fine sand particles, light gray (N7) to very light gray (N8), strong reaction to HCl, [Fort Thompson Formation]		SC-7: 84.1-85.0ft.
-85.0	85.0							
-86.0	86.0							
-87.0	87.0	R-28	88% (64%)					
-88.0	88.0							
-89.0	89.0							
-90.0	90.0			FD0				
-91.0	91.0	R-29	93% (93%)					
-92.0	92.0							
-93.0	93.0							
-94.0	94.0	R-30	50% (0%)			93.0-101.0 ft GRAINSTONE, calcareous, soft (H6) to moderately soft (H5), moderately (W5) weathered, fine sand to medium sand particles, vuggy, very light gray (N8), strong reaction to HCl, Zones of unconsolidated fine sand infilling of voids [Fort Thompson Formation]		
-95.0	95.0	R-31	87% (0%)					
-96.0	96.0							
-97.0	97.0							
-98.0	98.0	R-32	69% (31%)					
-99.0	99.0							

DATE STARTED: 8/20/13
DATE FINISHED: 9/6/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-16
HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

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GROUND SURFACE ELEVATION: 0.22 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	DESCRIPTION	USCS SYMBOL	REMARKS
-100.0							
-101.0	101.0	R-33	80% (35%)		101.0-115.0 ft GRAINSTONE, calcareous, moderately soft (H5), slightly (W3) weathered to moderately (W5) weathered, fine sand to medium sand particles, pitted to vuggy, max size: 1.5 in., light gray (N7) to very light gray (N8), strong reaction to HCl, [Fort Thompson Formation]		
-102.0	102.0						
-103.0	103.0	R-34	80% (80%)				SC-8: 102.5-103.5ft.
-104.0	104.0	R-35	90% (90%)				
-105.0	105.0						
-106.0	106.0						
-107.0	107.0	R-36	98% (98%)				
-108.0	108.0						
-109.0	109.0			FD0			
-110.0	110.0						
-111.0	111.0	R-37	100% (76%)				
-112.0	112.0						SC-9: 111.5-112.2ft.
-113.0	113.0						
-114.0	114.0	R-38	95% (76%)				
-115.0	115.0				115.0-118.7 ft WACKESTONE, calcareous, moderately soft (H5), slightly (W3) weathered to moderately (W5) weathered, fine sand particles, pitted to vuggy, max size: 1 in., strong reaction to HCl, [Fort Thompson Formation]		
-116.0	116.0						
-117.0	117.0	R-39	38% (28%)				
-118.0	118.0						
-119.0	119.0					sm	

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COORDINATES
N. 396976.23 ft E. 875797.30 ft
GROUND SURFACE ELEVATION: 0.22 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-120.0 to -131.0	121.0–131.0	S-1	21-17-6-7 N1(23) N2(13) 100%			118.7-131.0 ft Silty sand, 80% sand, fine to medium, subrounded, flat and elongated; 20% fines, low plasticity; yellowish gray (5Y 7/2), wet, strong HCl reaction, medium dense consistency, weak cementation, trace rock fragments, may be caved in material that fell in boring while tripping in/out of boring. [Upper Tamiami Formation]	sm	From 120.2 ft. to total depth, a combination of ST and SPT sampling, and destructive over-drilling with a 5 inch mud rotary bit were used. Intervals not sampled were drilled destructively using a 5 inch mud rotary bit.
		ST-1a	0%					ST-1a: 125 - 127.7ft, no recovery
		ST-1b	0%					ST-1b: 127.7 - 130.4ft, no recovery
-131.0 to -139.0	131.0–139.0	S-2	8-6-9-14 N1(15) N2(23) 90%			131.0-161.0 ft SILTY SAND, fine to medium, subrounded; 70% sand, fine, rounded, flat and elongated; 30% fines, low plasticity, low toughness; light olive gray (5Y 5/2), moist, weak HCl reaction, dense consistency, weak cementation, trace shells, delayed very weak HCl reaction, Sand/Fines ratio varies from 80/20 to 60/40. [Upper Tamiami Formation]	SM	
		ST-1	63%					
		S-3	9-15-18-25 N1(33) N2(43)					

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PROJECT: Turkey Point Units 6 and 7 Site
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COORDINATES
N. 396976.23 ft E. 875797.30 ft
GROUND SURFACE ELEVATION: 0.22 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-140.0		S-3	90%			131.0-161.0 ft SILTY SAND, fine to medium, subrounded; 70% sand, fine, rounded, flat and elongated; 30% fines, low plasticity, low toughness; light olive gray (5Y 5/2), moist, weak HCl reaction, dense consistency, weak cementation, trace shells, delayed very weak HCl reaction, Sand/Fines ratio varies from 80/20 to 60/40. [Upper Tamiami Formation]		
-141.0	141.0							
-142.0	142.0							
-143.0	143.0							
-144.0	144.0							
-145.0	145.0							
-146.0	146.0	S-4	8-14-22-34 N1(36) N2(56) 100%					
-147.0	147.0							
-148.0	148.0							
-149.0	149.0							
-150.0	150.0						SM	Trouble cleaning boring between 150-160ft. Material is caving in at the bottom of installed casing, at approximately 120ft.
-151.0	151.0	ST-2a	0%					
-152.0	152.0							
-153.0	153.0							
-154.0	154.0	S-5	7-8-17-21 N1(25) N2(38) 100%					
-155.0	155.0							
-156.0	156.0							
-157.0	157.0							
-158.0	158.0							
-159.0	159.0	ST-2	93%				ML	

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COORDINATES
N. 396976.23 ft E. 875797.30 ft
GROUND SURFACE ELEVATION: 0.22 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-160.0		ST-2					SM	
-161.0	161.0							
-162.0	162.0	S-6	6-8-14-33 N1(22) N2(47) 100%			161.0-215.0 ft SILT WITH SAND, 80% fines, medium plasticity, low toughness; 20% sand, fine, subrounded; grayish olive (10Y 4/2), moist, weak HCl reaction, medium stiff to stiff consistency, weak cementation, little shells, Plasticity and silt content increases with depth. [Lower Tamiami Formation]		
-163.0	163.0							
-164.0	164.0							
-165.0	165.0							
-166.0	166.0							
-167.0	167.0	ST-3a	0%					
-168.0	168.0							
-169.0	169.0							
-170.0	170.0	ST-3b	0%				ML	
-171.0	171.0							
-172.0	172.0							
-173.0	173.0	S-7	4-4-10-33 N1(14) N2(43) 100%					
-174.0	174.0							
-175.0	175.0							
-176.0	176.0							
-177.0	177.0							
-178.0	178.0							
-179.0	179.0							

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-180.0								
-181.0	181.0	S-8	4-8-13-32 N1(21) N2(45) 100%			161.0-215.0 ft SILT WITH SAND, 80% fines, medium plasticity, low toughness; 20% sand, fine, subrounded; grayish olive (10Y 4/2), moist, weak HCl reaction, medium stiff to stiff consistency, weak cementation, little shells, Placticity and silt content increases with depth. [Lower Tamiami Formation]		
-182.0	182.0							
-183.0	183.0							
-184.0	184.0							
-185.0	185.0							
-186.0	186.0	ST-3	40%					
-187.0	187.0							
-188.0	188.0							
-189.0	189.0	ST-4	100%					
-190.0	190.0						ML	
-191.0	191.0	S-9	2-5-10-34 N1(15) N2(44) 100%					
-192.0	192.0							
-193.0	193.0							
-194.0	194.0							
-195.0	195.0							
-196.0	196.0							
-197.0	197.0							
-198.0	198.0							
-199.0	199.0	S-10	3-6-14-37 N1(20) N2(51)					

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-200.0 to -215.0	200.0–215.0	S-10	100%			161.0-215.0 ft SILT WITH SAND, 80% fines, medium plasticity, low toughness; 20% sand, fine, subrounded; grayish olive (10Y 4/2), moist, weak HCl reaction, medium stiff to stiff consistency, weak cementation, little shells, Placticity and silt content increases with depth. [Lower Tamiami Formation]	ML	
	203.0–205.7	ST-5a	0%					ST-5a: 203.0 - 205.7ft, Shelby tube was damaged during sampling. Tube had to be retrieved with a screw wedge. No recovery in tube, boring was cleaned prior to attempting another sample.
	206.0–208.7	ST-5	100%					
	208.7–210.7	S-11	5-6-14-49 N1(20) N2(63) 100%					
-215.0 to -219.0	215.0–219.0					215.0-223.7 ft SILTY SAND, 80% sand, fine to medium, subrounded, flat and elongated; 20% fines, low plasticity, medium toughness; light olive gray (5Y 5/2), moist, weak HCl reaction, dense consistency, moderate cementation, [Peace River Formation]	SM	
	217.0–219.0	S-12	11-16-25-48 N1(41) N2(73) 100%					

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DRILLING CO. Huss Drilling
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-220.0 to -223.0	221.0–223.0	ST-6	93%			215.0-223.7 ft SILTY SAND, 80% sand, fine to medium, subrounded, flat and elongated; 20% fines, low plasticity, medium toughness; light olive gray (5Y 5/2), moist, weak HCl reaction, dense consistency, moderate cementation, [Peace River Formation]	SM	
-224.0 to -225.0	224.0–225.0	S-13	28-28-27-50 N1(55) N2(77) 100%			223.7-246.5 ft Sandy silt, 60% fines, low plasticity, no dilatancy, low toughness; 40% sand, fine to medium, subrounded; maximum grain size = 0.1 in., dusky yellow green (5GY 5/2), weak HCl reaction, dense consistency, weak cementation, trace gravel, [Peace River Formation]		
-226.0 to -232.0	226.0–232.0						ml	
-233.0 to -234.0	233.0–234.0	ST-7	67%				SM	
-235.0 to -236.0	235.0–236.0	S-14	10-13-21-48 N1(34) N2(69) 100%					
-237.0 to -239.0	237.0–239.0							

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-240.0						223.7-246.5 ft Sandy silt, 60% fines, low plasticity, no dilatancy, low toughness; 40% sand, fine to medium, subrounded; maximum grain size = 0.1 in., dusky yellow green (5GY 5/2), weak HCl reaction, dense consistency, weak cementation, trace gravel, [Peace River Formation]		
-241.0	241.0							
-242.0	242.0							
-243.0	243.0						ml	ST-8a, 243 - 245ft, Shelby tube was damaged during sampling. Sample is not able to be preserved. Soil will be collected from inside tube and used for index properties testing if required.
-244.0	244.0	ST-8a	53%					
-245.0	245.0	ST-8	80%				SM	
-246.0	246.0							
-247.0	247.0	S-15	18-18-27-50/5 N1(45) N2(50/5) 105%			246.5-267.25 ft SILTY SAND, 70% sand, fine to medium, subrounded; 30% fines, low plasticity, no dilatancy, low toughness; maximum grain size = 0.1 in., dusky yellow green (5GY 5/2), weak HCl reaction, dense consistency, weak cementation, trace gravel, [Peace River Formation]		
-248.0	248.0							
-249.0	249.0							
-250.0	250.0							
-251.0	251.0							
-252.0	252.0							
-253.0	253.0						SM	
-254.0	254.0							
-255.0	255.0							
-256.0	256.0	ST-9	88%				SM	
-257.0	257.0							
-258.0	258.0	S-16	11-14-20-48 N1(34) N2(68) 100%					
-259.0	259.0							

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-260.0 to -267.0	261.0–267.0					246.5-267.25 ft SILTY SAND, 70% sand, fine to medium, subrounded; 30% fines, low plasticity, no dilatancy, low toughness; maximum grain size = 0.1 in., dusky yellow green (5GY 5/2), weak HCl reaction, dense consistency, weak cementation, trace gravel, [Peace River Formation]	SM	
-267.0 to -268.0	267.0–268.0	ST-10	89%				SM	
-268.0 to -279.0	268.0–279.0	S-17	9-16-28-50 N1(44) N2(78) 100%			267.25-289.0 ft SANDY SILT, 60% fines, low plasticity, medium toughness; 40% sand, fine to medium, subrounded; dusky yellow green (5GY 5/2), dry, weak HCl reaction, medium dense consistency, weak cementation, [Peace River Formation] interbedded with sandy lean clay, 70% fines, medium plasticity; 30% sand, fine; pale olive (10Y 6/2), moist, weak HCl reaction, medium stiff consistency, weak cementation, [Peace River Formation]	ML	
		ST-11	100%					
		S-18						

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-280.0		S-18	10-23-35-50/4 N1(58) N2(50/4) 100%			267.25-289.0 ft SANDY SILT, 60% fines, low plasticity, medium toughness; 40% sand, fine to medium, subrounded; dusky yellow green (5GY 5/2), dry, weak HCl reaction, medium dense consistency, weak cementation, [Peace River Formation] interbedded with sandy lean clay, 70% fines, medium plasticity; 30% sand, fine; pale olive (10Y 6/2), moist, weak HCl reaction, medium stiff consistency, weak cementation, [Peace River Formation]	ML	
-281.0	281.0							
-282.0	282.0							
-283.0	283.0							
-284.0	284.0							
-285.0	285.0							
-286.0	286.0							
-287.0	287.0							
-288.0	288.0							
-289.0	289.0	ST-12	86%			289.0-310.1 ft SILTY SAND, 60% sand, fine to medium, subrounded; 40% fines, low plasticity, medium toughness; dusky yellow green (5GY 5/2), dry, weak HCl reaction, medium dense consistency, weak cementation, [Peace River Formation] interbedded with sandy lean clay, 70% fines, medium plasticity; 30% sand, fine; pale olive (10Y 6/2), moist, weak HCl reaction, medium stiff consistency, weak cementation, [Peace River Formation]	SM	
-290.0	290.0							
-291.0	291.0	S-19	14-29-48-50/3 N1(77) N2(50/3) 100%					
-292.0	292.0							
-293.0	293.0							
-294.0	294.0						SM	
-295.0	295.0							
-296.0	296.0							
-297.0	297.0							
-298.0	298.0							
-299.0	299.0	ST-13	100%					

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ENGINEERS/CONSULTANTS/CM

Paul C. Rizzo Associates, Inc
500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
www.rizzoassoc.com

Boring R-7-1

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396976.23 ft E. 875797.30 ft
GROUND SURFACE ELEVATION: 0.22 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-300.0		ST-13				289.0-310.1 ft SILTY SAND, 60% sand, fine to medium, subrounded; 40% fines, low plasticity, medium toughness; dusky yellow green (5GY 5/2), dry, weak HCl reaction, medium dense consistency, weak cementation, [Peace River Formation] interbedded with sandy lean clay, 70% fines, medium plasticity; 30% sand, fine; pale olive (10Y 6/2), moist, weak HCl reaction, medium stiff consistency, weak cementation, [Peace River Formation]	SM	
-301.0	301.0	S-20	24-38-50/5 N1(50/5) 100%					
-302.0	302.0							
-303.0	303.0							
-304.0	304.0							
-305.0	305.0							
-306.0	306.0							
-307.0	307.0							
-308.0	308.0							
-309.0	309.0							
-310.0	310.0	ST-14	95%			310.1-320.95 ft SILTY SAND, 70% sand, fine to medium, subrounded; 30% fines, low plasticity, medium toughness; dusky yellow green (5GY 5/2), dry, weak HCl reaction, medium dense consistency, weak cementation, [Peace River Formation] interbedded with sandy lean clay, 70% fines, medium plasticity; 30% sand, fine; pale olive (10Y 6/2), moist, weak HCl reaction, medium stiff consistency, weak cementation, [Peace River Formation]	SM	
-311.0	311.0							
-312.0	312.0	S-21	23-41-50/4 N1(50/4) 96%					
-313.0	313.0							
-314.0	314.0							
-315.0	315.0							
-316.0	316.0							
-317.0	317.0							
-318.0	318.0							ST-15, less than 20in. recovery.
-319.0	319.0	ST-15	71%					
		ST-16						

DATE STARTED: 8/20/13
DATE FINISHED: 9/6/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-16
HAMMER ID:

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Boring R-7-1

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396976.23 ft E. 875797.30 ft
GROUND SURFACE ELEVATION: 0.22 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-320.0							SM	
-321.0	321.0	ST-16	72%			320.95-450.5 ft Silty sand, 80% sand, fine to medium, subrounded; 20% fines, low plasticity, medium toughness; pale olive (10Y 6/2) with dusky yellow green (5GY 5/2), moist, weak HCl reaction, dense consistency, weak cementation, [Peace River Formation] interbedded with sandy lean clay, 90% fines, medium plasticity, low toughness; 10% sand, fine; 0% gravel; dusky yellow green (5GY 5/2), dry, strong HCl reaction, soft consistency, weak cementation, Exist as lenses up to 0.3ft in thickness. Some lenses contain no sand. [Peace River Formation]	SP-SM	
-322.0	322.0	S-22	50/3 N1(50/3) 100%					
-323.0	323.0							
-324.0	324.0							
-325.0	325.0							
-326.0	326.0							
-327.0	327.0							
-328.0	328.0							
-329.0	329.0	ST-17	92%				SP-SM	
-330.0	330.0	S-23	50/5 N1(50/5) 100%				sm	
-331.0	331.0							
-332.0	332.0							
-333.0	333.0							
-334.0	334.0							
-335.0	335.0							
-336.0	336.0							
-337.0	337.0							
-338.0	338.0	ST-18	85%				SP	
-339.0	339.0	S-24	50/4 N1(50/4) 100%					

DATE STARTED: 8/20/13
DATE FINISHED: 9/6/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-16
HAMMER ID:

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Boring R-7-1

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396976.23 ft E. 875797.30 ft
GROUND SURFACE ELEVATION: 0.22 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-340.0						320.95-450.5 ft Silty sand, 80% sand, fine to medium, subrounded; 20% fines, low plasticity, medium toughness; pale olive (10Y 6/2) with dusky yellow green (5GY 5/2), moist, weak HCl reaction, dense consistency, weak cementation, [Peace River Formation] interbedded with sandy lean clay, 90% fines, medium plasticity, low toughness; 10% sand, fine; 0% gravel; dusky yellow green (5GY 5/2), dry, strong HCl reaction, soft consistency, weak cementation, Exist as lenses up to 0.3ft in thickness. Some lenses contain no sand. [Peace River Formation]		
-341.0	341.0							
-342.0	342.0							
-343.0	343.0							
-344.0	344.0							
-345.0	345.0							
-346.0	346.0	ST-19	75%				SP-SM	
-347.0	347.0	S-25	49-50/4 N1(50/4) 100%					
-348.0	348.0							
-349.0	349.0							
-350.0	350.0						sm	
-351.0	351.0							
-352.0	352.0							
-353.0	353.0							
-354.0	354.0							
-355.0	355.0	ST-20	80%				SP-SM	
-356.0	356.0	S-26	50/4 N1(50/4) 100%					
-357.0	357.0							
-358.0	358.0							
-359.0	359.0							

DATE STARTED: 8/20/13
DATE FINISHED: 9/6/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-16
HAMMER ID:

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PROJECT: Turkey Point Units 6 and 7 Site
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COORDINATES
N. 396976.23 ft E. 875797.30 ft
GROUND SURFACE ELEVATION: 0.22 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-360.0						320.95-450.5 ft Silty sand, 80% sand, fine to medium, subrounded; 20% fines, low plasticity, medium toughness; pale olive (10Y 6/2) with dusky yellow green (5GY 5/2), moist, weak HCl reaction, dense consistency, weak cementation, [Peace River Formation] interbedded with sandy lean clay, 90% fines, medium plasticity, low toughness; 10% sand, fine; 0% gravel; dusky yellow green (5GY 5/2), dry, strong HCl reaction, soft consistency, weak cementation, Exist as lenses up to 0.3ft in thickness. Some lenses contain no sand. [Peace River Formation]		
-361.0	361.0							
-362.0	362.0							
-363.0	363.0							
-364.0	364.0	ST-21	64%					
-365.0	365.0	S-27	50/3 N1(50/3) 100%					
-366.0	366.0							
-367.0	367.0							
-368.0	368.0							
-369.0	369.0							
-370.0	370.0						sm	
-371.0	371.0							
-372.0	372.0							
-373.0	373.0	ST-22	68%				SP-SM	
-374.0	374.0	S-28	50/4 N1(50/4) 100%					
-375.0	375.0							
-376.0	376.0							
-377.0	377.0							
-378.0	378.0							
-379.0	379.0							

DATE STARTED: 8/20/13
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APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

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PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396976.23 ft E. 875797.30 ft
GROUND SURFACE ELEVATION: 0.22 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-380.0						320.95-450.5 ft Silty sand, 80% sand, fine to medium, subrounded; 20% fines, low plasticity, medium toughness; pale olive (10Y 6/2) with dusky yellow green (5GY 5/2), moist, weak HCl reaction, dense consistency, weak cementation, [Peace River Formation] interbedded with sandy lean clay, 90% fines, medium plasticity, low toughness; 10% sand, fine; 0% gravel; dusky yellow green (5GY 5/2), dry, strong HCl reaction, soft consistency, weak cementation, Exist as lenses up to 0.3ft in thickness. Some lenses contain no sand. [Peace River Formation]		
-381.0	381.0							
-382.0	382.0							
-383.0	383.0							
-384.0	384.0	S-29	50/5 N1(50/5) 100%					
-385.0	385.0							
-386.0	386.0							
-387.0	387.0							
-388.0	388.0							
-389.0	389.0							
-390.0	390.0						sm	
-391.0	391.0	ST-23	76%				SM	
-392.0	392.0	S-30	50/4 N1(50/4) 86%					
-393.0	393.0							
-394.0	394.0							
-395.0	395.0							
-396.0	396.0							
-397.0	397.0							
-398.0	398.0							
-399.0	399.0							

DATE STARTED: 8/20/13
DATE FINISHED: 9/6/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-16
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GROUND SURFACE ELEVATION: 0.22 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-400.0						320.95-450.5 ft Silty sand, 80% sand, fine to medium, subrounded; 20% fines, low plasticity, medium toughness; pale olive (10Y 6/2) with dusky yellow green (5GY 5/2), moist, weak HCl reaction, dense consistency, weak cementation, [Peace River Formation] interbedded with sandy lean clay, 90% fines, medium plasticity, low toughness; 10% sand, fine; 0% gravel; dusky yellow green (5GY 5/2), dry, strong HCl reaction, soft consistency, weak cementation, Exist as lenses up to 0.3ft in thickness. Some lenses contain no sand. [Peace River Formation]		
-401.0	401.0							
-402.0	402.0	S-31	39-50/3 N1(50/3) 80%					
-403.0	403.0							
-404.0	404.0							
-405.0	405.0							
-406.0	406.0							
-407.0	407.0							
-408.0	408.0							
-409.0	409.0							
-410.0	410.0	ST-24	76%				sm	
-411.0	411.0	S-32	50/5 N1(50/5) 88%					
-412.0	412.0							
-413.0	413.0							
-414.0	414.0							
-415.0	415.0							
-416.0	416.0							
-417.0	417.0							
-418.0	418.0							
-419.0	419.0							

DATE STARTED: 8/20/13
DATE FINISHED: 9/6/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
NOTES:
APPROVED BY: EOT
DRILLER: Eddie Palmer
DRILL RIG: DR-16
HAMMER ID:

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GROUND SURFACE ELEVATION: 0.22 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-420.0		S-33	50/5 N1(50/5) 100%			320.95-450.5 ft Silty sand, 80% sand, fine to medium, subrounded; 20% fines, low plasticity, medium toughness; pale olive (10Y 6/2) with dusky yellow green (5GY 5/2), moist, weak HCl reaction, dense consistency, weak cementation, [Peace River Formation] interbedded with sandy lean clay, 90% fines, medium plasticity, low toughness; 10% sand, fine; 0% gravel; dusky yellow green (5GY 5/2), dry, strong HCl reaction, soft consistency, weak cementation, Exist as lenses up to 0.3ft in thickness. Some lenses contain no sand. [Peace River Formation]		
-421.0	421.0							
-422.0	422.0							
-423.0	423.0							
-424.0	424.0							
-425.0	425.0							
-426.0	426.0							
-427.0	427.0							
-428.0	428.0							
-429.0	429.0	S-34	34-50/3 N1(50/3) 80%					
-430.0	430.0						sm	
-431.0	431.0							
-432.0	432.0							
-433.0	433.0							
-434.0	434.0							
-435.0	435.0							
-436.0	436.0							
-437.0	437.0	ST-25	73%				SP-SM	
-438.0	438.0	S-35	26-32-50/4 N1(50/4) 81%					
-439.0	439.0							

DATE STARTED: 8/20/13
DATE FINISHED: 9/6/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-16
HAMMER ID:

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PROJECT: Turkey Point Units 6 and 7 Site
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COORDINATES
N. 396976.23 ft E. 875797.30 ft
GROUND SURFACE ELEVATION: 0.22 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	DESCRIPTION	USCS SYMBOL	REMARKS
-440.0 to -450.5	440.0–450.5	S-36 (448.0–449.0)	29-50/5 N1(50/5) 95%		320.95-450.5 ft Silty sand, 80% sand, fine to medium, subrounded; 20% fines, low plasticity, medium toughness; pale olive (10Y 6/2) with dusky yellow green (5GY 5/2), moist, weak HCl reaction, dense consistency, weak cementation, [Peace River Formation] interbedded with sandy lean clay, 90% fines, medium plasticity, low toughness; 10% sand, fine; 0% gravel; dusky yellow green (5GY 5/2), dry, strong HCl reaction, soft consistency, weak cementation, Exist as lenses up to 0.3ft in thickness. Some lenses contain no sand. [Peace River Formation]	sm	
-450.5 to -458.0	450.5–458.0	R-40 (453.0–458.0)	0%		450.5-458.0 ft LIMESTONE, Description based on observation of cuttings only. Core run (R-40) yielded no recovery. Cuttings returned consisted of Shell fragments. Material in this interval is more competent than the above layers; interpreted as the Arcadia formation.		Description below 450.5ft is based on sample S-37 (458.0-459.4ft) and observations of cuttings during destructive drilling. 453-458ft., Core run using conventional NWD4 barrel. No recovery.
-458.0 to -458.4	458.0–458.4	S-37 (458.0–459.4)	12-5-50/5 N1(50/5) 71%		458.0-458.4 ft Lean clay with sand, 80% fines, medium plasticity, low toughness; 20% sand; light olive gray (5Y 5/2), weak HCl reaction, [Arcadia Formation]	cl	

DATE STARTED: 8/20/13
DATE FINISHED: 9/6/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-16
HAMMER ID:

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Boring R-7-1

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COORDINATES
N. 396976.23 ft E. 875797.30 ft
GROUND SURFACE ELEVATION: 0.22 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
						458.4-458.9 ft MUDSTONE, dolomitic, soft to moderately hard, slightly weathered, silt to very fine sand particles, weak reaction to HCl, [Arcadia Formation]		
						---- Bottom of Boring at 459.40 ft.----		

DATE STARTED: 8/20/13
DATE FINISHED: 9/6/13
FIELD GEOLOGIST: Jason Lee
CHECKED BY: Rolando Benitez
DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
NOTES:
APPROVED BY: EOT
DRILLER: Eddie Palmer
DRILL RIG: DR-16
HAMMER ID:

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Boring R-7-2

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.03 ft E. 875788.86 ft
GROUND SURFACE ELEVATION: 0.06 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
						0.0-27.0 ft No Sample Recovered.		0.0 - 27.0 ft., destructively drilled using (2 7/8 inch and 2 15/16 inch) mud rotary bits. Measured water level varied within one foot of ground surface.
-1.0	1.0							
-2.0	2.0							
-3.0	3.0							
-4.0	4.0							
-5.0	5.0							
-6.0	6.0							
-7.0	7.0							
-8.0	8.0							
-9.0	9.0							
-10.0	10.0							
-11.0	11.0							
-12.0	12.0							
-13.0	13.0							
-14.0	14.0							
-15.0	15.0							
-16.0	16.0							
-17.0	17.0							
-18.0	18.0							
-19.0	19.0							

DATE STARTED: 9/10/13
DATE FINISHED: 9/25/13
FIELD GEOLOGIST: Rolando Benitez
CHECKED BY: Rolando Benitez

DRILLING METHOD: Mud Rotary, PQ, NWD4
DRILLING CO. Huss Drilling

NOTES: Destructivey drilled and cored (NWD4 Conventional Coring) pockets for Pressuremeter testing.

APPROVED BY: EOT

DRILLER: Ben Huss

DRILL RIG: DR-18

HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

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Boring R-7-2

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.03 ft E. 875788.86 ft
GROUND SURFACE ELEVATION: 0.06 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-21.0	21.0					0.0-27.0 ft No Sample Recovered.		
-22.0	22.0							
-23.0	23.0							
-24.0	24.0							
-25.0	25.0							
-26.0	26.0							
-27.0	27.0							27.0 - 95.0 ft., a combination of destructive drilling using (2 7/8 inch and 2 15/16 inch) mud rotary bits and NWD4 conventional coring were used to create pockets for pressuremeter testing. Cored to produce a better pocket for the pressuremeter testing. Recovery and RQD not to be compared with those from PQ wireline coring.
-28.0	28.0					27.0-45.0 ft BOUNDSTONE, fossiliferous, moderately hard to moderately soft, moderately weathered, very fine sand to silt particles, pitted to vuggy, typical diameter: 0.2 in., max size: 0.8 in., very light gray (N8) to white (N9), strong reaction to HCl, wet, iron oxide staining, Calcareous. Bounstone and wackstone. [Key Largo Limestone]		
-29.0	29.0	R-1	34% (8%)					
-30.0	30.0							
-31.0	31.0							
-32.0	32.0							
-33.0	33.0							
-34.0	34.0	R-2	52% (30%)					
-35.0	35.0					35- ft R.D. = 0°, moderately spaced, slightly open; wet with seepage, filling: not healed, thin calcite, fresh, moderately soft; surface: rough, planar, fresh, moderately hard; Coated with recrystallized calcite.		
-36.0	36.0					36-42 ft R.D. = 60°, widely to moderately spaced, slightly open; wet with seepage, filling: not healed, thin calcite, fresh, moderately soft; surface: rough, planar, fresh, moderately hard; Coated with recrystallized calcite.		
-37.0	37.0			FD4				
-38.0	38.0	R-3	62% (16%)					
-39.0	39.0							

DATE STARTED: 9/10/13
DATE FINISHED: 9/25/13
FIELD GEOLOGIST: Rolando Benitez
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, NWD4
DRILLING CO. Huss Drilling
DRILLER: Ben Huss

NOTES: Destructivey drilled and cored (NWD4 Conventional Coring) pockets for Pressuremeter testing.
DRILL RIG: DR-18
HAMMER ID:

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ENGINEERS/CONSULTANTS/CM

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Boring R-7-2

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.03 ft E. 875788.86 ft
GROUND SURFACE ELEVATION: 0.06 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-41.0	41.0	R-3	62% (16%)	FD4		27.0-45.0 ft BOUNDSTONE, fossiliferous, moderately hard to moderately soft, moderately weathered, very fine sand to silt particles, pitted to vuggy, typical diameter: 0.2 in., max size: 0.8 in., very light gray (N8) to white (N9), strong reaction to HCl, wet, iron oxide staining, Calcareous. Bounstone and wackstone. [Key Largo Limestone]		
-42.0	42.0							
-43.0	43.0							
-44.0	44.0							
-45.0	45.0	R-4	57% (30%)			45.0-51.5 ft PACKSTONE, fossiliferous, moderately hard to moderately soft, moderately weathered, silt to granule particles, pitted to vuggy, typical diameter: 0.3 in., max size: 1.0 in., very light gray (N8) and pale greenish yellow (10Y 8/2), strong reaction to HCl, wet, iron oxide staining, Calcareous. Abundant moldic porosity. Most vugs are a result of this moldic porosity. From 45 to 46 ft the color is light olive gray (5G 6/1). [Fort Thompson Formation]		
-46.0	46.0							
-47.0	47.0							
-48.0	48.0							
-49.0	49.0							
-50.0	50.0	R-5	42% (32%)					
-51.0	51.0							
-52.0	52.0					51.5-58.0 ft PACKSTONE, fossiliferous, moderately hard, moderately weathered, silt to granule particles, pitted to vuggy, typical diameter: 0.01 in., max size: 0.03 in., very light gray (N8) and pale greenish yellow (10Y 8/2), strong reaction to HCl, wet, iron oxide staining, Calcareous. Abundant moldic porosity. Most vugs are a result of this moldic porosity. Packstone to grainstone. [Fort Thompson Formation]		
-53.0	53.0							
-54.0	54.0							
-55.0	55.0	R-6	76% (60%)					
-56.0	56.0							
-57.0	57.0							
-58.0	58.0					58.0-65.0 ft No Sample Recovered.		
-59.0	59.0							

DATE STARTED: 9/10/13
DATE FINISHED: 9/25/13
FIELD GEOLOGIST: Rolando Benitez
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, NWD4
DRILLING CO. Huss Drilling
DRILLER: Ben Huss

NOTES: Destructivey drilled and cored (NWD4 Conventional Coring) pockets for Pressuremeter testing.
DRILL RIG: DR-18
HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

Paul C. Rizzo Associates, Inc
500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
www.rizzoassoc.com

Boring R-7-2

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.03 ft E. 875788.86 ft
GROUND SURFACE ELEVATION: 0.06 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-61.0	61.0					58.0-65.0 ft No Sample Recovered.		
-62.0	62.0							
-63.0	63.0							
-64.0	64.0							
-65.0	65.0							
-66.0	66.0					65.0-78.0 ft PACKSTONE, fossiliferous, moderately hard, moderately weathered, silt to granule particles, pitted to vuggy, typical diameter: 0.01 in., max size: 0.03 in., very light gray (N8) and pale greenish yellow (10Y 8/2), strong reaction to HCl, wet, iron oxide staining, Calcareous. Abundant moldic porosity. Most vugs are a result of this moldic porosity. Packstone to grainstone. [Fort Thompson Formation]		Very soft material drilled between 65.5 and 67.5 ft.
-67.0	67.0	R-7	52% (10%)					
-68.0	68.0							
-69.0	69.0							
-70.0	70.0							
-71.0	71.0	R-8	27% (0%)					
-72.0	72.0							
-73.0	73.0							
-74.0	74.0							
-75.0	75.0	R-9	78% (28%)					
-76.0	76.0							
-77.0	77.0							
-78.0	78.0					78.0-90.0 ft No Sample Recovered.		
-79.0	79.0							

DATE STARTED: 9/10/13
DATE FINISHED: 9/25/13
FIELD GEOLOGIST: Rolando Benitez
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, NWD4
DRILLING CO. Huss Drilling
DRILLER: Ben Huss

NOTES: Destructivey drilled and cored (NWD4 Conventional Coring) pockets for Pressuremeter testing.
DRILL RIG: DR-18
HAMMER ID:

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Boring R-7-2

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396966.03 ft E. 875788.86 ft
GROUND SURFACE ELEVATION: 0.06 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
						78.0-90.0 ft No Sample Recovered.		
-81.0	81.0							
-82.0	82.0							
-83.0	83.0							
-84.0	84.0							
-85.0	85.0							
-86.0	86.0							
-87.0	87.0							
-88.0	88.0							
-89.0	89.0							
-90.0	90.0					90.0-95.0 ft GRAINSTONE, calcareous, soft (H6) to moderately soft (H5), moderately (W5) weathered, fine sand to medium sand particles, vuggy, very light gray (N8), strong reaction to HCl, Zones of unconsolidated fine sand infilling of voids [Fort Thompson Formation]		
-91.0	91.0							
-92.0	92.0	R-10	50% (21%)					
-93.0	93.0							Bottom of coring at 95.0ft. Boring continues to 370.0ft, and was destructively drilled alternating between (2 7/8 inch and 2 15/16 inch) mud rotary bits to accomodate pressuremeter testing pocket drilling.
-94.0	94.0							
	95.0					---- Bottom of Boring at 95.00 ft.----		

DATE STARTED: 9/10/13
DATE FINISHED: 9/25/13
FIELD GEOLOGIST: Rolando Benitez
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, NWD4
DRILLING CO. Huss Drilling
DRILLER: Ben Huss

NOTES: Destructivey drilled and cored (NWD4 Conventional Coring) pockets for Pressuremeter testing.
DRILL RIG: DR-18
HAMMER ID:

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Boring R-7-3

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396957.30 ft E. 875783.79 ft
GROUND SURFACE ELEVATION: 0.01 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
						0.0-20.0 ft No Sample recovered.		0 - 20.0 ft., destructively drilled using a mud rotary bit. Measured water level varied within one foot of ground surface.
-1.0	1.0							
-2.0	2.0							
-3.0	3.0							
-4.0	4.0							
-5.0	5.0							
-6.0	6.0							
-7.0	7.0							
-8.0	8.0							
-9.0	9.0							
-10.0	10.0							
-11.0	11.0							At 11ft, mud circulation reduced to a minimum.
-12.0	12.0							
-13.0	13.0							
-14.0	14.0							
-15.0	15.0							
-16.0	16.0							
-17.0	17.0							
-18.0	18.0							
-19.0	19.0							

DATE STARTED: 8/14/13
DATE FINISHED: 8/22/13
FIELD GEOLOGIST: Rolando Benitez
CHECKED BY: Rolando Benitez
DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
NOTES:
APPROVED BY: EOT
DRILLER: Eddie Palmer
DRILL RIG: DR-16
HAMMER ID:

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ENGINEERS/CONSULTANTS/CM

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Boring R-7-3

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396957.30 ft E. 875783.79 ft
GROUND SURFACE ELEVATION: 0.01 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-21.0	21.0	R-1	12% (0%)			20.0-25.6 ft LIMESTONE, moderately soft to moderately hard, moderately to intensely weathered, granule to pebble particles, yellowish gray (5Y 8/1) and very light gray (N8), strong reaction to HCl, wet, Recovered only as rock fragments. [Miami Limestone]		20.0 - 120.0 ft., NWD4 conventional coring.
-22.0	22.0							
-23.0	23.0							
-24.0	24.0							
-25.0	25.0							
-26.0	26.0	R-2	100% (47%)			25.6-28.0 ft LIMESTONE, fossiliferous, disturbed, horizontal, moderately soft to moderately hard, moderately weathered, very fine sand to pebble particles, pitted to vuggy, typical diameter: 0.25 in., max size: 1.2 in., light gray (N7) to very light gray (N8), strong reaction to HCl, wet, [Miami Limestone]		Lost circulation at 26.0ft.
-27.0	27.0							
-28.0	28.0	R-3	79% (71%)			28.0-35.0 ft LIMESTONE, fossiliferous, moderately hard, moderately weathered, very fine sand to silt particles, pitted to vuggy, typical diameter: 0.2 in., max size: 1.0 in., very light gray (N8) to white (N9), strong reaction to HCl, wet, iron oxide staining, Calcareous. Coralline to mudstone. One inch vugs filled wih moderatety soft to hard grainstone, light brown in color. [Key Largo Limestone]		
-29.0	29.0							
-30.0	30.0							
-31.0	31.0							
-32.0	32.0							
-33.0	33.0							Tool drop from 33.0 to 34.5 ft.
-34.0	34.0							
-35.0	35.0	R-4	100% (27%)			35.0-43.0 ft LIMESTONE, disturbed, moderately hard to moderately soft, moderately weathered, very fine sand particles, pitted to vuggy, typical diameter: 0.7 in., max size: 2.0 in., very light gray (N8) to yellowish gray (5Y 8/1), strong reaction to HCl, wet, Calcareous. Recrystallized calcite coating previously disolved vugs and pits. [Key Largo Limestone]		
-36.0	36.0							
-37.0	37.0	R-5	37% (29%)					
-38.0	38.0							
-39.0	39.0							

DATE STARTED: 8/14/13
DATE FINISHED: 8/22/13
FIELD GEOLOGIST: Rolando Benitez
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-16
HAMMER ID:

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Boring R-7-3

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396957.30 ft E. 875783.79 ft
GROUND SURFACE ELEVATION: 0.01 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
						35.0-43.0 ft LIMESTONE, disturbed, moderately hard to moderately soft, moderately weathered, very fine sand particles, pitted to vuggy, typical diameter: 0.7 in., max size: 2.0 in., very light gray (N8) to yellowish gray (5Y 8/1), strong reaction to HCl, wet, Calcareous. Recrystallized calcite coating previously disolved vugs and pits. [Key Largo Limestone]		
-41.0	41.0							
-42.0	42.0							
-43.0	43.0	R-6	88% (88%)			43.0-48.5 ft LIMESTONE, fossiliferous, moderately hard, moderately weathered, very fine sand to silt particles, pitted to vuggy, typical diameter: 0.5 in., max size: 2.0 in., very light gray (N8) to grayish yellow (5Y 8/4), strong reaction to HCl, wet, iron oxide staining, Calcareous. Coralline to mudstone. Vugs and pit surfaces coated with recrystallized calcite. [Key Largo Limestone]		
-44.0	44.0							
-45.0	45.0							
-46.0	46.0							
-47.0	47.0	R-7	100% (92%)					
-48.0	48.0							Tool drop from 48.0 - 48.6ft.
-49.0	49.0					48.5-49.7 ft LIMESTONE, disturbed, moderately hard, moderately weathered, silt particles, vuggy, typical diameter: 0.5 in., max size: 1 in., medium gray (N5) and yellowish gray (5Y 8/1), strong reaction to HCl, wet, Calcareous. Almost all vugs are filled with the medium gray mudstone, also moderately hard. [Fort Thompson Formation]		
-50.0	50.0					49.7-62.0 ft MUDSTONE, fossiliferous, moderately hard, moderately weathered, silt particles, pitted to vuggy, typical diameter: 0.4 in., max size: 1.4 in., very light gray (N8) and pale greenish yellow (10Y 8/2), wet, iron oxide staining, Calcareous. Abundant moldic porosity. Most vugs are a result of this moldic porosity. [Fort Thompson Formation]		
-51.0	51.0							
-52.0	52.0	R-8	98% (96%)					
-53.0	53.0							
-54.0	54.0							
-55.0	55.0							
-56.0	56.0							
-57.0	57.0							
-58.0	58.0							
-59.0	59.0							

DATE STARTED: 8/14/13
DATE FINISHED: 8/22/13
FIELD GEOLOGIST: Rolando Benitez
CHECKED BY: Rolando Benitez
DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
NOTES:
APPROVED BY: EOT
DRILLER: Eddie Palmer
DRILL RIG: DR-16
HAMMER ID:

Paul C. Rizzo Associates, Inc.
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Boring R-7-3

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396957.30 ft   E. 875783.79 ft
GROUND SURFACE ELEVATION: 0.01 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
								Tool drop from 60.0 - 60.6ft.
-61.0	61.0	R-8	98% (96%)					
-62.0	62.0					62.0-72.7 ft LIMESTONE, fossiliferous, disturbed, horizontal, moderately hard, moderately weathered, very fine sand to pebble particles, pitted to vuggy, typical diameter: 0.25 in., max size: 1.0 in., light gray (N7) to very light gray (N8), strong reaction to HCl, wet, [Fort Thompson Formation]		
-63.0	63.0							At 63.0 - 65.0ft, soft zone, slighty faster drilling rate with no tool drop.
-64.0	64.0							
-65.0	65.0							
-66.0	66.0	R-9	53% (28%)					
-67.0	67.0							
-68.0	68.0							
-69.0	69.0							At 68.5- 70.5ft, softer material with faster drilling rates. No tool drop.
-70.0	70.0							
-71.0	71.0	R-10	100% (53%)					
-72.0	72.0							
-73.0	73.0	R-11	100% (70%)			72.7-75.0 ft LIMESTONE, fossiliferous, bioturbated, horizontal, moderately hard, moderately weathered, very fine sand to pebble particles, vuggy to pitted, typical diameter: 0.5 in., max size: 1.5 in., light gray (N7) to very light gray (N8), strong reaction to HCl, wet, Calcareous. Coarser grained than layer above. [Fort Thompson Formation]		
-74.0	74.0							
-75.0	75.0					75.0-101.6 ft LIMESTONE, fossiliferous, disturbed, moderately hard, moderately weathered, very fine sand to granule particles, vuggy to pitted, typical diameter: 0.75 in., max size: 2.5 in., light gray (N7) to very light gray (N8), strong reaction to HCl, wet, iron oxide staining, Gastropod and bivalve fossils. Abundant moldic porosity with white soft silty fine calcareous sand. [Fort Thompson Formation]		
-76.0	76.0							
-77.0	77.0	R-12	85% (25%)					At 77.0 - 78.0 ft, Softer zone with an increase in drlling rate; no tool drop.
-78.0	78.0							At 78.0 ft, abundant secondary moldic porosity associated mostly with bivalves.
-79.0	79.0	R-13	100%					

DATE STARTED: 8/14/13
DATE FINISHED: 8/22/13
FIELD GEOLOGIST: Rolando Benitez
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-16
HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

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Boring R-7-3

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396957.30 ft E. 875783.79 ft
GROUND SURFACE ELEVATION: 0.01 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		R-13	(87%)					
-81.0	81.0	R-14	100% (60%)			75.0-101.6 ft LIMESTONE, fossiliferous, disturbed, moderately hard, moderately weathered, very fine sand to granule particles, vuggy to pitted, typical diameter: 0.75 in., max size: 2.5 in., light gray (N7) to very light gray (N8), strong reaction to HCl, wet, iron oxide staining, Gastropod and bivalve fossils. Abundant moldic porosity with white soft silty fine calcareous sand. [Fort Thompson Formation]		
-82.0	82.0							
-83.0	83.0							
-84.0	84.0							
-85.0	85.0							
-86.0	86.0							
-87.0	87.0	R-15	80% (57%)					
-88.0	88.0							
-89.0	89.0							
-90.0	90.0							
-91.0	91.0							
-92.0	92.0							
-93.0	93.0							
-94.0	94.0							
-95.0	95.0							
-96.0	96.0	R-16	93% (57%)					
-97.0	97.0							
-98.0	98.0							
-99.0	99.0							

DATE STARTED: 8/14/13
DATE FINISHED: 8/22/13
FIELD GEOLOGIST: Rolando Benitez
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-16
HAMMER ID:

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Boring R-7-3

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396957.30 ft E. 875783.79 ft
GROUND SURFACE ELEVATION: 0.01 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
		R-16	93% (57%)					
-101.0	101.0							
-102.0	102.0					101.6-111.0 ft LIMESTONE, fossiliferous, moderately hard to moderately soft, moderately weathered, very fine sand to medium sand particles, pitted to vuggy, typical diameter: 0.3 in., max size: 0.90 in., light gray (N7) to very light gray (N8), strong reaction to HCl, wet, iron oxide staining, Gastropod and bivalve fossils. Very abundant moldic porosity, with white soft silty fine calcareous sand filling. [Fort Thompson Formation]		
-103.0	103.0							
-104.0	104.0							
-105.0	105.0							
-106.0	106.0							
-107.0	107.0	R-17	100% (85%)					
-108.0	108.0							
-109.0	109.0							
-110.0	110.0							
-111.0	111.0					111.0-120.0 ft LIMESTONE, fossiliferous, moderately soft to moderately hard, moderately to intensely weathered, very fine sand to medium sand particles, pitted, typical diameter: 0.2 in., max size: 1.0 in., yellowish gray (5Y 8/1) to very light gray (N8), strong reaction to HCl, wet, iron oxide staining, Gastropod and bivalve fossils. Very abundant moldic porosity, with very light gray soft silty fine to medium calcareous sand filling. [Fort Thompson Formation]		
-112.0	112.0							
-113.0	113.0							
-114.0	114.0							
-115.0	115.0							At 115.0 - 125.0 ft, softer zone.
-116.0	116.0	R-18	35% (20%)					
-117.0	117.0							
-118.0	118.0							
-119.0	119.0							

DATE STARTED: 8/14/13
DATE FINISHED: 8/22/13
FIELD GEOLOGIST: Rolando Benitez
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
DRILLER: Eddie Palmer

NOTES:

DRILL RIG: DR-16
HAMMER ID:

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Boring R-7-3

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396957.30 ft E. 875783.79 ft
GROUND SURFACE ELEVATION: 0.01 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
						120.0-125.0 ft No Sample recovered.		120.0 - 125.0 ft, destructively drilled with mud rotary bit and NWJ drill pipe.
-121.0	121.0							
-122.0	122.0							
-123.0	123.0							Tests continued from 125.0 - 288.2ft, using CPT probe.
-124.0	124.0							
	125.0					---- Bottom of Boring at 125.00 ft.----		

DATE STARTED: 8/14/13
DATE FINISHED: 8/22/13
FIELD GEOLOGIST: Rolando Benitez
CHECKED BY: Rolando Benitez
DRILLING METHOD: Mud Rotary, PQ, SPT, ST, NWD4
DRILLING CO. Huss Drilling
NOTES:
APPROVED BY: EOT
DRILLER: Eddie Palmer
DRILL RIG: DR-16
HAMMER ID:

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500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
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Boring R-7-4

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396958.51 ft E. 875605.22 ft
GROUND SURFACE ELEVATION: -0.53 ft

SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	DESCRIPTION	USCS SYMBOL
			0.0-2.0 ft Crushed stone (Road base layer) Unsampled.	
R-1	70% (0%)		2.0-5.6 ft Peat, blackish red (5R 2/2) to grayish red (10R 4/2), organic odor, moist, strong HCl reaction, Plastic to Spongy consistency, some celulose	ol/oh
R-2	86% (40%)	FD0	5.6-11.2 ft GRAINSTONE, calcareous, hard to soft, slightly to intensely weathered, fine sand to very coarse sand particles, pitted, max size: 0.5 in., very pale orange (10YR 8/2) and light bluish gray (5B 7/1), massive bedded, strong reaction to HCl, moist, lower contact is conformable and gradational, Zones of loose sandy limestone in competent hard sandy limestone. Some shells and shell fragments. [Miami Limestone]	
R-3	100% (88%)	FD1	11.2-17.2 ft GRAINSTONE, calcareous, hard to moderately soft, fresh to slightly weathered, fine sand to pebble particles, pitted to cavities, max size: 1.5 in., light bluish gray (5B 7/1) and very light gray (N8), massive bedded, strong reaction to HCl, moist, lower contact is conformable and gradational, Some shells and shell fragments. [Miami Limestone] 13.5- ft Random fracture, R.D. = 0°, slightly open; filling: not healed; surface: rough, undulating, moderately soft.	
R-4	96% (54%)	FD7 FD0	17.2-30.2 ft PACKSTONE, calcareous, hard to moderately soft, slightly to moderately weathered, clay to very coarse sand particles, vuggy to pitted, max size: 1.5 in., white (N9) and light bluish gray (5B 7/1), massive bedded, strong reaction to HCl, moist, lower contact is sharp, Zones of soft loose sandy limestone in competent hard micrite packstone. Loose soft zones break easily. [Miami Limestone] 17.5-19.2 ft Fracture zone, R.D. = 80°, wide; filling: totally healed, thick,	

Elevation scale (ft): -1.0, -2.0, -3.0, -4.0, -5.0, -6.0, -7.0, -8.0, -9.0, -10.0, -11.0, -12.0, -13.0, -14.0, -15.0, -16.0, -17.0, -18.0, -19.0

Depth scale (ft): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 14.0, 15.0, 16.0, 17.0, 18.0, 19.0

REMARKS

0 - 2.0 ft., Destructively drilled using 5 inch mud rotary bit.
Measured water level varied within one foot of ground surface.
2.0 - 126.00 ft., PQ wireline coring.

DATE STARTED: 9/3/13
DATE FINISHED: 9/5/13
FIELD GEOLOGIST: Doug Raszewski
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ
DRILLING CO. Huss Drilling
DRILLER: Anthony Hudson

NOTES: Angle of boring is 16 degrees toward bearing 115. depth is measured depth in boring.

DRILL RIG: DR-5
HAMMER ID:

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ENGINEERS/CONSULTANTS/CM

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500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
www.rizzoassoc.com

Boring R-7-4

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396958.51 ft E. 875605.22 ft
GROUND SURFACE ELEVATION: -0.53 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-20.0 to -21.0	21.0	R-4	96% (54%)	FD0		fresh, hard; surface: rough, fresh, hard; Soft sediment fracture filled with black micritic limestone. 19.3- ft Joint, R.D. = 0°, moderately open; filling: not healed, sand; surface: moderately rough, undulating, hard; Sand filling on surface.		
-22.0 to -26.0	22.0–26.0	R-5	50% (32%)	FD0		17.2-30.2 ft PACKSTONE, calcareous, hard to moderately soft, slightly to moderately weathered, clay to very coarse sand particles, vuggy to pitted, max size: 1.5 in., white (N9) and light bluish gray (5B 7/1), massive bedded, strong reaction to HCl, moist, lower contact is sharp, Zones of soft loose sandy limestone in competent hard micrite packstone. Loose soft zones break easily. [Miami Limestone]		Soft zone with no recovery from approximately 23.0 - 23.3 ft and 24.6-26.6 ft.
-27.0 to -31.0	27.0–31.0	R-6	86% (86%)	FD0		28.7- ft Joint; filling: sandy clay, soft (H6); surface: planar, moderately hard (H4).		SC-1: 27.7-28.7 ft Soft gray sand at 30.2 ft.
-32.0 to -36.0	32.0–37.0	R-7	50% (28%)	FD7 / FD2		30.2-49.9 ft WACKESTONE, calcareous, interbedded, hard to moderately hard, fresh to moderately weathered, clay to fine sand particles, pitted to cavities, max size: 5.0 in., white (N9) to light gray (N7), moderately to thickly bedded, closely to widely fractured, weak reaction to HCl, moist, lower contact is conformable and gradational, 1-4 inch voids common. 2-3 inch filled voids or soft zones present above ~42 ft. occasional shells/fossils and moldic porosity. Voids are coated with calcite crystals below about 42 feet. Void surfaces coated with dark yellowish brown (10 YR 4/2), sandy clay. [Key Largo Limestone] interbedded with BOUNDSTONE, calcareous, moderately soft to hard, fresh to slightly weathered, pitted to cavities, max size: 5.0 in., white (N9) to light gray (N7), thinly to moderately bedded, closely to widely fractured, weak reaction to HCl, moist, lower contact is conformable and gradational, Calcite filling fractures and voids below 42.0 ft. [Key Largo Limestone] 32.1-32.4 ft Random fracture, R.D. = 50°, moderately wide; filling: not healed, moderately thick sandy clay, intensely weathered, very soft to soft; surface: rough, undulating, intensely weathered, moderately hard; Likely extends from void to void. 32.6-32.8 ft Random fracture, R.D. = 30°, moderately wide; filling: not healed, moderately thick sandy clay, intensely weathered, very soft to soft; surface: rough, undulating, intensely weathered, moderately hard; Likely extends from void to void.		2.5 in. void in core from 32.4-32.6 ft. Soft zone with no recovery from approximately 34.5-36.5 ft., most likely composed of soft moderate yellowsh brown (10YR 5/4) sandy clay material that covers void surfaces in R-7.
-37.0 to -39.0	37.0–39.0	R-8	44% (16%)	FD2		33- ft Joint, R.D. = 30°, moderately open; filling: not healed, moderately thin sandy clay, intensely weathered, very soft to soft; surface: rough, planar, intensely weathered, moderately hard. 33.1- ft Joint, R.D. = 30°, moderately open; filling: not healed, moderately		Very soft,no drilling resistance, no recovery from approximately 39.0 - 41.5 ft.

DATE STARTED: 9/3/13
DATE FINISHED: 9/5/13
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APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ
DRILLING CO. Huss Drilling
DRILLER: Anthony Hudson

NOTES: Angle of boring is 16 degrees toward bearing 115. depth is measured depth in boring.
DRILL RIG: DR-5
HAMMER ID:

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www.rizzoassoc.com

Boring R-7-4

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES

N. 396958.51 ft E. 875605.22 ft

GROUND SURFACE ELEVATION: -0.53 ft

ELEVATION (Feet)	DEPTH (Feet)
-40.0	41.0
-41.0	42.0
-42.0	43.0
-43.0	44.0
-44.0	45.0
-45.0	46.0
-46.0	47.0
-47.0	48.0
-48.0	49.0
-49.0	50.0
-50.0	51.0
-51.0	52.0
-52.0	53.0
-53.0	54.0
-54.0	55.0
-55.0	56.0
-56.0	57.0
-57.0	58.0
-58.0	59.0

SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY
R-8	44% (16%)	
R-9	90% (78%)	
R-10	100% (90%)	FD2
R-11	88% (88%)	
R-12	58% (30%)	

DESCRIPTION

thin sandy clay, intensely weathered, very soft to soft; surface: rough, planar, intensely weathered, moderately hard.
33.4-33.6 ft Joint, R.D. = 30°, moderately open; filling: not healed, moderately thin sandy clay, intensely weathered, very soft to soft; surface: rough, planar, intensely weathered, moderately hard.
38.2-38.3 ft Joint, R.D. = 30°, open; filling: not healed, thin sandy clay, intensely weathered, very soft to soft; surface: rough, planar, intensely weathered, moderately hard.
38.3-38.4 ft Joint, R.D. = 30°, moderately open; filling: not healed, moderately thin sandy clay, intensely weathered, very soft to soft; surface: rough, planar, intensely weathered, moderately hard.

30.2-49.9 ft WACKESTONE, calcareous, interbedded, hard to moderately hard, fresh to moderately weathered, clay to fine sand particles, pitted to cavities, max size: 5.0 in., white (N9) to light gray (N7), moderately to thickly bedded, closely to widely fractured, weak reaction to HCl, moist, lower contact is conformable and gradational, 1-4 inch voids common. 2-3 inch filled voids or soft zones present above ~42 ft. occasional shells/fossils and moldic porosity. Voids are coated with calcite crystals below about 42 feet. Void surfaces coated with dark yellowish brown (10 YR 4/2), sandy clay. [Key Largo Limestone]
interbedded with BOUNDSTONE, calcareous, moderately soft to hard, fresh to slightly weathered, pitted to cavities, max size: 5.0 in., white (N9) to light gray (N7), thinly to moderately bedded, closely to widely fractured, weak reaction to HCl, moist, lower contact is conformable and gradational, Calcite filling fractures and voids below 42.0 ft. [Key Largo Limestone]
45.7-46.3 ft Joint, R.D. = 60°, slightly open; filling: partly healed, very thin calcite, fresh, soft; surface: rough, planar, fresh, moderately hard.
45.9-46.2 ft Joint, R.D. = 55°, slightly open; filling: partly healed, very thin calcite, fresh, soft; surface: rough, planar, fresh, moderately hard.

49.9-53.2 ft PACKSTONE, calcareous, very soft (H7) to hard (H3), fresh to slightly weathered, clay to coarse sand particles, vuggy to pitted, max size: 1.0 in., medium gray (N5) to light gray (N7), thickly bedded, strong reaction to HCl, moist, lower contact is unconformable and sharp, This layer is the transition to Ft. thompson formation. Shelly grainstone segments with packstone clasts in lowest ~1.0 ft. Core breaks easily, brittle. [Key Largo Limestone]
52.7- ft Joint, R.D. = 15°.

53.2-59.0 ft PACKSTONE, calcareous, soft to hard, fresh to moderately weathered, clay to coarse sand particles, pitted to cavities, typical diameter: 0.2 in., max size: 12.0 in., white (N9) to very light gray (N8), massive bedded, strong reaction to HCl, wet, Shells are mostly dissolved. Most vugs are moldic porosity. Pale brown (5YR 5/2) sand filled voids up to 12 inches in size. From 56.0 - 59.0ft, abundant shell molds are present. [Fort Thompson Formation]

59.2- ft Incipient fracture, tight; filling: not healed, clean; surface: rough, planar, moderately hard.

USCS SYMBOL

REMARKS

Very broken and voided w/ calcite coating from approximately 44.2 - 44.6ft. Boundstone. Voids aid in mechanical breakage of core.

SC-2: 48.2-49.0 ft.

50.2-51.4 ft: Sample crumbled when transfered to core box.

Contact is erosive extending from 53.0-53.4 ft.

Zero resistance to drilling from 56.4-57.0 ft.

Zero resistance to drilling at approximately 58.2 and 60.0 ft.; loose sand present around rubble zones.

DATE STARTED: 9/3/13
DATE FINISHED: 9/5/13
FIELD GEOLOGIST: Doug Raszewski
CHECKED BY: Rolando Benitez
APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ
DRILLING CO. Huss Drilling
DRILLER: Anthony Hudson

NOTES: Angle of boring is 16 degrees toward bearing 115. depth is measured depth in boring.

DRILL RIG: DR-5
HAMMER ID:

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

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500 Penn Center Blvd. Suite 100, Pittsburgh, PA 15235
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Boring R-7-4

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396958.51 ft E. 875605.22 ft
GROUND SURFACE ELEVATION: -0.53 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-59.0						59.5- ft Joint, tight; filling: not healed, clean; surface: rough, planar, moderately hard.		
-60.0	61.0	R-12	58% (30%)			59.0-122.7 ft GRAINSTONE, calcareous, hard to soft, fresh to slightly weathered, very coarse sand to silt particles, pitted to cavities, typical diameter: 0.25-3 in., max size: 18.0 in., white (N9) to very light gray (N8), thickly to massive bedded, strong reaction to HCl, moist, Shells are mostly dissolved. Most vugs are moldic porosity. Numerous voids with remnants of sand filling. Zones of high void content, breaks easily into rubble. From 77.0 - 87.0ft, abundant shell molds. From 113.0 - 114.5ft, Large shell molds present. [Fort Thompson Formation] with layers of PACKSTONE, calcareous, soft to hard, fresh to slightly weathered, clay to granule particles, cavities to pitted, max size: 2.0 in., white (N9) to very light gray (N8), thinly to thickly bedded, strong reaction to HCl, moist, lower contact is conformable and gradational, [Fort Thompson Formation]		Loose sand caused inner barrel to get stuck in outer barrel after R-12.
-61.0	62.0							
-62.0	63.0							
-63.0	64.0	R-13	96% (86%)					Zero resistance to drilling from 63.7 - 64.7 ft. Open void observed in half of the core recovered for this depth interval. Some loose sand present on surface of the void.
-64.0	65.0							
-65.0	66.0							
-66.0	67.0							
-67.0	68.0			FD2				
-68.0	69.0	R-14	54% (12%)					Zero resistance to drilling from approximately 69.5-70.5 ft.
-69.0	70.0							
-70.0	71.0							
-71.0	72.0							Low recovery (in R-14) and broken rock assumed to be due to voids & soft zones
-72.0	73.0	R-15	90% (67%)					
-73.0	74.0							
-74.0	75.0							R-16 is very broken due to voids.
-75.0	76.0	R-16	100% (0%)			75.8-76.1 ft Joint, R.D. = 40°, slightly open; filling: not healed; surface: moderately rough, undulating, slightly weathered, moderately soft to moderately hard. 75.9-76.2 ft Joint, R.D. = 40°, slightly open; filling: not healed; surface: moderately rough, undulating, slightly weathered, moderately soft to moderately hard.		
-76.0	77.0							Multiple small soft/void zones noted while drilling R-17. Zero resistance to drilling from 77.0 - 82.0 ft.
-77.0	78.0	R-17	66% (38%)	FD0				
	79.0							

DATE STARTED: 9/3/13
DATE FINISHED: 9/5/13
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APPROVED BY: EOT

DRILLING METHOD: Mud Rotary, PQ
DRILLING CO. Huss Drilling
DRILLER: Anthony Hudson

NOTES: Angle of boring is 16 degrees toward bearing 115. depth is measured depth in boring.
DRILL RIG: DR-5
HAMMER ID:

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Boring R-7-4

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396958.51 ft E. 875605.22 ft
GROUND SURFACE ELEVATION: -0.53 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-78.0								3 in. void in core in R-17.
-79.0	81.0	R-17	66% (38%)			59.0-122.7 ft GRAINSTONE, calcareous, hard to soft, fresh to slightly weathered, very coarse sand to silt particles, pitted to cavities, typical diameter: 0.25-3 in., max size: 18.0 in., white (N9) to very light gray (N8), thickly to massive bedded, strong reaction to HCl, moist, Shells are mostly dissolved. Most vugs are moldic porosity. Numerous voids with remnants of sand filling. Zones of high void content, breaks easily into rubble. From 77.0 - 87.0ft, abundant shell molds. From 113.0 - 114.5ft, Large shell molds present. [Fort Thompson Formation] with layers of PACKSTONE, calcareous, soft to hard, fresh to slightly weathered, clay to granule particles, cavities to pitted, max size: 2.0 in., white (N9) to very light gray (N8), thinly to thickly bedded, strong reaction to HCl, moist, lower contact is conformable and gradational, [Fort Thompson Formation]		
-80.0	82.0							Much moldic porosity in R-18.
-81.0	83.0							
-82.0	84.0	R-18	100% (96%)					SC-3: 83.7-84.6 ft.
-83.0	85.0			FD0				
-84.0	86.0							
-85.0	87.0							
-86.0	88.0							Very broken with sand filled voids from approximately 88.0 - 89.0 ft.
-87.0	89.0	R-19	94% (66%)					
-88.0	90.0							
-89.0	91.0			FD6		91-91.2 ft Joint, R.D. = 50°, open; filling: partly healed, very thin calcite, fresh, moderately soft; surface: rough, planar, fresh, moderately hard; Sand on fracture surface.		
-90.0	92.0							
-91.0	93.0					92.6-92.7 ft Joint, R.D. = 25°, moderately open; filling: not healed, fresh; surface: slightly rough, planar, fresh, hard. 92.9-93 ft Joint, R.D. = 25°, moderately open; filling: not healed, fresh; surface: slightly rough, planar, fresh, hard.		Due to the presence of many pits and vugs, core is mechanically broken from approximately 92.5 to 96.0 ft and 102.0 - 104.0 ft.
-92.0	94.0 / 95.0	R-20	86% (64%)					
-93.0	96.0							
-94.0	97.0			FD1				
-95.0	98.0							Driller reports multiple small soft sandy zones during drilling, mostly in upper and lower parts of run R-21.
-96.0	99.0	R-21	72% (56%)			99- ft Random fracture, R.D. = 30°, tight; filling: not healed, fresh; surface: moderately rough, undulating, fresh, hard.		
-97.0								

DATE STARTED: 9/3/13
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PROJECT: Turkey Point Units 6 and 7 Site
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COORDINATES
N. 396958.51 ft E. 875605.22 ft
GROUND SURFACE ELEVATION: -0.53 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-98.0	101.0	R-21	72% (56%)	FD8		59.0-122.7 ft GRAINSTONE, calcareous, hard to soft, fresh to slightly weathered, very coarse sand to silt particles, pitted to cavities, typical diameter: 0.25-3 in., max size: 18.0 in., white (N9) to very light gray (N8), thickly to massive bedded, strong reaction to HCl, moist, Shells are mostly dissolved. Most vugs are moldic porosity. Numerous voids with remnants of sand filling. Zones of high void content, breaks easily into rubble. From 77.0 - 87.0ft, abundant shell molds. From 113.0 - 114.5ft, Large shell molds present. [Fort Thompson Formation] with layers of PACKSTONE, calcareous, soft to hard, fresh to slightly weathered, clay to granule particles, cavities to pitted, max size: 2.0 in., white (N9) to very light gray (N8), thinly to thickly bedded, strong reaction to HCl, moist, lower contact is conformable and gradational, [Fort Thompson Formation] 101-101.1 ft Fracture zone.		
-99.0	102.0							
-100.0	103.0							Upper 1.7 ft of R-22 is mostly broken with loose sand present.
-101.0	104.0	R-22	92% (66%)					
-102.0	105.0							Abundant shell molds from 104.5-113.0 ft.
-103.0	106.0							
-104.0	107.0							
-105.0	108.0							
-106.0	109.0	R-23	100% (100%)					SC-4: 109.4-110.8 ft.
-107.0	110.0							
-108.0	111.0			FD1				
-109.0	112.0							Sand filled void from 112.0-112.3 ft.
-110.0	113.0							
-111.0	114.0	R-24	100% (78%)					
-112.0	115.0					115.4-115.6 ft Joint, R.D. = 50°, slightly open; filling: not healed, fresh; surface: moderately rough, planar, fresh, hard.		Multiple <1 in. voids w/ loose sand present from 115.5-116.5 ft.
-113.0	116.0							
-114.0	117.0							Soft sandy zone from approximately 117.2-118.7 ft. just minor sand and rubble recovered.
-115.0	118.0	R-25	44% (28%)					
-116.0	119.0							

DATE STARTED: 9/3/13
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APPROVED BY: EOT

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DRILLING CO. Huss Drilling
DRILLER: Anthony Hudson

NOTES: Angle of boring is 16 degrees toward bearing 115. depth is measured depth in boring.

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Boring R-7-4

PROJECT: Turkey Point Units 6 and 7 Site
PROJECT NO.: 13-5054

COORDINATES
N. 396958.51 ft E. 875605.22 ft
GROUND SURFACE ELEVATION: -0.53 ft

ELEVATION (Feet)	DEPTH (Feet)	SAMPLE OR RUN NO.	BLOW/6in & (N) OR %REC (%RQD)	FRACTURE DENSITY	PROFILE	DESCRIPTION	USCS SYMBOL	REMARKS
-117.0						59.0-122.7 ft GRAINSTONE, calcareous, hard to soft, fresh to slightly weathered, very coarse sand to silt particles, pitted to cavities, typical diameter: 0.25-3 in., max size: 18.0 in., white (N9) to very light gray (N8), thickly to massive bedded, strong reaction to HCl, moist, Shells are mostly dissolved. Most vugs are moldic porosity. Numerous voids with remnants of sand filling. Zones of high void content, breaks easily into rubble. From 77.0 - 87.0ft, abundant shell molds. From 113.0 - 114.5ft, Large shell molds present. [Fort Thompson Formation] with layers of PACKSTONE, calcareous, soft to hard, fresh to slightly weathered, clay to granule particles, cavities to pitted, max size: 2.0 in., white (N9) to very light gray (N8), thinly to thickly bedded, strong reaction to HCl, moist, lower contact is conformable and gradational, [Fort Thompson Formation]		Soft sandy zone from approximately 120.8-121.8 ft.; only minor sand and rubble recovered.
	121.0	R-25	44% (28%)	FD1				
-118.0	122.0							
		R-26						
-119.0			86% (0%)					
	123.0							
-120.0	124.0							
-121.0	125.0					122.7-126.0 ft Material not recovered. Upper Tamiami formation.		
-122.0	126.0					---- Bottom of Boring at 126.00 ft.----		

DATE STARTED: 9/3/13
DATE FINISHED: 9/5/13
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APPROVED BY: EOT

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DRILL RIG: DR-5
HAMMER ID:

APPENDIX B

KLEINFELDER RCTS TESTING RESULTS

LABORATORY DATA REPORT
RESONANT COLUMN AND TORSIONAL SHEAR (RCTS) TESTING
TURKEY POINT UNITS 6 & 7 SITE
MIAMI-DADE COUNTY, FL
KLEINFELDER PROJECT NO. 136473

February 5, 2014

DCN: 136473.4-ALB14RP001
Rev. 1

Prepared By:

KLEINFELDER
Bright People. Right Solutions.

9019 Washington Street NE, Building A
Albuquerque, New Mexico 87113

LABORATORY DATA REPORT
RESONANT COLUMN AND TORSIONAL SHEAR (RCTS) TESTING
TURKEY POINT UNITS 6 & 7 SITE
MIAMI-DADE COUNTY, FL
KLEINFELDER PROJECT NO. 136473

Prepared by: KLEINFELDER

Bright People. Right Solutions.

9019 Washington Street NE, Building. A
Albuquerque, NM 87113

Author Approval: ______________________ 2/5/2014
Jed A. Stoken, PE, Project Professional — Date

Reviewer Approval: ______________________ 2/5/2014
Joseph P. Laird, PE, Technical Lead — Date

Project Manager Approval: ______________________ 2/5/2014
John S. North, PE, Project Manager — Date

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1.0 INTRODUCTION

1.1 DESCRIPTION OF THE PROJECT

Florida Power and Light (FPL) Company is exploring the possibility of constructing two new nuclear reactor units, Turkey Point Units 6 & 7, in Miami-Dade County Florida. Paul C. Rizzo Associates, Inc. (Rizzo) has been contracted by FPL to perform a supplementary geological, geotechnical, and geophysical site investigation for the proposed units. As part of this site characterization, Rizzo subcontracted with Kleinfelder West Inc. (Kleinfelder) to perform dynamic soil and rock property testing of selected samples collected from the subject site. Dynamic property testing was conducted in accordance with the Kleinfelder Laboratory Testing Work Plan (Kleinfelder, 2013a).

This laboratory data report documents the “Fixed-Free” Resonant Column and Torsional Shear (RCTS) tests performed by Kleinfelder, the scope of which is detailed in the “Agreement for Laboratory Services between Rizzo (Consultant) and Kleinfelder West, Inc. (Laboratory),” dated September 24, 2013.

1.2 PURPOSE AND SCOPE

The primary objective of the laboratory RCTS testing performed by Kleinfelder was to measure the dynamic properties of the site-specific samples. The RCTS test sequence characterizes shear modulus reduction and material damping relationships over a range of small to intermediate shear strains, as well as comparison of values versus time, confining pressures, frequency and number of cycles. It is anticipated that Rizzo will utilize the RCTS laboratory results in conducting subsequent seismic site characterization studies. This laboratory data report is a summary of our work and includes discussion of the following components:

- RCTS Test Background and Test Parameters;
- Sample Handling and Storage;
- Test Specimen Preparation, Including Photographic Records;
- Data Summary Plots and Tables;
- Comparison of RCTS Test Results; and
- Discussion of Quality of Test Data.

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1.3 QUALITY ASSURANCE

Kleinfelder personnel performed the work presented in this data report in accordance with the applicable requirements of the Kleinfelder Nuclear Services Quality Management Program (KNS-QMP) as stated in the Kleinfelder Quality Assurance Project Plan (QAPP) (Kleinfelder, 2013b). Quality assurance activities were performed under the general oversight of Kleinfelder's Deputy Director of Quality Assurance, Benjamin Trujillo, CQA.

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2.0 STANDARDS AND PROCEDURES

2.1 SAMPLE HANDLING AND STORAGE

Samples for RCTS Testing were received at Kleinfelder's Dynamics Laboratory in Albuquerque, NM. Samples were handled, labeled and stored in accordance with the requirements of Kleinfelder's QAPP (Kleinfelder, 2013b) and work plan (Kleinfelder, 2013a). Receipt inspections were performed on the shipments at the time of arrival and prior to sample preparation and testing activities. Soil samples were designated as "Group D" fragile, while rock core samples were designated as "Special Care".

As required, samples were removed according to standards or procedures specified in Table 2.1-1. Prior to subdividing samples, the identification markings were transferred to the split sample portions to facilitate consistent identification of all pieces. Samples not tested but retained for possible future use, as determined by Rizzo, are stored at Kleinfelder's dynamic laboratory until final disposition.

Table 2.1-1 Summary of Sample Handling and Storage Standards / Procedures

Name	Standard / Procedure
Measurement of Soil and Rock Dynamic Properties by the Resonant Column and Torsional Shear Method	KNS-TP-8.10
Standard Practices for Preserving and Transporting Soil Samples	ASTM D4220
Standard Practices for Preserving and Transporting Rock Core Samples	ASTM D5079

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2.2 LABORATORY TESTING

The “fixed-free” RCTS test measures dynamic properties of individual soil or rock specimens by two independent methodologies, resonant column (RC) and torsional shear (TS). Specifically, the properties that are measured during testing are shear modulus (or shear wave velocity) and material damping ratio. In both the RC and TS tests, the cylindrical specimen is fixed at the base and sinusoidally rotated in torsion at the top, free end. Kleinfelder uses the RCTS device designed by Professor Kenneth H. Stokoe II of the University of Texas at Austin and manufactured by Trautwein Soil Test Equipment (Trauwein). The robust design/construction allows for dynamic property measurement from small (< 0.0001 %) to intermediate (up to about 0.3 %) shearing strains, low to high confining pressures (up to about 400 psi) and varied frequency, number of cycles and time of confinement. Further discussion of the RCTS test methodology is provided in Appendix A, “RCTS Testing of Soil and Rock Samples”.

Kleinfelder developed an internal standard operating procedure (Kleinfelder, 2012) for RCTS testing that is based on the procedures employed by Professor Stokoe and modified to account for the Trautwein Data Acquisition (DAQ) system. All testing was performed by trained and qualified staff in accordance with the standard or procedure shown in Table 2.2-1.

Table 2.2-1 Summary of Laboratory Test Procedures

Test Name	Standard / Procedure
Resonant Column and Torsional Shear (RCTS)	KNS-TP-8.10
Moisture Content	ASTM D2216

2.3 TEST PARAMETERS

The samples selected for testing and their corresponding estimated in-situ mean effective stress (σ'_m) were specified by Rizzo in their laboratory testing work plan (Rizzo, 2013) and shown below in Table 2.3-1.

Table 2.3-1 Estimated In-Situ Mean Effective Stress of RCTS Samples

Boring No.	Sample No.	Sample Depth (Top), ft	Sample Depth (Bottom), ft	Sample Length, ft	Estimated In-Situ Mean Effective Stress		
					σ'_m kPa	σ'_m psf	σ'_m psi
B-615	CS-01	32.6	33.4	0.8	76	1580	11
B-714	CS-01	29.4	30.2	0.8	69	1440	10
B-728	CS-04	53.4	54.2	0.8	124	2590	18
R-7-1	SC-3	40.1	41.0	0.9	97	2020	14
R-6-1b	SC-3	47.2	48.6	1.4	110	2300	16
R-6-1b	ST-1	134.0	136.7	2.0	317	6620	46
R-7-1	ST-5	206.0	208.7	2.7	70	10100	70
R-6-1b	ST-2	144.7	147.7	1.1	338	7060	49
R-6-1b	ST-7	169.9	172.6	2.6	400	8350	58

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3.0 RESONANT COLUMN TORSIONAL SHEAR TEST RESULTS

3.1 SAMPLE RECEIPT AND CHAIN-OF-CUSTODY RECORDS

Samples were sent to Kleinfelder's dynamics testing laboratory in six shipments. The first four shipments arrived at about the same time and contained a total of five rock core samples within three padded cardboard containers and one padded plastic container. The first four shipments were received and placed into a secure, climate-controlled storage area prior to receipt inspection. On October 10, 2013, the sample containers for these four shipments were opened and their contents inspected. The chain-of-custody (COC) records were signed and a receipt inspection report (RIR) was completed by Kleinfelder at that time. All five of the rock core samples were accepted and used in the RCTS laboratory testing program, although one sample (R-7-1 SC-3) could not be tested due to insufficient specimen length.

The fifth shipment consisted of three thin-walled, Shelby tube samples contained within a wooden packing crate. They were received and inspected on November 6, 2013. The COC record was signed and a separate RIR was completed at that time. The shipment contained three primary samples containing soil to be used in RCTS testing. All three of the primary samples were used in the RCTS laboratory testing program, although one sample (R-6-1b ST-2) could not be tested due to lack of undisturbed soil.

The sixth shipment consisted of three additional thin-walled, Shelby tube samples contained within a wooden packing crate. They were received and inspected on December 9, 2013. The COC record was signed and a separate RIR was completed at that time. The shipment contained three secondary samples containing soil which could be used for RCTS testing as a substitute for the one unsuitable primary sample received in the fifth shipment as discussed above. One of the three secondary samples was used in the RCTS laboratory testing program.

3.2 RCTS SPECIMEN PREPARATION AND TESTING NOTES

Specimen preparation and testing was conducted in accordance with the most recent project work plan and KNS-TP-8.10. Specimen preparation was conducted by one of two methods depending on whether the sample was a rock core or a soil sample within a Shelby tube.

Rock core specimens were prepared by decreasing the sample diameter to 1.45-inches using a coring machine and core barrel. This is done primarily to increase the maximum shearing strain that can be tested in the RCTS apparatus by decreasing the diameter and therefore reducing the overall total resistance to torsional shear of the specimen. The rock coring process was conducted by first trimming a 6-inch length of core using a rock saw. For most of the samples, there was not enough core length to subdivide and the entire sample was consumed during testing. Upon trimming, the samples were grouted into CMU blocks to fix the sample against rotation during coring. The samples were cored using a portable coring machine with a 1.5-inch Outside Diameter (OD), thin-walled diamond-impregnated core barrel, and then trimmed to their final length of about 4-inches using the rock saw. One Specimen, K2-13-004, broke in the middle during coring due to a natural vug in the sample and consequently could not be tested.

Due to the stiffness of the rock, satisfactory coupling of the rock specimen and the test apparatus platens (top cap and base pedestal) could not be achieved without the use of an epoxy cement bonding agent. A wet surface epoxy (Loctite® Marine Epoxy) was used to provide satisfactory boding with the moist rock. In addition, steel top caps and base pedestals proportioned and fabricated specifically for testing stiffer rock specimens were used.

Soil specimens were prepared by first subdividing the Shelby tube and selecting one portion for testing. The soil within the Shelby tube was examined and visually classified according to the Unified Soil Classification System (USCS). One specimen, K2-13-008, upon subdivision and subsequent examination was determined to consist primarily of highly disturbed borehole material and was unsuitable for testing. Samples were extruded from the Shelby tube using a hand-operated sample extruder.

Due to the sensitive nature of the soil, samples were extruded directly into the testing membranes, the ends were trimmed square, and the specimen placed immediately into the RCTS Testing apparatus.

Isotropic confining pressures applied to the specimens during testing were assigned by Rizzo based on the estimated in-situ mean effective stress (σ'_m). The isotropic confining pressures (σ'_o) used during testing consisted of a sequence of pressures

equivalent to about ¼, ½, 1, 2, and 4 times the mean effective stress. Table 3.2-1 presents the specimen numbers, their corresponding midpoint depths, and range of isotropic confining pressures applied during testing. Detailed specimen preparation notes and photographs documenting sample splits, specimen coring, membrane and epoxy placement, and placement into the RCTS apparatus are presented for each specimen in Appendix B through J.

Instances in which abnormal testing results were observed are also discussed in the specimen notes. In particular, there was often difficulty maintaining isotropic confinement around the encapsulated specimens and extreme tilting of the sand specimen upon increases in confining pressure causing the magnets to contact the electrical coils at the free-end of the sample. In some cases, the testing was not able to be completed at the higher pressure stages. However, RCTS test results were completed to at least the estimated mean effective pressure for all seven tested specimens.

Table 3.2-1 Summary of RCTS Specimens and Testing Pressures

						Testing Pressures σ'_o (psi)				
Kleinfelder Specimen No.	Boring No.	Rizzo Sample No	Specimen Midpoint Depth (ft)	Material Type	Mean Effective Stress σ'_m (psi)	Stage (1)	Stage (2)	Stage (3)	Stage (4)	Stage (5)
K2-13-001	B-615	CS-01	32.9	Limestone (Key Largo)	11	3	6	11	23	45
K2-13-002	B-714	CS-01	29.7	Limestone (Key Largo)	10	3	5	10	20	40
K2-13-003	B-728	CS-04	54.0	Limestone (Fort Thompson)	18	5	9	18	47	72
K2-13-004	R-7-1	SC-3	40.8	Limestone (Key Largo)	14	Test Not Performed (see Appendix E)				
K2-13-005	R-6-1b	SC-3	47.9	Limestone (Fort Thompson)	16	4	8	16	45	64
K2-13-006	R-6-1b	ST-1	136.3	Silty Sand (SM)	46	11	23	46	82	183
K2-13-007	R-7-1	ST-5	208.2	Silty Sand (SM)	70	18	35	70	121	281
K2-13-008	R-6-1b	ST-2	147.3	Disturbed	49	Test Not Performed (see Appendix I)				
K2-13-009	R-6-1b	ST-7	172.0	Silty Sand (SM)	58	14	29	58	101	232

3.3 RCTS TEST RESULTS

The RCTS test summary data plots for the tested specimens are presented in Appendices B through J of this report. Dynamic properties are affected by numerous in-situ conditions. The RCTS method allows for comparisons of critically affecting factors relative to low-amplitude shear modulus (G_{max}) and shear wave velocity (V_s), low-amplitude material damping ratio (D_{min}), as well as nonlinear dynamic properties such as normalized shear modulus (G/G_{max}) and material damping ratio (D). The following summary plots are included in Appendices B through J:

- G_{max} and D_{min} versus time of confinement;
- Void ratio (e) and total unit weight versus time of confinement;
- V_s, G_{max} and D_{min} versus isotropic confining pressure;
- Void ratio (e) and total unit weight versus isotropic confining pressure;
- G, G/G_{max} and D versus:
  - Shearing strain;
  - Number of cycles; and
  - Excitation Frequency.

3.4 COMPARISON OF RCTS TEST RESULTS

The results of the RCTS testing were divided into three groups for comparison. The grouping was based on material classification and consisted of the following general rock/soil types:

- Limestone (Key Largo Formation);
- Limestone (Fort Thompson Formation); and
- Silty Sand (SM).

Low-amplitude (small shearing strain) shear modulus and material damping ratio results are presented in Figures 3.4-1 and 3.4-2. In the figures, the relationship between shear modulus and confining pressure and material damping ratio and confining pressure are presented. Individual specimen results are presented in the graphs with color coding to indicate like material group. The figures show the expected trend of increasing shear modulus with increasing confining pressure and decreasing material damping ratio with increasing confining pressure.

High-amplitude (small to intermediate shearing strain) normalized shear modulus reduction and material damping ratio results are presented in Figures 3.4-3 to 3.4-8. In the figures, the relationship between normalized shear modulus and shearing strain and material damping ratio and shearing strain are presented for specimens at their in-situ mean effective stresses. Results have been grouped together based on material type. The figures show the expected trend of decreasing normalized shear modulus with increasing shearing strain and increasing material damping ratio with increasing shearing strain. For reference purposes, the Electric Power Research Institute (EPRI) nonlinear "degradation curves" for sands at various depths (EPRI, 1993) have been included in the figures.

Curve fits were developed for the high-amplitude results of the three material groups and are presented in Figures 3.4-3 to 3.4-8 as a yellow line. The lines are solid in the range of shearing strain tested in the laboratory and dashed in the projected range beyond that tested. Curve fits were performed using the functions developed by Darendeli (2001) which requires defining the following three parameters:

- 'a' the slope of the curve;
- 'γ_r' the shearing strain at G/G_{max} of 0.5; and
- 'D_{min}' the minimum material damping ratio.

The Darendeli Parameters for the three material groups are presented in text boxes within Figures 3.4-3 to 3.4-8 and summarized in Table 3.4-1 below.

Table 3.4-1 Summary of Darendeli (2001) Curve Fit Parameters by Material Type

		Darendeli (2001) Curve Fit Parameters		
Material Type	**RCTS Specimens**	**a**	**γ_r, %**	**D_{min}, %**
Limestone (Key Largo Formation)	K2-13-001, K2-13-002	1.11	$1.62x10^{-1}$	0.57
Limestone (Fort Thompson Formation)	K2-13-003, K2-13-005	0.95	$8.43x10^{-2}$	0.56
Silty Sand (SM)	K2-13-006, K2-13-007, K2-13-009	0.95	$1.04x10^{-1}$	0.50

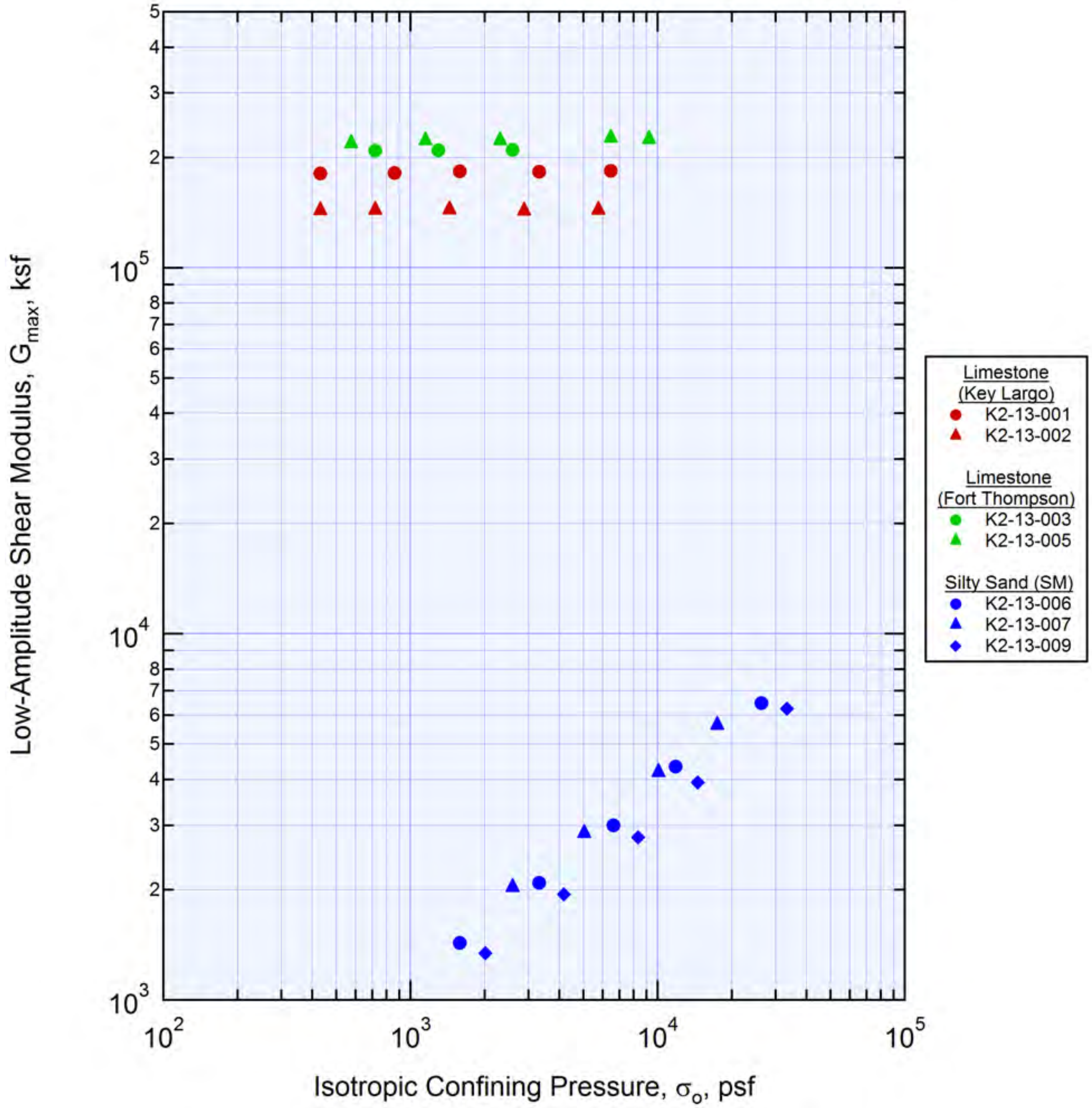

Figure 3.4-1 Variation in Small-Strain Shear Modulus with Confining Pressure

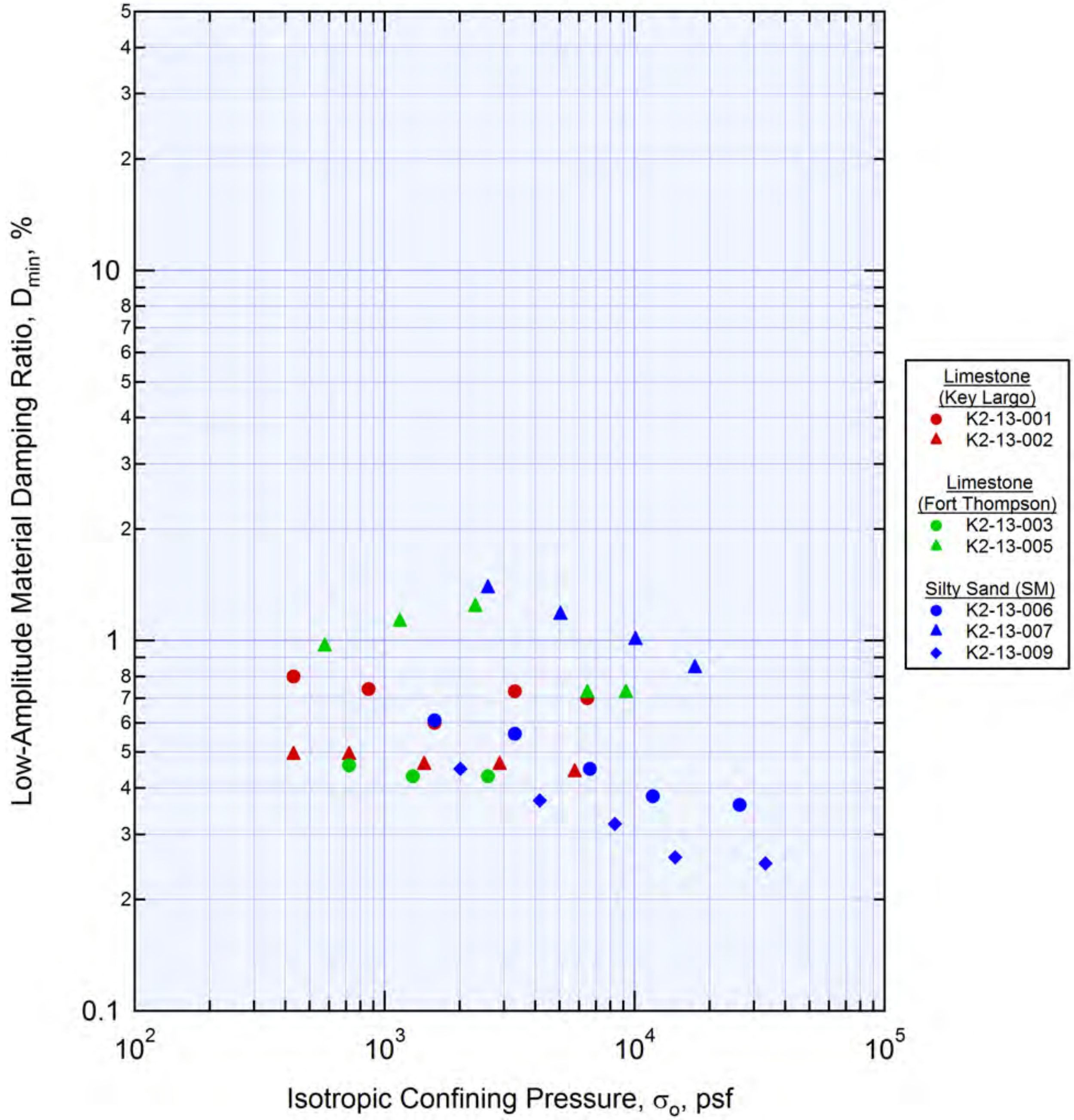

Figure 3.4-2 Variation in Small-Strain Material Damping Ratio with Confining Pressure

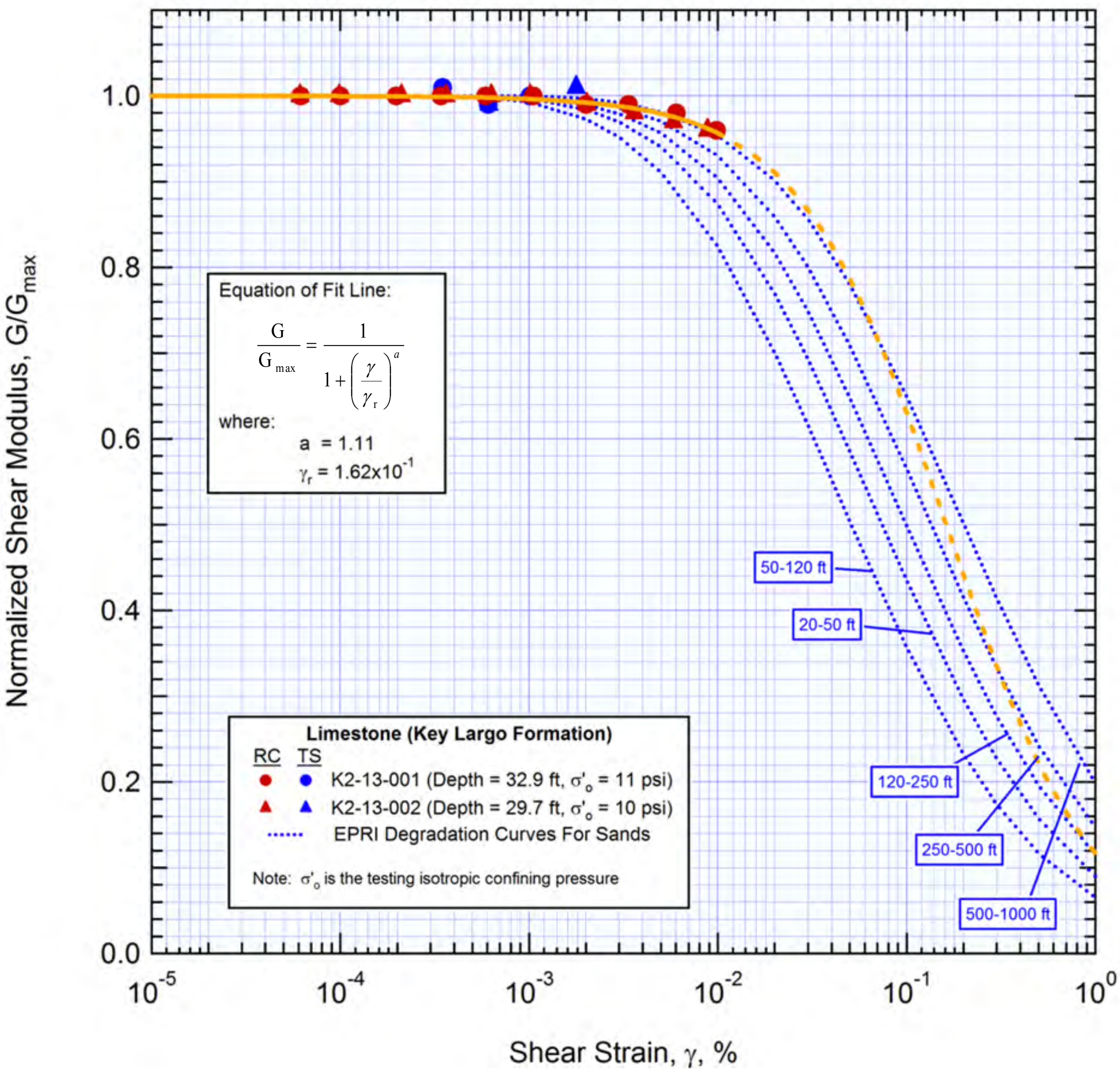

Figure 3.4-3 Variation in Normalized Shear Modulus with Shearing Strain of the Key Largo Limestone Specimens at Their Estimated Mean Effective Stress (Electric Power Research Institute Degradation Curves for Sand Plotted for Reference)

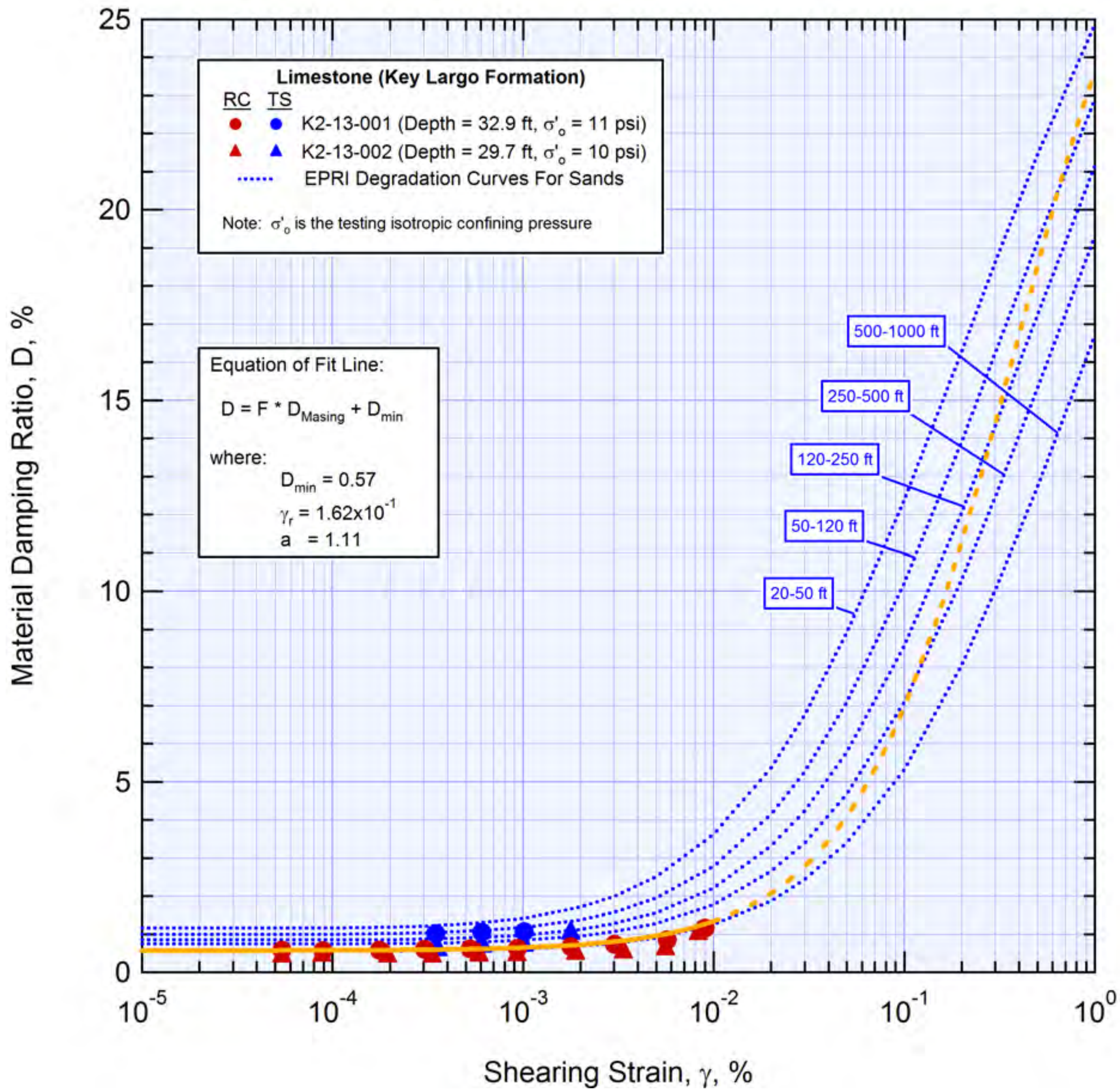

Figure 3.4-4 Variation in Material Damping Ratio with Shearing Strain of the Key Largo Limestone Specimens at Their Estimated Mean Effective Stress (Electric Power Research Institute Degradation Curves for Sand Plotted for Reference)

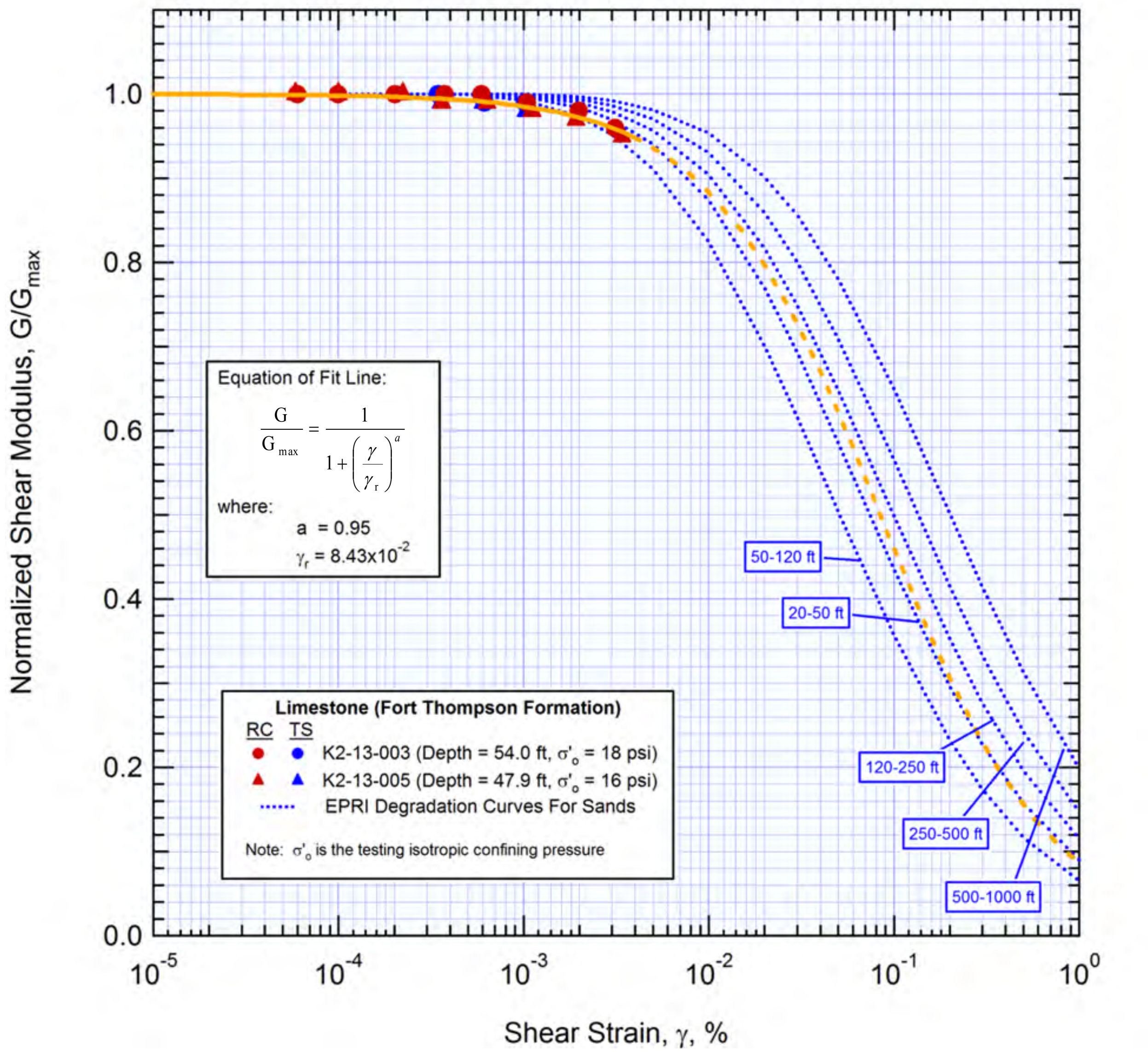

Figure 3.4-5 Variation in Normalized Shear Modulus with Shearing Strain of the Fort Thompson Limestone Specimens at Their Estimated Mean Effective Stress (Electric Power Research Institute Degradation Curves for Sand Plotted for Reference)

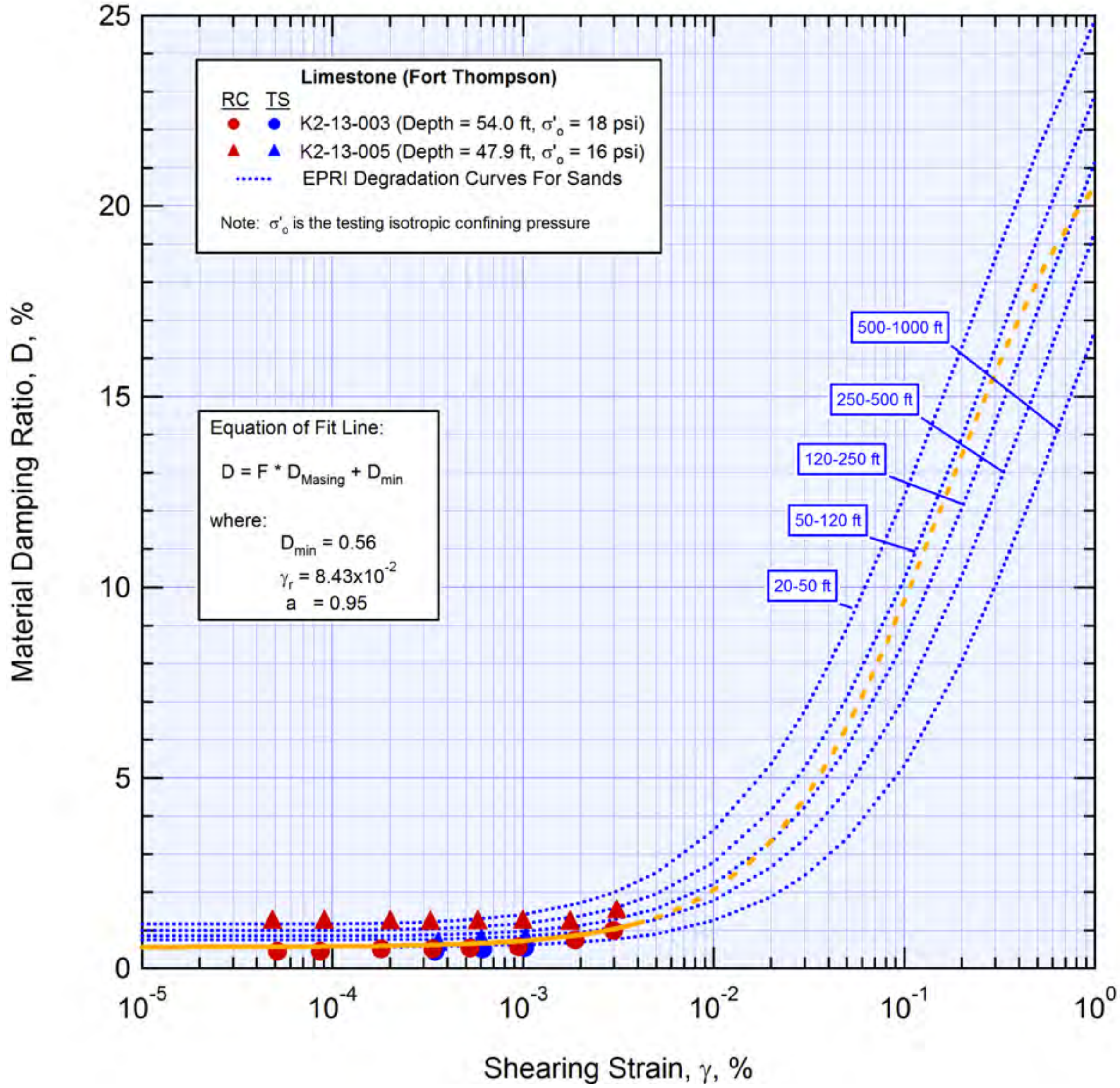

Figure 3.4-6 Variation in Material Damping Ratio with Shearing Strain of the Fort Thompson Limestone Specimens at Their Estimated Mean Effective Stress (Electric Power Research Institute Degradation Curves for Sand Plotted for Reference)

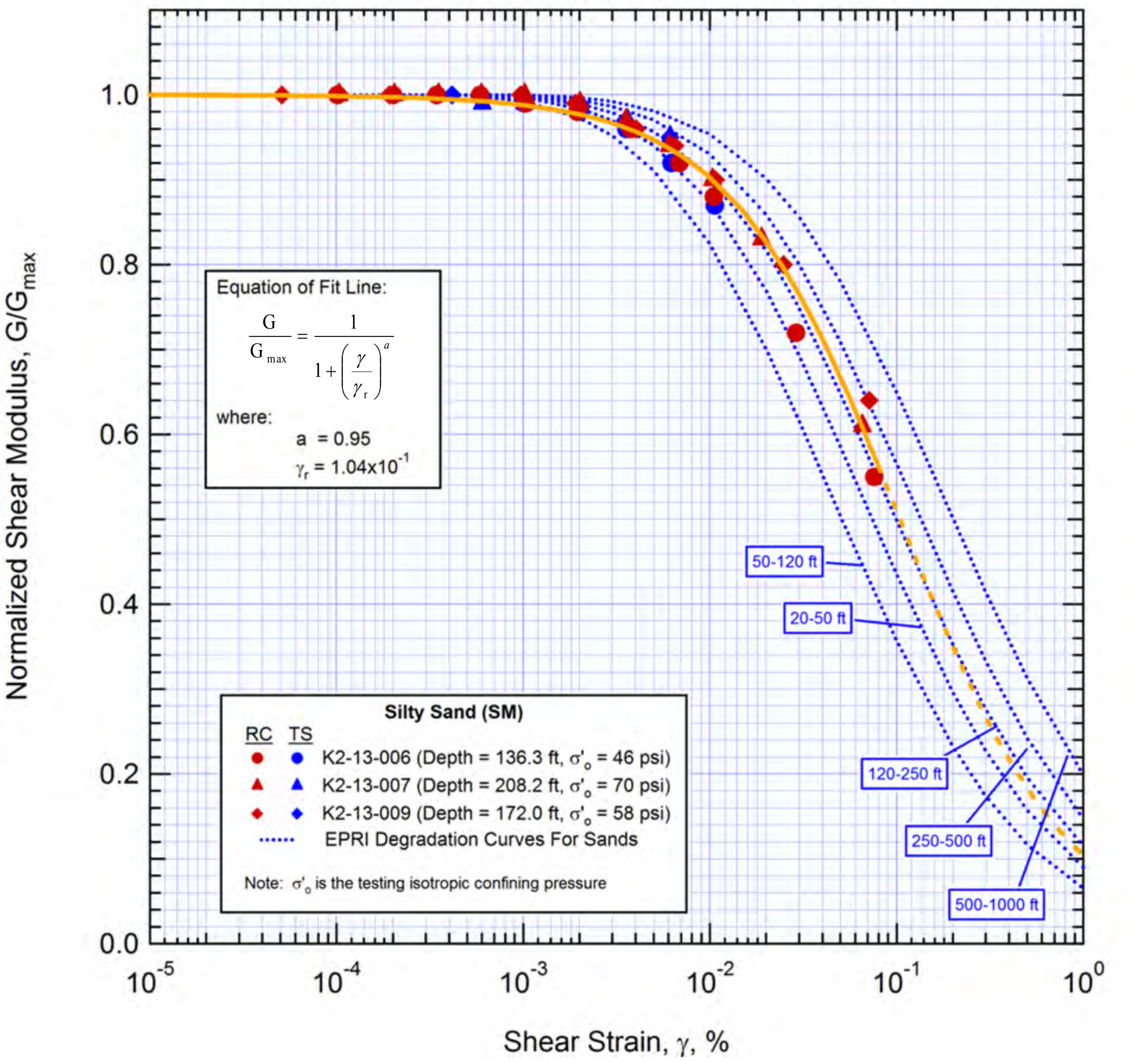

Figure 3.4-7 Variation in Normalized Shear Modulus with Shearing Strain of the Silty Sand Specimens at Their Estimated Mean Effective Stress (Electric Power Research Institute Degradation Curves for Sand Plotted for Reference)

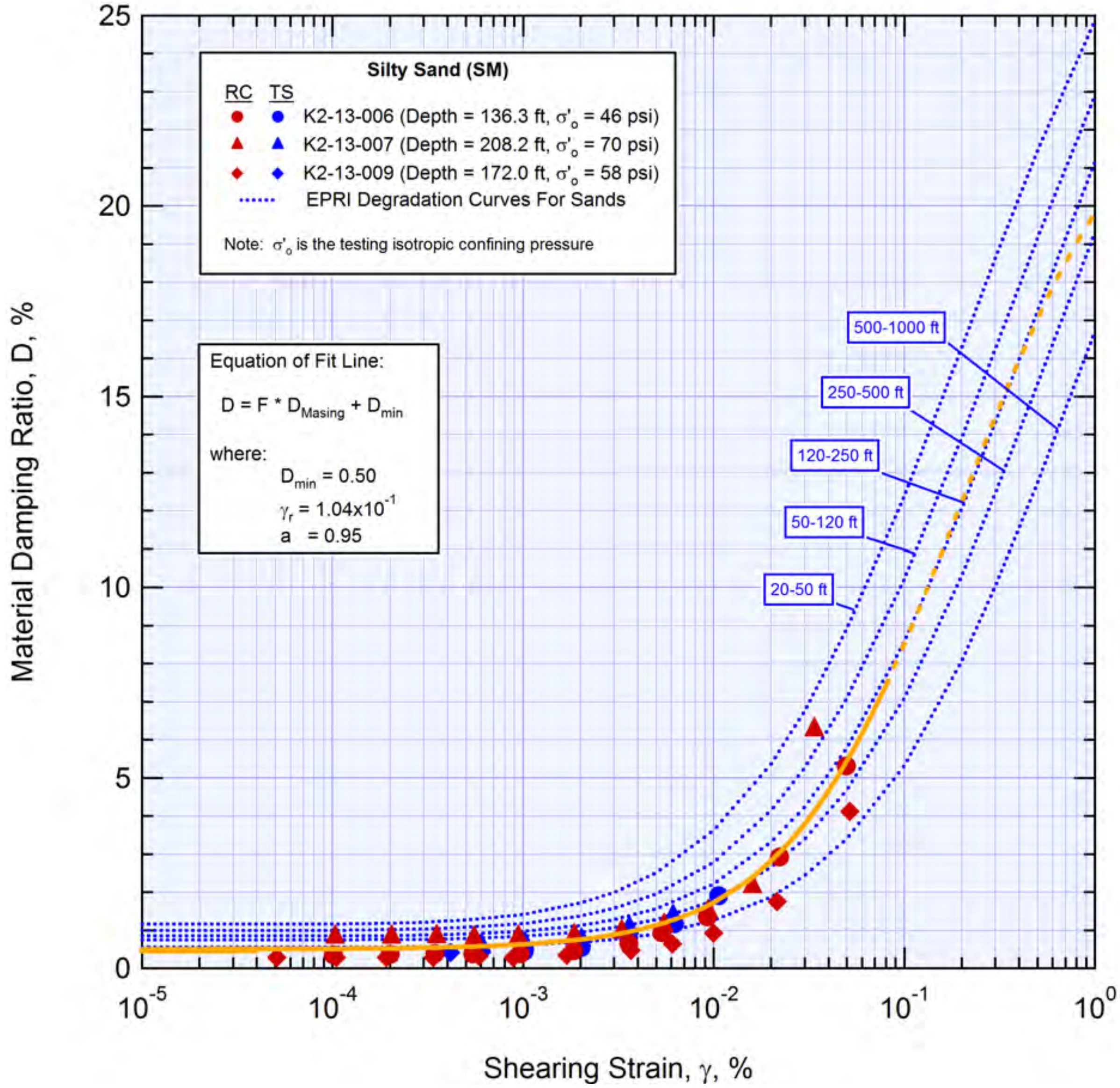

Figure 3.4-8 Variation in Material Damping Ratio with Shearing Strain of the Silty Sand Specimens at Their Estimated Mean Effective Stress (Electric Power Research Institute Degradation Curves for Sand Plotted for Reference)

3.5 QUALITY OF TEST RESULTS

The quality of results for RCTS tests are characterized by evaluating the raw and reduced test data. The following criteria may be considered in the evaluation of test quality.

- Quality of Waveforms;
- Consistency of Sample;
- Expected Data Trends;
- Comparison of RC and TS Data; and
- Comparison of RCTS Data to Field Dynamic Property Measurements.

Although a detailed interpretation of the data is beyond the scope of this data report, the following discussion highlights some considerations of the test data.

3.5.1 Quality of Waveforms

For the seven completed RC tests, one dominant, properly aligned, resonant peak, a valid free vibration decay response, and a low noise to signal ratio in both the time and frequency domain was generally observed from small to intermediate shearing strains, roughly between $1x10^{-4}$% and $1x10^{-2}$% for the limestone samples and between $1x10^{-4}$% and $7x10^{-2}$% for the silty sand samples. For the limestone samples, abnormal resonance curves (e.g. wide curves with ambiguous peaks) were generally observed at strains greater than about $1x10^{-2}$%. Where such conditions were observed, we were not able to measure credible dynamic properties.

For the completed TS tests, proper hysteretic torsional stress – shearing strain loop and low noise to signal ratio were typically also observed from small to intermediate shearing strains, roughly between $3x10^{-4}$% and $2x10^{-3}$% for the limestone samples and $4x10^{-4}$% and $1x10^{-2}$% for the silty sand samples. The TS tests were generally performed at increasing shearing strains until the limit of our power delivery system was reached.

The overall quality of waveforms was excellent for the range of shearing strains noted above.

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3.5.2 Consistency of Samples

The limestone samples exhibited variable amounts of solution pitting (i.e. vugs). Due to their random orientation, the consistency of the test specimens were heterogeneous with the more vuggy or porous specimens exhibiting a lower unit weight. There is a trend of increasing small-strain shear wave velocity with corresponding increased unit weight for the four limestone specimens.

The silty sand samples were a uniform, fine-grained sand with a slight plasticity due to the silt content. Little apparent disturbance of the soil was observable in the tested specimens. The initial total unit weights of the three specimens were similar, ranging from about 118 to 120 pounds per cubic feet. Due to the increase of confining pressure at the start of successive low-amplitude pressure stages, these specimens often exhibited differential settlement / tilting. If the specimen distortion was significant, the test had to be temporarily suspended to re-adjust the coils around the magnets/drive plate.

3.5.3 Expected Data Trends

The relatively high shear modulus values and low material damping (about 1 percent or less) are typical for medium strong, intact limestone. The limestone samples exhibited a very slight increase in G_{max} and slight decrease in D with a corresponding increase in confining pressure as anticipated. On the comparison plots illustrating the dynamic non-linear properties, a slight amount of modulus reduction and increase in damping ratio was observed in the range of shearing strains tested. The EPRI reduction curves for sand are shown as a point of reference only since there is a lack of published non-linear dynamic properties for limestone.

The completed tests of silty sand samples exhibited typical sand data trends including an increase of G and decrease of D with increasing time and magnitude of confinement. As shown on the comparison plots, the shapes of the G/G_{max} versus shearing strain and D versus shearing strain curves compare well to the EPRI degradation curves of sandy soils in similar depth ranges to those tested.

Overall, typical data trends for the soil and rock tested were observed.

3.5.4 Comparison of RC and TS Data

For the completed tests, there is an excellent overall corroboration in magnitude of values and similarity of data trends between RC and TS tests. These corroborative measurements from separate tests may be observed on the plots of G and D with increasing excitation frequency and plots of G/G_{max} and D versus shearing strain.

3.5.5 Comparison of RCTS Data to Field Dynamic Property Measurements

Kleinfelder did not review field dynamic properties measurements from the site. However, such a comparison could be useful to document the corroboration between the measured RCTS low-strain shear modulus results and the shear wave velocities recorded in the field.

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4.0 LIMITATIONS

The data, and findings contained in this report were developed based on laboratory tests performed on samples collected, provided by, authorized and approved by Rizzo. This report was prepared in accordance with the approved Laboratory Test Plan. No warranty, expressed or implied, is made. It is the client's responsibility to see that all parties to the project, including the designer, contractor, subcontractors, and other authorized users are made aware of this report in its entirety. The use of information contained in this report for design and construction-bidding purposes should be done at the user's option and risk.

Other standards or documents referenced in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard; they are not incorporated into it or "included by reference" as that latter term is used relative to contracts or other matters of law.

This report may be used only by the client and their designees only for the purposes stated, within reasonable time from the issuance. Land or facility use, site conditions (both on- and off-site), regulations, or other factors may change over time, and additional work may be required with the passage of time.

As the samples tested were sampled and transported to our laboratory by parties other than Kleinfelder staff, this report makes no representation of whether the samples are representative of the material onsite.

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5.0 REFERENCES

Darendeli, M., 2001, “Development of a New Family of Normalized Modulus Reduction and Material Damping Curves,” PhD. Dissertation, Department of Civil Engineering, University of Texas, Austin, pp. 362.

Electrical Power Research Institute (EPRI), 1993, “Guidelines for Determining Design Basis Ground Motions, Vol. 2: Appendices for Ground Motion Estimation”, EPRI TR 102293, Project 3302.

Kleinfelder West, Inc., 2012, “Measurement of Soil and Rock Dynamic Properties by the Resonant Column and Torsional Shear Method”, KNS-TP-8.10, Rev 2, May 30, 2012.

Kleinfelder West, Inc., 2013a, “Laboratory Testing Work Plan, Dynamic Property Testing of Soil and Rock Samples, Turkey Point Nuclear Power Plant Units 6 & 7,” Document Number 136473.3-ALB13WP001, Rev. 2, December 10, 2013.

Kleinfelder West, Inc., 2013b, “Quality Assurance Project Plan Checklist,” Document Number 136473.6-ALB13QP001, Rev. 1, November 28, 2013.

Paul C. Rizzo Associates, Inc., 2013,”Laboratory Testing Work Plan, Supplemental Geological, Geotechnical, and Geophysical Field Investigation Program, Turkey Point Nuclear Power Plant Units 6 and 7,” Document Number 135054/13, Revision No. 4, November 18, 2013.

APPENDIX A

RCTS Testing of Soil and Rock Samples

RCTS TESTING OF SOIL AND ROCK SAMPLES

1.0 INTRODUCTION

Resonant column and torsional shear (RCTS) equipment shall be employed in this investigation for measurement of the deformational characteristics (shear modulus and material damping in shear) of soil and rock specimens. The design of this equipment was developed at The University of Texas at Austin (Isenhower, 1979; Lodde, 1982; Ni, 1987; and Kim, 1991) and construction of the hardware and software was performed by Troutwein Soil Testing Equipment, Inc. The equipment is of the fixed-free type, with the bottom of the specimen fixed and torsional excitation applied to the top. Both resonant column (RC) and torsional shear (TS) tests can be performed in a sequential series on the same specimen over a shearing strain range from about 10^{-4}% to slightly more than 10^{-1}%. The primary difference between the two types of tests is the excitation frequency. In the RC test, frequencies above 20 Hz are required and inertia of the specimen and drive system are needed to analyze the measurements. On the other hand, slow cyclic loading involving frequencies generally below 10 Hz is performed in the TS test and inertia does not enter into data analysis.

2.0 RESONANT COLUMN AND TORSIONAL SHEAR EQUIPMENT

The RCTS apparatus can be idealized as a fixed-free system as shown in Fig. 1. The bottom end of the specimen is fixed against rotation at the base pedestal, and top end of the specimen is connected to the driving system. The driving system, which consists of a top cap and drive plate, can rotate freely to excite the specimen in cyclic torsion.

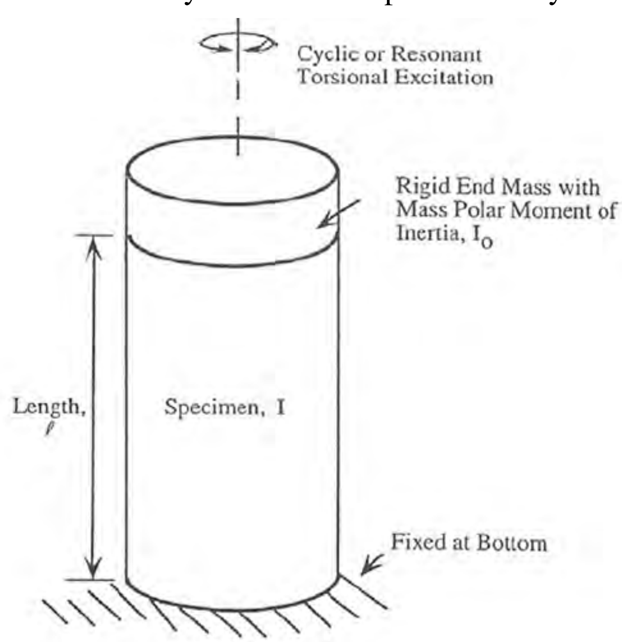


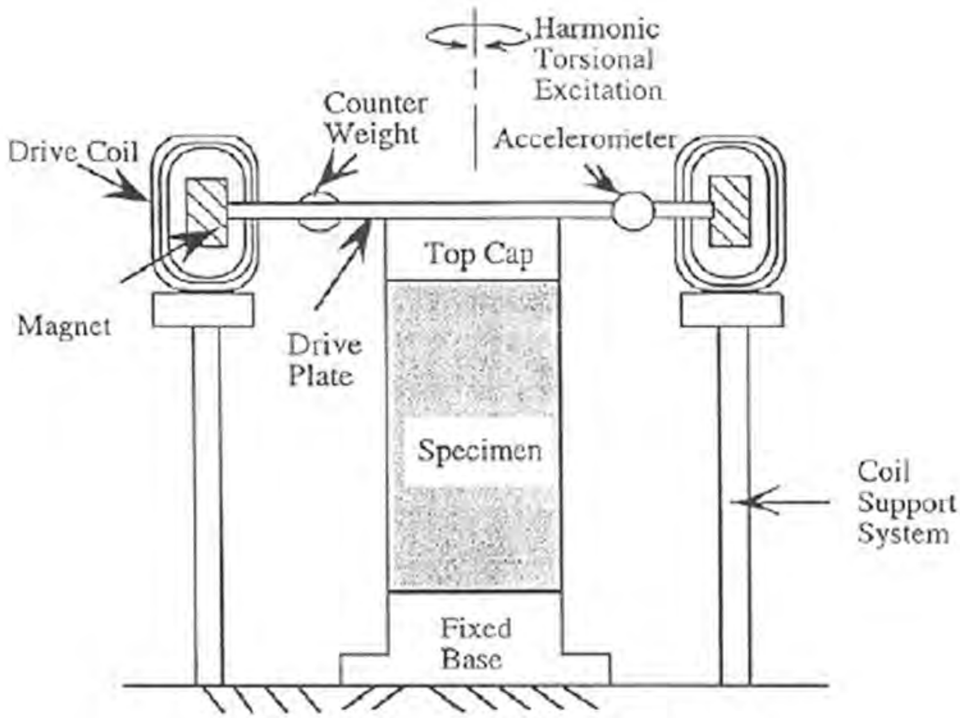
Figure 1. Idealized Fixed-Free RCTS Equipment

A simplified diagram of a fixed-free resonant column (RC) test is shown in Fig. 2. The basic operational principle is to vibrate the cyclindrical specimen in first-mode torsional motion. Harmonic torsional excitation is applied to the top of the specimen over a range in frequencies, and the variation of the acceleration amplitude of the specimen with frequency is obtained. Once first-mode resonance is established, measurements of the resonant frequency and amplitude of vibration are made. These measurements are then combined with equipment characteristics and specimen size to calculate shear wave velocity and shear modulus based on elastic wave propagation. Material damping is determined either from the width of the frequency response curve or from the free-vibration decay curve.

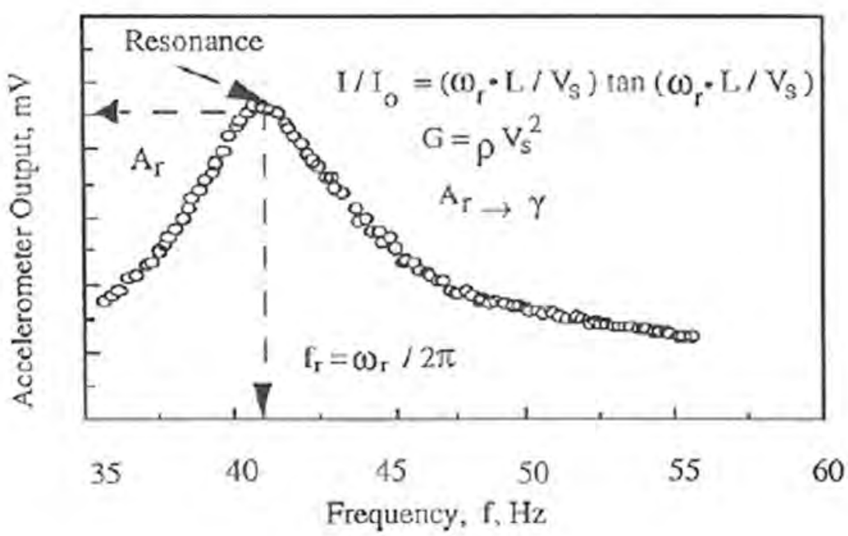
The torsional shear (TS) test is another method of determining shear modulus and material damping using the same RCTS equipment but operating it in a different manner. The simplified configuration of the torsional shear test is shown in Fig. 3. A cyclic torsional force with a given frequency, generally below 10 Hz, is applied at the top of the specimen. Instead of determining the resonant frequency, the stress-strain hysteresis loop is determined from measuring the torque-twist response of the specimen. Proximitors are used to measure the angle of twist while the voltage applied to the coil is calibrated to yield torque. Shear modulus is calculated from the slope of a line through the end points of the hysteresis loop, and material damping is obtained from the area of the hysteresis loop as shown in Fig. 3.

The RCTS apparatus used in this study has three advantages. First, both resonant column and torsional shear tests can be performed with the same set-up simply by changing (outside the apparatus) the frequency of the forcing function. Variability due to preparing “identical” samples is eliminated so that both rest results can be compared effectively. Second, the torsional shear test can be performed over a shearing strain range between 5 x 10^{-4}% and about 1 x 10^{-1}%, depending upon specimen stiffness. Common types of torsional shear tests, which generate torque by a mechanical motor outside of the confining chamber, are usually performed at strains above 0.01% because of system compliance. However, the RCTS apparatus used in this study generates torque with an electrical coil magnet system inside the confining chamber, thus eliminating the problem with an external motor. The torsional shear test can be performed at the same low-strain amplitudes as the resonant column test, and results between torsional shear and resonant column testing can be easily compared over a wide range of strains. Third, the loading frequency in the torsional shear test can be changed easily from 0.01 Hz to 10 Hz. Therefore, the effect of frequency on deformational characteristics can be conveniently investigated using this apparatus.

The RCTS apparatus consists of four basic subsystems which are: 1. a confinement system, 2. a drive system, 3. a height-change measurement system, and 4. a motion monitoring system. The general configuration of the RCTS apparatus (without the confinement system) is shown in Fig. 4. The RCTS is automated so that a microcomputer controls the test, collects the data, and reduces the results. Computer aided subsystems are discussed in the following sections.

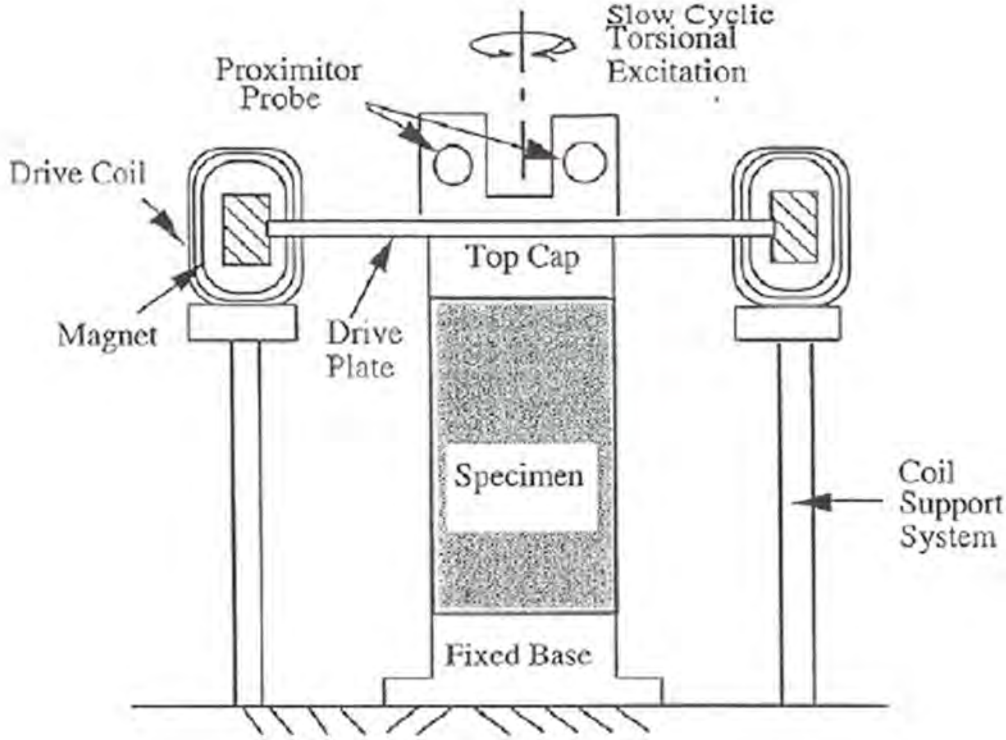


a) Specimen in the Resonant Column Apparatus
(Confinement Chamber Not Shown)

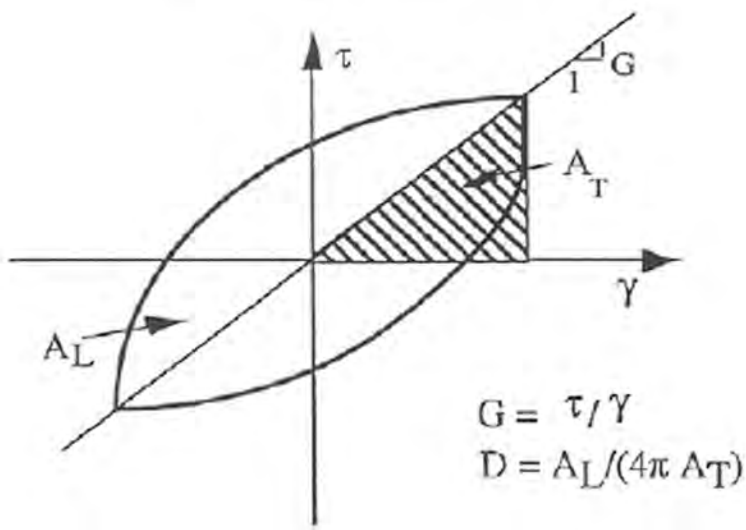


b) Typical Frequency Response Curve

Figure 2. Simplified Diagram of a Fixed-Free Resonant Column Test and an Associated Frequency Response Curve

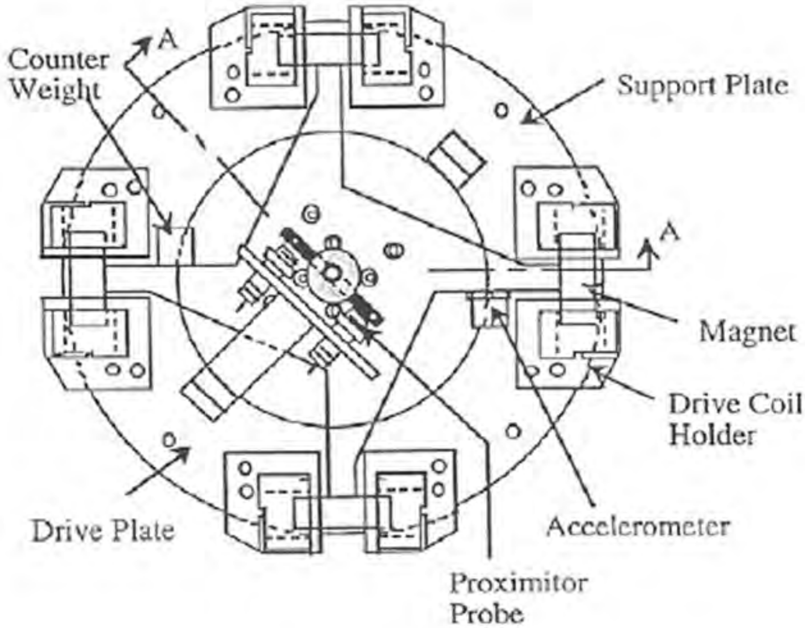


a) Specimen in the Torsional Shear Test Apparatus
(Confinement Chamber Not Shown)

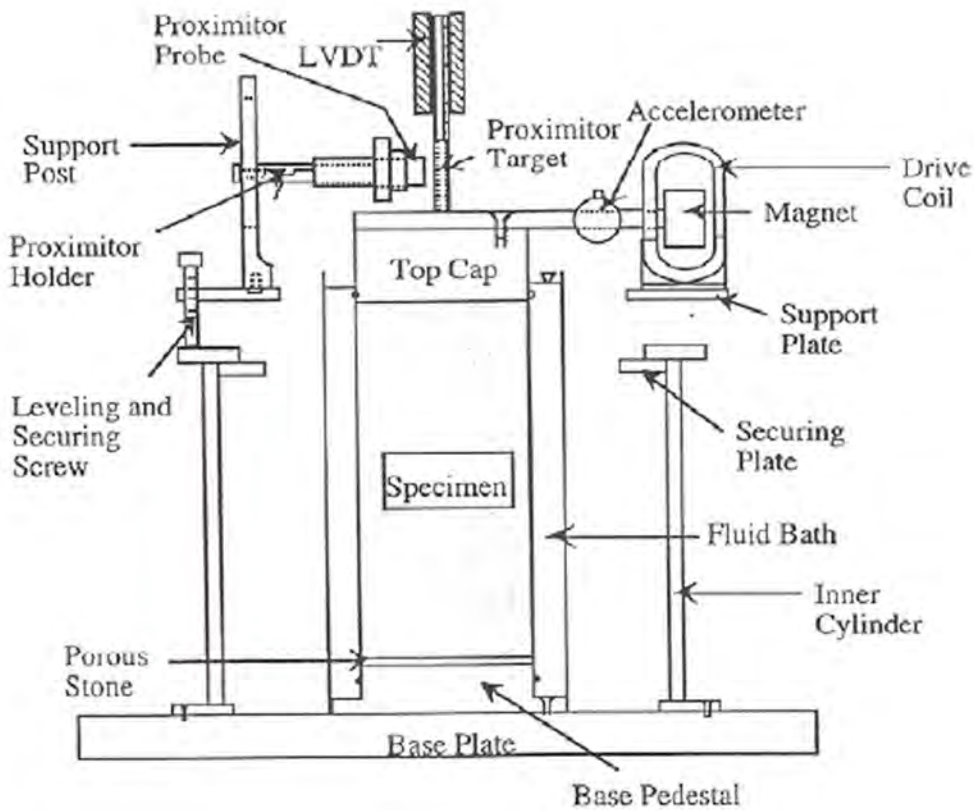


b) Measurement of Shear Modulus and Damping Ratio

Figure 3. Configuration of a Torsional Shear Test and Evaluation of Shear Modulus and Material Damping Ratio



a) Top View



b) Cross Section View

Figure 4. Simplified Configuration of the RCTS Apparatus.

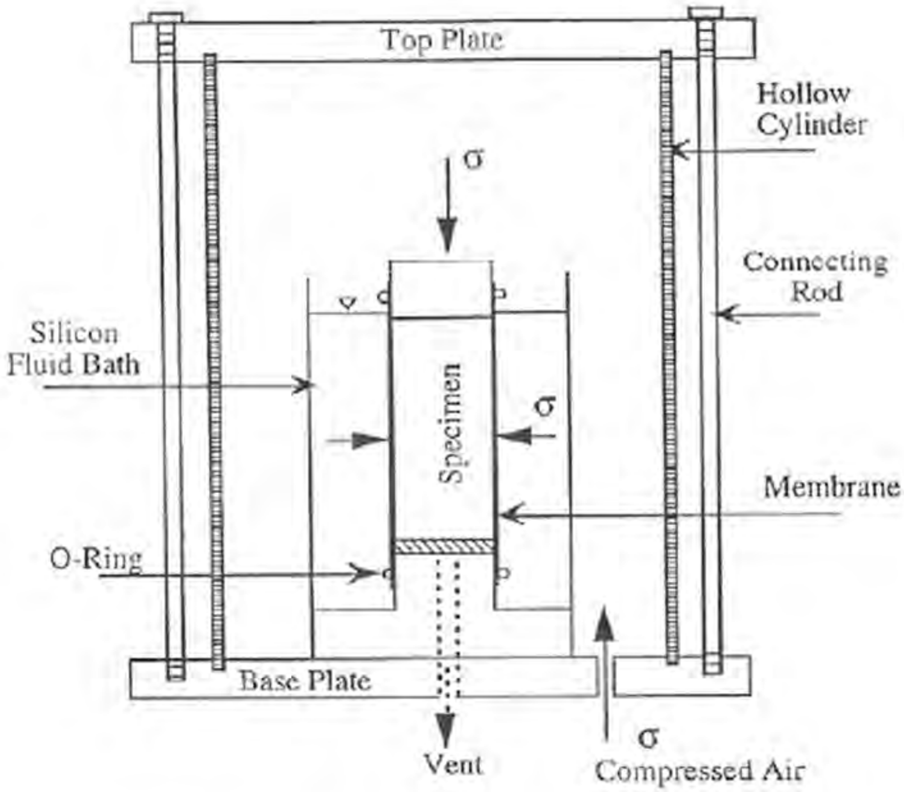


Figure 5. Simplified Configuration of Confinement System

2.2 RCTS Confinement System

The confining chamber is made of stainless steel. A thin walled hollow cylinder fits into circular grooves machined in base and top plates. Six stainless steel connecting rods are used to secure the base and top plates to the hollow cylinder, and O-rings in the circular grooves are used to seal the chamber. In this configuration, the chamber has been designed to withstand a maximum air pressure of about 500 psi (3447 kPa).

Compressed air is used to confine isotropically the specimen in the RCTS device. The air pressure to the chamber generally is regulated by a Fairchild M 10 regulator and air supplied to the regulator is filtered. At high confining pressures, additional regulators are used. The soil specimen is sealed in a membrane and pore pressure in the specimen is vented to atmospheric pressure.

The only calibrated portions of the confinement system are the pressure gauges which are used to read the cell air pressure. These gauges are calibrated every year.

2.3 Drive System

The drive system consists of a four-armed drive plate, four magnets, eight drive coils, a power amplifier, and a function generator internal to the data acquisition (DAQ) board. Each magnet is rigidly attached to the end of one arm of the drive plate as shown in Fig. 4. Eight drive coils encircle the ends of the four magnets so that the drive plate excites the soil specimen in torsional motion when a current is passed through the coils. The maximum torque that the drive system can develop depends on the strength of the magnets and drive coils, length of the arms of the drive plate, and the electrical characteristics of the function generator and power amplifier.

The DAQ board (NI M-Series PCI6251) within the micro-computer outputs sinusoidal voltage to the power amplifiers (Geotac DV604), which amplify the voltage approximately 15 to 20 times, and outputs the signal to the drive coils. In the resonant column (RC) test, the DAQ board performs frequency sweeps with a constant amplitude, while in the torsional shear test a fixed-frequency N-cycle mode is used.

Two aspects of the drive system in the RCTS equipment system have to be calibrated. First, the mass polar moment of the inertia, I_o, of each drive plate and top cap must be determine. This is done using specimens made of metal rods which are used as fixed-free torsional pendulums as discussed by Isenhower (1979) and Lodde (1982). The second aspect consists of determining the torque-current calibration factor for each drive plate. This process also involves use of the metal rods as discussed by Isenhower and Lodde. These calibrations are performed every year.

2.4 Height-Change Measurement System

The height change of the specimen is measured to account for the changes in the length and mass of the specimen during consolidation or swell. This measurement is also used to calculate change in the mass moment of inertia, mass density, and void ratio during testing (by assuming isotropic strain under isotopic confinement and constant degree of saturation). The height change is measured by a linear variable differential transformer (LVDT). The height change measurement system consists of an LVDT (TransTek Model 0243) and a monitor system (TESTNet). The LVDT core rests on a raised platform at the center of rotation of the drive plate to minimize friction during RCTS testing.

2.5 Motion Monitoring System

Dynamic soil and rock properties are obtained in the RC test at the resonant frequency which is usually above 20 Hz while torsional shear testing is used to measure the low-frequency (below 10 Hz) cyclic stress-strain relationship of soil. Because of the different frequencies applied in the resonant column and torsional shear tests, different motion monitoring systems are used.

Resonant Column (RC) Test

The motion monitoring system in the RC test is designed to measure the resonant frequency, shearing strain, and free-vibration decay curve. This system consists of an accelerometer (Columbia Research Laboratory Model 3021), a charge amplifier (Columbia Research Laboratory Model 4601), and the DAQ Board. The accelerometer and charge amplifier is calibrated once ever two years.

The accelerometer is oriented to be sensitive to torsional vibrations of the drive plate. The charge amplifier conditions the accelerometer output to be linear for all levels of acceleration in the test. The DAQ board reads the output voltage from the accelerometer at each frequency. The resonant frequency is obtained from the frequency response curve. Once the resonant frequency is obtained, the DAQ board outputs a signal to excite the specimen at the resonant frequency and then suddenly stops the current so that the free-vibration decay curve is recorded. The resonant frequencies of soil and rock specimens are typically in the range of 20 Hz to 300 Hz with this equipment.

Torsional Shear (TS) Test

The motion system in the TS test (3300 Proximitor System) is used to monitor torque-twist hysteresis loops of the specimen this system consists of two proximitors (Bently Nevada 3300XL 5/8 mm), two proximitor probes (Bently Nevada M 3300XL 8 mm), a Proximitor Signal Conditioner (PROX) (Geotac AMP804), a DC power supply (Geotac DV604), and a U-shaped target. The U-shaped target is secured to the top of the drive plate, and the two proximitor probes are rigidly attached to the support stand. The entire system is calibrated yearly using a micrometer as discussed in ALB-SOP-8.2.

The function of the proximitor probes is to measure the width of the air gap between the target and the probe tip. Because the proximitor probes do not touch the drive plate, no compliance problems are introduced into the measurement. Two probes are used and the operational amplifier subtracts the signal of one probe from the other so that the effect of bending in the specimen toward the probes can be eliminated. The proximitor system is a very effective low-frequency motion monitoring system which does not introduce any compliance problems into the measurement. With the simultaneous measurement of torque, load-displacement hysteresis loops can be determined.

3.0 METHOD OF ANALYSIS IN THE RESONANT COLUMN TEST

The resonant column test is based on the one-dimensional wave equation derived from the theory of elasticity. The shear modulus is obtained by measuring the first-mode resonant frequency while material damping is evaluated from either the free vibration decay curve or from the width of the frequency response curve assuming viscous damping.

3.1 Shear Modulus

The governing equation of motion for the fixed-free torsional resonant column test is:

$$\frac{\Sigma I}{I_o} = \frac{\varpi_n \times \ell}{V_s} \times \tan\left(\frac{\omega_n \times \ell}{V_S}\right) \qquad \text{(Equation 1)}$$

where:

$\Sigma I = I_s + I_m + \ldots$,
I_s = mass moment of inertia of specimen,
I_m = mass moment of inertia of membrane,
I_o = mass moment of inertia of rigid end mass at the top of specimen,
ℓ = length of specimen,
V_s = shear wave velocity of the specimen, and
ω_n = undamped natural circular frequency of the system.

The value of I_o is known from the calibration of the drive plate. The values of I_s and ℓ are easily determined from the specimen size and weight. Once the first-mode resonant frequency is determined, the shear wave velocity can be calculated from Eq. 1 by assuming the resonant circular frequency and ω_n are equal.

As noted above and shown in Fig. 2 the resonant circular frequency, ω_r, is measured instead of undamped natural frequency, ω_n, and ω_r is used to calculate shear wave velocity. If the damping in the system is zero, ω_r and ω_n are equal. The relationship between ω_r and ω_n is:

$$\omega_r = \omega_n \sqrt{1 - 2D^2} \qquad \text{(Equation 2)}$$

where:

D = material damping ratio.

A typical damping ratio encountered in the resonant column test is less than 20 percent, which corresponds to a difference of less than 5 percent between ω_r and ω_n. The damping measured in the resonant column test is usually less than 10 percent, and ω_r can by used instead of ω_n with less than a two percent error.

Once the shear wave velocity is determined, shear modulus is calculated from the relationship:

$$G = \rho \cdot V_s^2 \qquad \text{(Equation 3)}$$

where:

ρ = total mass density of the specimen (total unit weight divided by gravity).

3.2 Shearing Strain

The shearing strain varies radially within the specimen and may be expressed as a function of the distance from the longitudinal axis as illustrated in Fig. 6. The equivalent shearing strain, γ_{eq} or γ, is represented by:

$$\gamma = \frac{r_{eq} \cdot \theta_{max}}{\ell} \qquad \text{(Equation 4)}$$

where:

r_{eq} = equivalent radius,
θ_{max} = angle of twist at the top of the specimen, and
ℓ = length of the specimen.

Chen and Stokoe (1979) studied the radial distribution in shearing strain to find a value of r_{eq} for the specimen tested in the RCTS equipment to evaluate an effective strain. They found that the value of r_{eq} varied from $0.82 \cdot r_o$ for a peak shearing strain amplitude below 0.001% to $0.79 \cdot r_o$ for a peak shearing strain of 0.1% for a solid specimen. The value of 0.79 has been adopted for testing.

In the resonant column test, the resonant period (T_r, seconds), and output voltage of accelerometer (A_c, volts (RMS)) at resonance are measured. Accelerometer output is changed to displacement by using the accelerometer calibration factor (CF, volts/in/sec^2) assuming harmonic motion. The accelerometer displacement is divided by the distance (D_{ac}, inches) between the location of accelerometer and the axis of the specimen to calculate the angle of twist at the top of the specimen (θ_{max}). The shearing strain is then calculated by:

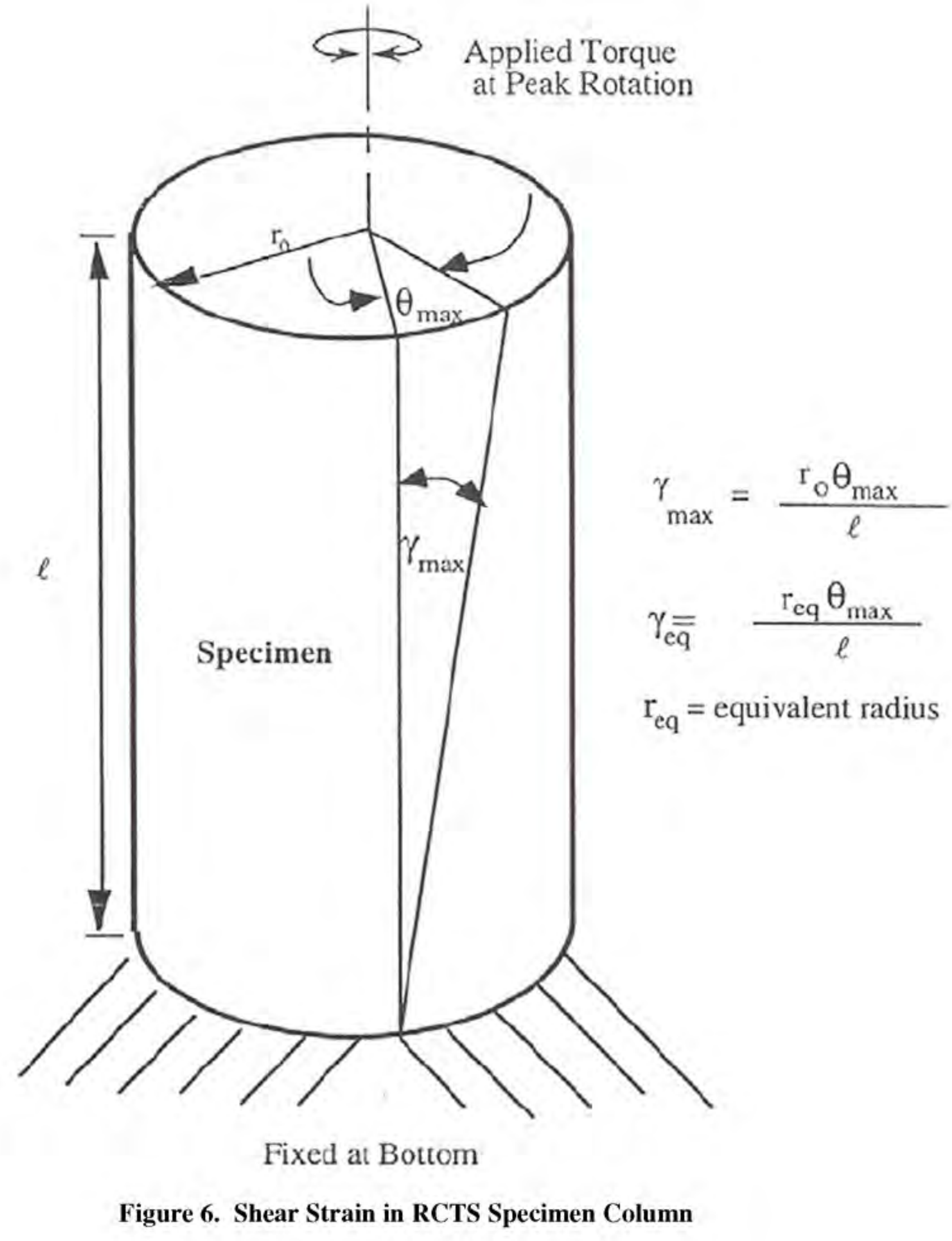


Figure 6. Shear Strain in RCTS Specimen Column

$$\gamma = r_{eq} \times \frac{A_c \times T_r^{\,2}}{4 \times \pi \times CF} \times \frac{1}{D_{ac}} \times \frac{1}{\ell} \qquad \text{(Equation 5)}$$

where:

r_{eq} = equivalent radius,
A_c = accelerometer output voltage,
T_r = resonant period,
CF = accelerometer calibration factor,
D_{ac} = distance between the accelerometers and specimen axis, and
ℓ = length of the specimen.

3.3 Material Damping

In the resonant column test, material damping ratio can be evaluated from either the free-vibration decay method or from the half-power bandwidth method. Each of these methods is discussed below. It is important to note that, in these measurements, the damping measurement includes material damping in the specimen plus any damping in the equipment. Calibration of equipment damping is discussed in Section 5.

Free-Vibration Decay Method

Material damping in soils and rock specimens can be quite complex to define. However, the theory for a single-degree-of-freedom system with viscous damping is a useful framework for describing the effect of damping which occurs in soil (Richart et al., 1970). The decay of free vibrations of a single-degree-of-freedom system with viscous damping is described by the logarithmic decrement, δ, which is the ratio of the natural logarithm of two successive amplitudes of motion as:

$$\delta = \ln\left(\frac{Z_1}{Z_2}\right) = \frac{2 \times \pi \times D}{\sqrt{1 - D^2}} \qquad \text{(Equation 6)}$$

where:

Z_1 and Z_2 = two successive strain amplitudes of motion, and
D = material damping ratio

The free-vibration decay curve is recorded by shutting off the driving force while the specimen is vibrating at the resonant frequency. The amplitude of each cycle is measured from the decay curve, and the logarithmic decrement is then calculated using Eq. 6. Material damping ratio is calculated from logarithmic decrement according to:

$$D = \sqrt{\frac{\delta^2}{4 \times \pi^2 + \delta^2}} \qquad \text{(Equation 7)}$$

A typical damping measurement from a free-vibration decay curve (from a metal calibration specimen) is shown in Fig. 7.

In this method, it is not certain which strain amplitude is a representative strain for damping ratio calculated by Eq. 7 because strain amplitude decreases during free-vibration decay. In this study, a representative strain amplitude was used as the peak strain, the representative strain is smaller than the peak strain, and the average strain determined for the first three cycles of free vibration was used.

Half-Power Bandwidth Method

Another method of measuring damping in the resonant column damping in the resonant column test is the half-power bandwidth method, which is based on measurement of the width of the frequency response curve near resonance. From the frequency response curve, the logarithmic decrement can be calculated from:

$$\delta = \frac{\pi}{2} \times \frac{{f_2}^2 - {f_1}^2}{{f_r}^2} \times \sqrt{\frac{A^2}{{A_{\max}}^2 - A^2}} \times \frac{\sqrt{1-2D^2}}{1-D^2} \qquad \text{(Equation 8)}$$

where:

f_1 = frequency below the resonance where the strain amplitude A,
f_2 = frequency above the resonance where the strain amplitude A,
f_r = resonant frequency, and
D = material damping ratio

If the damping ratio is small and A is chosen as 0.707 A_{max}, which is called the half power point, Eq. 8 can be simplified as:

$$\delta = \pi \times \frac{f_2 - f_1}{f_r} \qquad \text{(Equation 9)}$$

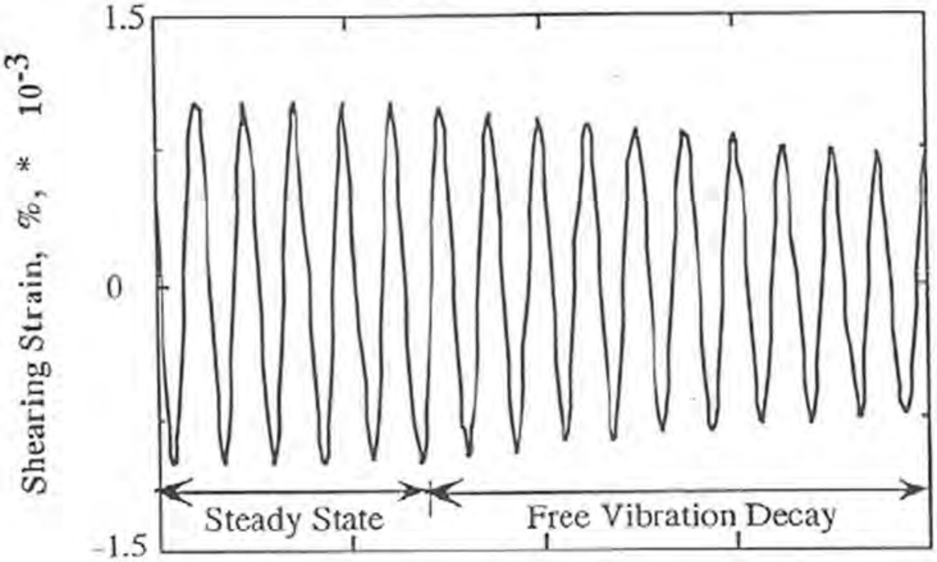
Therefore, the damping ratio can be expressed as:

$$D = \frac{f_2 - f_1}{2 \times f_r} \qquad \text{(Equation 10)}$$

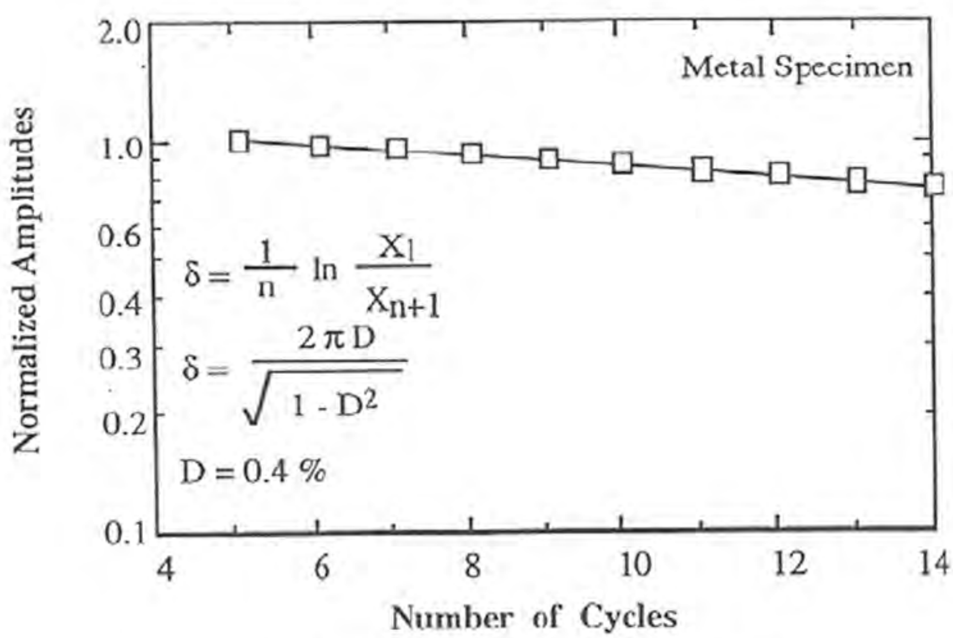
A typical damping measurement by the half-power bandwidth method (for a metal calibration specimen) is shown in Fig. 8.

Background noise can be a problem in measuring material damping using the free-vibration decay method at strains less than about 0.001%. On the other hand, background noise generally has a smaller effect on the frequency response curve at strains below 0.001%. Therefore, the half-power bandwidth method is preferred to the free-vibration decay method for making small-strain damping measurements. However, at large strains,

symmetry in the frequency response curve is no longer maintained, and a serious error can be introduced in the half-power bandwidth method (Ni, 1987).



a) free vibration decay curve



b) analysis of free-vibration decay cuve

Figure 7. Determination of Material Damping Ratio from the Free-Vibration Decay Curve Using a Metal

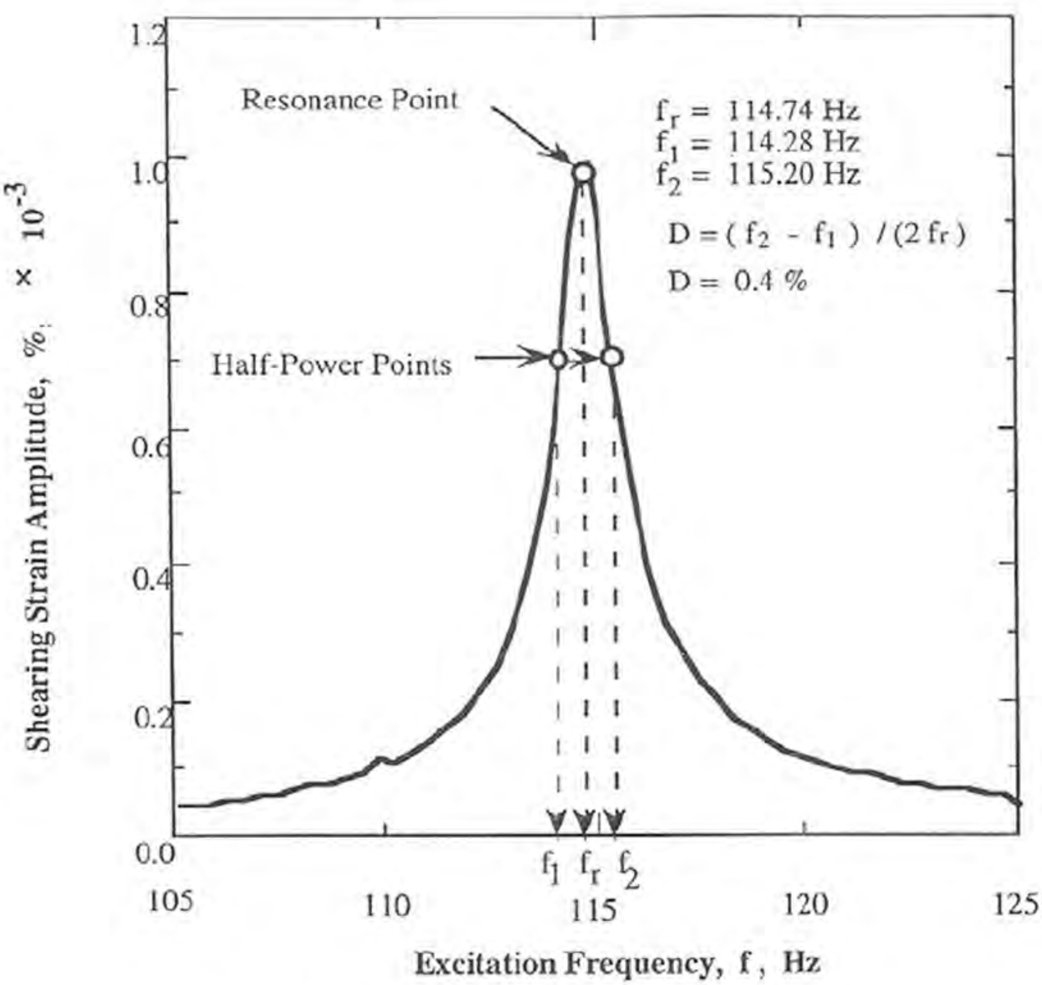


Figure 8. Determination of Material Damping from the Half-Power Bandwidth Method Using a Metal Specimen

4.0 METHOD OF ANALYSIS IN THE TORSIONAL SHEAR

The torsional shear test is another method of determining the deformational characteristics (modulus and damping) of soil and rock specimens using the same RCTS device. Rather than measuring the dynamic response of the specimen, the actual stress-strain hysteresis loop is determined by means of measuring the torque-twist curve. Shear modulus is calculated from the slope of the hysteresis loop, and the hysteric damping ratio is calculated using the area of the hysteresis loop.

4.1 Shear Modulus

Because shear modulus is calculated from the stress-strain hysteresis loop, shearing stress, and shearing strain in the torsional shear test need to be defined.
Shearing Stress

Determination of shearing stress in the torsional shear test is based on the theory of elasticity for circular or tubular rods in pure torsion. Assume that pre torque, T, is applied to the top of the specimen. The torque can be calculated from:

$$T = \int_{r_i}^{r_o} \tau_r \times (2 \times \pi \times r) \times r \, dr \qquad \text{(Equation 11)}$$

where:

τ_r = shearing stress at a distance r from the axis of the specimen,
r_o = outside radius, and
r_i = inside radius.

If the shearing stress is assumed to vary linearly across the radius:

$$\tau_r = \tau_m \times \left(r / r_o \right) \qquad \text{(Equation 12)}$$

where τ_m is the maximum shearing stress at $r = r_o$. Eq. 12 can be rewritten as:

$$T = \frac{\tau_m}{r_o} \times \frac{\pi}{2} \times \left(r_o^4 - r_i^4 \right) = \frac{\tau_m}{r_o} \times J_p \qquad \text{(Equation 13)}$$

where J_p is the polar moment of inertia. From Eq. 13, one can write:

$$\tau_m = r_o \times \frac{T}{J_p} \qquad \text{(Equation 14)}$$

Because shearing stress is assumed to vary linearly across the radius, the average torsional shearing stress is defined as:

$$\tau_{avg} = r_{eq} \times \frac{T}{J_p} \quad \text{(Equation 15)}$$

The value of r_{eq} is the same value as used in the resonant column analysis for calculation of shearing strain (Section 3.2).

The value of applied torque, T, is calculated from the input voltage applied to the drive system, V_T (Volts), and the torque calibration factor, K_T (torque / Volts). Thus, average shearing stress becomes:

$$\tau_{avg} = r_{eq} \times K_T \times V_T / J_p \quad \text{(Equation 16)}$$

<u>Shearing Strain</u>

Calculation of shearing strain in the torsional shear test follows the same procedure used in the resonant column test. The proximitor system directly measures the displacement (instead of acceleration measured in the resonant test). Hence, the angle of twist (θ) is calculated from the proximitor output, V_p (volts), and the proximitor calibration factor, K_p (rad/volt). Shearing strain, γ, is then calculated from:

$$\gamma = r_{eq} \times \Sigma K_p \times V_p / \ell \quad \text{(Equation 17)}$$

<u>Shear Modulus</u>

Once the stress-strain hysteresis loop is measured, the shear modulus, G, is calculated from the slope of a line through the end points of the hysteresis loop as shown in Fig. 9. Thus, the shear modulus is calculated from:

$$G = \tau / \gamma \quad \text{(Equation 18)}$$

where:

τ = peak shearing stress and
γ = peak shearing strain.

4.2 Hysteretic Damping Ratio

Hysteretic damping ratio in the torsional shear test is measured using the amount of energy dissipated in one complete cycle of loading and the peak strain energy stored in the specimen during the cycle.

In the torsional shear test, the dissipated energy is measured from the area of the stress-strain hysteresis loop. The energy per cycle, W_d, due to a viscous damping force, F_d, is:

$$W_d = \int_0^T F_d \cdot \dot{x} \, dt \qquad \text{(Equation 19)}$$

where:

$\dot{x}$ = a velocity and
T = a period.

For simple harmonic motion with frequency of ω, i.e. $x = A \cdot \mathrm{Cos}(\omega t - \phi)$, W_d becomes:

$$W_d = \pi \cdot c \cdot \omega \cdot A^2 \qquad \text{(Equation 20)}$$

From Eq. 20, the viscous damping coefficient can be expressed as:

$$c = \frac{W_d}{\pi \cdot \omega \cdot A^2} \qquad \text{(Equation 21)}$$

The peak strain energy, W_s, stored by the spring is equal to the area under the secant modulus line Fig. 9 and can be written as:

$$W_s = \frac{k \cdot A^2}{2} \qquad \text{(Equation 22)}$$

The critical damping coefficient, C_c, is:

$$C_c = 2 \cdot \sqrt{k \cdot m} = \frac{2 \cdot k}{\omega_n} \qquad \text{(Equation 23)}$$

where:
k = the elastic spring constant,
m = mass, and
ω_n = the natural frequency of the system.

Using Eq. 22, Eq. 23 can be rewritten as:

$$C_c = \frac{4 \cdot W_s}{\omega_n \cdot A^2} \qquad \text{(Equation 24)}$$

Therefore, the damping ratio, D, can be expressed as:

$$D = \frac{C}{C_c} = \frac{W_d}{4 \cdot \pi \cdot W_s} \cdot \frac{\omega_n}{\omega} \qquad \text{(Equation 25)}$$

For soil or rock materials, damping is often assumed to be frequency independent. Therefore, ω_n / ω is ignored and hysteretic damping is written as:

$$D = \frac{1}{4 \times \pi} \times \frac{W_d}{W_s} \qquad \text{(Equation 26)}$$

where:

W_d = the area of the hysteresis loop and
W_s = the area of the triangle as shown in Fig. 9.

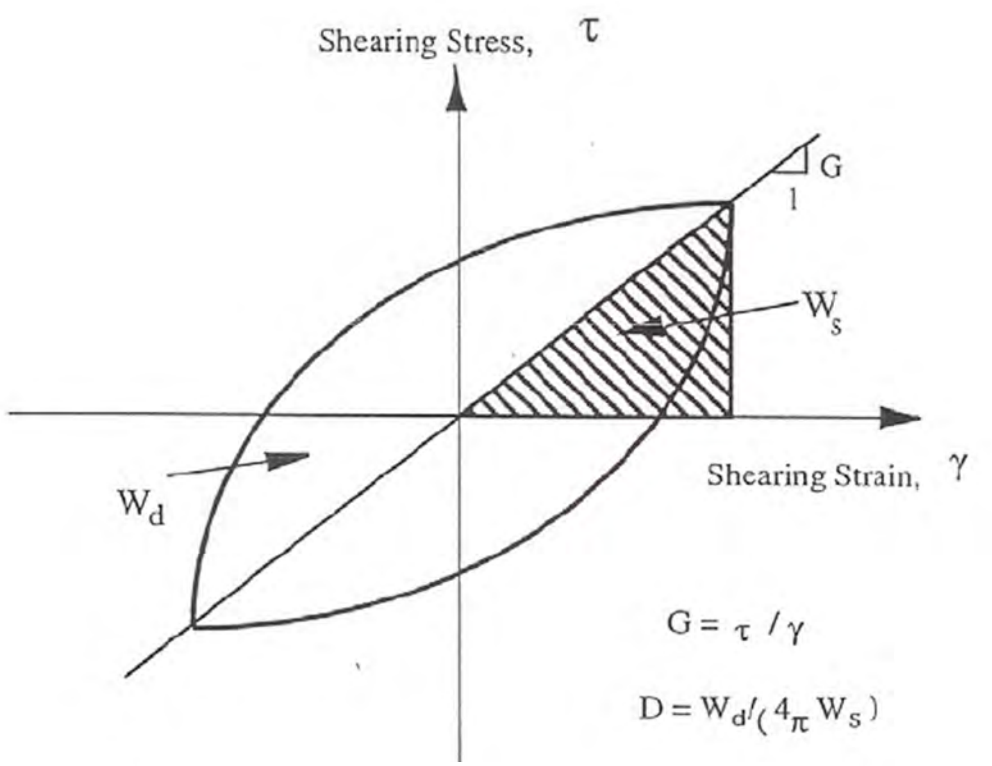


Figure 9. Determination of Shear Modulus and Damping Ratio in the Torsional Shear Test

5.0 REFERNCE

Chen, A.T.F., Stokoe, K.H., II (1979), "Interpretation of Strain Dependent Modulus and Damping from Torsional Soil Tests," Report No. USGS-GD-79-002, NTIS No. PB-298479, U.S. Geological Survey, 46 pp.

Isenhower, W.M. (1979), "Torsional Simple Shear/Resonant Column Properties of San Francisco Bay Mud," Geotechnical Engineering Thesis, GT 80-1, University of Texas, Dec., 307 pp.

Kim, D.S. (1991), "Deformational Characteristics of Soils at Small to Intermediate Strains from Cyclic Tests," Ph.D. Dissertation, The University of Texas at Austin, June, 295 pp.

Lodde, P.F. (1982), "Shear Moduli and Material Damping of San Francisco Bay Mud," M.S. Thesis, The University of Texas at Austin, June, 295 pp.

Ni, S.H. (1987), "Dynamic Properties of Sand Under True Triaxial Stress States from Resonant Column/Torsional Shear Tests," Ph.D. Dissertation, The University of Texas at Austin, 421 pp.

Richart, F.E.,Jr., Hall, J.R.,Jr., and Woods, R.D. (1970), Vibration of Soils and Foundations, Prentice-Hall Inc., Englewood Cliffs, New Jersey, 414 pp.

APPENDIX B

Results for Kleinfelder Specimen ID K2-13-001

- *Specimen Preparation Notes*
- *RCTS Testing Results*

SPECIMEN PREPARATION NOTES

Specimen No.:	K2-13-001	**Project No :**	136473	**Page** 1 **of** 4	

Boring No.: B-615 **Date of Preparation..:** 10/12/2013

Sample No..: 615-CS-01 **Depth..:** 32.6 - 33.1 feet

Disposition of Rock Core Sample

☒ No Apparent Disturbance	☐ Apparent Disturbance	☐ Apparent Slaking Due to Coring
☒ Other (Describe)	Sample consisted of a Limestone of the Key Largo Fomration with Small to Large Sized Vugs	

Specimen Preparation Notes

Trimming Method :	Rotary coring with water lubricant, 1.5-inch OD diameter core barrel		**Affixation to Platens :**	Epoxied to 2.8-inch diameter steel top cap and base pedestal	
Ave. Length (in.) :	3.9682	**Ave. Diameter (in.):**	1.449	**L/D**	2.7
Total Unit Weight . (pcf) :	138.4	**Moisture Content (%)**	9.6	**% Saturation (Assume SG = 2.70)**	77.4

Specimen Testing Comments

1) Sample 615-CS-01 was predominately a medium strong rock with small to large sized vugs. One vug extended all the way through the core from one side to the other (see Photo B.3). Due to the rock hardness, the sample could not be trimmed by hand and it was decided to core the nominally 2.5-inch diameter sample with a 1.5-inch outside diameter (OD), thin-walled diamond-impregnated core barrel.

2) Sample was trimmed to an approximate 6-inch length and grouted into an CMU block on 10/12/13. See Photos B.4 through B.6.

3) Sample was cored on 10/13/13. See Photo B.7. One approximately 1.45-inch diameter specimen resulted from the rotary coring. The specimen was of sufficient length for RCTS Testing and the sample ends were trimmed to the final length of about 4.0-inches. The completed specimen still contained the vug that extended through the original sample (see Photo B.8).

4) Specimen was epoxied to the 2.8-inch diameter steel top cap and base pedestal on 12/9/13.

5) Testing commenced on 12/10/13 and was completed on 12/12/13. The full test sequence was completed, with confining pressures ranging from 3 psi to 45 psi.

☒ **See Attached Photographs**

SPECIMEN PREPARATION NOTES

KLEINFELDER
Bright People. Right Solutions.

Specimen No: K2-13-001

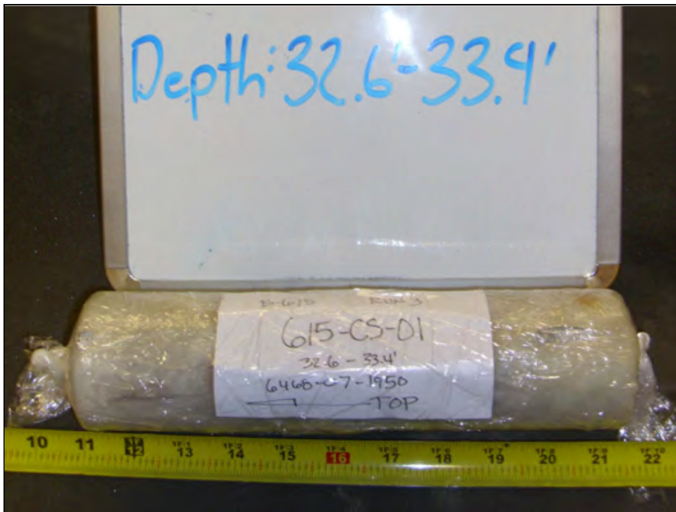


Photo B.1

Sample 615-CS-01 after removal from the protective transport container.

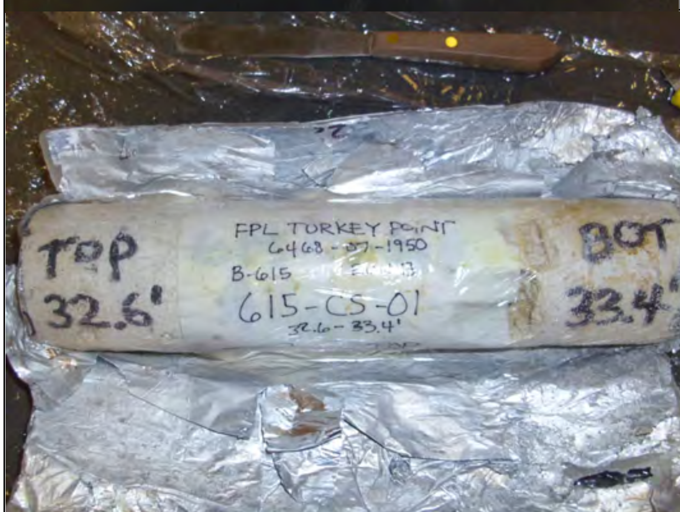


Photo B.2

Sample after removal from the wax casing and aluminum foil.

Photo B.3

Close up of vug in sample that extends all the way through the core

SPECIMEN PREPARATION NOTES

Specimen No: K2-13-001

Photo B.4

Trimming the sample to an approximate 6-inch length as preparation for grouting in a CMU block. Note the modeling clay used to seal off natural vugs in sample to prevent grout infiltration.

Photo B.5

Grouting sample in a CMU block as preparation for down coring the sample. Note the specimen number written on the side of the CMU block to maintain sample control.

Photo B.6

Rotary coring of specimen using the 1.5-inch OD core barrel.

SPECIMEN PREPARATION NOTES

KLEINFELDER
Bright People. Right Solutions.

Specimen No: K2-13-001

Photo B.7

Specimen after down coring to an approximate 1.45-inch diameter.

Photo B.8

Close-up of vug still in specimen after down coring.

Photo B.9

Specimen after affixation to the steal top cap and base pedestal using epoxy. Note modeling clay placed in natural vugs to prevent membrane puncture during testing.

Kleinfelder Specimen ID:

K2-13-001

Boring No: B-615
Sample No: 615-CS-01

Limestone (Key Largo Formation)
Depth = 32.6 ft – 33.1 ft (below existing ground surface)
Total Unit Weight = 138.4 lb/ft^3
Natural Moisture Content = 9.6%
Estimated In-Situ Mean Effective Stress = 11 psi

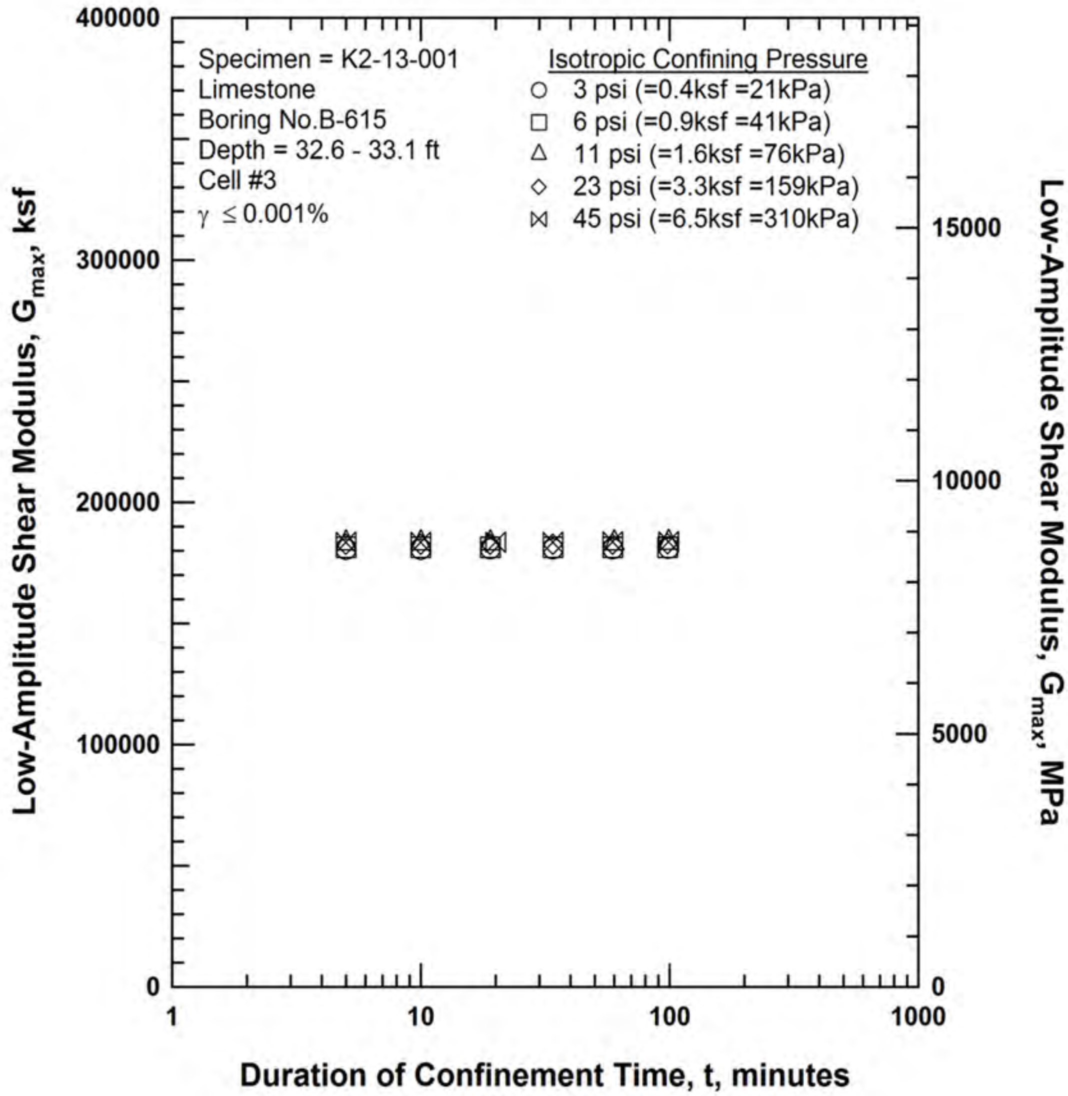


Figure B.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-001

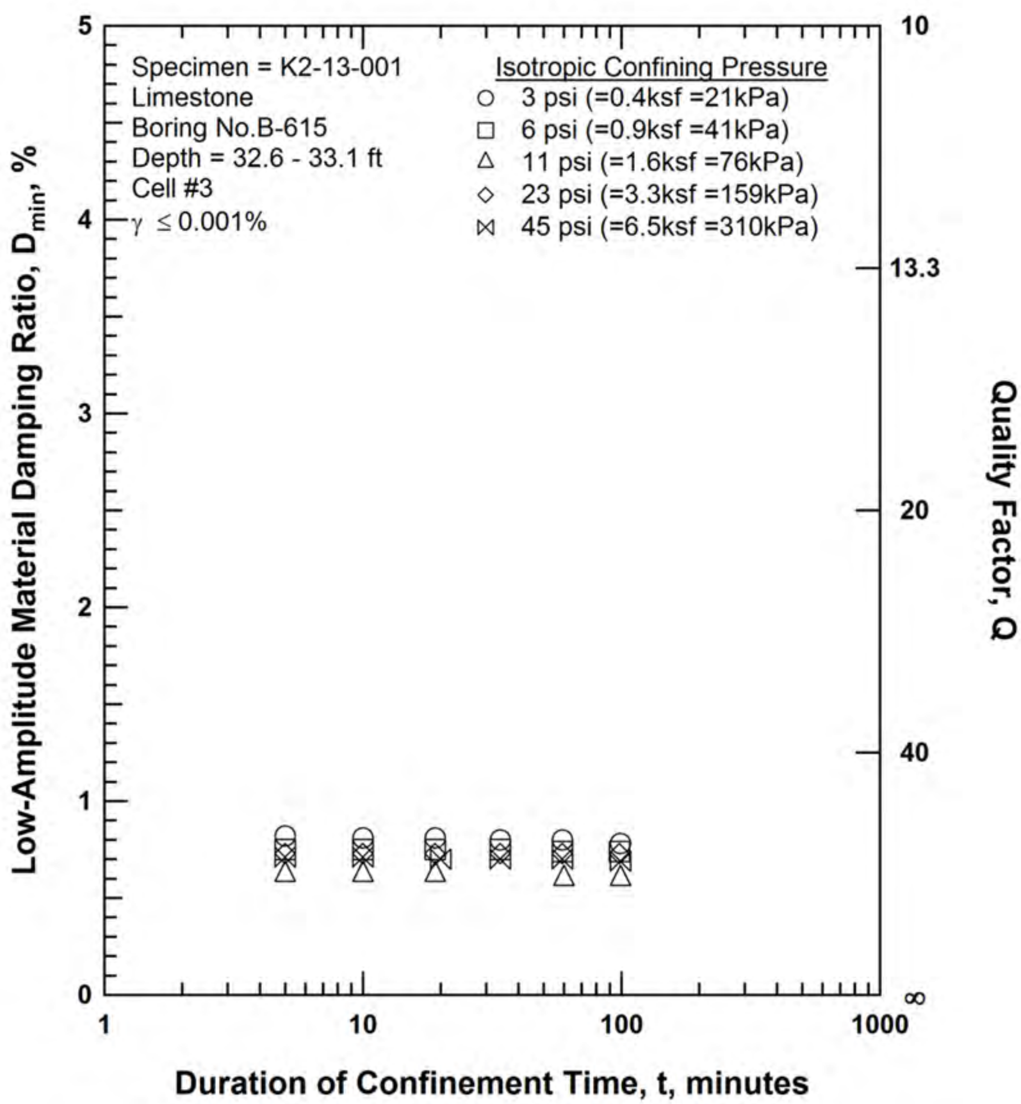


Figure B.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-001

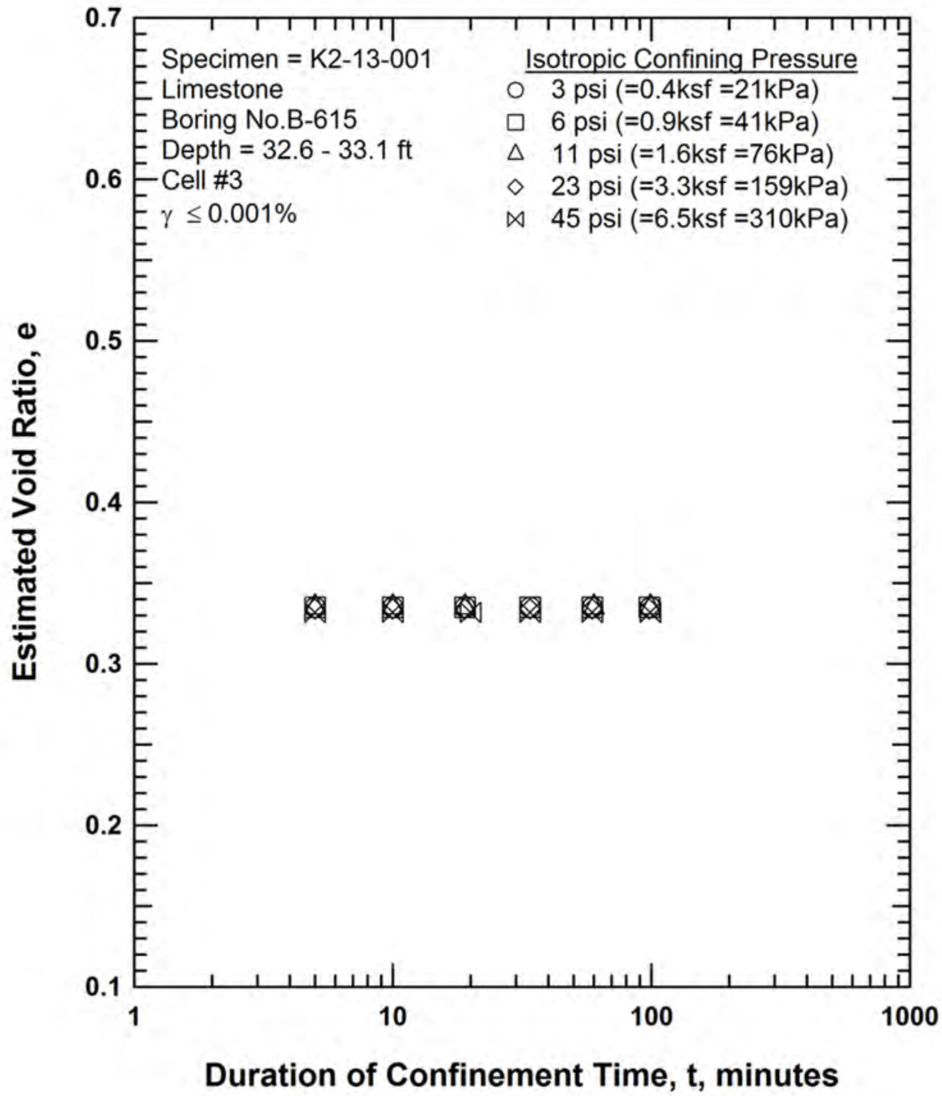


Figure B.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Test of Specimen K2-13-001

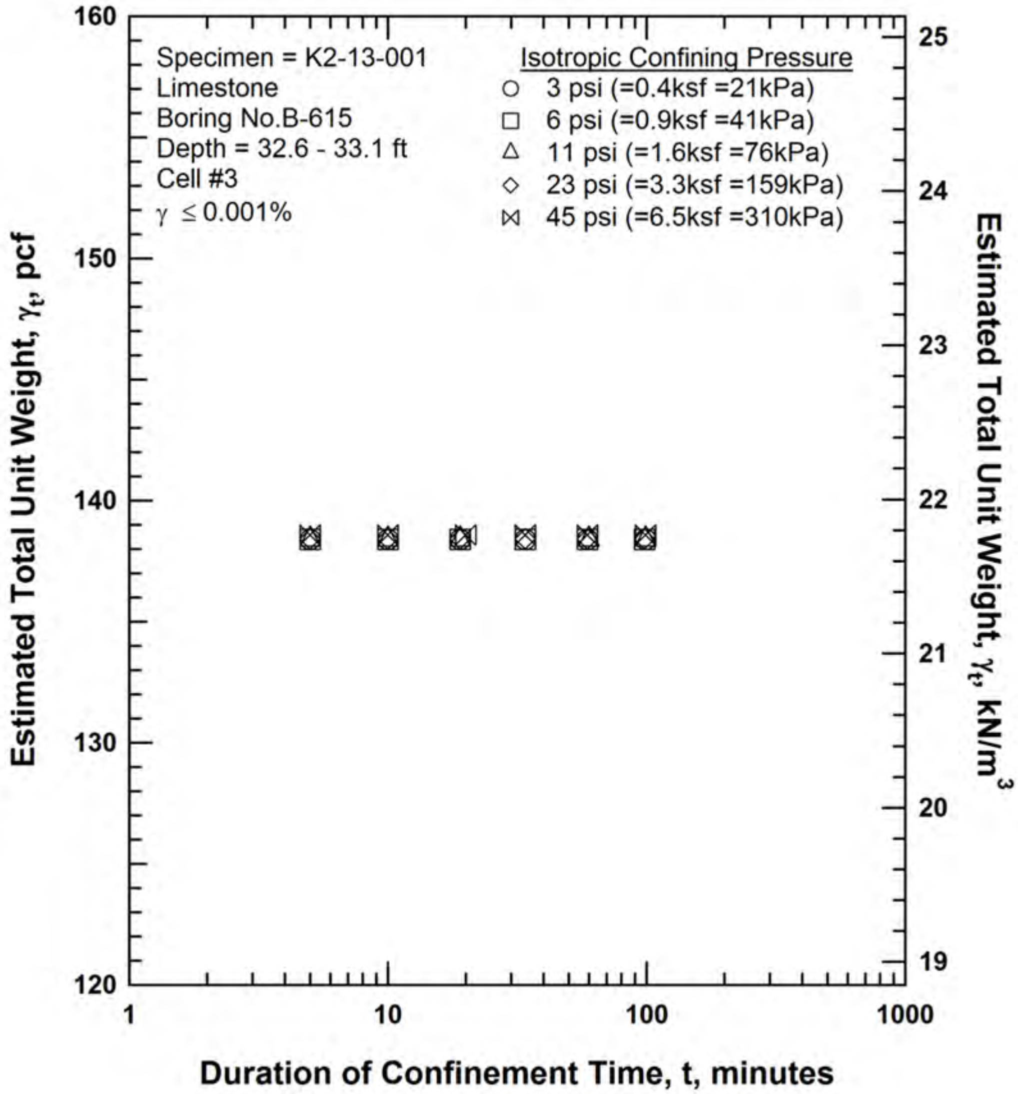


Figure B.4 Variation in Estimated Total Unit Weight with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-001

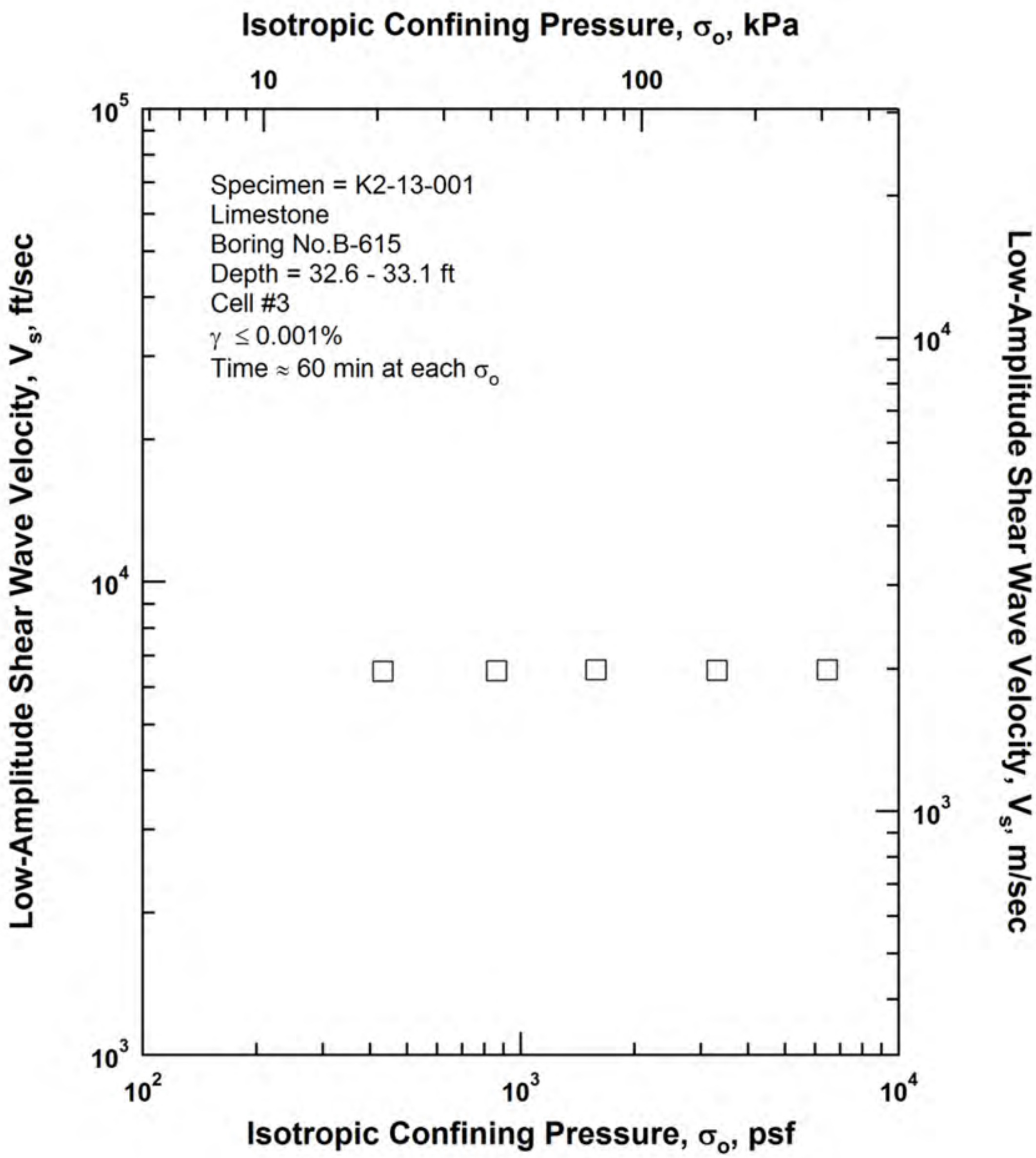


Figure B.5 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-001

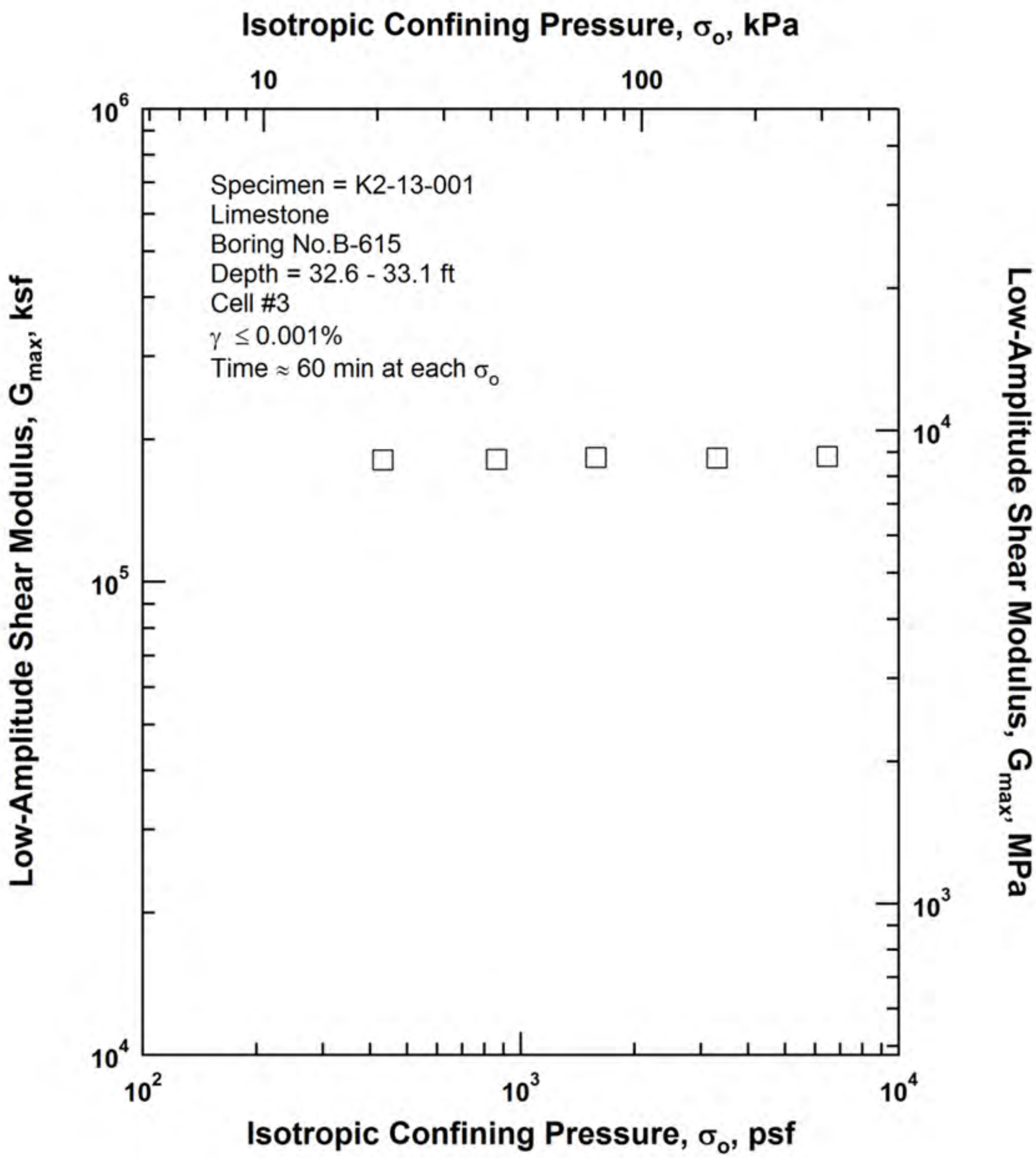


Figure B.6 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Test of Specimen K2-13-001

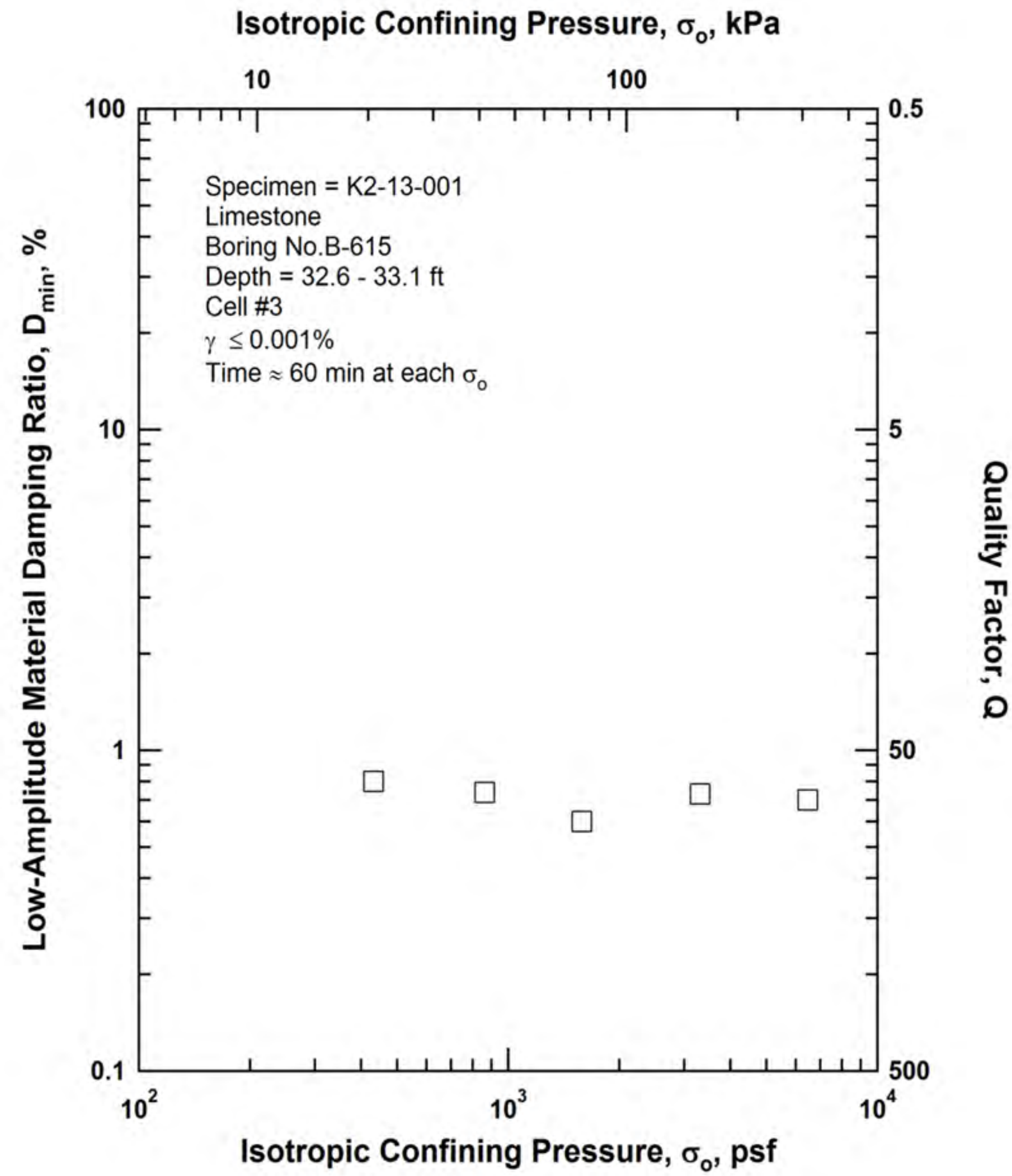


Figure B.7 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-001

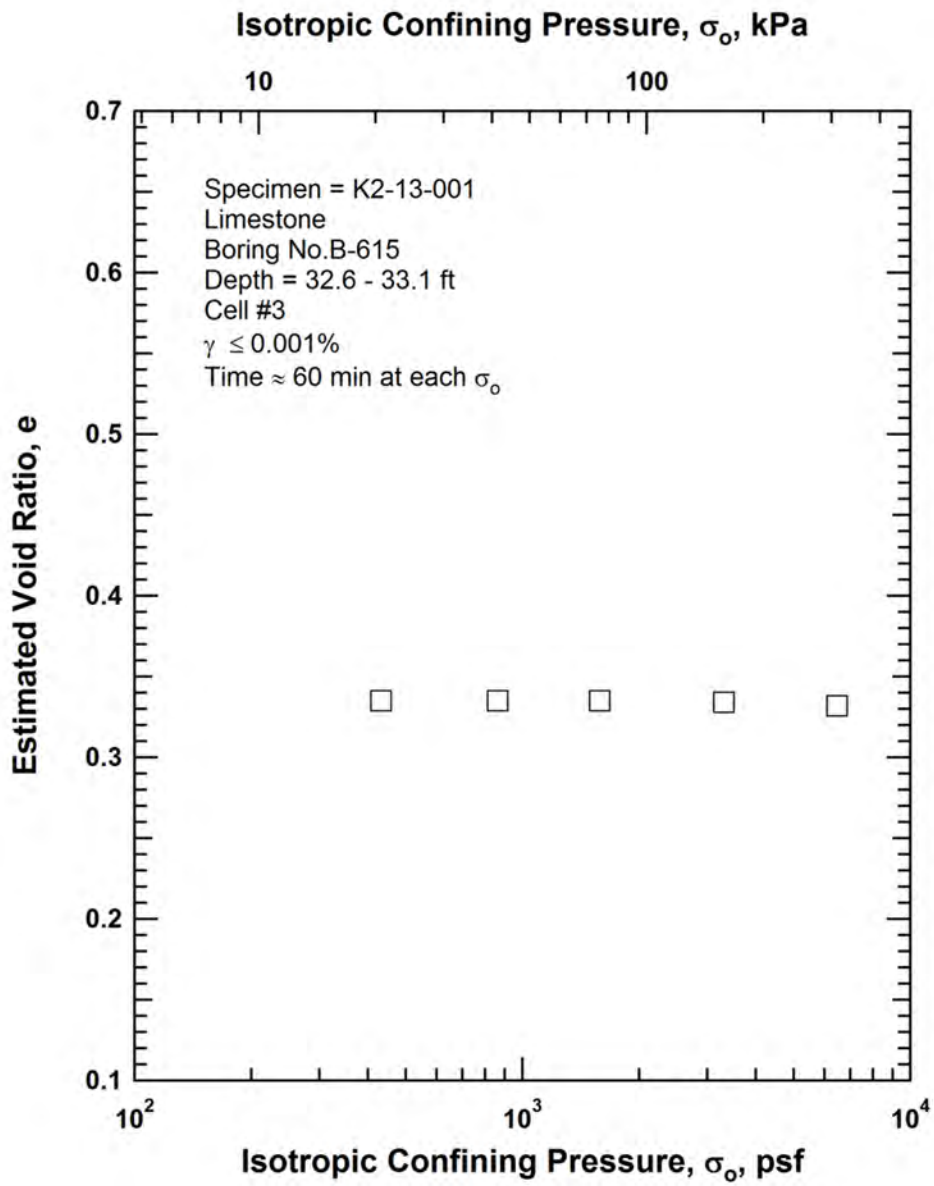


Figure B.8 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-001

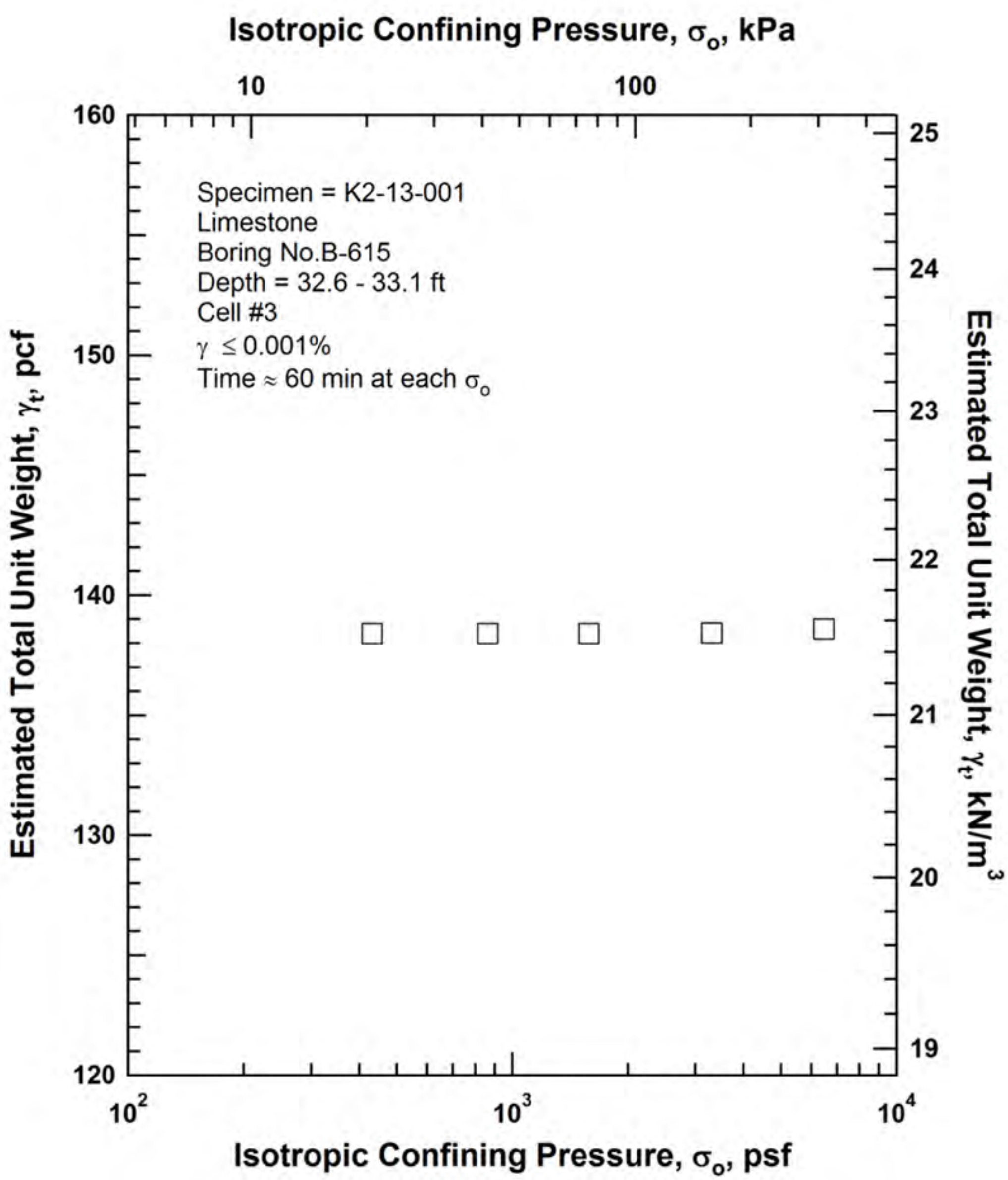


Figure B.9 Variation in Estimated Total Unit Weight with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-001

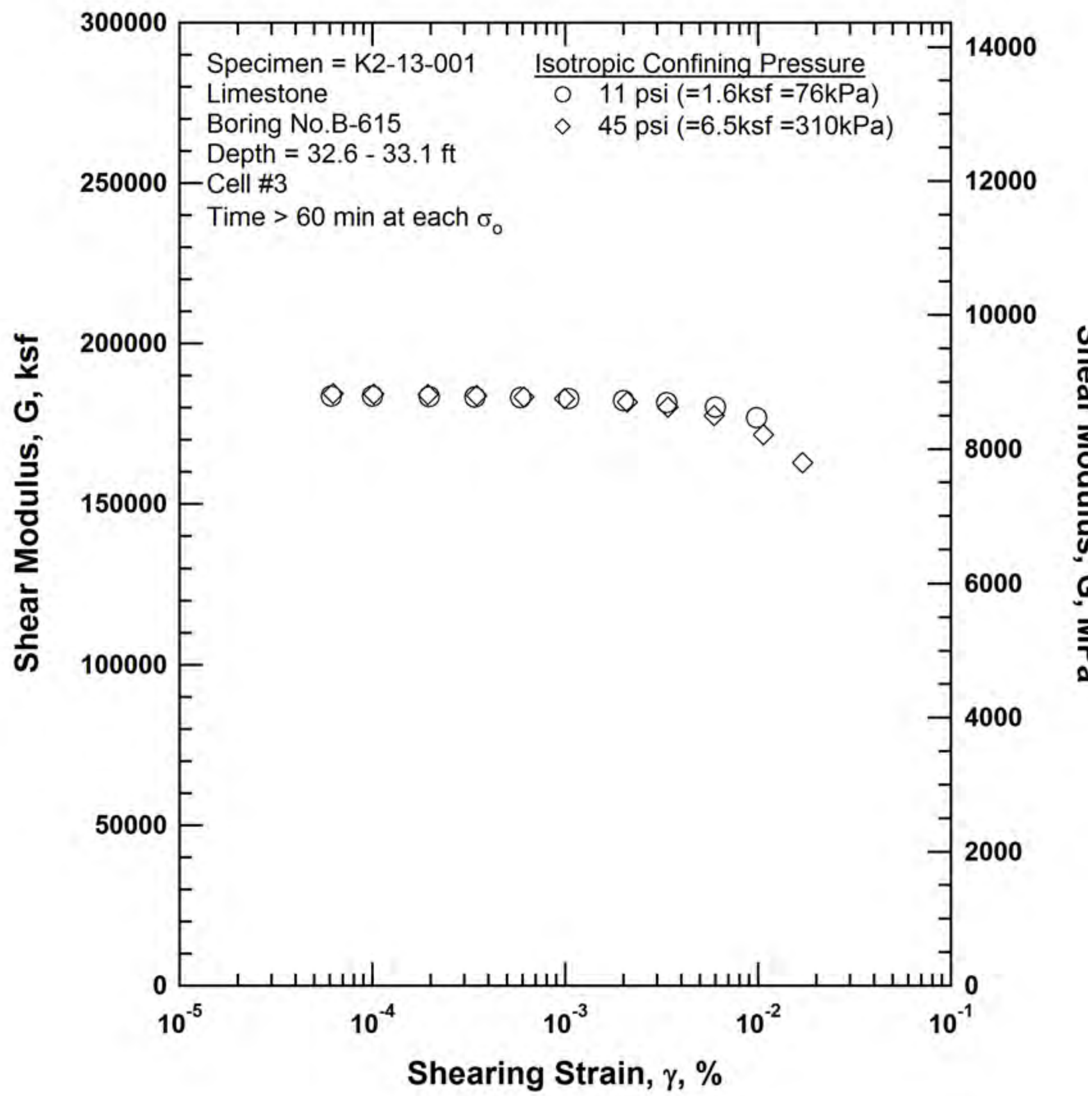


Figure B.10 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-001

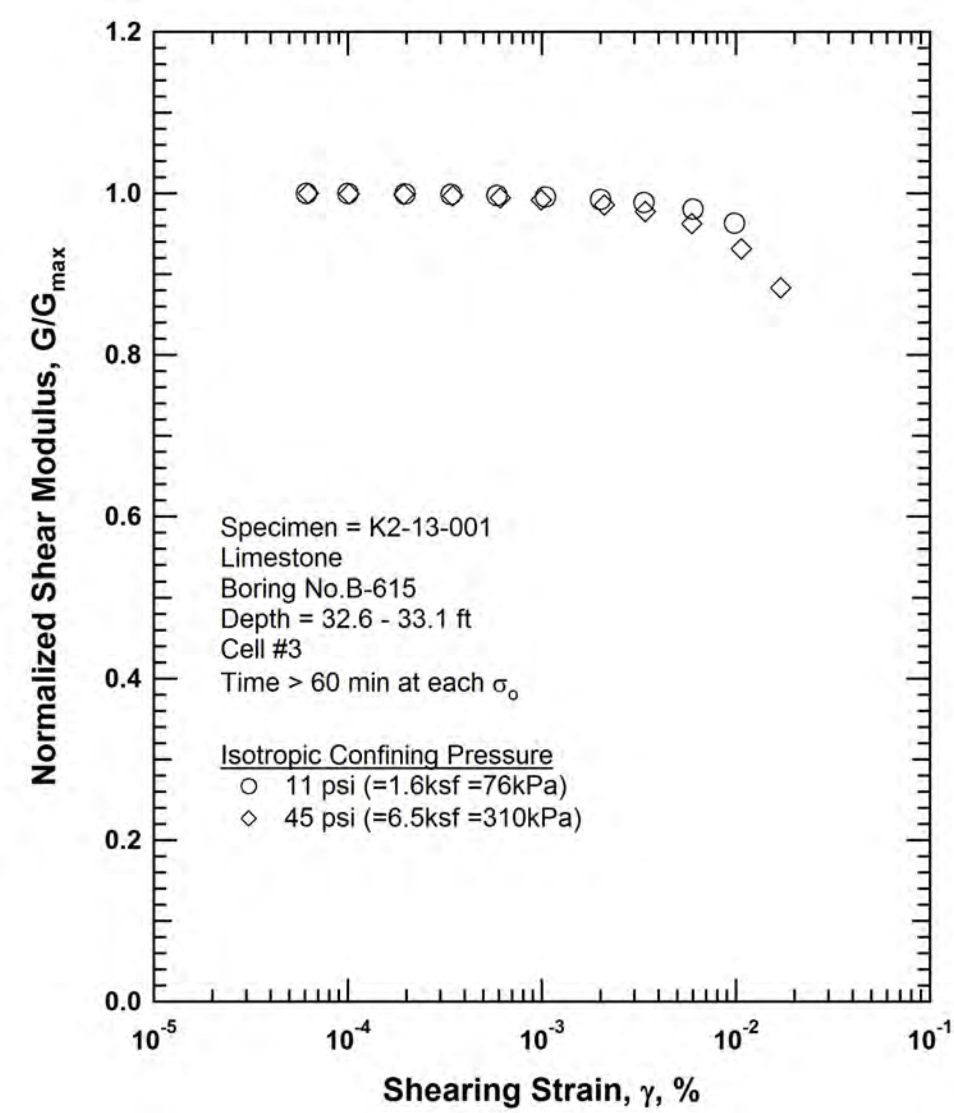


Figure B.11 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-001

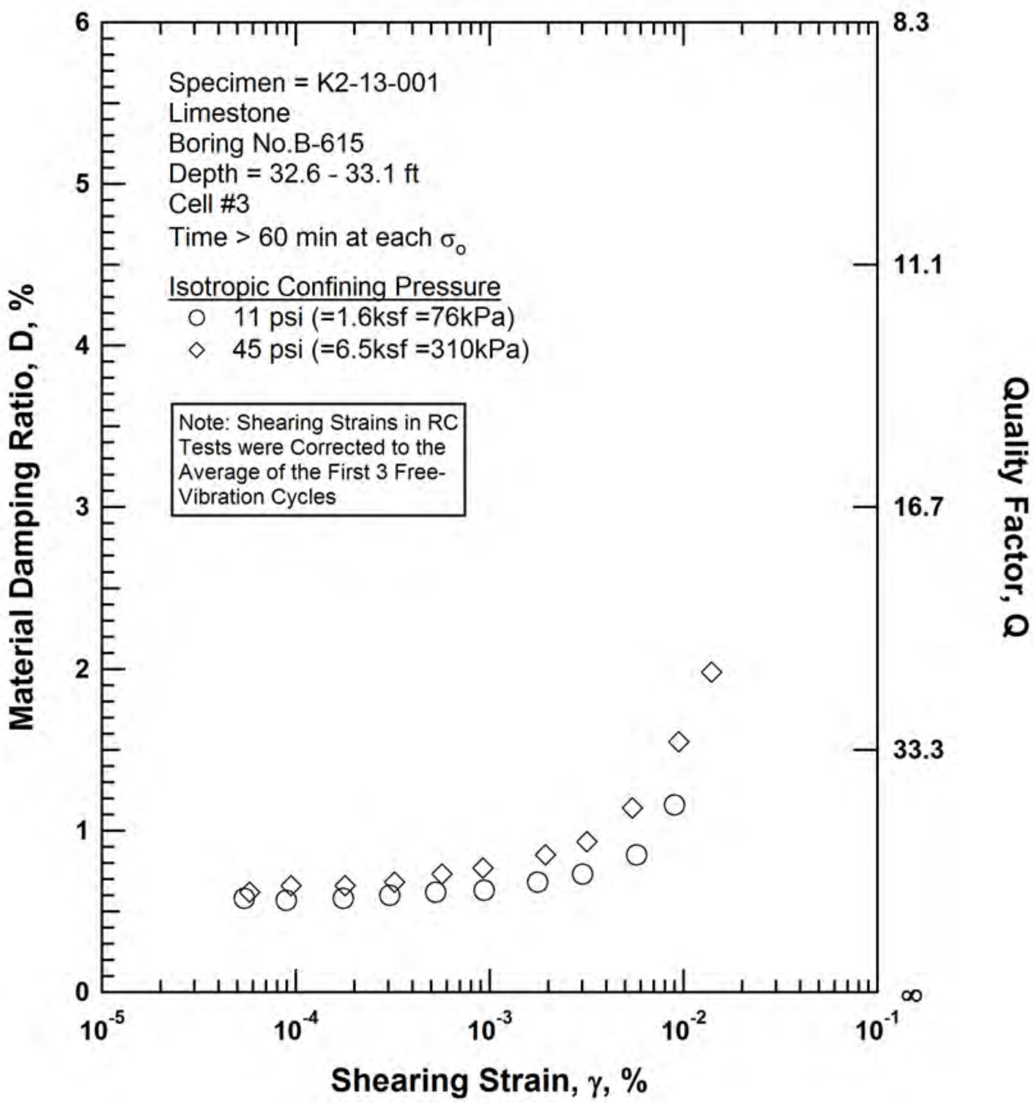
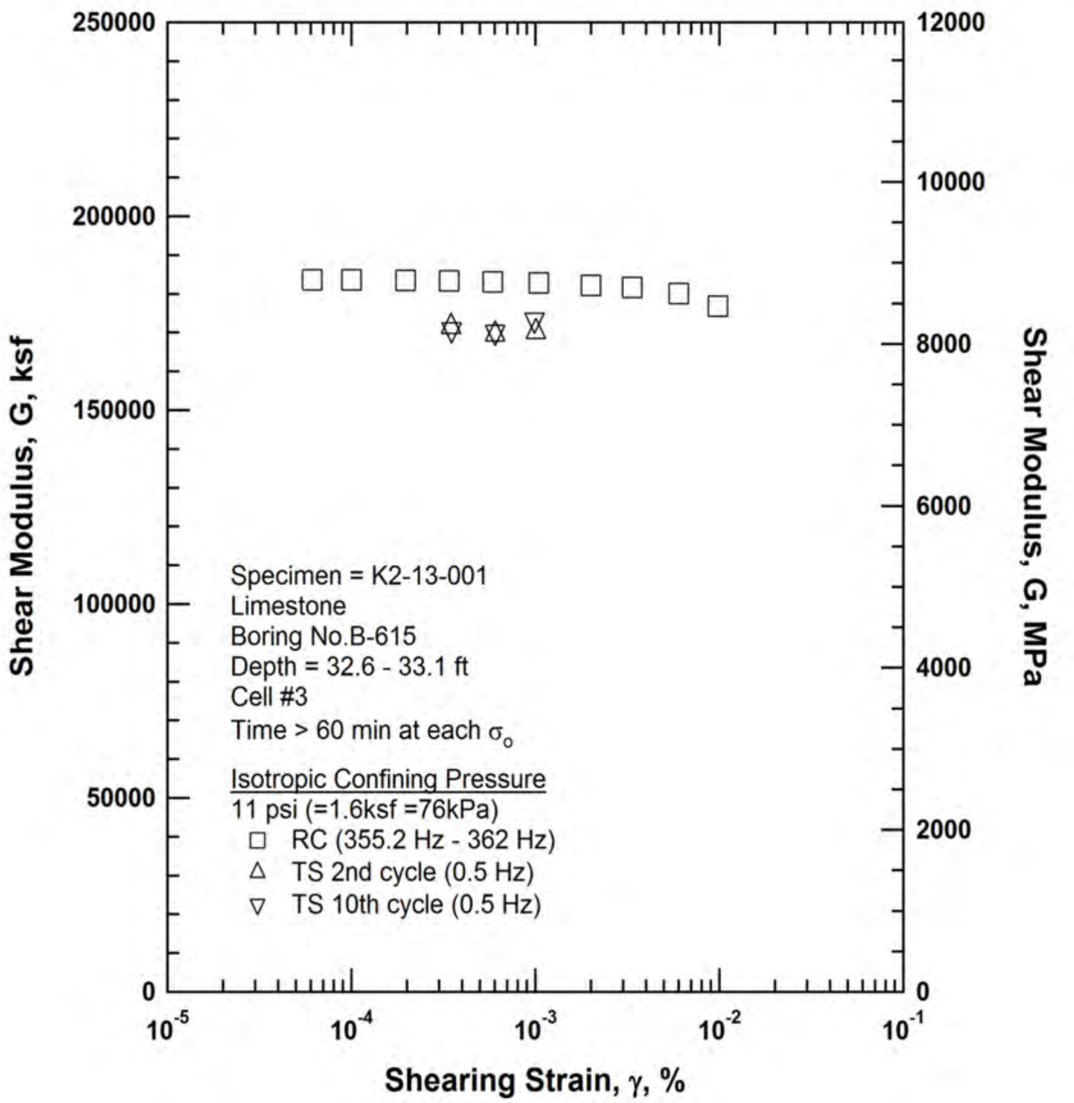


Figure B.12 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-001



Note:
* Average result of first ten cycles.

Figure B.13 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 11 psi (=1.6ksf =76kPa) from the Combined RCTS Tests of Specimen K2-13-001

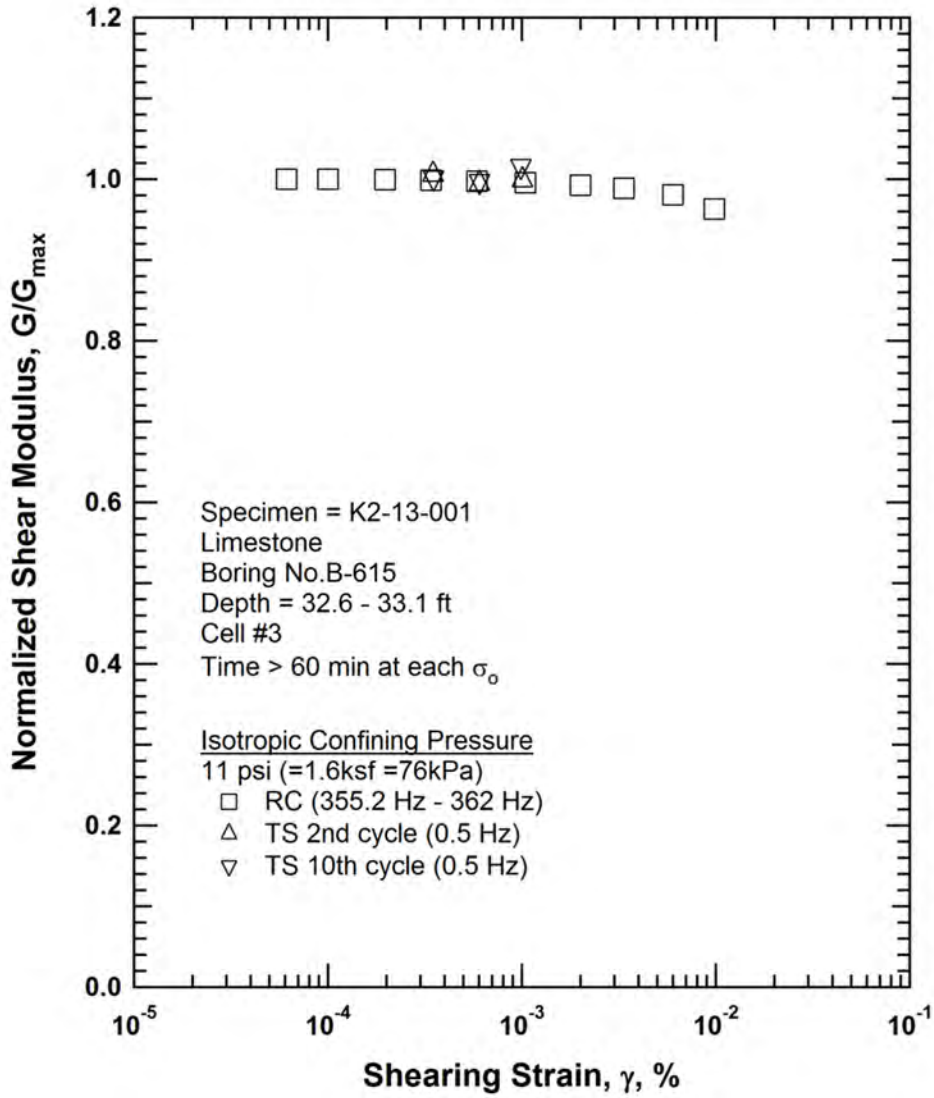
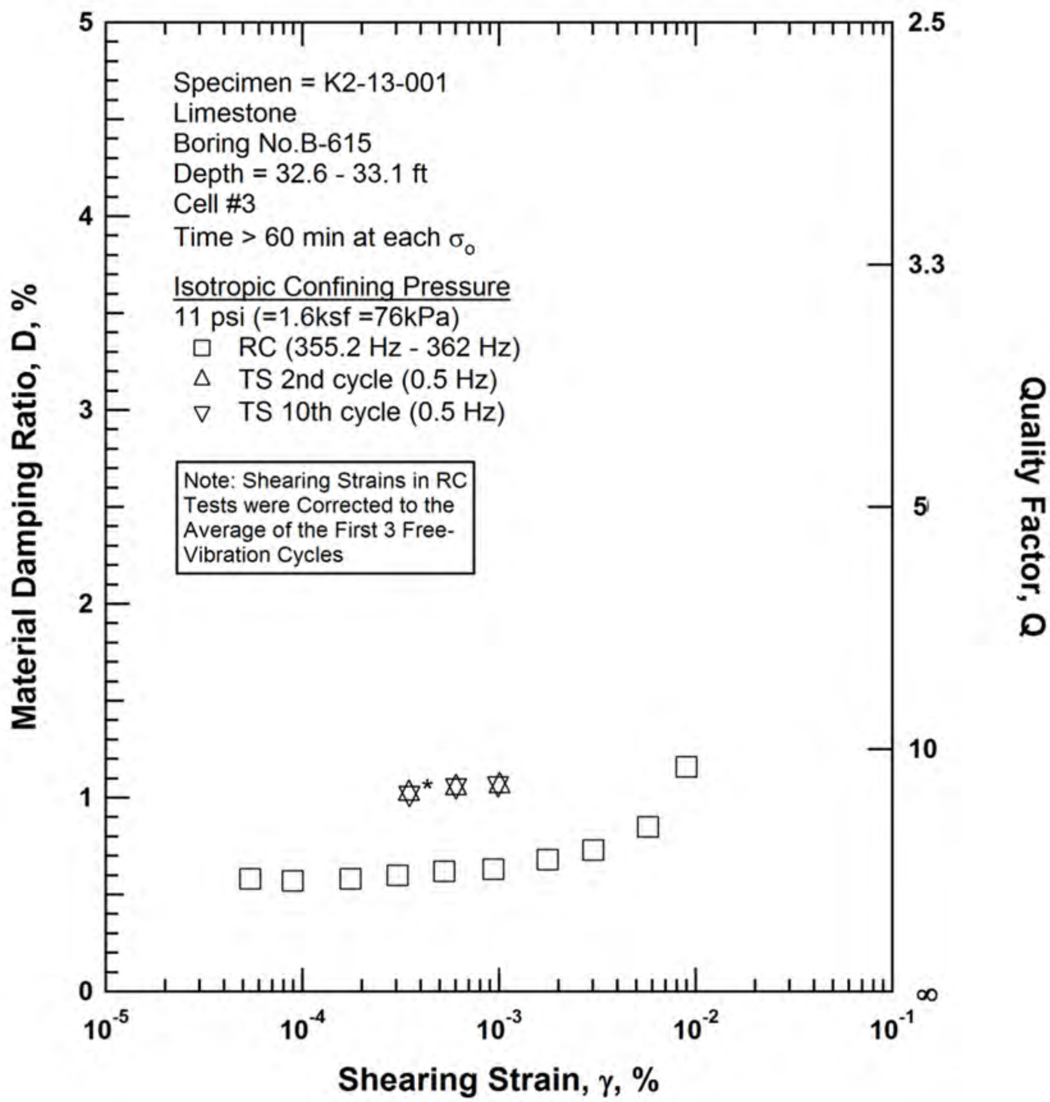


Figure B.14 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 11 psi (=1.6ksf =76kPa) from the Combined RCTS Tests of Specimen K2-13-001



Note:
* Average result of first ten cycles.

Figure B.15 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 11 psi (=1.6ksf =76kPa) from the Combined RCTS Tests of Specimen K2-13-001

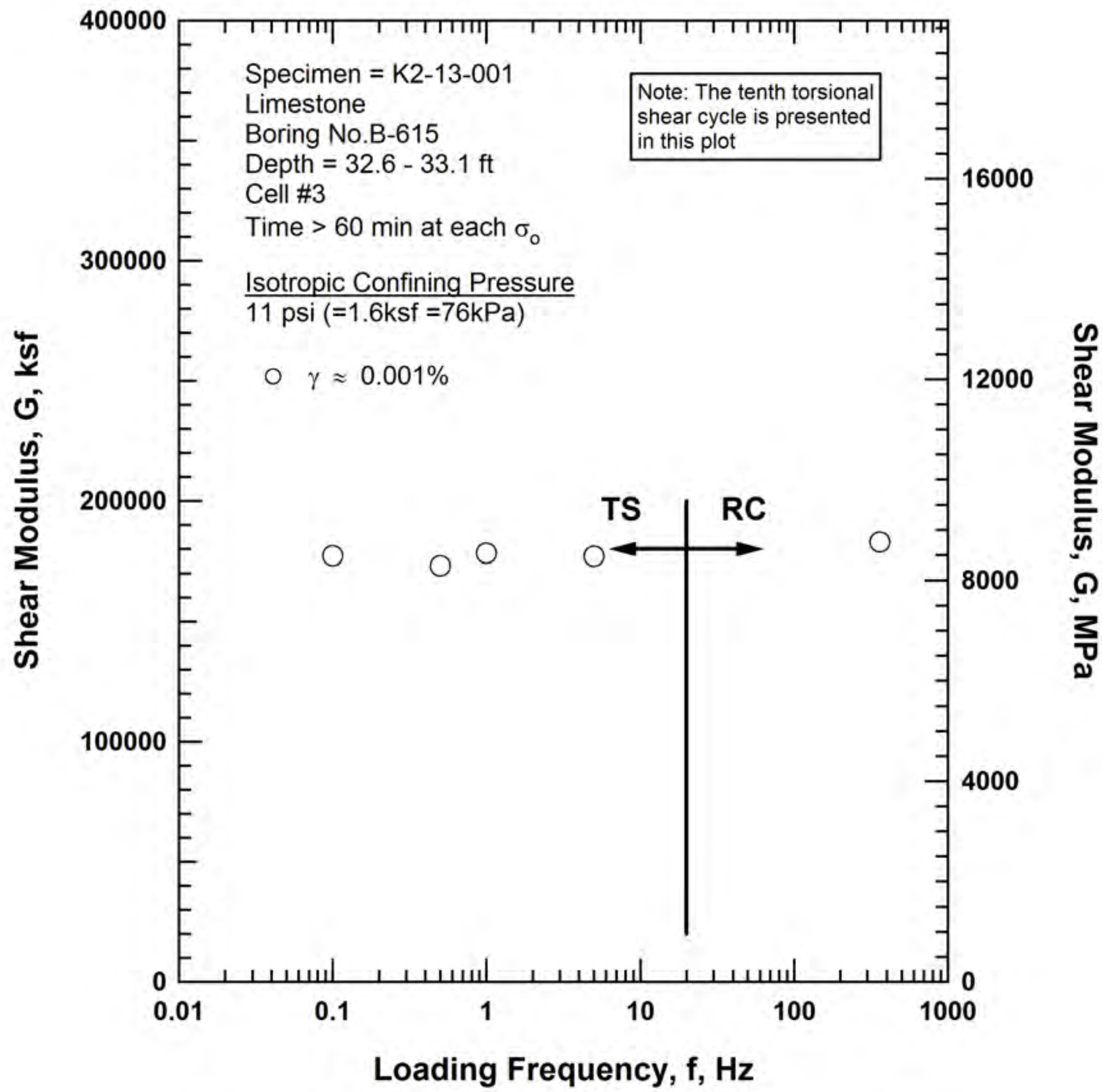


Figure B.16 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 11 psi (=1.6ksf =76kPa) from the Combined RCTS Tests of Specimen K2-13-001

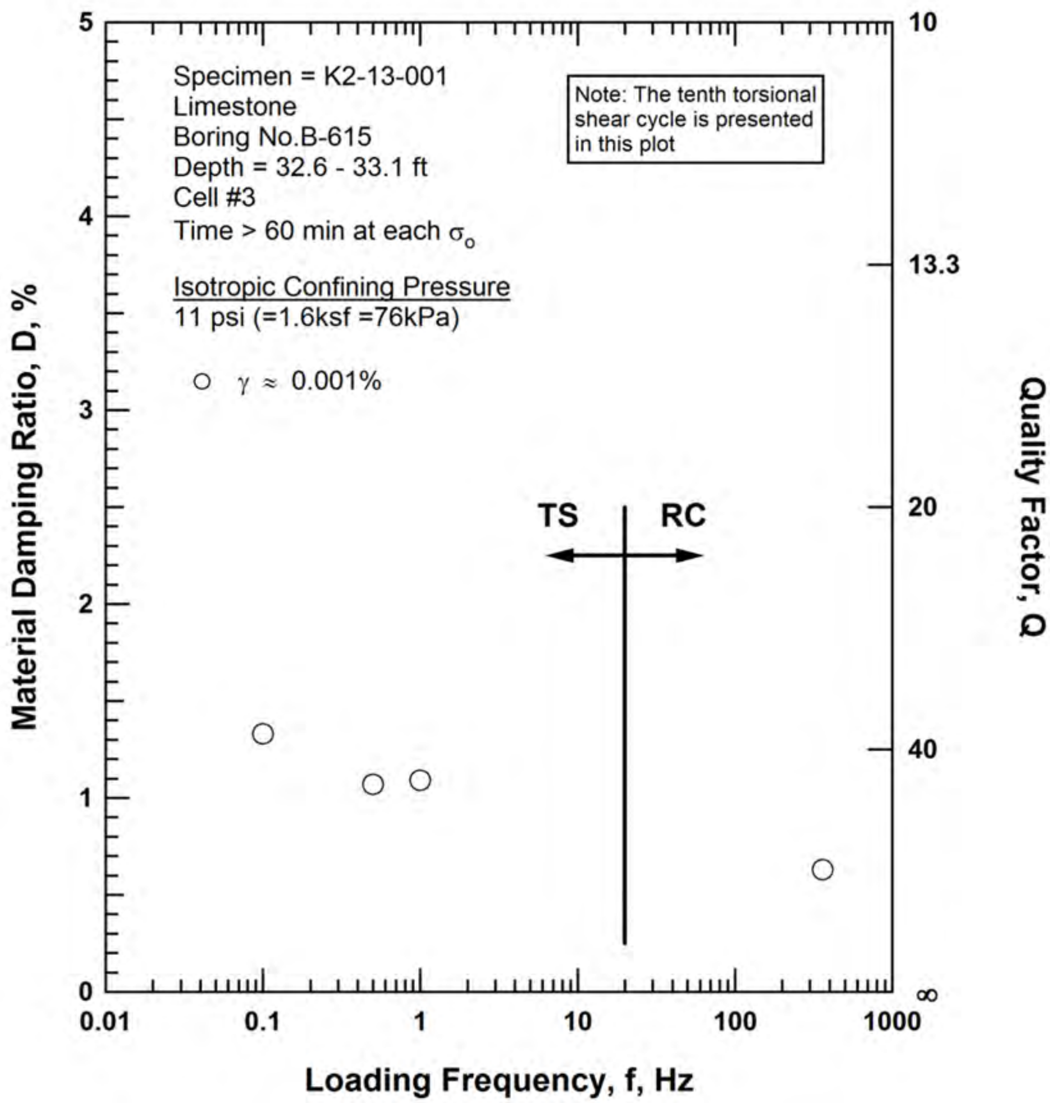


Figure B.17 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 11 psi (=1.6ksf =76kPa) from the Combined RCTS Tests of Specimen K2-13-001

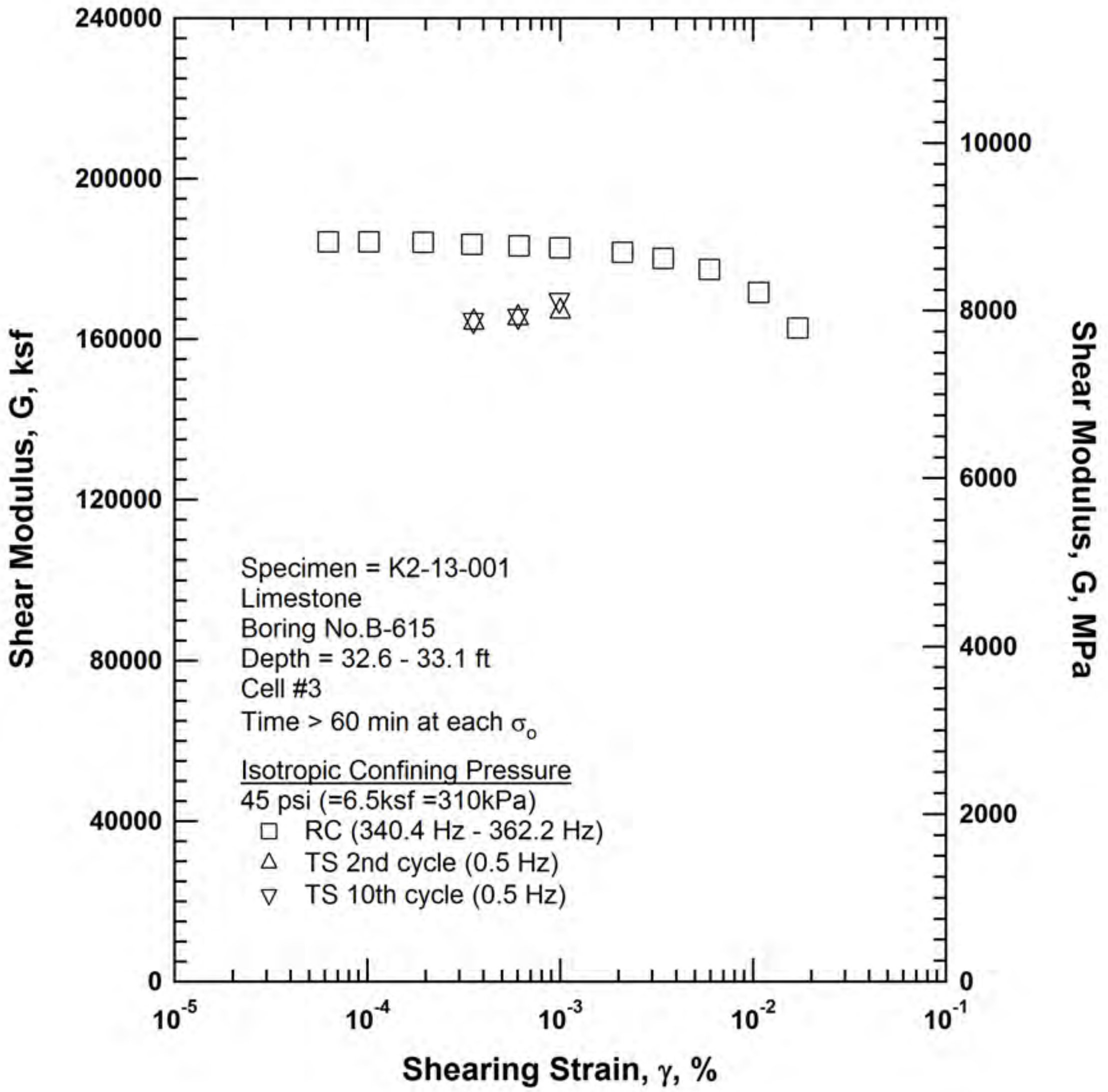


Figure B.18 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 45 psi (=6.5ksf =310kPa) from the Combined RCTS Tests of Specimen K2-13-001

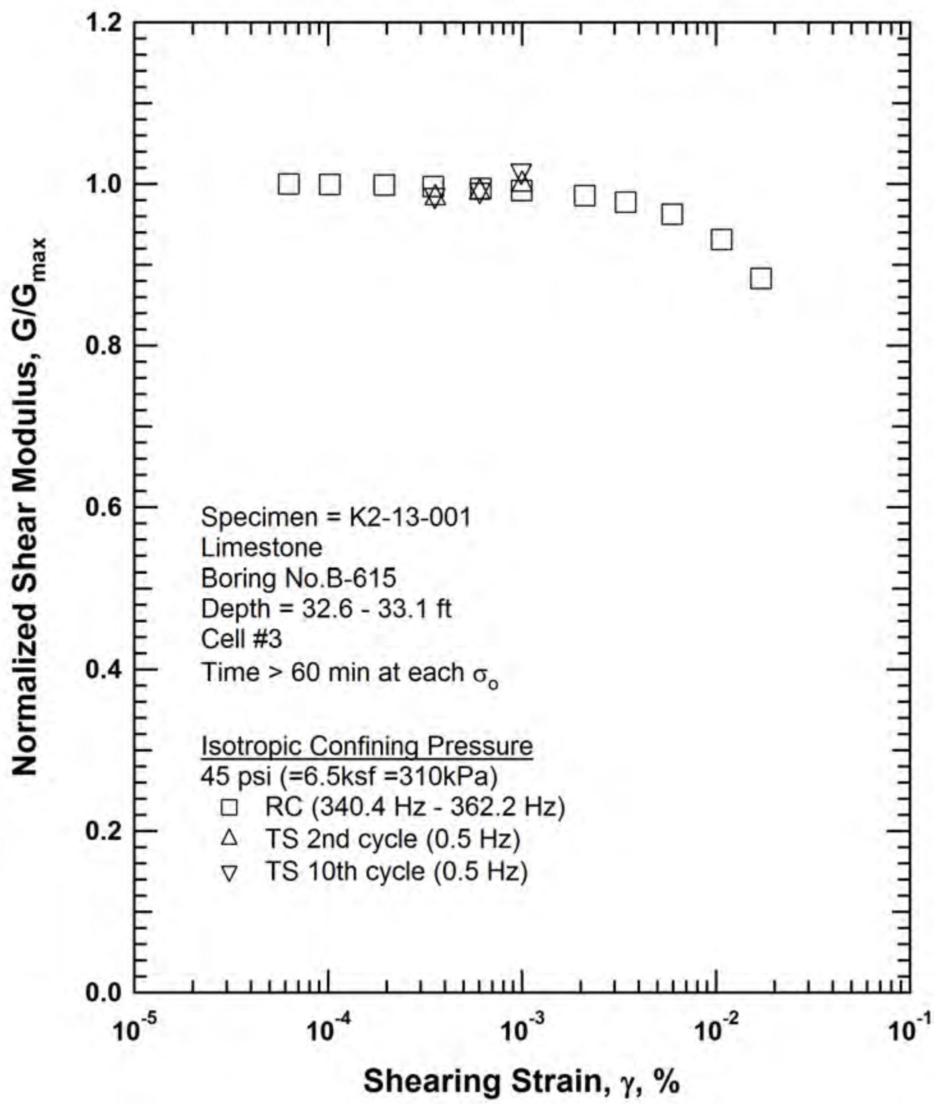


Figure B.19 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 45 psi (=6.5ksf =310kPa) from the Combined RCTS Tests of Specimen K2-13-001

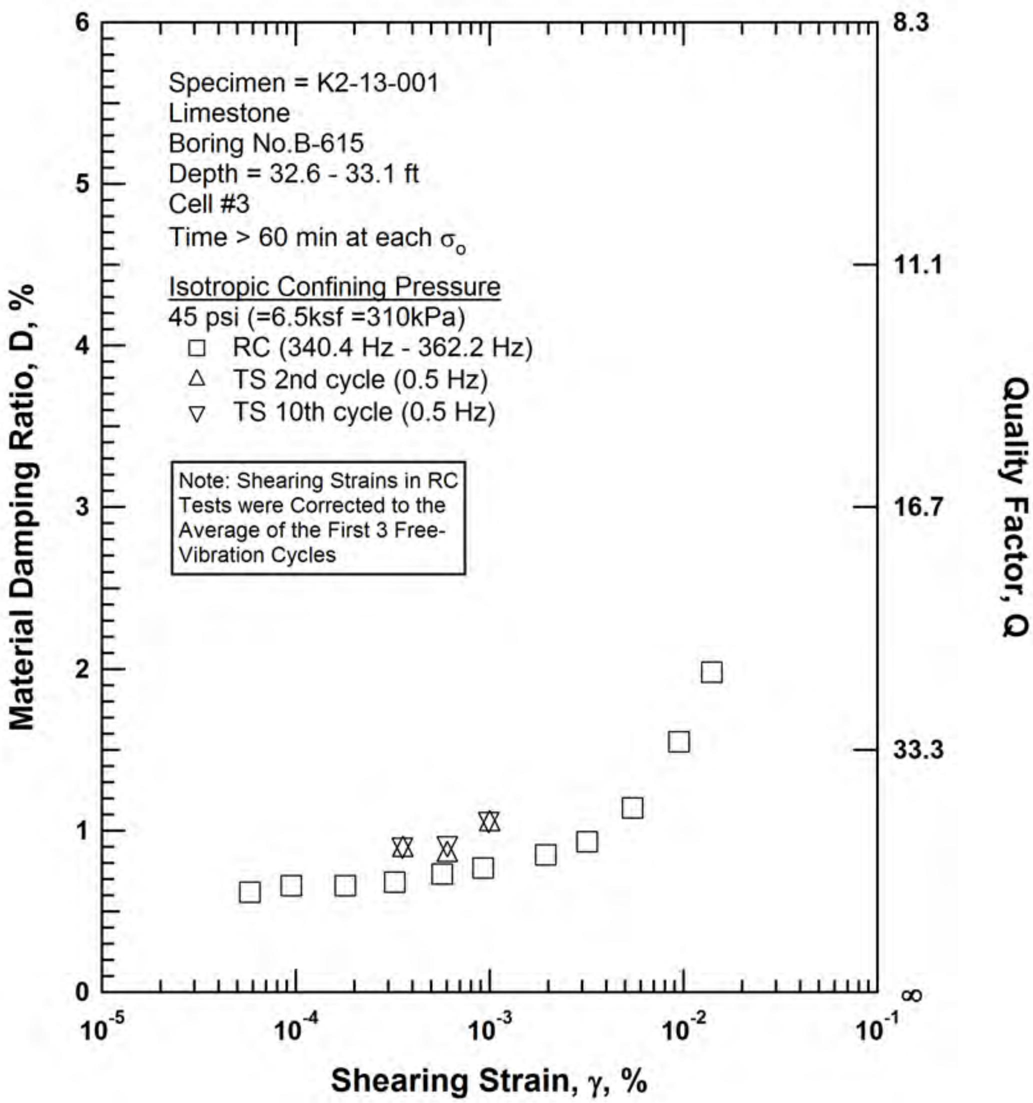


Figure B.20 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 45 psi (=6.5ksf =310kPa) from the Combined RCTS Tests of Specimen K2-13-001

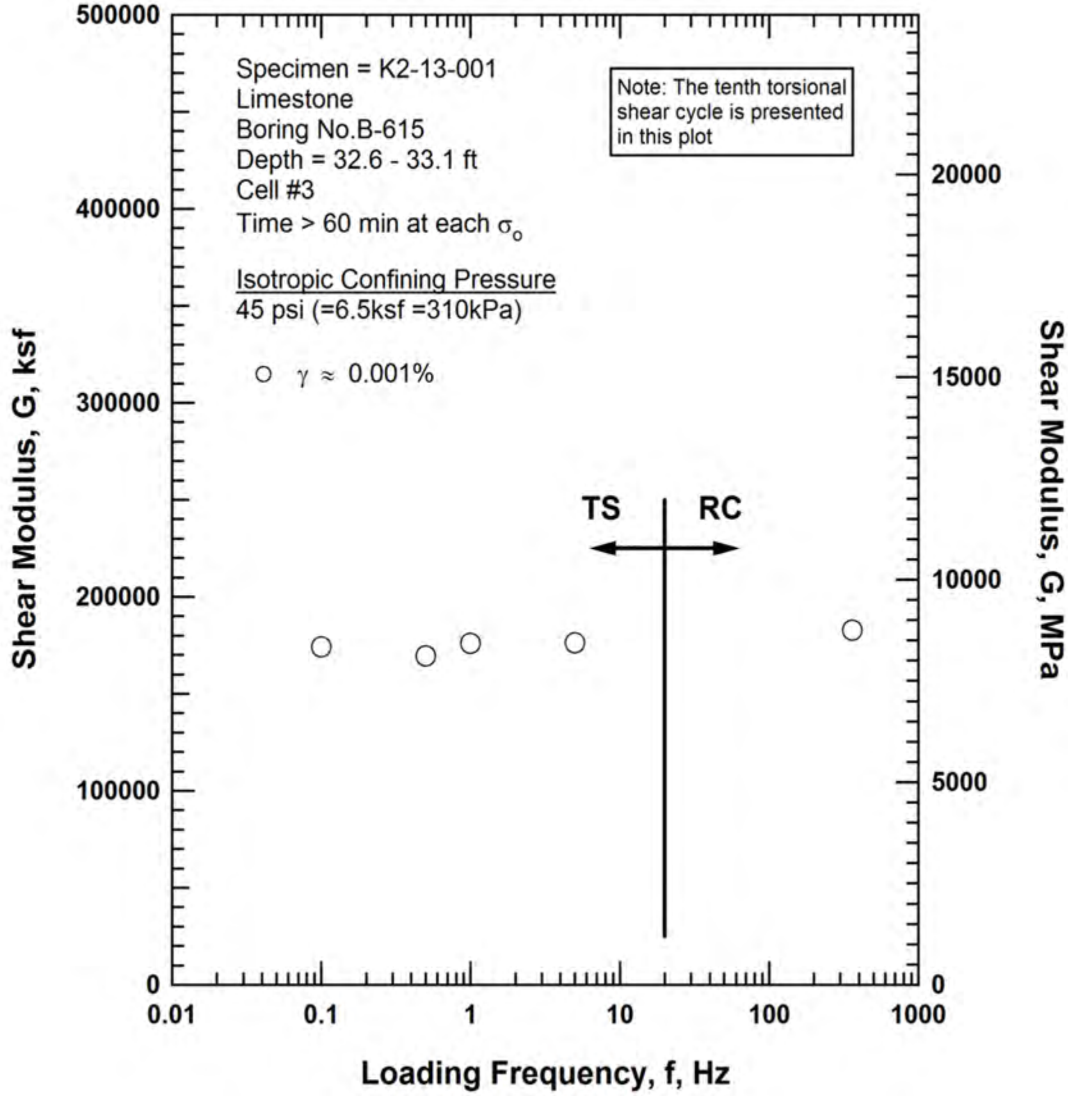


Figure B.21 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 45 psi (=6.5ksf =310kPa) from the Combined RCTS Tests of Specimen K2-13-001

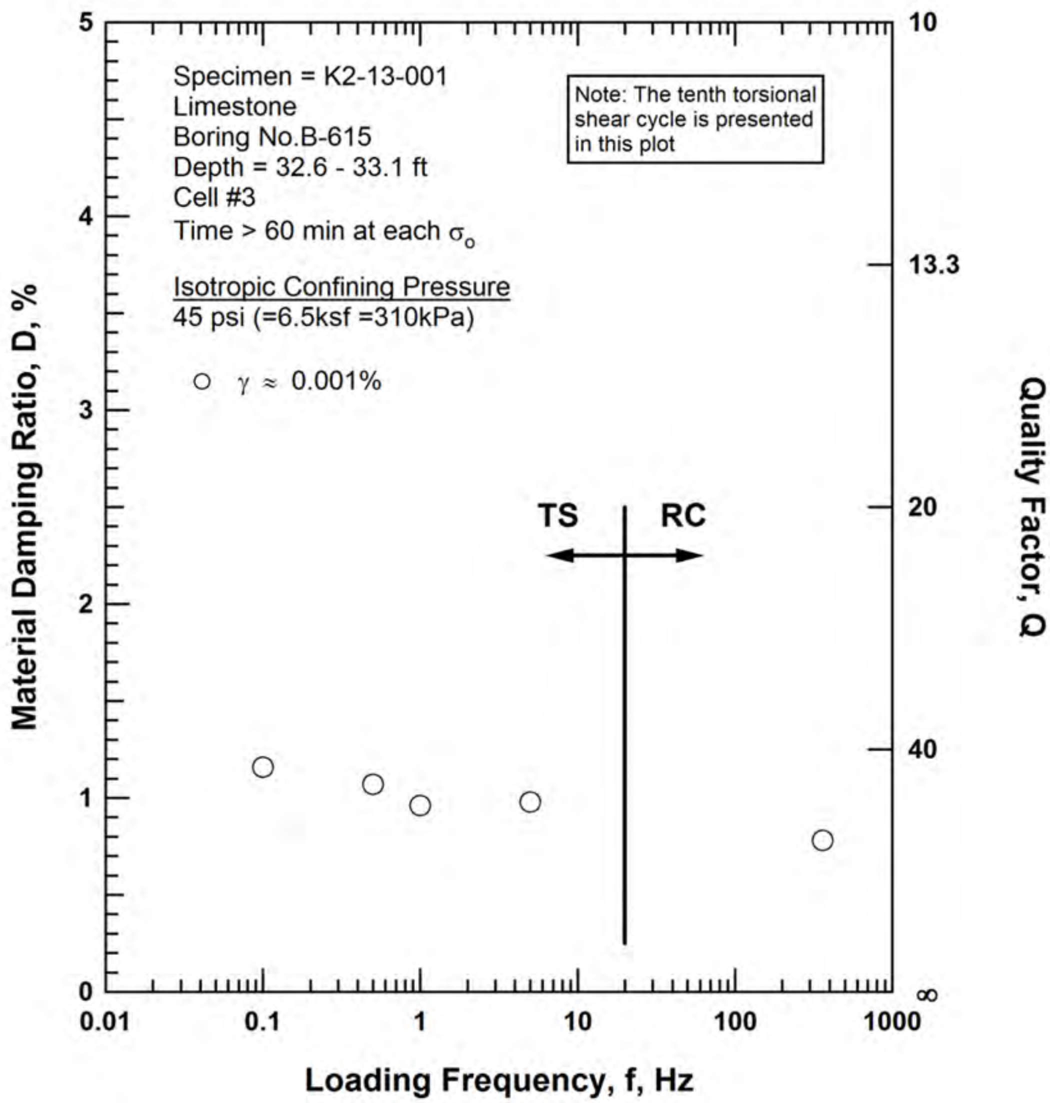


Figure B.22 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 45 psi (=6.5ksf =310kPa) from the Combined RCTS Tests of Specimen K2-13-001

Table B.1 Variation in Low-Amplitude Shear Wave Velocity, Low-Amplitude Shear Modulus, Low-Amplitude Material Damping Ratio, Estimated Void Ratio, and Estimated Total Unit Weight with Isotropic Confining Pressure from RC Tests of Specimen K2-13-001

Isotropic Confining Pressure, σ_o			Low-Amplitude Shear Modulus, G_{max}		Low-Amplitude Shear Wave Velocity, V_s	Low-Amplitude Material Damping Ratio, D_{min}	Estimated Void Ratio, e	Estimated Total Unit Weight, γ_t
(psi)	(psf)	(kPa)	(ksf)	(MPa)	(fps)	(%)	(Unitless)	(pcf)
3	432	21	180900	8662	6490	0.80	0.335	138.4
6	864	41	181500	8689	6500	0.74	0.335	138.4
11	1584	76	183200	8772	6530	0.60	0.335	138.4
23	3312	159	182800	8750	6520	0.73	0.334	138.4
45	6480	310	183700	8795	6530	0.70	0.332	138.6

Table B.2 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen K2-13-001; Isotropic Confining Pressure σ_o = 11 psi (=1.6 ksf = 76 kPa)

Second Cycle				Tenth Cycle			
Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
3.48E-04[(1)]	171500	1.01	1.02	3.49E-04[(1)]	170800	1.00	1.02
6.05E-04	169500	0.99	1.05	6.04E-04	170000	1.00	1.06
1.01E-03	170200	1.00	1.06	9.88E-04	173200	1.02	1.07

[(1)] Damping Results were Averaged for the First Ten Cycles at this Shearing Strain

Table B.3 Variation in Shear Modulus, Normalized Shear Modulus, and Material Damping with Shearing Strain from RC Tests of Specimen K2-13-001; Isotropic Confining Pressure σ_o = 11 psi (=1.6 ksf = 76 kPa)

Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average Shearing Strain, %[1]	Material Damping Ratio, D, %[2]
6.13E-05	183600	1.00	5.43E-05	0.58
9.97E-05	183600	1.00	8.90E-05	0.57
1.97E-04	183400	1.00	1.76E-04	0.58
3.40E-04	183300	1.00	3.04E-04	0.60
5.86E-04	183100	1.00	5.25E-04	0.62
1.05E-03	182800	1.00	9.34E-04	0.63
2.00E-03	182200	0.99	1.77E-03	0.68
3.36E-03	181600	0.99	3.01E-03	0.73
6.02E-03	180100	0.98	5.71E-03	0.85
9.84E-03	176800	0.96	8.99E-03	1.16
1.70E-02	162770	0.88	1.40E-02	1.98

(1) Average Shearing Strain from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

(2) Average Damping Ratio from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

Table B.4 Variation in Shear Modulus and Material Damping with Frequency from RC/TS Tests of Specimen K2-13-001; Isotropic Confining Pressure σ_o = 11 psi (=1.6 ksf = 76 kPa)

Approximate Shearing Strain, γ, %	Frequency, Hz	Shear Modulus, G, ksf	Material Damping Ratio, D, %
0.001	0.1	177400	1.33
	0.5	173200	1.07
	1.0	178400	1.09
	5.0	177000	--[1]
	361.2	182800	0.63

(1) Material Damping Ratio Results Not Obtained at 5.0 Hz

Table B.5 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen K2-13-001; Isotropic Confining Pressure σ_o = 45 psi (=6.5 ksf = 310 kPa)

Second Cycle				Tenth Cycle			
Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
3.56E-04	164100	0.98	0.88	3.55E-04	164600	0.99	0.91
6.06E-04	165200	0.99	0.85	6.04E-04	165700	0.99	0.92
1.00E-03	166900	1.00	1.04	9.87E-04	169700	1.02	1.07

Table B.6 Variation in Shear Modulus, Normalized Shear Modulus, and Material Damping with Shearing Strain from RC Tests of Specimen K2-13-001; Isotropic Confining Pressure σ_o = 45 psi (=6.5 ksf = 310 kPa)

Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average Shearing Strain, %[(1)]	Material Damping Ratio, D, %[(2)]
6.26E-05	184300	1.00	5.81E-05	0.62
1.02E-04	184200	1.00	9.49E-05	0.66
1.95E-04	184100	1.00	1.80E-04	0.66
3.47E-04	183700	1.00	3.24E-04	0.68
6.12E-04	183300	0.99	5.71E-04	0.73
9.92E-04	182800	0.99	9.23E-04	0.77
2.10E-03	181700	0.99	1.95E-03	0.85
3.42E-03	180200	0.98	3.19E-03	0.93
5.94E-03	177400	0.96	5.45E-03	1.14
1.07E-02	171600	0.93	9.45E-03	1.55

(1) Average Shearing Strain from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

(2) Average Damping Ratio from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

Table B.7 Variation in Shear Modulus and Material Damping with Frequency from RC/TS Tests of Specimen K2-13-001; Isotropic Confining Pressure σ_o = 45 psi (=6.5 ksf = 310 kPa)

Approximate Shearing Strain, γ, %	Frequency, Hz	Shear Modulus, G, ksf	Material Damping Ratio, D, %
0.001	0.1	174300	1.16
	0.5	169700	1.07
	1.0	175900	0.96
	5.0	176300	0.98
	360.7	182800	0.78

APPENDIX C

Results for Kleinfelder Specimen ID K2-13-002

- *Specimen Preparation Notes*
- *RCTS Testing Results*

SPECIMEN PREPARATION NOTES

Specimen No.:	K2-13-002

Project No : 136473 **Page** 1 **of** 4

Boring No.: B-714 **Date of Preparation..:** 10/12/13

Sample No..: 714-CS-01 **Depth..:** 29.4 - 29.9 feet

Disposition of Rock Core Sample

☒ No Apparent Disturbance ☐ Apparent Disturbance ☐ Apparent Slaking Due to Coring

☒ Other (Describe) Sample consisted of a Limestone with Small to Large Sized Vugs

Specimen Preparation Notes

Trimming Method :	Rotary coring with water lubricant, 1.5-inch OD diameter core barrel		**Affixation to Platens :**	Epoxied to 2.8-inch diameter steel top cap and base pedestal	
Ave. Length (in.) :	4.0265	**Ave. Diameter (in.):**	1.451	**L/D**	2.8
Total Unit Weight . (pcf) :	129.8	**Moisture Content (%)**	8.7	**% Saturation (Assume SG = 2.70)**	57.0

Specimen Testing Comments

1) Sample 714-CS-01 was predominately a medium strong rock with small to large sized vugs (see Photo C.1 to C.2). Due to the rock hardness, the sample could not be trimmed by hand and it was decided to core the nominally 2.5-inch diameter sample with a 1.5-inch outside diameter (OD), thin-walled diamond-impregnated core barrel.

2) Sample was trimmed to an approximate 6-inch length and grouted into an CMU block on 10/12/13. See Photos C.3 through C.4.

3) Sample was cored on 10/13/13. See Photo C.5. One approximately 1.45-inch diameter specimen resulted from the air rotary coring. The specimen was of sufficient length for RCTS Testing and the sample ends were trimmed to the final length of about 4.0-inches.

4) Specimen was epoxied to the 2.8-inch diameter steel top cap and base pedestal on 12/10/13.

5) Testing commenced on 12/11/13 and was completed on 12/13/13. The full test sequence was completed, with confining pressures ranging from 3 psi to 40 psi.

☒ **See Attached Photographs**

SPECIMEN PREPARATION NOTES

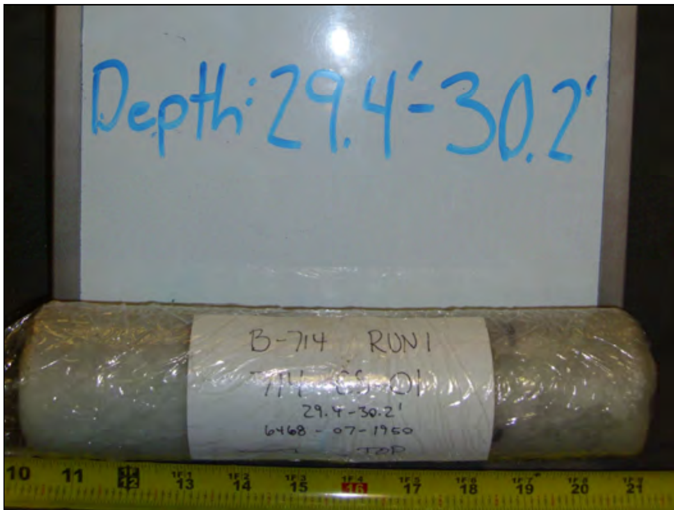


Photo C.1

Sample 714-CS-01 after removal from the protective transport container.

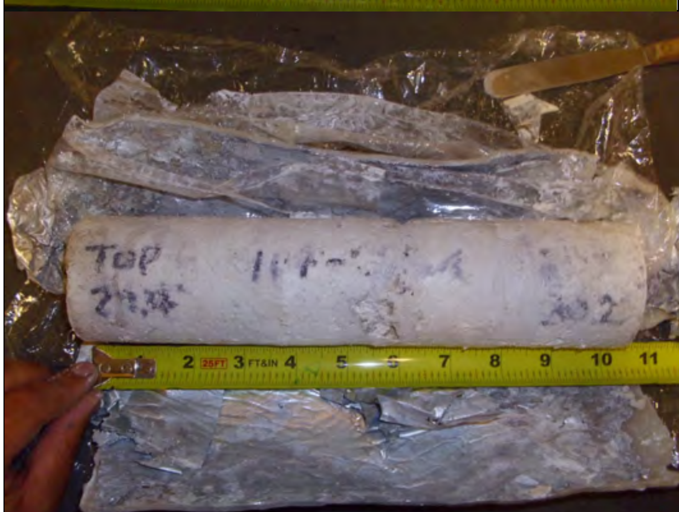


Photo C.2

Sample after removal from the wax casing and aluminum foil.

Photo C.3

Trimming the sample to an approximate 6-inch length as preparation for grouting in a CMU block. Note the modeling clay used to seal off natural vugs in sample to prevent grout infiltration.

SPECIMEN PREPARATION NOTES

Specimen No: K2-13-002

Photo C.4

Grouting sample in a CMU block as preparation for down coring the sample. Note the specimen number written on the side of the CMU block to maintain sample control.

Photo C.5

Rotary coring of specimen using the 1.5-inch OD core barrel.

Photo C.6

Specimen after down coring to an approximate 1.45-inch diameter.

SPECIMEN PREPARATION NOTES

Specimen No: K2-13-002 **Page 4 of 4**

Photo C.7

Specimen after affixation to the steal top cap and base pedestal using epoxy. Note modeling clay placed in natural vugs to prevent membrane puncture during testing.

Kleinfelder Specimen ID:

K2-13-002

Boring No: B-714
Sample No: CS-01

Limestone (Key Largo Formation)
Depth = 29.4 ft – 29.9 ft (below existing ground surface)
Total Unit Weight = 129.8 lb/ft^3
Natural Moisture Content = 8.7%
Estimated In-Situ Mean Effective Stress = 10 psi

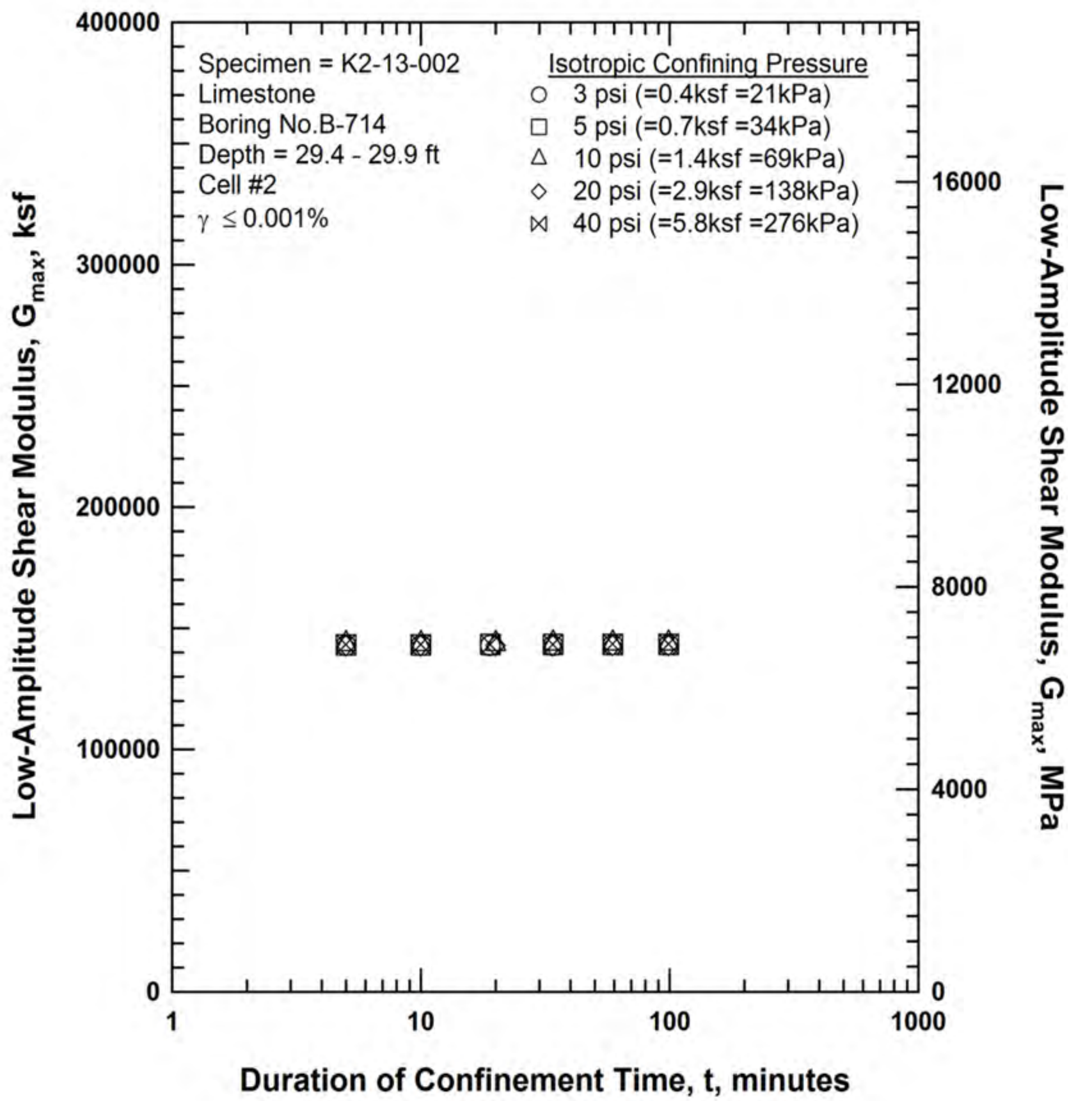


Figure C.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-002

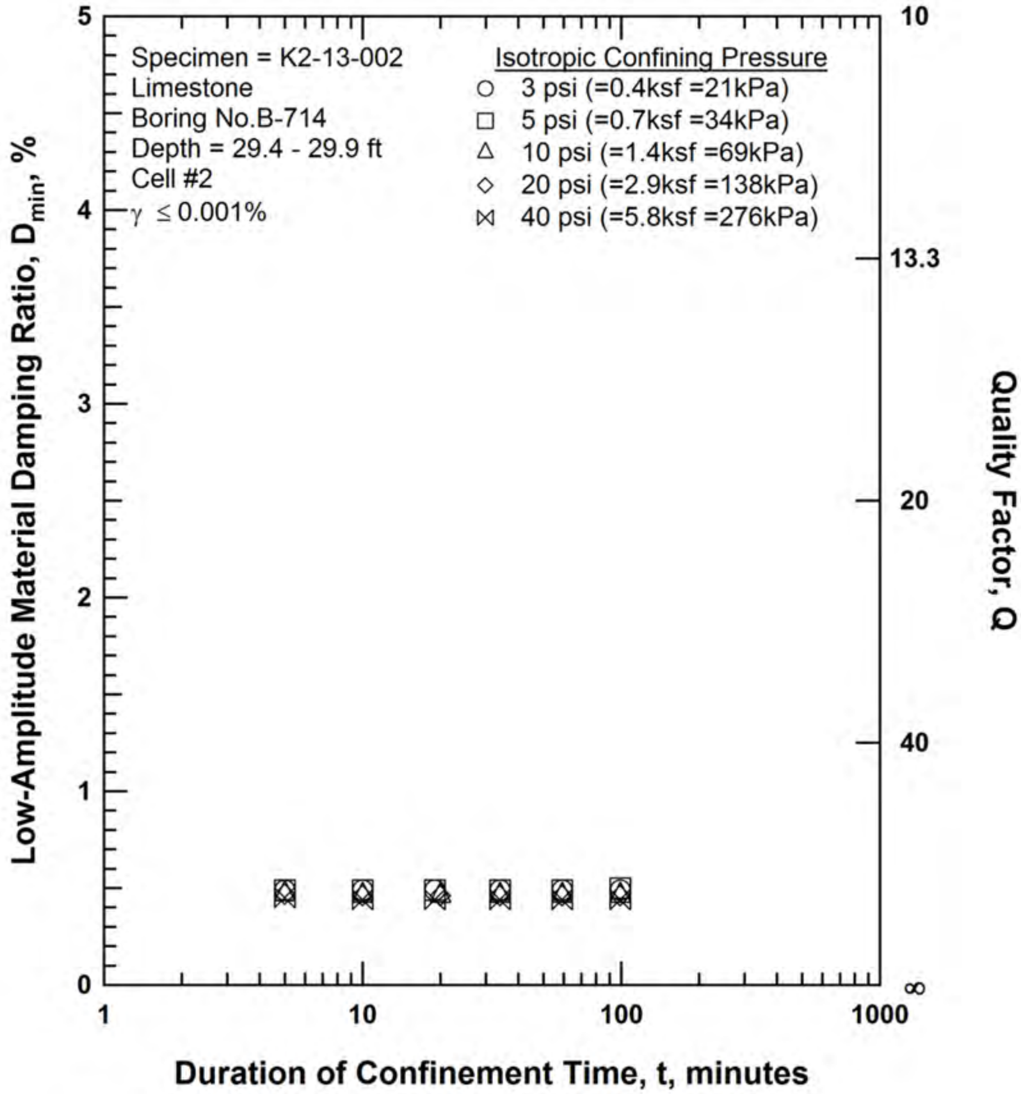


Figure C.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-002

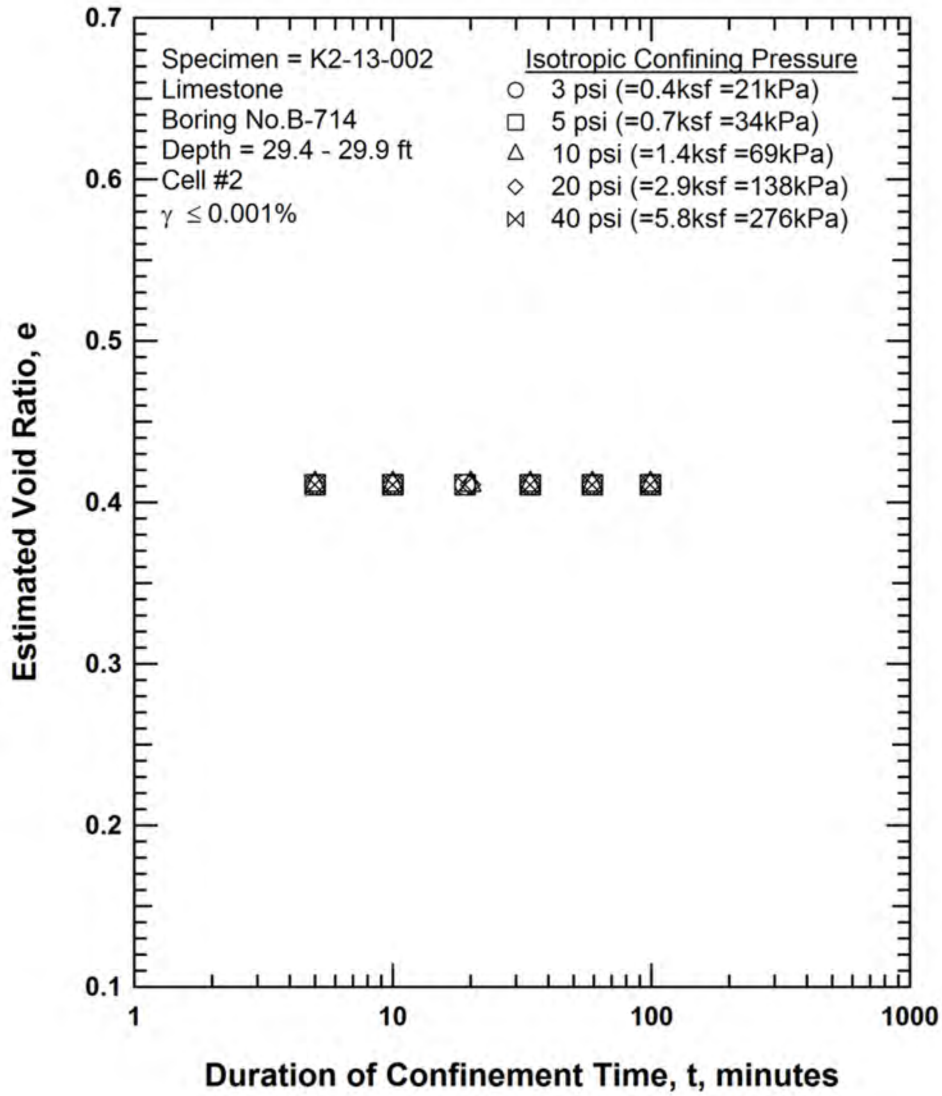


Figure C.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Test of Specimen K2-13-002

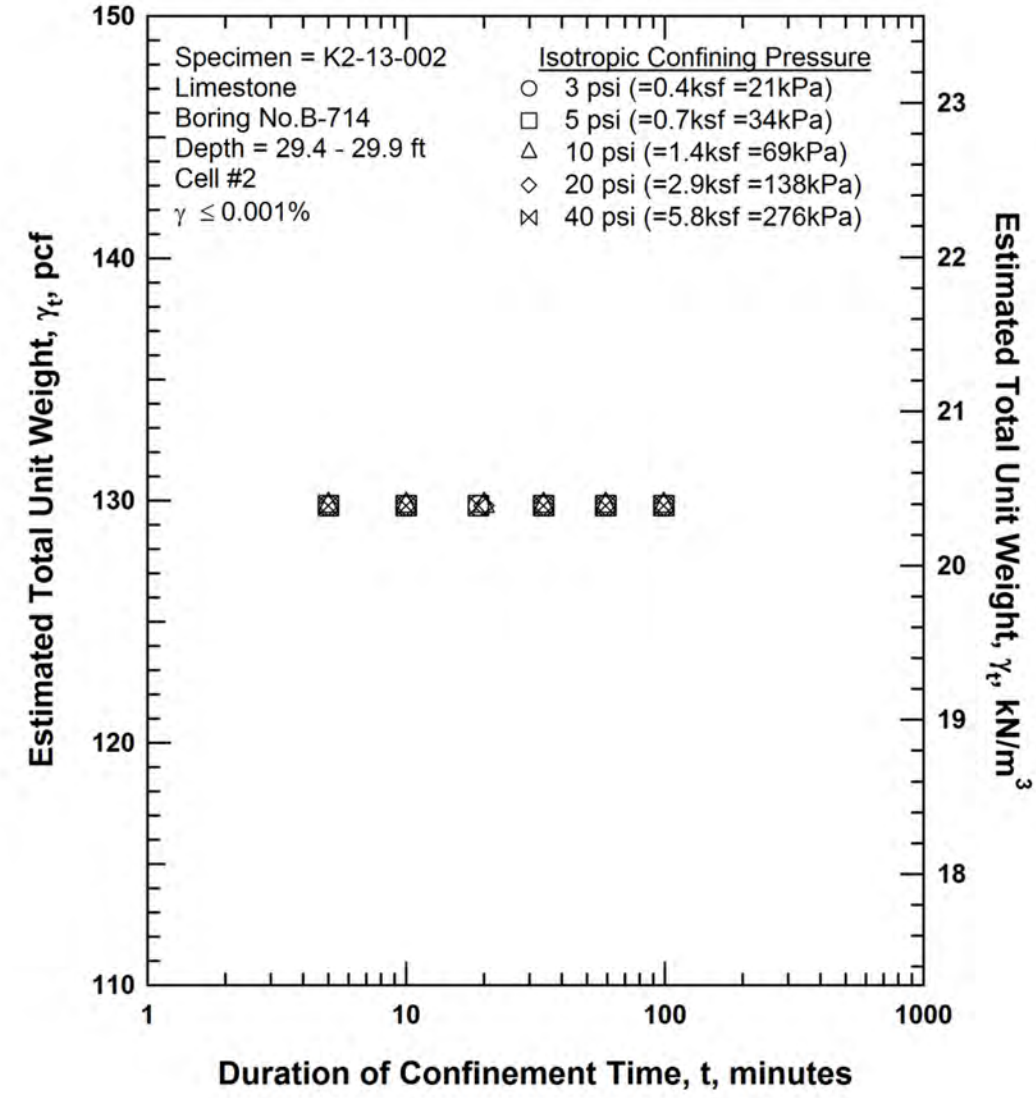


Figure C.4 Variation in Estimated Total Unit Weight with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-002

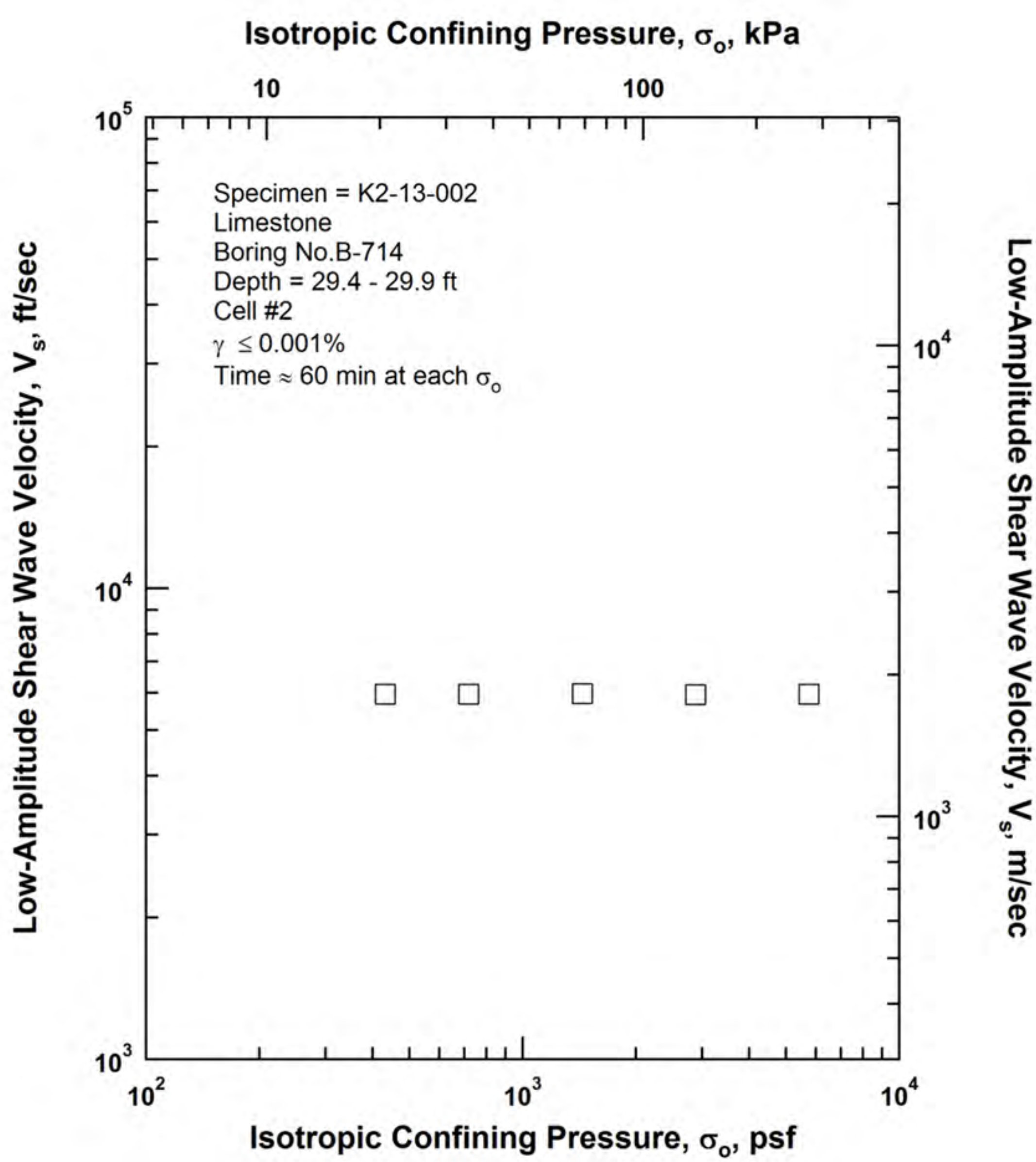


Figure C.5 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-002

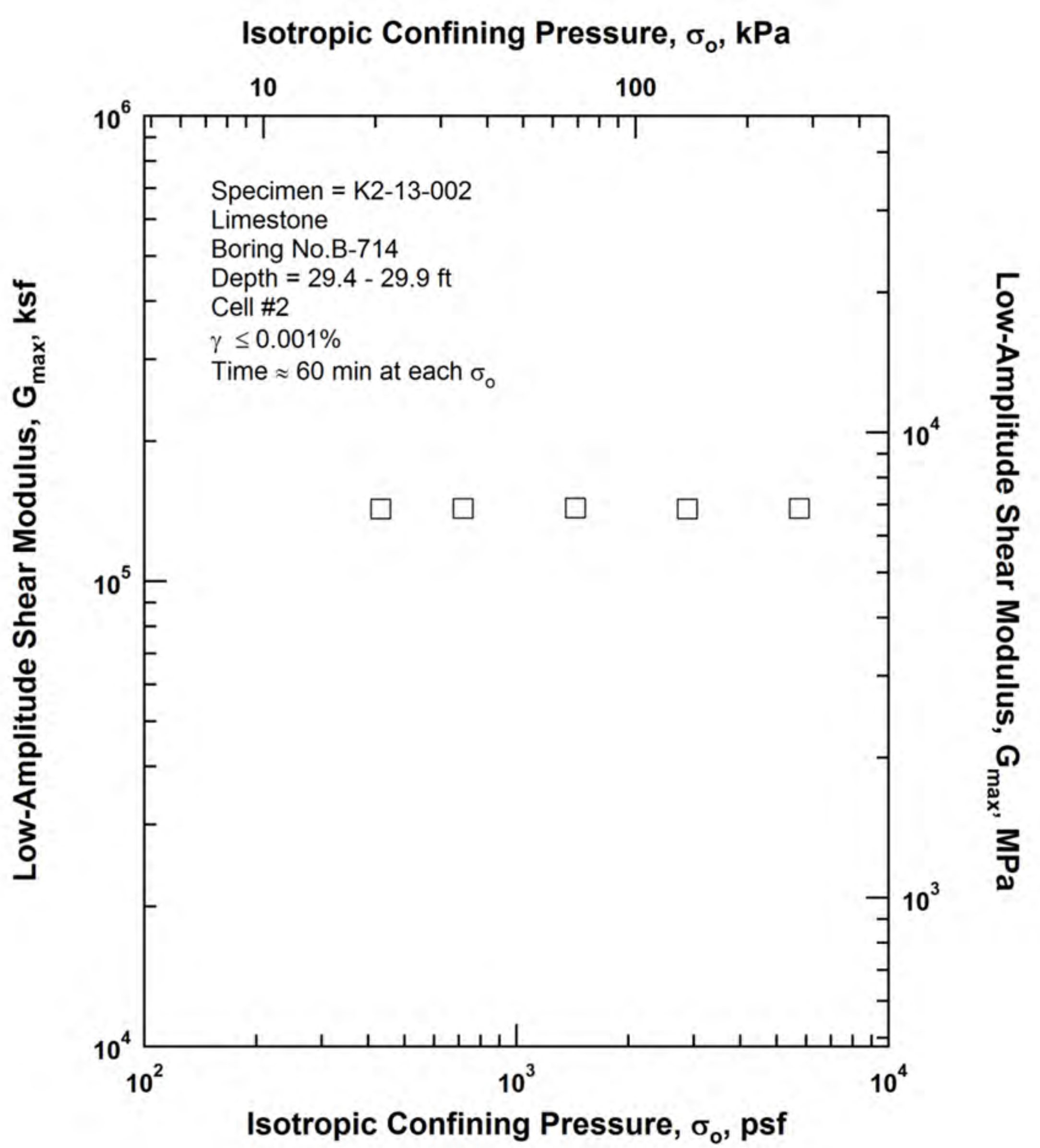


Figure C.6 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Test of Specimen K2-13-002

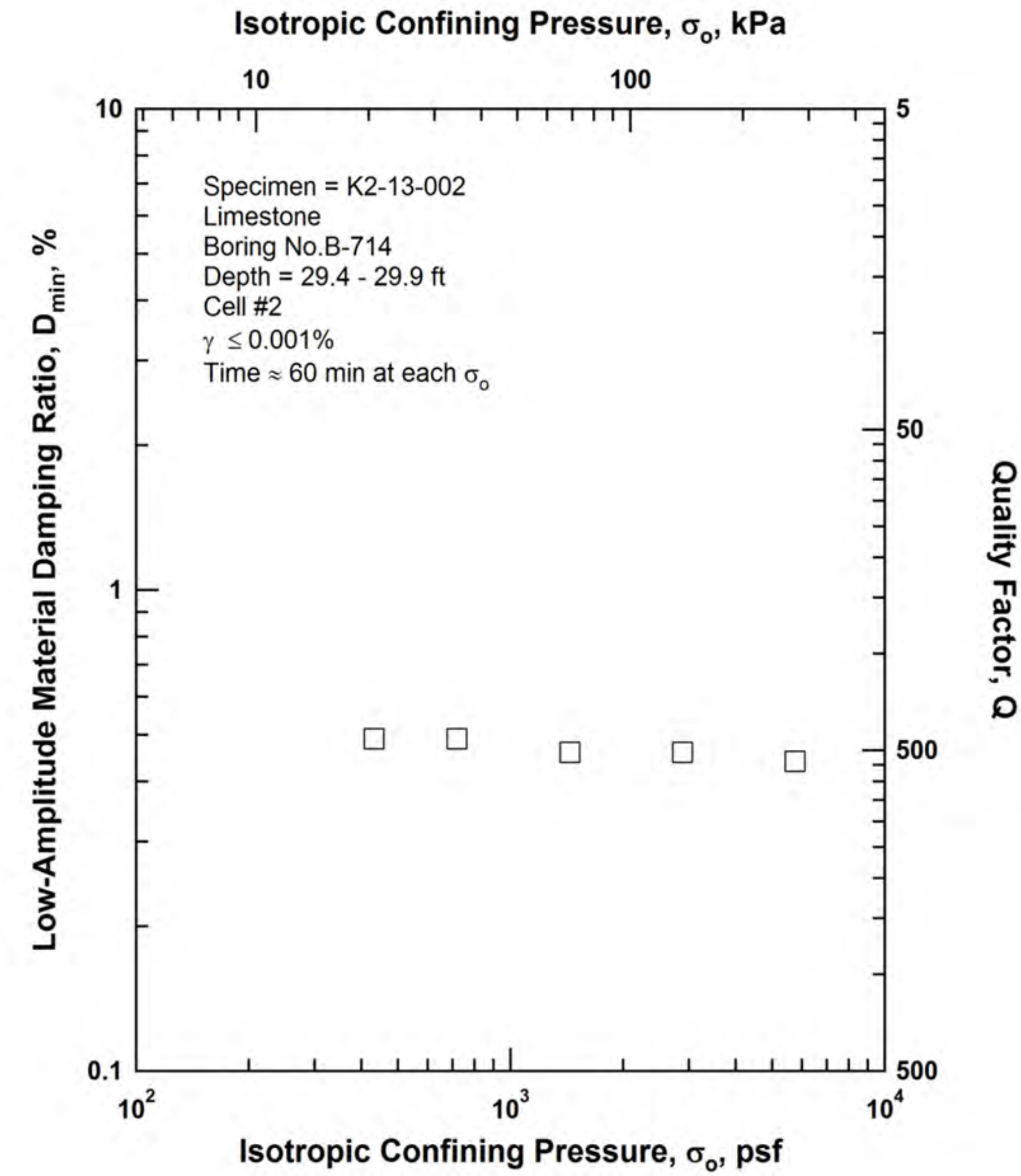


Figure C.7 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-002

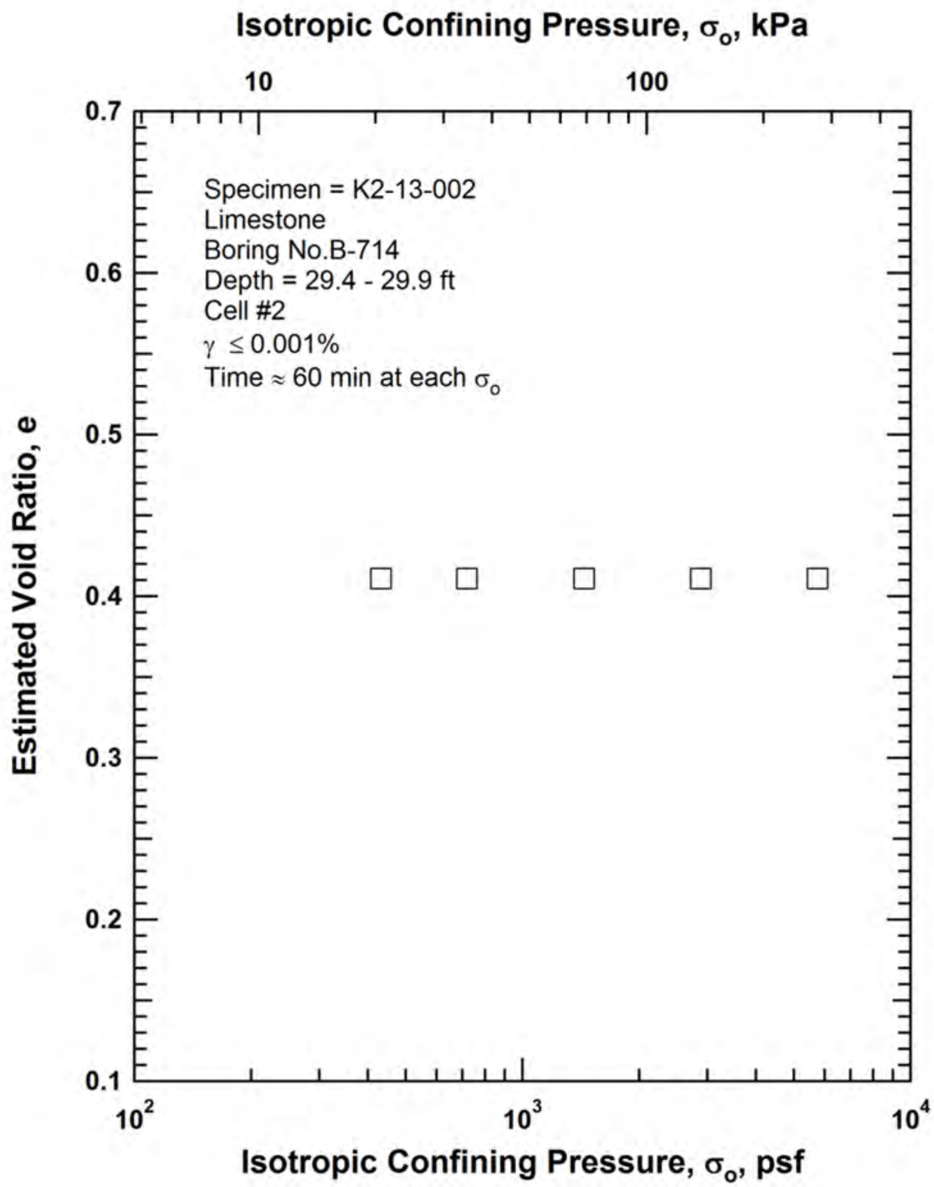


Figure C.8 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-002

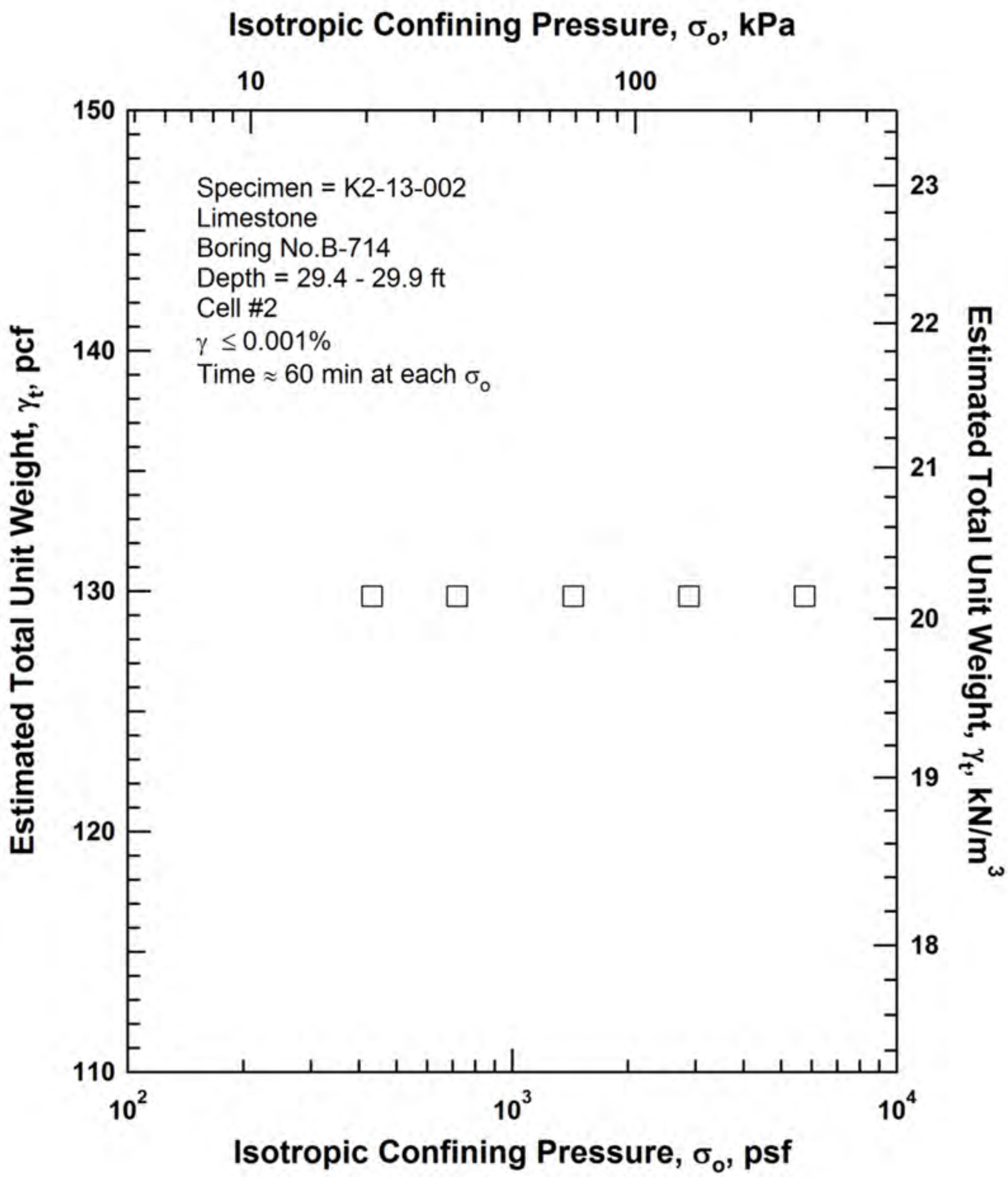


Figure C.9 Variation in Estimated Total Unit Weight with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-002

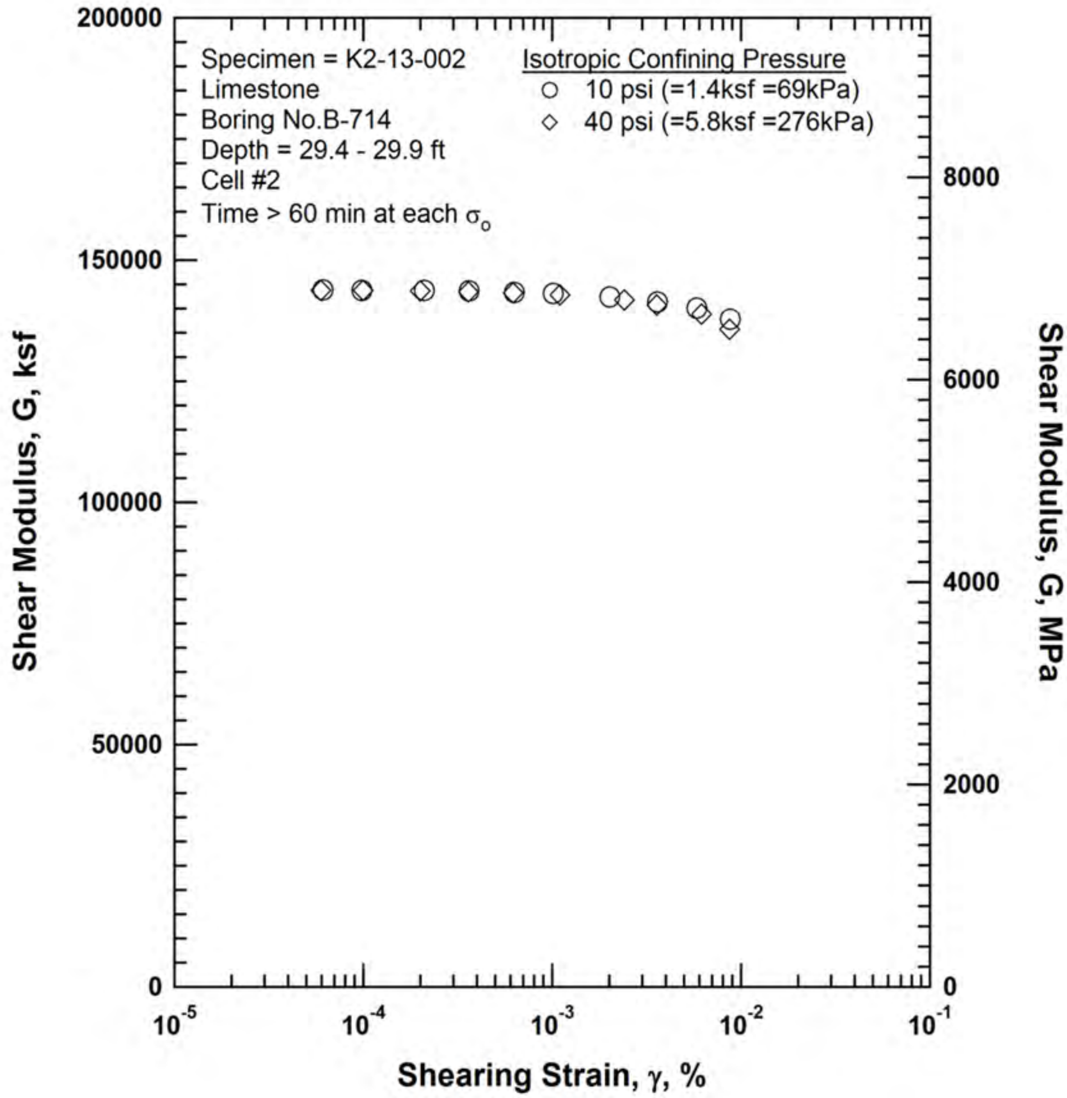


Figure C.10 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-002

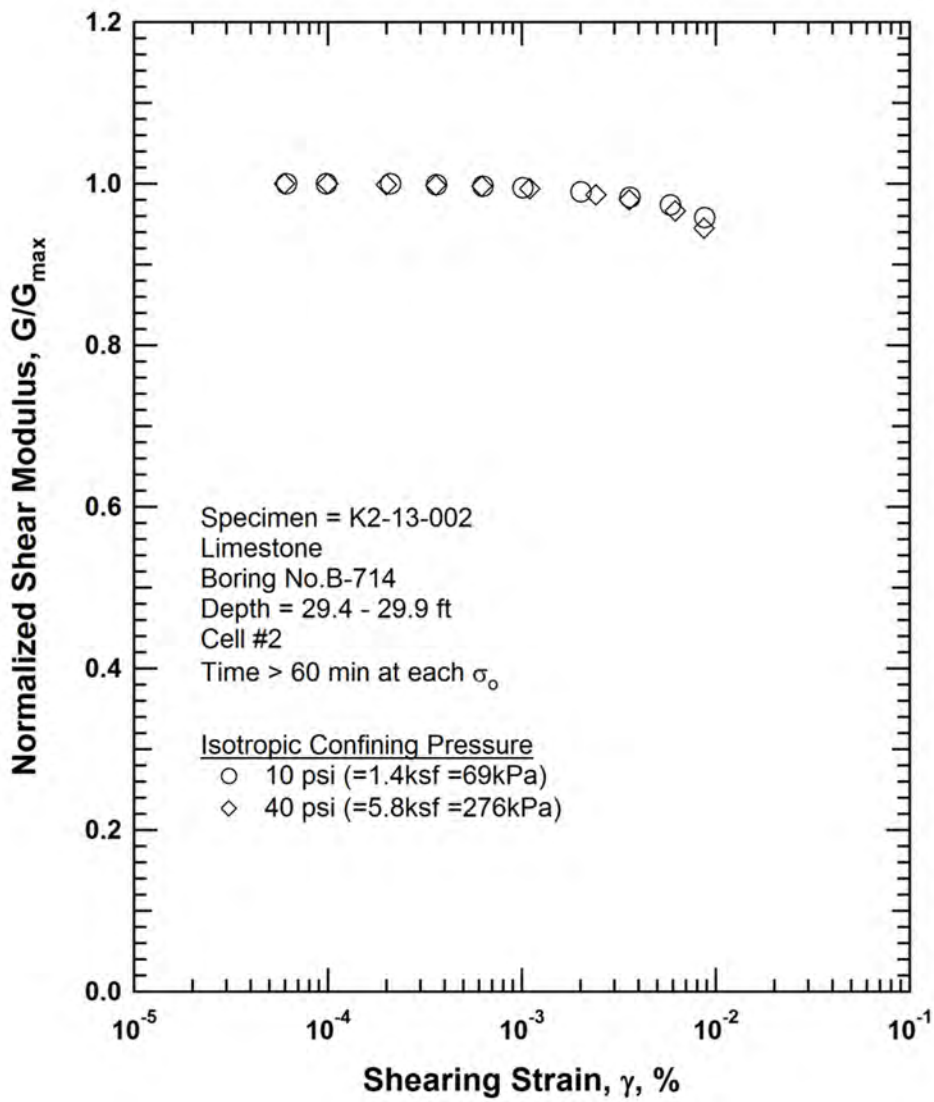


Figure C.11 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-002

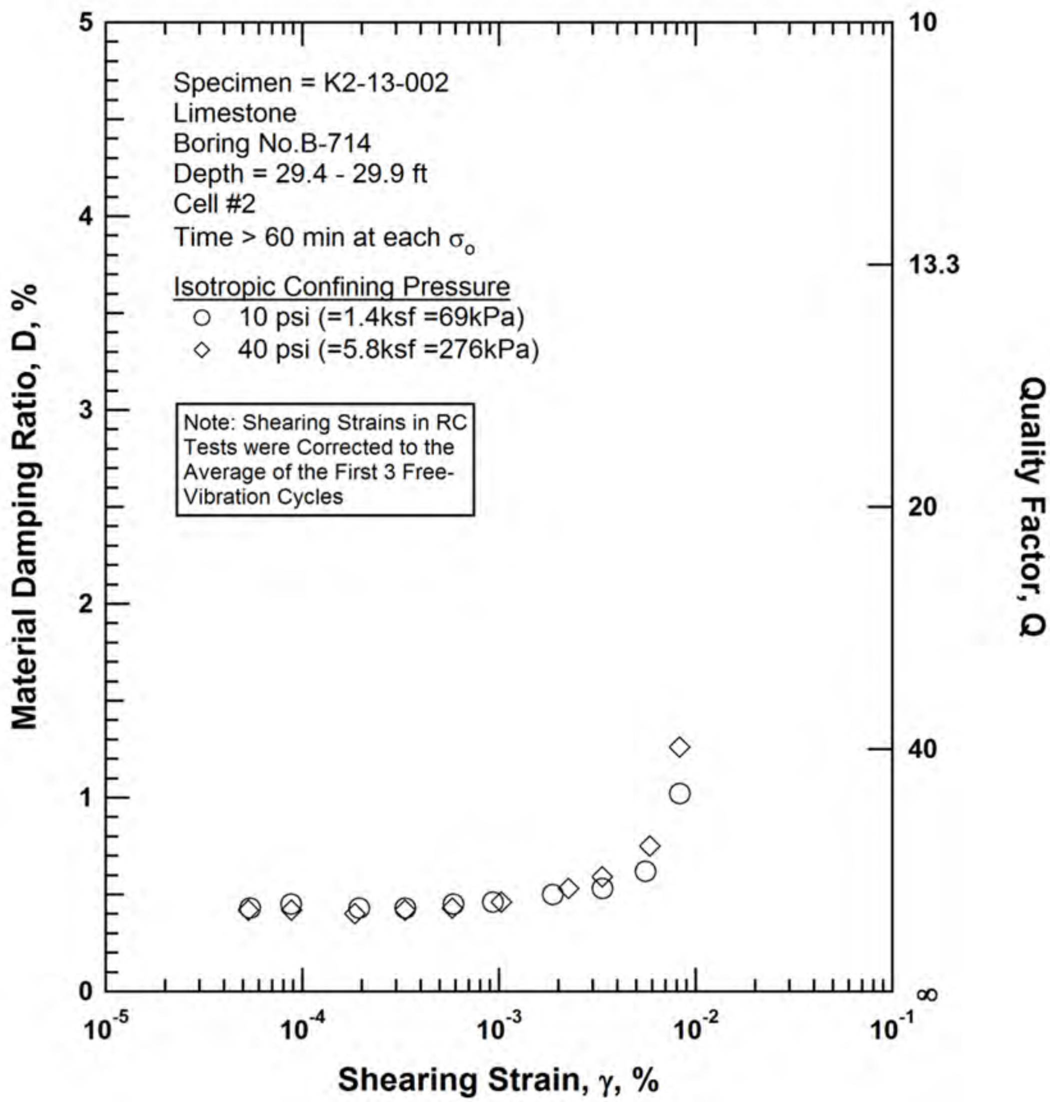


Figure C.12 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-002

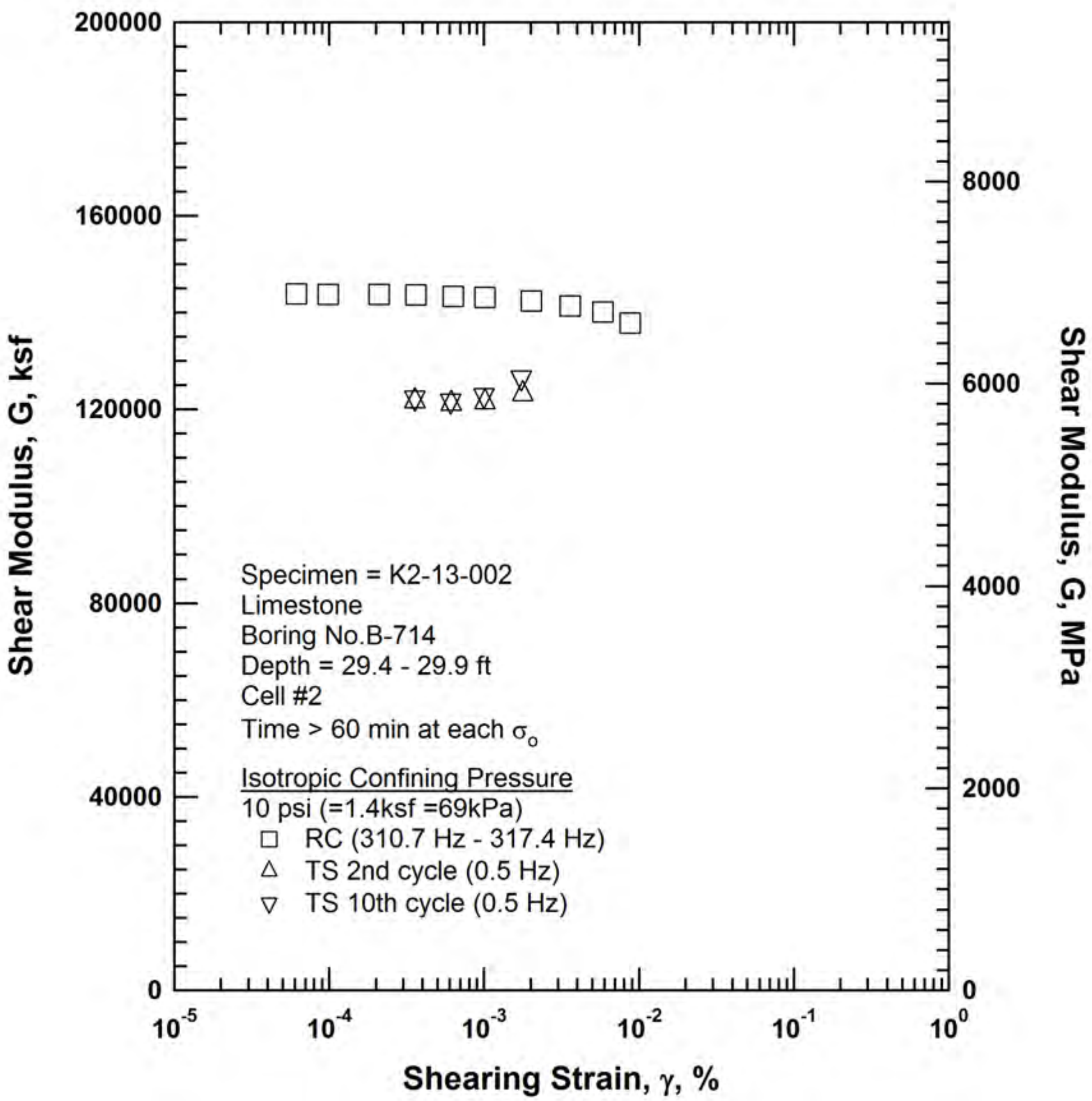


Figure C.13 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 10 psi (=1.4ksf =69kPa) from the Combined RCTS Tests of Specimen K2-13-002

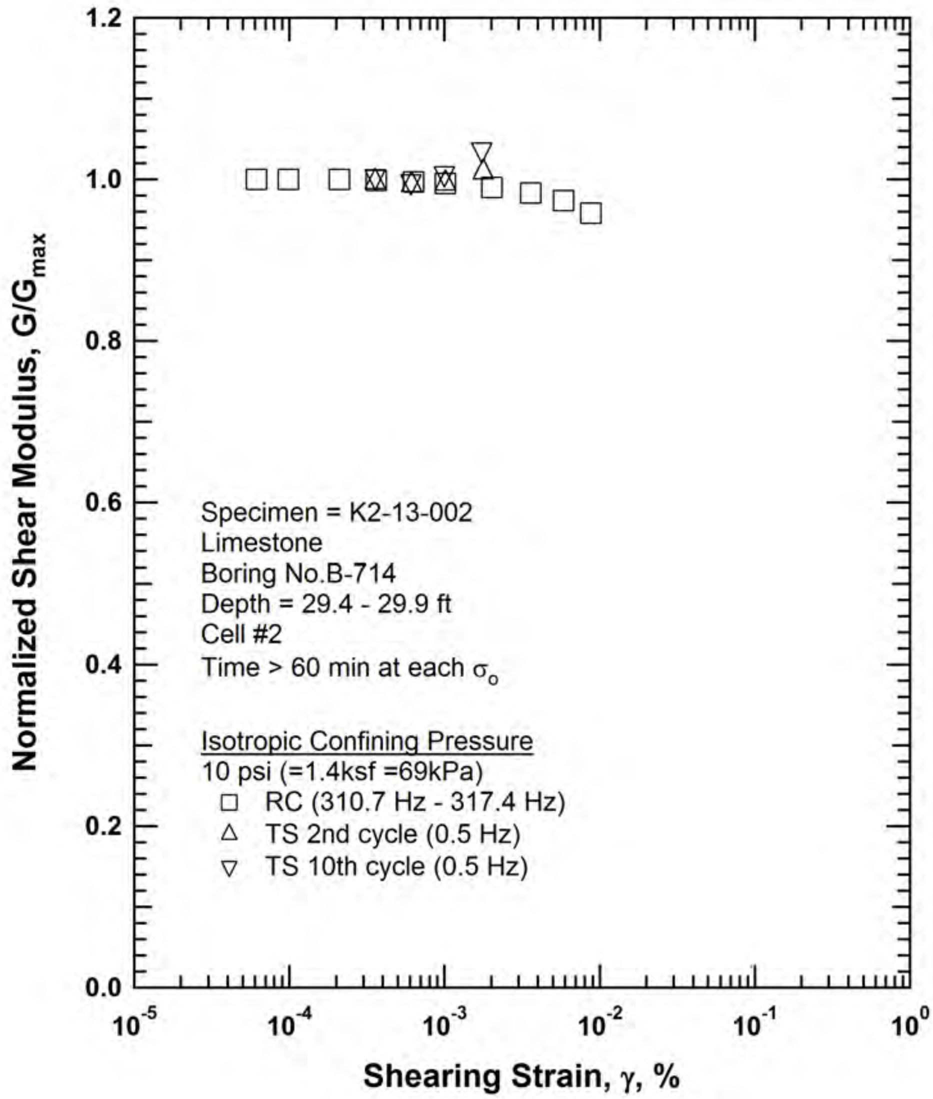


Figure C.14 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 10 psi (=1.4ksf =69kPa) from the Combined RCTS Tests of Specimen K2-13-002

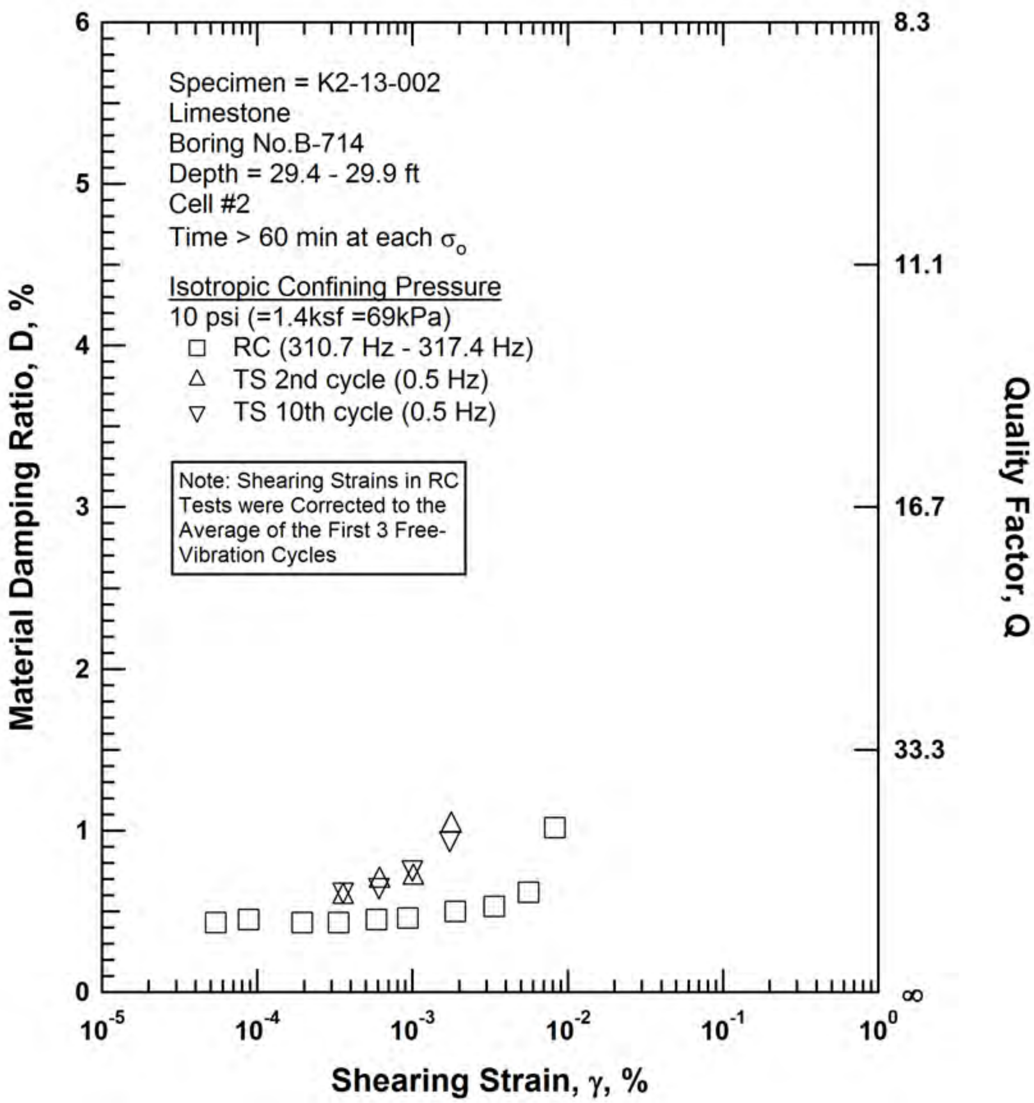


Figure C.15 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 10 psi (=1.4ksf =69kPa) from the Combined RCTS Tests of Specimen K2-13-002

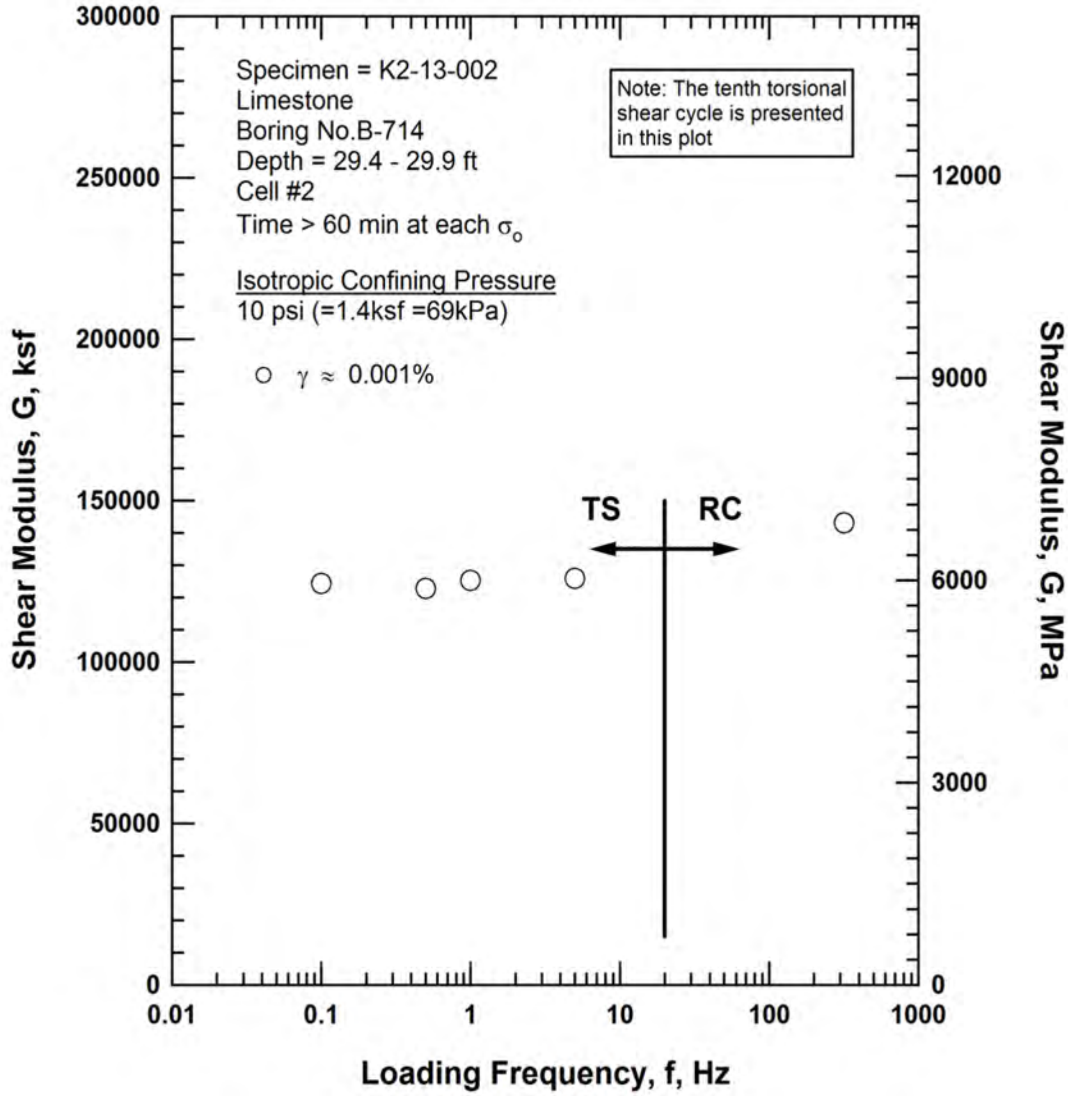


Figure C.16 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 10 psi (=1.4ksf =69kPa) from the Combined RCTS Tests of Specimen K2-13-002

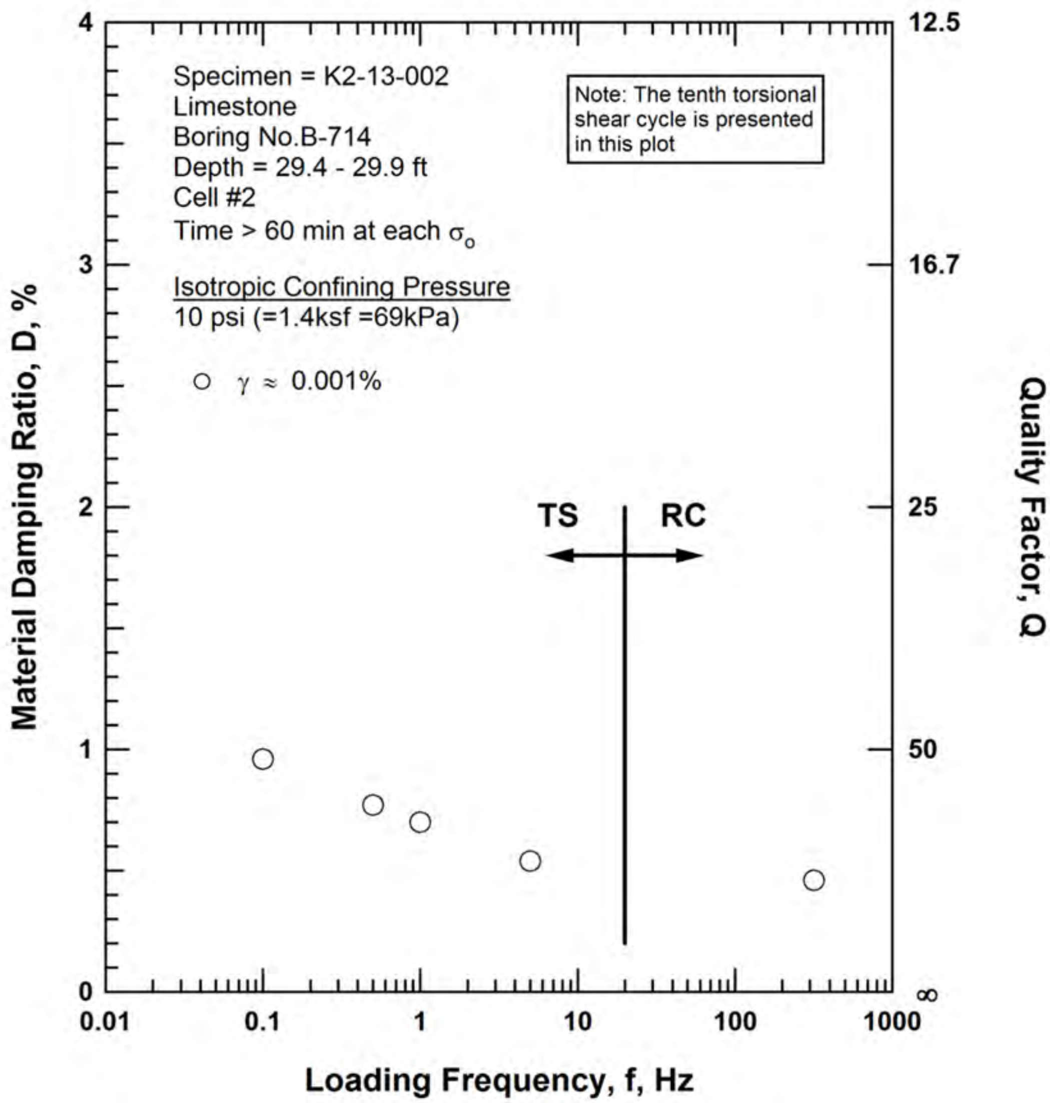


Figure C.17 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 10 psi (=1.4ksf =69kPa) from the Combined RCTS Tests of Specimen K2-13-002

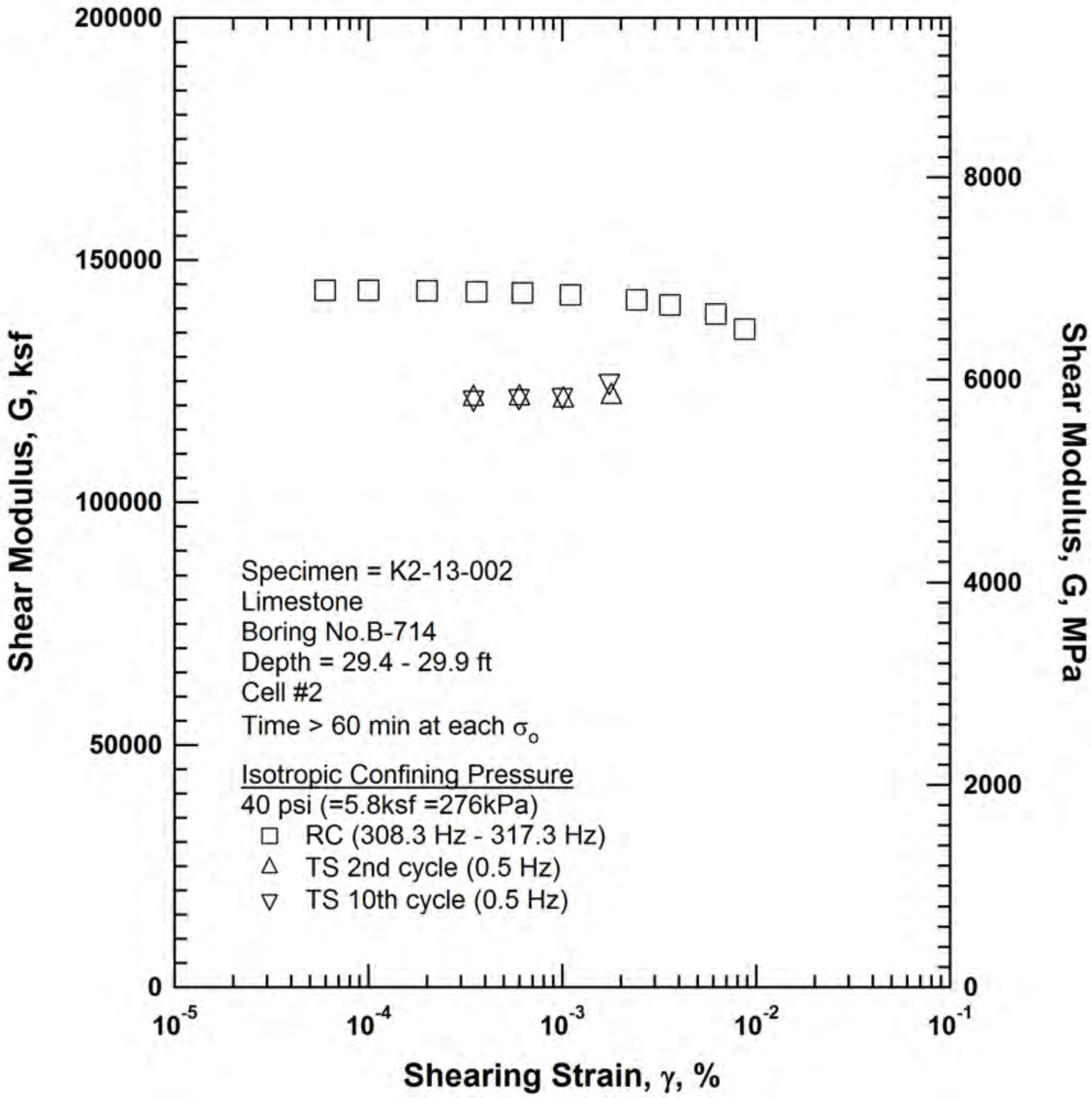


Figure C.18 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 40 psi (=5.8ksf =276kPa) from the Combined RCTS Tests of Specimen K2-13-002

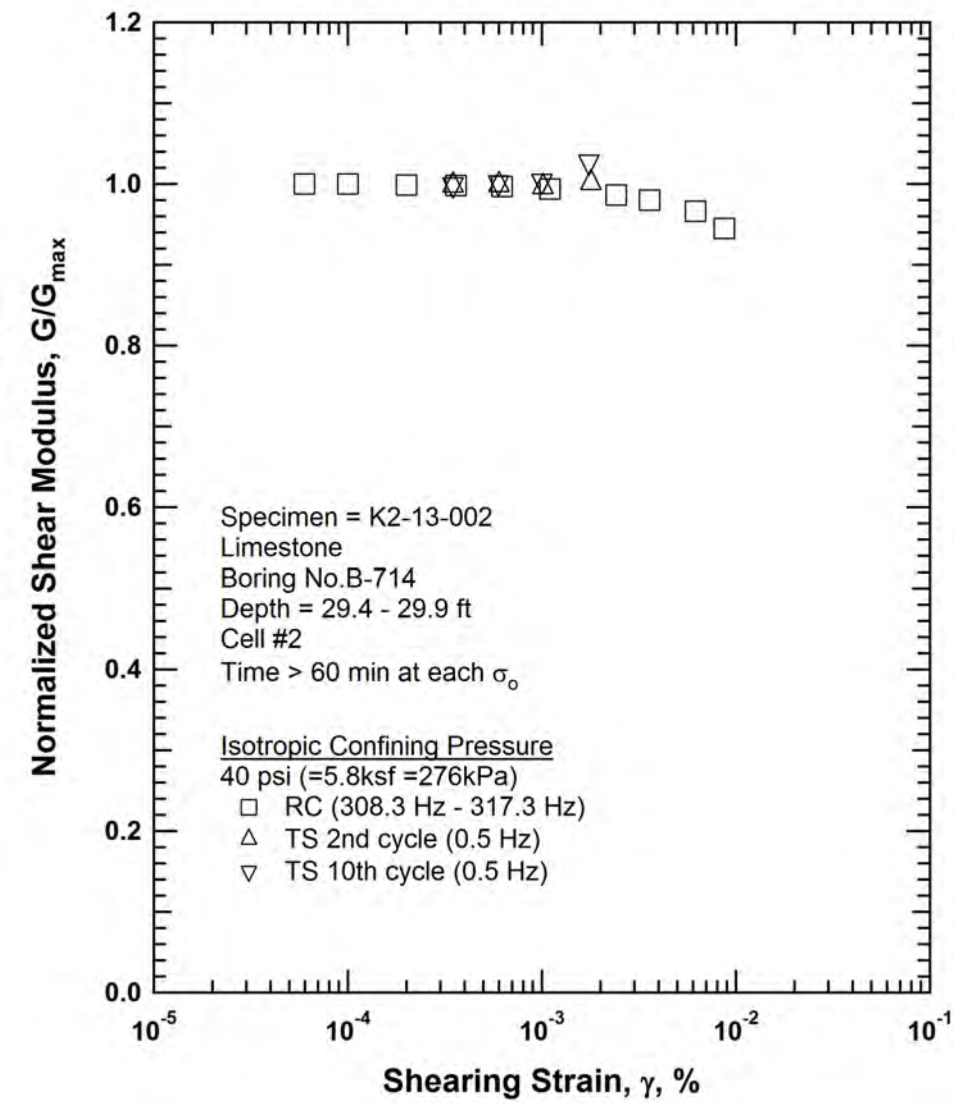


Figure C.19 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 40 psi (=5.8ksf =276kPa) from the Combined RCTS Tests of Specimen K2-13-002

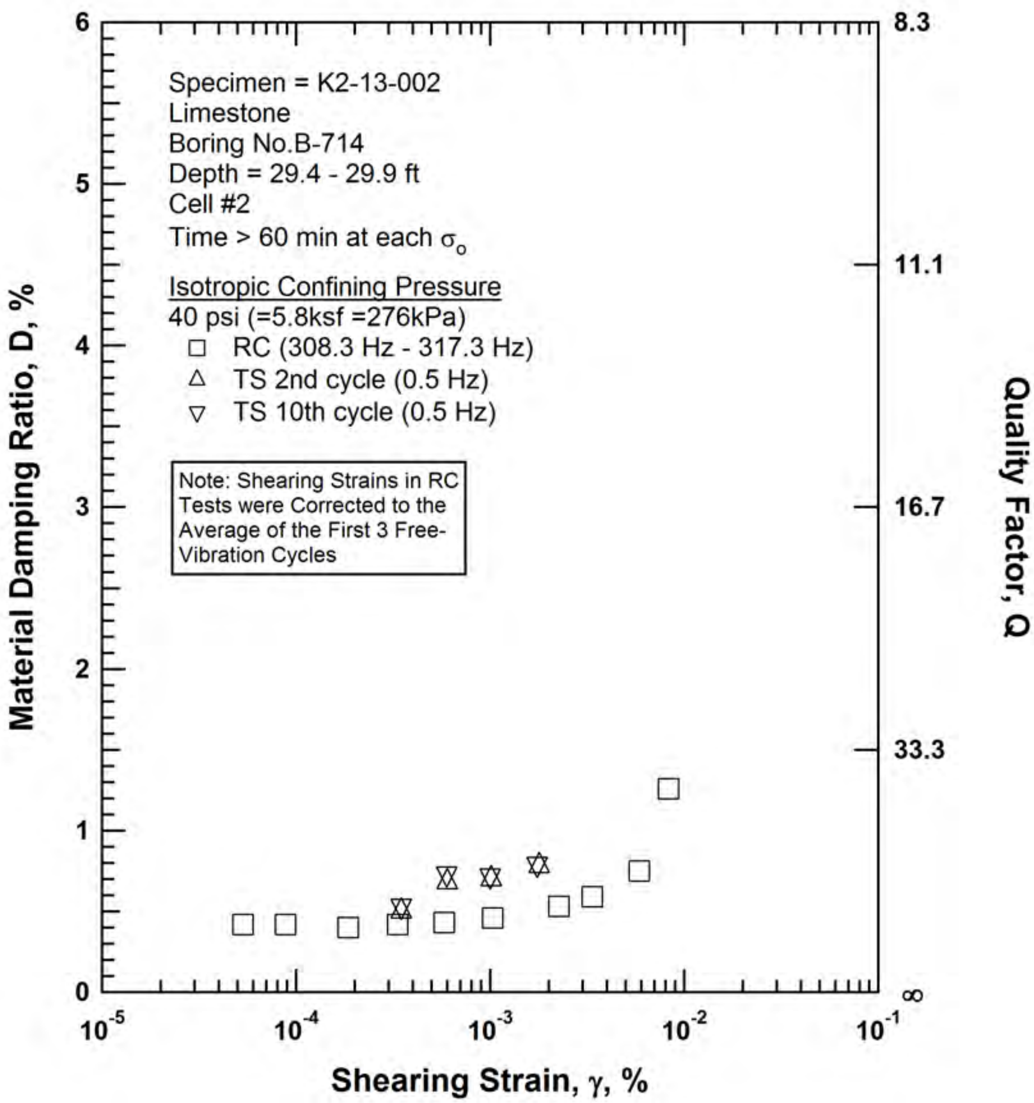


Figure C.20 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 40 psi (=5.8ksf =276kPa) from the Combined RCTS Tests of Specimen K2-13-002

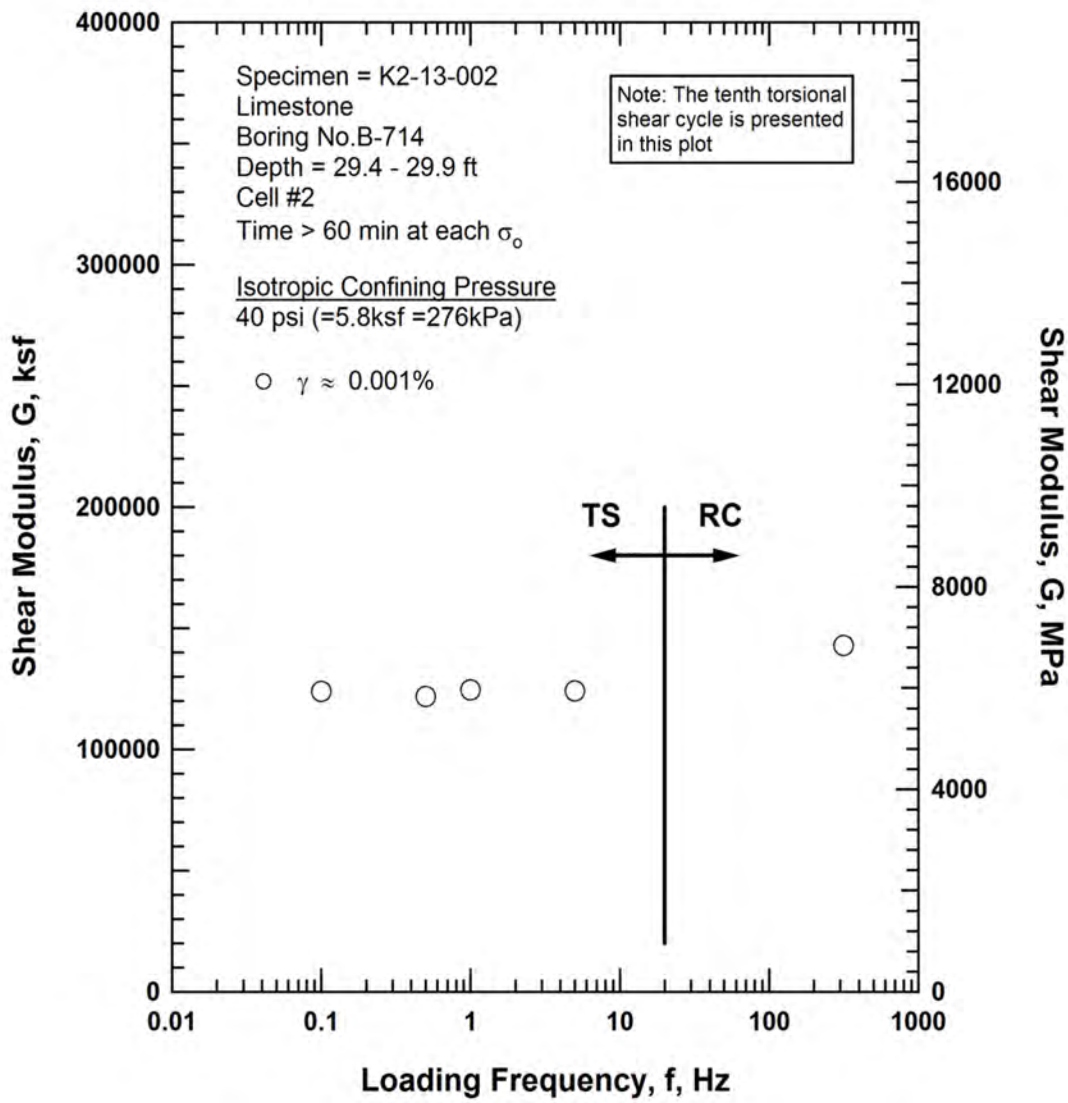


Figure C.21 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 40 psi (=5.8ksf =276kPa) from the Combined RCTS Tests of Specimen K2-13-002

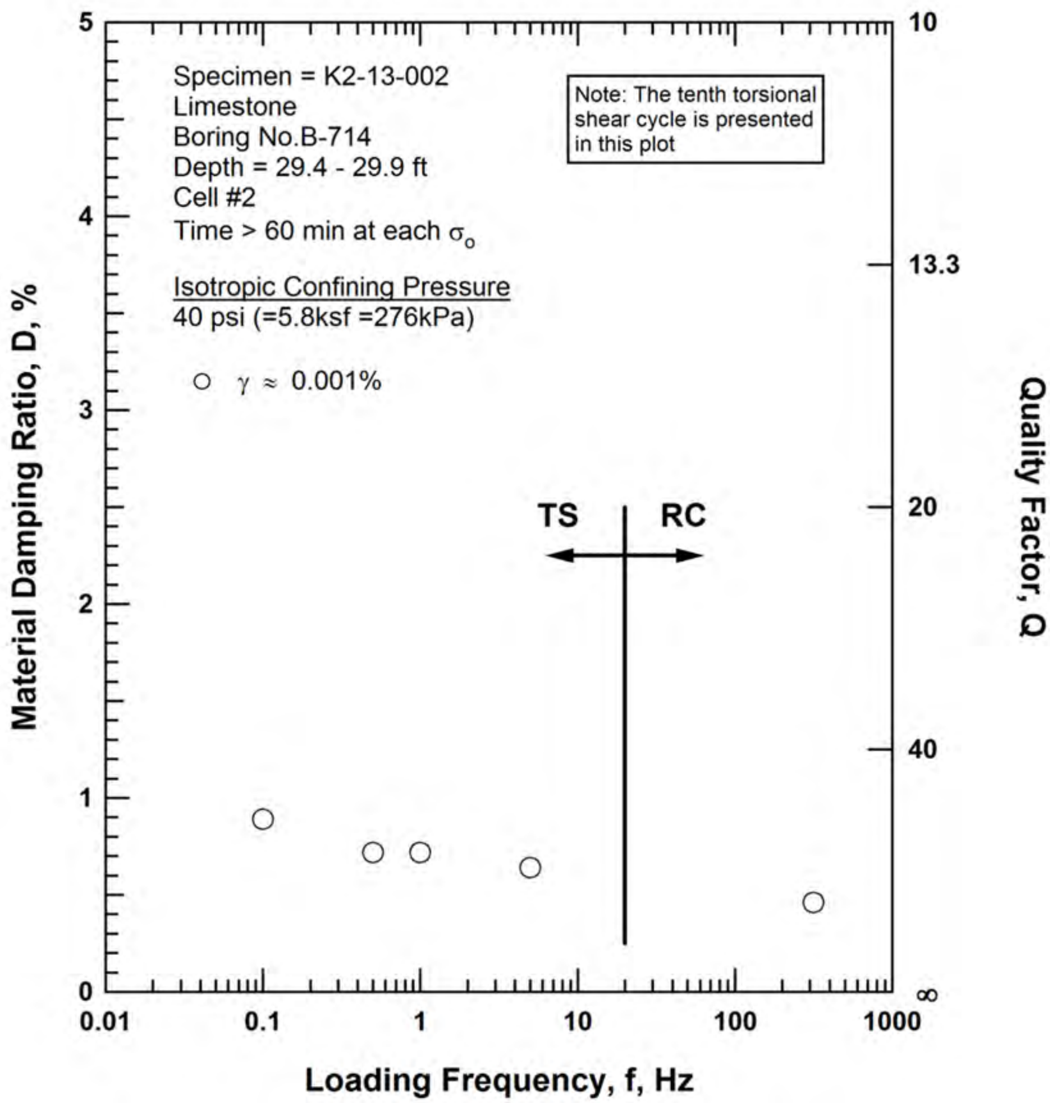


Figure C.22 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 40 psi (=5.8ksf =276kPa) from the Combined RCTS Tests of Specimen K2-13-002

Table C.1 Variation in Low-Amplitude Shear Wave Velocity, Low-Amplitude Shear Modulus, Low-Amplitude Material Damping Ratio, Estimated Void Ratio, and Estimated Total Unit Weight with Isotropic Confining Pressure from RC Tests of Specimen K2-13-002

Isotropic Confining Pressure, σ_o			Low-Amplitude Shear Modulus, G_{max}		Low-Amplitude Shear Wave Velocity, V_s	Low-Amplitude Material Damping Ratio, D_{min}	Estimated Void Ratio, e	Estimated Total Unit Weight, γ_t
(psi)	(psf)	(kPa)	(ksf)	(MPa)	(fps)	(%)	(Unitless)	(pcf)
3	432	21	143100	6852	5960	0.49	0.411	129.8
5	720	34	143300	6859	5960	0.49	0.411	129.8
10	1440	69	143700	6882	5970	0.46	0.411	129.8
20	2880	138	142800	6839	5950	0.46	0.411	129.8
40	5760	276	143500	6868	5960	0.44	0.411	129.8

Table C.2 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen K2-13-002; Isotropic Confining Pressure σ_o = 10 psi (=1.4 ksf = 69 kPa)

Second Cycle				Tenth Cycle			
Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
3.58E-04	121700	1.00	0.59	3.56E-04	122300	1.00	0.63
6.12E-04	121200	0.99	0.69	6.10E-04	121600	1.00	0.66
1.01E-03	121500	1.00	0.71	9.95E-04	122800	1.01	0.77
1.77E-03	123130	1.01	1.03	1.73E-03	126410	1.04	0.95

Table C.3 Variation in Shear Modulus, Normalized Shear Modulus, and Material Damping with Shearing Strain from RC Tests of Specimen K2-13-002; Isotropic Confining Pressure σ_o = 10 psi (=1.4 ksf = 69 kPa)

Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average Shearing Strain, %(1)	Material Damping Ratio, D, %(2)
6.12E-05	143800	1.00	5.42E-05	0.43
9.85E-05	143700	1.00	8.79E-05	0.45
2.10E-04	143700	1.00	1.94E-04	0.43
3.63E-04	143600	1.00	3.33E-04	0.43
6.30E-04	143400	1.00	5.87E-04	0.45
1.01E-03	143100	1.00	9.30E-04	0.46
2.02E-03	142400	0.99	1.88E-03	0.50
3.60E-03	141400	0.98	3.35E-03	0.53
5.83E-03	140100	0.97	5.57E-03	0.62
8.79E-03	137800	0.96	8.28E-03	1.02

(1) Average Shearing Strain from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

(2) Average Damping Ratio from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

Table C.4 Variation in Shear Modulus and Material Damping with Frequency from RC/TS Tests of Specimen K2-13-002; Isotropic Confining Pressure σ_o = 10 psi (=1.4 ksf = 69 kPa)

Approximate Shearing Strain, γ, %	Frequency, Hz	Shear Modulus, G, ksf	Material Damping Ratio, D, %
0.001	0.1	124300	0.96
	0.5	122800	0.77
	1.0	125400	0.70
	5.0	125900	0.54
	316.6	143100	0.46

Table C.5 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen K2-13-002; Isotropic Confining Pressure σ_o = 40 psi (=5.8 ksf = 276 kPa)

Second Cycle				Tenth Cycle			
Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
3.49E-04	121300	1.00	0.50	3.48E-04	121500	1.00	0.53
6.00E-04	121500	1.00	0.68	5.98E-04	121700	1.00	0.73
1.01E-03	121100	1.00	0.70	1.00E-03	122000	1.00	0.72
1.79E-03	121730	1.00	0.78	1.75E-03	124860	1.03	0.79

Table C.6 Variation in Shear Modulus, Normalized Shear Modulus, and Material Damping with Shearing Strain from RC Tests of Specimen K2-13-002; Isotropic Confining Pressure σ_o = 40 psi (=5.8 ksf = 276 kPa)

Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average Shearing Strain, %(1)	Material Damping Ratio, D, %(2)
5.96E-05	143700	1.00	5.32E-05	0.42
9.99E-05	143700	1.00	8.83E-05	0.42
2.01E-04	143600	1.00	1.85E-04	0.40
3.60E-04	143500	1.00	3.34E-04	0.42
6.24E-04	143300	1.00	5.78E-04	0.43
1.10E-03	142800	0.99	1.03E-03	0.46
2.42E-03	141700	0.99	2.26E-03	0.53
3.59E-03	140800	0.98	3.36E-03	0.59
6.18E-03	138900	0.97	5.86E-03	0.75
8.71E-03	135700	0.95	8.32E-03	1.26

(1) Average Shearing Strain from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

(2) Average Damping Ratio from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

Table C.7 Variation in Shear Modulus and Material Damping with Frequency from RC/TS Tests of Specimen K2-13-002; Isotropic Confining Pressure σ_o = 40 psi (=5.8 ksf = 276 kPa)

Approximate Shearing Strain, γ, %	Frequency, Hz	Shear Modulus, G, ksf	Material Damping Ratio, D, %
0.001	0.1	124100	0.89
	0.5	122000	0.72
	1	124700	0.72
	5	124100	0.64
	316.3	142800	0.46

APPENDIX D

Results for Kleinfelder Specimen ID K2-13-003

- *Specimen Preparation Notes*
- *RCTS Testing Results*

SPECIMEN PREPARATION NOTES

Specimen No.: K2-13-003	**Project No :** 136473		

Boring No.: B-728 **Date of Preparation..:** 10/12/13

Sample No..: 728-CS-04 **Depth..:** 53.7 - 54.2 feet

Disposition of Rock Core Sample

☒ No Apparent Disturbance ☐ Apparent Disturbance ☐ Apparent Slaking Due to Coring

☒ Other (Describe) Sample consisted of a Limestone of the Fort Thompson Formation with Small to Medium vugs

Specimen Preparation Notes

Trimming Method :	Rotary coring with water lubricant, 1.5-inch OD diameter core barrel		**Affixation to Platens :**	Epoxied to 2.8-inch diameter steel top cap and base pedestal	
Ave. Length (in.) :	4.0893	**Ave. Diameter (in.):**	1.449	**L/D**	2.8
Total Unit Weight . (pcf) :	144.3	**Moisture Content (%)**	7.7	**% Saturation (Assume SG = 2.70)**	80.7

Specimen Testing Comments

1) Sample 728-CS-04 was predominately a medium strong rock with small to medium sized vugs (see Photo D.1 to D.2). Due to the rock hardness, the sample could not be trimmed by hand and it was decided to core the nominally 2.5-inch diameter sample with a 1.5-inch outside diameter (OD), thin-walled diamond-impregnated core barrel.

2) Sample was trimmed to an approximate 6-inch length and grouted into an CMU block on 10/12/13. See Photos D.3 through D.4.

3) Sample was cored on 10/13/13. See Photo D.5. One approximately 1.45-inch diameter specimen resulted from the rotary coring. The specimen was of sufficient length for RCTS Testing and the sample ends were trimmed to the final length of about 4.1-inches.

4) Specimen was epoxied to the 2.8-inch diameter steel top cap and base pedestal on 12/11/13.

5) Testing commenced on 12/12/13, beginning with 5 psi pressure.

6) A membrane leak was detected during low-amplitude resonant column testing of Pressure Stage 4 (47 psi). Due to the leak, testing was terminated at Pressure Stage 4. Testing ended on 12/14/13.

☒ **See Attached Photographs**

KLEINFELDER
Bright People. Right Solutions.

SPECIMEN PREPARATION NOTES

Specimen No: K2-13-003

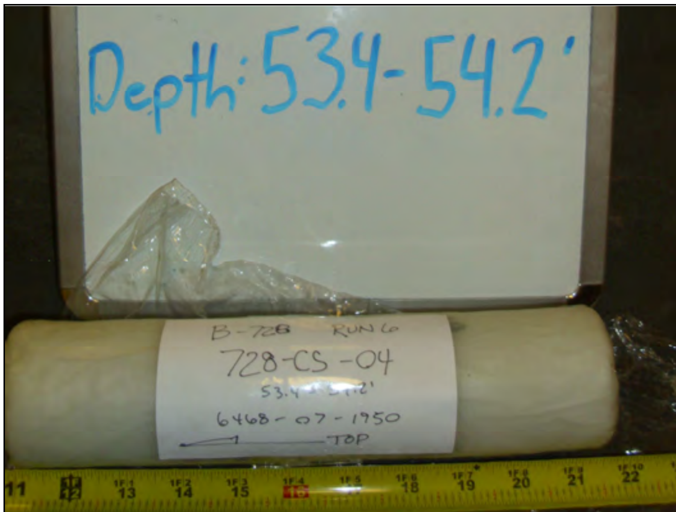


Photo D.1

Sample 728-CS-01 after removal from the protective transport container.

Photo D.2

Sample after removal from the wax casing and aluminum foil.

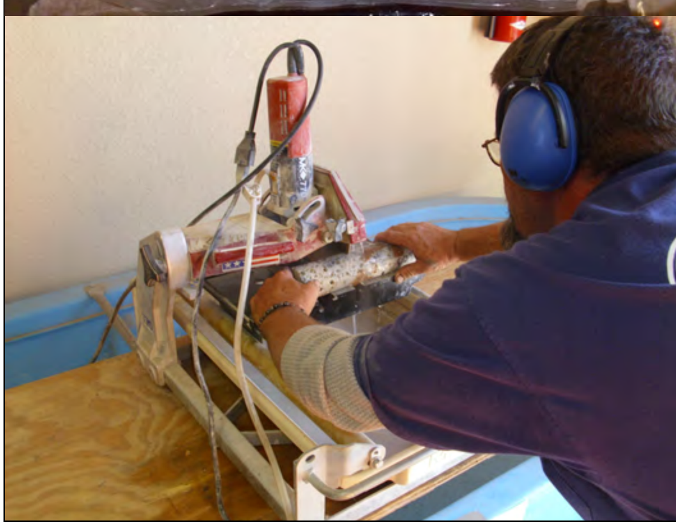


Photo C.3

Trimming the sample to an approximate 6-inch length as preparation for grouting in a CMU block. Note the modeling clay used to seal off natural vugs in sample to prevent grout infiltration.

SPECIMEN PREPARATION NOTES

Specimen No: K2-13-003

Photo D.4

Grouting sample in a CMU block as preparation for down coring the sample. Note the specimen number written on the side of the CMU block to maintain sample control.

Photo D.5

Rotary coring of specimen using the 1.5-inch OD core barrel.

Photo D.6

Specimen after down coring to an approximate 1.45-inch diameter.

SPECIMEN PREPARATION NOTES

Specimen No: K2-13-003

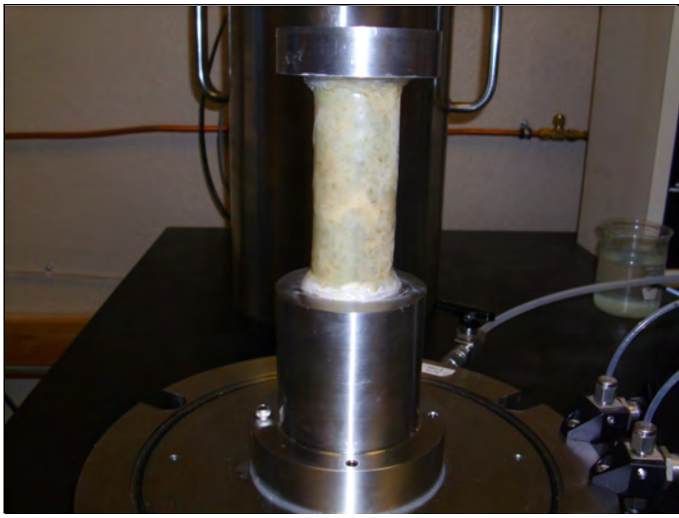


Photo D.7

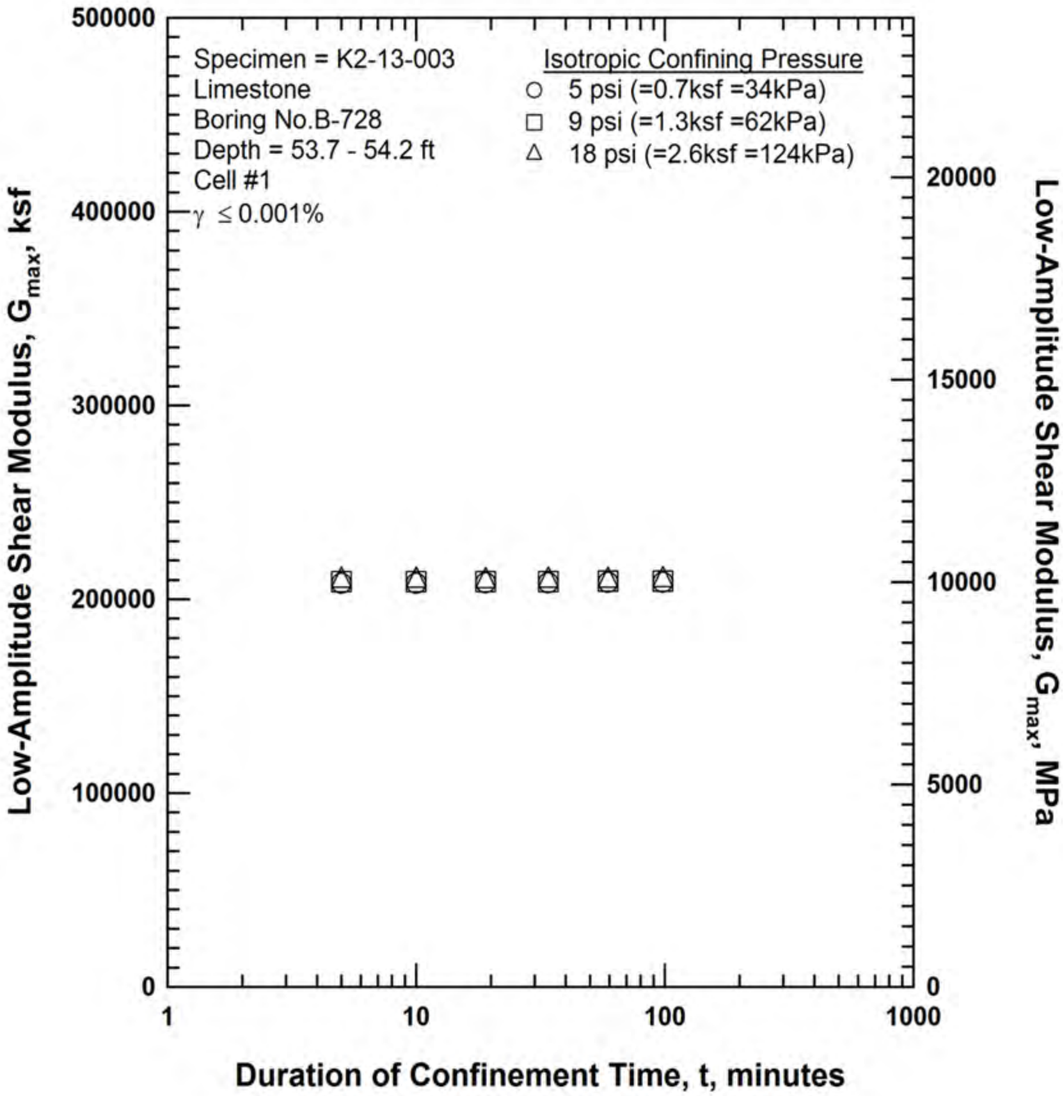
Specimen after affixation to the steal top cap and base pedestal using epoxy. Note modeling clay placed in natural vugs to prevent membrane puncture during testing.

Kleinfelder Specimen ID:

K2-13-003

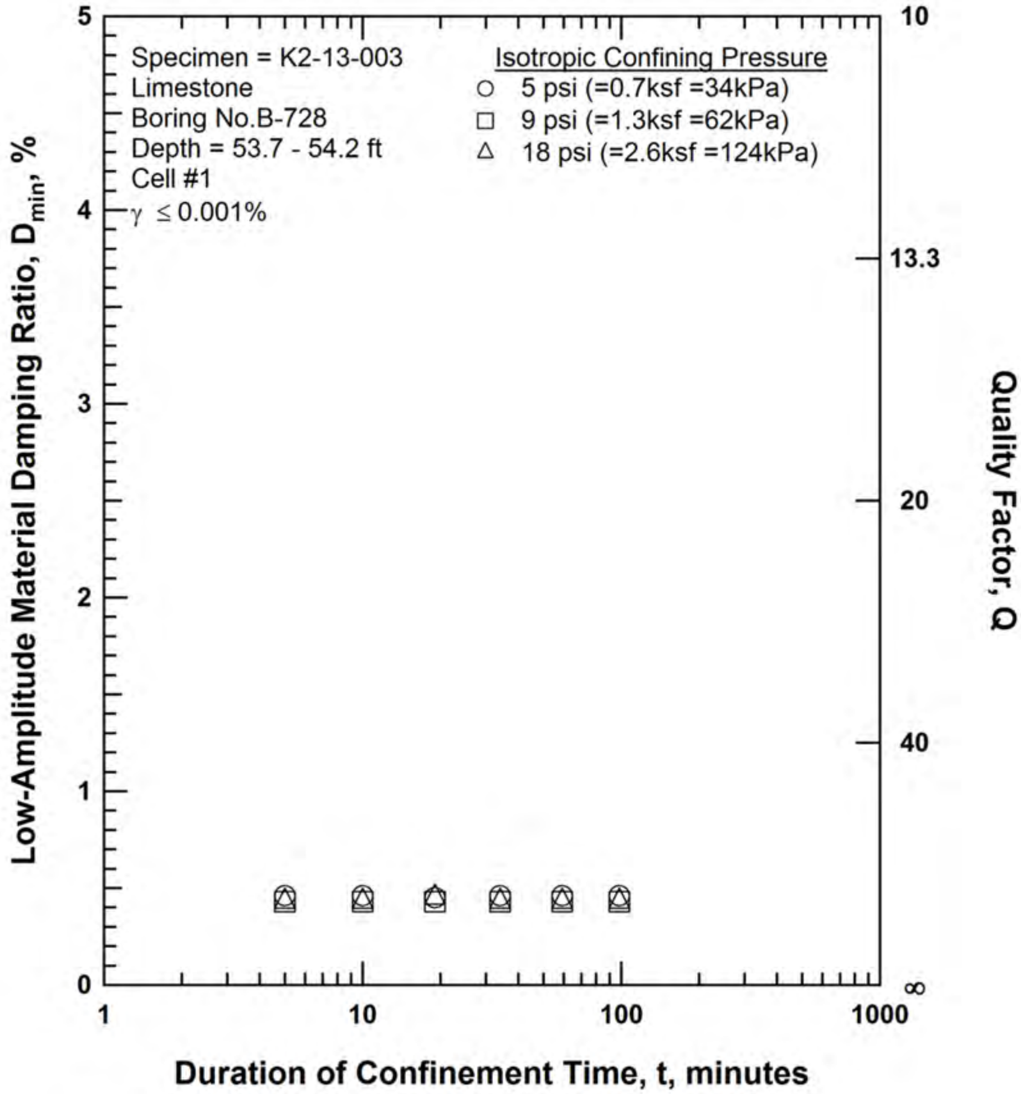
Boring No: B-728
Sample No: CS-04

Limestone (Fort Thompson Formation)
Depth = 53.7 ft – 54.2 ft (below existing ground surface)
Total Unit Weight = 144.3 lb/ft^3
Natural Moisture Content = 7.7%
Estimated In-Situ Mean Effective Stress = 18 psi



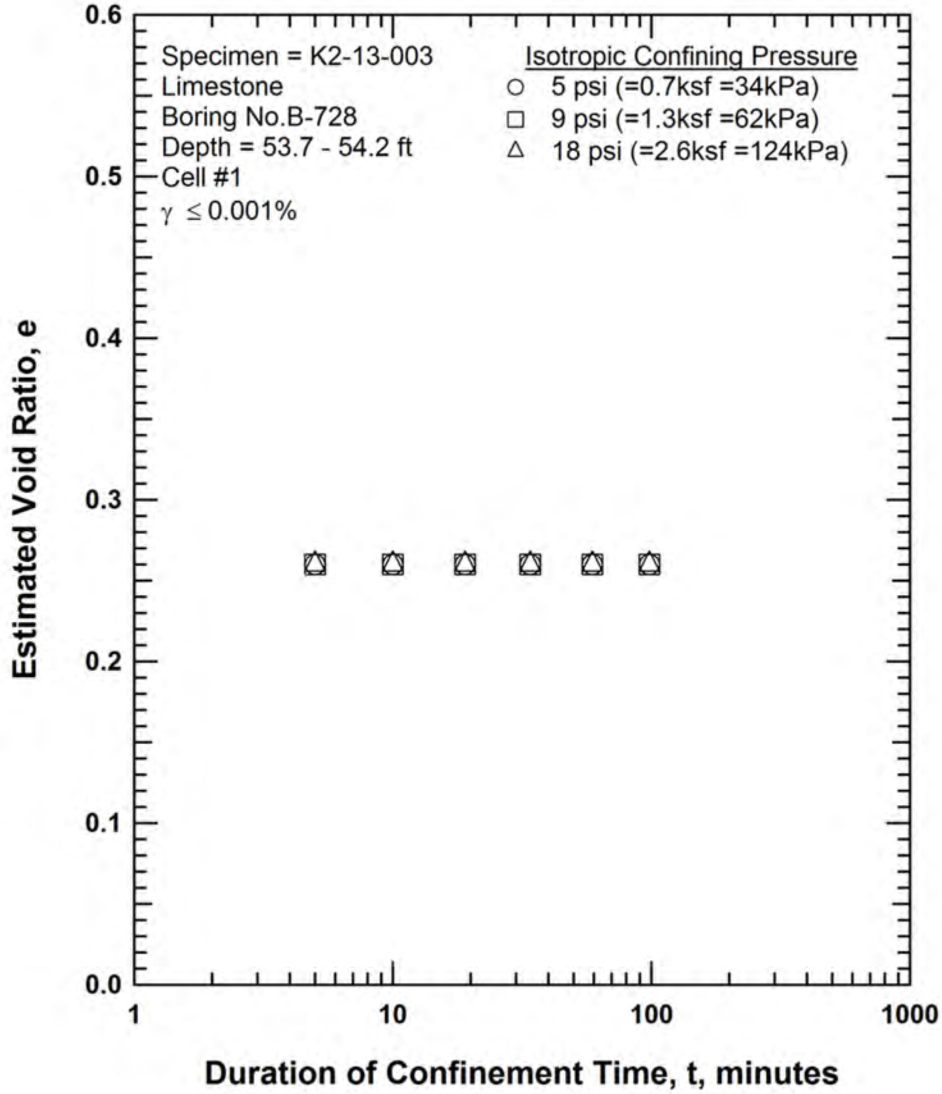
Note:
Membrane puncture at 47 psi prevented testing at higher confining pressures.

Figure D.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-003



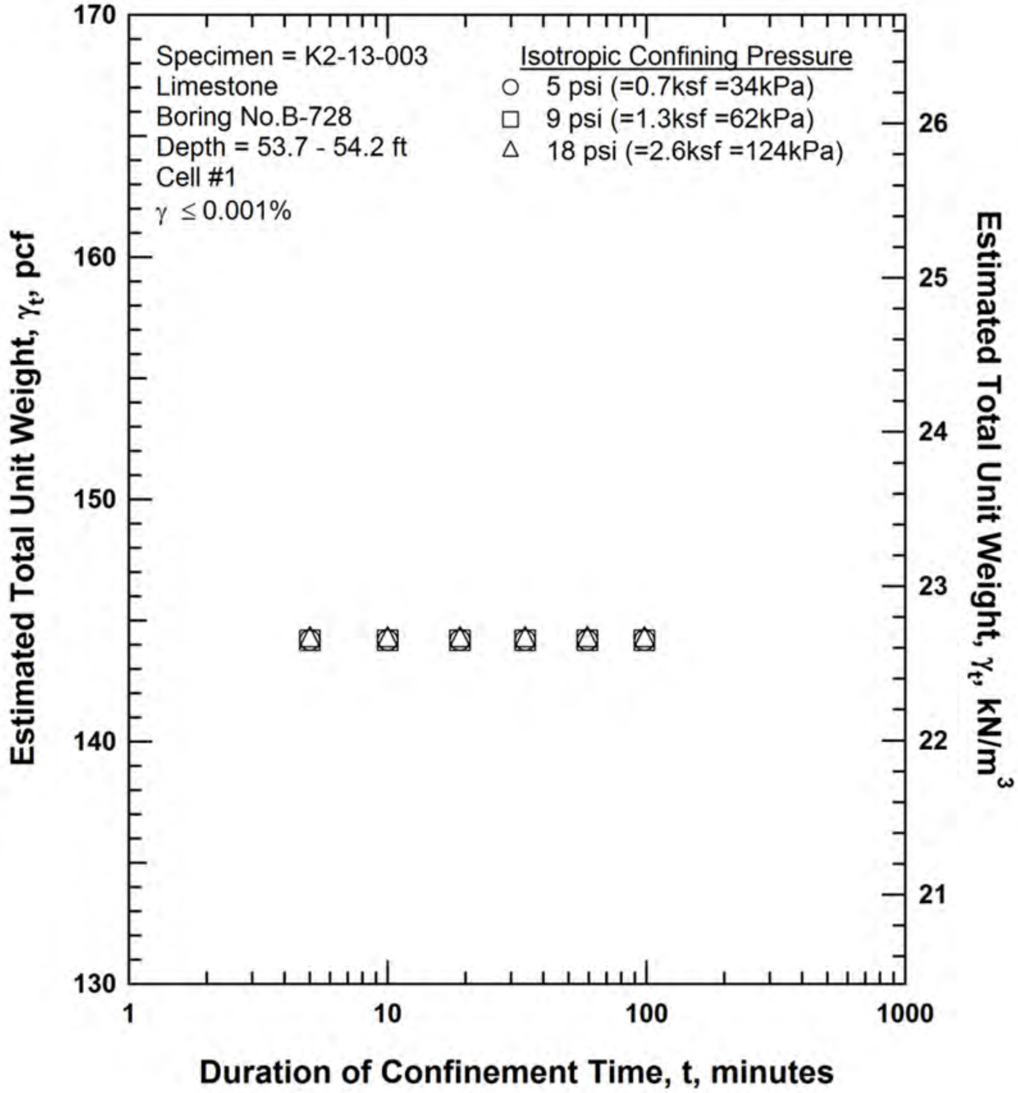
Note:
Membrane puncture at 47 psi prevented testing at higher confining pressures.

Figure D.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-003



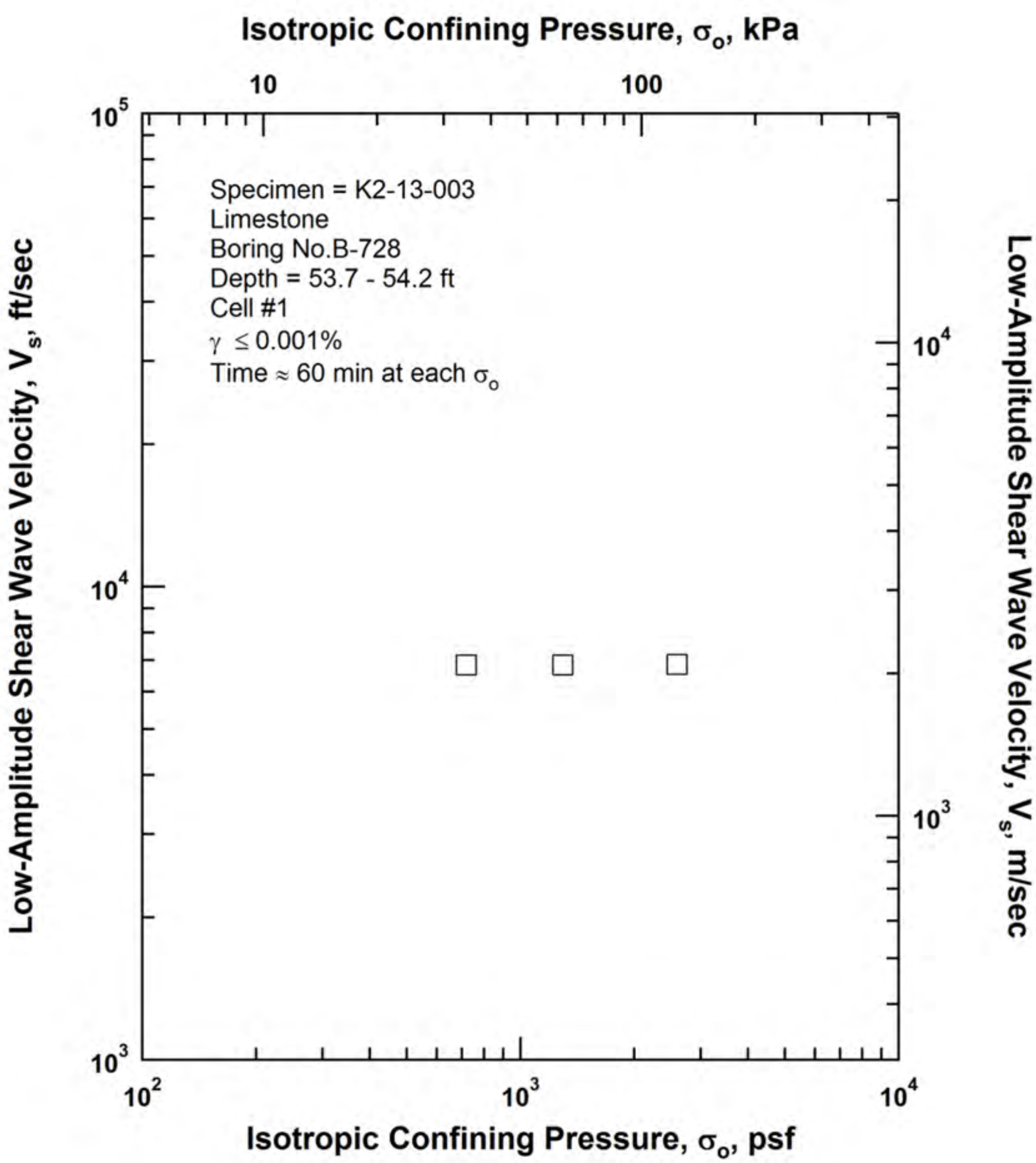
Note:
Membrane puncture at 47 psi prevented testing at higher confining pressures.

Figure D.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Test of Specimen K2-13-003



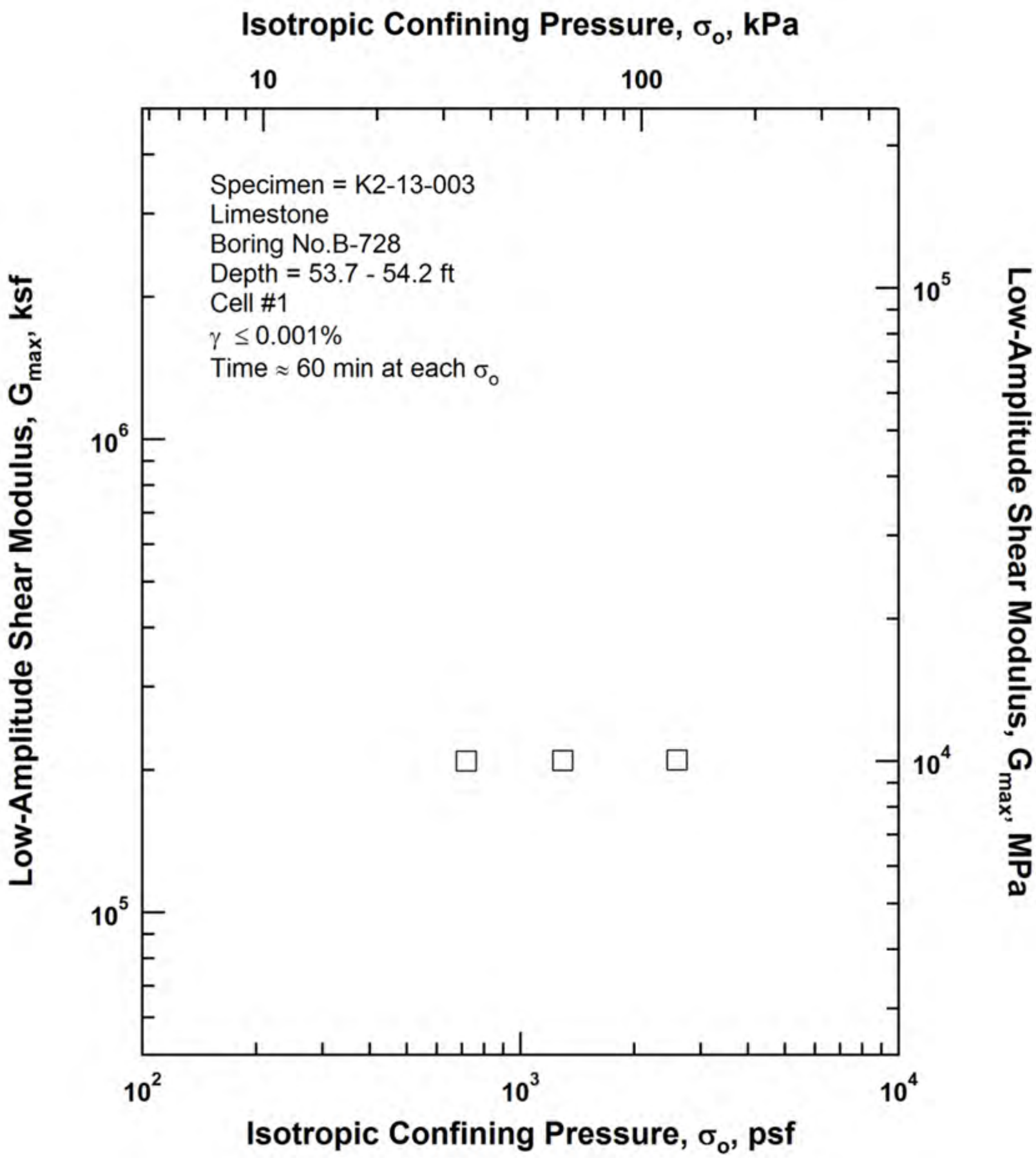
Note:
Membrane puncture at 47 psi prevented testing at higher confining pressures.

Figure D.4 Variation in Estimated Total Unit Weight with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-003



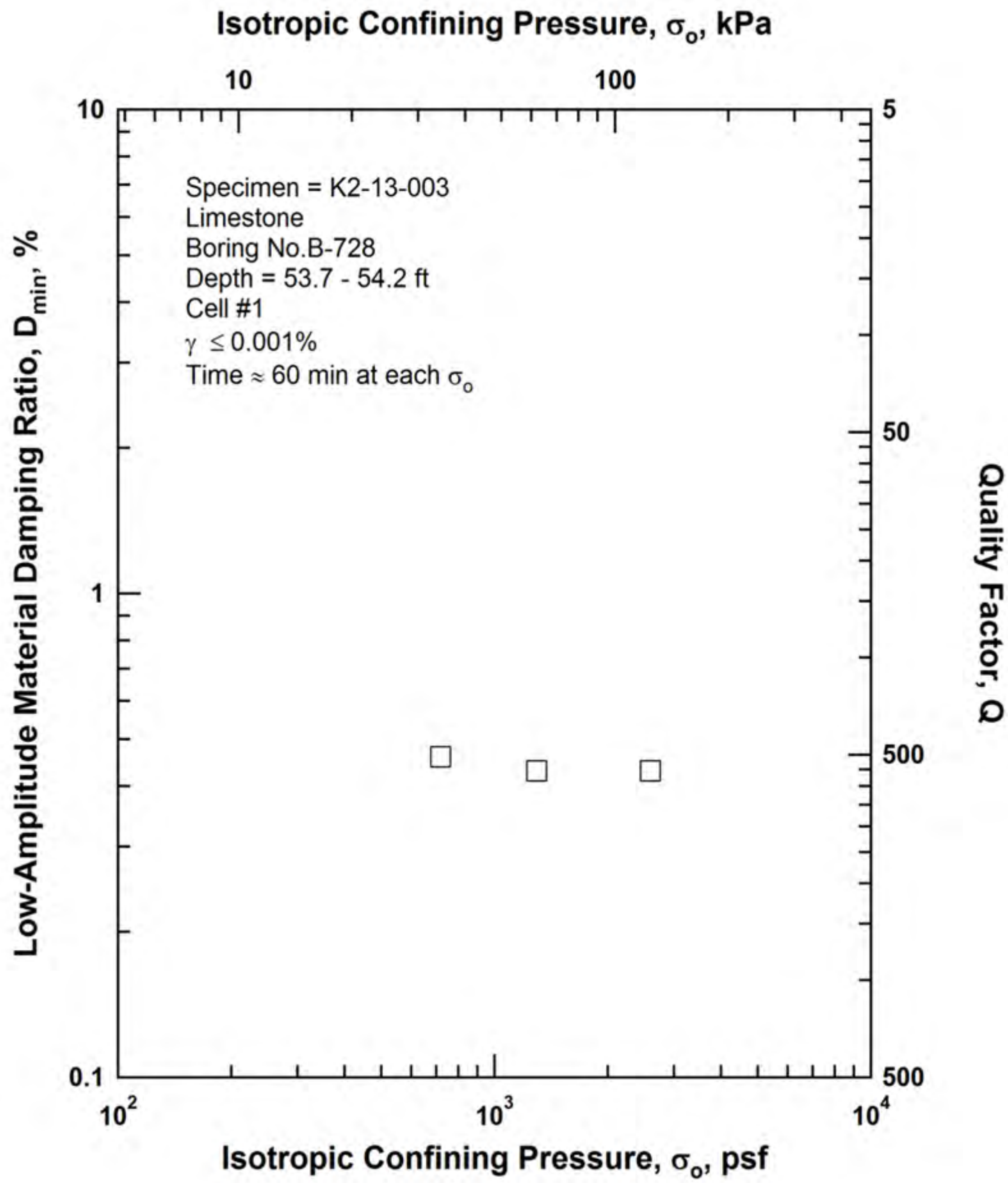
Note:
Membrane puncture at 47 psi prevented testing at higher confining pressures.

Figure D.5 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-003



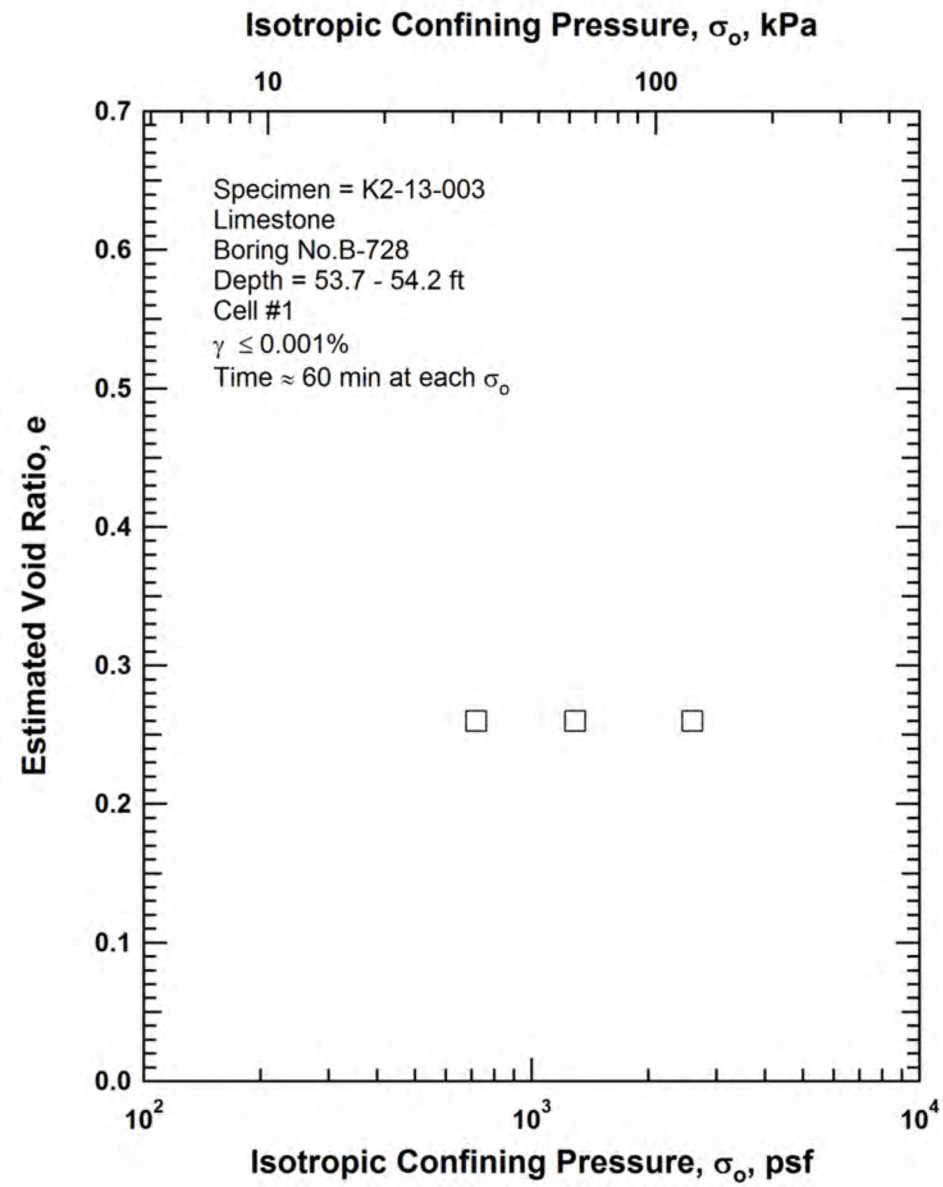
Note:
Membrane puncture at 47 psi prevented testing at higher confining pressures.

Figure D.6 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Test of Specimen K2-13-003



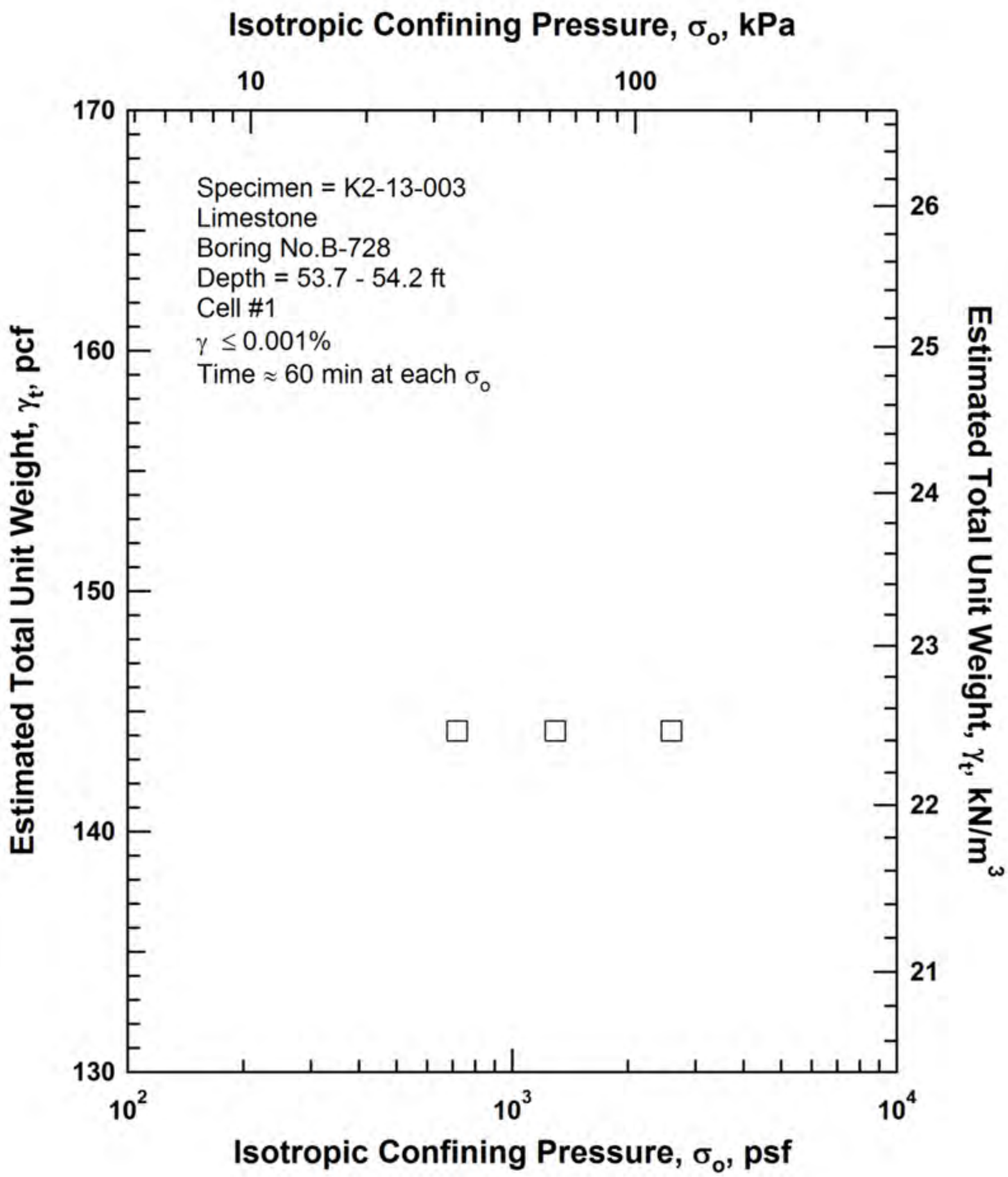
Note:
Membrane puncture at 47 psi prevented testing at higher confining pressures.

Figure D.7 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-003



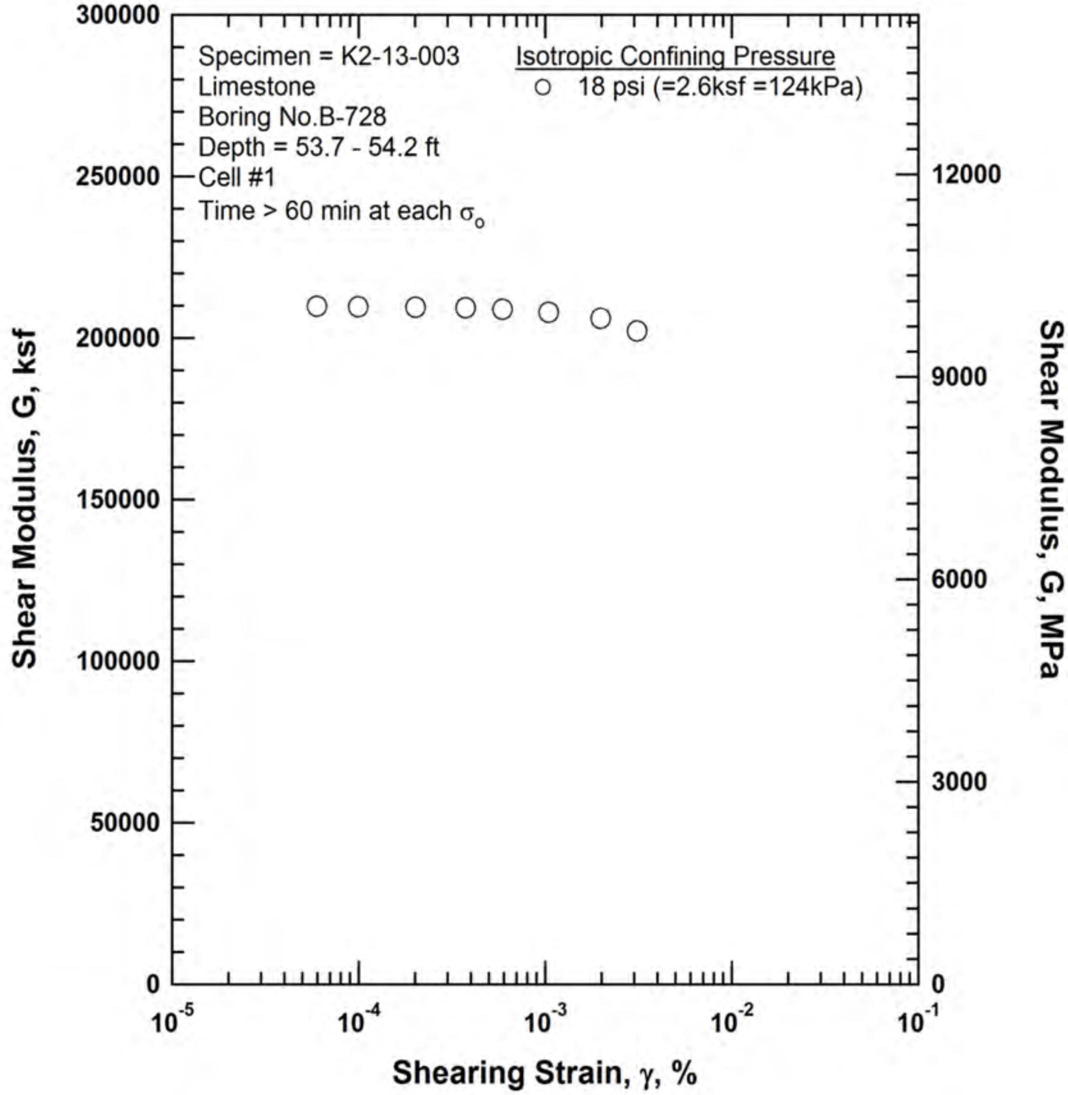
Note:
Membrane puncture at 47 psi prevented testing at higher confining pressures.

Figure D.8 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-003



Note:
Membrane puncture at 47 psi prevented testing at higher confining pressures.

Figure D.9 Variation in Estimated Total Unit Weight with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-003



Note:
Membrane puncture at 47 psi prevented testing at higher confining pressures.

Figure D.10 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-003

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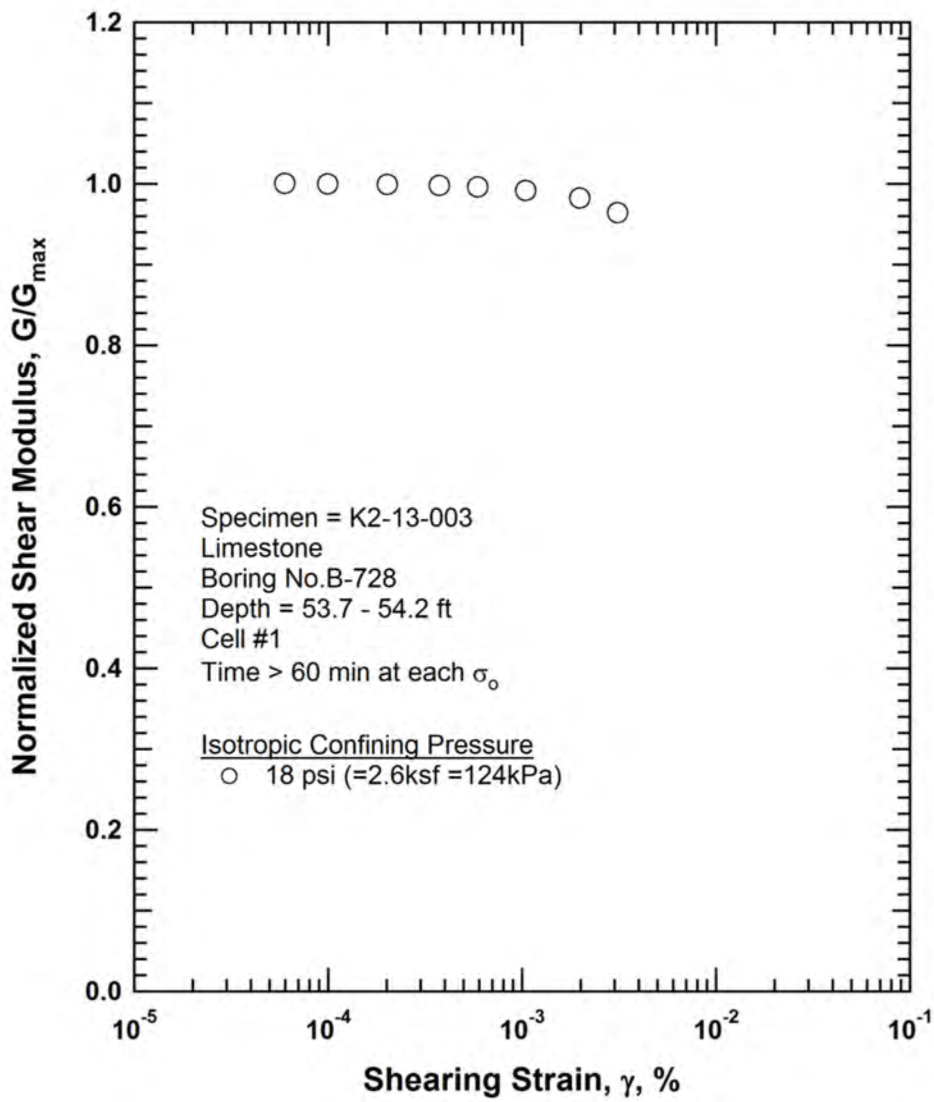
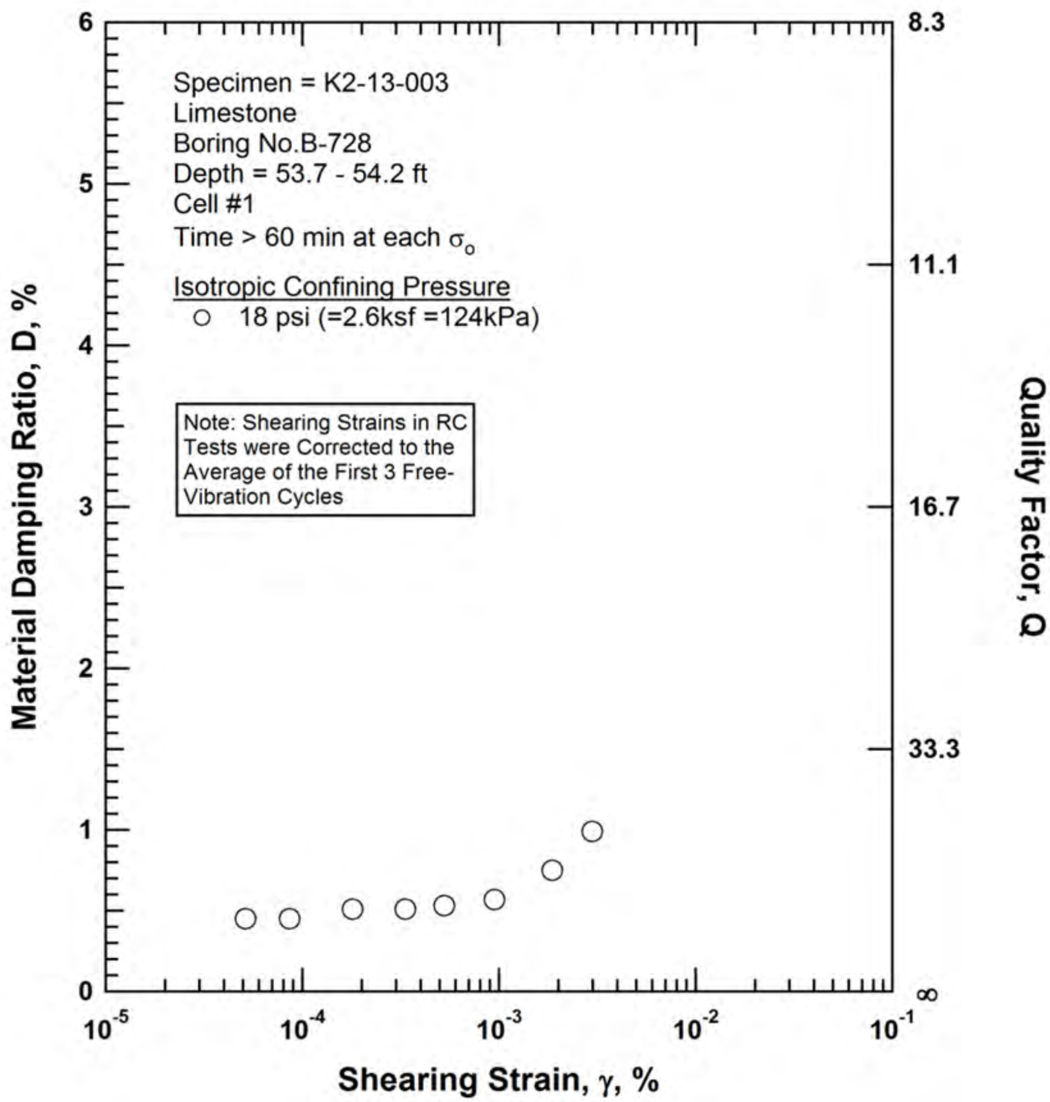


Note:
Membrane puncture at 47 psi prevented testing at higher confining pressures.

Figure D.11 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-003



Note:
Membrane puncture at 47 psi prevented testing at higher confining pressures.

Figure D.12 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-003

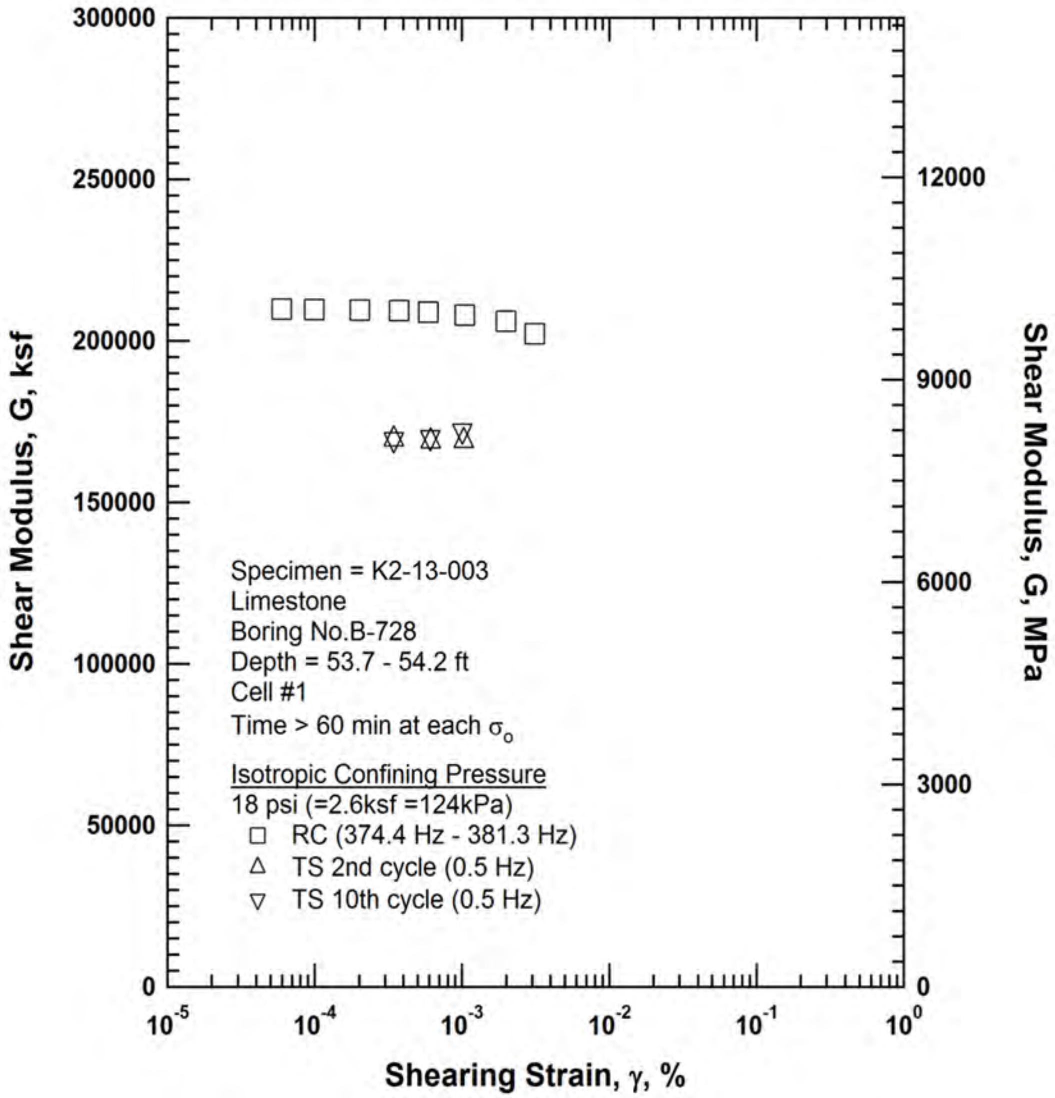


Figure D.13 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 18 psi (=2.6ksf =124kPa) from the Combined RCTS Tests of Specimen K2-13-003

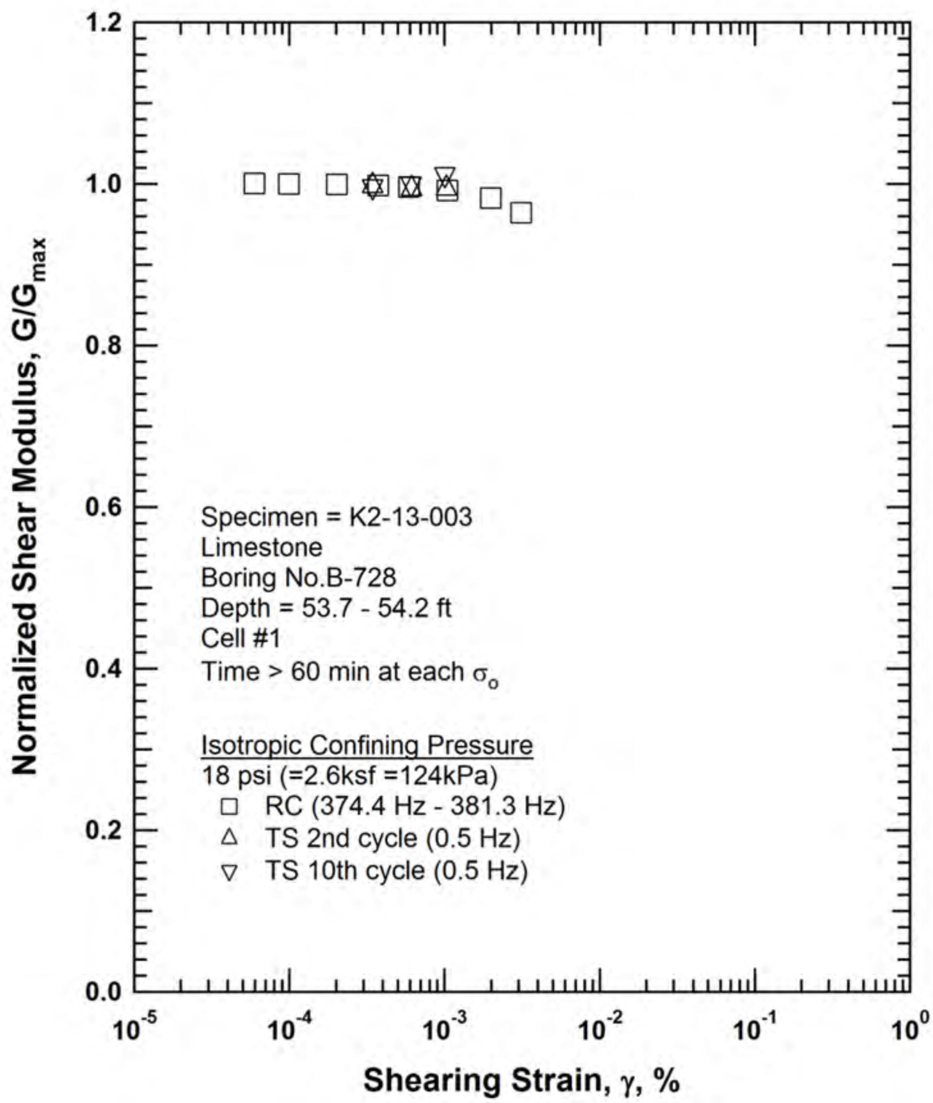
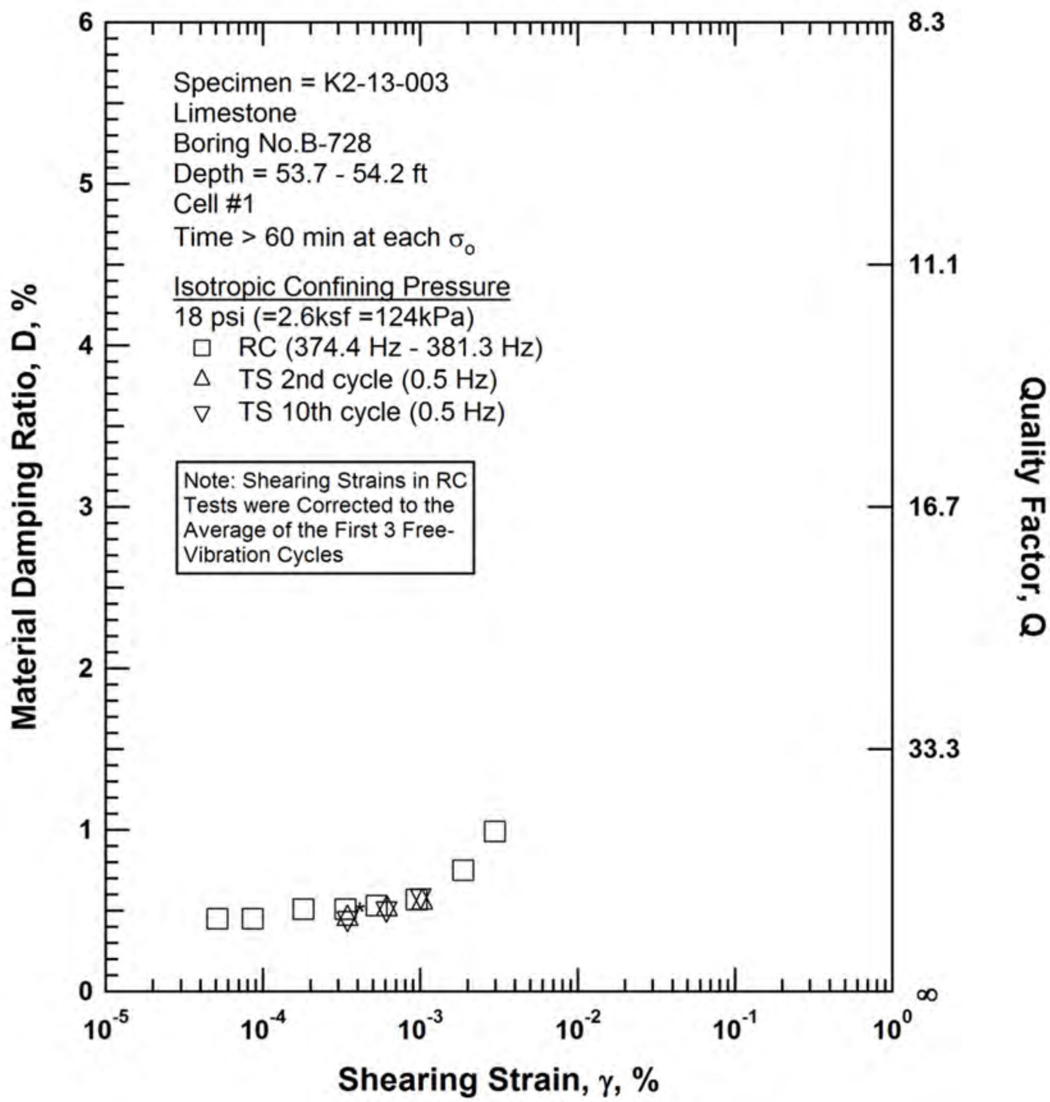


Figure D.14 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 18 psi (=2.6ksf =124kPa) from the Combined RCTS Tests of Specimen K2-13-003



Note:
* Average result of first ten cycles.

Figure D.15 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 18 psi (=2.6ksf =124kPa) from the Combined RCTS Tests of Specimen K2-13-003

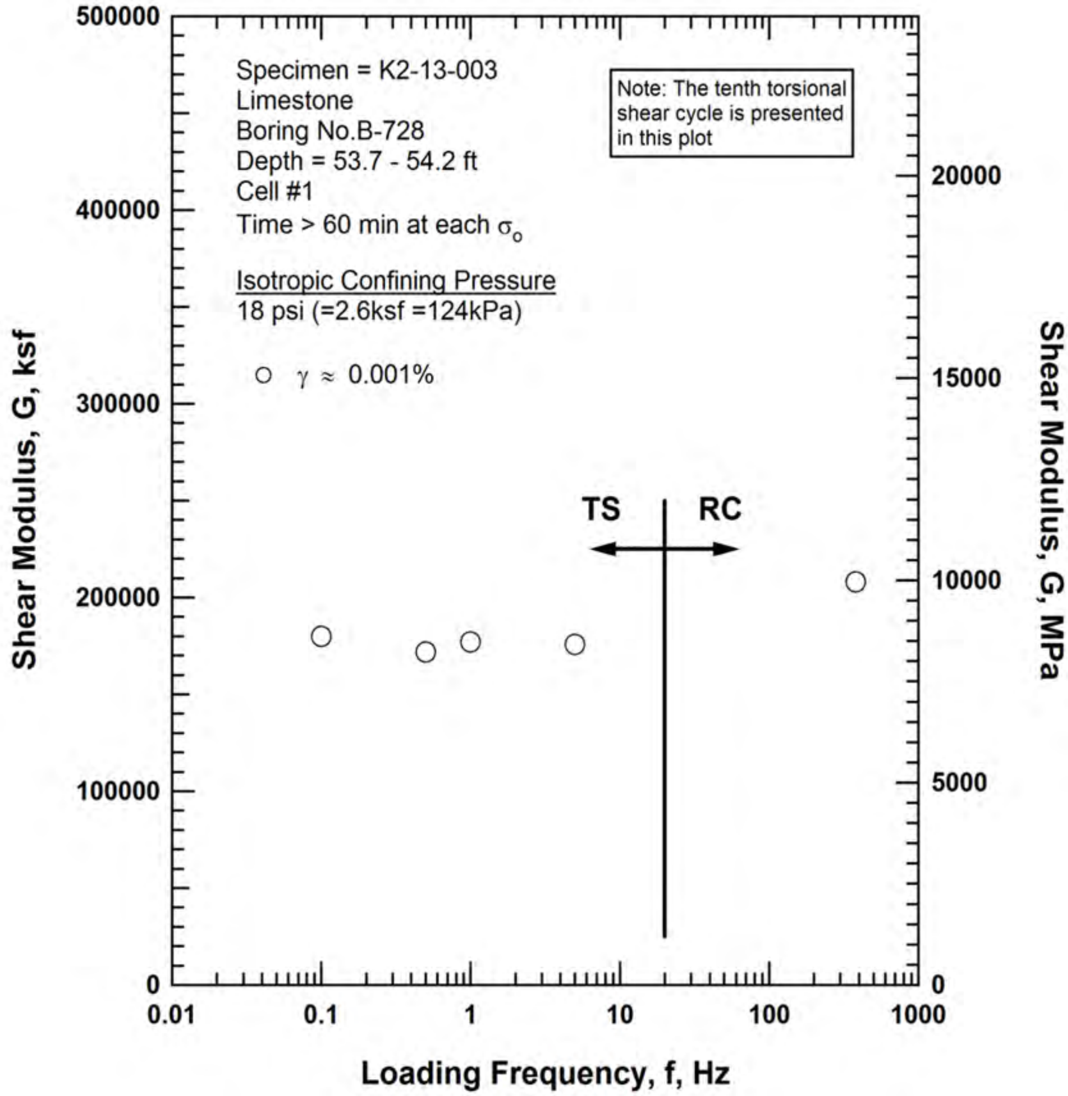


Figure D.16 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 18 psi (=2.6ksf =124kPa) from the Combined RCTS Tests of Specimen K2-13-003

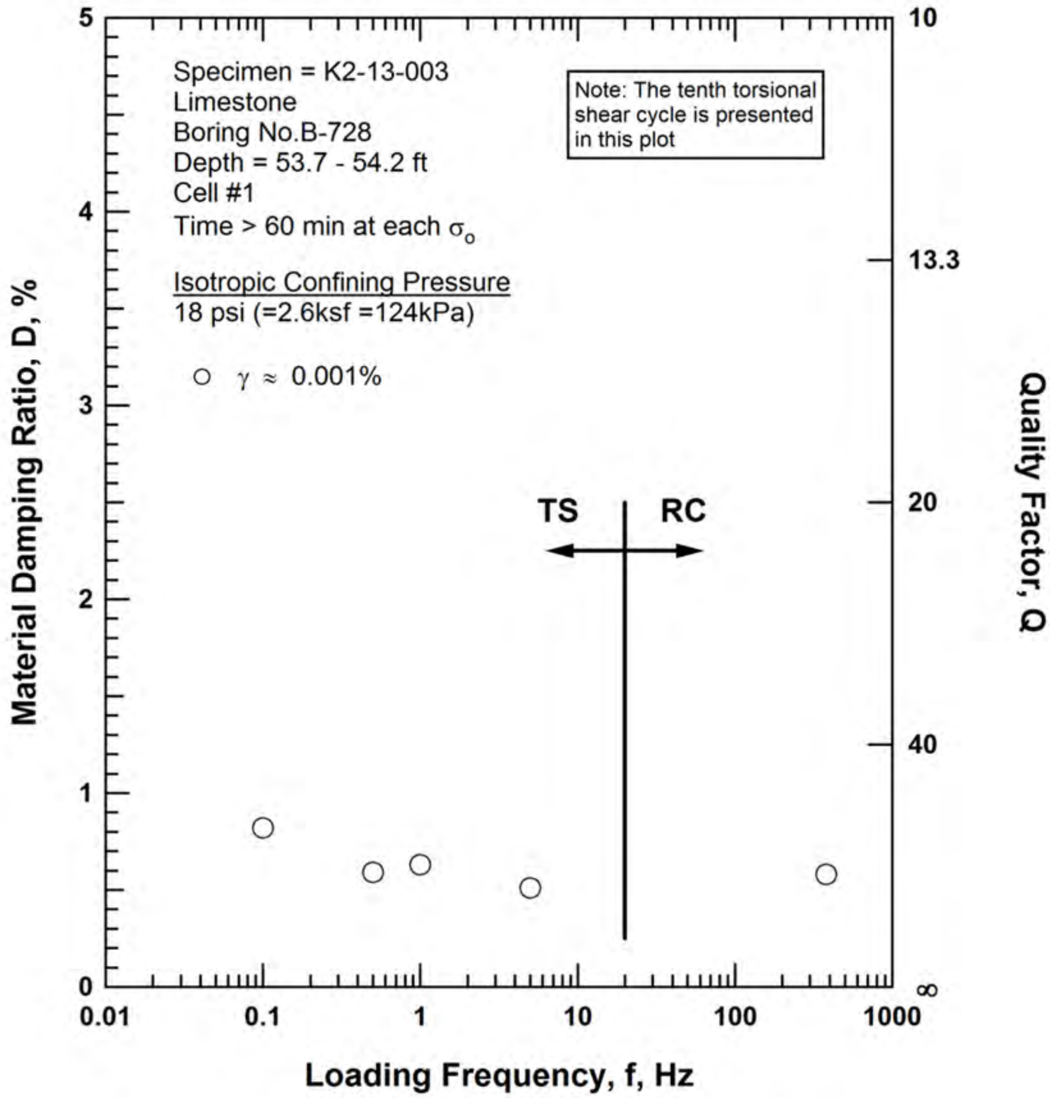


Figure D.17 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 18 psi (=2.6ksf =124kPa) from the Combined RCTS Tests of Specimen K2-13-003

Table D.1 Variation in Low-Amplitude Shear Wave Velocity, Low-Amplitude Shear Modulus, Low-Amplitude Material Damping Ratio, Estimated Void Ratio, and Estimated Total Unit Weight with Isotropic Confining Pressure from RC Tests of Specimen K2-13-003

Isotropic Confining Pressure, σ_o [1]			Low-Amplitude Shear Modulus, G_{max}		Low-Amplitude Shear Wave Velocity, V_s	Low-Amplitude Material Damping Ratio, D_{min}	Estimated Void Ratio, e	Estimated Total Unit Weight, γ_t
(psi)	(psf)	(kPa)	(ksf)	(MPa)	(fps)	(%)	(Unitless)	(pcf)
5	720	34	208800	9999	6830	0.46	0.26	144.2
9	1296	62	209300	10020	6830	0.43	0.26	144.2
18	2592	124	209700	10040	6840	0.43	0.26	144.2

(1) Membrane puncture at 47 psi prevented testing at higher confining pressures

Table D.2 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen K2-13-003; Isotropic Confining Pressure σ_o = 18 psi (=2.6 ksf = 124 kPa)

Second Cycle				Tenth Cycle			
Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
3.44E-04[1]	169500	1.00	0.45	3.45E-04[1]	169300	1.00	0.45
6.12E-04	168900	0.99	0.51	6.08E-04	169900	1.00	0.51
1.02E-03	169000	0.99	0.55	1.01E-03	172000	1.01	0.59

(1) Damping Results were Averaged for the First Ten Cycles at this Shearing Strain

Table D.3 Variation in Shear Modulus, Normalized Shear Modulus, and Material Damping with Shearing Strain from RC Tests of Specimen K2-13-003; Isotropic Confining Pressure σ_o = 18 psi (=2.6 ksf = 124 kPa)

Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average Shearing Strain, %[1]	Material Damping Ratio, D, %[2]
5.97E-05	209800	1.00	5.14E-05	0.45
9.94E-05	209700	1.00	8.59E-05	0.45
2.02E-04	209500	1.00	1.80E-04	0.51
3.74E-04	209400	1.00	3.34E-04	0.51
5.91E-04	208900	1.00	5.27E-04	0.53
1.04E-03	208000	0.99	9.45E-04	0.57
1.98E-03	206100	0.98	1.87E-03	0.75
3.11E-03	202200	0.96	2.98E-03	0.99

(1) Average Shearing Strain from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

(2) Average Damping Ratio from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

Table D.4 Variation in Shear Modulus and Material Damping with Frequency from RC/TS Tests of Specimen K2-13-003; Isotropic Confining Pressure σ_o = 18 psi (=2.6 ksf = 124 kPa)

Approximate Shearing Strain, γ, %	Frequency, Hz	Shear Modulus, G, ksf	Material Damping Ratio, D, %
0.001	0.1	180000	0.82
	0.5	172000	0.59
	1.0	177100	0.63
	5.0	175700	0.51
	379.7	208000	0.58

APPENDIX E

Results for Kleinfelder Specimen ID K2-13-004

- *Specimen Preparation Notes*

SPECIMEN PREPARATION NOTES

Specimen No.: K2-13-004	**Project No :** 136473	**Page** 1 **of** 4	

Boring No.: R-7-1 **Date of Preparation..:** 10/12/13

Sample No..: SC-3 **Depth..:** 40.5 - 41.0 feet

Disposition of Rock Core Sample

☒ No Apparent Disturbance	☐ Apparent Disturbance	☐ Apparent Slaking Due to Coring
☒ Other (Describe)	Sample consisted of a Limestone of the Key Largo Formation with Large Vugs Along Its Length	

Specimen Preparation Notes

Trimming Method :	Rotary coring with water lubricant, 1.5-inch OD diameter core barrel		**Affixation to Platens :**	n/a	
Ave. Length (in.) :	n/a	**Ave. Diameter (in.):**	n/a	**L/D**	n/a
Total Unit Weight . (pcf) :	n/a	**Moisture Content (%)**	n/a	**% Saturation (Assume SG = 2.70)**	n/a

Specimen Testing Comments

1) Sample R-7-1 SC-3 was predominately a medium strong rock with large vugs along its length (see Photo E.1 to E.4). Due to the rock hardness, the sample could not be trimmed by hand and it was decided to core the nominally 3-inch diameter sample with a 1.5-inch outside diameter (OD), thin-walled diamond-impregnated core barrel.

2) Sample was trimmed to an approximate 6-inch length and grouted into an CMU block on 10/12/13. See Photos E.5 through E.6.

3) Sample was cored on 10/13/13. See Photo E.7. Two fragments of rock, each too small for an acceptable RCTS specimen length, resulted from the coring (See Photo E.7).

4) According to the Rizzo Work Plan for Laboratory Testing (Rizzo, 2013), only two of the three Key Largo Limestone Samples sent to Kleinfelder were to be tested using the RCTS Method. Since no viable test specimen was obtained for K2-13-004, the other two Key Largo Formation specimens (K2-13-001 and K2-13-002) were tested instead.

☒ **See Attached Photographs**

Specimen No: K2-13-004

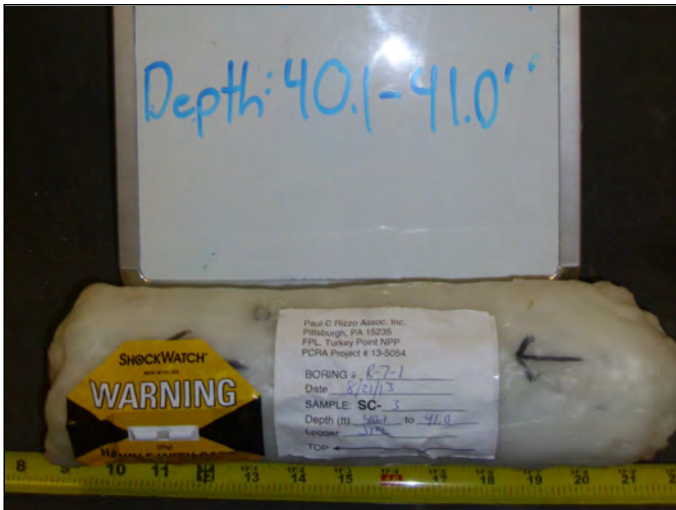


Photo E.1

Sample R-7-1 SC-3 after removal from the protective transport container.

Photo E.2

Sample after removal from the wax casing and aluminum foil. Note large vugs along length of the sample.

Photo E.3

Sample bottom after removal from the wax casing and aluminum foil.

SPECIMEN PREPARATION NOTES

Specimen No: K2-13-004

Photo E.4

Sample top after removal from the wax casing and aluminum foil.

Photo D.5

Trimming the sample to an approximate 6-inch length as preparation for grouting in a CMU block. Note the modeling clay used to seal off natural vugs in sample to prevent grout infiltration.

Photo E.6

Grouting sample in a CMU block as preparation for down coring the sample. Note the specimen number written on the side of the CMU block to maintain sample control.

SPECIMEN PREPARATION NOTES

Specimen No: K2-13-004

Photo E.7

Rotary coring of specimen using the 1.5-inch OD core barrel.

Photo E.8

Specimen after down coring to an approximate 1.45-inch diameter. Note the break in the middle of the core leaving two pieces, each less than the minimum required testing length of about 4-inches

APPENDIX F

Results for Kleinfelder Specimen ID K2-13-005

- *Specimen Preparation Notes*
- *RCTS Testing Results*

SPECIMEN PREPARATION NOTES

Specimen No.: K2-13-005

Project No : 136473

Boring No.: R-6-1b

Date of Preparation..: 10/12/13

Sample No..: SC-3

Depth..: 47.6 - 48.1 feet

Disposition of Rock Core Sample

☒ No Apparent Disturbance ☐ Apparent Disturbance ☐ Apparent Slaking Due to Coring

☒ Other (Describe) Sample consisted of a Limestone of the Fort Thompson Formation with Small to Large Sized Vugs

Specimen Preparation Notes

Trimming Method :	Rotary coring with water lubricant, 1.5-inch OD diameter core barrel		**Affixation to Platens :**	Epoxied to 2.8-inch diameter steel top cap and base pedestal	
Ave. Length (in.) :	4.0597	**Ave. Diameter (in.):**	1.451	**L/D**	2.8
Total Unit Weight . (pcf) :	151.8	**Moisture Content (%)**	3.6	**% Saturation (Assume SG = 2.70)**	64.6

Specimen Testing Comments

1) Sample R-6-1b was predominately a medium strong rock with small to large sized vugs (see Photo F.1 to F.2). Due to the rock hardness, the sample could not be trimmed by hand and it was decided to core the nominally 3-inch diameter sample with a 1.5-inch outside diameter (OD), thin-walled diamond-impregnated core barrel.

2) Sample was trimmed to an approximate 6-inch length and grouted into an CMU block on 10/12/13 (See Photos F.3 through F.4).

3) Sample was cored on 10/13/13 (See Photo F.5). One approximately 1.45-inch diameter specimen resulted from the rotary coring. The specimen was of sufficient length for RCTS Testing and the sample ends were trimmed to the final length of about 4.1-inches.

4) Specimen was epoxied to the 2.8-inch diameter steel top cap and base pedestal on 12/13/13.

5) Testing commenced on 12/14/13 and was completed on 12/16/13. The full test sequence was completed, with confining pressures ranging from 4 psi to 64 psi.

☒ **See Attached Photographs**

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SPECIMEN PREPARATION NOTES

Specimen No: K2-13-005

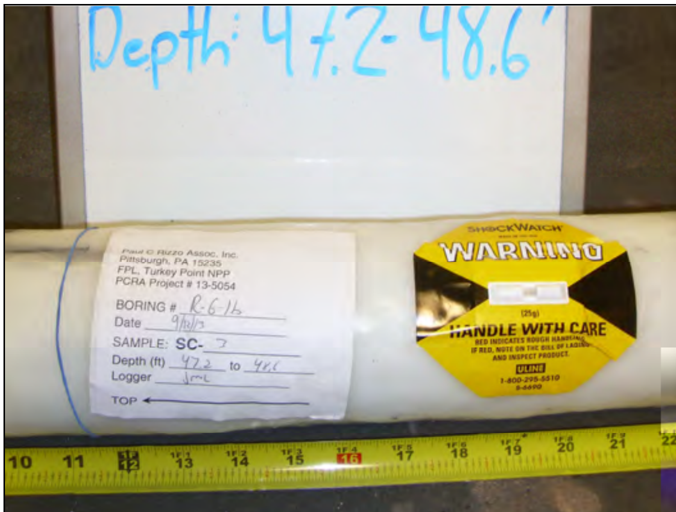


Photo F.1

Sample R-6-1b SC-3 after removal from the protective transport container. Note the shock indicator is untripped.

Photo F.2

Sample after removal from the wax casing and aluminum foil.

Photo F.3

Trimming the sample to an approximate 6-inch length as preparation for grouting in a CMU block. Note the modeling clay used to seal off natural vugs in sample to prevent grout infiltration.

SPECIMEN PREPARATION NOTES

Specimen No: K2-13-005

Photo F.4

Grouting sample in a CMU block as preparation for down coring the sample. Note the specimen number written on the side of the CMU block to maintain sample control.

Photo F.5

Rotary coring of specimen using the 1.5-inch OD core barrel.

Photo F.6

Specimen after down coring to an approximate 1.45-inch diameter.

Kleinfelder Specimen ID:

K2-13-005

Boring No: R-6-1b
Sample No: SC-3

Limestone (Fort Thompson Formation)
Depth = 47.6 ft – 48.1 ft (below existing ground surface)
Total Unit Weight = 151.8 lb/ft^3
Natural Moisture Content = 3.6%
Estimated In-Situ Mean Effective Stress = 16 psi

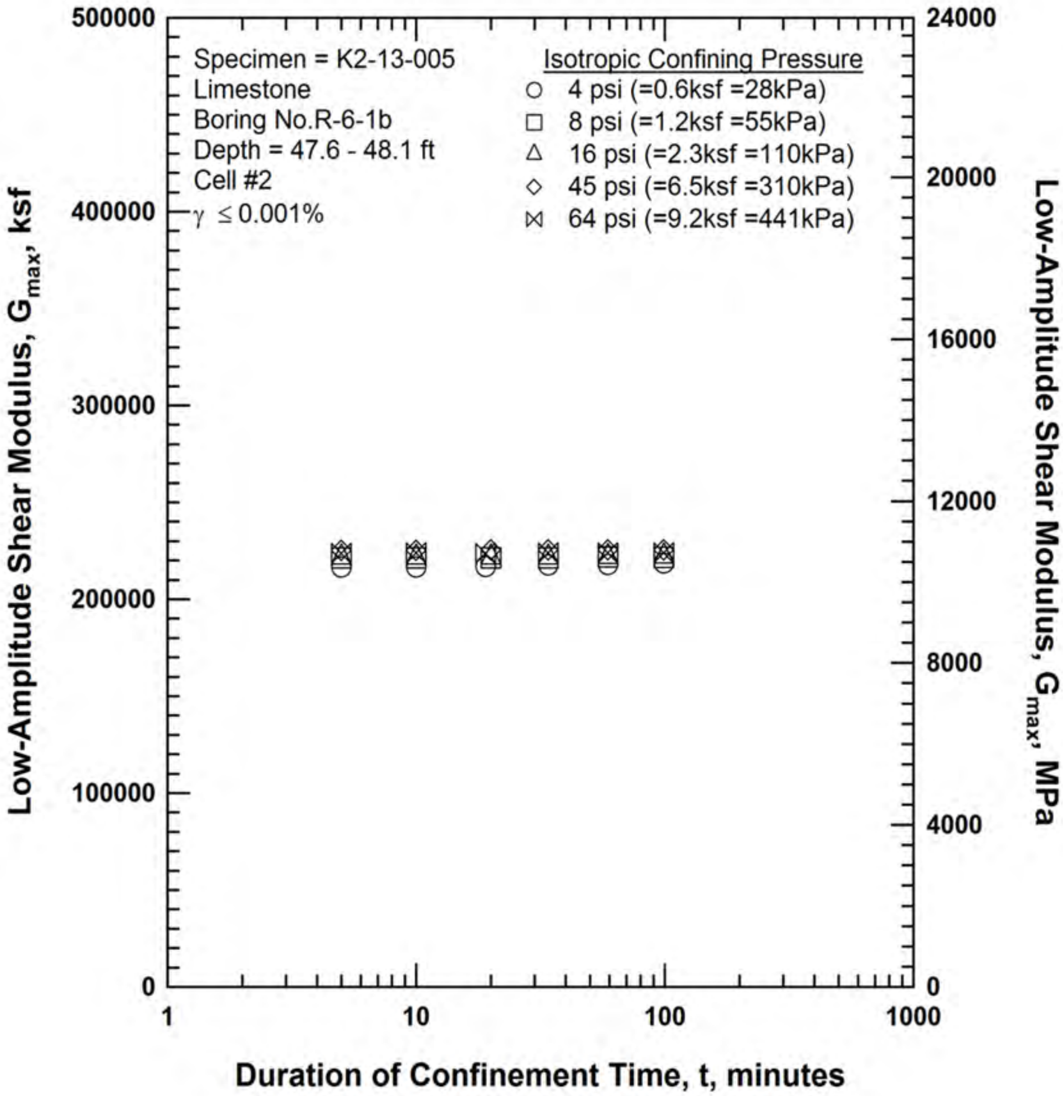


Figure F.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-005

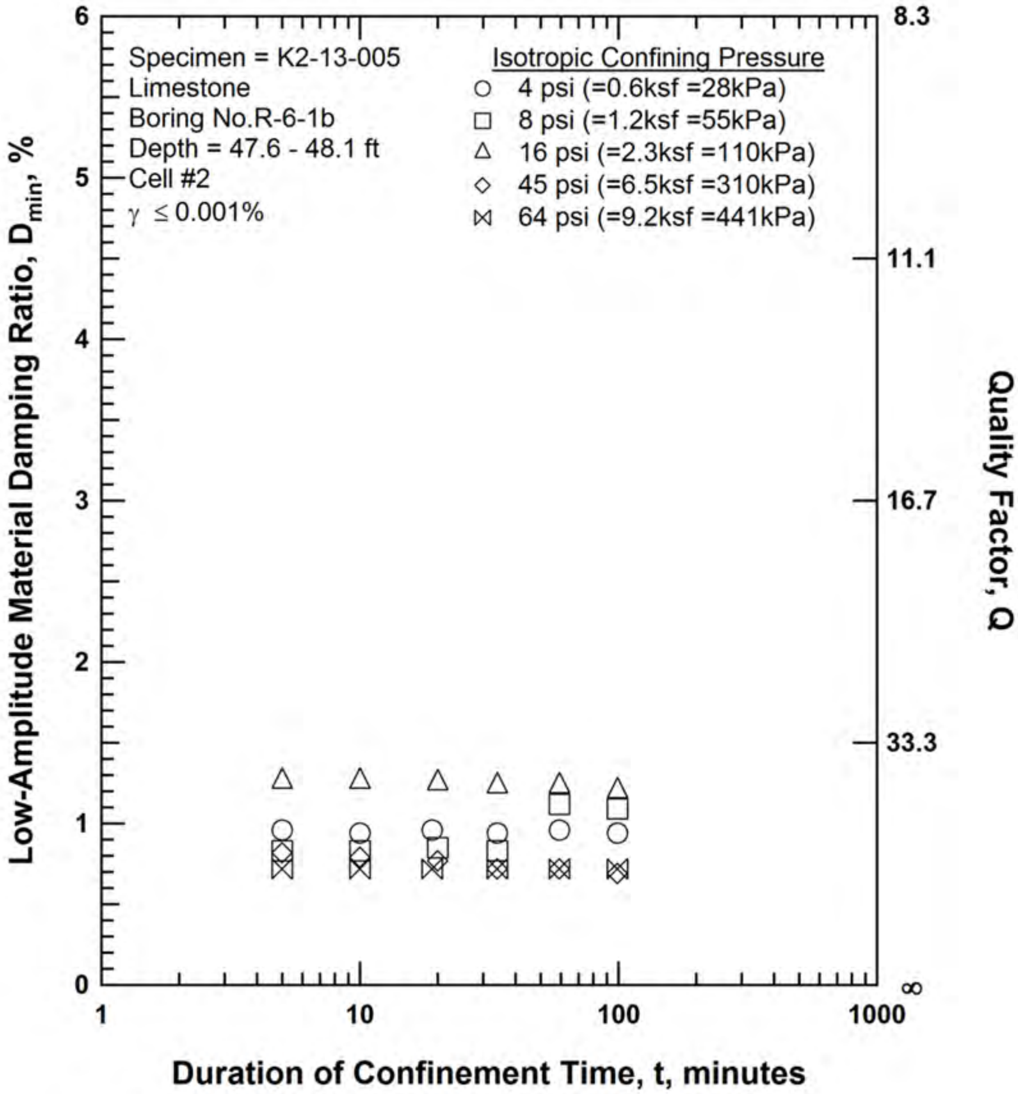


Figure F.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-005

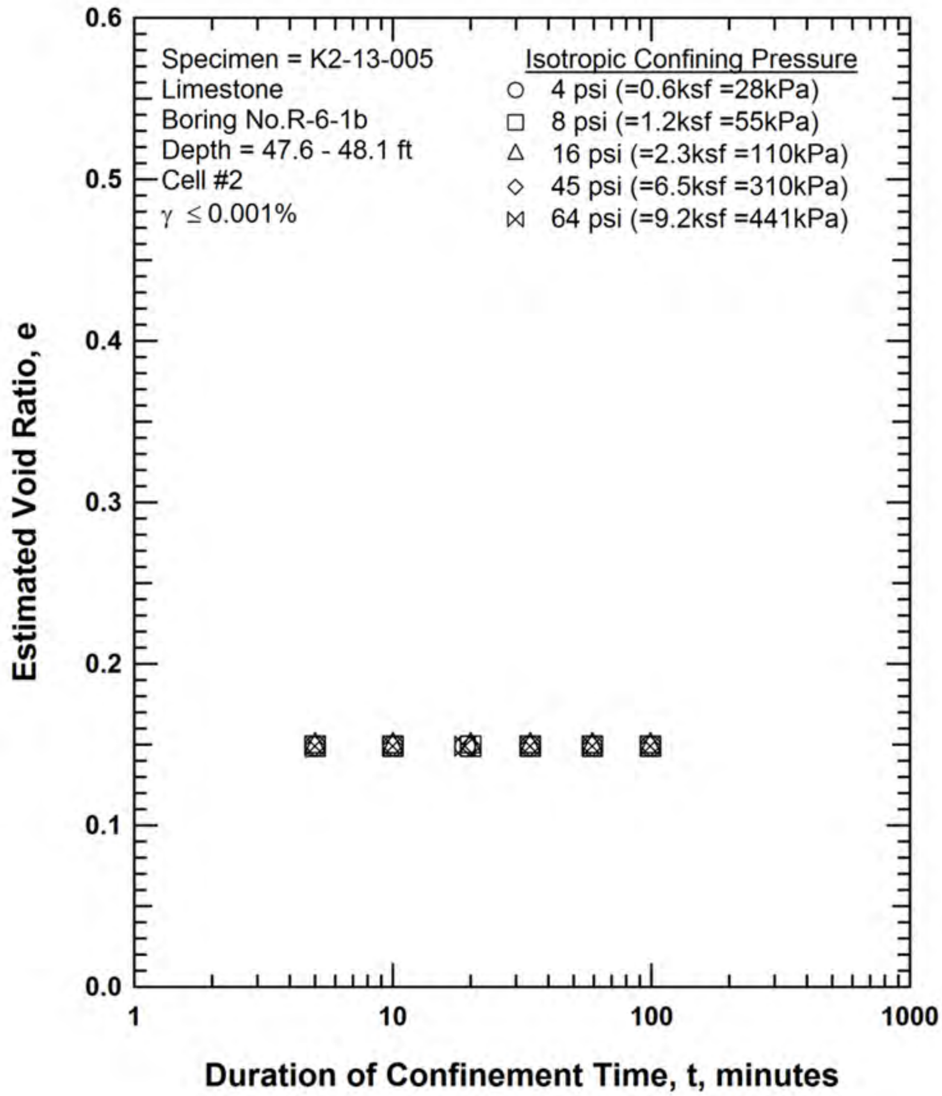


Figure F.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Test of Specimen K2-13-005

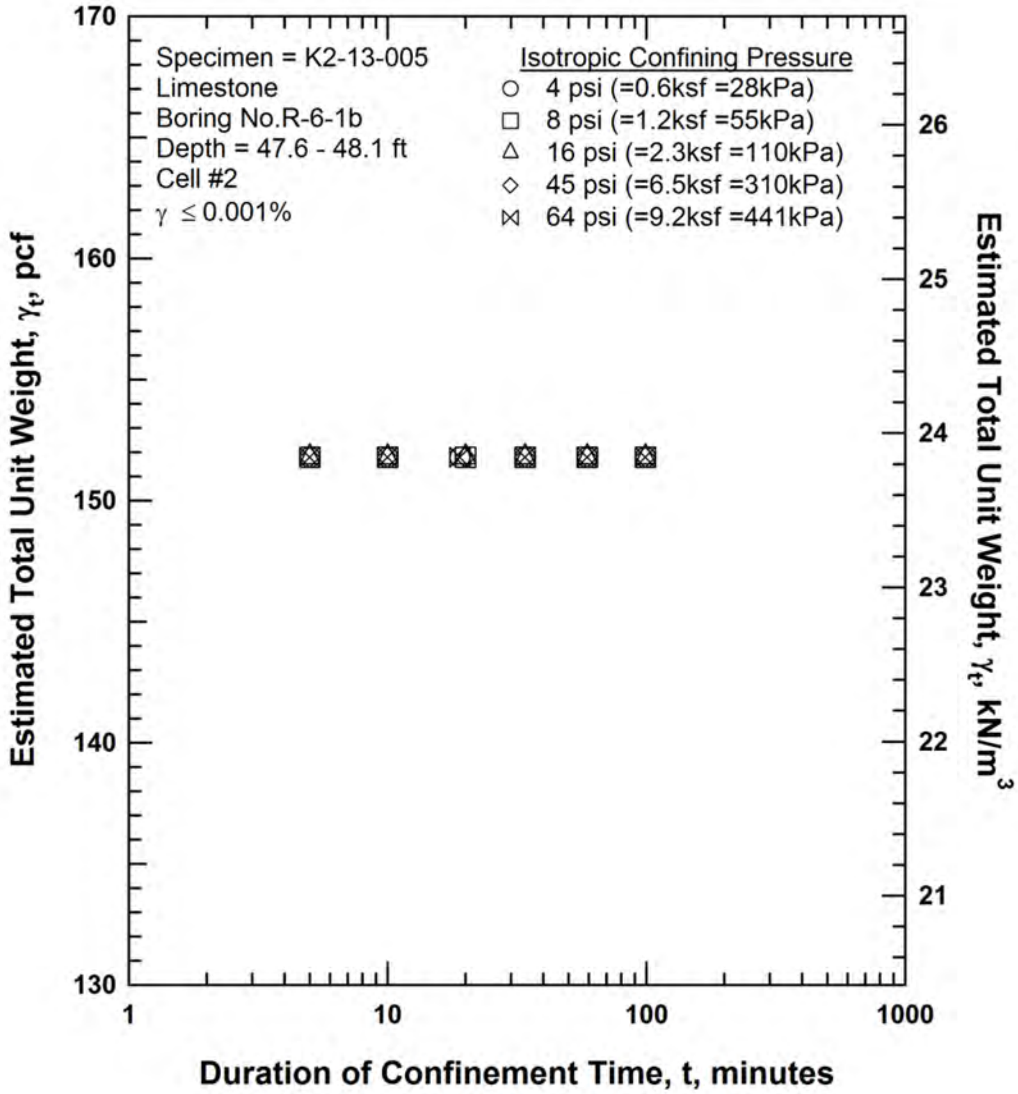


Figure F.4 Variation in Estimated Total Unit Weight with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-005

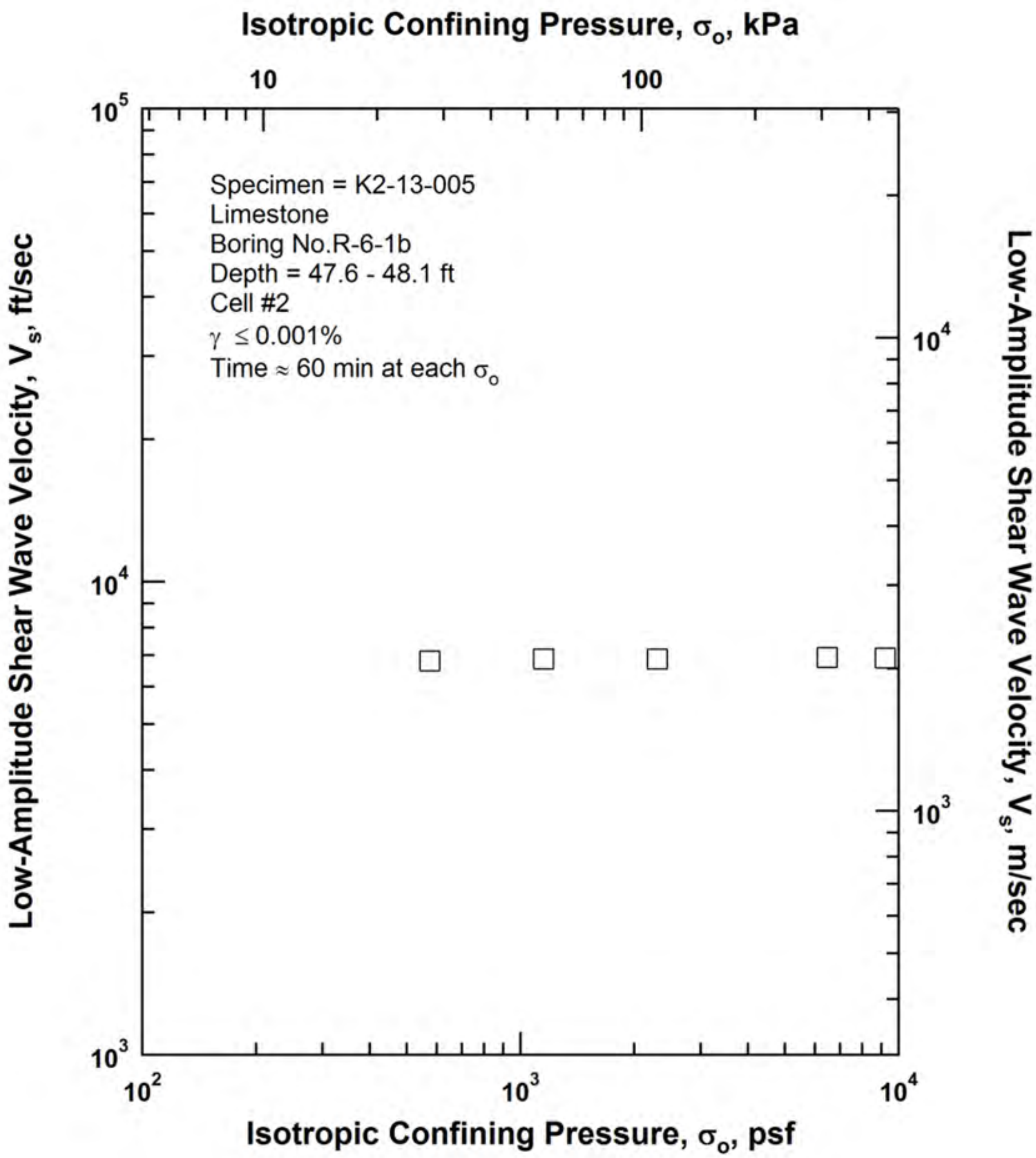


Figure F.5 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-005

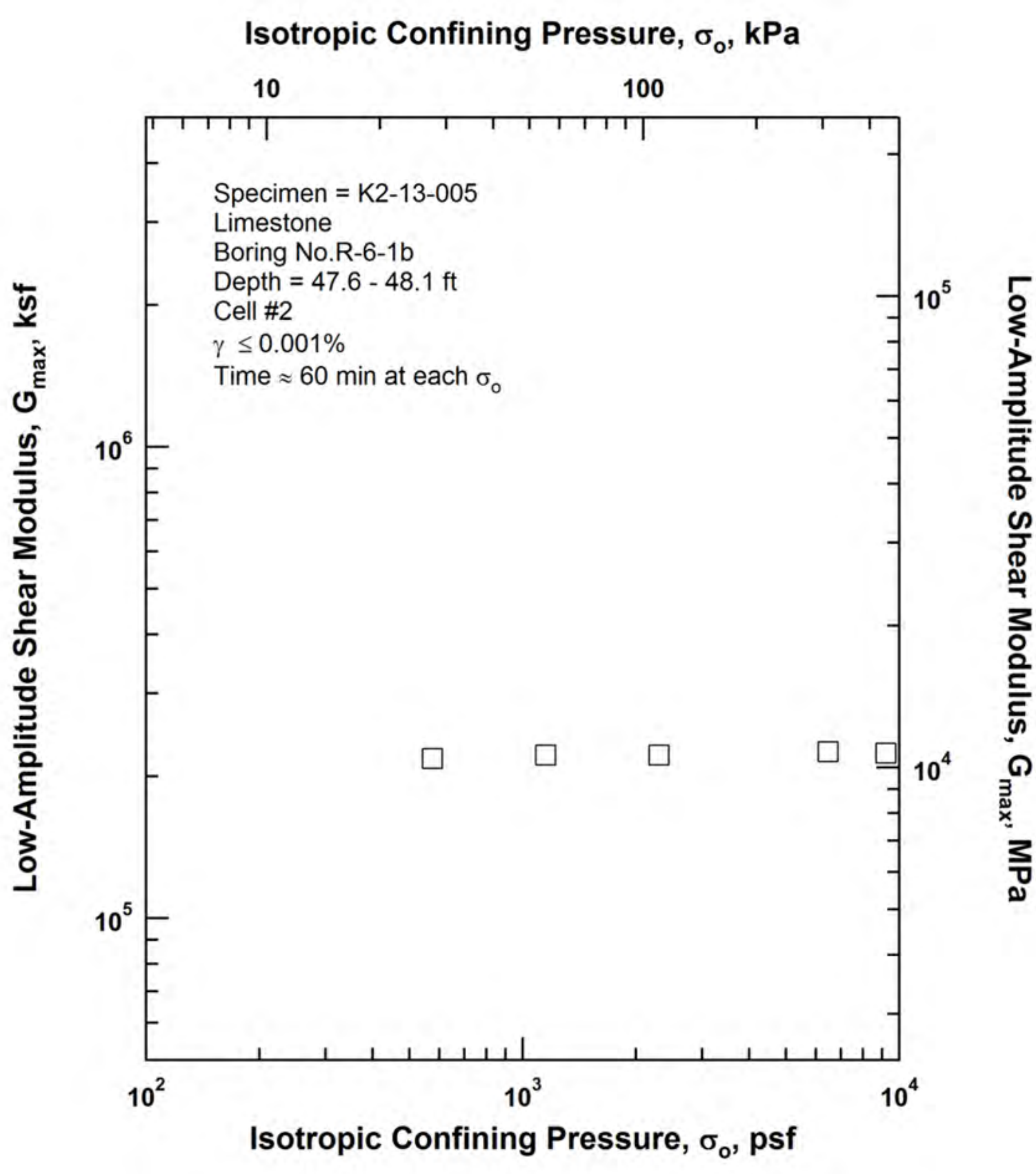


Figure F.6 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Test of Specimen K2-13-005

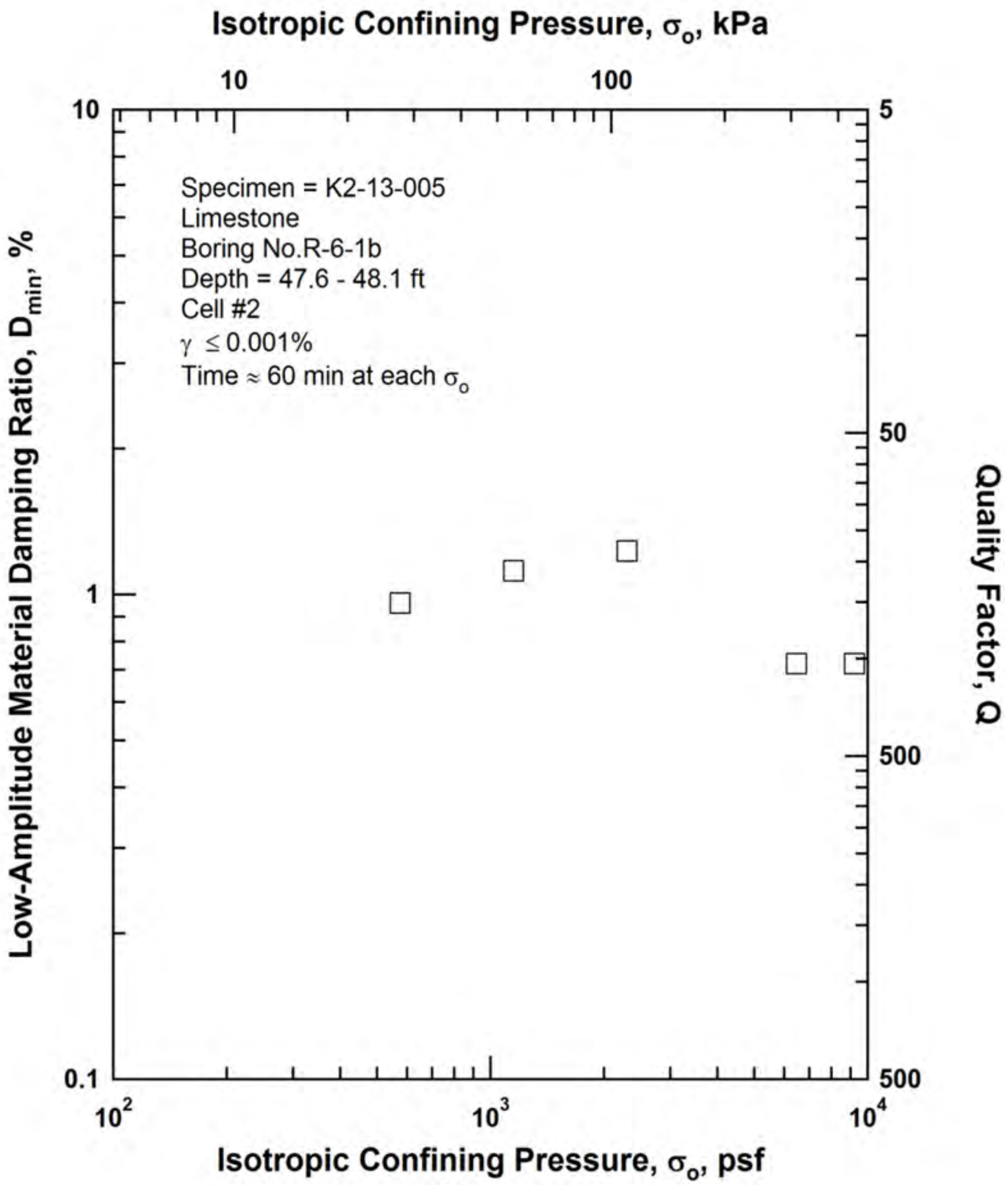


Figure F.7 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-005

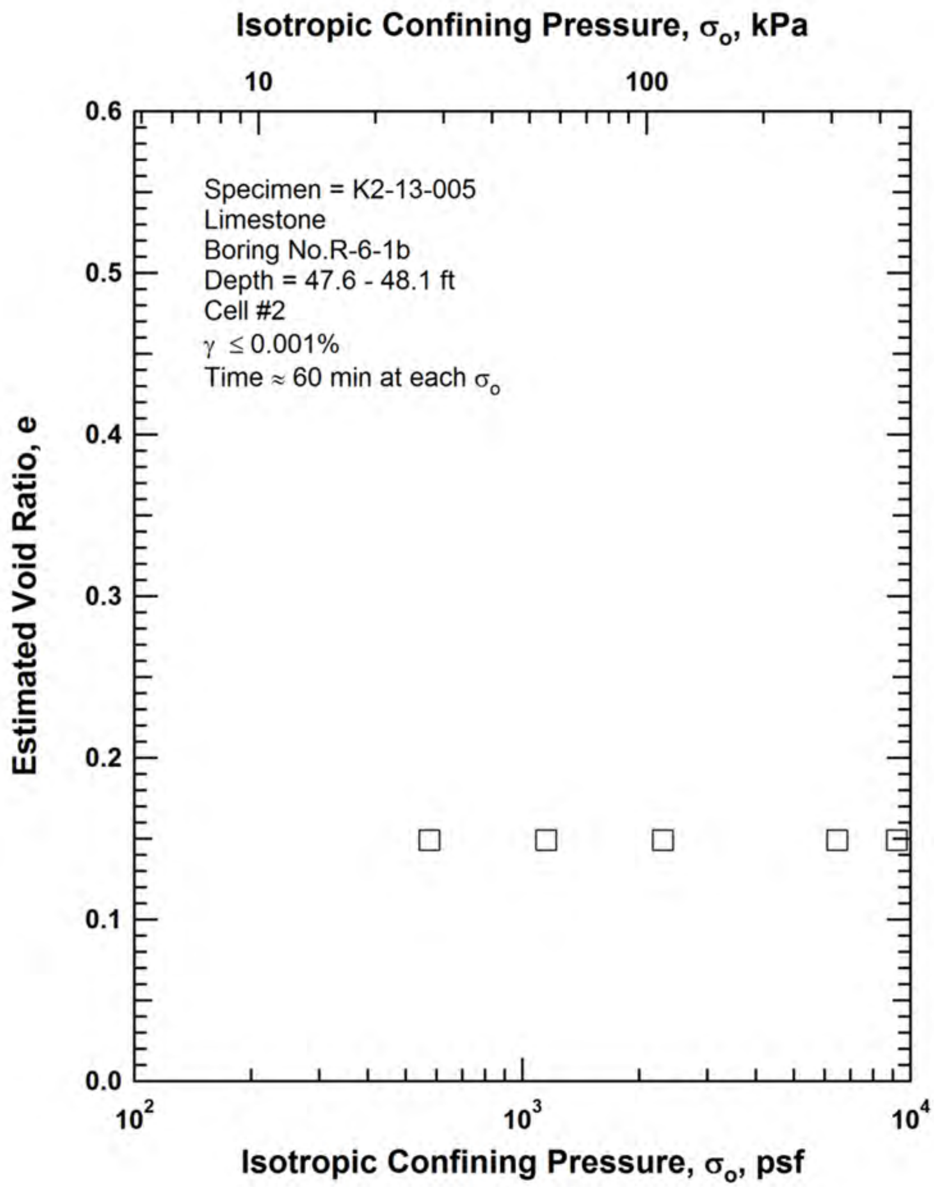


Figure F.8 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-005

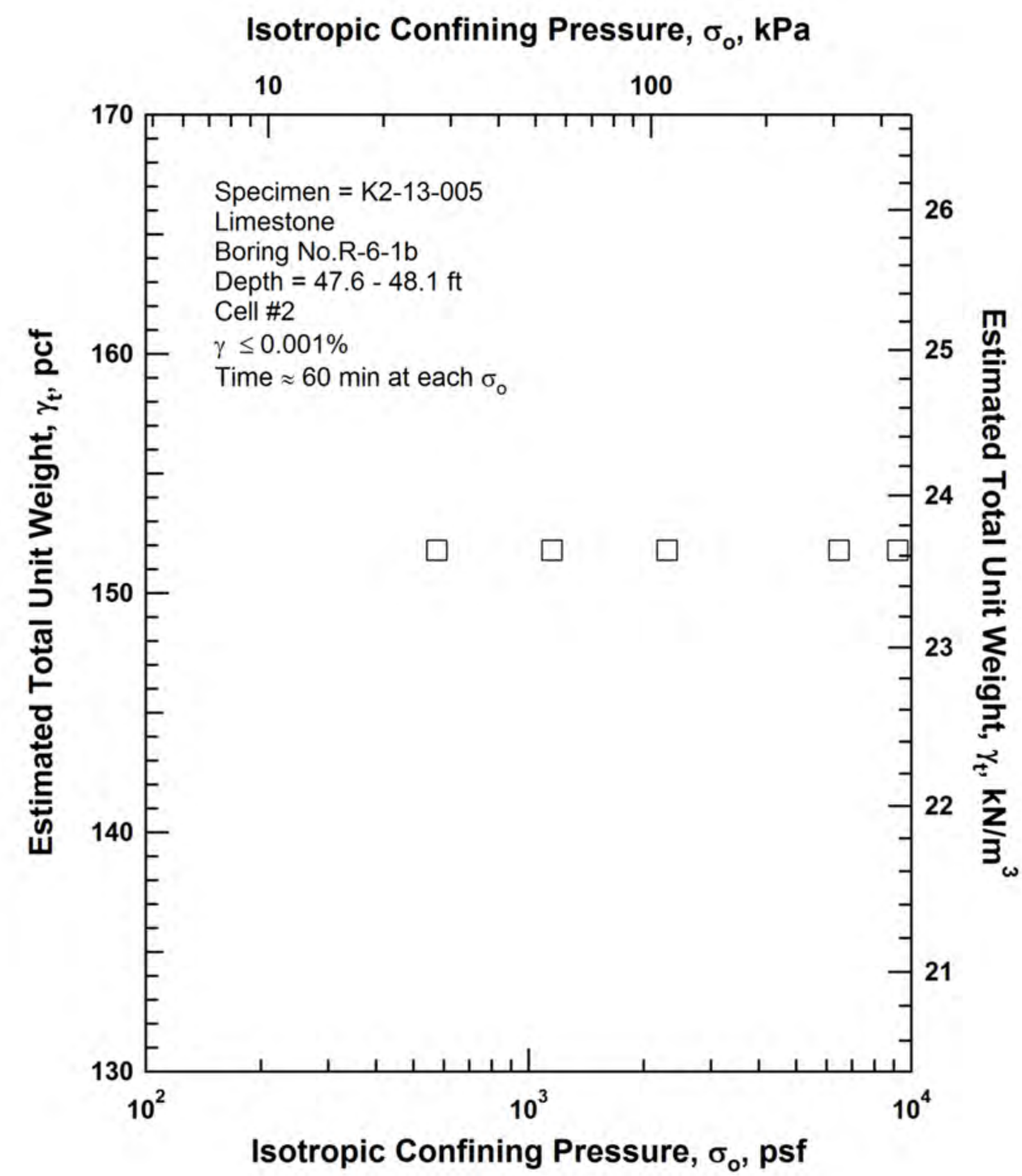


Figure F.9 Variation in Estimated Total Unit Weight with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-005

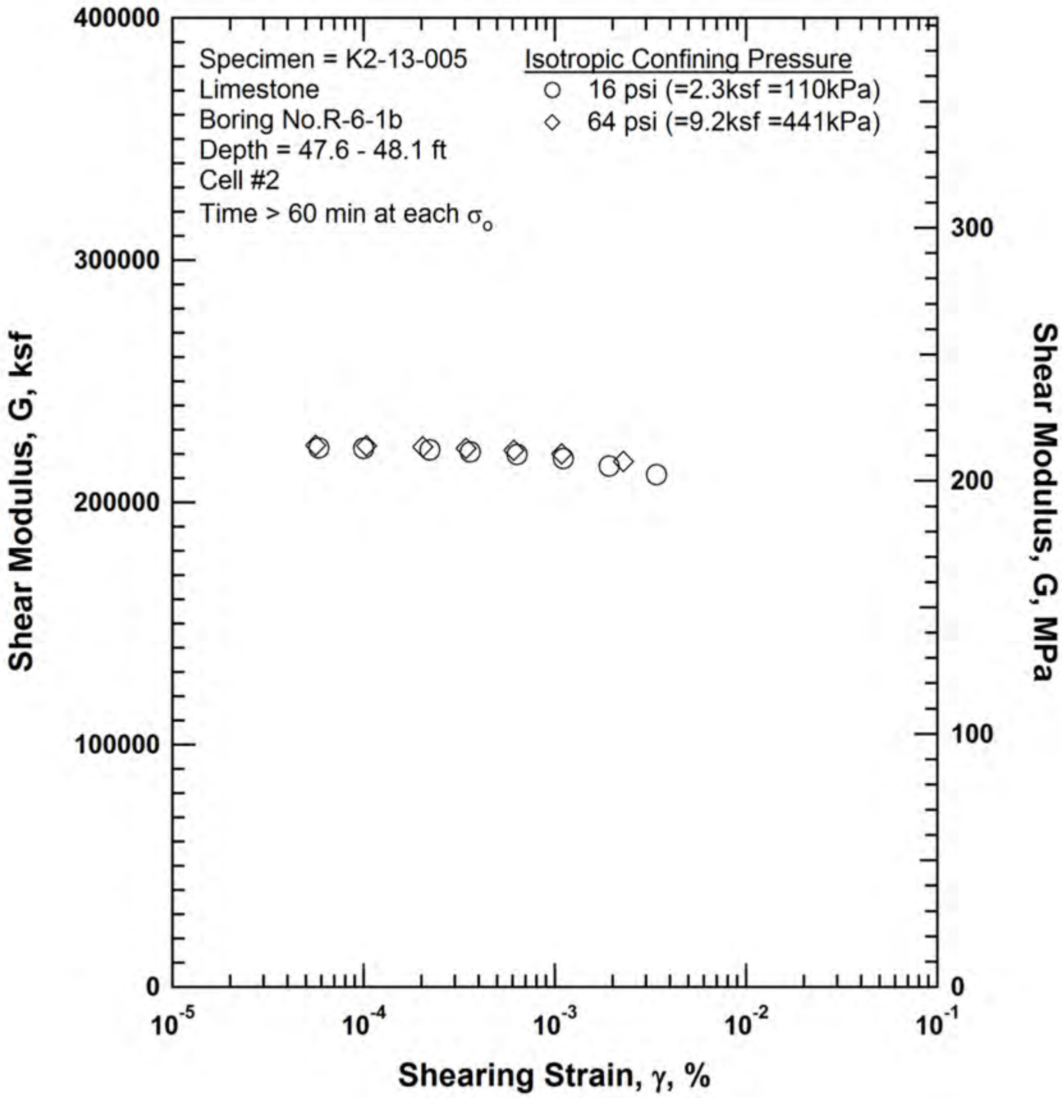


Figure F.10 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-005

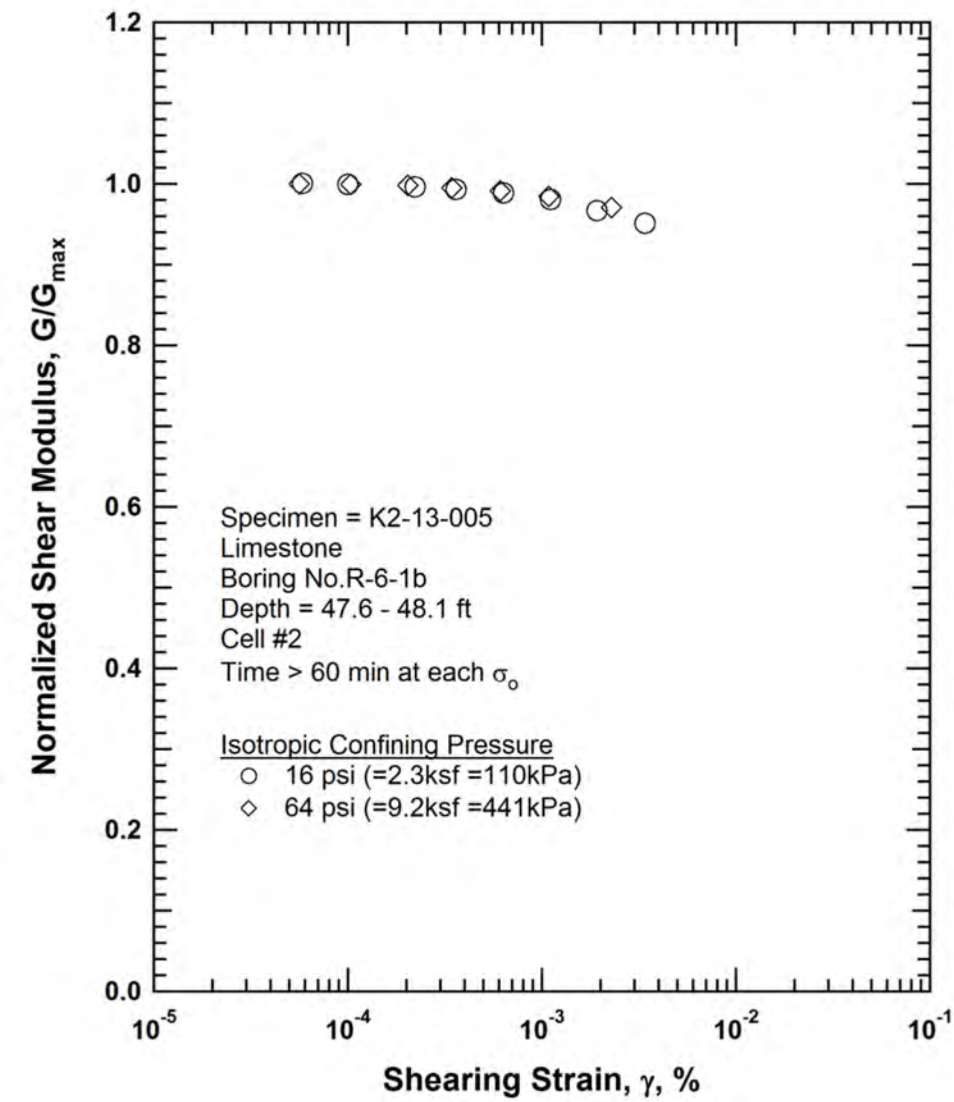


Figure F.11 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-005

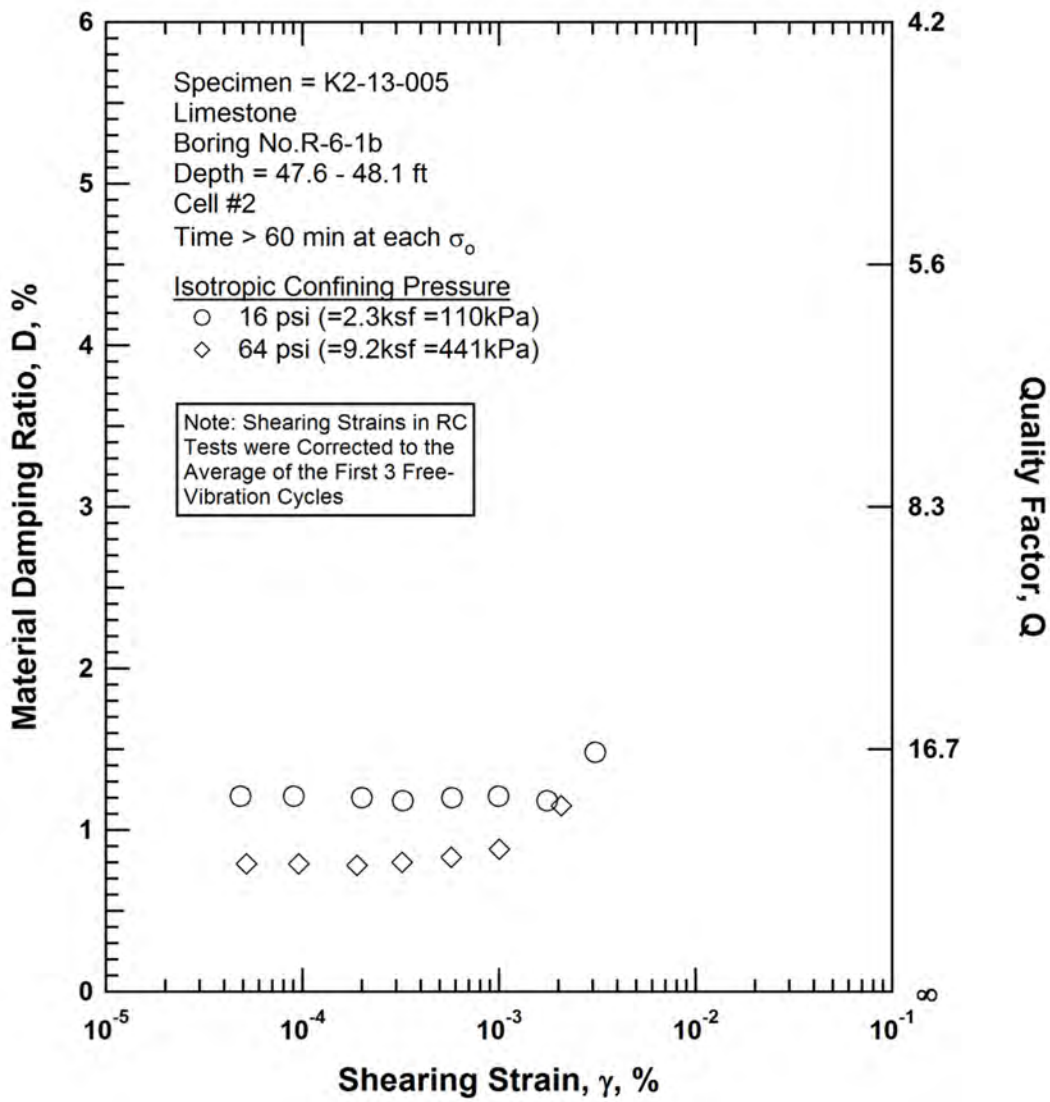


Figure F.12 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-005

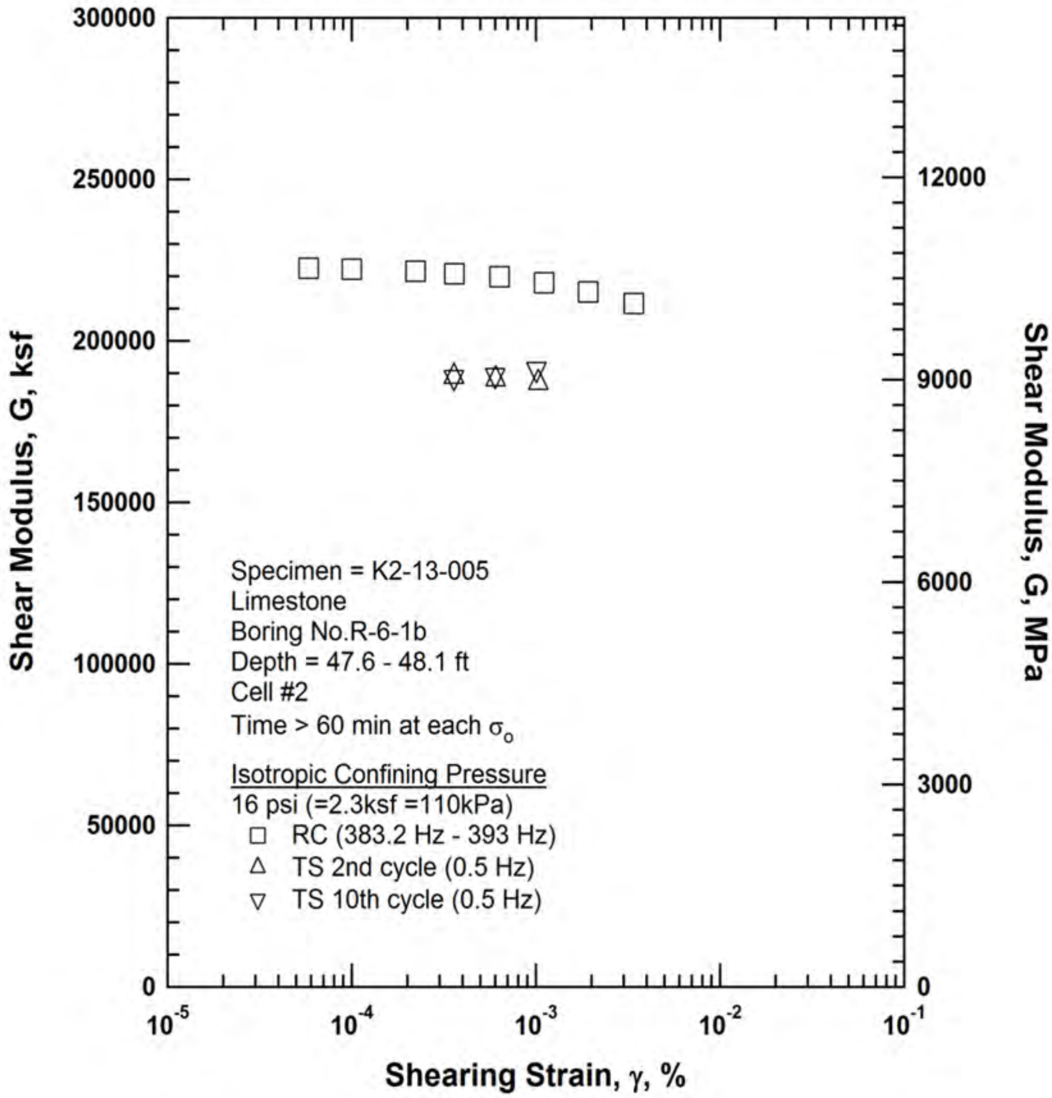


Figure F.13 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 16 psi (=2.3ksf =110kPa) from the Combined RCTS Tests of Specimen K2-13-005

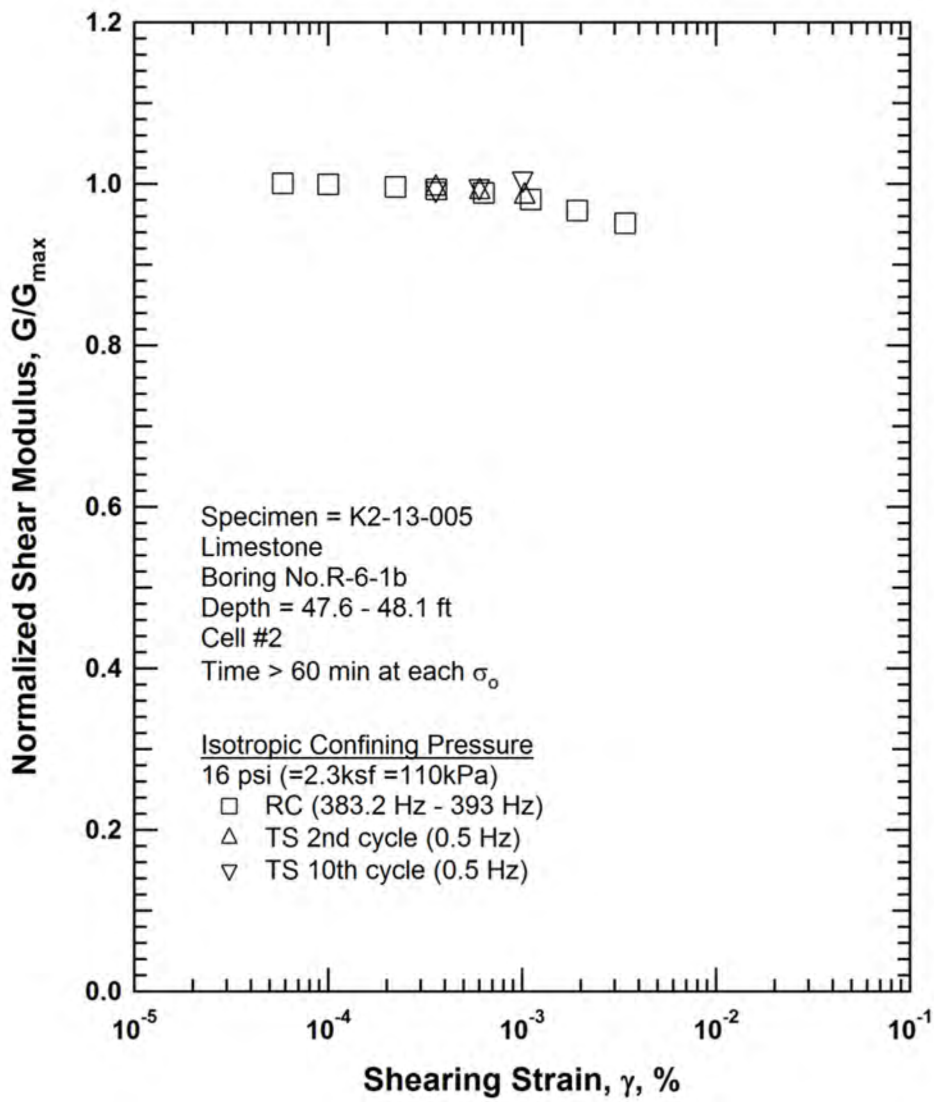


Figure F.14 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 16 psi (=2.3ksf =110kPa) from the Combined RCTS Tests of Specimen K2-13-005

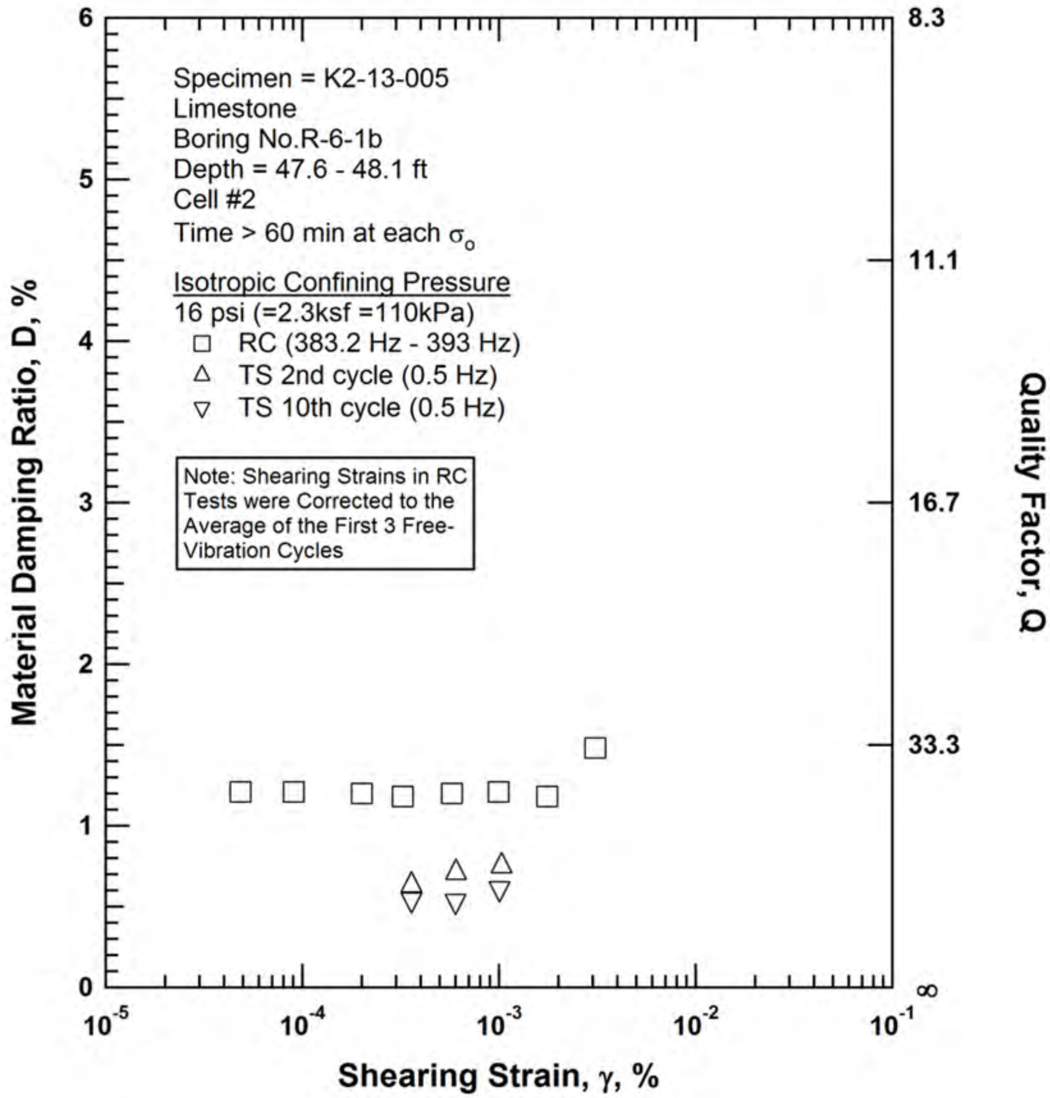


Figure F.15 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 16 psi (=2.3ksf =110kPa) from the Combined RCTS Tests of Specimen K2-13-005

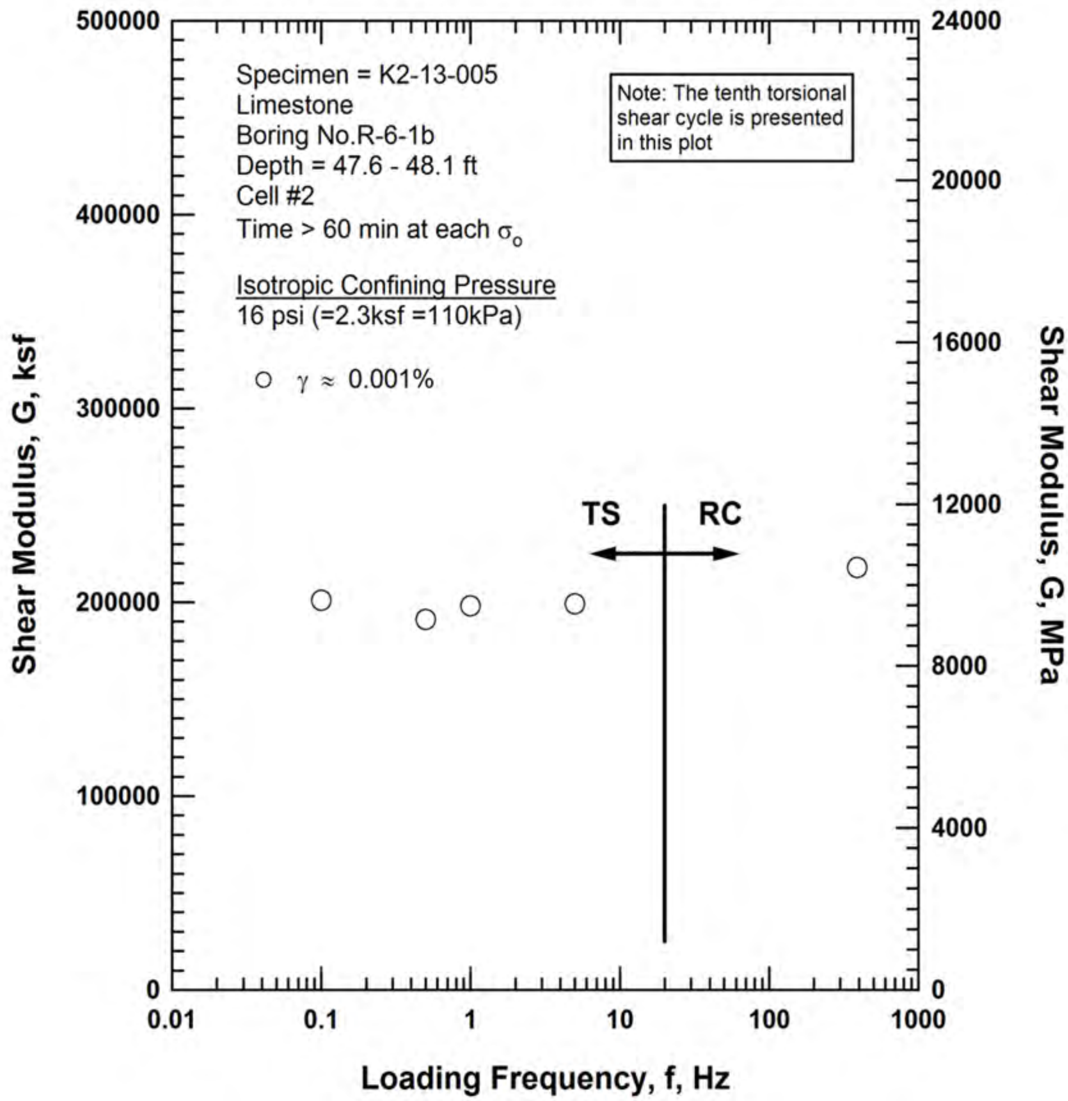


Figure F.16 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 16 psi (=2.3ksf =110kPa) from the Combined RCTS Tests of Specimen K2-13-005

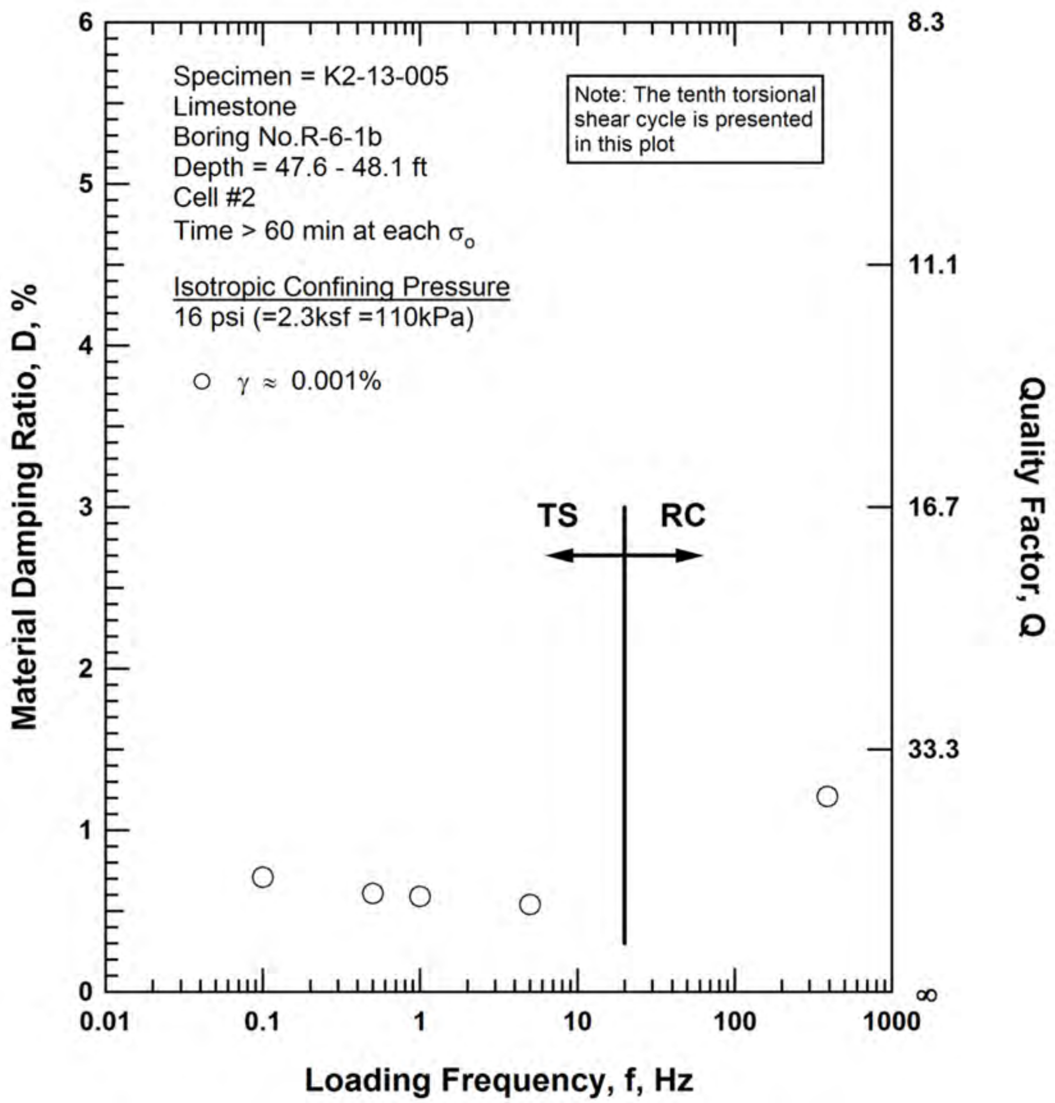


Figure F.17 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 16 psi (=2.3ksf =110kPa) from the Combined RCTS Tests of Specimen K2-13-005

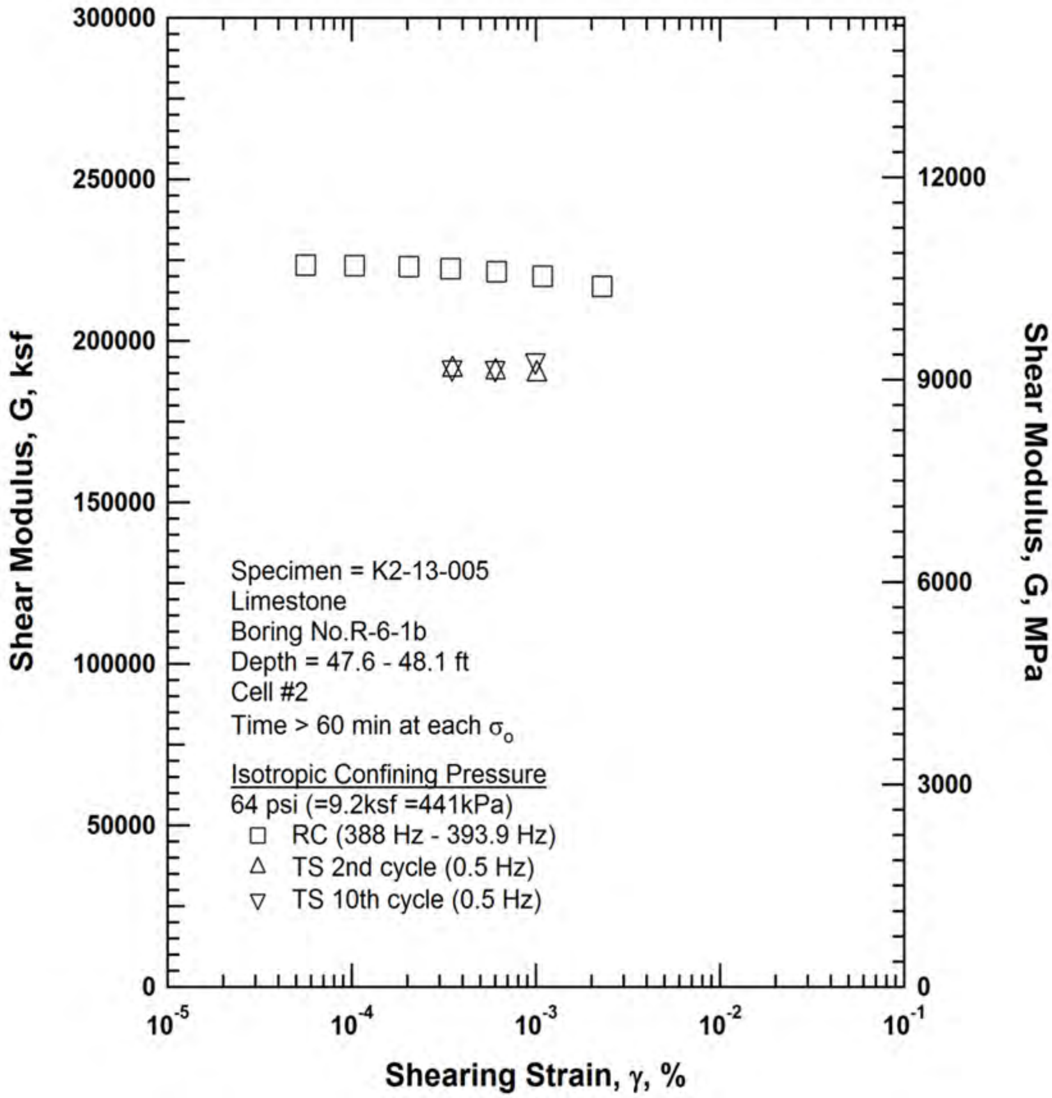


Figure F.18 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 64 psi (=9.2ksf =441kPa) from the Combined RCTS Tests of Specimen K2-13-005

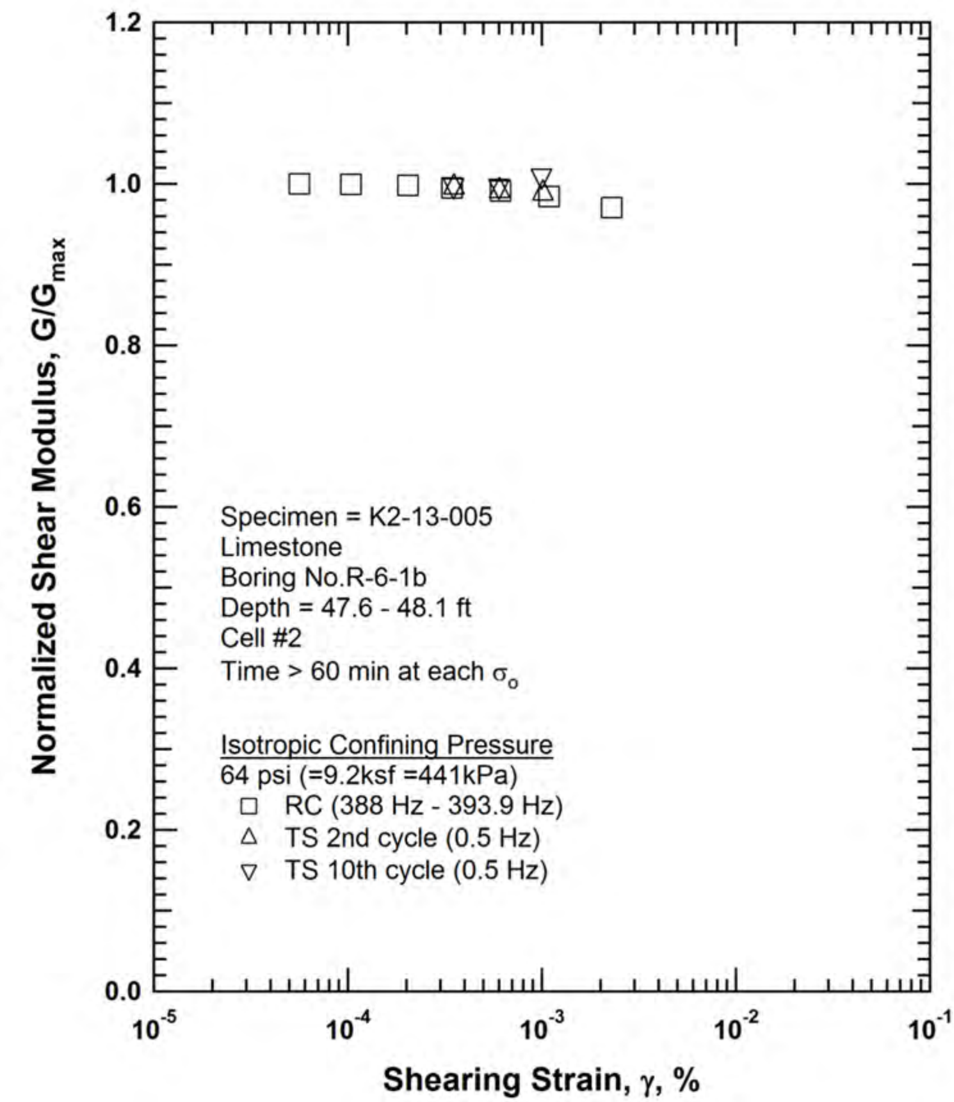


Figure F.19 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 64 psi (=9.2ksf =441kPa) from the Combined RCTS Tests of Specimen K2-13-005

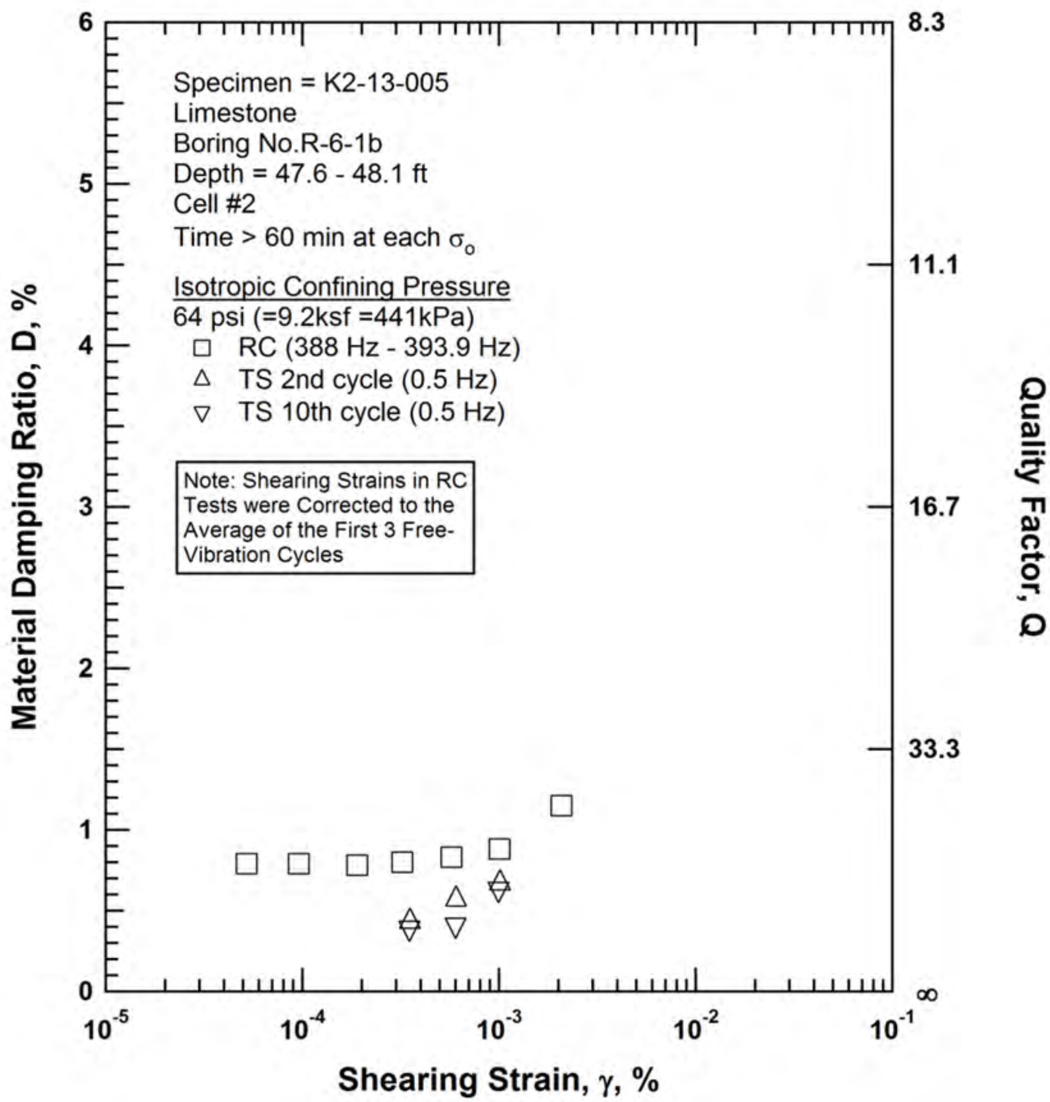


Figure F.20 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 64 psi (=9.2ksf =441kPa) from the Combined RCTS Tests of Specimen K2-13-005

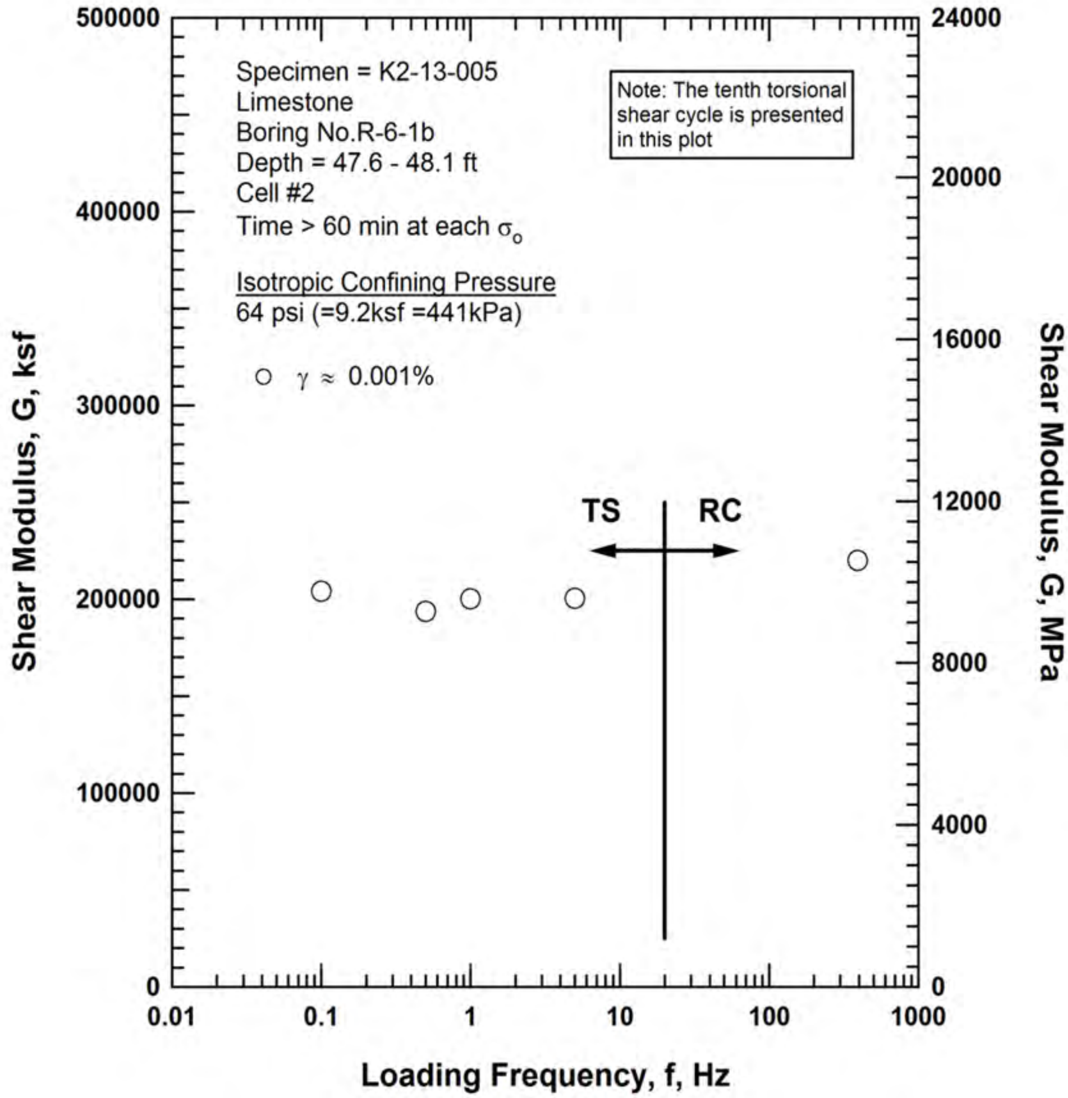


Figure F.21 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 64 psi (=9.2ksf =441kPa) from the Combined RCTS Tests of Specimen K2-13-005

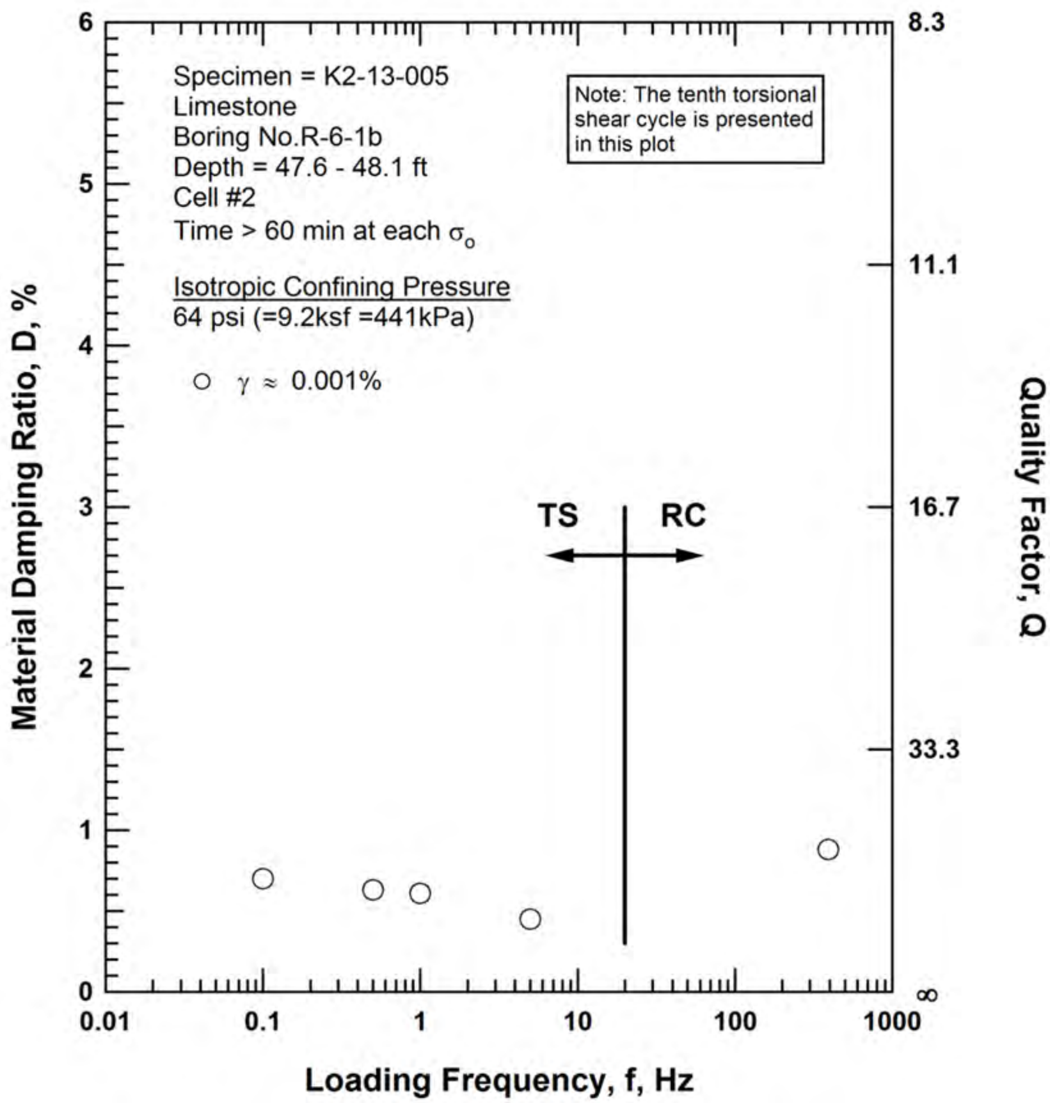


Figure F.22 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 64 psi (=9.2ksf =441kPa) from the Combined RCTS Tests of Specimen K2-13-005

Table F.1 Variation in Low-Amplitude Shear Wave Velocity, Low-Amplitude Shear Modulus, Low-Amplitude Material Damping Ratio, Estimated Void Ratio, and Estimated Total Unit Weight with Isotropic Confining Pressure from RC Tests of Specimen K2-13-005

Isotropic Confining Pressure, σ_o			Low-Amplitude Shear Modulus, G_{max}		Low-Amplitude Shear Wave Velocity, V_s	Low-Amplitude Material Damping Ratio, D_{min}	Estimated Void Ratio, e	Estimated Total Unit Weight, γ_t
(psi)	(psf)	(kPa)	(ksf)	(MPa)	(fps)	(%)	(Unitless)	(pcf)
4	576	28	217900	10433	6800	0.96	0.149	151.8
8	1152	55	221800	10621	6860	1.12	0.149	151.8
16	2304	110	222000	10627	6860	1.23	0.149	151.8
45	6480	310	225600	10801	6910	0.72	0.149	151.8
64	9216	441	223900	10720	6890	0.72	0.149	151.8

Table F.2 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen K2-13-005; Isotropic Confining Pressure σ_o = 16 psi (=2.3 ksf = 110 kPa)

Second Cycle				Tenth Cycle			
Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
3.58E-04	188900	0.99	0.63	3.58E-04	188700	0.99	0.54
6.03E-04	188100	0.99	0.71	5.99E-04	189300	1.00	0.53
1.03E-03	187000	0.98	0.75	1.01E-03	191100	1.01	0.61

Table F.3 Variation in Shear Modulus, Normalized Shear Modulus, and Material Damping with Shearing Strain from RC Tests of Specimen K2-13-005; Isotropic Confining Pressure σ_o = 16 psi (=2.3 ksf = 110 kPa)

Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average Shearing Strain, %[(1)]	Material Damping Ratio, D, %[(2)]
5.84E-05	222500	1.00	4.83E-05	1.21
1.00E-04	222200	1.00	9.03E-05	1.21
2.22E-04	221600	1.00	2.01E-04	1.20
3.61E-04	220900	0.99	3.25E-04	1.18
6.34E-04	219900	0.99	5.76E-04	1.20
1.11E-03	218000	0.98	9.96E-04	1.21
1.92E-03	215100	0.97	1.76E-03	1.18
3.40E-03	211500	0.95	3.09E-03	1.48

[(1)] Average Shearing Strain from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

[(2)] Average Damping Ratio from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

Table F.4 Variation in Shear Modulus and Material Damping with Frequency from RC/TS Tests of Specimen K2-13-005; Isotropic Confining Pressure σ_o = 16 psi (=2.3 ksf = 110 kPa)

Approximate Shearing Strain, γ, %	Frequency, Hz	Shear Modulus, G, ksf	Material Damping Ratio, D, %
0.001	0.1	201100	0.71
	0.5	191100	0.61
	1.0	198100	0.59
	5.0	199100	0.54
	389.0	218000	1.21

Table F.5 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen K2-13-005; Isotropic Confining Pressure σ_o = 64 psi (=9.2 ksf = 441 kPa)

Second Cycle				Tenth Cycle			
Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
3.51E-04	191200	1.00	0.43	3.51E-04	191600	1.00	0.39
6.03E-04	190300	0.99	0.57	6.00E-04	191400	1.00	0.41
3.51E-04	191200	1.00	0.43	3.51E-04	191600	1.00	0.39

Table F.6 Variation in Shear Modulus, Normalized Shear Modulus, and Material Damping with Shearing Strain from RC Tests of Specimen K2-13-005; Isotropic Confining Pressure σ_o = 64 psi (=9.2 ksf = 441 kPa)

Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average Shearing Strain, %(1)	Material Damping Ratio, D, %(2)
5.63E-05	223400	1.00	5.20E-05	0.79
1.04E-04	223300	1.00	9.61E-05	0.79
2.05E-04	222900	1.00	1.90E-04	0.78
3.45E-04	222300	1.00	3.21E-04	0.80
6.11E-04	221400	0.99	5.72E-04	0.83
1.09E-03	220000	0.98	1.01E-03	0.88
2.29E-03	216800	0.97	2.08E-03	1.15

(1) Average Shearing Strain from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

(2) Average Damping Ratio from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

Table F.7 Variation in Shear Modulus and Material Damping with Frequency from RC/TS Tests of Specimen K2-13-005; Isotropic Confining Pressure σ_o = 64 psi (=9.2 ksf = 441 kPa)

Approximate Shearing Strain, γ, %	Frequency, Hz	Shear Modulus, G, ksf	Material Damping Ratio, D, %
0.001	0.1	204300	0.7
	0.5	193800	0.63
	1	200300	0.61
	5	200600	0.45
	390.8	220000	0.88

APPENDIX G

Results for Kleinfelder Specimen ID K2-13-006

- *Specimen Preparation Notes*
- *RCTS Testing Results*

SPECIMEN PREPARATION NOTES

Specimen No.: K2-13-006

Project No : 136473 **Page** 1 **of** 3

Boring No.: R-6-1b **Date of Preparation..:** 11/7/13

Sample No..: ST-1 **Depth..:** 136.0 – 136.5 feet

Disposition of Sample

☒ No Apparent Disturbance ☐ Apparent Disturbance ☐ Compacted Sample

☐ Other (Describe)

Specimen Preparation Notes

Preparation Method :	Extruded from Shelby Tube with No Trimming		**Affixation to Platens :**	2.8-inch diameter platens, no adhesive used	
Ave. Length (in.) :	5.5528	**Ave. Diameter (in.):**	2.838	**L/D**	2.0
Total Unit Weight (pcf) :	119.9	**Moisture Content (%) :**	26.7	**% Saturation (Assume SG = 2.65):**	91.6

Specimen Testing Comments

1) Sample was extruded from the Shelby Tube directly into a latex membrane for testing on 11/7/13. No trimming of the sample was performed except to square the end.

2) Testing commenced on 11/7/13 and was completed on 11/10/13. The full test sequence was completed, with confining pressures ranging from 11 psi to 183 psi.

☒ **See Attached Photographs**

SPECIMEN PREPARATION NOTES

Photo G.1

Sample R-6-1b ST-1 after removal from the transport container. Note the shock indicator is untripped.

Photo G.2

Sample after subdividing the bottom 7-inches for testing.

Photo G.3

Specimen being extruded directly into latex testing membrane.

SPECIMEN PREPARATION NOTES

Photo G.4

Trimming the bottom end of the specimen square before placement on base pedestal.

Photo G.4

Specimen after placement on base pedestal and vacuum pressure is applied.

Kleinfelder Specimen ID:

K2-13-006

Boring No: R-6-1b
Sample No: ST-1

Silty Sand (SM)
Depth = 136.0 ft – 136.5 ft (below existing ground surface)
Total Unit Weight = 119.9 lb/ft^3
Natural Moisture Content = 26.7%
Estimated In-Situ Mean Effective Stress = 46 psi

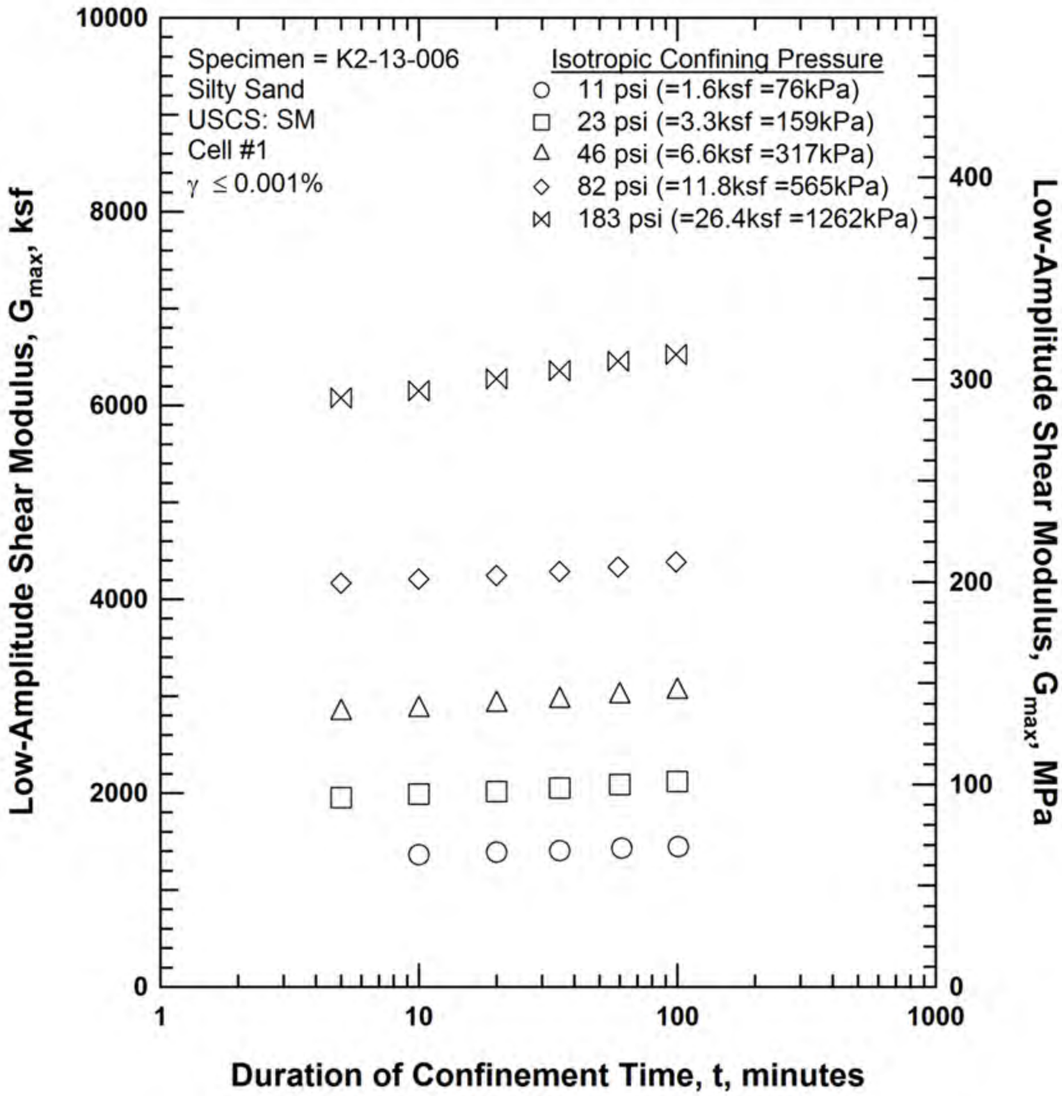


Figure G.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-006

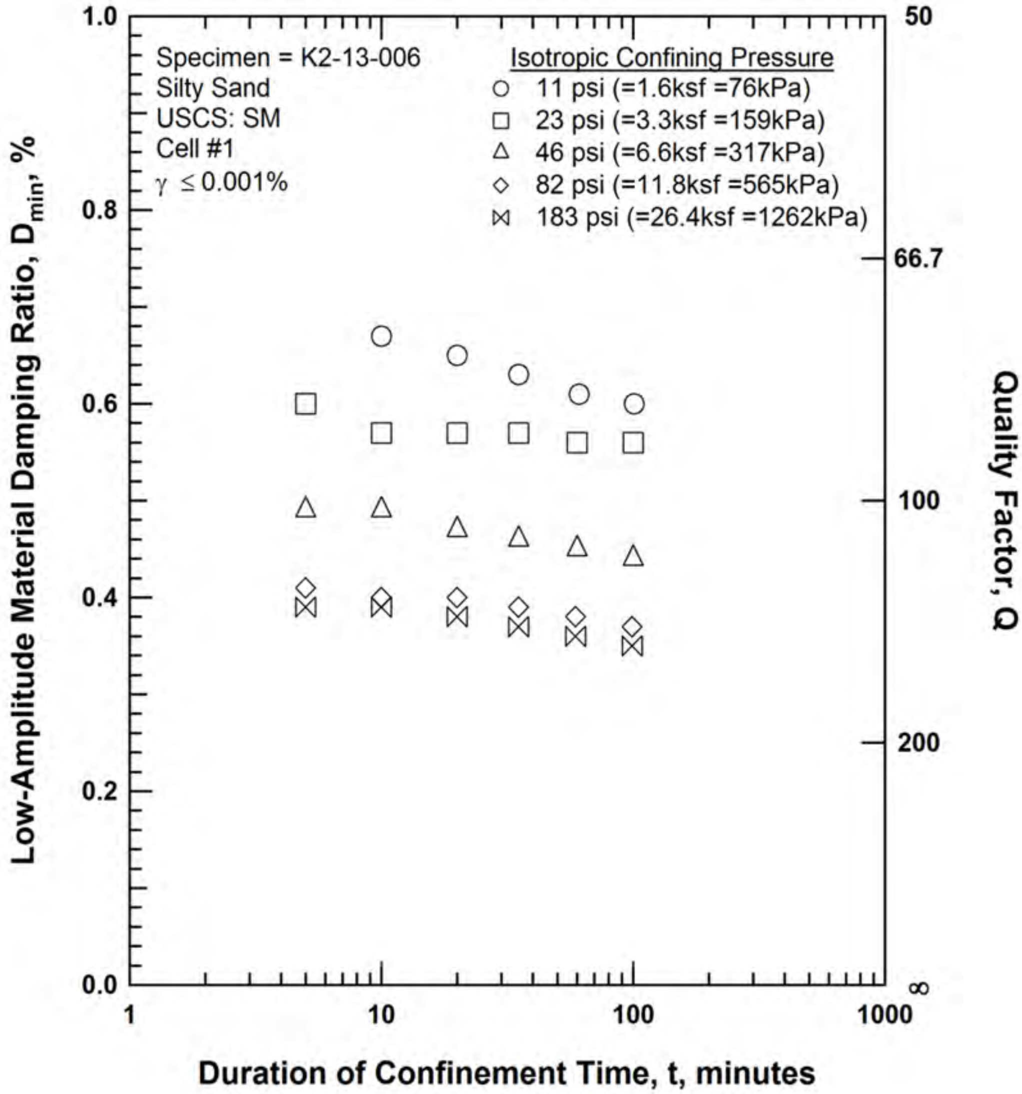


Figure G.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-006

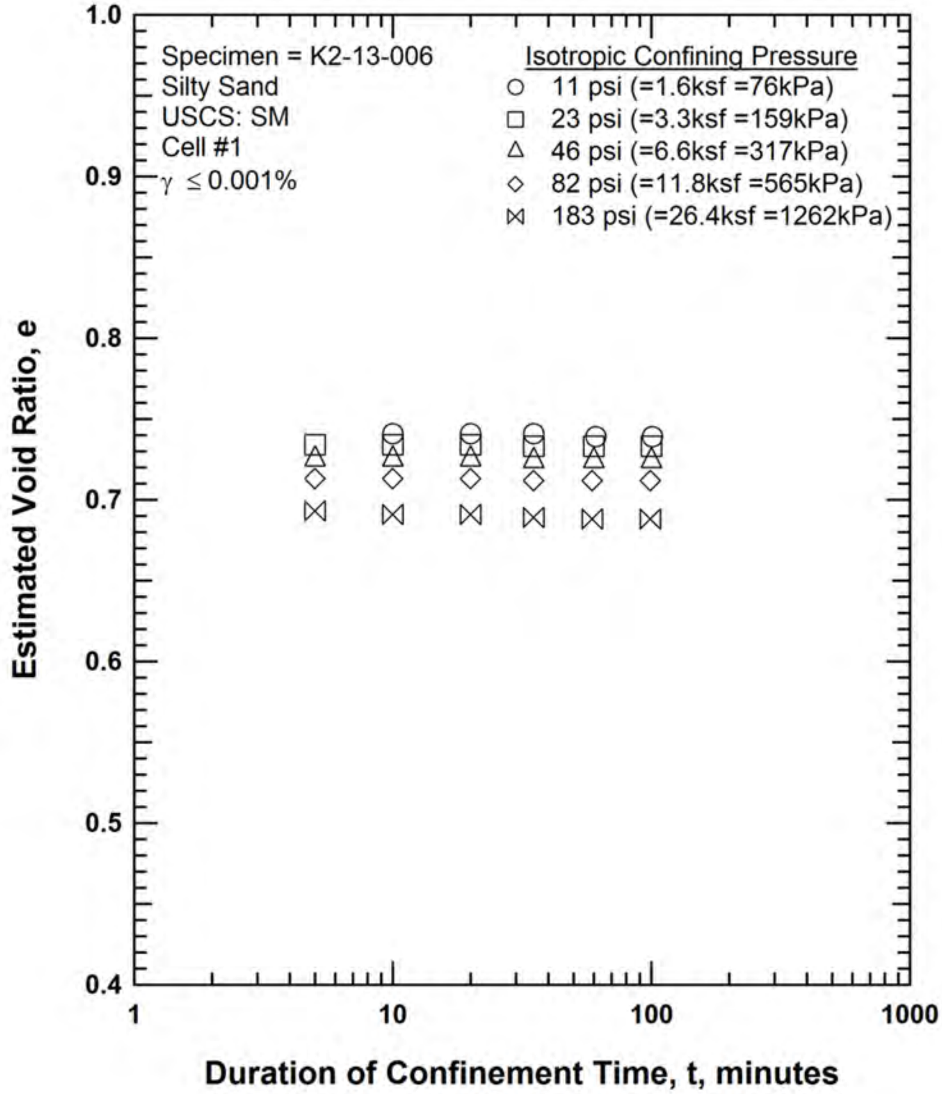


Figure G.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Test of Specimen K2-13-006

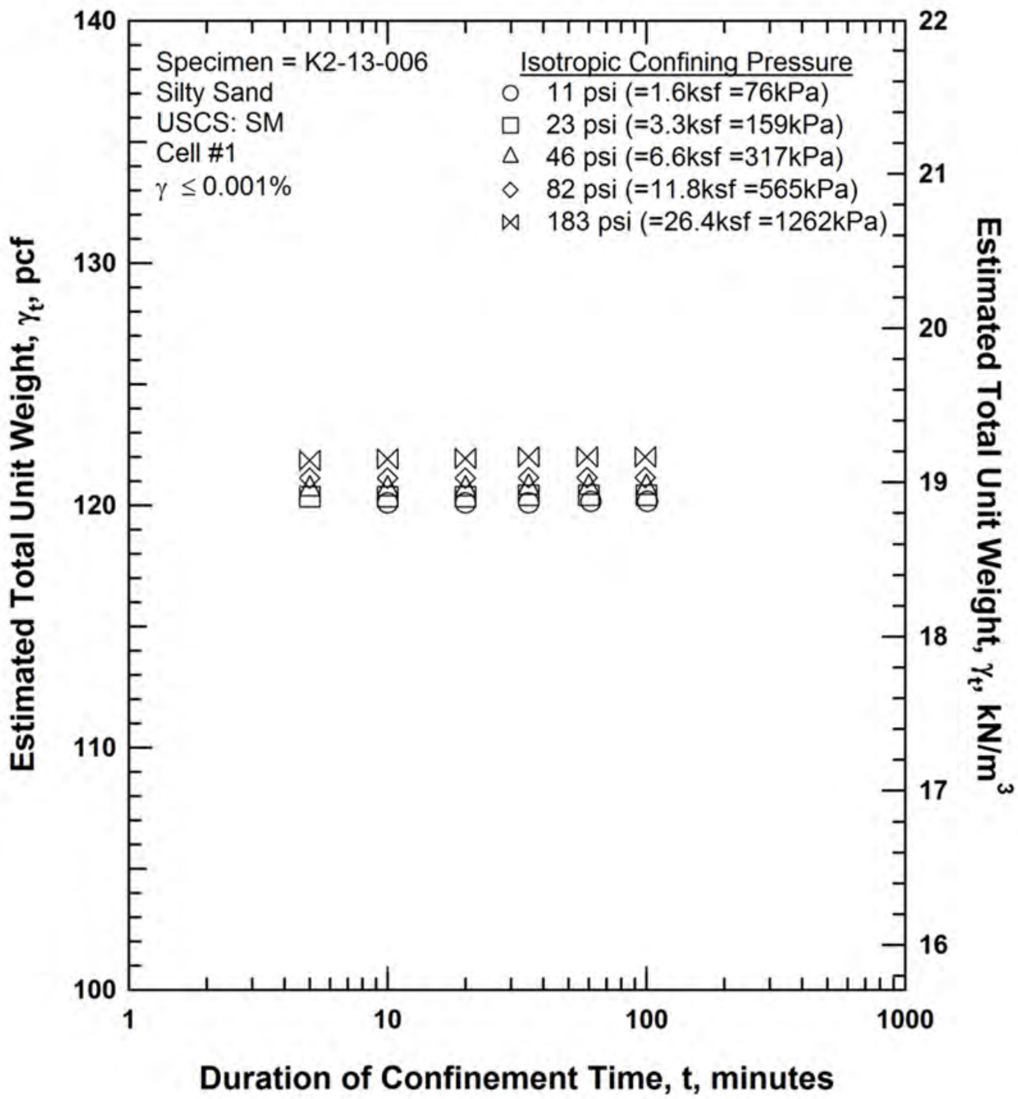


Figure G.4 Variation in Estimated Total Unit Weight with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-006

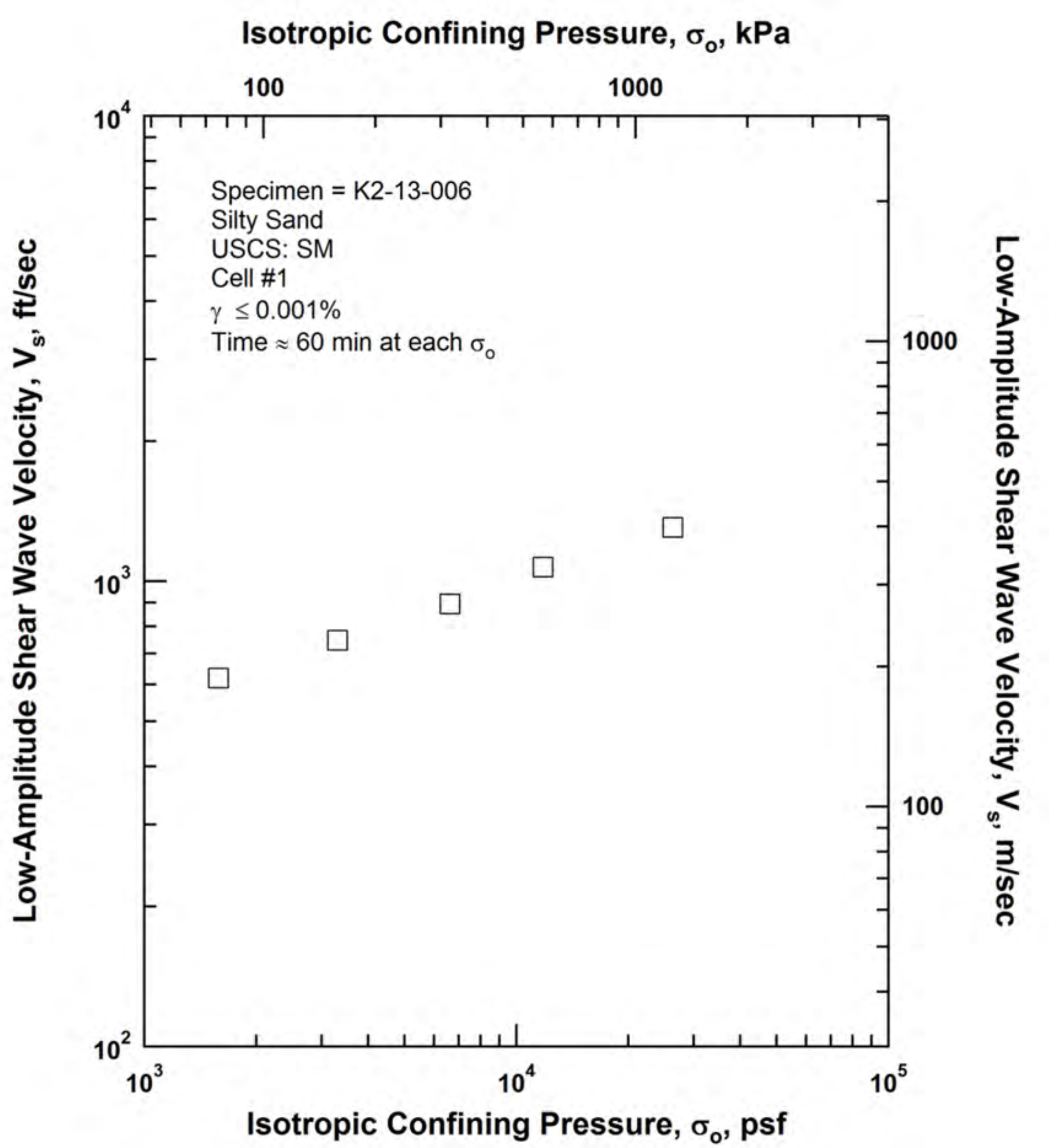


Figure G.5 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-006

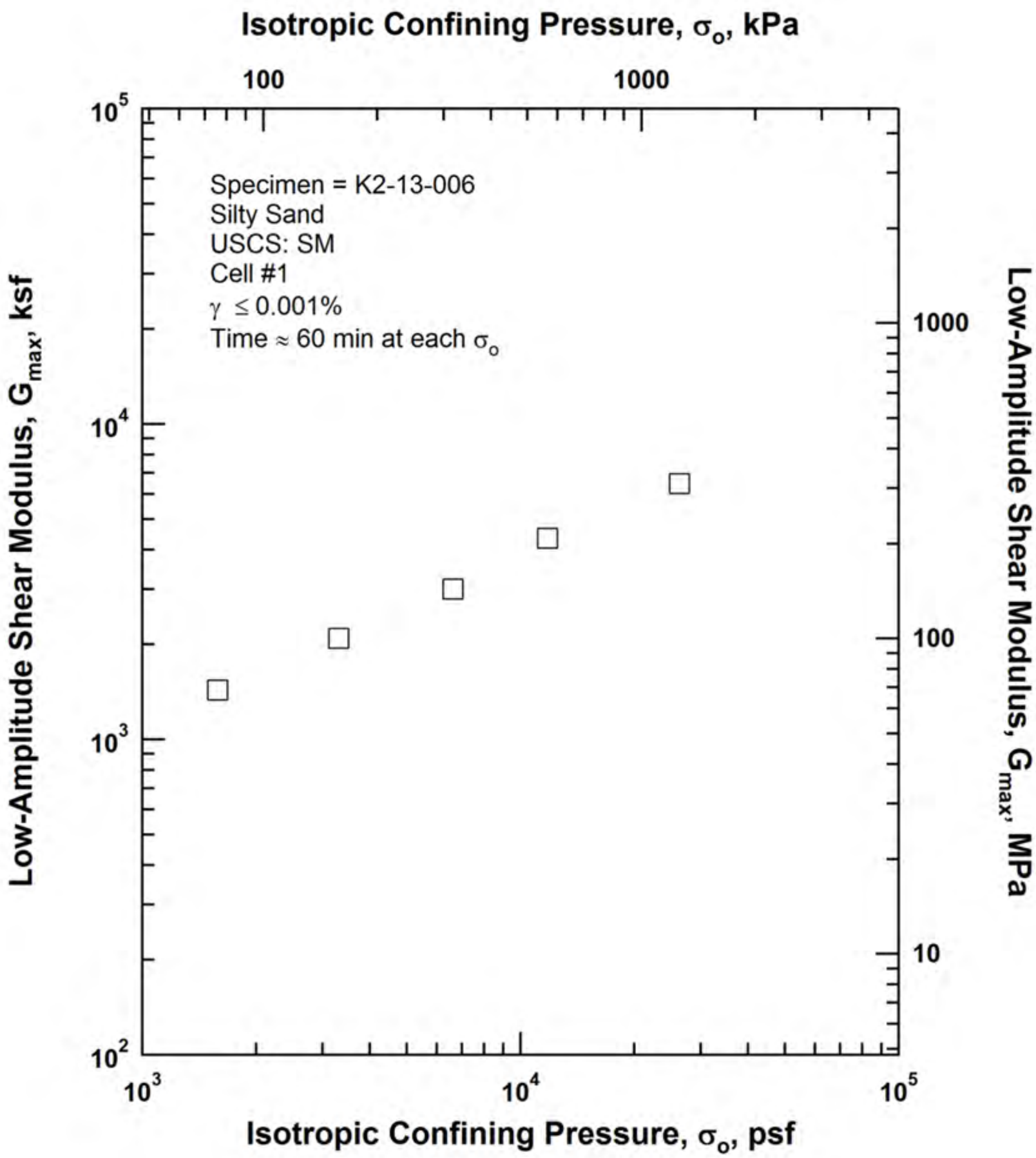


Figure G.6 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Test of Specimen K2-13-006

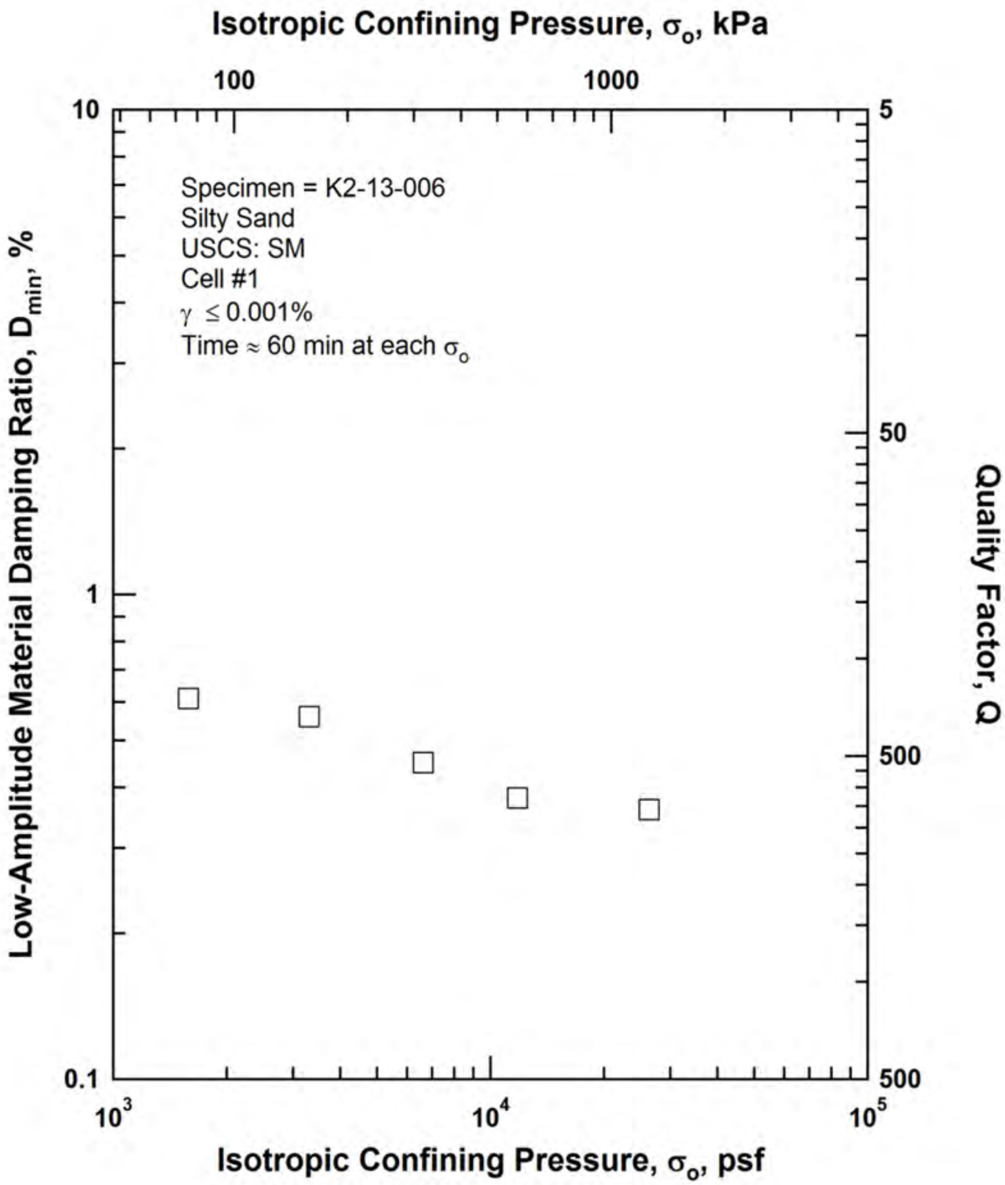


Figure G.7 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-006

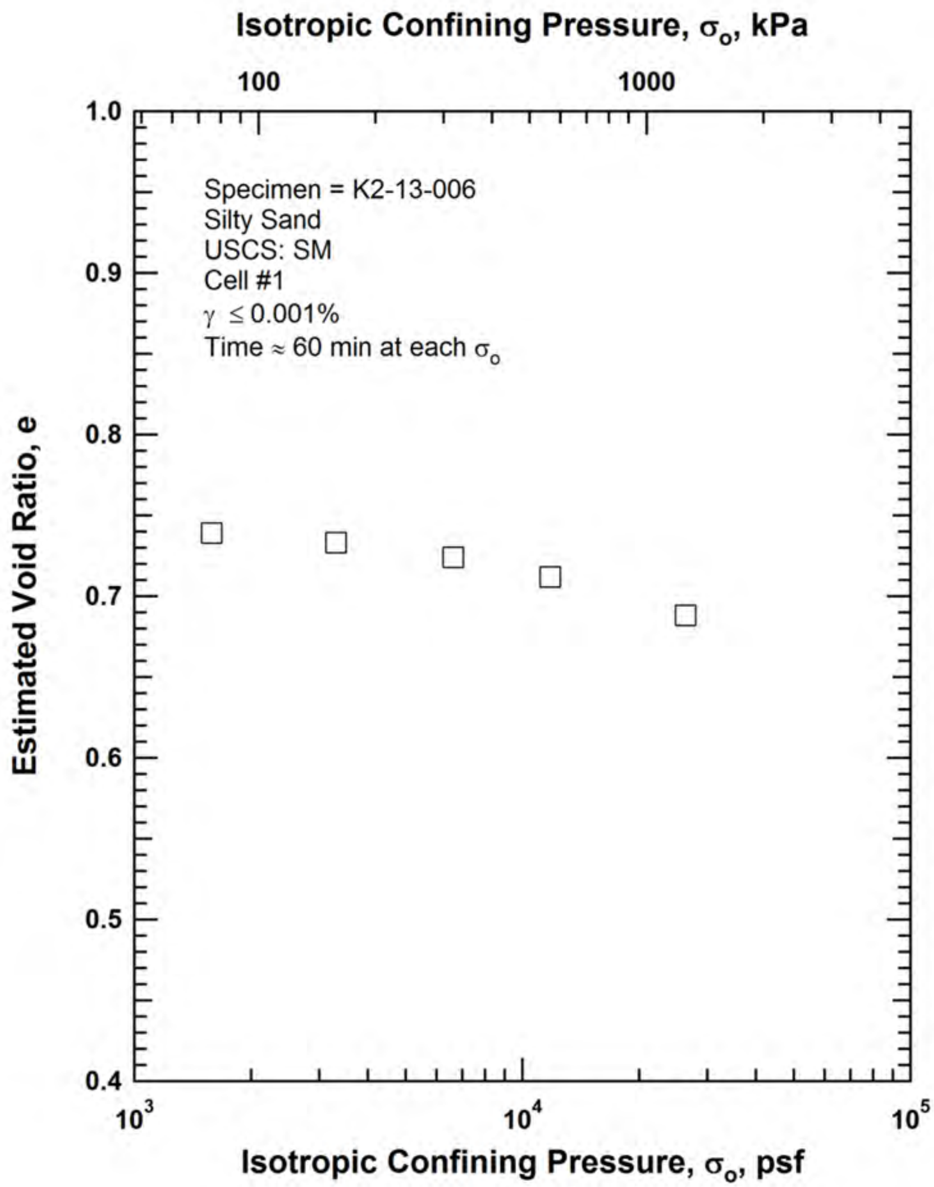


Figure G.8 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-006

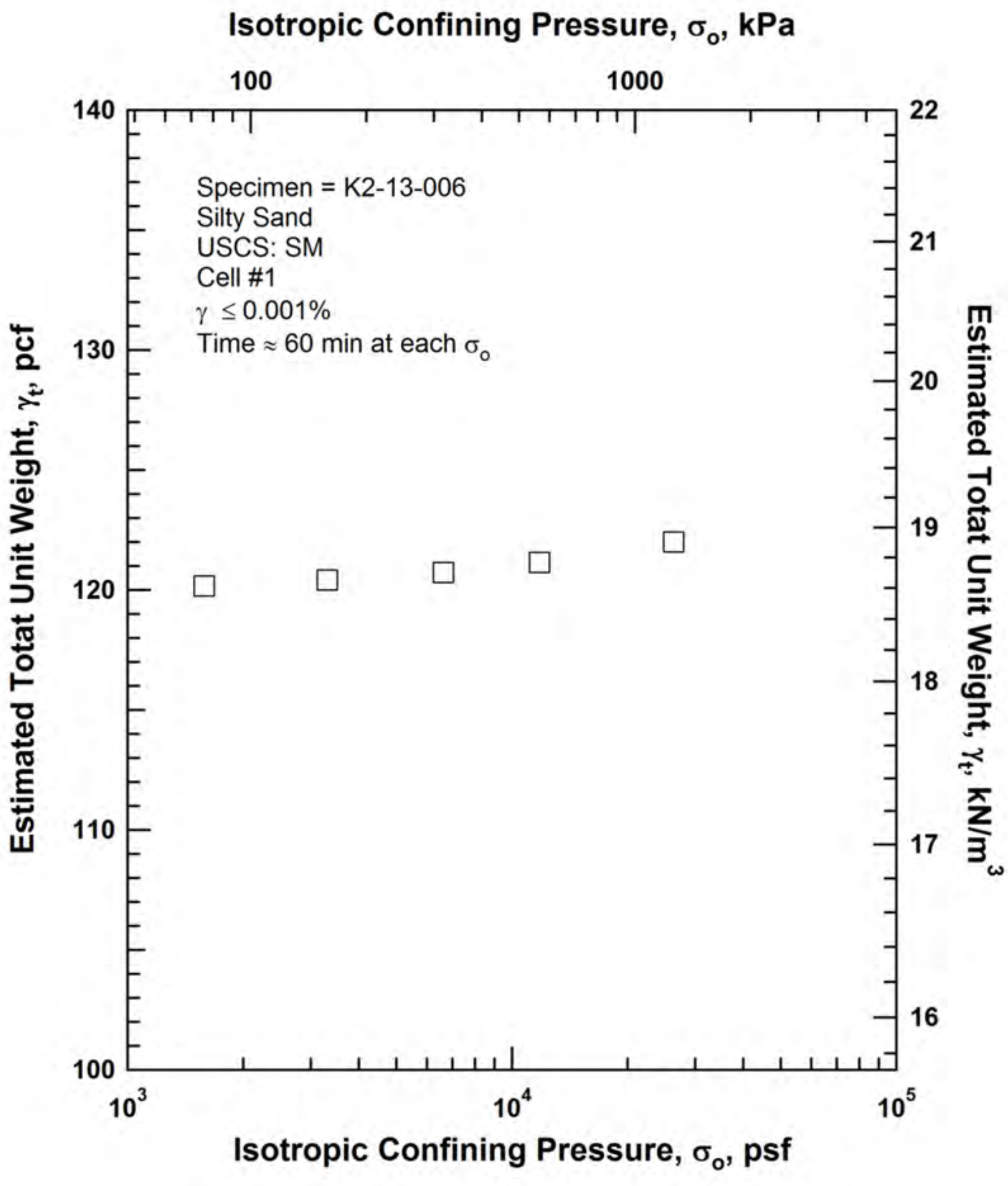


Figure G.9 Variation in Estimated Total Unit Weight with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-006

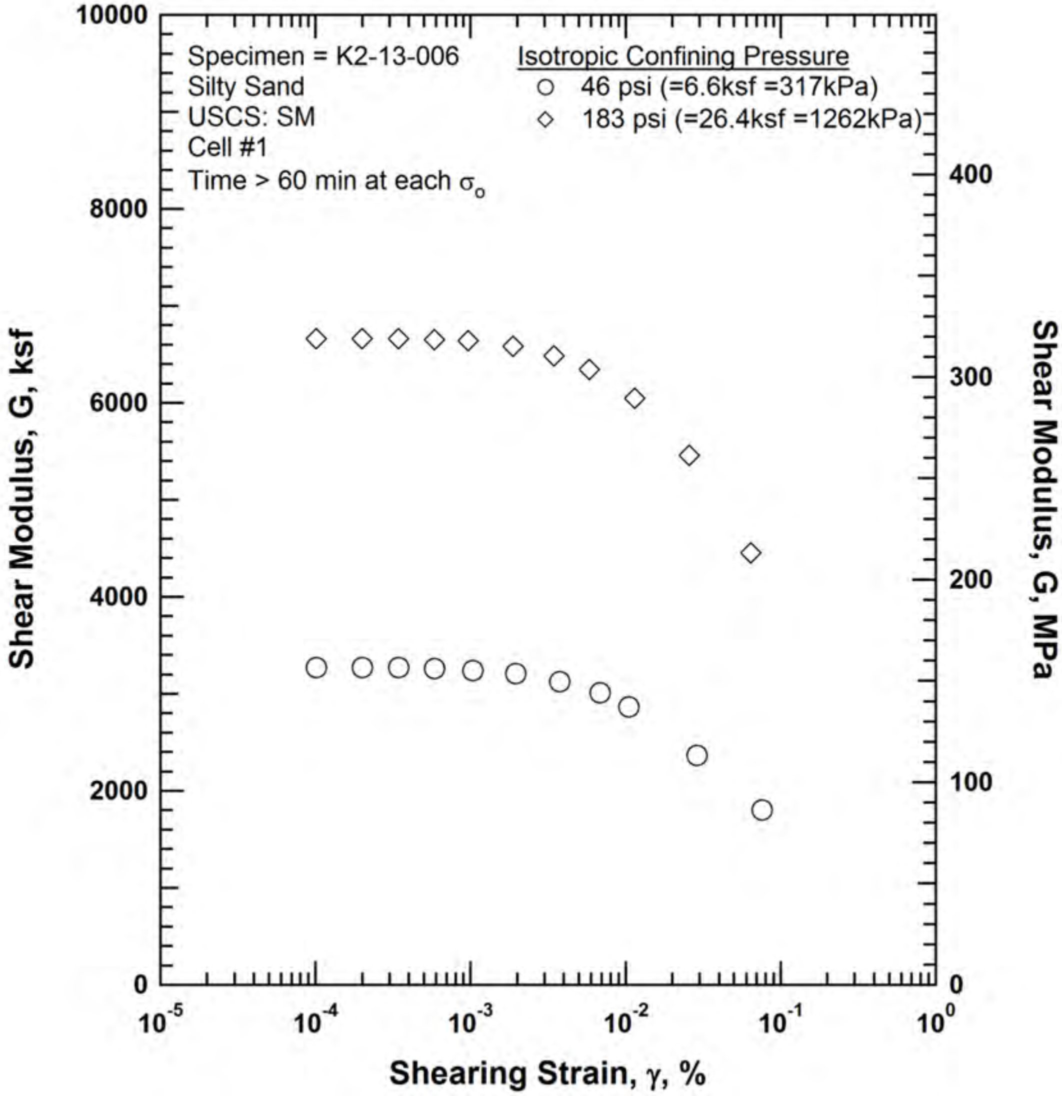


Figure G.10 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-006

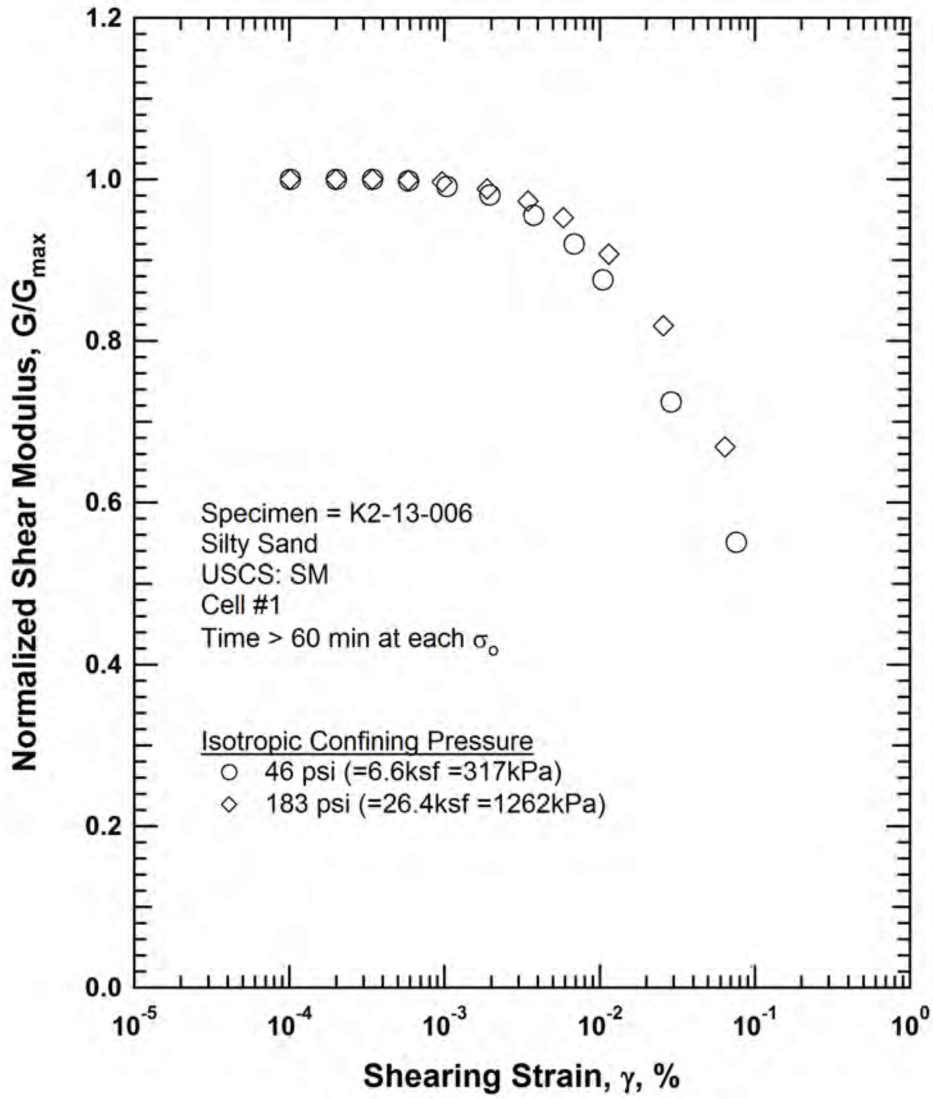


Figure G.11 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-006

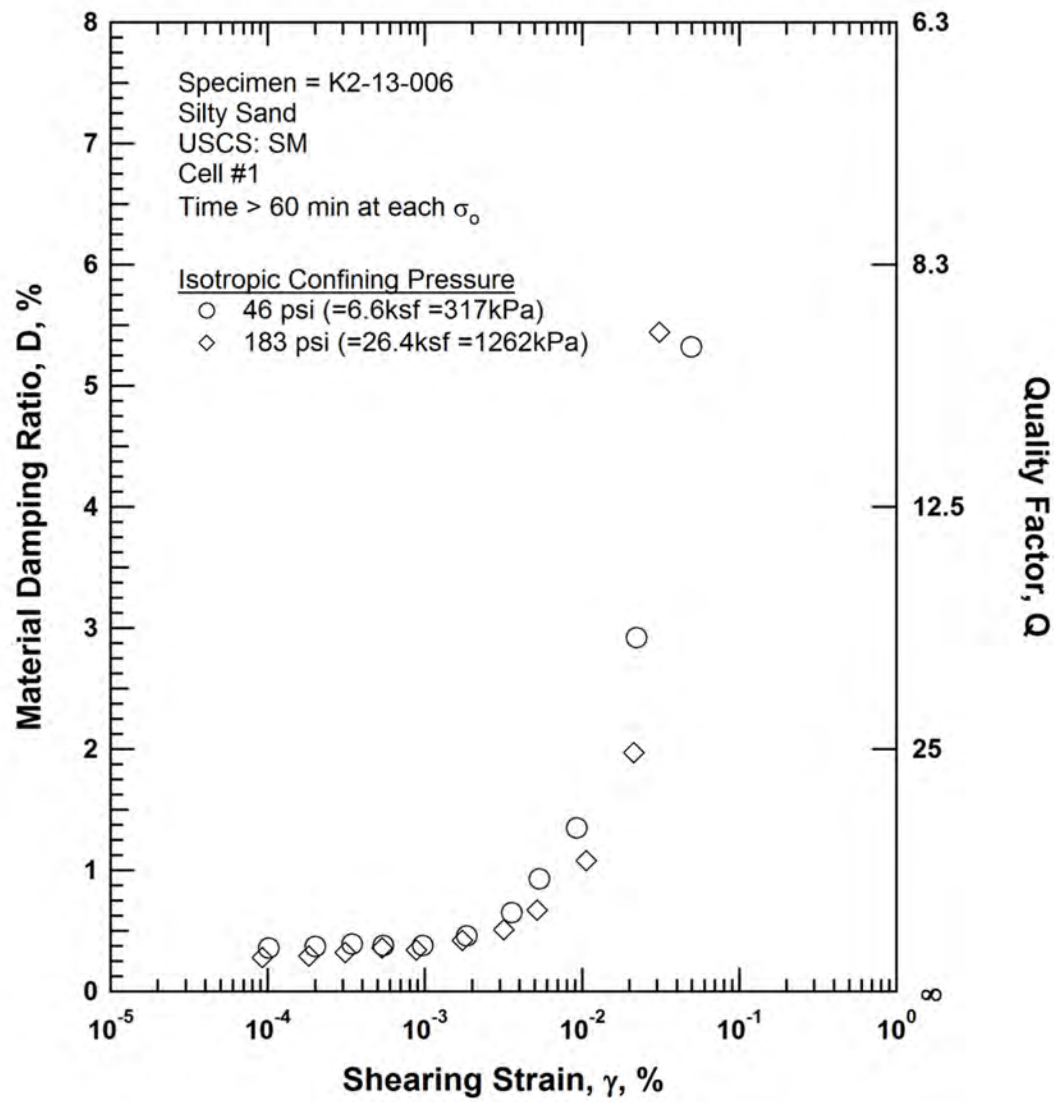


Figure G.12 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-006

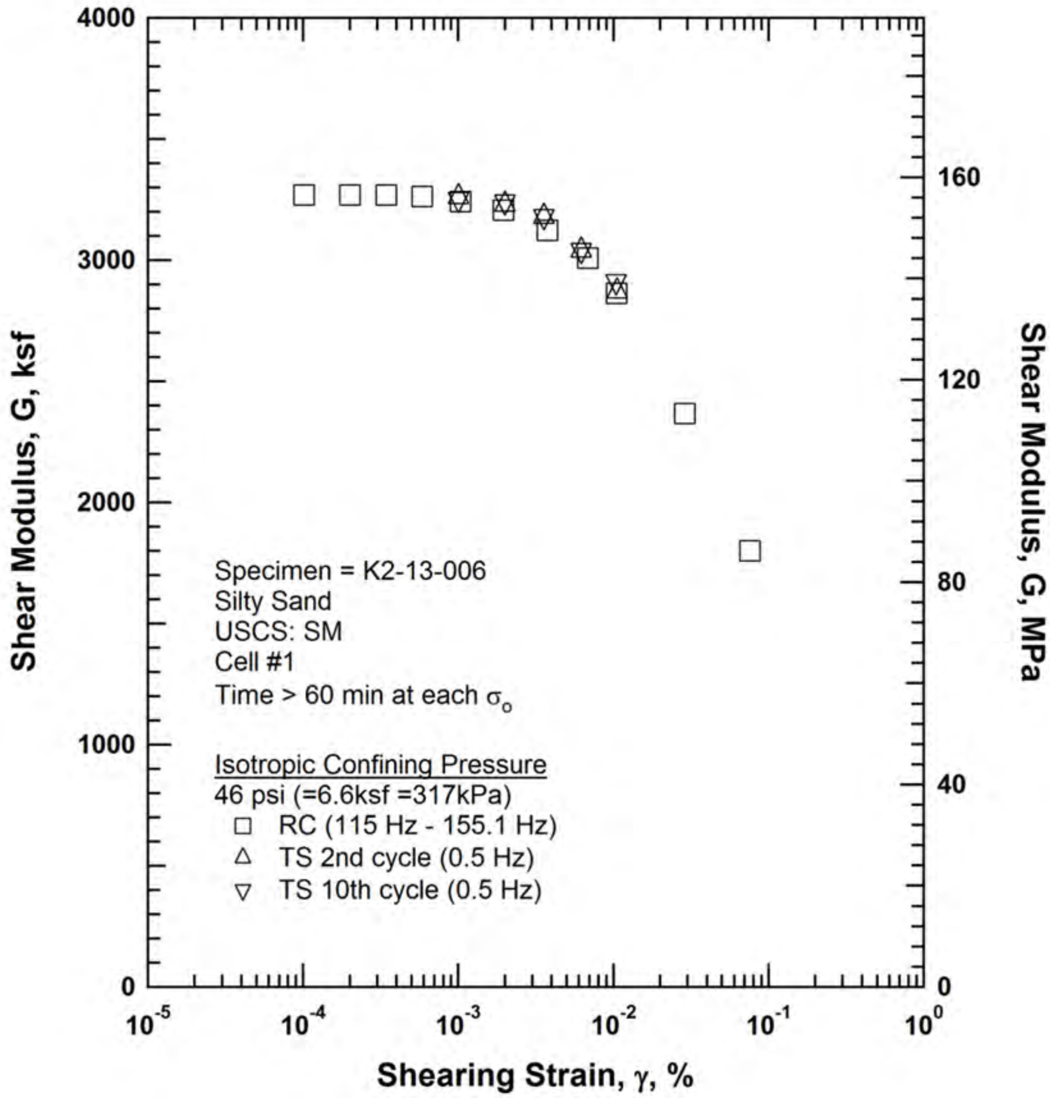


Figure G.13 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 46 psi (=6.6ksf =317kPa) from the Combined RCTS Tests of Specimen K2-13-006

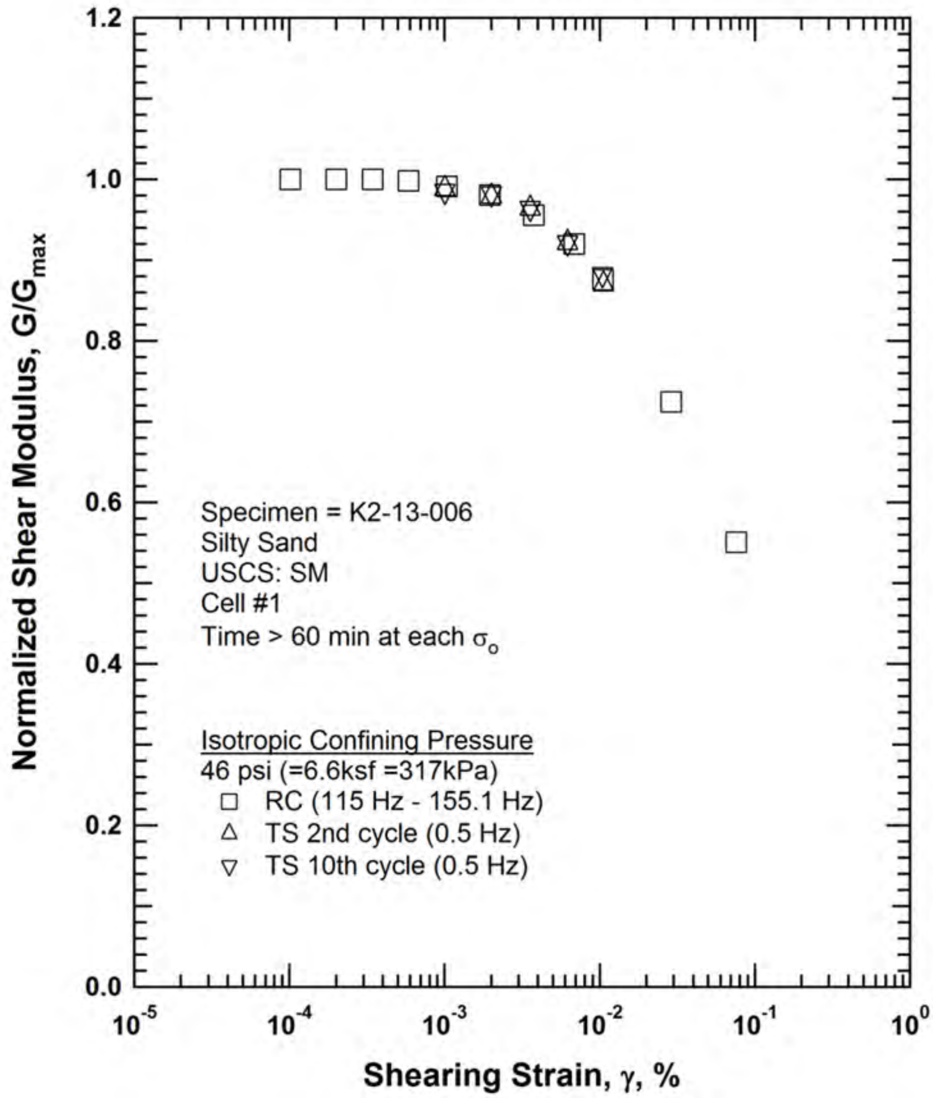


Figure G.14 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 46 psi (=6.6ksf =317kPa) from the Combined RCTS Tests of Specimen K2-13-006

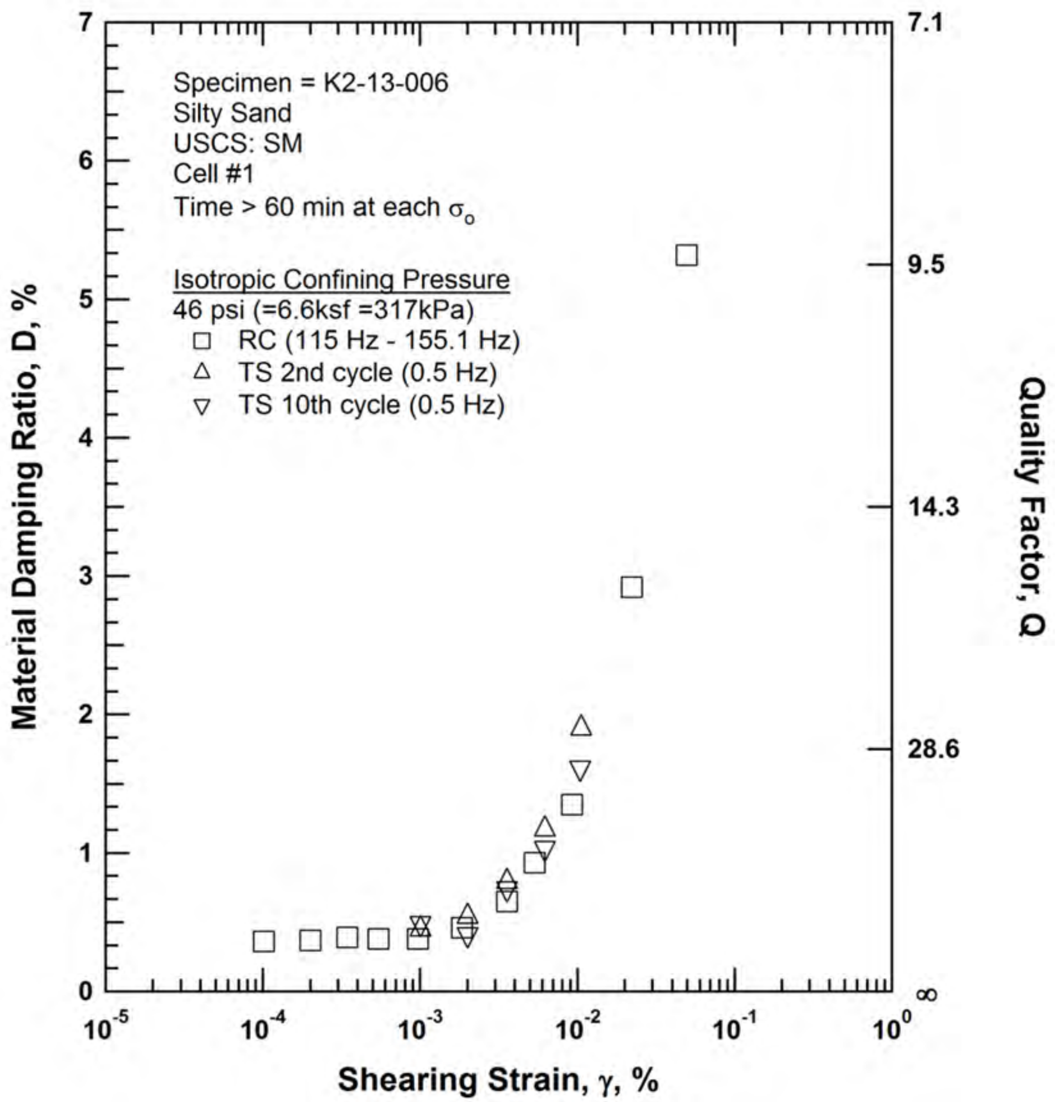


Figure G.15 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 46 psi (=6.6ksf =317kPa) from the Combined RCTS Tests of Specimen K2-13-006

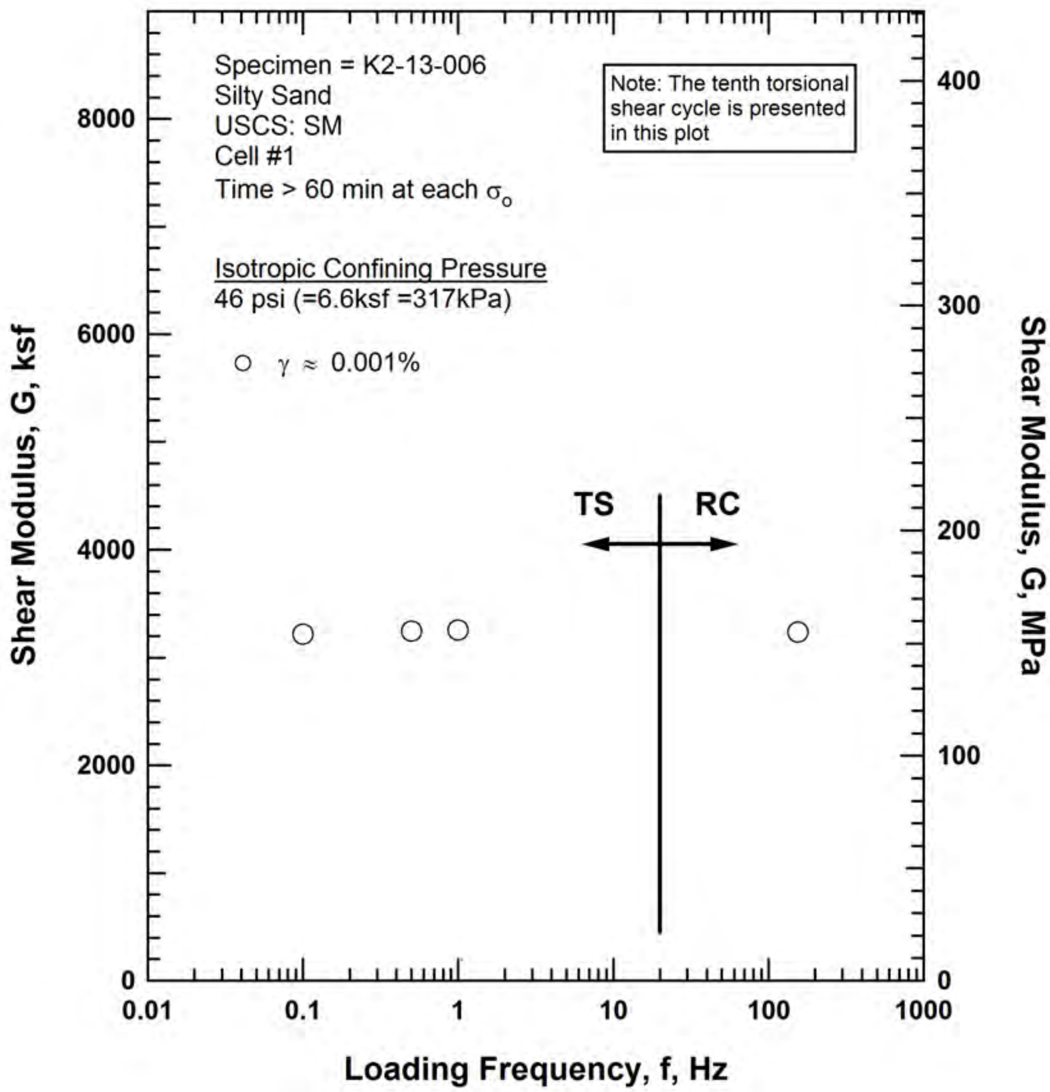


Figure G.16 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 46 psi (=6.6ksf =317kPa) from the Combined RCTS Tests of Specimen K2-13-006

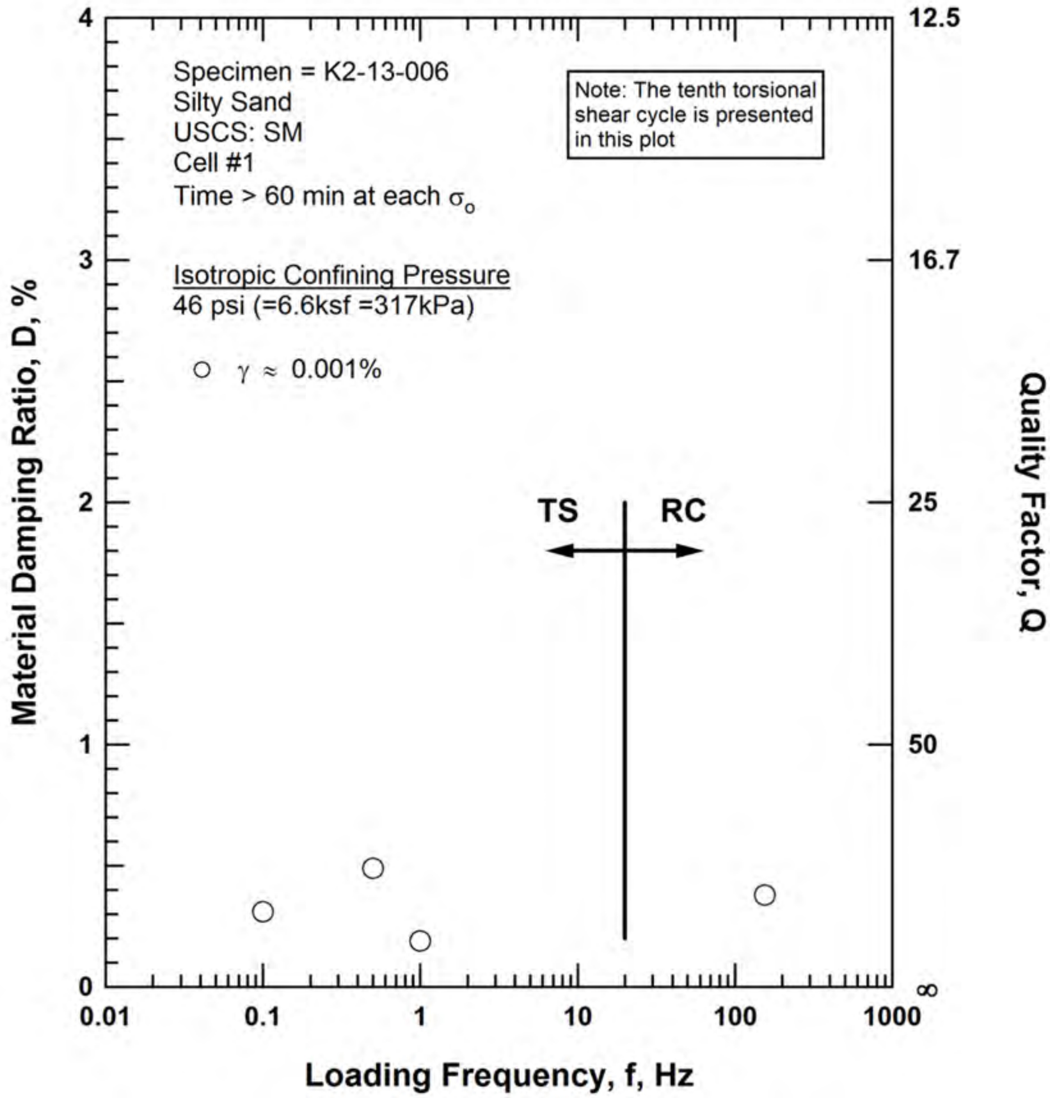


Figure G.17 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 46 psi (=6.6ksf =317kPa) from the Combined RCTS Tests of Specimen K2-13-006

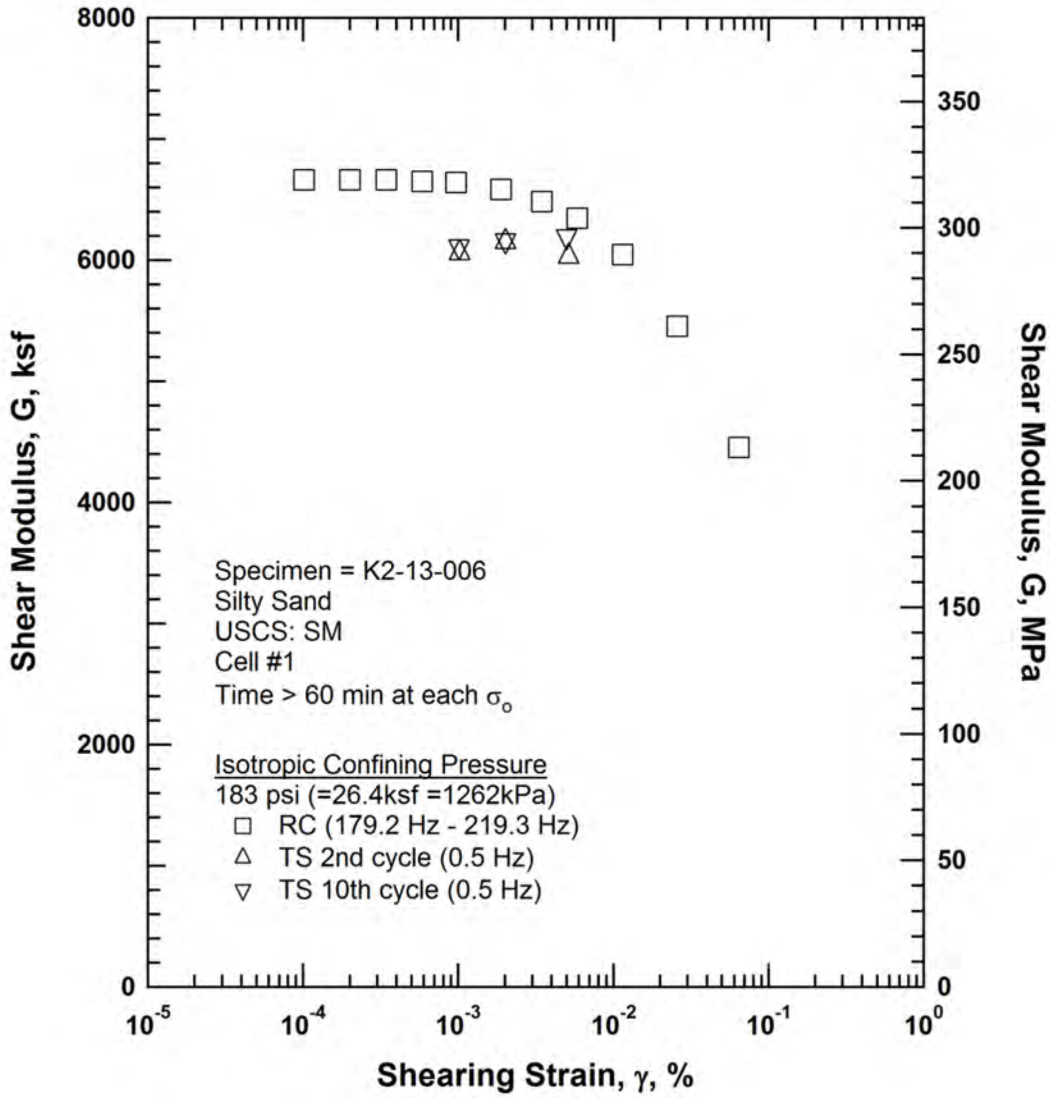


Figure G.18 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 183 psi (=26.4ksf =1262kPa) from the Combined RCTS Tests of Specimen K2-13-006

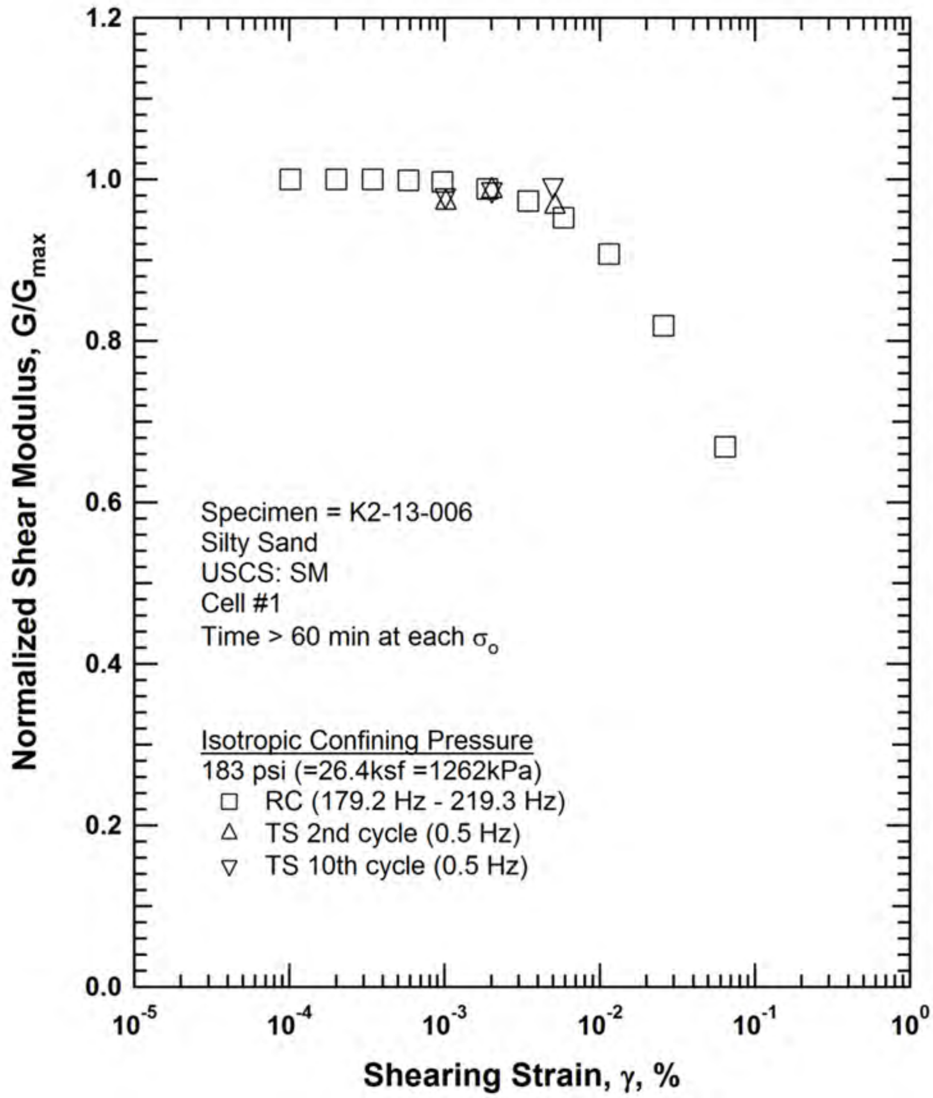


Figure G.19 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 183 psi (=26.4ksf =1262kPa) from the Combined RCTS Tests of Specimen K2-13-006

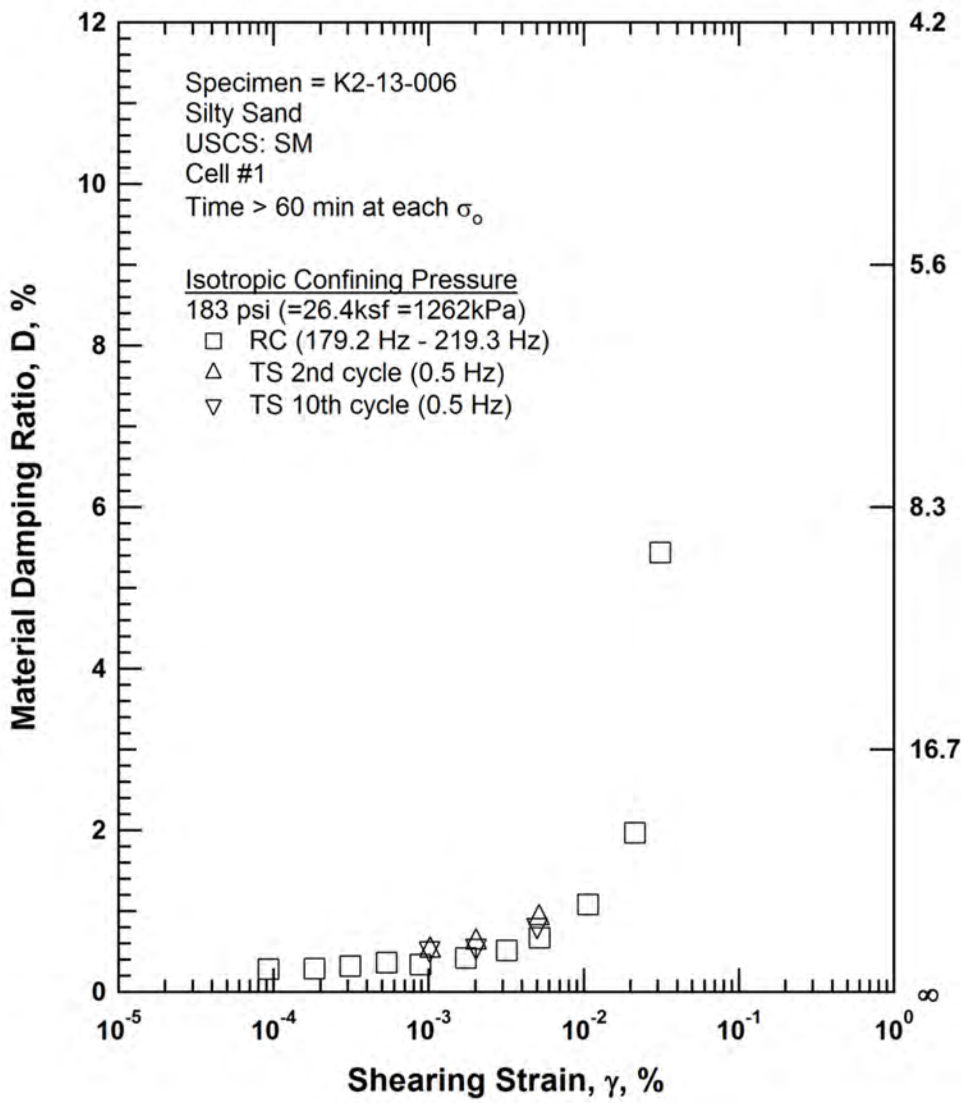


Figure G.20 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 183 psi (=26.4ksf =1262kPa) from the Combined RCTS Tests of Specimen K2-13-006

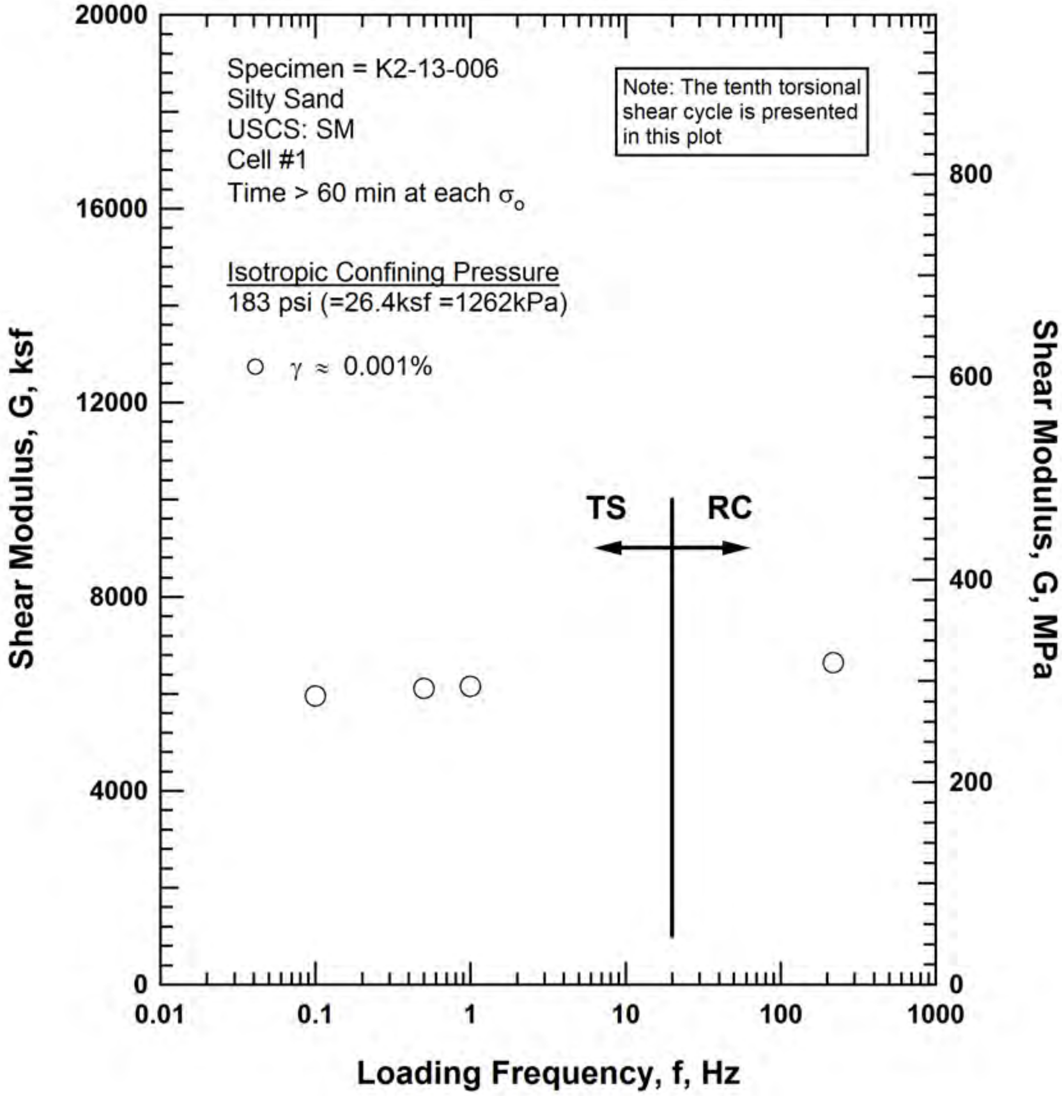


Figure G.21 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 183 psi (=26.4ksf =1262kPa) from the Combined RCTS Tests of Specimen K2-13-006

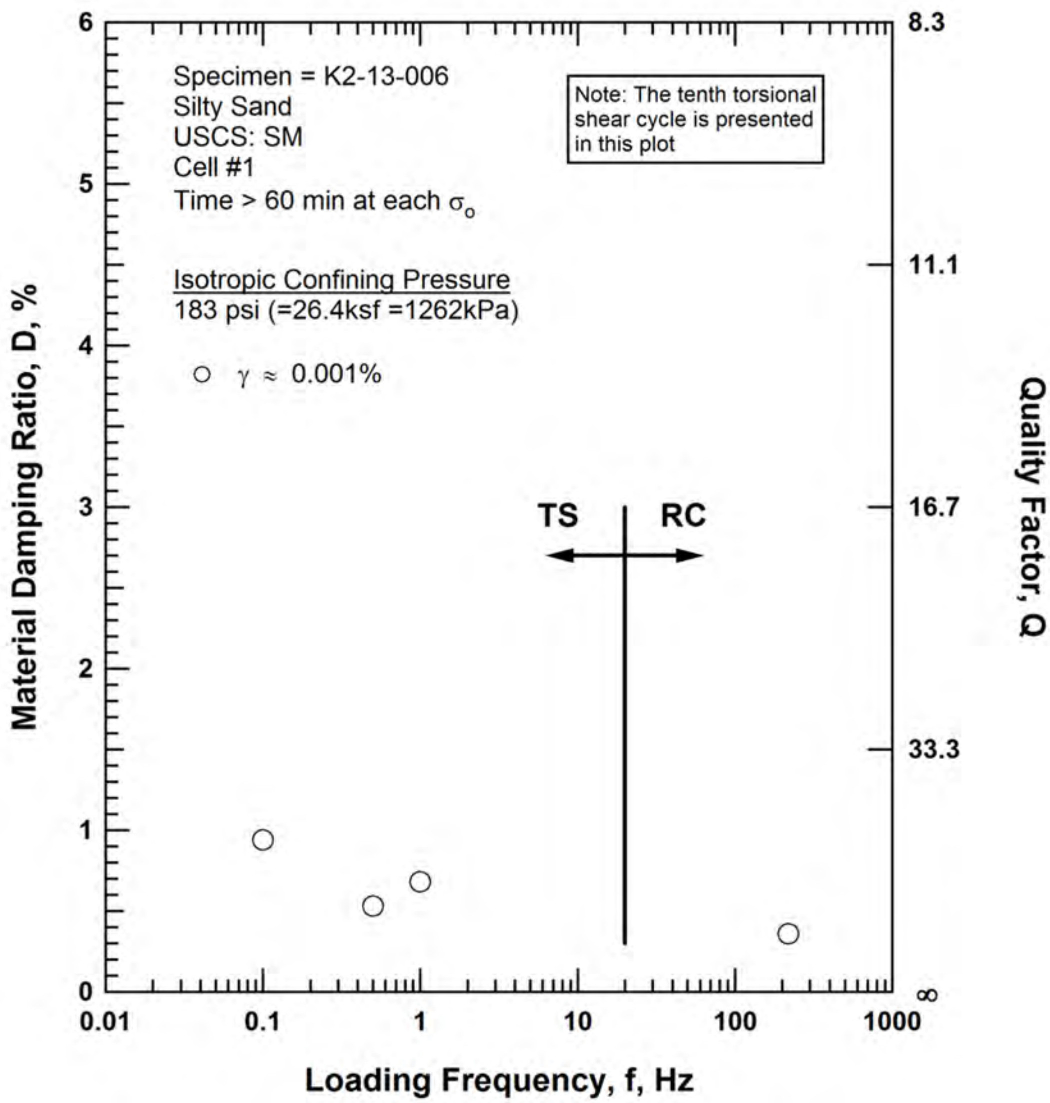


Figure G.22 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 183 psi (=26.4ksf =1262kPa) from the Combined RCTS Tests of Specimen K2-13-006

Table G.1 Variation in Low-Amplitude Shear Wave Velocity, Low-Amplitude Shear Modulus, Low-Amplitude Material Damping Ratio, Estimated Void Ratio, and Estimated Total Unit Weight with Isotropic Confining Pressure from RC Tests of Specimen K2-13-006

Isotropic Confining Pressure, σ_o			Low-Amplitude Shear Modulus, G_{max}		Low-Amplitude Shear Wave Velocity, V_s	Low-Amplitude Material Damping Ratio, D_{min}	Estimated Void Ratio, e	Estimated Total Unit Weight, γ_t
(psi)	(psf)	(kPa)	(ksf)	(MPa)	(fps)	(%)	(Unitless)	(pcf)
11	1584	76	1430	69	620	0.61	0.739	120.2
23	3312	159	2090	100	750	0.56	0.733	120.4
46	6624	317	3000	144	890	0.45	0.724	120.7
82	11808	565	4340	208	1070	0.38	0.712	121.1
183	26352	1262	6460	309	1310	0.36	0.688	122.0

Table G.2 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen K2-13-006; Isotropic Confining Pressure σ_o = 46 psi (=6.6 ksf = 317 kPa)

Second Cycle				Tenth Cycle			
Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
1.01E-03	3260	0.99	0.45	1.01E-03	3250	0.98	0.49
2.01E-03	3230	0.98	0.54	2.01E-03	3240	0.98	0.41
3.57E-03	3180	0.96	0.79	3.58E-03	3180	0.96	0.74
6.20E-03	3040	0.92	1.17	6.19E-03	3040	0.92	1.03
1.06E-02	2870	0.87	1.90	1.04E-02	2910	0.88	1.61

Table G.3 Variation in Shear Modulus, Normalized Shear Modulus, and Material Damping with Shearing Strain from RC Tests of Specimen K2-13-006; Isotropic Confining Pressure σ_o = 46 psi (=6.6 ksf = 317 kPa)

Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average Shearing Strain, %[1]	Material Damping Ratio, D, %[2]
1.01E-04	3270	1.00	1.01E-04	0.36
2.00E-04	3270	1.00	2.00E-04	0.37
3.44E-04	3270	1.00	3.44E-04	0.39
5.87E-04	3260	1.00	5.45E-04	0.38
1.03E-03	3240	0.99	9.65E-04	0.38
1.95E-03	3210	0.98	1.84E-03	0.46
3.76E-03	3120	0.96	3.58E-03	0.65
6.86E-03	3010	0.92	5.33E-03	0.93
1.05E-02	2860	0.88	9.26E-03	1.35
2.89E-02	2370	0.72	2.21E-02	2.92
7.57E-02	1800	0.55	4.96E-02	5.32

(1) Average Shearing Strain from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

(2) Average Damping Ratio from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

Table G.4 Variation in Shear Modulus and Material Damping with Frequency from RC/TS Tests of Specimen K2-13-006; Isotropic Confining Pressure σ_o = 46 psi (=6.6 ksf = 317 kPa)

Approximate Shearing Strain, γ, %	Frequency, Hz	Shear Modulus, G, ksf	Material Damping Ratio, D, %
0.001	0.1	3220	0.31
	0.5	3250	0.49
	1.0	3260	0.19
	154.4	3240	0.38

Table G.5 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen K2-13-006; Isotropic Confining Pressure σ_o = 183 psi (=26.4 ksf = 1262 kPa)

Second Cycle				Tenth Cycle			
Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
1.02E-03	6060	0.97	0.51	1.01E-03	6110	0.98	0.53
2.02E-03	6150	0.99	0.61	2.01E-03	6160	0.99	0.56
5.15E-03	6030	0.97	0.91	5.01E-03	6190	0.99	0.82

(1) Results were Averaged for the First Ten Cycles at this Shearing Strain

Table G.6 Variation in Shear Modulus, Normalized Shear Modulus, and Material Damping with Shearing Strain from RC Tests of Specimen K2-13-006; Isotropic Confining Pressure σ_o = 183 psi (=26.4 ksf = 1262 kPa)

Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average Shearing Strain, %(1)	Material Damping Ratio, D, %(2)
1.01E-04	6660	1.00	9.28E-05	0.28
2.00E-04	6660	1.00	1.83E-04	0.29
3.43E-04	6660	1.00	3.13E-04	0.32
5.86E-04	6650	1.00	5.34E-04	0.36
9.66E-04	6640	1.00	8.81E-04	0.34
1.88E-03	6580	0.99	1.73E-03	0.42
3.47E-03	6480	0.97	3.18E-03	0.51
5.84E-03	6350	0.95	5.17E-03	0.67
1.15E-02	6050	0.91	1.07E-02	1.08
2.57E-02	5460	0.82	2.14E-02	1.97
6.42E-02	4450	0.67	3.10E-02	5.44

(1) Average Shearing Strain from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

(2) Average Damping Ratio from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

Table G.7 Variation in Shear Modulus and Material Damping with Frequency from RC/TS Tests of Specimen K2-13-006; Isotropic Confining Pressure σ_o = 183 psi (=26.4 ksf = 1262 kPa)

Approximate Shearing Strain, γ, %	Frequency, Hz	Shear Modulus, G, ksf	Material Damping Ratio, D, %
0.001	0.1	5960	0.94
	0.5	6110	0.53
	1	6160	0.68
	218.9	6640	0.36

APPENDIX H

Results for Kleinfelder Specimen ID K2-13-007

- *Specimen Preparation Notes*
- *RCTS Testing Results*

SPECIMEN PREPARATION NOTES

Specimen No.: K2-13-007

Project No : 136473

Page 1 **of** 3

Boring No.: R-7-1

Date of Preparation..: 11/8/13

Sample No..: ST-5

Depth..: 207.9 – 208.4 feet

Disposition of Sample

☒ No Apparent Disturbance ☐ Apparent Disturbance ☐ Compacted Sample

☐ Other (Describe)

Specimen Preparation Notes

Preparation Method :	Extruded from Shelby Tube with No Trimming		**Affixation to Platens :**	2.8-inch diameter platens, no adhesive used	
Ave. Length (in.) :	5.6533	**Ave. Diameter (in.):**	2.848	**L/D**	2.0
Total Unit Weight (pcf) :	118.2	**Moisture Content (%) :**	32.0	**% Saturation (Assume SG = 2.65):**	100

Specimen Testing Comments

1) Sample was extruded from the Shelby Tube directly into a latex membrane for testing on 11/8/13. No trimming of the sample was performed except to square the end.

2) Testing commenced on 11/8/13, beginning with 18 psi pressure.

3) The specimen tilted so that the magnets made contact with the electrical coils during the low-amplitude resonant column testing of Pressure Stage 5 (281 psi). The system could not be readjusted in a way that prevented the magnets from contacting the coils, therefore the testing was terminated at Pressure Stage 5. Testing ended on 11/11/13.

☒ **See Attached Photographs**

SPECIMEN PREPARATION NOTES

Photo H.1

Sample R-7-1 ST-5 after removal from the transport container.

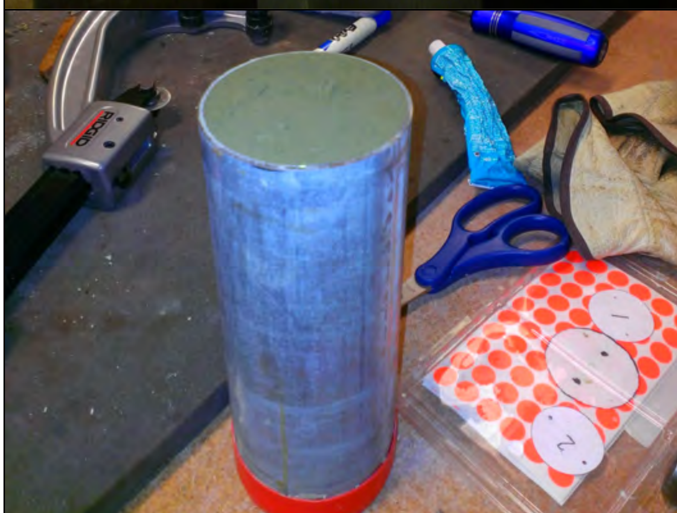


Photo H.2

Sample after subdividing the bottom 7-inches for testing.

Photo H.3

Top view of specimen being extruded directly into latex testing membrane. Note the top cap placed on top of the specimen.

Photo H.4

Specimen after placement on base pedestal and vacuum pressure is applied.

Kleinfelder Specimen ID:

K2-13-007

Boring No: R-7-1
Sample No: ST-5

Silty Sand (SM)
Depth = 207.9 ft – 208.4 ft (below existing ground surface)
Total Unit Weight = 118.2 lb/ft^3
Natural Moisture Content = 32.0%
Estimated In-Situ Mean Effective Stress = 70 psi

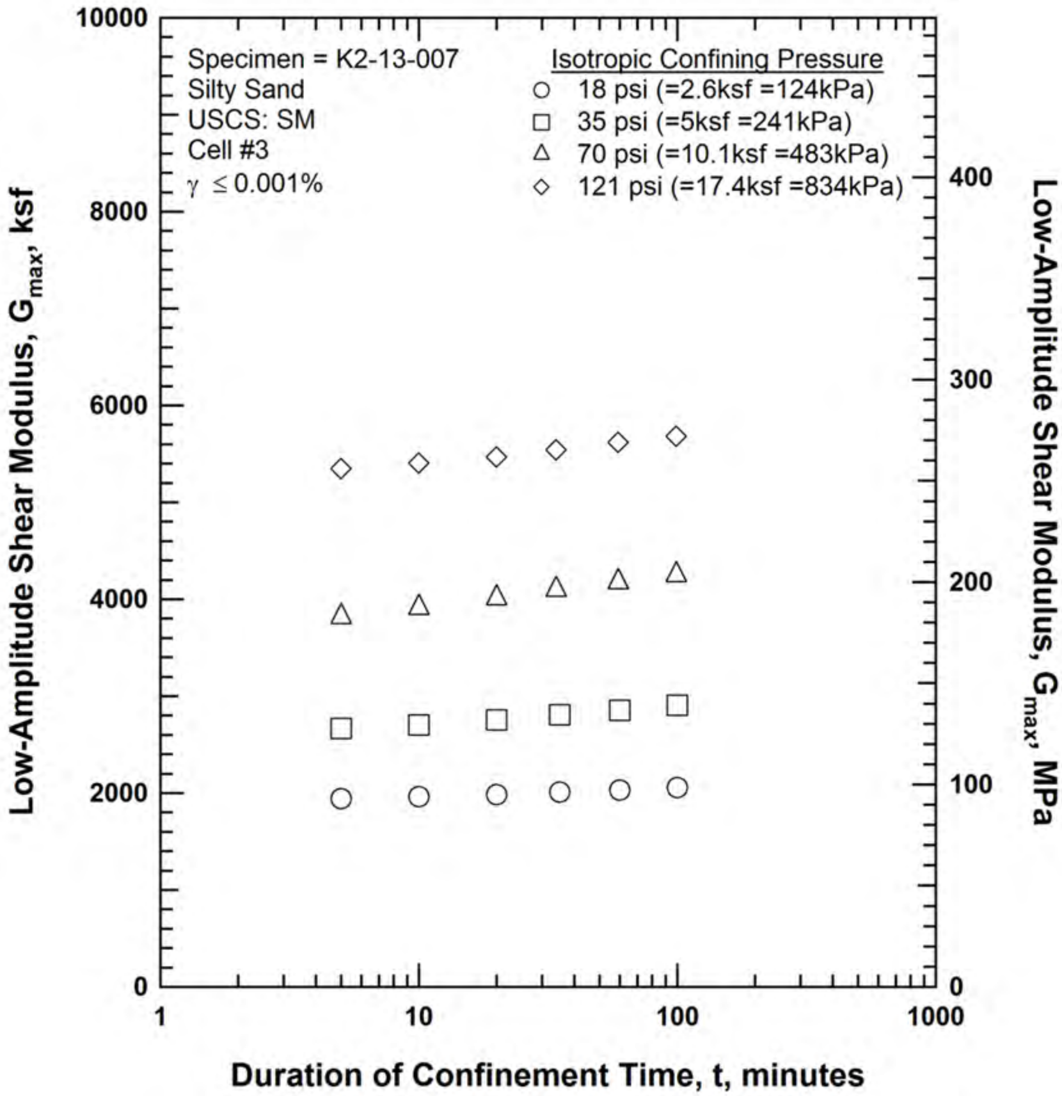


Figure H.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-007

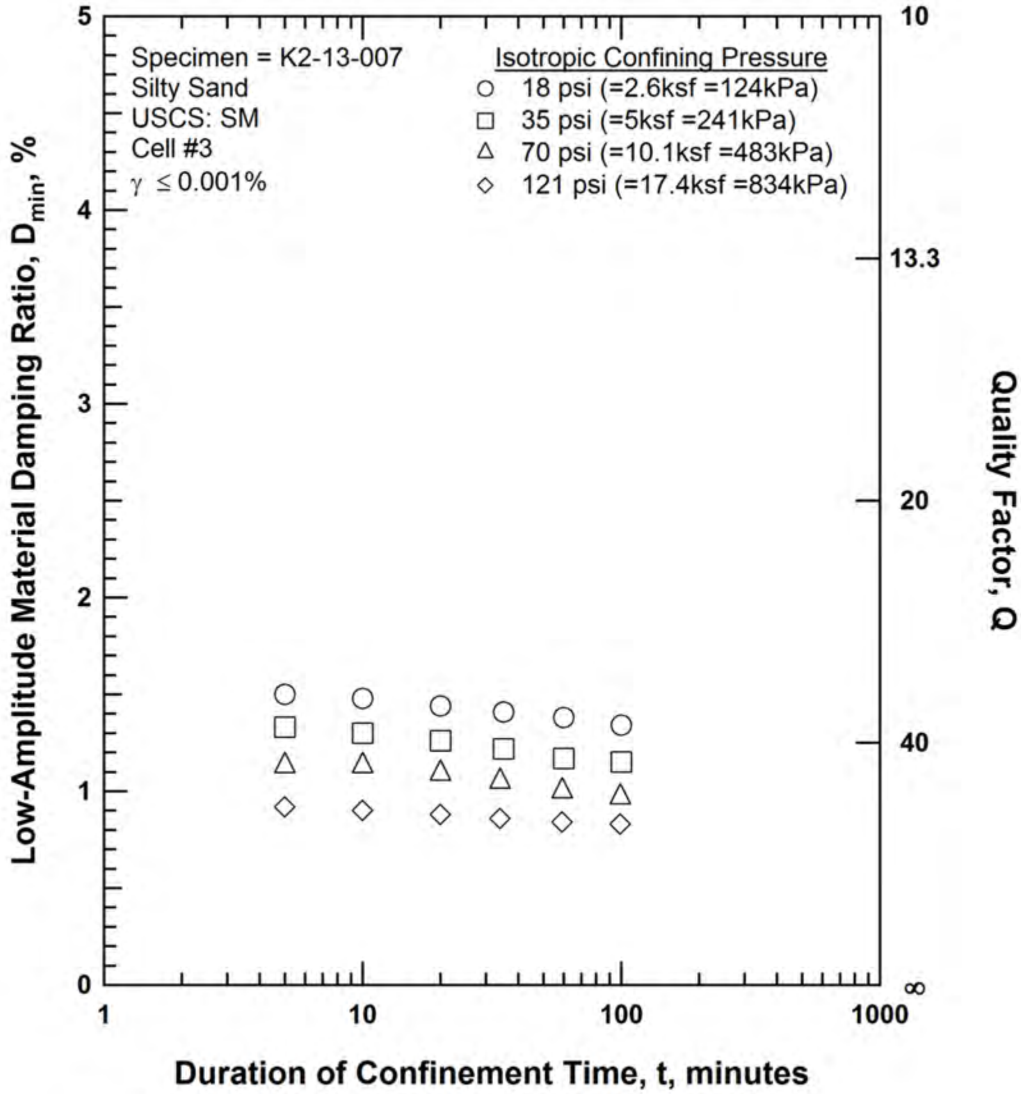


Figure H.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-007

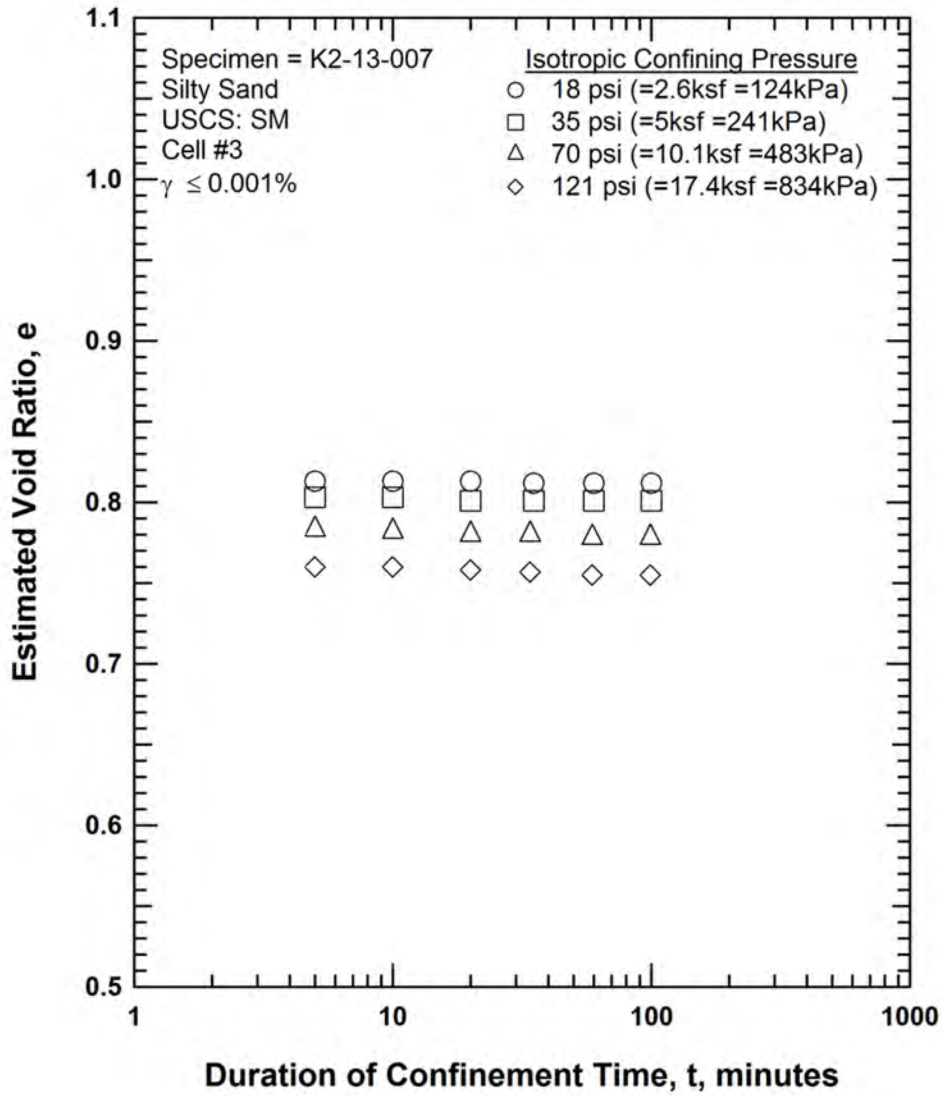


Figure H.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Test of Specimen K2-13-007

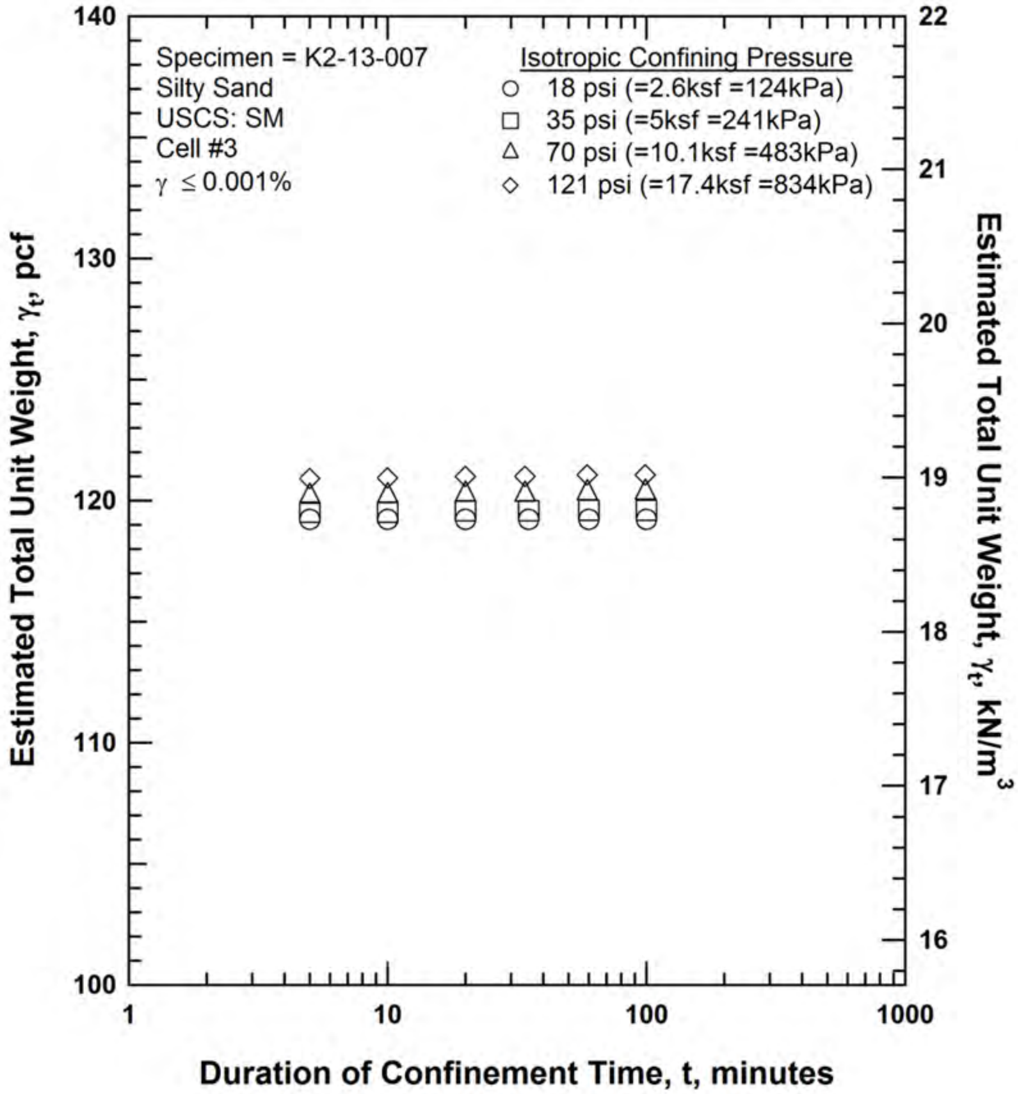
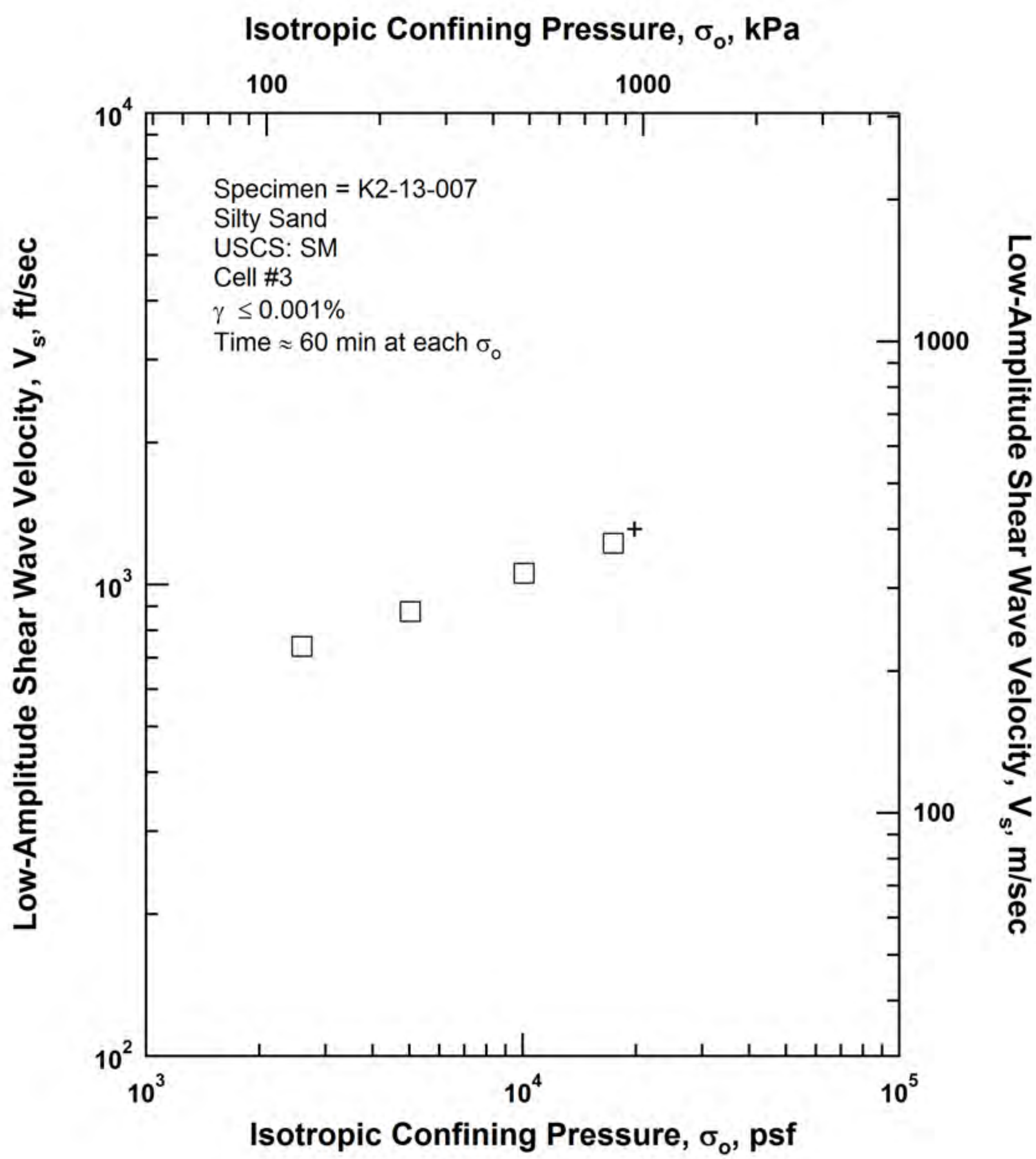
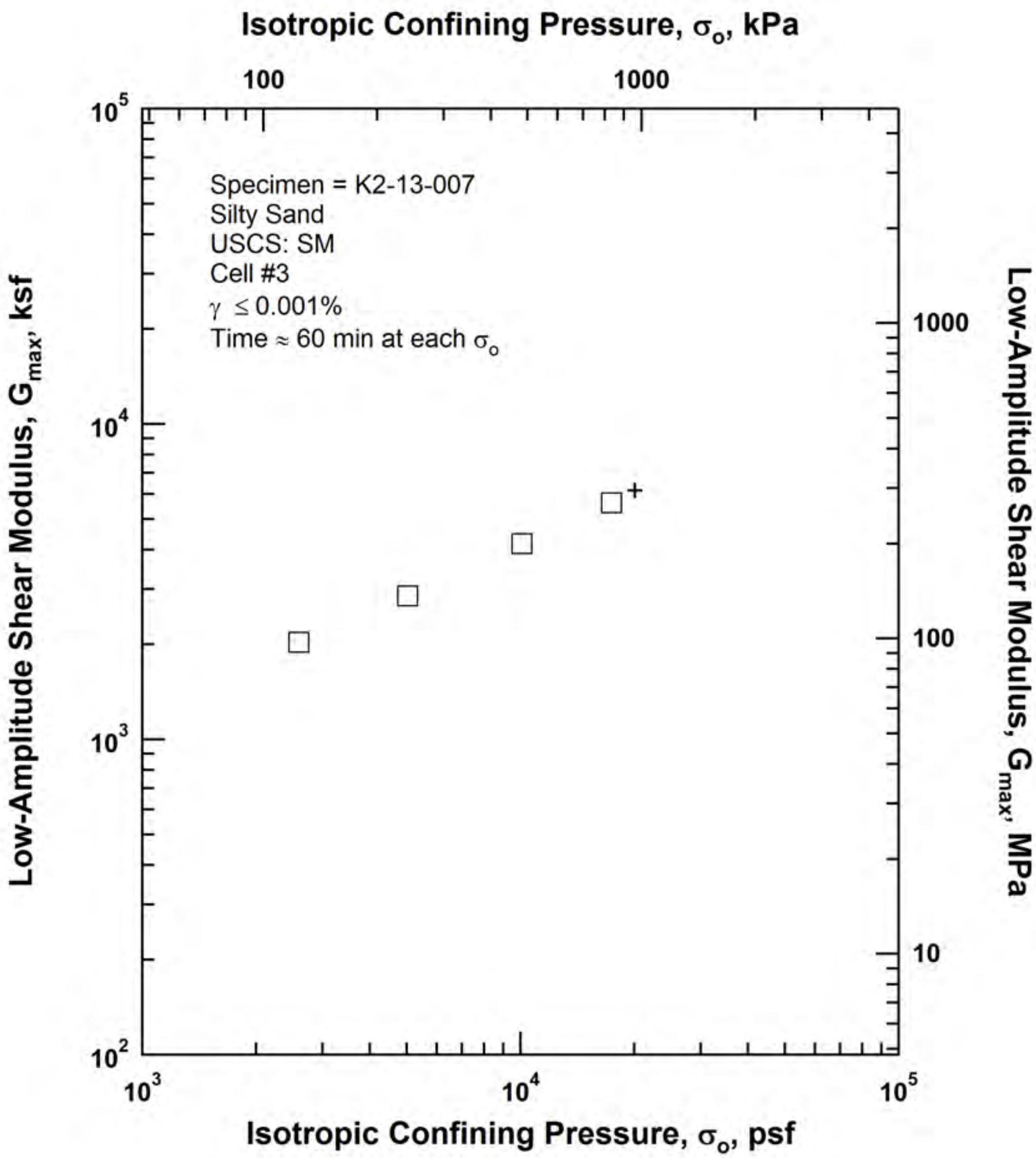


Figure H.4 Variation in Estimated Total Unit Weight with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-007



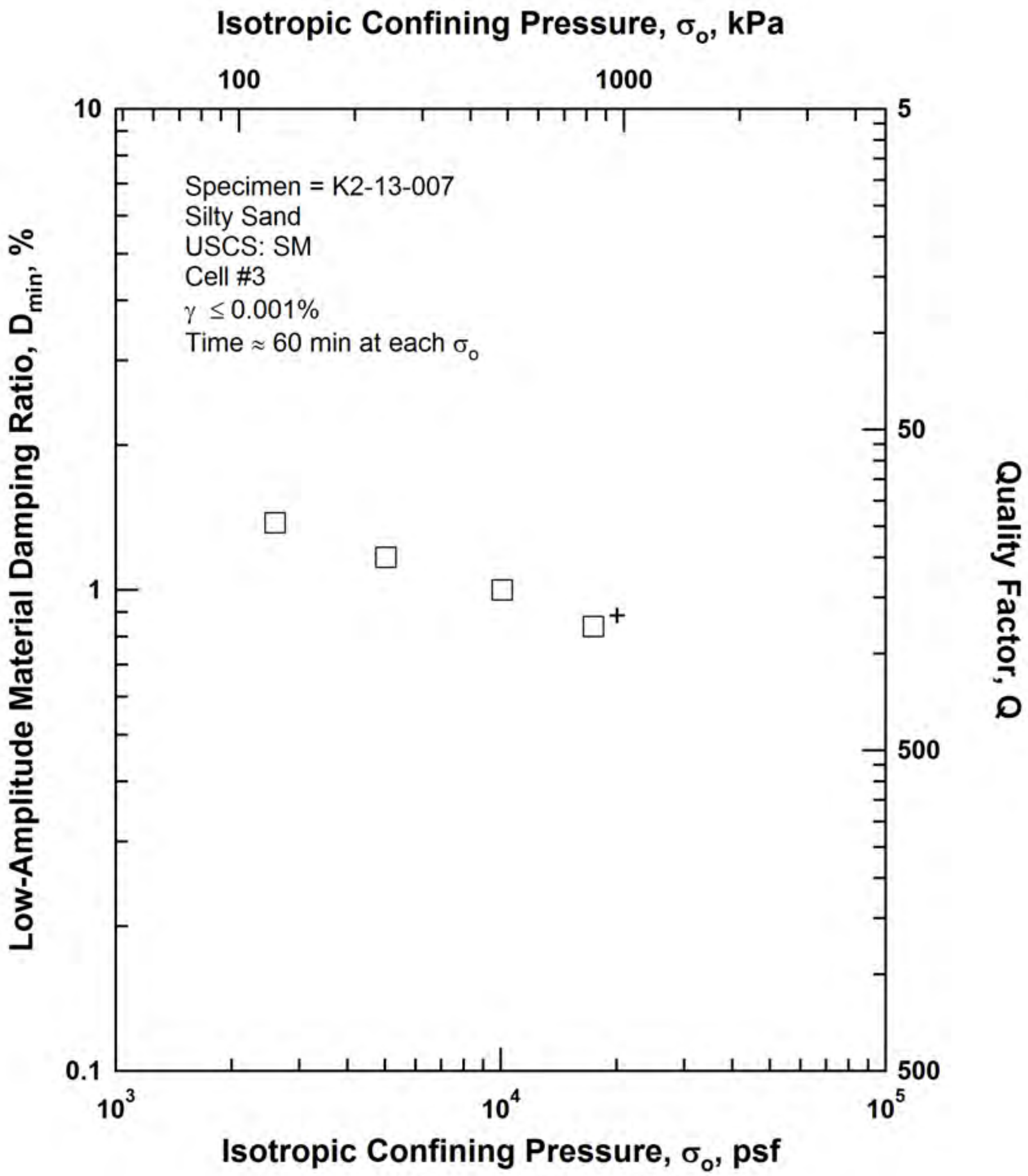
Note:
\+ Excessive specimen tilt at 281 psi prevented testing at that pressure.

Figure H.5 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-007



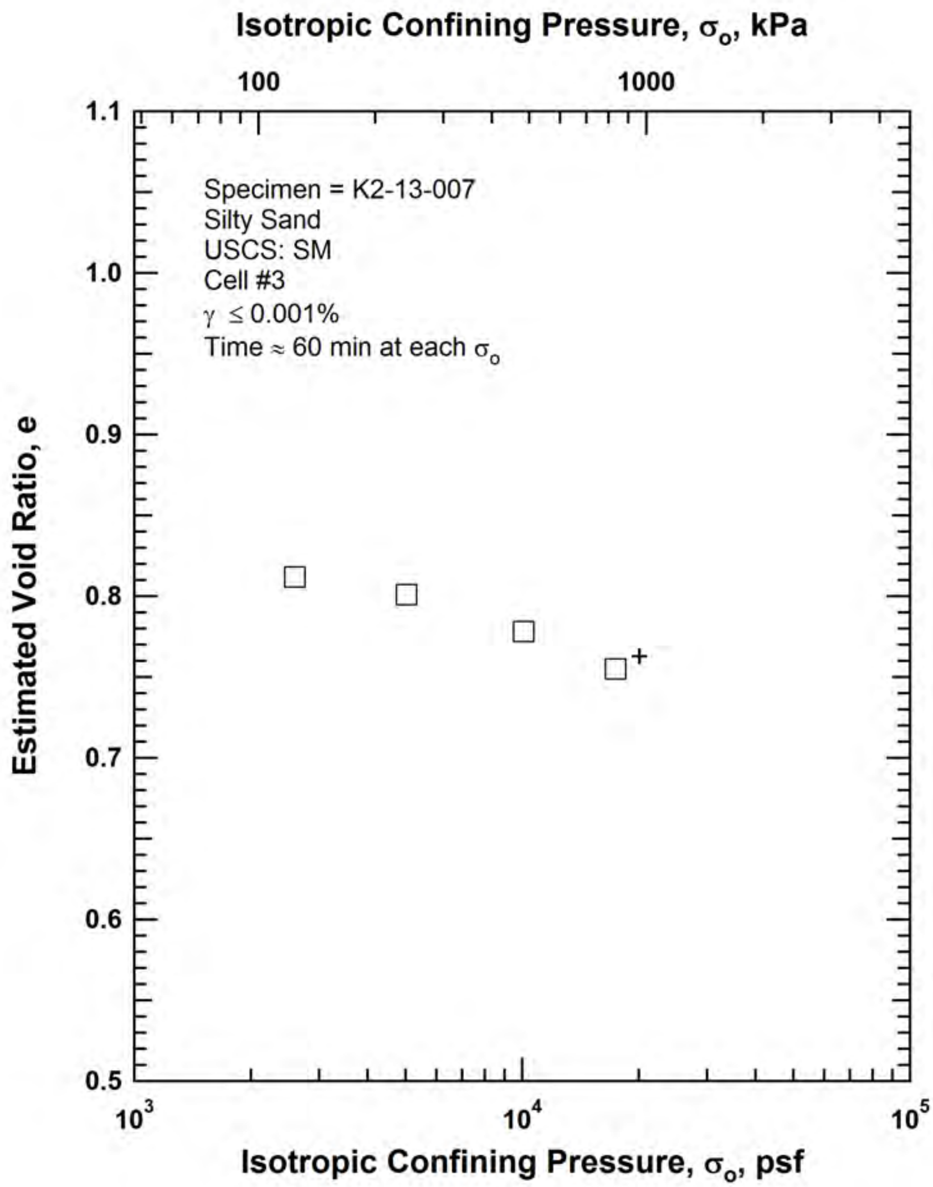
Note:
+ Excessive specimen tilt at 281 psi prevented testing at that pressure.

Figure H.6 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Test of Specimen K2-13-007



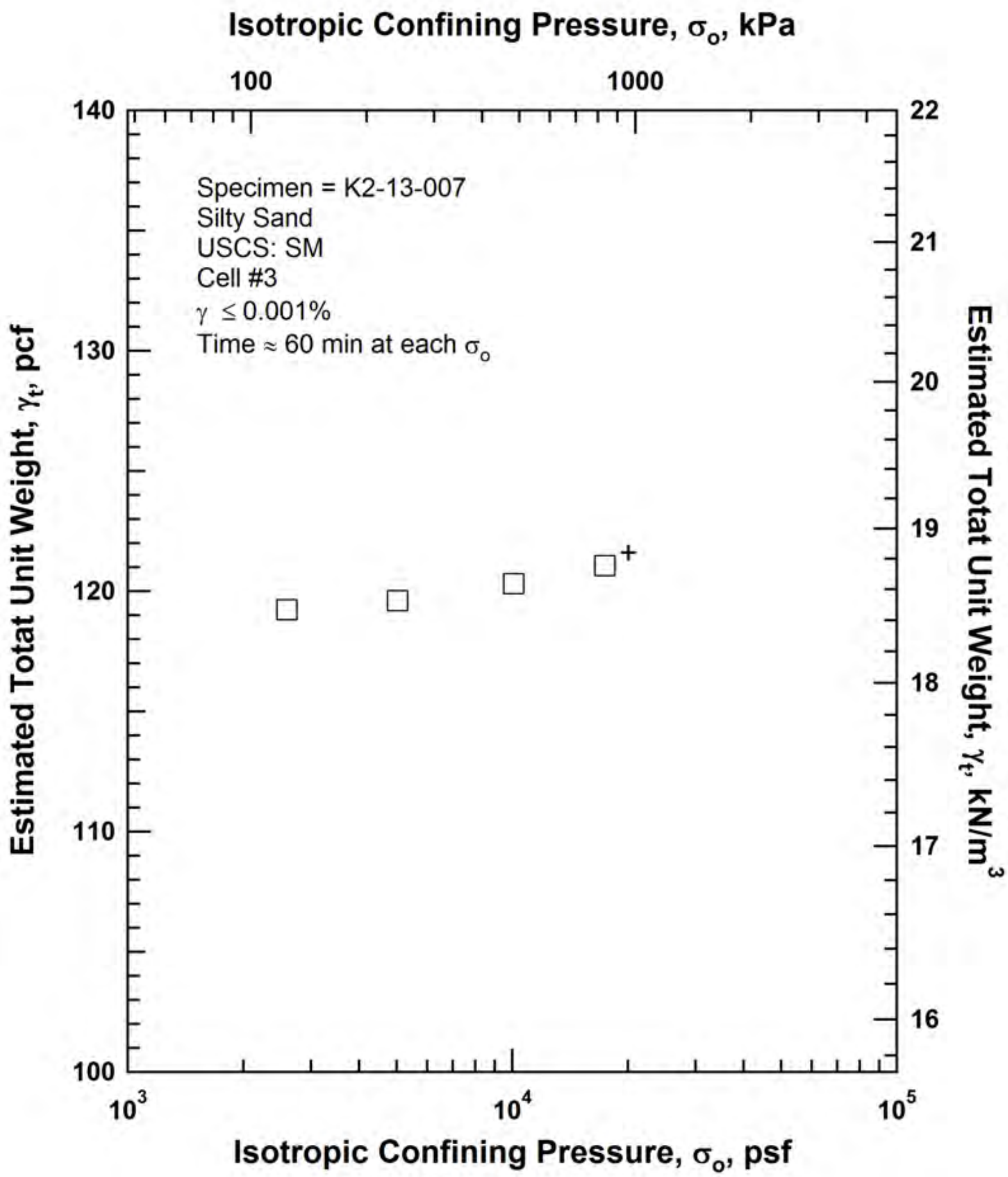
Note:
\+ Excessive specimen tilt at 281 psi prevented testing at that pressure.

Figure H.7 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-007



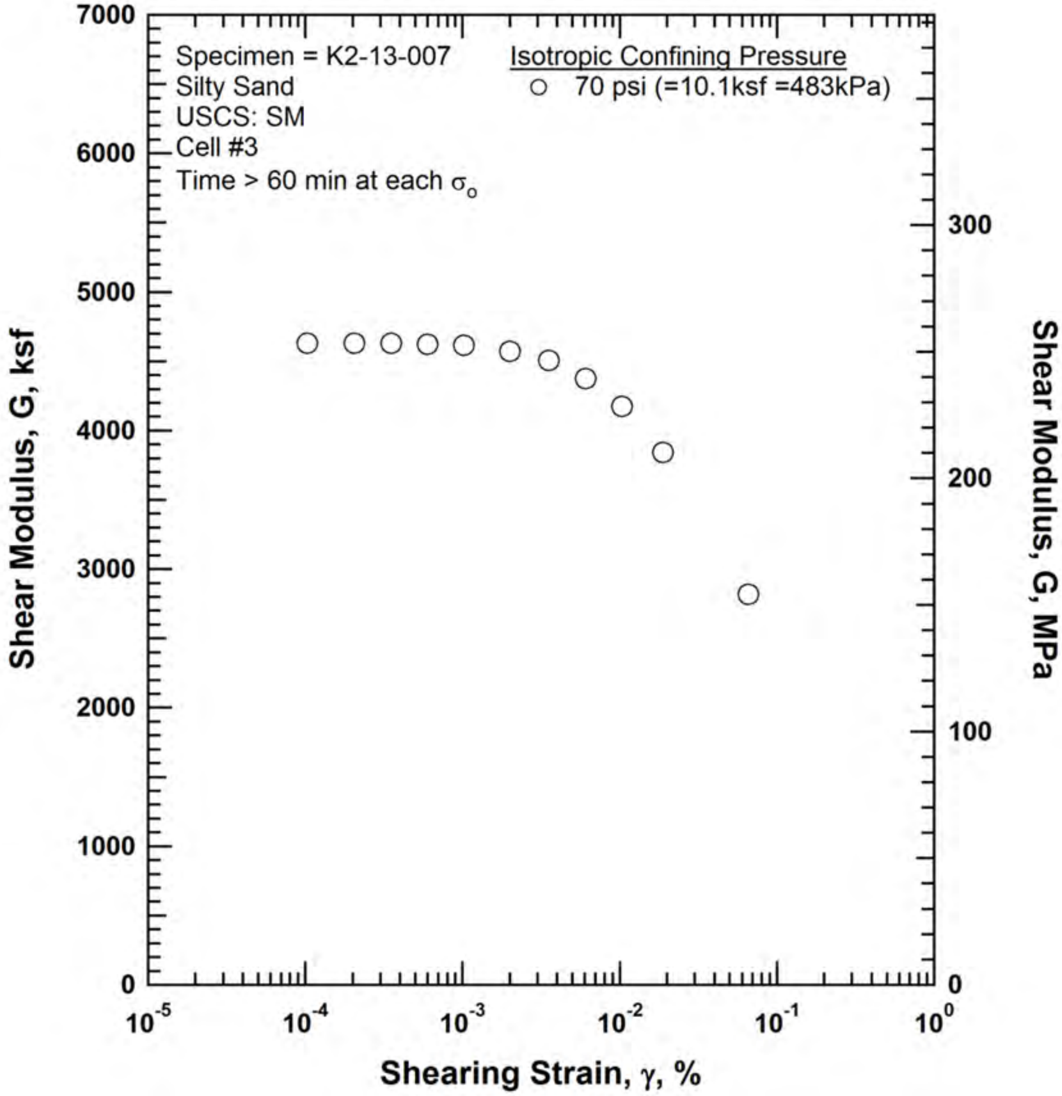
Note:
+ Excessive specimen tilt at 281 psi prevented testing at that pressure.

Figure H.8 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-007



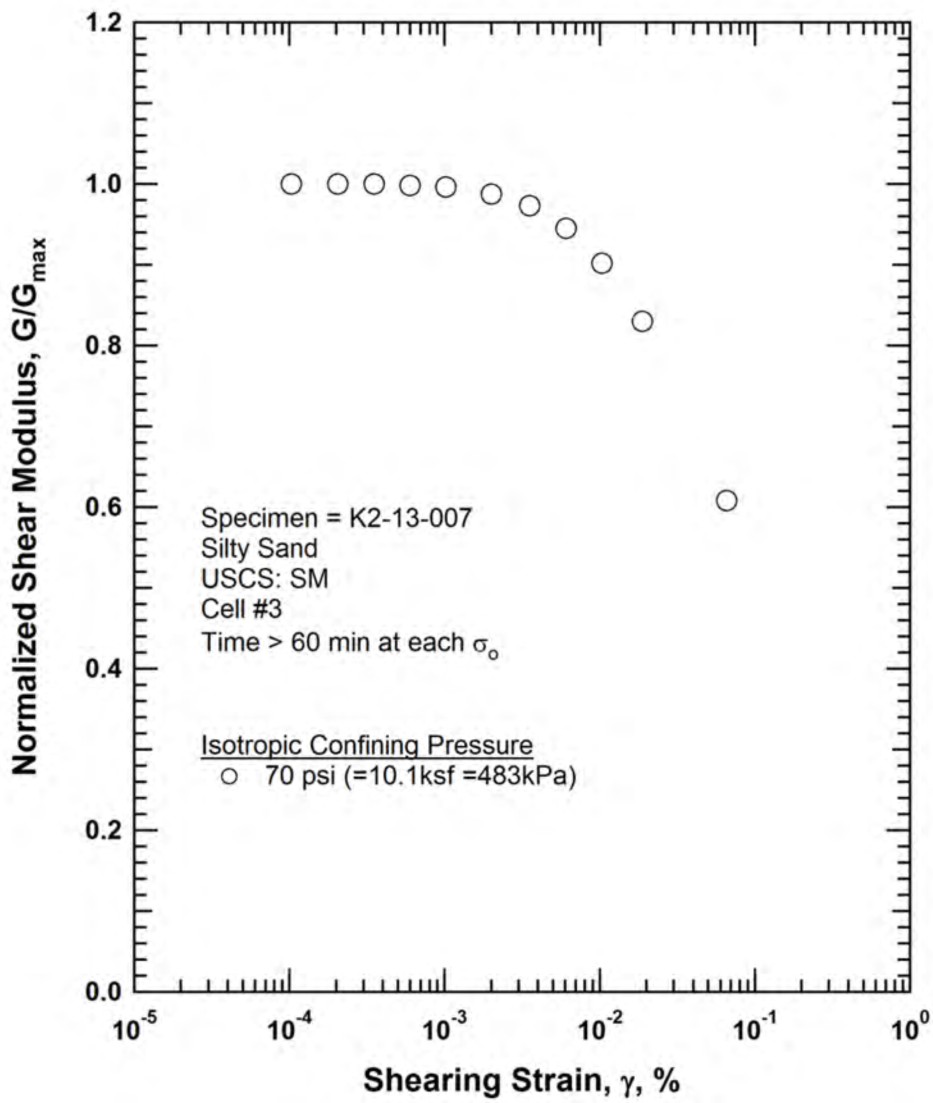
Note:
\+ Excessive specimen tilt at 281 psi prevented testing at that pressure.

Figure H.9 Variation in Estimated Total Unit Weight with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-007



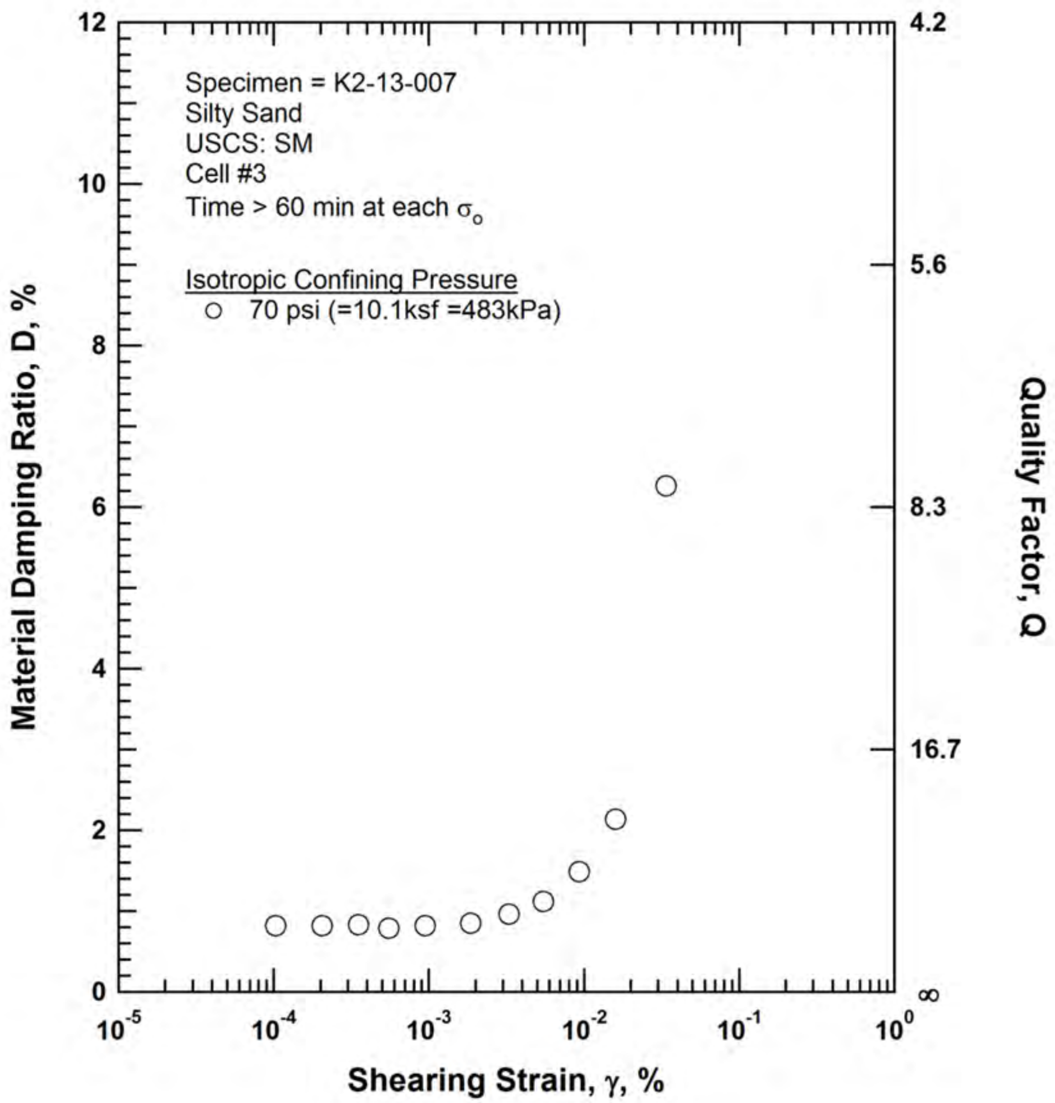
Note:
Excessive specimen tilt at 281 psi prevented testing at that pressure.

Figure H.10 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-007



Note:
Excessive specimen tilt at 281 psi prevented testing at that pressure.

Figure H.11 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-007



Note:
Excessive specimen tilt at 281 psi prevented testing at that pressure.

Figure H.12 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-007

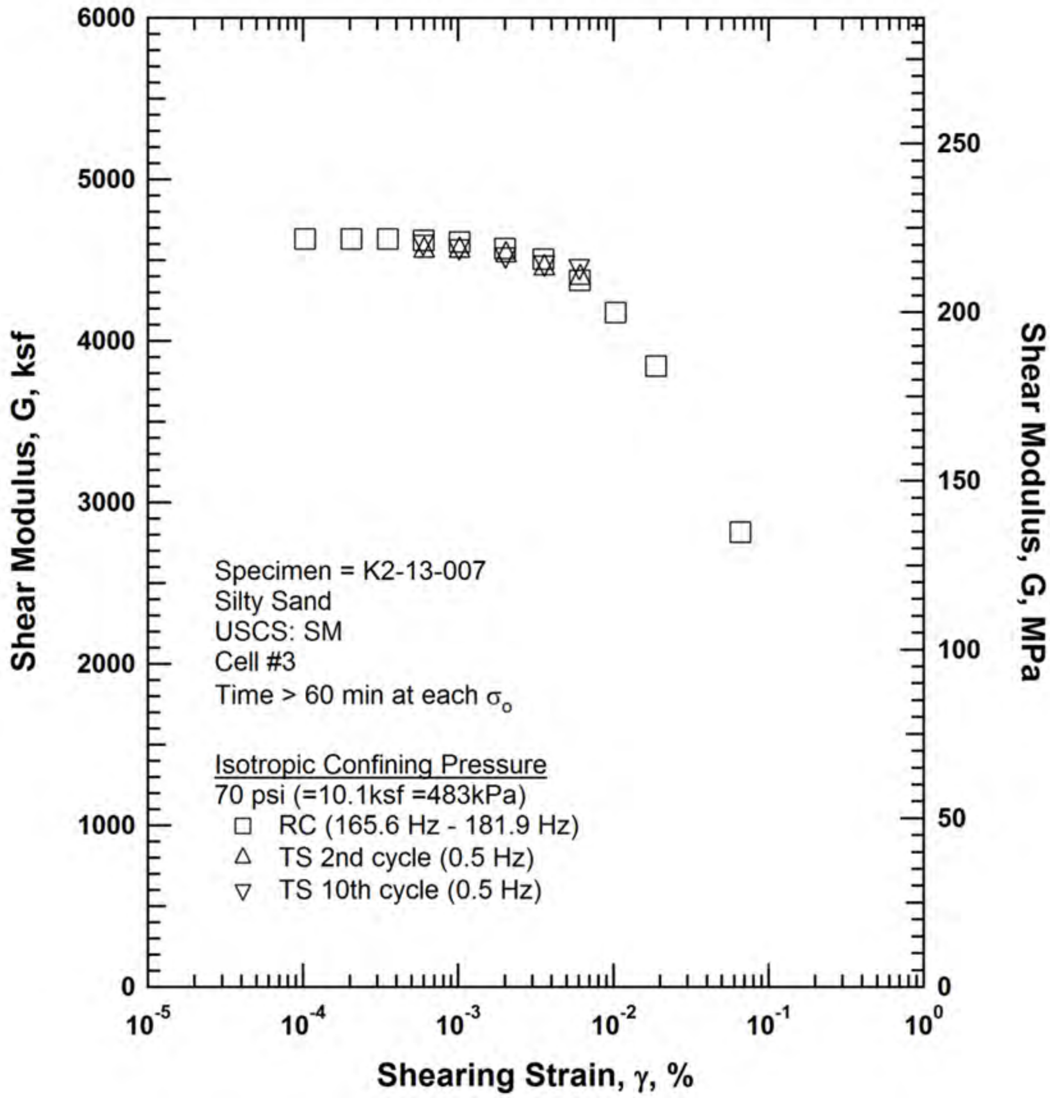


Figure H.13 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 70 psi (=10.1ksf =483kPa) from the Combined RCTS Tests of Specimen K2-13-007

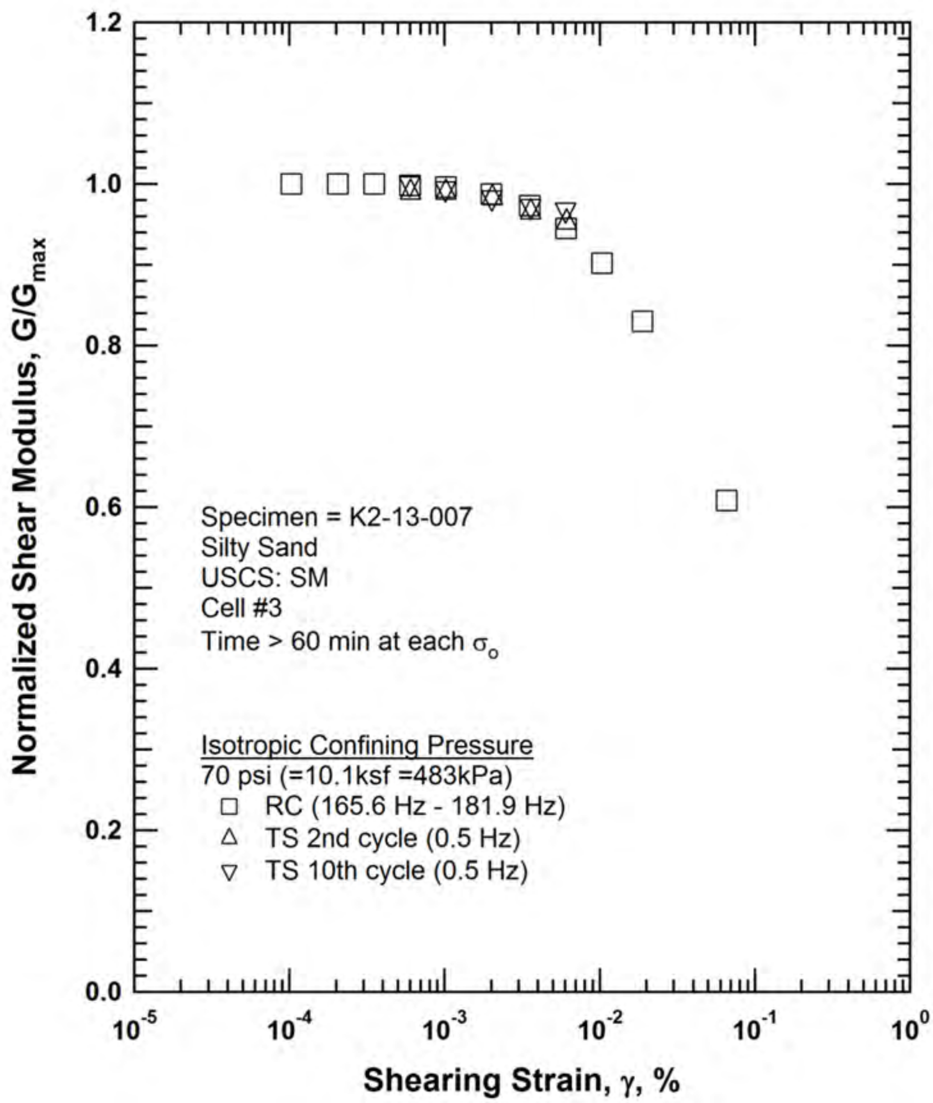


Figure H.14 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 70 psi (=10.1ksf =483kPa) from the Combined RCTS Tests of Specimen K2-13-007

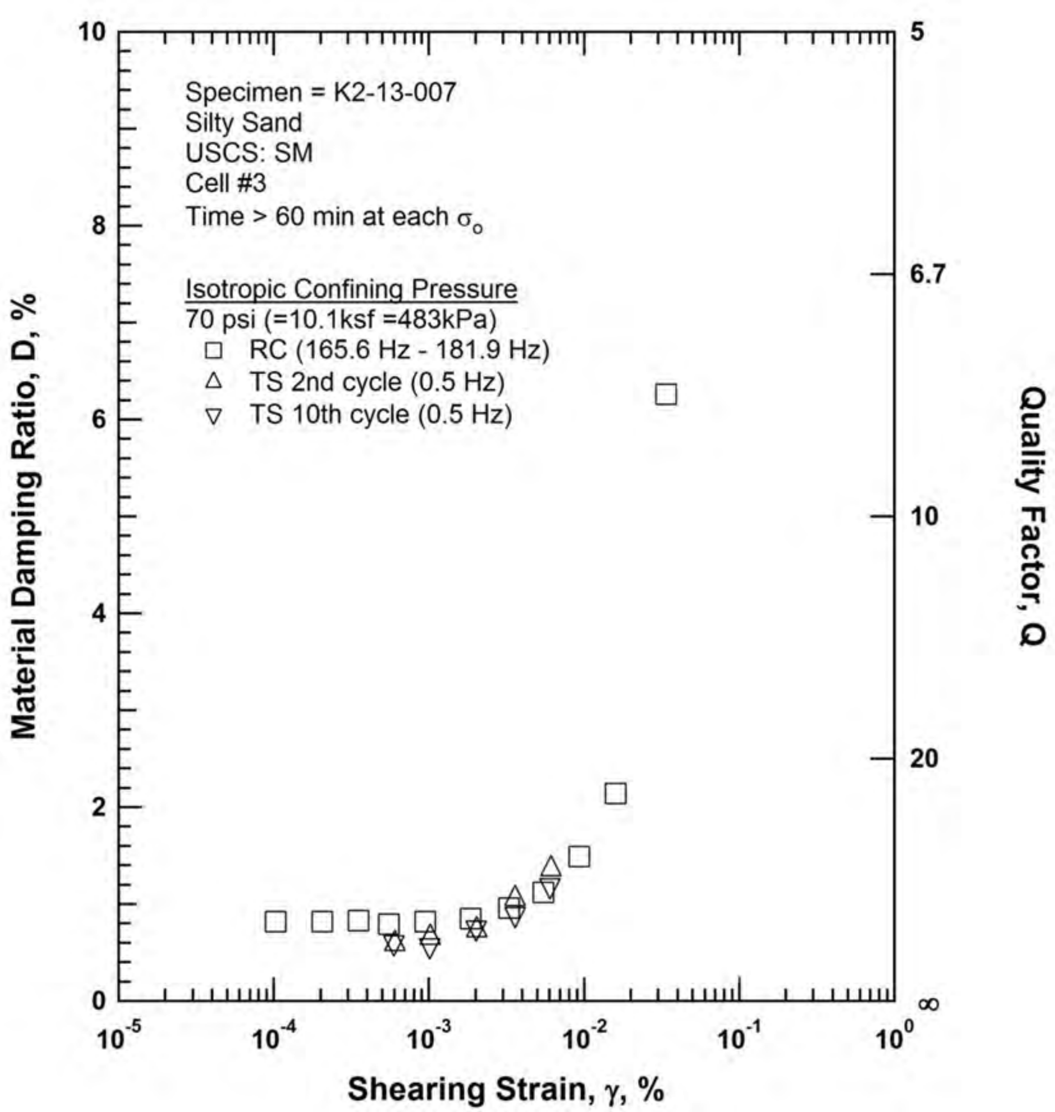


Figure H.15 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 70 psi (=10.1ksf =483kPa) from the Combined RCTS Tests of Specimen K2-13-007

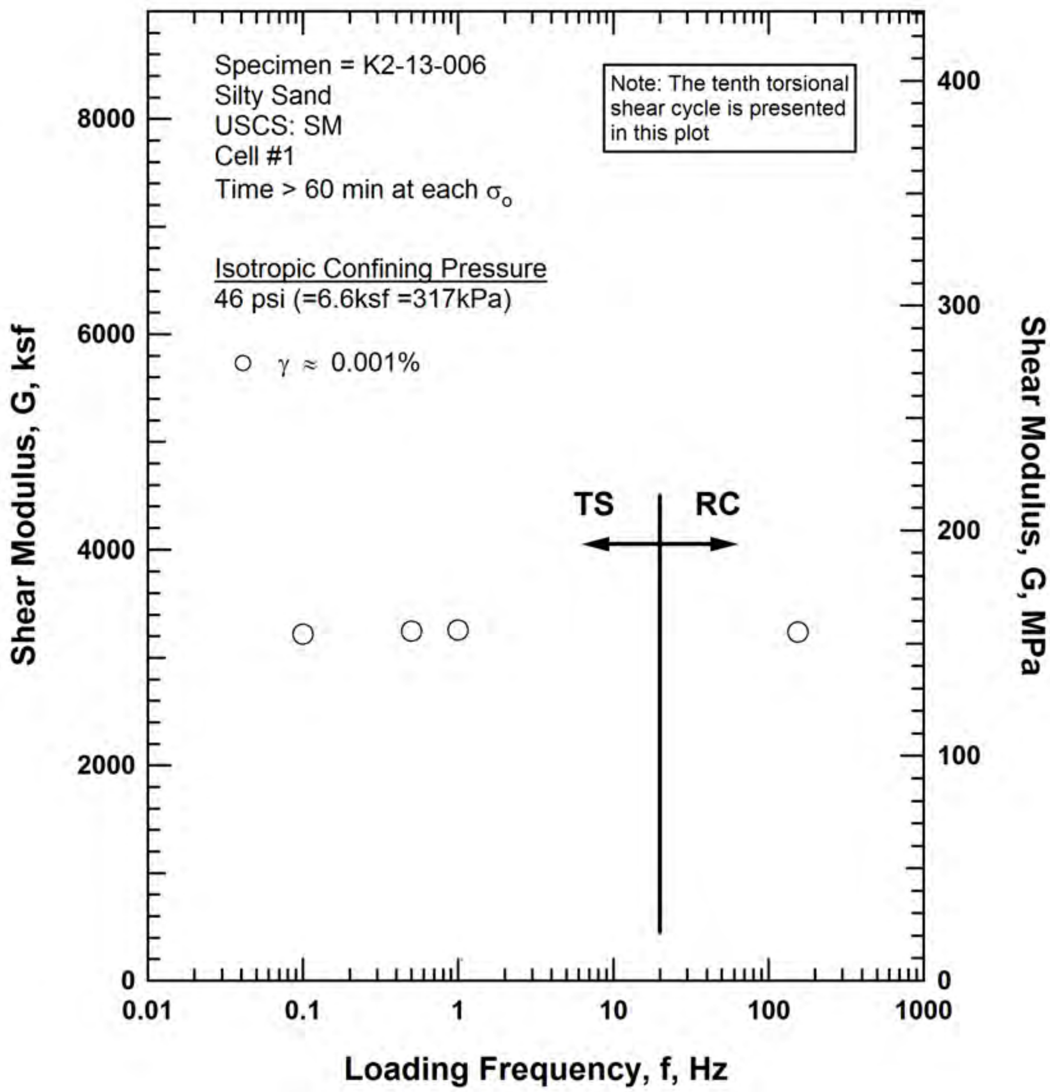


Figure H.16 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 70 psi (=10.1ksf =483kPa) from the Combined RCTS Tests of Specimen K2-13-007

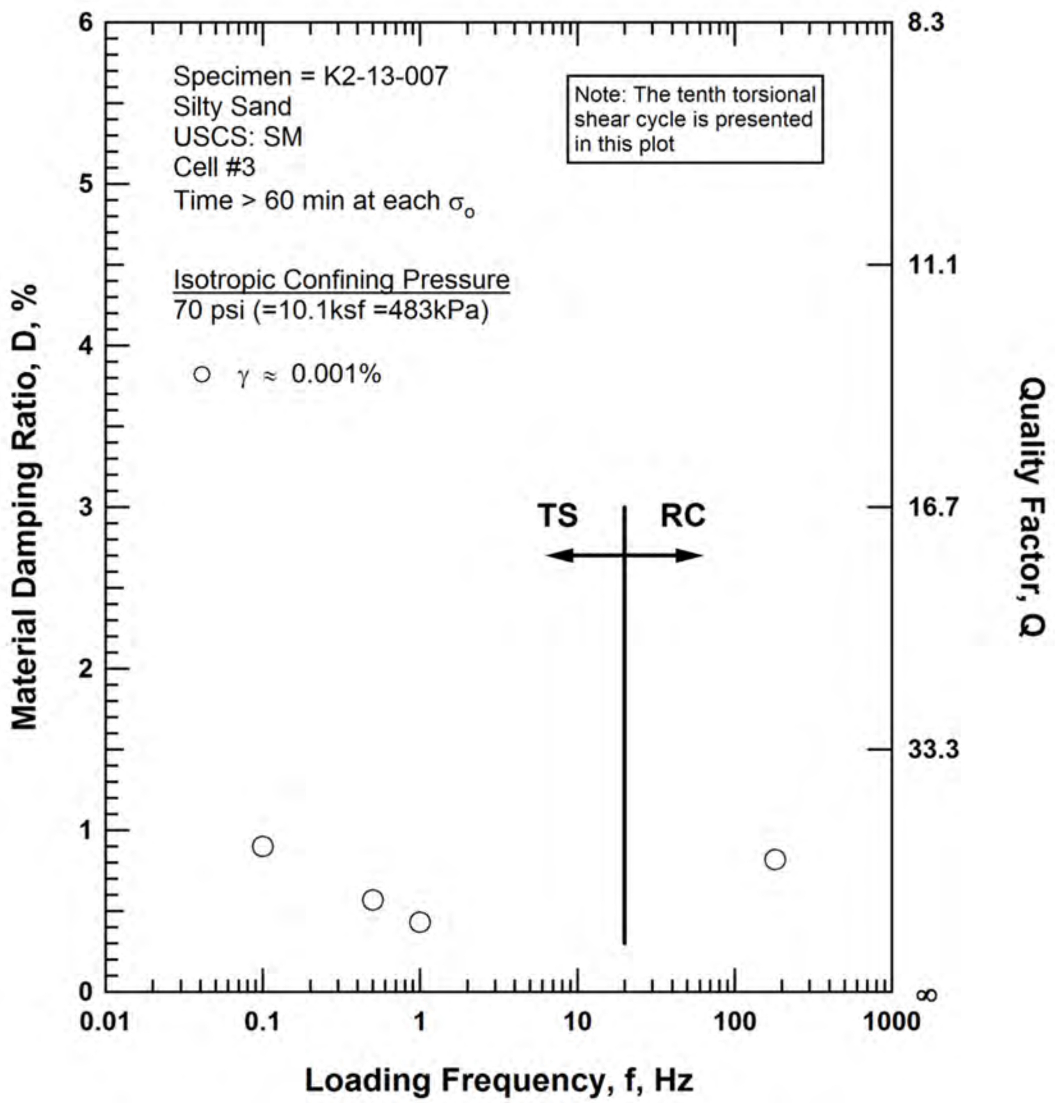


Figure H.17 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 70 psi (=10.1ksf =483kPa) from the Combined RCTS Tests of Specimen K2-13-007

Table H.1 Variation in Low-Amplitude Shear Wave Velocity, Low-Amplitude Shear Modulus, Low-Amplitude Material Damping Ratio, Estimated Void Ratio, and Estimated Total Unit Weight with Isotropic Confining Pressure from RC Tests of Specimen K2-13-007

Isotropic Confining Pressure, σ_o			Low-Amplitude Shear Modulus, G_{max}		Low-Amplitude Shear Wave Velocity, V_s	Low-Amplitude Material Damping Ratio, D_{min}	Estimated Void Ratio, e	Estimated Total Unit Weight, γ_t
(psi)	(psf)	(kPa)	(ksf)	(MPa)	(fps)	(%)	(Unitless)	(pcf)
18	2592	124	2030	97	740	1.38	0.812	119.2
35	5040	241	2850	137	880	1.17	0.801	119.6
70	10080	483	4180	200	1060	1.00	0.778	120.3
121(1)	17424	834	5620	269	1220	0.84	0.755	121.1

(1) Excessive specimen tilt at 281 psi prevented testing at that pressure

Table H.2 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen K2-13-007; Isotropic Confining Pressure σ_o = 70 psi (=10.1 ksf = 483 kPa)

Second Cycle				Tenth Cycle			
Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
6.03E-04	4560	0.99	0.59	5.96E-04	4610	1.00	0.60
1.02E-03	4560	0.99	0.65	1.01E-03	4580	0.99	0.57
2.02E-03	4530	0.98	0.73	2.02E-03	4530	0.98	0.75
3.60E-03	4450	0.97	1.05	3.58E-03	4480	0.97	0.89
6.13E-03	4390	0.95	1.36	6.04E-03	4460	0.97	1.19

Table H.3 Variation in Shear Modulus, Normalized Shear Modulus, and Material Damping with Shearing Strain from RC Tests of Specimen K2-13-007; Isotropic Confining Pressure σ_o = 70 psi (=10.1 ksf = 483 kPa)

Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average Shearing Strain, %[1]	Material Damping Ratio, D, %[2]
1.03E-04	4630	1.00	1.03E-04	0.82
2.04E-04	4630	1.00	2.04E-04	0.82
3.51E-04	4630	1.00	3.51E-04	0.83
5.97E-04	4620	1.00	5.52E-04	0.79
1.02E-03	4610	1.00	9.44E-04	0.82
2.01E-03	4570	0.99	1.85E-03	0.85
3.55E-03	4510	0.97	3.28E-03	0.96
6.06E-03	4380	0.94	5.47E-03	1.12
1.03E-02	4180	0.90	9.34E-03	1.49
1.89E-02	3840	0.83	1.60E-02	2.14
6.56E-02	2820	0.61	3.37E-02	6.26

(1) Average Shearing Strain from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

(2) Average Damping Ratio from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

Table H.4 Variation in Shear Modulus and Material Damping with Frequency from RC/TS Tests of Specimen K2-13-007; Isotropic Confining Pressure σ_o = 70 psi (=10.1 ksf = 483 kPa)

Approximate Shearing Strain, γ, %	Frequency, Hz	Shear Modulus, G, ksf	Material Damping Ratio, D, %
0.001	0.1	4520	0.90
	0.5	4580	0.57
	1.0	4640	0.43
	181.5	4610	0.82

APPENDIX I

Results for Kleinfelder Specimen ID K2-13-008

- *Specimen Preparation Notes*

SPECIMEN PREPARATION NOTES

Specimen No.: K2-13-008

Project No : 136473 **Page** 1 **of** 3

Boring No.: R-6-1b **Date of Preparation..:** 11/11/13

Sample No..: ST-2 **Depth..:** 147.0 – 147.5 feet

Disposition of Sample

☐ No Apparent Disturbance ☒ Apparent Disturbance ☐ Compacted Sample

☒ Other (Describe) Sample appeared to be primarily composed of highly disturbed borehole cuttings

Specimen Preparation Notes

Preparation Method :	n/a		**Affixation to Platens :**	n/a	
Ave. Length (in.) :	n/a	**Ave. Diameter (in.):**	n/a	**L/D**	n/a
Total Unit Weight (pcf) :	n/a	**Moisture Content (%) :**	n/a	**% Saturation (Assume SG = 2.65):**	n/a

Specimen Testing Comments

1) Sample was removed from the Shelby Tube on 11/11/13. The soil within consisted of highly disturbed material that appeared to be borehole cuttings and caved-in material from the sidewall of the boring. Due to the disturbed nature of the soil, RCTS Testing was not performed on the sample.

☒ **See Attached Photographs**

Photo I.1

Sample R-6-1b ST-2 after removal from the transport container.

Photo I.2

Sample after subdividing Shelby Tube. Note large void on right side of tube.

SPECIMEN PREPARATION NOTES

Specimen K2-13-008

Photo I.3

View of the top of the subdivided Shelby Tube.

APPENDIX J

Results for Kleinfelder Specimen ID K2-13-009

- *Specimen Preparation Notes*
- *RCTS Testing Results*

KLEINFELDER
Bright People. Right Solutions.

SPECIMEN PREPARATION NOTES

Specimen No.: K2-13-009

Project No : 136473

Page 1 **of** 3

Boring No.: R-6-1b

Date of Preparation..: 12/11/13

Sample No..: ST-7

Depth..: 171.7 – 172.2 feet

Disposition of Sample

☒ No Apparent Disturbance ☐ Apparent Disturbance ☐ Compacted Sample

☐ Other (Describe)

Specimen Preparation Notes

Preparation Method :	Extruded from Shelby Tube with No Trimming		**Affixation to Platens :**	2.8-inch diameter platens, no adhesive used	
Ave. Length (in.) :	5.7628	**Ave. Diameter (in.):**	2.833	**L/D**	2.0
Total Unit Weight (pcf) :	119.9	**Moisture Content (%) :**	28.9	**% Saturation (Assume SG = 2.65):**	98.3

Specimen Testing Comments

1) Sample was extruded from the Shelby Tube directly into a latex membrane for testing on 12/10/13. No trimming of the sample was performed except to square the end.

2) Testing commenced on 12/10/13, beginning with 14 psi pressure.

3) The specimen tilted so that the magnets made contact with the electrical coils during the low-amplitude resonant column testing of Pressure Stage 5 (232 psi). The coil-magnet system was readjusted and the testing was resumed after retesting the low-amplitude resonant column series at Pressure Stage 4 (101 psi).

4) The full test sequence was completed on 12/11/13.

☒ **See Attached Photographs**

SPECIMEN PREPARATION NOTES

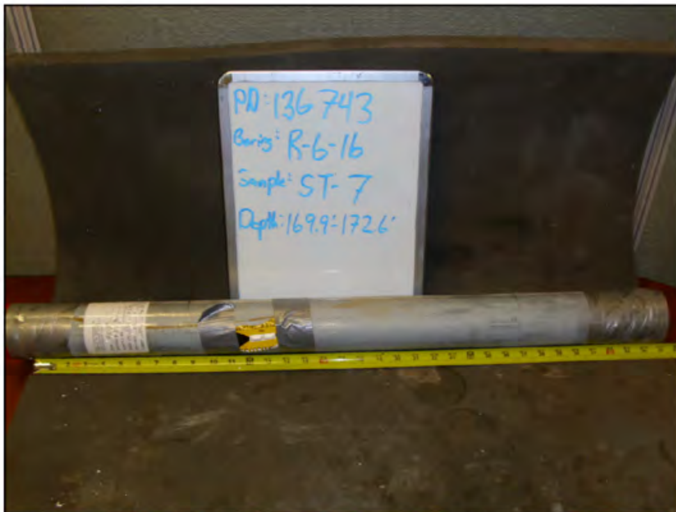


Photo J.1

Sample R-6-1b ST-7 after removal from the transport container.

Photo J.2

Specimen being extruded directly into latex testing membrane.

SPECIMEN PREPARATION NOTES

Specimen K2-13-009

Photo J.3

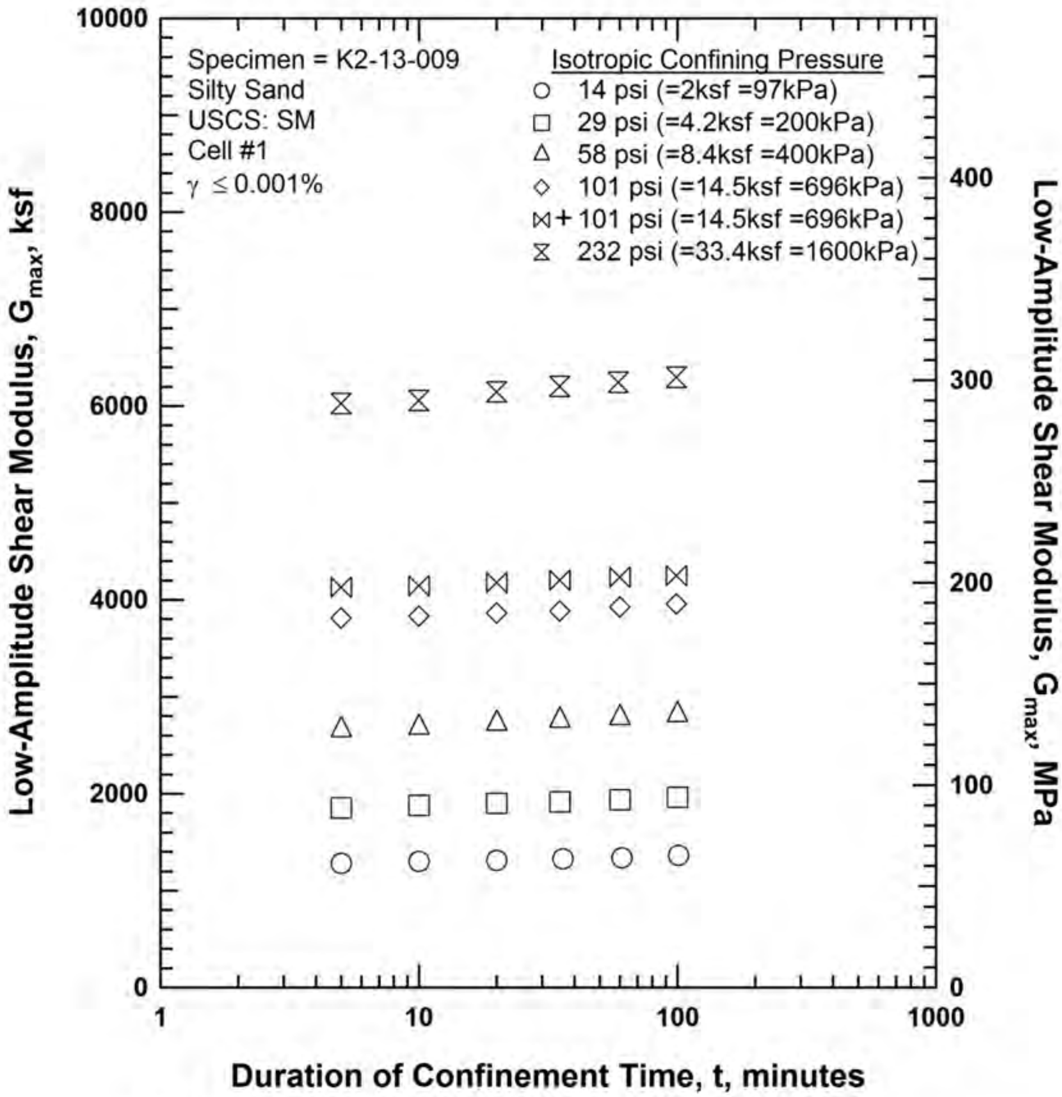
Specimen after placement on base pedestal and vacuum pressure is applied.

Kleinfelder Specimen ID:

K2-13-009

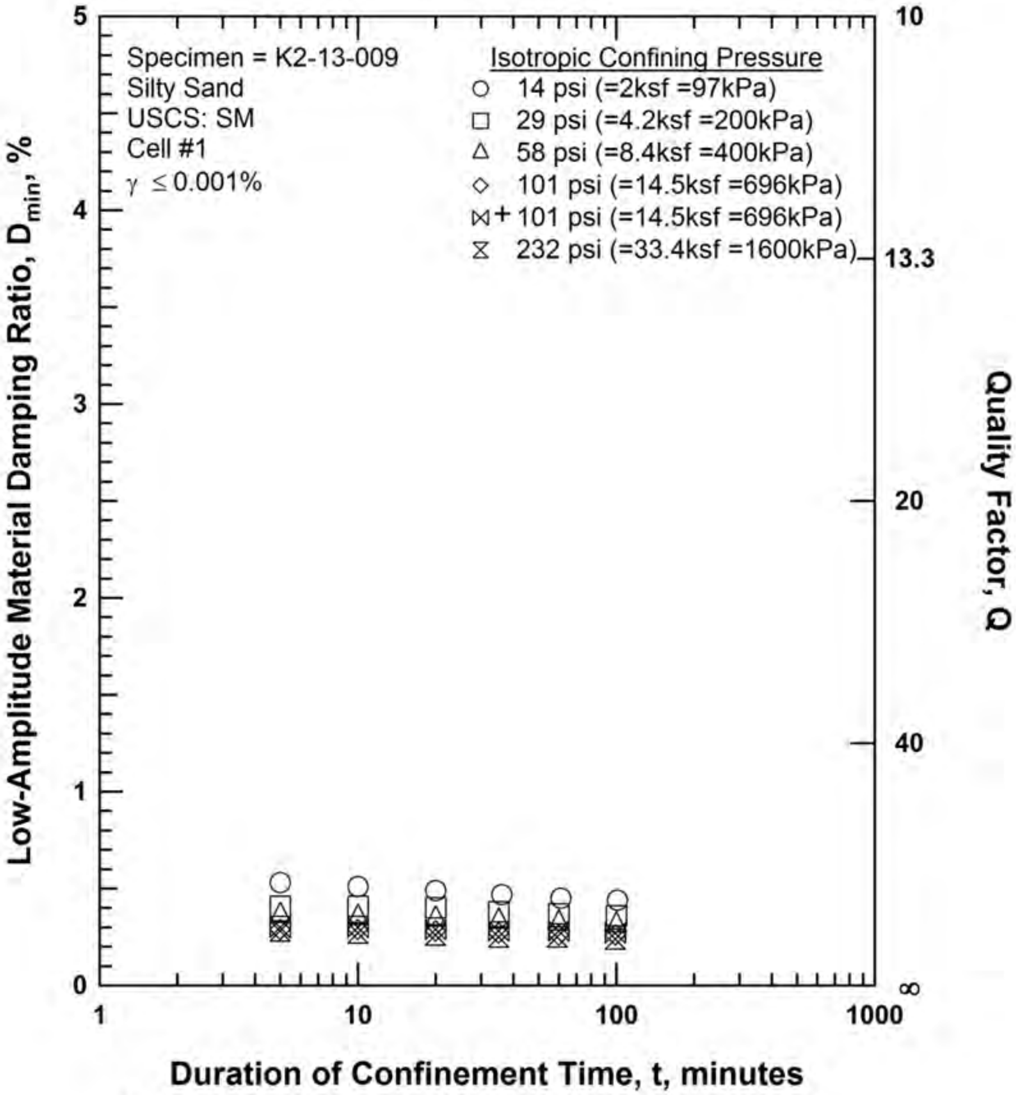
Boring No: R-6-1b
Sample No: ST-7

Silty Sand (SM)
Depth = 171.7 ft – 172.2 ft (below existing ground surface)
Total Unit Weight = 119.9 lb/ft^3
Natural Moisture Content = 28.9%
Estimated In-Situ Mean Effective Stress = 58 psi



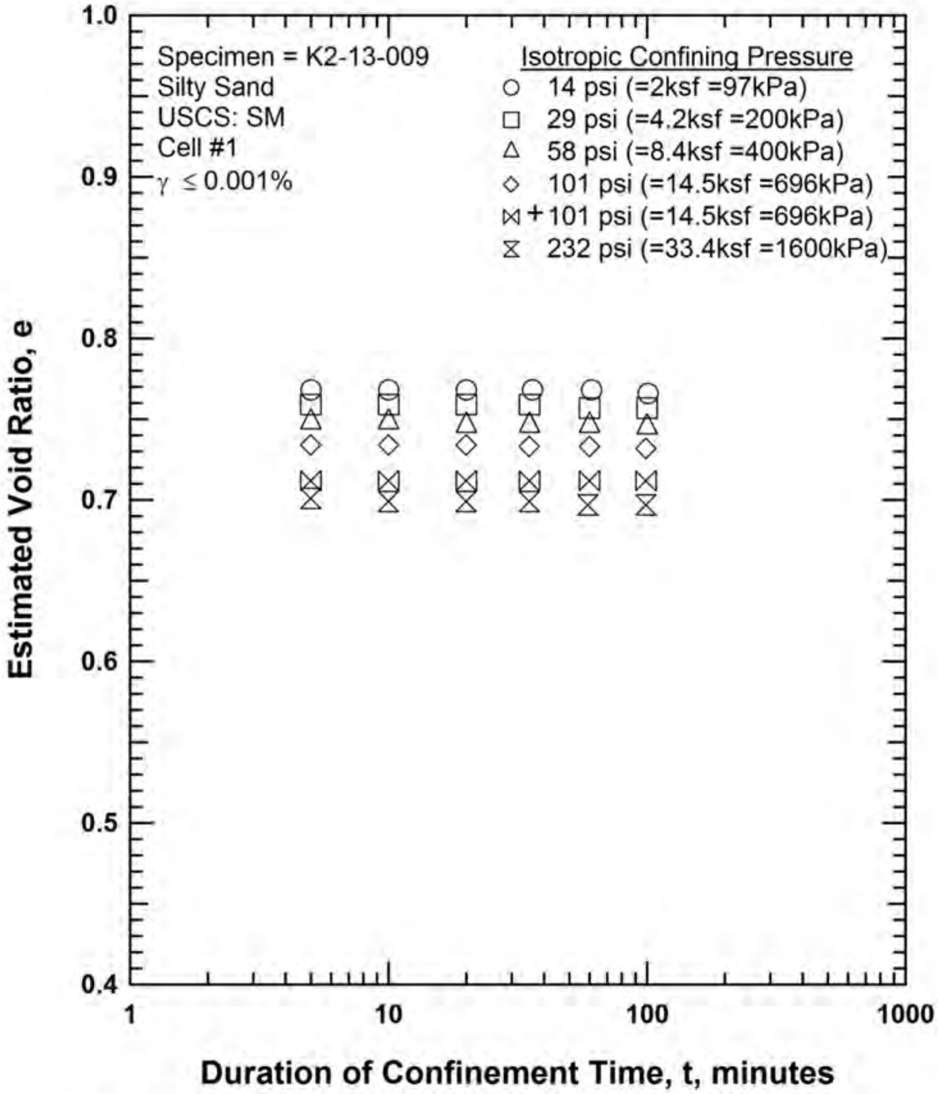
Note:
+ Retest of 101 psi confining pressure after adjustment of system to prevent contact of the coil and magnets at the 232 psi confining pressure.

Figure J.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-009



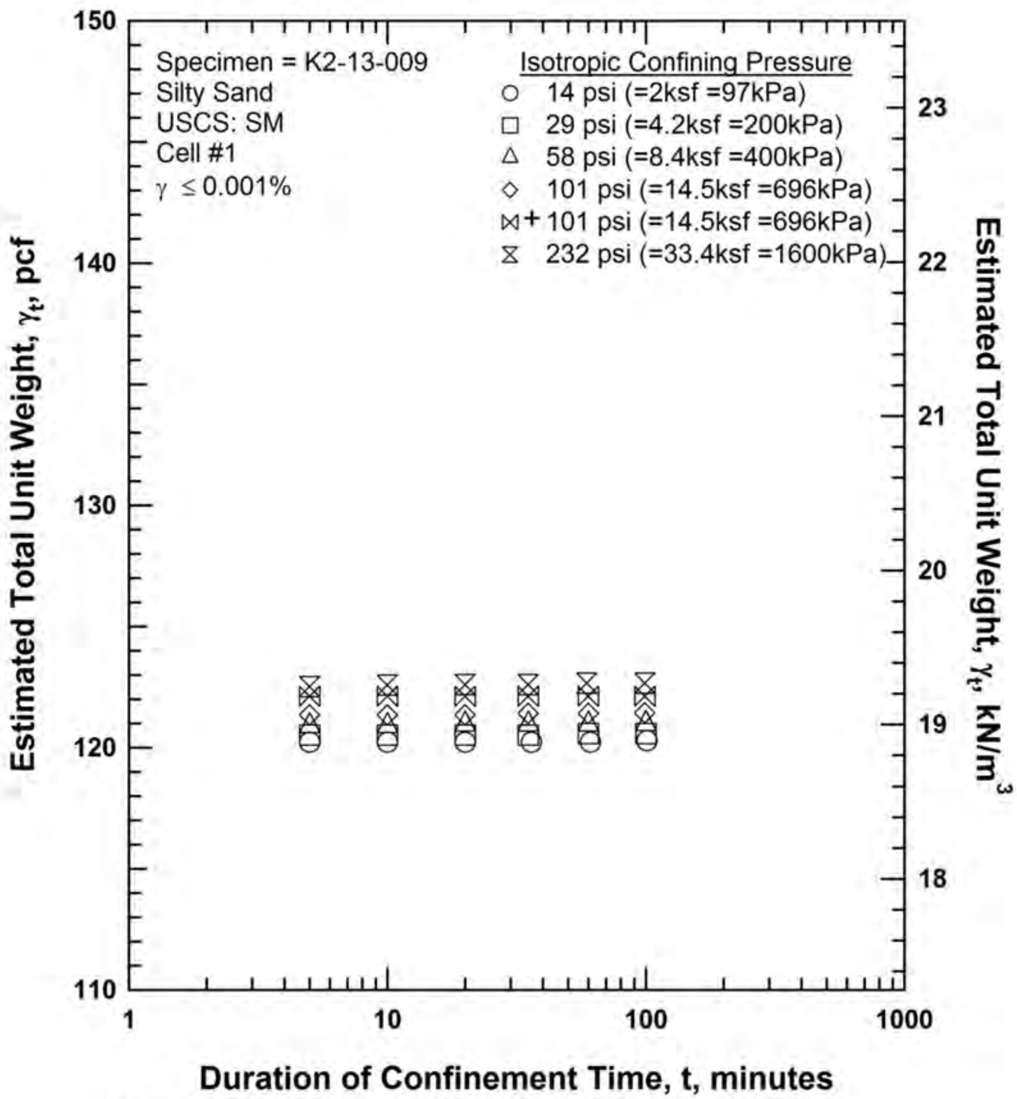
Note:
+ Retest of 101 psi confining pressure after adjustment of system to prevent contact of the coil and magnets at the 232 psi confining pressure.

Figure J.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-009



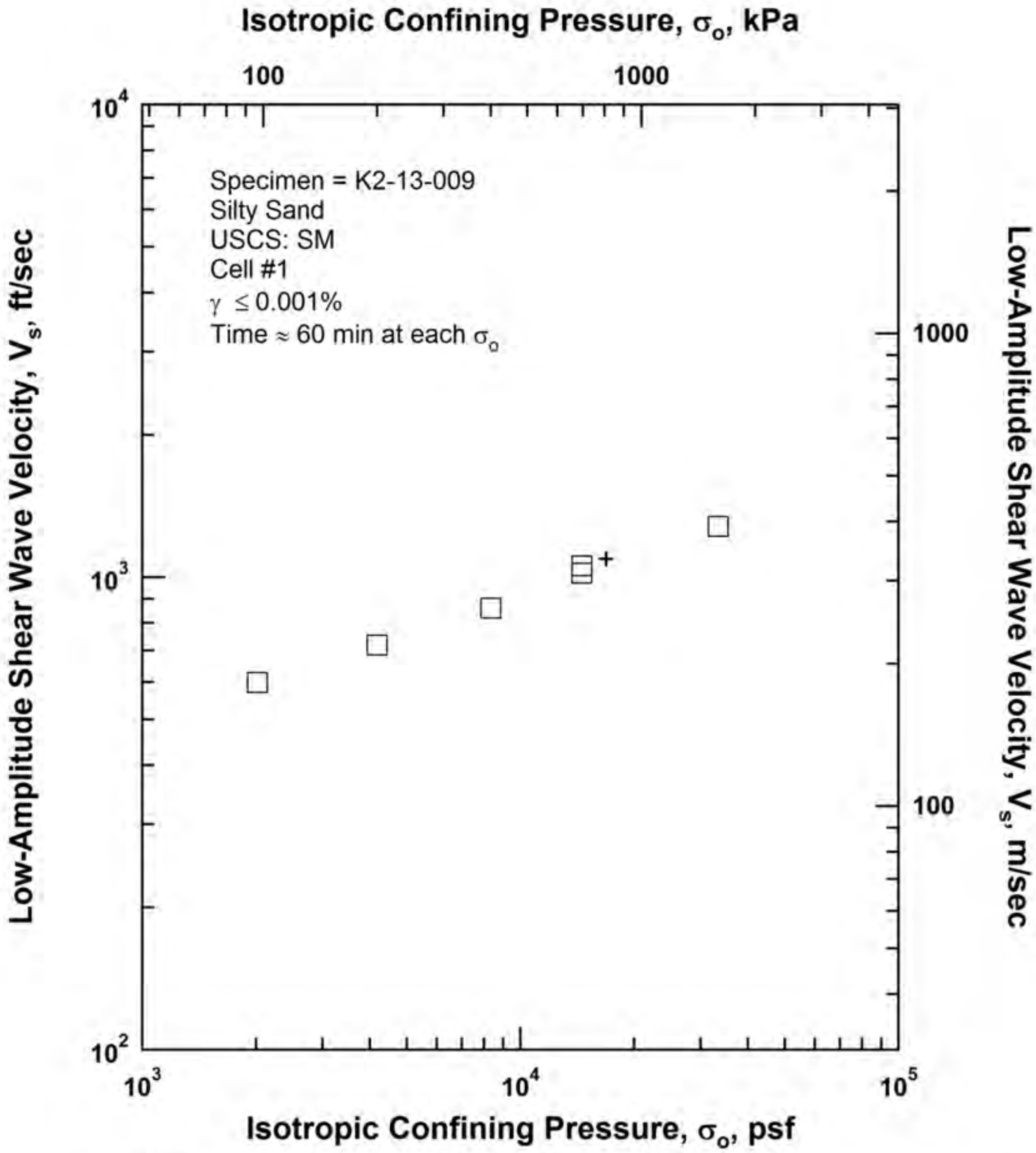
Note:
\+ Retest of 101 psi confining pressure after adjustment of system to prevent contact of the coil and magnets at the 232 psi confining pressure.

Figure J.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Test of Specimen K2-13-009



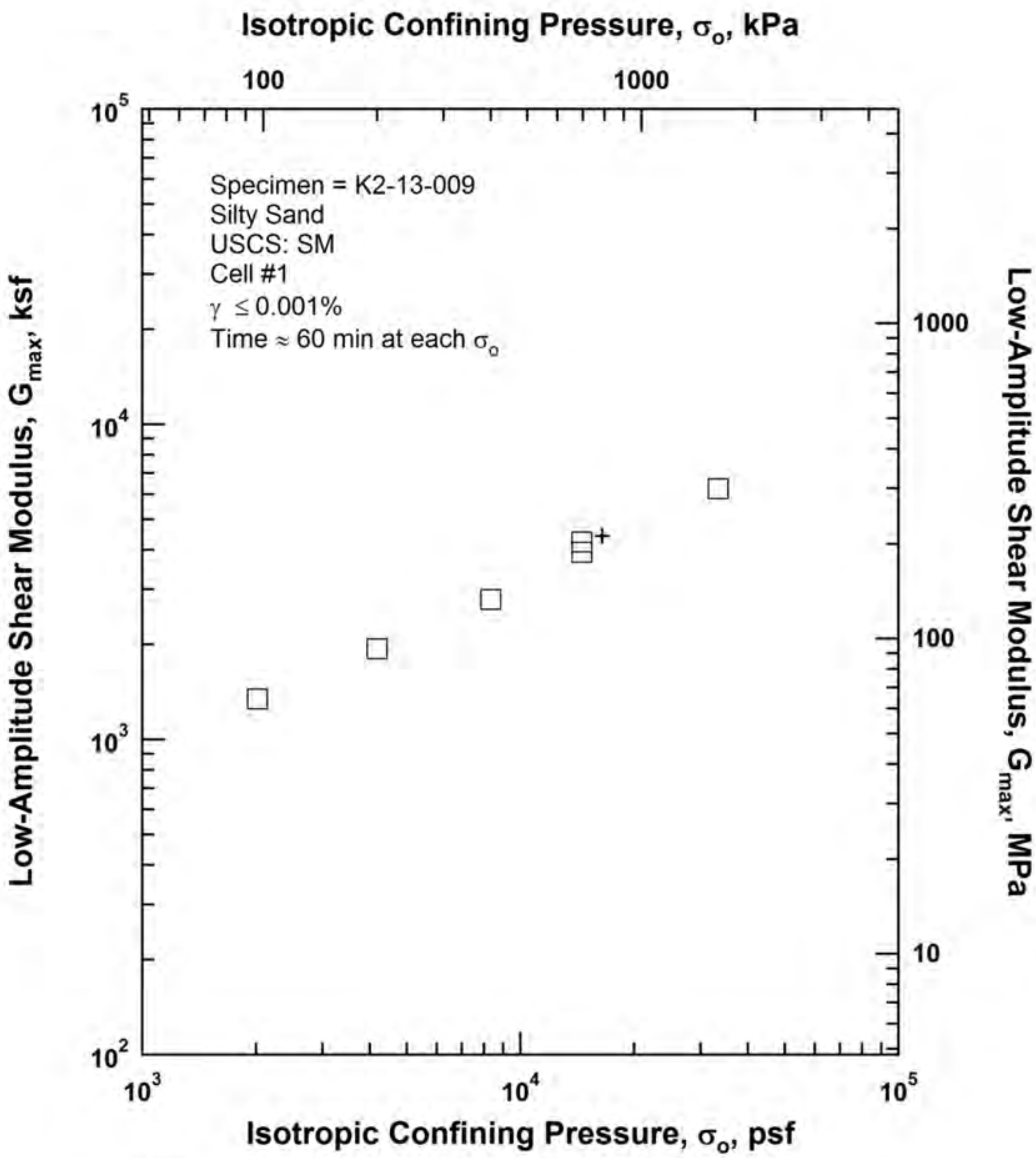
Note:
+ Retest of 101 psi confining pressure after adjustment of system to prevent contact of the coil and magnets at the 232 psi confining pressure.

Figure J.4 Variation in Estimated Total Unit Weight with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-009



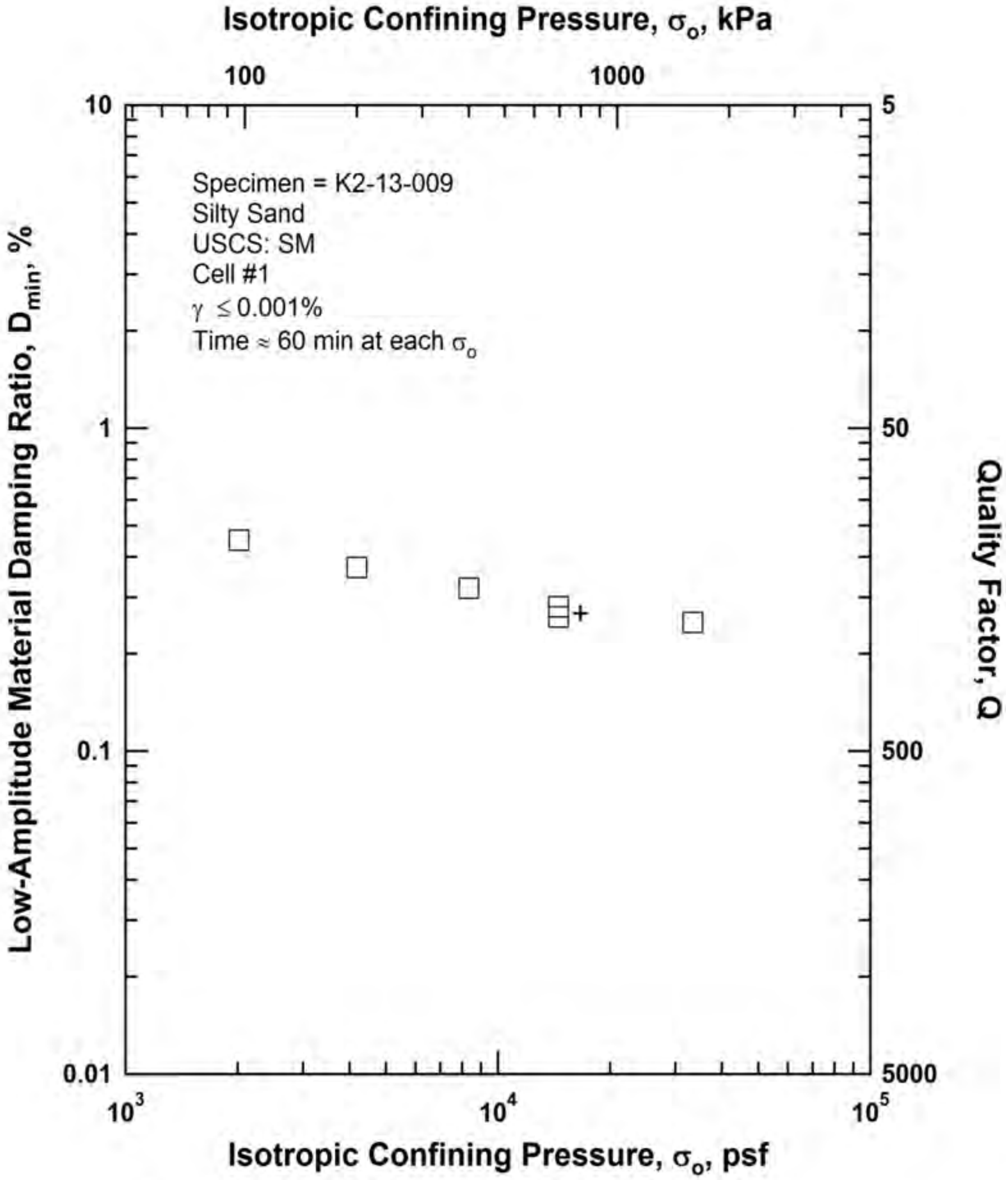
Note:
+ Retest of 101 psi confining pressure after adjustment of system to prevent contact of the coil and magnets at the 232 psi confining pressure.

Figure J.5 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-009



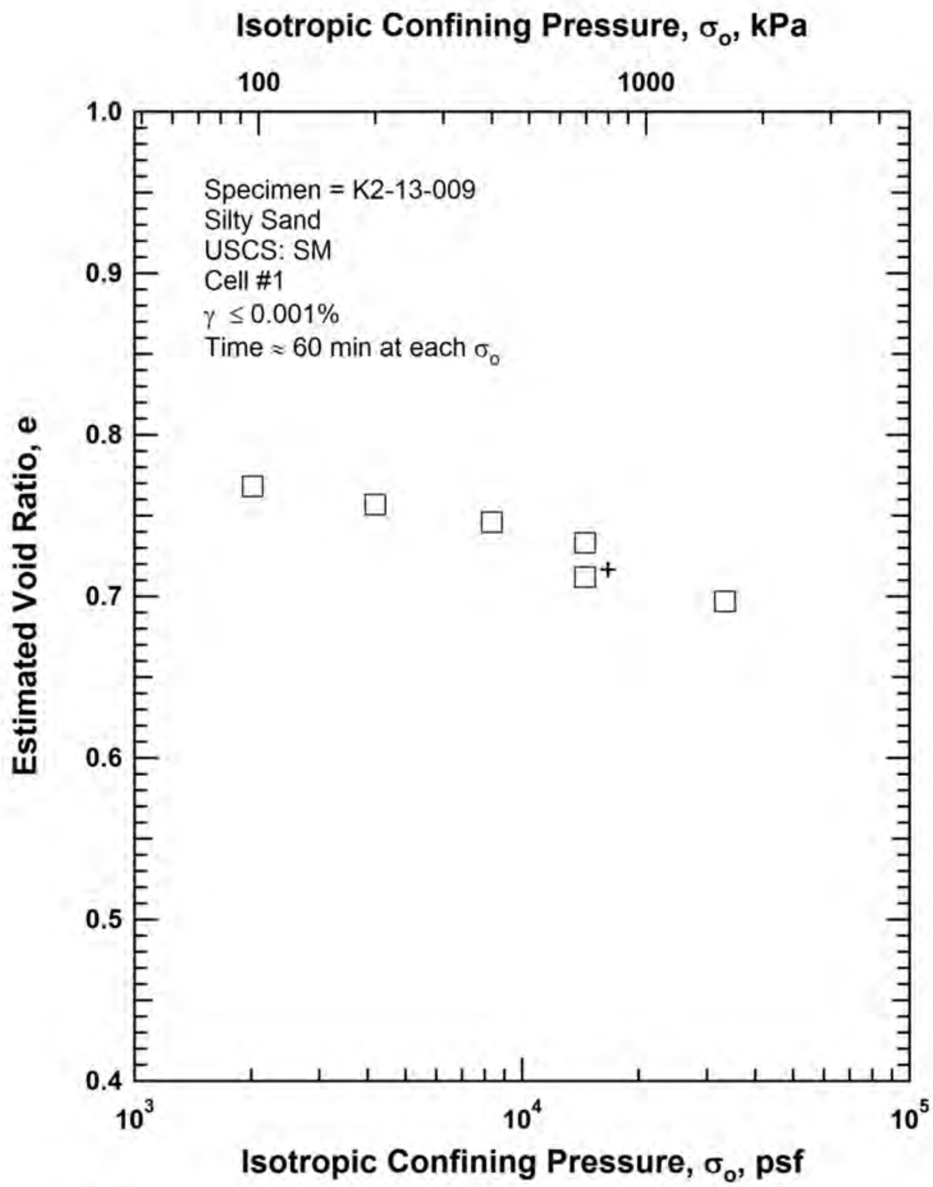
Note:
\+ Retest of 101 psi confining pressure after adjustment of system to prevent contact of the coil and magnets at the 232 psi confining pressure.

Figure J.6 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Test of Specimen K2-13-009



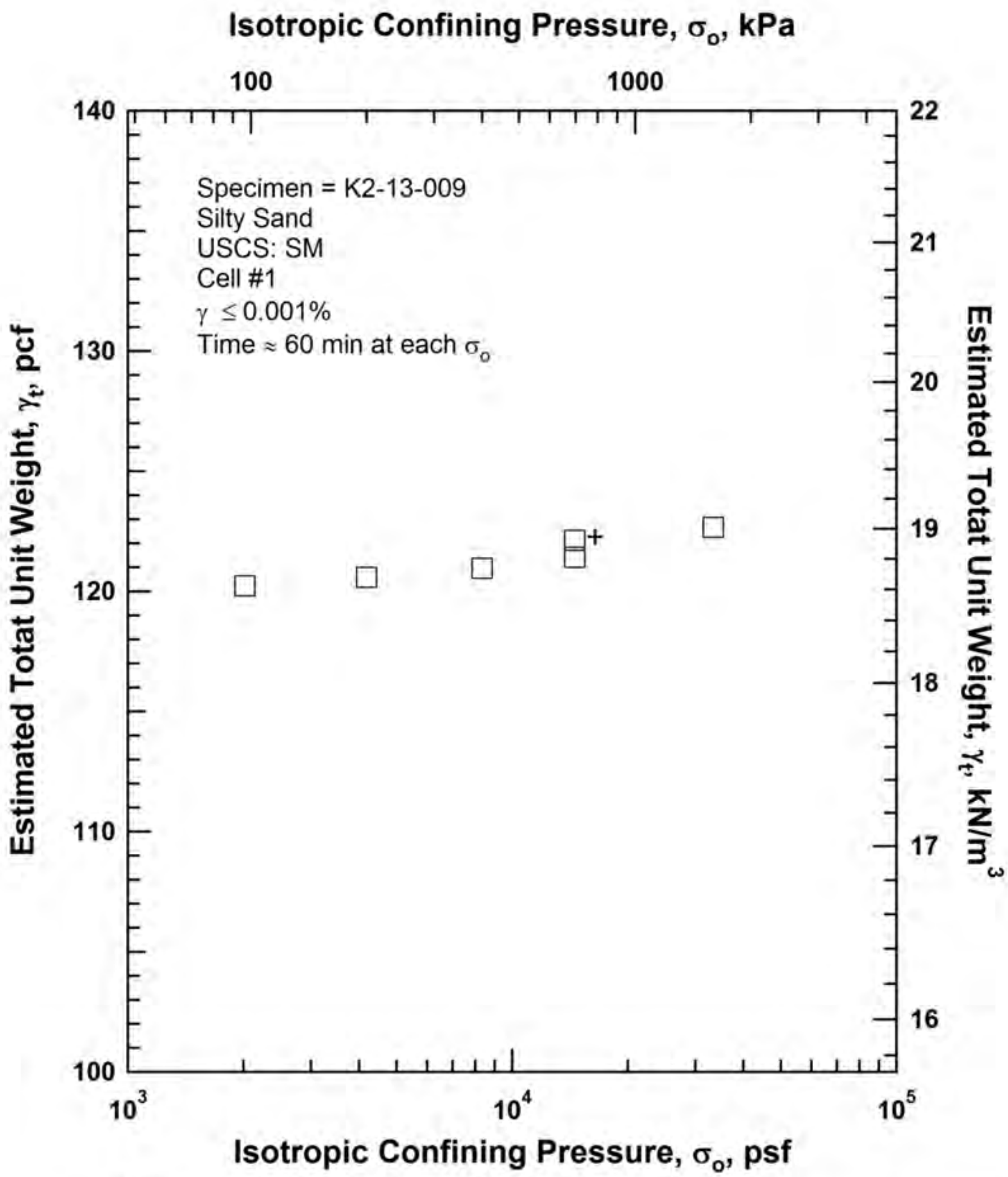
Note:
+ Retest of 101 psi confining pressure after adjustment of system to prevent contact of the coil and magnets at the 232 psi confining pressure.

Figure J.7 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-009



Note:
+ Retest of 101 psi confining pressure after adjustment of system to prevent contact of the coil and magnets at the 232 psi confining pressure.

Figure J.8 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-009



Note:
+ Retest of 101 psi confining pressure after adjustment of system to prevent contact of the coil and magnets at the 232 psi confining pressure.

Figure J.9 Variation in Estimated Total Unit Weight with Isotropic Confining Pressure from Resonant Column Tests of Specimen K2-13-009

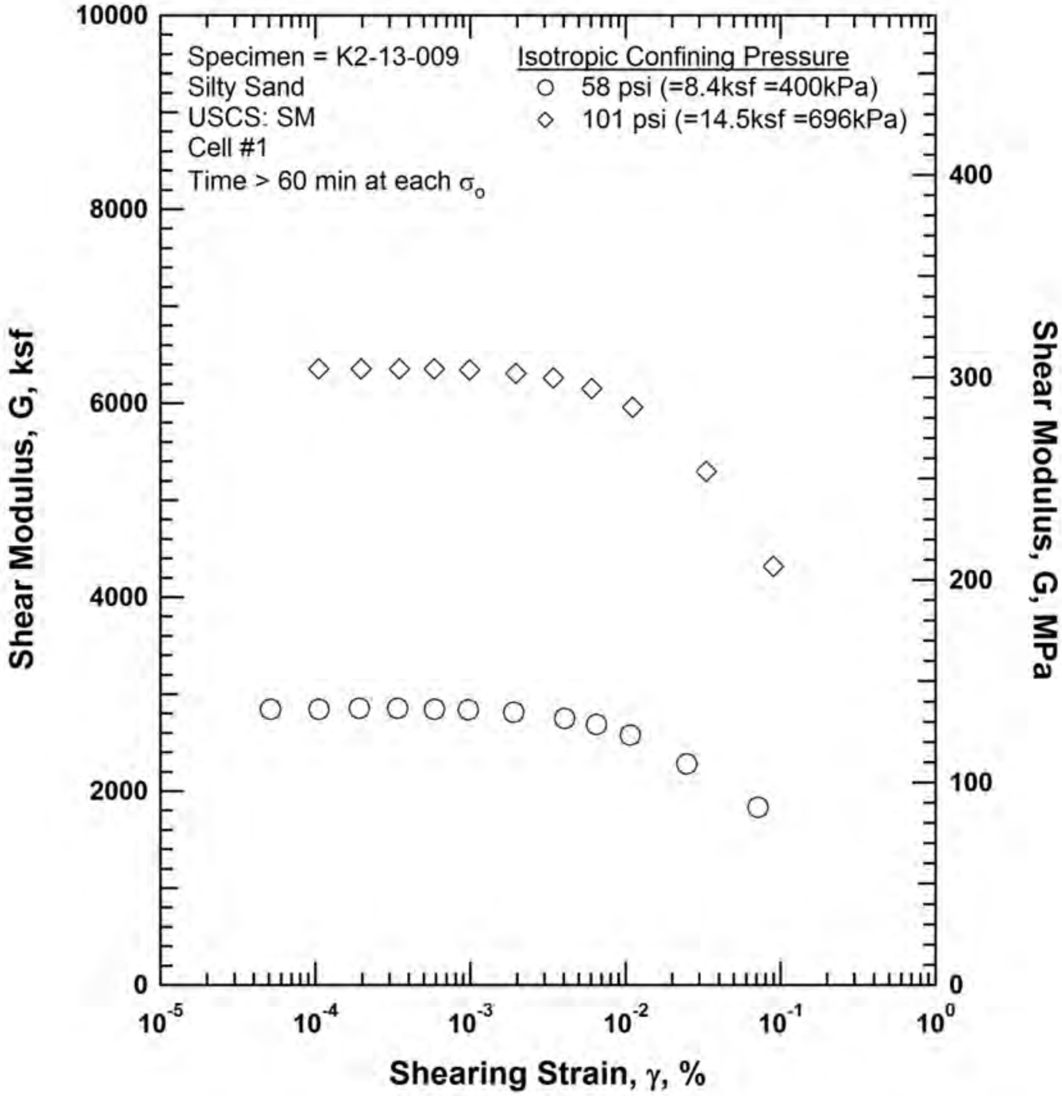


Figure J.10 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-009

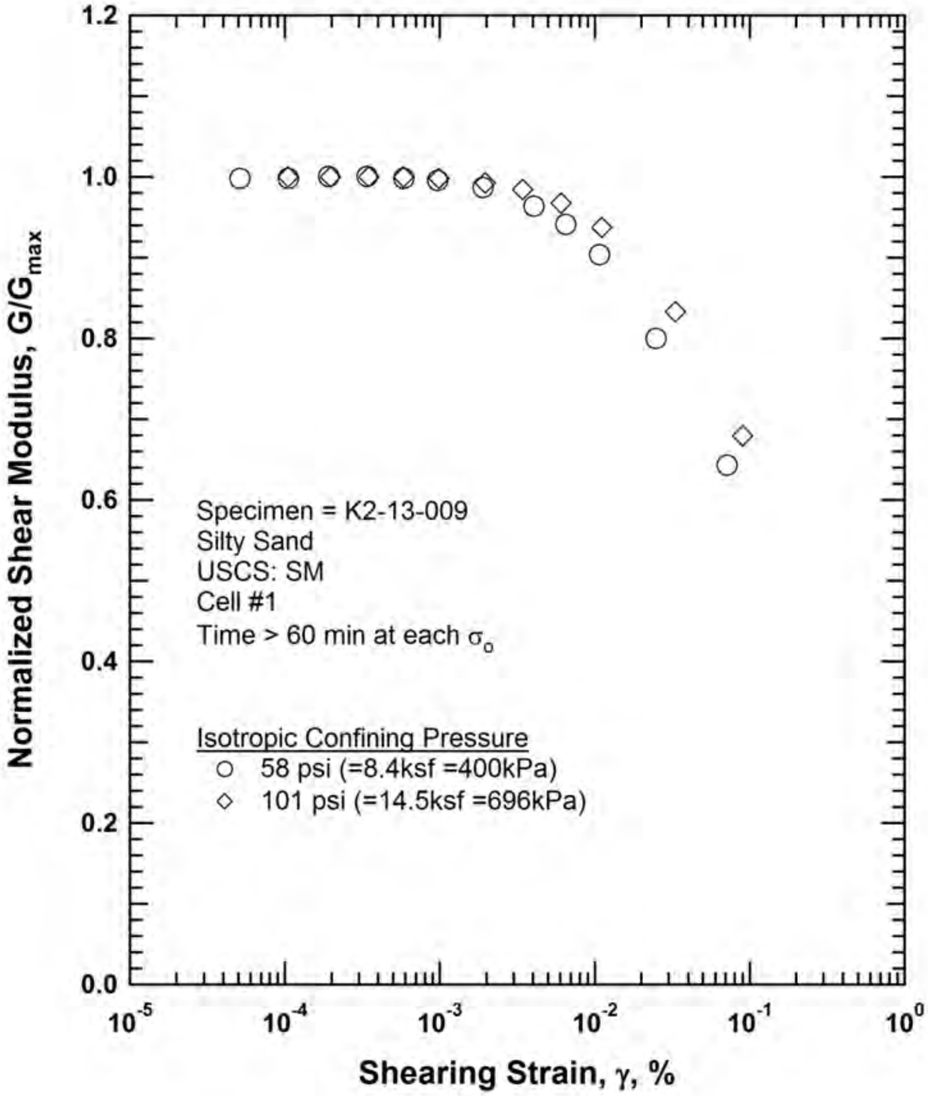


Figure J.11 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-009

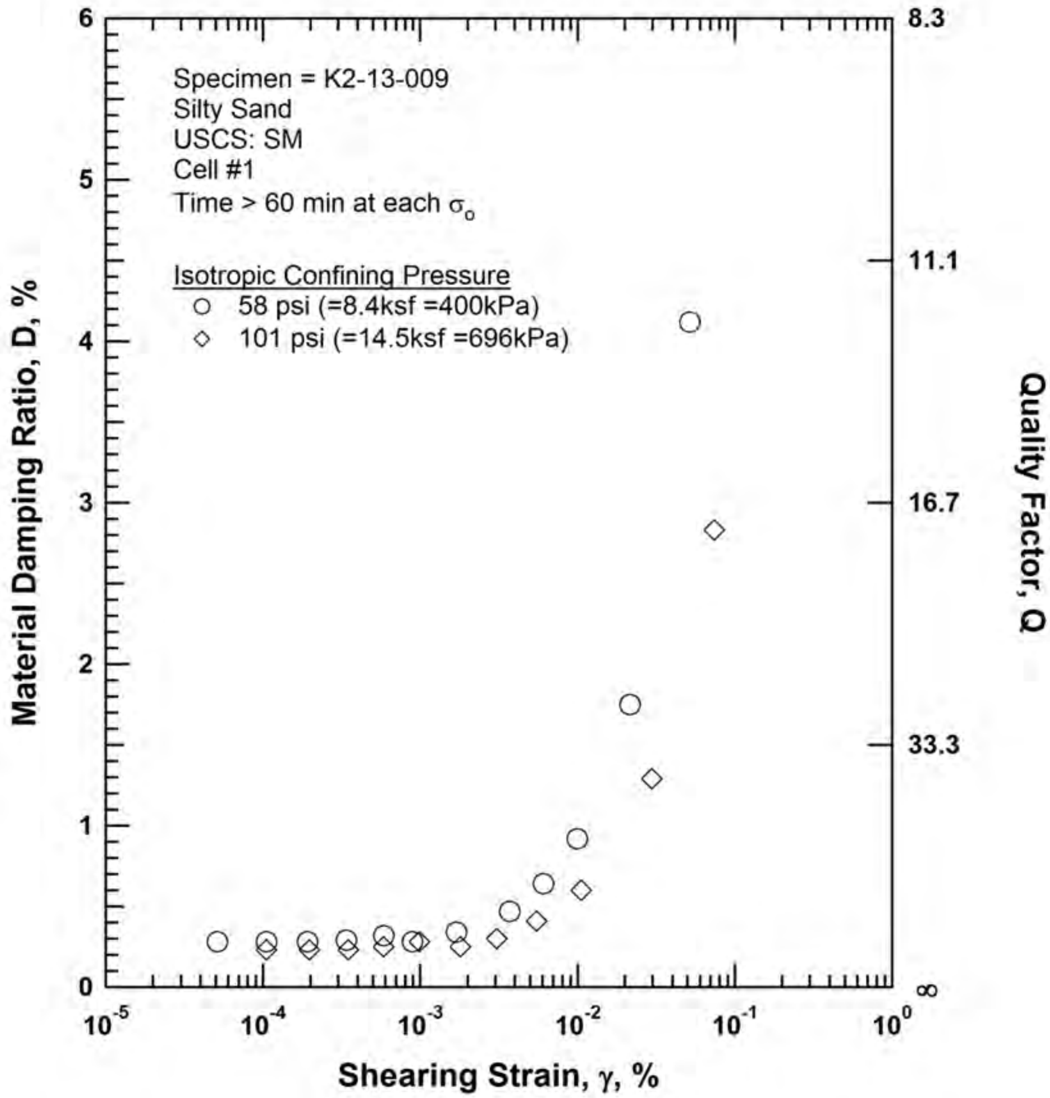


Figure J.12 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests of Specimen K2-13-009

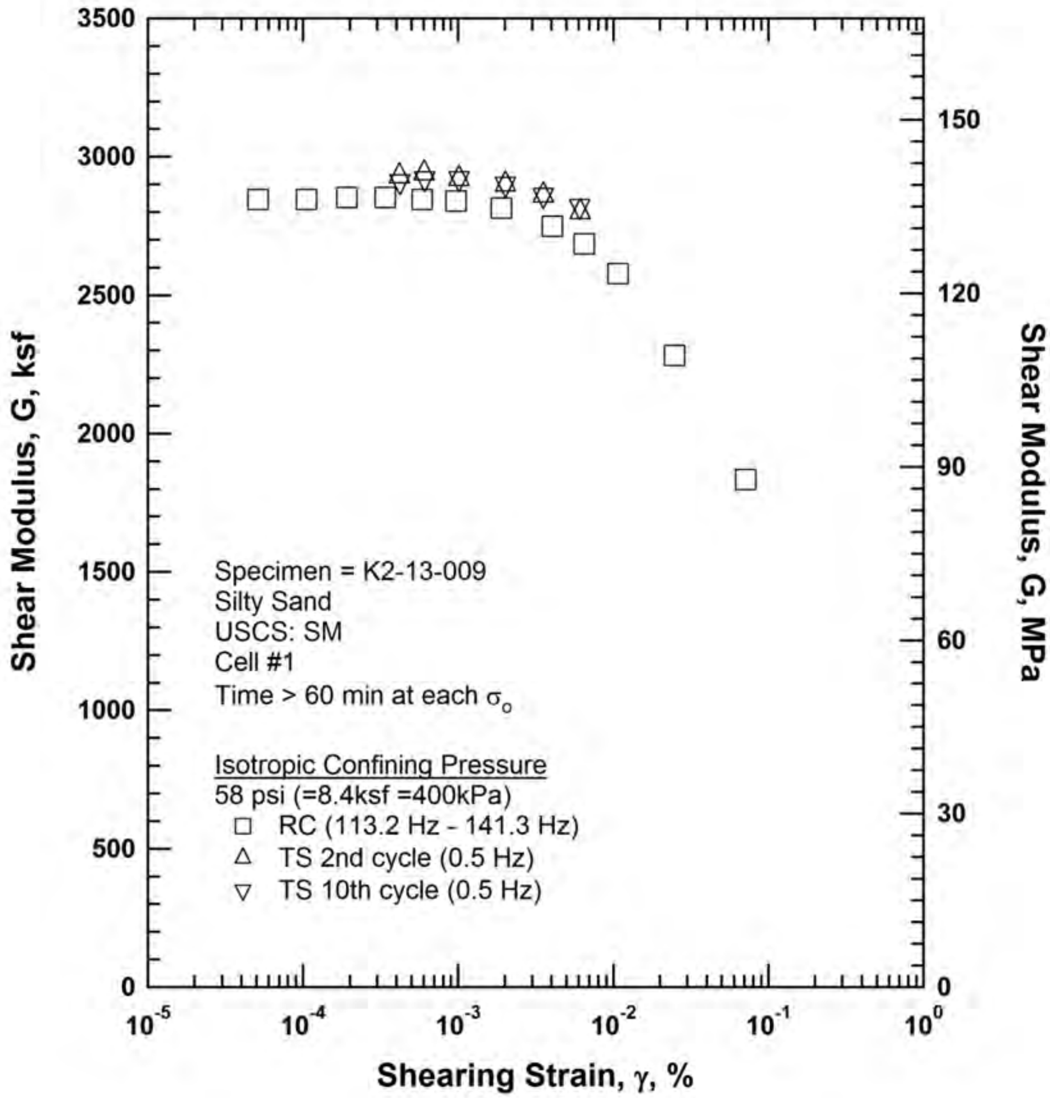


Figure J.13 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 58 psi (=8.4ksf =400kPa) from the Combined RCTS Tests of Specimen K2-13-009

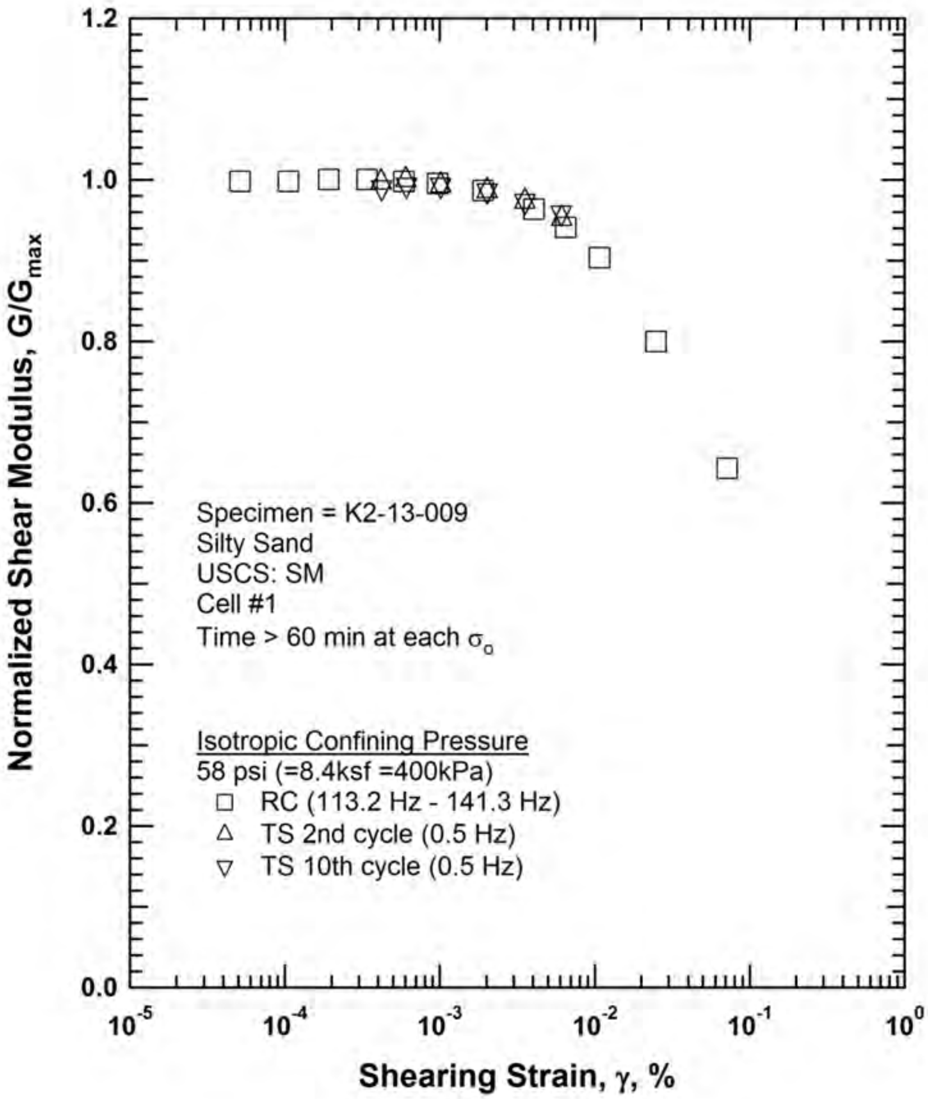


Figure J.14 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 58 psi (=8.4ksf =400kPa) from the Combined RCTS Tests of Specimen K2-13-009

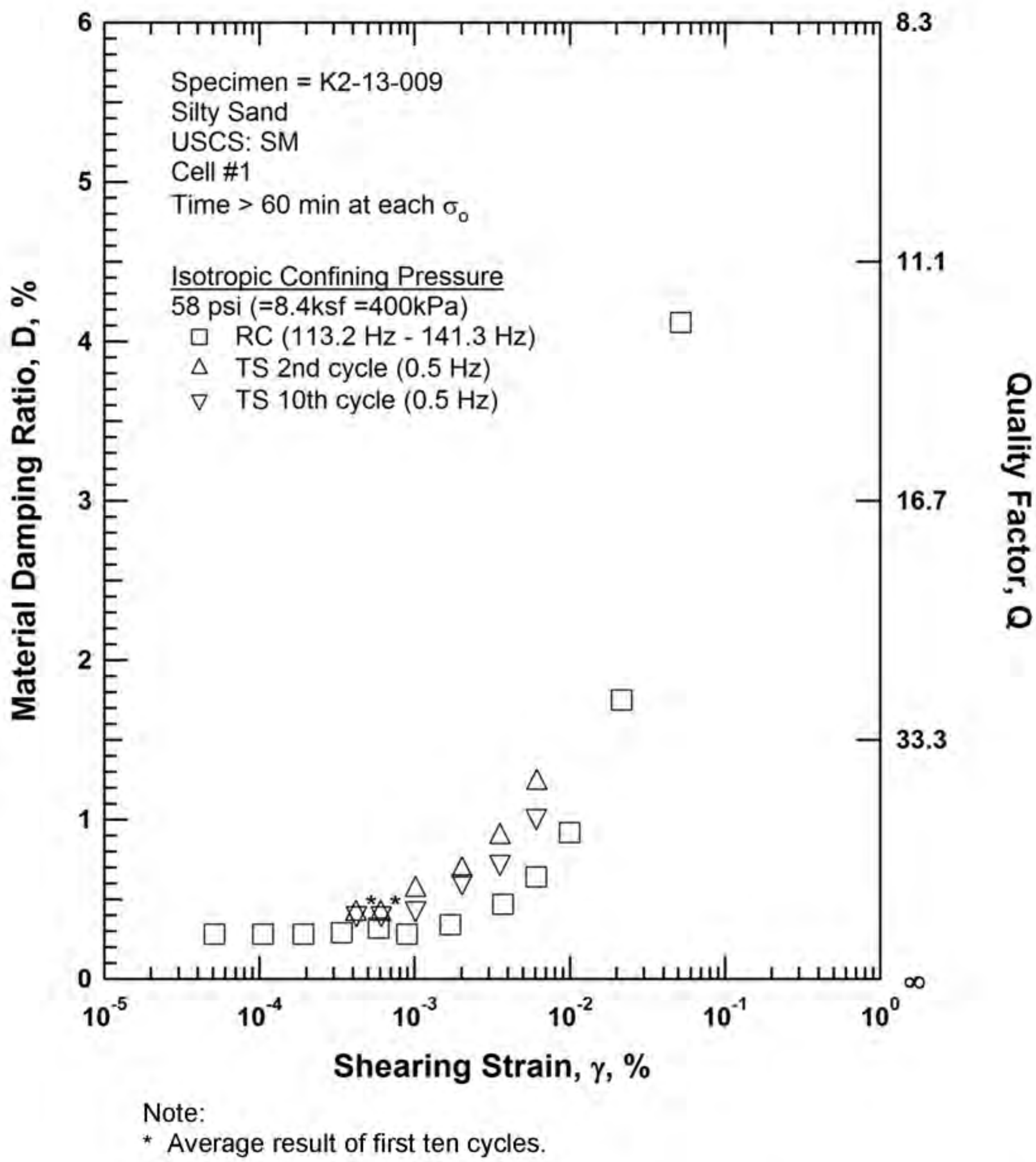


Figure J.15 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 58 psi (=8.4ksf =400kPa) from the Combined RCTS Tests of Specimen K2-13-009

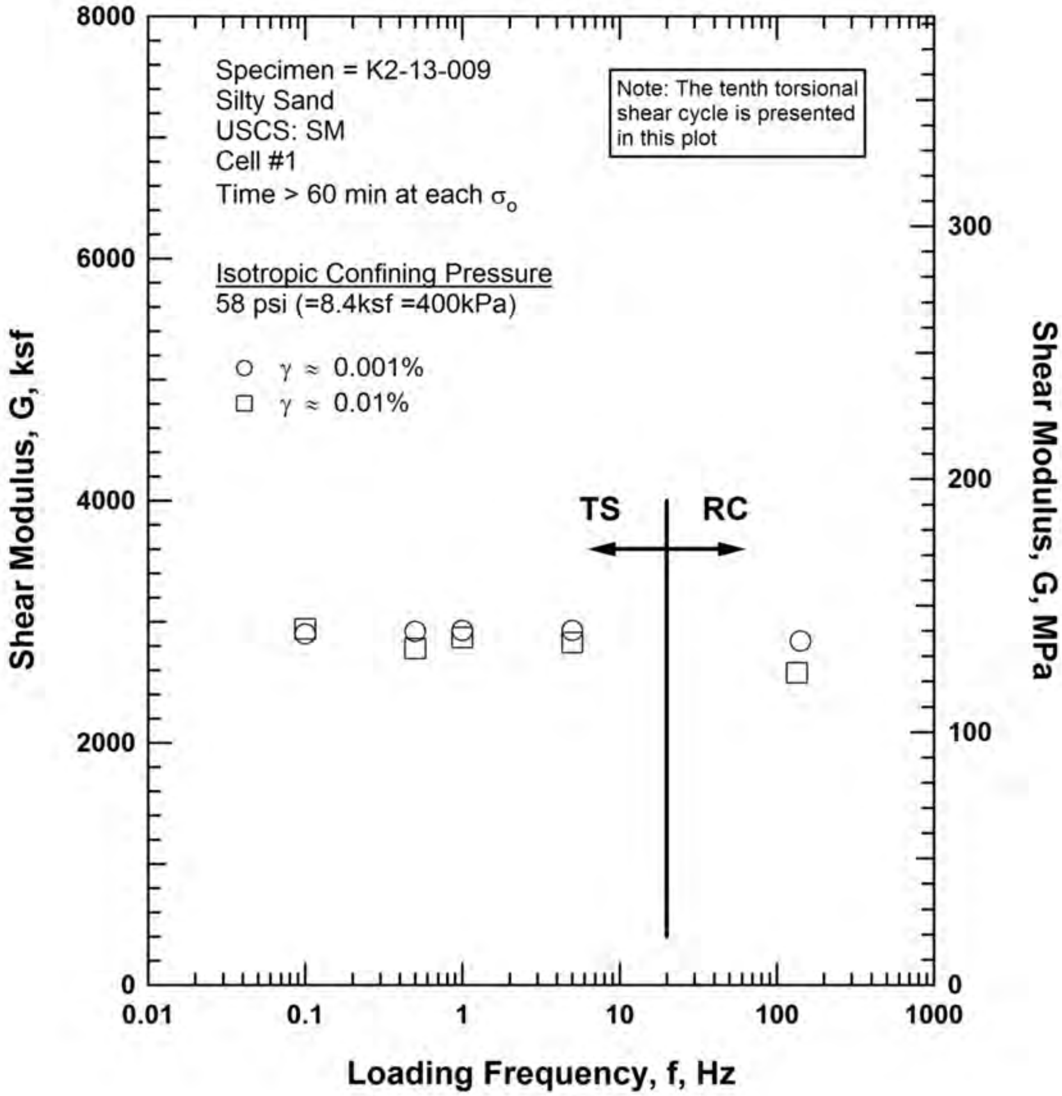


Figure J.16 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 58 psi (=8.4ksf =400kPa) from the Combined RCTS Tests of Specimen K2-13-009

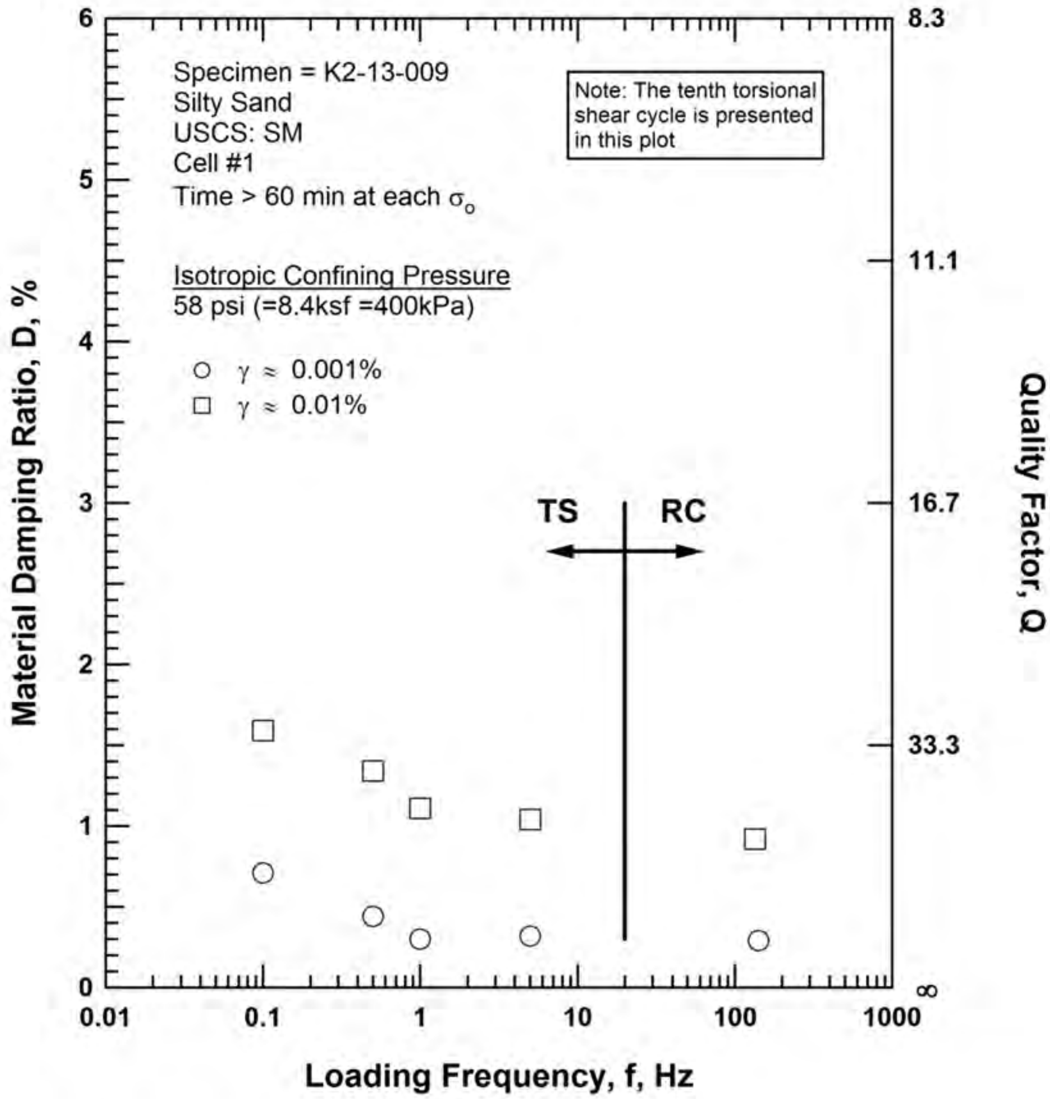


Figure J.17 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 58 psi (=8.4ksf =400kPa) from the Combined RCTS Tests of Specimen K2-13-009

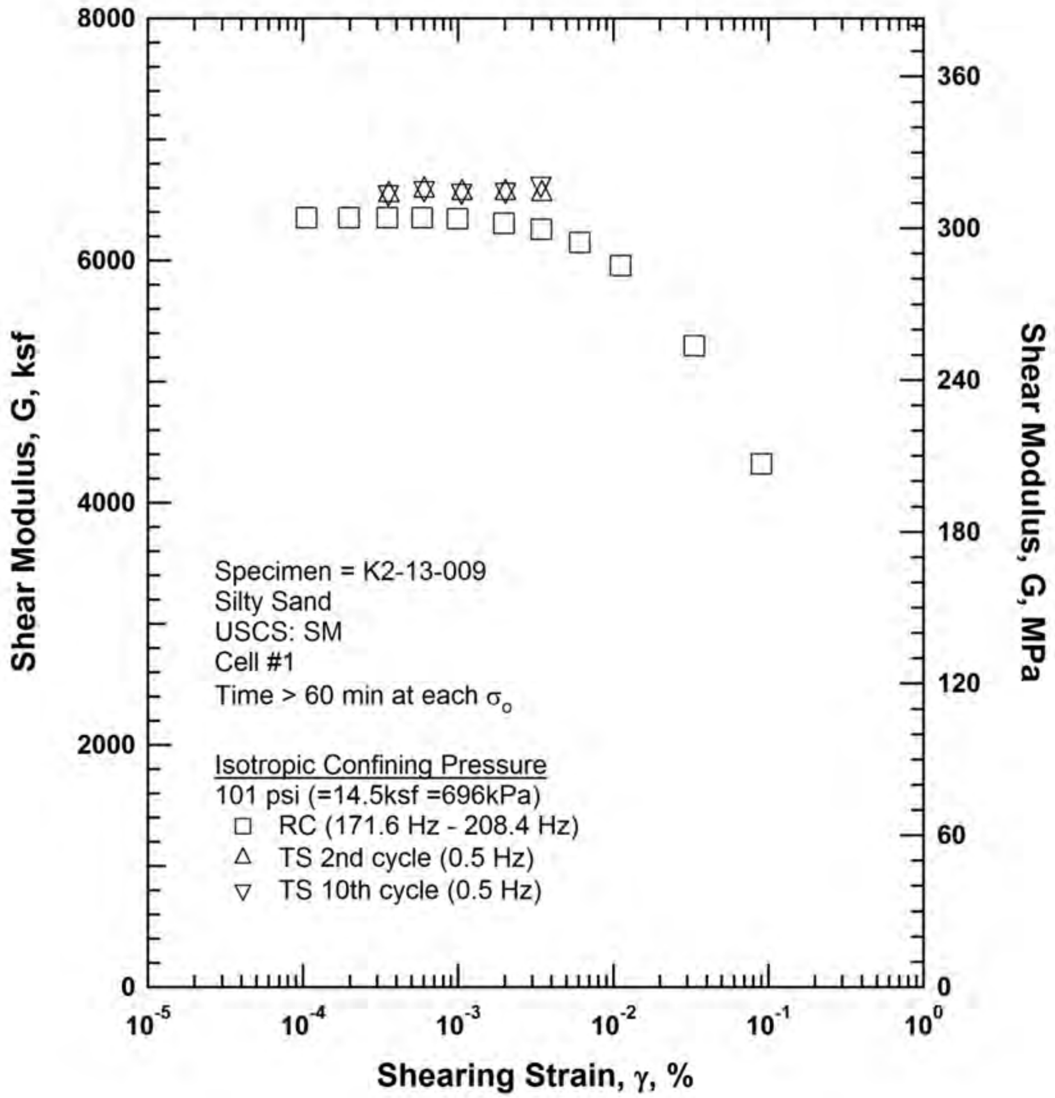


Figure J.18 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 232 psi (=33.4ksf =1600kPa) from the Combined RCTS Tests of Specimen K2-13-009

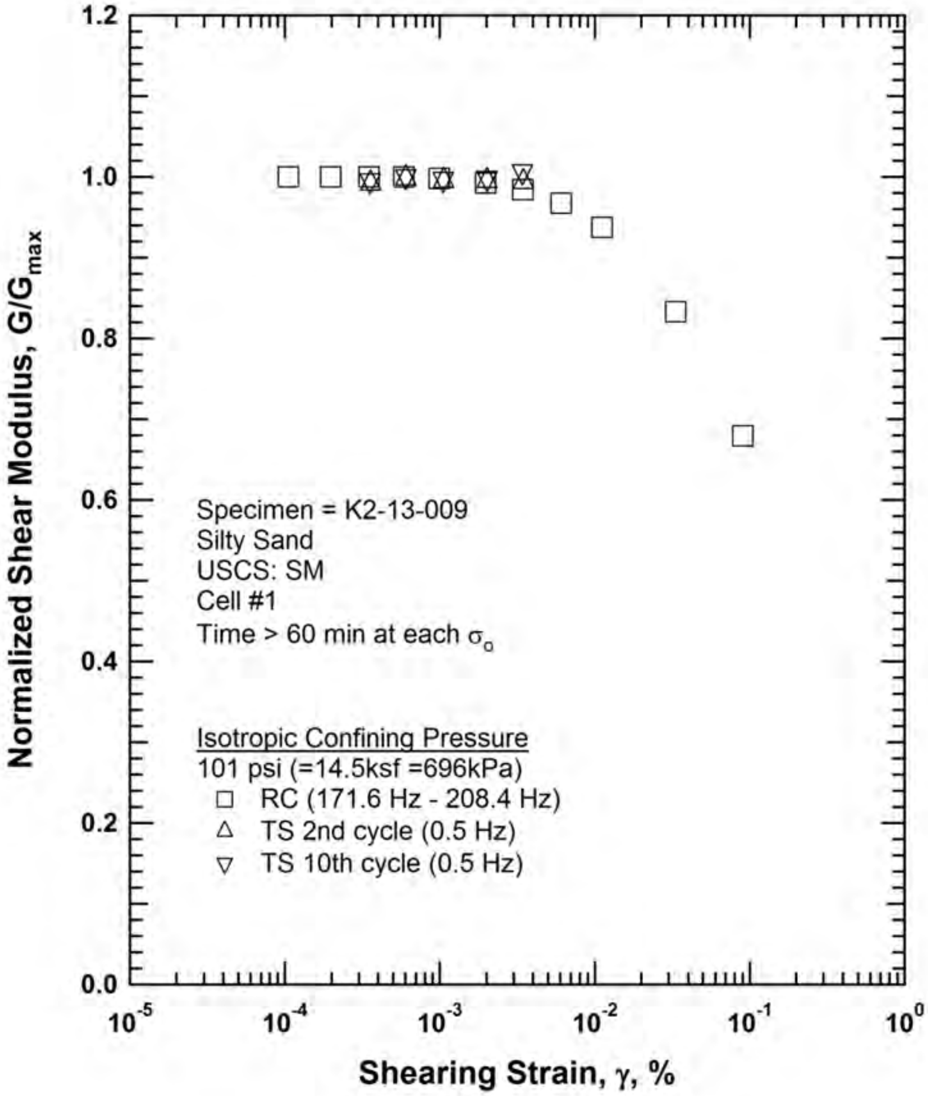
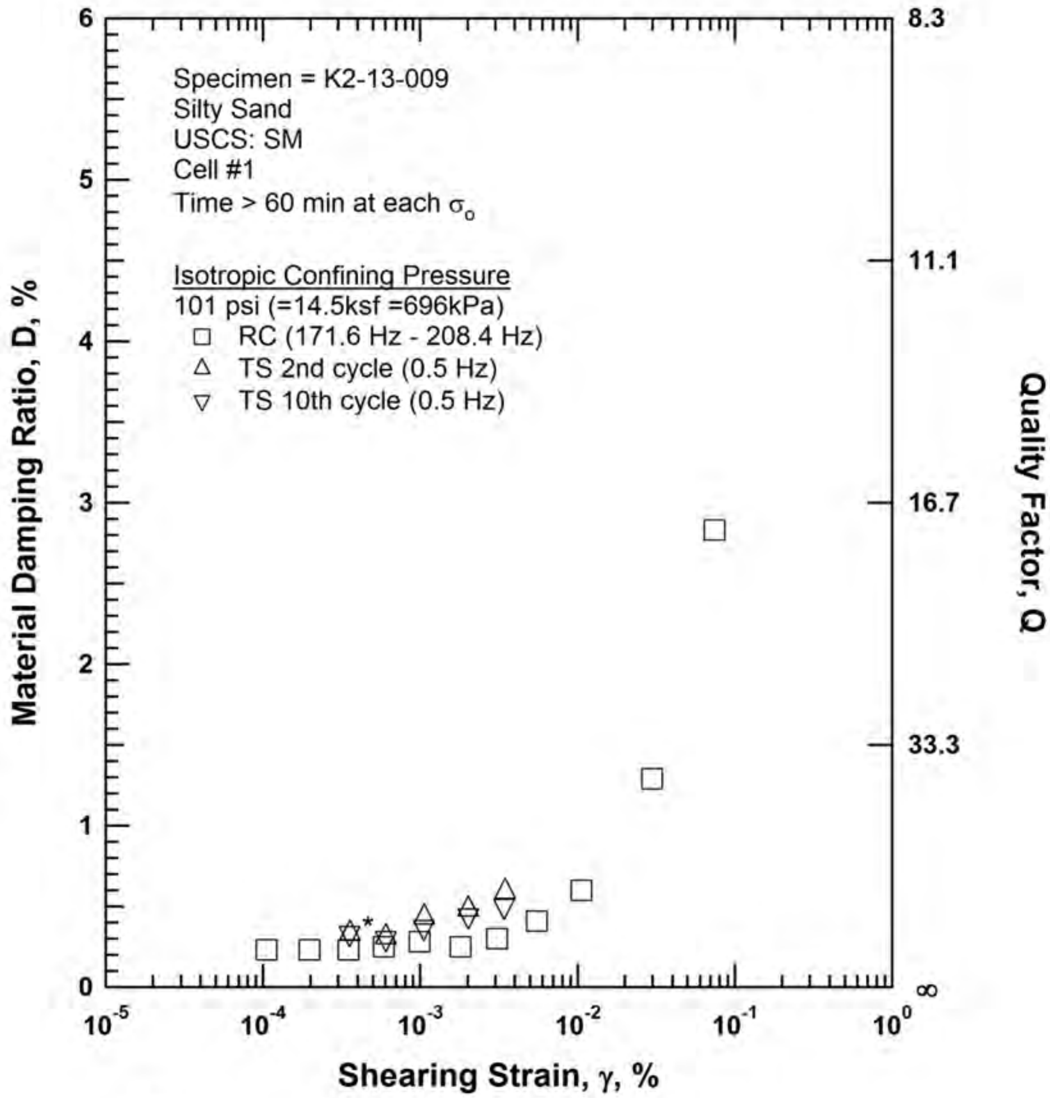


Figure J.19 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 232 psi (=33.4ksf =1600kPa) from the Combined RCTS Tests of Specimen K2-13-009



Note:
* Average result of first ten cycles.

Figure J.20 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 232 psi (=33.4ksf =1600kPa) from the Combined RCTS Tests of Specimen K2-13-009

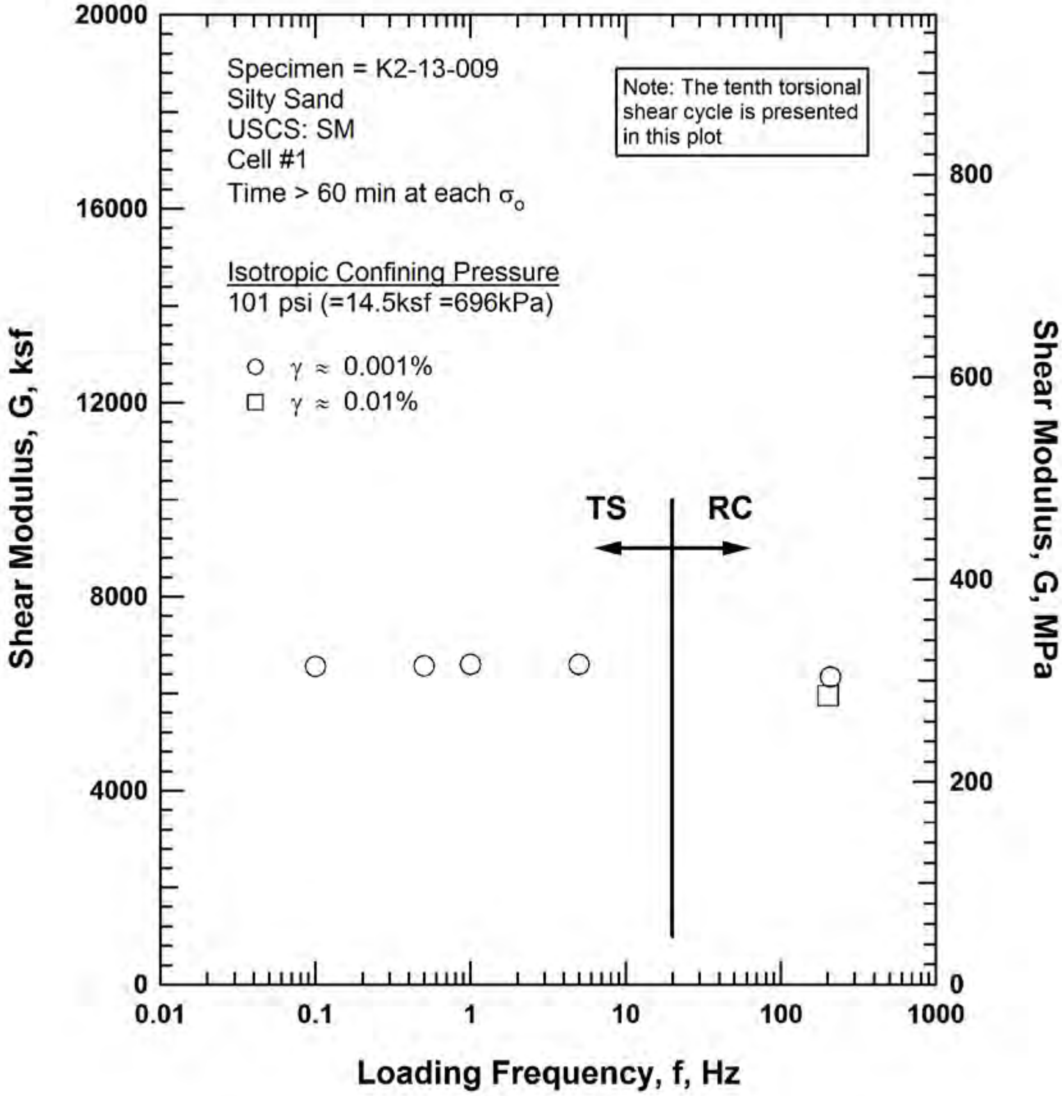


Figure J.21 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 232 psi (=33.4ksf =1600kPa) from the Combined RCTS Tests of Specimen K2-13-009

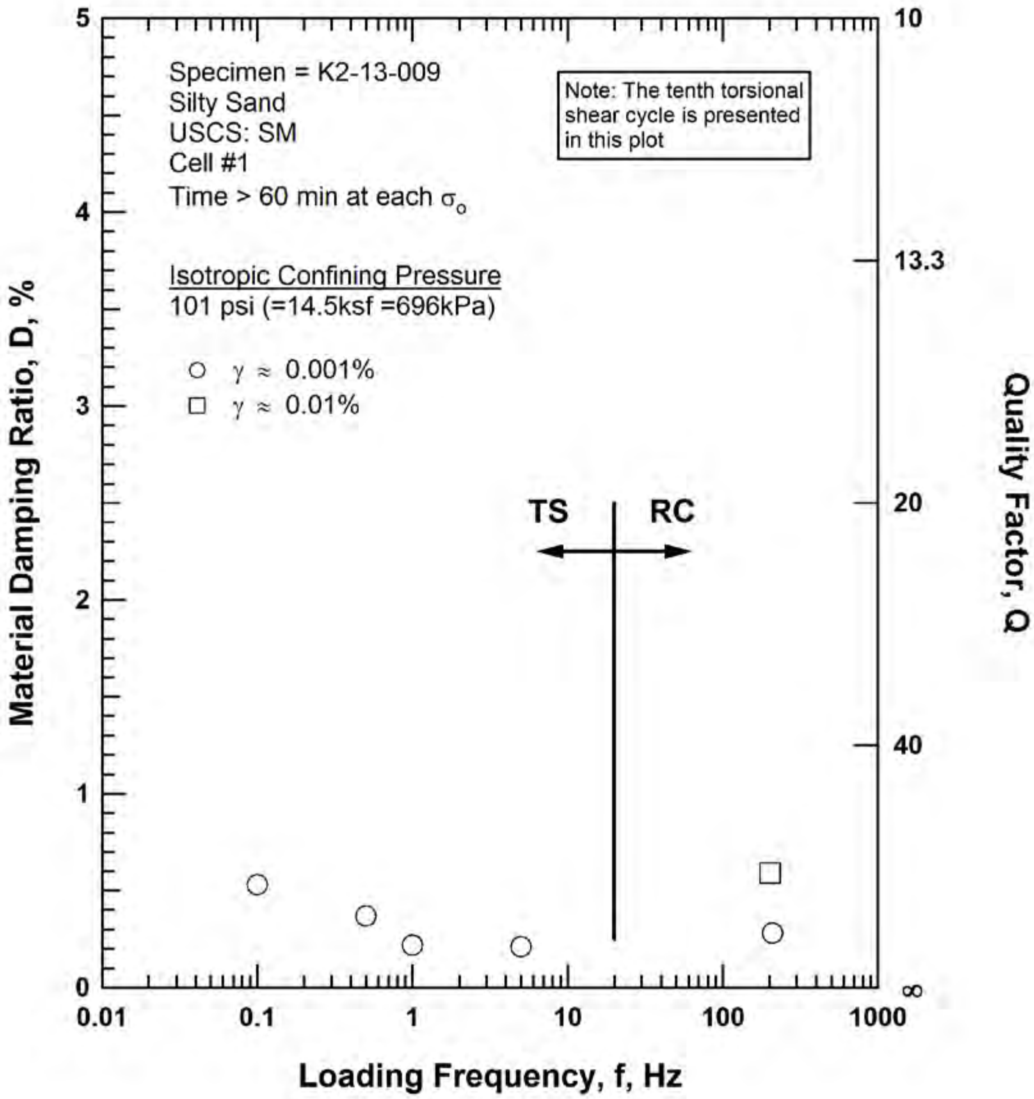


Figure J.22 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 232 psi (=33.4ksf =1600kPa) from the Combined RCTS Tests of Specimen K2-13-009

Table J.1 Variation in Low-Amplitude Shear Wave Velocity, Low-Amplitude Shear Modulus, Low-Amplitude Material Damping Ratio, Estimated Void Ratio, and Estimated Total Unit Weight with Isotropic Confining Pressure from RC Tests of Specimen K2-13-009

Isotropic Confining Pressure, σ_o			Low-Amplitude Shear Modulus, G_{max}		Low-Amplitude Shear Wave Velocity, V_s	Low-Amplitude Material Damping Ratio, D_{min}	Estimated Void Ratio, e	Estimated Total Unit Weight, γ_t
(psi)	(psf)	(kPa)	(ksf)	(MPa)	(fps)	(%)	(Unitless)	(pcf)
14	2016	97	1340	64	600	0.45	0.768	120.2
29	4176	200	1940	93	720	0.37	0.757	120.6
58	8352	400	2780	133	860	0.32	0.746	121.0
101	14544	696	3930	188	1020	0.26	0.733	121.4
101(1)	14544	696	4230	203	1060	0.28	0.712	122.1
232	33408	1600	6250	299	1280	0.25	0.697	122.7

(1) Retest of 101 psi Confining Pressure after Adjustment of System to Prevent Contact of the Coil and Magnets at the 232 psi Confining Pressure

Table J.2 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen K2-13-009; Isotropic Confining Pressure σ_o = 58 psi (=8.4 ksf = 400 kPa)

Second Cycle				Tenth Cycle			
Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
4.17E-04(1)	2930	1.00	0.41	4.20E-04(1)	2910	0.99	0.41
6.04E-04(1)	2940	1.00	0.41	6.07E-04(1)	2920	0.99	0.41
1.01E-03	2920	0.99	0.56	1.01E-03	2920	0.99	0.44
2.01E-03	2900	0.99	0.68	2.01E-03	2900	0.99	0.61
3.53E-03	2860	0.97	0.89	3.53E-03	2860	0.97	0.73
6.11E-03	2800	0.95	1.23	6.08E-03	2820	0.96	1.02

(1) Damping Results were Averaged for the First Ten Cycles at this Shearing Strain

Table J.3 Variation in Shear Modulus, Normalized Shear Modulus, and Material Damping with Shearing Strain from RC Tests of Specimen K2-13-009; Isotropic Confining Pressure σ_o = 58 psi (=8.4 ksf = 400 kPa)

Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average Shearing Strain, %[1]	Material Damping Ratio, D, %[2]
5.11E-05	2850	1.00	5.11E-05	0.28
1.05E-04	2850	1.00	1.05E-04	0.28
1.92E-04	2850	1.00	1.92E-04	0.28
3.39E-04	2850	1.00	3.39E-04	0.29
5.87E-04	2850	1.00	5.87E-04	0.32
9.69E-04	2840	1.00	8.90E-04	0.28
1.90E-03	2810	0.99	1.70E-03	0.34
4.04E-03	2750	0.96	3.69E-03	0.47
6.50E-03	2690	0.94	6.09E-03	0.64
1.07E-02	2580	0.90	9.99E-03	0.92
2.48E-02	2280	0.80	2.15E-02	1.75
7.14E-02	1830	0.64	5.18E-02	4.12

(1) Average Shearing Strain from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

(2) Average Damping Ratio from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

Table J.4 Variation in Shear Modulus and Material Damping with Frequency from RC/TS Tests of Specimen K2-13-009; Isotropic Confining Pressure σ_o = 58 psi (=8.4 ksf = 400 kPa)

Approximate Shearing Strain, γ, %	Frequency, Hz	Shear Modulus, G, ksf	Material Damping Ratio, D, %
0.001	0.1	2900	0.71
	0.5	2920	0.44
	1.0	2930	0.30
	5.0	2930	0.32
	141.1	2840	0.29
0.01	0.1	2940	1.59
	0.5	2780	1.34
	1.0	2870	1.11
	5.0	2830	1.04
	129.7	3750	6.34

Table J.5 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen K2-13-009; Isotropic Confining Pressure σ_o = 232 psi (=33.4 ksf = 1600 kPa)

Second Cycle				Tenth Cycle			
Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
3.56E-04[(1)]	6540	0.99	0.33	3.55E-04[(1)]	6560	1.00	0.33
6.02E-04	6580	1.00	0.31	6.02E-04	6590	1.00	0.30
1.06E-03	6560	1.00	0.43	1.05E-03	6570	1.00	0.37
2.02E-03	6560	1.00	0.48	2.01E-03	6580	1.00	0.44
3.47E-03	6550	0.99	0.59	3.42E-03	6630	1.01	0.50

[(1)] Damping Results were Averaged for the First Ten Cycles at this Shearing Strain

Table J.6 Variation in Shear Modulus, Normalized Shear Modulus, and Material Damping with Shearing Strain from RC Tests of Specimen K2-13-009; Isotropic Confining Pressure σ_o = 232 psi (=33.4 ksf = 1600 kPa)

Peak Shearing Strain, γ, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average Shearing Strain, %[(1)]	Material Damping Ratio, D, %[(2)]
1.05E-04	6360	1.00	1.05E-04	0.23
1.98E-04	6360	1.00	1.98E-04	0.23
3.49E-04	6360	1.00	3.49E-04	0.23
5.85E-04	6360	1.00	5.85E-04	0.25
9.89E-04	6350	1.00	9.89E-04	0.28
1.98E-03	6310	0.99	1.80E-03	0.25
3.43E-03	6260	0.98	3.07E-03	0.30
6.07E-03	6150	0.97	5.51E-03	0.41
1.11E-02	5960	0.94	1.05E-02	0.60
3.32E-02	5300	0.83	2.97E-02	1.29
8.99E-02	4320	0.68	7.40E-02	2.83

[(1)] Average Shearing Strain from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

[(2)] Average Damping Ratio from the First Three Cycle of the Free Vibration Decay Curve or from Half Power Damping for shearing strains less than 0.001%

Table J.7 Variation in Shear Modulus and Material Damping with Frequency from RC/TS Tests of Specimen K2-13-009; Isotropic Confining Pressure σ_o = 232 psi (=33.4 ksf = 1600 kPa)

Approximate Shearing Strain, γ, %	Frequency, Hz	Shear Modulus, G, ksf	Material Damping Ratio, D, %
0.001	0.1	6560	0.53
	0.5	6570	0.37
	1	6600	0.22
	5	6600	0.21
	208.2	6350	0.28
0.011	0.1	n/a	n/a
	0.5	n/a	n/a
	1	n/a	n/a
	5	n/a	n/a
	201.8	5960	0.59

APPENDIX C

GEOTECHNICS LABORATORY TESTING RESULTS

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January 21, 2014

Project No. 2013-465-01,02,03

Mr. Onur Tastan, PhD, P.E.
Project Director
Paul C. Rizzo & Associates, Inc.
Penn Center East
500 Penn Center Blvd., Suite 100
Pittsburgh, PA 15235

Transmittal
Laboratory Test Results
Turkey Point Nuclear Power Plant Units 6&7
Project Number #13-5054
Report Revision 2

Please find attached the requested laboratory test results as requested in the Executed Agreement for Laboratory Services dated October 29, 2013 for the Turkey Point Nuclear Power Plant located near Homestead, Florida.

The tests were outlined on the Project Verification Form that was transmitted to your firm prior to the testing. The testing was performed in general accordance with the methods listed on the enclosed data sheets. The test results are believed to be representative of the samples that were submitted for testing and are indicative only of the specimens which were evaluated. We have no direct knowledge of the origin of the samples and imply no position with regard to the nature of the test results, i.e. pass/fail and no claims as to the suitability of the material for its intended use.

The test data and all associated project information provided shall be held in strict confidence and disclosed to other parties only with authorization by our Client. The test data submitted herein is considered integral with this report and is not to be reproduced except in whole and only with the authorization of the Client and Geotechnics. The remaining sample materials for this project will be retained for a minimum of 90 days as directed by the Geotechnics' Quality Program.

We are pleased to provide these testing services. Should you have any questions or if we may be of further assistance, please contact our office.

Respectively submitted,
Geotechnics, Inc.

Randy O'Rourke
President

David R. Backstrom
Laboratory Director

We understand that you have a choice in your laboratory services and we thank you for choosing Geotechnics.

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	147.7-149.8
Project No.:	2013-465-001	Shelby Tube No.:	ST-3
Lab ID:	2013-465-001-021	Recovery (ft):	1.7

MOISTURE CONTENT

Section Number	**1**	**2**	**3**	**4**	**5**
Tare Number	561				
Weight of Tare & Wet Sample (g)	197.20				
Weight of Tare & Dry Sample (g)	171.80				
Weight of Tare (g)	86.47				
Moisture Content (%)	29.77				

UNIT WEIGHT

	1	2	3	4	5
Weight of Tube & Wet Sample (g)		1626.93	1612.13	1583.15	
Weight of Tube (g)		442.88	440.48	430.65	
Weight of Wet Sample (g)		1184.05	1171.65	1152.50	
Length 1 (in)		5.944	5.910	5.803	
Length 2 (in)		5.945	5.912	5.813	
Length 3 (in)		5.951	5.906	5.826	
Top Diameter (in)		2.888	2.881	2.877	
Middle Diameter (in)		2.889	2.872	2.875	
Bottom Diameter (in)		2.870	2.868	2.878	
Sample Volume (cm^3)		635.85	628.06	619.22	
Moisture Content (%)		29.77	29.77	29.77	
Unit Wet Weight (g/cm^3)		1.86	1.87	1.86	
Unit Wet Weight (pcf)		116.20	116.41	116.14	
Unit Dry Weight (g/cm^3)		**1.44**	**1.44**	**1.43**	
Unit Dry Weight (pcf)		**89.5**	**89.7**	**89.5**	

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
147.8				TOP OF MATERIAL	
148.3		4		GREENISH GRAY SILTY SAND	C.U., UNIT WGT. GRAIN SIZE, HYDROMETER, LIMITS, SP. GR.
148.8		3			C.U., UNIT WGT.
149.3		2			C.U., UNIT WGT.
149.8		1			W.C.

Note *: When full recovery is not achieved, the elevation can not be accurately definei*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JCM*	Date	*11/11/13*	Checked By	CLK	Date	12/6/13

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Shelby Tube Unit Weight

ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	147.7-149.8
Project No.	2013-465-001	Sample No.	ST-3
Lab ID #	2013-465-001-021	Recovery (ft)	1.7

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	162.5-165.2
Project No.:	2013-465-001	Shelby Tube No.:	ST-5
Lab ID:	2013-465-001-022	Recovery (ft):	2.4

MOISTURE CONTENT

Section Number	1	2	3	4	5
Tare Number	897				
Weight of Tare & Wet Sample (g)	238.02				
Weight of Tare & Dry Sample (g)	208.58				
Weight of Tare (g)	109.72				
Moisture Content (%)	29.78				

UNIT WEIGHT

	2	3	4
Weight of Tube & Wet Sample (g)	1633.46	1652.60	1623.36
Weight of Tube (g)	448.59	451.45	441.13
Weight of Wet Sample (g)	1184.87	1201.15	1182.23
Length 1 (in)	5.948	5.997	5.880
Length 2 (in)	5.948	5.991	5.877
Length 3 (in)	5.938	6.000	5.885
Top Diameter (in)	2.881	2.869	2.872
Middle Diameter (in)	2.866	2.861	2.878
Bottom Diameter (in)	2.864	2.860	2.878
Sample Volume (cm^3)	630.35	632.70	626.03
Moisture Content (%)	29.78	29.78	29.78
Unit Wet Weight (g/cm^3)	1.88	1.90	1.89
Unit Wet Weight (pcf)	117.29	118.46	117.84
Unit Dry Weight (g/cm^3)	**1.45**	**1.46**	**1.46**
Unit Dry Weight (pcf)	**90.4**	**91.3**	**90.8**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
163.2					
163.7		4			C.U., UNIT WGT
164.2		3		GREENISH GRAY SANDY SILT	C.U., UNIT WGT
164.7		2			C.U., UNIT WGT., GRAIN SIZE, HYDROMETER, LIMITS, SP. GR.
165.2		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JCM*	Date	*10/29/13*	Checked By	CLK	Date	12/6/13

 DCN: CT-S37 DATE:4-10-13 REVISION: 3 *Shelby.xls*

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Shelby Tube Unit Weight

ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	162.5-165.2
Project No.	2013-465-001	Sample No.	ST-5
Lab ID #	2013-465-001-022	Recovery (ft)	2.4

Equipment	Equipment ID#	Calibration Due Date
Oven	G256	10/12/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Balance	NA	NA

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A-358

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	177.3-180.0
Project No.:	2013-465-001	Shelby Tube No.:	ST-9
Lab ID:	2013-465-001-023	Recovery (ft):	2.6

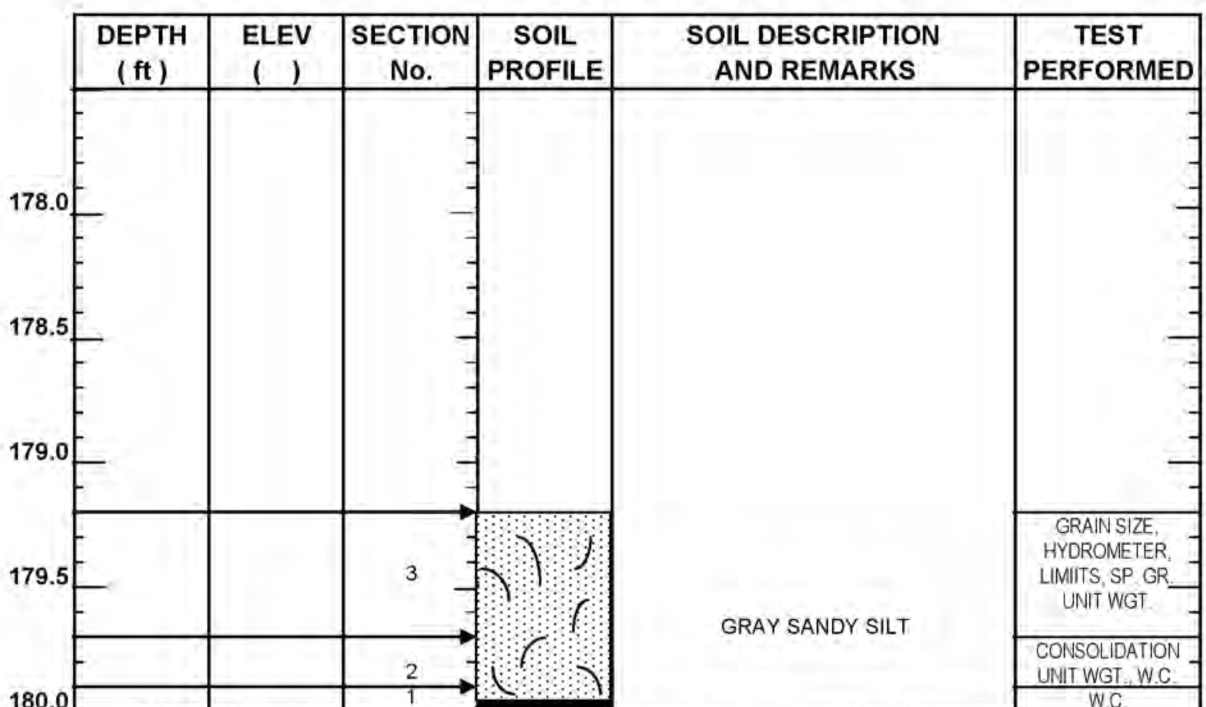
MOISTURE CONTENT

Section Number	1	2	3
Tare Number	2636	2653	
Weight of Tare & Wet Sample (g)	109.14	122.78	
Weight of Tare & Dry Sample (g)	84.23	95.05	
Weight of Tare (g)	6.74	6.64	
Moisture Content (%)	32.15	31.37	

UNIT WEIGHT

	1	2	3
Weight of Tube & Wet Sample (g)		570.37	1618.94
Weight of Tube (g)		157.49	448.31
Weight of Wet Sample (g)		412.88	1170.63
Length 1 (in)		2.092	5.927
Length 2 (in)		2.109	5.949
Length 3 (in)		2.080	5.937
Top Diameter (in)		2.878	2.888
Middle Diameter (in)		2.869	2.879
Bottom Diameter (in)		2.867	2.887
Sample Volume (cm^3)		222.16	635.91
Moisture Content (%)		31.37	31.37
Unit Wet Weight (g/cm^3)		1.86	1.84
Unit Wet Weight (pcf)		115.97	114.87
Unit Dry Weight (g/cm^3)		**1.41**	**1.40**
Unit Dry Weight (pcf)		**88.3**	**87.4**

SOIL PROFILE AND SAMPLING



***Note**: When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JAM*	Date	*11/7/13*	Checked By	CLK	Date	11/25/13

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Shelby Tube Unit Weight

ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	177.3-180.0
Project No.	2013-465-001	Sample No.	ST-9
Lab ID #	2013-465-001-023	Recovery (ft)	2.6

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	184.7-187.4
Project No.:	2013-465-001	Shelby Tube No.:	ST-11
Lab ID:	2013-465-001-024	Recovery (ft):	2.7

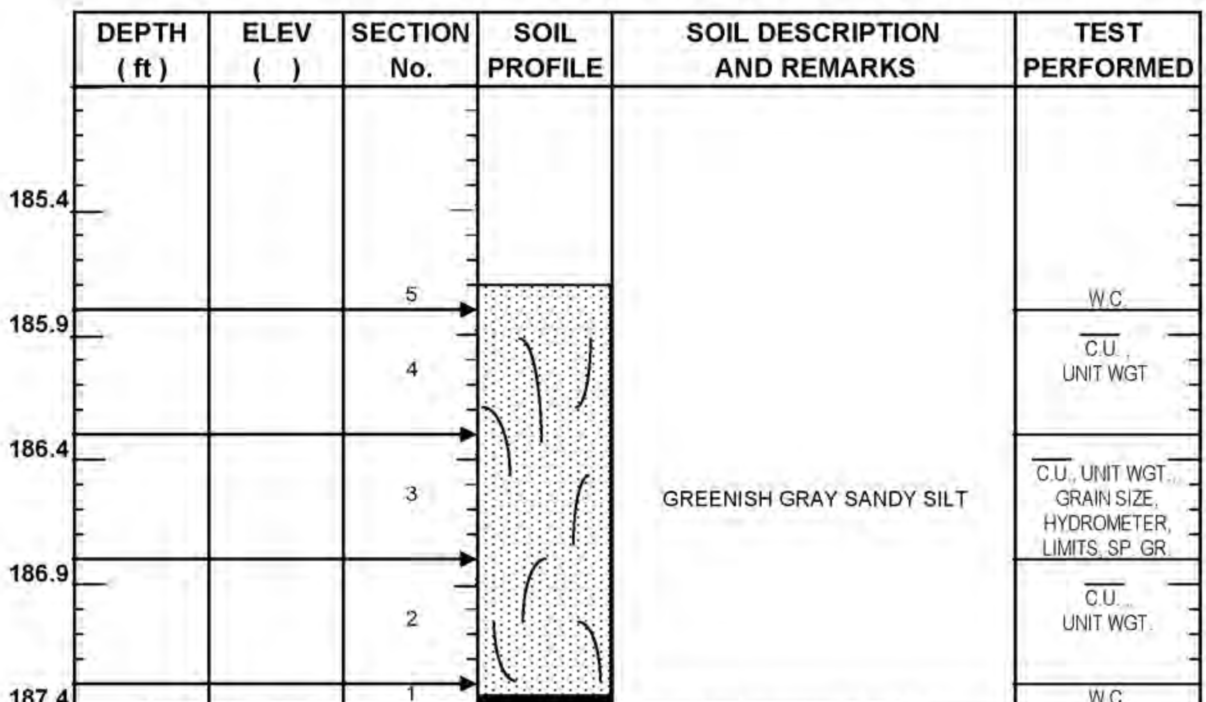
MOISTURE CONTENT

Section Number	**1**	**2**	**3**	**4**	**5**
Tare Number	1125				1125
Weight of Tare & Wet Sample (g)	262.02				161.41
Weight of Tare & Dry Sample (g)	218.10				141.61
Weight of Tare (g)	83.85				83.82
Moisture Content (%)	32.72				34.26

UNIT WEIGHT

	2	3	4
Weight of Tube & Wet Sample (g)	1617.76	1624.82	1608.19
Weight of Tube (g)	446.52	446.24	442.73
Weight of Wet Sample (g)	1171.24	1178.58	1165.46
Length 1 (in)	5.954	5.956	5.928
Length 2 (in)	5.957	5.961	5.936
Length 3 (in)	5.958	5.953	5.939
Top Diameter (in)	2.863	2.879	2.863
Middle Diameter (in)	2.870	2.866	2.869
Bottom Diameter (in)	2.869	2.863	2.874
Sample Volume (cm^3)	630.27	631.18	628.53
Moisture Content (%)	32.72	32.72	34.26
Unit Wet Weight (g/cm^3)	1.86	1.87	1.85
Unit Wet Weight (pcf)	115.96	116.52	115.71
Unit Dry Weight (g/cm^3)	**1.40**	**1.41**	**1.38**
Unit Dry Weight (pcf)	**87.4**	**87.8**	**86.2**

SOIL PROFILE AND SAMPLING



***Note**: When full recovery is not achieved, the elevation can not be accurately definec*
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Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JM*	Date	*11/1/13*	Checked By	CLK	Date	12/3/13

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Shelby Tube Unit Weight
ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	184.7-187.4
Project No.	2013-465-001	Sample No.	ST-11
Lab ID #	2013-465-001-024	Recovery (ft)	2.7

Equipment	Equipment ID#	Calibration Due Date
Oven	G256	10/12/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Balance	G1395	6/4/14

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	192.1-194.8
Project No.:	2013-465-001	Shelby Tube No.:	ST-13
Lab ID:	2013-465-001-025	Recovery (ft):	2.7

MOISTURE CONTENT

Section Number	**1**	**2**
Tare Number	2695	
Weight of Tare & Wet Sample (g)	207.09	
Weight of Tare & Dry Sample (g)	160.95	
Weight of Tare (g)	6.67	
Moisture Content (%)	29.91	

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	1861.30
Weight of Tube (g)	518.92
Weight of Wet Sample (g)	1342.38
Length 1 (in)	6.732
Length 2 (in)	6.725
Length 3 (in)	6.726
Top Diameter (in)	2.881
Middle Diameter (in)	2.882
Bottom Diameter (in)	2.886
Sample Volume (cm^3)	719.69
Moisture Content (%)	29.91
Unit Wet Weight (g/cm^3)	1.87
Unit Wet Weight (pcf)	116.39
Unit Dry Weight (g/cm^3)	**1.44**
Unit Dry Weight (pcf)	**89.6**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
192.8					
193.3					
193.8					
194.3		2		GRAY SANDY SILT	GRAIN SIZE, HYDROMETER, LIMITS, SP. GR., UNIT WGT.
194.8		1			W.C.

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Tested By	*JAM*	Date	*11/7/13*	Checked By	CLK	Date	11/25/13

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Shelby Tube Unit Weight

ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	192.1-194.8
Project No.	2013-465-001	Sample No.	ST-13
Lab ID #	2013-465-001-025	Recovery (ft)	2.7

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	199.5-202.2
Project No.:	2013-465-001	Shelby Tube No.:	ST-15
Lab ID:	2013-465-001-026	Recovery (ft):	2.3

MOISTURE CONTENT

Section Number	**1**	**2**	**3**	**4**	**5**
Tare Number	1692				575
Weight of Tare & Wet Sample (g)	215.32				205.12
Weight of Tare & Dry Sample (g)	193.40				174.97
Weight of Tare (g)	82.55				82.49
Moisture Content (%)	19.77				32.60

UNIT WEIGHT

	1	2	3	4	5
Weight of Tube & Wet Sample (g)		1666.61	1663.99	1639.47	
Weight of Tube (g)		446.64	450.04	445.95	
Weight of Wet Sample (g)		1219.97	1213.95	1193.52	
Length 1 (in)		5.955	5.998	5.958	
Length 2 (in)		5.958	6.009	5.947	
Length 3 (in)		5.964	6.008	5.940	
Top Diameter (in)		2.882	2.868	2.872	
Middle Diameter (in)		2.874	2.873	2.878	
Bottom Diameter (in)		2.878	2.863	2.877	
Sample Volume (cm^3)		635.25	635.71	633.09	
Moisture Content (%)		19.77	19.77	19.77	
Unit Wet Weight (g/cm^3)		1.92	1.91	1.89	
Unit Wet Weight (pcf)		119.84	119.16	117.64	
Unit Dry Weight (g/cm^3)		**1.60**	**1.59**	**1.57**	
Unit Dry Weight (pcf)		**100.1**	**99.5**	**98.2**	

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
200.2					
		5			W.C.
200.7		4			C.U., UNIT WGT
201.2		3		GREENISH GRAY SANDY SILT	C.U., UNIT WGT.
201.7		2			C.U., UNIT WGT. GRAIN SIZE, HYDROMETER, LIMITS
		1			W.C.
202.2					

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Tested By	*JM*	Date	*11/1/13*	Checked By	CLK	Date	12/3/13

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	199.5-202.2
Project No.	2013-465-001	Sample No.	ST-15
Lab ID #	2013-465-001-026	Recovery (ft)	2.3

Equipment	Equipment ID#	Calibration Due Date
Oven	G256	10/12/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Oven	G1387	8/16/14

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	206.9-209.6
Project No.:	2013-465-001	Shelby Tube No.:	ST-17
Lab ID:	2013-465-001-027	Recovery (ft):	2.7

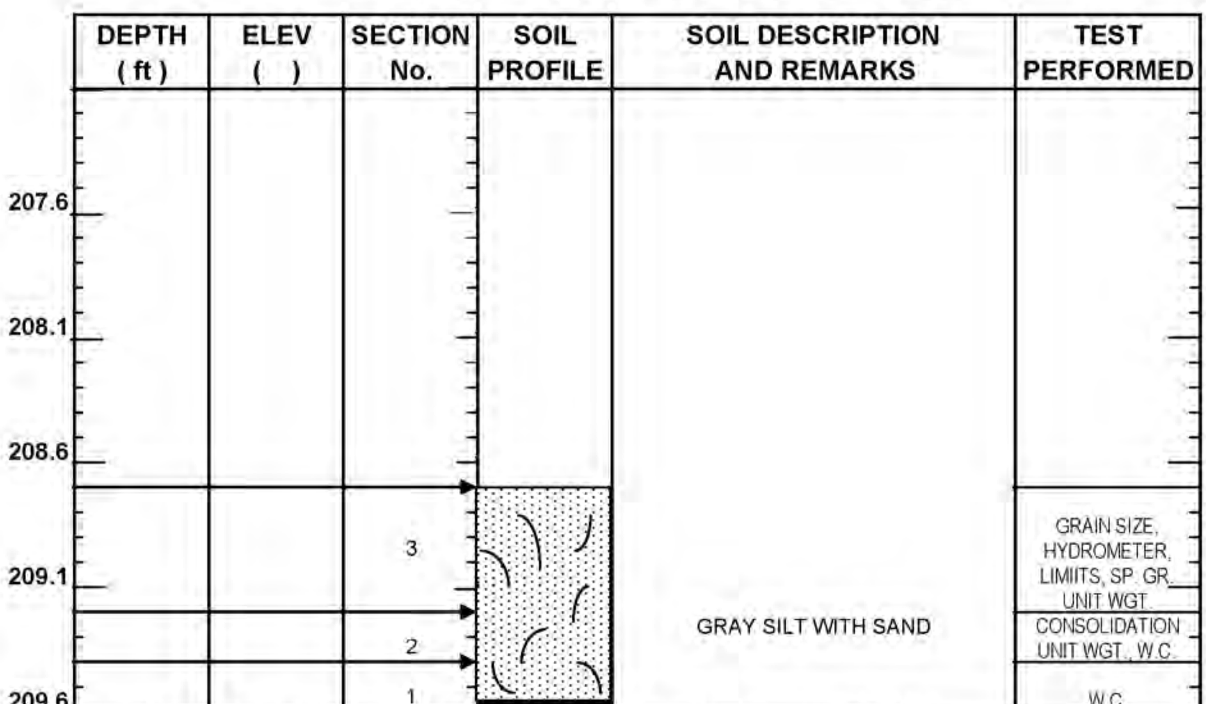
MOISTURE CONTENT

Section Number	1	2	3
Tare Number	2711	2668	
Weight of Tare & Wet Sample (g)	219.20	111.65	
Weight of Tare & Dry Sample (g)	166.83	85.91	
Weight of Tare (g)	6.71	6.92	
Moisture Content (%)	32.71	32.59	

UNIT WEIGHT

	1	2	3
Weight of Tube & Wet Sample (g)		751.89	1661.79
Weight of Tube (g)		204.69	464.39
Weight of Wet Sample (g)		547.20	1197.40
Length 1 (in)		2.758	6.130
Length 2 (in)		2.751	6.136
Length 3 (in)		2.755	6.140
Top Diameter (in)		2.871	2.873
Middle Diameter (in)		2.873	2.875
Bottom Diameter (in)		2.869	2.870
Sample Volume (cm^3)		292.23	651.63
Moisture Content (%)		32.59	32.59
Unit Wet Weight (g/cm^3)		1.87	1.84
Unit Wet Weight (pcf)		116.84	114.66
Unit Dry Weight (g/cm^3)		**1.41**	**1.39**
Unit Dry Weight (pcf)		**88.1**	**86.5**

SOIL PROFILE AND SAMPLING



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Tested By	*JAM*	Date	*11/7/13*	Checked By	CLK	Date	11/25/13

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Shelby Tube Unit Weight

ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	206.9-209.6
Project No.	2013-465-001	Sample No.	ST-17
Lab ID #	2013-465-001-027	Recovery (ft)	2.7

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

SHELBY TUBE UNIT WEIGHT

ASTM D7263-09

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	224.2-226.3
Project No.:	2013-465-001	Shelby Tube No.:	ST-22
Lab ID:	2013-465-001-028	Recovery (ft):	1.5

MOISTURE CONTENT

Section Number	1	2	3	4	5
Tare Number	576			2683	
Weight of Tare & Wet Sample (g)	203.80			230.35	
Weight of Tare & Dry Sample (g)	181.94			194.10	
Weight of Tare (g)	84.40			6.56	
Moisture Content (%)	22.41			19.33	

UNIT WEIGHT

	1	2	3	4	5
Weight of Tube & Wet Sample (g)		1614.12	1673.79		
Weight of Tube (g)		417.72	429.46		
Weight of Wet Sample (g)		1196.40	1244.33		
Length 1 (in)		5.635	5.785		
Length 2 (in)		5.630	5.781		
Length 3 (in)		5.622	5.778		
Top Diameter (in)		2.866	2.866		
Middle Diameter (in)		2.875	2.860		
Bottom Diameter (in)		2.876	2.883		
Sample Volume (cm^3)		597.71	612.75		
Moisture Content (%)		22.41	22.41		
Unit Wet Weight (g/cm^3)		2.00	2.03		
Unit Wet Weight (pcf)		124.90	126.72		
Unit Dry Weight (g/cm^3)		**1.64**	**1.66**		
Unit Dry Weight (pcf)		**102.0**	**103.5**		

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
224.3					
224.8					
		4			CONSOLIDATION, W.C.
225.3		3		GREENISH GRAY SILTY SAND	C.U., UNIT WGT GRAIN SIZE, HYDROMETER, LIMITS, SP. GR.
225.8		2			C.U., UNIT WGT.
226.3		1			W.C.

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Tested By	*JM*	Date	*11/8/13*	Checked By	CLK	Date	12/3/13

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Shelby Tube Unit Weight

ASTM D7263-09

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	224.2-226.3
Project No.	2013-465-001	Sample No.	ST-22
Lab ID #	2013-465-001-028	Recovery (ft)	1.5

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	232.7-235.4
Project No.:	2013-465-001	Shelby Tube No.:	ST-25
Lab ID:	2013-465-001-029	Recovery (ft):	2.4

MOISTURE CONTENT

Section Number	**1**	**2**
Tare Number	2684	
Weight of Tare & Wet Sample (g)	273.40	
Weight of Tare & Dry Sample (g)	215.13	
Weight of Tare (g)	6.76	
Moisture Content (%)	27.96	

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	1728.42
Weight of Tube (g)	447.73
Weight of Wet Sample (g)	1280.69
Length 1 (in)	6.288
Length 2 (in)	6.281
Length 3 (in)	6.279
Top Diameter (in)	2.881
Middle Diameter (in)	2.889
Bottom Diameter (in)	2.874
Sample Volume (cm^3)	671.31
Moisture Content (%)	27.96
Unit Wet Weight (g/cm^3)	1.91
Unit Wet Weight (pcf)	119.04
Unit Dry Weight (g/cm^3)	**1.49**
Unit Dry Weight (pcf)	**93.0**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
233.4					
233.9					
234.4					
234.9		2		GRAY SILTY SAND	GRAIN SIZE, HYDROMETER, LIMITS, SP. GR., UNIT WGT.
235.4		1			W.C.

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Tested By	*JAM*	Date	*11/7/13*	Checked By	CLK	Date	11/25/13

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Shelby Tube Unit Weight

ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	232.7-235.4
Project No.	2013-465-001	Sample No.	ST-25
Lab ID #	2013-465-001-029	Recovery (ft)	2.4

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	250.9-253.3
Project No.:	2013-465-001	Shelby Tube No.:	ST-31
Lab ID:	2013-465-001-030	Recovery (ft):	1.6

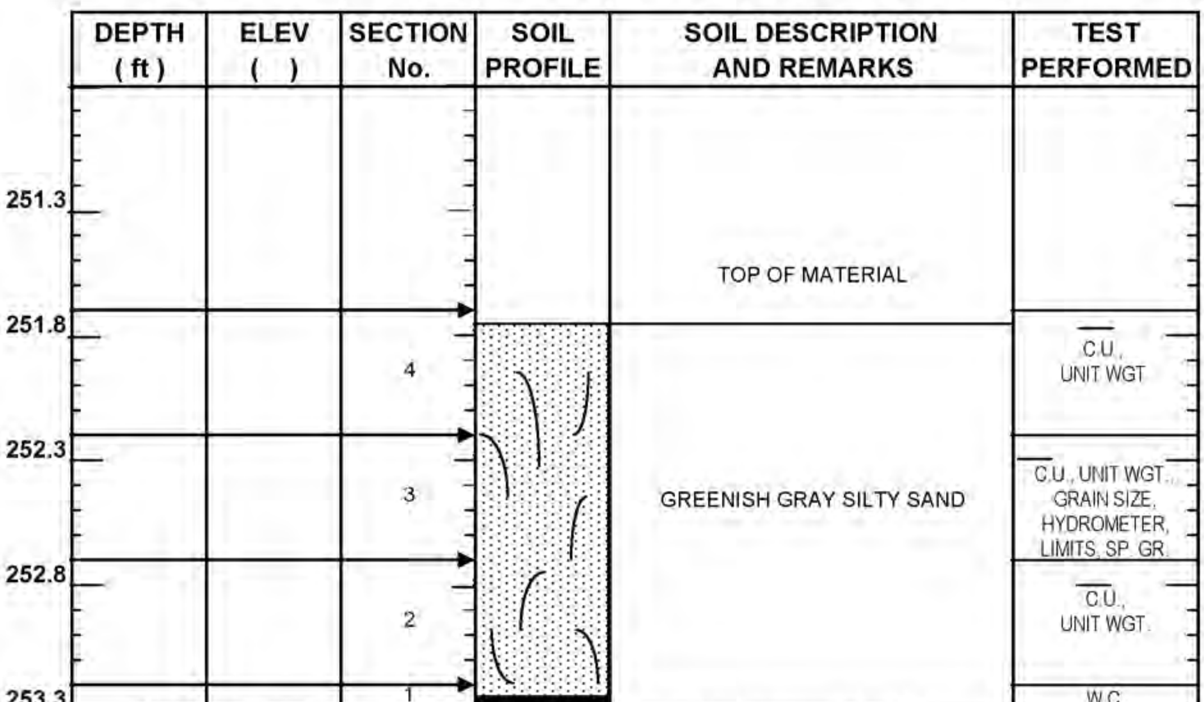
MOISTURE CONTENT

Section Number	**1**	**2**	**3**	**4**	**5**
Tare Number	895				
Weight of Tare & Wet Sample (g)	157.73				
Weight of Tare & Dry Sample (g)	149.60				
Weight of Tare (g)	109.49				
Moisture Content (%)	20.27				

UNIT WEIGHT

	1	2	3	4	5
Weight of Tube & Wet Sample (g)		1646.85	1639.42	1120.10	
Weight of Tube (g)		400.60	402.41	0.00	
Weight of Wet Sample (g)		1246.25	1237.01	1120.10	
Length 1 (in)		5.792	5.833	5.237	
Length 2 (in)		5.802	5.828	5.224	
Length 3 (in)		5.805	5.835	5.235	
Top Diameter (in)		2.878	2.880	2.872	
Middle Diameter (in)		2.873	2.883	2.877	
Bottom Diameter (in)		2.882	2.888	2.878	
Sample Volume (cm^3)		618.12	624.16	556.85	
Moisture Content (%)		20.27	20.27	20.27	
Unit Wet Weight (g/cm^3)		2.02	1.98	2.01	
Unit Wet Weight (pcf)		125.81	123.67	125.52	
Unit Dry Weight (g/cm^3)		**1.68**	**1.65**	**1.67**	
Unit Dry Weight (pcf)		**104.6**	**102.8**	**104.4**	

SOIL PROFILE AND SAMPLING



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Tested By	*JCM*	Date	*11/8/13*	Checked By	CLK	Date	12/6/13

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Shelby Tube Unit Weight
ASTM D2937-10
EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	250.9-253.3
Project No.	2013-465-001	Sample No.	ST-31
Lab ID #	2013-465-001-030	Recovery (ft)	1.6

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	257.8-260.5
Project No.:	2013-465-003	Shelby Tube No.:	ST-33
Lab ID:	2013-465-003-001	Recovery (ft):	NA

MOISTURE CONTENT

Section Number	**1**	**2**	**3**
Tare Number	2661	2773	
Weight of Tare & Wet Sample (g)	177.24	181.61	
Weight of Tare & Dry Sample (g)	142.41	146.32	
Weight of Tare (g)	6.68	6.93	
Moisture Content (%)	25.66	25.32	

UNIT WEIGHT

	1	2	3
Weight of Tube & Wet Sample (g)		691.19	1341.01
Weight of Tube (g)		178.16	348.62
Weight of Wet Sample (g)		513.03	992.39
Length 1 (in)		2.499	4.864
Length 2 (in)		2.495	4.834
Length 3 (in)		2.497	4.851
Top Diameter (in)		2.888	2.871
Middle Diameter (in)		2.872	2.877
Bottom Diameter (in)		2.871	2.875
Sample Volume (cm^3)		266.00	515.68
Moisture Content (%)		25.32	25.32
Unit Wet Weight (g/cm^3)		1.93	1.92
Unit Wet Weight (pcf)		120.35	120.09
Unit Dry Weight (g/cm^3)		**1.54**	**1.54**
Unit Dry Weight (pcf)		**96.0**	**95.8**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
258.5					
259.0					
259.5					
260.0		3			GRAIN SIZE, HYDROMETER, LIMITS, SP. GR., UNIT WGT.
		2		GRAY SILTY SAND	UNIT WGT., W.C., CONSOLIDATION
260.5		1			W.C.

***Note**: When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

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ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	257.8-260.5
Project No.	2013-465-003	Sample No.	ST-33
Lab ID #	2013-465-003-001	Recovery (ft)	NA

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	269.8-272.5
Project No.:	2013-465-001	Shelby Tube No.:	ST-37
Lab ID:	2013-465-001-031	Recovery (ft):	2.1

MOISTURE CONTENT

Section Number	**1**	**2**
Tare Number	2553	
Weight of Tare & Wet Sample (g)	206.51	
Weight of Tare & Dry Sample (g)	168.75	
Weight of Tare (g)	6.68	
Moisture Content (%)	23.30	

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	1723.32
Weight of Tube (g)	457.47
Weight of Wet Sample (g)	1265.85
Length 1 (in)	6.173
Length 2 (in)	6.179
Length 3 (in)	6.187
Top Diameter (in)	2.873
Middle Diameter (in)	2.877
Bottom Diameter (in)	2.871
Sample Volume (cm^3)	656.79
Moisture Content (%)	23.30
Unit Wet Weight (g/cm^3)	1.93
Unit Wet Weight (pcf)	120.26
Unit Dry Weight (g/cm^3)	**1.56**
Unit Dry Weight (pcf)	**97.5**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
270.5					
271.0					
271.5					
272.0		2		GRAY SILTY SAND	GRAIN SIZE, HYDROMETER, LIMITS, UNIT WGT.
272.5		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	269.8-272.5
Project No.	2013-465-001	Sample No.	ST-37
Lab ID #	2013-465-001-031	Recovery (ft)	2.1

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	279.8-282.5
Project No.:	2013-465-001	Shelby Tube No.:	ST-40
Lab ID:	2013-465-001-032	Recovery (ft):	2.7

MOISTURE CONTENT

Section Number	1	2	3	4	5
Tare Number	1692				2620
Weight of Tare & Wet Sample (g)	214.91				117.72
Weight of Tare & Dry Sample (g)	184.40				91.57
Weight of Tare (g)	82.55				7.25
Moisture Content (%)	29.96				31.01

UNIT WEIGHT

	2	3	4
Weight of Tube & Wet Sample (g)	1626.55	1616.50	1631.89
Weight of Tube (g)	419.79	415.46	421.62
Weight of Wet Sample (g)	1206.76	1201.04	1210.27
Length 1 (in)	5.922	5.885	5.941
Length 2 (in)	5.937	5.894	5.973
Length 3 (in)	5.928	5.894	5.952
Top Diameter (in)	2.885	2.882	2.874
Middle Diameter (in)	2.884	2.879	2.888
Bottom Diameter (in)	2.880	2.890	2.883
Sample Volume (cm^3)	634.25	630.48	636.48
Moisture Content (%)	29.96	29.96	29.96
Unit Wet Weight (g/cm^3)	1.90	1.90	1.90
Unit Wet Weight (pcf)	118.73	118.87	118.65
Unit Dry Weight (g/cm^3)	**1.46**	**1.47**	**1.46**
Unit Dry Weight (pcf)	**91.4**	**91.5**	**91.3**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
280.5					
		5			CONSOLIDATION, W.C.
281.0		4			C.U., UNIT WGT., GRAIN SIZE, HYDROMETER, LIMITS, SP. GR.
281.5		3		GREENISH GRAY CLAYEY SAND	C.U., UNIT WGT.
282.0		2			C.U., UNIT WGT.
282.5		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately definer*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JCM*	Date	*11/13/13*	Checked By	CLK	Date	12/6/13

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	279.8-282.5
Project No.	2013-465-001	Sample No.	ST-40
Lab ID #	2013-465-001-032	Recovery (ft)	2.7

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

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Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	299.6-302.3
Project No.:	2013-465-001	Shelby Tube No.:	ST-46
Lab ID:	2013-465-001-033	Recovery (ft):	1.8

MOISTURE CONTENT

Section Number	1	2	3	4	5
Tare Number	578				
Weight of Tare & Wet Sample (g)	213.54				
Weight of Tare & Dry Sample (g)	195.77				
Weight of Tare (g)	84.28				
Moisture Content (%)	15.94				

UNIT WEIGHT

	1	2	3	4	5
Weight of Tube & Wet Sample (g)		1713.58	1708.79	1700.88	
Weight of Tube (g)		421.95	424.65	415.27	
Weight of Wet Sample (g)		1291.63	1284.14	1285.61	
Length 1 (in)		5.898	5.958	5.890	
Length 2 (in)		5.887	5.964	5.891	
Length 3 (in)		5.886	5.954	5.888	
Top Diameter (in)		2.829	2.883	2.885	
Middle Diameter (in)		2.887	2.877	2.884	
Bottom Diameter (in)		2.877	2.877	2.880	
Sample Volume (cm^3)		621.98	635.66	630.04	
Moisture Content (%)		15.94	15.94	15.94	
Unit Wet Weight (g/cm^3)		2.08	2.02	2.04	
Unit Wet Weight (pcf)		129.58	126.06	127.33	
Unit Dry Weight (g/cm^3)		**1.79**	**1.74**	**1.76**	
Unit Dry Weight (pcf)		**111.8**	**108.7**	**109.8**	

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
300.3					
300.8		4			C.U., UNIT WGT., GRAIN SIZE, HYDROMETER, LIMITS, SP. GR.
301.3		3		GREENISH GRAY WELL GRADED SAND WITH SILT	C.U., UNIT WGT.
301.8		2			C.U., UNIT WGT.
302.3		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately definec*
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Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JCM*	Date	*11/24/13*	Checked By	CLK	Date	12/10/13

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Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	299.6-302.3
Project No.	2013-465-001	Sample No.	ST-46
Lab ID #	2013-465-001-033	Recovery (ft)	1.8

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

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Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	317.8-319.9
Project No.:	2013-465-001	Shelby Tube No.:	ST-52
Lab ID:	2013-465-001-034	Recovery (ft):	1.7

MOISTURE CONTENT

Section Number	1	2	3
Tare Number		2660	
Weight of Tare & Wet Sample (g)		323.78	
Weight of Tare & Dry Sample (g)		260.74	
Weight of Tare (g)		6.63	
Moisture Content (%)		24.81	

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	1766.15
Weight of Tube (g)	459.08
Weight of Wet Sample (g)	1307.07
Length 1 (in)	6.344
Length 2 (in)	6.398
Length 3 (in)	6.389
Top Diameter (in)	2.889
Middle Diameter (in)	2.891
Bottom Diameter (in)	2.887
Sample Volume (cm^3)	685.02
Moisture Content (%)	24.81
Unit Wet Weight (g/cm^3)	1.91
Unit Wet Weight (pcf)	119.06
Unit Dry Weight (g/cm^3)	**1.53**
Unit Dry Weight (pcf)	**95.4**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
317.9					
318.4					
318.9					
319.4		3		GRAY POORLY GRADED SAND WITH SILT	GRAIN SIZE, HYDROMETER, LIMITS, SP. GR., UNIT WGT.
		2			W.C.
319.9		1	EMPTY		

***Note**: When full recovery is not achieved, the elevation can not be accurately definec*
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Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JAM*	Date	*11/8/13*	Checked By	CLK	Date	11/25/13

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	317.8-319.9
Project No.	2013-465-001	Sample No.	ST-52
Lab ID #	2013-465-001-034	Recovery (ft)	1.7

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	325.9-328.0
Project No.:	2013-465-001	Shelby Tube No.:	ST-55
Lab ID:	2013-465-001-035	Recovery (ft):	1.4

MOISTURE CONTENT

Section Number	1	2	3	4	5
Tare Number	576				
Weight of Tare & Wet Sample (g)	142.54				
Weight of Tare & Dry Sample (g)	131.51				
Weight of Tare (g)	84.46				
Moisture Content (%)	23.44				

UNIT WEIGHT

	1	2	3	4	5
Weight of Tube & Wet Sample (g)		1641.98	1628.53	1201.53	
Weight of Tube (g)		415.62	408.97	245.27	
Weight of Wet Sample (g)		1226.36	1219.56	956.26	
Length 1 (in)		5.829	5.800	4.853	
Length 2 (in)		5.833	5.811	4.757	
Length 3 (in)		5.834	5.801	4.853	
Top Diameter (in)		2.886	2.879	2.880	
Middle Diameter (in)		2.885	2.882	2.882	
Bottom Diameter (in)		2.882	2.874	2.886	
Sample Volume (cm^3)		624.45	618.87	515.60	
Moisture Content (%)		23.44	23.44	23.44	
Unit Wet Weight (g/cm^3)		1.96	1.97	1.85	
Unit Wet Weight (pcf)		122.55	122.97	115.73	
Unit Dry Weight (g/cm^3)		**1.59**	**1.60**	**1.50**	
Unit Dry Weight (pcf)		**99.3**	**99.6**	**93.8**	

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
326.0					
326.5				TOP OF MATERIAL	
		4			C.U., UNIT WGT
327.0		3		GREENISH GRAY SILTY SAND	C.U., UNIT WGT.
327.5		2			C.U., UNIT WGT.
328.0		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JCM*	Date	*11/29/13*	Checked By	CLK	Date	12/10/13

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	325.9-328.0
Project No.	2013-465-001	Sample No.	ST-55
Lab ID #	2013-465-001-035	Recovery (ft)	1.4

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

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Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	341.5-344.2
Project No.:	2013-465-001	Shelby Tube No.:	ST-61
Lab ID:	2013-465-001-036	Recovery (ft):	1.8

MOISTURE CONTENT

Section Number	**1**	**2**
Tare Number	2685	
Weight of Tare & Wet Sample (g)	180.60	
Weight of Tare & Dry Sample (g)	141.30	
Weight of Tare (g)	6.66	
Moisture Content (%)	29.19	

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	1808.55
Weight of Tube (g)	465.62
Weight of Wet Sample (g)	1342.93
Length 1 (in)	6.452
Length 2 (in)	6.461
Length 3 (in)	6.450
Top Diameter (in)	2.882
Middle Diameter (in)	2.881
Bottom Diameter (in)	2.876
Sample Volume (cm^3)	688.85
Moisture Content (%)	29.19
Unit Wet Weight (g/cm^3)	1.95
Unit Wet Weight (pcf)	121.65
Unit Dry Weight (g/cm^3)	**1.51**
Unit Dry Weight (pcf)	**94.2**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
342.2					
342.7					
343.2					
343.7		2		GRAY POORLY GRADED SAND WITH SILT	GRAIN SIZE, HYDROMETER, LIMITS, UNIT WGT.
344.2		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JAM*	Date	*11/8/13*	Checked By	CLK	Date	11/25/13

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	341.5-344.2
Project No.	2013-465-001	Sample No.	ST-61
Lab ID #	2013-465-001-036	Recovery (ft)	1.8

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	355.9-358.6
Project No.:	2013-465-001	Shelby Tube No.:	ST-66
Lab ID:	2013-465-001-037	Recovery (ft):	2.7

MOISTURE CONTENT					
Section Number	1	2	3	4	5
Tare Number	1122				2736
Weight of Tare & Wet Sample (g)	163.46				146.15
Weight of Tare & Dry Sample (g)	146.93				117.21
Weight of Tare (g)	84.17				6.66
Moisture Content (%)	26.34				26.18
UNIT WEIGHT					
Weight of Tube & Wet Sample (g)		1665.81	1646.82	1637.49	716.94
Weight of Tube (g)		422.56	417.51	420.90	188.16
Weight of Wet Sample (g)		1243.25	1229.31	1216.59	528.78
Length 1 (in)		5.983	5.900	5.949	2.623
Length 2 (in)		5.984	5.910	5.943	2.603
Length 3 (in)		5.983	5.909	5.957	2.608
Top Diameter (in)		2.888	2.888	2.882	2.878
Middle Diameter (in)		2.887	2.887	2.881	2.886
Bottom Diameter (in)		2.876	2.881	2.885	2.871
Sample Volume (cm^3)		640.36	632.85	636.32	278.44
Moisture Content (%)		26.34	26.34	26.34	26.18
Unit Wet Weight (g/cm^3)		1.94	1.94	1.91	1.90
Unit Wet Weight (pcf)		121.15	121.21	119.30	118.50
Unit Dry Weight (g/cm^3)		**1.54**	**1.54**	**1.51**	**1.51**
Unit Dry Weight (pcf)		**95.9**	**95.9**	**94.4**	**93.9**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
356.6					
		5		GREENISH GRAY SILTY SAND	UNIT WGT., W.C. CONSOLIDATION
357.1		4			C.U., UNIT WGT SP.GR
357.6		3			C.U., UNIT WGT.
358.1		2			C.U., UNIT WGT.
358.6		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately define*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JCM*	Date	*10/21/13*	Checked By	CLK	Date	12/10/13

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	355.9-358.6
Project No.	2013-465-001	Sample No.	ST-66
Lab ID #	2013-465-001-037	Recovery (ft)	2.7

Equipment	Equipment ID#	Calibration Due Date
Oven	G256	10/12/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G134	1/9/14
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	358.6-361.3
Project No.:	2013-465-001	Shelby Tube No.:	ST-67
Lab ID:	2013-465-001-038	Recovery (ft):	1.6

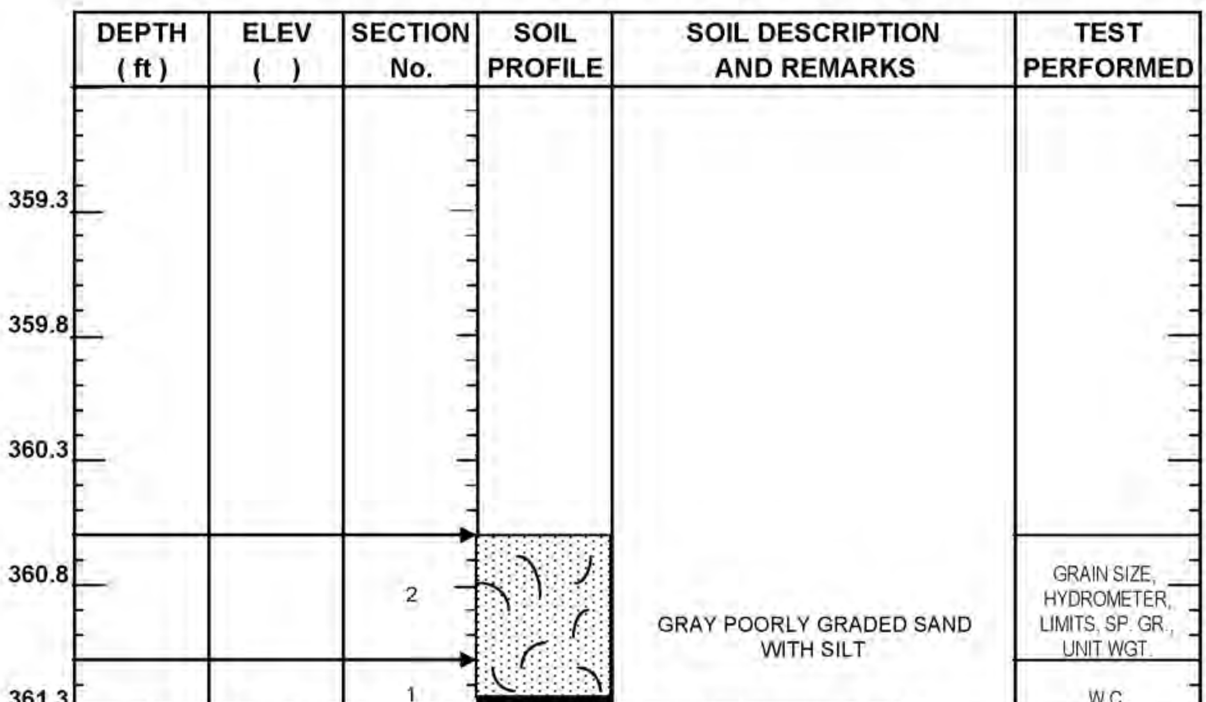
MOISTURE CONTENT

Section Number	**1**	**2**
Tare Number	2518	
Weight of Tare & Wet Sample (g)	206.75	
Weight of Tare & Dry Sample (g)	165.49	
Weight of Tare (g)	8.28	
Moisture Content (%)	26.25	

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	1728.48
Weight of Tube (g)	446.30
Weight of Wet Sample (g)	1282.18
Length 1 (in)	6.253
Length 2 (in)	6.271
Length 3 (in)	6.273
Top Diameter (in)	2.880
Middle Diameter (in)	2.879
Bottom Diameter (in)	2.870
Sample Volume (cm^3)	667.17
Moisture Content (%)	26.25
Unit Wet Weight (g/cm^3)	1.92
Unit Wet Weight (pcf)	119.92
Unit Dry Weight (g/cm^3)	**1.52**
Unit Dry Weight (pcf)	**95.0**

SOIL PROFILE AND SAMPLING



***Note**: When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JAM*	Date	*11/8/13*	Checked By	CLK	Date	11/25/13

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ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	358.6-361.3
Project No.	2013-465-001	Sample No.	ST-67
Lab ID #	2013-465-001-038	Recovery (ft)	1.6

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	381.4-384.1
Project No.:	2013-465-001	Shelby Tube No.:	ST-75
Lab ID:	2013-465-001-039	Recovery (ft):	2.2

MOISTURE CONTENT

Section Number	**1**	**2**
Tare Number	2579	
Weight of Tare & Wet Sample (g)	156.81	
Weight of Tare & Dry Sample (g)	119.45	
Weight of Tare (g)	6.78	
Moisture Content (%)	33.16	

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	1737.18
Weight of Tube (g)	460.10
Weight of Wet Sample (g)	1277.08
Length 1 (in)	6.372
Length 2 (in)	6.375
Length 3 (in)	6.382
Top Diameter (in)	2.885
Middle Diameter (in)	2.884
Bottom Diameter (in)	2.873
Sample Volume (cm^3)	681.00
Moisture Content (%)	33.16
Unit Wet Weight (g/cm^3)	1.88
Unit Wet Weight (pcf)	117.02
Unit Dry Weight (g/cm^3)	**1.41**
Unit Dry Weight (pcf)	**87.9**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
382.1					
382.6					
383.1					
383.6		2		GRAY POORLY GRADED SAND WITH SILT	GRAIN SIZE, HYDROMETER, LIMITS, SP. GR., UNIT WGT.
384.1		1			W.C.

***Note**: When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JAM*	Date	*11/11/13*	Checked By	CLK	Date	11/25/13

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Shelby Tube Unit Weight

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	381.4-384.1
Project No.	2013-465-001	Sample No.	ST-75
Lab ID #	2013-465-001-039	Recovery (ft)	2.2

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	401.9-404.6
Project No.:	2013-465-001	Shelby Tube No.:	ST-82
Lab ID:	2013-465-001-040	Recovery (ft):	1.9

MOISTURE CONTENT

Section Number	1	2	3	4	5
Tare Number	914				2702
Weight of Tare & Wet Sample (g)	238.70				135.40
Weight of Tare & Dry Sample (g)	210.46				113.52
Weight of Tare (g)	110.32				6.61
Moisture Content (%)	28.20				20.47

UNIT WEIGHT

	2	3	4	5
Weight of Tube & Wet Sample (g)	1611.78	1657.58	1590.60	653.23
Weight of Tube (g)	419.97	420.09	417.28	188.07
Weight of Wet Sample (g)	1191.81	1237.49	1173.32	465.16
Length 1 (in)	5.929	5.947	5.914	2.671
Length 2 (in)	5.904	5.948	5.915	2.663
Length 3 (in)	5.928	5.933	5.912	2.672
Top Diameter (in)	2.872	2.880	2.883	2.884
Middle Diameter (in)	2.881	2.892	2.888	2.871
Bottom Diameter (in)	2.886	2.882	2.886	2.873
Sample Volume (cm^3)	631.86	636.45	633.78	284.09
Moisture Content (%)	28.20	28.20	28.20	20.47
Unit Wet Weight (g/cm^3)	1.89	1.94	1.85	1.64
Unit Wet Weight (pcf)	117.70	121.33	115.52	102.17
Unit Dry Weight (g/cm^3)	**1.47**	**1.52**	**1.44**	**1.36**
Unit Dry Weight (pcf)	**91.8**	**94.6**	**90.1**	**84.8**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
402.6					
		5			W.C., UNIT WGT., CONSOLIDATION
403.1		4			C.U., UNIT WGT., GRAIN SIZE, HYDROMETER, LIMITS, SP. GR.
403.6		3		GREENISH GRAY SILTY SAND	C.U., UNIT WGT.
404.1		2			C.U., UNIT WGT.
404.6		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JCM*	Date	*11/26/13*	Checked By	CLK	Date	12/10/13

DCN: CT-S37 DATE:4-10-13 REVISION: 3

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	401.9-404.6
Project No.	2013-465-001	Sample No.	ST-82
Lab ID #	2013-465-001-040	Recovery (ft)	1.9

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

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Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	419.5-422.2
Project No.:	2013-465-001	Shelby Tube No.:	ST-88
Lab ID:	2013-465-001-041	Recovery (ft):	2.5

MOISTURE CONTENT

Section Number	**1**	**2**
Tare Number	2685	
Weight of Tare & Wet Sample (g)	291.17	
Weight of Tare & Dry Sample (g)	233.03	
Weight of Tare (g)	6.71	
Moisture Content (%)	25.69	

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	1715.88
Weight of Tube (g)	438.06
Weight of Wet Sample (g)	1277.82
Length 1 (in)	6.156
Length 2 (in)	6.168
Length 3 (in)	6.157
Top Diameter (in)	2.881
Middle Diameter (in)	2.876
Bottom Diameter (in)	2.883
Sample Volume (cm^3)	657.63
Moisture Content (%)	25.69
Unit Wet Weight (g/cm^3)	1.94
Unit Wet Weight (pcf)	121.25
Unit Dry Weight (g/cm^3)	**1.55**
Unit Dry Weight (pcf)	**96.5**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
420.2					
420.7					
421.2					
421.7		2		GRAY POORLY GRADED SAND WITH SILT	GRAIN SIZE, HYDROMETER, LIMITS, UNIT WGT.
422.2		1			W.C.

***Note**: When full recovery is not achieved, the elevation can not be accurately definei*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JAM*	Date	*11/8/13*	Checked By	CLK	Date	11/25/13

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	419.5-422.2
Project No.	2013-465-001	Sample No.	ST-88
Lab ID #	2013-465-001-041	Recovery (ft)	2.5

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	445.9-448.6
Project No.:	2013-465-001	Shelby Tube No.:	ST-97
Lab ID:	2013-465-001-042	Recovery (ft):	2.1

MOISTURE CONTENT

Section Number	**1**	**2**
Tare Number	2518	
Weight of Tare & Wet Sample (g)	229.74	
Weight of Tare & Dry Sample (g)	182.56	
Weight of Tare (g)	8.44	
Moisture Content (%)	27.10	

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	1744.64
Weight of Tube (g)	466.55
Weight of Wet Sample (g)	1278.09
Length 1 (in)	6.373
Length 2 (in)	6.371
Length 3 (in)	6.377
Top Diameter (in)	2.881
Middle Diameter (in)	2.869
Bottom Diameter (in)	2.873
Sample Volume (cm^3)	677.73
Moisture Content (%)	27.10
Unit Wet Weight (g/cm^3)	1.89
Unit Wet Weight (pcf)	117.68
Unit Dry Weight (g/cm^3)	**1.48**
Unit Dry Weight (pcf)	**92.6**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
446.6					
447.1					
447.6					
448.1		2		GRAY SILTY SAND	GRAIN SIZE, HYDROMETER, LIMITS, SP. GR., UNIT WGT.
448.6		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JAM*	Date	*11/11/13*	Checked By	CLK	Date	11/25/13

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	445.9-448.6
Project No.	2013-465-001	Sample No.	ST-97
Lab ID #	2013-465-001-042	Recovery (ft)	2.1

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	136.0-138.7
Project No.:	2013-465-001	Shelby Tube No.:	ST-1
Lab ID:	2013-465-001-001	Recovery (ft):	1.5

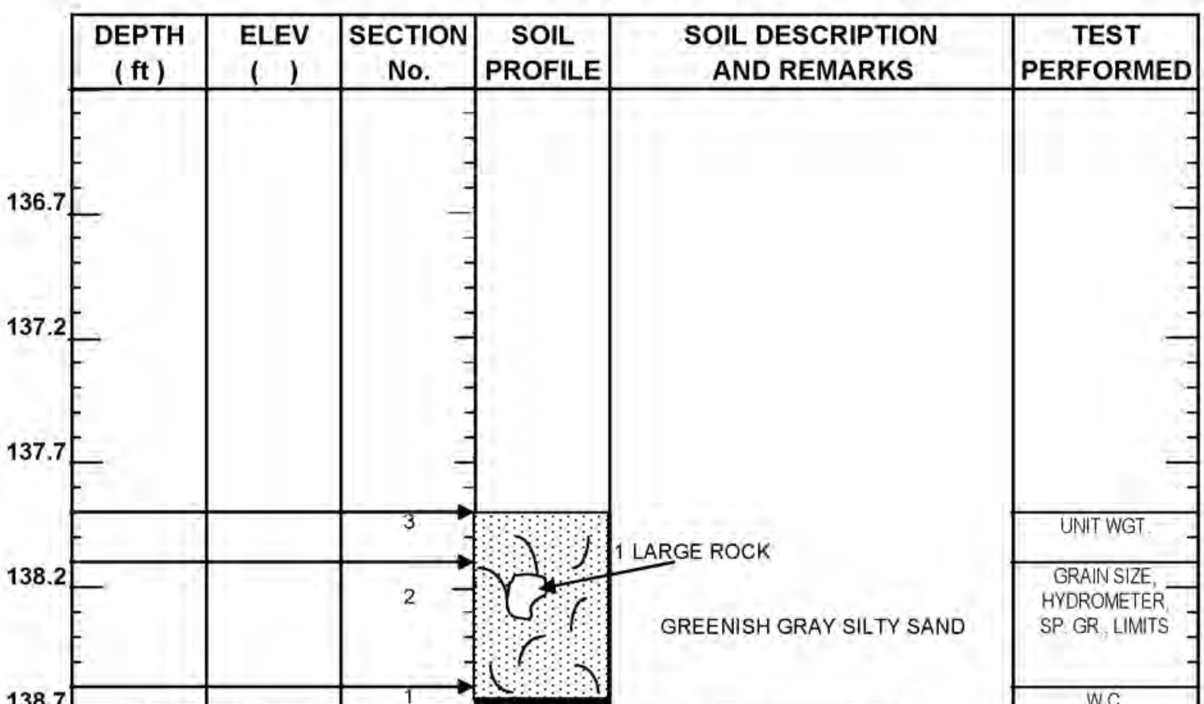
MOISTURE CONTENT

Section Number	**1**	**2**
Tare Number	2605	
Weight of Tare & Wet Sample (g)	135.81	
Weight of Tare & Dry Sample (g)	113.87	
Weight of Tare (g)	6.81	
Moisture Content (%)	20.49	

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	667.91
Weight of Tube (g)	172.57
Weight of Wet Sample (g)	495.34
Length 1 (in)	2.261
Length 2 (in)	2.257
Length 3 (in)	2.263
Top Diameter (in)	2.881
Middle Diameter (in)	2.883
Bottom Diameter (in)	2.876
Sample Volume (cm^3)	241.30
Moisture Content (%)	20.49
Unit Wet Weight (g/cm^3)	2.05
Unit Wet Weight (pcf)	128.10
Unit Dry Weight (g/cm^3)	**1.70**
Unit Dry Weight (pcf)	**106.3**

SOIL PROFILE AND SAMPLING



***Note**: When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JAM*	Date	*12/5/13*	Checked By	CLK	Date	12/11/13

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Shelby Tube Unit Weight

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	136.0-138.7
Project No.	2013-465-001	Sample No.	ST-1
Lab ID #	2013-465-001-001	Recovery (ft)	1.5

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1485	11/11/14
Calipers	G1122	12/2/14
Pi Tape	NA	NA
Balance	NA	NA

SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	158.0-160.7
Project No.:	2013-465-001	Shelby Tube No.:	ST-2
Lab ID:	2013-465-001-002	Recovery (ft):	2.5

MOISTURE CONTENT

Section Number	**1**	**2**
Tare Number	2564	
Weight of Tare & Wet Sample (g)	352.42	
Weight of Tare & Dry Sample (g)	266.14	
Weight of Tare (g)	6.69	
Moisture Content (%)	33.25	

UNIT WEIGHT

Weight of Tube & Wet Sample (g)		
Weight of Tube (g)		
Weight of Wet Sample (g)		
Length 1 (in)		
Length 2 (in)		
Length 3 (in)		
Top Diameter (in)		
Middle Diameter (in)		
Bottom Diameter (in)		
Sample Volume (cm^3)		
Moisture Content (%)		
Unit Wet Weight (g/cm^3)		
Unit Wet Weight (pcf)		
Unit Dry Weight (g/cm^3)		
Unit Dry Weight (pcf)		

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
158.7					
159.2					
159.7					
160.2		1		GRAY SANDY SILT (SHELBY TUBE WAS RECEIVED IN AN OVAL SHAPE, SO THERE IS NO UNIT WGT. FOR THIS SAMPLE)	GRAIN SIZE, HYDROMETER, LIMITS, SP. GR., W.C.
160.7					

***Note**: When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JAM*	Date	*11/2/13*	Checked By	CLK	Date	11/20/13

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	158.0-160.7
Project No.	2013-465-001	Sample No.	ST-2
Lab ID #	2013-465-001-002	Recovery (ft)	2.5

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	188.0-190.7
Project No.:	2013-465-001	Shelby Tube No.:	ST-4
Lab ID:	2013-465-001-003	Recovery (ft):	2.7

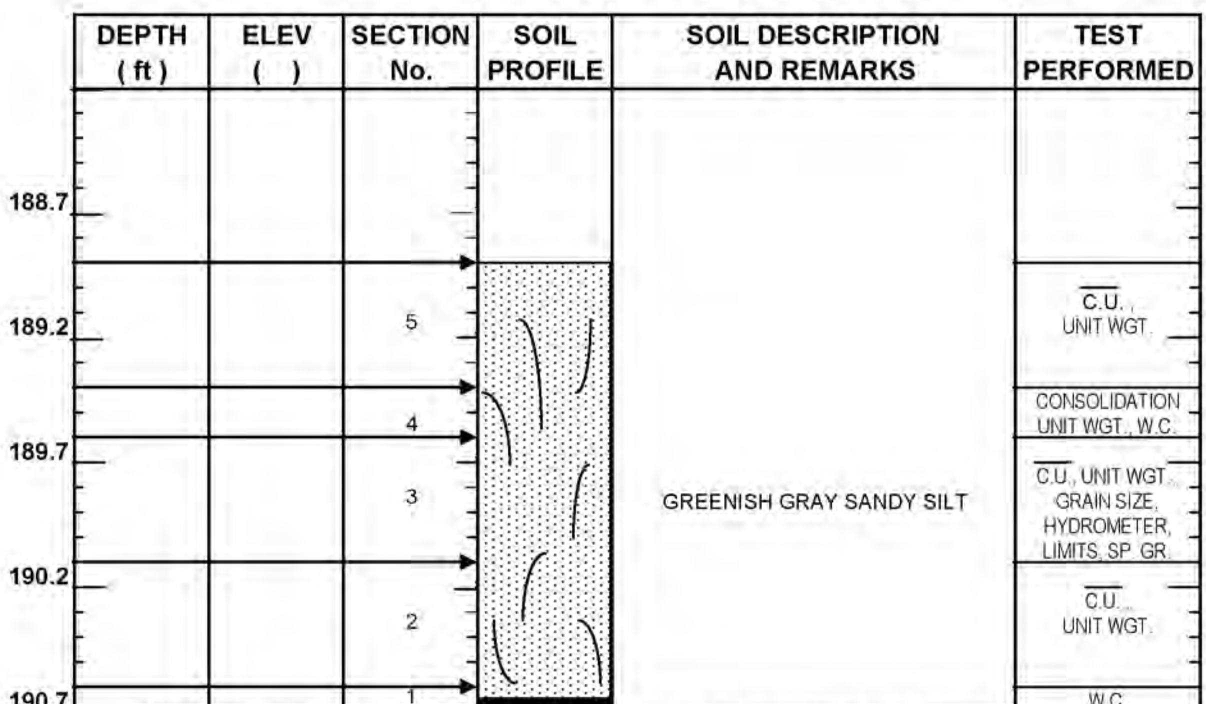
MOISTURE CONTENT

Section Number	**1**	**2**	**3**	**4**	**5**
Tare Number	560			2535	
Weight of Tare & Wet Sample (g)	161.29			134.43	
Weight of Tare & Dry Sample (g)	142.44			102.29	
Weight of Tare (g)	82.61			6.71	
Moisture Content (%)	31.51			33.63	

UNIT WEIGHT

	1	2	3	4	5
Weight of Tube & Wet Sample (g)		1596.45	1583.70	659.26	1580.70
Weight of Tube (g)		412.68	414.30	175.27	418.13
Weight of Wet Sample (g)		1183.77	1169.40	483.99	1162.57
Length 1 (in)		5.923	5.946	2.476	5.921
Length 2 (in)		5.923	5.948	2.486	5.903
Length 3 (in)		5.919	5.944	2.479	5.923
Top Diameter (in)		2.872	2.878	2.871	2.882
Middle Diameter (in)		2.884	2.875	2.876	2.879
Bottom Diameter (in)		2.880	2.875	2.875	2.879
Sample Volume (cm^3)		631.56	632.99	263.68	631.51
Moisture Content (%)		31.51	31.51	33.63	33.63
Unit Wet Weight (g/cm^3)		1.87	1.85	1.84	1.84
Unit Wet Weight (pcf)		116.96	115.28	114.54	114.87
Unit Dry Weight (g/cm^3)		**1.43**	**1.40**	**1.37**	**1.38**
Unit Dry Weight (pcf)		**88.9**	**87.7**	**85.7**	**86.0**

SOIL PROFILE AND SAMPLING



Note: *When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JM*	Date	*10/28/13*	Checked By	CLK	Date	12/3/13

DCN: CT-S37 DATE:4-10-13 REVISION: 3
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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	188.0-190.7
Project No.	2013-465-001	Sample No.	ST-4
Lab ID #	2013-465-001-003	Recovery (ft)	2.7

Equipment	Equipment ID#	Calibration Due Date
Oven	G256	10/12/14
Balance	G1395	6/4/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Balance	G1047	3/25/14

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	221.0-223.7
Project No.:	2013-465-001	Shelby Tube No.:	ST-6
Lab ID:	2013-465-001-004	Recovery (ft):	2.5

MOISTURE CONTENT

Section Number	**1**	**2**
Tare Number	2678	
Weight of Tare & Wet Sample (g)	168.82	
Weight of Tare & Dry Sample (g)	141.88	
Weight of Tare (g)	6.64	
Moisture Content (%)	19.92	

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	1590.51
Weight of Tube (g)	417.31
Weight of Wet Sample (g)	1173.20
Length 1 (in)	5.528
Length 2 (in)	5.558
Length 3 (in)	5.551
Top Diameter (in)	2.883
Middle Diameter (in)	2.881
Bottom Diameter (in)	2.890
Sample Volume (cm^3)	593.93
Moisture Content (%)	19.92
Unit Wet Weight (g/cm^3)	1.98
Unit Wet Weight (pcf)	123.26
Unit Dry Weight (g/cm^3)	**1.65**
Unit Dry Weight (pcf)	**102.8**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
221.7					
222.2					
222.7					
223.2		2		GRAY SILTY SAND	GRAIN SIZE, HYDROMETER, LIMITS, SP. GR., UNIT WGT.
223.7		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JAM*	Date	*11/6/13*	Checked By	CLK	Date	11/20/13

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Shelby Tube Unit Weight

ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	221.0-223.7
Project No.	2013-465-001	Sample No.	ST-6
Lab ID #	2013-465-001-004	Recovery (ft)	2.5

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	232.0-234.7
Project No.:	2013-465-001	Shelby Tube No.:	ST-7
Lab ID:	2013-465-001-005	Recovery (ft):	1.7

MOISTURE CONTENT

Section Number	**1**	**2**	**3**	**4**	**5**
Tare Number	538				573
Weight of Tare & Wet Sample (g)	205.89				275.38
Weight of Tare & Dry Sample (g)	185.49				230.12
Weight of Tare (g)	81.93				82.38
Moisture Content (%)	19.70				30.63

UNIT WEIGHT

	1	2	3	4	5
Weight of Tube & Wet Sample (g)		1658.93	1628.58	1591.73	
Weight of Tube (g)		419.73	410.19	402.45	
Weight of Wet Sample (g)		1239.20	1218.39	1189.28	
Length 1 (in)		5.967	5.887	5.803	
Length 2 (in)		5.964	5.889	5.795	
Length 3 (in)		5.969	5.884	5.800	
Top Diameter (in)		2.876	2.881	2.871	
Middle Diameter (in)		2.870	2.868	2.883	
Bottom Diameter (in)		2.876	2.877	2.882	
Sample Volume (cm^3)		634.30	626.38	618.52	
Moisture Content (%)		19.70	19.70	19.70	
Unit Wet Weight (g/cm^3)		1.95	1.95	1.92	
Unit Wet Weight (pcf)		121.91	121.38	119.98	
Unit Dry Weight (g/cm^3)		**1.63**	**1.63**	**1.61**	
Unit Dry Weight (pcf)		**101.8**	**101.4**	**100.2**	

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
232.7					
		5			W.C.
233.2		4			C.U., UNIT WGT
233.7		3		GREENISH GRAY SILTY SAND	C.U., UNIT WGT., GRAIN SIZE, HYDROMETER, LIMITS, SP. GR.
234.2		2			C.U., UNIT WGT.
234.7		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
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Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JM*	Date	*10/29/13*	Checked By	CLK	Date	12/3/13

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Shelby Tube Unit Weight

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	232.0-234.7
Project No.	2013-465-001	Sample No.	ST-7
Lab ID #	2013-465-001-005	Recovery (ft)	1.7

Equipment	Equipment ID#	Calibration Due Date
Oven	G256	10/12/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Balance	G1395	6/4/14

SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	244.5 - 246.5
Project No.:	2013-465-001	Shelby Tube No.:	ST-8
Lab ID:	2013-465-001-006	Recovery (ft):	1.6

MOISTURE CONTENT

Section Number	**1**	**2**	**3**
Tare Number	2733	2513	2641
Weight of Tare & Wet Sample (g)	292.48	186.21	41.08
Weight of Tare & Dry Sample (g)	239.83	153.33	34.67
Weight of Tare (g)	6.75	8.45	6.67
Moisture Content (%)	22.59	22.69	22.89

UNIT WEIGHT

		2	3
Weight of Tube & Wet Sample (g)		788.31	1815.76
Weight of Tube (g)		200.43	458.49
Weight of Wet Sample (g)		587.88	1357.27
Length 1 (in)		2.773	6.419
Length 2 (in)		2.832	6.432
Length 3 (in)		2.802	6.431
Top Diameter (in)		2.868	2.869
Middle Diameter (in)		2.880	2.873
Bottom Diameter (in)		2.886	2.868
Sample Volume (cm^3)		298.74	681.37
Moisture Content (%)		22.69	22.89
Unit Wet Weight (g/cm^3)		1.97	1.99
Unit Wet Weight (pcf)		122.80	124.30
Unit Dry Weight (g/cm^3)		**1.60**	**1.62**
Unit Dry Weight (pcf)		**100.1**	**101.1**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
244.5					
245.0					
245.5		3		GRAY SILTY SAND	GRAIN SIZE, HYDROMETER, LIMITS, SP. GR., UNIT WGT., W.C.
246.0		2			Consolidation, W.C., UNIT WGT.
246.5		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
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Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*CLK*	Date	*10/25/13*	Checked By	KC	Date	11/25/13

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	244.5-246.5
Project No.	2013-465-001	Sample No.	ST-8
Lab ID #	2013-465-001-006	Recovery (ft)	1.6

Equipment	Equipment ID#	Calibration Due Date
Oven	G624	11/9/13
Balance	G1393	5/13/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	255.0-257.5
Project No.:	2013-465-001	Shelby Tube No.:	ST-9
Lab ID:	2013-465-001-007	Recovery (ft):	2.2

MOISTURE CONTENT

Section Number	1	2	3	4	5
Tare Number	615				
Weight of Tare & Wet Sample (g)	165.03				
Weight of Tare & Dry Sample (g)	148.69				
Weight of Tare (g)	84.20				
Moisture Content (%)	25.34				

UNIT WEIGHT

	1	2	3	4	5
Weight of Tube & Wet Sample (g)		1639.75	1652.83	1640.71	
Weight of Tube (g)		418.42	414.25	418.04	
Weight of Wet Sample (g)		1221.33	1238.58	1222.67	
Length 1 (in)		5.952	5.926	5.940	
Length 2 (in)		5.945	5.927	5.940	
Length 3 (in)		5.943	5.928	5.944	
Top Diameter (in)		2.876	2.881	2.879	
Middle Diameter (in)		2.878	2.878	2.873	
Bottom Diameter (in)		2.880	2.883	2.875	
Sample Volume (cm^3)		633.94	633.01	632.34	
Moisture Content (%)		25.34	25.34	25.34	
Unit Wet Weight (g/cm^3)		1.93	1.96	1.93	
Unit Wet Weight (pcf)		120.22	122.09	120.65	
Unit Dry Weight (g/cm^3)		**1.54**	**1.56**	**1.54**	
Unit Dry Weight (pcf)		**95.9**	**97.4**	**96.3**	

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
255.5					
256.0		4			C.U., UNIT WGT
256.5		3		GREENISH GRAY SILTY SAND	C.U., UNIT WGT., GRAIN SIZE, HYDROMETER, LIMITS, SP. GR.
257.0		2			C.U., UNIT WGT.
257.5		1			W.C.

***Note**: When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JCM*	Date	*11/10/13*	Checked By	CLK	Date	12/6/13

DCN: CT-S37 DATE:4-10-13 REVISION: 3
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Shelby Tube Unit Weight

ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	255.0-257.5
Project No.	2013-465-001	Sample No.	ST-9
Lab ID #	2013-465-001-007	Recovery (ft)	2.2

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	266.0-268.7
Project No.:	2013-465-001	Shelby Tube No.:	ST-10
Lab ID:	2013-465-001-008	Recovery (ft):	2.4

MOISTURE CONTENT

Section Number	1	2	3	4	5
Tare Number	785				2569
Weight of Tare & Wet Sample (g)	241.37				82.33
Weight of Tare & Dry Sample (g)	207.74				65.80
Weight of Tare (g)	85.30				6.67
Moisture Content (%)	27.47				27.96

UNIT WEIGHT

	1	2	3	4	5
Weight of Tube & Wet Sample (g)		1641.62	1585.58	1617.22	
Weight of Tube (g)		421.96	417.45	414.83	
Weight of Wet Sample (g)		1219.66	1168.13	1202.39	
Length 1 (in)		5.961	5.964	5.875	
Length 2 (in)		5.953	5.949	5.868	
Length 3 (in)		5.954	5.952	5.861	
Top Diameter (in)		2.877	2.879	2.883	
Middle Diameter (in)		2.872	2.874	2.880	
Bottom Diameter (in)		2.881	2.871	2.882	
Sample Volume (cm^3)		634.34	633.36	627.15	
Moisture Content (%)		27.47	27.47	27.47	
Unit Wet Weight (g/cm^3)		1.92	1.84	1.92	
Unit Wet Weight (pcf)		119.98	115.09	119.64	
Unit Dry Weight (g/cm^3)		**1.51**	**1.45**	**1.50**	
Unit Dry Weight (pcf)		**94.1**	**90.3**	**93.9**	

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
266.7					
		5			CONSOLIDATION, W.C.
267.2		4			C.U., UNIT WGT.
267.7		3			GRAIN SIZE, HYDROMETER, LIMITS, SP. GR., UNIT WGT., C.U.
268.2		2		GREENISH GRAY SILTY SAND	C.U., UNIT WGT.
268.7		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately definec*
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Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JCM*	Date	*11/10/13*	Checked By	CLK	Date	12/9/13

DCN: CT-S37 DATE:4-10-13 REVISION: 3
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Shelby Tube Unit Weight

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	266.0-268.7
Project No.	2013-465-001	Sample No.	ST-10
Lab ID #	2013-465-001-008	Recovery (ft)	2.4

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	277.0-279.7
Project No.:	2013-465-001	Shelby Tube No.:	ST-11
Lab ID:	2013-465-001-009	Recovery (ft):	2.7

MOISTURE CONTENT

Section Number	1	2	3	4	5
Tare Number	1125				2659
Weight of Tare & Wet Sample (g)	238.65				118.05
Weight of Tare & Dry Sample (g)	202.50				92.50
Weight of Tare (g)	84.10				6.59
Moisture Content (%)	30.53				29.74

UNIT WEIGHT

	1	2	3	4	5
Weight of Tube & Wet Sample (g)		1603.83	1621.62	1624.20	
Weight of Tube (g)		410.61	416.45	415.96	
Weight of Wet Sample (g)		1193.22	1205.17	1208.24	
Length 1 (in)		5.871	5.967	5.935	
Length 2 (in)		5.895	5.956	5.952	
Length 3 (in)		5.875	5.920	5.957	
Top Diameter (in)		2.877	2.879	2.880	
Middle Diameter (in)		2.884	2.887	2.884	
Bottom Diameter (in)		2.871	2.872	2.883	
Sample Volume (cm^3)		626.58	634.63	635.99	
Moisture Content (%)		30.53	30.53	30.53	
Unit Wet Weight (g/cm^3)		1.90	1.90	1.90	
Unit Wet Weight (pcf)		118.83	118.50	118.55	
Unit Dry Weight (g/cm^3)		**1.46**	**1.45**	**1.46**	
Unit Dry Weight (pcf)		**91.0**	**90.8**	**90.8**	

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
277.7					
		5			CONSOLIDATION W.C.
278.2		4			C.U., UNIT WGT., GRAIN SIZE, HYDROMETER, LIMITS, SP. GR.
278.7		3		GREENISH GRAY SANDY SILT	C.U., UNIT WGT.
279.2		2			C.U., UNIT WGT.
279.7		1			W.C.

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Tested By	*JCM*	Date	*11/17/13*	Checked By	CLK	Date	12/6/13

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Shelby Tube Unit Weight

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	277.0-279.7
Project No.	2013-465-001	Sample No.	ST-11
Lab ID #	2013-465-001-009	Recovery (ft)	2.7

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	288.0-290.2
Project No.:	2013-465-001	Shelby Tube No.:	ST-12
Lab ID:	2013-465-001-010	Recovery (ft):	1.85

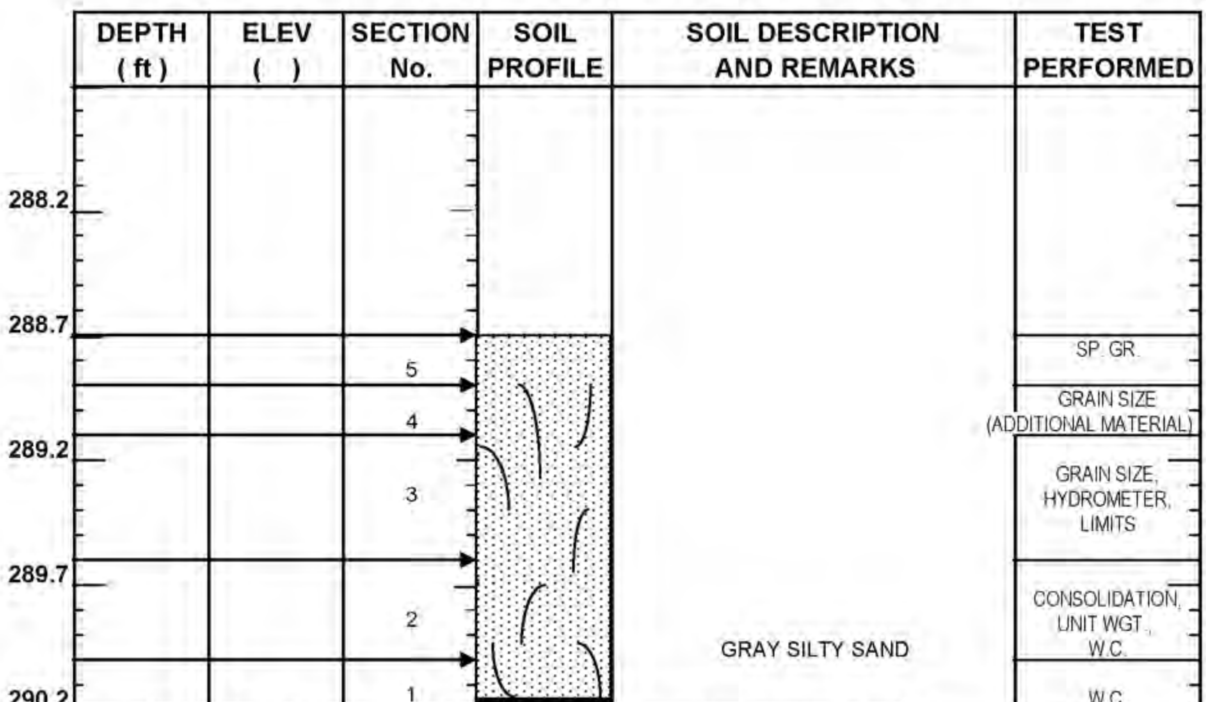
MOISTURE CONTENT

Section Number	**1**	**2**
Tare Number	2652	2668
Weight of Tare & Wet Sample (g)	295.43	135.34
Weight of Tare & Dry Sample (g)	237.03	110.46
Weight of Tare (g)	6.68	6.79
Moisture Content (%)	25.35	24.00

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	599.31
Weight of Tube (g)	157.34
Weight of Wet Sample (g)	441.97
Length 1 (in)	2.176
Length 2 (in)	2.174
Length 3 (in)	2.192
Top Diameter (in)	2.872
Middle Diameter (in)	2.865
Bottom Diameter (in)	2.873
Sample Volume (cm^3)	231.18
Moisture Content (%)	24.00
Unit Wet Weight (g/cm^3)	1.91
Unit Wet Weight (pcf)	119.30
Unit Dry Weight (g/cm^3)	**1.54**
Unit Dry Weight (pcf)	**96.2**

SOIL PROFILE AND SAMPLING



Note: *When full recovery is not achieved, the elevation can not be accurately definet*
Indicate each cut of the tube with an arrow
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Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*DB*	Date	*10/25/13*	Checked By	CLK	Date	11/25/13

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Shelby Tube Unit Weight

ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	288.0-290.2
Project No.	2013-465-001	Sample No.	ST-12
Lab ID #	2013-465-001-010	Recovery (ft)	1.85

Equipment	Equipment ID#	Calibration Due Date
Oven	G624	11/9/13
Balance	G1393	5/13/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	298.0-300.7
Project No.:	2013-465-001	Shelby Tube No.:	ST-13
Lab ID:	2013-465-001-011	Recovery (ft):	2.7

MOISTURE CONTENT

Section Number	1	2	3	4	5
Tare Number	2717	2541			
Weight of Tare & Wet Sample (g)	214.96	130.28			
Weight of Tare & Dry Sample (g)	171.83	105.74			
Weight of Tare (g)	6.79	6.88			
Moisture Content (%)	26.13	24.82			

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	656.00	1948.67	1672.08	1682.14
Weight of Tube (g)	164.03	501.67	413.23	411.76
Weight of Wet Sample (g)	491.97	1447.00	1258.85	1270.38
Length 1 (in)	2.389	6.965	5.914	5.972
Length 2 (in)	2.384	6.957	5.918	5.945
Length 3 (in)	2.375	6.956	5.918	5.963
Top Diameter (in)	2.888	2.887	2.877	2.877
Middle Diameter (in)	2.875	2.881	2.881	2.868
Bottom Diameter (in)	2.871	2.879	2.870	2.867
Sample Volume (cm^3)	254.00	744.13	629.86	632.12
Moisture Content (%)	24.82	24.82	26.95	26.95
Unit Wet Weight (g/cm^3)	1.94	1.94	2.00	2.01
Unit Wet Weight (pcf)	120.86	121.34	124.71	125.41
Unit Dry Weight (g/cm^3)	**1.55**	**1.56**	**1.57**	**1.58**
Unit Dry Weight (pcf)	**96.8**	**97.2**	**98.2**	**98.8**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
		7			WC
298.7		6			C.U., UNIT WGT
299.2		5			C.U., UNIT WGT
299.7		4			C.U., UNIT WGT
300.2		3		GRAY SILTY SAND	UNIT WGT., GRAIN SIZE, HYDROMETER, LIMITS, SP. GR.
		2			CONSOLIDATION, UNIT WGT., W.C.
300.7		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately defined*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*DB/JCM*	Date	*10/28/13*	Checked By	CLK	Date	12/10/13

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SHELBY TUBE UNIT WEIGHT
ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	298.0-300.7
Project No.:	2013-465-001	Shelby Tube No.:	ST-13
Lab ID:	2013-465-001-011	Recovery (ft):	2.7

MOISTURE CONTENT

Section Number	6	7	8	9	10
Tare Number		785			
Weight of Tare & Wet Sample (g)		279.70			
Weight of Tare & Dry Sample (g)		238.44			
Weight of Tare (g)		85.34			
Moisture Content (%)		26.95			

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	1635.67
Weight of Tube (g)	407.77
Weight of Wet Sample (g)	1227.90
Length 1 (in)	5.873
Length 2 (in)	5.885
Length 3 (in)	5.881
Top Diameter (in)	2.881
Middle Diameter (in)	2.872
Bottom Diameter (in)	2.884
Sample Volume (cm^3)	627.23
Moisture Content (%)	26.95
Unit Wet Weight (g/cm^3)	1.96
Unit Wet Weight (pcf)	122.16
Unit Dry Weight (g/cm^3)	**1.54**
Unit Dry Weight (pcf)	**96.2**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
		7			WC
298.7		6			C.U., UNIT WGT
299.2		5			C.U., UNIT WGT
299.7		4			C.U., UNIT WGT
300.2		3		GRAY SILTY SAND	UNIT WGT., GRAIN SIZE, HYDROMETER, LIMITS, SP. GR.
		2			CONSOLIDATION, UNIT WGT
300.7		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately defined*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By *DB/JCM* Date *10/28/13* Checked By CLK Date 12/10/13

 DCN: CT-S37 DATE:4-10-13 REVISION: 3 *Shelby.xls*

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Shelby Tube Unit Weight

ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	298.0-300.7
Project No.	2013-465-001	Sample No.	ST-13
Lab ID #	2013-465-001-011	Recovery (ft)	2.7

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	309.0-311.2
Project No.:	2013-465-001	Shelby Tube No.:	ST-14
Lab ID:	2013-465-001-012	Recovery (ft):	2.2

MOISTURE CONTENT

Section Number	**1**	**2**
Tare Number	2636	
Weight of Tare & Wet Sample (g)	177.86	
Weight of Tare & Dry Sample (g)	141.24	
Weight of Tare (g)	6.71	
Moisture Content (%)	27.22	

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	1777.22
Weight of Tube (g)	472.60
Weight of Wet Sample (g)	1304.62
Length 1 (in)	6.526
Length 2 (in)	6.546
Length 3 (in)	6.529
Top Diameter (in)	2.886
Middle Diameter (in)	2.881
Bottom Diameter (in)	2.877
Sample Volume (cm^3)	698.13
Moisture Content (%)	27.22
Unit Wet Weight (g/cm^3)	1.87
Unit Wet Weight (pcf)	116.61
Unit Dry Weight (g/cm^3)	**1.47**
Unit Dry Weight (pcf)	**91.7**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
309.2					
309.7					
310.2					
310.7		2		GRAY SILTY SAND	GRAIN SIZE, HYDROMETER, LIMITS, SP. GR., UNIT WGT.
311.2		1			W.C.

***Note**: When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JAM*	Date	*11/6/13*	Checked By	CLK	Date	11/25/13

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Shelby Tube Unit Weight

ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	309.0-311.2
Project No.	2013-465-001	Sample No.	ST-14
Lab ID #	2013-465-001-012	Recovery (ft)	2.2

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	319.7-322.2
Project No.:	2013-465-001	Shelby Tube No.:	ST-16
Lab ID:	2013-465-001-013	Recovery (ft):	1.9

MOISTURE CONTENT

Section Number	**1**	**2**
Tare Number	2725	
Weight of Tare & Wet Sample (g)	191.98	
Weight of Tare & Dry Sample (g)	155.79	
Weight of Tare (g)	6.73	
Moisture Content (%)	24.28	

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	1647.09	1614.54	1624.78
Weight of Tube (g)	408.16	405.35	414.61
Weight of Wet Sample (g)	1238.93	1209.19	1210.17
Length 1 (in)	5.808	5.814	5.883
Length 2 (in)	5.882	5.812	5.897
Length 3 (in)	5.817	5.811	5.897
Top Diameter (in)	2.867	2.872	2.879
Middle Diameter (in)	2.884	2.874	2.875
Bottom Diameter (in)	2.871	2.871	2.874
Sample Volume (cm^3)	620.38	617.18	627.27
Moisture Content (%)	24.28	24.28	24.28
Unit Wet Weight (g/cm^3)	2.00	1.96	1.93
Unit Wet Weight (pcf)	124.62	122.26	120.39
Unit Dry Weight (g/cm^3)	**1.61**	**1.58**	**1.55**
Unit Dry Weight (pcf)	**100.3**	**98.4**	**96.9**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
320.2				TOP OF MATERIAL	
		5		GRAY POORLY GRADED SAND WITH SILT	GRAIN SIZE, HYDROMETER
320.7		4			C.U., UNIT WGT.
321.2		3			C.U., UNIT WGT.
321.7		2			C.U., UNIT WGT. SP. GR., LIMITS
322.2		1			W.C.

***Note**: When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JAM*	Date	*11/21/13*	Checked By	CLK	Date	12/11/13

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	319.7-322.2
Project No.	2013-465-001	Sample No.	ST-16
Lab ID #	2013-465-001-013	Recovery (ft)	1.9

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	328.0-330.4
Project No.:	2013-465-001	Shelby Tube No.:	ST-17
Lab ID:	2013-465-001-014	Recovery (ft):	2.2

MOISTURE CONTENT

Section Number	**1**	**2**
Tare Number	2755	
Weight of Tare & Wet Sample (g)	214.84	
Weight of Tare & Dry Sample (g)	172.33	
Weight of Tare (g)	6.65	
Moisture Content (%)	25.66	

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	1735.87
Weight of Tube (g)	441.37
Weight of Wet Sample (g)	1294.50
Length 1 (in)	6.226
Length 2 (in)	6.216
Length 3 (in)	6.211
Top Diameter (in)	2.885
Middle Diameter (in)	2.883
Bottom Diameter (in)	2.881
Sample Volume (cm^3)	665.13
Moisture Content (%)	25.66
Unit Wet Weight (g/cm^3)	1.95
Unit Wet Weight (pcf)	121.44
Unit Dry Weight (g/cm^3)	**1.55**
Unit Dry Weight (pcf)	**96.6**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
328.4					
328.9					
329.4					
329.9		2		GRAY POORLY GRADED SAND WITH SILT	GRAIN SIZE, HYDROMETER, LIMITS, UNIT WGT.
330.4		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately definec*
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Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JAM*	Date	*11/7/13*	Checked By	CLK	Date	11/25/13

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	328.0-330.4
Project No.	2013-465-001	Sample No.	ST-17
Lab ID #	2013-465-001-014	Recovery (ft)	2.2

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	337.0-339.0
Project No.:	2013-465-001	Shelby Tube No.:	ST-18
Lab ID:	2013-465-001-015	Recovery (ft):	1.7

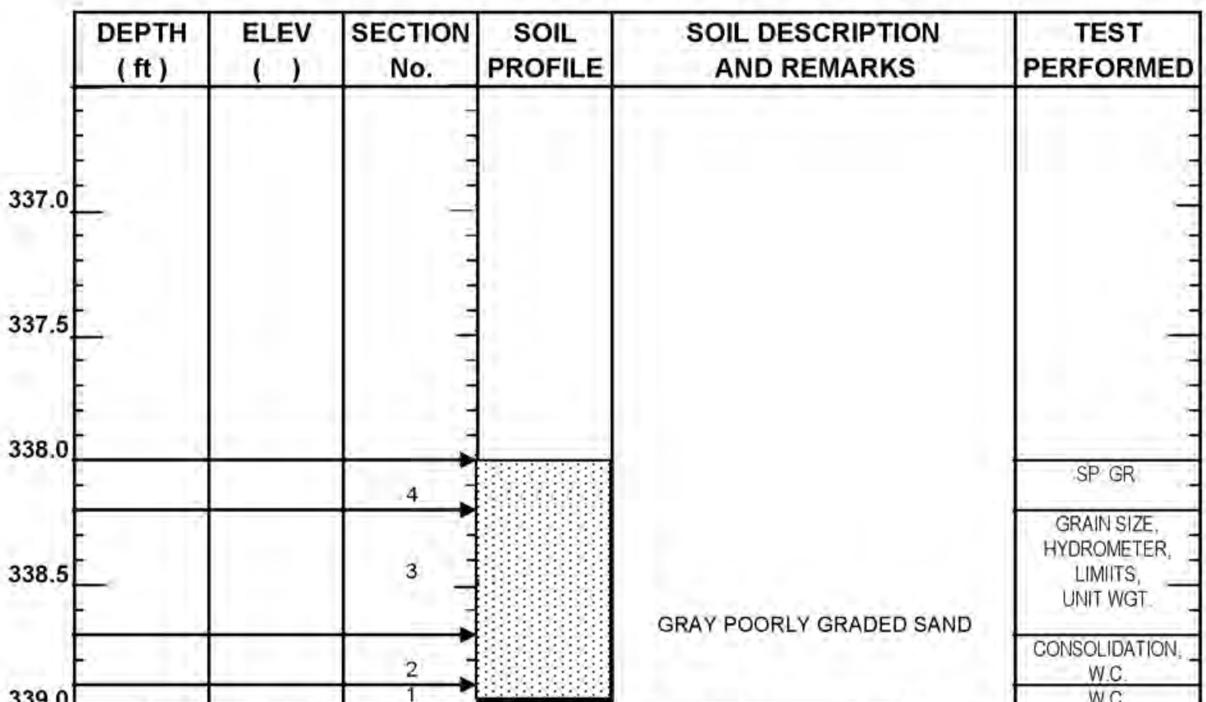
MOISTURE CONTENT

Section Number	1	2	3
Tare Number	2759	2726	
Weight of Tare & Wet Sample (g)	34.57	157.09	
Weight of Tare & Dry Sample (g)	28.97	128.02	
Weight of Tare (g)	6.62	6.72	
Moisture Content (%)	25.06	23.97	

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	1134.51
Weight of Tube (g)	0.00
Weight of Wet Sample (g)	1134.51
Length 1 (in)	5.713
Length 2 (in)	5.702
Length 3 (in)	5.711
Top Diameter (in)	2.887
Middle Diameter (in)	2.890
Bottom Diameter (in)	2.881
Sample Volume (cm^3)	611.95
Moisture Content (%)	23.97
Unit Wet Weight (g/cm^3)	1.85
Unit Wet Weight (pcf)	115.68
Unit Dry Weight (g/cm^3)	**1.50**
Unit Dry Weight (pcf)	**93.3**

SOIL PROFILE AND SAMPLING



Note: *When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JAM*	Date	*11/5/13*	Checked By	CLK	Date	11/25/13

 DCN: CT-S37 DATE:4-10-13 REVISION: 3 *Shelby.xls*

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Shelby Tube Unit Weight

ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	337.0-339.0
Project No.	2013-465-001	Sample No.	ST-18
Lab ID #	2013-465-001-015	Recovery (ft)	1.7

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	345.0-347.0
Project No.:	2013-465-001	Shelby Tube No.:	ST-19
Lab ID:	2013-465-001-016	Recovery (ft):	1.5

MOISTURE CONTENT

Section Number	**1**
Tare Number	2543
Weight of Tare & Wet Sample (g)	243.75
Weight of Tare & Dry Sample (g)	195.27
Weight of Tare (g)	6.82
Moisture Content (%)	25.73

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	1756.71
Weight of Tube (g)	456.15
Weight of Wet Sample (g)	1300.56
Length 1 (in)	6.394
Length 2 (in)	6.343
Length 3 (in)	6.351
Top Diameter (in)	2.880
Middle Diameter (in)	2.884
Bottom Diameter (in)	2.879
Sample Volume (cm^3)	679.70
Moisture Content (%)	25.73
Unit Wet Weight (g/cm^3)	1.91
Unit Wet Weight (pcf)	119.40
Unit Dry Weight (g/cm^3)	**1.52**
Unit Dry Weight (pcf)	**95.0**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
345.0					
345.5					
346.0					
346.5		2		GRAY POORLY GRADED SAND WITH SILT	GRAIN SIZE, HYDROMETER, LIMITS, UNIT WGT.
347.0		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JAM*	Date	*11/7/13*	Checked By	CLK	Date	11/25/13

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Shelby Tube Unit Weight

ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	345.0-347.0
Project No.	2013-465-001	Sample No.	ST-19
Lab ID #	2013-465-001-016	Recovery (ft)	1.5

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	354.0-356.0
Project No.:	2013-465-001	Shelby Tube No.:	ST-20
Lab ID:	2013-465-001-017	Recovery (ft):	1.5

MOISTURE CONTENT

Section Number	**1**	**2**	**3**	**4**	**5**
Tare Number	1706				
Weight of Tare & Wet Sample (g)	132.62				
Weight of Tare & Dry Sample (g)	122.68				
Weight of Tare (g)	82.80				
Moisture Content (%)	24.92				

UNIT WEIGHT

	1	2	3	4	5
Weight of Tube & Wet Sample (g)		1613.08	1612.50	1419.54	
Weight of Tube (g)		404.83	405.08	294.66	
Weight of Wet Sample (g)		1208.25	1207.42	1124.88	
Length 1 (in)		5.812	5.808	5.530	
Length 2 (in)		5.822	5.812	5.538	
Length 3 (in)		5.827	5.807	5.515	
Top Diameter (in)		2.877	2.876	2.873	
Middle Diameter (in)		2.883	2.881	2.875	
Bottom Diameter (in)		2.876	2.877	2.877	
Sample Volume (cm^3)		620.76	619.26	588.04	
Moisture Content (%)		0.00	0.00	0.00	
Unit Wet Weight (g/cm^3)		1.95	1.95	1.91	
Unit Wet Weight (pcf)		121.46	121.67	119.37	
Unit Dry Weight (g/cm^3)		**1.95**	**1.95**	**1.91**	
Unit Dry Weight (pcf)		**121.5**	**121.7**	**119.4**	

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
354.0				TOP OF MATERIAL	
354.5		4			C.U., UNIT WGT.
355.0		3			GRAIN SIZE, HYDROMETER, SP. GR., LIMITS, UNIT WGT, C.U.
355.5		2		GREENISH GRAY POORLY GRADED SAND WITH SILT	C.U., UNIT WGT.
356.0		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JCM*	Date	*11/23/13*	Checked By	CLK	Date	12/10/13

DCN: CT-S37 DATE:4-10-13 REVISION: 3

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Shelby Tube Unit Weight

ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	354.0-356.0
Project No.	2013-465-001	Sample No.	ST-20
Lab ID #	2013-465-001-017	Recovery (ft)	1.5

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	372.0-374.5
Project No.:	2013-465-001	Shelby Tube No.:	ST-22
Lab ID:	2013-465-001-018	Recovery (ft):	1.7

MOISTURE CONTENT

Section Number	**1**
Tare Number	2748
Weight of Tare & Wet Sample (g)	165.88
Weight of Tare & Dry Sample (g)	132.99
Weight of Tare (g)	6.60
Moisture Content (%)	26.02

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	1810.47
Weight of Tube (g)	472.70
Weight of Wet Sample (g)	1337.77
Length 1 (in)	6.579
Length 2 (in)	6.581
Length 3 (in)	6.577
Top Diameter (in)	2.884
Middle Diameter (in)	2.881
Bottom Diameter (in)	2.888
Sample Volume (cm^3)	704.44
Moisture Content (%)	26.02
Unit Wet Weight (g/cm^3)	1.90
Unit Wet Weight (pcf)	118.50
Unit Dry Weight (g/cm^3)	**1.51**
Unit Dry Weight (pcf)	**94.0**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
372.5					
373.0					
373.5					
374.0		2		GRAY POORLY GRADED SAND WITH SILT	GRAIN SIZE, HYDROMETER, LIMITS, UNIT WGT.
374.5		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JAM*	Date	*11/7/13*	Checked By	CLK	Date	11/25/13

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Shelby Tube Unit Weight

ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	372.0-374.5
Project No.	2013-465-001	Sample No.	ST-22
Lab ID #	2013-465-001-018	Recovery (ft)	1.7

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	390.0-392.5
Project No.:	2013-465-001	Shelby Tube No.:	ST-23
Lab ID:	2013-465-001-019	Recovery (ft):	2.5

MOISTURE CONTENT

Section Number	**1**	**2**	**3**	**4**	**5**
Tare Number	1126				
Weight of Tare & Wet Sample (g)	182.10				
Weight of Tare & Dry Sample (g)	161.54				
Weight of Tare (g)	84.87				
Moisture Content (%)	26.82				

UNIT WEIGHT

	1	2	3	4	5
Weight of Tube & Wet Sample (g)		1557.30	1637.42	1672.34	
Weight of Tube (g)		405.21	414.42	417.37	
Weight of Wet Sample (g)		1152.09	1223.00	1254.97	
Length 1 (in)		5.817	5.927	5.964	
Length 2 (in)		5.806	5.923	5.961	
Length 3 (in)		5.805	5.925	5.964	
Top Diameter (in)		2.883	2.875	2.871	
Middle Diameter (in)		2.873	2.877	2.882	
Bottom Diameter (in)		2.881	2.881	2.887	
Sample Volume (cm^3)		619.73	631.48	636.56	
Moisture Content (%)		26.82	26.82	26.82	
Unit Wet Weight (g/cm^3)		1.86	1.94	1.97	
Unit Wet Weight (pcf)		116.00	120.85	123.02	
Unit Dry Weight (g/cm^3)		**1.47**	**1.53**	**1.55**	
Unit Dry Weight (pcf)		**91.5**	**95.3**	**97.0**	

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
390.5					
		5			CONSOLIDATION
391.0		4			C.U., UNIT WGT
391.5		3		GREENISH GRAY SILTY SAND	C.U., UNIT WGT
392.0		2			C.U., UNIT WGT., GRAIN SIZE, HYDROMETER, LIMITS, SP. GR.
392.5		1			W.C.

Note: *When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JCM*	Date	*11/18/13*	Checked By	CLK	Date	12/6/13

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Shelby Tube Unit Weight

ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	390.0-392.5
Project No.	2013-465-001	Sample No.	ST-23
Lab ID #	2013-465-001-019	Recovery (ft)	2.5

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1047	3/25/14
Calipers	G1123	12/13/13
Pi Tape	G1121	1/14/14
Balance	NA	NA

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SHELBY TUBE UNIT WEIGHT

ASTM D2937-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-7-1
Client Reference:	Turkey Point Units 6 & 7 Site	Depth Pushed (ft):	436.0-437.5
Project No.:	2013-465-001	Shelby Tube No.:	ST-25
Lab ID:	2013-465-001-020	Recovery (ft):	1.1

MOISTURE CONTENT

Section Number	**1**	**2**
Tare Number	2755	
Weight of Tare & Wet Sample (g)	119.80	
Weight of Tare & Dry Sample (g)	92.66	
Weight of Tare (g)	6.73	
Moisture Content (%)	31.58	

UNIT WEIGHT

Weight of Tube & Wet Sample (g)	1899.83
Weight of Tube (g)	500.40
Weight of Wet Sample (g)	1399.43
Length 1 (in)	6.989
Length 2 (in)	6.978
Length 3 (in)	6.981
Top Diameter (in)	2.882
Middle Diameter (in)	2.879
Bottom Diameter (in)	2.884
Sample Volume (cm^3)	746.28
Moisture Content (%)	31.58
Unit Wet Weight (g/cm^3)	1.88
Unit Wet Weight (pcf)	117.01
Unit Dry Weight (g/cm^3)	**1.43**
Unit Dry Weight (pcf)	**88.9**

SOIL PROFILE AND SAMPLING

DEPTH (ft)	ELEV ( )	SECTION No.	SOIL PROFILE	SOIL DESCRIPTION AND REMARKS	TEST PERFORMED
435.5					
436.0					
436.5					
437.0		2		GRAY POORLY GRADED SAND WITH SILT	GRAIN SIZE, HYDROMETER, LIMITS, SP. GR., UNIT WGT.
437.5		1			W.C.

***Note**: When full recovery is not achieved, the elevation can not be accurately definec*
Indicate each cut of the tube with an arrow
Indicate dividing line between soil types with a solid lin
Indicate wax by cross-hatching. Indicate soil types by standard symbols

Tested By	*JAM*	Date	*11/7/13*	Checked By	CLK	Date	11/25/13

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Shelby Tube Unit Weight

ASTM D2937-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-7-1
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	436.0-437.5
Project No.	2013-465-001	Sample No.	ST-25
Lab ID #	2013-465-001-020	Recovery (ft)	1.1

Equipment	Equipment ID#	Calibration Due Date
Oven	G1387	8/16/14
Balance	G1394	5/15/14
Calipers	G1122	12/3/13
Pi Tape	NA	NA
Balance	NA	NA

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SPECIFIC GRAVITY

ASTM D 854-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth (ft):	148.2-148.7
Project No.:	2013-465-001	Sample No.:	ST-3
Lab ID:	2013-465-001-021	Visual Description:	**Greenish Gray Silty Sand**
			(MInus No.4 sieve material,oven dried)

Replicate Number	**1**	**2**
Pycnometer ID	G 1255	G 1403
Weight of Pycnometer + Soil + Water (g)	747.5	737.83
Temperature (^{o}C)	26.3	25.8
Weight of Pycnometer + Water (g)	684.94	675.29
Tare Number	692	2333
Weight of Tare + Dry Soil (g)	195.86	198.83
Weight of Tare (g)	94.97	97.81
Weight of Dry Soil (g)	100.89	101.02
Specific Gravity of Soil @ Measured Temperature	2.632	2.625
Specific Gravity of Water @ Measured Temperature	0.99671	0.99684
Conversion Factor for Measured Temperature	0.99850	0.99864
Specific Gravity @ 20^{o} Celsius	2.636	2.629

Average Specific Gravity @ 20^{o} Celsius	2.63

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SPECIFIC GRAVITY

ASTM D 854-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	148.2-148.7
Project No.	2013-465-001	Sample No.	ST-3
Lab ID #	2013-465-001-021		

Equipment	Equipment ID#	Calibration Due Date
Oven	G1118	11/27/13
Balance	G1057	11/4/14
#4 Sieve	G025	8/20/14
Pycnometer	G1255	Initial Only
Pycnometer	G1403	Initial Only
Thermometer	G1412	6/12/14
Vacuum Pump	G824	10/11/14

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SPECIFIC GRAVITY

ASTM D 854-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth (ft):	164.6-165.1
Project No.:	2013-465-001	Sample No.:	ST-5
Lab ID:	2013-465-001-022	Visual Description:	**Greenish Gray Silt**
			(MInus No.4 sieve material,oven dried)

Replicate Number	**1**	**2**
Pycnometer ID	G 1255	G 1403
Weight of Pycnometer + Soil + Water (g)	735.15	723.9
Temperature (^{o}C)	25.5	24.3
Weight of Pycnometer + Water (g)	685.04	675.49
Tare Number	958	1681
Weight of Tare + Dry Soil (g)	179.57	177.39
Weight of Tare (g)	99.05	99.76
Weight of Dry Soil (g)	80.52	77.63
Specific Gravity of Soil @ Measured Temperature	2.648	2.657
Specific Gravity of Water @ Measured Temperature	0.99692	0.99723
Conversion Factor for Measured Temperature	0.99871	0.99902
Specific Gravity @ 20^{o} Celsius	2.651	2.660

Average Specific Gravity @ 20^{o} Celsius	2.66

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SPECIFIC GRAVITY

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	164.6-165.1
Project No.	2013-465-001	Sample No.	ST-5
Lab ID #	2013-465-001-022		

Equipment	Equipment ID#	Calibration Due Date
Oven	G1118	11/27/13
Balance	G1057	11/5/14
#4 Sieve	G025	8/20/14
Pycnometer	G1255	Initial Only
Pycnometer	G1403	Initial Only
Thermometer	G1412	6/12/14
Vacuum Pump	G824	10/11/14

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SPECIFIC GRAVITY

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Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth (ft):	179.2-179.7
Project No.:	2013-465-001	Sample No.:	ST-9
Lab ID:	2013-465-001-023	Visual Description:	**Gray Silt**
			(MInus No.4 sieve material,oven dried)

Replicate Number	**1**	**2**
Pycnometer ID	G 1255	G 1403
Weight of Pycnometer + Soil + Water (g)	747.14	738.32
Temperature (^{o}C)	26.1	25.0
Weight of Pycnometer + Water (g)	684.96	675.40
Tare Number	656	679
Weight of Tare + Dry Soil (g)	195.33	198.11
Weight of Tare (g)	95.42	96.73
Weight of Dry Soil (g)	99.91	101.38
Specific Gravity of Soil @ Measured Temperature	2.648	2.636
Specific Gravity of Water @ Measured Temperature	0.99677	0.99705
Conversion Factor for Measured Temperature	0.99856	0.99884
Specific Gravity @ 20^o Celsius	2.652	2.639

Average Specific Gravity @ 20^o Celsius	2.65

Tested By	*TO*	*Date*	*11/14/13*	*Checked By*	*KC*	*Date*	*11/15/13*

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	179.2-179.7
Project No.	2013-465-001	Sample No.	ST-9
Lab ID #	2013-465-001-023		

Equipment	Equipment ID#	Calibration Due Date
Oven	G1118	11/27/13
Balance	G1057	11/4/14
#4 Sieve	G025	8/20/14
Pycnometer	G1255	Initial Only
Pycnometer	G1403	Initial Only
Thermometer	G1412	6/12/14
Vacuum Pump	G824	10/11/14

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Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth (ft):	186.3-186.8
Project No.:	2013-465-001	Sample No.:	ST-11
Lab ID:	2013-465-001-024	Visual Description:	**Greenish Gray Silt**
			(MInus No.4 sieve material,oven dried)

Replicate Number	**1**	**2**
Pycnometer ID	G 1255	G 1403
Weight of Pycnometer + Soil + Water (g)	731.98	723.39
Temperature (^{o}C)	25.1	24.8
Weight of Pycnometer + Water (g)	685.09	675.42
Tare Number	924	649
Weight of Tare + Dry Soil (g)	176.77	174.24
Weight of Tare (g)	100.82	96.83
Weight of Dry Soil (g)	75.95	77.41
Specific Gravity of Soil @ Measured Temperature	2.613	2.629
Specific Gravity of Water @ Measured Temperature	0.99703	0.99710
Conversion Factor for Measured Temperature	0.99882	0.99889
Specific Gravity @ 20^{o} Celsius	2.616	2.632

Average Specific Gravity @ 20^{o} Celsius	2.62

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SPECIFIC GRAVITY

ASTM D 854-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	186.3-186.8
Project No.	2013-465-001	Sample No.	ST-11
Lab ID #	2013-465-001-024		

Equipment	Equipment ID#	Calibration Due Date
Oven	G1118	11/27/13
Balance	G1057	11/5/14
#4 Sieve	G025	8/20/14
Pycnometer	G1255	Initial Only
Pycnometer	G1403	Initial Only
Thermometer	G1412	6/12/14
Vacuum Pump	G824	10/11/14

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SPECIFIC GRAVITY

ASTM D 854-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth (ft):	194.1-194.6
Project No.:	2013-465-001	Sample No.:	ST-13
Lab ID:	2013-465-001-025	Visual Description:	**Gray Silt**

(MInus No.4 sieve material,oven dried)

Replicate Number	**1**	**2**
Pycnometer ID	G 1255	G 1403
Weight of Pycnometer + Soil + Water (g)	747.75	739.05
Temperature (^{o}C)	25.8	25.1
Weight of Pycnometer + Water (g)	685.00	675.39
Tare Number	928	2327
Weight of Tare + Dry Soil (g)	203.85	199.62
Weight of Tare (g)	102.66	97.09
Weight of Dry Soil (g)	101.19	102.53
Specific Gravity of Soil @ Measured Temperature	2.632	2.638
Specific Gravity of Water @ Measured Temperature	0.99684	0.99703
Conversion Factor for Measured Temperature	0.99864	0.99882
Specific Gravity @ 20^{o} Celsius	2.636	2.641

Average Specific Gravity @ 20^{o} Celsius	2.64

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SPECIFIC GRAVITY

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	194.1-194.6
Project No.	2013-465-001	Sample No.	ST-13
Lab ID #	2013-465-001-025		

Equipment	Equipment ID#	Calibration Due Date
Oven	G1118	11/27/13
Balance	G1057	11/4/14
#4 Sieve	G025	8/20/14
Pycnometer	G1255	Initial Only
Pycnometer	G1403	Initial Only
Thermometer	G1412	6/12/14
Vacuum Pump	G824	10/11/14

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SPECIFIC GRAVITY

ASTM D 854-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth (ft):	208.7-209.2
Project No.:	2013-465-001	Sample No.:	ST-17
Lab ID:	2013-465-001-027	Visual Description:	**Gray Silty Sand**
			(MInus No.4 sieve material,oven dried)

Replicate Number	**1**	**2**
Pycnometer ID	G 1255	G 1403
Weight of Pycnometer + Soil + Water (g)	748.19	737.79
Temperature (^{o}C)	26.0	25.1
Weight of Pycnometer + Water (g)	684.98	675.39
Tare Number	960	1465
Weight of Tare + Dry Soil (g)	200.86	199.37
Weight of Tare (g)	99.17	98.71
Weight of Dry Soil (g)	101.69	100.66
Specific Gravity of Soil @ Measured Temperature	2.643	2.631
Specific Gravity of Water @ Measured Temperature	0.99679	0.99703
Conversion Factor for Measured Temperature	0.99858	0.99882
Specific Gravity @ 20^{o} Celsius	2.647	2.634

Average Specific Gravity @ 20^{o} Celsius	2.64

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SPECIFIC GRAVITY

ASTM D 854-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	208.7-209.2
Project No.	2013-465-001	Sample No.	ST-17
Lab ID #	2013-465-001-027		

Equipment	Equipment ID#	Calibration Due Date
Oven	G1118	11/27/13
Balance	G1057	11/5/14
#4 Sieve	G025	8/20/14
Pycnometer	G1255	Initial Only
Pycnometer	G1403	Initial Only
Thermometer	G1412	6/12/14
Vacuum Pump	G824	10/11/14

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SPECIFIC GRAVITY
ASTM D 854-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth (ft):	225.2-225.7
Project No.:	2013-465-001	Sample No.:	ST-22
Lab ID:	2013-465-001-028	Visual Description:	**Greenish Gray Silt**
			(MInus No.4 sieve material,oven dried)

Replicate Number	**1**	**2**
Pycnometer ID	G 1255	G 1403
Weight of Pycnometer + Soil + Water (g)	748.27	738.81
Temperature (^{o}C)	24.0	23.5
Weight of Pycnometer + Water (g)	685.23	675.58
Tare Number	924	649
Weight of Tare + Dry Soil (g)	202.57	198.74
Weight of Tare (g)	100.87	96.94
Weight of Dry Soil (g)	101.70	101.80
Specific Gravity of Soil @ Measured Temperature	2.630	2.639
Specific Gravity of Water @ Measured Temperature	0.99730	0.99742
Conversion Factor for Measured Temperature	0.99909	0.99922
Specific Gravity @ 20^{o} Celsius	2.633	2.641

Average Specific Gravity @ 20^{o} Celsius	2.64

Tested By	*TO*	*Date*	*11/15/13*	*Checked By*	*KC*	*Date*	*11/18/13*

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SPECIFIC GRAVITY

ASTM D 854-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	225.2-225.7
Project No.	2013-465-001	Sample No.	ST-22
Lab ID #	2013-465-001-028		

Equipment	Equipment ID#	Calibration Due Date
Oven	G1118	11/27/13
Balance	G1057	11/4/14
#4 Sieve	G025	8/20/14
Pycnometer	G1255	Initial Only
Pycnometer	G1403	Initial Only
Thermometer	G1412	6/12/14
Vacuum Pump	G824	10/11/14

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SPECIFIC GRAVITY
ASTM D 854-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth (ft):	234.7-235.2
Project No.:	2013-465-001	Sample No.:	ST-25
Lab ID:	2013-465-001-029	Visual Description:	**Gray Silty Sand**
			(MInus No.4 sieve material,oven dried)

Replicate Number	**1**	**2**
Pycnometer ID	G 1255	G 1403
Weight of Pycnometer + Soil + Water (g)	748.78	738.83
Temperature (^{o}C)	25.6	25.6
Weight of Pycnometer + Water (g)	685.03	675.32
Tare Number	889	675
Weight of Tare + Dry Soil (g)	204.51	199.24
Weight of Tare (g)	102.28	97.6
Weight of Dry Soil (g)	102.23	101.64
Specific Gravity of Soil @ Measured Temperature	2.657	2.666
Specific Gravity of Water @ Measured Temperature	0.99690	0.99690
Conversion Factor for Measured Temperature	0.99869	0.99869
Specific Gravity @ 20^{o} Celsius	2.660	2.669

Average Specific Gravity @ 20^{o} Celsius	2.66

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	234.7-235.2
Project No.	2013-465-001	Sample No.	ST-25
Lab ID #	2013-465-001-029		

Equipment	Equipment ID#	Calibration Due Date
Oven	G1118	11/27/13
Balance	G1057	11/4/14
#4 Sieve	G025	8/20/14
Pycnometer	G1255	Initial Only
Pycnometer	G1403	Initial Only
Thermometer	G1412	6/12/14
Vacuum Pump	G824	10/11/14

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SPECIFIC GRAVITY

ASTM D 854-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth (ft):	252.2-252.7
Project No.:	2013-465-001	Sample No.:	ST-31
Lab ID:	2013-465-001-030	Visual Description:	**Greenish Gray Silty Sand**
			(MInus No.4 sieve material,oven dried)

Replicate Number	**1**	**2**
Pycnometer ID	G 1255	G 1403
Weight of Pycnometer + Soil + Water (g)	747.56	738.17
Temperature (^{o}C)	24.7	24.5
Weight of Pycnometer + Water (g)	685.15	675.46
Tare Number	1681	1678
Weight of Tare + Dry Soil (g)	200.14	189.9
Weight of Tare (g)	99.72	89.01
Weight of Dry Soil (g)	100.42	100.89
Specific Gravity of Soil @ Measured Temperature	2.642	2.642
Specific Gravity of Water @ Measured Temperature	0.99713	0.99718
Conversion Factor for Measured Temperature	0.99892	0.99897
Specific Gravity @ 20^{o} Celsius	2.645	2.645

Average Specific Gravity @ 20^{o} Celsius	2.65

Tested By TO *Date* 11/15/13 *Checked By* KC *Date* 11/18/13

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	252.2-252.7
Project No.	2013-465-001	Sample No.	ST-31
Lab ID #	2013-465-001-030		

Equipment	Equipment ID#	Calibration Due Date
Oven	G1118	11/27/13
Balance	G1057	11/4/14
#4 Sieve	G025	8/20/14
Pycnometer	G1255	Initial Only
Pycnometer	G1403	Initial Only
Thermometer	G1412	6/12/14
Vacuum Pump	G824	10/11/14

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SPECIFIC GRAVITY

ASTM D 854-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth (ft):	259.7-260.1
Project No.:	2013-465-003	Sample No.:	ST-33
Lab ID:	2013-465-003-001	Visual Description:	**Gray Silty Sand**
			(MInus No.4 sieve material,oven dried)

Replicate Number	**1**	**2**
Pycnometer ID	G 1255	G 1403
Weight of Pycnometer + Soil + Water (g)	747.16	737.1
Temperature (^{o}C)	24.9	24.7
Weight of Pycnometer + Water (g)	685.12	675.44
Tare Number	633	679
Weight of Tare + Dry Soil (g)	196.97	196.14
Weight of Tare (g)	96.99	96.77
Weight of Dry Soil (g)	99.98	99.37
Specific Gravity of Soil @ Measured Temperature	2.635	2.635
Specific Gravity of Water @ Measured Temperature	0.99708	0.99713
Conversion Factor for Measured Temperature	0.99887	0.99892
Specific Gravity @ 20^{o} Celsius	2.638	2.638

Average Specific Gravity @ 20^{o} Celsius	2.64

Tested By *TO* *Date* *12/2/13* *Checked By* *KC* *Date* *12/3/13*

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SPECIFIC GRAVITY

ASTM D 854-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	259.7-260.1
Project No.	2013-465-003	Sample No.	ST-33
Lab ID #	2013-465-003-001		

Equipment	Equipment ID#	Calibration Due Date
Oven	G1118	11/23/14
Balance	G1057	11/4/14
#4 Sieve	G025	8/20/14
Pycnometer	G1255	Initial Only
Pycnometer	G1403	Initial Only
Thermometer	G1412	6/12/14
Vacuum Pump	G824	10/11/14

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SPECIFIC GRAVITY

ASTM D 854-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth (ft):	280.9-281.4
Project No.:	2013-465-001	Sample No.:	ST-40
Lab ID:	2013-465-001-032	Visual Description:	**Greenish Gray Silty Sand**
			(MInus No.4 sieve material,oven dried)

Replicate Number	**1**	**2**
Pycnometer ID	G 1255	G 1403
Weight of Pycnometer + Soil + Water (g)	747.75	737.33
Temperature (^{o}C)	23.9	23.6
Weight of Pycnometer + Water (g)	685.24	675.57
Tare Number	973	694
Weight of Tare + Dry Soil (g)	202.21	194.35
Weight of Tare (g)	102.03	94.98
Weight of Dry Soil (g)	100.18	99.37
Specific Gravity of Soil @ Measured Temperature	2.659	2.642
Specific Gravity of Water @ Measured Temperature	0.99733	0.99740
Conversion Factor for Measured Temperature	0.99912	0.99919
Specific Gravity @ 20° Celsius	2.661	2.644

Average Specific Gravity @ 20° Celsius	2.65

Tested By TO *Date* 11/21/13 *Checked By* KC *Date* 11/22/13

DCN: CT-S5 Date: 9/22/13 Revision: 19 *Gravity.xls*

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SPECIFIC GRAVITY

ASTM D 854-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	280.9-281.4
Project No.	2013-465-001	Sample No.	ST-40
Lab ID #	2013-465-001-032		

Equipment	Equipment ID#	Calibration Due Date
Oven	G1118	11/27/13
Balance	G1057	11/4/14
#4 Sieve	G025	8/20/14
Pycnometer	G1255	Initial Only
Pycnometer	G1403	Initial Only
Thermometer	G1412	6/12/14
Vacuum Pump	G824	10/11/14

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SPECIFIC GRAVITY

ASTM D 854-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth (ft):	300.7-301.2
Project No.:	2013-465-001	Sample No.:	ST-46
Lab ID:	2013-465-001-033	Visual Description:	**Greenish Gray Silty Sand**
			(MInus No.4 sieve material,oven dried)

Replicate Number	**1**	**2**
Pycnometer ID	G 1255	G 1403
Weight of Pycnometer + Soil + Water (g)	747.59	737.28
Temperature (^{o}C)	25.9	25.4
Weight of Pycnometer + Water (g)	684.99	675.35
Tare Number	947	2324
Weight of Tare + Dry Soil (g)	202.04	199.24
Weight of Tare (g)	100.72	98.7
Weight of Dry Soil (g)	101.32	100.54
Specific Gravity of Soil @ Measured Temperature	2.617	2.604
Specific Gravity of Water @ Measured Temperature	0.99682	0.99695
Conversion Factor for Measured Temperature	0.99861	0.99874
Specific Gravity @ 20^{o} Celsius	2.620	2.607

Average Specific Gravity @ 20^{o} Celsius	2.61

Tested By TO *Date* 12/4/13 *Checked By* KC *Date* 12/5/13

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SPECIFIC GRAVITY

ASTM D 854-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	300.7-301.2
Project No.	2013-465-001	Sample No.	ST-46
Lab ID #	2013-465-001-033		

Equipment	Equipment ID#	Calibration Due Date
Oven	G1118	11/23/14
Balance	G1057	11/4/14
#4 Sieve	G025	8/20/14
Pycnometer	G1255	Initial Only
Pycnometer	G1403	Initial Only
Thermometer	G1412	6/12/14
Vacuum Pump	G824	10/11/14

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SPECIFIC GRAVITY

ASTM D 854-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth (ft):	319.0-319.5
Project No.:	2013-465-001	Sample No.:	ST-52
Lab ID:	2013-465-001-034	Visual Description:	**Gray Sand**
			(MInus No.4 sieve material,oven dried)

Replicate Number	**1**	**2**
Pycnometer ID	G 1255	G 1403
Weight of Pycnometer + Soil + Water (g)	747.15	738.72
Temperature (^{o}C)	27.2	26.4
Weight of Pycnometer + Water (g)	684.81	675.21
Tare Number	1614	672
Weight of Tare + Dry Soil (g)	195.7	200.14
Weight of Tare (g)	94.99	97.36
Weight of Dry Soil (g)	100.71	102.78
Specific Gravity of Soil @ Measured Temperature	2.624	2.617
Specific Gravity of Water @ Measured Temperature	0.99647	0.99669
Conversion Factor for Measured Temperature	0.99826	0.99848
Specific Gravity @ 20^{o} Celsius	2.629	2.621

Average Specific Gravity @ 20^{o} Celsius	2.62

Tested By TO *Date* 11/13/13 *Checked By* KC *Date* 11/14/13

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SPECIFIC GRAVITY

ASTM D 854-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	319.0-319.5
Project No.	2013-465-001	Sample No.	ST-52
Lab ID #	2013-465-001-034		

Equipment	Equipment ID#	Calibration Due Date
Oven	G1118	11/27/13
Balance	G1057	11/5/14
#4 Sieve	G025	8/20/14
Pycnometer	G1255	Initial Only
Pycnometer	G1403	Initial Only
Thermometer	G1412	6/12/14
Vacuum Pump	G824	10/11/14

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SPECIFIC GRAVITY

ASTM D 854-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth (ft):	357.0-357.5
Project No.:	2013-465-001	Sample No.:	ST-66
Lab ID:	2013-465-001-037	Visual Description:	**Greenish Gray Silty Sand**
			(MInus No.4 sieve material,oven dried)

Replicate Number	**1**	**2**
Pycnometer ID	G 1255	G 1403
Weight of Pycnometer + Soil + Water (g)	747.23	737.54
Temperature (^{o}C)	25.8	25.4
Weight of Pycnometer + Water (g)	685.00	675.35
Tare Number	952	516
Weight of Tare + Dry Soil (g)	203.36	193.02
Weight of Tare (g)	102.72	92.44
Weight of Dry Soil (g)	100.64	100.58
Specific Gravity of Soil @ Measured Temperature	2.620	2.620
Specific Gravity of Water @ Measured Temperature	0.99684	0.99695
Conversion Factor for Measured Temperature	0.99864	0.99874
Specific Gravity @ 20° Celsius	2.623	2.623

Average Specific Gravity @ 20° Celsius	2.62

Tested By TO *Date* 11/18/13 *Checked By* KC *Date* 11/19/13

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SPECIFIC GRAVITY

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EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	357.0-357.5
Project No.	2013-465-001	Sample No.	ST-66
Lab ID #	2013-465-001-037		

Equipment	Equipment ID#	Calibration Due Date
Oven	G1118	11/27/13
Balance	G1057	11/4/14
#4 Sieve	G025	8/20/14
Pycnometer	G1255	Initial Only
Pycnometer	G1403	Initial Only
Thermometer	G1412	6/12/14
Vacuum Pump	G824	10/11/14

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SPECIFIC GRAVITY

ASTM D 854-10

Client:	Paul C. Rizzo & Associates	Boring No.:	R-6-1b
Client Reference:	Turkey Point Units 6 & 7 Site	Depth (ft):	360.6-361.1
Project No.:	2013-465-001	Sample No.:	ST-67
Lab ID:	2013-465-001-038	Visual Description:	**Gray Sand**
			(MInus No.4 sieve material,oven dried)

Replicate Number	**1**	**2**
Pycnometer ID	G 1255	G 1403
Weight of Pycnometer + Soil + Water (g)	747.7	738.46
Temperature (°C)	25.3	25.0
Weight of Pycnometer + Water (g)	685.07	675.40
Tare Number	633	1321
Weight of Tare + Dry Soil (g)	198.13	199.78
Weight of Tare (g)	96.89	97.66
Weight of Dry Soil (g)	101.24	102.12
Specific Gravity of Soil @ Measured Temperature	2.622	2.615
Specific Gravity of Water @ Measured Temperature	0.99698	0.99705
Conversion Factor for Measured Temperature	0.99877	0.99884
Specific Gravity @ 20° Celsius	2.625	2.618

Average Specific Gravity @ 20° Celsius	2.62

Tested By TO *Date* 11/14/13 *Checked By* KC *Date* 11/15/13

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SPECIFIC GRAVITY

ASTM D 854-10

EQUIPMENT LIST

Client	Paul C. Rizzo & Associates	Boring No.	R-6-1b
Client Reference	Turkey Point Units 6 & 7 Site	Depth (ft)	360.6-361.1
Project No.	2013-465-001	Sample No.	ST-67
Lab ID #	2013-465-001-038		

Equipment	Equipment ID#	Calibration Due Date
Oven	G1118	11/27/13
Balance	G1057	11/4/14
#4 Sieve	G025	8/20/14
Pycnometer	G1255	Initial Only
Pycnometer	G1403	Initial Only
Thermometer	G1412	6/12/14
Vacuum Pump	G824	10/11/14