FOUNDATION REPORT

5TH STREET BRIDGE OVER THE FEATHER RIVER
BRIDGE NO. 18C0142

AND

2ND STREETOVERCROSSING
BRIDGE NO. 18C0143

SUTTER COUNTY, CALIFORNIA

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Prepared for:

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EMI Project No. 13-121

August 5, 2016

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

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Geotechnical & Earthquake Engineering

August 5, 2016

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Dokken Engineering
110 Blue Ravine Road, Suite 200
Folsom, CA 95630

Attention: Mr. Matt Griggs

Subject: **5th Street Bridge over the Feather River, Bridge No. 18C0142**
2nd StreetOvercrossing, Bridge No. 18C0143
Yuba City, Sutter County, California

Dear Mr. Griggs:

Attached is our Foundation Report for the 5th Street Bridge over the Feather River (Bridge No. 18C0142) and 2nd Street Overcrossing (Bridge No. 18C0143) bridge replacement projects in Yuba City, Sutter County, California. This report follows the California Department of Transportation (Caltrans) Foundation Report Preparation for Bridges (2009b), and presents the results of our analyses and recommendations for design and construction of the bridge foundations for the subject bridge.

We appreciate the opportunity to provide geotechnical services for this project. If you have any questions please do not hesitate to contact us.

Sincerely,
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1.0 INTRODUCTION

1.1 Purpose and Scope of Work

This Foundation Report (FR) presents the findings and conclusions of a geotechnical study conducted by Earth Mechanics, Inc. (EMI) for the 5th Street Bridge (Bridge No. 18C0142 Replace) over the Feather River and 2nd Street Overcrossing (OC) (Bridge No. 18C0143 Replace) in Yuba City, Sutter County, California. This report presents results of our foundation analysis and provides design and construction recommendations to assist Dokken Engineering (Dokken) in preparing the project Plans, Specifications, and Estimates (PS&E) for the project. Current report supersedes all previous reports.

The geotechnical services provided for this project included the following tasks:

- Collection and review of existing geotechnical information;
- Geotechnical field exploration including drilling and logging of exploratory borings;
- Laboratory testing of selected subsurface soil samples;
- Engineering analysis to develop foundation design and construction recommendations;
- Preparation of this report to present our findings, conclusions, and recommendations.

1.2 Project Description

The City of Yuba City, in cooperation with the City of Marysville and the California Department of Transportation (Caltrans), has proposed to replace the 5th Street Bridge over the Feather River (Bridge No. 18C0142) and the 2nd Street OC (Bridge No. 18C0143). The existing bridges are rated as "functionally obsolete" by Caltrans under the Federal Highway Administration (FHWA) inspection criteria, due to inadequate lane and shoulder widths. In addition, due to forecasted increase in vehicular traffic between Yuba City and Marysville, the existing two lane bridges will operate at failing levels of service by 2035, and additional traffic lanes will be necessary. The proposed project will also improve pedestrian and bicycle access between the two cities.

1.2.1 Project Location

The project site is located in Sutter and Yuba Counties between the cities of Yuba City and Marysville. In the project area, the 5th Street trends in a west-east direction and crosses over the Second Street, the Feather River and the Riverfront Park Complex on the east bank of the river. At the bridge site the Feather River flows in a northwest-southeast direction. Levees with maximum slope of 2 to 1 (horizontal to vertical) protect the adjacent Yuba City to the west and Marysville to the east of the river during high floods. The site location map is shown in Figure 1.

1.2.2 Existing Structure

The existing 5th Street Bridge was built in 1958 as a 26-span bridge comprising of a 21-span main bridge, a two-span slab bridge over the west levee, a single-span slab bridge over the east levee, and a two-span bridge over the 2nd Street at the west approach. The bridge has a total length of 2,071.78 feet, and total width of 35.41 feet. It carries one lane of traffic in each direction over the Feather River and across the Riverfront Park Complex. The two spans over the

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main Feather River channel are 151.3 feet long and use cast in-place post-tensioned concrete girders. Other spans are approximately 80 feet long and use pre-cast pre-stressed concrete I-beams.

Bridge foundations are supported on 16-inch hexagonal precast pre-stressed concrete (PCC) piles, with some piles battered in longitudinal or transverse directions. There is also a railroad bridge parallel to the 5th Street Bridge, approximately 50 feet (from centerline to centerline) to the south.

1.2.3 Proposed Structures

Based on the preliminary plans provided by the structural engineers, the proposed 5th Street Bridge replacement alternative is a 10-span cast-in-place post-tensioned (CIP/PS) concrete box girder bridge supported by closed-end, seat abutments and square multi-column piers. The proposed bridge has a total length of about 1,868 feet and total deck width of about 76.5 feet, and provides two traffic lanes in each direction. The beginning and end of this bridge will be set at El. +92.58 feet and +87.57 feet, respectively. The horizontal alignment of the replacement bridge will be shifted to the north, away from the railroad bridge.

The 2nd Street OC replacement is a single-span precast prestressed wide flange girder bridge supported by closed-end, seat abutments. It is proposed to carry 2 traffic lanes in each direction and a westbound off-ramp to 2nd Street over 2nd Street in Yuba City. The proposed bridge has a total length of 148 feet, and variable total width between 86.9 and 106.2 feet. The beginning and end of this bridge will be set at El. +84.81 feet and +90.16 feet, respectively.

1.3 Limitations

This report is intended for use by Dokken Engineering, the City of Yuba City, and the California Department of Transportation for improvements proposed for the proposed project. This report is based on the project as described herein and the information obtained from the exploratory borings at the approximate locations indicated on the attached plans. The findings and recommendations contained in this report are based on the results of the field investigation, laboratory tests, and engineering analyses. Also, soils and subsurface conditions encountered in the exploratory borings are presumed to be representative of the project site; however, subsurface conditions and characteristics of soils between exploratory borings can vary. Findings reflect an interpretation of the direct evidence obtained. Recommendations presented herein are based on the assumption that an appropriate level of quality control and quality assurance (inspections and tests) will be provided during construction. EMI should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Modifications to the project plans or variations in subsurface conditions may require re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations contained herein are applicable to the specific design elements and locations which are the subject of this report. Data, opinions, and recommendations herein have no applicability to any other design elements or to any other locations, and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of EMI.

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EMI is not responsible for construction means, methods, techniques, sequences, or procedures, or for safety precautions or programs in connection with the construction, for the acts or omissions of the Contractor, or any other person performing any of the construction, or for the failure of any worker to carry out the construction in accordance with the final construction drawings and specifications.

Services performed by EMI were conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or guarantee is included or intended.

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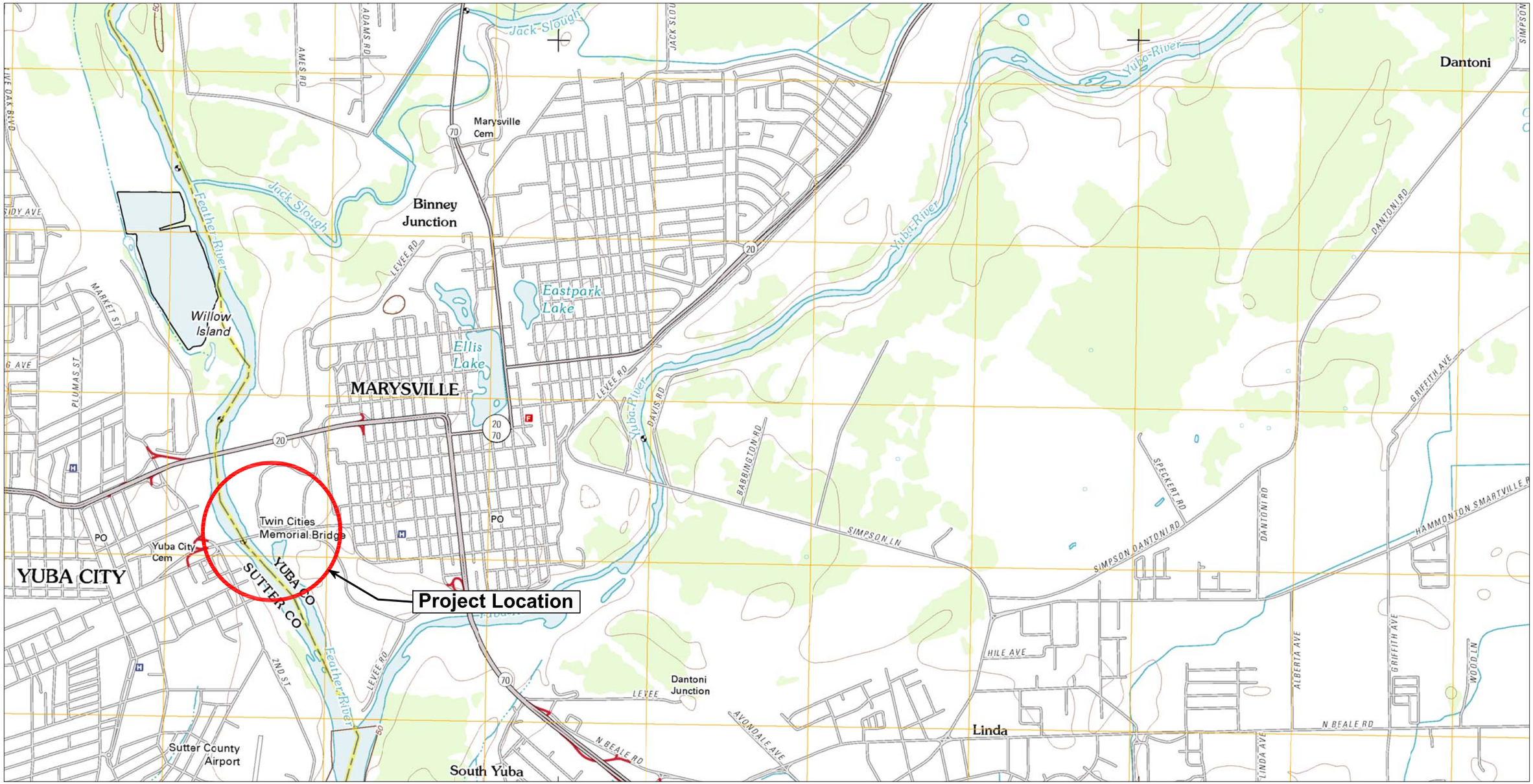

N

0 2,000 4,000 FEET

SCALE 1" = 2,000'

Earth Mechanics, Inc.

Geotechnical and Earthquake Engineering

5th Street Bridge Replacement Project

Project No. 13-121 | Date: August 2015

SITE LOCATION MAP

REFERENCE: USGS Topographic 7.5 Minute Quadrangle Maps - Yuba City Quadrangle (2012)

Figure 1

2.0 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 Existing Information

Previous geotechnical studies at the site are as follows:

- The as-built LOTB from a soil report by Porter, Urquhart, McCreary and O'Brien (1957),
- A Preliminary Geotechnical Report by Taber (2008),
- Seismic and Liquefaction Study for the 5th Street Bridge Replacement Project – Bridge No. 18C0142 (Dokken, 2013),
- CPT Site Investigation – 5th Street Bridge, Yuba City, CA (Gregg Drilling, 2011), performed for the aforementioned seismic and liquefaction study by Dokken.

Previous boring data includes 3 rotary wash and 4 piston type sampler borings from the as-built LOTB, one boring and 7 CPTs from Taber 2008 investigation, and 6 seismic CPTs from Dokken seismic and liquefaction study performed by Gregg Drilling in 2011. Table 1 shows the information from previous explorations. Top-of-hole elevation at the time of investigation was between +63 and +33 feet. The deepest CPT (DE-CPT-02) was advanced to El. -60.5 feet, approximately 105 feet below grade. LOTB sheets are included in Appendix A.

Vertical control of all of the existing available subsurface information is based upon the National Geodetic Vertical Datum of 1988 (NGVD 88).

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Table 1. Previous Exploration Information

Date of Drilling	Boring No.	Type	Approx. Ground Surface El. (ft)	Approx. Bottom of Hole El. (ft)	Water Level El. (ft)
1956	P-1	Piston Sampler	+53	-10	N/A
1956	W-2	Wash	+33	-19	N/A
1956	W-3	Wash	+36	-25	N/A
1956	W-4	Wash	+47	-18	N/A
1956	P-5	Piston Sampler	+56	+16	N/A
1956	P-6	Piston Sampler	+52	+0	N/A
1956	P-7	Piston Sampler	+57	-4	N/A
August 2007	CPT-1	CPT	+61.4	-19	N/A
August 2007	B-1	Auger/Rotary	+53.6	-28	+41.1
August 2007	CPT-2	CPT	+54.6	+3	N/A
August 2007	CPT-3	CPT	+54.6	+5	N/A
August 2007	CPT-4	CPT	+53.9	+12	N/A
August 2007	CPT-5	CPT	+51.6	-12	N/A
August 2007	CPT-6	CPT	+53.8	-20	N/A
August 2007	CPT-7	CPT	+55.2	-28	N/A
May 2011	DE-CPT-01	Seismic CPT	+63	-37	N/A
May 2011	DE-CPT-02	Seismic CPT	+54.5	-60.5	N/A
May 2011	DE-CPT-03	Seismic CPT	+54	-46	N/A
May 2011	DE-CPT-04	Seismic CPT	+50	-46	N/A
May 2011	DE-CPT-05	Seismic CPT	+52.5	-47.5	N/A
May 2011	DE-CPT-06	Seismic CPT	+55	-45	N/A
Note: All elevations are based on NAVD88.					

2.2 Supplemental Field Investigation

A field investigation program initially consisting of drilling 13 geotechnical borings was planned at the subject bridge site to determine subsurface conditions and collect soil samples from the site. 12 soil borings on land were completed between October 8 and December 12, 2013, and they were drilled using rotary-wash technique with a truck-mounted drill rig equipped with a 5-inch diameter auger. However, due to the issue of permit delay and special equipment required, WR-13-003 in the Feather River cannot be finished at the preparation of this report. As the subsurface condition has been well defined by the available soil information from the above 12 borings and previous subsurface investigation, drilling this boring will be performed later only for confirmation purposes. Per the request by structural engineers for locating possible barrow materials to construct abutments, one additional boring by hand auger (HA-13-014) was performed on March 4, 2016, in a basin area about 300 feet northwest of the 2nd Street OC.

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General soil exploration information from those borings is summarized in Table 2. Approximate locations of borings are shown in Figure 2 (excluding HA-13-014).

Table 2. Soil Exploration Information performed by EMI

Boring No.	Approx. Station	Boring Type	Station Line	Approx. Offset (ft)	Approx. Ground Surface El. (ft)	Approx. Bottom of Hole El. (ft)	Approx. Groundwater El. During Drilling (ft)
R-13-001	34+82	RW	"F" Line	14 Lt.	+85.2	-84	+42.2
R-13-002	35+91	HSA	"F" Line	14 Lt.	+61.8	+56.7	NE
WR-13-003	Not completed	-	-	-	-	-	-
R-13-004	40+42	RW	"F" Line	17 Lt.	+55	-85.5	+31
R-13-005	42+61	RW	"F" Line	4 Rt.	+52.5	-90.5	+46.5
R-13-006	44+50	RW	"F" Line	26 Lt.	+54.5	-85.5	+48.5
R-13-007	46+50	RW	"F" Line	15 Lt.	+54	-86	+45.5
R-13-008	48+50	RW	"F" Line	27 Lt.	+53	-87	+41
R-13-009	50+50	RW	"F" Line	26 Lt.	+51.2	-86.3	NM
R-13-010	52+40	RW	"F" Line	6 Rt.	+55.4	-89.5	NM
R-13-011	54+35	RW	"F" Line	26 Lt.	+87	-14.5	+44
R-13-012	32+73	RW	"F" Line	32 Lt.	+61.8	-38.6	+39.8
R-13-013	33+90	RW	"F" Line	2 Rt	+63.4	-38.1	+53.4
HA-13-014	NM	HA	"F" Line	NM	+61.0	+60.0	NM

Notes:

1. Stations and offsets are approximate.
2. GSE = Ground Surface Elevation estimated from topographic plans
3. HSA = Hollow-Stem Auger; RW = Rotary Wash; HA = Hand Auger.
4. NE = Not Encountered, NM = Not Measured
5. All elevations are based on NAVD88.

Our field representatives visually classified the soil cuttings in accordance with Caltrans' Soil and Rock Logging Classification Manual (2010a) and maintained a detailed record of subsurface materials as well as the groundwater conditions encountered in the exploratory borings. The Log-of-Test-Borings (LOTB) sheets, and other pertinent information are presented in Appendix A. It should be noted that the lines designating the interface between materials on the LOTB sheets and boring records generally represent approximate boundaries. The actual transition between subsurface materials is usually gradual.

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When subsurface conditions permitted, alternating relatively undisturbed soil sampling and Standard Penetration Test (SPT, ASTM D1586) were performed in the borings at 5-foot depth intervals. Relatively undisturbed drive samples were obtained using a Modified California split-spoon sampler (3.25-inch outer diameter) lined with brass rings. Each of these brass rings is 1-inch long with a 2.5-inch outside diameter. The SPT were performed with a SPT sampler (1.4-inch inside diameter) without liners. The SPT sampler was driven into the ground using a 140-lb hammer free falling from a height of 30 inches. The number of blows to advance the samplers was recorded at every 6 inches of penetration, or until refusal. Only the total number of blows for the final 12 inches or less of driving of the SPT sampler is shown on the LOTB sheets. The total blow counts required to drive the SPT sampler for the last 12 inches is referred as the Standard Penetration Resistance (N-value), and can be used to correlate in-situ soil strengths. The rated efficiency of the hammer as provided by the drilling contractor was noted and reported on the LOTB sheets.

After completion, the borings were backfilled with a one-sack lean cement mix in accordance with the requirements of the County of Sutter. The surrounding ground surfaces were restored to generally match the existing condition.

2.3 Laboratory Testing

Laboratory tests were performed to determine relevant physical characteristics and engineering properties of soils that exist at the site. Selected soil samples were tested to determine soil classification and physical and engineering properties. A list of tests performed, the corresponding test methods, and purpose of testing is presented in Table 3.

The laboratory soil tests were conducted in general accordance with California Test (CT) methods or American Society for Testing and Materials (ASTM) standards. The locations where tests were performed are shown on the LOTB sheets in Appendix A and the test results are presented in Appendix B.

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Table 3. Explanation of Laboratory Tests Performed

Type of Test	Applicable Test Method	Purpose
Dry Density	ASTM[1] D 2937	Estimate in-situ soil density
Moisture Content	ASTM D 2216	Estimate in-situ soil moisture content
No. 200 Wash	ASTM D 1140	Estimate percentage of gravel, sand, and fines content
Sieve Analysis	ASTM D 422	Determine grain size distribution
Pocket Penetrometer	-	Estimate unconfined compressive strength of cohesive soil
Atterberg Limits	ASTM D 4318	Evaluate plasticity of fine grained particles
Direct Shear	ASTM D 3080	Estimate strength parameters of soil
Unconsolidated-Undrained Triaxial Compression	ASTM D 2850	Estimate strength parameters of soil
Consolidation	ASTM D 2435	Estimate compressibility parameters of soil
Compaction Test	ASTM D 1557	Determine maximum density and optimum moisture of soil
Sand Equivalent	ASTM D 2419/CT[2] 217	Determine sand equivalent of soil
Soil pH	CT 532/643	Determine corrosion potential of site soil
Minimum Resistivity	CT 532/643	Determine corrosion potential of site soil
Sulfate Content	CT 417	Determine corrosion potential of site soil
Chloride Content	CT 422	Determine corrosion potential of site soil

Notes:

1. ASTM = American Society for Testing and Materials.
2. CT = California Test Method.

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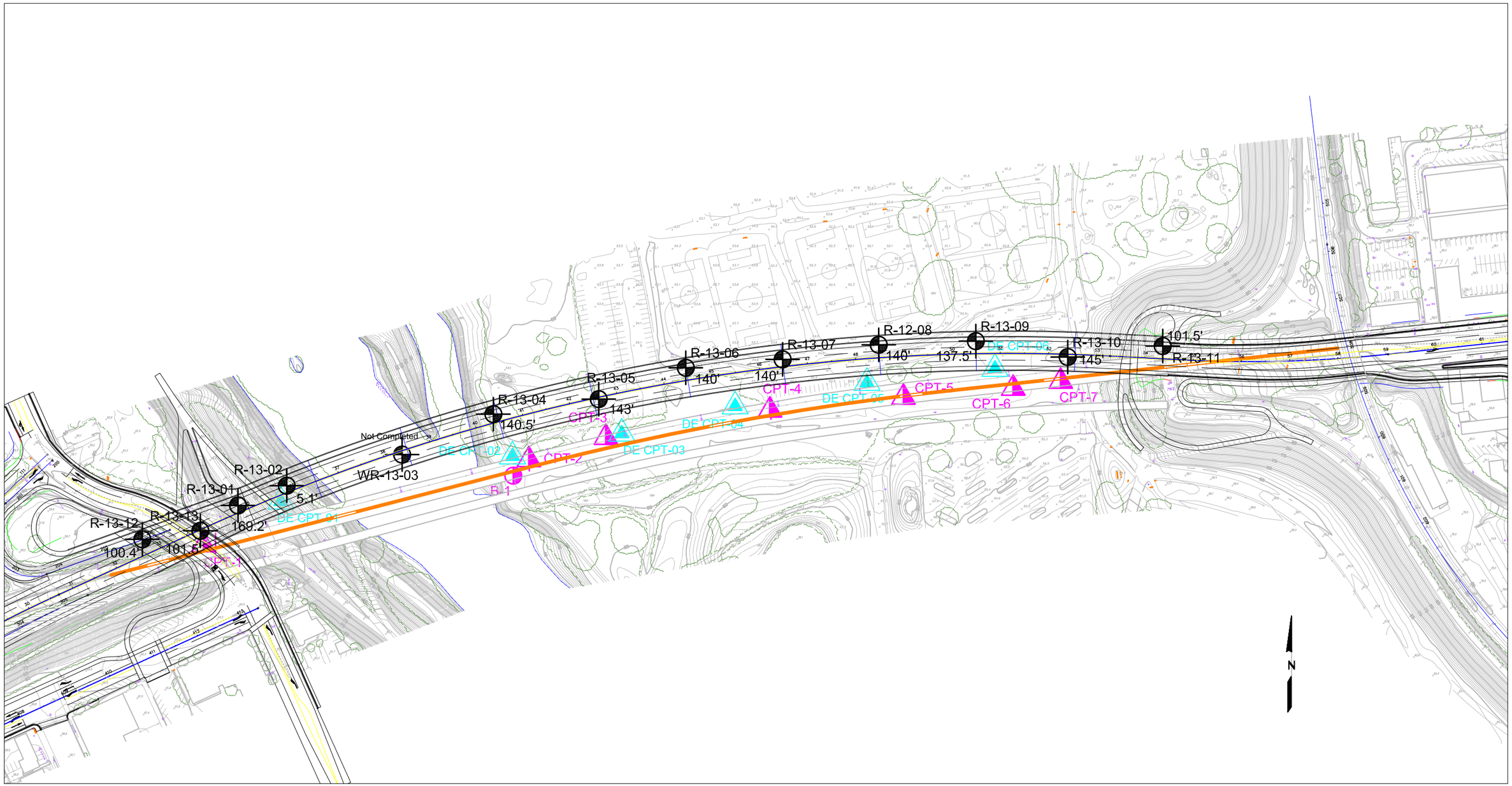

R-12-01 Location of Mud Rotary Boring by Earth Mechanics (Depth)

CPT-1 Location of Cone Penetrometer Test Sounding by Taber (2008)

DE CPT-01 Location of Cone Penetrometer Test Sounding by Dokken (2011)

B-1 Location of Geotechnical Boring by Taber (2008)

Location of Proposed Bridge Pier and Abutment

0 200 400 FEET

SCALE 1" = 200'

Earth Mechanics, Inc.

Geotechnical and Earthquake Engineering

5th Street Bridge Replacement Project

Project No. 13-121

Date: August 2015

Boring Location Map

Figure 2

3.0 GEOLOGY

3.1 Physiography

The project area is located within Sacramento Valley within the northern portion of the Great Valley physiographic province. The Great Valley is an elongated, asymmetric structural trough extending approximately 450 miles long and 50 miles wide in a general northwest-southeast direction. The province is bounded by the Sierra Nevada Mountains to the east, the Coast Ranges to the west, the Transverse Range to the south, and the Klamath Mountains to the north. The Great Valley is underlain by a very thick sequence of Holocene to Jurassic age alluvial sediments. These sediments have been folded along an asymmetric syncline axis which lies to the east within the central portion of the Coast Ranges. The thick sequences of alluvial sediments are underlain by basement rock of the Sierra Nevada Mountains.

3.2 Stratigraphy

The project site is located at the western edge of Yuba County which is underlain by alluvial deposits associated with alluvial fan, stream channel and stream terrace deposition. The alluvial deposits vary in age from recent Holocene alluvial deposition associated with the Feather River as well as older alluvial formations including the Modesto and Riverbank Formations. Both the Riverbank and younger Modesto formations consist of upper and lower members, which are distinguishable by the soil horizons. The Holocene to Pleistocene alluvium overlies the sedimentary and volcanic deposits associated with the Sutter Formation. Mantling the Sutter Formation is the Chico Formation which consists of thick sequences of marine sandstone and conglomerate with some minor siltstone. Units are shown on the Regional Geologic Map (Figure 3).

The geologic formations in the area, following the nomenclature of Helley and Harwood (1985), and Saucedo and Wagner (1992) in descending stratigraphic order are:

- Alluvial and Stream Channel Deposits, Holocene (Qa and Qsc);
- Modesto Formation, Pleistocene (Qmu and Qml);
- Riverbank Formation, Pleistocene, (Qru and Qrl);
- Sutter Formation, Pliocene, MioCene and Oligocene, (Ts);
- Chico Formation, Cretaceous, (Kc);

The project site is immediately underlain by stream channel deposits and alluvium associated with the Feather River. These deposits consist Holocene age unconsolidated silts, sands and gravels with unit thicknesses varying between less than a foot to 80 ft thick regionally. Locally the Holocene alluvium is underlain by the upper member of the Modesto Formation which consists of tan to light gray alluvial gravel, sand, silt and clay. The Pleistocene age Modesto Formation is mapped a terrace along the west side of the Feather River. The eastern edge of the project site is underlain by the upper member of the Riverbank Formation. The Riverbank Formation is older than the Modesto Formation and consists of dark-brown to red alluvial gravels, sands, silts, and minor clays. The project site also has some man-made levees which are located underneath the existing bridge abutment. The levees are composed of artificial fill material derived locally as graded and compacted alluvial soils.

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3.2.1 Faulting

The project site is located within the Sacramento Valley region of the Great Valley Geomorphic Province. The region consists of numerous active and potentially active faults including the Cleveland Hill (Foothills Fault System), Swain Ravine lineament (Foothills Fault System), Spenceville Fault (Foothills Fault System), Dunnigan Hills, and Sulphur Creek Fault. Of these faults, the Cleveland Hill fault is identified as Alquist-Priolo (AP) Earthquake Fault Zones defined by the Alquist-Priolo Earthquake Hazards Act of 1972 revised in 1994. The AP faults not only represent earthquake shaking hazards, but have a potential for surface ground rupture. The type and magnitude of the seismic hazard affecting the site are dependent on the distance and causative faults and the intensity and magnitude of the seismic event. Other potentially active faults may not be identified as AP Earthquake Fault Zones because their locations are not well defined and/or they have not generated earthquakes in historical time. Locally, smaller faults exist within the valley floor within the vicinity of the site location as well. The project corridor does not enter into any AP fault zones and does not cross any active fault traces. The nearest active/potentially fault is over 15.3 miles away from the project site (Figure 4).

3.2.1.1 Foothills Fault System, Northern Reach Section (Cleveland Hill Fault, Swain Ravine linament, and Spenceville fault)

The Foothills Fault System is located east of the project site and extends north-northwest along the eastern margin of the Great Valley geomorphic province. The Foothills Fault System is broken up into numerous separately mapped normal fault lineaments including the Cleveland Hill Fault, Swain Ravine lineament, Prairie Creek lineament, and Spenceville Fault. Other segments including the Bear Mountain Fault Zone extend further south as part of the Foothills Fault System. According to Microearthquake studies within the Sierra foothills since 1975, the Foothills Fault System is seismically active between Oroville and Folsom. The study indicated a reoccurrence pattern of low level magnitude 1.0 events over an extended time period (Cramer and other, 1978). The closest segment (Spenceville fault) of the Foothills Fault System is located 15.3 miles east of the project site.

3.2.1.2 Great Valley Fault System

The nearest segment of the Great Valley Fault is located approximately 34 miles west of the project site. The Great Valley fault system is a compressional feature that extends approximately 326 miles northwest-southeast along the western margin of the San Joaquin Valley. The fault system is a blind thrust system comprised of 14 segments. The southern segments are considered to be the source of both the magnitude 6.4 1983 Coalinga earthquake and the magnitude 6.2 1985 Kettlemen earthquakes. One of the northern segments is believed to be the source of the 1892 Winters-Vacaville earthquakes. According to Caltrans ARS Online, the Great Valley fault system is capable of producing earthquakes of moment magnitudes 6.4 to 7.1. The fault is considered active though is not identified to be within an AP Earthquake Fault Zone as it is not clearly defined.

3.2.1.3 Dunnigan Hills Fault

The Dunnigan Hils fault is located approximately 28 miles southwest of the project site. The

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fault is considered to be potentially active but is not delineated within an Alquist-Priolo Earthquake Fault Zone. The fault extends northwest-southeast between the town of Dunnigan and an area to the northwest of the town of Yolo.

3.2.1.4 San Andreas Fault (North Coast)

The San Andreas fault (North Coast) is located approximately 96 miles southwest of the project site. The San Andreas fault zone (SAFZ) is located approximately 67 miles southwest of the project site. The SAFZ extends approximately 600 miles between the Salton Sea and Cape Mendocino. The SAFZ is the plate tectonic boundary between the North American Plate and the Pacific Plate. The last major earthquake to occur on the southern segment of the SAFZ was a magnitude 7.9 earthquake at Fort Tejon in 1857. The fault is considered to have the potential of generating a maximum moment magnitude of 7.9. Most areas along the SAFZ have been designated as AP Special Studies Zones.

3.3 Seismicity

The project site is located in the Sacramento Valley region of northern California which contains few active and potentially active faults and is considered a region of low to moderate seismic activity. Seismicity in the valley is widely dispersed across the valley and along its margins. Moderate seismic activity has occurred along the southwest margin near Lake Berryessa and within the Coast Ranges-Sierran block boundary zone where the 1892 6.5 moment magnitude Vacaville-Winters earthquake occurred. Additionally, in the Sierran foothills near Oroville, a M_L 5.7 earthquake occurred along the Cleveland Hill Fault in 1975. Additionally, some moderate seismicity has been recorded within the Sacramento Valley interior along the Willows and Corning faults. All of the moderate seismic events occurred over 10 miles away from the project site location.

The only historical seismicity that was relatively proximal to the project site includes a series of events occurring between 1975 and 1977 with magnitudes ranging from 0.7 to 2.1. Two events were located southeast of Honcut and one event east of Marysville (Marks and Lindh, 1977). The 2.1 magnitude event occurred 10 km east of Honcut.

3.4 Geologic Hazards

3.4.1 Fault Rupture

There are no known active surface faults within the project limits so ground rupture is not a factor. The nearest active fault is located approximately 15 miles from the project vicinity (Figure 4), as a result low to moderate ground shaking should be anticipated at the site in the event of an earthquake.

The California Division of Mines and Geology (2007) has not identified Alquist-Priolo Fault Zones through the site; therefore, the risk of ground surface rupture and related hazards is considered low.

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3.4.2 Landslide

The only slopes within the project limits include stream banks associated with the Feather River and man-made fill slopes and embankments associated with roadway and freeway improvements, there is no evidence of existing deep-seated landslides in the project area. Minor surficial slumps may occur along the stream banks in response to undermining and erosion by the streams, though the embankments have been maintained as part of the proposed bridge improvements. The bridge abutments were analyzed for slope stability, and the risk for landsliding is considered low.

3.4.3 Liquefaction

The site has a high liquefaction potential due to presence of loose coarse-grained deposits and high groundwater levels throughout the soil profile. Previous studies by Taber (2008) and Dokken (2011) indicate widespread liquefaction potential. Due to high potential for liquefaction at the site, comprehensive liquefaction hazard assessments have been performed in Section 5.2.

3.4.4 Flooding

According to Dokken (2013), Wreco (2012) performed hydraulic analysis of the Feather River using HEC-RAS model provided by MBK Engineers. The model represented the Feather River and its tributaries from major reservoirs within the watershed basin to its confluence with the Sacramento River (2006). According to this study, the 100-year and 200-year events had peak flows of 165,000 and 192,000 ft^3/sec.

Water surface elevation in the Feather River was measured at El. +41.8 feet in November 1956. The design flood high water level on as-built drawings is El. +82.5 feet. This elevation is a few feet below the crest of the levees. Since seismic and flood load cases are considered separately, for liquefaction analyses and seismic design a lower groundwater elevation can be used (see Section 4.2)

3.4.5 Scour Evaluation

According to Taber (2008), scour data for the existing bridge was provided by TRC. The data indicated that total scour on the order of 6.8, 8.1, and 7.7 feet was anticipated at Piers 3, 4, and 5 of the existing 5th Street Bridge, respectively. The more detailed scour study for the proposed replacement bridge alignment by Wreco (2016) is described in Section 5.4.

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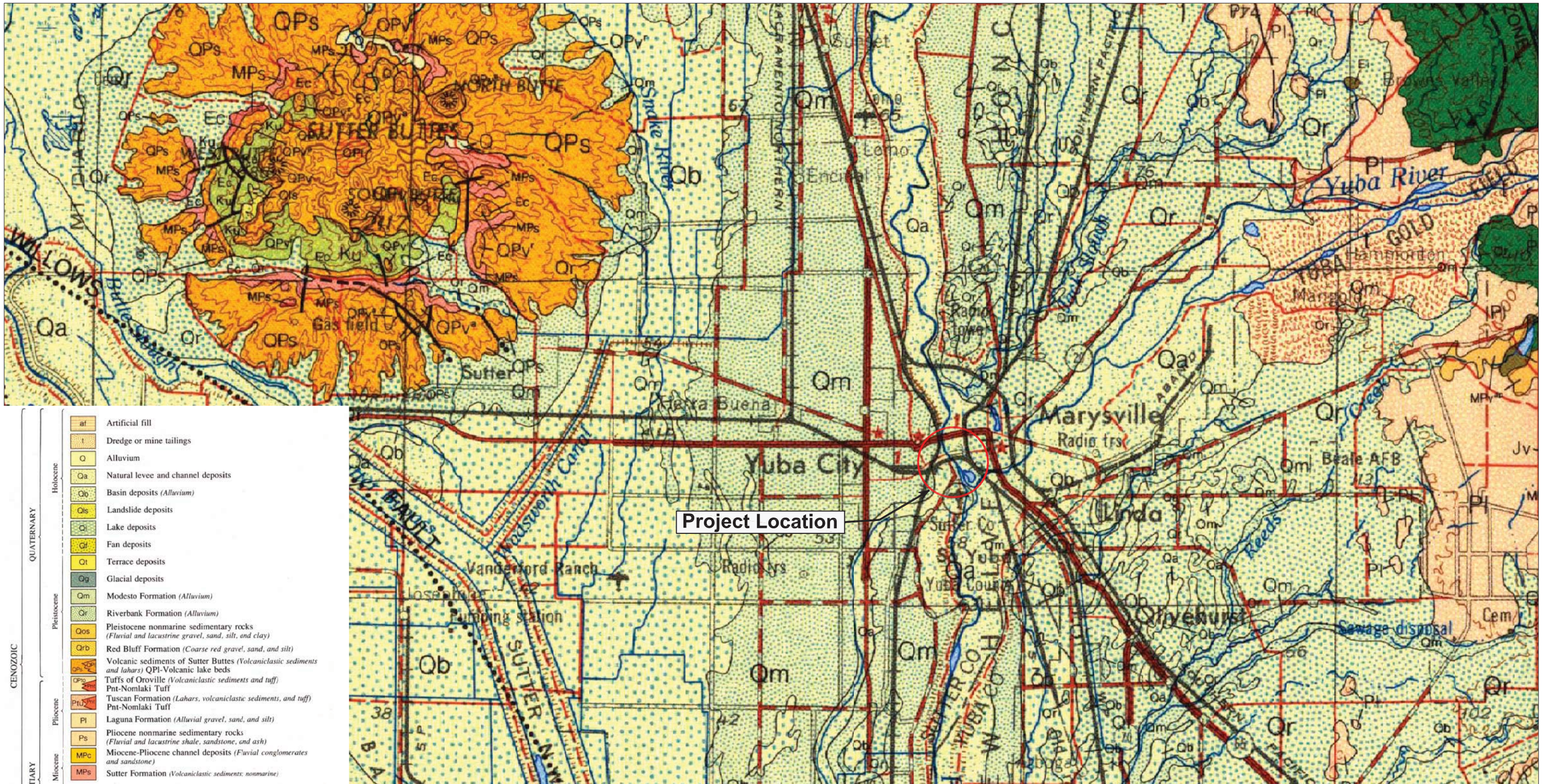


CENOZOIC	QUATERNARY	Holocene	af	Artificial fill
			t	Dredge or mine tailings
			Q	Alluvium
			Qa	Natural levee and channel deposits
			Qb	Basin deposits *(Alluvium)*
			Qls	Landslide deposits
			Ql	Lake deposits
			Qf	Fan deposits
		Pleistocene	Qt	Terrace deposits
			Qg	Glacial deposits
			Qm	Modesto Formation *(Alluvium)*
			Qr	Riverbank Formation *(Alluvium)*
			Qos	Pleistocene nonmarine sedimentary rocks *(Fluvial and lacustrine gravel, sand, silt, and clay)*
			Qrb	Red Bluff Formation *(Coarse red gravel, sand, and silt)*
			QPs	Volcanic sediments of Sutter Buttes *(Volcaniclasic sediments and lahars)* QPl-Volcanic lake beds
	TERTIARY	Pliocene	QPo	Tuffs of Oroville *(Volcaniclastic sediments and tuff)* Pnt-Nomlaki Tuff
			PnT	Tuscan Formation *(Lahars, volcaniclastic sediments, and tuff)* Pnt-Nomlaki Tuff
			Pl	Laguna Formation *(Alluvial gravel, sand, and silt)*
			Ps	Pliocene nonmarine sedimentary rocks *(Fluvial and lacustrine shale, sandstone, and ash)*
		Miocene	MPc	Miocene-Pliocene channel deposits *(Fluvial conglomerates and sandstone)*
			MPs	Sutter Formation *(Volcaniclastic sediments; nonmarine)*
		Oligocene		
		Eocene	Ec	Capay Formation *(Sandstone and shale; marine)*
			Ei	Ione Formation *(Quartzose sandstone, claystone, and conglomerate; mostly nonmarine)*
			Tg	"Auriferous" Gravels
	CRETACEOUS		Ku	Upper Cretaceous rocks *(Shale and sandstone; marine)*
			Kc	Chico Formation *(Sandstone, conglomerate, and siltstone; marine)*

N

0 10,000 20,000 FEET

SCALE 1" = 10,000'

Earth Mechanics, Inc.

Geotechnical and Earthquake Engineering

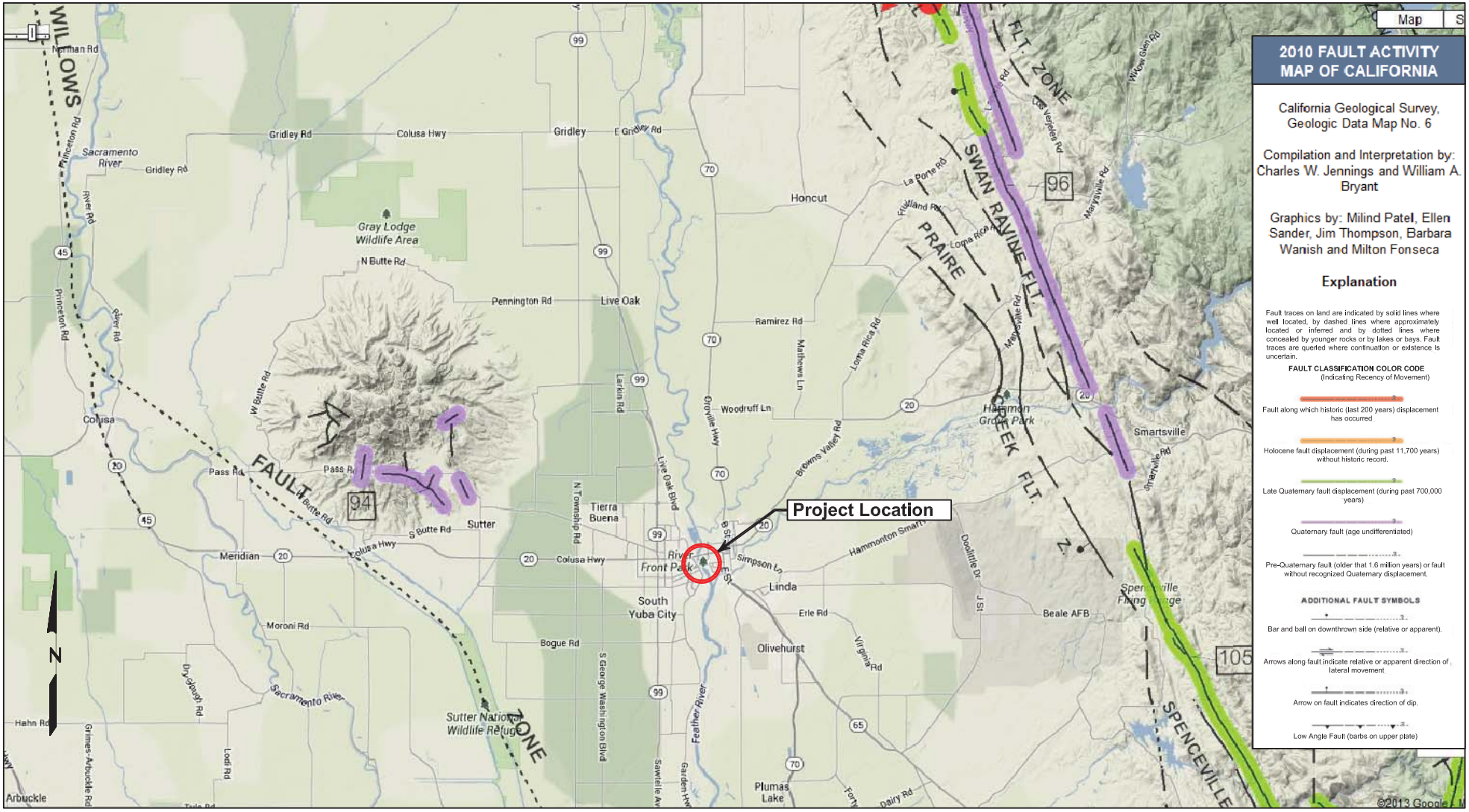
5th Street Bridge Replacement Project

Project No. 13-121 Date: August 2015

REGIONAL GEOLOGIC MAP

REFERENCE: Saucedo, G. J. and Wagner, D. L., 1992, Regional Geologic Map of the Chico Quadrangle, California, California Geological Survey, Regional Geologic Map No. 7A, 1:250,000 scale.

Figure 3



0 25,000 50,000 FEET

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

5th Street Bridge Replacement Project

Project No. 13-121

Date: August 2015

Regional Fault Map

Figure 4

4.0 SUBSURFACE CONDITIONS

4.1 Subsurface Conditions

Soil stratigraphy is defined by the available soils information and the exploratory borings (described in Section 2.0) performed under the supervision of EMI personnel for the project and previous subsurface investigation performed by others.

Soil boring data indicates that the top 25 to 40 feet of site soils (above approximate El. +20 feet) are generally very loose to loose silty sand, sand, and soft sandy silt. These soils are followed by about 20 to 25 feet of interbeded layers of medium dense sand, sand with pea gravel, silty sand, and stiff sandy silt. The sandy deposits are generally fine to coarse grained. Below this depth (approximate El. +0 feet) the soil layers consist of dense to very dense sand and silty sand, and very stiff to hard sandy silt. Standard penetration test (SPT) blowcounts were larger than 50 below El. -20 feet. It should be noted that in some CPTs at about El. -20 feet there is a transition from sandy soils to silty soils, resulting in a drop in soil resistance.

The soil exploration performed in the levees indicates the west levee is made of loose clayey sand, while the east levee comprises of medium dense silty sand and medium stiff to stiff clay and silt.

It should be noted that the above soil description is general and is intended to describe the subsurface in very broad terms. The soil description above should not be construed to mean that the subsurface profile is uniform and that soil is homogeneous within the project area. Details on stratigraphy at each borehole location are provided on the LOTB sheets presented in Appendix A.

4.2 Groundwater Conditions

Groundwater was encountered in August 2007 at El. +41.1 feet in Boring B-1 near Pier 5 of the existing bridge. Also, water surface elevation in the Feather River was measured at El. +41.8 feet in November 1956. The observed ground water levels in the recent 2013 investigation were between El. +31 feet in Boring R-13-004, and El. +53.4 feet in Boring R-13-013.

The design flood high water level on as-built drawings of the existing 5th Street Bridge is El. +82.5 feet. This elevation is a few feet below the crest of the levees. The current design flood high water level for a 200-year event per plans is El. +79.6 ft. Since seismic and flood load cases are considered separately, for liquefaction analyses and seismic design a lower groundwater elevation can be used. It is assumed that during the seismic event the groundwater is near the top of the main channel of the river. Therefore, groundwater at El. +50 feet is recommended to be used for seismic and liquefaction design. For slope stability analyses a higher groundwater at about El. +80 feet should be considered as a flood extreme event.

4.3 Idealized Soil Profiles

Based on the information collected from borings and CPTs, idealized soil profiles for foundation analysis and design were developed along the proposed bridge alignment. The subsurface profile beneath the proposed structure is shown in Figure 5A, 5B and 5C. It should be noted that the

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loose silty/sandy material (light-orange colored) stretching underneath across the east bank of the Feather River up to Abutment 11 is potentially liquefiable layer as identified in Section 5.2. In this figure, the vertical red line segments denote potential liquefaction zones, which are identified in either CPT or SPT data. Due to some variation in soil conditions along the proposed 5th Street Bridge, individual idealized soil profile and soil parameters for geotechnical design were developed for each support location. For the relatively uniform subsoil condition at the 2nd Street OC, only one idealized soil profile was developed. These site-specific individual idealized soil profiles and soil parameters are included in Appendix C.

The soil internal friction angles in Appendix C are primarily based on published correlations with SPT blow counts (Lam and Martin, 1986). The blow counts obtained from non-standard penetration tests using a Modified California Sampler were converted to standard blow count using the Burmister's standard relationships (Winterkorn and Fang, 1975) with a conversion factor of 0.5 for coarse-grained soils and 0.7 for fine-grained soils. The above internal friction angles obtained using the SPT correlation is also comparable to the laboratory test results in Appendix B.

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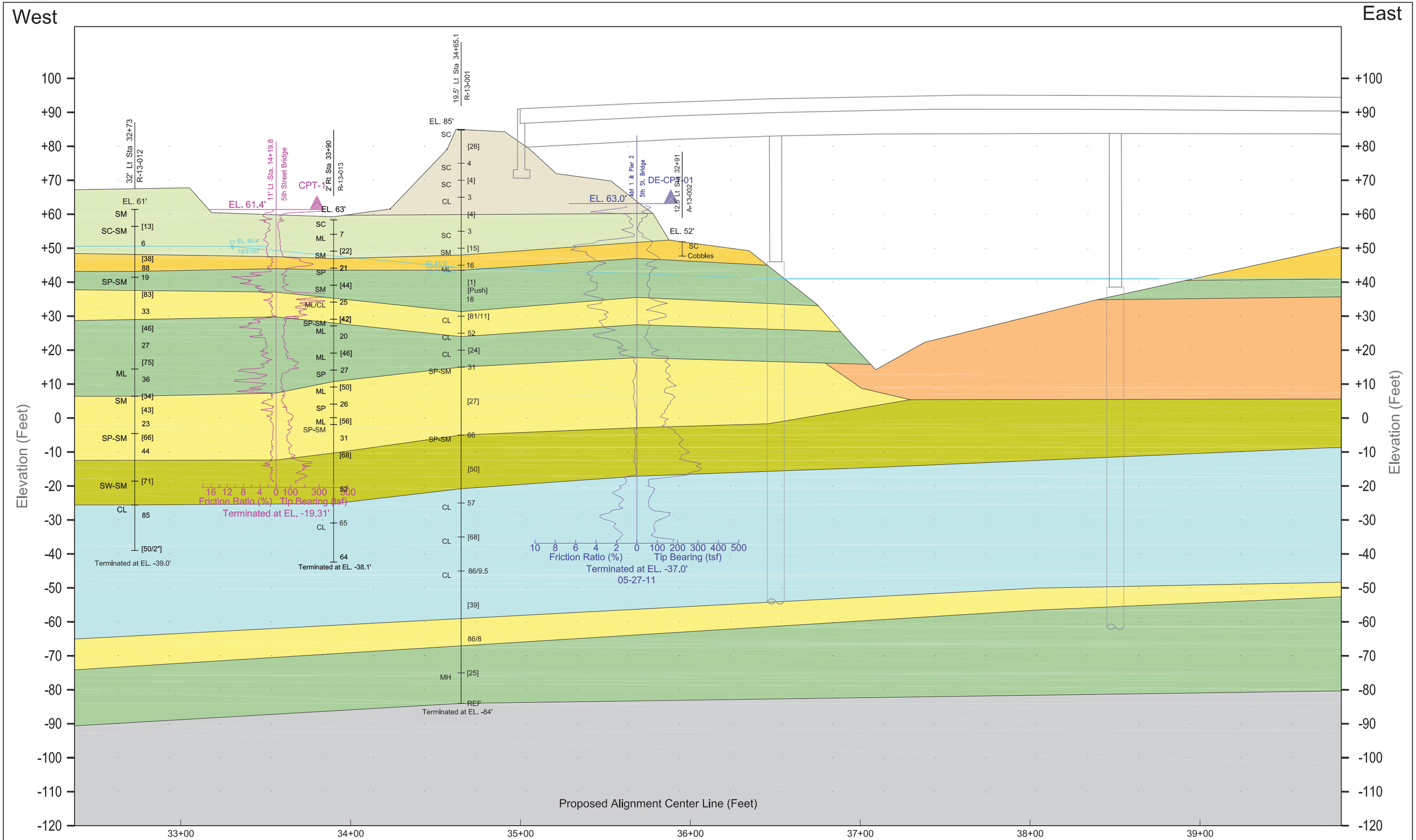
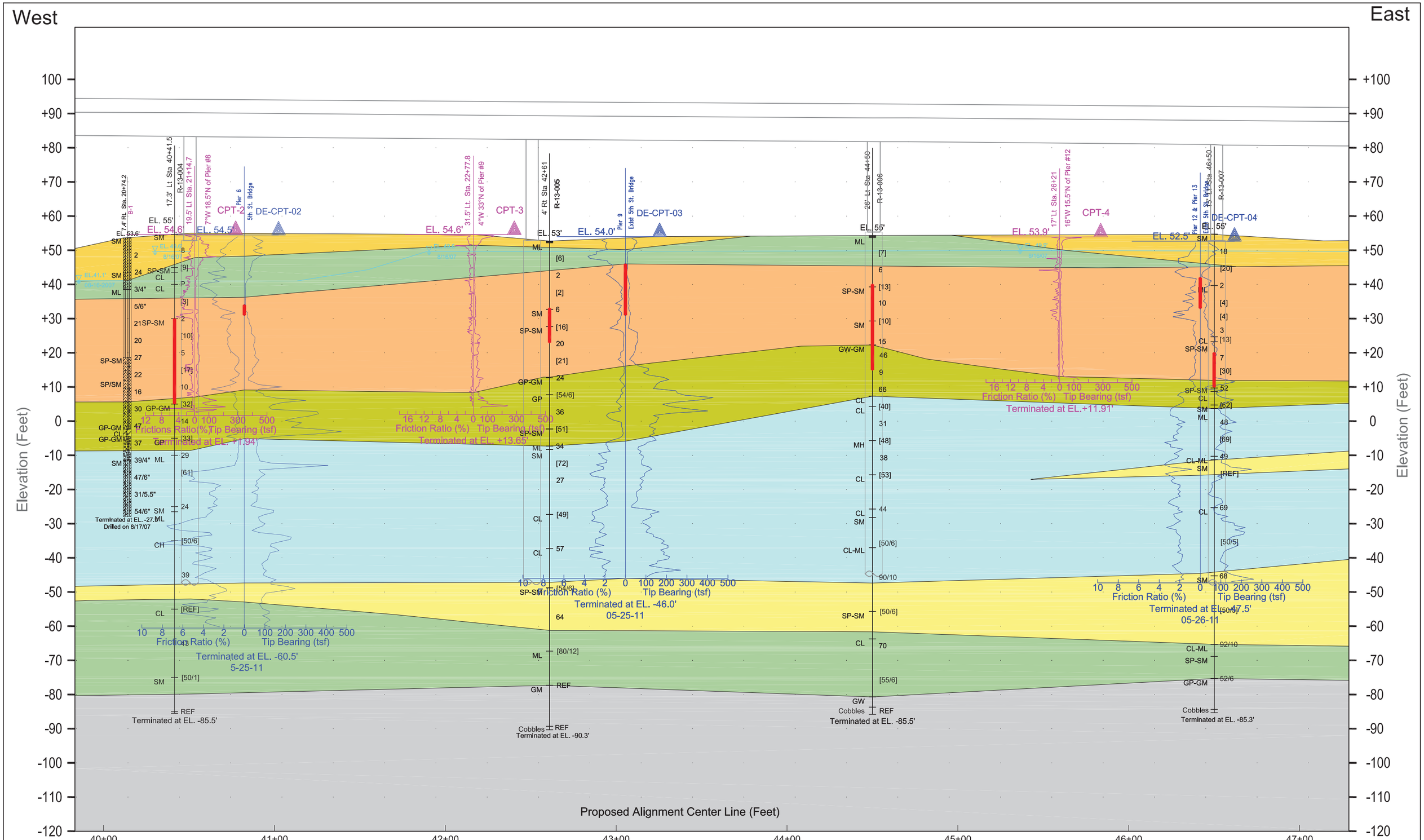

West
East
Elevation (Feet)
Proposed Alignment Center Line (Feet)
33+00
34+00
35+00
36+00
37+00
38+00
39+00
32' Lt Sta 32+73
R-13-012
11' Lt Sta. 14+19.8
5th Street Bridge
CPT-1
2' Rt Sta 33+90
R-13-013
19.5' Lt Sta 34+65.1
R-13-001
Abt 1 & Pier 2
5th St. Bridge
DE-CPT-01
12.8' Lt Sta 32+91
A-13-002
EL. 61'
EL. 61.4'
EL. 63'
EL. 85'
EL. 63.0'
EL. 52'
SC
Cobbles
EL. 50.4'
10/31/07
EL. 41.0'
Terminated at EL. -19.31'
Terminated at EL. -39.0'
Terminated at EL. -38.1'
Terminated at EL. -37.0'
05-27-11
Terminated at EL. -84'
Friction Ratio (%)
Tip Bearing (tsf)
F Fill
A SILTY SAND
B SILTY SAND with GRAVEL
C SANDY CLAY to SILT
D SAND with SILT
E GRAVEL with SILT
F CLAY
G GRAVEL
SILTY SAND / Potentially Liquefiable Zone
Soil Contact (Interpreted based on subsurface information)
Groundwater Table
Approximate Static Groundwater Table
Scale:
Horizontal = 1"=50'
Vertical = 1"=25'
2X Vertical Exaggeration
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering
5th Street Bridge
Subsurface Cross Section
Figure 5A
SHEET 1 OF 3


West
East
Elevation (Feet)
Proposed Alignment Center Line (Feet)
40+00
41+00
42+00
43+00
44+00
45+00
46+00
47+00
CPT-2
DE-CPT-02
CPT-3
DE-CPT-03
CPT-4
DE-CPT-04
R-13-004
R-13-005
R-13-006
R-13-007
Friction Ratio (%)
Tip Bearing (tsf)
Terminated at EL. -85.5'
Terminated at EL. -90.3'
Terminated at EL. -46.0'
05-25-11
Terminated at EL. -60.5'
5-25-11
Terminated at EL. +11.91'
05-26-11
Terminated at EL. -85.3'
Fill
SILTY SAND with GRAVEL
SAND with SILT
CLAY
SILTY SAND / Potentially Liquefiable Zone
SILTY SAND
SANDY CLAY to SILT
GRAVEL with SILT
GRAVEL
Soil Contact (Interpreted based on subsurface information)
Groundwater Table
Approximate Static Groundwater Table
Scale:
Horizontal = 1"=50'
Vertical = 1"=25'
2X Vertical Exaggeration
Earth Mechanics, Inc.
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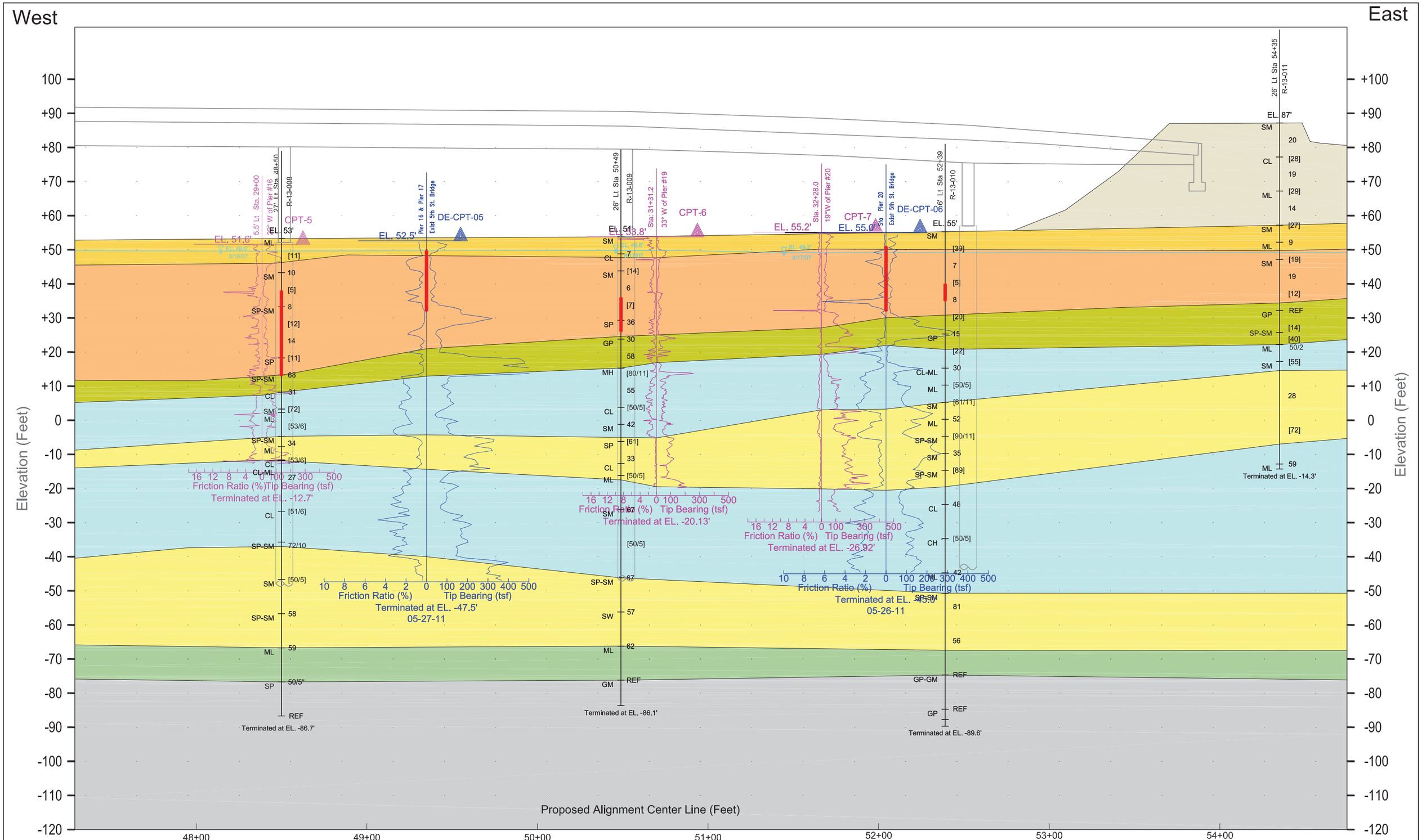
5th Street Bridge
Subsurface Cross Section
Figure 5B
SHEET 1 OF 3


West
East
Elevation (Feet)
Proposed Alignment Center Line (Feet)
48+00
49+00
50+00
51+00
52+00
53+00
54+00
CPT-5
EL. 53'
EL. 51.6'
R-13-008
DE-CPT-05
EL. 52.5'
Pier 16 & Pier 17
Exist 5th St. Bridge
Friction Ratio (%)Tip Bearing (tsf)
Terminated at EL. -12.7'
Friction Ratio (%) Tip Bearing (tsf)
Terminated at EL. -47.5'
05-27-11
Terminated at EL. -86.7'
R-13-009
CPT-6
EL. 51'
EL. 48.8'
Sta. 31+31.2
33' W of Pier #19
Terminated at EL. -20.13'
Terminated at EL. -86.1'
CPT-7
EL. 55.2'
EL. 55.0'
Sta. 32+28.0
19' W of Pier #20
Pier 20
DE-CPT-06
EL. 55'
R-13-010
Terminated at EL. -26.92'
05-26-11
Terminated at EL. -89.6'
R-13-011
EL. 87'
Terminated at EL. -14.3'
F Fill
A SILTY SAND
B SILTY SAND with GRAVEL
C SANDY CLAY to SILT
D SAND with SILT
E GRAVEL with SILT
F CLAY
G GRAVEL
SILTY SAND / Potentially Liquefiable Zone
Soil Contact (Interpreted based on subsurface information)
Groundwater Table
Approximate Static Groundwater Table
Scale:
Horizontal = 1"=50'
Vertical = 1"=25'
2X Vertical Exaggeration
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering
5th Street Bridge
Subsurface Cross Section
Figure 5C
SHEET 1 OF 3

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Seismic Study and Recommendations

The site is located in seismically active northern California and is subject to shaking from both local and distant earthquakes. The nearest substantial local sources of earthquakes are provided in Table 4, along with their fault type and their maximum earthquake magnitude according to the Caltrans Fault Database V2a (Merriam, 2012). The site to fault distances were determined using the Caltrans ARS Online web tool V2.3.06 (Caltrans, 2013a).

Table 4. Fault Data

Fault	Fault Type (1)	Maximum Earthquake Magnitude	Distance from Site to Fault (miles)	Surface Fault/Blind Fault
Foothills Fault System northern reach section (Spenceville fault)	N	6.5	12.7	Surface
Foothills Fault System northern reach section (Swain Ravine fault zone)	N	6.5	16.0	Surface
Great Valley 03 Mysterious Ridge fault	R	7.0	34.4	Blind
Bartlett Springs fault	SS	7.2	64	Surface
Maacama fault zone	SS	7.4	70	Surface
San Andreas fault (North Coast)	SS	8.0	96	Surface

Notes:
1. N = Normal, R = Reverse, SS = Strike Slip.

For seismic design purposes, ARS curves can be developed in accordance with the Methodology for Developing Design Response Spectrum for Use in Seismic Design Criteria (SDC) (Caltrans, 2013b) procedures, considering the following response spectra:

- Deterministic Criteria based on late-Quaternary faults in 2012 fault database (Merriam, 2012);
- Probabilistic Criteria based on 5% in 50 years probability of exceedance ground motion; and
- Minimum Deterministic Spectrum based on a M_w = 6.5 vertical strike slip event occurring at a distance of 7.5 miles from the site.

The design ARS curve is the envelope of the above spectra.

5.1.1 Soil Type Classification

The preliminary parameters of small-strain shear wave velocity for the upper 100 feet (V_{s30}) of subsurface materials were estimated using the measured velocities in six seismic CPT soundings performed in 2011. Based on these measurements, the whole project site has an estimated V_{s30} of 305 m/sec (~1,000 ft/sec) and it could be initially classified as a Soil Profile Type D, per Figure B.12 of the Caltrans SDC.

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However, the 5th Street Bridge site has a high liquefaction potential (see Sections 2.4.3 and 5.2), therefore it is classified as a Soil Profile Type F. According to Appendix B of the Caltrans SDC, for Soil Profile Type F, a site response analysis is required for both preliminary and final seismic designs. For the 2nd Street OC site with negligible liquefaction potential, no site response analysis is needed to develop the corresponding seismic design criteria.

5.1.2 Design Acceleration Response Spectra for 5th Street Bridge

In order to perform site response analyses for this bridge site, base ground motions were developed for firm-ground conditions where liquefaction is not anticipated. The firm-ground condition was assumed at El. –100 ft based on the review of the idealized soil profile. The site classification for firm-ground was characterized with a V_{s30} of 560 m/sec (~1,840 ft/sec) over a depth of 100 feet below this elevation. This V_{s30} value was used in the Caltrans ARS Online V2.3.06 tool (Caltrans, 2013a).to determine seismic criteria for firm-ground conditions serving as 'reference rock motion' in subsequent site response analyses to evaluate pier specific earthquake time histories.

5.1.2.1 Seismic Design Criteria for Firm-Ground

The deterministic and probabilistic acceleration response spectrum (ARS) curves for firm-ground conditions (at El. -100 ft) were developed by the Caltrans ARS Online V2.3.06 tool. The firm-ground spectra were used to develop spectrum-compatible acceleration time histories, which were subsequently used as base motions in site response analyses.

The Caltrans ARS Online tool develops the deterministic spectrum using the average of median response spectra calculated by two Next Generations Attenuations (NGA) ground motion prediction equations developed by Campbell-Bozorgnia (2008) and Chiou-Youngs (2008). These equations are applied to all faults considered to be active in the last 750,000 years (late-Quaternary age) that are capable of producing a moment magnitude earthquake of 6.0 or greater. The Caltrans ARS Online tool obtains the probabilistic spectrum from the USGS (2008) National Hazard Map for 5% probability of exceedance in 50 years. Both deterministic and probabilistic spectra account for site effects through incorporation of the parameter V_{s30}.

To account for near-fault effects, Caltrans ARS Online applies a period-dependent adjustment factor to the probabilistic and deterministic ARS curves. For sites within 15 km of a causative fault, such as the subject site, the adjustment is zero for $T \leq 0.5$ seconds, then ramps up linearly to a 20% increase at $T = 1$ second and remains at a 20% increase for $T > 1.0$ second. Caltrans ARS Online applies an additional amplification factor based on the average of the basin amplification factors included in the Campbell-Bozorgnia (2008) and Chiou-Youngs (2008) Ground Motion Prediction Equations for the site-specific $Z_{1.0}$ and $Z_{2.5}$ values.

The following table summarizes the pertinent site specific input data for the deterministic and probabilistic analyses:

Site Latitude, Longitude:	39.1390°, -121.6053°
V_{s30} – Shear Wave Velocity for firm ground:	1,840ft/sec (560 m/sec)

Based on ARS Online results, the minimum deterministic response spectrum controls the design response spectrum for the project. The resulting firm-ground ARS curve together with its digitized coordinates is presented in Figure 6.

5.1.2.2 Startup Ground Motions

For site response analysis and soil-structure interaction studies of the bridge, time histories of spectrum-compatible bedrock motions are required. The first step in developing spectrum-compatible bedrock motions is selection of seed motions. These motions are generally selected from a large database of recorded ground motions.

Seismic hazard deaggregation results are used for identification of most likely earthquake magnitude and source-to-site distances that has the highest contribution to the seismic hazard at the bridge site. According to the ARS Online results presented in Section 5.1.2.1, the seismic hazard at the bridge site is controlled by the minimum deterministic criteria, which is characterized by an M 6.5 vertical strike-slip event occurring at a distance of 12 km (7.5 miles) from the site. Although this scenario establishes the minimum spectrum, the spectrum is intended to represent the possibility of a wide range of magnitude-distance scenarios.

Based on these results, three ground motion records are selected from the ground motion database for use as startup motions. Records from earthquakes of moment magnitudes (M_w) ranging from 6.4 to 7.5 with rupture distances of between 12.8 to 15.6 km are selected. The earthquake events include Loma Prieta (1989), Imperial Valley (1979) and Kocaeli (1999). Table 5 shows the selected three startup ground motion sets.

Table 5. Startup Ground Motions

Set	Year / Name of Earthquake	Earthquake Magnitude	Station Name	V_{s30} (m/s)	Closest Distance (km)	Fault Type(1)
1	1989 Loma Prieta	6.93	Gilroy Array #3	350	12.8	RO
2	1979 Imperial Valley	6.40	Calexico Fir Station	-	15.6	SS
3	1999 Kocaeli	7.51	Arcelik	523	13.5	SS

Notes:
1. N = Normal, R = Reverse, RO = Reverse-Oblique, SS = Strike Slip.

Two components of the start-up motion (fault normal – FN and fault parallel - FP) were spectrally matched to the firm-ground design ARS using RSPMATCH v2.2 computer program (Abrahamson, 1998).

As part of the spectral matching procedure, a baseline correction is applied to the ground motions. The baseline is computed by fitting the displacement time history to a high order polynomial (order 4 to 7) and excluding the constant and linear terms. The second derivative of this displacement baseline is computed and it is subtracted from the acceleration ground motion. The resulting ground motion is baseline corrected in acceleration, velocity, and displacement. The startup and spectrum-compatible firm-ground motions are shown in Appendix D.

5.1.2.3 Site Response and Kinematic Soil-Structure Interaction Analyses

In order or develop pier-specific time histories and the design ARS curves for the subject site, site response and kinematic soil-structure interaction analyses were performed.

Equivalent linear site response analyses were conducted using the computer program SHAKE91 (Idriss and Sun 1992) to estimate ground motions at various depths. The dynamic shear modulus and damping of soil layers were estimated using relationships provided in the Electric Power Research Institute (EPRI) for sands (EPRI, 1993) and the Vucetic and Dobry relationships for clay (1991). These relationships have been adopted by Caltrans for major toll bridges as well as by the Nuclear Regulatory Agency for nuclear power plants. Soil layer shear wave velocities were determined based on the nearby CPT measurements (DE-CPT-01 to DE-CPT-05), and can be found in Appendix C. The firm-ground motions were applied as input motion at elevation of -100 feet for all support locations. Site response analysis was performed at each support of the 5th Street Bridge for two horizontal components of the ground motion. Free field motions were estimated at the selected depths at an interval of 5 feet for soil-structure interaction (SSI) analysis. For the post-liquefaction scenario, a reduced shear wave velocity of 300 ft/sec was assigned for all liquefiable layers.

Our kinematic soil-structure interaction analysis consists of modeling the total pile-soil foundation system for each individual pile from the pile tip up to the pile cap using our in-house KIPS program, which is dedicated to performing kinematic soil-pile interaction analyses (EMI 1999). Linearized lateral soil resistance (p-y) and axial soil resistance (t-z) springs are modeled in KIPS and the depth varying free-field motions from SHAKE are input to the KIPS program to define the ground excitation level to the bridge structure. The kinematic motion is calculated at the pile cut-off elevation or pile cap level and implicitly contains the statically condensed forces transmitted from the ground to the superstructure along the entire embedded pile length. Therefore, the effects of the depth-varying shaking intensity in soil column, the depth-varying soil stiffnesses, and the pile properties are included in the solution. The kinematic motions formed the basis for development of ARS design curves for the pile-supported structure. A detailed formulation of kinematic motion and its discussion can be found in a MCEER report (Lam and Law 2000). Estimated depth-varying free-field and kinematic motions are included in Appendix D. Figure 7 depicts the fault-normal spectral results at Bent 5 under the post-liquefaction condition for Motion Set 1. Due to the coupling effect of soil-structure interactions, the kinematic motion of Bentr 5 foundation system at the pile cut-off elevation resembles the free-field motion at a depth of about 30 feet.

5.1.2.4 Design Acceleration Response Spectra

Figure 8 shows the resultant kinematic motions of 11 5th Street Bridge supports resulting from three motion sets and two horizontal components under the pre-liquefaction condition. In this figure, the thick solid black line represents the firm-ground input motion at elevation of -100 feet, and the thick dotted black line depicts the mean plus one standard deviation curve of all kinematic motions (a probability of about 84%). For reality, a practical ARS curve should be smooth-wise with only one peak, and hence the solid blue line represents the smoothened curve for the mean plus one standard deviation curve, which is recommended as the design ARS curve

for response spectrum analyses of the bridge. Figure 9 shows those curves for the post-liquefaction condition.

Figure 10 shows our recommended non-liquefied and liquefied ARS curves together with their digitized coordinates. These two sets of our recommended ARS curves can be adopted by the structural engineers in their linear response spectrum analyses of the bridge. For non-linear time history analyses of the bridge, pier specific kinematic time histories can be used. The recommended ARS design curves can also be shown on the general plan of final PS&E drawings to document the basis of seismic design.

5.1.3 Design Acceleration Response Spectra for 2nd Street OC

As aforementioned, no liquefiable soil layer appears underneath this bridge site and the Caltrans ARS Online V2 (2012) was used directly to develop the corresponding ARS curve. The design ARS curve and the digitized coordinates are presented in Figure 11. The following table summarizes the pertinent site specific input data for the deterministic and probabilistic analyses:

Site Latitude, Longitude:	39.1384°, -121.6079
V_{s30} – Shear Wave Velocity for firm ground:	787ft/sec (240 m/sec)

The value of the V_{S30} adopted at this bridge site was correlated based on the SPT blow counts of EMI Borings R-13-012 and R-13-013.

5.1.4 Ground Rupture

No major faults traverse through the whole project site area. The California Division of Mines and Geology (2007) has not identified Alquist-Priolo Fault Zones through or in the proximity of the site; therefore, the risk of ground surface rupture and related hazards is considered low.

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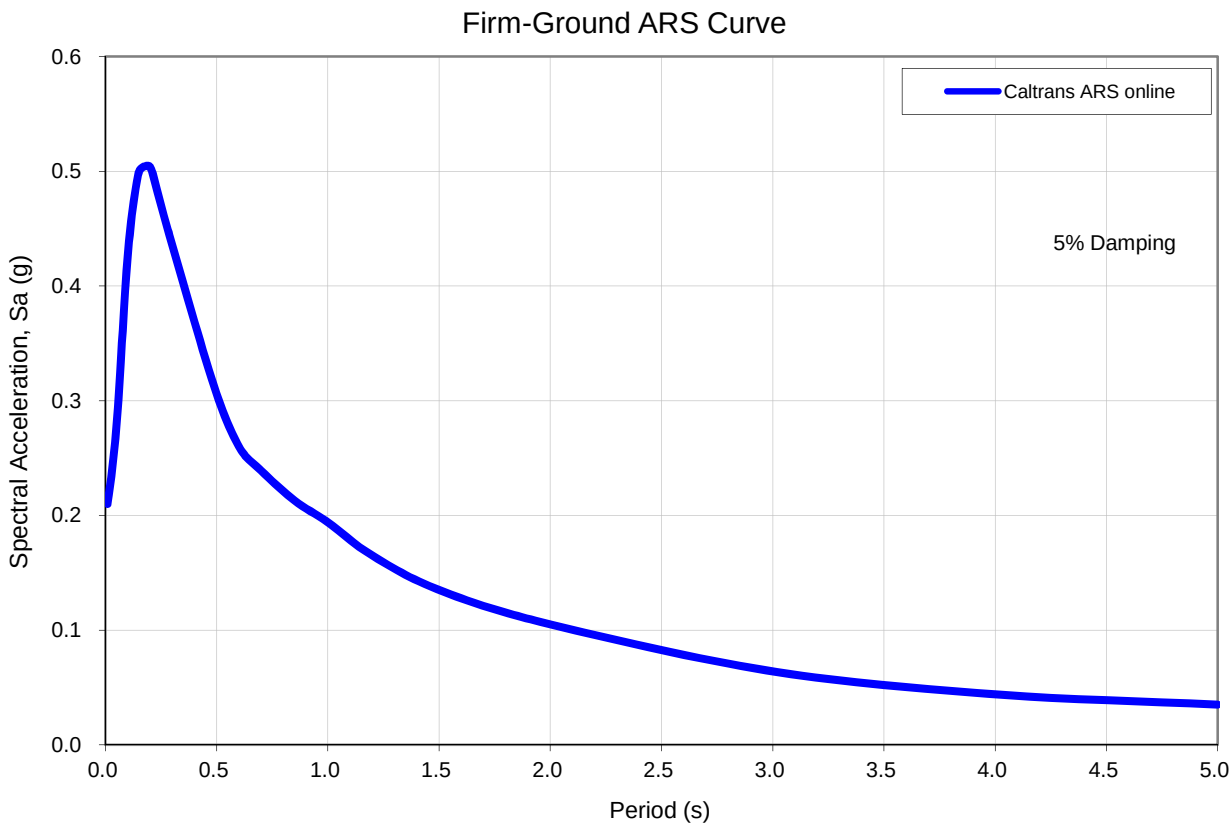

Site Data

Latitude (degrees)	33.139
Longitude (degrees)	-121.605
Shearwave Velocity, Vs30 (m/sec)	560
Peak Ground Acceleration (g)	0.210

Spectral Coordinates (Caltrans, 2012)

Period (sec)	Acc. (g)
0.010	0.210
0.050	0.277
0.100	0.425
0.150	0.499
0.200	0.504
0.250	0.470
0.300	0.436
0.400	0.369
0.500	0.306
0.600	0.260

Period (sec)	Acc. (g)
0.700	0.239
0.850	0.213
1.000	0.194
1.200	0.165
1.500	0.135
2.000	0.105
3.000	0.064
4.000	0.044
5.000	0.035

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I 5th Street Bridge

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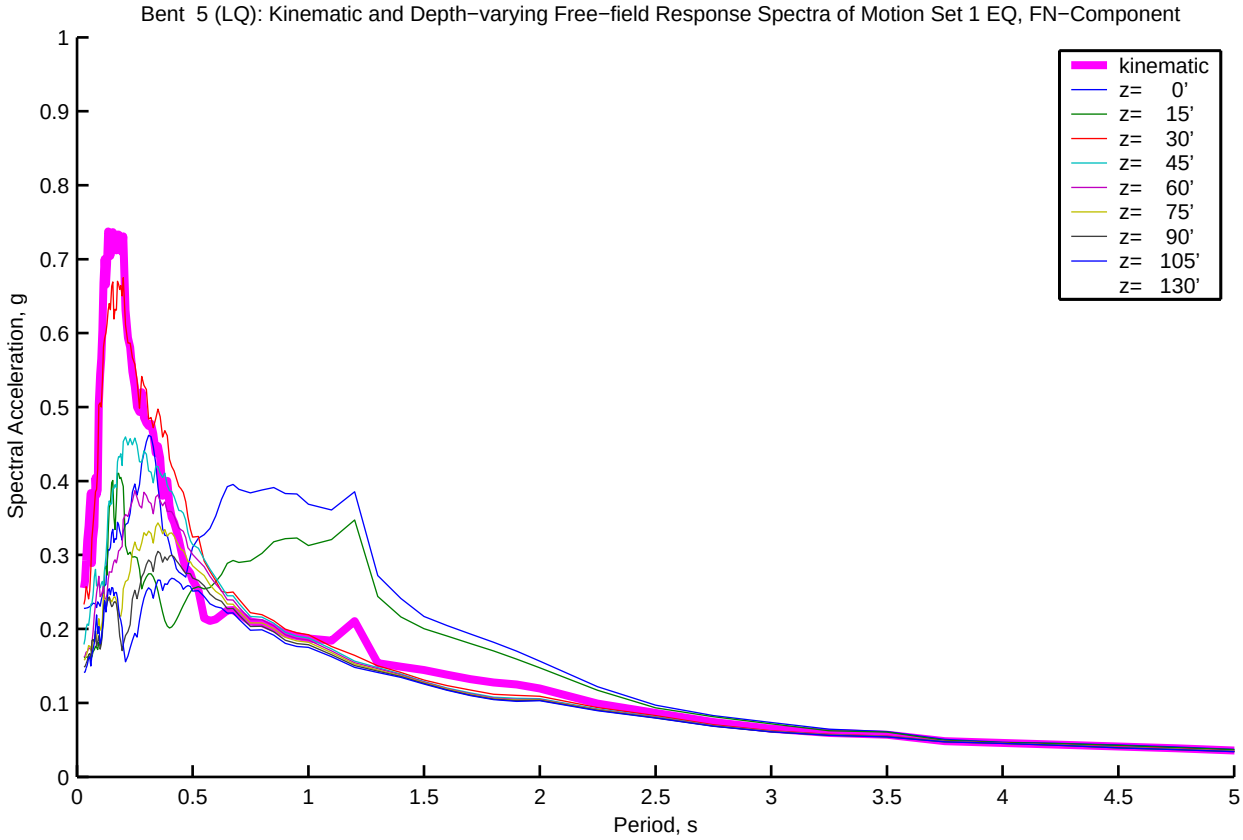
Firm-Ground ARS Curve

Figure 6



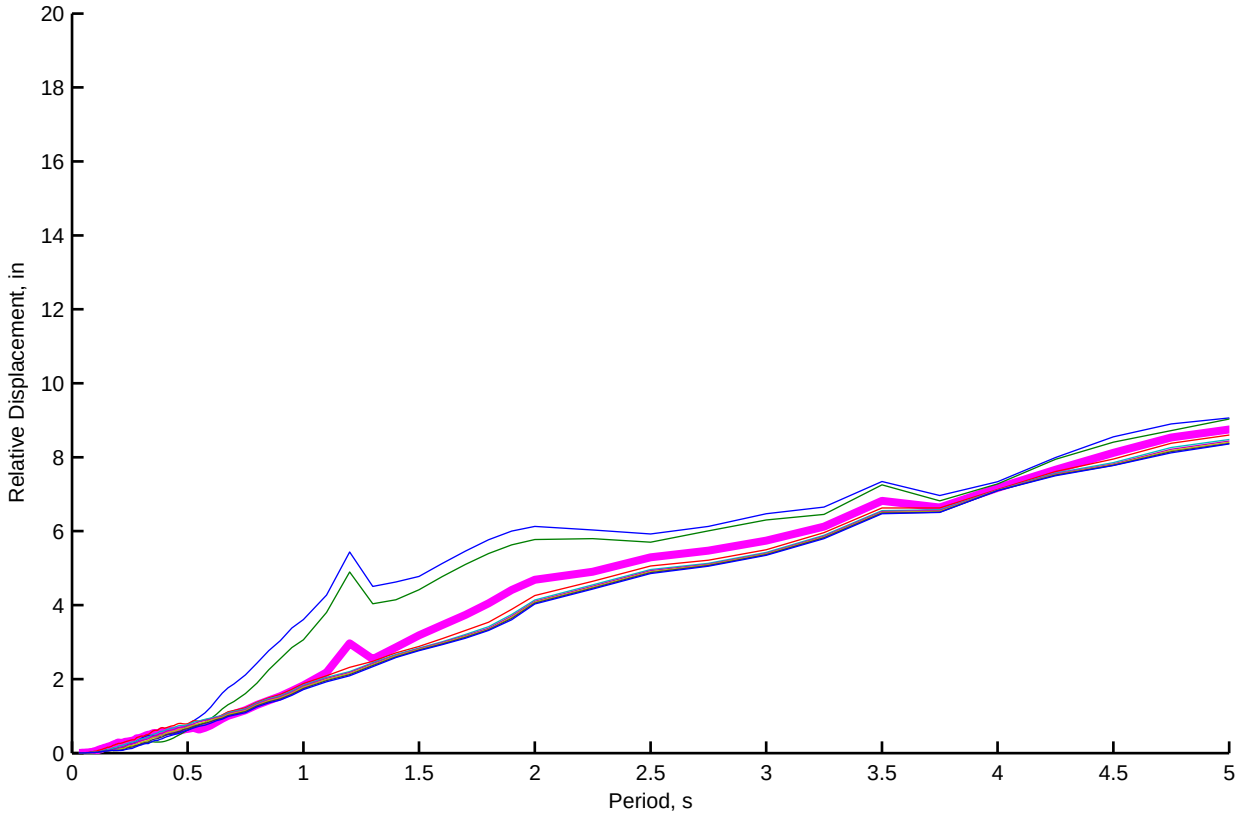
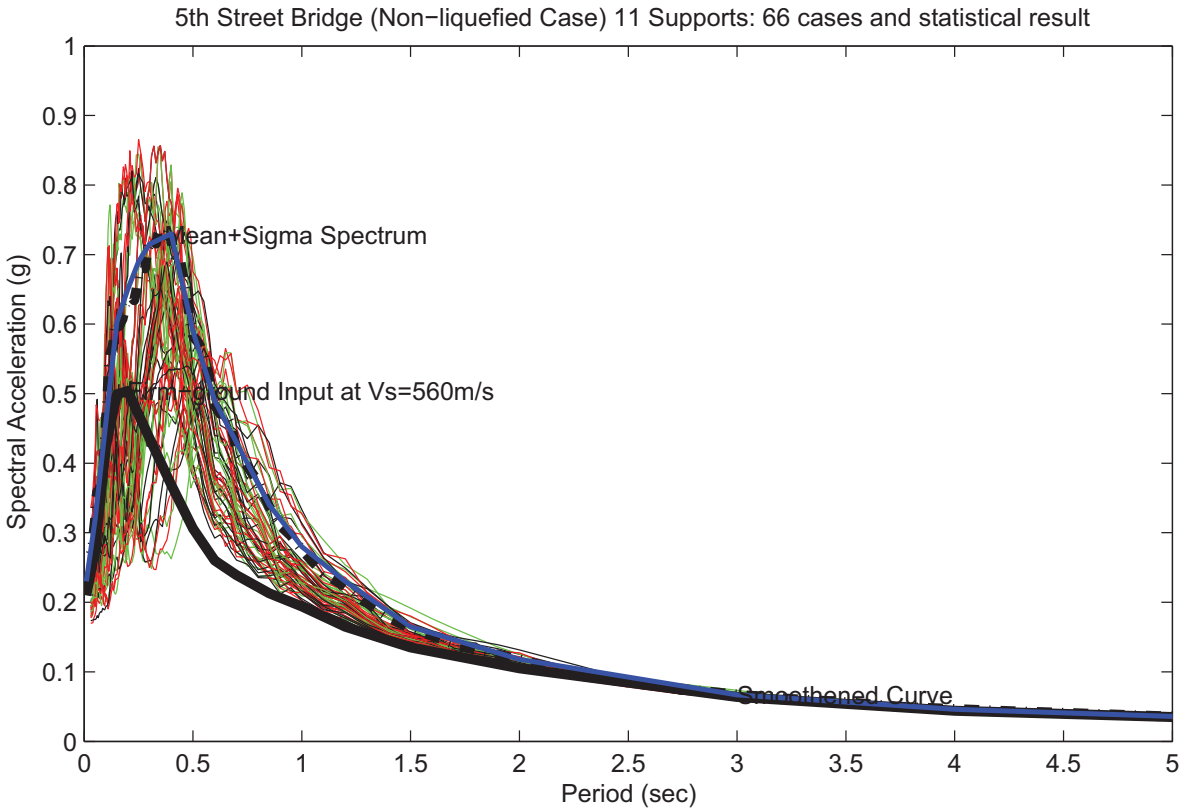


Figure 7. Fault-Normal Free-Field and Kinematic Motions at Bent 5 under Post-Liquefaction Condition for Motion Set 1



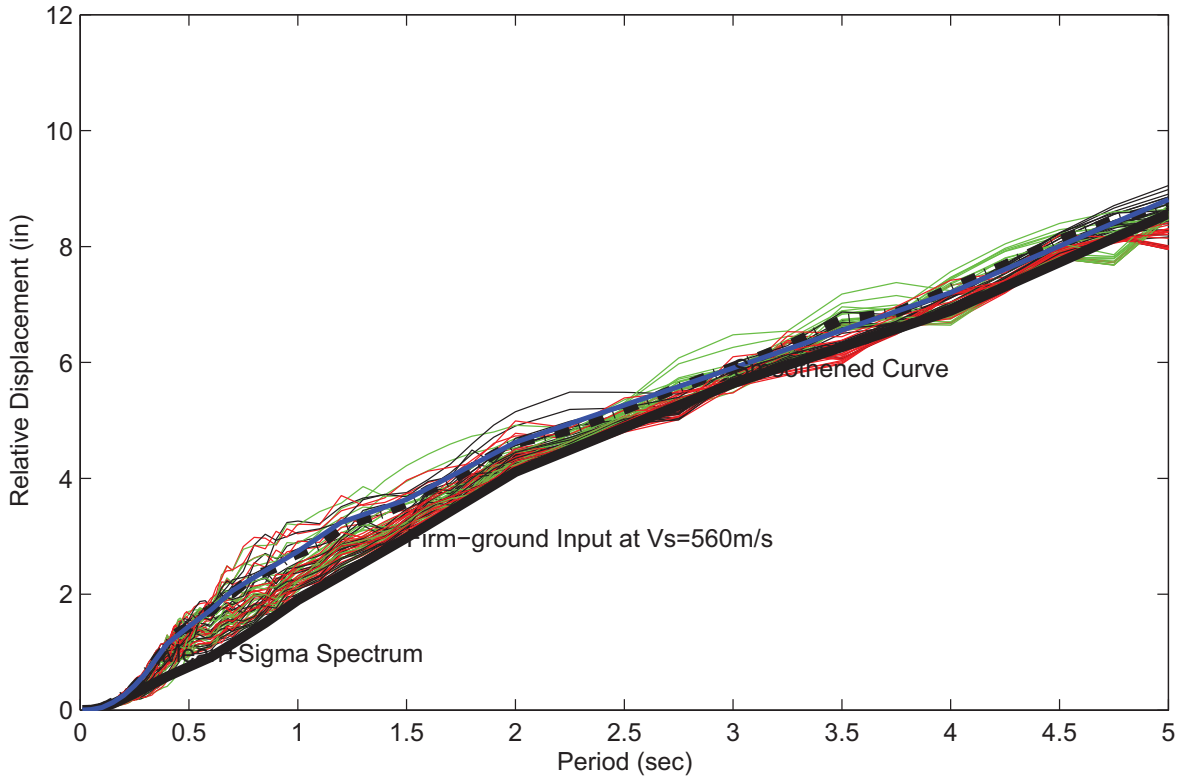
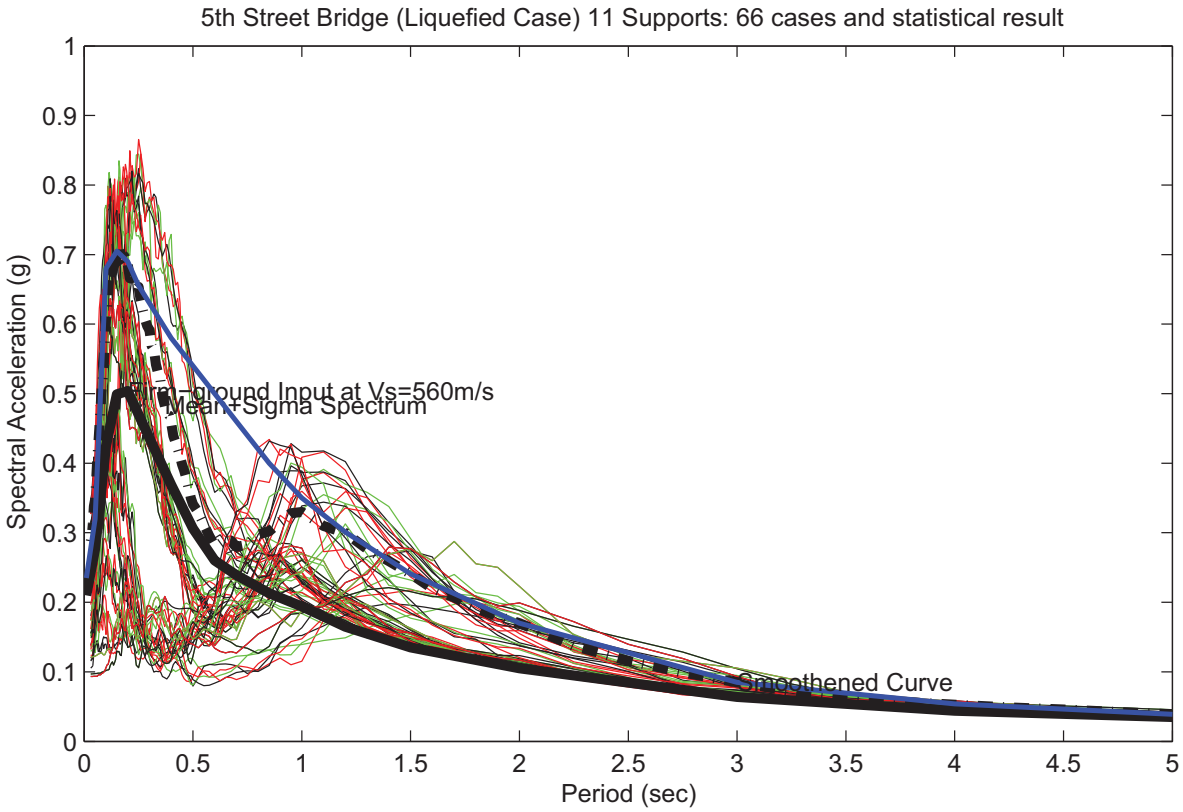


Figure 8. Resultant Kinematic Motions of 11 5th Street Bridge Supports for Pre-Liquefaction Condition



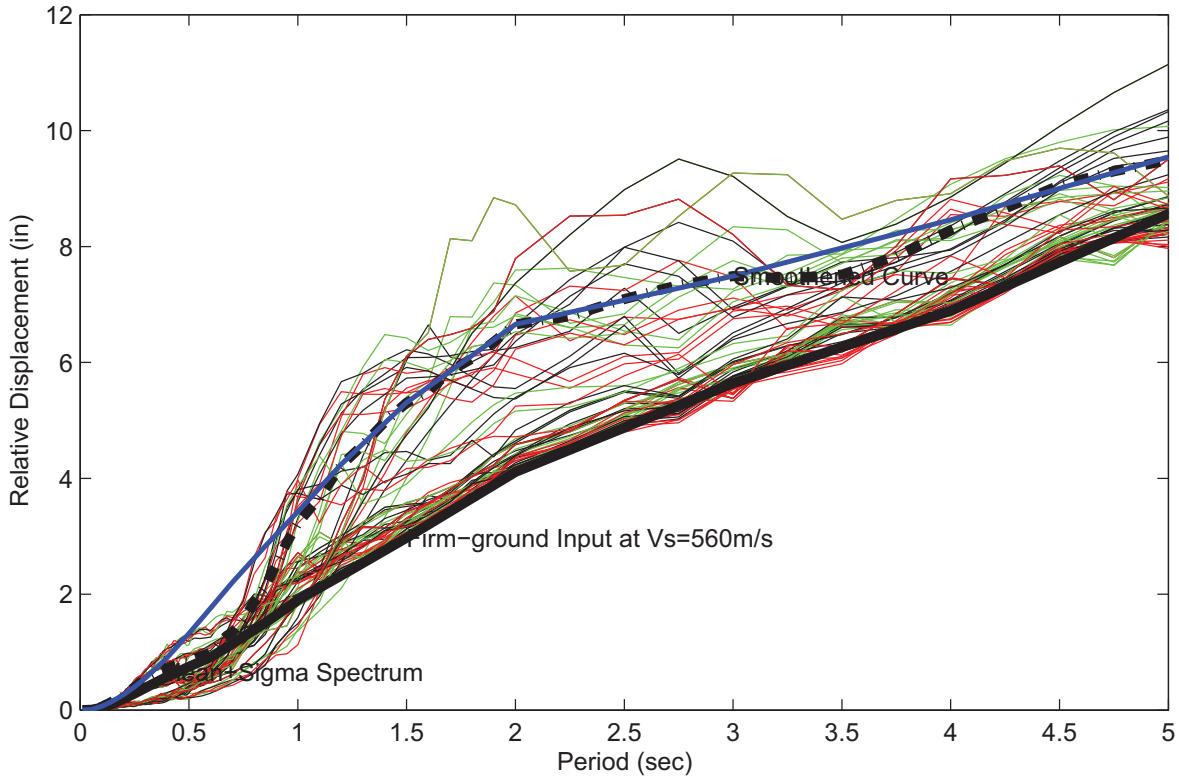
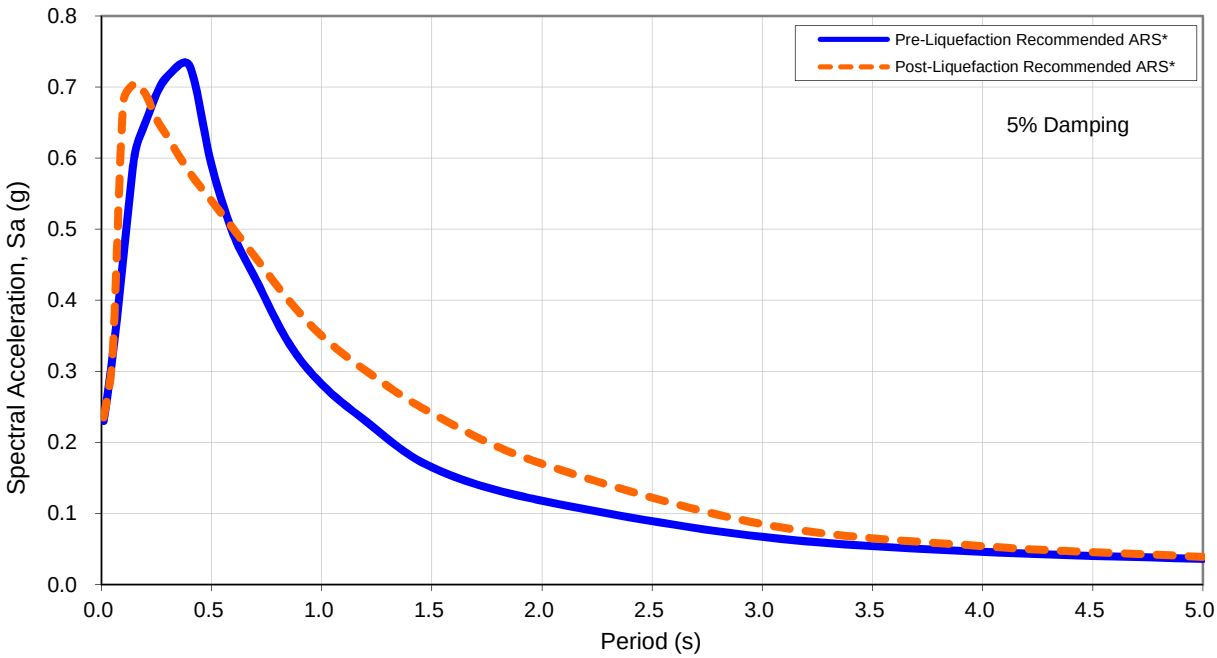


Figure 9. Resultant Kinematic Motions of 11 5th Street Bridge Supports for Post-Liquefaction Condition



Latitude: 33.1390 Longitude: -121.6053

Spectral Coordinates

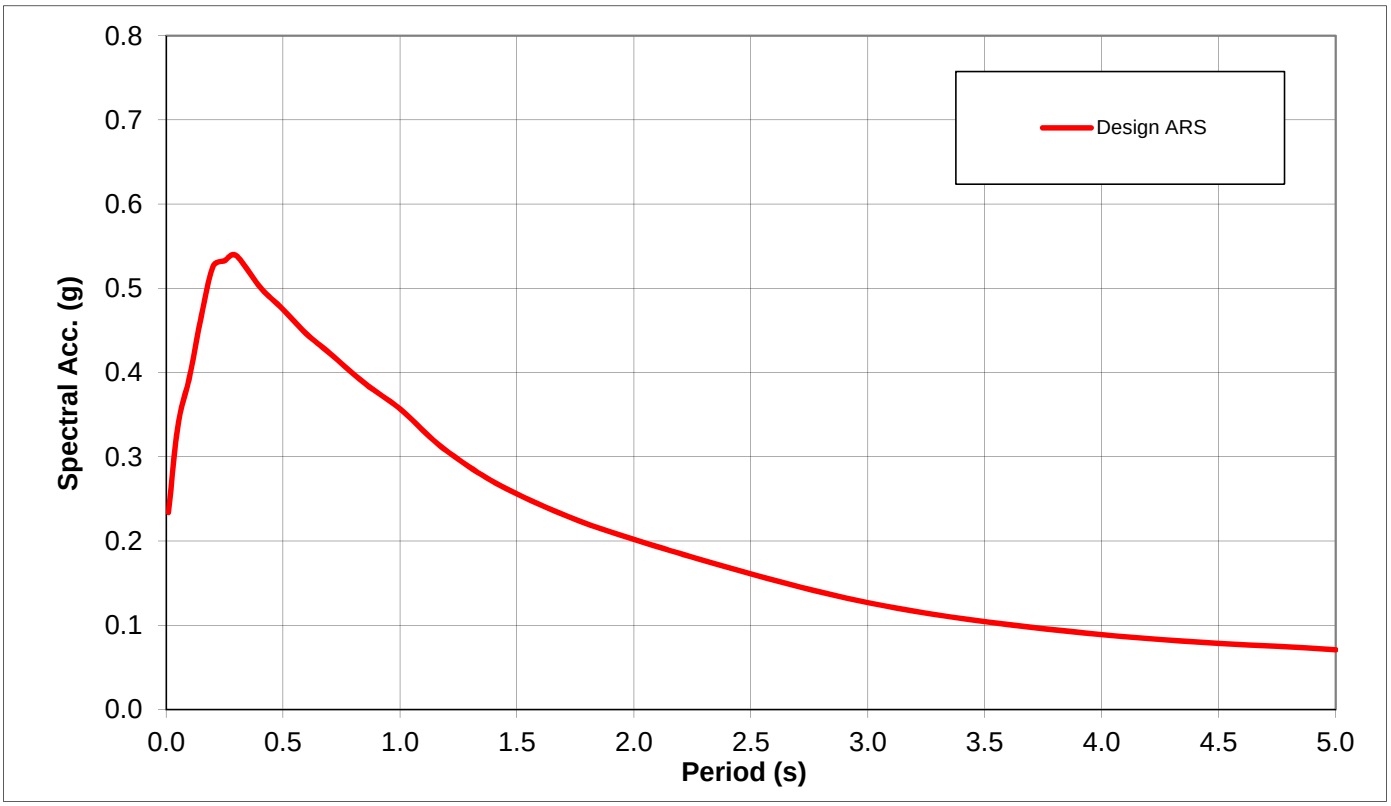
Pre-Liquefaction

Period (s)	Acc. (g)
0.010	0.230
0.050	0.319
0.100	0.460
0.150	0.603
0.200	0.650
0.250	0.690
0.300	0.715
0.400	0.730
0.500	0.590
0.600	0.492
0.700	0.430
0.850	0.340
1.000	0.282
1.200	0.230
1.500	0.165
2.000	0.118
3.000	0.067
4.000	0.046
5.000	0.036

Post-Liquefaction

Period (s)	Acc. (g)
0.010	0.235
0.050	0.320
0.100	0.680
0.150	0.705
0.200	0.690
0.250	0.655
0.300	0.630
0.400	0.580
0.500	0.540
0.600	0.500
0.700	0.460
0.850	0.400
1.000	0.350
1.200	0.301
1.500	0.241
2.000	0.170
3.000	0.085
4.000	0.054
5.000	0.039

*based on kinemation motion results



Design ARS Curve for 5% Damping

Shear Wave Velocity (V_{s30}) = 240 m/s

Design ARS

Period (sec)	**Acc.** (g)
0.01	0.234
0.05	0.337
0.10	0.395
0.15	0.467
0.20	0.526
0.25	0.533
0.30	0.539
0.40	0.502
0.50	0.475
0.60	0.446
0.70	0.423
0.85	0.387
1.00	0.357
1.20	0.307
1.50	0.256
2.00	0.202
3.00	0.127
4.00	0.089
5.00	0.071

5.2 Liquefaction

5.2.1 Previous Liquefaction Studies

Taber (2008) evaluated liquefaction potential using SPT, CPT, and laboratory test data, based on the methods published by Youd et al. (2001). The analyses were performed for one boring and seven CPTs (CPT-1 through CPT-7), using a PGA value of 0.20 g and groundwater at El. +50 ft. The conclusion was that extensive liquefaction potential exists in top 25 to 50 ft of the soil profile between Pier 5 and Abutment 22 of the existing bridge. Dokken analyses were performed on data from six CPT soundings, using a PGA of 0.22 g, earthquake moment magnitude of 6.5, and groundwater elevation at ground surface at each CPT location. The results of these analyses were generally in agreement with Taber results. According to Dokken's analyses, a ±35-ft thick sandy soil layer located between approximately El. +50 to El. +10 ft has high liquefaction potential. This layer extends from the Feather River channel east to approximately Pier 20 of the existing bridge. Under the design seismic event this soil is predicted to have a high potential for lateral spreading and seismically induced settlement.

5.2.2 Liquefaction Analyses Using 2013 Boring Data

Liquefaction potential at the site was also evaluated using the SPT blowcounts from the recent soil investigation. The analyses were performed using a PGA of 0.227 g and moment magnitude of 6.5. These analyses confirm that liquefaction potential exists for the soil layer between EL. +50 to El. +10 ft, and between Pier 2 and Abutment 11.

The analyses results are included in Appendix E. The results are shown in graphical format on Figures 5A, 5B and 5C.

5.2.3 Liquefaction Analyses Using CPT Data

EMI performed an independent liquefaction analysis using CPT data for DE-CPT-01 through DE-CPT-06. These analyses were performed using CLiq v.1.7 computer program (Geologismiki Software, 2016). The analyses results are included in Appendix E. The results were consistent with results shown in graphical format on Figures 5A, 5B and 5C.

The results from liquefaction analyses (both SPT- and CPT-based) were in general agreement with previous studies and indicated that liquefaction potential exists between Pier 2 and Abutment 11 of the new bridge. The zone with liquefaction potential is depicted on Figures 5A, 5B and 5C.

5.2.4 Seismically-Induced Settlement

Taber (2008) used the data from one boring and seven CPTs to evaluate seismically-induced settlement. It was evaluated between 0 and 12 inches, with an average value of 5.25 inches.

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According to Dokken's analyses, seismically-induced settlements were estimated to be up to 11 inches in the region between the existing Piers 8 to 14 (DE-CPT-03 to DE-CPT-05), with settlement extending from the ground surface to approximately 40- to 50-feet below ground surface (bgs). Settlement between the existing Piers 2 to 7 (DE-CPT-01 and DE-CPT-02) was estimated from 3 to 8 inches, extending from depth 67 to 83 feet bgs. At the east extent of the Feather River floodplain near Pier 20 (DE-CPT-06), up to 8 inches of settlement was predicted, extending to a depth of 75 feet bgs.

Seismic settlements were also evaluated by EMI using CPT data from DE-CPT-01 through DE-CPT-06. The computer program CLiq was used to evaluate settlements. Based on these analyses (Appendix E), vertical settlements were in the range of 0.7 to about 7 inches.

5.2.5 Liquefaction-Induced Lateral Spreading

Taber consultants (2008) estimated lateral spreading displacements on the order of 5 to 8 inches near existing Piers 4 through 8. Potential for lateral spreading involving the levees could not be evaluated by Taber due to lack of soil data.

In order to evaluate the EMI performed slope stability and sliding block analyses for different sliding mechanisms for liquefied soil conditions. Based on these analyses it appears that sliding blocks in vicinity of Abutment 11 of the proposed bridge have the lowest yield coefficient. Based on liquefaction analyses results in Appendix E, the average clean sand SPT resistance $(N_1)_{60\text{-}cs}$ for the liquefied layer was determined to be about 17. Using the equation by Idriss and Boulanger (2007), the normalized residual shear strength ratio was evaluated as 0.38 if void redistribution effects are insignificant, and 0.14 if void redistribution effect is significant. For the 5th Street Bridge site conditions, the effect of void redistribution is judged to be insignificant, because there are no continuous layers of low permeability soils next to the liquefiable soils. Therefore a normalized residual strength ratio of 0.28 was used in slope stability analyses and yield coefficient evaluations.

The yield coefficient for sliding masses involving Abutment 11 approach embankment of the proposed bridge was evaluated to be about 0.13 g (see slope stability analyses in Appendix E). This values is more than 50% of the site PGA, therefore, as discussed in Section C.11.6.5.2.2 of the AASHTO LRFD Design Specifications (AASHTO, 2012), the permanent ground deformation is expected to be less than 1 to 2 inches. This deformation is judged to be an insignificant factor in design of the bridge foundations.

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5.3 Soil Corrosivity

As part of the 2013 site investigation and laboratory testing, samples representative of soils throughout the project area were tested to determine corrosivity including minimum resistivity, pH, soluble sulfate content, and soluble chloride content. Eight soil samples were tested for corrosivity using the procedures described in California Test Methods 417, 422, 532, and 643. Corrosion tests were also performed by Taber Consultants on two samples from their 2008 boring. The soil corrosivity test results are summarized in Table 6.

Test results indicate pH values between 5.49 and 9.44, minimum resistivity values between 1,100 and 7,700 ohm-cm, chloride values between 11.8 and 278 parts per million (ppm), and sulfate values between 10 and 210 ppm.

According to Caltrans criteria (Corrosion Guidelines V2.0, 2012), soils are considered corrosive if the pH is 5.5 or less, or chloride concentration is 500 parts per million (ppm) or greater, or sulfate concentration is 2,000 ppm or greater.

Based on these test results and Caltrans criteria, all the measured corrosivity parameters, except one border line pH value of 5.49, are indicative of non-corrosive soils.

For structural elements, appropriate corrosion mitigation measures for "corrosive" conditions shall be provided depending on the service environment, amount of aggressive ion salts (chloride or sulfate), pH level and the desired service life of the structure.

Table 6. Soil Corrosion Test Results

Boring No.	Sample No.	Sample Depth (ft)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Chloride Content (ppm)	Sulfate Content (ppm)
R-13-001	4	20	Sandy lean Clay (CL)	1,100	9.44	278	210
R-13-004	2	10	Poorly-graded Sand with Silt (SP-SM)	4,400	7.77	30	136
R-13-004	4	20	Lean Clay (CL)	3,100	7.25	30	126
R-13-005	1	5	Silty Sand (SM)	6,500	7.08	169	10
R-13-007	1	5	Silty Sand (SM)	5,100	7.65	241	30
R-13-009	2	10	Silty Sand (SM)	7,700	7.19	102	30
R-13-011	4	20	Sandy Silt (ML)	4,700	7.77	162	30
R-13-013	2	10	Silty Sand (SM)	6,000	7.33	114	30
B-1 (8/2007)	3 & 4	15 – 20	Sandy Silt w/ Gravel (ML)	3,750	5.49	11.8	62.1
B-1 (8/2007)	15 & 16	75 – 80	Silty Sand w/ Gravel (SM)	1,130	7.77	14.8	31.5

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5.4 Scour

Based on the estimates by TRC that are provided in the Preliminary Geotechnical Report by Taber (2008), total scour on the order of 6.8, 8.1, and 7.7 feet is anticipated at Piers 3, 4, and 5 of the existing 5th Street bridge, respectively.

Wreco (2016) recently performed additional study along the alignment of the replacement bridge and provided the scour information under several conditions. The current Caltrans LRFD practice considers the following scour depths in pile analysis at each limit state,

- The total depth of long-term degradation scour, contraction scour and local pier scour should be considered under Service Limit State;
- The total depth of long-term degradation scour, contraction scour and 50% of local pier scour should be considered under Strength Limit State; and
- Only the depth of long-term degradation scour and contraction scour should be considered under Extreme Limit State.

According to the current scour data provided by Wreco (2016), the scour depths and design surface elevations at the nine support locations of 5th Street Bridge near Feather River channel and in the flooded plain are summarized in the following table:

Table 7. Summary of Scour Depths

Support	Original Grade[1] (ft)	Scour Depth		Design Surface Elevation (ft)		
		Long-term Degradation and Contraction Scour Elevation (ft)	Local Pier Scour Depth (ft)	Service Limit State	Strength Limit State	Extreme Limit State
Bent 2	42	32.8	8.6	24.2	28.5	32.8
Bent 3	36	10.6	17.4	-6.8	1.9	10.6
Bent 4	54	43.3	11.4	31.9	37.6	43.3
Bent 5	53	49.0	9.9	39.1	44.1	49.0
Bent 6	55	50.4	8.8	41.6	46.0	50.4
Bent 7	55	48.8	9.6	39.2	44.0	48.8
Bent 8	53	48.0	10.5	37.5	42.8	48.0
Bent 9	52	49.9	10.1	39.8	44.9	49.9
Bent 10	55	50.5	9.9	40.6	45.6	50.5

Notes:
1. Estimated from the given plans.

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These scour estimates were used in foundation analysis and design of the 5th Street Bridge. Pile cut-off elevations were determined by the structural engineers based on these scour depths, and they were used by EMI in geotechnical design. No scour is considered for the 2nd Street OC, where no river and channel is present.

5.5 Foundation Type

Due to the project site's seismicity, high vertical and lateral load demands are anticipated on the bridge foundations. Shallow foundations are not considered a suitable foundation type for the proposed bridge structure, primarily because of large loads, the presence of loose and fine-grained soil at relatively shallow depths, and liquefaction and seismic settlement potential. Therefore, deep foundations system is recommended. For the deep foundation alternatives, soil conditions indicate that Cast-In-Drilled-Hole (CIDH) piles, concrete Cast-In-Steel-Shell (CISS) piles, driven steel and driven precast concrete piles are all feasible alternatives for the proposed structure.

As discussed in the previous sections, soil liquefaction was one of the geotechnical issues that influenced the selection of the recommended foundation types. Large diameter piles generally perform far better than smaller diameter piles during liquefaction because lateral resistance of a pile foundation depends on its flexural stiffness EI (the pile moment of inertia I is proportional to D^4 where D is the pile diameter). It is therefore desirable to employ as large a diameter as practically possible to resist lateral loading on the pile. For large diameter shafts, site soils may present difficult driving conditions at depth for CISS piles. Besides, pile driving is generally not allowed in existing levees; therefore CIDH piles are the preferred pile alternative.

Based on these considerations, for the 5th Street Bridge, 118-inch diameter CIDH piles are recommended for pier foundations. A wet construction method is anticipated which generally requires gamma-gamma cross hole testing as a standard of practice to verify pile concrete integrity.

For the 5th Street Bridge abutments, CIDH piles or driven precast concrete piles were evaluated as potential alternatives. Since the abutment foundations will be within the footprint of the existing levees of the Feather River, pile driving is not permitted per USACE guidelines. Based on these considerations, 2-foot diameter CIDH piles are recommended for abutments.

For the 2nd Street OC, which is located completely in land and is not underlain by liquefiable soil layers, Caltrans standard Class 200 driven piles are recommended at two abutment locations.

5.6 Pile Design for the 5th Street Bridge

The Load and Resistance Factor Design (LRFD) method is used for both abutment and bent piles. The foundation design data sheet and foundation loads were provided by the structural designers following the latest Caltrans Memo to Designers 3-1 (Caltrans, 2008), and are shown in Table 8 and Table 9, respectively. As discussed in Section 5.4, scouring should be considered in pile design for the piers within the Feather River channel. The scour depth estimates were considered by structure engineers in determining the pile cut-off elevations, as shown in Table 7.

Table 8. Foundation Design Data Sheet for the 5th Street Bridge

Location	Design Method	Pile Type	Finished Grade El. (ft)	Pile Cut-off El. (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (inch)	Number of Piles per Support
					B	L		
Abutment 1	LRFD	24-in CIDH	81-87	72.75	16	86.8	1	32
Bent 2	LRFD	118-in CIDH	38-50	13	-	-	1	3
Bent 3	LRFD	118-in CIDH	25*	13	-	-	1	3
Bent 4	LRFD	118-in CIDH	55	13	-	-	1	3
Bent 5	LRFD	118-in CIDH	53	45	-	-	1	3
Bent 6	LRFD	118-in CIDH	55	45	-	-	1	3
Bent 7	LRFD	118-in CIDH	53	45	-	-	1	3
Bent 8	LRFD	118-in CIDH	52	45	-	-	1	3
Bent 9	LRFD	118-in CIDH	52	45	-	-	1	3
Bent 10	LRFD	118-in CIDH	55	41	-	-	1	3
Abutment11	LRFD	24-in CIDH	73-78	66.75	10.0	85.0	1	18

Note: * Estimated bottom of channel elevation.

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Table 9. Foundation Design Loads for the 5th Street Bridge

Support No.	Service-I Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Event Limit State (Controlling Group, kips)			
	Total Load		Perm-anent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abutment 1	1217	183	629	6506	267	0	0	-	-	0	0
Bent 2	7985	2927	7323	11113	4101	0	0	3,799	1,503	0	0
Bent 3	8389	3079	7718	11581	4245	0	0	3,620	1,599	0	0
Bent 4	9138	3287	8487	12587	4514	0	0	4,005	1,945	0	0
Bent 5	7780	2939	7053	10800	4059	0	0	3,773	1,551	0	0
Bent 6	7804	2983	7138	10592	3997	0	0	3,762	1,638	0	0
Bent 7	8617	3167	7839	11735	4314	0	0	4,321	1,723	0	0
Bent 8	7745	2924	7011	10773	4051	0	0	3,927	1,550	0	0
Bent 9	7889	3019	7230	10617	4006	0	0	3,936	1,569	0	0
Bent 10	7191	2760	6523	9942	3807	0	0	4,443	1,843	0	0
Abutment 11	1066	237	636	4590	345	0	52	-	-	0	0

5.6.1 Downdrag Load Due to Liquefaction

According to Figures 5A through 5C, a 15 to 35 feet thick potentially liquefiable layer is present underneath the Bent 3 through Abutment 11. Wherever this layer is present, the downdrag loads from settlement of the liquefiable layer should be considered in determining design pile lengths.

According to EMI's analyses on existing CPTs (DE-CPT-02 to DE-CPT-06) (Section 5.2.4), seismically-induced settlements were estimated to be up to 7 inches in the region between proposed Bent 3 to 10, with a settlement zone up to a depth of 35 feet. A neutral axis analysis was performed to determine the downdrag loads on CIDH piles. A neutral axis for downdrag is an elevation along the pile, above which the soil applies negative skin friction on pile. Assuming a displacement of 0.1 to 0.5 inch is needed to mobilize friction between the soil and pile, the neutral axis for downdrag consideration for Bent 3 through Bent 10 was estimated to be at elevation of +30 feet.

For the Service Load Limit State with a permissible pile-head settlement of 1 inch, a downdrag load equal to two times the soil resistance above the neutral axis was added to the service load, according to the AASHTO (2010) procedure (Section 10.7.4).

For the Extreme Event Limit State, piles were designed for the liquefied condition, as a worse case scenario. For CIDH piles in the zones with liquefaction induced settlement potential (Bent 3 through Abutment 11), downdrag loading was considered. However, it should be noted that in absence of an allowable displacement criteria, liquefaction induced downdrag has no impact on

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ultimate axial resistance of the piles. In the event of liquefaction-induced settlement, the downdrag load will be added to the structural load demand. Should the new larger demand becomes close to or exceed the ultimate resistance; the pile will undergo a large settlement on order of several inches. This large settlement will in turn reduce the downdrag load, because if the pile displaces further than the surrounding soil at a certain depth, the skin friction will act as an upward resisting force, eliminating the downdrag load at that depth. This mechanism can be demonstrated using a displacement-based downdrag analysis. Based on this explanation, pile tip elevations for the Extreme Event Limit State under the liquefied soil conditions were determined by neglecting the soil resistance above the neutral axis. On the other hand, no downdrag considerations were taken into account for determining the pile tip elevations for the Strength Limit State. The design tip elevations were further verified by a displacement-based liquefaction-induced downdrag analysis, as described below.

The computer program BMCOL76 (Matlock and Bogard, 1977) was adopted to conduct this displacement-based downdrag analysis. A series of nonlinear skin friction (t-z) and tip resistance (q-u) springs, calculated by SHAFT computer program, were used in the BMCOL76 pile model. The liquefaction-induced settlement profile calculated from the CPTs in the liquefaction zone (DE-CPT-02 to DE-CPT-06) was applied as soil movement in the model. The BMCOL76 analyses results at two support locations are included in Appendix E. Given the design pile length controlled by the Strength Limit State, these results indicate that: 1) the downdrag phenomena disappears when the pile top settles more than 6 inches; and 2) at a pile top settlement of 6 inches, the axial resistance exceeds the load demand (nominal compression) defined by the Strength Limit State.

5.6.2 Pile Axial Capacity

The axial capacity of CIDH shafts were estimated using the computer program SHAFT (Ensoft, 2007) using FHWA method (O'Neill and Reese, 1999). Based on AASHTO LRFD BDS (2010) recommendations, a group efficiency factor of 1.0 was used in the calculations. For the strength limit state, per California Amendments to AASHTO LRFD Bridge Design Specifications – Fourth Edition (Caltrans, 2011), a resistance factor of 0.7 was applied to the ultimate resistance.

The calculated factored axial geotechnical capacities and pile tip elevations for CIDH piles are presented in Table 10. Pile Data Table for the bridge plans is provided in Table 11. Axial pile capacity calculations are provided in Appendix E.

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Table 10. Foundation Design Recommendations (5th Street Bridge)

Location	Pile Type	Cut-off El. (ft)	Service-I Limit State Load (kips) per support	Total Permissible Support Settlement (inch)	Required Factored Nominal Resistance (kips)				Design Tip El. (ft)[1]	Specified Tip El (ft)[2]
					Strength Limit		Extreme Event			
					Comp (φ= 0.7)	Tension (φ= 0.7)	Comp (φ= 1.0)	Tension (φ= 1.0)		
Abut 1	24" CIDH	73.75	183	1	268	0	TBD	0	+24 (a-I) +? (a-II) +42 (c) +29 (d)	+24
Bent 2	118" CIDH	18.0	7985	1	4101	0	1,503	0	-102 (a-I) +2 (a-II) -39 (c) -72 (d)	-102
Bent 3	118" CIDH	18.0	8389	1	4245	0	1,599	0	-108 (a-I) -15 (a-II) -40 (c) -72 (d)	-108
Bent 4	118" CIDH	18.0	9138	1	4514	0	1,945	0	-116 (a-I) -22 (a-II) -42 (c) -72 (d)	-116
Bent 5	118" CIDH	45.0	7780	1	4059	0	1,551	0	-79 (a-I) -1 (a-II) -33 (c) -45 (d)	-79
Bent 6	118" CIDH	45.0	7804	1	3997	0	1,638	0	-68 (a-I) +3 (a-II) -28 (c) -45 (d)	-68
Bent 7	118" CIDH	45.0	8617	1	4314	0	1,723	0	-82 (a-I) -5 (a-II) -34 (c) -45 (d)	-82
Bent 8	118" CIDH	45.0	7745	1	4051	0	1,550	0	-78 (a-I) +1 (a-II) -23 (c) -45 (d)	-78
Bent 9	118" CIDH	45.0	7889	1	4006	0	1,569	0	-67 (a-I) +8 (a-II) -26 (c) -45 (d)	-67

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Location	Pile Type	Cut-off El. (ft)	Service-I Limit State Load (kips) per support	Total Permissible Support Settlement (inch)	Required Factored Nominal Resistance (kips)				Design Tip El. (ft)[1]	Specified Tip El (ft)[2]
					Strength Limit		Extreme Event			
					Comp (φ = 0.7)	Tension (φ = 0.7)	Comp (φ = 1.0)	Tension (φ = 1.0)		
Bent 10	118" CIDH	45.0	7191	1	3807	0	1,843	0	-57 (a-I) +7 (a-II) -16 (c) -45 (d)	-57
Abut 11	24" CIDH	66.75	237	1	345	52	TBD	0	-7 (a-I) +? (a-II) +22 (a-I) +5 (c) +22 (d)	-7

Notes:

1. Design tip elevations are controlled by: (a-I) Compression (Strength Limit), (b-I) Tension (Strength Limit), (a-II) Compression (Extreme Event), (b-II) Tension (Extreme Event), (c) Settlement, (d) Lateral Load.
2. The specified tip elevation shall not be raised above the design tip elevations for tension, lateral load, and settlement.

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Table 11. Pile Data Table for the 5th Street Bridge

Location	Pile Type	Nominal Resistance (kips)		Design Tip El. (ft)[1]	Specified Tip El. (ft)[2]	Nominal Driving Resistance (kips)
		Compression	Tension			
Abutment 1	24" CIDH	385	0	+24 (a) +42 (c) +29 (d)	+24	N/A
Bent 2	118" CIDH	5860	0	-102 (a) -39 (c) -72 (d)	-102	N/A
Bent 3	118" CIDH	6065	0	-108 (a) -40 (c) -72 (d)	-108	N/A
Bent 4	118" CIDH	6450	0	-116 (a) -42 (c) -72 (d)	-116	N/A
Bent 5	118" CIDH	5800	0	-79 (a) -33 (c) -45 (d)	-79	N/A
Bent 6	118" CIDH	5710	0	-68 (a) -28 (c) -45 (d)	-68	N/A
Bent 7	118" CIDH	6165	0	-82 (a) -34 (c) -45 (d)	-82	N/A
Bent 8	118" CIDH	5790	0	-78 (a) -23 (c) -45 (d)	-78	N/A
Bent 9	118" CIDH	5725	0	-67 (a) -26 (c) -45 (d)	-67	N/A
Bent 10	118" CIDH	5440	0	-57 (a) -16 (c) -45 (d)	-57	N/A
Abutment 11	24" CIDH	385	0	-7 (a) +22 (b) +5 (c) +22 (d)	-7	N/A

Notes:

1. Design Tip Elevations are controlled by the following demands: (a) Compression, (b) Tension (c) Settlement, and (d) Lateral Loads.
2. The specified tip elevation shall not be raised above the design tip elevations for compression, settlement, or lateral load.

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5.7 Pile Design for the 2nd Street OC

Unlike the 5th Street Bridge, Caltrans standard Class 200 driven piles were selected for the 2nd Street Bridge abutments. Also per Caltrans policy, LRFD method is used for abutment piles. The foundation design data sheet and foundation loads were provided by the structural designers, following the latest Caltrans Memo to Designers 3-1 (Caltrans, 2014) format, and are shown in Table 12 and Table 13, respectively.

The axial capacity of Class 200 driven piles were estimated using the computer program APILE (Ensoft, 2007). Specifically, we used the Nordlund method outlined in the AASHTO LRFD Bridge Design Specifications (2007) to compute the geotechnical resistances in the predominantly cohesionless onsite soils. The pile capacity is based on soil resistance only and may be further limited by the pile-head connection details and the strength of the pile materials. Group efficiency is not a design issue for cohesionless soils as long as the on-center pile spacing is at least 2.5 times the maximum pile width per Section 10.7.3.9 of AASHTO LRFD Bridge Design Specifications (2007). Uplift resistance is taken to be two-third of the skin friction in compression.

The calculated factored axial geotechnical capacities and pile tip elevations for the Class 200 piles at the abutments are presented in Table 14. The Pile Data Table is provided in Table 15. The axial pile capacities are based on soil resistance only and may be further limited by the pile-head connection details. Because no potentially liquefiable layers exist at this subject bridge site, downdrag is not a design consideration.

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Table 12. Foundation Design Data Sheet for the 2nd Street OC

Location	Design Method	Pile Type	Finished Grade El. (ft)	Pile Cut-off El. (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (inch)	Number of Piles per Support
					B	L		
Abut 1 - Rt	LRFD	Class 200	70.0	65.5	9	58.5	2	21
Abut 1 - Lt	LRFD	Class 200	64.0	62.0	11	69.5	2	26
Abut 2 - Rt	LRFD	Class 200	75.0	69.25	14.5	74	2	28
Abut 2 - Lt	LRFD	Class 200	64.0	59.25	8	33	2	19

Table 13. Foundation Design Loads for the 2nd Street OC

Support No.	Service-I Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Event Limit State (Controlling Group, kips)			
	Total Load		Perm-anent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abut 1 - Rt	1096	TBD	628	3705	263	N/A	62	TBD	TBD	TBD	TBD
Abut 1 - Lt	3149	TBD	2651	4650	276	N/A	66	TBD	TBD	TBD	TBD
Abut 2 - Rt	3500	TBD	2886	4972	266	N/A	78	TBD	TBD	TBD	TBD
Abut 2 - Lt	1654	TBD	1294	3302	280	N/A	78	TBD	TBD	TBD	TBD

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Table 14. Foundation Design Recommendations for the 2nd Street OC

Location	Pile Type	Cut-off El. (ft)	Service-I Limit State Load (kips) per support	Total Permissible Support Settlement (inch)	Required Factored Nominal Resistance (kips)				Design Tip El. (ft)[1]	Specified Tip El. (ft)[2]
					Strength Limit		Extreme Event			
					Comp (φ= 0.7)	Tension (φ= 0.7)	Comp (φ= 1.0)	Tension (φ= 1.0)		
Abut 1 - Rt	Class 200	65.5	1096	2	263	62	TBD	0	-6 (a-I) +? (a-II) +15 (b-I) +? (c) +30 (d)	-6
Abut 1 - Lt	Class 200	62.0	3149	2	276	66	TBD	0	-10 (a-I) +? (a-II) +15 (b-I) +? (c) +30 (d)	-10
Abut 2 - Rt	Class 200	69.25	3500	2	266	78	TBD	0	-7 (a-I) +? (a-II) +13 (b-I) +?? (c) +30 (d)	-7
Abut 2 - Lt	Class 200	59.25	1654	2	280	78	TBD	0	-11 (a-I) +? (a-II) +13 (b-I) +? (c) +29 (d)	-11

Notes:

1. Design tip elevations are controlled by: (a-I) Compression (Strength Limit), (b-I) Tension (Strength Limit), (a-II) Compression (Extreme Event), (b-II) Tension (Extreme Event), (c) Settlement, (d) Lateral Load.
2. The specified tip elevation shall not be raised above the design tip elevations for cases (c) and (d).

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Table 15. Pile Data Table for the 2nd Street OC

Location	Pile Type	Nominal Resistance (kips)		Design Tip El. (ft)[1]	Specified Tip El. (ft)[2]	Nominal Driving Resistance (kips)
		Compression	Tension			
Abut 1 – Rt.	Class 200	380	90	-6 (a) +15 (b) +? (c) +30 (d)	-6	380
Abut 1 – Lt.	Class 200	395	95	-10 (a) +15 (b) +? (c) +30 (d)	-10	395
Abut 2 – Rt.	Class 200	380	115	-7 (a) +1? (c) +30 (d)	-7	380
Abut 2 – Lt.	Class 200	400	115	-11 (a) +13 (b) +? (c) +29 (d)	-11	400

Notes:

1. Design Tip Elevations are controlled by the following demands: (a) Compression, (b) Tension (c) Settlement, and (d) Lateral Loads.
2. The specified tip elevation shall not be raised above the design tip elevations for compression, settlement, or lateral load.

5.8 Lateral Pile Capacity

Lateral resistance for CIDH piles was evaluated using the computer program LPILE 6.0 (Ensoft, 2010). LPile soil parameters for all supports are provided in Appendix C (Idealized Soil Profiles). The API Sand model (API 2000) was used to internally generated p-y curves for sandy soils. The Soft Clay (Matlock, 1970) model and the stiff clay without free water model (Reese, 1975) were used to internally generated p-y curves for soft and stiff fine-grained soils, respectively. Group efficiency factors (GEF) or p-multipliers for pile supported foundations were estimated using the procedure presented in the Group 7.0 Technical Manual (Ensoft, 2006).

5.8.1 Lateral Pile Solutions for 5th Street Bridge Piers

For pier foundations, lateral load solutions were used to estimate spring coefficients at pile cutoff elevation. These spring coefficients were provided to the structural designers to incorporate in the global bridge model. For Bent 3 through Bent 10 with a pile center-to-center spacing (SP) of 26 feet, GEFs of 0.86 and 0.72 were used in the longitudinal and transverse directions, respectively. For Bent 2 with a little larger SP (27.67 feet), GEFs of 0.88 and 0.74 were adopted in the longitudinal and transverse directions, respectively,

5.8.2 Lateral Pile Resistance for the 5th Street Bridge Abutments

For the CIDH piles at 5th Street Bridge abutments, GEFs of 0.75 (Abutment 1) and 0.85 (Abutment 11) were used in the LPILE models. For abutment piles, a 20-foot long permanent

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casing with an effective thickness (thickness after subtracting sacrificial thickness due to corrosion) of ½ inch was used to increase bending stiffness. Moreover, the abutment piles were assumed to have partial fixity to the pile cap. The concrete section was assumed to have rotational fixity, but the steel shell was assumed to be pinned at pile head. Lateral pile solutions for the 5th Street Bridge abutments are shown in Table 16.

Table 16. Lateral Pile Solutions for Abutments 1 and 11 of the 5th Street Bridge

Support Location	CIDH Pile Diameter (inch)	Pile Head Deflection (inch)	Pile Head Shear (kips)	Maximum Moment (kip-in)	Depth to Maximum Moment from Pile Head (feet)
Abutment 1 (GEF =0.75)	24	¼	16.4	1,312	0.00
		0.4	26.1	2,094	0.00
		½	32.5	2,613	0.00
		1	62.6	5,145	0.00
		2	112.6	9,833	0.00
Abutment 11 (GEF =0.85)	24	¼	48.9	2,456	0.00
		0.4	69.9	3,736	0.00
		½	81.1	4,501	0.00
		1	120.7	7,763	0.00
		2	170.8	12,857	0.00

5.8.3 Lateral Pile Resistance for the 2nd Street OC Abutments

For Class 200 driven piles at the 2nd Street OC abutments, GEFs of 0.85 (Abutment 1) and 0.87 (Abutment 2) were used in the LPILE models. Pile head connection for these abutments was assumed to be pinned to the pile cap. Lateral pile solutions for the 2nd Street OC abutments are shown in Table 17. According to the plans, the first row of piles in the font of each abutment will be battered into the ground. Additional lateral resistance will be provided by the horizontal components of the axial capacities of these battered piles.

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Table 17. Lateral Pile Solutions for Abutments 1 and 2 of the 2nd Street Bridge

Support Location	Pile Type	Pile Head Deflection (inch)	Pile Head Shear (kips)	Maximum Moment (kip-in)	Depth to Maximum Moment from Pile Head (feet)
Abutment 1 (GEF = 0.85)	Class 200	¼	5.4	231	5.6
		½	10.1	457	5.6
		1	16.8	881	6.1
		2	25.2	1,643	6.5
Abutment 2 (GEF = 0.87)	Class 200	¼	5.5	234	5.6
		½	10.2	461	5.6
		1	17.1	890	5.85.41
		2	25.6	1,657	6.510.1

5.9 Bridge Abutment Walls

5.9.1 Earth Pressures

Static Earth Pressure. If abutment walls are free to move laterally at the top, a static active lateral earth pressure of 36 psf per foot of depth is recommended for a free draining, level and compacted backfill. If lateral movement at the top of abutment walls is restrained, the lateral earth pressure for a free draining, level and compacted backfill should follow Section 5.5.5.11 of the Caltrans Bridge Design Specification (Caltrans, 2004). For this condition, we recommend a coefficient of active lateral earth pressure of 0.3, a coefficient of at-rest lateral earth pressure of 0.47 and a soil unit weight of 120 pcf.

A uniform lateral pressure due to traffic loading, equivalent to a vertical pressure produced by at least 2 feet of earth with a soil unit weight of 120 pcf, should be added to the above lateral earth pressure. Therefore for abutment walls that are free to move laterally at the top, the recommended uniform lateral earth pressure is 72 psf; for abutment walls where lateral movement at the top of the abutment walls is restrained, the recommended uniform lateral earth pressure is 113 psf.

Seismic Earth Pressure. The seismic lateral active earth pressure was estimated using the Mononobe-Okabe analysis with a seismic coefficient of 0.12 g, which is one-half of the PGA of about 0.24 g, as recommended by AASHTO (2007). For walls that are free to rotate, the seismic increment should be modeled as a triangle with an equivalent fluid pressure of 9 pcf. This seismic increment should be added to the static earth pressure. The resultant of the seismic lateral pressure increment should be applied at 0.33H above the bottom of the footing.

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5.9.2 Passive Resistance

Under seismic loading, an ultimate passive earth pressure of 5 ksf may be used for the approach backfill and abutment walls with an effective height equal to or greater than 5.5 feet. For abutment walls with effective heights less than 5.5 feet, the maximum passive pressure shall be reduced proportional to the wall height (e.g., for a 4 feet high wall, the maximum passive pressure is [4/5.5]x5ksf = 3.6 ksf). The horizontal movement at which the maximum passive pressure is expected to be fully mobilized can be determined following the procedure outlined in Section 7.8.1 of the Caltrans SDC (2013b).

5.10 Approach Embankments

To elevate the road grades to the proposed finished grade at the bridge approaches, about 3 and 6 feet of additional embankment fill will be placed at two abutments of the 5th Street Bridge and the 2nd Street OC, respectively. The approach embankments for both bridges will be retained by Caltrans Standard Type 1 retaining walls.

5.10.1 Bridge Abutment Slope Stability

The "global" stability of the proposed slopes at the bridge abutments were evaluated for both static and pseudo-static conditions using the computer program Slide 7.0 (Rocscience, 2016). The idealized soil profiles below each abutment of 5th Street Bridge and that of 2nd Street OC, as shown in Appendix C, were used in the slope stability model. The material used for the proposed embankment fill was modeled with a friction angle of 32 degrees and minimum cohesion of 100 psf. For liquefied soils, a normalized residual strength ratio of 0.28 was used.

Slope stability analyses for the static condition were conducted using a 240 psf (equivalent of 2-feet soil surcharge) to represent traffic loading, with the design water table at El. +80 feet. In accordance with Caltrans guidelines (Caltrans, 2009), stability analysis for the seismic condition was performed using the pseudo-static approach with a seismic coefficient of 0.08 g; Caltrans guidelines require a seismic coefficient equal to one-third the peak horizontal acceleration but not exceeding 0.2.

According to the results of the analyses, the slopes meet the minimum required factor-of-safety for deep-seated failure of 1.5 for the static condition and 1.1 for the seismic condition per Caltrans guidelines (Caltrans, 2009). A summary of the slope stability results is presented in Table 18. Appendix E provides graphical results of the slope stability analyses.

The yield coefficient of the critical failure planes going through Abutment 11 approach embankment was evaluated to be about 0.13 g.

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Table 18. Factor of Safety for Slope Stability

Location	Static		Pseudostatic	
	Circular Failure	Block Failure	Circular Failure	Block Failure
5th Street Bridge, Abutment 1	1.772	N/A	1.475	N/A
5th Street Bridge, Abutment 11	2.025	1.97	1.171	1.163
2nd Street OC, Abutment 1	2.17	N/A	1.68	N/A
2nd Street OC, Abutment 2	1.58	N/A	1.15	N/A

Other forms of external stability such as sliding and overturning of the retaining walls and abutments shall be evaluated by the bridge designers.

For embankment slopes with a gradient of 2:1 (H:V) or flatter, surficial stability should not be a design concern. For steeper embankment slopes up to a gradient of 1.5:1 (H:V), slope paving shall be provided to prevent surficial instability and erosion. In all cases, proper maintenance with erosion protection and drainage control in accordance with Section 21 of Caltrans Standard Specifications (2015) is recommended.

5.11 Abutment Wingwalls

Due to the anticipated fill heights at the abutments, typical wingwalls cantilevered off the abutment backwall are not feasible. Caltrans Standard Type 1 retaining walls are required on both sides of the approach embankments at abutments of the 5th Street Bridge and the 2nd Street OC to retain the proposed embankment fill. For the 5th Street Bridge, retaining walls are about 26 and 140 feet in total length at Abutment 1 and Abutment 11, respectively, and vary from 2 to 15 feet in design height. For the 2nd Street OC, retaining walls are about 38 and 80 feet in total length at Abutment 1 and Abutment 2, respectively, and vary from 5 to 36 feet in height.

5.11.1 Earth Pressures

An active earth pressure coefficient of 0.3 and a soil unit weight of 120 lb/ft^3 are recommended for a level backfill. For cantilever retaining walls, a static active lateral earth pressure of 36 psf per feet of depth is recommended for a level backfill. A traffic surcharge equivalent to a vertical pressure produced by at least 2 feet of earth should be added to the above lateral earth pressure values. Other design requirements are specified in Section 3.20 of the Caltrans Bridge Design Specifications (Caltrans, 2000).

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5.11.2 Foundation Recommendations

The retaining wall footings will be embedded in import fill material placed as part of the project improvements. At Abutment 11 of 5th Street Bridge where medium dense sandy and stiff clayey materials appear in top 30 feet and liquefiable layers at elevations from +50 to +35 feet, compacted structure backfill overlying native soils are suitable for support of Caltrans Standard Type 1 retaining walls on spread footings up to a design height of 5 feet. At Abutment 1 of the 2nd Street OC, due to the presence of compressible near surface material, compacted structure backfill overlying native soils are suitable for support of Caltrans Standard Type 1 retaining walls on spread footings up to a design height of 10 feet.

Spread Footings. Fill placement should be performed in accordance with Section 19 of the Caltrans Standard Specifications (2015). In addition, the upper 4 feet of fill placed below the footing bottom should be required to meet the Caltrans Standard Specification (2015) requirements for structure backfill. The limits of the select fill material should extend laterally from two feet beyond the edges of the footing out and down at an inclination of 1:1 (H:V) to natural grade. The select fill material should be compacted to at least 95% relative compaction determined using CT 216.

Assuming the above earthwork is performed, the estimated net allowable and gross allowable uniform bearing stress of the compacted fill will exceed the demands for Caltrans Standard Type 1 retaining walls as shown on the Caltrans Standard Plans (2010b) for retaining walls up to 10 feet in design height. The estimated settlement of proposed retaining wall footings is estimated to be less than 1 in for the service limit state. The gross allowable uniform bearing stress is based on a resistance factor of 0.45 per AASHTO LRFD Bridge Design Specifications.

Pile Foundations. Due to the limited bearing capacity of native soils, deep foundations consisting of Caltrans Standard Class 200 driven piles will be required for Caltrans Standard Type 1 retaining walls greater than 10 feet in design height at Abutment 2 of the 2nd Street OC. 24" CIDH piles are recommended for the abutments of the 5th Street Bridge, where driven piles are not allowed in the existing levees. Table 19 shows the design data for wingwall piles.

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Table 19. Abutment Wingwall Pile Design Data Sheet

Location	Wall Design Height (ft)	Pile Type	Footing Bottom Elevation (ft)	Pile Cap Size (ft)		No. of Piles	Max. Load per Pile (kip)			
				B	L		Service	Strength	Extreme I	Extreme II
5th Street Bridge, Abut 1S	TBD	24" CIDH	79.0	TBD	TBD	2	TBD	TBD	TBD	TBD
	TBD		83.0	TBD	TBD	5	TBD	TBD	TBD	TBD
5th Street Bridge, Abut 11N	TBD		74.0	TBD	TBD	4	TBD	TBD	TBD	TBD
	TBD		76.5	TBD	TBD	3	TBD	TBD	TBD	TBD
5th Street Bridge, Abut 11S	TBD		70.0	TBD	TBD	3	TBD	TBD	TBD	TBD
	TBD		72.0	TBD	TBD	3	TBD	TBD	TBD	TBD
	TBD		74.0	TBD	TBD	3	TBD	TBD	TBD	TBD
	TBD		76.0	TBD	TBD	3	TBD	TBD	TBD	TBD
2nd Street OC, Abut 2N	TBD	Class 200	63.58	TBD	TBD	4	TBD	TBD	TBD	TBD
	TBD		67.25	TBD	TBD	4	TBD	TBD	TBD	TBD
	TBD		70.83	TBD	TBD	3	TBD	TBD	TBD	TBD

Axial Pile Capacity. The calculated axial capacities and pile tip elevations for a single driven Class 200 pile and a single 24" CIDH piles were evaluated using computer programs APILE (Ensoft, 2007) and SHAFT (Ensoft, 2007), respectively. The results are summarized in Table 20. Uplift resistance is taken to be two-third of the skin friction in compression. Pile group effects can be neglected if the on-center spacing is equal to or greater than 3 times the pile width.

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Table 20. Pile Data Table – Abutment Retaining Walls

Location (Wall Height)	Pile Type	Nominal Resistance (kips)		Design Tip El. (ft)[1]	Specified Tip El. (ft)	Nominal Driving Resistance (kips)
		Compression	Tension			
5th Street Bridge, Abut 1S (H = ?ft)	24" CIDH	200	0	+35 (a) +? (c) +40 (d)	+35	N/A
5th Street Bridge, Abut 1S (H = ?ft)	24" CIDH	200	0	+35 (a) +? (c) +40 (d)	+35	N/A
5th Street Bridge, Abut 11N (H = ?ft)	24" CIDH	200	0	+10 (a) +? (c) +35 (d)	+10	N/A
5th Street Bridge, Abut 11N (H = ?ft)	24" CIDH	200	0	+10 (a) +? (c) +37 (d)	+10	N/A
5th Street Bridge, Abut 11S (H = ?ft)	24" CIDH	200	0	+10 (a) +? (c) +33 (d)	+10	N/A
5th Street Bridge, Abut 11S (H = ?ft)	24" CIDH	200	0	+10 (a) +? (c) +35 (d)	+10	N/A
5th Street Bridge, Abut 11S (H = ?ft)	24" CIDH	200	0	+10 (a) +? (c) +35 (d)	+10	N/A
5th Street Bridge, Abut 11S (H = ?ft)	24" CIDH	200	0	+10 (a) +? (c) +37 (d)	+10	N/A
2nd Street OC, Abut 2N (H = ? ft)	Class 200	200	0	+4 (a) +? (c) +32 (d)	+4	200
2nd Street OC, Abut 2N (H = ? ft)	Class 200	200	0	+4 (a) +? (c) +35 (d)	+4	200
2nd Street OC, Abut 2N (H = ? ft)	Class 200	200	0	+4 (a) +? (c) +38 (d)	+4	200

Notes:

1. Design Tip Elevations are controlled by the following demands: (a) Compression, (b) Tension (c) Settlement, and (d) Lateral Loads.
2. The specified tip elevation shall not be raised above the design tip elevations for compression, settlement, or lateral load.

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Lateral Pile Capacity: Lateral pile analyses for a single pile were performed for a free-head condition using the computer program LPILE6.0 (Ensoft, 2010). The resulting pile-head shear and maximum moment for a range of pile-head lateral deflections are shown in Table 21. The solutions presented in Table 19 are entirely based on soil resistance and linear pile properties. Therefore, these values may be limited by the flexural strength (plastic moment) of the piles and other connection details. Linear interpolation can be used for solutions between pile-head deflections of 0.25 and 2 inches.

Non-linear soil resistance versus lateral pile movement curves were generated internally by LPILE according to the methods proposed by: API (2000) for sand; Reese et al. (1975) for stiff fine-grained soils; and Matlock (1970) for soft fine-grained soils.

The on-center spacing between two adjacent piles perpendicular to the face of the wall is at least 3 pile diameters. Based upon the recommendations for pile group reduction factors (P-Multipliers) for piles with a minimum 3 diameter on-center pile spacing provided in California Amendments to AASHTO LRFD Bridge Design Specifications – Fourth Edition (2011), a P-Multiplier of 0.60 was included in the analysis to account for group effects.

Table 21. Lateral Pile Solutions – Abutment Wingwall Piles

Support Location	Pile Type	Pile Head Deflection (in)	Pile Head Shear (kip)	Max Moment (kip-in)	Depth to Maximum Moment from Pile Top (ft)
5th Street Bridge, Abut 1S	24” CIDH	¼	TBD	TBD	TBD
		½	TBD	TBD	TBD
		1	TBD	TBD	TBD
		2	TBD	TBD	TBD
5th Street Bridge, Abut 11N,S	24” CIDH	¼	TBD	TBD	TBD
		½	TBD	TBD	TBD
		1	TBD	TBD	TBD
		2	TBD	TBD	TBD
2nd Street OC, Abut 2N	Class 200	¼	TBD	TBD	TBD
		½	TBD	TBD	TBD
		1	TBD	TBD	TBD
		2	TBD	TBD	TBD

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6.0 CONSTRUCTION CONSIDERATIONS

All work should be performed in accordance with the Caltrans Standard Specifications (2015) except as indicated in the Special Provisions prepared for the project improvements.

6.1 Earthwork

6.1.1 General

Earthwork should be performed in accordance with Section 19 of the Caltrans Standard Specifications (2015). Appropriate measures should be taken to prevent damage to adjacent existing structures and utilities. Design and construction of temporary slopes or shoring should be made the contractor's responsibility. It should be noted that it is the responsibility of the contractor to oversee the safety of the workers in the field during construction. The contractor shall conform to all applicable occupational safety and health standards, rules, regulations, and orders established by the State of California. In addition, other State, County, or Municipal regulations may supersede the recommendations presented in this section. If an excavation shoring design is required, the geotechnical consultant should review the plan to confirm that recommendations presented in this report have been applied to the design.

Heavy construction equipment should not be used immediately adjacent to shoring due to large lateral pressures induced by such equipment unless the shoring is designed to accommodate resulting pressures. Excavated soils or construction materials should not be stockpiled adjacent to shoring or open excavations. Stockpiled soil and construction materials should be set back a distance at least equal to the height of the excavation.

In fill areas, complete removal of compressible surficial materials including topsoil, loose or soft alluvium, and unsuitable fill is required prior to fill placement. The top 8 inches of material within all areas to receive compacted fill should be scarified and re-compacted to 90% relative compaction; the scarification should extend horizontally a minimum distance of 2 feet from edges of new fills or structures. The scarification should be performed beneath all new embankments. Fill placed on sloping ground should be properly keyed and benched into existing ground and placed as specified in Section 19-6 of the Caltrans Standard Specifications (2015). A fill key should be placed at the toe of fill slope. The key should be excavated 2 feet below existing grade. The bottom of the fill key should be firm and unyielding prior to placing compacted fill.

6.1.1 Material for Fill

On-site Soils: In general, the on-site soils are not corrosive and they can potentially be re-used as compacted fill for backfill. Due to their variable moisture content, moisture conditioning will be necessary to achieve the required degree of compaction.

The following is a summary of the gradation, sand equivalency, plasticity index and peak friction angle of the onsite soils as sampled.

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Table 22. On-Site Borrow Source Analysis

Boring No.	Depth (ft)	Soil Type	Gradation (% Passing)									Sand Equi.	Plast. Index	Peak Angle ϕ' (°)	Maxi. Dry Density (pcf)
			6"	4"	3"	2"	¾"	#4	#30	#50	#200				
R-13-001	0-5	SM	100	100	100	100	100	97	85	67	31	-	NP	33	100
R-13-011	0-5	CL	100	100	100	100	100	97	90	83	60	-	11	29	112
HA-13-014	0-5	CL	100	100	100	100	100	100	99	91	68	15	-	33	125

Recently the structural engineer inquired whether the top portion of the exiting levee can be incorporated in construction of the new abutments of the 5th Street Bridge. It should be noted that loose / caving soils were encountered during drilling of the top 30 feet of the Boring R-13-01 in vicinity of the Abutment 1. In addition, according to compaction test results the maximum dry density of the levee material, as shown in Table 20, is low. Therefore, suitability of this material should be verified through compaction tests during construction.

Earthwork factors in general earthwork application consist of the shrinkage factor and the bulkage factor. The shrinkage factor measures the reduction in volume of soil from its in-situ condition in the borrow source to its final compacted stage. The bulkage factor measures the increase in volume of soil from its in-situ condition in the borrow source to a loose state in transportation. Theoretically, these factors can be calculated based on laboratory testing results. However, in practice, the volumetric changes of on-site materials in different stages of grading vary drastically with unaccountable factors such as losses in hauling, imprecision in grading and variations in compaction effort, etc. All these factors can lead to the need of import or export on a planned balanced earthwork project.

Although accurate grading factors cannot be determined, the volume change of near-surface soils (upper 5 feet) after compaction is estimated to be on the order of +5% to -5% for determining preliminary earthwork quantities. Excavated materials may be assumed to bulk 3 to 10% for hauling purposes.

Imported Fill: Each proposed borrow source should be sampled (at least 50 pounds), tested and accepted for use prior to delivery of the soils to the site. Contractor should allow a minimum of 3 working days for required geotechnical laboratory testing. Soils imported prior to acceptance may be rejected if they are not suitable.

Slurry Cement Backfill: In areas where mechanical compaction of soil is impractical due to space constraints, slurry cement backfill using a two-sack mix meeting requirements of Caltrans Standard Specifications 19-3.03F (2015) typically may be substituted for compacted backfill.

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6.1.2 Cuts and Excavations

Temporary cuts may be required in areas where drainage improvements and footings are proposed. Temporary excavations, including temporary shoring, necessary to construct the bridge abutments or other structures will need to be designed by the contractor for local and global stability, once the means and methods of construction are determined.

6.1.3 Groundwater Control

Groundwater was encountered in Boring B-1 (2007) at elevation of +41 feet, and the design groundwater elevation is +50 feet. Therefore, groundwater is expected to be encountered within pertinent depths of construction. Should groundwater be encountered during footing construction, it should be controlled in accordance with Section 19-3.03B of the Caltrans Standard Specifications (2015). Any seepage or groundwater removed from an excavation should be tested and disposed of in compliance with all applicable local, state and federal requirements.

Free water should not be allowed to stand in any excavations. If excavations become flooded, at least the bottom 6 inches of soil should be removed and replaced or re-compacted to 95% relative compaction. Additional removals may be required at the discretion of the project Engineer.

6.2 CIDH Pile Construction

1. The CIDH piles should be constructed in accordance with Section 49-3 of the Caltrans Standard Specification (2015).

2. For on-center pile spacing less than three times the pile diameter, no two adjacent piles can be constructed concurrently. No borings or excavations should be drilled immediately adjacent to another pile until the concrete in the other pile has attained a minimum compressive strength of 1,800 psi.

3. Pile boreholes should be inspected and approved by the geotechnical engineer prior to the installation of reinforcement. Extreme care in drilling, placement of steel, and the pouring of concrete is essential to avoid excessive disturbance of pile boring walls.

4. Loose soils should be cleaned from the bottom of the borings using a cleanout bucket. Concrete placement by pumping or tremie tube to the bottom of the pile borings is recommended. Specifications should require that sufficient space be provided in the pile reinforcing cage during fabrication to allow the insertion of a tremie tube for concrete placement. The pile reinforcing cage should be installed and the concrete pumped immediately after drilling is completed.

5. During the current site investigation, groundwater was encountered in soil borings between elevations +31.0 and +53.4 feet. Based on these elevations it is expected that the groundwater will be encountered during pile construction. Actual groundwater elevation may be different during construction due to seasonal rainfall, surface runoff and other man-made conditions.

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6. Sandy soils susceptible to caving were encountered in our soil borings and these materials are expected to be within pertinent depths of construction of the CIDH piles. To prevent caving from occurring, a wet construction method or an oscillator/rotator method with a full length temporary casing can be used.

7. As a minimum Caltrans requirement, Gamma-Gamma testing should be performed to detect anomaly in concrete for CIDH piles installed below water. Equally spaced 2-inch diameter (Schedule 40) PVC access tubes should be pre-installed in CIDH piles to facilitate Gamma-Gamma logging. Since Gamma-Gamma logging tests anomalies generally around the PVC tubes, Cross-hole Sonic Logging (CSL) can be performed as a complementary test for anomaly between tubes so that if any anomaly is found, its limits can be more precisely determined.

8. For wet pile construction, the contractor should be required to maintain a minimum 10 ft head of slurry over the piezometric surface at all times during CIDH pile construction. The minimum 10 ft head of slurry should be required during shaft excavation to help avoid a "quick" condition at the bottom of the CIDH pile excavation. Water should not be allowed as slurry, even if fulllength casing is used during shaft excavation. For the construction joint at the bottom of the column reinforcement for Type I or Type II shafts, the minimum 10 ft slurry head over the piezometric surface should be required to be maintained until the concrete has reached its initial set.

9. If caving occurs, a temporary casing maybe required during construction. Casings should have an outer diameter equal to or exceeding the pile diameter. Temporary casing should be pulled as the concrete is being poured while always maintaining at least a 5 ft head of concrete inside the casing. Contractor can choose to use a "wet" method of construction to control caving. Driven or vibrated temporary casing must be removed unless approved by the Engineer. Any impacts from driving or vibrating casing must be evaluated by the contractor, and the contractor is responsible for proving to the owner that any potential damage due to driving or vibrating casing has been mitigated.

10. In the event that any boring becomes bell-shaped and cannot be advanced due to severe caving, all loose material should be removed from the bottom of the boring and the caved region filled with a low-strength sand-cement slurry. Drilling may continue when the slurry has reached its initial set.

6.3 Driven Pile Construction

1. Piles should be driven at least to the specified tip elevation and the bearing value should be checked with the pile-driving formula given in Section 49-2.01A(4)(c) of the Caltrans Standard Specifications (2015) using the nominal driving resistance). However, if the specified tip elevation is reached without achieving the design load, pile driving should continue until bearing is attained. In this case, it may be prudent to allow the pile to "set up" before continuing the driving.

2. The selected pile-driving hammer such as diesel-type hammers should be able to deliver sufficient energy to drive the piles at a penetration rate of not less than 1/8 inch per blow at

the required bearing value. Vibratory hammers and undersized predrilling below the embankment fill are not allowed for pile installation.

3. Drivability of piles was considered for the bridge site. Based on the available soil boring data, hard driving may be encountered beginning at El. +30 feet.

6.4 Backdrain and Backfill Requirements for Abutment Walls

Caltrans Structure Backfill should be used as backfill material behind the bridge abutment walls as shown in Figure 12. Backfill should be compacted in accordance with Section 19-5 of the Caltrans Standard Specifications (2015). Backfill should be placed in loose lifts not exceeding 8 inches in thickness, moisture-conditioned to near optimum moisture content, and compacted to at least 95 percent relative compaction. The relative compaction should be based on the maximum density determined by California Test Method 216. Jetting or flooding to compact backfill is not recommended. Heavy compaction equipment, such as vibratory rollers, dozers, or loaders, should not be used adjacent to the abutment walls in order to avoid damaging the walls due to large lateral earth pressures.

Backdrains should be installed behind abutment walls to relieve hydrostatic pressure. Backdrains should be constructed in accordance with Bridge Detail 3-1 on Sheet B0-3 per Caltrans Standard Plans (2010b) or the geocomposite drain alternative per Section 6 of the Caltrans Bridge Design Details (1992).

6.5 Review of Construction Plans

Recommendations contained herein are based on current design information. The geotechnical consultant should review the final construction plans and specifications in order to confirm that the general intent of the recommendations contained in this report have been incorporated into the final construction documents. Recommendations presented in this report may require modification or additional recommendations may be necessary based on the final design.

6.6 Geotechnical Observation and Testing

It is recommended that inspections and testing be performed by qualified geotechnical personnel during the following stages of construction:

- Grading operations, including excavations and placement of compacted fill,
- Shoring installation, if necessary,
- Pile construction,
- Backdrain installation and backfilling of bridge abutment walls and retaining walls,
- Removal or installation of support of buried utilities or structures, and
- When any unusual subsurface conditions are encountered.

6.7 Differing Site Conditions

The analyses and recommendations contained in this report are based on the data obtained from the review of available geologic references, our site reconnaissance, soil borings, and laboratory

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testing. The soil boring logs indicate subsurface conditions only at specific locations and times drilled, and only to the depths penetrated. Boring logs do not necessarily reflect subsurface variations that may exist between such locations. If variations in subsurface conditions from those described in this report are noted during construction, the recommendations presented in this report must be re-evaluated. In the event that any changes in the nature, design, or location of the proposed facilities occur, the conclusions and recommendations in this report should not be considered valid unless the changes are reviewed and conclusions of this report are verified in writing by the designer. Therefore, upon encountering any site conditions that are perceived to differ materially from those conditions anticipated in this report, the resident engineer should contact the geotechnical designer immediately.

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APPENDIX A

LOG-OF-TEST-BORINGS AND CPT SOUNDINGS

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BENCHMARK

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2010)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) For Soil Legend, see Caltrans Standard Plan A10F and A10G.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
03	SUT/YU	.	.	====	====

Amir G Zand — REGISTERED ENGINEER — DATE XX-XX

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER AMIR G. ZAND NO. GE 3029 EXP. 06/30/17 GEOTECHNICAL STATE OF CALIFORNIA

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

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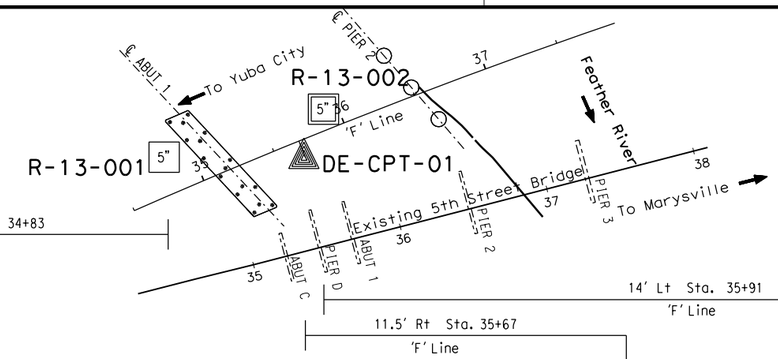
3541 INVESTMENT BLVD, SUITE #4
HAYWARD, CA 94545



N

PLAN
1" = 50'

25' Lt Sta. 34+83 'F' Line

11.5' Rt Sta. 35+67 'F' Line

14' Lt Sta. 35+91 'F' Line

R-13-001

EL. +85.0'

Blows	Recovery	Sample	Description
			ASPHALT 3" thick.
26	2.4	M UW	CLAYEY SAND (SC); brown; moist; fine SAND; nonplastic fines. Medium dense; few GRAVEL, max.½in. dia.; mostly medium to fine SAND; some low plasticity fines.
4	1.4	M PA	CLAYEY SAND with GRAVEL (SC); very loose; moist; 16% GRAVEL, max.½in. dia.; 44% medium to fine SAND; 40% low plasticity fines; Sampled from shoe.
4	2.4	M UW DS	CLAYEY SAND (SC); very loose; moist; few GRAVEL, max.½in. dia.; mostly medium to fine SAND; some low plasticity fines.
3	1.4	M CR PI	SANDY lean CLAY (CL); soft; brown to dark yellowish brown; moist; some medium to fine SAND; mostly nonplastic fines.
4	2.4		No Recovery.
3	1.4	M C PA	CLAYEY SAND (SC); very loose; yellowish brown; moist; 3% GRAVEL; 51% medium to fine SAND; 46% low plasticity fines; lost mud circulation, boring relocated.
15	2.4	M UW	SILTY SAND (SM); medium dense; brown; moist; mostly medium to fine SAND; some nonplastic fines; lost mud circulation.
16	1.4	M	SANDY SILT (ML); very stiff; brown to dark yellowish brown; moist; some fine SAND; mostly low plasticity fines; lost mud circulation several times,
GWS EL. 41.2' 10-16-13	1	2.4	No Recovery.
	P	2.4	Wet; few GRAVEL; little fine SAND; mostly low plasticity fines; lost mud circulation.
18	1.4		
81/11	2.4	M UW PA PP	SANDY lean CLAY (CL); hard; olive brown mottled with dark yellowish brown; moist; few GRAVEL, max.¼in. dia.; 41% fine SAND; 59% medium plasticity fines; few mica; PP>4.5 tsf.
52	1.4	PP	Lean CLAY (CL); hard; light brown; moist; few fine SAND; mostly medium to high plasticity fines; PP=3 tsf.
24	2.4	M PP	SANDY lean CLAY (CL); very stiff; light brown to yellowish brown; moist; few fine SAND; mostly medium plasticity fines; PP=3 tsf.
31	1.4		Poorly-graded SAND with SILT (SP-SM); dense; gray to olive gray; moist; trace GRAVEL; mostly coarse to medium SAND; few medium plasticity fines; lost drilling mud.
27	2.4	M	Medium dense; light gray to gray; moist; mostly medium to fine SAND; few nonplastic fines.
66	1.4		Very dense; few GRAVEL; mostly coarse to fine SAND; few nonplastic fines; trace mica.
50	2.4		Dense; moist; mostly fine SAND; few nonplastic fines.
57	1.4	M UW PP	SANDY lean CLAY (CL); hard; gray; moist; few GRAVEL; mostly medium to fine SAND; some nonplastic fines; PP>4.5 tsf.

DE-CPT-01

EL. +63.0'

A-13-002

EL. +63.0'

Blows	Recovery	Sample	Description
			CLAYEY SAND with GRAVEL (SC); yellowish brown; moist; rounded GRAVEL, max. 4 in. dia.; mostly coarse to fine SAND; some nonplastic fines.
REF	1.4		COBBLES; brown to gray; moist; mostly rounded GRAVEL, max. 6 in. dia.; some coarse to fine SAND; few nonplastic fines; hard drilling, rig chattered violently. No recovery.

Terminated at EL. 58.0'
12-10-13
Hammer Efficiency Ratio (ERi) = 86%

Blows	Recovery	Sample	Description
68	2.4	PP	Lean CLAY with SAND (CL); hard; gray; moist; little fine SAND; mostly high plasticity fines; PP=3 tsf.
86/10	1.4	M UW PP	Lean CLAY (CL); hard; gray to grayish brown; moist; few medium to fine SAND; mostly high plasticity fines; PP>4.5 tsf.
39	2.4	PP	Moist; fine SAND; high plasticity fines; PP>4.5 tsf.
86/8	1.4	PP	Moist to wet; fine SAND; high plasticity fines; pp>4 tsf.
25	2.4	M	SILT (ML); very stiff; gray and olive; moist; few medium to fine SAND; mostly low plasticity fines; PP>4.5 tsf.
REF	1.4		Rock fragments in shoe; fine grained; black; fresh; hard.

Terminated at EL. -84.16'
12-12-13
Hammer Efficiency Ratio (ERi) = 86%

ELEVATION (ft): -20, -30, -40, -50, -60, -70, -80, -90, -100, -110

ELEVATION (ft): +90, +80, +70, +60, +50, +40, +30, +20, +10, 0, -10, -20, -30, -40

10 8 6 4 2 0 — Friction Ratio (%)

100 200 300 400 500 — Tip Bearing (tsf)

Terminated at EL. -37.0'
05-27-11

STATIONING ALONG 'F' LINE

32+00 33+00 34+00 35+00 36+00 37+00

PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY	K. THANT	M. HOSHIYAMA/K. THANT FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	A. ZAND PROJECT ENGINEER	BRIDGE NO. 18C0142	5TH STREET BRIDGE OVER FEATHER RIVER
SIGN OFF DATE	CHECKED BY	T. MAR	DATE: 10/03/2016			POST MILES LOCAL	LOG OF TEST BORINGS NO.1

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: xxxx
PROJECT NUMBER & PHASE: xxxx
CONTRACT NO.: xx-xxxx

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES | SHEET | OF

PROJECT ID:

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
03	SUT/YU	.	.		

REGISTERED ENGINEER — DATE XX-XX

PLANS APPROVAL DATE

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REGISTERED PROFESSIONAL ENGINEER AMIR G. ZAND NO. GE 3029 EXP. 06/30/17 GEOTECHNICAL STATE OF CALIFORNIA

EARTH MECHANICS, INC.
3541 INVESTMENT BLVD, SUITE #4
HAYWARD, CA 94545

BENCHMARK

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2010)

(2) 2.4" samples were taken using a California Modified Sampler.

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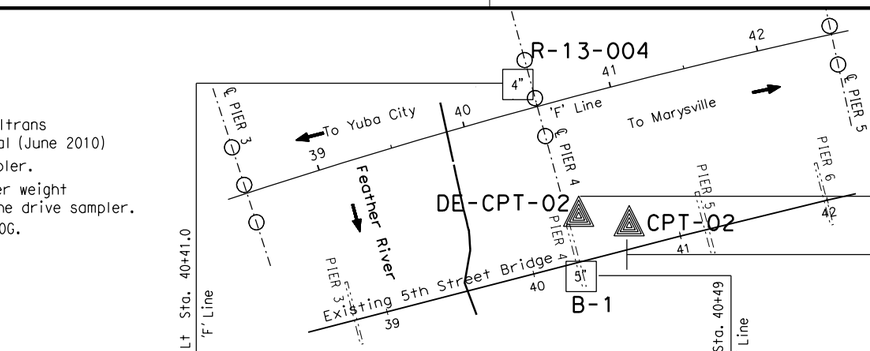
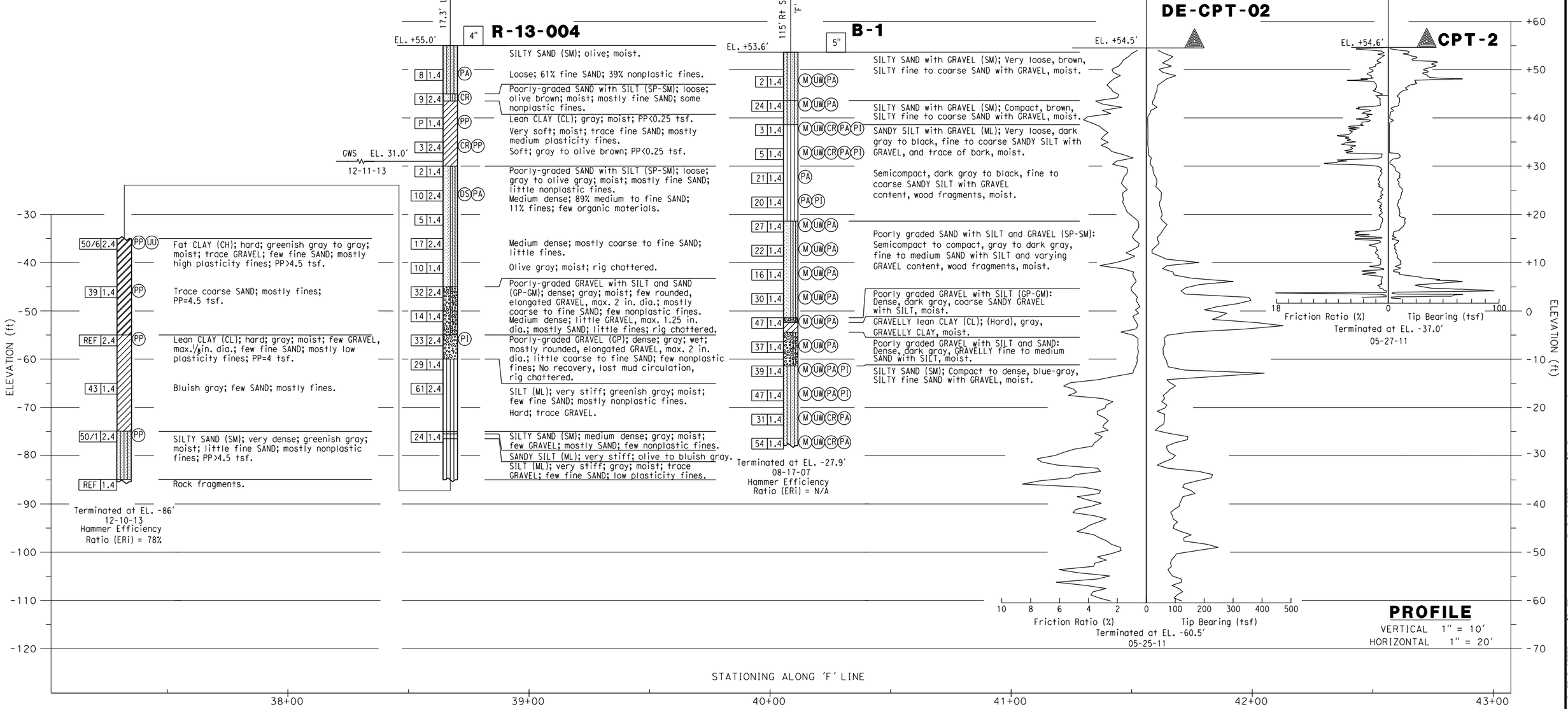
(4) For Soil Legend, see Caltrans Standard Plan A10F and A10G.





DESIGN OVERSIGHT	DRAWN BY	K. THANT	M. HOSHIYAMA/K. THANT — FIELD INVESTIGATION BY:
SIGN OFF DATE	CHECKED BY	T. MAR	DATE: 10/03/2016

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

A. ZAND — PROJECT ENGINEER

BRIDGE NO. 18C0142 — POST MILES LOCAL

5TH STREET BRIDGE OVER FEATHER RIVER
LOG OF TEST BORINGS NO.2

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: XXXX
PROJECT NUMBER & PHASE: XXXX
CONTRACT NO.: XX-XXXX

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES — SHEET — OF

PROJECT ID:

FILE => $REQUEST

USERNAME => $USER — DATE PLOTTED => $DATE — TIME PLOTTED => $TIME

BENCHMARK

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
03	SUT/YU	.	.		

REGISTERED ENGINEER — DATE XX-XX

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER AMIR G. ZAND NO. GE 3029 EXP. 06/30/17 GEOTECHNICAL STATE OF CALIFORNIA

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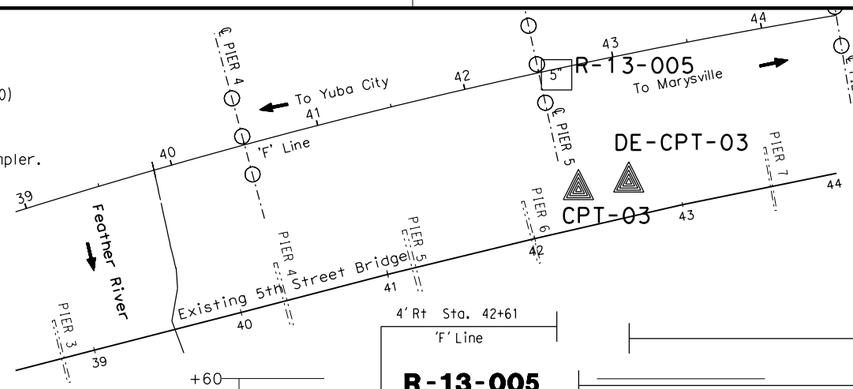
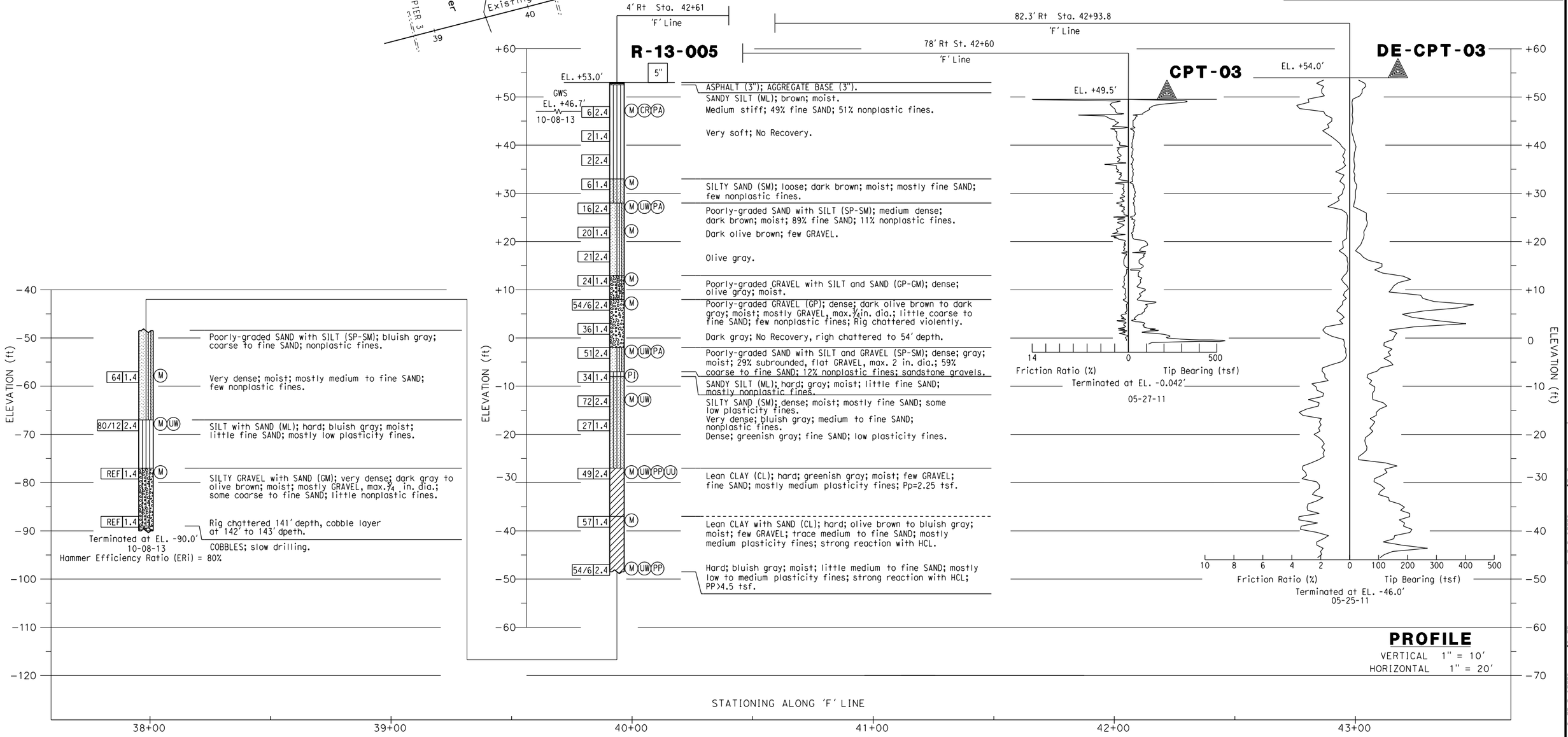
3541 INVESTMENT BLVD, SUITE #4
HAYWARD, CA 94545



PLAN
1" = 50'



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY K. THANT	M. HOSHIYAMA/K. THANT FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	A. ZAND PROJECT ENGINEER	BRIDGE NO. 18C0142
SIGN OFF DATE	CHECKED BY T. MAR	DATE: 10/03/2016			POST MILES LOCAL

5TH STREET BRIDGE OVER FEATHER RIVER

LOG OF TEST BORINGS NO.3

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: XXXX
PROJECT NUMBER & PHASE: XXXX
CONTRACT NO.: XX-XXXX

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES | SHEET | OF

PROJECT ID:

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

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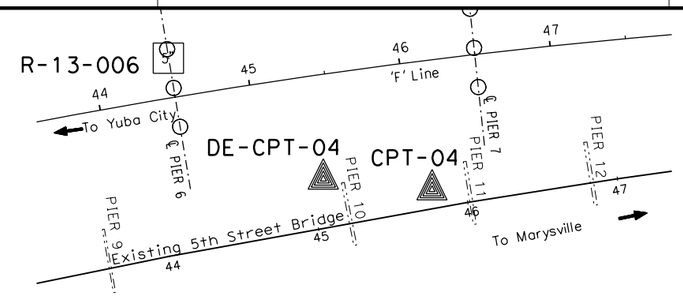

PLAN
1" = 50'

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
03	SUT/YU	.	.		

Amir G Zand
REGISTERED ENGINEER
XX-XX
DATE

PLANS APPROVAL DATE

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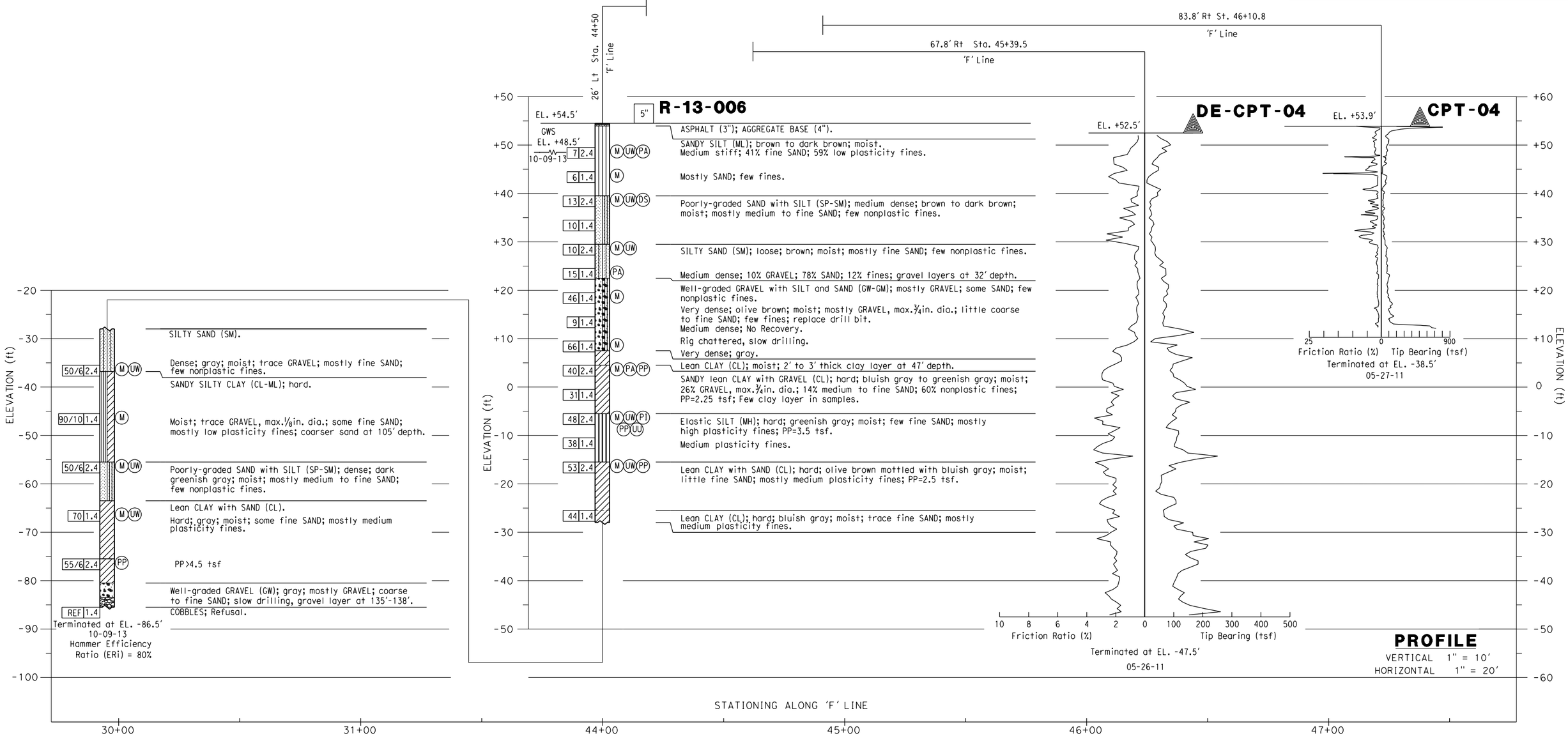
EARTH MECHANICS, INC.
3541 INVESTMENT BLVD, SUITE #4
HAYWARD, CA 94545



PROFILE
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HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY	K. THANT	M. HOSHIYAMA/K. THANT FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	A. ZAND PROJECT ENGINEER	BRIDGE NO. 18C0142	5TH STREET BRIDGE OVER FEATHER RIVER
SIGN OFF DATE	CHECKED BY	T. MAR	DATE: 10/03/2016			POST MILES LOCAL	LOG OF TEST BORINGS NO.4

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: xxxx
PROJECT NUMBER & PHASE: xxxx
CONTRACT NO.: xx-xxxx

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES | SHEET | OF

PROJECT ID:

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

BENCHMARK

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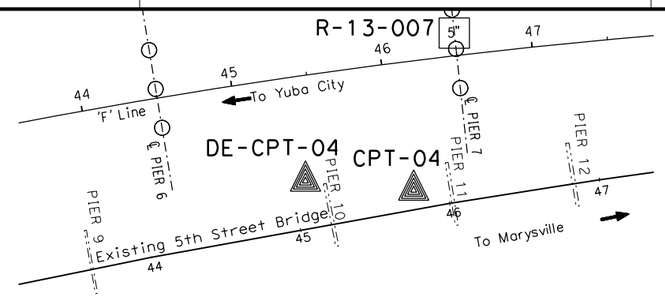

PLAN
1" = 50'

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
03	SUT/YU	.	.		

Amir G Zand
REGISTERED ENGINEER
XX-XX
DATE

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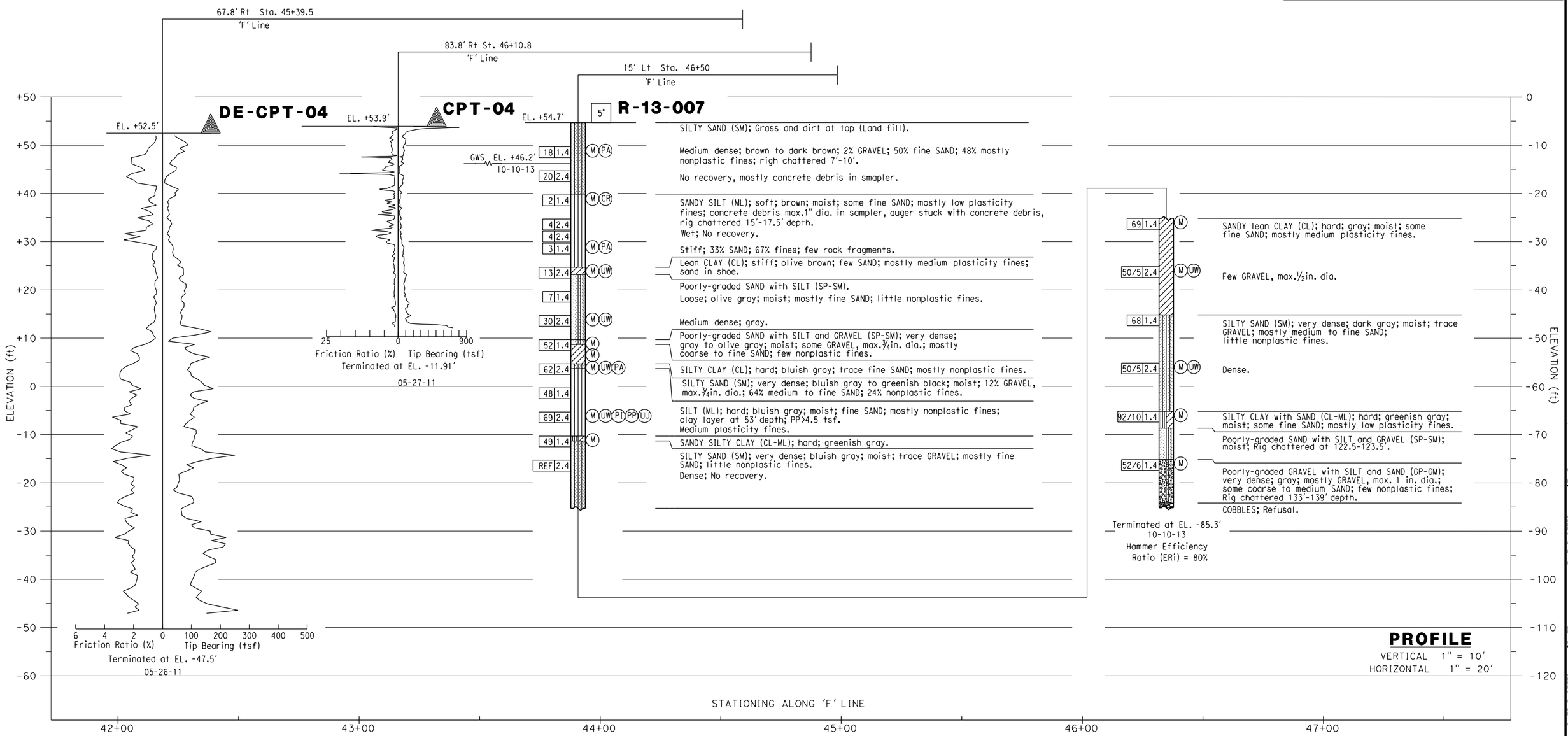
EARTH MECHANICS, INC.
3541 INVESTMENT BLVD, SUITE #4
HAYWARD, CA 94545



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY	K. THANT	M. HOSHIYAMA/K. THANT FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	A. ZAND PROJECT ENGINEER
SIGN OFF DATE	CHECKED BY	T. MAR	DATE: 10/03/2016		

BRIDGE NO. 18C0142
POST MILES LOCAL

5TH STREET BRIDGE OVER FEATHER RIVER
LOG OF TEST BORINGS NO.5

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: XXXX
PROJECT NUMBER & PHASE: XXXX
CONTRACT NO.: XX-XXXX

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES | SHEET | OF

PROJECT ID:

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

BENCHMARK

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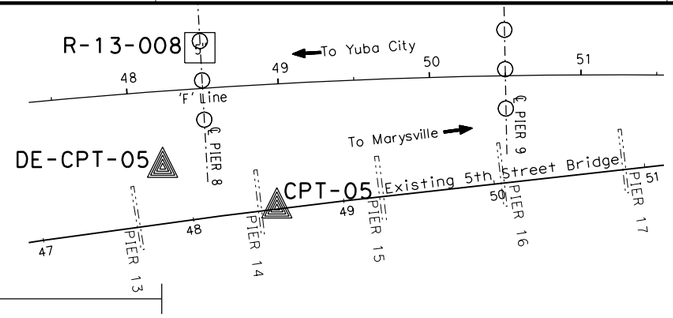

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
03	SUT/YU	.	.	====	====

REGISTERED ENGINEER — DATE XX-XX

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER AMIR G. ZAND NO. GE 3029 EXP. 06/30/17 GEOTECHNICAL STATE OF CALIFORNIA

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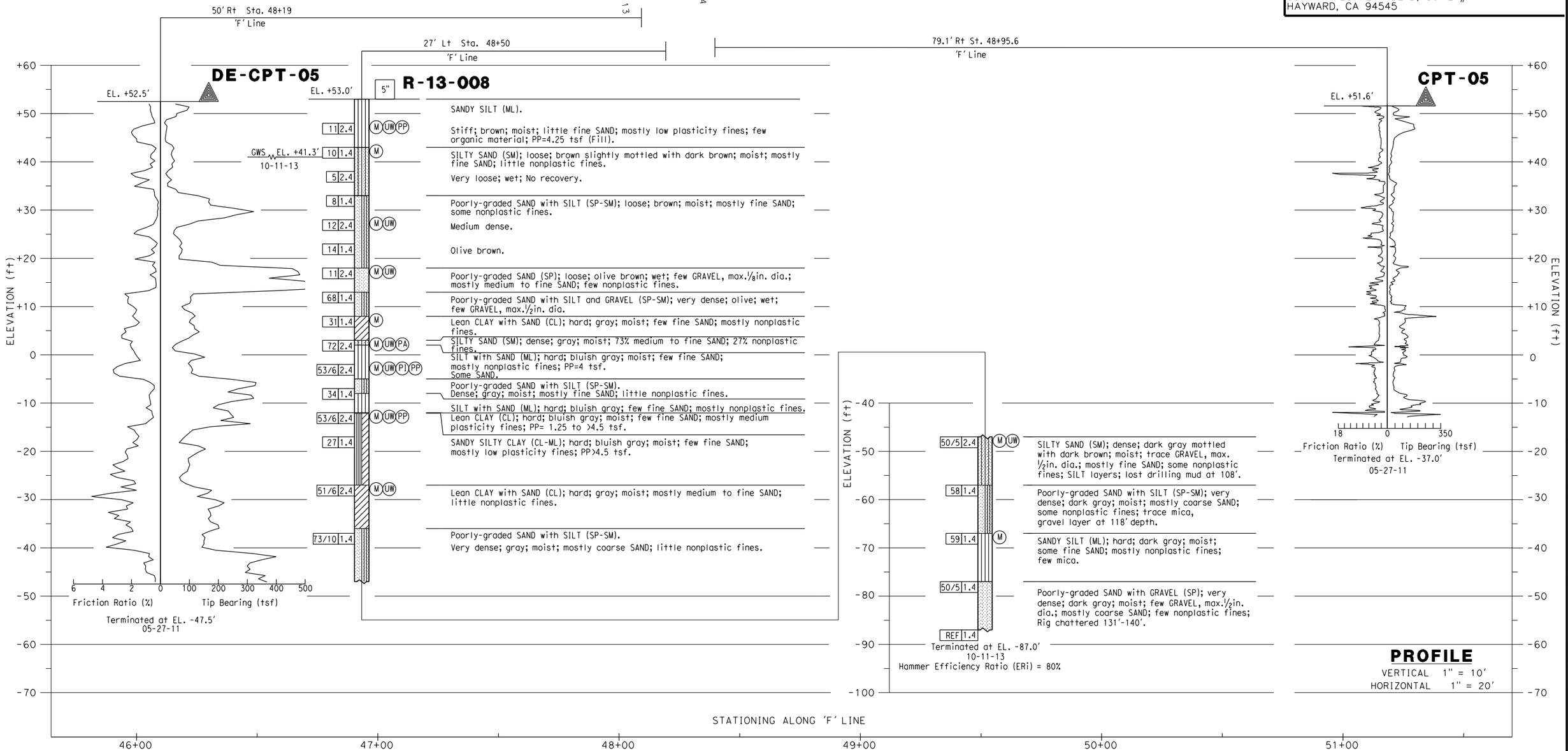
HAYWARD, CA 94545

PLAN
1" = 50'



DESIGN OVERSIGHT	DRAWN BY	K. THANT	M. HOSHIYAMA/K. THANT FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	A. ZAND PROJECT ENGINEER
SIGN OFF DATE	CHECKED BY	T. MAR	DATE: 10/03/2016		

BRIDGE NO. 18C0142 — POST MILES LOCAL

5TH STREET BRIDGE OVER FEATHER RIVER
LOG OF TEST BORINGS NO.6

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: xxxx
PROJECT NUMBER & PHASE: xxxx
CONTRACT NO.: xx-xxxx

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES — SHEET — OF

PROJECT ID:

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

BENCHMARK

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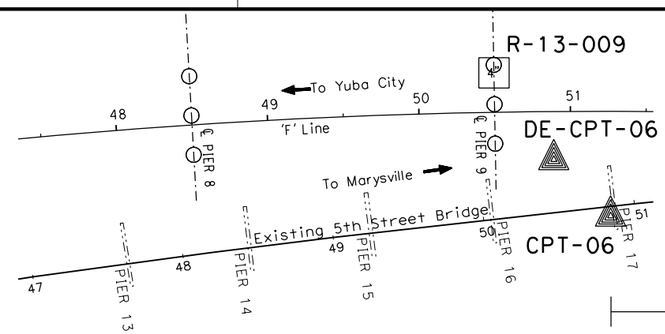

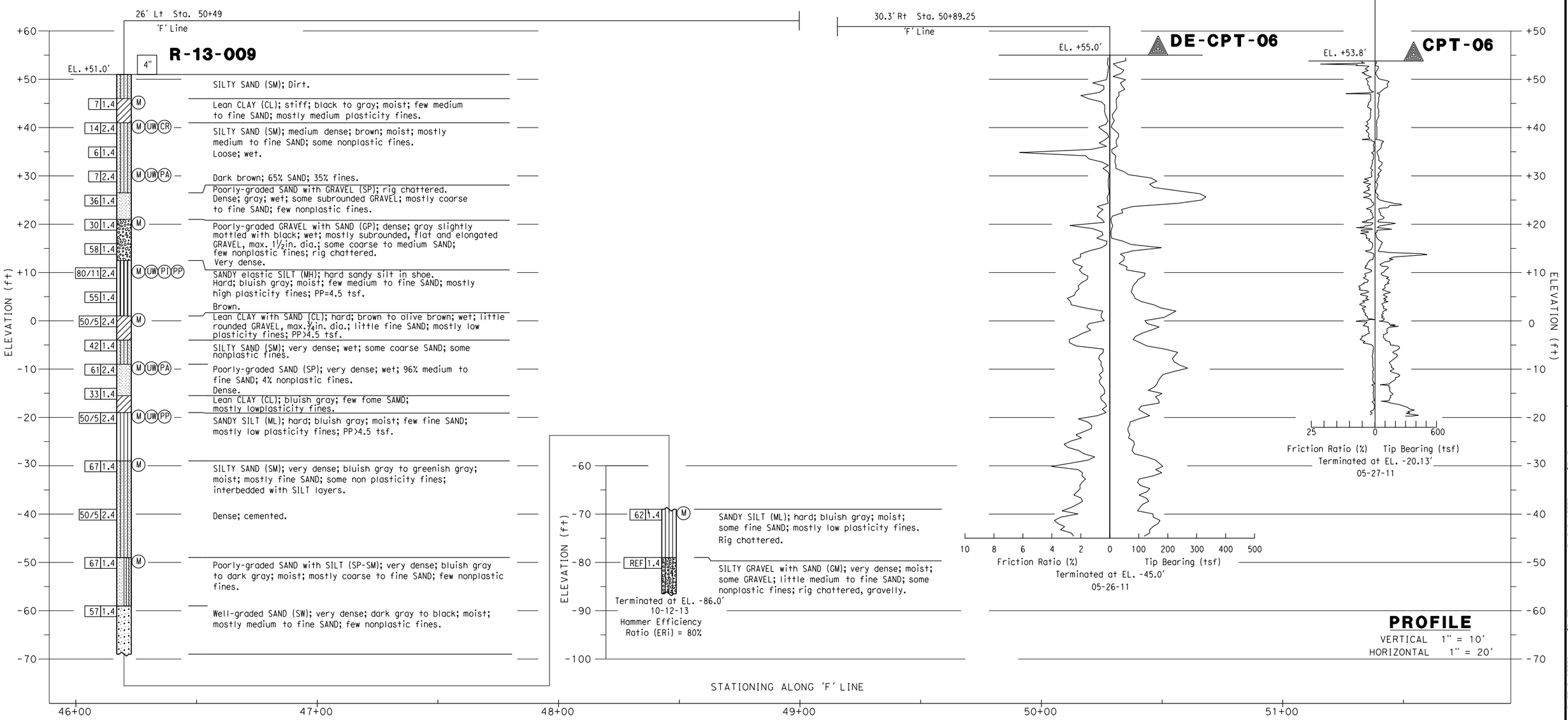

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
03	SUT/YU	.	.		

Amir G Zand — REGISTERED ENGINEER — DATE xx-xx

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REGISTERED PROFESSIONAL ENGINEER AMIR G. ZAND NO. GE 3029 EXP. 06/30/17 GEOTECHNICAL STATE OF CALIFORNIA

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EARTH MECHANICS, INC.
3541 INVESTMENT BLVD, SUITE #4
HAYWARD, CA 94545

DESIGN OVERSIGHT	DRAWN BY	K. THANT	M. HOSHIYAMA/K. THANT FIELD INVESTIGATION BY:
SIGN OFF DATE	CHECKED BY	T. MAR	DATE: 10/03/2016

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

A. ZAND — PROJECT ENGINEER

BRIDGE NO. 18C0142 — POST MILES LOCAL

5TH STREET BRIDGE OVER FEATHER RIVER
LOG OF TEST BORINGS NO.7

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: xxxx
PROJECT NUMBER & PHASE: xxxx
CONTRACT NO.: xx-xxxx

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES — SHEET — OF

PROJECT ID:

FILE => $REQUEST

USERNAME => $USER — DATE PLOTTED => $DATE — TIME PLOTTED => $TIME

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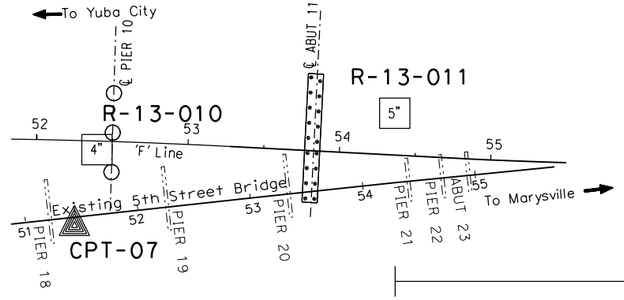

PLAN

1" = 50'

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
03	SUT/YU	.	.	====	====

Amir G Zand — REGISTERED ENGINEER — DATE XX-XX

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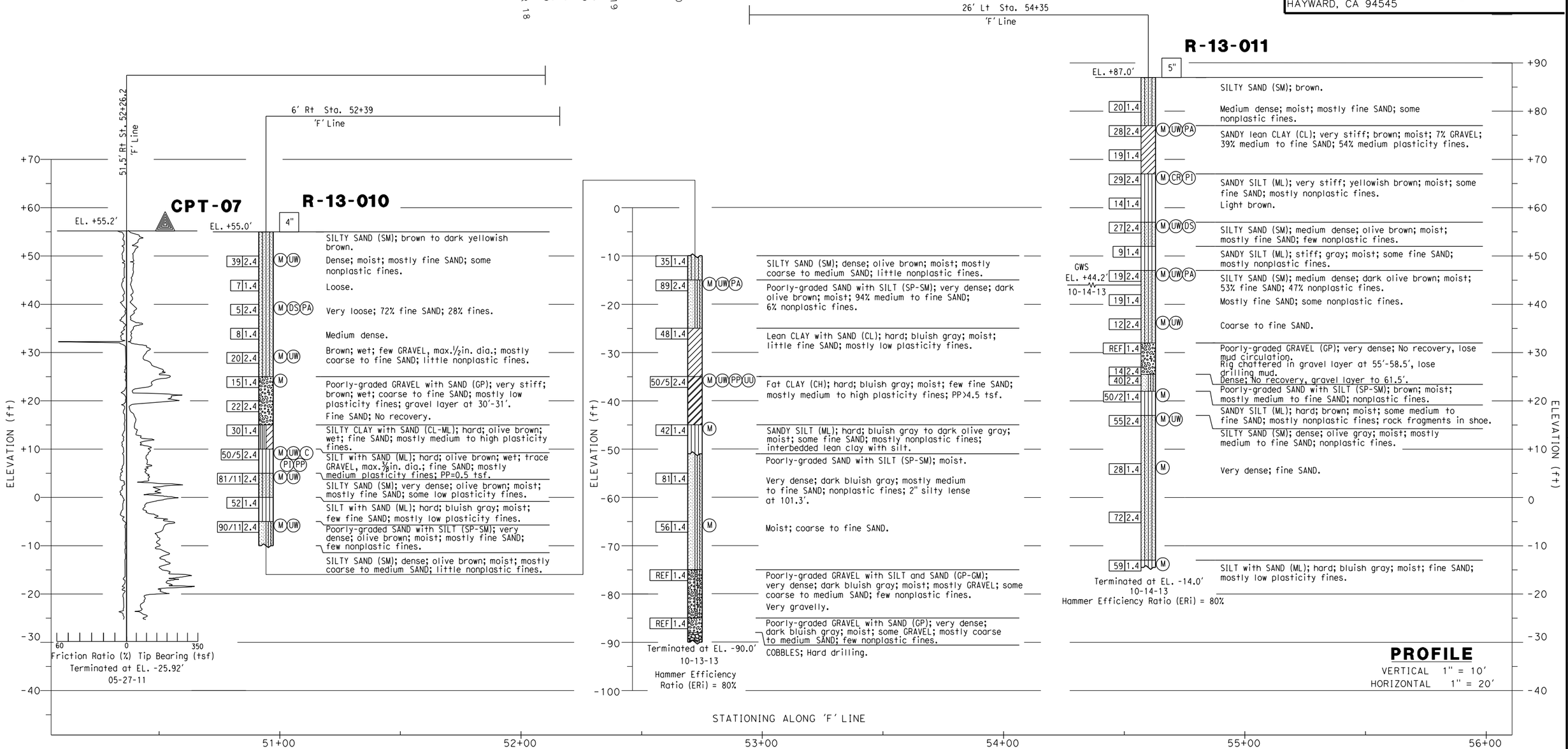

PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY	K. THANT	M. HOSHIYAMA/K. THANT FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	A. ZAND PROJECT ENGINEER	BRIDGE NO. 18C0142 / POST MILES LOCAL	5TH STREET BRIDGE OVER FEATHER RIVER
SIGN OFF DATE	CHECKED BY	T. MAR	DATE: 10/03/2016				LOG OF TEST BORINGS NO.8

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: XXXX
PROJECT NUMBER & PHASE: XXXX
CONTRACT NO.: XX-XXXX

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES | SHEET | OF

PROJECT ID:

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

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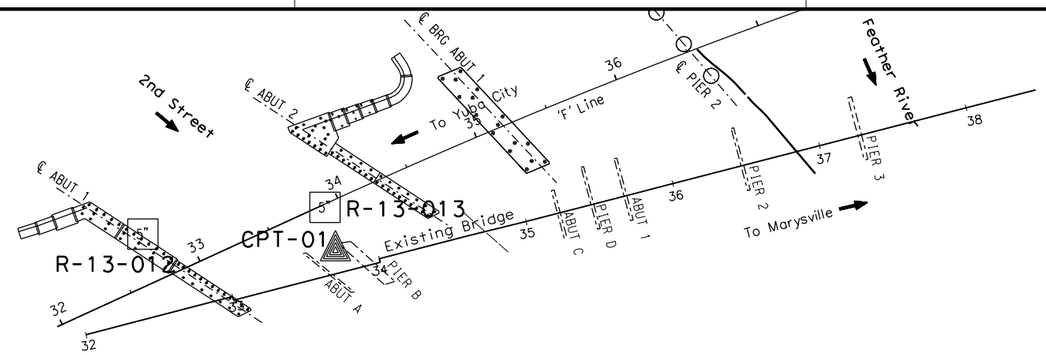

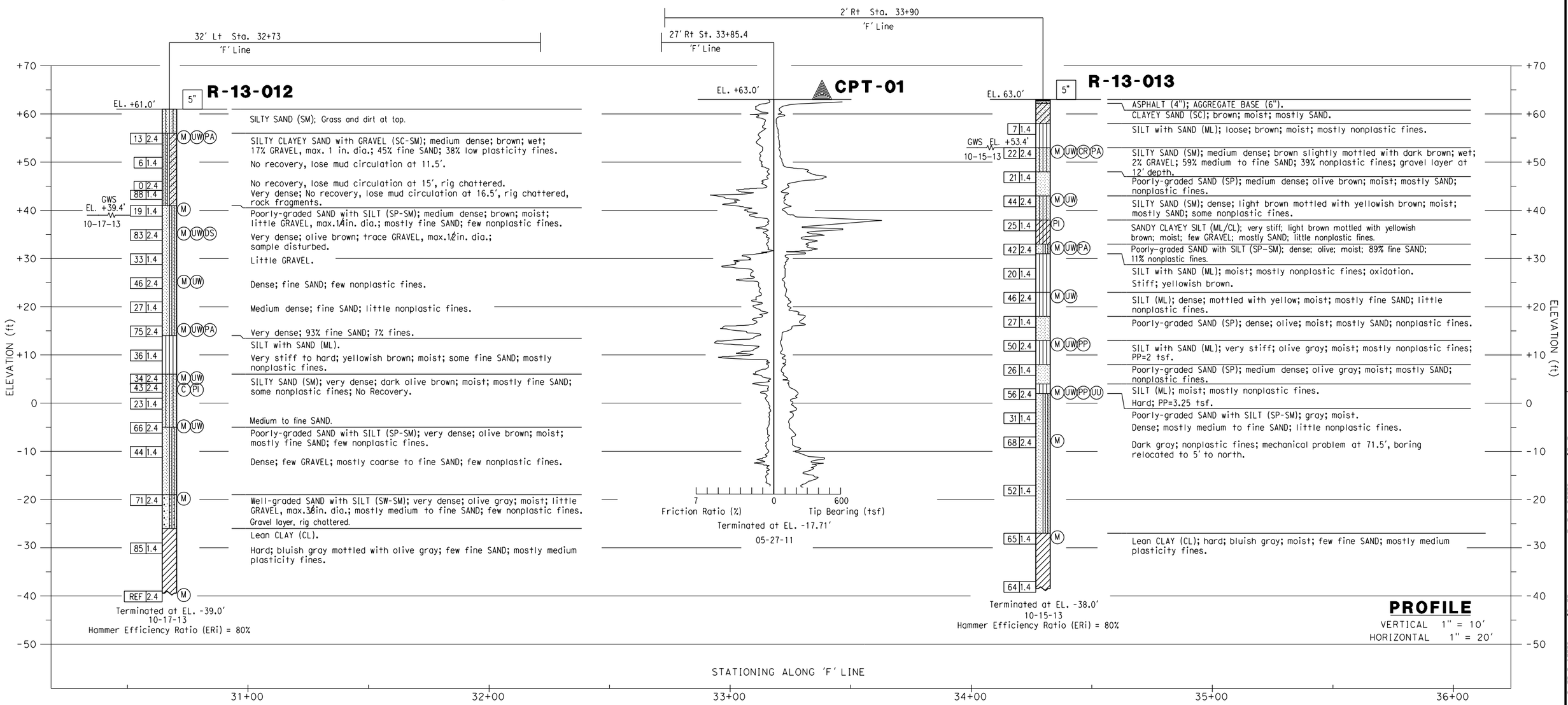

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
03	SUT/YU	.	.		

REGISTERED ENGINEER — DATE XX-XX

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REGISTERED PROFESSIONAL ENGINEER AMIR G. ZAND NO. GE 3029 EXP. 06/30/17 GEOTECHNICAL STATE OF CALIFORNIA

EARTH MECHANICS, INC.
3541 INVESTMENT BLVD, SUITE #4
HAYWARD, CA 94545

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY K. THANT

CHECKED BY T. MAR

M. HOSHIYAMA/K. THANT
FIELD INVESTIGATION BY:
DATE: 10/03/2016

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

A. ZAND
PROJECT ENGINEER

BRIDGE NO. 18C0143
POST MILES LOCAL

2ND STREET UNDERCROSSING
LOG OF TEST BORING NO.1

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: XXXX
PROJECT NUMBER & PHASE: XXXX
CONTRACT NO.: XX-XXXX

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
03	SUT/YU	.	.	====	====

Amir G Zand
REGISTERED ENGINEER

XX-XX
DATE

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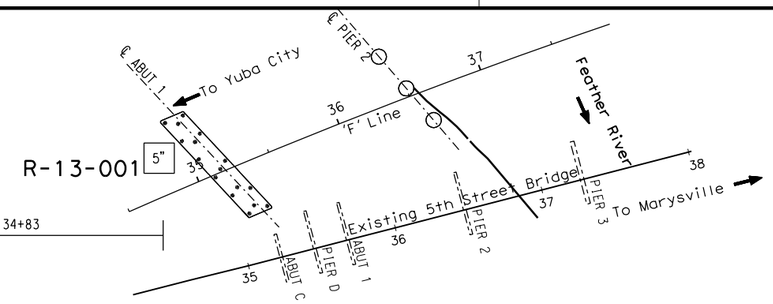

N
PLAN
1" = 50'

R-13-001

EL. +85.0'

5"

Blows	Moisture (%)	Sample	Description
			ASPHALT 3" thick.
26	2.4	M UW	CLAYEY SAND (SC); brown; moist; fine SAND; nonplastic fines. Medium dense; few GRAVEL, max.½in. dia.; mostly medium to fine SAND; some low plasticity fines.
4	1.4	M PA	CLAYEY SAND with GRAVEL (SC); very loose; moist; 16% GRAVEL, max.½in. dia.; 44% medium to fine SAND; 40% low plasticity fines; Sampled from shoe.
4	2.4	M UW DS	CLAYEY SAND (SC); very loose; moist; few GRAVEL, max.½in. dia.; mostly medium to fine SAND; some low plasticity fines.
3	1.4	M CR PI	SANDY lean CLAY (CL); soft; brown to dark yellowish brown; moist; some medium to fine SAND; mostly nonplastic fines.
4	2.4		No Recovery.
3	1.4	M C PA	CLAYEY SAND (SC); very loose; yellowish brown; moist; 3% GRAVEL; 51% medium to fine SAND; 46% low plasticity fines; lost mud circulation, boring relocated.
15	2.4	M UW	SILTY SAND (SM); medium dense; brown; moist; mostly medium to fine SAND; some nonplastic fines; lost mud circulation.
16	1.4	M	SANDY SILT (ML); very stiff; brown to dark yellowish brown; moist; some fine SAND; mostly low plasticity fines; lost mud circulation several times,
GWS EL. 41.2' 10-16-13	1	2.4	No Recovery.
	P	2.4	Wet; few GRAVEL; little fine SAND; mostly low plasticity fines; lost mud circulation.
18	1.4		
81/11	2.4	M UW PA PP	SANDY lean CLAY (CL); hard; olive brown mottled with dark yellowish brown; moist; few GRAVEL, max.¼in. dia.; 41% fine SAND; 59% medium plasticity fines; few mica; PP>4.5 tsf.
52	1.4	PP	Lean CLAY (CL); hard; light brown; moist; few fine SAND; mostly medium to high plasticity fines; PP=3 tsf.
24	2.4	M PP	SANDY lean CLAY (CL); very stiff; light brown to yellowish brown; moist; few fine SAND; mostly medium plasticity fines; PP=3 tsf.
31	1.4		Poorly-graded SAND with SILT (SP-SM); dense; gray to olive gray; moist; trace GRAVEL; mostly coarse to medium SAND; few medium plasticity fines; lost drilling mud.
27	2.4	M	Medium dense; light gray to gray; moist; mostly medium to fine SAND; few nonplastic fines.
66	1.4		Very dense; few GRAVEL; mostly coarse to fine SAND; few nonplastic fines; trace mica.
50	2.4		Dense; moist; mostly fine SAND; few nonplastic fines.
57	1.4	M UW PP	SANDY lean CLAY (CL); hard; gray; moist; few GRAVEL; mostly medium to fine SAND; some nonplastic fines; PP>4.5 tsf.

Blows	Moisture (%)	Sample	Description
68	2.4	PP	Lean CLAY with SAND (CL); hard; gray; moist; little fine SAND; mostly high plasticity fines; PP=3 tsf.
86/10	1.4	M UW PP	Lean CLAY (CL); hard; gray to grayish brown; moist; few medium to fine SAND; mostly high plasticity fines; PP>4.5 tsf.
39	2.4	PP	Moist; fine SAND; high plasticity fines; PP>4.5 tsf.
86/8	1.4	PP	Moist to wet; fine SAND; high plasticity fines; pp>4 tsf.
25	2.4	M	SILT (ML); very stiff; gray and olive; moist; few medium to fine SAND; mostly low plasticity fines; PP>4.5 tsf.
REF	1.4		Rock fragments in shoe; fine grained; black; fresh; hard.

Terminated at EL. -84.16'
12-12-13
Hammer Efficiency Ratio (ERi) = 86%

ELEVATION (ft): -20, -30, -40, -50, -60, -70, -80, -90, -100, -110

ELEVATION (ft): +90, +80, +70, +60, +50, +40, +30, +20, +10, 0, -10, -20, -30, -40

STATIONING ALONG PROPOSED 'F' LINE

32+00 33+00 34+00 35+00 36+00 37+00

PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY	K. THANT	M. HOSHIYAMA/K. THANT FIELD INVESTIGATION BY:
SIGN OFF DATE	CHECKED BY	T. MAR	DATE: 10/03/2016

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

A. ZAND
PROJECT ENGINEER

BRIDGE NO. 18C0143
POST MILES LOCAL

2ND STREET UNDERCROSSING
LOG OF TEST BORINGS NO.2

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: XXXX
PROJECT NUMBER & PHASE: XXXX
CONTRACT NO.: XX-XXXX

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES SHEET OF

PROJECT ID:

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

APPENDIX B

LABORATORY TEST RESULTS

DRAFT

TABLE A-1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : *13-121* **Project Name :** Dokken, 5th Street Bridge PSR PR

Boring No .	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (tsf)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resistivity CT-532 (ohm-cm)	Soil-pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
R-13-001	*D-1*	5	SC	17.7	137.2									
R-13-001	*S-2*	10	SC	39.5				16:44:40						
R-13-001	*D-3*	15	SC	39.9	107.2									
R-13-001	*S-4*	20	CL	46.1						42/28/13	1100	9.4	210	278
R-13-001	*S-6*	30	SC	52.1				3:51:46						
R-13-001	*D-7*	35	SM	15.4	130.3									
R-13-001	*S-8*	40	ML	37.6										
R-13-005	*D-1*	5	ML	26.1	109.1			0:49:51			6500	7.1	10	169
R-13-005	*S-4*	20	SM	30.0										
R-13-005	*D-5*	25	SP-SM	32.4	121.4			0:89:11						
R-13-005	*S-6*	30	SP-SM	28.2										
R-13-005	*S-8*	40	GP-GM	17.1										
R-13-005	*S-9*	45	GP	6.3										
R-13-005	*D-11*	55	SP-SM	17.9	128.2			29:59:12						
R-13-005	*S-12*	60	SC							47/29/18				
R-13-005	*D-13*	65	SM	27.5	123.1									
R-13-005	*D-15*	80	CL	50.9	103.1	2.25								
R-13-005	*S-16*	90	CL	32.7										
R-13-005	*D-17*	100	CL	36.6	116.6	>4.5								
R-13-005	*S-18*	110	SP-SM	21.5										
R-13-005	*D-19*	120	ML	36.4	116.1									
R-13-005	*S-20*	130	GM	12.8										
R-13-006	*D-1*	5	ML	26.2	114.9			0:41:59						
R-13-006	*S-2*	10	ML	24.5										
R-13-006	*D-3*	15	SP-SM	27.4	120.3									
R-13-006	*D-5*	25	SM	34.4	117.5									
R-13-006	*S-6*	30	SP-SM					10:78:12						
R-13-006	*S-7*	35	GW-GM	8.4										
R-13-006	*S-9*	45	GW-GM	4.8										
R-13-006	*D-10*	50	CL	33.1		2.25		26:14:60						
R-13-006	*D-12*	60	MH	46.1	111.4	3.5				61/32/9				
R-13-006	*D-14*	70	CL	44.1	113.2	2.5								
R-13-006	*D-16*	90	SM	31.6	121.6									
R-13-006	*S-17*	100	CL-ML	30.6										
R-13-006	*D-18*	110	SP-SM	26.0	126.7									
R-13-006	*D-20*	130	CL	33.9	116.2	>4.5								
R-13-007	*S-1*	5	SM	17.1				2:50:48						
R-13-007	*S-3*	15	ML	26.6							5100	7.7	30	241
R-13-007	*S-5*	25	ML	45.3				0:33:67						
R-13-007	*D-6*	30	CL	44.0	114.6									

TABLE A-1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : *13-121* **Project Name :** Dokken, 5th Street Bridge PSR PR

Boring No .	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (tsf)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resistivity CT-532 (ohm-cm)	Soil-pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
R-13-007	*D-8*	40	SP-SM	14.4	130.5									
R-13-007	*S-9-1*	45	SP-SM	7.4										
R-13-007	*S-9-2*	46	CL	40.4										
R-13-007	*D-10*	50	SM	33.4	120.3			12:64:24						
R-13-007	*D-12*	60	ML	41.4	112.7	>4.5				46/28/18				
R-13-007	*S-13*	65	CL-ML	33.3										
R-13-007	*S-15*	80	CL	36.1										
R-13-007	*D-16*	90	CL	32.1	119.2									
R-13-007	*D-18*	110	SM	19.2	132.5									
R-13-007	*S-19*	120	CL-ML	36.4										
R-13-007	*S-20*	130	GP-GM	12.1										
R-13-008	*D-1*	5	ML	18.6	116.4	4.25								
R-13-008	*S-2*	10	SM	22.1										
R-13-008	*D-5*	25	SP-SM	33.9	118.8									
R-13-008	*D-7*	35	SP	24.2	122.6									
R-13-008	*S-9*	45	CL	50.3										
R-13-008	*D-10*	50	SM	33.4	114.5			0:73:27						
R-13-008	*D-11*	55	ML	44.7	110.7	4.0				44/28/16				
R-13-008	*D-13*	65	CL to CL-ML	28.8	124.4	1.25 to >4.5								
R-13-008	*D-15*	80	CL	43.9	108.0									
R-13-008	*D-17*	100	SM	28.5	117.9									
R-13-008	*S-19*	120	ML	29.8										
R-13-009	*S-1*	5	CL	36.3										
R-13-009	*D-2*	10	SM	16.8	122.4						7700	7.2	30	102
R-13-009	*D-4*	20	SM	22.4	128.0			0:65:35						
R-13-009	*S-6*	30	GP	5.0										
R-13-009	*D-8*	40	MH	29.6	119.2	4.5				51/29/22				
R-13-009	*D-10*	50	CL	33.8										
R-13-009	*D-12*	60	SP	26.9	126.2			0:96:4						
R-13-009	*D-14*	70	ML	21.5	132.5	>4.5								
R-13-009	*S-15*	80	SM	35.9										
R-13-009	*S-17*	100	SP-SM	18.0										
R-13-009	*S-19*	120	ML	31.8										
R-13-010	*D-1*	5	SM	6.6	130.2									
R-13-010	*D-3*	15	SM	15.9				0:72:28						
R-13-010	*D-5*	25	SM	15.2	137.7									
R-13-010	*S-6*	30	GP	5.3										
R-13-010	*D-9*	45	ML	44.8	109.4	0.5				39/26/13				
R-13-010	*D-10*	50	SM	38.2	113.9									
R-13-010	*D-12*	60	SP-SM	18.9	130.4									

TABLE A-1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : *13-121* **Project Name :** Dokken, 5th Street Bridge PSR PR

Boring No .	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (tsf)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resistivity CT-532 (ohm-cm)	Soil-pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
R-13-010	*D-14*	70	SP-SM	23.0	126.5			0:94:6						
R-13-010	*D-16*	90	CH	33.7	114.4	>4.5								
R-13-010	*S-17*	100	ML	41.2										
R-13-010	*S-19*	120	SP-SM	20.3										
R-13-011	*D-2*	10	CL	17.5	129.0			7:39:54						
R-13-011	*D-4*	20	ML	16.9						N.P.	4700	7.8	30	162
R-13-011	*D-6*	30	SM	15.2	129.0									
R-13-011	*D-8*	40	SM	17.5	130.6			0:53:47						
R-13-011	*D-10*	50	SM	20.3	134.0									
R-13-011	*S-13*	65	ML	27.8										
R-13-011	*D-14*	70	SM	24.9	127.5									
R-13-011	*S-15*	80	SM	26.9										
R-13-011	*S-17*	100	ML	31.7										
R-13-012	*D-1*	5	SC-SM	15.3	139.3			17:45:38						
R-13-012	*S-4*	20	SP-SM	22.0										
R-13-012	*D-5*	25	SP-SM	15.4	136.0									
R-13-012	*D-7*	35	SP-SM	25.9	125.9									
R-13-012	*D-9*	45	SP-SM	22.1	127.6			0:93:7						
R-13-012	*D-11*	55	SM	33.7	120.5					N.P.				
R-13-012	*D-13*	65	SM to SP-SM	21.8	129.0									
R-13-012	*S-15*	80	SW-SM	14.3										
R-13-012	*S-17*	100	CL	29.4										
R-13-013	*D-2*	10	SM	12.2	122.5			2:59:39						
R-13-013	*D-4*	20	SM	11.1	119.3						600	7.4	30	114
R-13-013	*S-5*	25	ML							28/28/0				
R-13-013	*D-6*	30	SP-SM	27.0	122.2			0:89:11						
R-13-013	*D-8*	40	SM	27.5	121.1									
R-13-013	*D-10*	50	ML	35.1	111.6	2.0								
R-13-013	*D-12*	60	ML	31.7	115.6	3.25								
R-13-013	*S-14*	70	SP-SM	22.2										
R-13-013	*S-16*	90	CL	24.0										

TABLE A-1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : *13-121* **Project Name :** Dokken, 5th Street Bridge PSR PR

Boring No .	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (tsf)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resistivity CT-532 (ohm-cm)	Soil-pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
R-13-001	*D-11*	55	CL	23.9	128.9	>4.5		0:41:59						
R-13-001	*D-13*	65	CL	37.6										
R-13-001	*S-15*	80	SP-SM	27.5										
R-13-001	*D-18*	110	CL	36.9	117.8	>4.5								
R-13-001	*D-20*	130	CL	34.8	119.6	>4.5								
R-13-001	*S-23*	160	ML	39.1										
R-13-004	*S-1*	5	SM	18.3				0:61:39						
R-13-004	*D-2*	10	SP-SM to CL	0.8	80.1						4400	7.8	30	136
R-13-004	*D-4*	20	CL	56.3	102.2						3100	7.3	30	126
R-13-004	*S-5*	25	SP-SM	28.5										
R-13-004	*D-6*	30	SP-SM	36.5	115.6			0:89:11						
R-13-004	*D-8*	40	SP-SM	28.2	118.8									
R-13-004	*D-10*	50	GP-GM	9.1	144.1									
R-13-004	*D-12*	60	GP	1.5						N.P.				
R-13-004	*S-15-1*	80	SM	25.6										
R-13-004	*S-15-2*	80.5	ML	34.5										
R-13-004	*D-16*	90	CH	34.2	120.9	>4.5								
R-13-004	*D-18*	110	CL	37.7	120.9									
R-13-004	*D-20*	130	SM	31.1	116.2									

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

ASTM D2850

Project Name:	Dokken, 5th Street Bridge PSR PR			**Project No:**	13-121
Boring No.:	R-13-010	**Tested by:**	RJ	**Date:**	11/02/13
Depth (ft):	90	**Checked by:**		**Date:**	
Sample No.	D-16	**Sample Type:**	R		

Sample Description: Gray , CLAYSTONE (CH)

	1	2	3		
Diameter (in.):	2.42	2.42	2.42	Average:	2.420
Height (in.):	5.075	5.054	5.075	Average:	5.068

Moisture Content Calculation		
Wt. Wet Sample + Container (gms):		185.42
Wt. Dry Sample + Container (gms):		153.38
Container (gms)	No. 63	58.4
Moisture Content (%)		**33.7**

Density and Saturation	
Wt. Wet Sample + Container (gms)	916.82
Container (gms)	228.92
Wet Density (pcf)	**112.3**
Dry Density (pcf)	**84.0**
Void Ratio	**1.006**
% Saturation	**90.5**

Assume Gs=2.70

Test Data Filename:	13121B10D16.trx

SKETCH / PHOTO AFTER TEST:

PHOTO FILE NAME: est In Process\13-121 - Dokken, 5th Street Bridge PSR P

Shear	
Rate of Deformation (% strain / min) =	**1**
Confining Stress (ksf):	**7.18**

Failure Criterion: **criterion 1 is used**

1. the maximum deviator stress within 15% strain
2. the stress at 10% strain for no peak stress.

At Failure	
Deviator Stress (ksf)	**14.35**
Eff. Minor Principal Stress (ksf)=	**7.18**
Eff. Major Principal Stress (ksf)=	**21.54**
Axial Strain (%)=	**13.06**

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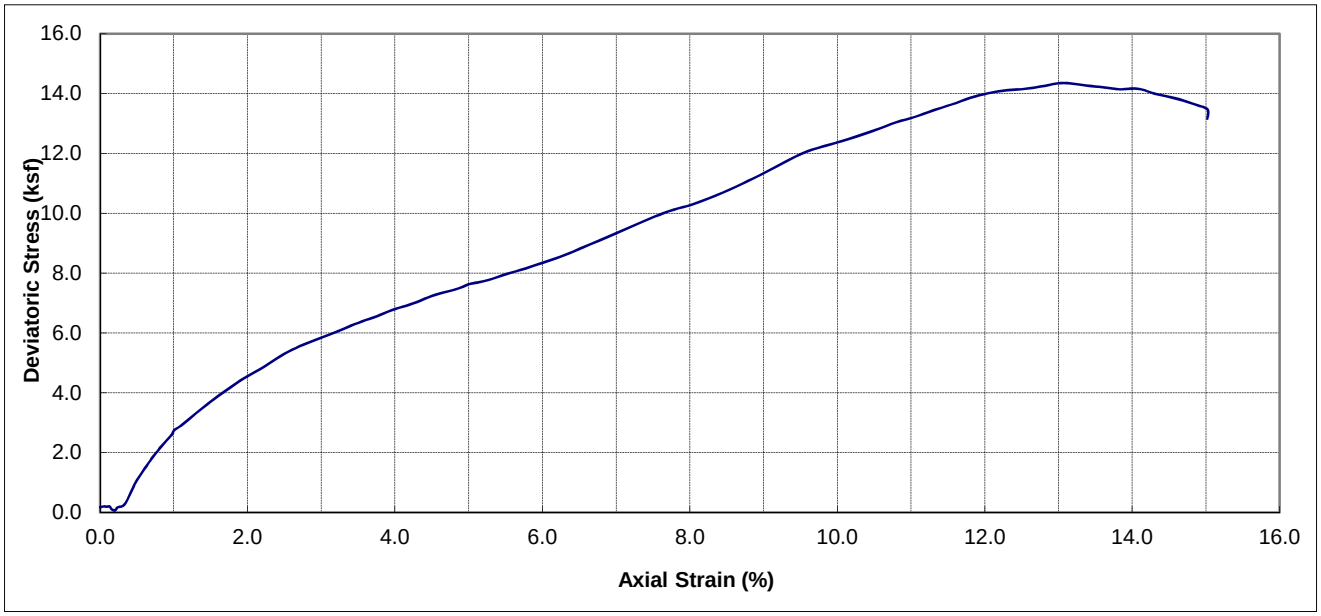

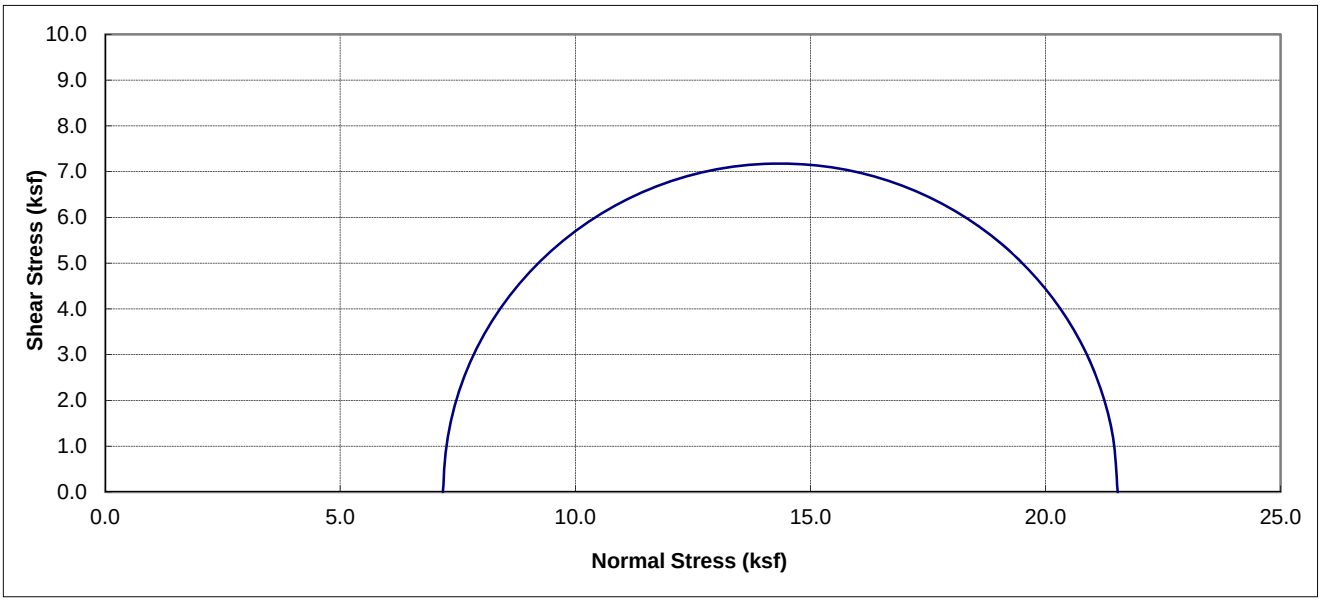

Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	10% Axial Strain Dev. Stress (ksf)	Initial Saturation (%)
R-13-010	D-16	90	Gray , CLAYSTONE (CH)	84.0	33.73	7.18	14.35	90.5

Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	**Dokken, 5th Street Bridge PSR PR**
	UNCONSOLIDATED UNDRAINED TEST
Project No. : 13-121 **Date :** 11/02/13	**(ASTM D2850)** **Figure No. :**

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

ASTM D2850

Project Name:	Dokken, 5th Street Bridge PSR PR			**Project No:**	13-1214
Boring No.:	R-13-005	**Tested by:**	RJ	**Date:**	11/02/13
Depth (ft):	80	**Checked by:**		**Date:**	
Sample No.	D-15	**Sample Type:**	R		
Sample Description:	Olive to Gray , LEAN CLAY (CL)				

	1	2	3		
Diameter (in.):	2.42	2.419	2.424	Average:	2.421
Height (in.):	5.054	5.030	5.054	Average:	5.046

Moisture Content Calculation		
Wt. Wet Sample + Container (gms):		183.45
Wt. Dry Sample + Container (gms):		141.32
Container (gms)	No. 60	58.52
Moisture Content (%)		**50.9**

Density and Saturation	
Wt. Wet Sample + Container (gms)	845.01
Container (gms)	228.92
Wet Density (pcf)	**101.2**
Dry Density (pcf)	**67.1**
Void Ratio	**1.512**
% Saturation	**90.9**

Assume Gs=2.70

Test Data Filename:	13121B5D15.xls

SKETCH / PHOTO AFTER TEST:

PHOTO FILE NAME: est In Process\13-121 - Dokken, 5th Street Bridge PSR P

Shear	
Rate of Deformation (% strain / min) =	**1**
Confining Stress (ksf):	**6.34**

Failure Criterion: **criterion 2 is used**

1. the maximum deviator stress within 15% strain
2. the stress at 10% strain for no peak stress.

At Failure	
Deviator Stress (ksf)	**6.53**
Eff. Minor Principal Stress (ksf)=	**6.34**
Eff. Major Principal Stress (ksf)=	**12.87**
Axial Strain (%)=	**10.04**

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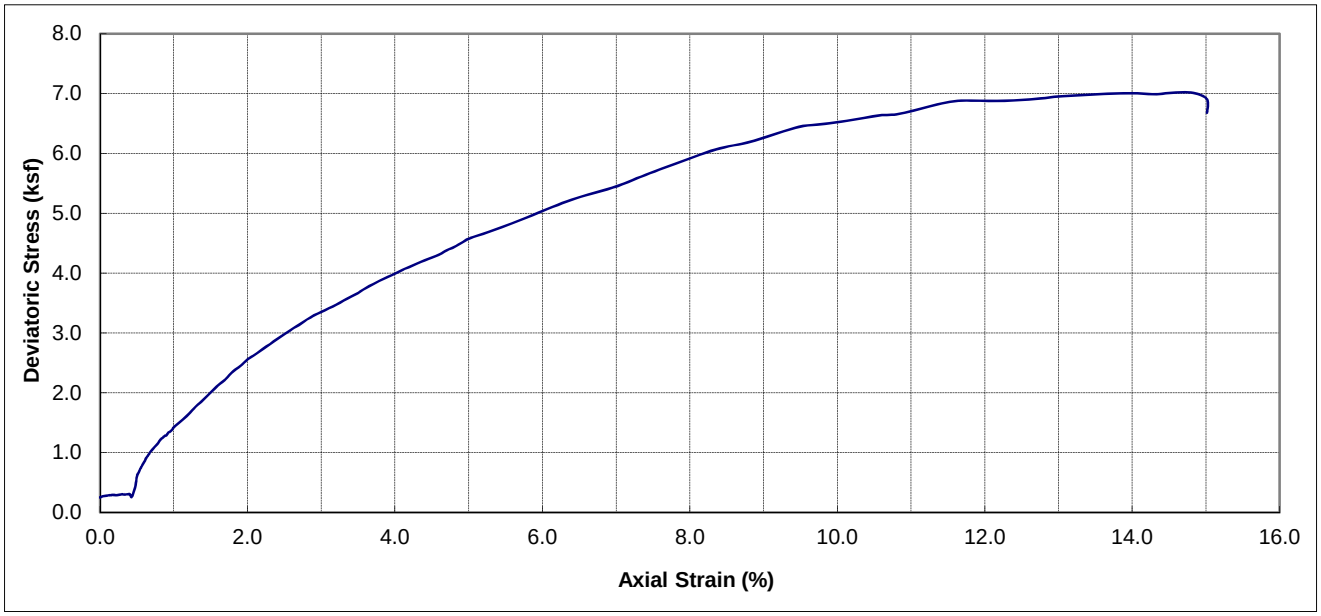

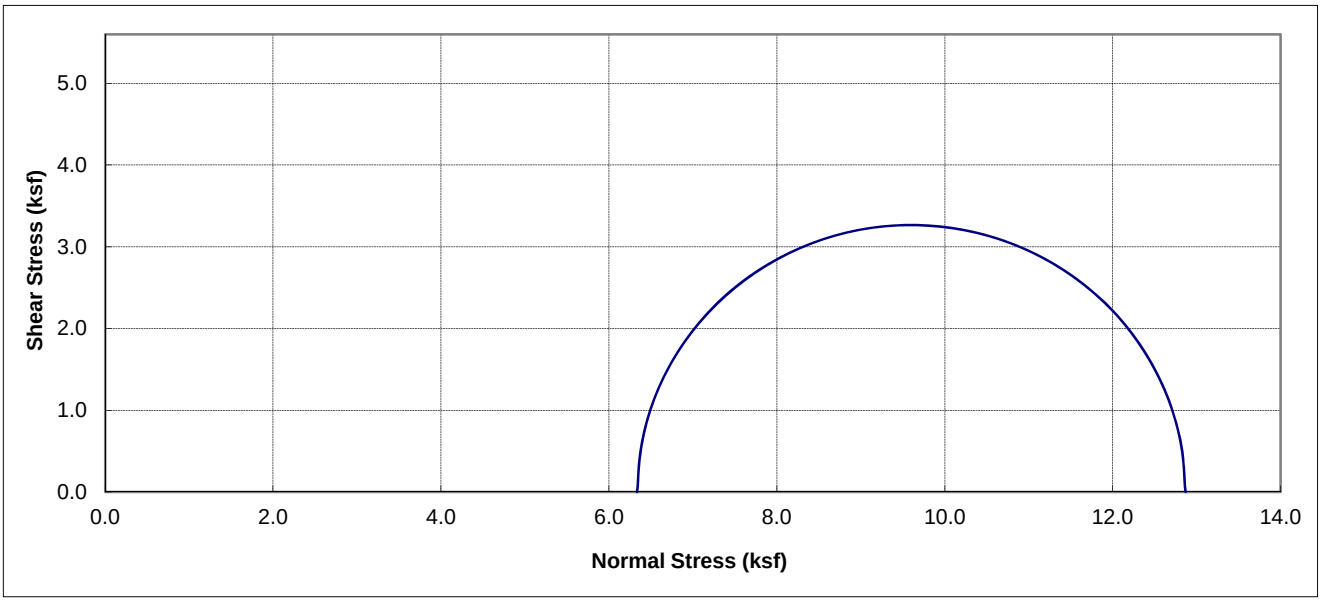

Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	10% Axial Strain Dev. Stress (ksf)	Initial Saturation (%)
R-13-005	D-15	80	Olive to Gray , LEAN CLAY (CL)	67.1	50.88	6.34	6.53	90.9

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Dokken, 5th Street Bridge PSR PR

UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 13-1214 | Date : 11/02/13 | Figure No. :

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

ASTM D2850

Project Name:	Dokken, 5th Street Bridge PSR PR			**Project No:**	13-1214
Boring No.:	R-13-006	**Tested by:**	RJ	**Date:**	11/02/13
Depth (ft):	60	**Checked by:**		**Date:**	
Sample No.	D-12	**Sample Type:**	R		

Sample Description: Gray , LEAN CLAY (CL)

	1	2	3		
Diameter (in.):	2.41	2.418	2.415	Average:	2.414
Height (in.):	5.082	5.077	5.072	Average:	5.077

Moisture Content Calculation		
Wt. Wet Sample + Container (gms):		193.75
Wt. Dry Sample + Container (gms):		151.22
Container (gms)	No. 61	58.96
Moisture Content (%)		**46.1**

Density and Saturation	
Wt. Wet Sample + Container (gms)	888.94
Container (gms)	228.92
Wet Density (pcf)	**108.1**
Dry Density (pcf)	**74.0**
Void Ratio	**1.277**
% Saturation	**97.5**

Assume Gs=2.70

Test Data Filename:	13121B6D12.trx

SKETCH / PHOTO AFTER TEST:

PHOTO FILE NAME: est In Process\13-121 - Dokken, 5th Street Bridge PSR P

Shear	
Rate of Deformation (% strain / min) =	**1**
Confining Stress (ksf):	**4.75**

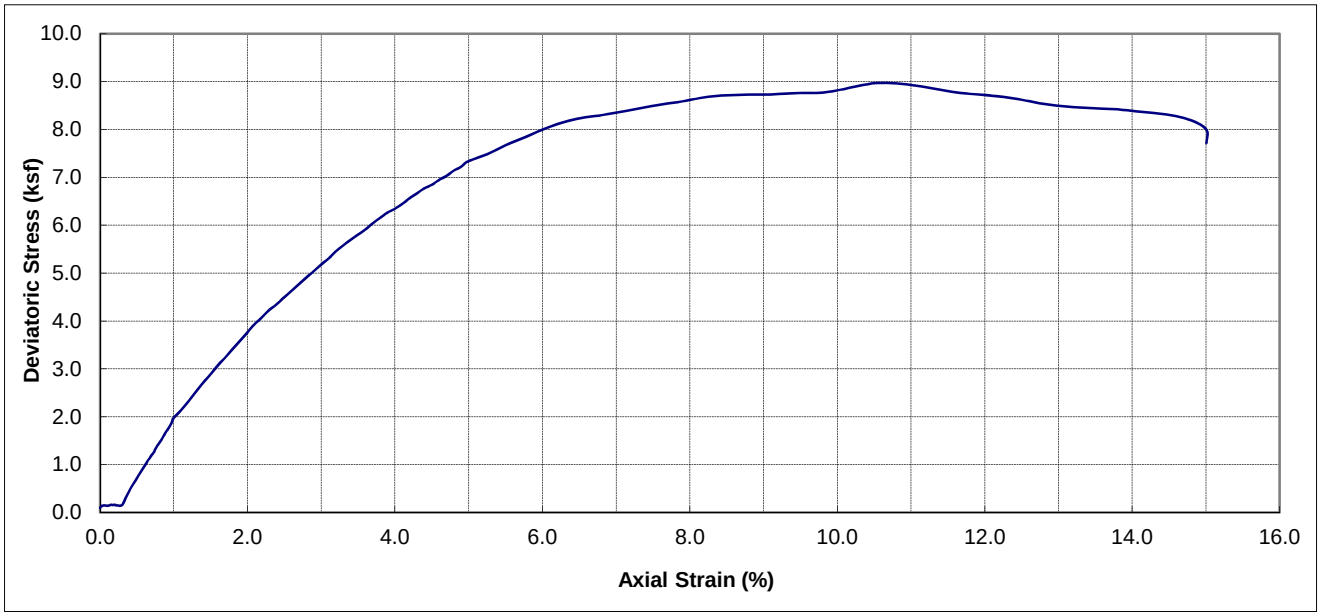
Failure Criterion: **criterion 1 is used**

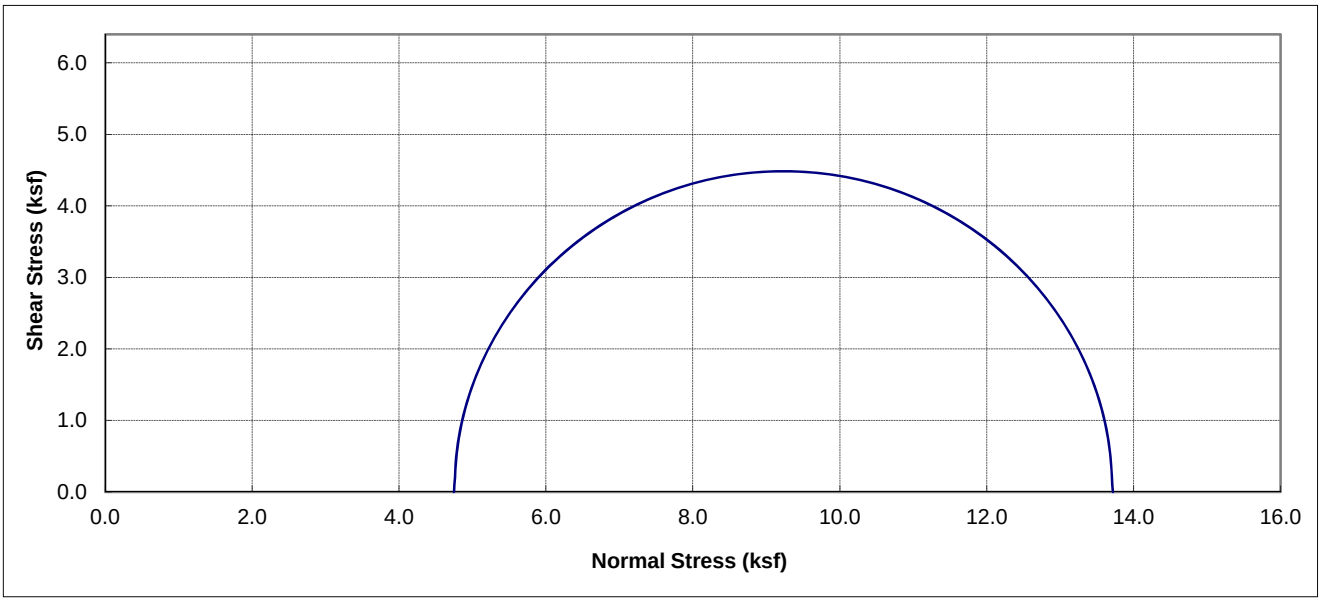
1. the maximum deviator stress within 15% strain
2. the stress at 10% strain for no peak stress.

At Failure	
Deviator Stress (ksf)	**8.97**
Eff. Minor Principal Stress (ksf)=	**4.75**
Eff. Major Principal Stress (ksf)=	**13.72**
Axial Strain (%)=	**10.53**

Earth Mechanics, Inc.

Geotechnical and Earthquake Engineering





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	10% Axial Strain Dev. Stress (ksf)	Initial Saturation (%)
R-13-006	D-12	60	Gray , LEAN CLAY (CL)	74.0	46.10	4.75	8.97	97.5

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

Dokken, 5th Street Bridge PSR PR

UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 13-1214 | Date : 11/02/13 | Figure No. :

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

ASTM D2850

Project Name:	Dokken, 5th Street Bridge PSR PR			**Project No:**	13-1214
Boring No.:	R-13-007	**Tested by:**	RJ	**Date:**	11/02/13
Depth (ft):	60	**Checked by:**		**Date:**	
Sample No.	D-12	**Sample Type:**	R		

Sample Description: Gray , LEAN CLAY (CL)

	1	2	3		
Diameter (in.):	2.42	2.425	2.419	Average:	2.421
Height (in.):	5.014	5.024	5.017	Average:	5.018

Moisture Content Calculation		
Wt. Wet Sample + Container (gms):		192.46
Wt. Dry Sample + Container (gms):		153.52
Container (gms)	No. 62	59.35
Moisture Content (%)		**41.4**

Density and Saturation	
Wt. Wet Sample + Container (gms)	905.69
Container (gms)	228.92
Wet Density (pcf)	**111.5**
Dry Density (pcf)	**78.9**
Void Ratio	**1.136**
% Saturation	**98.3**

Assume Gs=2.70

Test Data Filename:	13121B7D12.xls

SKETCH / PHOTO AFTER TEST:

PHOTO FILE NAME: est In Process\13-121 - Dokken, 5th Street Bridge PSR P

Shear	
Rate of Deformation (% strain / min) =	**1**
Confining Stress (ksf):	**4.75**

Failure Criterion: **criterion 2 is used**

1. the maximum deviator stress within 15% strain
2. the stress at 10% strain for no peak stress.

At Failure	
Deviator Stress (ksf)	**9.02**
Eff. Minor Principal Stress (ksf)=	**4.75**
Eff. Major Principal Stress (ksf)=	**13.78**
Axial Strain (%)=	**10.04**

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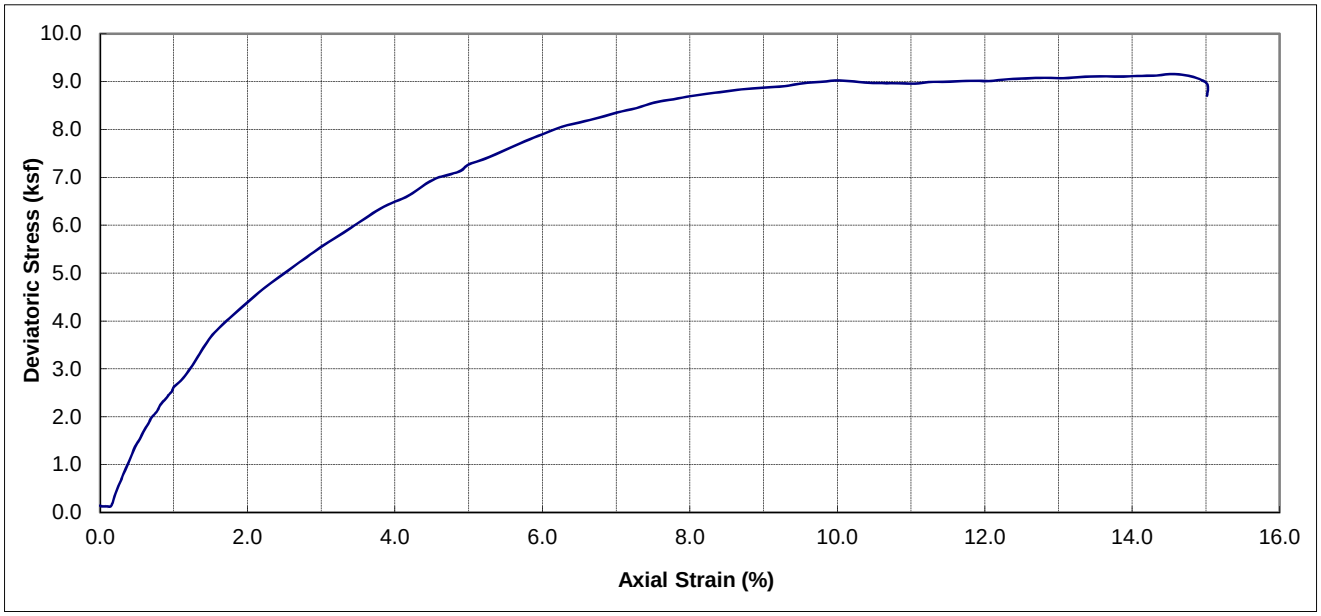

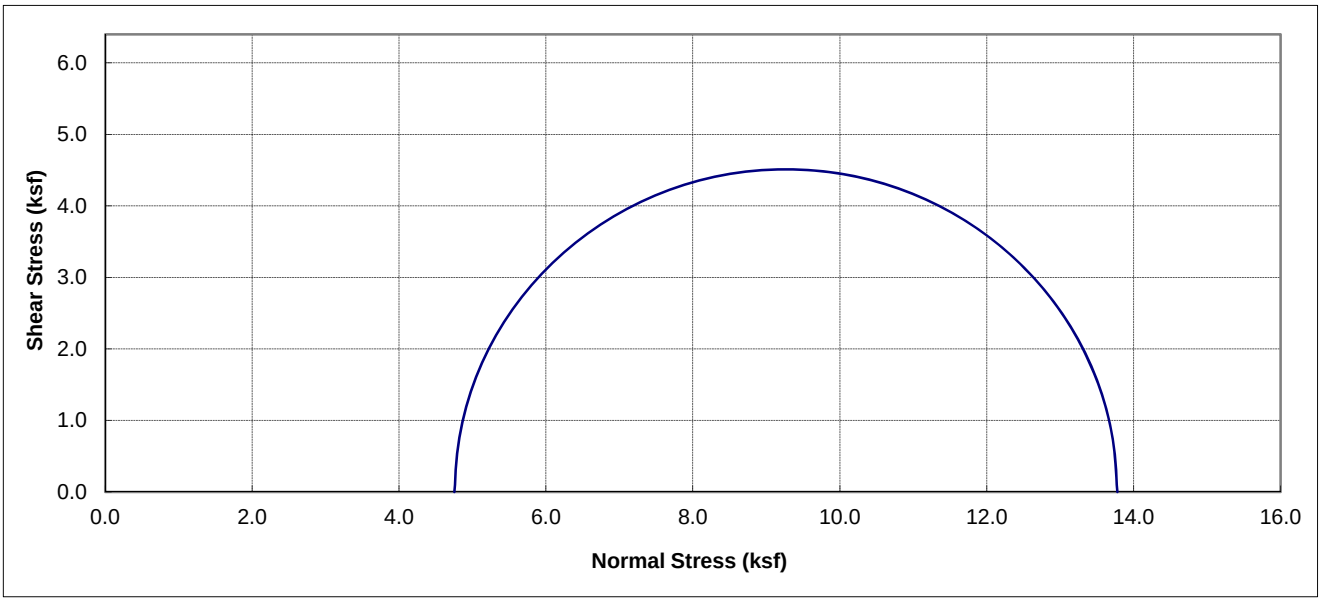

Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	10% Axial Strain Dev. Stress (ksf)	Initial Saturation (%)
R-13-007	D-12	60	Gray , LEAN CLAY (CL)	78.9	41.35	4.75	9.02	98.3

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Geotechnical and Earthquake Engineering

Dokken, 5th Street Bridge PSR PR

UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 13-1214 | Date : 11/02/13 | Figure No. :

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

ASTM D2850

Project Name:	Dokken, 5th Street Bridge PSR PR			**Project No:**	13-121
Boring No.:	R-13-004	**Tested by:**	RJ	**Date:**	01/02/14
Depth (ft):	90	**Checked by:**		**Date:**	
Sample No.	D-16	**Sample Type:**	R		
Sample Description:	Gray , CLAYSTONE (CH)				

	1	2	3		
Diameter (in.):	2.413	2.416	2.42	Average:	2.416
Height (in.):	5.037	5.038	5.060	Average:	5.045

Moisture Content Calculation		
Wt. Wet Sample + Container (gms):		191.96
Wt. Dry Sample + Container (gms):		157.75
Container (gms)	No. 9	57.66
Moisture Content (%)		**34.2**

Density and Saturation	
Wt. Wet Sample + Container (gms)	955.08
Container (gms)	228.92
Wet Density (pcf)	**119.5**
Dry Density (pcf)	**89.1**
Void Ratio	**0.892**
% Saturation	**103.5**

Assume Gs=2.70

Test Data Filename:	13121R4D16.trx

SKETCH / PHOTO AFTER TEST:

PHOTO FILE NAME: st In Process\13-121 - Dokken, 5th Street Bridge PSR P

Shear	
Rate of Deformation (% strain / min) =	**1**
Confining Stress (ksf):	**7.20**

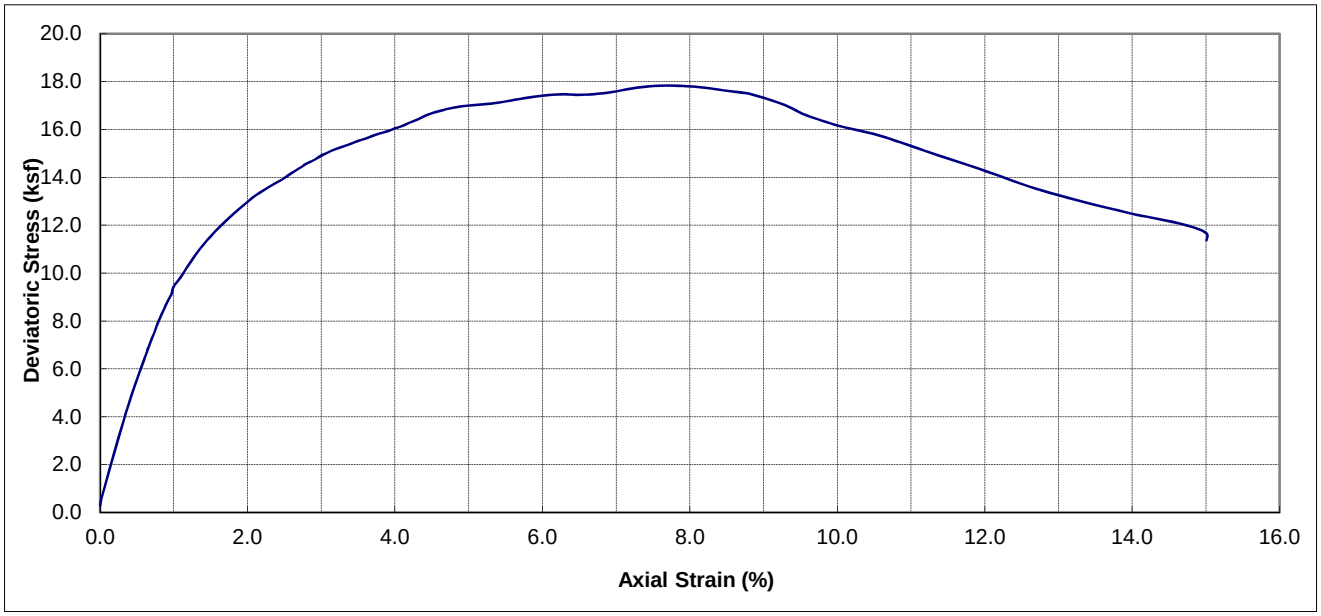
Failure Criterion: **criterion 1 is used**

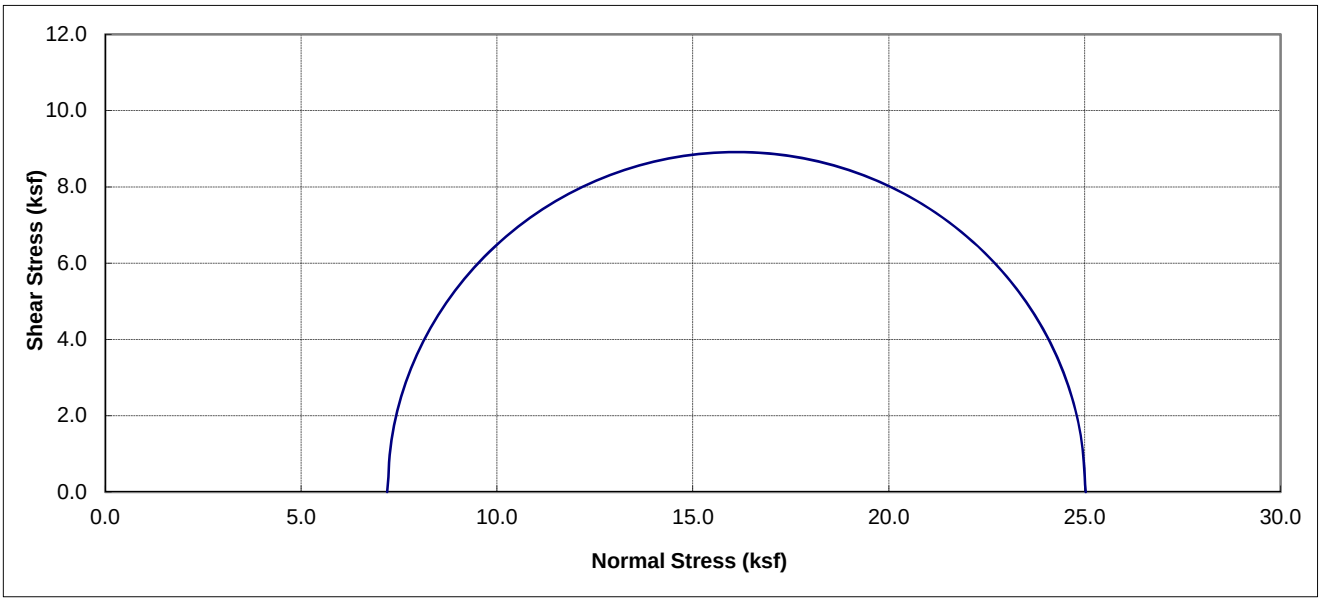
1. the maximum deviator stress within 15% strain
2. the stress at 10% strain for no peak stress.

At Failure	
Deviator Stress (ksf)	**17.83**
Eff. Minor Principal Stress (ksf)=	**7.20**
Eff. Major Principal Stress (ksf)=	**25.03**
Axial Strain (%)=	**7.78**

Earth Mechanics, Inc.

Geotechnical and Earthquake Engineering





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	10% Axial Strain Dev. Stress (ksf)	Initial Saturation (%)
R-13-004	D-16	90	Gray , CLAYSTONE (CH)	89.1	34.18	7.20	17.83	103.5

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Geotechnical and Earthquake Engineering

Dokken, 5th Street Bridge PSR PR

UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 13-121 | Date : 01/02/14 | Figure No. :

COMPACTION TEST

(ASTM D-1557-91)

Project Name :	Dokken, 5th Street Bridge PSR PR				
Project No. :	13-121	Sampleing By :		Date :	
Boring No. :	HA-13-14	Prepared By :	TK	Date :	
Sample No. :	B-0	Test By :	KK	Date :	3/21/2016
Depth (ft/m) :		Calculated By :	JF	Date :	3/23/2016
Location :		Checked By :	RJ	Date :	
Description :	Brown, SANDY lean CLAY (CL)				1

Estimated Moisture Content (%)	Field	10	4	6	8
Container Number		S-57	S-58	S-52	
Wt. of Wet Soil + Container (gm)		552.64	584.98	611.47	
Wt. of Dry Soil + Container (gm)		518.48	536.84	547.56	
Weight of Container (gm)		64.66	62.70	63.09	
Moisture Content (%)		7.53	10.15	13.19	
Weight of Wet Soil + Mold (gm)		3945.00	4045.00	4005.00	
Weight of Mold (gm)	1960.00	1960.00	1960.00	1960.00	1960.00
Wet Density (pcf)		131.41	138.03	135.39	
Dry Density (pcf)		122.22	125.31	119.61	

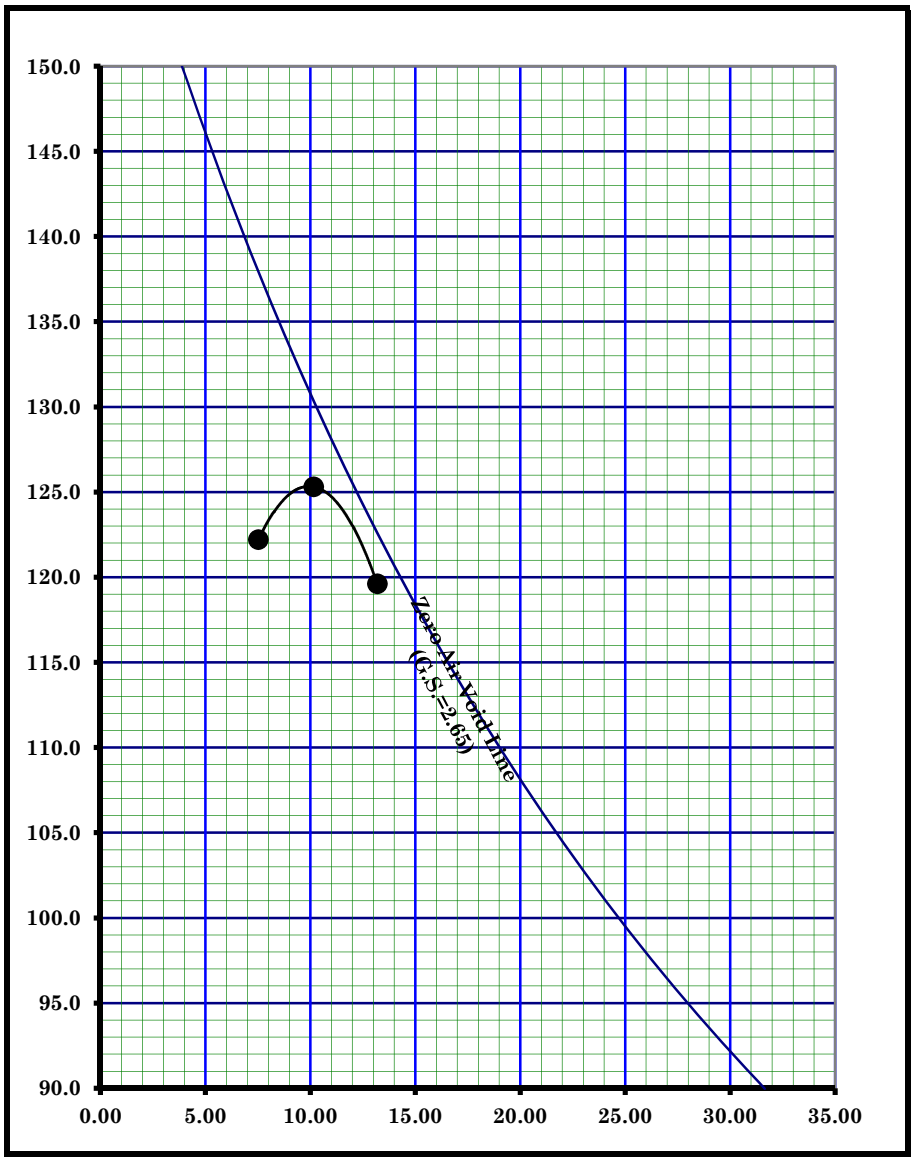
Hammer Weight : 10 (lb.)

Hammer Drop : 18"

Rammer Used		
	Manual	
	Mechanical	X

Total Wt. of Soil : 22340.00

Sieve	Weight Sample Retained	% of	% of Passing
3/4"	0.00	0.00	100.00
3/8"	0.00	0.00	100.00
No. 4	3290.00	14.73	85.27



Mold Volume (ft^3)	0.0333

Test Method

A — 4" Mold; 5 Layer; 25 Blow / Layer

X — Material Passing No. 4 Sieve; If < 20% Material + No. 4 Sieve

Mold Volume (ft^3) = 0.0333

B — 4" Mold; 5 Layer; 25 Blow / Layer

— Material Passing 3/8" Sieve; If > 20% Material + No. 4 Sieve; < 20% Material + 3/8" Sieve

Mold Volume (ft^3) = 0.0333

C — 6" Mold; 5 Layer; 56 Blow / Layer

— Material Passing 3/4" Sieve; If > 20% Material + 3/8" Sieve; < 30% Material + 3/4" Sieve

Mold Volume (ft^3) = 0.07502

Other — 6" Mold; 5 Layer; 56 Blow / Layer

If test Specimen > 5% by weight of Oversize (Coarse Fraction) and material will not be included in the tests. (>40%+No.4, >30%+3/4" Sieve)

Correction must be made to the unit weight and water content of test specimen

Maximun Density				Optium Moisture
Dry		Wet		
(pcf)	(kN/m^3)	(pcf)	(kN/m^3)	(%)
125.5	19.8	138.1	21.7	10.0

COMPACTION TEST

(ASTM D-1557-91)

Project Name :	Dokken, 5th Street Bridge PSR PR				
Project No. :	13-121	Sampleing By :		Date :	
Boring No. :	A-13-01	Prepared By :	TK	Date :	
Sample No. :	B-0	Test By :	KK	Date :	3/21/2016
Depth (ft/m) :		Calculated By :	JF	Date :	3/23/2016
Location :		Checked By :	RJ	Date :	
Description :	Brown, SILTY SAND (SM)				1

Estimated Moisture Content (%)	Field	10	4	6	8
Container Number		M-1	M-2	M-3	
Wt. of Wet Soil + Container (gm)		504.36	477.49	611.62	
Wt. of Dry Soil + Container (gm)		472.56	441.80	547.85	
Weight of Container (gm)		147.62	147.89	147.14	
Moisture Content (%)		9.79	12.14	15.91	
Weight of Wet Soil + Mold (gm)		3490.00	3625.00	3675.00	
Weight of Mold (gm)	1960.00	1960.00	1960.00	1960.00	1960.00
Wet Density (pcf)		101.29	110.23	113.54	
Dry Density (pcf)		92.26	98.29	97.95	

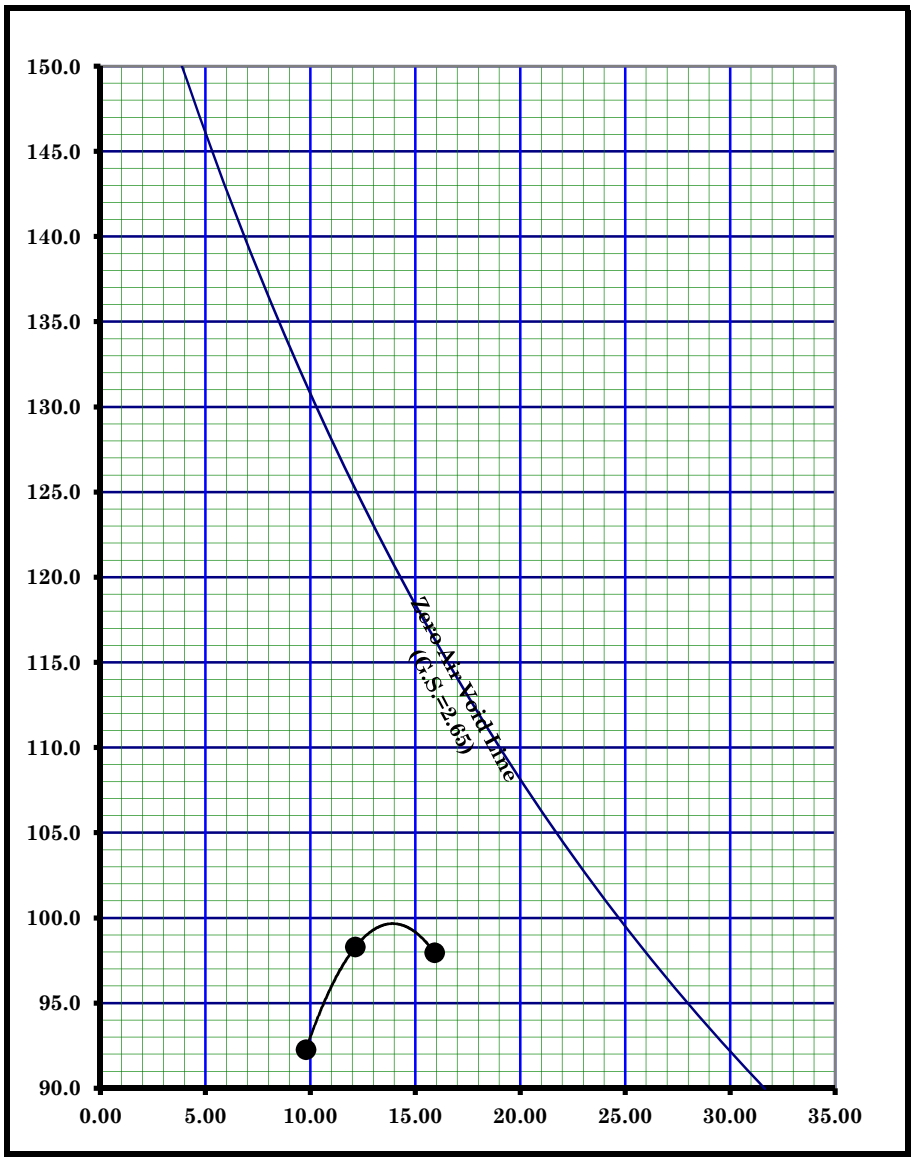
Hammer Weight : 10 (lb.)

Hammer Drop : 18"

Rammer Used		
	Manual	
	Mechanical	X

Total Wt. of Soil : 22340.00

Sieve	Weight Sample Retained	% of	% of Passing
3/4"	0.00	0.00	100.00
3/8"	0.00	0.00	100.00
No. 4	3290.00	14.73	85.27



Mold Volume (ft^3)	0.0333

Test Method

A — 4" Mold; 5 Layer; 25 Blow / Layer

X — Material Passing No. 4 Sieve; If < 20% Material + No. 4 Sieve

Mold Volume (ft^3) = 0.0333

B — 4" Mold; 5 Layer; 25 Blow / Layer

— Material Passing 3/8" Sieve; If > 20% Material + No. 4 Sieve; < 20% Material + 3/8" Sieve

Mold Volume (ft^3) = 0.0333

C — 6" Mold; 5 Layer; 56 Blow / Layer

— Material Passing 3/4" Sieve; If > 20% Material + 3/8" Sieve; < 30% Material + 3/4" Sieve

Mold Volume (ft^3) = 0.07502

Other — 6" Mold; 5 Layer; 56 Blow / Layer

If test Specimen > 5% by weight of Oversize (Coarse Fraction) and material will not be included in the tests. (>40%+No.4, >30%+3/4" Sieve)

Correction must be made to the unit weight and water content of test specimen

Maximun Density				Optium Moisture
Dry		Wet		
(pcf)	(kN/m^3)	(pcf)	(kN/m^3)	(%)
100.0	15.7	114.0	17.9	14.0

COMPACTION TEST

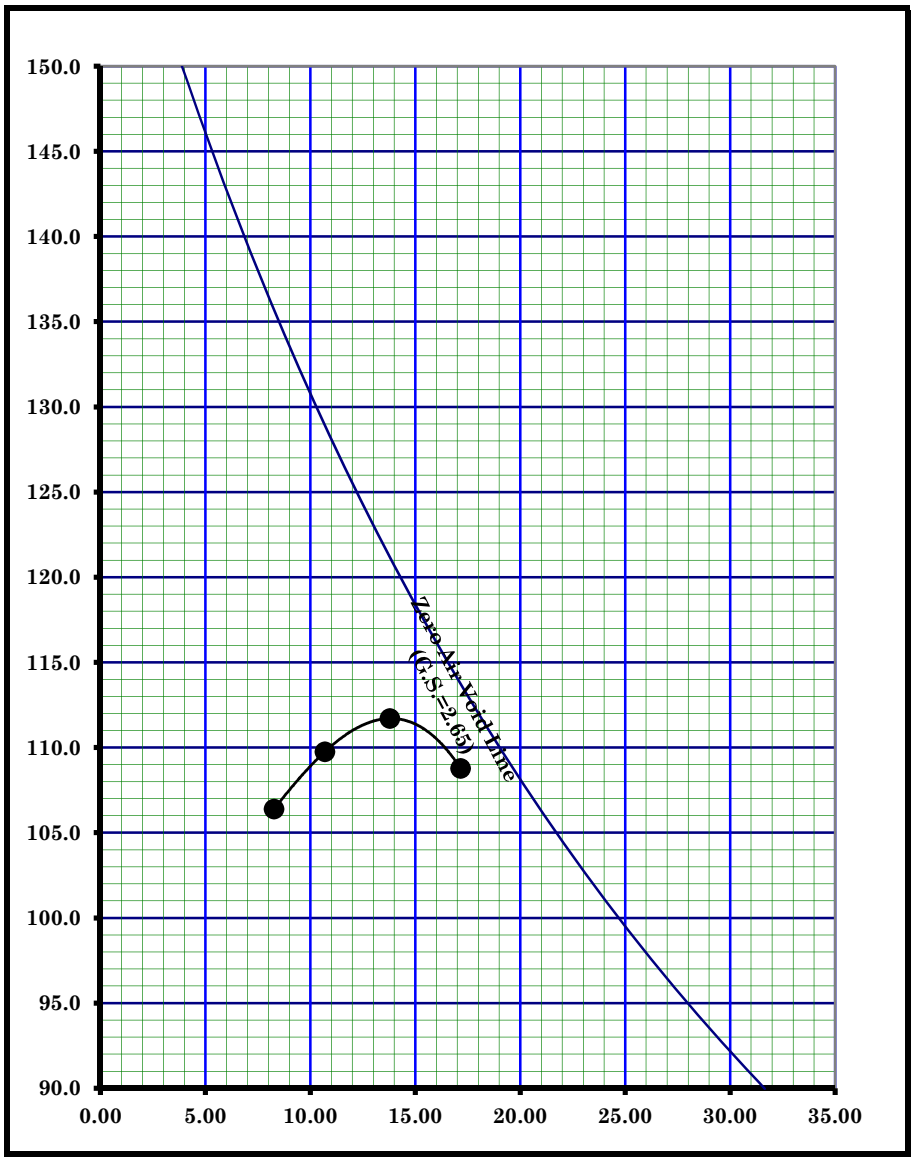
(ASTM D-1557-91)

Project Name :	Dokken, 5th Street Bridge PSR PR				
Project No. :	13-121	Sampleing By :		Date :	
Boring No. :	R-13-011	Prepared By :	TK	Date :	
Sample No. :	B-0	Test By :	KK	Date :	3/21/2016
Depth (ft/m) :		Calculated By :	JF	Date :	3/23/2016
Location :		Checked By :	RJ	Date :	
Description :	Brown, SANDY lean CLAY (CL)				1

Estimated Moisture Content (%)	Field	10	4	6	8
Container Number		S-44	S-17	S-23	S-10
Wt. of Wet Soil + Container (gm)		471.91	517.65	485.58	557.34
Wt. of Dry Soil + Container (gm)		442.95	478.78	440.51	493.17
Weight of Container (gm)		92.97	115.12	113.68	119.08
Moisture Content (%)		8.27	10.69	13.79	17.15
Weight of Wet Soil + Mold (gm)		3700.00	3795.00	3880.00	3885.00
Weight of Mold (gm)	1960.00	1960.00	1960.00	1960.00	1960.00
Wet Density (pcf)		115.19	121.48	127.11	127.44
Dry Density (pcf)		106.39	109.75	111.71	108.78

Hammer Weight : 10 (lb.)			
Hammer Drop : 18"			
Rammer Used	Manual		
	Mechanical	X	
Total Wt. of Soil :	22340.00		

Sieve	Weight Sample Retained	% of	% of Passing
3/4"	0.00	0.00	100.00
3/8"	0.00	0.00	100.00
No. 4	3290.00	14.73	85.27



Mold Volume (ft^3)	0.0333

Test Method

A — 4" Mold; 5 Layer; 25 Blow / Layer

[X] Material Passing No. 4 Sieve
If < 20% Material + No. 4 Sieve
Mold Volume (ft^3) = 0.0333

B — 4" Mold; 5 Layer; 25 Blow / Layer

[#] Material Passing 3/8" Sieve
If > 20% Material + No. 4 Sieve
< 20% Material + 3/8" Sieve
Mold Volume (ft^3) = 0.0333

C — 6" Mold; 5 Layer; 56 Blow / Layer

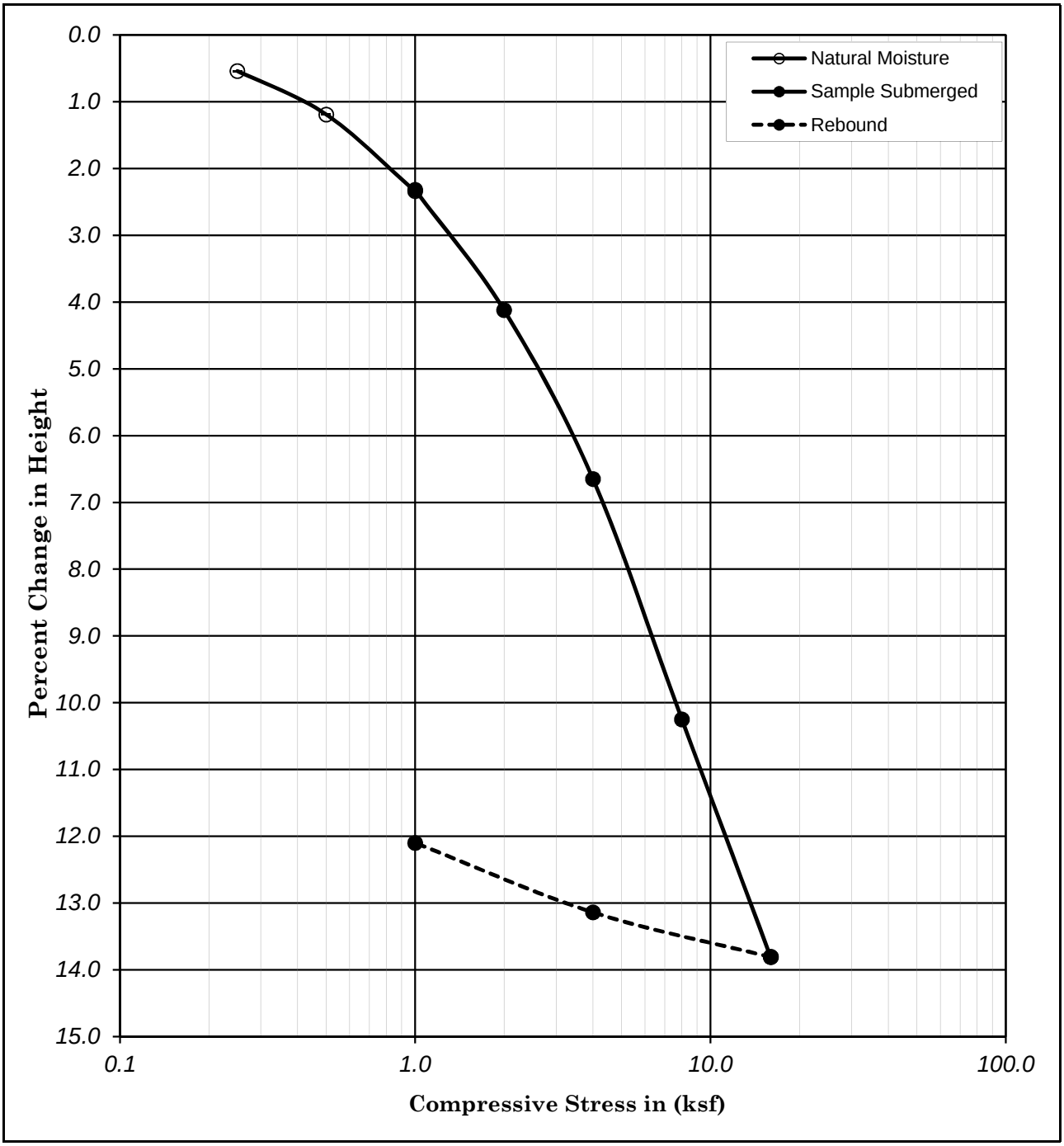
[#] Material Passing 3/4" Sieve
If > 20% Material + 3/8" Sieve
< 30% Material + 3/4" Sieve
Mold Volume (ft^3) = 0.07502

Other — 6" Mold; 5 Layer; 56 Blow / Layer

[ ] If test Specimen > 5% by weight of Oversize (Coarse Fraction) and material will not be included in the tests. (>40%+No.4, >30%+3/4" Sieve)

Correction must be made to the unit weight and water content of test specimen

Maximun Density				Optium Moisture
Dry		Wet		
(pcf)	(kN/m^3)	(pcf)	(kN/m^3)	(%)
112.0	17.6	127.7	20.1	14.0



Boring No.	: R-13-010			Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-9			Plastic Limit :	-						
Depth (ft)	: 45.0	46.5		Plastic Index :	-	Initial	39.28	83.19	13.09	103.33	1.03
Depth (m)	: 13.73	14.18		Specific Gravity :	2.70	Final	31.57	94.65	14.90	109.16	0.78

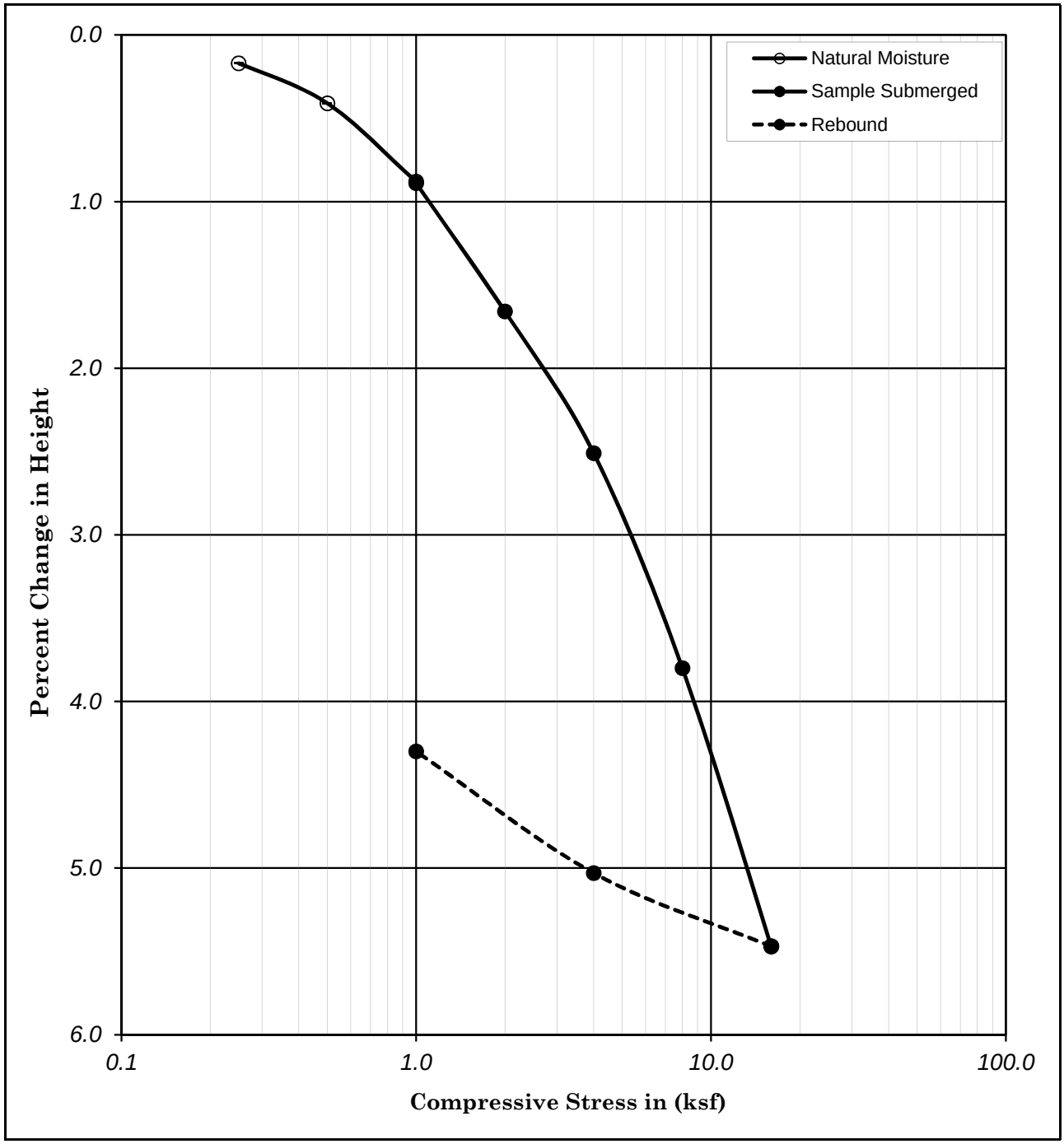
Description : Olive-brown, SANDY SILT (ML)

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

Dokken, 5th Street Bridge PSR PR

Project No. : 13-121 11/20/13

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Boring No.	: R-13-012			Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-11			Plastic Limit :	-						
Depth	(ft) :	56.5	58.0	Plastic Index :	-	Initial	34.68	88.78	13.97	104.18	0.90
	(m) :	17.23	17.69	Specific Gravity :	2.70	Final	32.69	92.78	14.60	108.05	0.82

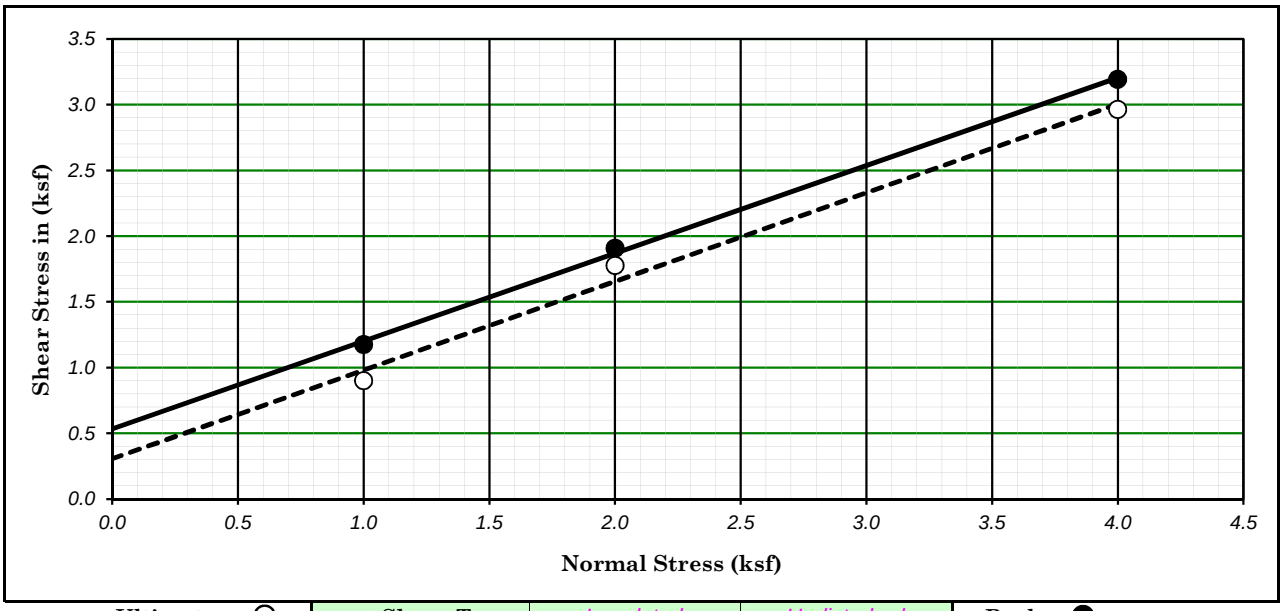
Description : Dark olive-brown, SILTY SAND (SM)

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

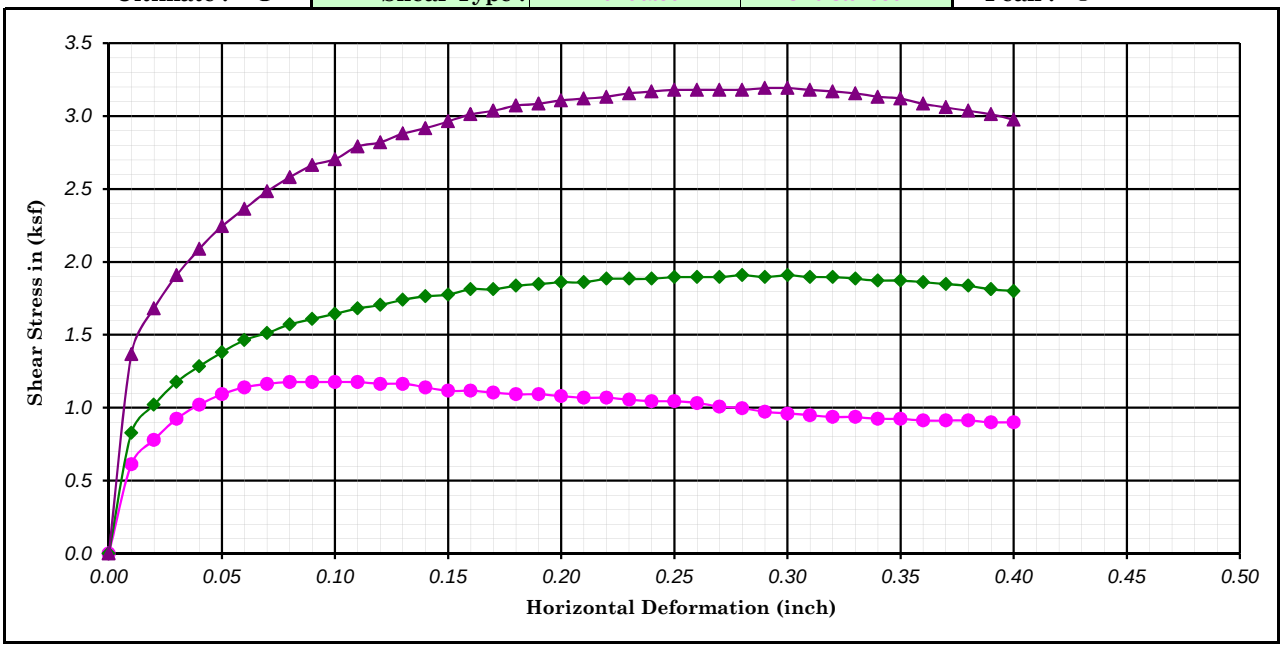
Dokken, 5th Street Bridge PSR PR

Project No. : 13-121 11/20/13

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : R-13-001		Strength Intercept (C) :	0.53	(ksf)	Peak	0.31	(ksf)	Ultimate
Sample No. : B-0			25.57	(kPa)		14.65	(kPa)	
Depth (ft/m) : 0.0	0.00	Friction Angle (ϕ) :	33.73	Degree		34.00	Degree	
Description : Dark brown, SILTY SAND (SM)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	14.01	88.27	13.89	0.91	1.00	47.88	1.18	56.31	0.90	43.09
◆	13.72	88.56	13.94	0.90	2.00	95.76	1.91	91.36	1.78	85.03
▲	14.50	88.61	13.95	0.90	4.00	191.52	3.19	152.83	2.96	141.92

Earth Mechanics, Inc.
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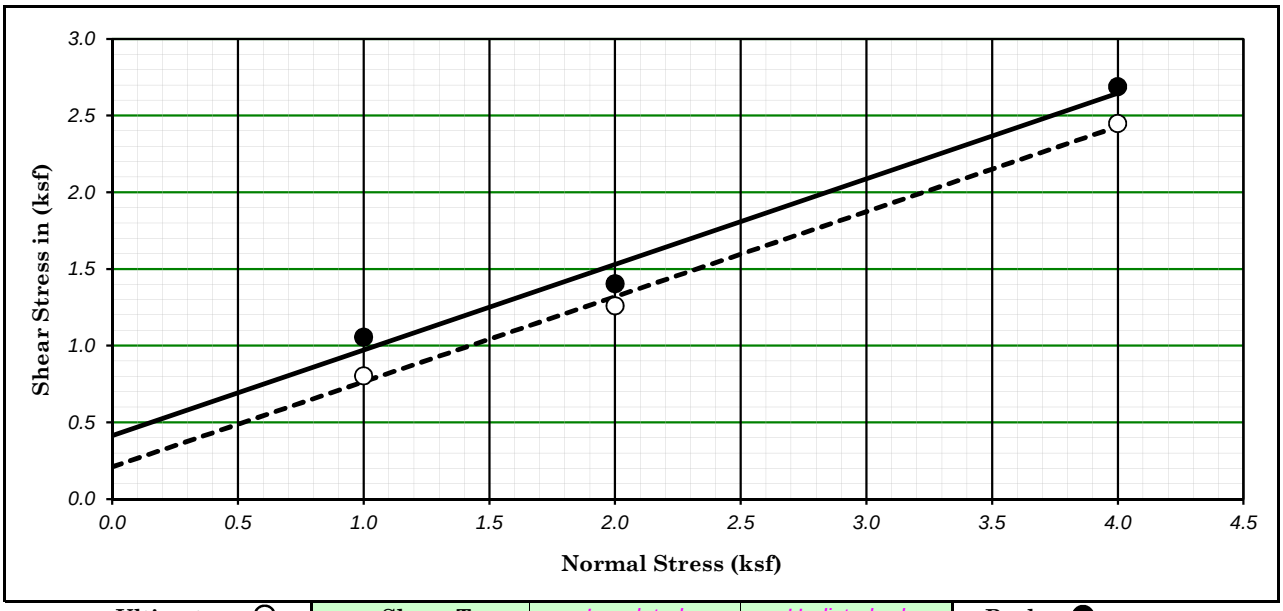
Dokken, 5th Street Bridge PSR PR

DIRECT SHEAR TEST (ASTM D-3080)

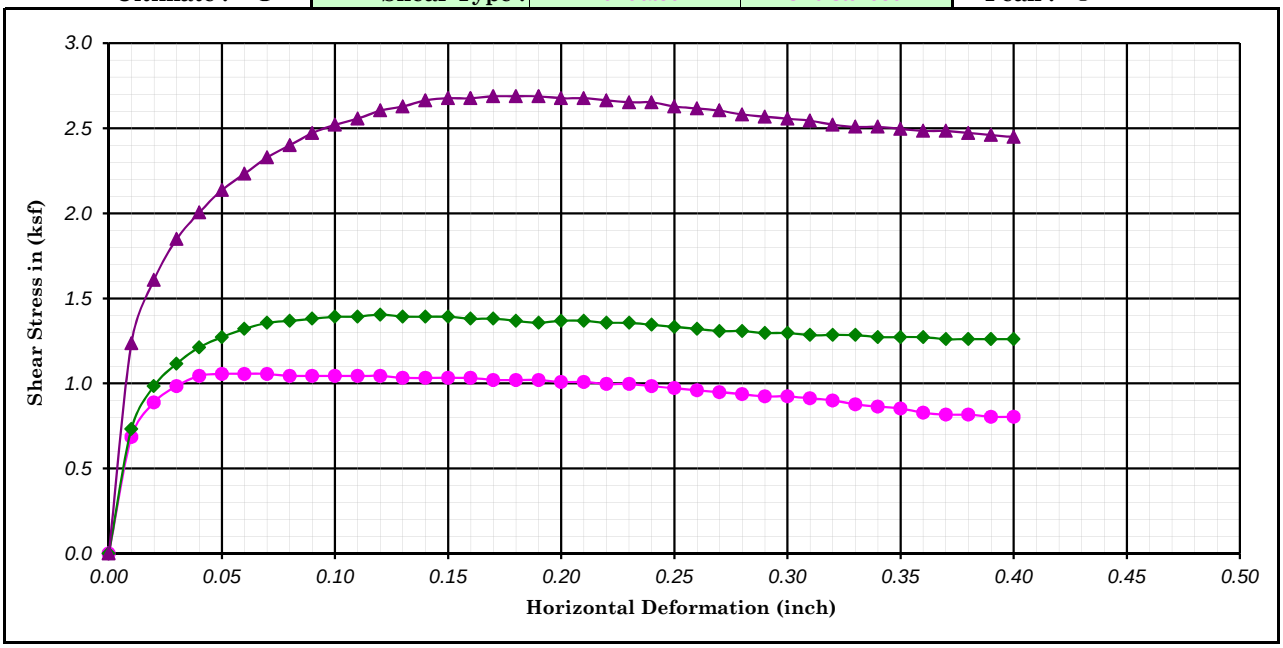
Project No. : 13-121

Date :

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : R-13-011		Strength Intercept (C) :	0.41	(ksf)	Peak	0.21	(ksf)	Ultimate
Sample No. : B-0			19.82	(kPa)		10.05	(kPa)	
Depth (ft/m) : 0.0	0.00	Friction Angle (ϕ) :	29.16	Degree		29.01	Degree	
Description : Dark brown, SANDY lean CLAY (CL)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	26.37	91.39	14.38	0.84	1.00	47.88	1.06	50.56	0.80	38.50
◆	25.09	92.64	14.58	0.82	2.00	95.76	1.40	67.22	1.26	60.33
▲	25.60	90.95	14.32	0.85	4.00	191.52	2.69	128.70	2.45	117.21

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

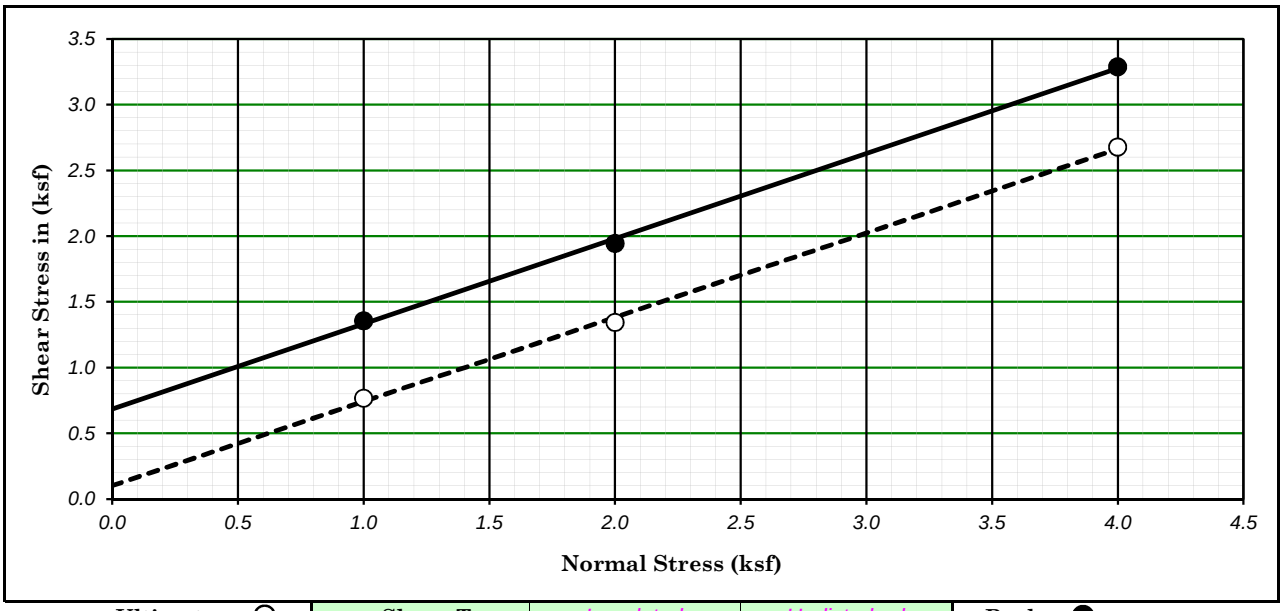
Dokken, 5th Street Bridge PSR PR

DIRECT SHEAR TEST (ASTM D-3080)

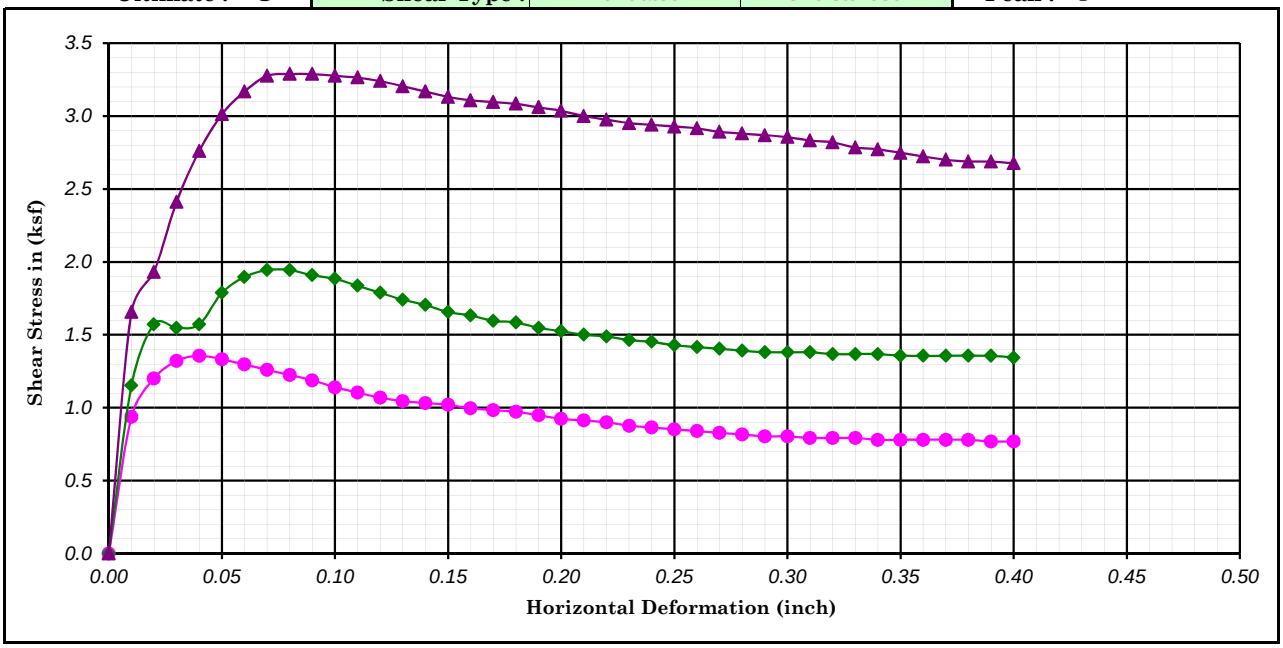
Project No. : 13-121

Date :

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : HA-13-014		Strength Intercept (C) :	0.68	(ksf)	Peak	0.10	(ksf)	Ultimate
Sample No. : B-0			32.75	(kPa)		4.88	(kPa)	
Depth (ft/m) : 0.0	0.00	Friction Angle (ϕ) :	32.94	Degree		32.63	Degree	
Description : Dark brown, SANDY lean CLAY (CL)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	20.89	107.96	16.99	0.56	1.00	47.88	1.36	64.93	0.77	36.77
◆	20.74	108.34	17.05	0.56	2.00	95.76	1.94	93.08	1.34	64.35
▲	19.51	109.86	17.29	0.53	4.00	191.52	3.29	157.43	2.68	128.13

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Geotechnical and Earthquake Engineering

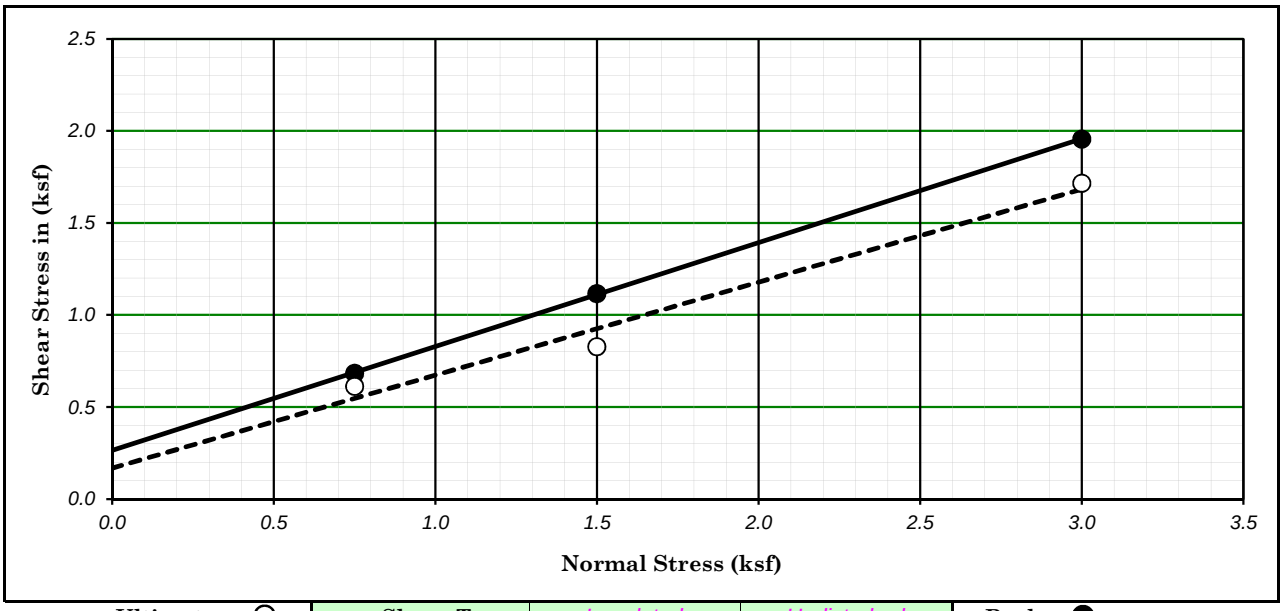
Dokken, 5th Street Bridge PSR PR

DIRECT SHEAR TEST (ASTM D-3080)

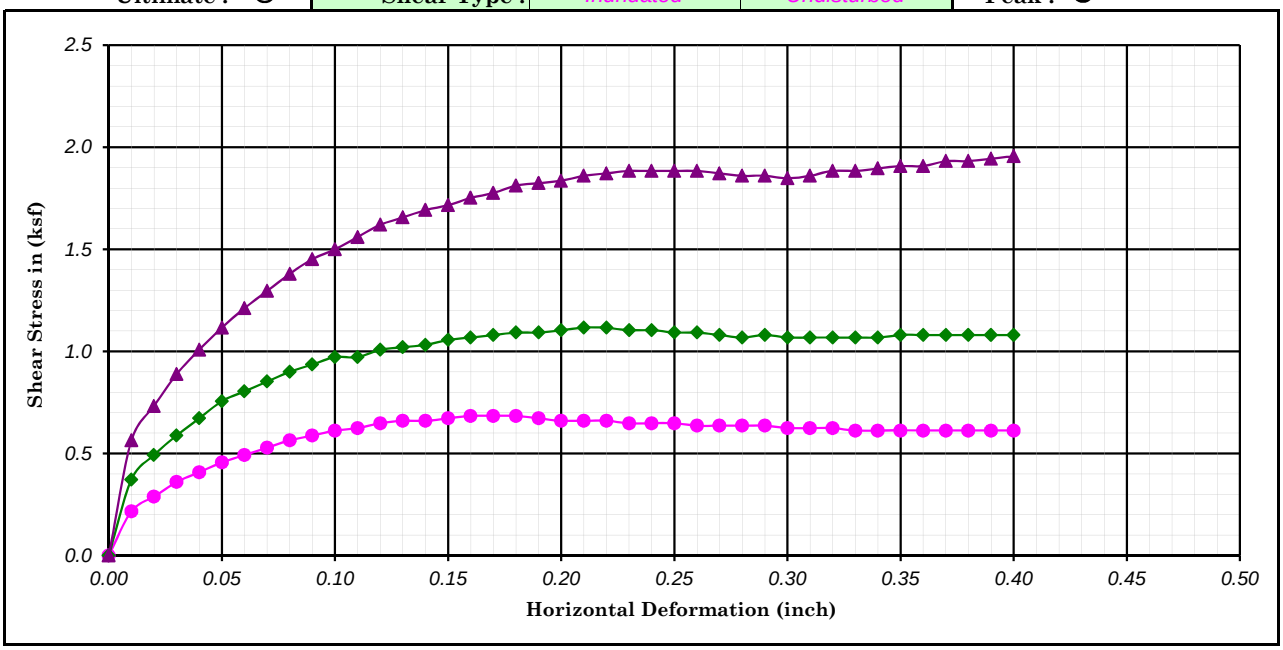
Project No. : 13-121

Date :

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : R-13-001		Strength Intercept (C) :	0.26	(ksf)	Peak	0.17	(ksf)	Ultimate
Sample No. : D-3			12.64	(kPa)		8.04	(kPa)	
Depth (ft/m) : 15.0	0.00	Friction Angle (ϕ) :	29.45	Degree		26.80	Degree	
Description : Dark yellowish brown, CLAYEY SAND (SC)						Shear Rate (inch/minute) :	0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	43.46	77.05	12.13	1.19	0.75	35.91	0.68	32.75	0.61	29.30
◆	44.35	74.17	11.67	1.27	1.50	71.82	1.12	53.43	0.83	39.64
▲	40.62	75.41	11.87	1.24	3.00	143.64	1.96	93.65	1.72	82.16

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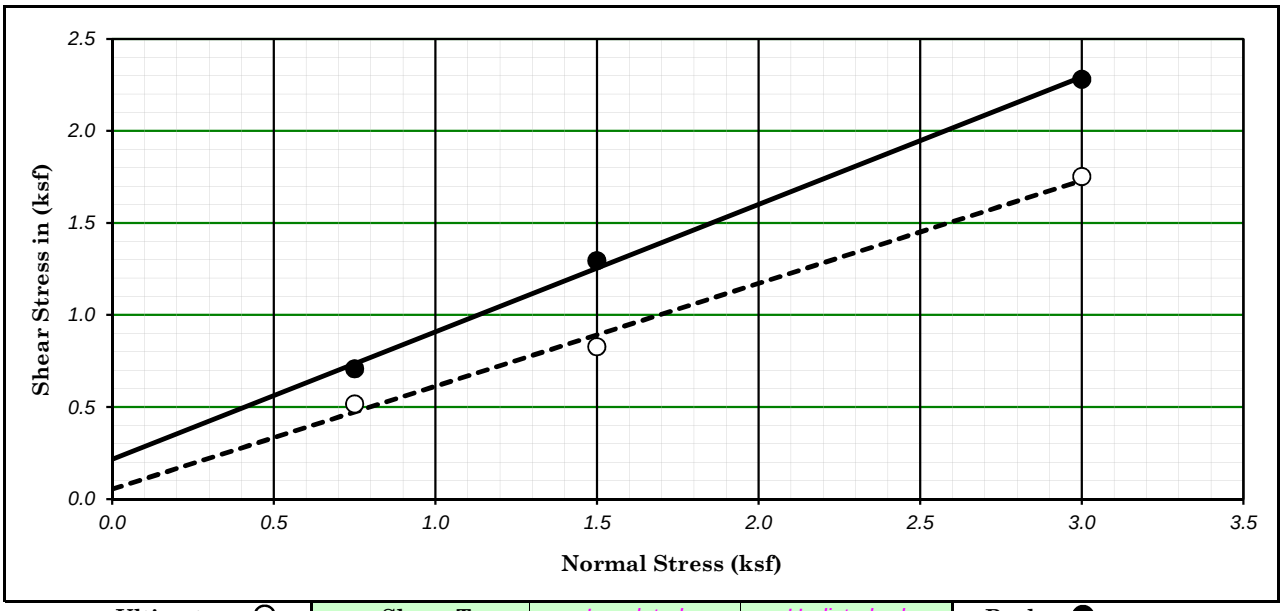
Dokken, 5th Street Bridge PSR PR

DIRECT SHEAR TEST (ASTM D-3080)

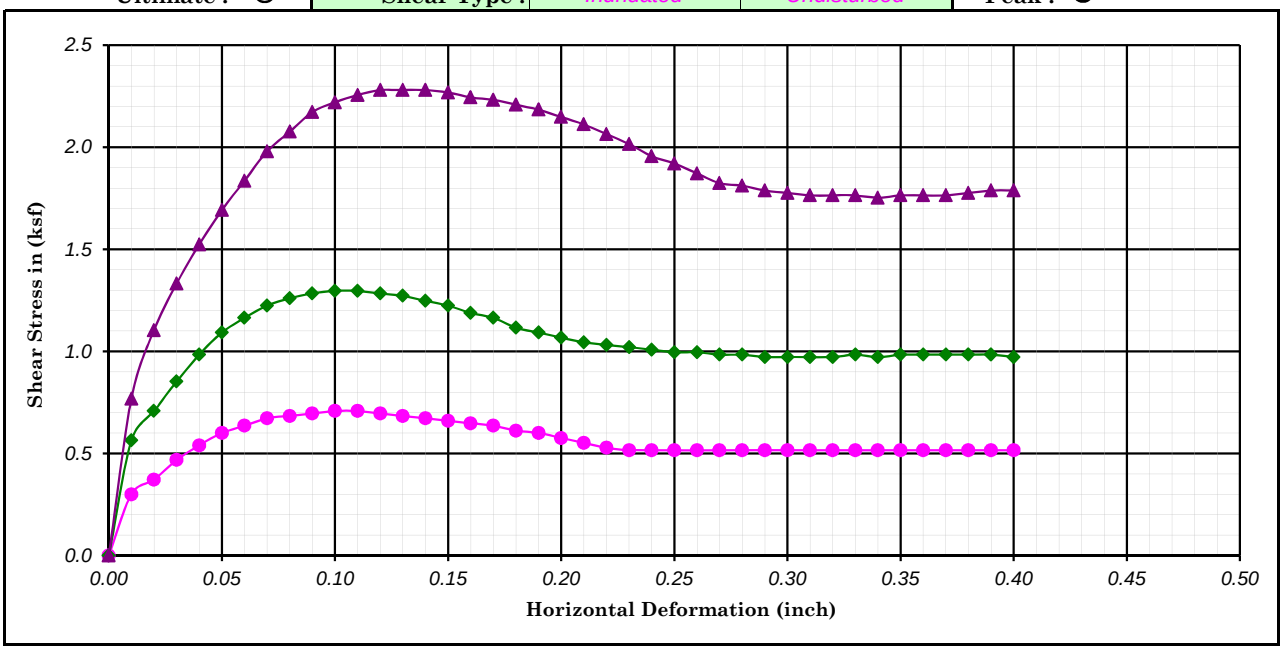
Project No. : 13-121

Date :

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : R-13-006		Strength Intercept (C) :	0.22	(ksf)	Peak	0.05	(ksf)	Ultimate
Sample No. : D-3			10.34	(kPa)		2.59	(kPa)	
Depth (ft/m) : 15.0	0.00	Friction Angle (ϕ) :	34.71	Degree		29.20	Degree	
Description : Dark olive-brown, Poorly graded SAND with SILT (SP-SM)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	29.66	92.16	14.51	0.83	0.75	35.91	0.71	33.90	0.52	24.71
◆	30.05	91.82	14.45	0.84	1.50	71.82	1.30	62.05	0.83	39.64
▲	30.20	92.13	14.50	0.83	3.00	143.64	2.28	109.17	1.75	83.89

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

Dokken, 5th Street Bridge PSR PR

DIRECT SHEAR TEST (ASTM D-3080)

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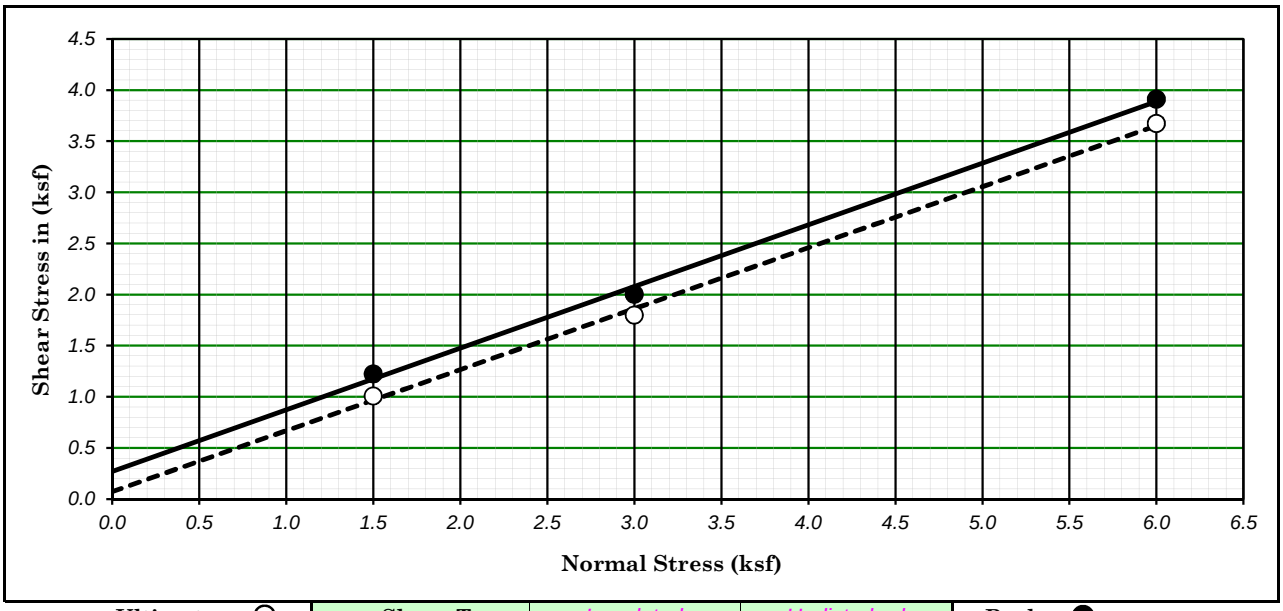
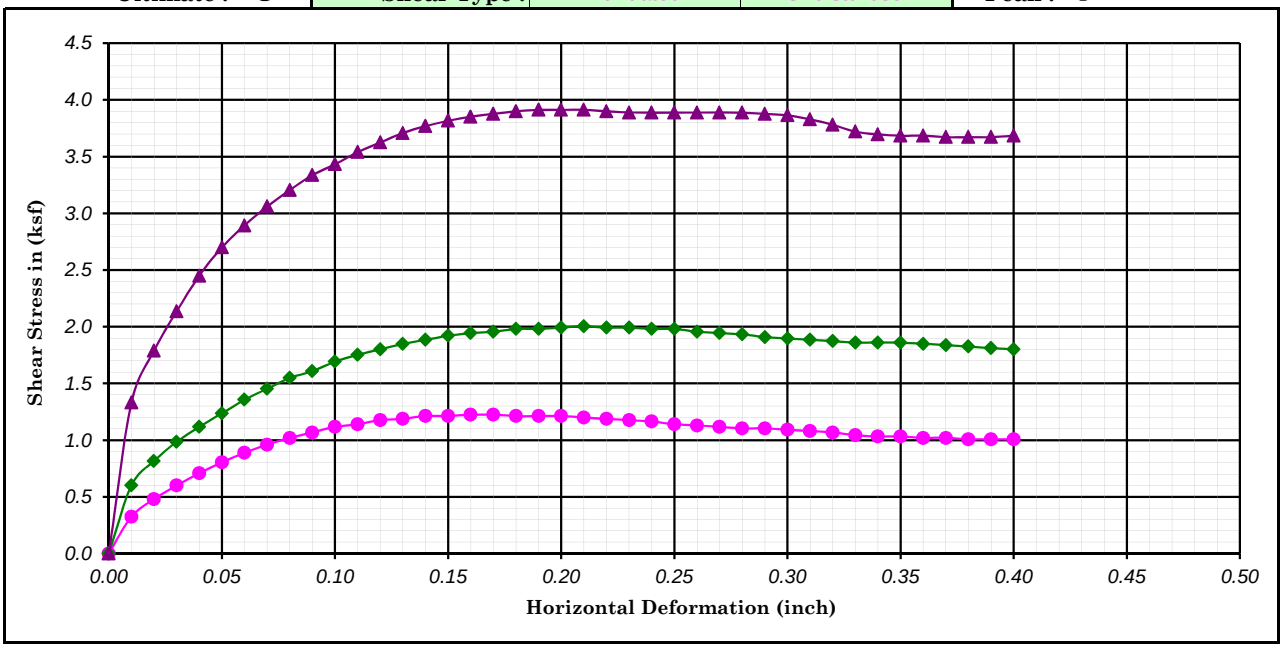
Date :

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : R-13-004		Strength Intercept (C) :	0.27	(ksf)	Peak	0.07	(ksf)	Ultimate
Sample No. : D-6			12.93	(kPa)		3.45	(kPa)	
Depth (ft/m) : 30.0	0.00	Friction Angle (ϕ) :	31.08	Degree		30.82	Degree	
Description : Dark gray, Poorly graded SAND with SILT and organic (SP-SM)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	40.24	79.86	12.57	1.11	1.50	71.82	1.22	58.61	1.01	48.26
◆	38.93	82.45	12.98	1.04	3.00	143.64	2.00	95.95	1.80	86.18
▲	34.73	85.35	13.43	0.97	6.00	287.28	3.91	187.31	3.67	175.82

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Geotechnical and Earthquake Engineering

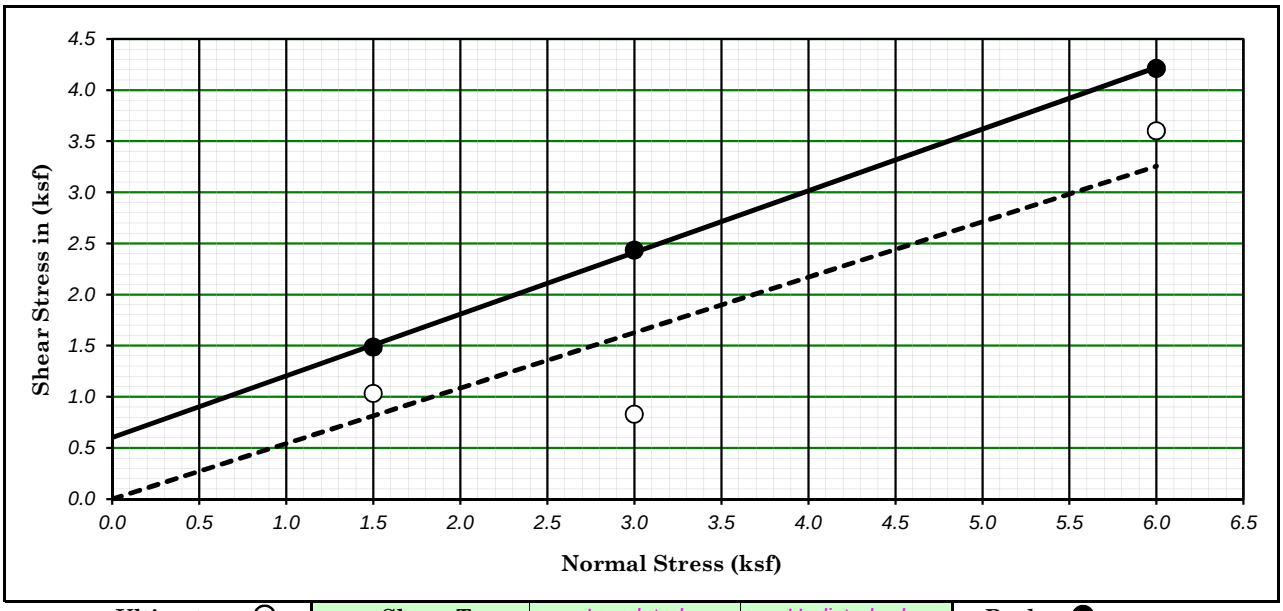
Dokken, 5th Street Bridge PSR PR

DIRECT SHEAR TEST (ASTM D-3080)

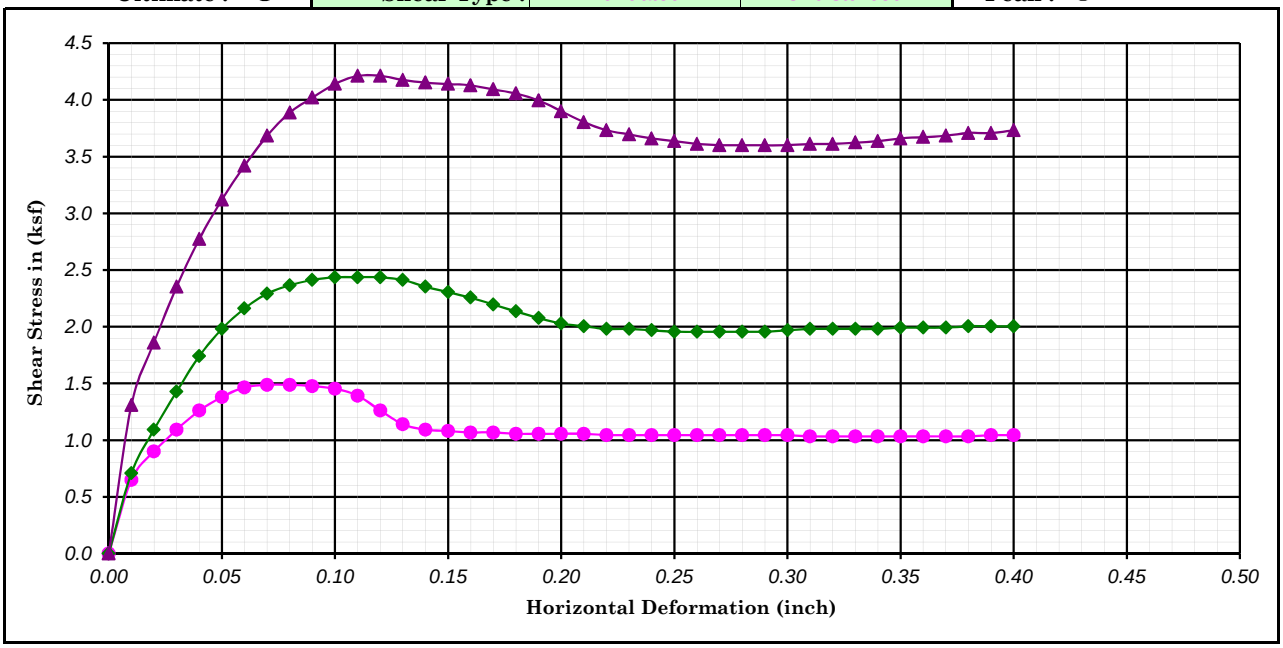
Project No. : 13-121

Date :

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : R-13-011		Strength Intercept (C) :	0.60	(ksf)	Peak	0.00	(ksf)	Ultimate
Sample No. : D-6			28.73	(kPa)		0.00	(kPa)	
Depth (ft/m) : 30.0	0.00	Friction Angle (ϕ) :	31.11	Degree		28.48	Degree	
Description : Dark yellowish brown, CLAYEY SAND (SC)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	19.12	110.25	17.35	0.53	1.50	71.82	1.49	71.25	1.03	49.41
◆	19.08	109.81	17.28	0.54	3.00	143.64	2.44	116.64	0.83	39.64
▲	18.57	109.48	17.23	0.54	6.00	287.28	4.21	201.67	3.60	172.37

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Geotechnical and Earthquake Engineering

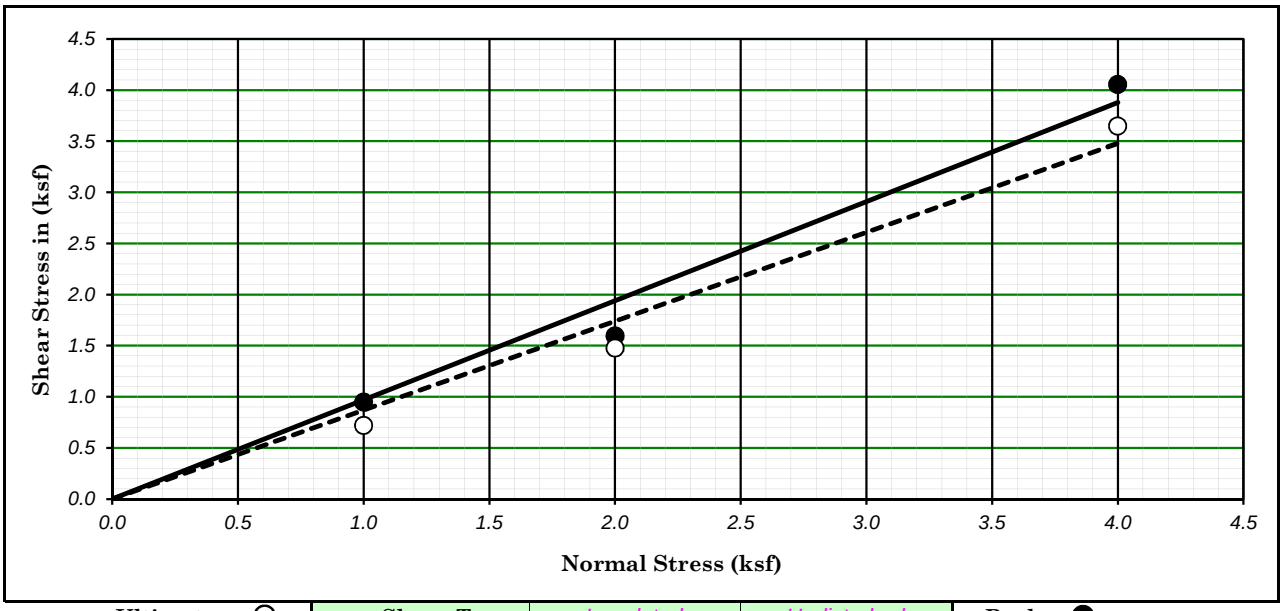
Dokken, 5th Street Bridge PSR PR

DIRECT SHEAR TEST (ASTM D-3080)

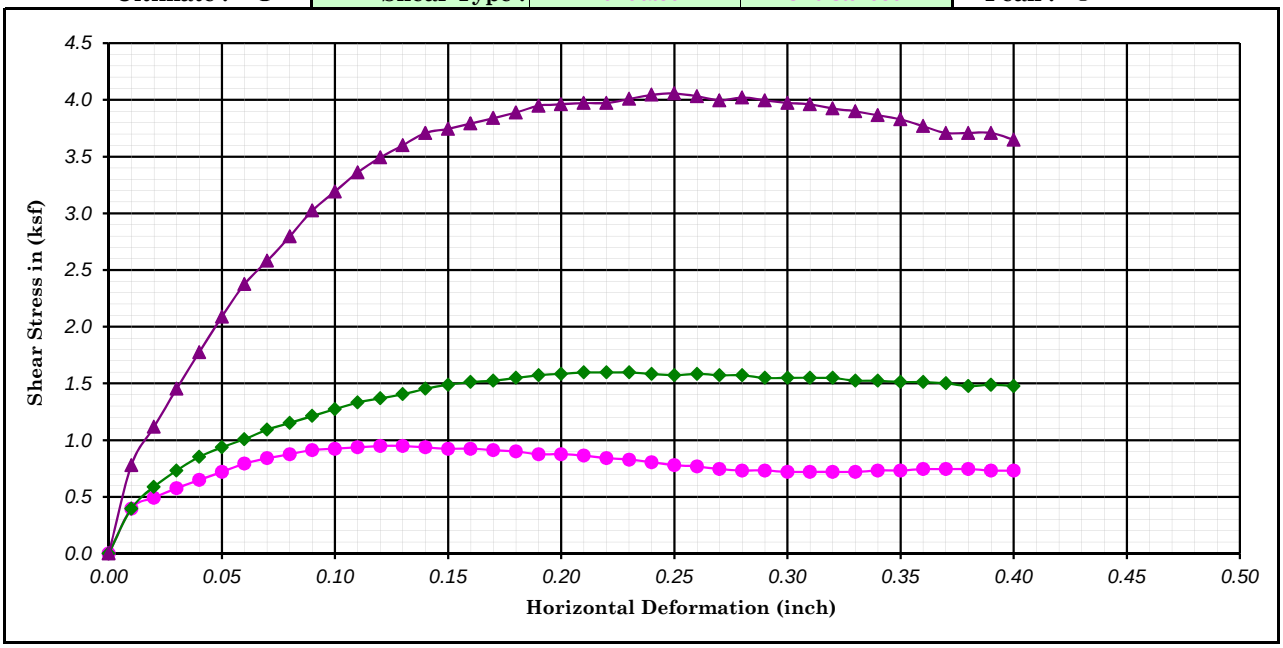
Project No. : 13-121

Date :

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : R-13-012		Strength Intercept (C) :	0.00	(ksf)	Peak	0.00	(ksf)	Ultimate
Sample No. : D-5			0.00	(kPa)		0.00	(kPa)	
Depth (ft/m) : 25.0	0.00	Friction Angle (ϕ) :	44.12	Degree		41.01	Degree	
Description : Dark olive-brown, Poorly graded SAND with SILT (SP-SM)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	23.95	102.56	16.14	0.64	1.00	47.88	0.95	45.39	0.72	34.47
◆	23.80	102.97	16.21	0.64	2.00	95.76	1.60	76.42	1.48	70.67
▲	18.22	111.72	17.59	0.51	4.00	191.52	4.06	194.20	3.65	174.67

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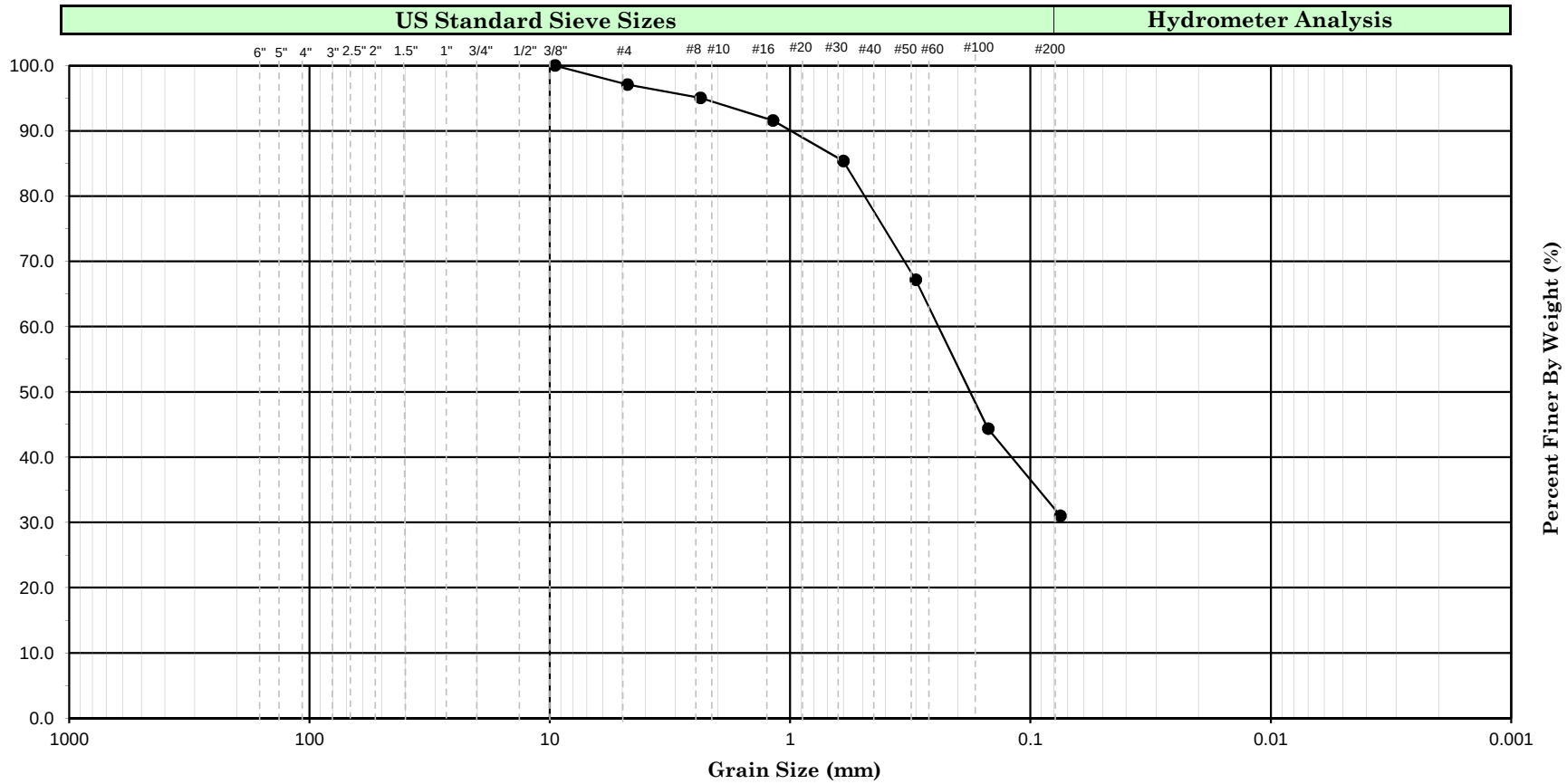
Dokken, 5th Street Bridge PSR PR

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 13-121

Date :

Figure No. :



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Depth (ft)		Depth (m)		Soil Color	Soil Description	U.S.C.S.
●	R-13-001	B-0	0				dark brown	Silty sand	SM
Remark									

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Dokken, 5th Street Bridge PSR PR

Project No. : 13-121

Date : 03/18/16

GRAIN SIZE ANALYSIS
(ASTM D-422)

Figure No. :

Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Depth (ft)		Depth (m)		Soil Color	Soil Description	U.S.C.S.
●	R-13-011	B-0	0				Dark brown	Sandy lean clay	CL
Remark									

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Dokken, 5th Street Bridge PSR PR

Project No. : 13-121

Date : 03/18/16

GRAIN SIZE ANALYSIS
(ASTM D-422)

Figure No. :

Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Depth (ft)		Depth (m)		Soil Color	Soil Description	U.S.C.S.
●	HA-13-014	B-0	0				brown	Sandy lean clay	CL
Remark									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

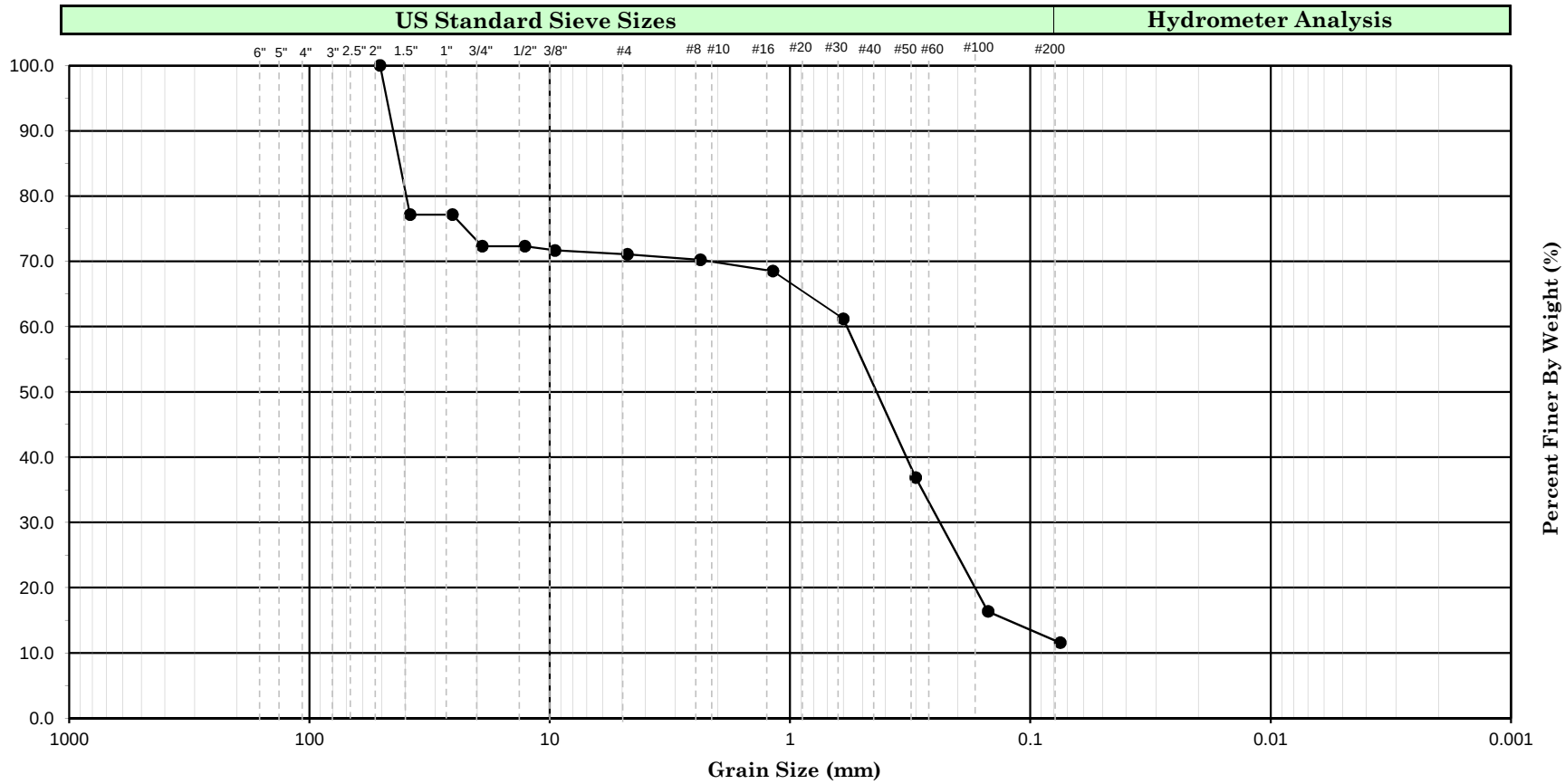
Dokken, 5th Street Bridge PSR PR

Project No. : 13-121

Date : 03/18/16

GRAIN SIZE ANALYSIS
(ASTM D-422)

Figure No. :



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Depth (ft)		Depth (m)		Soil Color	Soil Description	U.S.C.S.
●	R-13-005	D-11	55				olive-brown	Poorly graded sand with silt with gravel	SP-SM
Remark									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

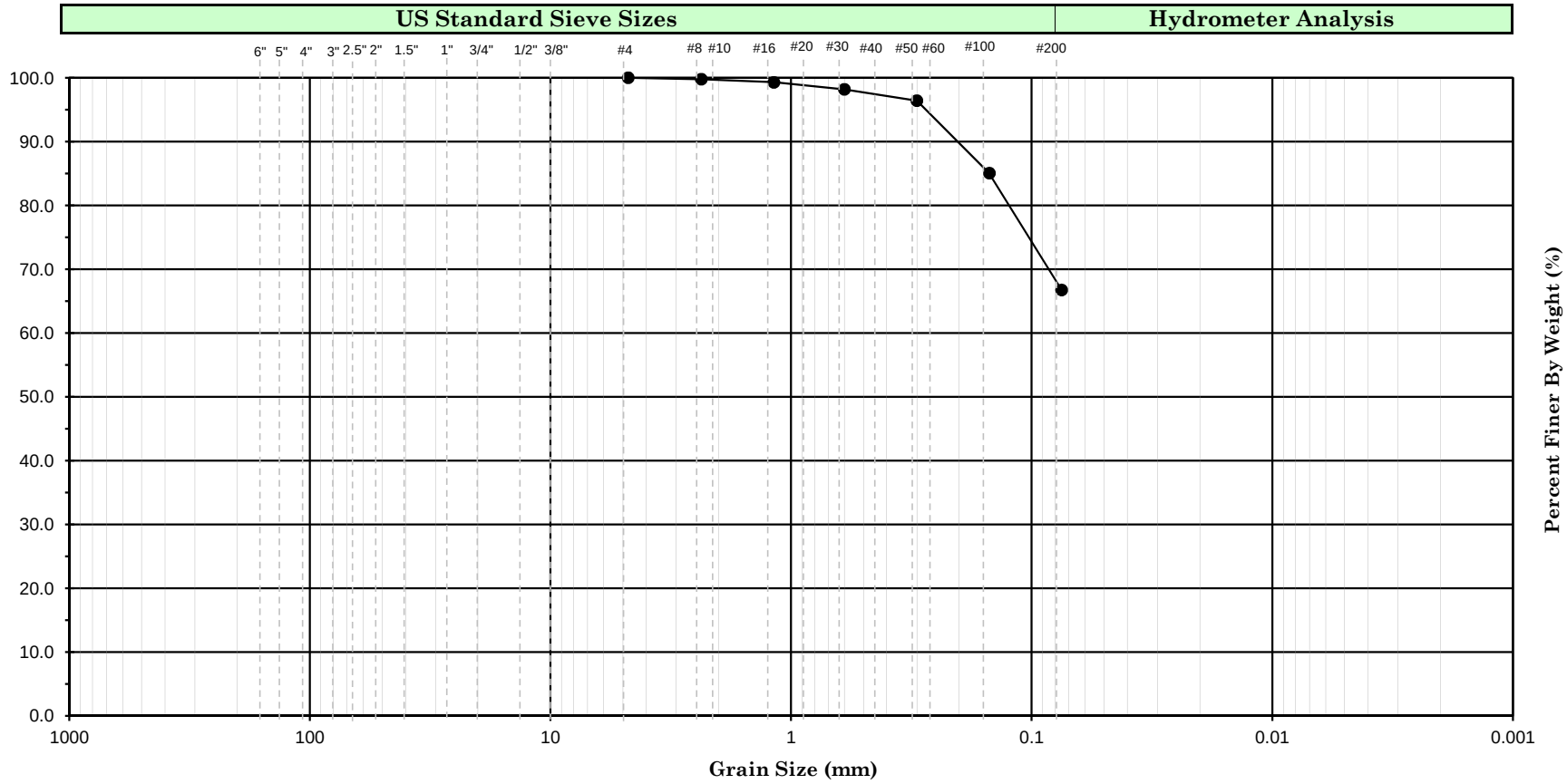
Dokken, 5th Street Bridge PSR PR

Project No. : 13-121

Date : 11/08/13

GRAIN SIZE ANALYSIS
(ASTM D-422)

Figure No. :



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Depth (ft)		Depth (m)		Soil Color	Soil Description	U.S.C.S.
●	R-13-007	S-5	25				olive-brown	Sandy silt	ML
Remark									

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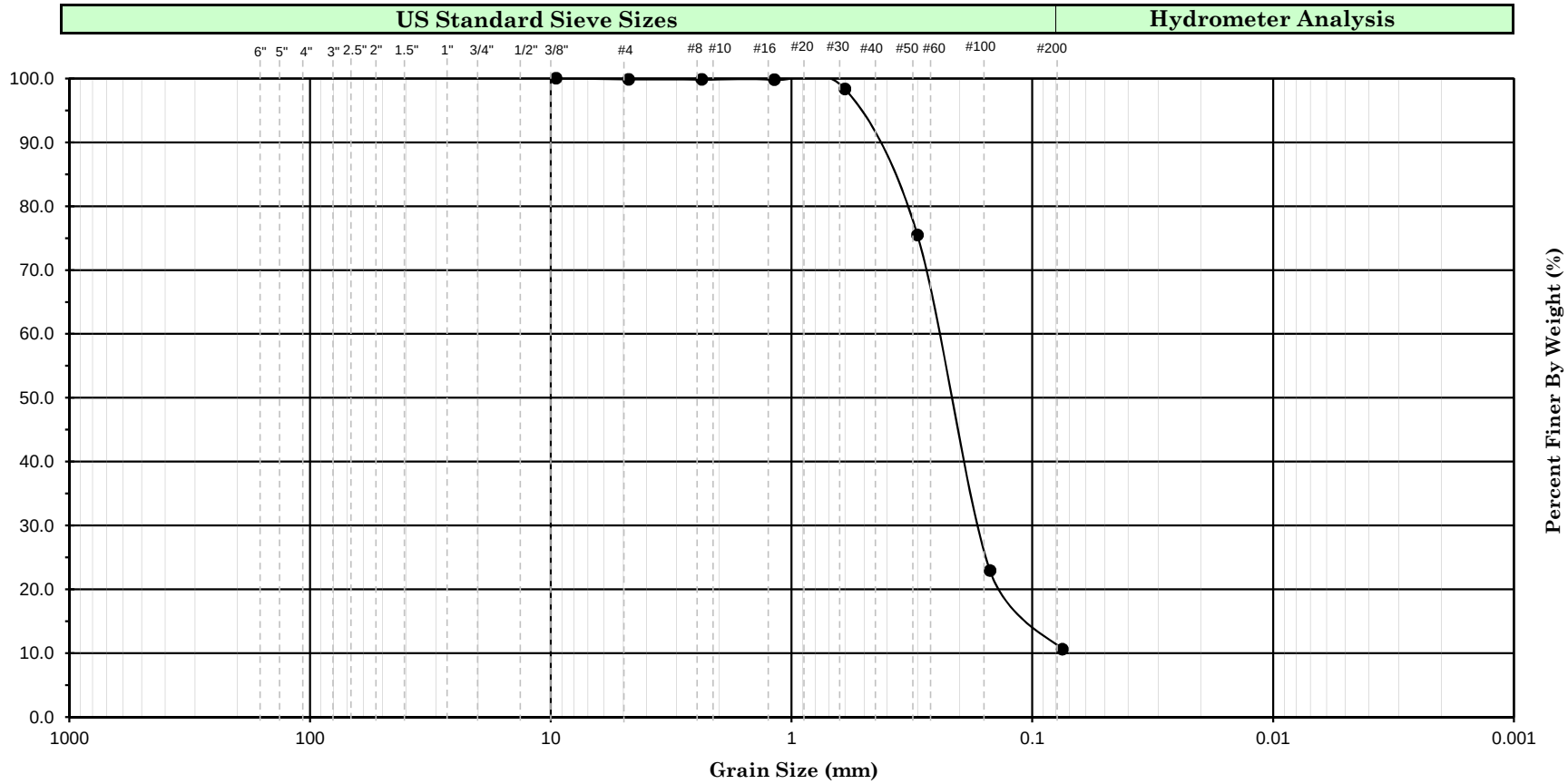
Dokken, 5th Street Bridge PSR PR

Project No. : 13-121

Date : 11/08/13

GRAIN SIZE ANALYSIS
(ASTM D-422)

Figure No. :



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Depth (ft)		Depth (m)		Soil Color	Soil Description	U.S.C.S.
●	R-13-013	D-6	30				brown	Poorly graded sand with silt	SP-SM
Remark									

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Dokken, 5th Street Bridge PSR PR

Project No. : 13-121

Date : 11/08/13

GRAIN SIZE ANALYSIS
(ASTM D-422)

Figure No. :

SAND EQUIVALENT (ASTM D-2419 / CT-217)

Project No : 13-121 **Project Name :** Dokken, 5th Street Bridge PSR PR

Sampled By :	Date :	Computed By : JF	Date : 03/20/16	Stock Solution Prepared By :	Remark :
Prepared By :	Date :	Checked By :	Date :	Stock Solution Prepared at :	
Tested By : KK	Date :			(Max. 14 Days) Will Expired at :	

1. Level of Stock Solution should be maintained between 36" & 46" above the work surface.
2. Diluted one full tin (85 ml) Stock solution in one gallon (3.8 liter) water at (21^{0}C).
3. Tested Sample should be passing No.4 Sieve.

Boring No. : HA-13-014	Boring No. :	Boring No. :	Boring No. :
Sample No. : B-0	Sample No. :	Sample No. :	Sample No. :
Depth (ft) : 0	Depth (ft) :	Depth (ft) :	Depth (ft) :
Depth (m) :	Depth (m) :	Depth (m) :	Depth (m) :
Soil Description CL	Soil Description	Soil Description	Soil Description

4. Fill plastic cylinder with 4 ± 0.1 inches working solution.

Sample Drying By / Container Number											
Air : X	Oven :	Air : X	Oven :	Air :	Oven :	Air :	Oven :	Air :	Oven :		

5. Pour each tin measurement of specimen into plastic cylinder.

Tin Can Number											
A	B	C	D	E	F	G	H	I	A	B	C
Cylinder Number											
1	2	3	7	8	9	1	2	3	7	8	9

6. Release air bubbles and promote through wetting at :	Time												
	11:38:00	11:41:00	11:44:00	15:07:00	15:10:00	15:13:00	15:55:00	15:58:00	16:01:00				
7. Stay undisturbed for 10 ± 1 minute to :	11:48:00	11:51:00	11:54:00	15:17:00	15:20:00	15:23:00	16:05:00	16:08:00	16:11:00				
8. Fill working solution up to (15") at :	11:51:00	11:54:00	11:57:00	15:20:00	15:23:00	15:26:00	16:08:00	16:11:00	16:14:00				
9. Stay undisturbed for 20 ± 15 seconds to :	12:11:00	12:14:00	12:17:00	15:40:00	15:43:00	15:46:00	16:28:00	16:31:00	16:34:00				
10. Clay reading (top level of sidment at 20 minute period or line demarcation time, when clay reading falls between 0.1" graduation record the higher).	10.80	10.20	10.40										
11. Sand reading(Lower the weighted foot assemble and record top edge of indicator (inch),substract 10 in.)	1.50	1.50	1.60										
Sand Equivalent = Sand reading / Clay Reading	13.89	14.71	15.38										
Sand Equivalent — Average	14.66												
Sand Equivalent — Reported	15												

Particle Size Distribution Report

% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	11.3	3.2	6.4	50.1	29.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75 in.	100.0		
.5 in.	95.4		
#4	88.7		
#10	85.5		
#40	79.1		
#200	29.0		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 1.69 D_{60}= 0.181 D_{50}= 0.134
D_{30}= 0.0770 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

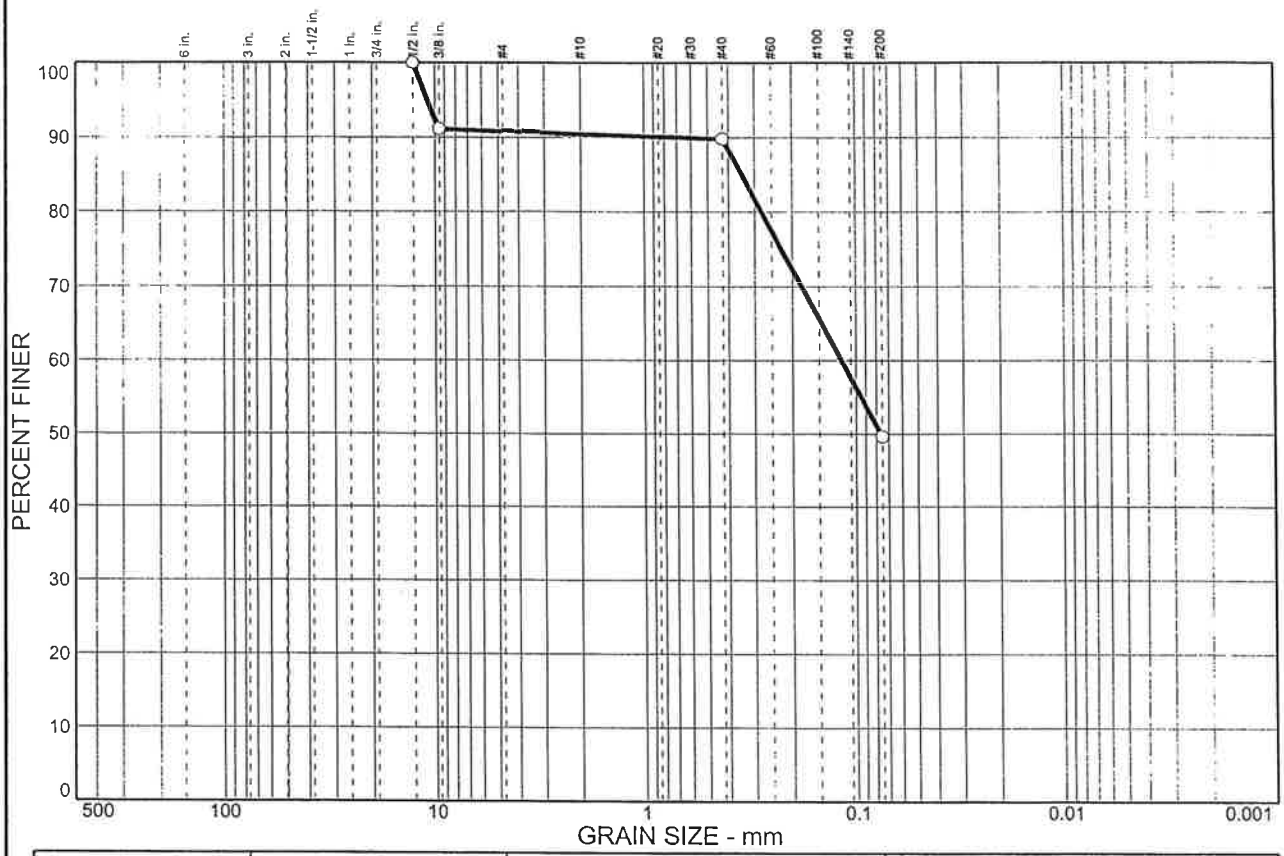
*Note: Samples tested precludes particle sizes>1.4" diameter.
Total dry weight of sample tested=456 grams.

Sample No.: 1/2 **Source of Sample:** **Date:** 8-22-07
Location: Boring 1 **Depth:** 10.0'-12.0'

Taber
Since 1954

Client: TRC
Project: Fifth Street Bridge @ Feather River
Project No: 1R2/304/016 **Figure** 2

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	9.2	0.4	0.6	40.2	49.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5 in.	100.0		
.375 in.	91.1		
#40	89.8		
#200	49.6		

* (no specification provided)

Material Description

Atterberg Limits

PL= NP LL= 27 PI= NP

Coefficients

D_{85}= 0.345 D_{60}= 0.117 D_{50}= 0.0763
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

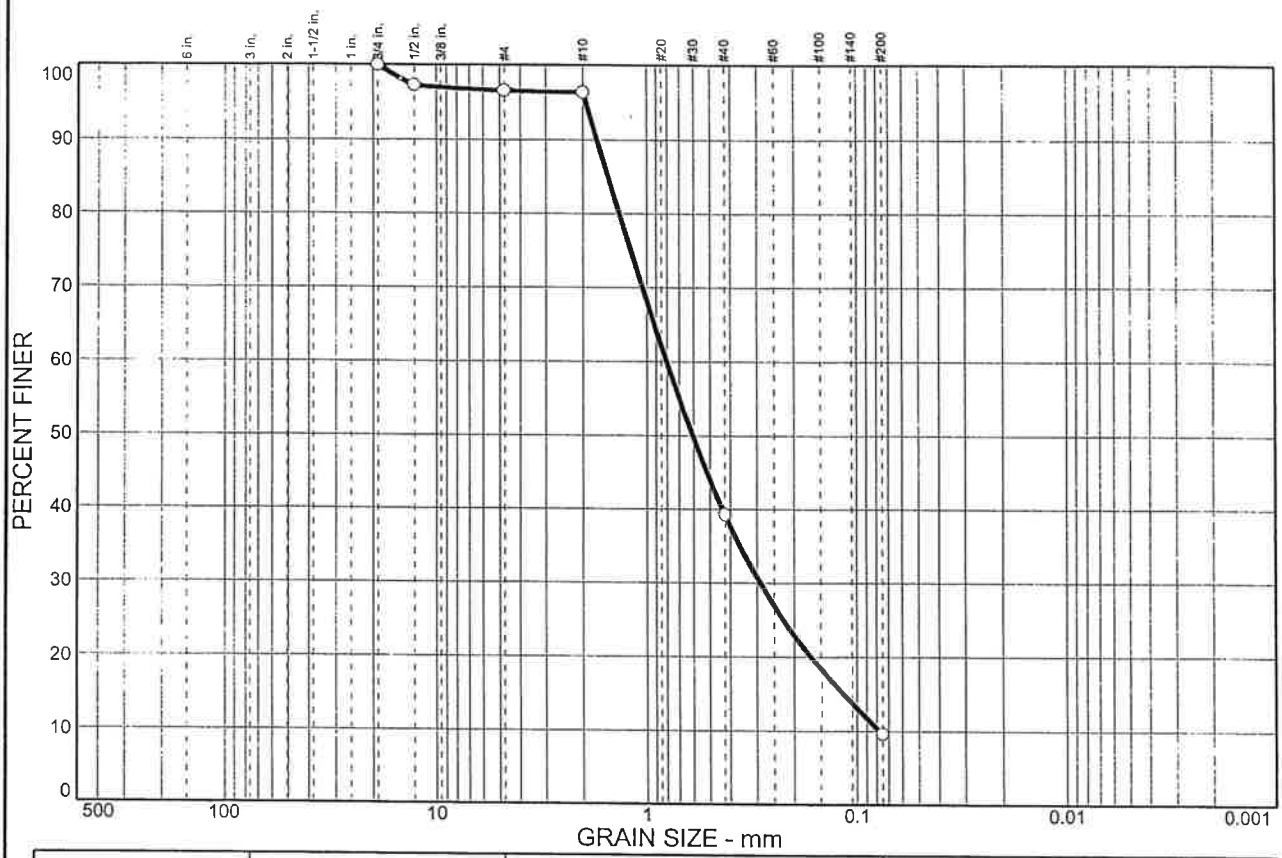
*Note: Sample tested precludes particle sizes>1.4" diameter.
Total dry weight of sample tested=281 grams.

Sample No.: 1/3+1/4A+1/6 comp. **Source of Sample:** **Date:** 8-22-07
Location: Boring 1 **Depth:** 15.0'-32.0'

Taber
Since 1954

Client: TRC
Project: Fifth Street Bridge @ Feather River
Project No: 1R2/304/016 **Figure** 2

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	3.4	0.2	57.1	29.7	9.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75 in.	100.0		
.5 in.	97.3		
#4	96.6		
#10	96.4		
#40	39.3		
#200	9.6		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 1.52 D_{60}= 0.805 D_{50}= 0.604
D_{30}= 0.290 D_{15}= 0.116 D_{10}= 0.0776
C_u= 10.37 C_c= 1.35

Classification

USCS= AASHTO=

Remarks

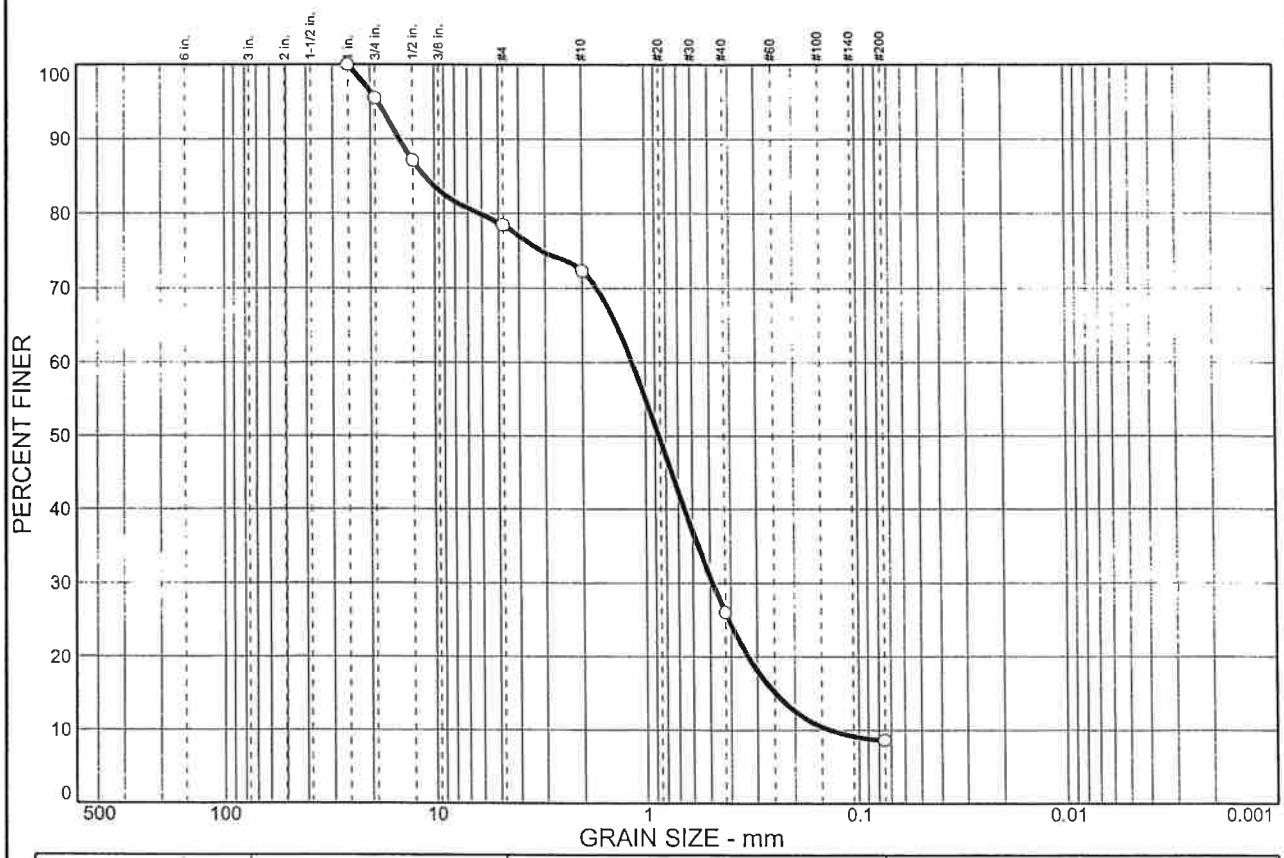
*Note: Sample tested precludes particle sizes>1.4" diameter.
Total dry weight of sample tested=1058 grams.

Sample No.: 1/7+1/8 comp. **Source of Sample:** **Date:** 8-22-07
Location: Boring 1 **Depth:** 35.0'-42.0'

Taber
Since 1954

Client: TRC
Project: Fifth Street Bridge @ Feather River
Project No: 1R2/304/016 **Figure** 2

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	4.5	17.1	6.1	46.3	17.4	8.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
.75 in.	95.5		
.5 in.	87.1		
#4	78.4		
#10	72.3		
#40	26.0		
#200	8.6		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 11.1 D_{60}= 1.16 D_{50}= 0.864
D_{30}= 0.487 D_{15}= 0.246 D_{10}= 0.137
C_u= 8.49 C_c= 1.50

Classification

USCS= AASHTO=

Remarks

*Note: Sample tested precludes particle sizes>1.4" diameter.
Total dry weight of sample tested=971 grams.

Sample No.: 1/9+1/10 comp. **Source of Sample:** **Date:** 8-22-07
Location: Boring 1 **Depth:** 45.0'-52.0'

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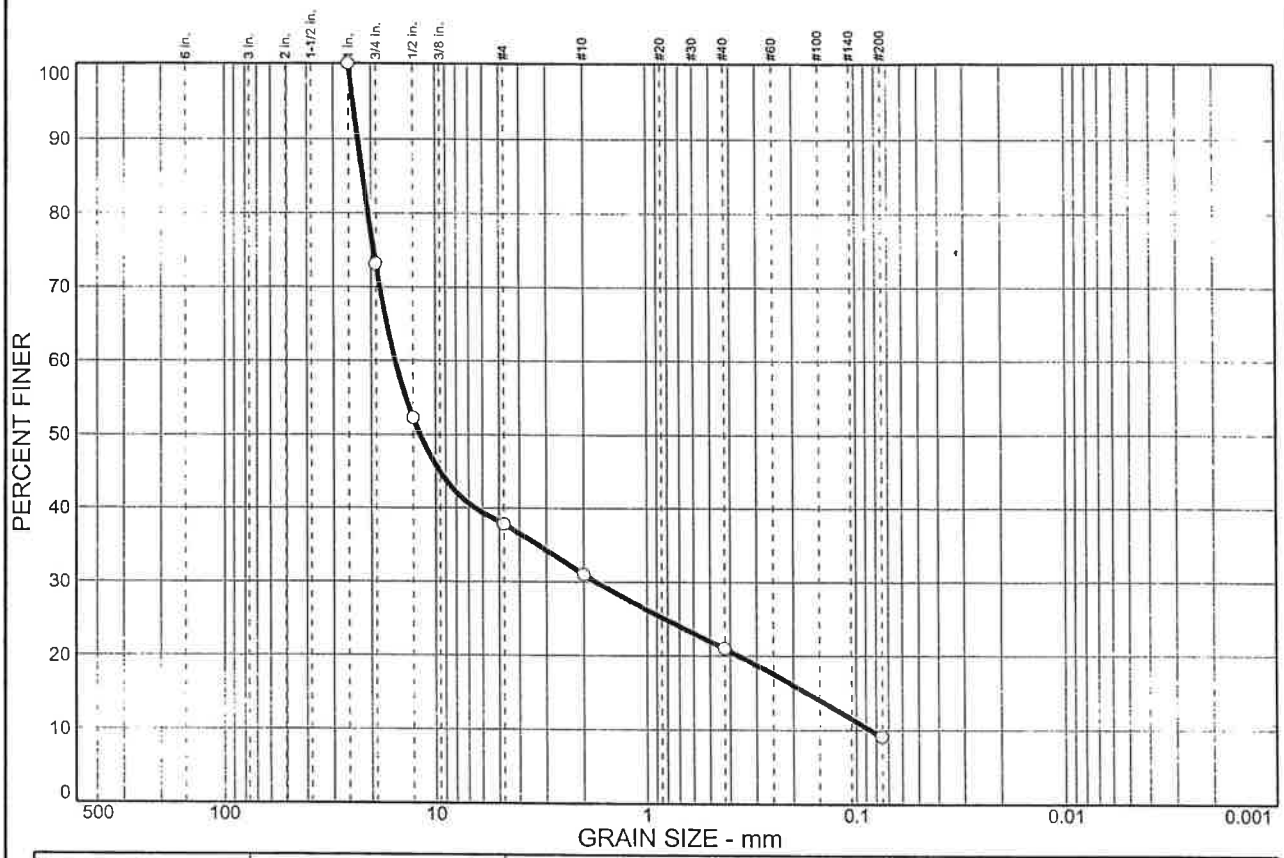
Since 1954

Client: TRC
Project: Fifth Street Bridge @ Feather River
Project No: 1R2/304/016 **Figure** 2

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	26.9	35.3	6.8	10.0	11.9	9.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
.75 in.	73.1		
.5 in.	52.2		
#4	37.8		
#10	31.0		
#40	21.0		
#200	9.1		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 21.8 D_{60}= 15.4 D_{50}= 11.8
D_{30}= 1.75 D_{15}= 0.172 D_{10}= 0.0850
C_u= 181.57 C_c= 2.34

Classification

USCS= AASHTO=

Remarks

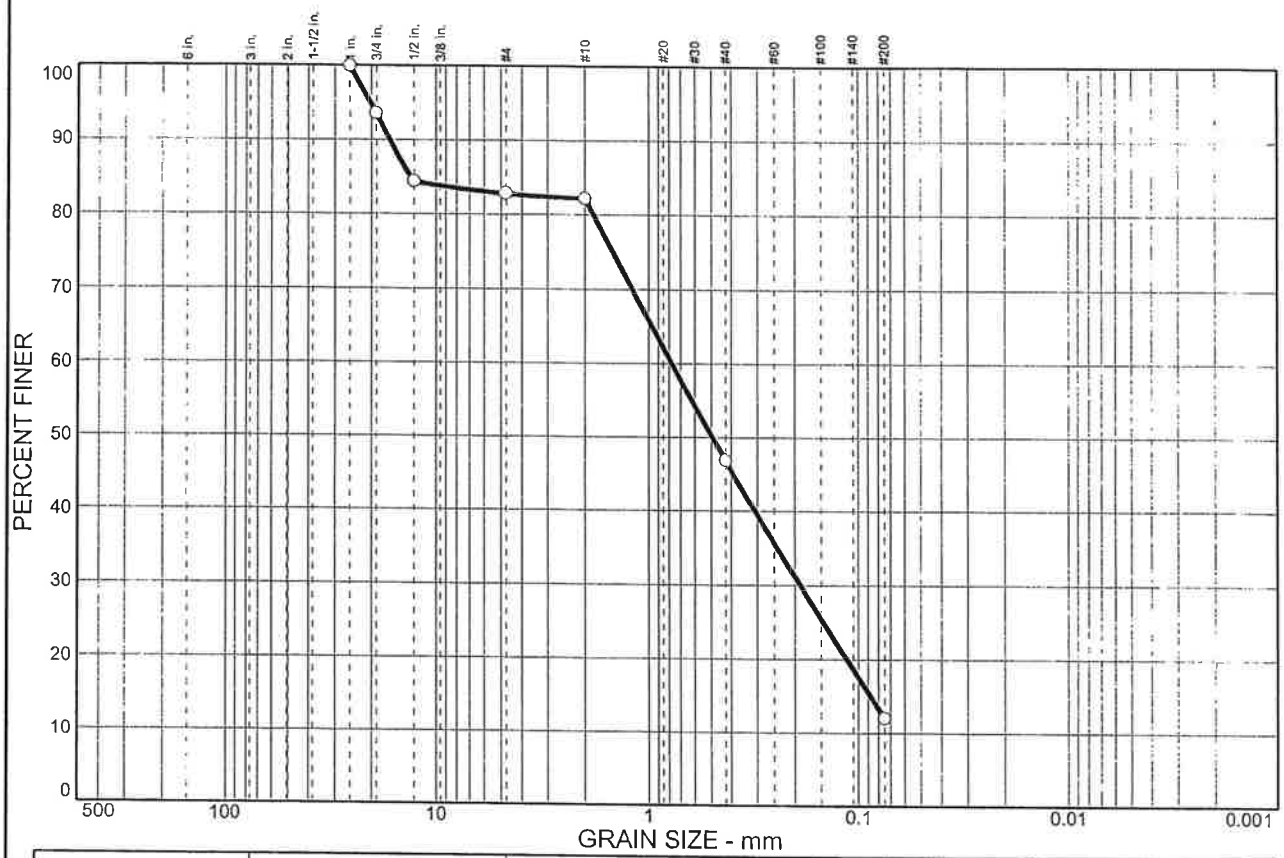
*Note: Sample tested precludes particle sizes>1.4" diameter.
Total dry weight of sample tested=439 grams.

Sample No.: 1/11 **Source of Sample:** **Date:** 8-22-07
Location: Boring 1 **Depth:** 55.0'-57.0'

Taber
Since 1954

Client: TRC
Project: Fifth Street Bridge @ Feather River
Project No: 1R2/304/016 **Figure** 2

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	6.4	10.8	0.6	35.4	34.8	12.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
.75 in.	93.6		
.5 in.	84.4		
#4	82.8		
#10	82.2		
#40	46.8		
#200	12.0		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 13.1 D_{60}= 0.773 D_{50}= 0.493
D_{30}= 0.188 D_{15}= 0.0875 D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

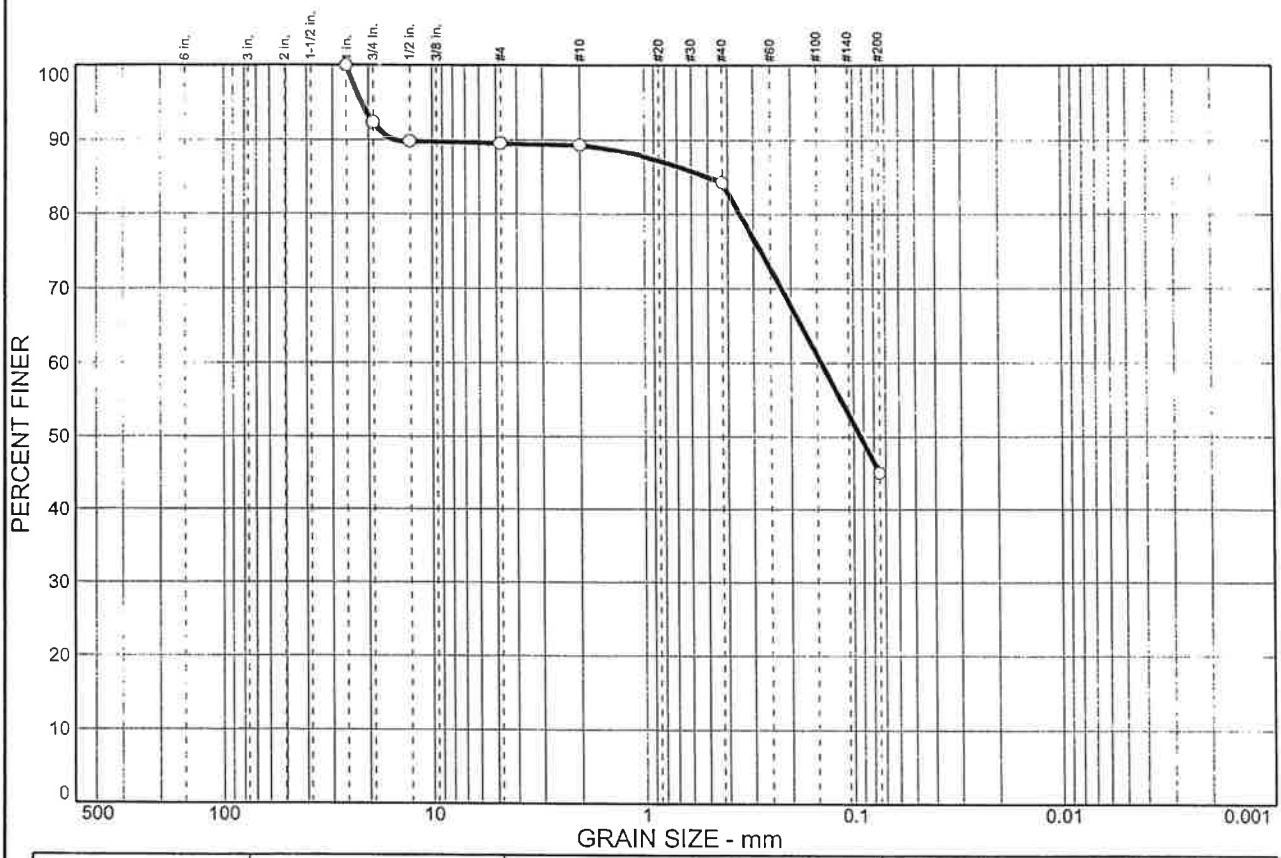
*Note: Sample tested precludes particle sizes>1.4" diameter.
Total dry weight of sample tested=656 grams.

Sample No.: 1/12 **Source of Sample:** **Date:** 8-22-07
Location: Boring 1 **Depth:** 60.0'-62.0'

Taber
Since 1954

Client: TRC
Project: Fifth Street Bridge @ Feather River
Project No: 1R2/304/016 **Figure** 2

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	7.7	2.8	0.2	5.1	39.2	45.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
.75 in.	92.3		
.5 in.	89.8		
#4	89.5		
#10	89.3		
#40	84.2		
#200	45.0		

* (no specification provided)

Material Description

Atterberg Limits

PL= NP LL= 29 PI= NP

Coefficients

D_{85}= 0.498 D_{60}= 0.143 D_{50}= 0.0929
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

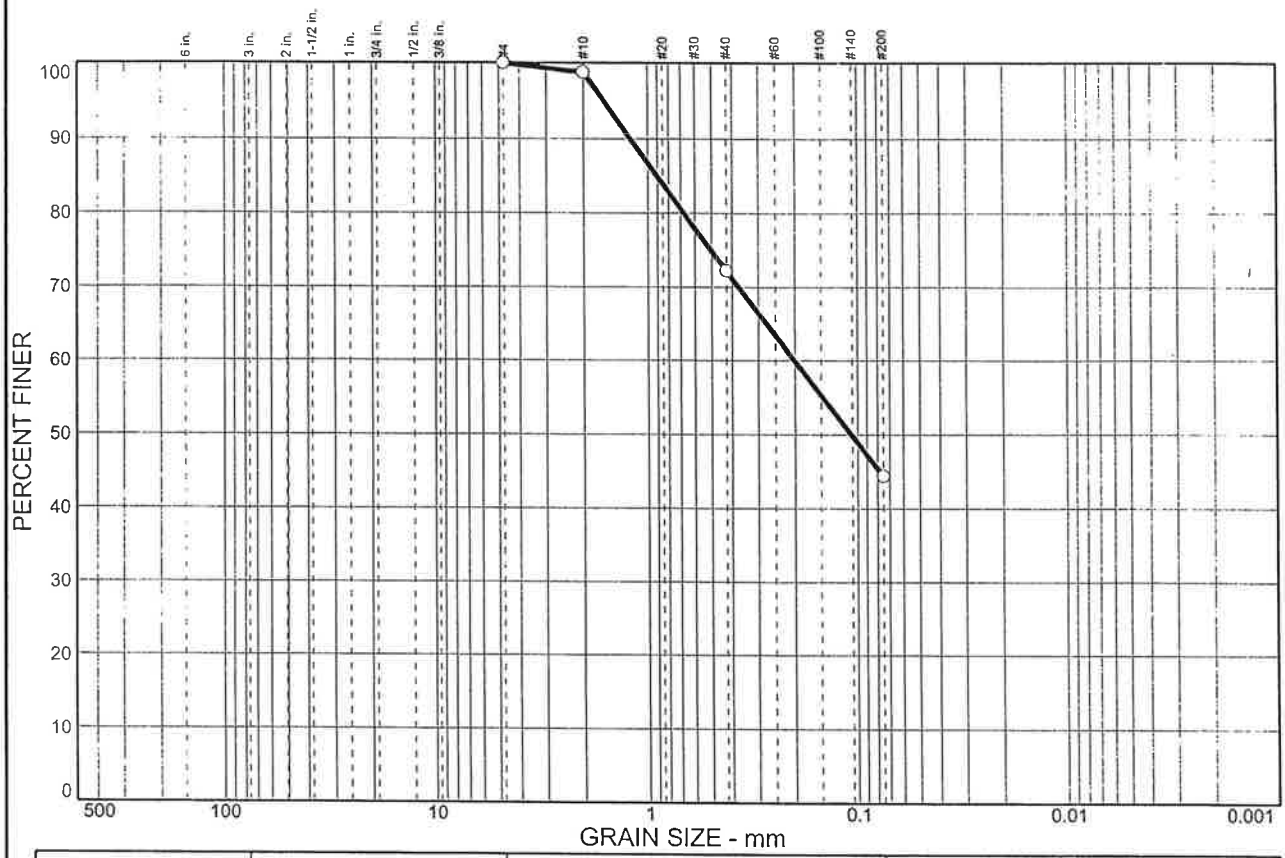
*Note: Sample tested precludes particle sizes>1.4" diameter.
Total dry weight of sample tested=1101 grams.

Sample No.: 1/13+1/14 comp. **Source of Sample:** **Date:** 8-22-07
Location: Boring 1 **Depth:** 65.0'-72.0'

Taber
Since 1954

Client: TRC
Project: Fifth Street Bridge @ Feather River
Project No: 1R2/304/016 **Figure** 2

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	1.2	26.6	27.8	44.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	98.8		
#40	72.2		
#200	44.4		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.904 D_{60}= 0.201 D_{50}= 0.107
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

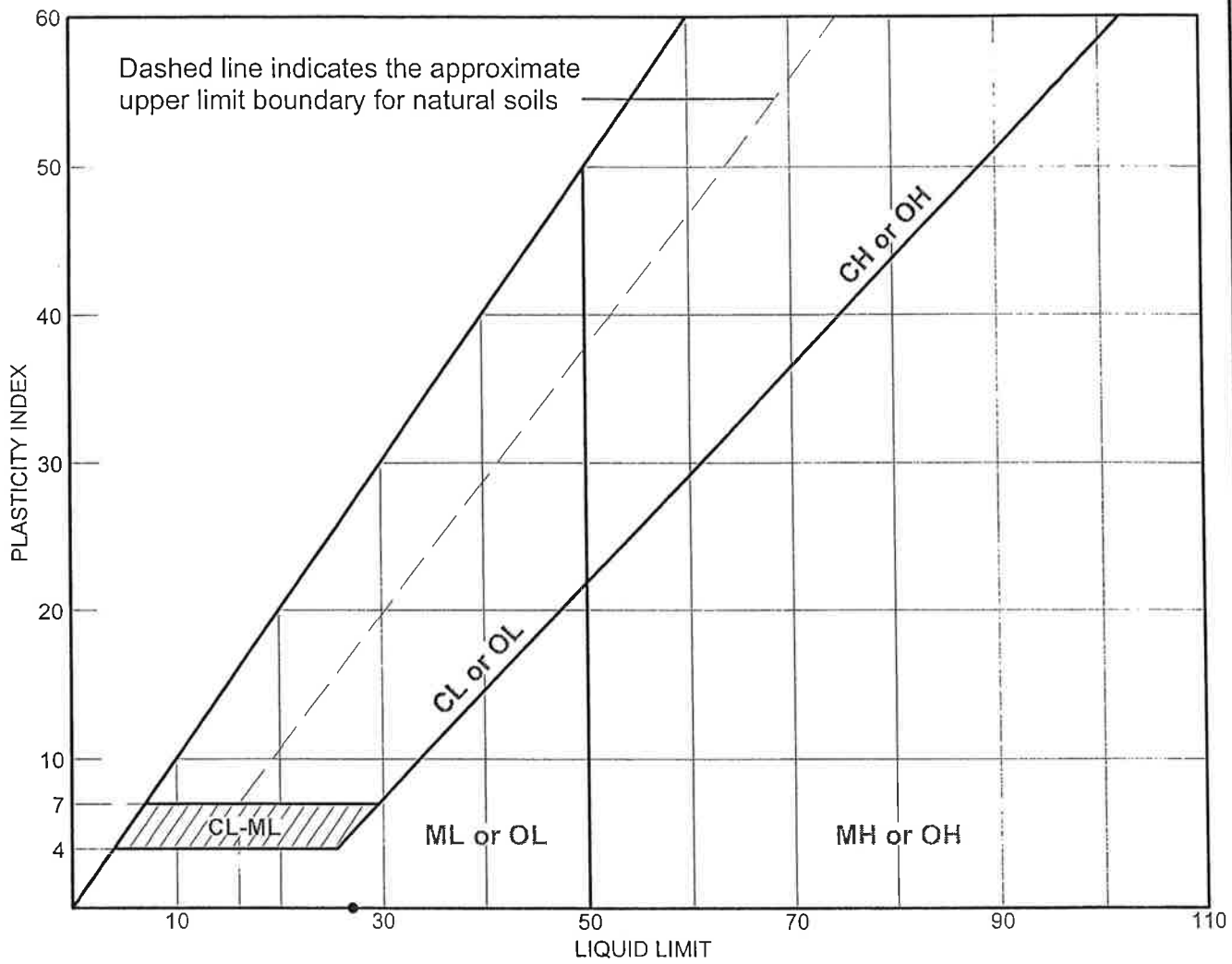
*Note: Sample tested precludes particle sizes>1.4" diameter.
Total dry weight of sample tested=284 grams.

Sample No.: 1/15+1/16 comp. **Source of Sample:** **Date:** 8-22-07
Location: Boring 1 **Depth:** 75.0'-82.0'

Taber
Since 1954

Client: TRC
Project: Fifth Street Bridge @ Feather River
Project No: 1R2/304/016 **Figure** 2

LIQUID AND PLASTIC LIMITS TEST REPORT



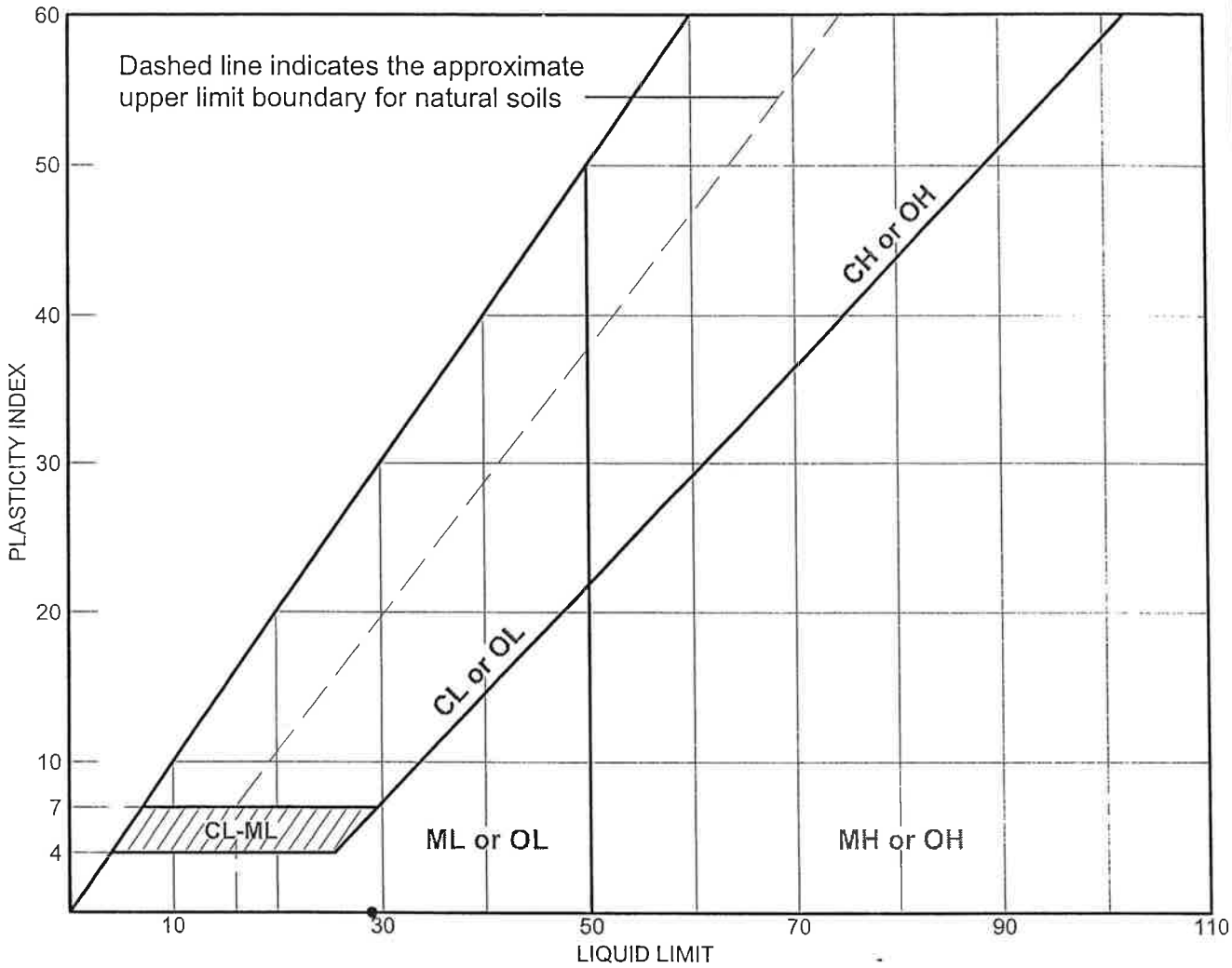
SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●		1/3,4A&1/6	15.0'-32.0'		NP	27	NP	

Taber
Since 1954

Client: TRC
Project: Fifth Street Bridge @ Feather River
Project No.: 1R2/304/016 **Figure** 2

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●		1/13+1/14	65.0'-72.0'		NP	29	NP	

Taber
Since 1954

Client: TRC
Project: Fifth Street Bridge @ Feather River
Project No.: 1R2/304/016 **Figure** 2

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/24/2007
Date Submitted 08/21/2007

To: Ralph Fisher
Taber Consultants
3911 West Capital Avenue
W. Sacramento, CA 95691-2116

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : IR2/304/016 Site ID : 1/3+1/4A+1/4B+.
Thank you for your business.

* For future reference to this analysis please use SUN # 51513-102883.

EVALUATION FOR SOIL CORROSION

Soil pH	5.49	
Minimum Resistivity	3.75 ohm-cm (x1000)	
Chloride	11.8 ppm	00.00118 %
Sulfate	62.1 ppm	00.00621 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

AUG 27 2007

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/24/2007
Date Submitted 08/21/2007

To: Ralph Fisher
Taber Consultants
3911 West Capital Avenue
W. Sacramento, CA 95691-2116

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : IR2/304/016 Site ID : 1/15+1/16 COMP..
Thank you for your business.

* For future reference to this analysis please use SUN # 51513-102884.

EVALUATION FOR SOIL CORROSION

Soil pH	7.77	
Minimum Resistivity	1.13 ohm-cm (x1000)	
Chloride	14.8 ppm	00.00148 %
Sulfate	31.5 ppm	00.00315 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

APPENDIX C

SITE-SPECIFIC IDEALIZED SOIL PROFILES AND SOIL PARAMETERS

DRAFT

Site-specific idealized soil profiles and soil parameters for pre- and post-liquefaction conditions are presented in this appendix, including one unified idealized soil profile for the Second Street OC, and individual idealized soil profile per support location for the proposed Fifth Street Bridge.

Table 1. Idealized Soil Profile and Soil Parameters (2nd Street OC, pre-/post-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
Above +60	Fill	3 to (26) N = 5	105	28	100	10	-	1300
+60 to +45	SM/SC/ML	6 to (22) N = 7	110	29	50	15 above GWE, 15 below GWE	-	1300
+45 to +35	SP/SP-SM/SM/ML	16 to (44) N = 20	120	33	50	60	-	1300
+35 to +10	ML/CL	20 to (75) N = 25	125	-	2,500	-	0.008	1300
+10 to -25	SP-SM/ML	(34) to (68) N = 24	125	34	50	70	-	1300 to 1400
-25 to -65	CL	(39) to (86/9.5”) N = 45	125	-	4,000	-	0.005	1400 to 1840
-65 to -100	SM/ML/MH	25 to REF N = 45	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft.
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-01).

Table 2. Idealized Soil Profile and Soil Parameters (Abutment 1, pre-/post-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
Above +60	Fill	3 to (26) N = 5	105	28	50	10	-	600 to 650
+60 to +50	SM/SC/ML	3 to (15) N = 7	110	29	50	15 above GWE, 15 below GWE	-	650 to 1100
+50 to +35	SP/SP-SM/SM/ML	16 to 18 N = 17	120	32	50	50	-	1100 to 1300
+35 to +15	ML/CL	(24) to (81/11”) N = 21	125	-	2,000	-	0.01	1300
+15 to -20	SP-SM/ML	(27) to 66 N = 23	125	34	50	70	-	1300
-20 to -60	CL	(39) to (86/9.5”) N = 45	125	-	4,000	-	0.005	1300 to 1840
-60 to -100	SM/ML/MH	25 to REF N = 45	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft (for slope stability analysis, use +80 ft).
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-01).

Table 3. Idealized Soil Profile and Soil Parameters (Bent 2, pre-/post-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+42 to +32	SP/ML	1 to 18 N = 5	105	28	50	10	-	1000 to 1300
+32 to +17	CL/ML	(24) to (81/11”) N = 20	120	-	2000	-	0.01	1300
+17 to -18	SP-SM/SM/ML	(27) to 66 N = 35	125	36	50	90	-	1300 to 1840
-18 to -53	CL	(39) to (86/9.5”) N = 45	125	-	4,000	-	0.005	1840
-53 to -100	SM/ML	25 to REF N = 45	130	38	50	118	-	1840

Notes:

4. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
5. Design ground water elevation is +50 ft.
6. Estimated from the Vs measurements of adjacent CPT (DE-CPT-01).

Table 4a. Idealized Soil Profile and Soil Parameters (Bent 3, pre-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+35 to +5	SP/SP	N = 5	105	28	50	10	-	500
+5 to -10	SP-SM	14 to (47) N = 22	120	34	50	70	-	500 to 1000
-10 to -50	CL/ML	24 to (50/6”) N = 30	125	-	4,000	-	0.005	1000 to 1840
-50 to -100	SM/ML/SP	N = 45	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft.
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-02).

Table 4b. Idealized Soil Profile and Soil Parameters (Bent 3, post-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+35 to +5	Liquefied layer	N = 5	105	-	400	-	0.015	300
+5 to -10	SP-SM	14 to (47) N = 22	120	34	50	70	-	500 to 1000
-10 to -50	CL/ML	24 to (50/6”) N = 30	125	-	4,000	-	0.005	1000 to 1840
-50 to -100	SM/ML/SP	N = 45	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft.
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-02).

Table 5a. Idealized Soil Profile and Soil Parameters (Bent 4, pre-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+55 to +35	CL/SM	(9) to 8 N =7	110	-	800	-	0.012	500
+35 to +5	SP-SMP	2 to (17) N = 5	105	28	50	10	-	500 to 1000
+5 to -10	GP-GM	14 to (47) N = 22	120	34	50	70	-	1000 to 1200
-10 to -50	ML/SM/CH	24 to (50/6") N = 30	125	-	4,000	-	0.005	1200 to 1840
-50 to -100	SM/GW/CL	(50/1") to REF N = 45	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft.
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-02).

Table 5b. Idealized Soil Profile and Soil Parameters (Bent 4, post-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+55 to +35	CL/SM	(9) to 8 N =7	110	-	800	-	0.012	500
+35 to +5	Liquefied layer	N = 5	105	-	400	-	0.015	300
+5 to -10	GP-GM	14 to (47) N = 22	120	34	50	70	-	1000 to 1200
-10 to -50	ML/SM/CH	24 to (50/6") N = 30	125	-	4,000	-	0.005	1200 to 1840
-50 to -100	SM/GW/CL	(50/1") to REF N = 45	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft.
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-02).

Table 6a. Idealized Soil Profile and Soil Parameters (Bent 5, pre-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+53 to +43	ML	N =4	105	-	500	-	0.014	500
+43 to +13	SP-SM	(2) to 20 N = 5	105	28	50	10	-	500 to 600
+13 to -7	GP-GM	24 to (54/6") N = 24	120	34	50	70	-	600 to 1400
-7 to -47	ML/SM/CH	27 to 57 N = 30	125	-	4,000	-	0.005	1400 to 1840
-47 to -100	SM/GW/CL	64 to REF N = 64	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft.
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-03).

Table 6b. Idealized Soil Profile and Soil Parameters (Bent 5, post-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+53 to +43	ML	N =4	105	-	500	-	0.014	500
+43 to +13	Liquefied layer	(2) to 20 N = 5	105	-	400	-	0.015	300
+13 to -7	GP-GM	24 to (54/6") N = 24	120	34	50	70	-	600 to 1400
-7 to -47	ML/SM/CH	27 to 57 N = 30	125	-	4,000	-	0.005	1400 to 1840
-47 to -100	SM/GW/CL	64 to REF N = 64	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft.
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-03).

Table 7a. Idealized Soil Profile and Soil Parameters (Bent 6, pre-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+55 to +45	ML	N =4	105	-	500	-	0.014	550
+45 to +20	SP-SM/SM	(10) to 10 N = 5	105	28	50	10	-	550 to 900
+20 to +10	GP-GM	9 to 66 N = 23	120	34	50	70	-	900 to 1000
+10 to -45	CL/.ML/SM	(40) to (90/10”) N = 30	125	-	4,000	-	0.005	1000 to 1840
-45 to -100	SM/CL/GW	70 to REF N = 64	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft.
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-04).

Table 7b. Idealized Soil Profile and Soil Parameters (Bent 6, post-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+55 to +45	ML	N =4	105	-	500	-	0.014	550
+45 to +20	Liquefied layer	(10) to 10 N = 5	105	-	400	-	0.015	300
+20 to +10	GP-GM	9 to 66 N = 23	120	34	50	70	-	900 to 1000
+10 to -45	CL/.ML/SM	(40) to (90/10”) N = 30	125	-	4,000	-	0.005	1000 to 1840
-45 to -100	SM/CL/GW	70 to REF N = 64	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft.
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-0405).

Table 8a. Idealized Soil Profile and Soil Parameters (Bent 7, pre-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+55 to +45	SM	N =18	110	32	50	70 +GWE, 50 -	-	550
+45 to +10	ML/SP-SM/CL	2 to (13) N = 5	105	28	50	10	-	550 to 600
+10 to +5	SP-SM	(62) to 52 N = 30	125	36	50	90	-	600 to 650
+5 to -45	CL/.ML/SM	(62) to REF N = 35	125	-	4,000	-	0.005	650 to 1840
-45 to -100	SM/CL-ML/GW	68 to REF N = 64	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft.
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-04).

Table 8b. Idealized Soil Profile and Soil Parameters (Bent 7, post-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+55 to +45	SM	N =18	110	32	50	70 +GWE, 50 -	-	550
+45 to +10	Liquefied layer	2 to (13) N = 5	105	-	400	-	0.015	300
+10 to +5	SP-SM	(62) to 52 N = 30	125	36	50	90	-	600 to 650
+5 to -45	CL/.ML/SM	(62) to REF N = 35	125	-	4,000	-	0.005	650 to 1840
-45 to -100	SM/CL-ML/GW	68 to REF N = 64	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft.
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-04).

Table 9a. Idealized Soil Profile and Soil Parameters (Bent 8, pre-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+53 to +48	ML/SM	N =6	105	28	50	10, 10	-	550
+48 to +13	SM/SP-SM	(5) to 14 N = 5	105	28	50	10	-	550 to 800
+13 to +8	SP-SM	31 to 68 N = 32	125	36	50	90	-	800
+8 to -32	CL/.ML/SM	27 to (53/6”) N = 32	125	-	4,000	-	0.005	800 to 1840
-32 to -100	SM/ML/GW	58 to REF N = 60	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft.
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-05).

Table 9b. Idealized Soil Profile and Soil Parameters (Bent 8, post-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+53 to +48	ML/SM	N =6	105	28	50	10, 10	-	550
+48 to +13	Liquefied layer	(5) to 14 N = 5	105	-	400	-	0.015	300
+13 to +8	SP-SM	31 to 68 N = 32	125	36	50	90	-	800
+8 to -32	CL/.ML/SM	27 to (53/6”) N = 32	125	-	4,000	-	0.005	800 to 1840
-32 to -100	SM/ML/GW	58 to REF N = 60	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft.
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-05).

Table 10a. Idealized Soil Profile and Soil Parameters (Bent 9, pre-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+54 to +49	SM	N =6	105	28	50	10, 10	-	600
+49 to +24	SM/SP	(7) to 36 N = 5	105	28	50	10	-	600 to 700
+24 to +14	GP	30 to 58 N = 32	125	36	50	90	-	700 to 800
+14 to -46	CL/.ML/SM	33 to (50/5”) N = 34	125	-	4,000	-	0.005	800 to 1840
-46 to -100	SM/ML/GW	57 to REF N = 60	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft.
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-06).

Table 10b. Idealized Soil Profile and Soil Parameters (Bent 9, post-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+54 to +49	SM	N =6	105	28	50	10, 10	-	600
+49 to +24	Liquefied layer	(7) to 36 N = 5	105	-	400	-	0.015	300
+24 to +14	GP	30 to 58 N = 32	125	36	50	90	-	700 to 800
+14 to -46	CL/.ML/SM	33 to (50/5”) N = 34	125	-	4,000	-	0.005	800 to 1840
-46 to -100	SM/ML/GW	57 to REF N = 60	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft.
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-06).

Table 11a. Idealized Soil Profile and Soil Parameters (Bent 10, pre-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+55 to +50	SM	N =10	110	30	50	45, 33	-	650
+50 to +30	SM	(5) to 8 N = 5	105	28	50	10	-	650 to 750
+30 to +20	GP	N = 15	120	32	50	50	-	750
+20 to -50	CL/.ML/SM	30 to (50/5”) N = 34	125	-	4,000	-	0.005	750 to 1840
-50 to -100	SP-SM/GW	56 to REF N = 60	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft.
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-06).

Table 11b. Idealized Soil Profile and Soil Parameters (Bent 10, post-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+55 to +50	SM	N =10	110	30	50	45, 33	-	650
+50 to +30	Liquefied layer	(5) to 8 N = 5	105	-	400	-	0.015	300
+30 to +20	GP	N = 15	120	32	50	50	-	750
+20 to -50	CL/.ML/SM	30 to (50/5”) N = 34	125	-	4,000	-	0.005	750 to 1840
-50 to -100	SP-SM/GW	56 to REF N = 60	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft.
3. Estimated from the Vs measurements of adjacent CPTs (DE-CPT-06).

Table 12a. Idealized Soil Profile and Soil Parameters (Abutment 11, pre-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+88 to +57	Fill	14 to (28) N =15	110	32	100	70	-	600
+57 to +52	SM/ML	9 to (27) N =10	110	30	50	45, 33	-	600
+52 to +32	SM	(12) to 19 N = 6	105	28	50	10	-	600 to 650
+32 to +22	GP/SP-SM	(14) to REF N = 15	120	32	50	50	-	650 to 900
+22 to -48	ML/SM	28 to 50/2” N = 34	125	-	4,000	-	0.005	900 to 1840
-48 to -100	SP-SM/GW	N = 50	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft (for slope stability analysis, use +80 ft).
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-06).

Table 12b. Idealized Soil Profile and Soil Parameters (Abutment 11, post-liquefaction)

Approx. Elevation (ft)	Predominant Soil Type	Range of Corrected SPT Blowcount [1]; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion / Undrained Shear Strength (psf)	Initial Subgrade Modulus, k (pci)	Strain at 50% of the Max. Stress, ε_{50}	Shear Wave Velocity, Vs[3] (fps)
+88 to +57	Fill	14 to (28) N =15	110	32	100	70	-	600
+57 to +52	SM/ML	9 to (27) N =10	110	30	50	45, 33	-	600
+52 to +32	Liquefied layer	(12) to 19 N = 6	105	-	400	-	0.015	300
+32 to +22	GP/SP-SM	(14) to REF N = 15	120	32	50	50	-	650 to 900
+22 to -48	ML/SM	28 to 50/2” N = 34	125	-	4,000	-	0.005	900 to 1840
-48 to -100	SP-SM/GW	N = 50	130	38	50	118	-	1840

Notes:

1. Values in ( ) are converted SPT blowcounts corrected for sampler size using a correction of 0.5 for coarse-grained soils and 0.7 for fine-grained soils.
2. Design ground water elevation is +50 ft (for slope stability analysis, use +80 ft).
3. Estimated from the Vs measurements of adjacent CPT (DE-CPT-06).

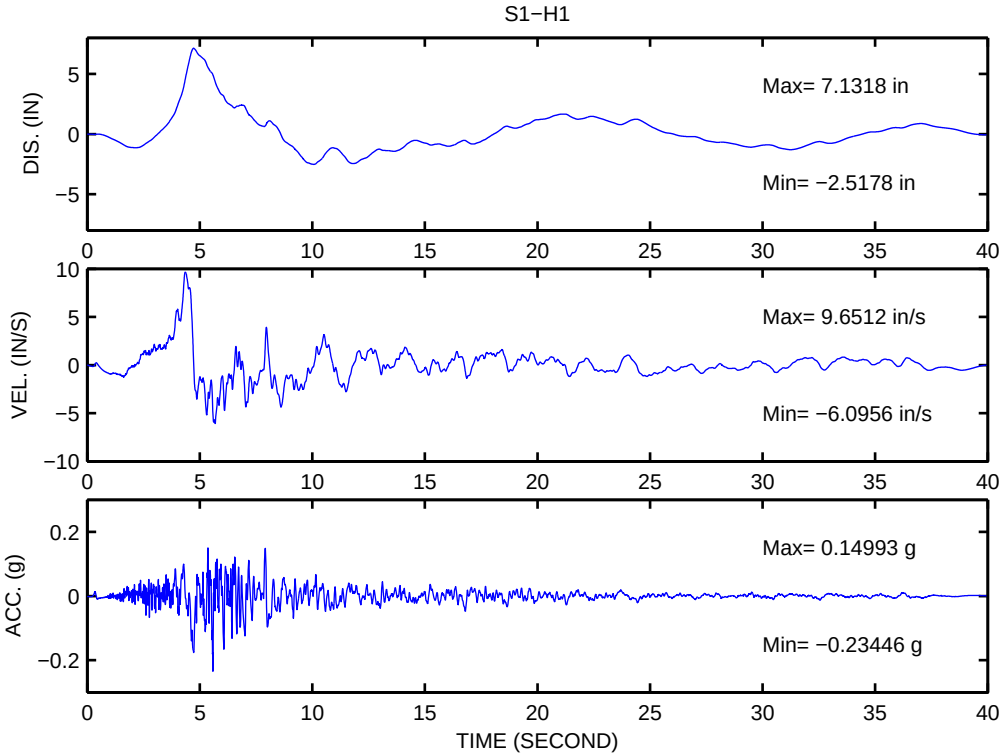
APPENDIX D

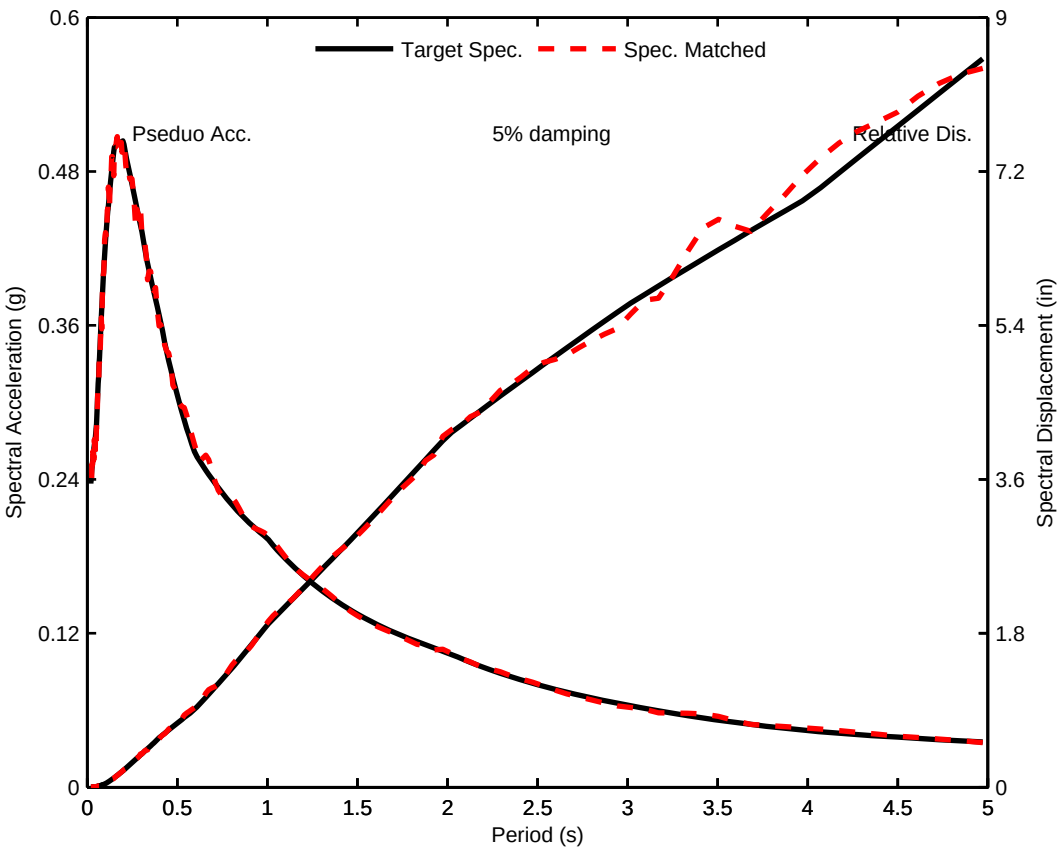
SPECTRUM-COMPTIBLE, DEPTH-VARYING FREE-FIELD, AND KINEMATIC MOTIONS

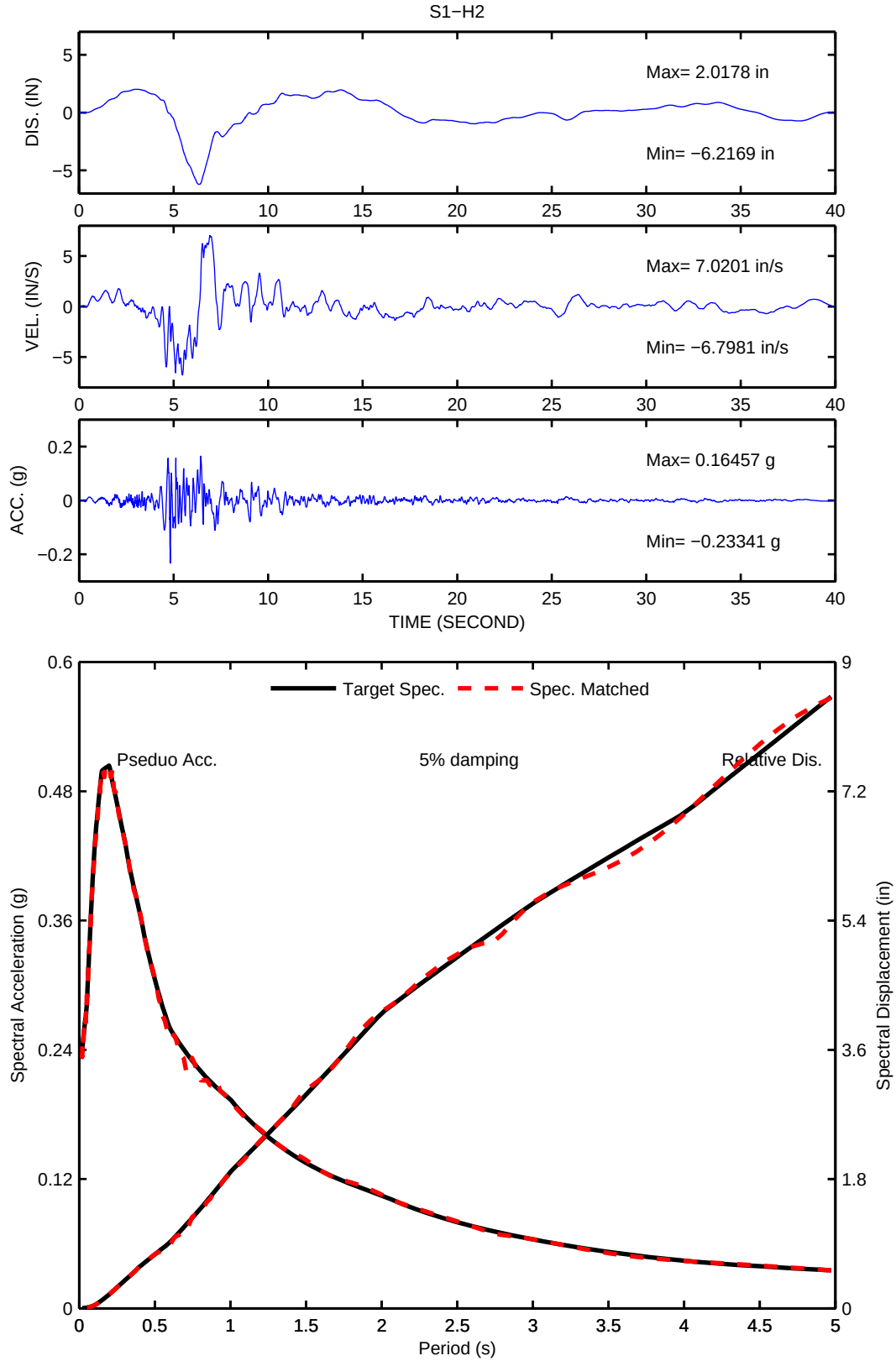
DRAFT

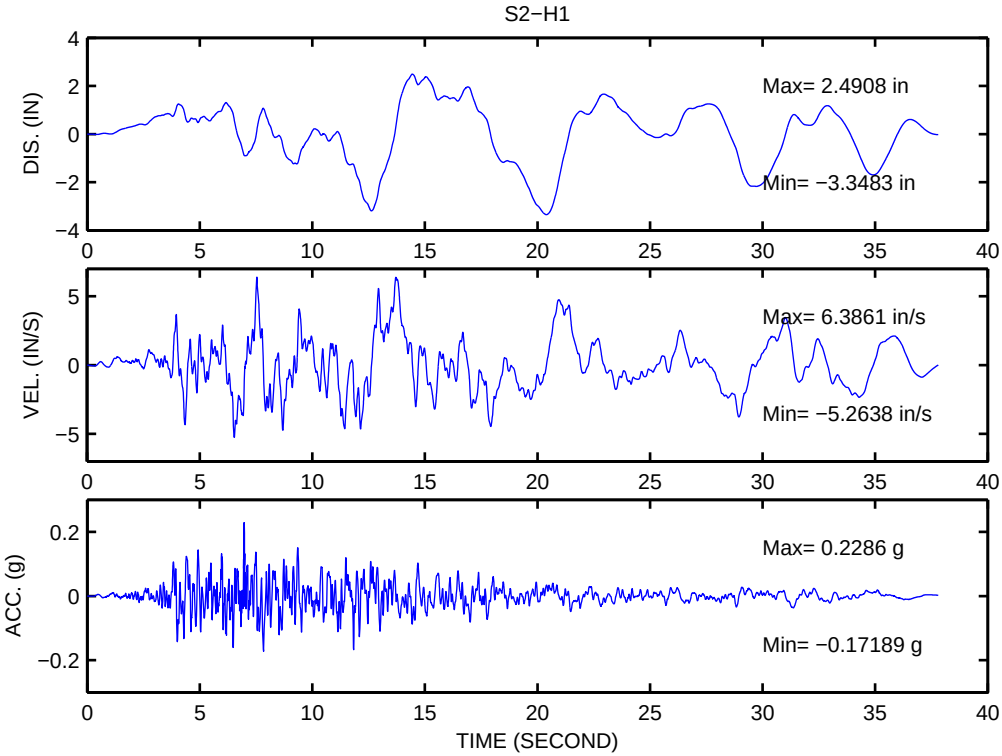
Spectrum-Compatible Motions (3 sets and 2 components FN, FP)

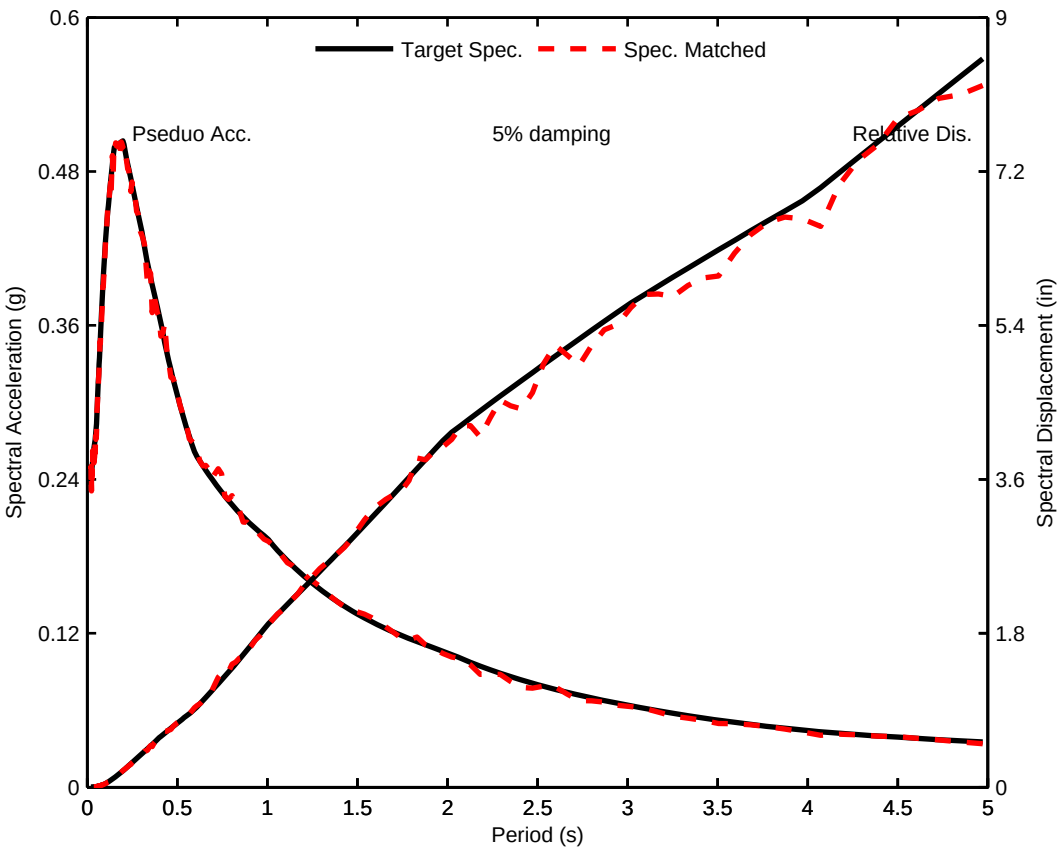
Checked by CY

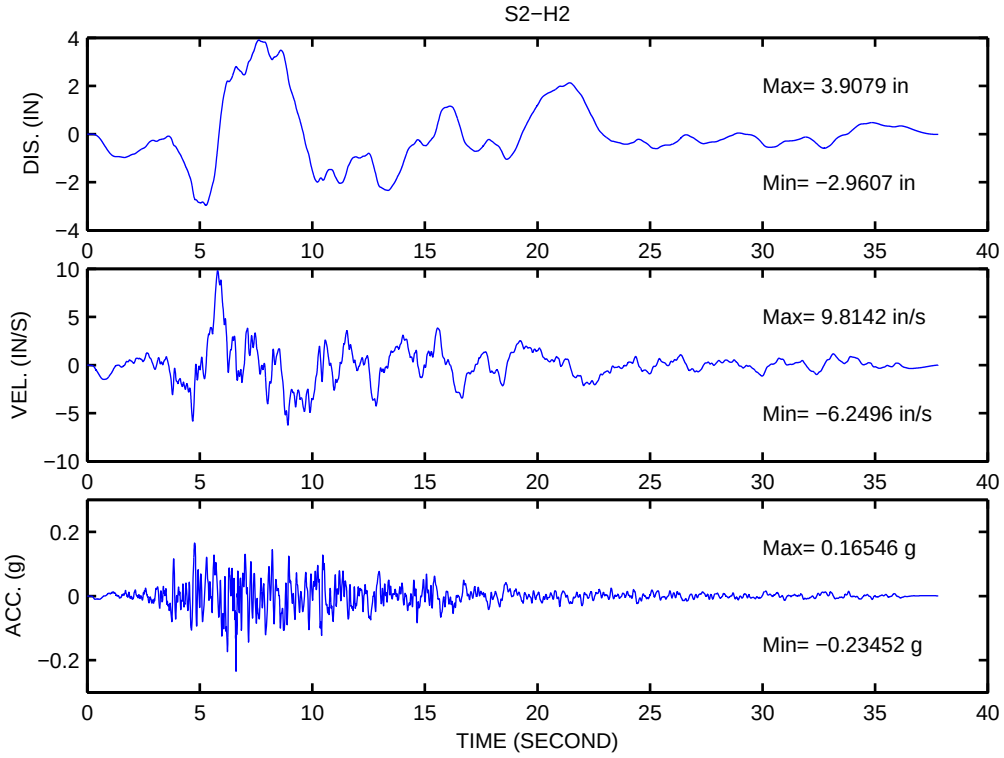

S1−H1
DIS. (IN)
Max= 7.1318 in
Min= −2.5178 in
VEL. (IN/S)
Max= 9.6512 in/s
Min= −6.0956 in/s
ACC. (g)
Max= 0.14993 g
Min= −0.23446 g
TIME (SECOND)

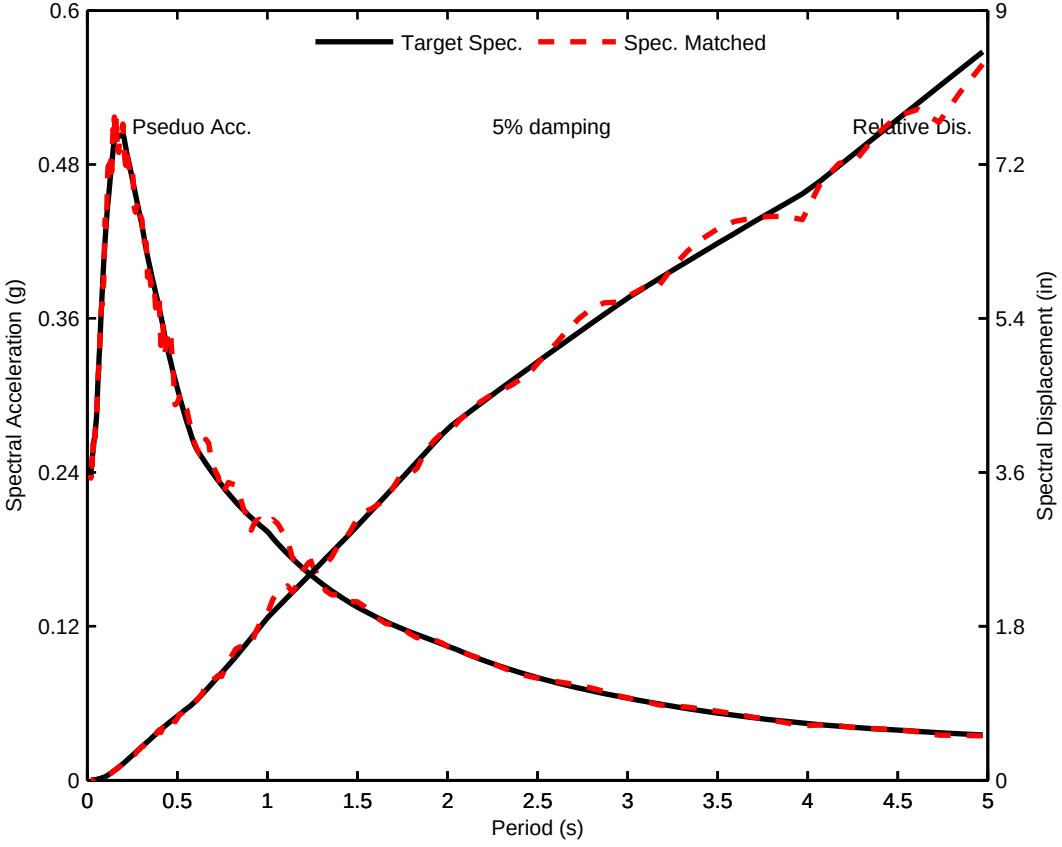

Target Spec.
Spec. Matched
Pseduo Acc.
5% damping
Relative Dis.
Spectral Acceleration (g)
Spectral Displacement (in)
Period (s)

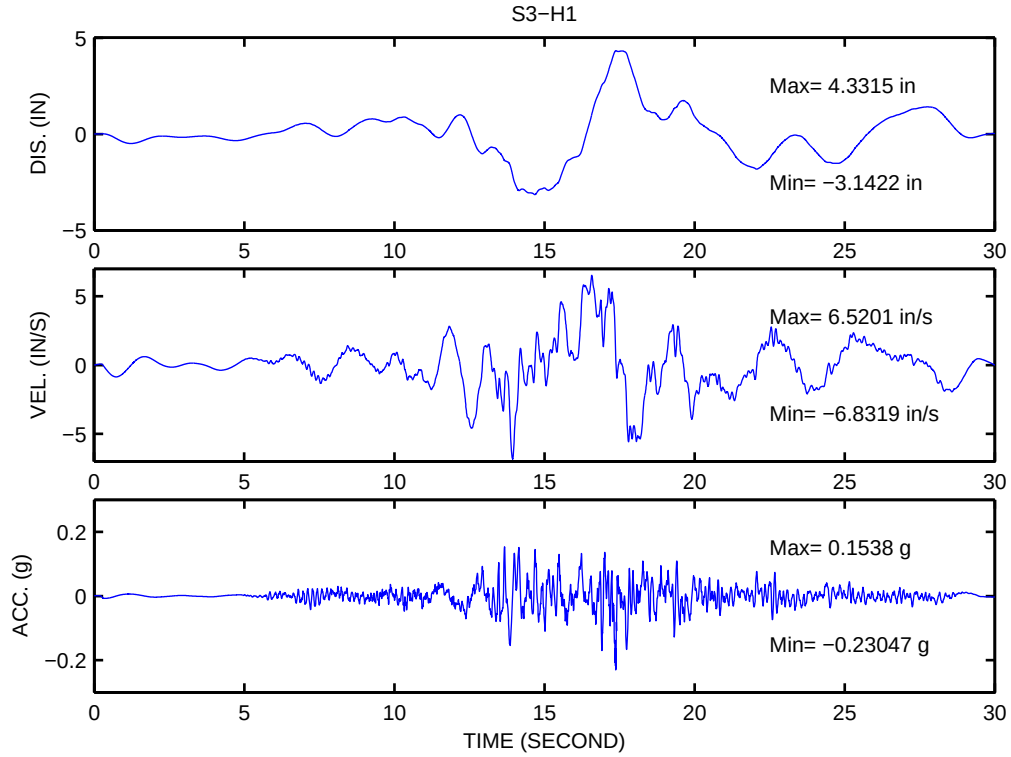

S1−H2
DIS. (IN)
Max= 2.0178 in
Min= −6.2169 in
VEL. (IN/S)
Max= 7.0201 in/s
Min= −6.7981 in/s
ACC. (g)
Max= 0.16457 g
Min= −0.23341 g
TIME (SECOND)
Target Spec.
Spec. Matched
Pseduo Acc.
5% damping
Relative Dis.
Spectral Acceleration (g)
Spectral Displacement (in)
Period (s)

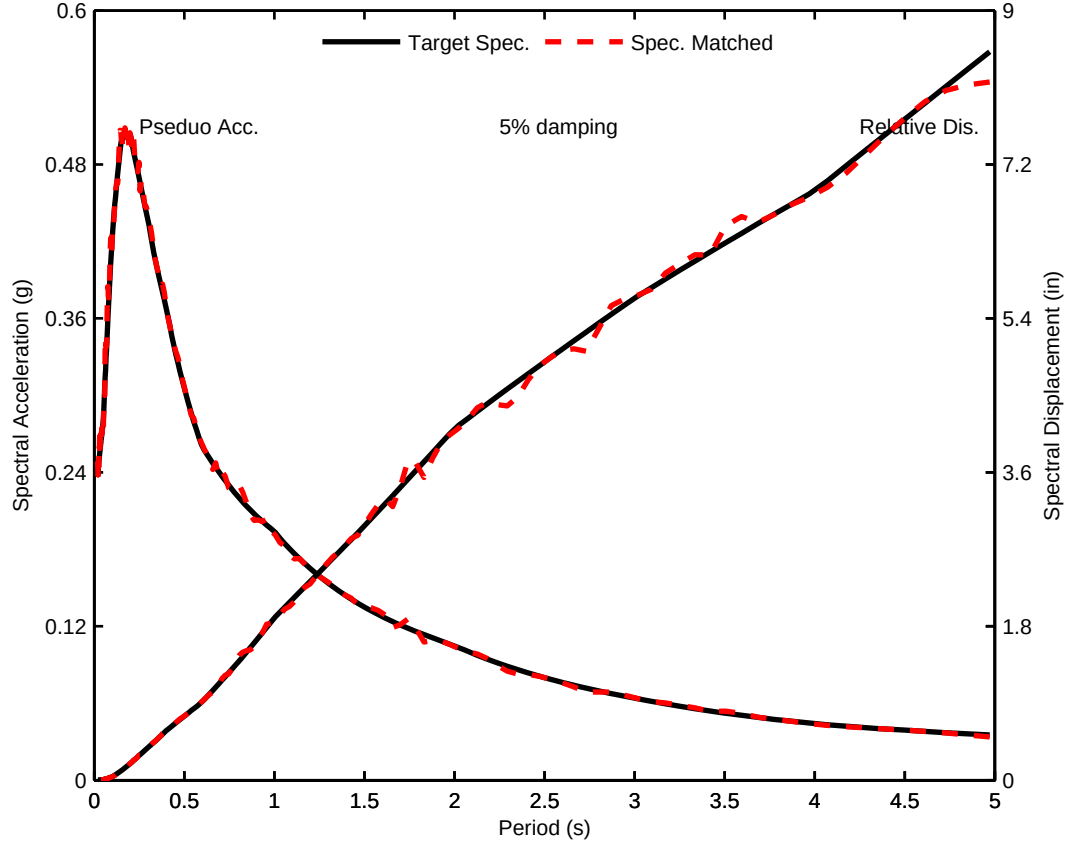

S2−H1
DIS. (IN)
Max= 2.4908 in
Min= −3.3483 in
VEL. (IN/S)
Max= 6.3861 in/s
Min= −5.2638 in/s
ACC. (g)
Max= 0.2286 g
Min= −0.17189 g
TIME (SECOND)

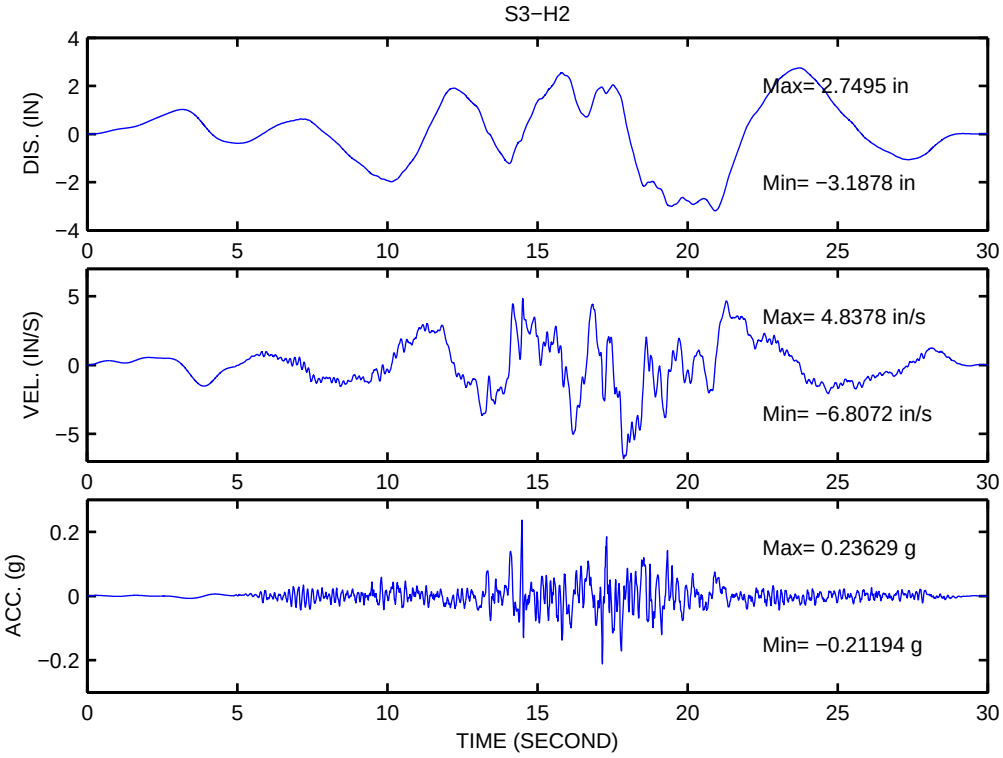

Target Spec.
Spec. Matched
Pseduo Acc.
5% damping
Relative Dis.
Spectral Acceleration (g)
Spectral Displacement (in)
Period (s)

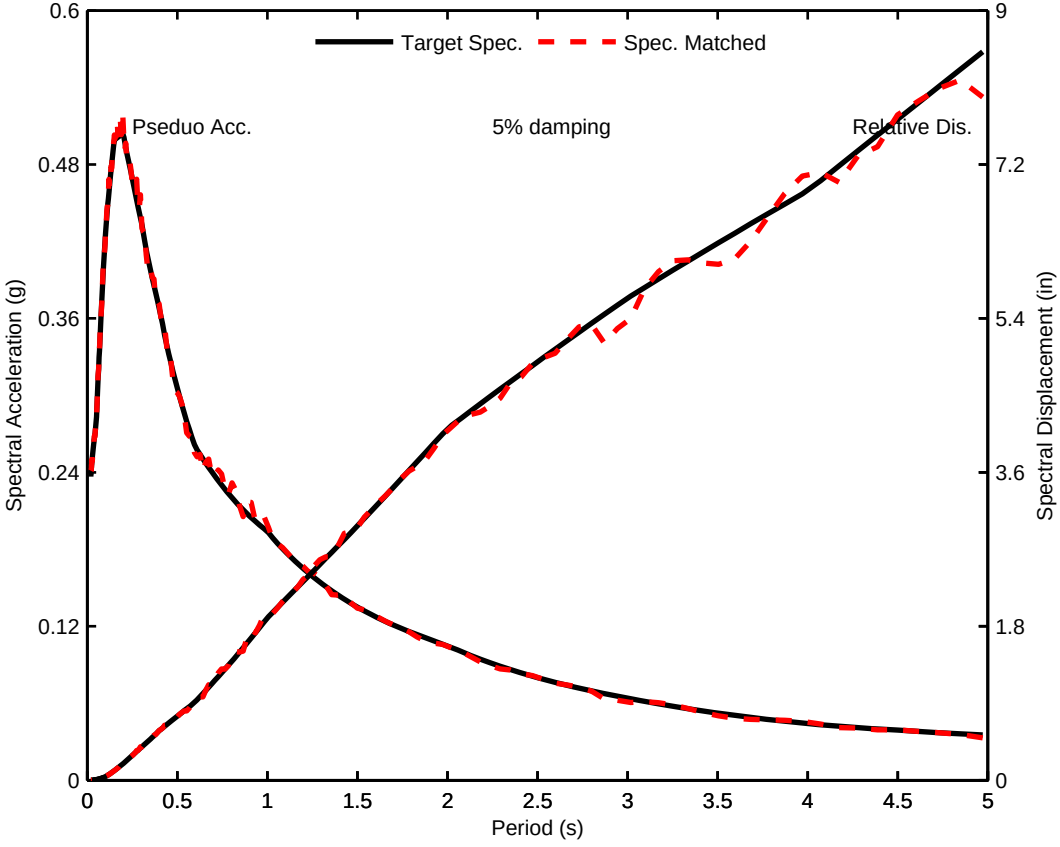

S2−H2
DIS. (IN)
Max= 3.9079 in
Min= −2.9607 in
VEL. (IN/S)
Max= 9.8142 in/s
Min= −6.2496 in/s
ACC. (g)
Max= 0.16546 g
Min= −0.23452 g
TIME (SECOND)


Target Spec.
Spec. Matched
Pseduo Acc.
5% damping
Relative Dis.
Spectral Acceleration (g)
Spectral Displacement (in)
Period (s)


S3−H1
DIS. (IN)
Max= 4.3315 in
Min= −3.1422 in
VEL. (IN/S)
Max= 6.5201 in/s
Min= −6.8319 in/s
ACC. (g)
Max= 0.1538 g
Min= −0.23047 g
TIME (SECOND)


Target Spec.
Spec. Matched
Pseduo Acc.
5% damping
Relative Dis.
Spectral Acceleration (g)
Spectral Displacement (in)
Period (s)

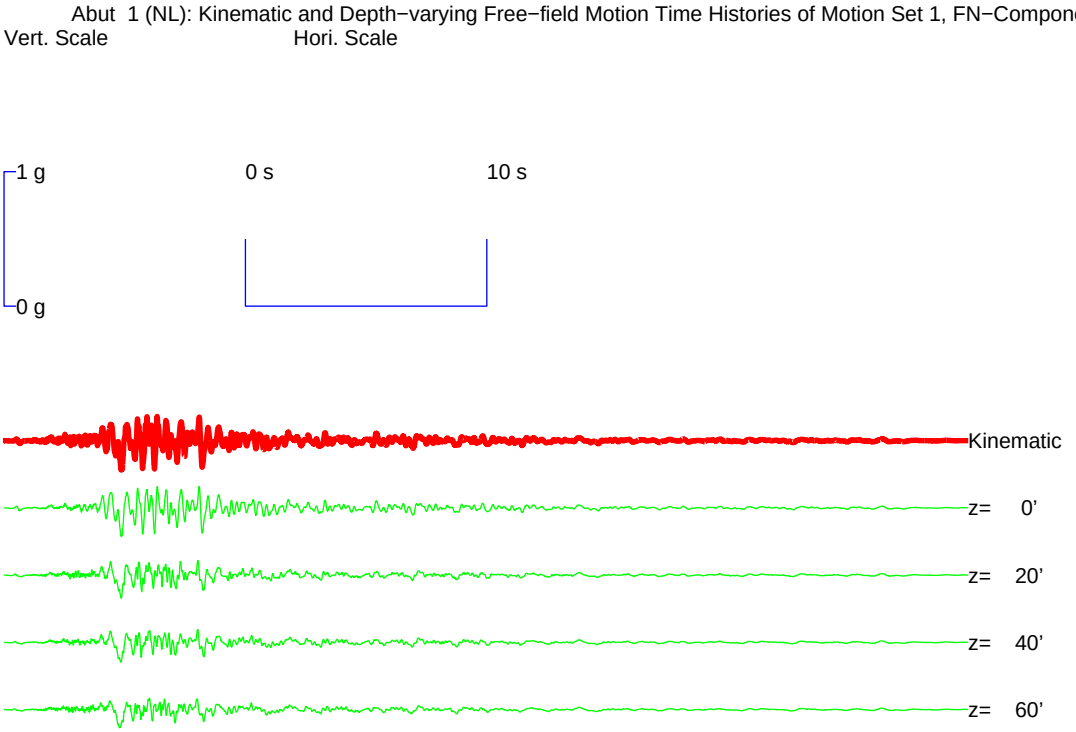

S3−H2
DIS. (IN)
Max= 2.7495 in
Min= −3.1878 in
VEL. (IN/S)
Max= 4.8378 in/s
Min= −6.8072 in/s
ACC. (g)
Max= 0.23629 g
Min= −0.21194 g
TIME (SECOND)

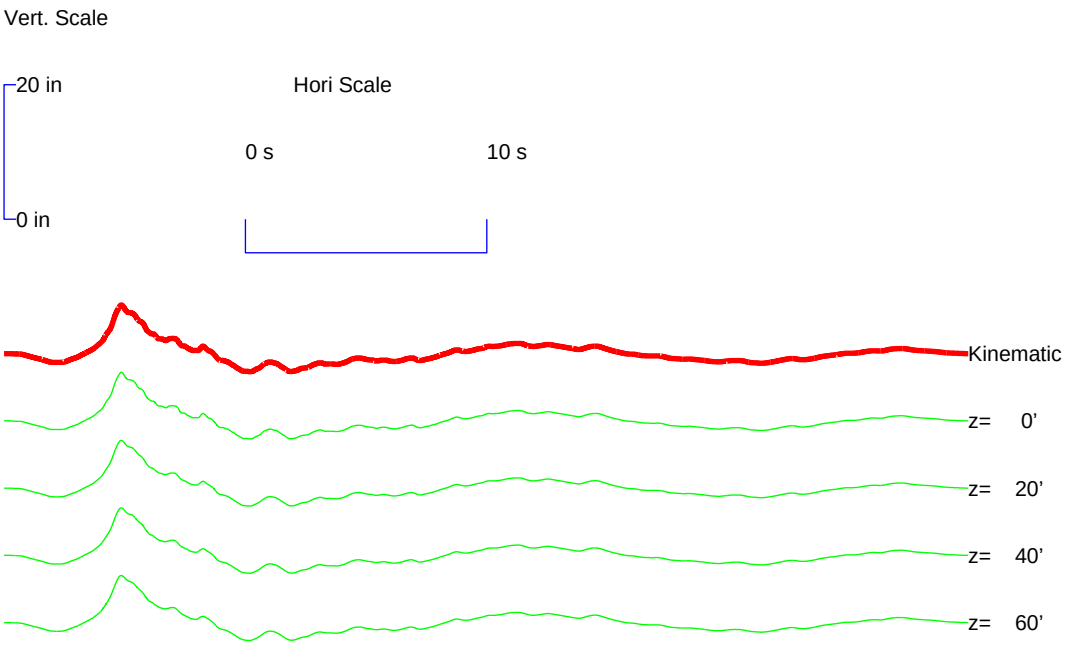

Target Spec.
Spec. Matched
Pseduo Acc.
5% damping
Relative Dis.
Spectral Acceleration (g)
Spectral Displacement (in)
Period (s)

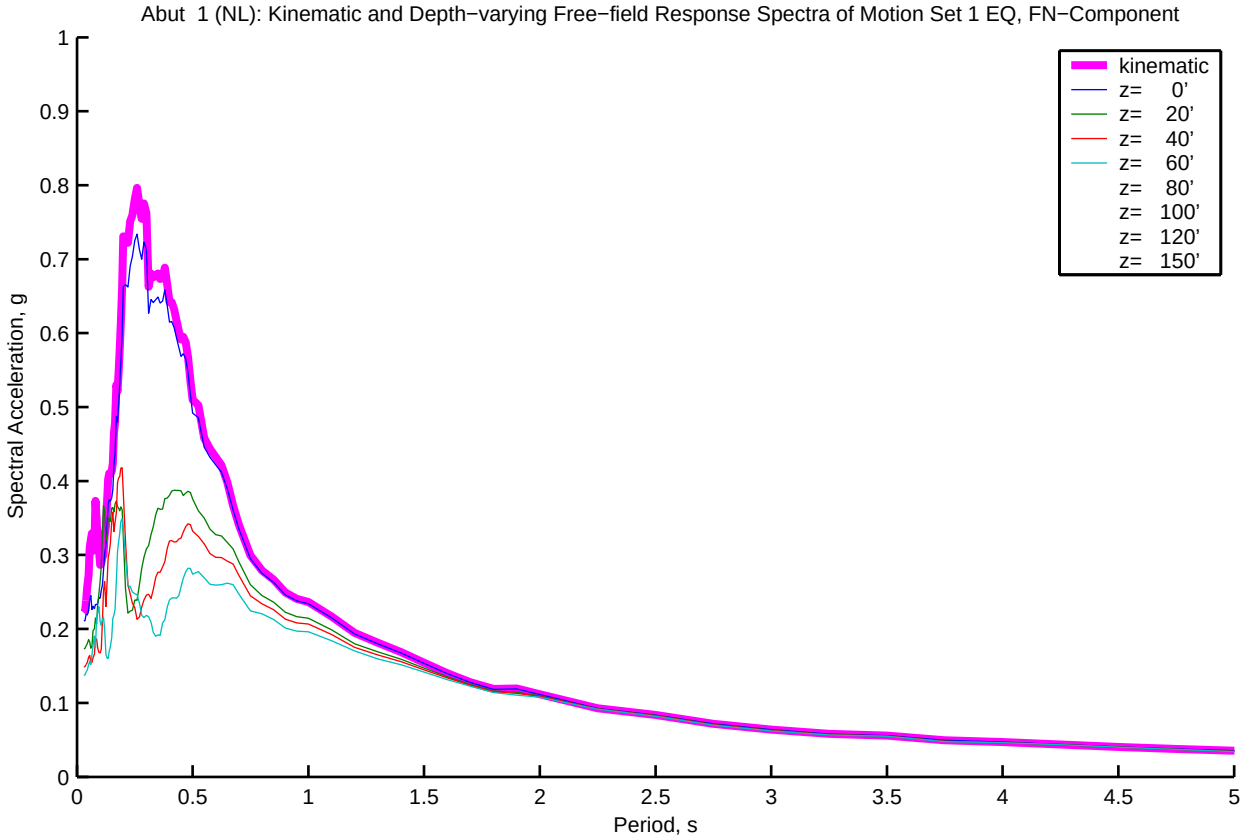
Depth-Varying Free-Field and Kinematic Motions

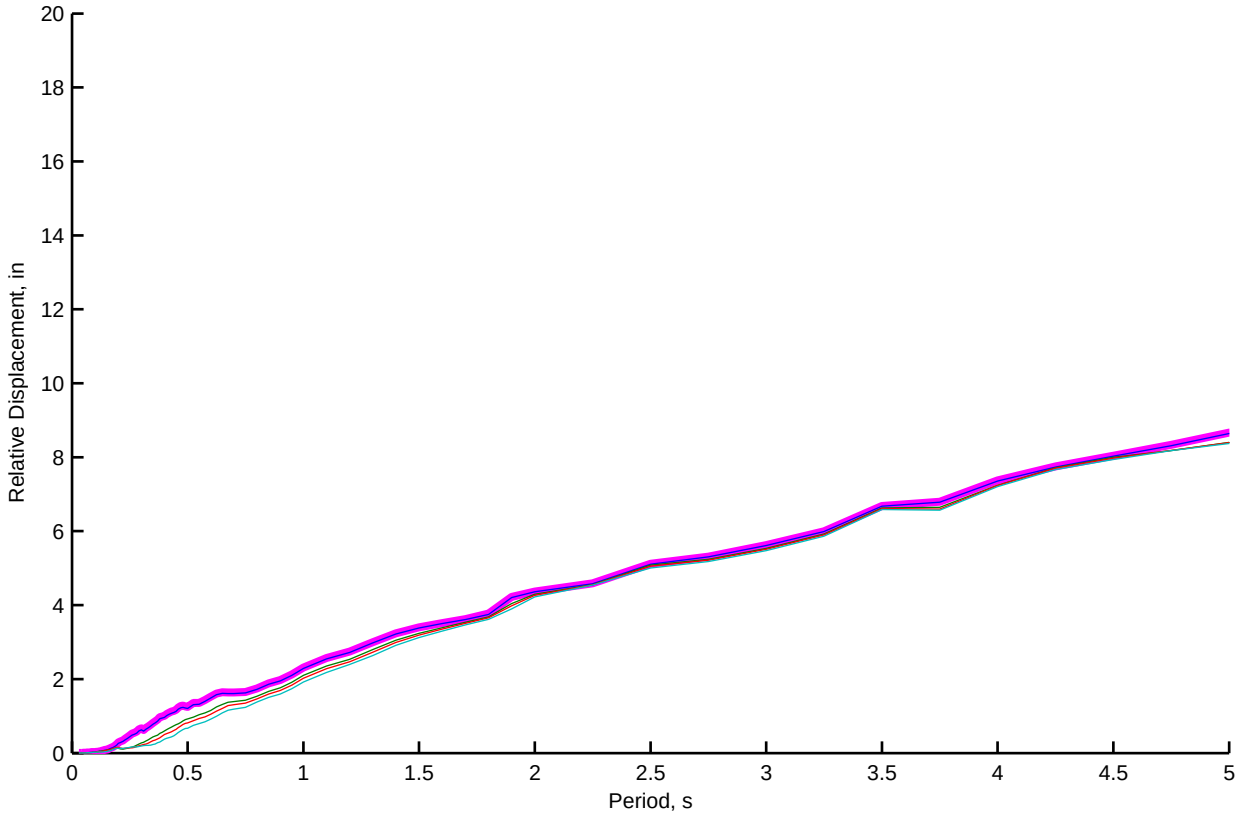
Checked by CY

Abut 1 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component

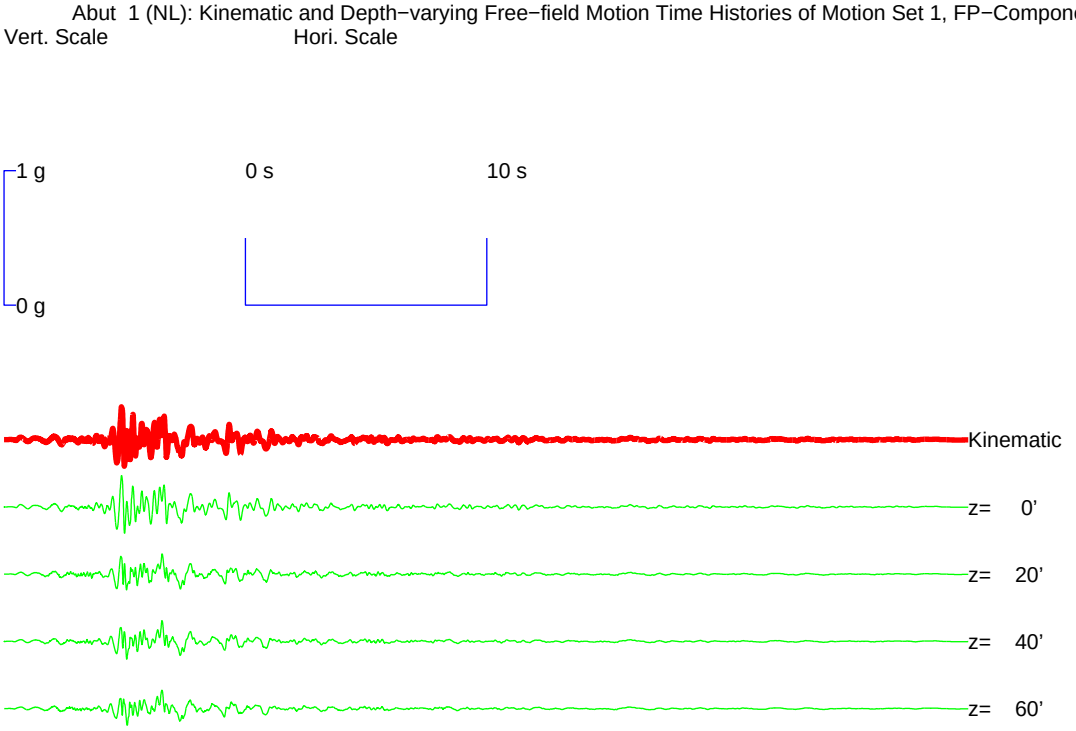


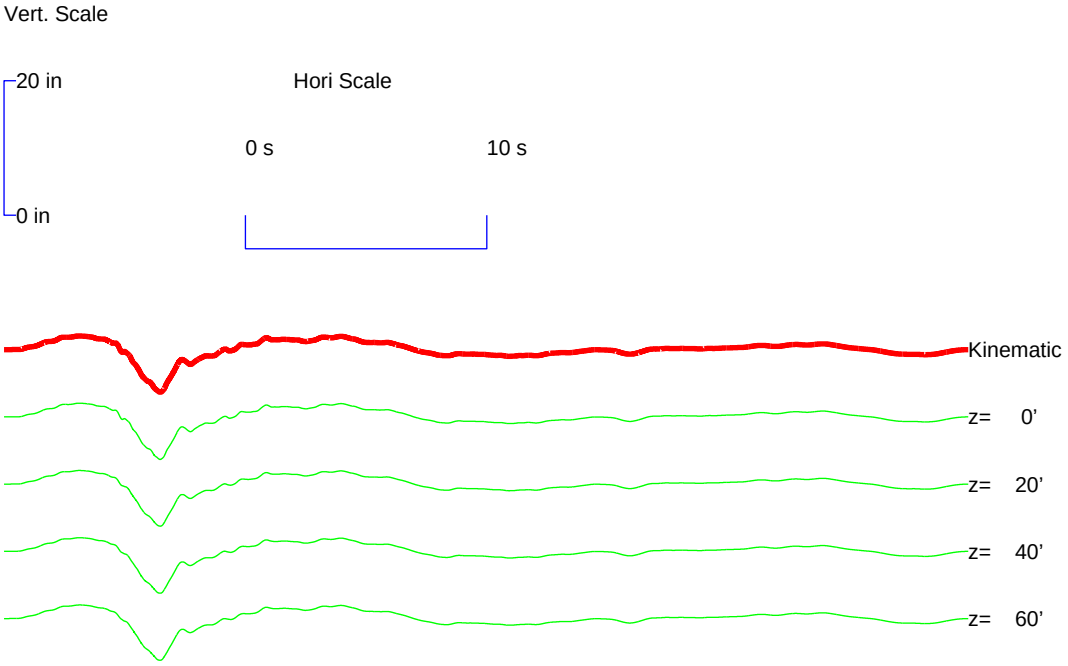


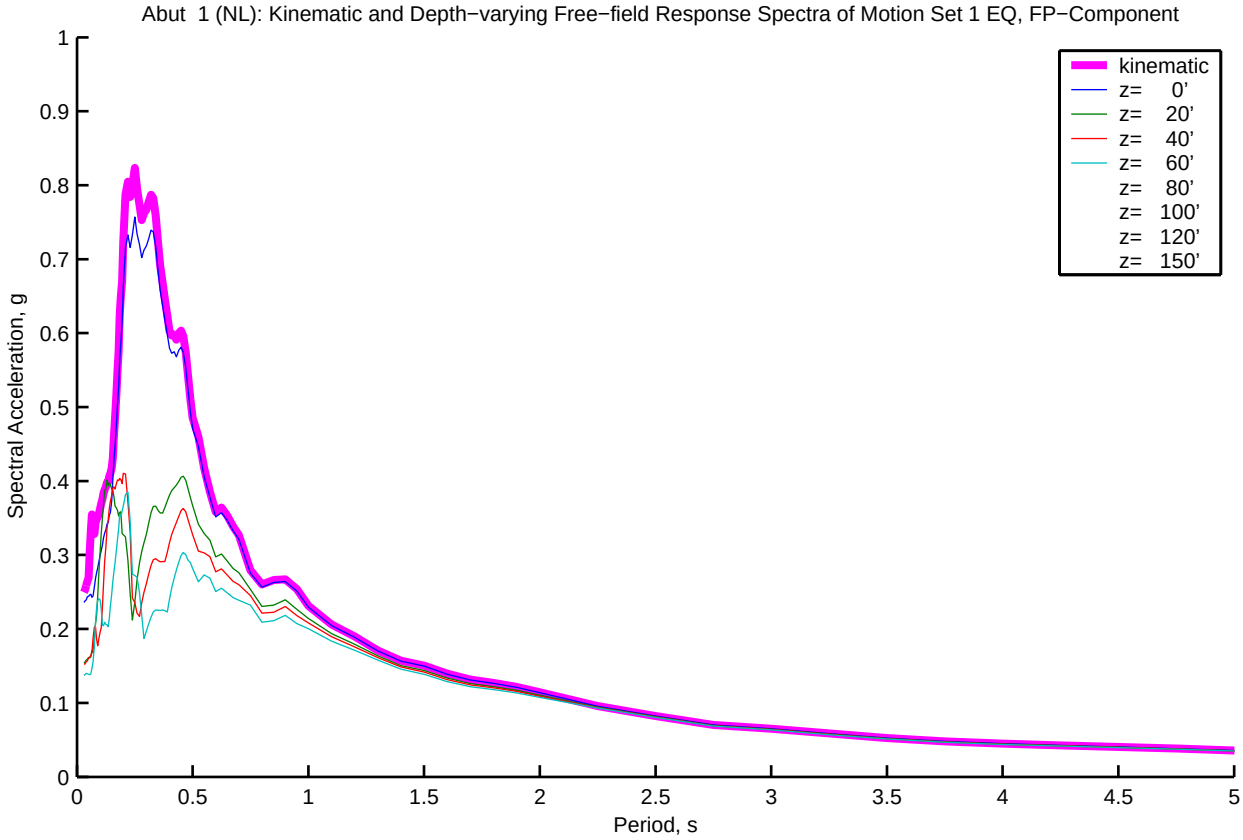

Abut 1 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 150'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

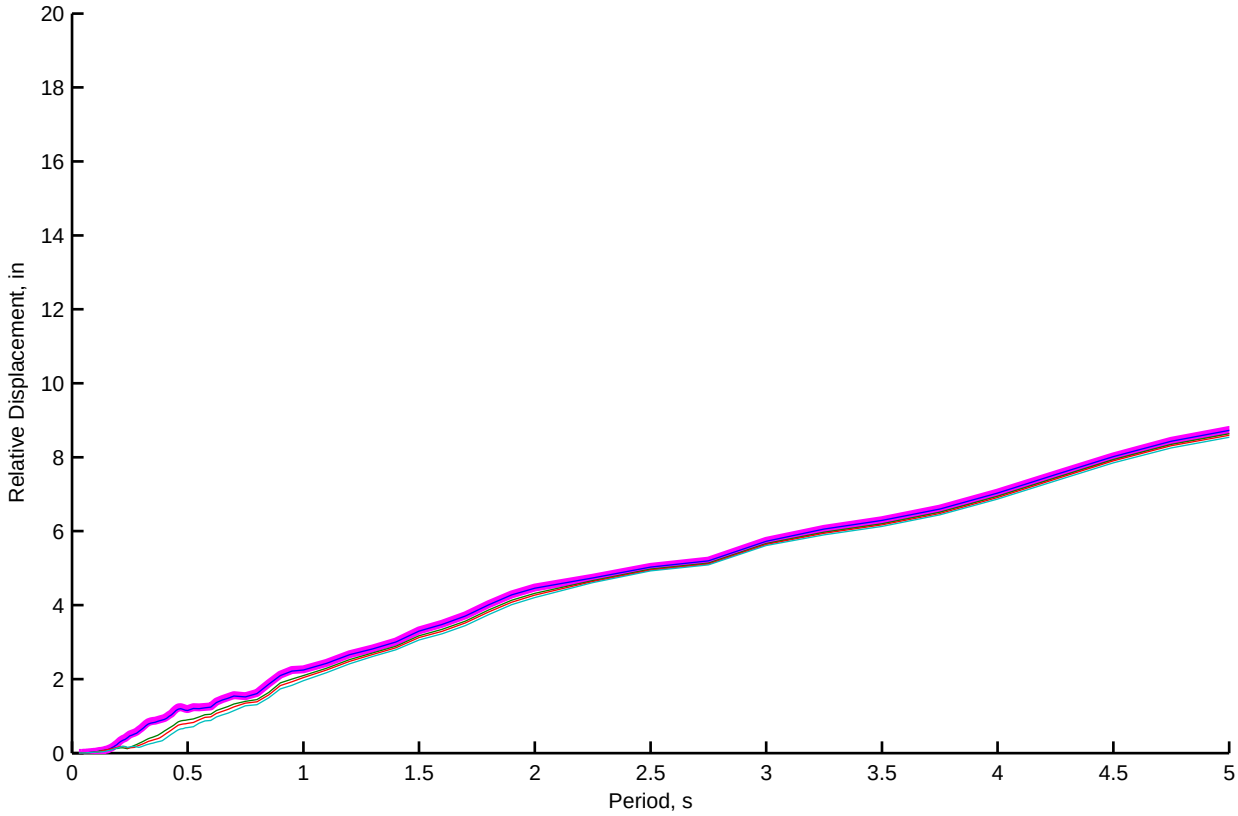

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Abut 1 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component

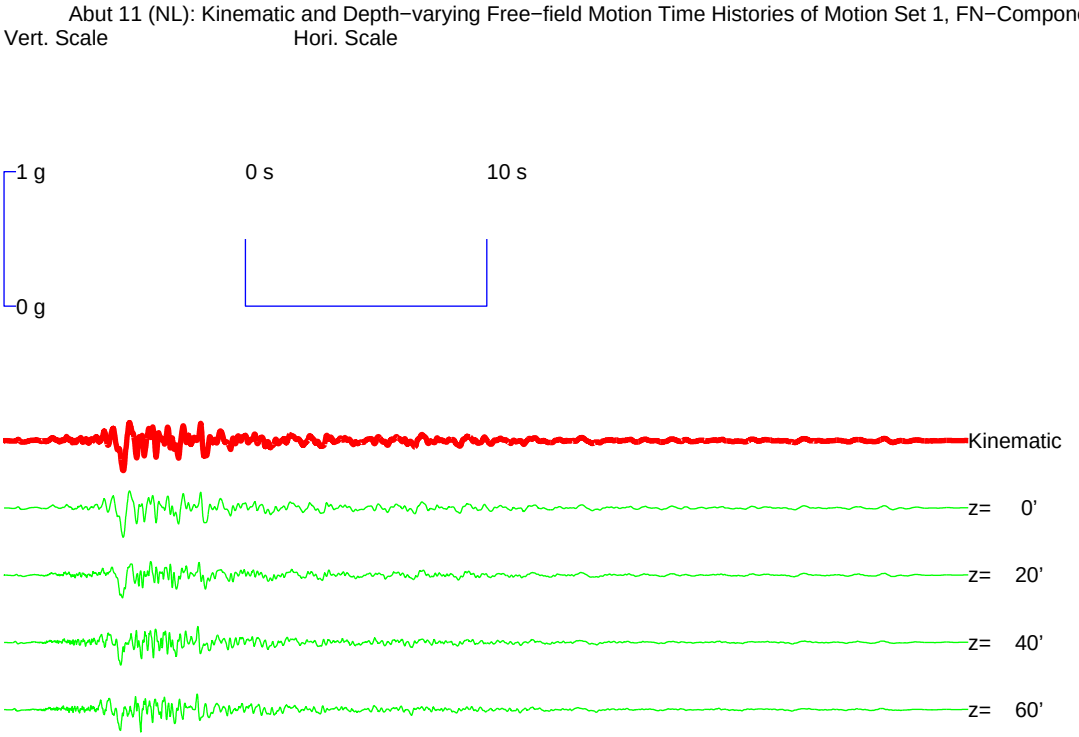


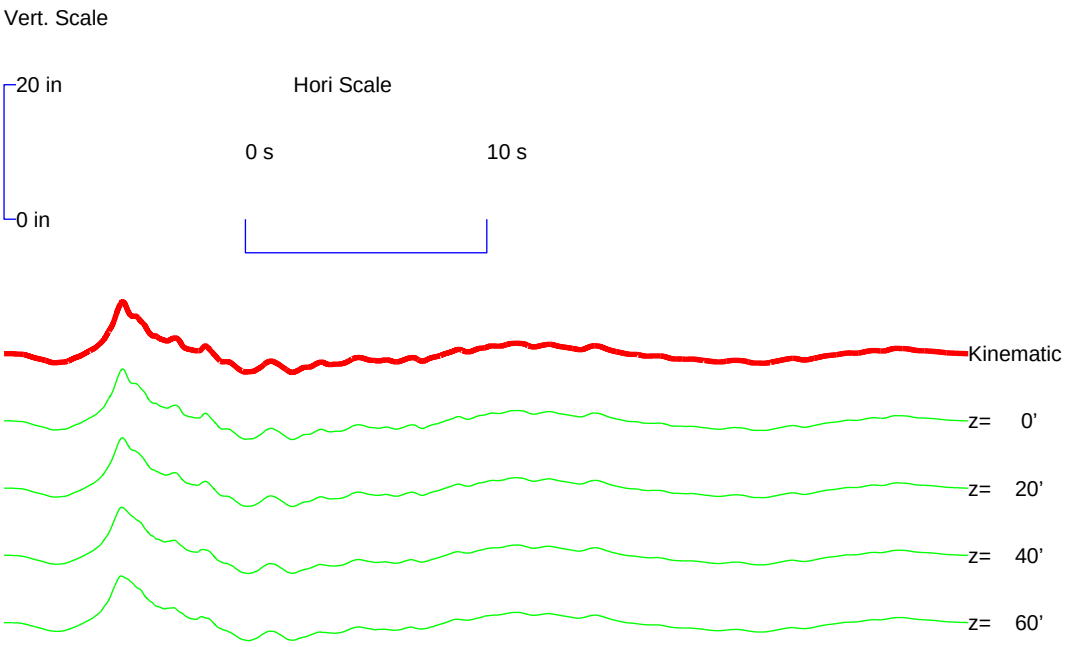


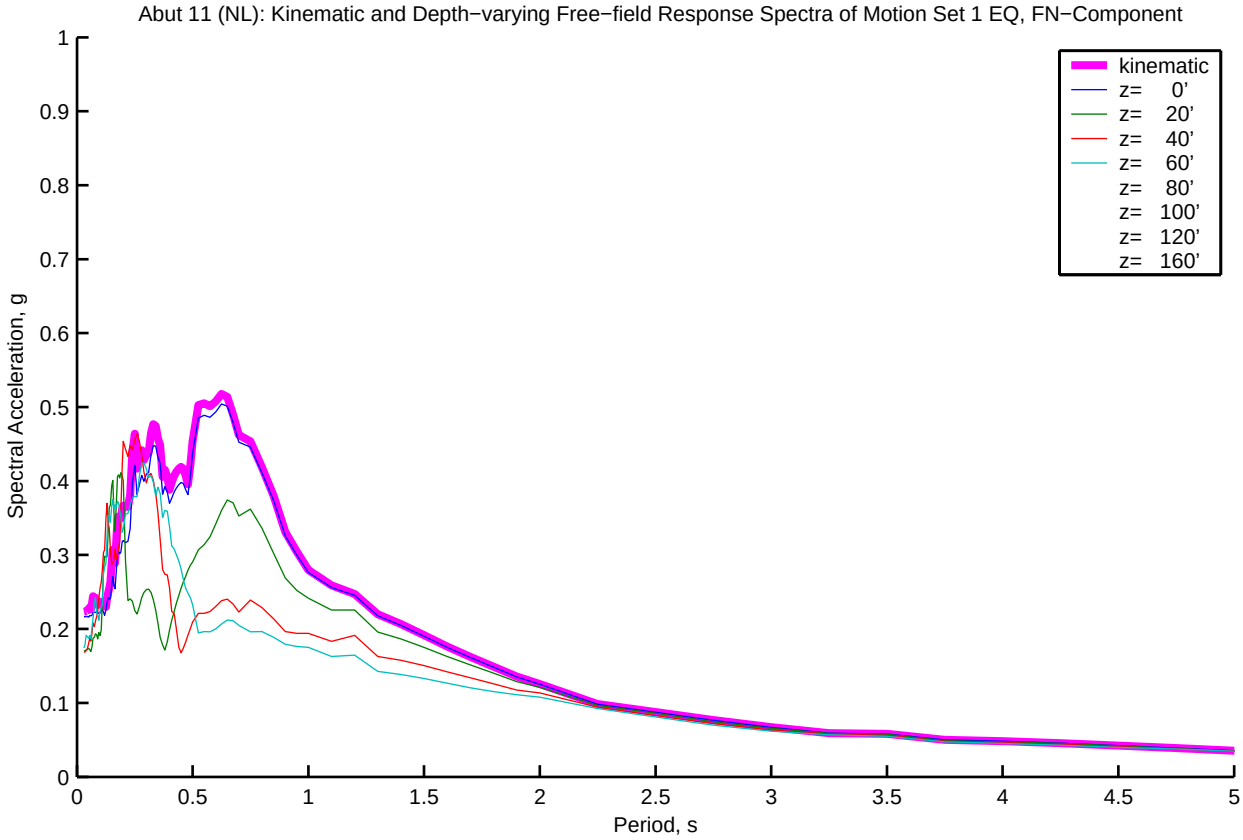

Abut 1 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 150'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

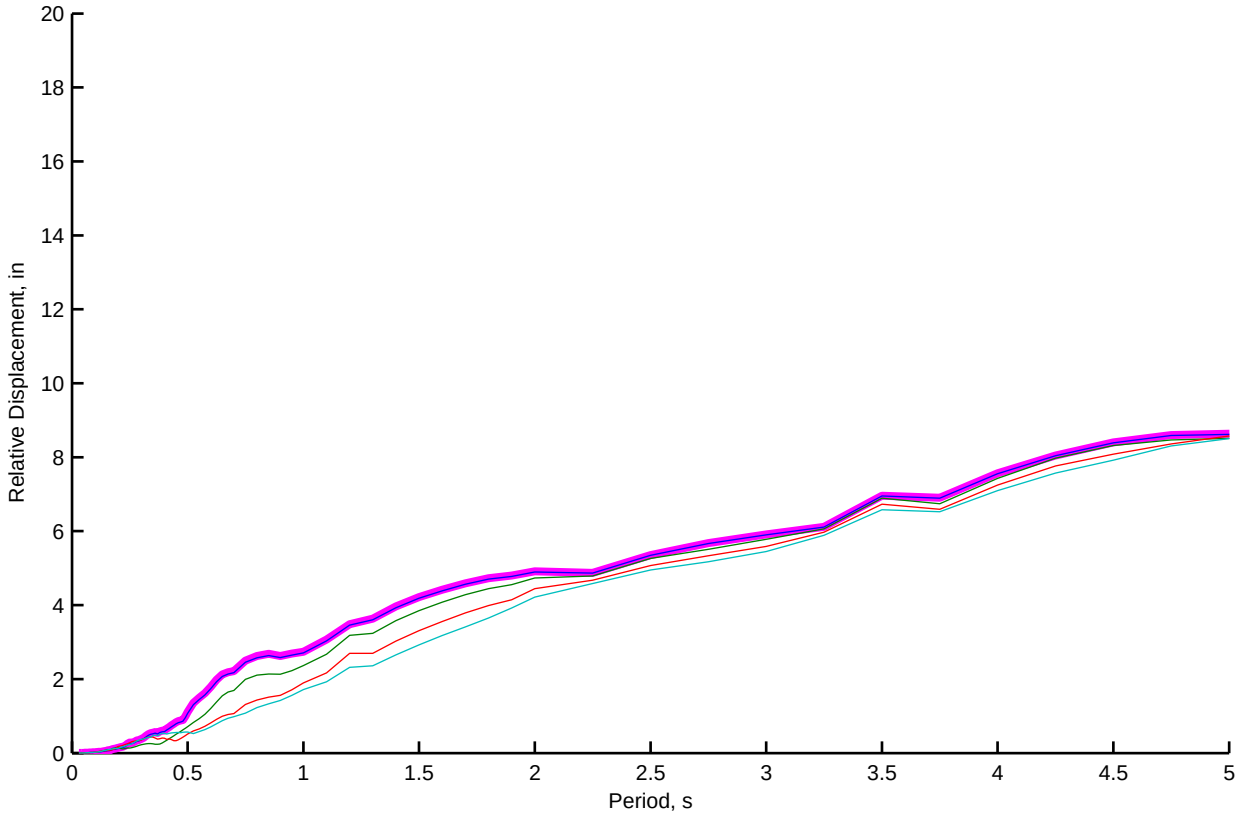

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Abut 11 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component

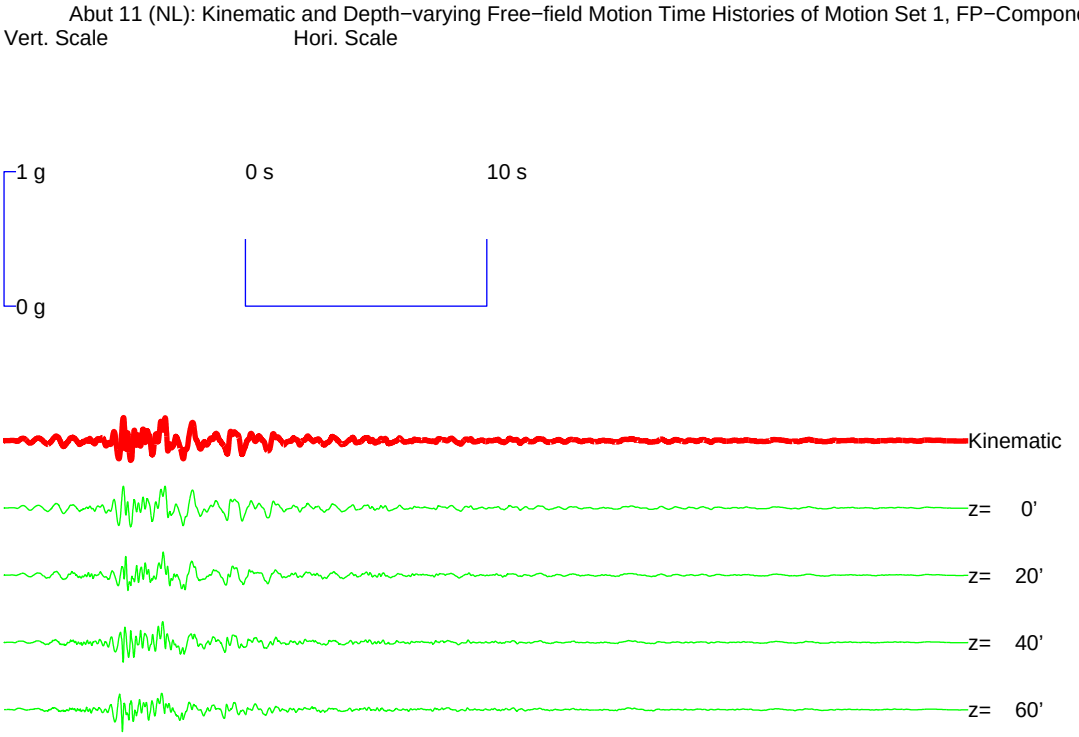


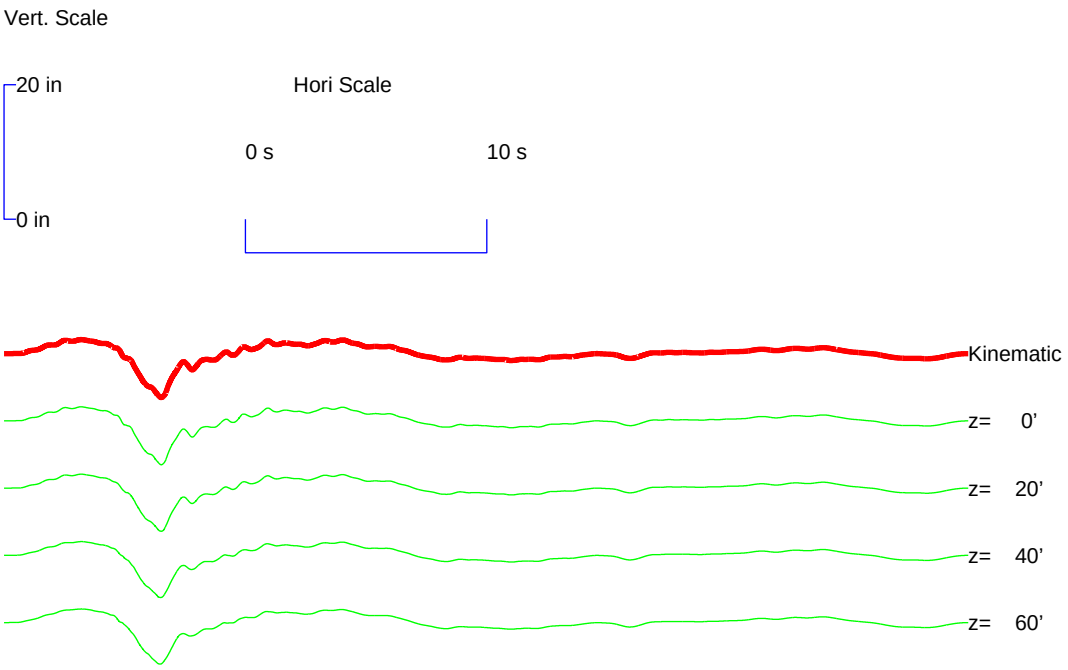


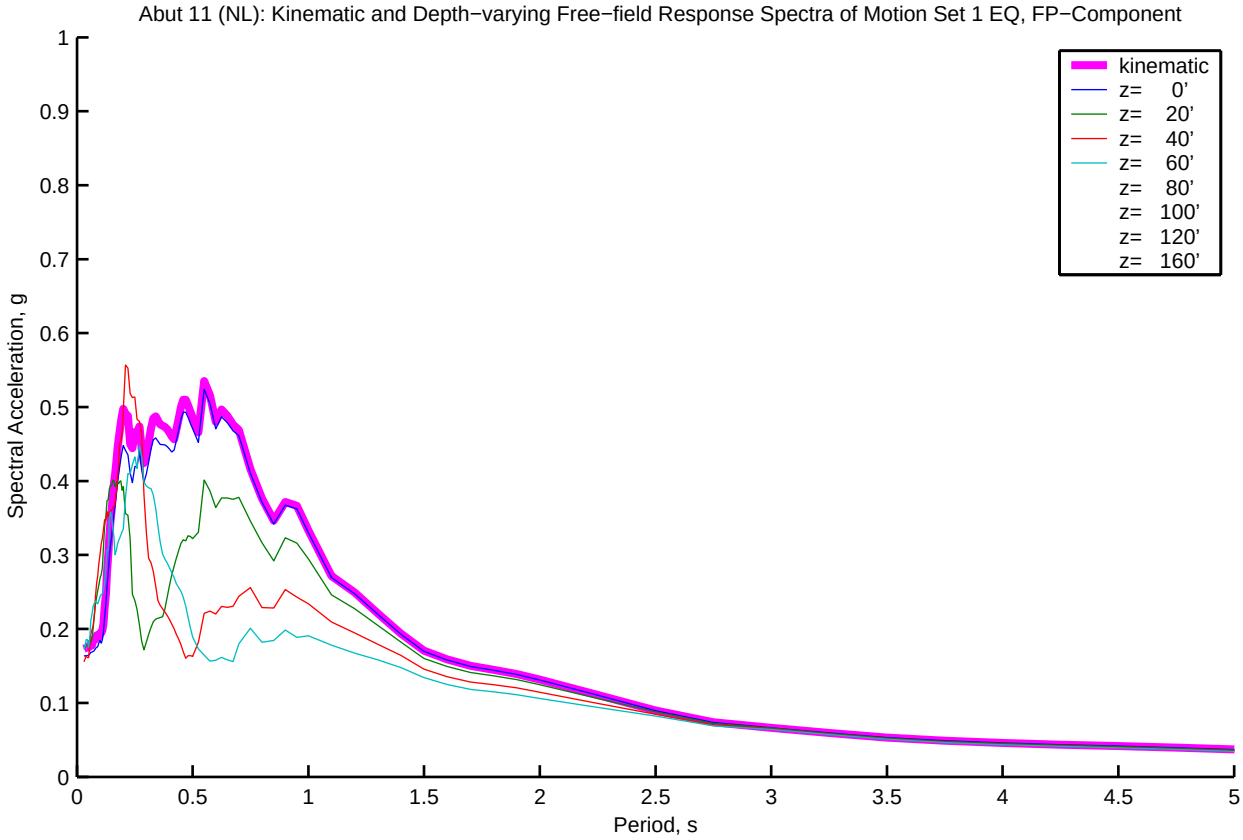

Abut 11 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 160'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

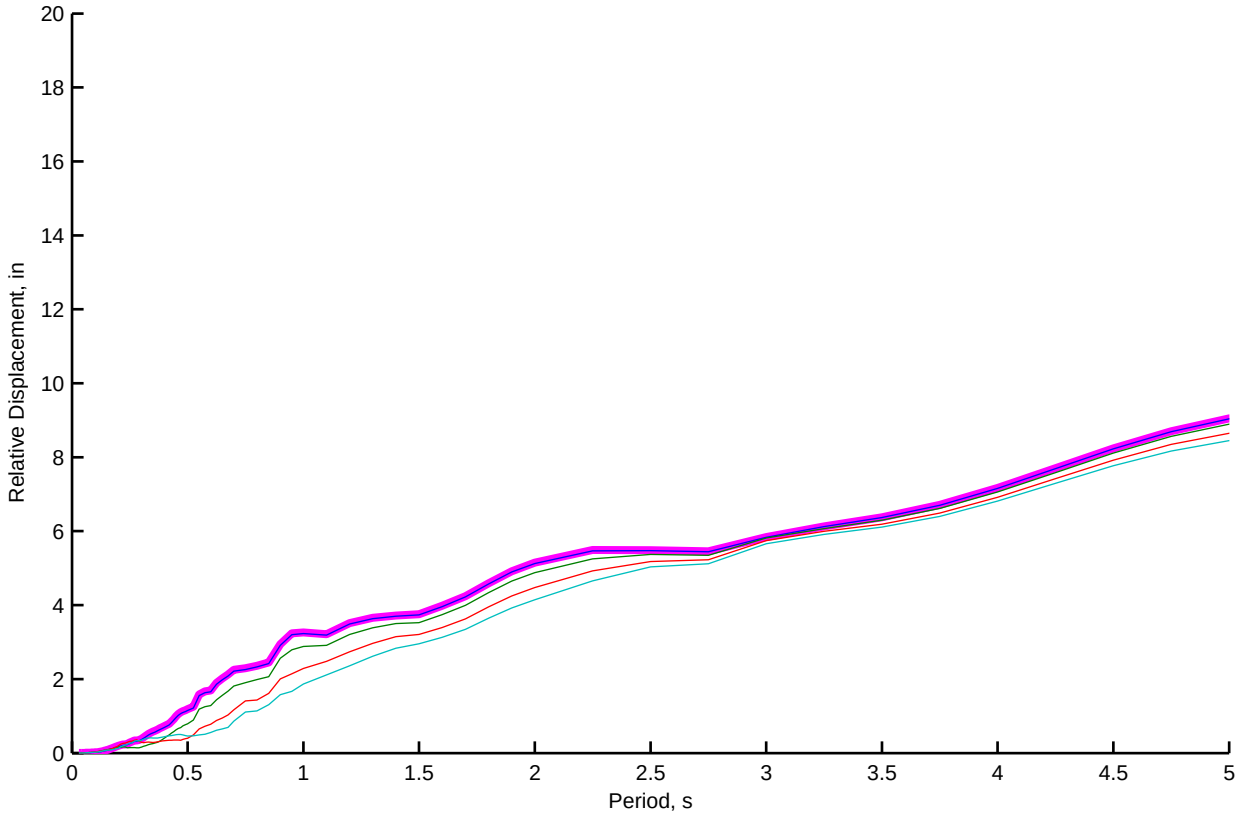

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Abut 11 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component






Abut 11 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 160'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5


Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
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2.5
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3.5
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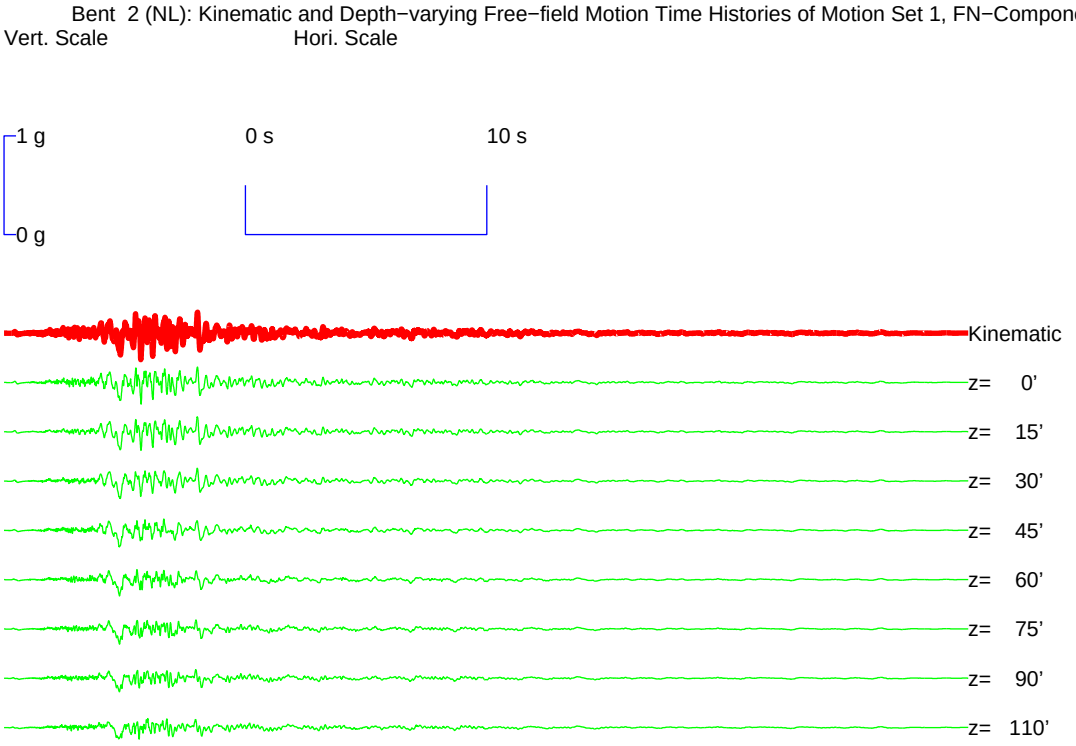
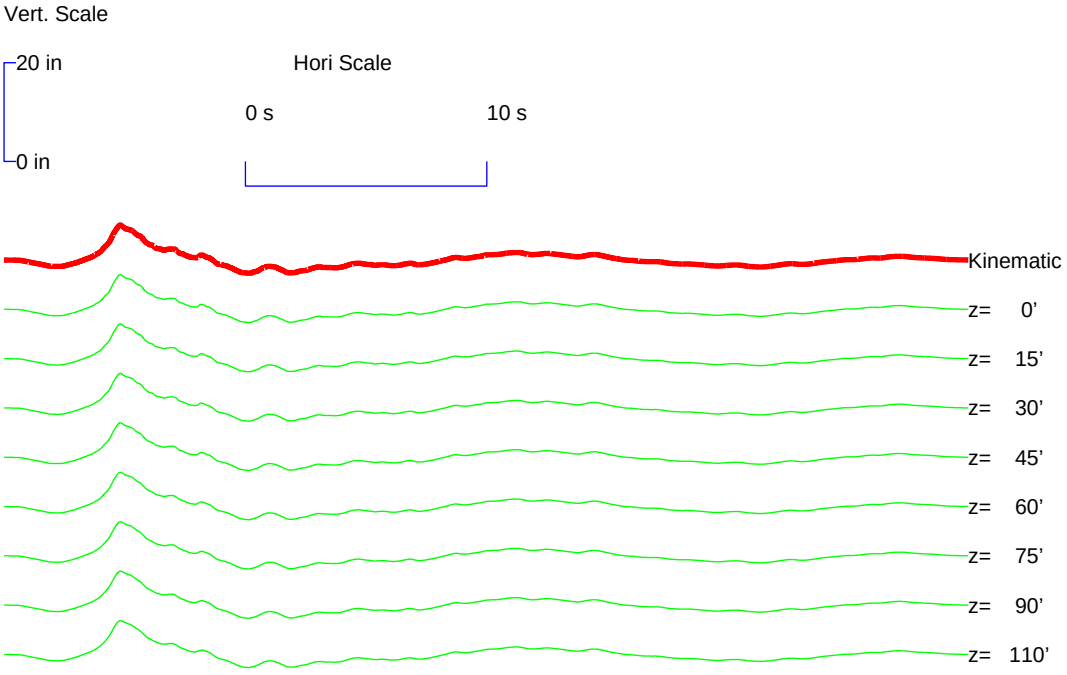
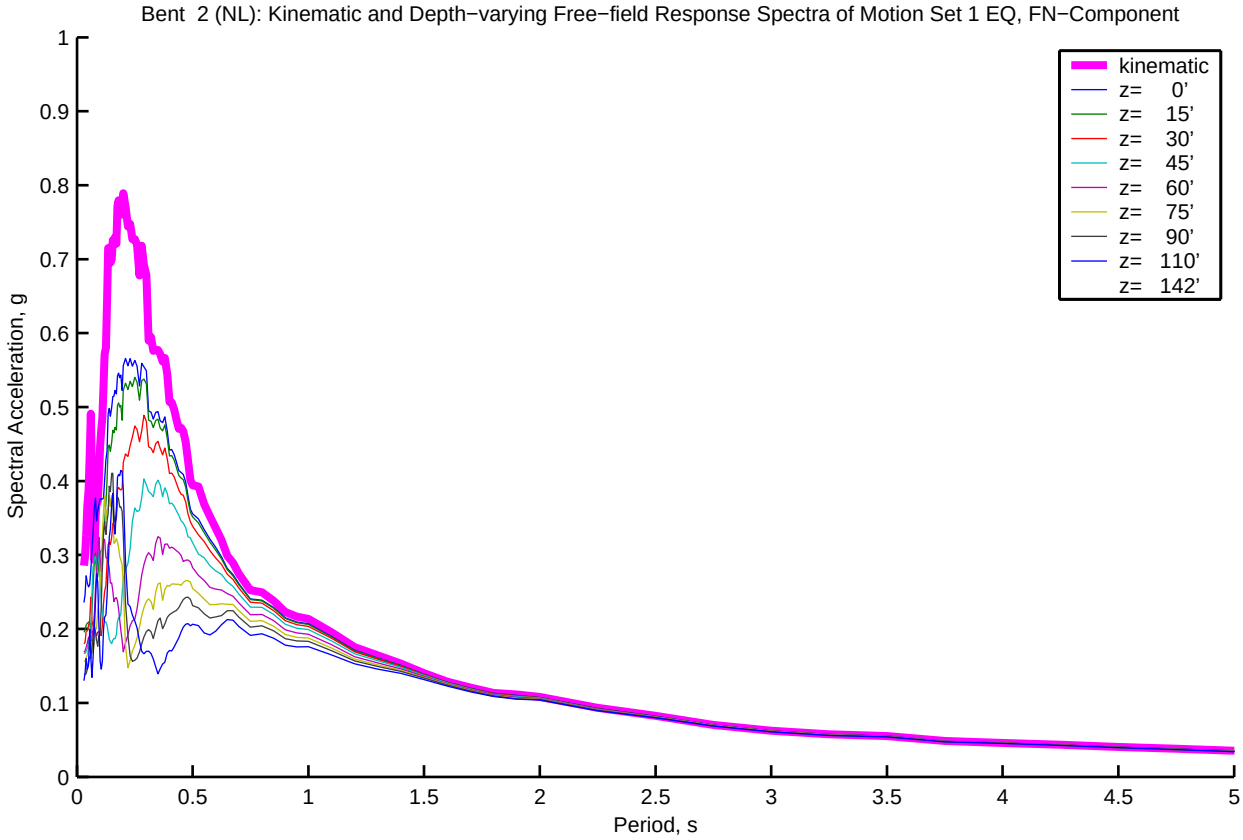
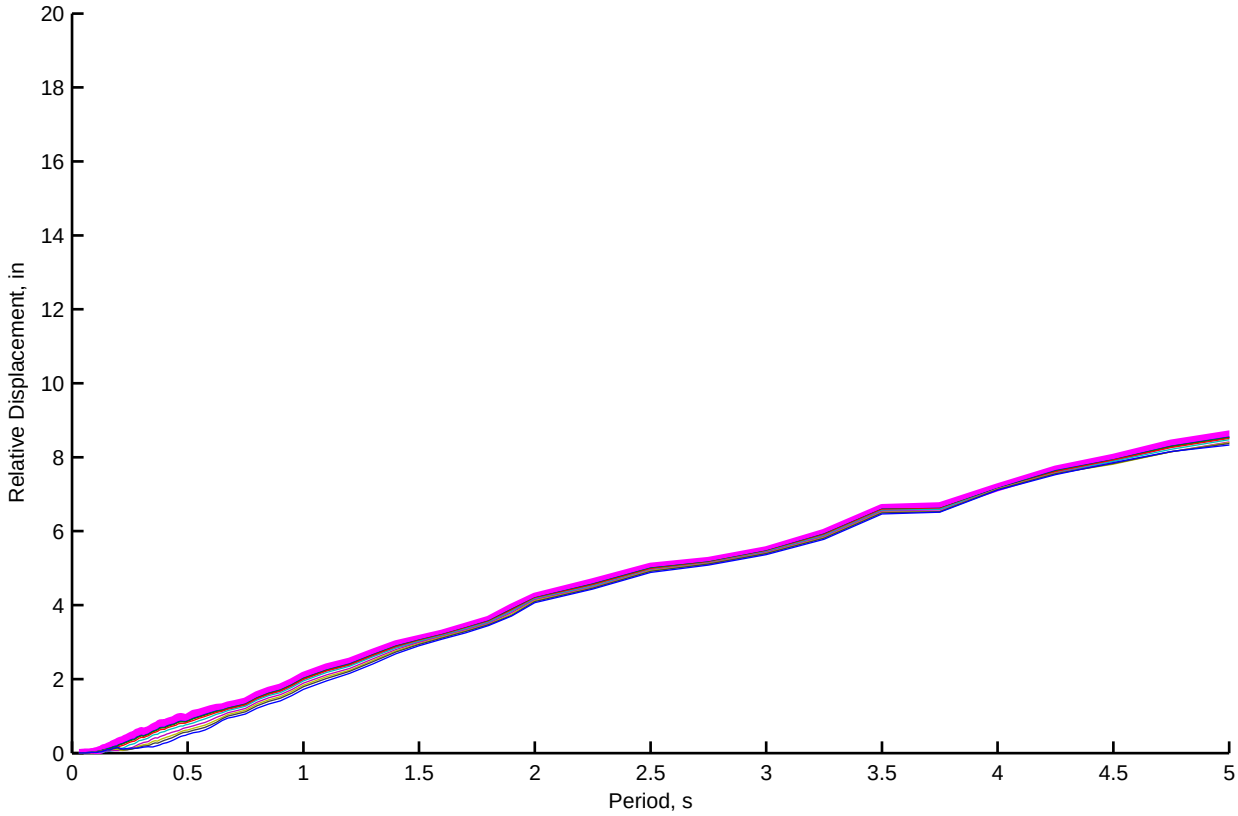
4.5
5

Bent 2 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component






Bent 2 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 142'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5


Relative Displacement, in
Period, s
0
2
4
6
8
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12
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16
18
20
0.5
1
1.5
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2.5
3
3.5
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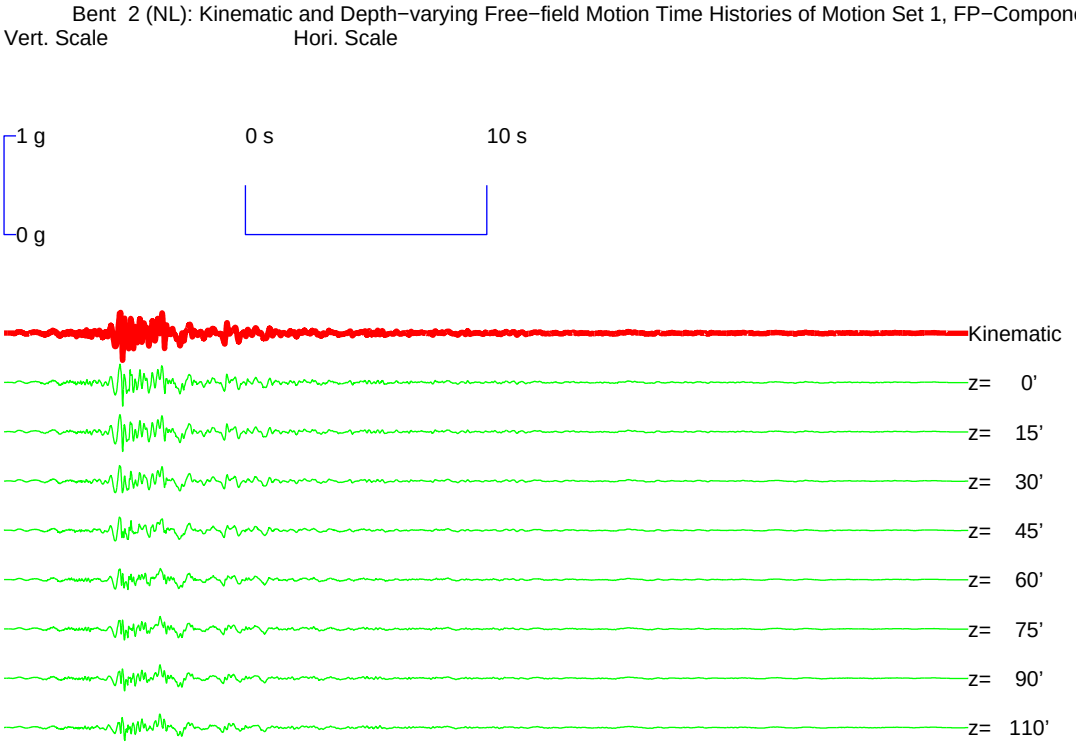
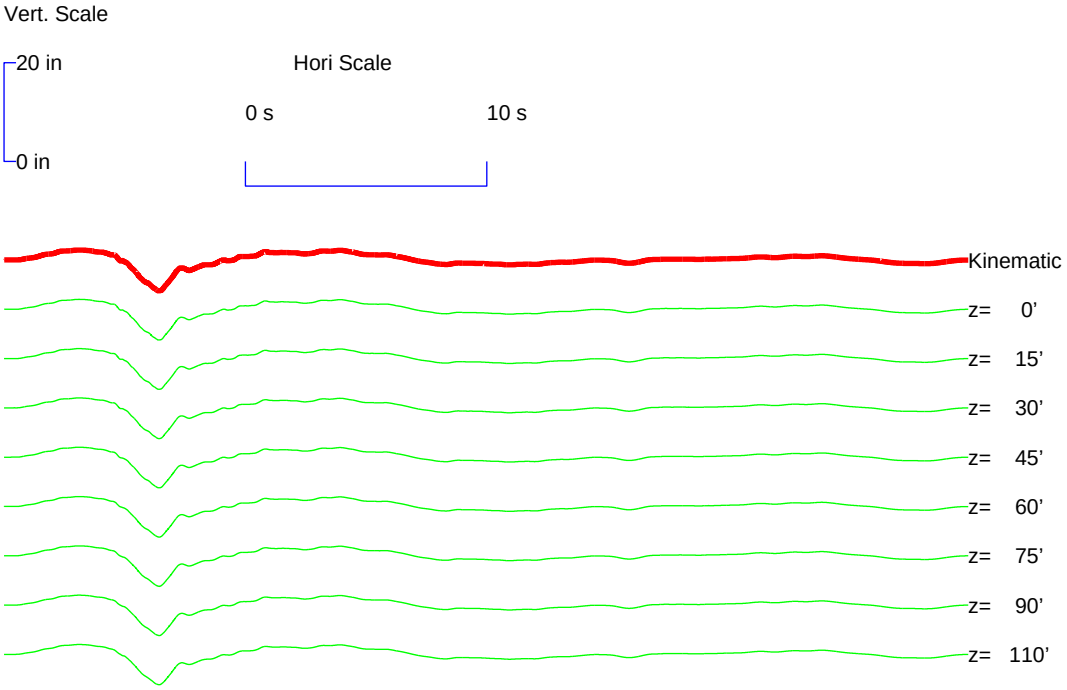
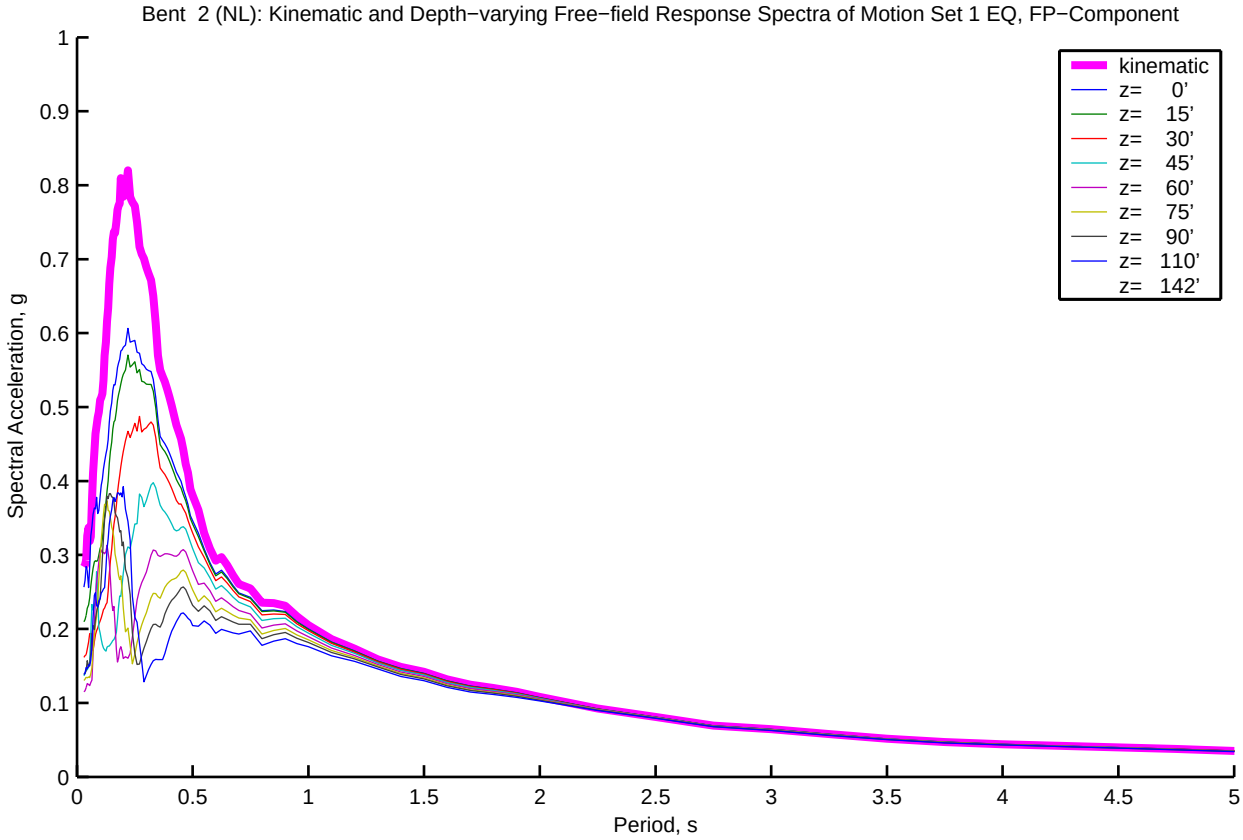
4.5
5

Bent 2 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component






Bent 2 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 142'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
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0.5
1.5
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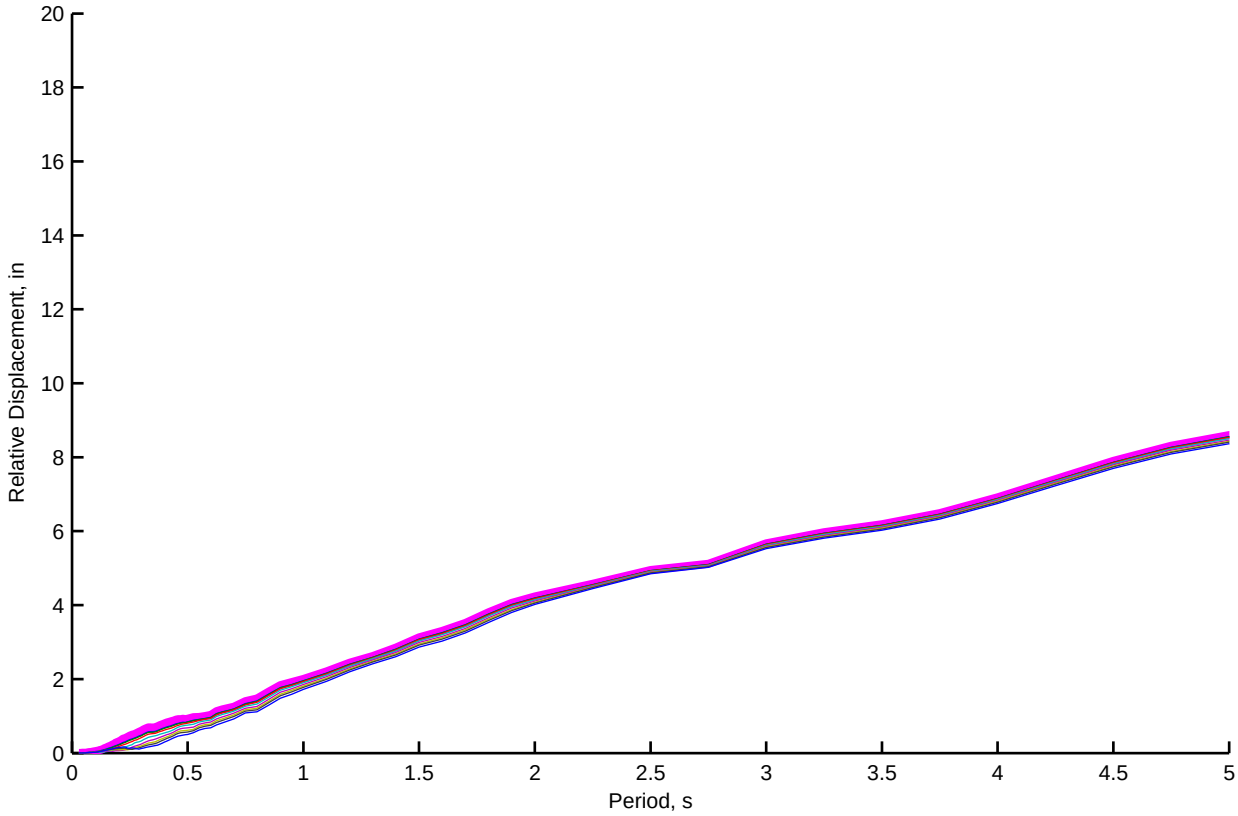
Relative Displacement, in
Period, s
0
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0.5
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3.5
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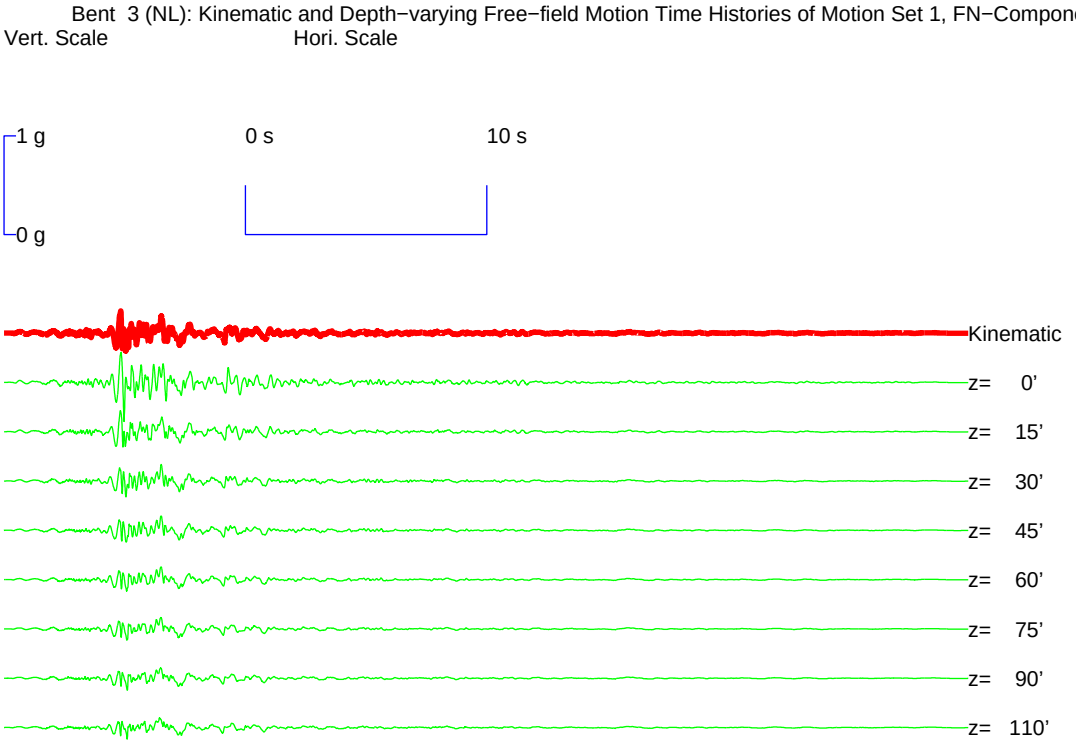
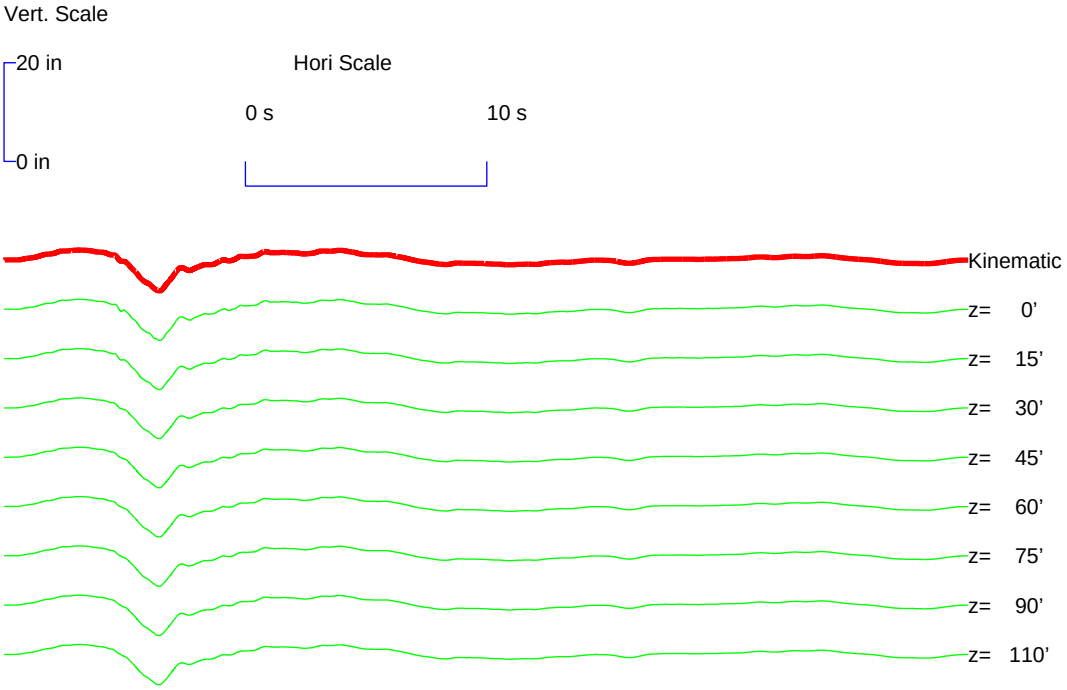
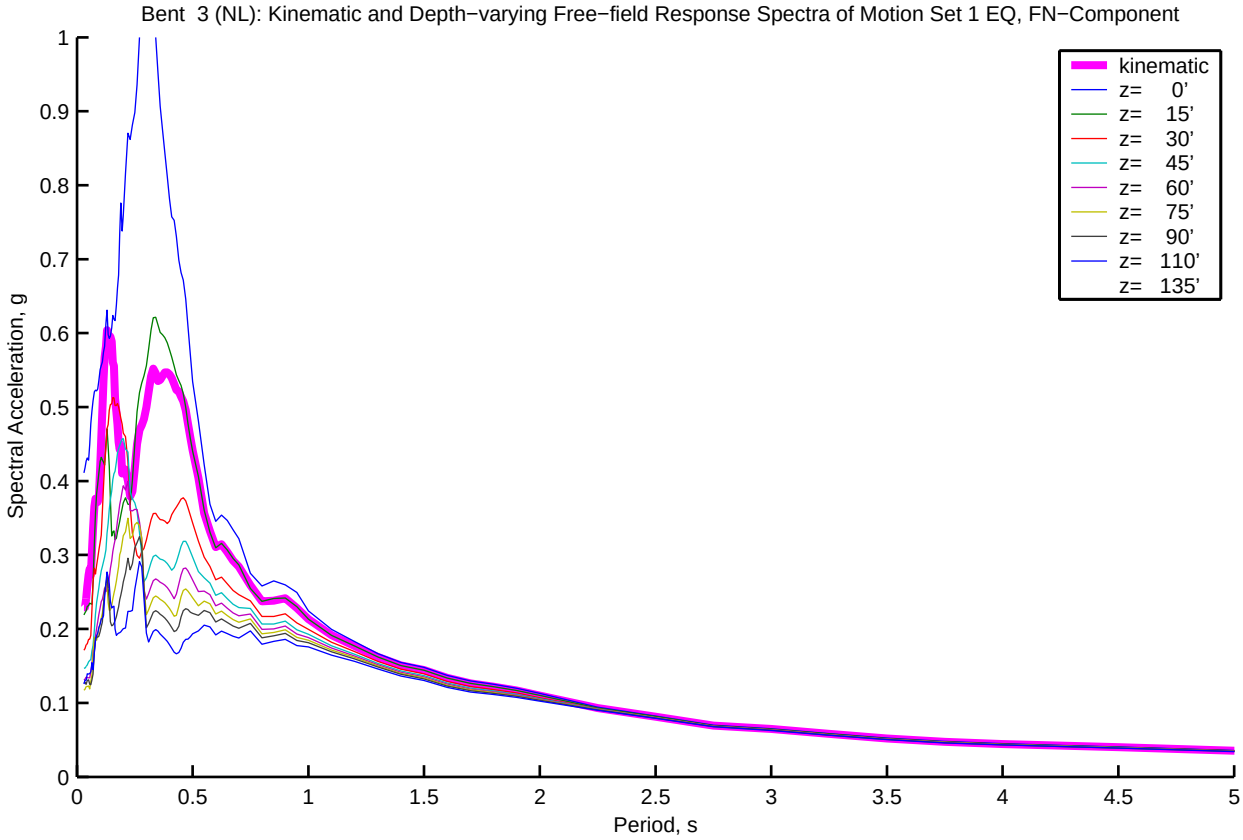
Bent 3 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component






Bent 3 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 135'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
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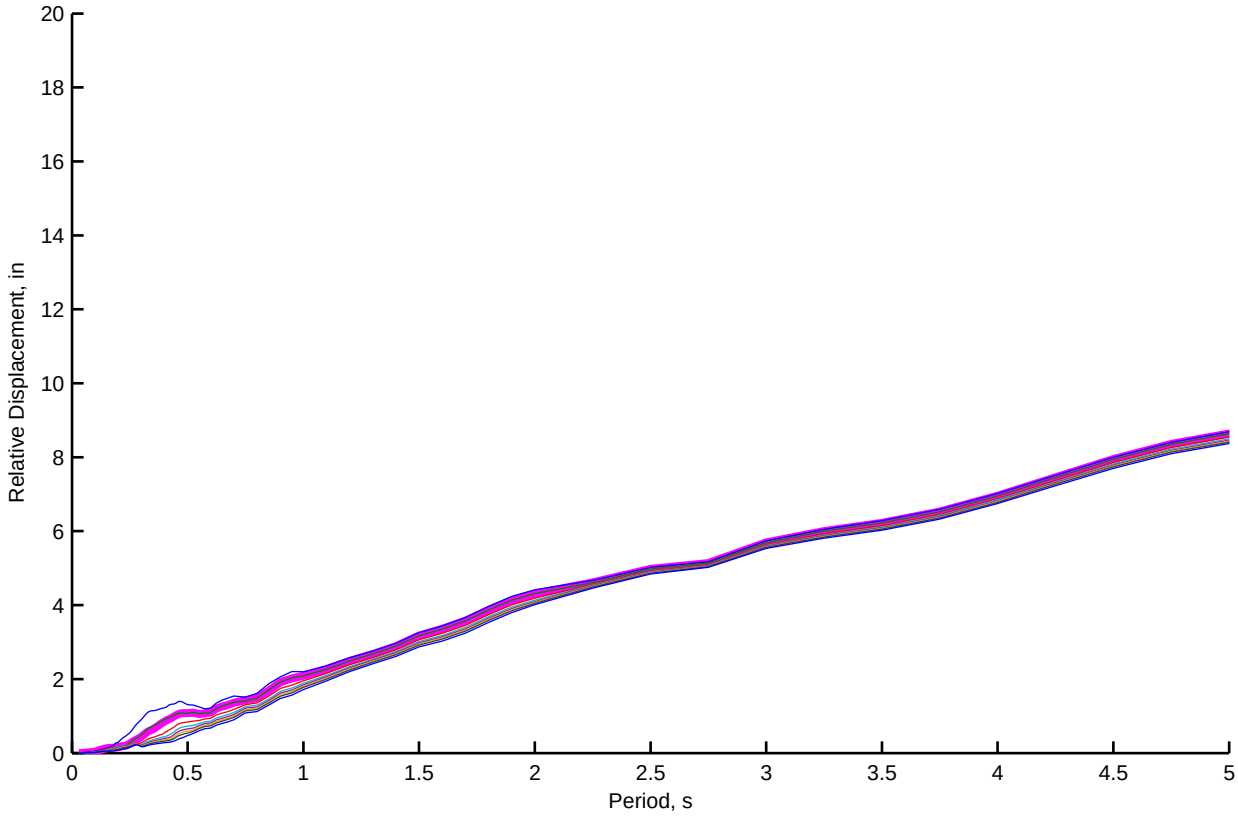
Relative Displacement, in
Period, s
0
2
4
6
8
10
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14
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18
20
0.5
1
1.5
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2.5
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3.5
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4.5
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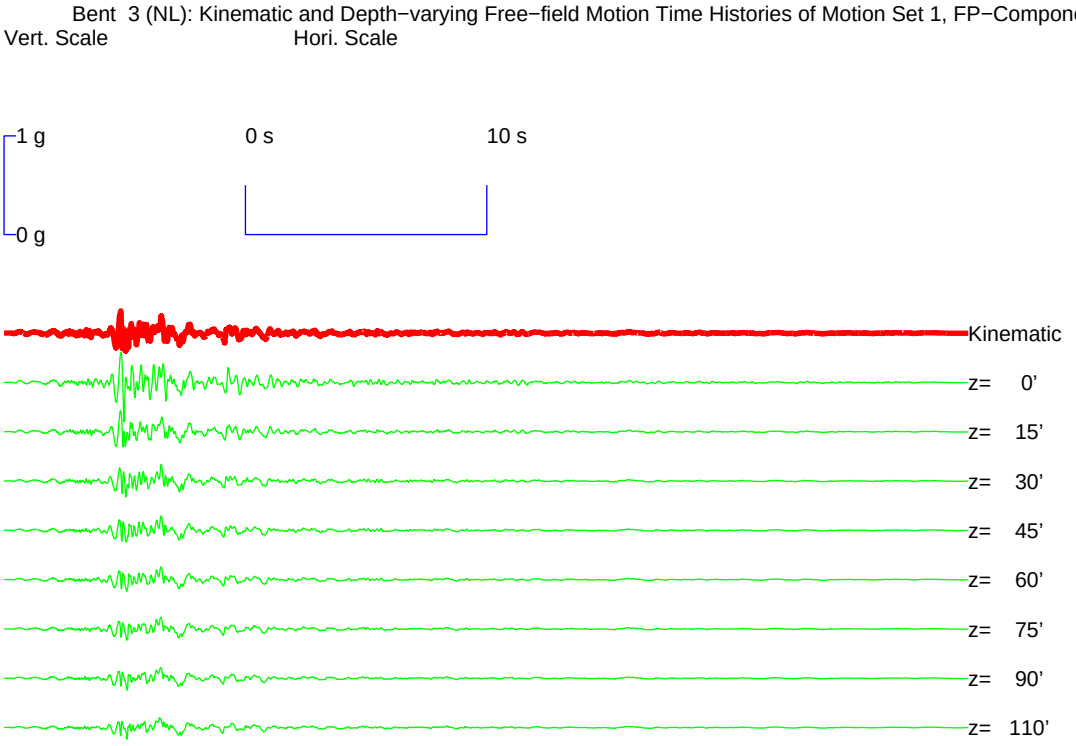
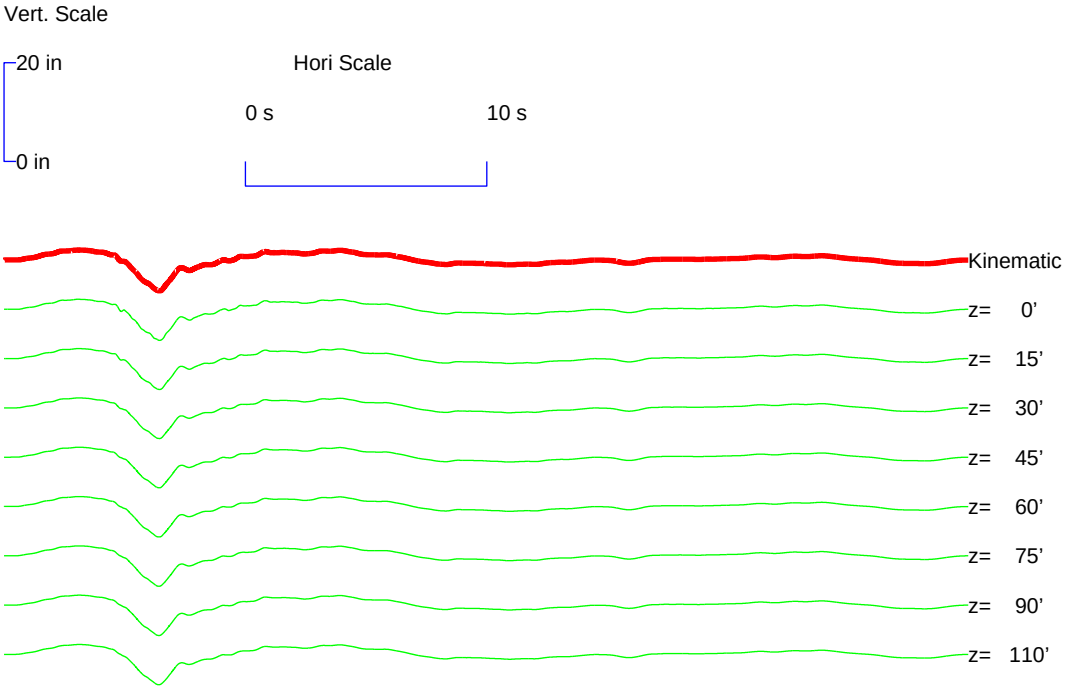
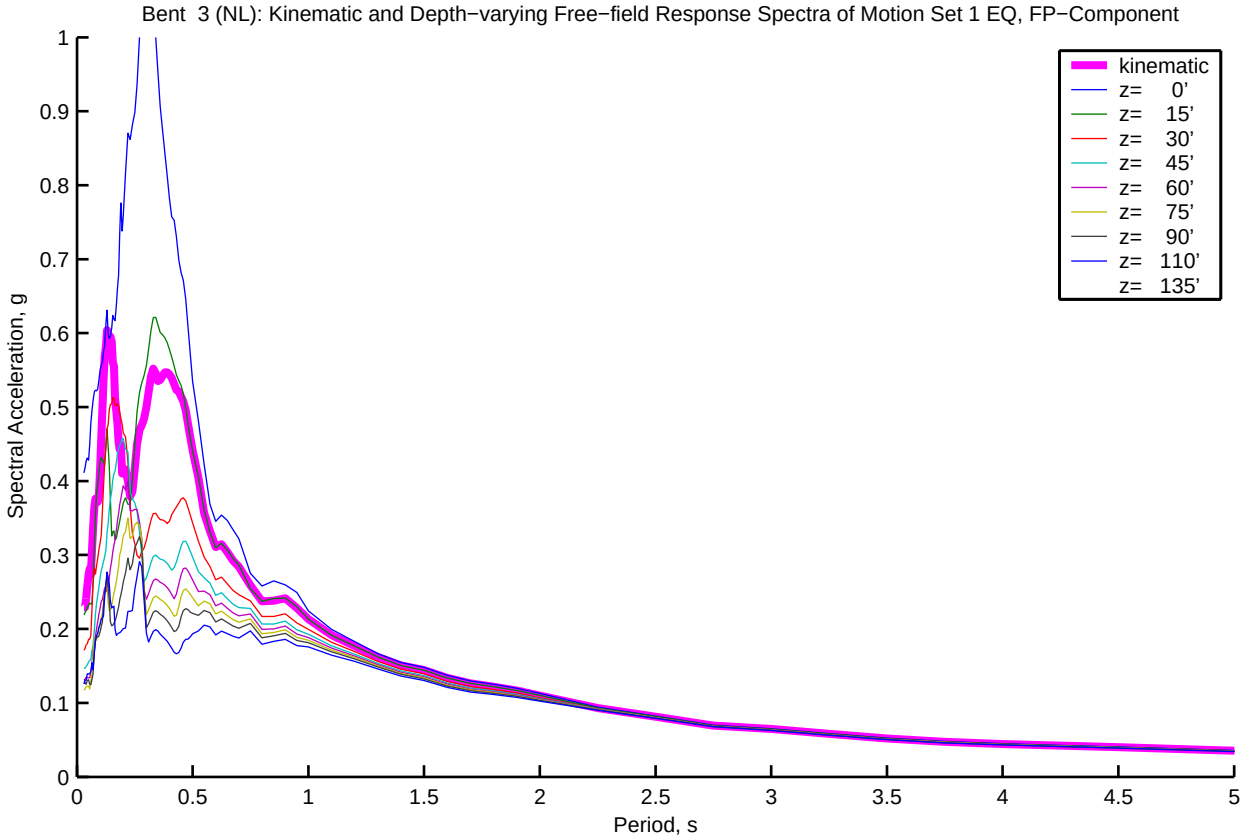
Bent 3 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component






Bent 3 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 135'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
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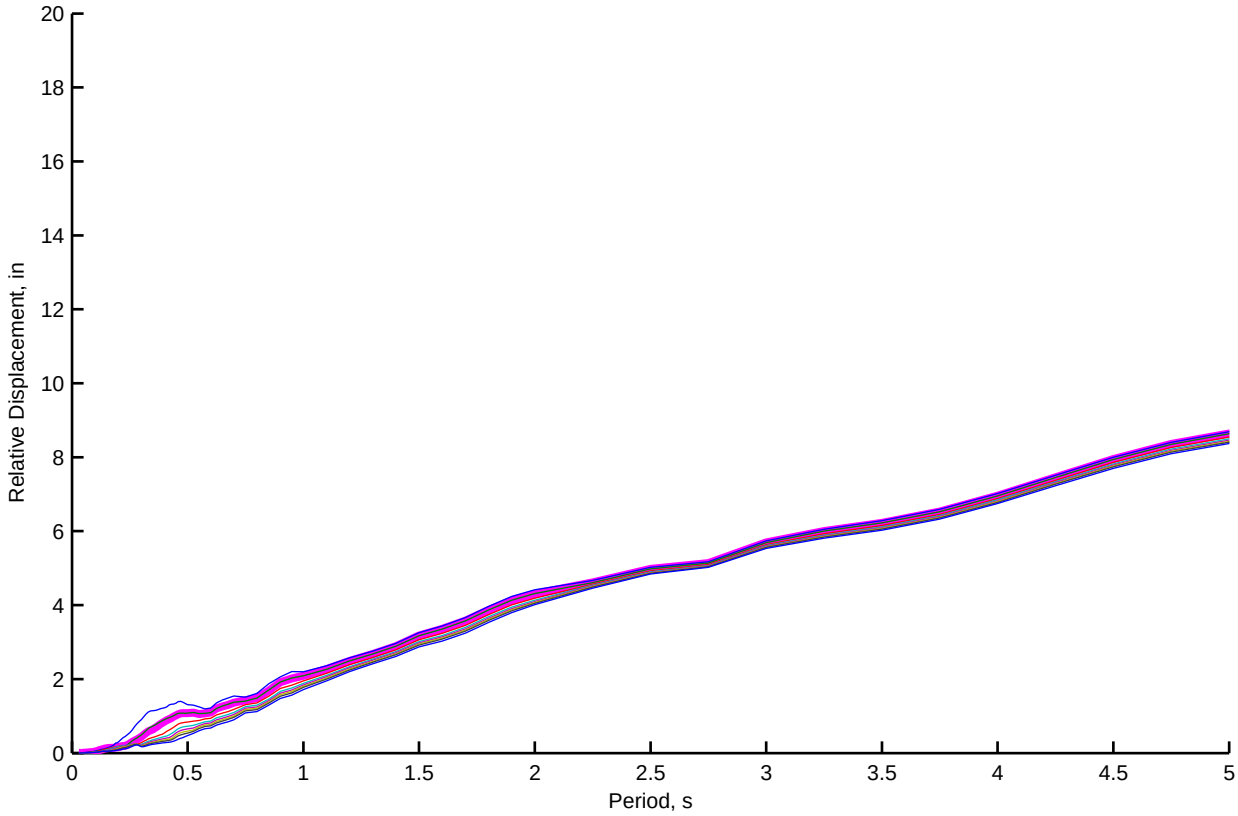
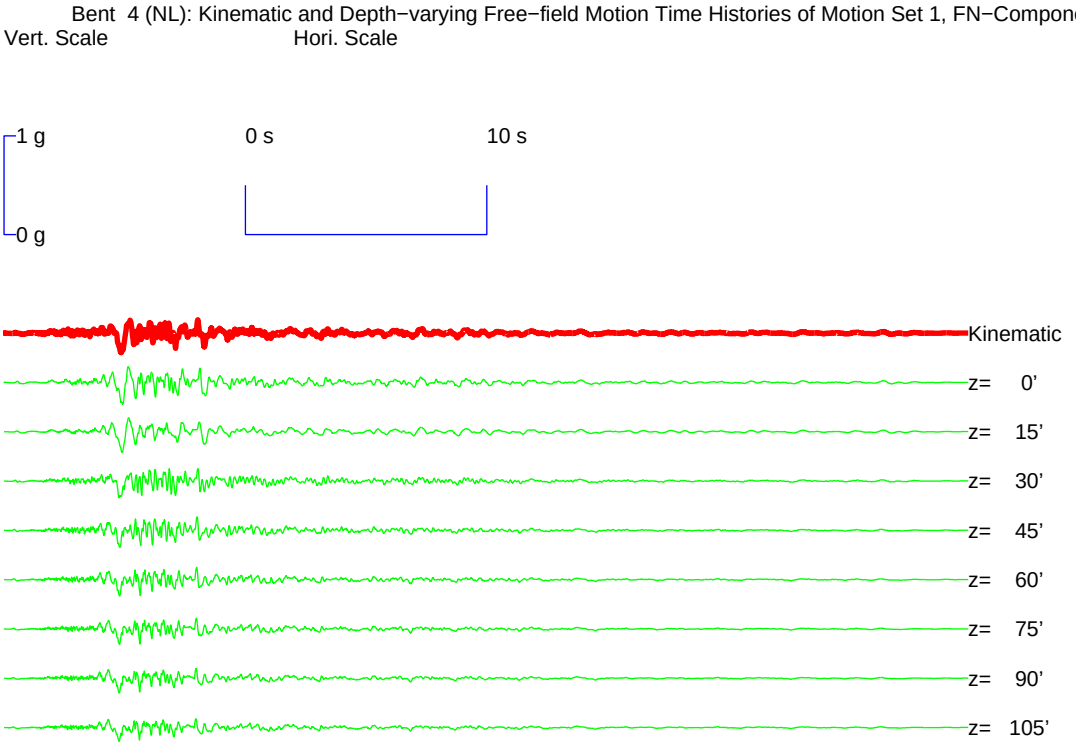
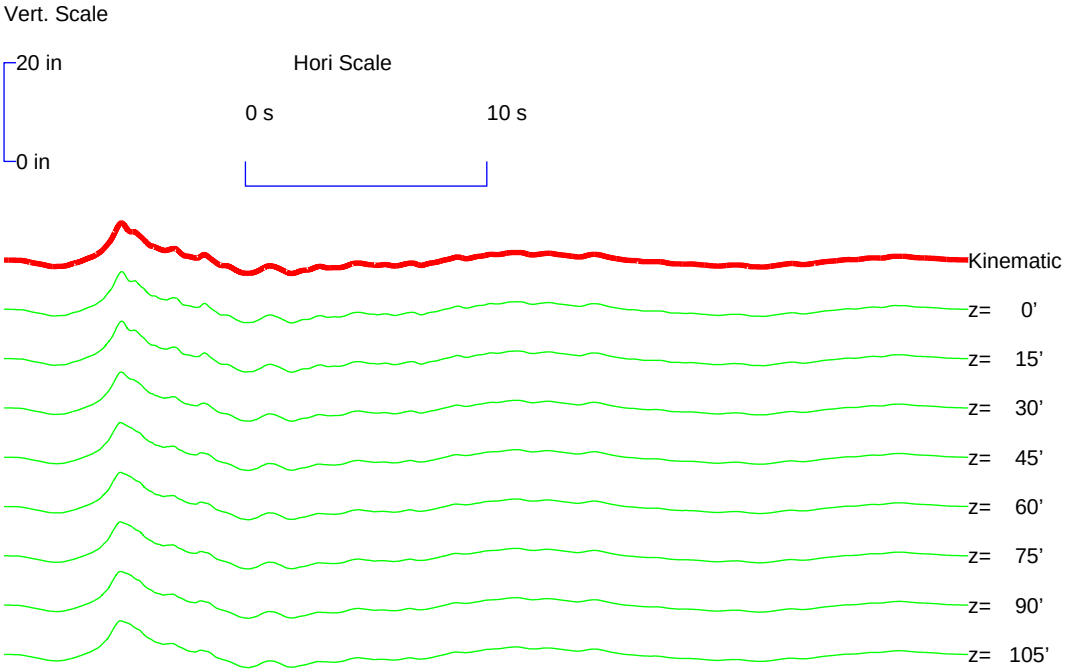
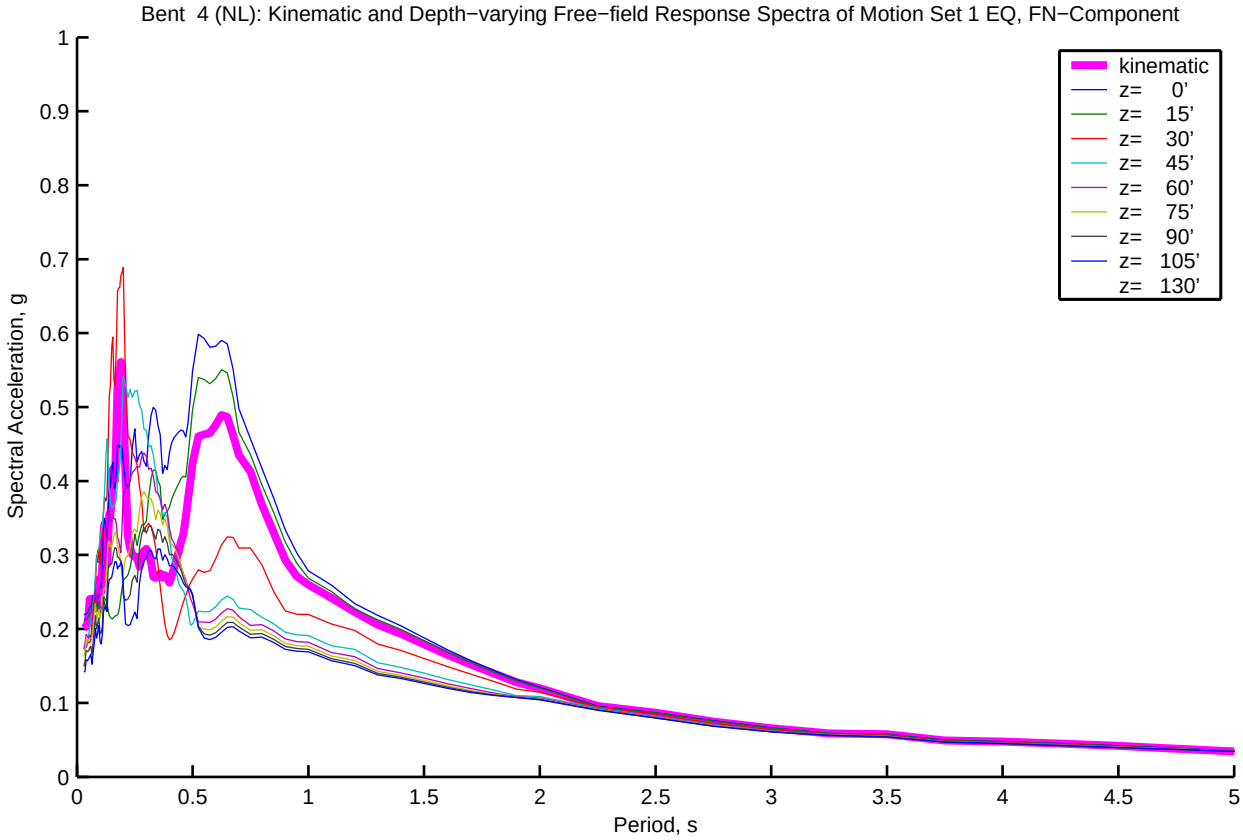
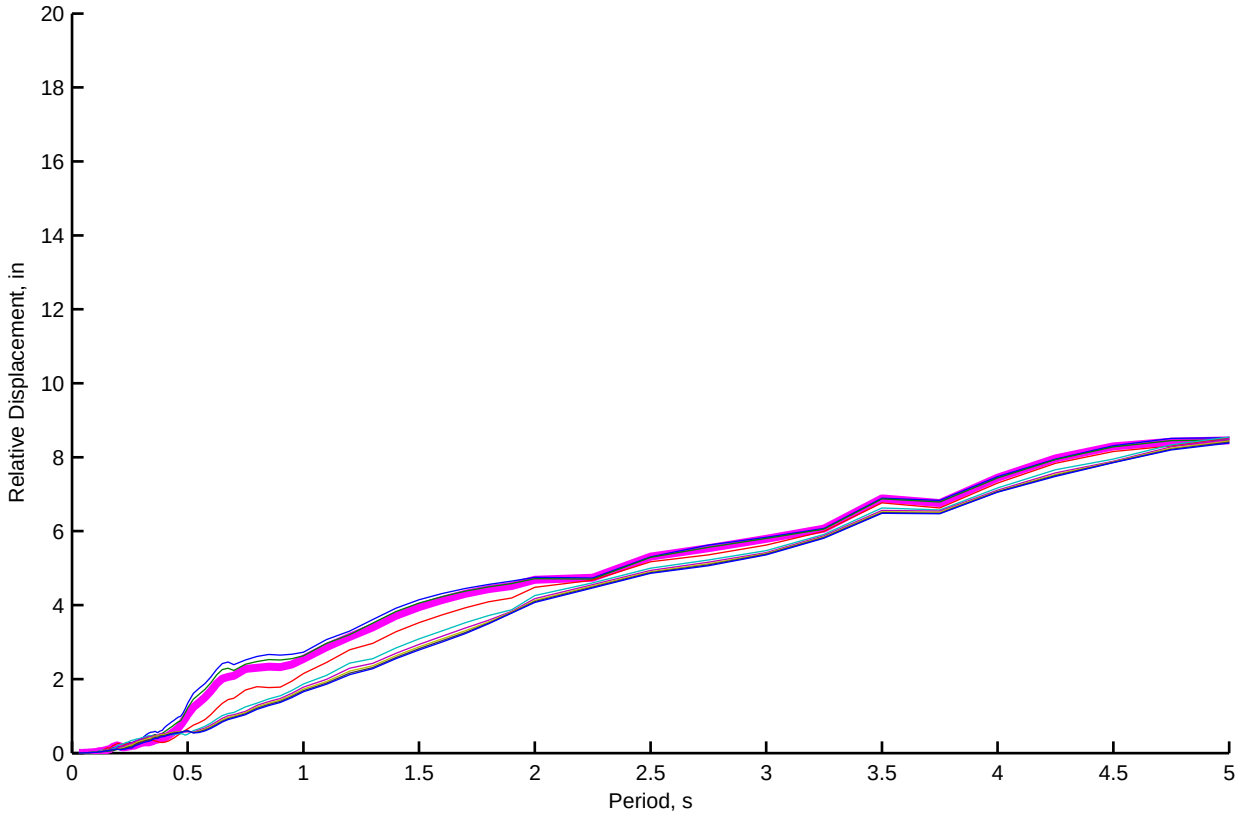

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 4 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component

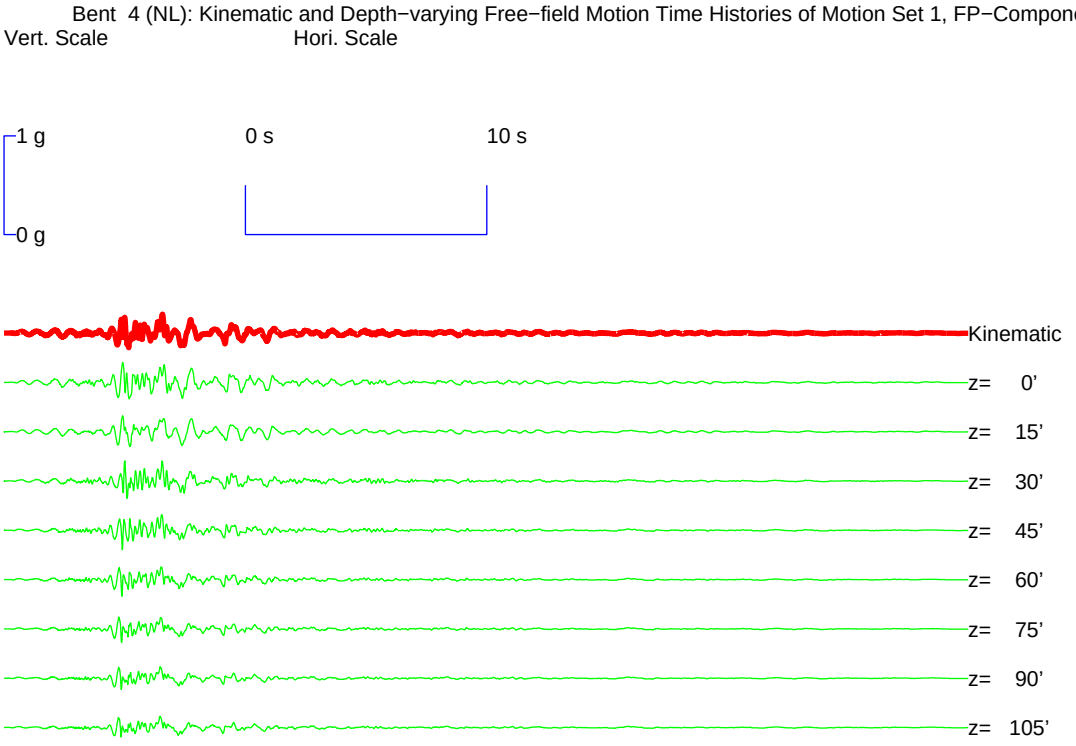


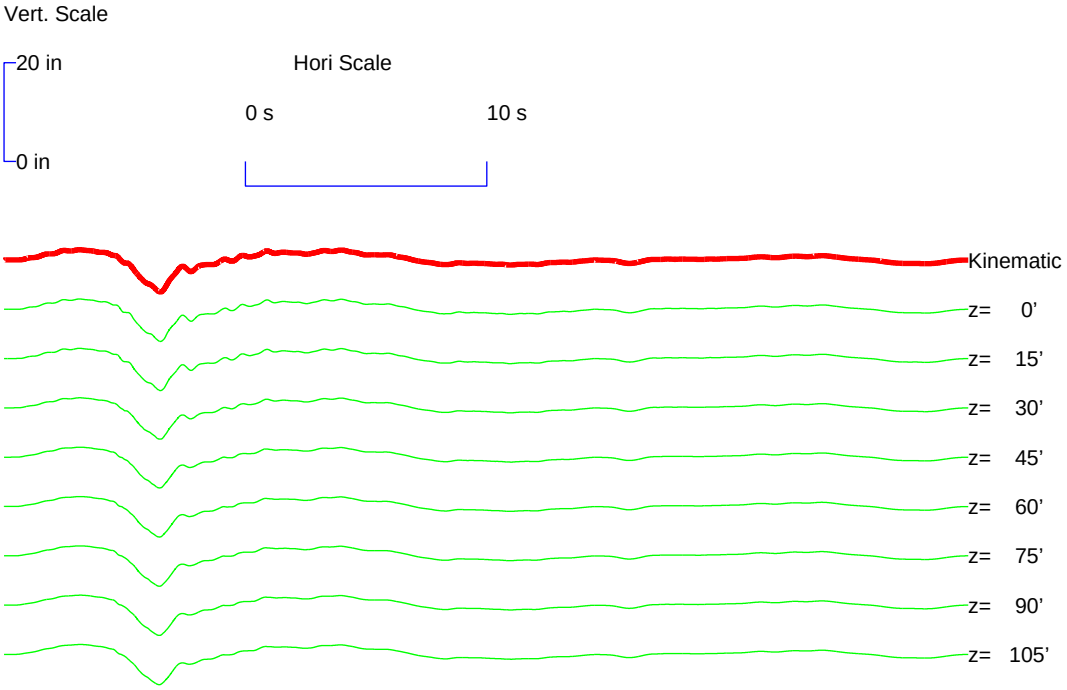


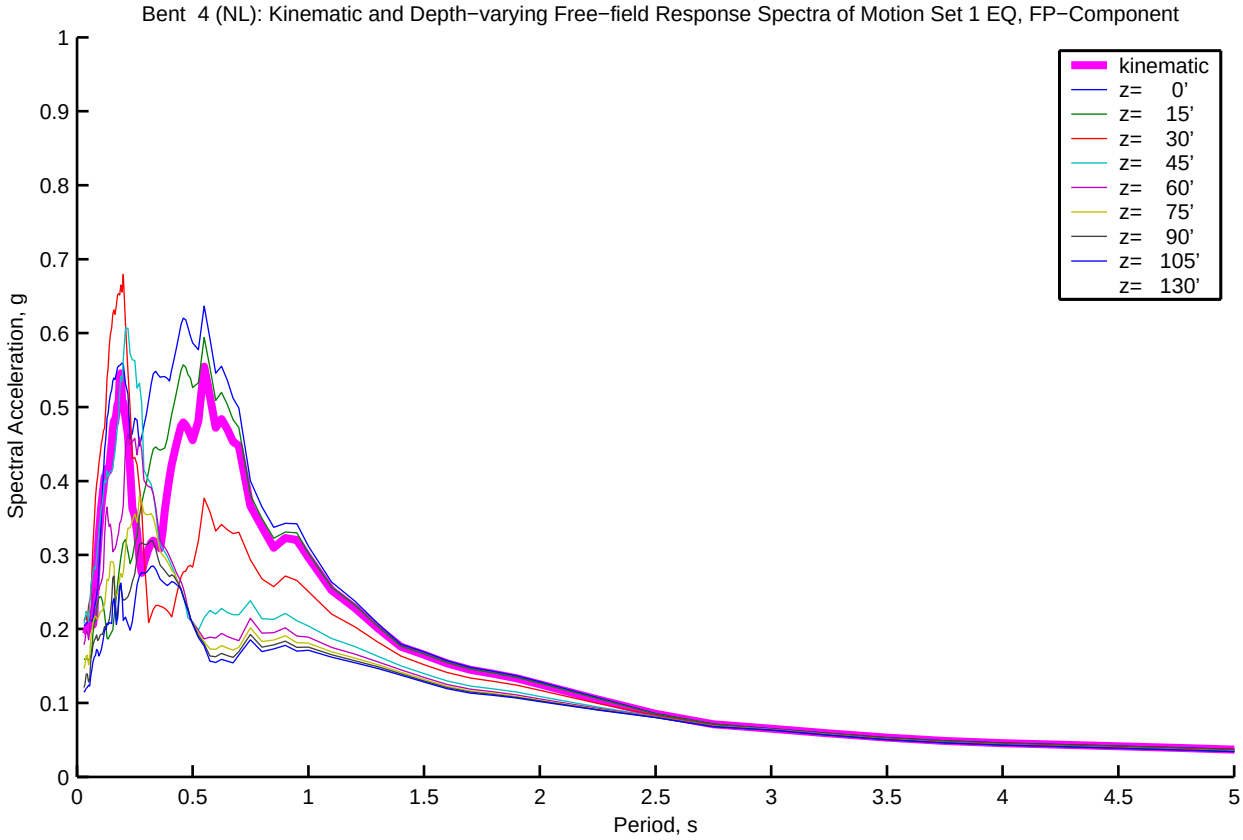

Bent 4 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

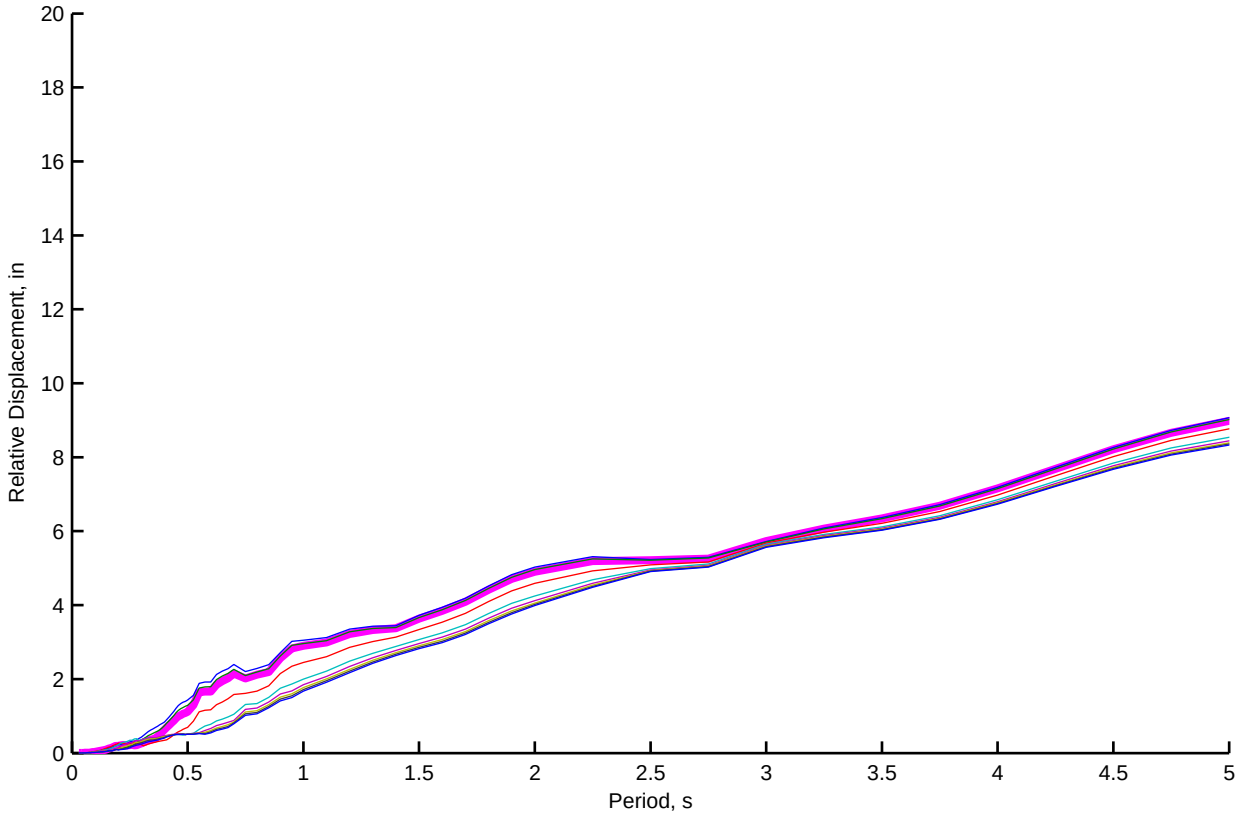

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 4 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component






Bent 4 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5


Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
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2.5
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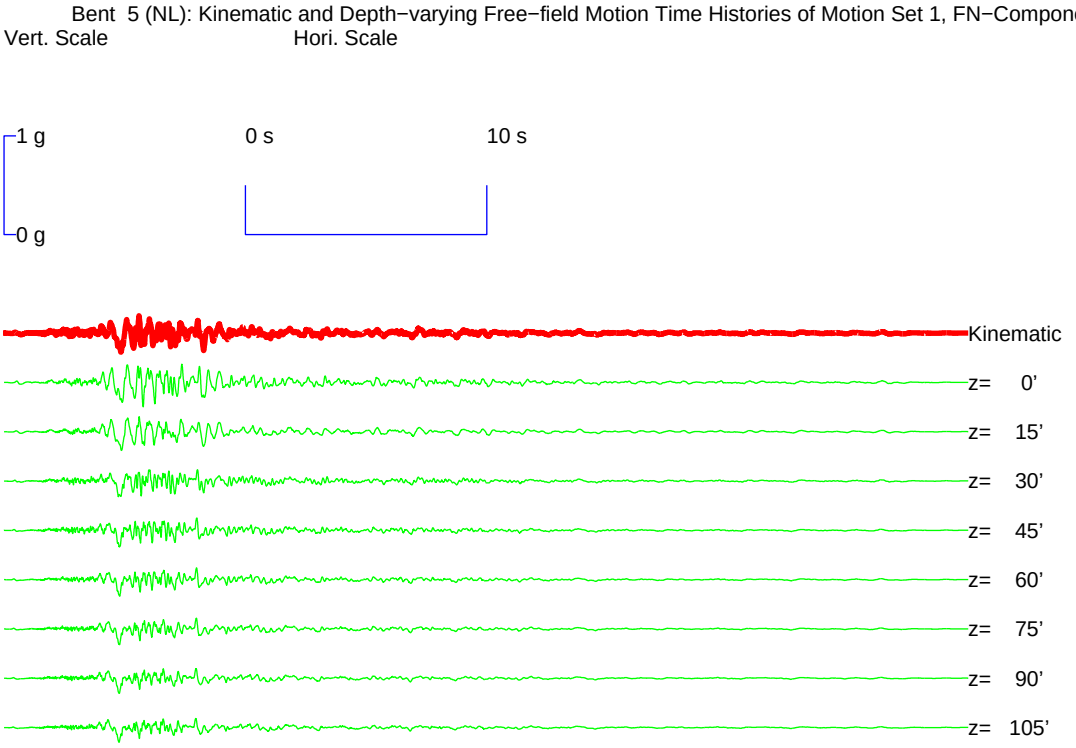
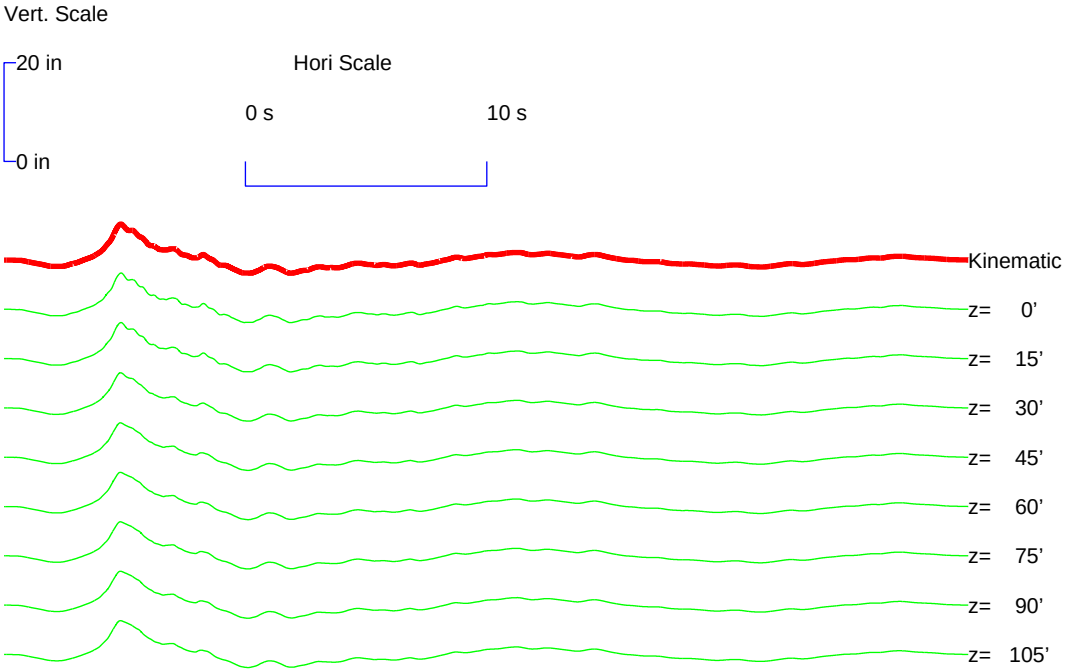
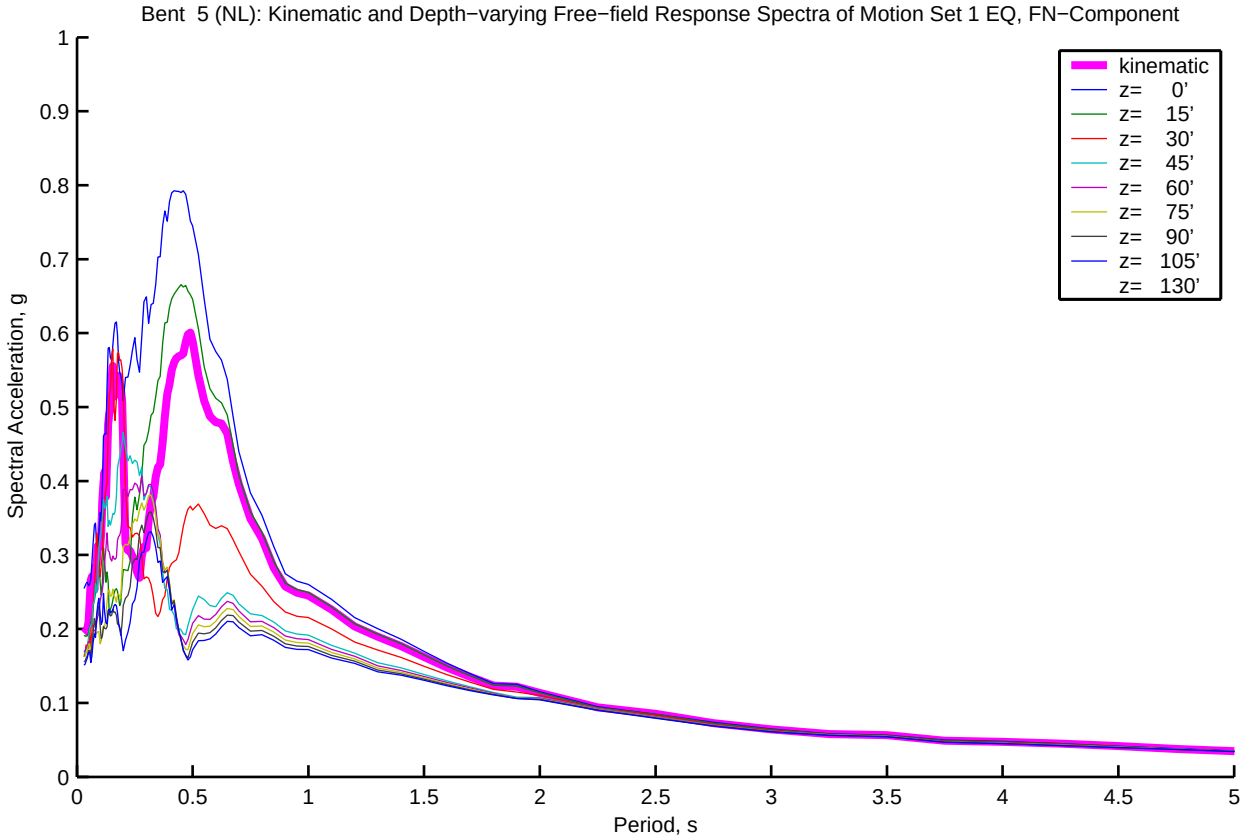
3.5
4
4.5
5

Bent 5 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component






Bent 5 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
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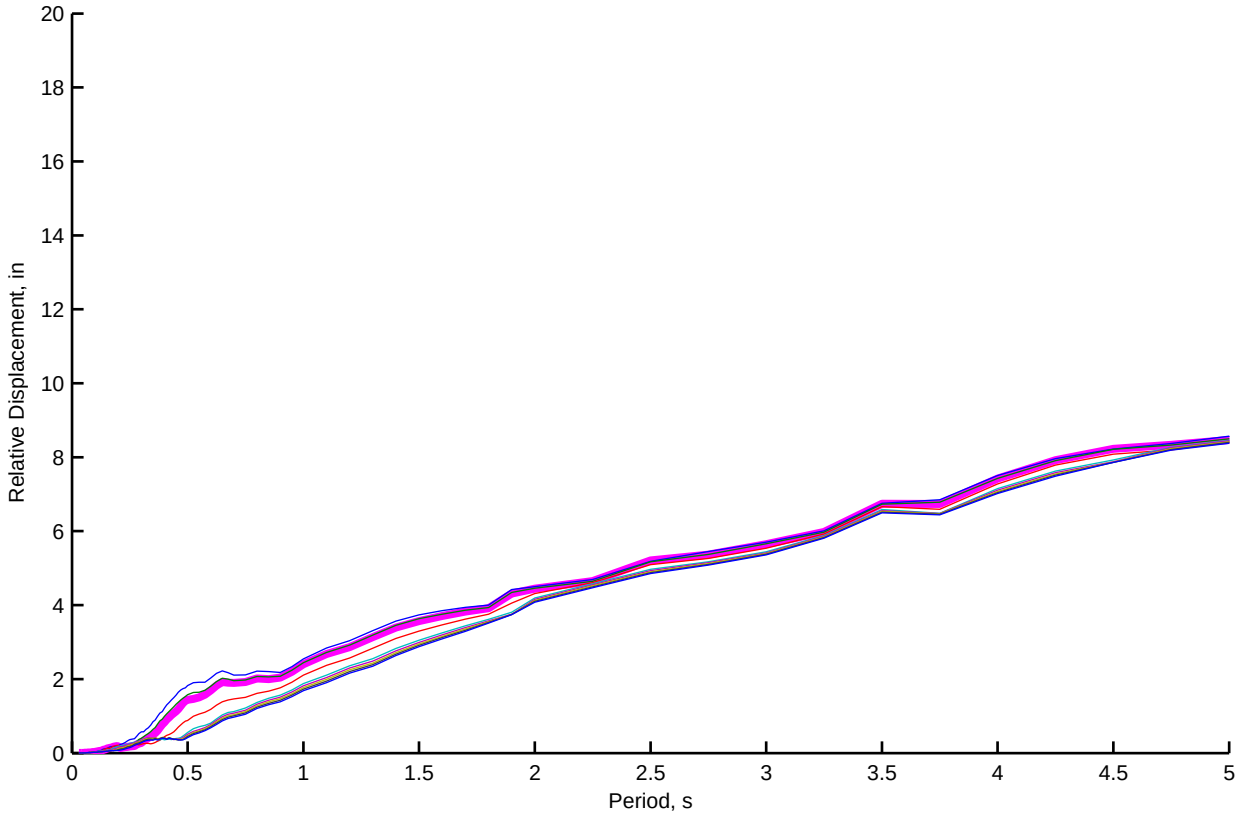
Relative Displacement, in
Period, s
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2
4
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0.5
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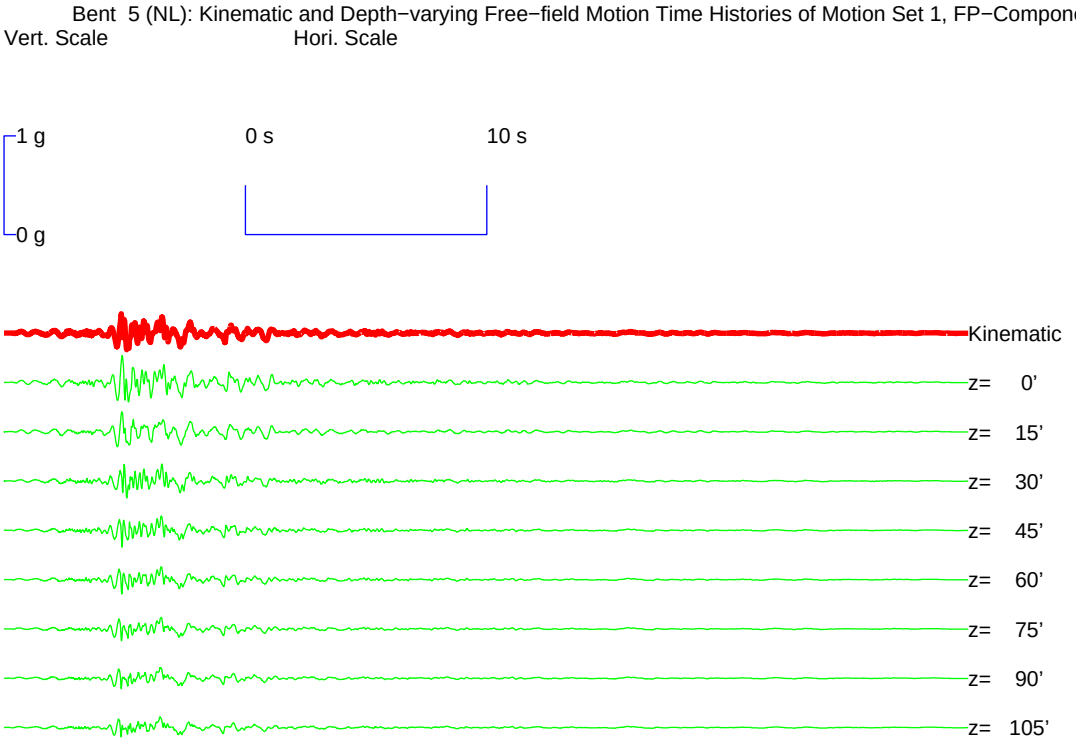
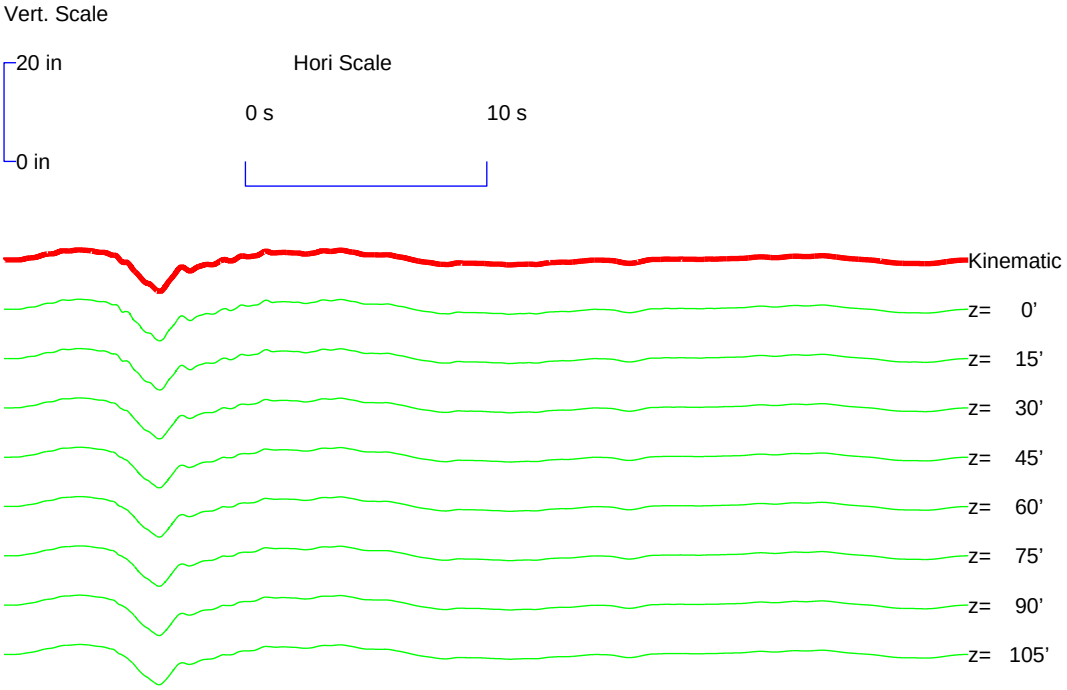
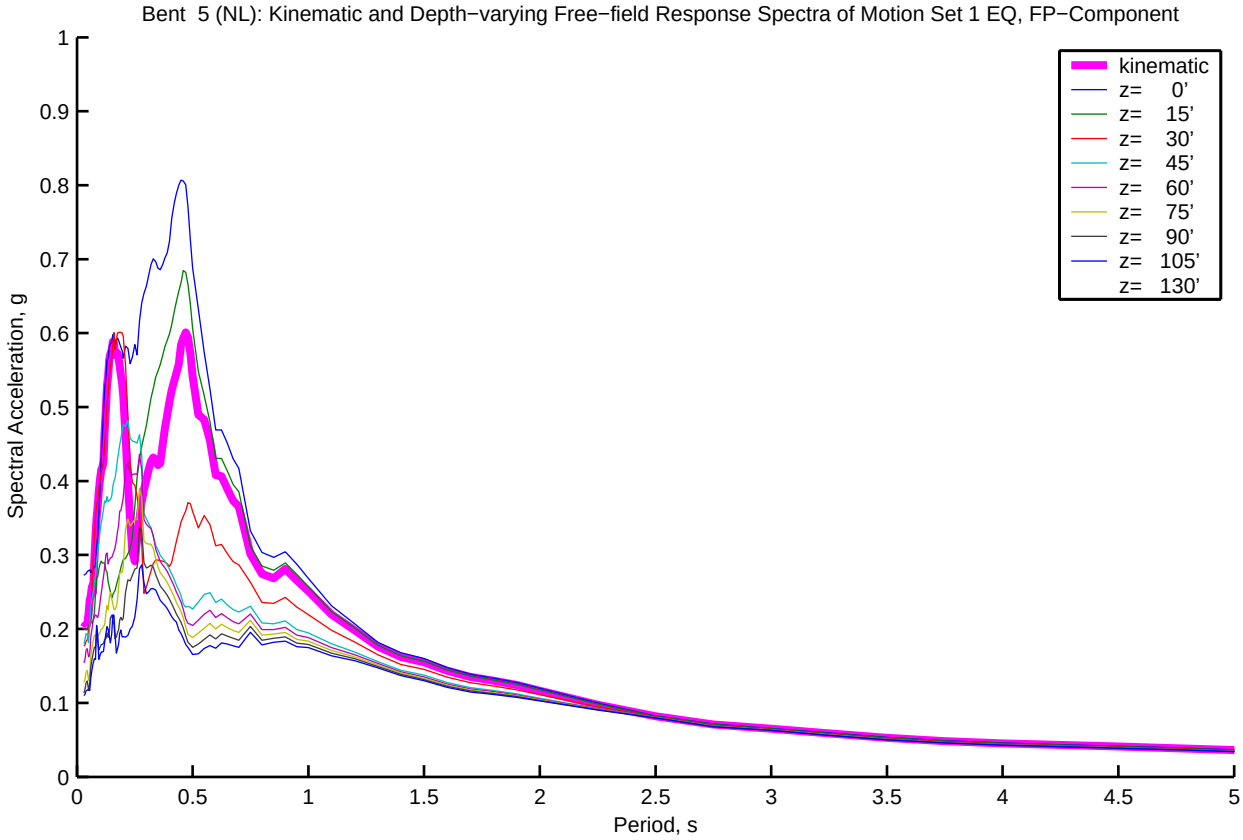
5

Bent 5 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component






Bent 5 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
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4
4.5
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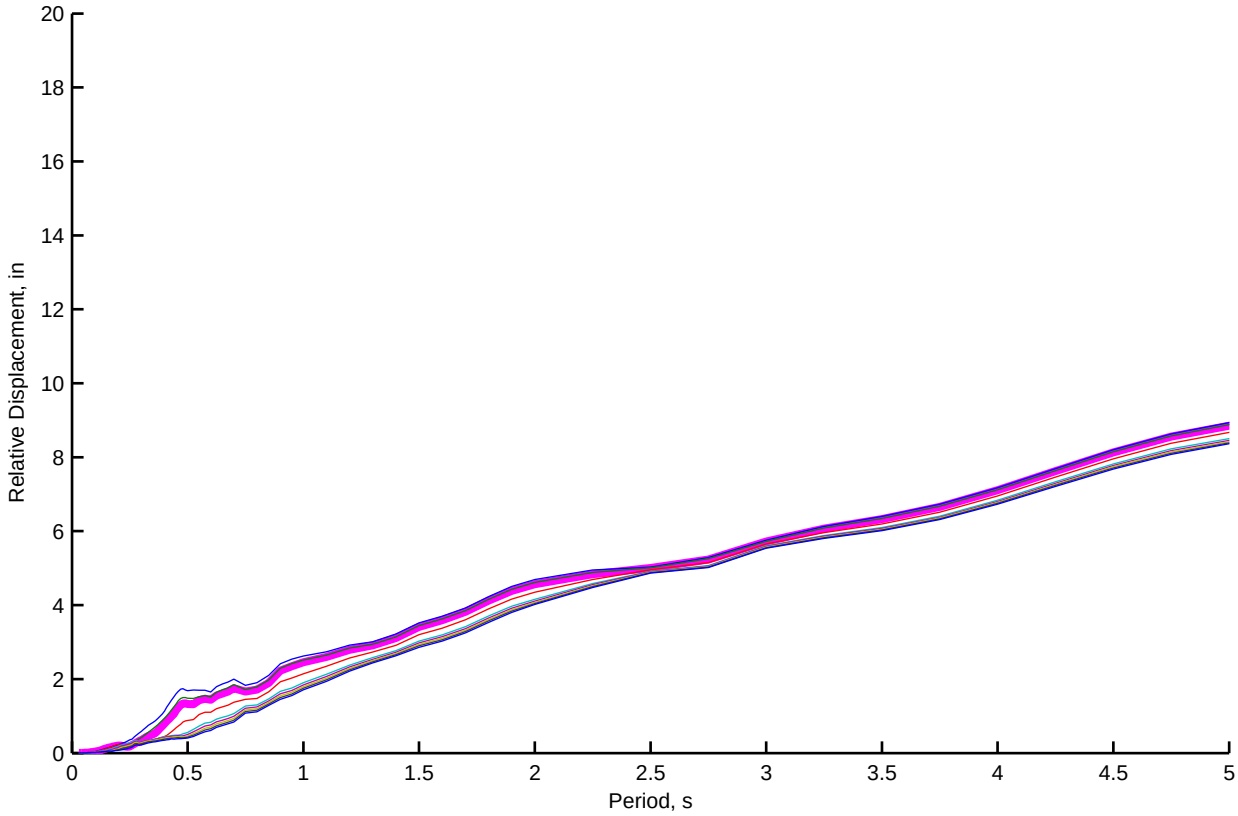
Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
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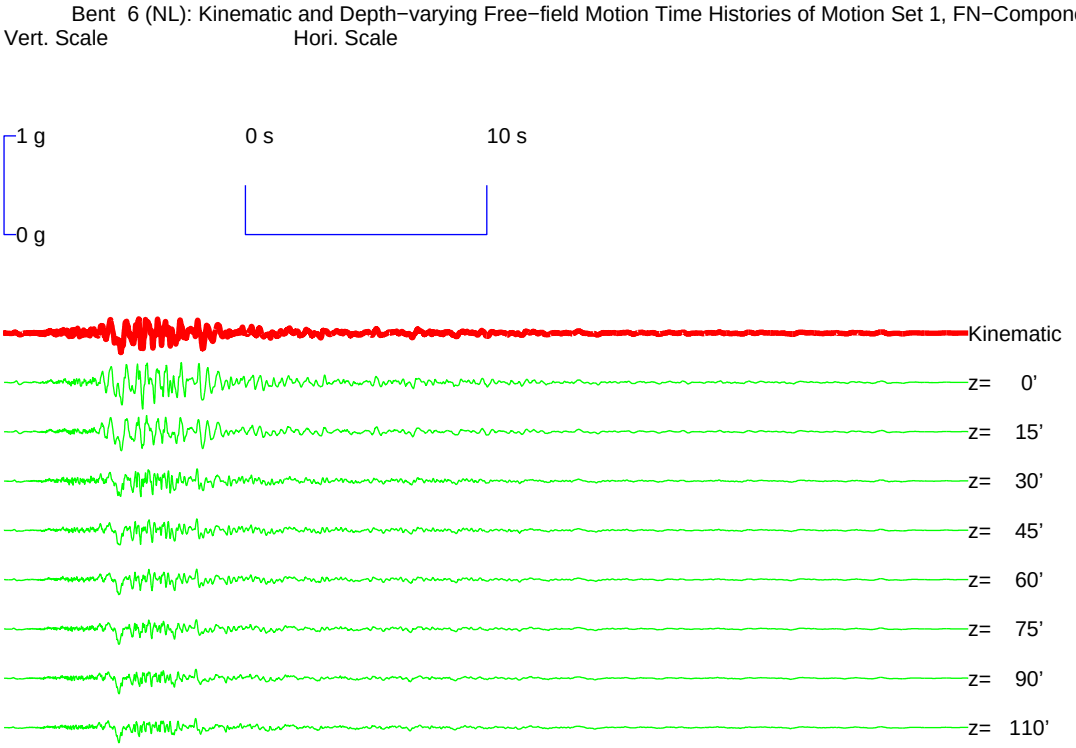
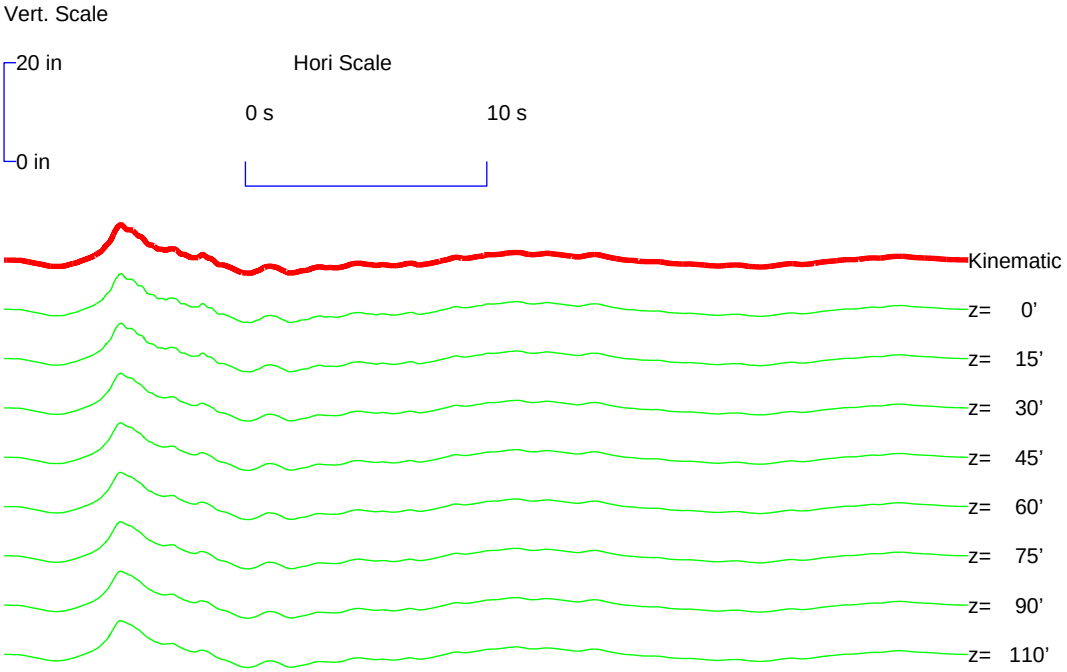
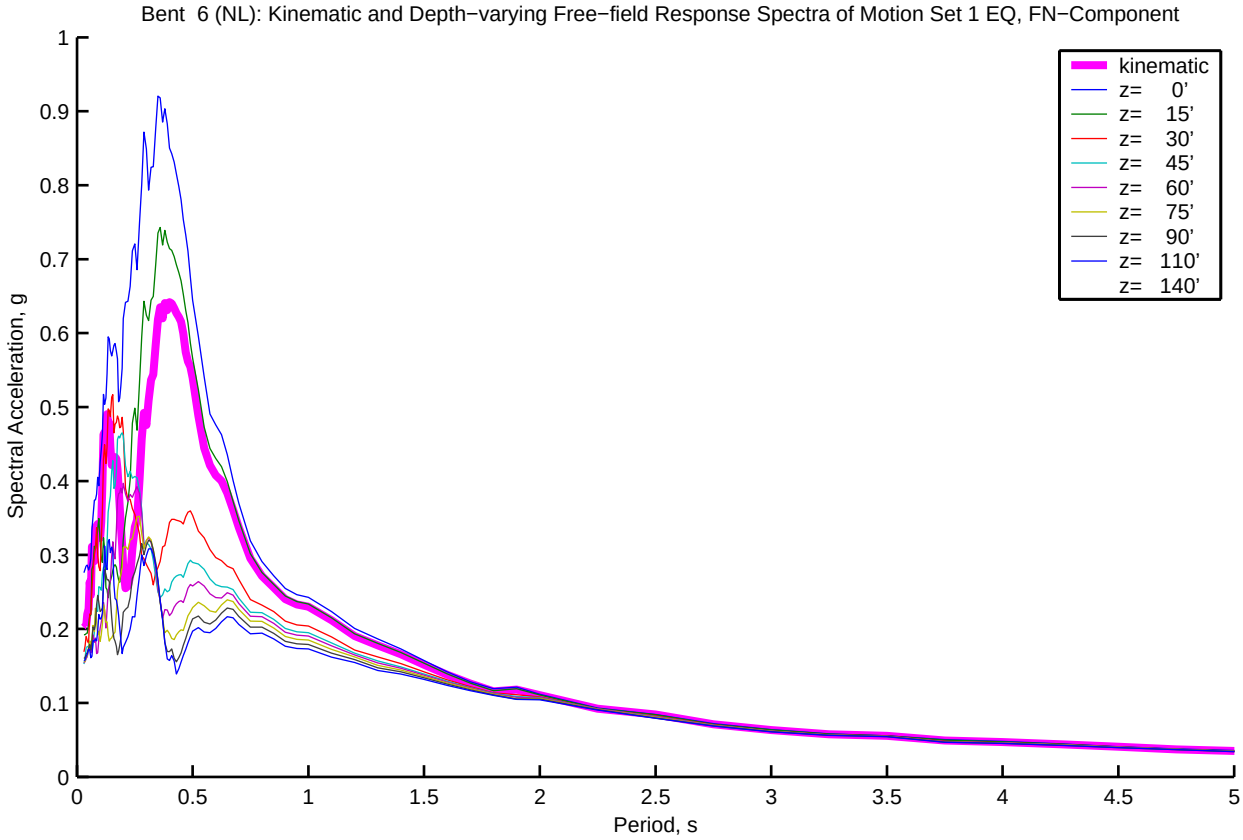
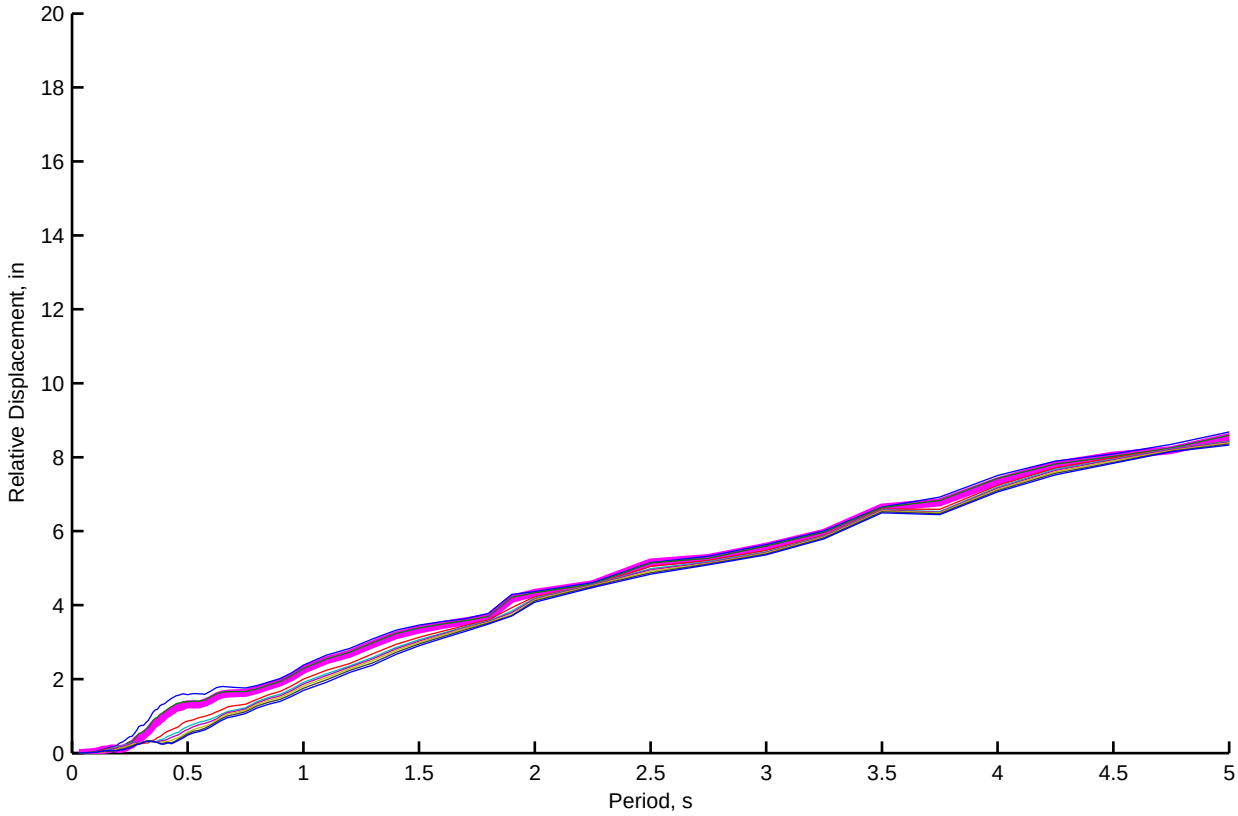
2.5
3
3.5
4
4.5
5

Bent 6 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component

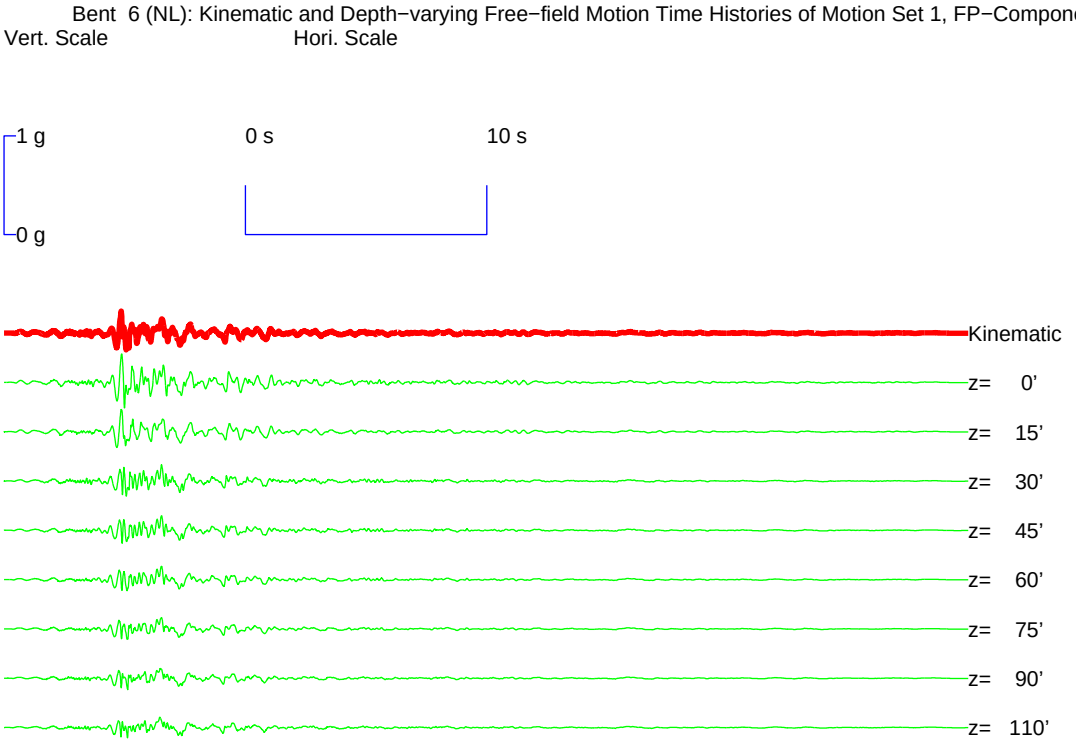


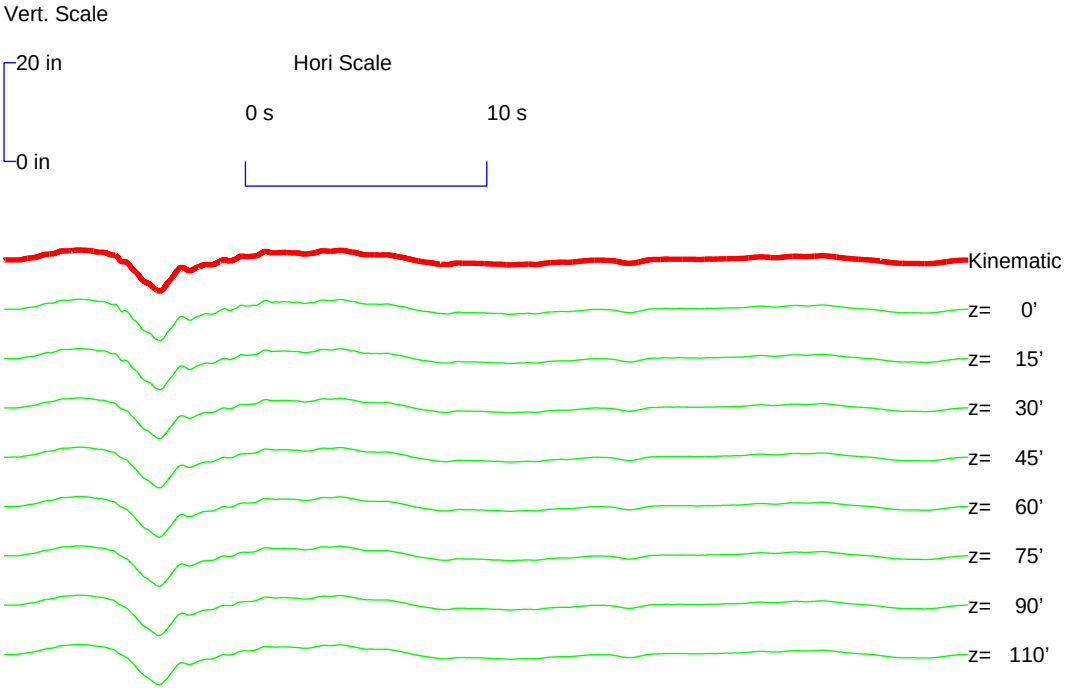


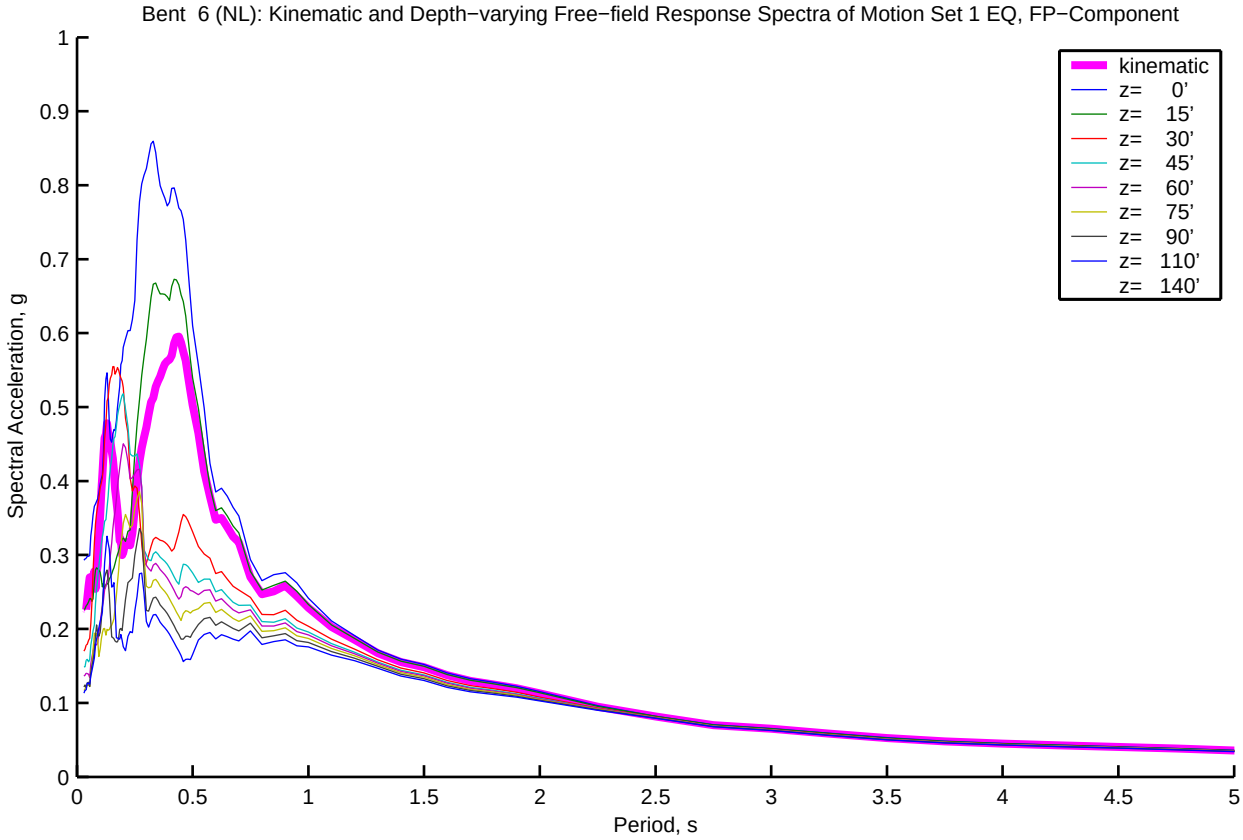

Bent 6 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'

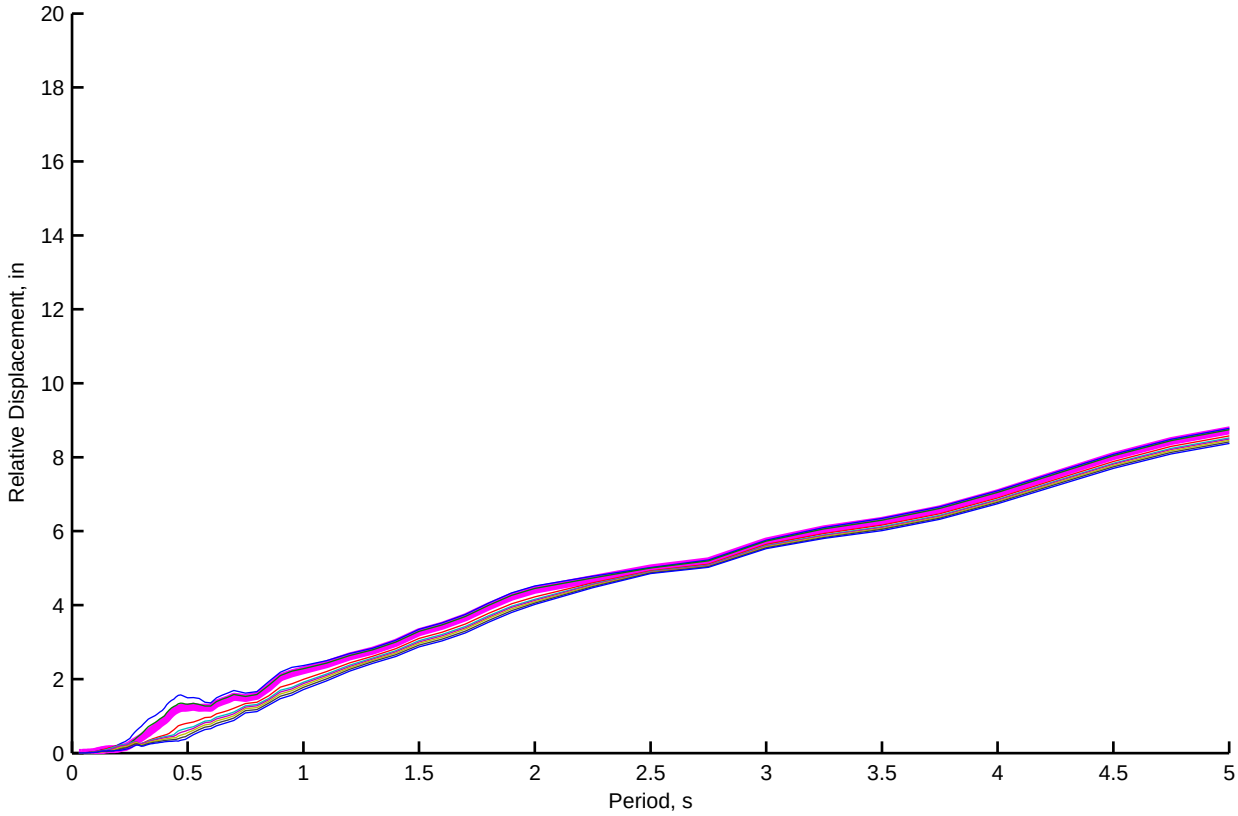

Relative Displacement, in
Period, s

Bent 6 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component

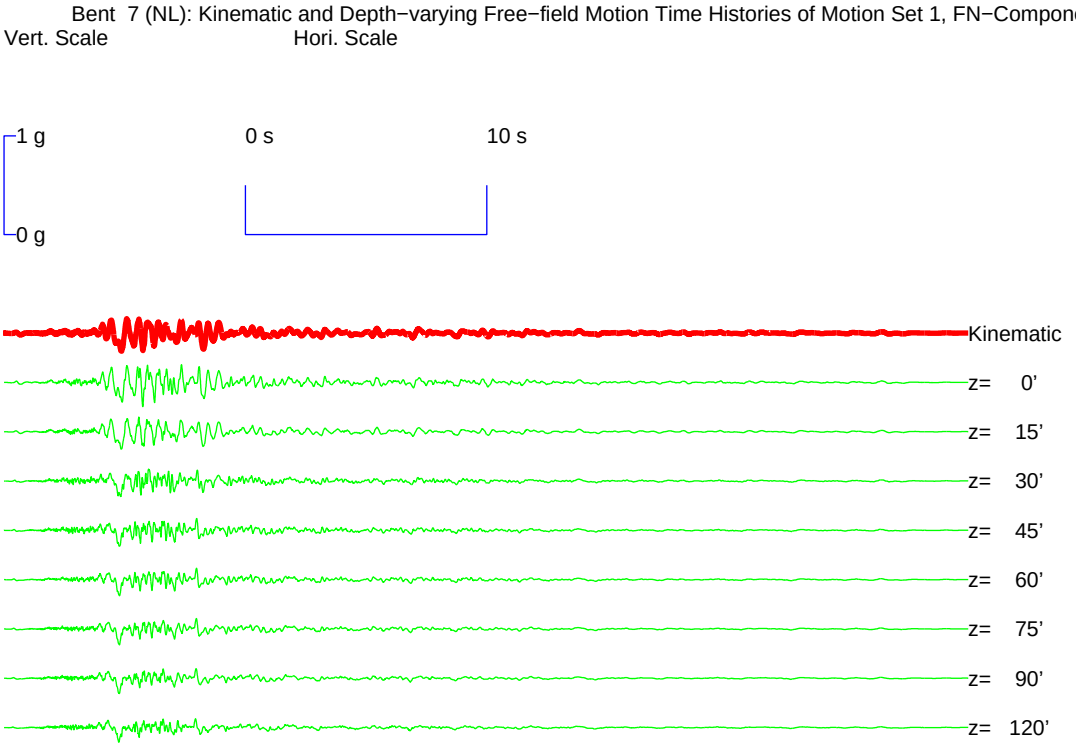


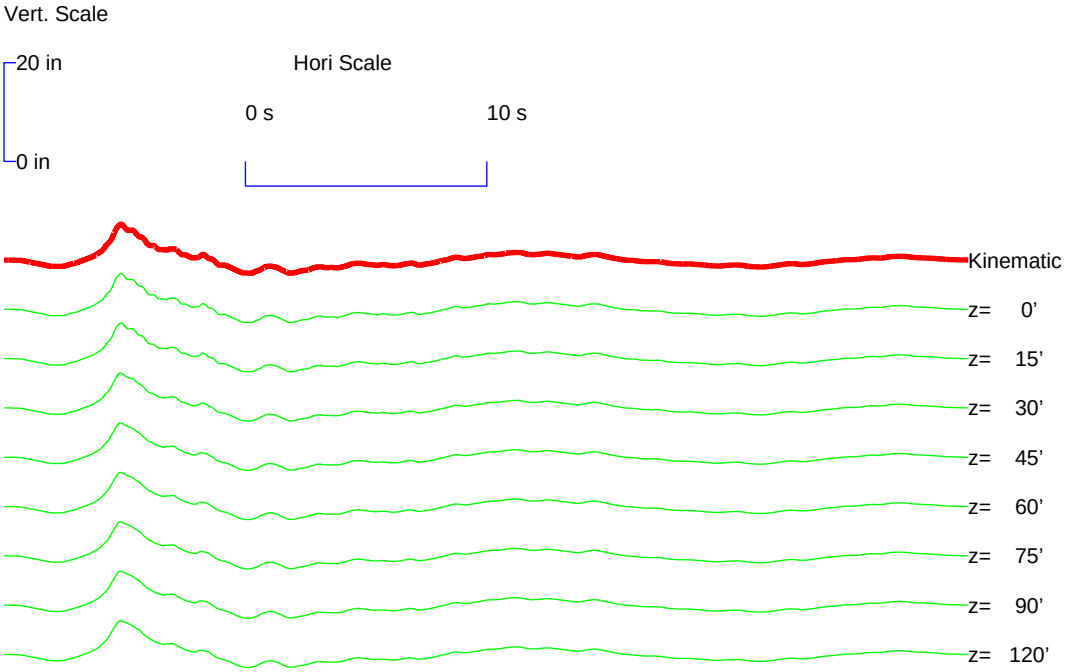


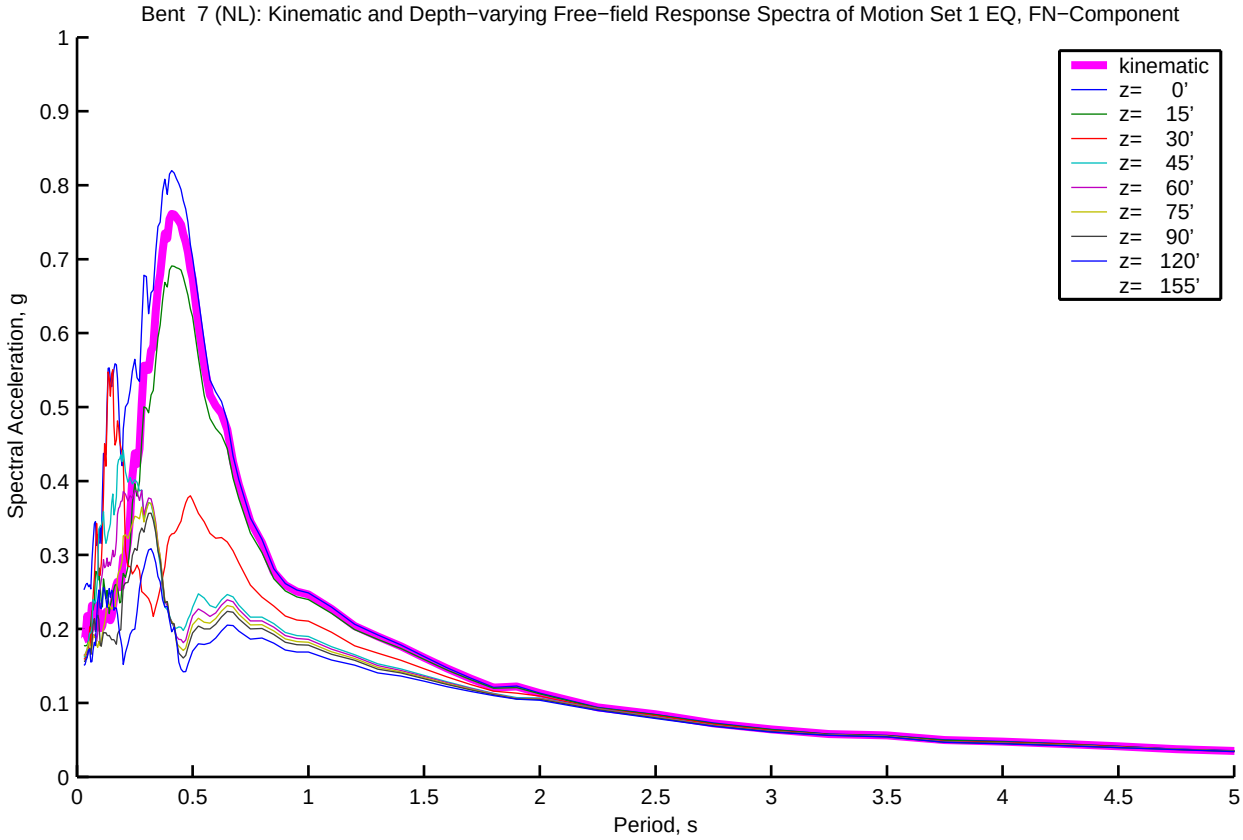

Bent 6 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'


Relative Displacement, in
Period, s

Bent 7 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component






Bent 7 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 155'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
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1
0.5
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2.5
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4.5
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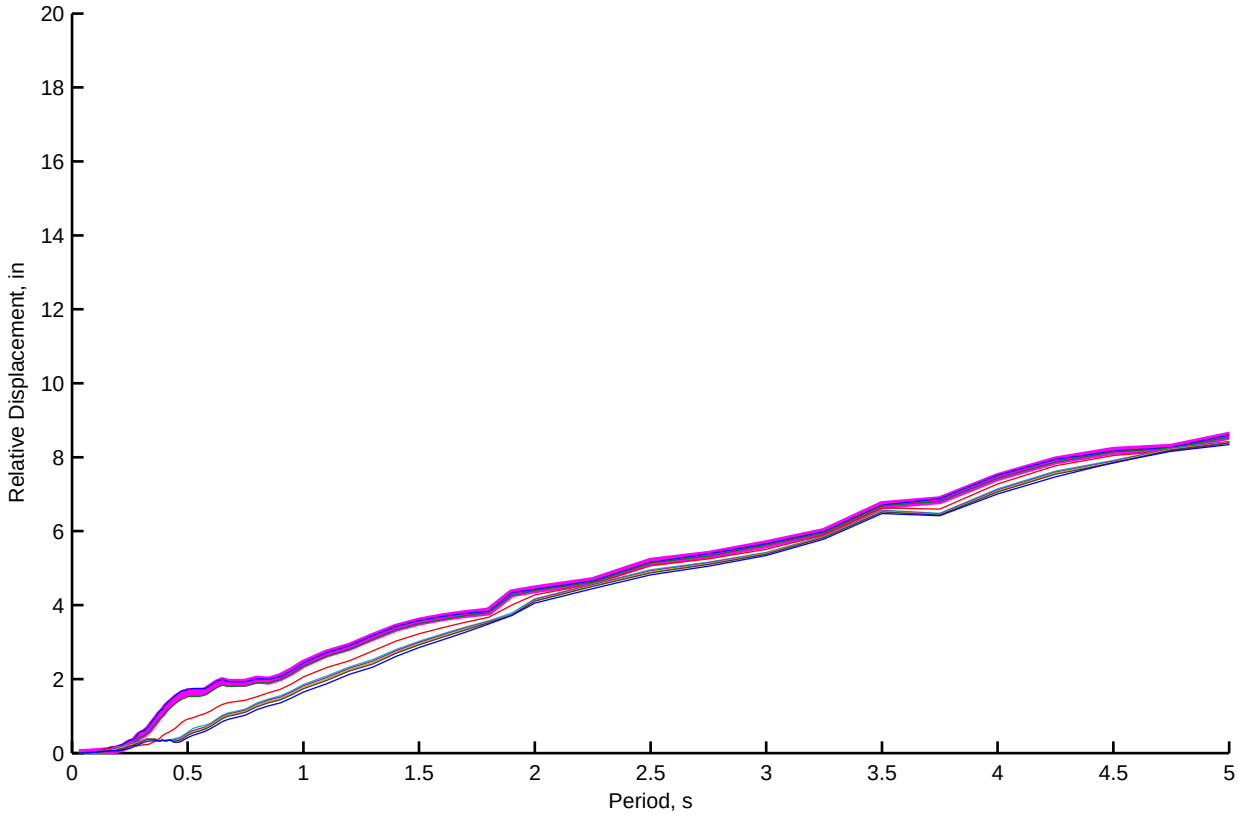
Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
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2.5
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3.5
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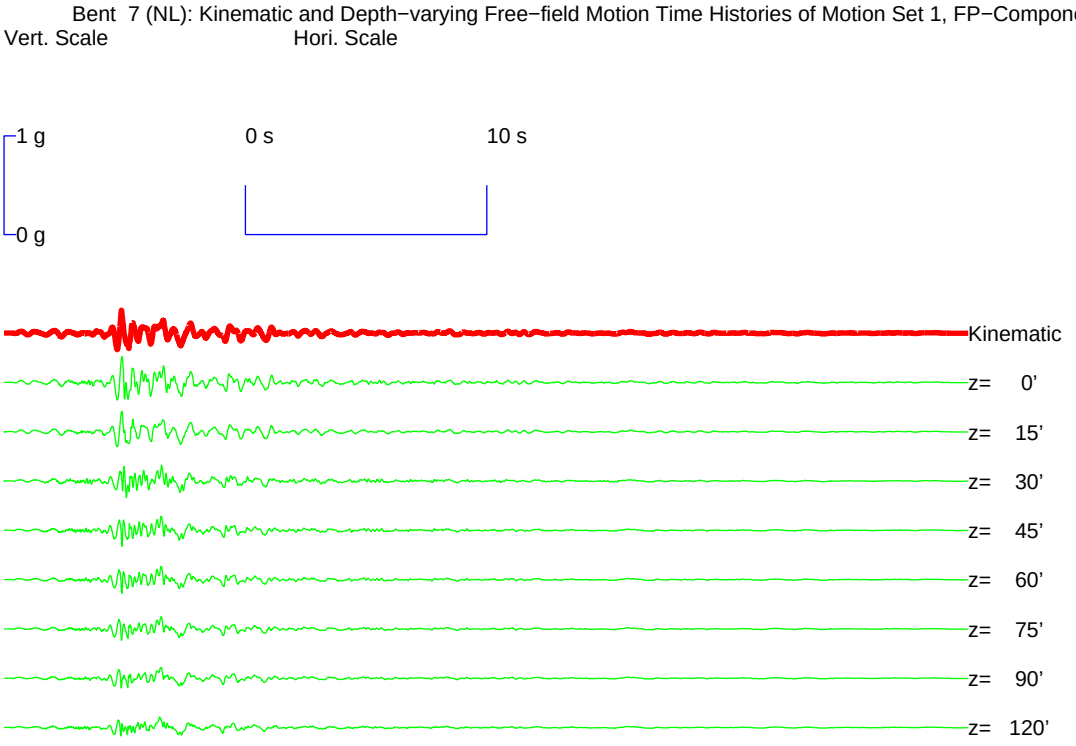
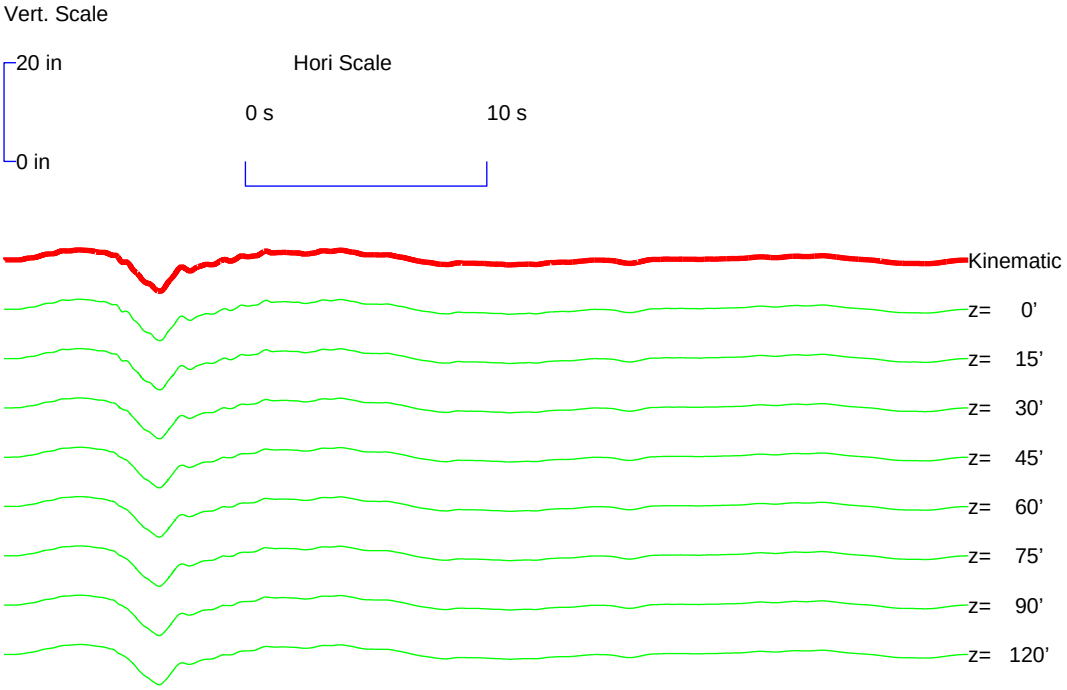
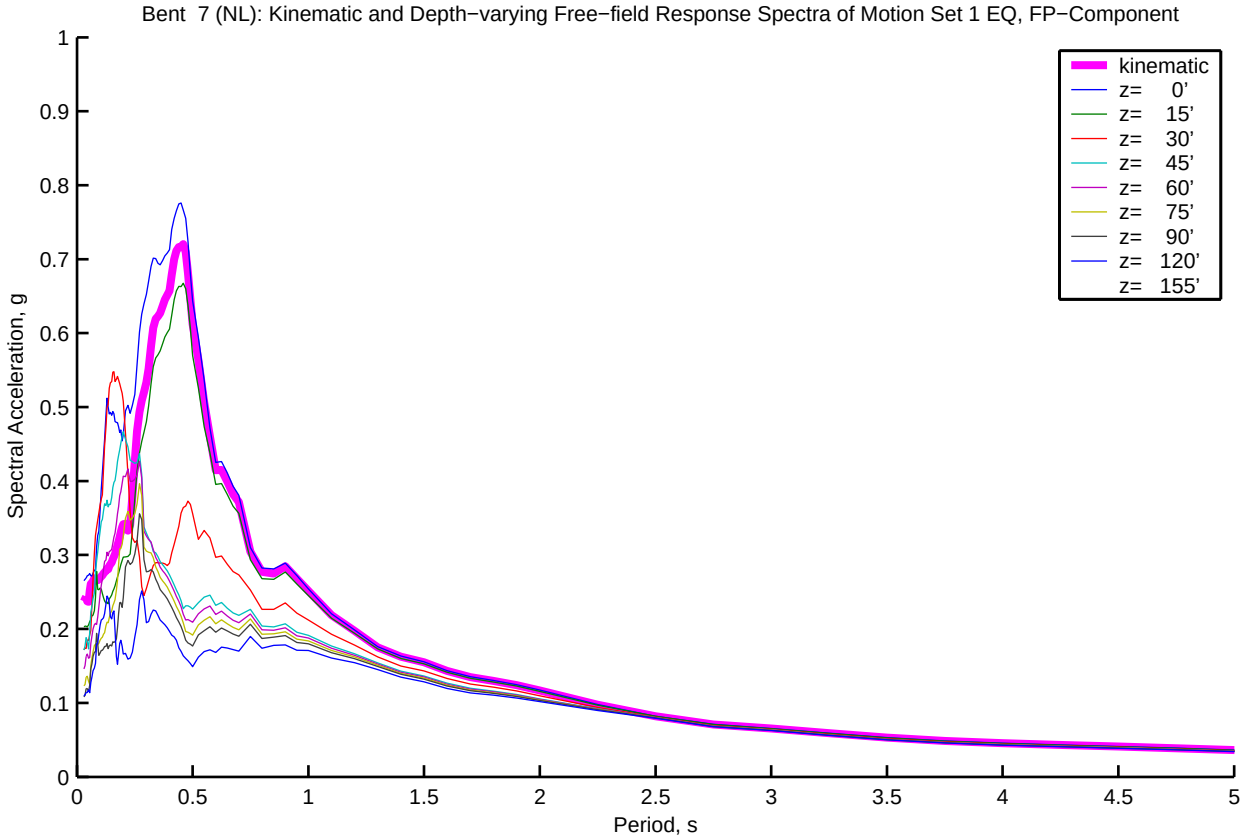
4.5
5

Bent 7 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component






Bent 7 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 155'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
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2.5
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3.5
4
4.5
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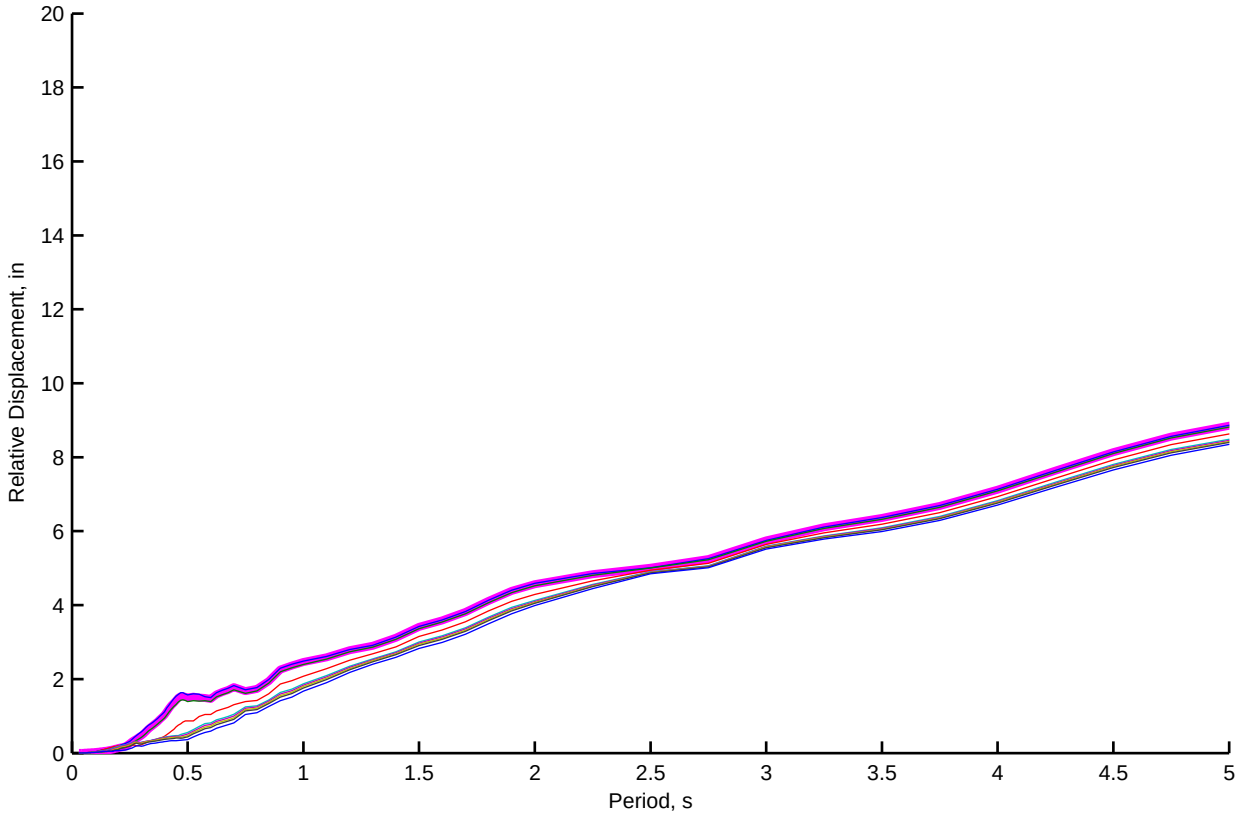
Relative Displacement, in
Period, s
0
2
4
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12
14
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0.5
1
1.5
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2.5
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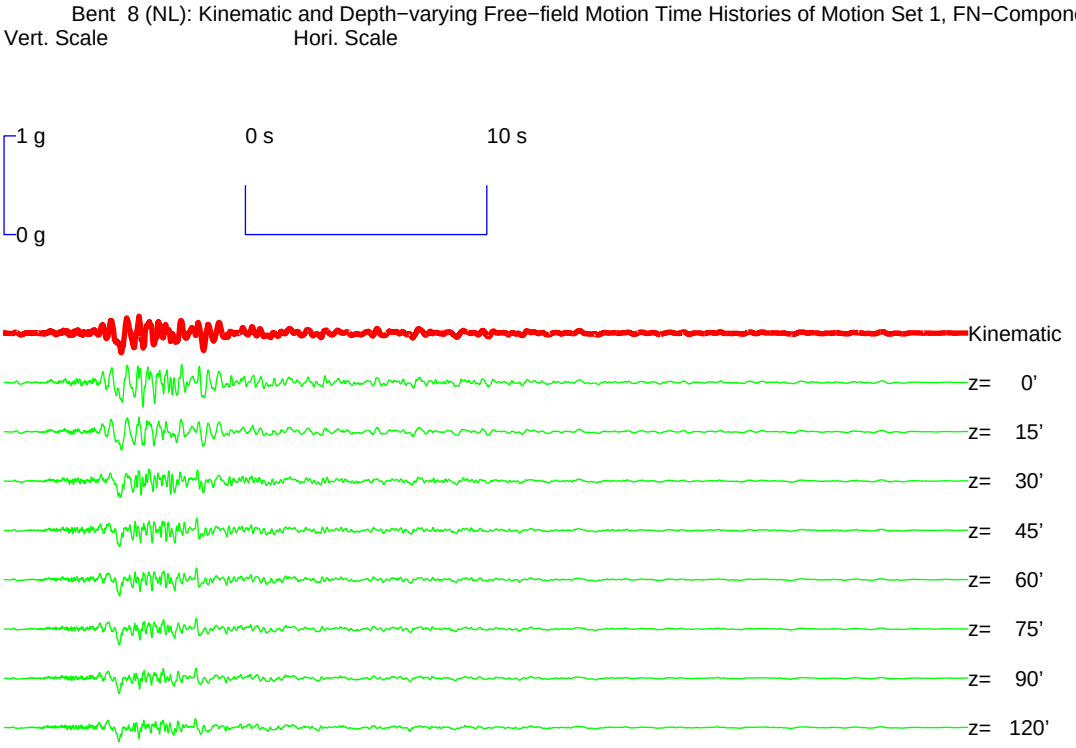
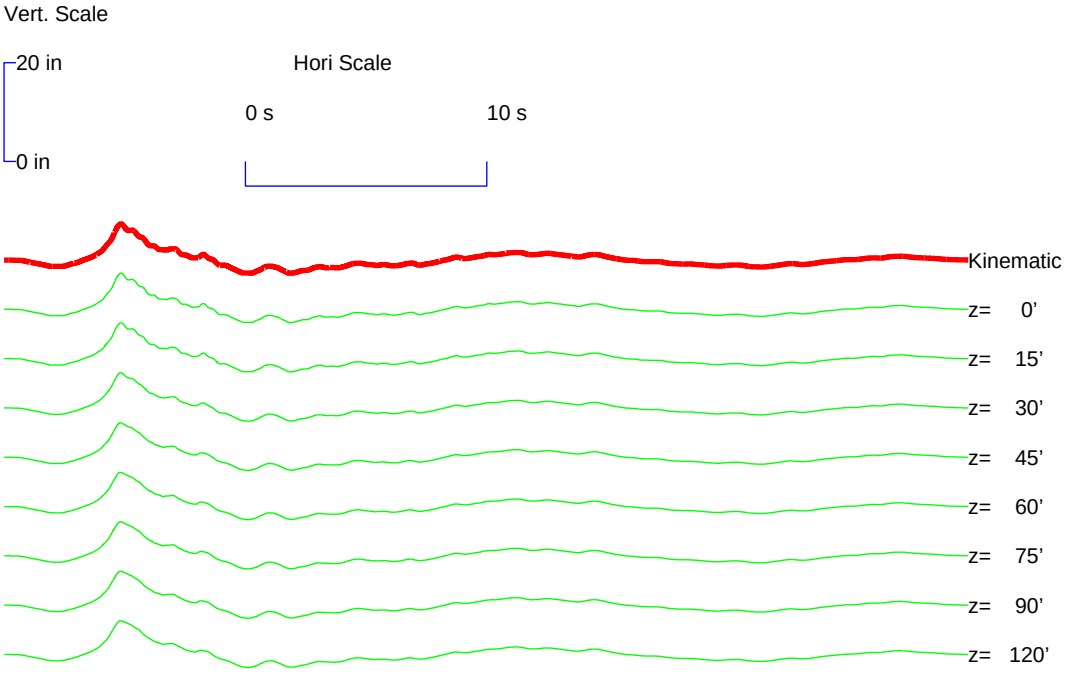
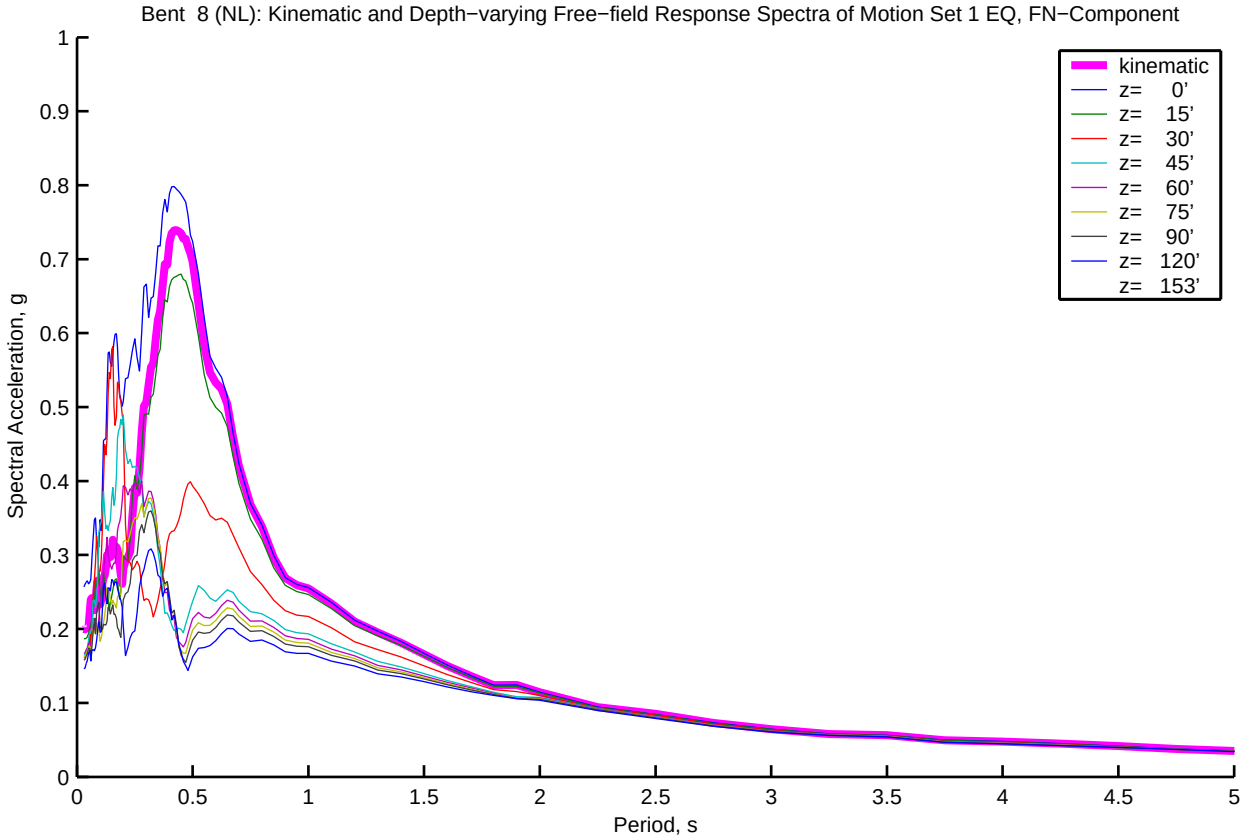
Bent 8 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component






Bent 8 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 153'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
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3.5
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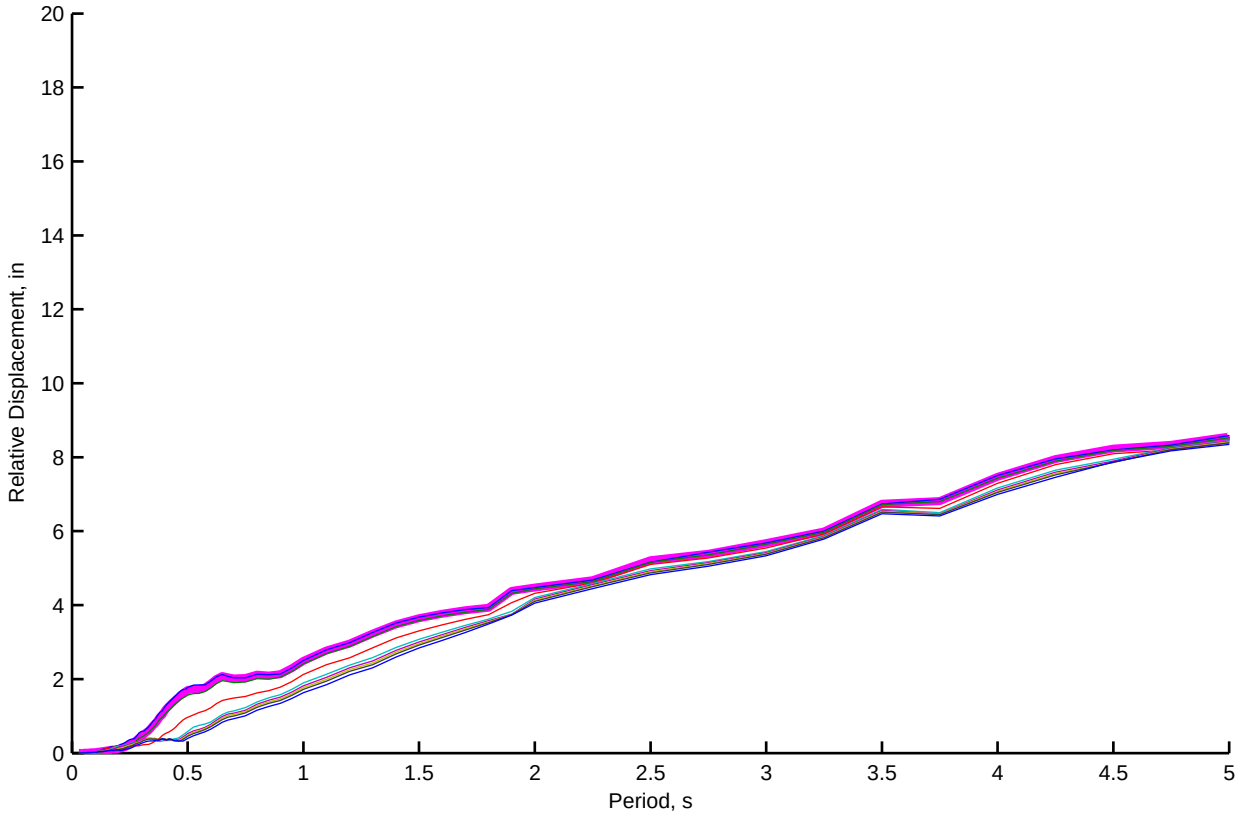
Relative Displacement, in
Period, s
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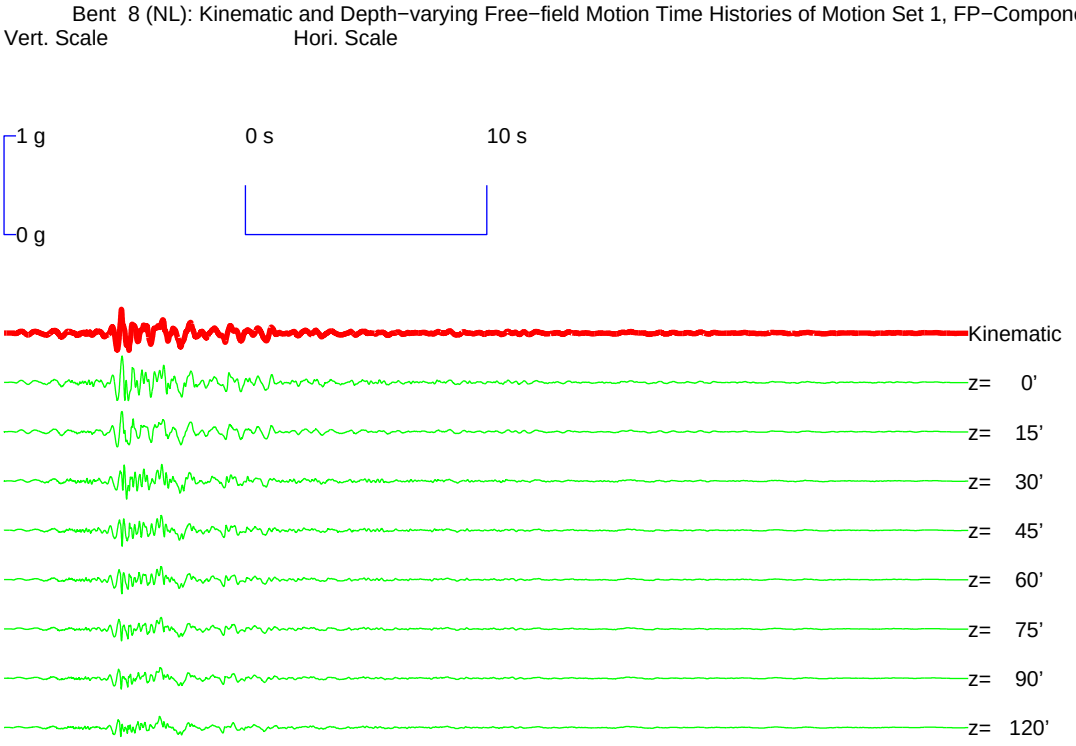
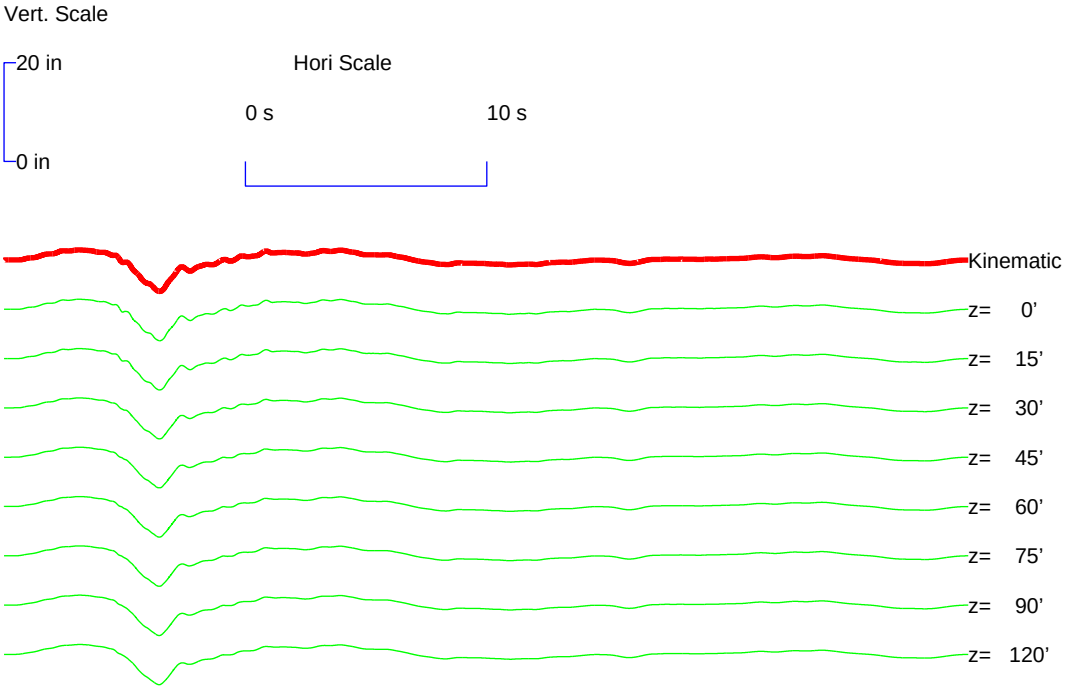
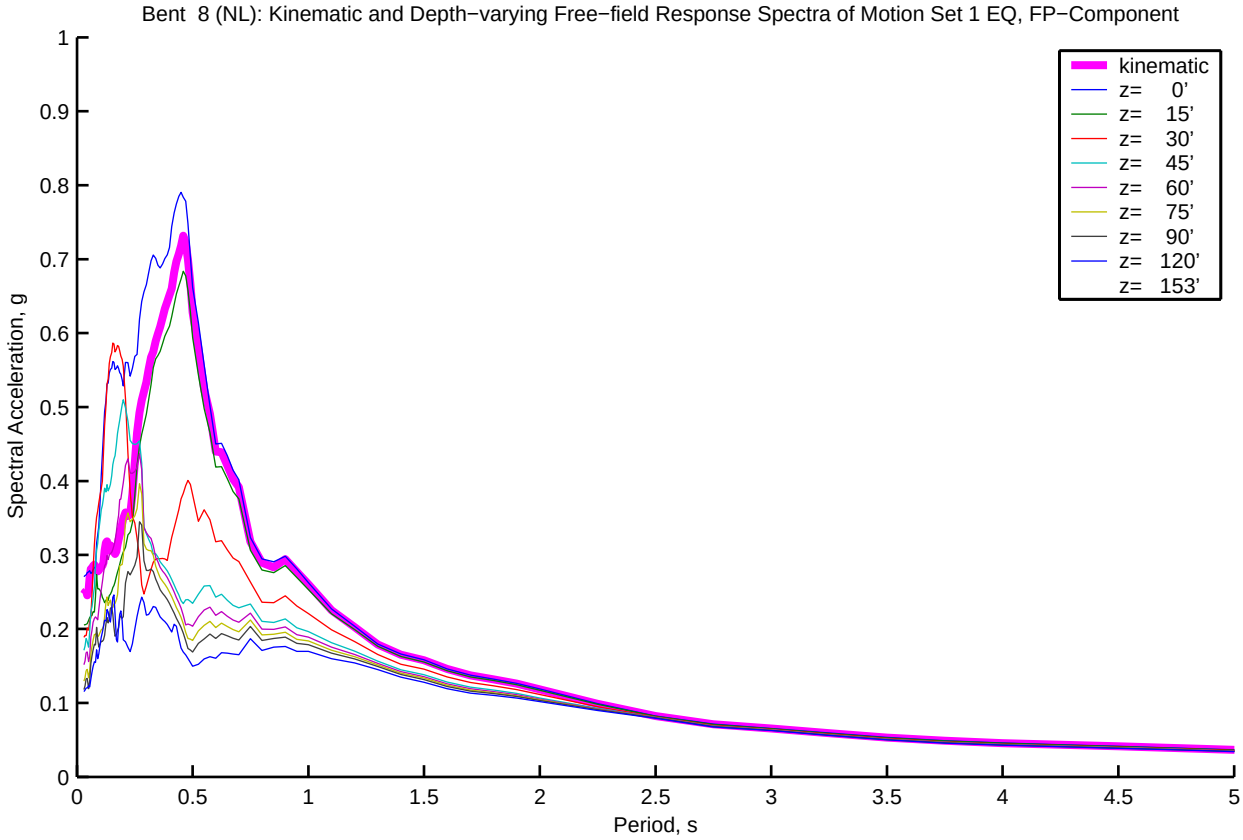
Bent 8 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component






Bent 8 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 153'
0
0.1
0.2
0.3
0.4
0.5
0.6
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0.8
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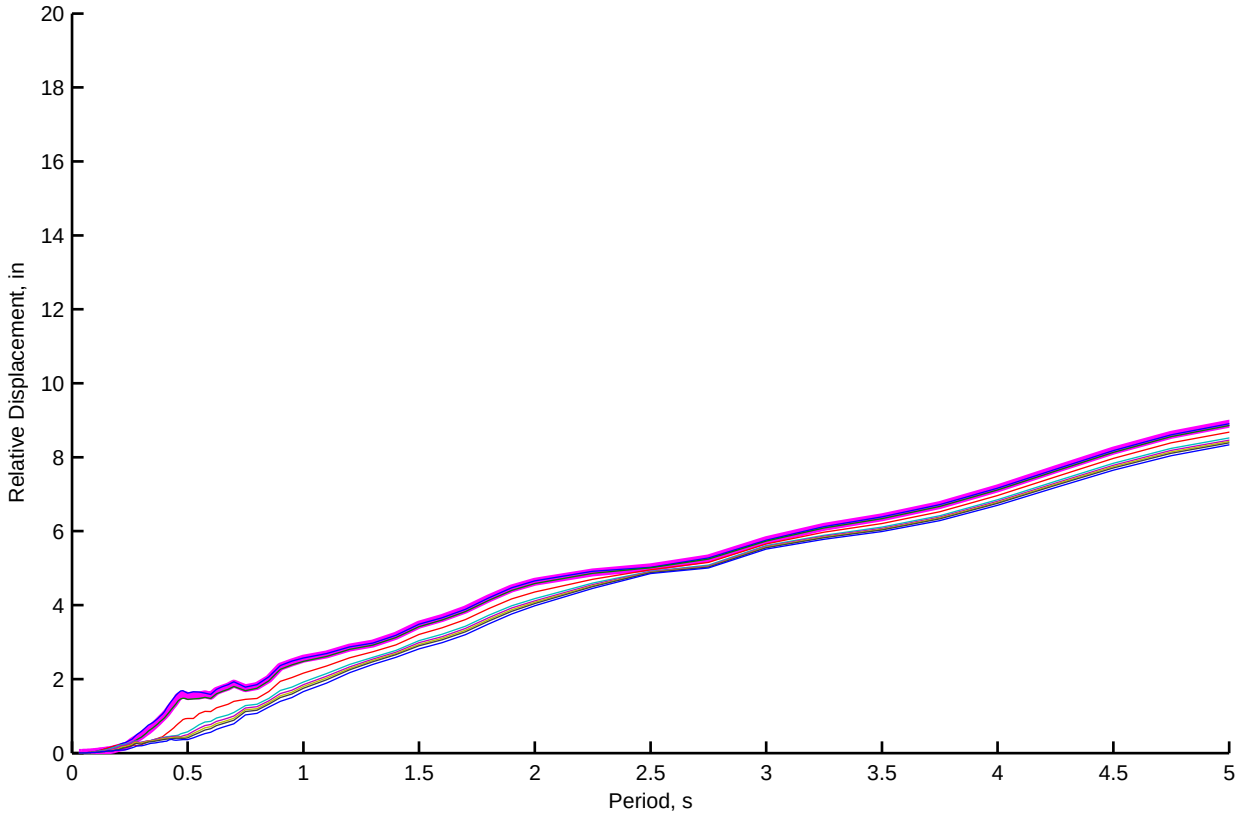
Relative Displacement, in
Period, s
0
2
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0.5
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1.5
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4.5
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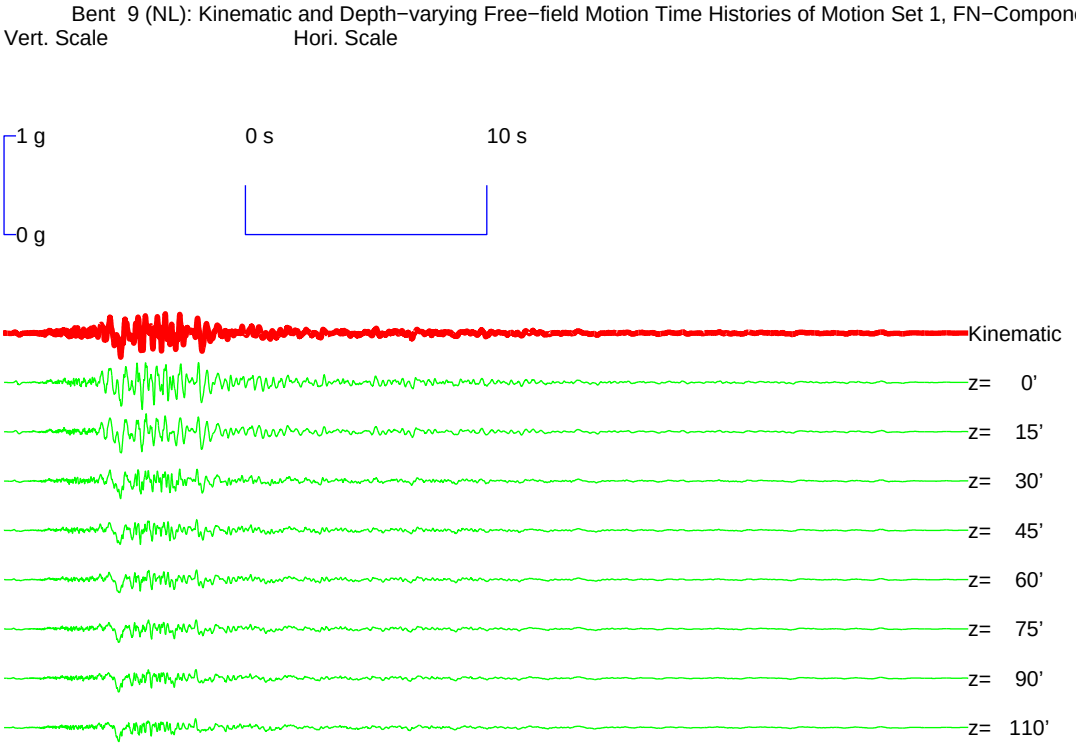
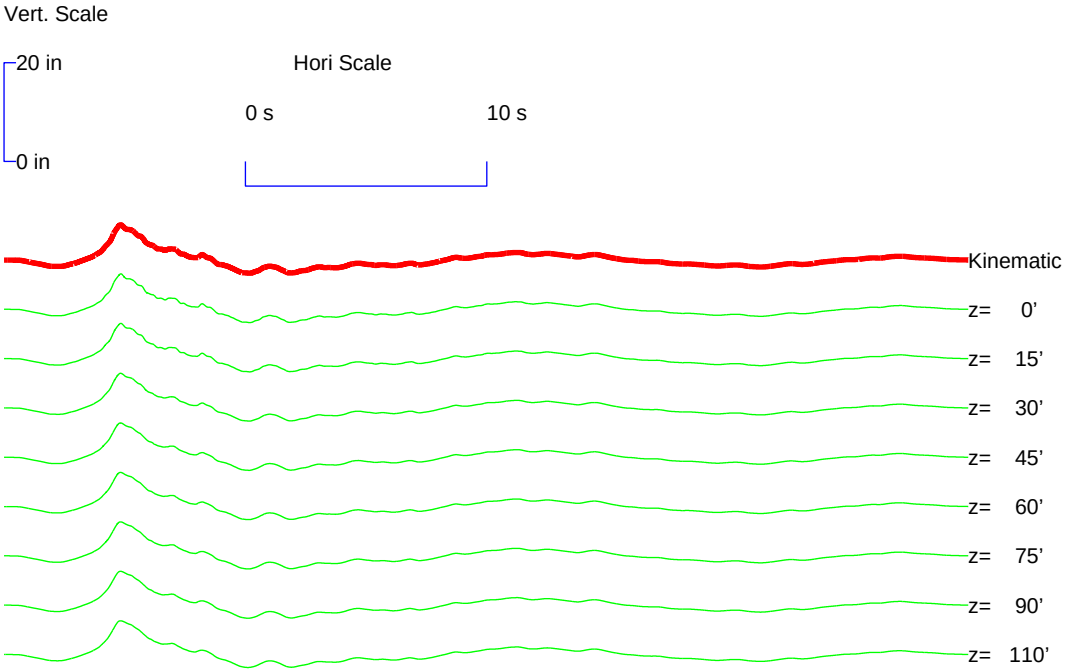
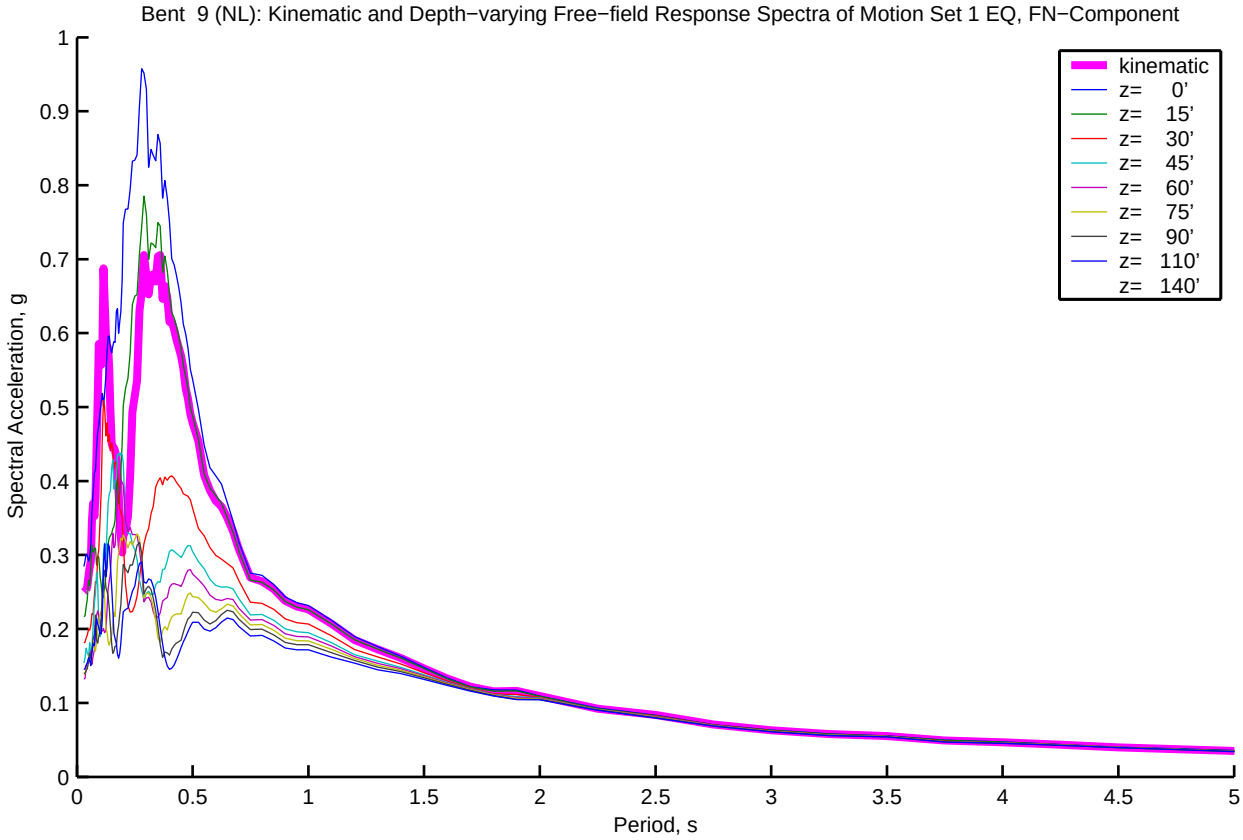
Bent 9 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component






Bent 9 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'
0
0.1
0.2
0.3
0.4
0.5
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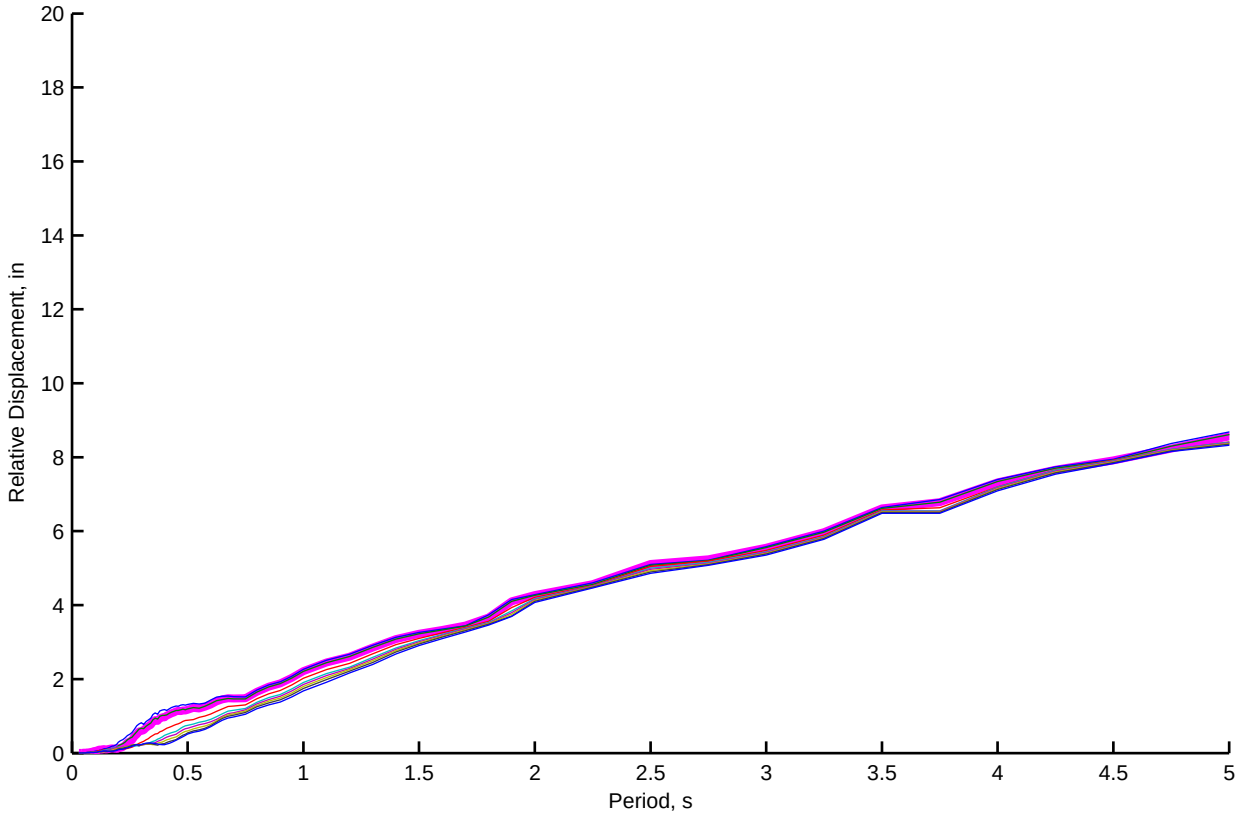
Relative Displacement, in
Period, s
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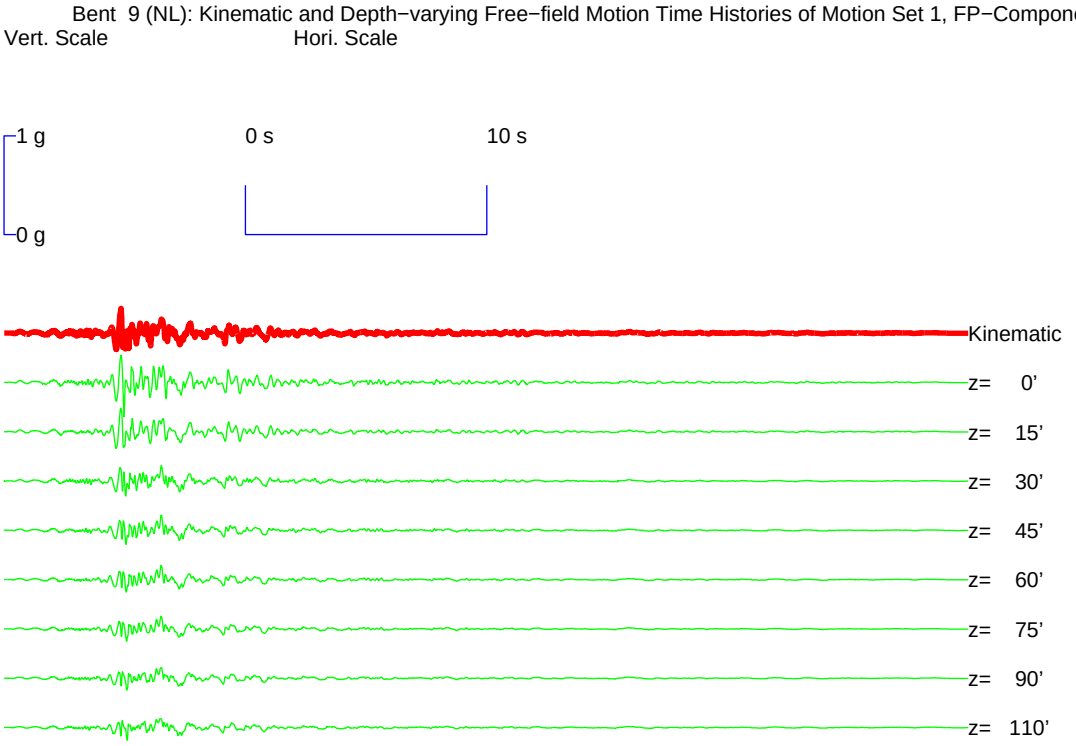
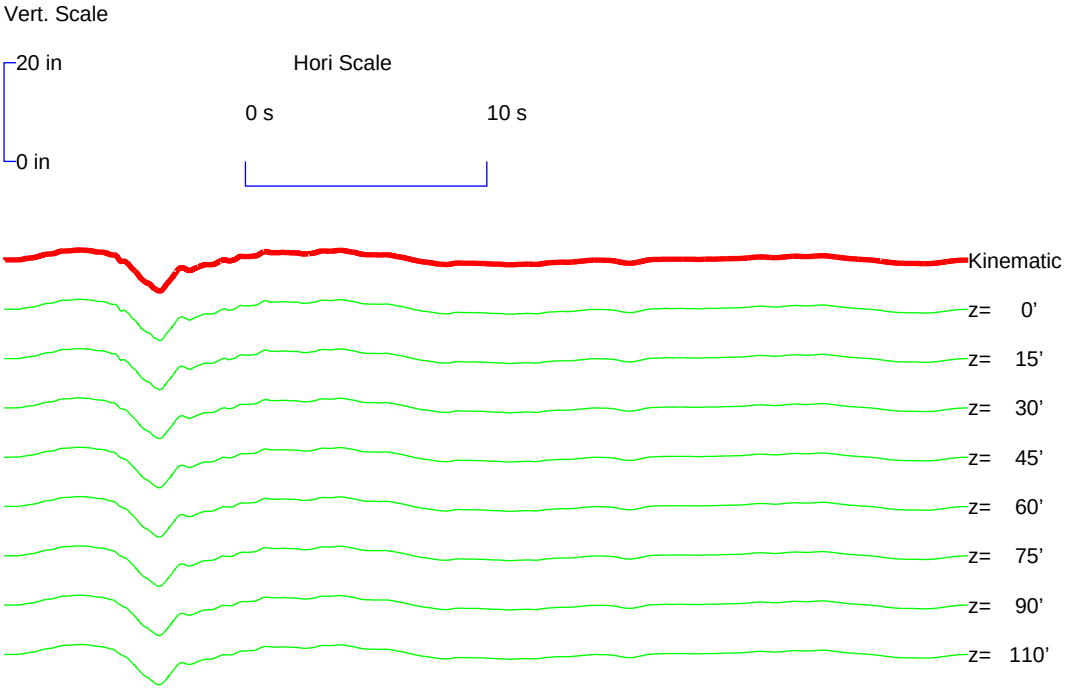
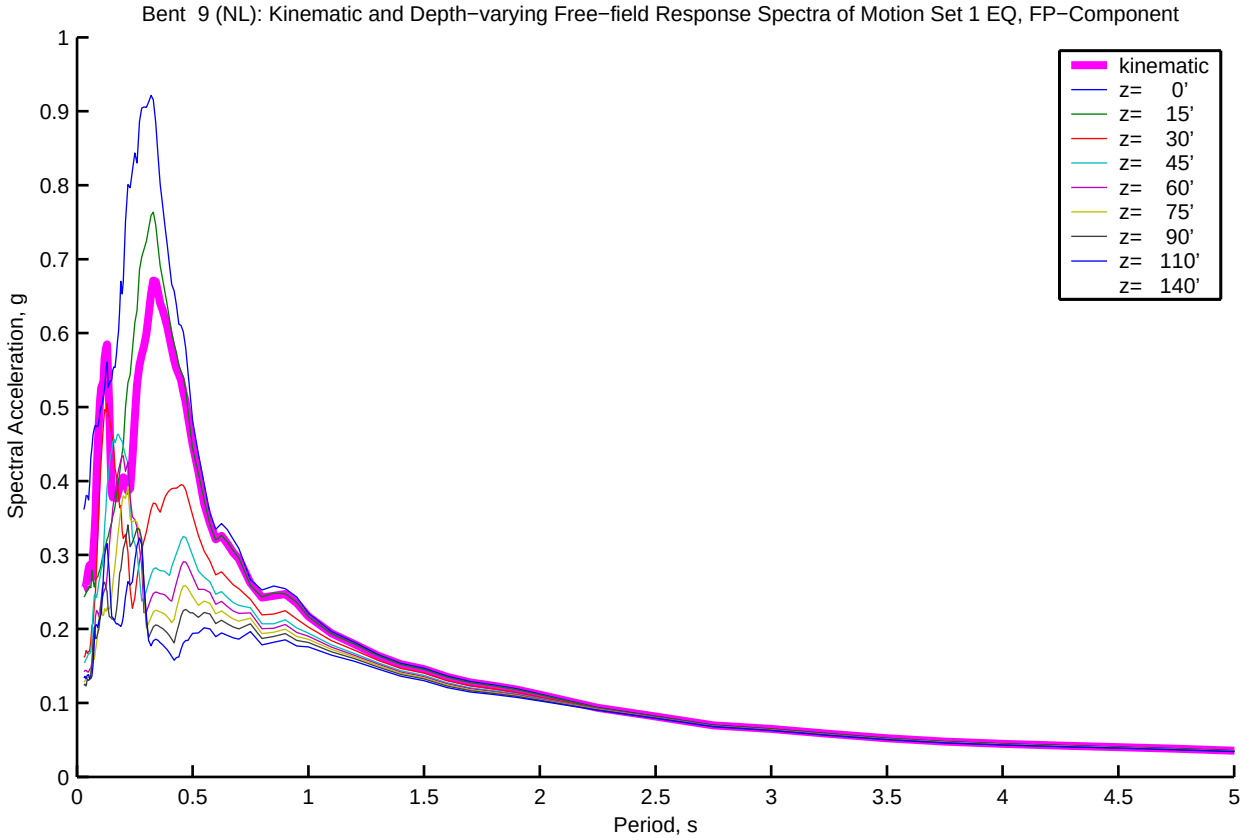
Bent 9 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component






Bent 9 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'
0
0.1
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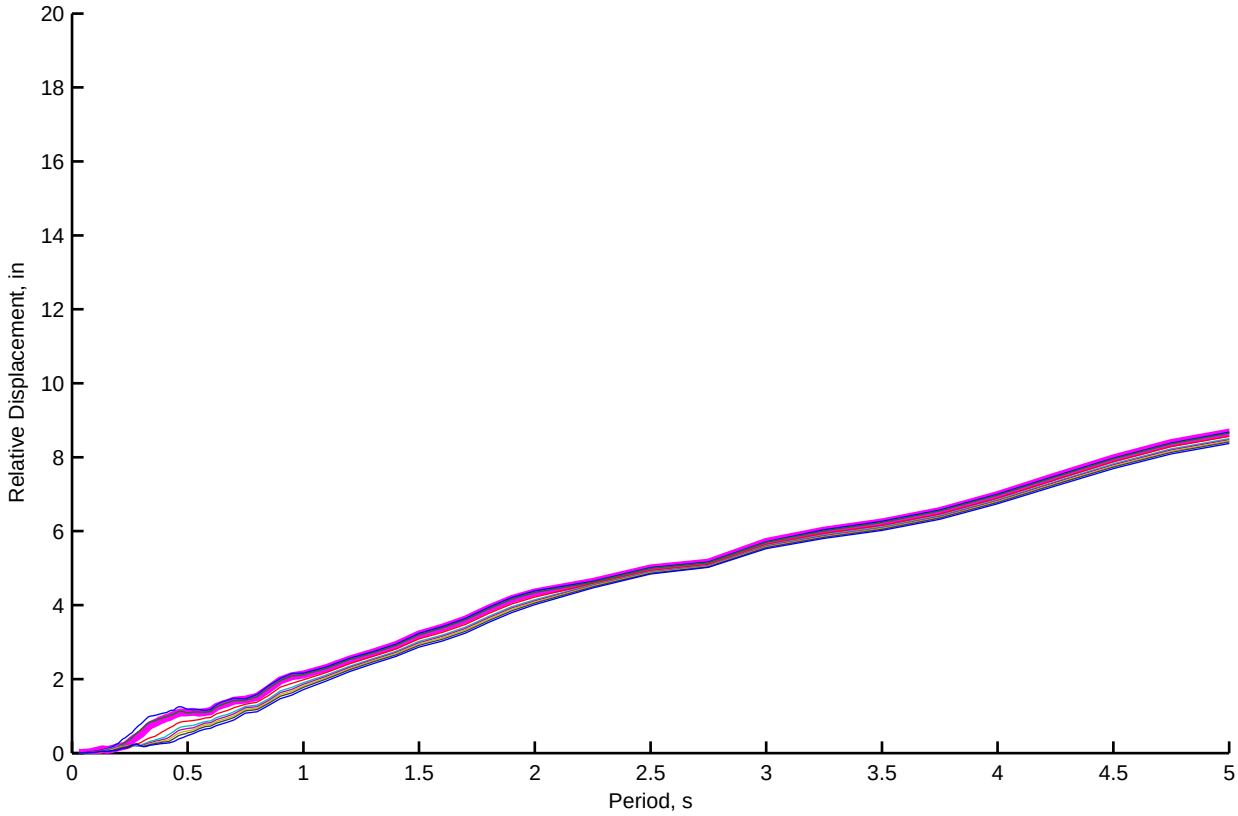
Relative Displacement, in
Period, s
0
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10
12
14
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18
20
0.5
1
1.5
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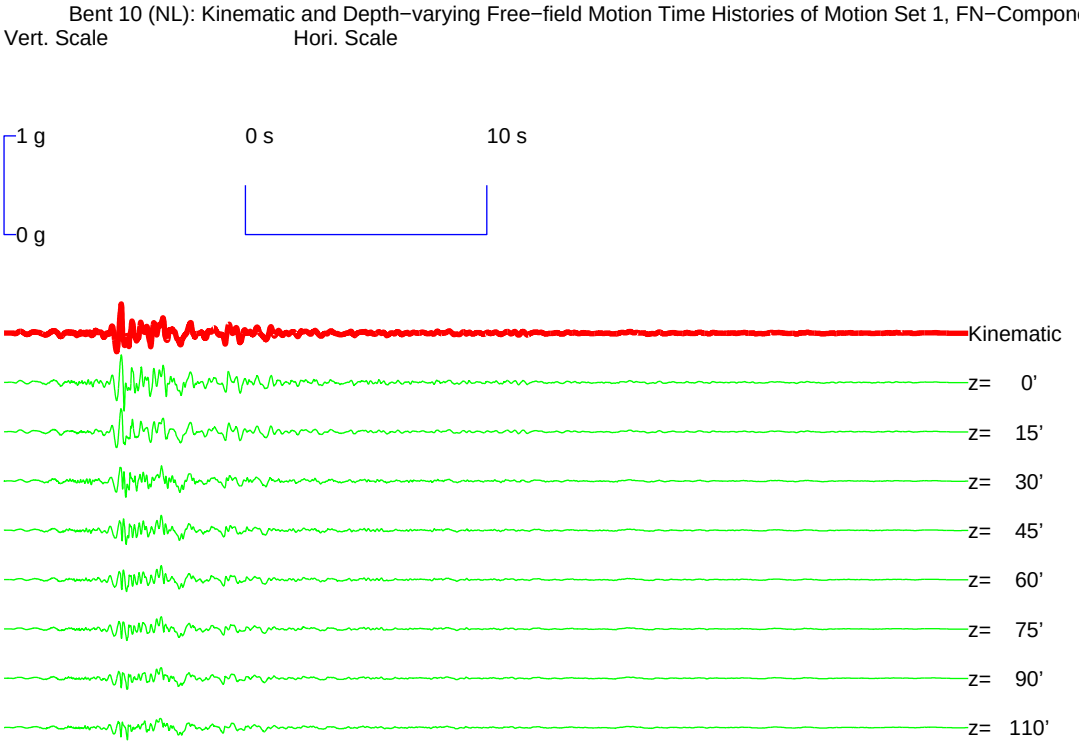
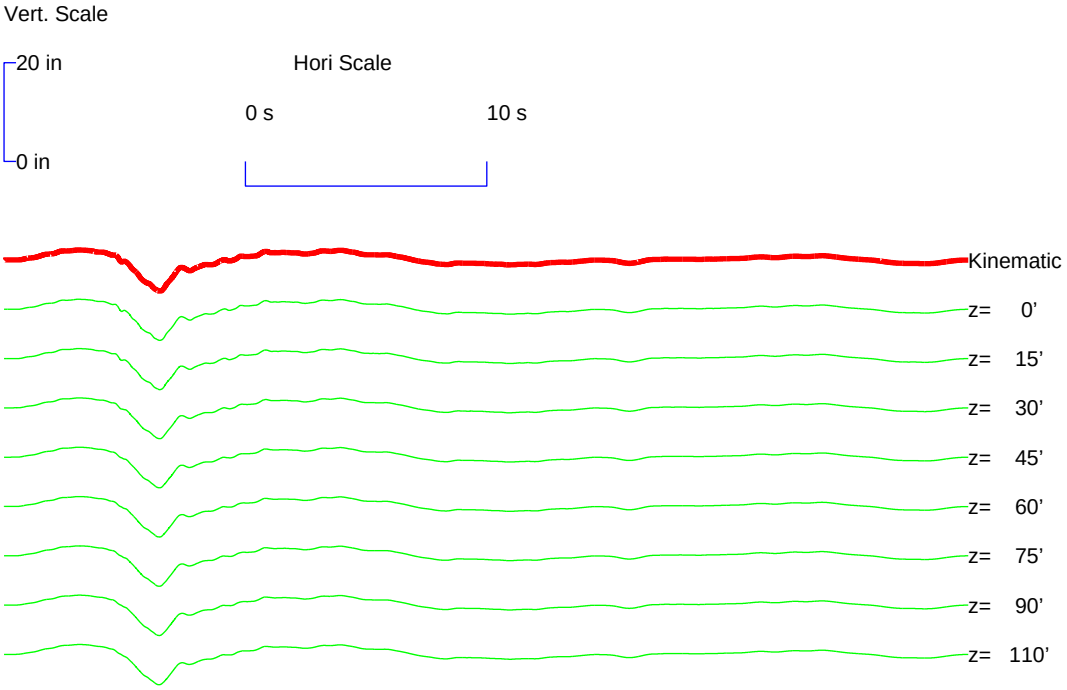
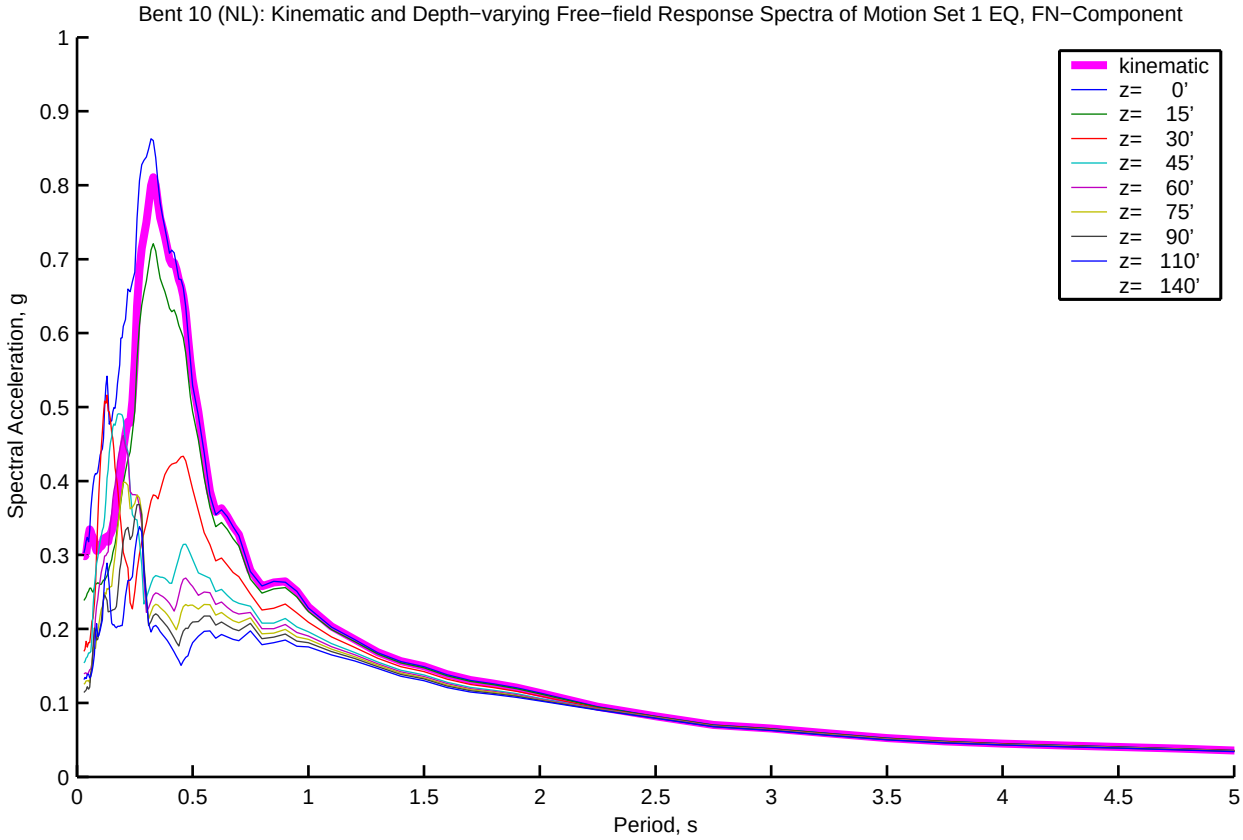
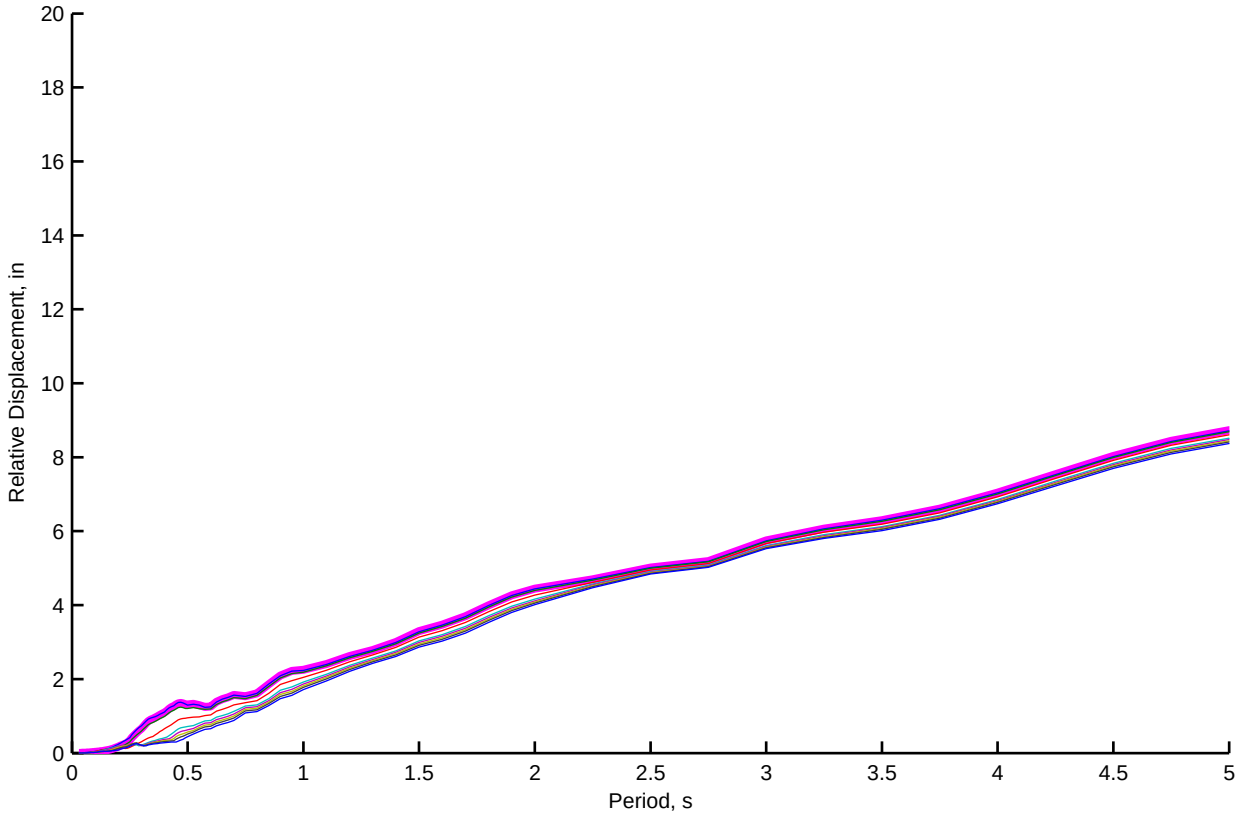
2.5
3
3.5
4
4.5
5

Bent 10 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component

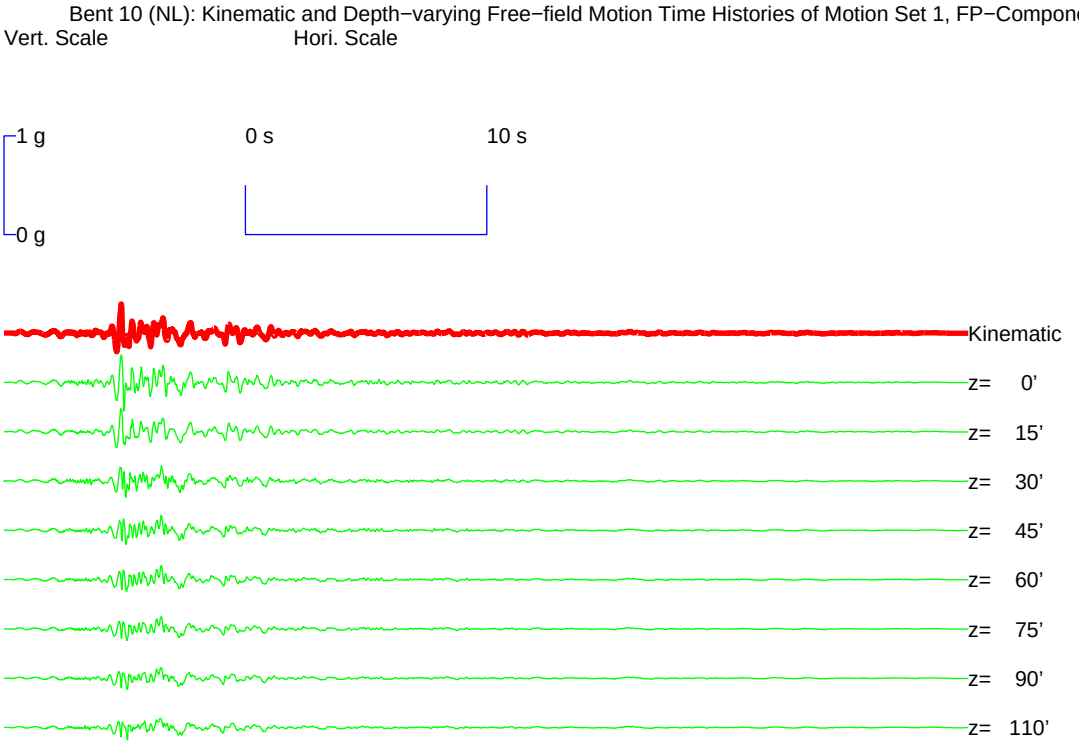


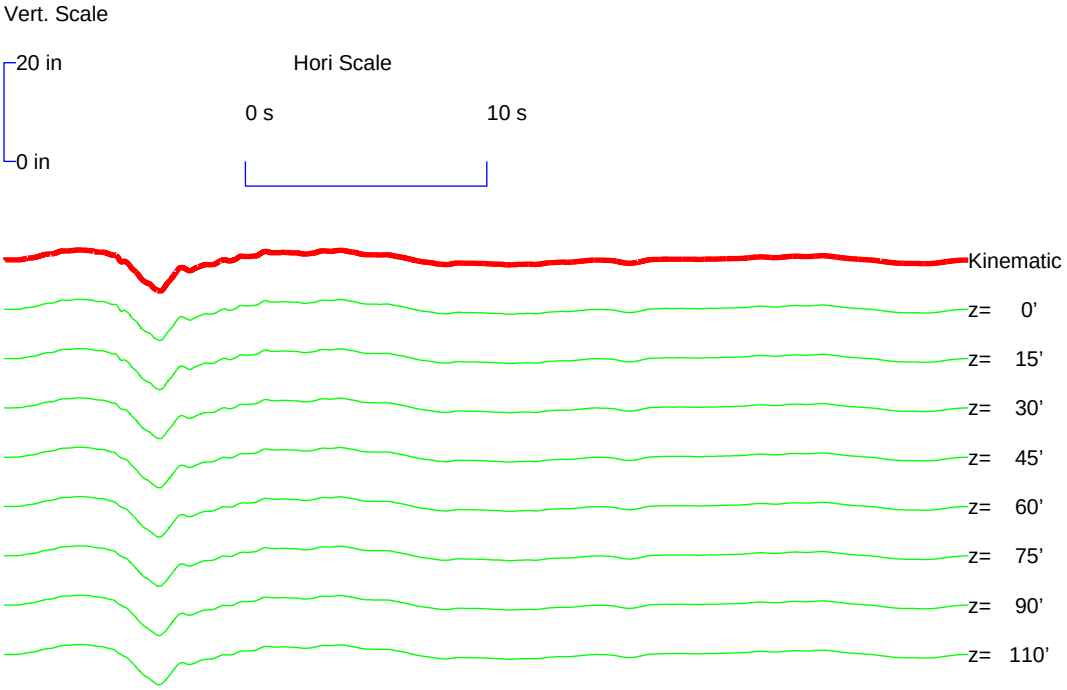


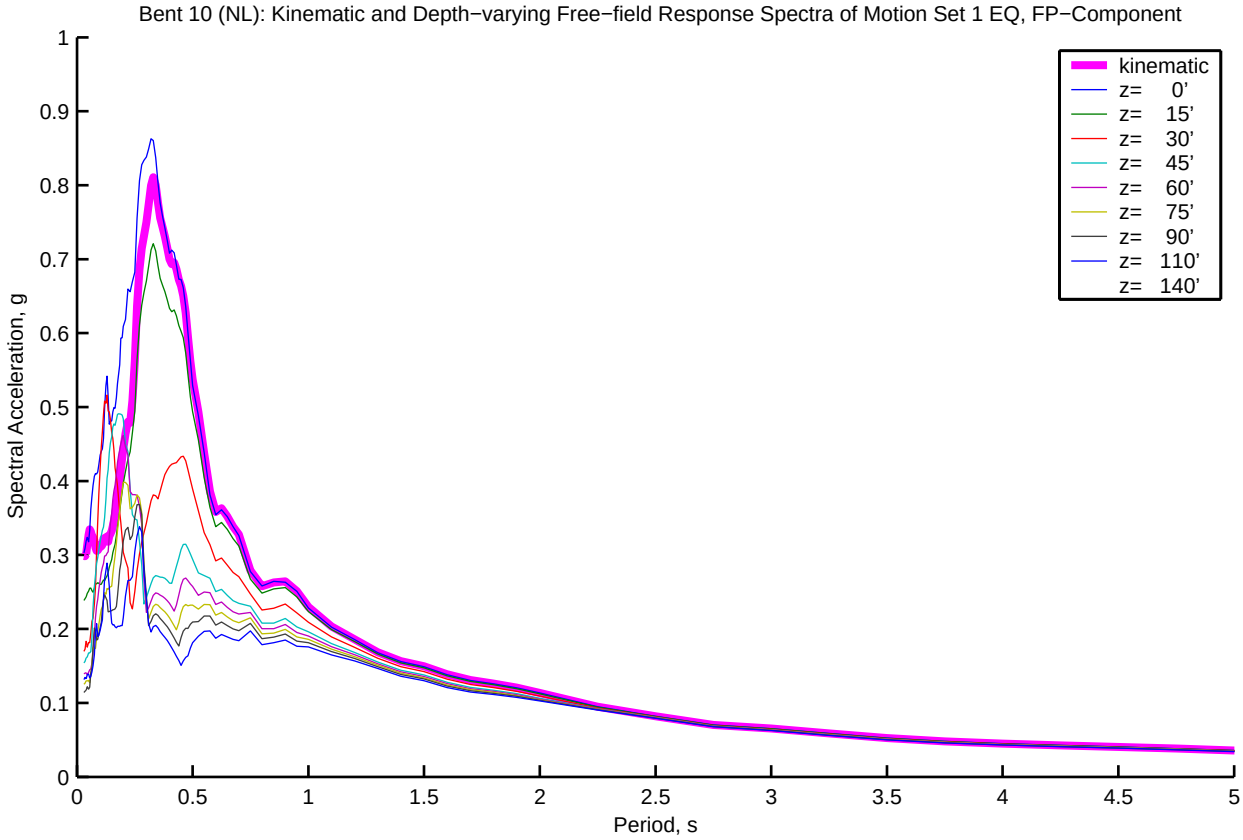

Bent 10 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'

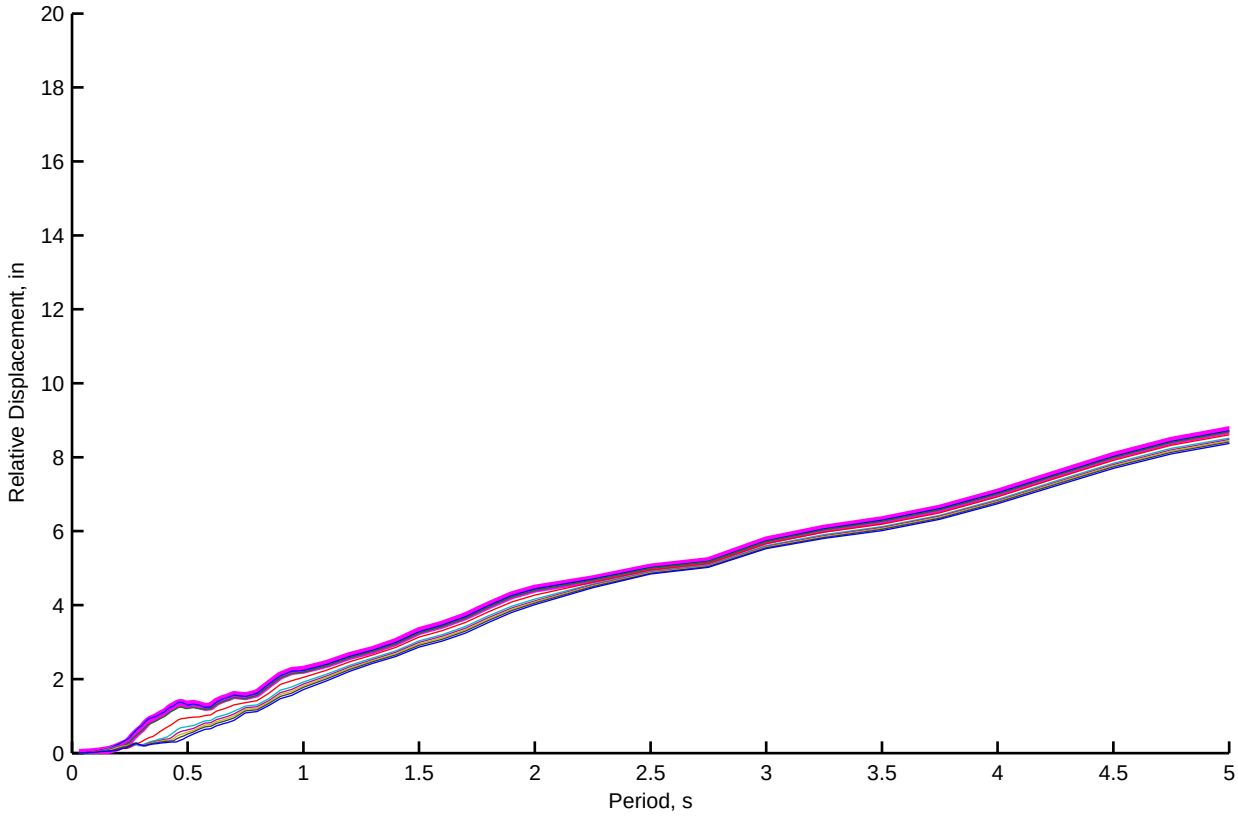

Relative Displacement, in
Period, s

Bent 10 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component

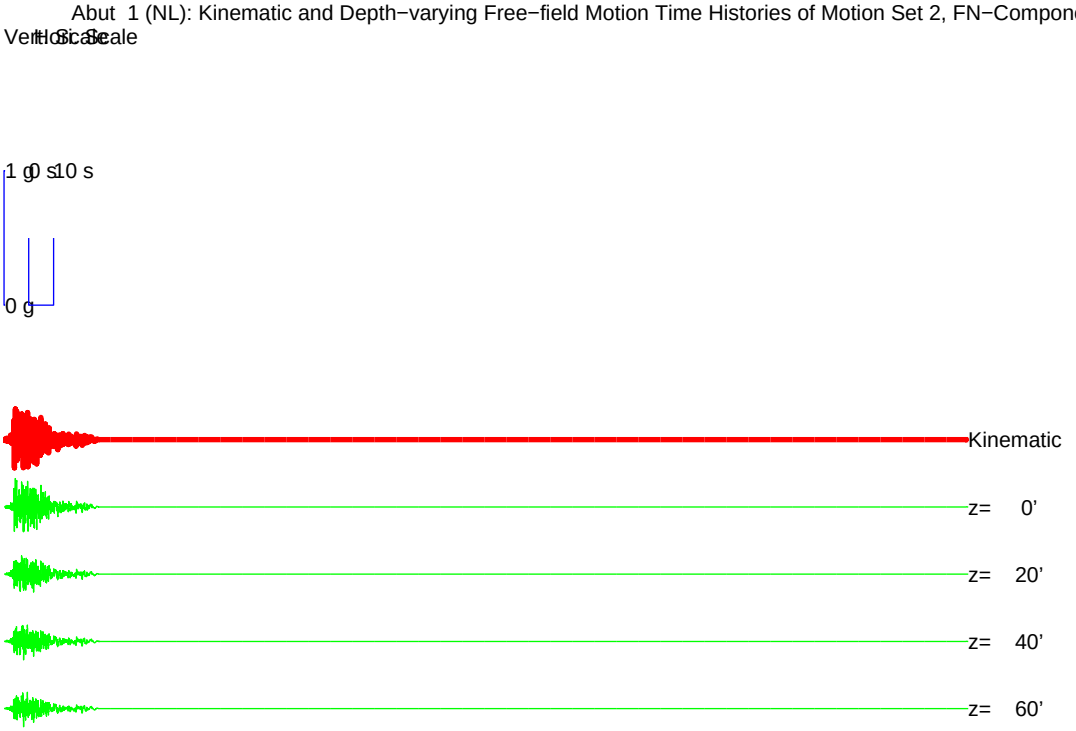


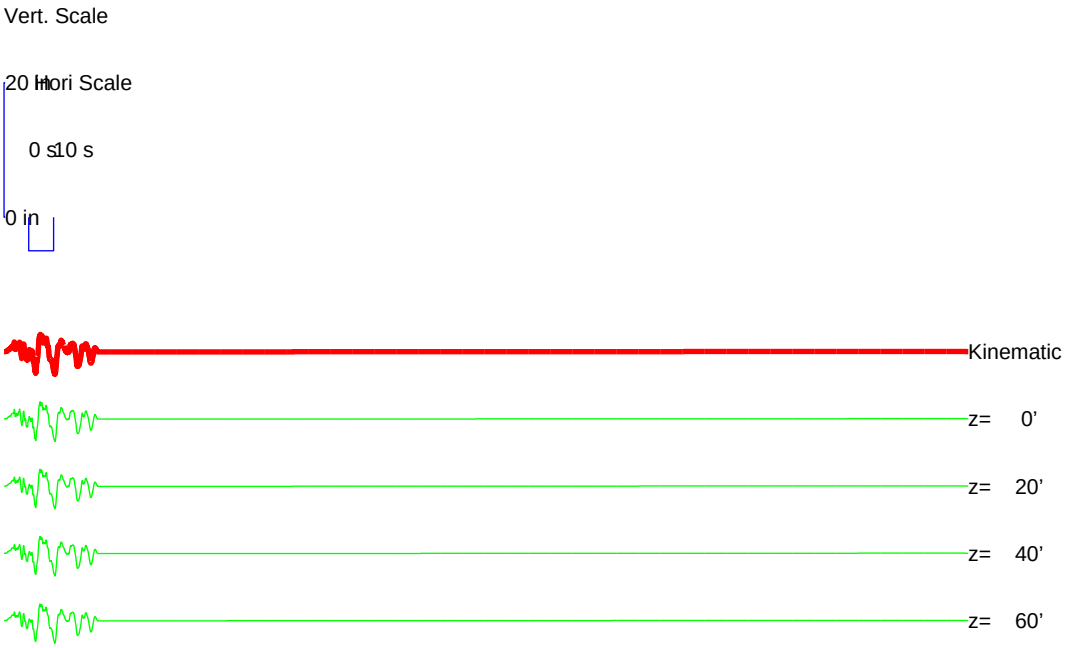


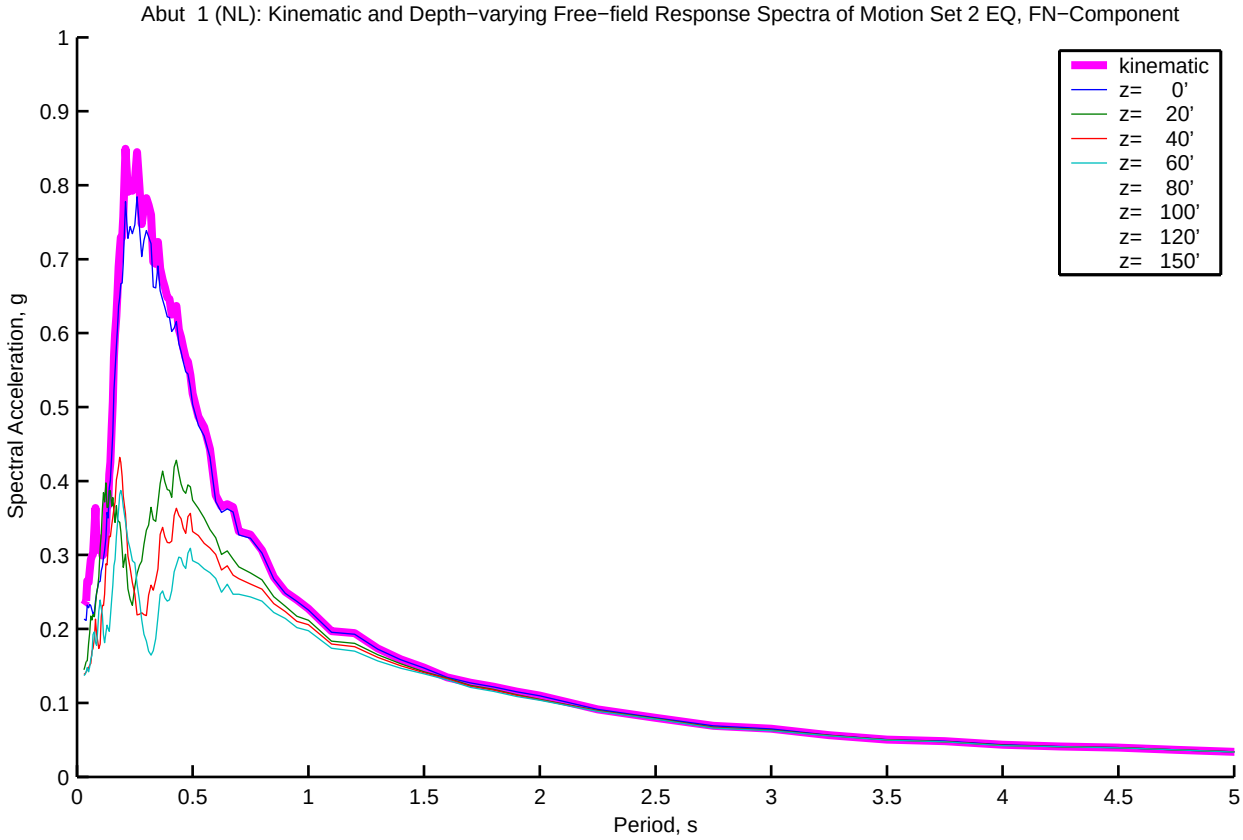

Bent 10 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'

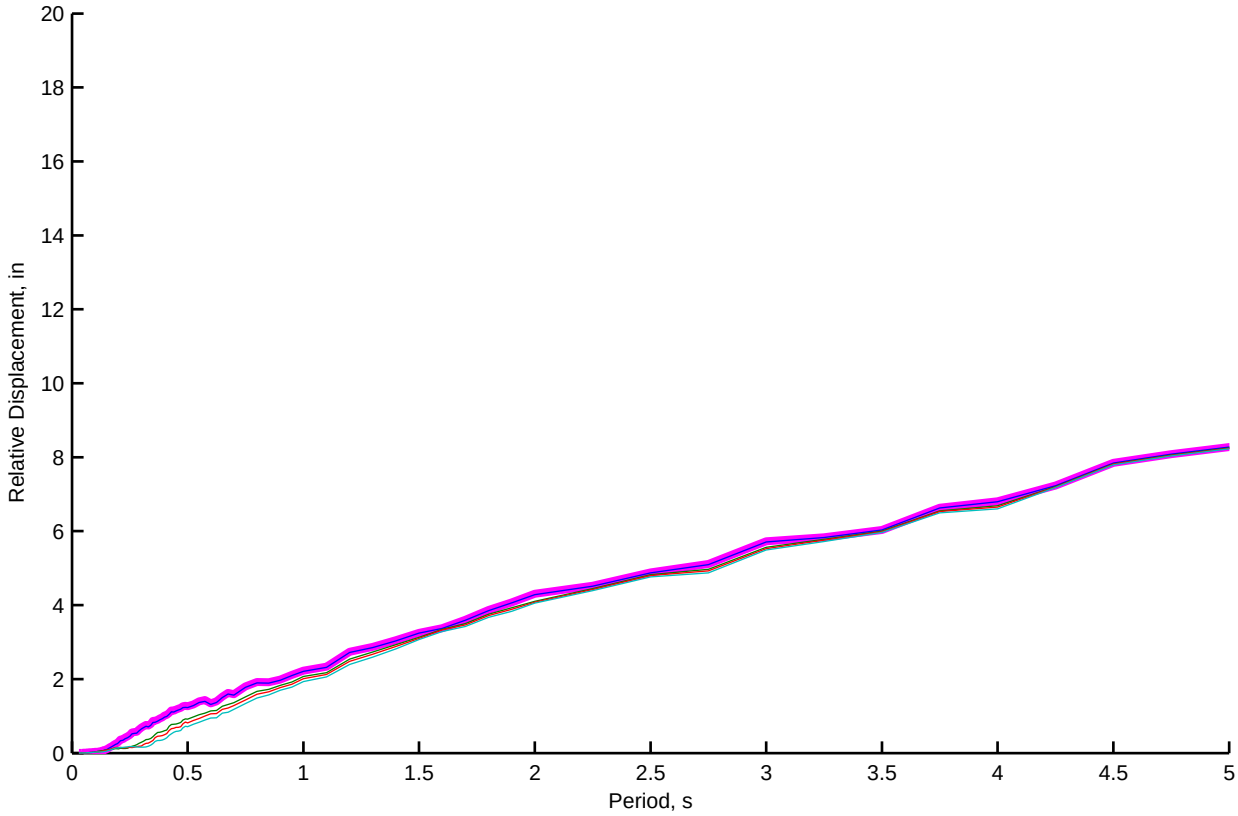

Relative Displacement, in
Period, s

Abut 1 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

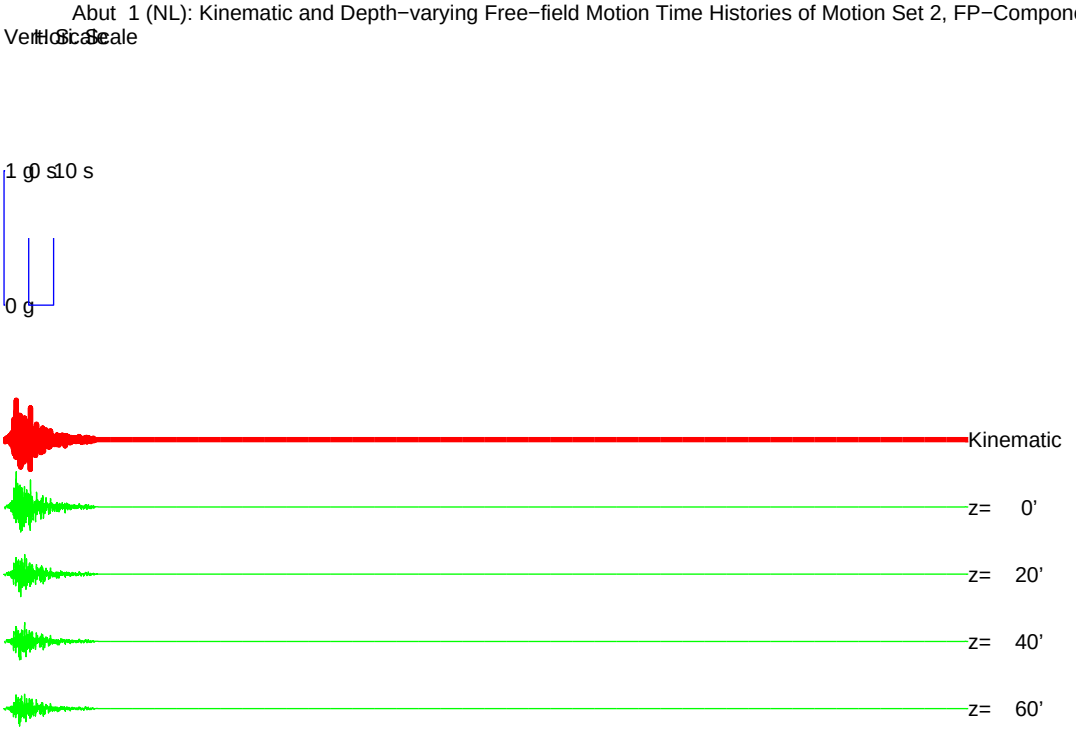


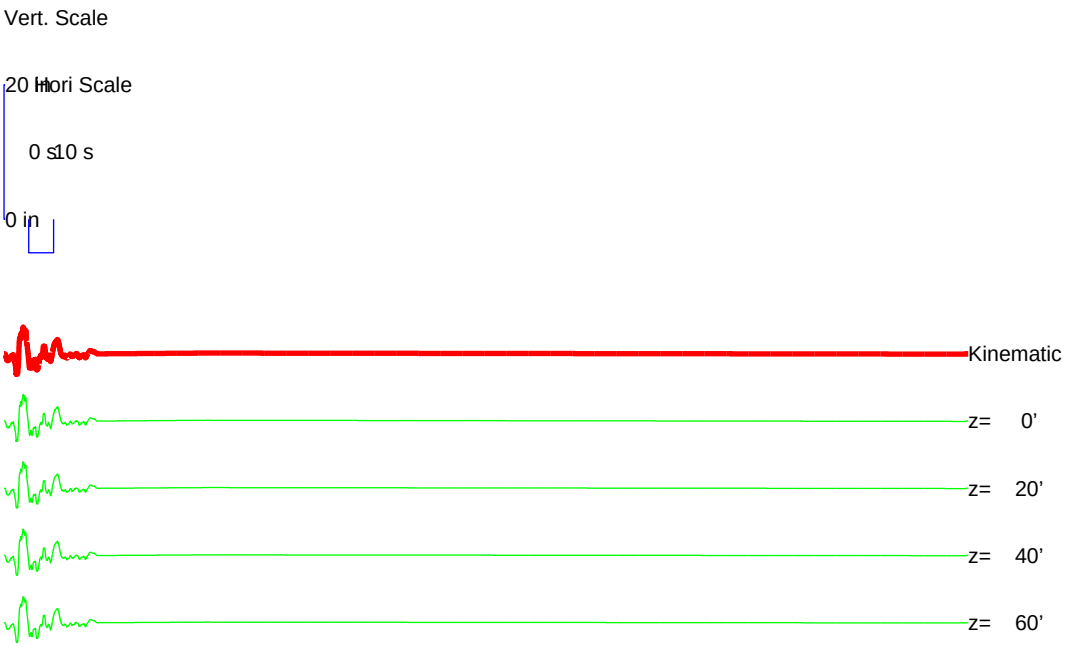


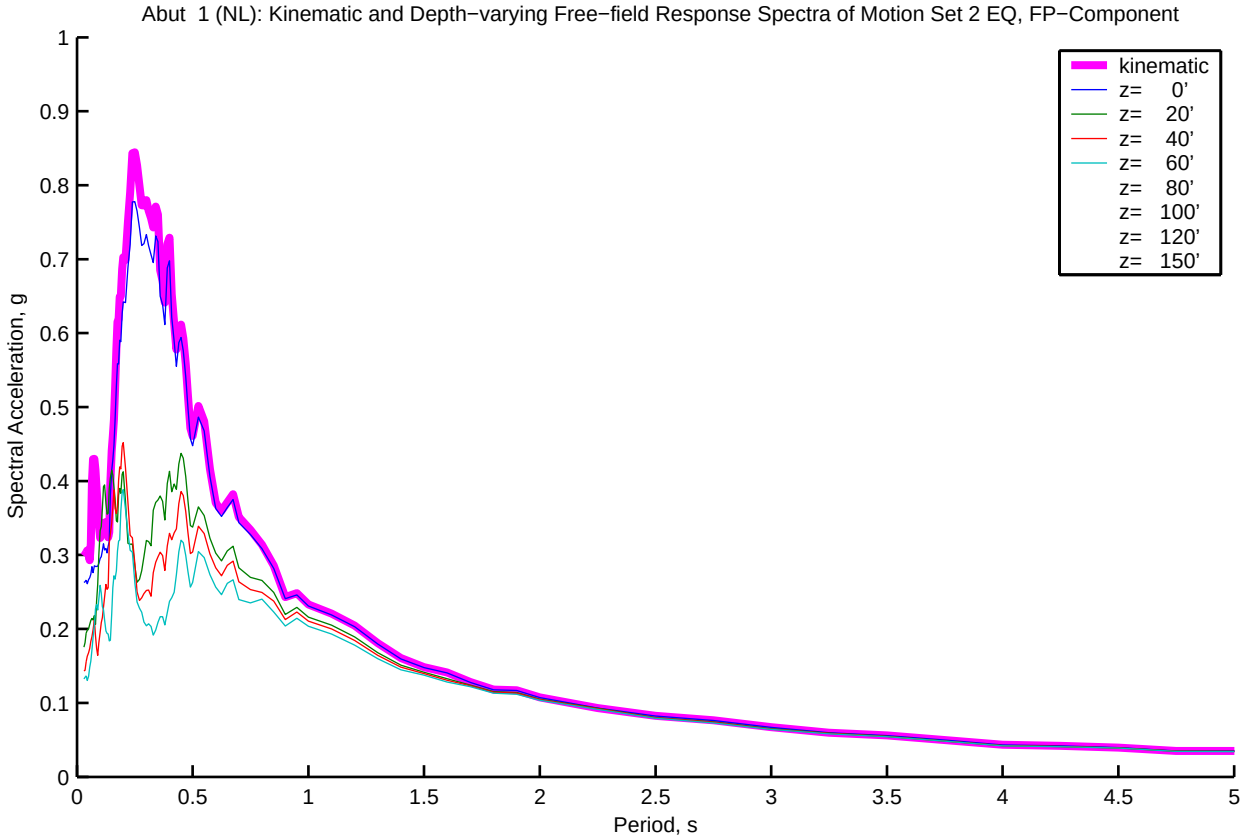

Abut 1 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 150'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

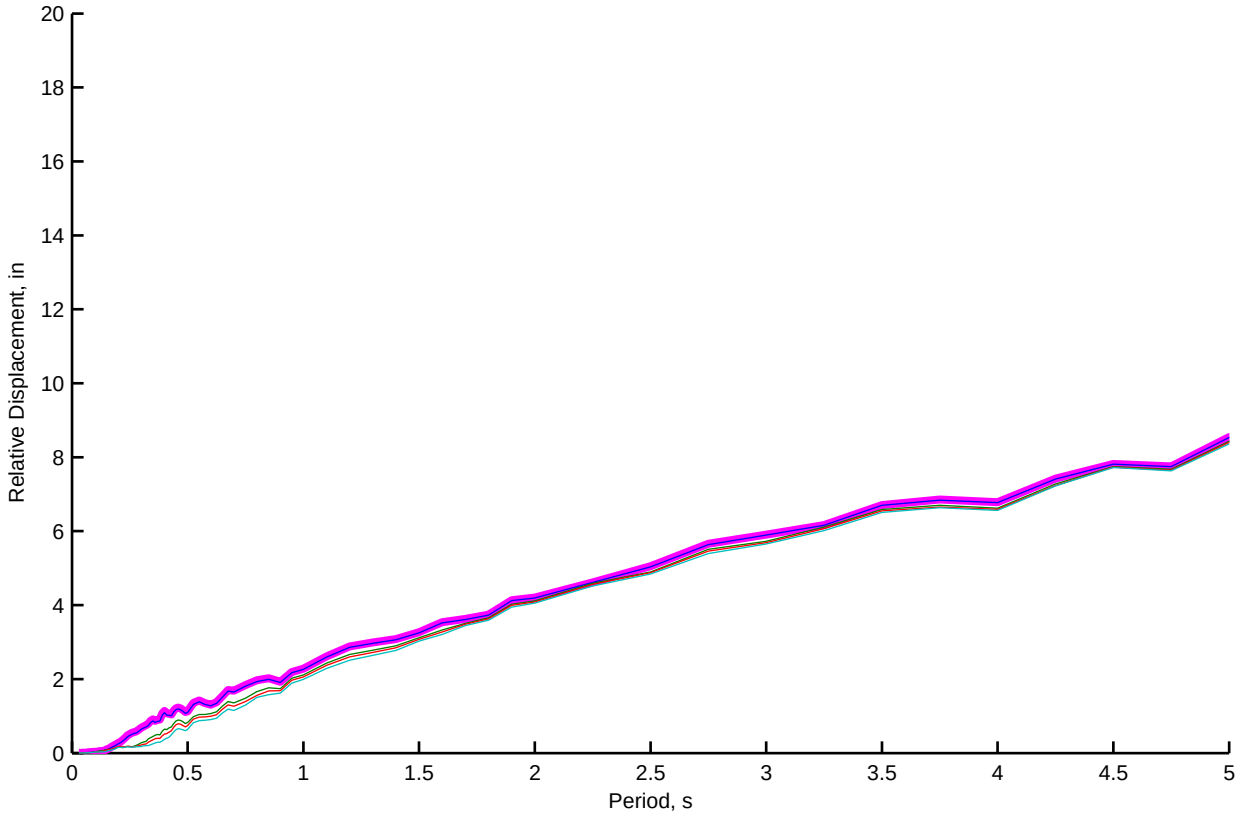

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Abut 1 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

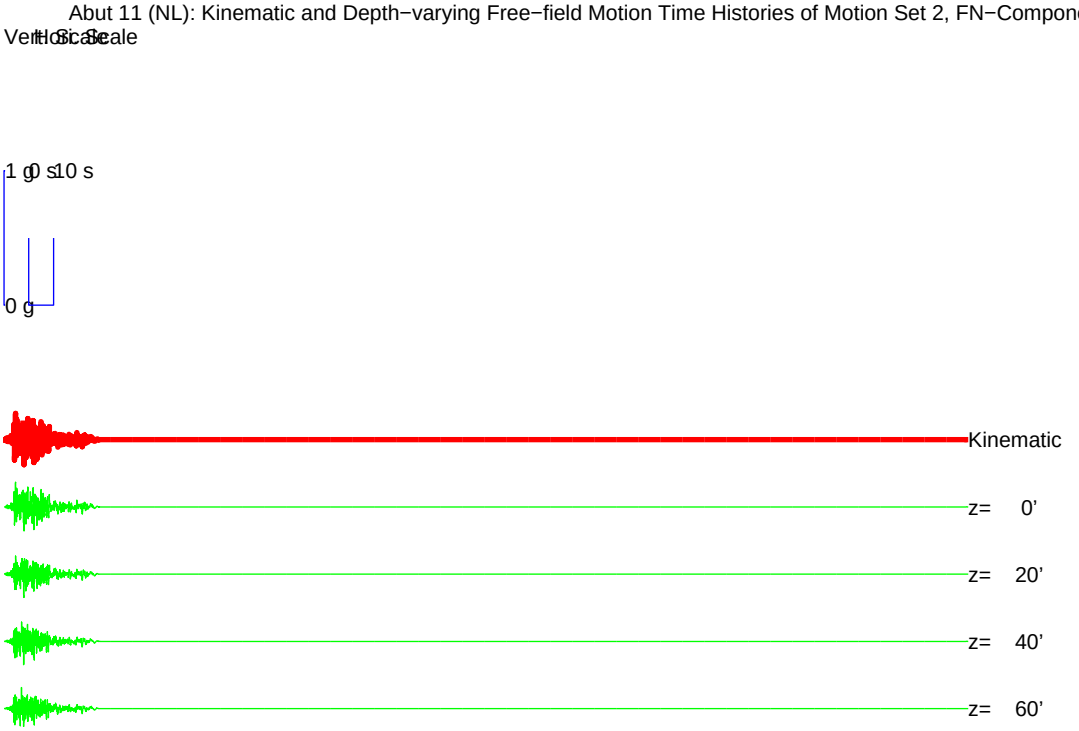


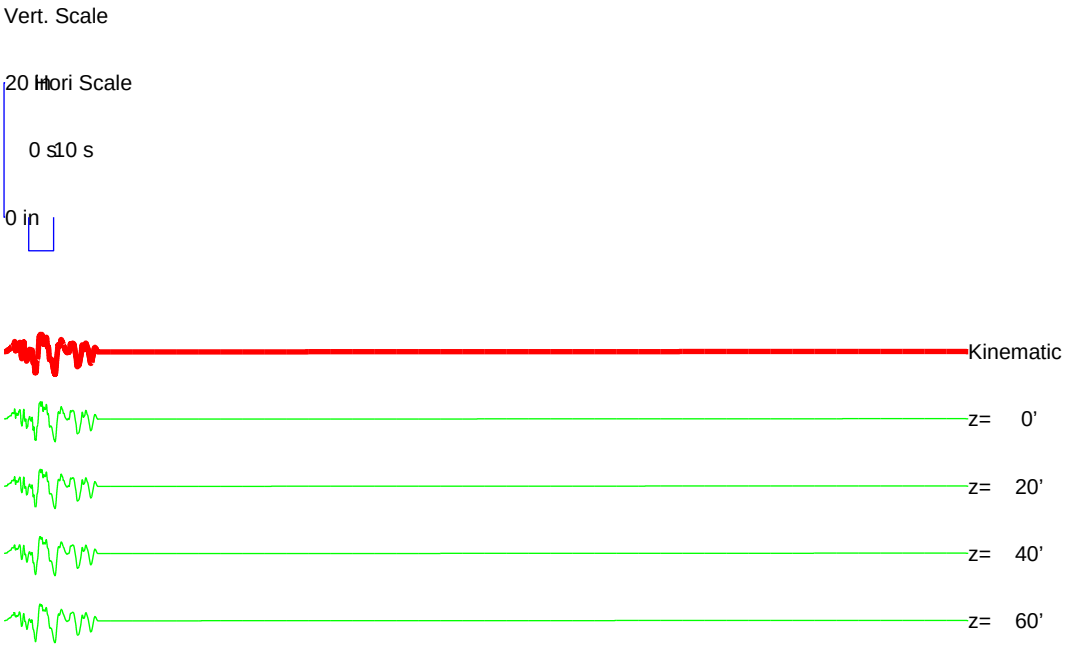


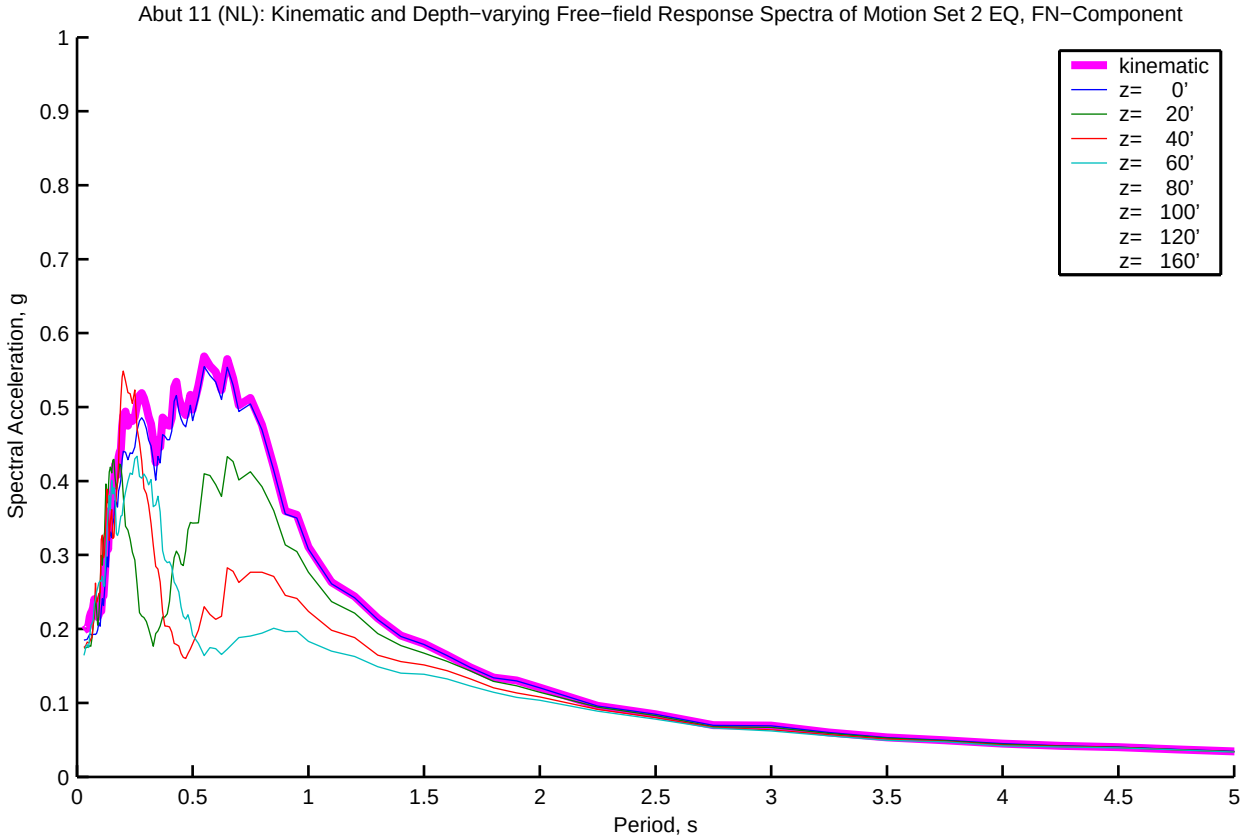

Abut 1 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 150'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

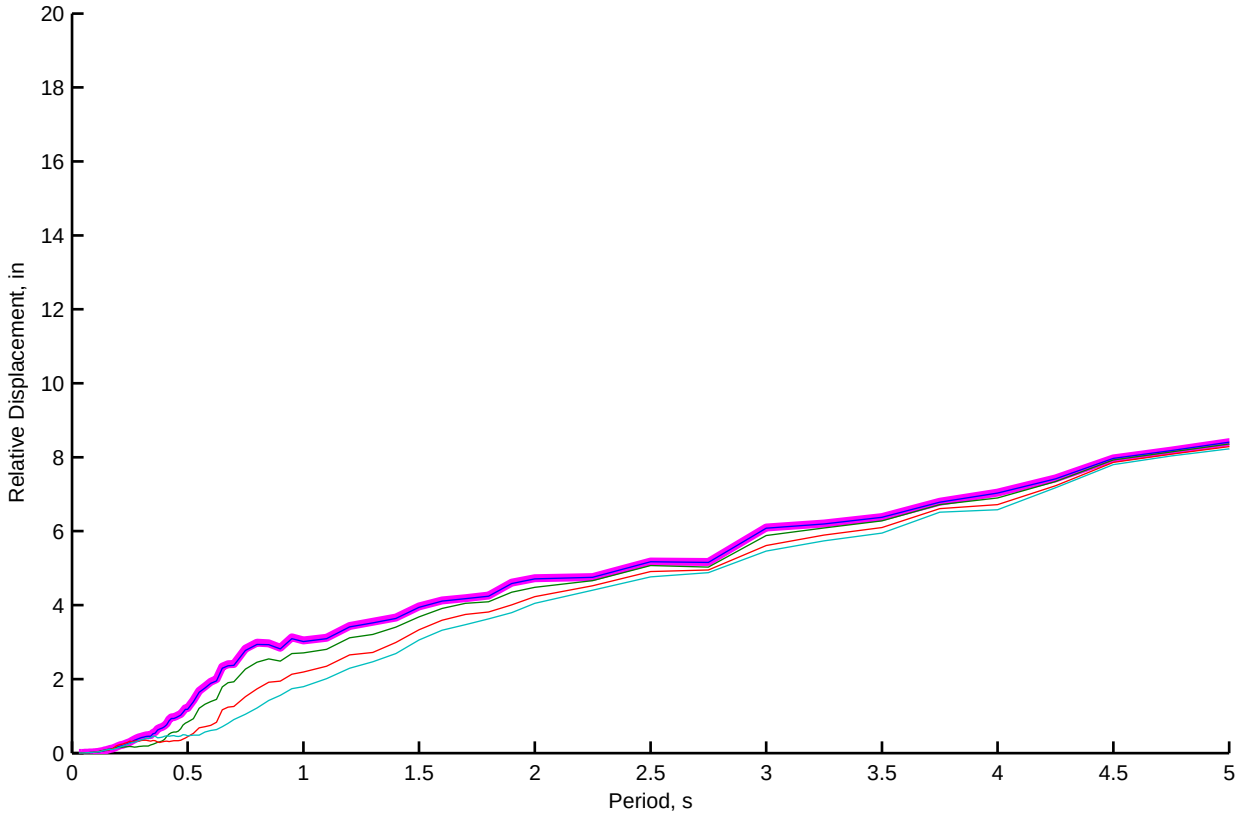

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Abut 11 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

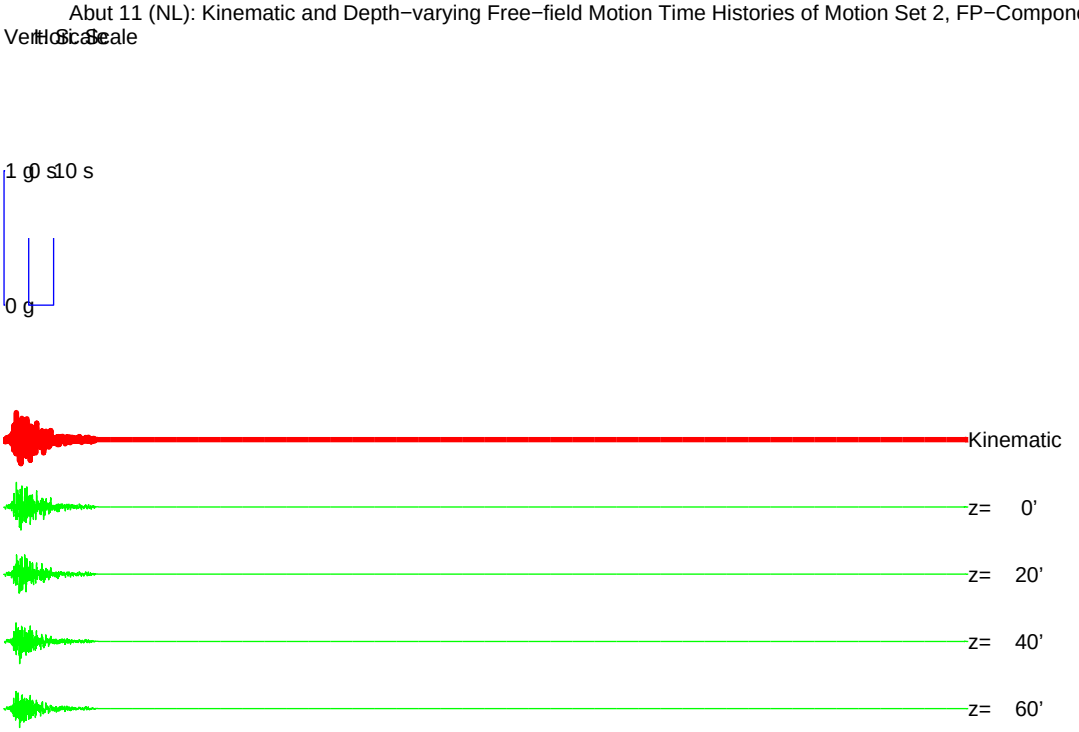


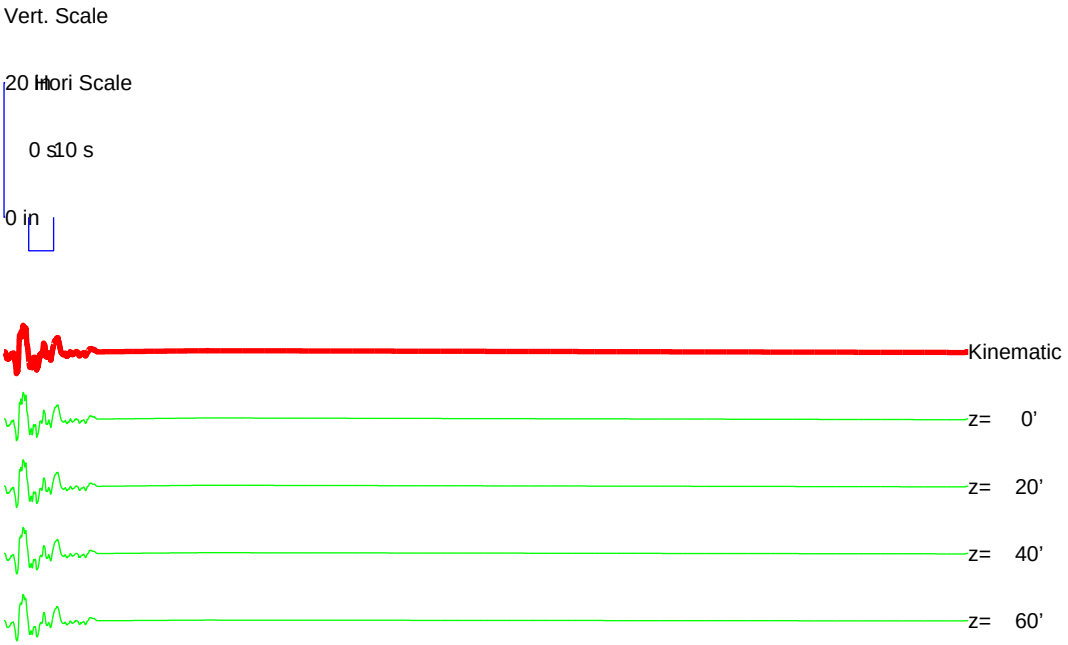


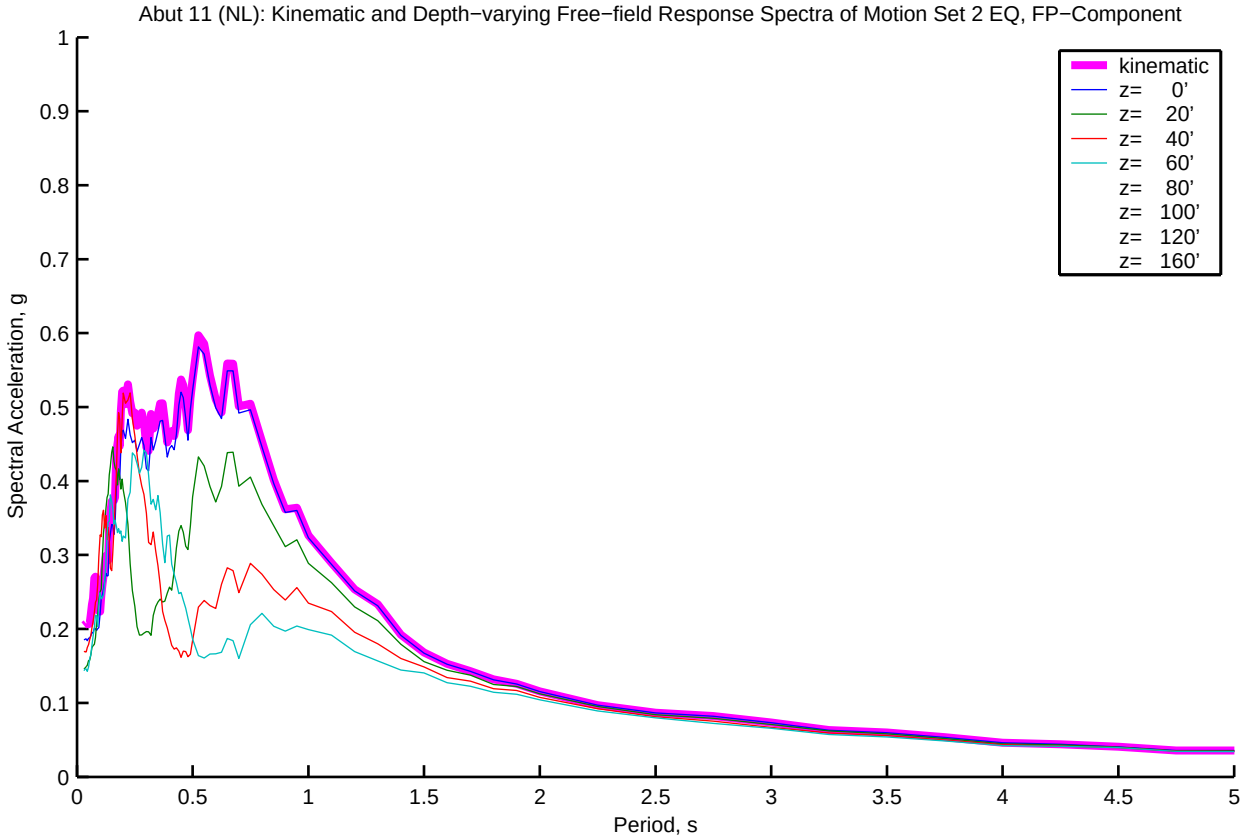

Abut 11 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 160'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

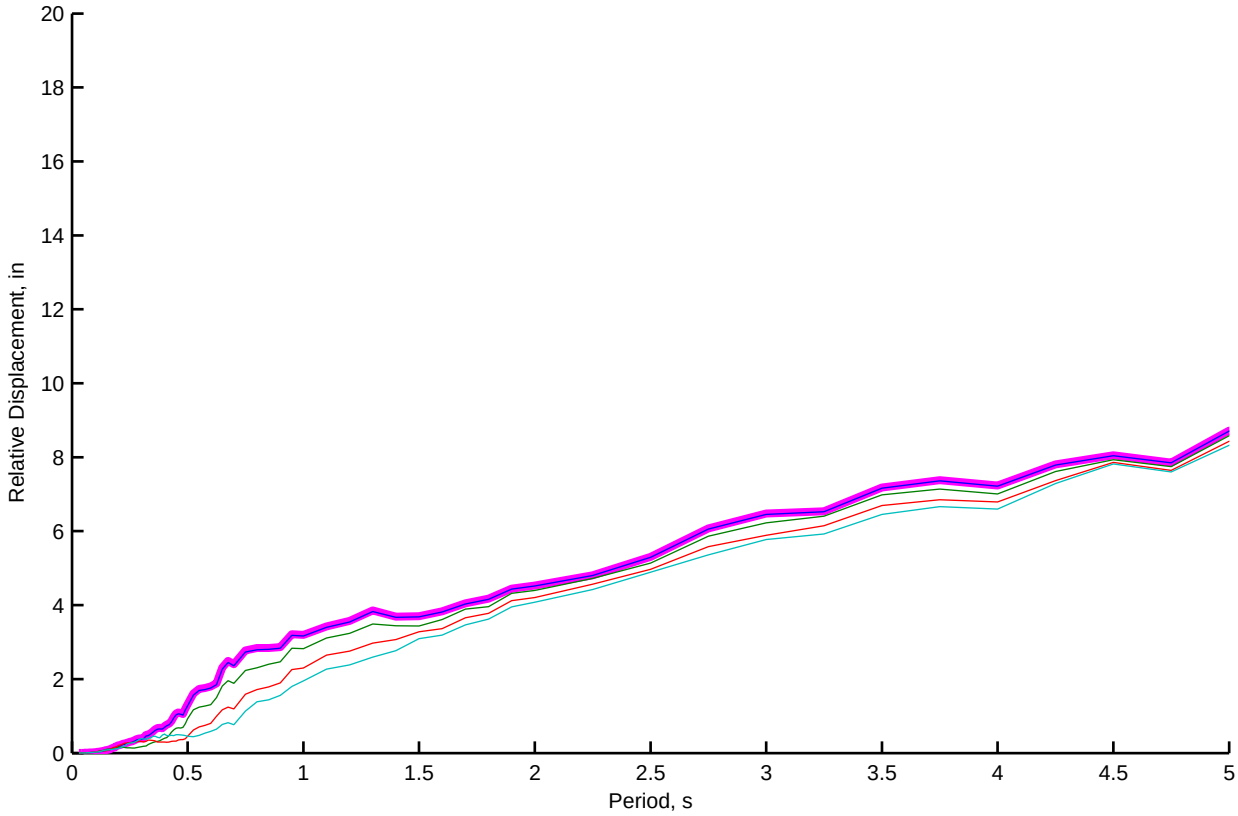

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Abut 11 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

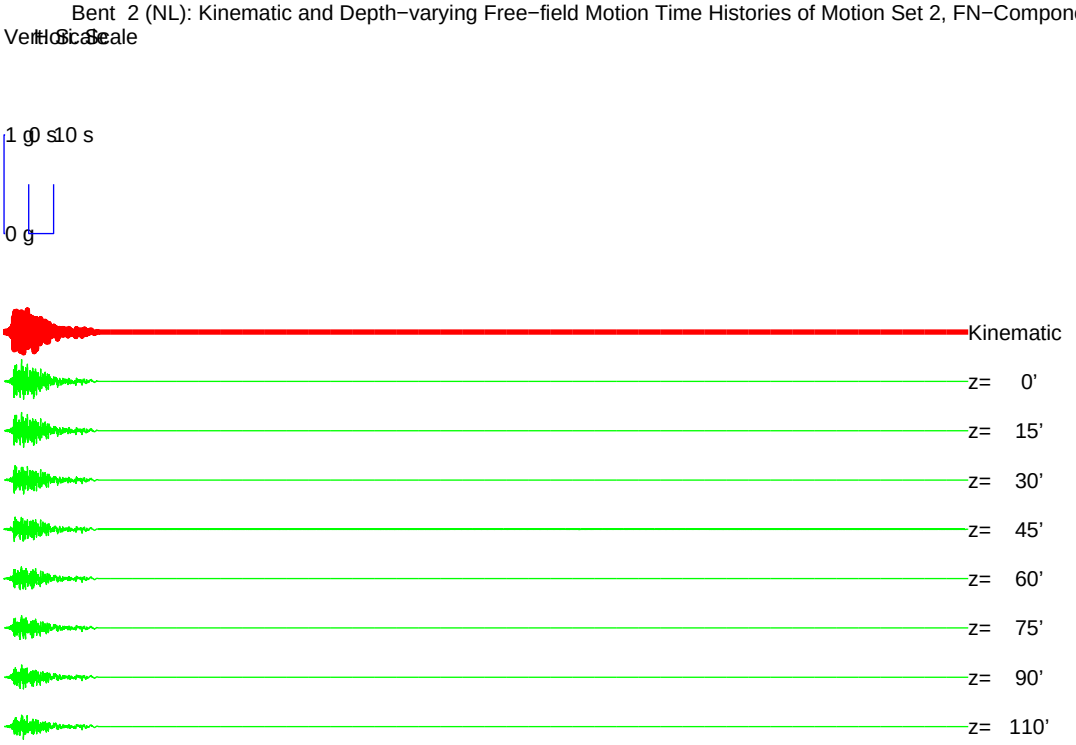


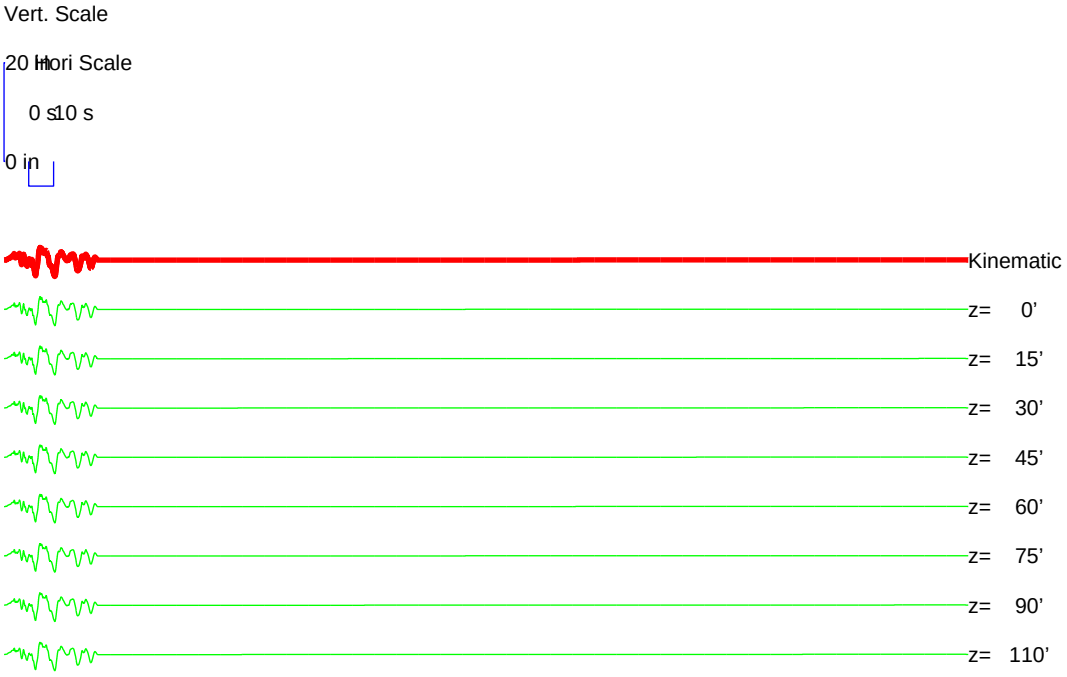


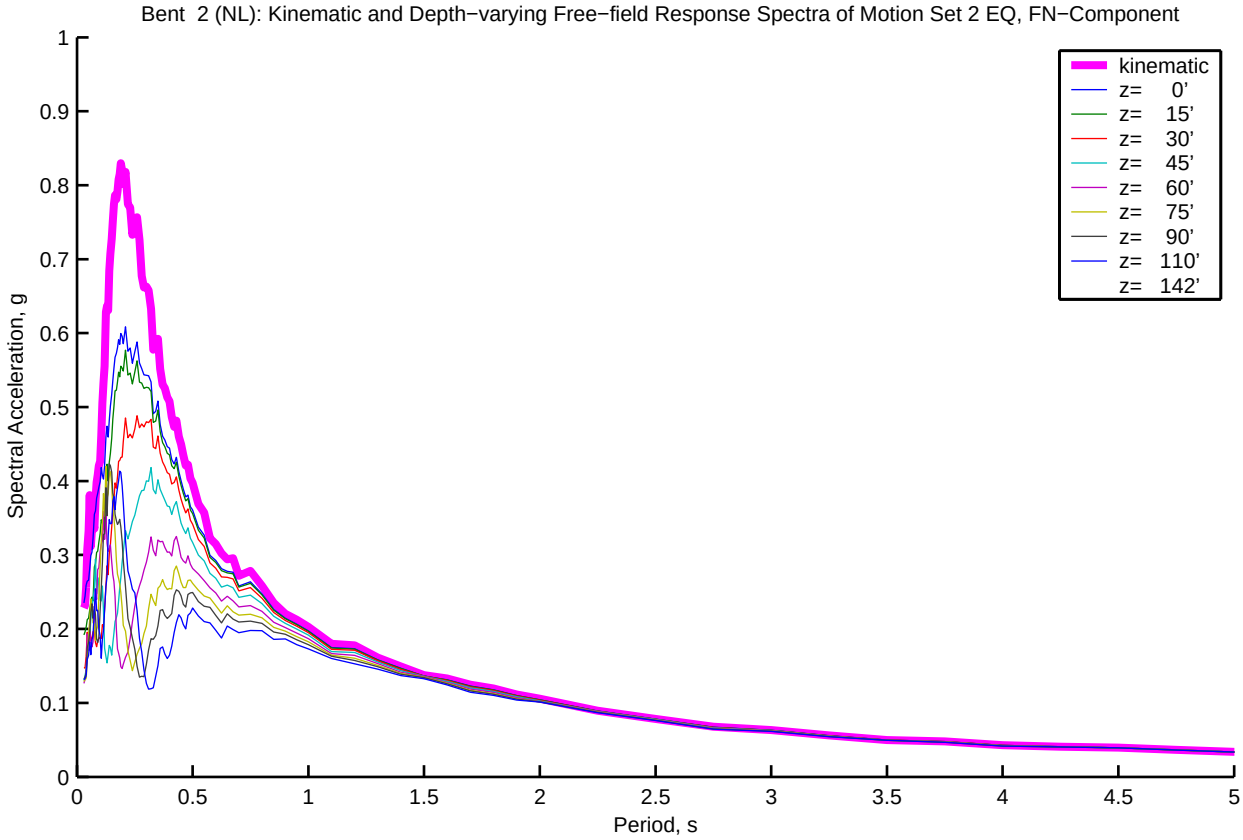

Abut 11 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 160'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

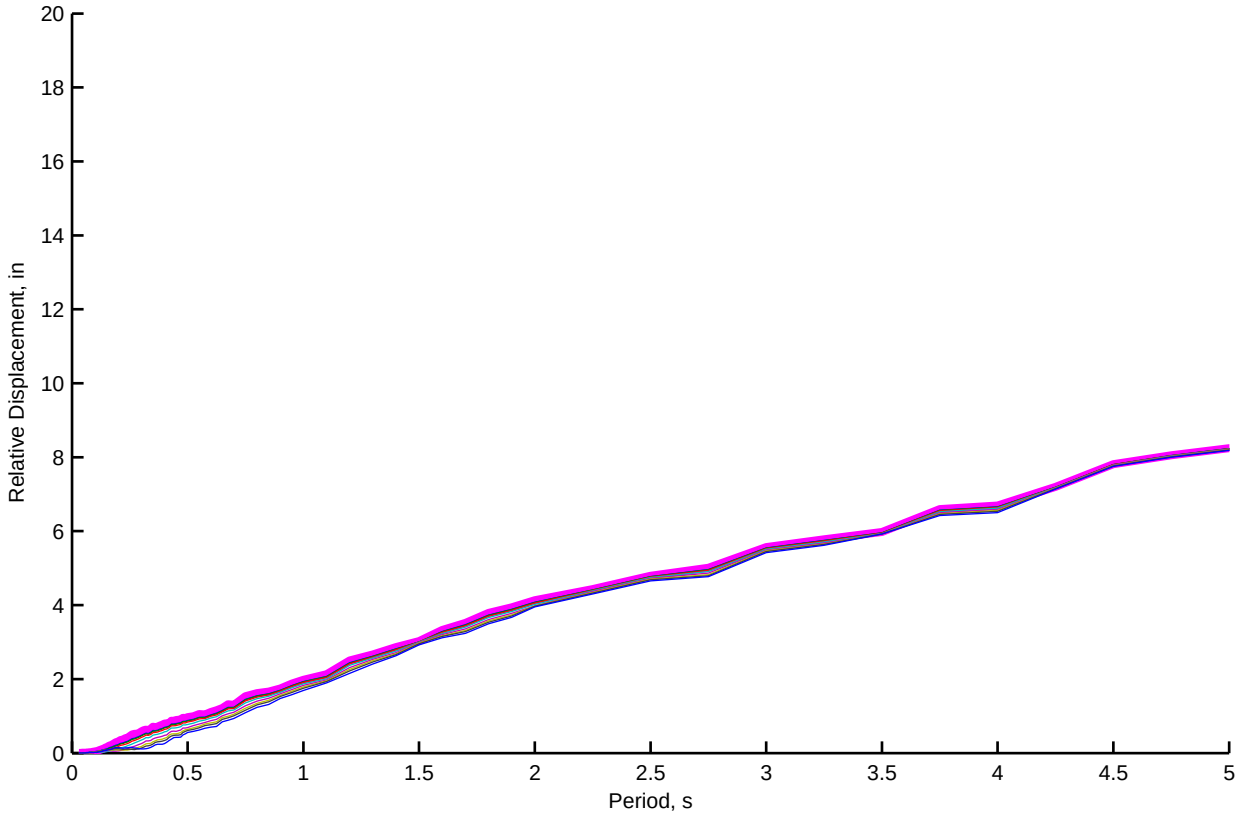

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 2 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

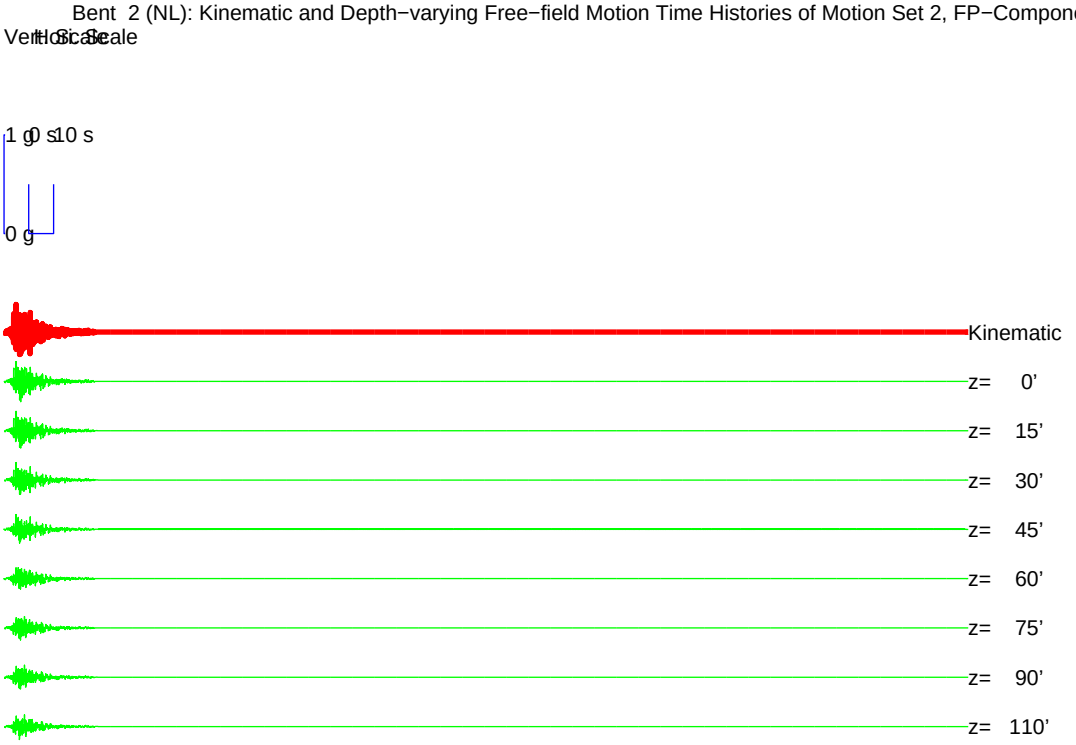


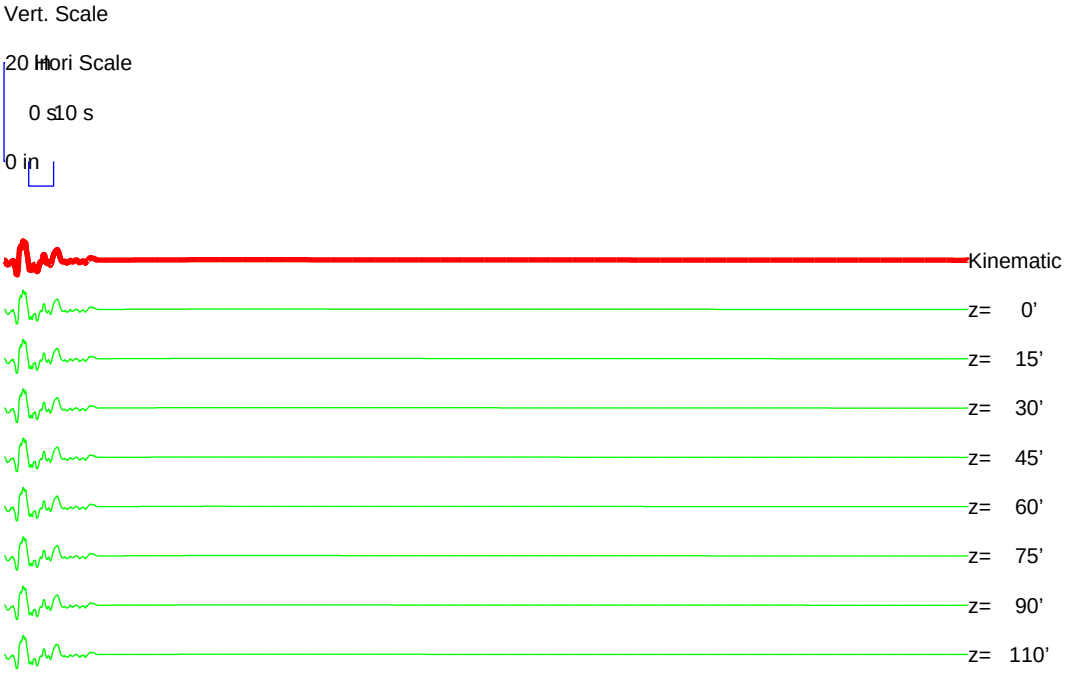


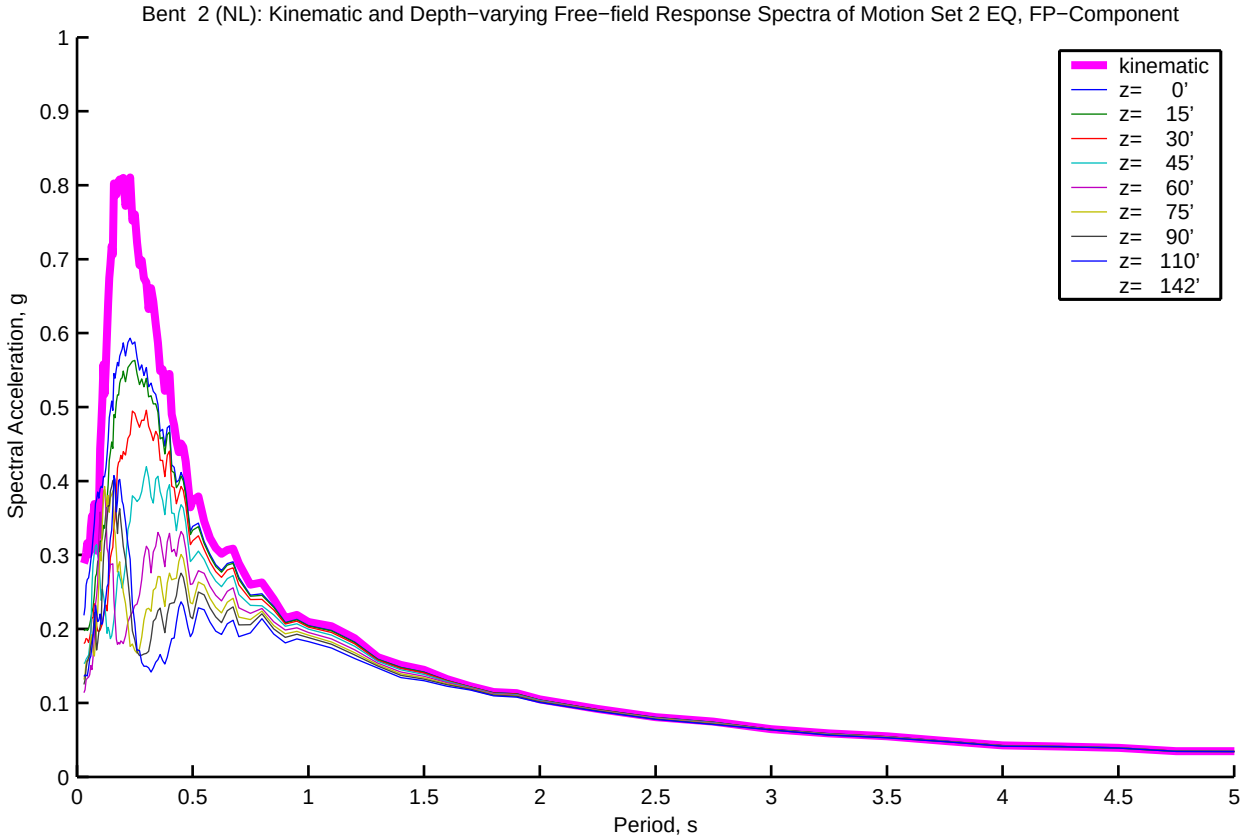

Bent 2 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 142'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

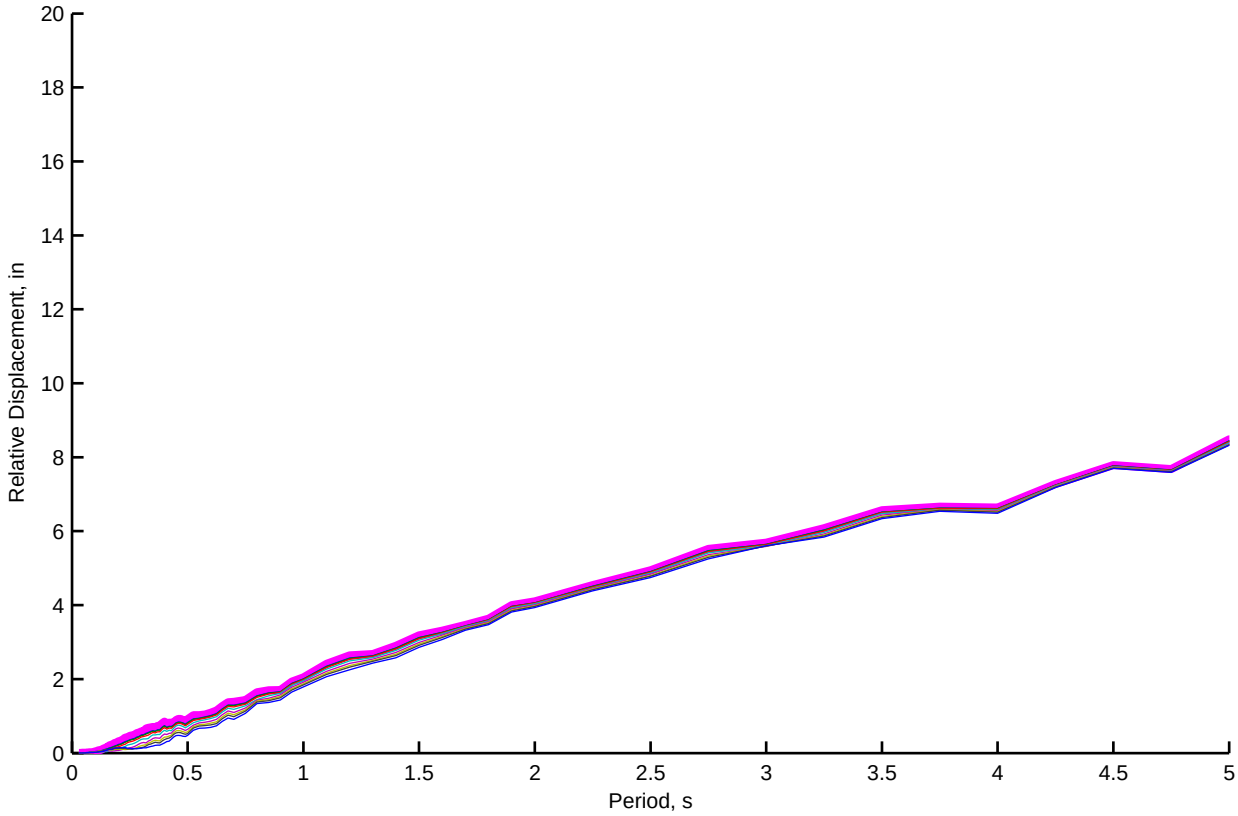

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 2 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

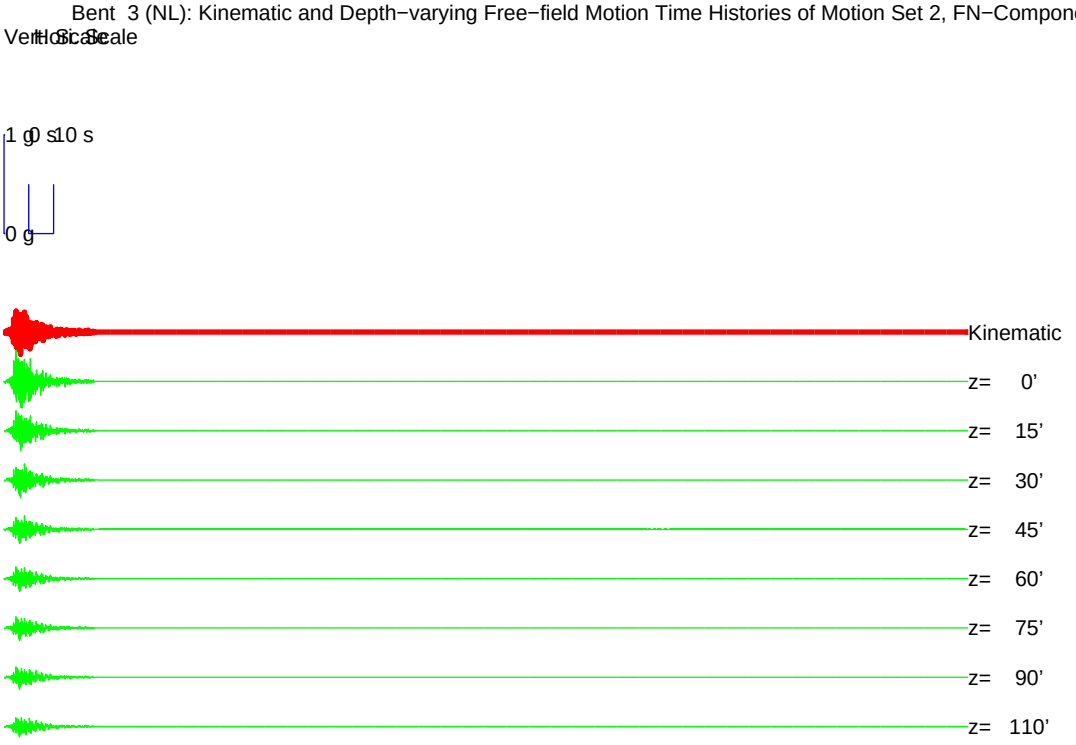


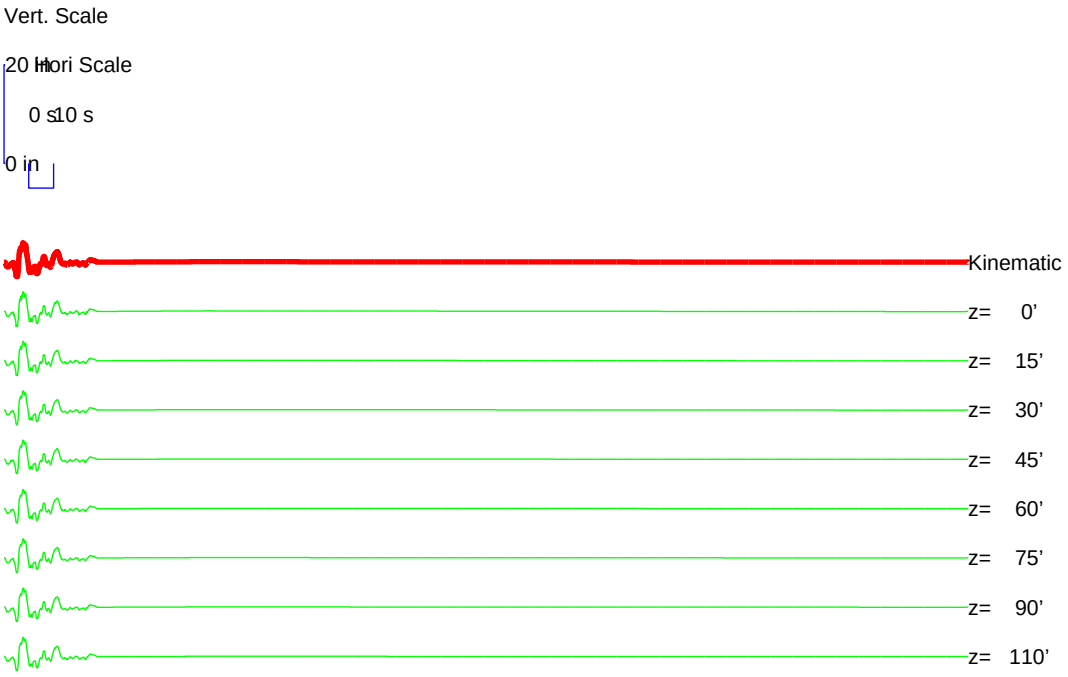


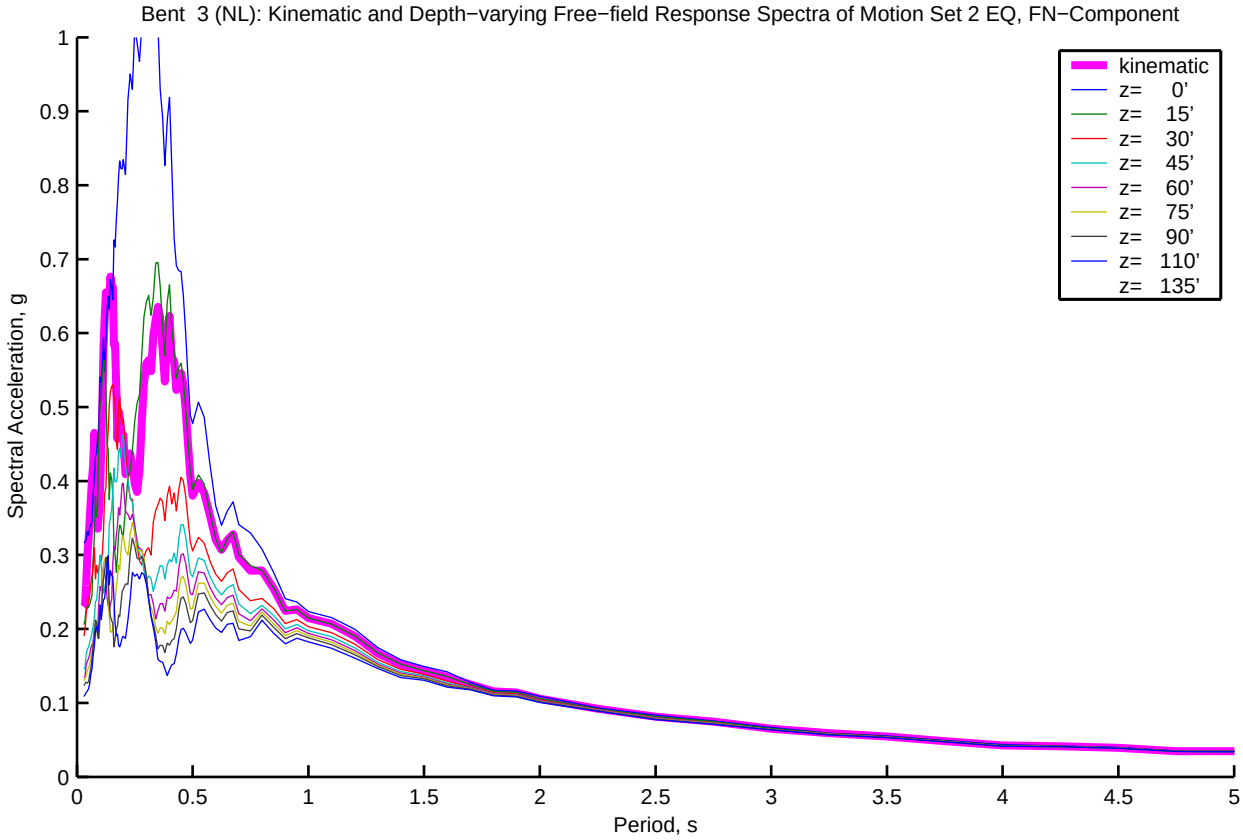

Bent 2 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 142'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

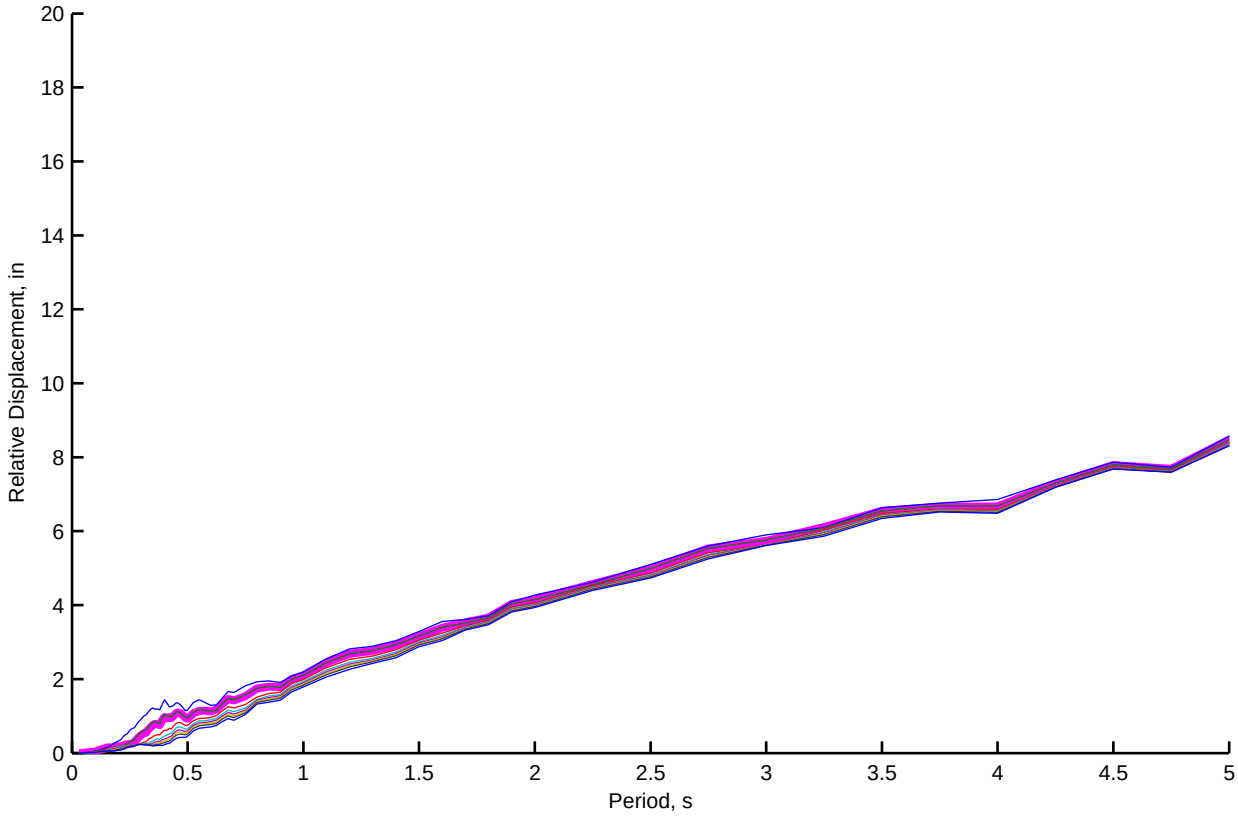

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 3 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

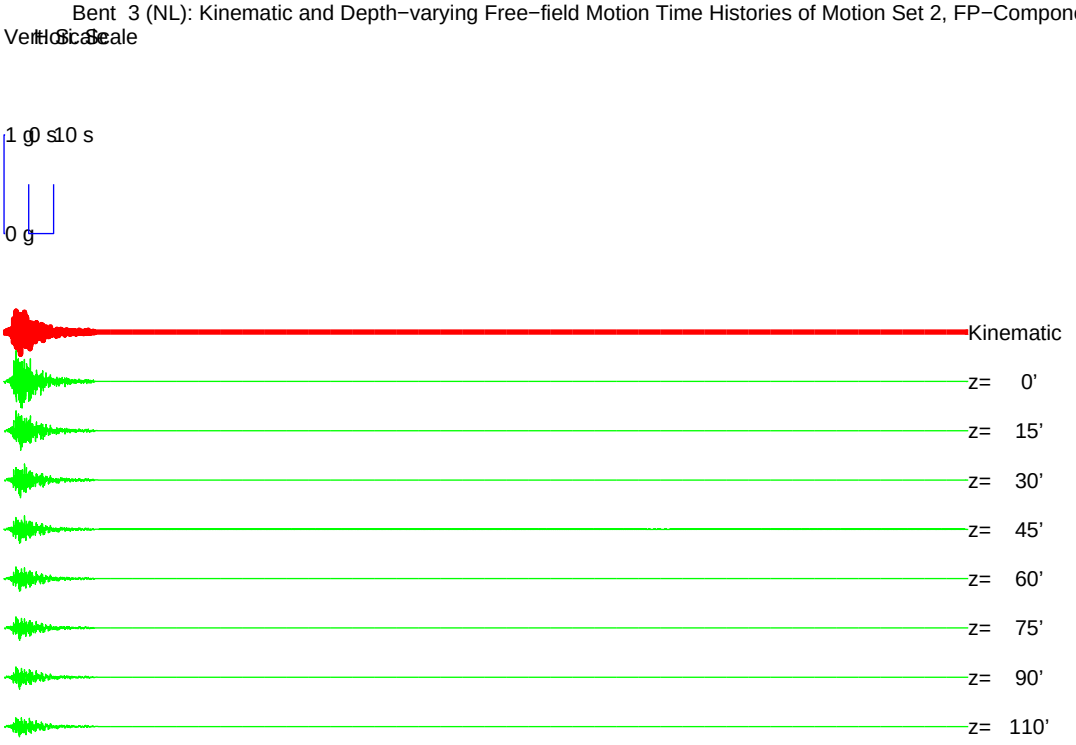


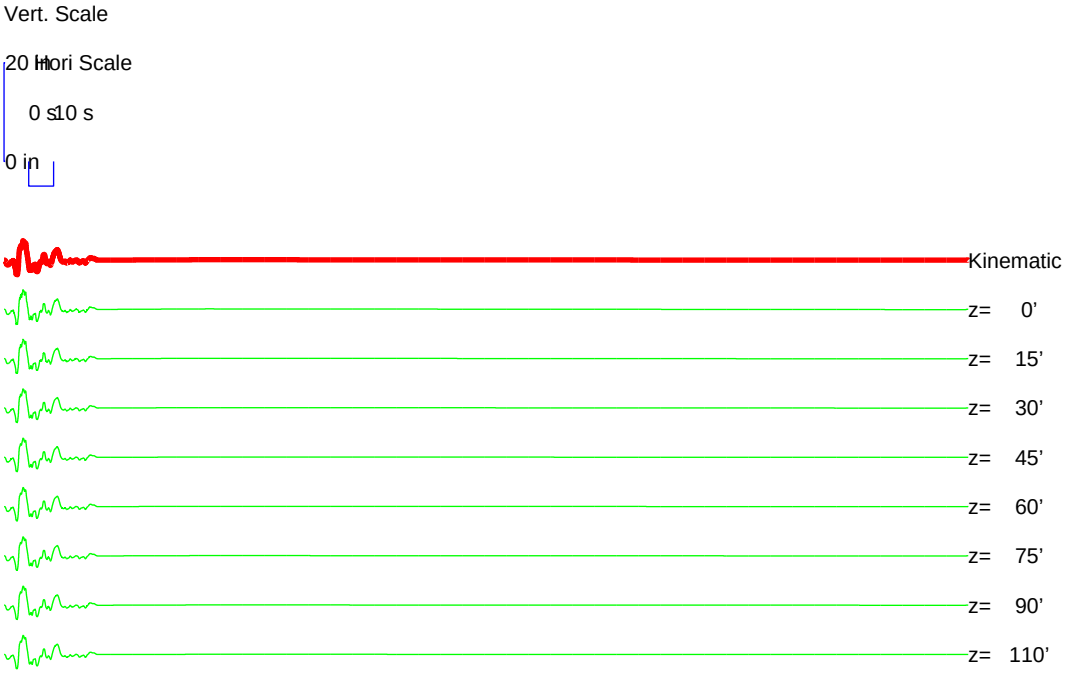


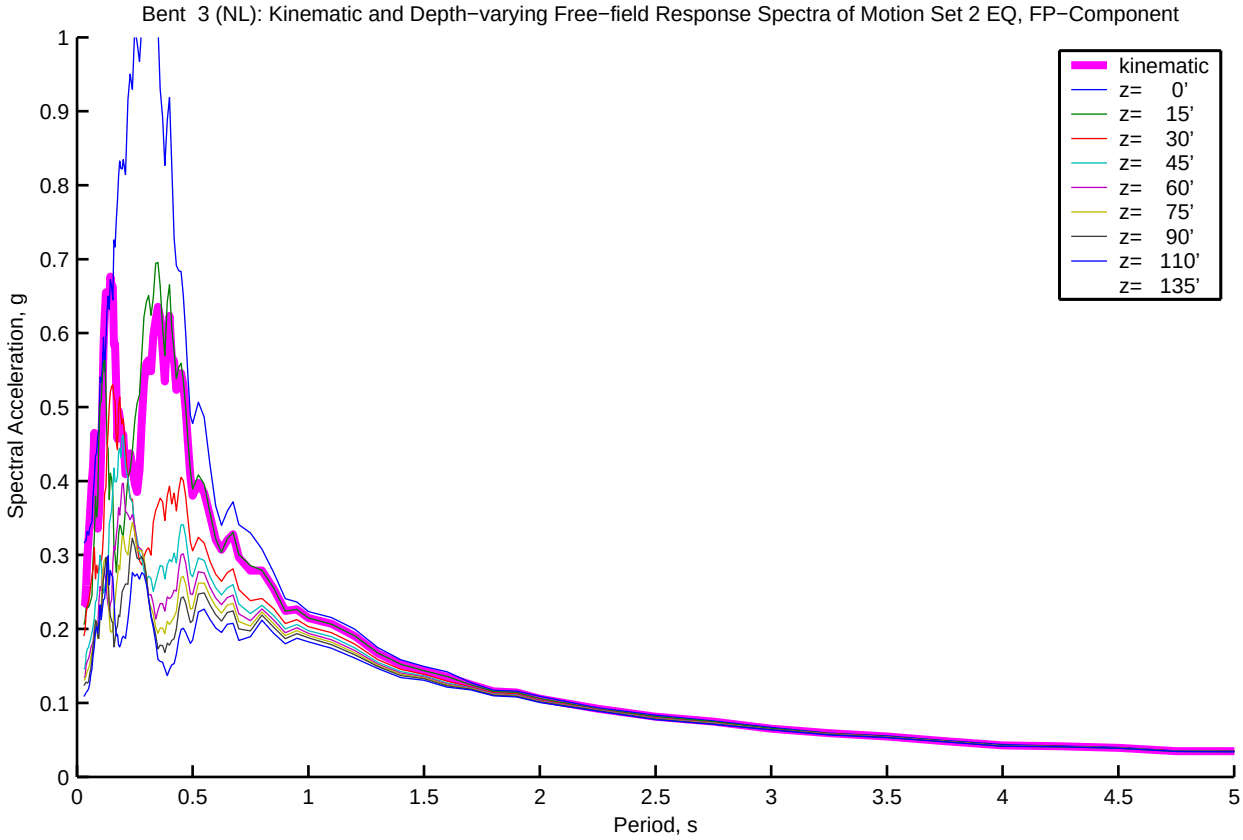

Bent 3 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 135'

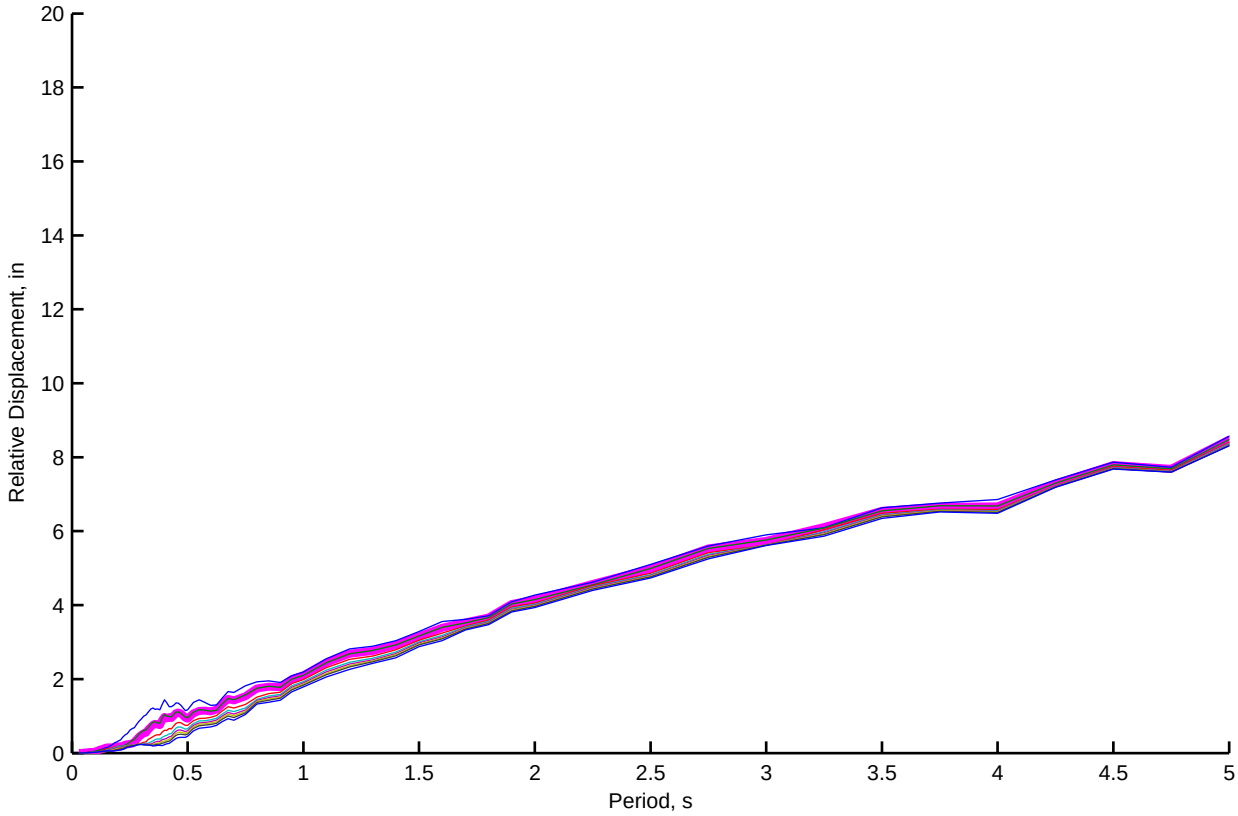

Relative Displacement, in
Period, s

Bent 3 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

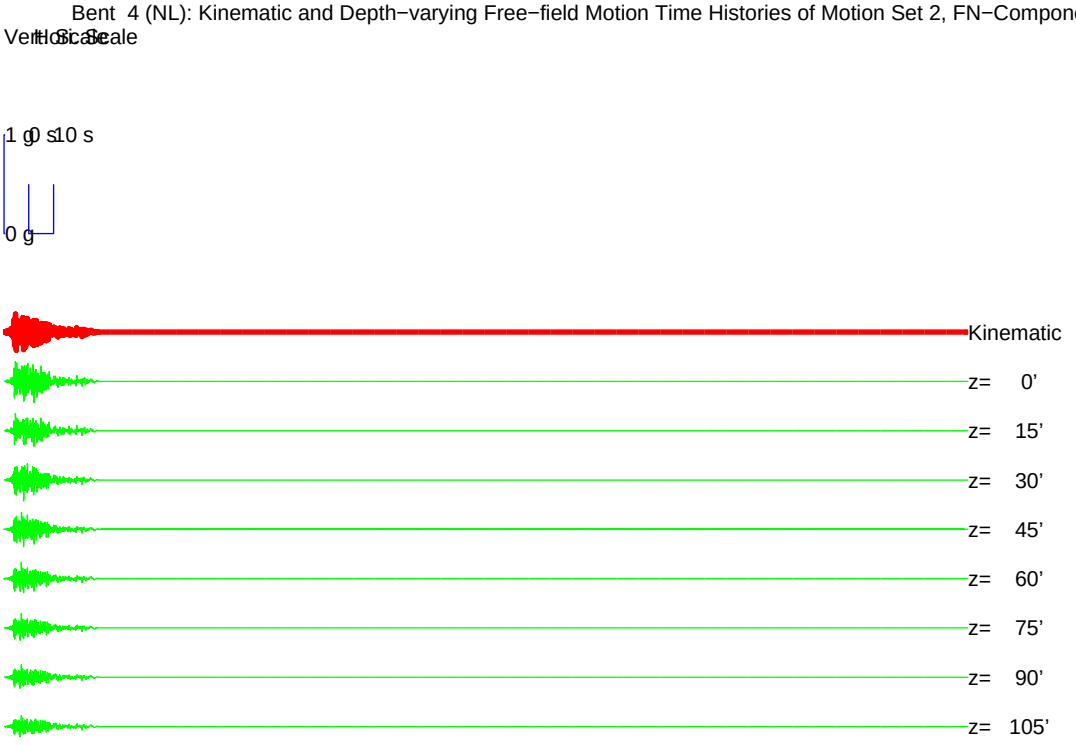


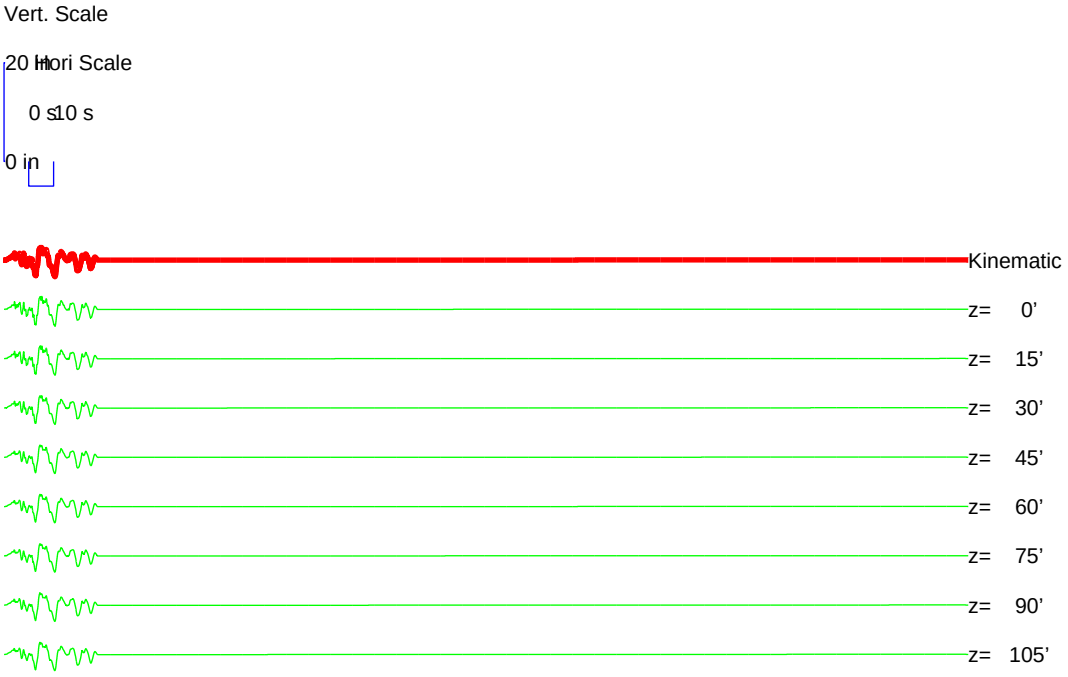


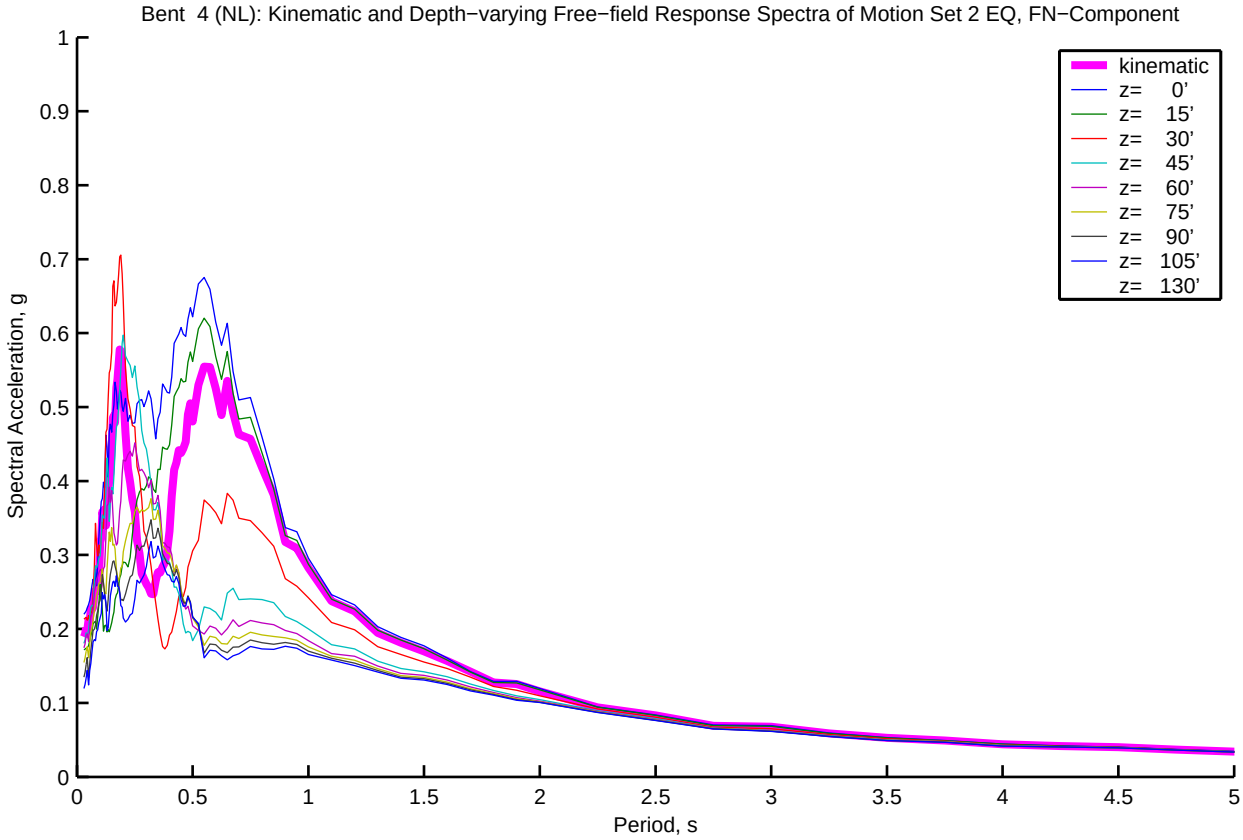

Bent 3 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 135'

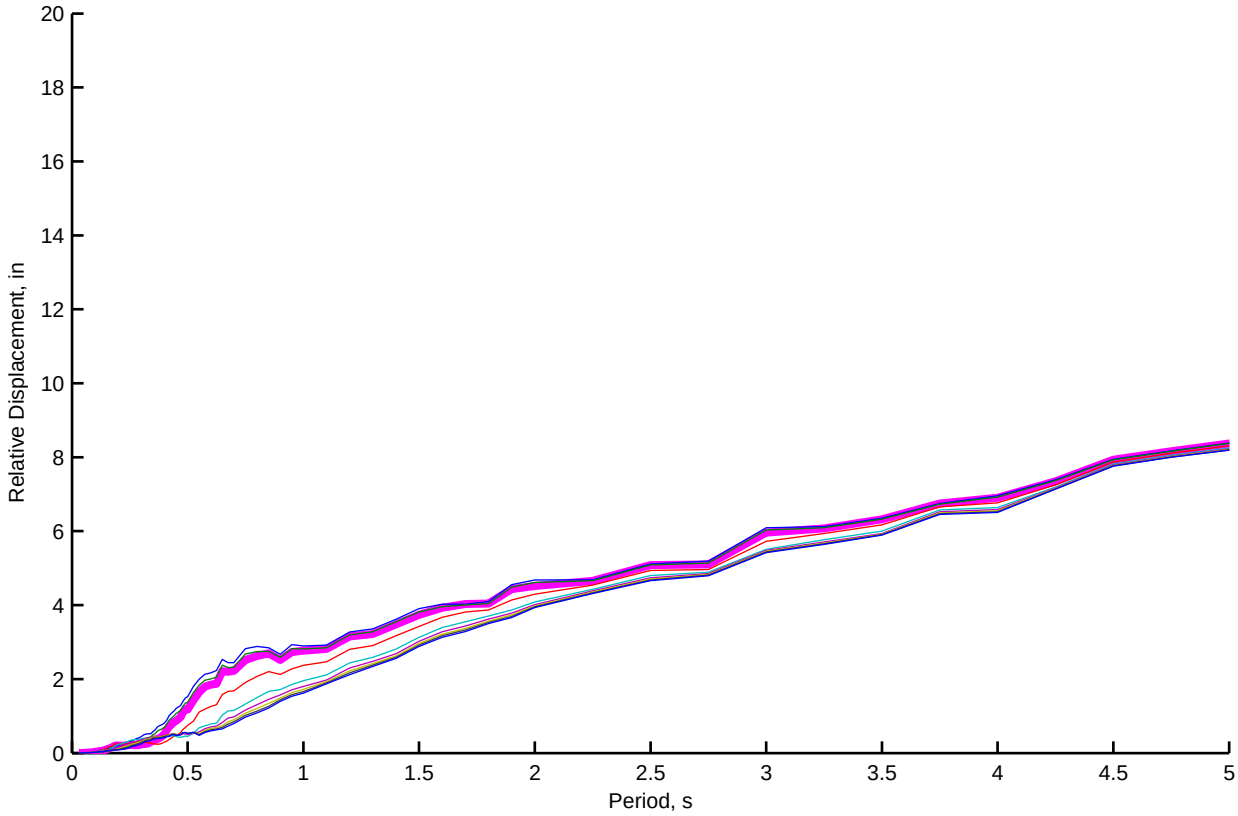

Relative Displacement, in
Period, s

Bent 4 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

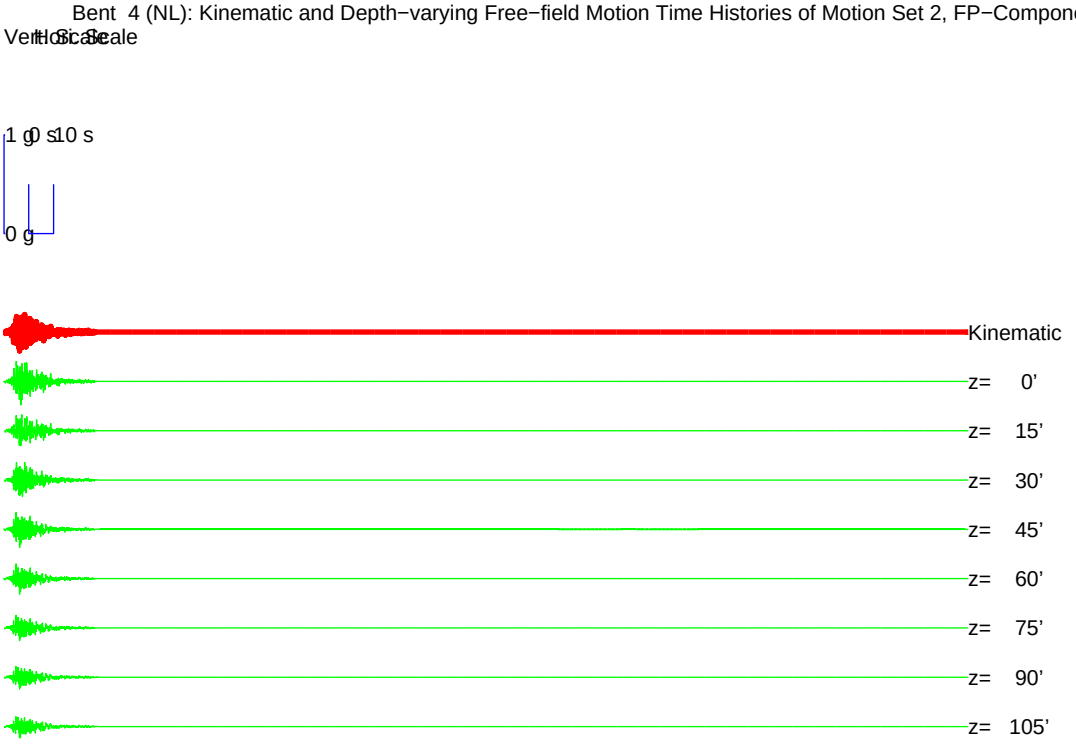


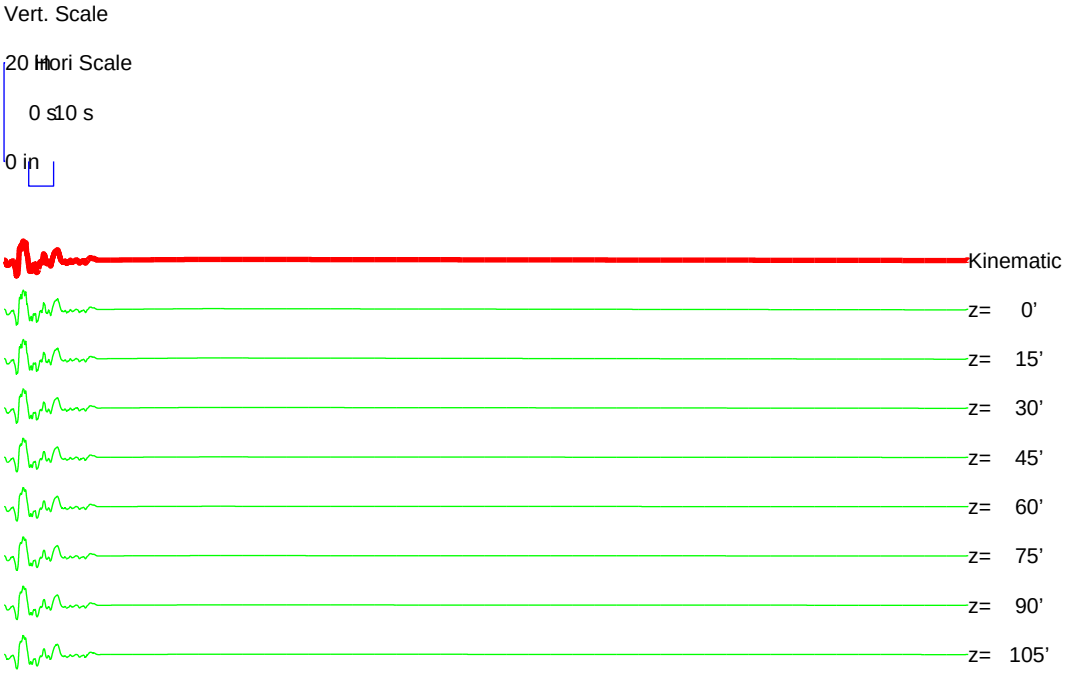


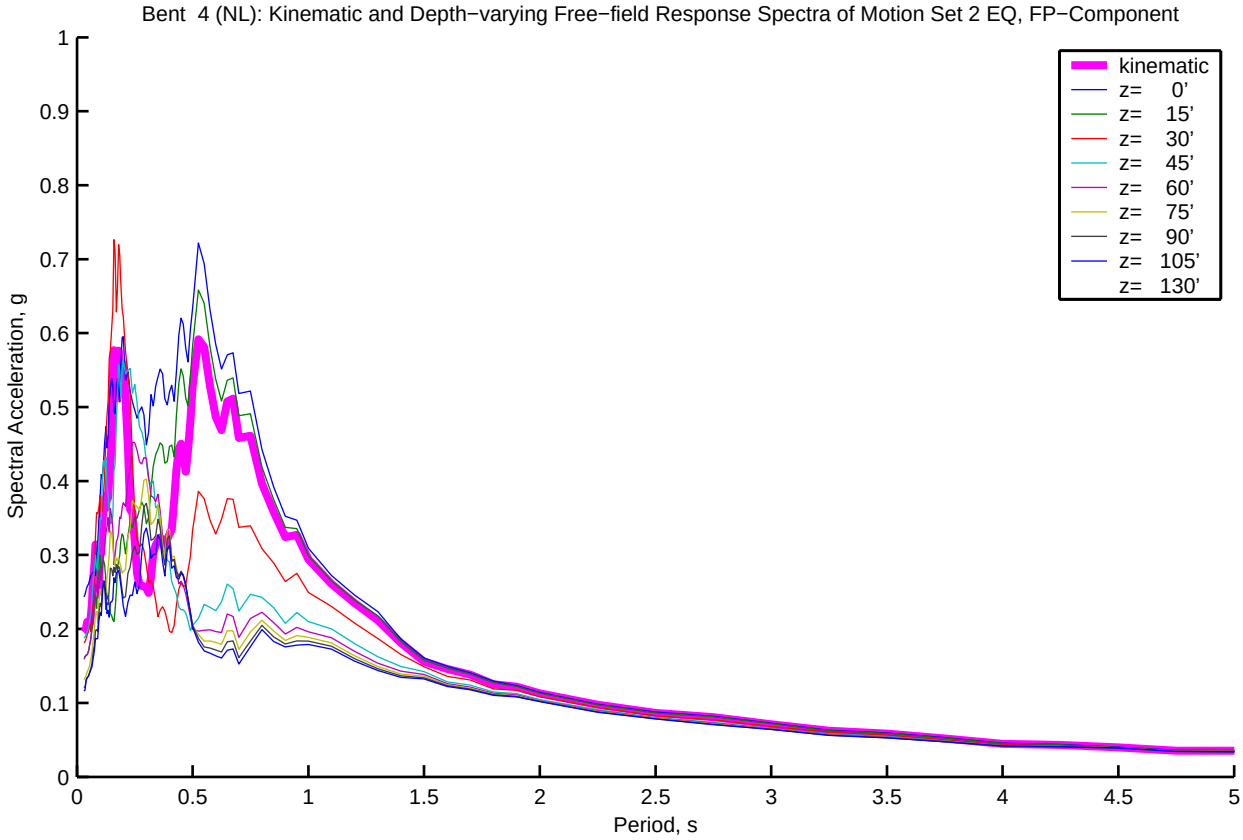

Bent 4 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

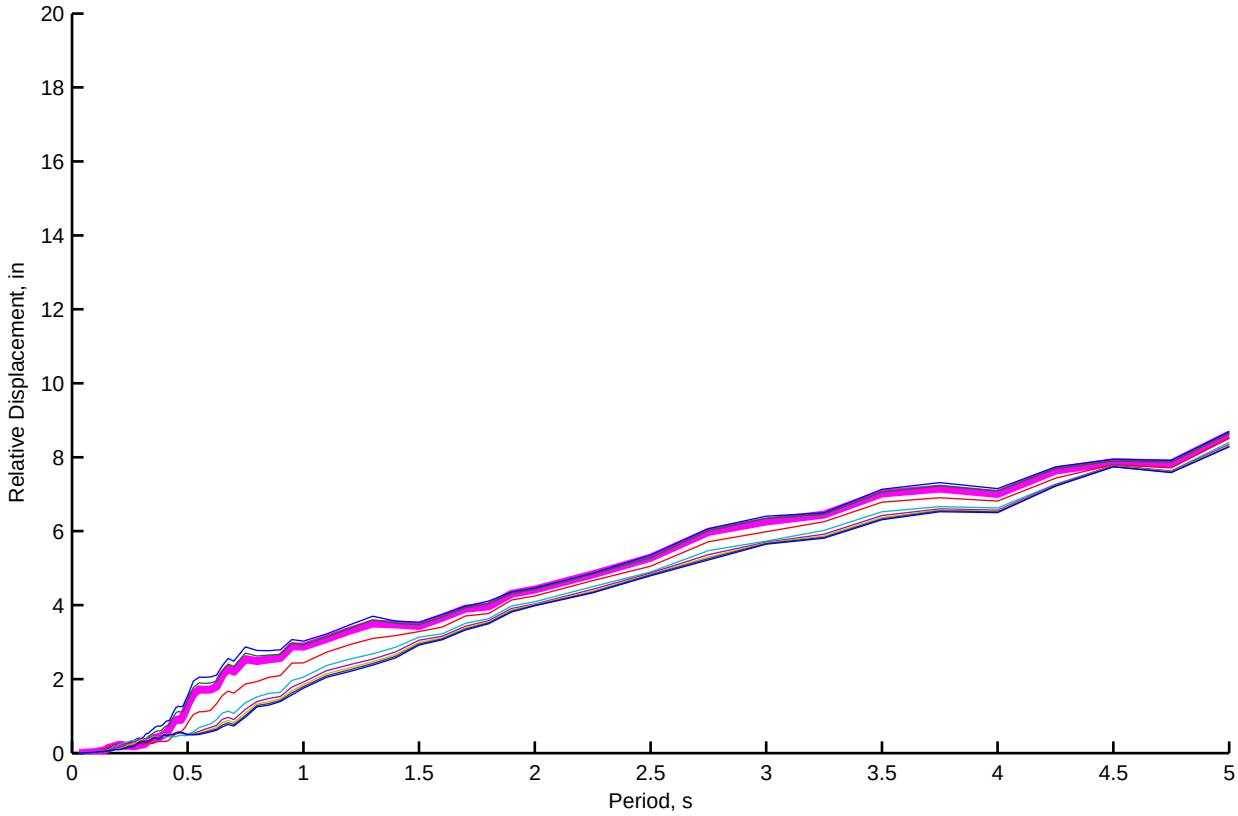

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 4 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

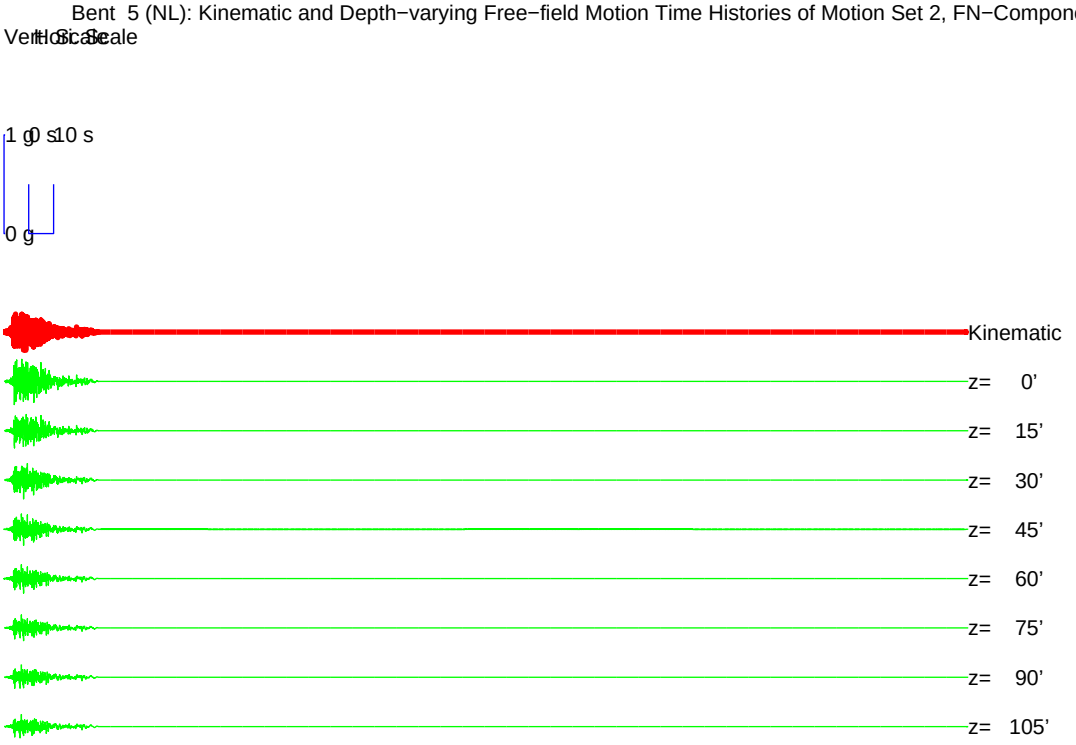


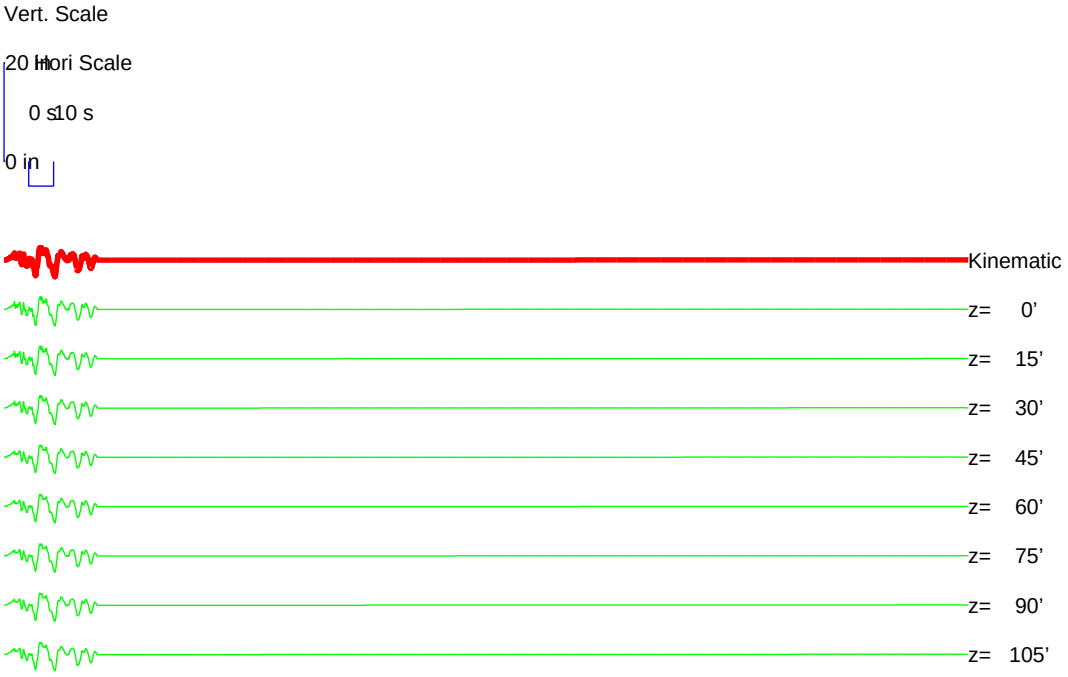


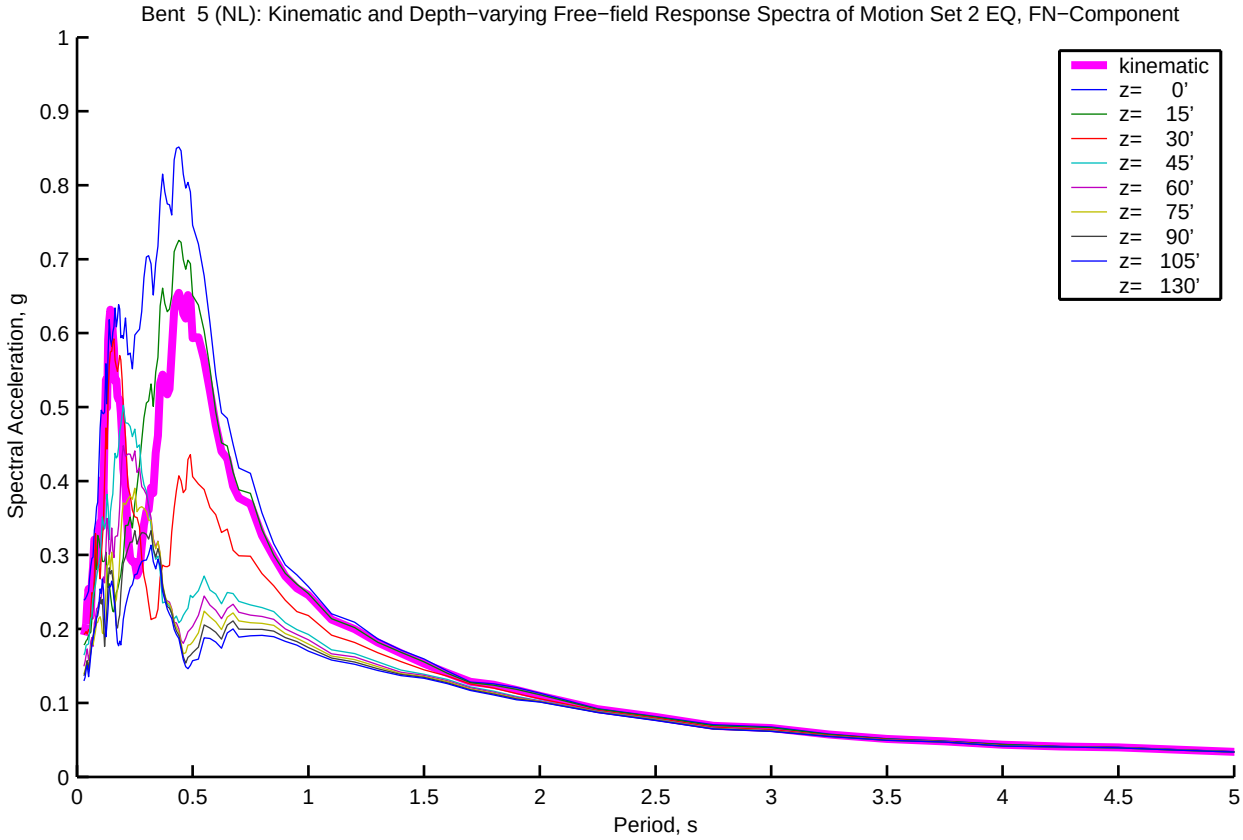

Bent 4 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

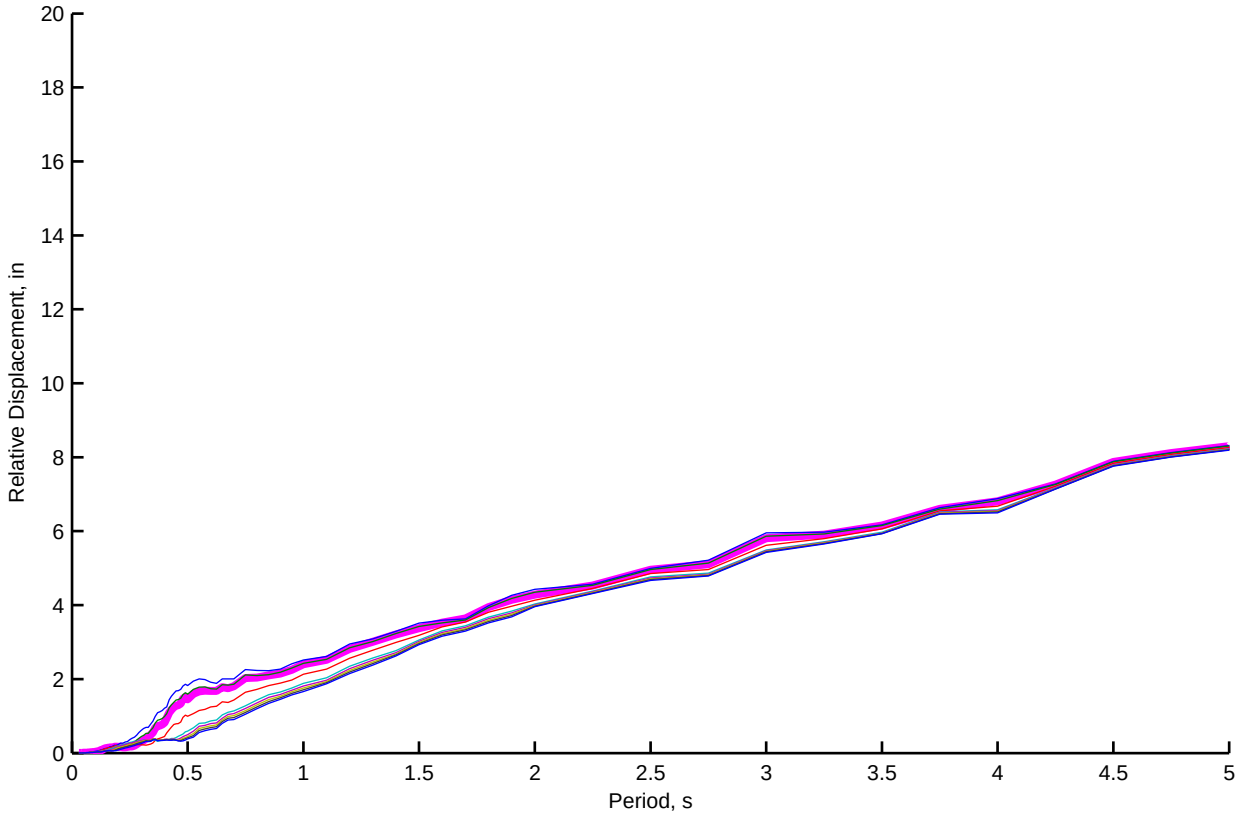

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 5 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

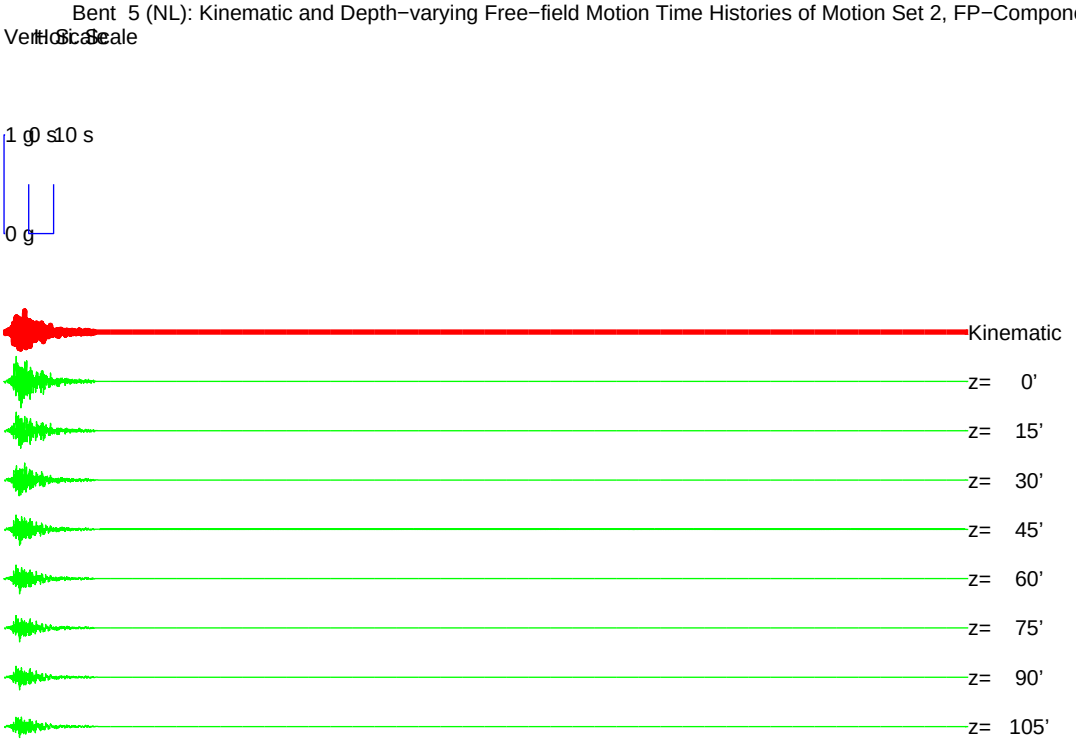


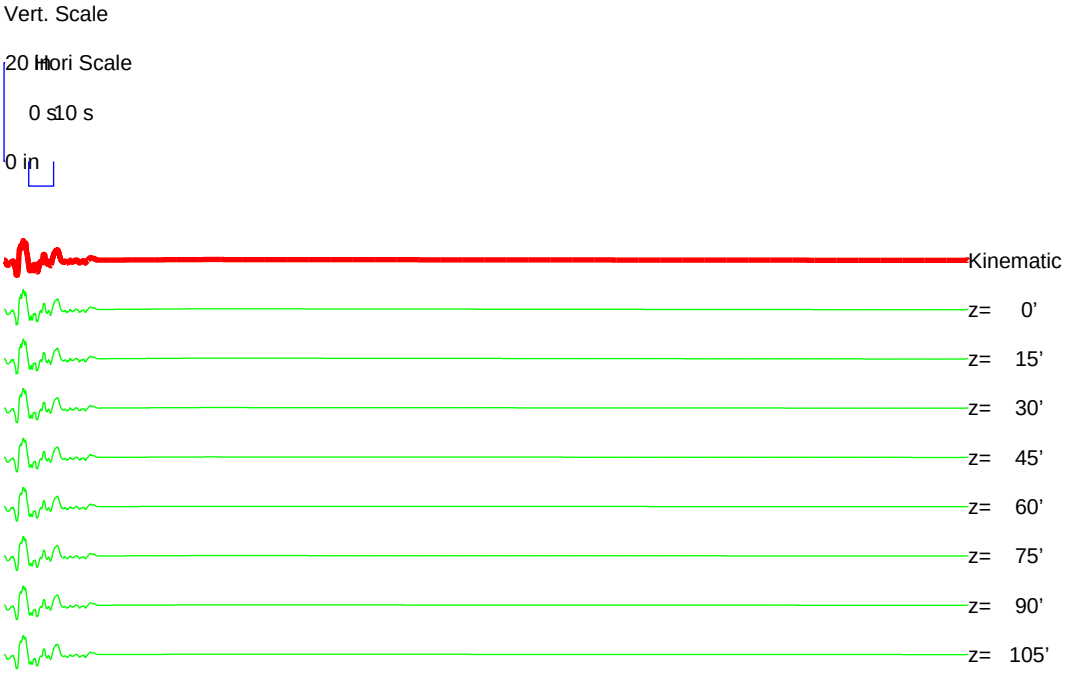


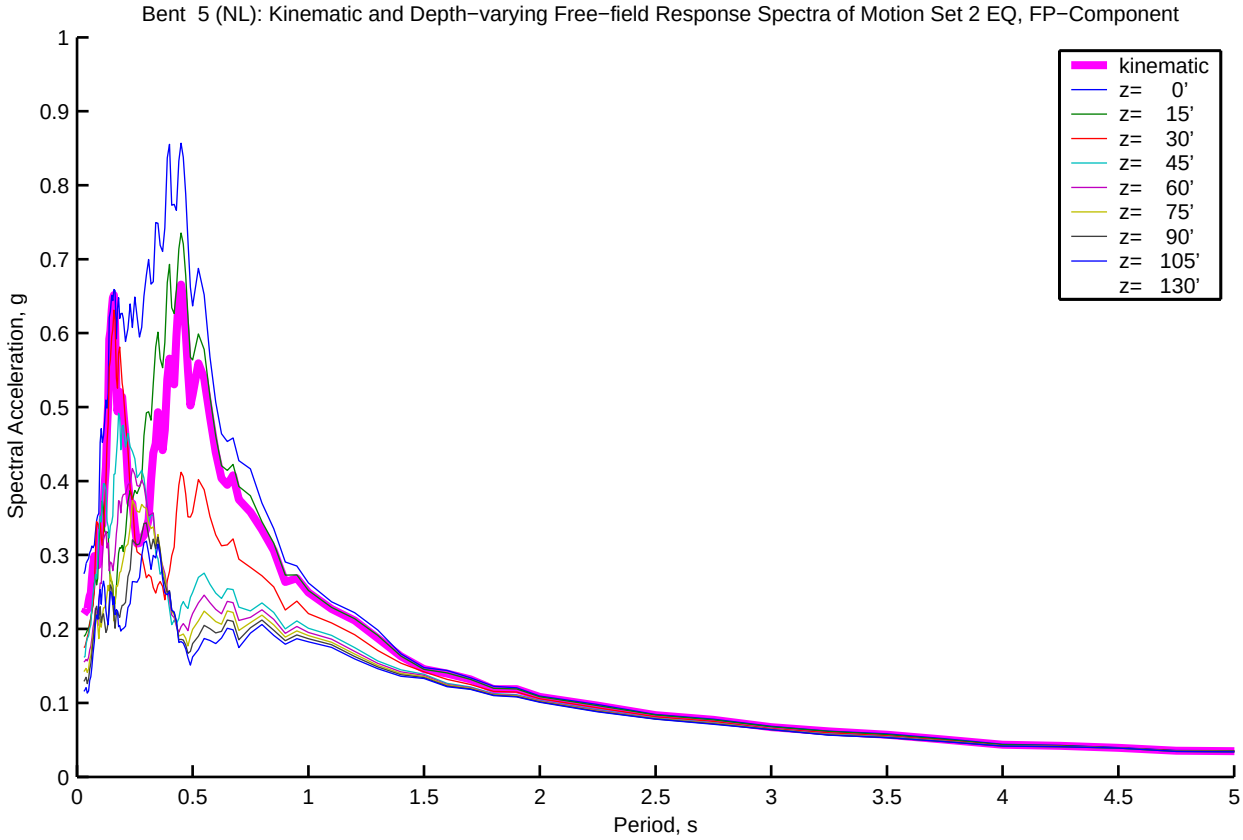

Bent 5 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5


Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 5 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component






Bent 5 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
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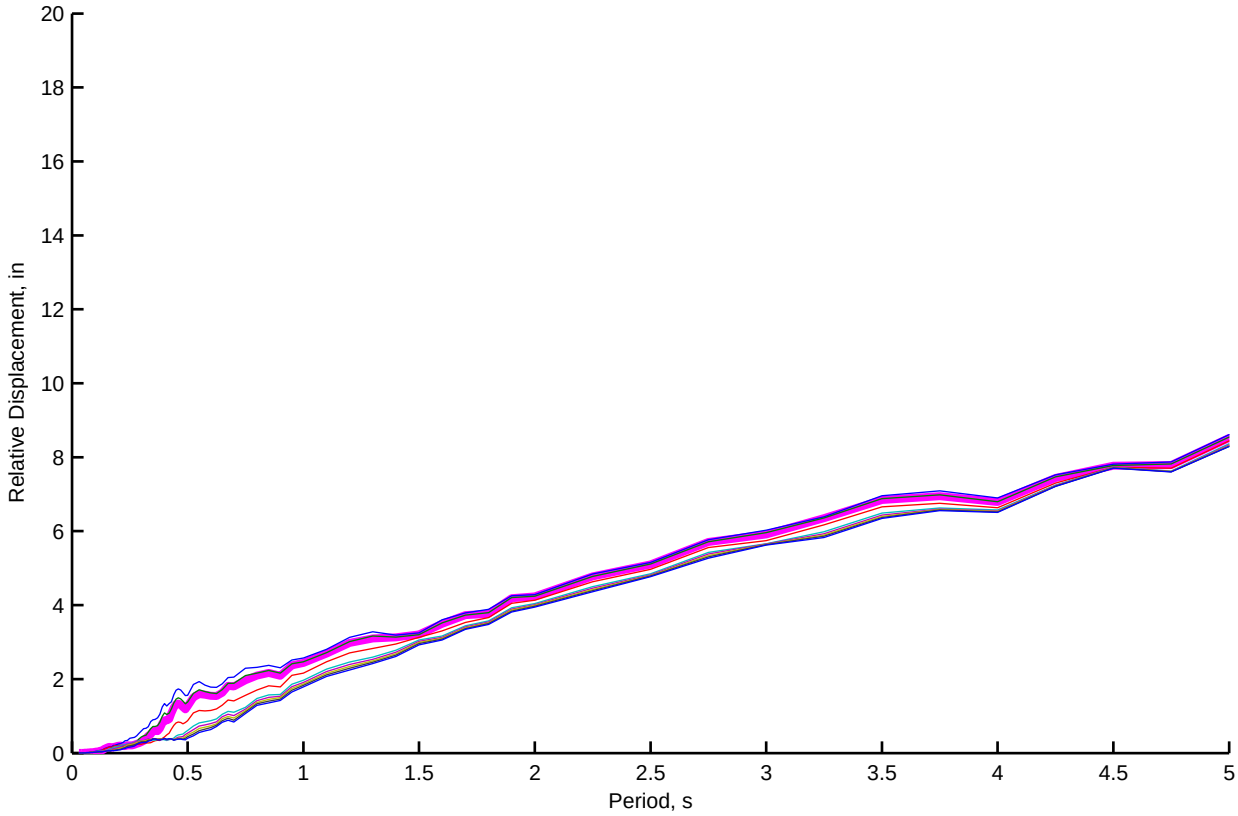
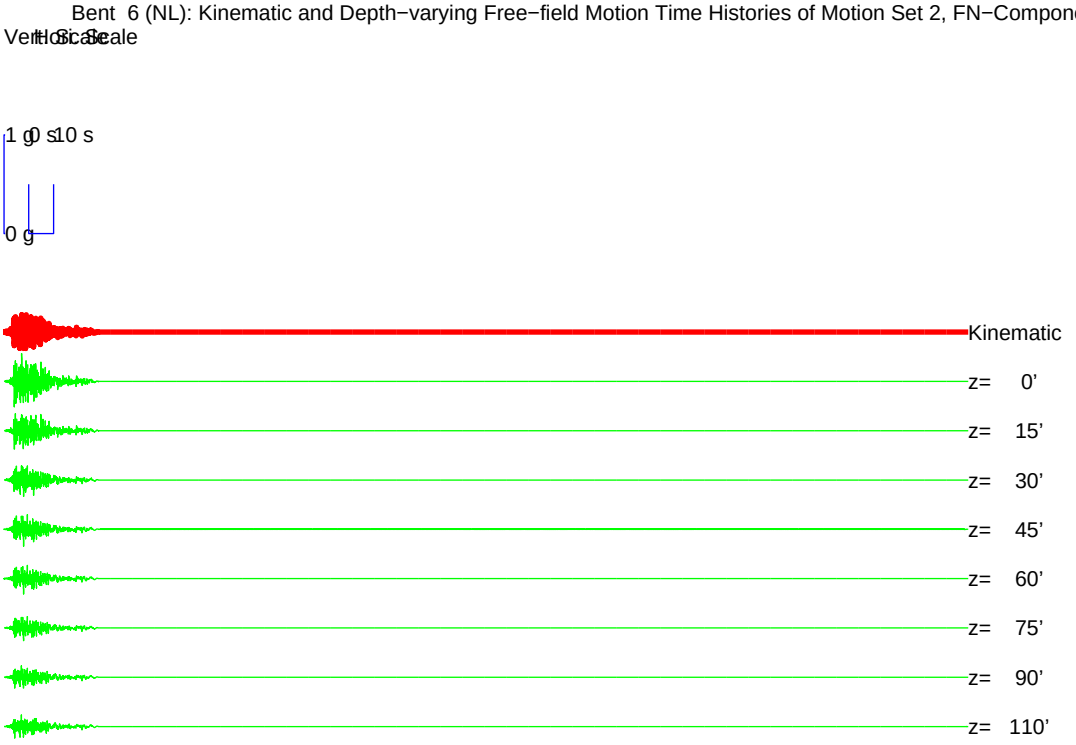
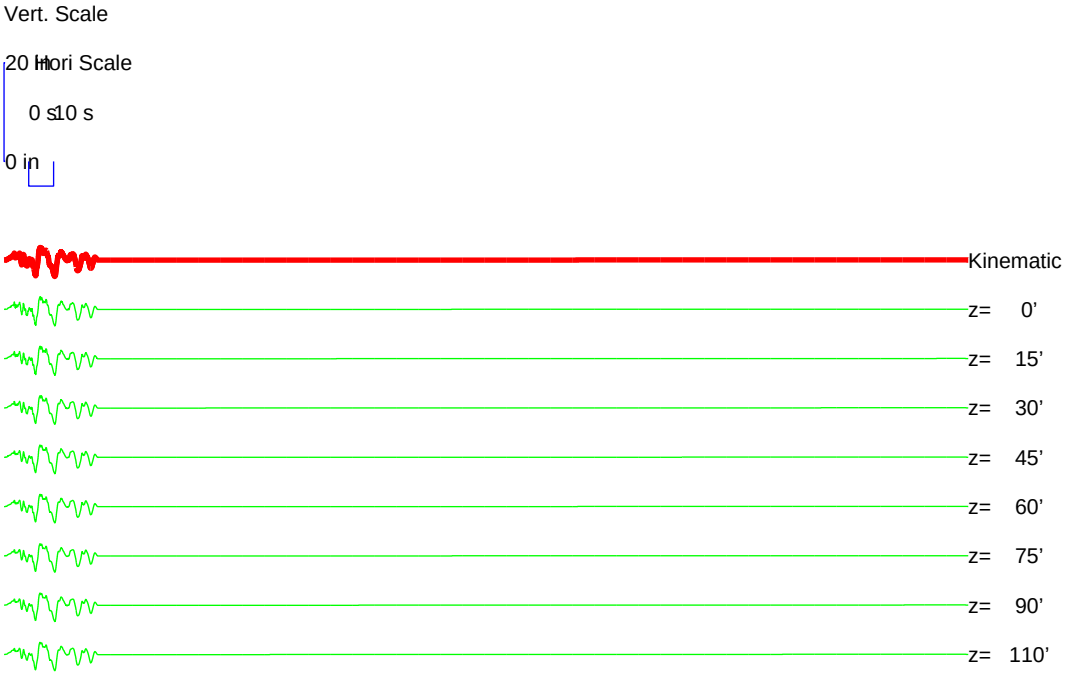
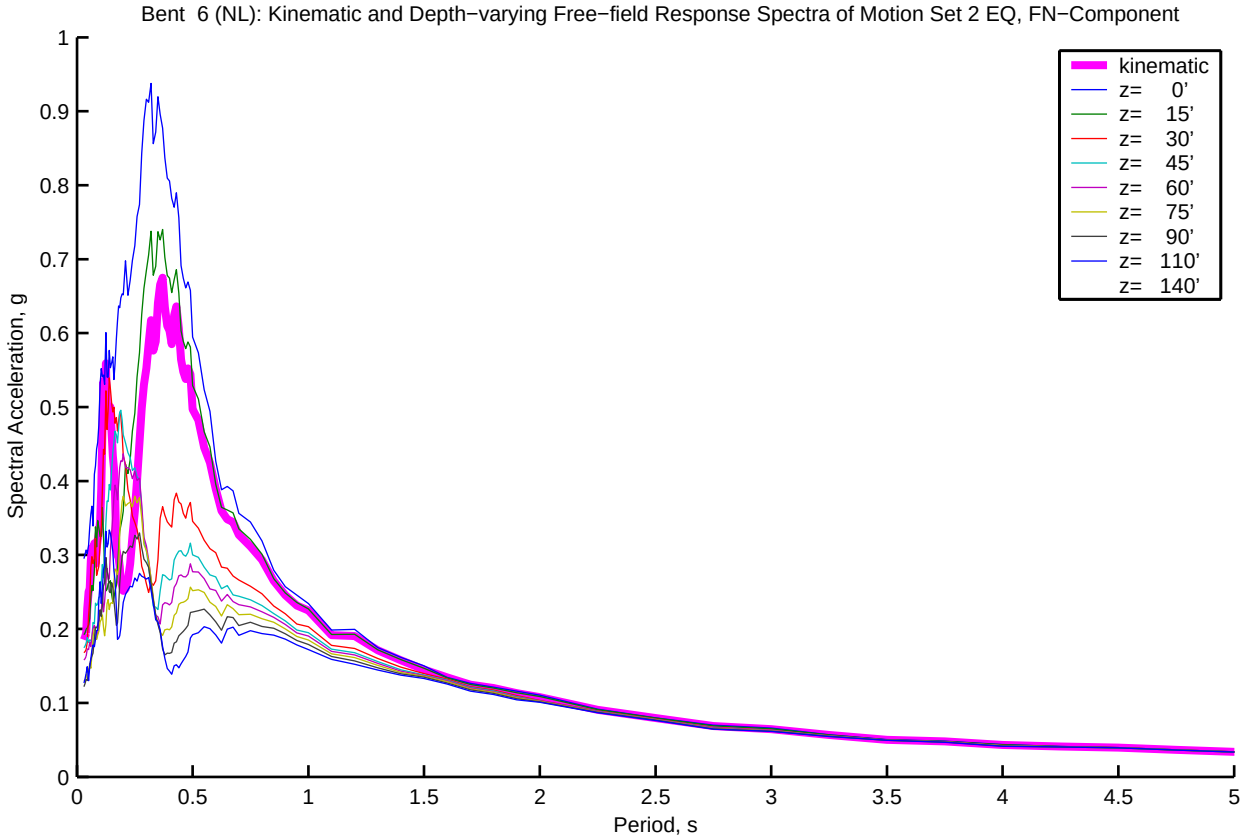
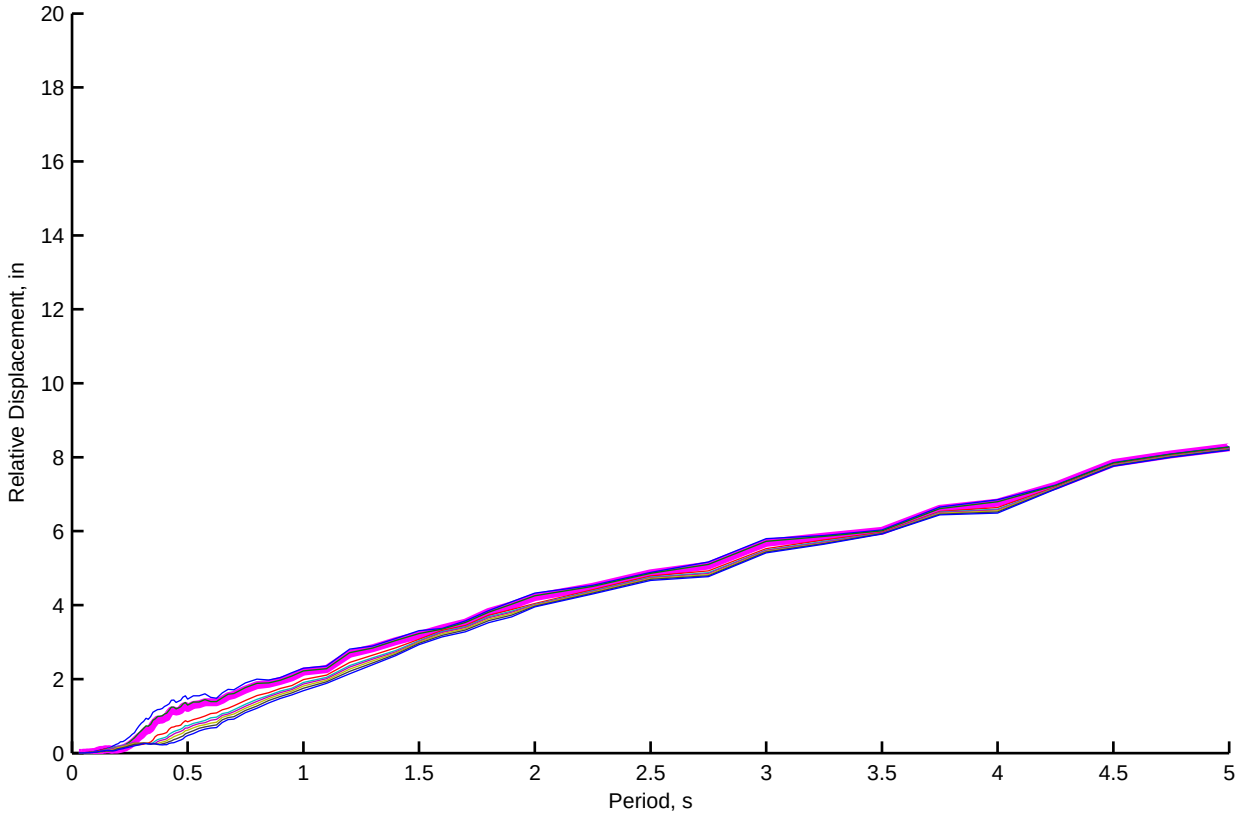

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 6 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

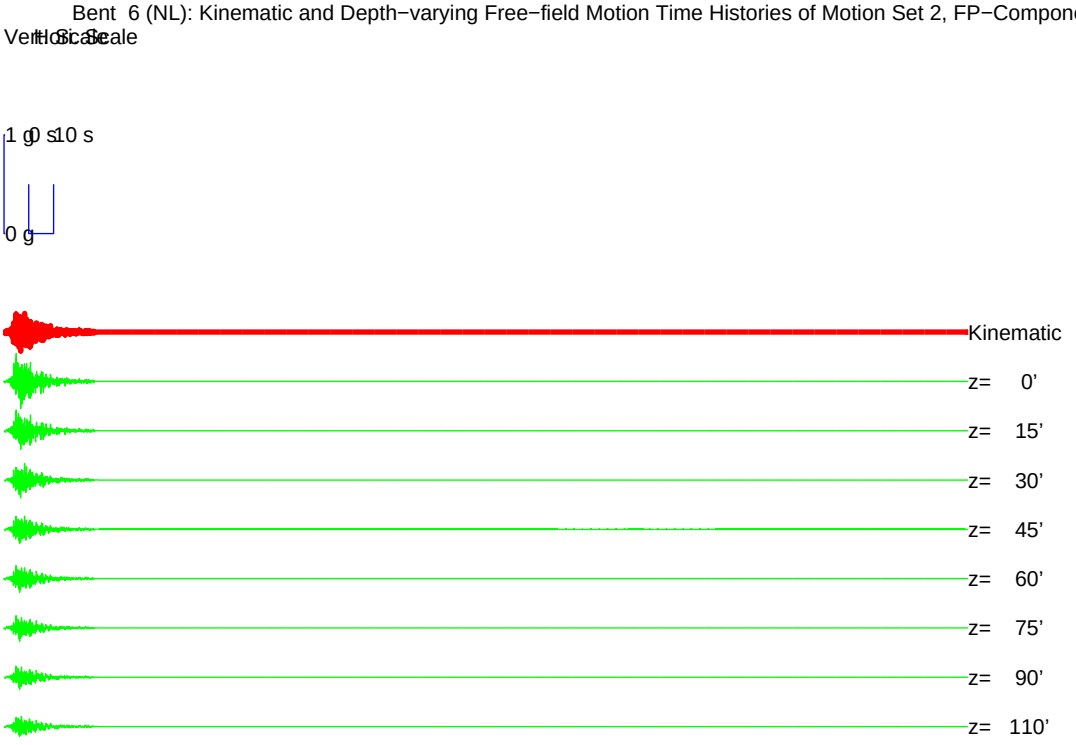


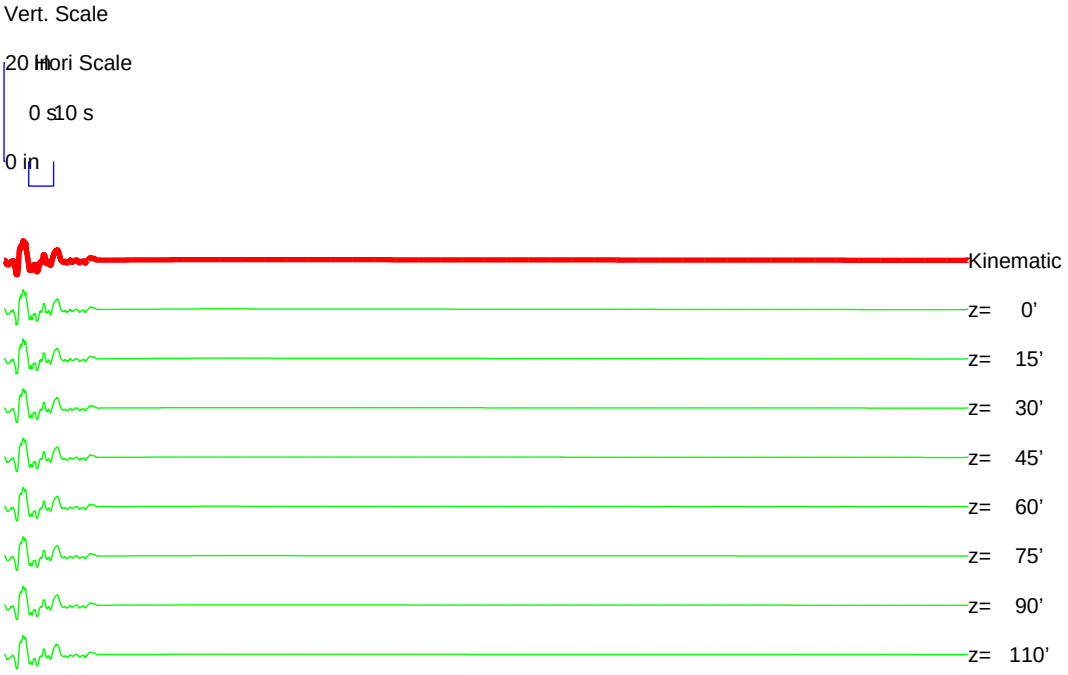


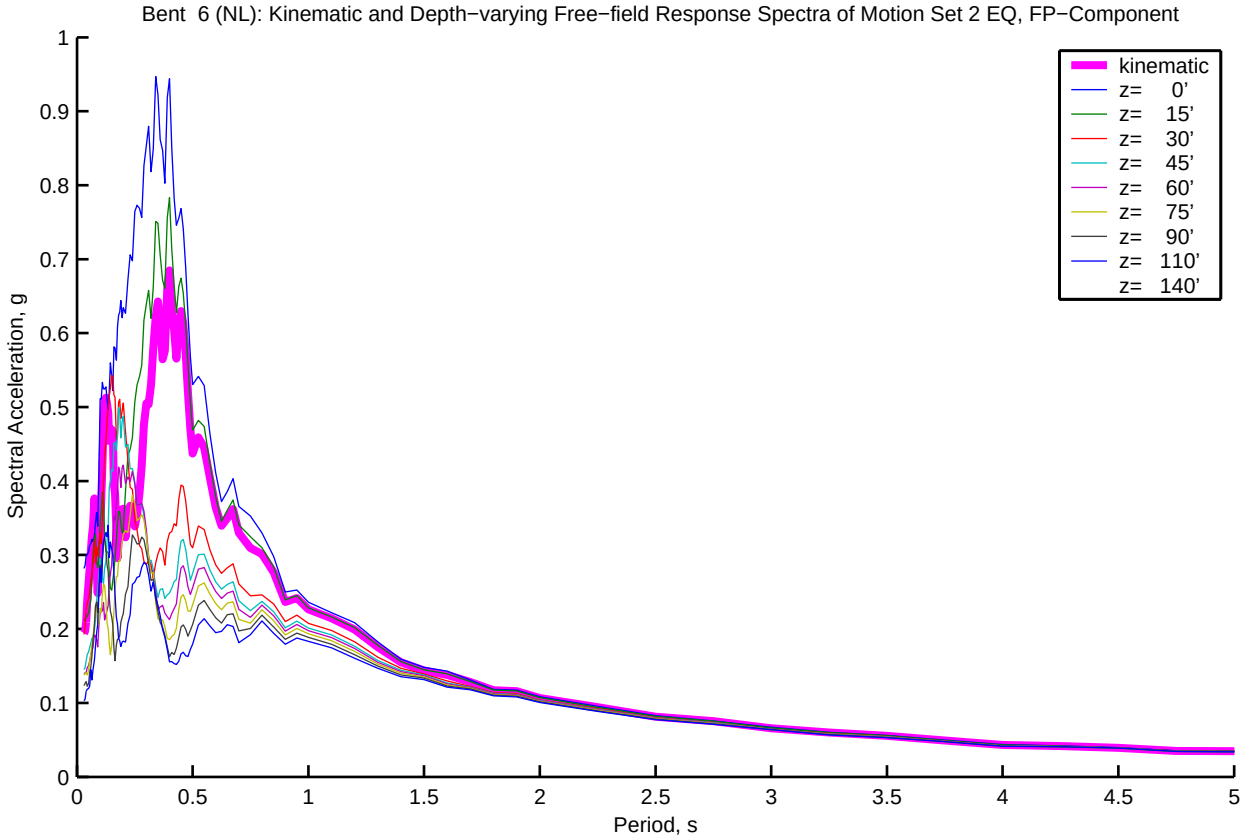

Bent 6 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'

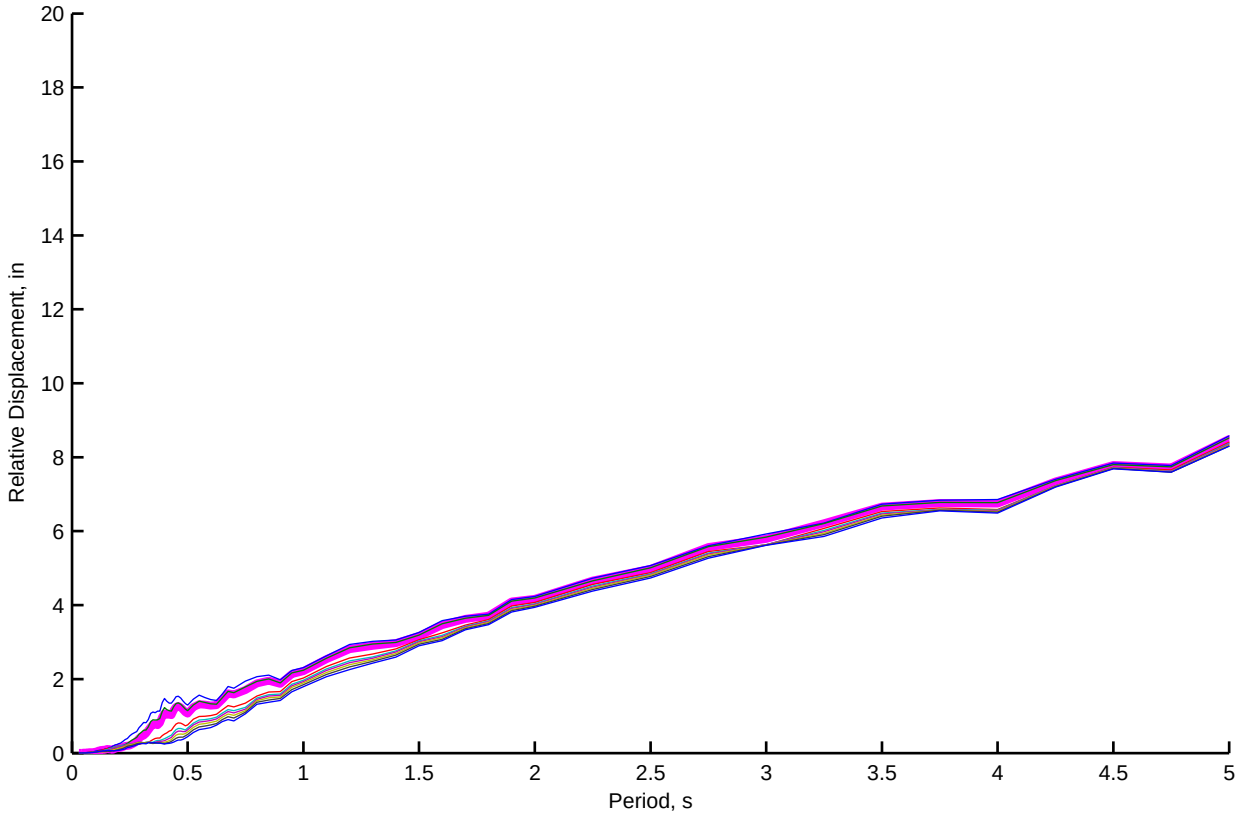

Relative Displacement, in
Period, s

Bent 6 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

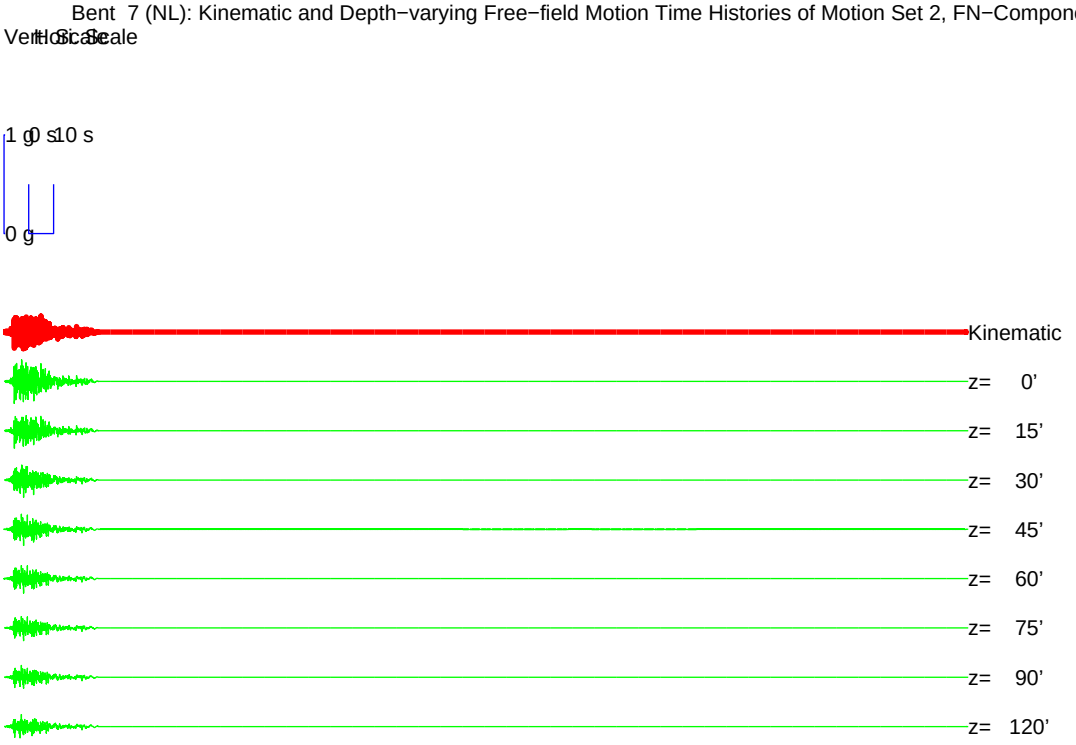


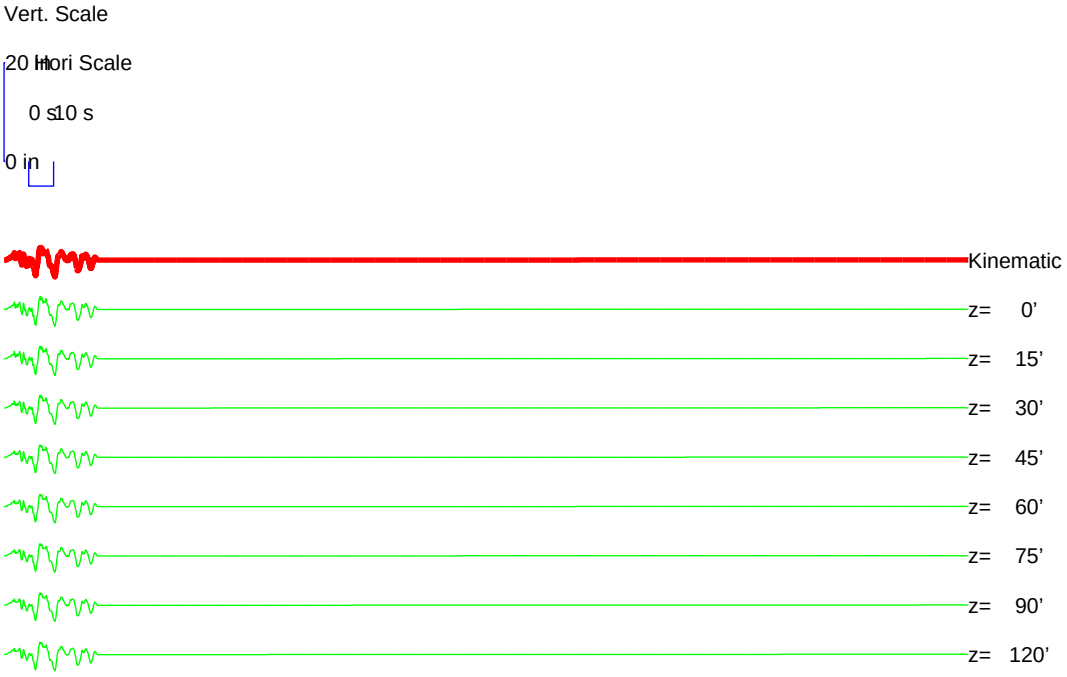


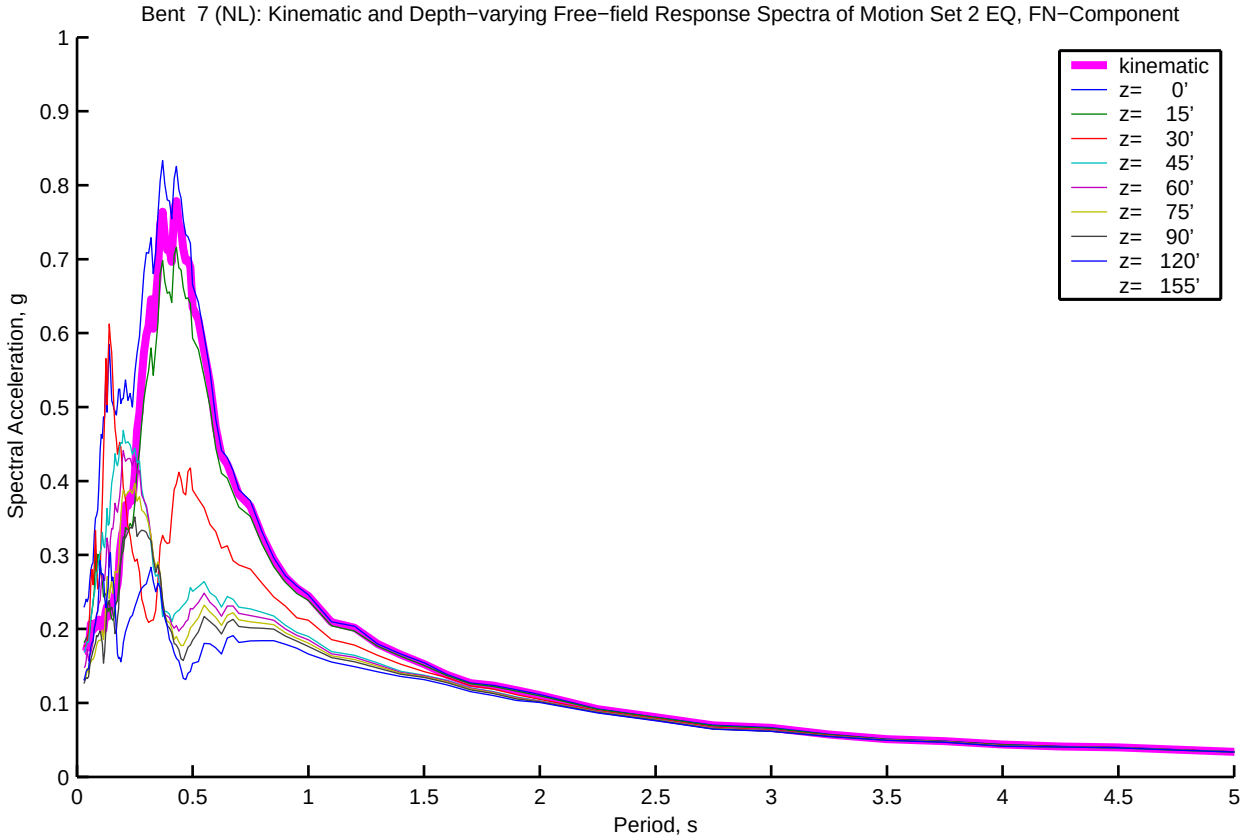

Bent 6 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'

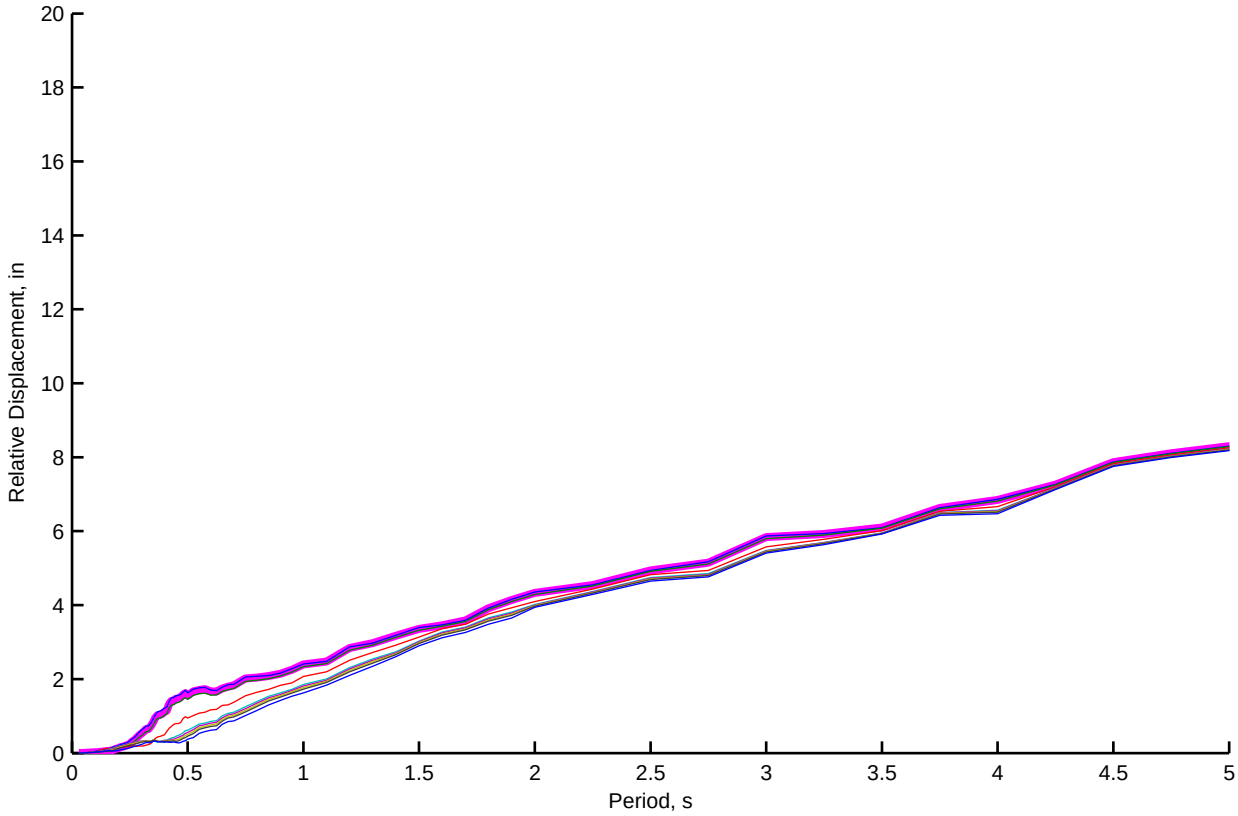

Relative Displacement, in
Period, s

Bent 7 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component






Bent 7 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 155'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5


Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
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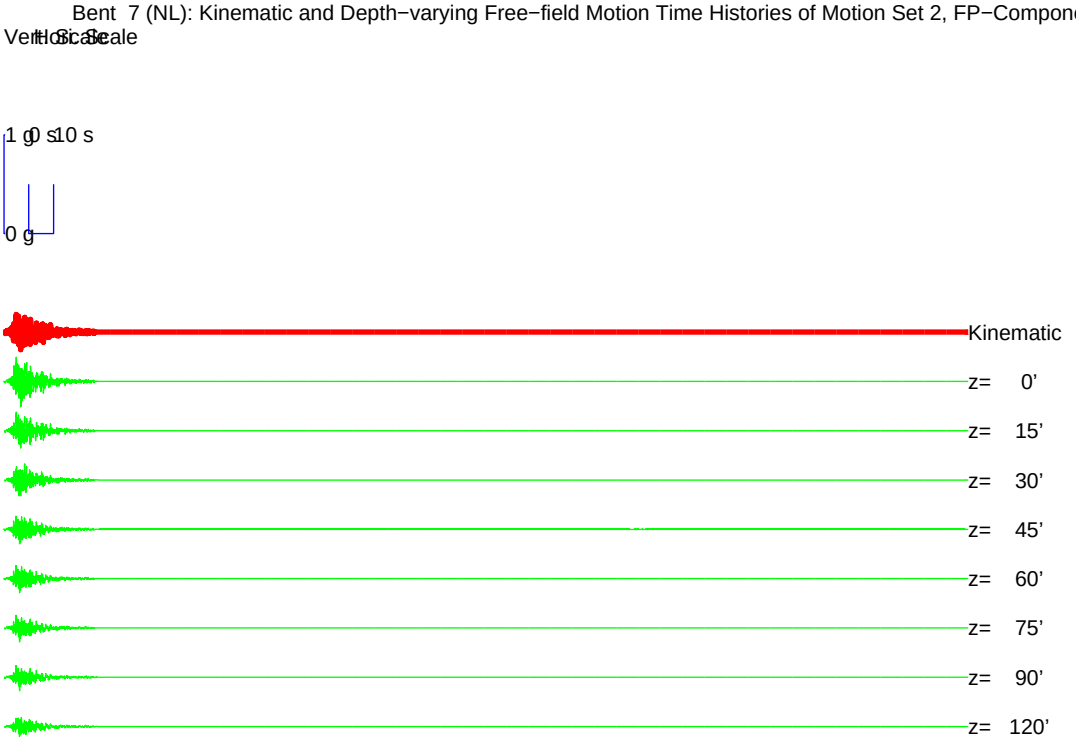
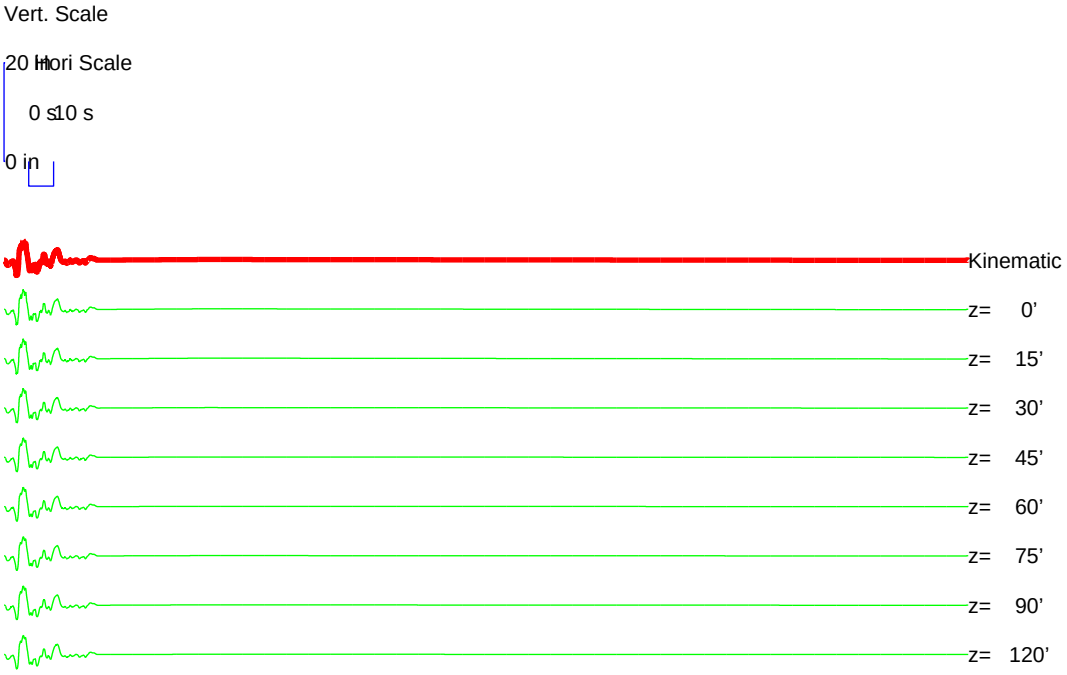
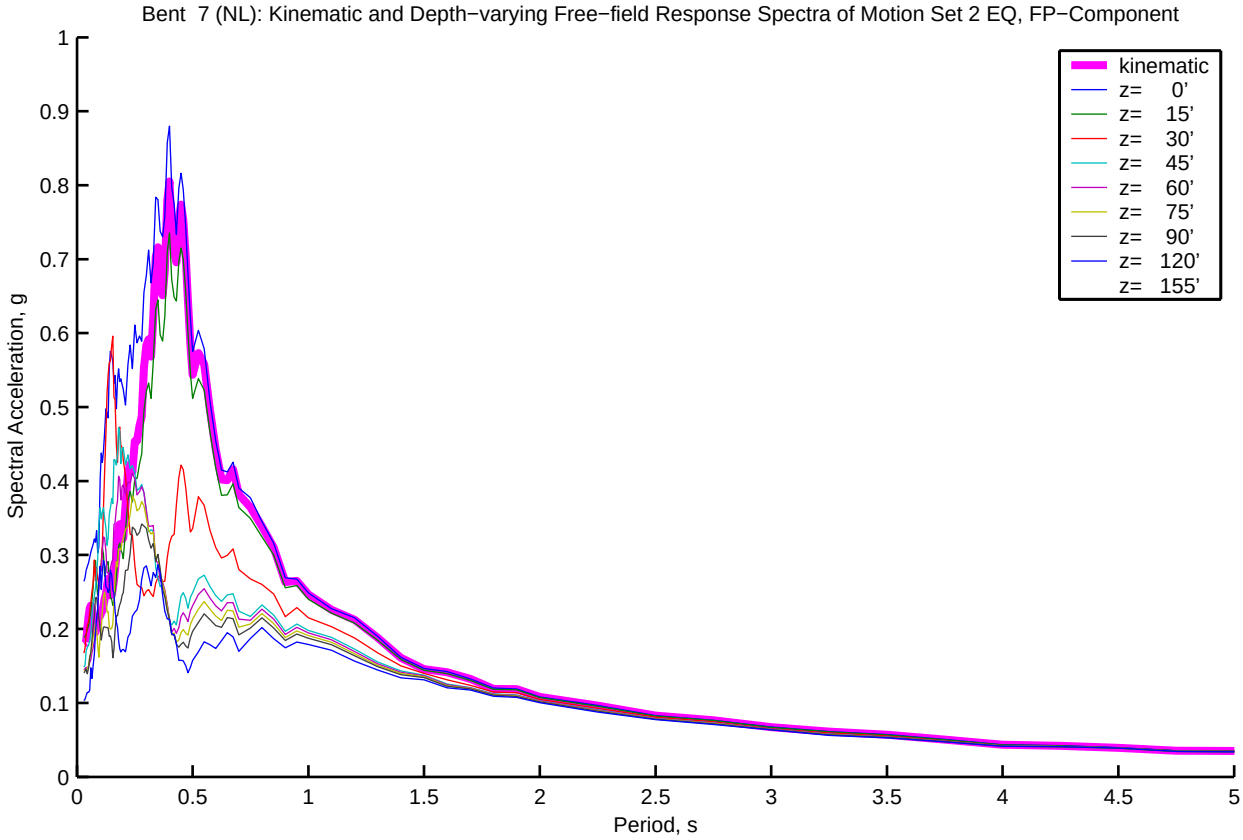
4.5
5

Bent 7 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component






Bent 7 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 155'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
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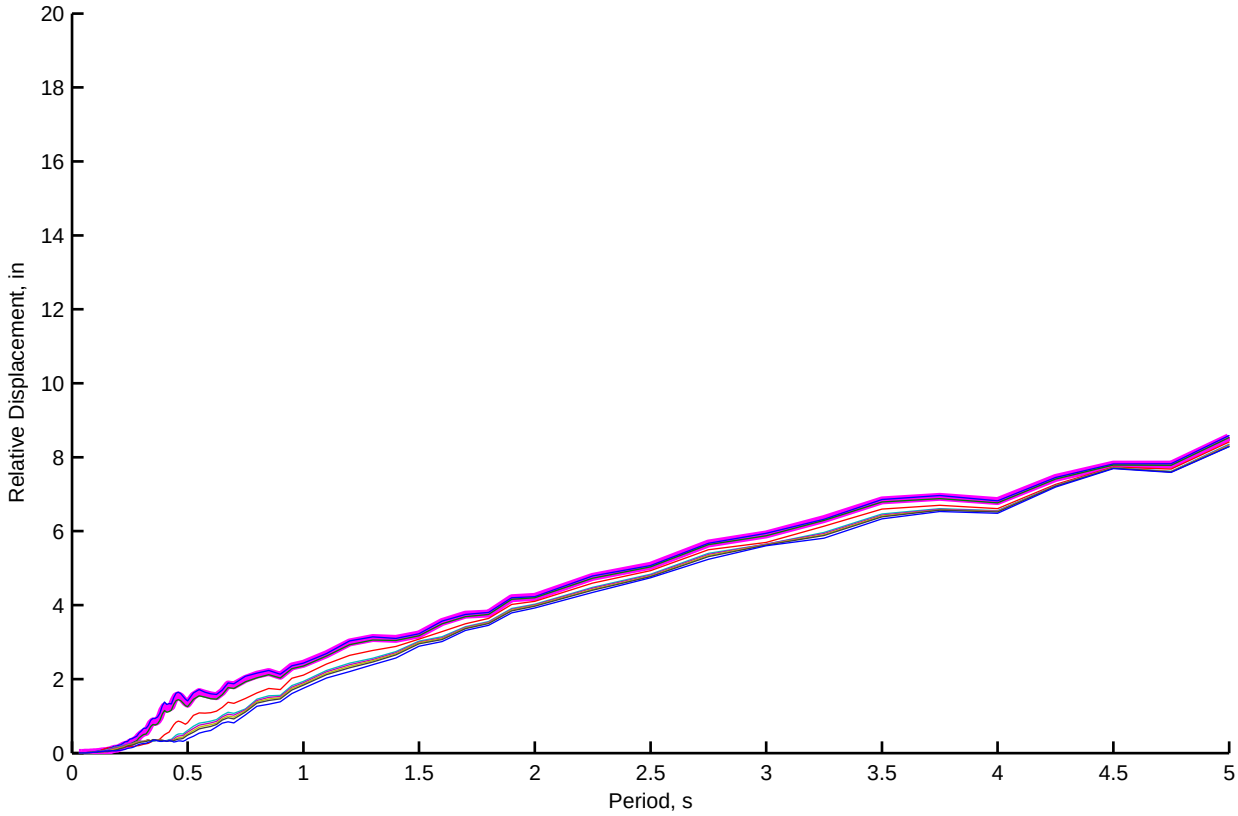
Relative Displacement, in
Period, s
0
2
4
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14
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18
20
0.5
1
1.5
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2.5
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3.5
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4.5
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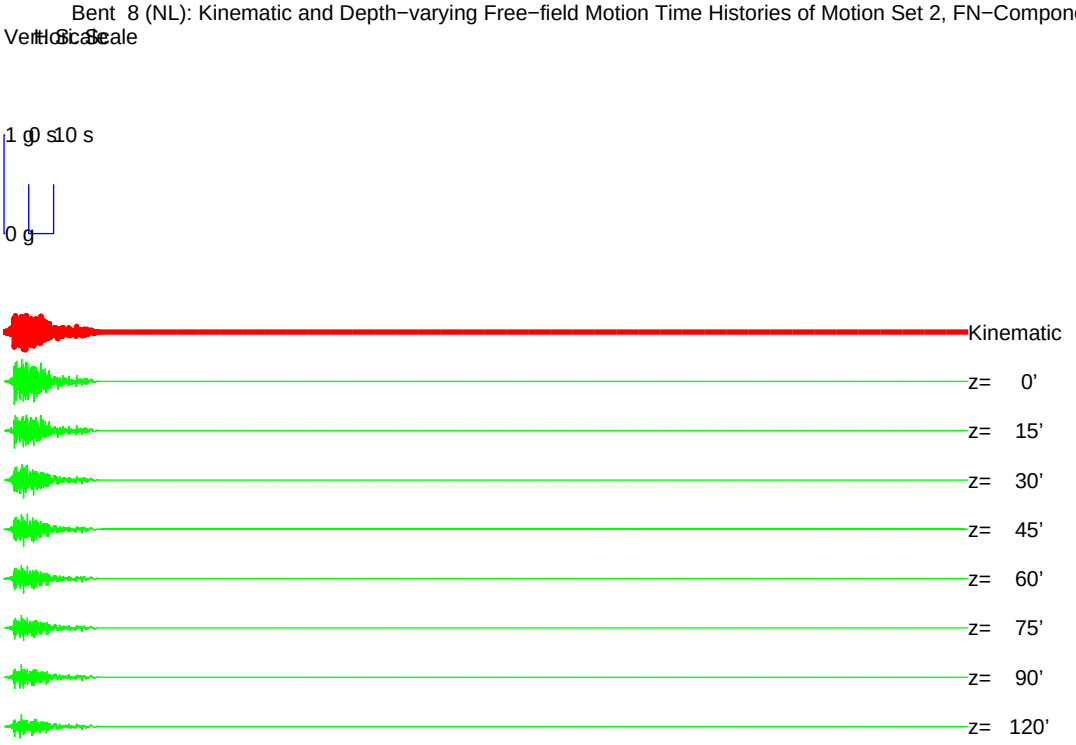
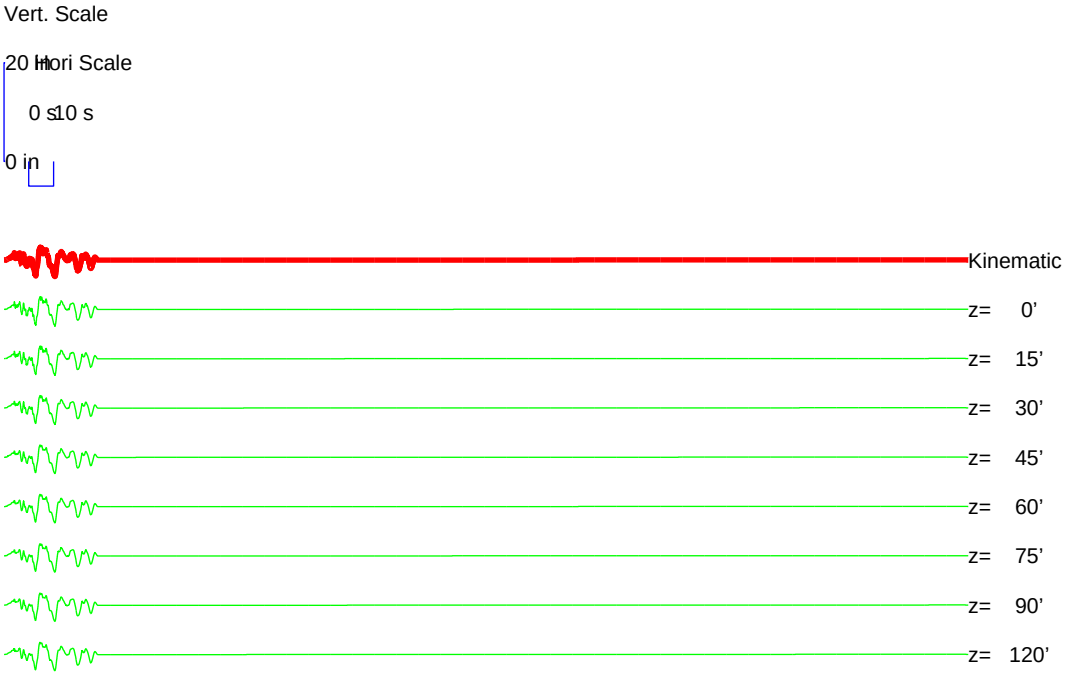
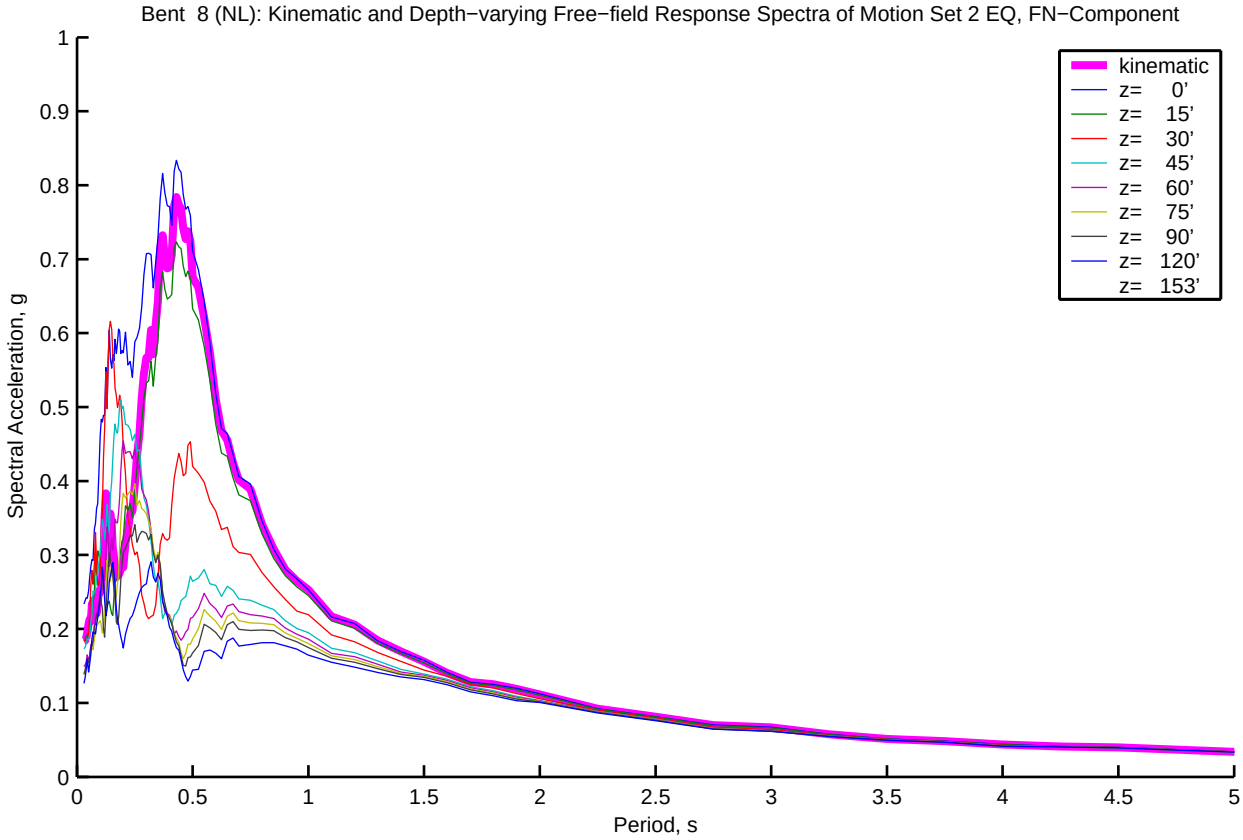
Bent 8 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component






Bent 8 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 153'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
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4.5
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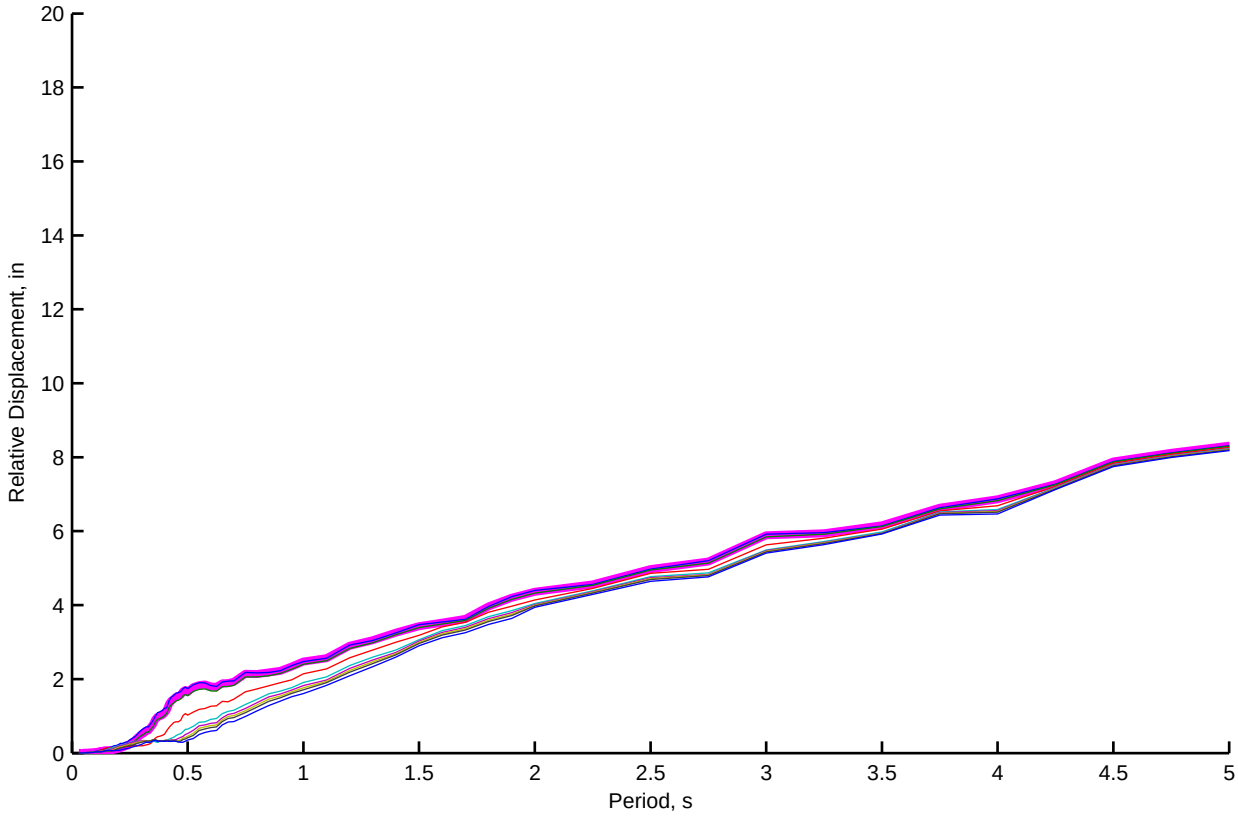
Relative Displacement, in
Period, s
0
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12
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0.5
1
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4.5
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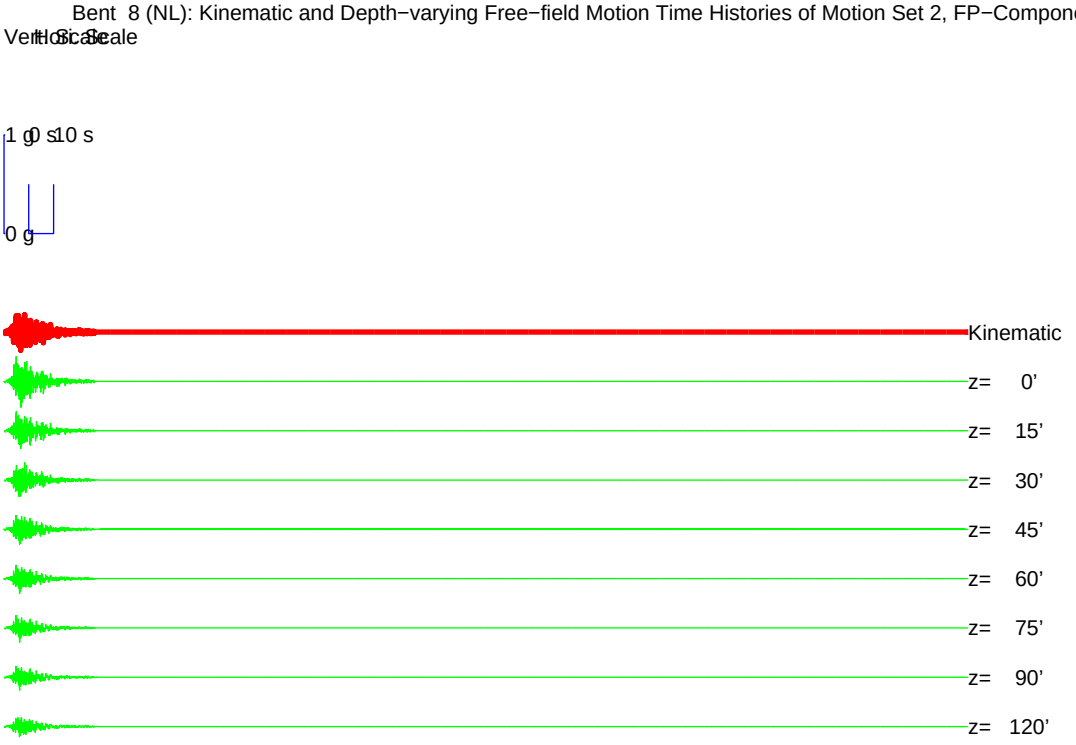
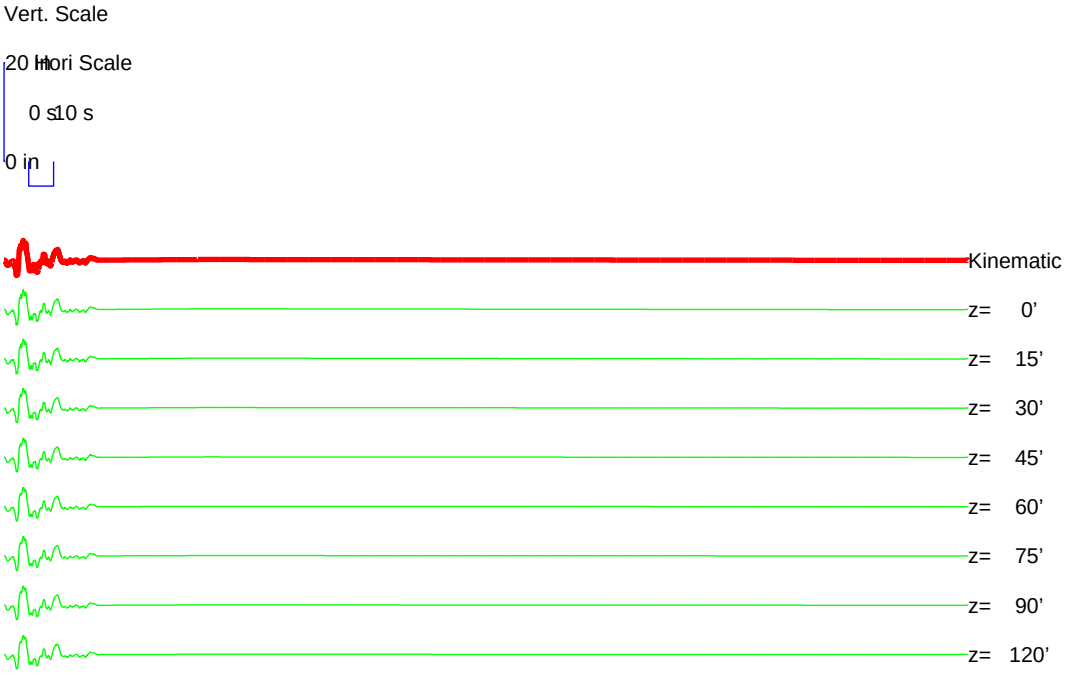
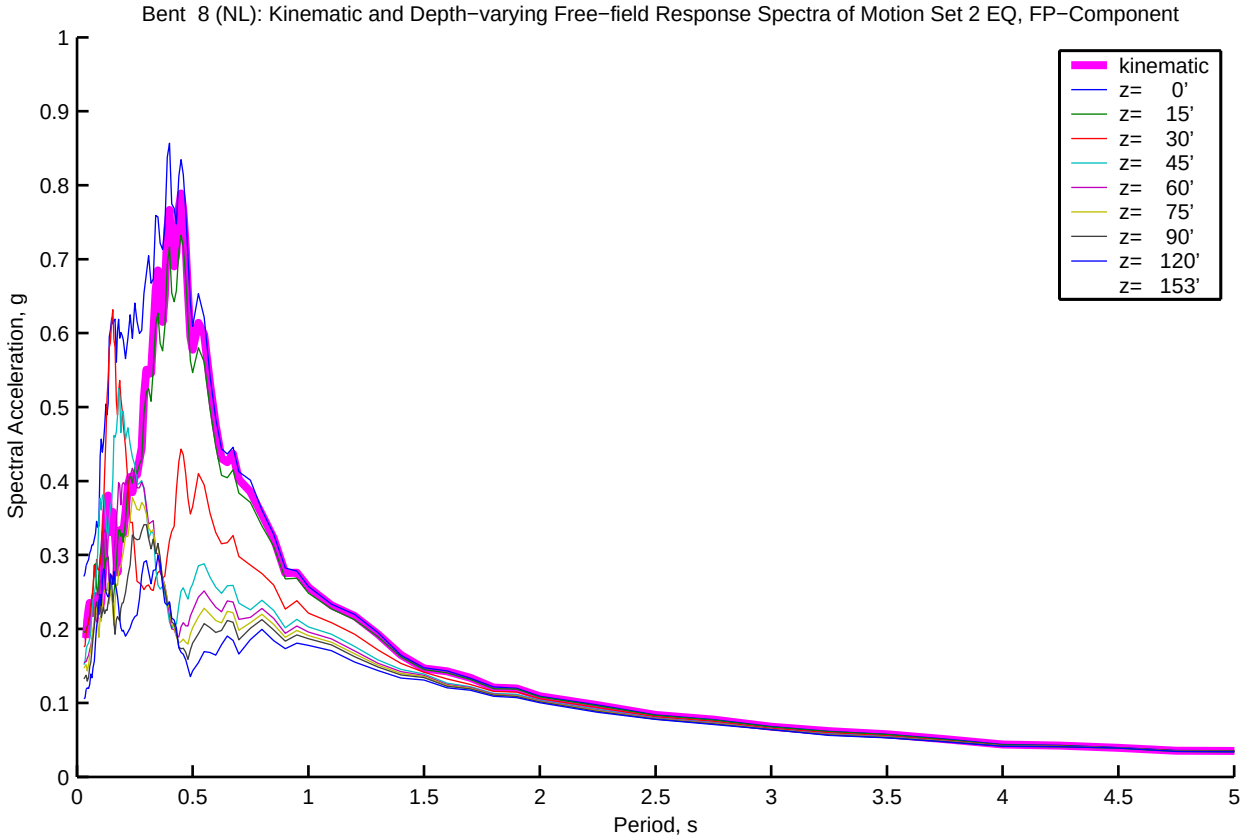
Bent 8 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component






Bent 8 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 153'
0
0.1
0.2
0.3
0.4
0.5
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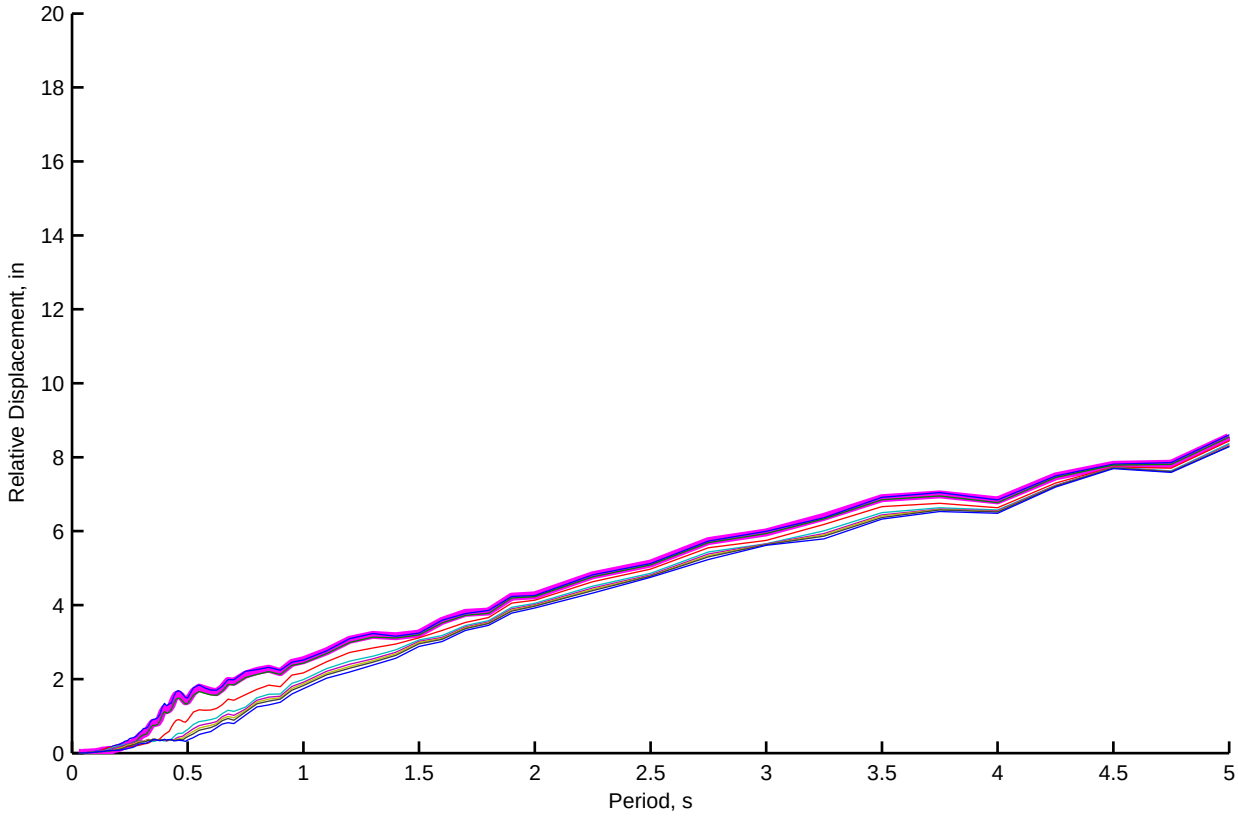
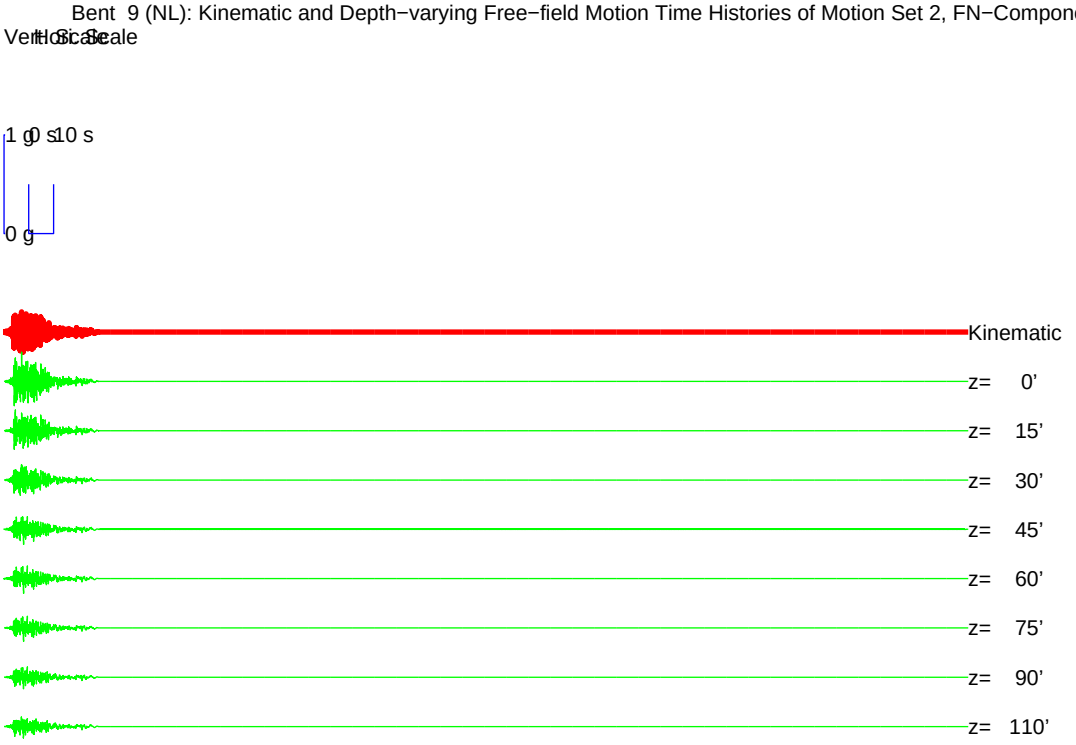
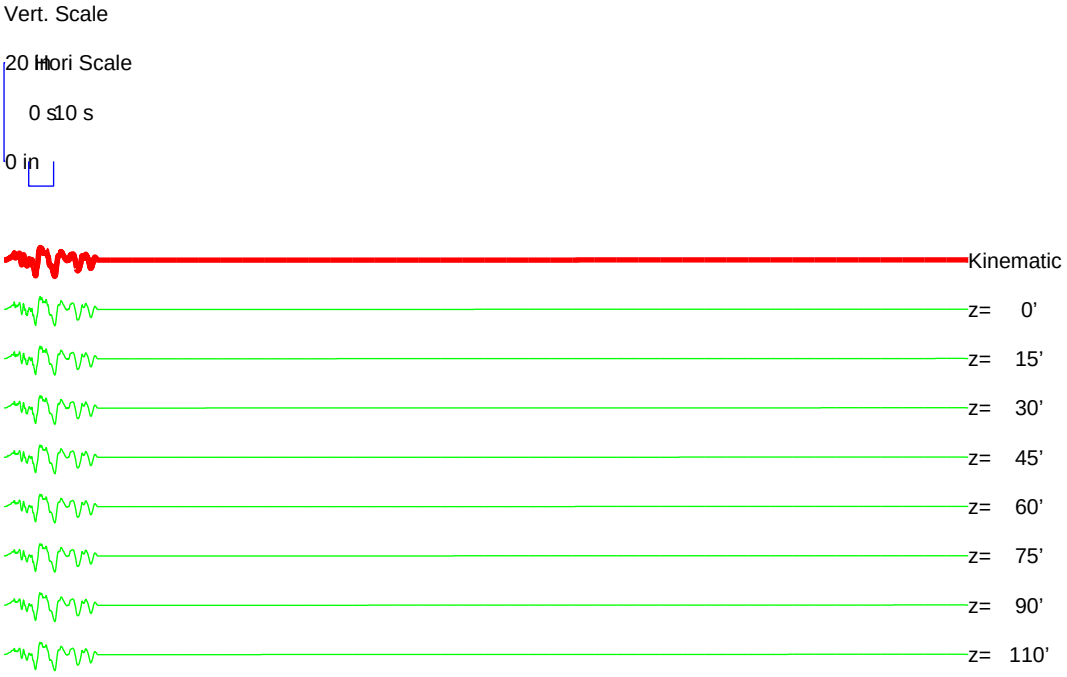
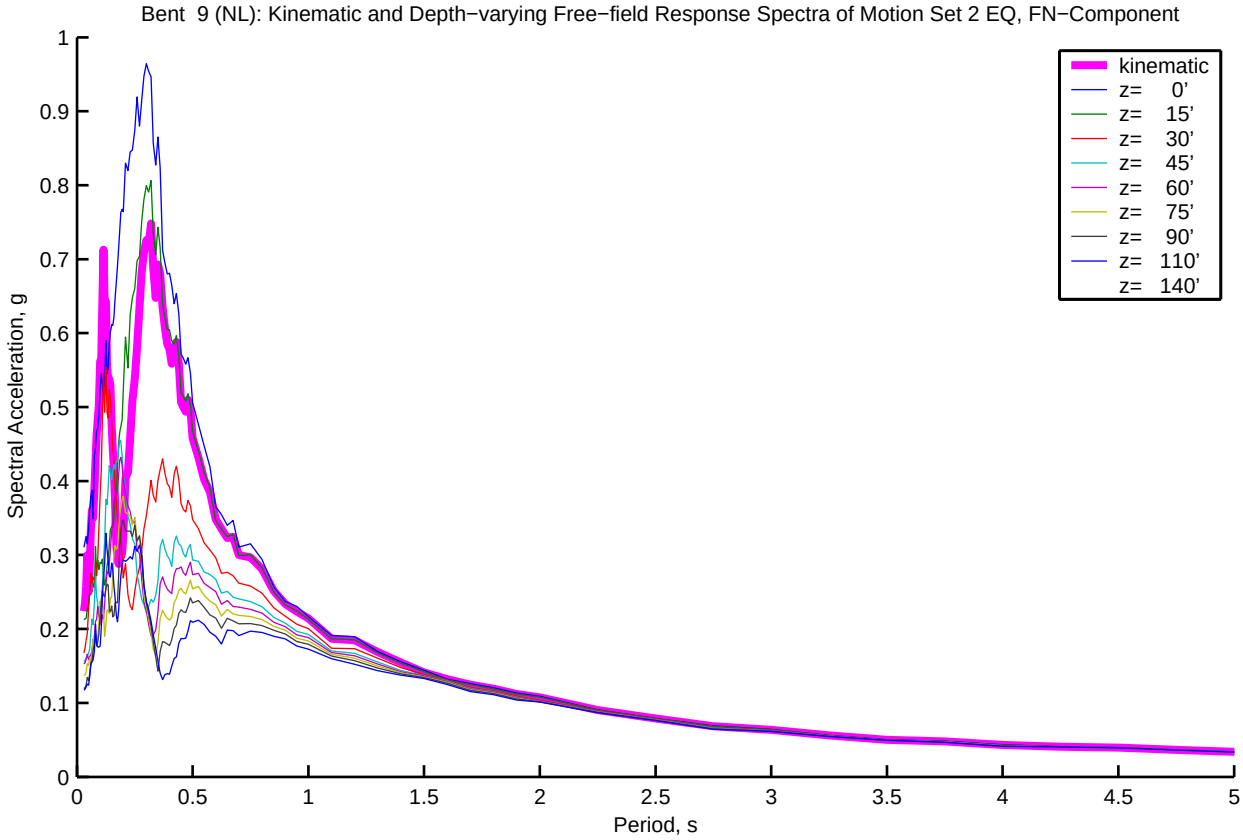
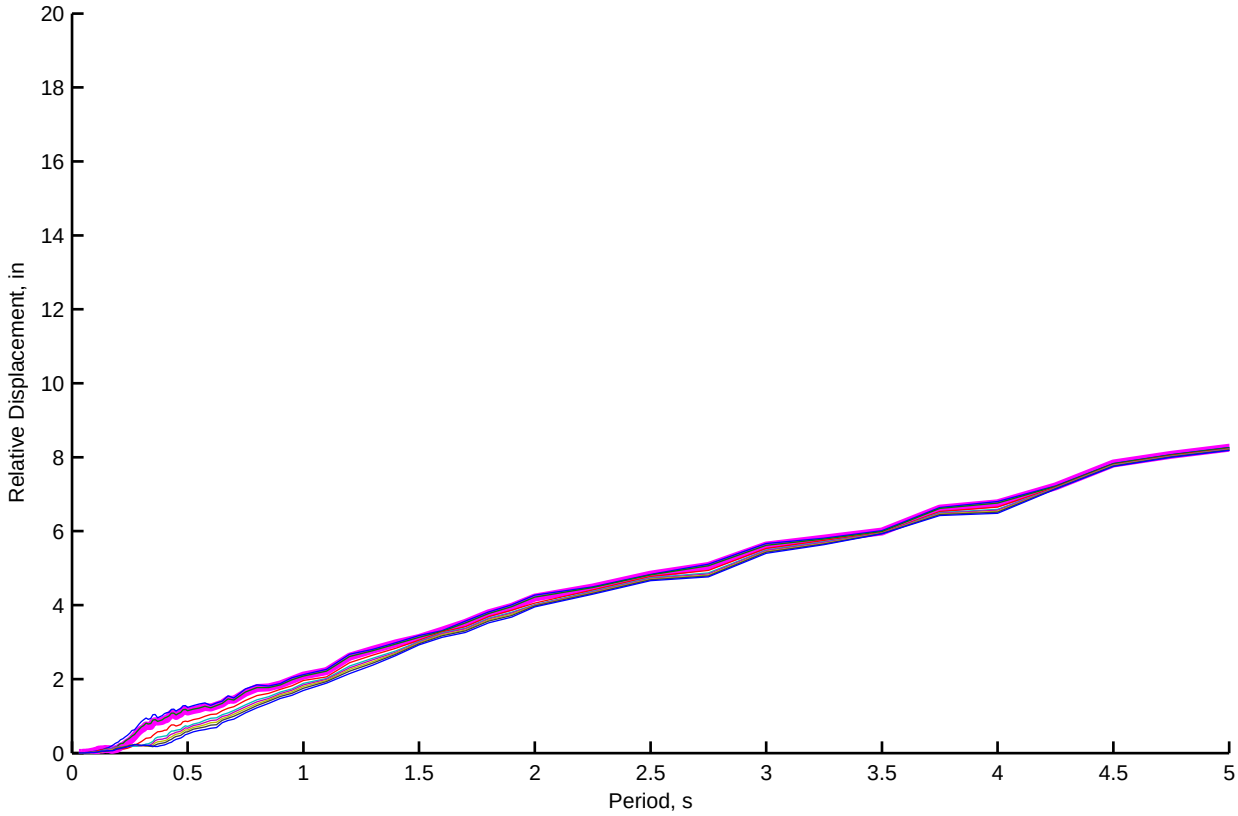

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 9 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

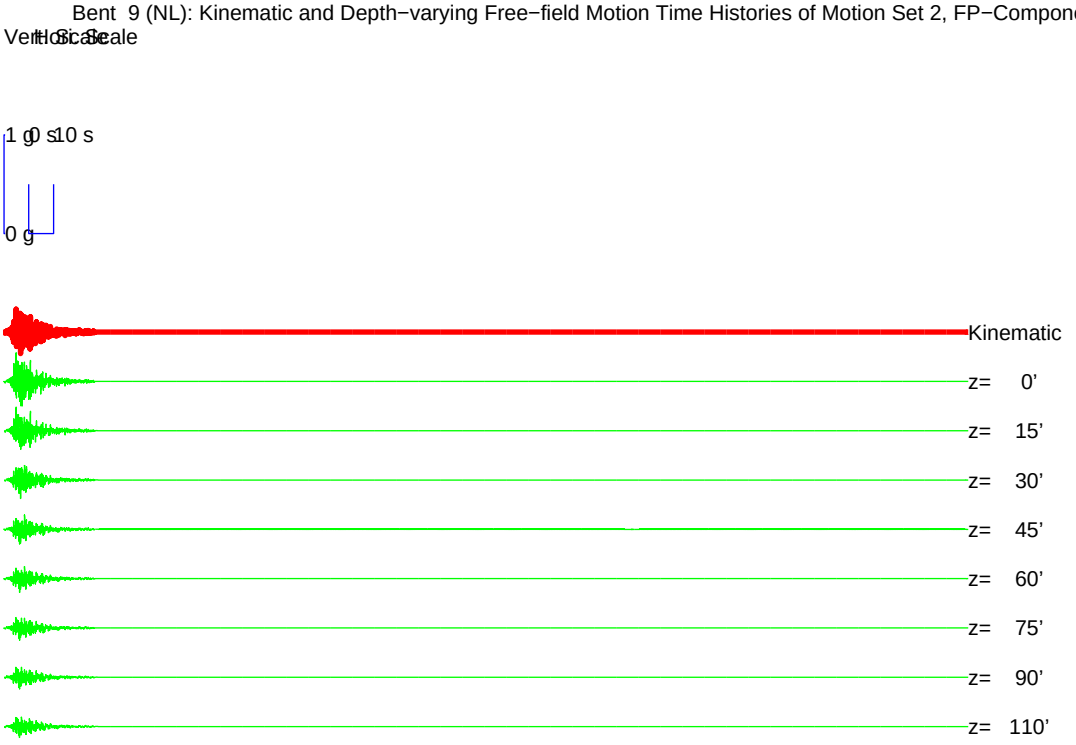


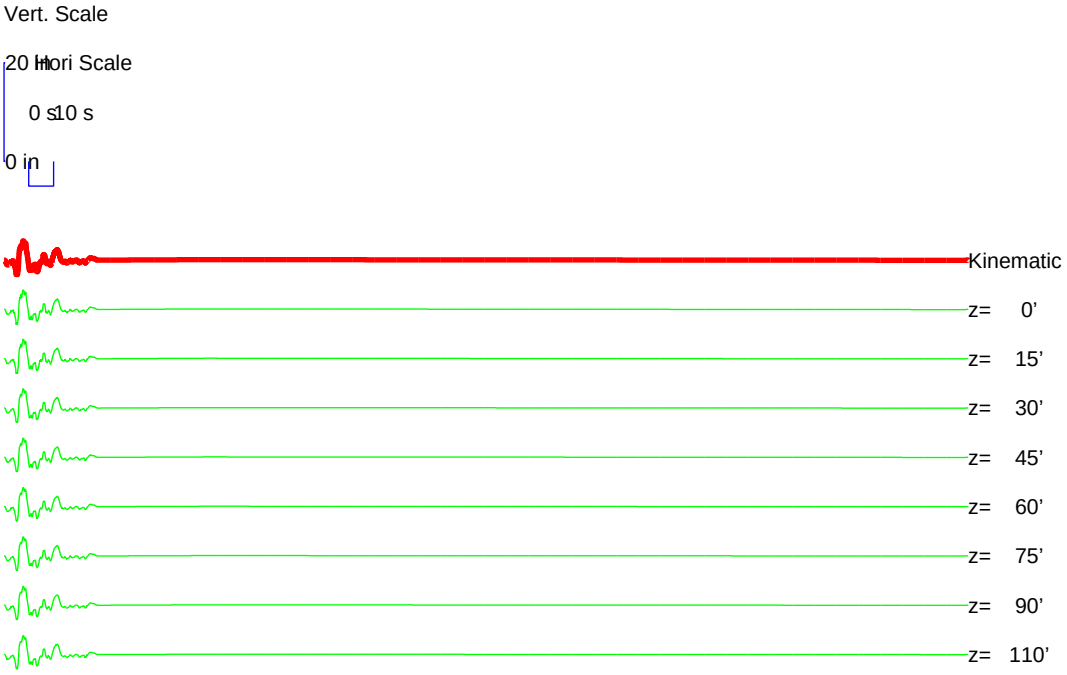


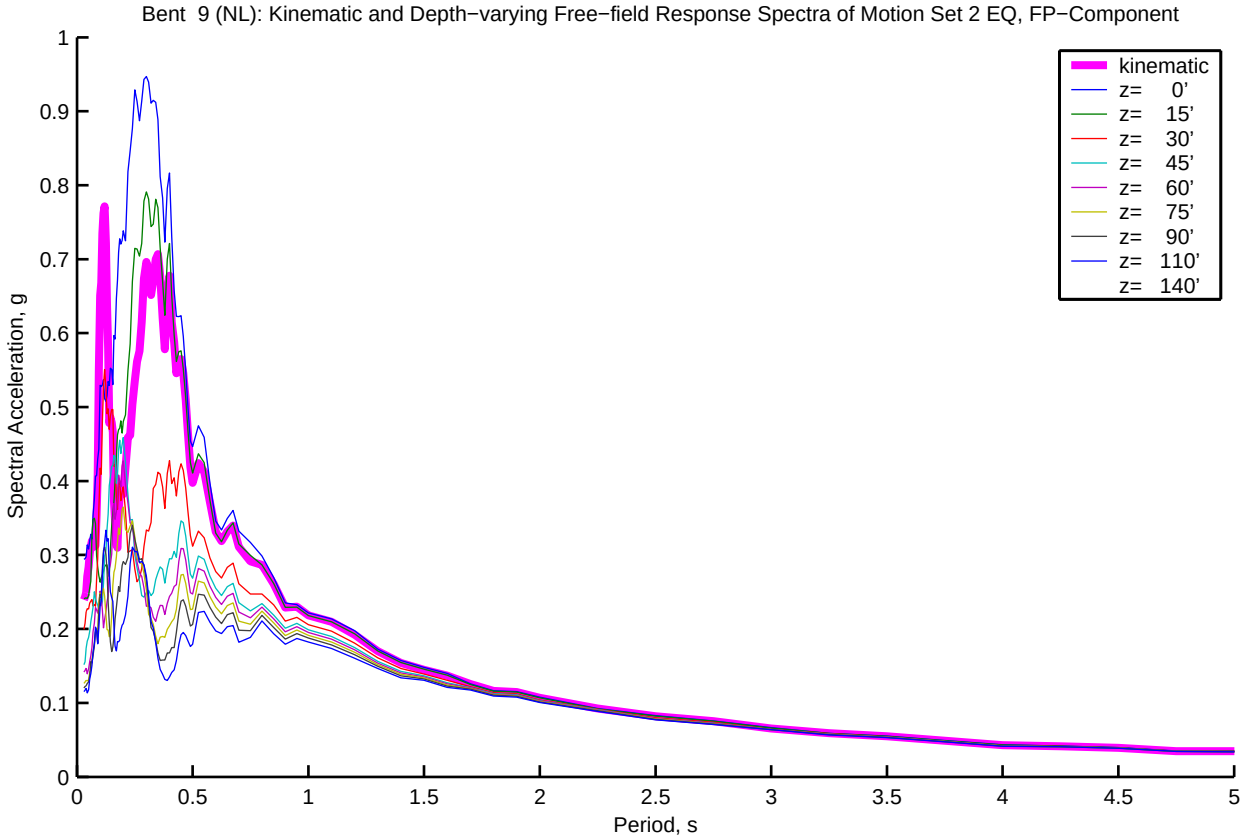

Bent 9 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'

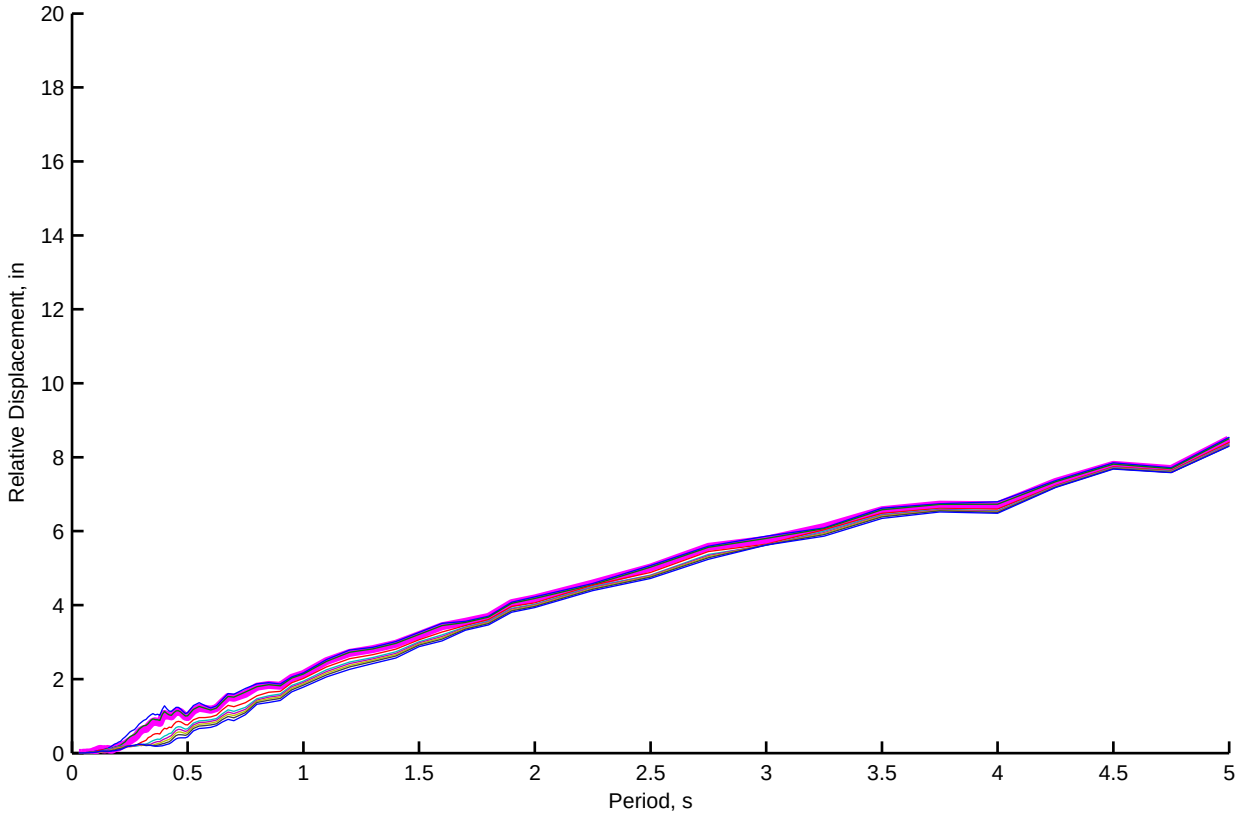

Relative Displacement, in
Period, s

Bent 9 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

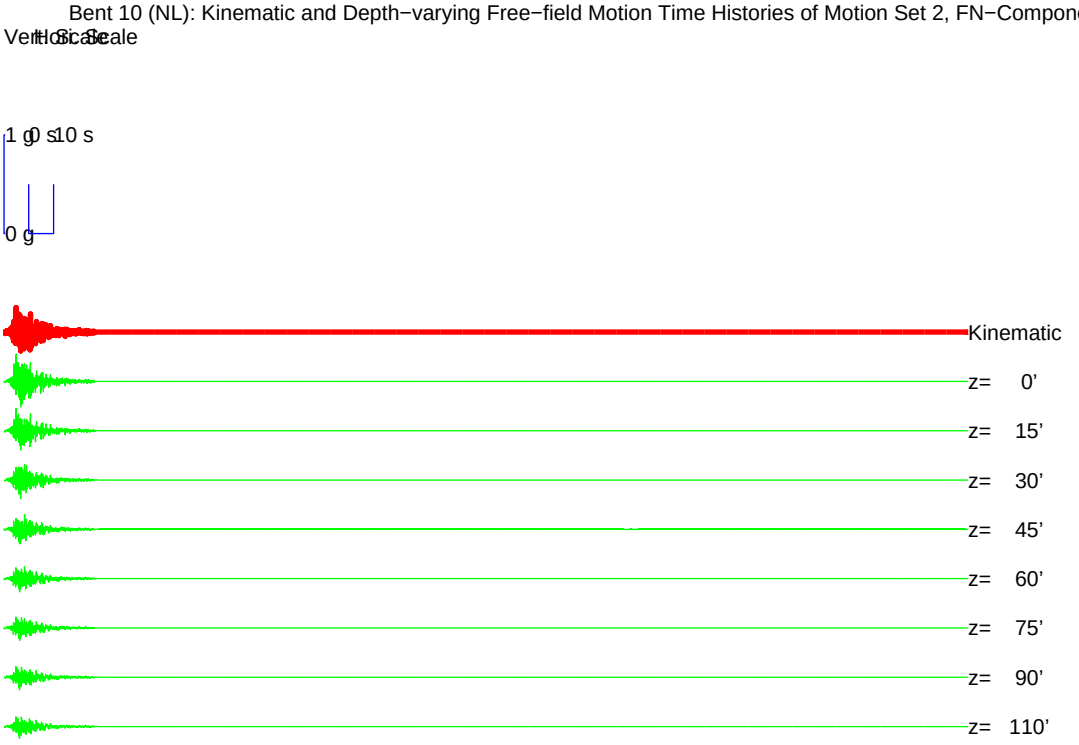


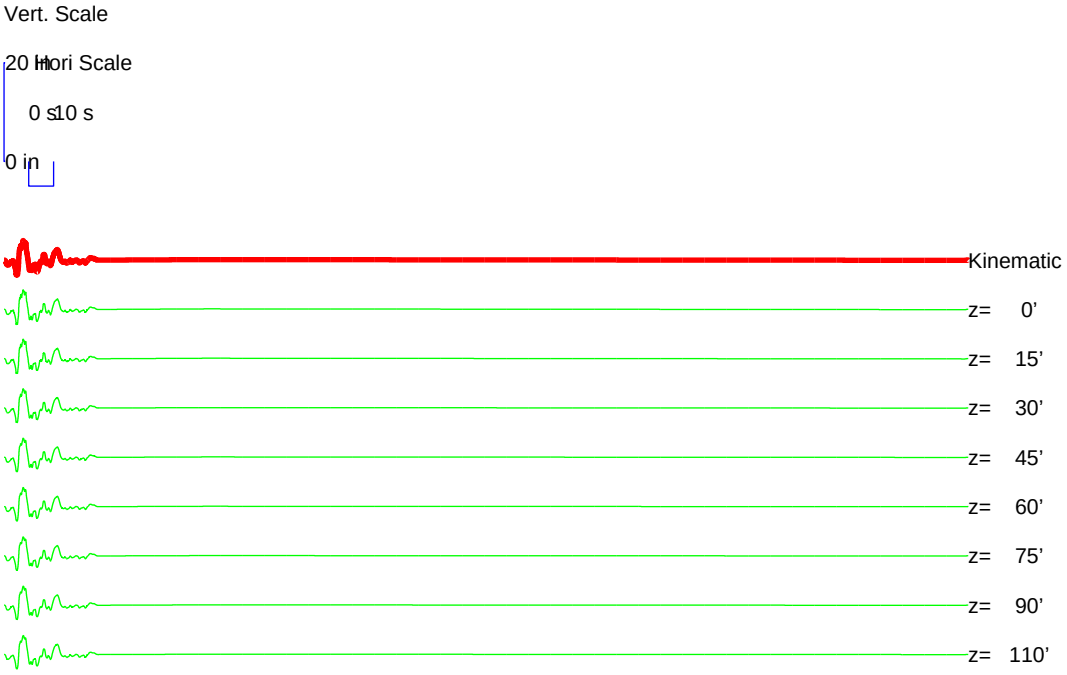


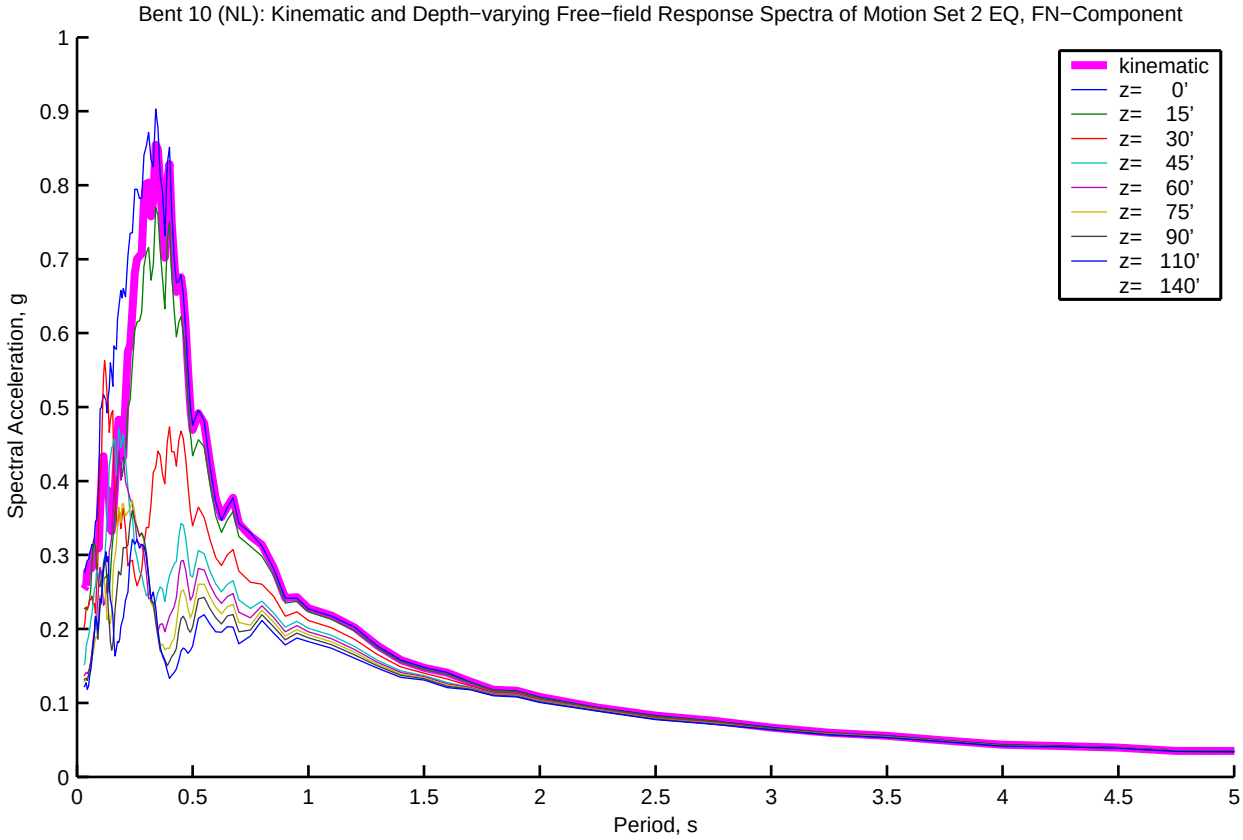

Bent 9 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'

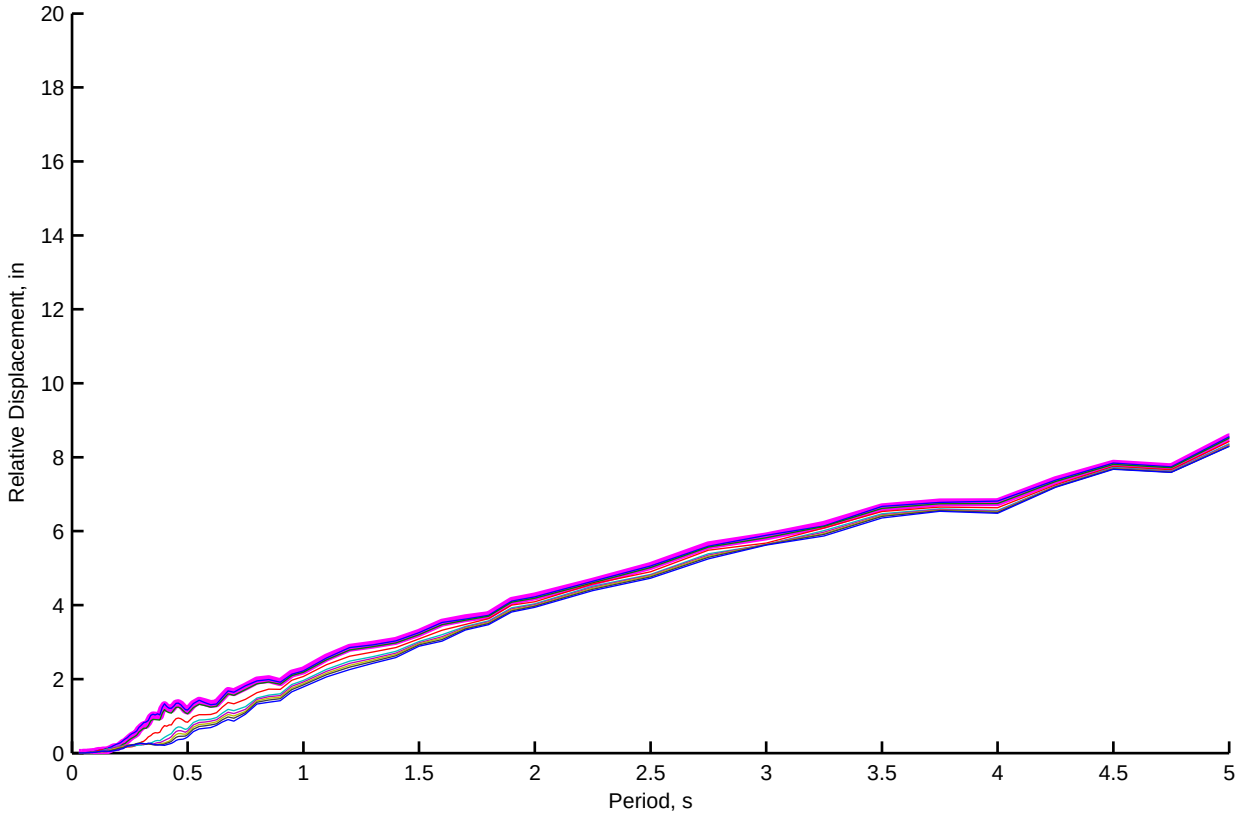

Relative Displacement, in
Period, s

Bent 10 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

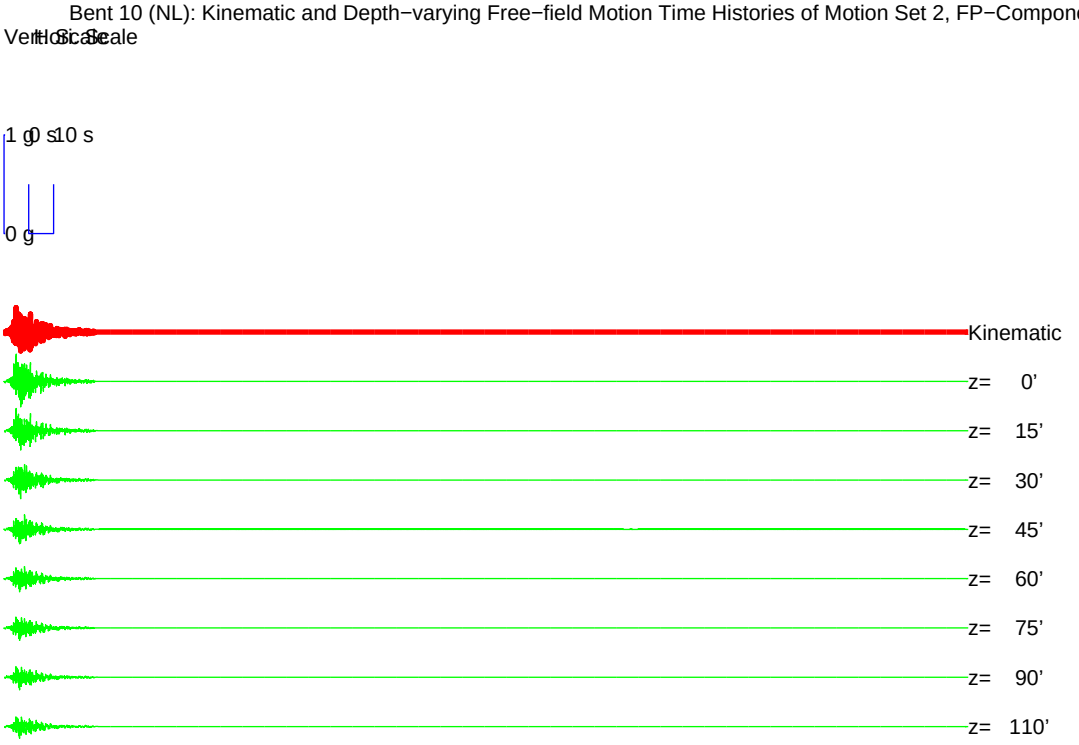


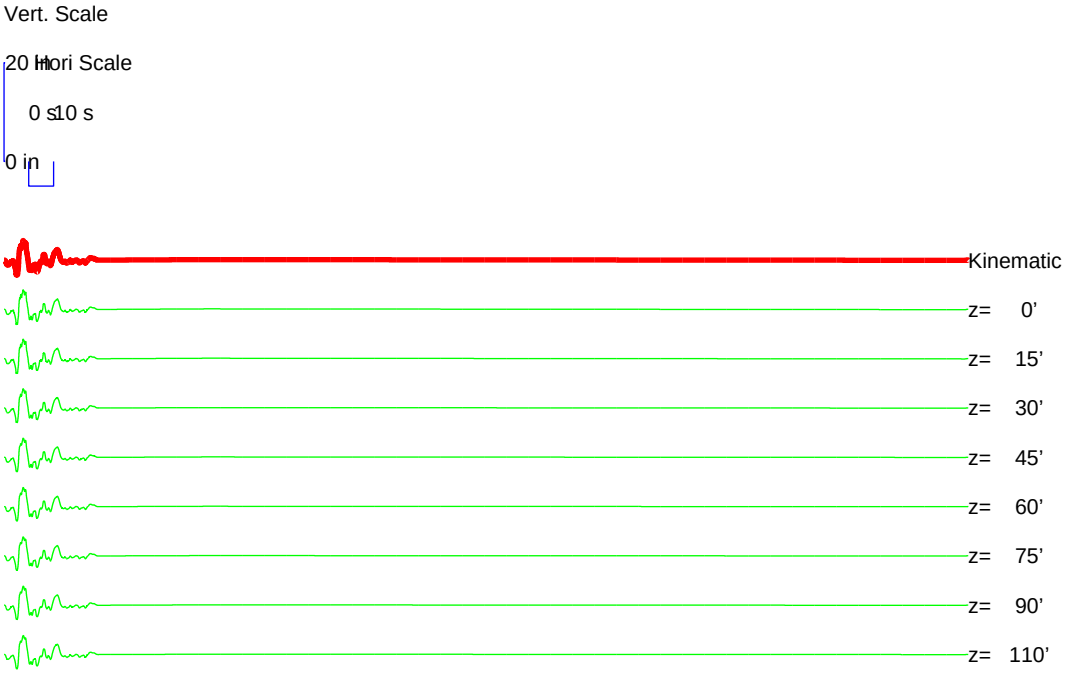


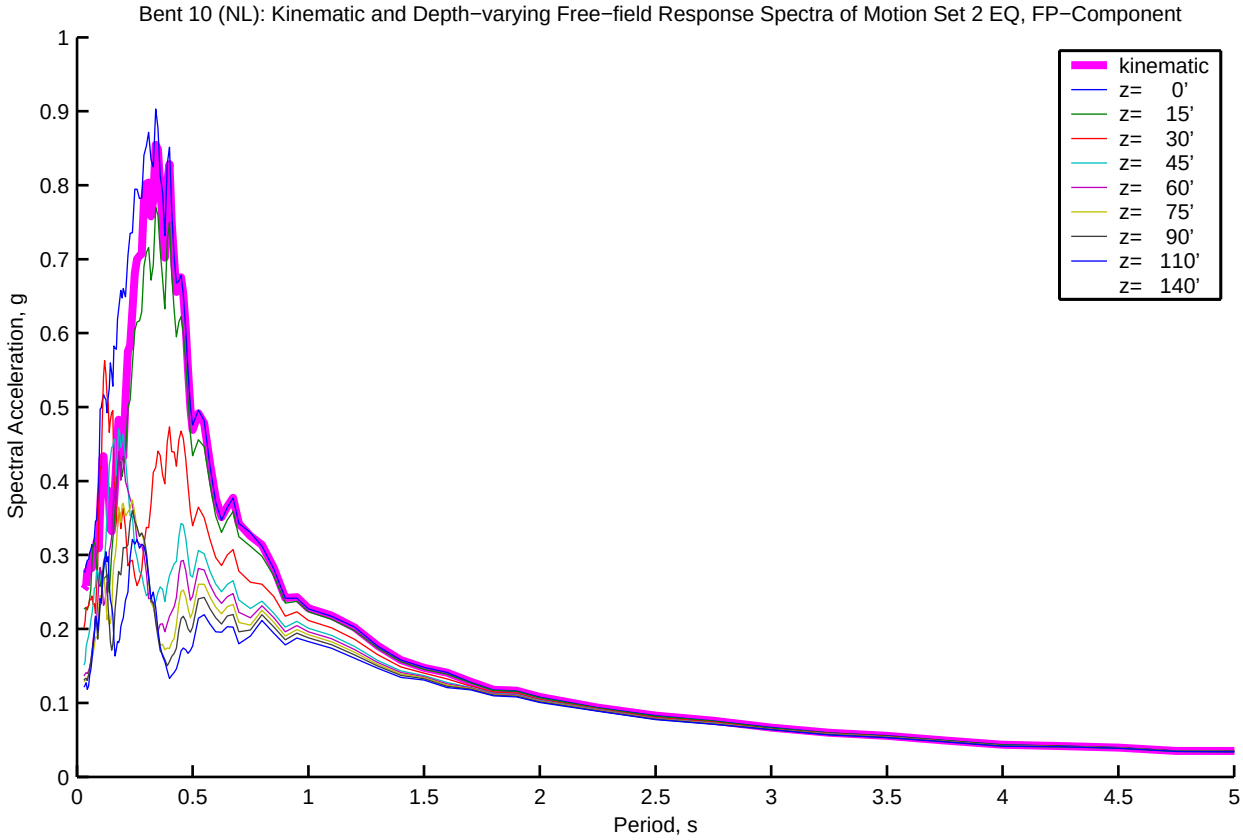

Bent 10 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'

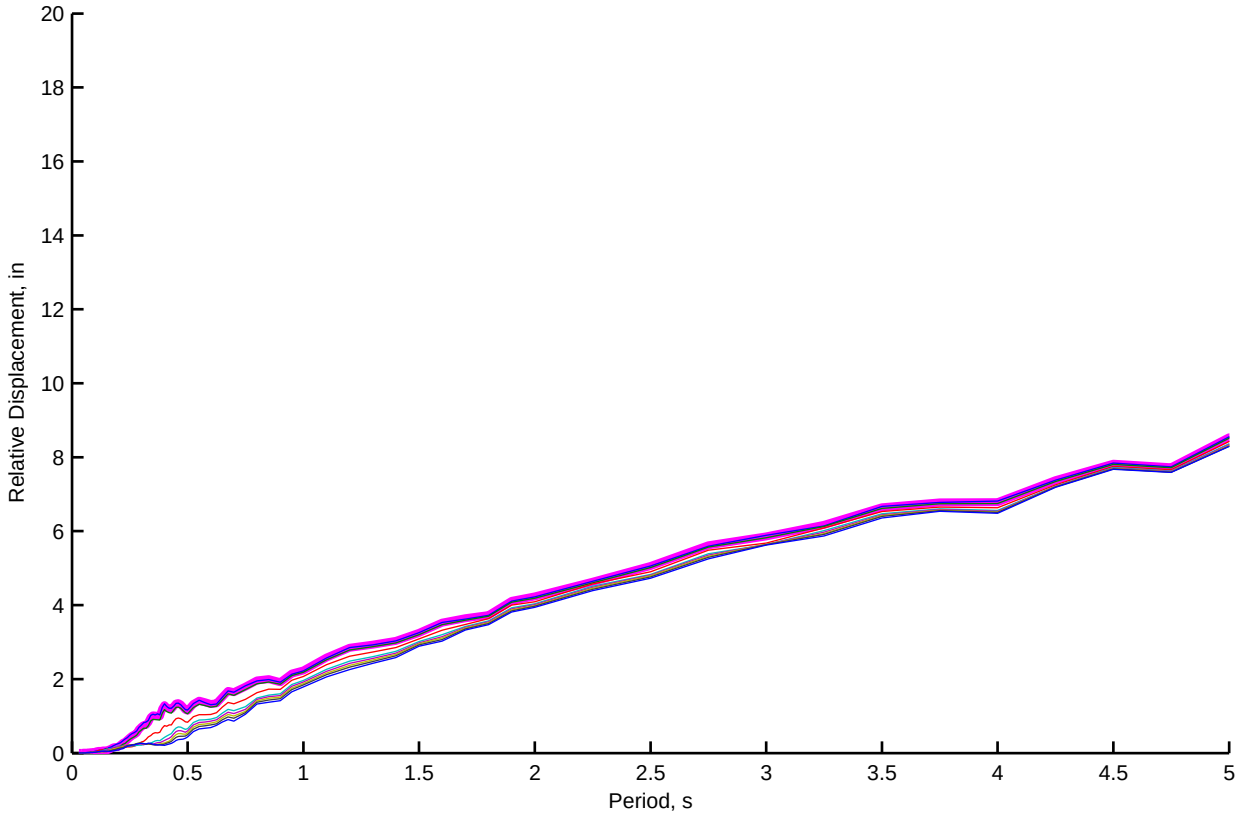

Relative Displacement, in
Period, s

Bent 10 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

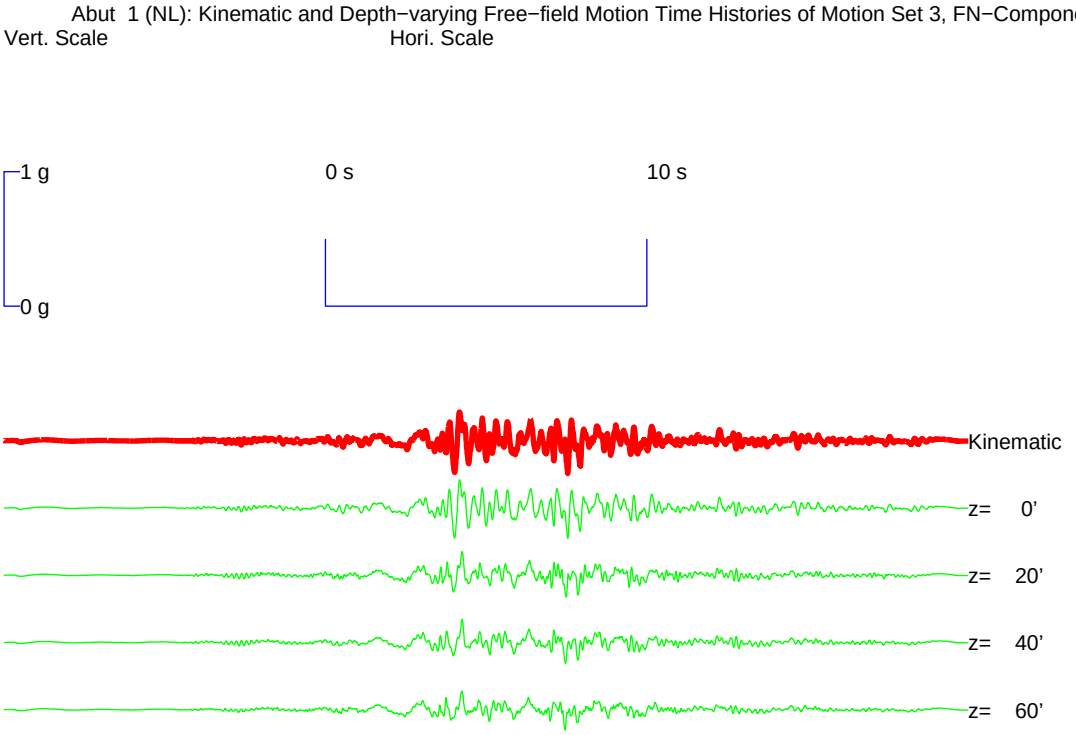


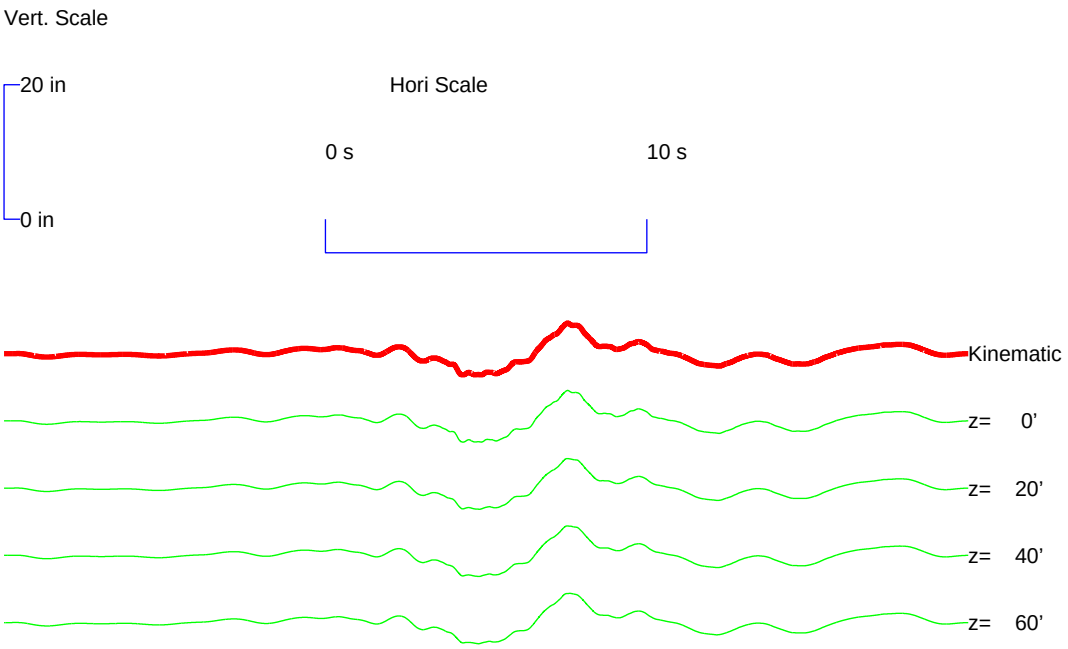


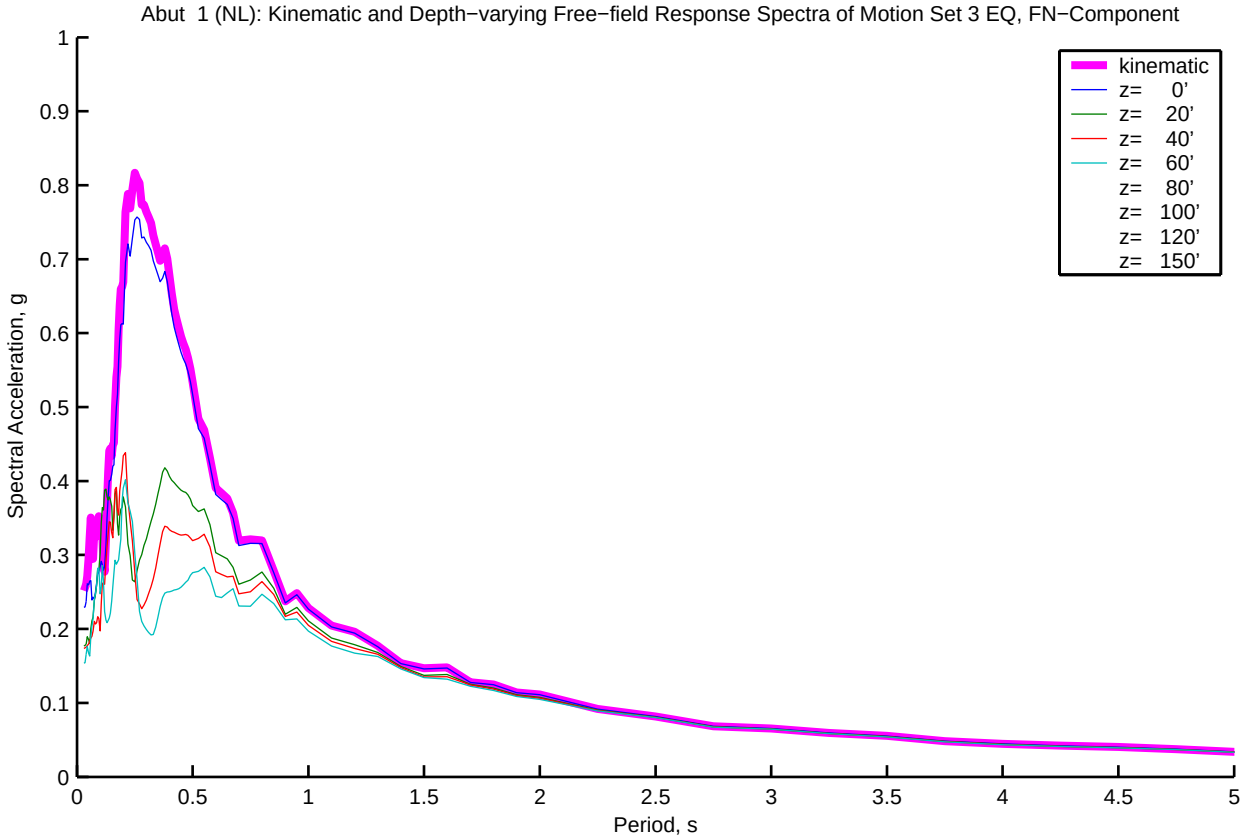

Bent 10 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'

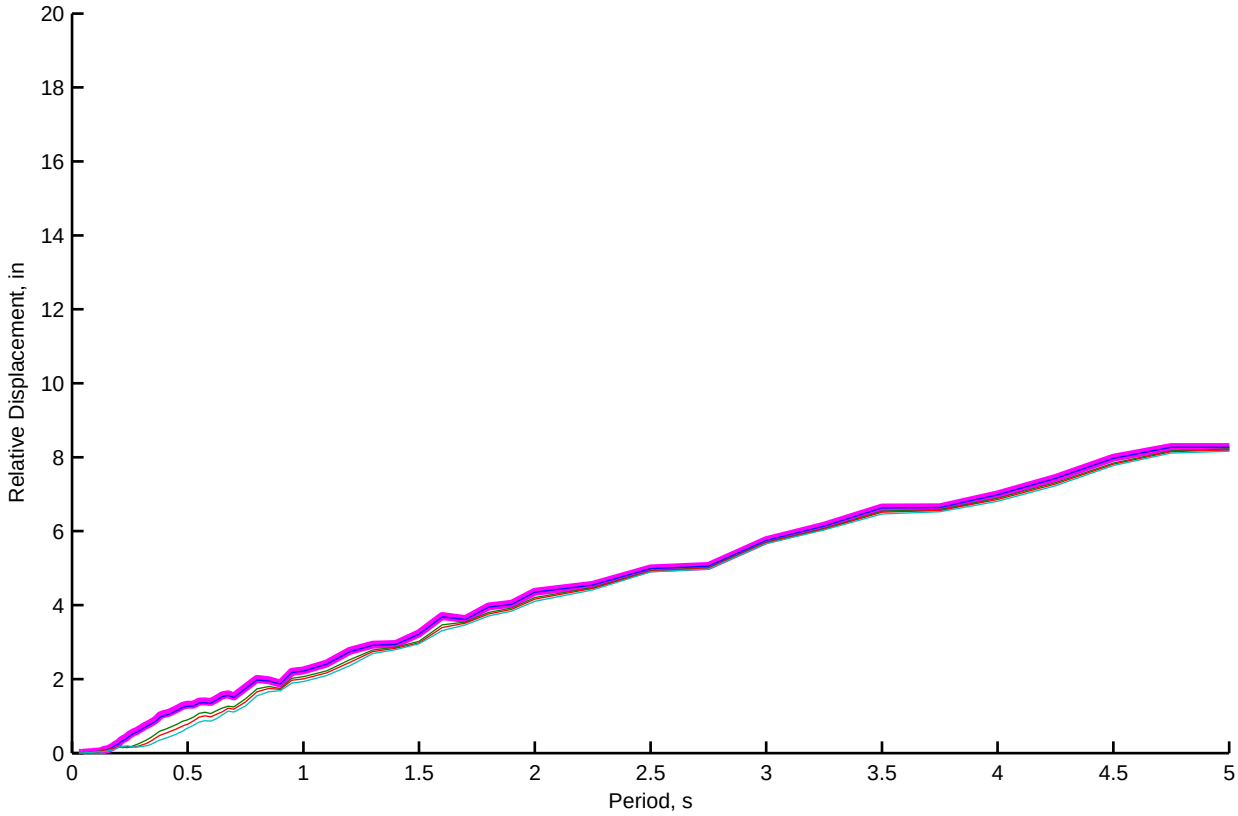

Relative Displacement, in
Period, s

Abut 1 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component

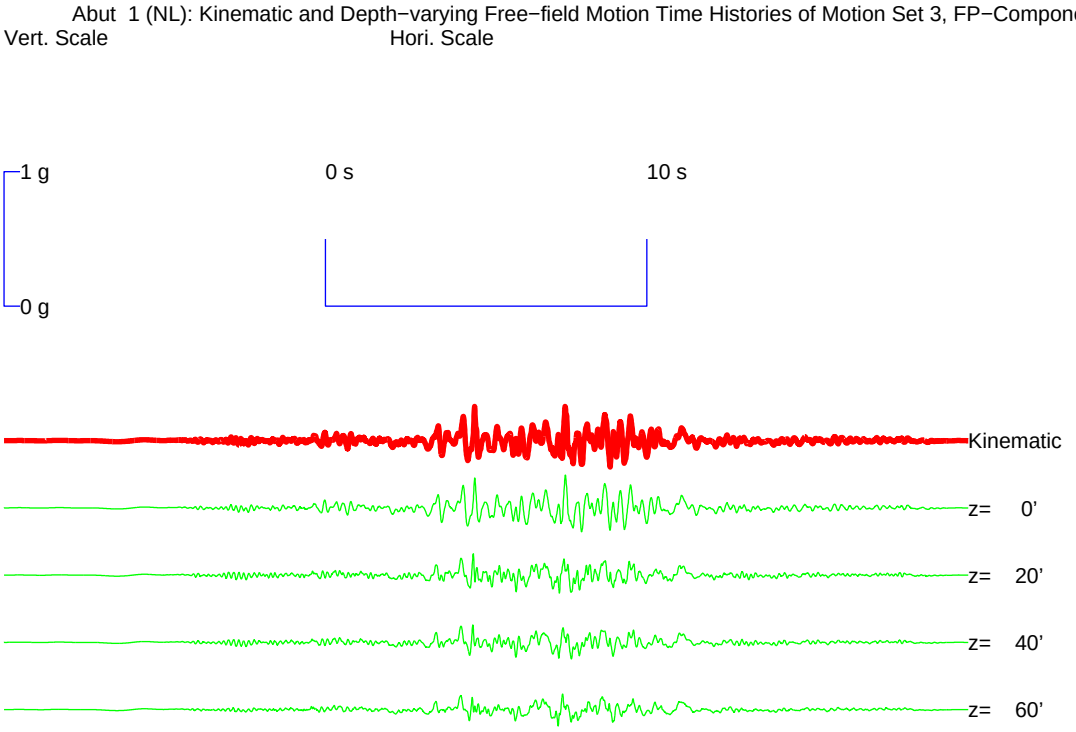


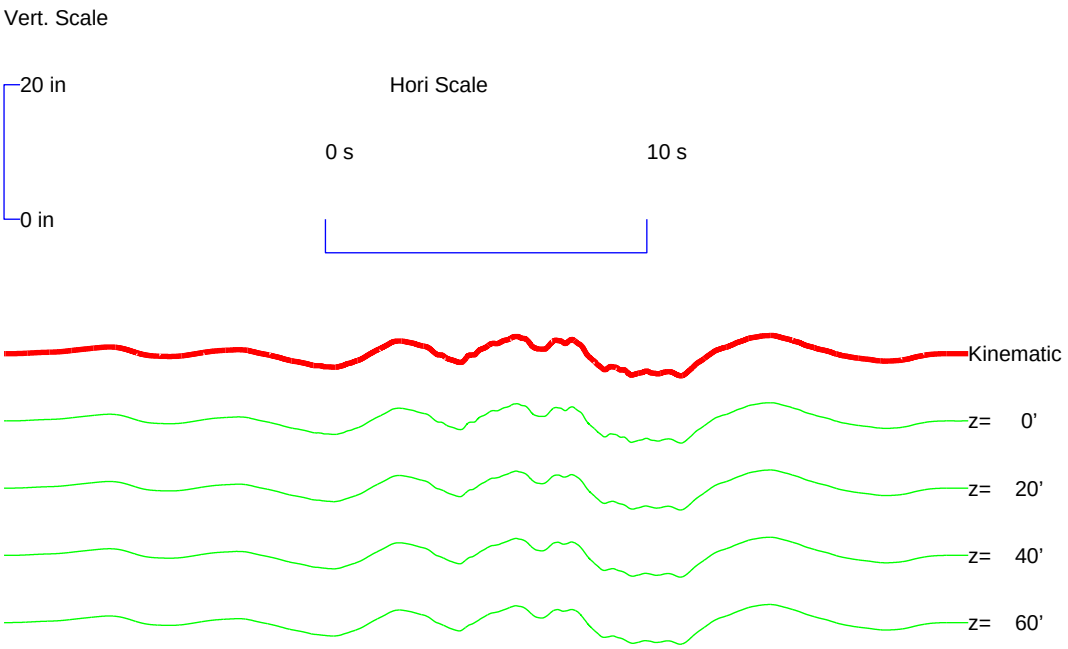


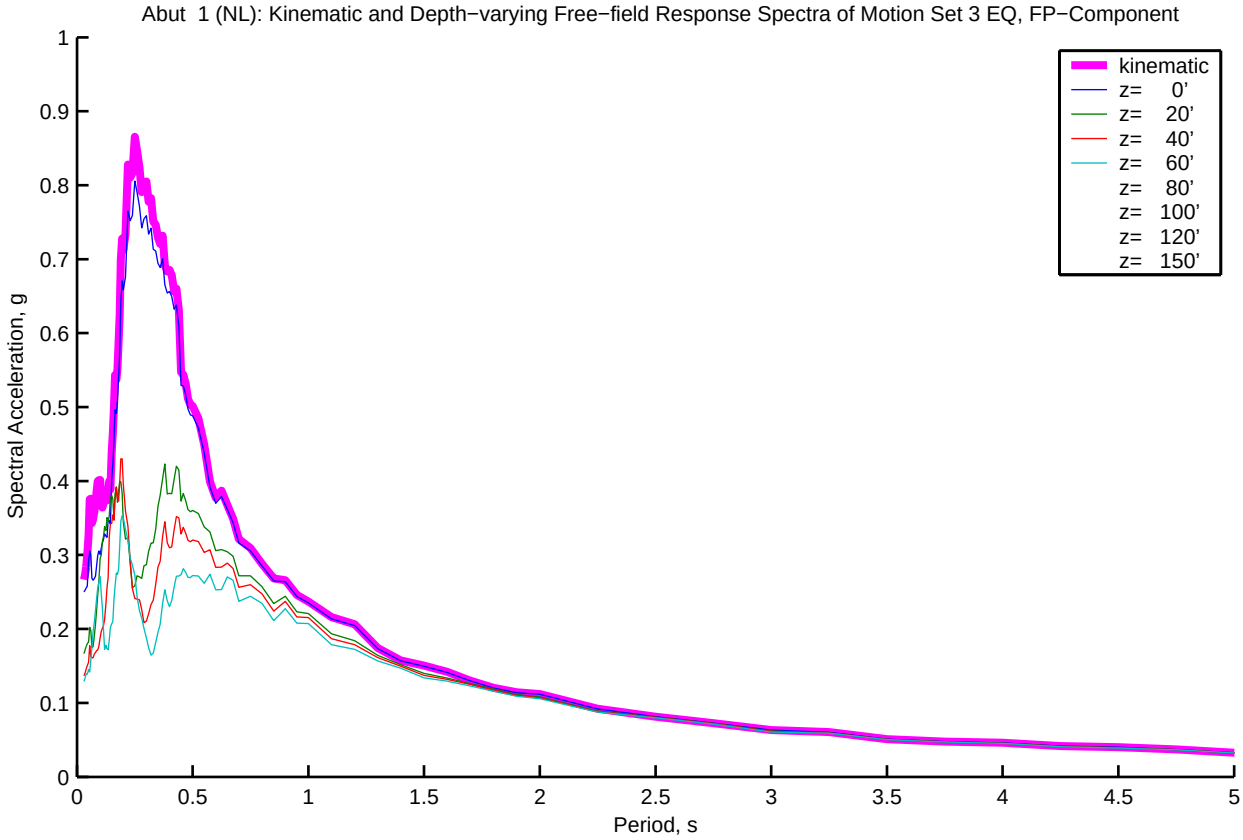

Abut 1 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 150'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

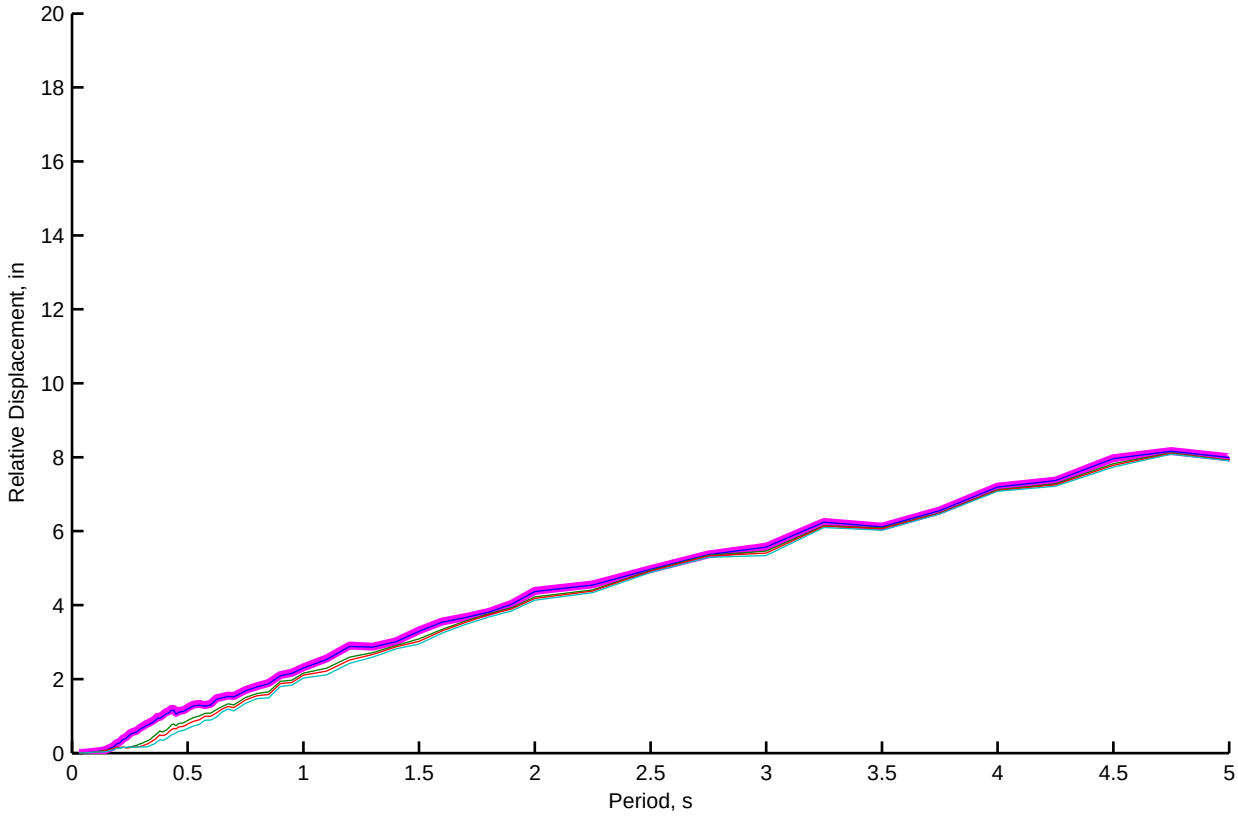

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Abut 1 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component

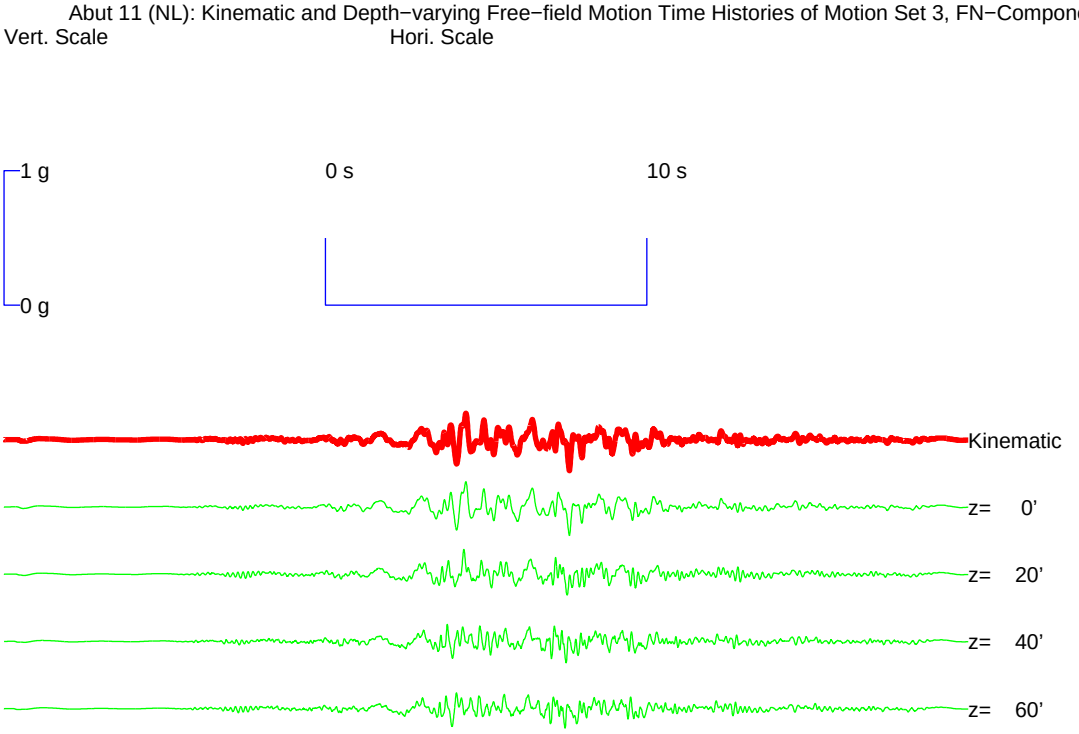


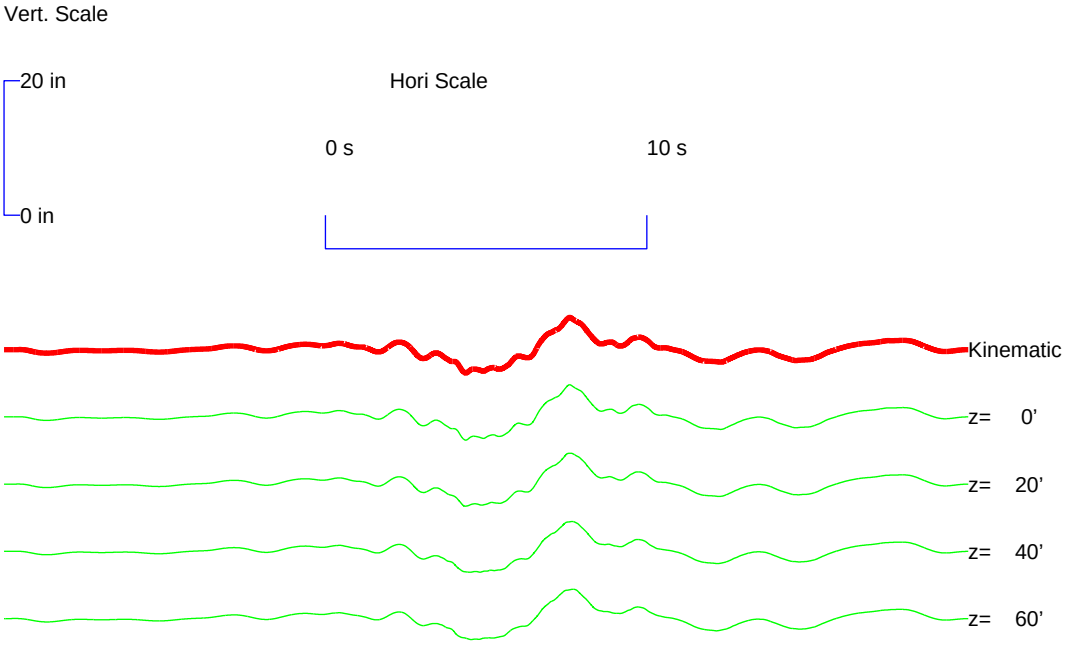


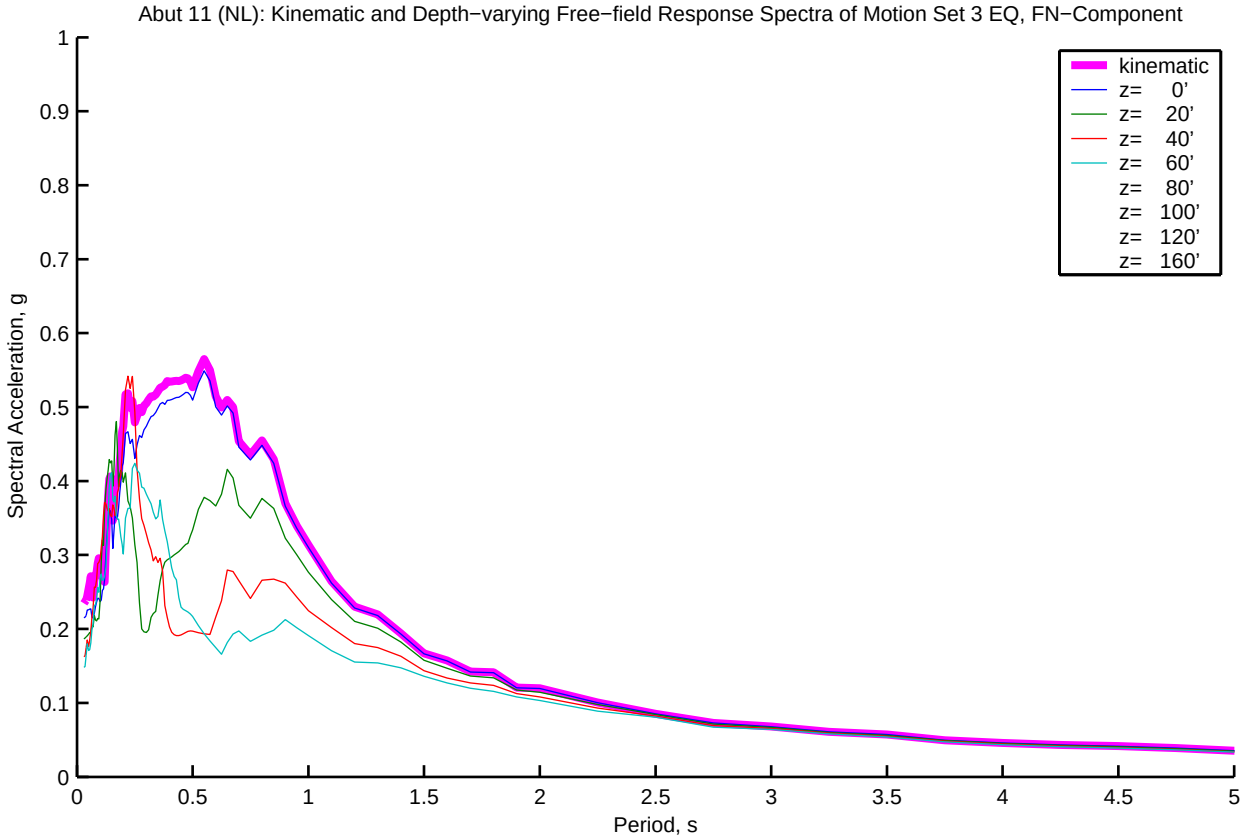

Abut 1 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 150'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

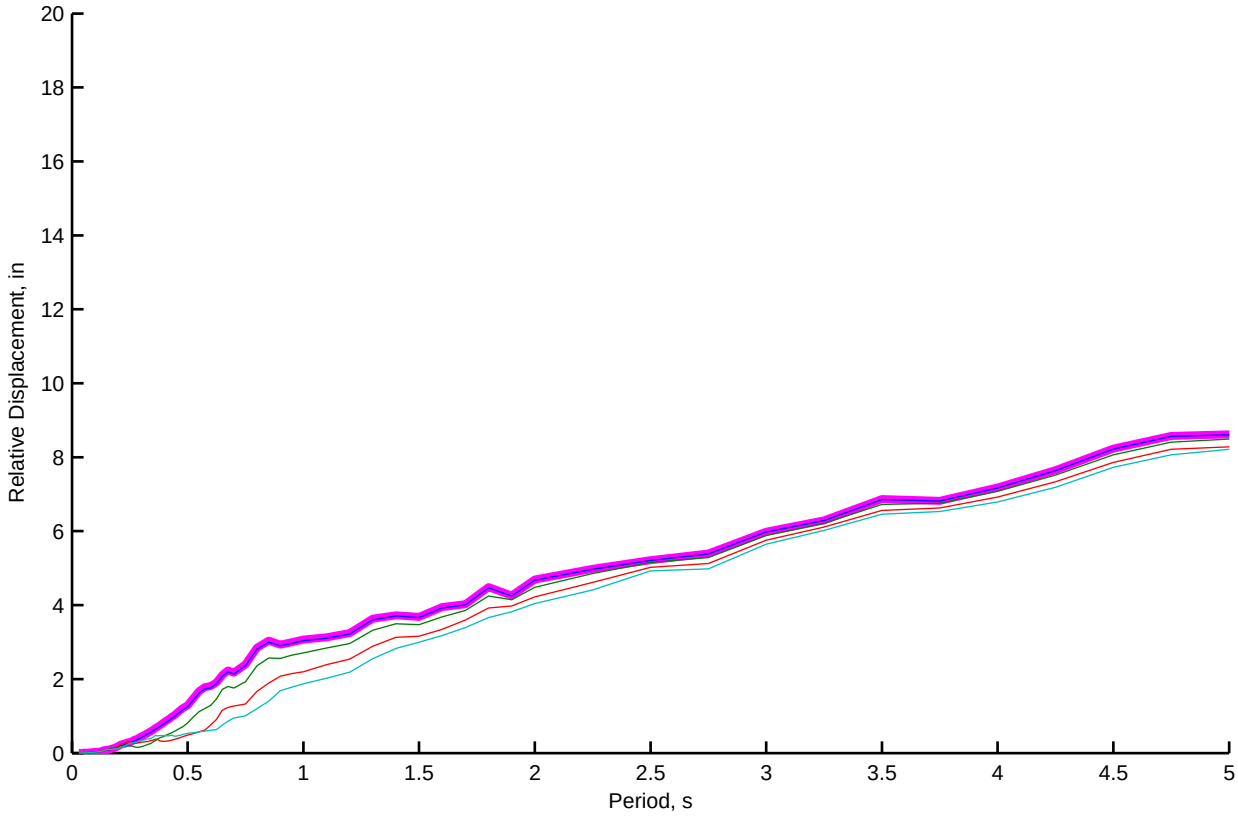

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Abut 11 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component

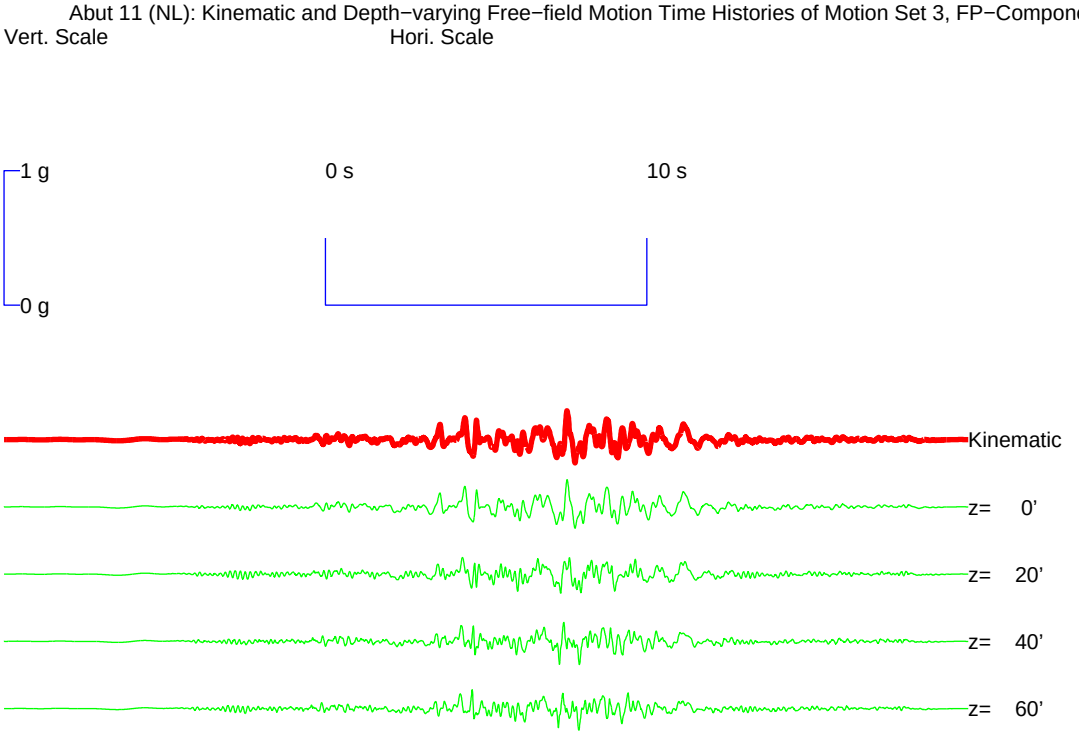


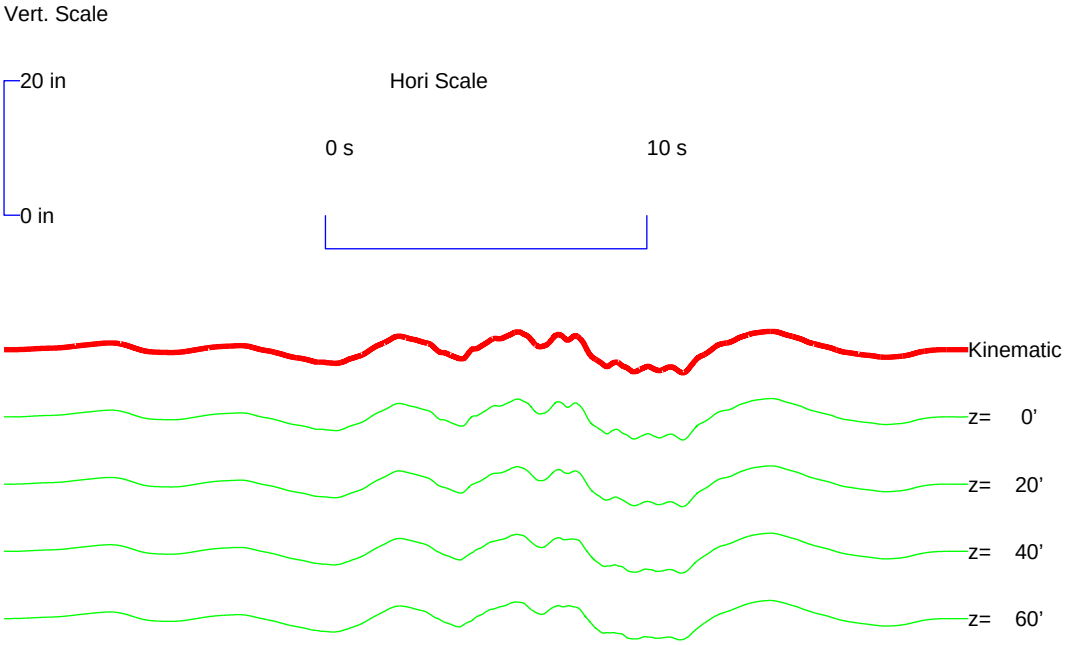


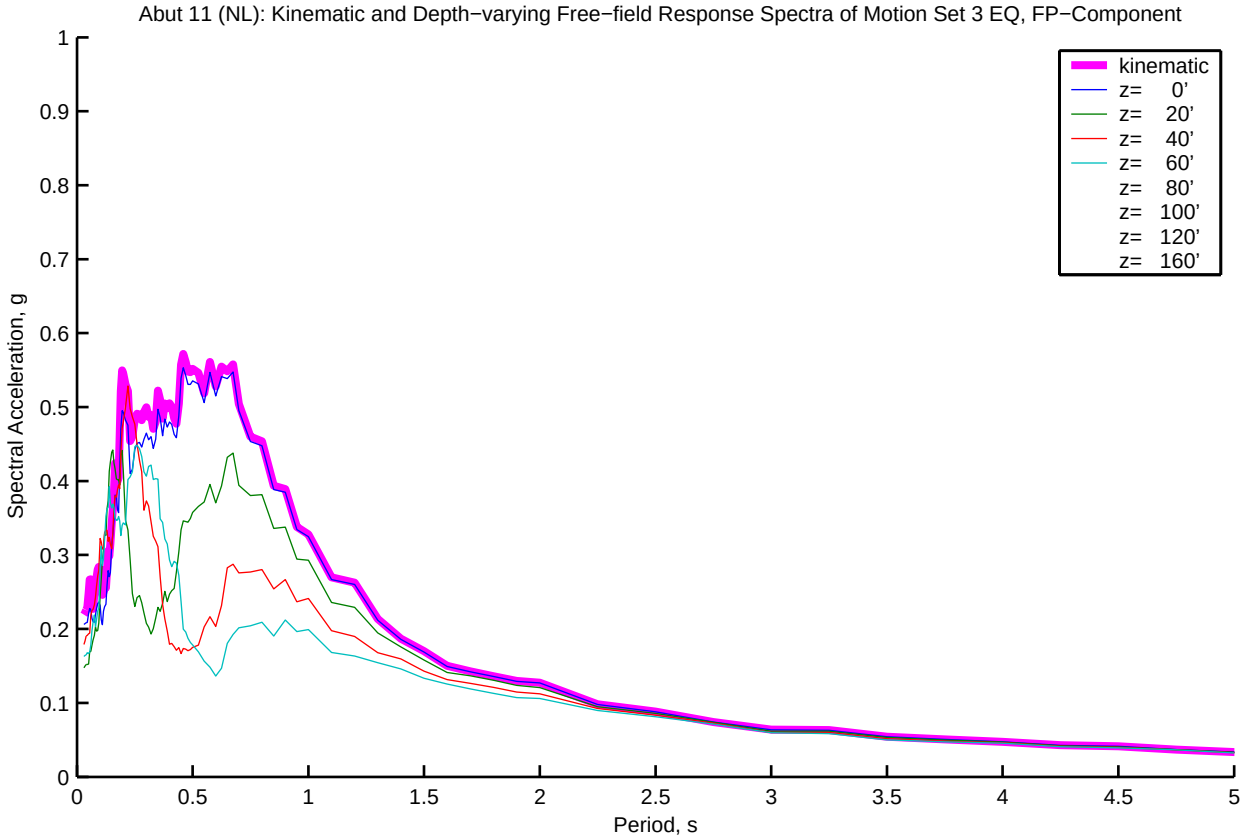

Abut 11 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 160'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

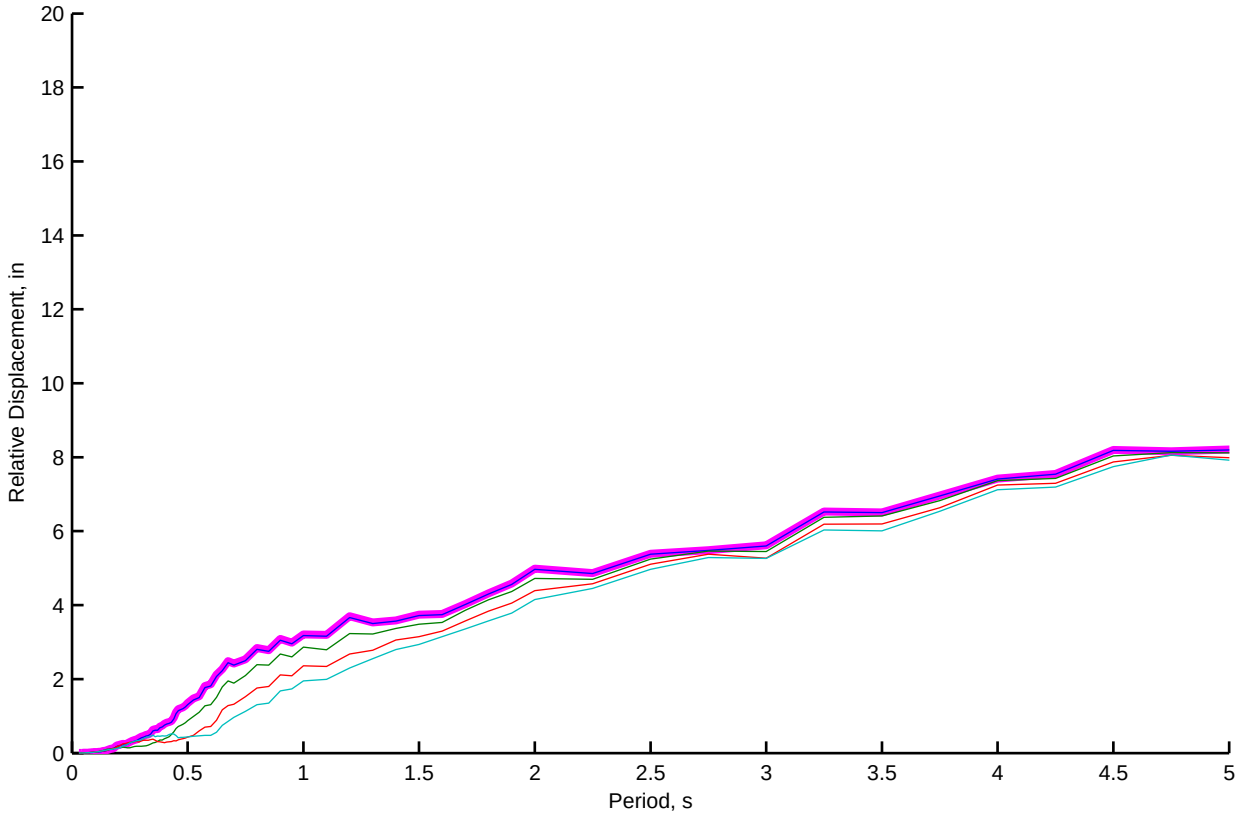

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Abut 11 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component

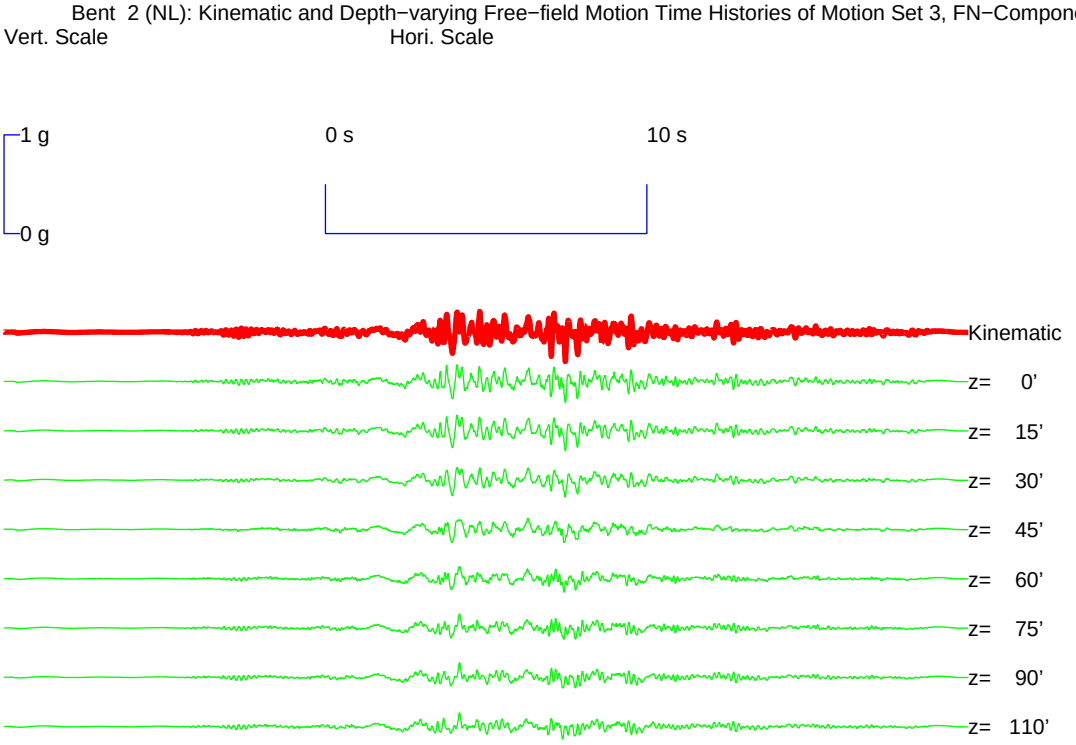


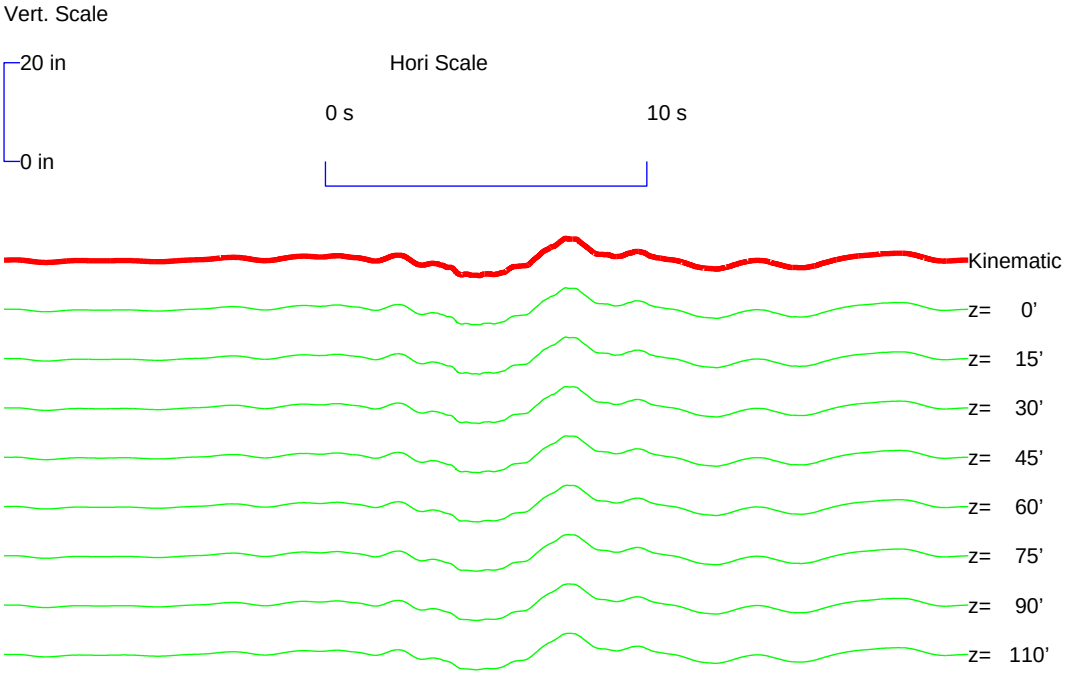


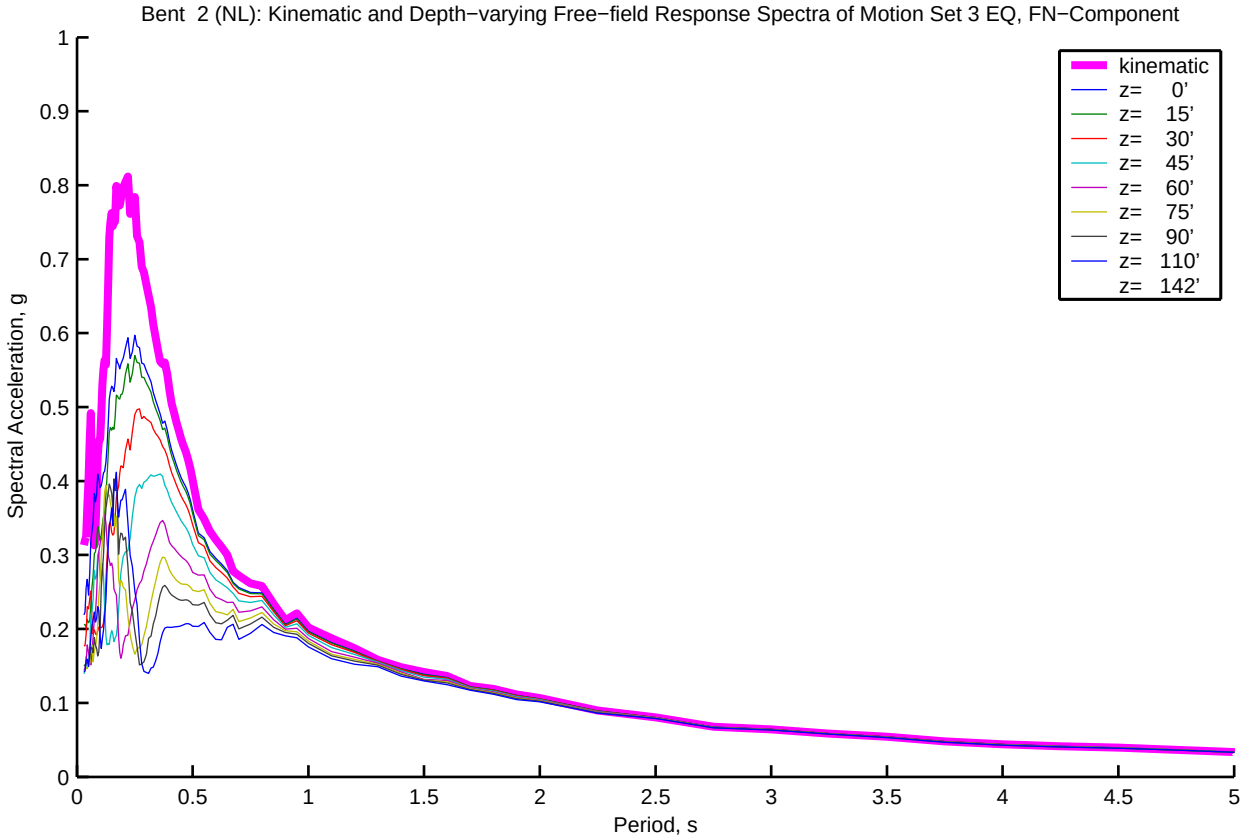

Abut 11 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 160'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

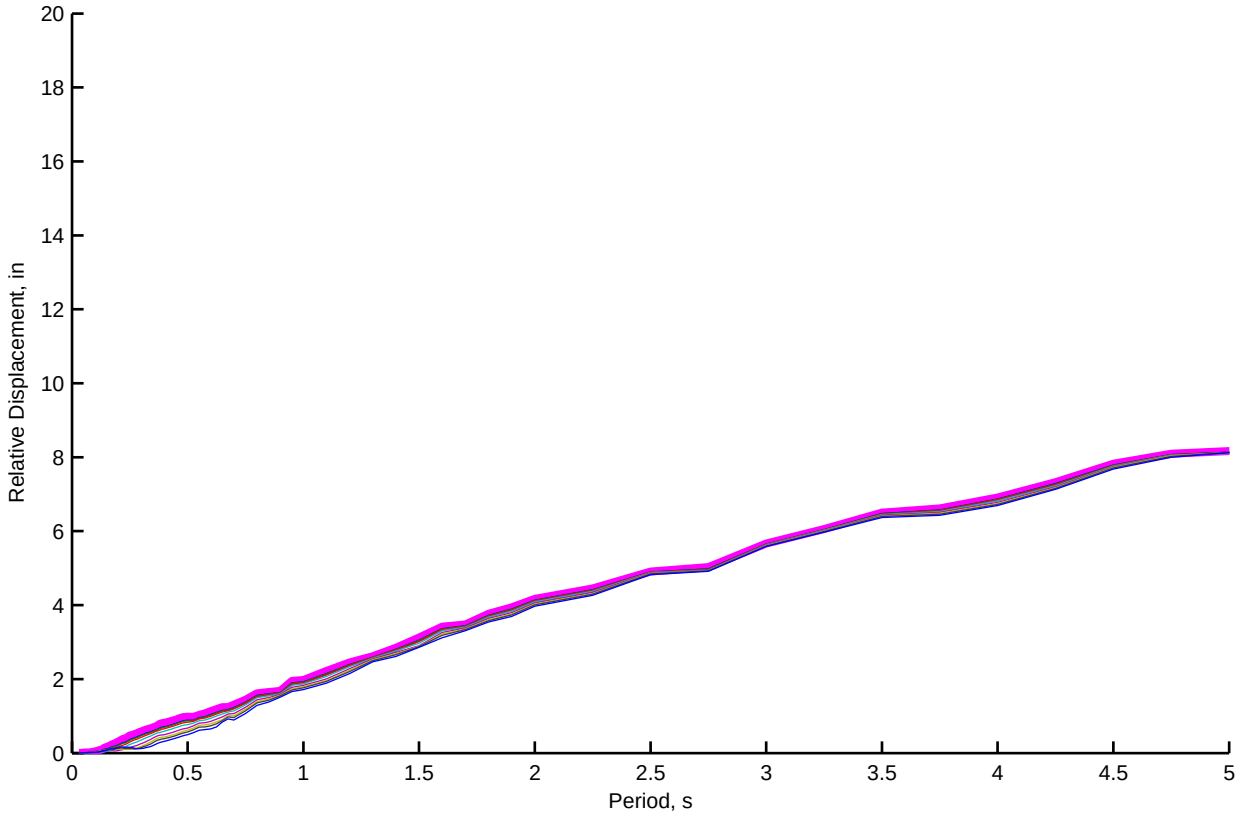

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 2 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component

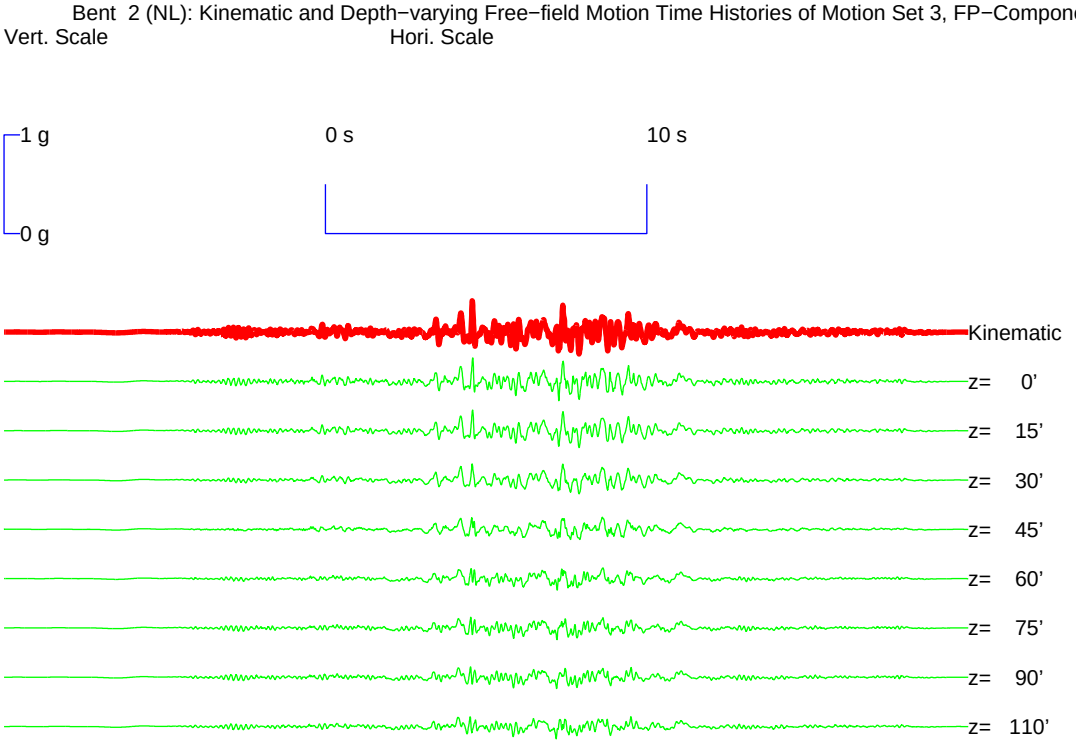


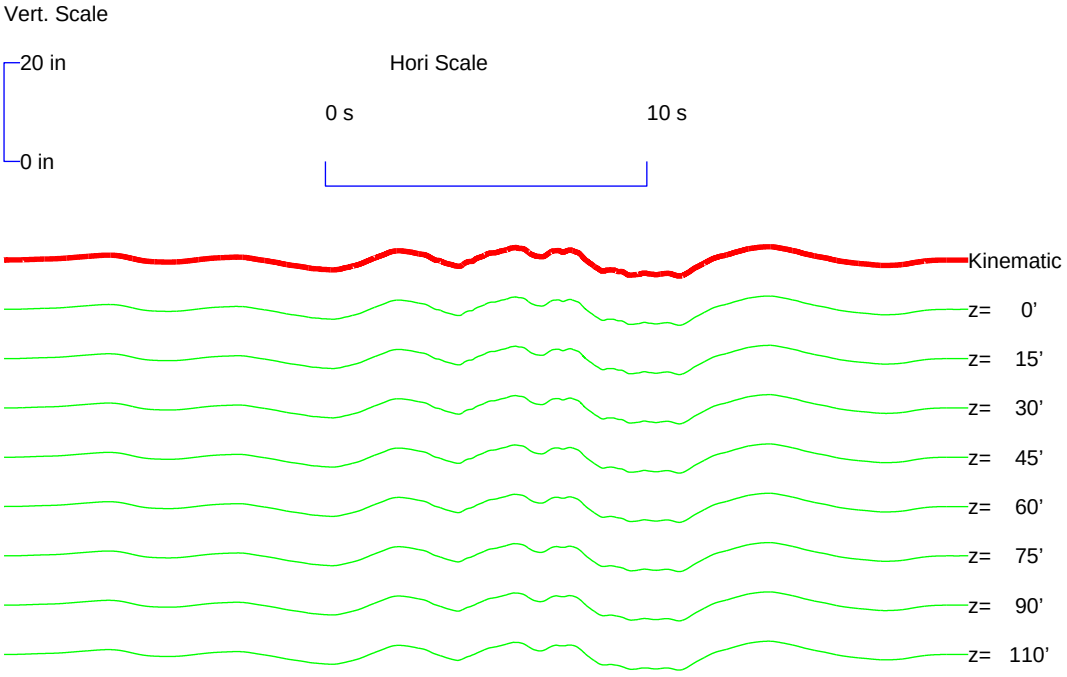


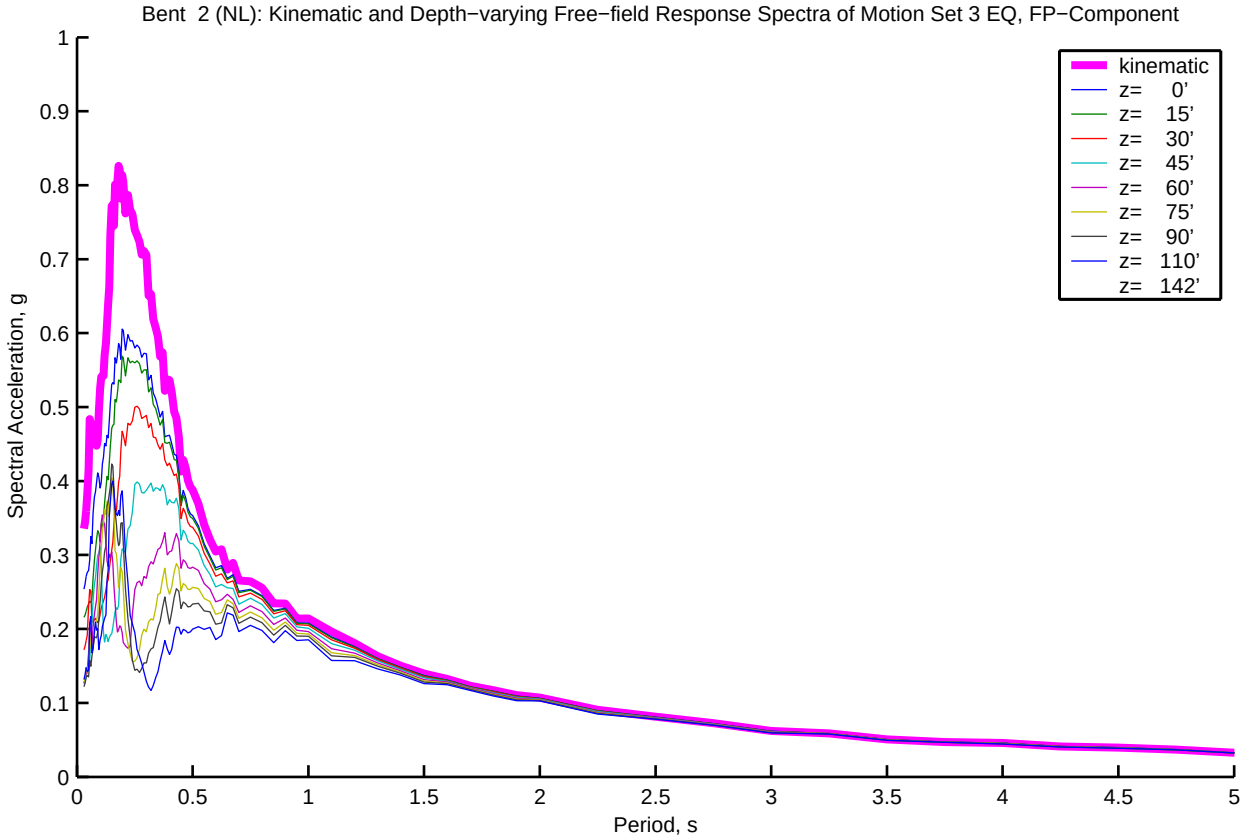

Bent 2 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 142'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

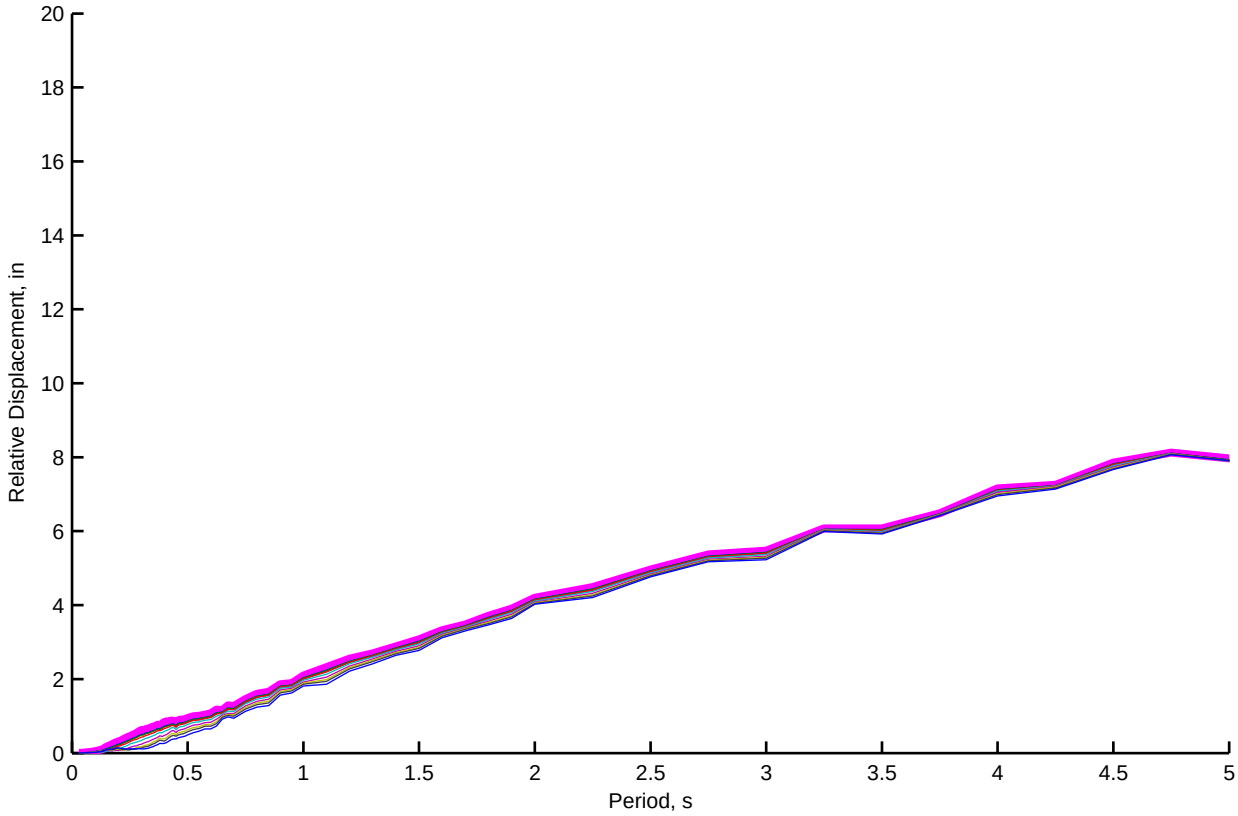

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 2 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component

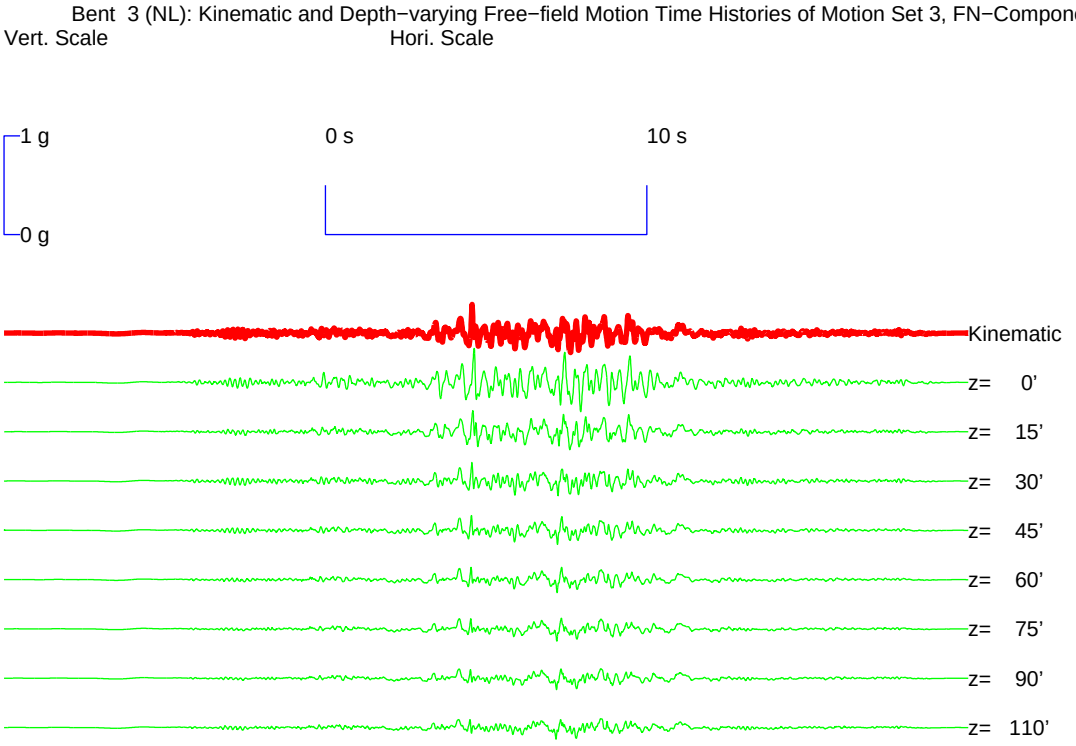


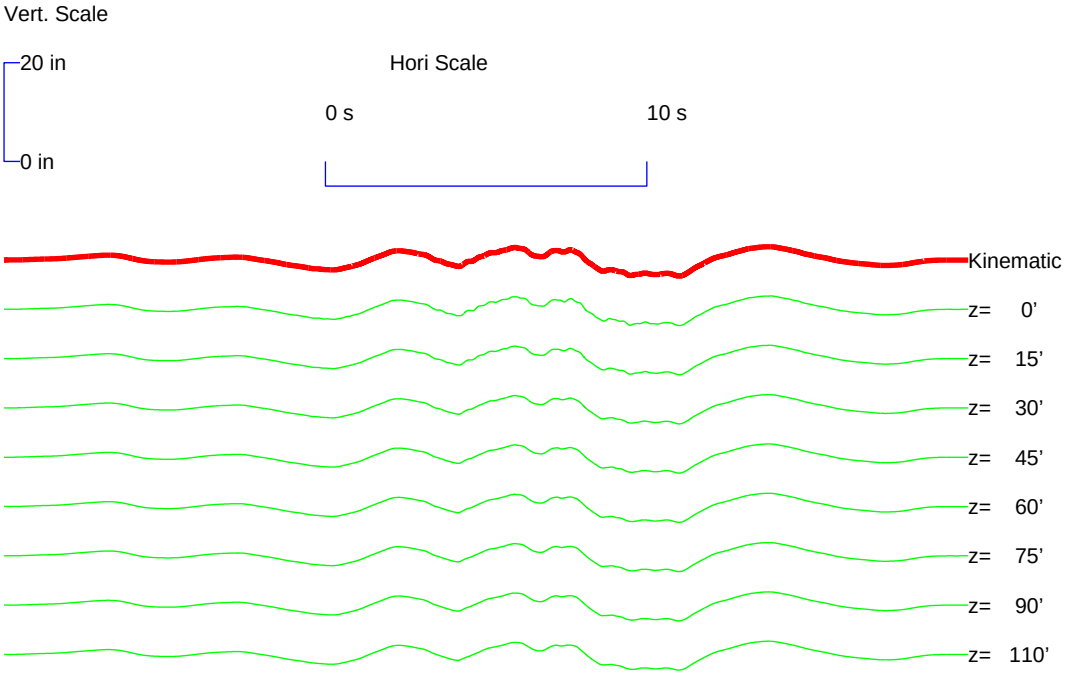


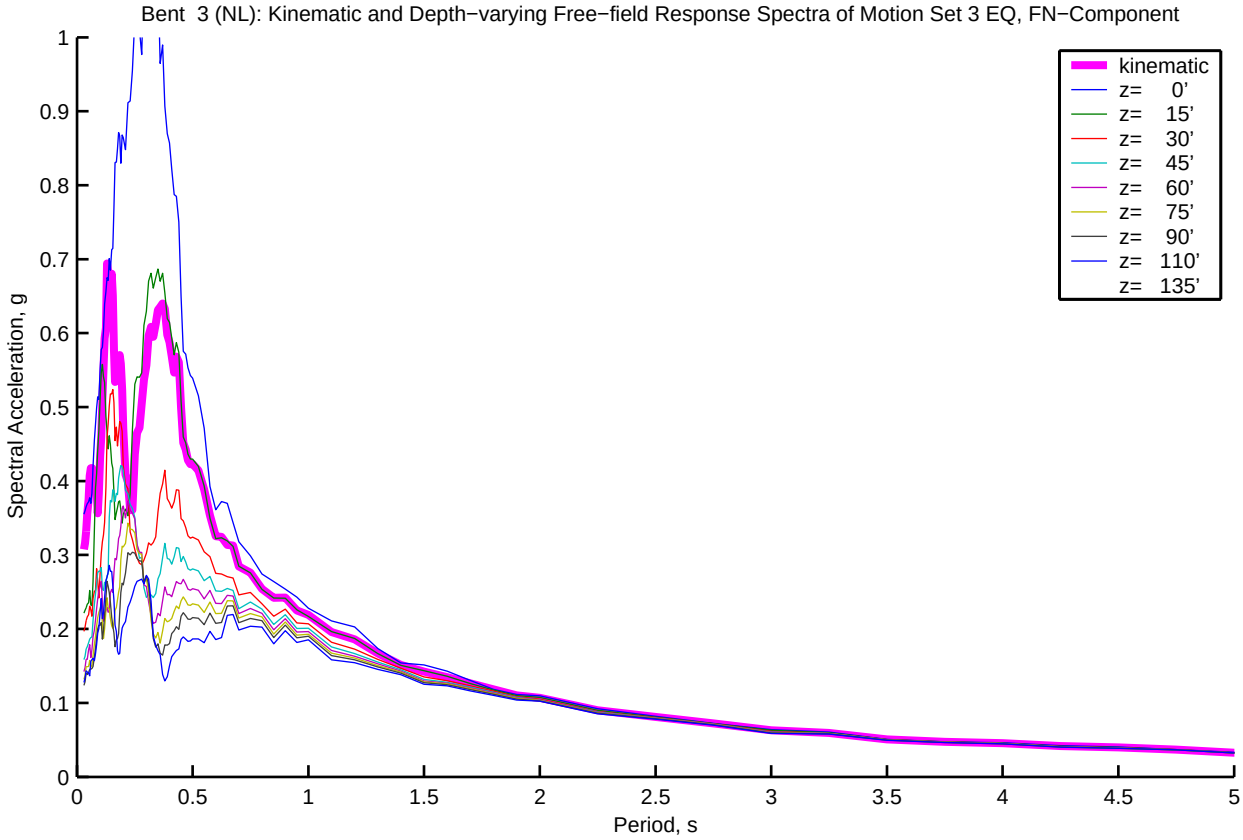

Bent 2 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 142'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

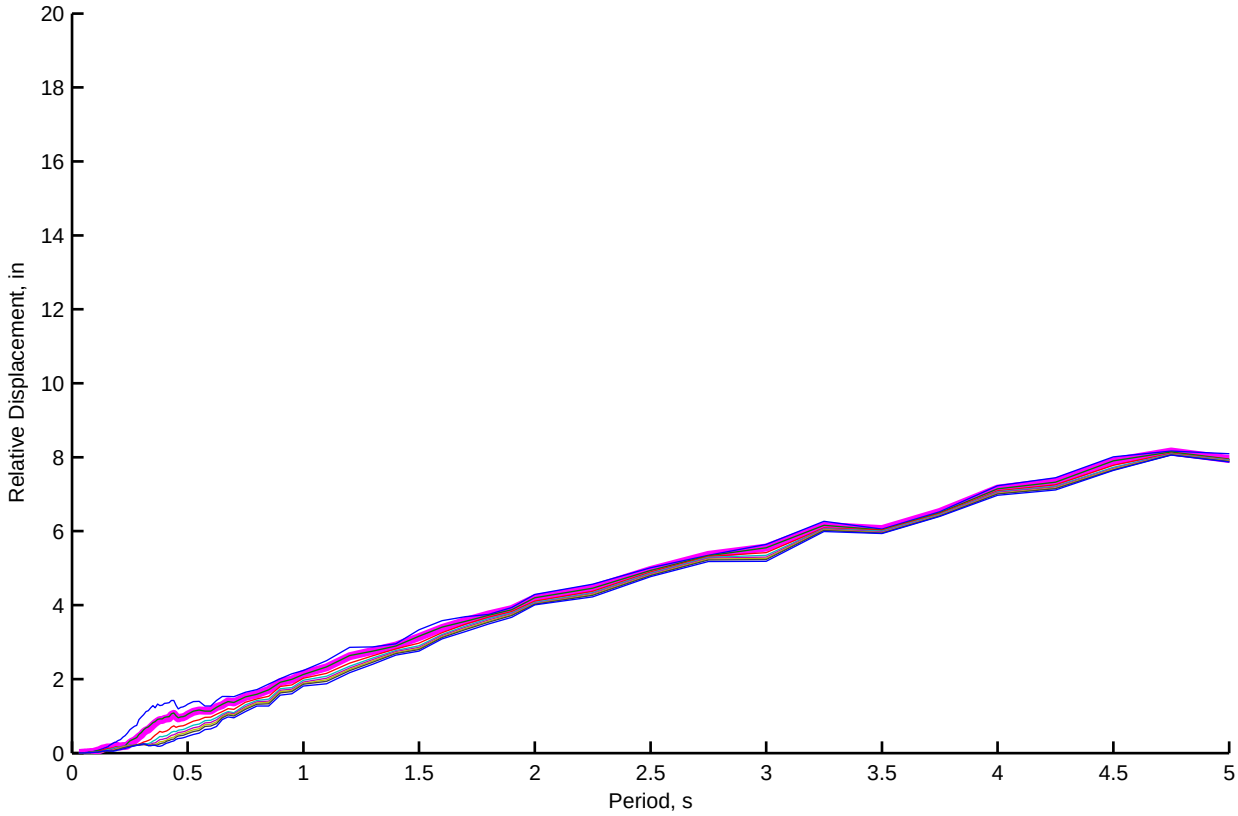

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 3 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component

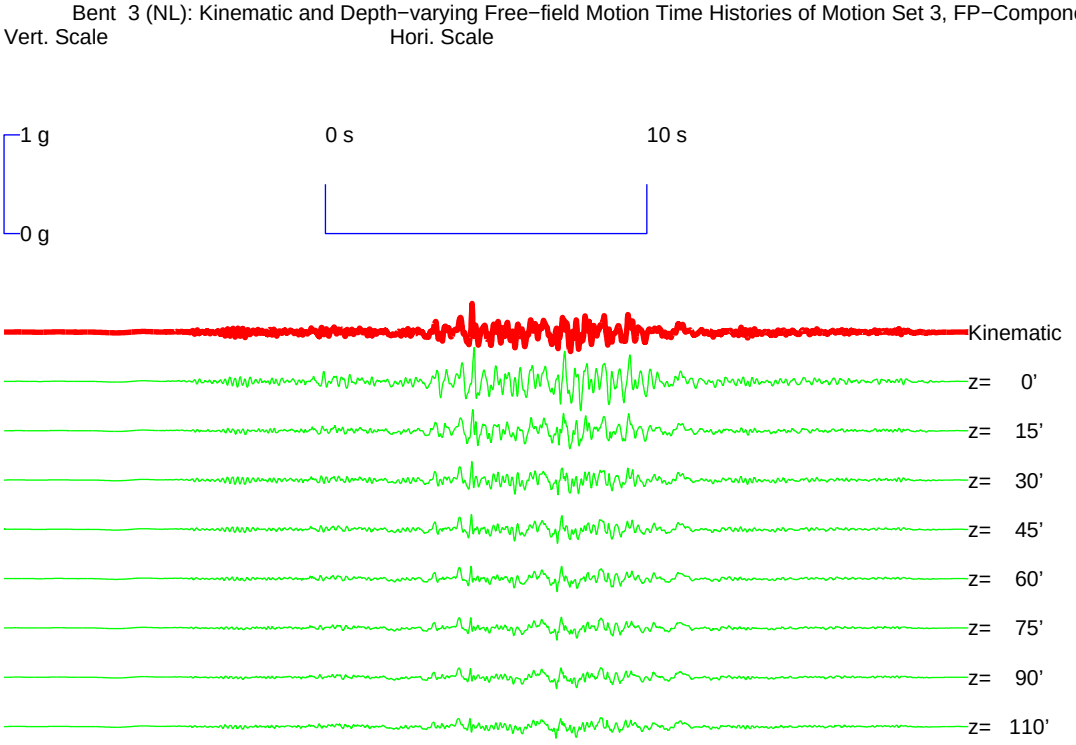


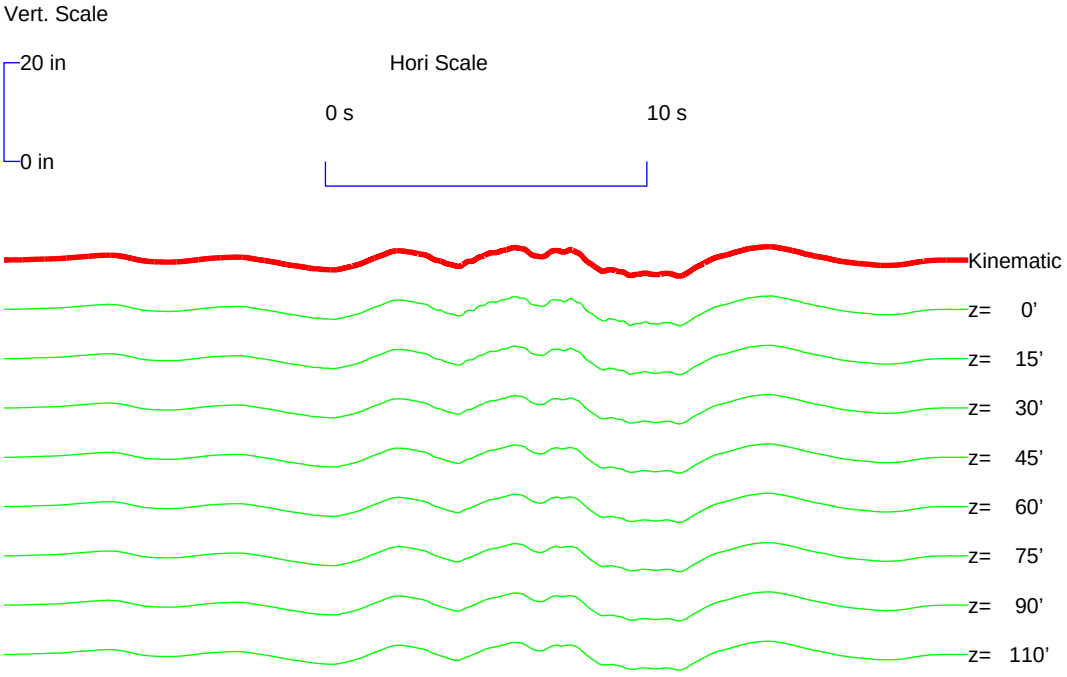


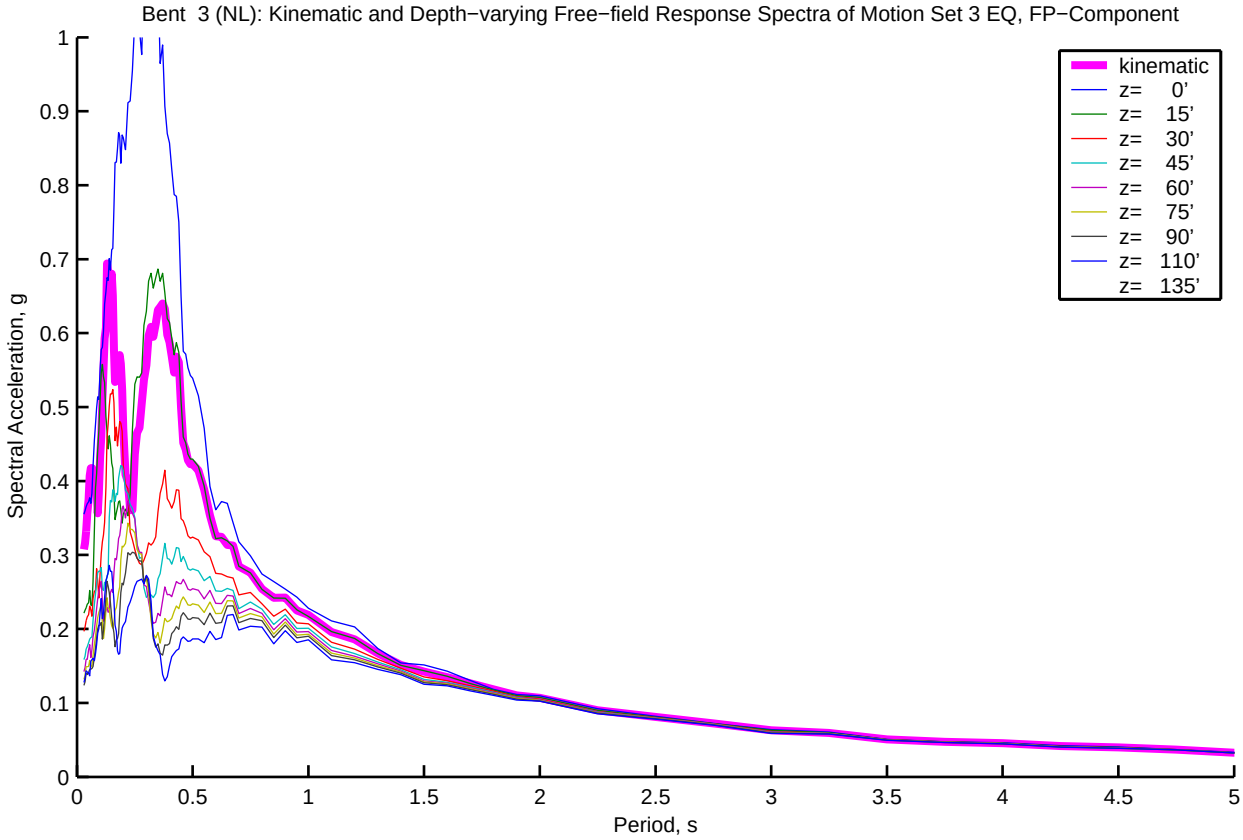

Bent 3 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 135'

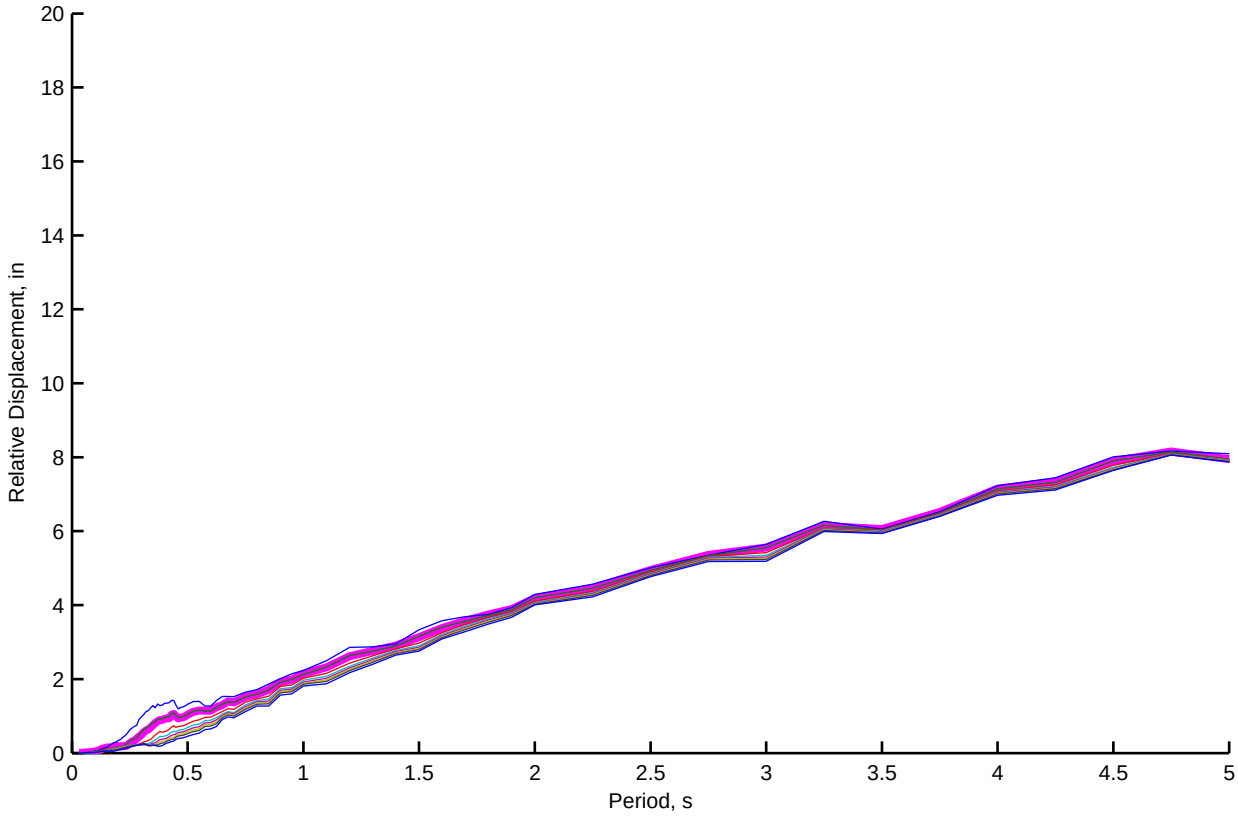

Relative Displacement, in
Period, s

Bent 3 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component

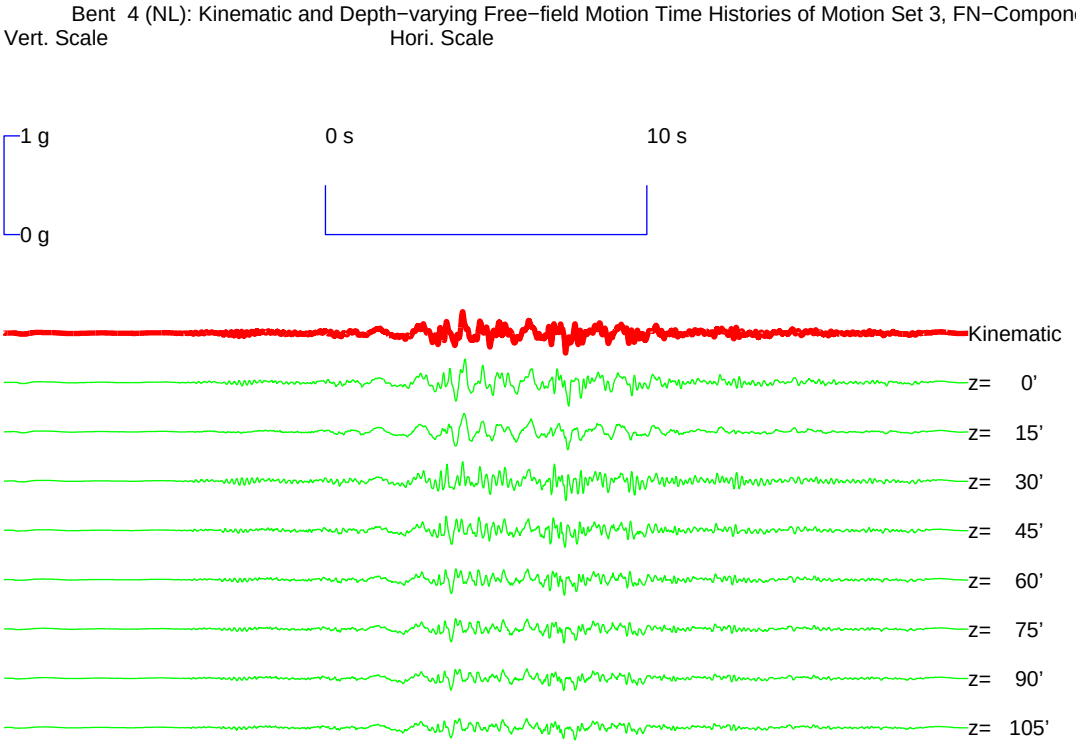


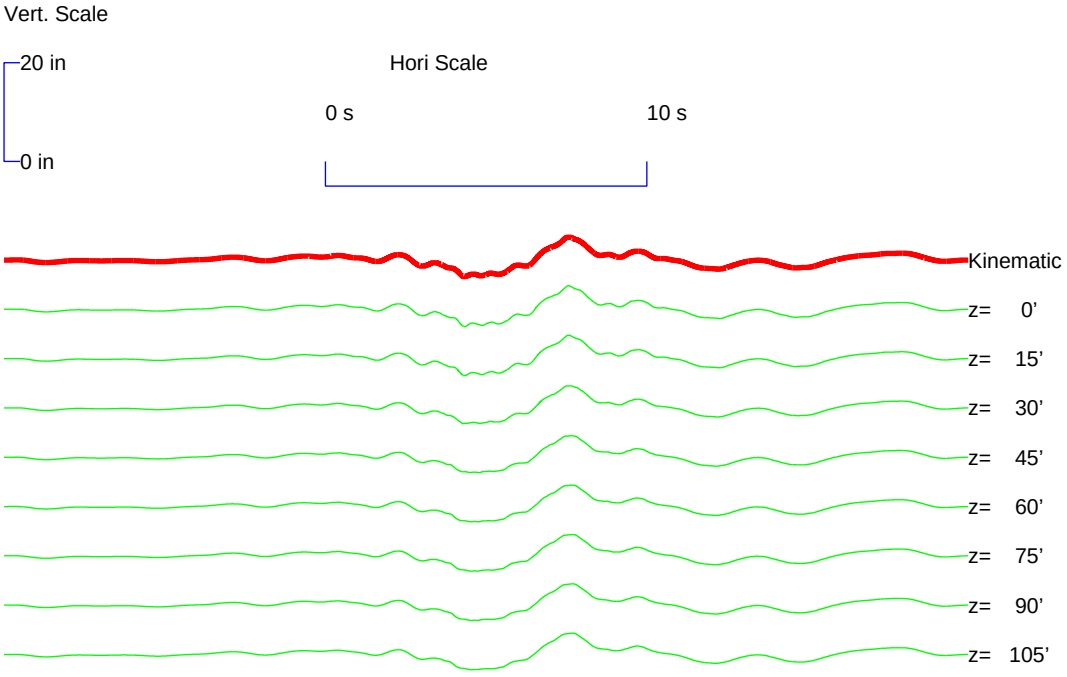


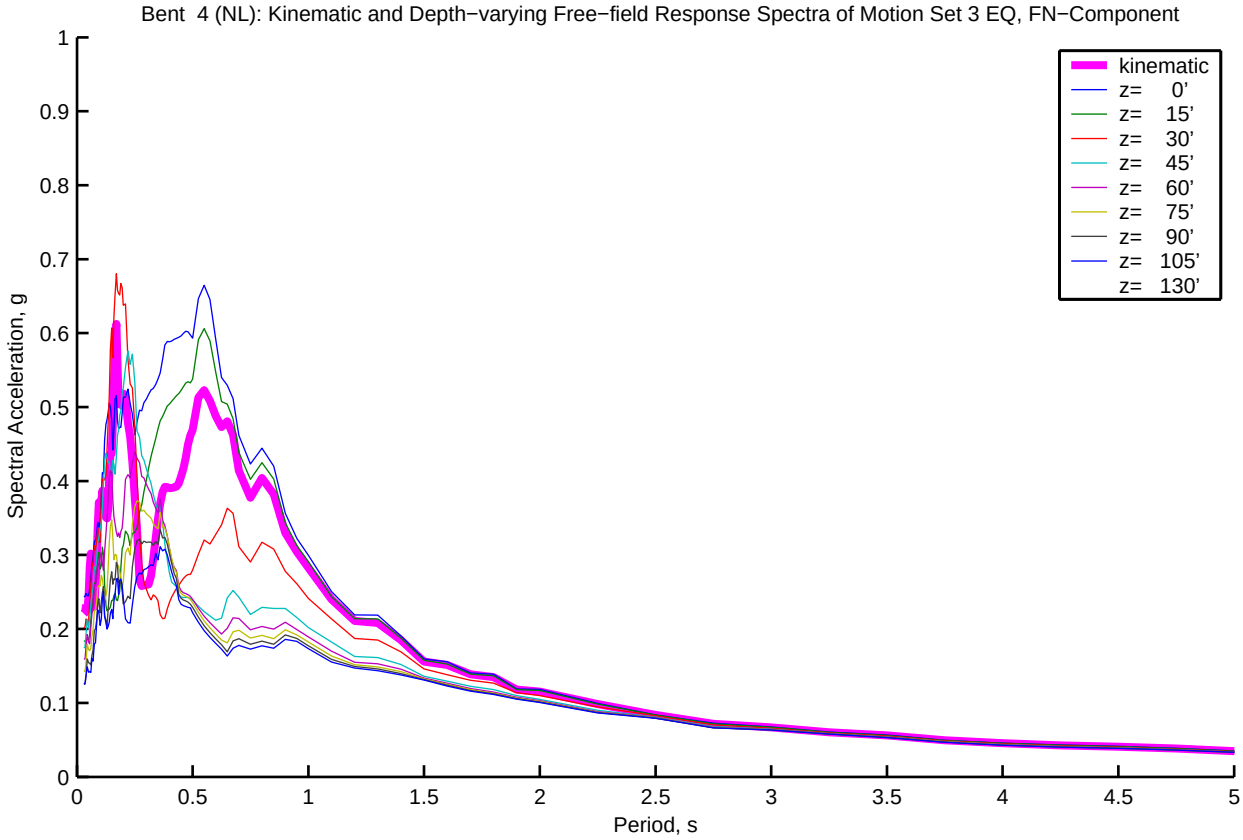

Bent 3 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 135'

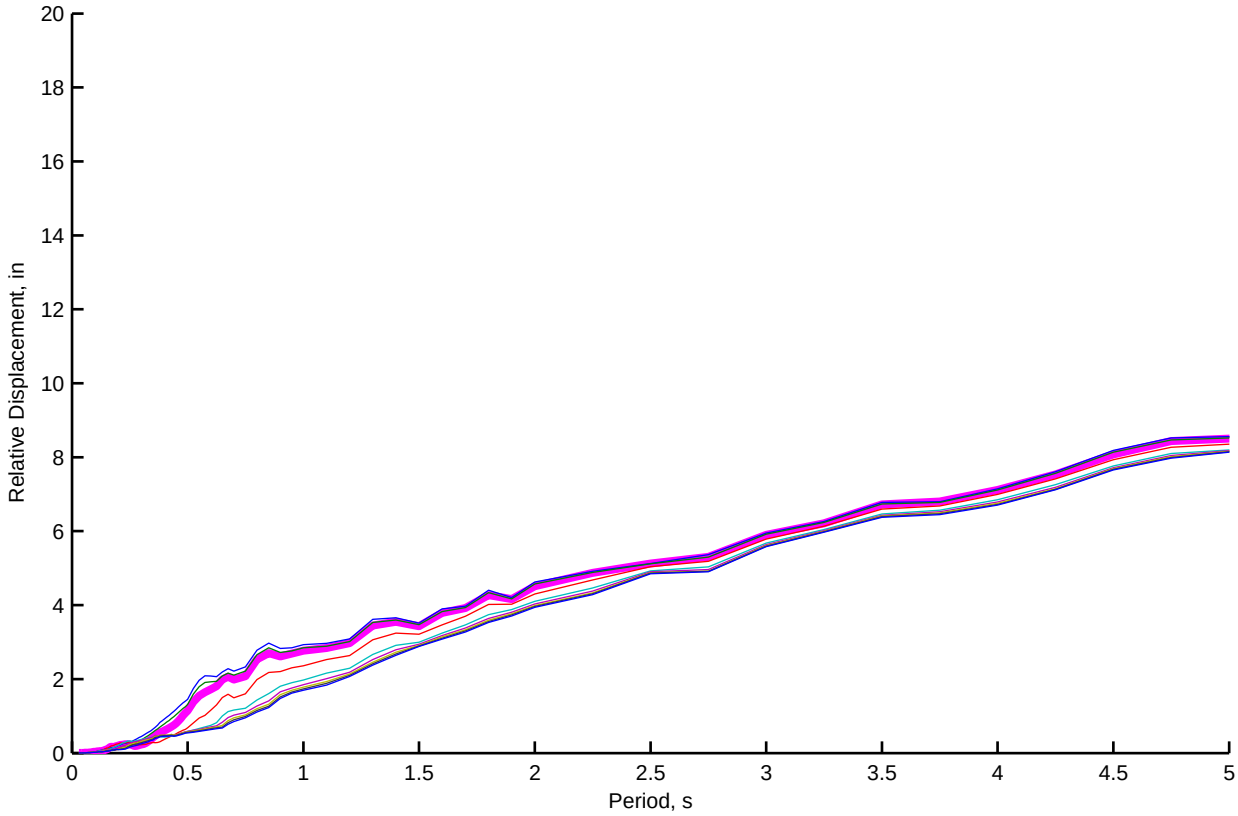

Relative Displacement, in
Period, s

Bent 4 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component

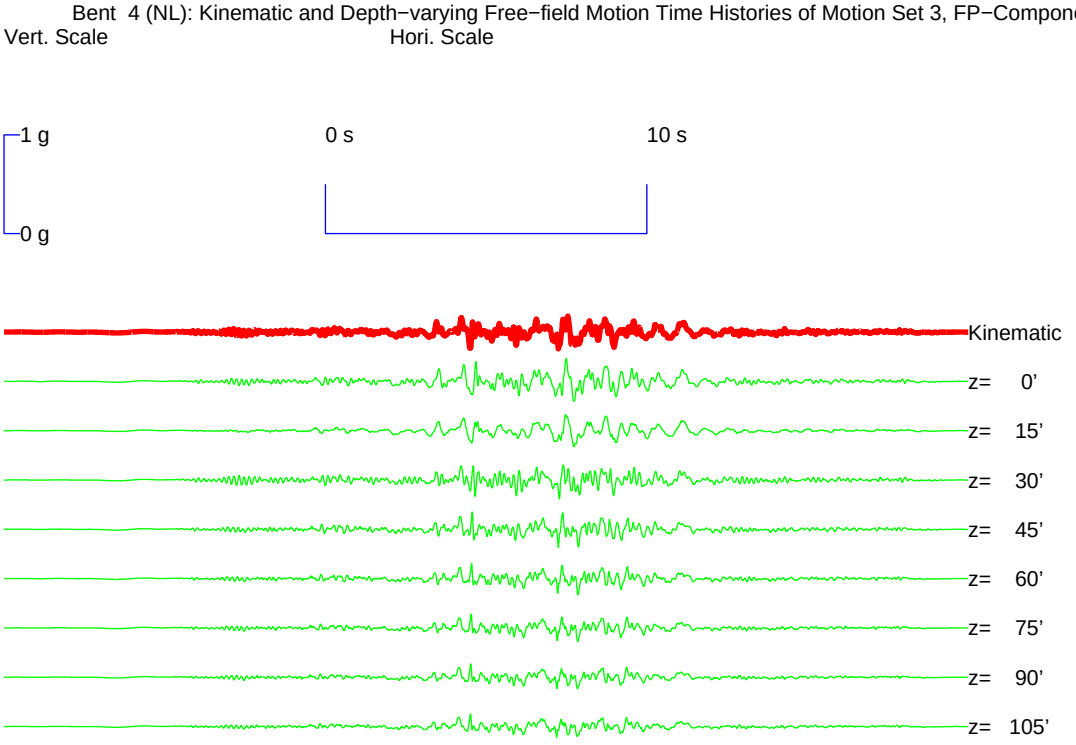


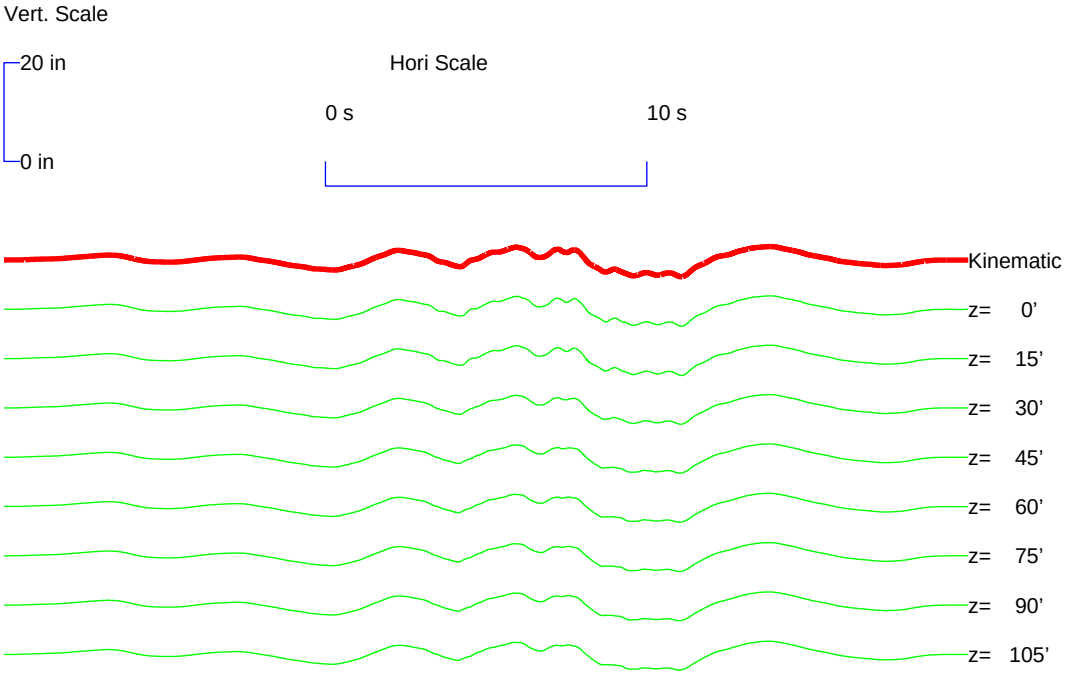


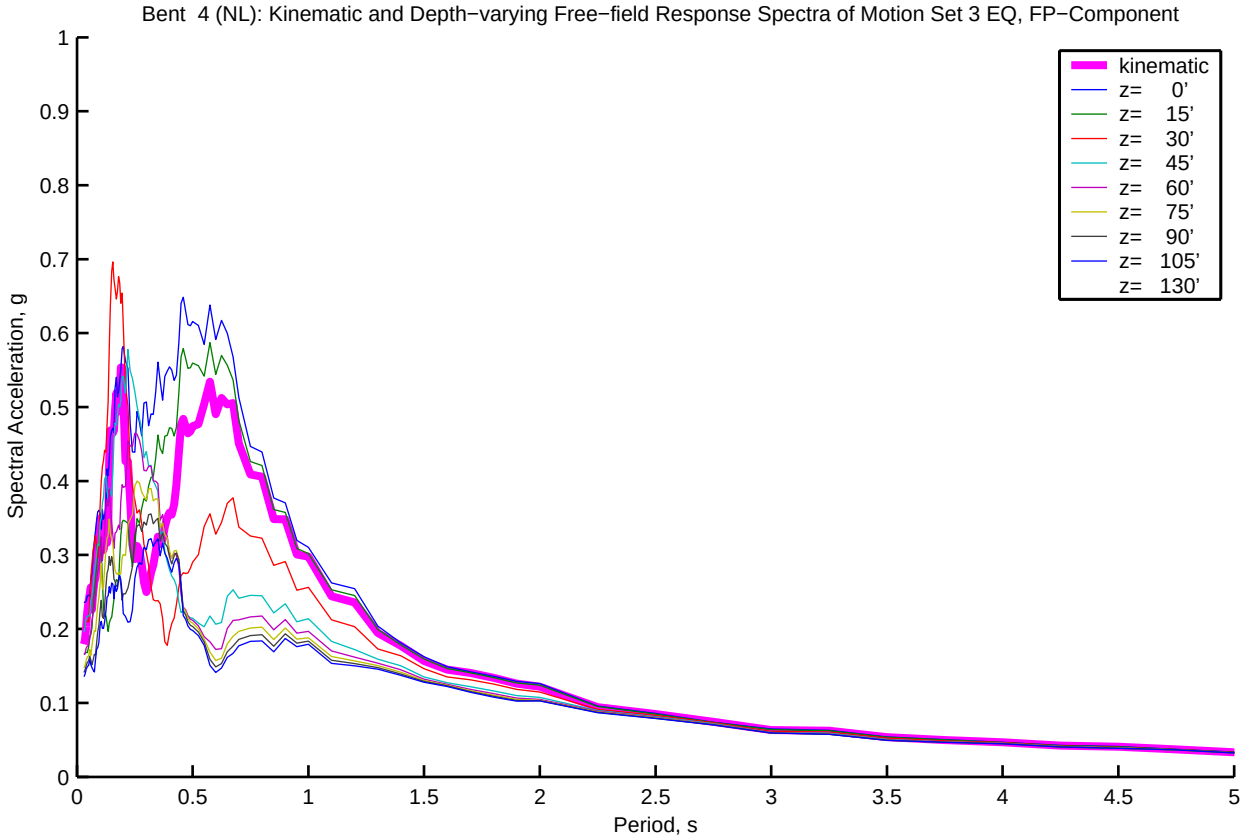

Bent 4 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

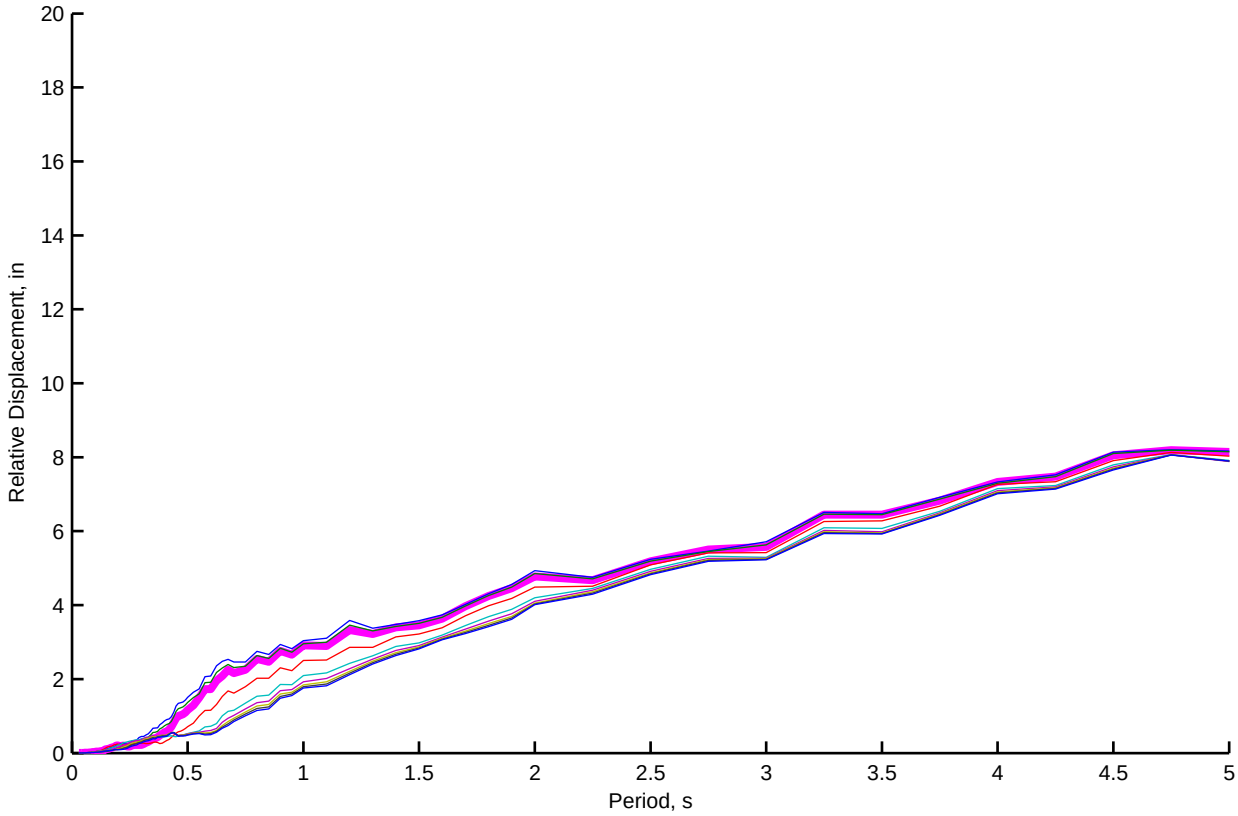

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 4 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component

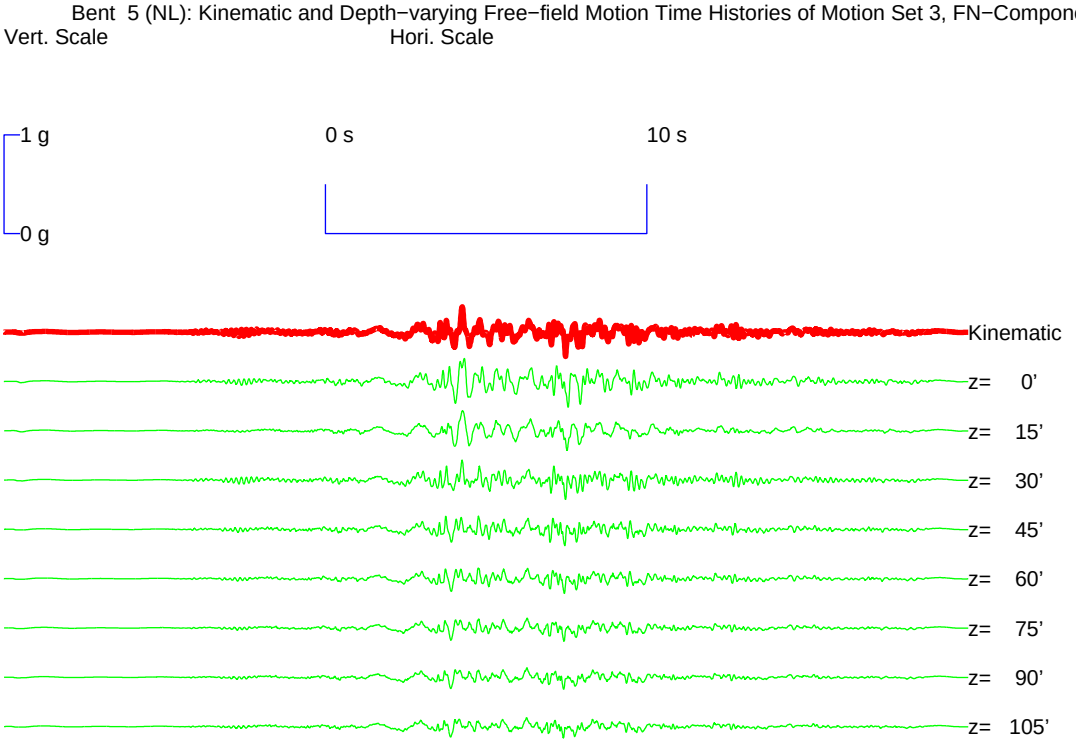


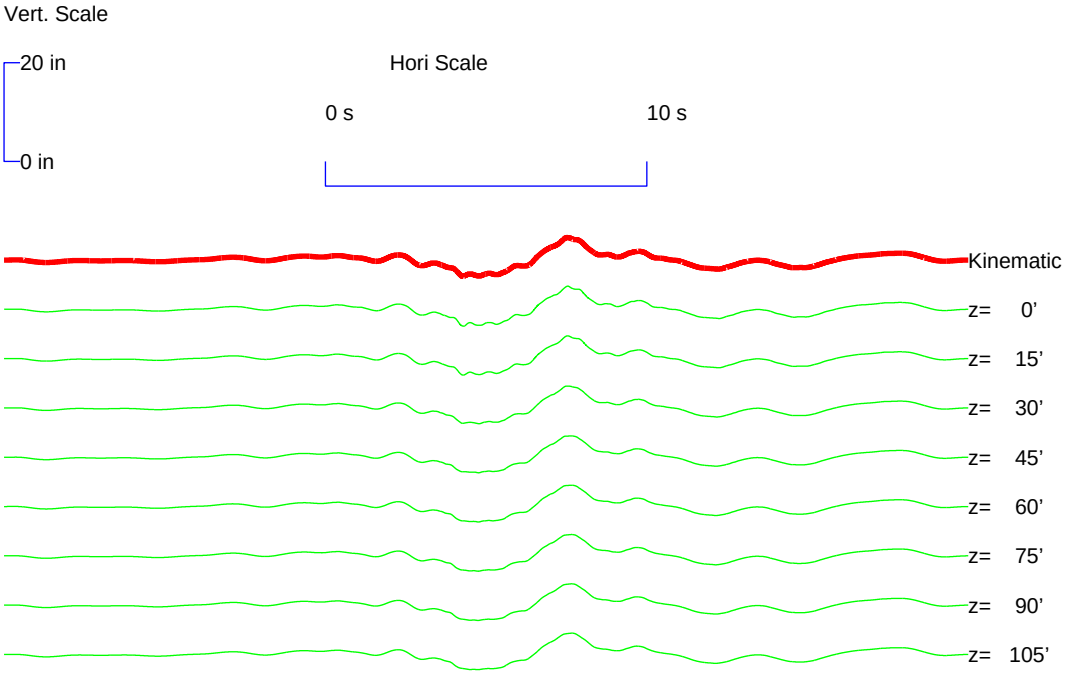


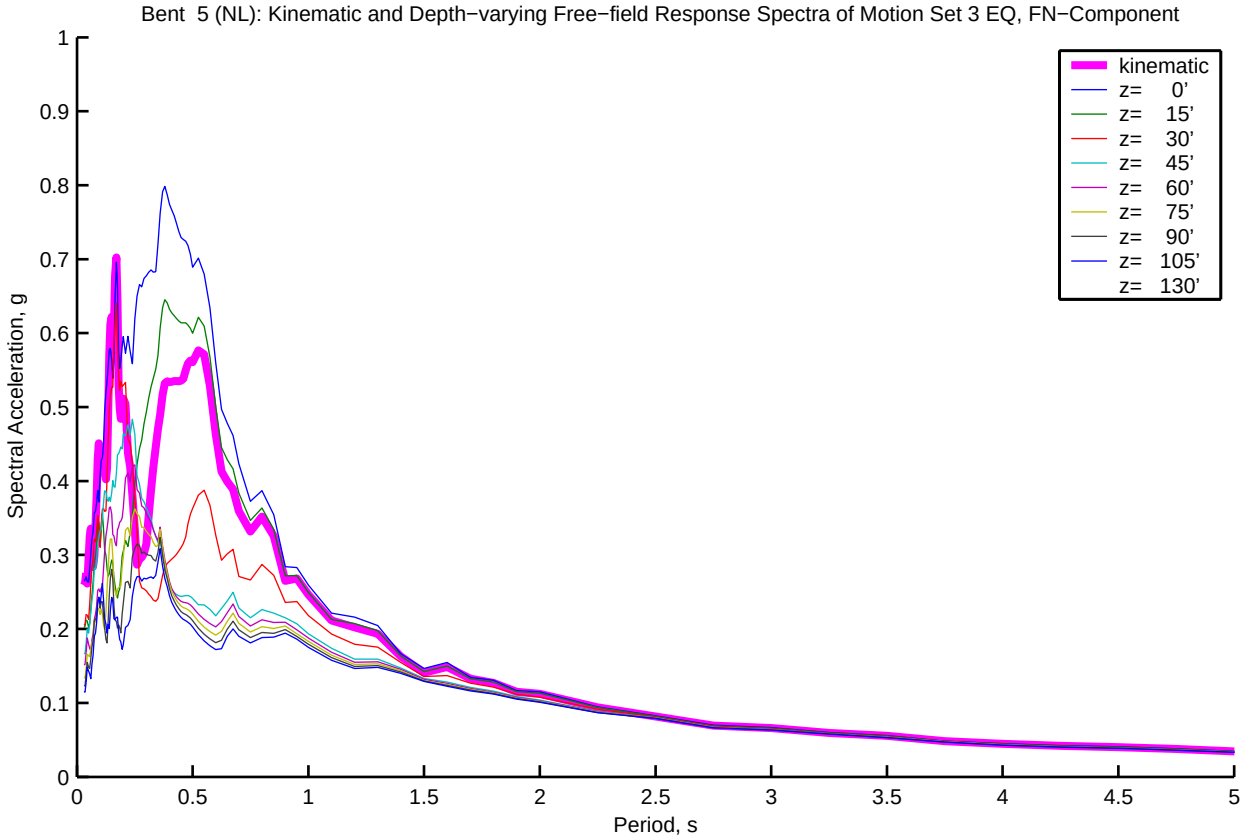

Bent 4 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

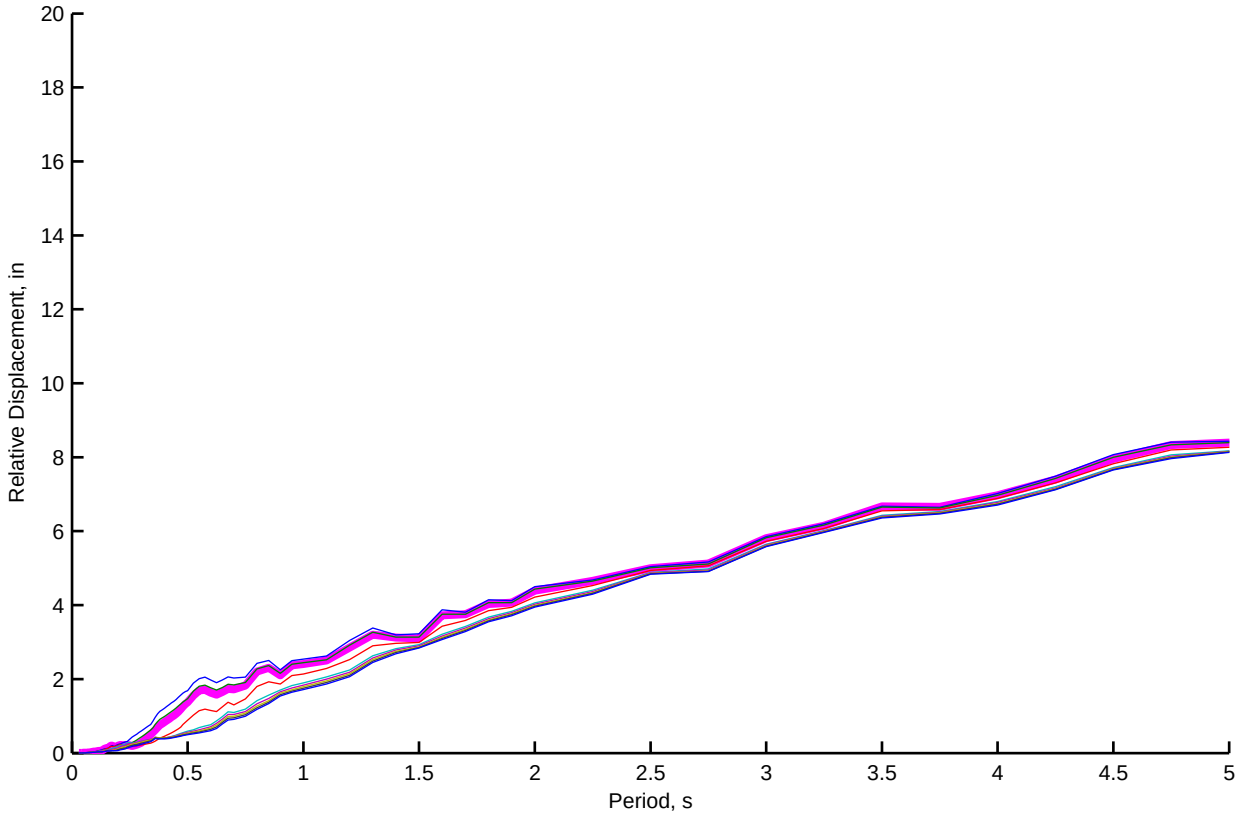

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 5 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component

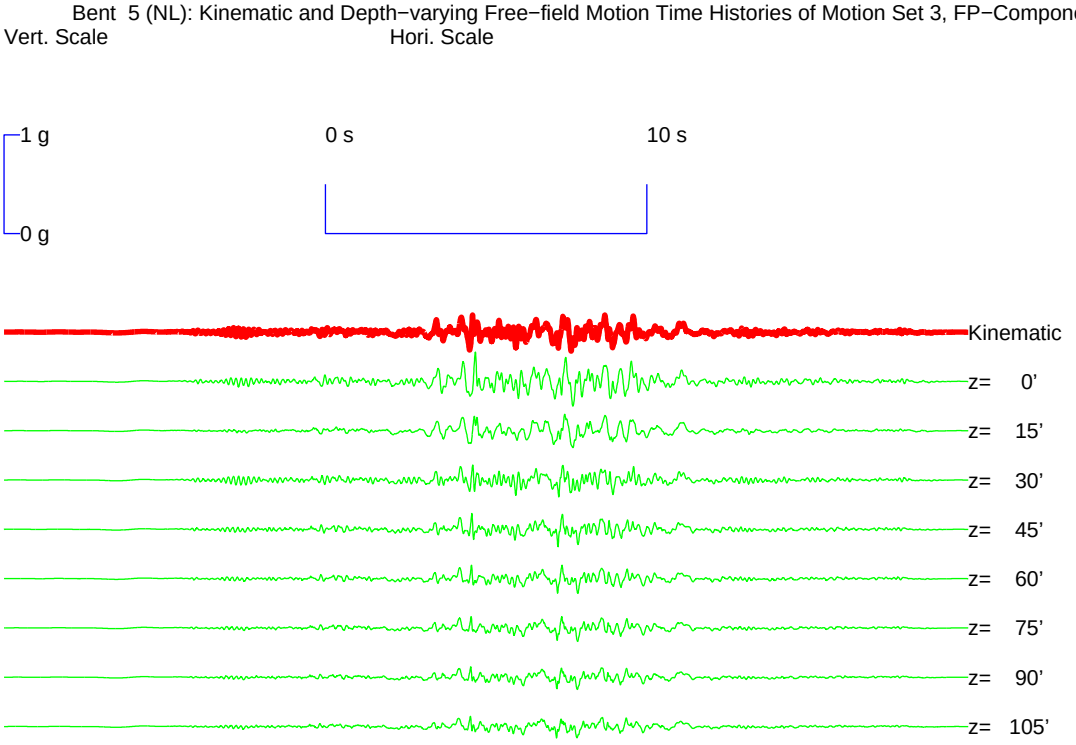


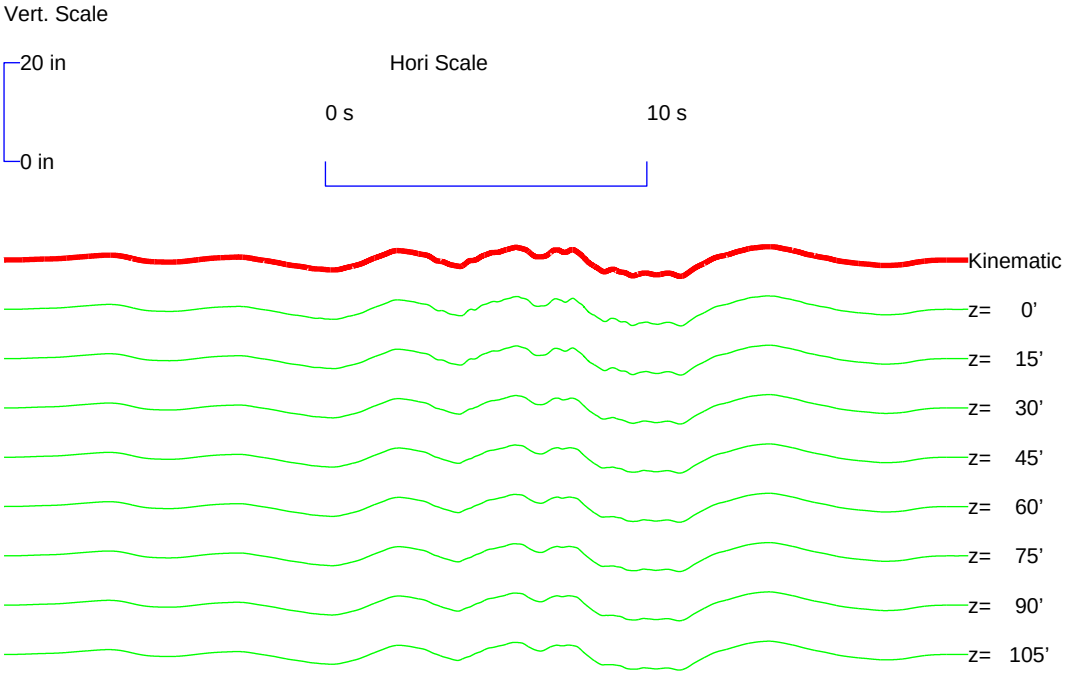


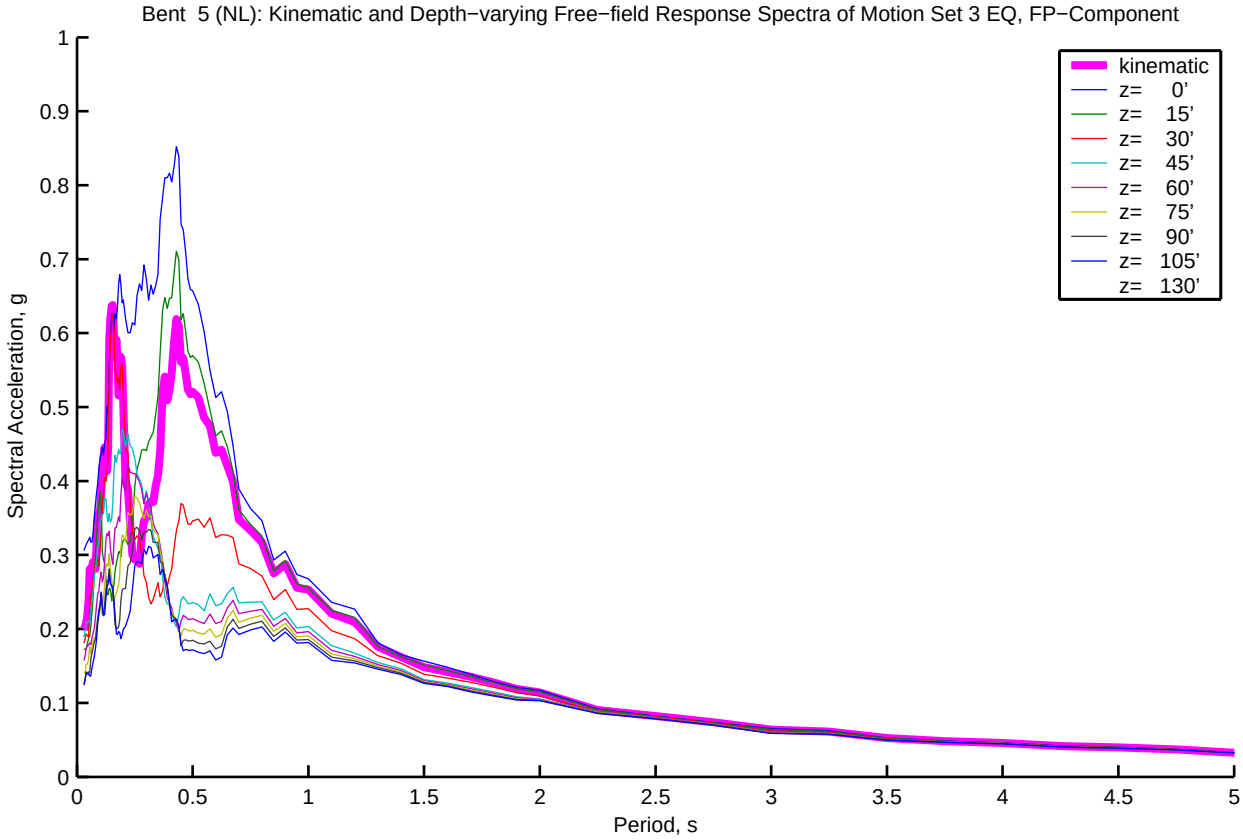

Bent 5 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'

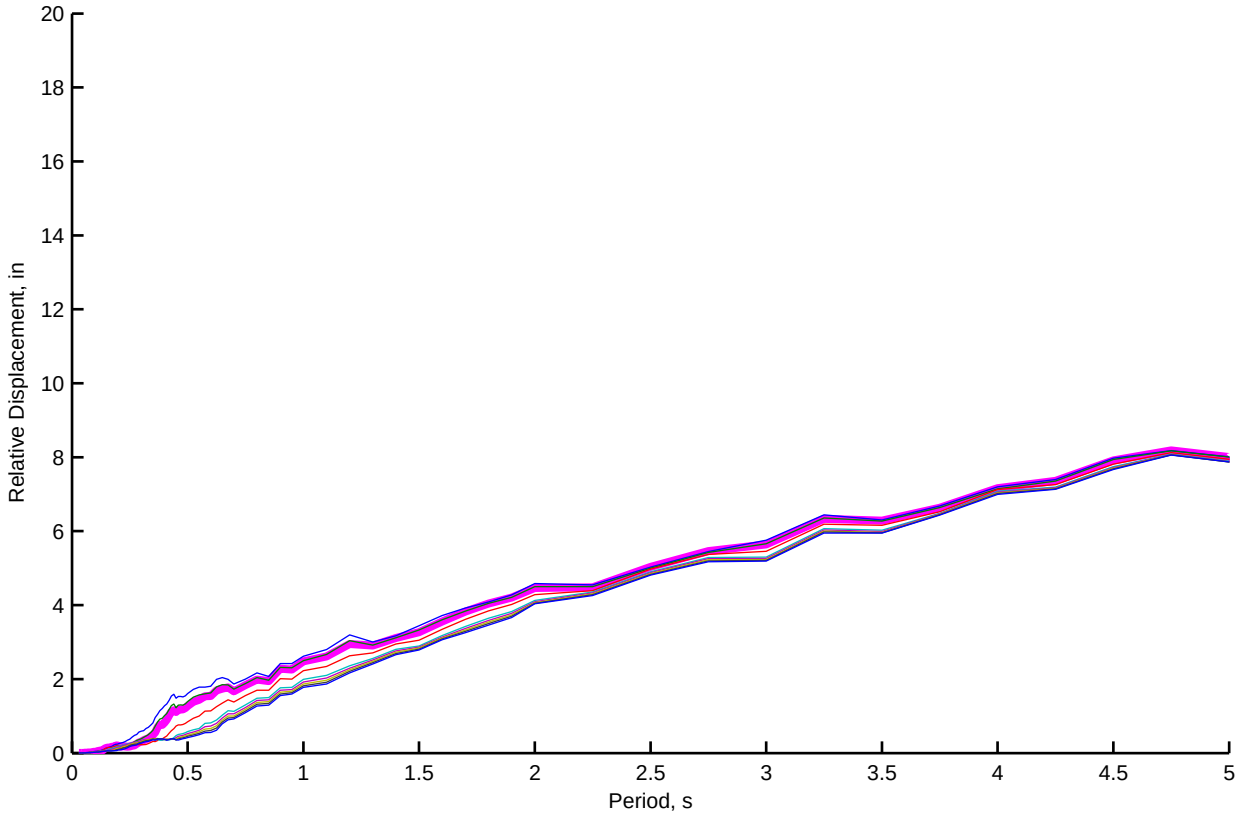

Relative Displacement, in
Period, s

Bent 5 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component

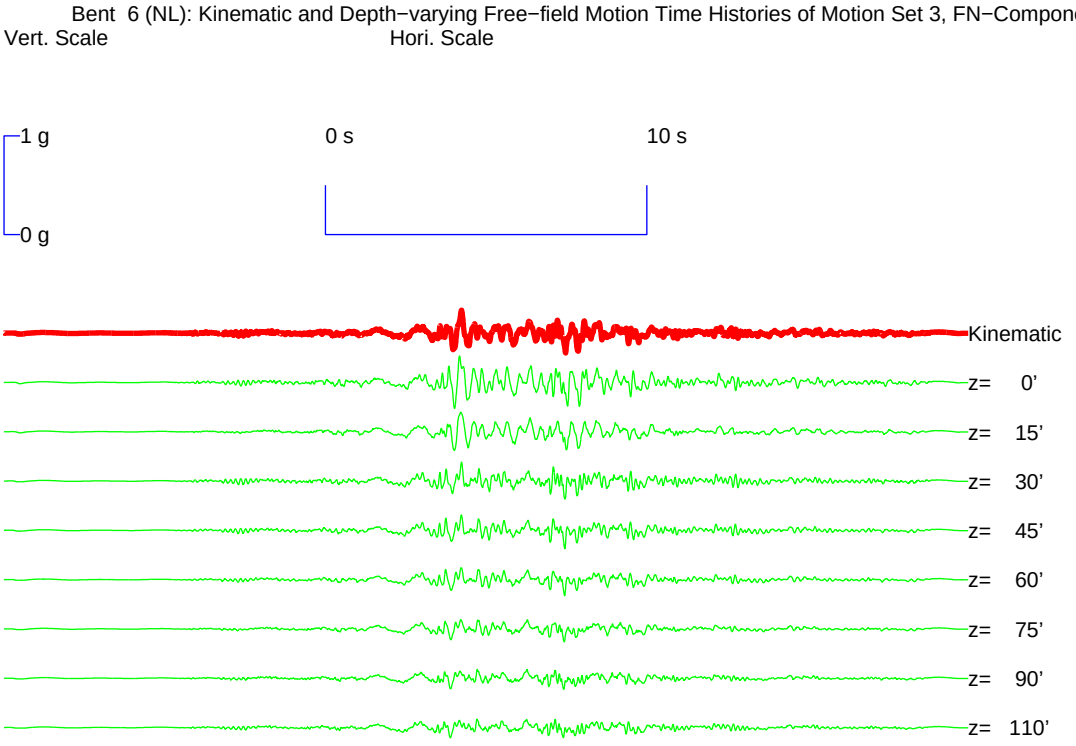


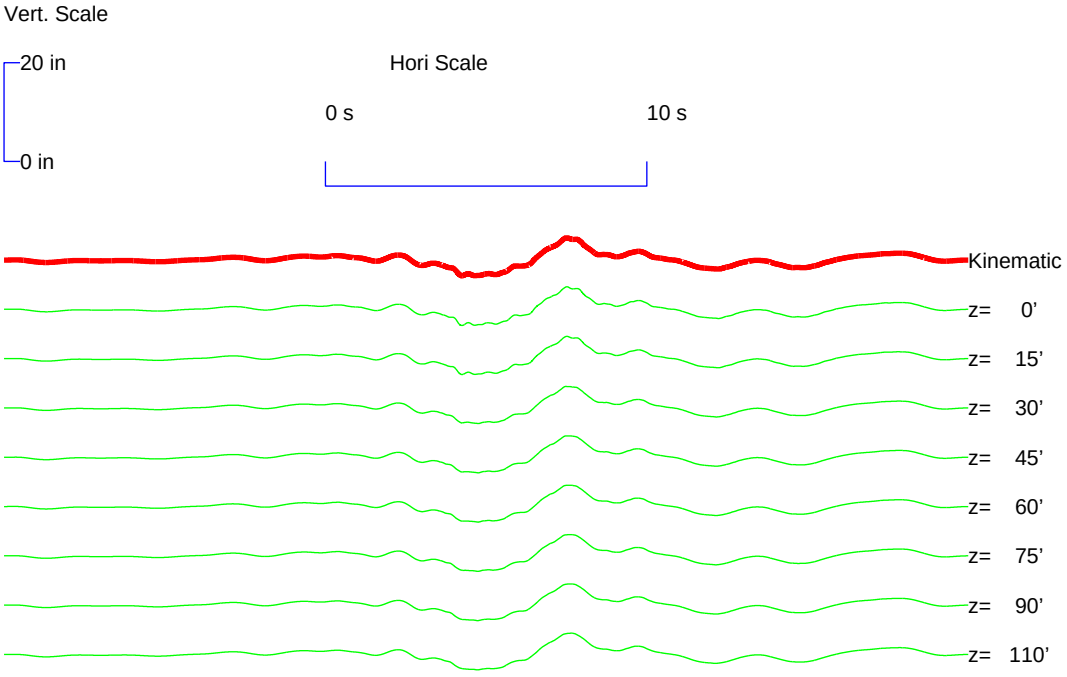


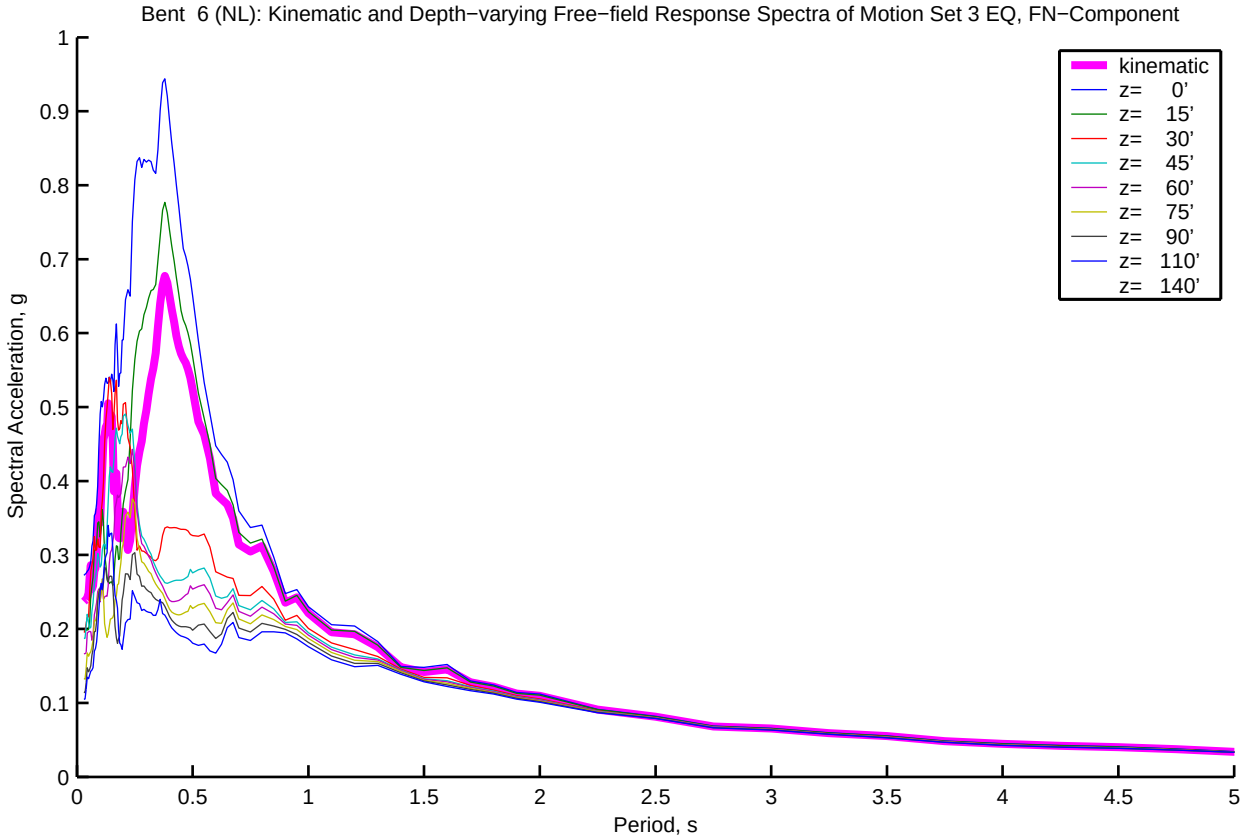

Bent 5 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'

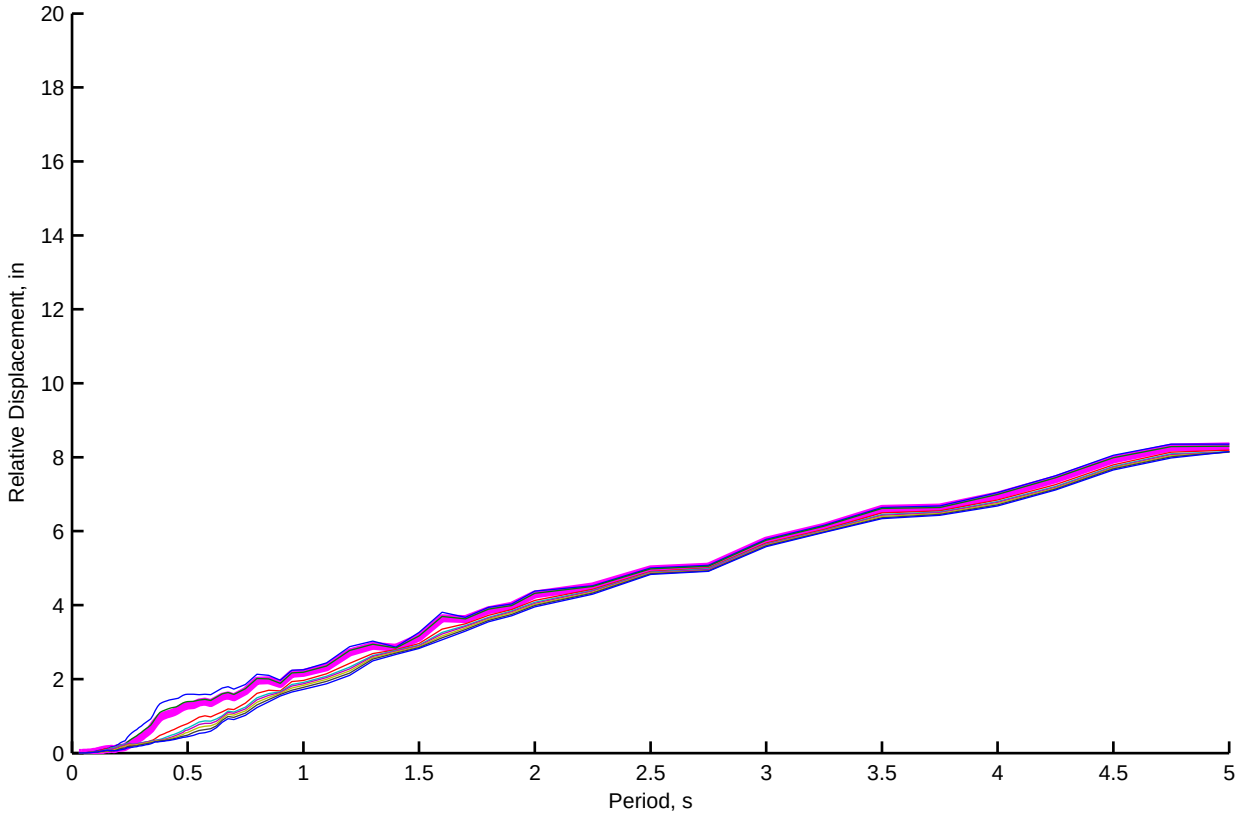

Relative Displacement, in
Period, s

Bent 6 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component

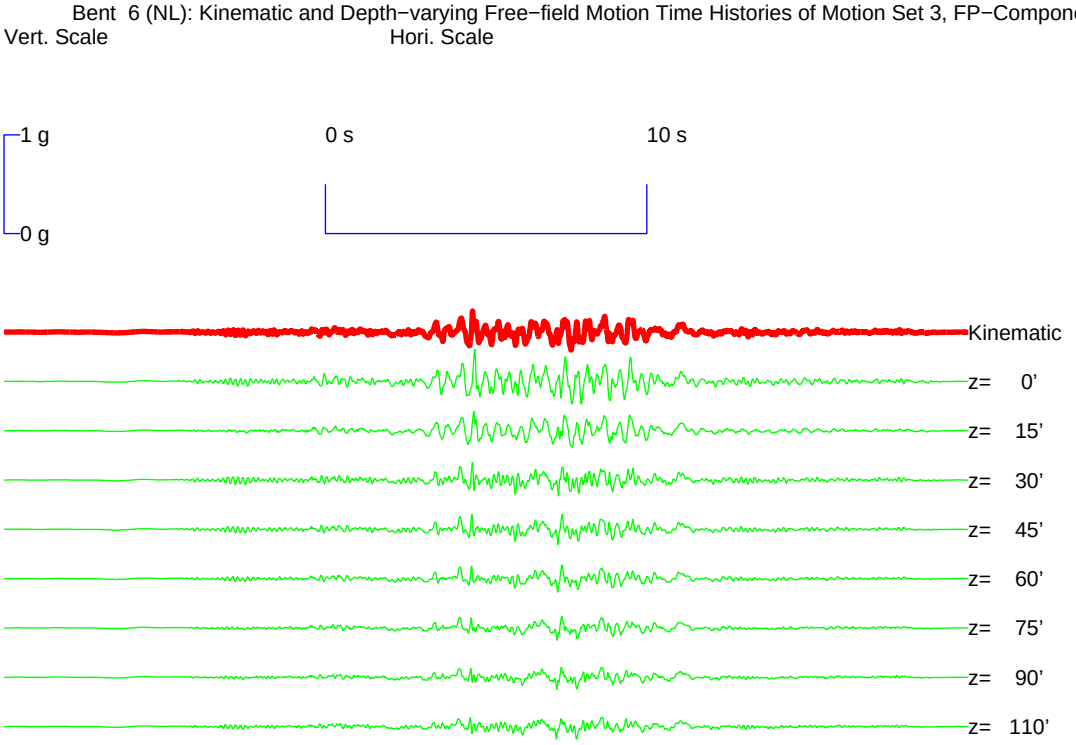


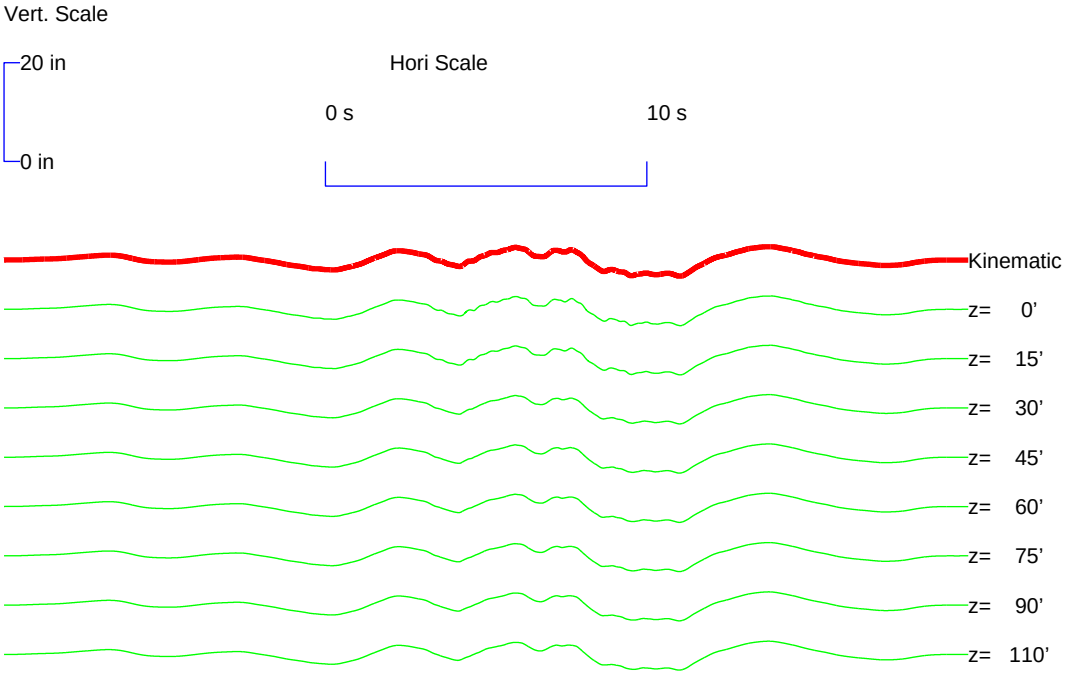


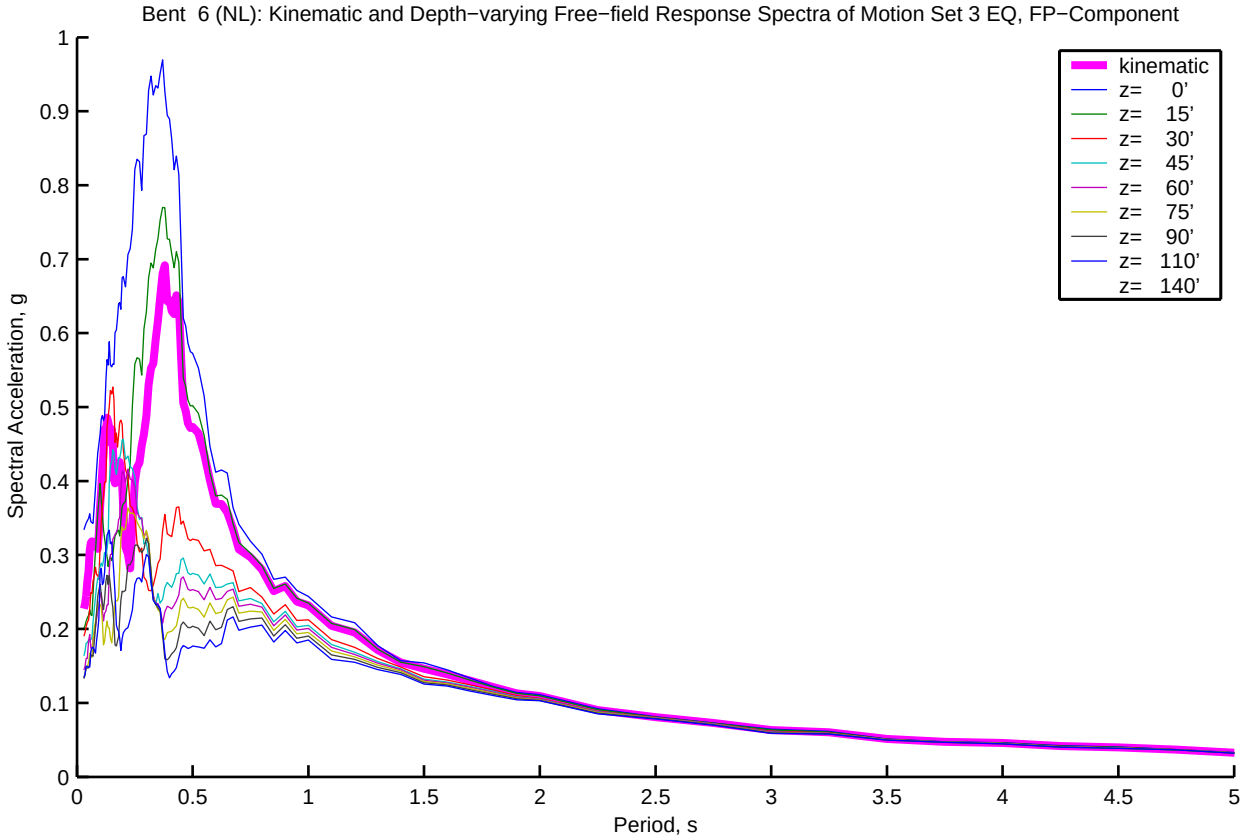

Bent 6 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'


Relative Displacement, in
Period, s

Bent 6 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component






Bent 6 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
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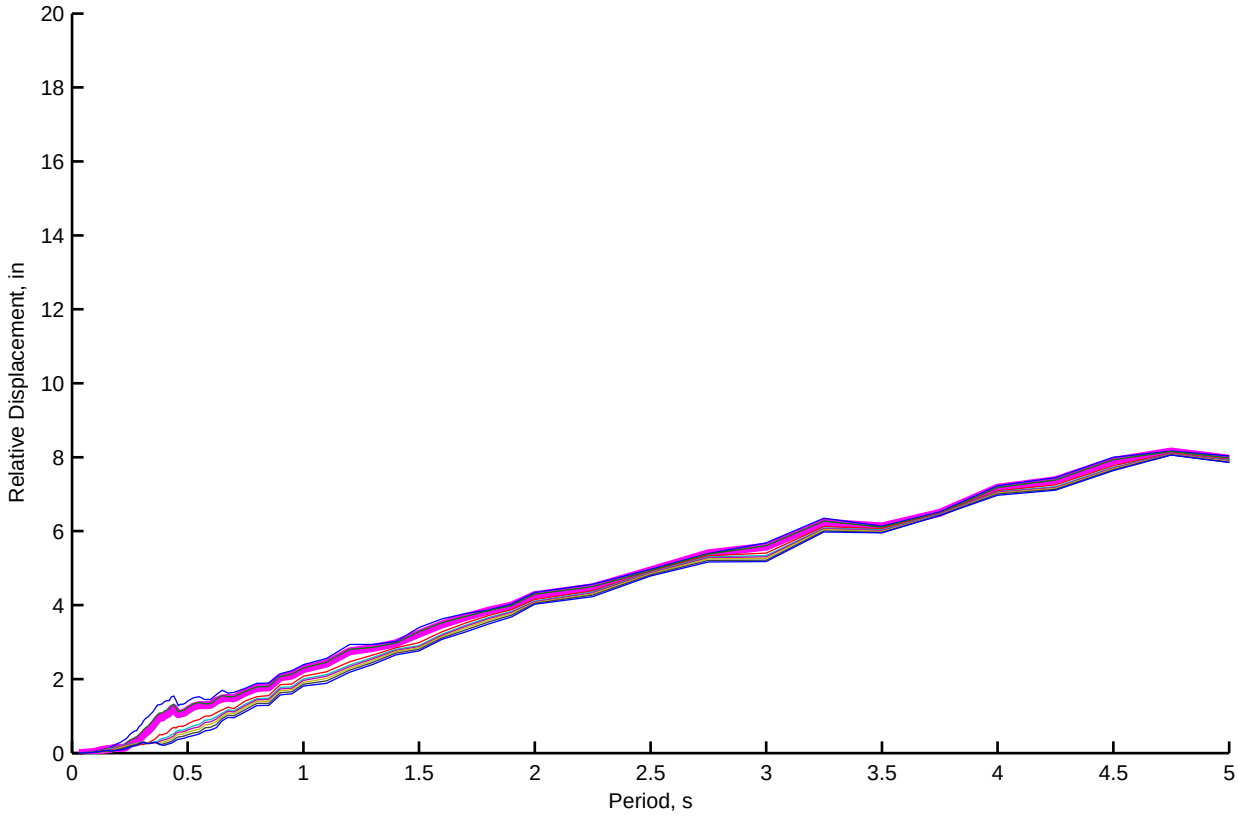
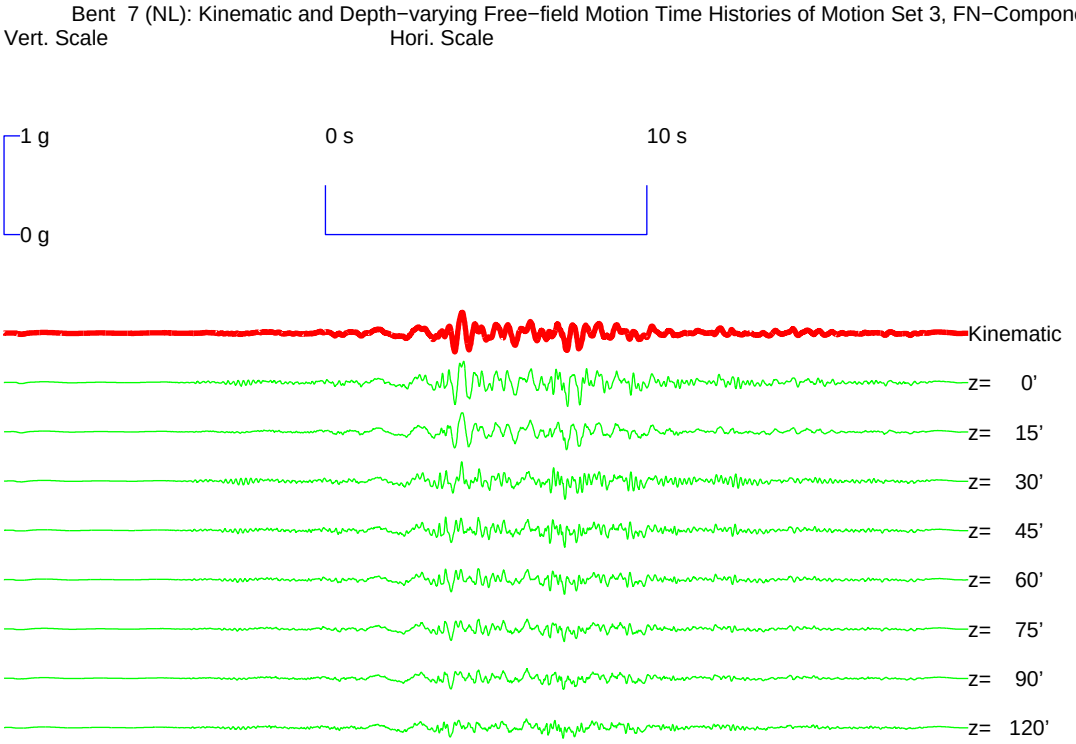
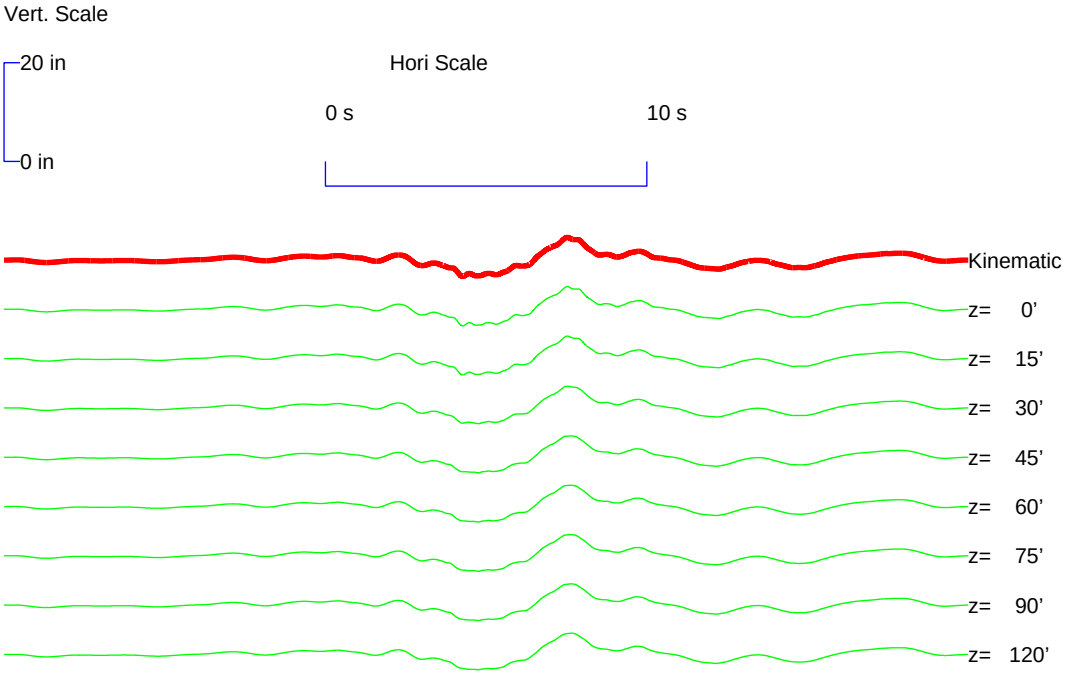
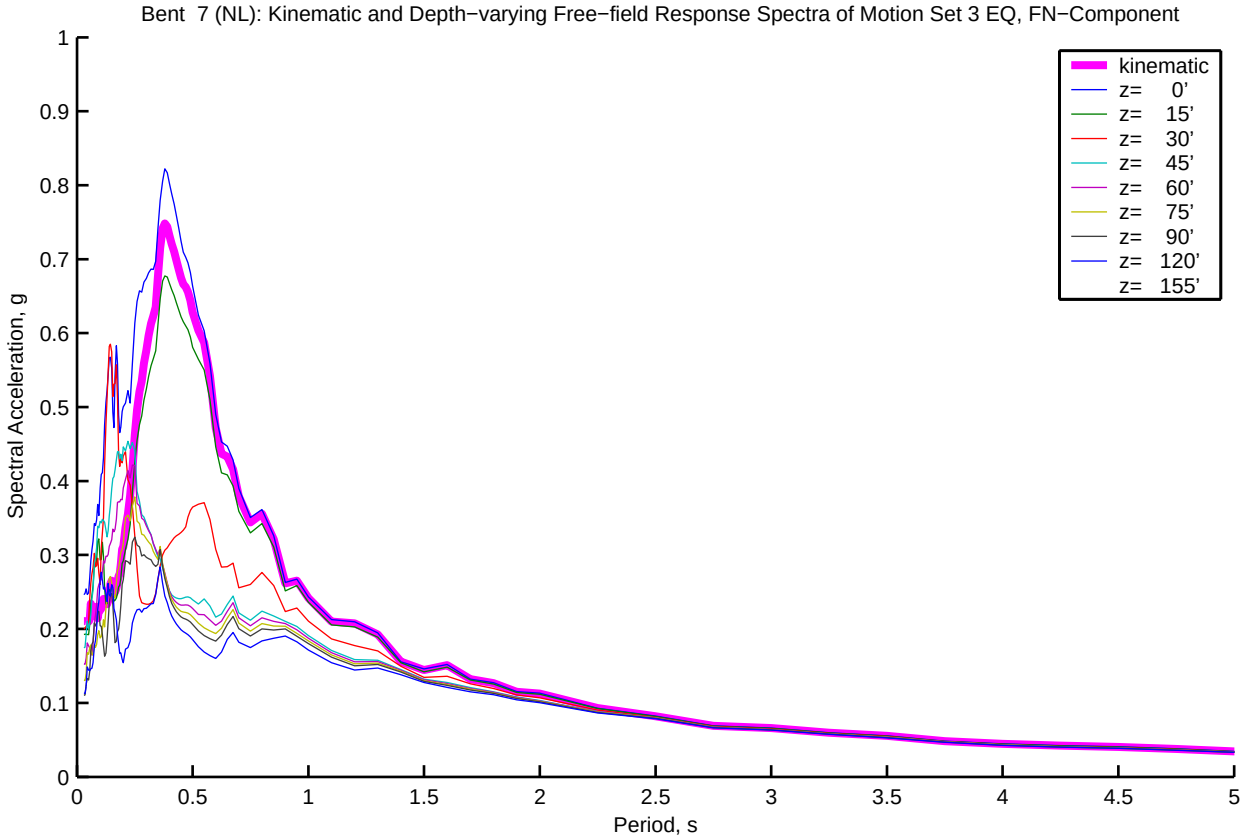
4
4.5
5

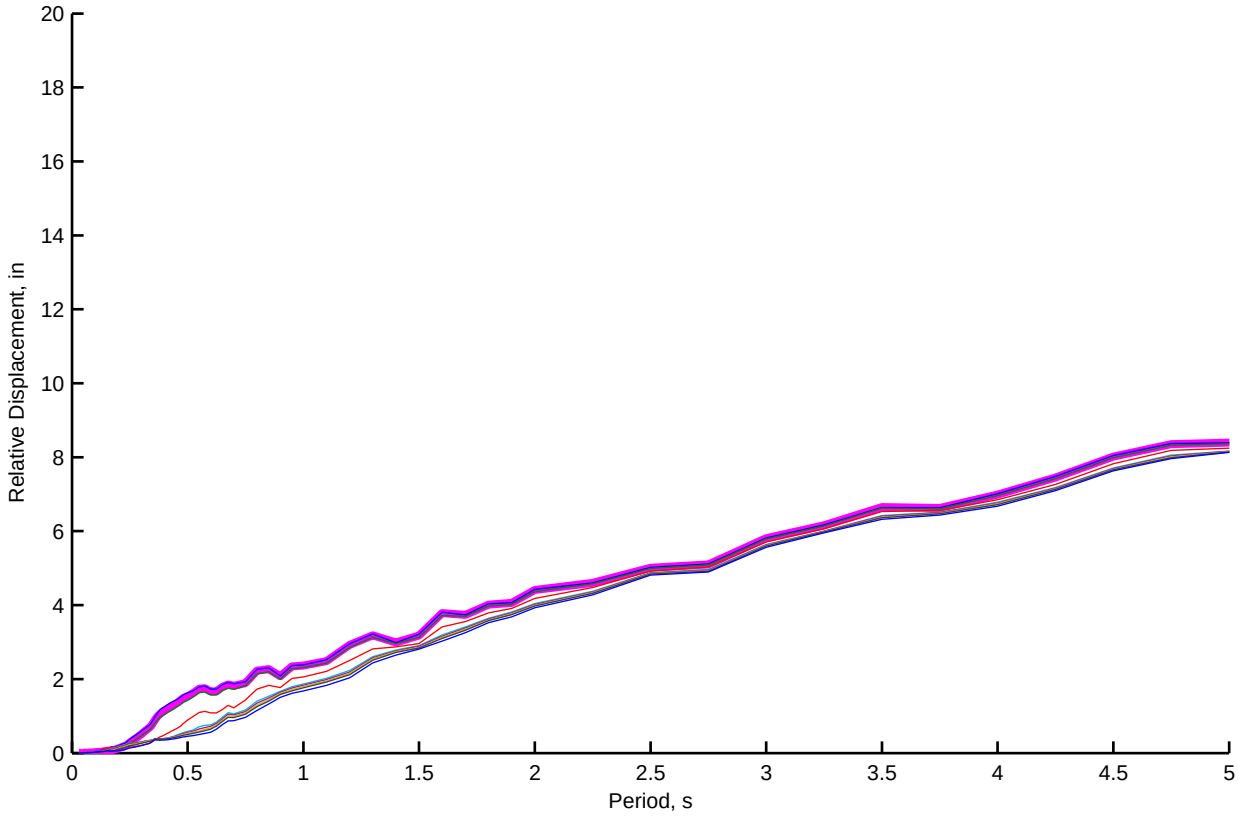

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 7 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component

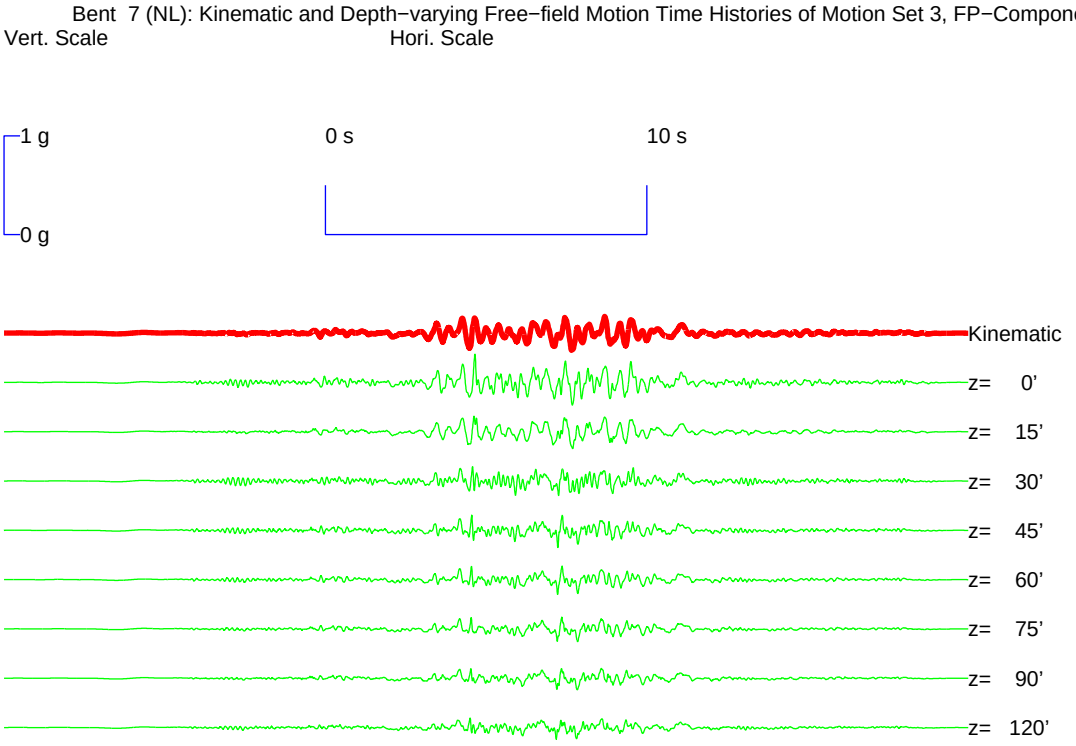


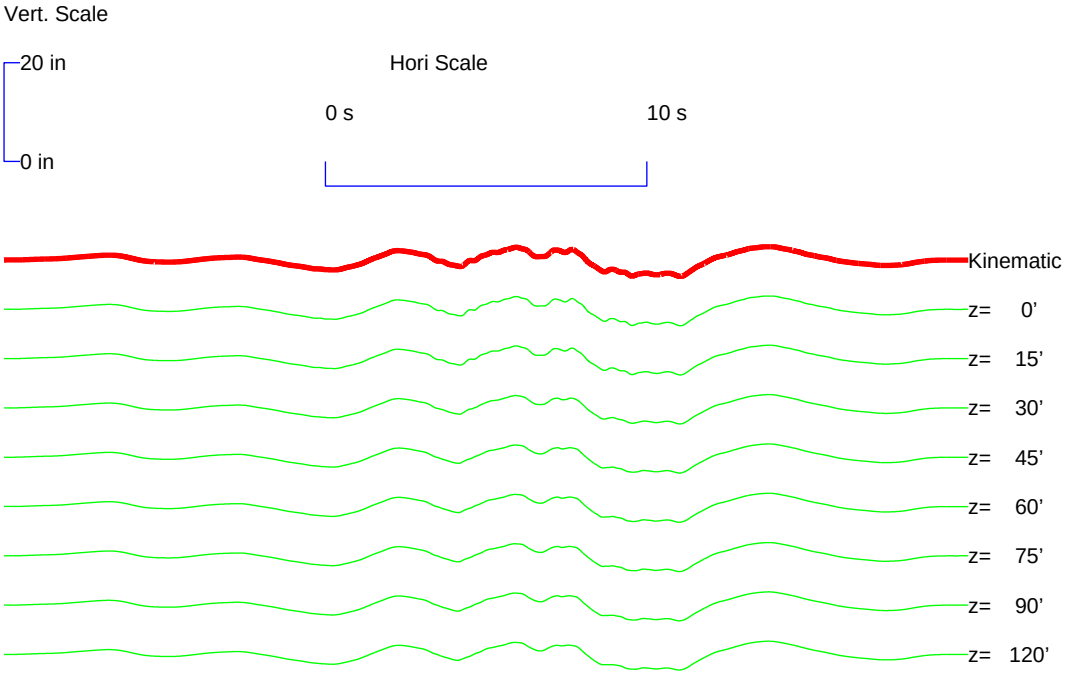


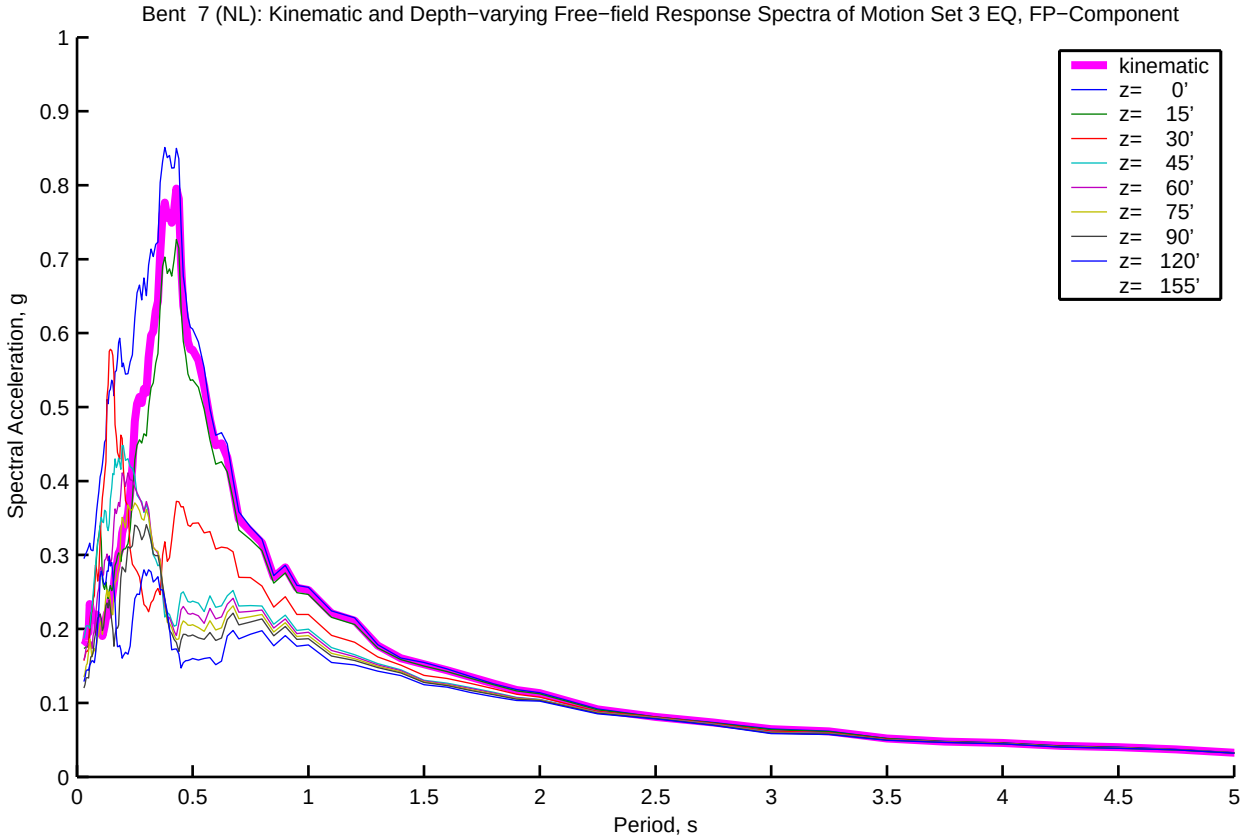

Bent 7 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 155'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

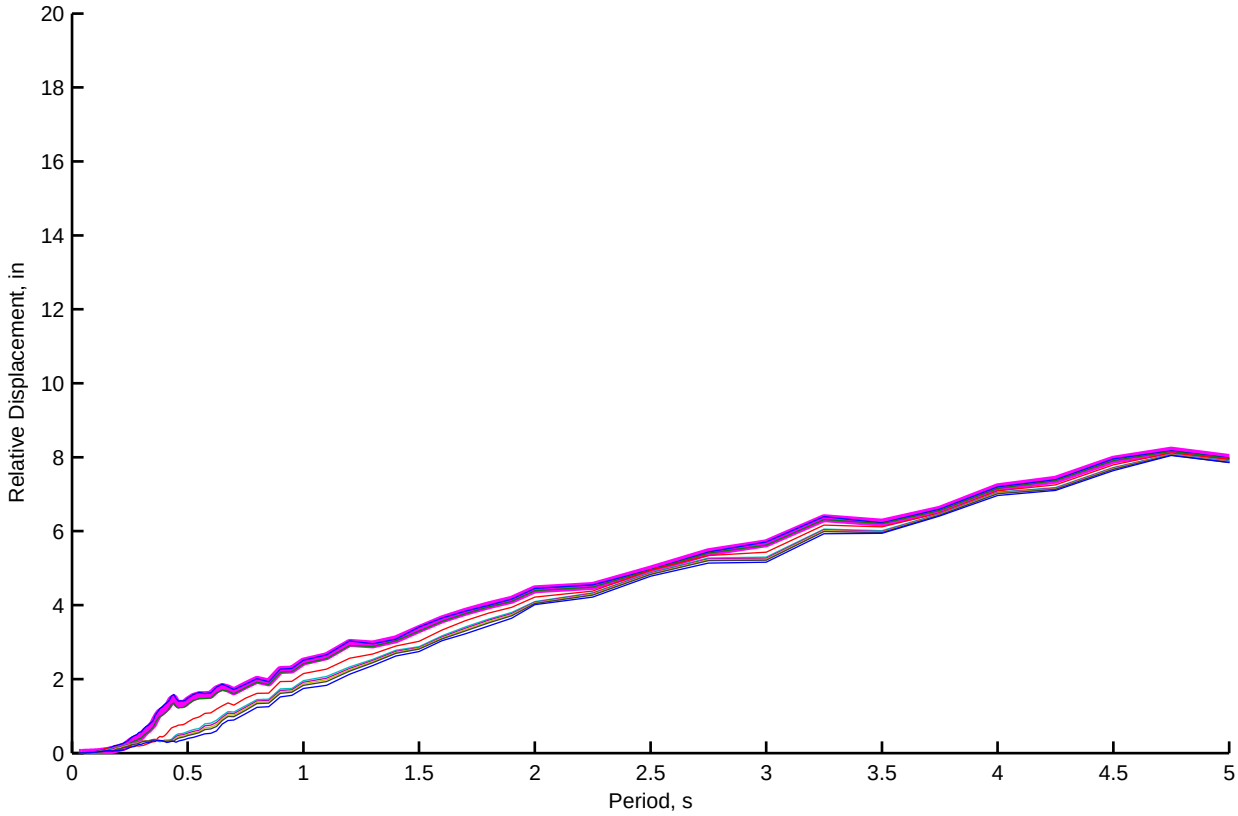

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 7 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component

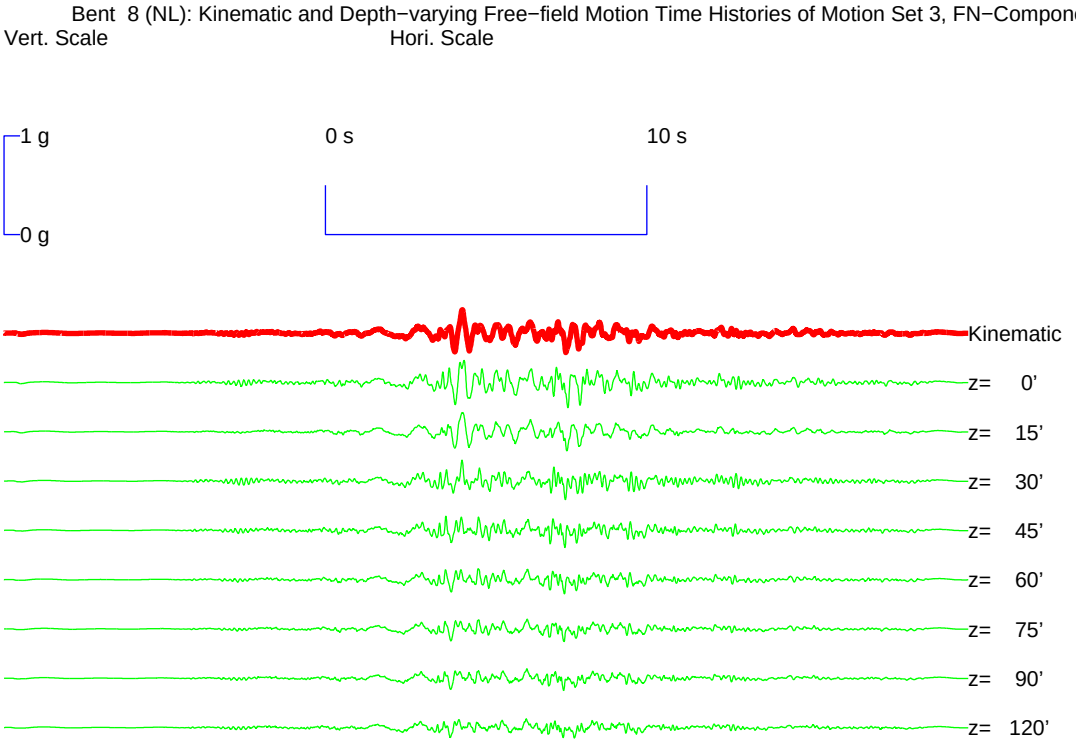


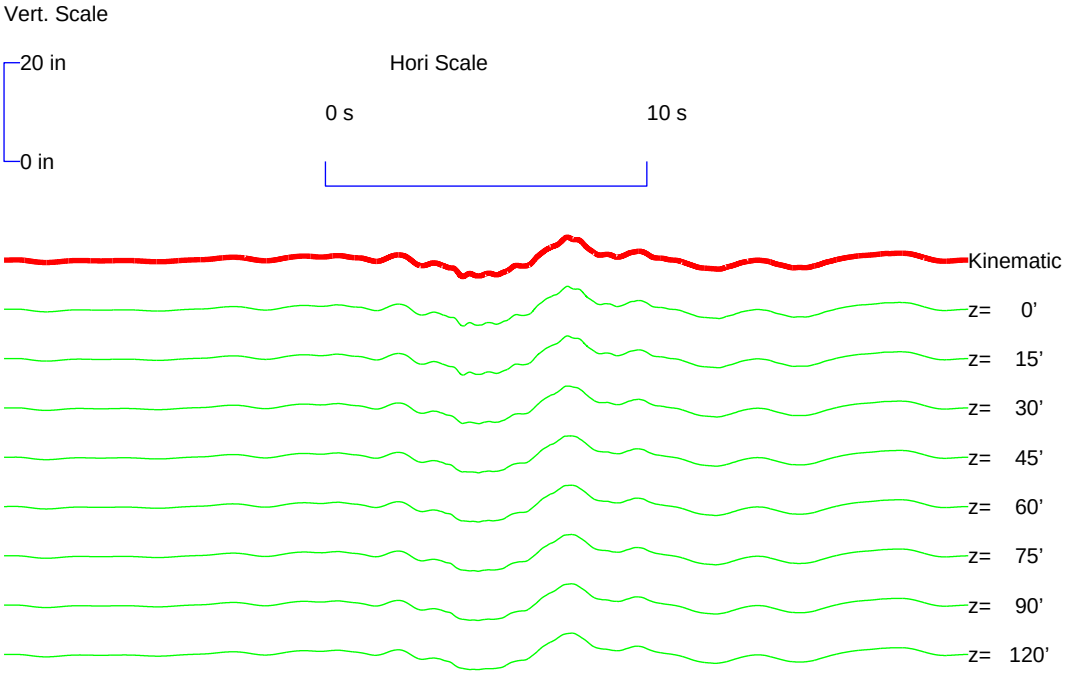


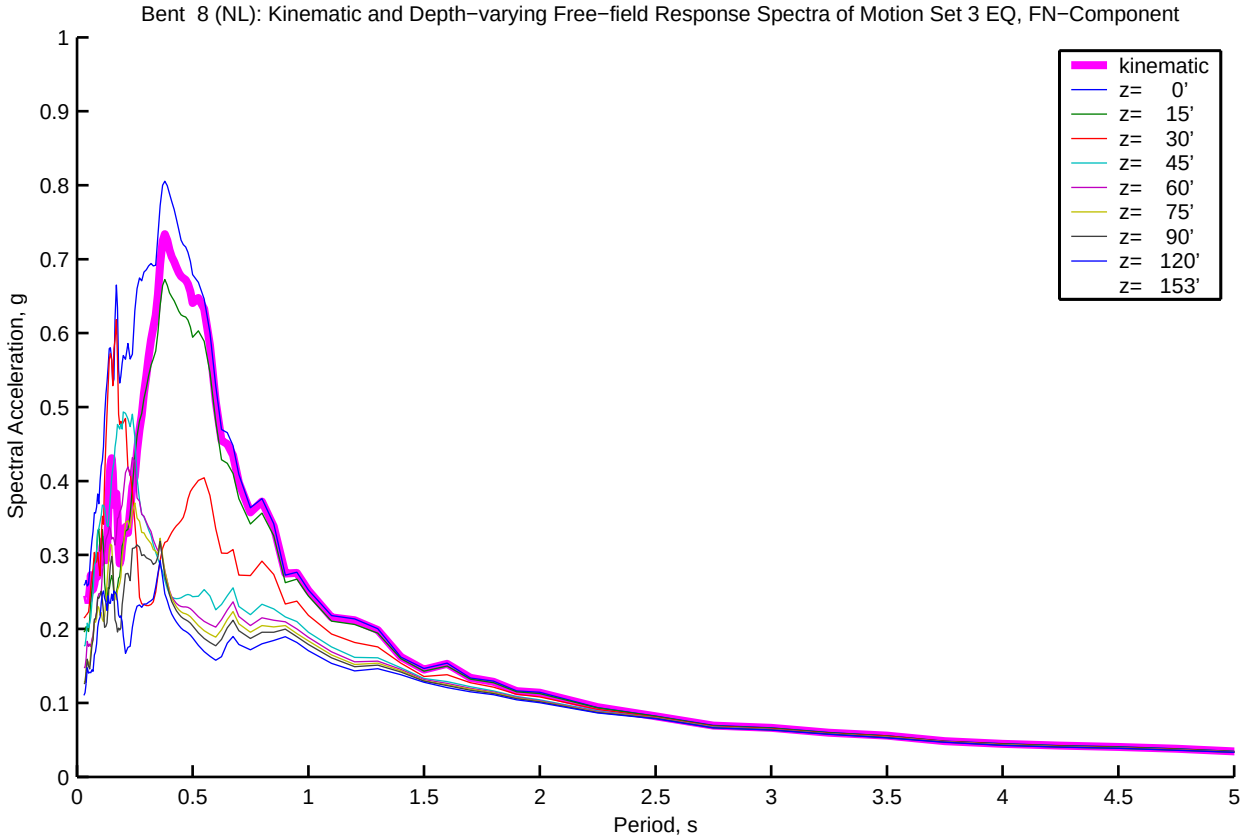

Bent 7 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 155'


Relative Displacement, in
Period, s

Bent 8 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component






Bent 8 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 153'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
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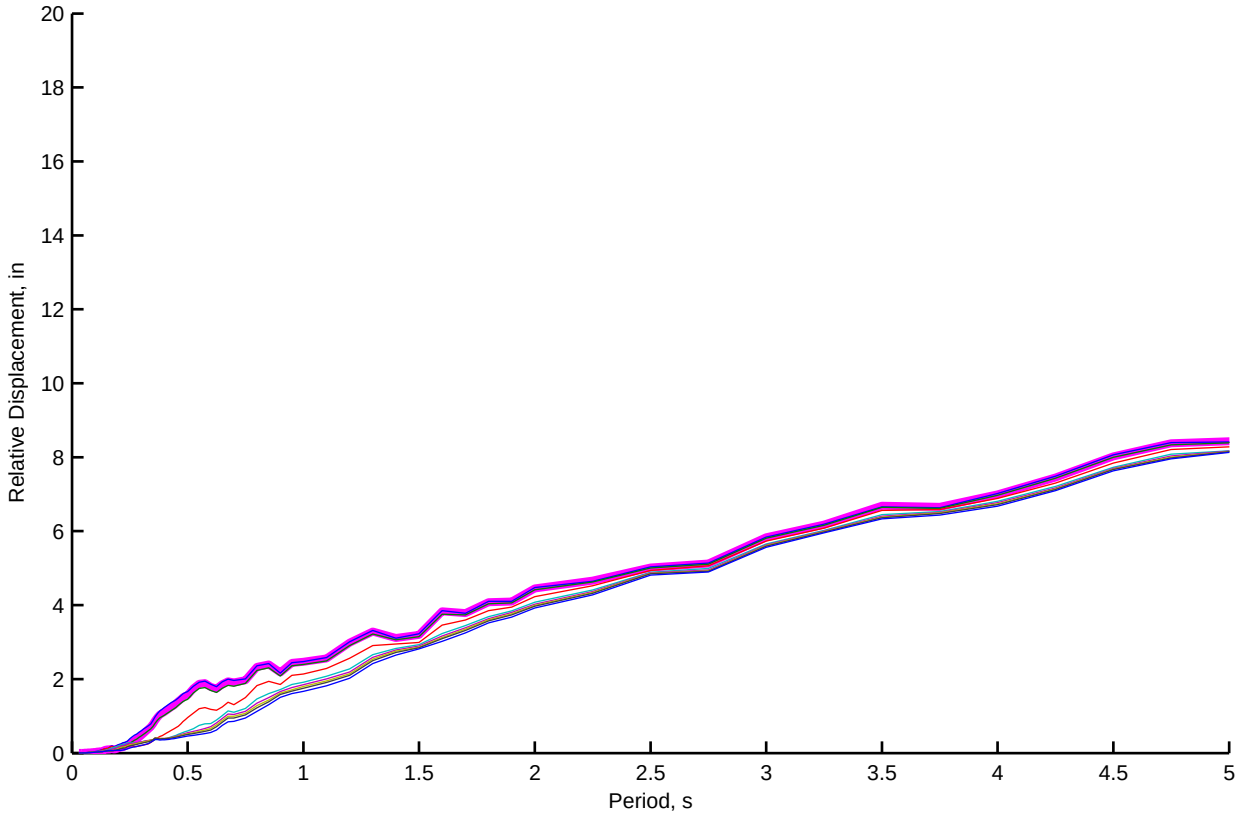
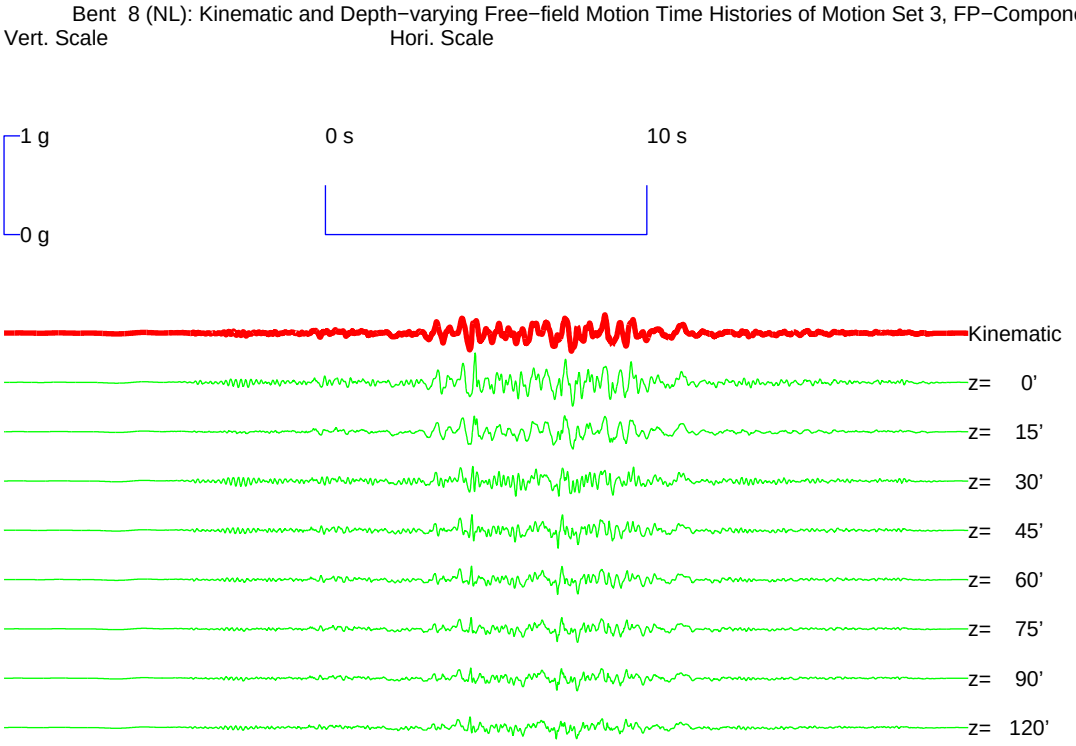
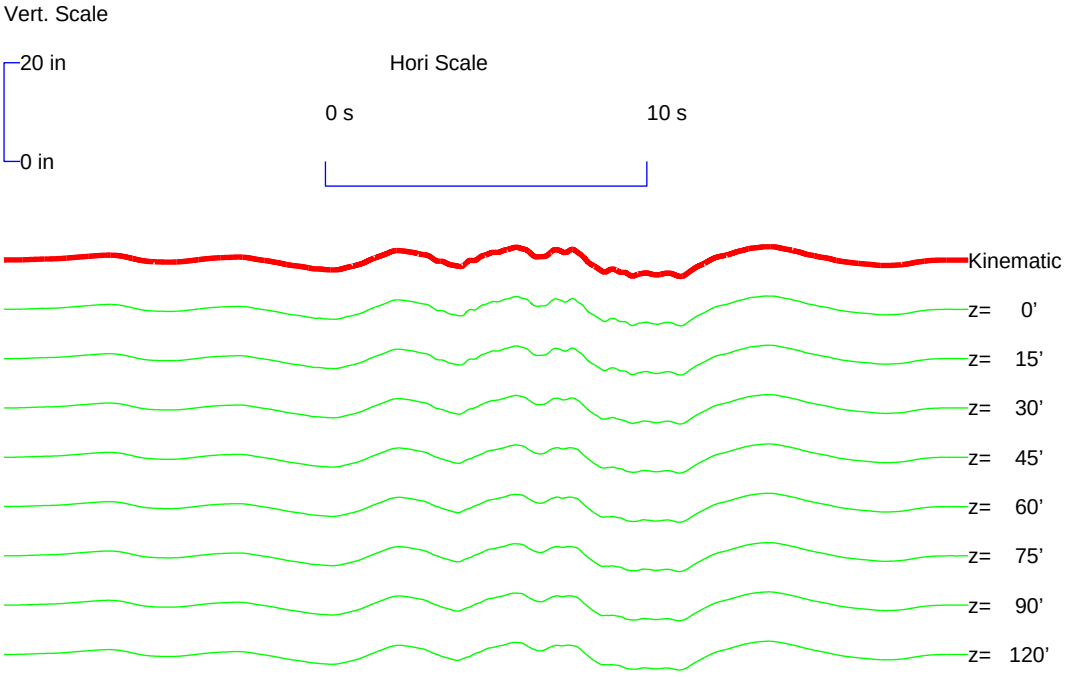
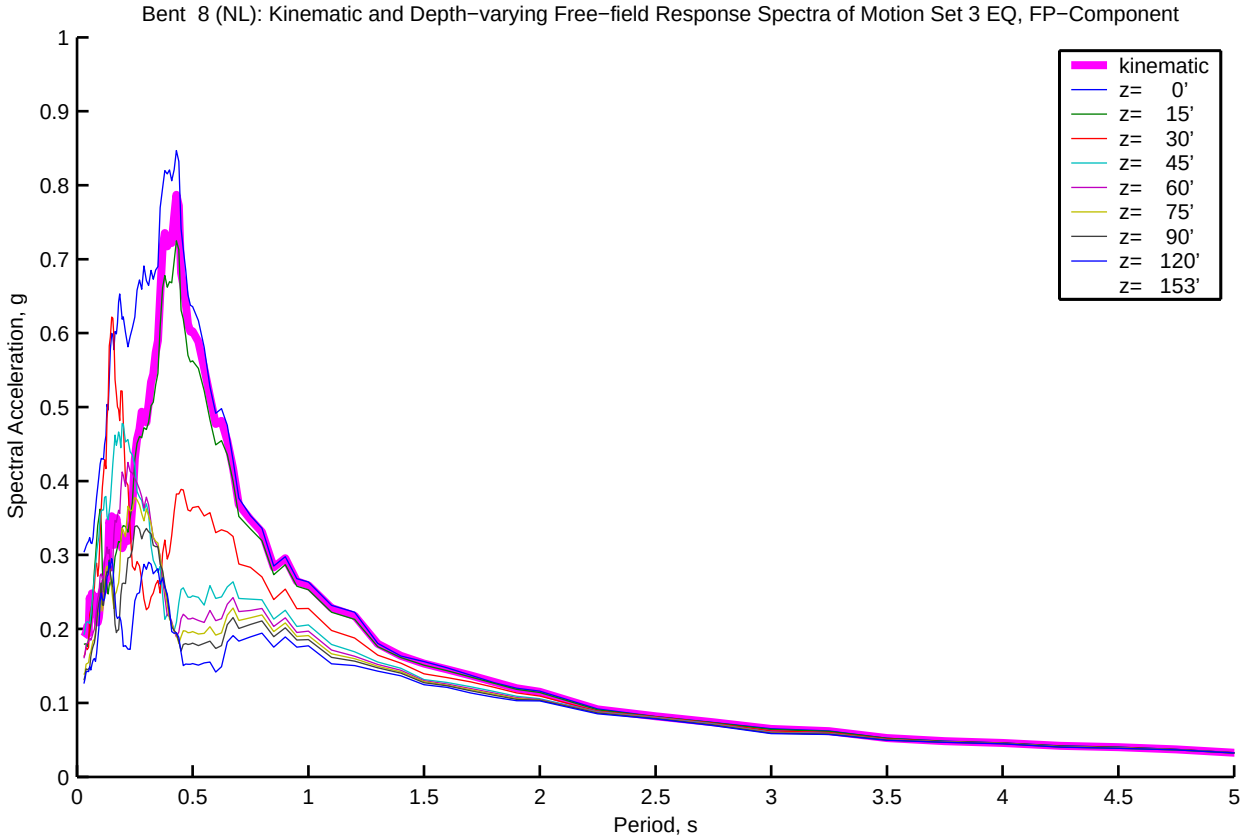
3.5
4
4.5
5

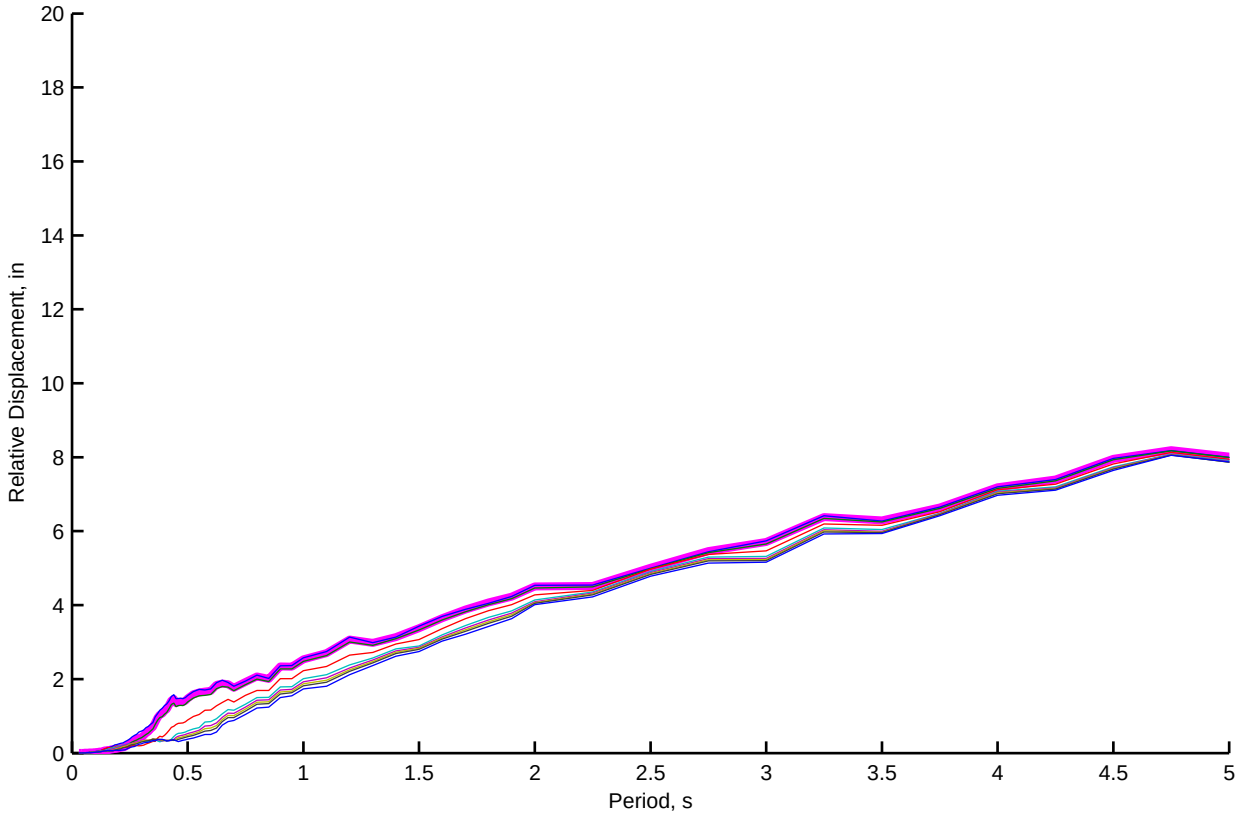

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 8 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component

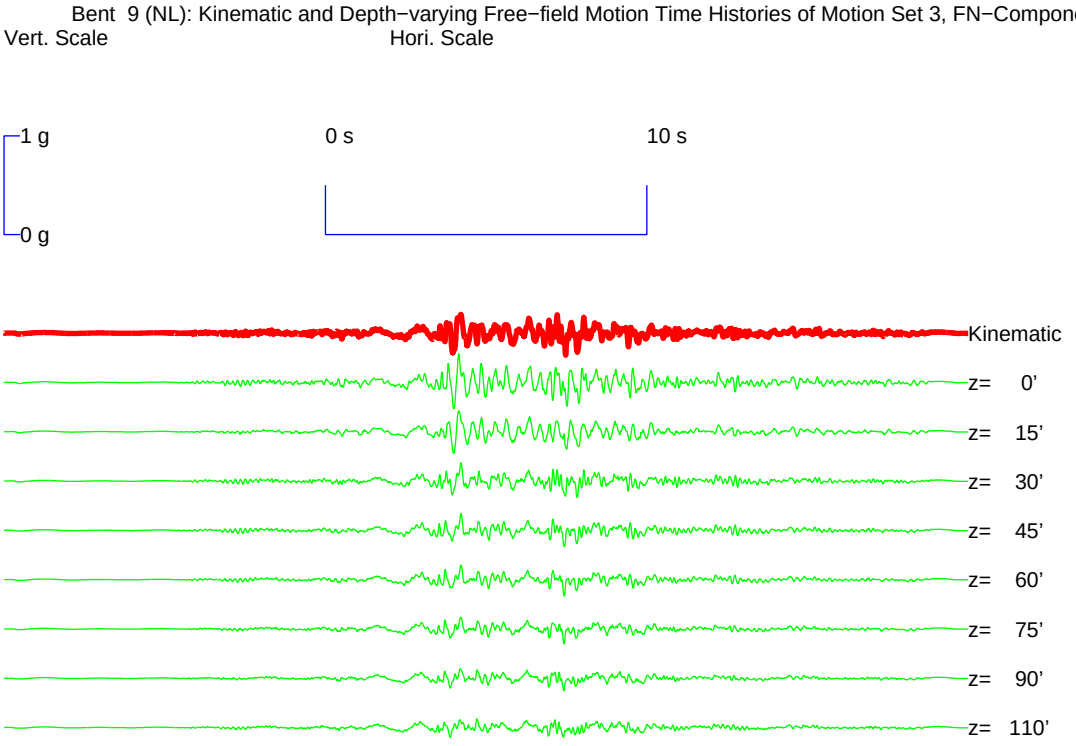


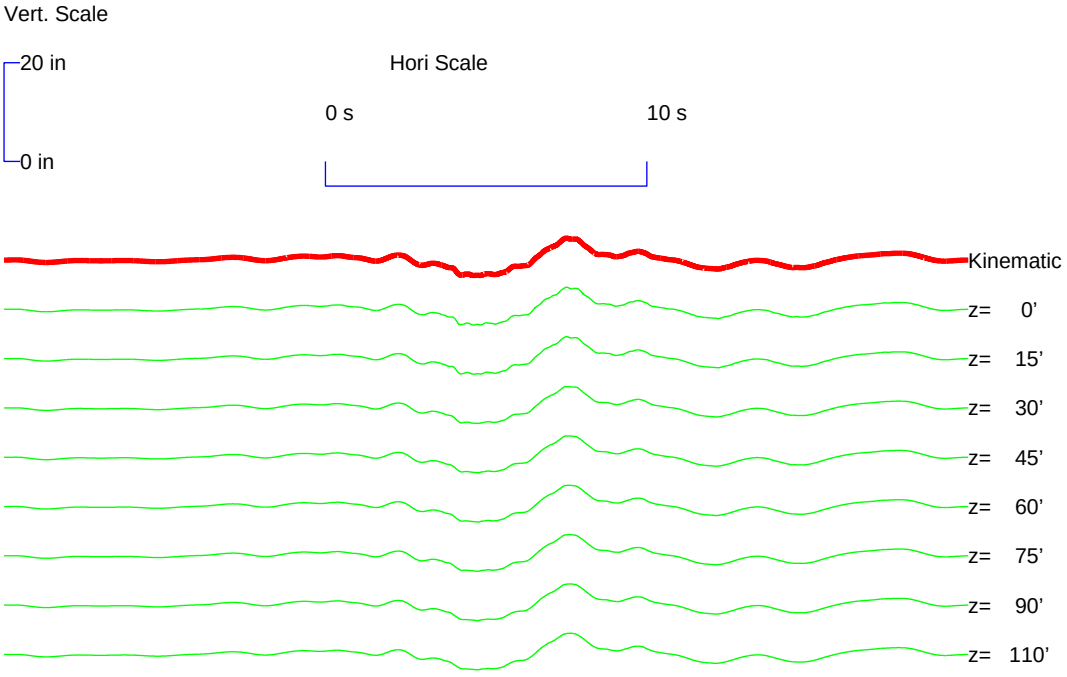


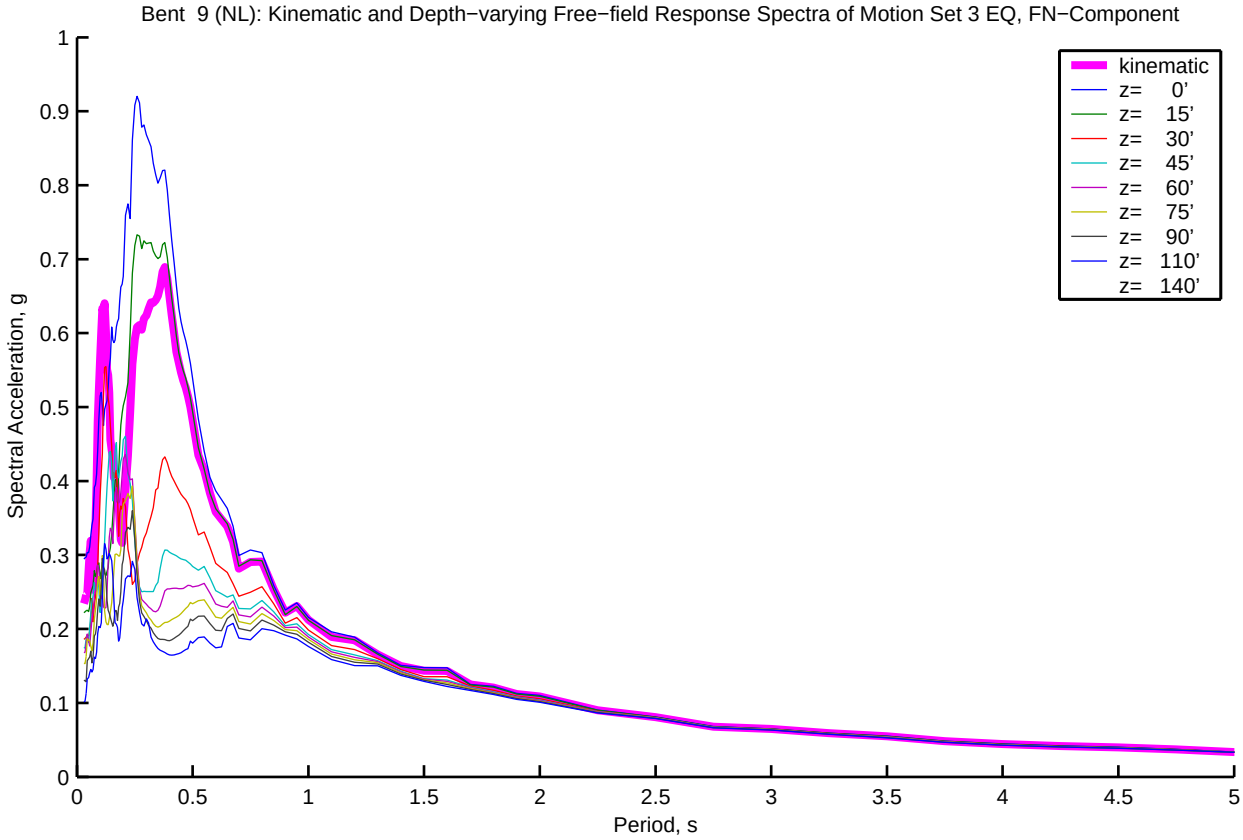

Bent 8 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 153'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5


Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 9 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component






Bent 9 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'
0
0.1
0.2
0.3
0.4
0.5
0.6
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0.8
0.9
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2.5
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4.5
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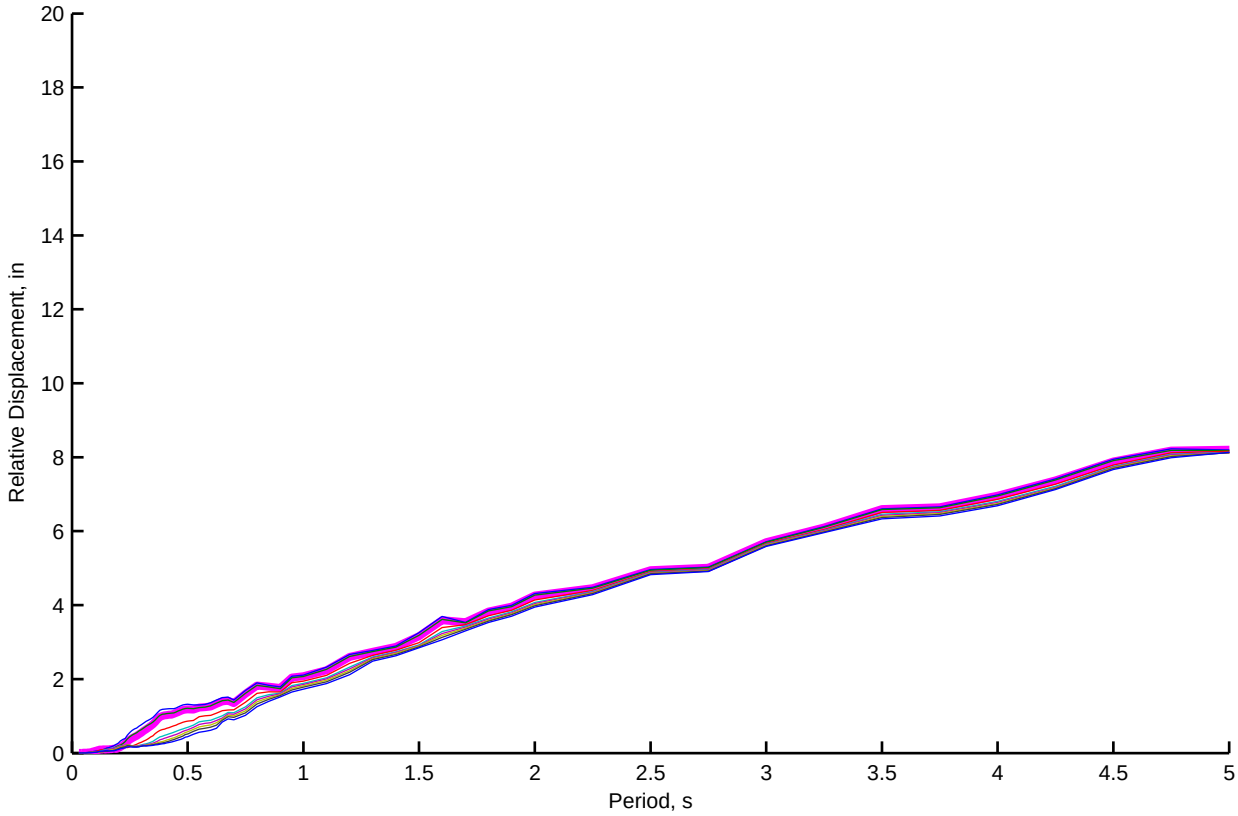
Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
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2.5
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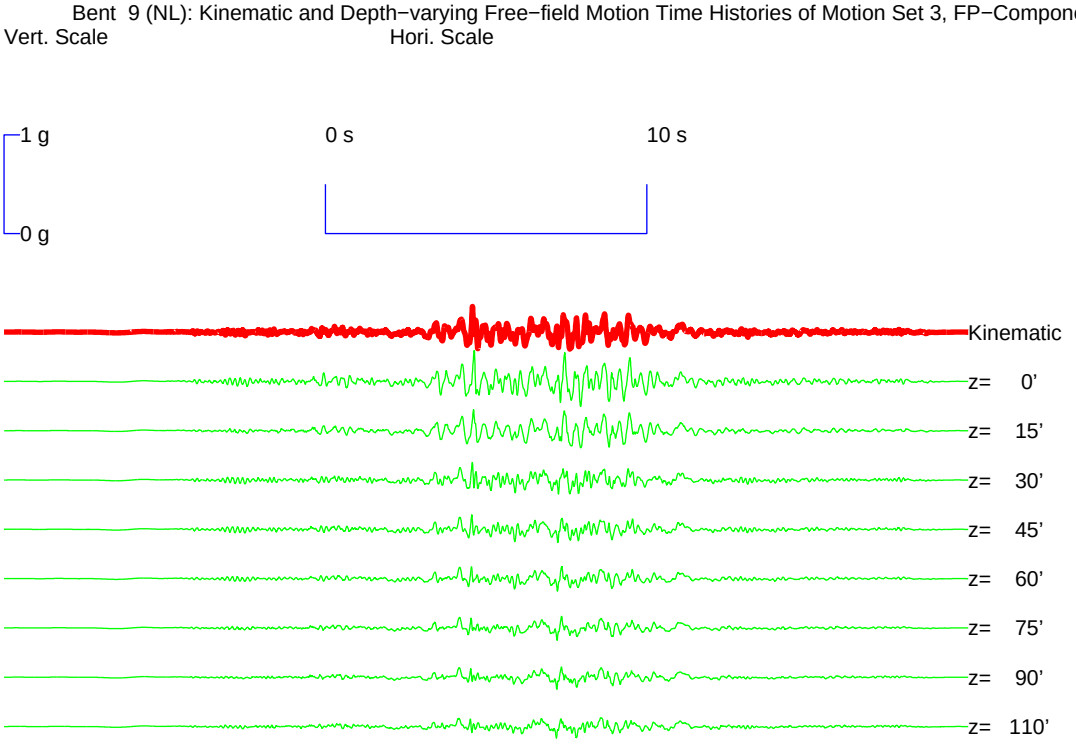
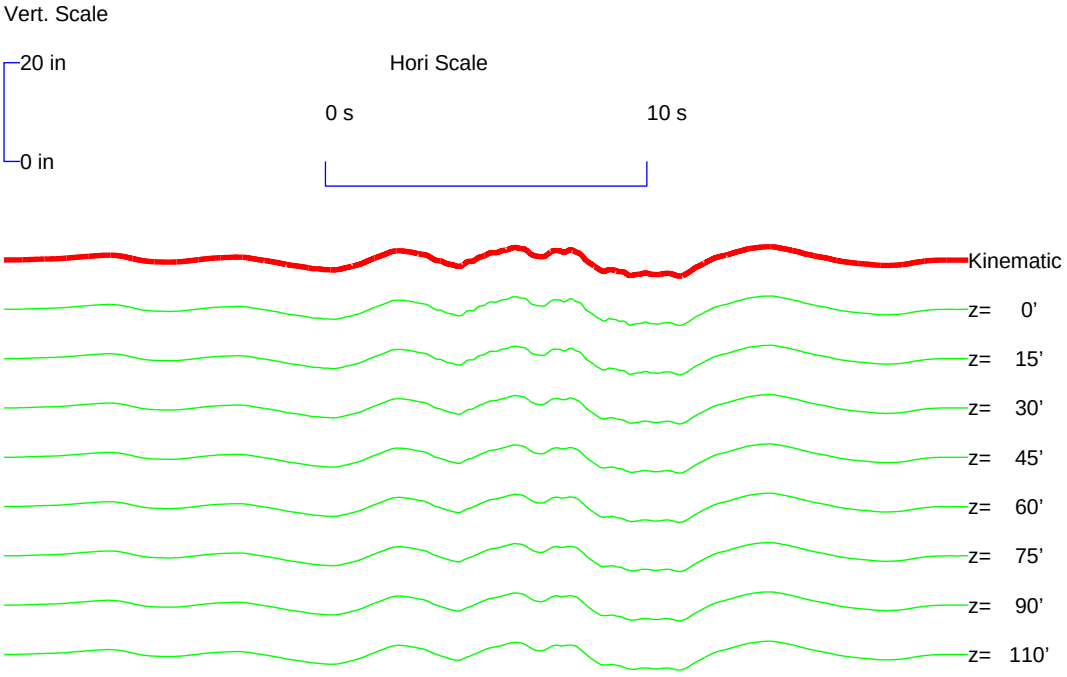
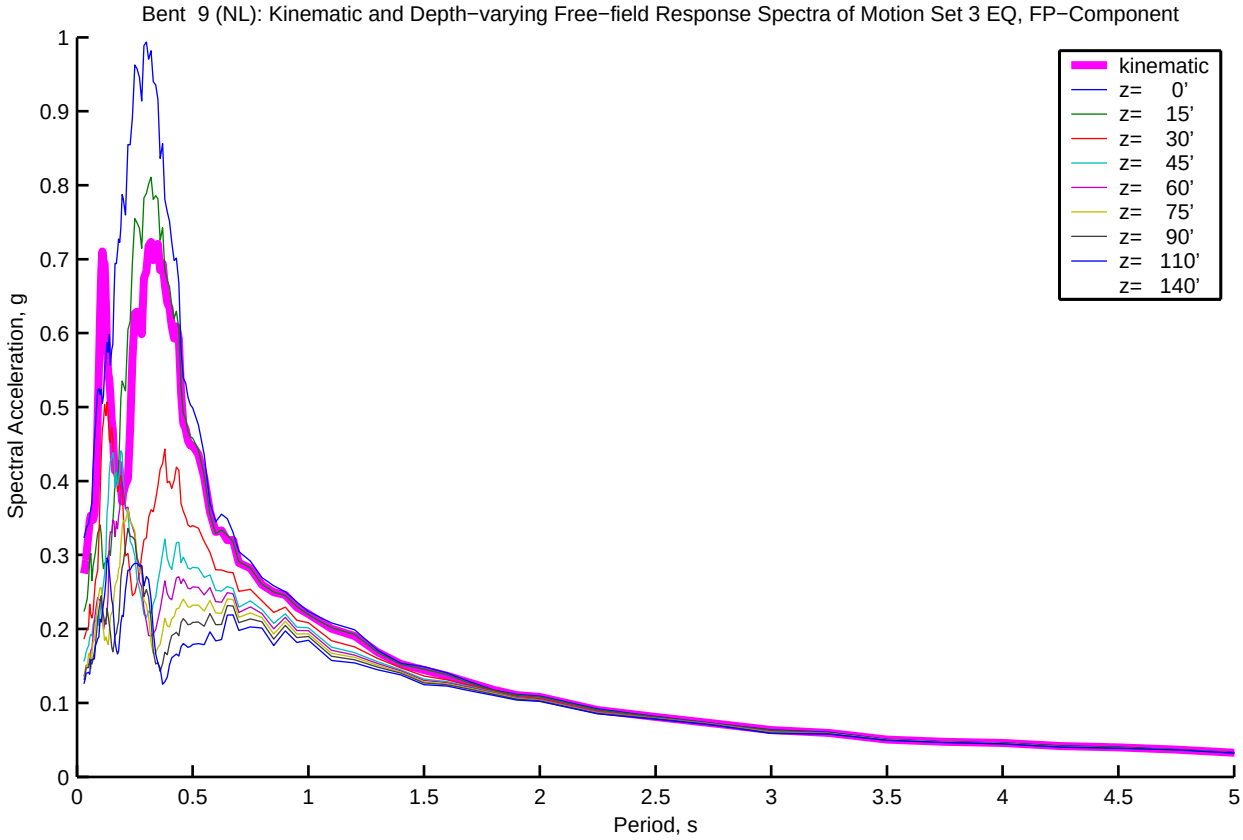
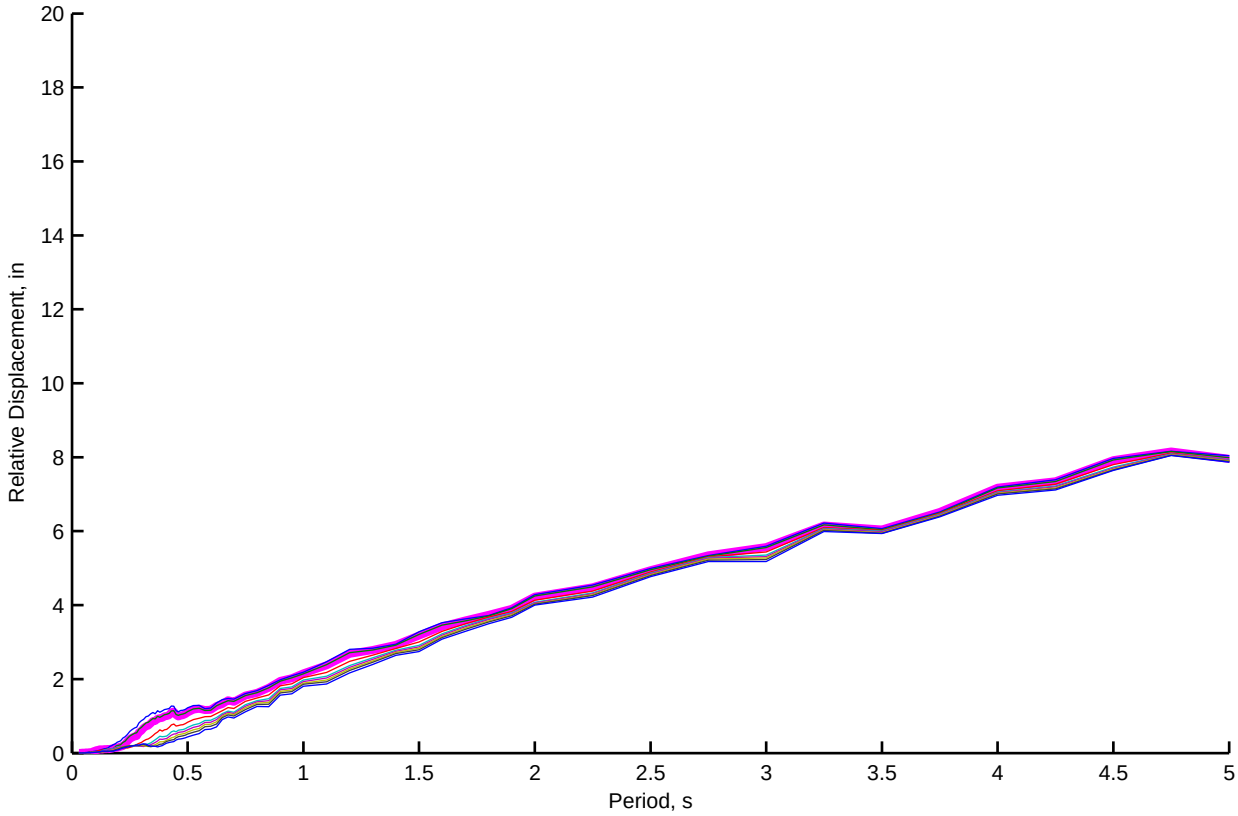
3.5
4
4.5
5

Bent 9 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component

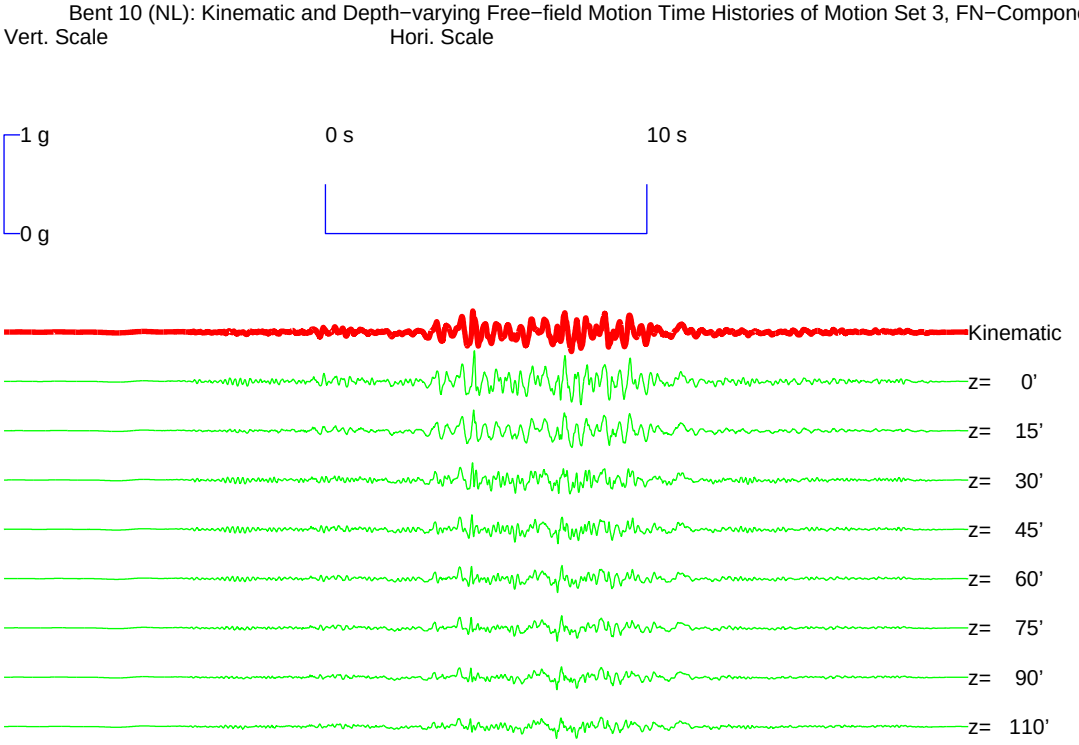


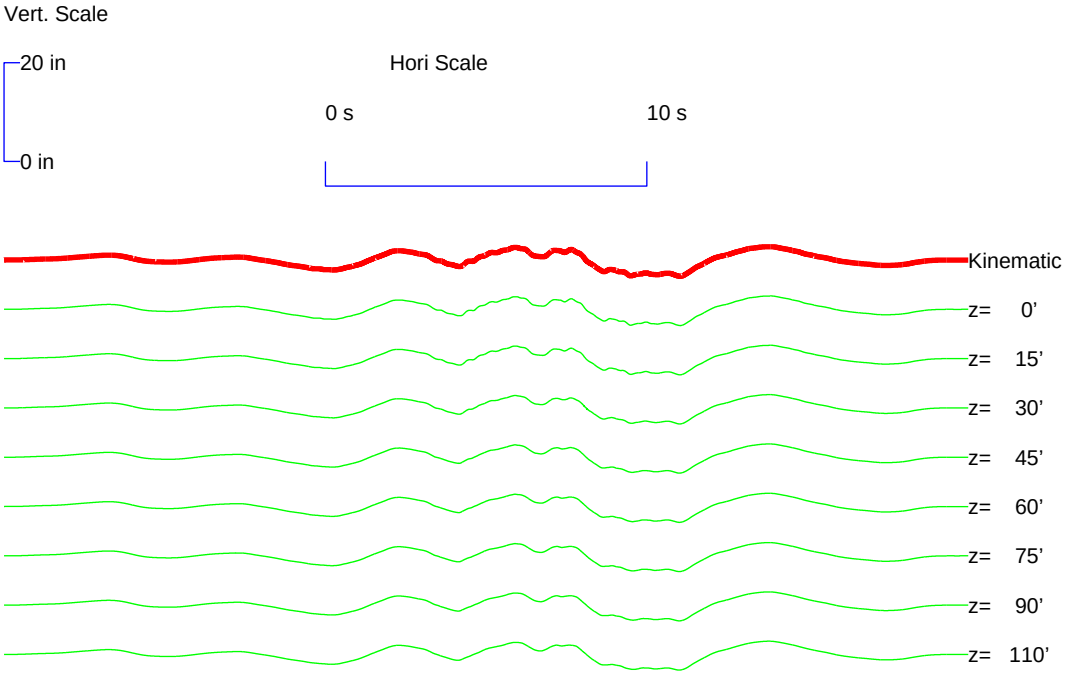


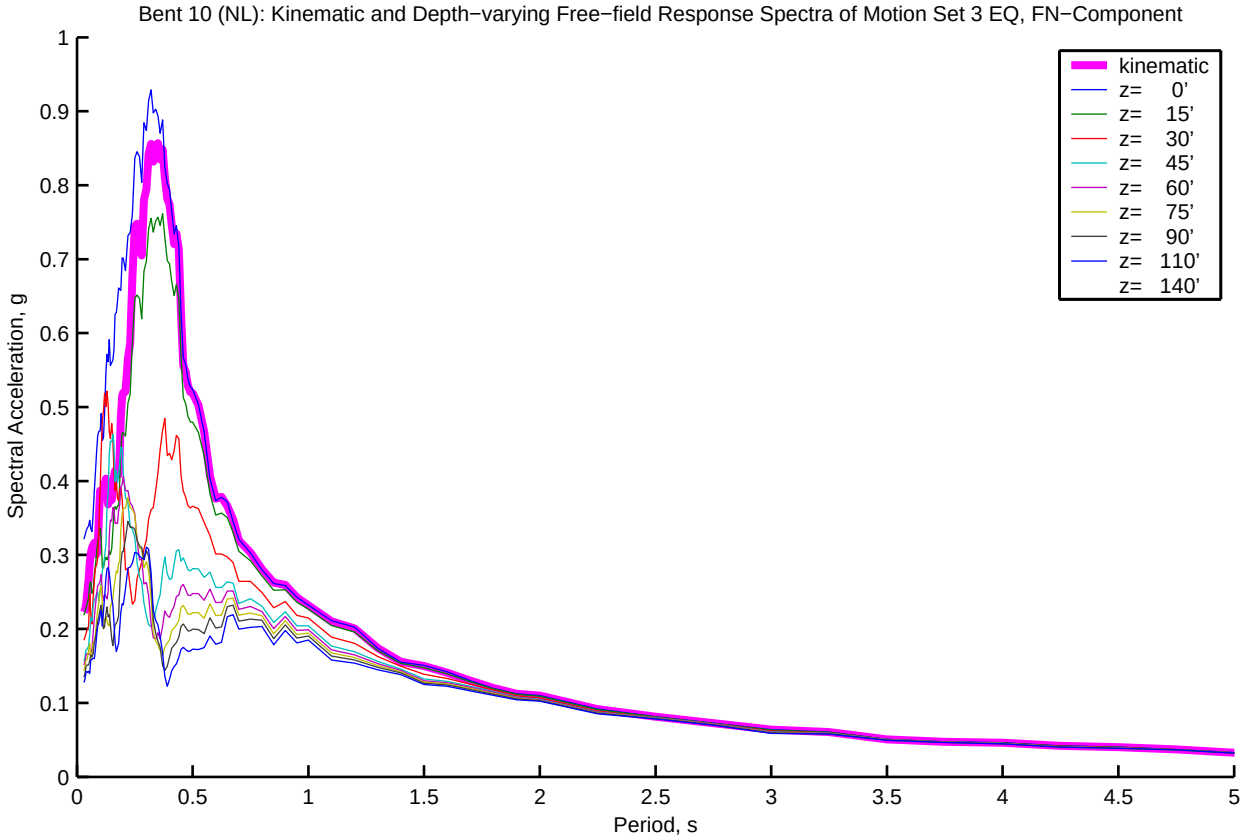

Bent 9 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'

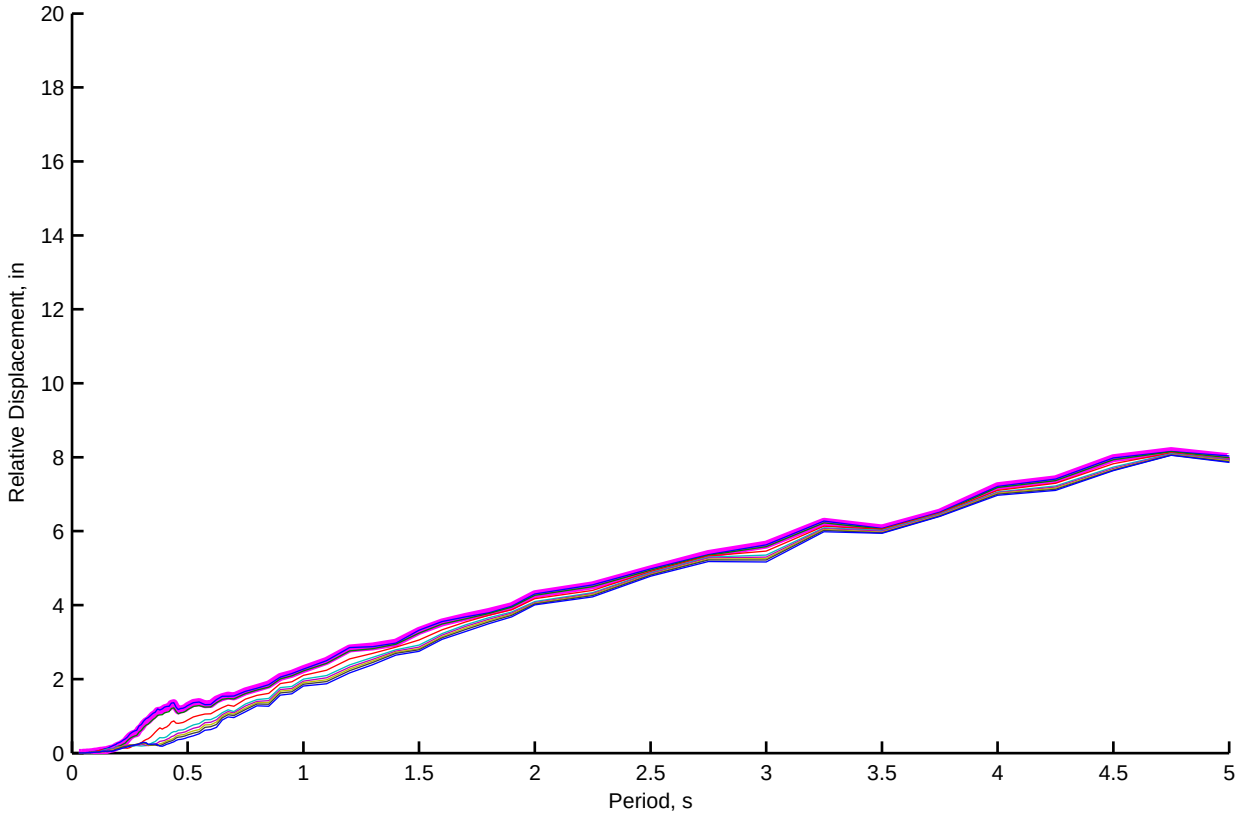

Relative Displacement, in
Period, s

Bent 10 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component

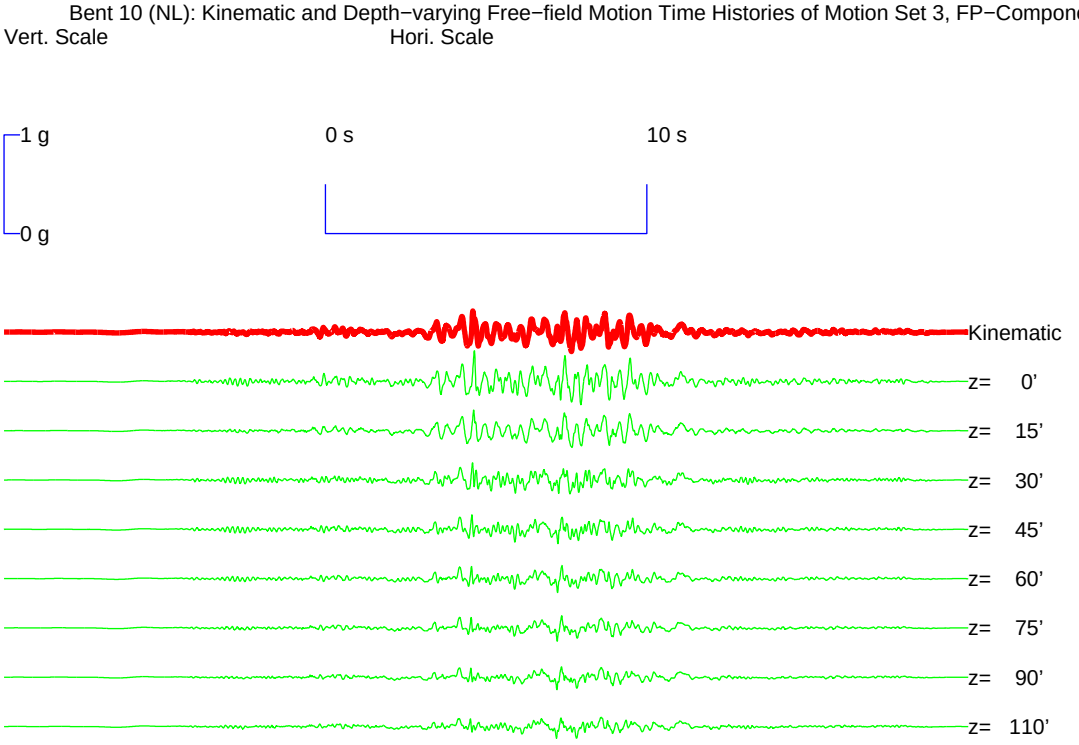


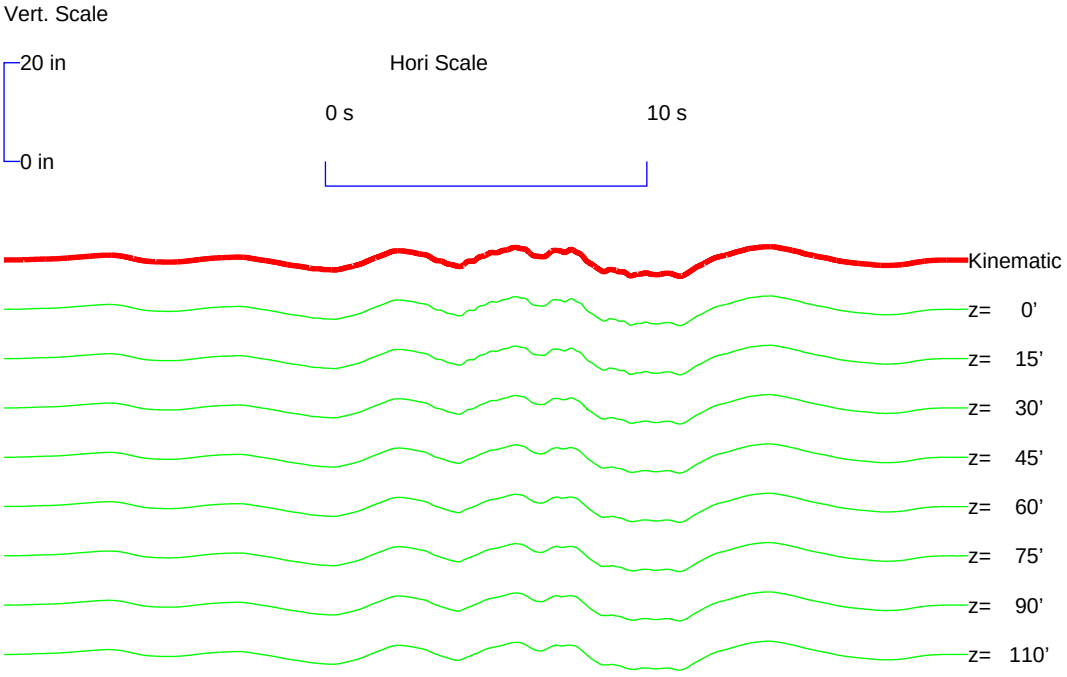


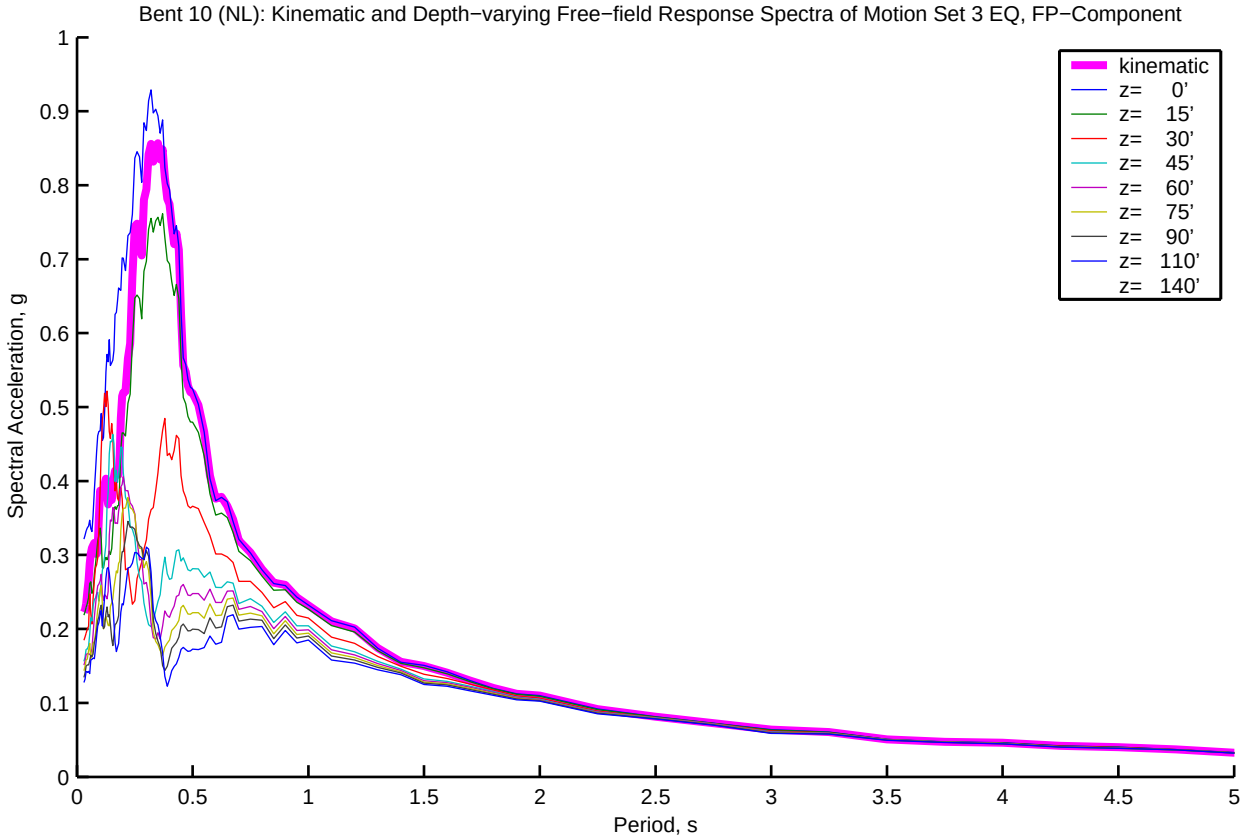

Bent 10 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'

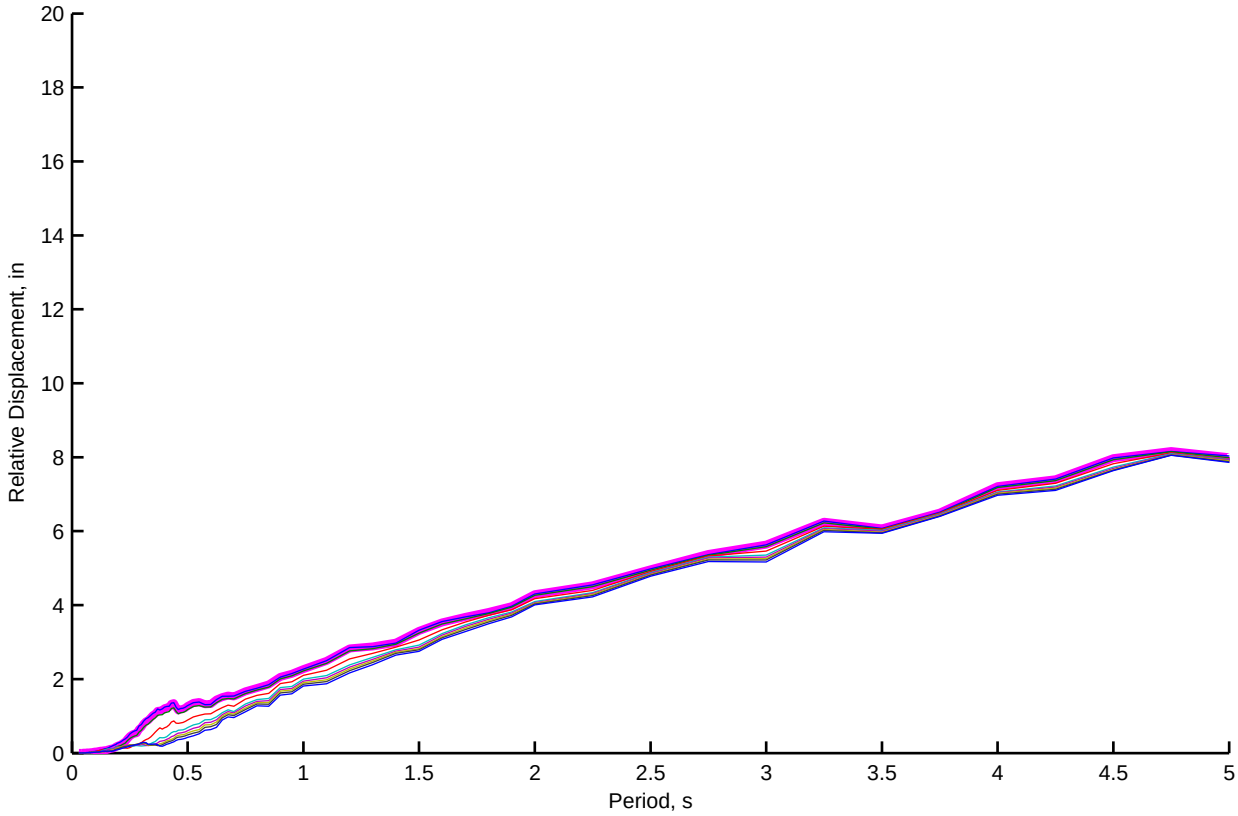

Relative Displacement, in
Period, s

Bent 10 (NL): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component

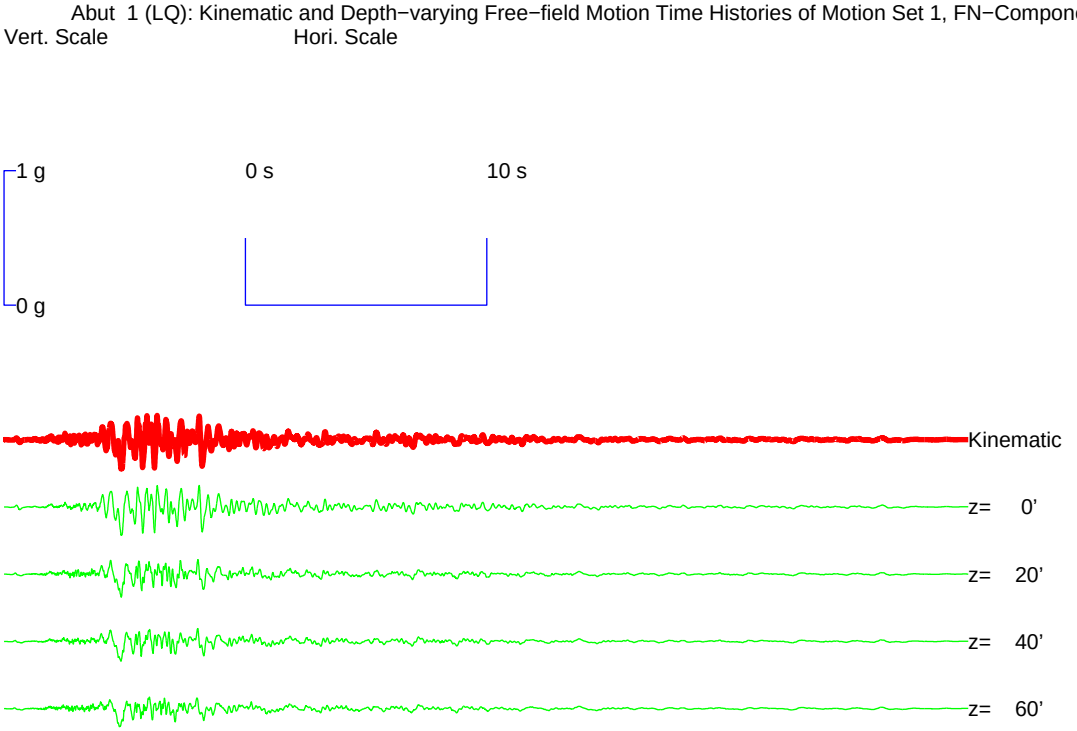


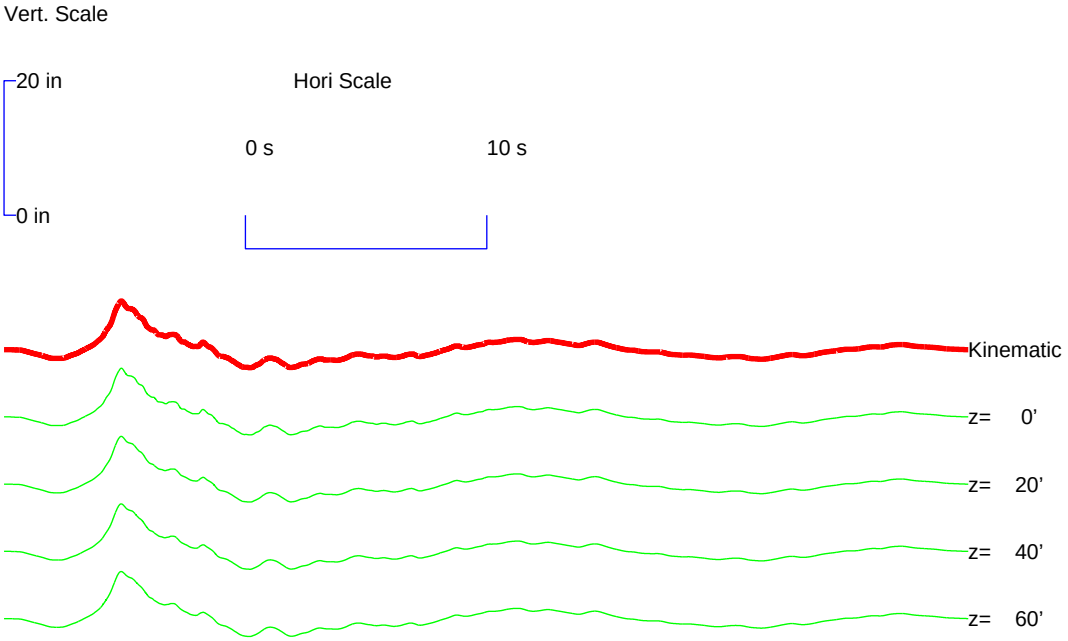


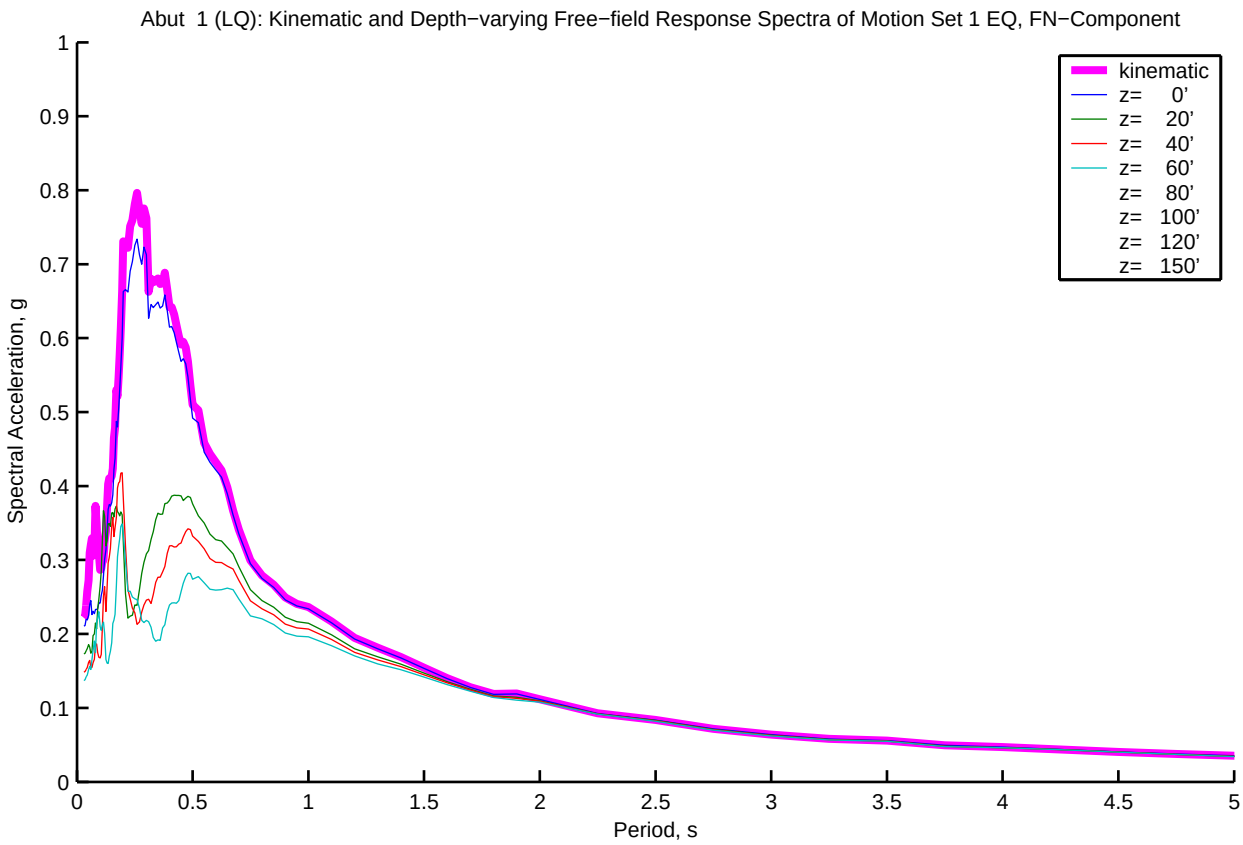

Bent 10 (NL): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'

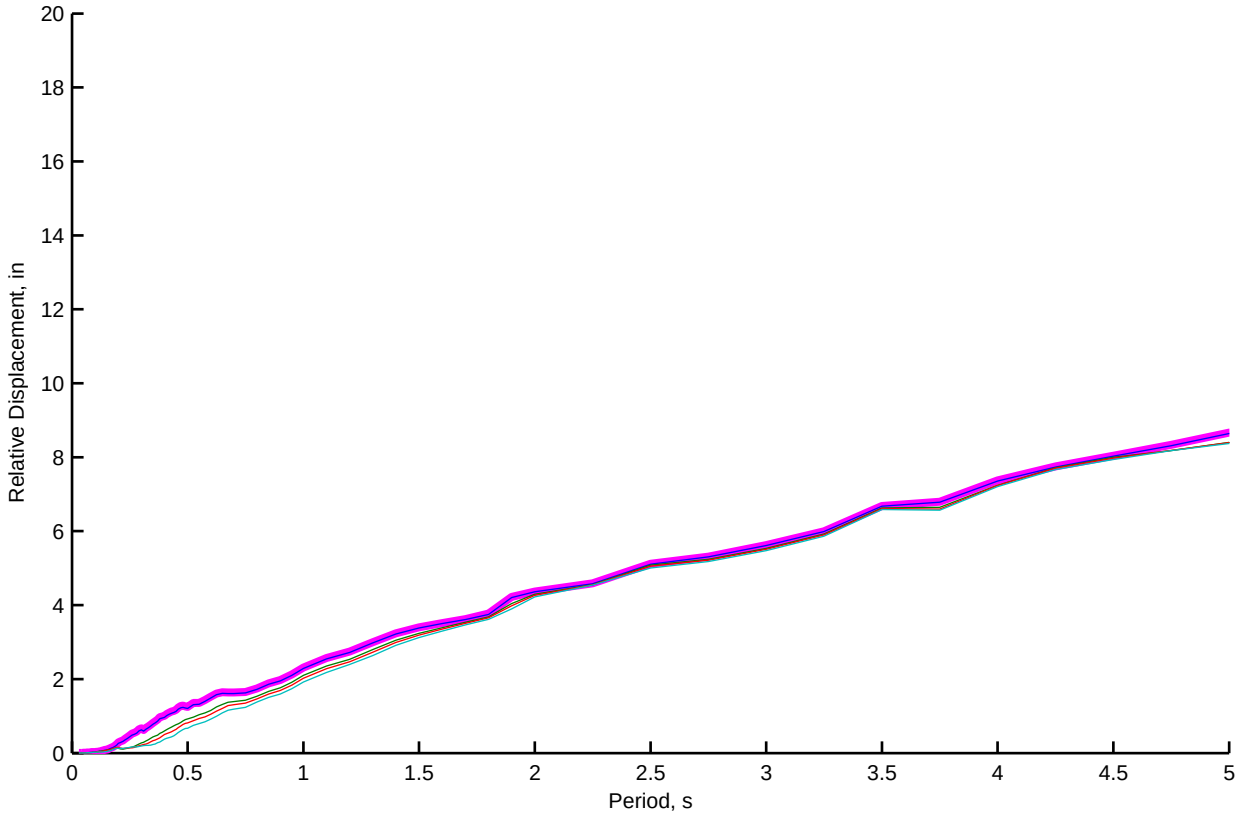

Relative Displacement, in
Period, s

Abut 1 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component

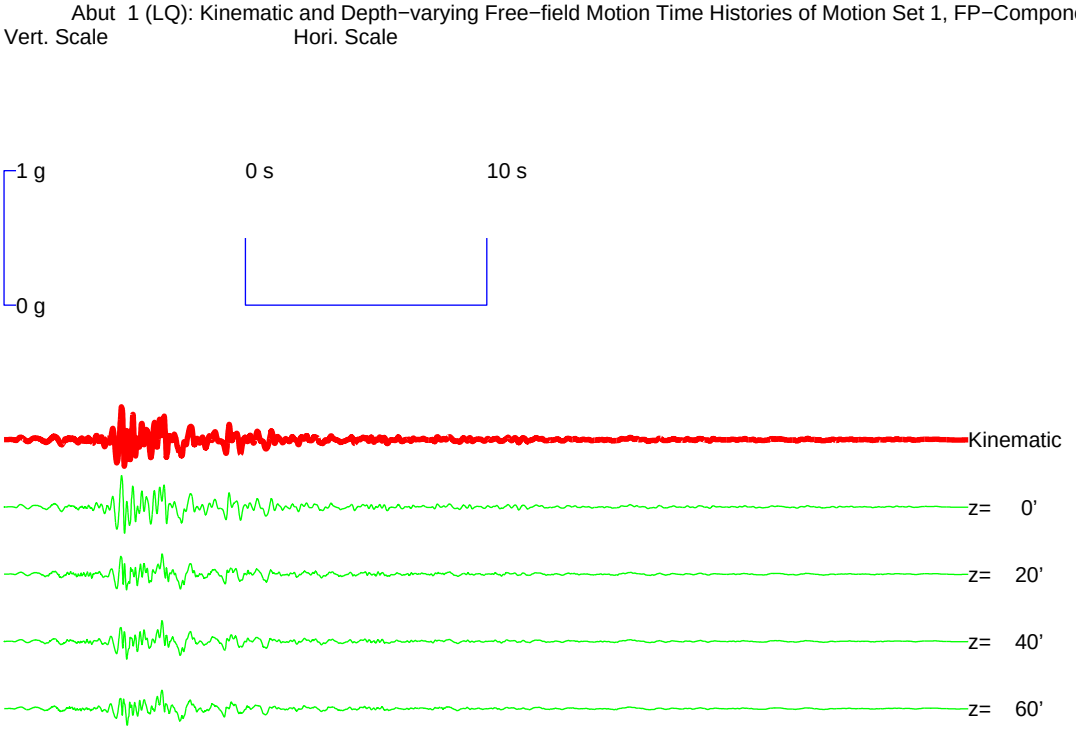


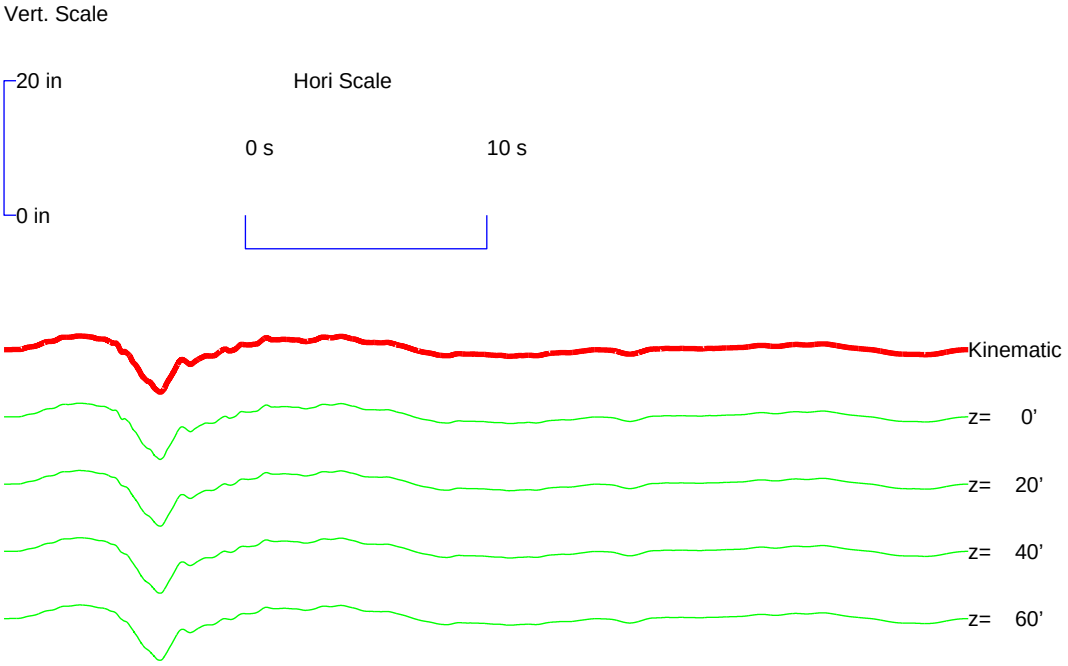


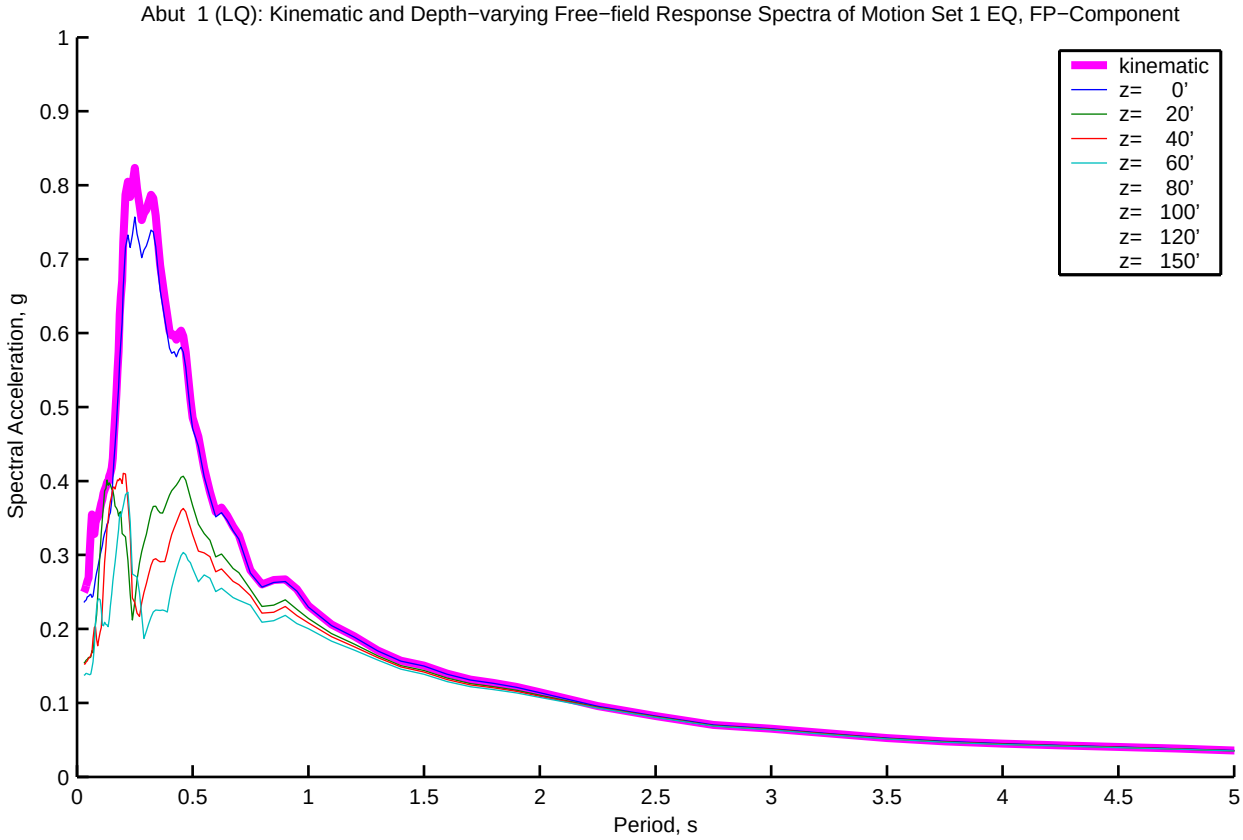

Abut 1 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 150'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

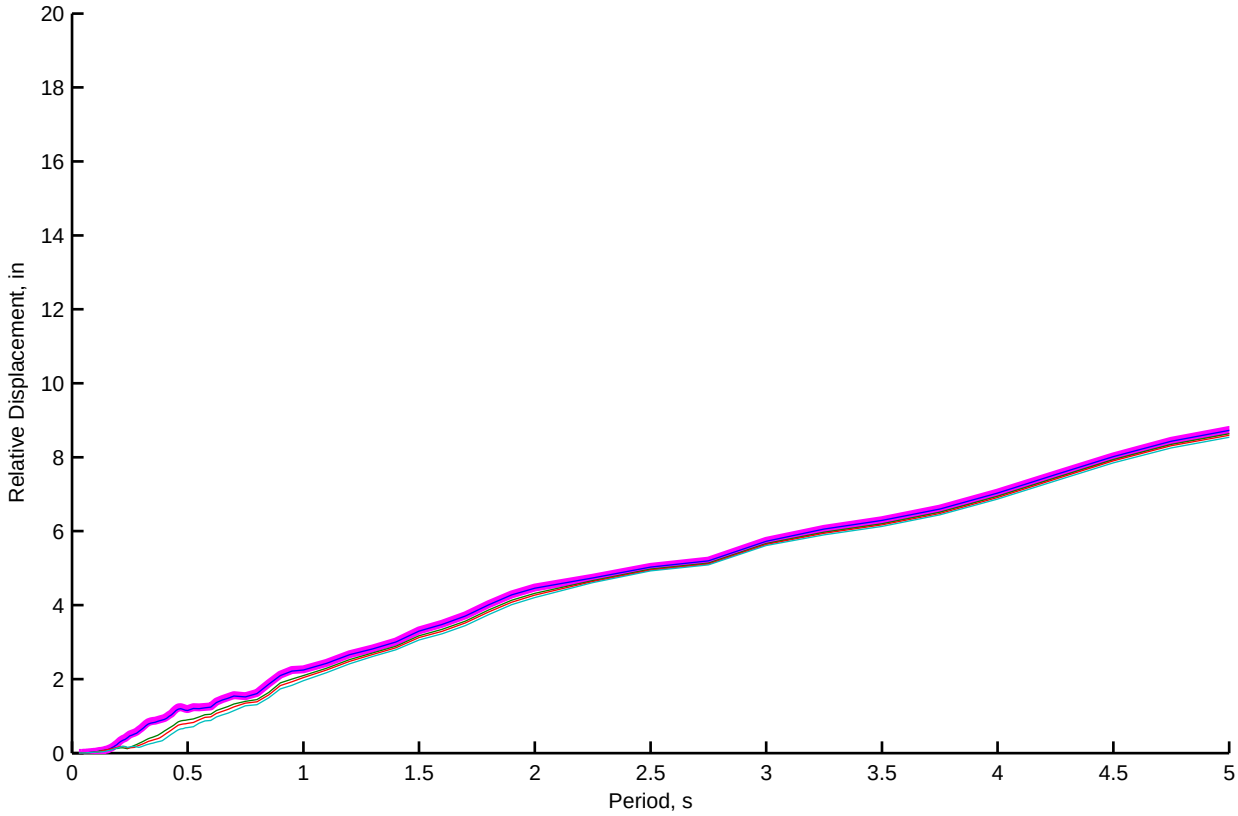

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Abut 1 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component

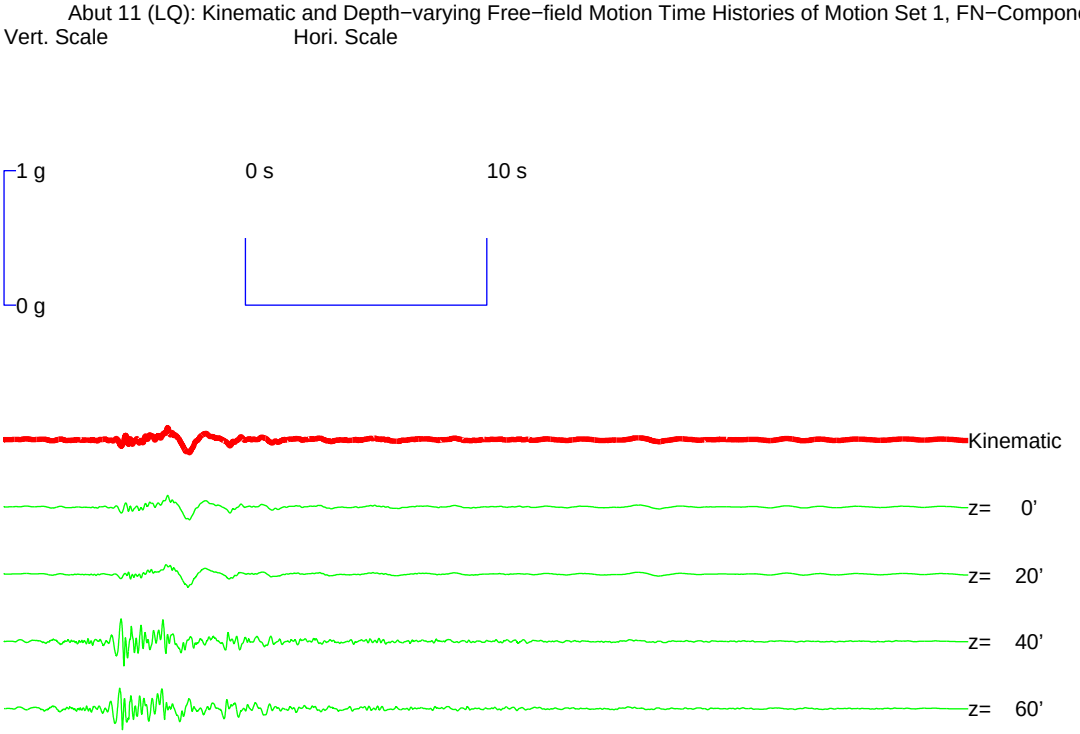


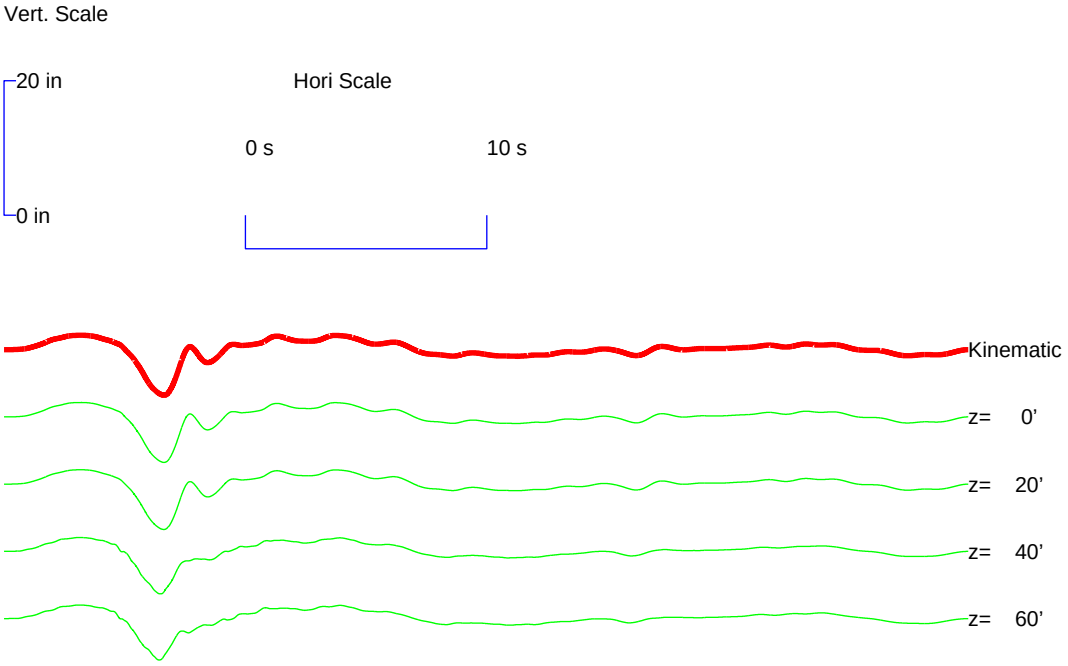


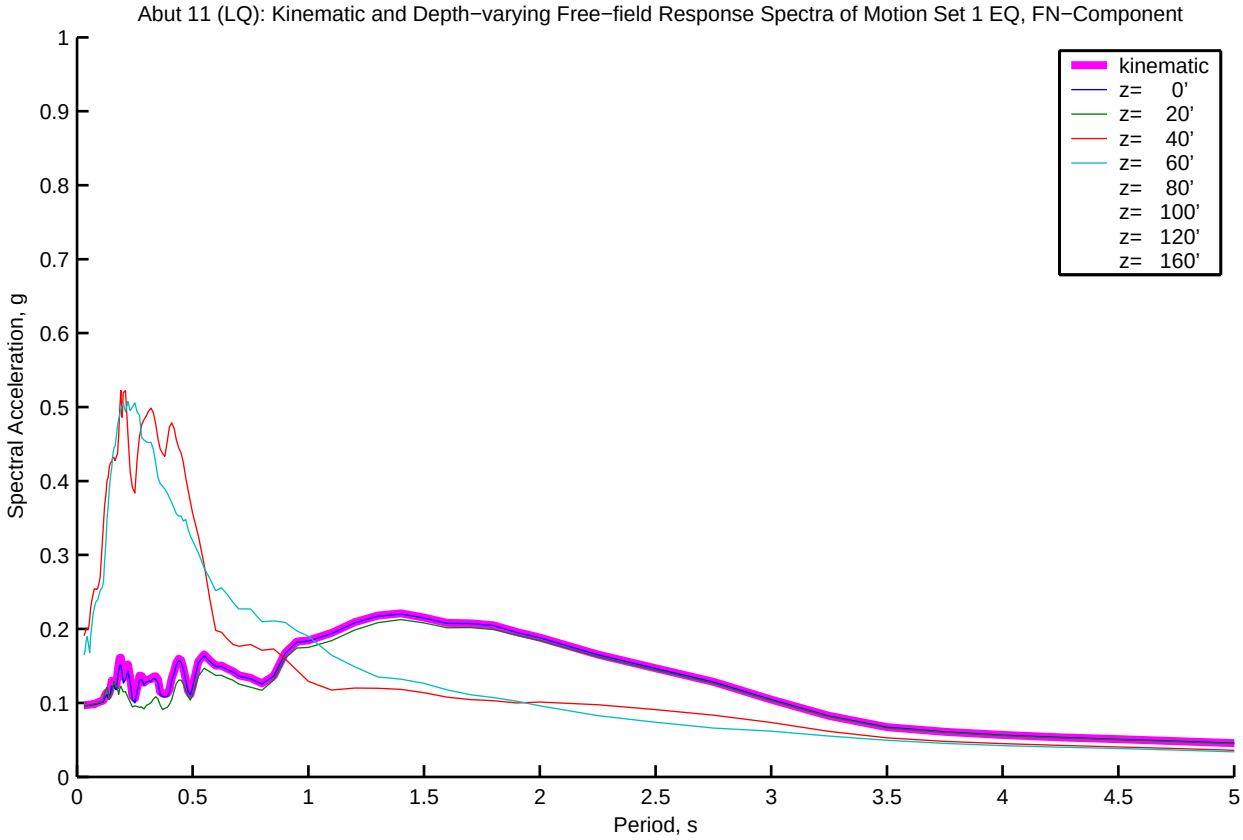

Abut 1 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 150'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

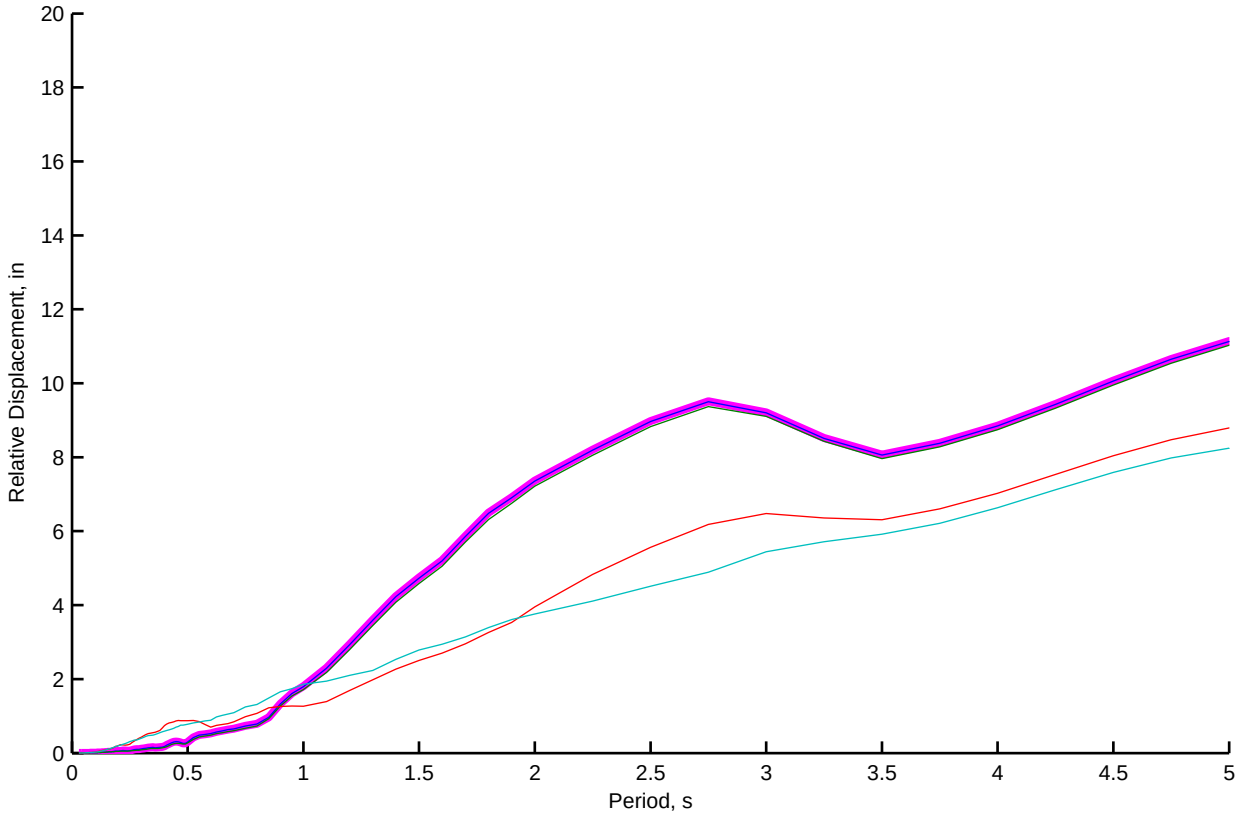

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Abut 11 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component

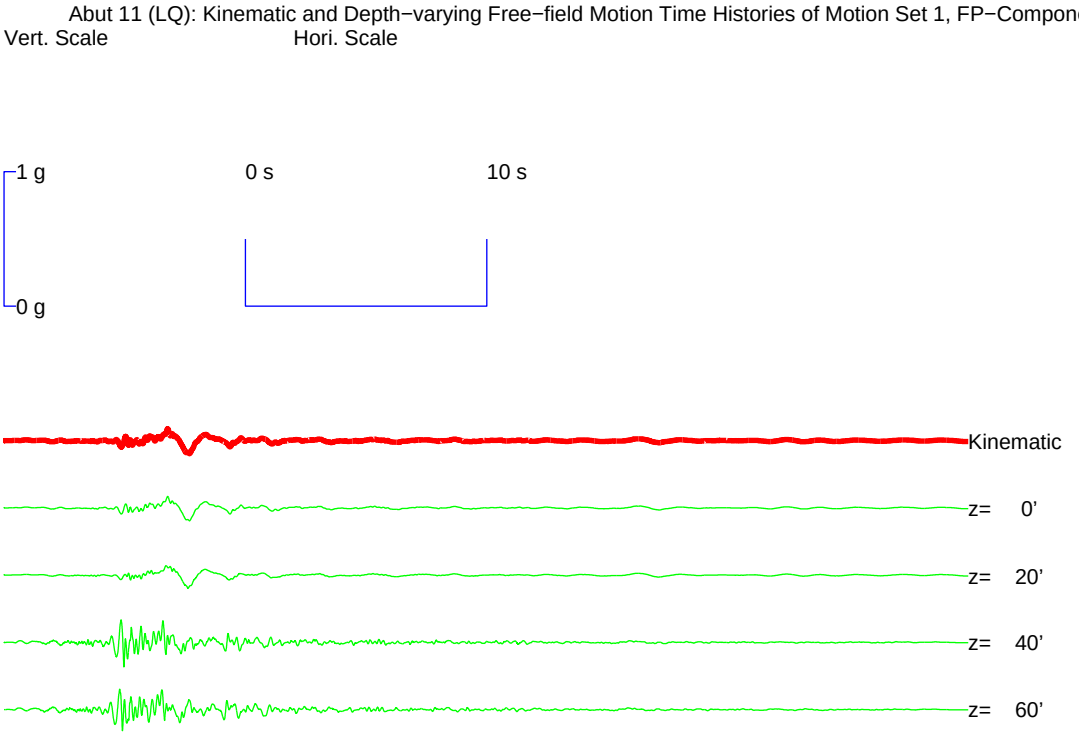


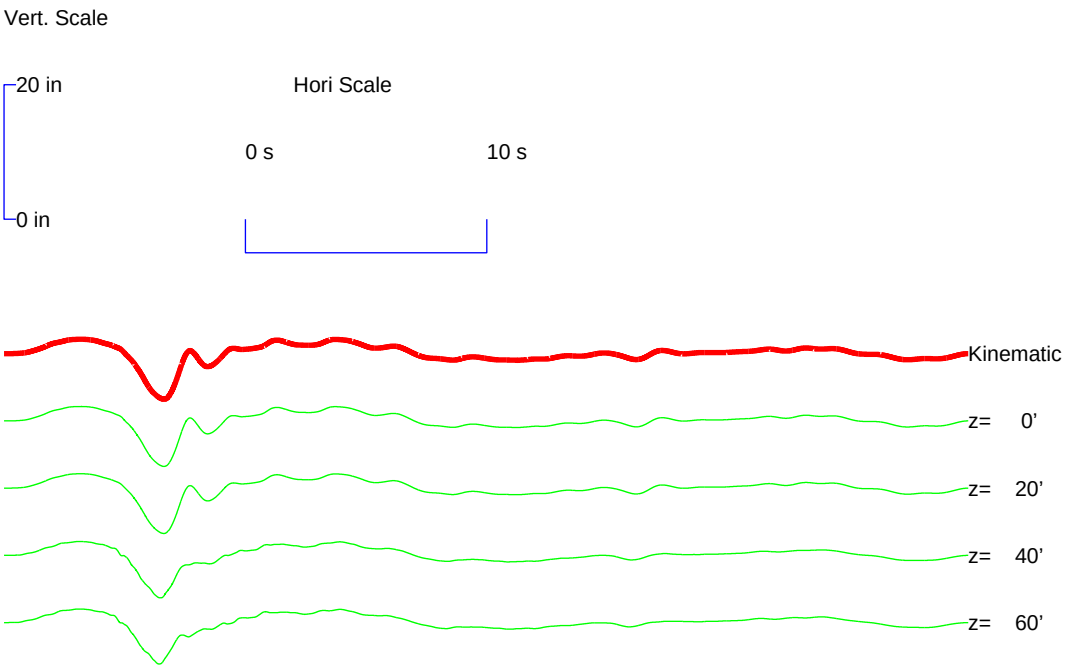


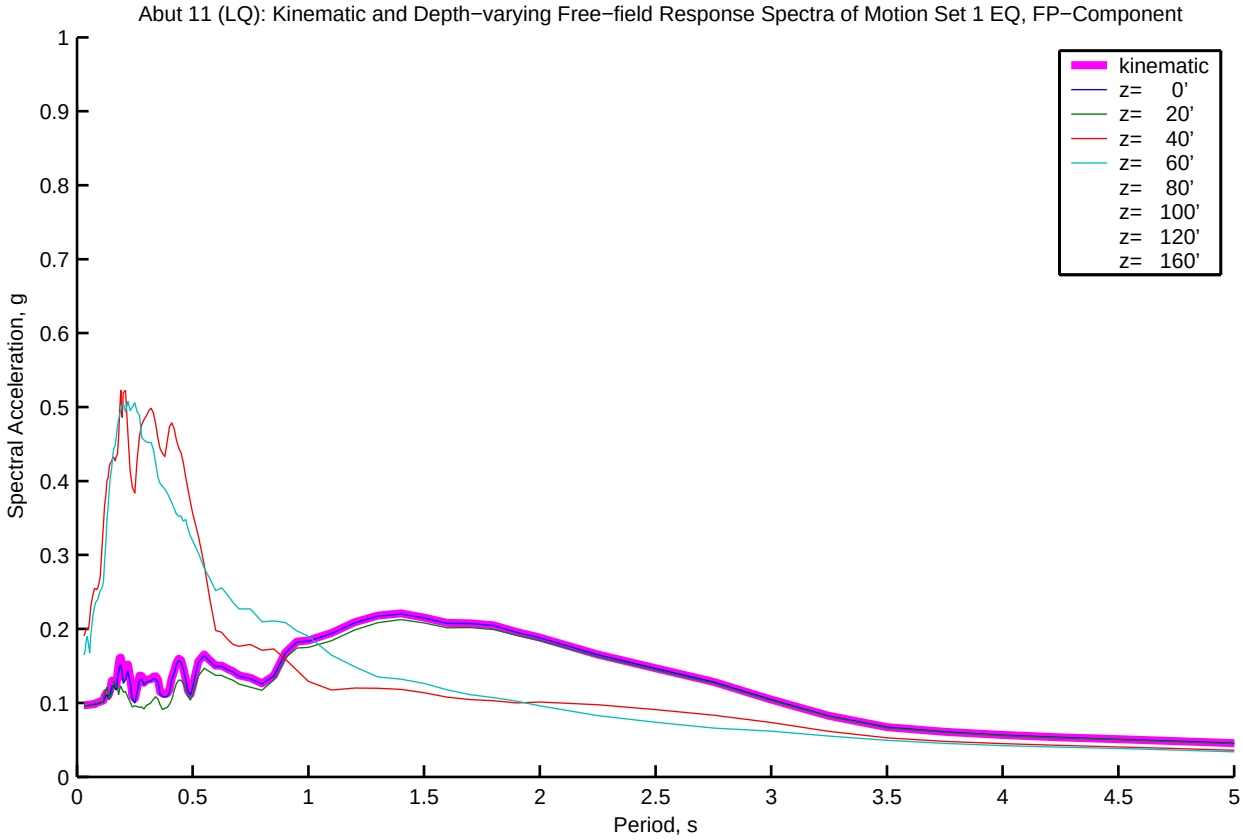

Abut 11 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 160'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

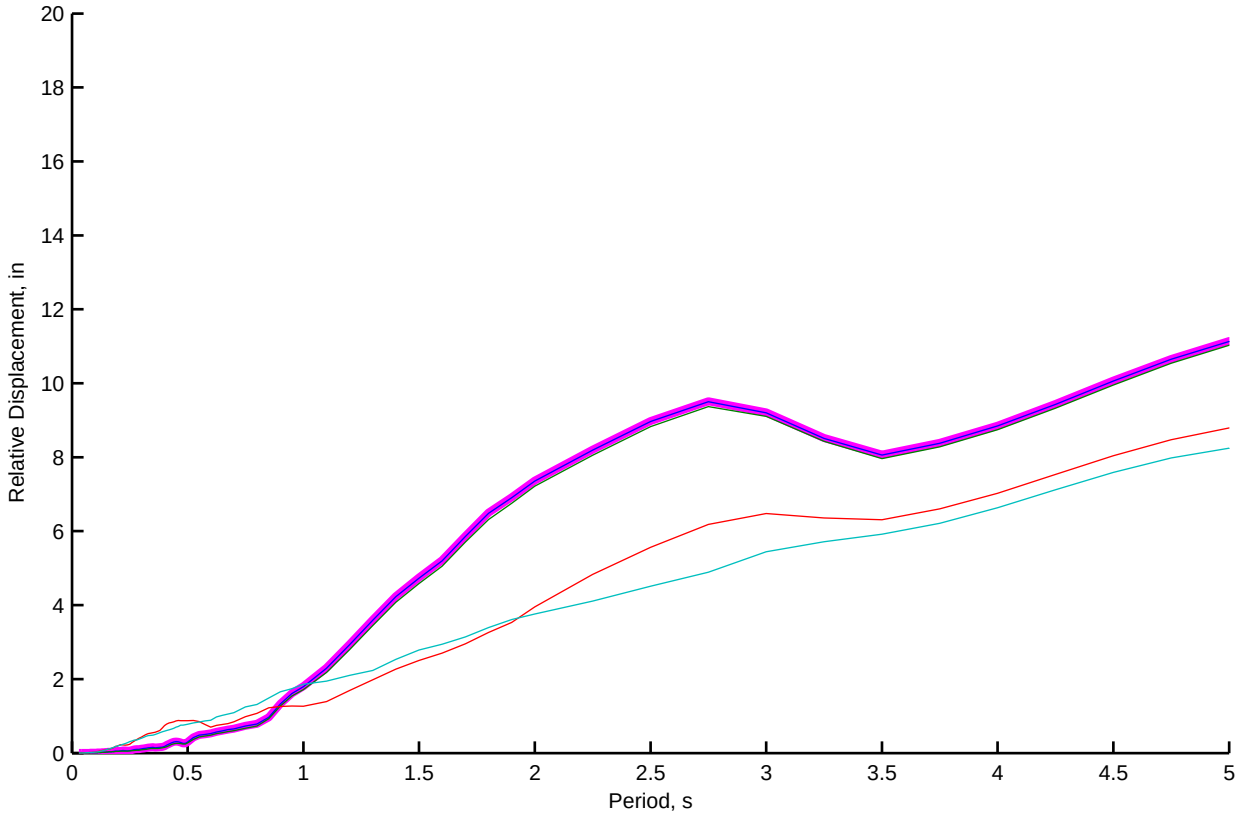

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Abut 11 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component

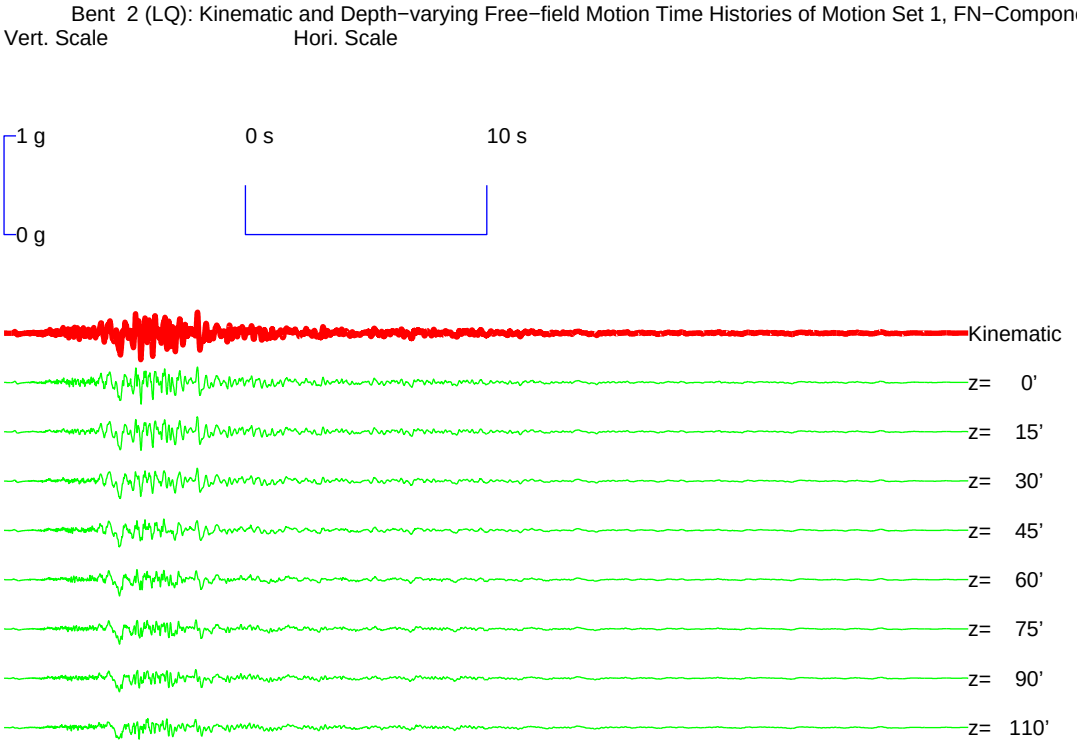


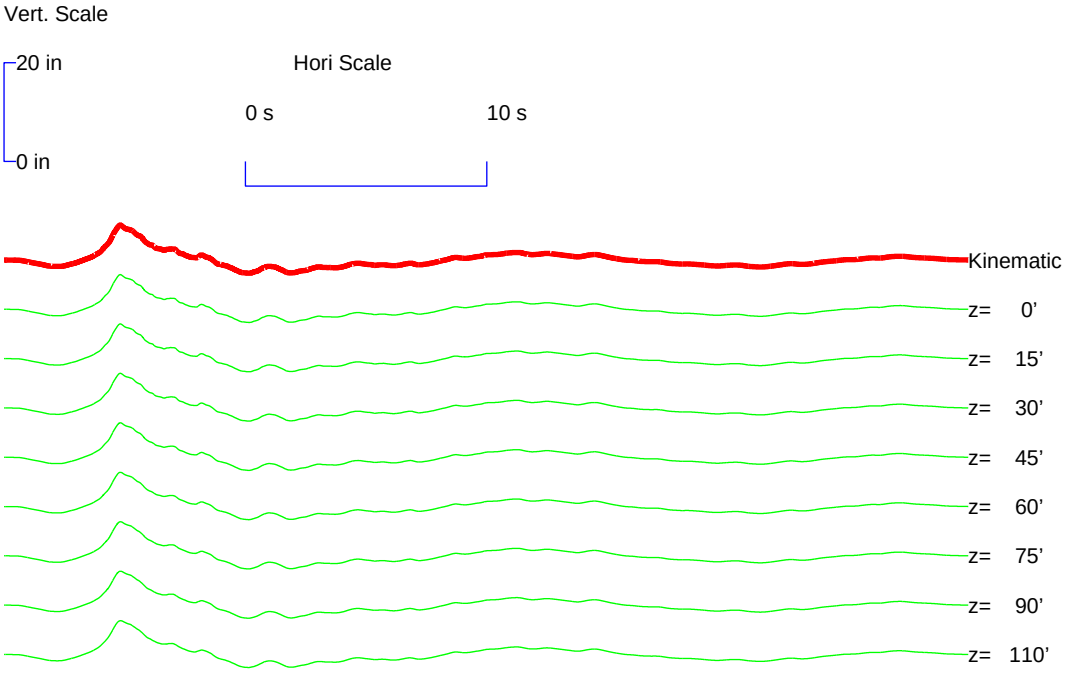


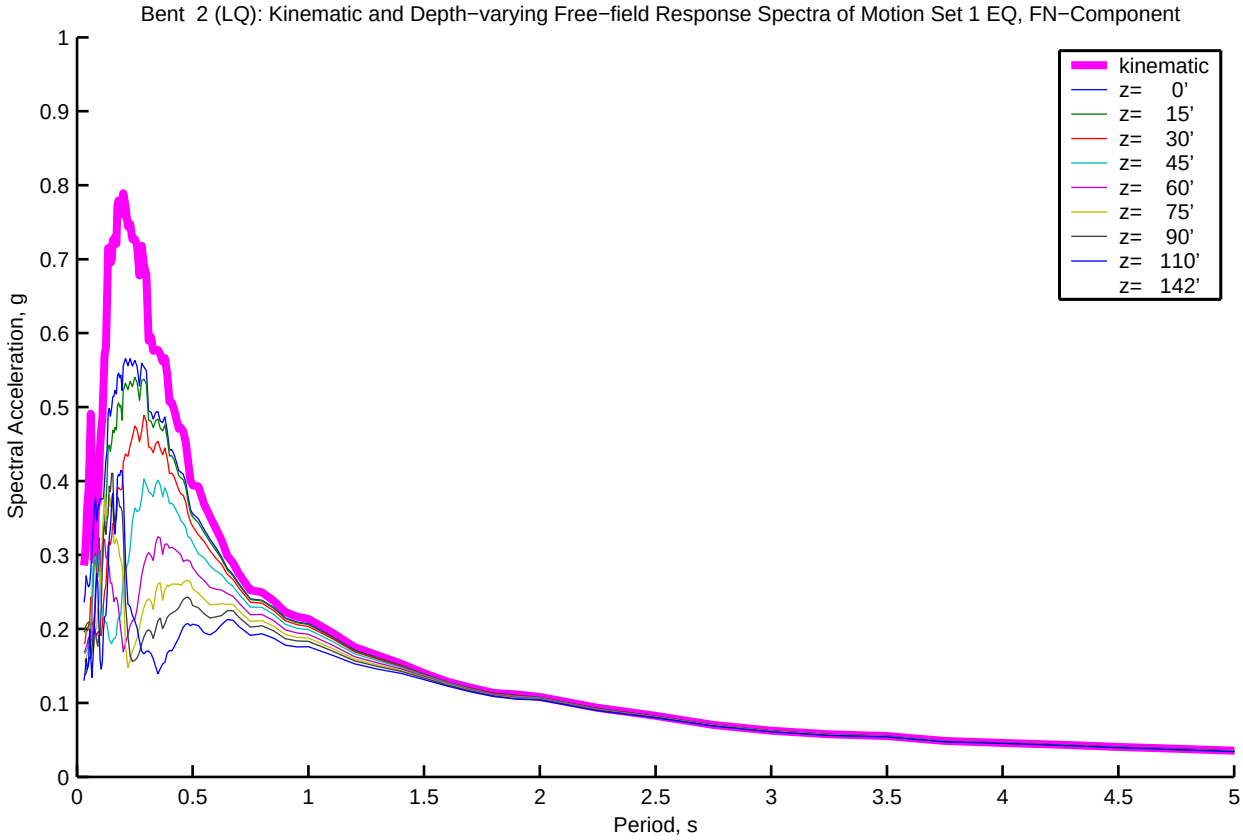

Abut 11 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 160'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

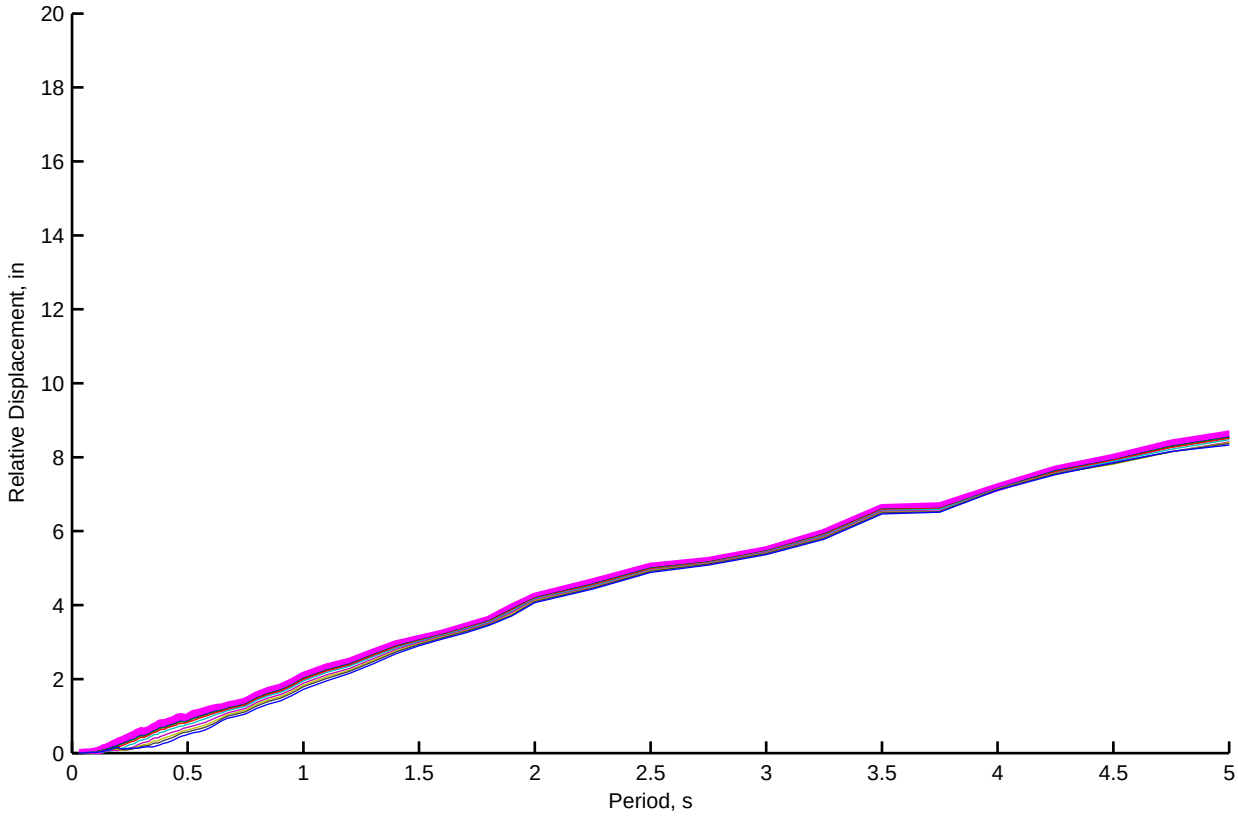

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 2 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component

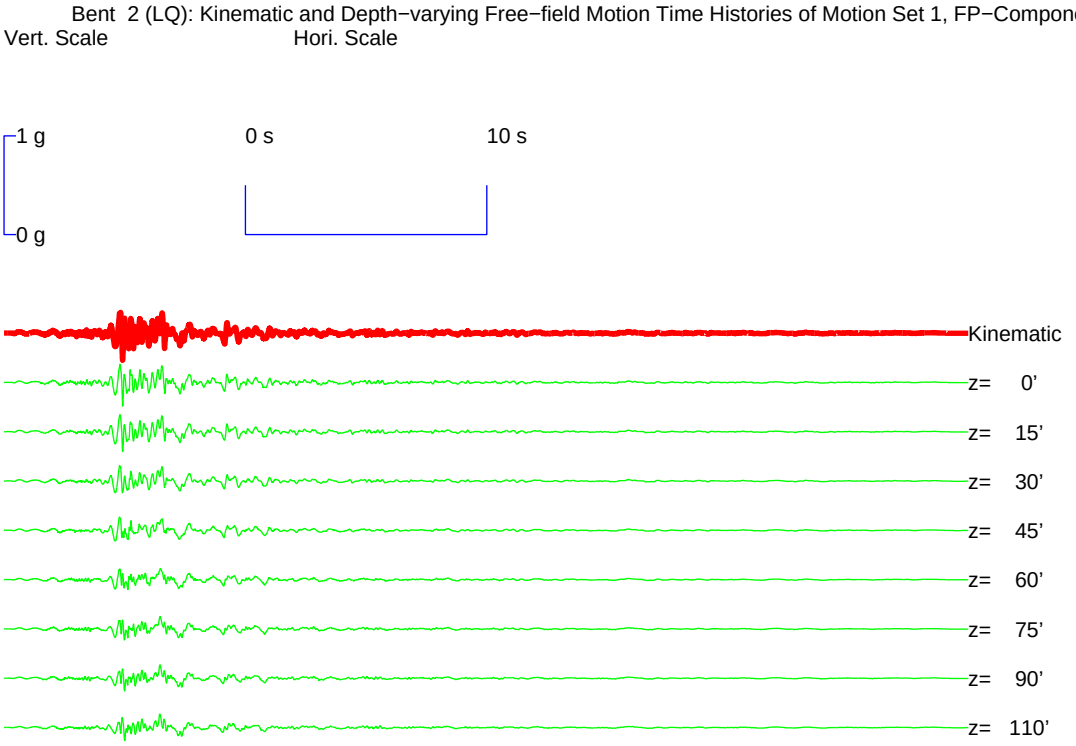


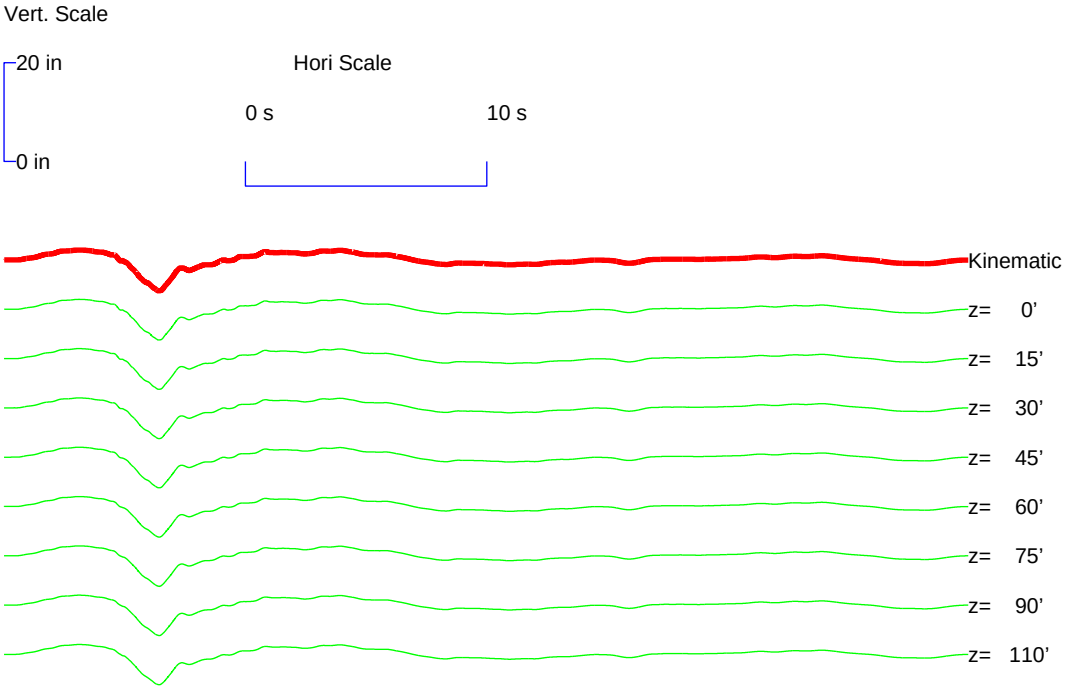


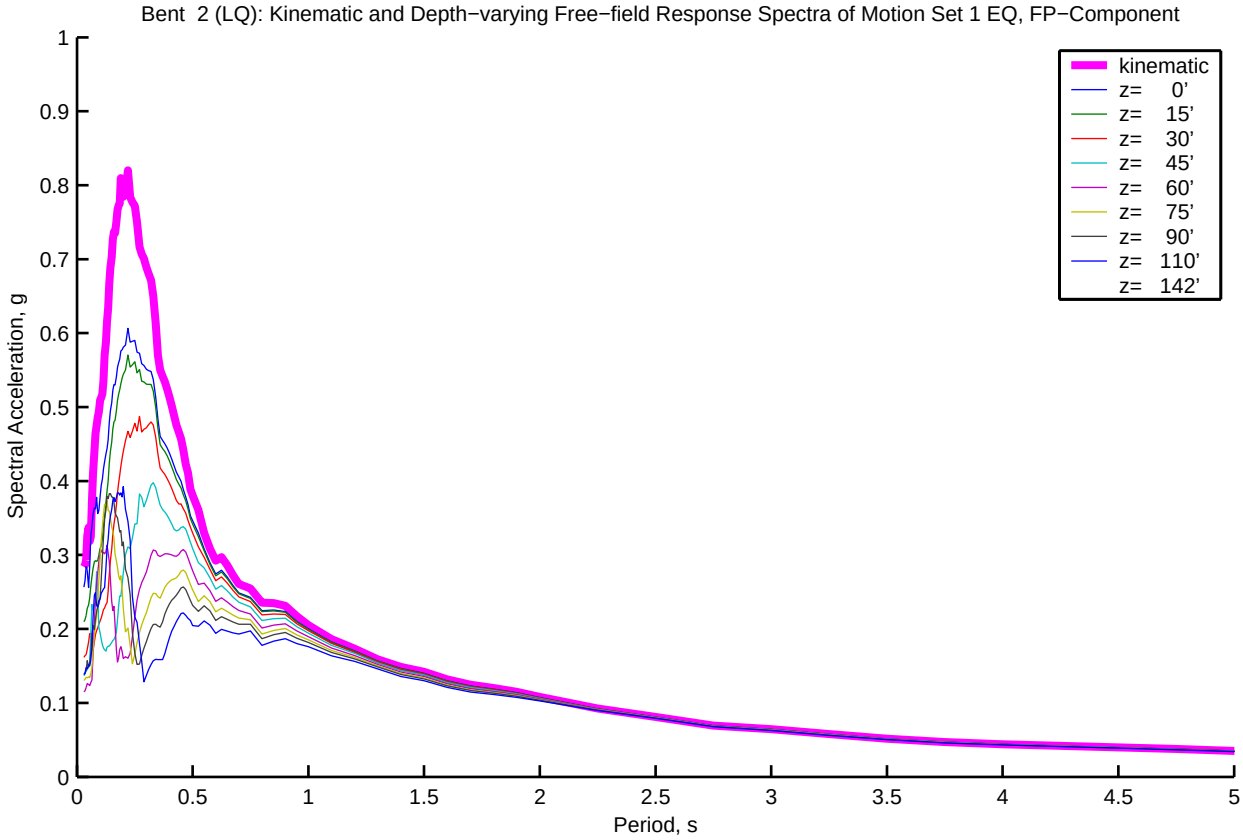

Bent 2 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 142'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

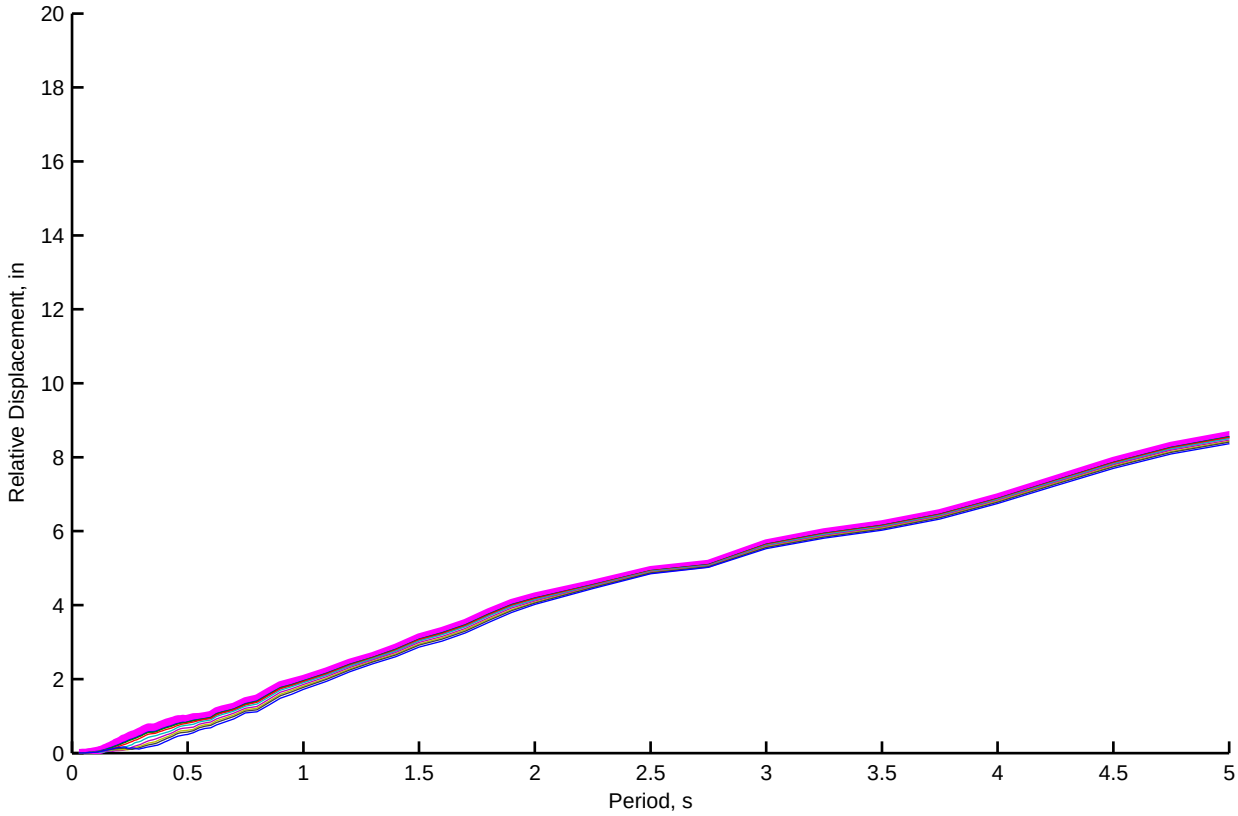

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 2 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component

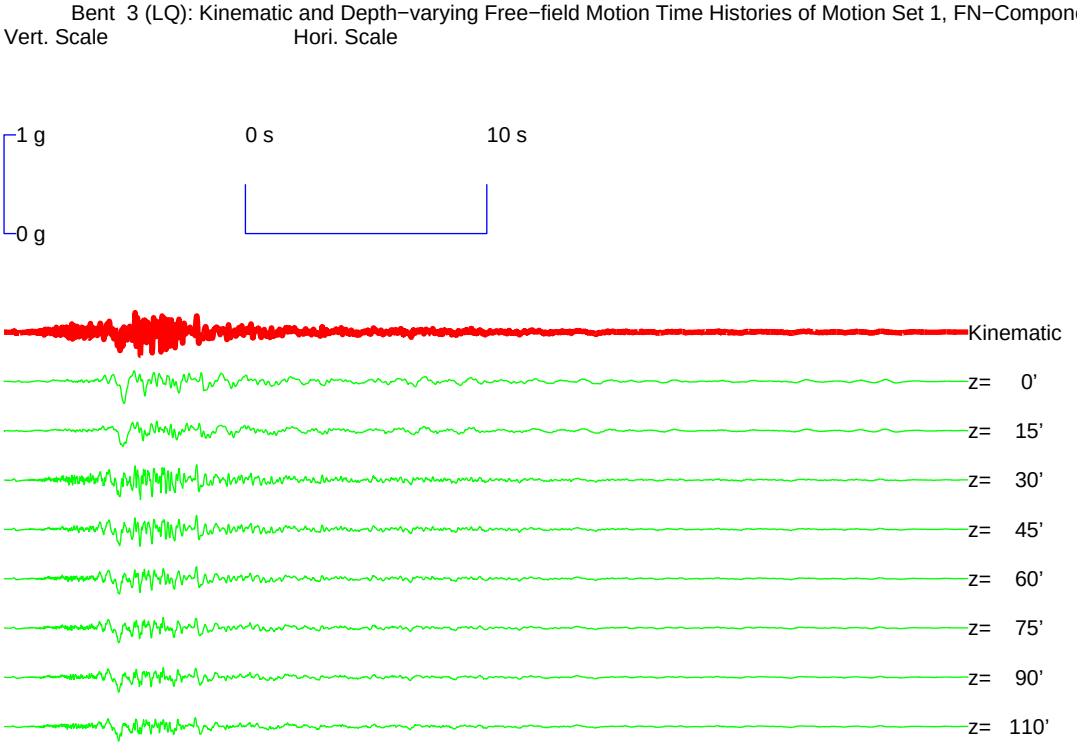


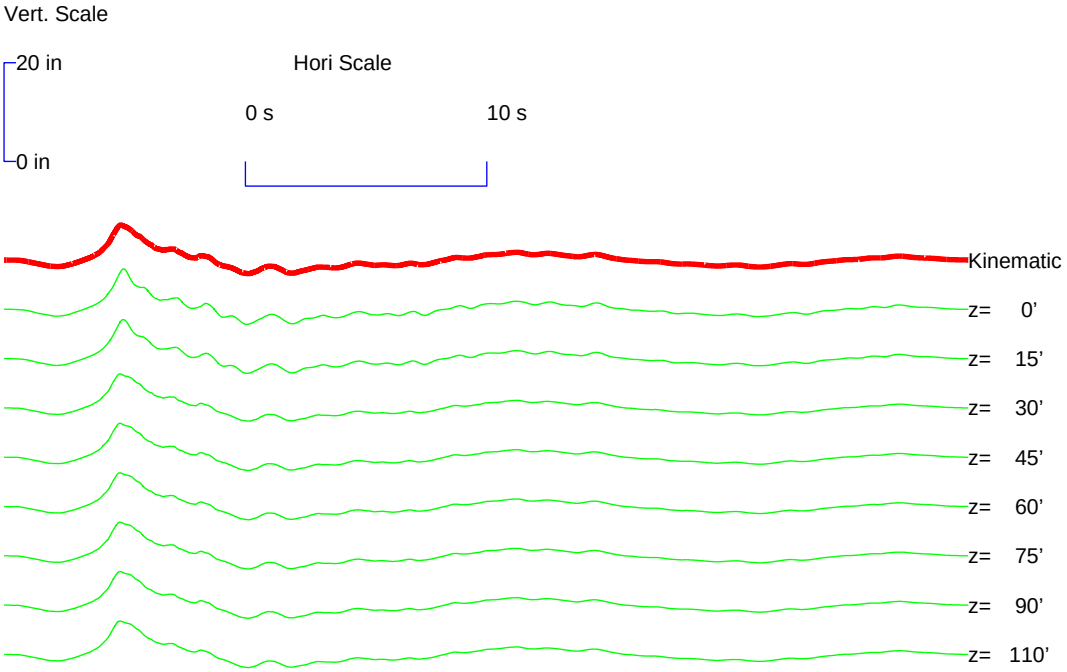


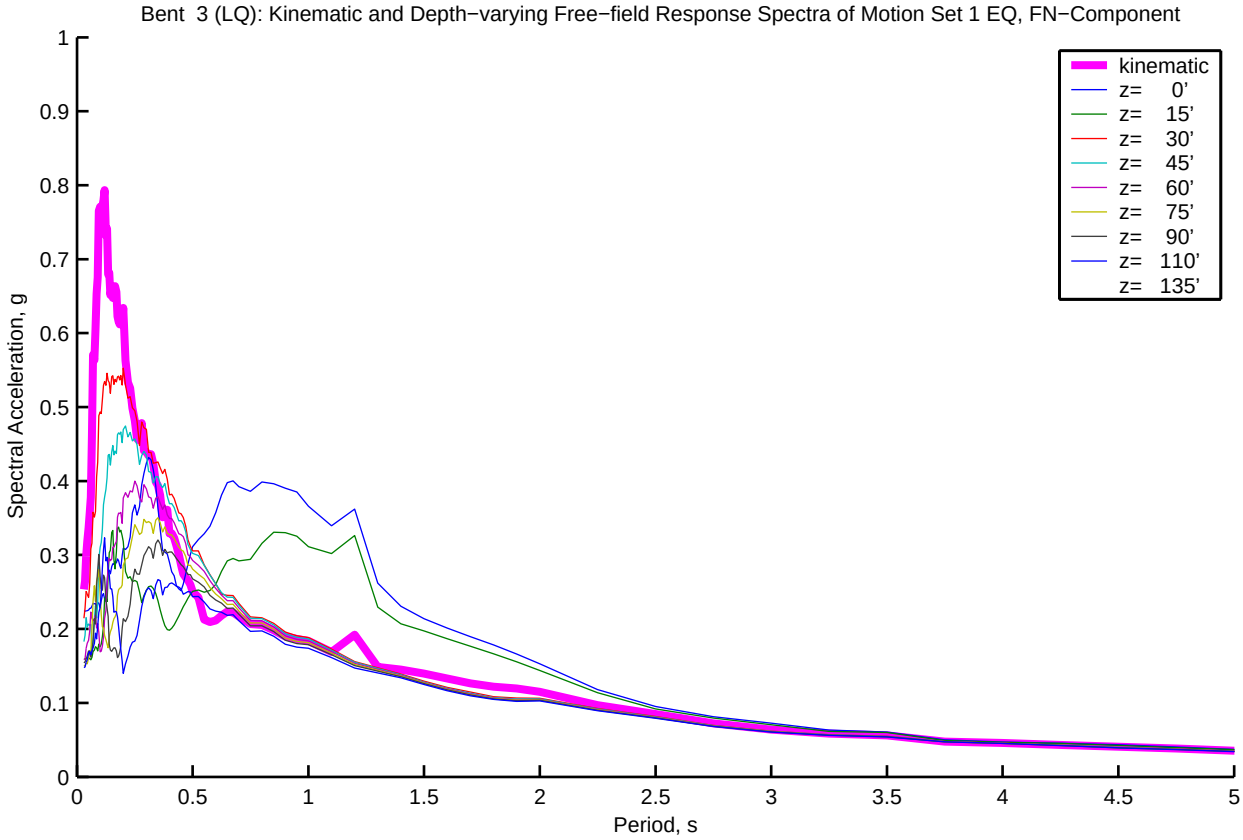

Bent 2 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 142'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

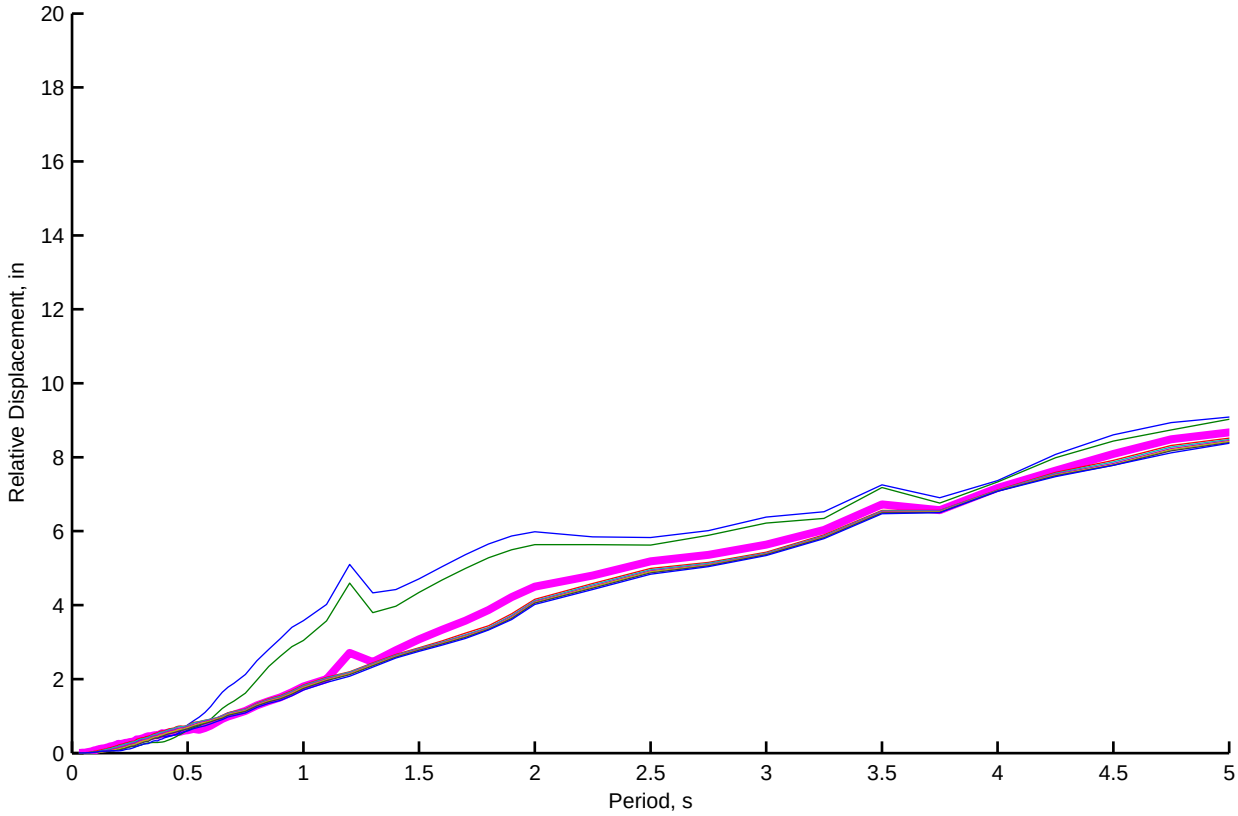

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 3 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component

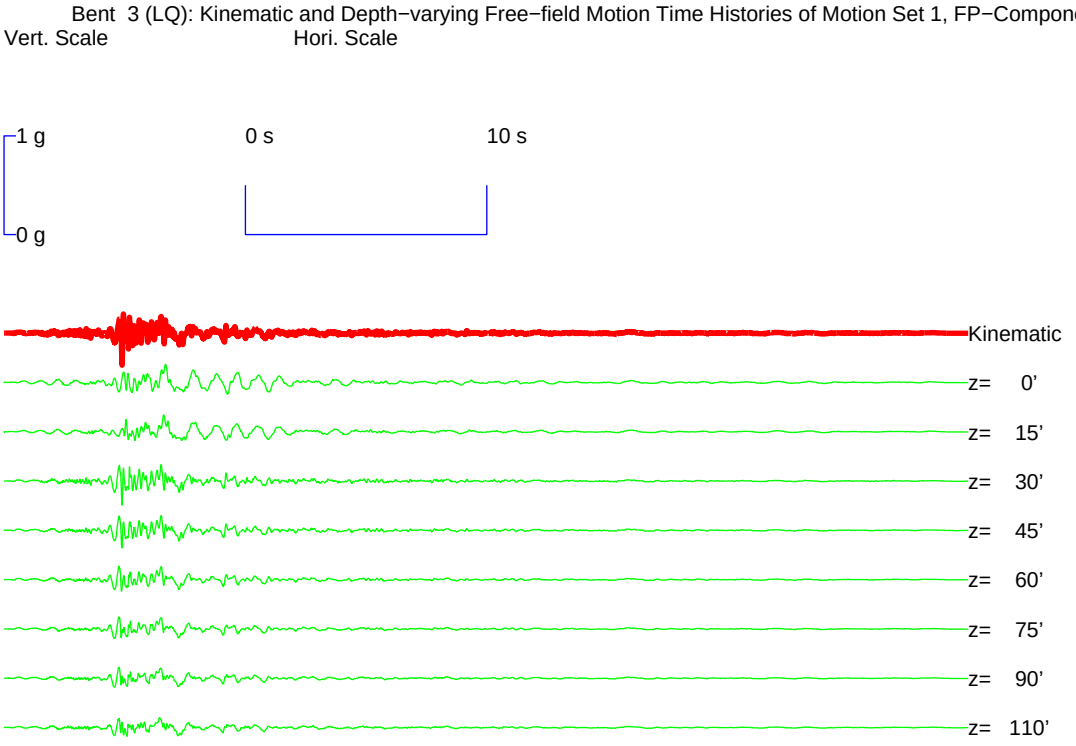


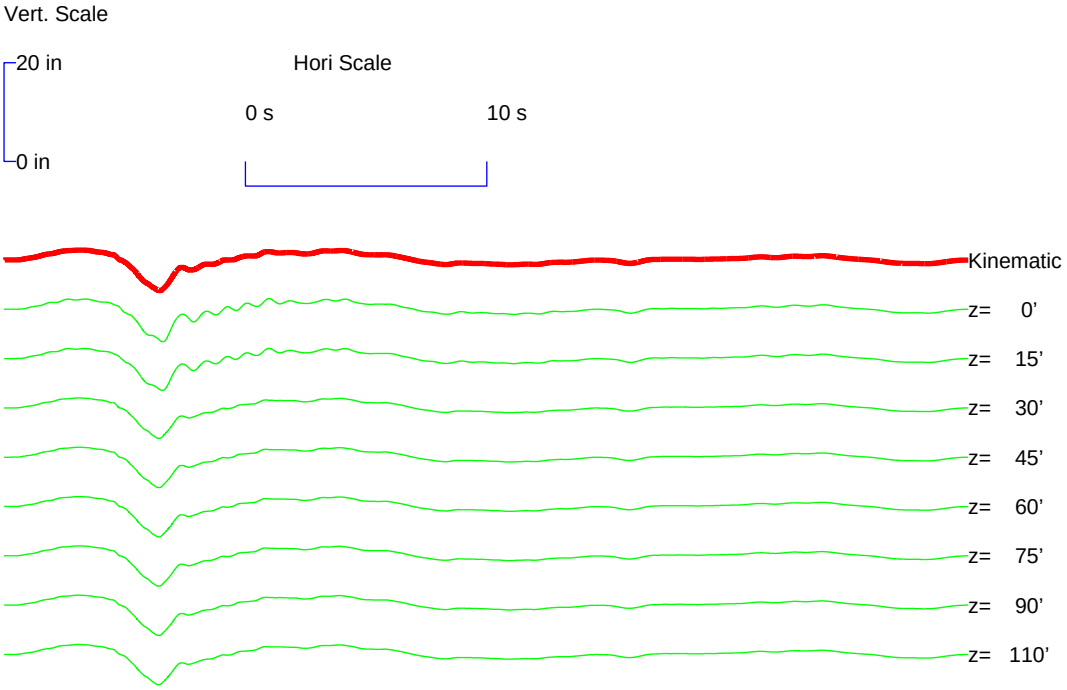


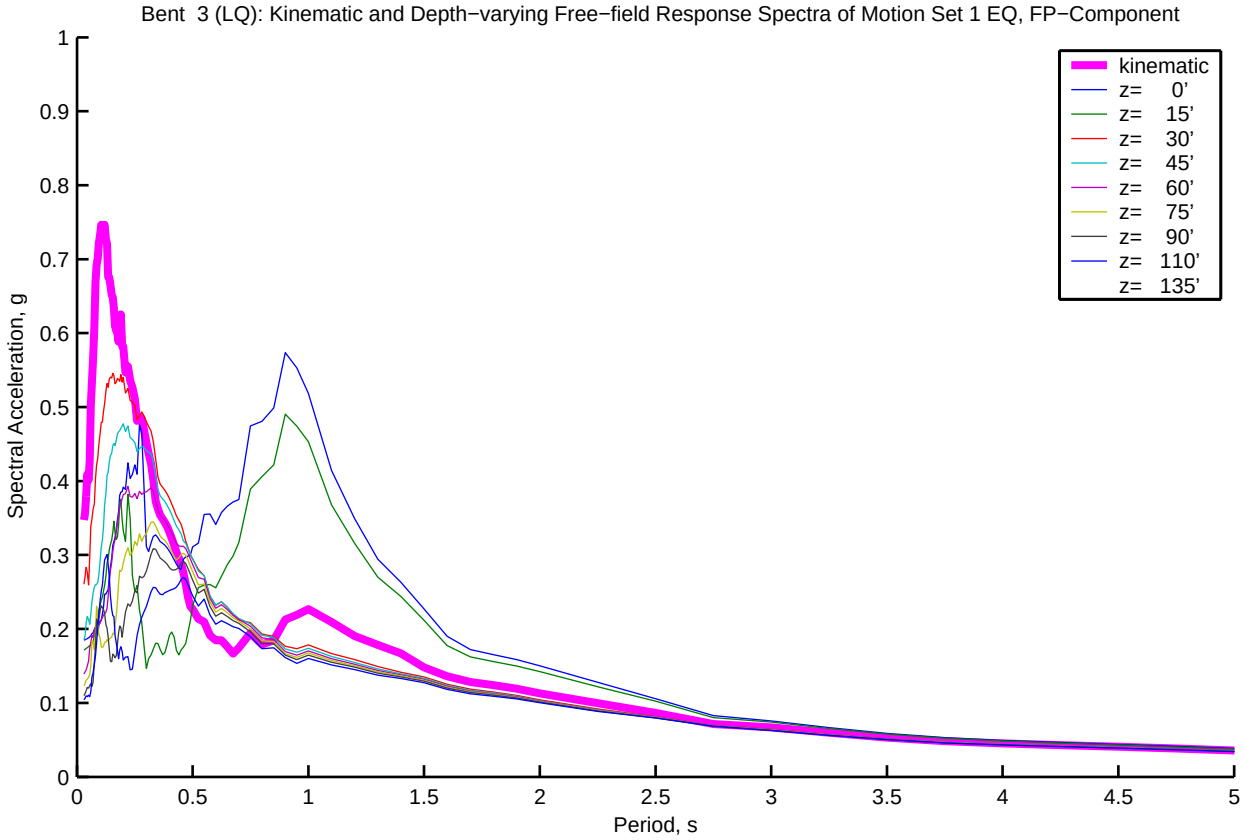

Bent 3 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 135'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

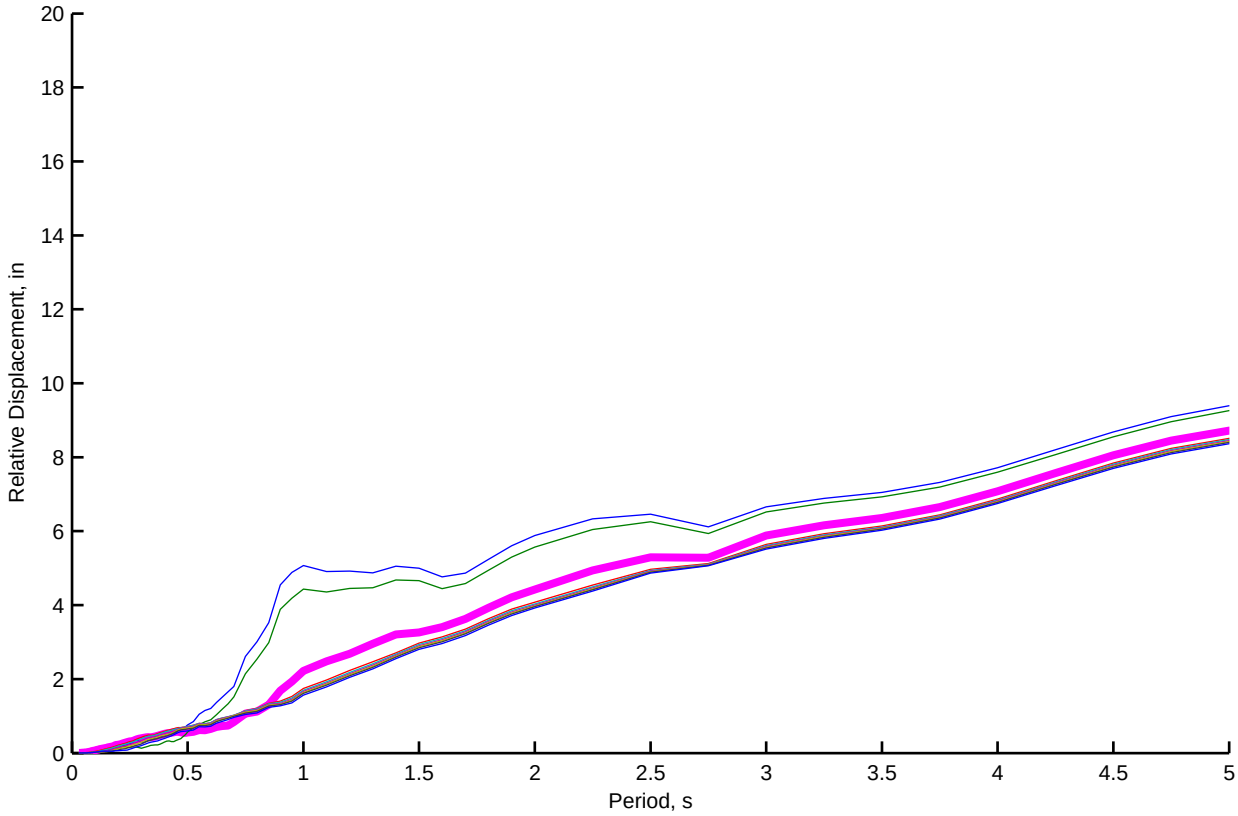

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 3 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component

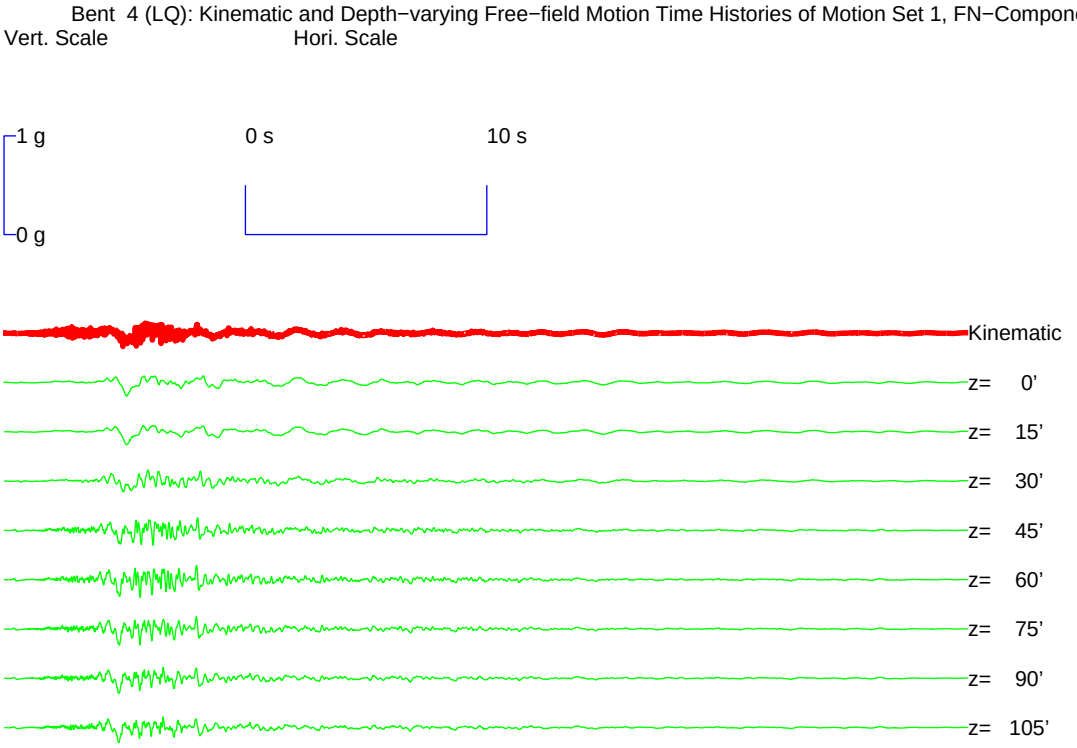


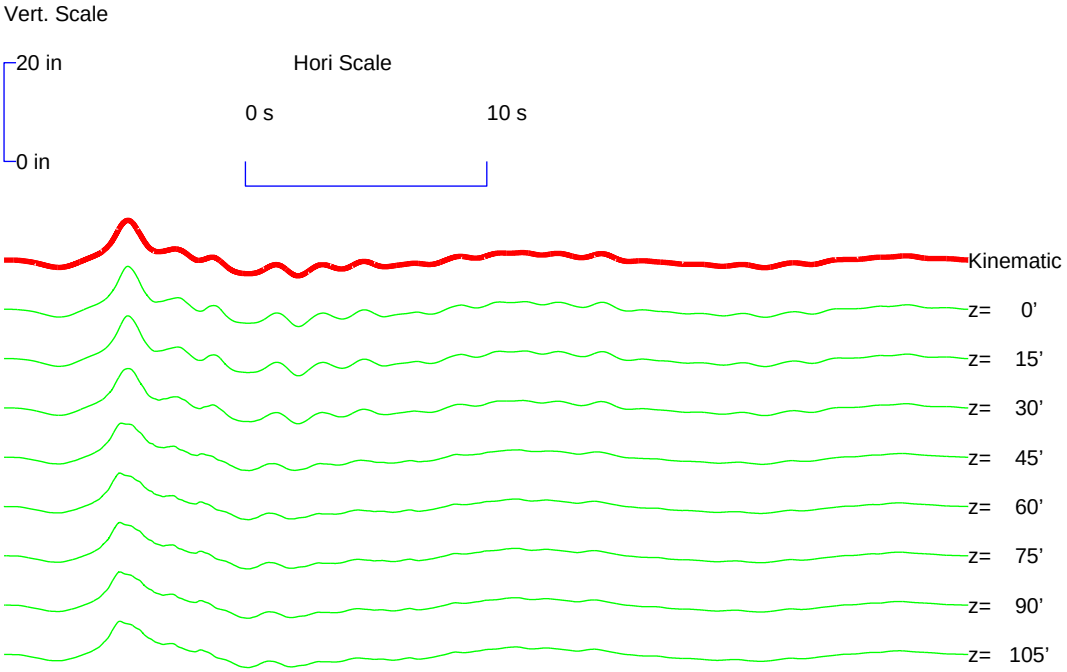


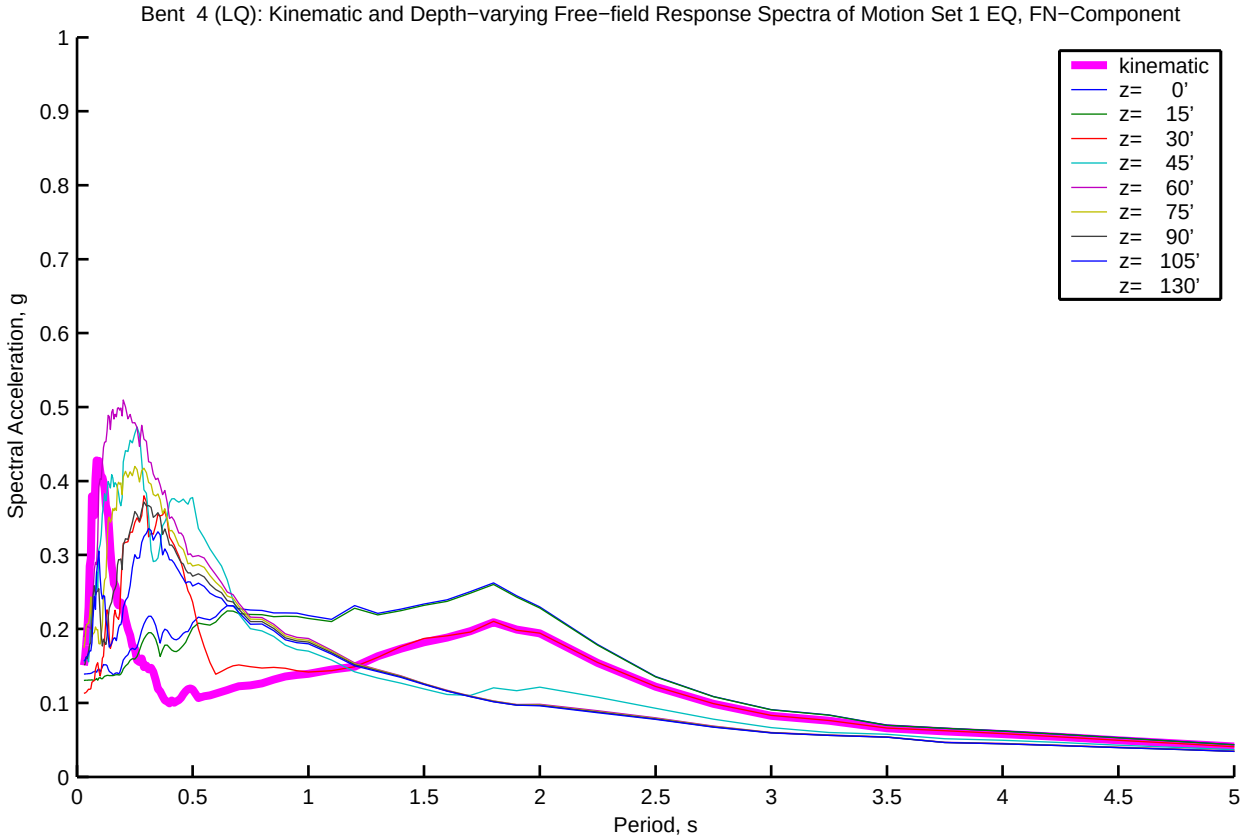

Bent 3 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 135'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5


Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 4 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component






Bent 4 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
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2.5
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4.5
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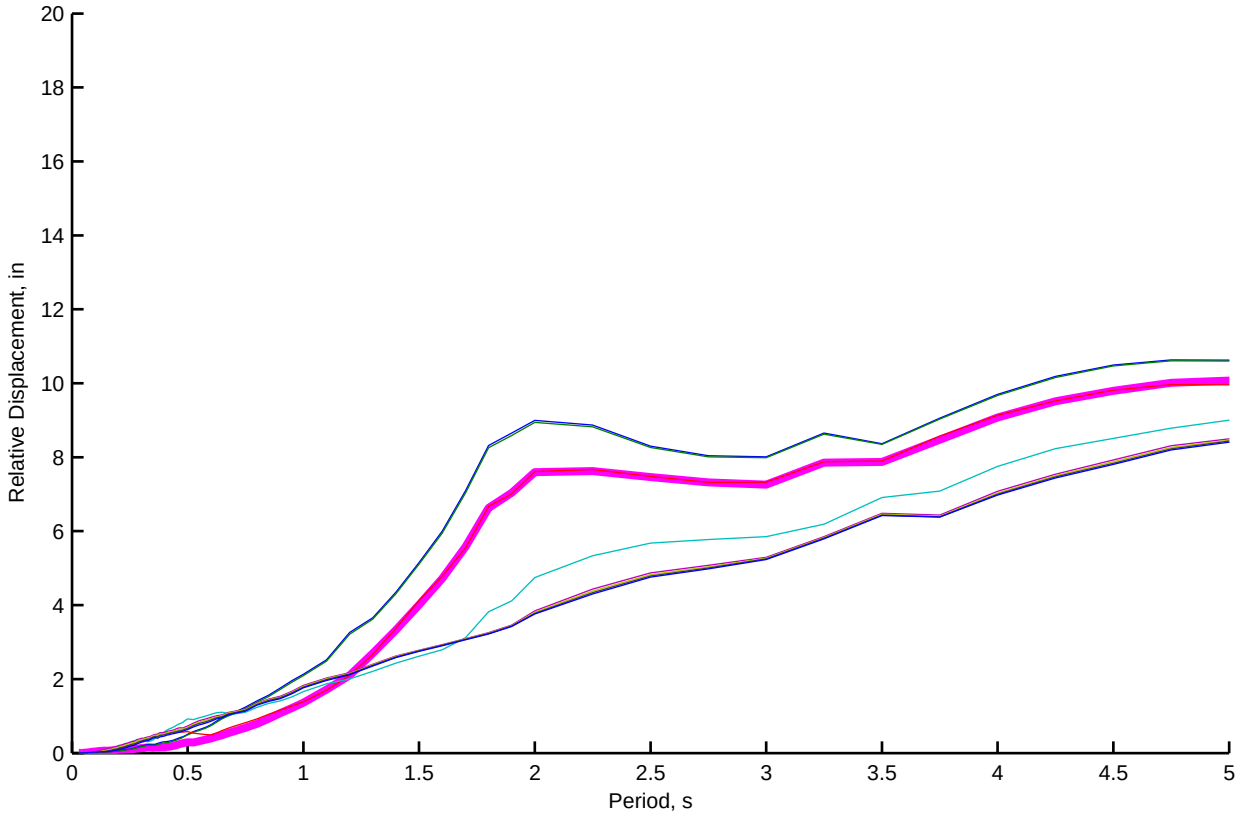
Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
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2.5
3
3.5
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4.5
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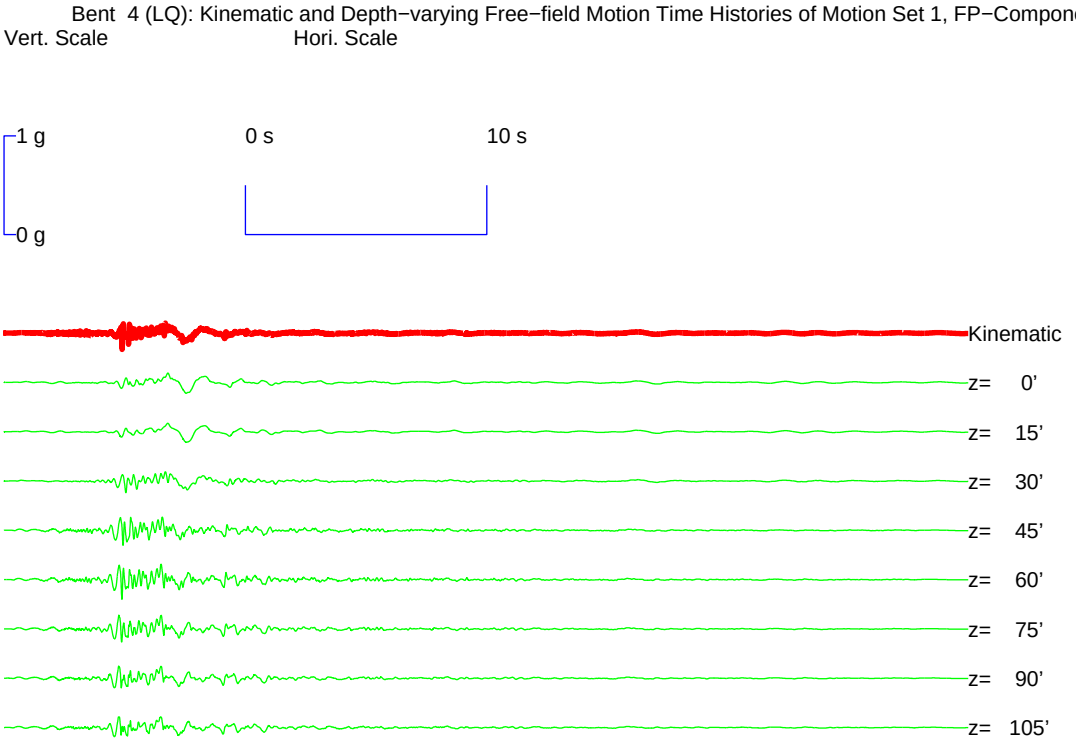
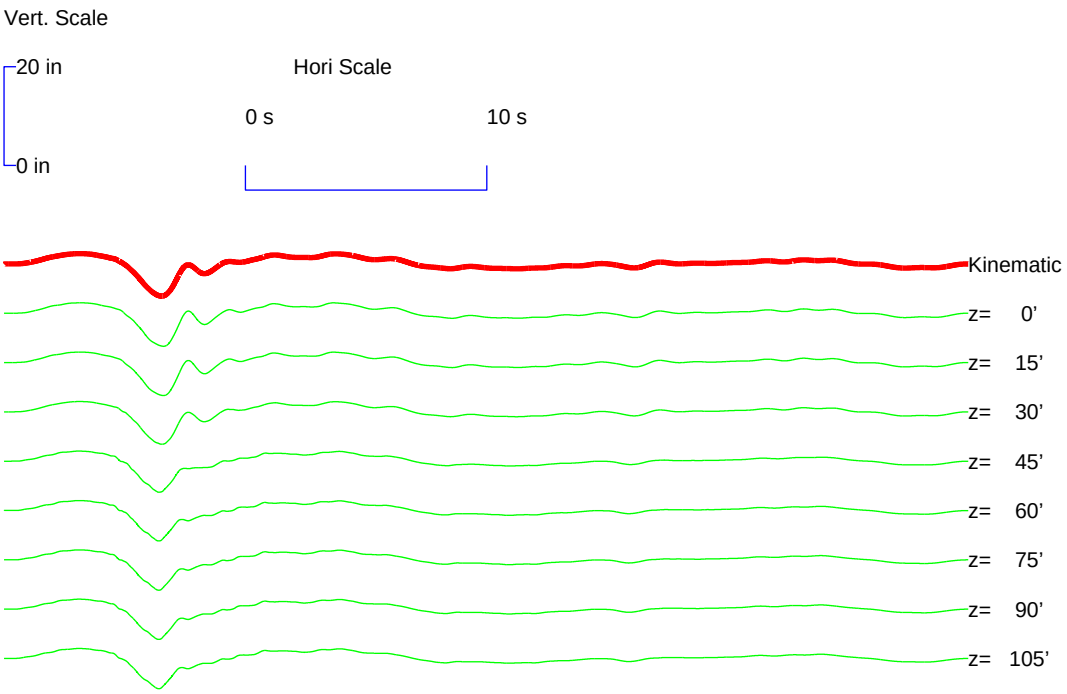
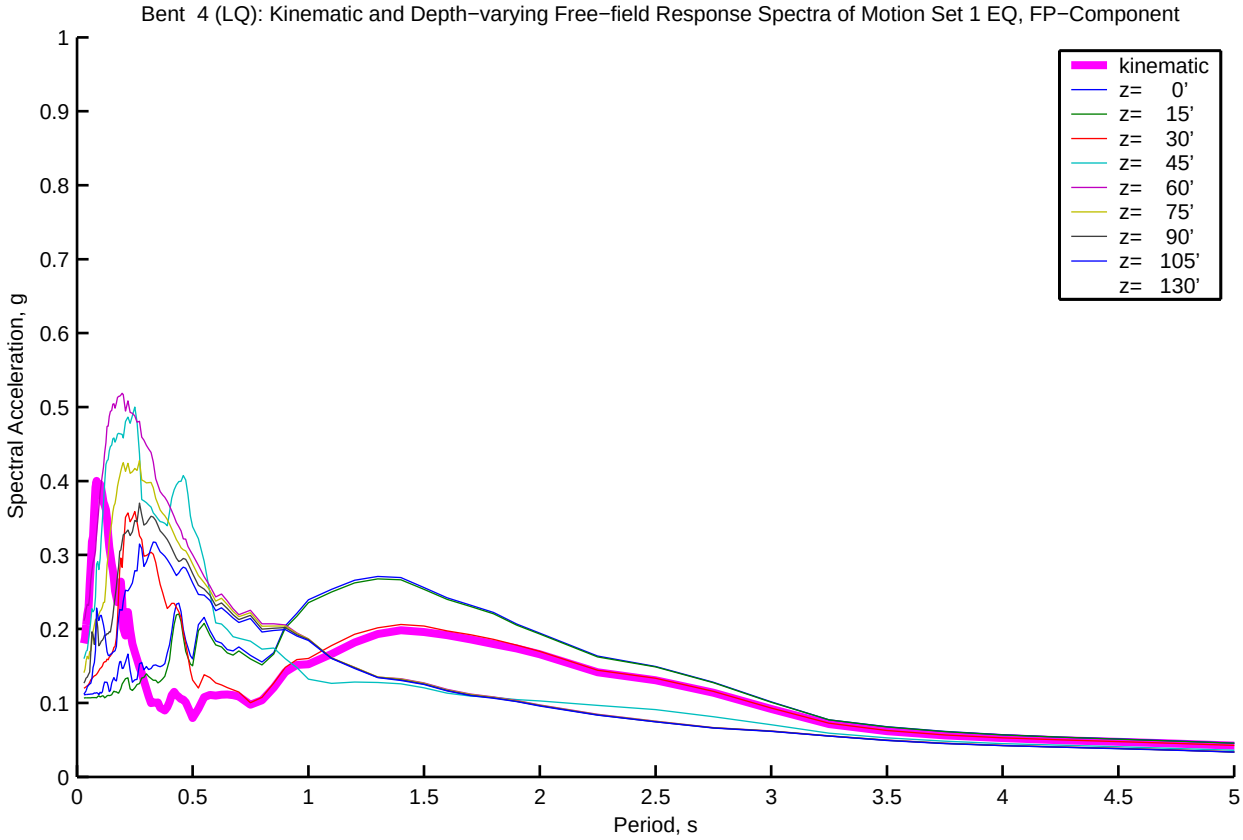
Bent 4 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component






Bent 4 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
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0.5
1.5
2
2.5
3
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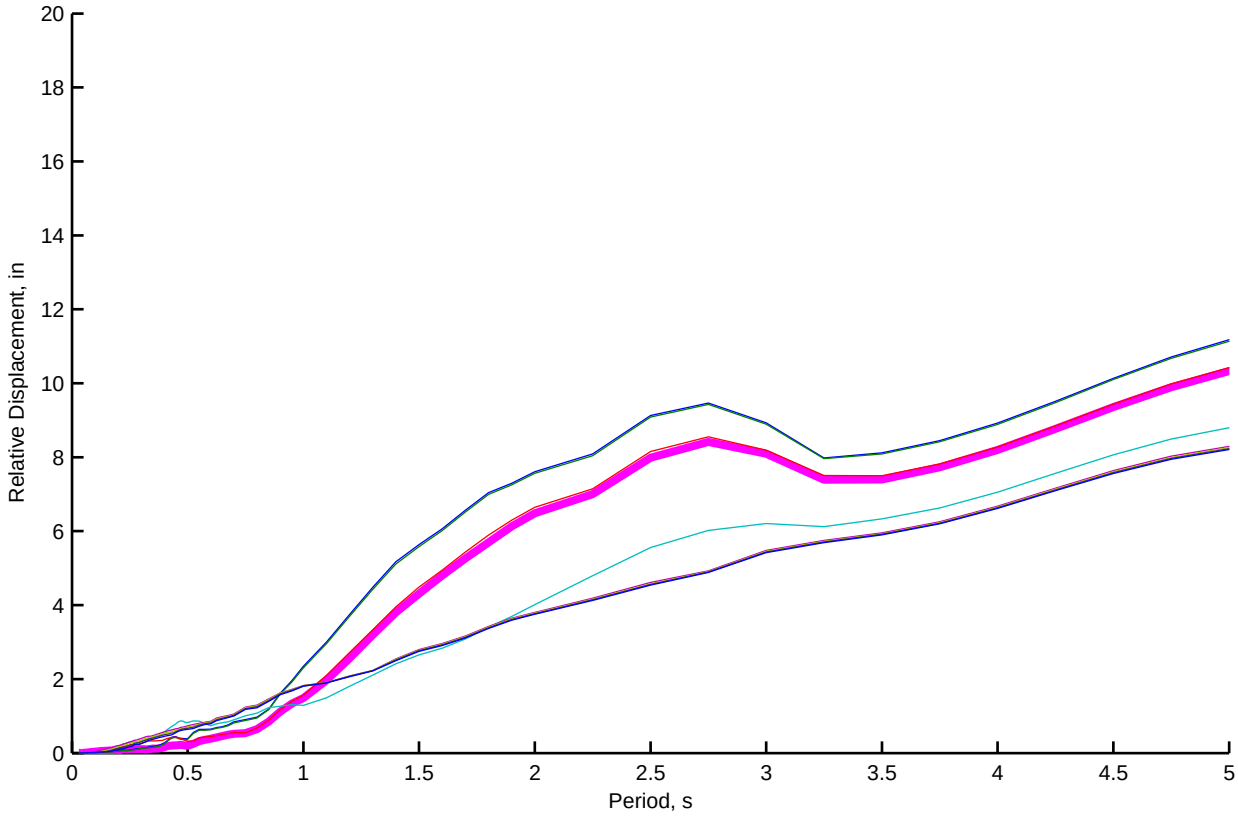
Relative Displacement, in
Period, s
0
2
4
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0.5
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1.5
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4.5
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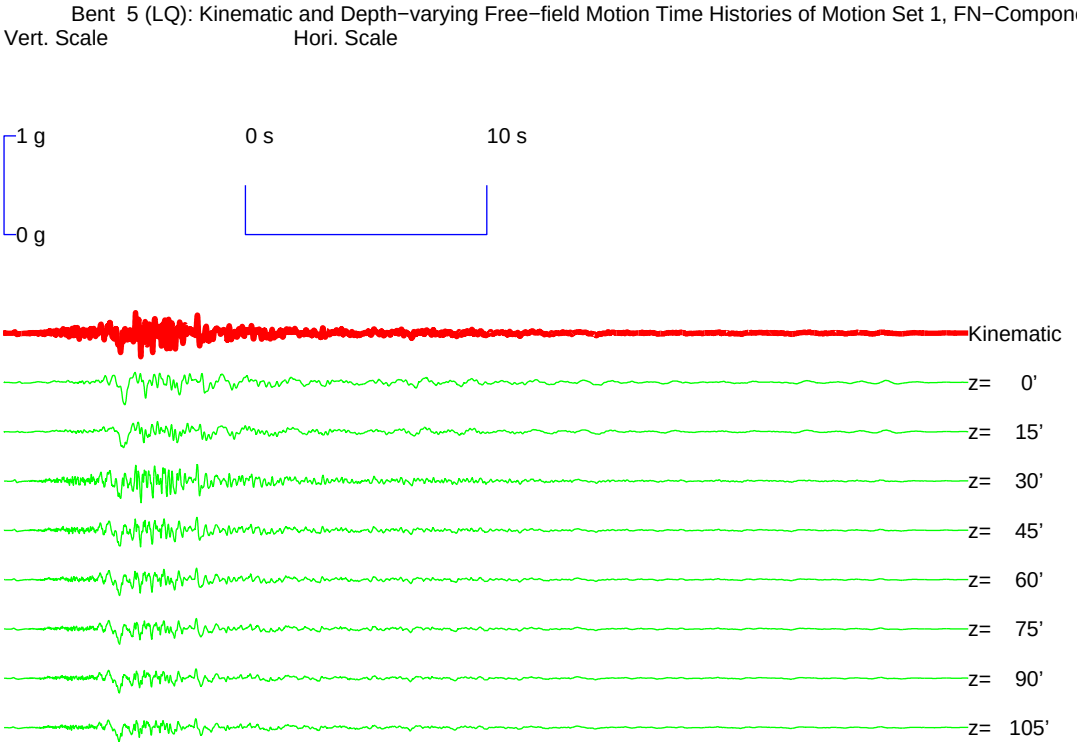
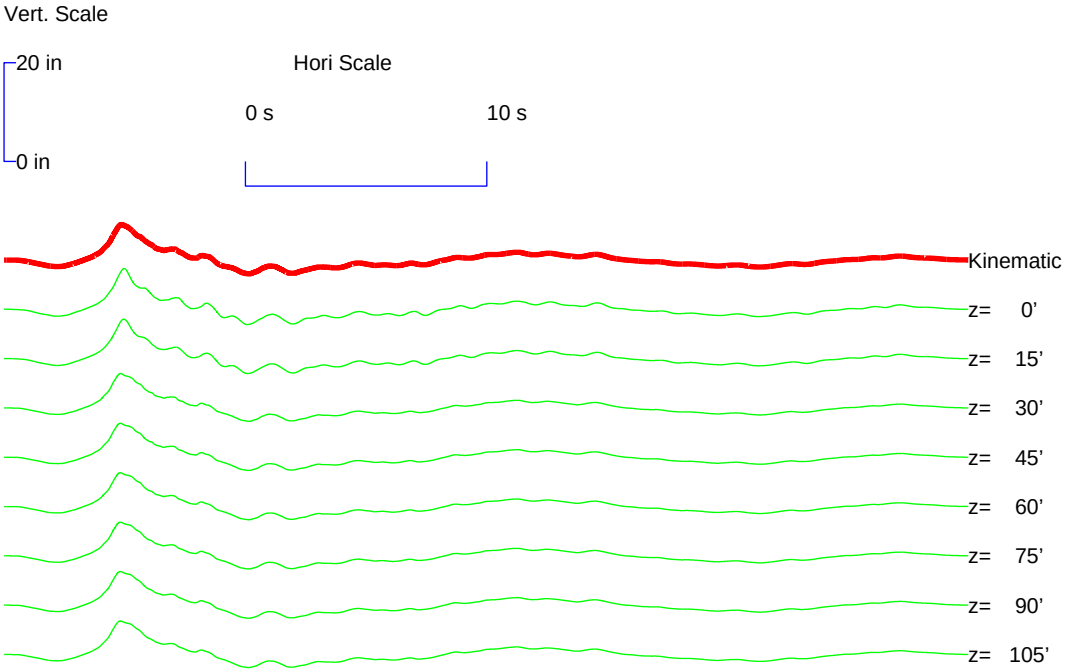
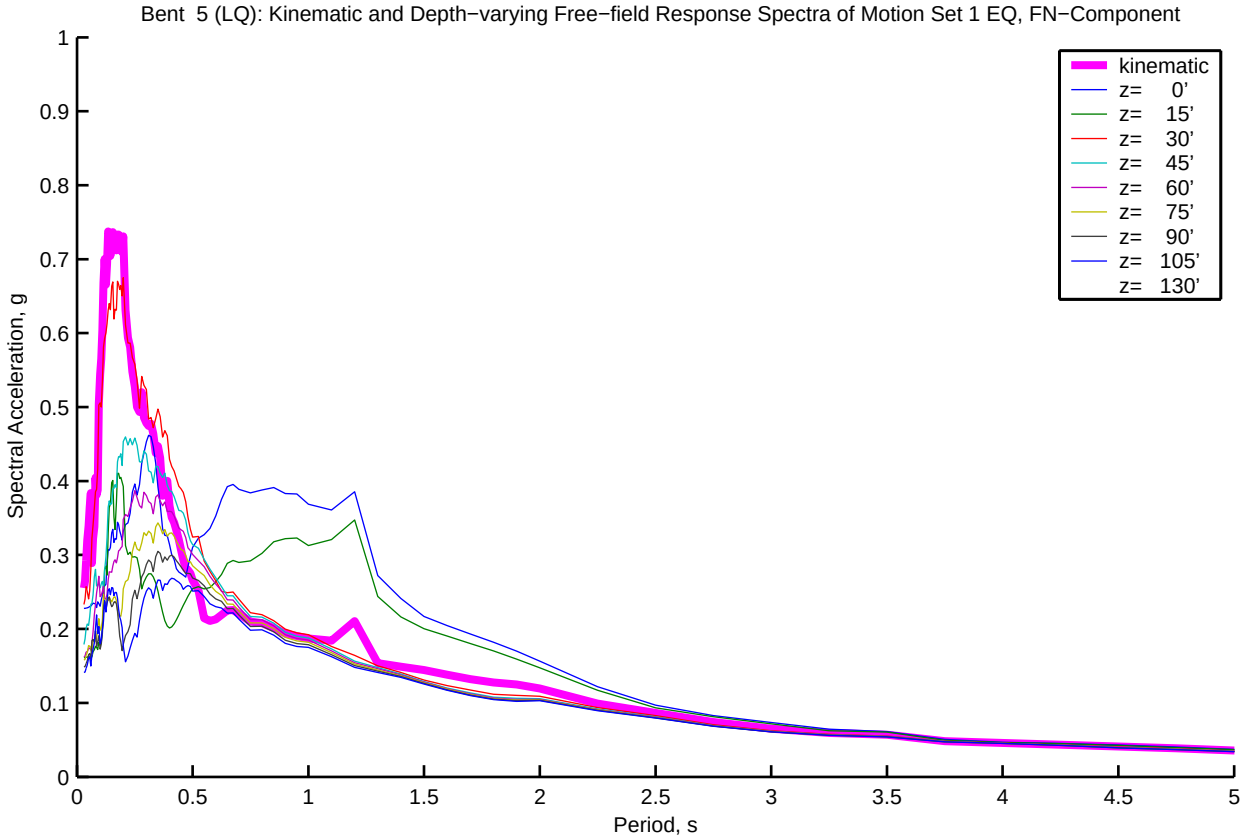
Bent 5 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component






Bent 5 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
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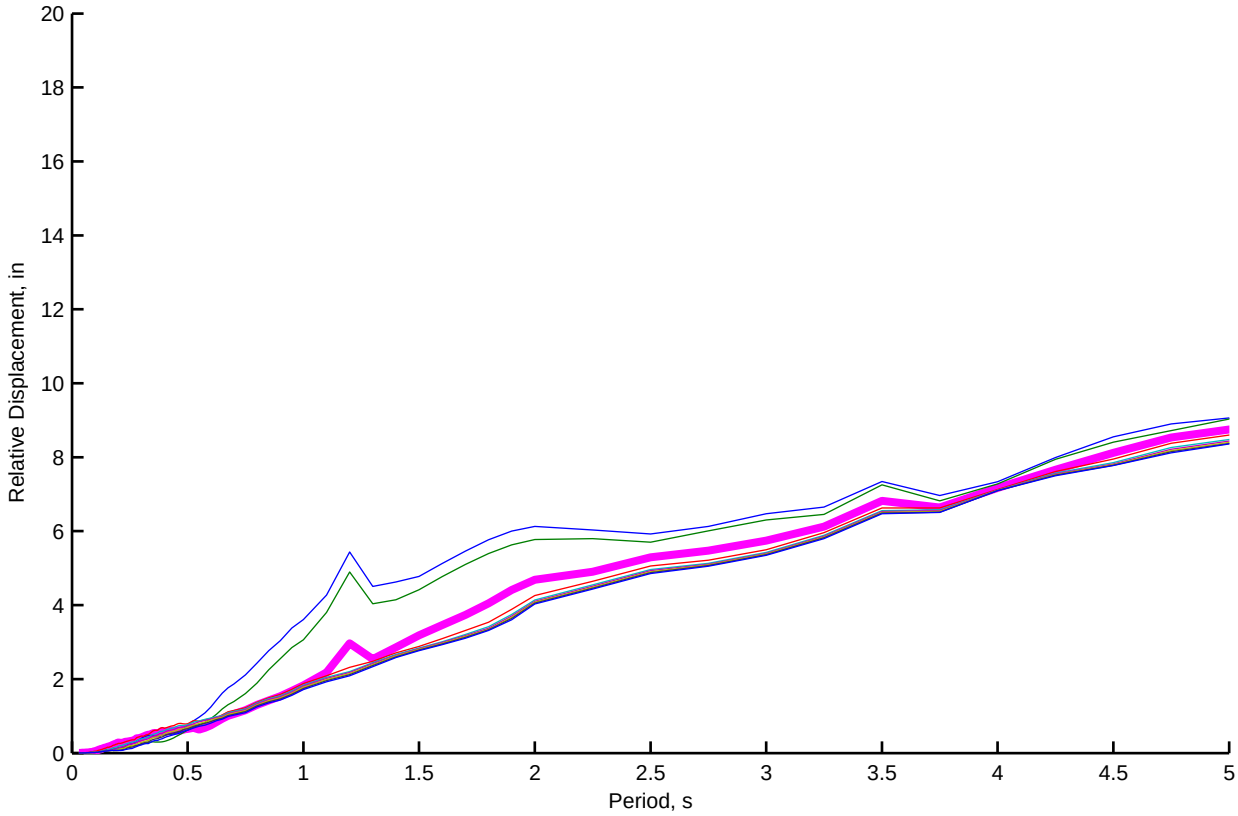
Relative Displacement, in
Period, s
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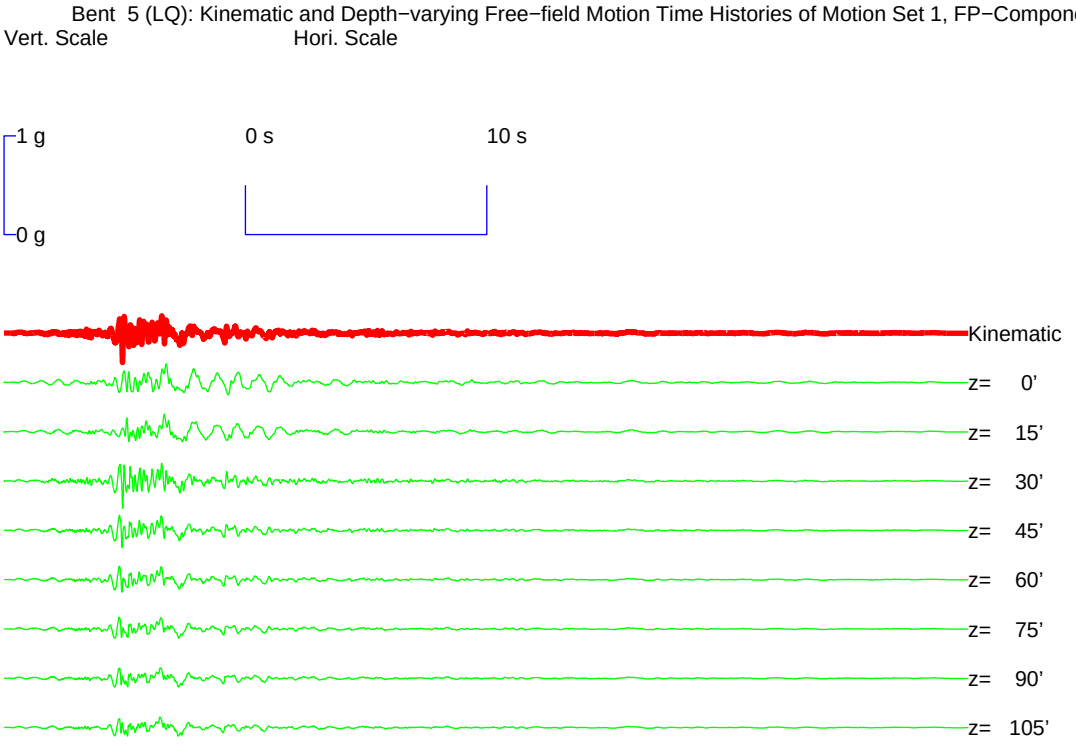
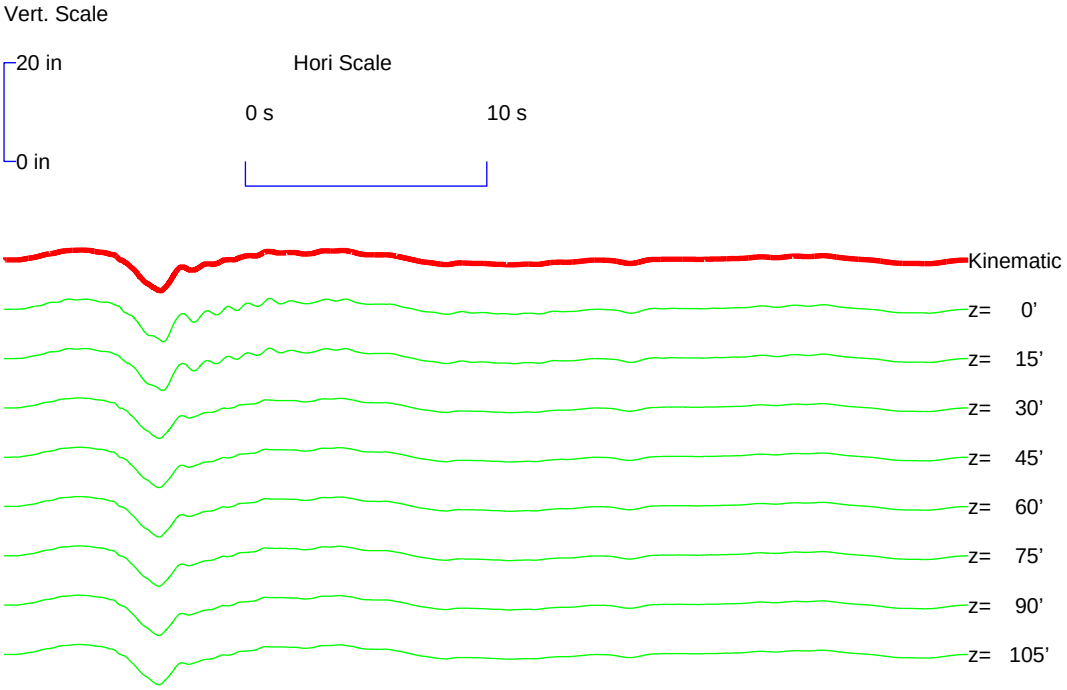
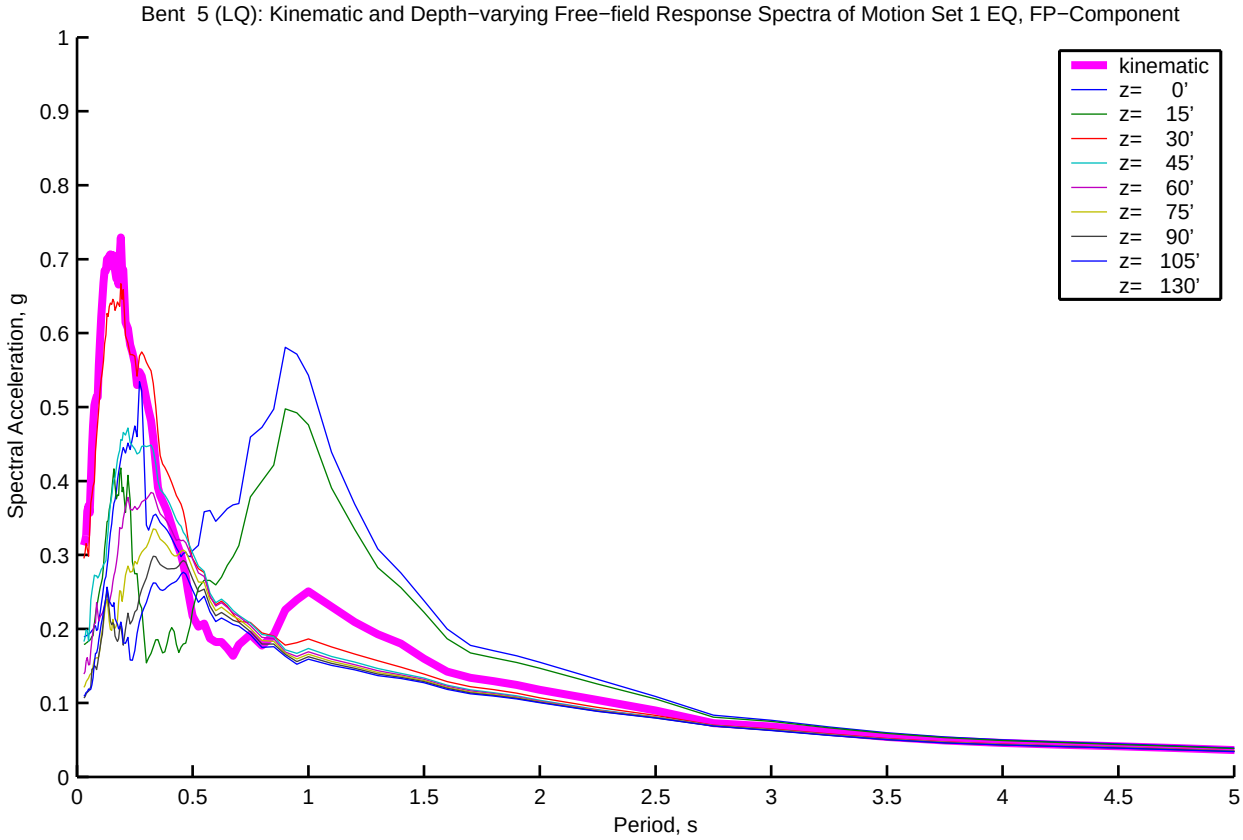
Bent 5 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component






Bent 5 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
0
0.1
0.2
0.3
0.4
0.5
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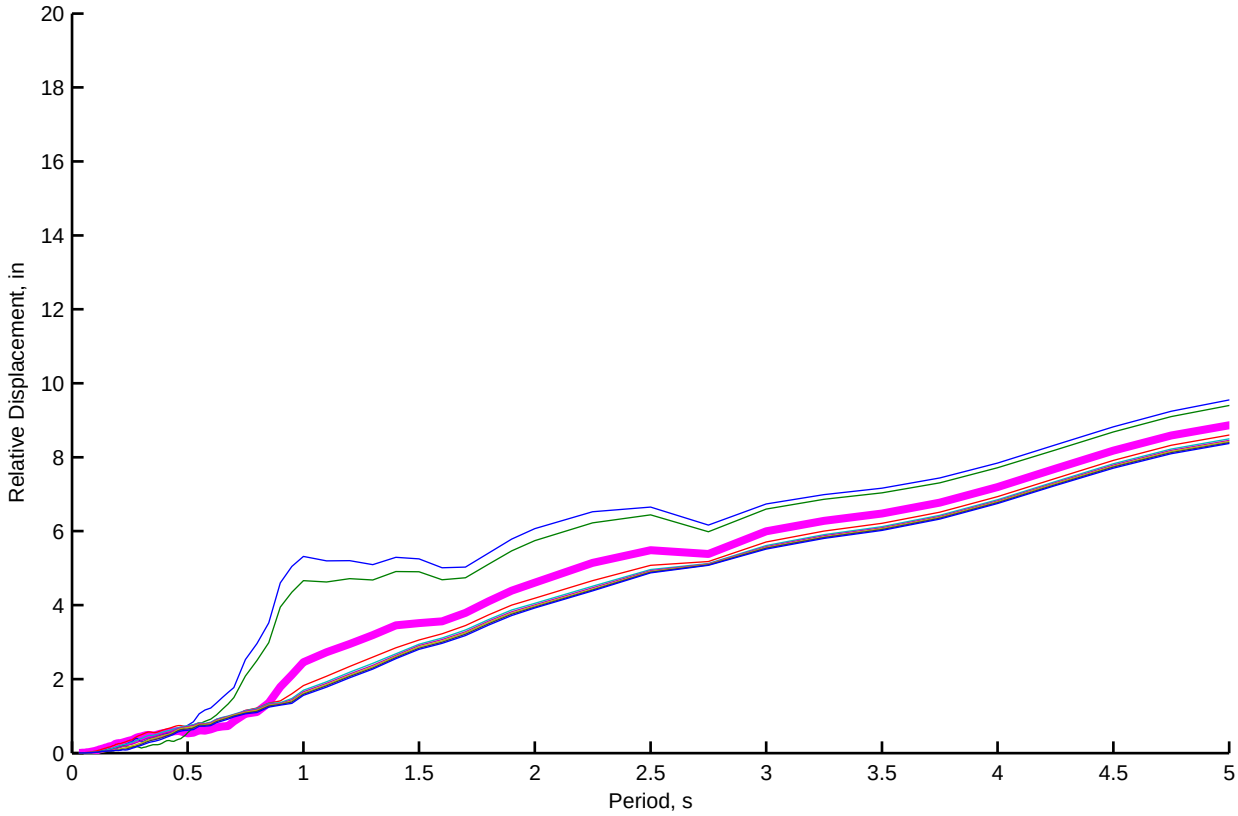
Relative Displacement, in
Period, s
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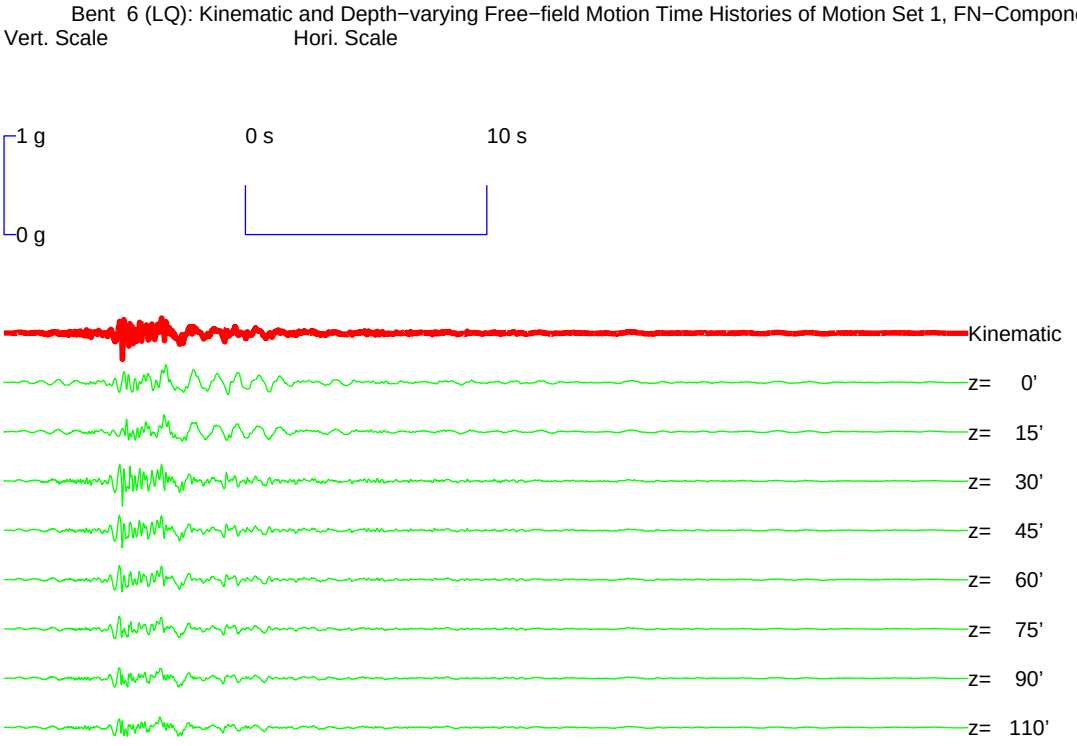
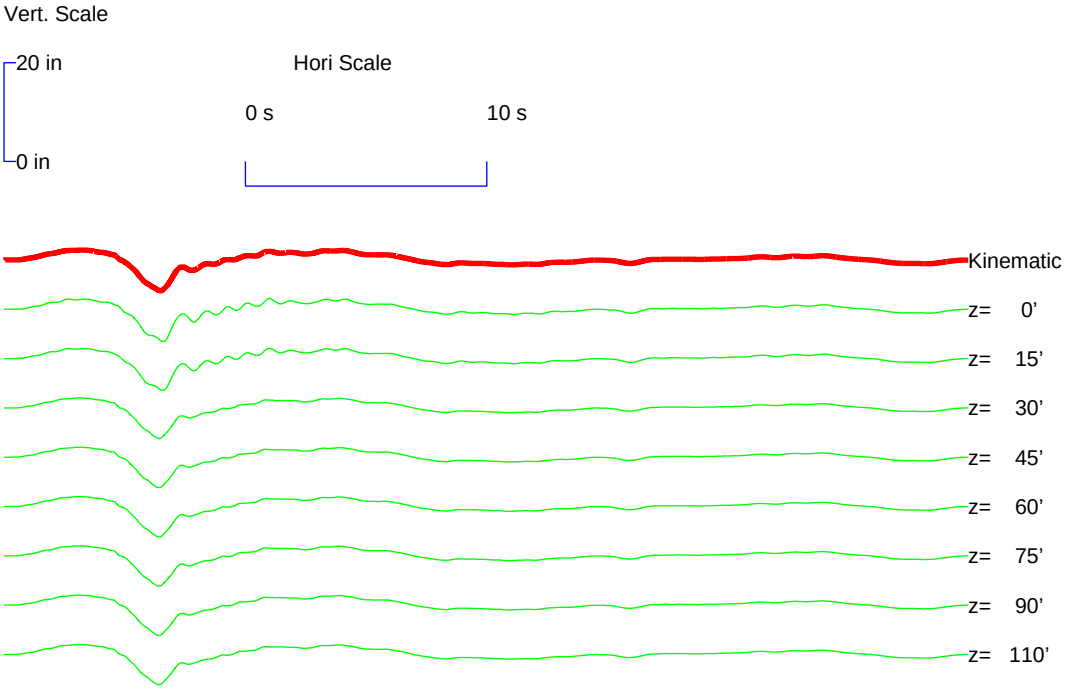
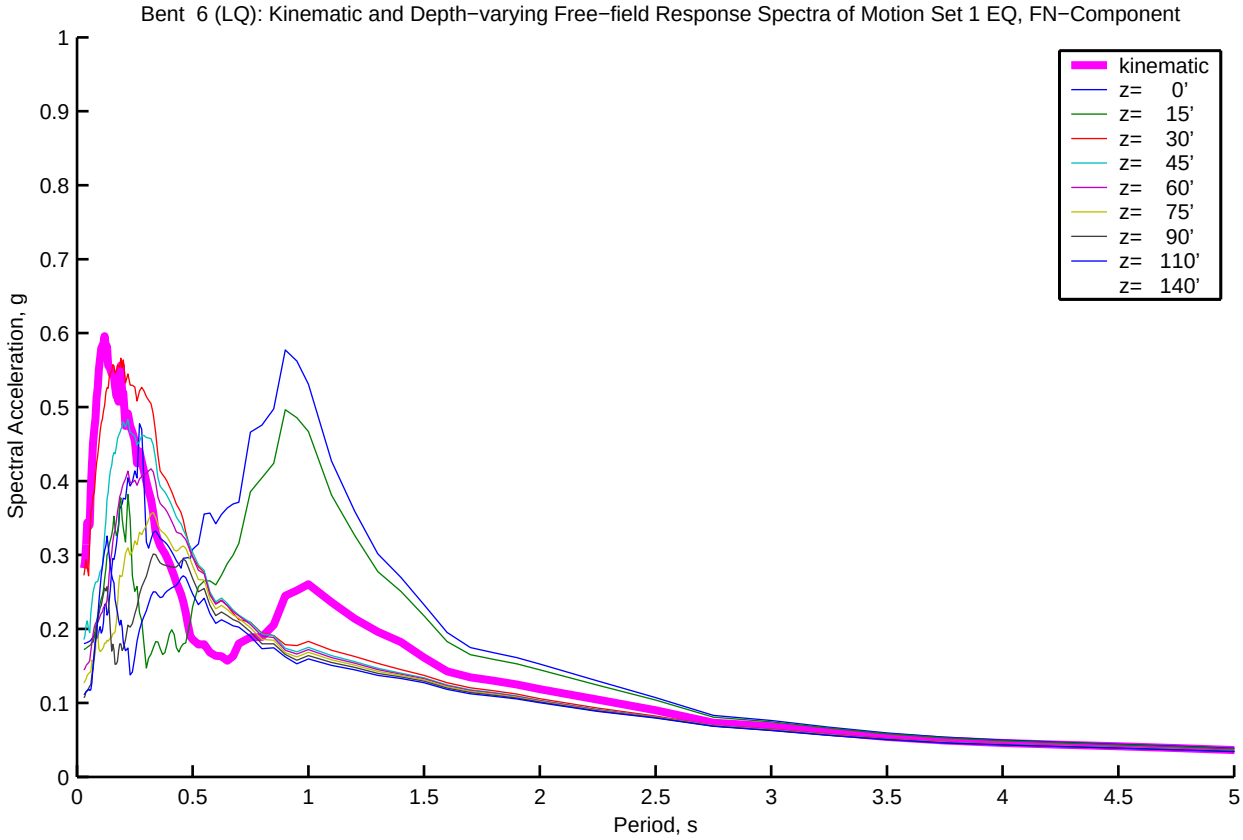
Bent 6 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component






Bent 6 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
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2.5
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4.5
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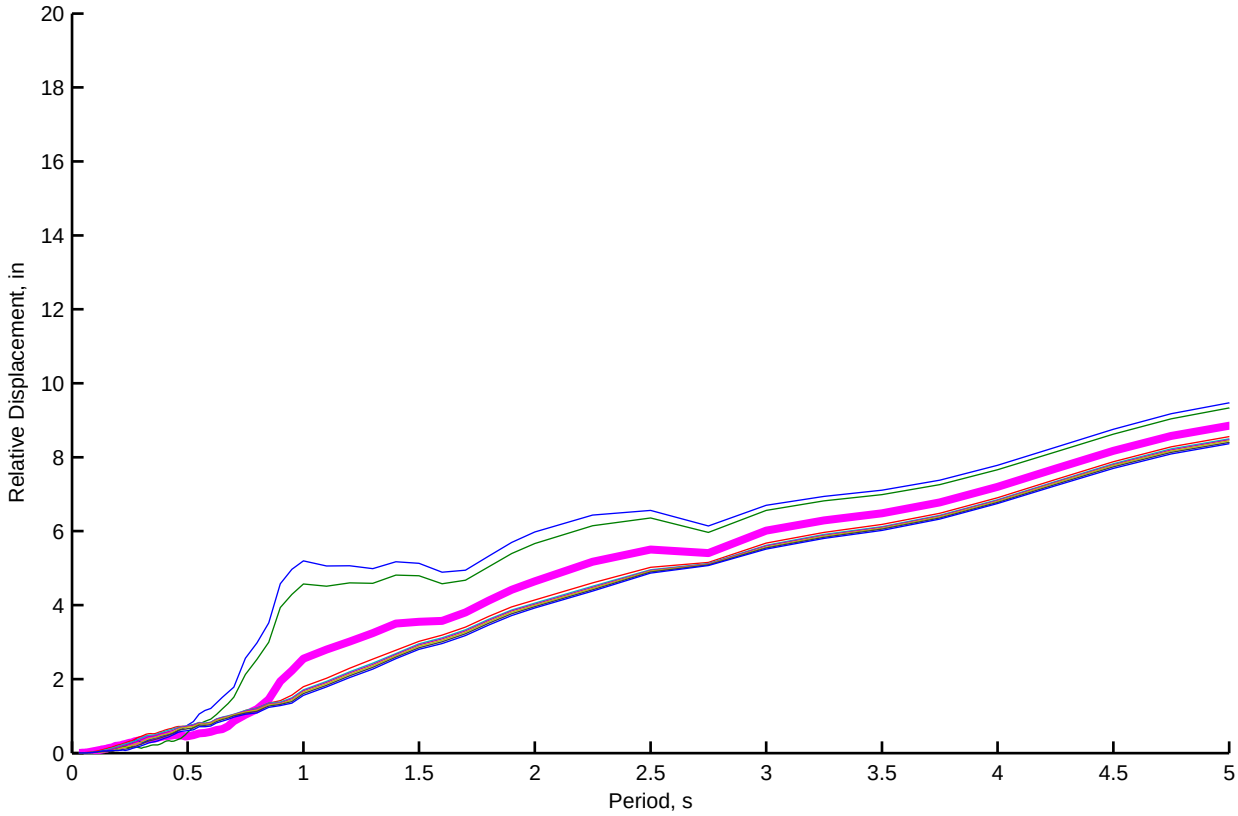
Relative Displacement, in
Period, s
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1
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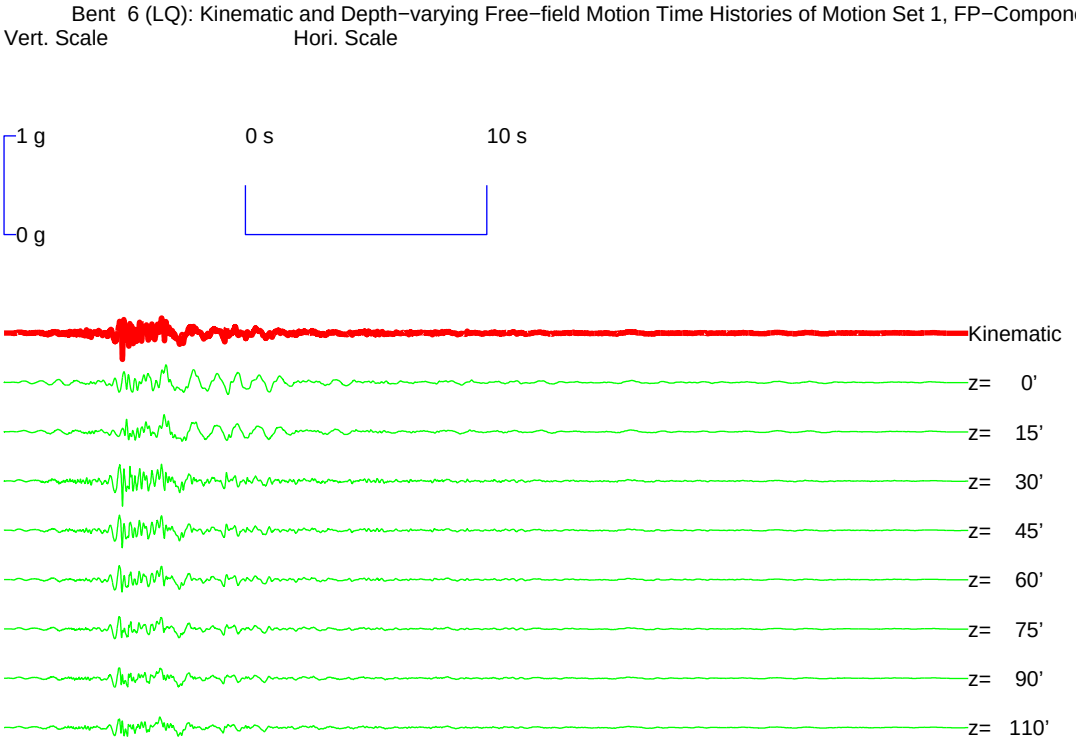
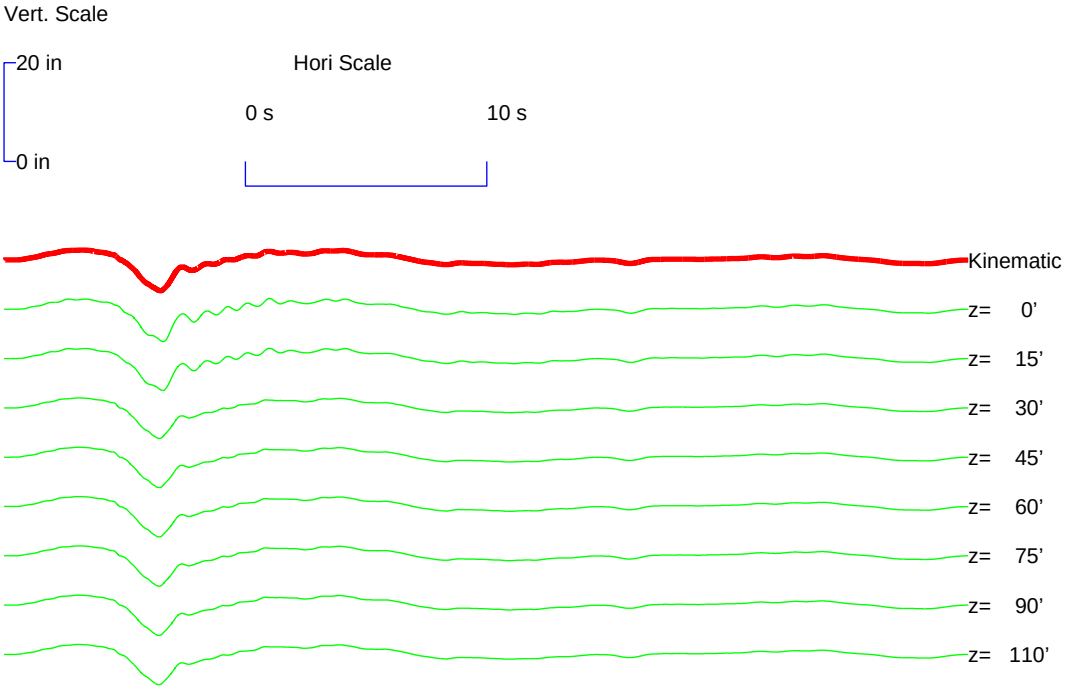
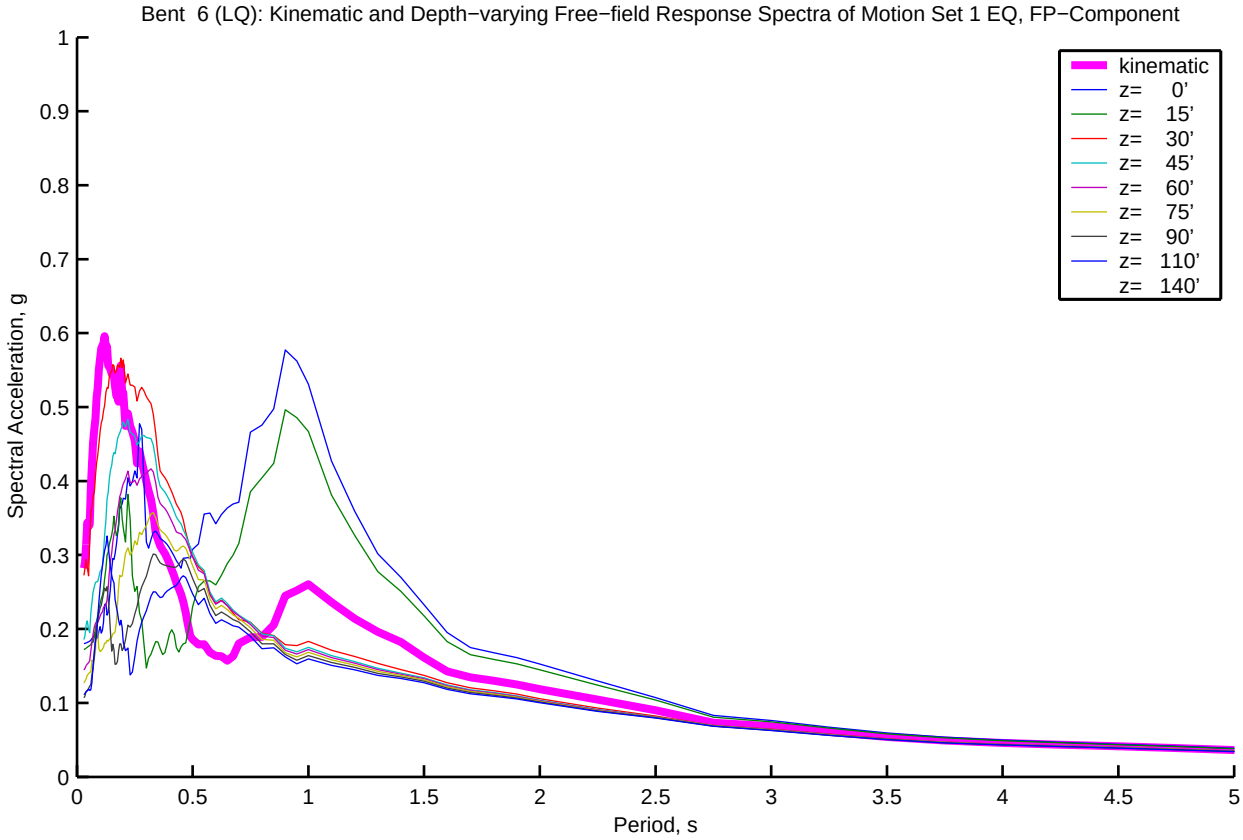
Bent 6 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component






Bent 6 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
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2.5
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3.5
4
4.5
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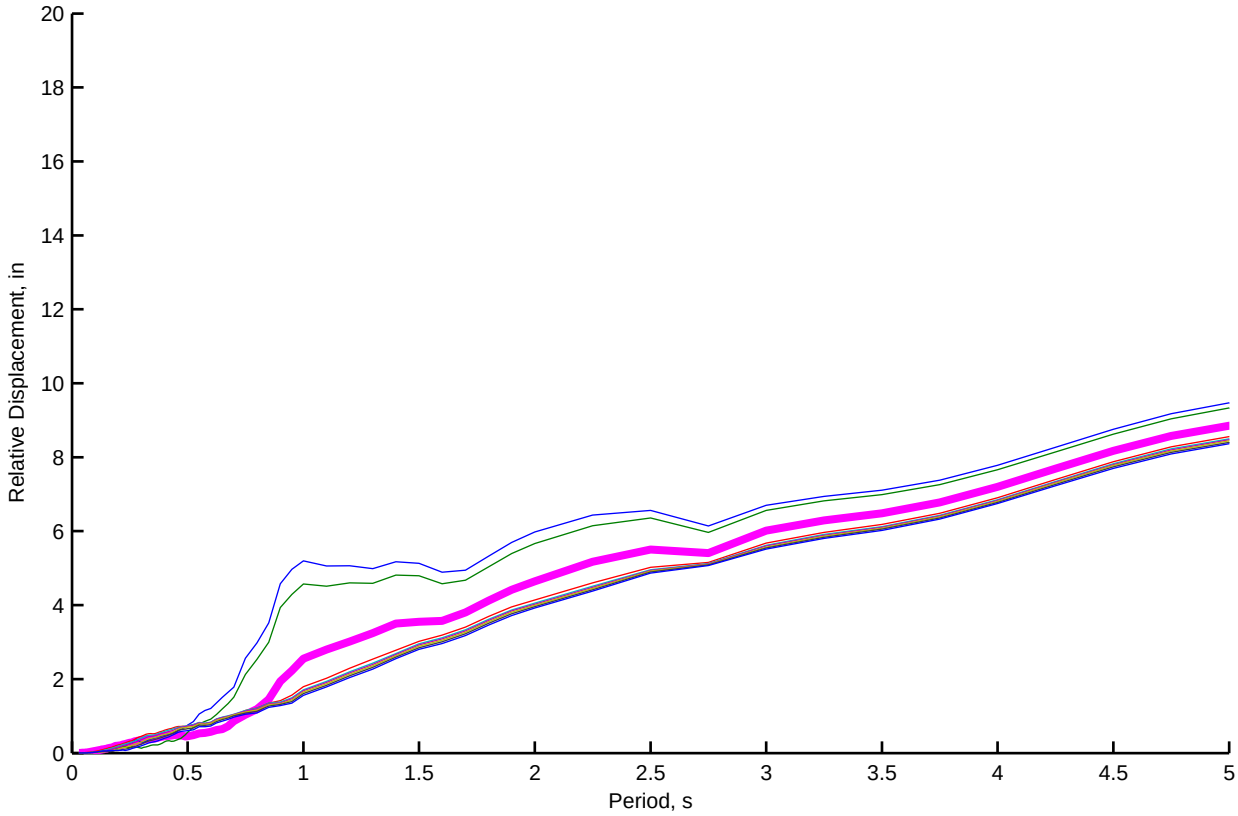
Relative Displacement, in
Period, s
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2
4
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12
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0.5
1
1.5
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2.5
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4.5
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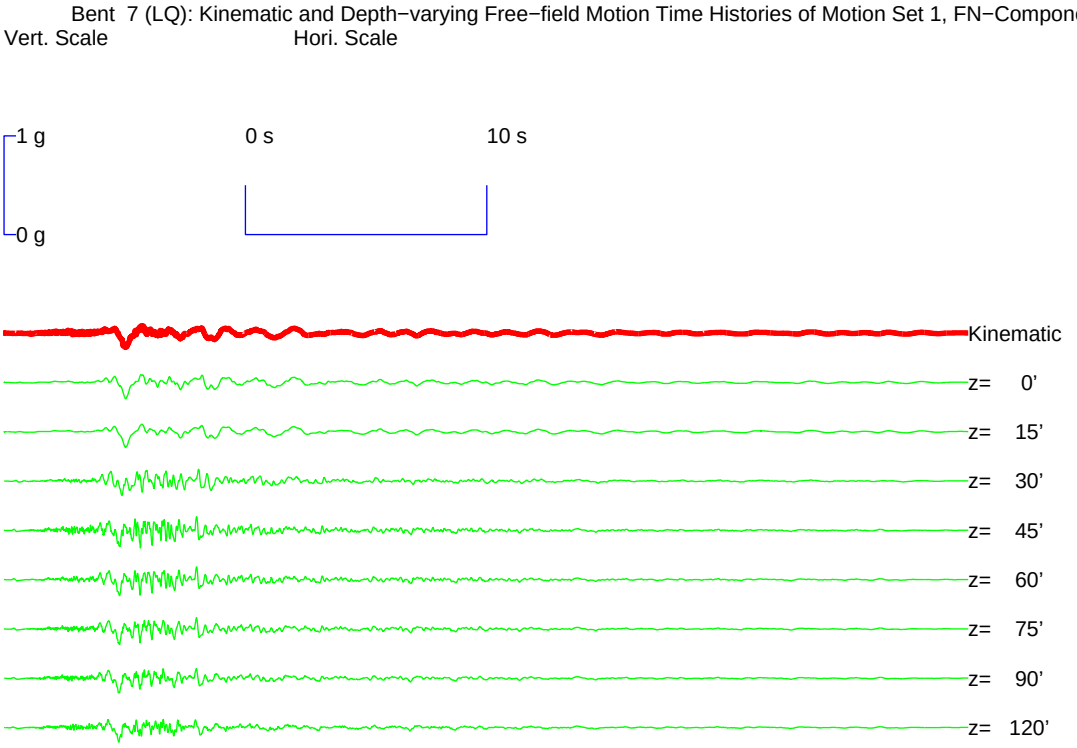
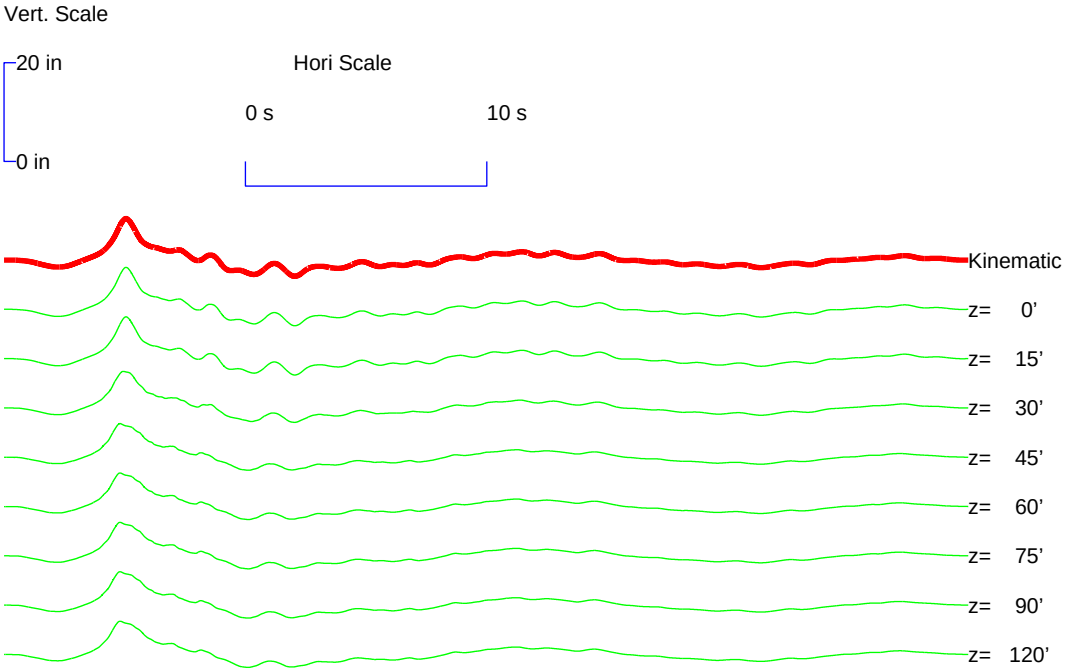
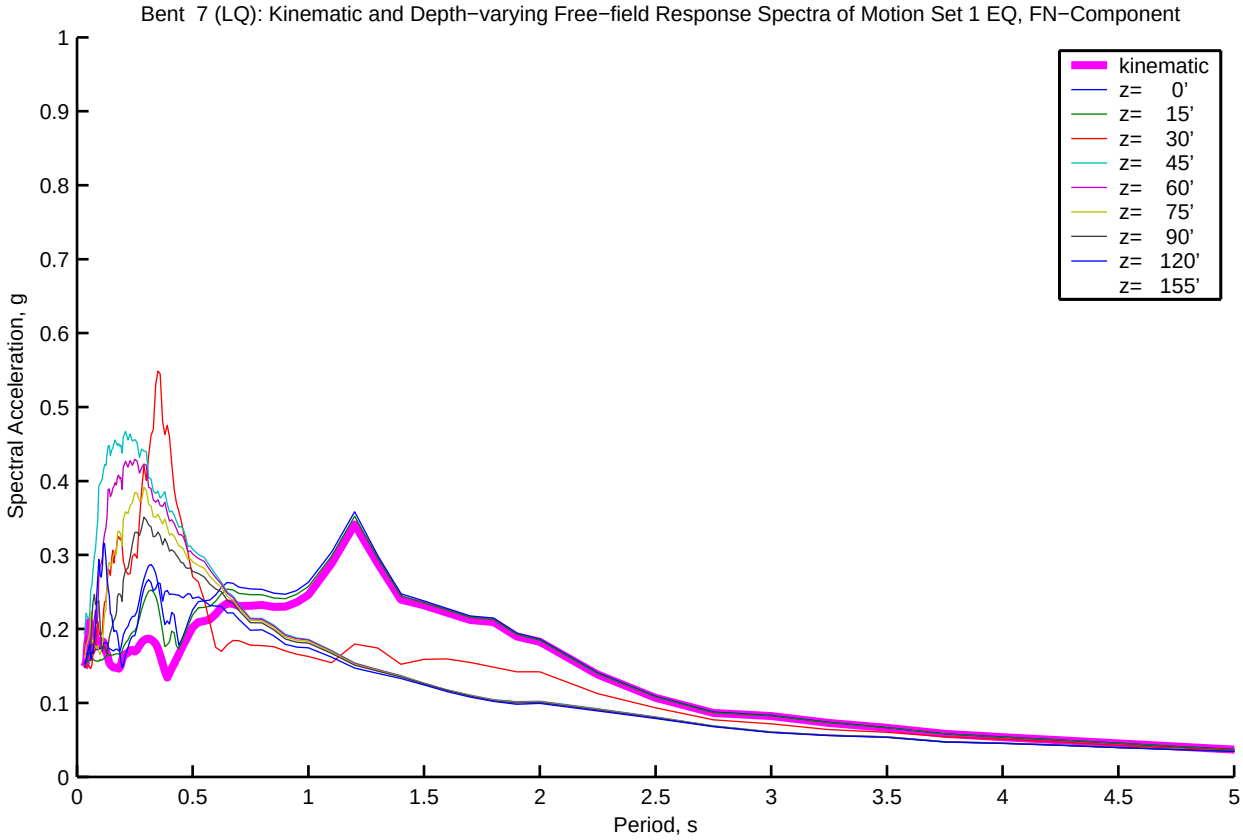
Bent 7 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component






Bent 7 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 155'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
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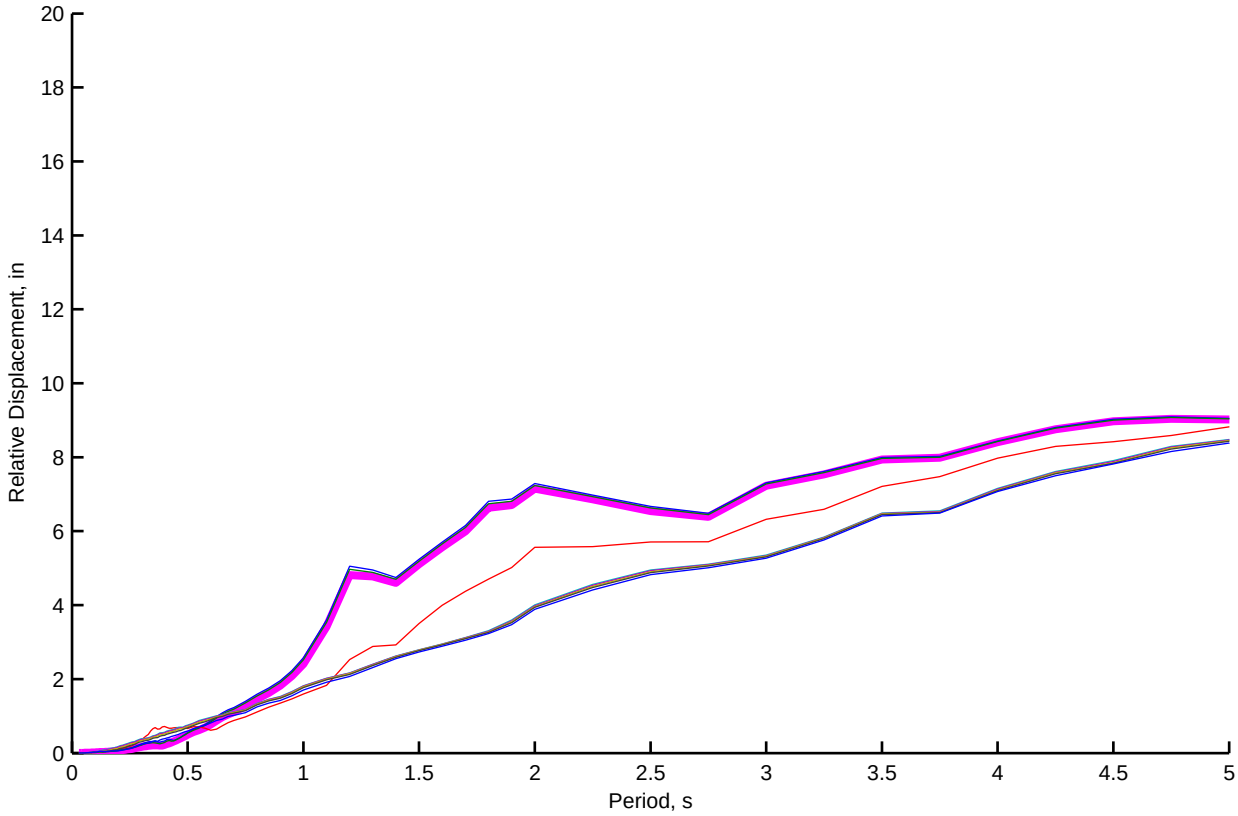
Relative Displacement, in
Period, s
0
2
4
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8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
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4.5
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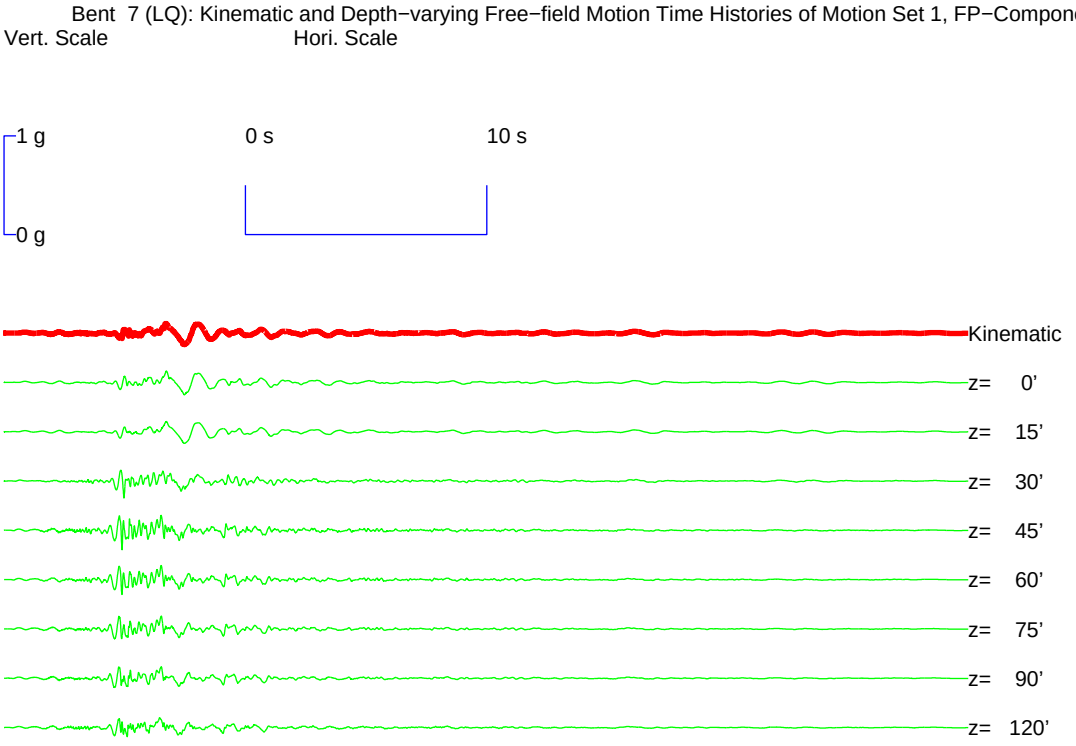
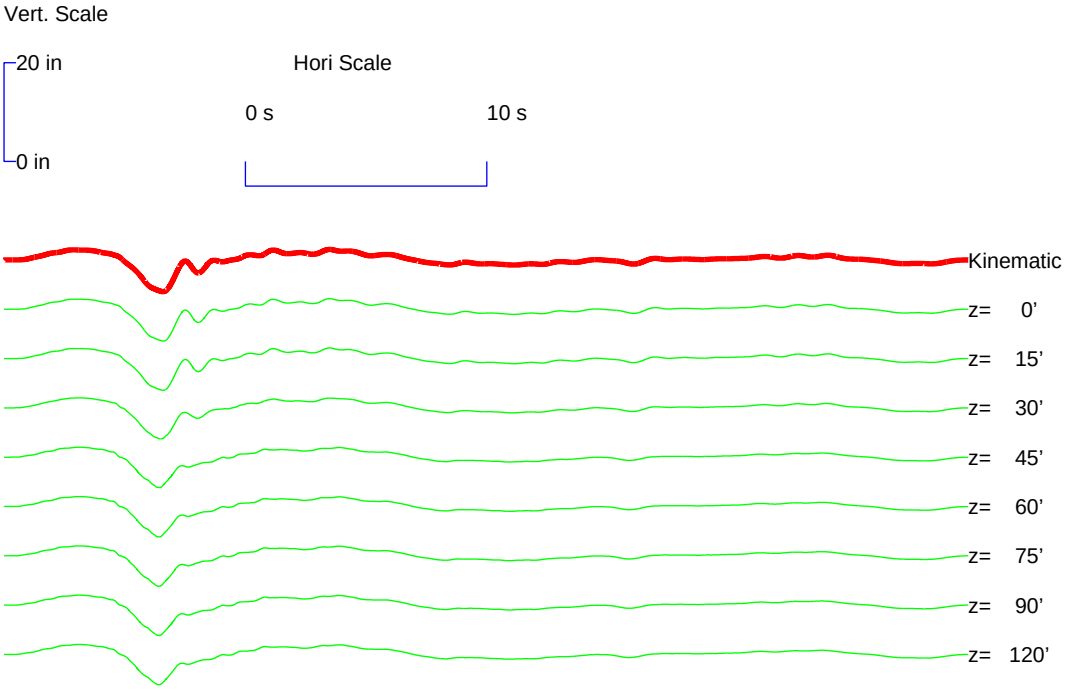
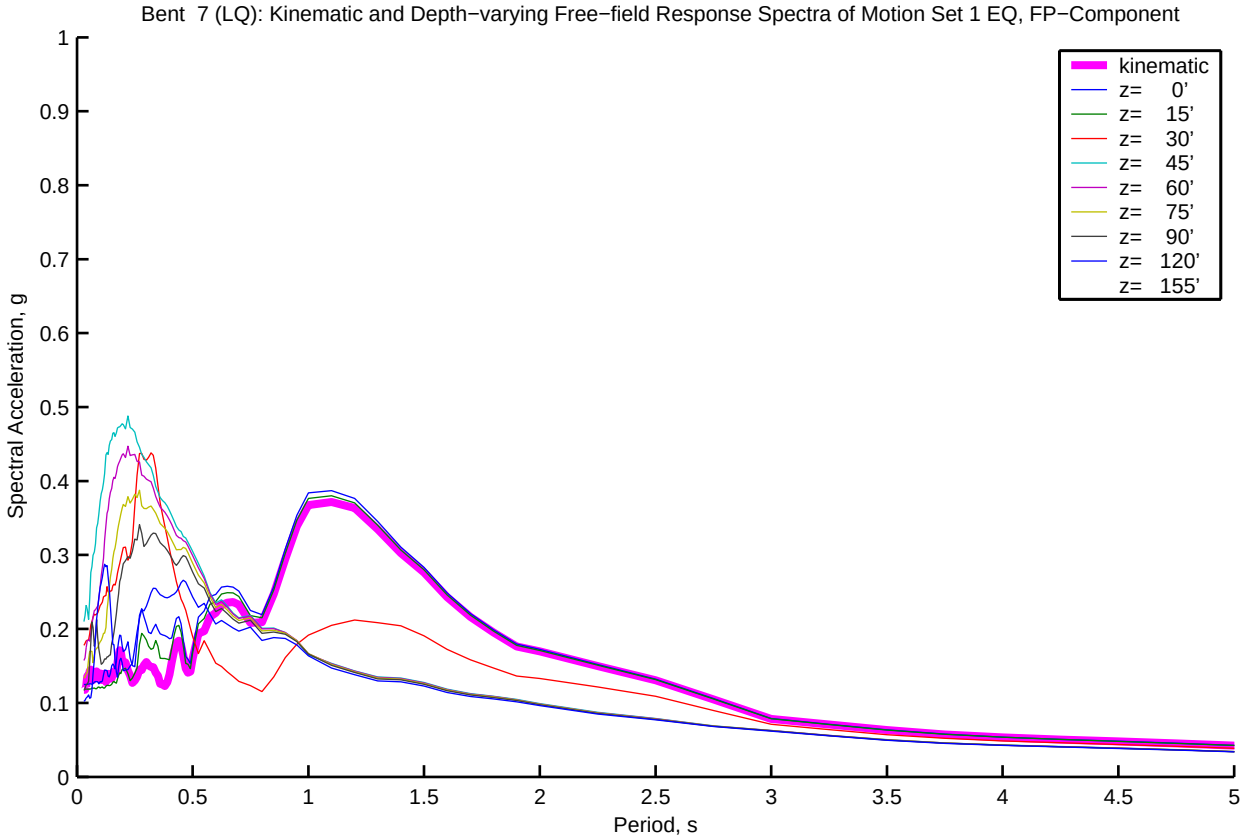
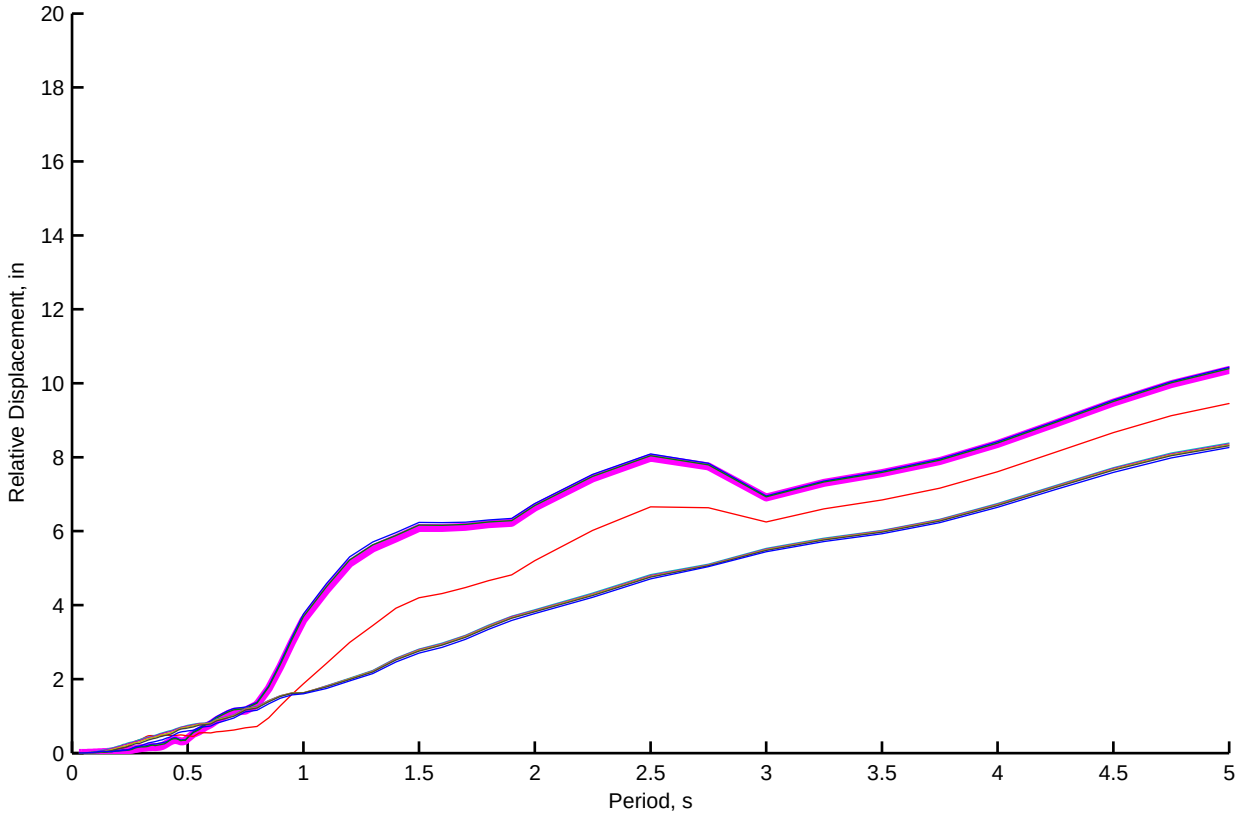
Bent 7 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component






Bent 7 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 155'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5


Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
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18
20
0.5
1
1.5
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2.5
3
3.5
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4.5
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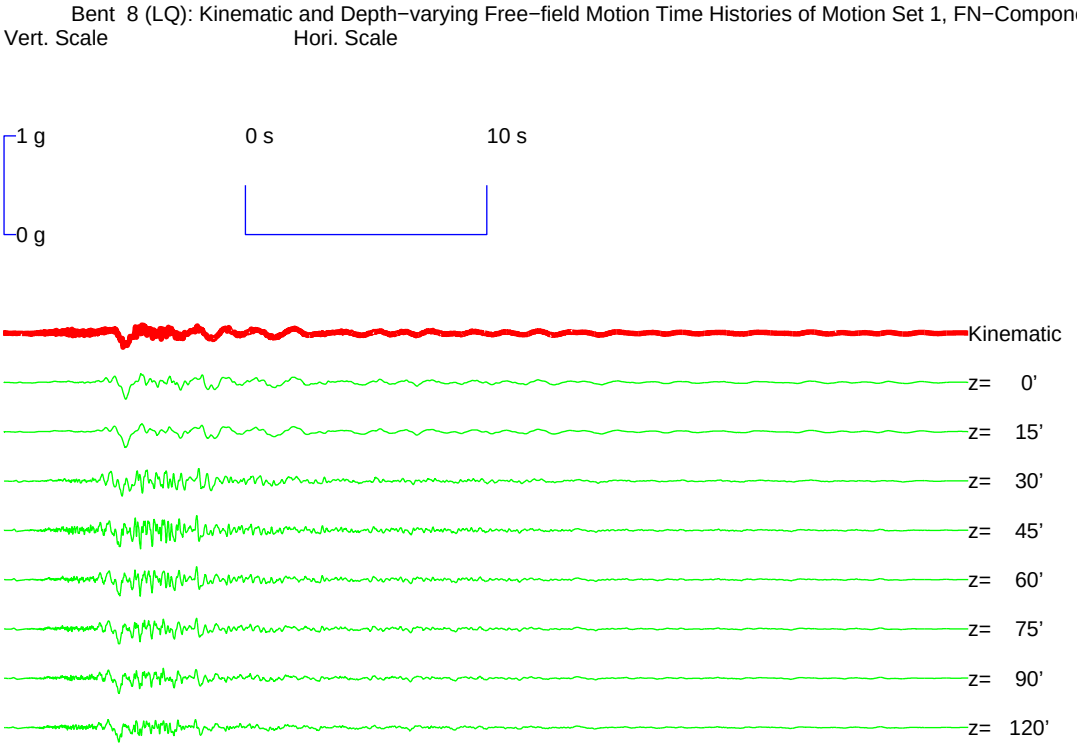
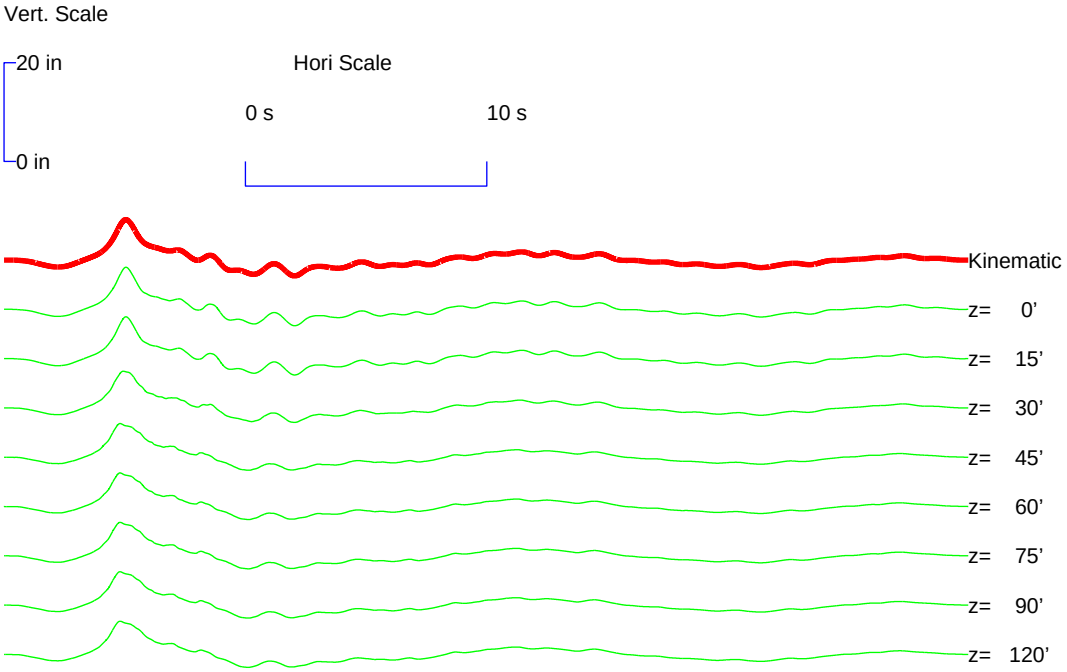
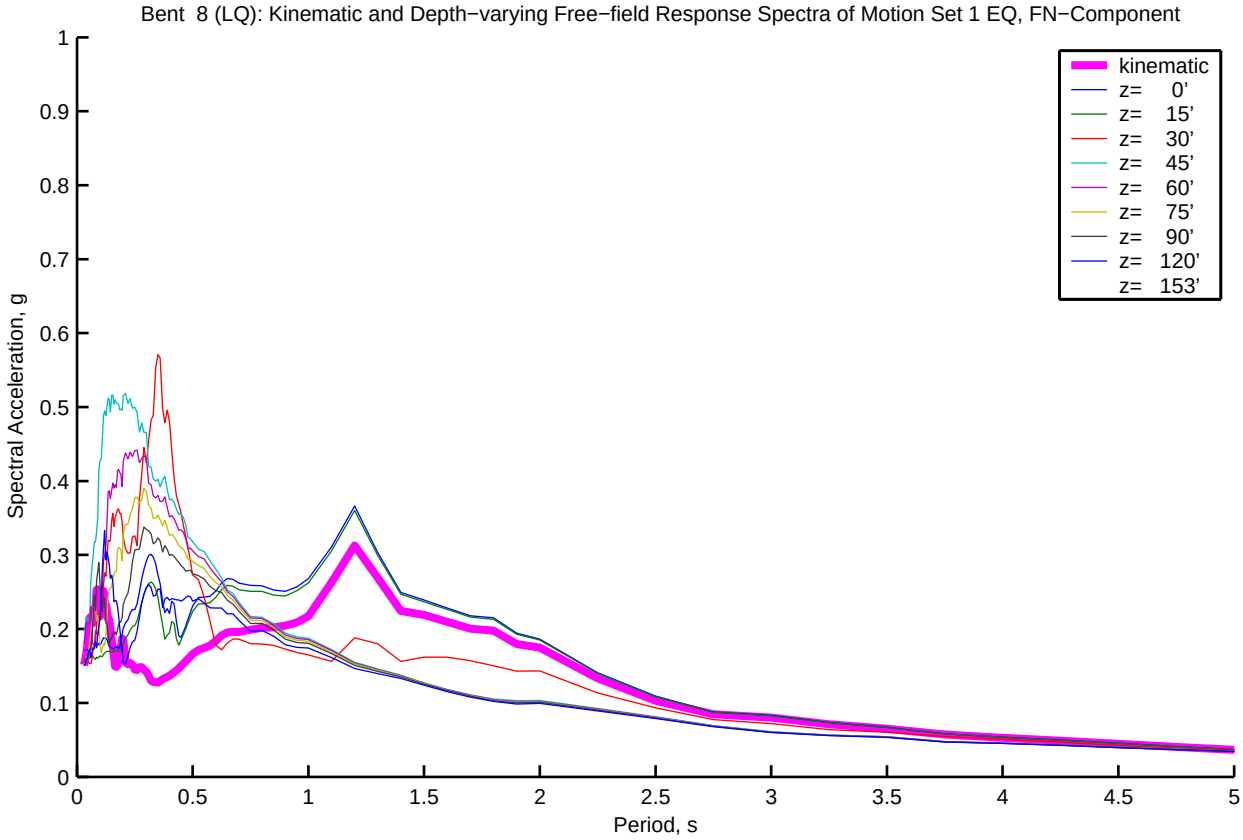
Bent 8 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component






Bent 8 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 153'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
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4
4.5
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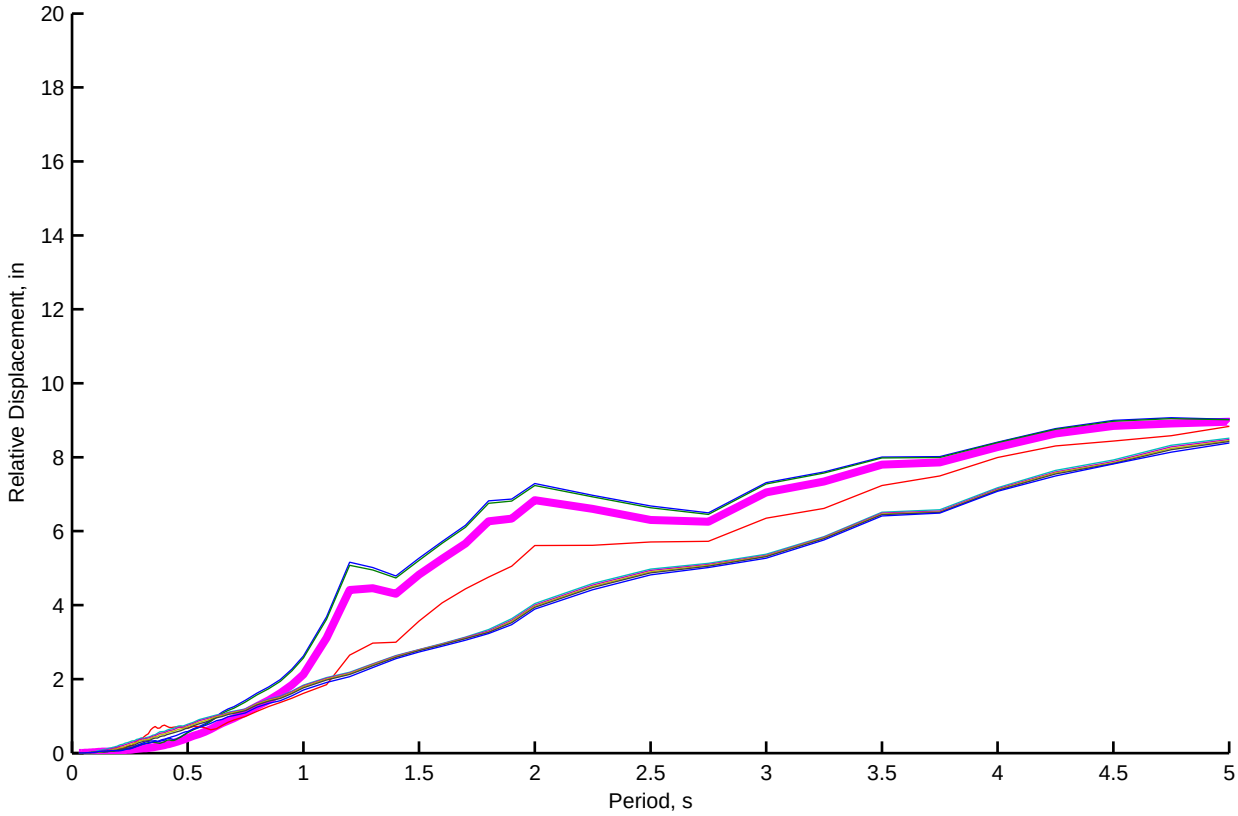
Relative Displacement, in
Period, s
0
2
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8
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0.5
1
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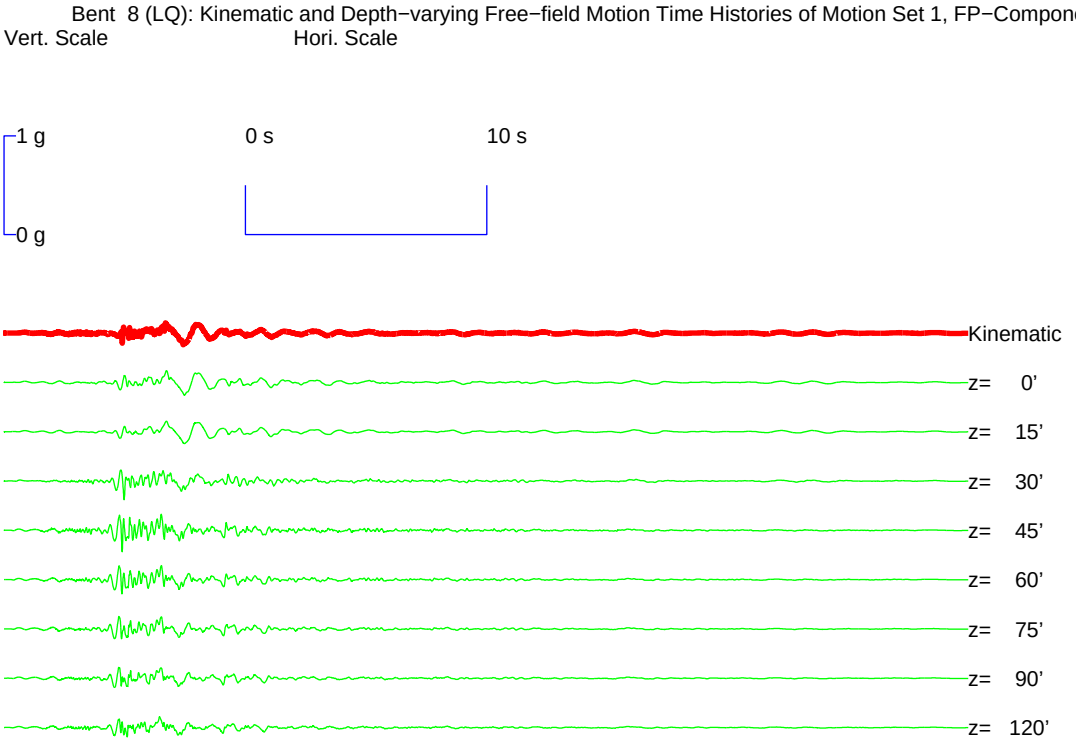
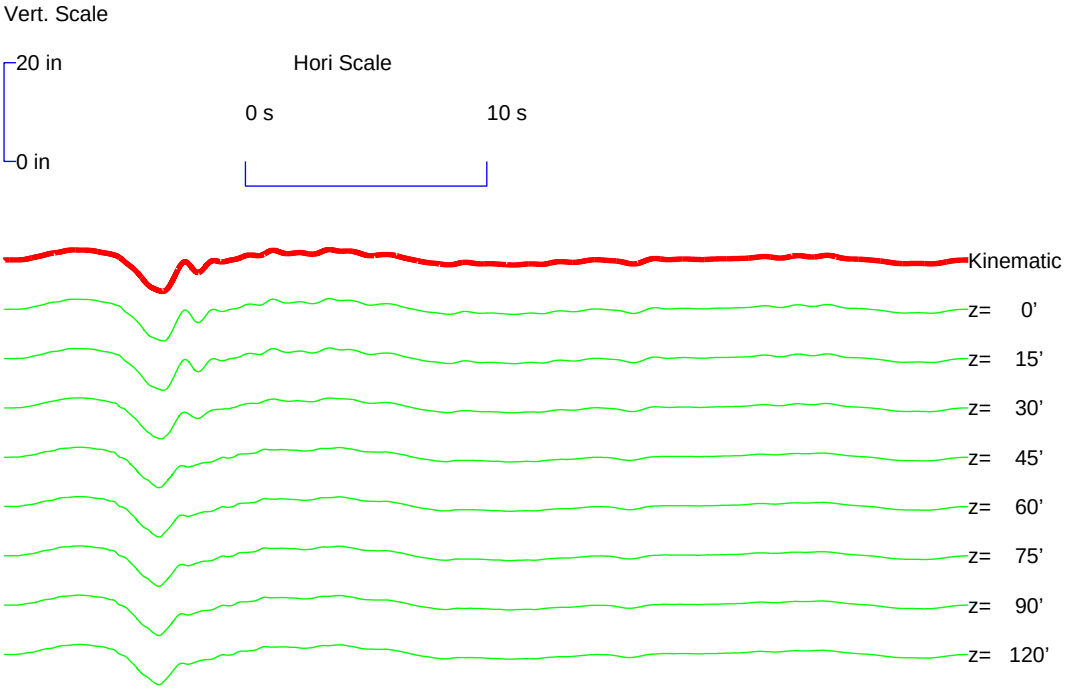
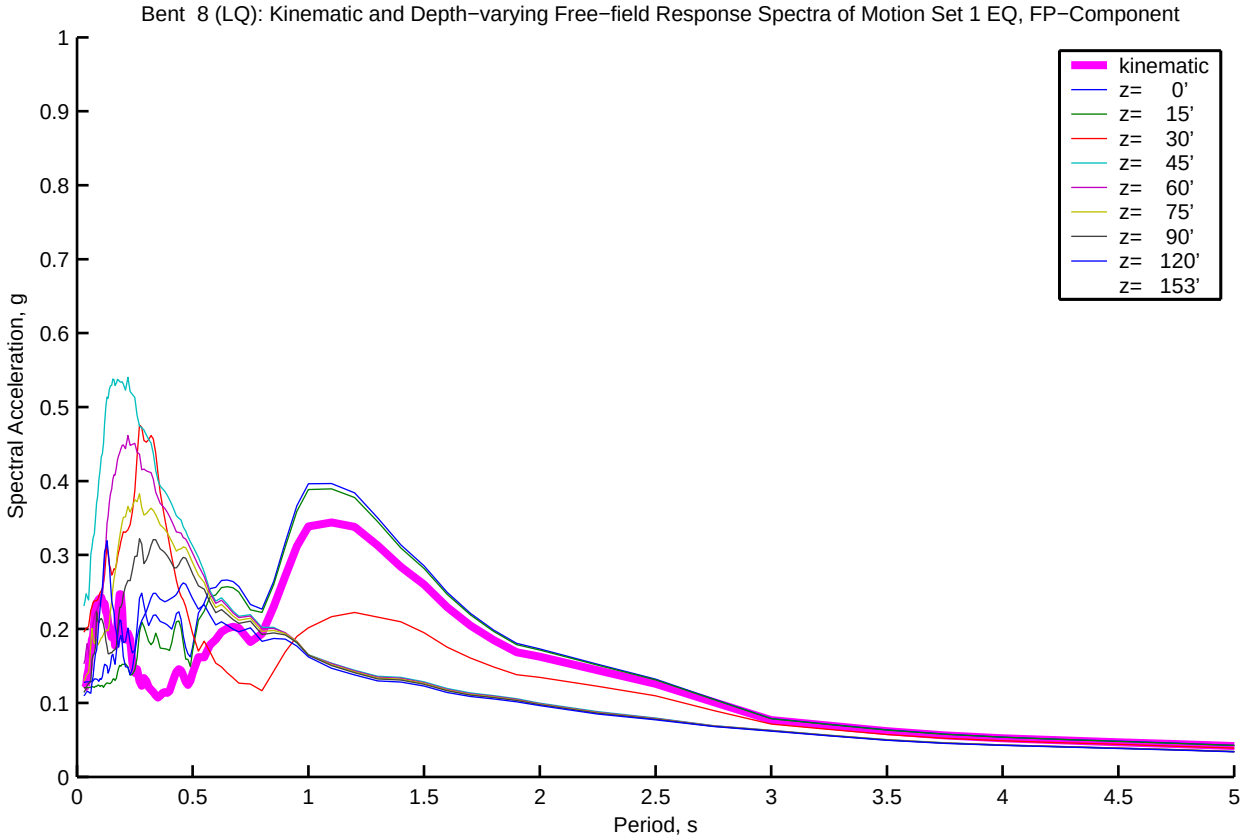
Bent 8 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component






Bent 8 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 153'
0
0.1
0.2
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0.5
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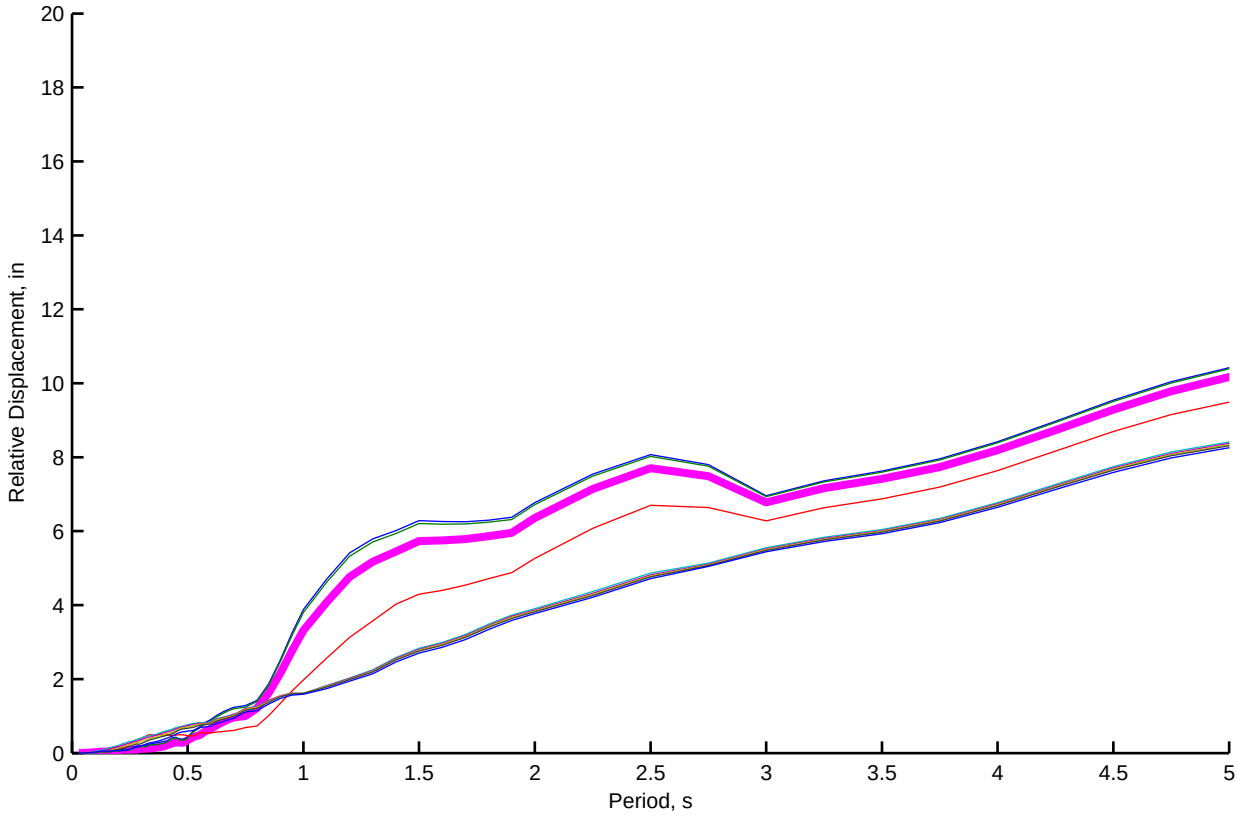
Relative Displacement, in
Period, s
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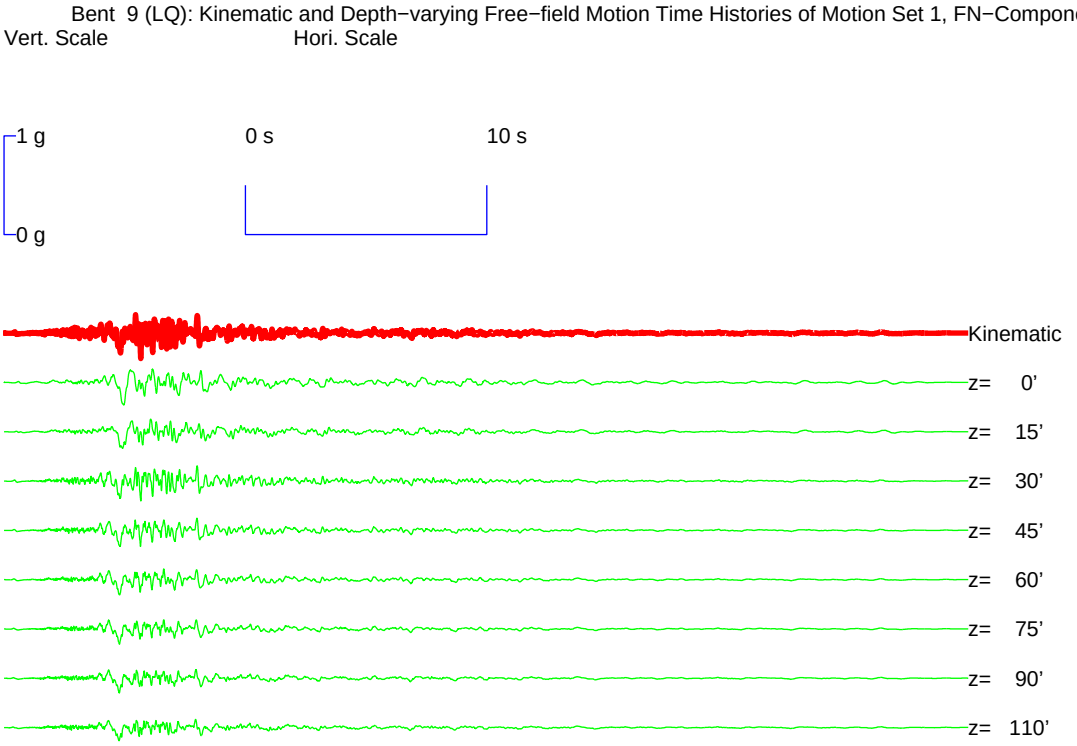
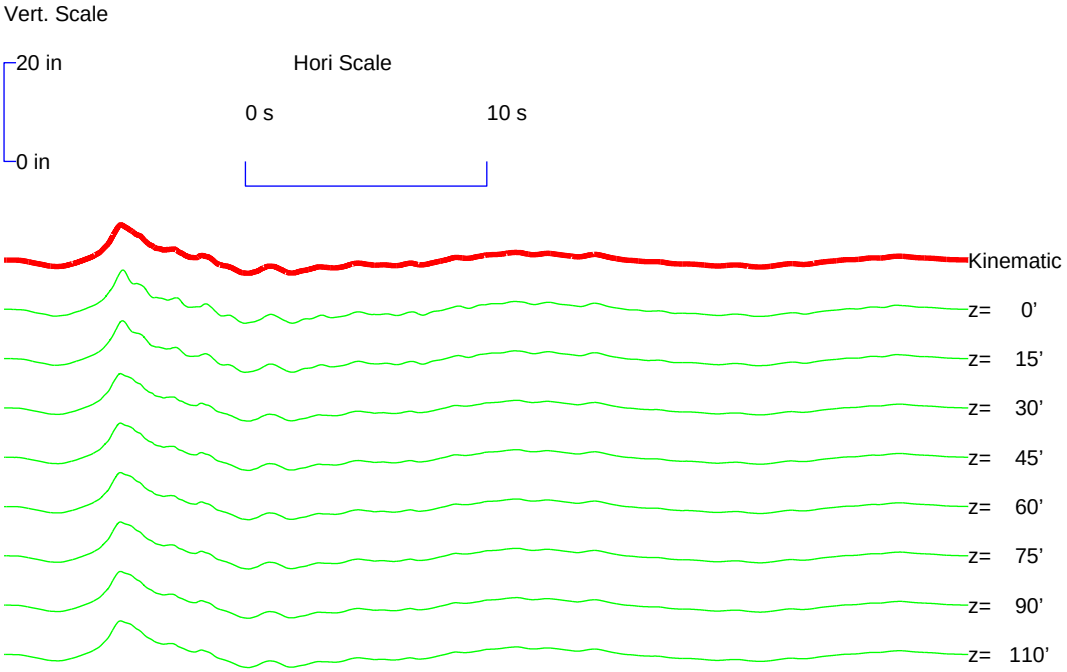
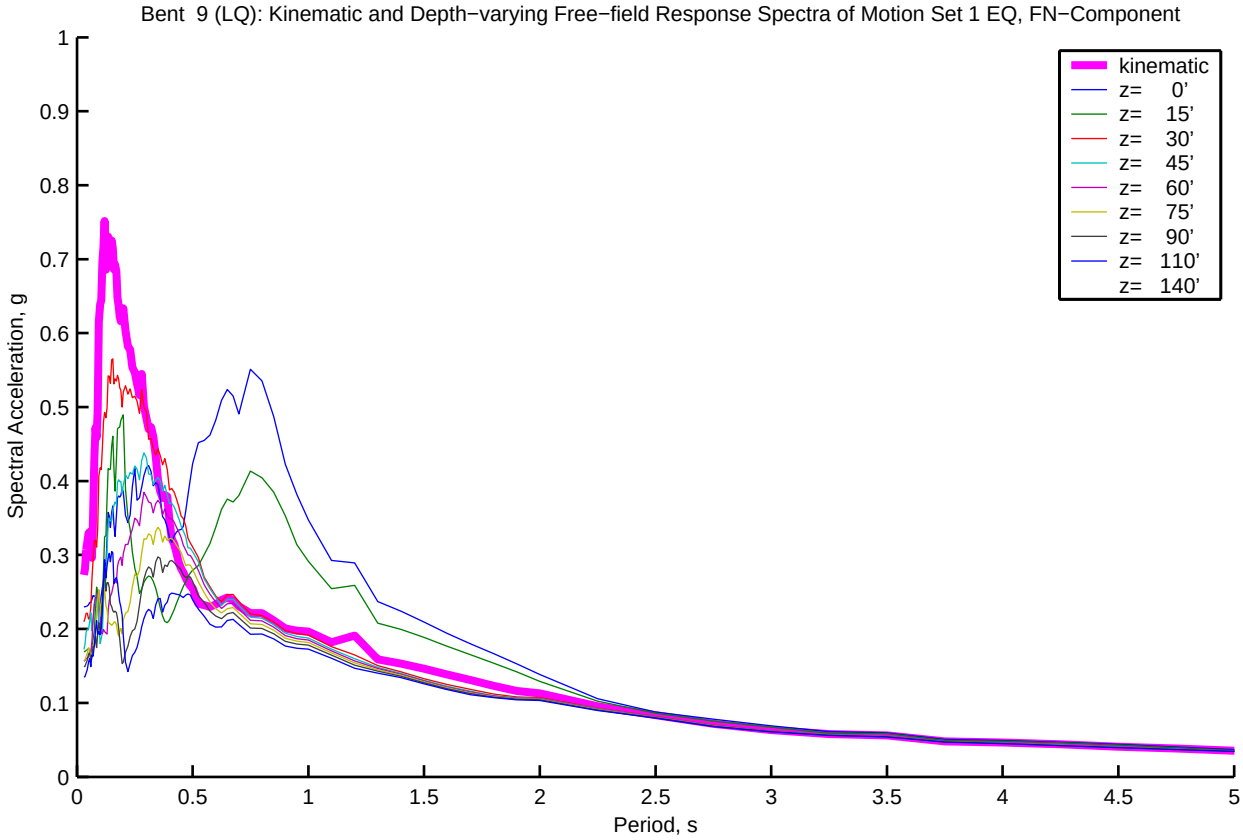
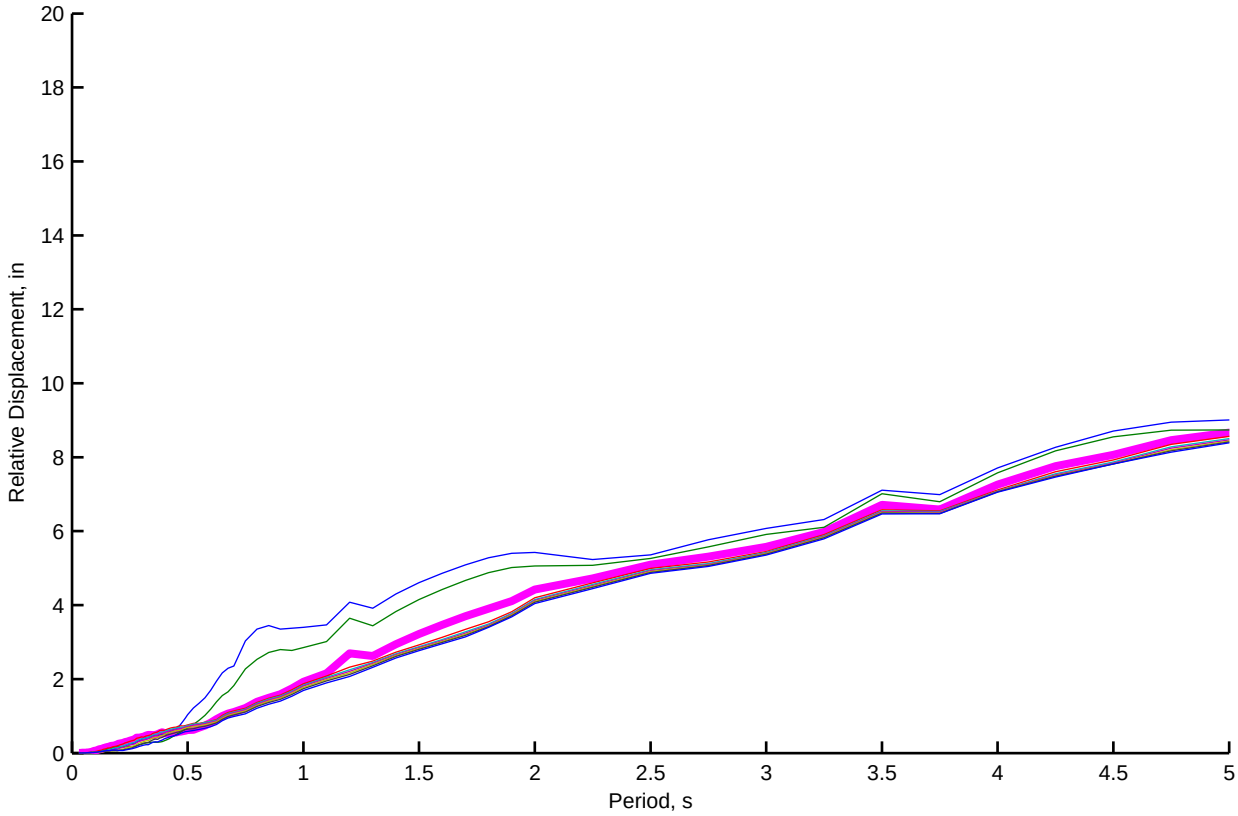
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 9 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component

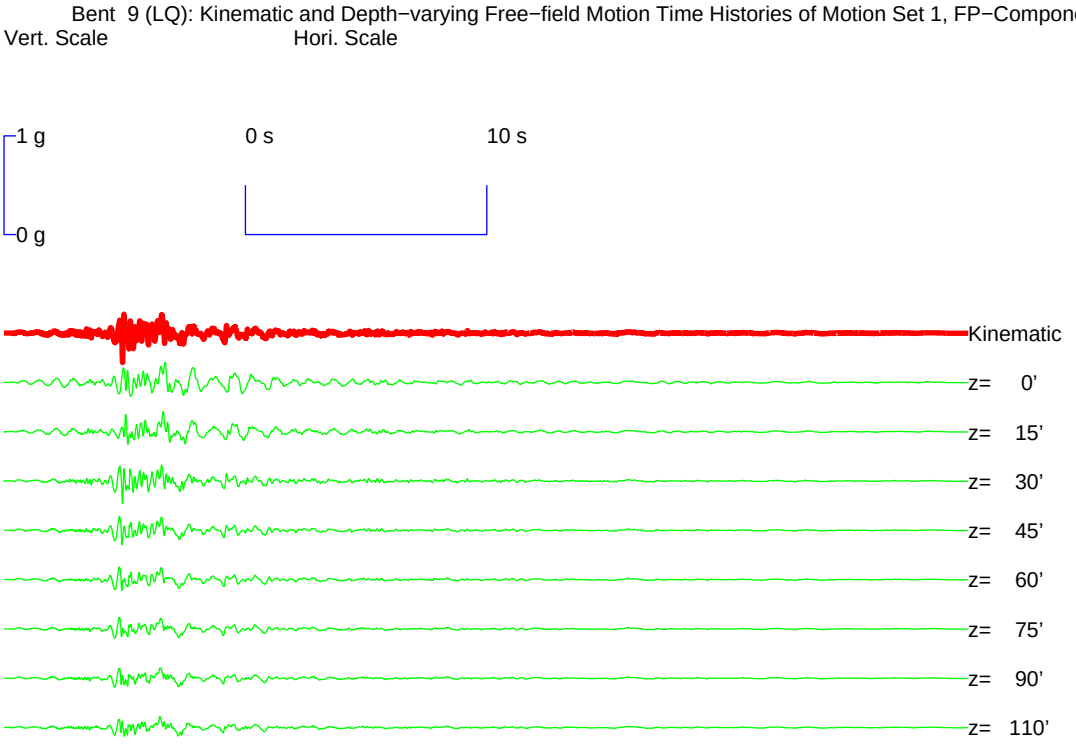


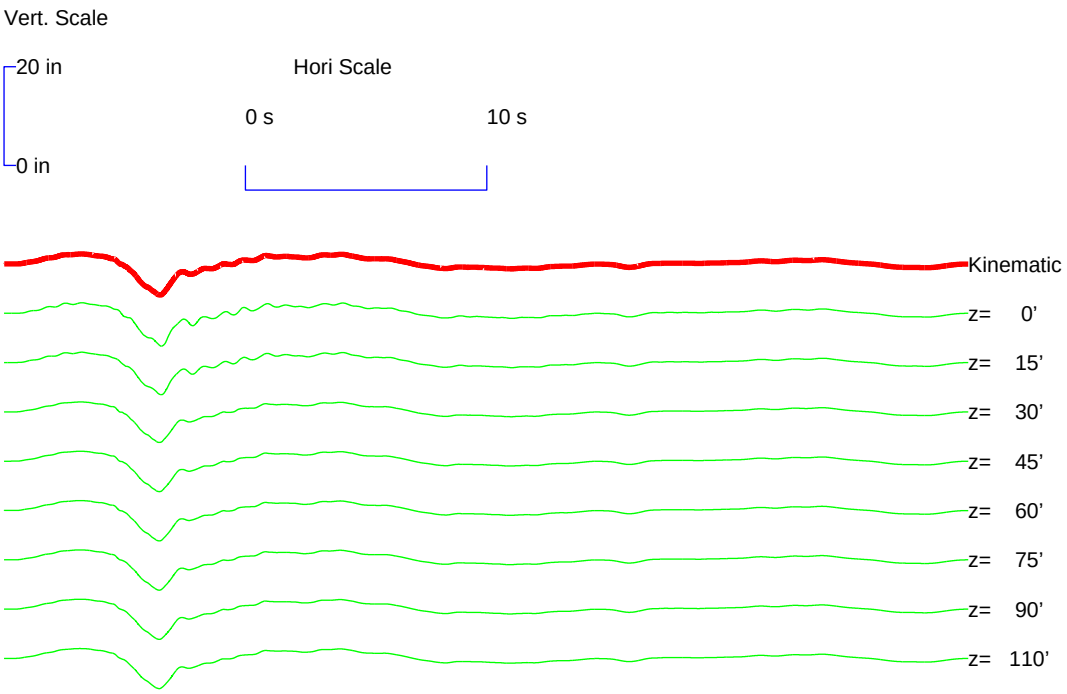


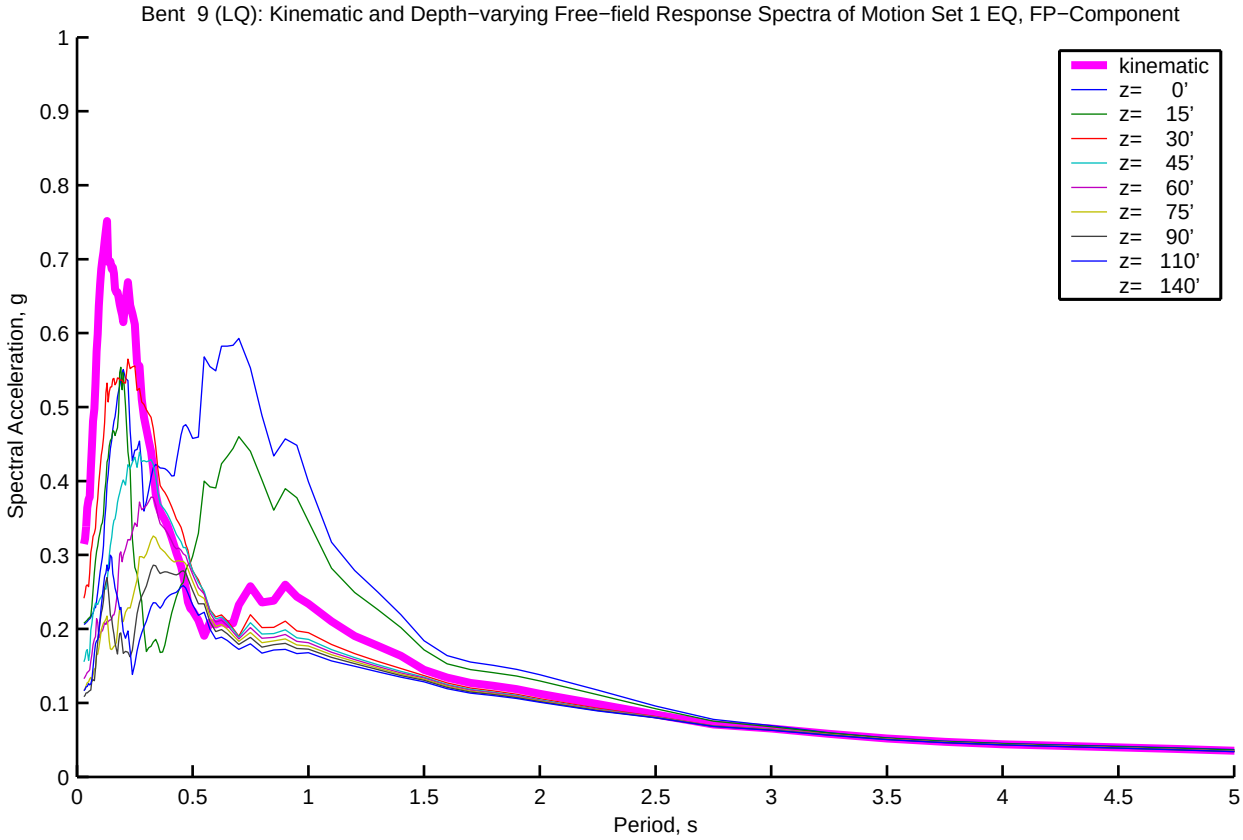

Bent 9 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

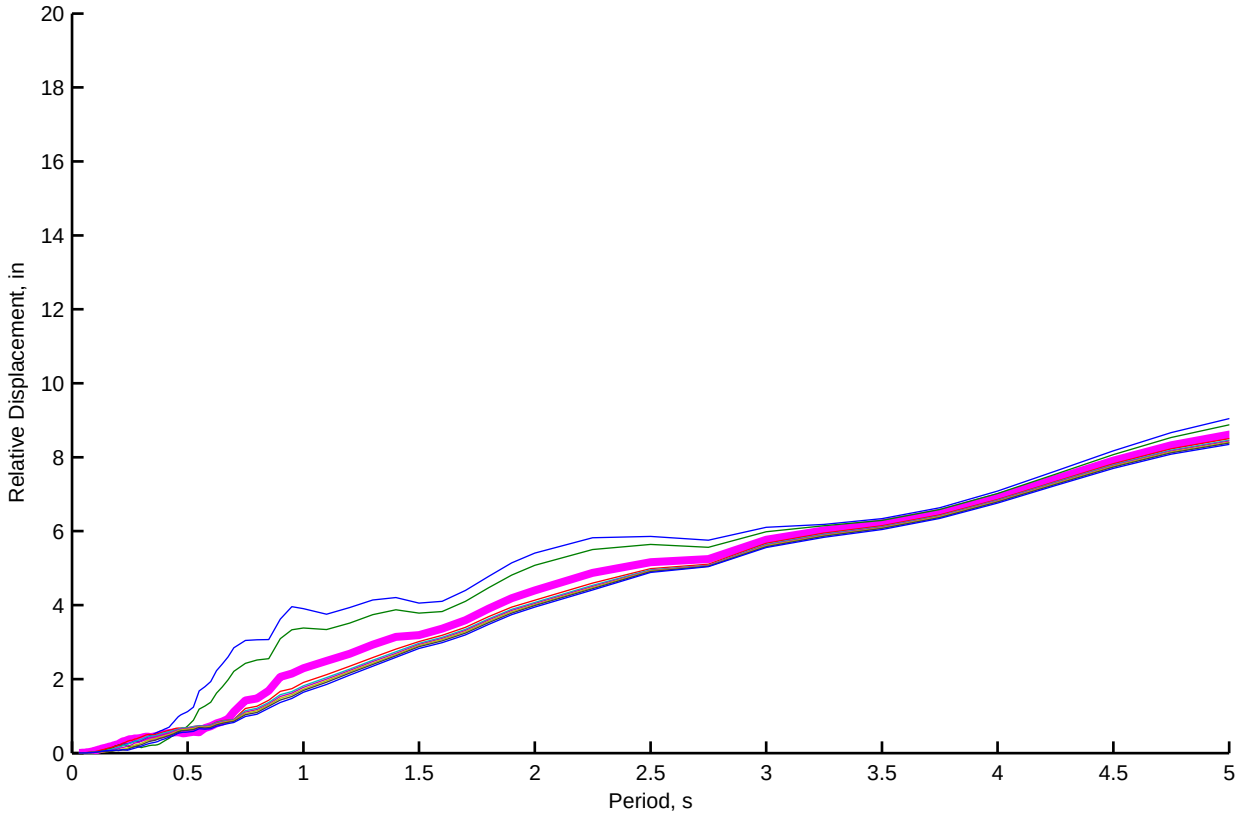

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 9 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component

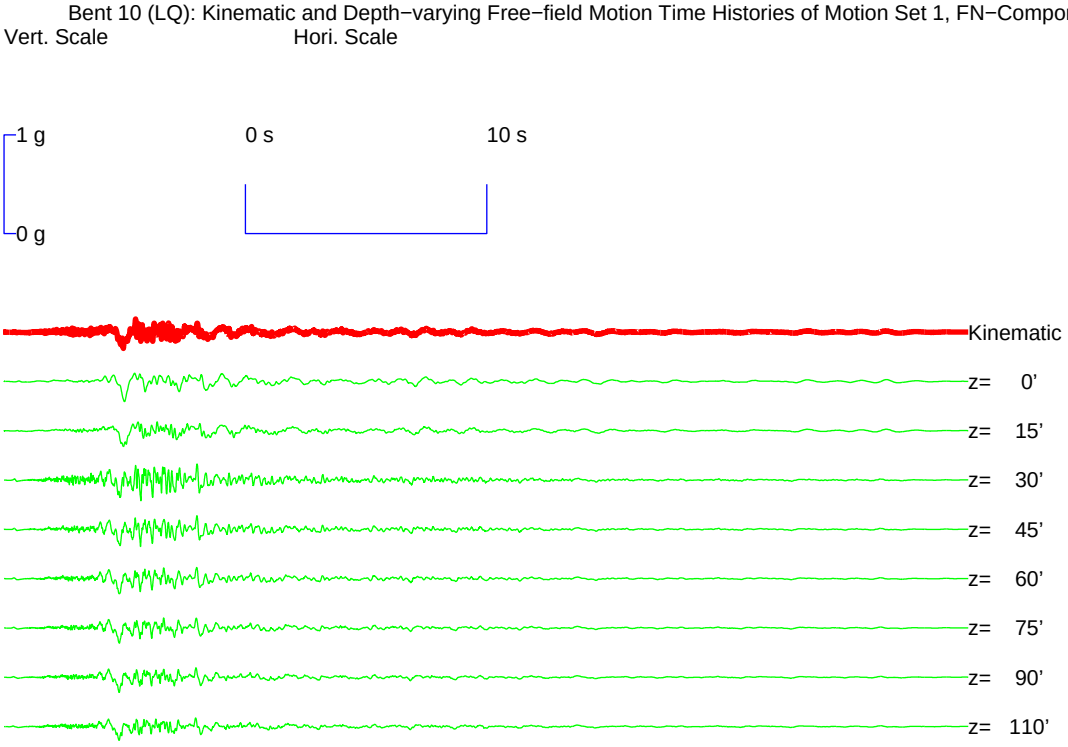


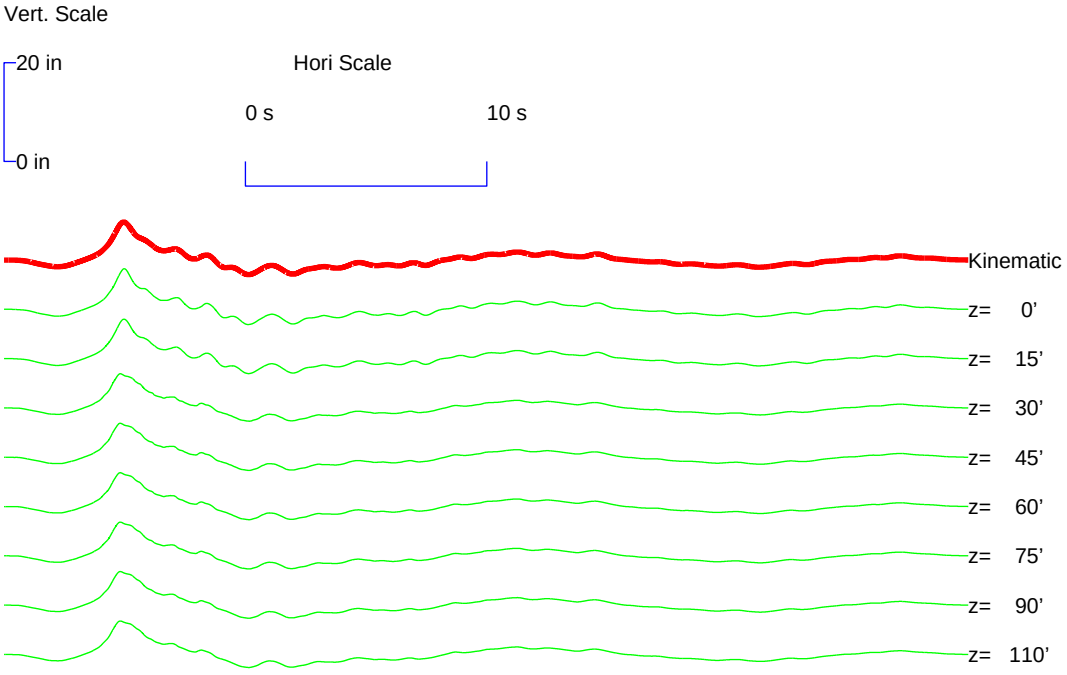


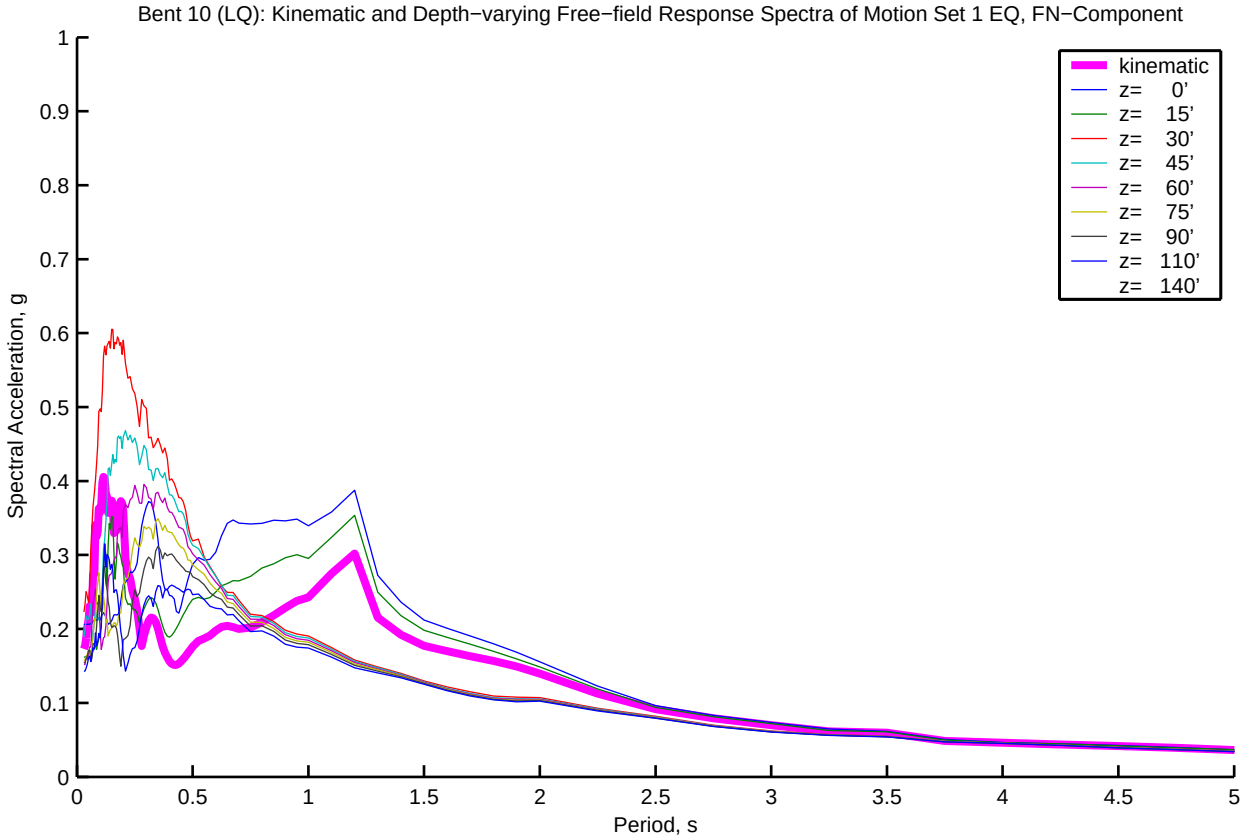

Bent 9 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

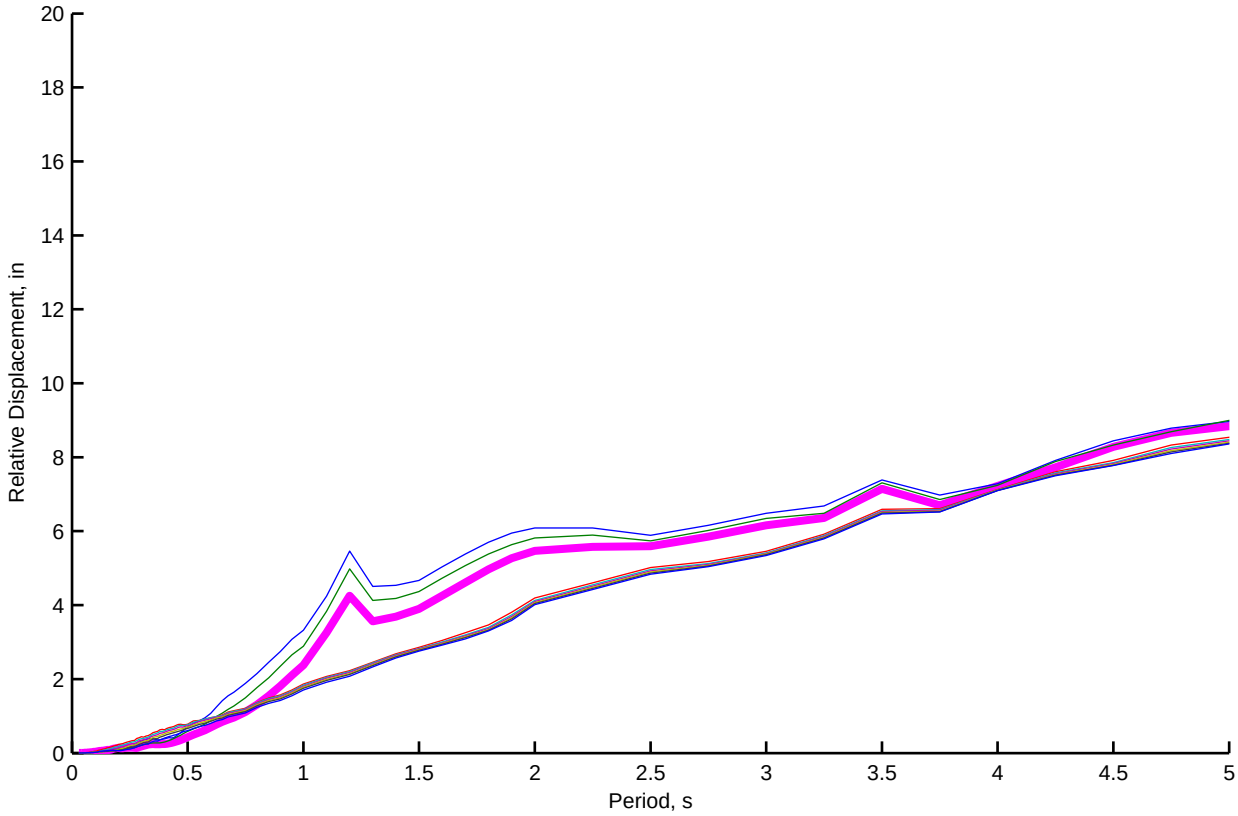

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 10 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FN−Component

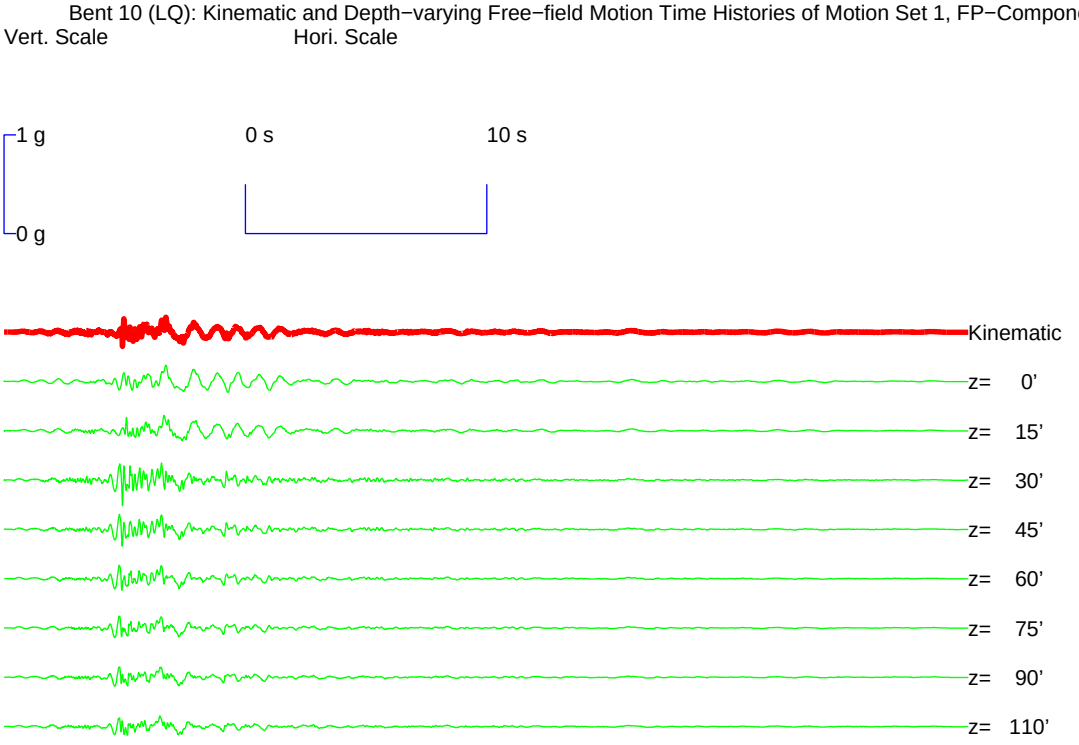


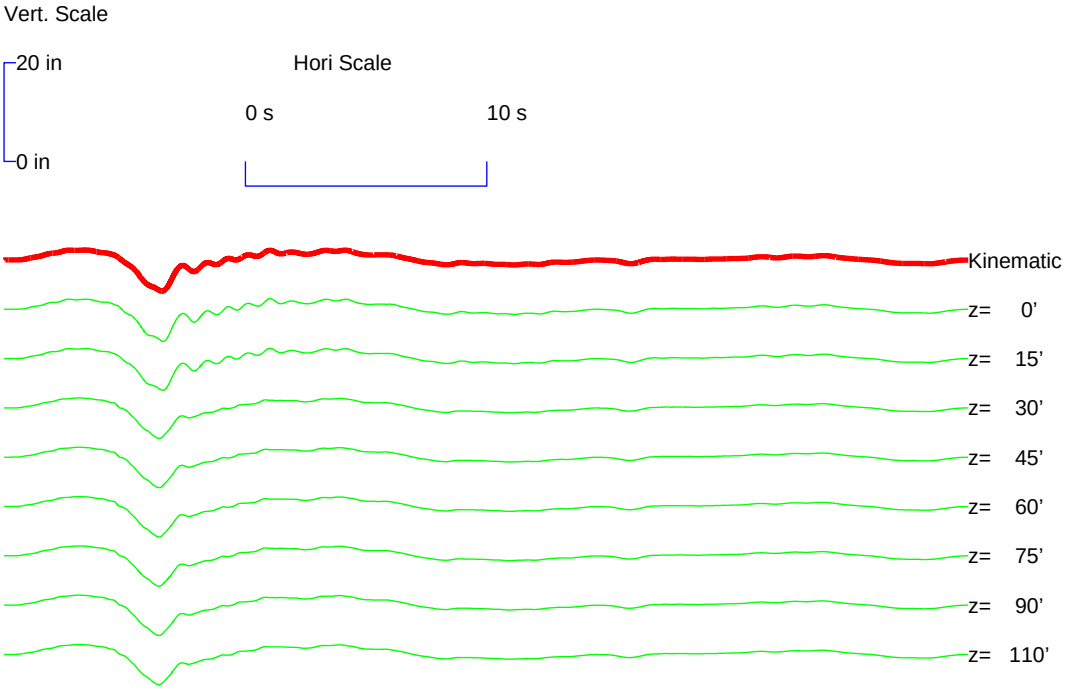


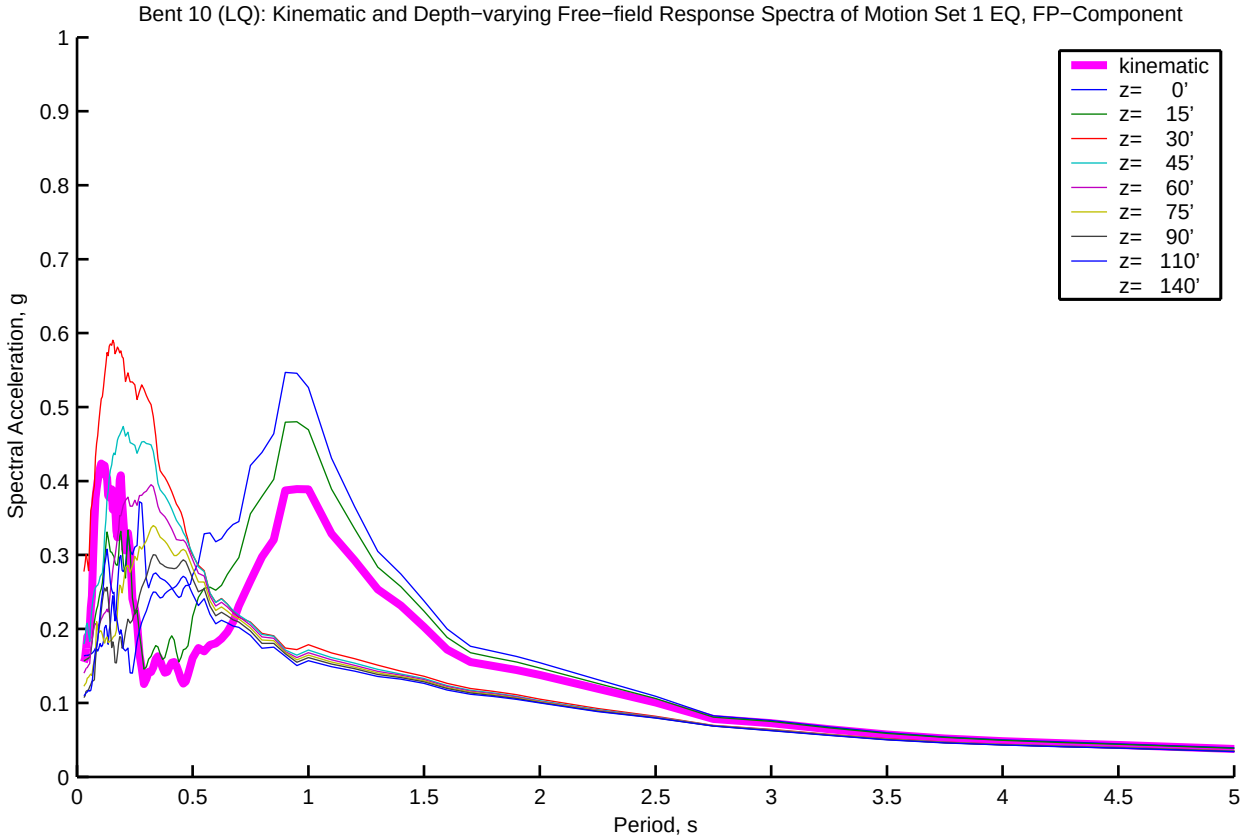

Bent 10 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

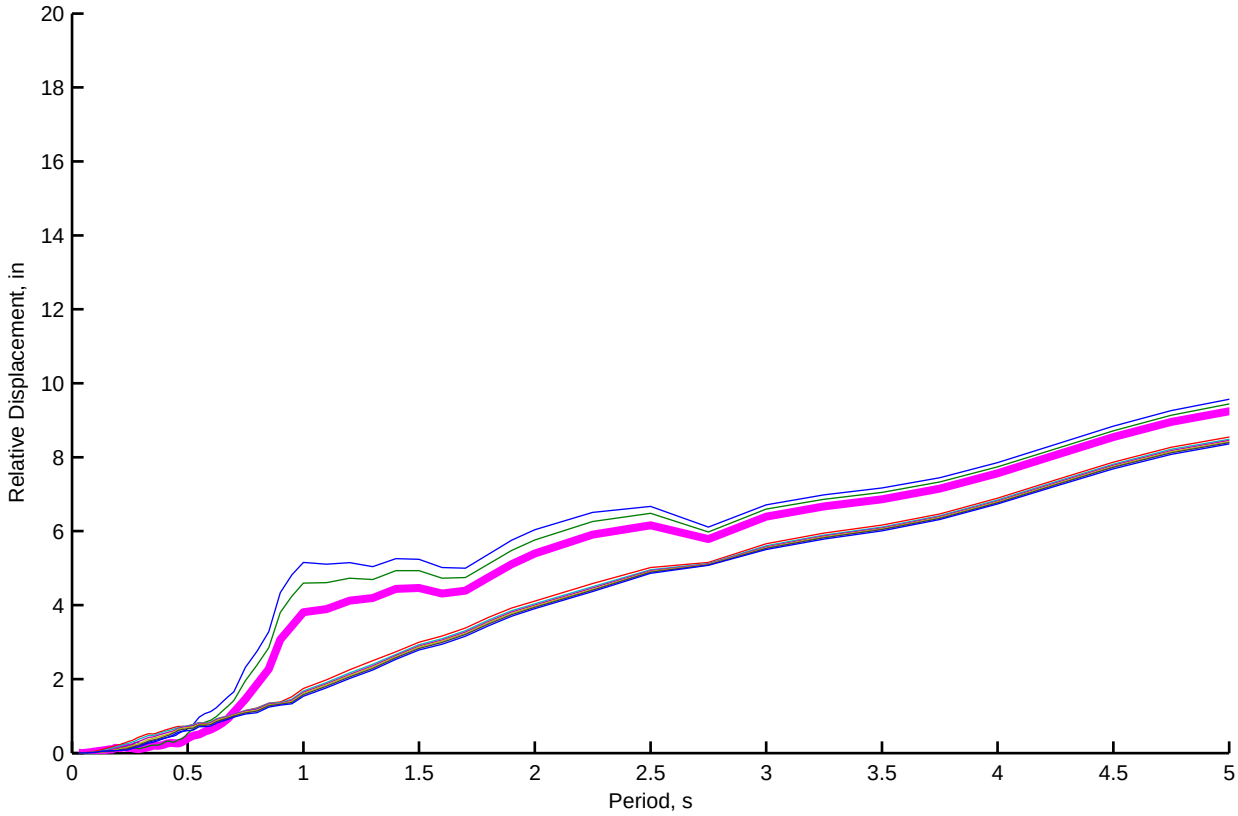

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 10 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 1, FP−Component

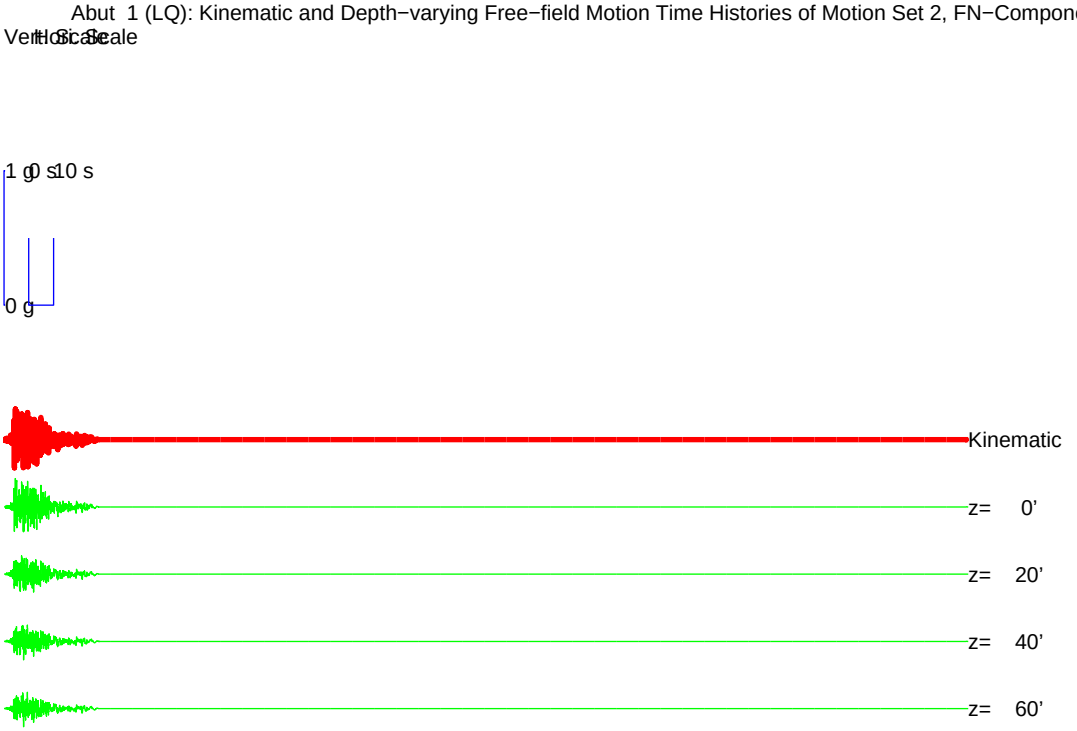


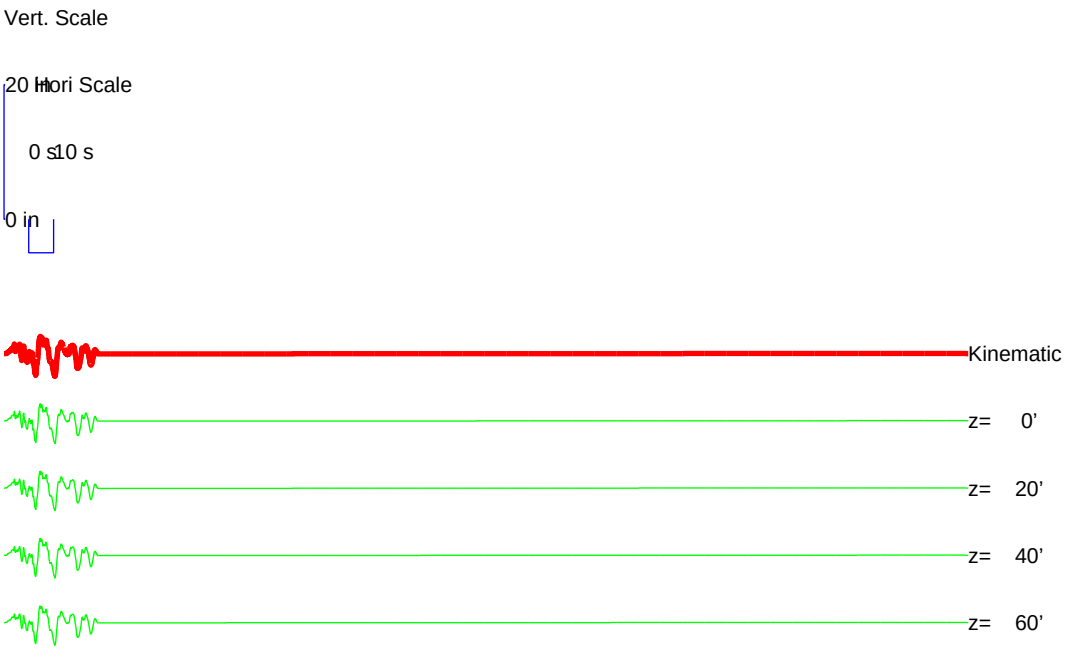


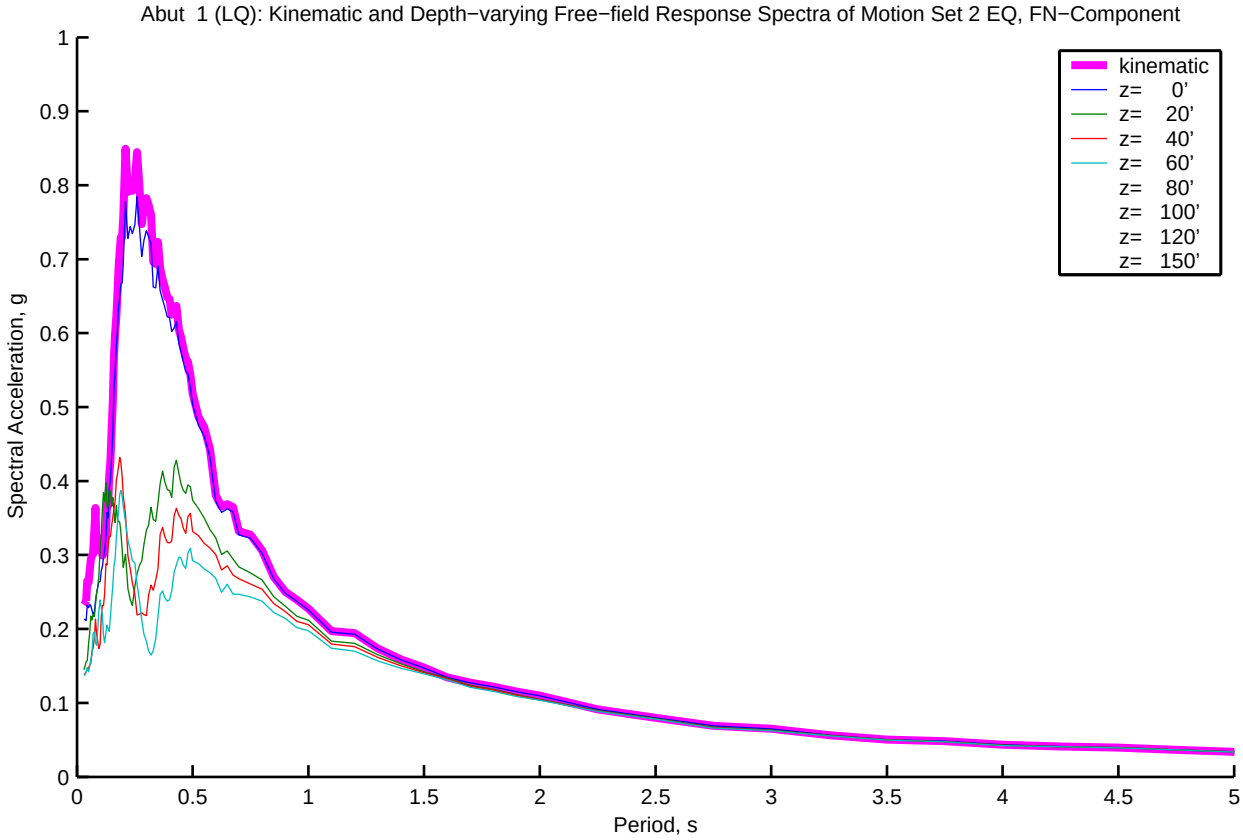

Bent 10 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 1 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'

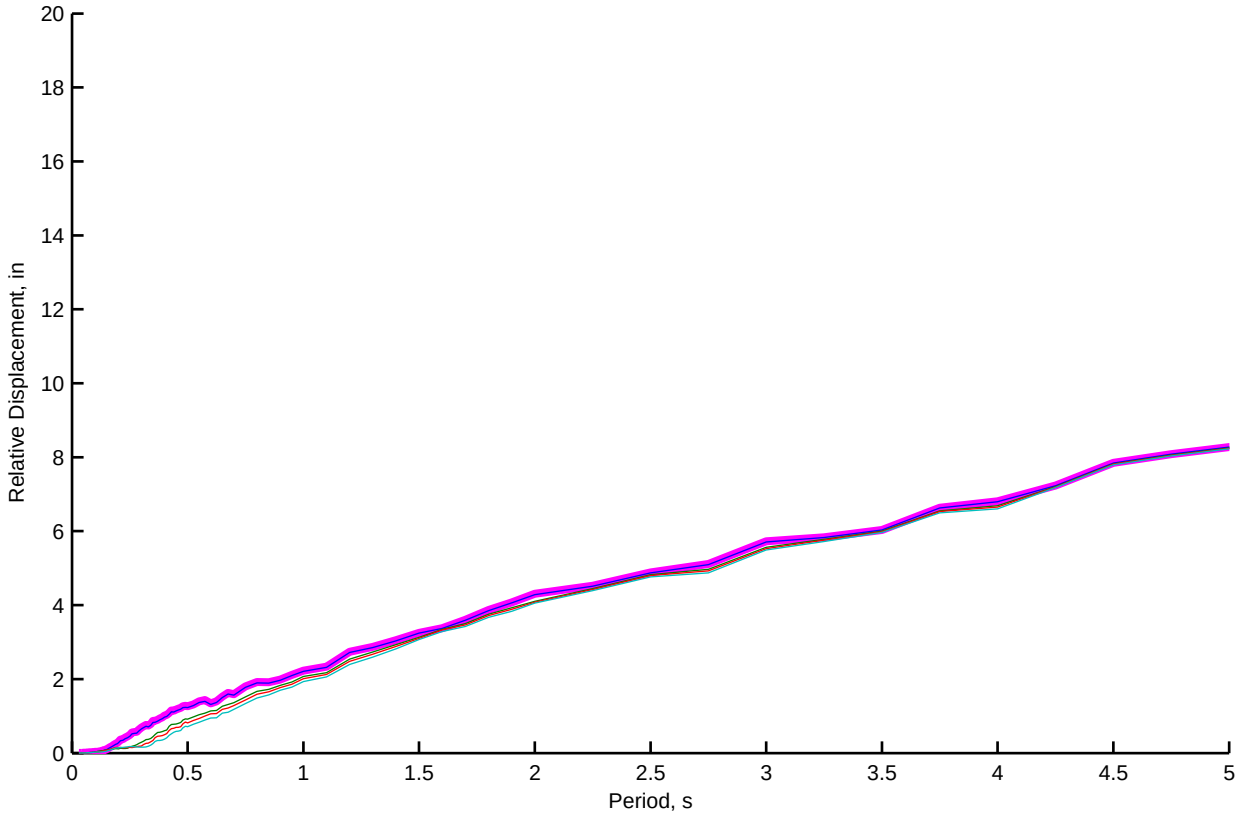

Relative Displacement, in
Period, s

Abut 1 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

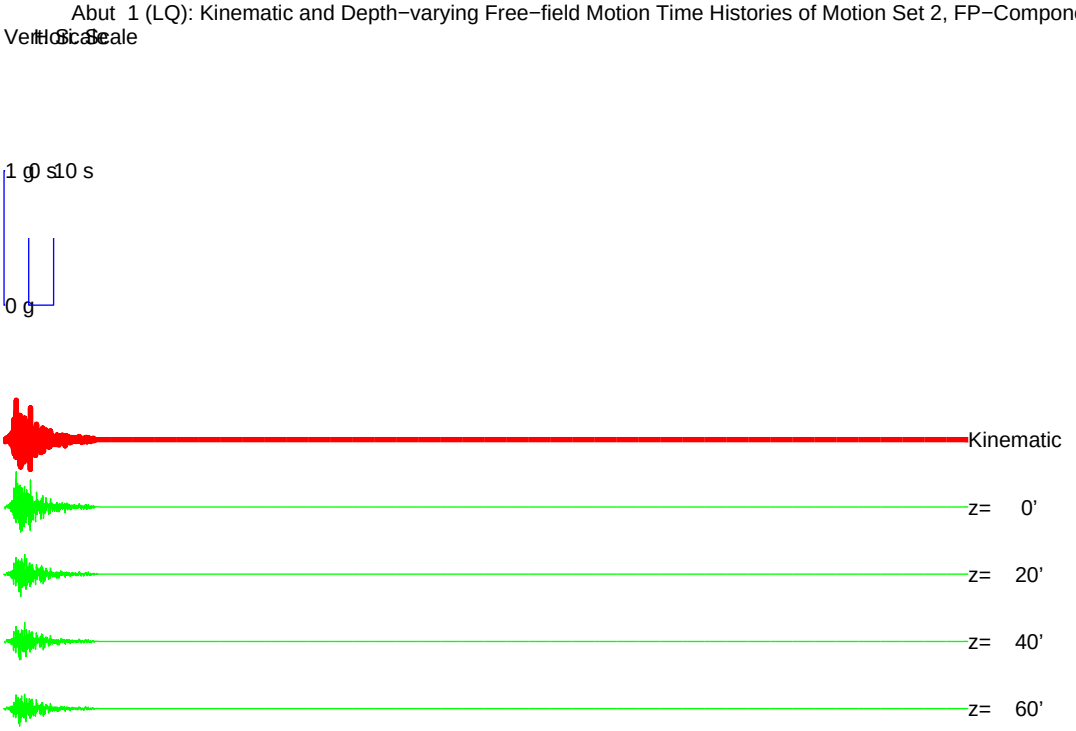


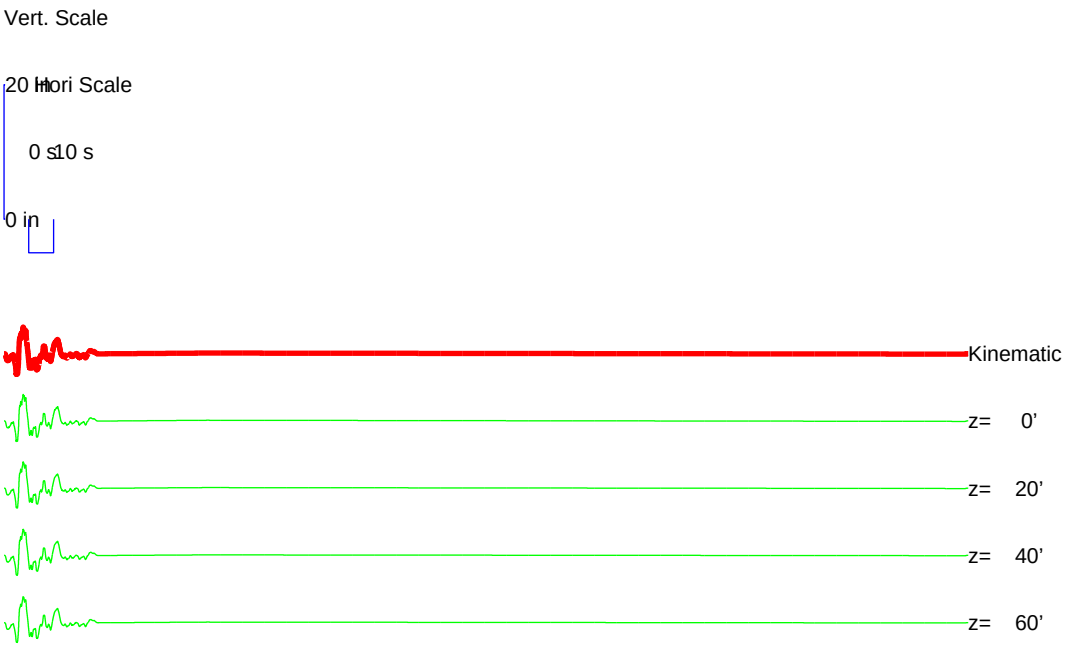


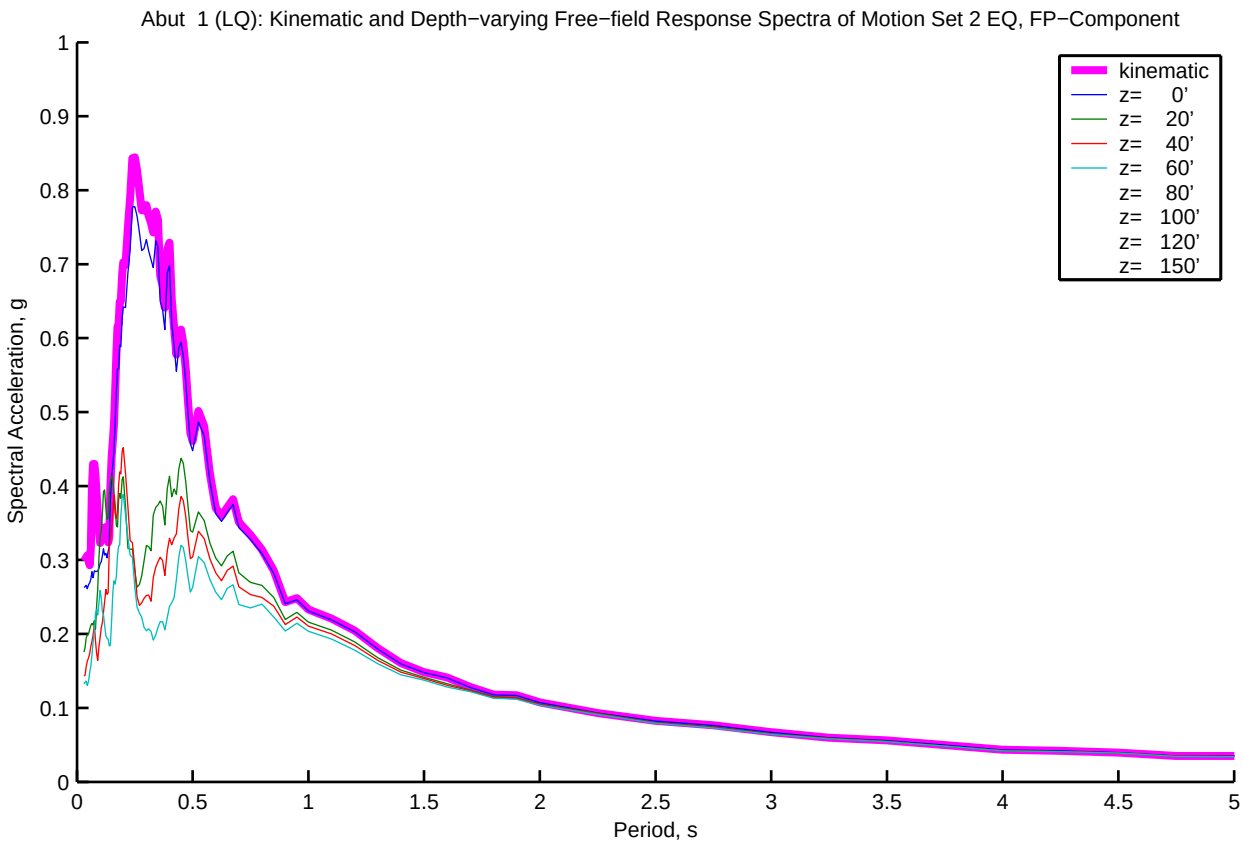

Abut 1 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 150'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

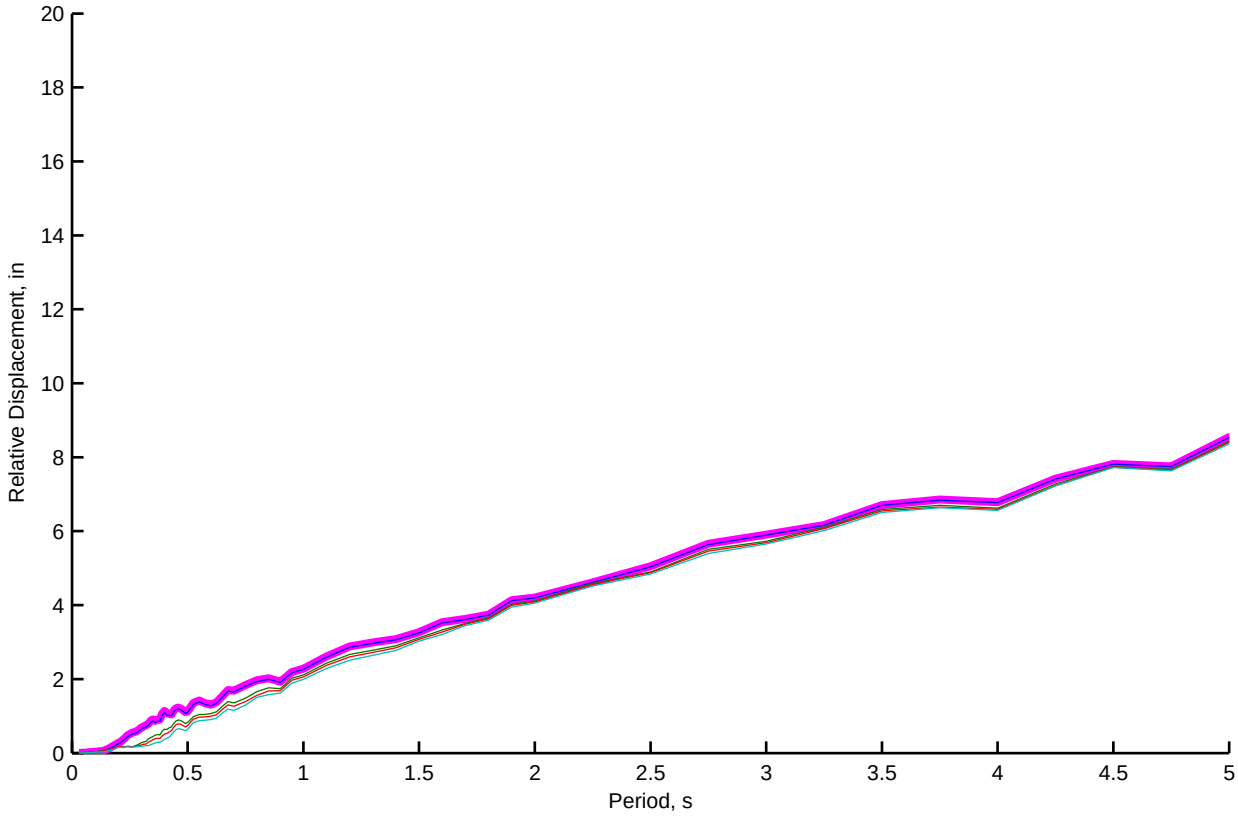

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Abut 1 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

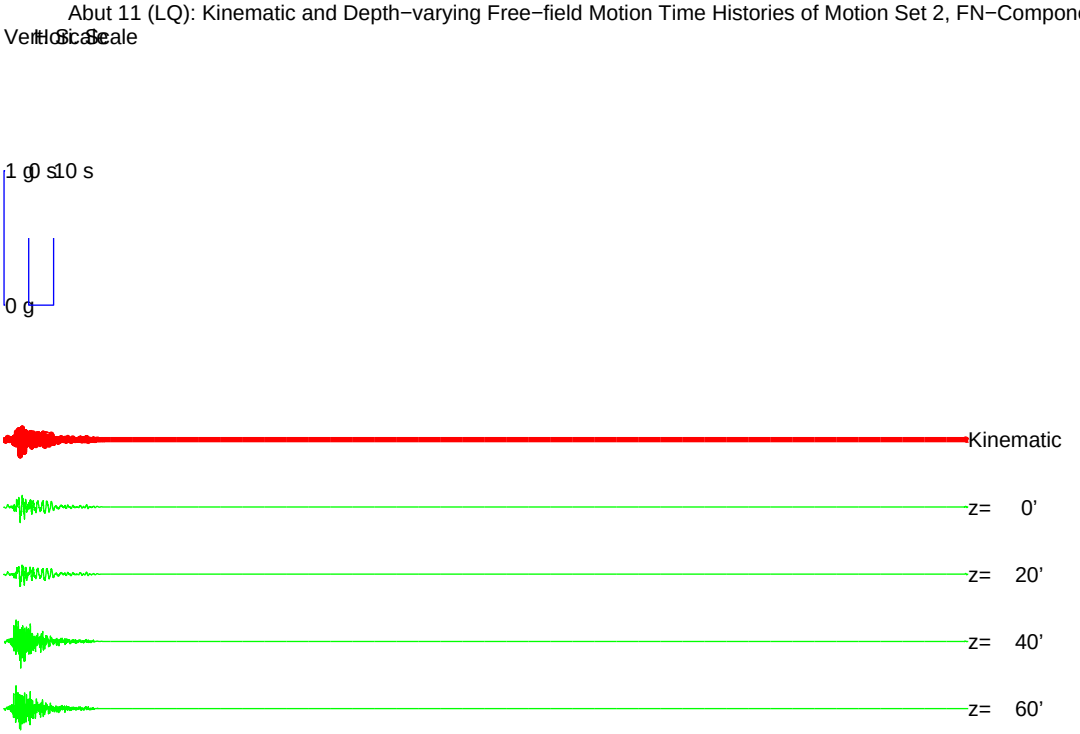


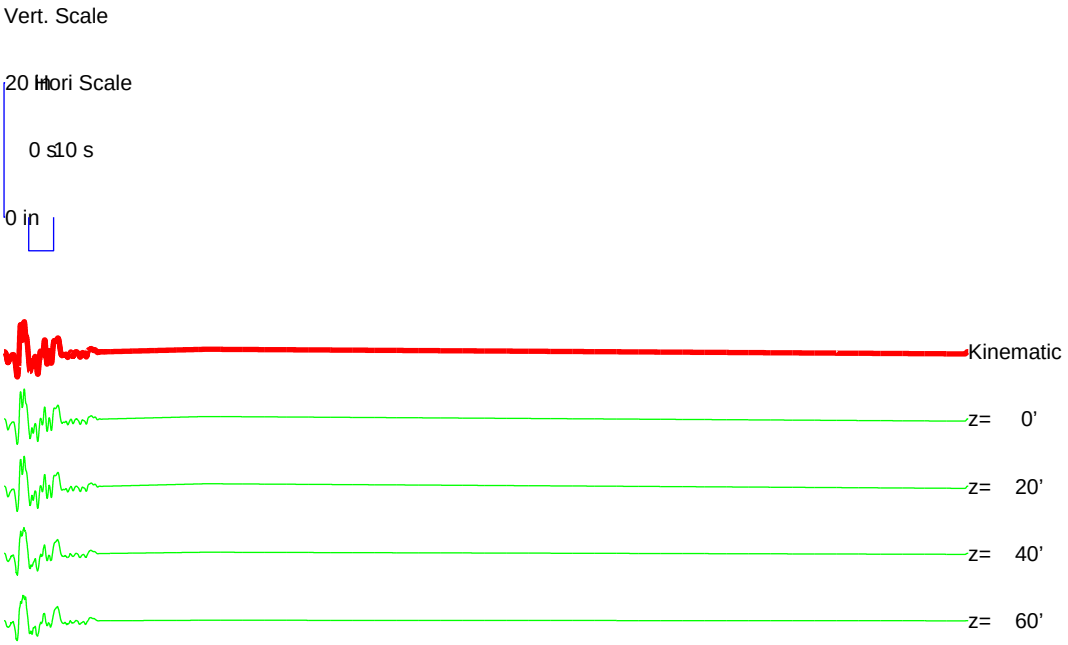


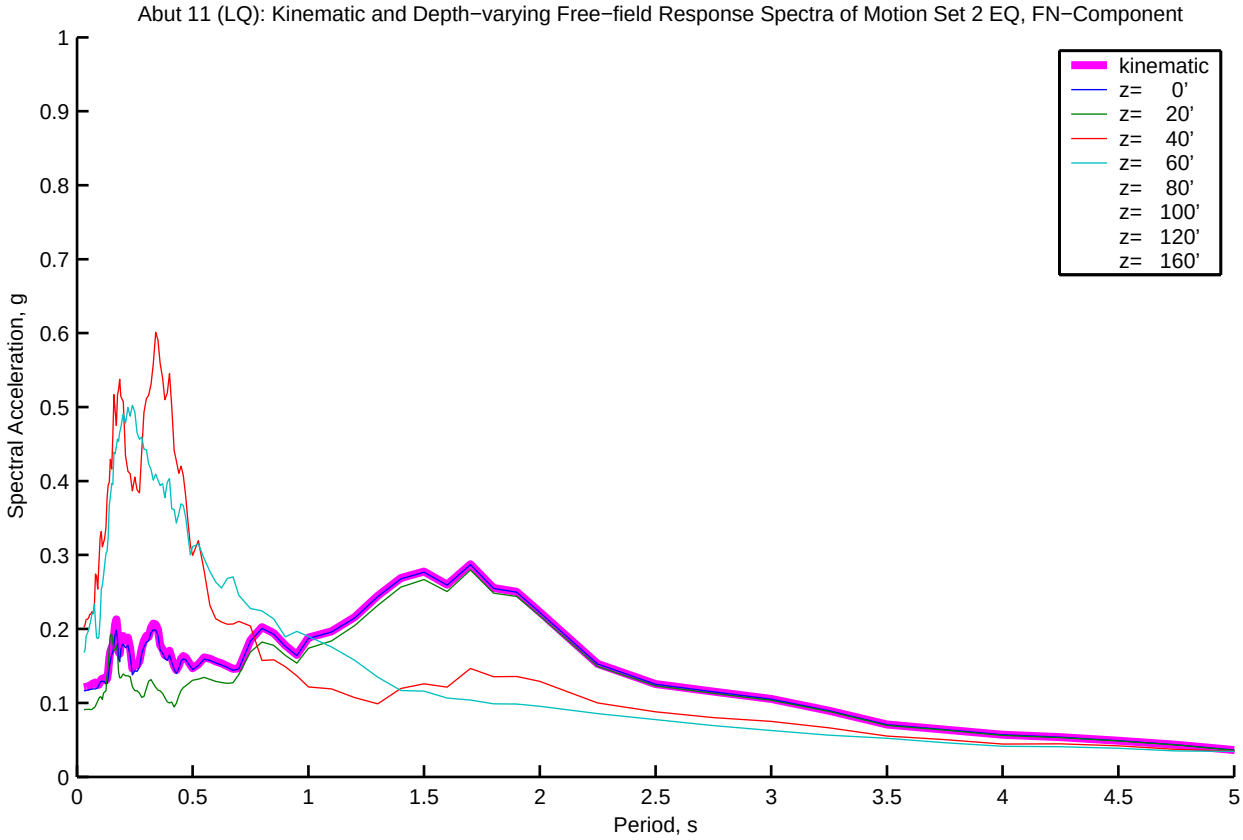

Abut 1 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 150'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

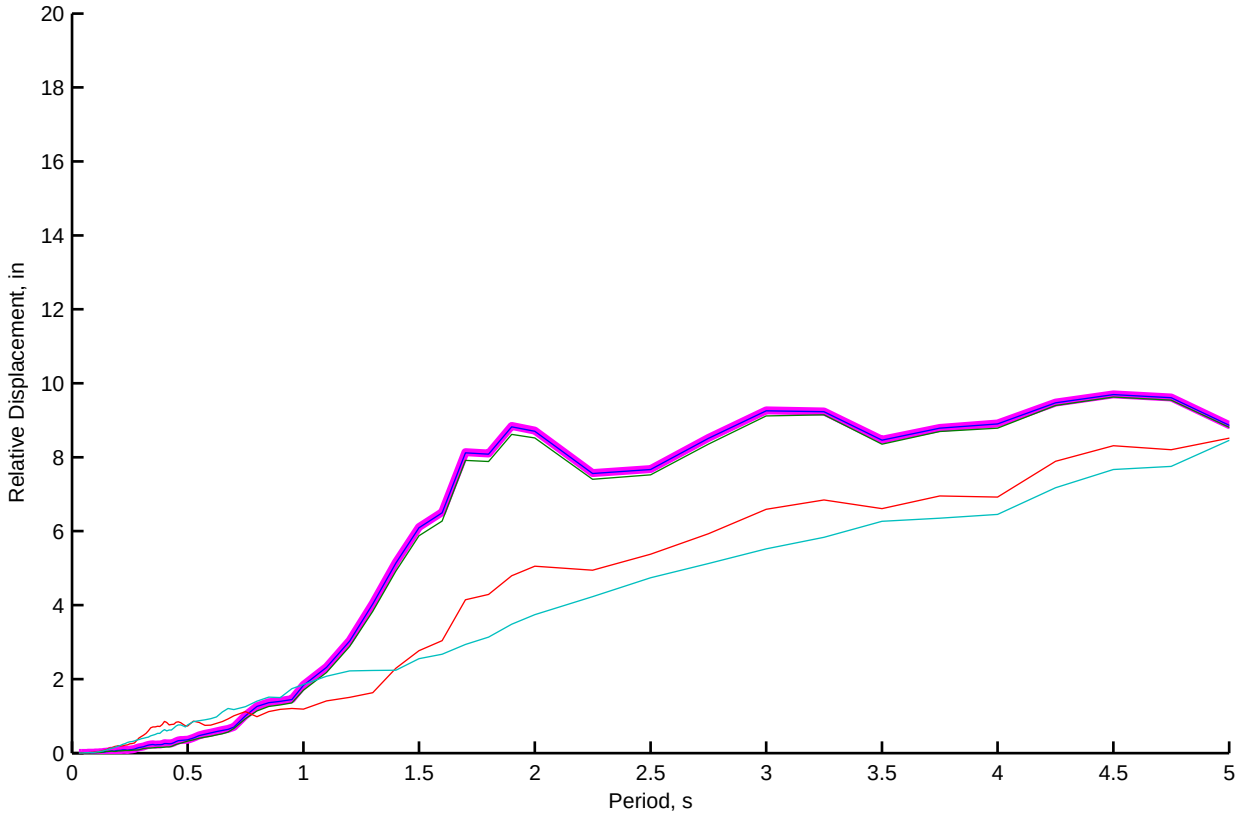

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Abut 11 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

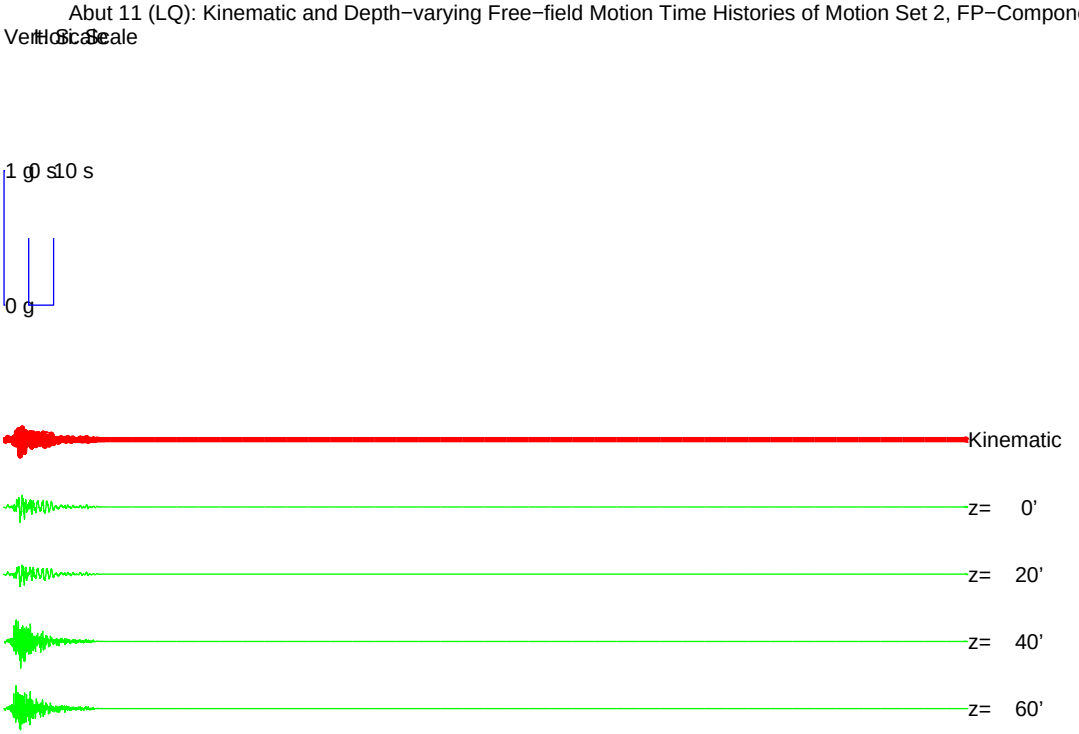


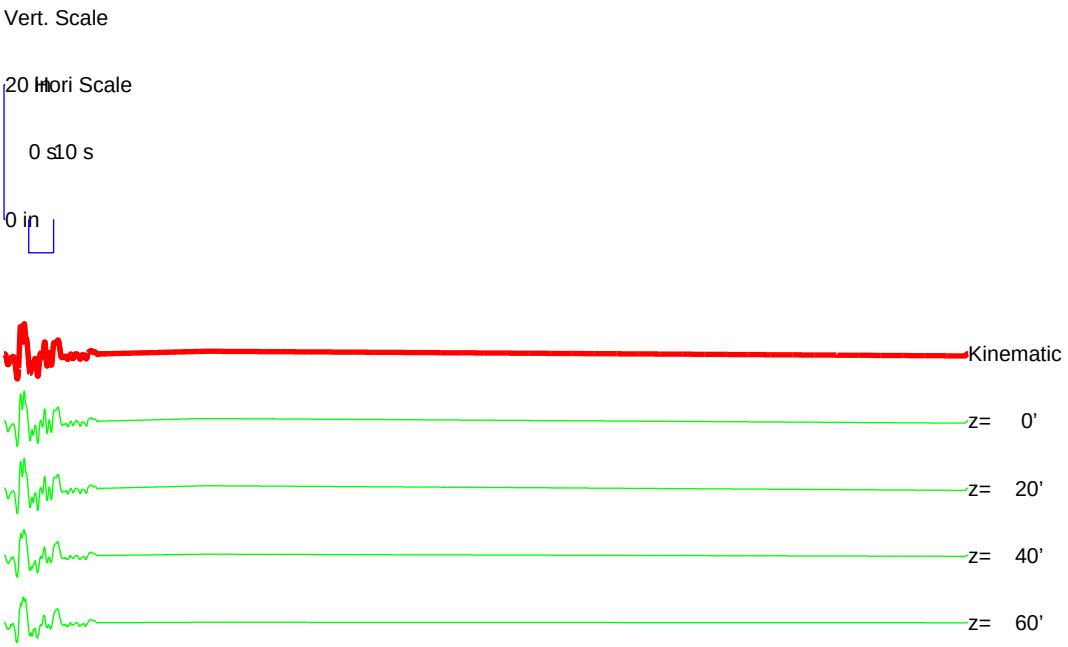


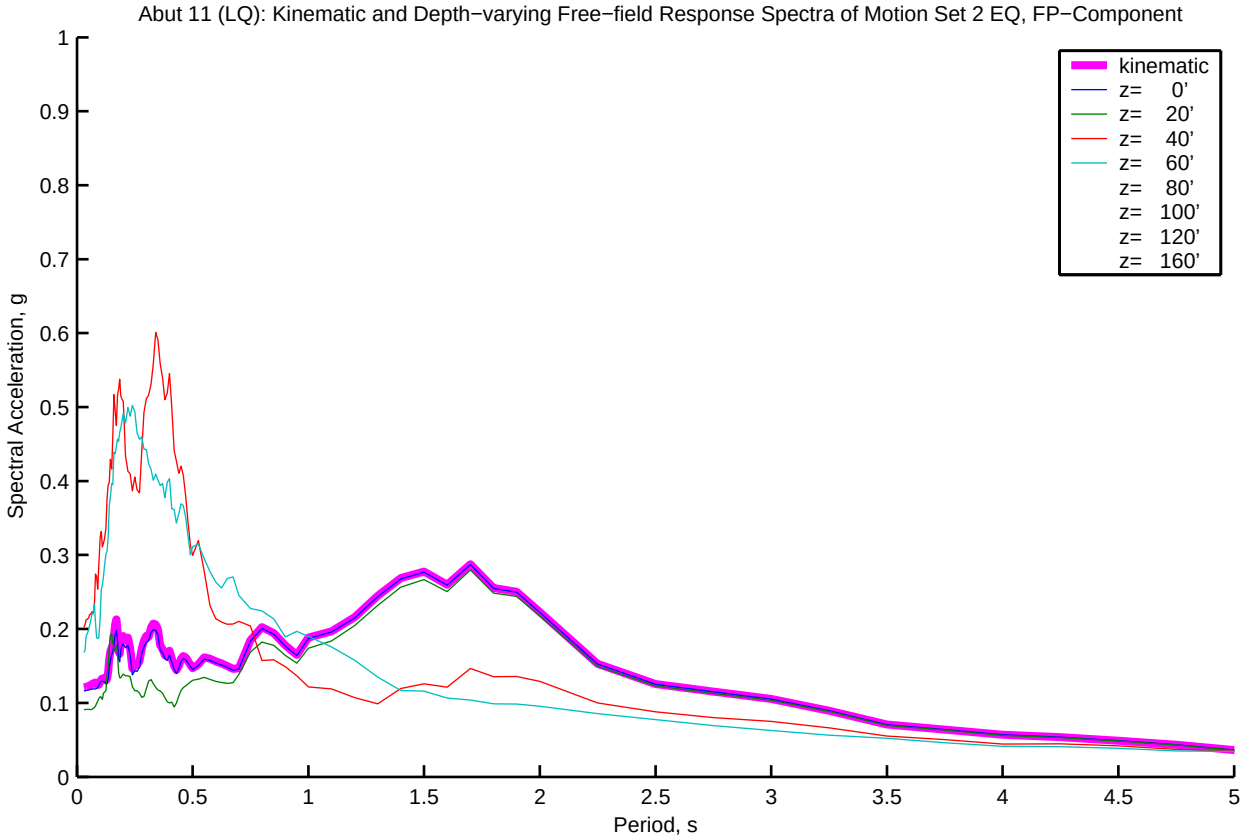

Abut 11 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 160'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

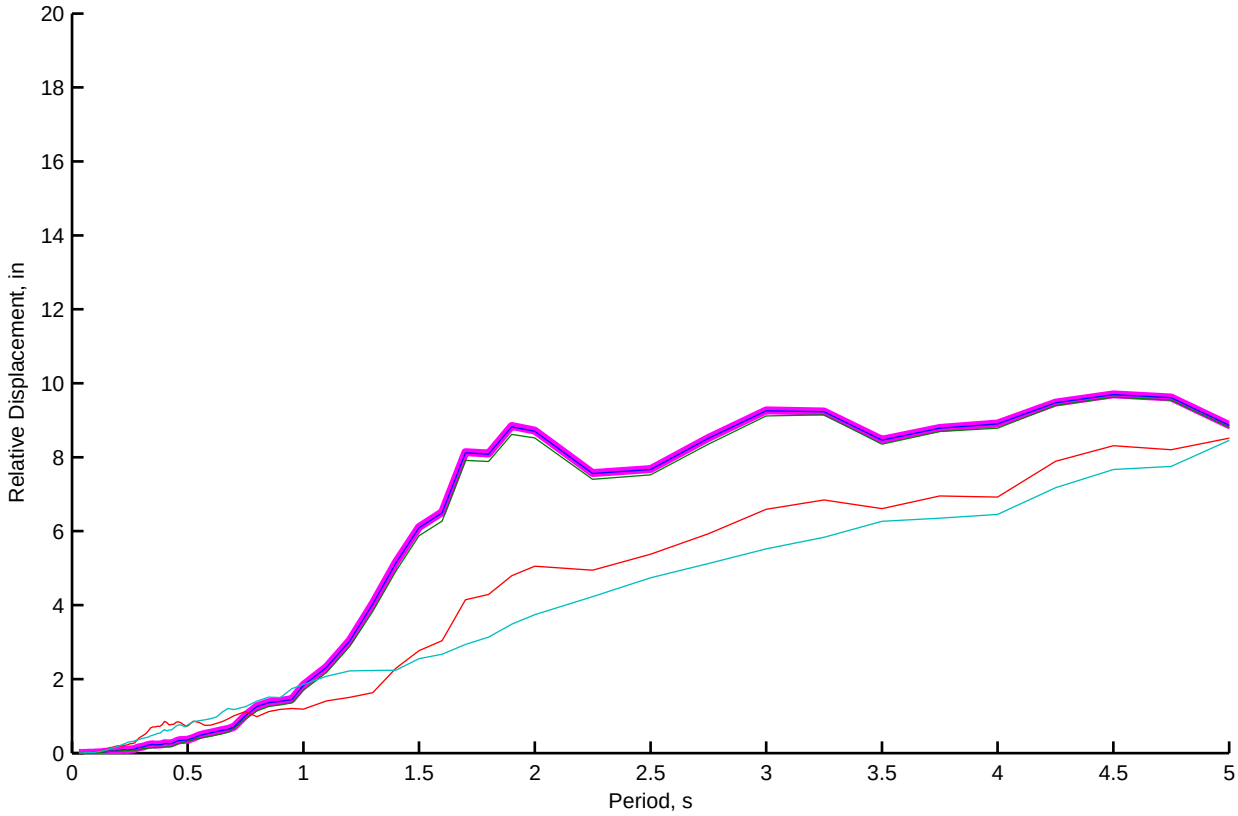

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Abut 11 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

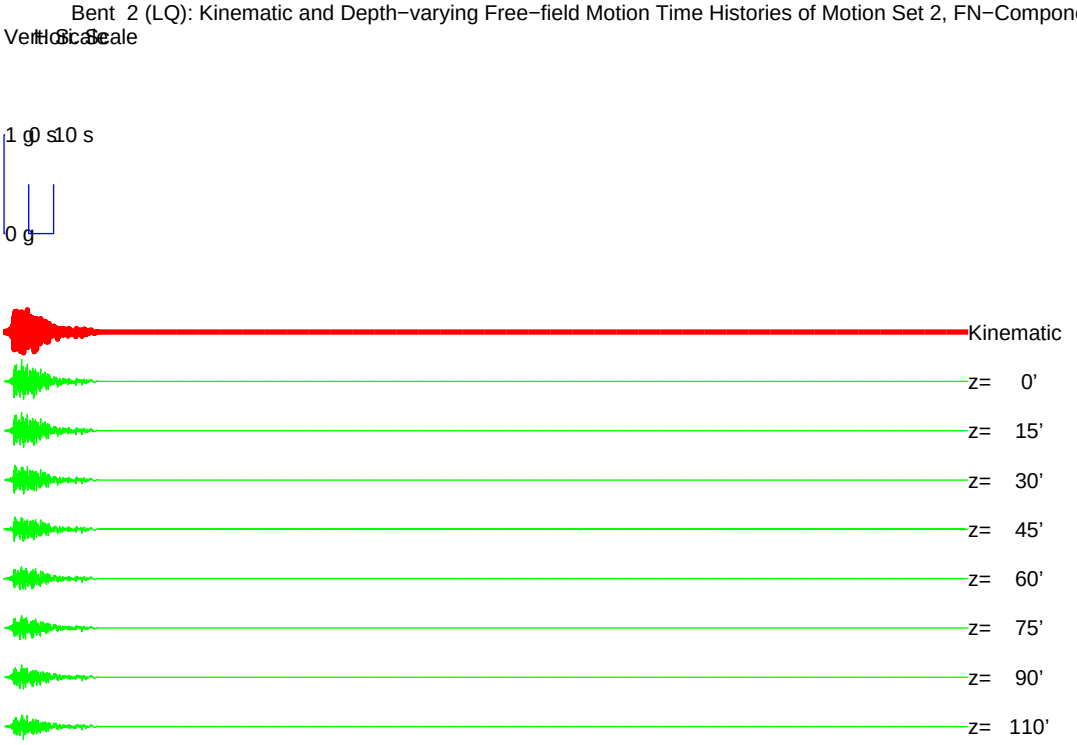


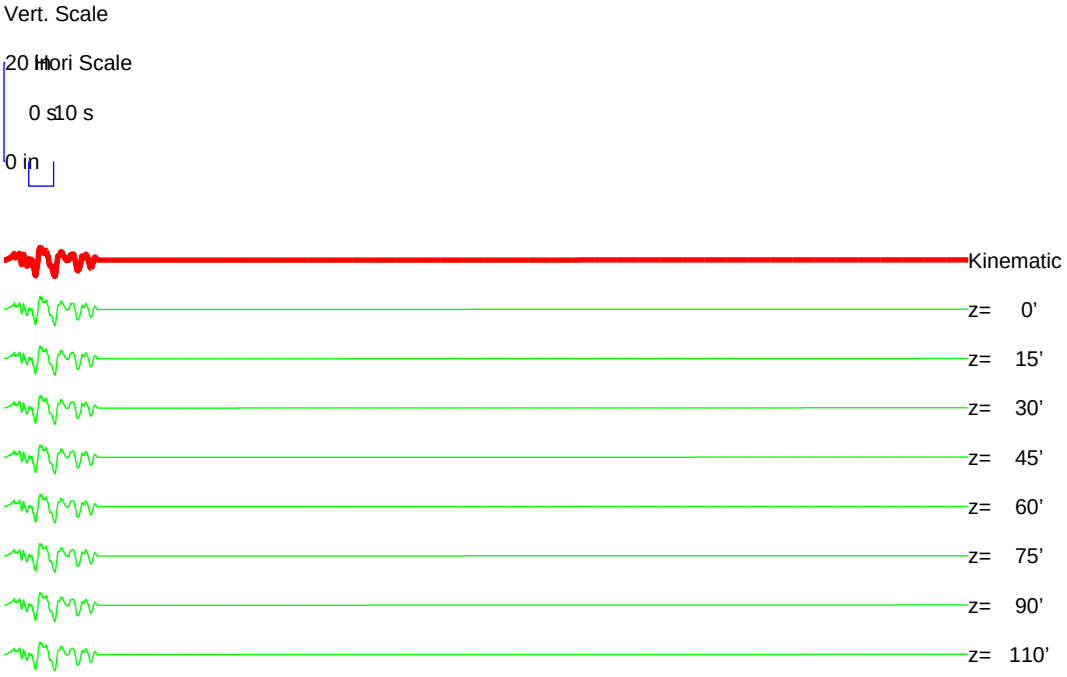


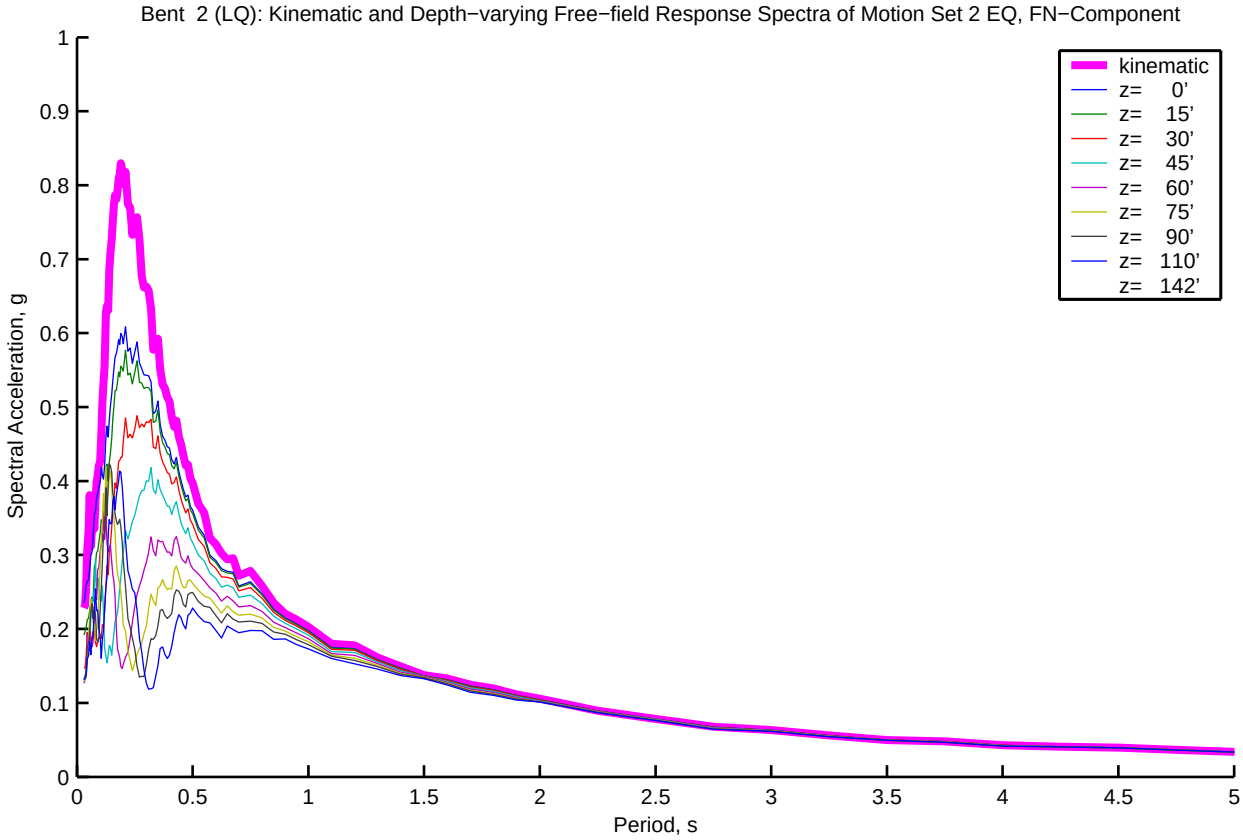

Abut 11 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 160'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

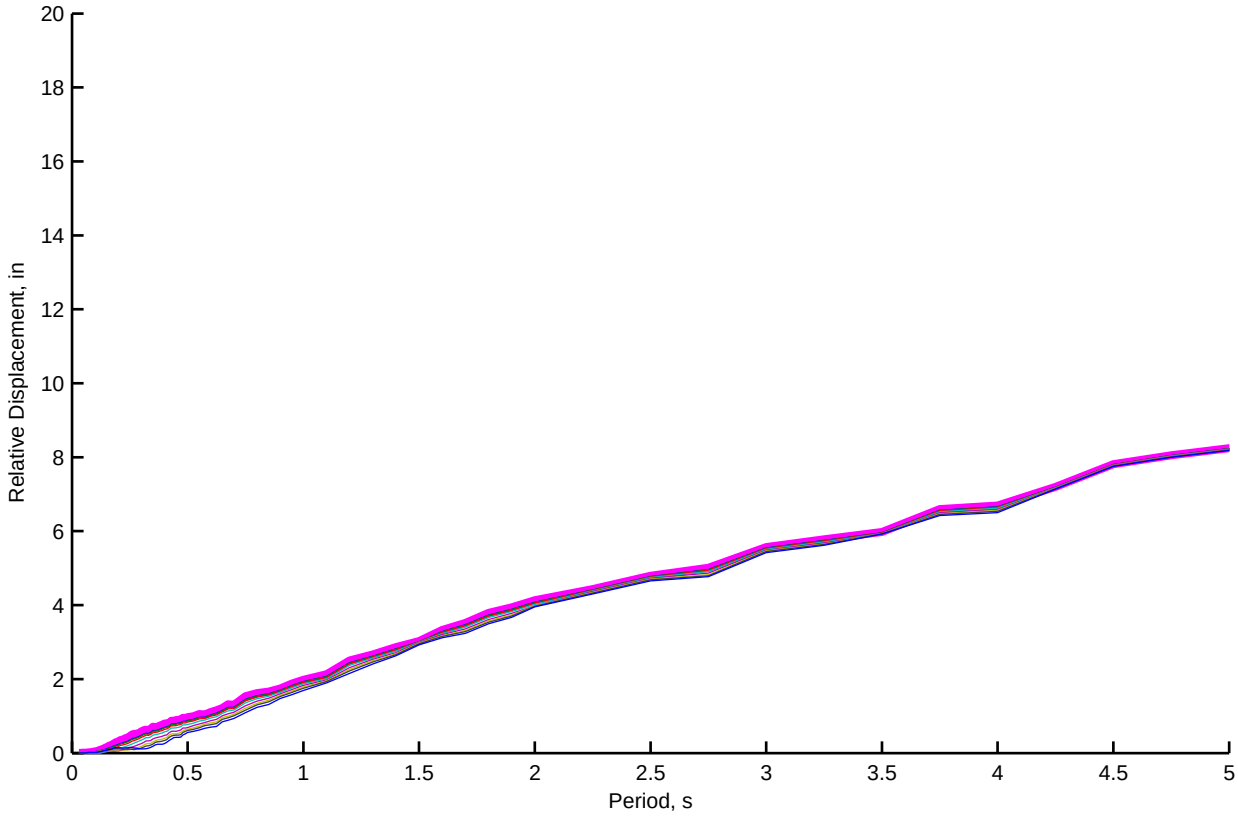

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 2 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

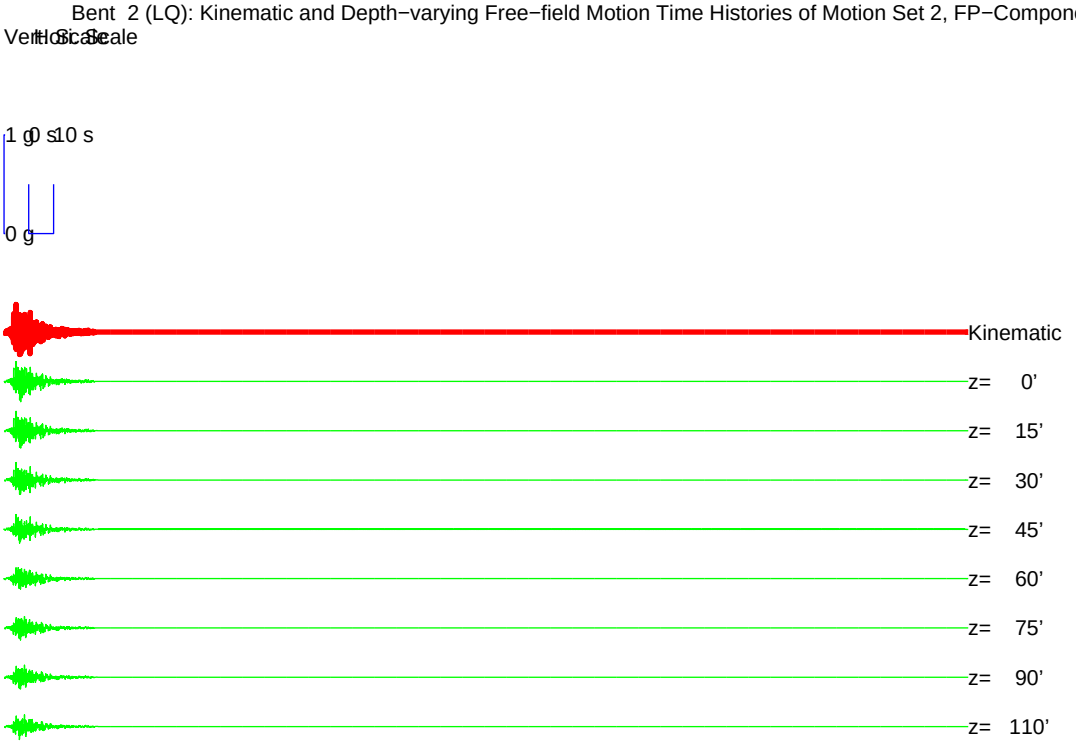


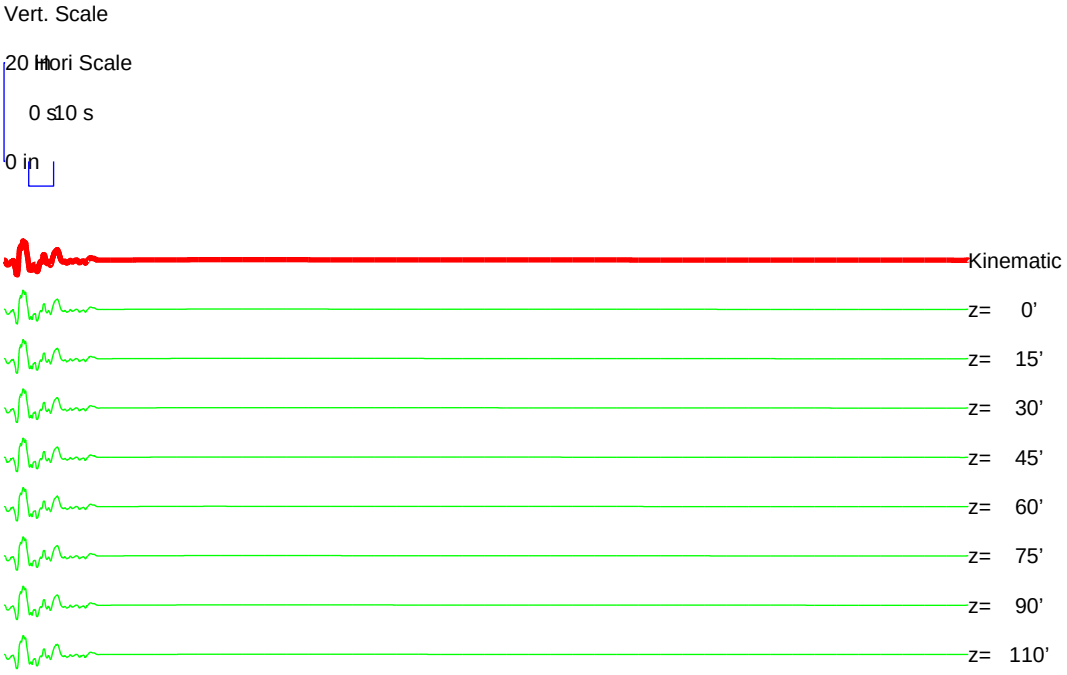


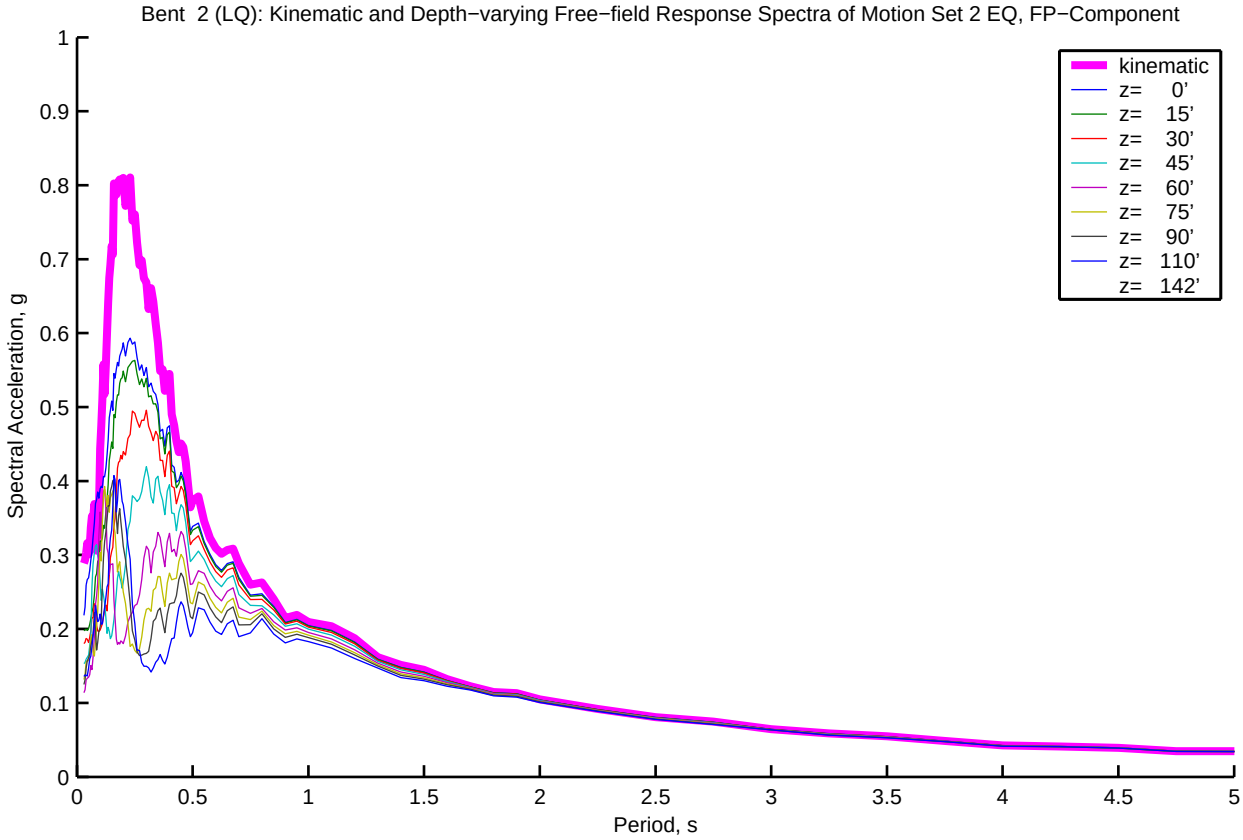

Bent 2 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 142'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

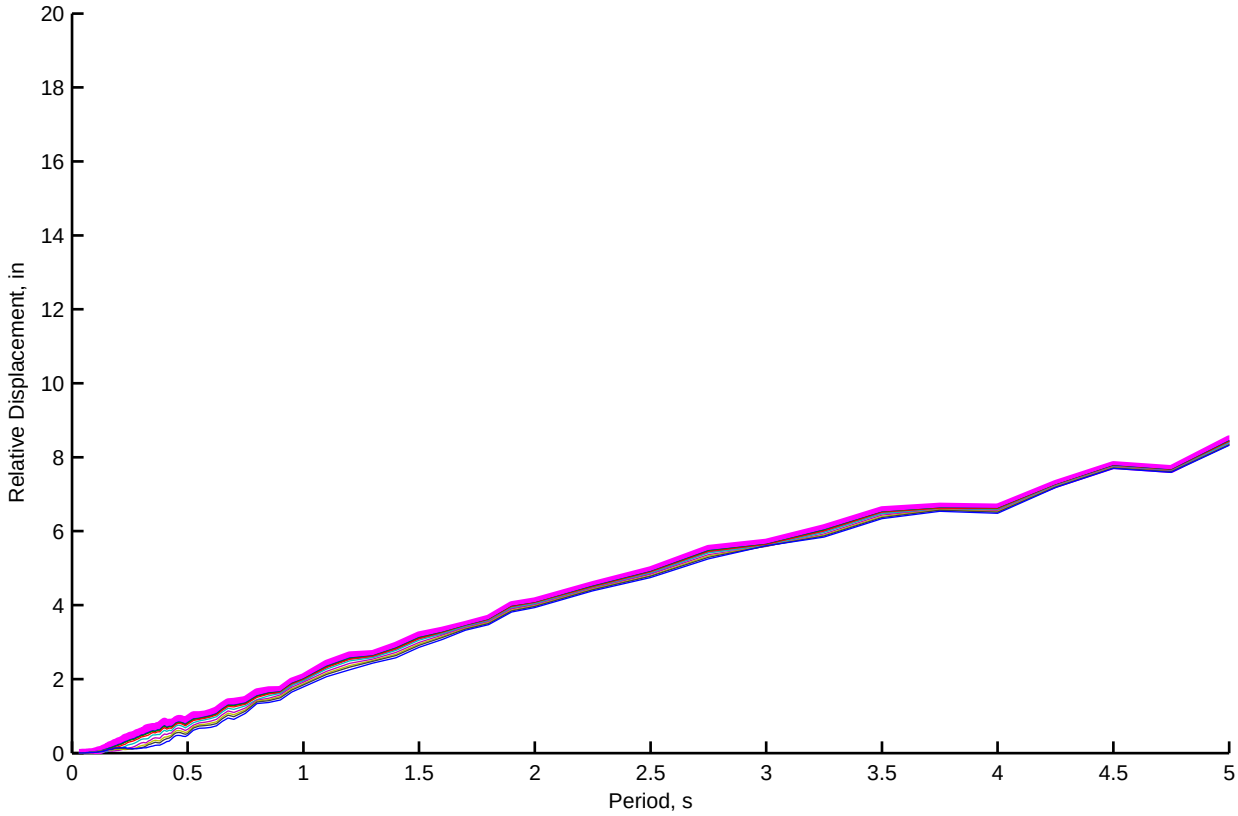

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 2 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

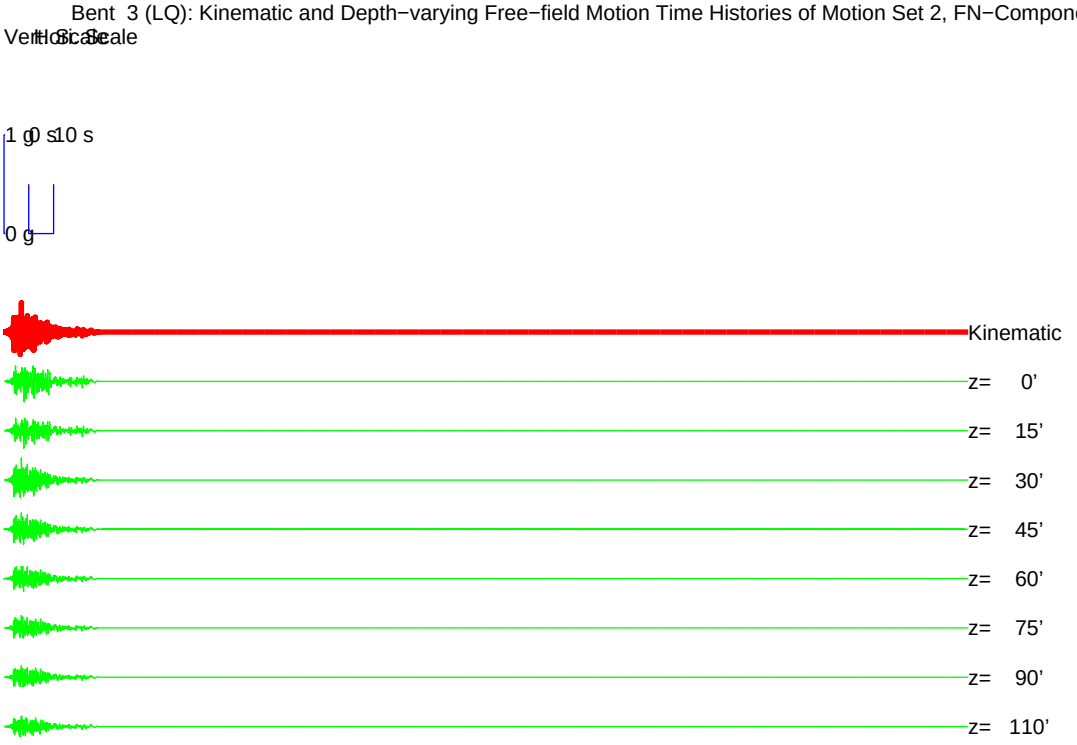


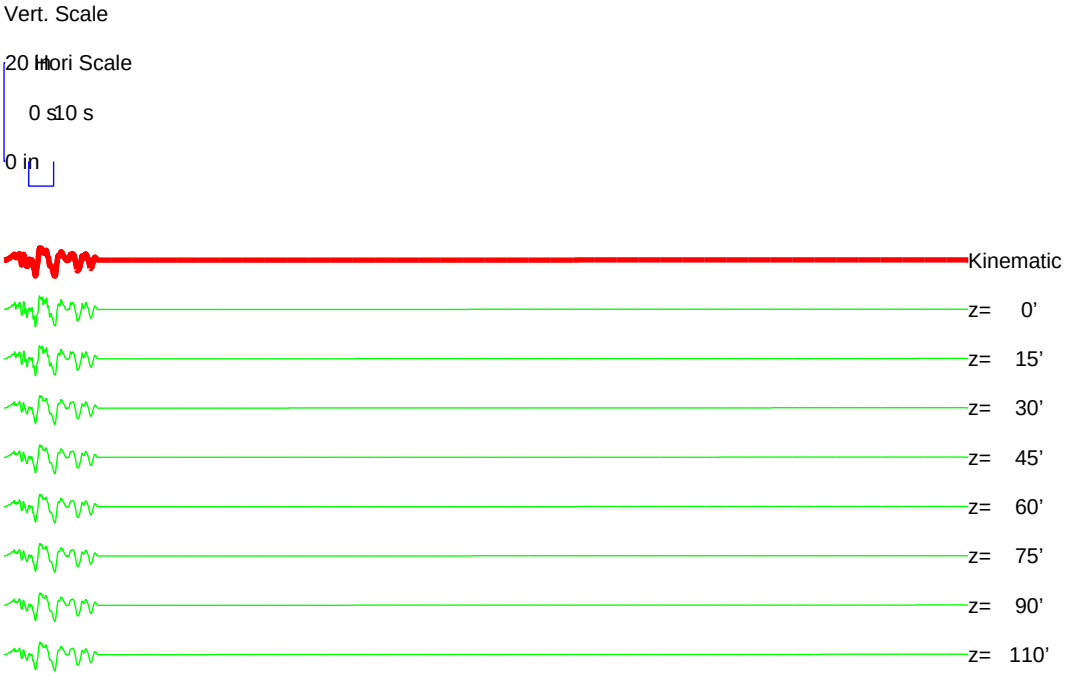


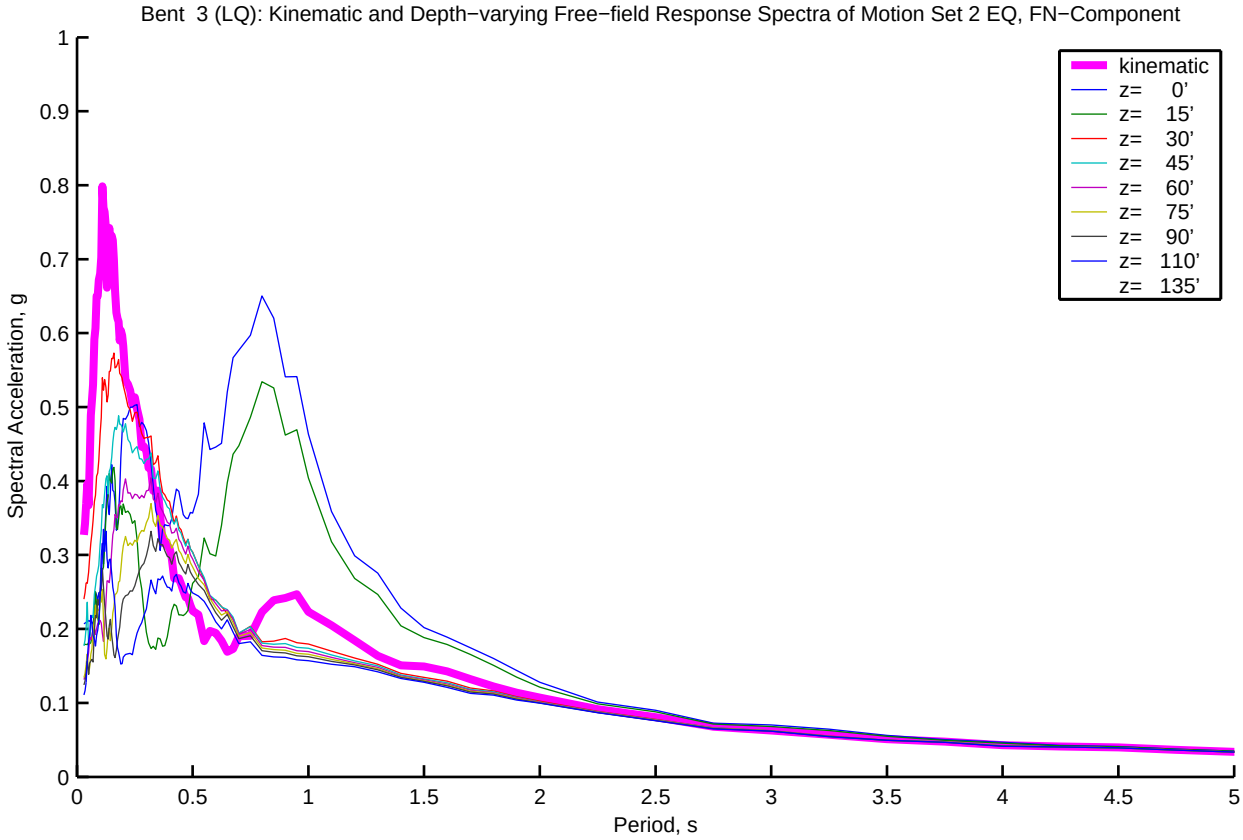

Bent 2 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 142'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

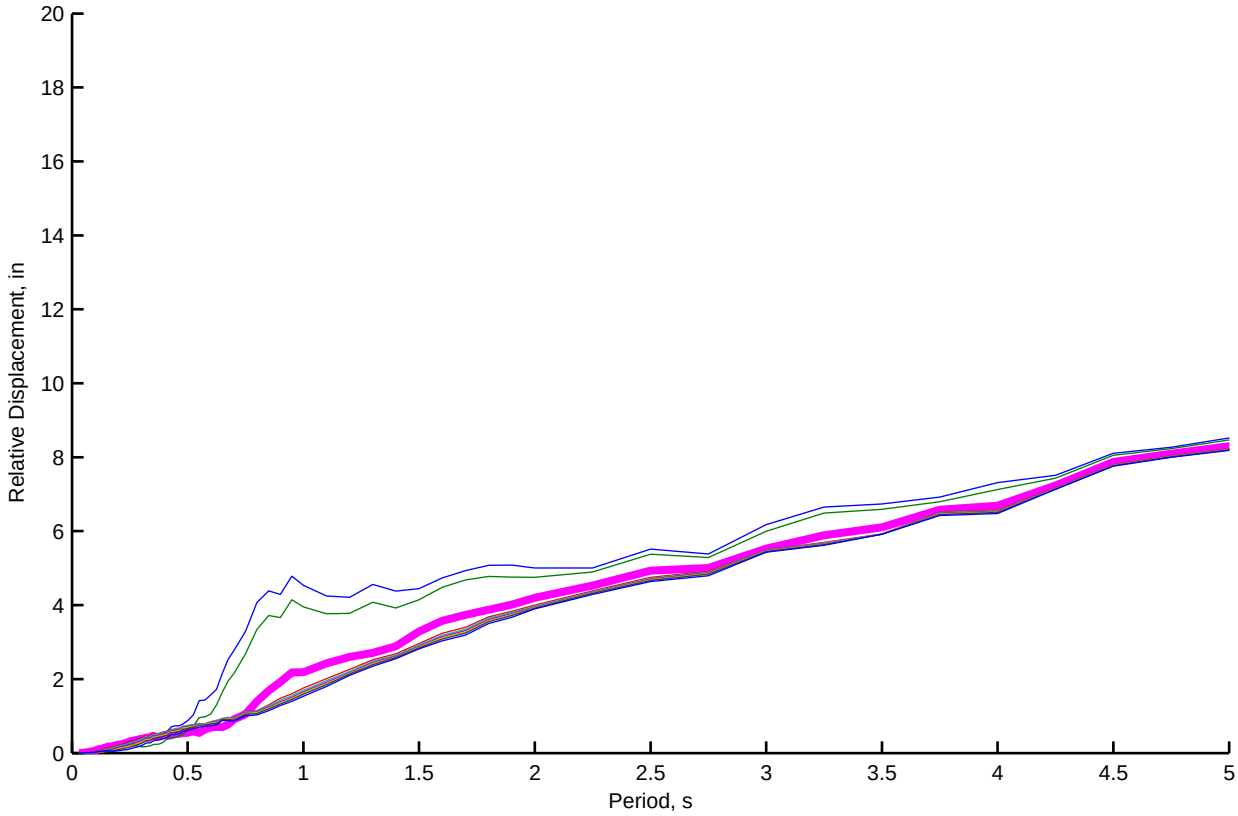

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 3 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

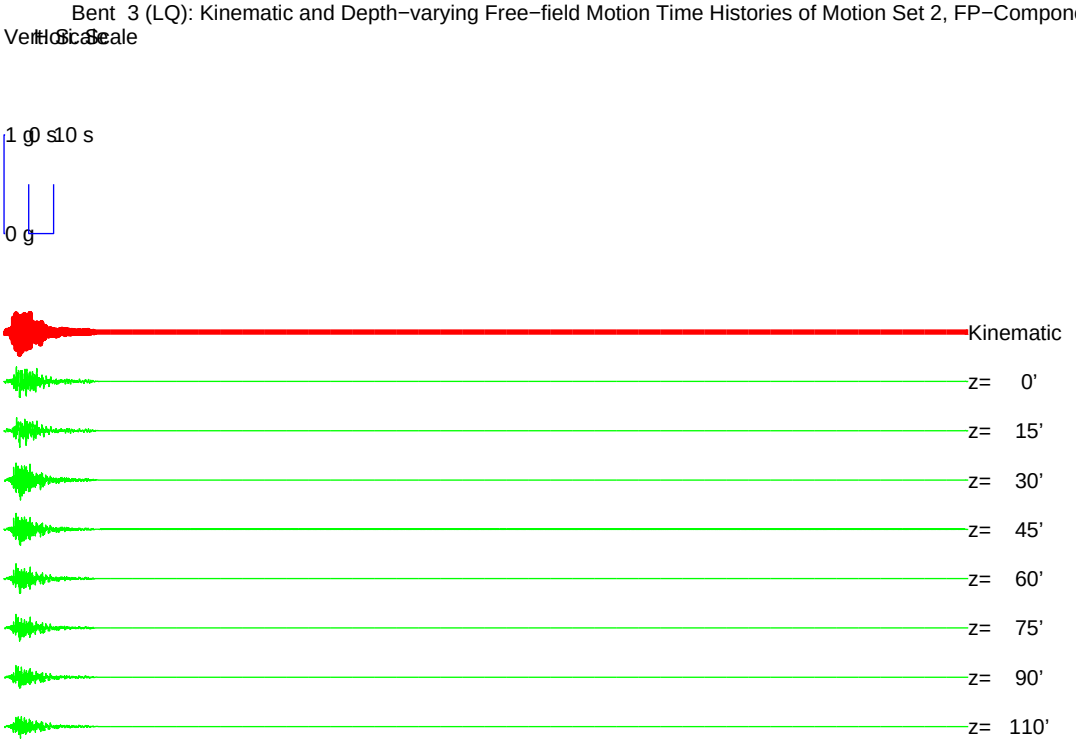


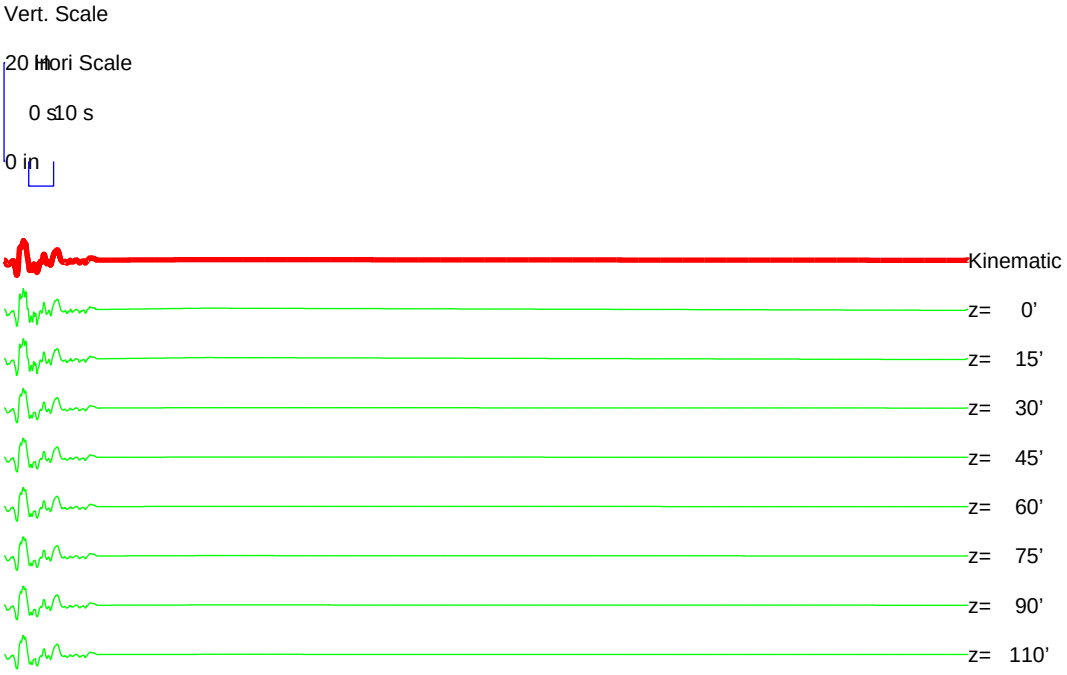


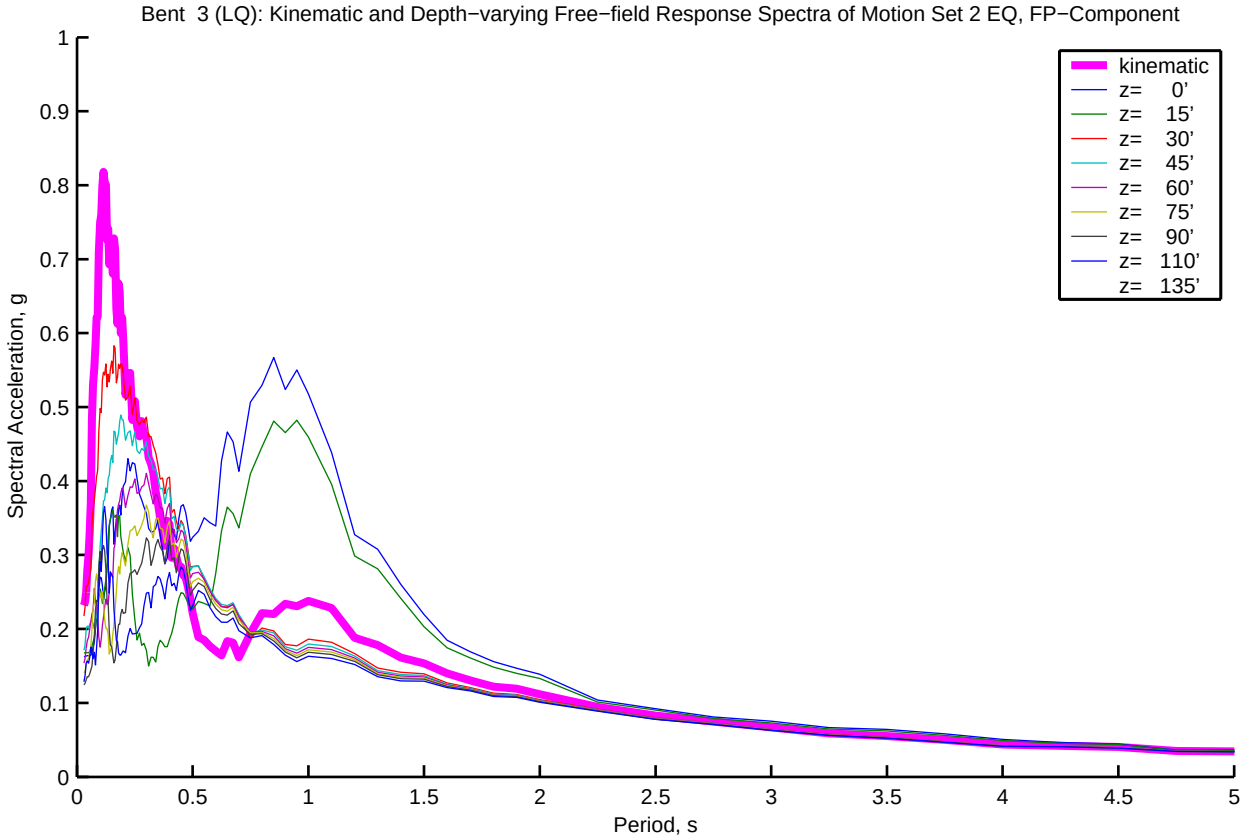

Bent 3 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 135'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

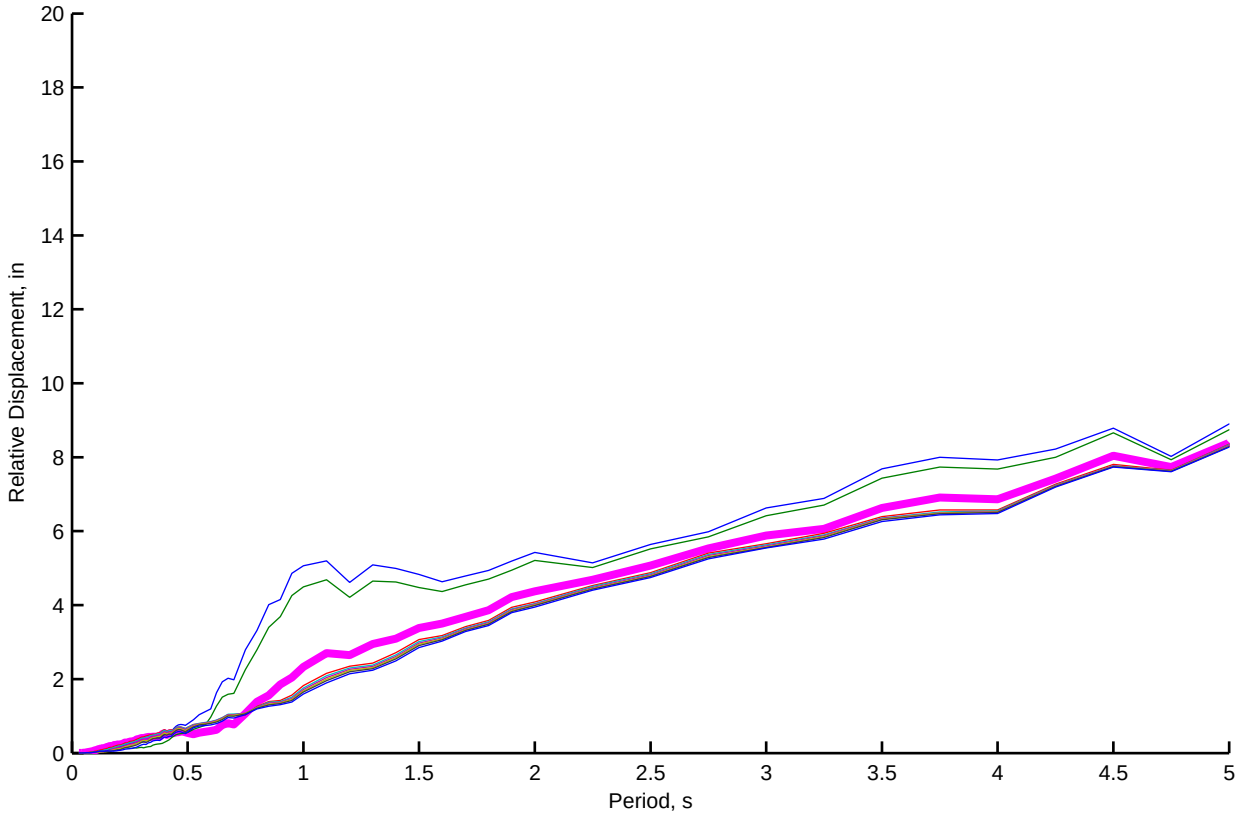

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 3 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

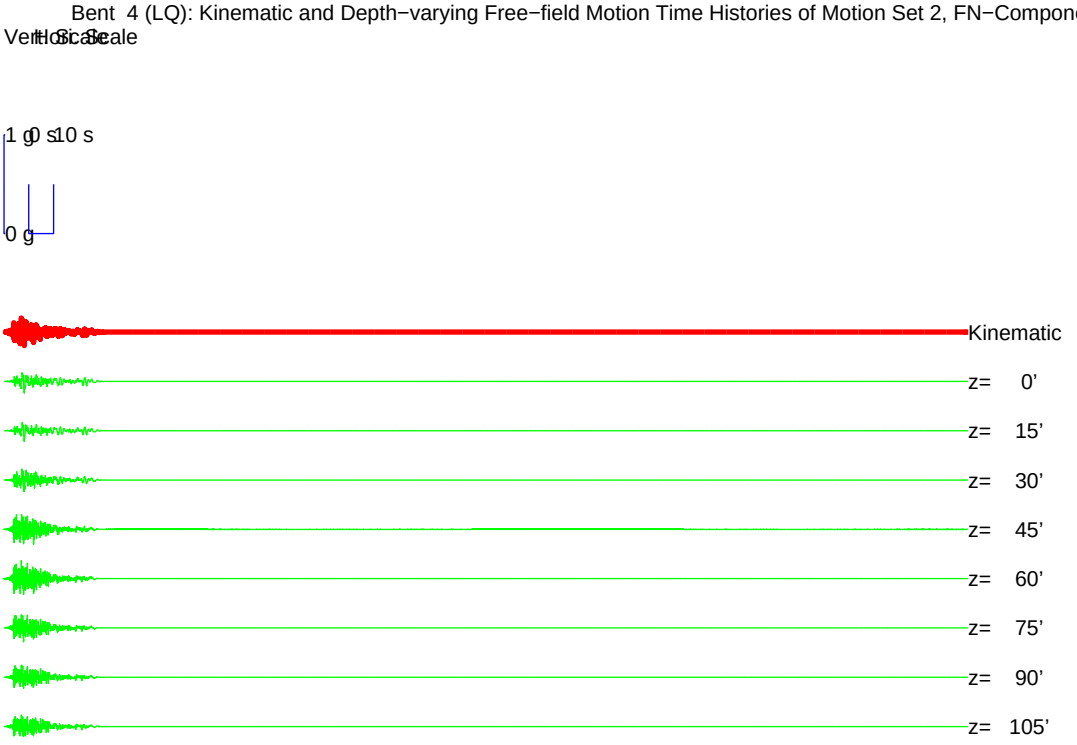


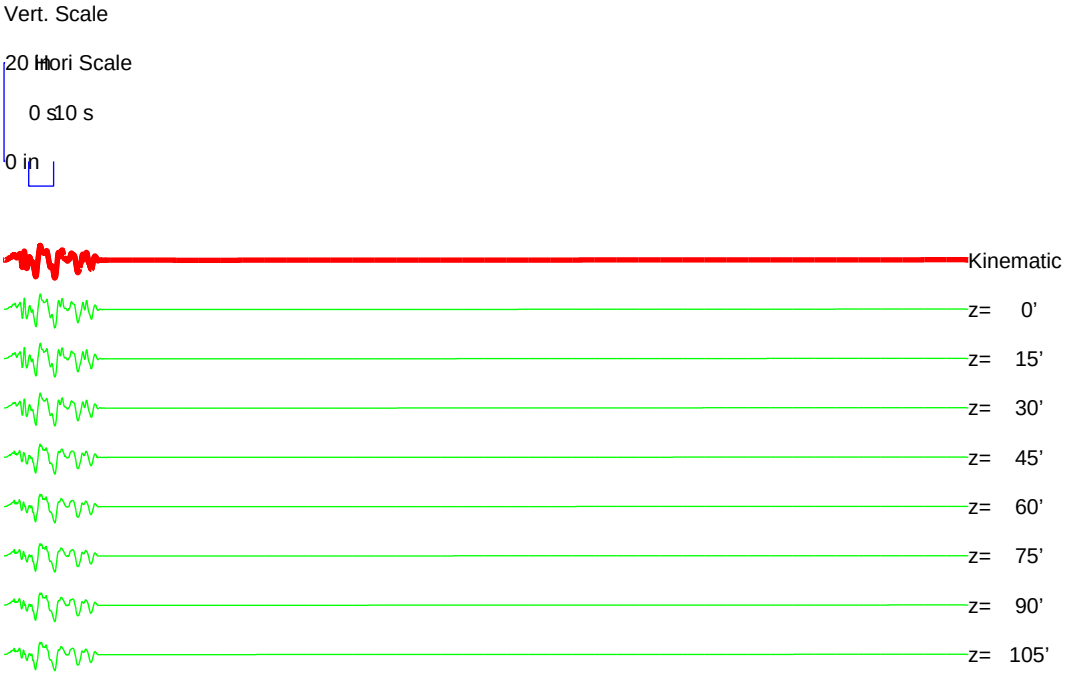


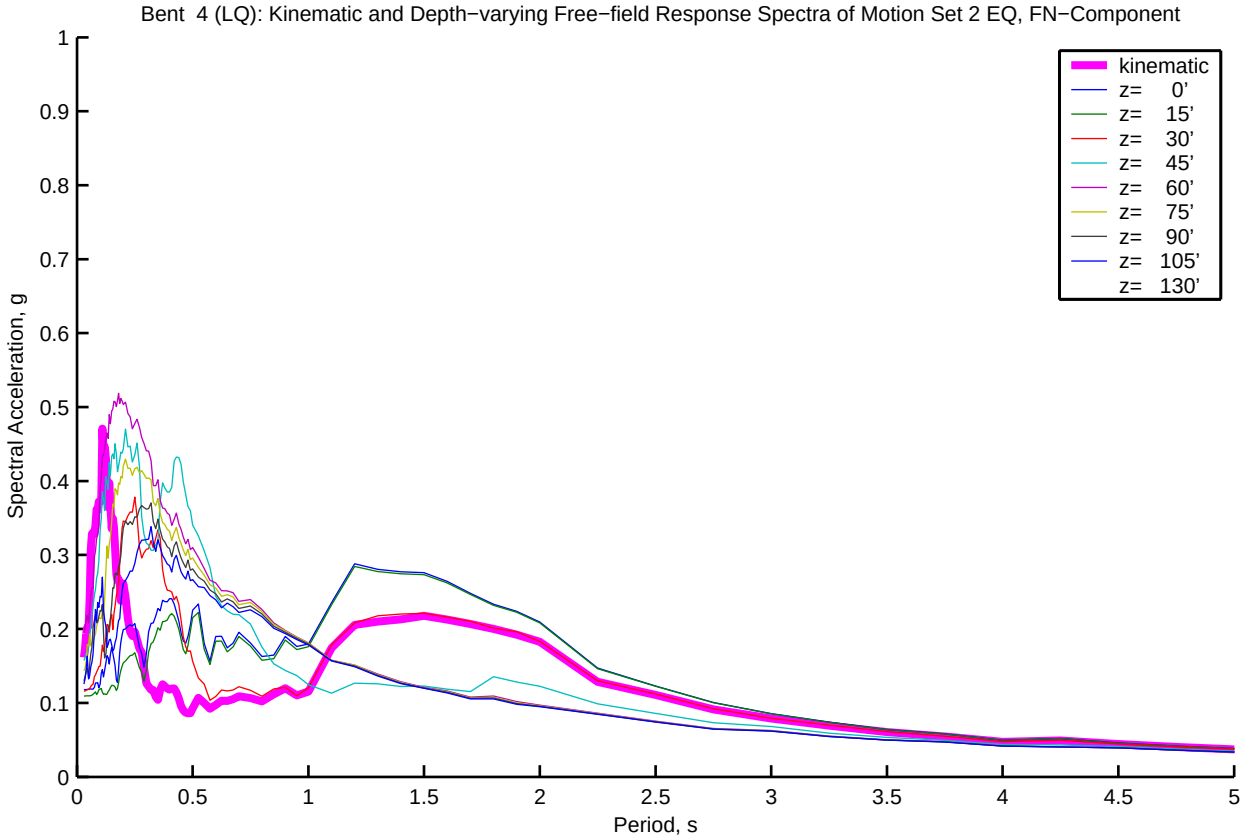

Bent 3 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 135'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

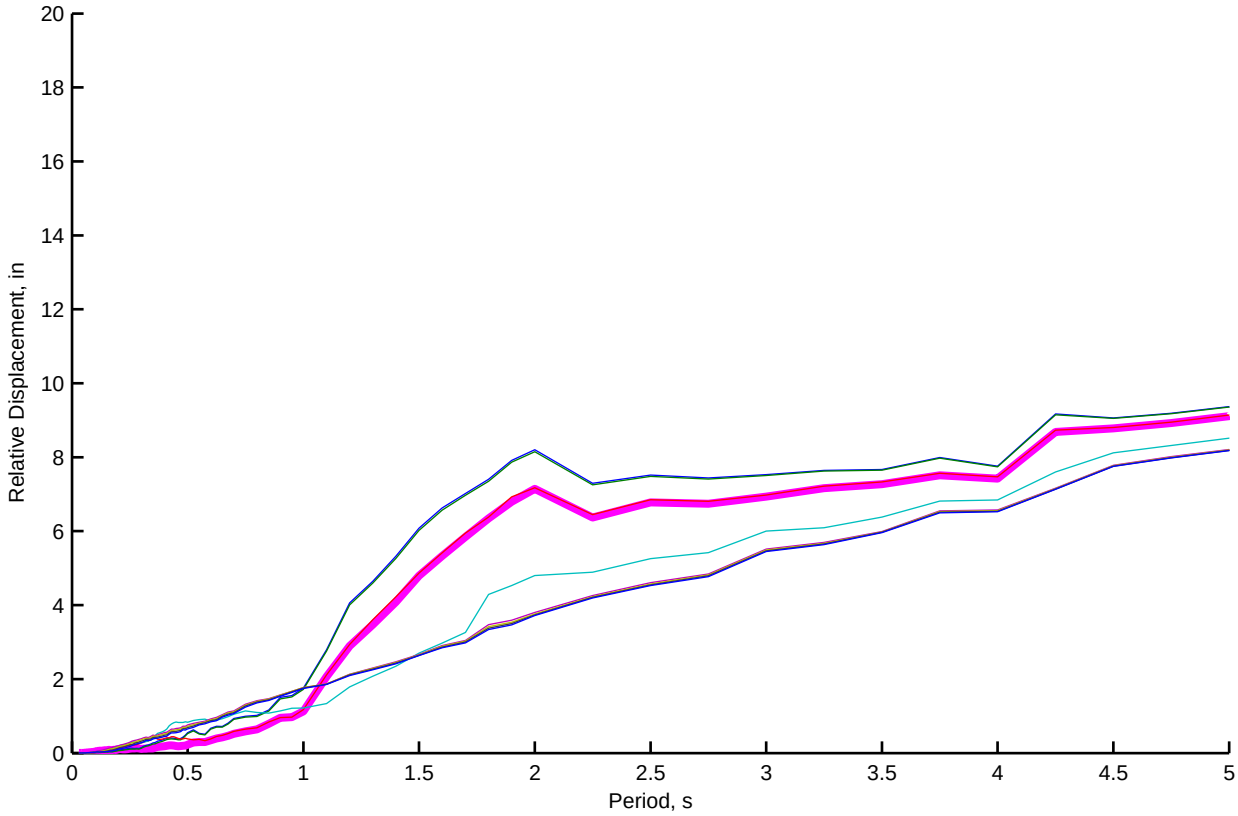

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 4 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

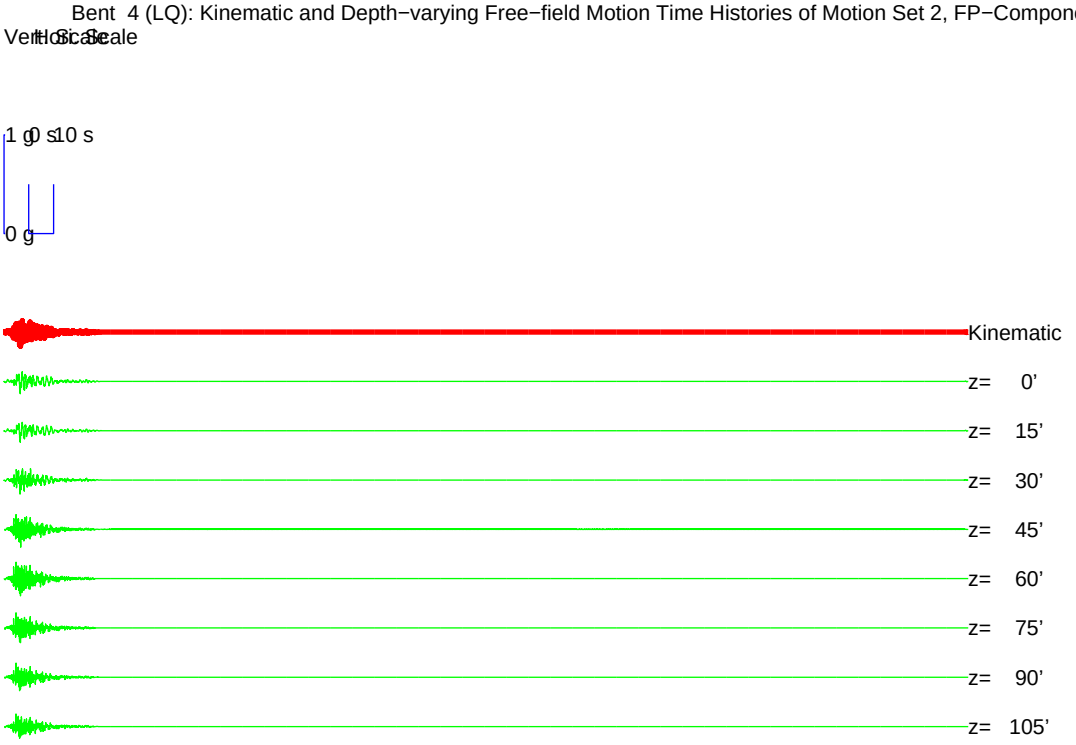


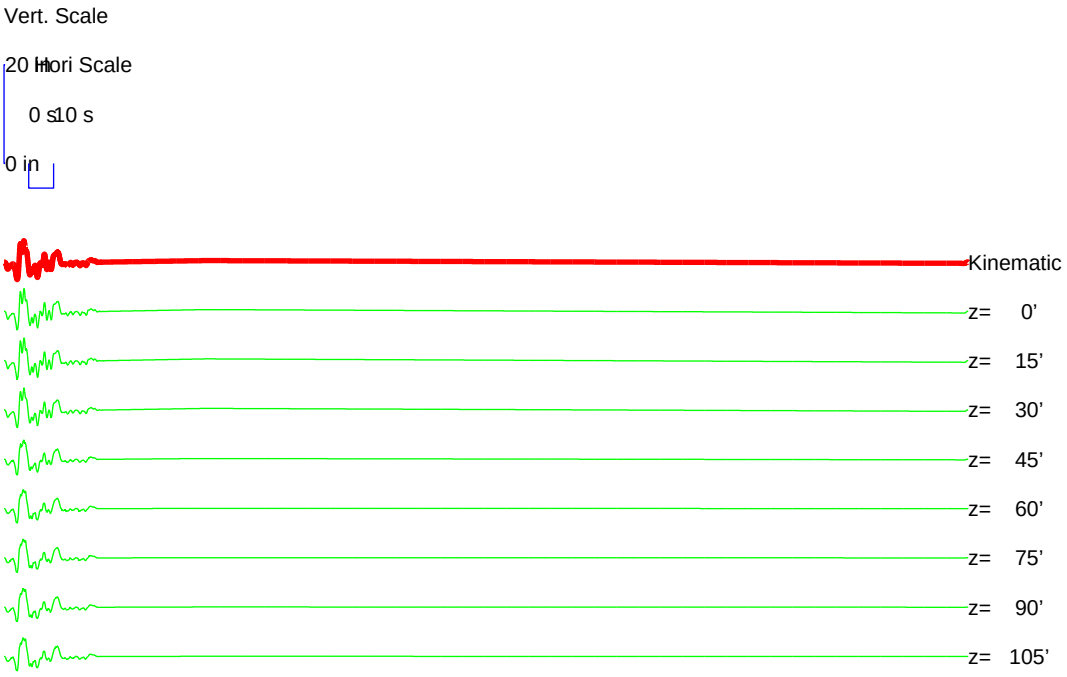


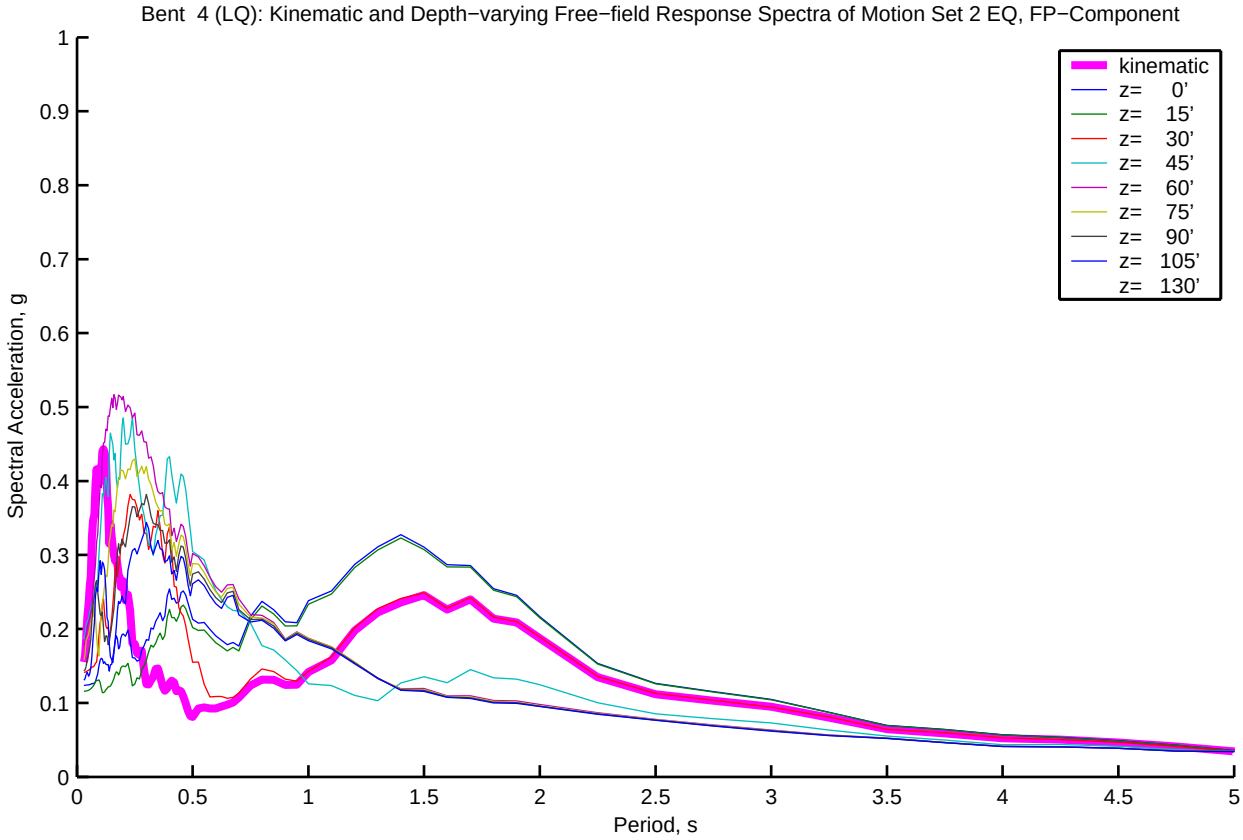

Bent 4 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

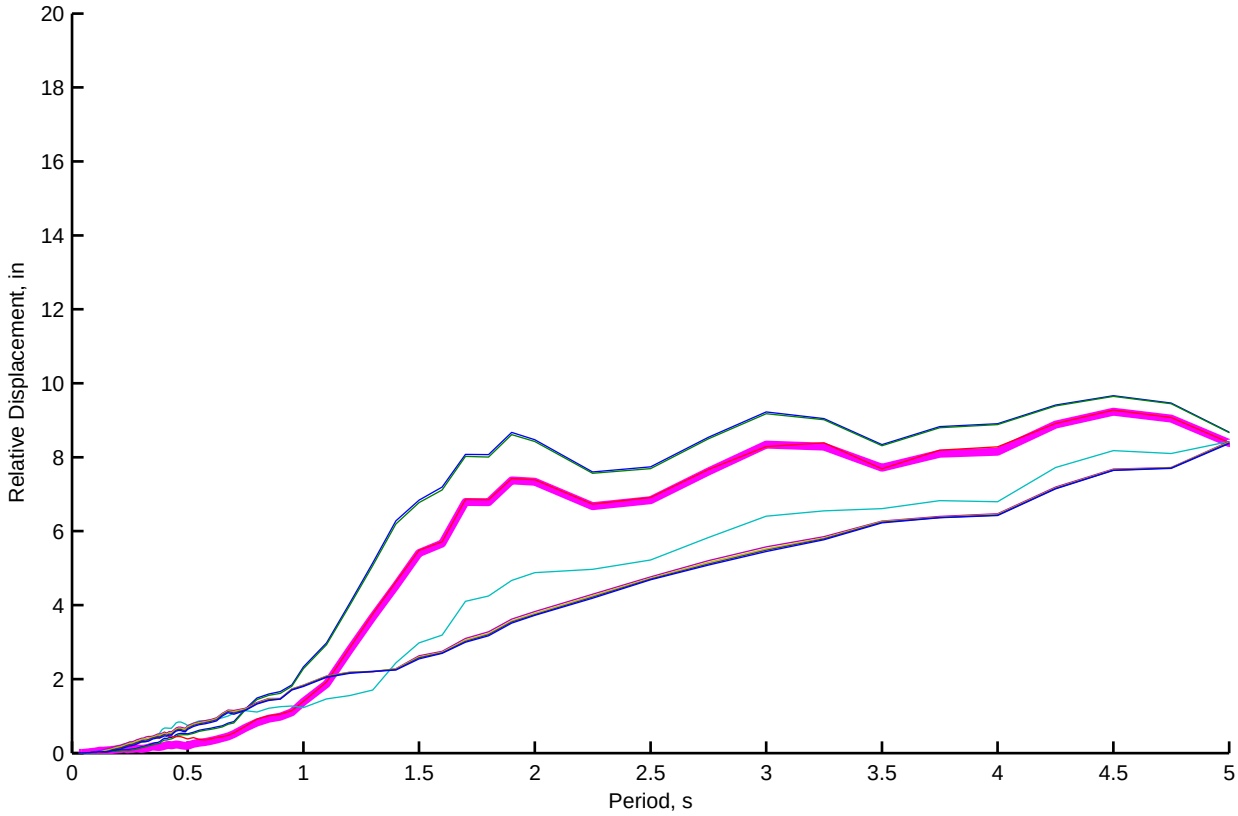

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 4 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

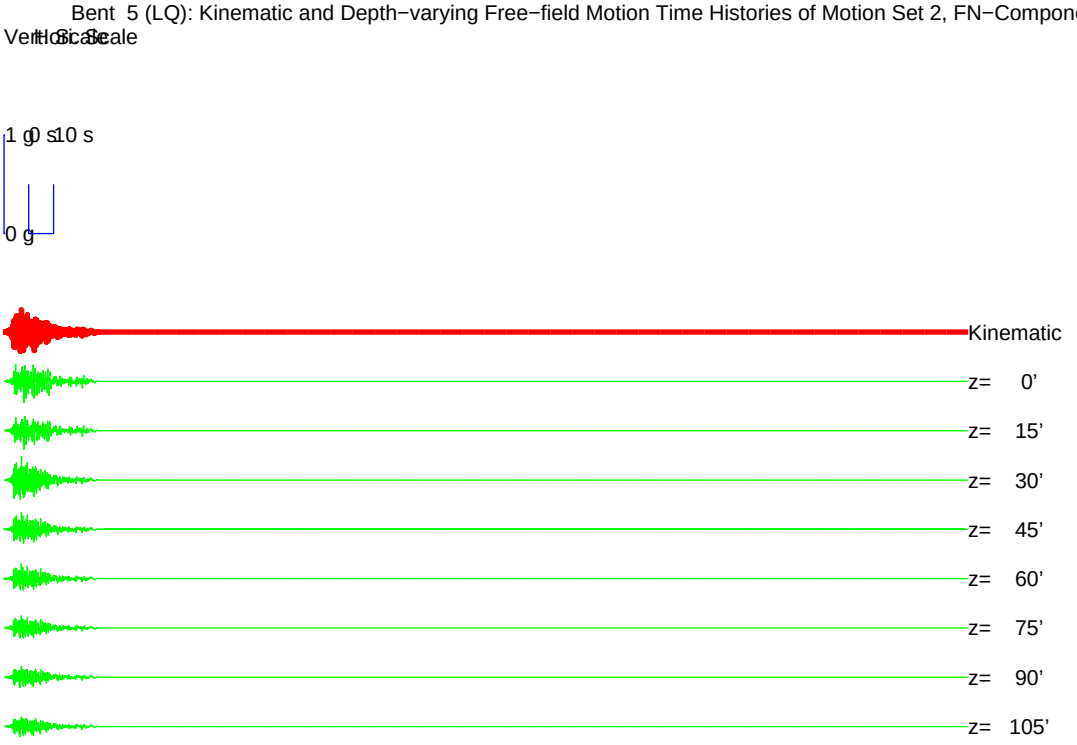


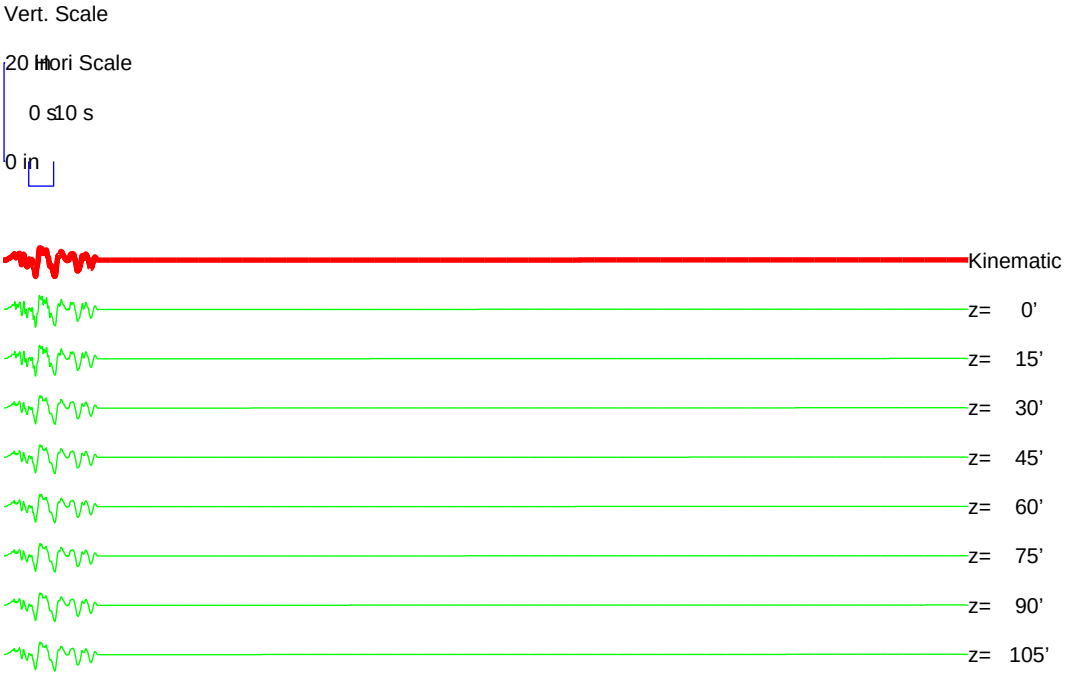


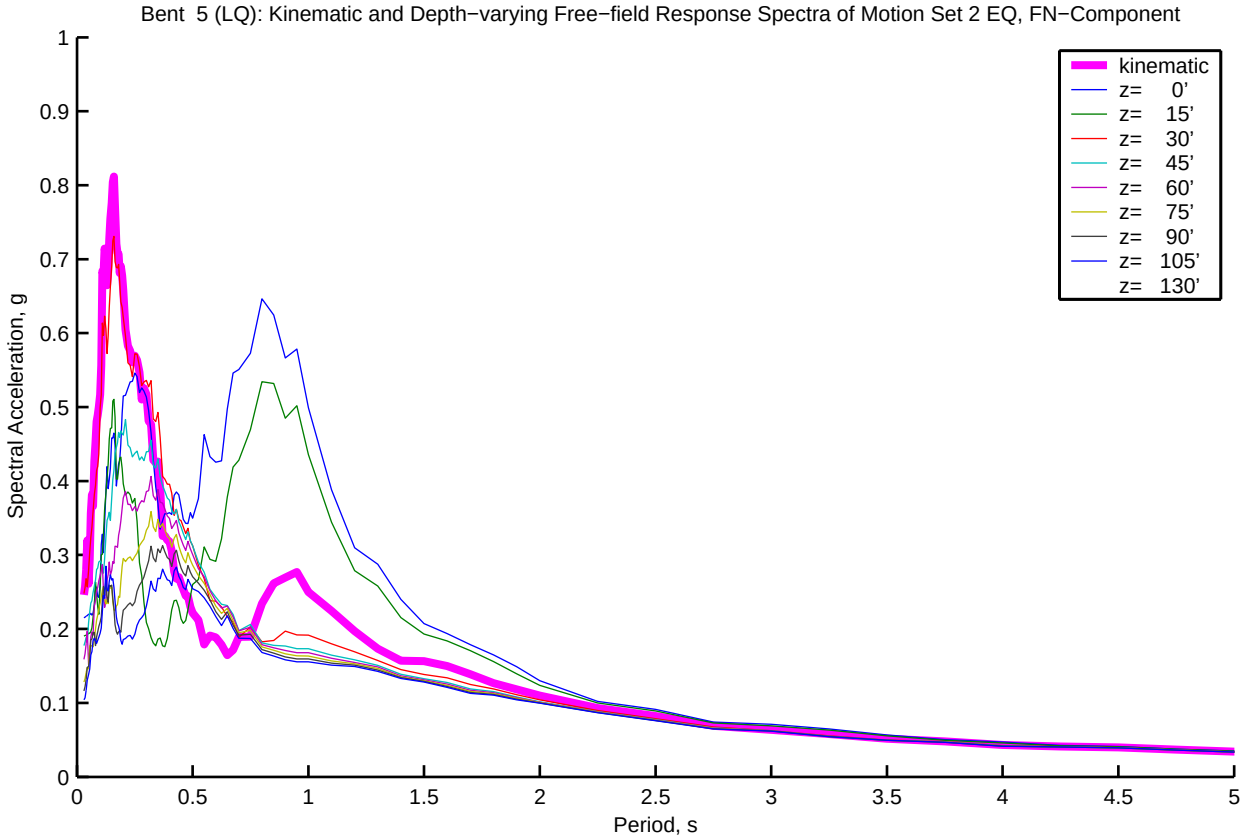

Bent 4 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

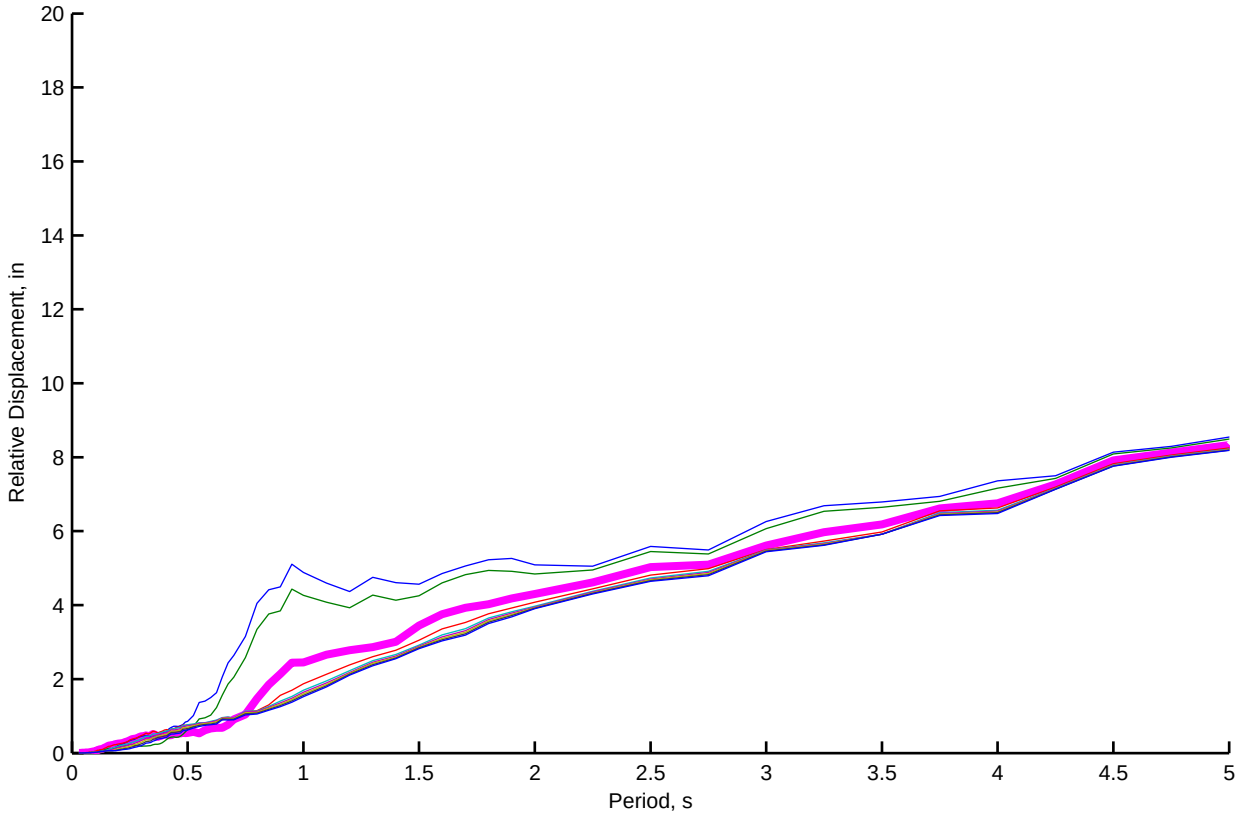

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 5 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

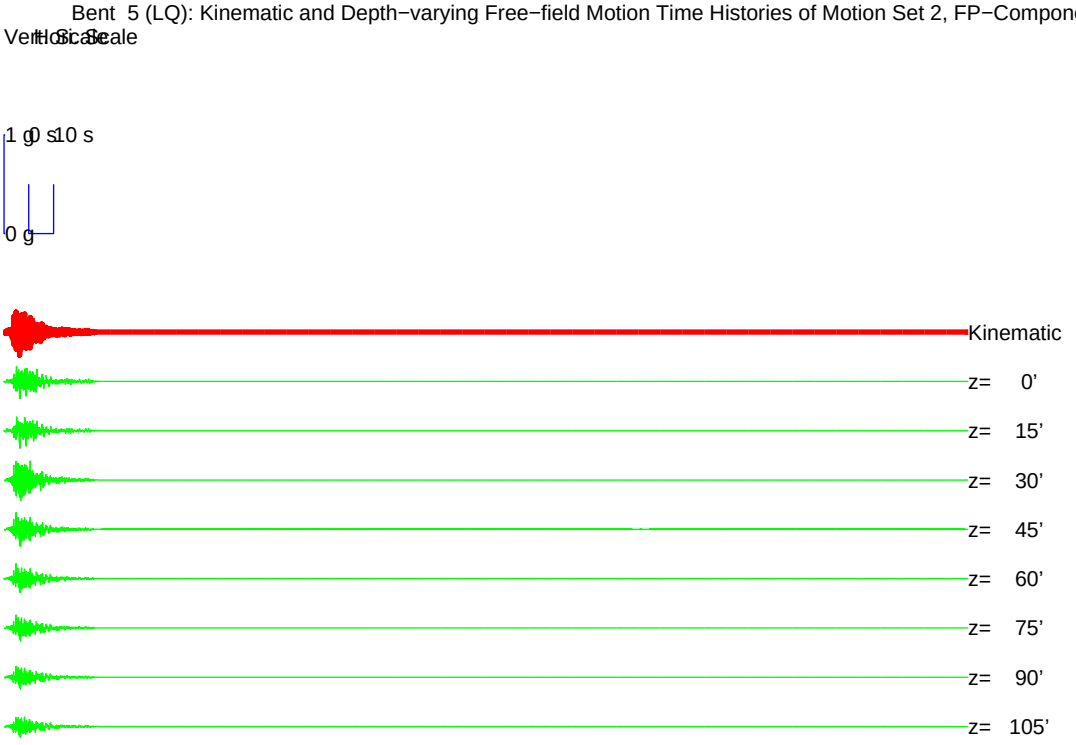


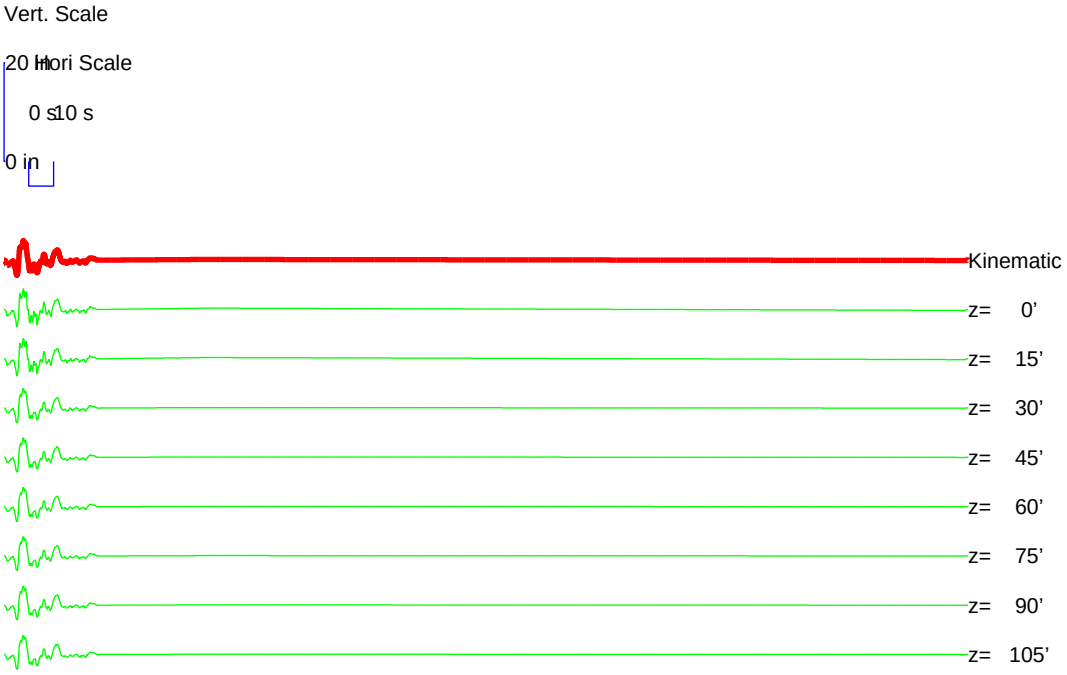


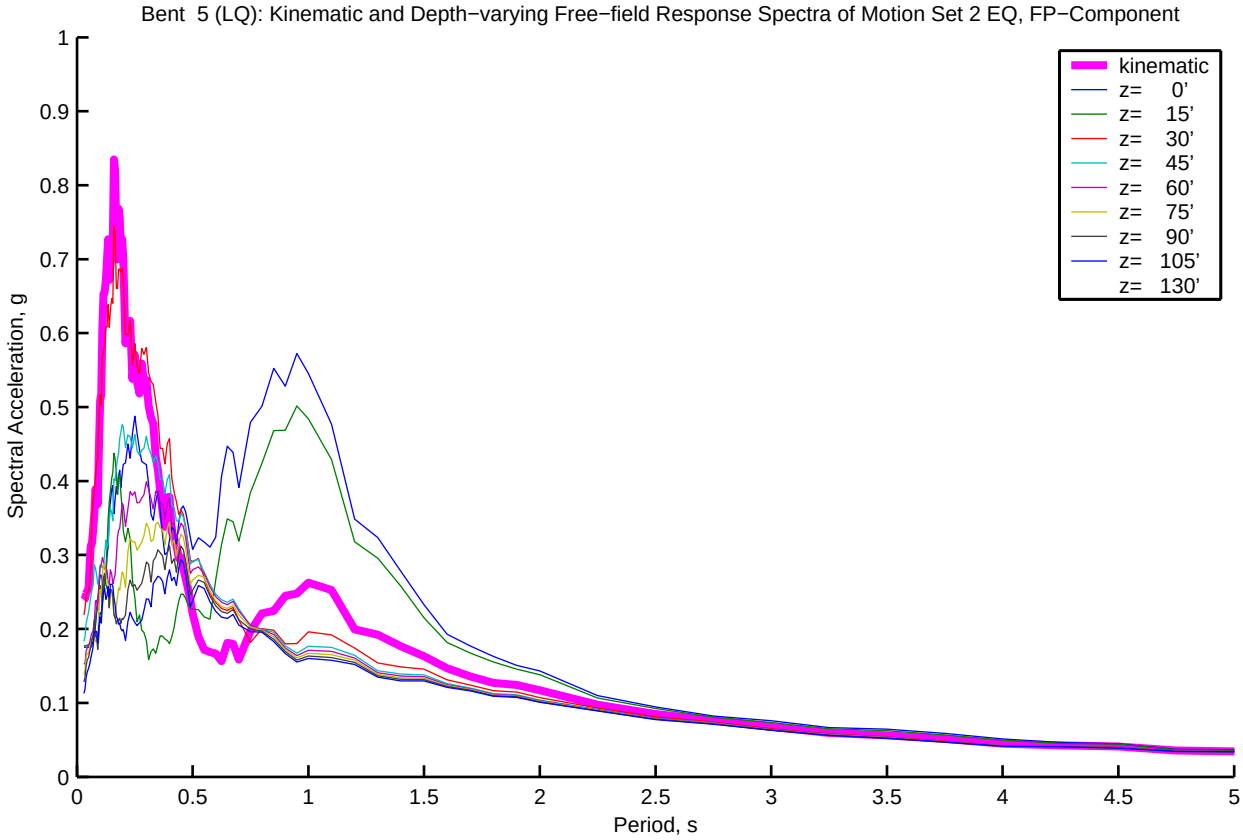

Bent 5 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

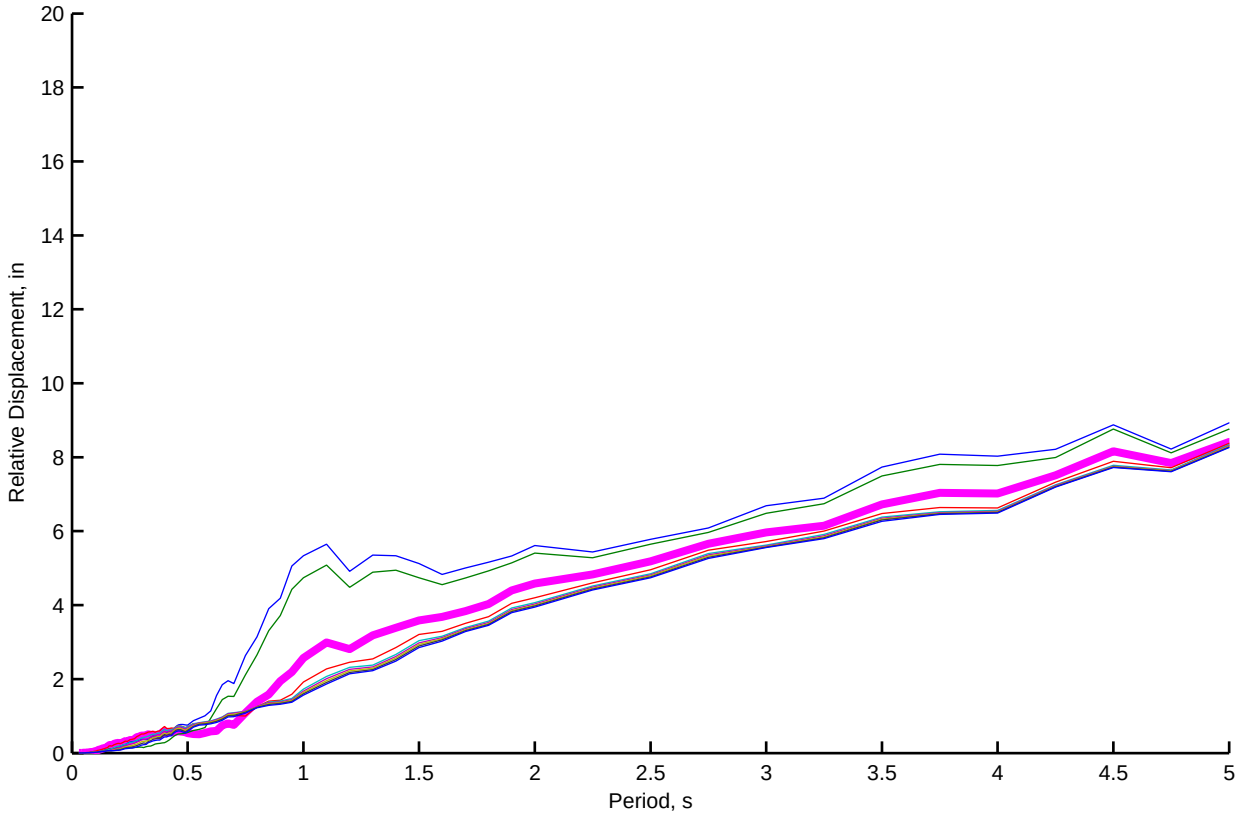

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 5 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

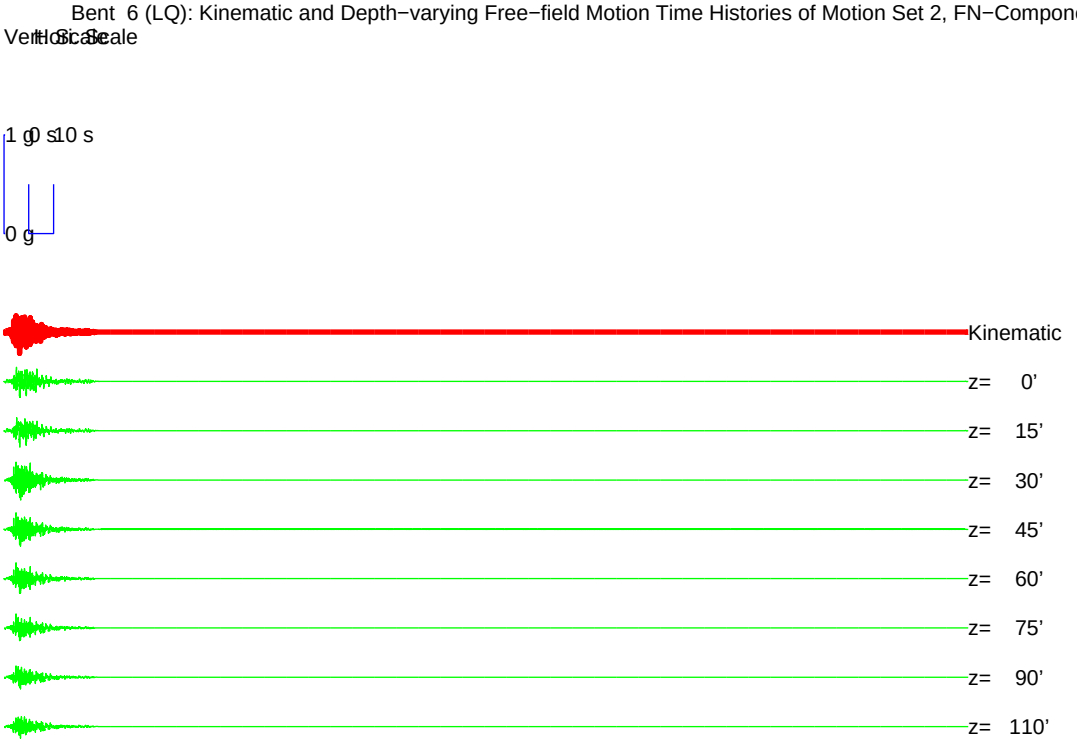


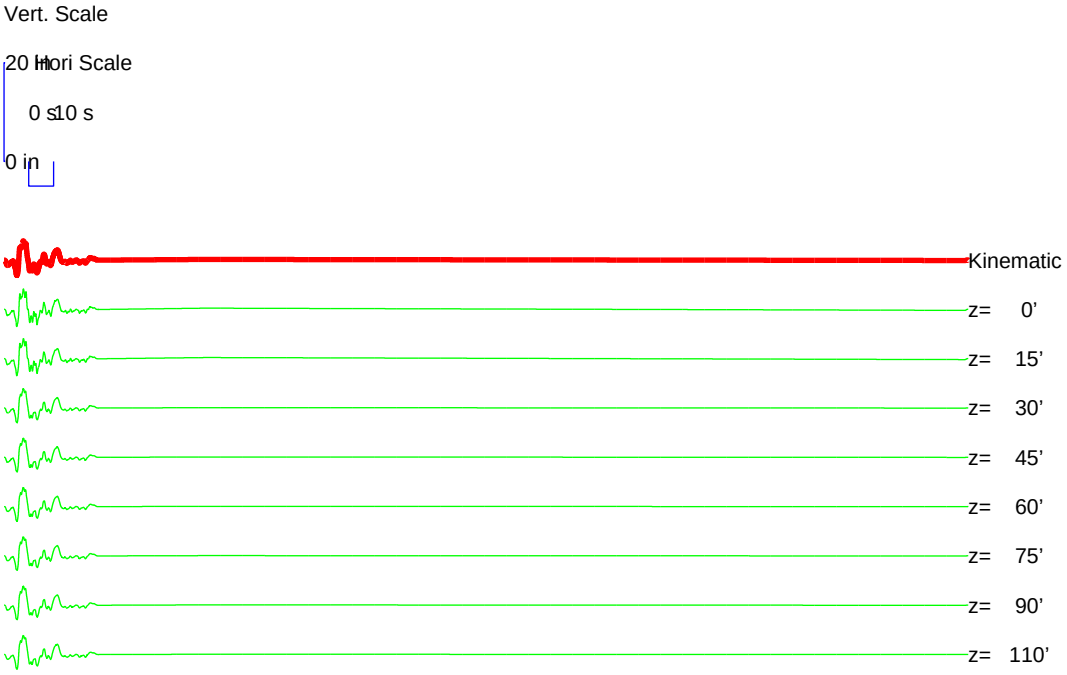


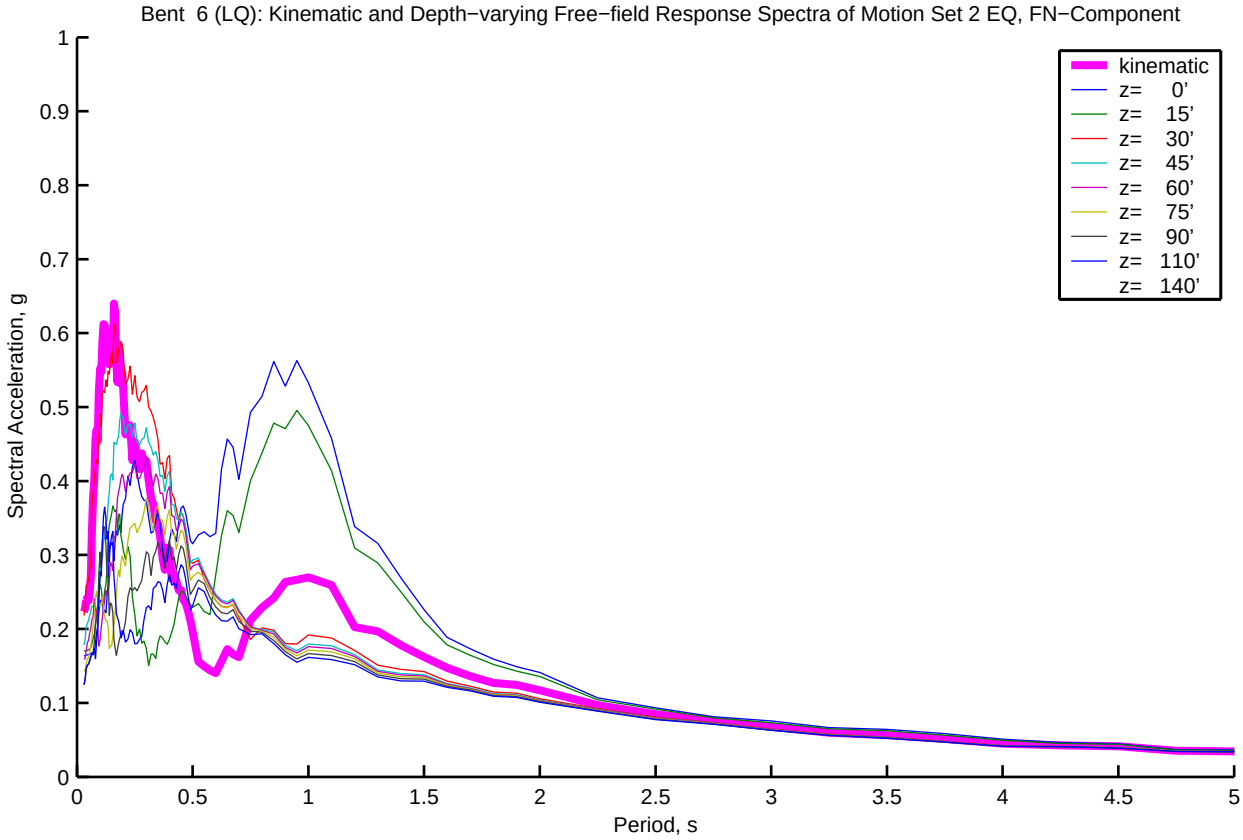

Bent 5 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'

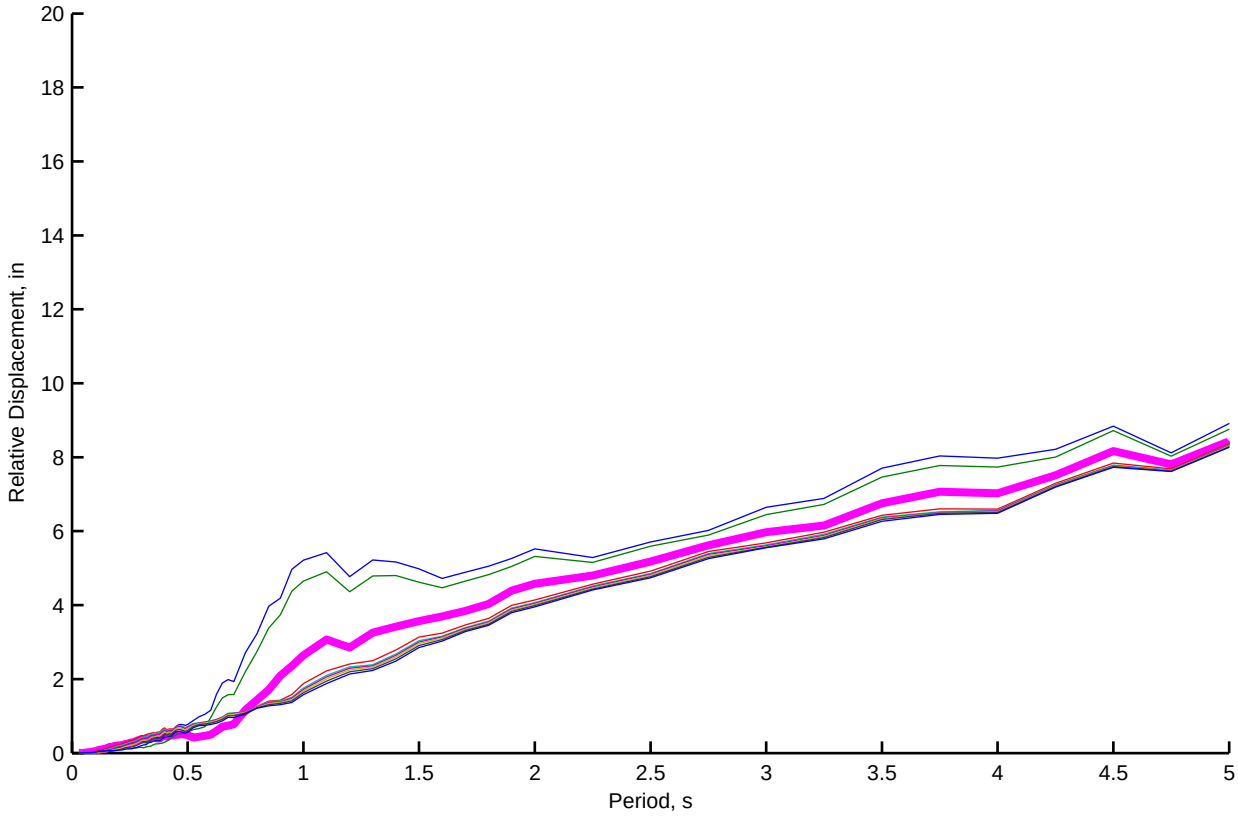

Relative Displacement, in
Period, s

Bent 6 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

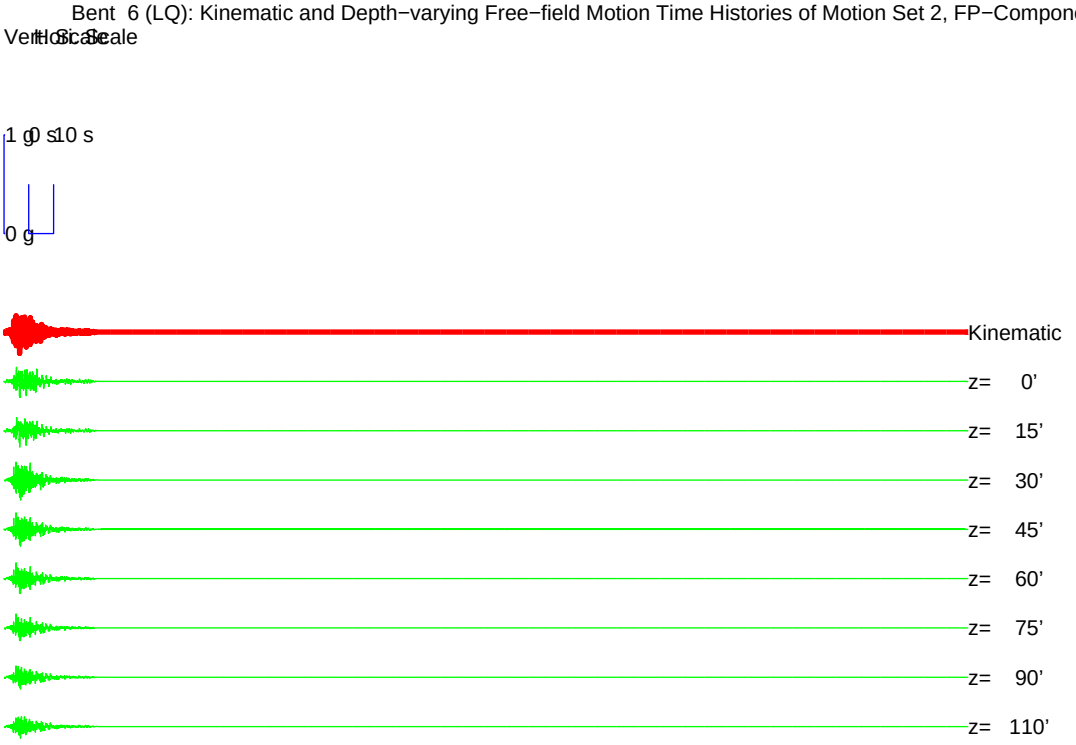


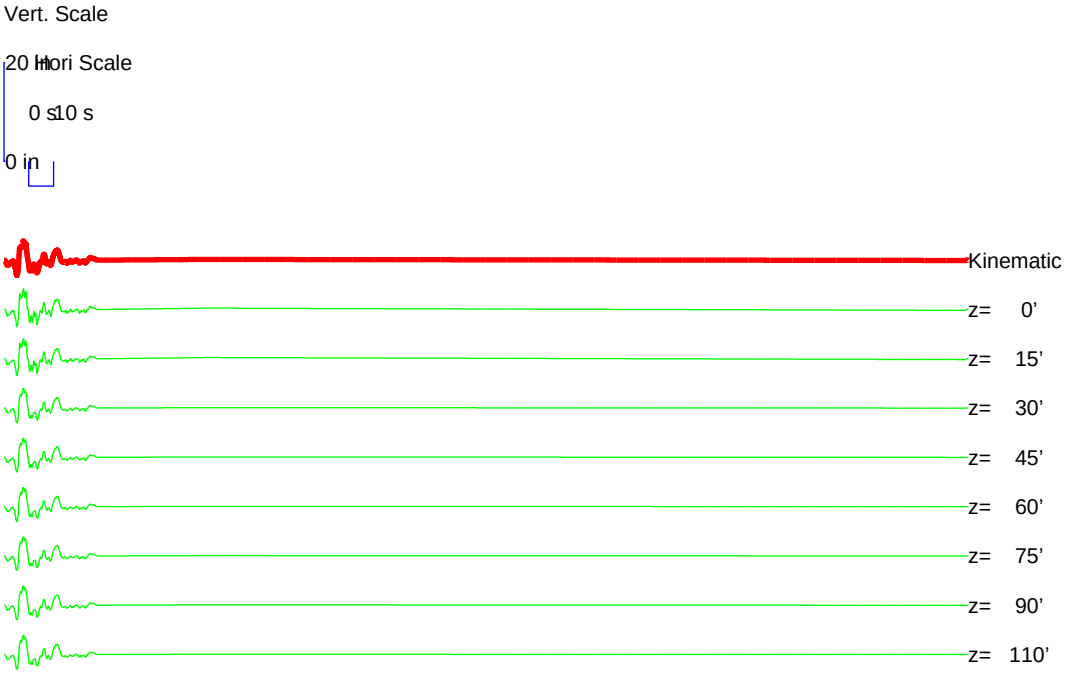


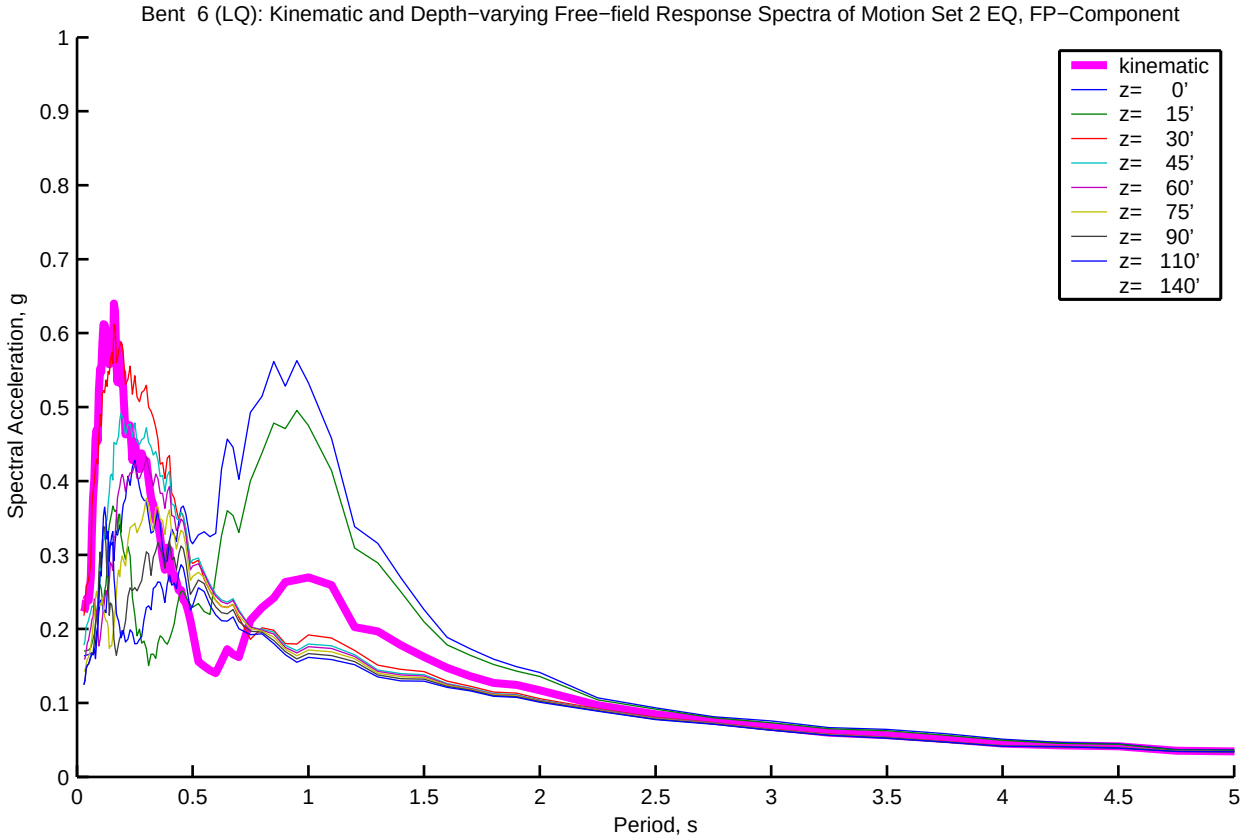

Bent 6 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

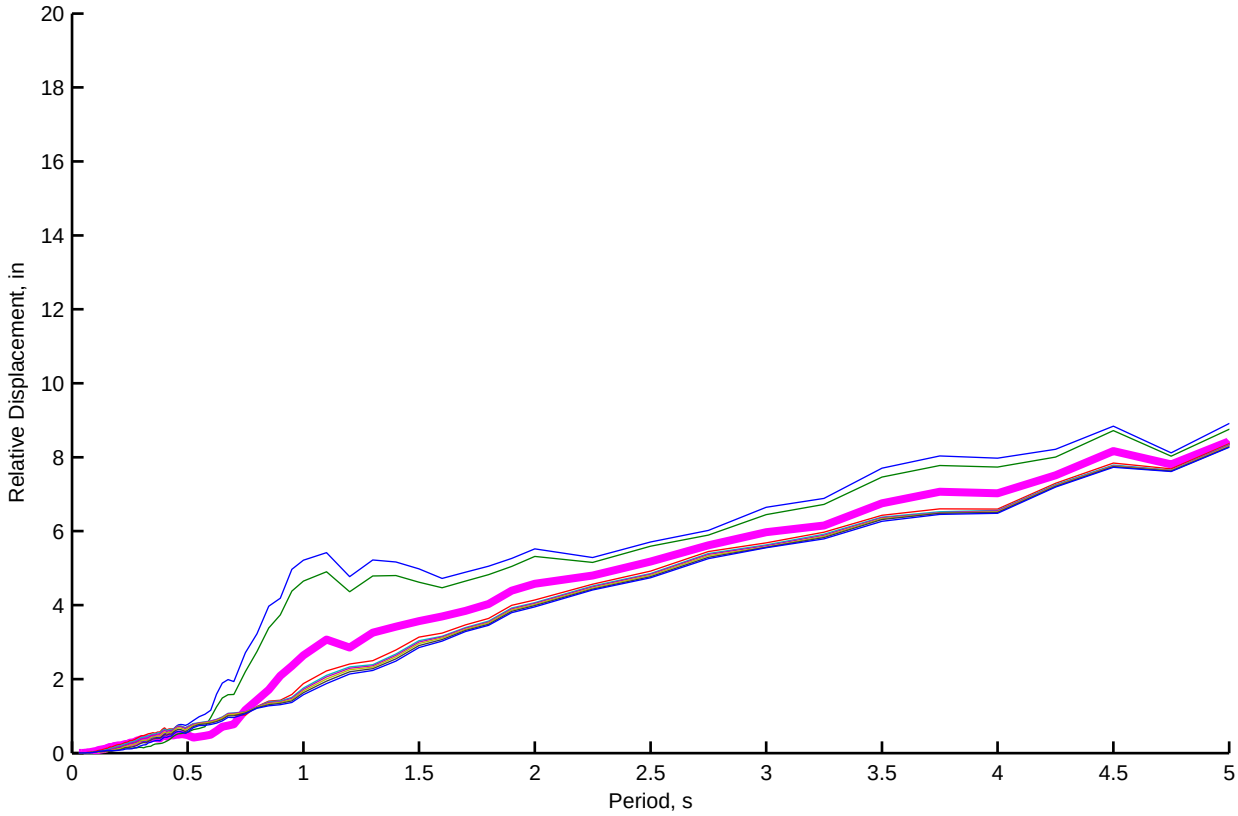

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 6 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

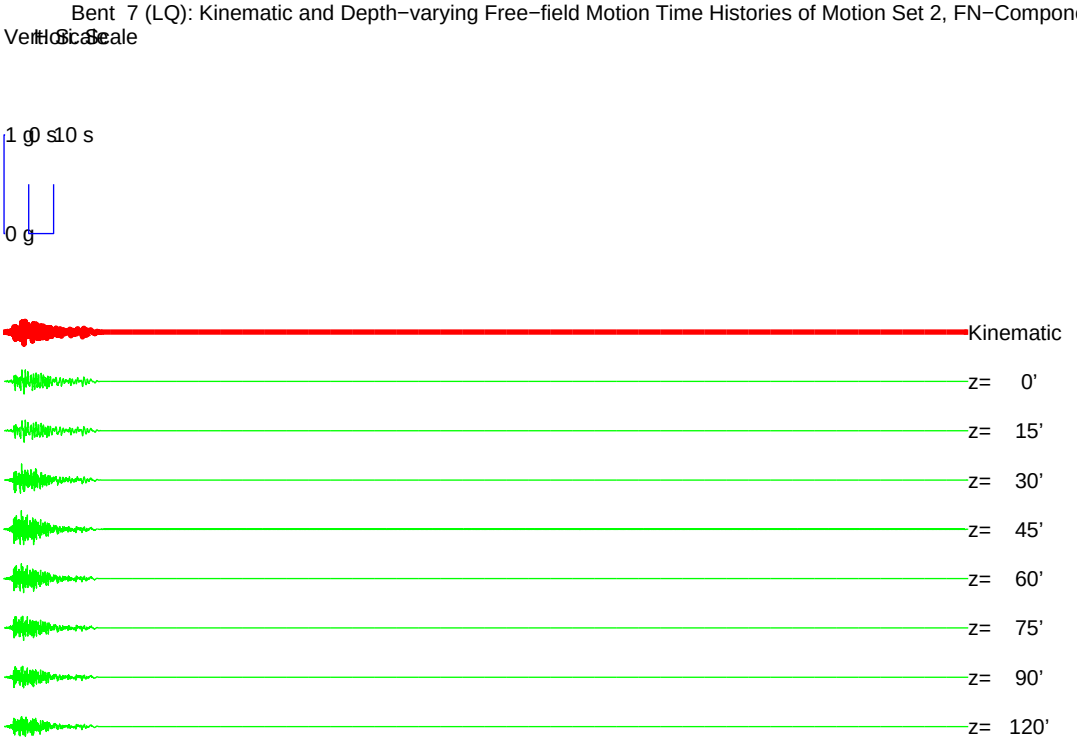


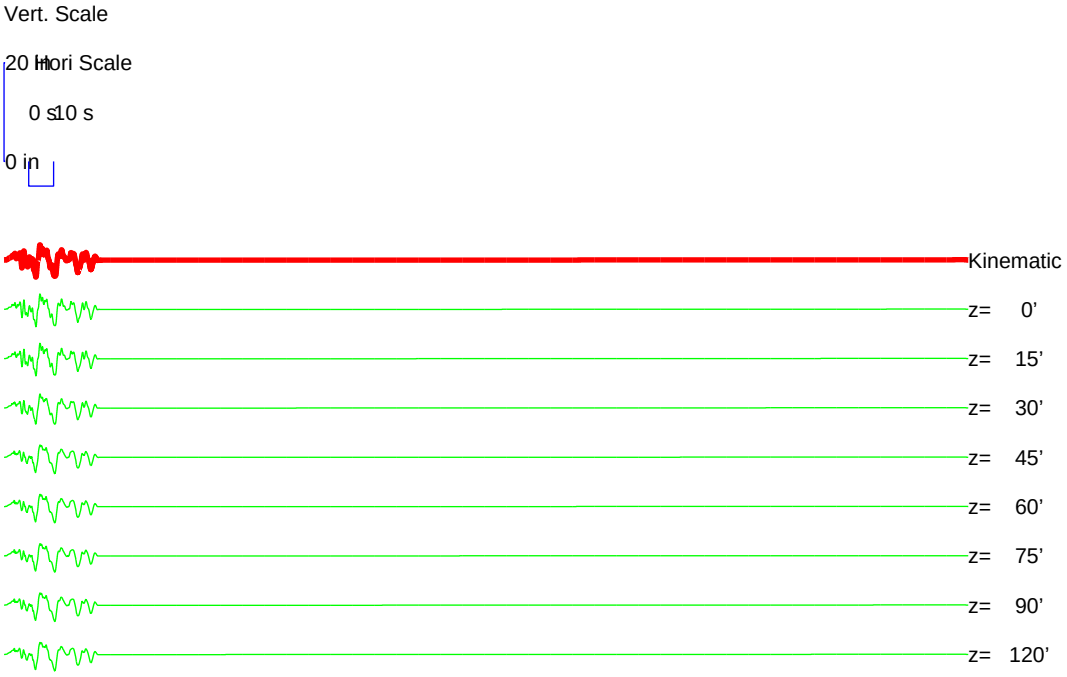


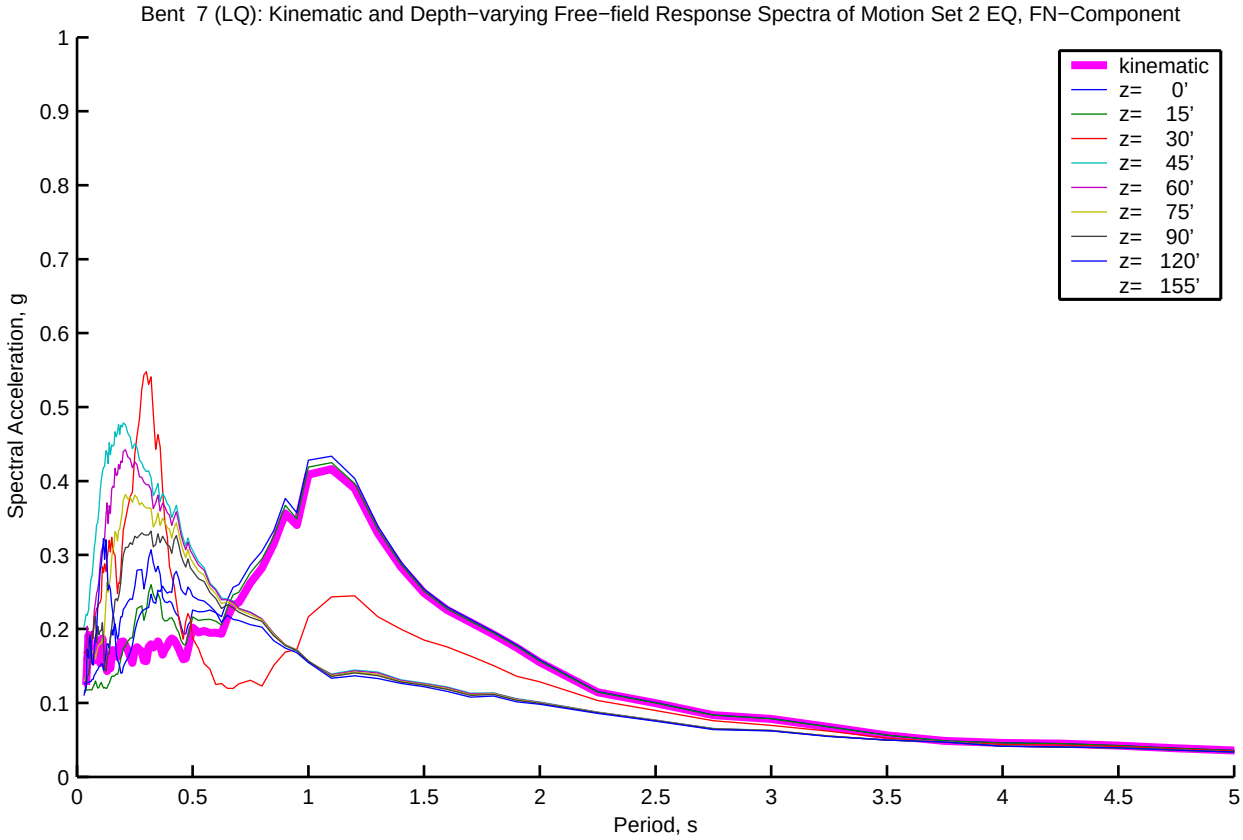

Bent 6 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

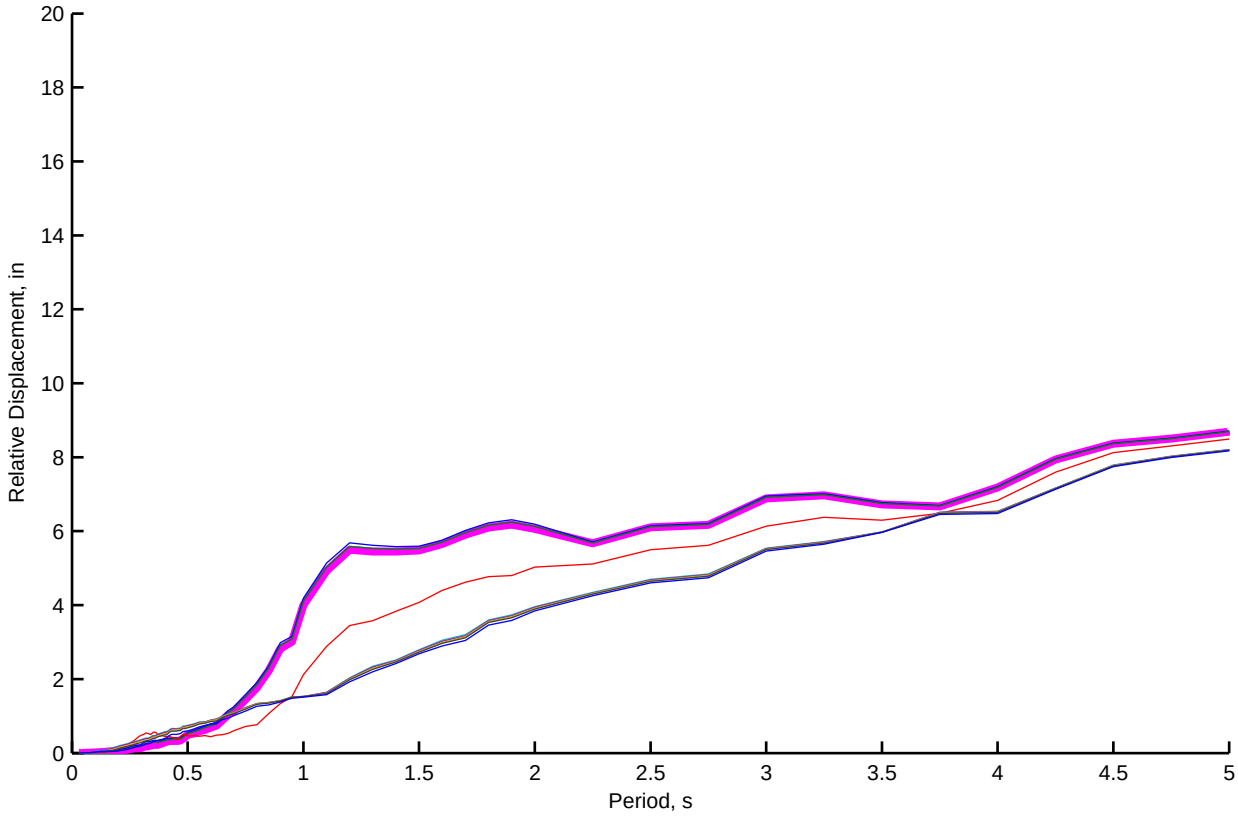

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 7 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

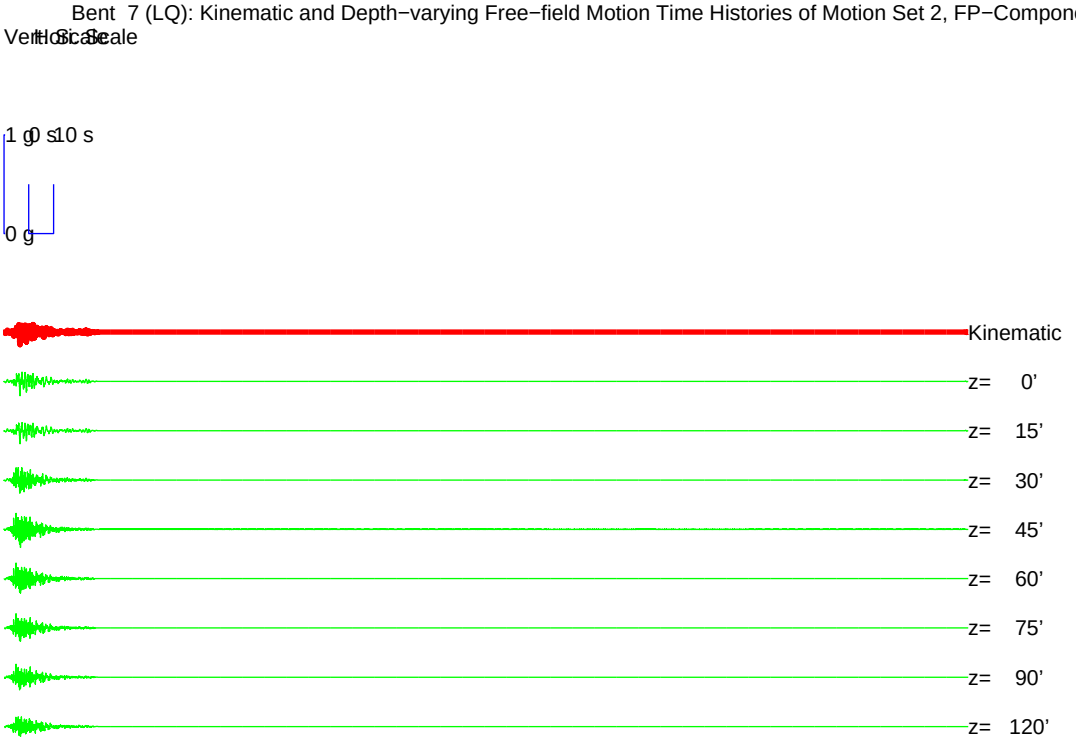


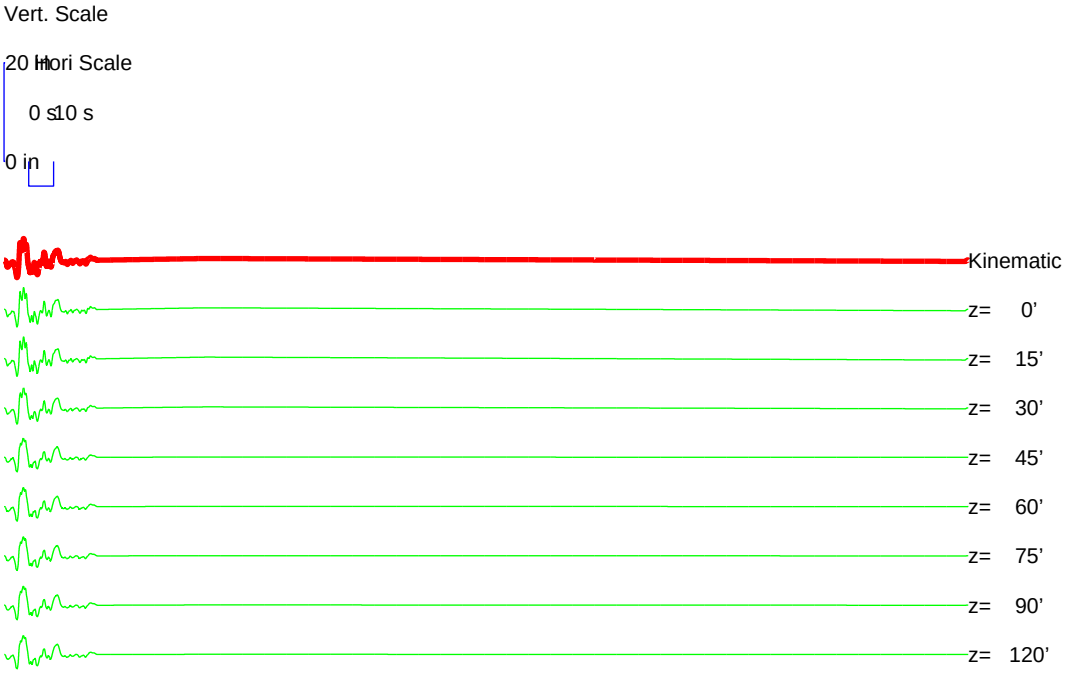


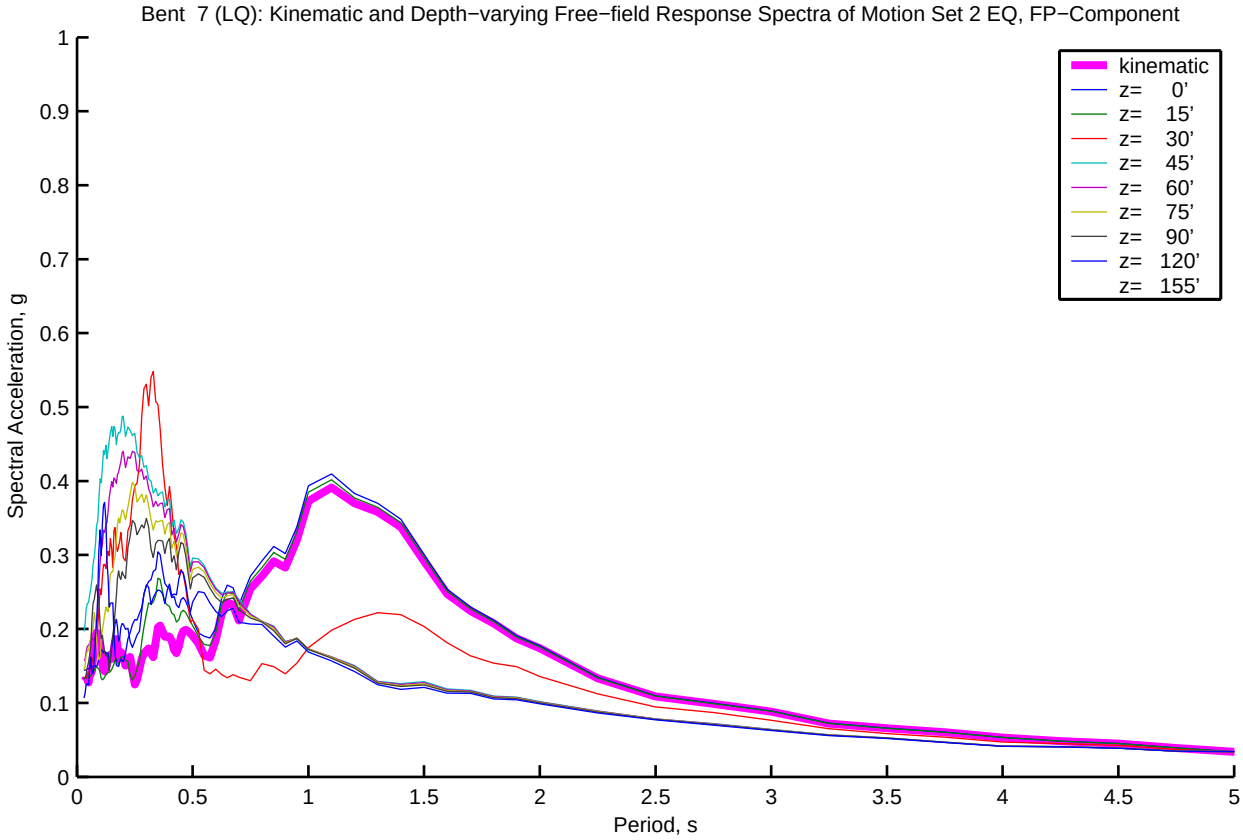

Bent 7 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 155'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

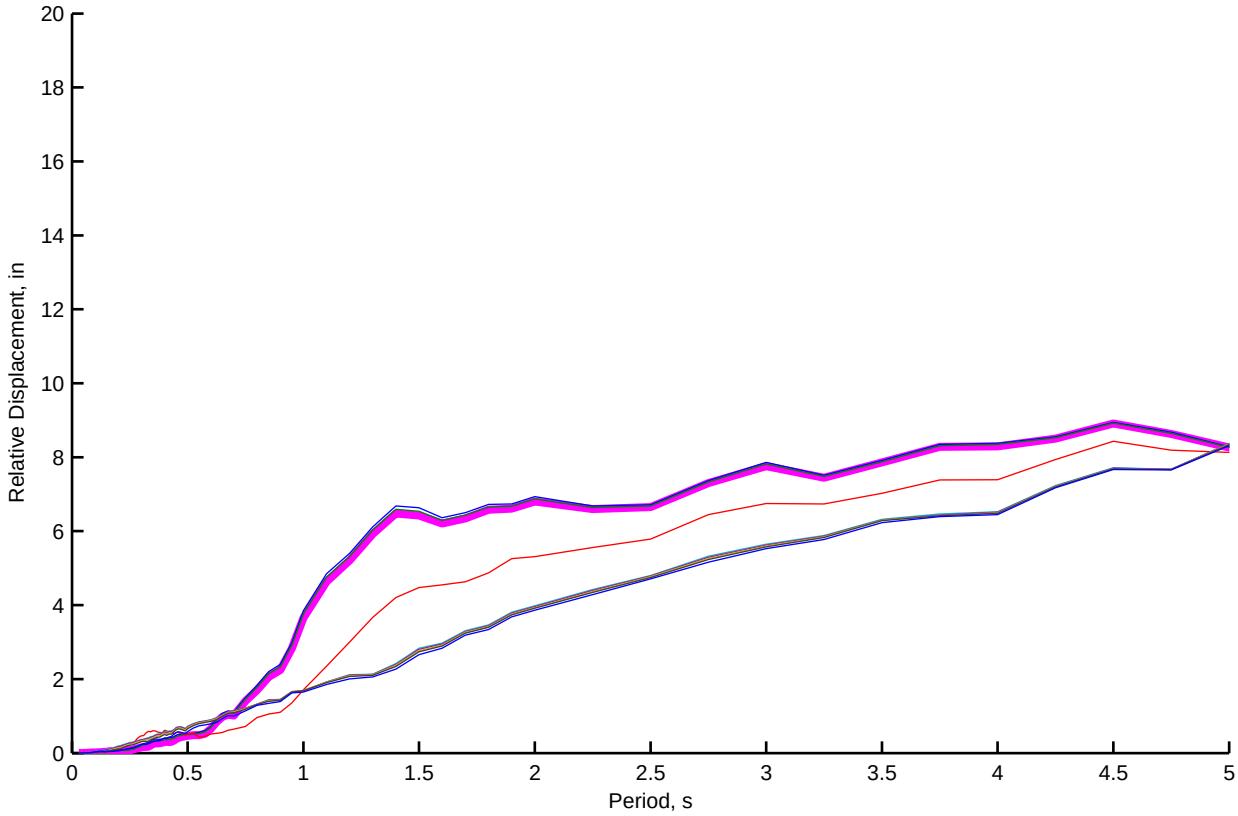

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 7 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

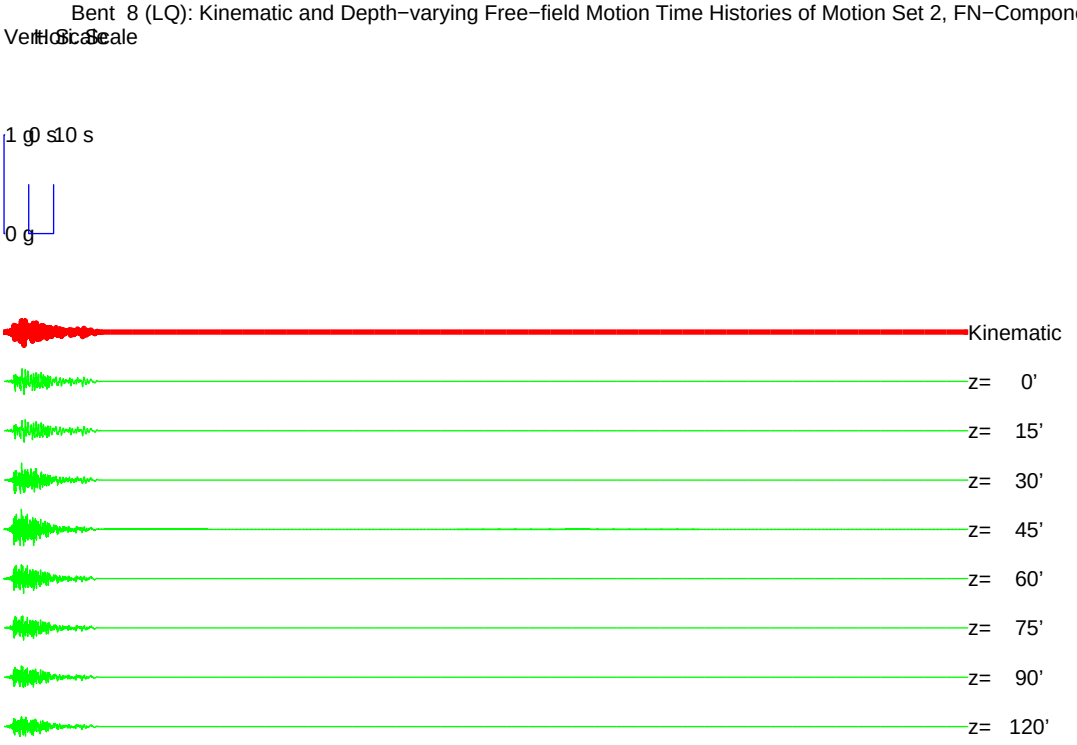


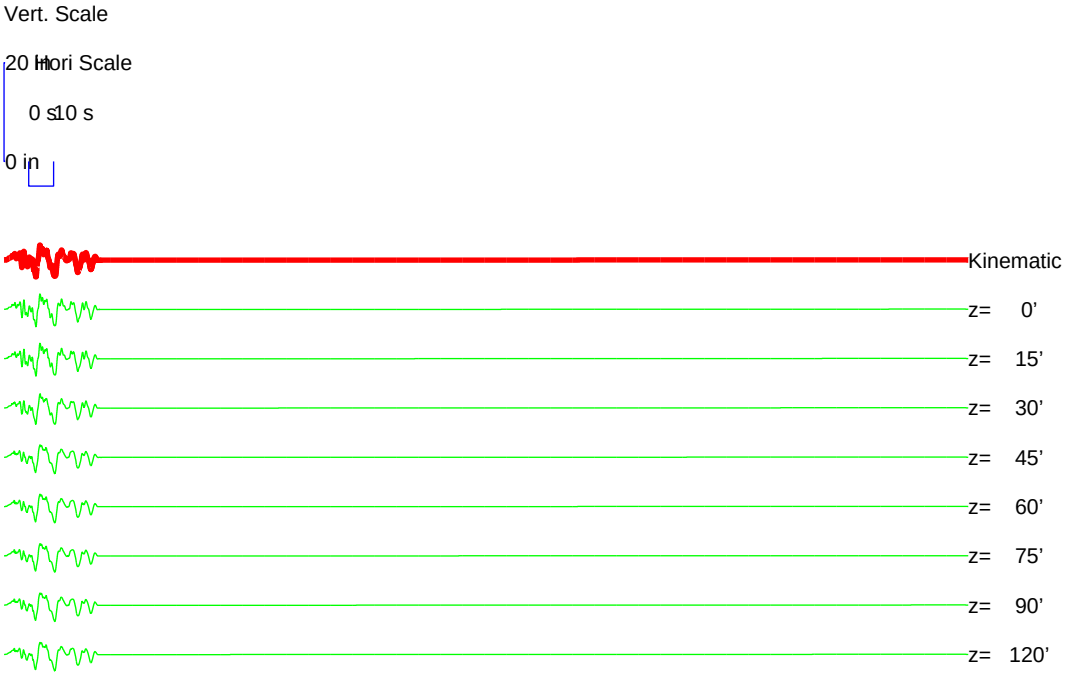


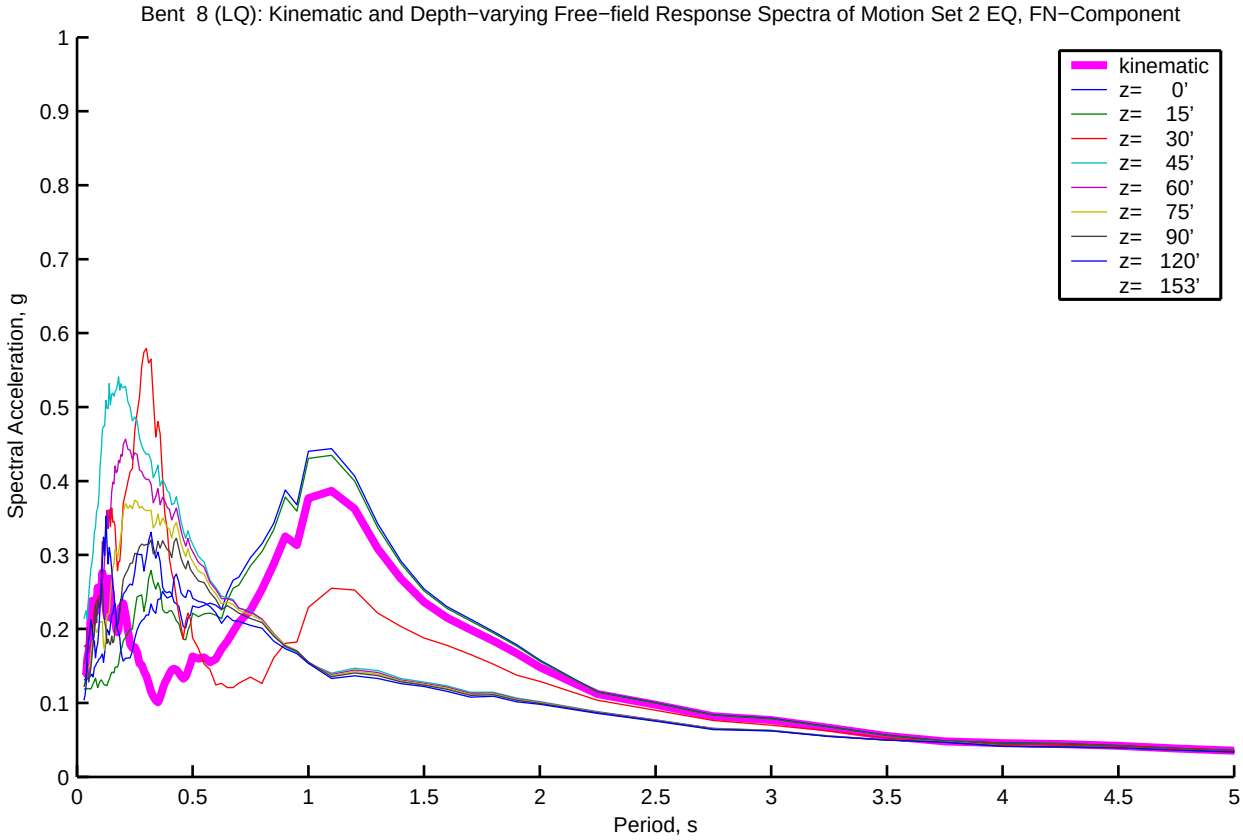

Bent 7 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 155'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

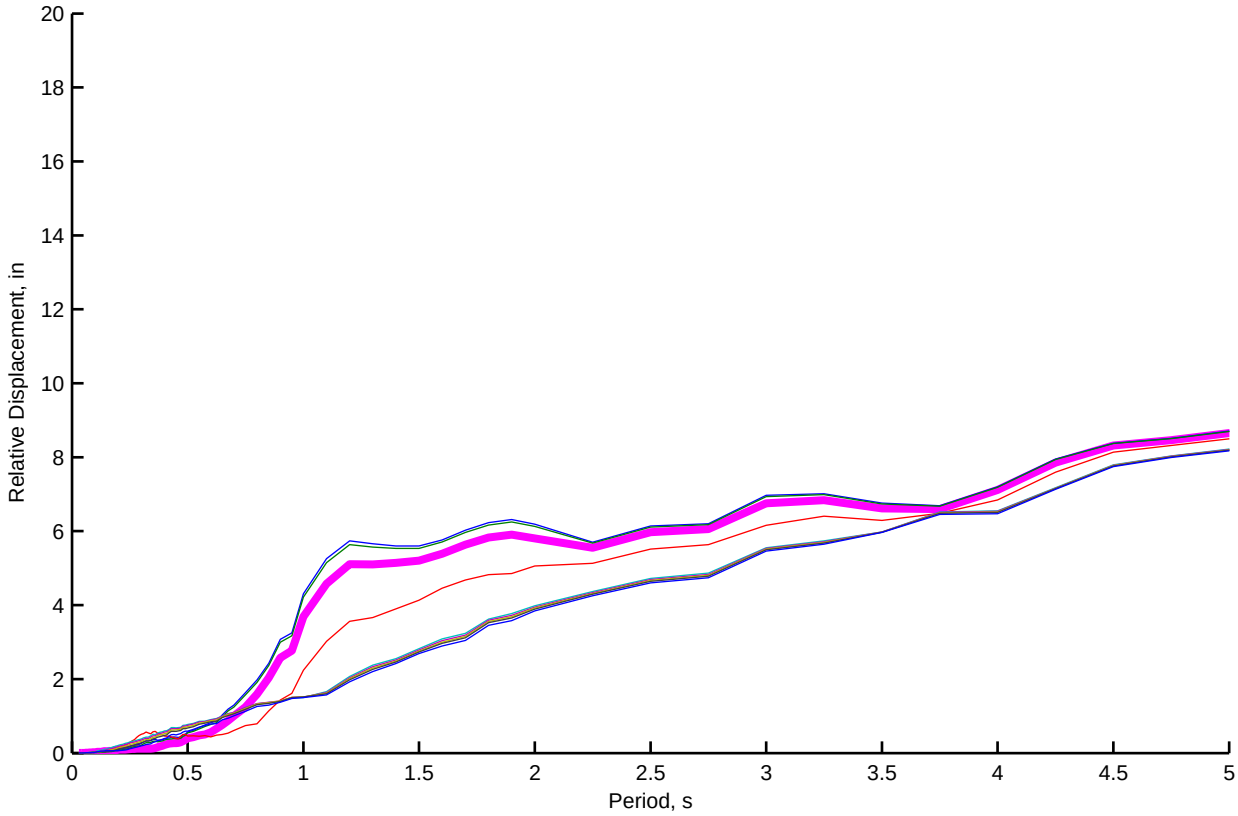

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 8 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

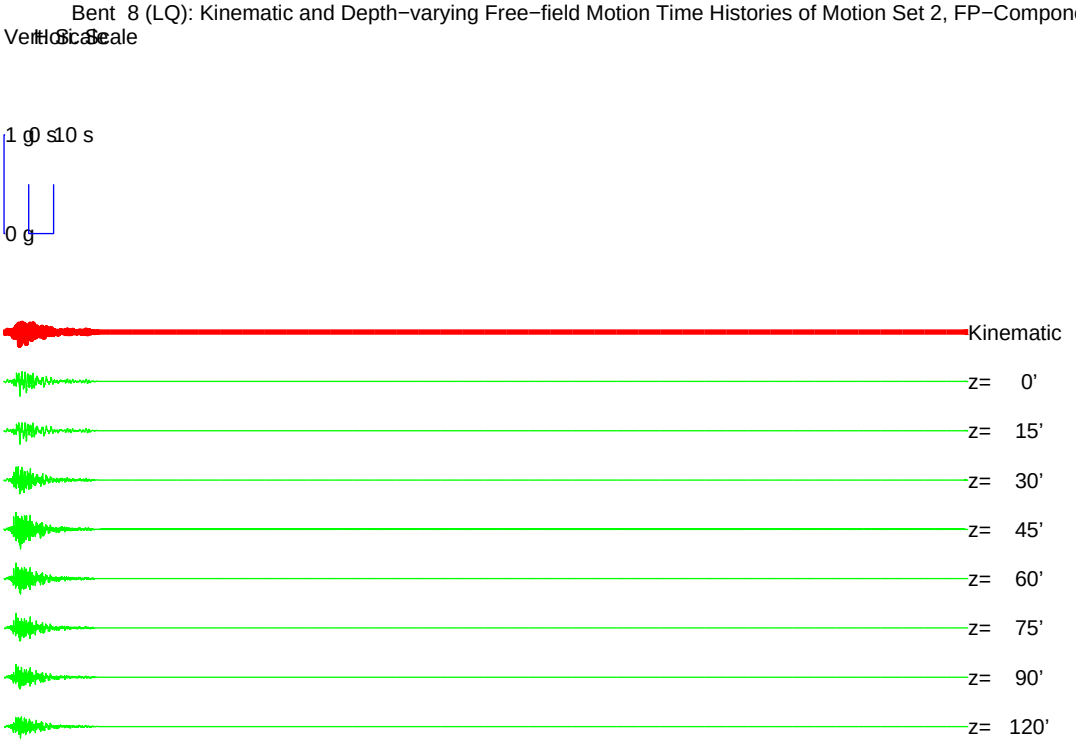


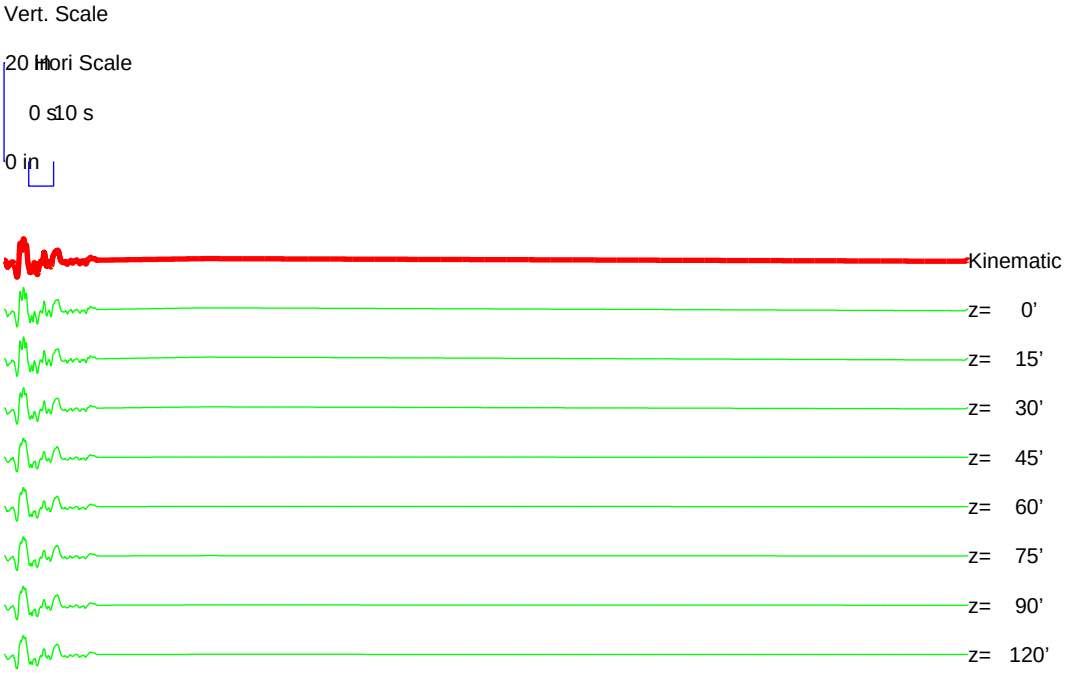


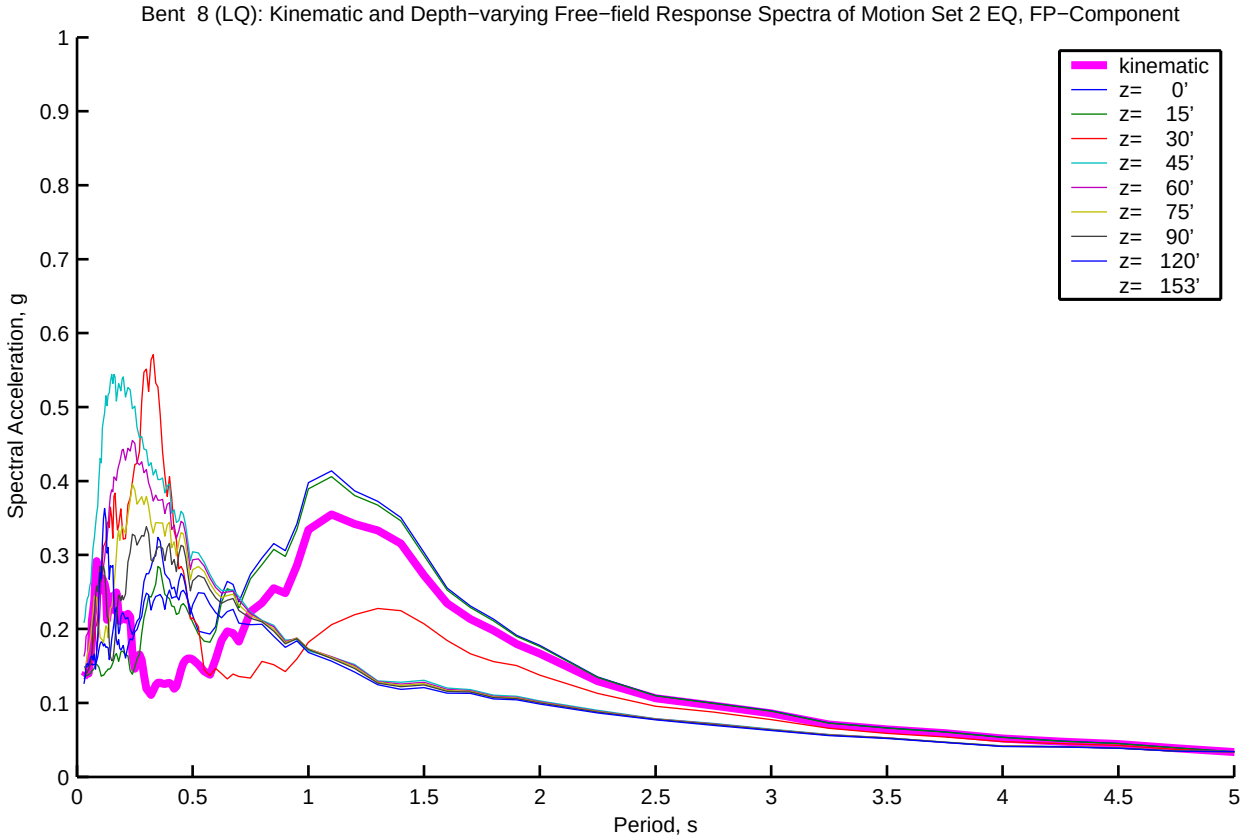

Bent 8 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 153'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

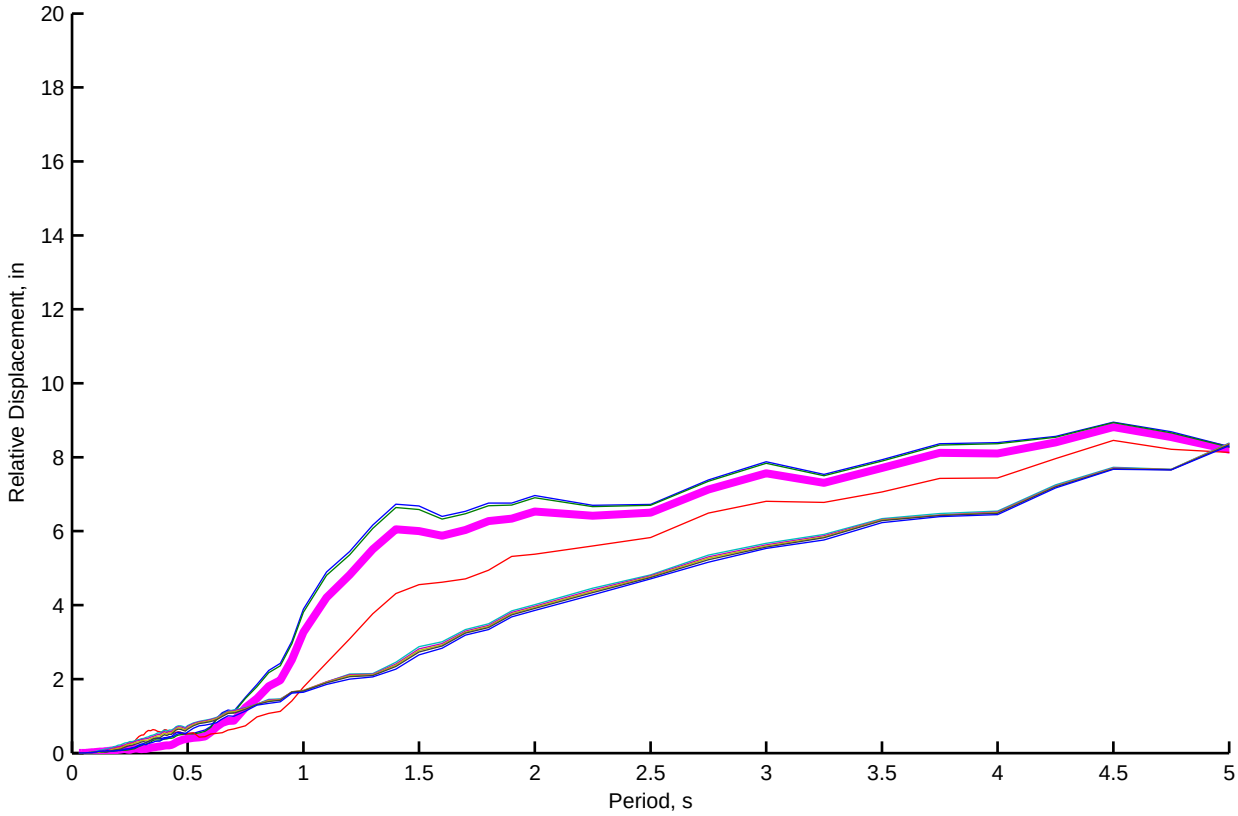

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 8 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

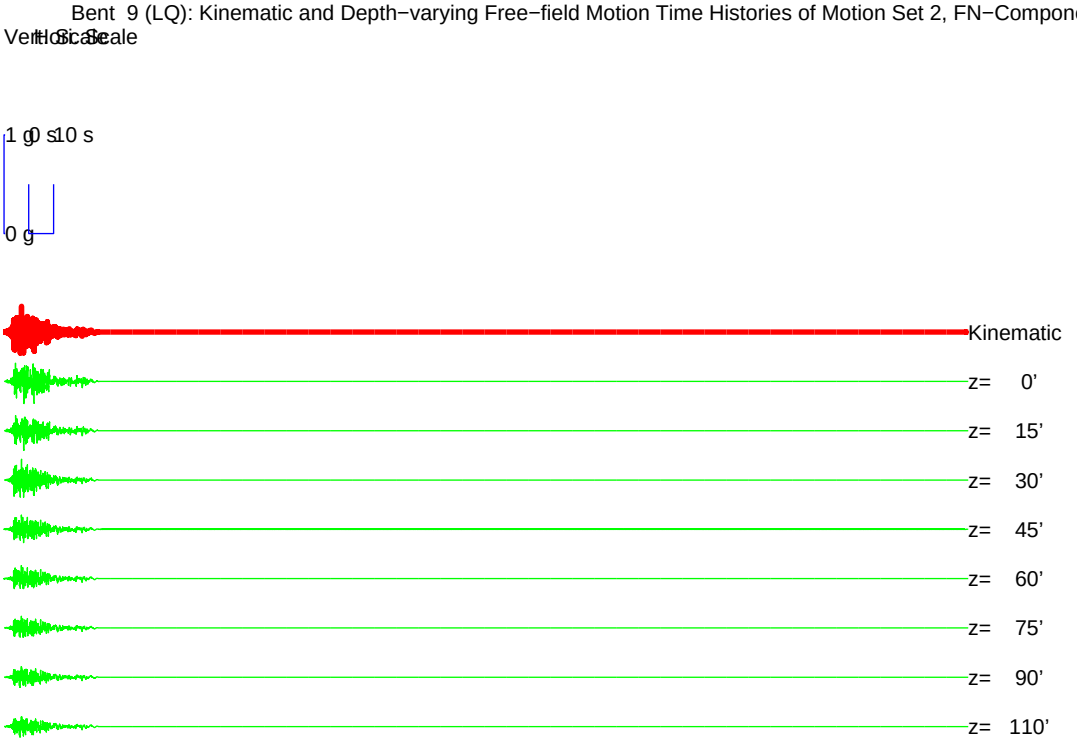


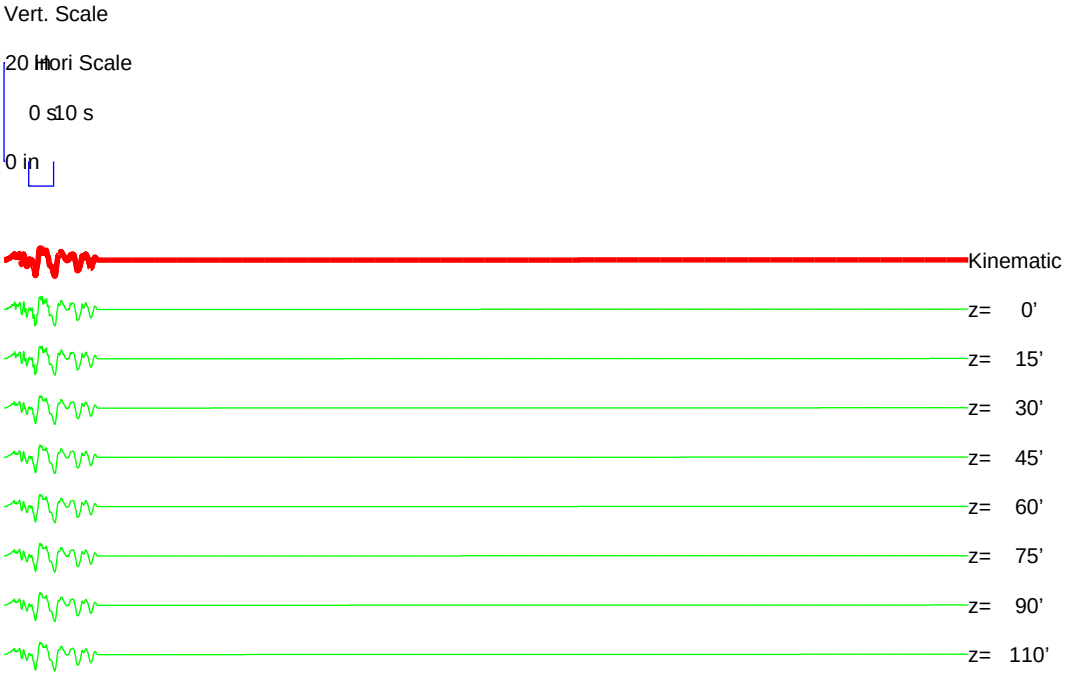


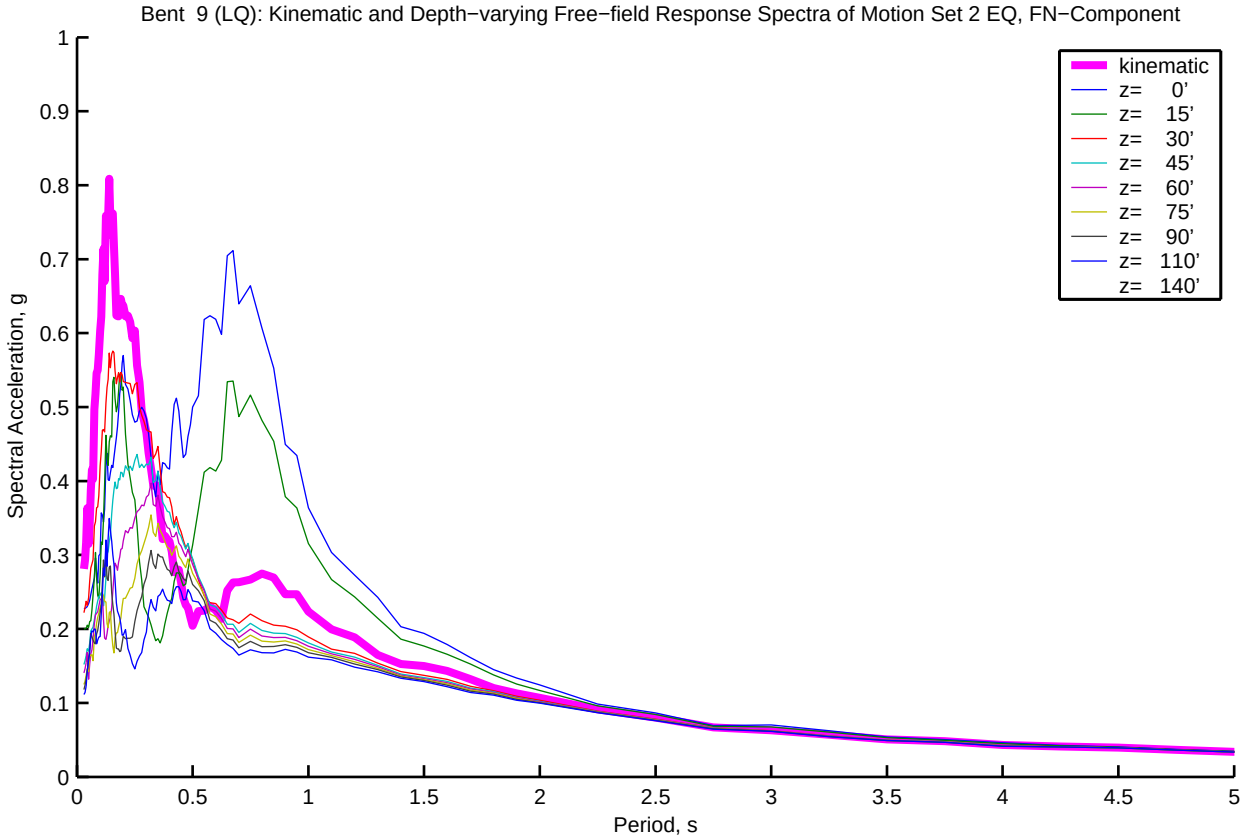

Bent 8 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 153'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

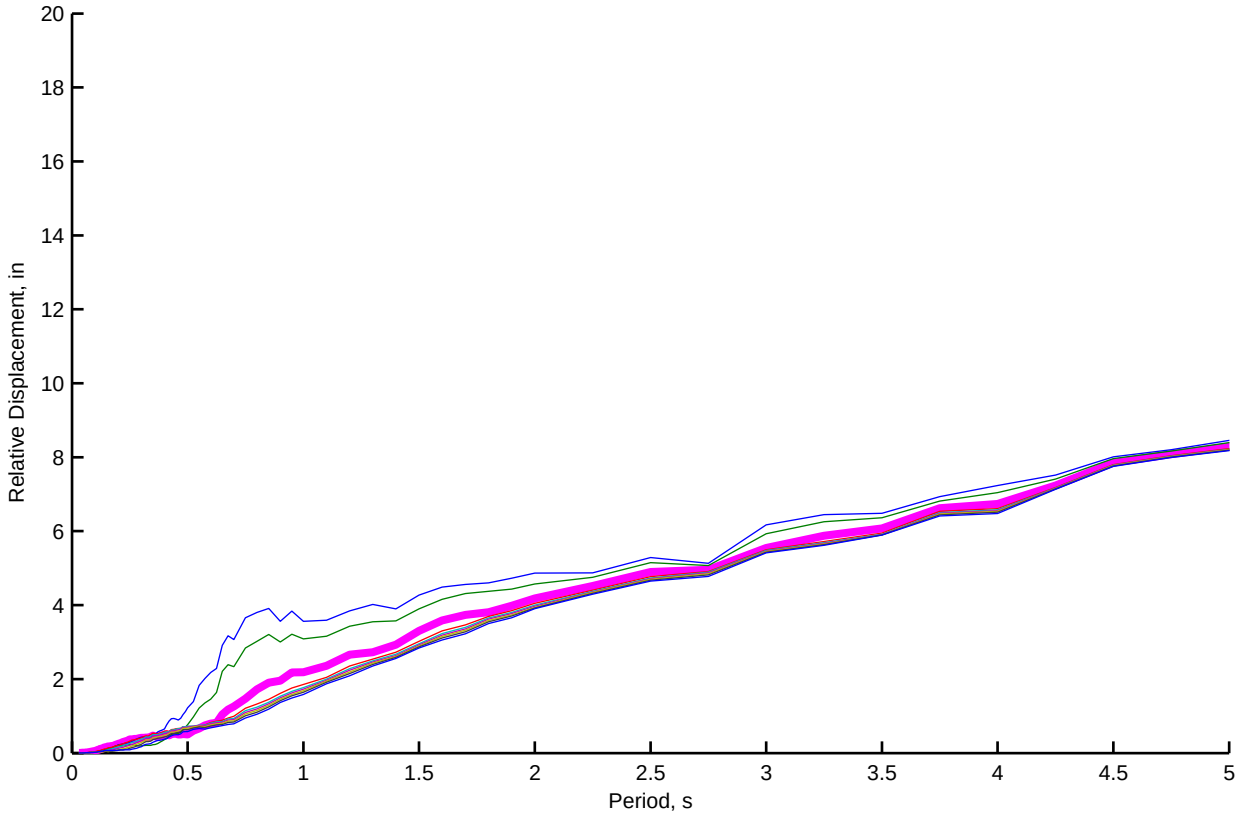

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 9 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

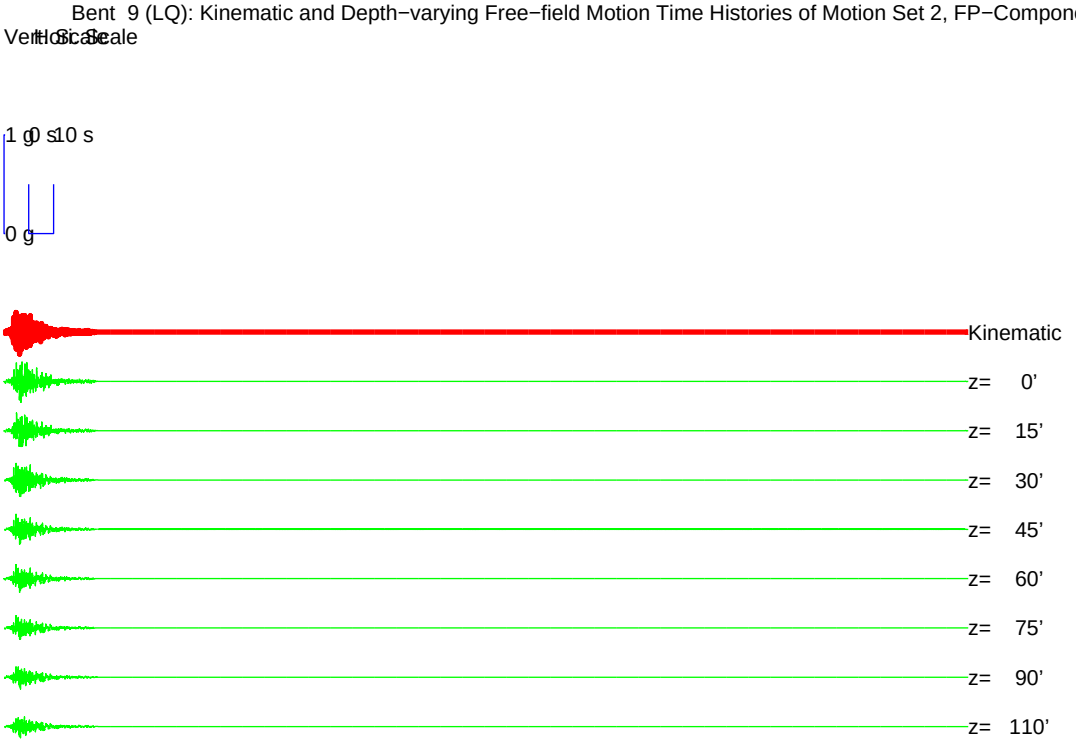


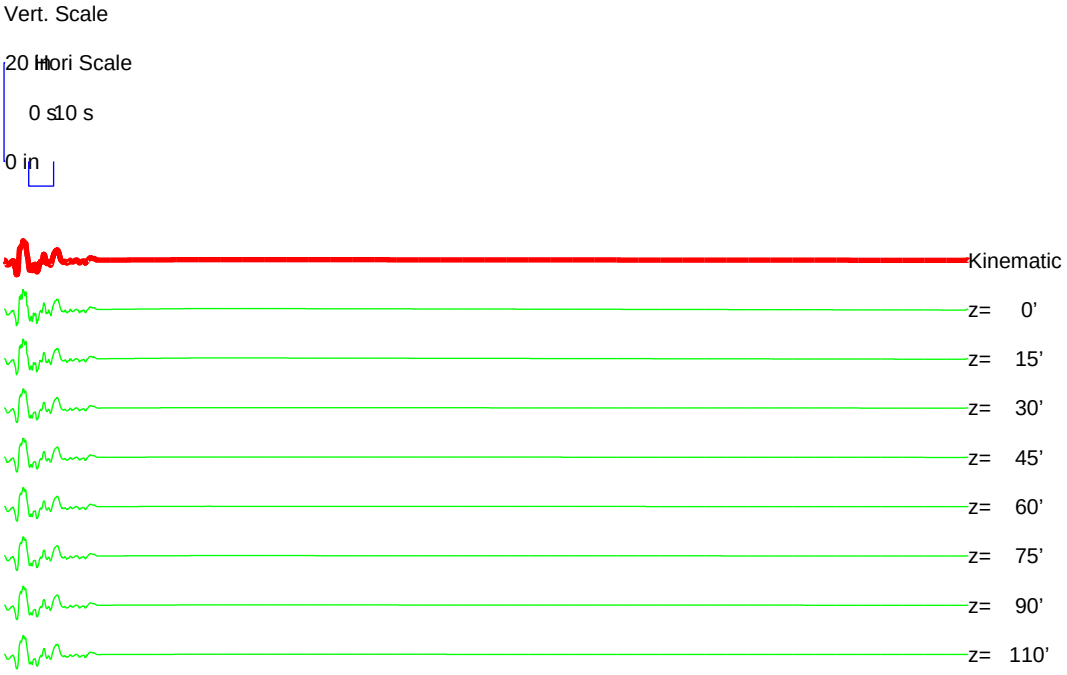


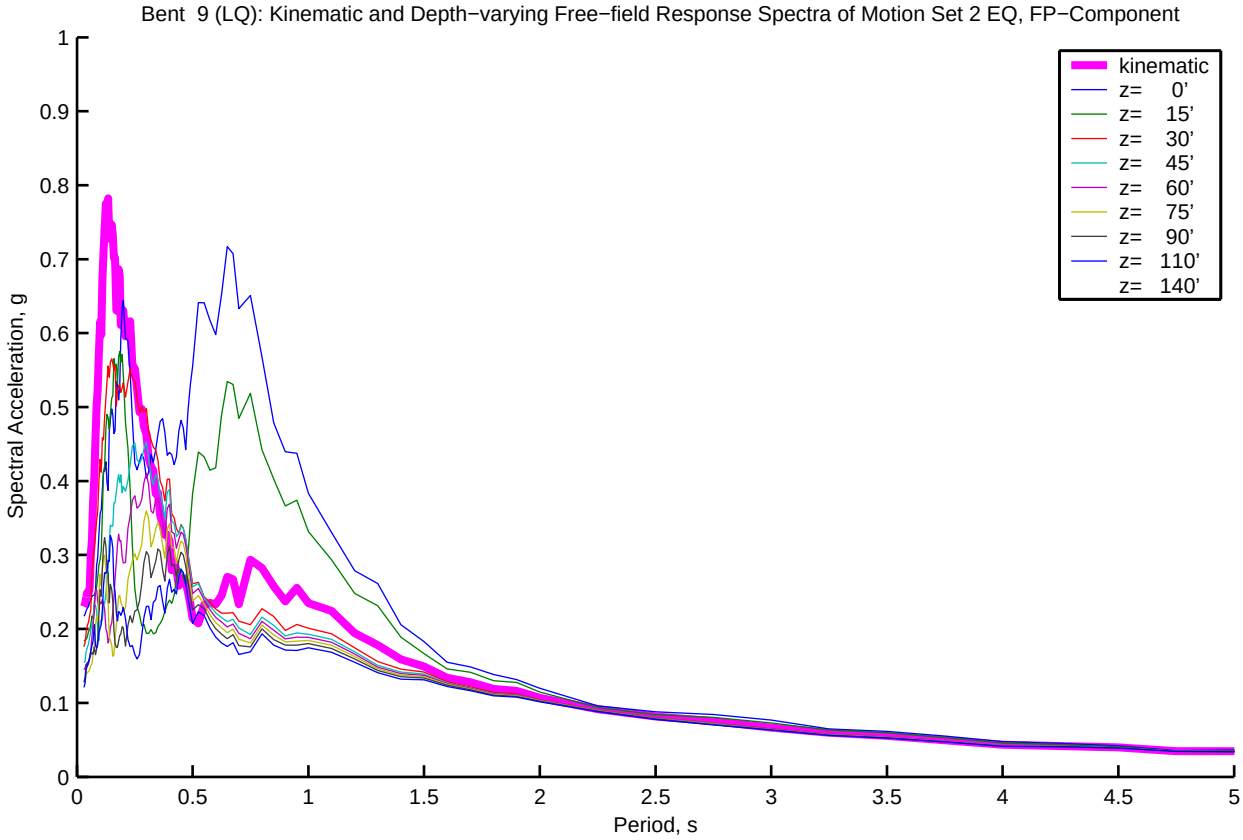

Bent 9 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

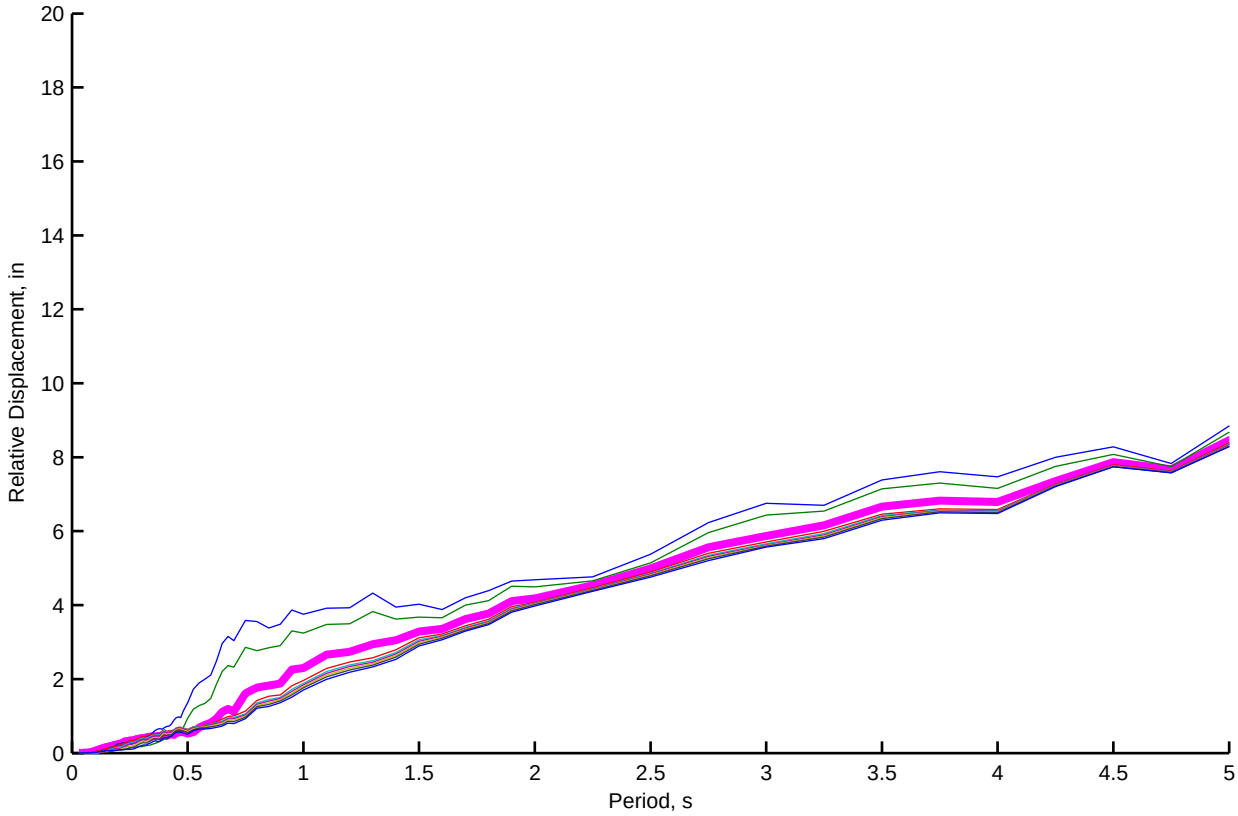

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 9 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

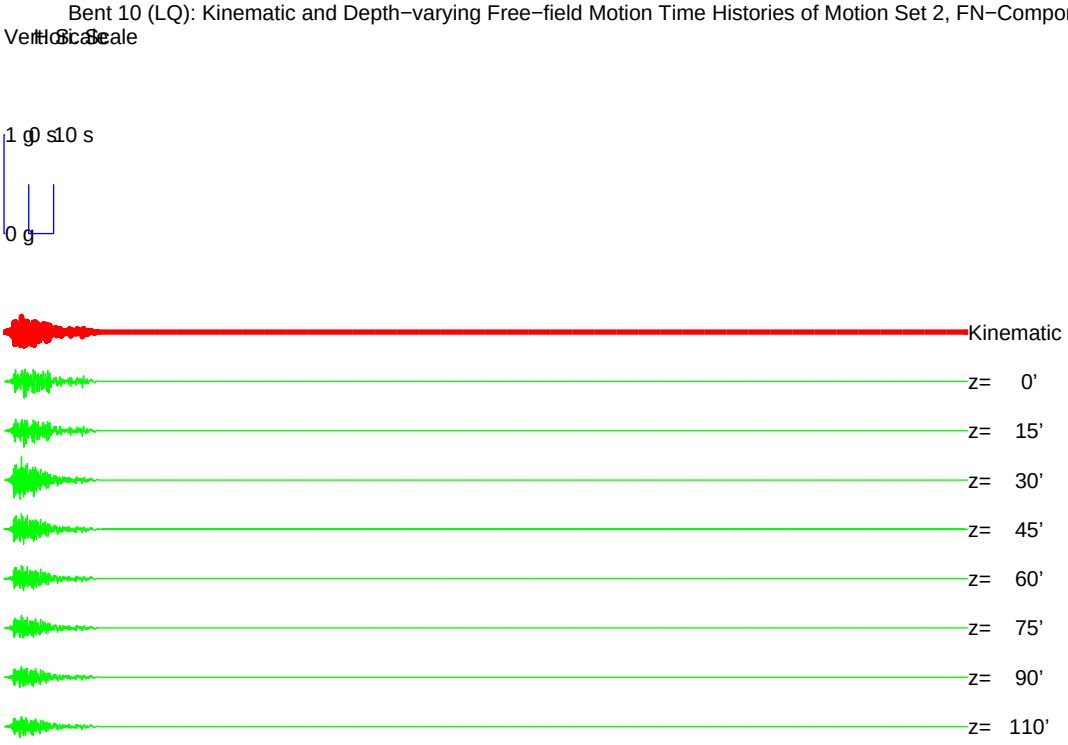


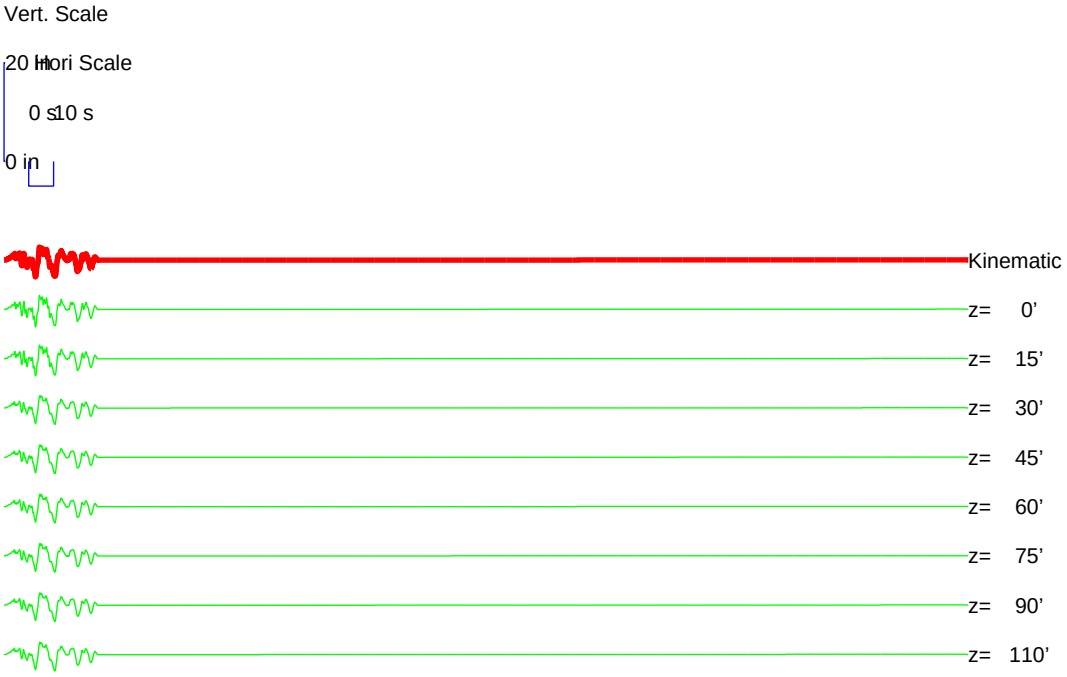


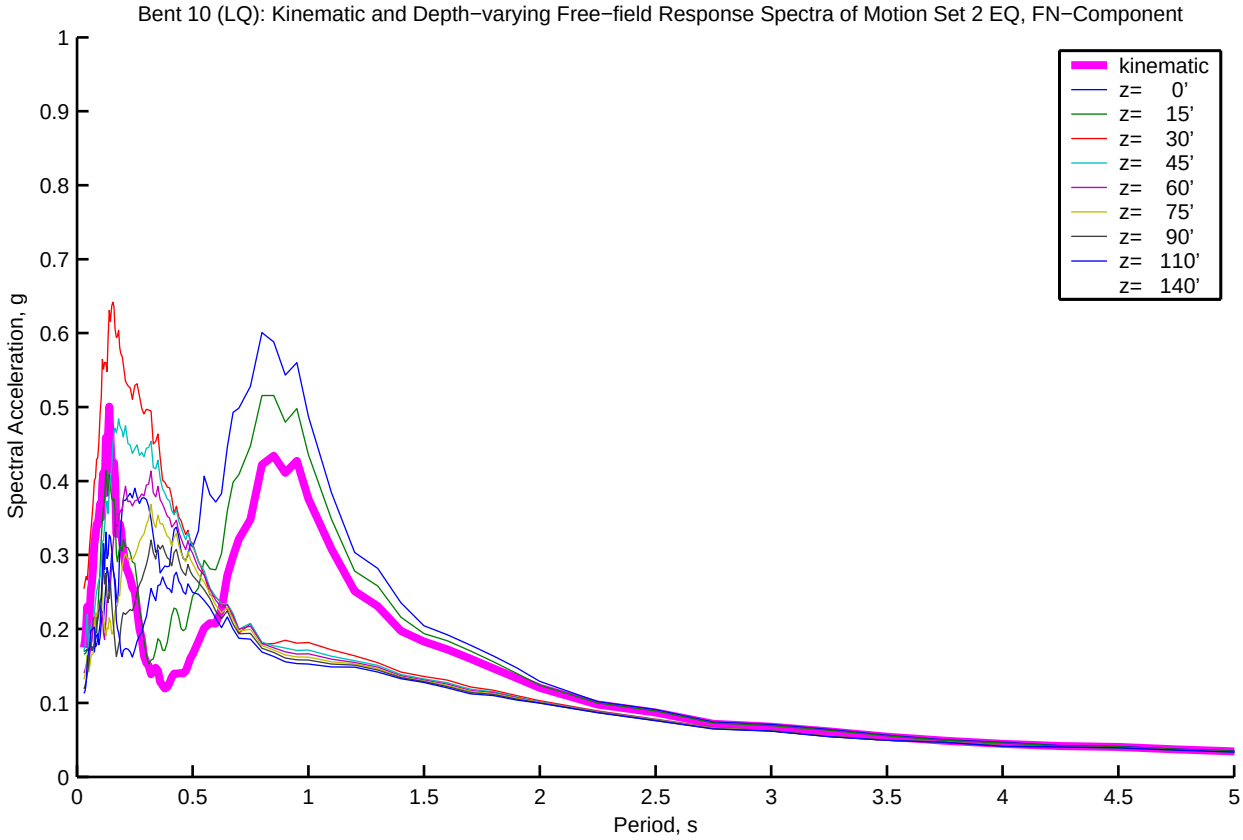

Bent 9 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

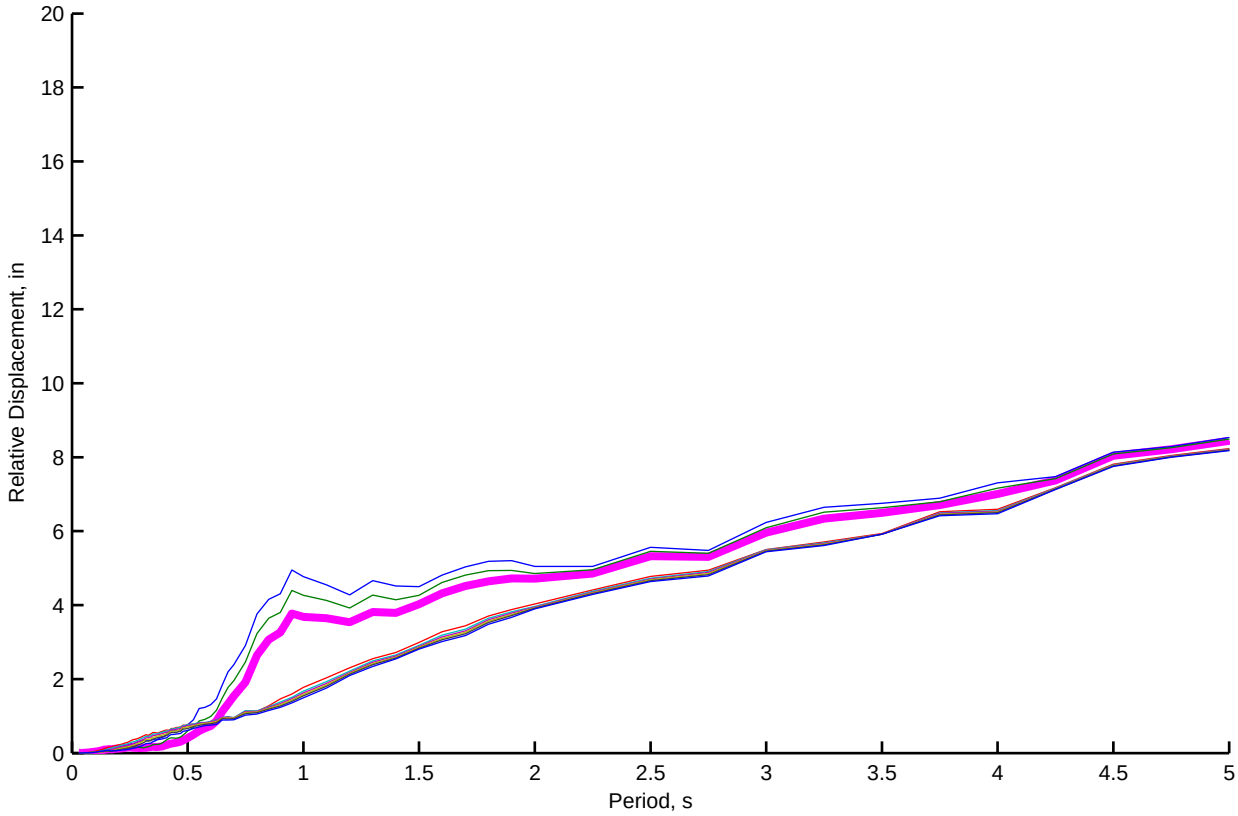

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 10 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FN−Component

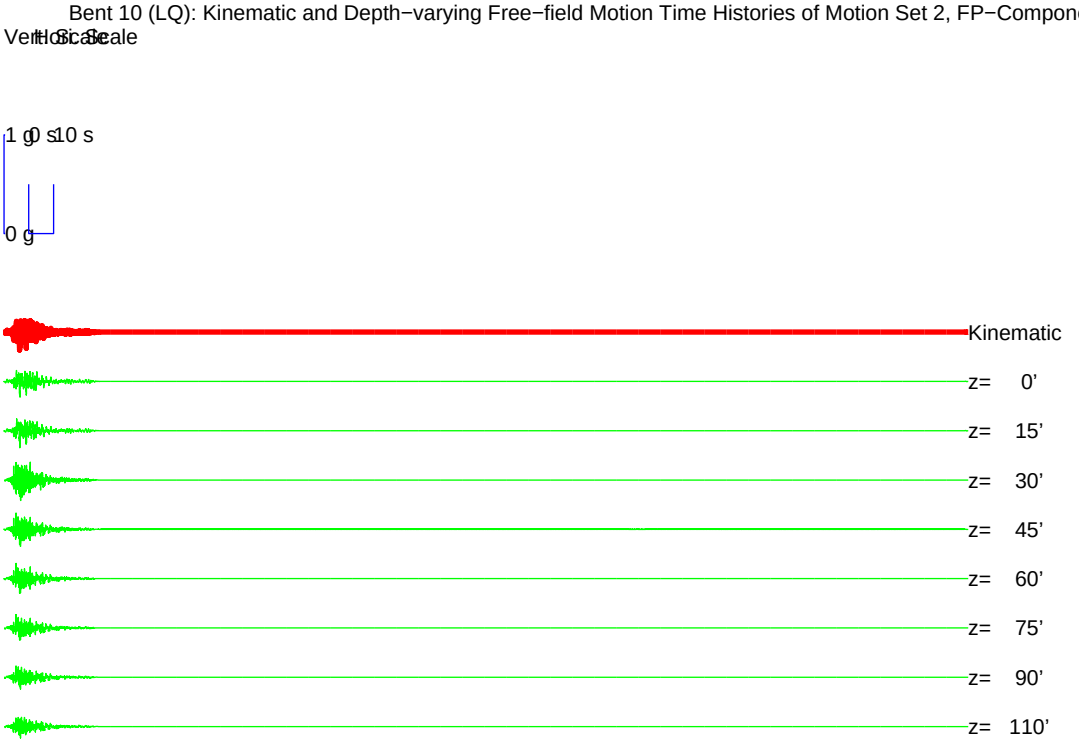


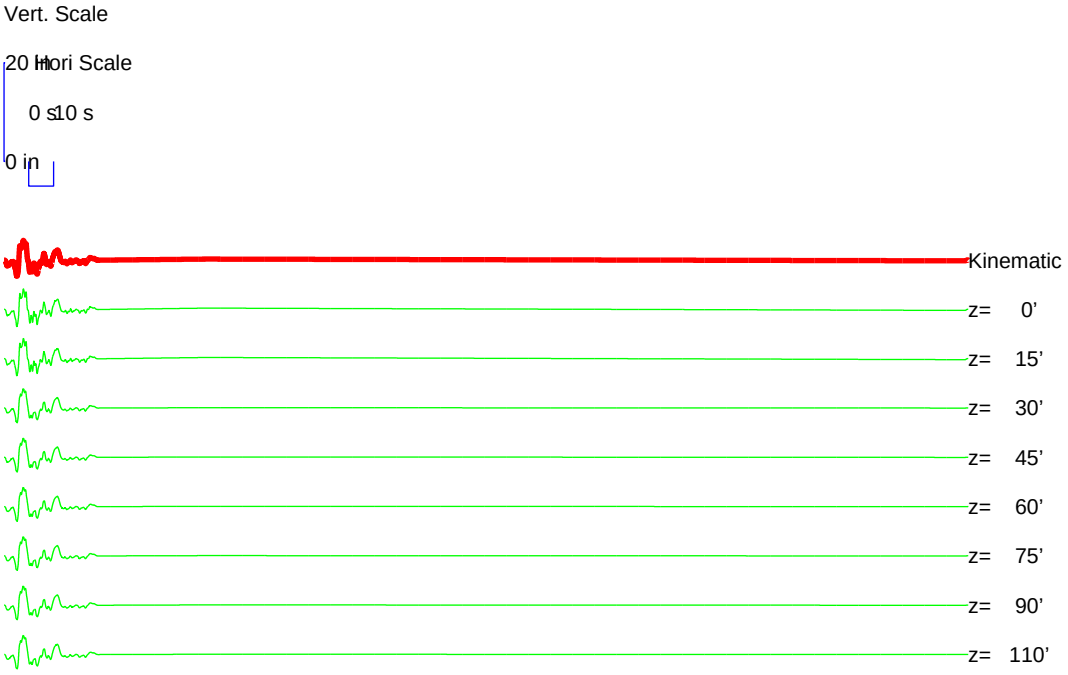


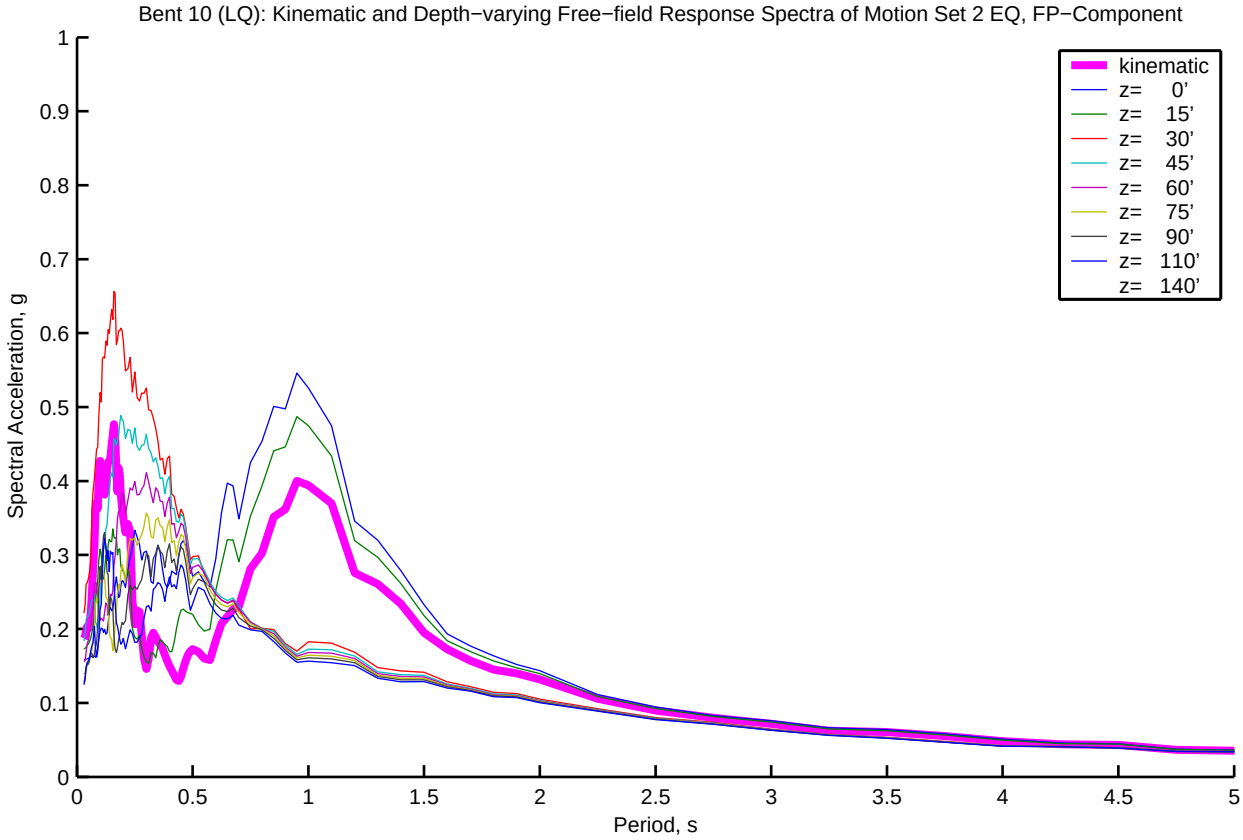

Bent 10 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'

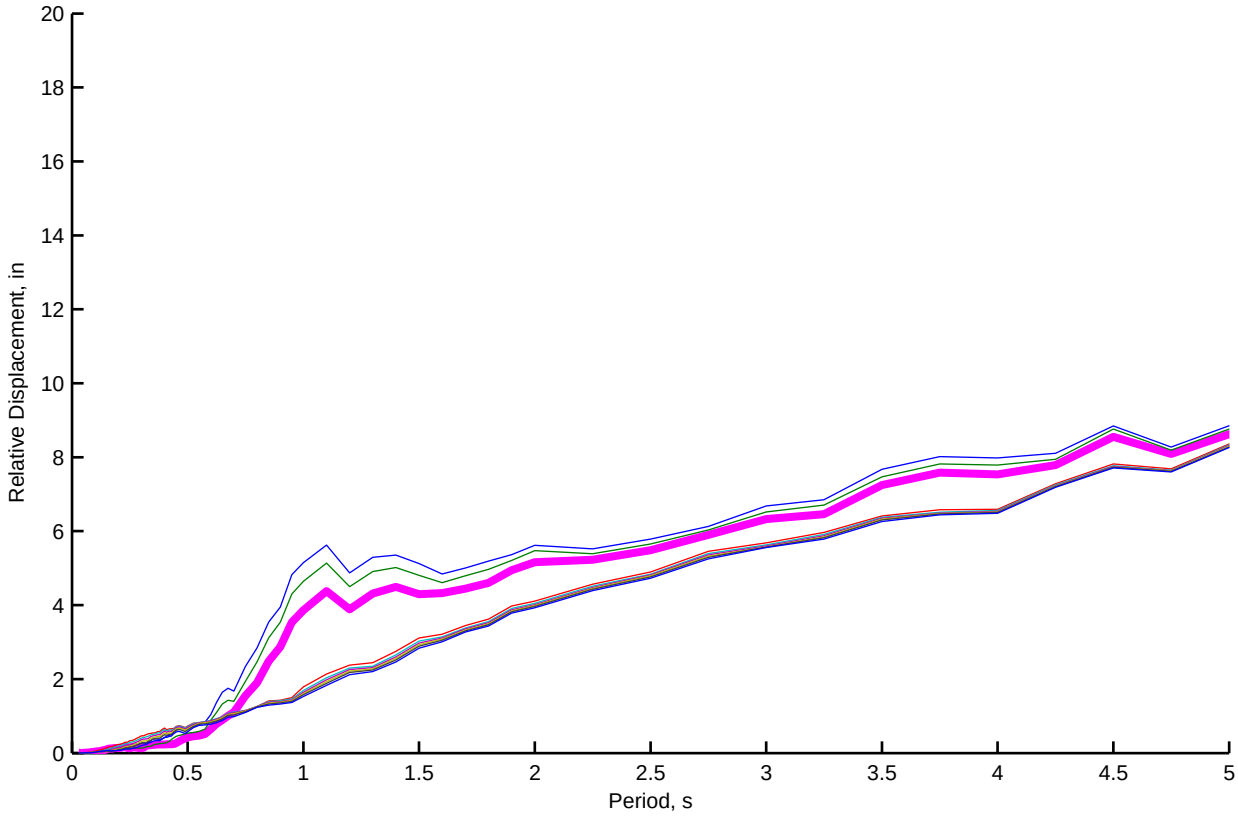

Relative Displacement, in
Period, s

Bent 10 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 2, FP−Component

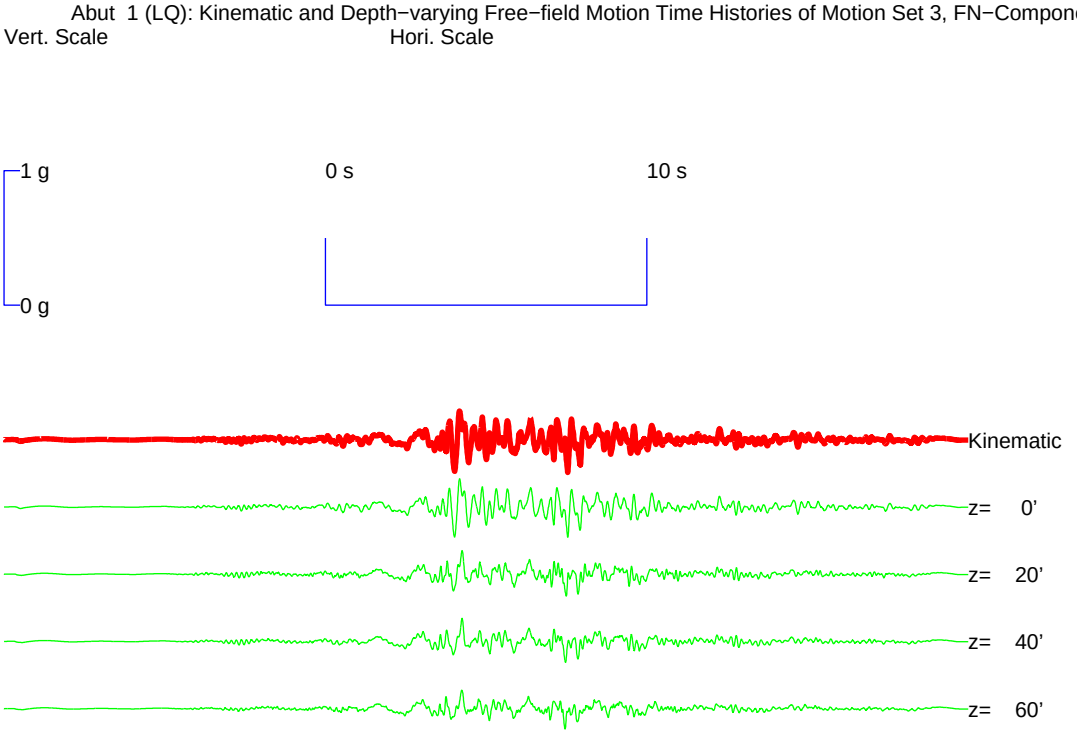


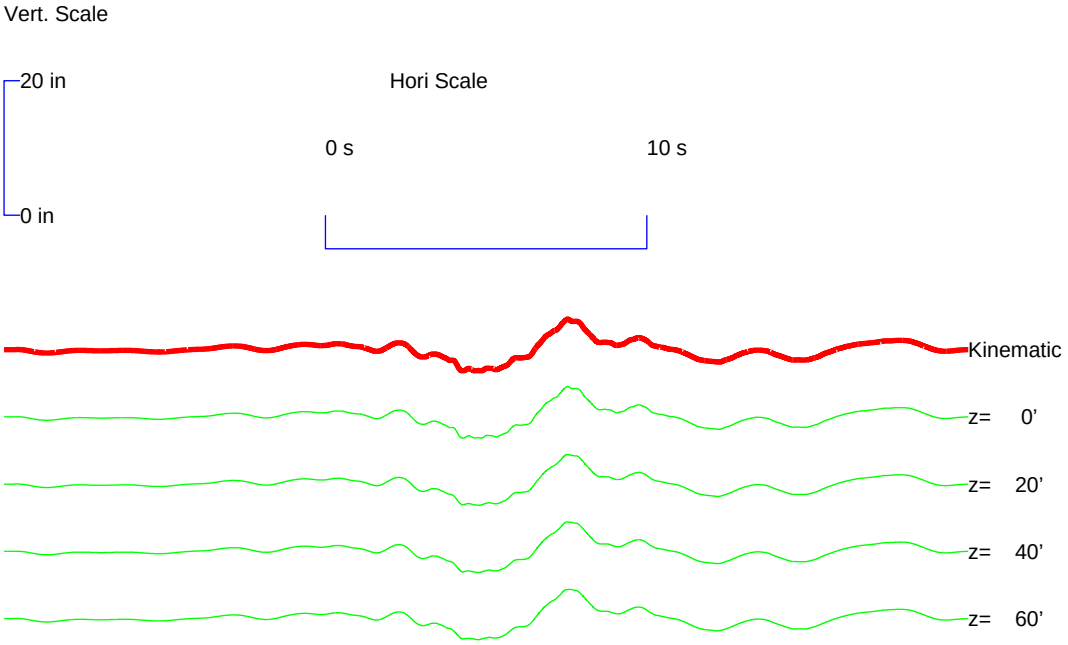


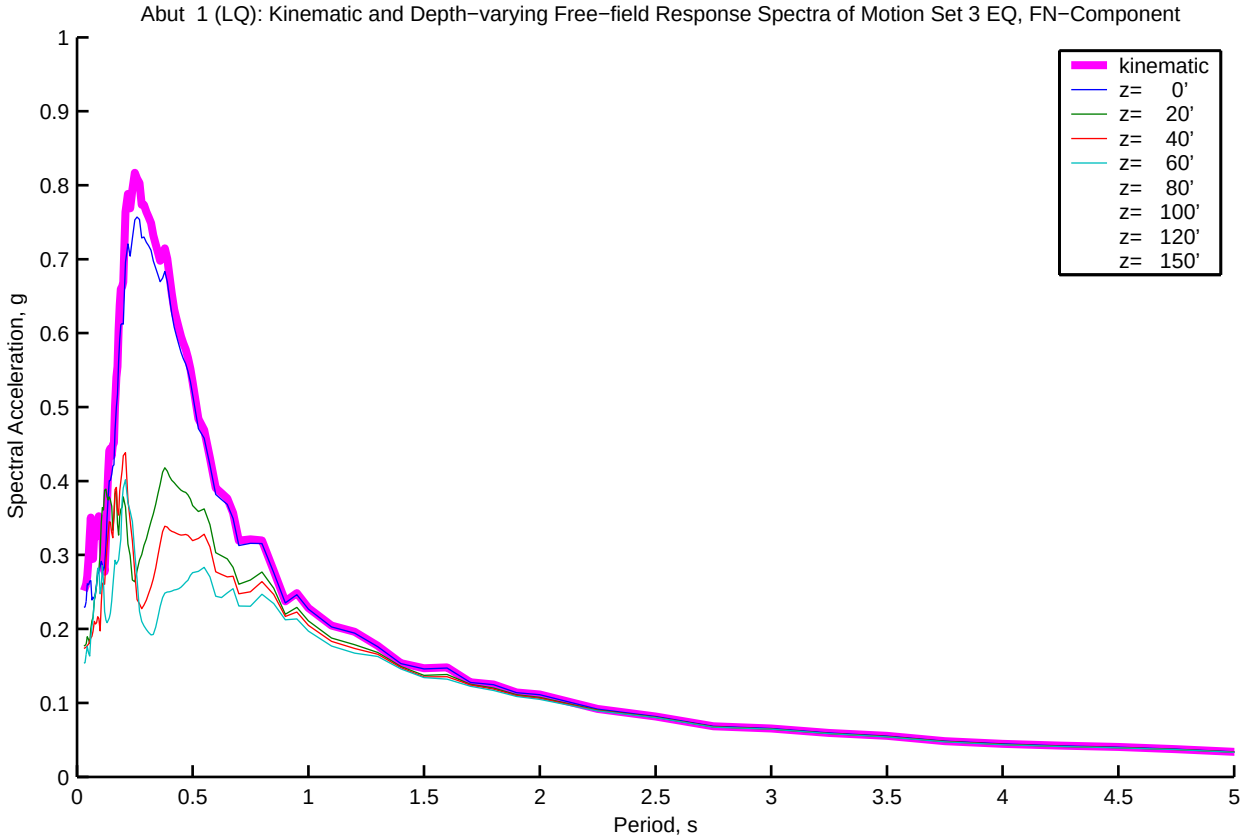

Bent 10 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 2 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'

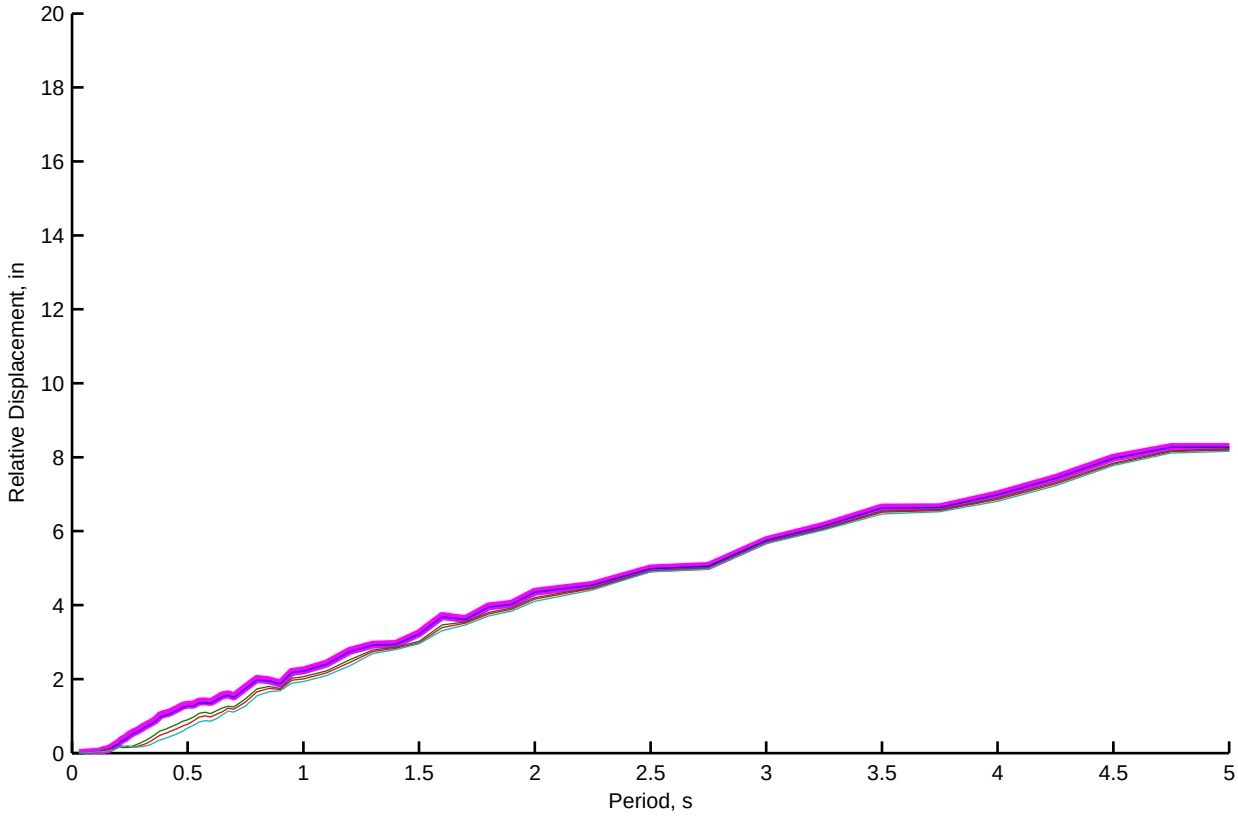

Relative Displacement, in
Period, s

Abut 1 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component

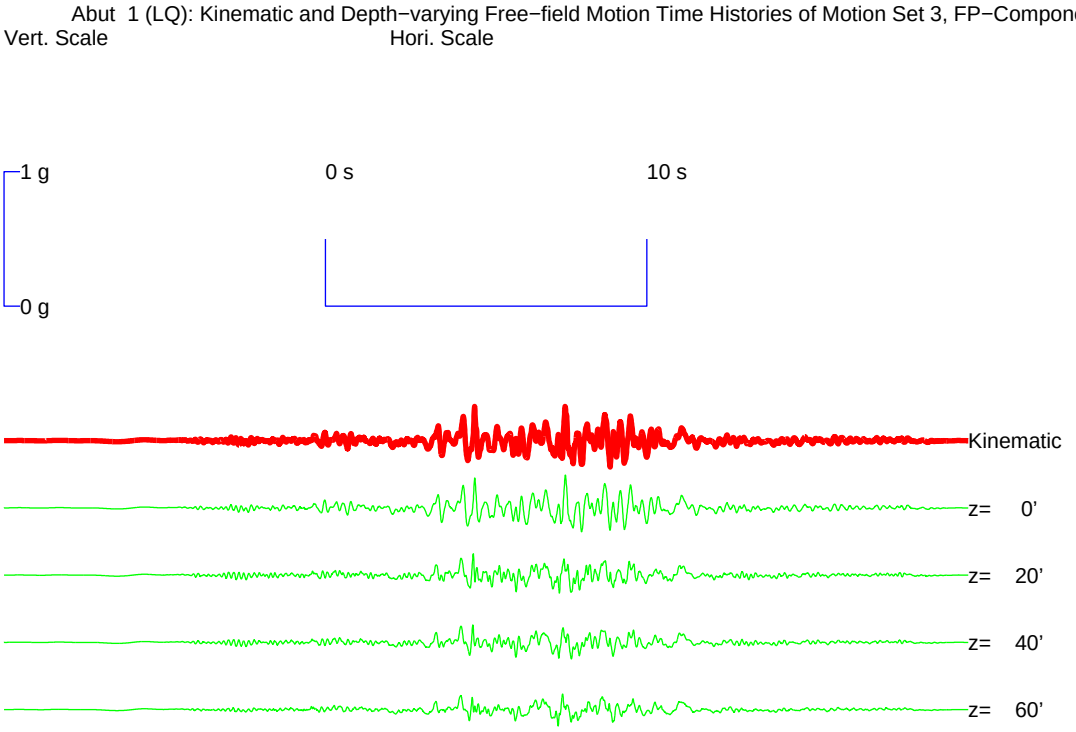


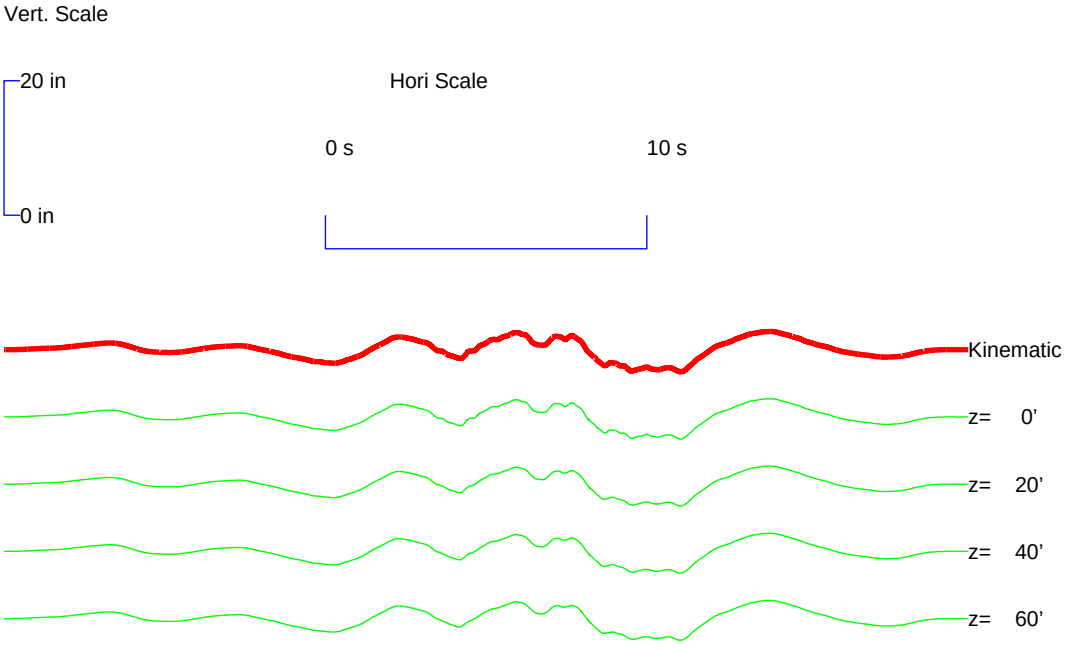


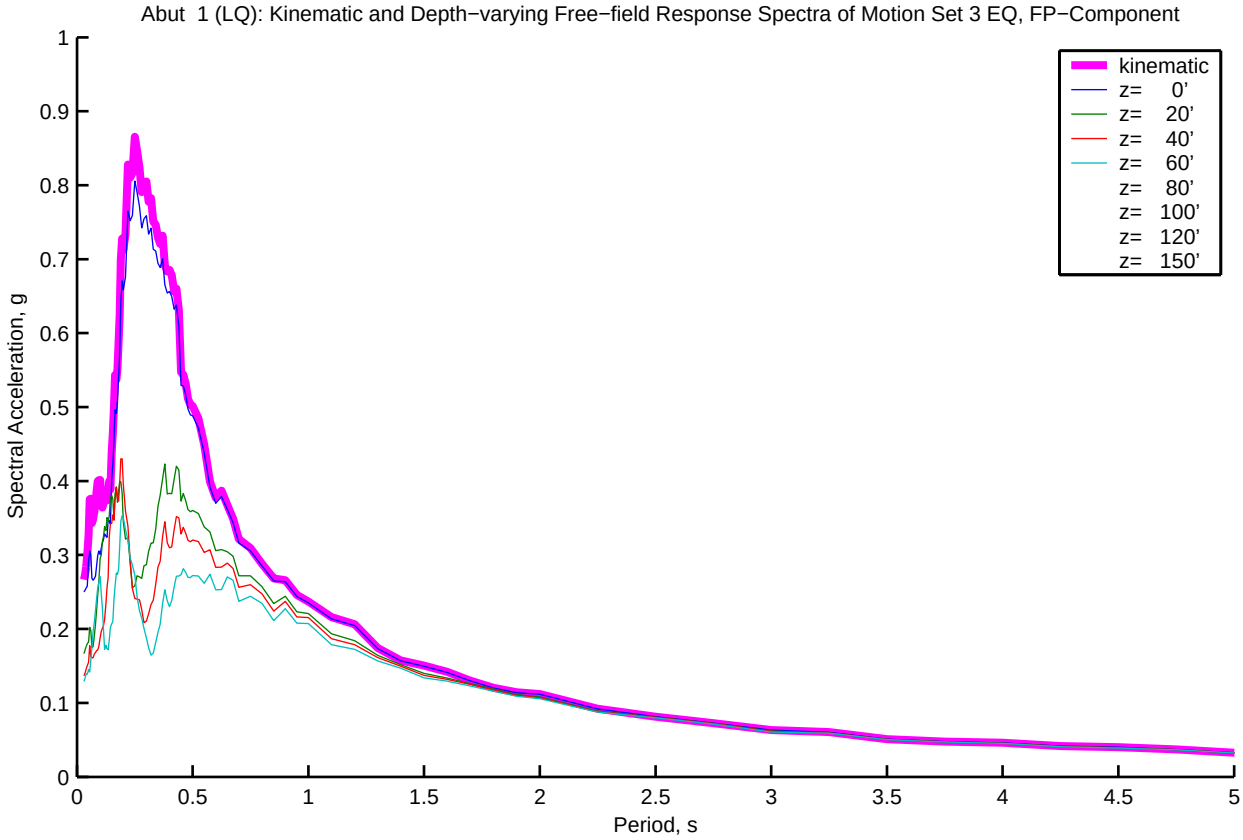

Abut 1 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 150'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

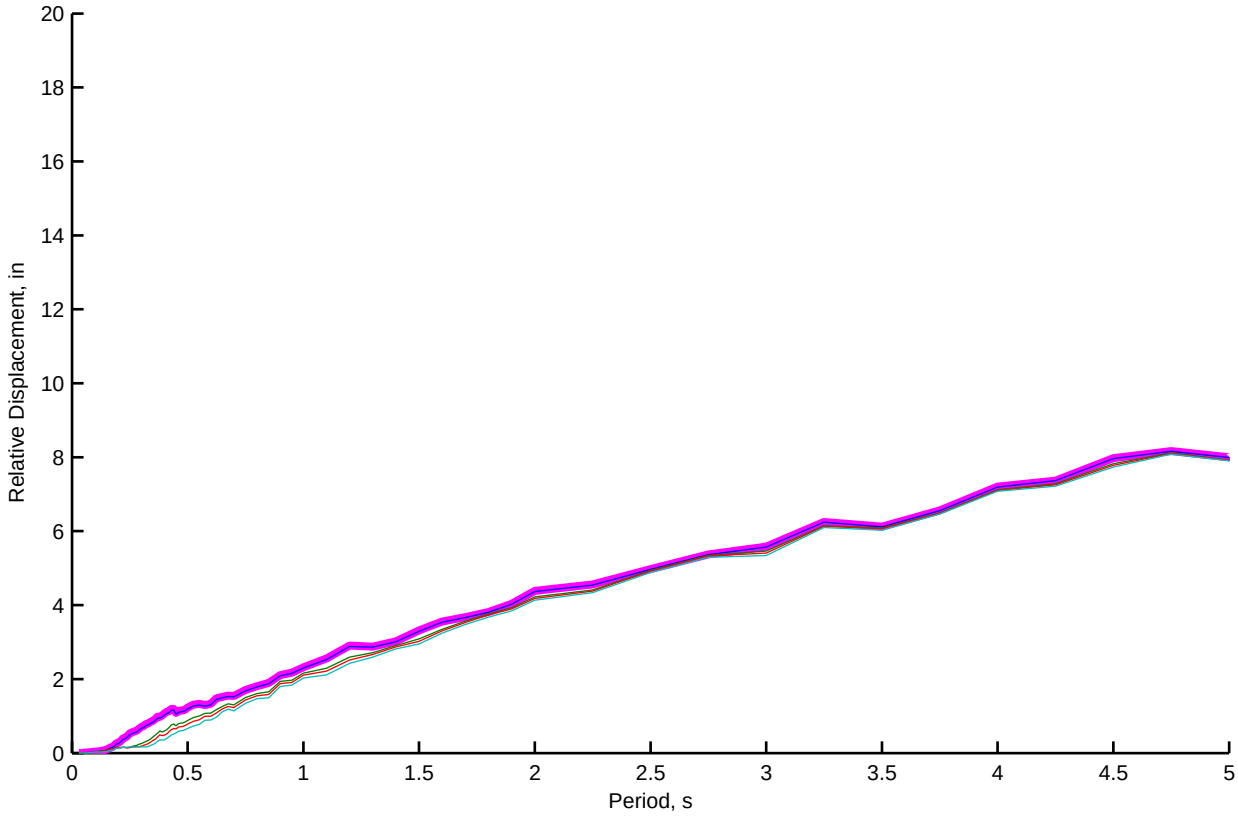

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Abut 1 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component

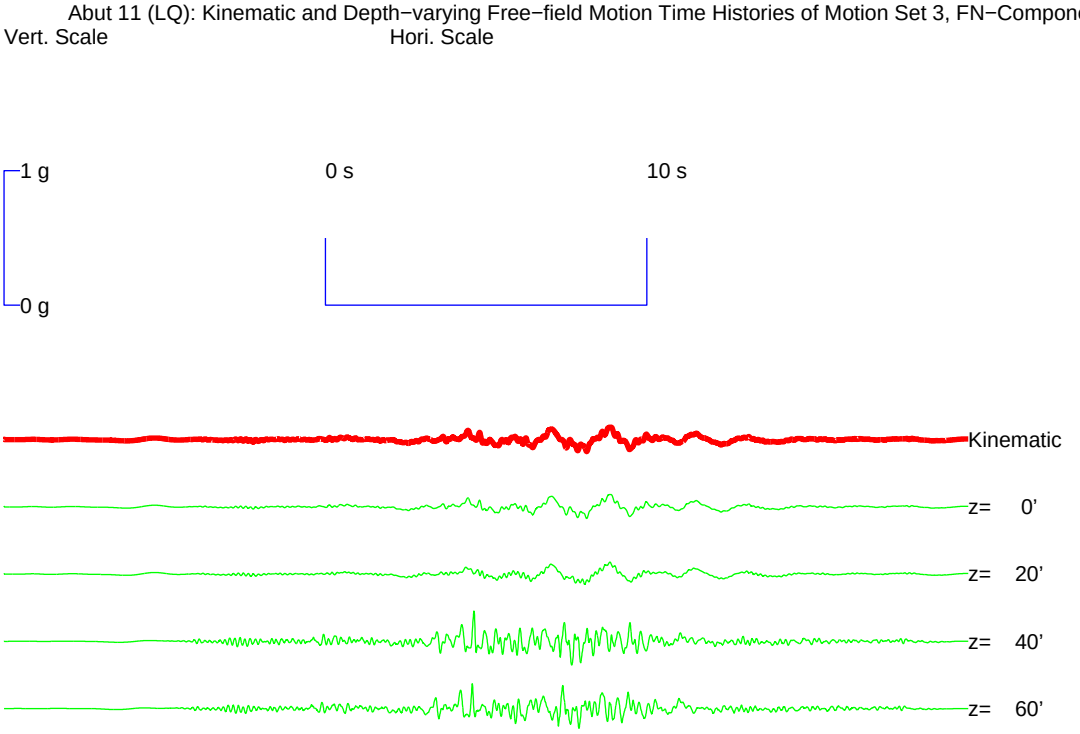


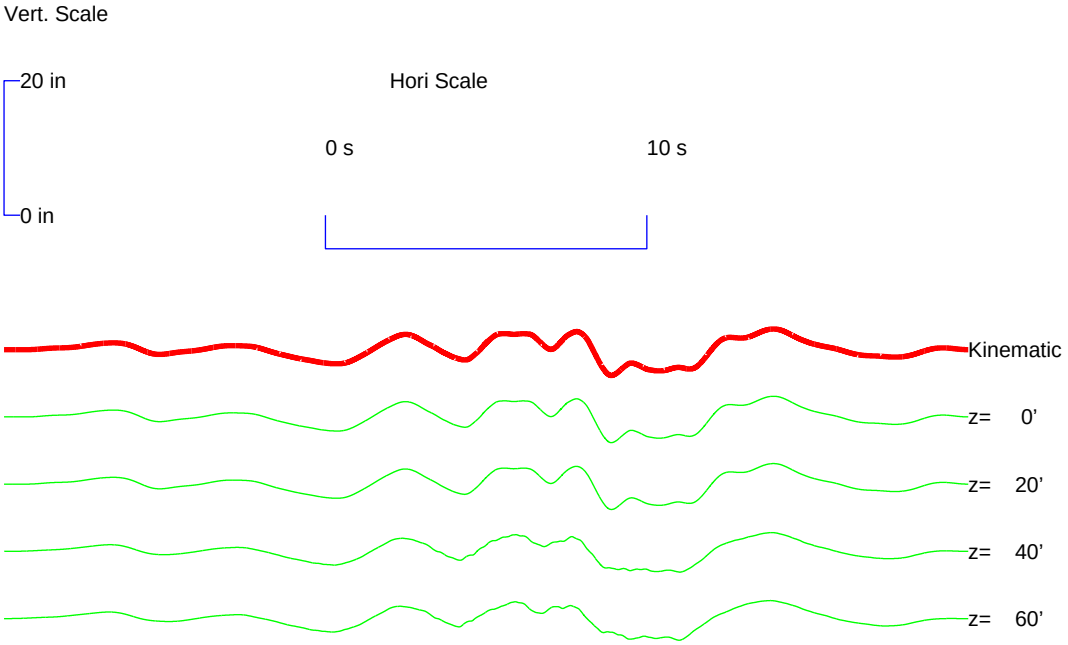


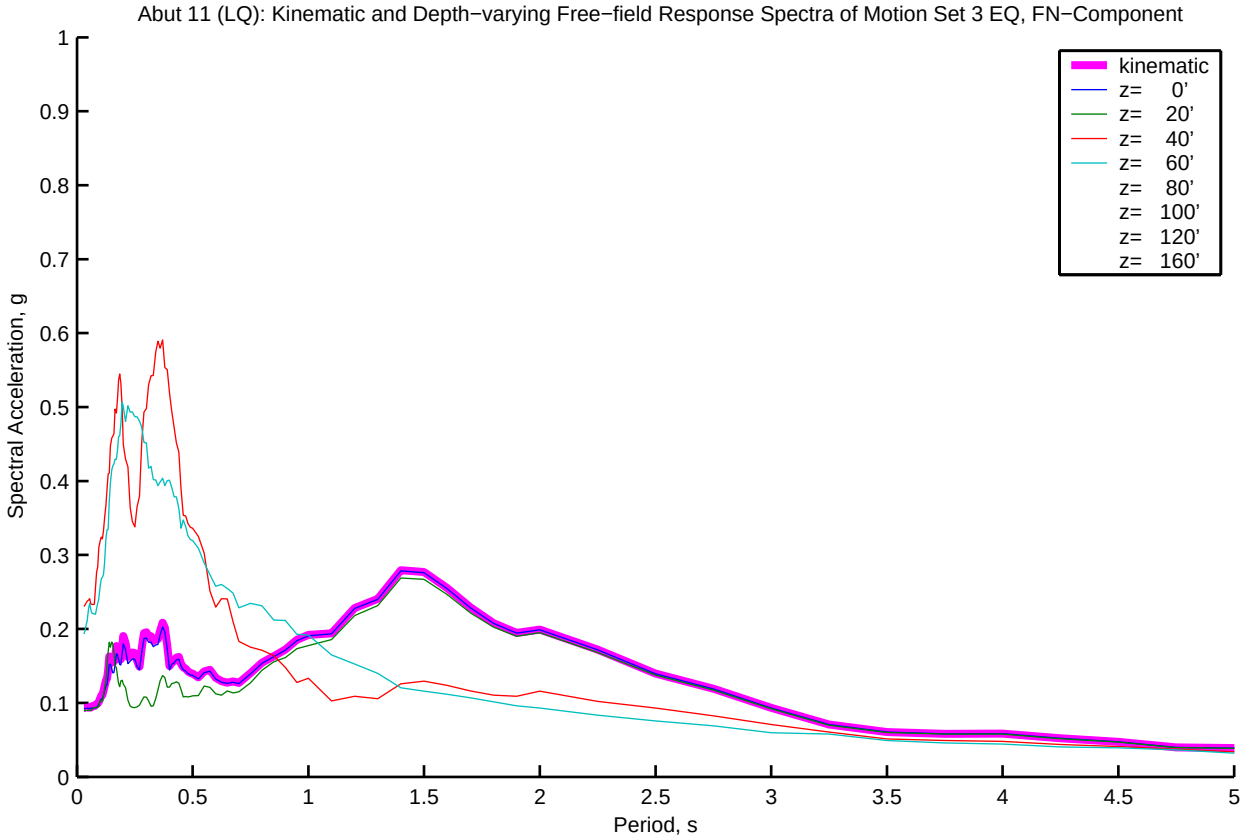

Abut 1 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 150'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

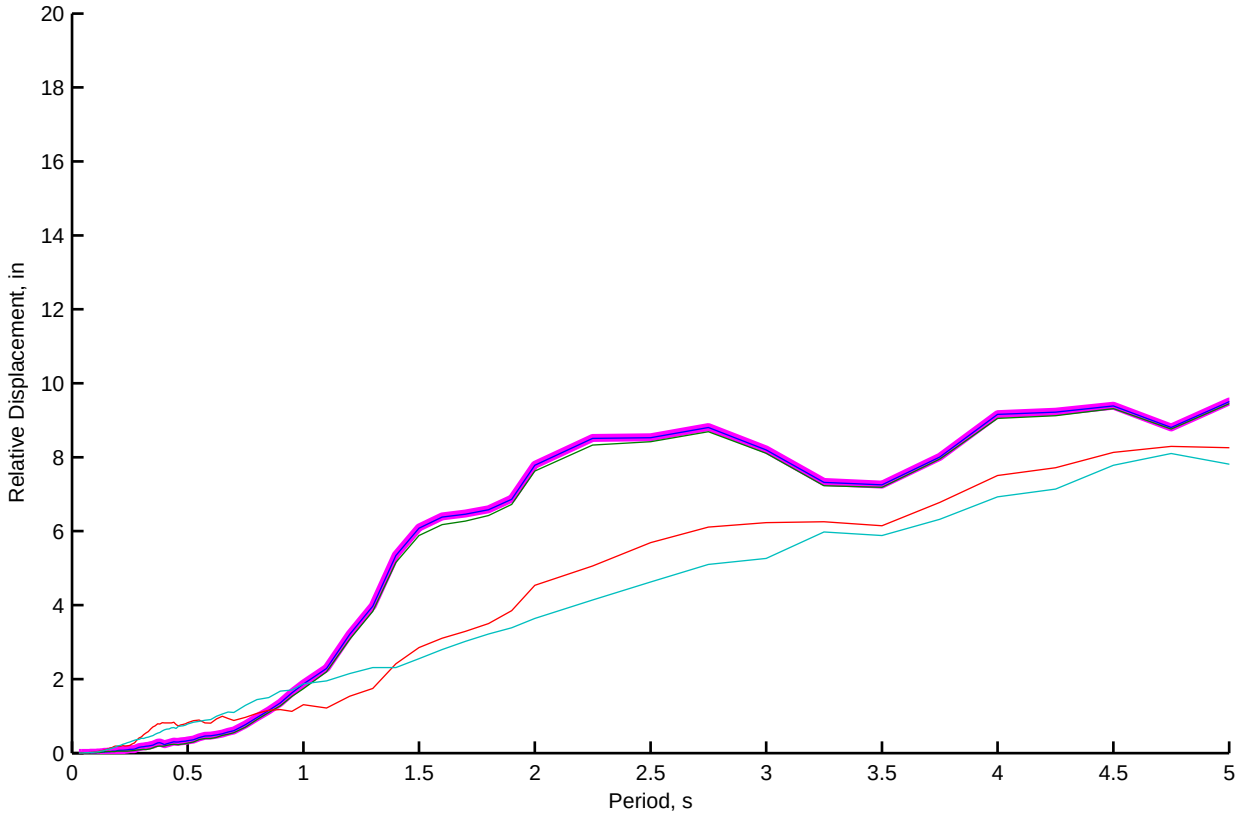

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Abut 11 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component

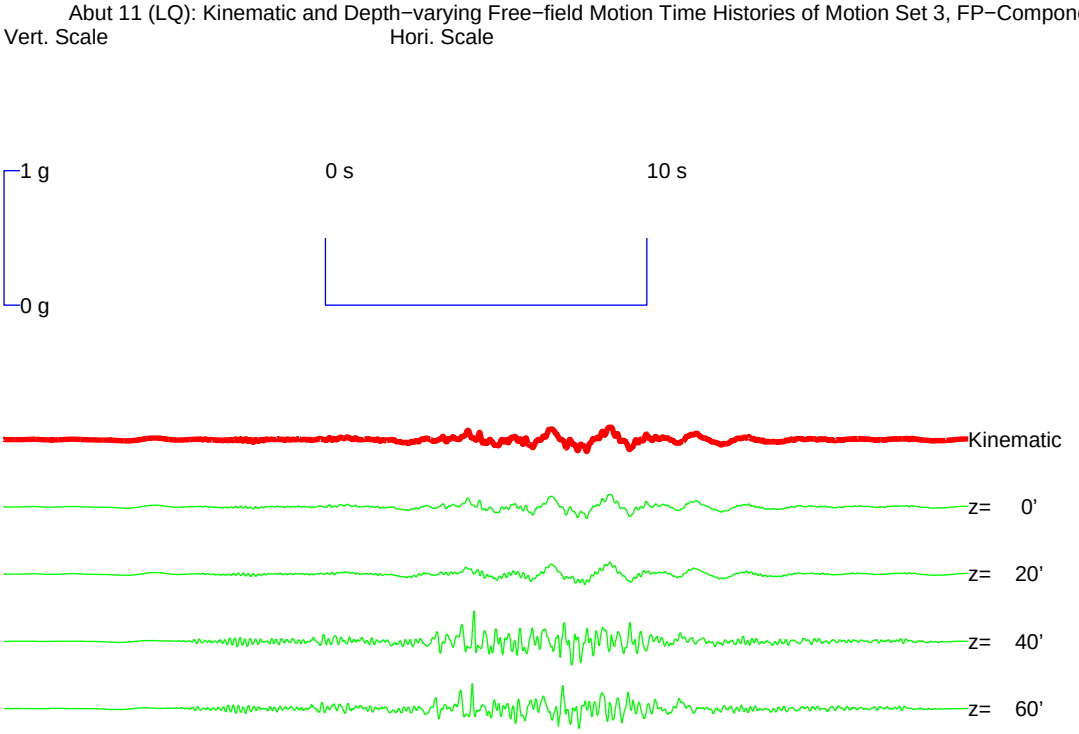


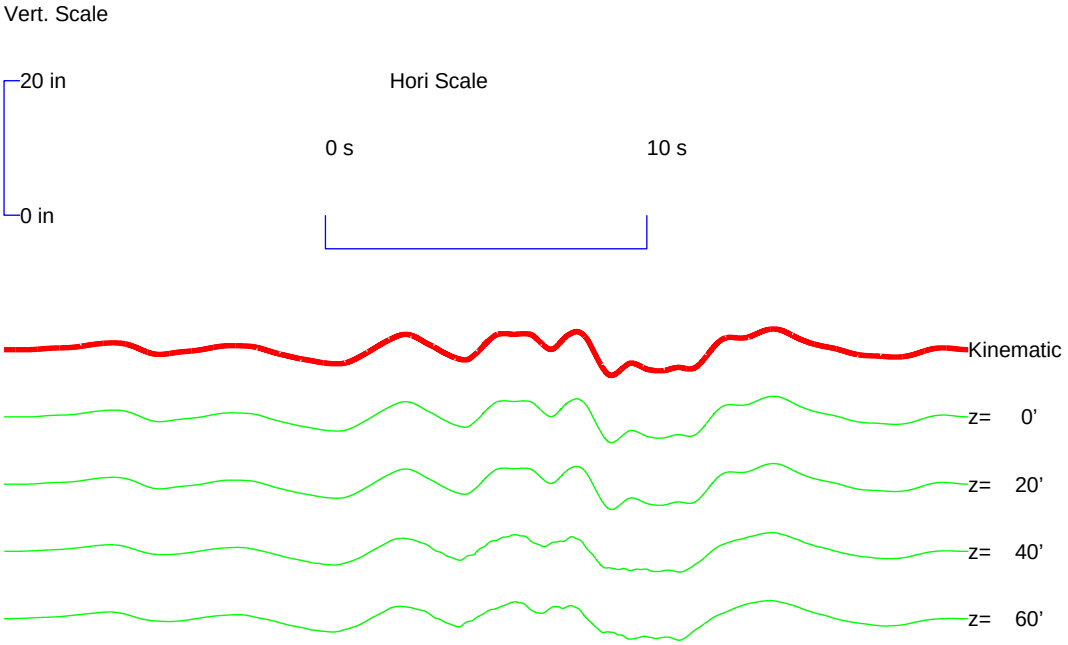


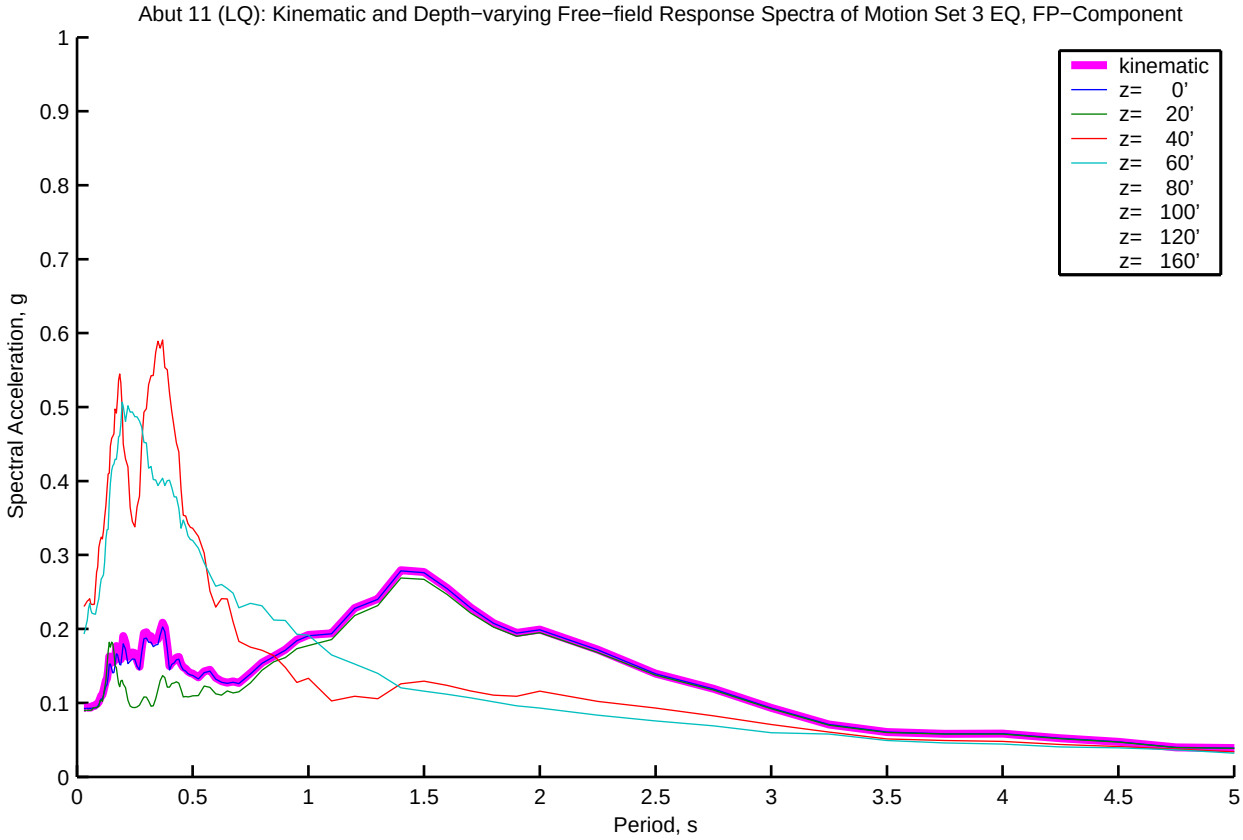

Abut 11 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 160'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5

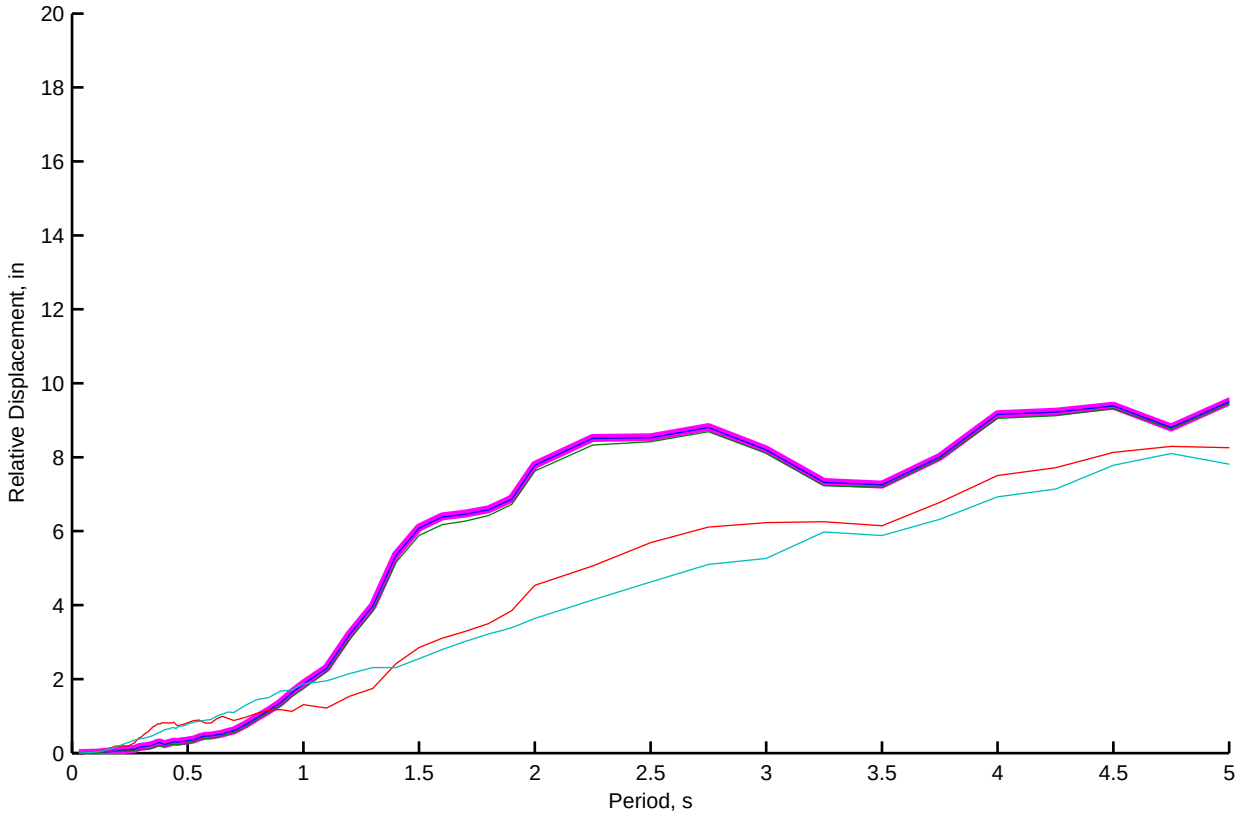

Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Abut 11 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component

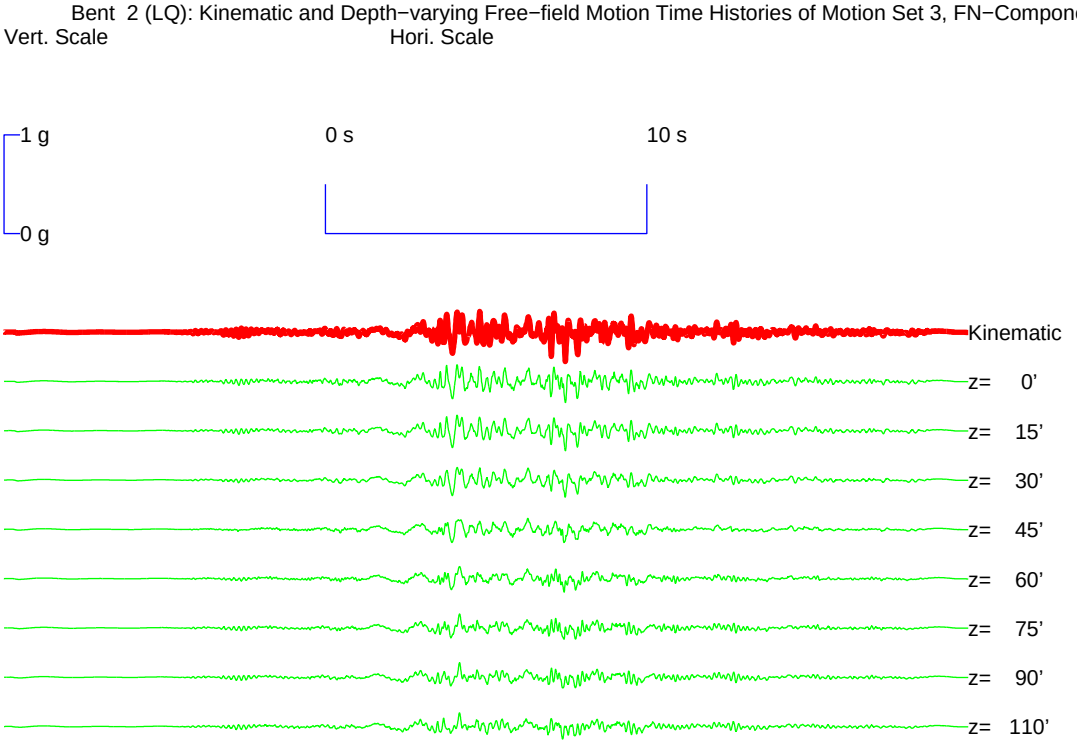


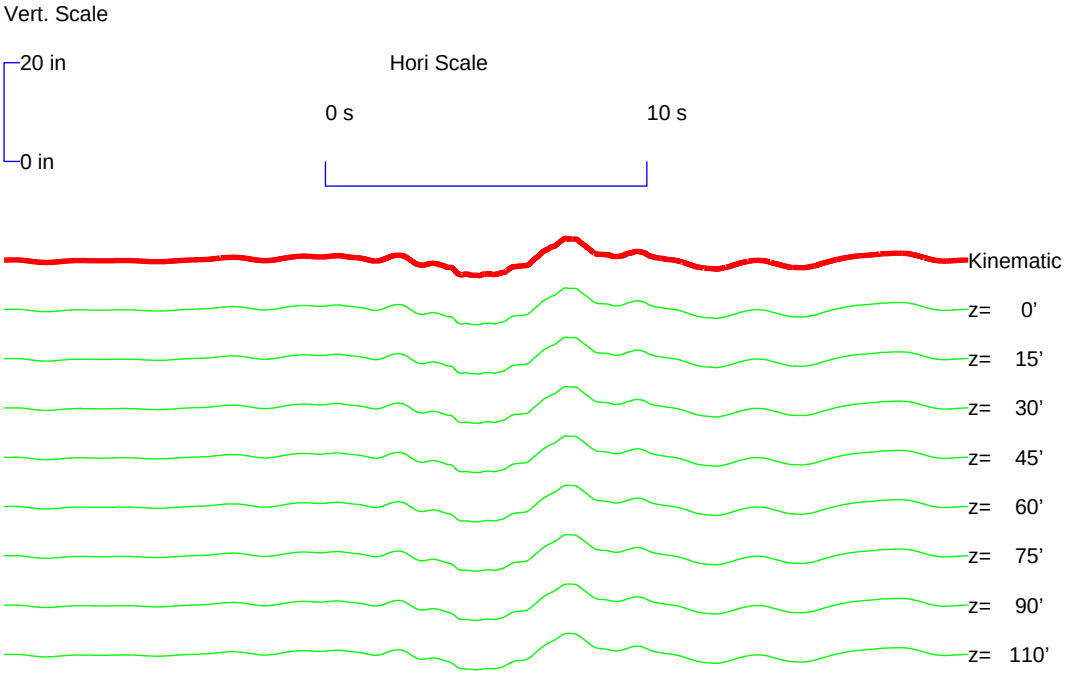


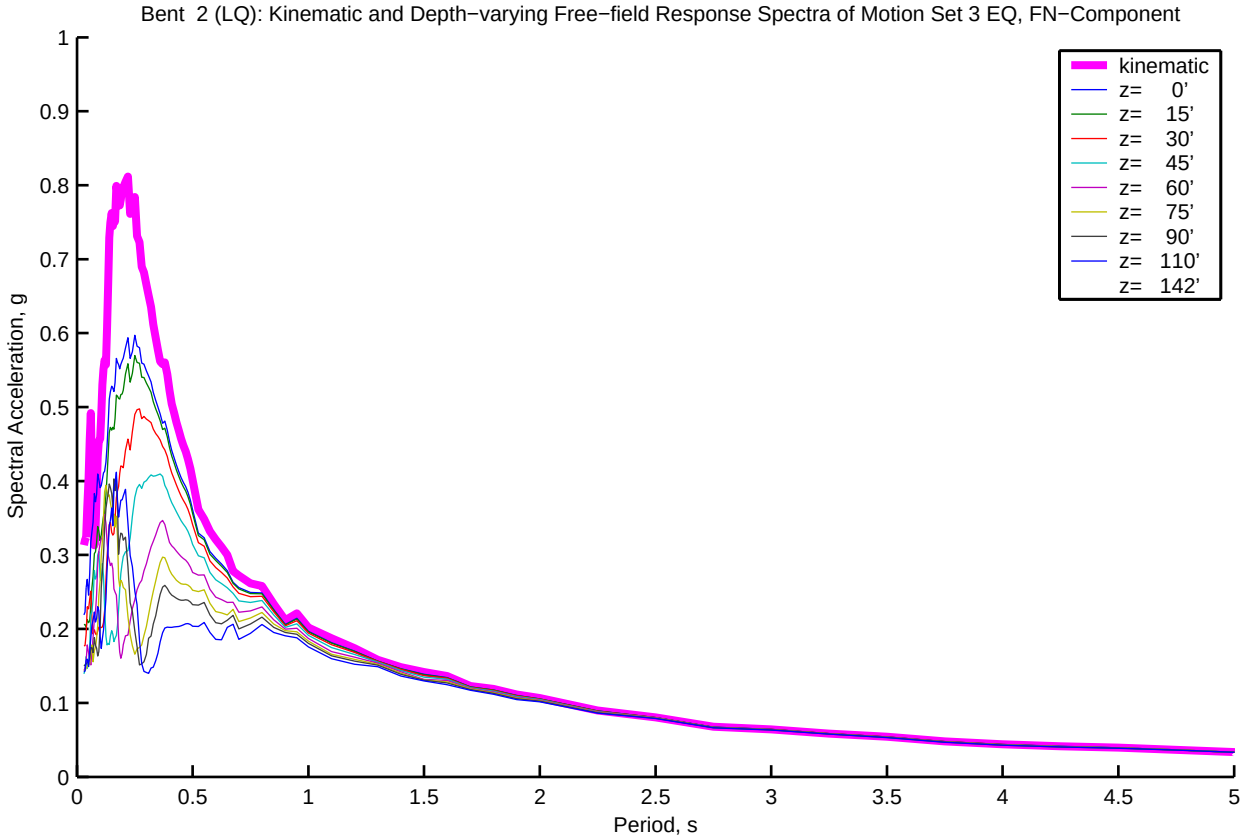

Abut 11 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
kinematic
z= 0'
z= 20'
z= 40'
z= 60'
z= 80'
z= 100'
z= 120'
z= 160'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5


Relative Displacement, in
Period, s
0
2
4
6
8
10
12
14
16
18
20
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Bent 2 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component






Bent 2 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 142'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
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1.5
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4
4.5
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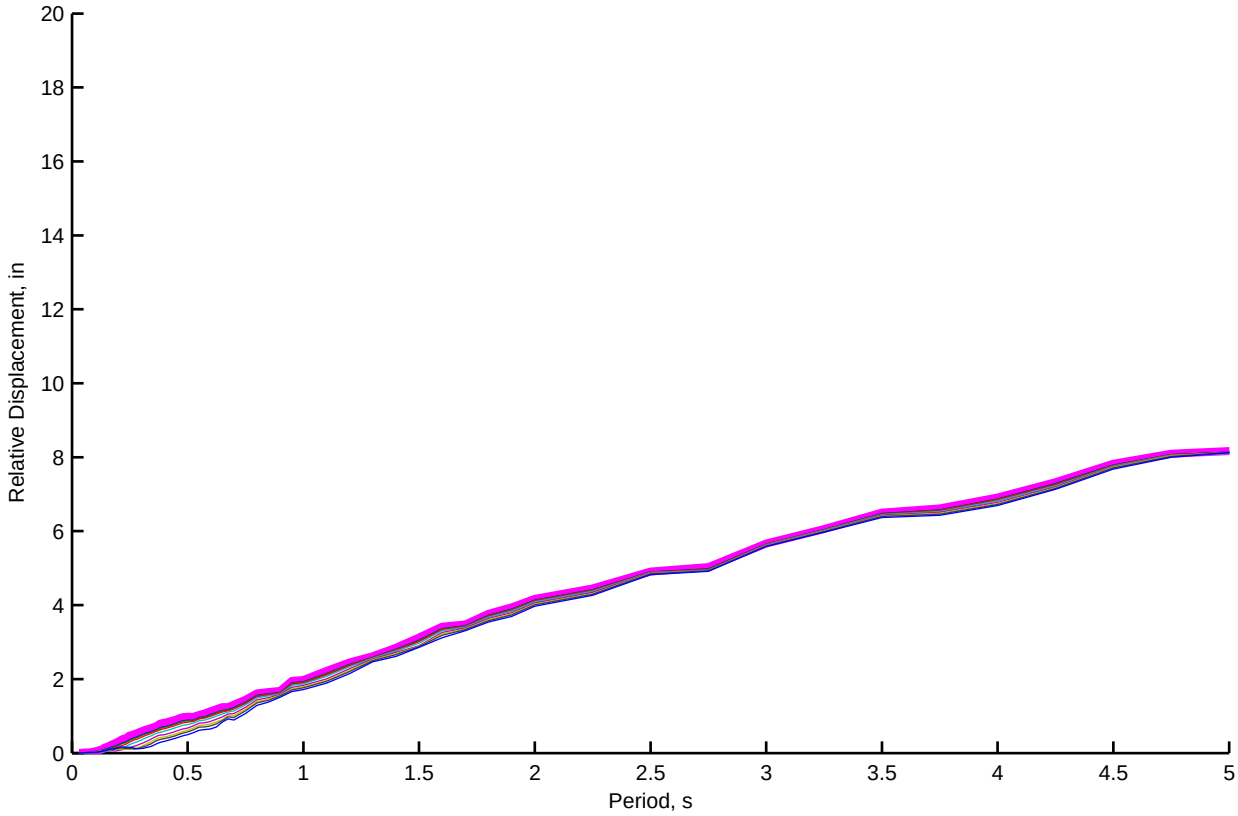
Relative Displacement, in
Period, s
0
2
4
6
8
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14
16
18
20
0.5
1
1.5
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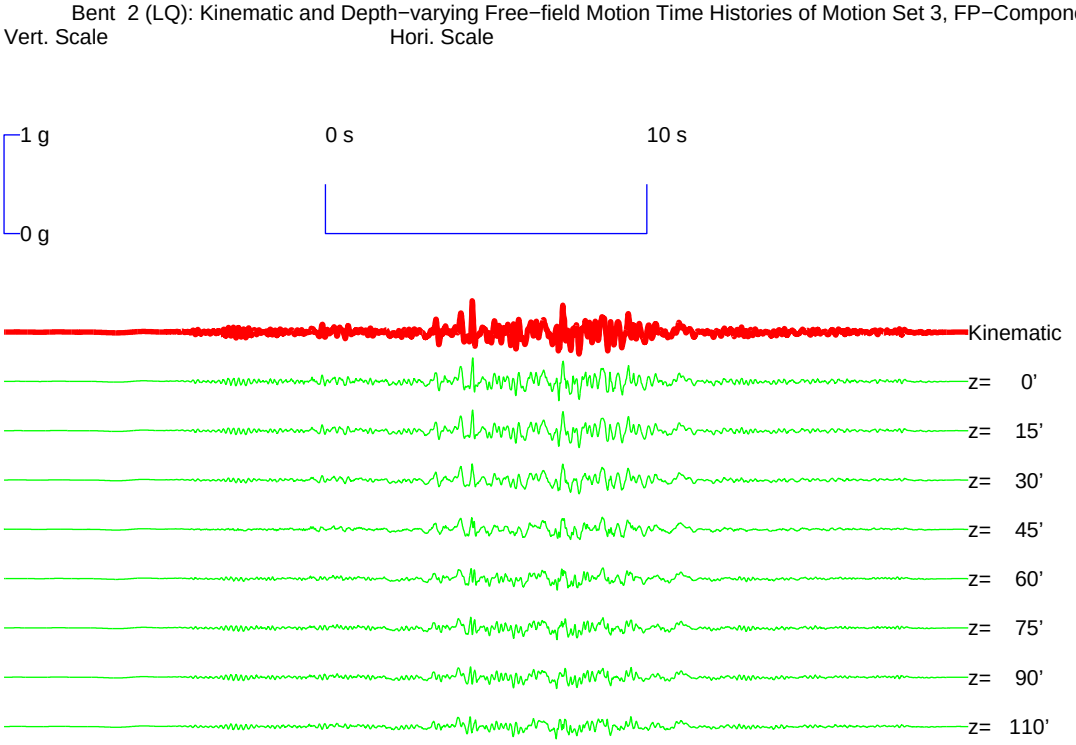
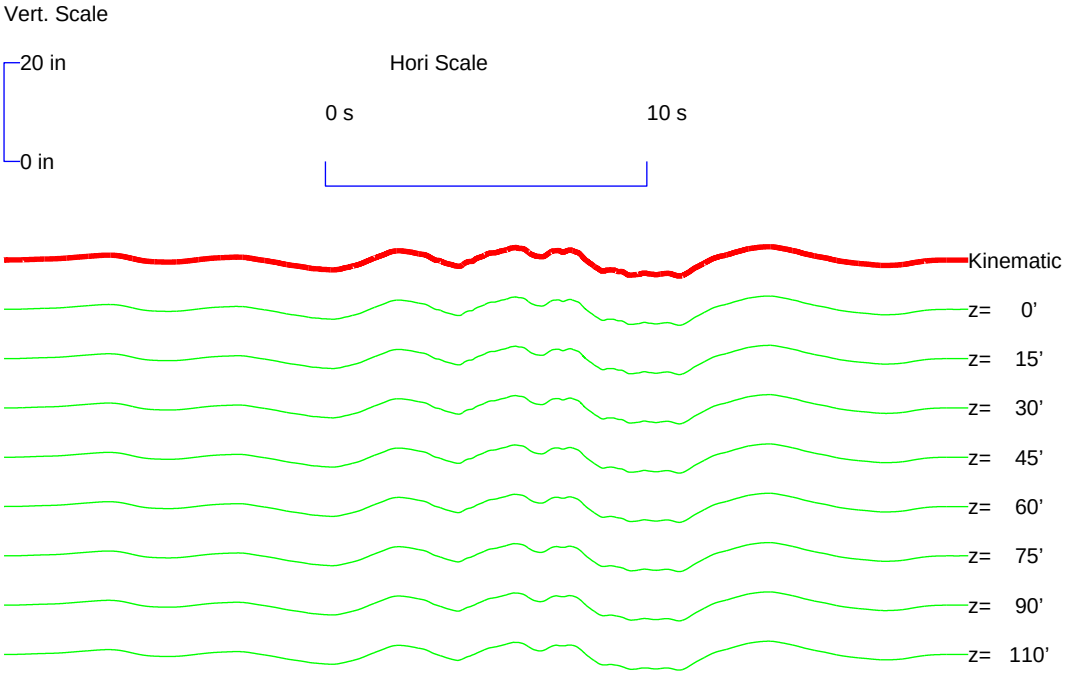
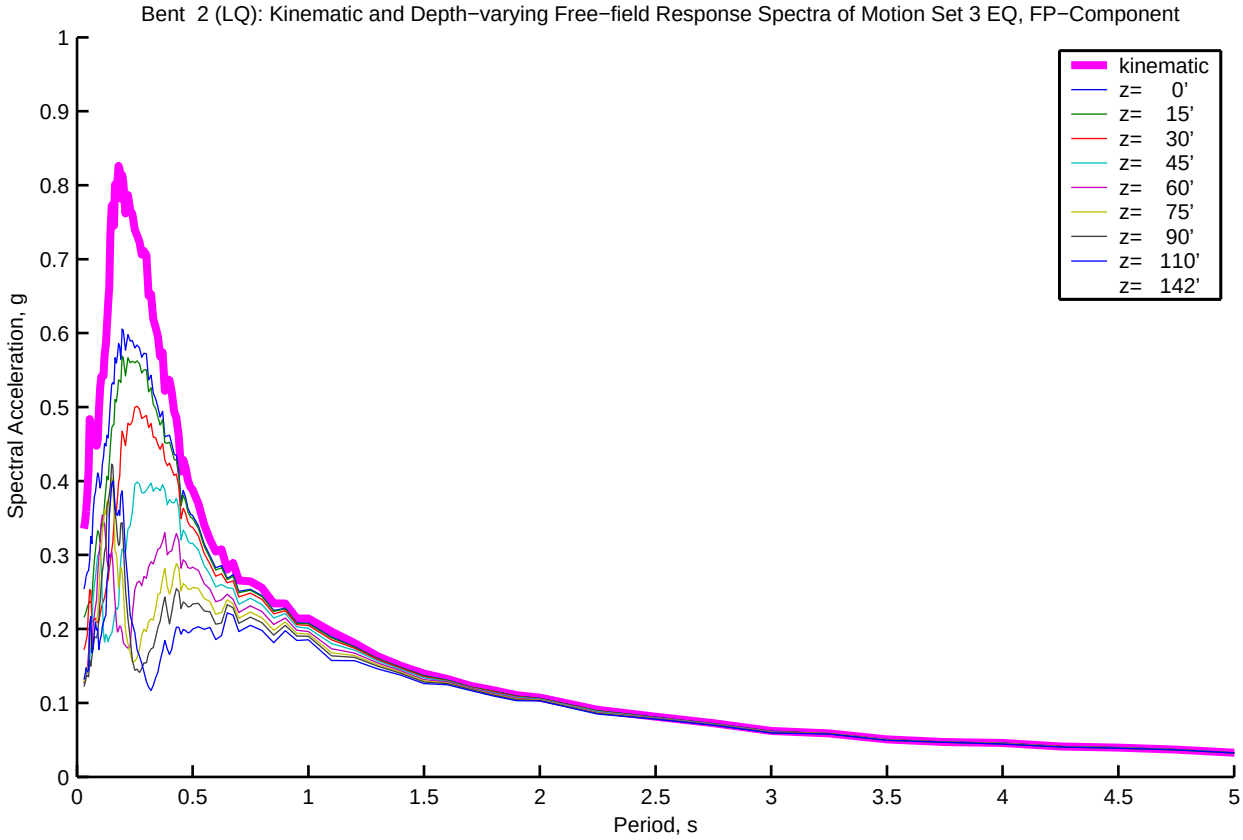
Bent 2 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component






Bent 2 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 142'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
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0.5
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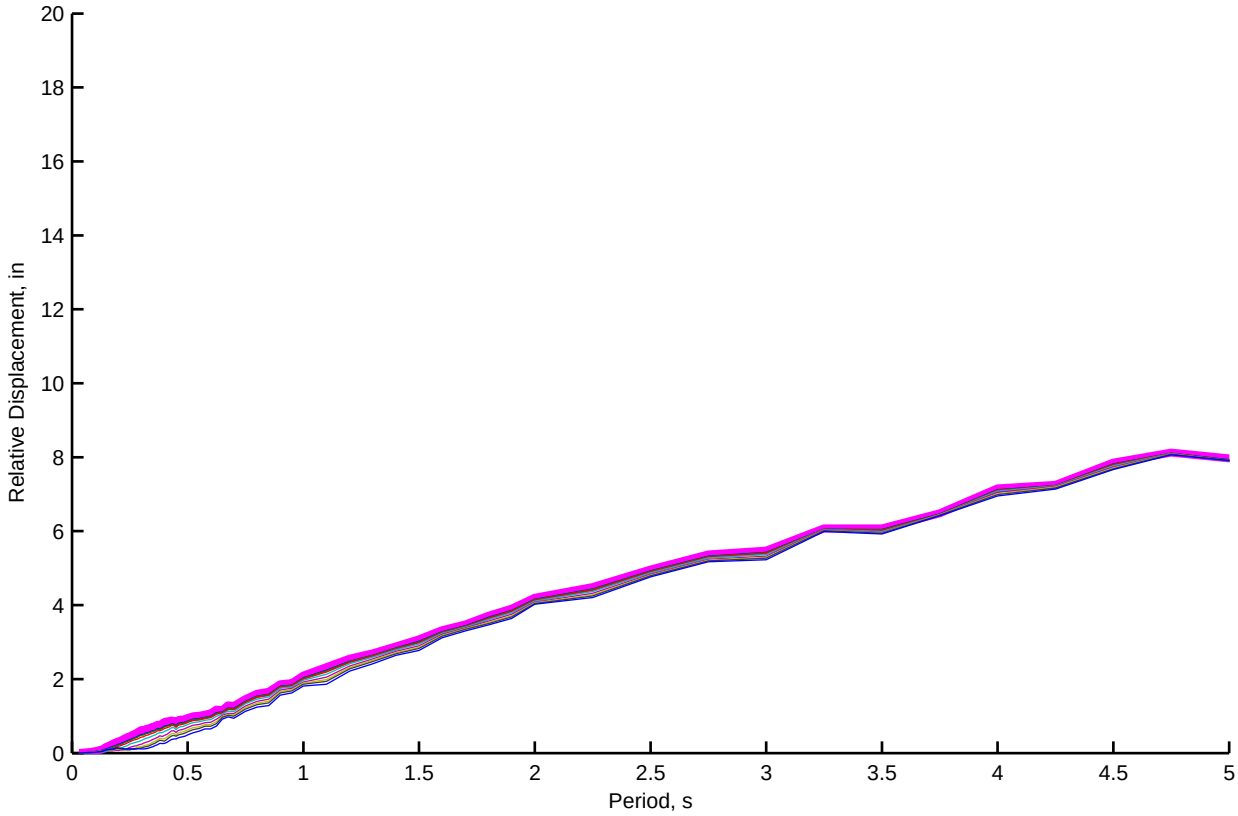
Relative Displacement, in
Period, s
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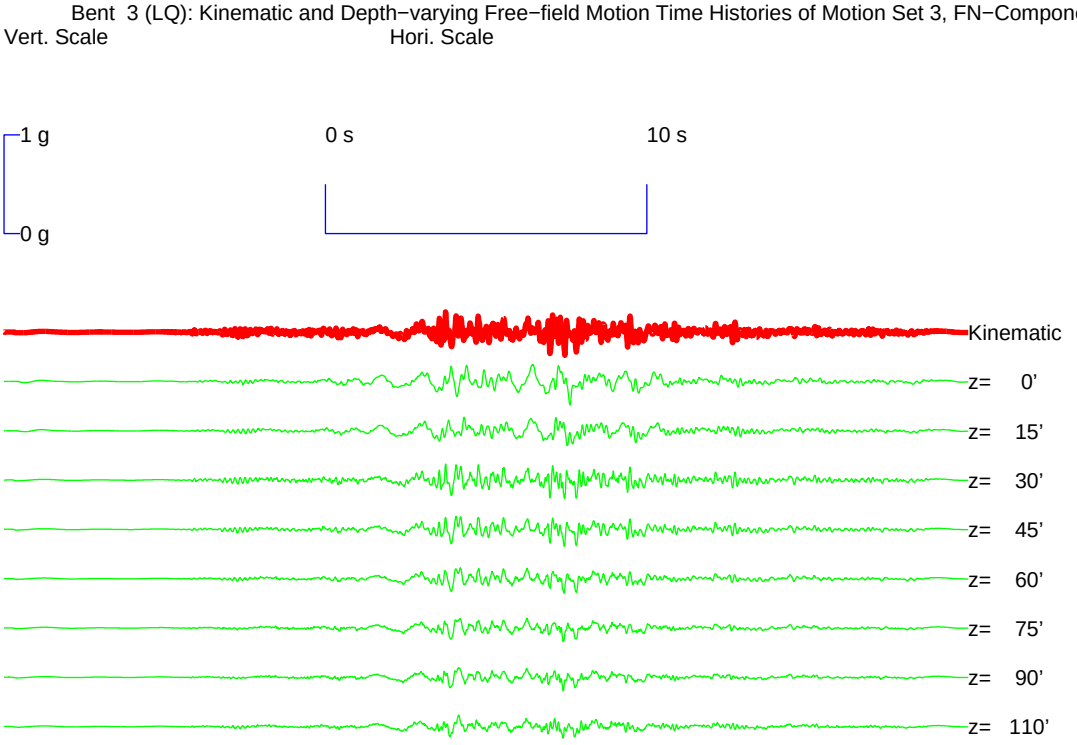
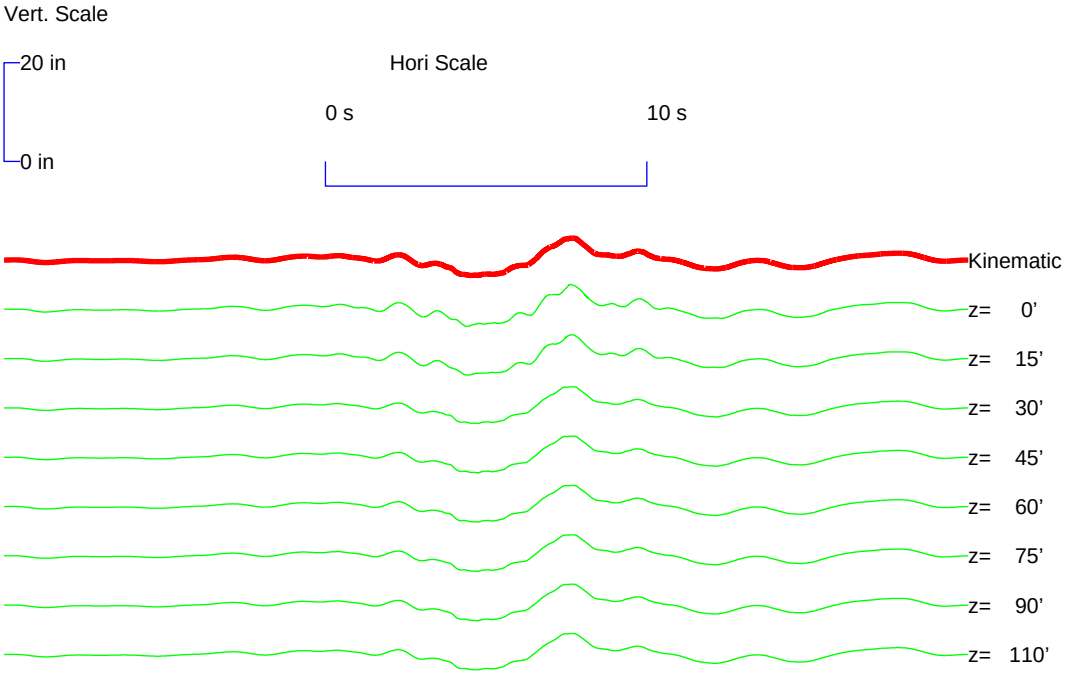
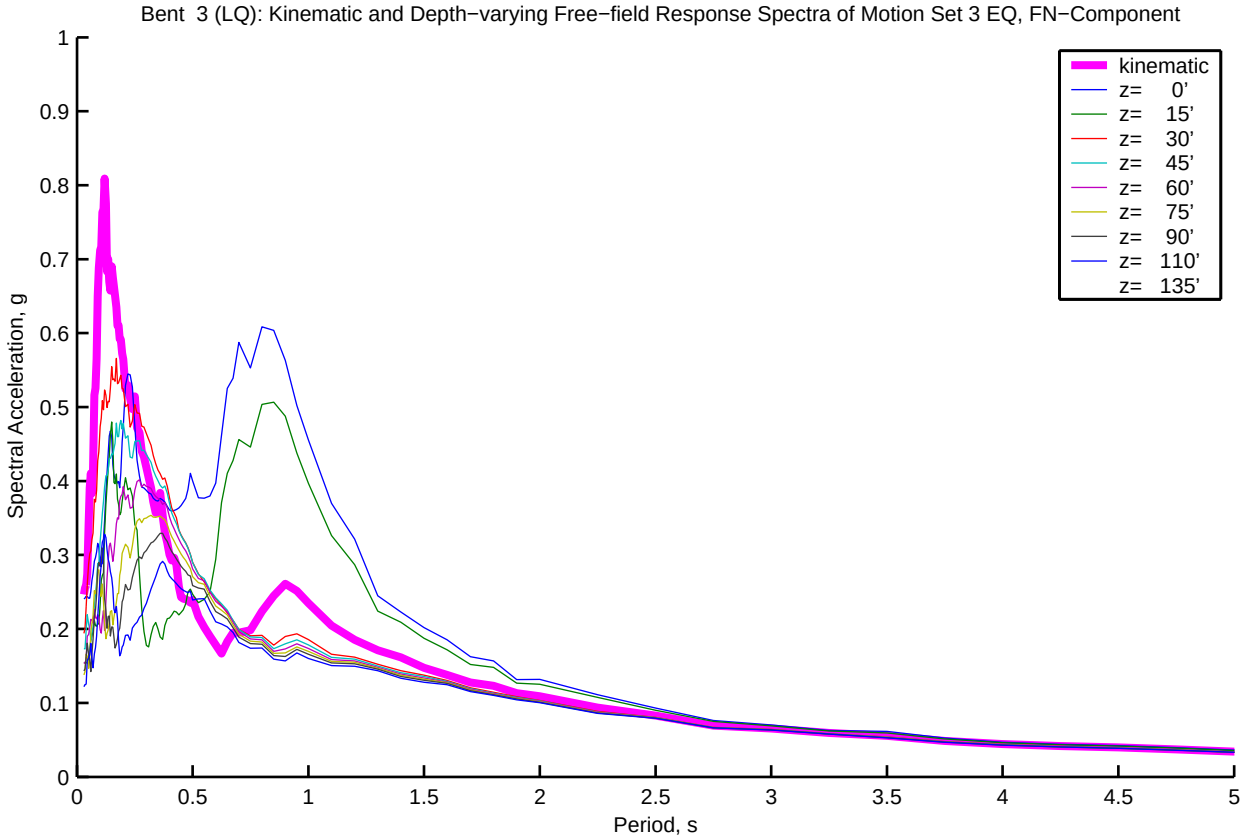
Bent 3 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component






Bent 3 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 135'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
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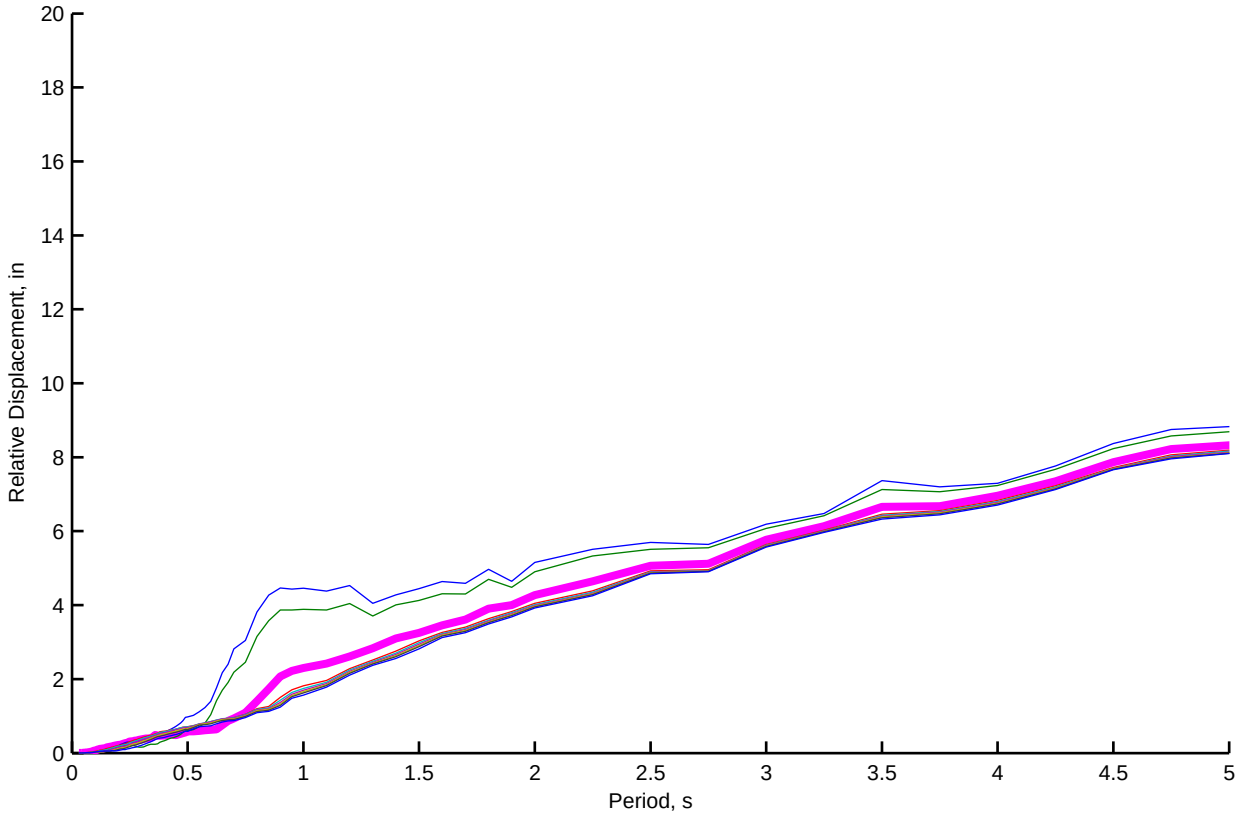
Relative Displacement, in
Period, s
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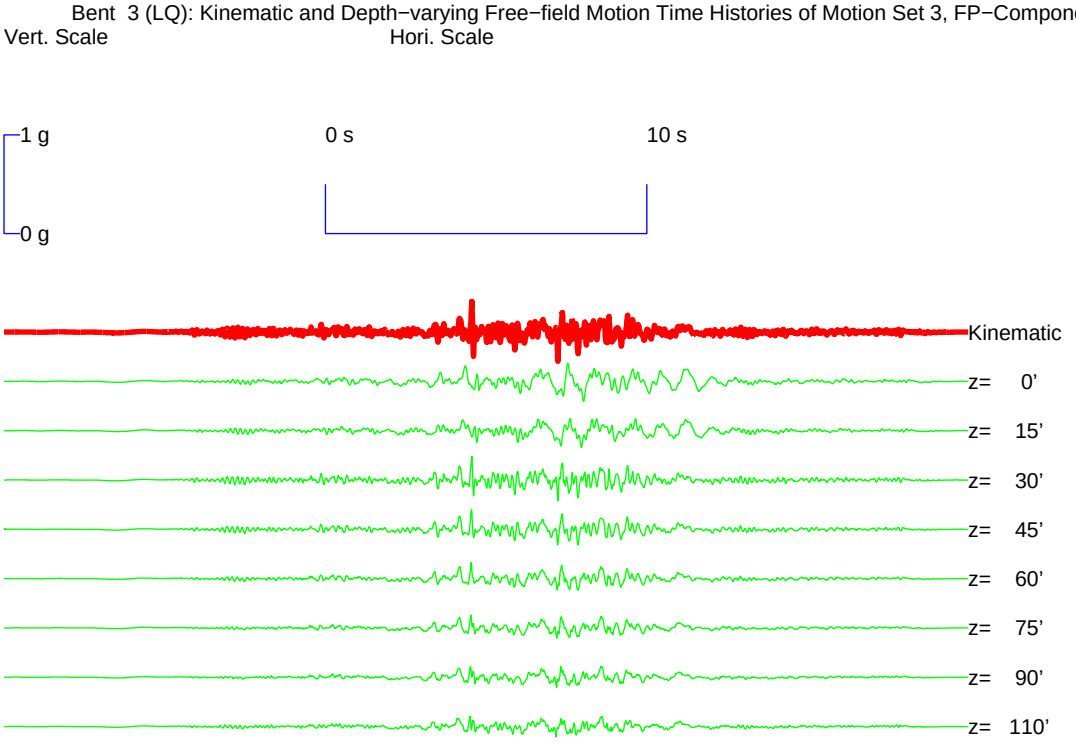
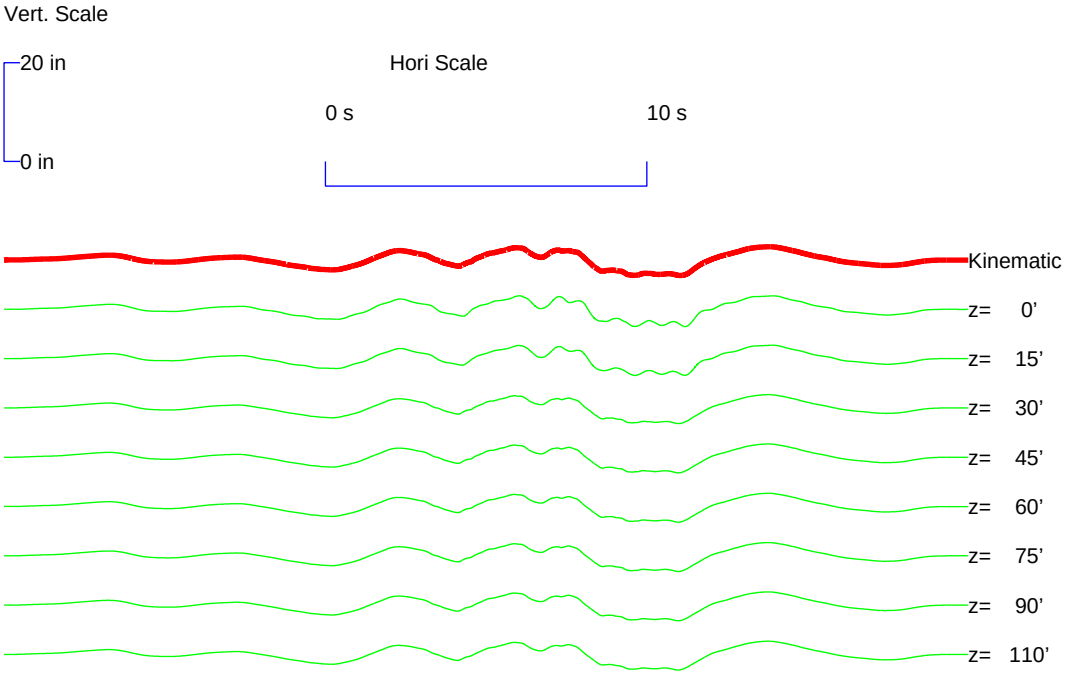
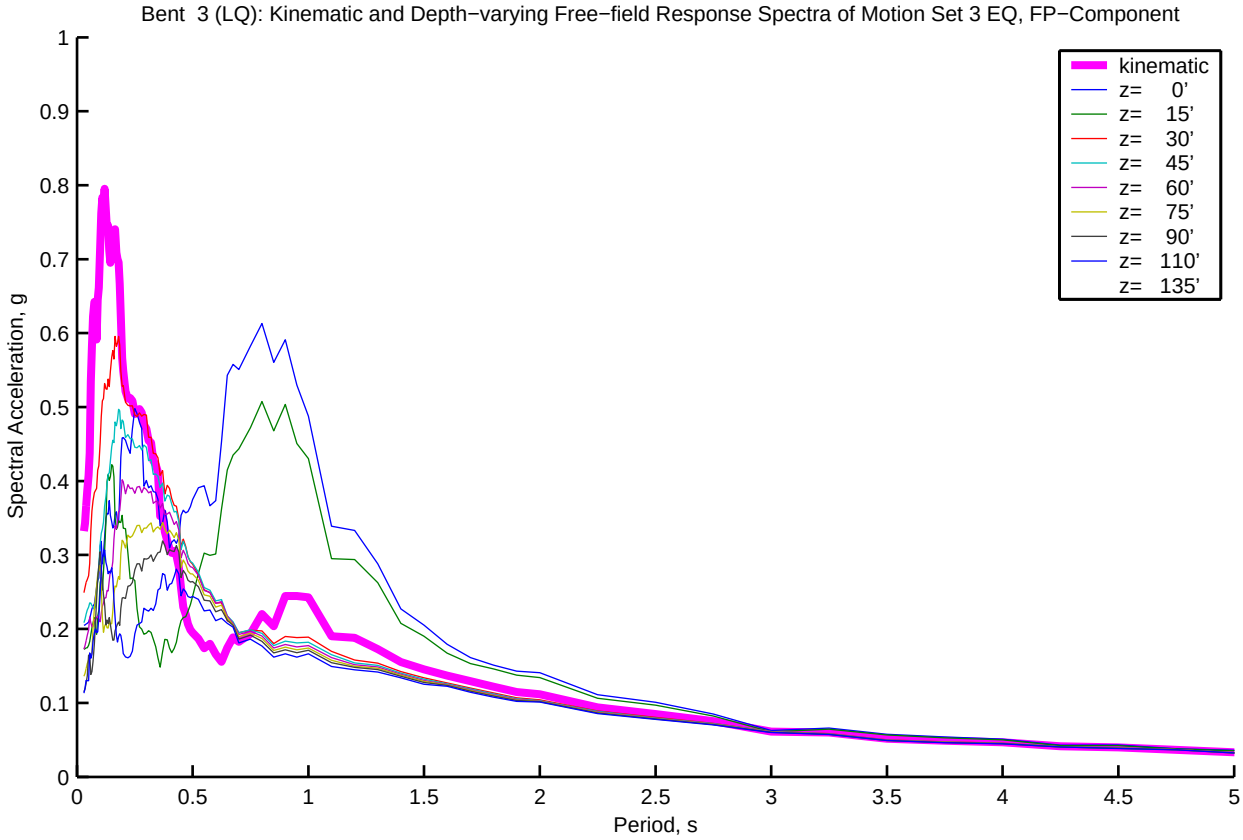
Bent 3 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component






Bent 3 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 135'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
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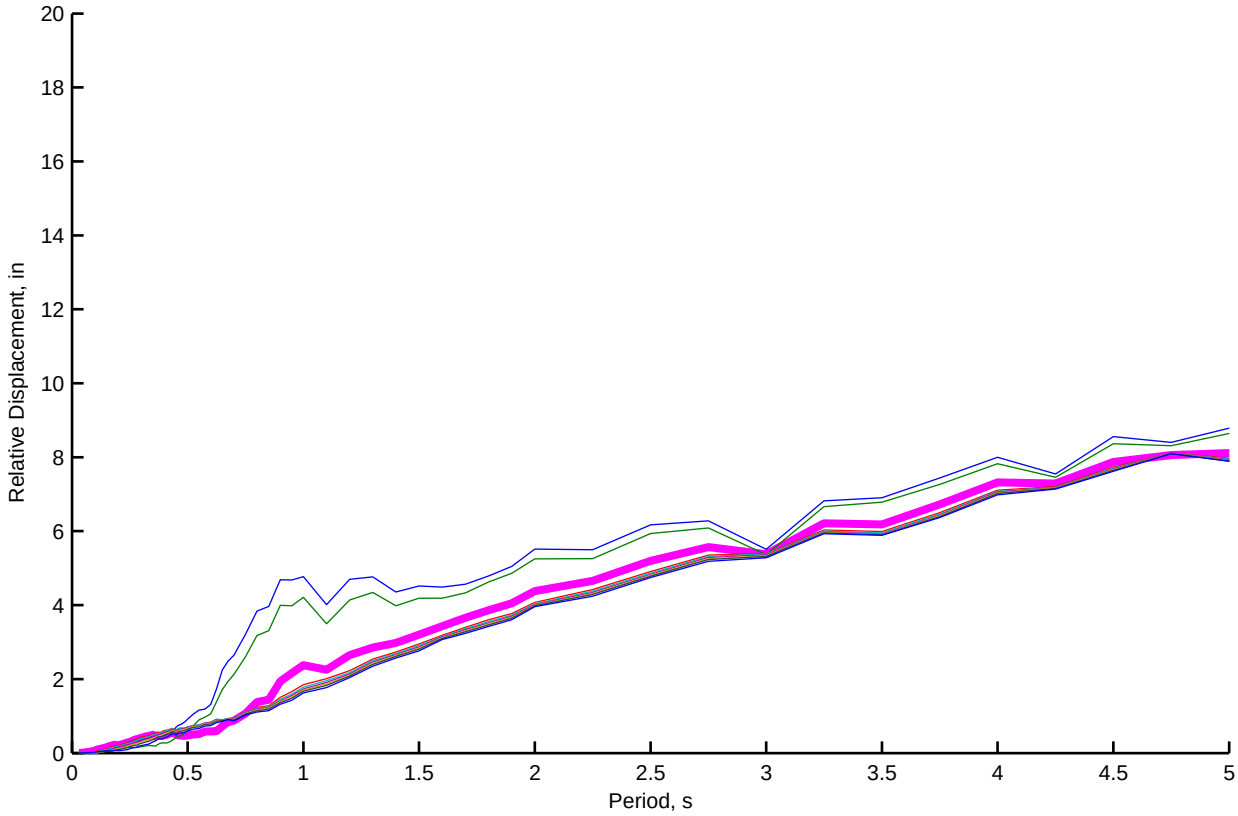
Relative Displacement, in
Period, s
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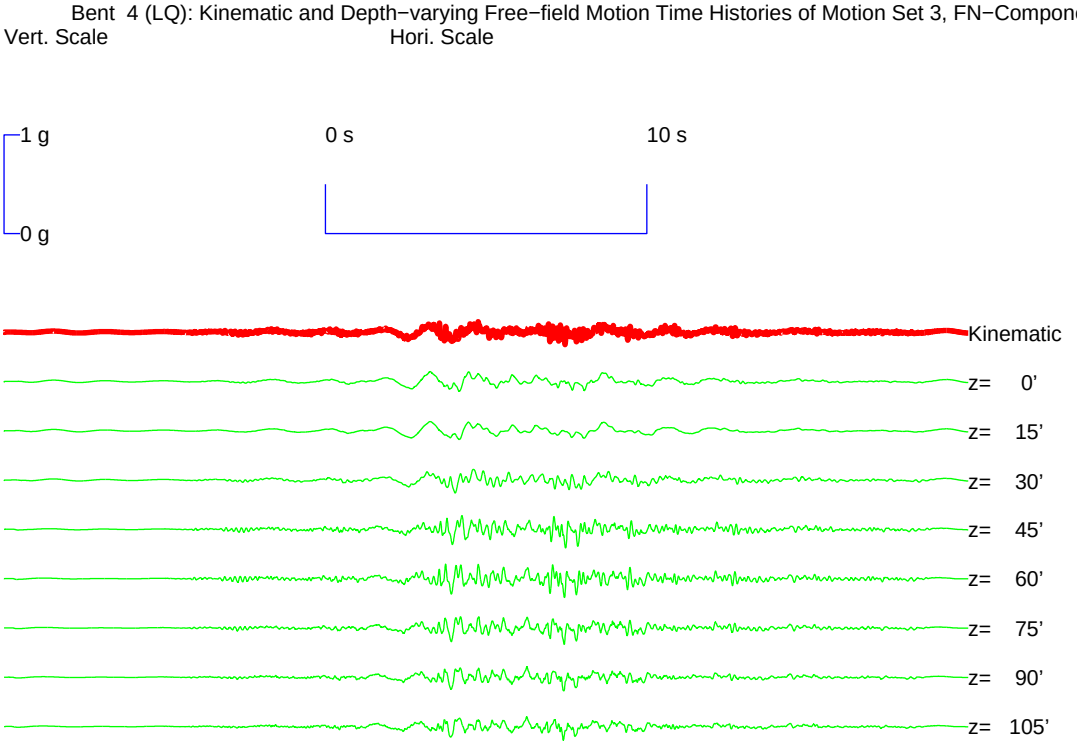
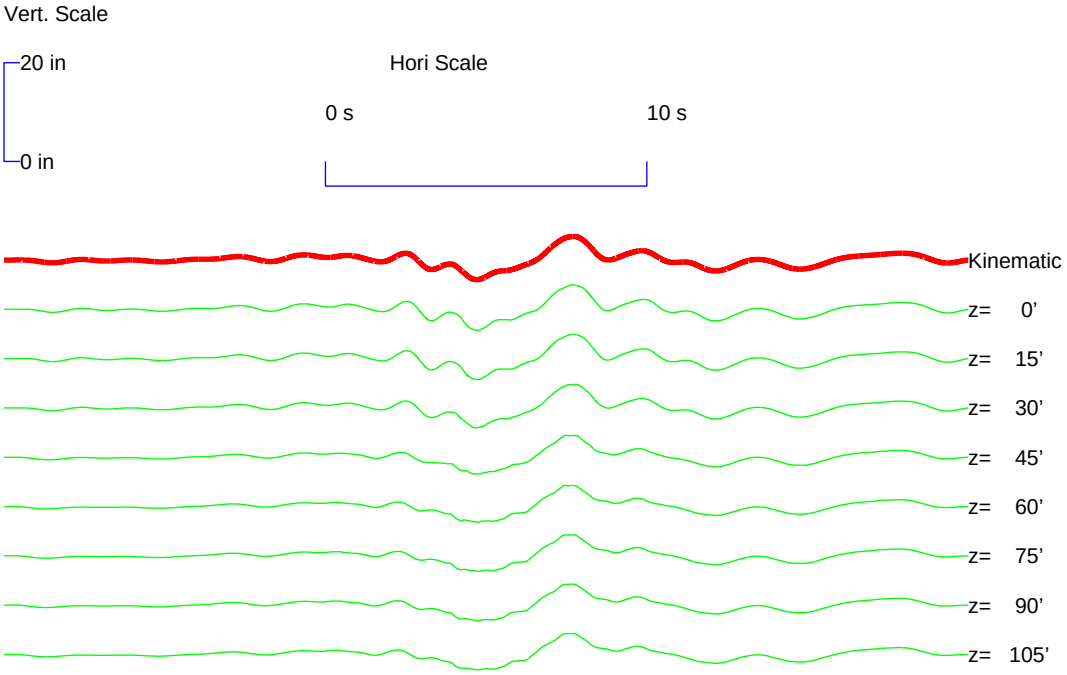
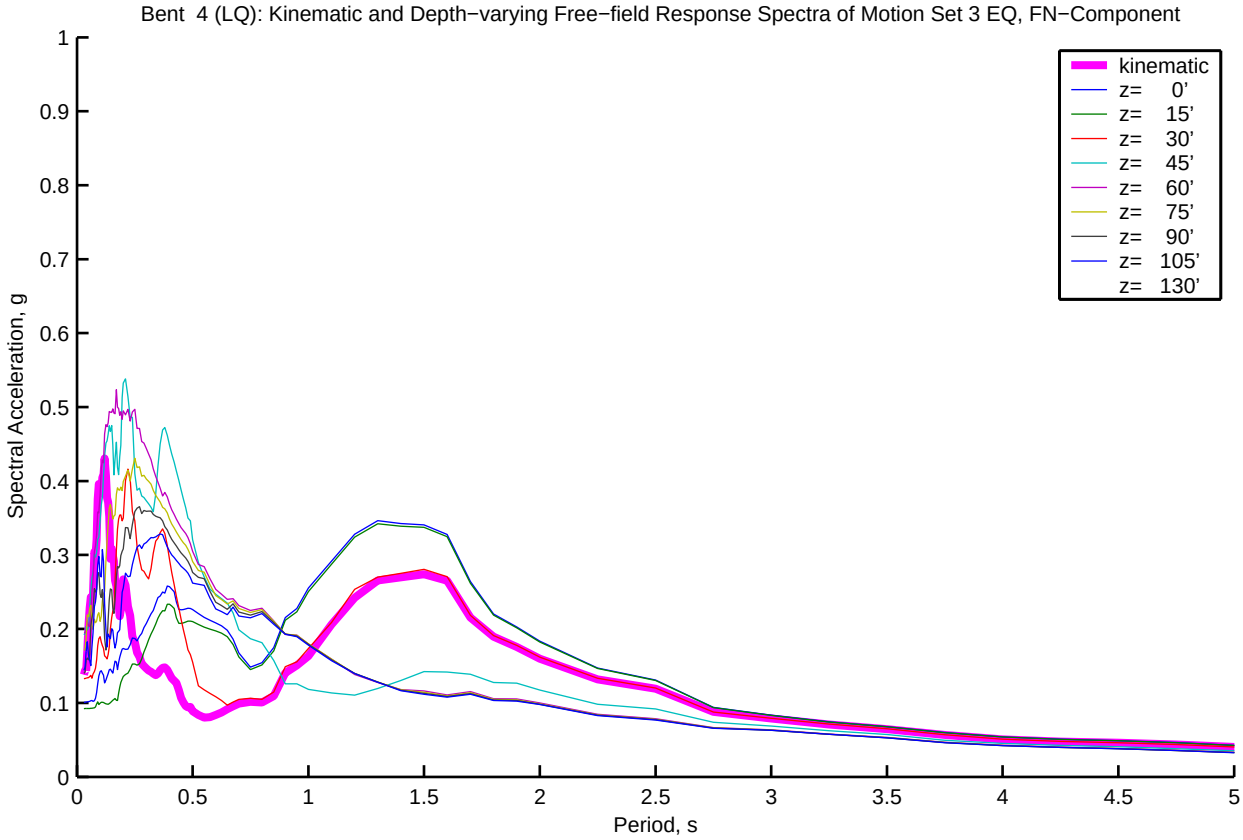
Bent 4 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component






Bent 4 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
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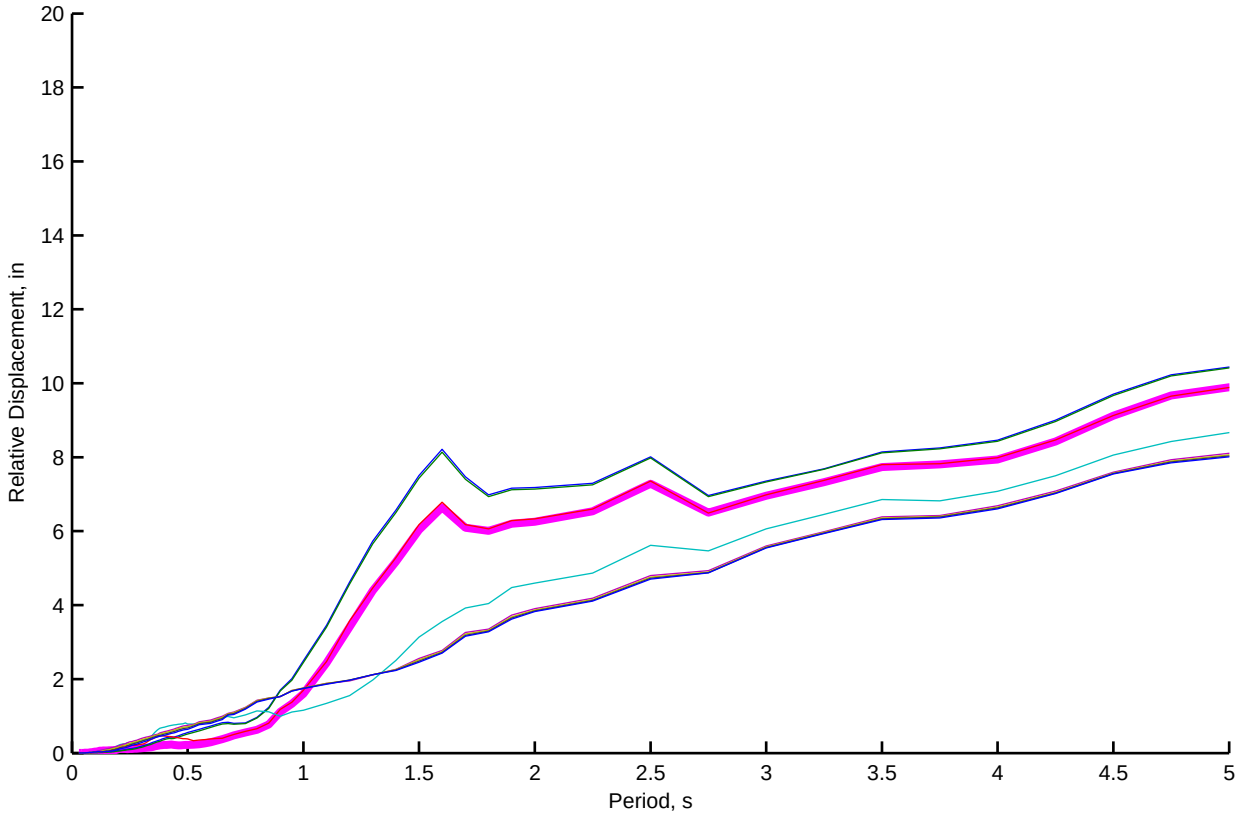
Relative Displacement, in
Period, s
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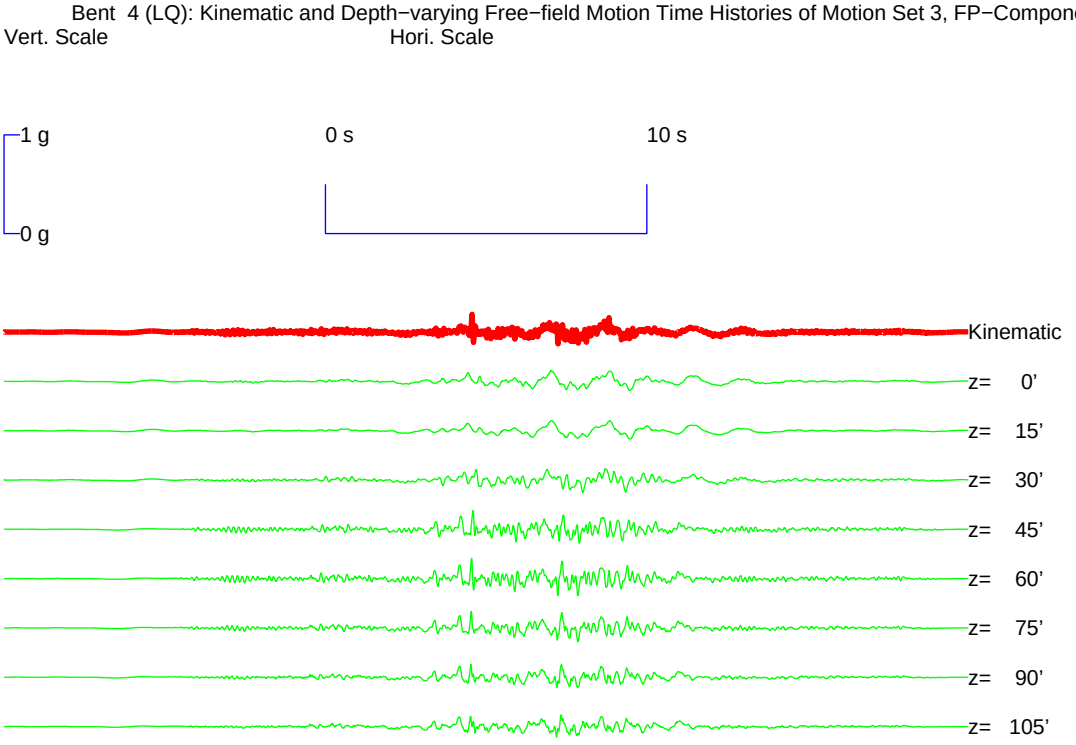
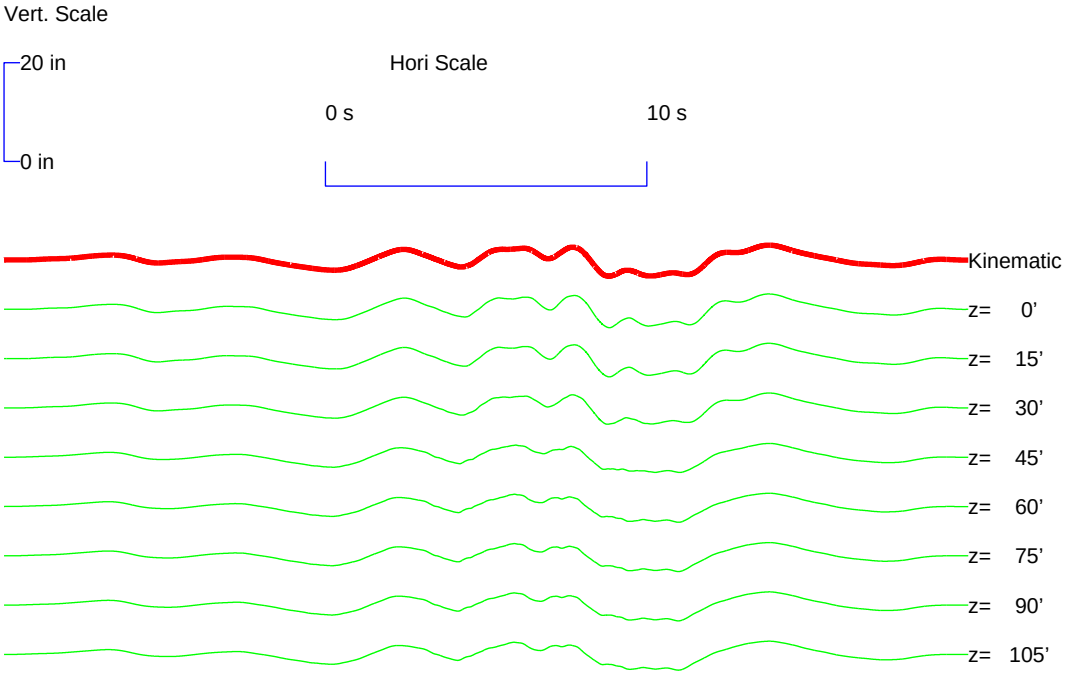
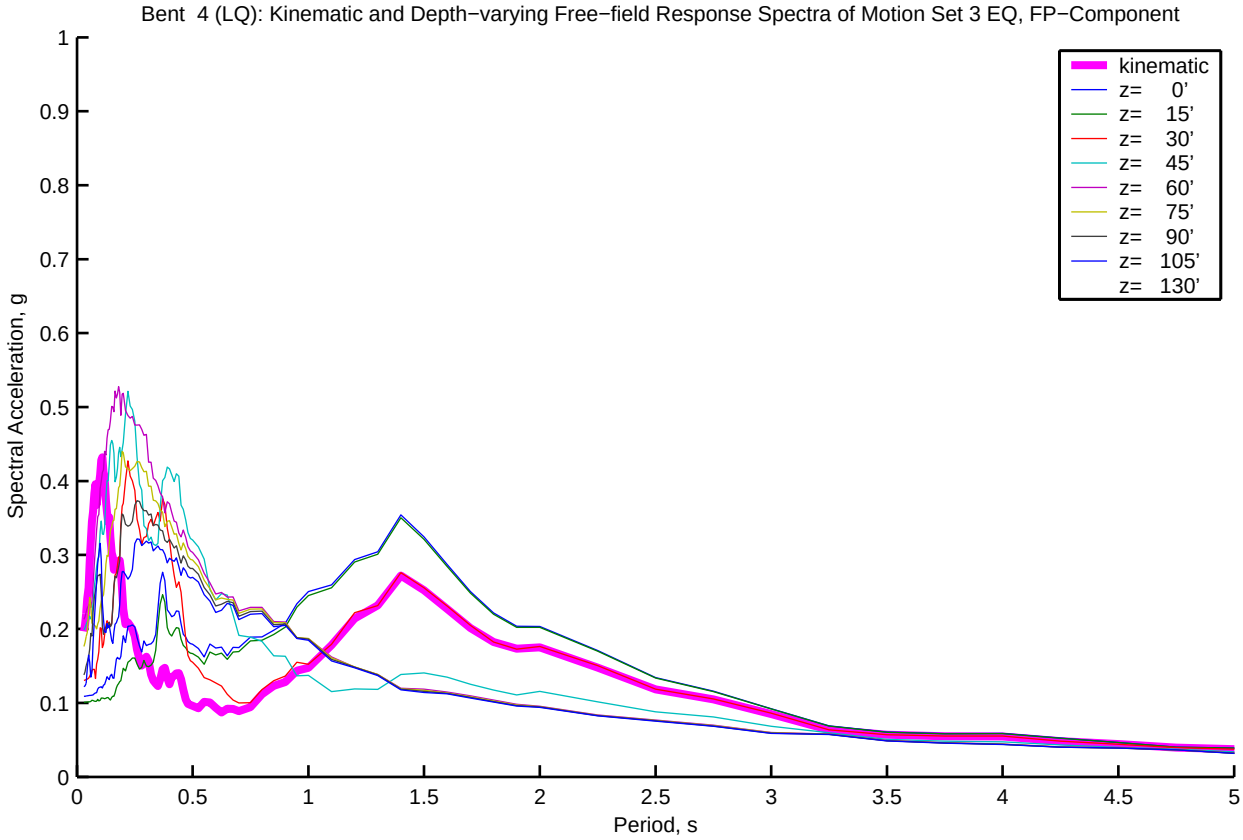
Bent 4 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component






Bent 4 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
0
0.1
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0.3
0.4
0.5
0.6
0.7
0.8
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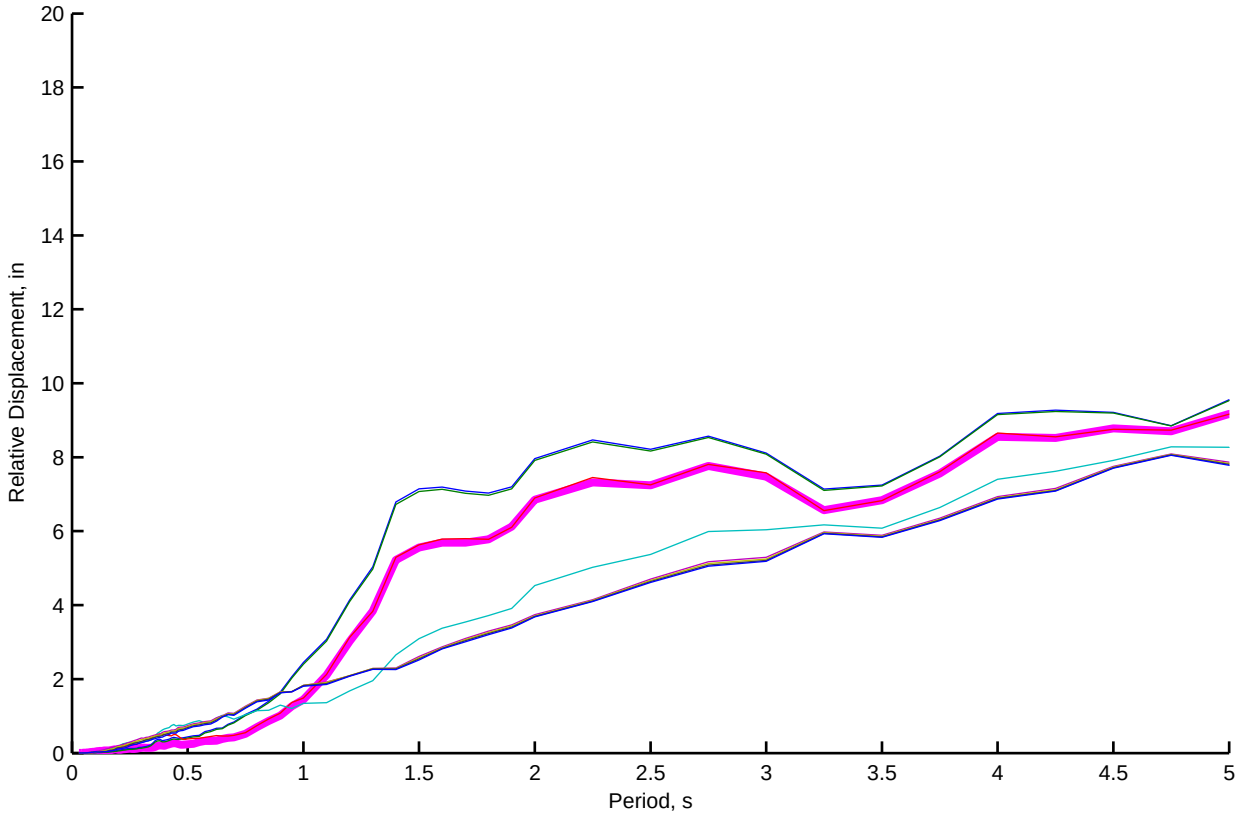
Relative Displacement, in
Period, s
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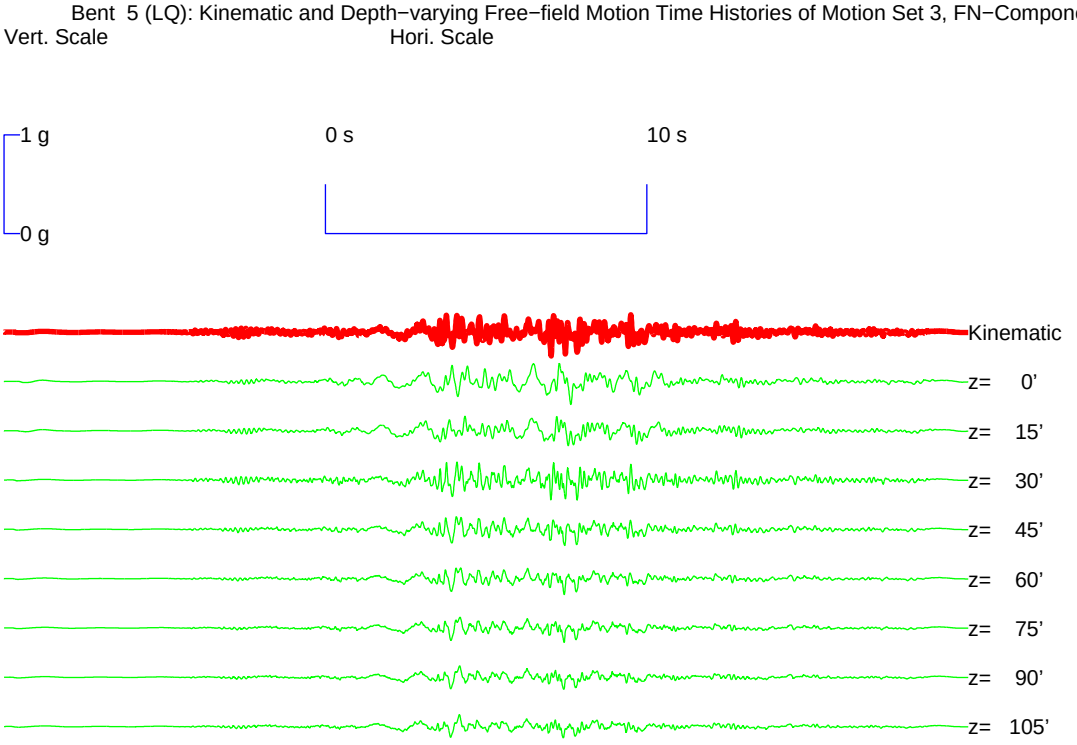
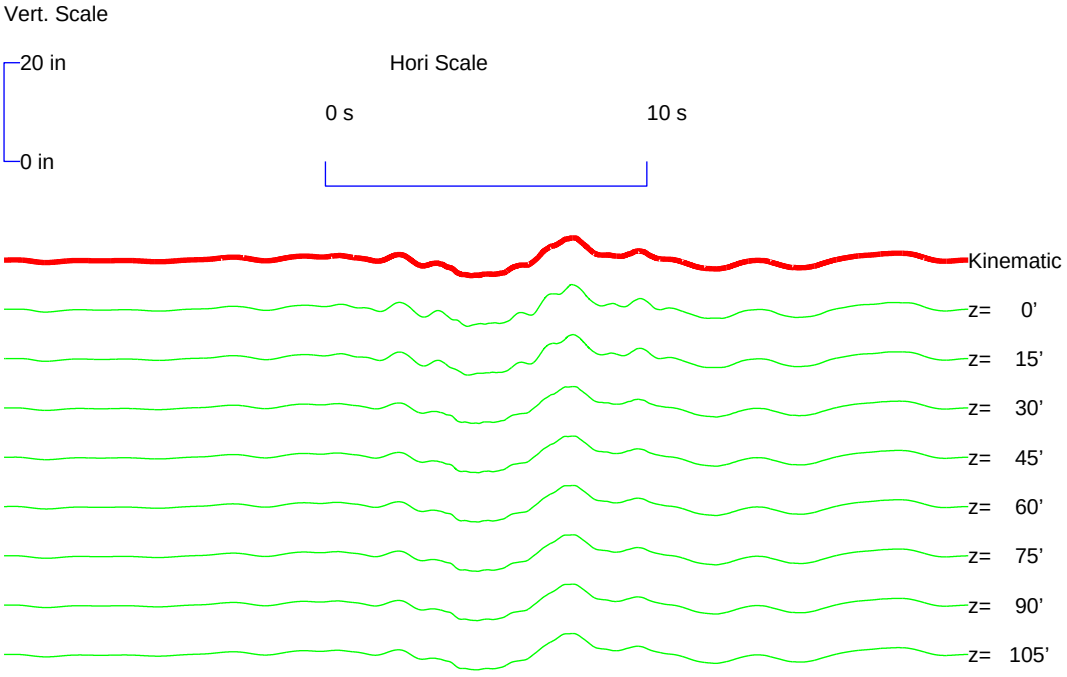
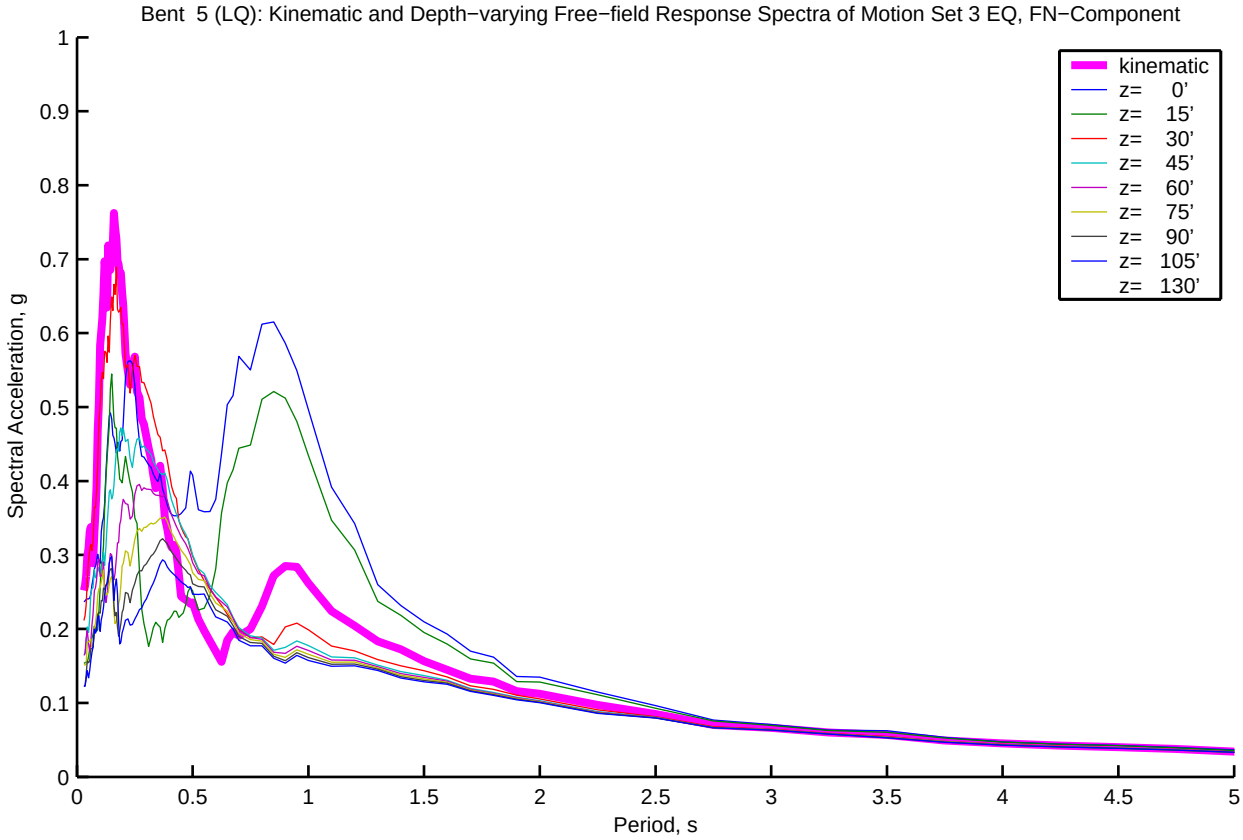
Bent 5 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component






Bent 5 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
0
0.1
0.2
0.3
0.4
0.5
0.6
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0.8
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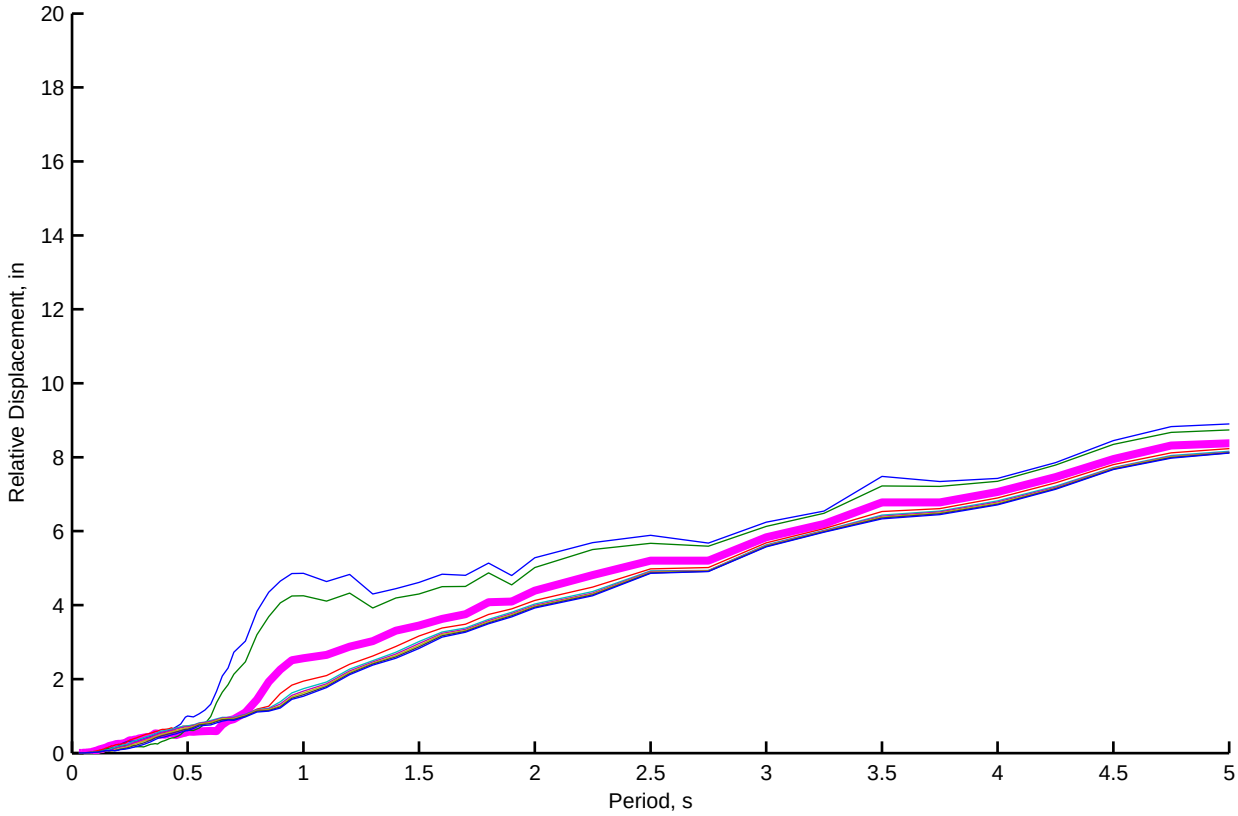
Relative Displacement, in
Period, s
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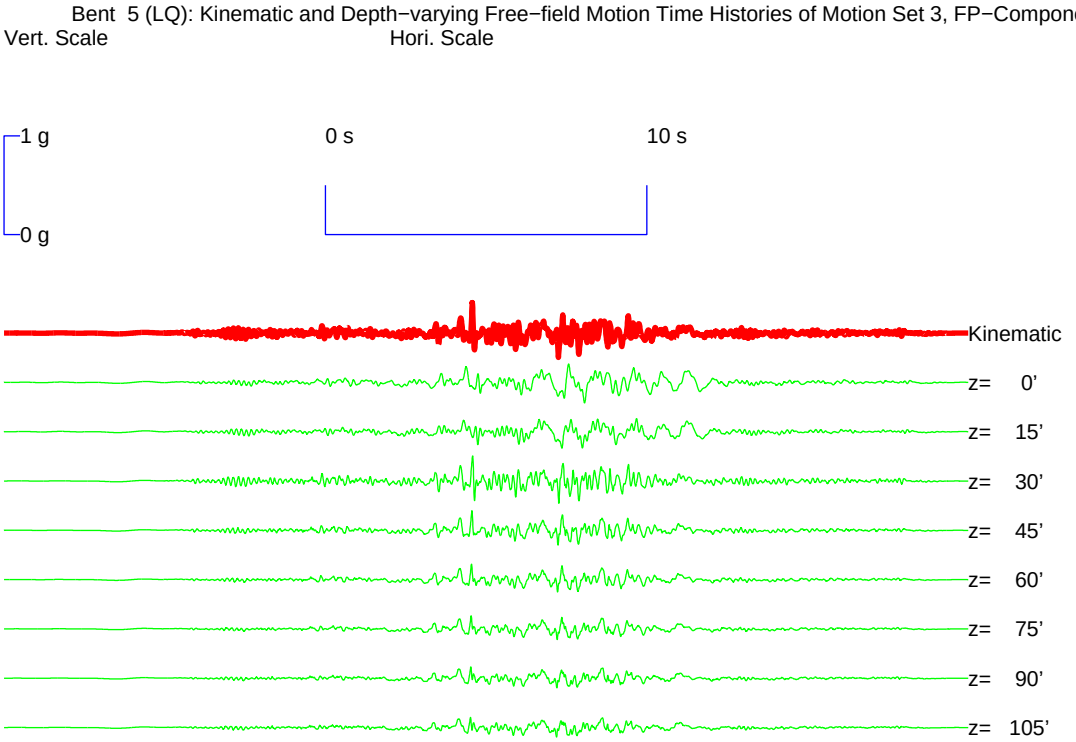
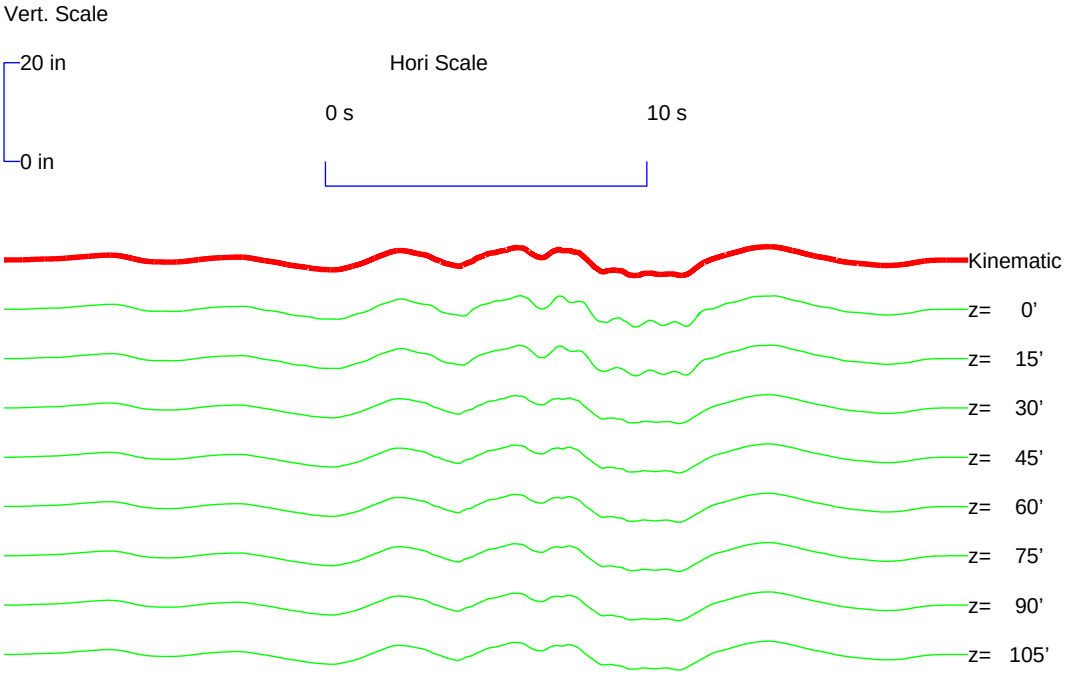
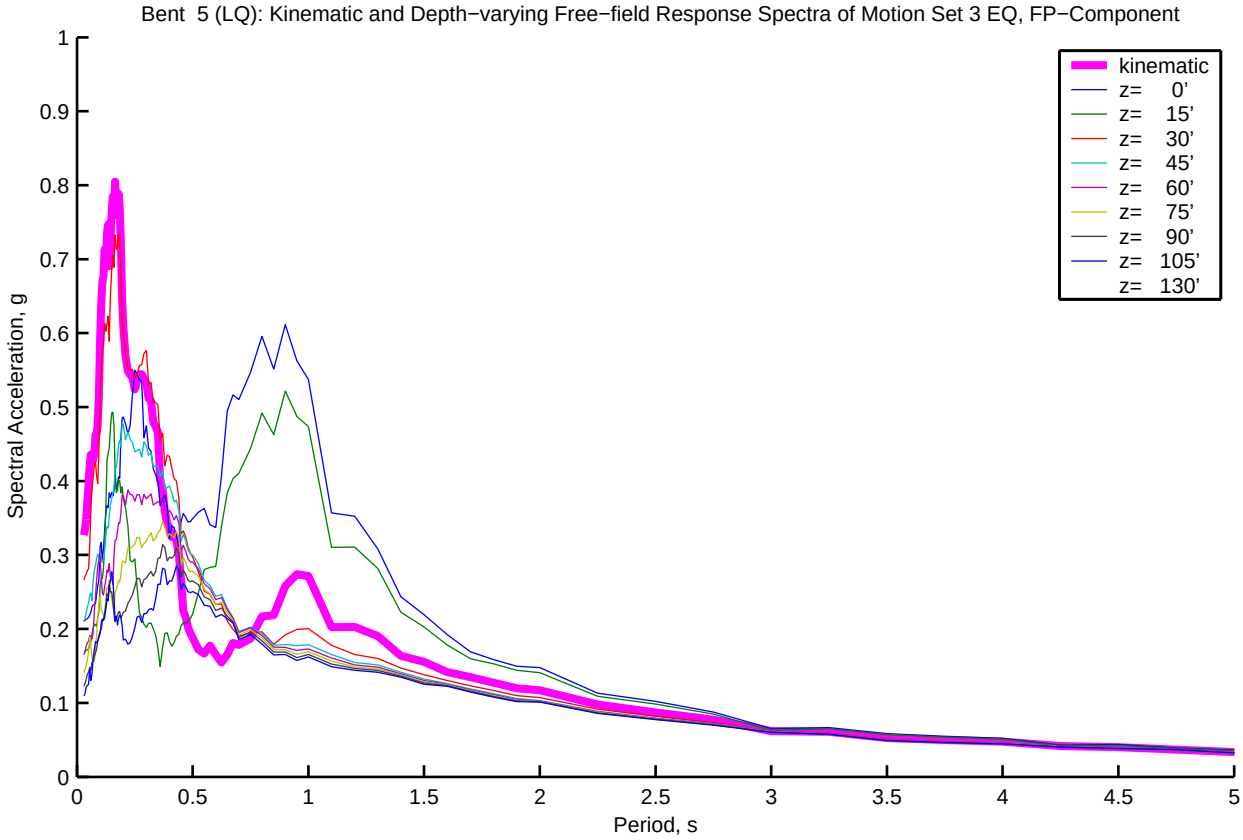
Bent 5 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component






Bent 5 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 105'
z= 130'
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
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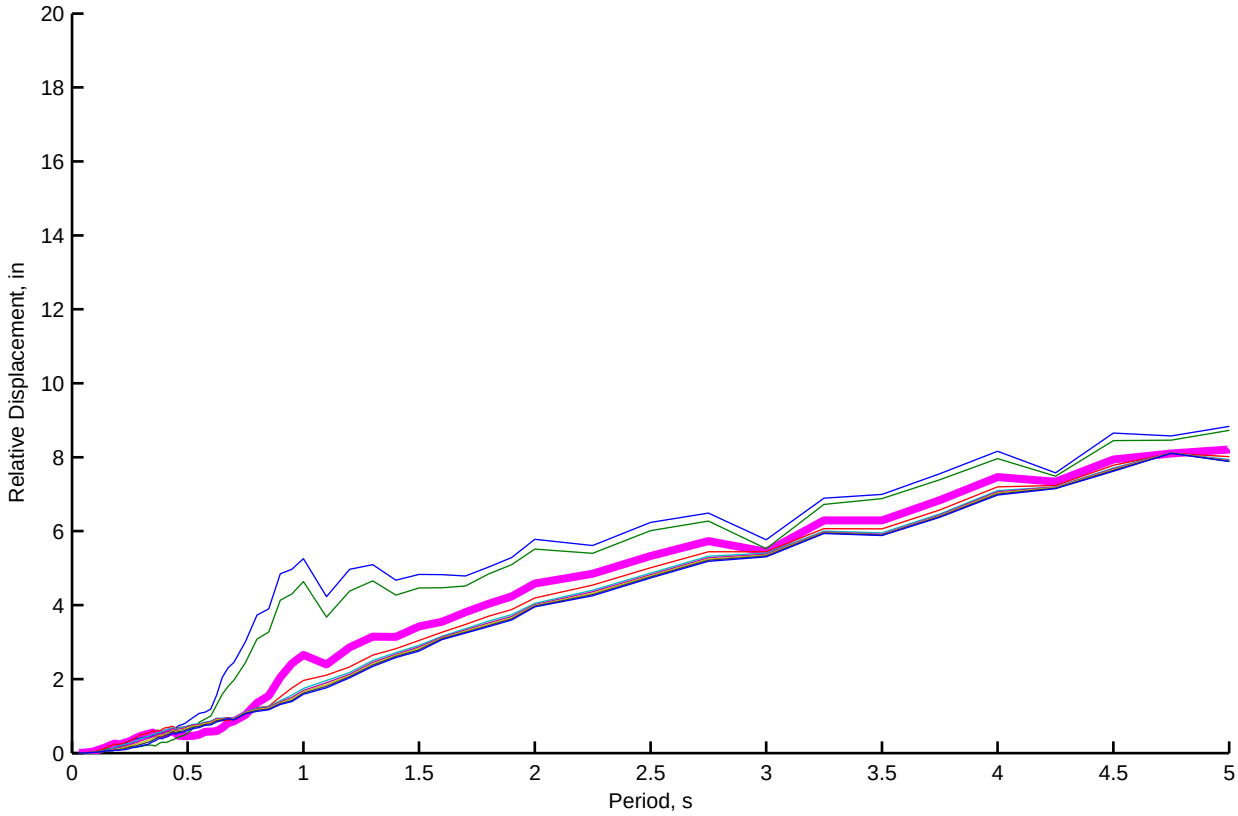
Relative Displacement, in
Period, s
0
2
4
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0.5
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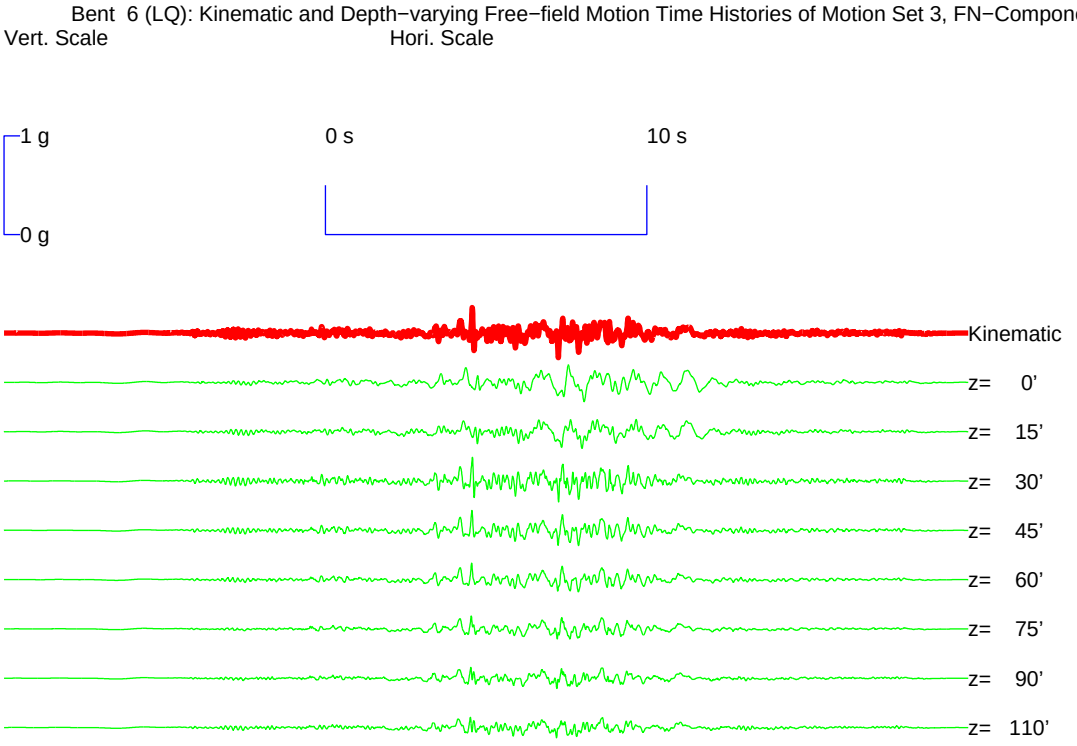
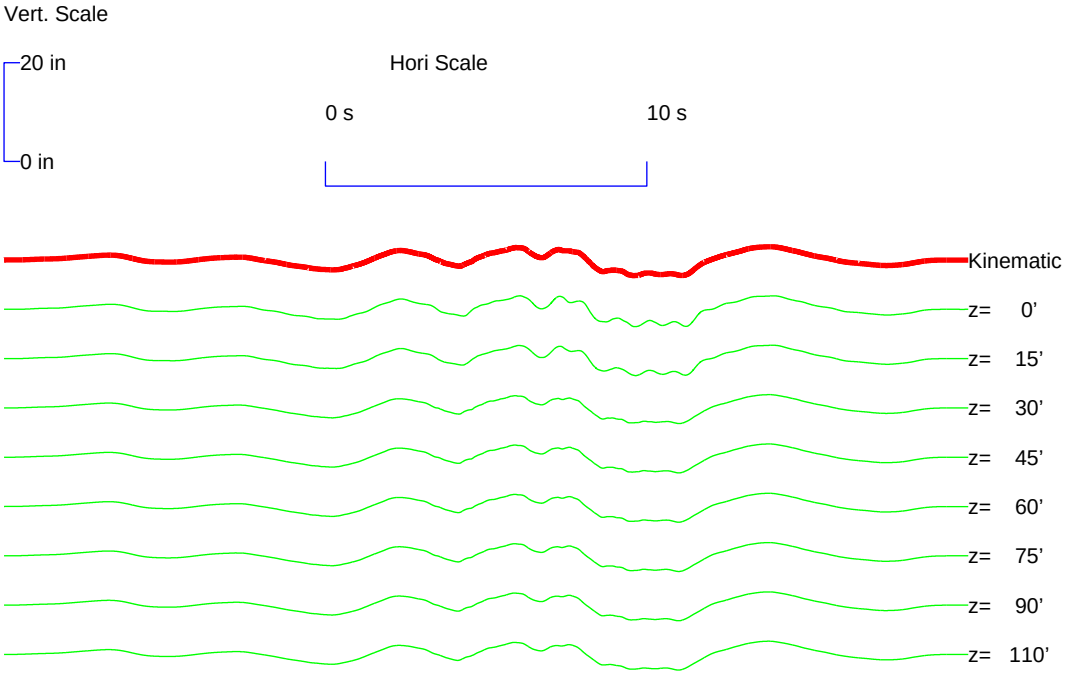
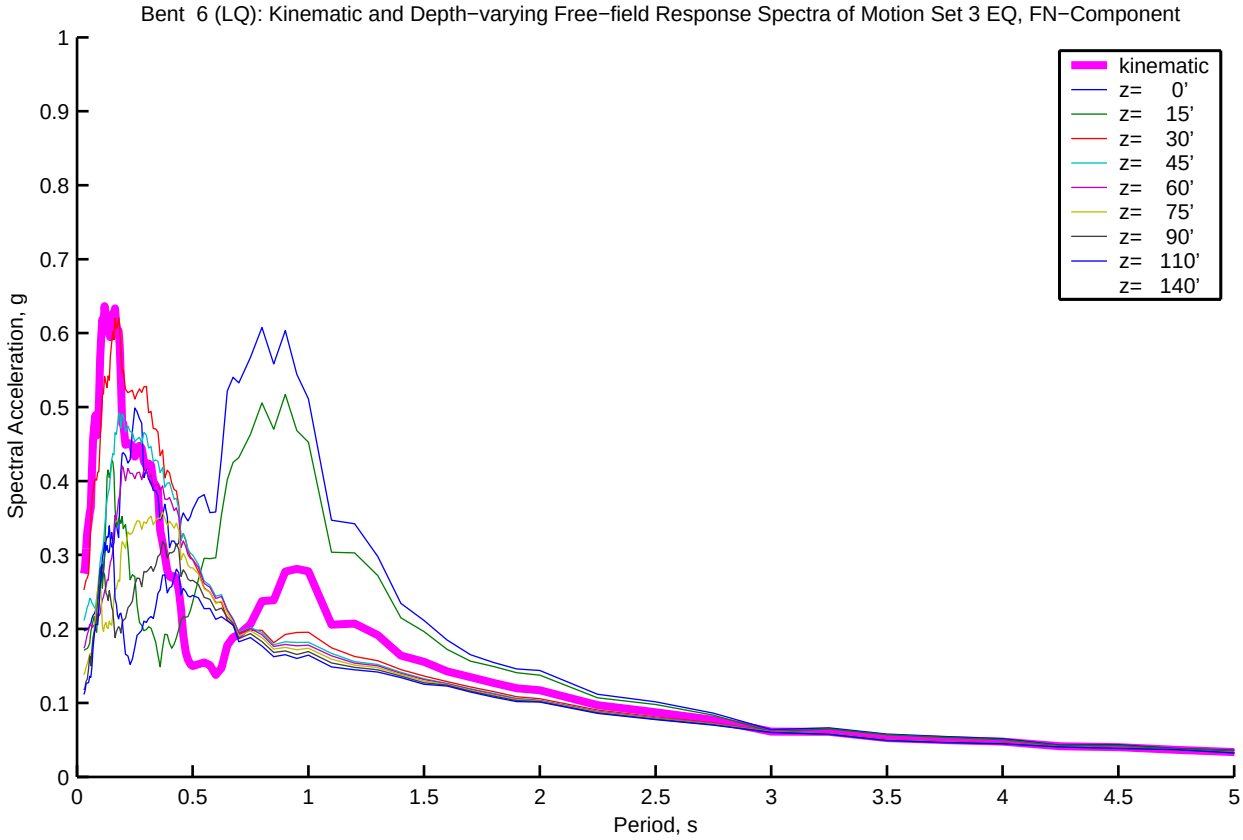
Bent 6 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component






Bent 6 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
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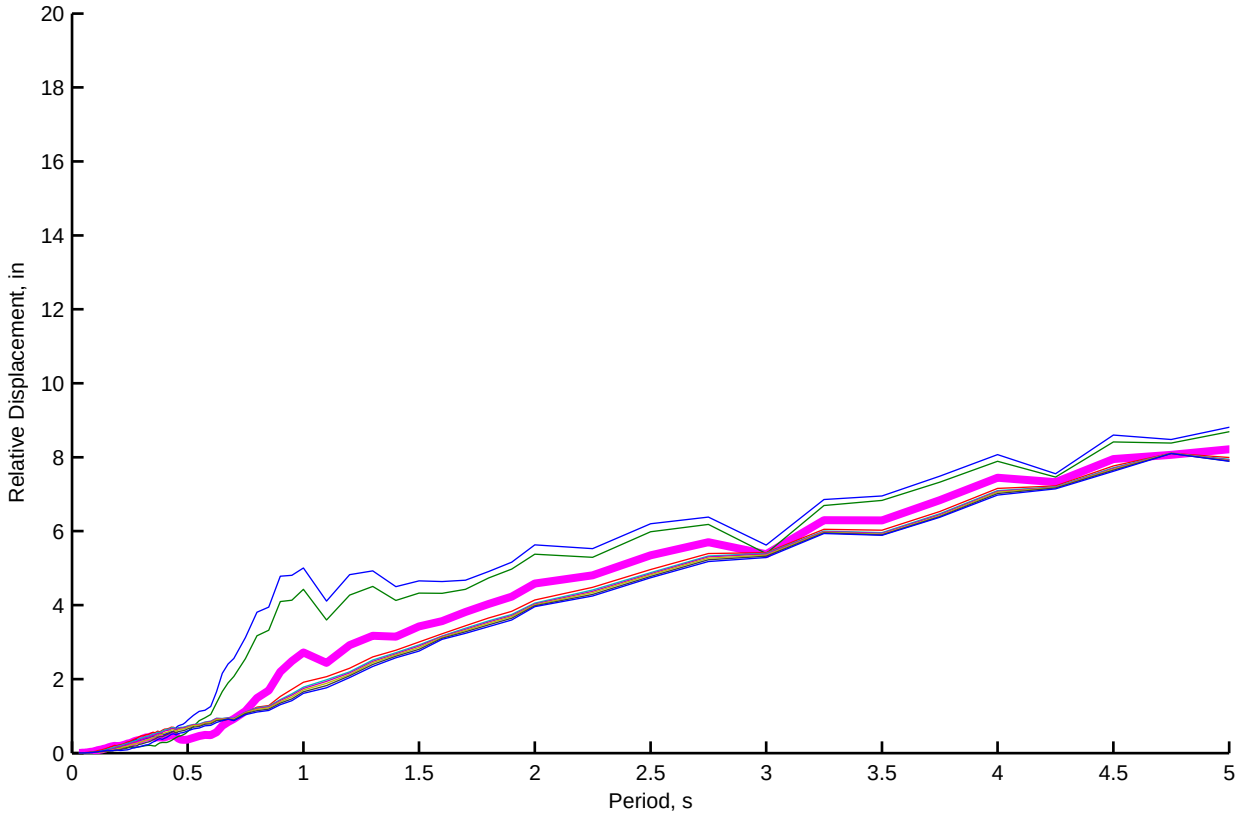
Relative Displacement, in
Period, s
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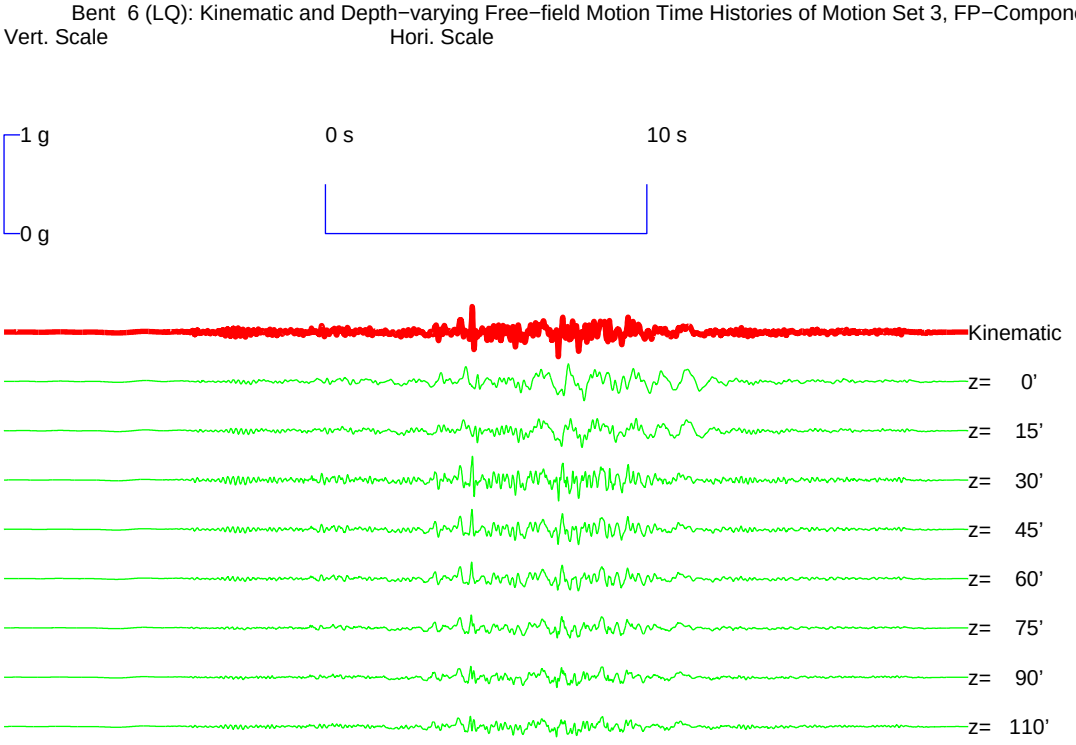
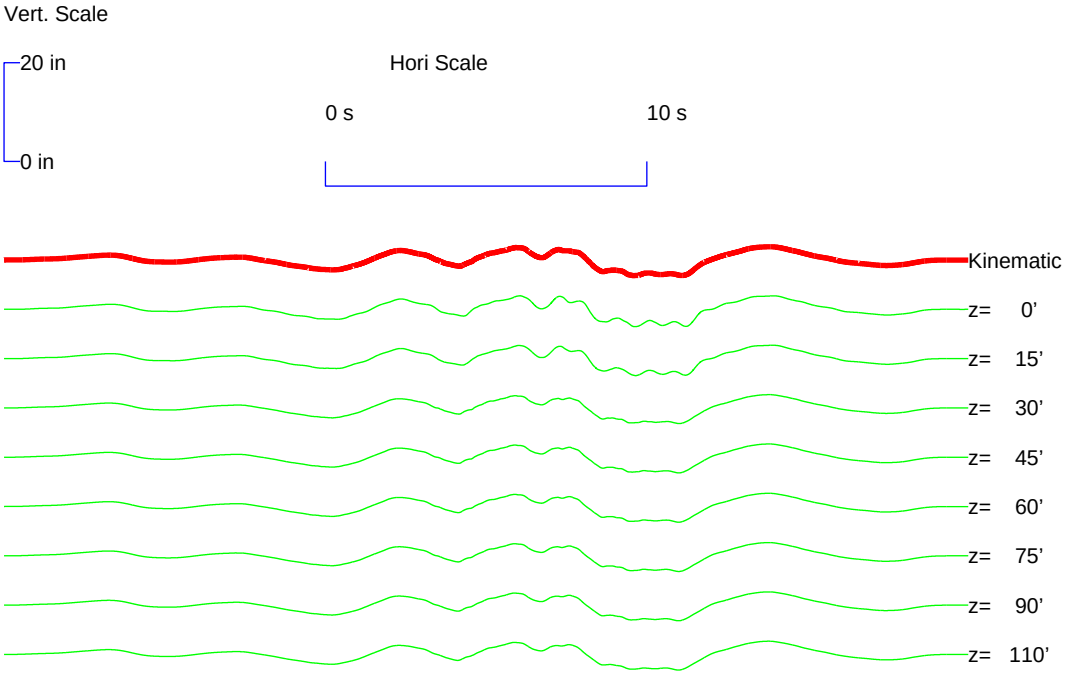
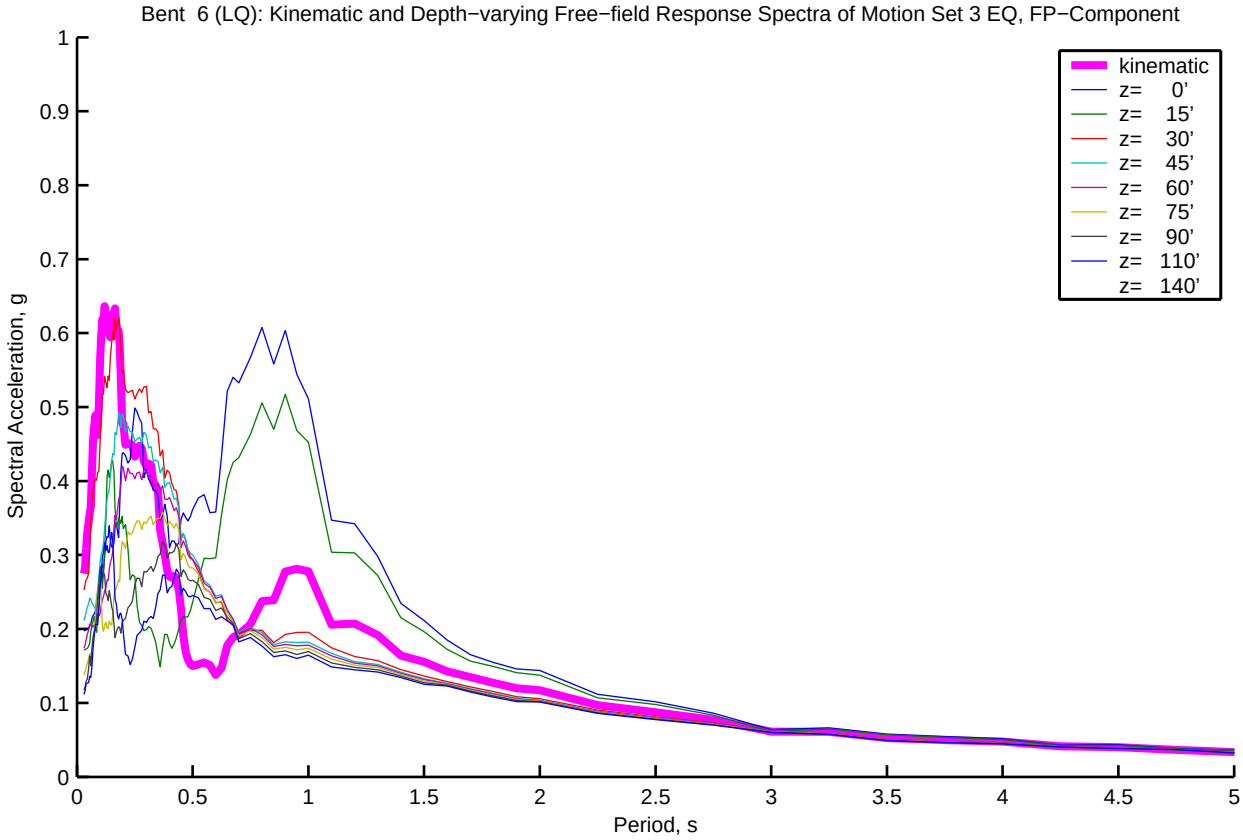
Bent 6 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component






Bent 6 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
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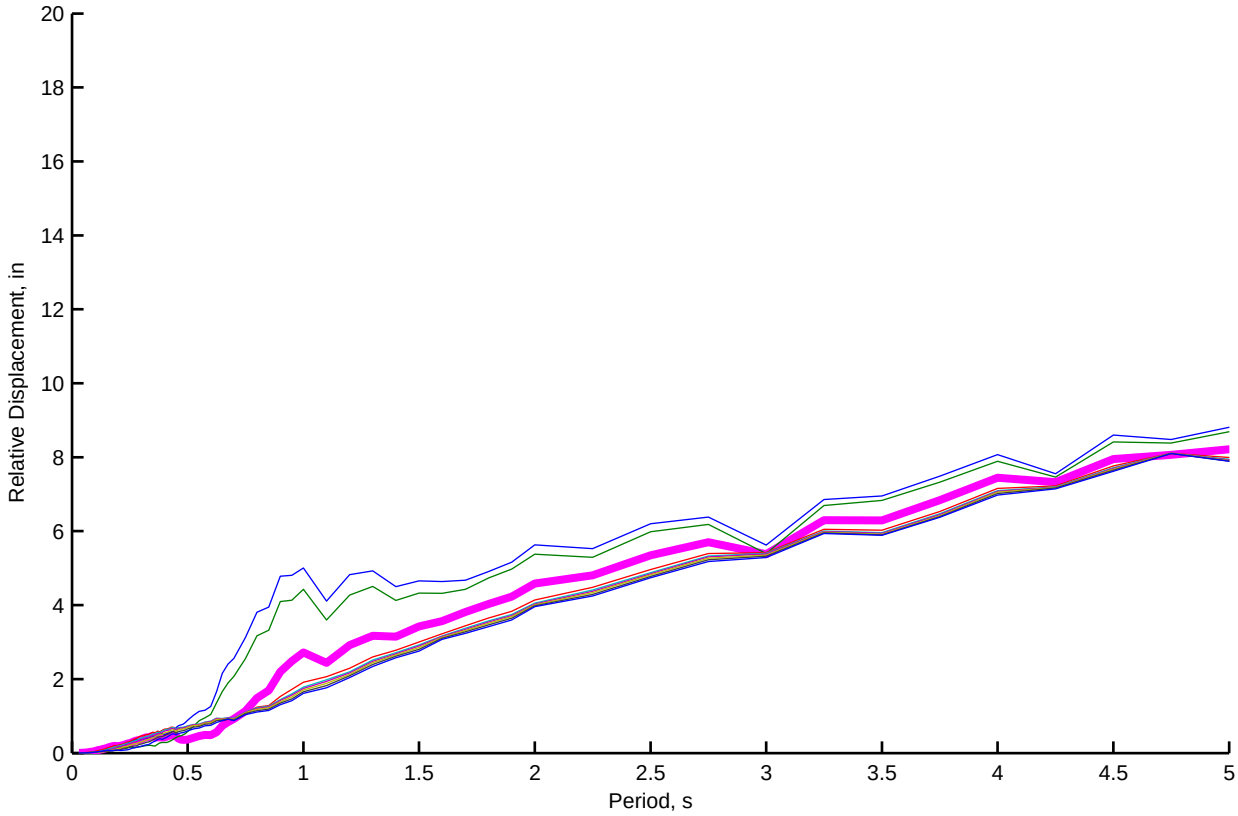
Relative Displacement, in
Period, s
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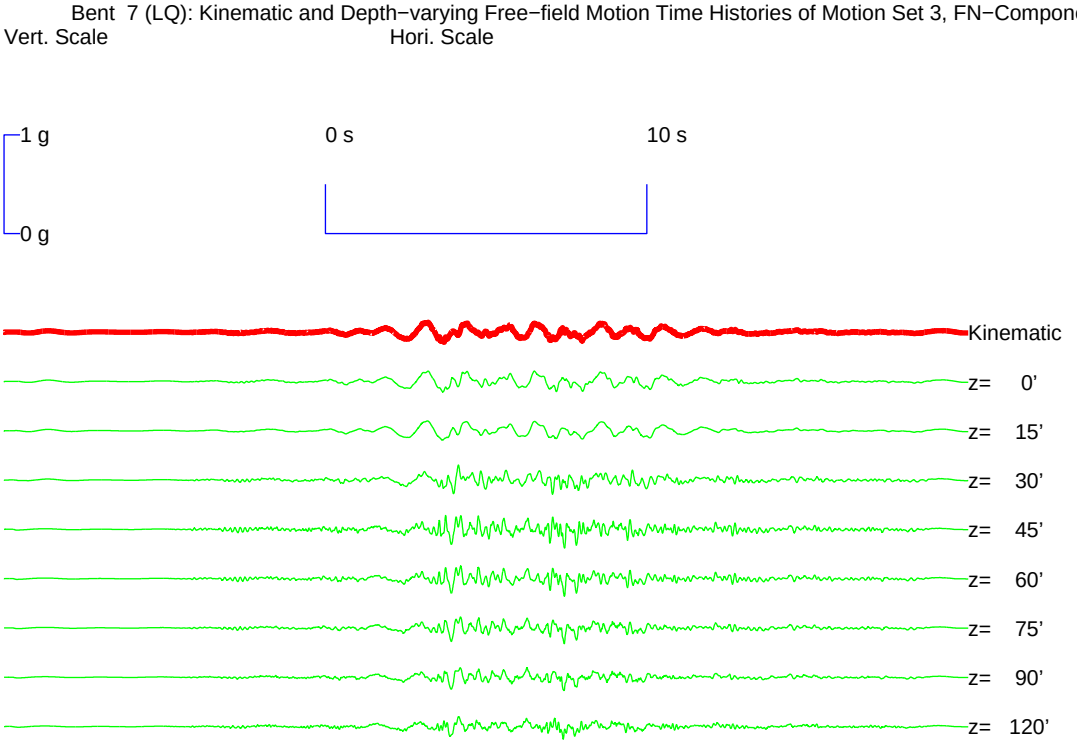
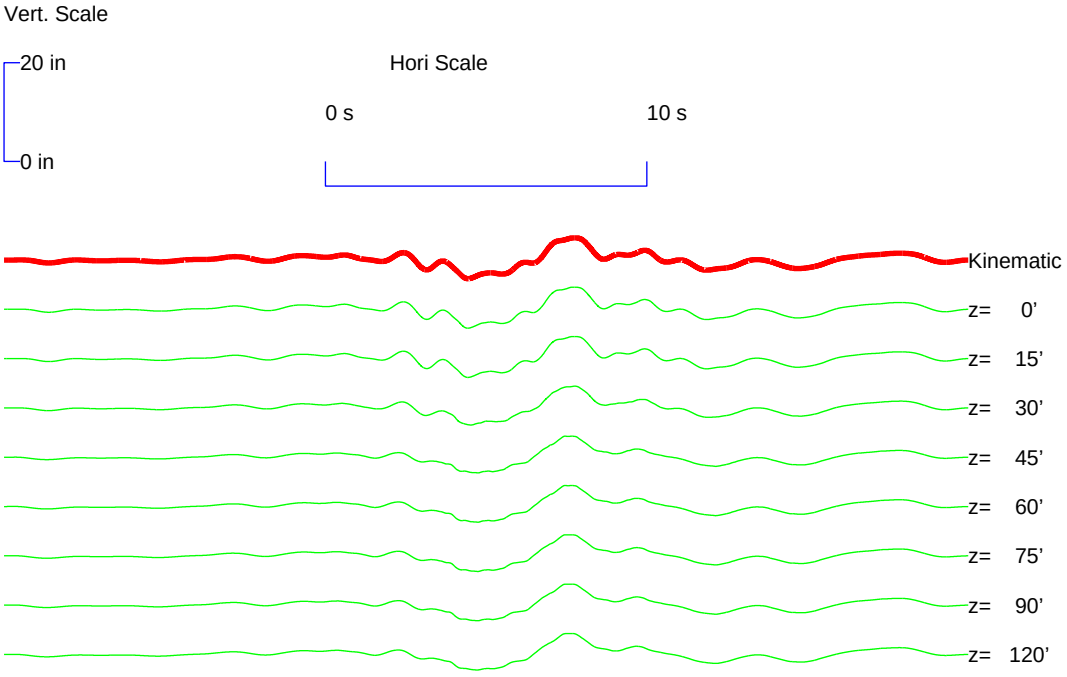
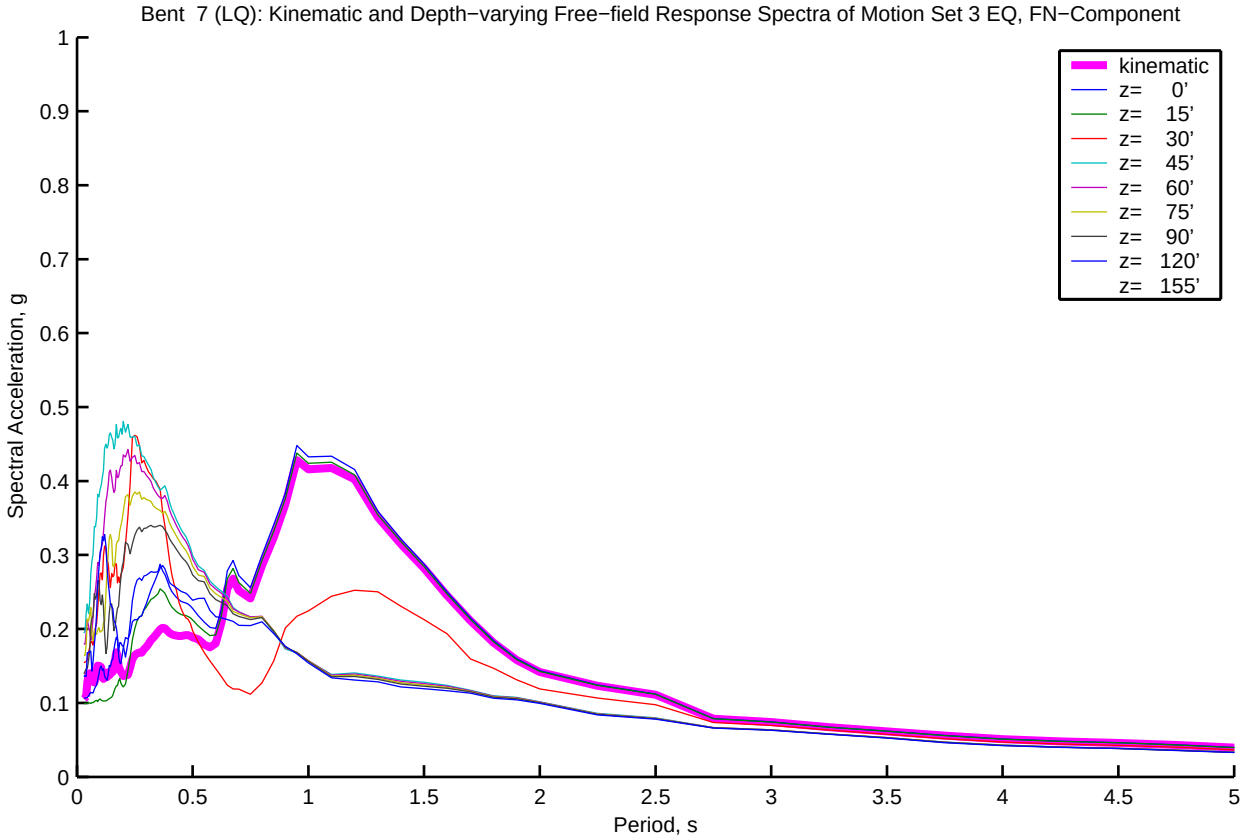
Bent 7 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component






Bent 7 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 155'
0
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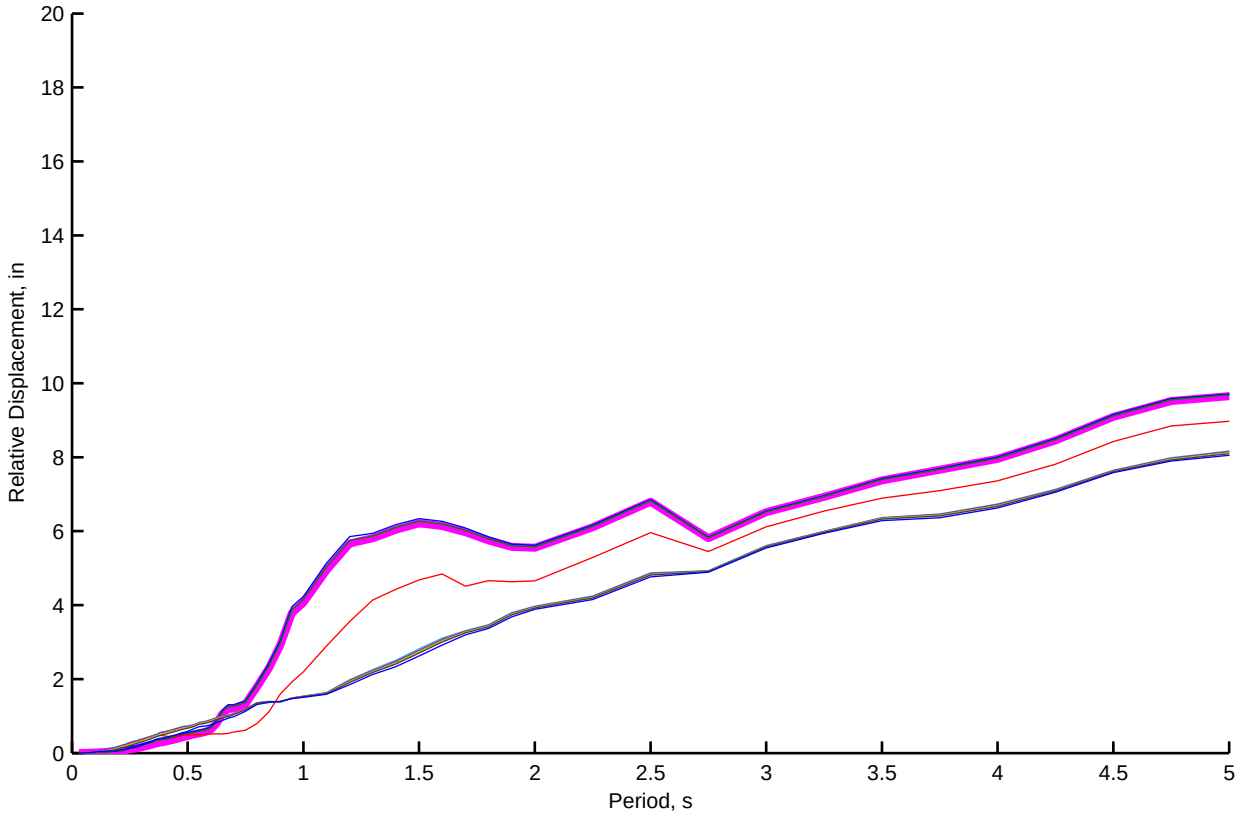
Relative Displacement, in
Period, s
0
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4
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12
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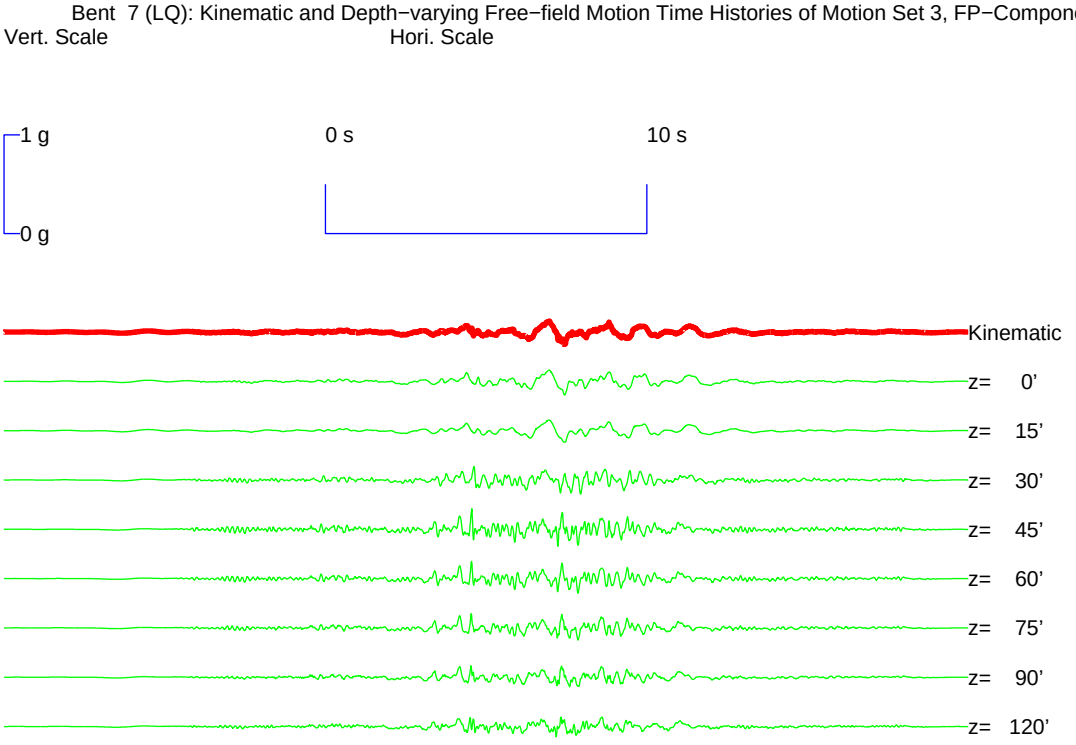
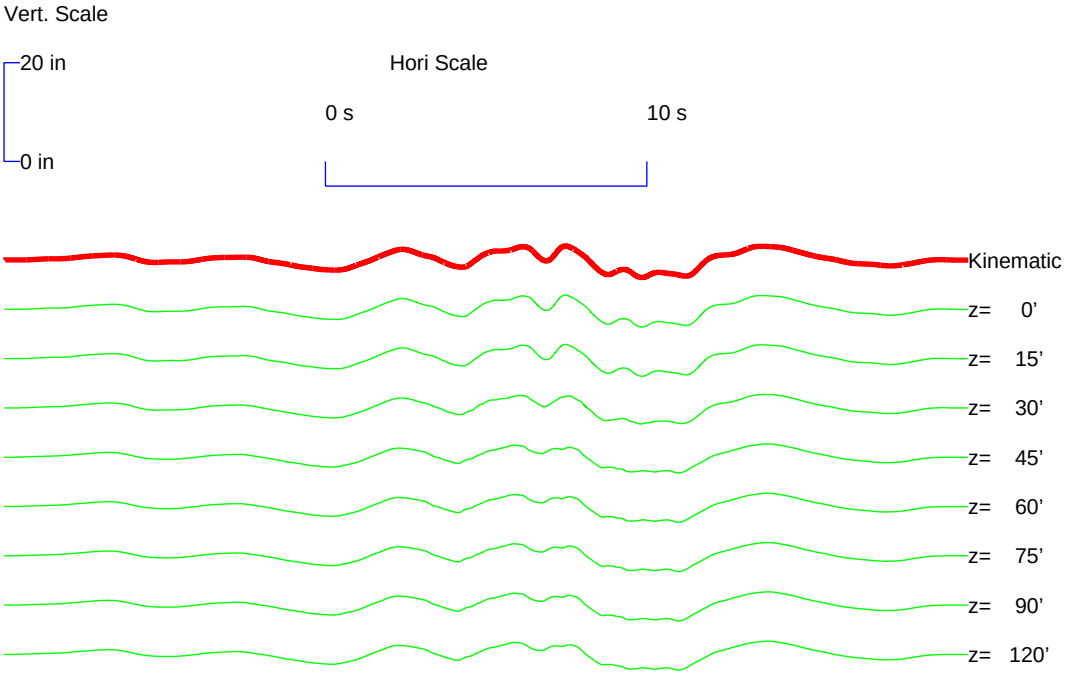
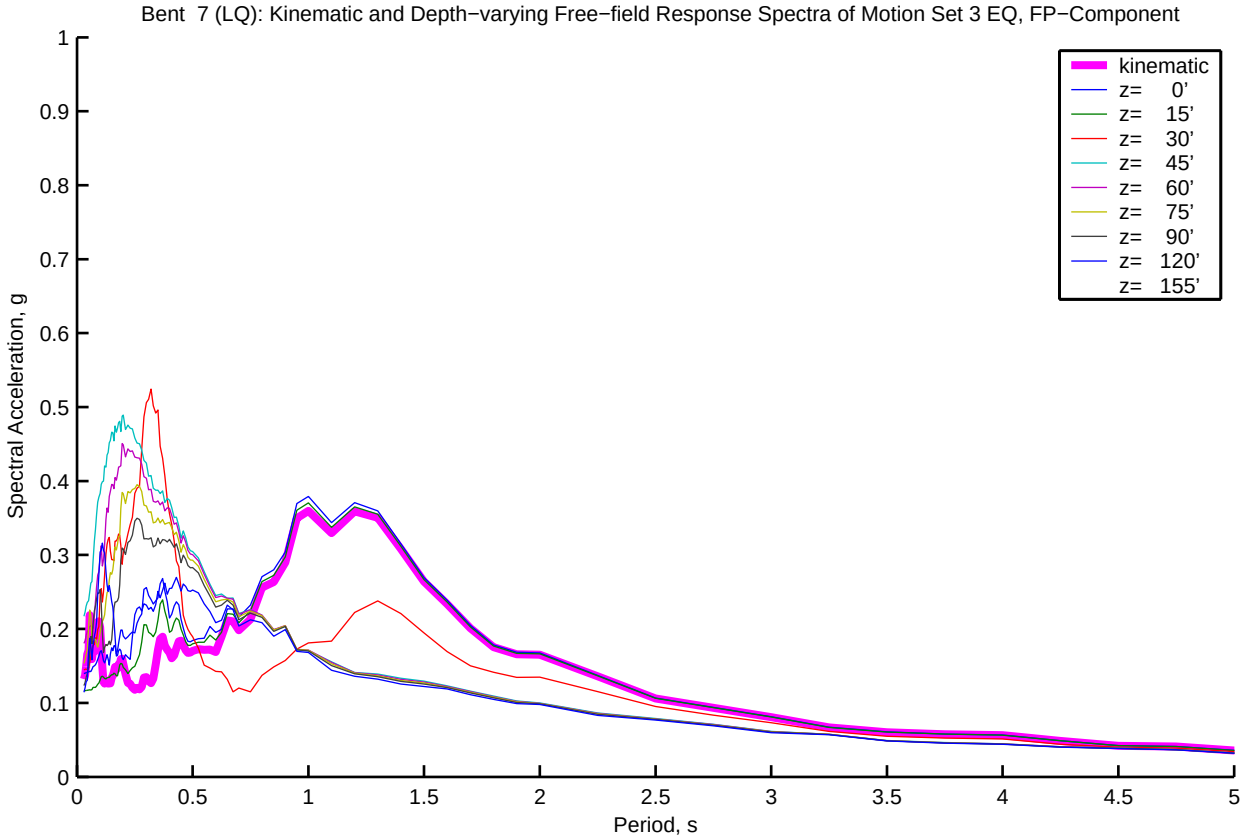
Bent 7 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component






Bent 7 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 155'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
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0.5
1.5
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2.5
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3.5
4
4.5
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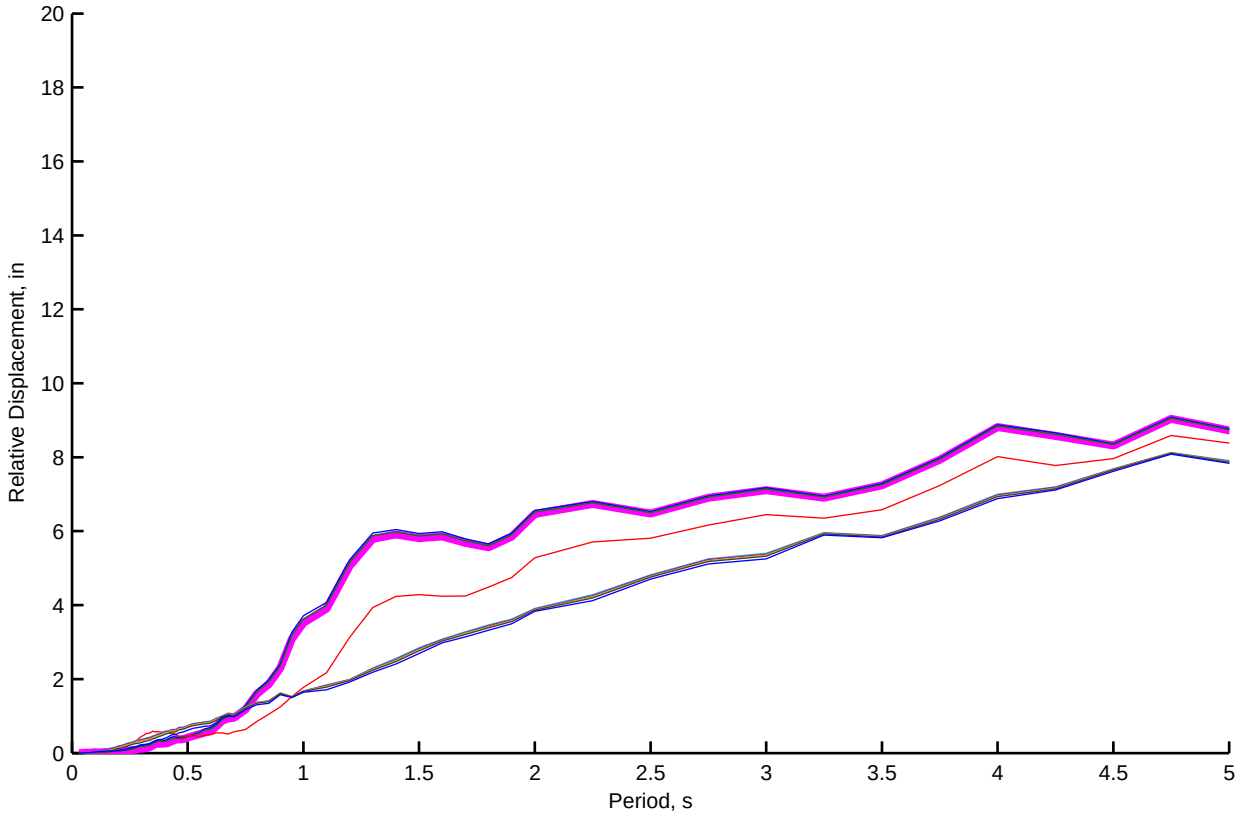
Relative Displacement, in
Period, s
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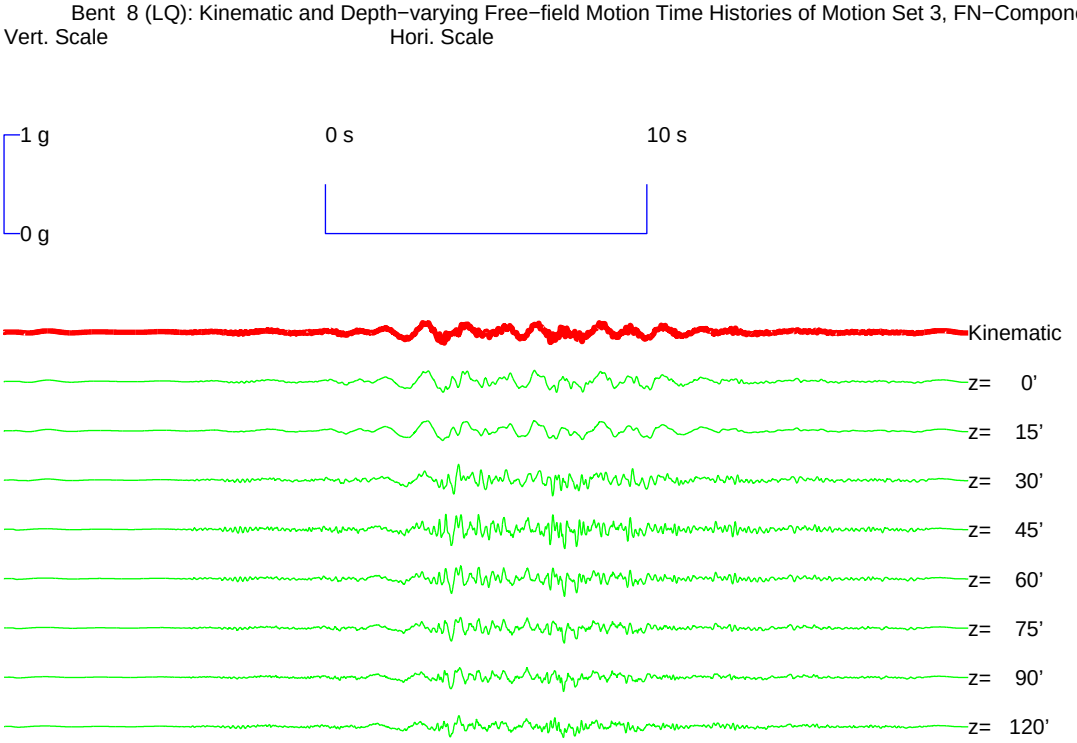
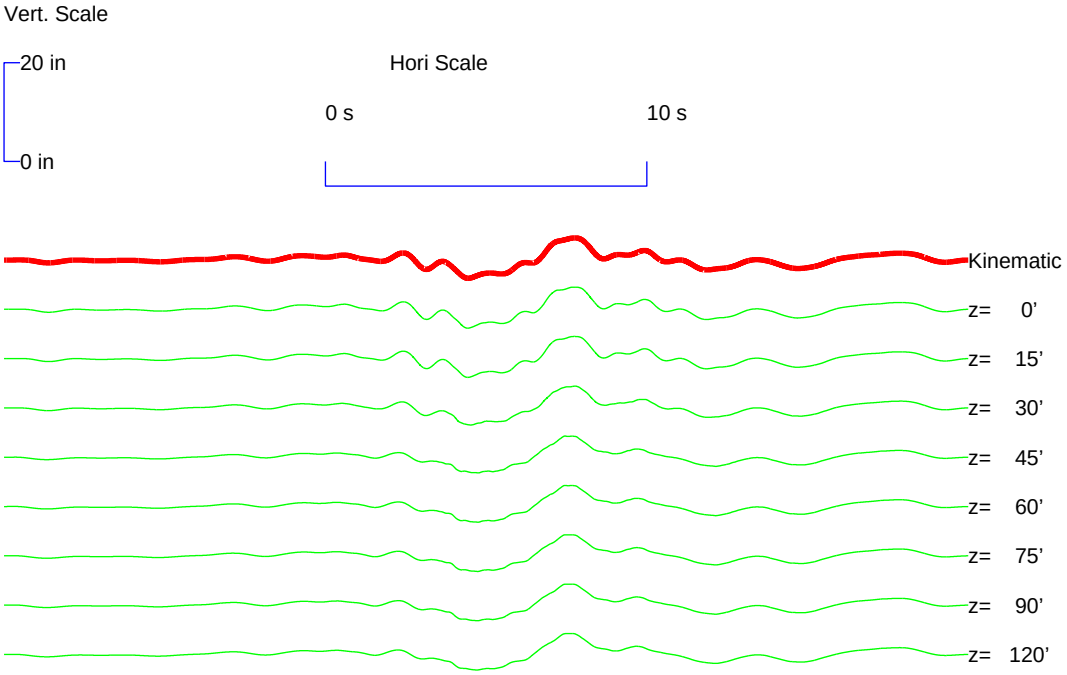
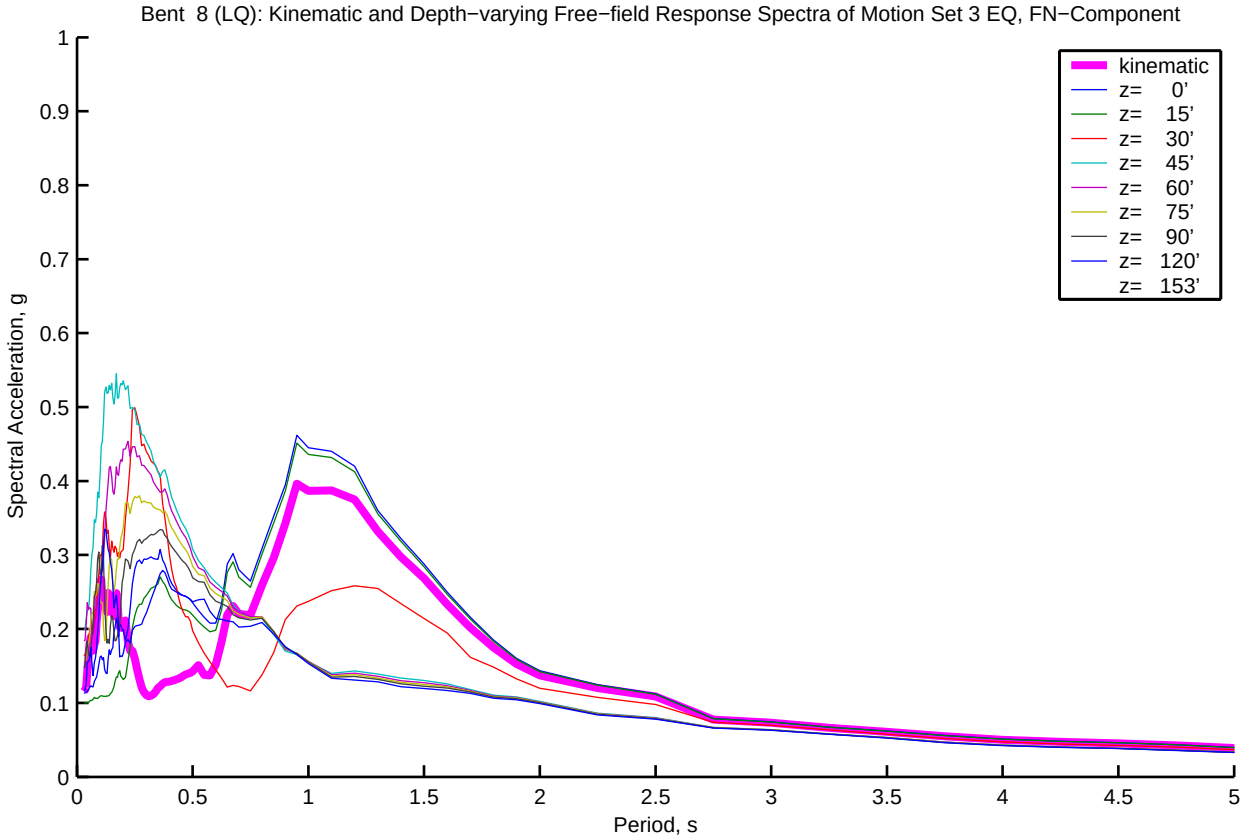
Bent 8 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component






Bent 8 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 153'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
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0.5
1.5
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2.5
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4.5
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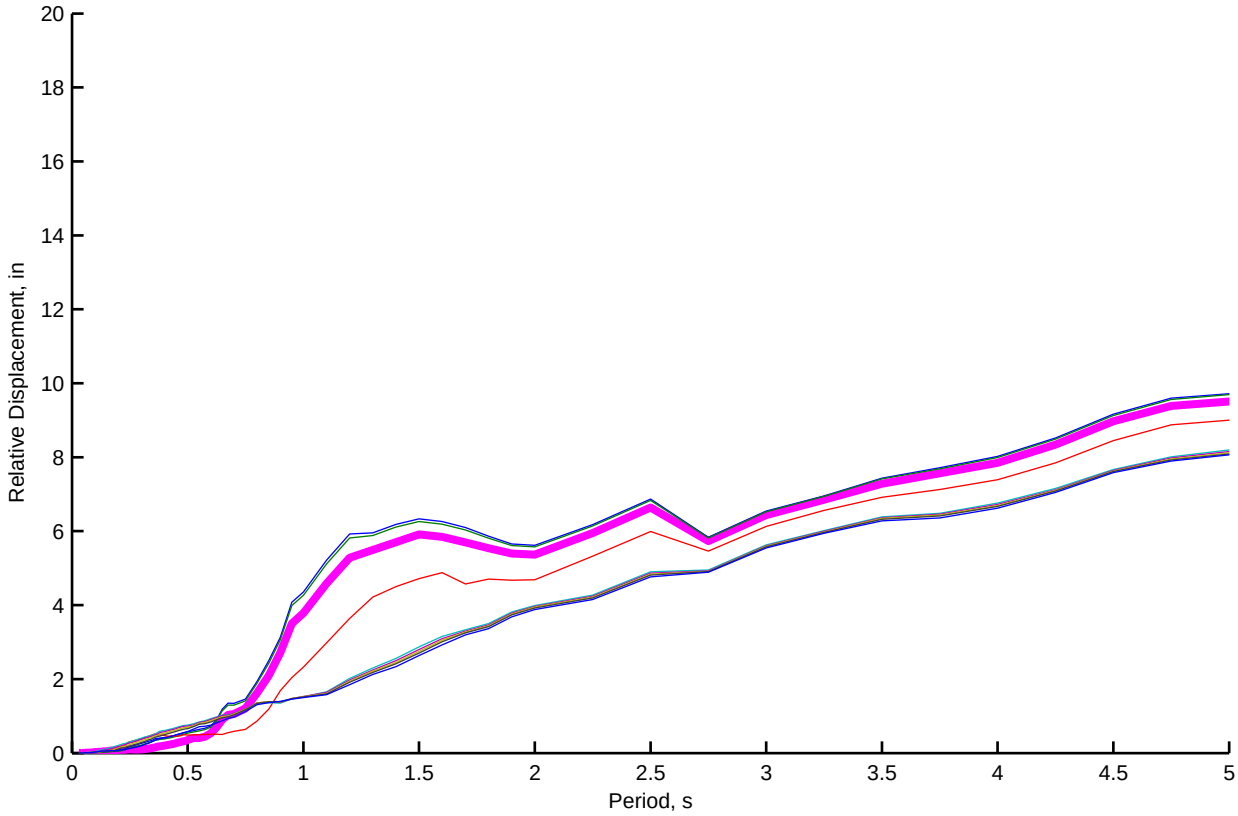
Relative Displacement, in
Period, s
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0.5
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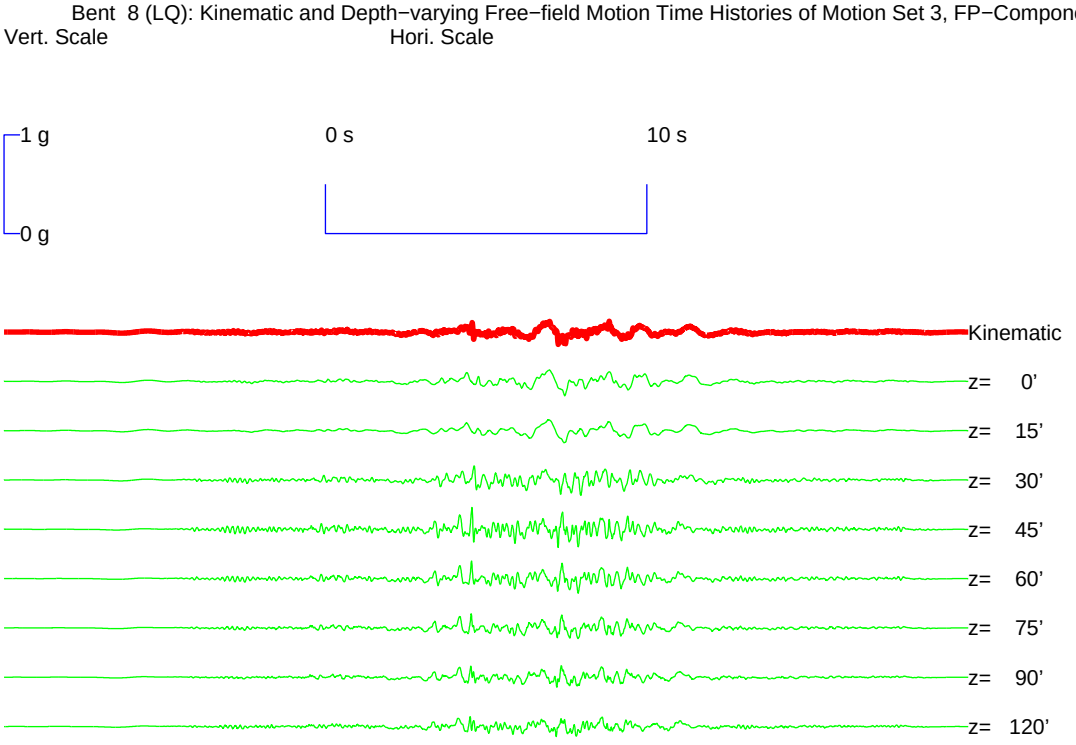
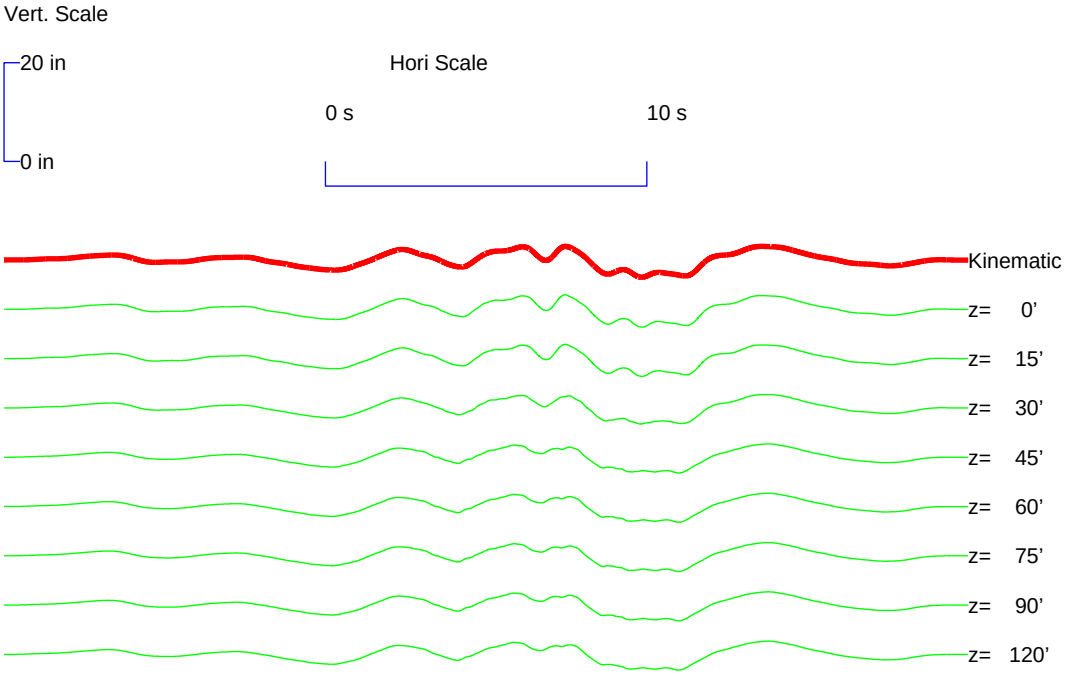
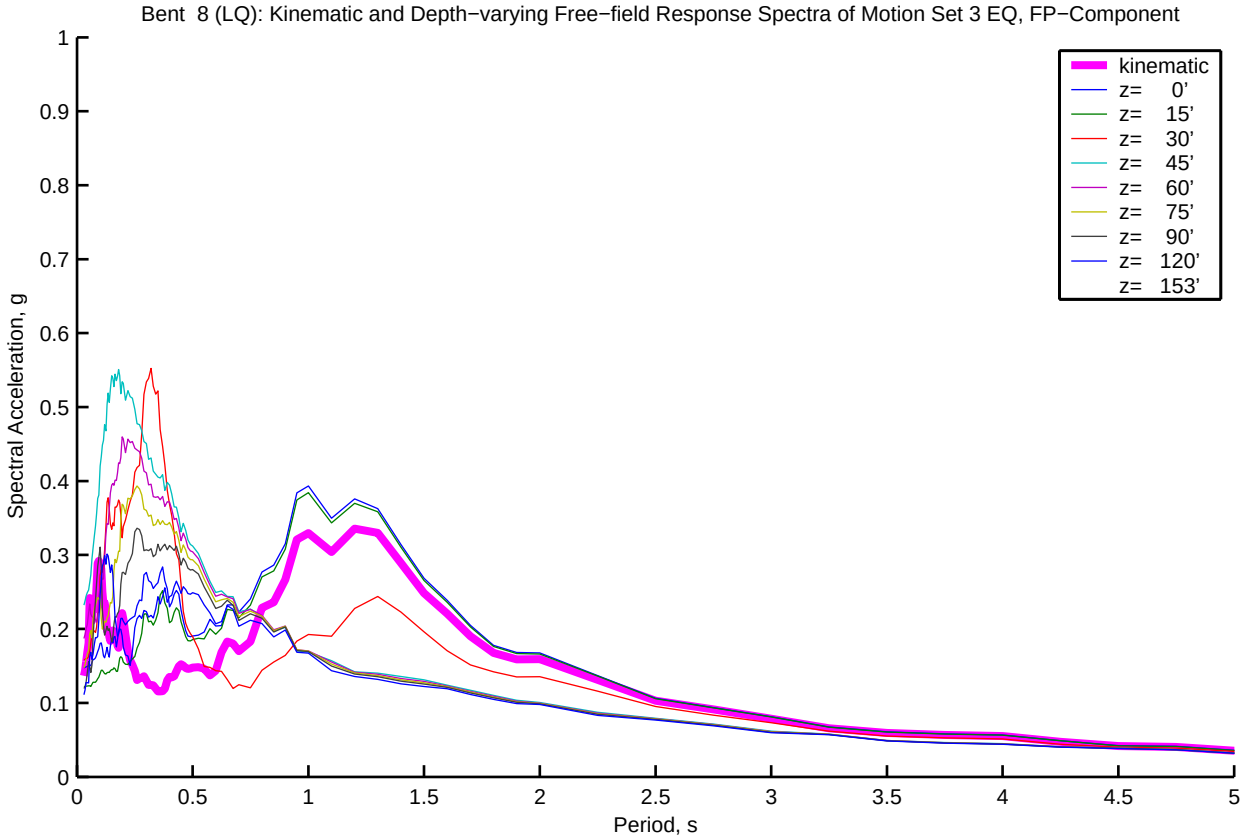
Bent 8 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component






Bent 8 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 120'
z= 153'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
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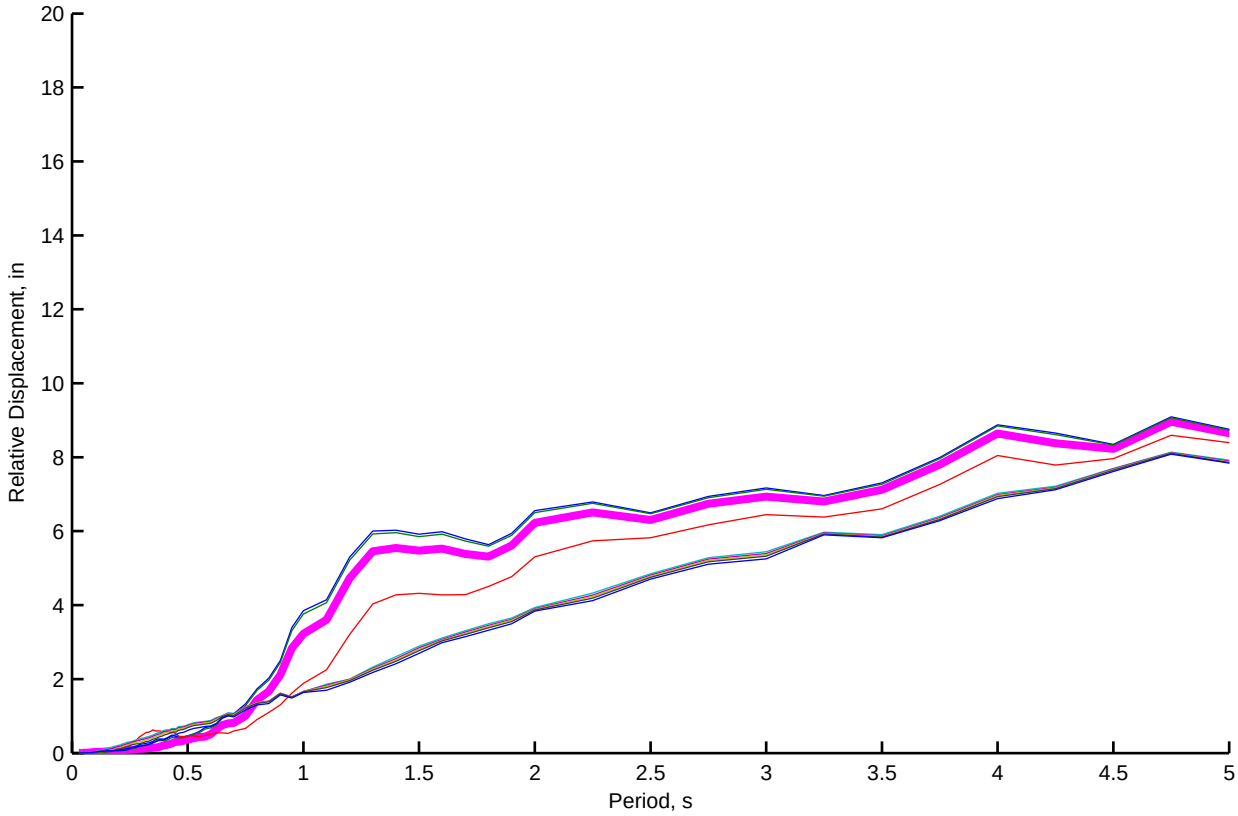
Relative Displacement, in
Period, s
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0.5
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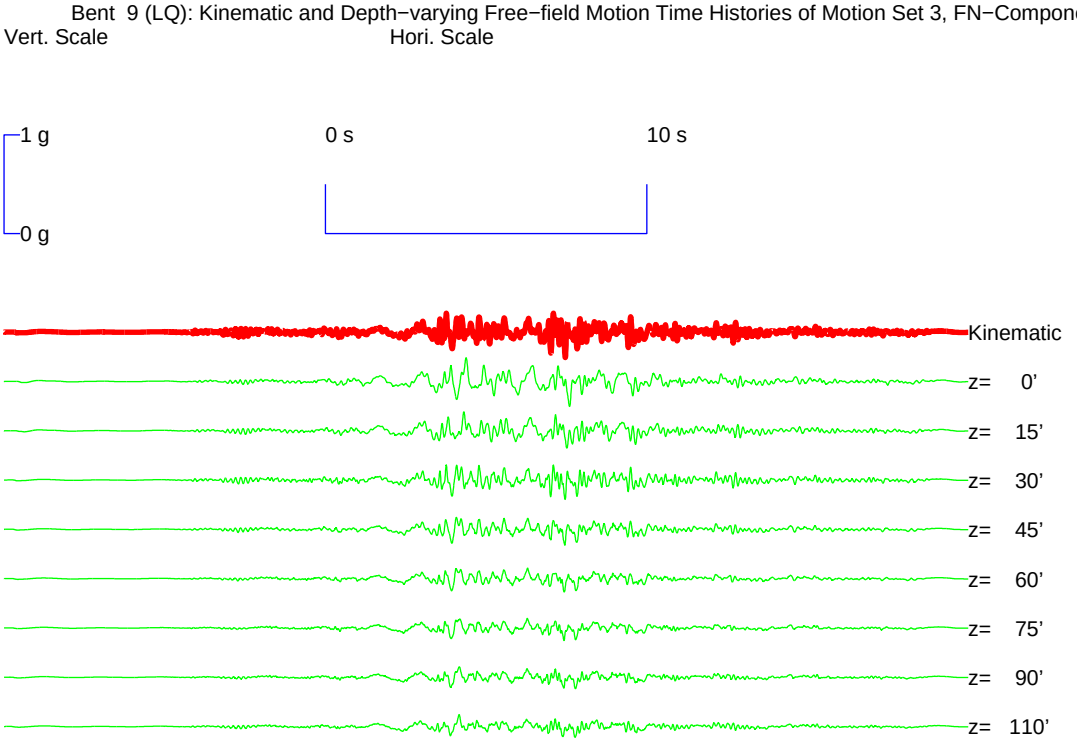
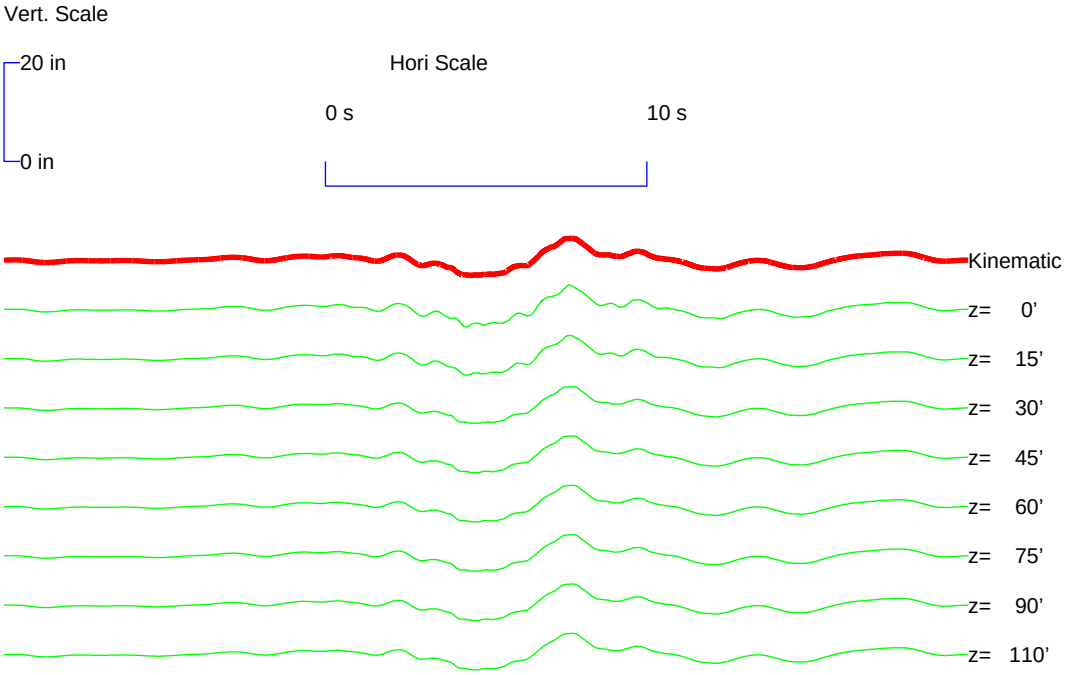
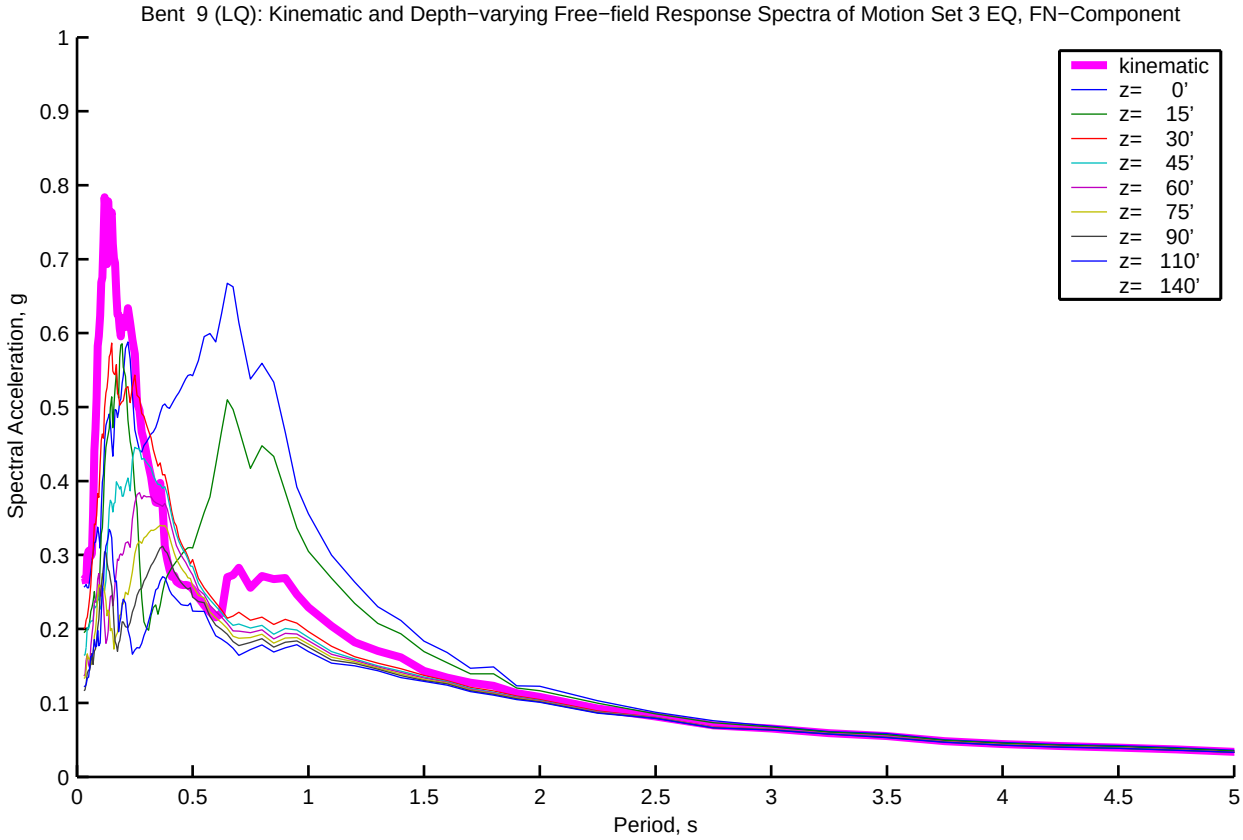
Bent 9 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component






Bent 9 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
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0.5
1.5
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3.5
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4.5
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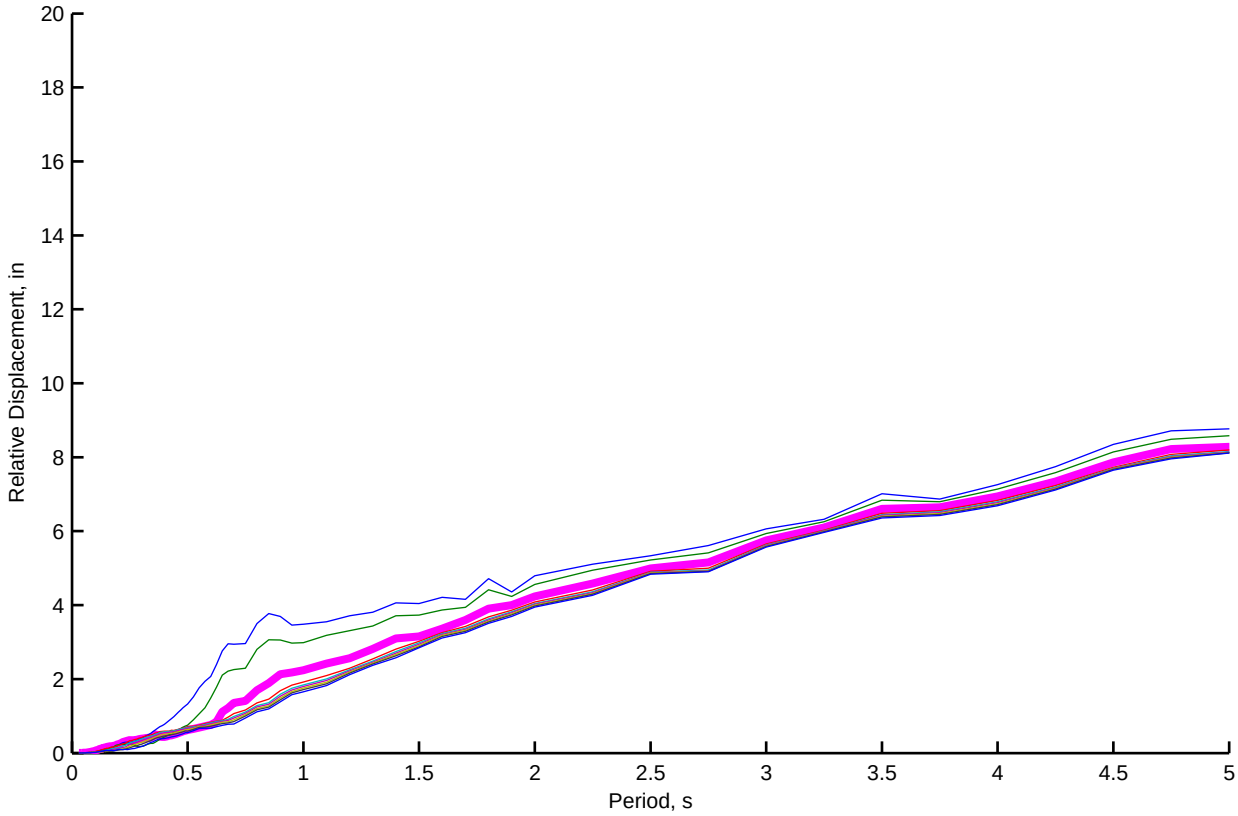
Relative Displacement, in
Period, s
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0.5
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4.5
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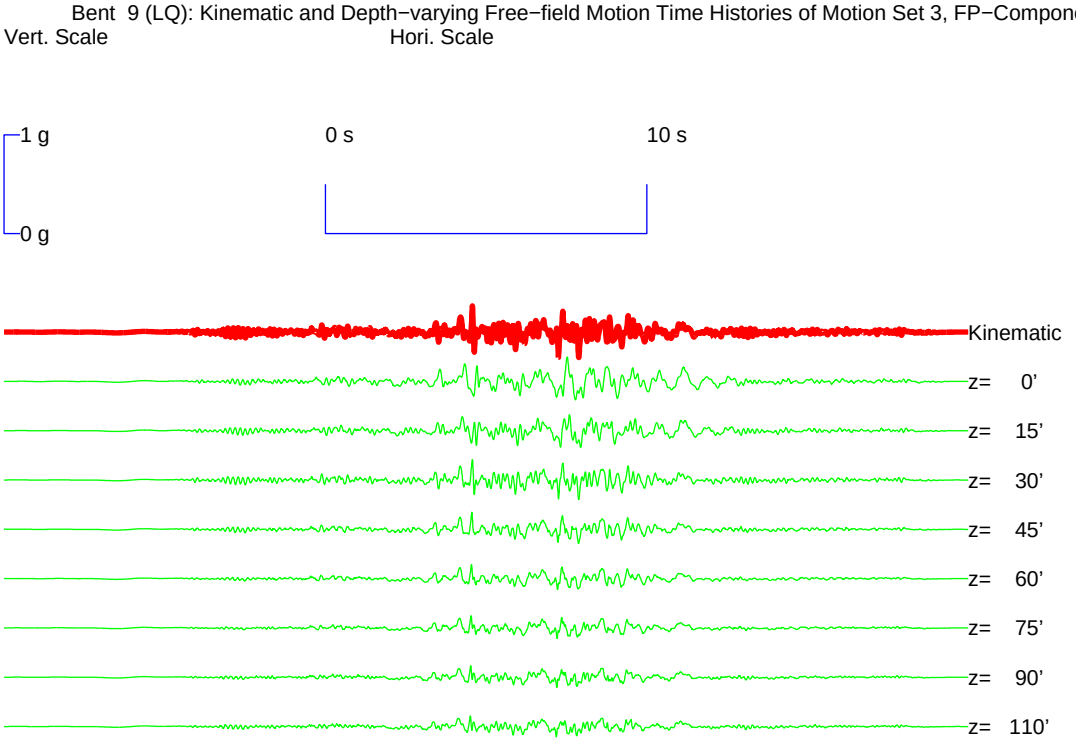
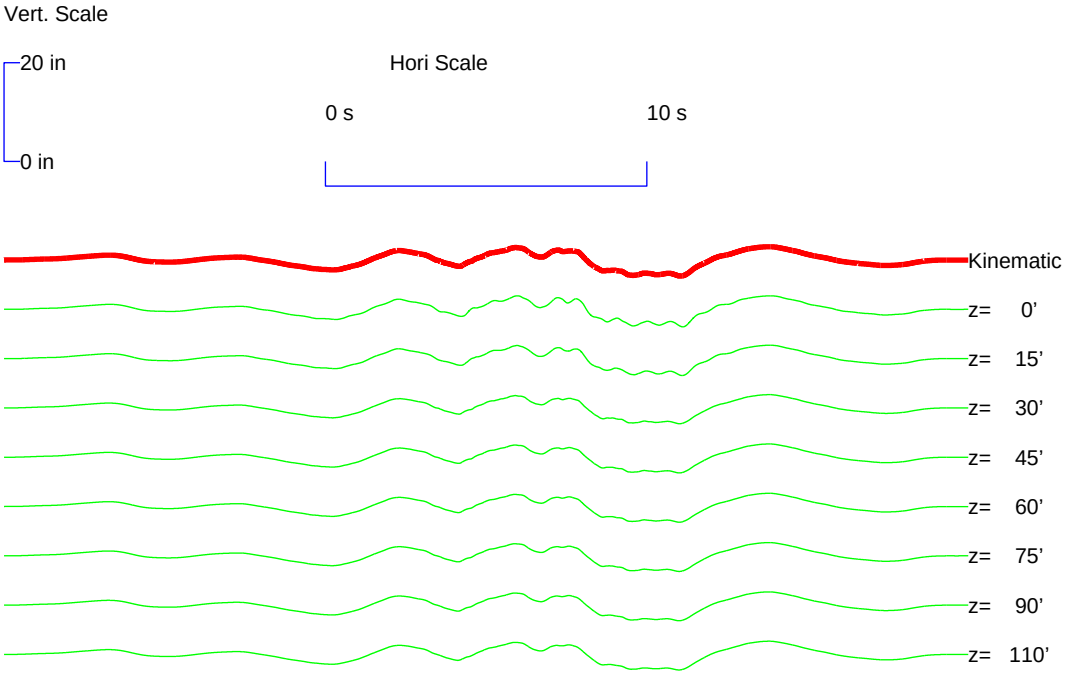
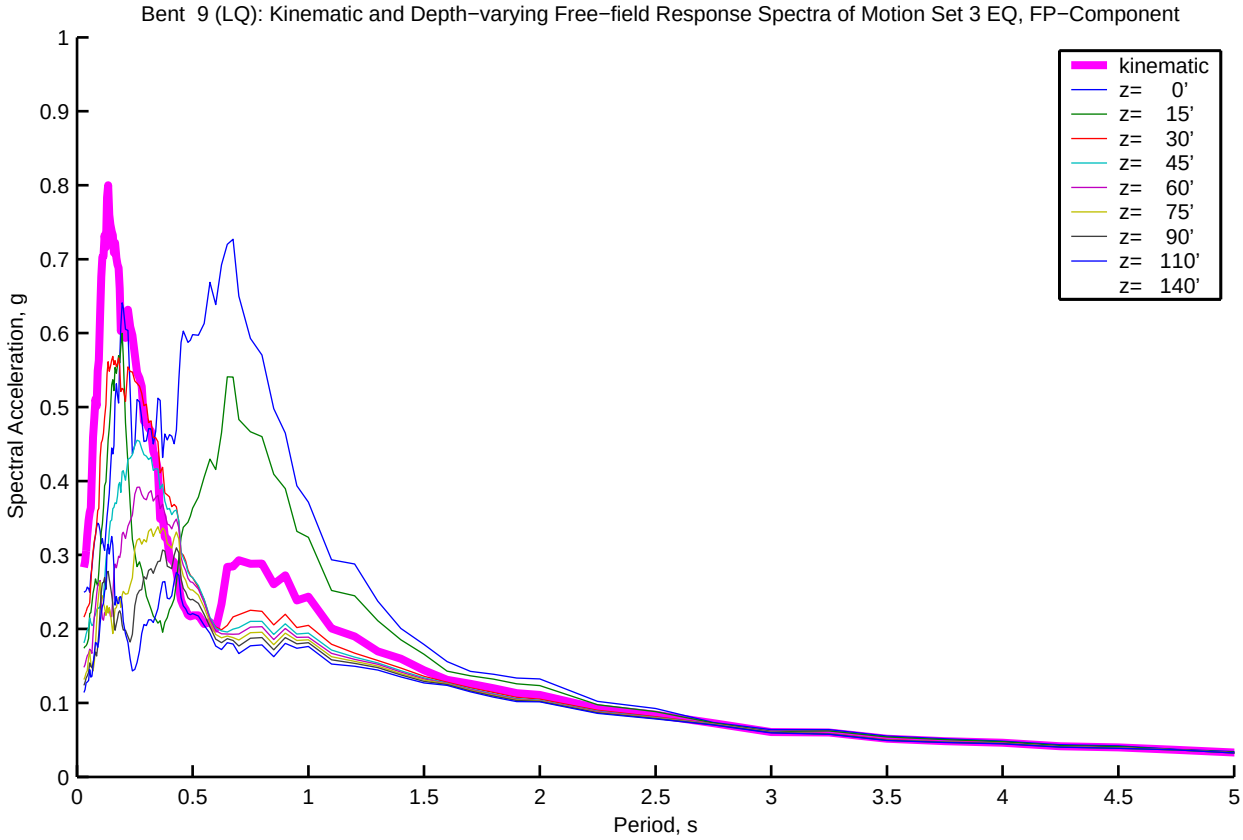
Bent 9 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component






Bent 9 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
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0.5
1.5
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2.5
3
3.5
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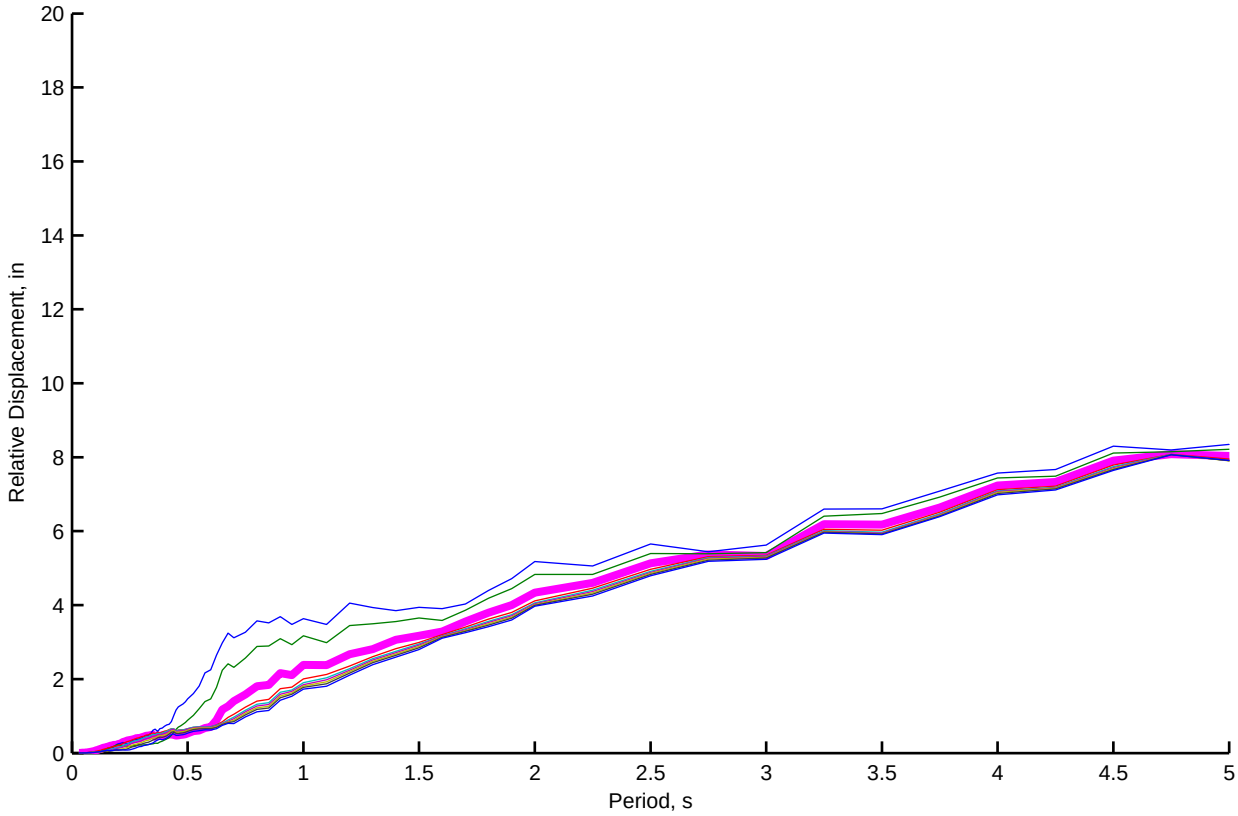
4.5
5


Relative Displacement, in
Period, s
0
2
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14
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0.5
1
1.5
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2.5
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3.5
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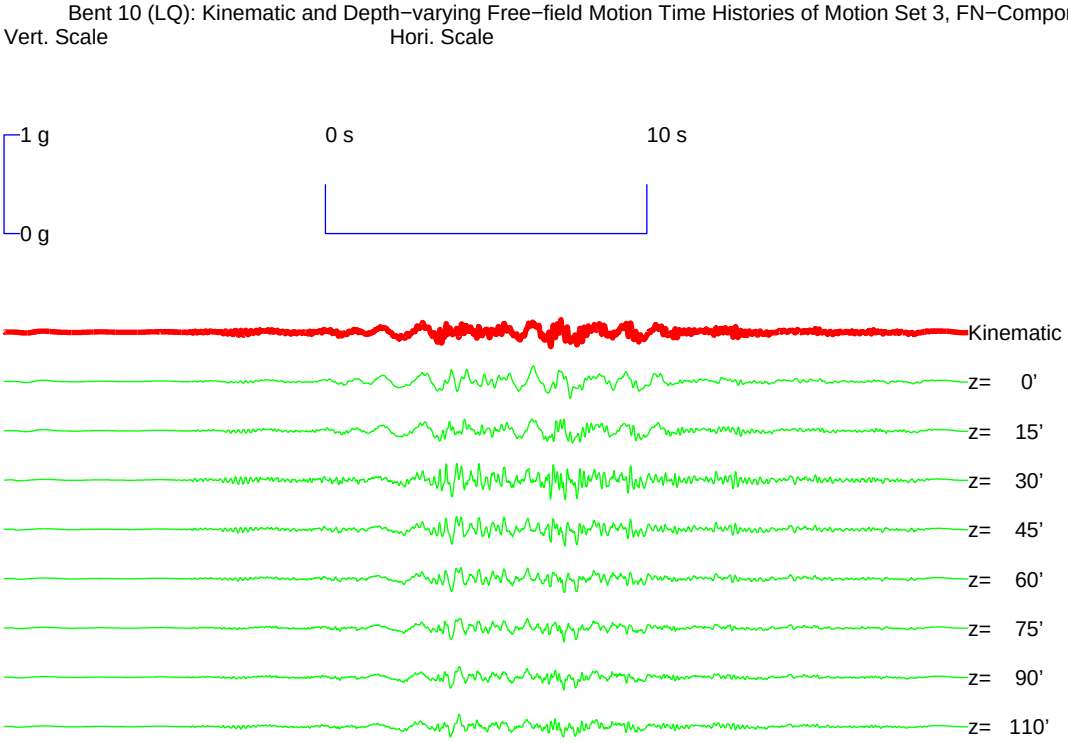
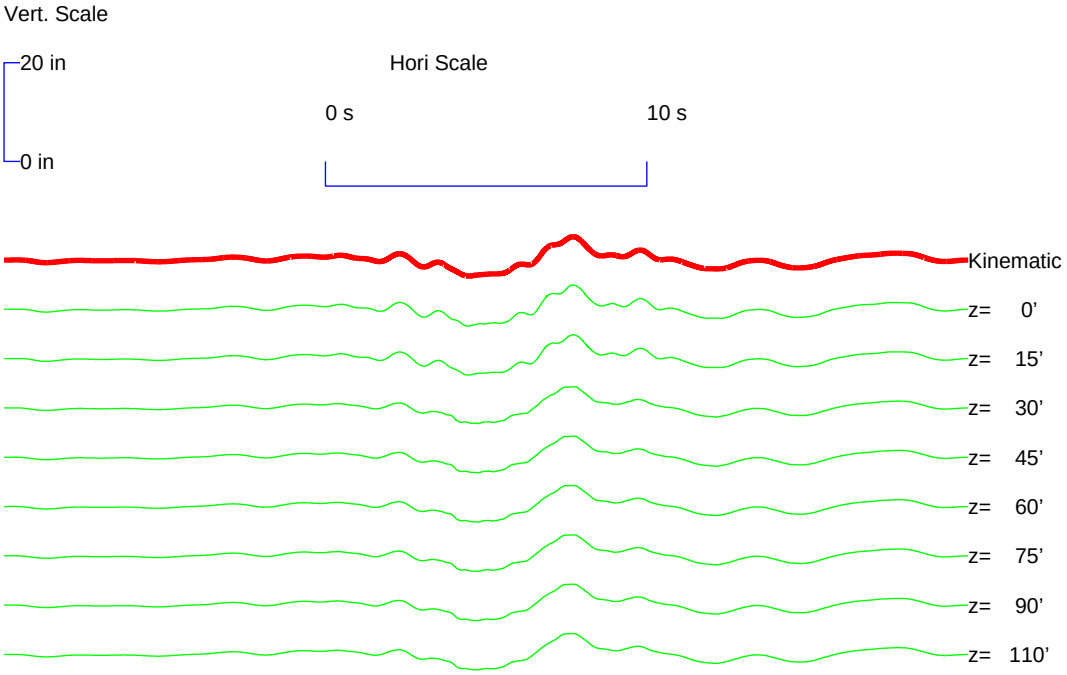
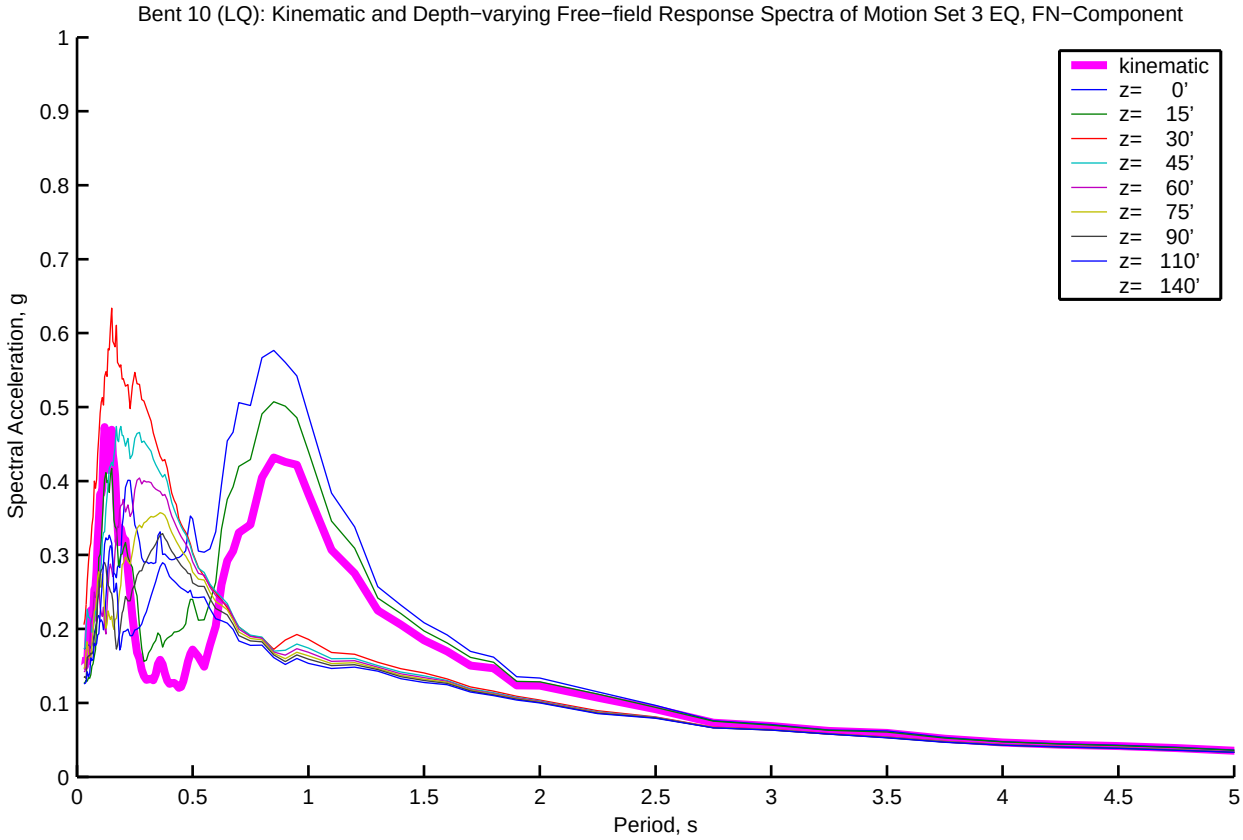
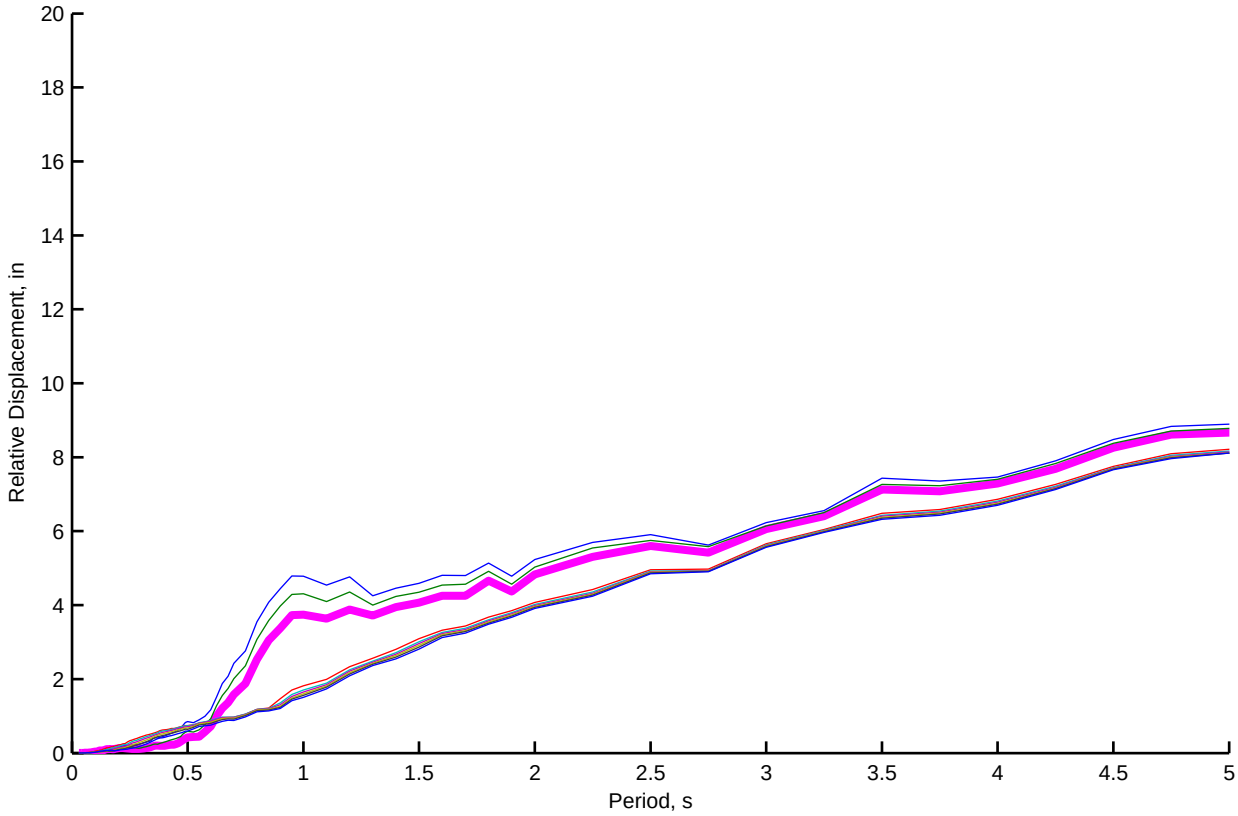
4.5
5

Bent 10 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FN−Component






Bent 10 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FN−Component
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'
Spectral Acceleration, g
Period, s
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.5
1.5
2
2.5
3
3.5
4
4.5
5


Relative Displacement, in
Period, s
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2.5
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3.5
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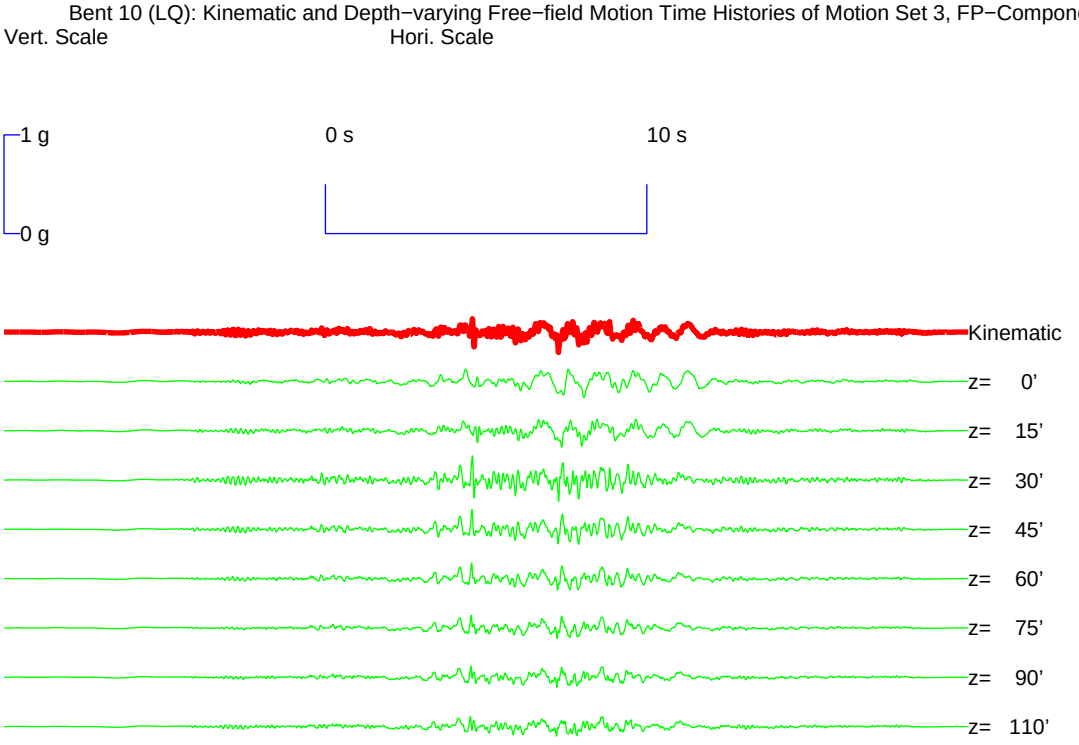
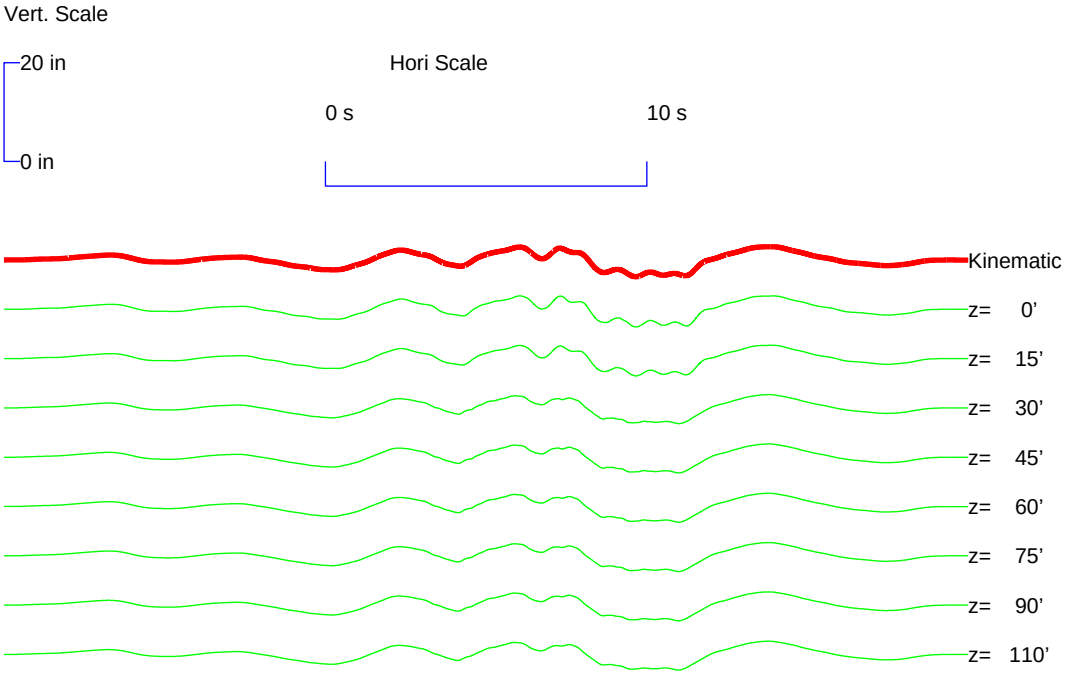
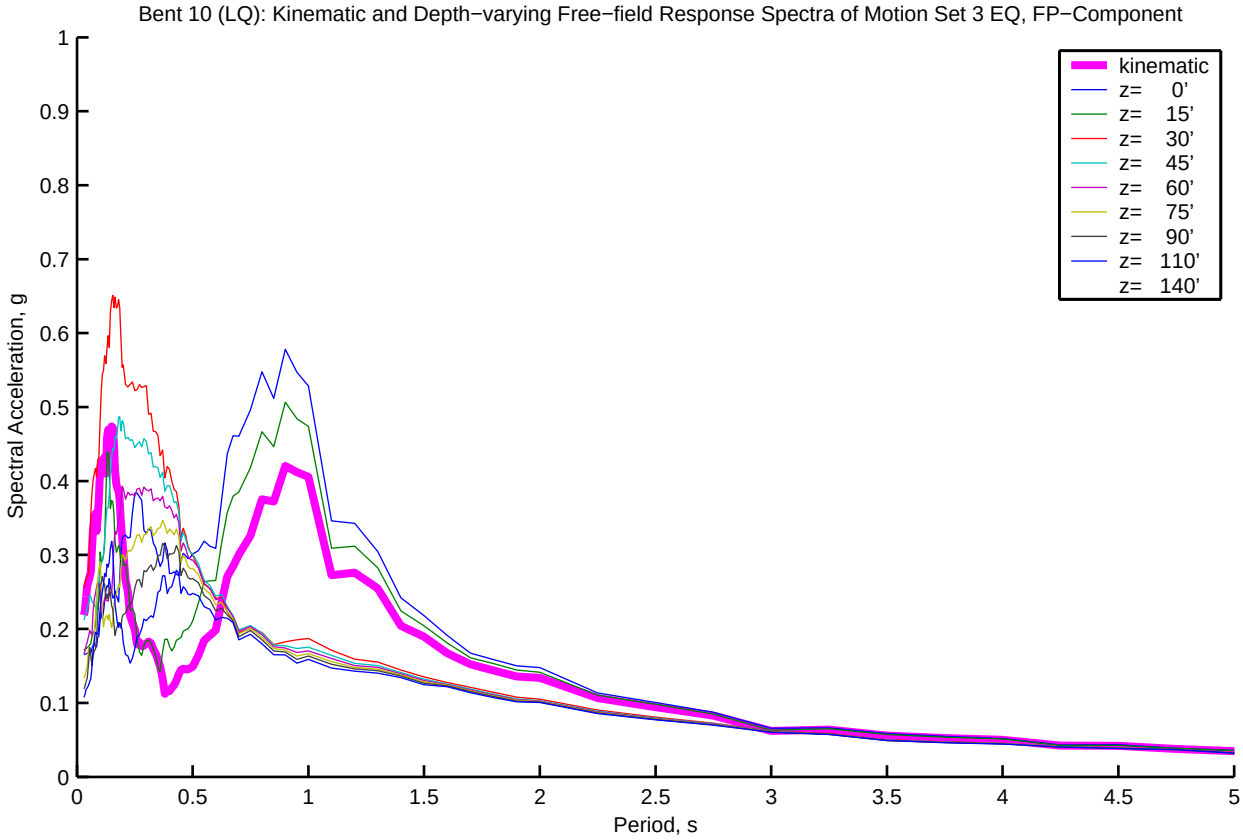
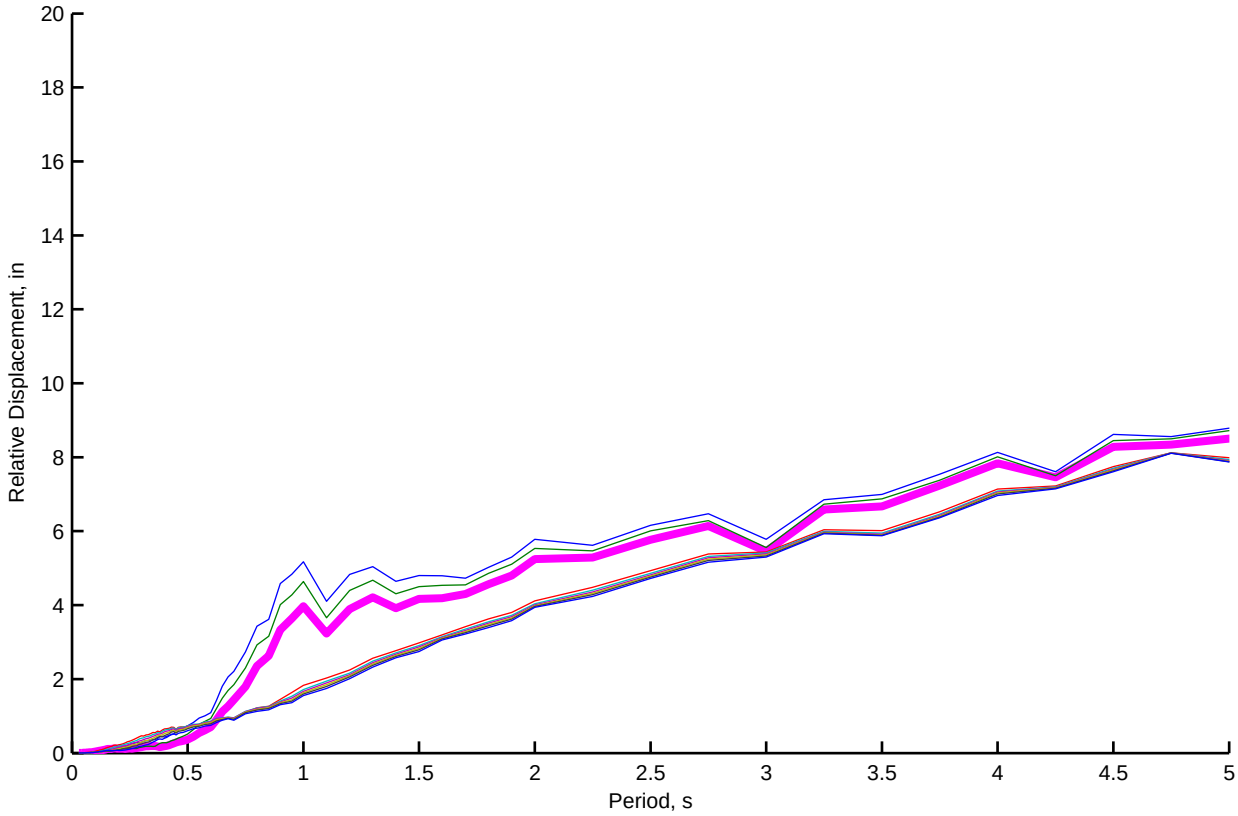
4.5
5

Bent 10 (LQ): Kinematic and Depth−varying Free−field Motion Time Histories of Motion Set 3, FP−Component






Bent 10 (LQ): Kinematic and Depth−varying Free−field Response Spectra of Motion Set 3 EQ, FP−Component
Spectral Acceleration, g
Period, s
kinematic
z= 0'
z= 15'
z= 30'
z= 45'
z= 60'
z= 75'
z= 90'
z= 110'
z= 140'


Relative Displacement, in
Period, s

APPENDIX E

ANALYSES AND CALCULATIONS

DRAFT

Liquefaction and Lateral Spreading Analysis

5th Street Bridge, Yuba City **EMI Project No.** **13-121** Version - 12/05

LIQUEFACTION ANALYSIS, ACC. = 0.227 g

Liquefaction analysis is performed following Seed's Procedure, outlined by Seed et al. (1985), Seed and Harder (1990), updated NCEER (1997), Martin et al. (1999) and Youd et al. (2001)

Calculated by: **TC 12/26/2013**

Checked by: AZ 8/19/2016

Emean/E60 = Energy Ratio to correct to standard 60% Energy
Surcharge = Any surcharge on top of the ground (psf)
acc. max = maximum peak acceleration at the ground surface (g's)
[1]C_N = square root of (100 kPa or 1.04427 tsf/effective overburden)
The induced cyclic stress ratio (CSR i) by a given peak ground acceleration (acc. max) is:

CSR i = 0.65 x acc max. x total normal stress x rd / (effective normal stress x g)

The resisting cyclic stress ratio (CRR r) is equal to:
CRR r = $CRR_{7.5}$ x Cm x K sigma

where: Cm = Earthquake Magnitude Correction Factor (Blake, NCEER Table 3, Eq.4)
K sigma = Normalized resistance factor (Fig. 14 from NCEER Liquefaction workshop, Harder Boulanger)
$CRR_{7.5}$ = Resisting Cyclic Stress Ratio. It is a function of the content of fines
(Figure 2, NCEER Workshop, after Seed et al 1985))

Factor of Safety, F_L is:
F_L = CRR r / CSR i

R-13-001

Emean (%)	86	Present Ground El.	85	Borehole Dia. (in)	5	Tot. Unit Wt. (pcf)	25.0	=Design Water Table Depth.	44.0	=Field Water Table Depth.	Acc. max =	0.227	g	Earthq. I	6.5
C_E	1.43	Future Ground El.	85	C_B	1.00	120	60	=Design Water El.	41	=Field Water El.				Cm=	1.44

DEPTH OF SOIL SAMPLE (ft.)	EL. (ft.)	SOIL TYPE	FIELD BLOW COUNT N	SAMPLER TYPE 1=SPT =CA.MOI	SAMPLER LINED 1=UNLINED 2=LINED	EST. PERCENT OF FINES (%)	DESIGN TOTAL OVERBUR. PRESS. (tsf)	PRESENT EFFEC. OVERBUR. PRESS. (tsf)	C_N	C_R	C_S	C_{ST}	STRESS REDUC. COEFF. rd	DESIGN EFFEC. OVERBUR. PRESS. (tsf)	INDUCED CYCLIC STRESS RATIO	CORRECT BLOW COUNT N160	(N1)60cs	K sigma	CYCLIC STRESS RATIO M=7.5	CYCLIC STRESS RATIO verburd Cc Mag Corr	RESIST. FACTOR OF SAFETY (F_L)	RESIST. WILL IT LIQUEFY?
-			-	-		-	-	-	-				-	-	-	-		-	-		-	-
5	80	SC	26	2	2	40.0	0.30	0.30	1.70	0.80	1.00	0.67	0.99	0.30	0.15	34	46	1.00	High N	0.00	LARGE	AboveWT
10	75	SC	4	1	1	40.0	0.60	0.60	1.32	0.85	1.20	1.00	0.98	0.60	0.14	8	14	1.00	0.15	0.22	1.53	AboveWT
15	70	SC	4	2	2	40.0	0.90	0.90	1.08	0.85	1.00	0.67	0.97	0.90	0.14	3	9	1.00	0.11	0.15	1.07	AboveWT
20	65	SC	3	1	1	40.0	1.20	1.20	0.93	0.95	1.20	1.00	0.95	1.20	0.14	5	10	0.97	0.12	0.16	1.17	AboveWT
25	60	CL	4	2	2	60.0	1.50	1.50	0.83	0.95	1.00	0.67	0.94	1.50	0.14	3	9	0.93	0.10	0.14	0.98	fines
30	55	SC	3	1	1	40.0	1.80	1.80	0.76	1.00	1.20	1.00	0.93	1.64	0.15	4	10	0.91	0.11	0.15	0.97	yes
35	50	SM	15	2	2	30.0	2.10	2.10	0.71	1.00	1.00	0.67	0.89	1.79	0.15	10	16	0.89	0.17	0.22	1.45	no
40	45	ML	16	1	1	60.0	2.40	2.40	0.66	1.00	1.20	1.00	0.85	1.93	0.16	18	27	0.87	0.33	0.42	2.68	fines
45	40	ML?	1	2	2	60.0	2.70	2.67	0.63	1.00	1.00	0.67	0.81	2.08	0.15	1	6	0.87	0.08	0.10	0.63	fines
50	35	ML	18	1	1	75.0	3.00	2.81	0.61	1.00	1.20	1.00	0.77	2.22	0.15	19	28	0.86	0.36	0.44	2.90	fines
55	30	ML	100	2	2	75.0	3.30	2.96	0.59	1.00	1.00	0.67	0.73	2.36	0.15	57	73	0.85	High N	0.00	LARGE	high N
60	25	CL	52	1	1	95.0	3.60	3.10	0.58	1.00	1.20	1.00	0.69	2.51	0.15	52	67	0.84	High N	0.00	LARGE	high N
65	20	ML	24	2	2	90.0	3.90	3.24	0.57	1.00	1.00	0.67	0.64	2.65	0.14	13	21	0.83	0.22	0.27	1.90	fines
70	15	SP	31	1	1	5.0	4.20	3.39	0.56	1.00	1.20	1.00	0.60	2.80	0.13	30	30	0.82	0.44	0.52	3.88	depth>50'
80	5	SP	27	1	1	5.0	4.80	3.68	0.53	1.00	1.20	1.00	0.55	3.08	0.13	25	25	0.78	0.29	0.32	2.55	depth>50'
90	-5	SP/SM	66	2	2	10.0	5.40	3.96	0.51	1.00	1.00	0.67	0.52	3.37	0.12	32	34	0.76	High N	0.00	LARGE	high N
100	-15	SP-SM	50	1	1	10.0	6.00	4.25	0.50	0.95	1.20	1.00	0.50	3.66	0.12	40	42	0.74	High N	0.00	LARGE	high N
110	-25	SM	67	2	2	40.0	6.60	4.54	0.48	0.95	1.00	0.67	0.50	3.95	0.12	29	40	0.73	High N	0.00	LARGE	high N
120	-35	CL	68	1	1	80.0	7.20	4.83	0.46	0.95	1.20	1.00	0.50	4.24	0.13	52	67	0.71	High N	0.00	LARGE	high N
130	-45	CL	100	2	2	95.0	7.80	5.12	0.45	0.95	1.00	0.67	0.50	4.52	0.13	41	54	0.70	High N	0.00	LARGE	high N
140	-55	CL	39	1	1	95.0	8.40	5.40	0.44	0.95	1.20	1.00	0.50	4.81	0.13	28	39	0.68	High N	0.00	LARGE	high N
150	-65	CL	100	2	2	95.0	9.00	5.69	0.43	0.95	1.00	0.67	0.50	5.10	0.13	39	52	0.67	High N	0.00	LARGE	high N
160	-75	MH	25	1	1	90.0	9.60	5.98	0.42	0.95	1.20	1.00	0.50	5.39	0.13	17	25	0.66	0.30	0.29	2.19	fines
169	-84	RF	100	1	1	2.0	10.14	6.24	0.41	0.95	1.20	1.00	0.50	5.65	0.13	67	67	0.66	High N	0.00	LARGE	high N

5th Street Bridge, Yuba City **EMI Project No.** **13-121** Version - 12/05

LIQUEFACTION ANALYSIS, ACC. = 0.227 g

Liquefaction analysis is performed following Seed's Procedure, outlined by Seed et al. (1985), Seed and Harder (1990), updated NCEER (1997), Martin et al. (1999) and Youd et al. (2001)

Calculated by: **TC 12/26/2013**

Checked by: AZ 8/19/2016

Emean/E60 = Energy Ratio to correct to standard 60% Energy
Surcharge = Any surcharge on top of the ground (psf)
acc. max = maximum peak acceleration at the ground surface (g's)
[1]C_N = square root of (100 kPa or 1.04427 tsf/effective overburden)
The induced cyclic stress ratio (CSR i) by a given peak ground acceleration (acc. max) is:

CSR i = 0.65 x acc max. x total normal stress x rd / (effective normal stress x g)

The resisting cyclic stress ratio (CRR r) is equal to:
CRR r = $CRR_{7.5}$ x Cm x K sigma

where: Cm = Earthquake Magnitude Correction Factor (Blake, NCEER Table 3, Eq.4)
K sigma = Normalized resistance factor (Fig. 14 from NCEER Liquefaction workshop, Harder Boulanger)
$CRR_{7.5}$ = Resisting Cyclic Stress Ratio. It is a function of the content of fines
(Figure 2, NCEER Workshop, after Seed et al 1985))

Factor of Safety, F_L is:
F_L = CRR r / CSR i

R-13-004

Emean (%)	86	Present Ground El.	55	Borehole Dia. (in)	5	Tot. Unit Wt. (pcf)	0.0	=Design Water Table Depth.	10.0	=Field Water Table Depth.	Acc. max =	0.227	g	Earthq. M	6.5
C_E	1.43	Future Ground El.	55	C_B	1.00	120	55	=Design Water El.	45	=Field Water El.				Cm=	1.44

DEPTH OF SOIL SAMPLE (ft.)	EL. (ft.)	SOIL TYPE	FIELD BLOW COUNT N	SAMPLER TYPE 1=SPT =CA.MOI	SAMPLER LINED 1=UNLINED 2=LINED	EST. PERCENT OF FINES (%)	DESIGN TOTAL OVERBUR. PRESS. (tsf)	PRESENT EFFEC. OVERBUR. PRESS. (tsf)	C_N	C_R	C_S	C_{ST}	STRESS REDUC. COEFF. rd	DESIGN EFFEC. OVERBUR. PRESS. (tsf)	INDUCED CYCLIC STRESS RATIO	CORRECT BLOW COUNT N160	(N1)60cs	K sigma	CYCLIC STRESS RATIO M=7.5	CYCLIC STRESS RATIO verburd Cc Mag Corr	RESIST. FACTOR OF SAFETY (F_L)	RESIST. WILL IT LIQUEFY?
-			-	-		-	-	-	-				-	-	-	-		-	-		-	-
5	50	SM	8	1	1	25.0	0.30	0.30	1.70	0.80	1.20	1.00	0.99	0.14	0.30	19	25	1.00	0.29	0.43	1.40	no
10	45	CL	14	2	2	90.0	0.60	0.60	1.32	0.85	1.00	0.67	0.98	0.29	0.30	15	23	1.00	0.26	0.37	1.23	fines
15	40	CL	0.5	1	1	95.0	0.90	0.74	1.18	0.85	1.20	1.00	0.97	0.43	0.30	1	6	1.00	0.08	0.12	0.39	fines
20	35	CL	3	2	2	95.0	1.20	0.89	1.08	0.95	1.00	0.67	0.95	0.58	0.29	3	9	1.00	0.10	0.14	0.49	fines
25	30	SP-SM	2	1	1	15.0	1.50	1.03	1.01	0.95	1.20	1.00	0.94	0.72	0.29	3	6	1.00	0.08	0.11	0.39	yes
30	25	SP-SM?	10	2	2	20.0	1.80	1.18	0.94	1.00	1.00	0.67	0.93	0.86	0.29	9	13	1.00	0.14	0.21	0.72	yes
35	20	SP-SM?	5	1	1	20.0	2.10	1.32	0.89	1.00	1.20	1.00	0.89	1.01	0.27	8	12	1.00	0.13	0.19	0.69	yes
40	15	SP/SM	17	2	2	15.0	2.40	1.46	0.84	1.00	1.00	0.67	0.85	1.15	0.26	14	17	0.98	0.18	0.25	0.97	yes
45	10	SP/SM	10	1	1	15.0	2.70	1.61	0.81	1.00	1.20	1.00	0.81	1.30	0.25	14	17	0.96	0.18	0.25	1.01	no
50	5	SP?	32	2	2	10.0	3.00	1.75	0.77	1.00	1.00	0.67	0.77	1.44	0.24	24	25	0.94	0.29	0.39	1.67	depth>50'
55	0	SP?	14	1	1	20.0	3.30	1.90	0.74	1.00	1.20	1.00	0.73	1.58	0.22	18	23	0.92	0.26	0.34	1.51	depth>50'
60	-5	GP-GM?	33	2	2	20.0	3.60	2.04	0.72	1.00	1.00	0.67	0.69	1.73	0.21	23	28	0.90	0.37	0.48	2.26	depth>50'
65	-10	ML	31	1	1	95.0	3.90	2.18	0.69	1.00	1.20	1.00	0.64	1.87	0.20	37	49	0.88	High N	0.00	LARGE	high N
70	-15	ML	61	2	2	95.0	4.20	2.33	0.67	1.00	1.00	0.67	0.60	2.02	0.19	39	52	0.88	High N	0.00	LARGE	high N
80	-25	SP-SM	24	1	1	12.0	4.80	2.62	0.63	1.00	1.20	1.00	0.55	2.30	0.17	26	28	0.86	0.39	0.48	2.83	depth>50'
90	-35	CL	100	2	2	93.0	5.40	2.90	0.60	1.00	1.00	0.67	0.52	2.59	0.16	57	74	0.83	High N	0.00	LARGE	high N
100	-45	CL	39	1	1	97.0	6.00	3.19	0.57	0.95	1.20	1.00	0.50	2.88	0.15	36	49	0.81	High N	0.00	LARGE	high N
110	-55	CL	100	2	2	85.0	6.60	3.48	0.55	0.95	1.00	0.67	0.50	3.17	0.15	50	65	0.77	High N	0.00	LARGE	high N
120	-65	CL	43	1	1	90.0	7.20	3.77	0.53	0.95	1.20	1.00	0.50	3.46	0.15	37	49	0.75	High N	0.00	LARGE	high N
130	-75	ML	100	2	2	80.0	7.80	4.06	0.51	0.95	1.00	0.67	0.50	3.74	0.15	46	60	0.74	High N	0.00	LARGE	high N
140	-85	RF	100	1	1	2.0	8.40	4.34	0.49	0.95	1.20	1.00	0.50	4.03	0.15	80	80	0.72	High N	0.00	LARGE	high N

5th Street Bridge, Yuba City **EMI Project No.** **13-121** Version - 12/05

LIQUEFACTION ANALYSIS, ACC. = 0.227 g

Liquefaction analysis is performed following Seed's Procedure, outlined by Seed et al. (1985), Seed and Harder (1990), updated NCEER (1997), Martin et al. (1999) and Youd et al. (2001)

Calculated by: **TC 10/31/2013**

Checked by: AZ 8/19/2016

Emean/E60 = Energy Ratio to correct to standard 60% Energy
Surcharge = Any surcharge on top of the ground (psf)
acc. max = maximum peak acceleration at the ground surface (g's)
[1]C_N = square root of (100 kPa or 1.04427 tsf/effective overburden)
The induced cyclic stress ratio (CSR i) by a given peak ground acceleration (acc. max) is:

CSR i = 0.65 x acc max. x total normal stress x rd / (effective normal stress x g)

The resisting cyclic stress ratio (CRR r) is equal to:
CRR r = $CRR_{7.5}$ x Cm x K sigma

where: Cm = Earthquake Magnitude Correction Factor (Blake, NCEER Table 3, Eq.4)
K sigma = Normalized resistance factor (Fig. 14 from NCEER Liquefaction workshop, Harder Boulanger)
$CRR_{7.5}$ = Resisting Cyclic Stress Ratio. It is a function of the content of fines
(Figure 2, NCEER Workshop, after Seed et al 1985))

Factor of Safety, F_L is:
F_L = CRR r / CSR i

R-13-005

Emean (%)	79	Present Ground El.	53	Borehole Dia. (in)	5	Tot. Unit Wt. (pcf)	0.0	=Design Water Table Depth.	8.0	=Field Water Table Depth.	Acc. max =	0.227	g	Earthq. M	6.5
C_E	1.32	Future Ground El.	53	C_B	1.00	120	53	=Design Water El.	45	=Field Water El.				Cm=	1.44

DEPTH OF SOIL SAMPLE (ft.)	EL. (ft.)	SOIL TYPE	FIELD BLOW COUNT N	SAMPLER TYPE 1=SPT =CA.MOI	SAMPLER LINED 1=UNLINED 2=LINED	EST. PERCENT OF FINES (%)	DESIGN TOTAL OVERBUR. PRESS. (tsf)	PRESENT EFFEC. OVERBUR. PRESS. (tsf)	C_N	C_R	C_S	C_{ST}	STRESS REDUC. COEFF. rd	DESIGN EFFEC. OVERBUR. PRESS. (tsf)	INDUCED CYCLIC STRESS RATIO	CORRECT BLOW COUNT N160	(N1)60cs	K sigma	CYCLIC STRESS RATIO M=7.5	CYCLIC STRESS RATIO verburd Cc Mag Corr	RESIST. FACTOR OF SAFETY (F_L)	RESIST. WILL IT LIQUEFY?
-			-	-		-	-	-	-				-	-	-	-		-	-		-	-
5	48	ML	6	2	2	51.0	0.30	0.30	1.70	0.80	1.00	0.67	0.99	0.14	0.30	7	14	1.00	0.15	0.21	0.69	fines
10	43	ML	2	1	1	51.0	0.60	0.54	1.39	0.85	1.20	1.00	0.98	0.29	0.30	4	9	1.00	0.11	0.16	0.52	fines
15	38	ML	2	2	2	51.0	0.90	0.68	1.24	0.85	1.00	0.67	0.97	0.43	0.30	2	7	1.00	0.09	0.13	0.43	fines
20	33	SM	6	1	1	20.0	1.20	0.83	1.12	0.95	1.20	1.00	0.95	0.58	0.29	10	15	1.00	0.16	0.22	0.77	yes
25	28	SP-SM	16	2	2	11.0	1.50	0.97	1.04	0.95	1.00	0.67	0.94	0.72	0.29	14	15	1.00	0.16	0.24	0.82	yes
30	23	SP-SM	20	1	1	11.0	1.80	1.11	0.97	1.00	1.20	1.00	0.93	0.86	0.29	31	33	1.00	High N	0.00	LARGE	high N
35	18	SP-SM	21	2	2	11.0	2.10	1.26	0.91	1.00	1.00	0.67	0.89	1.01	0.27	17	18	1.00	0.20	0.28	1.04	no
40	13	GP-GM	24	1	1	7.0	2.40	1.40	0.86	1.00	1.20	1.00	0.85	1.15	0.26	33	33	0.98	High N	0.00	LARGE	high N
45	8	GP	100	2	2	4.0	2.70	1.55	0.82	1.00	1.00	0.67	0.81	1.30	0.25	72	72	0.96	High N	0.00	LARGE	high N
50	3	GP	36	1	1	4.0	3.00	1.69	0.79	1.00	1.20	1.00	0.77	1.44	0.24	45	45	0.94	High N	0.00	LARGE	high N
55	-2	SP-SM	51	2	2	12.0	3.30	1.83	0.75	1.00	1.00	0.67	0.73	1.58	0.22	34	36	0.92	High N	0.00	LARGE	high N
60	-7	SM	34	1	1	40.0	3.60	1.98	0.73	1.00	1.20	1.00	0.69	1.73	0.21	39	52	0.90	High N	0.00	LARGE	high N
65	-12	SM	72	2	2	40.0	3.90	2.12	0.70	1.00	1.00	0.67	0.64	1.87	0.20	44	58	0.88	High N	0.00	LARGE	high N
70	-17	SM	27	1	1	40.0	4.20	2.27	0.68	1.00	1.20	1.00	0.60	2.02	0.19	29	40	0.88	High N	0.00	LARGE	high N
80	-27	CL	49	2	2	99.0	4.80	2.55	0.64	1.00	1.00	0.67	0.55	2.30	0.17	27	38	0.86	High N	0.00	LARGE	high N
90	-37	CL	57	1	1	80.0	5.40	2.84	0.61	1.00	1.20	1.00	0.52	2.59	0.16	55	71	0.83	High N	0.00	LARGE	high N
100	-47	CL	100	2	2	80.0	6.00	3.13	0.58	0.95	1.00	0.67	0.50	2.88	0.15	48	63	0.81	High N	0.00	LARGE	high N
110	-57	SP-SM	74	1	1	7.0	6.60	3.42	0.55	0.95	1.20	1.00	0.50	3.17	0.15	61	62	0.77	High N	0.00	LARGE	high N
120	-67	ML	100	2	2	75.0	7.20	3.71	0.53	0.95	1.00	0.67	0.50	3.46	0.15	44	58	0.75	High N	0.00	LARGE	high N
130	-77	GM	100	1	1	15.0	7.80	3.99	0.51	0.95	1.20	1.00	0.50	3.74	0.15	77	83	0.74	High N	0.00	LARGE	high N
140	-87	GM	100	1	1	15.0	8.40	4.28	0.49	0.95	1.20	1.00	0.50	4.03	0.15	74	80	0.72	High N	0.00	LARGE	high N

5th Street Bridge, Yuba City **EMI Project No.** **13-121** Version - 12/05

LIQUEFACTION ANALYSIS, ACC. = 0.227 g

Liquefaction analysis is performed following Seed's Procedure, outlined by Seed et al. (1985), Seed and Harder (1990), updated NCEER (1997), Martin et al. (1999) and Youd et al. (2001)

Calculated by: **TC 10/31/2013**

Checked by: AZ 8/19/2016

Emean/E60 = Energy Ratio to correct to standard 60% Energy
Surcharge = Any surcharge on top of the ground (psf)
acc. max = maximum peak acceleration at the ground surface (g's)
[1]C_N = square root of (100 kPa or 1.04427 tsf/effective overburden)
The induced cyclic stress ratio (CSR i) by a given peak ground acceleration (acc. max) is:

CSR i = 0.65 x acc max. x total normal stress x rd / (effective normal stress x g)

The resisting cyclic stress ratio (CRR r) is equal to:
CRR r = $CRR_{7.5}$ x Cm x K sigma

where: Cm = Earthquake Magnitude Correction Factor (Blake, NCEER Table 3, Eq.4)
K sigma = Normalized resistance factor (Fig. 14 from NCEER Liquefaction workshop, Harder Boulanger)
$CRR_{7.5}$ = Resisting Cyclic Stress Ratio. It is a function of the content of fines
(Figure 2, NCEER Workshop, after Seed et al 1985))

Factor of Safety, F_L is:
F_L = CRR r / CSR i

R-13-006

Emean (%)	79	Present Ground El.	55	Borehole Dia. (in)	5	Tot. Unit Wt. (pcf)	0.0	=Design Water Table Depth.	10.0	=Field Water Table Depth.	Acc. max =	0.227	g	Earthq. M	6.5
C_E	1.32	Future Ground El.	55	C_B	1.00	120	55	=Design Water El.	45	=Field Water El.				Cm=	1.44

DEPTH OF SOIL SAMPLE (ft.)	EL. (ft.)	SOIL TYPE	FIELD BLOW COUNT N	SAMPLER TYPE 1=SPT =CA.MOI	SAMPLER LINED 1=UNLINED 2=LINED	EST. PERCENT OF FINES (%)	DESIGN TOTAL OVERBUR. PRESS. (tsf)	PRESENT EFFEC. OVERBUR. PRESS. (tsf)	C_N	C_R	C_S	C_{ST}	STRESS REDUC. COEFF. rd	DESIGN EFFEC. OVERBUR. PRESS. (tsf)	INDUCED CYCLIC STRESS RATIO	CORRECT BLOW COUNT N160	(N1)60cs	K sigma	CYCLIC STRESS RATIO M=7.5	CYCLIC STRESS RATIO verburd Cc Mag Corr	RESIST. FACTOR OF SAFETY (F_L)	RESIST. WILL IT LIQUEFY?
-			-	-		-	-	-	-				-	-	-	-		-	-		-	-
5	50	ML	7	2	2	59.0	0.30	0.30	1.70	0.80	1.00	0.67	0.99	0.14	0.30	8	15	1.00	0.16	0.23	0.76	fines
10	45	ML	6	1	1	59.0	0.60	0.60	1.32	0.85	1.20	1.00	0.98	0.29	0.30	11	18	1.00	0.19	0.27	0.91	fines
15	40	SP-SM	13	2	2	10.0	0.90	0.74	1.18	0.85	1.00	0.67	0.97	0.43	0.30	11	13	1.00	0.14	0.20	0.66	yes
20	35	SP-SM	10	1	1	10.0	1.20	0.89	1.08	0.95	1.20	1.00	0.95	0.58	0.29	16	17	1.00	0.19	0.27	0.92	yes
25	30	SM	10	2	2	20.0	1.50	1.03	1.01	0.95	1.00	0.67	0.94	0.72	0.29	8	13	1.00	0.14	0.20	0.68	yes
30	25	SP-SM	16	1	1	12.0	1.80	1.18	0.94	1.00	1.20	1.00	0.93	0.86	0.29	24	26	1.00	0.32	0.46	1.59	no
35	20	GW-GM	46	1	1	9.0	2.10	1.32	0.89	1.00	1.20	1.00	0.89	1.01	0.27	65	66	1.00	High N	0.00	LARGE	high N
40	15	GW-GM	9	1	1	9.0	2.40	1.46	0.84	1.00	1.20	1.00	0.85	1.15	0.26	12	13	0.98	0.14	0.20	0.75	yes
45	10	GW-GM	66	1	1	9.0	2.70	1.61	0.81	1.00	1.20	1.00	0.81	1.30	0.25	84	86	0.96	High N	0.00	LARGE	high N
50	5	CL	40	2	2	60.0	3.00	1.75	0.77	1.00	1.00	0.67	0.77	1.44	0.24	27	37	0.94	High N	0.00	LARGE	high N
55	0	CL	31	1	1	60.0	3.30	1.90	0.74	1.00	1.20	1.00	0.73	1.58	0.22	36	49	0.92	High N	0.00	LARGE	high N
60	-5	MH	48	2	2	95.0	3.60	2.04	0.72	1.00	1.00	0.67	0.69	1.73	0.21	30	41	0.90	High N	0.00	LARGE	high N
65	-10	MH	38	1	1	95.0	3.90	2.18	0.69	1.00	1.20	1.00	0.64	1.87	0.20	42	55	0.88	High N	0.00	LARGE	high N
70	-15	CL	53	2	2	80.0	4.20	2.33	0.67	1.00	1.00	0.67	0.60	2.02	0.19	31	42	0.88	High N	0.00	LARGE	high N
80	-25	CL	44	1	1	80.0	4.80	2.62	0.63	1.00	1.20	1.00	0.55	2.30	0.17	44	58	0.86	High N	0.00	LARGE	high N
90	-35	SM	100	2	2	25.0	5.40	2.90	0.60	1.00	1.00	0.67	0.52	2.59	0.16	53	63	0.83	High N	0.00	LARGE	high N
100	-45	CL-ML	100	1	1	60.0	6.00	3.19	0.57	0.95	1.20	1.00	0.50	2.88	0.15	86	108	0.81	High N	0.00	LARGE	high N
110	-55	SP-SM	100	2	2	10.0	6.60	3.48	0.55	0.95	1.00	0.67	0.50	3.17	0.15	46	47	0.77	High N	0.00	LARGE	high N
120	-65	CL	70	1	1	80.0	7.20	3.77	0.53	0.95	1.20	1.00	0.50	3.46	0.15	55	71	0.75	High N	0.00	LARGE	high N
130	-75	CL	100	2	2	80.0	7.80	4.06	0.51	0.95	1.00	0.67	0.50	3.74	0.15	42	56	0.74	High N	0.00	LARGE	high N
		GW/GP																				

5th Street Bridge, Yuba City **EMI Project No.** **13-121** Version - 12/05

LIQUEFACTION ANALYSIS, ACC. = 0.227 g

Liquefaction analysis is performed following Seed's Procedure, outlined by Seed et al. (1985), Seed and Harder (1990), updated NCEER (1997), Martin et al. (1999) and Youd et al. (2001)

Calculated by: **TC 10/31/2013**

Checked by: AZ 8/19/2016

Emean/E60 = Energy Ratio to correct to standard 60% Energy
Surcharge = Any surcharge on top of the ground (psf)
acc. max = maximum peak acceleration at the ground surface (g's)
[1]C_N = square root of (100 kPa or 1.04427 tsf/effective overburden)
The induced cyclic stress ratio (CSR i) by a given peak ground acceleration (acc. max) is:

CSR i = 0.65 x acc max. x total normal stress x rd / (effective normal stress x g)

The resisting cyclic stress ratio (CRR r) is equal to:
CRR r = $CRR_{7.5}$ x Cm x K sigma

where: Cm = Earthquake Magnitude Correction Factor (Blake, NCEER Table 3, Eq.4)
K sigma = Normalized resistance factor (Fig. 14 from NCEER Liquefaction workshop, Harder Boulanger)
$CRR_{7.5}$ = Resisting Cyclic Stress Ratio. It is a function of the content of fines
(Figure 2, NCEER Workshop, after Seed et al 1985))

Factor of Safety, F_L is:
F_L = CRR r / CSR i

R-13-007

Emean (%)	79	Present Ground El.	55	Borehole Dia. (in)	5	Tot. Unit Wt. (pcf)	0.0	=Design Water Table Depth.	10.0	=Field Water Table Depth.	Acc. max =	0.227	g	Earthq. M	6.5
C_E	1.32	Future Ground El.	55	C_B	1.00	120	55	=Design Water El.	45	=Field Water El.				Cm=	1.44

DEPTH OF SOIL SAMPLE (ft.)	EL. (ft.)	SOIL TYPE	FIELD BLOW COUNT N	SAMPLER TYPE 1=SPT =CA.MOI	SAMPLER LINED 1=UNLINED 2=LINED	EST. PERCENT OF FINES (%)	DESIGN TOTAL OVERBUR. PRESS. (tsf)	PRESENT EFFEC. OVERBUR. PRESS. (tsf)	C_N	C_R	C_S	C_{ST}	STRESS REDUC. COEFF. rd	DESIGN EFFEC. OVERBUR. PRESS. (tsf)	INDUCED CYCLIC STRESS RATIO	CORRECT BLOW COUNT N160	(N1)60cs	K sigma	CYCLIC STRESS RATIO M=7.5	CYCLIC STRESS RATIO verburd Cc Mag Corr	RESIST. FACTOR OF SAFETY (F_L)	RESIST. WILL IT LIQUEFY?
-			-	-		-	-	-	-				-	-	-	-		-	-		-	-
5	50	SM	18	1	1	48.0	0.30	0.30	1.70	0.80	1.20	1.00	0.99	0.14	0.30	39	51	1.00	High N	0.00	LARGE	high N
10	45	SM	20	2	2	48.0	0.60	0.60	1.32	0.85	1.00	0.67	0.98	0.29	0.30	20	29	1.00	0.39	0.57	1.88	no
15	40	ML	2	1	1	70.0	0.90	0.74	1.18	0.85	1.20	1.00	0.97	0.43	0.30	3	9	1.00	0.10	0.15	0.50	fines
20	35	ML	4	2	2	70.0	1.20	0.89	1.08	0.95	1.00	0.67	0.95	0.58	0.29	4	9	1.00	0.11	0.15	0.53	fines
25	30	ML	3	1	1	67.0	1.50	1.03	1.01	0.95	1.20	1.00	0.94	0.72	0.29	5	10	1.00	0.12	0.17	0.58	fines
30	25	CL	13	2	2	90.0	1.80	1.18	0.94	1.00	1.00	0.67	0.93	0.86	0.29	11	18	1.00	0.19	0.27	0.96	fines
35	20	SP-SM	7	1	1	10.0	2.10	1.32	0.89	1.00	1.20	1.00	0.89	1.01	0.27	10	11	1.00	0.12	0.17	0.64	yes
40	15	SP-SM	30	2	2	10.0	2.40	1.46	0.84	1.00	1.00	0.67	0.85	1.15	0.26	22	24	0.98	0.27	0.38	1.44	no
45	10	SP-SM	52	1	1	10.0	2.70	1.61	0.81	1.00	1.20	1.00	0.81	1.30	0.25	66	69	0.96	High N	0.00	LARGE	high N
50	5	SM	62	2	2	24.0	3.00	1.75	0.77	1.00	1.00	0.67	0.77	1.44	0.24	42	51	0.94	High N	0.00	LARGE	high N
55	0	ML	48	1	1	95.0	3.30	1.90	0.74	1.00	1.20	1.00	0.73	1.58	0.22	56	73	0.92	High N	0.00	LARGE	high N
60	-5	ML	69	2	2	95.0	3.60	2.04	0.72	1.00	1.00	0.67	0.69	1.73	0.21	43	57	0.90	High N	0.00	LARGE	high N
65	-10	CL-ML	49	1	1	60.0	3.90	2.18	0.69	1.00	1.20	1.00	0.64	1.87	0.20	54	69	0.88	High N	0.00	LARGE	high N
70	-15	SM	100	2	2	20.0	4.20	2.33	0.67	1.00	1.00	0.67	0.60	2.02	0.19	59	67	0.88	High N	0.00	LARGE	high N
80	-25	CL	69	1	1	70.0	4.80	2.62	0.63	1.00	1.20	1.00	0.55	2.30	0.17	69	88	0.86	High N	0.00	LARGE	high N
90	-35	CL	100	2	2	60.0	5.40	2.90	0.60	1.00	1.00	0.67	0.52	2.59	0.16	53	68	0.83	High N	0.00	LARGE	high N
100	-45	SM	68	1	1	20.0	6.00	3.19	0.57	0.95	1.20	1.00	0.50	2.88	0.15	58	67	0.81	High N	0.00	LARGE	high N
110	-55	SM	100	2	2	15.0	6.60	3.48	0.55	0.95	1.00	0.67	0.50	3.17	0.15	46	50	0.77	High N	0.00	LARGE	high N
120	-65	CL-ML	100	1	1	75.0	7.20	3.77	0.53	0.95	1.20	1.00	0.50	3.46	0.15	79	100	0.75	High N	0.00	LARGE	high N
130	-75	GP-GM	100	1	1	10.0	7.80	4.06	0.51	0.95	1.20	1.00	0.50	3.74	0.15	76	79	0.74	High N	0.00	LARGE	high N

5th Street Bridge, Yuba City **EMI Project No.** **13-121** Version - 12/05

LIQUEFACTION ANALYSIS, ACC. = 0.227 g

Liquefaction analysis is performed following Seed's Procedure, outlined by Seed et al. (1985), Seed and Harder (1990), updated NCEER (1997), Martin et al. (1999) and Youd et al. (2001)

Calculated by: **TC 10/31/2013**

Checked by: AZ 8/19/2016

Emean/E60 = Energy Ratio to correct to standard 60% Energy
Surcharge = Any surcharge on top of the ground (psf)
acc. max = maximum peak acceleration at the ground surface (g's)
[1]C_N = square root of (100 kPa or 1.04427 tsf/effective overburden)
The induced cyclic stress ratio (CSR i) by a given peak ground acceleration (acc. max) is:

CSR i = 0.65 x acc max. x total normal stress x rd / (effective normal stress x g)

The resisting cyclic stress ratio (CRR r) is equal to:
CRR r = $CRR_{7.5}$ x Cm x K sigma

where: Cm = Earthquake Magnitude Correction Factor (Blake, NCEER Table 3, Eq.4)
K sigma = Normalized resistance factor (Fig. 14 from NCEER Liquefaction workshop, Harder Boulanger)
$CRR_{7.5}$ = Resisting Cyclic Stress Ratio. It is a function of the content of fines
(Figure 2, NCEER Workshop, after Seed et al 1985))

Factor of Safety, F_L is:
F_L = CRR r / CSR i

R-13-008

Emean (%)	79	Present Ground El.	53	Borehole Dia. (in)	5	Tot. Unit Wt. (pcf)	0.0	=Design Water Table Depth.	8.0	=Field Water Table Depth.	Acc. max =	0.227	g	Earthq. M	6.5
C_E	1.32	Future Ground El.	53	C_B	1.00	120	53	=Design Water El.	45	=Field Water El.				Cm=	1.44

DEPTH OF SOIL SAMPLE (ft.)	EL. (ft.)	SOIL TYPE	FIELD BLOW COUNT N	SAMPLER TYPE 1=SPT =CA.MOI	SAMPLER LINED 1=UNLINED 2=LINED	EST. PERCENT OF FINES (%)	DESIGN TOTAL OVERBUR. PRESS. (tsf)	PRESENT EFFEC. OVERBUR. PRESS. (tsf)	C_N	C_R	C_S	C_{ST}	STRESS REDUC. COEFF. rd	DESIGN EFFEC. OVERBUR. PRESS. (tsf)	INDUCED CYCLIC STRESS RATIO	CORRECT BLOW COUNT N160	(N1)60cs	K sigma	CYCLIC STRESS RATIO M=7.5	CYCLIC STRESS RATIO verburd Cc Mag Corr	RESIST. FACTOR OF SAFETY (F_L)	RESIST. WILL IT LIQUEFY?
-			-	-		-	-	-	-				-	-	-	-		-	-		-	-
5	48	ML	11	2	2	80.0	0.30	0.30	1.70	0.80	1.00	0.67	0.99	0.14	0.30	13	21	1.00	0.22	0.32	1.07	fines
10	43	SM	10	1	1	40.0	0.60	0.54	1.39	0.85	1.20	1.00	0.98	0.29	0.30	19	27	1.00	0.35	0.51	1.69	no
15	38	SM	5	2	2	40.0	0.90	0.68	1.24	0.85	1.00	0.67	0.97	0.43	0.30	5	11	1.00	0.12	0.17	0.57	yes
20	33	SP-SM	8	1	1	10.0	1.20	0.83	1.12	0.95	1.20	1.00	0.95	0.58	0.29	14	15	1.00	0.16	0.23	0.77	yes
25	28	SP-SM	12	2	2	10.0	1.50	0.97	1.04	0.95	1.00	0.67	0.94	0.72	0.29	10	11	1.00	0.13	0.18	0.63	yes
30	23	SP-SM	14	1	1	10.0	1.80	1.11	0.97	1.00	1.20	1.00	0.93	0.86	0.29	21	23	1.00	0.25	0.36	1.28	no
35	18	SP	11	2	2	4.0	2.10	1.26	0.91	1.00	1.00	0.67	0.89	1.01	0.27	9	9	1.00	0.10	0.15	0.54	yes
40	13	SP-SM	68	1	1	15.0	2.40	1.40	0.86	1.00	1.20	1.00	0.85	1.15	0.26	93	100	0.98	High N	0.00	LARGE	high N
45	8	CL	31	1	1	80.0	2.70	1.55	0.82	1.00	1.20	1.00	0.81	1.30	0.25	40	53	0.96	High N	0.00	LARGE	high N
50	3	SM	72	2	2	27.0	3.00	1.69	0.79	1.00	1.00	0.67	0.77	1.44	0.24	50	61	0.94	High N	0.00	LARGE	high N
55	-2	ML	100	2	2	80.0	3.30	1.83	0.75	1.00	1.00	0.67	0.73	1.58	0.22	66	84	0.92	High N	0.00	LARGE	high N
60	-7	SP-SM	34	1	1	15.0	3.60	1.98	0.73	1.00	1.20	1.00	0.69	1.73	0.21	39	43	0.90	High N	0.00	LARGE	high N
65	-12	CL-ML	100	2	2	90.0	3.90	2.12	0.70	1.00	1.00	0.67	0.64	1.87	0.20	62	79	0.88	High N	0.00	LARGE	high N
70	-17	CL-ML	27	1	1	90.0	4.20	2.27	0.68	1.00	1.20	1.00	0.60	2.02	0.19	29	40	0.88	High N	0.00	LARGE	high N
80	-27	CL	100	2	2	80.0	4.80	2.55	0.64	1.00	1.00	0.67	0.55	2.30	0.17	56	72	0.86	High N	0.00	LARGE	high N
90	-37	SP-SM	100	1	1	15.0	5.40	2.84	0.61	1.00	1.20	1.00	0.52	2.59	0.16	96	103	0.83	High N	0.00	LARGE	high N
100	-47	SM	100	2	2	30.0	6.00	3.13	0.58	0.95	1.00	0.67	0.50	2.88	0.15	48	60	0.81	High N	0.00	LARGE	high N
110	-57	SP-SM	58	1	1	15.0	6.60	3.42	0.55	0.95	1.20	1.00	0.50	3.17	0.15	48	53	0.77	High N	0.00	LARGE	high N
120	-67	ML	59	1	1	70.0	7.20	3.71	0.53	0.95	1.20	1.00	0.50	3.46	0.15	47	61	0.75	High N	0.00	LARGE	high N
130	-77	SP	100	1	1	5.0	7.80	3.99	0.51	0.95	1.20	1.00	0.50	3.74	0.15	77	77	0.74	High N	0.00	LARGE	high N

5th Street Bridge, Yuba City **EMI Project No.** **13-121** Version - 12/05

LIQUEFACTION ANALYSIS, ACC. = 0.227 g

Liquefaction analysis is performed following Seed's Procedure, outlined by Seed et al. (1985), Seed and Harder (1990), updated NCEER (1997), Martin et al. (1999) and Youd et al. (2001)

Calculated by: **TC 10/31/2013**

Checked by: AZ 8/19/2016

Emean/E60 = Energy Ratio to correct to standard 60% Energy
Surcharge = Any surcharge on top of the ground (psf)
acc. max = maximum peak acceleration at the ground surface (g's)
[1]C_N = square root of (100 kPa or 1.04427 tsf/effective overburden)
The induced cyclic stress ratio (CSR i) by a given peak ground acceleration (acc. max) is:

CSR i = 0.65 x acc max. x total normal stress x rd / (effective normal stress x g)

The resisting cyclic stress ratio (CRR r) is equal to:
CRR r = $CRR_{7.5}$ x Cm x K sigma

where: Cm = Earthquake Magnitude Correction Factor (Blake, NCEER Table 3, Eq.4)
K sigma = Normalized resistance factor (Fig. 14 from NCEER Liquefaction workshop, Harder Boulanger)
$CRR_{7.5}$ = Resisting Cyclic Stress Ratio. It is a function of the content of fines
(Figure 2, NCEER Workshop, after Seed et al 1985))

Factor of Safety, F_L is:
F_L = CRR r / CSR i

R-13-009

Emean (%)	79	Present Ground El.	51	Borehole Dia. (in)	5	Tot. Unit Wt. (pcf)	0.0	=Design Water Table Depth.	6.0	=Field Water Table Depth.	Acc. max =	0.227	g	Earthq. M	6.5
C_E	1.32	Future Ground El.	51	C_B	1.00	120	51	=Design Water El.	45	=Field Water El.				Cm=	1.44

DEPTH OF SOIL SAMPLE (ft.)	EL. (ft.)	SOIL TYPE	FIELD BLOW COUNT N	SAMPLER TYPE 1=SPT =CA.MOI	SAMPLER LINED 1=UNLINED 2=LINED	EST. PERCENT OF FINES (%)	DESIGN TOTAL OVERBUR. PRESS. (tsf)	PRESENT EFFEC. OVERBUR. PRESS. (tsf)	C_N	C_R	C_S	C_{ST}	STRESS REDUC. COEFF. rd	DESIGN EFFEC. OVERBUR. PRESS. (tsf)	INDUCED CYCLIC STRESS RATIO	CORRECT BLOW COUNT N160	(N1)60cs	K sigma	CYCLIC STRESS RATIO M=7.5	CYCLIC STRESS RATIO verburd Cc Mag Corr	RESIST. FACTOR OF SAFETY (F_L)	RESIST. WILL IT LIQUEFY?
-			-	-		-	-	-	-				-	-	-	-		-	-		-	-
5	46	CL	7	1	1	80.0	0.30	0.30	1.70	0.80	1.20	1.00	0.99	0.14	0.30	15	23	1.00	0.26	0.37	1.22	fines
10	41	SM	14	2	2	40.0	0.60	0.48	1.48	0.85	1.00	0.67	0.98	0.29	0.30	15	24	1.00	0.27	0.38	1.28	no
15	36	SM	6	1	1	40.0	0.90	0.62	1.30	0.85	1.20	1.00	0.97	0.43	0.30	10	18	1.00	0.19	0.27	0.91	yes
20	31	SM	7	2	2	35.0	1.20	0.76	1.17	0.95	1.00	0.67	0.95	0.58	0.29	7	13	1.00	0.14	0.21	0.70	yes
25	26	SP	36	1	1	5.0	1.50	0.91	1.07	0.95	1.20	1.00	0.94	0.72	0.29	58	58	1.00	High N	0.00	LARGE	high N
30	21	GP	30	1	1	4.0	1.80	1.05	1.00	1.00	1.20	1.00	0.93	0.86	0.29	47	47	1.00	High N	0.00	LARGE	high N
35	16	GP	58	1	1	4.0	2.10	1.20	0.93	1.00	1.20	1.00	0.89	1.01	0.27	86	86	1.00	High N	0.00	LARGE	high N
40	11	MH	100	2	2	65.0	2.40	1.34	0.88	1.00	1.00	0.67	0.85	1.15	0.26	77	98	0.98	High N	0.00	LARGE	high N
45	6	MH	55	1	1	65.0	2.70	1.48	0.84	1.00	1.20	1.00	0.81	1.30	0.25	73	92	0.96	High N	0.00	LARGE	high N
50	1	CL	100	2	2	75.0	3.00	1.63	0.80	1.00	1.00	0.67	0.77	1.44	0.24	70	89	0.94	High N	0.00	LARGE	high N
55	-4	SM	42	1	1	30.0	3.30	1.77	0.77	1.00	1.20	1.00	0.73	1.58	0.22	51	64	0.92	High N	0.00	LARGE	high N
60	-9	SP	61	2	2	4.0	3.60	1.92	0.74	1.00	1.00	0.67	0.69	1.73	0.21	39	39	0.90	High N	0.00	LARGE	high N
65	-14	SP	33	1	1	4.0	3.90	2.06	0.71	1.00	1.20	1.00	0.64	1.87	0.20	37	37	0.88	High N	0.00	LARGE	high N
70	-19	ML	100	2	2	70.0	4.20	2.20	0.69	1.00	1.00	0.67	0.60	2.02	0.19	60	77	0.88	High N	0.00	LARGE	high N
80	-29	SM	67	1	1	40.0	4.80	2.49	0.65	1.00	1.20	1.00	0.55	2.30	0.17	69	87	0.86	High N	0.00	LARGE	high N
90	-39	SM	100	2	2	40.0	5.40	2.78	0.61	1.00	1.00	0.67	0.52	2.59	0.16	54	69	0.83	High N	0.00	LARGE	high N
100	-49	SP-SM	67	1	1	10.0	6.00	3.07	0.58	0.95	1.20	1.00	0.50	2.88	0.15	59	61	0.81	High N	0.00	LARGE	high N
110	-59	SW	57	1	1	4.0	6.60	3.36	0.56	0.95	1.20	1.00	0.50	3.17	0.15	48	48	0.77	High N	0.00	LARGE	high N
120	-69	ML	62	1	1	60.0	7.20	3.64	0.54	0.95	1.20	1.00	0.50	3.46	0.15	50	65	0.75	High N	0.00	LARGE	high N
130	-79	GM	100	1	1	35.0	7.80	3.93	0.52	0.95	1.20	1.00	0.50	3.74	0.15	77	98	0.74	High N	0.00	LARGE	high N

5th Street Bridge, Yuba City **EMI Project No.** **13-121** Version - 12/05

LIQUEFACTION ANALYSIS, ACC. = 0.227 g

Liquefaction analysis is performed following Seed's Procedure, outlined by Seed et al. (1985), Seed and Harder (1990), updated NCEER (1997), Martin et al. (1999) and Youd et al. (2001)

Calculated by: **TC 10/31/2013**

Checked by: AZ 8/19/2016

Emean/E60 = Energy Ratio to correct to standard 60% Energy
Surcharge = Any surcharge on top of the ground (psf)
acc. max = maximum peak acceleration at the ground surface (g's)
[1]C_N = square root of (100 kPa or 1.04427 tsf/effective overburden)
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CRR r = $CRR_{7.5}$ x Cm x K sigma

where: Cm = Earthquake Magnitude Correction Factor (Blake, NCEER Table 3, Eq.4)
K sigma = Normalized resistance factor (Fig. 14 from NCEER Liquefaction workshop, Harder Boulanger)
$CRR_{7.5}$ = Resisting Cyclic Stress Ratio. It is a function of the content of fines
(Figure 2, NCEER Workshop, after Seed et al 1985))

Factor of Safety, F_L is:
F_L = CRR r / CSR i

R-13-010

Emean (%)	79	Present Ground El.	55	Borehole Dia. (in)	5	Tot. Unit Wt. (pcf)	0.0	=Design Water Table Depth.	10.0	=Field Water Table Depth.	Acc. max =	0.227	g	Earthq. M	6.5
C_E	1.32	Future Ground El.	55	C_B	1.00	120	55	=Design Water El.	45	=Field Water El.				Cm=	1.44

DEPTH OF SOIL SAMPLE (ft.)	EL. (ft.)	SOIL TYPE	FIELD BLOW COUNT N	SAMPLER TYPE 1=SPT =CA.MOI	SAMPLER LINED 1=UNLINED 2=LINED	EST. PERCENT OF FINES (%)	DESIGN TOTAL OVERBUR. PRESS. (tsf)	PRESENT EFFEC. OVERBUR. PRESS. (tsf)	C_N	C_R	C_S	C_{ST}	STRESS REDUC. COEFF. rd	DESIGN EFFEC. OVERBUR. PRESS. (tsf)	INDUCED CYCLIC STRESS RATIO	CORRECT BLOW COUNT N160	(N1)60cs	K sigma	CYCLIC STRESS RATIO M=7.5	CYCLIC STRESS RATIO verburd Cc Mag Corr	RESIST. FACTOR OF SAFETY (F_L)	RESIST. WILL IT LIQUEFY?
-			-	-		-	-	-	-				-	-	-	-		-	-		-	-
5	50	SM	39	2	2	30.0	0.30	0.30	1.70	0.80	1.00	0.67	0.99	0.14	0.30	47	58	1.00	High N	0.00	LARGE	high N
10	45	SM	7	1	1	30.0	0.60	0.60	1.32	0.85	1.20	1.00	0.98	0.29	0.30	12	19	1.00	0.20	0.29	0.98	yes
15	40	SM	5	2	2	28.0	0.90	0.74	1.18	0.85	1.00	0.67	0.97	0.43	0.30	4	10	1.00	0.11	0.16	0.53	yes
20	35	SM	8	1	1	40.0	1.20	0.89	1.08	0.95	1.20	1.00	0.95	0.58	0.29	13	21	1.00	0.22	0.32	1.10	no
25	30	SM	20	2	2	20.0	1.50	1.03	1.01	0.95	1.00	0.67	0.94	0.72	0.29	17	22	1.00	0.24	0.34	1.18	no
30	25	CL	15	1	1	60.0	1.80	1.18	0.94	1.00	1.20	1.00	0.93	0.86	0.29	22	32	1.00	High N	0.00	LARGE	high N
35	20	CL	22	2	2	60.0	2.10	1.32	0.89	1.00	1.00	0.67	0.89	1.01	0.27	17	26	1.00	0.30	0.44	1.60	fines
40	15	CL-ML	30	1	1	85.0	2.40	1.46	0.84	1.00	1.20	1.00	0.85	1.15	0.26	40	53	0.98	High N	0.00	LARGE	high N
45	10	ML	100	2	2	65.0	2.70	1.61	0.81	1.00	1.00	0.67	0.81	1.30	0.25	71	90	0.96	High N	0.00	LARGE	high N
50	5	SM	100	2	2	40.0	3.00	1.75	0.77	1.00	1.00	0.67	0.77	1.44	0.24	68	86	0.94	High N	0.00	LARGE	high N
55	0	ML	52	1	1	85.0	3.30	1.90	0.74	1.00	1.20	1.00	0.73	1.58	0.22	61	78	0.92	High N	0.00	LARGE	high N
60	-5	SP-SM	100	2	2	6.0	3.60	2.04	0.72	1.00	1.00	0.67	0.69	1.73	0.21	63	63	0.90	High N	0.00	LARGE	high N
65	-10	SM	35	1	1	25.0	3.90	2.18	0.69	1.00	1.20	1.00	0.64	1.87	0.20	38	47	0.88	High N	0.00	LARGE	high N
70	-15	SP-SM	48	2	2	6.0	4.20	2.33	0.67	1.00	1.00	0.67	0.60	2.02	0.19	28	28	0.88	0.38	0.48	2.61	depth>50'
80	-25	CL	48	1	1	80.0	4.80	2.62	0.63	1.00	1.20	1.00	0.55	2.30	0.17	48	62	0.86	High N	0.00	LARGE	high N
90	-35	CH	100	2	2	95.0	5.40	2.90	0.60	1.00	1.00	0.67	0.52	2.59	0.16	53	68	0.83	High N	0.00	LARGE	high N
100	-45	ML	42	1	1	70.0	6.00	3.19	0.57	0.95	1.20	1.00	0.50	2.88	0.15	36	48	0.81	High N	0.00	LARGE	high N
110	-55	SP-SM	81	1	1	10.0	6.60	3.48	0.55	0.95	1.20	1.00	0.50	3.17	0.15	67	69	0.77	High N	0.00	LARGE	high N
120	-65	SP-SM	56	1	1	10.0	7.20	3.77	0.53	0.95	1.20	1.00	0.50	3.46	0.15	44	46	0.75	High N	0.00	LARGE	high N
130	-75	GP-GM	100	1	1	10.0	7.80	4.06	0.51	0.95	1.20	1.00	0.50	3.74	0.15	76	79	0.74	High N	0.00	LARGE	high N
140	-85	GP	100	1	1	0.0	8.40	4.34	0.49	0.95	1.20	1.00	0.50	4.03	0.15	74	74	0.72	High N	0.00	LARGE	high N

5th Street Bridge, Yuba City **EMI Project No.** **13-121** Version - 12/05

LIQUEFACTION ANALYSIS, ACC. = 0.227 g

Liquefaction analysis is performed following Seed's Procedure, outlined by Seed et al. (1985), Seed and Harder (1990), updated NCEER (1997), Martin et al. (1999) and Youd et al. (2001)

Calculated by: **TC 10/31/2013**

Checked by: AZ 8/19/2016

Emean/E60 = Energy Ratio to correct to standard 60% Energy
Surcharge = Any surcharge on top of the ground (psf)
acc. max = maximum peak acceleration at the ground surface (g's)
[1]C_N = square root of (100 kPa or 1.04427 tsf/effective overburden)
The induced cyclic stress ratio (CSR i) by a given peak ground acceleration (acc. max) is:

CSR i = 0.65 x acc max. x total normal stress x rd / (effective normal stress x g)

The resisting cyclic stress ratio (CRR r) is equal to:
CRR r = $CRR_{7.5}$ x Cm x K sigma

where: Cm = Earthquake Magnitude Correction Factor (Blake, NCEER Table 3, Eq.4)
K sigma = Normalized resistance factor (Fig. 14 from NCEER Liquefaction workshop, Harder Boulanger)
$CRR_{7.5}$ = Resisting Cyclic Stress Ratio. It is a function of the content of fines
(Figure 2, NCEER Workshop, after Seed et al 1985))

Factor of Safety, F_L is:
F_L = CRR r / CSR i

R-13-011

Emean (%)	79	Present Ground El.	87	Borehole Dia. (in)	5	Tot. Unit Wt. (pcf)	27.0	=Design Water Table Depth.	42.0	=Field Water Table Depth.	Acc. max =	0.227	g	Earthq. M	6.5
C_E	1.32	Future Ground El.	87	C_B	1.00	120	60	=Design Water El.	45	=Field Water El.				Cm=	1.44

DEPTH OF SOIL SAMPLE (ft.)	EL. (ft.)	SOIL TYPE	FIELD BLOW COUNT N	SAMPLER TYPE 1=SPT =CA.MOI	SAMPLER LINED 1=UNLINED 2=LINED	EST. PERCENT OF FINES (%)	DESIGN TOTAL OVERBUR. PRESS. (tsf)	PRESENT EFFEC. OVERBUR. PRESS. (tsf)	C_N	C_R	C_S	C_{ST}	STRESS REDUC. COEFF. rd	DESIGN EFFEC. OVERBUR. PRESS. (tsf)	INDUCED CYCLIC STRESS RATIO	CORRECT BLOW COUNT N160	(N1)60cs	K sigma	CYCLIC STRESS RATIO M=7.5	CYCLIC STRESS RATIO verburd Cc Mag Corr	RESIST. FACTOR OF SAFETY (F_L)	RESIST. WILL IT LIQUEFY?
-			-	-		-	-	-	-				-	-	-	-		-	-		-	-
5	82	SM	20	1	1	25.0	0.30	0.30	1.70	0.80	1.20	1.00	0.99	0.30	0.15	43	52	1.00	High N	0.00	LARGE	AboveWT
10	77	CL	28	2	2	54.0	0.60	0.60	1.32	0.85	1.00	0.67	0.98	0.60	0.14	28	38	1.00	High N	0.00	LARGE	AboveWT
15	72	CL	19	1	1	30.0	0.90	0.90	1.08	0.85	1.20	1.00	0.97	0.90	0.14	27	36	1.00	High N	0.00	LARGE	AboveWT
20	67	ML	29	2	2	60.0	1.20	1.20	0.93	0.95	1.00	0.67	0.95	1.20	0.14	23	32	0.97	High N	0.00	LARGE	AboveWT
25	62	ML	14	1	1	60.0	1.50	1.50	0.83	0.95	1.20	1.00	0.94	1.50	0.14	18	26	0.93	0.31	0.42	3.03	AboveWT
30	57	SM	27	2	2	30.0	1.80	1.80	0.76	1.00	1.00	0.67	0.93	1.71	0.14	18	26	0.90	0.30	0.39	2.72	no
35	52	ML	9	1	1	70.0	2.10	2.10	0.71	1.00	1.20	1.00	0.89	1.85	0.15	10	17	0.88	0.18	0.23	1.55	fines
40	47	SM	19	2	2	47.0	2.40	2.40	0.66	1.00	1.00	0.67	0.85	1.99	0.15	11	18	0.86	0.19	0.24	1.60	no
45	42	SM	19	1	1	35.0	2.70	2.61	0.63	1.00	1.20	1.00	0.81	2.14	0.15	19	28	0.87	0.36	0.45	3.02	no
50	37	SM	12	2	2	40.0	3.00	2.75	0.62	1.00	1.00	0.67	0.77	2.28	0.15	6	13	0.86	0.14	0.17	1.15	depth>50'
55	32	GP	100	1	1	5.0	3.30	2.89	0.60	1.00	1.20	1.00	0.73	2.43	0.15	95	95	0.85	High N	0.00	LARGE	high N
62	25.5	SP	40	2	2	5.0	3.69	3.08	0.58	1.00	1.00	0.67	0.67	2.61	0.14	20	20	0.83	0.22	0.26	1.88	depth>50'
65	22	ML	100	1	1	94.0	3.90	3.18	0.57	1.00	1.20	1.00	0.64	2.71	0.14	90	114	0.82	High N	0.00	LARGE	high N
70	17	SM	55	2	2	25.0	4.20	3.33	0.56	1.00	1.00	0.67	0.60	2.86	0.13	27	34	0.81	High N	0.00	LARGE	high N
80	7	SM	28	1	1	25.0	4.80	3.61	0.54	1.00	1.20	1.00	0.55	3.15	0.12	24	31	0.77	High N	0.00	LARGE	high N
90	-3	SM	72	2	2	25.0	5.40	3.90	0.52	1.00	1.00	0.67	0.52	3.43	0.12	33	41	0.76	High N	0.00	LARGE	high N
100	-13	ML	59	1	1	80.0	6.00	4.19	0.50	0.95	1.20	1.00	0.50	3.72	0.12	44	58	0.74	High N	0.00	LARGE	high N

5th Street Bridge, Yuba City **EMI Project No.** **13-121** Version - 12/05

LIQUEFACTION ANALYSIS, ACC. = 0.227 g

Liquefaction analysis is performed following Seed's Procedure, outlined by Seed et al. (1985), Seed and Harder (1990), updated NCEER (1997), Martin et al. (1999) and Youd et al. (2001)

Calculated by: **TC 10/31/2013**

Checked by: AZ 8/19/2016

Emean/E60 = Energy Ratio to correct to standard 60% Energy
Surcharge = Any surcharge on top of the ground (psf)
acc. max = maximum peak acceleration at the ground surface (g's)
[1]C_N = square root of (100 kPa or 1.04427 tsf/effective overburden)
The induced cyclic stress ratio (CSR i) by a given peak ground acceleration (acc. max) is:

CSR i = 0.65 x acc max. x total normal stress x rd / (effective normal stress x g)

The resisting cyclic stress ratio (CRR r) is equal to:
CRR r = $CRR_{7.5}$ x Cm x K sigma

where: Cm = Earthquake Magnitude Correction Factor (Blake, NCEER Table 3, Eq.4)
K sigma = Normalized resistance factor (Fig. 14 from NCEER Liquefaction workshop, Harder Boulanger)
$CRR_{7.5}$ = Resisting Cyclic Stress Ratio. It is a function of the content of fines
(Figure 2, NCEER Workshop, after Seed et al 1985))

Factor of Safety, F_L is:
F_L = CRR r / CSR i

R-13-012

Emean (%)	79	Present Ground El.	61	Borehole Dia. (in)	5	Tot. Unit Wt. (pcf)	1.0	=Design Water Table Depth.	10.0	=Field Water Table Depth.	Acc. max =	0.227	g	Earthq. M	6.5
C_E	1.32	Future Ground El.	61	C_B	1.00	120	60	=Design Water El.	51	=Field Water El.				Cm=	1.44

DEPTH OF SOIL SAMPLE (ft.)	EL. (ft.)	SOIL TYPE	FIELD BLOW COUNT N	SAMPLER TYPE 1=SPT =CA.MOI	SAMPLER LINED 1=UNLINED 2=LINED	EST. PERCENT OF FINES (%)	DESIGN TOTAL OVERBUR. PRESS. (tsf)	PRESENT EFFEC. OVERBUR. PRESS. (tsf)	C_N	C_R	C_S	C_{ST}	STRESS REDUC. COEFF. rd	DESIGN EFFEC. OVERBUR. PRESS. (tsf)	INDUCED CYCLIC STRESS RATIO	CORRECT BLOW COUNT N160	(N1)60cs	K sigma	CYCLIC STRESS RATIO M=7.5	CYCLIC STRESS RATIO verburd Cc Mag Corr	RESIST. FACTOR OF SAFETY (F_L)	RESIST. WILL IT LIQUEFY?
-			-	-		-	-	-	-				-	-	-	-		-	-		-	-
5	56	SC-SM	13	2	2	38.0	0.30	0.30	1.70	0.80	1.00	0.67	0.99	0.18	0.25	16	24	1.00	0.27	0.38	1.54	no
10	51	SC-SM	6	1	1	38.0	0.60	0.60	1.32	0.85	1.20	1.00	0.98	0.32	0.27	11	18	1.00	0.19	0.27	1.01	no
17	44.5	SC-SM	100	1	1	38.0	0.99	0.79	1.15	0.95	1.20	1.00	0.96	0.51	0.28	173	212	1.00	High N	0.00	LARGE	high N
20	41	SP-SM	19	1	1	5.0	1.20	0.89	1.08	0.95	1.20	1.00	0.95	0.61	0.28	31	31	1.00	High N	0.00	LARGE	high N
25	36	SP-SM	89	2	2	5.0	1.50	1.03	1.01	0.95	1.00	0.67	0.94	0.75	0.28	75	75	1.00	High N	0.00	LARGE	high N
30	31	SP-SM	31	1	1	7.0	1.80	1.18	0.94	1.00	1.20	1.00	0.93	0.90	0.28	46	47	1.00	High N	0.00	LARGE	high N
35	26	SP-SM	46	2	2	7.0	2.10	1.32	0.89	1.00	1.00	0.67	0.89	1.04	0.27	36	36	0.99	High N	0.00	LARGE	high N
40	21	SP-SM	27	1	1	7.0	2.40	1.46	0.84	1.00	1.20	1.00	0.85	1.18	0.25	36	36	0.97	High N	0.00	LARGE	high N
45	16	SP-SM	75	2	2	7.0	2.70	1.61	0.81	1.00	1.00	0.67	0.81	1.33	0.24	53	54	0.95	High N	0.00	LARGE	high N
50	11	ML	36	1	1	85.0	3.00	1.75	0.77	1.00	1.20	1.00	0.77	1.47	0.23	44	58	0.93	High N	0.00	LARGE	high N
57	4.5	SM	43	2	2	40.0	3.39	1.94	0.73	1.00	1.00	0.67	0.71	1.66	0.22	28	38	0.91	High N	0.00	LARGE	high N
60	1	ML	21	1	1	80.0	3.60	2.04	0.72	1.00	1.20	1.00	0.69	1.76	0.21	24	33	0.89	High N	0.00	LARGE	high N
65	-4	SP-SM	66	2	2	7.0	3.90	2.18	0.69	1.00	1.00	0.67	0.64	1.90	0.19	40	40	0.87	High N	0.00	LARGE	high N
70	-9	SW-SM	43	1	1	7.0	4.20	2.33	0.67	1.00	1.20	1.00	0.60	2.05	0.18	45	46	0.88	High N	0.00	LARGE	high N
80	-19	SW-SM	71	1	1	7.0	4.80	2.62	0.63	1.00	1.20	1.00	0.55	2.34	0.17	71	72	0.85	High N	0.00	LARGE	high N
90	-29	CL	85	2	2	90.0	5.40	2.90	0.60	1.00	1.00	0.67	0.52	2.62	0.16	45	59	0.83	High N	0.00	LARGE	high N
100	-39	CL	100	2	2	90.0	6.00	3.19	0.57	0.95	1.00	0.67	0.50	2.91	0.15	48	62	0.81	High N	0.00	LARGE	high N

5th Street Bridge, Yuba City **EMI Project No.** **13-121** Version - 12/05

LIQUEFACTION ANALYSIS, ACC. = 0.227 g

Liquefaction analysis is performed following Seed's Procedure, outlined by Seed et al. (1985), Seed and Harder (1990), updated NCEER (1997), Martin et al. (1999) and Youd et al. (2001)

Calculated by: **TC 10/31/2013**

Checked by: AZ 8/19/2016

Emean/E60 = Energy Ratio to correct to standard 60% Energy
Surcharge = Any surcharge on top of the ground (psf)
acc. max = maximum peak acceleration at the ground surface (g's)
[1]C_N = square root of (100 kPa or 1.04427 tsf/effective overburden)
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where: Cm = Earthquake Magnitude Correction Factor (Blake, NCEER Table 3, Eq.4)
K sigma = Normalized resistance factor (Fig. 14 from NCEER Liquefaction workshop, Harder Boulanger)
$CRR_{7.5}$ = Resisting Cyclic Stress Ratio. It is a function of the content of fines
(Figure 2, NCEER Workshop, after Seed et al 1985))

Factor of Safety, F_L is:
F_L = CRR r / CSR i

R-13-013

Emean (%)	79	Present Ground El.	63	Borehole Dia. (in)	5	Tot. Unit Wt. (pcf)	3.0	=Design Water Table Depth.	12.0	=Field Water Table Depth.	Acc. max =	0.227	g	Earthq. M	6.5
C_E	1.32	Future Ground El.	63	C_B	1.00	120	60	=Design Water El.	51	=Field Water El.				Cm=	1.44

DEPTH OF SOIL SAMPLE (ft.)	EL. (ft.)	SOIL TYPE	FIELD BLOW COUNT N	SAMPLER TYPE 1=SPT =CA.MOD	SAMPLER LINED 1=UNLINED 2=LINED	EST. PERCENT OF FINES (%)	DESIGN TOTAL OVERBUR. PRESS. (tsf)	PRESENT EFFEC. OVERBUR. PRESS. (tsf)	C_N	C_R	C_S	C_{ST}	STRESS REDUC. COEFF. rd	DESIGN EFFEC. OVERBUR. PRESS. (tsf)	INDUCED CYCLIC STRESS RATIO	CORRECT BLOW COUNT N160	(N1)60cs	K sigma	CYCLIC STRESS RATIO M=7.5	CYCLIC STRESS RATIO verburd Cc Mag Corr	RESIST. FACTOR OF SAFETY (F_L)	RESIST. WILL IT LIQUEFY?
-			-	-		-	-	-	-				-	-	-	-		-	-		-	-
5	58	ML	7	1	1	93.0	0.30	0.30	1.70	0.80	1.20	1.00	0.99	0.24	0.18	15	23	1.00	0.26	0.37	2.02	fines
10	53	SM	22	2	2	39.0	0.60	0.60	1.32	0.85	1.00	0.67	0.98	0.38	0.23	22	31	1.00	High N	0.00	LARGE	high N
15	48	SP	21	1	1	3.0	0.90	0.81	1.14	0.85	1.20	1.00	0.97	0.53	0.24	32	32	1.00	High N	0.00	LARGE	high N
20	43	SM	44	2	2	15.0	1.20	0.95	1.05	0.95	1.00	0.67	0.95	0.67	0.25	38	43	1.00	High N	0.00	LARGE	high N
25	38	ML	31	1	1	75.0	1.50	1.09	0.98	0.95	1.20	1.00	0.94	0.81	0.26	45	60	1.00	High N	0.00	LARGE	high N
30	33	SP-SM	42	2	2	11.0	1.80	1.24	0.92	1.00	1.00	0.67	0.93	0.96	0.26	34	36	1.00	High N	0.00	LARGE	high N
35	28	ML	20	1	1	90.0	2.10	1.38	0.87	1.00	1.20	1.00	0.89	1.10	0.25	27	38	0.99	High N	0.00	LARGE	high N
40	23	SM	46	2	2	20.0	2.40	1.53	0.83	1.00	1.00	0.67	0.85	1.25	0.24	33	40	0.97	High N	0.00	LARGE	high N
45	18	SP	27	1	1	5.0	2.70	1.67	0.79	1.00	1.20	1.00	0.81	1.39	0.23	34	34	0.95	High N	0.00	LARGE	high N
50	13	ML	50	2	2	90.0	3.00	1.81	0.76	1.00	1.00	0.67	0.77	1.53	0.22	33	45	0.93	High N	0.00	LARGE	high N
55	8	SP	26	1	1	5.0	3.30	1.96	0.73	1.00	1.20	1.00	0.73	1.68	0.21	30	30	0.91	0.47	0.61	2.89	depth>50'
60	3	ML	56	2	2	95.0	3.60	2.10	0.70	1.00	1.00	0.67	0.69	1.82	0.20	35	47	0.88	High N	0.00	LARGE	high N
65	-2	SP-SM	31	1	1	12.0	3.90	2.25	0.68	1.00	1.20	1.00	0.64	1.97	0.19	33	36	0.86	High N	0.00	LARGE	high N
70	-7	SP-SM	36	1	1	10.0	4.20	2.39	0.66	1.00	1.20	1.00	0.60	2.11	0.18	38	39	0.87	High N	0.00	LARGE	high N
80	-17	SP	52	1	1	5.0	4.80	2.68	0.62	1.00	1.20	1.00	0.55	2.40	0.16	51	51	0.85	High N	0.00	LARGE	high N
90	-27	CL	65	1	1	95.0	5.40	2.97	0.59	1.00	1.20	1.00	0.52	2.69	0.16	61	78	0.83	High N	0.00	LARGE	high N
100	-37	CL	66	1	1	95.0	6.00	3.25	0.57	0.95	1.20	1.00	0.50	2.97	0.15	56	72	0.80	High N	0.00	LARGE	high N

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering
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Fountain Valley, CA 92708

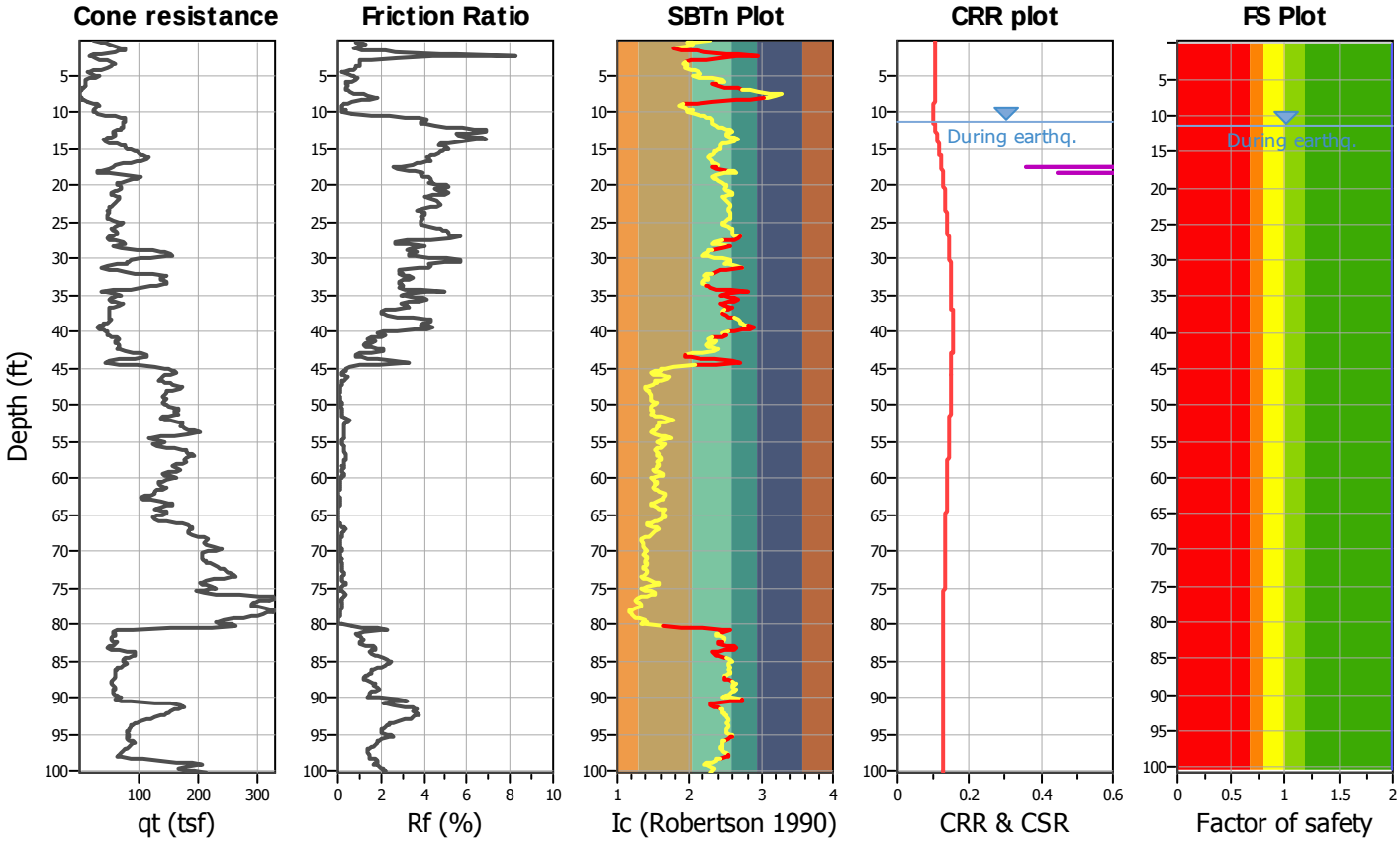
LIQUEFACTION ANALYSIS REPORT

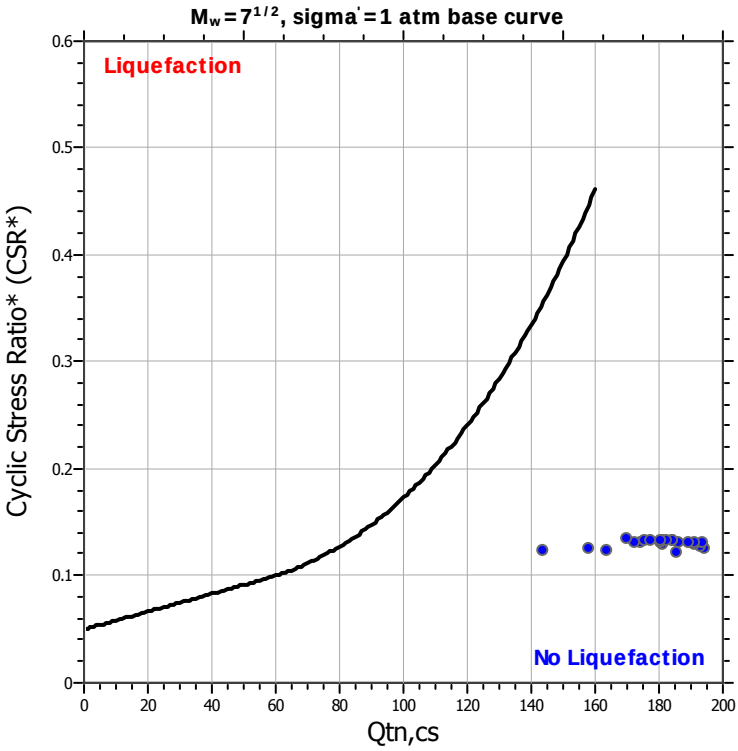
Project title : 5th Street Bridge **Location : Yuba City**

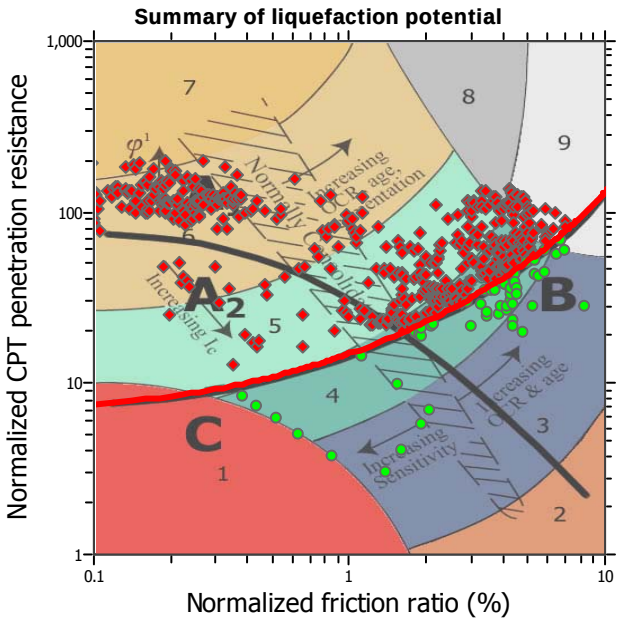
CPT file : 066DE-CPT-01

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	11.38 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	11.38 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	22.86 ft
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.23	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

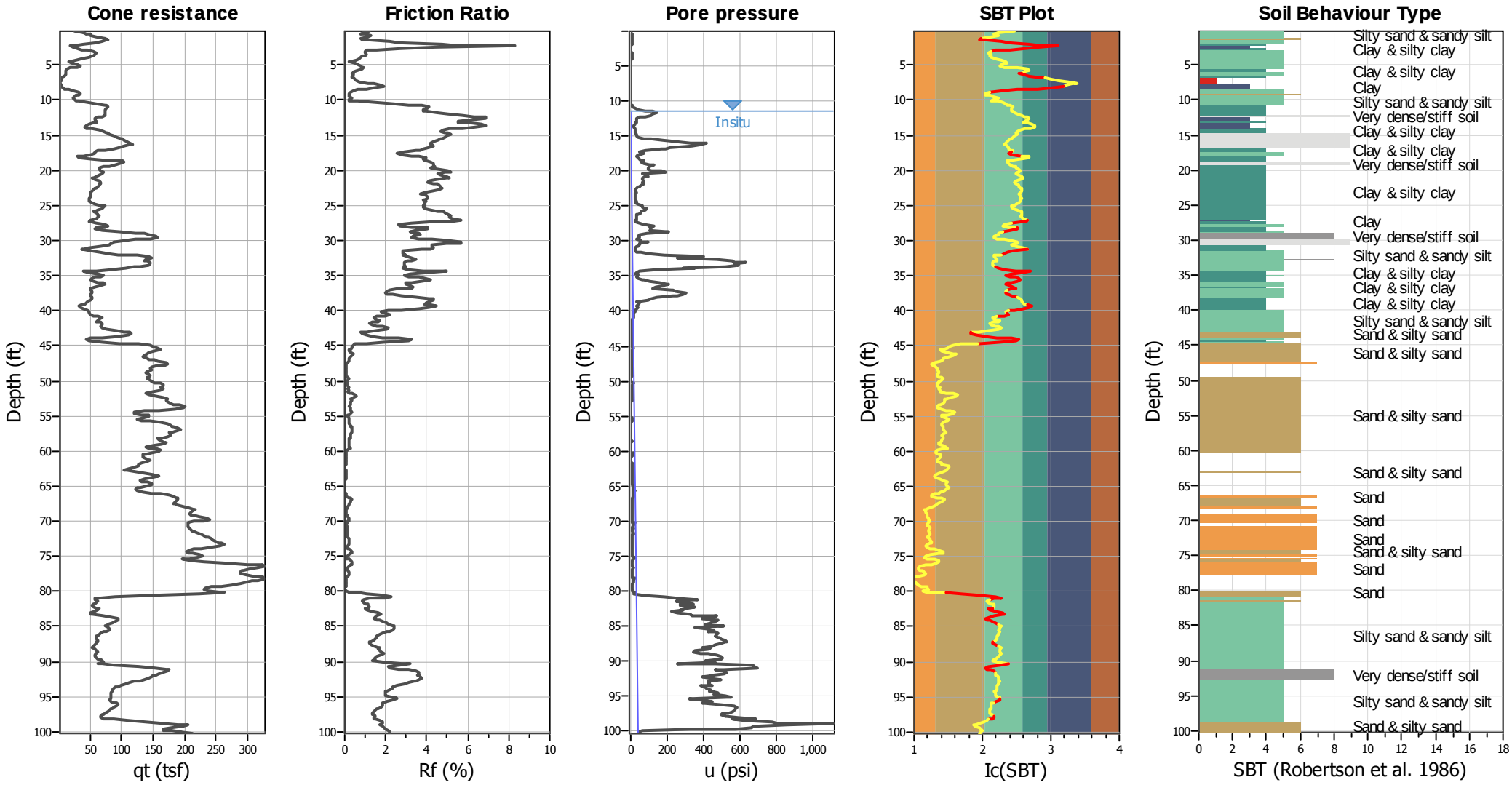






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



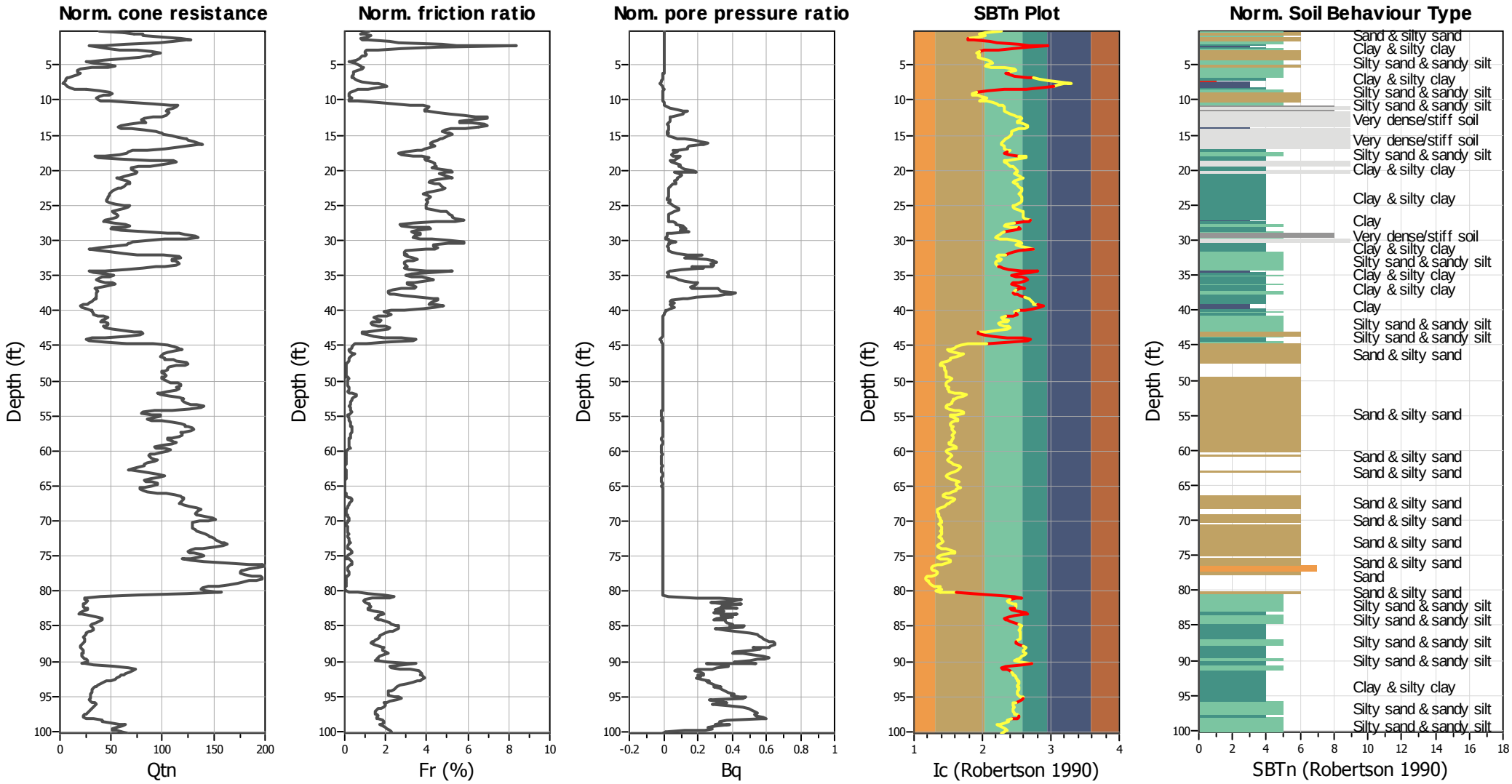
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.38 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	11.38 ft	Fill height:	N/A	Limit depth:	22.86 ft

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.38 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	11.38 ft	Fill height:	N/A	Limit depth:	22.86 ft

SBTn legend

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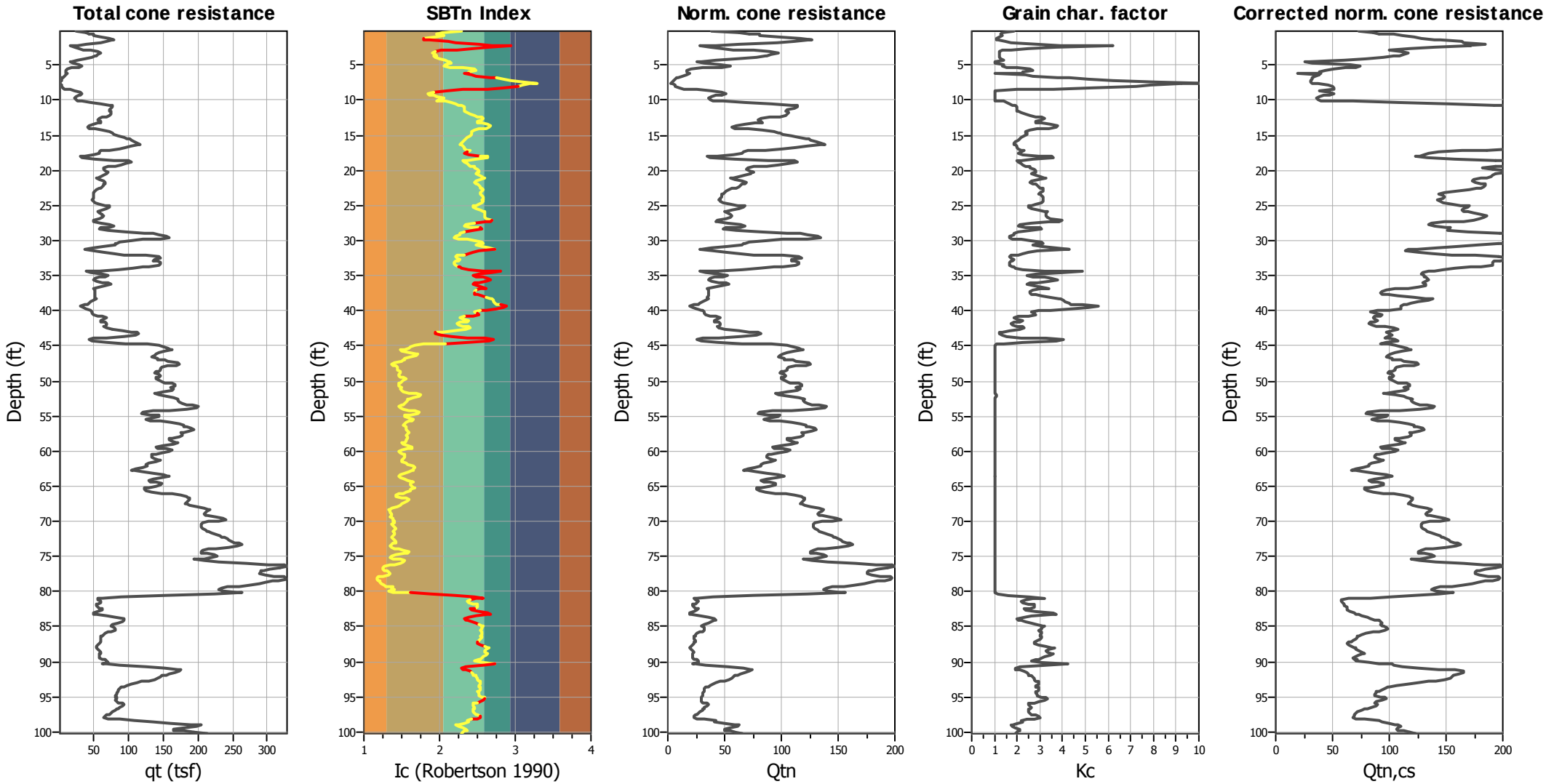
9. Very stiff fine grained

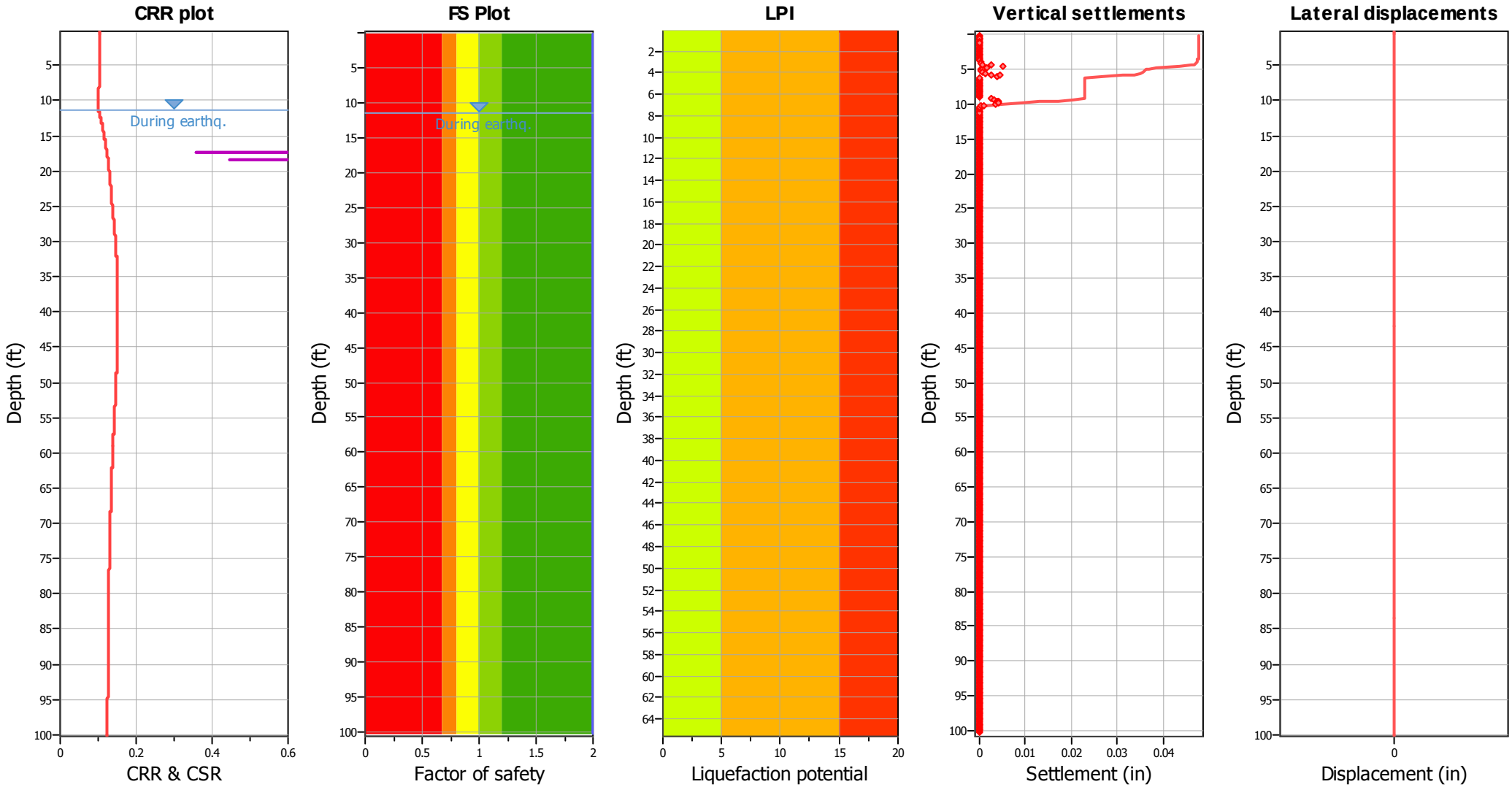
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.38 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	11.38 ft	Fill height:	N/A	Limit depth:	22.86 ft

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.38 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
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Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	11.38 ft	Fill height:	N/A	Limit depth:	22.86 ft

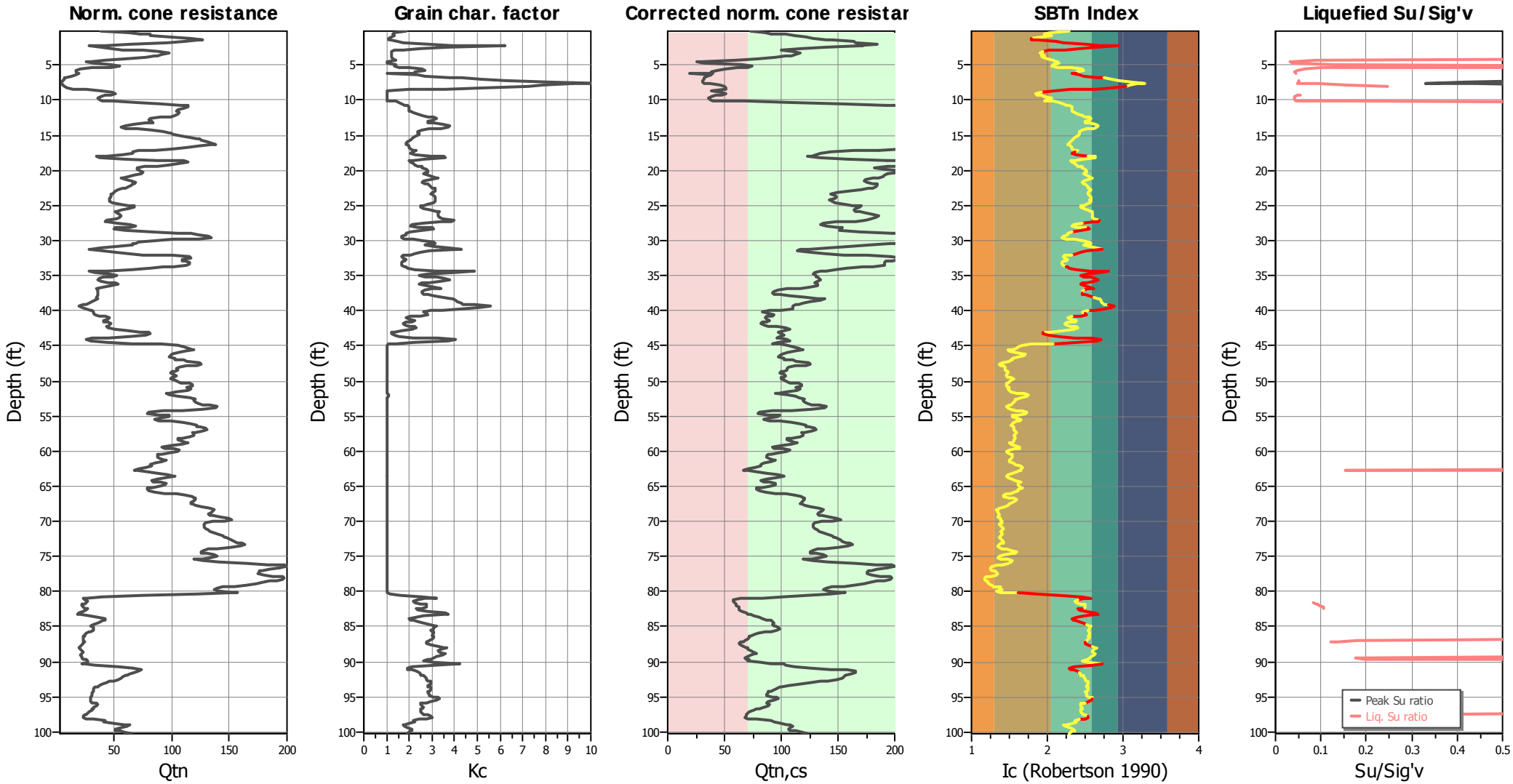
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

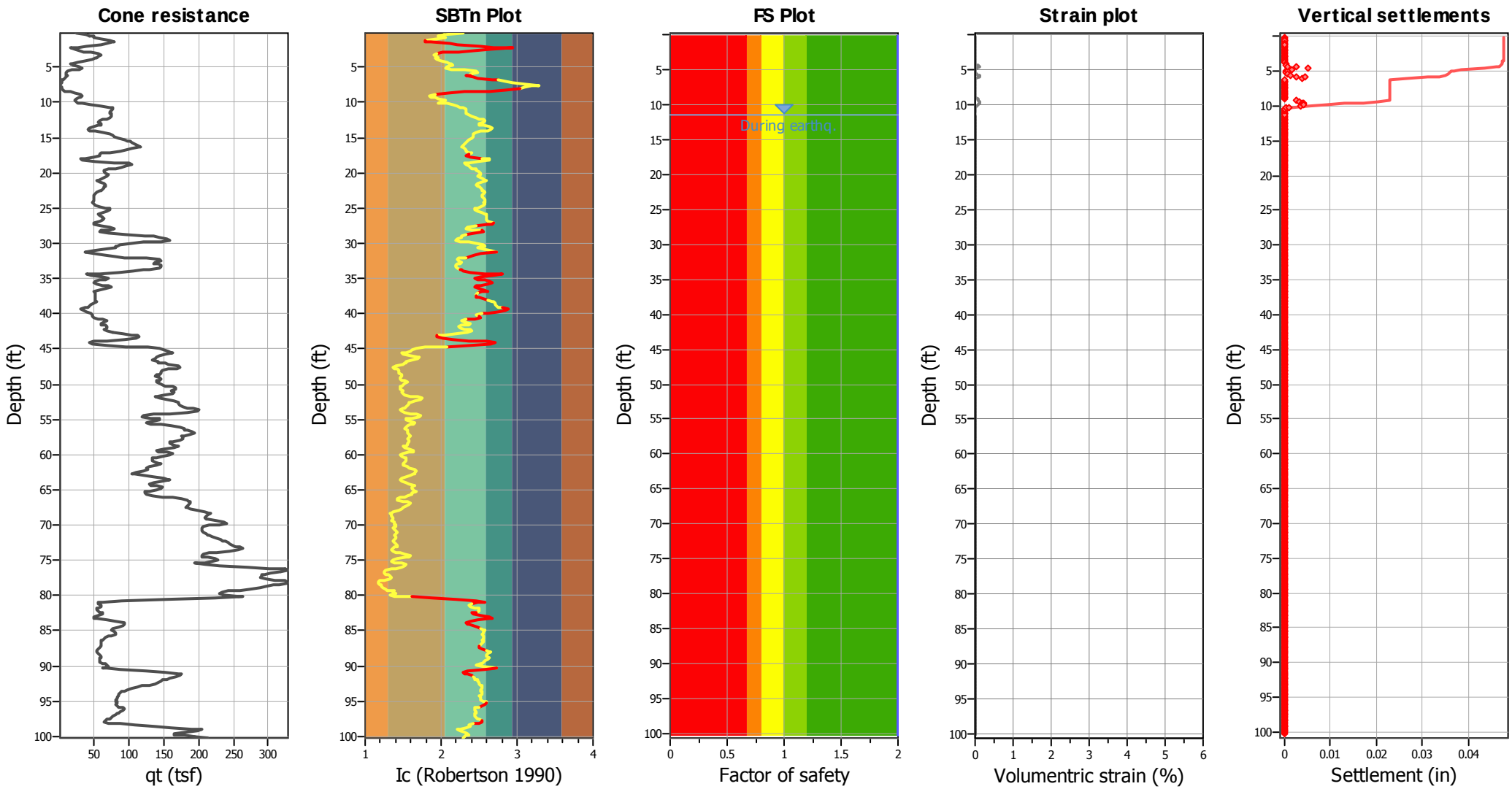
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.38 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	11.38 ft	Fill height:	N/A	Limit depth:	22.86 ft

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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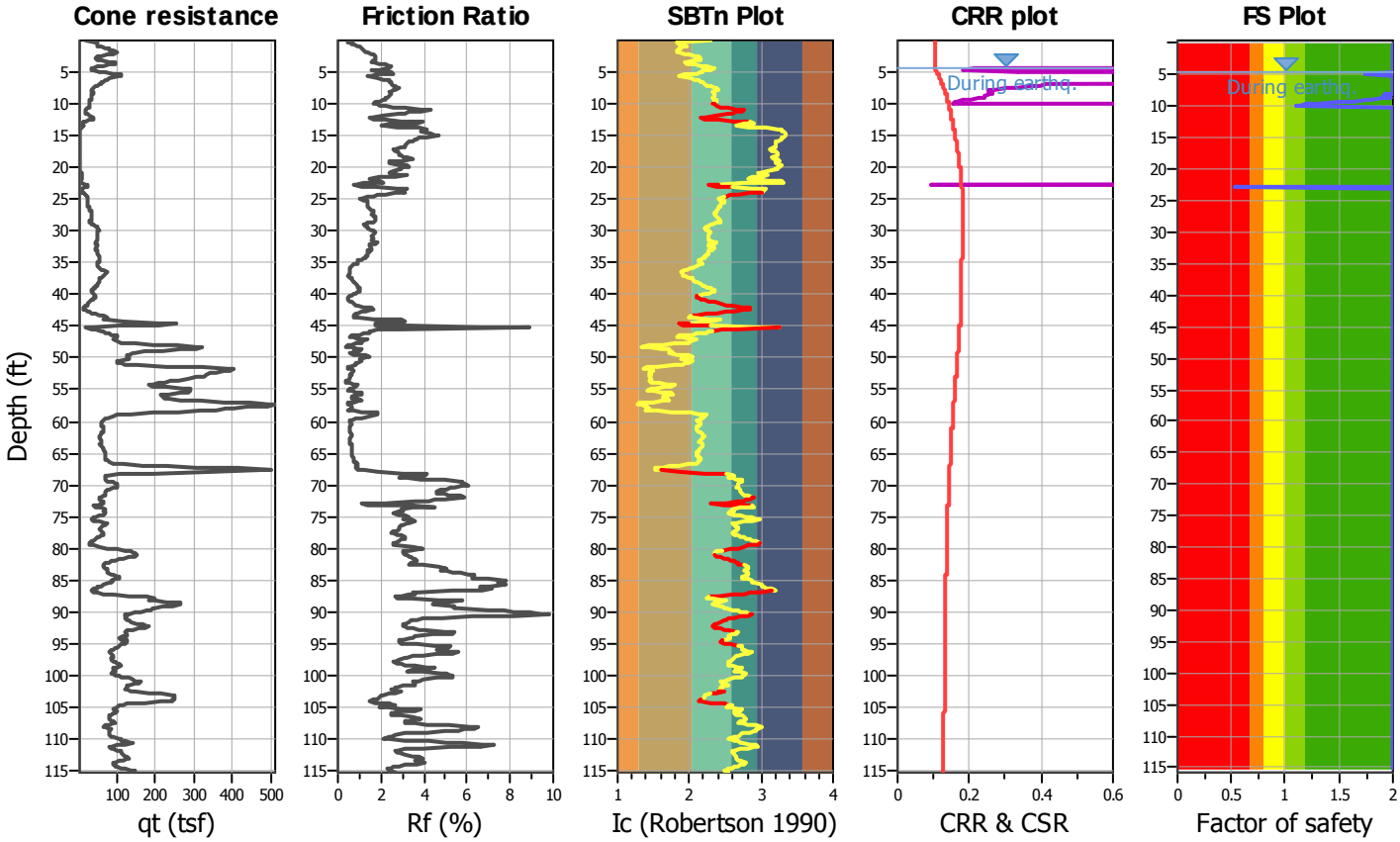
LIQUEFACTION ANALYSIS REPORT

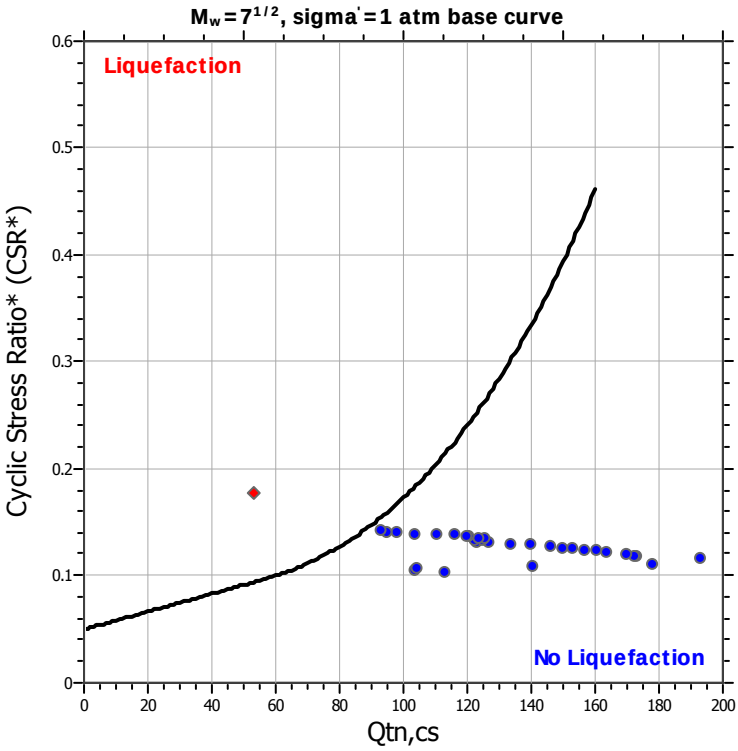
Project title : 5th Street Bridge **Location : Yuba City**

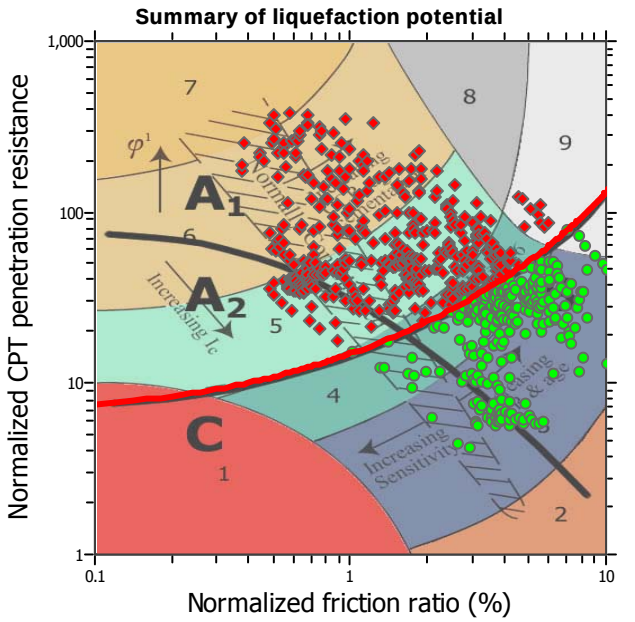
CPT file : 066DE-CPT-02

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	4.59 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	4.59 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	22.86 ft
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.23	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		







Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
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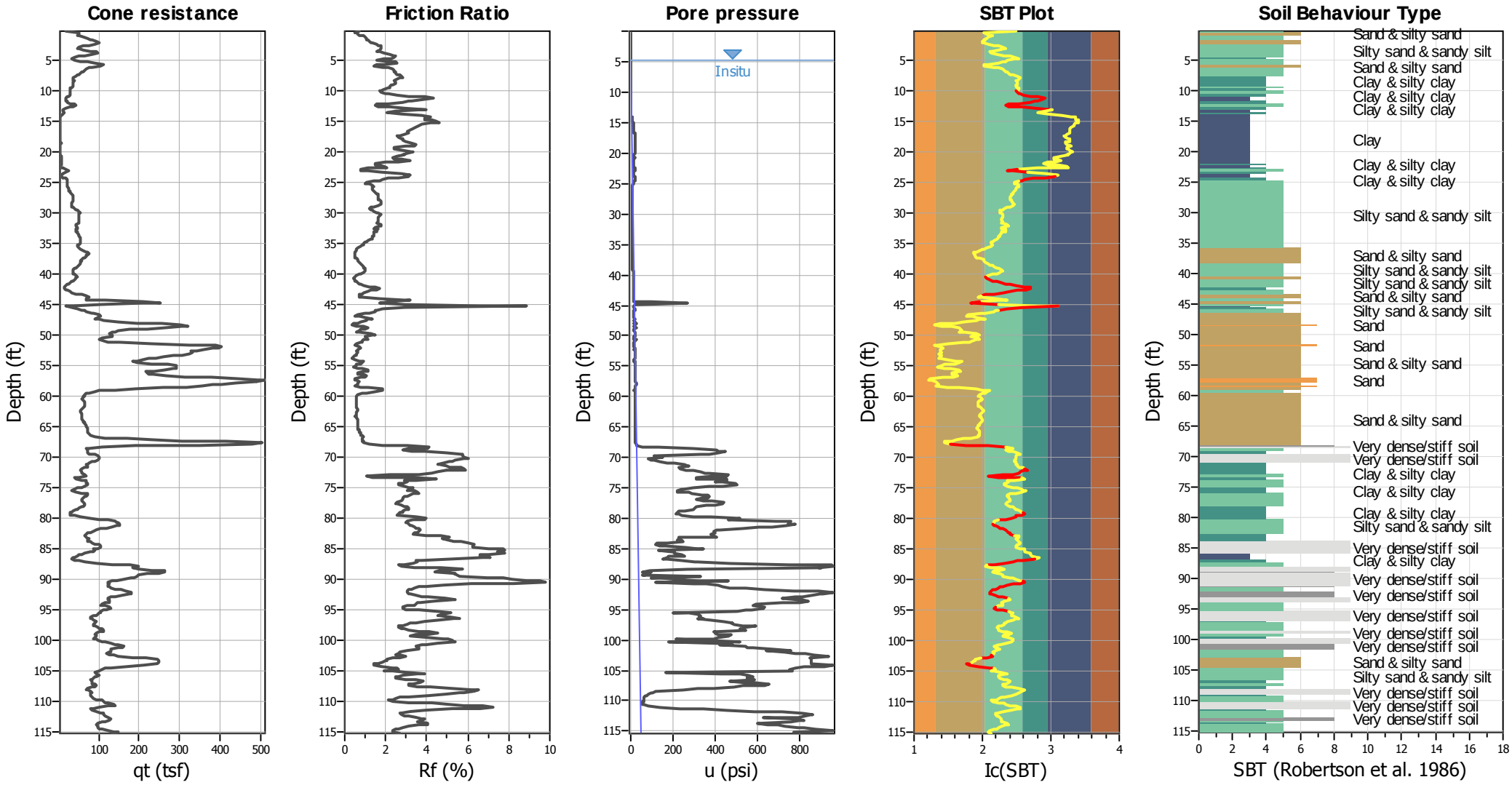
CPT basic interpretation plots



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Analysis method:	NCEER (1998)	Depth to water table (erthq.):	4.59 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	4.59 ft	Fill height:	N/A	Limit depth:	22.86 ft

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
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7. Gravely sand to sand
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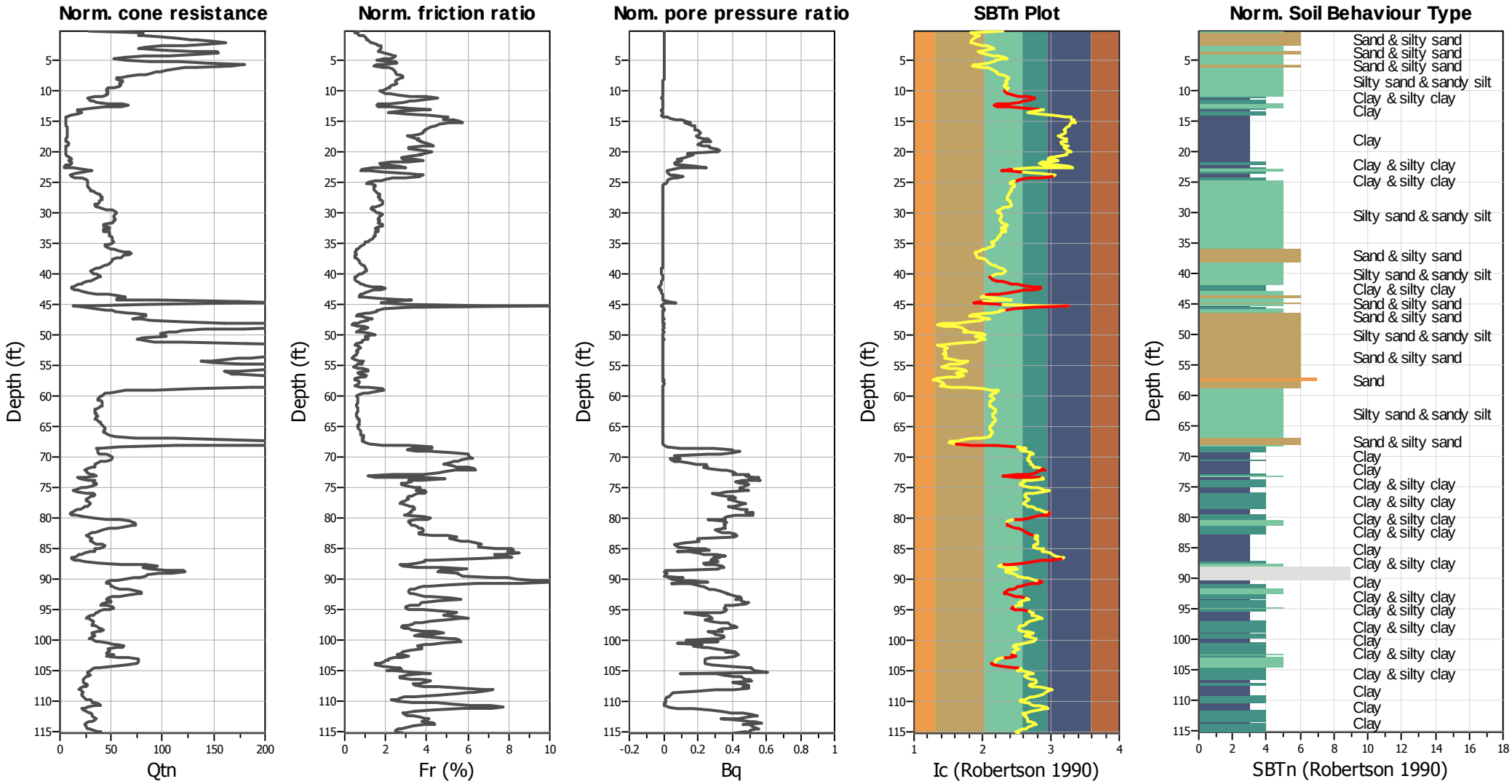
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



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Analysis method:	NCEER (1998)	Depth to water table (erthq.):	4.59 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
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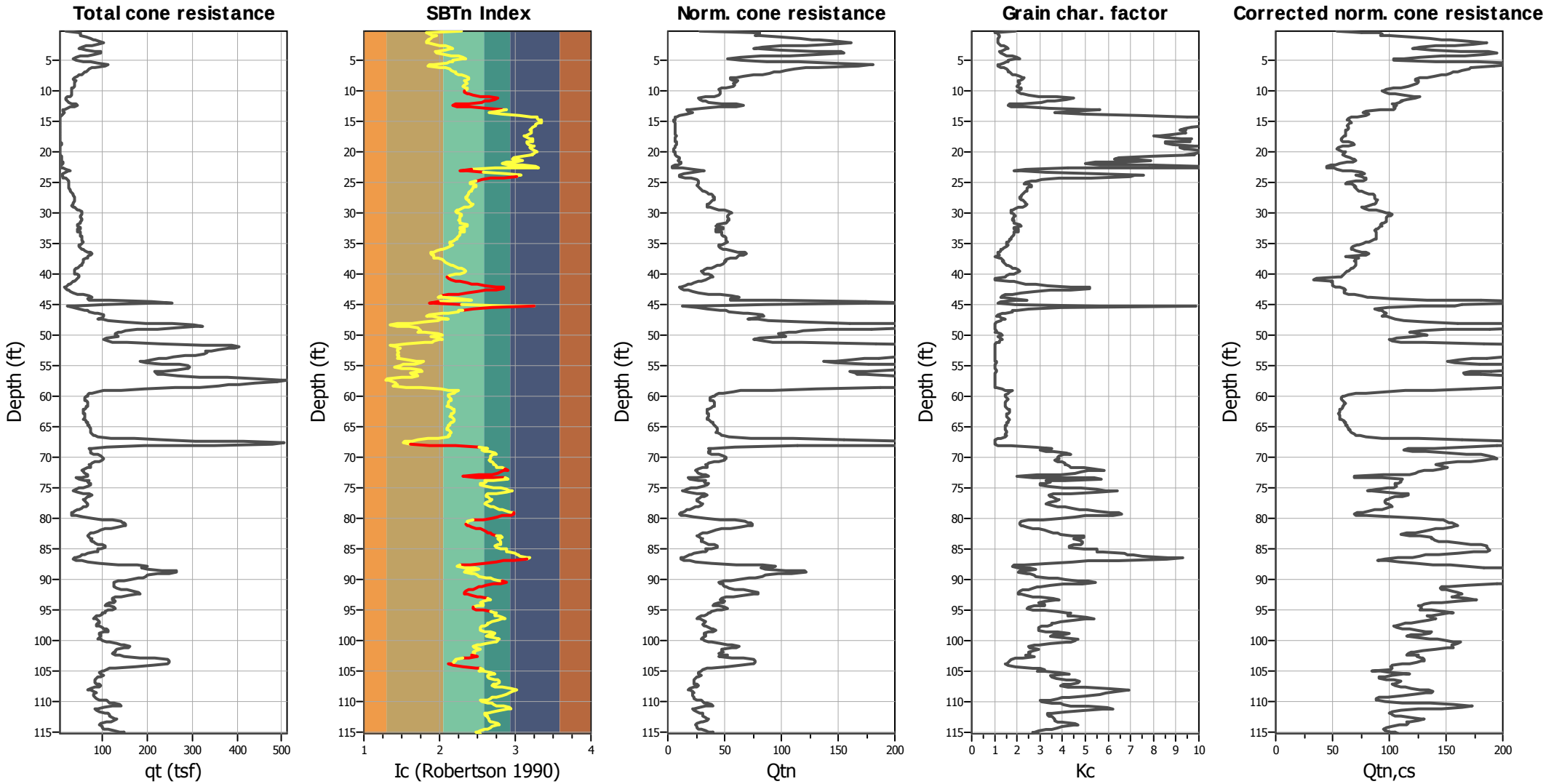
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	4.59 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
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Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
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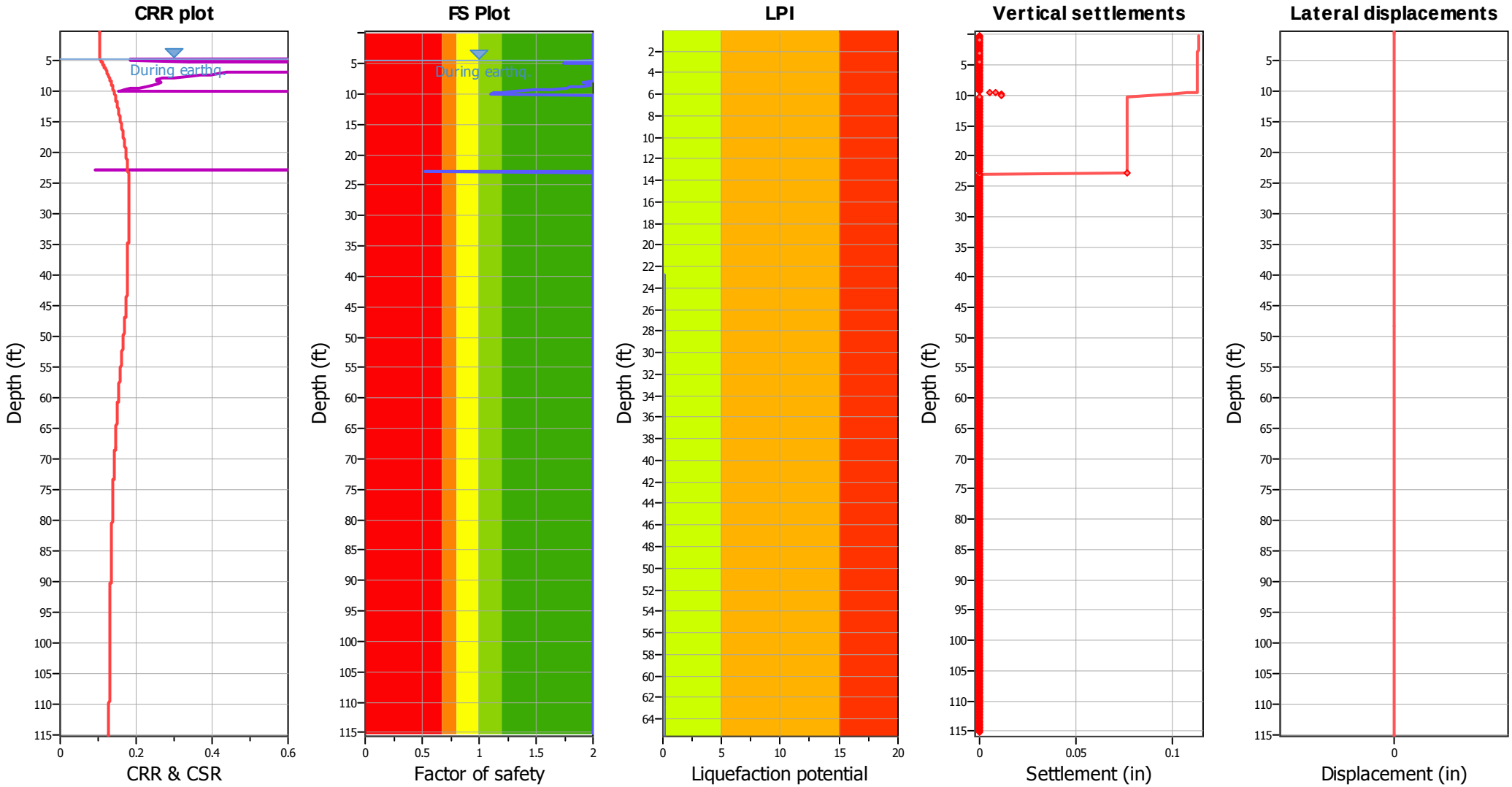
Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	4.59 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
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F.S. color scheme

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LPI color scheme

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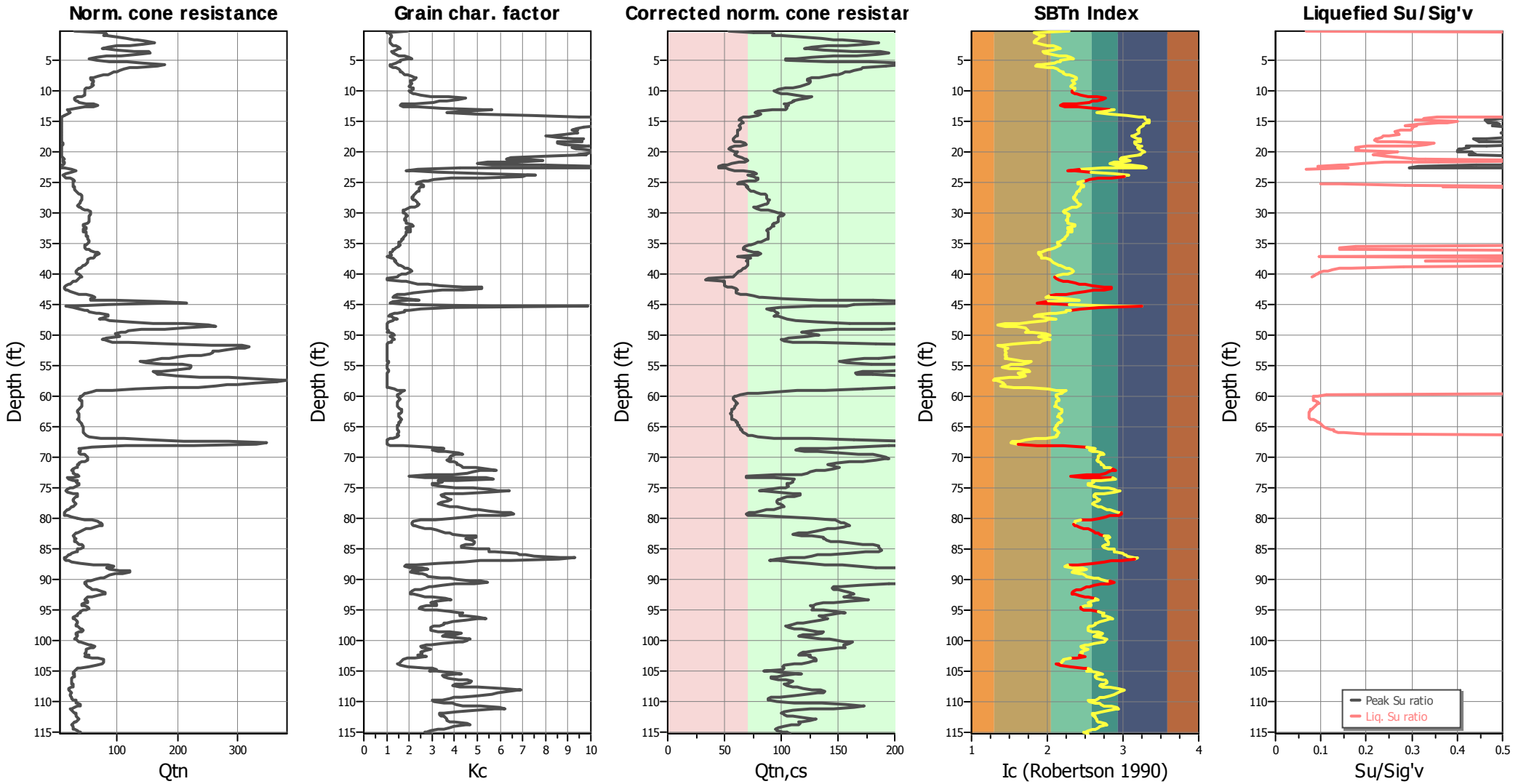

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Analysis method:	NCEER (1998)	Depth to water table (erthq.):	4.59 ft	Fill weight:	N/A
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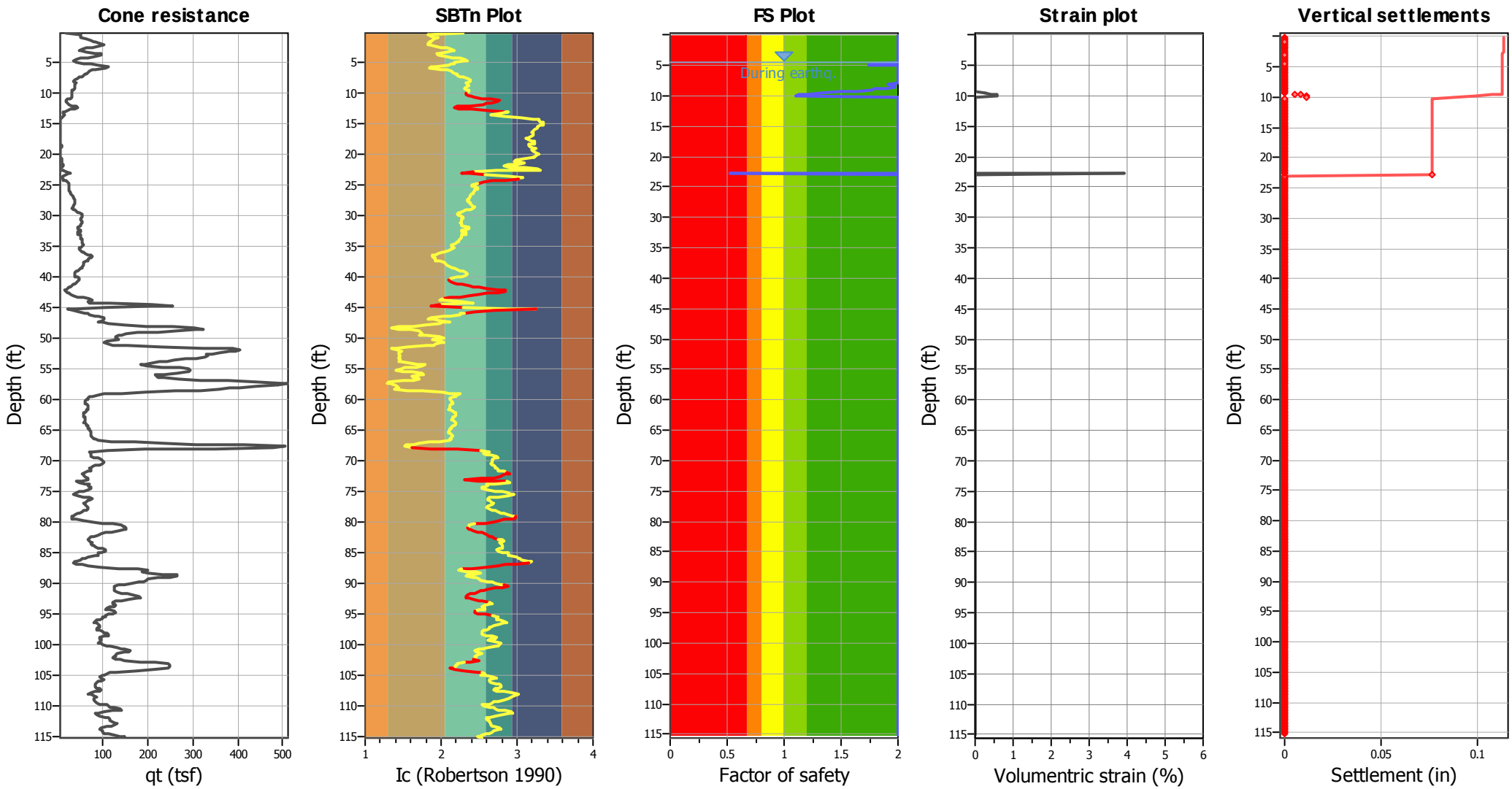
Depth to water table (insitu):	4.59 ft	Fill height:	N/A	Limit depth:	22.86 ft

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
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LIQUEFACTION ANALYSIS REPORT

Project title : 5th Street Bridge **Location : Yuba City**

CPT file : 066DE-CPT-03

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	4.59 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	4.59 ft	Fill height:	N/A	Limit depth applied:	Yes
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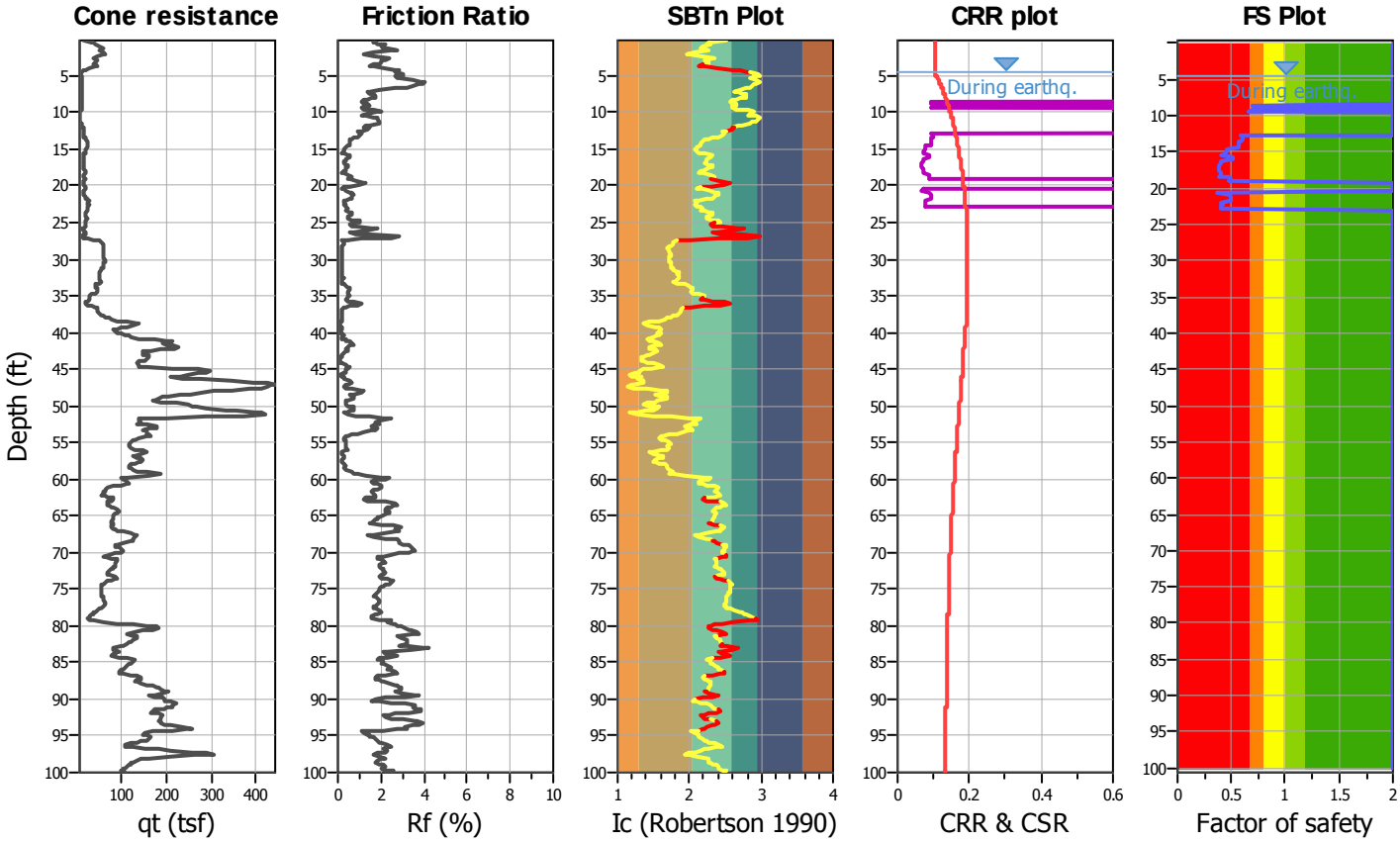
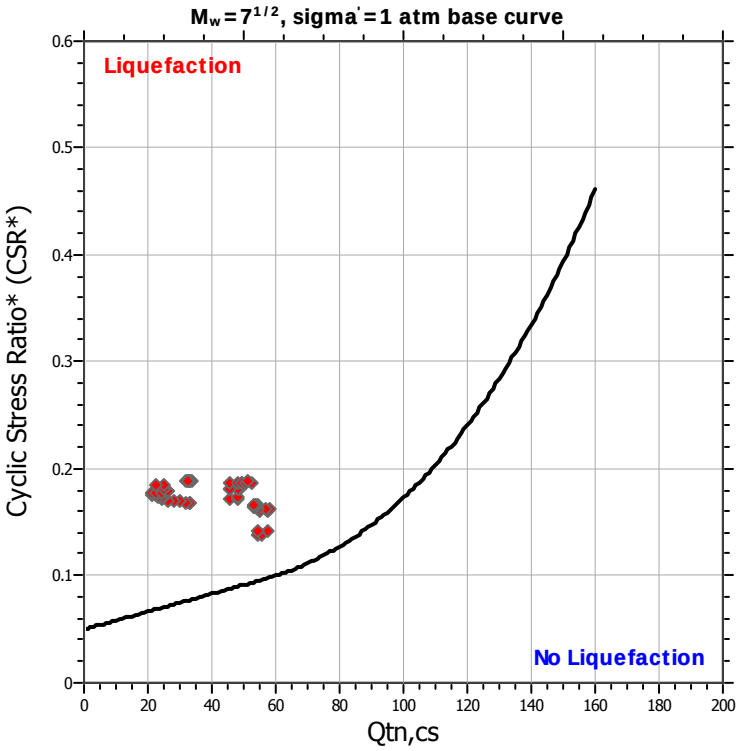
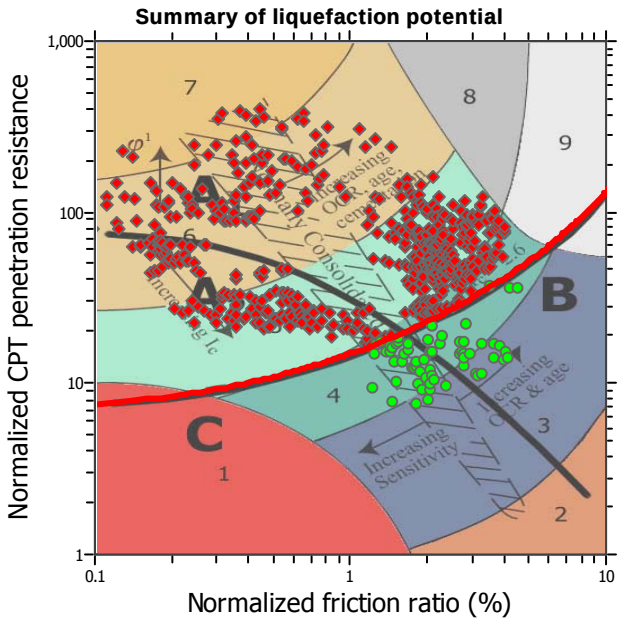
Peak ground acceleration:	0.23	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		







Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
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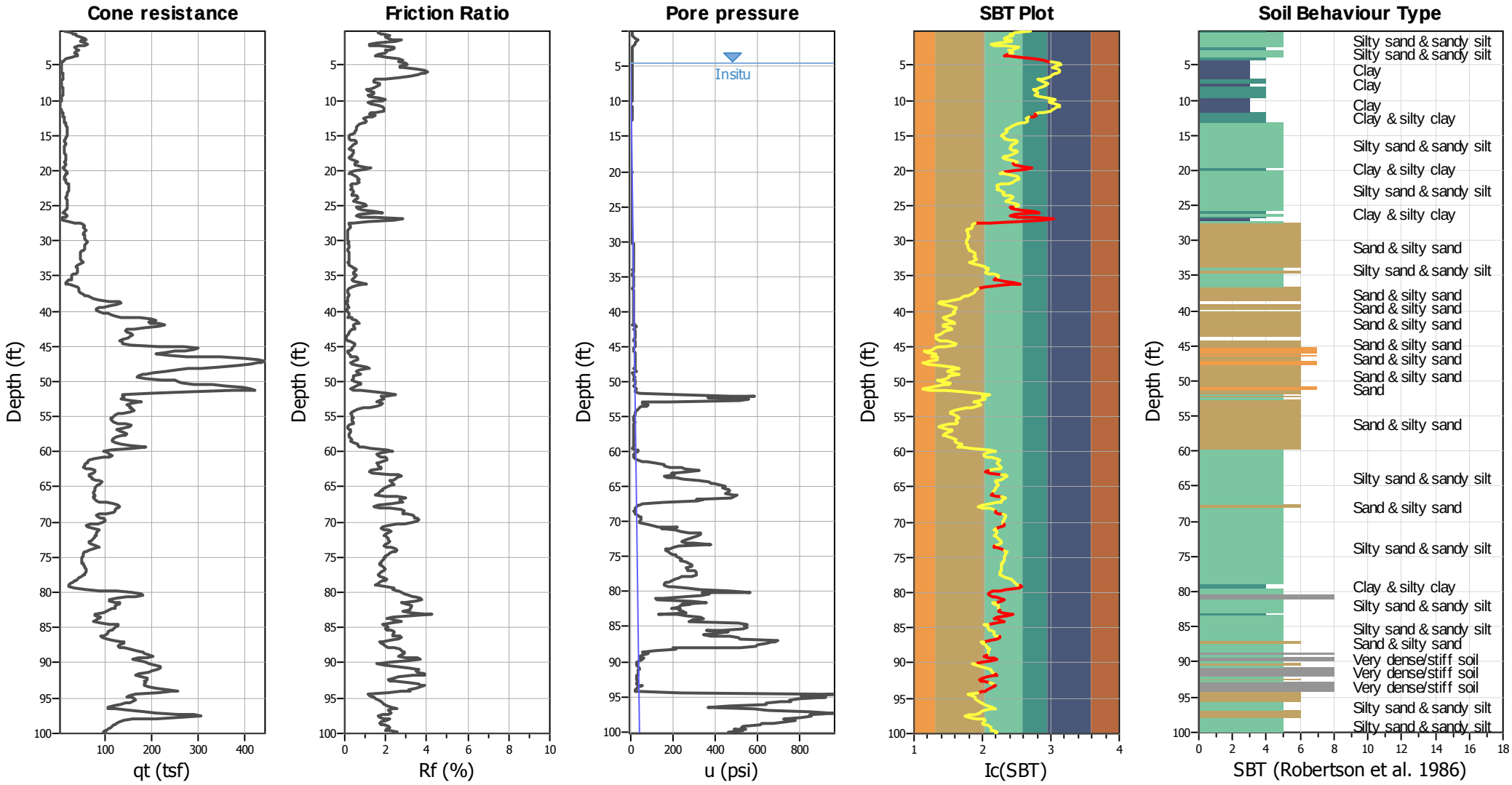
CPT basic interpretation plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	4.59 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
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Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
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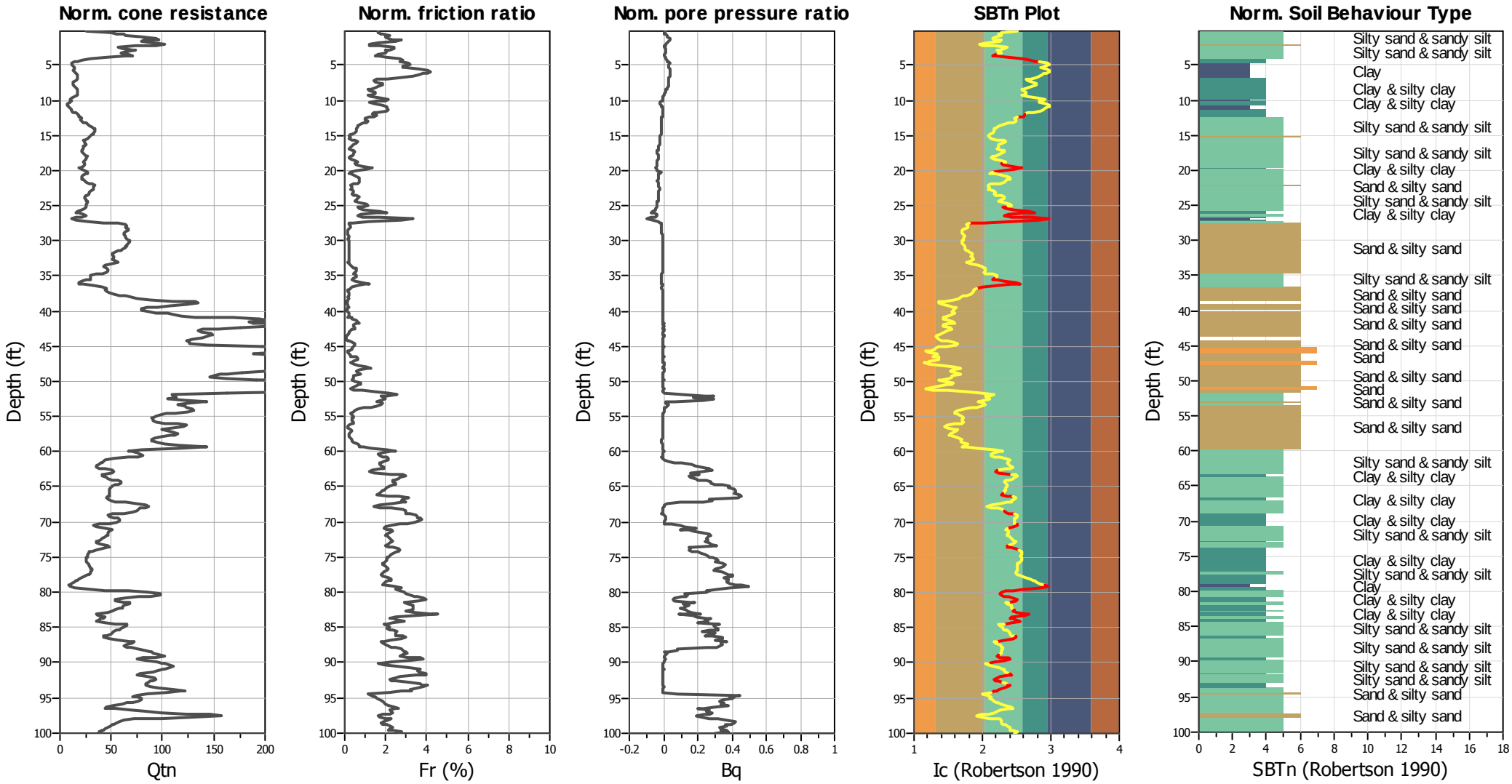
CPT basic interpretation plots (normalized)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	4.59 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
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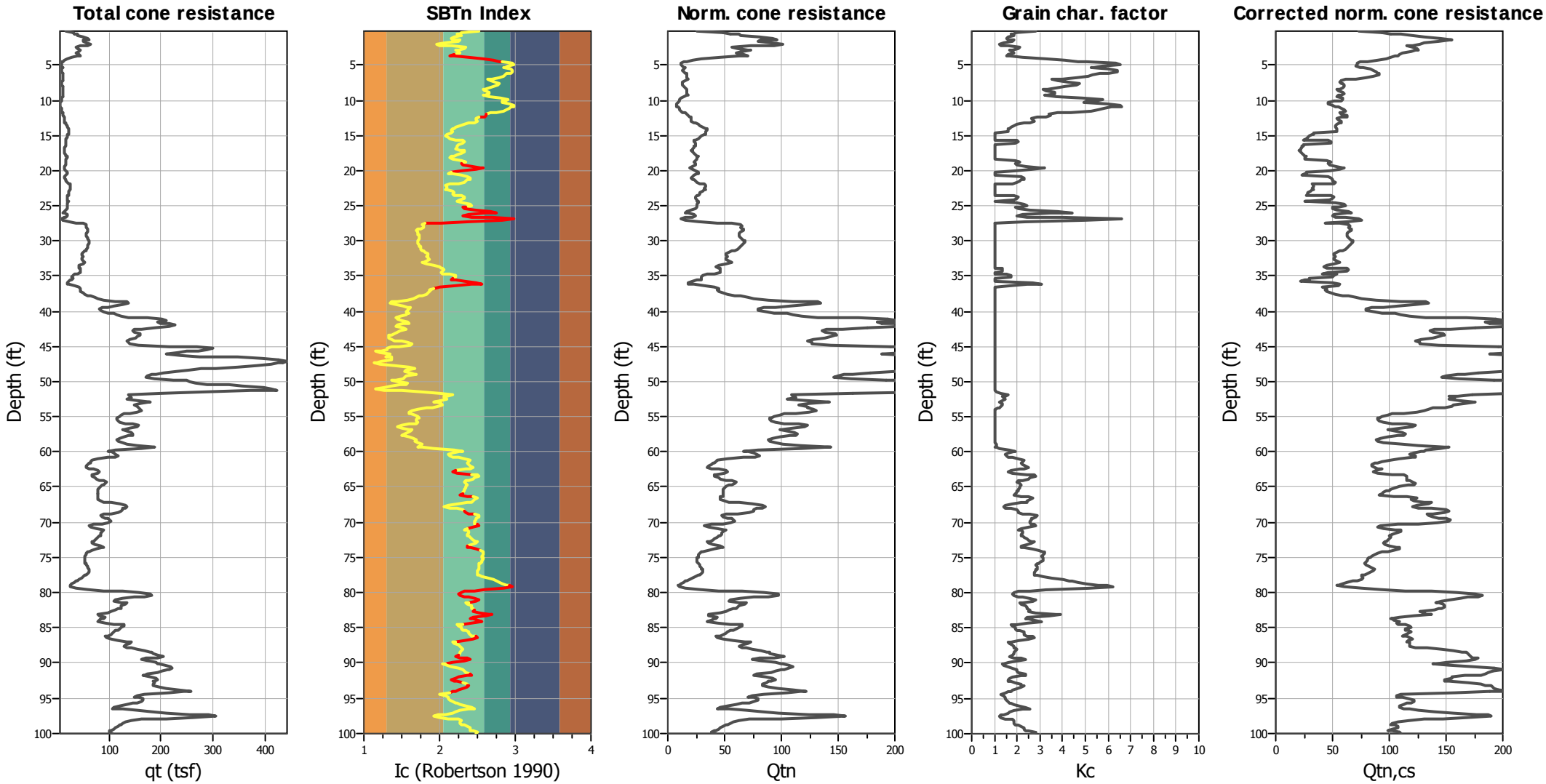
Liquefaction analysis overall plots (intermediate results)



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Analysis method:	NCEER (1998)	Depth to water table (erthq.):	4.59 ft	Fill weight:	N/A
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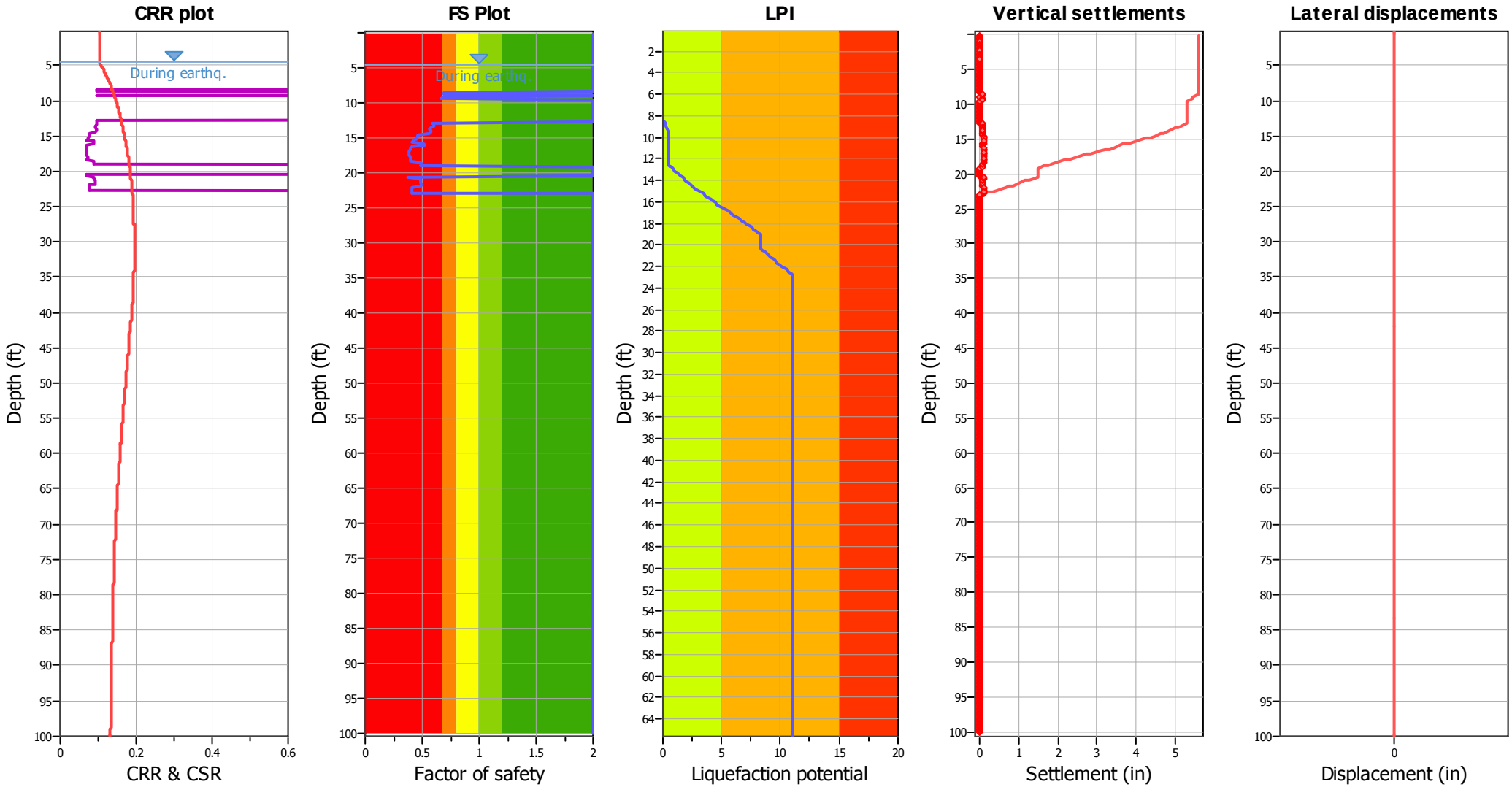
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	4.59 ft	Fill height:	N/A	Limit depth:	22.86 ft

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	4.59 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	4.59 ft	Fill height:	N/A	Limit depth:	22.86 ft

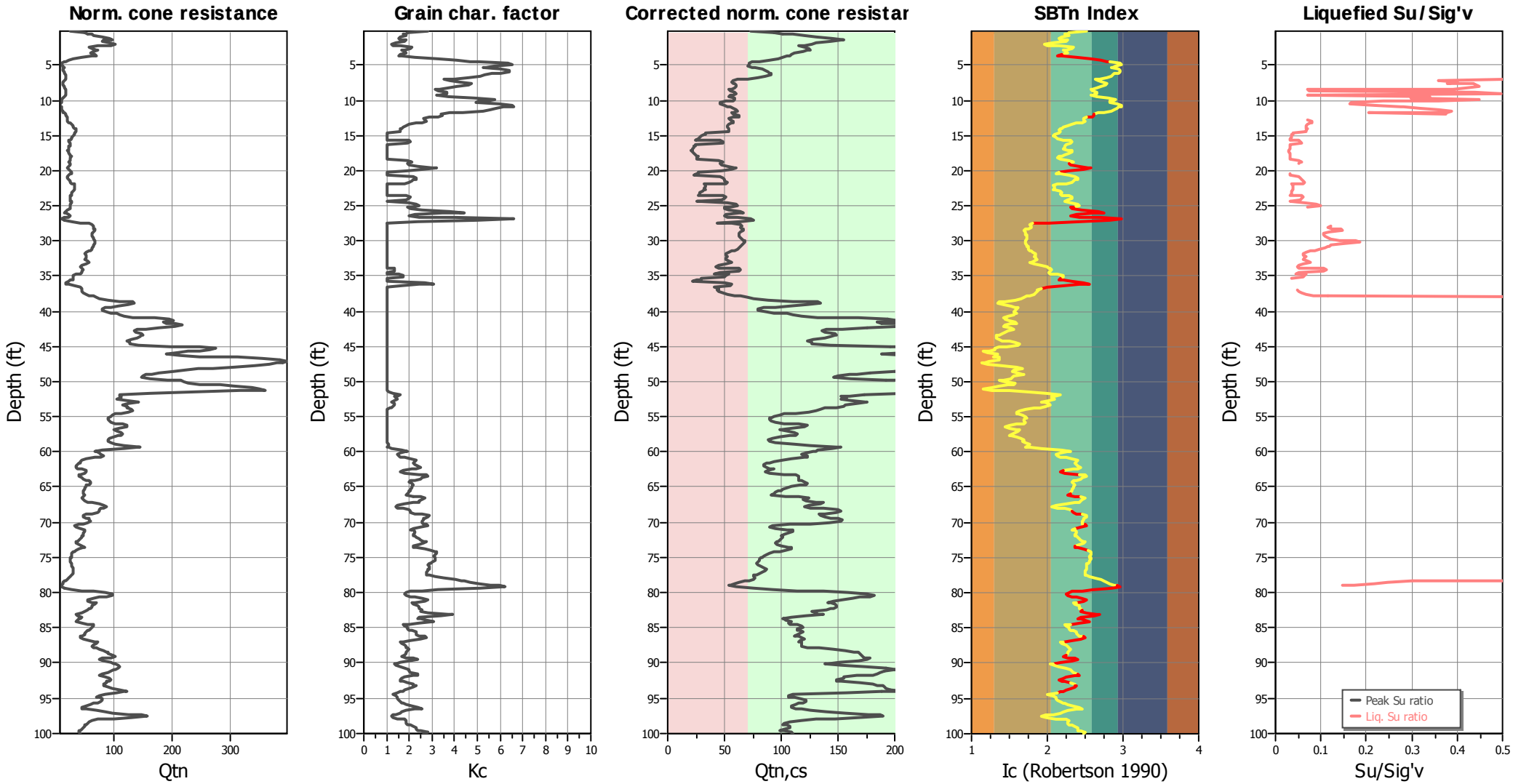
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

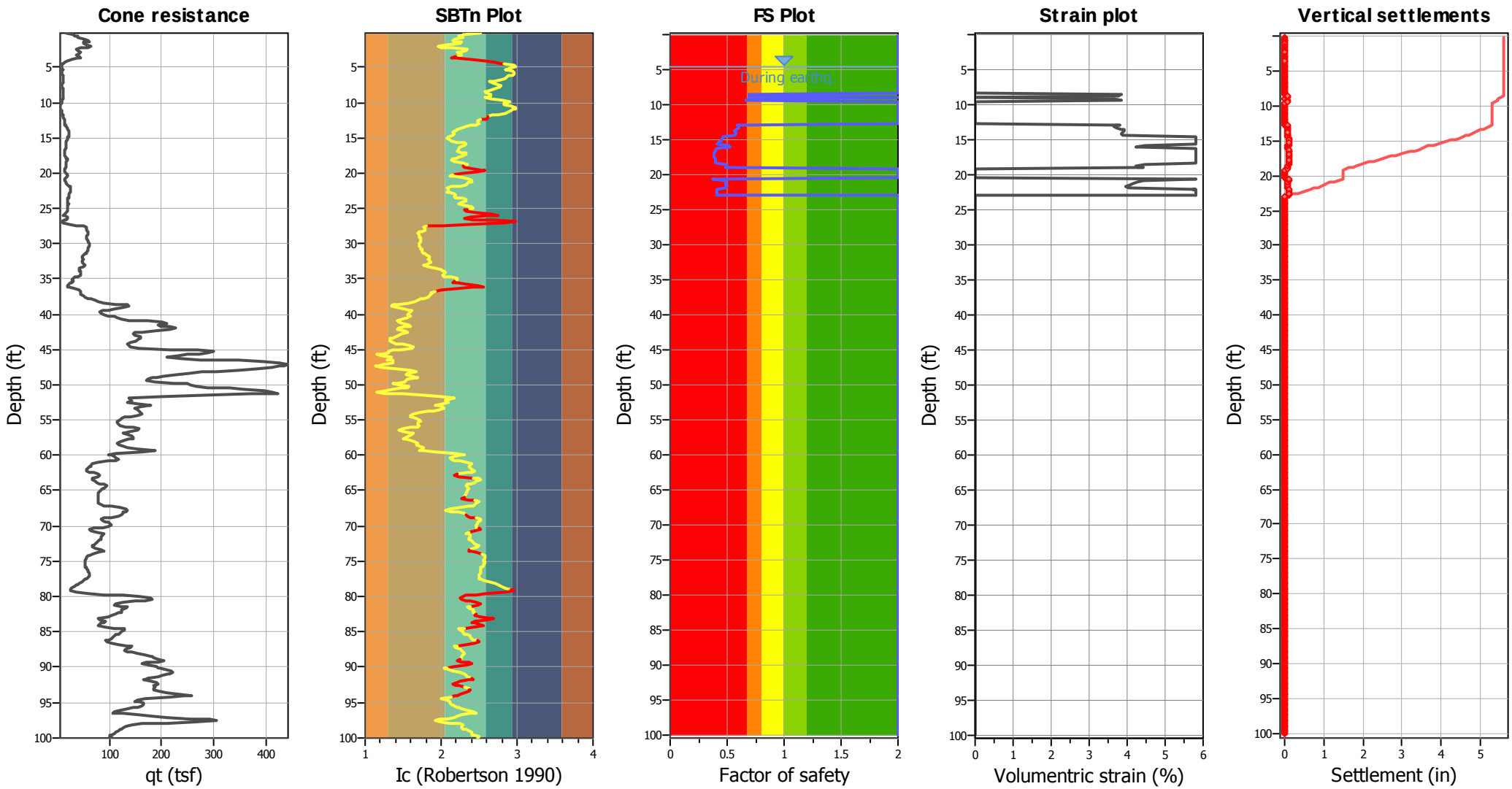
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	4.59 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	4.59 ft	Fill height:	N/A	Limit depth:	22.86 ft

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Earth Mechanics, Inc.
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17800 Newhope Street, Suite B
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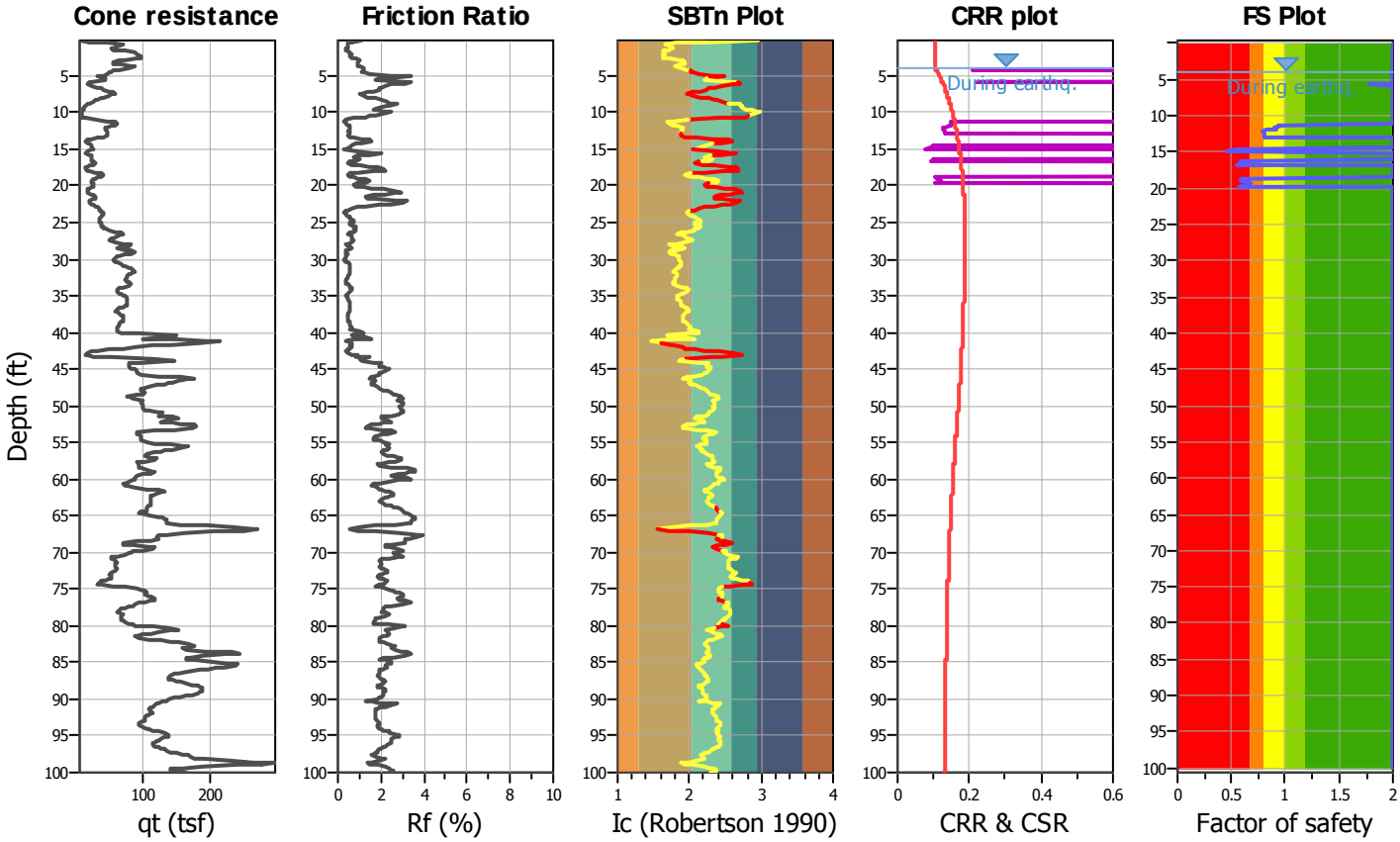
LIQUEFACTION ANALYSIS REPORT

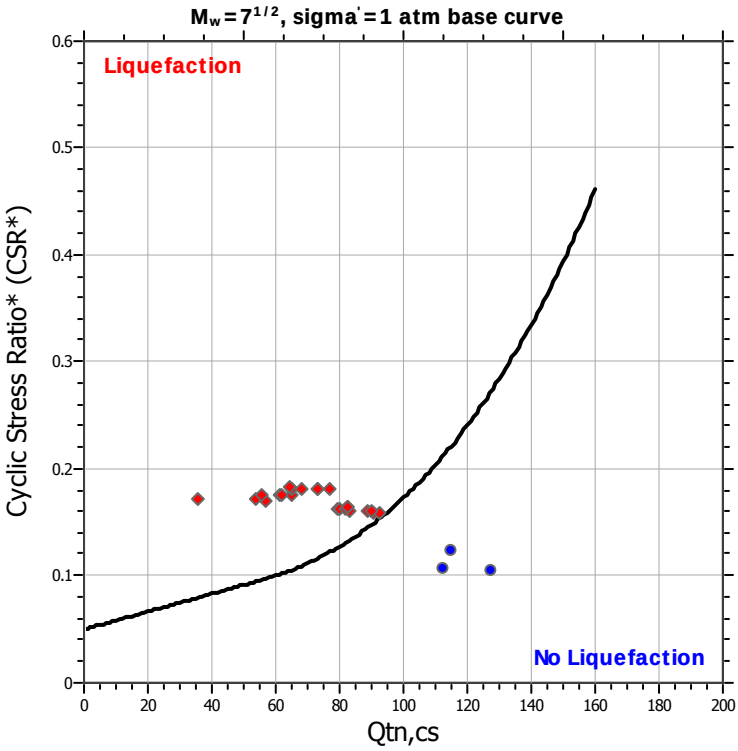
Project title : 5th Street Bridge **Location : Yuba City**

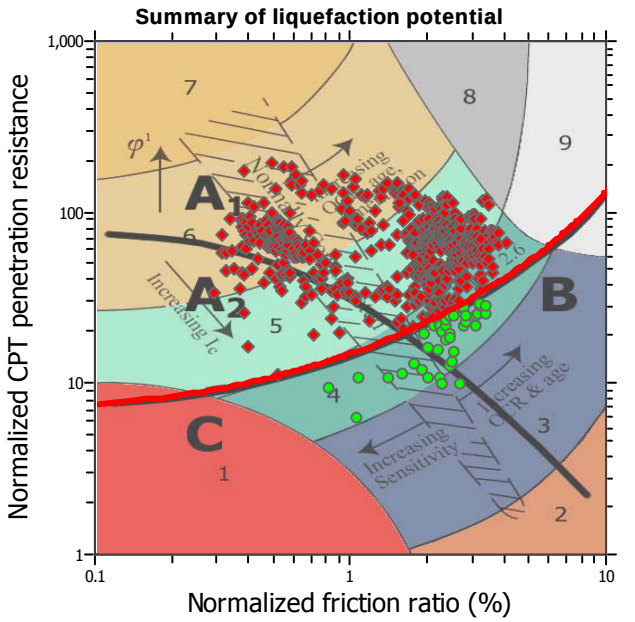
CPT file : 066DE-CPT-04

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	3.94 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	3.94 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	22.86 ft
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.23	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

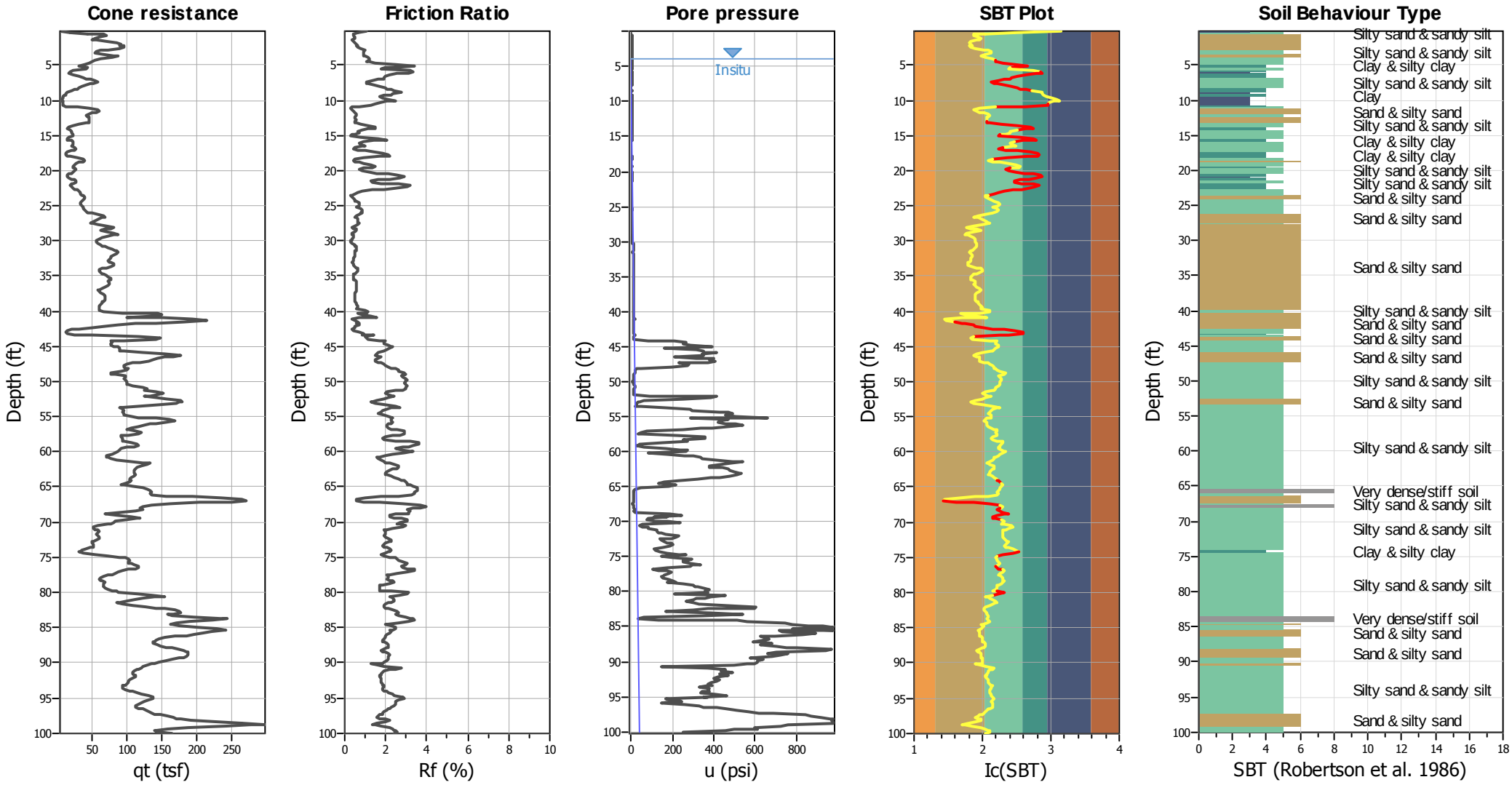






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



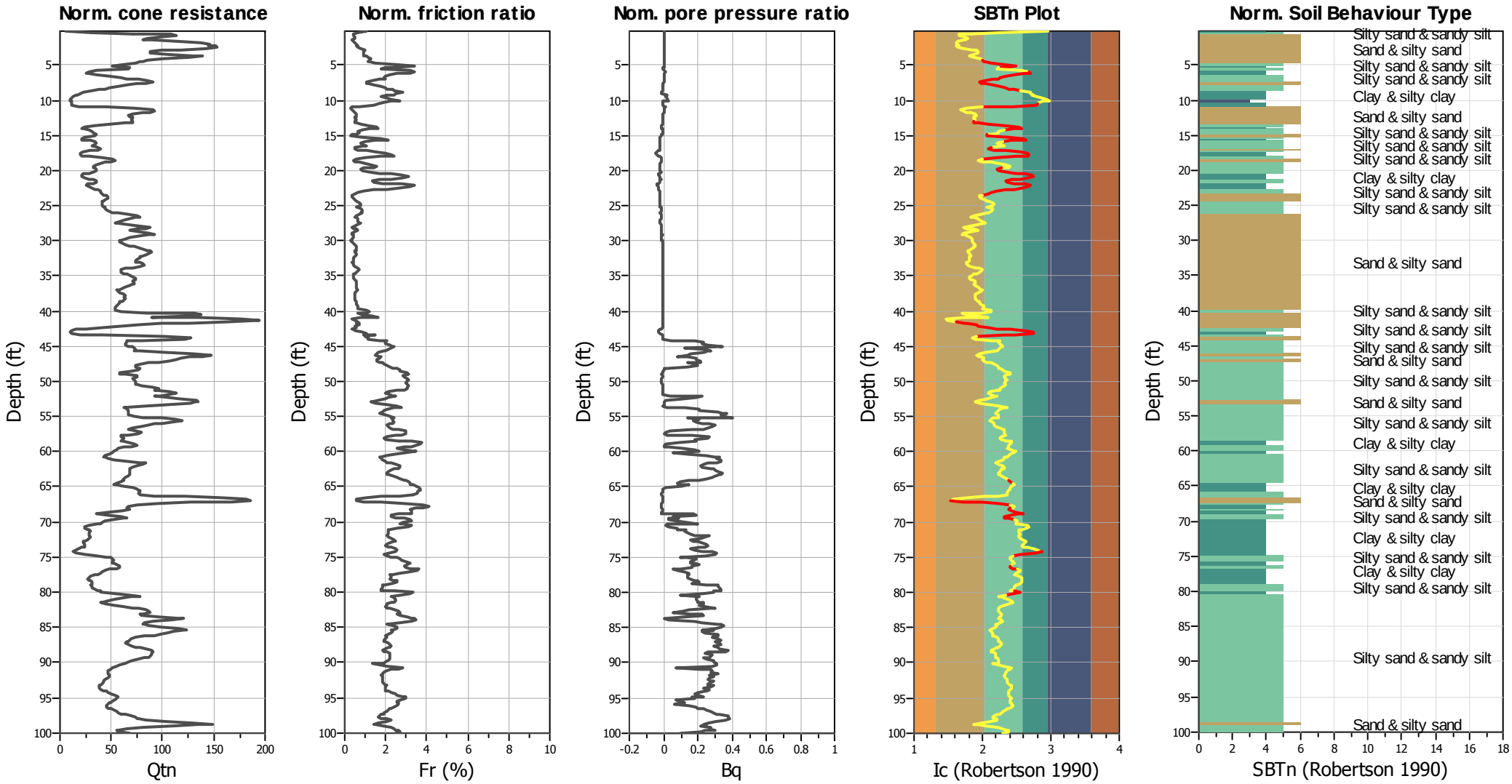
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	3.94 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	3.94 ft	Fill height:	N/A	Limit depth:	22.86 ft

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



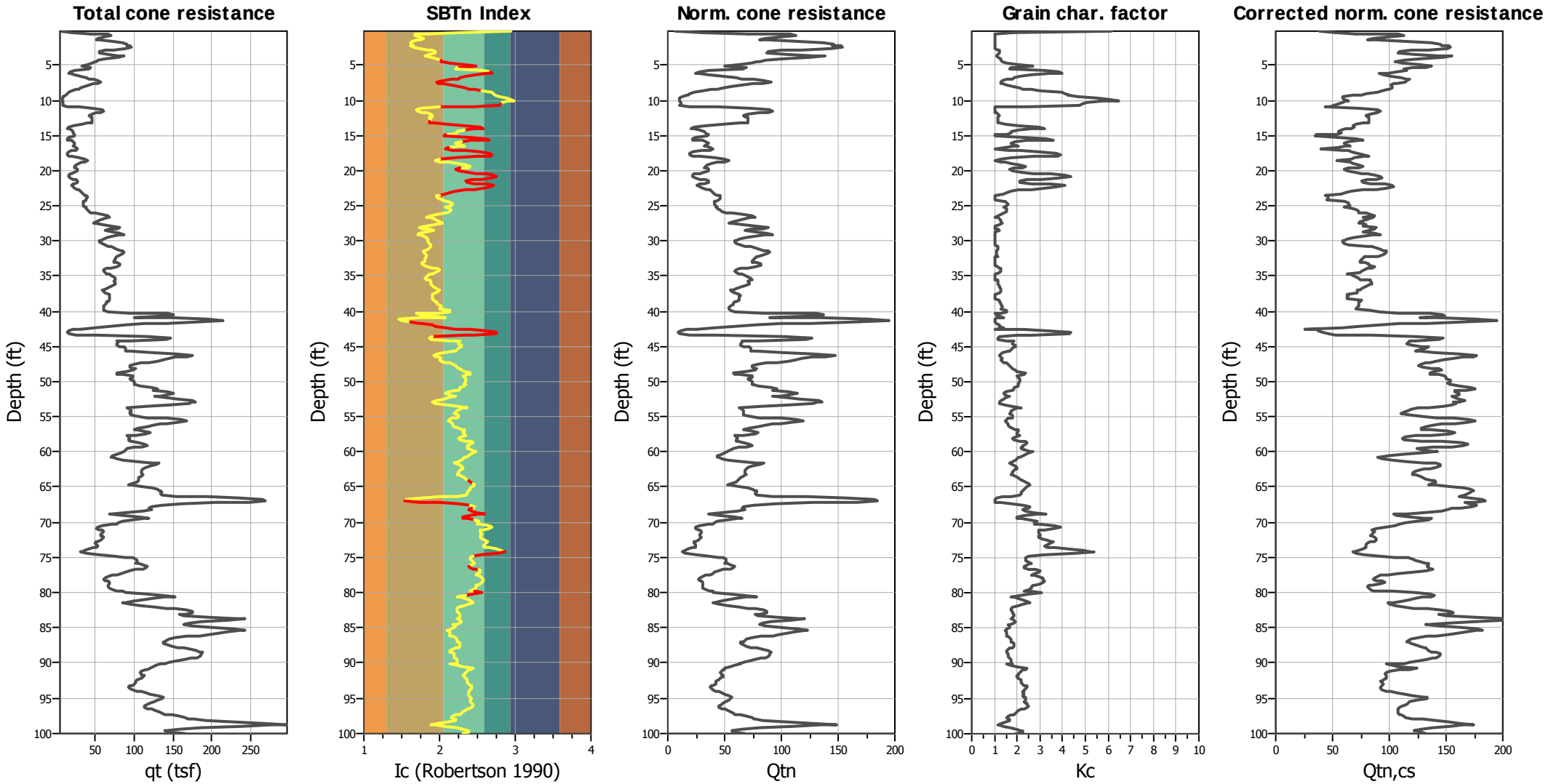
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	3.94 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	3.94 ft	Fill height:	N/A	Limit depth:	22.86 ft

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

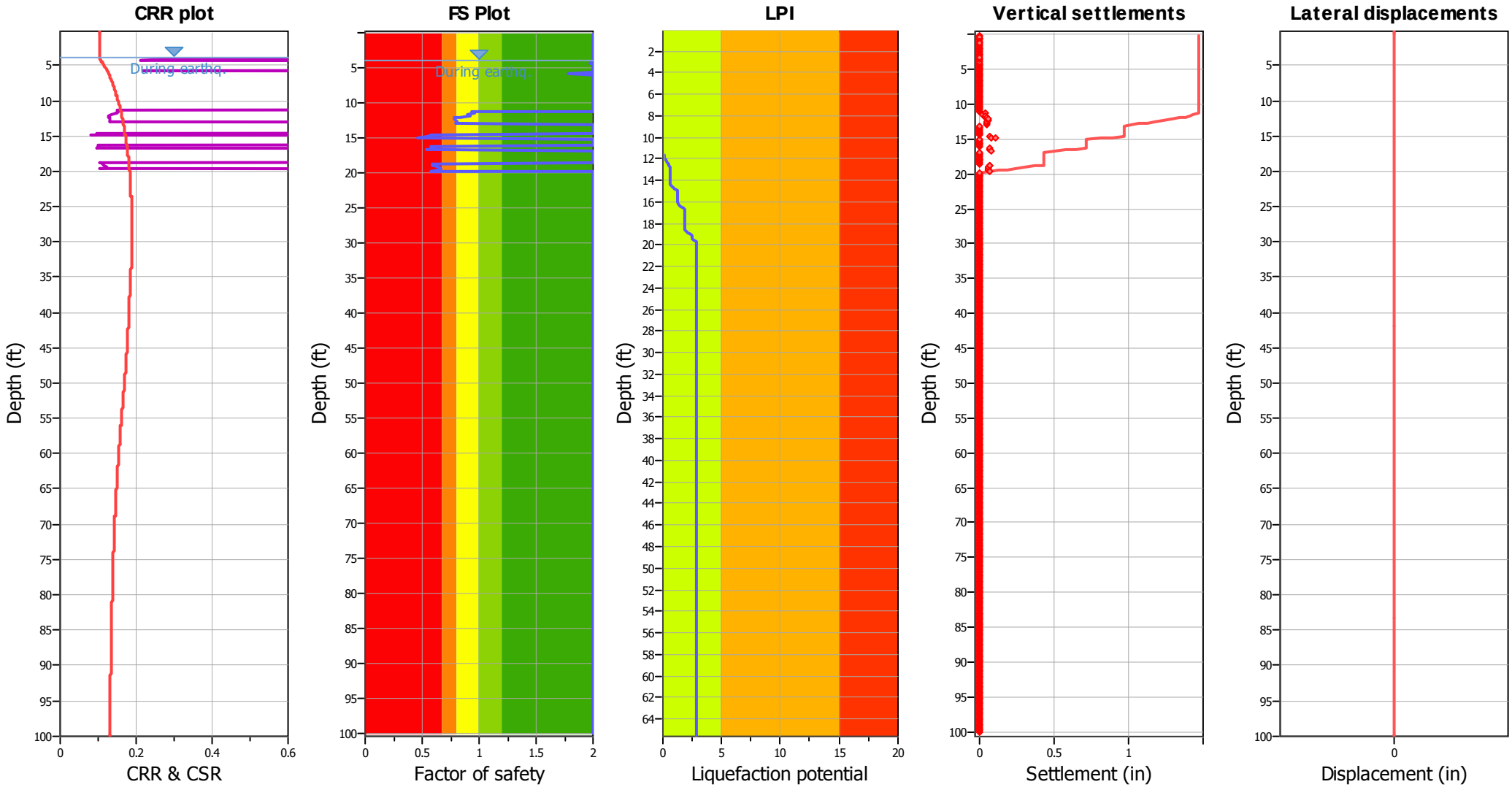
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	3.94 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	3.94 ft	Fill height:	N/A	Limit depth:	22.86 ft

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	3.94 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	3.94 ft	Fill height:	N/A	Limit depth:	22.86 ft

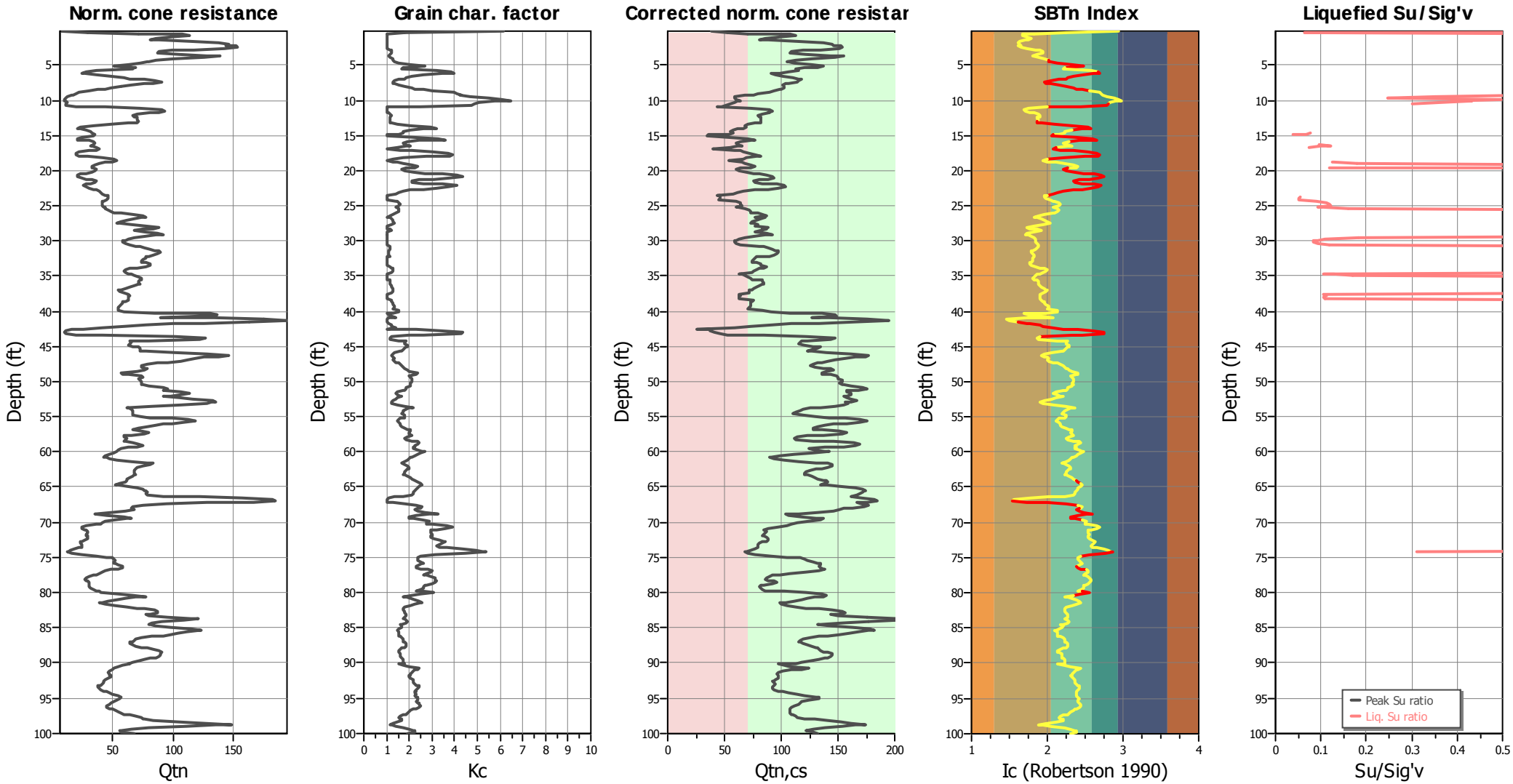
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

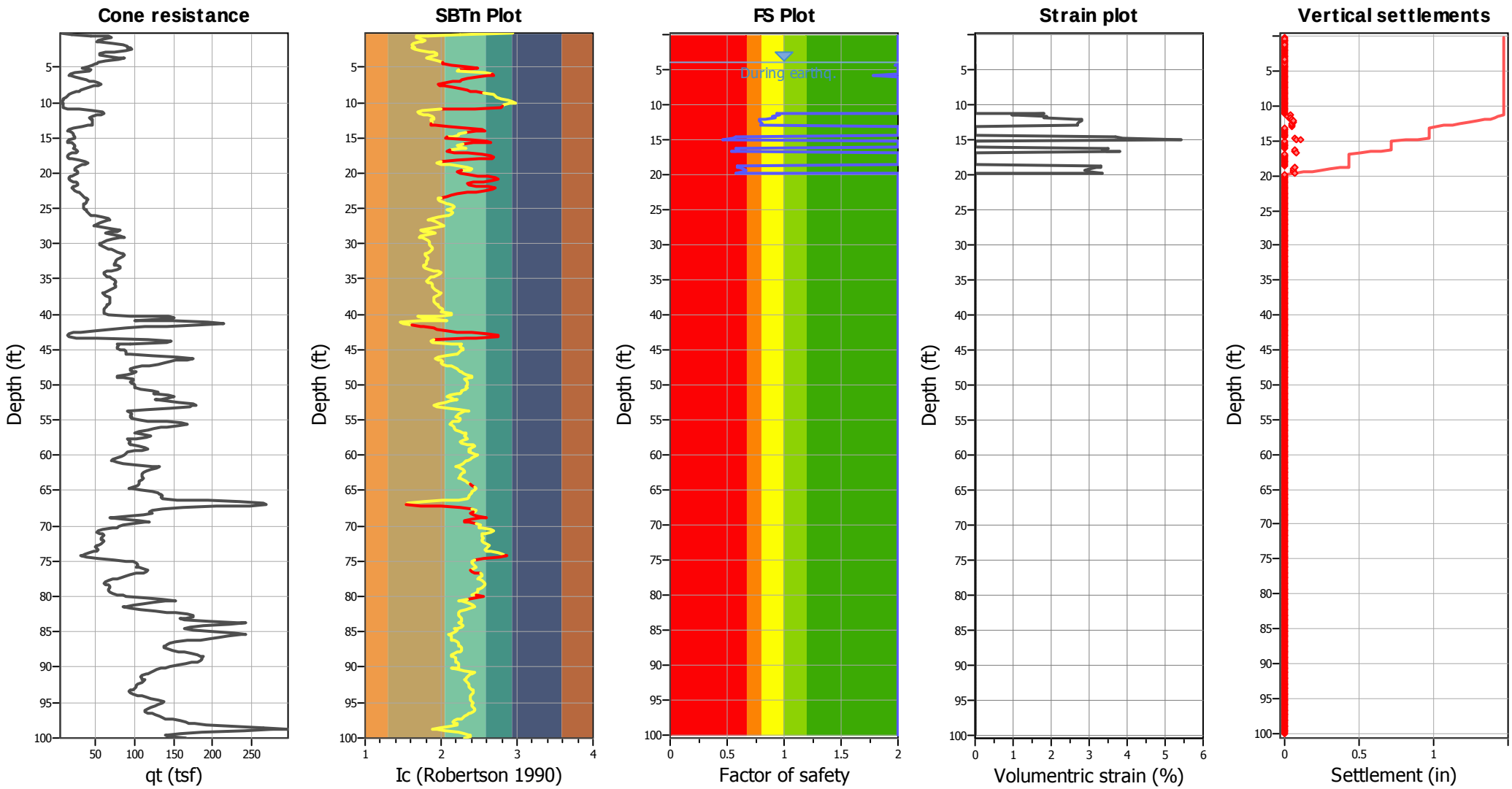
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	3.94 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	3.94 ft	Fill height:	N/A	Limit depth:	22.86 ft

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
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Fountain Valley, CA 92708

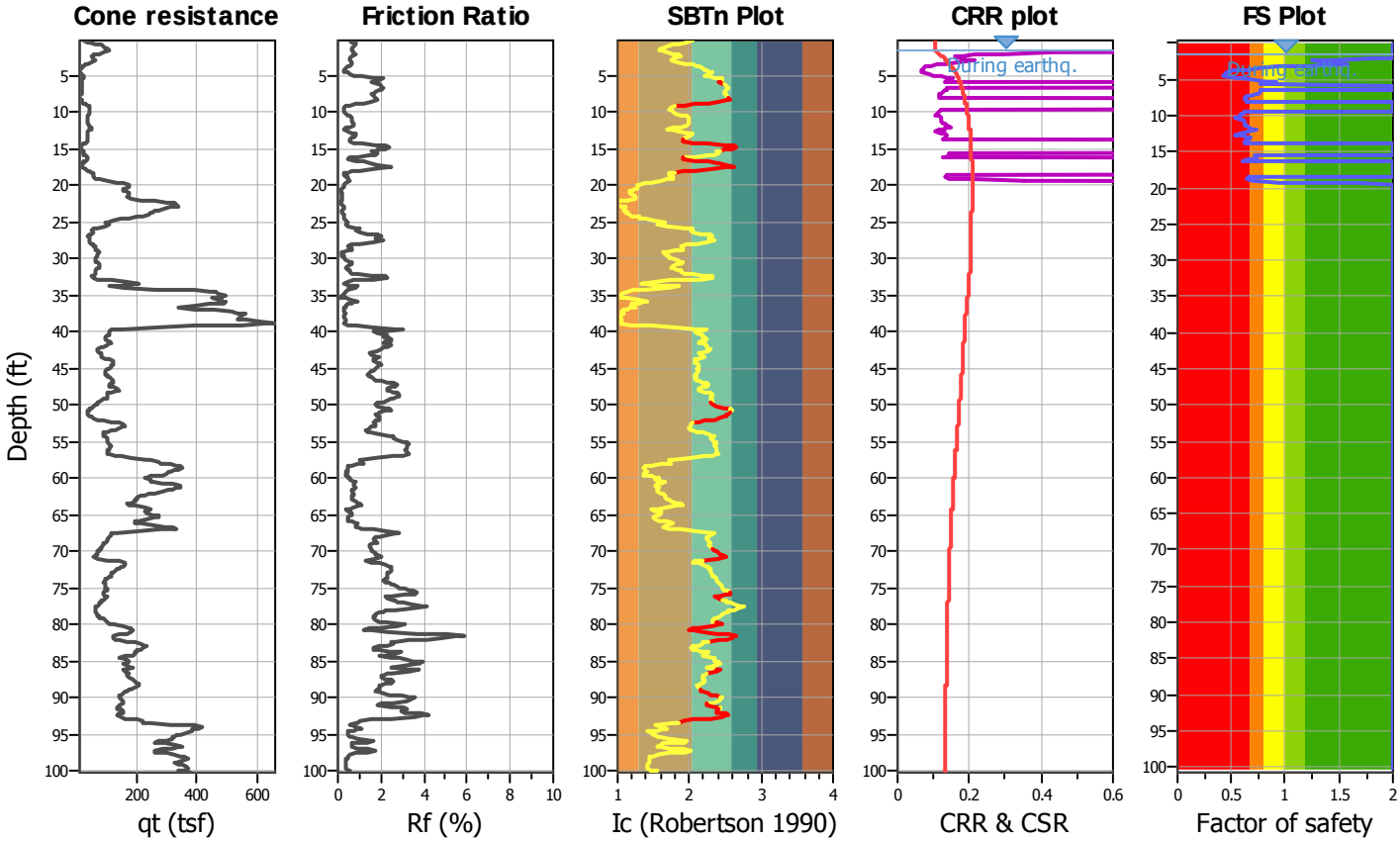
LIQUEFACTION ANALYSIS REPORT

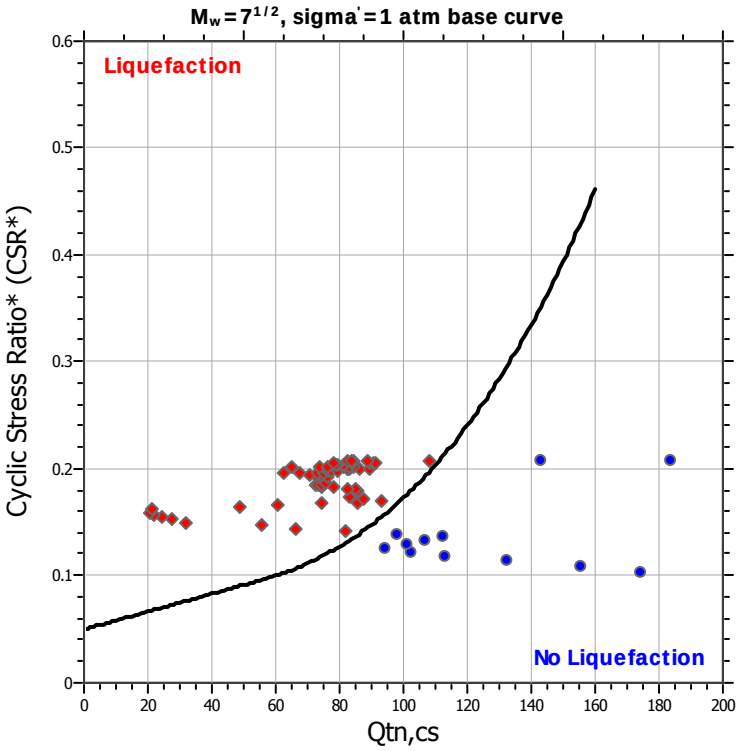
Project title : 5th Street Bridge **Location : Yuba City**

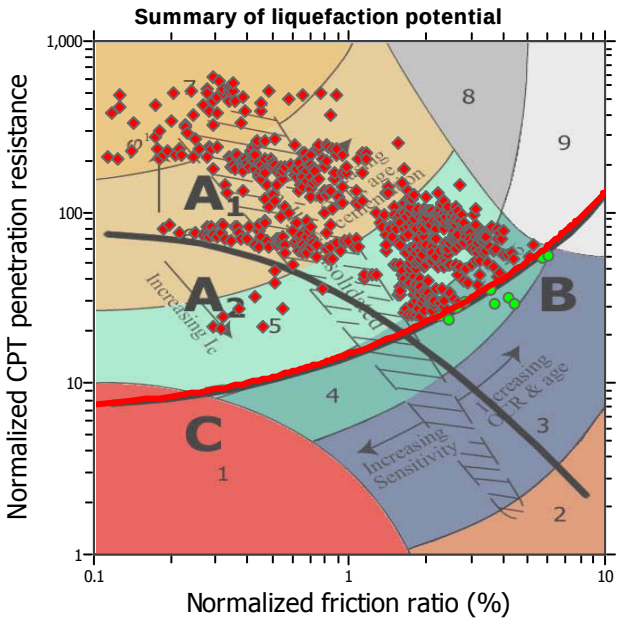
CPT file : 066DE-CPT-05

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	1.64 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	1.64 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	22.86 ft
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.23	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

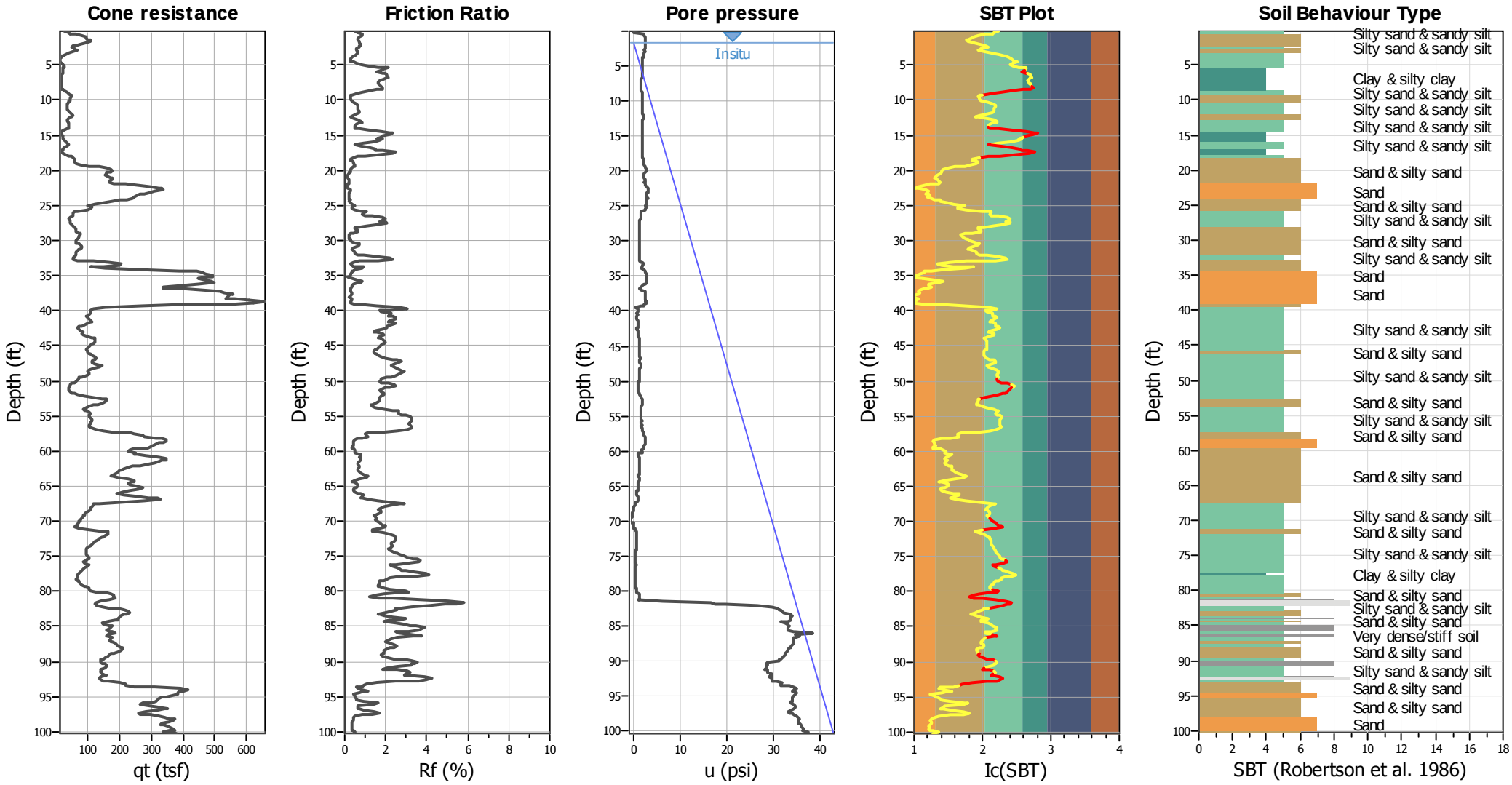






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



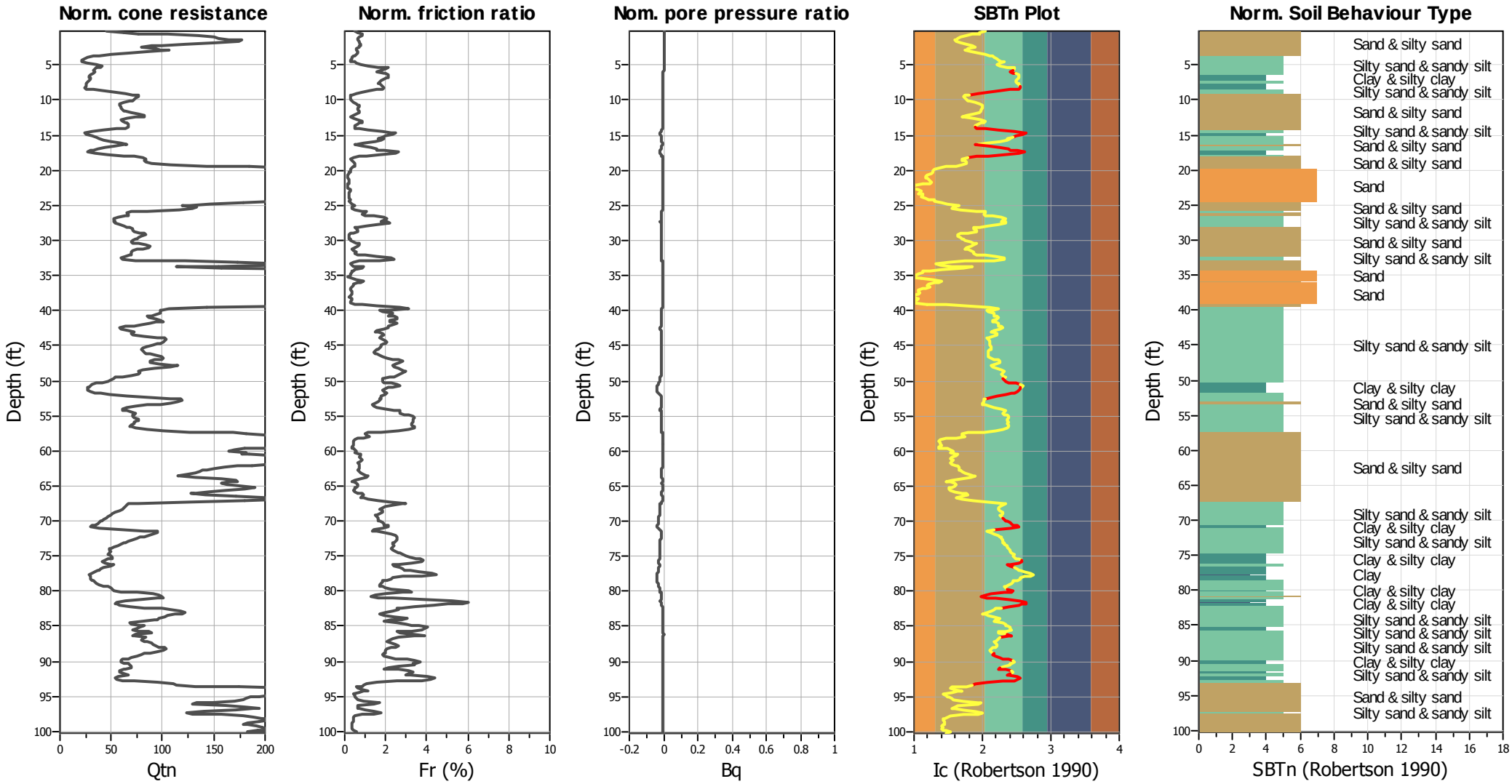
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	1.64 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.64 ft	Fill height:	N/A	Limit depth:	22.86 ft

SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

CPT basic interpretation plots (normalized)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	1.64 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.64 ft	Fill height:	N/A	Limit depth:	22.86 ft

SBTn legend

1. Sensitive fine grained
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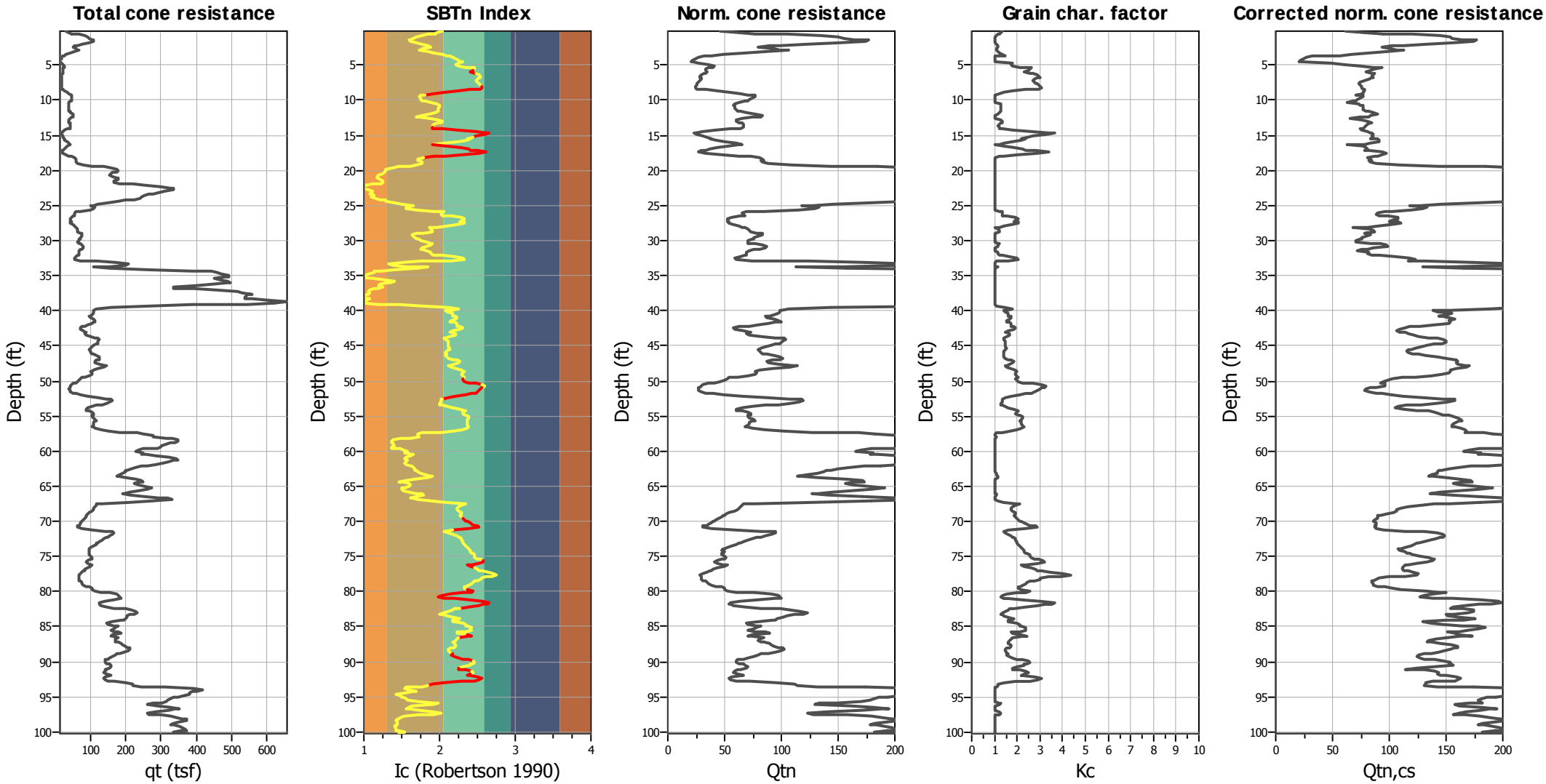
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

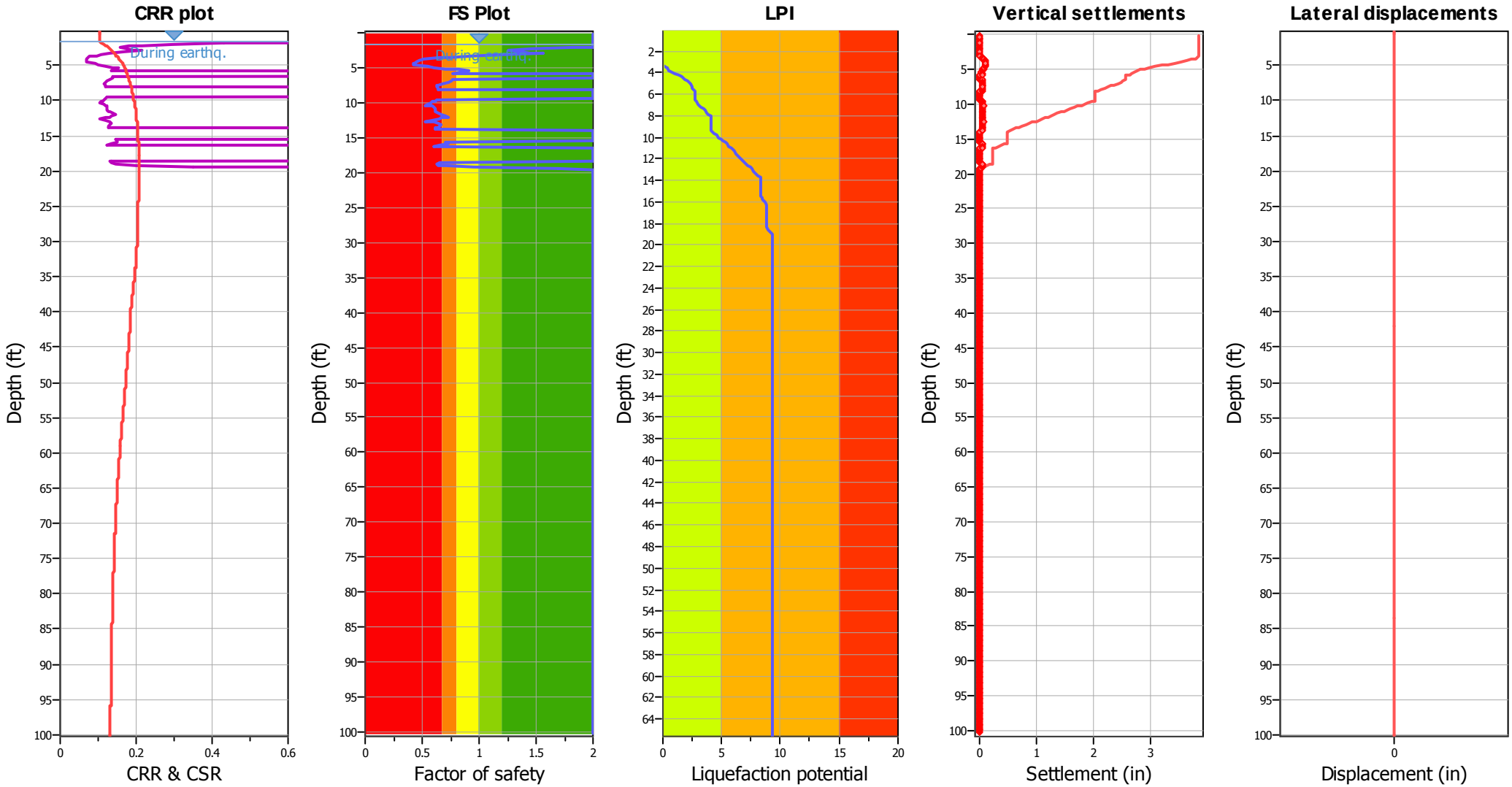
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	1.64 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.64 ft	Fill height:	N/A	Limit depth:	22.86 ft

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	1.64 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
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Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.64 ft	Fill height:	N/A	Limit depth:	22.86 ft

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
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LPI color scheme

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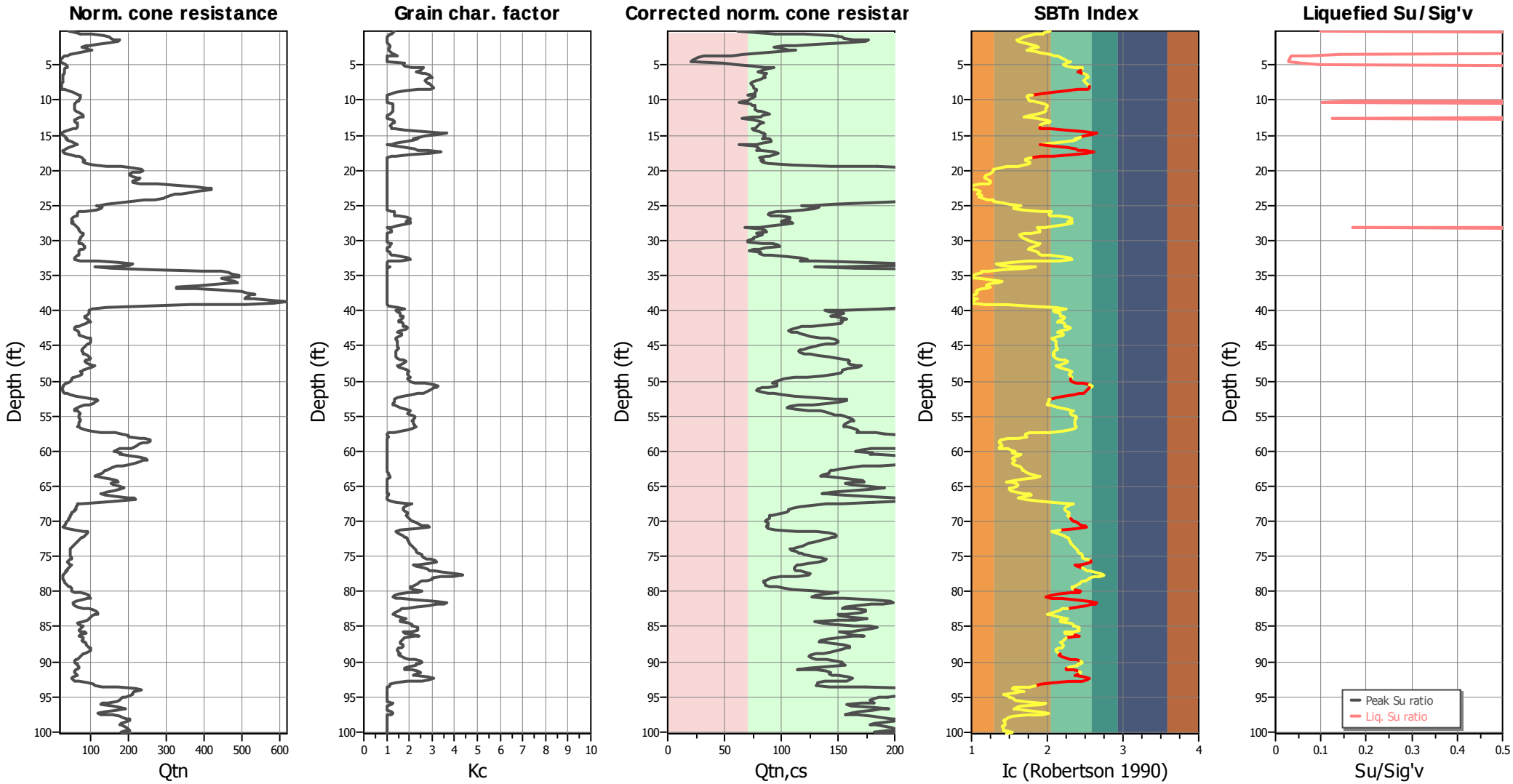
- High risk
- Low risk

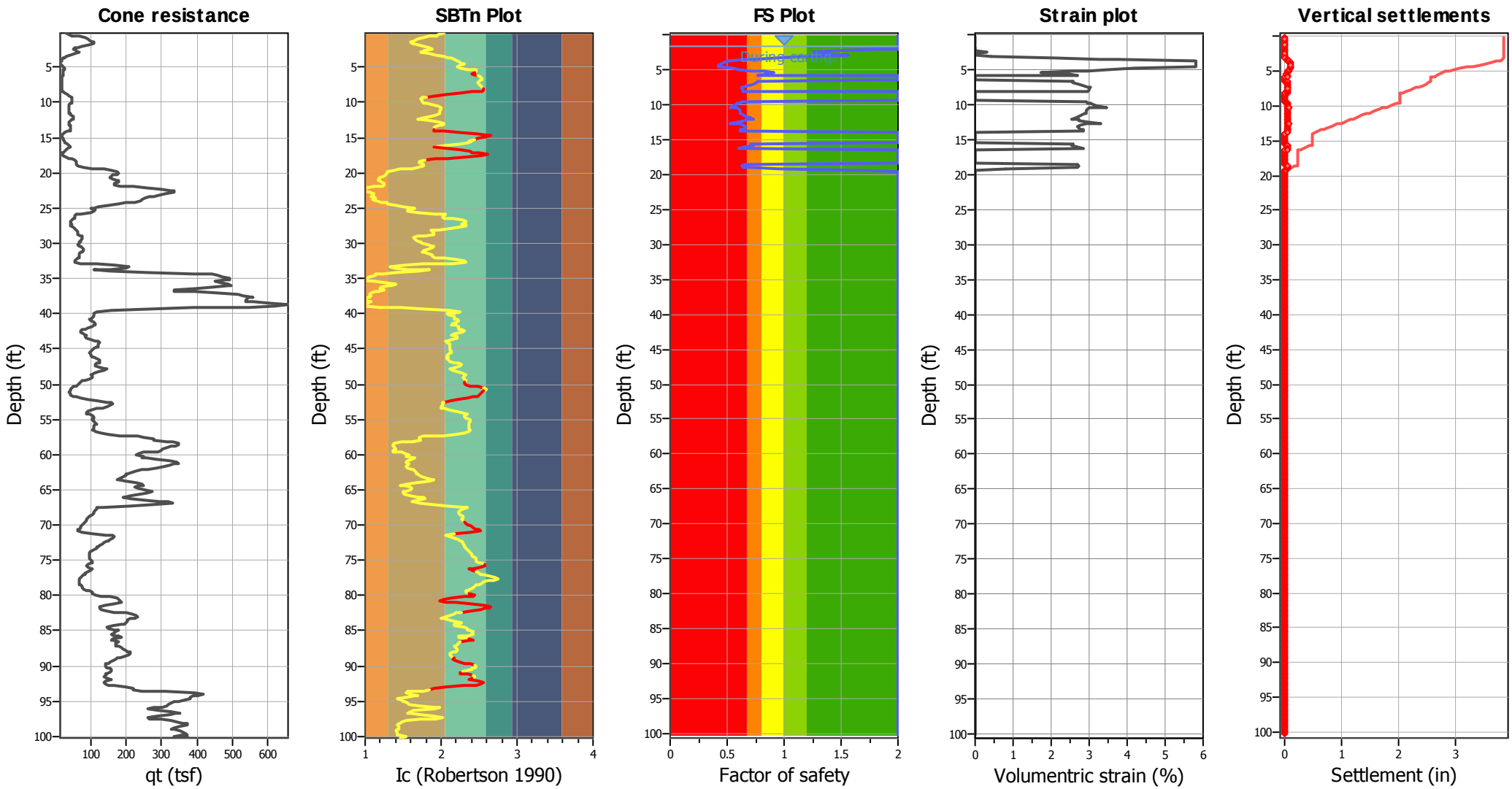
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	1.64 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.64 ft	Fill height:	N/A	Limit depth:	22.86 ft

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
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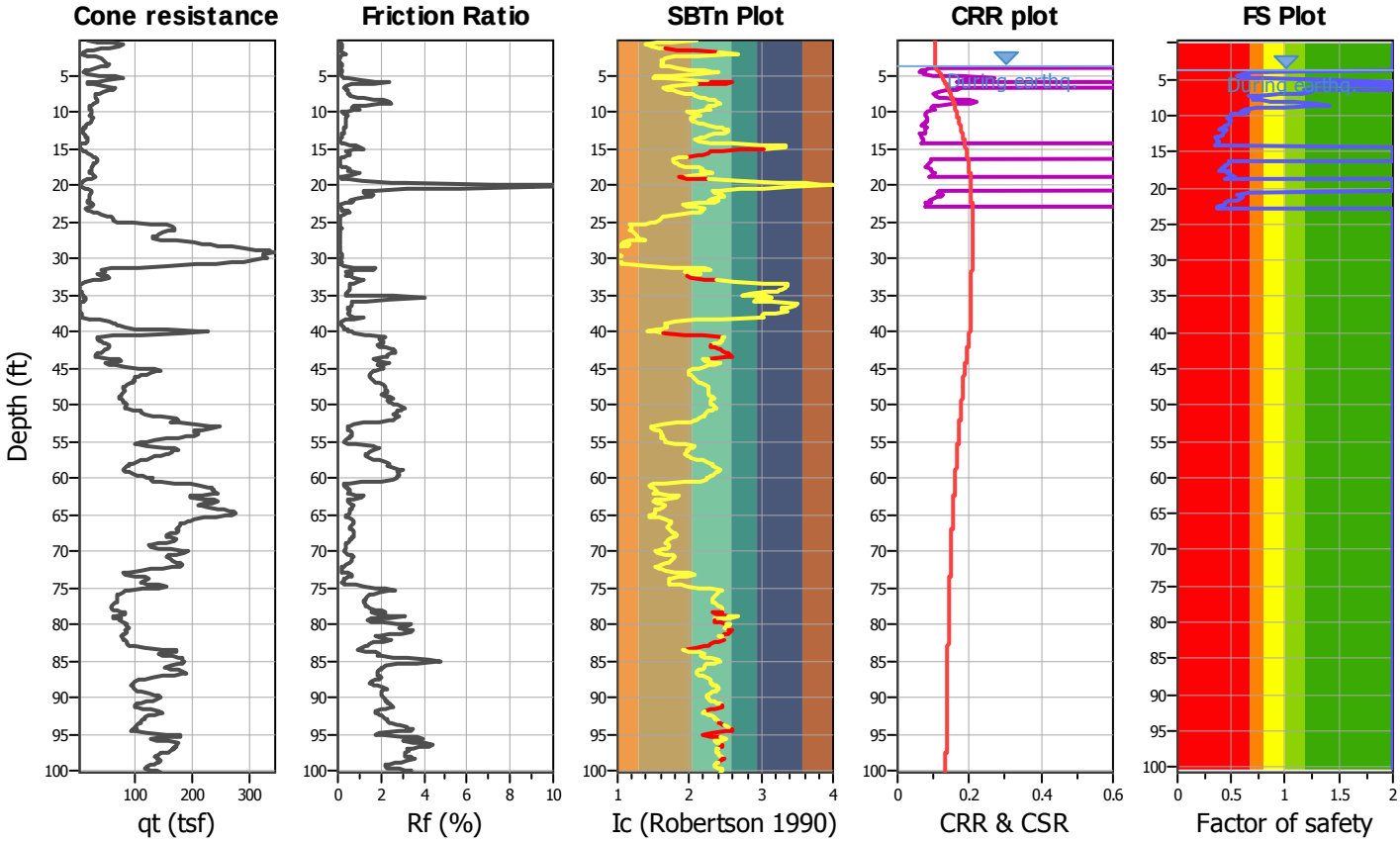
LIQUEFACTION ANALYSIS REPORT

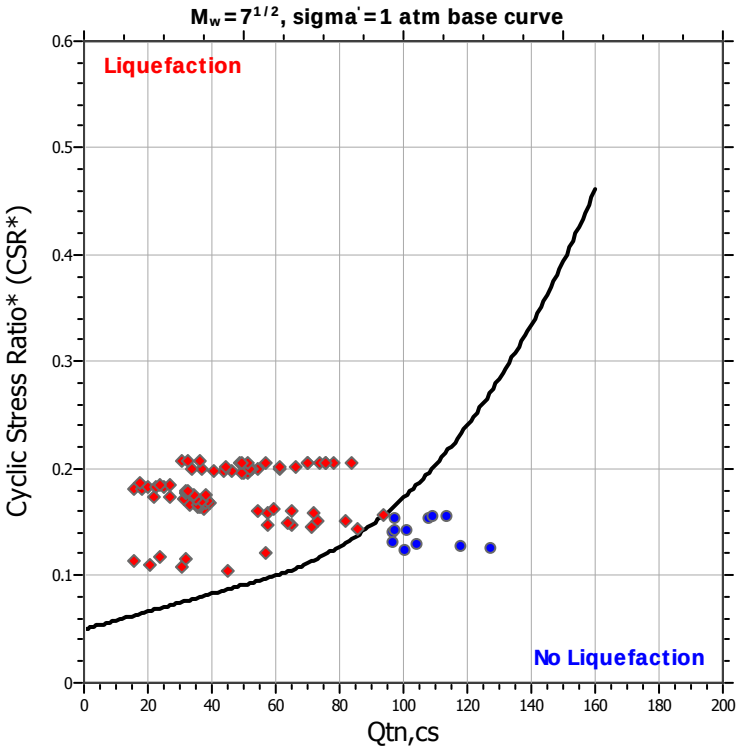
Project title : 5th Street Bridge **Location : Yuba City**

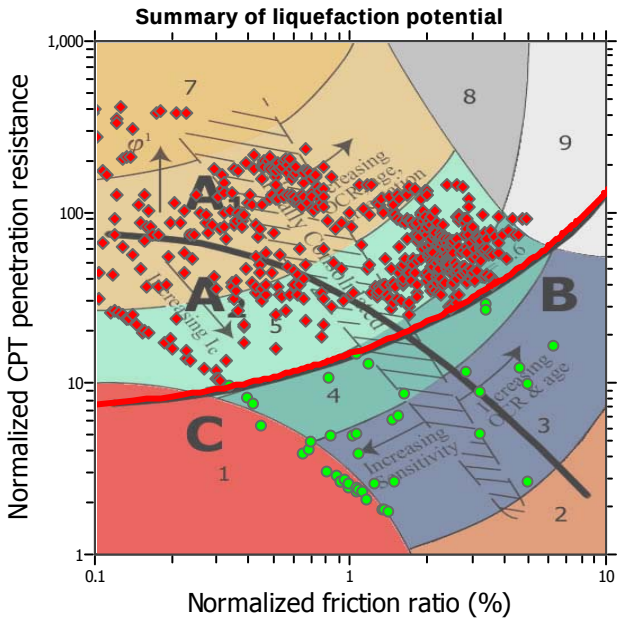
CPT file : 066DE-CPT-06

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	3.81 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	3.81 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	22.86 ft
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.23	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		







Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
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Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
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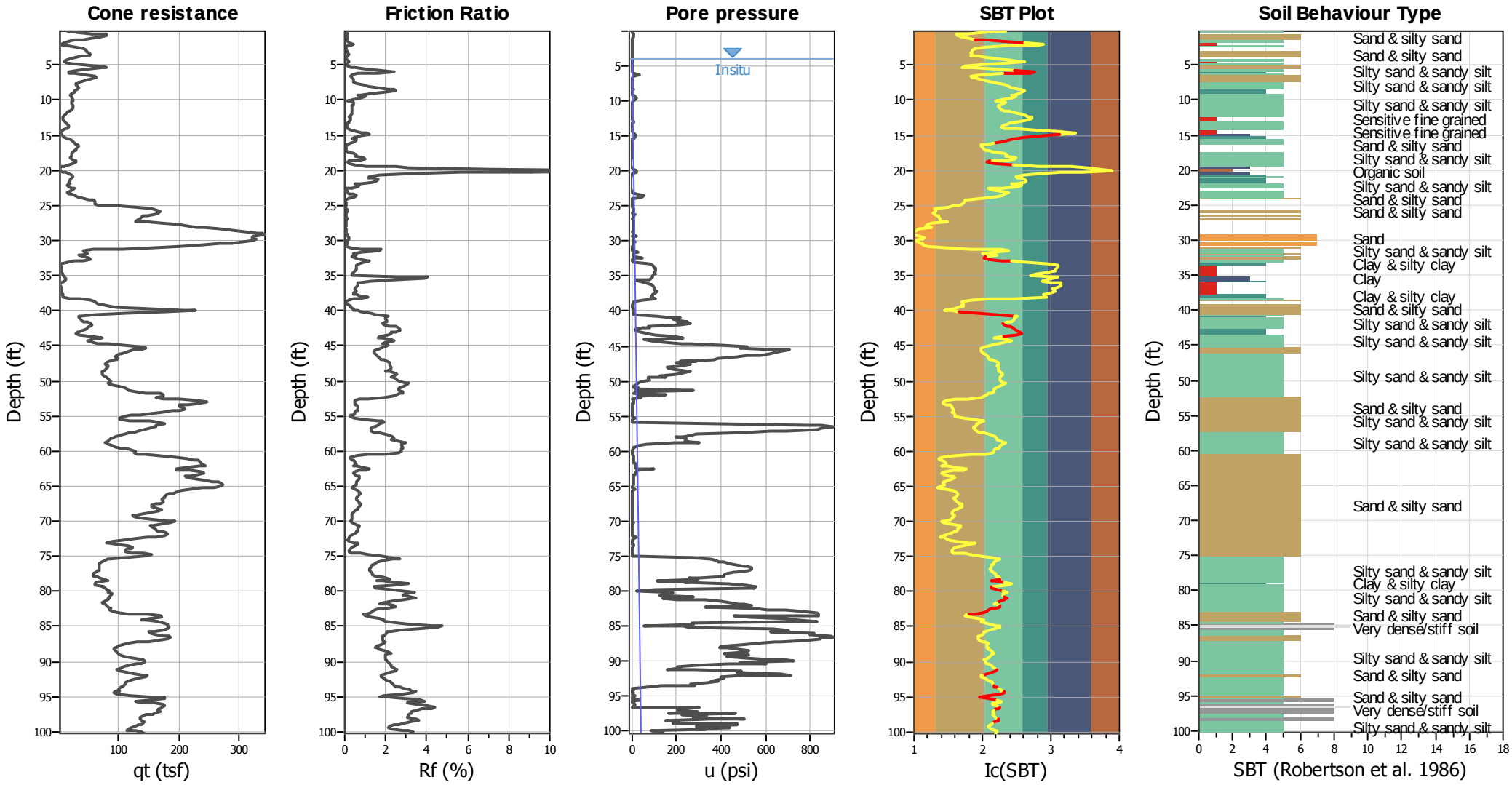
CPT basic interpretation plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	3.81 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	3.81 ft	Fill height:	N/A	Limit depth:	22.86 ft

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
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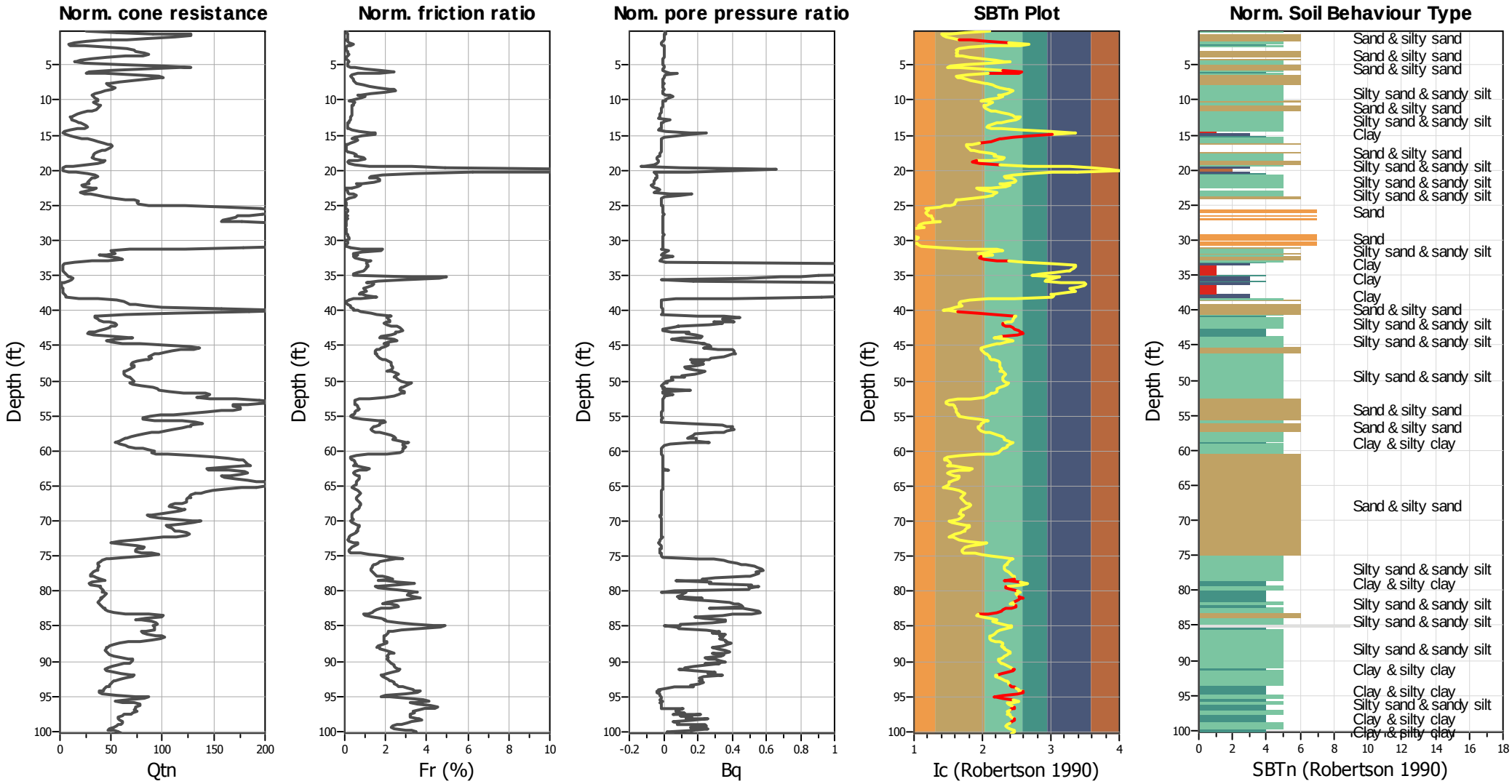
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



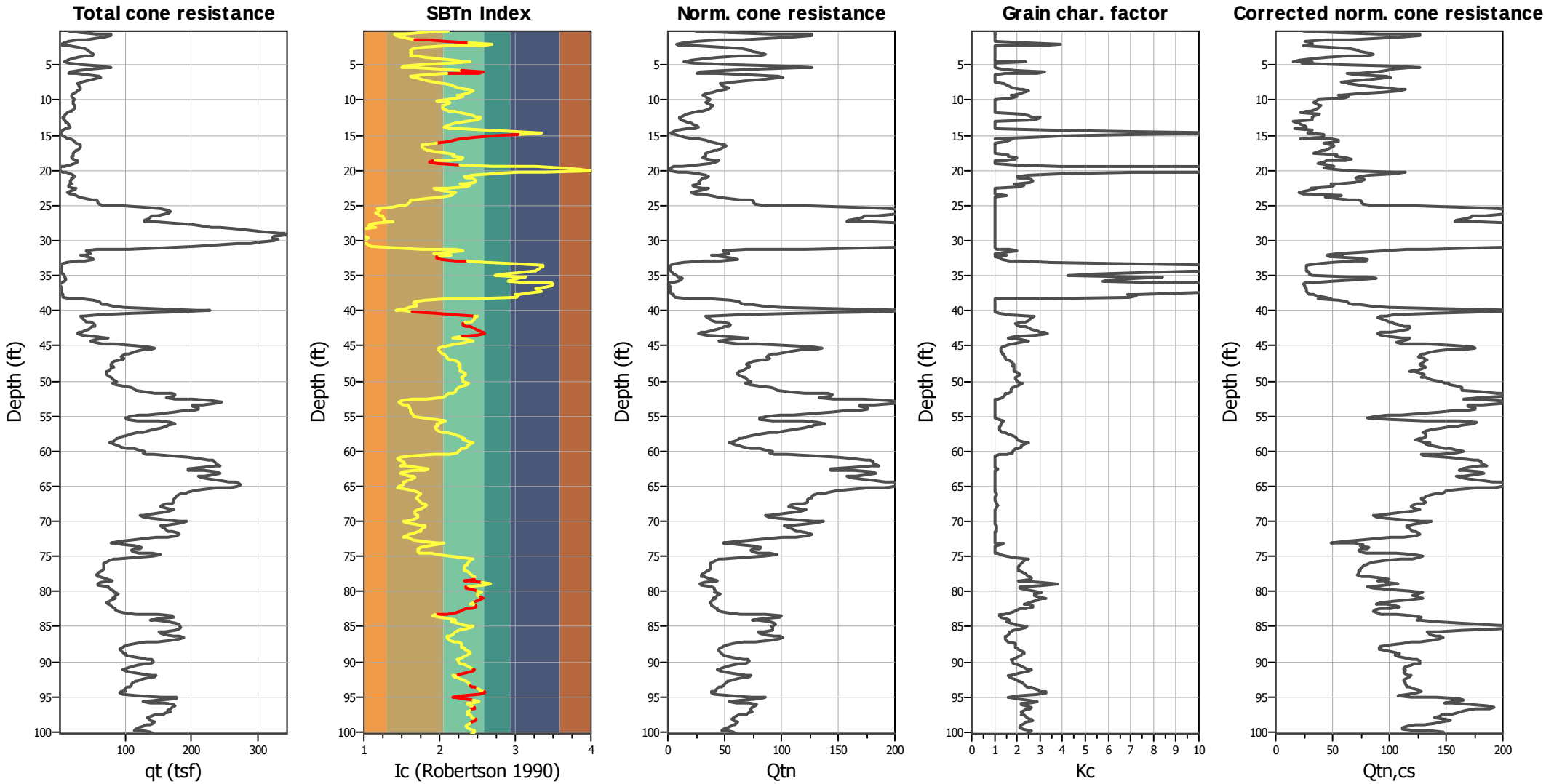
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	3.81 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	3.81 ft	Fill height:	N/A	Limit depth:	22.86 ft

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

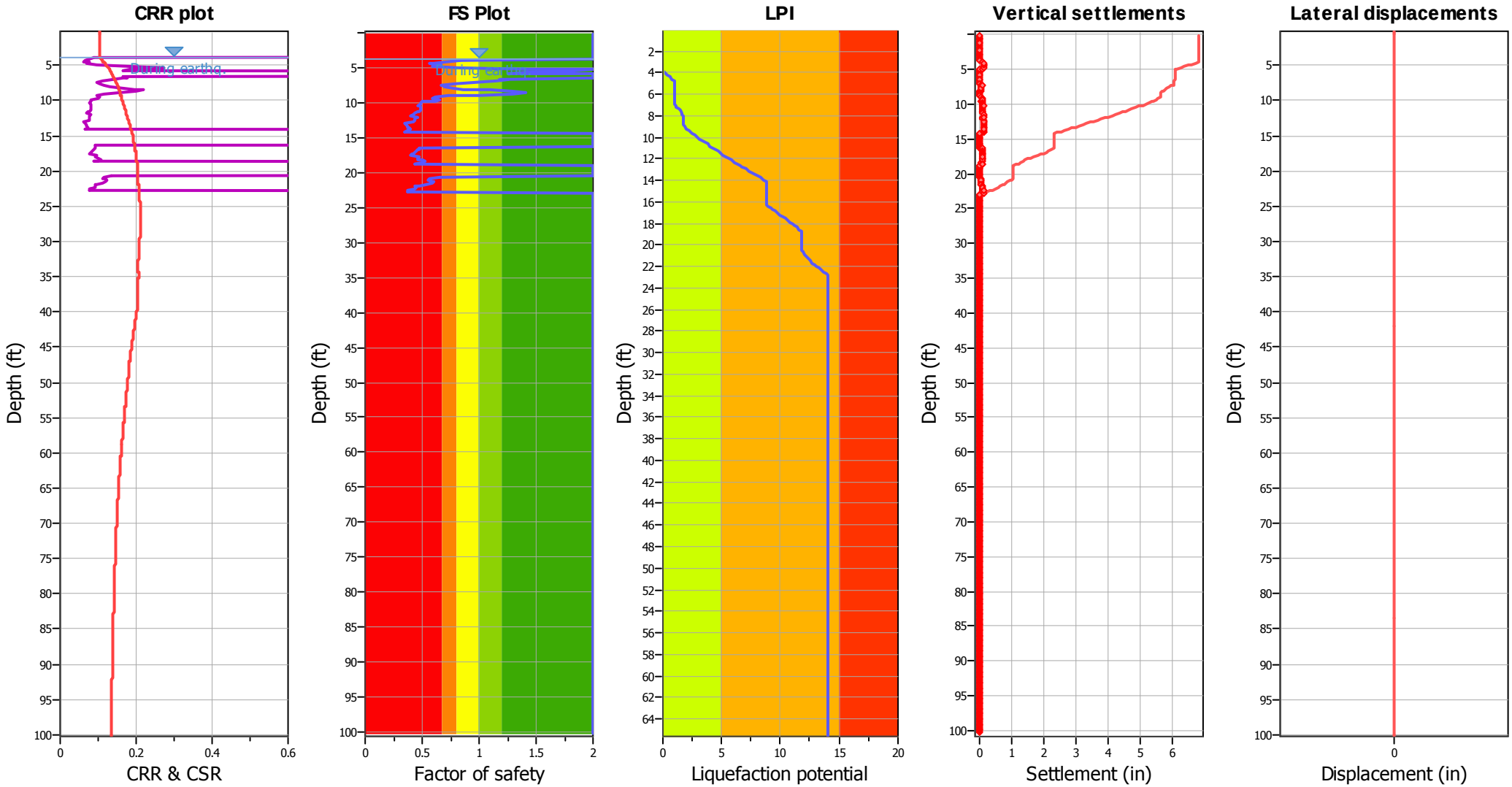
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	3.81 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	3.81 ft	Fill height:	N/A	Limit depth:	22.86 ft

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	3.81 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	3.81 ft	Fill height:	N/A	Limit depth:	22.86 ft

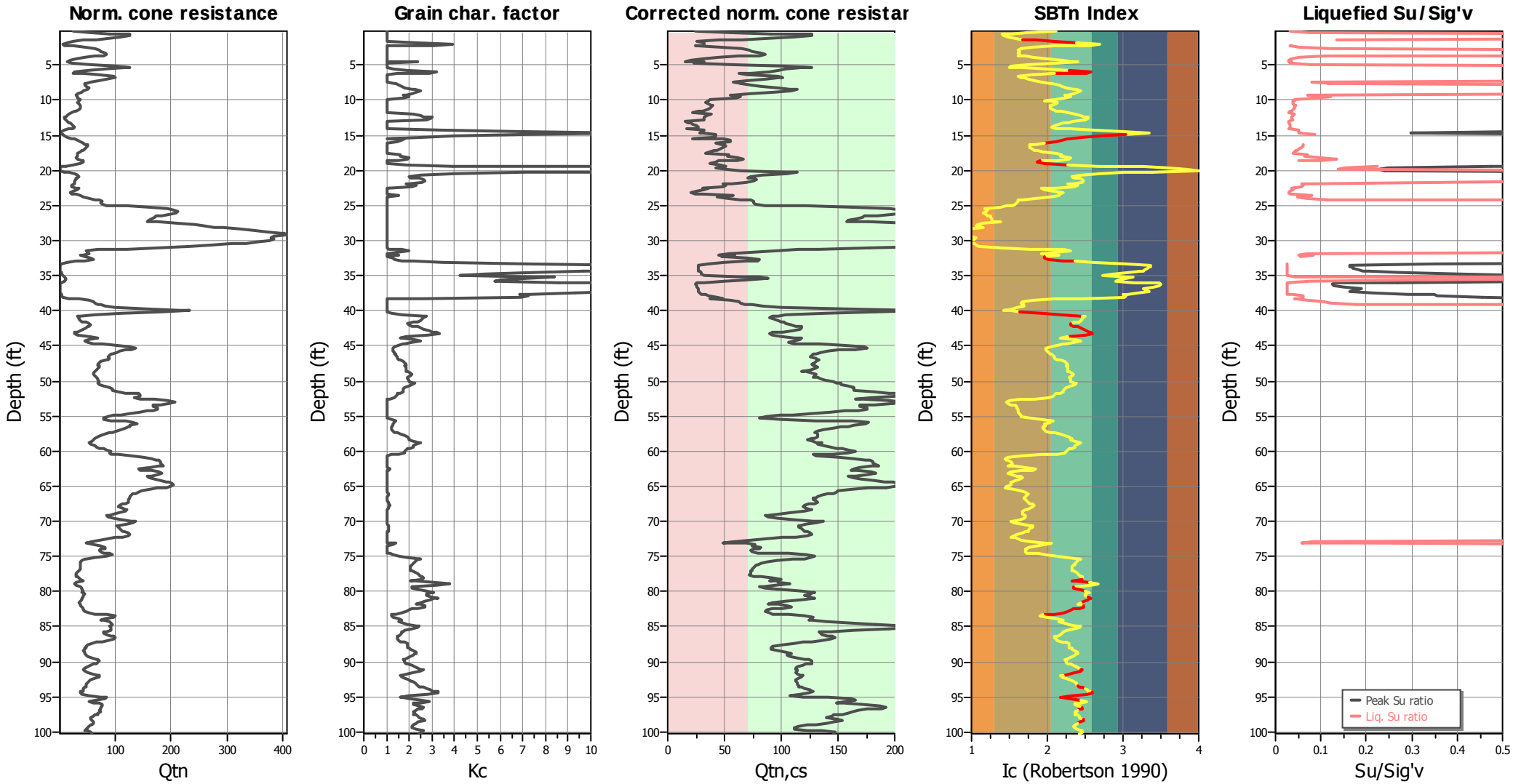
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

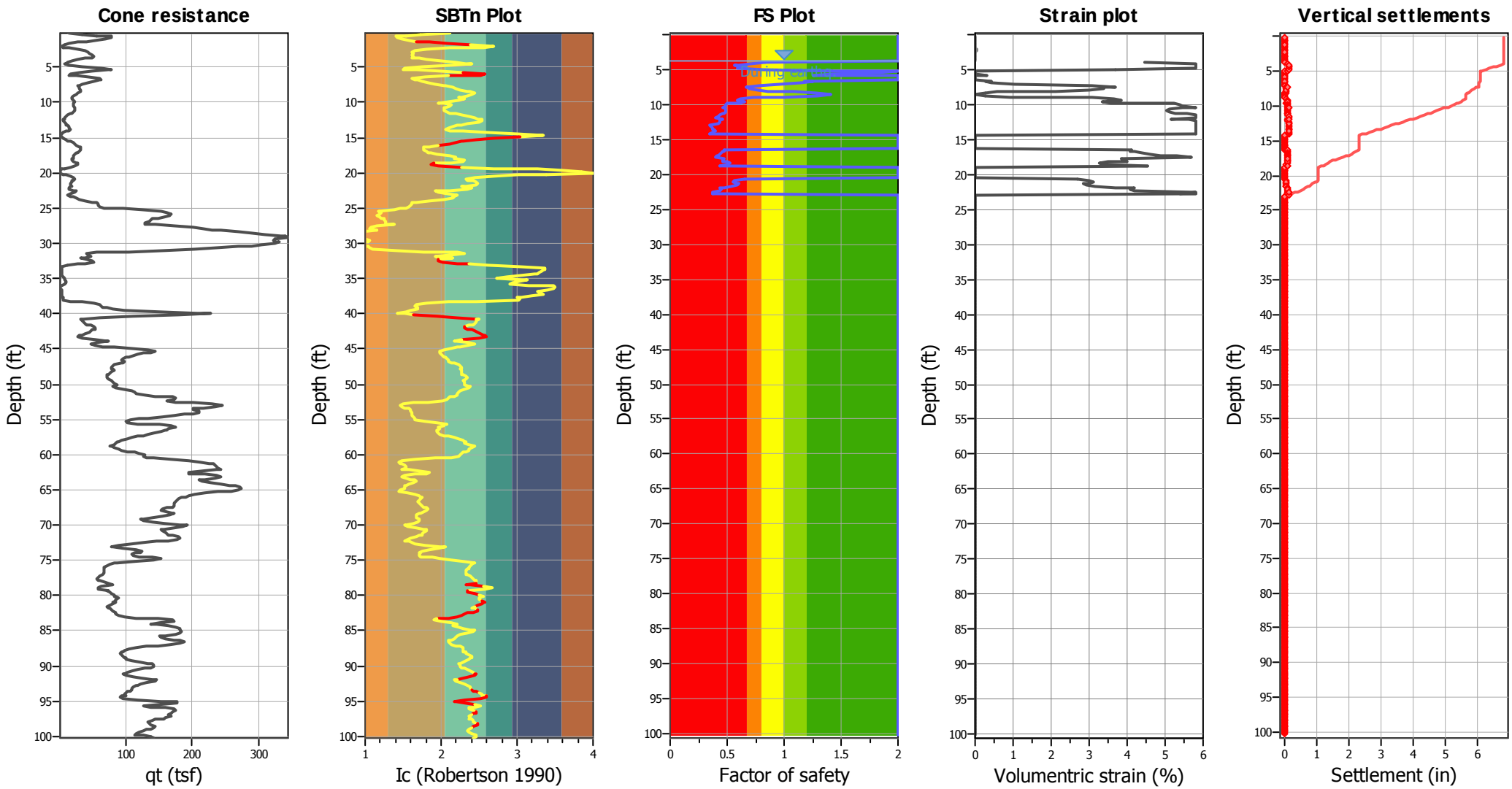
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

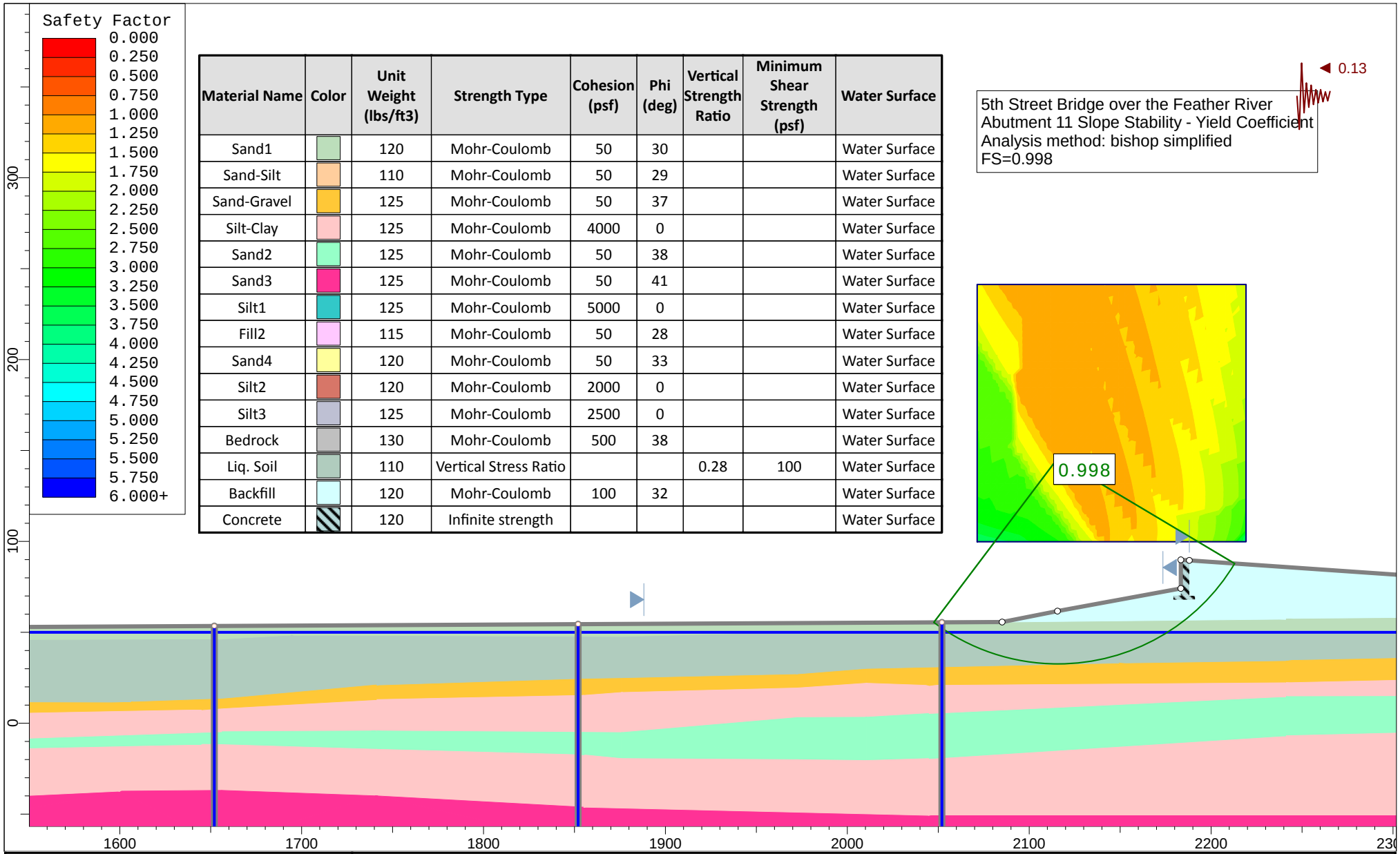
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	3.81 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.23	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	3.81 ft	Fill height:	N/A	Limit depth:	22.86 ft

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)	Water Surface
Sand1		120	Mohr-Coulomb	50	30			Water Surface
Sand-Silt		110	Mohr-Coulomb	50	29			Water Surface
Sand-Gravel		125	Mohr-Coulomb	50	37			Water Surface
Silt-Clay		125	Mohr-Coulomb	4000	0			Water Surface
Sand2		125	Mohr-Coulomb	50	38			Water Surface
Sand3		125	Mohr-Coulomb	50	41			Water Surface
Silt1		125	Mohr-Coulomb	5000	0			Water Surface
Fill2		115	Mohr-Coulomb	50	28			Water Surface
Sand4		120	Mohr-Coulomb	50	33			Water Surface
Silt2		120	Mohr-Coulomb	2000	0			Water Surface
Silt3		125	Mohr-Coulomb	2500	0			Water Surface
Bedrock		130	Mohr-Coulomb	500	38			Water Surface
Liq. Soil		110	Vertical Stress Ratio			0.28	100	Water Surface
Backfill		120	Mohr-Coulomb	100	32			Water Surface
Concrete		120	Infinite strength					Water Surface

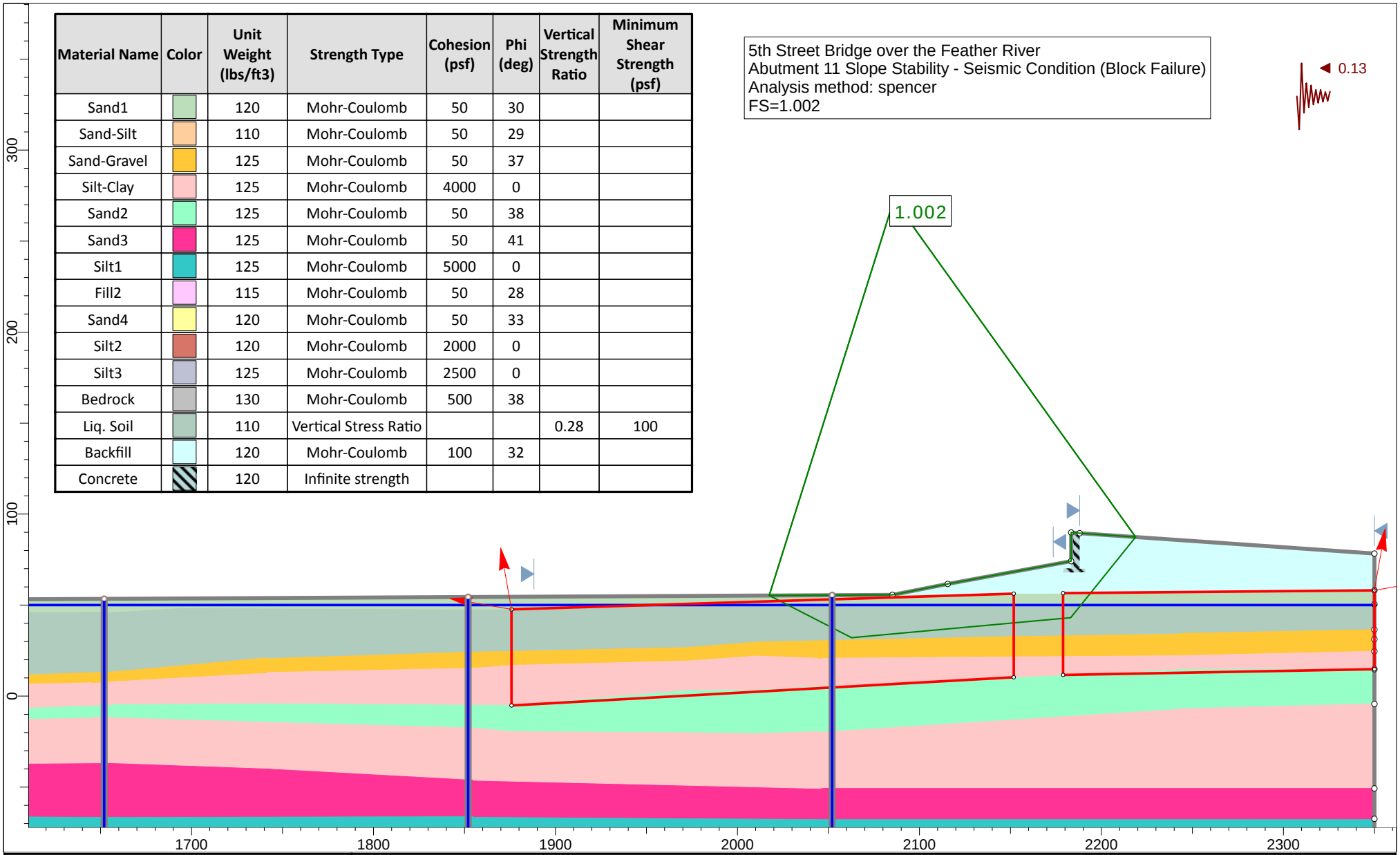
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

Project	5th Street Bridge over the Feather River		
Analysis Description	Abutment 11 Slope Stability - Yield Coefficient		
Drawn By	AZ	Scale 1:875	Company
Date			File Name Abut 11 Yield Coeff circular.slim

SLIDEINTERPRET 7.017

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Sand1		120	Mohr-Coulomb	50	30		
Sand-Silt		110	Mohr-Coulomb	50	29		
Sand-Gravel		125	Mohr-Coulomb	50	37		
Silt-Clay		125	Mohr-Coulomb	4000	0		
Sand2		125	Mohr-Coulomb	50	38		
Sand3		125	Mohr-Coulomb	50	41		
Silt1		125	Mohr-Coulomb	5000	0		
Fill2		115	Mohr-Coulomb	50	28		
Sand4		120	Mohr-Coulomb	50	33		
Silt2		120	Mohr-Coulomb	2000	0		
Silt3		125	Mohr-Coulomb	2500	0		
Bedrock		130	Mohr-Coulomb	500	38		
Liq. Soil		110	Vertical Stress Ratio			0.28	100
Backfill		120	Mohr-Coulomb	100	32		
Concrete		120	Infinite strength				

5th Street Bridge over the Feather River
Abutment 11 Slope Stability - Seismic Condition (Block Failure)
Analysis method: spencer
FS=1.002



Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

Project	5th Street Bridge over the Feather River
Analysis Description	Abutment 11 Slope Stability - Seismic Condition (Block Failure)
Drawn By	AZ
Scale	1:875
Company	
Date	
File Name	Abut 11 Yiled Acceleration Block.slim

SLIDEINTERPRET 7.017

Pile Axial and Settlement Design

APILE Axial Analysis – 2nd Street OC, Abutments 1&2, Class 200

C:\Users\t.ke\Documents\13-121 - Dokken, 5th Street Bridge PSR PR\DFR\Analysis\20160322AP_abuts\PC200_2ndAb1.cpt

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AXIALLY LOADING PILE ANALYSIS PROGRAM - APILEplus
VERSION 5.0 - (C) COPYRIGHT ENSOFT,INC.,1987-2008.

2nd Street OC, Abut1_2, NL, Class 200, 400kip

DESIGNER : EMI

DATE : 20160322

PILE PROPERTIES :

PERIMETER OF PILE WITH NONCIRCULAR SECTION= 54.40 IN.
TIP AREA OF PILE WITH NONCIRCULAR SECTION = 1.35 SQF
OUTSIDE DIAMETER OF CIRCULAR PILE = 0.00 IN.
INTERNAL DIAMETER OF CIRCULAR PILE = 0.00 IN.
PILE LENGTH = 100.00 FT.
MODULUS OF ELASTICITY = 0.477E+07 PSI

LENGTH OF SURFACE SECTION WITH ZERO SKIN FRICTION = 3.00 FT.
INCREMENT OF PILE LENGTH USED IN COMPUTATION = 1.00 FT.

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.52	110.00	29.00	14.00
10.00	SAND	0.52	110.00	29.00	14.00
10.00	SAND	0.52	47.60	29.00	14.00
15.00	SAND	0.52	47.60	29.00	14.00
15.00	SAND	0.46	57.60	33.00	32.00
25.00	SAND	0.46	57.60	33.00	32.00
25.00	CLAY	0.00	62.60	0.00	0.00
50.00	CLAY	0.00	62.60	0.00	0.00
50.00	SAND	0.44	62.60	34.00	40.00
85.00	SAND	0.44	62.60	34.00	40.00
85.00	CLAY	0.00	62.60	0.00	0.00
125.00	CLAY	0.00	62.60	0.00	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
9999.00	99999.00	0.00	0.00	0.00	0.00	0.00
9999.00	99999.00	0.00	0.00	0.00	0.00	0.00
9999.00	99999.00	0.00	0.00	0.00	0.00	0.00
9999.00	99999.00	0.00	0.00	0.00	0.00	0.00

9999.00	99999.00	0.00	0.00	0.00	0.00	0.00
9999.00	99999.00	0.00	0.00	0.00	0.00	0.00
9999.00	99999.00	2.50	1.25	0.00	0.00	0.00
9999.00	99999.00	2.50	1.25	0.00	0.00	0.00
9999.00	99999.00	0.00	0.00	0.00	0.00	0.00
9999.00	99999.00	0.00	0.00	0.00	0.00	0.00
9999.00	99999.00	4.00	2.00	0.00	0.00	0.00
9999.00	99999.00	4.00	2.00	0.00	0.00	0.00

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****
* COMPUTATION RESULT *
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	**********	**********	**********						
	* FED. HWY. METHOD *			* ARMY CORPS METHOD *			* LAMBDA 2 METHOD *		
	**********	**********	**********						
PILE PENETR-ATION	TOTAL SKIN FRIC	END BEARING	ULTIM CAPAC-ITY	TOTAL SKIN FRIC	END BEARING	ULTIM CAPAC-ITY	TOTAL SKIN FRIC	END BEARING	ULTIM CAPAC-ITY
FT.	KIP	KIP	KIP	KIP	KIP	KIP	KIP	KIP	KIP
0.0	0.0	3.2	3.2	0.0	4.6	4.6	0.0	3.0	3.0
1.0	0.0	5.4	5.4	0.0	7.8	7.8	0.0	5.1	5.1
2.0	0.0	7.6	7.6	0.0	11.0	11.0	0.0	7.2	7.2
3.0	0.3	9.7	10.1	0.2	14.2	14.4	0.0	9.3	9.3
4.0	1.2	11.9	13.1	0.7	17.4	18.1	1.2	11.4	12.5
5.0	2.2	14.1	16.3	1.3	20.6	21.9	1.8	13.4	15.3
6.0	3.5	16.1	19.6	2.0	23.8	25.8	2.6	15.5	18.1
7.0	5.0	17.4	22.4	2.9	27.0	29.9	3.5	17.6	21.1
8.0	6.7	18.0	24.6	3.9	29.9	33.8	4.5	19.5	24.0
9.0	8.6	18.0	26.7	5.1	32.2	37.3	5.5	21.0	26.6
10.0	10.8	18.0	28.9	6.4	33.9	40.3	6.6	22.2	28.8
11.0	13.2	18.0	31.2	7.7	35.3	43.1	7.8	23.1	30.9
12.0	15.6	18.0	33.7	9.2	36.7	45.9	9.0	24.0	33.0
13.0	18.2	29.8	48.0	10.7	46.7	57.3	10.2	35.1	45.3
14.0	20.8	43.8	64.6	12.2	58.2	70.4	11.5	48.1	59.5
15.0	23.6	58.6	82.2	14.0	69.9	83.9	12.7	61.6	74.3
16.0	27.3	61.0	88.3	15.8	71.3	87.1	14.0	64.1	78.0
17.0	31.9	63.4	95.3	17.6	71.8	89.4	15.3	66.6	81.8
18.0	36.7	65.5	102.3	19.3	71.8	91.2	16.6	69.1	85.7
19.0	41.7	67.0	108.7	21.1	71.8	92.9	17.9	71.6	89.5
20.0	46.9	67.6	114.5	22.9	71.8	94.7	19.3	74.1	93.4
21.0	52.3	67.7	120.0	24.6	71.8	96.5	20.7	76.6	97.2
22.0	57.9	67.7	125.6	26.4	71.8	98.2	22.3	79.1	101.4
23.0	63.6	56.3	119.9	28.2	59.1	87.3	24.1	65.1	89.2
24.0	69.6	43.4	112.9	30.0	44.8	74.8	26.0	48.2	74.2
25.0	75.7	30.5	106.2	31.9	30.5	62.4	27.9	30.5	58.4
26.0	81.6	30.5	112.1	35.9	30.5	66.3	32.3	30.5	62.8
27.0	88.4	30.5	118.9	41.5	30.5	72.0	36.8	30.5	67.2
28.0	96.4	30.5	126.9	47.2	30.5	77.7	41.2	30.5	71.7
29.0	104.3	30.5	134.8	52.9	30.5	83.3	45.8	30.5	76.2
30.0	112.3	30.5	142.7	58.5	30.5	89.0	50.3	30.5	80.8
31.0	120.2	30.5	150.7	64.2	30.5	94.7	54.9	30.5	85.4
32.0	128.2	30.5	158.6	69.9	30.5	100.3	59.6	30.5	90.1
33.0	136.1	30.5	166.6	75.5	30.5	106.0	64.3	30.5	94.7
34.0	144.1	30.5	174.5	81.2	30.5	111.7	69.0	30.5	99.5
35.0	152.0	30.5	182.5	86.9	30.5	117.3	73.8	30.5	104.2
36.0	159.9	30.5	190.4	92.5	30.5	123.0	78.6	30.5	109.0
37.0	167.9	30.5	198.4	98.2	30.5	128.7	83.4	30.5	113.9
38.0	175.8	30.5	206.3	103.9	30.5	134.3	88.3	30.5	118.8
39.0	183.8	30.5	214.2	109.5	30.5	140.0	93.2	30.5	123.7

40.0	191.7	30.5	222.2	115.2	30.5	145.7	98.2	30.5	128.7
41.0	199.7	30.5	230.1	120.9	30.5	151.3	103.2	30.5	133.7
42.0	207.6	30.5	238.1	126.5	30.5	157.0	108.2	30.5	138.7
43.0	215.6	30.5	246.0	132.2	30.5	162.7	113.3	30.5	143.8
44.0	223.5	30.5	254.0	137.9	30.5	168.3	118.4	30.5	148.9
45.0	231.4	30.5	261.9	143.5	30.5	174.0	123.6	30.5	154.1
46.0	239.4	30.5	269.9	149.2	30.5	179.7	128.8	30.5	159.3
47.0	247.3	30.5	277.8	154.9	30.5	185.3	134.1	30.5	164.5
48.0	255.3	51.7	307.0	160.5	51.9	212.4	139.3	79.4	218.8
49.0	263.2	75.6	338.8	166.2	76.0	242.2	144.7	135.8	280.5
50.0	271.2	99.6	370.7	168.4	100.2	268.6	150.0	193.3	343.4
51.0	281.5	99.6	381.1	170.5	100.2	270.7	153.6	196.7	350.3
52.0	294.4	99.6	393.9	172.7	100.2	272.9	157.2	200.1	357.3
53.0	307.4	99.6	407.0	174.9	100.2	275.1	160.9	203.5	364.4
54.0	320.8	99.6	420.3	177.1	100.2	277.3	164.6	206.9	371.5
55.0	334.3	99.6	433.8	179.2	100.2	279.4	168.4	210.3	378.7
56.0	348.0	99.6	447.6	181.4	100.2	281.6	172.3	213.7	386.0
57.0	362.0	99.6	461.6	183.6	100.2	283.8	176.2	217.1	393.3
58.0	376.2	99.6	475.8	185.7	100.2	285.9	180.2	220.5	400.7
59.0	390.7	99.6	490.2	187.9	100.2	288.1	184.3	223.9	408.1
60.0	405.3	99.6	504.9	190.1	100.2	290.3	188.4	227.2	415.6
61.0	420.2	99.6	519.8	192.2	100.2	292.4	192.6	230.6	423.2
62.0	435.3	99.6	534.9	194.4	100.2	294.6	196.8	234.0	430.8
63.0	450.6	99.6	550.2	196.6	100.2	296.8	201.1	237.4	438.5
64.0	466.2	99.6	565.8	198.8	100.2	299.0	205.5	240.5	446.0
65.0	482.0	99.6	581.5	200.9	100.2	301.1	209.9	242.6	452.5
66.0	498.0	99.6	597.5	203.1	100.2	303.3	214.4	243.6	458.0
67.0	514.2	99.6	613.8	205.3	100.2	305.5	219.0	243.7	462.7
68.0	530.7	99.6	630.2	207.4	100.2	307.6	223.6	243.7	467.4
69.0	547.4	99.6	646.9	209.6	100.2	309.8	228.3	243.7	472.1
70.0	564.3	99.6	663.8	211.8	100.2	312.0	233.1	243.7	476.8
71.0	581.4	99.6	681.0	213.9	100.2	314.1	237.9	243.7	481.6
72.0	598.8	99.6	698.3	216.1	100.2	316.3	242.8	243.7	486.5
73.0	616.4	99.6	715.9	218.3	100.2	318.5	247.7	243.7	491.4
74.0	634.2	99.6	733.7	220.5	100.2	320.6	252.7	243.7	496.5
75.0	652.2	99.6	751.8	222.6	100.2	322.8	257.8	243.7	501.5
76.0	670.5	99.6	770.0	224.8	100.2	325.0	262.9	243.8	506.7
77.0	688.9	99.6	788.5	227.0	100.2	327.2	268.1	243.8	511.9
78.0	707.7	99.6	807.2	229.1	100.2	329.3	273.4	243.8	517.1
79.0	726.6	99.6	826.2	231.3	100.2	331.5	278.7	243.7	522.4
80.0	745.8	99.6	845.3	233.5	100.2	333.7	284.1	243.7	527.8
81.0	765.1	99.6	864.7	235.6	100.2	335.8	289.5	243.7	533.3
82.0	784.8	99.6	884.3	237.8	100.2	338.0	295.0	243.7	538.8
83.0	804.6	84.0	888.6	240.0	84.4	324.4	300.6	183.9	484.5
84.0	824.7	66.4	891.0	242.1	66.6	308.7	306.2	116.3	422.6
85.0	844.9	48.7	893.7	244.3	48.7	293.1	312.0	48.7	360.7
86.0	858.8	48.7	907.5	249.9	48.7	298.7	320.6	48.7	369.4
87.0	865.3	48.7	914.0	259.0	48.7	307.8	329.4	48.7	378.1
88.0	871.0	48.7	919.7	268.1	48.7	316.8	338.2	48.7	386.9
89.0	876.7	48.7	925.4	277.1	48.7	325.9	347.0	48.7	395.7
90.0	882.4	48.7	931.1	286.2	48.7	335.0	355.8	48.7	404.6
91.0	888.1	48.7	936.9	295.3	48.7	344.0	364.7	48.7	413.5
92.0	893.8	48.7	942.6	304.3	48.7	353.1	373.7	48.7	422.4
93.0	899.5	48.7	948.3	313.4	48.7	362.2	382.6	48.7	431.4
94.0	905.2	48.7	954.0	322.5	48.7	371.2	391.6	48.7	440.4
95.0	910.9	48.7	959.7	331.5	48.7	380.3	400.7	48.7	449.4
96.0	916.7	48.7	965.4	340.6	48.7	389.4	409.8	48.7	458.5
97.0	922.4	48.7	971.1	349.7	48.7	398.4	418.9	48.7	467.7
98.0	928.1	48.7	976.8	358.7	48.7	407.5	428.1	48.7	476.8
99.0	933.8	48.7	982.5	367.8	48.7	416.6	437.3	48.7	486.1
100.0	939.5	48.7	988.3	376.9	48.7	425.6	446.6	48.7	495.3

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*    API RP-2A (1994)    *
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PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	3.0	3.0
1.00	0.0	5.1	5.1
2.00	0.0	7.2	7.2
3.00	0.2	9.3	9.4
4.00	0.6	11.4	11.9
5.00	1.1	13.4	14.5
6.00	1.7	15.5	17.3
7.00	2.5	17.6	20.1
8.00	3.3	19.5	22.9
9.00	4.3	21.0	25.4
10.00	5.4	22.2	27.6
11.00	6.6	23.1	29.7
12.00	7.8	24.0	31.8
13.00	9.1	35.1	44.2
14.00	10.4	48.1	58.5
15.00	11.8	61.6	73.4
16.00	13.3	64.1	77.4
17.00	14.9	66.6	81.5
18.00	16.5	69.1	85.6
19.00	18.2	71.6	89.8
20.00	20.0	74.1	94.1
21.00	21.8	76.6	98.4
22.00	23.7	79.1	102.8
23.00	25.7	65.1	90.8
24.00	27.7	48.2	75.9
25.00	29.8	30.5	60.3
26.00	33.5	30.5	64.0
27.00	38.9	30.5	69.4
28.00	44.3	30.5	74.8
29.00	49.8	30.5	80.2
30.00	55.2	30.5	85.7
31.00	60.8	30.5	91.2
32.00	66.3	30.5	96.8
33.00	71.9	30.5	102.4
34.00	77.6	30.5	108.0
35.00	83.3	30.5	113.7
36.00	89.0	30.5	119.5
37.00	94.8	30.5	125.3
38.00	100.7	30.5	131.2
39.00	106.7	30.5	137.1
40.00	112.7	30.5	143.1
41.00	118.8	30.5	149.2
42.00	124.9	30.5	155.4
43.00	131.1	30.5	161.6
44.00	137.4	30.5	167.9
45.00	143.8	30.5	174.2
46.00	150.2	30.5	180.6
47.00	156.6	30.5	187.1
48.00	163.2	79.4	242.6
49.00	169.8	135.8	305.6
50.00	176.4	193.3	369.8
51.00	181.7	196.7	378.4
52.00	185.7	200.1	385.8
53.00	189.7	203.5	393.2
54.00	193.8	206.9	400.7
55.00	197.9	210.3	408.2
56.00	202.2	213.7	415.8
57.00	206.5	217.1	423.5
58.00	210.8	220.5	431.3
59.00	215.3	223.9	439.1
60.00	219.8	227.2	447.0

61.00	224.3	230.6	455.0
62.00	229.0	234.0	463.0
63.00	233.7	237.4	471.1
64.00	238.5	240.5	479.0
65.00	243.3	242.6	485.9
66.00	248.2	243.6	491.8
67.00	253.2	243.7	497.0
68.00	258.3	243.7	502.0
69.00	263.4	243.7	507.2
70.00	268.6	243.7	512.4
71.00	273.9	243.7	517.6
72.00	279.2	243.7	523.0
73.00	284.6	243.7	528.4
74.00	290.1	243.7	533.8
75.00	295.6	243.7	539.4
76.00	301.2	243.8	545.0
77.00	306.9	243.8	550.7
78.00	312.7	243.8	556.4
79.00	318.5	243.7	562.2
80.00	324.4	243.7	568.1
81.00	330.3	243.7	574.1
82.00	336.4	243.7	580.1
83.00	342.5	183.9	526.3
84.00	348.6	116.3	464.9
85.00	354.9	48.7	403.6
86.00	363.4	48.7	412.2
87.00	374.3	48.7	423.1
88.00	385.2	48.7	434.0
89.00	396.2	48.7	445.0
90.00	407.3	48.7	456.1
91.00	418.4	48.7	467.2
92.00	429.6	48.7	478.3
93.00	440.8	48.7	489.6
94.00	452.1	48.7	500.9
95.00	463.5	48.7	512.2
96.00	474.9	48.7	523.6
97.00	486.3	48.7	535.1
98.00	497.8	48.7	546.6
99.00	509.4	48.7	558.2
100.00	521.0	48.7	569.8

AN ASTERISK WILL BE PLACED IN THE END-BEARING COLUMN
IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

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**************************************************
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING                      *
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T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.0000E+00	0.1732E-01
			0.0000E+00	0.3463E-01
			0.0000E+00	0.6926E-01
			0.0000E+00	0.1039E+00
			0.0000E+00	0.1385E+00
			0.0000E+00	0.1558E+00
			0.0000E+00	0.1732E+00

			0.0000E+00	0.8658E+00
			0.0000E+00	0.1732E+01
2	10	0.5025E+01		
			0.0000E+00	0.0000E+00
			0.9727E-01	0.1732E-01
			0.1945E+00	0.3463E-01
			0.3891E+00	0.6926E-01
			0.5836E+00	0.1039E+00
			0.7782E+00	0.1385E+00
			0.8754E+00	0.1558E+00
			0.9727E+00	0.1732E+00
			0.9727E+00	0.8658E+00
			0.9727E+00	0.1732E+01
3	10	0.9958E+01		
			0.0000E+00	0.0000E+00
			0.1680E+00	0.1732E-01
			0.3360E+00	0.3463E-01
			0.6720E+00	0.6926E-01
			0.1008E+01	0.1039E+00
			0.1344E+01	0.1385E+00
			0.1512E+01	0.1558E+00
			0.1680E+01	0.1732E+00
			0.1680E+01	0.8658E+00
			0.1680E+01	0.1732E+01
4	10	0.1000E+02		
			0.0000E+00	0.0000E+00
			0.1807E+00	0.1732E-01
			0.3614E+00	0.3463E-01
			0.7227E+00	0.6926E-01
			0.1084E+01	0.1039E+00
			0.1445E+01	0.1385E+00
			0.1626E+01	0.1558E+00
			0.1807E+01	0.1732E+00
			0.1807E+01	0.8658E+00
			0.1807E+01	0.1732E+01
5	10	0.1253E+02		
			0.0000E+00	0.0000E+00
			0.1960E+00	0.1732E-01
			0.3920E+00	0.3463E-01
			0.7839E+00	0.6926E-01
			0.1176E+01	0.1039E+00
			0.1568E+01	0.1385E+00
			0.1764E+01	0.1558E+00
			0.1960E+01	0.1732E+00
			0.1960E+01	0.8658E+00
			0.1960E+01	0.1732E+01
6	10	0.1496E+02		
			0.0000E+00	0.0000E+00
			0.2113E+00	0.1732E-01
			0.4226E+00	0.3463E-01
			0.8452E+00	0.6926E-01
			0.1268E+01	0.1039E+00
			0.1690E+01	0.1385E+00
			0.1902E+01	0.1558E+00
			0.2113E+01	0.1732E+00
			0.2113E+01	0.8658E+00
			0.2113E+01	0.1732E+01
7	10	0.1500E+02		
			0.0000E+00	0.0000E+00
			0.2261E+00	0.1732E-01
			0.4522E+00	0.3463E-01
			0.9043E+00	0.6926E-01
			0.1356E+01	0.1039E+00
			0.1809E+01	0.1385E+00
			0.2035E+01	0.1558E+00
			0.2261E+01	0.1732E+00

			0.2261E+01	0.8658E+00
			0.2261E+01	0.1732E+01
8	10	0.2002E+02		
			0.0000E+00	0.0000E+00
			0.2811E+00	0.1732E-01
			0.5621E+00	0.3463E-01
			0.1124E+01	0.6926E-01
			0.1686E+01	0.1039E+00
			0.2249E+01	0.1385E+00
			0.2530E+01	0.1558E+00
			0.2811E+01	0.1732E+00
			0.2811E+01	0.8658E+00
			0.2811E+01	0.1732E+01
9	10	0.2496E+02		
			0.0000E+00	0.0000E+00
			0.3202E+00	0.1732E-01
			0.6404E+00	0.3463E-01
			0.1281E+01	0.6926E-01
			0.1921E+01	0.1039E+00
			0.2562E+01	0.1385E+00
			0.2882E+01	0.1558E+00
			0.3202E+01	0.1732E+00
			0.3202E+01	0.8658E+00
			0.3202E+01	0.1732E+01
10	10	0.2500E+02		
			0.0000E+00	0.0000E+00
			0.1715E+01	0.2771E-01
			0.2859E+01	0.5368E-01
			0.4289E+01	0.9870E-01
			0.5146E+01	0.1385E+00
			0.5718E+01	0.1732E+00
			0.5146E+01	0.3463E+00
			0.5146E+01	0.5195E+00
			0.5146E+01	0.8658E+00
			0.5146E+01	0.3463E+01
11	10	0.3752E+02		
			0.0000E+00	0.0000E+00
			0.2705E+01	0.2771E-01
			0.4508E+01	0.5368E-01
			0.6761E+01	0.9870E-01
			0.8114E+01	0.1385E+00
			0.9015E+01	0.1732E+00
			0.8114E+01	0.3463E+00
			0.8114E+01	0.5195E+00
			0.8114E+01	0.8658E+00
			0.8114E+01	0.3463E+01
12	10	0.4996E+02		
			0.0000E+00	0.0000E+00
			0.3058E+01	0.2771E-01
			0.5097E+01	0.5368E-01
			0.7645E+01	0.9870E-01
			0.9174E+01	0.1385E+00
			0.1019E+02	0.1732E+00
			0.9174E+01	0.3463E+00
			0.9174E+01	0.5195E+00
			0.9174E+01	0.8658E+00
			0.9174E+01	0.3463E+01
13	10	0.5000E+02		
			0.0000E+00	0.0000E+00
			0.8119E+00	0.1732E-01
			0.1624E+01	0.3463E-01
			0.3248E+01	0.6926E-01
			0.4872E+01	0.1039E+00
			0.6495E+01	0.1385E+00
			0.7307E+01	0.1558E+00
			0.8119E+01	0.1732E+00

			0.8119E+01	0.8658E+00
			0.8119E+01	0.1732E+01
14	10	0.6753E+02		
			0.0000E+00	0.0000E+00
			0.7748E+00	0.1732E-01
			0.1550E+01	0.3463E-01
			0.3099E+01	0.6926E-01
			0.4649E+01	0.1039E+00
			0.6198E+01	0.1385E+00
			0.6973E+01	0.1558E+00
			0.7748E+01	0.1732E+00
			0.7748E+01	0.8658E+00
			0.7748E+01	0.1732E+01
15	10	0.8496E+02		
			0.0000E+00	0.0000E+00
			0.9550E+00	0.1732E-01
			0.1910E+01	0.3463E-01
			0.3820E+01	0.6926E-01
			0.5730E+01	0.1039E+00
			0.7640E+01	0.1385E+00
			0.8595E+01	0.1558E+00
			0.9550E+01	0.1732E+00
			0.9550E+01	0.8658E+00
			0.9550E+01	0.1732E+01
16	10	0.8500E+02		
			0.0000E+00	0.0000E+00
			0.3935E+01	0.2771E-01
			0.6558E+01	0.5368E-01
			0.9836E+01	0.9870E-01
			0.1180E+02	0.1385E+00
			0.1312E+02	0.1732E+00
			0.1180E+02	0.3463E+00
			0.1180E+02	0.5195E+00
			0.1180E+02	0.8658E+00
			0.1180E+02	0.3463E+01
17	10	0.1050E+03		
			0.0000E+00	0.0000E+00
			0.5343E+01	0.2771E-01
			0.8905E+01	0.5368E-01
			0.1336E+02	0.9870E-01
			0.1603E+02	0.1385E+00
			0.1781E+02	0.1732E+00
			0.1603E+02	0.3463E+00
			0.1603E+02	0.5195E+00
			0.1603E+02	0.8658E+00
			0.1603E+02	0.3463E+01
18	10	0.1250E+03		
			0.0000E+00	0.0000E+00
			0.5343E+01	0.2771E-01
			0.8905E+01	0.5368E-01
			0.1336E+02	0.9870E-01
			0.1603E+02	0.1385E+00
			0.1781E+02	0.1732E+00
			0.1603E+02	0.3463E+00
			0.1603E+02	0.5195E+00
			0.1603E+02	0.8658E+00
			0.1603E+02	0.3463E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.3047E+01	0.8658E-02
0.6094E+01	0.1732E-01

0.1219E+02	0.3463E-01
0.2437E+02	0.2251E+00
0.3656E+02	0.7273E+00
0.4387E+02	0.1264E+01
0.4875E+02	0.1732E+01
0.4875E+02	0.2597E+01
0.4875E+02	0.3463E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.3765E+03	0.5277E+02	0.3519E-01	0.1000E-03
0.4188E+03	0.6250E+02	0.3519E+00	0.1000E-02
0.4466E+03	0.6918E+02	0.1760E+01	0.5000E-02
0.4588E+03	0.7218E+02	0.3519E+01	0.1000E-01
0.4856E+03	0.7889E+02	0.1317E+02	0.5000E-01
0.4925E+03	0.8067E+02	0.1637E+02	0.1000E+00
0.5064E+03	0.8458E+02	0.3105E+02	0.5000E+00
0.5156E+03	0.8740E+02	0.4028E+02	0.1000E+01
0.5241E+03	0.9053E+02	0.4875E+02	0.2000E+01

SHAFT Axial Analysis – 5th Street Bridge, Abutment 1, 24” CIDH

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 6 (C)COPYRIGHT ENSOFT,INC.1989,1995,1998,2001,2003,2007

5th Street Bridge, Abut 1, 24" CIDH (comp) NL

PROPOSED DEPTH = 90.0 FT

NUMBER OF LAYERS = 7

WATER TABLE DEPTH = 24.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.995E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.140E+02

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.995E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.290E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.140E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.839E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.290E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.240E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.839E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.240E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.657E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.390E+02

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.200E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.390E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.200E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.590E+02

LAYER NO 5----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.463E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.590E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.940E+02

LAYER NO 6----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.940E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.134E+03

LAYER NO 7----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.134E+03

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00

SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.170E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 2.000 FT.
DIAMETER OF BASE = 2.000 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 3.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 4.524 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
4.0	0.47	1.25	0.00	1.25	1.25	1.25	3.82
5.0	0.58	3.56	0.00	3.56	3.56	3.56	6.12
6.0	0.70	5.87	0.00	5.87	5.87	5.87	8.41
7.0	0.81	8.51	0.00	8.51	8.51	8.51	10.45
8.0	0.93	11.46	0.00	11.46	11.46	11.46	12.32
9.0	1.05	14.72	0.00	14.72	14.72	14.72	14.05
10.0	1.16	18.26	0.00	18.26	18.26	18.26	15.69
11.0	1.28	22.08	0.00	22.08	22.08	22.08	17.25
12.0	1.40	26.16	0.00	26.16	26.16	26.16	18.73
13.0	1.51	30.51	0.00	30.51	30.51	30.51	20.17
14.0	1.63	35.10	0.00	35.10	35.10	35.10	21.55
15.0	1.75	39.95	0.00	39.95	39.95	39.95	22.89
16.0	1.86	45.05	0.00	45.05	45.05	45.05	24.20
17.0	1.98	50.39	0.00	50.39	50.39	50.39	25.47
18.0	2.09	55.95	0.00	55.95	55.95	55.95	26.71
19.0	2.21	61.74	0.00	61.74	61.74	61.74	27.92
20.0	2.33	67.73	0.00	67.73	67.73	67.73	29.10
21.0	2.44	73.94	5.99	79.92	79.92	79.92	32.70
22.0	2.56	80.34	13.17	93.51	93.51	93.51	36.52
23.0	2.68	86.93	16.76	103.69	103.69	103.69	38.74
24.0	2.79	93.70	16.76	110.46	110.46	110.46	39.55
25.0	2.91	100.51	16.76	117.27	117.27	117.27	40.31
26.0	3.03	107.36	16.76	124.12	124.12	124.12	41.02
27.0	3.14	114.24	16.76	131.00	131.00	131.00	41.69
28.0	3.26	121.15	16.76	137.91	137.91	137.91	42.33
29.0	3.37	128.09	16.76	144.85	144.85	144.85	42.92
30.0	3.49	135.06	16.76	151.82	151.82	151.82	43.49
31.0	3.61	142.05	16.76	158.81	158.81	158.81	44.02

32.0	3.72	149.06	16.76	165.82	165.82	165.82	44.53
33.0	3.84	156.09	16.76	172.85	172.85	172.85	45.01
34.0	3.96	163.14	16.76	179.90	179.90	179.90	45.47
35.0	4.07	170.20	16.76	186.96	186.96	186.96	45.90
36.0	4.19	177.27	20.87	198.14	198.14	198.14	47.30
37.0	4.31	184.35	25.81	210.16	210.16	210.16	48.81
38.0	4.42	191.43	28.28	219.71	219.71	219.71	49.69
39.0	4.54	198.52	28.28	226.80	226.80	226.80	49.97
40.0	4.65	201.98	28.28	230.26	230.26	230.26	49.47
41.0	4.77	205.43	28.28	233.71	233.71	233.71	48.98
42.0	4.89	208.89	28.28	237.17	237.17	237.17	48.52
43.0	5.00	212.35	28.28	240.62	240.62	240.62	48.09
44.0	5.12	215.80	28.28	244.08	244.08	244.08	47.67
45.0	5.24	219.26	28.28	247.54	247.54	247.54	47.27
46.0	5.35	222.71	28.28	250.99	250.99	250.99	46.89
47.0	5.47	226.17	28.28	254.45	254.45	254.45	46.52
48.0	5.59	229.63	28.28	257.91	257.91	257.91	46.17
49.0	5.70	233.08	28.28	261.36	261.36	261.36	45.84
50.0	5.82	236.54	28.28	264.82	264.82	264.82	45.51
51.0	5.93	240.00	28.28	268.27	268.27	268.27	45.20
52.0	6.05	243.45	28.28	271.73	271.73	271.73	44.90
53.0	6.17	246.91	28.28	275.19	275.19	275.19	44.62
54.0	6.28	250.36	28.28	278.64	278.64	278.64	44.34
55.0	6.40	253.82	28.28	282.10	282.10	282.10	44.08
56.0	6.52	257.28	30.15	287.43	287.43	287.43	44.11
57.0	6.63	260.73	32.40	293.13	293.13	293.13	44.19
58.0	6.75	264.19	33.52	297.71	297.71	297.71	44.11
59.0	6.87	267.65	33.52	301.16	301.16	301.16	43.86
60.0	6.98	274.42	33.52	307.94	307.94	307.94	44.10
61.0	7.10	281.16	33.52	314.68	314.68	314.68	44.33
62.0	7.21	287.85	33.52	321.37	321.37	321.37	44.54
63.0	7.33	294.50	33.52	328.02	328.02	328.02	44.74
64.0	7.45	301.09	33.52	334.61	334.61	334.61	44.93
65.0	7.56	307.64	33.52	341.16	341.16	341.16	45.10
66.0	7.68	314.13	33.52	347.65	347.65	347.65	45.26
67.0	7.80	320.57	33.52	354.09	354.09	354.09	45.41
68.0	7.91	326.95	33.52	360.47	360.47	360.47	45.55
69.0	8.03	333.27	33.52	366.79	366.79	366.79	45.68
70.0	8.15	339.52	33.52	373.04	373.04	373.04	45.80
71.0	8.26	345.72	33.52	379.24	379.24	379.24	45.90
72.0	8.38	351.84	33.52	385.36	385.36	385.36	45.99
73.0	8.50	357.90	33.52	391.42	391.42	391.42	46.08
74.0	8.61	363.89	33.52	397.40	397.40	397.40	46.15
75.0	8.73	369.80	33.52	403.32	403.32	403.32	46.21
76.0	8.84	375.64	33.52	409.15	409.15	409.15	46.26
77.0	8.96	381.40	33.52	414.91	414.91	414.91	46.30
78.0	9.08	387.08	33.52	420.60	420.60	420.60	46.34
79.0	9.19	392.68	33.52	426.19	426.19	426.19	46.36
80.0	9.31	398.19	33.52	431.71	431.71	431.71	46.37
81.0	9.43	403.62	33.52	437.14	437.14	437.14	46.38
82.0	9.54	408.96	33.52	442.48	442.48	442.48	46.37
83.0	9.66	414.21	33.52	447.73	447.73	447.73	46.36
84.0	9.78	419.37	33.52	452.89	452.89	452.89	46.33
85.0	9.89	424.44	33.52	457.96	457.96	457.96	46.30
86.0	10.01	429.45	33.52	462.97	462.97	462.97	46.26
87.0	10.12	434.50	33.52	468.02	468.02	468.02	46.23
88.0	10.24	439.61	33.52	473.13	473.13	473.13	46.20
89.0	10.36	444.77	33.52	478.29	478.29	478.29	46.18
90.0	10.47	449.97	33.52	483.49	483.49	483.49	46.16

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD	TOP MOVEMENT	TIP LOAD	TIP MOVEMENT
ton	IN.	ton	IN.

0.2151E+00	0.1184E-03	0.4888E-03	0.1000E-04
0.1075E+01	0.5920E-03	0.2444E-02	0.5000E-04
0.2151E+01	0.1184E-02	0.4888E-02	0.1000E-03
0.1052E+03	0.5922E-01	0.2444E+00	0.5000E-02
0.1476E+03	0.8633E-01	0.3666E+00	0.7500E-02
0.1816E+03	0.1105E+00	0.4888E+00	0.1000E-01
0.2921E+03	0.2086E+00	0.1222E+01	0.2500E-01
0.3675E+03	0.3027E+00	0.2444E+01	0.5000E-01
0.3957E+03	0.3571E+00	0.3666E+01	0.7500E-01
0.4130E+03	0.4009E+00	0.4888E+01	0.1000E+00
0.4403E+03	0.5855E+00	0.1196E+02	0.2500E+00
0.4415E+03	0.8409E+00	0.1929E+02	0.5000E+00
0.4440E+03	0.9696E+00	0.2208E+02	0.6250E+00
0.4474E+03	0.1131E+01	0.2575E+02	0.7813E+00
0.4549E+03	0.1560E+01	0.3402E+02	0.1200E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.4094E+00	0.1998E-03	0.6983E-03	0.1000E-04
0.2047E+01	0.9989E-03	0.3492E-02	0.5000E-04
0.4094E+01	0.1998E-02	0.6983E-02	0.1000E-03
0.1807E+03	0.9596E-01	0.3492E+00	0.5000E-02
0.2342E+03	0.1332E+00	0.5237E+00	0.7500E-02
0.2700E+03	0.1621E+00	0.6983E+00	0.1000E-01
0.3644E+03	0.2641E+00	0.1746E+01	0.2500E-01
0.4235E+03	0.3543E+00	0.3492E+01	0.5000E-01
0.4428E+03	0.4023E+00	0.5237E+01	0.7500E-01
0.4520E+03	0.4383E+00	0.6983E+01	0.1000E+00
0.4646E+03	0.6065E+00	0.1662E+02	0.2500E+00
0.4679E+03	0.8638E+00	0.2422E+02	0.5000E+00
0.4697E+03	0.9913E+00	0.2603E+02	0.6250E+00
0.4729E+03	0.1152E+01	0.2918E+02	0.7813E+00
0.4799E+03	0.1581E+01	0.3620E+02	0.1200E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.9548E-01	0.6333E-04	0.2793E-03	0.1000E-04
0.4774E+00	0.3166E-03	0.1397E-02	0.5000E-04
0.9548E+00	0.6333E-03	0.2793E-02	0.1000E-03
0.4822E+02	0.3186E-01	0.1397E+00	0.5000E-02
0.7134E+02	0.4766E-01	0.2095E+00	0.7500E-02
0.9308E+02	0.6301E-01	0.2793E+00	0.1000E-01
0.1940E+03	0.1430E+00	0.6983E+00	0.2500E-01
0.2919E+03	0.2398E+00	0.1397E+01	0.5000E-01
0.3414E+03	0.3073E+00	0.2095E+01	0.7500E-01
0.3711E+03	0.3612E+00	0.2793E+01	0.1000E+00
0.4151E+03	0.5636E+00	0.7290E+01	0.2500E+00
0.4150E+03	0.8180E+00	0.1436E+02	0.5000E+00
0.4183E+03	0.9479E+00	0.1813E+02	0.6250E+00
0.4219E+03	0.1110E+01	0.2232E+02	0.7813E+00
0.4299E+03	0.1540E+01	0.3184E+02	0.1200E+01

SHAFT Axial Analysis – 5th Street Bridge, Bent 2, 118” CIDH (NL only)

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 6 (C)COPYRIGHT ENSOFT,INC.1989,1995,1998,2001,2003,2007

5th Street Bridge, Bent 2, 11.8" CIDH (comp) NL

PROPOSED DEPTH = 125.0 FT

NUMBER OF LAYERS = 4

WATER TABLE DEPTH = 0.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.600E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.200E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.612E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.200E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.100E+01

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03

MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.100E+01

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.690E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.360E+02

LAYER NO 3----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.360E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.710E+02

LAYER NO 4----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.362E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.710E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.170E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 9.833 FT.
DIAMETER OF BASE = 9.833 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 5.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 109.366 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
6.0	16.88	5.87	1215.33	1221.20	1221.20	1221.20	69.88
7.0	19.69	14.52	1215.33	1229.85	1229.85	1229.85	62.46
8.0	22.50	23.17	1215.33	1238.50	1238.50	1238.50	55.04
9.0	25.32	32.70	1215.33	1248.03	1248.03	1248.03	49.30
10.0	28.13	43.08	1215.33	1258.40	1258.40	1258.40	44.74
11.0	30.94	54.27	1215.33	1269.60	1269.60	1269.60	41.03
12.0	33.75	66.25	1215.33	1281.58	1281.58	1281.58	37.97
13.0	36.57	78.99	1215.33	1294.31	1294.31	1294.31	35.39
14.0	39.38	92.46	1215.33	1307.78	1307.78	1307.78	33.21
15.0	42.19	106.63	1215.33	1321.96	1321.96	1321.96	31.33
16.0	45.01	121.48	1215.33	1336.81	1336.81	1336.81	29.70
17.0	47.82	136.99	1215.33	1352.32	1352.32	1352.32	28.28
18.0	50.63	153.13	1194.52	1347.65	1347.65	1347.65	26.62
19.0	53.45	169.88	1172.67	1342.55	1342.55	1342.55	25.12
20.0	56.26	187.22	1149.79	1337.00	1337.00	1337.00	23.77
21.0	59.07	205.11	1125.86	1330.97	1330.97	1330.97	22.53
22.0	61.88	223.55	1100.89	1324.45	1324.45	1324.45	21.40
23.0	64.70	242.52	1074.89	1317.40	1317.40	1317.40	20.36
24.0	67.51	261.98	1047.84	1309.82	1309.82	1309.82	19.40
25.0	70.32	281.92	1019.75	1301.67	1301.67	1301.67	18.51
26.0	73.14	302.33	990.62	1292.95	1292.95	1292.95	17.68
27.0	75.95	323.18	962.53	1285.71	1285.71	1285.71	16.93
28.0	78.76	344.45	937.57	1282.02	1282.02	1282.02	16.28
29.0	81.57	366.13	915.72	1281.85	1281.85	1281.85	15.71
30.0	84.39	388.20	896.99	1285.19	1285.19	1285.19	15.23
31.0	87.20	410.63	881.39	1292.02	1292.02	1292.02	14.82
32.0	90.01	433.42	868.91	1302.32	1302.32	1302.32	14.47
33.0	92.83	456.53	859.54	1316.08	1316.08	1316.08	14.18
34.0	95.64	479.97	853.30	1333.27	1333.27	1333.27	13.94
35.0	98.45	503.71	850.18	1353.89	1353.89	1353.89	13.75
36.0	101.26	527.73	850.18	1377.91	1377.91	1377.91	13.61
37.0	104.08	559.31	850.18	1409.49	1409.49	1409.49	13.54
38.0	106.89	590.88	850.18	1441.06	1441.06	1441.06	13.48
39.0	109.70	622.46	850.18	1472.64	1472.64	1472.64	13.42

40.0	112.52	654.04	850.18	1504.22	1504.22	1504.22	13.37
41.0	115.33	685.62	850.18	1535.80	1535.80	1535.80	13.32
42.0	118.14	717.19	850.18	1567.37	1567.37	1567.37	13.27
43.0	120.95	748.77	850.18	1598.95	1598.95	1598.95	13.22
44.0	123.77	780.35	850.18	1630.53	1630.53	1630.53	13.17
45.0	126.58	811.92	850.18	1662.10	1662.10	1662.10	13.13
46.0	129.39	843.50	850.18	1693.68	1693.68	1693.68	13.09
47.0	132.21	875.08	850.18	1725.26	1725.26	1725.26	13.05
48.0	135.02	906.66	850.18	1756.84	1756.84	1756.84	13.01
49.0	137.83	938.23	850.18	1788.41	1788.41	1788.41	12.98
50.0	140.65	969.81	850.18	1819.99	1819.99	1819.99	12.94
51.0	143.46	1001.39	850.18	1851.57	1851.57	1851.57	12.91
52.0	146.27	1032.96	850.18	1883.15	1883.15	1883.15	12.87
53.0	149.08	1064.54	912.52	1977.06	1977.06	1977.06	13.26
54.0	151.90	1096.12	977.98	2074.10	2074.10	2074.10	13.65
55.0	154.71	1127.70	1046.56	2174.25	2174.25	2174.25	14.05
56.0	157.52	1159.27	1118.25	2277.52	2277.52	2277.52	14.46
57.0	160.34	1190.85	1193.06	2383.91	2383.91	2383.91	14.87
58.0	163.15	1222.43	1270.99	2493.41	2493.41	2493.41	15.28
59.0	165.96	1254.00	1352.03	2606.04	2606.04	2606.04	15.70
60.0	168.77	1285.58	1436.19	2721.77	2721.77	2721.77	16.13
61.0	171.59	1317.16	1523.47	2840.63	2840.63	2840.63	16.56
62.0	174.40	1348.74	1607.63	2956.37	2956.37	2956.37	16.95
63.0	177.21	1380.31	1682.44	3062.76	3062.76	3062.76	17.28
64.0	180.03	1411.89	1747.90	3159.79	3159.79	3159.79	17.55
65.0	182.84	1443.47	1804.01	3247.48	3247.48	3247.48	17.76
66.0	185.65	1475.04	1850.77	3325.81	3325.81	3325.81	17.91
67.0	188.46	1506.62	1888.17	3394.79	3394.79	3394.79	18.01
68.0	191.28	1538.20	1916.22	3454.42	3454.42	3454.42	18.06
69.0	194.09	1569.78	1934.93	3504.70	3504.70	3504.70	18.06
70.0	196.90	1601.35	1944.28	3545.63	3545.63	3545.63	18.01
71.0	199.72	1632.93	1944.28	3577.21	3577.21	3577.21	17.91
72.0	202.53	1657.64	1944.28	3601.92	3601.92	3601.92	17.78
73.0	205.34	1682.16	1944.28	3626.43	3626.43	3626.43	17.66
74.0	208.15	1706.47	1944.28	3650.75	3650.75	3650.75	17.54
75.0	210.97	1730.57	1944.28	3674.85	3674.85	3674.85	17.42
76.0	213.78	1754.44	1944.28	3698.72	3698.72	3698.72	17.30
77.0	216.59	1778.07	1944.28	3722.35	3722.35	3722.35	17.19
78.0	219.41	1801.45	1944.28	3745.72	3745.72	3745.72	17.07
79.0	222.22	1824.56	1944.28	3768.84	3768.84	3768.84	16.96
80.0	225.03	1847.39	1944.28	3791.67	3791.67	3791.67	16.85
81.0	227.85	1869.94	1944.28	3814.21	3814.21	3814.21	16.74
82.0	230.66	1892.18	1944.28	3836.46	3836.46	3836.46	16.63
83.0	233.47	1914.11	1944.28	3858.38	3858.38	3858.38	16.53
84.0	236.28	1935.71	1944.28	3879.99	3879.99	3879.99	16.42
85.0	239.10	1956.98	1944.28	3901.25	3901.25	3901.25	16.32
86.0	241.91	1978.06	1944.28	3922.33	3922.33	3922.33	16.21
87.0	244.72	1999.40	1944.28	3943.68	3943.68	3943.68	16.11
88.0	247.54	2021.00	1944.28	3965.28	3965.28	3965.28	16.02
89.0	250.35	2042.86	1944.28	3987.14	3987.14	3987.14	15.93
90.0	253.16	2064.99	1944.28	4009.27	4009.27	4009.27	15.84
91.0	255.97	2087.38	1944.28	4031.65	4031.65	4031.65	15.75
92.0	258.79	2110.02	1944.28	4054.30	4054.30	4054.30	15.67
93.0	261.60	2132.93	1944.28	4077.21	4077.21	4077.21	15.59
94.0	264.41	2156.10	1944.28	4100.38	4100.38	4100.38	15.51
95.0	267.23	2179.53	1944.28	4123.81	4123.81	4123.81	15.43
96.0	270.04	2203.22	1944.28	4147.50	4147.50	4147.50	15.36
97.0	272.85	2227.17	1944.28	4171.45	4171.45	4171.45	15.29
98.0	275.66	2251.39	1944.28	4195.67	4195.67	4195.67	15.22
99.0	278.48	2275.86	1944.28	4220.14	4220.14	4220.14	15.15
100.0	281.29	2300.60	1944.28	4244.88	4244.88	4244.88	15.09
101.0	284.10	2325.59	1944.28	4269.87	4269.87	4269.87	15.03
102.0	286.92	2350.85	1944.28	4295.13	4295.13	4295.13	14.97
103.0	289.73	2376.37	1944.28	4320.65	4320.65	4320.65	14.91
104.0	292.54	2402.15	1944.28	4346.43	4346.43	4346.43	14.86
105.0	295.35	2428.19	1944.28	4372.47	4372.47	4372.47	14.80

106.0	298.17	2454.49	1944.28	4398.77	4398.77	4398.77	14.75
107.0	300.98	2481.06	1944.28	4425.33	4425.33	4425.33	14.70
108.0	303.79	2507.88	1944.28	4452.16	4452.16	4452.16	14.66
109.0	306.61	2534.97	1944.28	4479.24	4479.24	4479.24	14.61
110.0	309.42	2562.31	1944.28	4506.59	4506.59	4506.59	14.56
111.0	312.23	2589.92	1944.28	4534.20	4534.20	4534.20	14.52
112.0	315.04	2617.79	1944.28	4562.06	4562.06	4562.06	14.48
113.0	317.86	2645.92	1944.28	4590.19	4590.19	4590.19	14.44
114.0	320.67	2674.31	1944.28	4618.58	4618.58	4618.58	14.40
115.0	323.48	2702.96	1944.28	4647.24	4647.24	4647.24	14.37
116.0	326.30	2731.87	1944.28	4676.15	4676.15	4676.15	14.33
117.0	329.11	2761.04	1944.28	4705.32	4705.32	4705.32	14.30
118.0	331.92	2790.48	1944.28	4734.76	4734.76	4734.76	14.26
119.0	334.74	2820.18	1944.28	4764.45	4764.45	4764.45	14.23
120.0	337.55	2850.13	1944.28	4794.41	4794.41	4794.41	14.20
121.0	340.36	2880.35	1944.28	4824.63	4824.63	4824.63	14.18
122.0	343.17	2910.83	1944.28	4855.11	4855.11	4855.11	14.15
123.0	345.99	2941.57	1944.28	4885.85	4885.85	4885.85	14.12
124.0	348.80	2972.57	1944.28	4916.85	4916.85	4916.85	14.10
125.0	351.61	3003.83	1944.28	4948.11	4948.11	4948.11	14.07

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1225E+00	0.1525E-04	0.5767E-02	0.1000E-04
0.6126E+00	0.7626E-04	0.2884E-01	0.5000E-04
0.1225E+01	0.1525E-03	0.5767E-01	0.1000E-03
0.6126E+02	0.7626E-02	0.2884E+01	0.5000E-02
0.9189E+02	0.1144E-01	0.4325E+01	0.7500E-02
0.1225E+03	0.1525E-01	0.5767E+01	0.1000E-01
0.3063E+03	0.3813E-01	0.1442E+02	0.2500E-01
0.6133E+03	0.7628E-01	0.2884E+02	0.5000E-01
0.9203E+03	0.1144E+00	0.4325E+02	0.7500E-01
0.1216E+04	0.1524E+00	0.5767E+02	0.1000E+00
0.2226E+04	0.3507E+00	0.1442E+03	0.2500E+00
0.2899E+04	0.6371E+00	0.2884E+03	0.5000E+00
0.3552E+04	0.1362E+01	0.6708E+03	0.1180E+01
0.4014E+04	0.3174E+01	0.1244E+04	0.2950E+01
0.4737E+04	0.6182E+01	0.1973E+04	0.5900E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1790E+00	0.1751E-04	0.8239E-02	0.1000E-04
0.8948E+00	0.8757E-04	0.4119E-01	0.5000E-04
0.1790E+01	0.1751E-03	0.8239E-01	0.1000E-03
0.8948E+02	0.8757E-02	0.4119E+01	0.5000E-02
0.1342E+03	0.1314E-01	0.6179E+01	0.7500E-02
0.1790E+03	0.1751E-01	0.8239E+01	0.1000E-01
0.4479E+03	0.4380E-01	0.2060E+02	0.2500E-01
0.8966E+03	0.8762E-01	0.4119E+02	0.5000E-01
0.1344E+04	0.1314E+00	0.6179E+02	0.7500E-01
0.1743E+04	0.1742E+00	0.8239E+02	0.1000E+00
0.2818E+04	0.3793E+00	0.2060E+03	0.2500E+00
0.3377E+04	0.6638E+00	0.4119E+03	0.5000E+00
0.3971E+04	0.1390E+01	0.9333E+03	0.1180E+01
0.4420E+04	0.3200E+01	0.1478E+04	0.2950E+01
0.5042E+04	0.6200E+01	0.2100E+04	0.5900E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.7176E-01	0.1315E-04	0.3295E-02	0.1000E-04
0.3588E+00	0.6576E-04	0.1648E-01	0.5000E-04
0.7176E+00	0.1315E-03	0.3295E-01	0.1000E-03
0.3588E+02	0.6576E-02	0.1648E+01	0.5000E-02
0.5382E+02	0.9864E-02	0.2472E+01	0.7500E-02
0.7176E+02	0.1315E-01	0.3295E+01	0.1000E-01
0.1794E+03	0.3288E-01	0.8239E+01	0.2500E-01
0.3589E+03	0.6576E-01	0.1648E+02	0.5000E-01
0.5386E+03	0.9865E-01	0.2472E+02	0.7500E-01
0.7175E+03	0.1315E+00	0.3295E+02	0.1000E+00
0.1560E+04	0.3197E+00	0.8239E+02	0.2500E+00
0.2381E+04	0.6092E+00	0.1648E+03	0.5000E+00
0.3131E+04	0.1334E+01	0.4083E+03	0.1180E+01
0.3607E+04	0.3148E+01	0.1011E+04	0.2950E+01
0.4432E+04	0.6165E+01	0.1847E+04	0.5900E+01

SHAFT Axial Analysis – 5th Street Bridge, Bent 3, 118” CIDH (NL and LQ)

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 6 (C)COPYRIGHT ENSOFT,INC.1989,1995,1998,2001,2003,2007

5th Street Bridge, Bent 3, 118"CIDH (comp) NL

PROPOSED DEPTH = 125.0 FT

NUMBER OF LAYERS = 4

WATER TABLE DEPTH = 0.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.101E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.130E+02

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.101E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.130E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.786E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.280E+02

LAYER NO 3----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.280E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.680E+02

LAYER NO 4----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.387E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.680E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 9.833 FT.
DIAMETER OF BASE = 9.833 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 5.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 109.366 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
6.0	16.88	3.99	671.72	675.71	675.71	675.71	39.12
7.0	19.69	9.88	706.34	716.22	716.22	716.22	36.37
8.0	22.50	15.77	740.97	756.74	756.74	756.74	33.63
9.0	25.32	22.25	768.67	790.92	790.92	790.92	31.24
10.0	28.13	29.31	794.27	823.59	823.59	823.59	29.28
11.0	30.94	36.93	812.86	849.79	849.79	849.79	27.46
12.0	33.75	45.08	824.42	869.51	869.51	869.51	25.76
13.0	36.57	53.75	828.94	882.69	882.69	882.69	24.14
14.0	39.38	63.15	833.33	896.47	896.47	896.47	22.76
15.0	42.19	73.25	837.57	910.82	910.82	910.82	21.59
16.0	45.01	84.02	841.66	925.69	925.69	925.69	20.57
17.0	47.82	95.45	845.59	941.04	941.04	941.04	19.68
18.0	50.63	107.51	849.34	956.85	956.85	956.85	18.90
19.0	53.45	120.17	852.73	972.90	972.90	972.90	18.20
20.0	56.26	133.42	855.29	988.72	988.72	988.72	17.57
21.0	59.07	147.24	857.11	1004.34	1004.34	1004.34	17.00
22.0	61.88	161.59	858.23	1019.83	1019.83	1019.83	16.48
23.0	64.70	176.47	858.74	1035.21	1035.21	1035.21	16.00
24.0	67.51	191.86	858.68	1050.54	1050.54	1050.54	15.56
25.0	70.32	207.72	858.13	1065.85	1065.85	1065.85	15.16
26.0	73.14	224.05	857.15	1081.20	1081.20	1081.20	14.78
27.0	75.95	240.83	855.79	1096.62	1096.62	1096.62	14.44
28.0	78.76	258.04	854.09	1112.13	1112.13	1112.13	14.12
29.0	81.57	289.62	852.78	1142.40	1142.40	1142.40	14.00
30.0	84.39	321.19	851.80	1172.99	1172.99	1172.99	13.90
31.0	87.20	352.77	851.10	1203.87	1203.87	1203.87	13.81
32.0	90.01	384.35	850.64	1234.99	1234.99	1234.99	13.72
33.0	92.83	415.92	850.36	1266.29	1266.29	1266.29	13.64
34.0	95.64	447.50	850.23	1297.73	1297.73	1297.73	13.57
35.0	98.45	479.08	850.18	1329.26	1329.26	1329.26	13.50
36.0	101.26	510.66	850.18	1360.84	1360.84	1360.84	13.44
37.0	104.08	542.23	850.18	1392.41	1392.41	1392.41	13.38
38.0	106.89	573.81	850.18	1423.99	1423.99	1423.99	13.32
39.0	109.70	605.39	850.18	1455.57	1455.57	1455.57	13.27
40.0	112.52	636.97	850.18	1487.15	1487.15	1487.15	13.22
41.0	115.33	668.54	850.18	1518.72	1518.72	1518.72	13.17

42.0	118.14	700.12	850.18	1550.30	1550.30	1550.30	13.12
43.0	120.95	731.70	850.18	1581.88	1581.88	1581.88	13.08
44.0	123.77	763.27	850.18	1613.45	1613.45	1613.45	13.04
45.0	126.58	794.85	850.18	1645.03	1645.03	1645.03	13.00
46.0	129.39	826.43	850.18	1676.61	1676.61	1676.61	12.96
47.0	132.21	858.01	850.18	1708.19	1708.19	1708.19	12.92
48.0	135.02	889.58	850.18	1739.76	1739.76	1739.76	12.89
49.0	137.83	921.16	850.18	1771.34	1771.34	1771.34	12.85
50.0	140.65	952.74	912.52	1865.26	1865.26	1865.26	13.26
51.0	143.46	984.31	977.98	1962.30	1962.30	1962.30	13.68
52.0	146.27	1015.89	1046.56	2062.45	2062.45	2062.45	14.10
53.0	149.08	1047.47	1118.25	2165.72	2165.72	2165.72	14.53
54.0	151.90	1079.05	1193.06	2272.11	2272.11	2272.11	14.96
55.0	154.71	1110.62	1270.99	2381.61	2381.61	2381.61	15.39
56.0	157.52	1142.20	1352.03	2494.23	2494.23	2494.23	15.83
57.0	160.34	1173.78	1436.19	2609.97	2609.97	2609.97	16.28
58.0	163.15	1205.35	1523.47	2728.83	2728.83	2728.83	16.73
59.0	165.96	1236.93	1607.63	2844.56	2844.56	2844.56	17.14
60.0	168.77	1268.51	1682.44	2950.95	2950.95	2950.95	17.48
61.0	171.59	1300.09	1747.90	3047.99	3047.99	3047.99	17.76
62.0	174.40	1331.66	1804.01	3135.67	3135.67	3135.67	17.98
63.0	177.21	1363.24	1850.77	3214.01	3214.01	3214.01	18.14
64.0	180.03	1394.82	1888.17	3282.99	3282.99	3282.99	18.24
65.0	182.84	1426.39	1916.22	3342.62	3342.62	3342.62	18.28
66.0	185.65	1457.97	1934.93	3392.90	3392.90	3392.90	18.28
67.0	188.46	1489.55	1944.28	3433.83	3433.83	3433.83	18.22
68.0	191.28	1521.13	1944.28	3465.40	3465.40	3465.40	18.12
69.0	194.09	1544.46	1944.28	3488.74	3488.74	3488.74	17.97
70.0	196.90	1567.68	1944.28	3511.96	3511.96	3511.96	17.84
71.0	199.72	1590.77	1944.28	3535.05	3535.05	3535.05	17.70
72.0	202.53	1613.73	1944.28	3558.01	3558.01	3558.01	17.57
73.0	205.34	1636.53	1944.28	3580.81	3580.81	3580.81	17.44
74.0	208.15	1659.18	1944.28	3603.45	3603.45	3603.45	17.31
75.0	210.97	1681.64	1944.28	3625.92	3625.92	3625.92	17.19
76.0	213.78	1703.91	1944.28	3648.19	3648.19	3648.19	17.07
77.0	216.59	1725.98	1944.28	3670.26	3670.26	3670.26	16.95
78.0	219.41	1747.84	1944.28	3692.12	3692.12	3692.12	16.83
79.0	222.22	1769.47	1944.28	3713.74	3713.74	3713.74	16.71
80.0	225.03	1790.85	1944.28	3735.13	3735.13	3735.13	16.60
81.0	227.85	1811.99	1944.28	3756.27	3756.27	3756.27	16.49
82.0	230.66	1832.86	1944.28	3777.14	3777.14	3777.14	16.38
83.0	233.47	1853.45	1944.28	3797.73	3797.73	3797.73	16.27
84.0	236.28	1873.76	1944.28	3818.03	3818.03	3818.03	16.16
85.0	239.10	1893.76	1944.28	3838.04	3838.04	3838.04	16.05
86.0	241.91	1913.61	1944.28	3857.88	3857.88	3857.88	15.95
87.0	244.72	1933.71	1944.28	3877.99	3877.99	3877.99	15.85
88.0	247.54	1954.08	1944.28	3898.36	3898.36	3898.36	15.75
89.0	250.35	1974.71	1944.28	3918.98	3918.98	3918.98	15.65
90.0	253.16	1995.59	1944.28	3939.87	3939.87	3939.87	15.56
91.0	255.97	2016.75	1944.28	3961.02	3961.02	3961.02	15.47
92.0	258.79	2038.16	1944.28	3982.43	3982.43	3982.43	15.39
93.0	261.60	2059.83	1944.28	4004.11	4004.11	4004.11	15.31
94.0	264.41	2081.76	1944.28	4026.04	4026.04	4026.04	15.23
95.0	267.23	2103.96	1944.28	4048.23	4048.23	4048.23	15.15
96.0	270.04	2126.41	1944.28	4070.69	4070.69	4070.69	15.07
97.0	272.85	2149.13	1944.28	4093.41	4093.41	4093.41	15.00
98.0	275.66	2172.11	1944.28	4116.38	4116.38	4116.38	14.93
99.0	278.48	2195.34	1944.28	4139.62	4139.62	4139.62	14.87
100.0	281.29	2218.84	1944.28	4163.12	4163.12	4163.12	14.80
101.0	284.10	2242.61	1944.28	4186.88	4186.88	4186.88	14.74
102.0	286.92	2266.63	1944.28	4210.90	4210.90	4210.90	14.68
103.0	289.73	2290.91	1944.28	4235.19	4235.19	4235.19	14.62
104.0	292.54	2315.45	1944.28	4259.73	4259.73	4259.73	14.56
105.0	295.35	2340.26	1944.28	4284.54	4284.54	4284.54	14.51
106.0	298.17	2365.33	1944.28	4309.60	4309.60	4309.60	14.45
107.0	300.98	2390.65	1944.28	4334.93	4334.93	4334.93	14.40

108.0	303.79	2416.24	1944.28	4360.52	4360.52	4360.52	14.35
109.0	306.61	2442.09	1944.28	4386.37	4386.37	4386.37	14.31
110.0	309.42	2468.20	1944.28	4412.48	4412.48	4412.48	14.26
111.0	312.23	2494.57	1944.28	4438.85	4438.85	4438.85	14.22
112.0	315.04	2521.20	1944.28	4465.48	4465.48	4465.48	14.17
113.0	317.86	2548.10	1944.28	4492.38	4492.38	4492.38	14.13
114.0	320.67	2575.25	1944.28	4519.53	4519.53	4519.53	14.09
115.0	323.48	2602.67	1944.28	4546.95	4546.95	4546.95	14.06
116.0	326.30	2630.35	1944.28	4574.62	4574.62	4574.62	14.02
117.0	329.11	2658.28	1944.28	4602.56	4602.56	4602.56	13.98
118.0	331.92	2686.48	1944.28	4630.76	4630.76	4630.76	13.95
119.0	334.74	2714.94	1944.28	4659.22	4659.22	4659.22	13.92
120.0	337.55	2743.66	1944.28	4687.94	4687.94	4687.94	13.89
121.0	340.36	2772.65	1944.28	4716.92	4716.92	4716.92	13.86
122.0	343.17	2801.89	1944.28	4746.17	4746.17	4746.17	13.83
123.0	345.99	2831.39	1944.28	4775.67	4775.67	4775.67	13.80
124.0	348.80	2861.16	1944.28	4805.44	4805.44	4805.44	13.78
125.0	351.61	2891.18	1944.28	4835.46	4835.46	4835.46	13.75

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1214E+00	0.1511E-04	0.5767E-02	0.1000E-04
0.6070E+00	0.7556E-04	0.2884E-01	0.5000E-04
0.1214E+01	0.1511E-03	0.5767E-01	0.1000E-03
0.6070E+02	0.7556E-02	0.2884E+01	0.5000E-02
0.9105E+02	0.1133E-01	0.4325E+01	0.7500E-02
0.1214E+03	0.1511E-01	0.5767E+01	0.1000E-01
0.3035E+03	0.3778E-01	0.1442E+02	0.2500E-01
0.6077E+03	0.7557E-01	0.2884E+02	0.5000E-01
0.9118E+03	0.1134E+00	0.4325E+02	0.7500E-01
0.1204E+04	0.1509E+00	0.5767E+02	0.1000E+00
0.2179E+04	0.3476E+00	0.1442E+03	0.2500E+00
0.2816E+04	0.6329E+00	0.2884E+03	0.5000E+00
0.3442E+04	0.1357E+01	0.6708E+03	0.1180E+01
0.3890E+04	0.3169E+01	0.1244E+04	0.2950E+01
0.4614E+04	0.6177E+01	0.1973E+04	0.5900E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1783E+00	0.1733E-04	0.8239E-02	0.1000E-04
0.8914E+00	0.8665E-04	0.4119E-01	0.5000E-04
0.1783E+01	0.1733E-03	0.8239E-01	0.1000E-03
0.8914E+02	0.8665E-02	0.4119E+01	0.5000E-02
0.1337E+03	0.1300E-01	0.6179E+01	0.7500E-02
0.1783E+03	0.1733E-01	0.8239E+01	0.1000E-01
0.4462E+03	0.4334E-01	0.2060E+02	0.2500E-01
0.8932E+03	0.8670E-01	0.4119E+02	0.5000E-01
0.1340E+04	0.1301E+00	0.6179E+02	0.7500E-01
0.1728E+04	0.1721E+00	0.8239E+02	0.1000E+00
0.2737E+04	0.3751E+00	0.2060E+03	0.2500E+00
0.3275E+04	0.6588E+00	0.4119E+03	0.5000E+00
0.3863E+04	0.1385E+01	0.9333E+03	0.1180E+01
0.4299E+04	0.3195E+01	0.1478E+04	0.2950E+01
0.4921E+04	0.6195E+01	0.2100E+04	0.5900E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.7041E-01	0.1306E-04	0.3295E-02	0.1000E-04
0.3520E+00	0.6528E-04	0.1648E-01	0.5000E-04
0.7041E+00	0.1306E-03	0.3295E-01	0.1000E-03
0.3520E+02	0.6528E-02	0.1648E+01	0.5000E-02
0.5281E+02	0.9793E-02	0.2472E+01	0.7500E-02
0.7041E+02	0.1306E-01	0.3295E+01	0.1000E-01
0.1760E+03	0.3264E-01	0.8239E+01	0.2500E-01
0.3521E+03	0.6529E-01	0.1648E+02	0.5000E-01
0.5284E+03	0.9793E-01	0.2472E+02	0.7500E-01
0.7043E+03	0.1306E+00	0.3295E+02	0.1000E+00
0.1531E+04	0.3176E+00	0.8239E+02	0.2500E+00
0.2319E+04	0.6057E+00	0.1648E+03	0.5000E+00
0.3022E+04	0.1329E+01	0.4083E+03	0.1180E+01
0.3481E+04	0.3143E+01	0.1011E+04	0.2950E+01
0.4307E+04	0.6160E+01	0.1847E+04	0.5900E+01

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
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5th Street Bridge, Bent 3, 118"CIDH (comp) LQ

PROPOSED DEPTH = 125.0 FT

NUMBER OF LAYERS = 4

WATER TABLE DEPTH = 0.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.600E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.759E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.130E+02

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.101E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.130E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.786E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.280E+02

LAYER NO 3----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.280E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.680E+02

LAYER NO 4----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.387E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.680E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 9.833 FT.
DIAMETER OF BASE = 9.833 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 5.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 109.366 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
6.0	16.88	3.40	690.94	694.34	694.34	694.34	40.09
7.0	19.69	6.80	720.80	727.60	727.60	727.60	36.95
8.0	22.50	10.20	750.66	760.85	760.85	760.85	33.81
9.0	25.32	13.59	774.51	788.11	788.11	788.11	31.13
10.0	28.13	16.99	797.21	814.21	814.21	814.21	28.95
11.0	30.94	20.39	813.85	834.24	834.24	834.24	26.96
12.0	33.75	23.79	824.42	848.21	848.21	848.21	25.13
13.0	36.57	27.19	828.94	856.13	856.13	856.13	23.41
14.0	39.38	36.58	833.33	869.91	869.91	869.91	22.09
15.0	42.19	46.68	837.57	884.25	884.25	884.25	20.96
16.0	45.01	57.46	841.66	899.12	899.12	899.12	19.98
17.0	47.82	68.89	845.59	914.48	914.48	914.48	19.12
18.0	50.63	80.94	849.34	930.29	930.29	930.29	18.37
19.0	53.45	93.61	852.73	946.34	946.34	946.34	17.71
20.0	56.26	106.86	855.29	962.15	962.15	962.15	17.10
21.0	59.07	120.67	857.11	977.78	977.78	977.78	16.55
22.0	61.88	135.03	858.23	993.26	993.26	993.26	16.05
23.0	64.70	149.91	858.74	1008.64	1008.64	1008.64	15.59
24.0	67.51	165.29	858.68	1023.97	1023.97	1023.97	15.17
25.0	70.32	181.16	858.13	1039.29	1039.29	1039.29	14.78
26.0	73.14	197.49	857.15	1054.64	1054.64	1054.64	14.42
27.0	75.95	214.27	855.79	1070.06	1070.06	1070.06	14.09
28.0	78.76	231.47	854.09	1085.57	1085.57	1085.57	13.78
29.0	81.57	263.05	852.78	1115.83	1115.83	1115.83	13.68
30.0	84.39	294.63	851.80	1146.43	1146.43	1146.43	13.59
31.0	87.20	326.21	851.10	1177.31	1177.31	1177.31	13.50
32.0	90.01	357.78	850.64	1208.42	1208.42	1208.42	13.43
33.0	92.83	389.36	850.36	1239.72	1239.72	1239.72	13.36
34.0	95.64	420.94	850.23	1271.16	1271.16	1271.16	13.29
35.0	98.45	452.51	850.18	1302.70	1302.70	1302.70	13.23
36.0	101.26	484.09	850.18	1334.27	1334.27	1334.27	13.18
37.0	104.08	515.67	850.18	1365.85	1365.85	1365.85	13.12
38.0	106.89	547.25	850.18	1397.43	1397.43	1397.43	13.07
39.0	109.70	578.82	850.18	1429.00	1429.00	1429.00	13.03
40.0	112.52	610.40	850.18	1460.58	1460.58	1460.58	12.98
41.0	115.33	641.98	850.18	1492.16	1492.16	1492.16	12.94

42.0	118.14	673.56	850.18	1523.74	1523.74	1523.74	12.90
43.0	120.95	705.13	850.18	1555.31	1555.31	1555.31	12.86
44.0	123.77	736.71	850.18	1586.89	1586.89	1586.89	12.82
45.0	126.58	768.29	850.18	1618.47	1618.47	1618.47	12.79
46.0	129.39	799.86	850.18	1650.04	1650.04	1650.04	12.75
47.0	132.21	831.44	850.18	1681.62	1681.62	1681.62	12.72
48.0	135.02	863.02	850.18	1713.20	1713.20	1713.20	12.69
49.0	137.83	894.60	850.18	1744.78	1744.78	1744.78	12.66
50.0	140.65	926.17	912.52	1838.70	1838.70	1838.70	13.07
51.0	143.46	957.75	977.98	1935.73	1935.73	1935.73	13.49
52.0	146.27	989.33	1046.56	2035.88	2035.88	2035.88	13.92
53.0	149.08	1020.90	1118.25	2139.15	2139.15	2139.15	14.35
54.0	151.90	1052.48	1193.06	2245.54	2245.54	2245.54	14.78
55.0	154.71	1084.06	1270.99	2355.05	2355.05	2355.05	15.22
56.0	157.52	1115.64	1352.03	2467.67	2467.67	2467.67	15.67
57.0	160.34	1147.21	1436.19	2583.41	2583.41	2583.41	16.11
58.0	163.15	1178.79	1523.47	2702.26	2702.26	2702.26	16.56
59.0	165.96	1210.37	1607.63	2818.00	2818.00	2818.00	16.98
60.0	168.77	1241.94	1682.44	2924.39	2924.39	2924.39	17.33
61.0	171.59	1273.52	1747.90	3021.42	3021.42	3021.42	17.61
62.0	174.40	1305.10	1804.01	3109.11	3109.11	3109.11	17.83
63.0	177.21	1336.68	1850.77	3187.44	3187.44	3187.44	17.99
64.0	180.03	1368.25	1888.17	3256.42	3256.42	3256.42	18.09
65.0	182.84	1399.83	1916.22	3316.05	3316.05	3316.05	18.14
66.0	185.65	1431.41	1934.93	3366.33	3366.33	3366.33	18.13
67.0	188.46	1462.98	1944.28	3407.26	3407.26	3407.26	18.08
68.0	191.28	1494.56	1944.28	3438.84	3438.84	3438.84	17.98
69.0	194.09	1517.89	1944.28	3462.17	3462.17	3462.17	17.84
70.0	196.90	1541.11	1944.28	3485.39	3485.39	3485.39	17.70
71.0	199.72	1564.21	1944.28	3508.49	3508.49	3508.49	17.57
72.0	202.53	1587.17	1944.28	3531.44	3531.44	3531.44	17.44
73.0	205.34	1609.97	1944.28	3554.25	3554.25	3554.25	17.31
74.0	208.15	1632.61	1944.28	3576.89	3576.89	3576.89	17.18
75.0	210.97	1655.07	1944.28	3599.35	3599.35	3599.35	17.06
76.0	213.78	1677.35	1944.28	3621.63	3621.63	3621.63	16.94
77.0	216.59	1699.42	1944.28	3643.70	3643.70	3643.70	16.82
78.0	219.41	1721.27	1944.28	3665.55	3665.55	3665.55	16.71
79.0	222.22	1742.90	1944.28	3687.18	3687.18	3687.18	16.59
80.0	225.03	1764.29	1944.28	3708.57	3708.57	3708.57	16.48
81.0	227.85	1785.42	1944.28	3729.70	3729.70	3729.70	16.37
82.0	230.66	1806.29	1944.28	3750.57	3750.57	3750.57	16.26
83.0	233.47	1826.89	1944.28	3771.16	3771.16	3771.16	16.15
84.0	236.28	1847.19	1944.28	3791.47	3791.47	3791.47	16.05
85.0	239.10	1867.20	1944.28	3811.47	3811.47	3811.47	15.94
86.0	241.91	1887.04	1944.28	3831.32	3831.32	3831.32	15.84
87.0	244.72	1907.15	1944.28	3851.42	3851.42	3851.42	15.74
88.0	247.54	1927.51	1944.28	3871.79	3871.79	3871.79	15.64
89.0	250.35	1948.14	1944.28	3892.42	3892.42	3892.42	15.55
90.0	253.16	1969.03	1944.28	3913.31	3913.31	3913.31	15.46
91.0	255.97	1990.18	1944.28	3934.46	3934.46	3934.46	15.37
92.0	258.79	2011.59	1944.28	3955.87	3955.87	3955.87	15.29
93.0	261.60	2033.26	1944.28	3977.54	3977.54	3977.54	15.20
94.0	264.41	2055.20	1944.28	3999.48	3999.48	3999.48	15.13
95.0	267.23	2077.39	1944.28	4021.67	4021.67	4021.67	15.05
96.0	270.04	2099.85	1944.28	4044.13	4044.13	4044.13	14.98
97.0	272.85	2122.56	1944.28	4066.84	4066.84	4066.84	14.90
98.0	275.66	2145.54	1944.28	4089.82	4089.82	4089.82	14.84
99.0	278.48	2168.78	1944.28	4113.06	4113.06	4113.06	14.77
100.0	281.29	2192.28	1944.28	4136.56	4136.56	4136.56	14.71
101.0	284.10	2216.04	1944.28	4160.32	4160.32	4160.32	14.64
102.0	286.92	2240.06	1944.28	4184.34	4184.34	4184.34	14.58
103.0	289.73	2264.35	1944.28	4208.62	4208.62	4208.62	14.53
104.0	292.54	2288.89	1944.28	4233.17	4233.17	4233.17	14.47
105.0	295.35	2313.69	1944.28	4257.97	4257.97	4257.97	14.42
106.0	298.17	2338.76	1944.28	4283.04	4283.04	4283.04	14.36
107.0	300.98	2364.09	1944.28	4308.37	4308.37	4308.37	14.31

108.0	303.79	2389.68	1944.28	4333.95	4333.95	4333.95	14.27
109.0	306.61	2415.53	1944.28	4359.80	4359.80	4359.80	14.22
110.0	309.42	2441.64	1944.28	4385.91	4385.91	4385.91	14.17
111.0	312.23	2468.01	1944.28	4412.29	4412.29	4412.29	14.13
112.0	315.04	2494.64	1944.28	4438.92	4438.92	4438.92	14.09
113.0	317.86	2521.53	1944.28	4465.81	4465.81	4465.81	14.05
114.0	320.67	2548.69	1944.28	4492.97	4492.97	4492.97	14.01
115.0	323.48	2576.10	1944.28	4520.38	4520.38	4520.38	13.97
116.0	326.30	2603.78	1944.28	4548.06	4548.06	4548.06	13.94
117.0	329.11	2631.72	1944.28	4576.00	4576.00	4576.00	13.90
118.0	331.92	2659.92	1944.28	4604.20	4604.20	4604.20	13.87
119.0	334.74	2688.38	1944.28	4632.66	4632.66	4632.66	13.84
120.0	337.55	2717.10	1944.28	4661.38	4661.38	4661.38	13.81
121.0	340.36	2746.08	1944.28	4690.36	4690.36	4690.36	13.78
122.0	343.17	2775.32	1944.28	4719.60	4719.60	4719.60	13.75
123.0	345.99	2804.83	1944.28	4749.11	4749.11	4749.11	13.73
124.0	348.80	2834.59	1944.28	4778.87	4778.87	4778.87	13.70
125.0	351.61	2864.62	1944.28	4808.90	4808.90	4808.90	13.68

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1210E+00	0.1511E-04	0.5767E-02	0.1000E-04
0.6048E+00	0.7554E-04	0.2884E-01	0.5000E-04
0.1210E+01	0.1511E-03	0.5767E-01	0.1000E-03
0.6048E+02	0.7554E-02	0.2884E+01	0.5000E-02
0.9071E+02	0.1133E-01	0.4325E+01	0.7500E-02
0.1210E+03	0.1511E-01	0.5767E+01	0.1000E-01
0.3024E+03	0.3777E-01	0.1442E+02	0.2500E-01
0.6055E+03	0.7556E-01	0.2884E+02	0.5000E-01
0.9085E+03	0.1133E+00	0.4325E+02	0.7500E-01
0.1198E+04	0.1509E+00	0.5767E+02	0.1000E+00
0.2164E+04	0.3475E+00	0.1442E+03	0.2500E+00
0.2792E+04	0.6327E+00	0.2884E+03	0.5000E+00
0.3413E+04	0.1357E+01	0.6708E+03	0.1180E+01
0.3857E+04	0.3169E+01	0.1244E+04	0.2950E+01
0.4581E+04	0.6177E+01	0.1973E+04	0.5900E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1779E+00	0.1733E-04	0.8239E-02	0.1000E-04
0.8894E+00	0.8663E-04	0.4119E-01	0.5000E-04
0.1779E+01	0.1733E-03	0.8239E-01	0.1000E-03
0.8894E+02	0.8663E-02	0.4119E+01	0.5000E-02
0.1334E+03	0.1300E-01	0.6179E+01	0.7500E-02
0.1779E+03	0.1733E-01	0.8239E+01	0.1000E-01
0.4452E+03	0.4333E-01	0.2060E+02	0.2500E-01
0.8912E+03	0.8668E-01	0.4119E+02	0.5000E-01
0.1336E+04	0.1300E+00	0.6179E+02	0.7500E-01
0.1719E+04	0.1721E+00	0.8239E+02	0.1000E+00
0.2713E+04	0.3749E+00	0.2060E+03	0.2500E+00
0.3246E+04	0.6586E+00	0.4119E+03	0.5000E+00
0.3833E+04	0.1384E+01	0.9333E+03	0.1180E+01
0.4266E+04	0.3195E+01	0.1478E+04	0.2950E+01
0.4888E+04	0.6195E+01	0.2100E+04	0.5900E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.6998E-01	0.1305E-04	0.3295E-02	0.1000E-04
0.3499E+00	0.6527E-04	0.1648E-01	0.5000E-04
0.6998E+00	0.1305E-03	0.3295E-01	0.1000E-03
0.3499E+02	0.6527E-02	0.1648E+01	0.5000E-02
0.5248E+02	0.9790E-02	0.2472E+01	0.7500E-02
0.6998E+02	0.1305E-01	0.3295E+01	0.1000E-01
0.1749E+03	0.3263E-01	0.8239E+01	0.2500E-01
0.3500E+03	0.6527E-01	0.1648E+02	0.5000E-01
0.5252E+03	0.9791E-01	0.2472E+02	0.7500E-01
0.7000E+03	0.1306E+00	0.3295E+02	0.1000E+00
0.1522E+04	0.3175E+00	0.8239E+02	0.2500E+00
0.2300E+04	0.6056E+00	0.1648E+03	0.5000E+00
0.2992E+04	0.1329E+01	0.4083E+03	0.1180E+01
0.3448E+04	0.3143E+01	0.1011E+04	0.2950E+01
0.4274E+04	0.6160E+01	0.1847E+04	0.5900E+01

SHAFT Axial Analysis – 5th Street Bridge, Bent 4, 118” CIDH (NL and LQ)

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 6 (C)COPYRIGHT ENSOFT,INC.1989,1995,1998,2001,2003,2007

5th Street Bridge, Bent 4, 118"'CIDH (comp) NL

PROPOSED DEPTH = 135.0 FT

NUMBER OF LAYERS = 4

WATER TABLE DEPTH = 0.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.101E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.130E+02

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.101E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.130E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.786E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.280E+02

LAYER NO 3----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.280E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.680E+02

LAYER NO 4----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.387E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.680E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 9.833 FT.
DIAMETER OF BASE = 9.833 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 5.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 109.366 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
6.0	16.88	3.99	671.72	675.71	675.71	675.71	39.12
7.0	19.69	9.88	706.34	716.22	716.22	716.22	36.37
8.0	22.50	15.77	740.97	756.74	756.74	756.74	33.63
9.0	25.32	22.25	768.67	790.92	790.92	790.92	31.24
10.0	28.13	29.31	794.27	823.59	823.59	823.59	29.28
11.0	30.94	36.93	812.86	849.79	849.79	849.79	27.46
12.0	33.75	45.08	824.42	869.51	869.51	869.51	25.76
13.0	36.57	53.75	828.94	882.69	882.69	882.69	24.14
14.0	39.38	63.15	833.33	896.47	896.47	896.47	22.76
15.0	42.19	73.25	837.57	910.82	910.82	910.82	21.59
16.0	45.01	84.02	841.66	925.69	925.69	925.69	20.57
17.0	47.82	95.45	845.59	941.04	941.04	941.04	19.68
18.0	50.63	107.51	849.34	956.85	956.85	956.85	18.90
19.0	53.45	120.17	852.73	972.90	972.90	972.90	18.20
20.0	56.26	133.42	855.29	988.72	988.72	988.72	17.57
21.0	59.07	147.24	857.11	1004.34	1004.34	1004.34	17.00
22.0	61.88	161.59	858.23	1019.83	1019.83	1019.83	16.48
23.0	64.70	176.47	858.74	1035.21	1035.21	1035.21	16.00
24.0	67.51	191.86	858.68	1050.54	1050.54	1050.54	15.56
25.0	70.32	207.72	858.13	1065.85	1065.85	1065.85	15.16
26.0	73.14	224.05	857.15	1081.20	1081.20	1081.20	14.78
27.0	75.95	240.83	855.79	1096.62	1096.62	1096.62	14.44
28.0	78.76	258.04	854.09	1112.13	1112.13	1112.13	14.12
29.0	81.57	289.62	852.78	1142.40	1142.40	1142.40	14.00
30.0	84.39	321.19	851.80	1172.99	1172.99	1172.99	13.90
31.0	87.20	352.77	851.10	1203.87	1203.87	1203.87	13.81
32.0	90.01	384.35	850.64	1234.99	1234.99	1234.99	13.72
33.0	92.83	415.92	850.36	1266.29	1266.29	1266.29	13.64
34.0	95.64	447.50	850.23	1297.73	1297.73	1297.73	13.57
35.0	98.45	479.08	850.18	1329.26	1329.26	1329.26	13.50
36.0	101.26	510.66	850.18	1360.84	1360.84	1360.84	13.44
37.0	104.08	542.23	850.18	1392.41	1392.41	1392.41	13.38
38.0	106.89	573.81	850.18	1423.99	1423.99	1423.99	13.32
39.0	109.70	605.39	850.18	1455.57	1455.57	1455.57	13.27
40.0	112.52	636.97	850.18	1487.15	1487.15	1487.15	13.22
41.0	115.33	668.54	850.18	1518.72	1518.72	1518.72	13.17

42.0	118.14	700.12	850.18	1550.30	1550.30	1550.30	13.12
43.0	120.95	731.70	850.18	1581.88	1581.88	1581.88	13.08
44.0	123.77	763.27	850.18	1613.45	1613.45	1613.45	13.04
45.0	126.58	794.85	850.18	1645.03	1645.03	1645.03	13.00
46.0	129.39	826.43	850.18	1676.61	1676.61	1676.61	12.96
47.0	132.21	858.01	850.18	1708.19	1708.19	1708.19	12.92
48.0	135.02	889.58	850.18	1739.76	1739.76	1739.76	12.89
49.0	137.83	921.16	850.18	1771.34	1771.34	1771.34	12.85
50.0	140.65	952.74	912.52	1865.26	1865.26	1865.26	13.26
51.0	143.46	984.31	977.98	1962.30	1962.30	1962.30	13.68
52.0	146.27	1015.89	1046.56	2062.45	2062.45	2062.45	14.10
53.0	149.08	1047.47	1118.25	2165.72	2165.72	2165.72	14.53
54.0	151.90	1079.05	1193.06	2272.11	2272.11	2272.11	14.96
55.0	154.71	1110.62	1270.99	2381.61	2381.61	2381.61	15.39
56.0	157.52	1142.20	1352.03	2494.23	2494.23	2494.23	15.83
57.0	160.34	1173.78	1436.19	2609.97	2609.97	2609.97	16.28
58.0	163.15	1205.35	1523.47	2728.83	2728.83	2728.83	16.73
59.0	165.96	1236.93	1607.63	2844.56	2844.56	2844.56	17.14
60.0	168.77	1268.51	1682.44	2950.95	2950.95	2950.95	17.48
61.0	171.59	1300.09	1747.90	3047.99	3047.99	3047.99	17.76
62.0	174.40	1331.66	1804.01	3135.67	3135.67	3135.67	17.98
63.0	177.21	1363.24	1850.77	3214.01	3214.01	3214.01	18.14
64.0	180.03	1394.82	1888.17	3282.99	3282.99	3282.99	18.24
65.0	182.84	1426.39	1916.22	3342.62	3342.62	3342.62	18.28
66.0	185.65	1457.97	1934.93	3392.90	3392.90	3392.90	18.28
67.0	188.46	1489.55	1944.28	3433.83	3433.83	3433.83	18.22
68.0	191.28	1521.13	1944.28	3465.40	3465.40	3465.40	18.12
69.0	194.09	1544.46	1944.28	3488.74	3488.74	3488.74	17.97
70.0	196.90	1567.68	1944.28	3511.96	3511.96	3511.96	17.84
71.0	199.72	1590.77	1944.28	3535.05	3535.05	3535.05	17.70
72.0	202.53	1613.73	1944.28	3558.01	3558.01	3558.01	17.57
73.0	205.34	1636.53	1944.28	3580.81	3580.81	3580.81	17.44
74.0	208.15	1659.18	1944.28	3603.45	3603.45	3603.45	17.31
75.0	210.97	1681.64	1944.28	3625.92	3625.92	3625.92	17.19
76.0	213.78	1703.91	1944.28	3648.19	3648.19	3648.19	17.07
77.0	216.59	1725.98	1944.28	3670.26	3670.26	3670.26	16.95
78.0	219.41	1747.84	1944.28	3692.12	3692.12	3692.12	16.83
79.0	222.22	1769.47	1944.28	3713.74	3713.74	3713.74	16.71
80.0	225.03	1790.85	1944.28	3735.13	3735.13	3735.13	16.60
81.0	227.85	1811.99	1944.28	3756.27	3756.27	3756.27	16.49
82.0	230.66	1832.86	1944.28	3777.14	3777.14	3777.14	16.38
83.0	233.47	1853.45	1944.28	3797.73	3797.73	3797.73	16.27
84.0	236.28	1873.76	1944.28	3818.03	3818.03	3818.03	16.16
85.0	239.10	1893.76	1944.28	3838.04	3838.04	3838.04	16.05
86.0	241.91	1913.61	1944.28	3857.88	3857.88	3857.88	15.95
87.0	244.72	1933.71	1944.28	3877.99	3877.99	3877.99	15.85
88.0	247.54	1954.08	1944.28	3898.36	3898.36	3898.36	15.75
89.0	250.35	1974.71	1944.28	3918.98	3918.98	3918.98	15.65
90.0	253.16	1995.59	1944.28	3939.87	3939.87	3939.87	15.56
91.0	255.97	2016.75	1944.28	3961.02	3961.02	3961.02	15.47
92.0	258.79	2038.16	1944.28	3982.43	3982.43	3982.43	15.39
93.0	261.60	2059.83	1944.28	4004.11	4004.11	4004.11	15.31
94.0	264.41	2081.76	1944.28	4026.04	4026.04	4026.04	15.23
95.0	267.23	2103.96	1944.28	4048.23	4048.23	4048.23	15.15
96.0	270.04	2126.41	1944.28	4070.69	4070.69	4070.69	15.07
97.0	272.85	2149.13	1944.28	4093.41	4093.41	4093.41	15.00
98.0	275.66	2172.11	1944.28	4116.38	4116.38	4116.38	14.93
99.0	278.48	2195.34	1944.28	4139.62	4139.62	4139.62	14.87
100.0	281.29	2218.84	1944.28	4163.12	4163.12	4163.12	14.80
101.0	284.10	2242.61	1944.28	4186.88	4186.88	4186.88	14.74
102.0	286.92	2266.63	1944.28	4210.90	4210.90	4210.90	14.68
103.0	289.73	2290.91	1944.28	4235.19	4235.19	4235.19	14.62
104.0	292.54	2315.45	1944.28	4259.73	4259.73	4259.73	14.56
105.0	295.35	2340.26	1944.28	4284.54	4284.54	4284.54	14.51
106.0	298.17	2365.33	1944.28	4309.60	4309.60	4309.60	14.45
107.0	300.98	2390.65	1944.28	4334.93	4334.93	4334.93	14.40

108.0	303.79	2416.24	1944.28	4360.52	4360.52	4360.52	14.35
109.0	306.61	2442.09	1944.28	4386.37	4386.37	4386.37	14.31
110.0	309.42	2468.20	1944.28	4412.48	4412.48	4412.48	14.26
111.0	312.23	2494.57	1944.28	4438.85	4438.85	4438.85	14.22
112.0	315.04	2521.20	1944.28	4465.48	4465.48	4465.48	14.17
113.0	317.86	2548.10	1944.28	4492.38	4492.38	4492.38	14.13
114.0	320.67	2575.25	1944.28	4519.53	4519.53	4519.53	14.09
115.0	323.48	2602.67	1944.28	4546.95	4546.95	4546.95	14.06
116.0	326.30	2630.35	1944.28	4574.62	4574.62	4574.62	14.02
117.0	329.11	2658.28	1944.28	4602.56	4602.56	4602.56	13.98
118.0	331.92	2686.48	1944.28	4630.76	4630.76	4630.76	13.95
119.0	334.74	2714.94	1944.28	4659.22	4659.22	4659.22	13.92
120.0	337.55	2743.66	1944.28	4687.94	4687.94	4687.94	13.89
121.0	340.36	2772.65	1944.28	4716.92	4716.92	4716.92	13.86
122.0	343.17	2801.89	1944.28	4746.17	4746.17	4746.17	13.83
123.0	345.99	2831.39	1944.28	4775.67	4775.67	4775.67	13.80
124.0	348.80	2861.16	1944.28	4805.44	4805.44	4805.44	13.78
125.0	351.61	2891.18	1944.28	4835.46	4835.46	4835.46	13.75
126.0	354.43	2921.47	1944.28	4865.75	4865.75	4865.75	13.73
127.0	357.24	2952.02	1944.28	4896.30	4896.30	4896.30	13.71
128.0	360.05	2982.83	1944.28	4927.11	4927.11	4927.11	13.68
129.0	362.86	3013.90	1944.28	4958.18	4958.18	4958.18	13.66
130.0	365.68	3045.23	1944.28	4989.51	4989.51	4989.51	13.64
131.0	368.49	3076.83	1944.28	5021.10	5021.10	5021.10	13.63
132.0	371.30	3108.68	1944.28	5052.96	5052.96	5052.96	13.61
133.0	374.12	3140.79	1944.28	5085.07	5085.07	5085.07	13.59
134.0	376.93	3173.17	1944.28	5117.45	5117.45	5117.45	13.58
135.0	379.74	3205.81	1944.28	5150.08	5150.08	5150.08	13.56

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1355E+00	0.1609E-04	0.5767E-02	0.1000E-04
0.6774E+00	0.8044E-04	0.2884E-01	0.5000E-04
0.1355E+01	0.1609E-03	0.5767E-01	0.1000E-03
0.6774E+02	0.8044E-02	0.2884E+01	0.5000E-02
0.1016E+03	0.1207E-01	0.4325E+01	0.7500E-02
0.1355E+03	0.1609E-01	0.5767E+01	0.1000E-01
0.3388E+03	0.4022E-01	0.1442E+02	0.2500E-01
0.6784E+03	0.8047E-01	0.2884E+02	0.5000E-01
0.1018E+04	0.1207E+00	0.4325E+02	0.7500E-01
0.1331E+04	0.1604E+00	0.5767E+02	0.1000E+00
0.2414E+04	0.3663E+00	0.1442E+03	0.2500E+00
0.3096E+04	0.6575E+00	0.2884E+03	0.5000E+00
0.3761E+04	0.1388E+01	0.6708E+03	0.1180E+01
0.4210E+04	0.3204E+01	0.1244E+04	0.2950E+01
0.4933E+04	0.6216E+01	0.1973E+04	0.5900E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.2001E+00	0.1874E-04	0.8239E-02	0.1000E-04
0.1000E+01	0.9369E-04	0.4119E-01	0.5000E-04
0.2001E+01	0.1874E-03	0.8239E-01	0.1000E-03
0.1000E+03	0.9369E-02	0.4119E+01	0.5000E-02
0.1500E+03	0.1405E-01	0.6179E+01	0.7500E-02
0.2001E+03	0.1874E-01	0.8239E+01	0.1000E-01
0.5009E+03	0.4686E-01	0.2060E+02	0.2500E-01
0.1003E+04	0.9376E-01	0.4119E+02	0.5000E-01
0.1502E+04	0.1406E+00	0.6179E+02	0.7500E-01

0.1899E+04	0.1849E+00	0.8239E+02	0.1000E+00
0.3020E+04	0.3989E+00	0.2060E+03	0.2500E+00
0.3601E+04	0.6881E+00	0.4119E+03	0.5000E+00
0.4195E+04	0.1418E+01	0.9333E+03	0.1180E+01
0.4632E+04	0.3232E+01	0.1478E+04	0.2950E+01
0.5255E+04	0.6236E+01	0.2100E+04	0.5900E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD	TOP MOVEMENT	TIP LOAD	TIP MOVEMENT
ton	IN.	ton	IN.
0.7838E-01	0.1365E-04	0.3295E-02	0.1000E-04
0.3919E+00	0.6827E-04	0.1648E-01	0.5000E-04
0.7838E+00	0.1365E-03	0.3295E-01	0.1000E-03
0.3919E+02	0.6827E-02	0.1648E+01	0.5000E-02
0.5878E+02	0.1024E-01	0.2472E+01	0.7500E-02
0.7838E+02	0.1365E-01	0.3295E+01	0.1000E-01
0.1959E+03	0.3413E-01	0.8239E+01	0.2500E-01
0.3921E+03	0.6827E-01	0.1648E+02	0.5000E-01
0.5883E+03	0.1024E+00	0.2472E+02	0.7500E-01
0.7833E+03	0.1365E+00	0.3295E+02	0.1000E+00
0.1694E+04	0.3305E+00	0.8239E+02	0.2500E+00
0.2560E+04	0.6259E+00	0.1648E+03	0.5000E+00
0.3326E+04	0.1357E+01	0.4083E+03	0.1180E+01
0.3787E+04	0.3175E+01	0.1011E+04	0.2950E+01
0.4611E+04	0.6197E+01	0.1847E+04	0.5900E+01

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 6 (C)COPYRIGHT ENSOFT,INC.1989,1995,1998,2001,2003,2007

5th Street Bridge, Bent 4, 118'''CIDH (comp) LQ

PROPOSED DEPTH = 135.0 FT

NUMBER OF LAYERS = 4

WATER TABLE DEPTH = 0.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.600E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.759E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.130E+02

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.101E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.130E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.786E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.280E+02

LAYER NO 3----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.280E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.680E+02

LAYER NO 4----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.387E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.680E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 9.833 FT.
DIAMETER OF BASE = 9.833 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 5.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 109.366 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
6.0	16.88	3.40	690.94	694.34	694.34	694.34	40.09
7.0	19.69	6.80	720.80	727.60	727.60	727.60	36.95
8.0	22.50	10.20	750.66	760.85	760.85	760.85	33.81
9.0	25.32	13.59	774.51	788.11	788.11	788.11	31.13
10.0	28.13	16.99	797.21	814.21	814.21	814.21	28.95
11.0	30.94	20.39	813.85	834.24	834.24	834.24	26.96
12.0	33.75	23.79	824.42	848.21	848.21	848.21	25.13
13.0	36.57	27.19	828.94	856.13	856.13	856.13	23.41
14.0	39.38	36.58	833.33	869.91	869.91	869.91	22.09
15.0	42.19	46.68	837.57	884.25	884.25	884.25	20.96
16.0	45.01	57.46	841.66	899.12	899.12	899.12	19.98
17.0	47.82	68.89	845.59	914.48	914.48	914.48	19.12
18.0	50.63	80.94	849.34	930.29	930.29	930.29	18.37
19.0	53.45	93.61	852.73	946.34	946.34	946.34	17.71
20.0	56.26	106.86	855.29	962.15	962.15	962.15	17.10
21.0	59.07	120.67	857.11	977.78	977.78	977.78	16.55
22.0	61.88	135.03	858.23	993.26	993.26	993.26	16.05
23.0	64.70	149.91	858.74	1008.64	1008.64	1008.64	15.59
24.0	67.51	165.29	858.68	1023.97	1023.97	1023.97	15.17
25.0	70.32	181.16	858.13	1039.29	1039.29	1039.29	14.78
26.0	73.14	197.49	857.15	1054.64	1054.64	1054.64	14.42
27.0	75.95	214.27	855.79	1070.06	1070.06	1070.06	14.09
28.0	78.76	231.47	854.09	1085.57	1085.57	1085.57	13.78
29.0	81.57	263.05	852.78	1115.83	1115.83	1115.83	13.68
30.0	84.39	294.63	851.80	1146.43	1146.43	1146.43	13.59
31.0	87.20	326.21	851.10	1177.31	1177.31	1177.31	13.50
32.0	90.01	357.78	850.64	1208.42	1208.42	1208.42	13.43
33.0	92.83	389.36	850.36	1239.72	1239.72	1239.72	13.36
34.0	95.64	420.94	850.23	1271.16	1271.16	1271.16	13.29
35.0	98.45	452.51	850.18	1302.70	1302.70	1302.70	13.23
36.0	101.26	484.09	850.18	1334.27	1334.27	1334.27	13.18
37.0	104.08	515.67	850.18	1365.85	1365.85	1365.85	13.12
38.0	106.89	547.25	850.18	1397.43	1397.43	1397.43	13.07
39.0	109.70	578.82	850.18	1429.00	1429.00	1429.00	13.03
40.0	112.52	610.40	850.18	1460.58	1460.58	1460.58	12.98
41.0	115.33	641.98	850.18	1492.16	1492.16	1492.16	12.94

42.0	118.14	673.56	850.18	1523.74	1523.74	1523.74	12.90
43.0	120.95	705.13	850.18	1555.31	1555.31	1555.31	12.86
44.0	123.77	736.71	850.18	1586.89	1586.89	1586.89	12.82
45.0	126.58	768.29	850.18	1618.47	1618.47	1618.47	12.79
46.0	129.39	799.86	850.18	1650.04	1650.04	1650.04	12.75
47.0	132.21	831.44	850.18	1681.62	1681.62	1681.62	12.72
48.0	135.02	863.02	850.18	1713.20	1713.20	1713.20	12.69
49.0	137.83	894.60	850.18	1744.78	1744.78	1744.78	12.66
50.0	140.65	926.17	912.52	1838.70	1838.70	1838.70	13.07
51.0	143.46	957.75	977.98	1935.73	1935.73	1935.73	13.49
52.0	146.27	989.33	1046.56	2035.88	2035.88	2035.88	13.92
53.0	149.08	1020.90	1118.25	2139.15	2139.15	2139.15	14.35
54.0	151.90	1052.48	1193.06	2245.54	2245.54	2245.54	14.78
55.0	154.71	1084.06	1270.99	2355.05	2355.05	2355.05	15.22
56.0	157.52	1115.64	1352.03	2467.67	2467.67	2467.67	15.67
57.0	160.34	1147.21	1436.19	2583.41	2583.41	2583.41	16.11
58.0	163.15	1178.79	1523.47	2702.26	2702.26	2702.26	16.56
59.0	165.96	1210.37	1607.63	2818.00	2818.00	2818.00	16.98
60.0	168.77	1241.94	1682.44	2924.39	2924.39	2924.39	17.33
61.0	171.59	1273.52	1747.90	3021.42	3021.42	3021.42	17.61
62.0	174.40	1305.10	1804.01	3109.11	3109.11	3109.11	17.83
63.0	177.21	1336.68	1850.77	3187.44	3187.44	3187.44	17.99
64.0	180.03	1368.25	1888.17	3256.42	3256.42	3256.42	18.09
65.0	182.84	1399.83	1916.22	3316.05	3316.05	3316.05	18.14
66.0	185.65	1431.41	1934.93	3366.33	3366.33	3366.33	18.13
67.0	188.46	1462.98	1944.28	3407.26	3407.26	3407.26	18.08
68.0	191.28	1494.56	1944.28	3438.84	3438.84	3438.84	17.98
69.0	194.09	1517.89	1944.28	3462.17	3462.17	3462.17	17.84
70.0	196.90	1541.11	1944.28	3485.39	3485.39	3485.39	17.70
71.0	199.72	1564.21	1944.28	3508.49	3508.49	3508.49	17.57
72.0	202.53	1587.17	1944.28	3531.44	3531.44	3531.44	17.44
73.0	205.34	1609.97	1944.28	3554.25	3554.25	3554.25	17.31
74.0	208.15	1632.61	1944.28	3576.89	3576.89	3576.89	17.18
75.0	210.97	1655.07	1944.28	3599.35	3599.35	3599.35	17.06
76.0	213.78	1677.35	1944.28	3621.63	3621.63	3621.63	16.94
77.0	216.59	1699.42	1944.28	3643.70	3643.70	3643.70	16.82
78.0	219.41	1721.27	1944.28	3665.55	3665.55	3665.55	16.71
79.0	222.22	1742.90	1944.28	3687.18	3687.18	3687.18	16.59
80.0	225.03	1764.29	1944.28	3708.57	3708.57	3708.57	16.48
81.0	227.85	1785.42	1944.28	3729.70	3729.70	3729.70	16.37
82.0	230.66	1806.29	1944.28	3750.57	3750.57	3750.57	16.26
83.0	233.47	1826.89	1944.28	3771.16	3771.16	3771.16	16.15
84.0	236.28	1847.19	1944.28	3791.47	3791.47	3791.47	16.05
85.0	239.10	1867.20	1944.28	3811.47	3811.47	3811.47	15.94
86.0	241.91	1887.04	1944.28	3831.32	3831.32	3831.32	15.84
87.0	244.72	1907.15	1944.28	3851.42	3851.42	3851.42	15.74
88.0	247.54	1927.51	1944.28	3871.79	3871.79	3871.79	15.64
89.0	250.35	1948.14	1944.28	3892.42	3892.42	3892.42	15.55
90.0	253.16	1969.03	1944.28	3913.31	3913.31	3913.31	15.46
91.0	255.97	1990.18	1944.28	3934.46	3934.46	3934.46	15.37
92.0	258.79	2011.59	1944.28	3955.87	3955.87	3955.87	15.29
93.0	261.60	2033.26	1944.28	3977.54	3977.54	3977.54	15.20
94.0	264.41	2055.20	1944.28	3999.48	3999.48	3999.48	15.13
95.0	267.23	2077.39	1944.28	4021.67	4021.67	4021.67	15.05
96.0	270.04	2099.85	1944.28	4044.13	4044.13	4044.13	14.98
97.0	272.85	2122.56	1944.28	4066.84	4066.84	4066.84	14.90
98.0	275.66	2145.54	1944.28	4089.82	4089.82	4089.82	14.84
99.0	278.48	2168.78	1944.28	4113.06	4113.06	4113.06	14.77
100.0	281.29	2192.28	1944.28	4136.56	4136.56	4136.56	14.71
101.0	284.10	2216.04	1944.28	4160.32	4160.32	4160.32	14.64
102.0	286.92	2240.06	1944.28	4184.34	4184.34	4184.34	14.58
103.0	289.73	2264.35	1944.28	4208.62	4208.62	4208.62	14.53
104.0	292.54	2288.89	1944.28	4233.17	4233.17	4233.17	14.47
105.0	295.35	2313.69	1944.28	4257.97	4257.97	4257.97	14.42
106.0	298.17	2338.76	1944.28	4283.04	4283.04	4283.04	14.36
107.0	300.98	2364.09	1944.28	4308.37	4308.37	4308.37	14.31

108.0	303.79	2389.68	1944.28	4333.95	4333.95	4333.95	14.27
109.0	306.61	2415.53	1944.28	4359.80	4359.80	4359.80	14.22
110.0	309.42	2441.64	1944.28	4385.91	4385.91	4385.91	14.17
111.0	312.23	2468.01	1944.28	4412.29	4412.29	4412.29	14.13
112.0	315.04	2494.64	1944.28	4438.92	4438.92	4438.92	14.09
113.0	317.86	2521.53	1944.28	4465.81	4465.81	4465.81	14.05
114.0	320.67	2548.69	1944.28	4492.97	4492.97	4492.97	14.01
115.0	323.48	2576.10	1944.28	4520.38	4520.38	4520.38	13.97
116.0	326.30	2603.78	1944.28	4548.06	4548.06	4548.06	13.94
117.0	329.11	2631.72	1944.28	4576.00	4576.00	4576.00	13.90
118.0	331.92	2659.92	1944.28	4604.20	4604.20	4604.20	13.87
119.0	334.74	2688.38	1944.28	4632.66	4632.66	4632.66	13.84
120.0	337.55	2717.10	1944.28	4661.38	4661.38	4661.38	13.81
121.0	340.36	2746.08	1944.28	4690.36	4690.36	4690.36	13.78
122.0	343.17	2775.32	1944.28	4719.60	4719.60	4719.60	13.75
123.0	345.99	2804.83	1944.28	4749.11	4749.11	4749.11	13.73
124.0	348.80	2834.59	1944.28	4778.87	4778.87	4778.87	13.70
125.0	351.61	2864.62	1944.28	4808.90	4808.90	4808.90	13.68
126.0	354.43	2894.91	1944.28	4839.19	4839.19	4839.19	13.65
127.0	357.24	2925.46	1944.28	4869.73	4869.73	4869.73	13.63
128.0	360.05	2956.27	1944.28	4900.54	4900.54	4900.54	13.61
129.0	362.86	2987.34	1944.28	4931.61	4931.61	4931.61	13.59
130.0	365.68	3018.67	1944.28	4962.95	4962.95	4962.95	13.57
131.0	368.49	3050.26	1944.28	4994.54	4994.54	4994.54	13.55
132.0	371.30	3082.11	1944.28	5026.39	5026.39	5026.39	13.54
133.0	374.12	3114.23	1944.28	5058.51	5058.51	5058.51	13.52
134.0	376.93	3146.61	1944.28	5090.88	5090.88	5090.88	13.51
135.0	379.74	3179.24	1944.28	5123.52	5123.52	5123.52	13.49

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1350E+00	0.1608E-04	0.5767E-02	0.1000E-04
0.6751E+00	0.8042E-04	0.2884E-01	0.5000E-04
0.1350E+01	0.1608E-03	0.5767E-01	0.1000E-03
0.6751E+02	0.8042E-02	0.2884E+01	0.5000E-02
0.1013E+03	0.1206E-01	0.4325E+01	0.7500E-02
0.1350E+03	0.1608E-01	0.5767E+01	0.1000E-01
0.3377E+03	0.4021E-01	0.1442E+02	0.2500E-01
0.6761E+03	0.8045E-01	0.2884E+02	0.5000E-01
0.1014E+04	0.1207E+00	0.4325E+02	0.7500E-01
0.1325E+04	0.1603E+00	0.5767E+02	0.1000E+00
0.2399E+04	0.3662E+00	0.1442E+03	0.2500E+00
0.3072E+04	0.6574E+00	0.2884E+03	0.5000E+00
0.3731E+04	0.1388E+01	0.6708E+03	0.1180E+01
0.4177E+04	0.3203E+01	0.1244E+04	0.2950E+01
0.4900E+04	0.6216E+01	0.1973E+04	0.5900E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1996E+00	0.1873E-04	0.8239E-02	0.1000E-04
0.9982E+00	0.9367E-04	0.4119E-01	0.5000E-04
0.1996E+01	0.1873E-03	0.8239E-01	0.1000E-03
0.9982E+02	0.9367E-02	0.4119E+01	0.5000E-02
0.1497E+03	0.1405E-01	0.6179E+01	0.7500E-02
0.1996E+03	0.1873E-01	0.8239E+01	0.1000E-01
0.4998E+03	0.4685E-01	0.2060E+02	0.2500E-01
0.1000E+04	0.9373E-01	0.4119E+02	0.5000E-01
0.1498E+04	0.1406E+00	0.6179E+02	0.7500E-01

0.1889E+04	0.1849E+00	0.8239E+02	0.1000E+00
0.2995E+04	0.3987E+00	0.2060E+03	0.2500E+00
0.3572E+04	0.6880E+00	0.4119E+03	0.5000E+00
0.4166E+04	0.1418E+01	0.9333E+03	0.1180E+01
0.4600E+04	0.3232E+01	0.1478E+04	0.2950E+01
0.5222E+04	0.6236E+01	0.2100E+04	0.5900E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD	TOP MOVEMENT	TIP LOAD	TIP MOVEMENT
ton	IN.	ton	IN.
0.7793E-01	0.1365E-04	0.3295E-02	0.1000E-04
0.3897E+00	0.6825E-04	0.1648E-01	0.5000E-04
0.7793E+00	0.1365E-03	0.3295E-01	0.1000E-03
0.3897E+02	0.6825E-02	0.1648E+01	0.5000E-02
0.5845E+02	0.1024E-01	0.2472E+01	0.7500E-02
0.7793E+02	0.1365E-01	0.3295E+01	0.1000E-01
0.1948E+03	0.3413E-01	0.8239E+01	0.2500E-01
0.3898E+03	0.6825E-01	0.1648E+02	0.5000E-01
0.5850E+03	0.1024E+00	0.2472E+02	0.7500E-01
0.7789E+03	0.1365E+00	0.3295E+02	0.1000E+00
0.1685E+04	0.3304E+00	0.8239E+02	0.2500E+00
0.2541E+04	0.6258E+00	0.1648E+03	0.5000E+00
0.3296E+04	0.1357E+01	0.4083E+03	0.1180E+01
0.3754E+04	0.3175E+01	0.1011E+04	0.2950E+01
0.4578E+04	0.6197E+01	0.1847E+04	0.5900E+01

SHAFT Axial Analysis – 5th Street Bridge, Bent 5, 118” CIDH (NL and LQ)

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
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5th Street Bridge, Bent 5, 118"CIDH (comp) NL

PROPOSED DEPTH = 130.0 FT

NUMBER OF LAYERS = 5

WATER TABLE DEPTH = 0.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.600E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.500E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.685E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.500E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.700E+01

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.114E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03

MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.700E+01

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.679E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.370E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.679E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.370E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.481E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.570E+02

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.570E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.970E+02

LAYER NO 5----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.970E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 9.833 FT.
DIAMETER OF BASE = 9.833 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 5.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 109.366 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
6.0	16.88	2.61	0.00	2.61	2.61	2.61	0.22
7.0	19.69	8.50	0.00	8.50	8.50	8.50	0.43
8.0	22.50	14.38	0.00	14.38	14.38	14.38	0.64
9.0	25.32	20.87	0.00	20.87	20.87	20.87	0.82
10.0	28.13	27.93	0.00	27.93	27.93	27.93	0.99
11.0	30.94	35.55	0.00	35.55	35.55	35.55	1.15
12.0	33.75	43.70	0.00	43.70	43.70	43.70	1.29
13.0	36.57	52.37	0.00	52.37	52.37	52.37	1.43
14.0	39.38	61.53	0.00	61.53	61.53	61.53	1.56
15.0	42.19	71.18	0.00	71.18	71.18	71.18	1.69

16.0	45.01	81.29	0.00	81.29	81.29	81.29	1.81
17.0	47.82	91.84	0.00	91.84	91.84	91.84	1.92
18.0	50.63	102.82	0.00	102.82	102.82	102.82	2.03
19.0	53.45	114.22	46.17	160.39	160.39	160.39	3.00
20.0	56.26	126.02	94.64	220.66	220.66	220.66	3.92
21.0	59.07	138.20	145.42	283.62	283.62	283.62	4.80
22.0	61.88	150.75	198.51	349.26	349.26	349.26	5.64
23.0	64.70	163.65	253.91	417.56	417.56	417.56	6.45
24.0	67.51	176.90	311.62	488.52	488.52	488.52	7.24
25.0	70.32	190.47	371.64	562.11	562.11	562.11	7.99
26.0	73.14	204.35	433.96	638.32	638.32	638.32	8.73
27.0	75.95	218.54	498.60	717.14	717.14	717.14	9.44
28.0	78.76	233.02	560.92	793.94	793.94	793.94	10.08
29.0	81.57	247.77	616.32	864.09	864.09	864.09	10.59
30.0	84.39	262.79	664.79	927.58	927.58	927.58	10.99
31.0	87.20	278.05	706.34	984.40	984.40	984.40	11.29
32.0	90.01	293.56	740.97	1034.53	1034.53	1034.53	11.49
33.0	92.83	309.29	768.67	1077.96	1077.96	1077.96	11.61
34.0	95.64	325.24	789.44	1114.68	1114.68	1114.68	11.66
35.0	98.45	341.39	803.29	1144.69	1144.69	1144.69	11.63
36.0	101.26	357.74	810.22	1167.96	1167.96	1167.96	11.53
37.0	104.08	374.27	810.22	1184.49	1184.49	1184.49	11.38
38.0	106.89	391.12	810.22	1201.34	1201.34	1201.34	11.24
39.0	109.70	408.29	812.49	1220.78	1220.78	1220.78	11.13
40.0	112.52	425.75	814.89	1240.63	1240.63	1240.63	11.03
41.0	115.33	443.48	817.39	1260.87	1260.87	1260.87	10.93
42.0	118.14	461.48	820.01	1281.49	1281.49	1281.49	10.85
43.0	120.95	479.73	822.74	1302.48	1302.48	1302.48	10.77
44.0	123.77	498.22	825.59	1323.81	1323.81	1323.81	10.70
45.0	126.58	516.92	828.55	1345.47	1345.47	1345.47	10.63
46.0	129.39	535.83	831.62	1367.45	1367.45	1367.45	10.57
47.0	132.21	554.93	834.81	1389.74	1389.74	1389.74	10.51
48.0	135.02	574.21	837.88	1412.09	1412.09	1412.09	10.46
49.0	137.83	593.65	840.62	1434.26	1434.26	1434.26	10.41
50.0	140.65	613.24	843.01	1456.24	1456.24	1456.24	10.35
51.0	143.46	632.96	845.06	1478.02	1478.02	1478.02	10.30
52.0	146.27	652.81	846.77	1499.57	1499.57	1499.57	10.25
53.0	149.08	672.76	848.13	1520.89	1520.89	1520.89	10.20
54.0	151.90	692.81	849.16	1541.97	1541.97	1541.97	10.15
55.0	154.71	712.95	849.84	1562.79	1562.79	1562.79	10.10
56.0	157.52	733.15	850.18	1583.33	1583.33	1583.33	10.05
57.0	160.34	753.41	850.18	1603.60	1603.60	1603.60	10.00
58.0	163.15	784.99	850.18	1635.17	1635.17	1635.17	10.02
59.0	165.96	816.57	850.18	1666.75	1666.75	1666.75	10.04
60.0	168.77	848.15	850.18	1698.33	1698.33	1698.33	10.06
61.0	171.59	879.72	850.18	1729.90	1729.90	1729.90	10.08
62.0	174.40	911.30	850.18	1761.48	1761.48	1761.48	10.10
63.0	177.21	942.88	850.18	1793.06	1793.06	1793.06	10.12
64.0	180.03	974.45	850.18	1824.64	1824.64	1824.64	10.14
65.0	182.84	1006.03	850.18	1856.21	1856.21	1856.21	10.15
66.0	185.65	1037.61	850.18	1887.79	1887.79	1887.79	10.17
67.0	188.46	1069.19	850.18	1919.37	1919.37	1919.37	10.18
68.0	191.28	1100.76	850.18	1950.94	1950.94	1950.94	10.20
69.0	194.09	1132.34	850.18	1982.52	1982.52	1982.52	10.21
70.0	196.90	1163.92	850.18	2014.10	2014.10	2014.10	10.23
71.0	199.72	1195.49	850.18	2045.68	2045.68	2045.68	10.24
72.0	202.53	1227.07	850.18	2077.25	2077.25	2077.25	10.26
73.0	205.34	1258.65	850.18	2108.83	2108.83	2108.83	10.27
74.0	208.15	1290.23	850.18	2140.41	2140.41	2140.41	10.28
75.0	210.97	1321.80	850.18	2171.98	2171.98	2171.98	10.30
76.0	213.78	1353.38	850.18	2203.56	2203.56	2203.56	10.31
77.0	216.59	1384.96	850.18	2235.14	2235.14	2235.14	10.32
78.0	219.41	1416.54	850.18	2266.72	2266.72	2266.72	10.33
79.0	222.22	1448.11	912.52	2360.63	2360.63	2360.63	10.62
80.0	225.03	1479.69	977.98	2457.67	2457.67	2457.67	10.92
81.0	227.85	1511.27	1046.56	2557.82	2557.82	2557.82	11.23

82.0	230.66	1542.84	1118.25	2661.09	2661.09	2661.09	11.54
83.0	233.47	1574.42	1193.06	2767.48	2767.48	2767.48	11.85
84.0	236.28	1606.00	1270.99	2876.98	2876.98	2876.98	12.18
85.0	239.10	1637.58	1352.03	2989.61	2989.61	2989.61	12.50
86.0	241.91	1669.15	1436.19	3105.34	3105.34	3105.34	12.84
87.0	244.72	1700.73	1523.47	3224.20	3224.20	3224.20	13.17
88.0	247.54	1732.31	1607.63	3339.94	3339.94	3339.94	13.49
89.0	250.35	1763.88	1682.44	3446.33	3446.33	3446.33	13.77
90.0	253.16	1795.46	1747.90	3543.36	3543.36	3543.36	14.00
91.0	255.97	1827.04	1804.01	3631.05	3631.05	3631.05	14.19
92.0	258.79	1858.62	1850.77	3709.38	3709.38	3709.38	14.33
93.0	261.60	1890.19	1888.17	3778.36	3778.36	3778.36	14.44
94.0	264.41	1921.77	1916.22	3837.99	3837.99	3837.99	14.52
95.0	267.23	1953.35	1934.93	3888.27	3888.27	3888.27	14.55
96.0	270.04	1984.92	1944.28	3929.20	3929.20	3929.20	14.55
97.0	272.85	2016.50	1944.28	3960.78	3960.78	3960.78	14.52
98.0	275.66	2036.97	1944.28	3981.25	3981.25	3981.25	14.44
99.0	278.48	2057.70	1944.28	4001.97	4001.97	4001.97	14.37
100.0	281.29	2078.69	1944.28	4022.96	4022.96	4022.96	14.30
101.0	284.10	2099.94	1944.28	4044.21	4044.21	4044.21	14.24
102.0	286.92	2121.45	1944.28	4065.73	4065.73	4065.73	14.17
103.0	289.73	2143.22	1944.28	4087.50	4087.50	4087.50	14.11
104.0	292.54	2165.25	1944.28	4109.53	4109.53	4109.53	14.05
105.0	295.35	2187.55	1944.28	4131.83	4131.83	4131.83	13.99
106.0	298.17	2210.11	1944.28	4154.38	4154.38	4154.38	13.93
107.0	300.98	2232.92	1944.28	4177.20	4177.20	4177.20	13.88
108.0	303.79	2256.00	1944.28	4200.28	4200.28	4200.28	13.83
109.0	306.61	2279.34	1944.28	4223.62	4223.62	4223.62	13.78
110.0	309.42	2302.94	1944.28	4247.22	4247.22	4247.22	13.73
111.0	312.23	2326.80	1944.28	4271.08	4271.08	4271.08	13.68
112.0	315.04	2350.92	1944.28	4295.20	4295.20	4295.20	13.63
113.0	317.86	2375.31	1944.28	4319.58	4319.58	4319.58	13.59
114.0	320.67	2399.95	1944.28	4344.23	4344.23	4344.23	13.55
115.0	323.48	2424.86	1944.28	4369.13	4369.13	4369.13	13.51
116.0	326.30	2450.02	1944.28	4394.30	4394.30	4394.30	13.47
117.0	329.11	2475.45	1944.28	4419.73	4419.73	4419.73	13.43
118.0	331.92	2501.14	1944.28	4445.42	4445.42	4445.42	13.39
119.0	334.74	2527.09	1944.28	4471.37	4471.37	4471.37	13.36
120.0	337.55	2553.30	1944.28	4497.58	4497.58	4497.58	13.32
121.0	340.36	2579.77	1944.28	4524.05	4524.05	4524.05	13.29
122.0	343.17	2606.51	1944.28	4550.78	4550.78	4550.78	13.26
123.0	345.99	2633.50	1944.28	4577.78	4577.78	4577.78	13.23
124.0	348.80	2660.75	1944.28	4605.03	4605.03	4605.03	13.20
125.0	351.61	2688.27	1944.28	4632.55	4632.55	4632.55	13.18
126.0	354.43	2716.05	1944.28	4660.32	4660.32	4660.32	13.15
127.0	357.24	2744.09	1944.28	4688.36	4688.36	4688.36	13.12
128.0	360.05	2772.39	1944.28	4716.66	4716.66	4716.66	13.10
129.0	362.86	2800.95	1944.28	4745.22	4745.22	4745.22	13.08
130.0	365.68	2829.77	1944.28	4774.04	4774.04	4774.04	13.06

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1174E+00	0.1576E-04	0.5767E-02	0.1000E-04
0.5872E+00	0.7878E-04	0.2884E-01	0.5000E-04
0.1174E+01	0.1576E-03	0.5767E-01	0.1000E-03
0.5872E+02	0.7878E-02	0.2884E+01	0.5000E-02
0.8808E+02	0.1182E-01	0.4325E+01	0.7500E-02
0.1174E+03	0.1576E-01	0.5767E+01	0.1000E-01
0.2936E+03	0.3939E-01	0.1442E+02	0.2500E-01
0.5879E+03	0.7880E-01	0.2884E+02	0.5000E-01
0.8821E+03	0.1182E+00	0.4325E+02	0.7500E-01
0.1167E+04	0.1575E+00	0.5767E+02	0.1000E+00

0.2110E+04	0.3570E+00	0.1442E+03	0.2500E+00
0.2744E+04	0.6439E+00	0.2884E+03	0.5000E+00
0.3346E+04	0.1367E+01	0.6708E+03	0.1180E+01
0.3788E+04	0.3179E+01	0.1244E+04	0.2950E+01
0.4513E+04	0.6189E+01	0.1973E+04	0.5900E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1722E+00	0.1832E-04	0.8239E-02	0.1000E-04
0.8609E+00	0.9162E-04	0.4119E-01	0.5000E-04
0.1722E+01	0.1832E-03	0.8239E-01	0.1000E-03
0.8609E+02	0.9162E-02	0.4119E+01	0.5000E-02
0.1291E+03	0.1374E-01	0.6179E+01	0.7500E-02
0.1722E+03	0.1832E-01	0.8239E+01	0.1000E-01
0.4309E+03	0.4582E-01	0.2060E+02	0.2500E-01
0.8626E+03	0.9168E-01	0.4119E+02	0.5000E-01
0.1292E+04	0.1375E+00	0.6179E+02	0.7500E-01
0.1689E+04	0.1826E+00	0.8239E+02	0.1000E+00
0.2673E+04	0.3866E+00	0.2060E+03	0.2500E+00
0.3179E+04	0.6699E+00	0.4119E+03	0.5000E+00
0.3761E+04	0.1397E+01	0.9333E+03	0.1180E+01
0.4194E+04	0.3207E+01	0.1478E+04	0.2950E+01
0.4816E+04	0.6209E+01	0.2100E+04	0.5900E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.6814E-01	0.1338E-04	0.3295E-02	0.1000E-04
0.3407E+00	0.6691E-04	0.1648E-01	0.5000E-04
0.6814E+00	0.1338E-03	0.3295E-01	0.1000E-03
0.3407E+02	0.6691E-02	0.1648E+01	0.5000E-02
0.5111E+02	0.1004E-01	0.2472E+01	0.7500E-02
0.6814E+02	0.1338E-01	0.3295E+01	0.1000E-01
0.1704E+03	0.3345E-01	0.8239E+01	0.2500E-01
0.3408E+03	0.6691E-01	0.1648E+02	0.5000E-01
0.5114E+03	0.1004E+00	0.2472E+02	0.7500E-01
0.6812E+03	0.1338E+00	0.3295E+02	0.1000E+00
0.1484E+04	0.3246E+00	0.8239E+02	0.2500E+00
0.2255E+04	0.6153E+00	0.1648E+03	0.5000E+00
0.2930E+04	0.1338E+01	0.4083E+03	0.1180E+01
0.3383E+04	0.3151E+01	0.1011E+04	0.2950E+01
0.4209E+04	0.6170E+01	0.1847E+04	0.5900E+01

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 6 (C)COPYRIGHT ENSOFT,INC.1989,1995,1998,2001,2003,2007

5th Street Bridge, Bent 5, 118"CIDH (comp) LQ

PROPOSED DEPTH = 130.0 FT

NUMBER OF LAYERS = 5

WATER TABLE DEPTH = 0.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.600E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.500E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.685E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.500E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.700E+01

LAYER NO 2----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.685E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11

DEPTH, FT = 0.700E+01

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.370E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.679E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.370E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.481E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.570E+02

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.570E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.970E+02

LAYER NO 5----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.970E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 9.833 FT.
DIAMETER OF BASE = 9.833 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 5.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 109.366 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
6.0	16.88	5.10	112.93	118.03	118.03	118.03	6.79
7.0	19.69	8.50	113.18	121.67	121.67	121.67	6.18
8.0	22.50	11.89	113.42	125.31	125.31	125.31	5.57
9.0	25.32	15.29	113.59	128.88	128.88	128.88	5.09
10.0	28.13	18.69	113.70	132.39	132.39	132.39	4.71
11.0	30.94	22.09	113.76	135.85	135.85	135.85	4.39
12.0	33.75	25.49	113.77	139.26	139.26	139.26	4.13
13.0	36.57	28.89	113.76	142.64	142.64	142.64	3.90
14.0	39.38	32.29	113.72	146.00	146.00	146.00	3.71
15.0	42.19	35.68	113.67	149.35	149.35	149.35	3.54

16.0	45.01	39.08	113.61	152.70	152.70	152.70	3.39
17.0	47.82	42.48	113.56	156.04	156.04	156.04	3.26
18.0	50.63	45.88	113.51	159.39	159.39	159.39	3.15
19.0	53.45	49.28	153.18	202.46	202.46	202.46	3.79
20.0	56.26	52.68	194.84	247.52	247.52	247.52	4.40
21.0	59.07	56.07	238.49	294.56	294.56	294.56	4.99
22.0	61.88	59.47	284.13	343.60	343.60	343.60	5.55
23.0	64.70	62.87	331.76	394.63	394.63	394.63	6.10
24.0	67.51	66.27	381.37	447.65	447.65	447.65	6.63
25.0	70.32	69.67	432.98	502.65	502.65	502.65	7.15
26.0	73.14	73.07	486.58	559.65	559.65	559.65	7.65
27.0	75.95	76.47	542.17	618.63	618.63	618.63	8.15
28.0	78.76	79.86	595.77	675.64	675.64	675.64	8.58
29.0	81.57	83.26	643.42	726.69	726.69	726.69	8.91
30.0	84.39	86.66	685.12	771.78	771.78	771.78	9.15
31.0	87.20	90.06	720.86	810.92	810.92	810.92	9.30
32.0	90.01	93.46	750.64	844.10	844.10	844.10	9.38
33.0	92.83	96.86	774.47	871.33	871.33	871.33	9.39
34.0	95.64	100.26	792.34	892.60	892.60	892.60	9.33
35.0	98.45	103.65	804.26	907.91	907.91	907.91	9.22
36.0	101.26	107.05	810.22	917.27	917.27	917.27	9.06
37.0	104.08	110.45	810.22	920.67	920.67	920.67	8.85
38.0	106.89	127.30	810.22	937.52	937.52	937.52	8.77
39.0	109.70	144.47	812.49	956.96	956.96	956.96	8.72
40.0	112.52	161.93	814.89	976.81	976.81	976.81	8.68
41.0	115.33	179.67	817.39	997.06	997.06	997.06	8.65
42.0	118.14	197.67	820.01	1017.68	1017.68	1017.68	8.61
43.0	120.95	215.92	822.74	1038.66	1038.66	1038.66	8.59
44.0	123.77	234.40	825.59	1059.99	1059.99	1059.99	8.56
45.0	126.58	253.10	828.55	1081.65	1081.65	1081.65	8.55
46.0	129.39	272.01	831.62	1103.64	1103.64	1103.64	8.53
47.0	132.21	291.11	834.81	1125.92	1125.92	1125.92	8.52
48.0	135.02	310.39	837.88	1148.27	1148.27	1148.27	8.50
49.0	137.83	329.83	840.62	1170.45	1170.45	1170.45	8.49
50.0	140.65	349.42	843.01	1192.43	1192.43	1192.43	8.48
51.0	143.46	369.14	845.06	1214.20	1214.20	1214.20	8.46
52.0	146.27	388.99	846.77	1235.75	1235.75	1235.75	8.45
53.0	149.08	408.94	848.13	1257.08	1257.08	1257.08	8.43
54.0	151.90	429.00	849.16	1278.15	1278.15	1278.15	8.41
55.0	154.71	449.13	849.84	1298.97	1298.97	1298.97	8.40
56.0	157.52	469.33	850.18	1319.52	1319.52	1319.52	8.38
57.0	160.34	489.60	850.18	1339.78	1339.78	1339.78	8.36
58.0	163.15	521.17	850.18	1371.35	1371.35	1371.35	8.41
59.0	165.96	552.75	850.18	1402.93	1402.93	1402.93	8.45
60.0	168.77	584.33	850.18	1434.51	1434.51	1434.51	8.50
61.0	171.59	615.91	850.18	1466.09	1466.09	1466.09	8.54
62.0	174.40	647.48	850.18	1497.66	1497.66	1497.66	8.59
63.0	177.21	679.06	850.18	1529.24	1529.24	1529.24	8.63
64.0	180.03	710.64	850.18	1560.82	1560.82	1560.82	8.67
65.0	182.84	742.21	850.18	1592.39	1592.39	1592.39	8.71
66.0	185.65	773.79	850.18	1623.97	1623.97	1623.97	8.75
67.0	188.46	805.37	850.18	1655.55	1655.55	1655.55	8.78
68.0	191.28	836.95	850.18	1687.13	1687.13	1687.13	8.82
69.0	194.09	868.52	850.18	1718.70	1718.70	1718.70	8.86
70.0	196.90	900.10	850.18	1750.28	1750.28	1750.28	8.89
71.0	199.72	931.68	850.18	1781.86	1781.86	1781.86	8.92
72.0	202.53	963.25	850.18	1813.44	1813.44	1813.44	8.95
73.0	205.34	994.83	850.18	1845.01	1845.01	1845.01	8.99
74.0	208.15	1026.41	850.18	1876.59	1876.59	1876.59	9.02
75.0	210.97	1057.99	850.18	1908.17	1908.17	1908.17	9.04
76.0	213.78	1089.56	850.18	1939.74	1939.74	1939.74	9.07
77.0	216.59	1121.14	850.18	1971.32	1971.32	1971.32	9.10
78.0	219.41	1152.72	850.18	2002.90	2002.90	2002.90	9.13
79.0	222.22	1184.29	912.52	2096.82	2096.82	2096.82	9.44
80.0	225.03	1215.87	977.98	2193.85	2193.85	2193.85	9.75
81.0	227.85	1247.45	1046.56	2294.01	2294.01	2294.01	10.07

82.0	230.66	1279.03	1118.25	2397.28	2397.28	2397.28	10.39
83.0	233.47	1310.60	1193.06	2503.66	2503.66	2503.66	10.72
84.0	236.28	1342.18	1270.99	2613.17	2613.17	2613.17	11.06
85.0	239.10	1373.76	1352.03	2725.79	2725.79	2725.79	11.40
86.0	241.91	1405.33	1436.19	2841.53	2841.53	2841.53	11.75
87.0	244.72	1436.91	1523.47	2960.38	2960.38	2960.38	12.10
88.0	247.54	1468.49	1607.63	3076.12	3076.12	3076.12	12.43
89.0	250.35	1500.07	1682.44	3182.51	3182.51	3182.51	12.71
90.0	253.16	1531.64	1747.90	3279.54	3279.54	3279.54	12.95
91.0	255.97	1563.22	1804.01	3367.23	3367.23	3367.23	13.15
92.0	258.79	1594.80	1850.77	3445.56	3445.56	3445.56	13.31
93.0	261.60	1626.37	1888.17	3514.54	3514.54	3514.54	13.43
94.0	264.41	1657.95	1916.22	3574.18	3574.18	3574.18	13.52
95.0	267.23	1689.53	1934.93	3624.46	3624.46	3624.46	13.56
96.0	270.04	1721.11	1944.28	3665.38	3665.38	3665.38	13.57
97.0	272.85	1752.68	1944.28	3696.96	3696.96	3696.96	13.55
98.0	275.66	1773.15	1944.28	3717.43	3717.43	3717.43	13.49
99.0	278.48	1793.88	1944.28	3738.16	3738.16	3738.16	13.42
100.0	281.29	1814.87	1944.28	3759.15	3759.15	3759.15	13.36
101.0	284.10	1836.12	1944.28	3780.40	3780.40	3780.40	13.31
102.0	286.92	1857.63	1944.28	3801.91	3801.91	3801.91	13.25
103.0	289.73	1879.40	1944.28	3823.68	3823.68	3823.68	13.20
104.0	292.54	1901.44	1944.28	3845.71	3845.71	3845.71	13.15
105.0	295.35	1923.73	1944.28	3868.01	3868.01	3868.01	13.10
106.0	298.17	1946.29	1944.28	3890.57	3890.57	3890.57	13.05
107.0	300.98	1969.11	1944.28	3913.38	3913.38	3913.38	13.00
108.0	303.79	1992.18	1944.28	3936.46	3936.46	3936.46	12.96
109.0	306.61	2015.52	1944.28	3959.80	3959.80	3959.80	12.91
110.0	309.42	2039.12	1944.28	3983.40	3983.40	3983.40	12.87
111.0	312.23	2062.98	1944.28	4007.26	4007.26	4007.26	12.83
112.0	315.04	2087.11	1944.28	4031.38	4031.38	4031.38	12.80
113.0	317.86	2111.49	1944.28	4055.77	4055.77	4055.77	12.76
114.0	320.67	2136.13	1944.28	4080.41	4080.41	4080.41	12.72
115.0	323.48	2161.04	1944.28	4105.32	4105.32	4105.32	12.69
116.0	326.30	2186.21	1944.28	4130.48	4130.48	4130.48	12.66
117.0	329.11	2211.63	1944.28	4155.91	4155.91	4155.91	12.63
118.0	331.92	2237.32	1944.28	4181.60	4181.60	4181.60	12.60
119.0	334.74	2263.27	1944.28	4207.55	4207.55	4207.55	12.57
120.0	337.55	2289.48	1944.28	4233.76	4233.76	4233.76	12.54
121.0	340.36	2315.95	1944.28	4260.23	4260.23	4260.23	12.52
122.0	343.17	2342.69	1944.28	4286.96	4286.96	4286.96	12.49
123.0	345.99	2369.68	1944.28	4313.96	4313.96	4313.96	12.47
124.0	348.80	2396.94	1944.28	4341.21	4341.21	4341.21	12.45
125.0	351.61	2424.45	1944.28	4368.73	4368.73	4368.73	12.42
126.0	354.43	2452.23	1944.28	4396.51	4396.51	4396.51	12.40
127.0	357.24	2480.27	1944.28	4424.55	4424.55	4424.55	12.39
128.0	360.05	2508.57	1944.28	4452.84	4452.84	4452.84	12.37
129.0	362.86	2537.13	1944.28	4481.41	4481.41	4481.41	12.35
130.0	365.68	2565.95	1944.28	4510.23	4510.23	4510.23	12.33

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD	TOP MOVEMENT	TIP LOAD	TIP MOVEMENT
ton	IN.	ton	IN.
0.1093E+00	0.1562E-04	0.5767E-02	0.1000E-04
0.5463E+00	0.7809E-04	0.2884E-01	0.5000E-04
0.1093E+01	0.1562E-03	0.5767E-01	0.1000E-03
0.5463E+02	0.7809E-02	0.2884E+01	0.5000E-02
0.8194E+02	0.1171E-01	0.4325E+01	0.7500E-02
0.1093E+03	0.1562E-01	0.5767E+01	0.1000E-01
0.2731E+03	0.3905E-01	0.1442E+02	0.2500E-01
0.5468E+03	0.7811E-01	0.2884E+02	0.5000E-01
0.8205E+03	0.1172E+00	0.4325E+02	0.7500E-01
0.1085E+04	0.1561E+00	0.5767E+02	0.1000E+00

0.1948E+04	0.3543E+00	0.1442E+03	0.2500E+00
0.2524E+04	0.6403E+00	0.2884E+03	0.5000E+00
0.3091E+04	0.1363E+01	0.6708E+03	0.1180E+01
0.3525E+04	0.3175E+01	0.1244E+04	0.2950E+01
0.4250E+04	0.6185E+01	0.1973E+04	0.5900E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1606E+00	0.1813E-04	0.8239E-02	0.1000E-04
0.8029E+00	0.9065E-04	0.4119E-01	0.5000E-04
0.1606E+01	0.1813E-03	0.8239E-01	0.1000E-03
0.8029E+02	0.9065E-02	0.4119E+01	0.5000E-02
0.1204E+03	0.1360E-01	0.6179E+01	0.7500E-02
0.1606E+03	0.1813E-01	0.8239E+01	0.1000E-01
0.4018E+03	0.4533E-01	0.2060E+02	0.2500E-01
0.8044E+03	0.9070E-01	0.4119E+02	0.5000E-01
0.1204E+04	0.1361E+00	0.6179E+02	0.7500E-01
0.1570E+04	0.1807E+00	0.8239E+02	0.1000E+00
0.2449E+04	0.3830E+00	0.2060E+03	0.2500E+00
0.2924E+04	0.6657E+00	0.4119E+03	0.5000E+00
0.3500E+04	0.1393E+01	0.9333E+03	0.1180E+01
0.3924E+04	0.3202E+01	0.1478E+04	0.2950E+01
0.4546E+04	0.6204E+01	0.2100E+04	0.5900E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.6289E-01	0.1329E-04	0.3295E-02	0.1000E-04
0.3145E+00	0.6647E-04	0.1648E-01	0.5000E-04
0.6289E+00	0.1329E-03	0.3295E-01	0.1000E-03
0.3145E+02	0.6647E-02	0.1648E+01	0.5000E-02
0.4717E+02	0.9971E-02	0.2472E+01	0.7500E-02
0.6289E+02	0.1329E-01	0.3295E+01	0.1000E-01
0.1572E+03	0.3324E-01	0.8239E+01	0.2500E-01
0.3145E+03	0.6647E-01	0.1648E+02	0.5000E-01
0.4719E+03	0.9972E-01	0.2472E+02	0.7500E-01
0.6289E+03	0.1330E+00	0.3295E+02	0.1000E+00
0.1373E+04	0.3228E+00	0.8239E+02	0.2500E+00
0.2074E+04	0.6123E+00	0.1648E+03	0.5000E+00
0.2683E+04	0.1334E+01	0.4083E+03	0.1180E+01
0.3125E+04	0.3147E+01	0.1011E+04	0.2950E+01
0.3954E+04	0.6166E+01	0.1847E+04	0.5900E+01

SHAFT Axial Analysis – 5th Street Bridge, Bent 6, 118” CIDH (NL and LQ)

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 6 (C)COPYRIGHT ENSOFT,INC.1989,1995,1998,2001,2003,2007

5th Street Bridge, Bent 6, 118"CIDH (comp) NL

PROPOSED DEPTH = 125.0 FT

NUMBER OF LAYERS = 5

WATER TABLE DEPTH = 0.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.600E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.500E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.661E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.500E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.500E+01

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03

MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.500E+01

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.761E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.300E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.761E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.300E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.646E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.400E+02

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.400E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.950E+02

LAYER NO 5----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.950E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 9.833 FT.
DIAMETER OF BASE = 9.833 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 5.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 109.366 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
6.0	16.88	3.99	0.00	3.99	3.99	3.99	0.30
7.0	19.69	9.88	0.00	9.88	9.88	9.88	0.50
8.0	22.50	15.77	0.00	15.77	15.77	15.77	0.70
9.0	25.32	22.25	0.00	22.25	22.25	22.25	0.88
10.0	28.13	29.31	0.00	29.31	29.31	29.31	1.04
11.0	30.94	36.93	0.00	36.93	36.93	36.93	1.19
12.0	33.75	45.08	46.17	91.25	91.25	91.25	2.70
13.0	36.57	53.75	94.64	148.39	148.39	148.39	4.06
14.0	39.38	62.92	145.42	208.34	208.34	208.34	5.29
15.0	42.19	72.56	198.51	271.08	271.08	271.08	6.42

16.0	45.01	82.67	253.91	336.59	336.59	336.59	7.48
17.0	47.82	93.23	311.62	404.85	404.85	404.85	8.47
18.0	50.63	104.21	371.64	475.85	475.85	475.85	9.40
19.0	53.45	115.61	433.96	549.57	549.57	549.57	10.28
20.0	56.26	127.40	498.60	626.00	626.00	626.00	11.13
21.0	59.07	139.58	560.92	700.50	700.50	700.50	11.86
22.0	61.88	152.13	618.60	770.73	770.73	770.73	12.45
23.0	64.70	165.04	669.46	834.50	834.50	834.50	12.90
24.0	67.51	178.28	713.52	891.80	891.80	891.80	13.21
25.0	70.32	191.85	750.76	942.61	942.61	942.61	13.40
26.0	73.14	205.74	781.19	986.93	986.93	986.93	13.49
27.0	75.95	219.93	804.81	1024.74	1024.74	1024.74	13.49
28.0	78.76	234.40	821.62	1056.03	1056.03	1056.03	13.41
29.0	81.57	249.16	831.62	1080.78	1080.78	1080.78	13.25
30.0	84.39	264.17	834.81	1098.98	1098.98	1098.98	13.02
31.0	87.20	279.61	837.88	1117.50	1117.50	1117.50	12.82
32.0	90.01	295.46	840.62	1136.08	1136.08	1136.08	12.62
33.0	92.83	311.70	843.01	1154.70	1154.70	1154.70	12.44
34.0	95.64	328.30	845.06	1173.36	1173.36	1173.36	12.27
35.0	98.45	345.27	846.77	1192.04	1192.04	1192.04	12.11
36.0	101.26	362.58	848.13	1210.71	1210.71	1210.71	11.96
37.0	104.08	380.21	849.16	1229.36	1229.36	1229.36	11.81
38.0	106.89	398.14	849.84	1247.98	1247.98	1247.98	11.68
39.0	109.70	416.37	850.18	1266.55	1266.55	1266.55	11.55
40.0	112.52	434.88	850.18	1285.06	1285.06	1285.06	11.42
41.0	115.33	466.46	850.18	1316.64	1316.64	1316.64	11.42
42.0	118.14	498.03	850.18	1348.21	1348.21	1348.21	11.41
43.0	120.95	529.61	850.18	1379.79	1379.79	1379.79	11.41
44.0	123.77	561.19	850.18	1411.37	1411.37	1411.37	11.40
45.0	126.58	592.77	850.18	1442.95	1442.95	1442.95	11.40
46.0	129.39	624.34	850.18	1474.52	1474.52	1474.52	11.40
47.0	132.21	655.92	850.18	1506.10	1506.10	1506.10	11.39
48.0	135.02	687.50	850.18	1537.68	1537.68	1537.68	11.39
49.0	137.83	719.07	850.18	1569.26	1569.26	1569.26	11.39
50.0	140.65	750.65	850.18	1600.83	1600.83	1600.83	11.38
51.0	143.46	782.23	850.18	1632.41	1632.41	1632.41	11.38
52.0	146.27	813.81	850.18	1663.99	1663.99	1663.99	11.38
53.0	149.08	845.38	850.18	1695.56	1695.56	1695.56	11.37
54.0	151.90	876.96	850.18	1727.14	1727.14	1727.14	11.37
55.0	154.71	908.54	850.18	1758.72	1758.72	1758.72	11.37
56.0	157.52	940.11	850.18	1790.30	1790.30	1790.30	11.37
57.0	160.34	971.69	850.18	1821.87	1821.87	1821.87	11.36
58.0	163.15	1003.27	850.18	1853.45	1853.45	1853.45	11.36
59.0	165.96	1034.85	850.18	1885.03	1885.03	1885.03	11.36
60.0	168.77	1066.42	850.18	1916.60	1916.60	1916.60	11.36
61.0	171.59	1098.00	850.18	1948.18	1948.18	1948.18	11.35
62.0	174.40	1129.58	850.18	1979.76	1979.76	1979.76	11.35
63.0	177.21	1161.16	850.18	2011.34	2011.34	2011.34	11.35
64.0	180.03	1192.73	850.18	2042.91	2042.91	2042.91	11.35
65.0	182.84	1224.31	850.18	2074.49	2074.49	2074.49	11.35
66.0	185.65	1255.89	850.18	2106.07	2106.07	2106.07	11.34
67.0	188.46	1287.46	850.18	2137.64	2137.64	2137.64	11.34
68.0	191.28	1319.04	850.18	2169.22	2169.22	2169.22	11.34
69.0	194.09	1350.62	850.18	2200.80	2200.80	2200.80	11.34
70.0	196.90	1382.20	850.18	2232.38	2232.38	2232.38	11.34
71.0	199.72	1413.77	850.18	2263.95	2263.95	2263.95	11.34
72.0	202.53	1445.35	850.18	2295.53	2295.53	2295.53	11.33
73.0	205.34	1476.93	850.18	2327.11	2327.11	2327.11	11.33
74.0	208.15	1508.50	850.18	2358.68	2358.68	2358.68	11.33
75.0	210.97	1540.08	850.18	2390.26	2390.26	2390.26	11.33
76.0	213.78	1571.66	850.18	2421.84	2421.84	2421.84	11.33
77.0	216.59	1603.24	912.52	2515.76	2515.76	2515.76	11.62
78.0	219.41	1634.81	977.98	2612.79	2612.79	2612.79	11.91
79.0	222.22	1666.39	1046.56	2712.95	2712.95	2712.95	12.21
80.0	225.03	1697.97	1118.25	2816.22	2816.22	2816.22	12.51
81.0	227.85	1729.54	1193.06	2922.60	2922.60	2922.60	12.83

82.0	230.66	1761.12	1270.99	3032.11	3032.11	3032.11	13.15
83.0	233.47	1792.70	1352.03	3144.73	3144.73	3144.73	13.47
84.0	236.28	1824.28	1436.19	3260.47	3260.47	3260.47	13.80
85.0	239.10	1855.85	1523.47	3379.32	3379.32	3379.32	14.13
86.0	241.91	1887.43	1607.63	3495.06	3495.06	3495.06	14.45
87.0	244.72	1919.01	1682.44	3601.45	3601.45	3601.45	14.72
88.0	247.54	1950.58	1747.90	3698.49	3698.49	3698.49	14.94
89.0	250.35	1982.16	1804.01	3786.17	3786.17	3786.17	15.12
90.0	253.16	2013.74	1850.77	3864.50	3864.50	3864.50	15.26
91.0	255.97	2045.32	1888.17	3933.49	3933.49	3933.49	15.37
92.0	258.79	2076.89	1916.22	3993.12	3993.12	3993.12	15.43
93.0	261.60	2108.47	1934.93	4043.40	4043.40	4043.40	15.46
94.0	264.41	2140.05	1944.28	4084.32	4084.32	4084.32	15.45
95.0	267.23	2171.62	1944.28	4115.90	4115.90	4115.90	15.40
96.0	270.04	2192.34	1944.28	4136.62	4136.62	4136.62	15.32
97.0	272.85	2213.32	1944.28	4157.60	4157.60	4157.60	15.24
98.0	275.66	2234.56	1944.28	4178.84	4178.84	4178.84	15.16
99.0	278.48	2256.06	1944.28	4200.34	4200.34	4200.34	15.08
100.0	281.29	2277.82	1944.28	4222.10	4222.10	4222.10	15.01
101.0	284.10	2299.85	1944.28	4244.12	4244.12	4244.12	14.94
102.0	286.92	2322.13	1944.28	4266.41	4266.41	4266.41	14.87
103.0	289.73	2344.67	1944.28	4288.95	4288.95	4288.95	14.80
104.0	292.54	2367.48	1944.28	4311.76	4311.76	4311.76	14.74
105.0	295.35	2390.55	1944.28	4334.83	4334.83	4334.83	14.68
106.0	298.17	2413.88	1944.28	4358.15	4358.15	4358.15	14.62
107.0	300.98	2437.47	1944.28	4381.74	4381.74	4381.74	14.56
108.0	303.79	2461.32	1944.28	4405.59	4405.59	4405.59	14.50
109.0	306.61	2485.43	1944.28	4429.71	4429.71	4429.71	14.45
110.0	309.42	2509.80	1944.28	4454.08	4454.08	4454.08	14.39
111.0	312.23	2534.43	1944.28	4478.71	4478.71	4478.71	14.34
112.0	315.04	2559.33	1944.28	4503.61	4503.61	4503.61	14.30
113.0	317.86	2584.48	1944.28	4528.76	4528.76	4528.76	14.25
114.0	320.67	2609.90	1944.28	4554.18	4554.18	4554.18	14.20
115.0	323.48	2635.58	1944.28	4579.86	4579.86	4579.86	14.16
116.0	326.30	2661.52	1944.28	4605.80	4605.80	4605.80	14.12
117.0	329.11	2687.72	1944.28	4632.00	4632.00	4632.00	14.07
118.0	331.92	2714.18	1944.28	4658.46	4658.46	4658.46	14.03
119.0	334.74	2740.90	1944.28	4685.18	4685.18	4685.18	14.00
120.0	337.55	2767.88	1944.28	4712.16	4712.16	4712.16	13.96
121.0	340.36	2795.13	1944.28	4739.41	4739.41	4739.41	13.92
122.0	343.17	2822.63	1944.28	4766.91	4766.91	4766.91	13.89
123.0	345.99	2850.40	1944.28	4794.68	4794.68	4794.68	13.86
124.0	348.80	2878.43	1944.28	4822.71	4822.71	4822.71	13.83
125.0	351.61	2906.72	1944.28	4850.99	4850.99	4850.99	13.80

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD	TOP MOVEMENT	TIP LOAD	TIP MOVEMENT
ton	IN.	ton	IN.
0.1283E+00	0.1584E-04	0.5767E-02	0.1000E-04
0.6417E+00	0.7920E-04	0.2884E-01	0.5000E-04
0.1283E+01	0.1584E-03	0.5767E-01	0.1000E-03
0.6417E+02	0.7920E-02	0.2884E+01	0.5000E-02
0.9625E+02	0.1188E-01	0.4325E+01	0.7500E-02
0.1283E+03	0.1584E-01	0.5767E+01	0.1000E-01
0.3209E+03	0.3960E-01	0.1442E+02	0.2500E-01
0.6426E+03	0.7922E-01	0.2884E+02	0.5000E-01
0.9641E+03	0.1188E+00	0.4325E+02	0.7500E-01
0.1273E+04	0.1582E+00	0.5767E+02	0.1000E+00
0.2234E+04	0.3560E+00	0.1442E+03	0.2500E+00
0.2851E+04	0.6405E+00	0.2884E+03	0.5000E+00
0.3414E+04	0.1361E+01	0.6708E+03	0.1180E+01
0.3809E+04	0.3169E+01	0.1244E+04	0.2950E+01
0.4535E+04	0.6177E+01	0.1973E+04	0.5900E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1906E+00	0.1853E-04	0.8239E-02	0.1000E-04
0.9531E+00	0.9267E-04	0.4119E-01	0.5000E-04
0.1906E+01	0.1853E-03	0.8239E-01	0.1000E-03
0.9531E+02	0.9267E-02	0.4119E+01	0.5000E-02
0.1430E+03	0.1390E-01	0.6179E+01	0.7500E-02
0.1906E+03	0.1853E-01	0.8239E+01	0.1000E-01
0.4772E+03	0.4635E-01	0.2060E+02	0.2500E-01
0.9553E+03	0.9274E-01	0.4119E+02	0.5000E-01
0.1431E+04	0.1391E+00	0.6179E+02	0.7500E-01
0.1854E+04	0.1841E+00	0.8239E+02	0.1000E+00
0.2792E+04	0.3840E+00	0.2060E+03	0.2500E+00
0.3275E+04	0.6649E+00	0.4119E+03	0.5000E+00
0.3847E+04	0.1390E+01	0.9333E+03	0.1180E+01
0.4239E+04	0.3197E+01	0.1478E+04	0.2950E+01
0.4861E+04	0.6197E+01	0.2100E+04	0.5900E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.7284E-01	0.1337E-04	0.3295E-02	0.1000E-04
0.3642E+00	0.6687E-04	0.1648E-01	0.5000E-04
0.7284E+00	0.1337E-03	0.3295E-01	0.1000E-03
0.3642E+02	0.6687E-02	0.1648E+01	0.5000E-02
0.5463E+02	0.1003E-01	0.2472E+01	0.7500E-02
0.7284E+02	0.1337E-01	0.3295E+01	0.1000E-01
0.1821E+03	0.3343E-01	0.8239E+01	0.2500E-01
0.3643E+03	0.6687E-01	0.1648E+02	0.5000E-01
0.5467E+03	0.1003E+00	0.2472E+02	0.7500E-01
0.7284E+03	0.1337E+00	0.3295E+02	0.1000E+00
0.1582E+04	0.3242E+00	0.8239E+02	0.2500E+00
0.2363E+04	0.6133E+00	0.1648E+03	0.5000E+00
0.2981E+04	0.1332E+01	0.4083E+03	0.1180E+01
0.3380E+04	0.3142E+01	0.1011E+04	0.2950E+01
0.4209E+04	0.6158E+01	0.1847E+04	0.5900E+01

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 6 (C)COPYRIGHT ENSOFT,INC.1989,1995,1998,2001,2003,2007

5th Street Bridge, Bent 6, 118"CIDH (comp) LQ

PROPOSED DEPTH = 125.0 FT

NUMBER OF LAYERS = 5

WATER TABLE DEPTH = 0.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.600E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.500E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.661E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.500E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.500E+01

LAYER NO 2----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.661E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11

DEPTH, FT = 0.500E+01

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.300E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.761E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.300E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.646E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.340E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.400E+02

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.400E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.950E+02

LAYER NO 5----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.950E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 9.833 FT.
DIAMETER OF BASE = 9.833 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 5.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 109.366 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
6.0	16.88	3.40	115.99	119.39	119.39	119.39	6.87
7.0	19.69	6.80	116.56	123.35	123.35	123.35	6.26
8.0	22.50	10.20	117.12	127.32	127.32	127.32	5.66
9.0	25.32	13.59	117.61	131.21	131.21	131.21	5.18
10.0	28.13	16.99	118.03	135.02	135.02	135.02	4.80
11.0	30.94	20.39	118.39	138.79	138.79	138.79	4.49
12.0	33.75	23.79	158.01	181.80	181.80	181.80	5.39
13.0	36.57	27.19	199.55	226.74	226.74	226.74	6.20
14.0	39.38	30.59	243.01	273.60	273.60	273.60	6.95
15.0	42.19	33.98	288.41	322.39	322.39	322.39	7.64

16.0	45.01	37.38	335.75	373.13	373.13	373.13	8.29
17.0	47.82	40.78	385.04	425.82	425.82	425.82	8.90
18.0	50.63	44.18	436.28	480.46	480.46	480.46	9.49
19.0	53.45	47.58	489.46	537.04	537.04	537.04	10.05
20.0	56.26	50.98	544.59	595.57	595.57	595.57	10.59
21.0	59.07	54.38	597.74	652.12	652.12	652.12	11.04
22.0	61.88	57.77	647.25	705.03	705.03	705.03	11.39
23.0	64.70	61.17	690.97	752.14	752.14	752.14	11.63
24.0	67.51	64.57	728.89	793.46	793.46	793.46	11.75
25.0	70.32	67.97	761.01	828.98	828.98	828.98	11.79
26.0	73.14	71.37	787.35	858.72	858.72	858.72	11.74
27.0	75.95	74.77	807.89	882.66	882.66	882.66	11.62
28.0	78.76	78.17	822.65	900.82	900.82	900.82	11.44
29.0	81.57	81.56	831.62	913.19	913.19	913.19	11.19
30.0	84.39	84.96	834.81	919.77	919.77	919.77	10.90
31.0	87.20	100.40	837.88	938.29	938.29	938.29	10.76
32.0	90.01	116.25	840.62	956.87	956.87	956.87	10.63
33.0	92.83	132.49	843.01	975.49	975.49	975.49	10.51
34.0	95.64	149.10	845.06	994.15	994.15	994.15	10.39
35.0	98.45	166.06	846.77	1012.83	1012.83	1012.83	10.29
36.0	101.26	183.37	848.13	1031.50	1031.50	1031.50	10.19
37.0	104.08	201.00	849.16	1050.15	1050.15	1050.15	10.09
38.0	106.89	218.93	849.84	1068.77	1068.77	1068.77	10.00
39.0	109.70	237.16	850.18	1087.34	1087.34	1087.34	9.91
40.0	112.52	255.67	850.18	1105.85	1105.85	1105.85	9.83
41.0	115.33	287.25	850.18	1137.43	1137.43	1137.43	9.86
42.0	118.14	318.82	850.18	1169.01	1169.01	1169.01	9.89
43.0	120.95	350.40	850.18	1200.58	1200.58	1200.58	9.93
44.0	123.77	381.98	850.18	1232.16	1232.16	1232.16	9.96
45.0	126.58	413.56	850.18	1263.74	1263.74	1263.74	9.98
46.0	129.39	445.13	850.18	1295.31	1295.31	1295.31	10.01
47.0	132.21	476.71	850.18	1326.89	1326.89	1326.89	10.04
48.0	135.02	508.29	850.18	1358.47	1358.47	1358.47	10.06
49.0	137.83	539.86	850.18	1390.05	1390.05	1390.05	10.09
50.0	140.65	571.44	850.18	1421.62	1421.62	1421.62	10.11
51.0	143.46	603.02	850.18	1453.20	1453.20	1453.20	10.13
52.0	146.27	634.60	850.18	1484.78	1484.78	1484.78	10.15
53.0	149.08	666.17	850.18	1516.35	1516.35	1516.35	10.17
54.0	151.90	697.75	850.18	1547.93	1547.93	1547.93	10.19
55.0	154.71	729.33	850.18	1579.51	1579.51	1579.51	10.21
56.0	157.52	760.91	850.18	1611.09	1611.09	1611.09	10.23
57.0	160.34	792.48	850.18	1642.66	1642.66	1642.66	10.25
58.0	163.15	824.06	850.18	1674.24	1674.24	1674.24	10.26
59.0	165.96	855.64	850.18	1705.82	1705.82	1705.82	10.28
60.0	168.77	887.21	850.18	1737.39	1737.39	1737.39	10.29
61.0	171.59	918.79	850.18	1768.97	1768.97	1768.97	10.31
62.0	174.40	950.37	850.18	1800.55	1800.55	1800.55	10.32
63.0	177.21	981.95	850.18	1832.13	1832.13	1832.13	10.34
64.0	180.03	1013.52	850.18	1863.70	1863.70	1863.70	10.35
65.0	182.84	1045.10	850.18	1895.28	1895.28	1895.28	10.37
66.0	185.65	1076.68	850.18	1926.86	1926.86	1926.86	10.38
67.0	188.46	1108.25	850.18	1958.44	1958.44	1958.44	10.39
68.0	191.28	1139.83	850.18	1990.01	1990.01	1990.01	10.40
69.0	194.09	1171.41	850.18	2021.59	2021.59	2021.59	10.42
70.0	196.90	1202.99	850.18	2053.17	2053.17	2053.17	10.43
71.0	199.72	1234.56	850.18	2084.74	2084.74	2084.74	10.44
72.0	202.53	1266.14	850.18	2116.32	2116.32	2116.32	10.45
73.0	205.34	1297.72	850.18	2147.90	2147.90	2147.90	10.46
74.0	208.15	1329.29	850.18	2179.48	2179.48	2179.48	10.47
75.0	210.97	1360.87	850.18	2211.05	2211.05	2211.05	10.48
76.0	213.78	1392.45	850.18	2242.63	2242.63	2242.63	10.49
77.0	216.59	1424.03	912.52	2336.55	2336.55	2336.55	10.79
78.0	219.41	1455.60	977.98	2433.58	2433.58	2433.58	11.09
79.0	222.22	1487.18	1046.56	2533.74	2533.74	2533.74	11.40
80.0	225.03	1518.76	1118.25	2637.01	2637.01	2637.01	11.72
81.0	227.85	1550.33	1193.06	2743.39	2743.39	2743.39	12.04

82.0	230.66	1581.91	1270.99	2852.90	2852.90	2852.90	12.37
83.0	233.47	1613.49	1352.03	2965.52	2965.52	2965.52	12.70
84.0	236.28	1645.07	1436.19	3081.26	3081.26	3081.26	13.04
85.0	239.10	1676.64	1523.47	3200.11	3200.11	3200.11	13.38
86.0	241.91	1708.22	1607.63	3315.85	3315.85	3315.85	13.71
87.0	244.72	1739.80	1682.44	3422.24	3422.24	3422.24	13.98
88.0	247.54	1771.37	1747.90	3519.28	3519.28	3519.28	14.22
89.0	250.35	1802.95	1804.01	3606.96	3606.96	3606.96	14.41
90.0	253.16	1834.53	1850.77	3685.29	3685.29	3685.29	14.56
91.0	255.97	1866.11	1888.17	3754.28	3754.28	3754.28	14.67
92.0	258.79	1897.68	1916.22	3813.91	3813.91	3813.91	14.74
93.0	261.60	1929.26	1934.93	3864.19	3864.19	3864.19	14.77
94.0	264.41	1960.84	1944.28	3905.11	3905.11	3905.11	14.77
95.0	267.23	1992.41	1944.28	3936.69	3936.69	3936.69	14.73
96.0	270.04	2013.13	1944.28	3957.41	3957.41	3957.41	14.65
97.0	272.85	2034.11	1944.28	3978.39	3978.39	3978.39	14.58
98.0	275.66	2055.35	1944.28	3999.63	3999.63	3999.63	14.51
99.0	278.48	2076.85	1944.28	4021.13	4021.13	4021.13	14.44
100.0	281.29	2098.61	1944.28	4042.89	4042.89	4042.89	14.37
101.0	284.10	2120.64	1944.28	4064.91	4064.91	4064.91	14.31
102.0	286.92	2142.92	1944.28	4087.20	4087.20	4087.20	14.25
103.0	289.73	2165.47	1944.28	4109.74	4109.74	4109.74	14.18
104.0	292.54	2188.27	1944.28	4132.55	4132.55	4132.55	14.13
105.0	295.35	2211.34	1944.28	4155.62	4155.62	4155.62	14.07
106.0	298.17	2234.67	1944.28	4178.94	4178.94	4178.94	14.02
107.0	300.98	2258.26	1944.28	4202.53	4202.53	4202.53	13.96
108.0	303.79	2282.11	1944.28	4226.38	4226.38	4226.38	13.91
109.0	306.61	2306.22	1944.28	4250.50	4250.50	4250.50	13.86
110.0	309.42	2330.59	1944.28	4274.87	4274.87	4274.87	13.82
111.0	312.23	2355.22	1944.28	4299.50	4299.50	4299.50	13.77
112.0	315.04	2380.12	1944.28	4324.40	4324.40	4324.40	13.73
113.0	317.86	2405.28	1944.28	4349.55	4349.55	4349.55	13.68
114.0	320.67	2430.69	1944.28	4374.97	4374.97	4374.97	13.64
115.0	323.48	2456.37	1944.28	4400.65	4400.65	4400.65	13.60
116.0	326.30	2482.31	1944.28	4426.59	4426.59	4426.59	13.57
117.0	329.11	2508.51	1944.28	4452.79	4452.79	4452.79	13.53
118.0	331.92	2534.97	1944.28	4479.25	4479.25	4479.25	13.49
119.0	334.74	2561.69	1944.28	4505.97	4505.97	4505.97	13.46
120.0	337.55	2588.68	1944.28	4532.95	4532.95	4532.95	13.43
121.0	340.36	2615.92	1944.28	4560.20	4560.20	4560.20	13.40
122.0	343.17	2643.43	1944.28	4587.70	4587.70	4587.70	13.37
123.0	345.99	2671.19	1944.28	4615.47	4615.47	4615.47	13.34
124.0	348.80	2699.22	1944.28	4643.50	4643.50	4643.50	13.31
125.0	351.61	2727.51	1944.28	4671.78	4671.78	4671.78	13.29

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1228E+00	0.1576E-04	0.5767E-02	0.1000E-04
0.6140E+00	0.7882E-04	0.2884E-01	0.5000E-04
0.1228E+01	0.1576E-03	0.5767E-01	0.1000E-03
0.6140E+02	0.7882E-02	0.2884E+01	0.5000E-02
0.9211E+02	0.1182E-01	0.4325E+01	0.7500E-02
0.1228E+03	0.1576E-01	0.5767E+01	0.1000E-01
0.3070E+03	0.3941E-01	0.1442E+02	0.2500E-01
0.6148E+03	0.7884E-01	0.2884E+02	0.5000E-01
0.9225E+03	0.1183E+00	0.4325E+02	0.7500E-01
0.1217E+04	0.1575E+00	0.5767E+02	0.1000E+00
0.2123E+04	0.3545E+00	0.1442E+03	0.2500E+00
0.2699E+04	0.6385E+00	0.2884E+03	0.5000E+00
0.3237E+04	0.1359E+01	0.6708E+03	0.1180E+01
0.3626E+04	0.3167E+01	0.1244E+04	0.2950E+01
0.4352E+04	0.6175E+01	0.1973E+04	0.5900E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1828E+00	0.1843E-04	0.8239E-02	0.1000E-04
0.9142E+00	0.9213E-04	0.4119E-01	0.5000E-04
0.1828E+01	0.1843E-03	0.8239E-01	0.1000E-03
0.9142E+02	0.9213E-02	0.4119E+01	0.5000E-02
0.1371E+03	0.1382E-01	0.6179E+01	0.7500E-02
0.1828E+03	0.1843E-01	0.8239E+01	0.1000E-01
0.4577E+03	0.4608E-01	0.2060E+02	0.2500E-01
0.9163E+03	0.9220E-01	0.4119E+02	0.5000E-01
0.1372E+04	0.1383E+00	0.6179E+02	0.7500E-01
0.1772E+04	0.1830E+00	0.8239E+02	0.1000E+00
0.2637E+04	0.3819E+00	0.2060E+03	0.2500E+00
0.3099E+04	0.6625E+00	0.4119E+03	0.5000E+00
0.3666E+04	0.1387E+01	0.9333E+03	0.1180E+01
0.4051E+04	0.3194E+01	0.1478E+04	0.2950E+01
0.4673E+04	0.6194E+01	0.2100E+04	0.5900E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.6927E-01	0.1333E-04	0.3295E-02	0.1000E-04
0.3463E+00	0.6663E-04	0.1648E-01	0.5000E-04
0.6927E+00	0.1333E-03	0.3295E-01	0.1000E-03
0.3463E+02	0.6663E-02	0.1648E+01	0.5000E-02
0.5195E+02	0.9994E-02	0.2472E+01	0.7500E-02
0.6927E+02	0.1333E-01	0.3295E+01	0.1000E-01
0.1732E+03	0.3331E-01	0.8239E+01	0.2500E-01
0.3464E+03	0.6663E-01	0.1648E+02	0.5000E-01
0.5198E+03	0.9995E-01	0.2472E+02	0.7500E-01
0.6928E+03	0.1333E+00	0.3295E+02	0.1000E+00
0.1506E+04	0.3232E+00	0.8239E+02	0.2500E+00
0.2239E+04	0.6117E+00	0.1648E+03	0.5000E+00
0.2809E+04	0.1330E+01	0.4083E+03	0.1180E+01
0.3200E+04	0.3139E+01	0.1011E+04	0.2950E+01
0.4031E+04	0.6156E+01	0.1847E+04	0.5900E+01

SHAFT Axial Analysis – 5th Street Bridge, Bent 7, 118” CIDH (NL and LQ)

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 6 (C)COPYRIGHT ENSOFT,INC.1989,1995,1998,2001,2003,2007

5th Street Bridge, Bent 7, 118"CIDH (comp) NL

PROPOSED DEPTH = 135.0 FT

NUMBER OF LAYERS = 5

WATER TABLE DEPTH = 0.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.500E+01

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.500E+01

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.646E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.400E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.646E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.400E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.594E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.450E+02

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.450E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.950E+02

LAYER NO 5----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.950E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 9.833 FT.
DIAMETER OF BASE = 9.833 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 5.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 109.366 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
6.0	16.88	3.99	0.00	3.99	3.99	3.99	0.30
7.0	19.69	9.88	0.00	9.88	9.88	9.88	0.50
8.0	22.50	15.77	0.00	15.77	15.77	15.77	0.70
9.0	25.32	22.25	0.00	22.25	22.25	22.25	0.88
10.0	28.13	29.31	0.00	29.31	29.31	29.31	1.04
11.0	30.94	36.93	0.00	36.93	36.93	36.93	1.19
12.0	33.75	45.08	0.00	45.08	45.08	45.08	1.34
13.0	36.57	53.75	0.00	53.75	53.75	53.75	1.47
14.0	39.38	62.92	0.00	62.92	62.92	62.92	1.60
15.0	42.19	72.56	0.00	72.56	72.56	72.56	1.72
16.0	45.01	82.67	0.00	82.67	82.67	82.67	1.84
17.0	47.82	93.23	0.00	93.23	93.23	93.23	1.95

18.0	50.63	104.21	0.00	104.21	104.21	104.21	2.06
19.0	53.45	115.61	0.00	115.61	115.61	115.61	2.16
20.0	56.26	127.40	0.00	127.40	127.40	127.40	2.26
21.0	59.07	139.58	0.00	139.58	139.58	139.58	2.36
22.0	61.88	152.13	69.25	221.38	221.38	221.38	3.58
23.0	64.70	165.04	141.96	307.00	307.00	307.00	4.75
24.0	67.51	178.28	218.14	396.42	396.42	396.42	5.87
25.0	70.32	191.85	297.77	489.63	489.63	489.63	6.96
26.0	73.14	205.74	380.87	586.61	586.61	586.61	8.02
27.0	75.95	219.93	446.63	666.55	666.55	666.55	8.78
28.0	78.76	234.40	514.80	749.21	749.21	749.21	9.51
29.0	81.57	249.16	585.40	834.56	834.56	834.56	10.23
30.0	84.39	264.17	658.43	922.60	922.60	922.60	10.93
31.0	87.20	279.44	726.95	1006.38	1006.38	1006.38	11.54
32.0	90.01	294.94	784.04	1078.98	1078.98	1078.98	11.99
33.0	92.83	310.68	829.70	1140.38	1140.38	1140.38	12.29
34.0	95.64	326.63	863.94	1190.56	1190.56	1190.56	12.45
35.0	98.45	342.78	886.75	1229.53	1229.53	1229.53	12.49
36.0	101.26	359.13	900.21	1259.33	1259.33	1259.33	12.44
37.0	104.08	375.65	906.40	1282.06	1282.06	1282.06	12.32
38.0	106.89	392.35	905.33	1297.69	1297.69	1297.69	12.14
39.0	109.70	409.21	896.99	1306.21	1306.21	1306.21	11.91
40.0	112.52	426.22	881.39	1307.61	1307.61	1307.61	11.62
41.0	115.33	443.57	868.91	1312.47	1312.47	1312.47	11.38
42.0	118.14	461.23	859.54	1320.77	1320.77	1320.77	11.18
43.0	120.95	479.20	853.30	1332.50	1332.50	1332.50	11.02
44.0	123.77	497.45	850.18	1347.63	1347.63	1347.63	10.89
45.0	126.58	515.97	850.18	1366.15	1366.15	1366.15	10.79
46.0	129.39	547.54	850.18	1397.72	1397.72	1397.72	10.80
47.0	132.21	579.12	850.18	1429.30	1429.30	1429.30	10.81
48.0	135.02	610.70	850.18	1460.88	1460.88	1460.88	10.82
49.0	137.83	642.28	850.18	1492.46	1492.46	1492.46	10.83
50.0	140.65	673.85	850.18	1524.03	1524.03	1524.03	10.84
51.0	143.46	705.43	850.18	1555.61	1555.61	1555.61	10.84
52.0	146.27	737.01	850.18	1587.19	1587.19	1587.19	10.85
53.0	149.08	768.58	850.18	1618.77	1618.77	1618.77	10.86
54.0	151.90	800.16	850.18	1650.34	1650.34	1650.34	10.86
55.0	154.71	831.74	850.18	1681.92	1681.92	1681.92	10.87
56.0	157.52	863.32	850.18	1713.50	1713.50	1713.50	10.88
57.0	160.34	894.89	850.18	1745.07	1745.07	1745.07	10.88
58.0	163.15	926.47	850.18	1776.65	1776.65	1776.65	10.89
59.0	165.96	958.05	850.18	1808.23	1808.23	1808.23	10.90
60.0	168.77	989.62	850.18	1839.81	1839.81	1839.81	10.90
61.0	171.59	1021.20	850.18	1871.38	1871.38	1871.38	10.91
62.0	174.40	1052.78	850.18	1902.96	1902.96	1902.96	10.91
63.0	177.21	1084.36	850.18	1934.54	1934.54	1934.54	10.92
64.0	180.03	1115.93	850.18	1966.11	1966.11	1966.11	10.92
65.0	182.84	1147.51	850.18	1997.69	1997.69	1997.69	10.93
66.0	185.65	1179.09	850.18	2029.27	2029.27	2029.27	10.93
67.0	188.46	1210.67	850.18	2060.85	2060.85	2060.85	10.93
68.0	191.28	1242.24	850.18	2092.42	2092.42	2092.42	10.94
69.0	194.09	1273.82	850.18	2124.00	2124.00	2124.00	10.94
70.0	196.90	1305.40	850.18	2155.58	2155.58	2155.58	10.95
71.0	199.72	1336.97	850.18	2187.15	2187.15	2187.15	10.95
72.0	202.53	1368.55	850.18	2218.73	2218.73	2218.73	10.96
73.0	205.34	1400.13	850.18	2250.31	2250.31	2250.31	10.96
74.0	208.15	1431.71	850.18	2281.89	2281.89	2281.89	10.96
75.0	210.97	1463.28	850.18	2313.46	2313.46	2313.46	10.97
76.0	213.78	1494.86	850.18	2345.04	2345.04	2345.04	10.97
77.0	216.59	1526.44	912.52	2438.96	2438.96	2438.96	11.26
78.0	219.41	1558.01	977.98	2535.99	2535.99	2535.99	11.56
79.0	222.22	1589.59	1046.56	2636.15	2636.15	2636.15	11.86
80.0	225.03	1621.17	1118.25	2739.42	2739.42	2739.42	12.17
81.0	227.85	1652.75	1193.06	2845.81	2845.81	2845.81	12.49
82.0	230.66	1684.32	1270.99	2955.31	2955.31	2955.31	12.81
83.0	233.47	1715.90	1352.03	3067.93	3067.93	3067.93	13.14

84.0	236.28	1747.48	1436.19	3183.67	3183.67	3183.67	13.47
85.0	239.10	1779.05	1523.47	3302.52	3302.52	3302.52	13.81
86.0	241.91	1810.63	1607.63	3418.26	3418.26	3418.26	14.13
87.0	244.72	1842.21	1682.44	3524.65	3524.65	3524.65	14.40
88.0	247.54	1873.79	1747.90	3621.69	3621.69	3621.69	14.63
89.0	250.35	1905.36	1804.01	3709.37	3709.37	3709.37	14.82
90.0	253.16	1936.94	1850.77	3787.70	3787.70	3787.70	14.96
91.0	255.97	1968.52	1888.17	3856.69	3856.69	3856.69	15.07
92.0	258.79	2000.09	1916.22	3916.32	3916.32	3916.32	15.13
93.0	261.60	2031.67	1934.93	3966.60	3966.60	3966.60	15.16
94.0	264.41	2063.25	1944.28	4007.53	4007.53	4007.53	15.16
95.0	267.23	2094.83	1944.28	4039.10	4039.10	4039.10	15.11
96.0	270.04	2114.96	1944.28	4059.24	4059.24	4059.24	15.03
97.0	272.85	2135.36	1944.28	4079.64	4079.64	4079.64	14.95
98.0	275.66	2156.02	1944.28	4100.30	4100.30	4100.30	14.87
99.0	278.48	2176.95	1944.28	4121.22	4121.22	4121.22	14.80
100.0	281.29	2198.13	1944.28	4142.41	4142.41	4142.41	14.73
101.0	284.10	2219.57	1944.28	4163.85	4163.85	4163.85	14.66
102.0	286.92	2241.28	1944.28	4185.55	4185.55	4185.55	14.59
103.0	289.73	2263.24	1944.28	4207.52	4207.52	4207.52	14.52
104.0	292.54	2285.47	1944.28	4229.75	4229.75	4229.75	14.46
105.0	295.35	2307.96	1944.28	4252.23	4252.23	4252.23	14.40
106.0	298.17	2330.71	1944.28	4274.98	4274.98	4274.98	14.34
107.0	300.98	2353.72	1944.28	4297.99	4297.99	4297.99	14.28
108.0	303.79	2376.99	1944.28	4321.26	4321.26	4321.26	14.22
109.0	306.61	2400.52	1944.28	4344.80	4344.80	4344.80	14.17
110.0	309.42	2424.31	1944.28	4368.59	4368.59	4368.59	14.12
111.0	312.23	2448.37	1944.28	4392.64	4392.64	4392.64	14.07
112.0	315.04	2472.68	1944.28	4416.96	4416.96	4416.96	14.02
113.0	317.86	2497.26	1944.28	4441.54	4441.54	4441.54	13.97
114.0	320.67	2522.10	1944.28	4466.37	4466.37	4466.37	13.93
115.0	323.48	2547.19	1944.28	4491.47	4491.47	4491.47	13.88
116.0	326.30	2572.55	1944.28	4516.83	4516.83	4516.83	13.84
117.0	329.11	2598.17	1944.28	4542.45	4542.45	4542.45	13.80
118.0	331.92	2624.06	1944.28	4568.33	4568.33	4568.33	13.76
119.0	334.74	2650.20	1944.28	4594.48	4594.48	4594.48	13.73
120.0	337.55	2676.60	1944.28	4620.88	4620.88	4620.88	13.69
121.0	340.36	2703.27	1944.28	4647.55	4647.55	4647.55	13.65
122.0	343.17	2730.19	1944.28	4674.47	4674.47	4674.47	13.62
123.0	345.99	2757.38	1944.28	4701.66	4701.66	4701.66	13.59
124.0	348.80	2784.83	1944.28	4729.11	4729.11	4729.11	13.56
125.0	351.61	2812.54	1944.28	4756.82	4756.82	4756.82	13.53
126.0	354.43	2840.51	1944.28	4784.79	4784.79	4784.79	13.50
127.0	357.24	2868.74	1944.28	4813.02	4813.02	4813.02	13.47
128.0	360.05	2897.23	1944.28	4841.51	4841.51	4841.51	13.45
129.0	362.86	2925.99	1944.28	4870.26	4870.26	4870.26	13.42
130.0	365.68	2955.00	1944.28	4899.28	4899.28	4899.28	13.40
131.0	368.49	2984.28	1944.28	4928.55	4928.55	4928.55	13.37
132.0	371.30	3013.81	1944.28	4958.09	4958.09	4958.09	13.35
133.0	374.12	3043.61	1944.28	4987.89	4987.89	4987.89	13.33
134.0	376.93	3073.67	1944.28	5017.95	5017.95	5017.95	13.31
135.0	379.74	3103.99	1944.28	5048.27	5048.27	5048.27	13.29

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1333E+00	0.1648E-04	0.5767E-02	0.1000E-04
0.6663E+00	0.8242E-04	0.2884E-01	0.5000E-04
0.1333E+01	0.1648E-03	0.5767E-01	0.1000E-03
0.6663E+02	0.8242E-02	0.2884E+01	0.5000E-02
0.9994E+02	0.1236E-01	0.4325E+01	0.7500E-02
0.1333E+03	0.1648E-01	0.5767E+01	0.1000E-01
0.3332E+03	0.4121E-01	0.1442E+02	0.2500E-01

0.6672E+03	0.8245E-01	0.2884E+02	0.5000E-01
0.1001E+04	0.1237E+00	0.4325E+02	0.7500E-01
0.1319E+04	0.1646E+00	0.5767E+02	0.1000E+00
0.2339E+04	0.3691E+00	0.1442E+03	0.2500E+00
0.2991E+04	0.6584E+00	0.2884E+03	0.5000E+00
0.3594E+04	0.1384E+01	0.6708E+03	0.1180E+01
0.4007E+04	0.3197E+01	0.1244E+04	0.2950E+01
0.4732E+04	0.6210E+01	0.1973E+04	0.5900E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1975E+00	0.1944E-04	0.8239E-02	0.1000E-04
0.9877E+00	0.9720E-04	0.4119E-01	0.5000E-04
0.1975E+01	0.1944E-03	0.8239E-01	0.1000E-03
0.9877E+02	0.9720E-02	0.4119E+01	0.5000E-02
0.1482E+03	0.1458E-01	0.6179E+01	0.7500E-02
0.1975E+03	0.1944E-01	0.8239E+01	0.1000E-01
0.4946E+03	0.4862E-01	0.2060E+02	0.2500E-01
0.9900E+03	0.9728E-01	0.4119E+02	0.5000E-01
0.1482E+04	0.1459E+00	0.6179E+02	0.7500E-01
0.1912E+04	0.1927E+00	0.8239E+02	0.1000E+00
0.2930E+04	0.4010E+00	0.2060E+03	0.2500E+00
0.3449E+04	0.6866E+00	0.4119E+03	0.5000E+00
0.4029E+04	0.1416E+01	0.9333E+03	0.1180E+01
0.4437E+04	0.3227E+01	0.1478E+04	0.2950E+01
0.5059E+04	0.6230E+01	0.2100E+04	0.5900E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.7619E-01	0.1378E-04	0.3295E-02	0.1000E-04
0.3810E+00	0.6892E-04	0.1648E-01	0.5000E-04
0.7619E+00	0.1378E-03	0.3295E-01	0.1000E-03
0.3810E+02	0.6892E-02	0.1648E+01	0.5000E-02
0.5715E+02	0.1034E-01	0.2472E+01	0.7500E-02
0.7619E+02	0.1378E-01	0.3295E+01	0.1000E-01
0.1905E+03	0.3446E-01	0.8239E+01	0.2500E-01
0.3811E+03	0.6892E-01	0.1648E+02	0.5000E-01
0.5719E+03	0.1034E+00	0.2472E+02	0.7500E-01
0.7615E+03	0.1378E+00	0.3295E+02	0.1000E+00
0.1650E+04	0.3332E+00	0.8239E+02	0.2500E+00
0.2478E+04	0.6277E+00	0.1648E+03	0.5000E+00
0.3158E+04	0.1353E+01	0.4083E+03	0.1180E+01
0.3578E+04	0.3167E+01	0.1011E+04	0.2950E+01
0.4405E+04	0.6189E+01	0.1847E+04	0.5900E+01

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 6 (C)COPYRIGHT ENSOFT,INC.1989,1995,1998,2001,2003,2007

5th Street Bridge, Bent 7, 118"CIDH (comp) LQ

PROPOSED DEPTH = 135.0 FT

NUMBER OF LAYERS = 5

WATER TABLE DEPTH = 0.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.500E+01

LAYER NO 2----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.661E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.500E+01

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.400E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.646E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.400E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.594E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.450E+02

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.450E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.950E+02

LAYER NO 5----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.950E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 9.833 FT.
DIAMETER OF BASE = 9.833 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 5.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 109.366 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
6.0	16.88	3.40	110.82	114.22	114.22	114.22	6.57
7.0	19.69	6.80	111.03	117.83	117.83	117.83	5.98
8.0	22.50	10.20	111.24	121.44	121.44	121.44	5.40
9.0	25.32	13.59	111.39	124.98	124.98	124.98	4.94
10.0	28.13	16.99	111.47	128.46	128.46	128.46	4.57
11.0	30.94	20.39	111.50	131.89	131.89	131.89	4.26
12.0	33.75	23.79	111.49	135.28	135.28	135.28	4.01
13.0	36.57	27.19	111.45	138.63	138.63	138.63	3.79
14.0	39.38	30.59	111.38	141.97	141.97	141.97	3.61
15.0	42.19	33.98	111.31	145.29	145.29	145.29	3.44
16.0	45.01	37.38	111.23	148.62	148.62	148.62	3.30
17.0	47.82	40.78	111.16	151.94	151.94	151.94	3.18

18.0	50.63	44.18	111.08	155.26	155.26	155.26	3.07
19.0	53.45	47.58	111.07	158.64	158.64	158.64	2.97
20.0	56.26	50.98	111.10	162.08	162.08	162.08	2.88
21.0	59.07	54.38	111.20	165.57	165.57	165.57	2.80
22.0	61.88	57.77	174.11	231.88	231.88	231.88	3.75
23.0	64.70	61.17	240.17	301.34	301.34	301.34	4.66
24.0	67.51	64.57	309.39	373.96	373.96	373.96	5.54
25.0	70.32	67.97	381.75	449.72	449.72	449.72	6.40
26.0	73.14	71.37	457.27	528.64	528.64	528.64	7.23
27.0	75.95	74.77	515.14	589.91	589.91	589.91	7.77
28.0	78.76	78.17	575.12	653.28	653.28	653.28	8.29
29.0	81.57	81.56	637.19	718.75	718.75	718.75	8.81
30.0	84.39	84.96	701.35	786.31	786.31	786.31	9.32
31.0	87.20	88.36	761.31	849.67	849.67	849.67	9.74
32.0	90.01	91.76	810.79	902.55	902.55	902.55	10.03
33.0	92.83	95.16	849.79	944.95	944.95	944.95	10.18
34.0	95.64	98.56	878.31	976.86	976.86	976.86	10.21
35.0	98.45	101.95	896.35	998.30	998.30	998.30	10.14
36.0	101.26	105.35	905.98	1011.34	1011.34	1011.34	9.99
37.0	104.08	108.75	909.30	1018.05	1018.05	1018.05	9.78
38.0	106.89	112.15	906.30	1018.45	1018.45	1018.45	9.53
39.0	109.70	115.55	896.99	1012.54	1012.54	1012.54	9.23
40.0	112.52	118.95	881.39	1000.34	1000.34	1000.34	8.89
41.0	115.33	136.29	868.91	1005.20	1005.20	1005.20	8.72
42.0	118.14	153.96	859.54	1013.50	1013.50	1013.50	8.58
43.0	120.95	171.92	853.30	1025.22	1025.22	1025.22	8.48
44.0	123.77	190.17	850.18	1040.35	1040.35	1040.35	8.41
45.0	126.58	208.69	850.18	1058.87	1058.87	1058.87	8.37
46.0	129.39	240.27	850.18	1090.45	1090.45	1090.45	8.43
47.0	132.21	271.85	850.18	1122.03	1122.03	1122.03	8.49
48.0	135.02	303.42	850.18	1153.60	1153.60	1153.60	8.54
49.0	137.83	335.00	850.18	1185.18	1185.18	1185.18	8.60
50.0	140.65	366.58	850.18	1216.76	1216.76	1216.76	8.65
51.0	143.46	398.15	850.18	1248.33	1248.33	1248.33	8.70
52.0	146.27	429.73	850.18	1279.91	1279.91	1279.91	8.75
53.0	149.08	461.31	850.18	1311.49	1311.49	1311.49	8.80
54.0	151.90	492.89	850.18	1343.07	1343.07	1343.07	8.84
55.0	154.71	524.46	850.18	1374.64	1374.64	1374.64	8.89
56.0	157.52	556.04	850.18	1406.22	1406.22	1406.22	8.93
57.0	160.34	587.62	850.18	1437.80	1437.80	1437.80	8.97
58.0	163.15	619.19	850.18	1469.38	1469.38	1469.38	9.01
59.0	165.96	650.77	850.18	1500.95	1500.95	1500.95	9.04
60.0	168.77	682.35	850.18	1532.53	1532.53	1532.53	9.08
61.0	171.59	713.93	850.18	1564.11	1564.11	1564.11	9.12
62.0	174.40	745.50	850.18	1595.68	1595.68	1595.68	9.15
63.0	177.21	777.08	850.18	1627.26	1627.26	1627.26	9.18
64.0	180.03	808.66	850.18	1658.84	1658.84	1658.84	9.21
65.0	182.84	840.23	850.18	1690.42	1690.42	1690.42	9.25
66.0	185.65	871.81	850.18	1721.99	1721.99	1721.99	9.28
67.0	188.46	903.39	850.18	1753.57	1753.57	1753.57	9.30
68.0	191.28	934.97	850.18	1785.15	1785.15	1785.15	9.33
69.0	194.09	966.54	850.18	1816.72	1816.72	1816.72	9.36
70.0	196.90	998.12	850.18	1848.30	1848.30	1848.30	9.39
71.0	199.72	1029.70	850.18	1879.88	1879.88	1879.88	9.41
72.0	202.53	1061.28	850.18	1911.46	1911.46	1911.46	9.44
73.0	205.34	1092.85	850.18	1943.03	1943.03	1943.03	9.46
74.0	208.15	1124.43	850.18	1974.61	1974.61	1974.61	9.49
75.0	210.97	1156.01	850.18	2006.19	2006.19	2006.19	9.51
76.0	213.78	1187.58	850.18	2037.76	2037.76	2037.76	9.53
77.0	216.59	1219.16	912.52	2131.68	2131.68	2131.68	9.84
78.0	219.41	1250.74	977.98	2228.72	2228.72	2228.72	10.16
79.0	222.22	1282.32	1046.56	2328.87	2328.87	2328.87	10.48
80.0	225.03	1313.89	1118.25	2432.14	2432.14	2432.14	10.81
81.0	227.85	1345.47	1193.06	2538.53	2538.53	2538.53	11.14
82.0	230.66	1377.05	1270.99	2648.03	2648.03	2648.03	11.48
83.0	233.47	1408.62	1352.03	2760.66	2760.66	2760.66	11.82

84.0	236.28	1440.20	1436.19	2876.39	2876.39	2876.39	12.17
85.0	239.10	1471.78	1523.47	2995.25	2995.25	2995.25	12.53
86.0	241.91	1503.36	1607.63	3110.99	3110.99	3110.99	12.86
87.0	244.72	1534.93	1682.44	3217.38	3217.38	3217.38	13.15
88.0	247.54	1566.51	1747.90	3314.41	3314.41	3314.41	13.39
89.0	250.35	1598.09	1804.01	3402.10	3402.10	3402.10	13.59
90.0	253.16	1629.66	1850.77	3480.43	3480.43	3480.43	13.75
91.0	255.97	1661.24	1888.17	3549.41	3549.41	3549.41	13.87
92.0	258.79	1692.82	1916.22	3609.04	3609.04	3609.04	13.95
93.0	261.60	1724.40	1934.93	3659.32	3659.32	3659.32	13.99
94.0	264.41	1755.97	1944.28	3700.25	3700.25	3700.25	13.99
95.0	267.23	1787.55	1944.28	3731.83	3731.83	3731.83	13.97
96.0	270.04	1807.69	1944.28	3751.97	3751.97	3751.97	13.89
97.0	272.85	1828.09	1944.28	3772.36	3772.36	3772.36	13.83
98.0	275.66	1848.75	1944.28	3793.03	3793.03	3793.03	13.76
99.0	278.48	1869.67	1944.28	3813.95	3813.95	3813.95	13.70
100.0	281.29	1890.85	1944.28	3835.13	3835.13	3835.13	13.63
101.0	284.10	1912.30	1944.28	3856.57	3856.57	3856.57	13.57
102.0	286.92	1934.00	1944.28	3878.28	3878.28	3878.28	13.52
103.0	289.73	1955.97	1944.28	3900.24	3900.24	3900.24	13.46
104.0	292.54	1978.19	1944.28	3922.47	3922.47	3922.47	13.41
105.0	295.35	2000.68	1944.28	3944.96	3944.96	3944.96	13.36
106.0	298.17	2023.43	1944.28	3967.71	3967.71	3967.71	13.31
107.0	300.98	2046.44	1944.28	3990.72	3990.72	3990.72	13.26
108.0	303.79	2069.71	1944.28	4013.99	4013.99	4013.99	13.21
109.0	306.61	2093.24	1944.28	4037.52	4037.52	4037.52	13.17
110.0	309.42	2117.04	1944.28	4061.31	4061.31	4061.31	13.13
111.0	312.23	2141.09	1944.28	4085.37	4085.37	4085.37	13.08
112.0	315.04	2165.41	1944.28	4109.68	4109.68	4109.68	13.04
113.0	317.86	2189.98	1944.28	4134.26	4134.26	4134.26	13.01
114.0	320.67	2214.82	1944.28	4159.10	4159.10	4159.10	12.97
115.0	323.48	2239.92	1944.28	4184.20	4184.20	4184.20	12.93
116.0	326.30	2265.28	1944.28	4209.56	4209.56	4209.56	12.90
117.0	329.11	2290.90	1944.28	4235.18	4235.18	4235.18	12.87
118.0	331.92	2316.78	1944.28	4261.06	4261.06	4261.06	12.84
119.0	334.74	2342.92	1944.28	4287.20	4287.20	4287.20	12.81
120.0	337.55	2369.33	1944.28	4313.60	4313.60	4313.60	12.78
121.0	340.36	2395.99	1944.28	4340.27	4340.27	4340.27	12.75
122.0	343.17	2422.92	1944.28	4367.20	4367.20	4367.20	12.73
123.0	345.99	2450.11	1944.28	4394.38	4394.38	4394.38	12.70
124.0	348.80	2477.55	1944.28	4421.83	4421.83	4421.83	12.68
125.0	351.61	2505.26	1944.28	4449.54	4449.54	4449.54	12.65
126.0	354.43	2533.23	1944.28	4477.51	4477.51	4477.51	12.63
127.0	357.24	2561.46	1944.28	4505.74	4505.74	4505.74	12.61
128.0	360.05	2589.96	1944.28	4534.23	4534.23	4534.23	12.59
129.0	362.86	2618.71	1944.28	4562.99	4562.99	4562.99	12.57
130.0	365.68	2647.73	1944.28	4592.00	4592.00	4592.00	12.56
131.0	368.49	2677.00	1944.28	4621.28	4621.28	4621.28	12.54
132.0	371.30	2706.54	1944.28	4650.81	4650.81	4650.81	12.53
133.0	374.12	2736.34	1944.28	4680.61	4680.61	4680.61	12.51
134.0	376.93	2766.39	1944.28	4710.67	4710.67	4710.67	12.50
135.0	379.74	2796.71	1944.28	4740.99	4740.99	4740.99	12.48

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1234E+00	0.1631E-04	0.5767E-02	0.1000E-04
0.6169E+00	0.8155E-04	0.2884E-01	0.5000E-04
0.1234E+01	0.1631E-03	0.5767E-01	0.1000E-03
0.6169E+02	0.8155E-02	0.2884E+01	0.5000E-02
0.9254E+02	0.1223E-01	0.4325E+01	0.7500E-02
0.1234E+03	0.1631E-01	0.5767E+01	0.1000E-01
0.3085E+03	0.4077E-01	0.1442E+02	0.2500E-01

0.6177E+03	0.8157E-01	0.2884E+02	0.5000E-01
0.9268E+03	0.1224E+00	0.4325E+02	0.7500E-01
0.1220E+04	0.1628E+00	0.5767E+02	0.1000E+00
0.2147E+04	0.3657E+00	0.1442E+03	0.2500E+00
0.2732E+04	0.6539E+00	0.2884E+03	0.5000E+00
0.3294E+04	0.1379E+01	0.6708E+03	0.1180E+01
0.3698E+04	0.3192E+01	0.1244E+04	0.2950E+01
0.4424E+04	0.6204E+01	0.1973E+04	0.5900E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1835E+00	0.1919E-04	0.8239E-02	0.1000E-04
0.9174E+00	0.9595E-04	0.4119E-01	0.5000E-04
0.1835E+01	0.1919E-03	0.8239E-01	0.1000E-03
0.9174E+02	0.9595E-02	0.4119E+01	0.5000E-02
0.1376E+03	0.1439E-01	0.6179E+01	0.7500E-02
0.1835E+03	0.1919E-01	0.8239E+01	0.1000E-01
0.4593E+03	0.4799E-01	0.2060E+02	0.2500E-01
0.9194E+03	0.9602E-01	0.4119E+02	0.5000E-01
0.1375E+04	0.1440E+00	0.6179E+02	0.7500E-01
0.1768E+04	0.1902E+00	0.8239E+02	0.1000E+00
0.2664E+04	0.3964E+00	0.2060E+03	0.2500E+00
0.3149E+04	0.6814E+00	0.4119E+03	0.5000E+00
0.3722E+04	0.1410E+01	0.9333E+03	0.1180E+01
0.4120E+04	0.3221E+01	0.1478E+04	0.2950E+01
0.4742E+04	0.6225E+01	0.2100E+04	0.5900E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.6993E-01	0.1367E-04	0.3295E-02	0.1000E-04
0.3496E+00	0.6837E-04	0.1648E-01	0.5000E-04
0.6993E+00	0.1367E-03	0.3295E-01	0.1000E-03
0.3496E+02	0.6837E-02	0.1648E+01	0.5000E-02
0.5245E+02	0.1026E-01	0.2472E+01	0.7500E-02
0.6993E+02	0.1367E-01	0.3295E+01	0.1000E-01
0.1748E+03	0.3418E-01	0.8239E+01	0.2500E-01
0.3497E+03	0.6837E-01	0.1648E+02	0.5000E-01
0.5248E+03	0.1026E+00	0.2472E+02	0.7500E-01
0.6993E+03	0.1368E+00	0.3295E+02	0.1000E+00
0.1519E+04	0.3309E+00	0.8239E+02	0.2500E+00
0.2264E+04	0.6240E+00	0.1648E+03	0.5000E+00
0.2867E+04	0.1348E+01	0.4083E+03	0.1180E+01
0.3276E+04	0.3162E+01	0.1011E+04	0.2950E+01
0.4105E+04	0.6184E+01	0.1847E+04	0.5900E+01

SHAFT Axial Analysis – 5th Street Bridge, Bent 8, 118” CIDH (NL and LQ)

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 6 (C)COPYRIGHT ENSOFT,INC.1989,1995,1998,2001,2003,2007

5th Street Bridge, Bent 8, 118"CIDH (comp) NL

PROPOSED DEPTH = 130.0 FT

NUMBER OF LAYERS = 5

WATER TABLE DEPTH = 0.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+01

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+01

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.679E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.370E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.679E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.370E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.625E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.420E+02

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.420E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.820E+02

LAYER NO 5----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.278E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.820E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 9.833 FT.
DIAMETER OF BASE = 9.833 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 5.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 109.366 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
6.0	16.88	3.99	0.00	3.99	3.99	3.99	0.30
7.0	19.69	9.88	0.00	9.88	9.88	9.88	0.50
8.0	22.50	15.77	0.00	15.77	15.77	15.77	0.70
9.0	25.32	22.25	0.00	22.25	22.25	22.25	0.88
10.0	28.13	29.31	0.00	29.31	29.31	29.31	1.04
11.0	30.94	36.93	0.00	36.93	36.93	36.93	1.19
12.0	33.75	45.08	0.00	45.08	45.08	45.08	1.34
13.0	36.57	53.75	0.00	53.75	53.75	53.75	1.47
14.0	39.38	62.92	0.00	62.92	62.92	62.92	1.60
15.0	42.19	72.56	0.00	72.56	72.56	72.56	1.72
16.0	45.01	82.67	0.00	82.67	82.67	82.67	1.84
17.0	47.82	93.23	0.00	93.23	93.23	93.23	1.95

18.0	50.63	104.21	0.00	104.21	104.21	104.21	2.06
19.0	53.45	115.61	69.25	184.86	184.86	184.86	3.46
20.0	56.26	127.40	141.96	269.36	269.36	269.36	4.79
21.0	59.07	139.58	218.14	357.72	357.72	357.72	6.06
22.0	61.88	152.13	297.77	449.90	449.90	449.90	7.27
23.0	64.70	165.04	380.87	545.91	545.91	545.91	8.44
24.0	67.51	178.28	446.63	624.91	624.91	624.91	9.26
25.0	70.32	191.85	514.80	706.66	706.66	706.66	10.05
26.0	73.14	205.74	585.40	791.14	791.14	791.14	10.82
27.0	75.95	219.93	658.43	878.35	878.35	878.35	11.57
28.0	78.76	234.40	726.95	961.35	961.35	961.35	12.21
29.0	81.57	249.16	784.04	1033.19	1033.19	1033.19	12.67
30.0	84.39	264.17	829.70	1093.87	1093.87	1093.87	12.96
31.0	87.20	279.44	863.94	1143.38	1143.38	1143.38	13.11
32.0	90.01	294.94	886.75	1181.69	1181.69	1181.69	13.13
33.0	92.83	310.68	900.21	1210.89	1210.89	1210.89	13.04
34.0	95.64	326.63	906.40	1233.03	1233.03	1233.03	12.89
35.0	98.45	342.78	905.33	1248.11	1248.11	1248.11	12.68
36.0	101.26	359.13	896.99	1256.12	1256.12	1256.12	12.40
37.0	104.08	375.65	881.39	1257.04	1257.04	1257.04	12.08
38.0	106.89	392.56	868.91	1261.47	1261.47	1261.47	11.80
39.0	109.70	409.83	859.54	1269.37	1269.37	1269.37	11.57
40.0	112.52	427.43	853.30	1280.74	1280.74	1280.74	11.38
41.0	115.33	445.37	850.18	1295.55	1295.55	1295.55	11.23
42.0	118.14	463.61	850.18	1313.79	1313.79	1313.79	11.12
43.0	120.95	495.19	850.18	1345.37	1345.37	1345.37	11.12
44.0	123.77	526.76	850.18	1376.95	1376.95	1376.95	11.13
45.0	126.58	558.34	850.18	1408.52	1408.52	1408.52	11.13
46.0	129.39	589.92	850.18	1440.10	1440.10	1440.10	11.13
47.0	132.21	621.50	850.18	1471.68	1471.68	1471.68	11.13
48.0	135.02	653.07	850.18	1503.25	1503.25	1503.25	11.13
49.0	137.83	684.65	850.18	1534.83	1534.83	1534.83	11.14
50.0	140.65	716.23	850.18	1566.41	1566.41	1566.41	11.14
51.0	143.46	747.81	850.18	1597.99	1597.99	1597.99	11.14
52.0	146.27	779.38	850.18	1629.56	1629.56	1629.56	11.14
53.0	149.08	810.96	850.18	1661.14	1661.14	1661.14	11.14
54.0	151.90	842.54	850.18	1692.72	1692.72	1692.72	11.14
55.0	154.71	874.11	850.18	1724.29	1724.29	1724.29	11.15
56.0	157.52	905.69	850.18	1755.87	1755.87	1755.87	11.15
57.0	160.34	937.27	850.18	1787.45	1787.45	1787.45	11.15
58.0	163.15	968.85	850.18	1819.03	1819.03	1819.03	11.15
59.0	165.96	1000.42	850.18	1850.60	1850.60	1850.60	11.15
60.0	168.77	1032.00	850.18	1882.18	1882.18	1882.18	11.15
61.0	171.59	1063.58	850.18	1913.76	1913.76	1913.76	11.15
62.0	174.40	1095.15	850.18	1945.34	1945.34	1945.34	11.15
63.0	177.21	1126.73	850.18	1976.91	1976.91	1976.91	11.16
64.0	180.03	1158.31	912.52	2070.83	2070.83	2070.83	11.50
65.0	182.84	1189.89	977.98	2167.87	2167.87	2167.87	11.86
66.0	185.65	1221.46	1046.56	2268.02	2268.02	2268.02	12.22
67.0	188.46	1253.04	1118.25	2371.29	2371.29	2371.29	12.58
68.0	191.28	1284.62	1193.06	2477.68	2477.68	2477.68	12.95
69.0	194.09	1316.19	1270.99	2587.18	2587.18	2587.18	13.33
70.0	196.90	1347.77	1352.03	2699.80	2699.80	2699.80	13.71
71.0	199.72	1379.35	1436.19	2815.54	2815.54	2815.54	14.10
72.0	202.53	1410.93	1523.47	2934.40	2934.40	2934.40	14.49
73.0	205.34	1442.50	1607.63	3050.14	3050.14	3050.14	14.85
74.0	208.15	1474.08	1682.44	3156.52	3156.52	3156.52	15.16
75.0	210.97	1505.66	1747.90	3253.56	3253.56	3253.56	15.42
76.0	213.78	1537.23	1804.01	3341.24	3341.24	3341.24	15.63
77.0	216.59	1568.81	1850.77	3419.58	3419.58	3419.58	15.79
78.0	219.41	1600.39	1888.17	3488.56	3488.56	3488.56	15.90
79.0	222.22	1631.97	1916.22	3548.19	3548.19	3548.19	15.97
80.0	225.03	1663.54	1934.93	3598.47	3598.47	3598.47	15.99
81.0	227.85	1695.12	1944.28	3639.40	3639.40	3639.40	15.97
82.0	230.66	1726.70	1944.28	3670.97	3670.97	3670.97	15.92
83.0	233.47	1745.31	1944.28	3689.59	3689.59	3689.59	15.80

84.0	236.28	1763.69	1944.28	3707.96	3707.96	3707.96	15.69
85.0	239.10	1781.82	1944.28	3726.09	3726.09	3726.09	15.58
86.0	241.91	1799.83	1944.28	3744.10	3744.10	3744.10	15.48
87.0	244.72	1818.10	1944.28	3762.38	3762.38	3762.38	15.37
88.0	247.54	1836.63	1944.28	3780.91	3780.91	3780.91	15.27
89.0	250.35	1855.42	1944.28	3799.70	3799.70	3799.70	15.18
90.0	253.16	1874.48	1944.28	3818.76	3818.76	3818.76	15.08
91.0	255.97	1893.79	1944.28	3838.07	3838.07	3838.07	14.99
92.0	258.79	1913.37	1944.28	3857.65	3857.65	3857.65	14.91
93.0	261.60	1933.21	1944.28	3877.49	3877.49	3877.49	14.82
94.0	264.41	1953.31	1944.28	3897.59	3897.59	3897.59	14.74
95.0	267.23	1973.67	1944.28	3917.95	3917.95	3917.95	14.66
96.0	270.04	1994.29	1944.28	3938.57	3938.57	3938.57	14.59
97.0	272.85	2015.17	1944.28	3959.45	3959.45	3959.45	14.51
98.0	275.66	2036.31	1944.28	3980.59	3980.59	3980.59	14.44
99.0	278.48	2057.72	1944.28	4002.00	4002.00	4002.00	14.37
100.0	281.29	2079.38	1944.28	4023.66	4023.66	4023.66	14.30
101.0	284.10	2101.31	1944.28	4045.59	4045.59	4045.59	14.24
102.0	286.92	2123.50	1944.28	4067.78	4067.78	4067.78	14.18
103.0	289.73	2145.95	1944.28	4090.22	4090.22	4090.22	14.12
104.0	292.54	2168.66	1944.28	4112.93	4112.93	4112.93	14.06
105.0	295.35	2191.63	1944.28	4135.90	4135.90	4135.90	14.00
106.0	298.17	2214.86	1944.28	4159.14	4159.14	4159.14	13.95
107.0	300.98	2238.35	1944.28	4182.63	4182.63	4182.63	13.90
108.0	303.79	2262.11	1944.28	4206.38	4206.38	4206.38	13.85
109.0	306.61	2286.12	1944.28	4230.40	4230.40	4230.40	13.80
110.0	309.42	2310.40	1944.28	4254.67	4254.67	4254.67	13.75
111.0	312.23	2334.93	1944.28	4279.21	4279.21	4279.21	13.71
112.0	315.04	2359.73	1944.28	4304.01	4304.01	4304.01	13.66
113.0	317.86	2384.79	1944.28	4329.07	4329.07	4329.07	13.62
114.0	320.67	2410.11	1944.28	4354.39	4354.39	4354.39	13.58
115.0	323.48	2435.69	1944.28	4379.97	4379.97	4379.97	13.54
116.0	326.30	2461.53	1944.28	4405.81	4405.81	4405.81	13.50
117.0	329.11	2487.64	1944.28	4431.92	4431.92	4431.92	13.47
118.0	331.92	2514.00	1944.28	4458.28	4458.28	4458.28	13.43
119.0	334.74	2540.63	1944.28	4484.91	4484.91	4484.91	13.40
120.0	337.55	2567.51	1944.28	4511.79	4511.79	4511.79	13.37
121.0	340.36	2594.66	1944.28	4538.94	4538.94	4538.94	13.34
122.0	343.17	2622.07	1944.28	4566.35	4566.35	4566.35	13.31
123.0	345.99	2649.74	1944.28	4594.02	4594.02	4594.02	13.28
124.0	348.80	2677.67	1944.28	4621.95	4621.95	4621.95	13.25
125.0	351.61	2705.86	1944.28	4650.14	4650.14	4650.14	13.23
126.0	354.43	2734.32	1944.28	4678.59	4678.59	4678.59	13.20
127.0	357.24	2763.03	1944.28	4707.31	4707.31	4707.31	13.18
128.0	360.05	2792.01	1944.28	4736.28	4736.28	4736.28	13.15
129.0	362.86	2821.24	1944.28	4765.52	4765.52	4765.52	13.13
130.0	365.68	2850.74	1944.28	4795.02	4795.02	4795.02	13.11

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1184E+00	0.1549E-04	0.5767E-02	0.1000E-04
0.5919E+00	0.7745E-04	0.2884E-01	0.5000E-04
0.1184E+01	0.1549E-03	0.5767E-01	0.1000E-03
0.5919E+02	0.7745E-02	0.2884E+01	0.5000E-02
0.8879E+02	0.1162E-01	0.4325E+01	0.7500E-02
0.1184E+03	0.1549E-01	0.5767E+01	0.1000E-01
0.2960E+03	0.3873E-01	0.1442E+02	0.2500E-01
0.5926E+03	0.7747E-01	0.2884E+02	0.5000E-01
0.8892E+03	0.1162E+00	0.4325E+02	0.7500E-01
0.1177E+04	0.1548E+00	0.5767E+02	0.1000E+00
0.2127E+04	0.3534E+00	0.1442E+03	0.2500E+00
0.2757E+04	0.6399E+00	0.2884E+03	0.5000E+00

0.3369E+04	0.1365E+01	0.6708E+03	0.1180E+01
0.3815E+04	0.3177E+01	0.1244E+04	0.2950E+01
0.4540E+04	0.6188E+01	0.1973E+04	0.5900E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1737E+00	0.1791E-04	0.8239E-02	0.1000E-04
0.8684E+00	0.8956E-04	0.4119E-01	0.5000E-04
0.1737E+01	0.1791E-03	0.8239E-01	0.1000E-03
0.8684E+02	0.8956E-02	0.4119E+01	0.5000E-02
0.1303E+03	0.1343E-01	0.6179E+01	0.7500E-02
0.1737E+03	0.1791E-01	0.8239E+01	0.1000E-01
0.4347E+03	0.4479E-01	0.2060E+02	0.2500E-01
0.8701E+03	0.8961E-01	0.4119E+02	0.5000E-01
0.1305E+04	0.1344E+00	0.6179E+02	0.7500E-01
0.1697E+04	0.1782E+00	0.8239E+02	0.1000E+00
0.2682E+04	0.3822E+00	0.2060E+03	0.2500E+00
0.3202E+04	0.6663E+00	0.4119E+03	0.5000E+00
0.3786E+04	0.1394E+01	0.9333E+03	0.1180E+01
0.4221E+04	0.3205E+01	0.1478E+04	0.2950E+01
0.4843E+04	0.6206E+01	0.2100E+04	0.5900E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.6869E-01	0.1325E-04	0.3295E-02	0.1000E-04
0.3434E+00	0.6627E-04	0.1648E-01	0.5000E-04
0.6869E+00	0.1325E-03	0.3295E-01	0.1000E-03
0.3434E+02	0.6627E-02	0.1648E+01	0.5000E-02
0.5151E+02	0.9940E-02	0.2472E+01	0.7500E-02
0.6869E+02	0.1325E-01	0.3295E+01	0.1000E-01
0.1717E+03	0.3313E-01	0.8239E+01	0.2500E-01
0.3435E+03	0.6627E-01	0.1648E+02	0.5000E-01
0.5155E+03	0.9941E-01	0.2472E+02	0.7500E-01
0.6868E+03	0.1325E+00	0.3295E+02	0.1000E+00
0.1495E+04	0.3218E+00	0.8239E+02	0.2500E+00
0.2268E+04	0.6117E+00	0.1648E+03	0.5000E+00
0.2952E+04	0.1336E+01	0.4083E+03	0.1180E+01
0.3410E+04	0.3150E+01	0.1011E+04	0.2950E+01
0.4236E+04	0.6169E+01	0.1847E+04	0.5900E+01

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
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5th Street Bridge, Bent 8, 118"CIDH (comp) LQ

PROPOSED DEPTH = 130.0 FT

NUMBER OF LAYERS = 5

WATER TABLE DEPTH = 0.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+01

LAYER NO 2----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.624E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+01

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.370E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.679E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.370E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.625E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.420E+02

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.420E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.820E+02

LAYER NO 5----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.278E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.820E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 9.833 FT.
DIAMETER OF BASE = 9.833 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 5.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 109.366 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
6.0	16.88	3.40	110.88	114.28	114.28	114.28	6.58
7.0	19.69	6.80	111.24	118.04	118.04	118.04	5.99
8.0	22.50	10.20	111.60	121.79	121.79	121.79	5.41
9.0	25.32	13.59	111.89	125.48	125.48	125.48	4.96
10.0	28.13	16.99	112.11	129.11	129.11	129.11	4.59
11.0	30.94	20.39	112.29	132.68	132.68	132.68	4.29
12.0	33.75	23.79	112.42	136.21	136.21	136.21	4.04
13.0	36.57	27.19	112.51	139.70	139.70	139.70	3.82
14.0	39.38	30.59	112.59	143.17	143.17	143.17	3.64
15.0	42.19	33.98	112.65	146.63	146.63	146.63	3.48
16.0	45.01	37.38	112.70	150.08	150.08	150.08	3.33
17.0	47.82	40.78	112.75	153.54	153.54	153.54	3.21

18.0	50.63	44.18	112.81	156.99	156.99	156.99	3.10
19.0	53.45	47.58	175.66	223.24	223.24	223.24	4.18
20.0	56.26	50.98	241.64	292.62	292.62	292.62	5.20
21.0	59.07	54.38	310.77	365.14	365.14	365.14	6.18
22.0	61.88	57.77	383.03	440.80	440.80	440.80	7.12
23.0	64.70	61.17	458.42	519.60	519.60	519.60	8.03
24.0	67.51	64.57	516.15	580.72	580.72	580.72	8.60
25.0	70.32	67.97	575.97	643.94	643.94	643.94	9.16
26.0	73.14	71.37	637.89	709.26	709.26	709.26	9.70
27.0	75.95	74.77	701.90	776.67	776.67	776.67	10.23
28.0	78.76	78.17	761.73	839.90	839.90	839.90	10.66
29.0	81.57	81.56	811.10	892.66	892.66	892.66	10.94
30.0	84.39	84.96	850.00	934.96	934.96	934.96	11.08
31.0	87.20	88.36	878.44	966.80	966.80	966.80	11.09
32.0	90.01	91.76	896.42	988.17	988.17	988.17	10.98
33.0	92.83	95.16	906.01	1001.17	1001.17	1001.17	10.79
34.0	95.64	98.56	909.30	1007.86	1007.86	1007.86	10.54
35.0	98.45	101.95	906.30	1008.25	1008.25	1008.25	10.24
36.0	101.26	105.35	896.99	1002.35	1002.35	1002.35	9.90
37.0	104.08	108.75	881.39	990.14	990.14	990.14	9.51
38.0	106.89	125.66	868.91	994.56	994.56	994.56	9.30
39.0	109.70	142.92	859.54	1002.47	1002.47	1002.47	9.14
40.0	112.52	160.53	853.30	1013.83	1013.83	1013.83	9.01
41.0	115.33	178.47	850.18	1028.65	1028.65	1028.65	8.92
42.0	118.14	196.71	850.18	1046.89	1046.89	1046.89	8.86
43.0	120.95	228.29	850.18	1078.47	1078.47	1078.47	8.92
44.0	123.77	259.86	850.18	1110.04	1110.04	1110.04	8.97
45.0	126.58	291.44	850.18	1141.62	1141.62	1141.62	9.02
46.0	129.39	323.02	850.18	1173.20	1173.20	1173.20	9.07
47.0	132.21	354.59	850.18	1204.77	1204.77	1204.77	9.11
48.0	135.02	386.17	850.18	1236.35	1236.35	1236.35	9.16
49.0	137.83	417.75	850.18	1267.93	1267.93	1267.93	9.20
50.0	140.65	449.33	850.18	1299.51	1299.51	1299.51	9.24
51.0	143.46	480.90	850.18	1331.08	1331.08	1331.08	9.28
52.0	146.27	512.48	850.18	1362.66	1362.66	1362.66	9.32
53.0	149.08	544.06	850.18	1394.24	1394.24	1394.24	9.35
54.0	151.90	575.63	850.18	1425.81	1425.81	1425.81	9.39
55.0	154.71	607.21	850.18	1457.39	1457.39	1457.39	9.42
56.0	157.52	638.79	850.18	1488.97	1488.97	1488.97	9.45
57.0	160.34	670.37	850.18	1520.55	1520.55	1520.55	9.48
58.0	163.15	701.94	850.18	1552.12	1552.12	1552.12	9.51
59.0	165.96	733.52	850.18	1583.70	1583.70	1583.70	9.54
60.0	168.77	765.10	850.18	1615.28	1615.28	1615.28	9.57
61.0	171.59	796.67	850.18	1646.86	1646.86	1646.86	9.60
62.0	174.40	828.25	850.18	1678.43	1678.43	1678.43	9.62
63.0	177.21	859.83	850.18	1710.01	1710.01	1710.01	9.65
64.0	180.03	891.41	912.52	1803.93	1803.93	1803.93	10.02
65.0	182.84	922.98	977.98	1900.96	1900.96	1900.96	10.40
66.0	185.65	954.56	1046.56	2001.12	2001.12	2001.12	10.78
67.0	188.46	986.14	1118.25	2104.39	2104.39	2104.39	11.17
68.0	191.28	1017.72	1193.06	2210.77	2210.77	2210.77	11.56
69.0	194.09	1049.29	1270.99	2320.28	2320.28	2320.28	11.95
70.0	196.90	1080.87	1352.03	2432.90	2432.90	2432.90	12.36
71.0	199.72	1112.45	1436.19	2548.64	2548.64	2548.64	12.76
72.0	202.53	1144.02	1523.47	2667.49	2667.49	2667.49	13.17
73.0	205.34	1175.60	1607.63	2783.23	2783.23	2783.23	13.55
74.0	208.15	1207.18	1682.44	2889.62	2889.62	2889.62	13.88
75.0	210.97	1238.76	1747.90	2986.66	2986.66	2986.66	14.16
76.0	213.78	1270.33	1804.01	3074.34	3074.34	3074.34	14.38
77.0	216.59	1301.91	1850.77	3152.67	3152.67	3152.67	14.56
78.0	219.41	1333.49	1888.17	3221.66	3221.66	3221.66	14.68
79.0	222.22	1365.06	1916.22	3281.29	3281.29	3281.29	14.77
80.0	225.03	1396.64	1934.93	3331.57	3331.57	3331.57	14.80
81.0	227.85	1428.22	1944.28	3372.50	3372.50	3372.50	14.80
82.0	230.66	1459.80	1944.28	3404.07	3404.07	3404.07	14.76
83.0	233.47	1478.41	1944.28	3422.68	3422.68	3422.68	14.66

84.0	236.28	1496.78	1944.28	3441.06	3441.06	3441.06	14.56
85.0	239.10	1514.91	1944.28	3459.19	3459.19	3459.19	14.47
86.0	241.91	1532.92	1944.28	3477.20	3477.20	3477.20	14.37
87.0	244.72	1551.20	1944.28	3495.47	3495.47	3495.47	14.28
88.0	247.54	1569.73	1944.28	3514.01	3514.01	3514.01	14.20
89.0	250.35	1588.52	1944.28	3532.80	3532.80	3532.80	14.11
90.0	253.16	1607.58	1944.28	3551.85	3551.85	3551.85	14.03
91.0	255.97	1626.89	1944.28	3571.17	3571.17	3571.17	13.95
92.0	258.79	1646.47	1944.28	3590.75	3590.75	3590.75	13.88
93.0	261.60	1666.31	1944.28	3610.58	3610.58	3610.58	13.80
94.0	264.41	1686.41	1944.28	3630.68	3630.68	3630.68	13.73
95.0	267.23	1706.77	1944.28	3651.04	3651.04	3651.04	13.66
96.0	270.04	1727.39	1944.28	3671.66	3671.66	3671.66	13.60
97.0	272.85	1748.27	1944.28	3692.55	3692.55	3692.55	13.53
98.0	275.66	1769.41	1944.28	3713.69	3713.69	3713.69	13.47
99.0	278.48	1790.82	1944.28	3735.09	3735.09	3735.09	13.41
100.0	281.29	1812.48	1944.28	3756.76	3756.76	3756.76	13.36
101.0	284.10	1834.41	1944.28	3778.69	3778.69	3778.69	13.30
102.0	286.92	1856.60	1944.28	3800.87	3800.87	3800.87	13.25
103.0	289.73	1879.04	1944.28	3823.32	3823.32	3823.32	13.20
104.0	292.54	1901.75	1944.28	3846.03	3846.03	3846.03	13.15
105.0	295.35	1924.72	1944.28	3869.00	3869.00	3869.00	13.10
106.0	298.17	1947.96	1944.28	3892.23	3892.23	3892.23	13.05
107.0	300.98	1971.45	1944.28	3915.73	3915.73	3915.73	13.01
108.0	303.79	1995.20	1944.28	3939.48	3939.48	3939.48	12.97
109.0	306.61	2019.22	1944.28	3963.50	3963.50	3963.50	12.93
110.0	309.42	2043.49	1944.28	3987.77	3987.77	3987.77	12.89
111.0	312.23	2068.03	1944.28	4012.31	4012.31	4012.31	12.85
112.0	315.04	2092.83	1944.28	4037.11	4037.11	4037.11	12.81
113.0	317.86	2117.89	1944.28	4062.17	4062.17	4062.17	12.78
114.0	320.67	2143.21	1944.28	4087.49	4087.49	4087.49	12.75
115.0	323.48	2168.79	1944.28	4113.07	4113.07	4113.07	12.71
116.0	326.30	2194.63	1944.28	4138.91	4138.91	4138.91	12.68
117.0	329.11	2220.74	1944.28	4165.01	4165.01	4165.01	12.66
118.0	331.92	2247.10	1944.28	4191.38	4191.38	4191.38	12.63
119.0	334.74	2273.73	1944.28	4218.00	4218.00	4218.00	12.60
120.0	337.55	2300.61	1944.28	4244.89	4244.89	4244.89	12.58
121.0	340.36	2327.76	1944.28	4272.04	4272.04	4272.04	12.55
122.0	343.17	2355.17	1944.28	4299.45	4299.45	4299.45	12.53
123.0	345.99	2382.84	1944.28	4327.12	4327.12	4327.12	12.51
124.0	348.80	2410.77	1944.28	4355.05	4355.05	4355.05	12.49
125.0	351.61	2438.96	1944.28	4383.24	4383.24	4383.24	12.47
126.0	354.43	2467.41	1944.28	4411.69	4411.69	4411.69	12.45
127.0	357.24	2496.13	1944.28	4440.41	4440.41	4440.41	12.43
128.0	360.05	2525.10	1944.28	4469.38	4469.38	4469.38	12.41
129.0	362.86	2554.34	1944.28	4498.62	4498.62	4498.62	12.40
130.0	365.68	2583.84	1944.28	4528.11	4528.11	4528.11	12.38

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1102E+00	0.1536E-04	0.5767E-02	0.1000E-04
0.5511E+00	0.7678E-04	0.2884E-01	0.5000E-04
0.1102E+01	0.1536E-03	0.5767E-01	0.1000E-03
0.5511E+02	0.7678E-02	0.2884E+01	0.5000E-02
0.8267E+02	0.1152E-01	0.4325E+01	0.7500E-02
0.1102E+03	0.1536E-01	0.5767E+01	0.1000E-01
0.2756E+03	0.3839E-01	0.1442E+02	0.2500E-01
0.5517E+03	0.7680E-01	0.2884E+02	0.5000E-01
0.8278E+03	0.1152E+00	0.4325E+02	0.7500E-01
0.1095E+04	0.1534E+00	0.5767E+02	0.1000E+00
0.1962E+04	0.3508E+00	0.1442E+03	0.2500E+00
0.2531E+04	0.6363E+00	0.2884E+03	0.5000E+00

0.3106E+04	0.1360E+01	0.6708E+03	0.1180E+01
0.3543E+04	0.3173E+01	0.1244E+04	0.2950E+01
0.4268E+04	0.6184E+01	0.1973E+04	0.5900E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1623E+00	0.1772E-04	0.8239E-02	0.1000E-04
0.8114E+00	0.8861E-04	0.4119E-01	0.5000E-04
0.1623E+01	0.1772E-03	0.8239E-01	0.1000E-03
0.8114E+02	0.8861E-02	0.4119E+01	0.5000E-02
0.1217E+03	0.1329E-01	0.6179E+01	0.7500E-02
0.1623E+03	0.1772E-01	0.8239E+01	0.1000E-01
0.4061E+03	0.4431E-01	0.2060E+02	0.2500E-01
0.8130E+03	0.8866E-01	0.4119E+02	0.5000E-01
0.1218E+04	0.1330E+00	0.6179E+02	0.7500E-01
0.1579E+04	0.1763E+00	0.8239E+02	0.1000E+00
0.2453E+04	0.3785E+00	0.2060E+03	0.2500E+00
0.2939E+04	0.6621E+00	0.4119E+03	0.5000E+00
0.3516E+04	0.1389E+01	0.9333E+03	0.1180E+01
0.3942E+04	0.3200E+01	0.1478E+04	0.2950E+01
0.4564E+04	0.6202E+01	0.2100E+04	0.5900E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.6337E-01	0.1317E-04	0.3295E-02	0.1000E-04
0.3169E+00	0.6583E-04	0.1648E-01	0.5000E-04
0.6337E+00	0.1317E-03	0.3295E-01	0.1000E-03
0.3169E+02	0.6583E-02	0.1648E+01	0.5000E-02
0.4753E+02	0.9875E-02	0.2472E+01	0.7500E-02
0.6337E+02	0.1317E-01	0.3295E+01	0.1000E-01
0.1584E+03	0.3292E-01	0.8239E+01	0.2500E-01
0.3169E+03	0.6583E-01	0.1648E+02	0.5000E-01
0.4756E+03	0.9876E-01	0.2472E+02	0.7500E-01
0.6339E+03	0.1317E+00	0.3295E+02	0.1000E+00
0.1382E+04	0.3200E+00	0.8239E+02	0.2500E+00
0.2082E+04	0.6087E+00	0.1648E+03	0.5000E+00
0.2697E+04	0.1332E+01	0.4083E+03	0.1180E+01
0.3143E+04	0.3146E+01	0.1011E+04	0.2950E+01
0.3972E+04	0.6165E+01	0.1847E+04	0.5900E+01

SHAFT Axial Analysis – 5th Street Bridge, Bent 9, 118” CIDH (NL and LQ)

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
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5th Street Bridge, Bent 9, 118"CIDH (comp) NL

PROPOSED DEPTH = 125.0 FT

NUMBER OF LAYERS = 5

WATER TABLE DEPTH = 0.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.100E+01

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.100E+01

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.812E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.260E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.812E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.260E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.690E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.360E+02

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.360E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.960E+02

LAYER NO 5----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.960E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 9.833 FT.
DIAMETER OF BASE = 9.833 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 5.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 109.366 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
6.0	16.88	3.99	-69.25	-65.25	-65.25	-65.25	-2.77
7.0	19.69	9.88	0.00	9.88	9.88	9.88	0.50
8.0	22.50	15.77	69.25	85.02	85.02	85.02	3.78
9.0	25.32	22.25	141.96	164.21	164.21	164.21	6.49
10.0	28.13	29.31	218.14	247.45	247.45	247.45	8.80
11.0	30.94	36.93	297.77	334.70	334.70	334.70	10.82
12.0	33.75	45.08	380.87	425.96	425.96	425.96	12.62
13.0	36.57	53.75	467.43	521.19	521.19	521.19	14.25
14.0	39.38	62.92	557.46	620.38	620.38	620.38	15.75
15.0	42.19	72.56	650.94	723.51	723.51	723.51	17.15
16.0	45.01	82.67	747.89	830.56	830.56	830.56	18.45
17.0	47.82	93.23	841.38	934.60	934.60	934.60	19.54

18.0	50.63	104.21	903.67	1007.88	1007.88	1007.88	19.91
19.0	53.45	115.61	954.54	1070.14	1070.14	1070.14	20.02
20.0	56.26	127.40	993.98	1121.38	1121.38	1121.38	19.93
21.0	59.07	139.58	1021.99	1161.57	1161.57	1161.57	19.66
22.0	61.88	152.13	1038.57	1190.70	1190.70	1190.70	19.24
23.0	64.70	165.04	1043.72	1208.76	1208.76	1208.76	18.68
24.0	67.51	178.28	1037.45	1215.73	1215.73	1215.73	18.01
25.0	70.32	191.85	1019.75	1211.60	1211.60	1211.60	17.23
26.0	73.14	205.74	990.62	1196.36	1196.36	1196.36	16.36
27.0	75.95	220.17	962.53	1182.71	1182.71	1182.71	15.57
28.0	78.76	235.14	937.57	1172.70	1172.70	1172.70	14.89
29.0	81.57	250.60	915.72	1166.32	1166.32	1166.32	14.30
30.0	84.39	266.56	896.99	1163.55	1163.55	1163.55	13.79
31.0	87.20	282.98	881.39	1164.37	1164.37	1164.37	13.35
32.0	90.01	299.85	868.91	1168.76	1168.76	1168.76	12.98
33.0	92.83	317.15	859.54	1176.70	1176.70	1176.70	12.68
34.0	95.64	334.86	853.30	1188.17	1188.17	1188.17	12.42
35.0	98.45	352.97	850.18	1203.15	1203.15	1203.15	12.22
36.0	101.26	371.45	850.18	1221.63	1221.63	1221.63	12.06
37.0	104.08	403.02	850.18	1253.20	1253.20	1253.20	12.04
38.0	106.89	434.60	850.18	1284.78	1284.78	1284.78	12.02
39.0	109.70	466.18	850.18	1316.36	1316.36	1316.36	12.00
40.0	112.52	497.75	850.18	1347.94	1347.94	1347.94	11.98
41.0	115.33	529.33	850.18	1379.51	1379.51	1379.51	11.96
42.0	118.14	560.91	850.18	1411.09	1411.09	1411.09	11.94
43.0	120.95	592.49	850.18	1442.67	1442.67	1442.67	11.93
44.0	123.77	624.06	850.18	1474.24	1474.24	1474.24	11.91
45.0	126.58	655.64	850.18	1505.82	1505.82	1505.82	11.90
46.0	129.39	687.22	850.18	1537.40	1537.40	1537.40	11.88
47.0	132.21	718.79	850.18	1568.98	1568.98	1568.98	11.87
48.0	135.02	750.37	850.18	1600.55	1600.55	1600.55	11.85
49.0	137.83	781.95	850.18	1632.13	1632.13	1632.13	11.84
50.0	140.65	813.53	850.18	1663.71	1663.71	1663.71	11.83
51.0	143.46	845.10	850.18	1695.28	1695.28	1695.28	11.82
52.0	146.27	876.68	850.18	1726.86	1726.86	1726.86	11.81
53.0	149.08	908.26	850.18	1758.44	1758.44	1758.44	11.79
54.0	151.90	939.84	850.18	1790.02	1790.02	1790.02	11.78
55.0	154.71	971.41	850.18	1821.59	1821.59	1821.59	11.77
56.0	157.52	1002.99	850.18	1853.17	1853.17	1853.17	11.76
57.0	160.34	1034.57	850.18	1884.75	1884.75	1884.75	11.76
58.0	163.15	1066.14	850.18	1916.32	1916.32	1916.32	11.75
59.0	165.96	1097.72	850.18	1947.90	1947.90	1947.90	11.74
60.0	168.77	1129.30	850.18	1979.48	1979.48	1979.48	11.73
61.0	171.59	1160.88	850.18	2011.06	2011.06	2011.06	11.72
62.0	174.40	1192.45	850.18	2042.63	2042.63	2042.63	11.71
63.0	177.21	1224.03	850.18	2074.21	2074.21	2074.21	11.70
64.0	180.03	1255.61	850.18	2105.79	2105.79	2105.79	11.70
65.0	182.84	1287.18	850.18	2137.36	2137.36	2137.36	11.69
66.0	185.65	1318.76	850.18	2168.94	2168.94	2168.94	11.68
67.0	188.46	1350.34	850.18	2200.52	2200.52	2200.52	11.68
68.0	191.28	1381.92	850.18	2232.10	2232.10	2232.10	11.67
69.0	194.09	1413.49	850.18	2263.67	2263.67	2263.67	11.66
70.0	196.90	1445.07	850.18	2295.25	2295.25	2295.25	11.66
71.0	199.72	1476.65	850.18	2326.83	2326.83	2326.83	11.65
72.0	202.53	1508.22	850.18	2358.40	2358.40	2358.40	11.64
73.0	205.34	1539.80	850.18	2389.98	2389.98	2389.98	11.64
74.0	208.15	1571.38	850.18	2421.56	2421.56	2421.56	11.63
75.0	210.97	1602.96	850.18	2453.14	2453.14	2453.14	11.63
76.0	213.78	1634.53	850.18	2484.71	2484.71	2484.71	11.62
77.0	216.59	1666.11	850.18	2516.29	2516.29	2516.29	11.62
78.0	219.41	1697.69	912.52	2610.21	2610.21	2610.21	11.90
79.0	222.22	1729.26	977.98	2707.25	2707.25	2707.25	12.18
80.0	225.03	1760.84	1046.56	2807.40	2807.40	2807.40	12.48
81.0	227.85	1792.42	1118.25	2910.67	2910.67	2910.67	12.77
82.0	230.66	1824.00	1193.06	3017.06	3017.06	3017.06	13.08
83.0	233.47	1855.57	1270.99	3126.56	3126.56	3126.56	13.39

84.0	236.28	1887.15	1352.03	3239.18	3239.18	3239.18	13.71
85.0	239.10	1918.73	1436.19	3354.92	3354.92	3354.92	14.03
86.0	241.91	1950.30	1523.47	3473.78	3473.78	3473.78	14.36
87.0	244.72	1981.88	1607.63	3589.51	3589.51	3589.51	14.67
88.0	247.54	2013.46	1682.44	3695.90	3695.90	3695.90	14.93
89.0	250.35	2045.04	1747.90	3792.94	3792.94	3792.94	15.15
90.0	253.16	2076.61	1804.01	3880.62	3880.62	3880.62	15.33
91.0	255.97	2108.19	1850.77	3958.96	3958.96	3958.96	15.47
92.0	258.79	2139.77	1888.17	4027.94	4027.94	4027.94	15.56
93.0	261.60	2171.34	1916.22	4087.57	4087.57	4087.57	15.63
94.0	264.41	2202.92	1934.93	4137.85	4137.85	4137.85	15.65
95.0	267.23	2234.50	1944.28	4178.78	4178.78	4178.78	15.64
96.0	270.04	2266.08	1944.28	4210.35	4210.35	4210.35	15.59
97.0	272.85	2287.54	1944.28	4231.81	4231.81	4231.81	15.51
98.0	275.66	2309.26	1944.28	4253.54	4253.54	4253.54	15.43
99.0	278.48	2331.24	1944.28	4275.52	4275.52	4275.52	15.35
100.0	281.29	2353.49	1944.28	4297.77	4297.77	4297.77	15.28
101.0	284.10	2375.99	1944.28	4320.27	4320.27	4320.27	15.21
102.0	286.92	2398.76	1944.28	4343.04	4343.04	4343.04	15.14
103.0	289.73	2421.79	1944.28	4366.07	4366.07	4366.07	15.07
104.0	292.54	2445.08	1944.28	4389.35	4389.35	4389.35	15.00
105.0	295.35	2468.63	1944.28	4412.90	4412.90	4412.90	14.94
106.0	298.17	2492.44	1944.28	4436.72	4436.72	4436.72	14.88
107.0	300.98	2516.51	1944.28	4460.79	4460.79	4460.79	14.82
108.0	303.79	2540.84	1944.28	4485.12	4485.12	4485.12	14.76
109.0	306.61	2565.44	1944.28	4509.71	4509.71	4509.71	14.71
110.0	309.42	2590.29	1944.28	4534.57	4534.57	4534.57	14.66
111.0	312.23	2615.41	1944.28	4559.69	4559.69	4559.69	14.60
112.0	315.04	2640.79	1944.28	4585.06	4585.06	4585.06	14.55
113.0	317.86	2666.43	1944.28	4610.70	4610.70	4610.70	14.51
114.0	320.67	2692.32	1944.28	4636.60	4636.60	4636.60	14.46
115.0	323.48	2718.49	1944.28	4662.76	4662.76	4662.76	14.41
116.0	326.30	2744.91	1944.28	4689.18	4689.18	4689.18	14.37
117.0	329.11	2771.59	1944.28	4715.87	4715.87	4715.87	14.33
118.0	331.92	2798.53	1944.28	4742.81	4742.81	4742.81	14.29
119.0	334.74	2825.74	1944.28	4770.02	4770.02	4770.02	14.25
120.0	337.55	2853.20	1944.28	4797.48	4797.48	4797.48	14.21
121.0	340.36	2880.93	1944.28	4825.21	4825.21	4825.21	14.18
122.0	343.17	2908.92	1944.28	4853.20	4853.20	4853.20	14.14
123.0	345.99	2937.17	1944.28	4881.45	4881.45	4881.45	14.11
124.0	348.80	2965.68	1944.28	4909.96	4909.96	4909.96	14.08
125.0	351.61	2994.45	1944.28	4938.73	4938.73	4938.73	14.05

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1343E+00	0.1604E-04	0.5767E-02	0.1000E-04
0.6717E+00	0.8021E-04	0.2884E-01	0.5000E-04
0.1343E+01	0.1604E-03	0.5767E-01	0.1000E-03
0.6717E+02	0.8021E-02	0.2884E+01	0.5000E-02
0.1008E+03	0.1203E-01	0.4325E+01	0.7500E-02
0.1343E+03	0.1604E-01	0.5767E+01	0.1000E-01
0.3360E+03	0.4011E-01	0.1442E+02	0.2500E-01
0.6727E+03	0.8024E-01	0.2884E+02	0.5000E-01
0.1009E+04	0.1204E+00	0.4325E+02	0.7500E-01
0.1330E+04	0.1602E+00	0.5767E+02	0.1000E+00
0.2316E+04	0.3588E+00	0.1442E+03	0.2500E+00
0.2937E+04	0.6436E+00	0.2884E+03	0.5000E+00
0.3495E+04	0.1364E+01	0.6708E+03	0.1180E+01
0.3876E+04	0.3172E+01	0.1244E+04	0.2950E+01
0.4602E+04	0.6180E+01	0.1973E+04	0.5900E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.2004E+00	0.1886E-04	0.8239E-02	0.1000E-04
0.1002E+01	0.9430E-04	0.4119E-01	0.5000E-04
0.2004E+01	0.1886E-03	0.8239E-01	0.1000E-03
0.1002E+03	0.9430E-02	0.4119E+01	0.5000E-02
0.1503E+03	0.1414E-01	0.6179E+01	0.7500E-02
0.2004E+03	0.1886E-01	0.8239E+01	0.1000E-01
0.5018E+03	0.4717E-01	0.2060E+02	0.2500E-01
0.1004E+04	0.9437E-01	0.4119E+02	0.5000E-01
0.1505E+04	0.1416E+00	0.6179E+02	0.7500E-01
0.1939E+04	0.1870E+00	0.8239E+02	0.1000E+00
0.2883E+04	0.3873E+00	0.2060E+03	0.2500E+00
0.3366E+04	0.6682E+00	0.4119E+03	0.5000E+00
0.3936E+04	0.1393E+01	0.9333E+03	0.1180E+01
0.4315E+04	0.3200E+01	0.1478E+04	0.2950E+01
0.4937E+04	0.6199E+01	0.2100E+04	0.5900E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.7578E-01	0.1348E-04	0.3295E-02	0.1000E-04
0.3789E+00	0.6738E-04	0.1648E-01	0.5000E-04
0.7578E+00	0.1348E-03	0.3295E-01	0.1000E-03
0.3789E+02	0.6738E-02	0.1648E+01	0.5000E-02
0.5684E+02	0.1011E-01	0.2472E+01	0.7500E-02
0.7578E+02	0.1348E-01	0.3295E+01	0.1000E-01
0.1895E+03	0.3369E-01	0.8239E+01	0.2500E-01
0.3791E+03	0.6738E-01	0.1648E+02	0.5000E-01
0.5688E+03	0.1011E+00	0.2472E+02	0.7500E-01
0.7578E+03	0.1348E+00	0.3295E+02	0.1000E+00
0.1643E+04	0.3264E+00	0.8239E+02	0.2500E+00
0.2442E+04	0.6162E+00	0.1648E+03	0.5000E+00
0.3054E+04	0.1335E+01	0.4083E+03	0.1180E+01
0.3436E+04	0.3144E+01	0.1011E+04	0.2950E+01
0.4266E+04	0.6160E+01	0.1847E+04	0.5900E+01

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
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5th Street Bridge, Bent 9, 118"CIDH (comp) LQ

PROPOSED DEPTH = 125.0 FT

NUMBER OF LAYERS = 5

WATER TABLE DEPTH = 0.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.100E+01

LAYER NO 2----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.612E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.100E+01

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.260E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.812E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.260E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.690E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.360E+02

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.360E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.960E+02

LAYER NO 5----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.960E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 9.833 FT.
DIAMETER OF BASE = 9.833 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 5.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 109.366 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
6.0	16.88	3.40	57.15	60.55	60.55	60.55	4.30
7.0	19.69	6.80	120.10	126.90	126.90	126.90	6.44
8.0	22.50	10.20	183.05	193.24	193.24	193.24	8.59
9.0	25.32	13.59	248.99	262.59	262.59	262.59	10.37
10.0	28.13	16.99	317.94	334.94	334.94	334.94	11.91
11.0	30.94	20.39	389.91	410.30	410.30	410.30	13.26
12.0	33.75	23.79	464.91	488.70	488.70	488.70	14.48
13.0	36.57	27.19	542.94	570.13	570.13	570.13	15.59
14.0	39.38	30.59	624.01	654.60	654.60	654.60	16.62
15.0	42.19	33.98	708.14	742.13	742.13	742.13	17.59
16.0	45.01	37.38	795.33	832.72	832.72	832.72	18.50
17.0	47.82	40.78	879.38	920.16	920.16	920.16	19.24

18.0	50.63	44.18	933.27	977.45	977.45	977.45	19.30
19.0	53.45	47.58	976.76	1024.34	1024.34	1024.34	19.17
20.0	56.26	50.98	1009.87	1060.85	1060.85	1060.85	18.86
21.0	59.07	54.38	1032.60	1086.97	1086.97	1086.97	18.40
22.0	61.88	57.77	1044.94	1102.72	1102.72	1102.72	17.82
23.0	64.70	61.17	1046.91	1108.09	1108.09	1108.09	17.13
24.0	67.51	64.57	1038.51	1103.09	1103.09	1103.09	16.34
25.0	70.32	67.97	1019.75	1087.72	1087.72	1087.72	15.47
26.0	73.14	71.37	990.62	1061.99	1061.99	1061.99	14.52
27.0	75.95	85.80	962.53	1048.34	1048.34	1048.34	13.80
28.0	78.76	100.76	937.57	1038.33	1038.33	1038.33	13.18
29.0	81.57	116.23	915.72	1031.95	1031.95	1031.95	12.65
30.0	84.39	132.19	896.99	1029.18	1029.18	1029.18	12.20
31.0	87.20	148.61	881.39	1030.00	1030.00	1030.00	11.81
32.0	90.01	165.48	868.91	1034.39	1034.39	1034.39	11.49
33.0	92.83	182.78	859.54	1042.32	1042.32	1042.32	11.23
34.0	95.64	200.49	853.30	1053.79	1053.79	1053.79	11.02
35.0	98.45	218.60	850.18	1068.78	1068.78	1068.78	10.86
36.0	101.26	237.07	850.18	1087.25	1087.25	1087.25	10.74
37.0	104.08	268.65	850.18	1118.83	1118.83	1118.83	10.75
38.0	106.89	300.23	850.18	1150.41	1150.41	1150.41	10.76
39.0	109.70	331.81	850.18	1181.99	1181.99	1181.99	10.77
40.0	112.52	363.38	850.18	1213.56	1213.56	1213.56	10.79
41.0	115.33	394.96	850.18	1245.14	1245.14	1245.14	10.80
42.0	118.14	426.54	850.18	1276.72	1276.72	1276.72	10.81
43.0	120.95	458.11	850.18	1308.29	1308.29	1308.29	10.82
44.0	123.77	489.69	850.18	1339.87	1339.87	1339.87	10.83
45.0	126.58	521.27	850.18	1371.45	1371.45	1371.45	10.83
46.0	129.39	552.85	850.18	1403.03	1403.03	1403.03	10.84
47.0	132.21	584.42	850.18	1434.60	1434.60	1434.60	10.85
48.0	135.02	616.00	850.18	1466.18	1466.18	1466.18	10.86
49.0	137.83	647.58	850.18	1497.76	1497.76	1497.76	10.87
50.0	140.65	679.15	850.18	1529.34	1529.34	1529.34	10.87
51.0	143.46	710.73	850.18	1560.91	1560.91	1560.91	10.88
52.0	146.27	742.31	850.18	1592.49	1592.49	1592.49	10.89
53.0	149.08	773.89	850.18	1624.07	1624.07	1624.07	10.89
54.0	151.90	805.46	850.18	1655.64	1655.64	1655.64	10.90
55.0	154.71	837.04	850.18	1687.22	1687.22	1687.22	10.91
56.0	157.52	868.62	850.18	1718.80	1718.80	1718.80	10.91
57.0	160.34	900.19	850.18	1750.38	1750.38	1750.38	10.92
58.0	163.15	931.77	850.18	1781.95	1781.95	1781.95	10.92
59.0	165.96	963.35	850.18	1813.53	1813.53	1813.53	10.93
60.0	168.77	994.93	850.18	1845.11	1845.11	1845.11	10.93
61.0	171.59	1026.50	850.18	1876.68	1876.68	1876.68	10.94
62.0	174.40	1058.08	850.18	1908.26	1908.26	1908.26	10.94
63.0	177.21	1089.66	850.18	1939.84	1939.84	1939.84	10.95
64.0	180.03	1121.24	850.18	1971.42	1971.42	1971.42	10.95
65.0	182.84	1152.81	850.18	2002.99	2002.99	2002.99	10.95
66.0	185.65	1184.39	850.18	2034.57	2034.57	2034.57	10.96
67.0	188.46	1215.97	850.18	2066.15	2066.15	2066.15	10.96
68.0	191.28	1247.54	850.18	2097.72	2097.72	2097.72	10.97
69.0	194.09	1279.12	850.18	2129.30	2129.30	2129.30	10.97
70.0	196.90	1310.70	850.18	2160.88	2160.88	2160.88	10.97
71.0	199.72	1342.28	850.18	2192.46	2192.46	2192.46	10.98
72.0	202.53	1373.85	850.18	2224.03	2224.03	2224.03	10.98
73.0	205.34	1405.43	850.18	2255.61	2255.61	2255.61	10.98
74.0	208.15	1437.01	850.18	2287.19	2287.19	2287.19	10.99
75.0	210.97	1468.58	850.18	2318.76	2318.76	2318.76	10.99
76.0	213.78	1500.16	850.18	2350.34	2350.34	2350.34	10.99
77.0	216.59	1531.74	850.18	2381.92	2381.92	2381.92	11.00
78.0	219.41	1563.32	912.52	2475.84	2475.84	2475.84	11.28
79.0	222.22	1594.89	977.98	2572.87	2572.87	2572.87	11.58
80.0	225.03	1626.47	1046.56	2673.03	2673.03	2673.03	11.88
81.0	227.85	1658.05	1118.25	2776.30	2776.30	2776.30	12.19
82.0	230.66	1689.62	1193.06	2882.68	2882.68	2882.68	12.50
83.0	233.47	1721.20	1270.99	2992.19	2992.19	2992.19	12.82

84.0	236.28	1752.78	1352.03	3104.81	3104.81	3104.81	13.14
85.0	239.10	1784.36	1436.19	3220.55	3220.55	3220.55	13.47
86.0	241.91	1815.93	1523.47	3339.40	3339.40	3339.40	13.80
87.0	244.72	1847.51	1607.63	3455.14	3455.14	3455.14	14.12
88.0	247.54	1879.09	1682.44	3561.53	3561.53	3561.53	14.39
89.0	250.35	1910.66	1747.90	3658.56	3658.56	3658.56	14.61
90.0	253.16	1942.24	1804.01	3746.25	3746.25	3746.25	14.80
91.0	255.97	1973.82	1850.77	3824.58	3824.58	3824.58	14.94
92.0	258.79	2005.40	1888.17	3893.57	3893.57	3893.57	15.05
93.0	261.60	2036.97	1916.22	3953.20	3953.20	3953.20	15.11
94.0	264.41	2068.55	1934.93	4003.48	4003.48	4003.48	15.14
95.0	267.23	2100.13	1944.28	4044.40	4044.40	4044.40	15.13
96.0	270.04	2131.70	1944.28	4075.98	4075.98	4075.98	15.09
97.0	272.85	2153.17	1944.28	4097.44	4097.44	4097.44	15.02
98.0	275.66	2174.89	1944.28	4119.17	4119.17	4119.17	14.94
99.0	278.48	2196.87	1944.28	4141.15	4141.15	4141.15	14.87
100.0	281.29	2219.12	1944.28	4163.39	4163.39	4163.39	14.80
101.0	284.10	2241.62	1944.28	4185.90	4185.90	4185.90	14.73
102.0	286.92	2264.39	1944.28	4208.67	4208.67	4208.67	14.67
103.0	289.73	2287.42	1944.28	4231.69	4231.69	4231.69	14.61
104.0	292.54	2310.71	1944.28	4254.98	4254.98	4254.98	14.54
105.0	295.35	2334.26	1944.28	4278.53	4278.53	4278.53	14.49
106.0	298.17	2358.07	1944.28	4302.34	4302.34	4302.34	14.43
107.0	300.98	2382.14	1944.28	4326.42	4326.42	4326.42	14.37
108.0	303.79	2406.47	1944.28	4350.75	4350.75	4350.75	14.32
109.0	306.61	2431.07	1944.28	4375.34	4375.34	4375.34	14.27
110.0	309.42	2455.92	1944.28	4400.20	4400.20	4400.20	14.22
111.0	312.23	2481.04	1944.28	4425.31	4425.31	4425.31	14.17
112.0	315.04	2506.41	1944.28	4450.69	4450.69	4450.69	14.13
113.0	317.86	2532.05	1944.28	4476.33	4476.33	4476.33	14.08
114.0	320.67	2557.95	1944.28	4502.23	4502.23	4502.23	14.04
115.0	323.48	2584.11	1944.28	4528.39	4528.39	4528.39	14.00
116.0	326.30	2610.54	1944.28	4554.81	4554.81	4554.81	13.96
117.0	329.11	2637.22	1944.28	4581.50	4581.50	4581.50	13.92
118.0	331.92	2664.16	1944.28	4608.44	4608.44	4608.44	13.88
119.0	334.74	2691.37	1944.28	4635.64	4635.64	4635.64	13.85
120.0	337.55	2718.83	1944.28	4663.11	4663.11	4663.11	13.81
121.0	340.36	2746.56	1944.28	4690.84	4690.84	4690.84	13.78
122.0	343.17	2774.55	1944.28	4718.82	4718.82	4718.82	13.75
123.0	345.99	2802.80	1944.28	4747.07	4747.07	4747.07	13.72
124.0	348.80	2831.31	1944.28	4775.58	4775.58	4775.58	13.69
125.0	351.61	2860.08	1944.28	4804.36	4804.36	4804.36	13.66

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1304E+00	0.1599E-04	0.5767E-02	0.1000E-04
0.6520E+00	0.7997E-04	0.2884E-01	0.5000E-04
0.1304E+01	0.1599E-03	0.5767E-01	0.1000E-03
0.6520E+02	0.7997E-02	0.2884E+01	0.5000E-02
0.9780E+02	0.1199E-01	0.4325E+01	0.7500E-02
0.1304E+03	0.1599E-01	0.5767E+01	0.1000E-01
0.3261E+03	0.3998E-01	0.1442E+02	0.2500E-01
0.6529E+03	0.7999E-01	0.2884E+02	0.5000E-01
0.9796E+03	0.1200E+00	0.4325E+02	0.7500E-01
0.1290E+04	0.1597E+00	0.5767E+02	0.1000E+00
0.2234E+04	0.3579E+00	0.1442E+03	0.2500E+00
0.2822E+04	0.6423E+00	0.2884E+03	0.5000E+00
0.3360E+04	0.1362E+01	0.6708E+03	0.1180E+01
0.3734E+04	0.3170E+01	0.1244E+04	0.2950E+01
0.4461E+04	0.6178E+01	0.1973E+04	0.5900E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1950E+00	0.1879E-04	0.8239E-02	0.1000E-04
0.9750E+00	0.9395E-04	0.4119E-01	0.5000E-04
0.1950E+01	0.1879E-03	0.8239E-01	0.1000E-03
0.9750E+02	0.9395E-02	0.4119E+01	0.5000E-02
0.1462E+03	0.1409E-01	0.6179E+01	0.7500E-02
0.1950E+03	0.1879E-01	0.8239E+01	0.1000E-01
0.4882E+03	0.4699E-01	0.2060E+02	0.2500E-01
0.9773E+03	0.9403E-01	0.4119E+02	0.5000E-01
0.1463E+04	0.1410E+00	0.6179E+02	0.7500E-01
0.1879E+04	0.1863E+00	0.8239E+02	0.1000E+00
0.2766E+04	0.3859E+00	0.2060E+03	0.2500E+00
0.3232E+04	0.6666E+00	0.4119E+03	0.5000E+00
0.3799E+04	0.1391E+01	0.9333E+03	0.1180E+01
0.4171E+04	0.3198E+01	0.1478E+04	0.2950E+01
0.4794E+04	0.6198E+01	0.2100E+04	0.5900E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.7315E-01	0.1344E-04	0.3295E-02	0.1000E-04
0.3657E+00	0.6722E-04	0.1648E-01	0.5000E-04
0.7315E+00	0.1344E-03	0.3295E-01	0.1000E-03
0.3657E+02	0.6722E-02	0.1648E+01	0.5000E-02
0.5486E+02	0.1008E-01	0.2472E+01	0.7500E-02
0.7315E+02	0.1344E-01	0.3295E+01	0.1000E-01
0.1829E+03	0.3361E-01	0.8239E+01	0.2500E-01
0.3659E+03	0.6722E-01	0.1648E+02	0.5000E-01
0.5490E+03	0.1008E+00	0.2472E+02	0.7500E-01
0.7316E+03	0.1344E+00	0.3295E+02	0.1000E+00
0.1587E+04	0.3257E+00	0.8239E+02	0.2500E+00
0.2349E+04	0.6151E+00	0.1648E+03	0.5000E+00
0.2922E+04	0.1333E+01	0.4083E+03	0.1180E+01
0.3297E+04	0.3142E+01	0.1011E+04	0.2950E+01
0.4128E+04	0.6159E+01	0.1847E+04	0.5900E+01

SHAFT Axial Analysis – 5th Street Bridge, Bent 10, 118” CIDH (NL and LQ)

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 6 (C)COPYRIGHT ENSOFT,INC.1989,1995,1998,2001,2003,2007

5th Street Bridge, Bent 10, 118"IDH (comp) NL

PROPOSED DEPTH = 125.0 FT

NUMBER OF LAYERS = 4

WATER TABLE DEPTH = 0.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.960E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.160E+02

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.960E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.160E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.812E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.260E+02

LAYER NO 3----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.260E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.960E+02

LAYER NO 4----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.960E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 9.833 FT.
DIAMETER OF BASE = 9.833 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 5.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 109.366 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
6.0	16.88	3.99	224.16	228.16	228.16	228.16	13.83
7.0	19.69	9.88	280.46	290.34	290.34	290.34	14.75
8.0	22.50	15.77	336.76	352.52	352.52	352.52	15.67
9.0	25.32	22.25	390.68	412.93	412.93	412.93	16.31
10.0	28.13	29.31	442.21	471.52	471.52	471.52	16.76
11.0	30.94	36.93	491.34	528.27	528.27	528.27	17.07
12.0	33.75	45.08	538.06	583.14	583.14	583.14	17.28
13.0	36.57	53.75	582.35	636.10	636.10	636.10	17.40
14.0	39.38	62.92	624.20	687.12	687.12	687.12	17.45
15.0	42.19	72.56	663.61	736.17	736.17	736.17	17.45
16.0	45.01	82.67	700.55	783.22	783.22	783.22	17.40
17.0	47.82	93.44	735.62	829.07	829.07	829.07	17.34
18.0	50.63	104.86	765.99	870.85	870.85	870.85	17.20
19.0	53.45	116.89	792.01	908.90	908.90	908.90	17.01
20.0	56.26	129.52	813.75	943.26	943.26	943.26	16.77
21.0	59.07	142.72	831.27	973.99	973.99	973.99	16.49
22.0	61.88	156.47	844.64	1001.11	1001.11	1001.11	16.18
23.0	64.70	170.76	853.93	1024.69	1024.69	1024.69	15.84
24.0	67.51	185.56	859.20	1044.76	1044.76	1044.76	15.48
25.0	70.32	200.85	860.51	1061.36	1061.36	1061.36	15.09
26.0	73.14	216.62	857.92	1074.54	1074.54	1074.54	14.69
27.0	75.95	248.19	855.79	1103.99	1103.99	1103.99	14.54
28.0	78.76	279.77	854.09	1133.87	1133.87	1133.87	14.40
29.0	81.57	311.35	852.78	1164.13	1164.13	1164.13	14.27
30.0	84.39	342.93	851.80	1194.73	1194.73	1194.73	14.16
31.0	87.20	374.50	851.10	1225.61	1225.61	1225.61	14.06
32.0	90.01	406.08	850.64	1256.72	1256.72	1256.72	13.96
33.0	92.83	437.66	850.36	1288.02	1288.02	1288.02	13.88
34.0	95.64	469.23	850.23	1319.46	1319.46	1319.46	13.80
35.0	98.45	500.81	850.18	1350.99	1350.99	1350.99	13.72
36.0	101.26	532.39	850.18	1382.57	1382.57	1382.57	13.65
37.0	104.08	563.97	850.18	1414.15	1414.15	1414.15	13.59
38.0	106.89	595.54	850.18	1445.72	1445.72	1445.72	13.53
39.0	109.70	627.12	850.18	1477.30	1477.30	1477.30	13.47
40.0	112.52	658.70	850.18	1508.88	1508.88	1508.88	13.41
41.0	115.33	690.28	850.18	1540.46	1540.46	1540.46	13.36

42.0	118.14	721.85	850.18	1572.03	1572.03	1572.03	13.31
43.0	120.95	753.43	850.18	1603.61	1603.61	1603.61	13.26
44.0	123.77	785.01	850.18	1635.19	1635.19	1635.19	13.21
45.0	126.58	816.58	850.18	1666.76	1666.76	1666.76	13.17
46.0	129.39	848.16	850.18	1698.34	1698.34	1698.34	13.13
47.0	132.21	879.74	850.18	1729.92	1729.92	1729.92	13.08
48.0	135.02	911.32	850.18	1761.50	1761.50	1761.50	13.05
49.0	137.83	942.89	850.18	1793.07	1793.07	1793.07	13.01
50.0	140.65	974.47	850.18	1824.65	1824.65	1824.65	12.97
51.0	143.46	1006.05	850.18	1856.23	1856.23	1856.23	12.94
52.0	146.27	1037.62	850.18	1887.81	1887.81	1887.81	12.91
53.0	149.08	1069.20	850.18	1919.38	1919.38	1919.38	12.87
54.0	151.90	1100.78	850.18	1950.96	1950.96	1950.96	12.84
55.0	154.71	1132.36	850.18	1982.54	1982.54	1982.54	12.81
56.0	157.52	1163.93	850.18	2014.11	2014.11	2014.11	12.79
57.0	160.34	1195.51	850.18	2045.69	2045.69	2045.69	12.76
58.0	163.15	1227.09	850.18	2077.27	2077.27	2077.27	12.73
59.0	165.96	1258.66	850.18	2108.85	2108.85	2108.85	12.71
60.0	168.77	1290.24	850.18	2140.42	2140.42	2140.42	12.68
61.0	171.59	1321.82	850.18	2172.00	2172.00	2172.00	12.66
62.0	174.40	1353.40	850.18	2203.58	2203.58	2203.58	12.64
63.0	177.21	1384.97	850.18	2235.15	2235.15	2235.15	12.61
64.0	180.03	1416.55	850.18	2266.73	2266.73	2266.73	12.59
65.0	182.84	1448.13	850.18	2298.31	2298.31	2298.31	12.57
66.0	185.65	1479.70	850.18	2329.89	2329.89	2329.89	12.55
67.0	188.46	1511.28	850.18	2361.46	2361.46	2361.46	12.53
68.0	191.28	1542.86	850.18	2393.04	2393.04	2393.04	12.51
69.0	194.09	1574.44	850.18	2424.62	2424.62	2424.62	12.49
70.0	196.90	1606.01	850.18	2456.19	2456.19	2456.19	12.47
71.0	199.72	1637.59	850.18	2487.77	2487.77	2487.77	12.46
72.0	202.53	1669.17	850.18	2519.35	2519.35	2519.35	12.44
73.0	205.34	1700.74	850.18	2550.93	2550.93	2550.93	12.42
74.0	208.15	1732.32	850.18	2582.50	2582.50	2582.50	12.41
75.0	210.97	1763.90	850.18	2614.08	2614.08	2614.08	12.39
76.0	213.78	1795.48	850.18	2645.66	2645.66	2645.66	12.38
77.0	216.59	1827.05	850.18	2677.23	2677.23	2677.23	12.36
78.0	219.41	1858.63	912.52	2771.15	2771.15	2771.15	12.63
79.0	222.22	1890.21	977.98	2868.19	2868.19	2868.19	12.91
80.0	225.03	1921.78	1046.56	2968.34	2968.34	2968.34	13.19
81.0	227.85	1953.36	1118.25	3071.61	3071.61	3071.61	13.48
82.0	230.66	1984.94	1193.06	3178.00	3178.00	3178.00	13.78
83.0	233.47	2016.52	1270.99	3287.50	3287.50	3287.50	14.08
84.0	236.28	2048.09	1352.03	3400.13	3400.13	3400.13	14.39
85.0	239.10	2079.67	1436.19	3515.86	3515.86	3515.86	14.70
86.0	241.91	2111.25	1523.47	3634.72	3634.72	3634.72	15.03
87.0	244.72	2142.82	1607.63	3750.46	3750.46	3750.46	15.33
88.0	247.54	2174.40	1682.44	3856.84	3856.84	3856.84	15.58
89.0	250.35	2205.98	1747.90	3953.88	3953.88	3953.88	15.79
90.0	253.16	2237.56	1804.01	4041.57	4041.57	4041.57	15.96
91.0	255.97	2269.13	1850.77	4119.90	4119.90	4119.90	16.09
92.0	258.79	2300.71	1888.17	4188.88	4188.88	4188.88	16.19
93.0	261.60	2332.29	1916.22	4248.51	4248.51	4248.51	16.24
94.0	264.41	2363.86	1934.93	4298.79	4298.79	4298.79	16.26
95.0	267.23	2395.44	1944.28	4339.72	4339.72	4339.72	16.24
96.0	270.04	2427.02	1944.28	4371.30	4371.30	4371.30	16.19
97.0	272.85	2449.06	1944.28	4393.34	4393.34	4393.34	16.10
98.0	275.66	2471.36	1944.28	4415.64	4415.64	4415.64	16.02
99.0	278.48	2493.92	1944.28	4438.20	4438.20	4438.20	15.94
100.0	281.29	2516.75	1944.28	4461.03	4461.03	4461.03	15.86
101.0	284.10	2539.83	1944.28	4484.11	4484.11	4484.11	15.78
102.0	286.92	2563.18	1944.28	4507.46	4507.46	4507.46	15.71
103.0	289.73	2586.79	1944.28	4531.06	4531.06	4531.06	15.64
104.0	292.54	2610.65	1944.28	4554.93	4554.93	4554.93	15.57
105.0	295.35	2634.78	1944.28	4579.06	4579.06	4579.06	15.50
106.0	298.17	2659.17	1944.28	4603.45	4603.45	4603.45	15.44
107.0	300.98	2683.83	1944.28	4628.10	4628.10	4628.10	15.38

108.0	303.79	2708.74	1944.28	4653.02	4653.02	4653.02	15.32
109.0	306.61	2733.91	1944.28	4678.19	4678.19	4678.19	15.26
110.0	309.42	2759.35	1944.28	4703.62	4703.62	4703.62	15.20
111.0	312.23	2785.04	1944.28	4729.32	4729.32	4729.32	15.15
112.0	315.04	2811.00	1944.28	4755.28	4755.28	4755.28	15.09
113.0	317.86	2837.22	1944.28	4781.49	4781.49	4781.49	15.04
114.0	320.67	2863.70	1944.28	4807.97	4807.97	4807.97	14.99
115.0	323.48	2890.44	1944.28	4834.71	4834.71	4834.71	14.95
116.0	326.30	2917.44	1944.28	4861.71	4861.71	4861.71	14.90
117.0	329.11	2944.70	1944.28	4888.98	4888.98	4888.98	14.86
118.0	331.92	2972.22	1944.28	4916.50	4916.50	4916.50	14.81
119.0	334.74	3000.01	1944.28	4944.28	4944.28	4944.28	14.77
120.0	337.55	3028.05	1944.28	4972.33	4972.33	4972.33	14.73
121.0	340.36	3056.36	1944.28	5000.63	5000.63	5000.63	14.69
122.0	343.17	3084.92	1944.28	5029.20	5029.20	5029.20	14.65
123.0	345.99	3113.75	1944.28	5058.03	5058.03	5058.03	14.62
124.0	348.80	3142.84	1944.28	5087.12	5087.12	5087.12	14.58
125.0	351.61	3172.19	1944.28	5116.47	5116.47	5116.47	14.55

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD	TOP MOVEMENT	TIP LOAD	TIP MOVEMENT
ton	IN.	ton	IN.
0.1475E+00	0.1633E-04	0.5767E-02	0.1000E-04
0.7375E+00	0.8165E-04	0.2884E-01	0.5000E-04
0.1475E+01	0.1633E-03	0.5767E-01	0.1000E-03
0.7375E+02	0.8165E-02	0.2884E+01	0.5000E-02
0.1106E+03	0.1225E-01	0.4325E+01	0.7500E-02
0.1475E+03	0.1633E-01	0.5767E+01	0.1000E-01
0.3690E+03	0.4083E-01	0.1442E+02	0.2500E-01
0.7388E+03	0.8168E-01	0.2884E+02	0.5000E-01
0.1108E+04	0.1225E+00	0.4325E+02	0.7500E-01
0.1450E+04	0.1628E+00	0.5767E+02	0.1000E+00
0.2489E+04	0.3628E+00	0.1442E+03	0.2500E+00
0.3111E+04	0.6477E+00	0.2884E+03	0.5000E+00
0.3657E+04	0.1368E+01	0.6708E+03	0.1180E+01
0.4008E+04	0.3175E+01	0.1244E+04	0.2950E+01
0.4734E+04	0.6183E+01	0.1973E+04	0.5900E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD	TOP MOVEMENT	TIP LOAD	TIP MOVEMENT
ton	IN.	ton	IN.
0.2224E+00	0.1933E-04	0.8239E-02	0.1000E-04
0.1112E+01	0.9666E-04	0.4119E-01	0.5000E-04
0.2224E+01	0.1933E-03	0.8239E-01	0.1000E-03
0.1112E+03	0.9666E-02	0.4119E+01	0.5000E-02
0.1668E+03	0.1450E-01	0.6179E+01	0.7500E-02
0.2224E+03	0.1933E-01	0.8239E+01	0.1000E-01
0.5570E+03	0.4835E-01	0.2060E+02	0.2500E-01
0.1115E+04	0.9674E-01	0.4119E+02	0.5000E-01
0.1670E+04	0.1451E+00	0.6179E+02	0.7500E-01
0.2115E+04	0.1909E+00	0.8239E+02	0.1000E+00
0.3066E+04	0.3915E+00	0.2060E+03	0.2500E+00
0.3550E+04	0.6726E+00	0.4119E+03	0.5000E+00
0.4116E+04	0.1397E+01	0.9333E+03	0.1180E+01
0.4468E+04	0.3203E+01	0.1478E+04	0.2950E+01
0.5091E+04	0.6203E+01	0.2100E+04	0.5900E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD	TOP MOVEMENT	TIP LOAD	TIP MOVEMENT
ton	IN.	ton	IN.
0.8205E-01	0.1362E-04	0.3295E-02	0.1000E-04
0.4102E+00	0.6808E-04	0.1648E-01	0.5000E-04
0.8205E+00	0.1362E-03	0.3295E-01	0.1000E-03
0.4102E+02	0.6808E-02	0.1648E+01	0.5000E-02
0.6154E+02	0.1021E-01	0.2472E+01	0.7500E-02
0.8205E+02	0.1362E-01	0.3295E+01	0.1000E-01
0.2051E+03	0.3404E-01	0.8239E+01	0.2500E-01
0.4105E+03	0.6808E-01	0.1648E+02	0.5000E-01
0.6159E+03	0.1021E+00	0.2472E+02	0.7500E-01
0.8203E+03	0.1362E+00	0.3295E+02	0.1000E+00
0.1771E+04	0.3293E+00	0.8239E+02	0.2500E+00
0.2605E+04	0.6199E+00	0.1648E+03	0.5000E+00
0.3199E+04	0.1338E+01	0.4083E+03	0.1180E+01
0.3547E+04	0.3147E+01	0.1011E+04	0.2950E+01
0.4378E+04	0.6163E+01	0.1847E+04	0.5900E+01

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 6 (C)COPYRIGHT ENSOFT,INC.1989,1995,1998,2001,2003,2007

5th Street Bridge, Bent 10, 118"IDH (comp) LQ

PROPOSED DEPTH = 125.0 FT

NUMBER OF LAYERS = 4

WATER TABLE DEPTH = 0.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.600E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.795E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.160E+02

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.960E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.160E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.812E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.260E+02

LAYER NO 3----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.260E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.960E+02

LAYER NO 4----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.960E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.200E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 9.833 FT.
DIAMETER OF BASE = 9.833 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 5.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 109.366 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
6.0	16.88	3.40	267.82	271.22	271.22	271.22	16.15
7.0	19.69	6.80	316.30	323.09	323.09	323.09	16.41
8.0	22.50	10.20	364.78	374.97	374.97	374.97	16.66
9.0	25.32	13.59	411.80	425.40	425.40	425.40	16.80
10.0	28.13	16.99	457.38	474.37	474.37	474.37	16.86
11.0	30.94	20.39	501.51	521.90	521.90	521.90	16.87
12.0	33.75	23.79	544.19	567.98	567.98	567.98	16.83
13.0	36.57	27.19	585.43	612.62	612.62	612.62	16.75
14.0	39.38	30.59	625.24	655.82	655.82	655.82	16.65
15.0	42.19	33.98	663.61	697.59	697.59	697.59	16.53
16.0	45.01	37.38	700.55	737.94	737.94	737.94	16.40
17.0	47.82	48.16	735.62	783.78	783.78	783.78	16.39
18.0	50.63	59.57	765.99	825.56	825.56	825.56	16.31
19.0	53.45	71.60	792.01	863.61	863.61	863.61	16.16
20.0	56.26	84.23	813.75	897.98	897.98	897.98	15.96
21.0	59.07	97.43	831.27	928.70	928.70	928.70	15.72
22.0	61.88	111.18	844.64	955.83	955.83	955.83	15.45
23.0	64.70	125.47	853.93	979.40	979.40	979.40	15.14
24.0	67.51	140.27	859.20	999.47	999.47	999.47	14.80
25.0	70.32	155.56	860.51	1016.07	1016.07	1016.07	14.45
26.0	73.14	171.33	857.92	1029.25	1029.25	1029.25	14.07
27.0	75.95	202.91	855.79	1058.70	1058.70	1058.70	13.94
28.0	78.76	234.48	854.09	1088.58	1088.58	1088.58	13.82
29.0	81.57	266.06	852.78	1118.84	1118.84	1118.84	13.72
30.0	84.39	297.64	851.80	1149.44	1149.44	1149.44	13.62
31.0	87.20	329.21	851.10	1180.32	1180.32	1180.32	13.54
32.0	90.01	360.79	850.64	1211.43	1211.43	1211.43	13.46
33.0	92.83	392.37	850.36	1242.73	1242.73	1242.73	13.39
34.0	95.64	423.95	850.23	1274.17	1274.17	1274.17	13.32
35.0	98.45	455.52	850.18	1305.70	1305.70	1305.70	13.26
36.0	101.26	487.10	850.18	1337.28	1337.28	1337.28	13.21
37.0	104.08	518.68	850.18	1368.86	1368.86	1368.86	13.15
38.0	106.89	550.26	850.18	1400.44	1400.44	1400.44	13.10
39.0	109.70	581.83	850.18	1432.01	1432.01	1432.01	13.05
40.0	112.52	613.41	850.18	1463.59	1463.59	1463.59	13.01
41.0	115.33	644.99	850.18	1495.17	1495.17	1495.17	12.96

42.0	118.14	676.56	850.18	1526.74	1526.74	1526.74	12.92
43.0	120.95	708.14	850.18	1558.32	1558.32	1558.32	12.88
44.0	123.77	739.72	850.18	1589.90	1589.90	1589.90	12.85
45.0	126.58	771.30	850.18	1621.48	1621.48	1621.48	12.81
46.0	129.39	802.87	850.18	1653.05	1653.05	1653.05	12.78
47.0	132.21	834.45	850.18	1684.63	1684.63	1684.63	12.74
48.0	135.02	866.03	850.18	1716.21	1716.21	1716.21	12.71
49.0	137.83	897.60	850.18	1747.79	1747.79	1747.79	12.68
50.0	140.65	929.18	850.18	1779.36	1779.36	1779.36	12.65
51.0	143.46	960.76	850.18	1810.94	1810.94	1810.94	12.62
52.0	146.27	992.34	850.18	1842.52	1842.52	1842.52	12.60
53.0	149.08	1023.91	850.18	1874.09	1874.09	1874.09	12.57
54.0	151.90	1055.49	850.18	1905.67	1905.67	1905.67	12.55
55.0	154.71	1087.07	850.18	1937.25	1937.25	1937.25	12.52
56.0	157.52	1118.64	850.18	1968.83	1968.83	1968.83	12.50
57.0	160.34	1150.22	850.18	2000.40	2000.40	2000.40	12.48
58.0	163.15	1181.80	850.18	2031.98	2031.98	2031.98	12.45
59.0	165.96	1213.38	850.18	2063.56	2063.56	2063.56	12.43
60.0	168.77	1244.95	850.18	2095.13	2095.13	2095.13	12.41
61.0	171.59	1276.53	850.18	2126.71	2126.71	2126.71	12.39
62.0	174.40	1308.11	850.18	2158.29	2158.29	2158.29	12.38
63.0	177.21	1339.68	850.18	2189.87	2189.87	2189.87	12.36
64.0	180.03	1371.26	850.18	2221.44	2221.44	2221.44	12.34
65.0	182.84	1402.84	850.18	2253.02	2253.02	2253.02	12.32
66.0	185.65	1434.42	850.18	2284.60	2284.60	2284.60	12.31
67.0	188.46	1465.99	850.18	2316.17	2316.17	2316.17	12.29
68.0	191.28	1497.57	850.18	2347.75	2347.75	2347.75	12.27
69.0	194.09	1529.15	850.18	2379.33	2379.33	2379.33	12.26
70.0	196.90	1560.72	850.18	2410.91	2410.91	2410.91	12.24
71.0	199.72	1592.30	850.18	2442.48	2442.48	2442.48	12.23
72.0	202.53	1623.88	850.18	2474.06	2474.06	2474.06	12.22
73.0	205.34	1655.46	850.18	2505.64	2505.64	2505.64	12.20
74.0	208.15	1687.03	850.18	2537.21	2537.21	2537.21	12.19
75.0	210.97	1718.61	850.18	2568.79	2568.79	2568.79	12.18
76.0	213.78	1750.19	850.18	2600.37	2600.37	2600.37	12.16
77.0	216.59	1781.77	850.18	2631.95	2631.95	2631.95	12.15
78.0	219.41	1813.34	912.52	2725.86	2725.86	2725.86	12.42
79.0	222.22	1844.92	977.98	2822.90	2822.90	2822.90	12.70
80.0	225.03	1876.50	1046.56	2923.05	2923.05	2923.05	12.99
81.0	227.85	1908.07	1118.25	3026.32	3026.32	3026.32	13.28
82.0	230.66	1939.65	1193.06	3132.71	3132.71	3132.71	13.58
83.0	233.47	1971.23	1270.99	3242.21	3242.21	3242.21	13.89
84.0	236.28	2002.81	1352.03	3354.84	3354.84	3354.84	14.20
85.0	239.10	2034.38	1436.19	3470.57	3470.57	3470.57	14.52
86.0	241.91	2065.96	1523.47	3589.43	3589.43	3589.43	14.84
87.0	244.72	2097.54	1607.63	3705.17	3705.17	3705.17	15.14
88.0	247.54	2129.11	1682.44	3811.56	3811.56	3811.56	15.40
89.0	250.35	2160.69	1747.90	3908.59	3908.59	3908.59	15.61
90.0	253.16	2192.27	1804.01	3996.28	3996.28	3996.28	15.79
91.0	255.97	2223.85	1850.77	4074.61	4074.61	4074.61	15.92
92.0	258.79	2255.42	1888.17	4143.59	4143.59	4143.59	16.01
93.0	261.60	2287.00	1916.22	4203.22	4203.22	4203.22	16.07
94.0	264.41	2318.58	1934.93	4253.50	4253.50	4253.50	16.09
95.0	267.23	2350.15	1944.28	4294.43	4294.43	4294.43	16.07
96.0	270.04	2381.73	1944.28	4326.01	4326.01	4326.01	16.02
97.0	272.85	2403.77	1944.28	4348.05	4348.05	4348.05	15.94
98.0	275.66	2426.07	1944.28	4370.35	4370.35	4370.35	15.85
99.0	278.48	2448.64	1944.28	4392.91	4392.91	4392.91	15.77
100.0	281.29	2471.46	1944.28	4415.74	4415.74	4415.74	15.70
101.0	284.10	2494.55	1944.28	4438.82	4438.82	4438.82	15.62
102.0	286.92	2517.89	1944.28	4462.17	4462.17	4462.17	15.55
103.0	289.73	2541.50	1944.28	4485.78	4485.78	4485.78	15.48
104.0	292.54	2565.37	1944.28	4509.64	4509.64	4509.64	15.42
105.0	295.35	2589.50	1944.28	4533.77	4533.77	4533.77	15.35
106.0	298.17	2613.89	1944.28	4558.16	4558.16	4558.16	15.29
107.0	300.98	2638.54	1944.28	4582.81	4582.81	4582.81	15.23

108.0	303.79	2663.45	1944.28	4607.73	4607.73	4607.73	15.17
109.0	306.61	2688.62	1944.28	4632.90	4632.90	4632.90	15.11
110.0	309.42	2714.06	1944.28	4658.34	4658.34	4658.34	15.06
111.0	312.23	2739.75	1944.28	4684.03	4684.03	4684.03	15.00
112.0	315.04	2765.71	1944.28	4709.99	4709.99	4709.99	14.95
113.0	317.86	2791.93	1944.28	4736.21	4736.21	4736.21	14.90
114.0	320.67	2818.41	1944.28	4762.68	4762.68	4762.68	14.85
115.0	323.48	2845.15	1944.28	4789.42	4789.42	4789.42	14.81
116.0	326.30	2872.15	1944.28	4816.43	4816.43	4816.43	14.76
117.0	329.11	2899.41	1944.28	4843.69	4843.69	4843.69	14.72
118.0	331.92	2926.93	1944.28	4871.21	4871.21	4871.21	14.68
119.0	334.74	2954.72	1944.28	4898.99	4898.99	4898.99	14.64
120.0	337.55	2982.76	1944.28	4927.04	4927.04	4927.04	14.60
121.0	340.36	3011.07	1944.28	4955.35	4955.35	4955.35	14.56
122.0	343.17	3039.64	1944.28	4983.91	4983.91	4983.91	14.52
123.0	345.99	3068.46	1944.28	5012.74	5012.74	5012.74	14.49
124.0	348.80	3097.55	1944.28	5041.83	5041.83	5041.83	14.45
125.0	351.61	3126.90	1944.28	5071.18	5071.18	5071.18	14.42

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1465E+00	0.1632E-04	0.5767E-02	0.1000E-04
0.7324E+00	0.8160E-04	0.2884E-01	0.5000E-04
0.1465E+01	0.1632E-03	0.5767E-01	0.1000E-03
0.7324E+02	0.8160E-02	0.2884E+01	0.5000E-02
0.1099E+03	0.1224E-01	0.4325E+01	0.7500E-02
0.1465E+03	0.1632E-01	0.5767E+01	0.1000E-01
0.3664E+03	0.4080E-01	0.1442E+02	0.2500E-01
0.7336E+03	0.8163E-01	0.2884E+02	0.5000E-01
0.1101E+04	0.1225E+00	0.4325E+02	0.7500E-01
0.1438E+04	0.1627E+00	0.5767E+02	0.1000E+00
0.2463E+04	0.3626E+00	0.1442E+03	0.2500E+00
0.3071E+04	0.6474E+00	0.2884E+03	0.5000E+00
0.3609E+04	0.1367E+01	0.6708E+03	0.1180E+01
0.3956E+04	0.3175E+01	0.1244E+04	0.2950E+01
0.4682E+04	0.6183E+01	0.1973E+04	0.5900E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.2212E+00	0.1932E-04	0.8239E-02	0.1000E-04
0.1106E+01	0.9660E-04	0.4119E-01	0.5000E-04
0.2212E+01	0.1932E-03	0.8239E-01	0.1000E-03
0.1106E+03	0.9660E-02	0.4119E+01	0.5000E-02
0.1659E+03	0.1449E-01	0.6179E+01	0.7500E-02
0.2212E+03	0.1932E-01	0.8239E+01	0.1000E-01
0.5539E+03	0.4832E-01	0.2060E+02	0.2500E-01
0.1109E+04	0.9668E-01	0.4119E+02	0.5000E-01
0.1659E+04	0.1450E+00	0.6179E+02	0.7500E-01
0.2097E+04	0.1907E+00	0.8239E+02	0.1000E+00
0.3026E+04	0.3912E+00	0.2060E+03	0.2500E+00
0.3503E+04	0.6722E+00	0.4119E+03	0.5000E+00
0.4067E+04	0.1397E+01	0.9333E+03	0.1180E+01
0.4416E+04	0.3203E+01	0.1478E+04	0.2950E+01
0.5038E+04	0.6203E+01	0.2100E+04	0.5900E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.8124E-01	0.1361E-04	0.3295E-02	0.1000E-04
0.4062E+00	0.6804E-04	0.1648E-01	0.5000E-04
0.8124E+00	0.1361E-03	0.3295E-01	0.1000E-03
0.4062E+02	0.6804E-02	0.1648E+01	0.5000E-02
0.6093E+02	0.1021E-01	0.2472E+01	0.7500E-02
0.8124E+02	0.1361E-01	0.3295E+01	0.1000E-01
0.2031E+03	0.3402E-01	0.8239E+01	0.2500E-01
0.4064E+03	0.6805E-01	0.1648E+02	0.5000E-01
0.6098E+03	0.1021E+00	0.2472E+02	0.7500E-01
0.8122E+03	0.1361E+00	0.3295E+02	0.1000E+00
0.1754E+04	0.3291E+00	0.8239E+02	0.2500E+00
0.2573E+04	0.6197E+00	0.1648E+03	0.5000E+00
0.3152E+04	0.1338E+01	0.4083E+03	0.1180E+01
0.3495E+04	0.3146E+01	0.1011E+04	0.2950E+01
0.4326E+04	0.6163E+01	0.1847E+04	0.5900E+01

SHAFT Axial Analysis – 5th Street Bridge, Abutment 11, 24” CIDH (NL and LQ)

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 6 (C)COPYRIGHT ENSOFT,INC.1989,1995,1998,2001,2003,2007

5th Street Bridge, Abut 11, 24" CIDH, NL (comp)

PROPOSED DEPTH = 90.0 FT

NUMBER OF LAYERS = 7

WATER TABLE DEPTH = 17.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.107E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.100E+02

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.107E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.100E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.977E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.150E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.977E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.150E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.943E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.170E+02

LAYER NO 4----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.943E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.170E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.701E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.350E+02

LAYER NO 5----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.701E+00

UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.350E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.594E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.450E+02

LAYER NO 6----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.450E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.115E+03

LAYER NO 7----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.115E+03

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11

DEPTH, FT = 0.167E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 2.000 FT.
DIAMETER OF BASE = 2.000 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 3.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 4.524 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
4.0	0.47	1.30	5.99	7.29	7.29	7.29	16.49
5.0	0.58	3.73	6.82	10.55	10.55	10.55	18.14
6.0	0.70	6.15	7.66	13.82	13.82	13.82	19.79
7.0	0.81	8.92	5.21	14.13	14.13	14.13	17.34
8.0	0.93	12.01	1.80	13.81	13.81	13.81	14.83
9.0	1.05	15.42	0.00	15.42	15.42	15.42	14.72
10.0	1.16	19.13	0.00	19.13	19.13	19.13	16.44
11.0	1.28	23.13	0.00	23.13	23.13	23.13	18.07
12.0	1.40	27.41	0.00	27.41	27.41	27.41	19.63
13.0	1.51	31.96	0.00	31.96	31.96	31.96	21.13
14.0	1.63	36.77	0.00	36.77	36.77	36.77	22.57
15.0	1.75	41.84	0.00	41.84	41.84	41.84	23.97
16.0	1.86	47.13	0.00	47.13	47.13	47.13	25.31
17.0	1.98	52.65	0.00	52.65	52.65	52.65	26.61
18.0	2.09	58.19	0.00	58.19	58.19	58.19	27.78
19.0	2.21	63.76	0.00	63.76	63.76	63.76	28.84
20.0	2.33	69.36	0.00	69.36	69.36	69.36	29.80
21.0	2.44	74.98	0.00	74.98	74.98	74.98	30.68
22.0	2.56	80.63	0.00	80.63	80.63	80.63	31.49
23.0	2.68	86.29	0.00	86.29	86.29	86.29	32.24
24.0	2.79	91.98	0.00	91.98	91.98	91.98	32.93
25.0	2.91	97.69	0.00	97.69	97.69	97.69	33.58
26.0	3.03	103.41	0.00	103.41	103.41	103.41	34.18
27.0	3.14	109.14	0.00	109.14	109.14	109.14	34.74
28.0	3.26	114.89	0.00	114.89	114.89	114.89	35.26
29.0	3.37	120.65	0.00	120.65	120.65	120.65	35.75
30.0	3.49	126.42	0.00	126.42	126.42	126.42	36.21
31.0	3.61	132.19	0.00	132.19	132.19	132.19	36.64
32.0	3.72	137.98	5.99	143.96	143.96	143.96	38.66
33.0	3.84	143.76	13.17	156.93	156.93	156.93	40.86

34.0	3.96	149.55	16.76	166.31	166.31	166.31	42.03
35.0	4.07	155.34	16.76	172.10	172.10	172.10	42.25
36.0	4.19	161.16	16.76	177.92	177.92	177.92	42.47
37.0	4.31	167.01	16.76	183.76	183.76	183.76	42.68
38.0	4.42	172.88	16.76	189.64	189.64	189.64	42.88
39.0	4.54	178.78	16.76	195.54	195.54	195.54	43.08
40.0	4.65	184.69	16.76	201.45	201.45	201.45	43.28
41.0	4.77	190.63	16.76	207.39	207.39	207.39	43.47
42.0	4.89	196.58	30.97	227.55	227.55	227.55	46.56
43.0	5.00	202.55	48.03	250.57	250.57	250.57	50.08
44.0	5.12	208.52	56.56	265.08	265.08	265.08	51.77
45.0	5.24	214.50	56.56	271.06	271.06	271.06	51.76
46.0	5.35	220.92	56.56	277.48	277.48	277.48	51.84
47.0	5.47	227.35	56.56	283.90	283.90	283.90	51.91
48.0	5.59	233.77	56.56	290.33	290.33	290.33	51.98
49.0	5.70	240.19	56.56	296.75	296.75	296.75	52.04
50.0	5.82	246.61	56.56	303.17	303.17	303.17	52.10
51.0	5.93	253.04	56.56	309.59	309.59	309.59	52.16
52.0	6.05	259.46	56.56	316.02	316.02	316.02	52.22
53.0	6.17	265.88	56.56	322.44	322.44	322.44	52.28
54.0	6.28	272.31	56.56	328.86	328.86	328.86	52.33
55.0	6.40	278.73	56.56	335.28	335.28	335.28	52.39
56.0	6.52	285.15	56.56	341.71	341.71	341.71	52.44
57.0	6.63	291.57	56.56	348.13	348.13	348.13	52.48
58.0	6.75	298.00	56.56	354.55	354.55	354.55	52.53
59.0	6.87	304.42	56.56	360.97	360.97	360.97	52.58
60.0	6.98	310.84	56.56	367.40	367.40	367.40	52.62
61.0	7.10	317.26	56.56	373.82	373.82	373.82	52.66
62.0	7.21	323.69	56.56	380.24	380.24	380.24	52.70
63.0	7.33	330.11	56.56	386.67	386.67	386.67	52.74
64.0	7.45	336.53	56.56	393.09	393.09	393.09	52.78
65.0	7.56	342.96	56.56	399.51	399.51	399.51	52.82
66.0	7.68	349.38	56.56	405.93	405.93	405.93	52.85
67.0	7.80	355.80	56.56	412.36	412.36	412.36	52.89
68.0	7.91	362.22	56.56	418.78	418.78	418.78	52.92
69.0	8.03	368.65	56.56	425.20	425.20	425.20	52.95
70.0	8.15	375.07	56.56	431.62	431.62	431.62	52.99
71.0	8.26	381.49	56.56	438.05	438.05	438.05	53.02
72.0	8.38	387.91	56.56	444.47	444.47	444.47	53.05
73.0	8.50	394.34	56.56	450.89	450.89	450.89	53.08
74.0	8.61	400.76	56.56	457.32	457.32	457.32	53.11
75.0	8.73	407.18	56.56	463.74	463.74	463.74	53.13
76.0	8.84	413.60	56.56	470.16	470.16	470.16	53.16
77.0	8.96	420.03	56.56	476.58	476.58	476.58	53.19
78.0	9.08	426.45	56.56	483.01	483.01	483.01	53.21
79.0	9.19	432.87	56.56	489.43	489.43	489.43	53.24
80.0	9.31	439.30	56.56	495.85	495.85	495.85	53.26
81.0	9.43	445.72	56.56	502.27	502.27	502.27	53.29
82.0	9.54	452.14	56.56	508.70	508.70	508.70	53.31
83.0	9.66	458.56	56.56	515.12	515.12	515.12	53.33
84.0	9.78	464.99	56.56	521.54	521.54	521.54	53.35
85.0	9.89	471.41	56.56	527.97	527.97	527.97	53.38
86.0	10.01	477.83	56.56	534.39	534.39	534.39	53.40
87.0	10.12	484.25	56.56	540.81	540.81	540.81	53.42
88.0	10.24	490.68	56.56	547.23	547.23	547.23	53.44
89.0	10.36	497.10	56.56	553.66	553.66	553.66	53.46
90.0	10.47	503.52	56.56	560.08	560.08	560.08	53.48

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.3873E+00	0.2118E-03	0.8248E-03	0.1000E-04
0.1936E+01	0.1059E-02	0.4124E-02	0.5000E-04

0.3873E+01	0.2118E-02	0.8248E-02	0.1000E-03
0.1716E+03	0.1021E+00	0.4124E+00	0.5000E-02
0.2272E+03	0.1437E+00	0.6186E+00	0.7500E-02
0.2682E+03	0.1778E+00	0.8248E+00	0.1000E-01
0.3896E+03	0.3010E+00	0.2062E+01	0.2500E-01
0.4522E+03	0.3908E+00	0.4124E+01	0.5000E-01
0.4764E+03	0.4439E+00	0.6186E+01	0.7500E-01
0.4829E+03	0.4763E+00	0.8248E+01	0.1000E+00
0.4929E+03	0.6423E+00	0.2017E+02	0.2500E+00
0.4791E+03	0.8817E+00	0.3254E+02	0.5000E+00
0.4836E+03	0.1013E+01	0.3726E+02	0.6250E+00
0.4897E+03	0.1178E+01	0.4345E+02	0.7813E+00
0.5031E+03	0.1616E+01	0.5740E+02	0.1200E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.8563E+00	0.4169E-03	0.1178E-02	0.1000E-04
0.4282E+01	0.2085E-02	0.5891E-02	0.5000E-04
0.8563E+01	0.4169E-02	0.1178E-01	0.1000E-03
0.2880E+03	0.1750E+00	0.5891E+00	0.5000E-02
0.3443E+03	0.2260E+00	0.8837E+00	0.7500E-02
0.3810E+03	0.2637E+00	0.1178E+01	0.1000E-01
0.4704E+03	0.3769E+00	0.2946E+01	0.2500E-01
0.5000E+03	0.4369E+00	0.5891E+01	0.5000E-01
0.5106E+03	0.4748E+00	0.8837E+01	0.7500E-01
0.5174E+03	0.5085E+00	0.1178E+02	0.1000E+00
0.5294E+03	0.6779E+00	0.2804E+02	0.2500E+00
0.5207E+03	0.9225E+00	0.4086E+02	0.5000E+00
0.5237E+03	0.1052E+01	0.4393E+02	0.6250E+00
0.5291E+03	0.1215E+01	0.4924E+02	0.7813E+00
0.5409E+03	0.1651E+01	0.6108E+02	0.1200E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1416E+00	0.9238E-04	0.4713E-03	0.1000E-04
0.7079E+00	0.4619E-03	0.2357E-02	0.5000E-04
0.1416E+01	0.9238E-03	0.4713E-02	0.1000E-03
0.7082E+02	0.4649E-01	0.2357E+00	0.5000E-02
0.1033E+03	0.6905E-01	0.3535E+00	0.7500E-02
0.1331E+03	0.9074E-01	0.4713E+00	0.1000E-01
0.2634E+03	0.1987E+00	0.1178E+01	0.2500E-01
0.3741E+03	0.3179E+00	0.2357E+01	0.5000E-01
0.4213E+03	0.3896E+00	0.3535E+01	0.7500E-01
0.4423E+03	0.4368E+00	0.4713E+01	0.1000E+00
0.4551E+03	0.6056E+00	0.1230E+02	0.2500E+00
0.4375E+03	0.8409E+00	0.2422E+02	0.5000E+00
0.4436E+03	0.9746E+00	0.3059E+02	0.6250E+00
0.4503E+03	0.1141E+01	0.3766E+02	0.7813E+00
0.4654E+03	0.1581E+01	0.5373E+02	0.1200E+01

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 6 (C)COPYRIGHT ENSOFT,INC.1989,1995,1998,2001,2003,2007

5th Street Bridge, Abut 11, 24" CIDH, LQ (comp)

PROPOSED DEPTH = 90.0 FT

NUMBER OF LAYERS = 7

WATER TABLE DEPTH = 17.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.107E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.100E+02

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.107E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.100E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.977E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.150E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.977E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.150E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.943E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.280E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.170E+02

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.170E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+03
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.350E+02

LAYER NO 5----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.701E+00

UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.350E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.594E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.450E+02

LAYER NO 6----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.450E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.511E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.400E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.115E+03

LAYER NO 7----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.115E+03

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11

DEPTH, FT = 0.167E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 2.000 FT.
DIAMETER OF BASE = 2.000 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 3.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 4.524 SQ.IN.
ELASTIC MODULUS, Ec = 0.342E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
4.0	0.47	1.30	5.99	7.29	7.29	7.29	16.49
5.0	0.58	3.73	6.82	10.55	10.55	10.55	18.14
6.0	0.70	6.15	7.66	13.82	13.82	13.82	19.79
7.0	0.81	8.92	5.21	14.13	14.13	14.13	17.34
8.0	0.93	12.01	1.80	13.81	13.81	13.81	14.83
9.0	1.05	15.42	0.00	15.42	15.42	15.42	14.72
10.0	1.16	19.13	0.00	19.13	19.13	19.13	16.44
11.0	1.28	23.13	0.00	23.13	23.13	23.13	18.07
12.0	1.40	27.41	0.00	27.41	27.41	27.41	19.63
13.0	1.51	31.96	0.00	31.96	31.96	31.96	21.13
14.0	1.63	36.77	2.02	38.79	38.79	38.79	23.81
15.0	1.75	41.84	4.44	46.28	46.28	46.28	26.52
16.0	1.86	47.13	5.66	52.79	52.79	52.79	28.35
17.0	1.98	52.65	5.66	58.30	58.30	58.30	29.47
18.0	2.09	53.34	5.66	58.99	58.99	58.99	28.16
19.0	2.21	54.03	5.66	59.69	59.69	59.69	26.99
20.0	2.33	54.72	5.66	60.38	60.38	60.38	25.94
21.0	2.44	55.41	5.66	61.07	61.07	61.07	24.99
22.0	2.56	56.10	5.66	61.76	61.76	61.76	24.12
23.0	2.68	56.79	5.66	62.45	62.45	62.45	23.33
24.0	2.79	57.49	5.66	63.14	63.14	63.14	22.61
25.0	2.91	58.18	5.66	63.83	63.83	63.83	21.94
26.0	3.03	58.87	5.66	64.52	64.52	64.52	21.33
27.0	3.14	59.56	5.66	65.22	65.22	65.22	20.76
28.0	3.26	60.25	5.66	65.91	65.91	65.91	20.23
29.0	3.37	60.94	5.66	66.60	66.60	66.60	19.73
30.0	3.49	61.63	5.66	67.29	67.29	67.29	19.27
31.0	3.61	62.32	5.66	67.98	67.98	67.98	18.84
32.0	3.72	63.02	9.62	72.64	72.64	72.64	19.51
33.0	3.84	63.71	14.38	78.09	78.09	78.09	20.33

34.0	3.96	64.40	16.76	81.16	81.16	81.16	20.51
35.0	4.07	65.09	16.76	81.85	81.85	81.85	20.10
36.0	4.19	70.91	16.76	87.67	87.67	87.67	20.93
37.0	4.31	76.76	16.76	93.52	93.52	93.52	21.72
38.0	4.42	82.63	16.76	99.39	99.39	99.39	22.48
39.0	4.54	88.53	16.76	105.29	105.29	105.29	23.20
40.0	4.65	94.45	16.76	111.21	111.21	111.21	23.89
41.0	4.77	100.38	16.76	117.14	117.14	117.14	24.55
42.0	4.89	106.33	30.97	137.31	137.31	137.31	28.09
43.0	5.00	112.30	48.03	160.33	160.33	160.33	32.04
44.0	5.12	118.27	56.56	174.83	174.83	174.83	34.14
45.0	5.24	124.25	56.56	180.81	180.81	180.81	34.53
46.0	5.35	130.68	56.56	187.23	187.23	187.23	34.98
47.0	5.47	137.10	56.56	193.65	193.65	193.65	35.41
48.0	5.59	143.52	56.56	200.08	200.08	200.08	35.82
49.0	5.70	149.94	56.56	206.50	206.50	206.50	36.21
50.0	5.82	156.37	56.56	212.92	212.92	212.92	36.59
51.0	5.93	162.79	56.56	219.35	219.35	219.35	36.96
52.0	6.05	169.21	56.56	225.77	225.77	225.77	37.31
53.0	6.17	175.63	56.56	232.19	232.19	232.19	37.65
54.0	6.28	182.06	56.56	238.61	238.61	238.61	37.97
55.0	6.40	188.48	56.56	245.04	245.04	245.04	38.28
56.0	6.52	194.90	56.56	251.46	251.46	251.46	38.59
57.0	6.63	201.33	56.56	257.88	257.88	257.88	38.88
58.0	6.75	207.75	56.56	264.30	264.30	264.30	39.16
59.0	6.87	214.17	56.56	270.73	270.73	270.73	39.43
60.0	6.98	220.59	56.56	277.15	277.15	277.15	39.69
61.0	7.10	227.02	56.56	283.57	283.57	283.57	39.95
62.0	7.21	233.44	56.56	290.00	290.00	290.00	40.19
63.0	7.33	239.86	56.56	296.42	296.42	296.42	40.43
64.0	7.45	246.28	56.56	302.84	302.84	302.84	40.66
65.0	7.56	252.71	56.56	309.26	309.26	309.26	40.89
66.0	7.68	259.13	56.56	315.69	315.69	315.69	41.10
67.0	7.80	265.55	56.56	322.11	322.11	322.11	41.31
68.0	7.91	271.98	56.56	328.53	328.53	328.53	41.52
69.0	8.03	278.40	56.56	334.95	334.95	334.95	41.72
70.0	8.15	284.82	56.56	341.38	341.38	341.38	41.91
71.0	8.26	291.24	56.56	347.80	347.80	347.80	42.09
72.0	8.38	297.67	56.56	354.22	354.22	354.22	42.28
73.0	8.50	304.09	56.56	360.64	360.64	360.64	42.45
74.0	8.61	310.51	56.56	367.07	367.07	367.07	42.63
75.0	8.73	316.93	56.56	373.49	373.49	373.49	42.79
76.0	8.84	323.36	56.56	379.91	379.91	379.91	42.96
77.0	8.96	329.78	56.56	386.34	386.34	386.34	43.12
78.0	9.08	336.20	56.56	392.76	392.76	392.76	43.27
79.0	9.19	342.62	56.56	399.18	399.18	399.18	43.42
80.0	9.31	349.05	56.56	405.60	405.60	405.60	43.57
81.0	9.43	355.47	56.56	412.03	412.03	412.03	43.71
82.0	9.54	361.89	56.56	418.45	418.45	418.45	43.85
83.0	9.66	368.32	56.56	424.87	424.87	424.87	43.99
84.0	9.78	374.74	56.56	431.29	431.29	431.29	44.12
85.0	9.89	381.16	56.56	437.72	437.72	437.72	44.25
86.0	10.01	387.58	56.56	444.14	444.14	444.14	44.38
87.0	10.12	394.01	56.56	450.56	450.56	450.56	44.50
88.0	10.24	400.43	56.56	456.99	456.99	456.99	44.62
89.0	10.36	406.85	56.56	463.41	463.41	463.41	44.74
90.0	10.47	413.27	56.56	469.83	469.83	469.83	44.86

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD	TOP MOVEMENT	TIP LOAD	TIP MOVEMENT
ton	IN.	ton	IN.
0.2708E+00	0.1697E-03	0.8248E-03	0.1000E-04
0.1354E+01	0.8484E-03	0.4124E-02	0.5000E-04

0.2708E+01	0.1697E-02	0.8248E-02	0.1000E-03
0.1232E+03	0.8330E-01	0.4124E+00	0.5000E-02
0.1668E+03	0.1198E+00	0.6186E+00	0.7500E-02
0.2011E+03	0.1509E+00	0.8248E+00	0.1000E-01
0.3073E+03	0.2674E+00	0.2062E+01	0.2500E-01
0.3662E+03	0.3554E+00	0.4124E+01	0.5000E-01
0.3896E+03	0.4081E+00	0.6186E+01	0.7500E-01
0.3958E+03	0.4403E+00	0.8248E+01	0.1000E+00
0.4052E+03	0.6061E+00	0.2017E+02	0.2500E+00
0.3912E+03	0.8455E+00	0.3254E+02	0.5000E+00
0.3958E+03	0.9770E+00	0.3726E+02	0.6250E+00
0.4019E+03	0.1142E+01	0.4345E+02	0.7813E+00
0.4156E+03	0.1580E+01	0.5740E+02	0.1200E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.5777E+00	0.3194E-03	0.1178E-02	0.1000E-04
0.2889E+01	0.1597E-02	0.5891E-02	0.5000E-04
0.5777E+01	0.3194E-02	0.1178E-01	0.1000E-03
0.2088E+03	0.1430E+00	0.5891E+00	0.5000E-02
0.2593E+03	0.1912E+00	0.8837E+00	0.7500E-02
0.2935E+03	0.2278E+00	0.1178E+01	0.1000E-01
0.3805E+03	0.3399E+00	0.2946E+01	0.2500E-01
0.4100E+03	0.3998E+00	0.5891E+01	0.5000E-01
0.4205E+03	0.4377E+00	0.8837E+01	0.7500E-01
0.4272E+03	0.4713E+00	0.1178E+02	0.1000E+00
0.4384E+03	0.6404E+00	0.2804E+02	0.2500E+00
0.4296E+03	0.8850E+00	0.4086E+02	0.5000E+00
0.4327E+03	0.1014E+01	0.4393E+02	0.6250E+00
0.4380E+03	0.1178E+01	0.4924E+02	0.7813E+00
0.4498E+03	0.1613E+01	0.6108E+02	0.1200E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1029E+00	0.7785E-04	0.4713E-03	0.1000E-04
0.5144E+00	0.3892E-03	0.2357E-02	0.5000E-04
0.1029E+01	0.7785E-03	0.4713E-02	0.1000E-03
0.5149E+02	0.3915E-01	0.2357E+00	0.5000E-02
0.7589E+02	0.5854E-01	0.3535E+00	0.7500E-02
0.9854E+02	0.7739E-01	0.4713E+00	0.1000E-01
0.2023E+03	0.1744E+00	0.1178E+01	0.2500E-01
0.2952E+03	0.2857E+00	0.2357E+01	0.5000E-01
0.3386E+03	0.3556E+00	0.3535E+01	0.7500E-01
0.3585E+03	0.4023E+00	0.4713E+01	0.1000E+00
0.3705E+03	0.5708E+00	0.1230E+02	0.2500E+00
0.3528E+03	0.8060E+00	0.2422E+02	0.5000E+00
0.3590E+03	0.9398E+00	0.3059E+02	0.6250E+00
0.3659E+03	0.1106E+01	0.3766E+02	0.7813E+00
0.3815E+03	0.1547E+01	0.5373E+02	0.1200E+01

Driven Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 2nd Street OC (Replace) **Location:** Abut 1
DONE BY: TK **DATE:** 04/28/16 **CHECKED BY:** AZ **DATE:** 04/28/16

Finish Grade Elevation = 60 ft
Cut Off Elevation = 60 ft
Pile type: Class 200, 14" PPC
Pre-liquefaction Condition(only)

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.4	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	0	Sand	1.00
(2)	0	15	Sand	1.00
(3)	15	25	Sand	1.00
(4)	25	50	Clay	1.00
(5)	50	85	Sand	1.00
(6)	85	125	Clay	1.00
(7)	125	160	Sand	1.00

(=>Pile Length)

Axial Group Reduction Factor (η) for Sandy Materials= 1.00
Axial Group Reduction Factor (η) for Clayey Materials= 1.00

Skin Resistance above neutral axis (=>Pile Length)
minus @ Ele.= 60 ' for Liq. settlement=0.1"
0 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State			
Elevation (ft)	Depth, z (ft)	Skin Friction (kips)	End Bearing (kips)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)
60	0	0	0		0	0	**0**	0		0	**0**
58	2	0	5	1.00	0	2	**2**	0	0	4	**4**
57	3	0	6	1.00	0	3	**3**	0	0	5	**5**
56	4	1	8	1.00	0	3	**4**	1	1	6	**7**
55	5	1	9	1.00	1	4	**5**	1	1	7	**9**
54	6	2	11	1.00	1	4	**6**	2	2	8	**10**
53	7	3	12	1.00	2	5	**7**	3	3	10	**12**
52	8	3	13	1.00	2	5	**8**	3	3	11	**14**
51	9	4	15	1.00	3	6	**9**	4	4	12	**16**
50	10	5	16	1.00	4	7	**10**	5	5	13	**18**
49	11	6	18	1.00	4	7	**12**	6	6	14	**21**
48	12	8	22	1.00	5	9	**14**	8	8	17	**25**
47	13	9	26	1.00	6	10	**17**	9	9	21	**30**
46	14	10	31	1.00	7	12	**20**	10	10	25	**35**
45	15	12	33	1.00	8	13	**22**	12	12	26	**38**
44	16	14	35	1.00	10	14	**24**	14	14	28	**42**
43	17	16	37	1.00	11	15	**26**	16	16	30	**45**
42	18	18	39	1.00	12	16	**28**	18	18	31	**49**
41	19	20	41	1.00	14	17	**30**	20	20	33	**53**
40	20	22	43	1.00	15	17	**33**	22	22	35	**56**
39	21	24	46	1.00	17	18	**35**	24	24	36	**60**
38	22	26	60	1.00	18	24	**43**	26	26	48	**75**
37	23	29	77	1.00	20	31	**51**	29	29	62	**90**
36	24	32	93	1.00	22	37	**59**	32	32	75	**106**
35	25	34	95	1.00	24	38	**62**	34	34	76	**111**
34	26	37	98	1.00	26	39	**65**	37	37	78	**115**
33	27	40	100	1.00	28	40	**68**	40	40	80	**120**
32	28	43	102	1.00	30	41	**71**	43	43	81	**124**
31	29	46	104	1.00	32	41	**74**	46	46	83	**129**
30	30	49	106	1.00	35	42	**77**	49	49	84	**134**
29	31	53	108	1.00	37	43	**80**	53	53	86	**139**
28	32	56	110	1.00	39	44	**83**	56	56	88	**143**
27	33	59	112	1.00	41	45	**86**	59	59	89	**149**
26	34	63	114	1.00	44	45	**89**	63	63	91	**153**
25	35	66	116	1.00	46	46	**92**	66	66	93	**159**
24	36	70	118	1.00	49	47	**96**	70	70	94	**164**
23	37	73	90	1.00	51	36	**87**	73	73	72	**145**
22	38	77	58	1.00	54	23	**77**	77	77	46	**123**
21	39	80	24	1.00	56	10	**66**	80	80	20	**100**
20	40	85	24	1.00	60	10	**69**	85	85	20	**105**
19	41	91	24	1.00	64	10	**74**	91	91	20	**111**
18	42	97	24	1.00	68	10	**78**	97	97	20	**117**
17	43	104	24	1.00	72	10	**82**	104	104	20	**123**	Strength T. (62,66k)
16	44	110	24	1.00	77	10	**87**	110	110	20	**129**
15	45	116	24	1.00	81	10	**91**	116	116	20	**135**	Strength T. (78k)
14	46	122	24	1.00	86	10	**95**	122	122	20	**142**
13	47	129	24	1.00	90	10	**100**	129	129	20	**148**
12	48	135	24	1.00	94	10	**104**	135	135	20	**154**
11	49	141	24	1.00	99	10	**109**	141	141	20	**161**
10	50	148	24	1.00	103	10	**113**	148	148	20	**167**
9	51	154	24	1.00	108	10	**118**	154	154	20	**174**
8	52	161	24	1.00	113	10	**122**	161	161	20	**180**
7	53	168	24	1.00	117	10	**127**	168	168	20	**187**
6	54	174	24	1.00	122	10	**132**	174	174	20	**194**
5	55	181	24	1.00	127	10	**136**	181	181	20	**201**
4	56	188	24	1.00	131	10	**141**	188	188	20	**207**	Strength RW (140k)
3	57	195	92	1.00	136	37	**173**	195	195	73	**268**	use EL +4'
2	58	201	168	1.00	141	67	**208**	201	201	134	**336**	Extreme (300k)
1	59	208	244	1.00	146	97	**243**	208	208	195	**403**	Use El +0'
0	60	214	244	1.00	150	97	**248**	214	214	195	**409**
-1	61	220	244	1.00	154	97	**251**	220	220	195	**415**
-2	62	225	244	1.00	158	97	**255**	225	225	195	**420**
-3	63	231	244	1.00	161	97	**259**	231	231	195	**425**
-4	64	236	244	1.00	165	97	**263**	236	236	195	**431**	a1R Strength (263k)
-5	65	242	244	1.00	169	97	**267**	242	242	195	**437**	a2R Strength (266k)
-6	66	247	244	1.00	173	97	**271**	247	247	195	**442**
-7	67	253	244	1.00	177	97	**275**	253	253	195	**448**
-8	68	259	244	1.00	181	97	**279**	259	259	195	**454**	a1L Strength (276k)
-9	69	265	244	1.00	185	97	**283**	265	265	195	**459**	a2L Strength (280k)
-10	70	270	244	1.00	189	97	**287**	270	270	195	**465**
-11	71	276	244	1.00	193	97	**291**	276	276	195	**471**
-12	72	282	244	1.00	198	97	**295**	282	282	195	**477**
-13	73	289	244	1.00	202	97	**299**	289	289	195	**483**
-14	74	295	244	1.00	206	97	**304**	295	295	195	**490**
-15	75	301	244	1.00	211	97	**308**	301	301	195	**496**
-16	76	307	244	1.00	215	97	**313**	307	307	195	**502**
-17	77	314	244	1.00	220	97	**317**	314	314	195	**509**
-18	78	320	244	1.00	224	97	**322**	320	320	195	**515**
-19	79	327	244	1.00	229	97	**326**	327	327	195	**522**
-20	80	333	244	1.00	233	97	**331**	333	333	195	**528**
-21	81	340	244	1.00	238	97	**335**	340	340	195	**535**
-22	82	347	244	1.00	243	97	**340**	347	347	195	**542**
-23	83	354	244	1.00	247	97	**345**	354	354	195	**548**

Driven Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 2nd Street OC (Replace) **Location:** Abut 1
DONE BY: TK **DATE:** 04/28/16 **CHECKED BY:** AZ **DATE:** 04/28/16

-24	84	360	244	1.00	252	97	**350**	360	360	195	**555**
-25	85	367	244	1.00	257	97	**355**	367	367	195	**562**
-26	86	374	244	1.00	262	97	**359**	374	374	195	**569**
-27	87	381	244	1.00	267	97	**364**	381	381	195	**576**
-28	88	389	244	1.00	272	97	**370**	389	389	195	**584**
-29	89	396	244	1.00	277	97	**375**	396	396	195	**591**
-30	90	403	244	1.00	282	97	**380**	403	403	195	**598**
-31	91	411	244	1.00	287	97	**385**	411	411	195	**605**
-32	92	418	184	1.00	293	74	**366**	418	418	147	**565**
-33	93	425	116	1.00	298	47	**344**	425	425	93	**518**
-34	94	433	49	1.00	303	19	**323**	433	433	39	**472**
-35	95	443	49	1.00	310	19	**329**	443	443	39	**482**
-36	96	455	49	1.00	318	19	**338**	455	455	39	**494**
-37	97	467	49	1.00	327	19	**346**	467	467	39	**506**
-38	98	479	49	1.00	335	19	**355**	479	479	39	**518**
-39	99	491	49	1.00	344	19	**363**	491	491	39	**530**
-40	100	503	49	1.00	352	19	**372**	503	503	39	**542**

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Abut 1
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

Finish Grade Elevation = 74 ft
Cut Off Elevation = 74 ft
Pile type: 24'"-diameter CIDH
Pre-liquefaction Condition(only)

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.0	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	39	Sand	1.00
(2)	39	59	Clay	1.00
(3)	59	94	Sand	1.00
(4)	94	134	Clay	1.00
(5)	94	150	sand	1.00

(=>Pile Length)

Axial Group Reduction Factor (η) for Sandy Materials= 1.00
Axial Group Reduction Factor (η) for Clayey Materials= 1.00
Reduction for top 20 feet casing= 0.40

Skin Resistance above neutral axis (refere (=>Pile Length)
minus @ Ele.= 74 ' for Liq. settlement=0.1"
0 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State				
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)	
74	0	0	0		0	0	**0**	0		0	**0**	
70	4	1	0	0.40	1	0	**1**	1	1	0	**1**	
69	5	4	0	0.40	2	0	**2**	3	3	0	**3**	
68	6	6	0	0.40	3	0	**3**	5	5	0	**5**	
67	7	9	0	0.40	5	0	**5**	7	7	0	**7**	
66	8	11	0	0.40	6	0	**6**	9	9	0	**9**	
65	9	15	0	0.40	8	0	**8**	12	12	0	**12**	
64	10	18	0	0.40	10	0	**10**	15	15	0	**15**	
63	11	22	0	0.40	12	0	**12**	18	18	0	**18**	
62	12	26	0	0.40	15	0	**15**	21	21	0	**21**	
61	13	31	0	0.40	17	0	**17**	24	24	0	**24**	
60	14	35	0	0.40	20	0	**20**	28	28	0	**28**	
59	15	40	0	0.40	22	0	**22**	32	32	0	**32**	
58	16	45	0	0.40	25	0	**25**	36	36	0	**36**	
57	17	50	0	0.40	28	0	**28**	40	40	0	**40**	
56	18	56	0	0.40	31	0	**31**	45	45	0	**45**	
55	19	62	0	0.40	35	0	**35**	49	49	0	**49**	
54	20	68	0	0.40	38	0	**38**	54	54	0	**54**	
53	21	74	6	1.00	47	0	**47**	67	67	10	**76**	
52	22	80	13	1.00	56	0	**56**	79	79	21	**100**	
51	23	87	17	1.00	65	0	**65**	93	93	27	**119**	
50	24	94	17	1.00	74	0	**74**	106	106	27	**133**	
49	25	101	17	1.00	84	0	**84**	120	120	27	**147**	
48	26	107	17	1.00	93	0	**93**	133	133	27	**160**	
47	27	114	17	1.00	103	0	**103**	147	147	27	**174**	
46	28	121	17	1.00	113	0	**113**	161	161	27	**188**	?Extreme (200k)?
45	29	128	17	1.00	122	0	**122**	175	175	27	**202**	Use El +41'
44	30	135	17	1.00	132	0	**132**	189	189	27	**216**	
43	31	142	17	1.00	142	0	**142**	203	203	27	**230**	Strength RW (140k)
42	32	149	17	1.00	152	0	**152**	217	217	27	**244**	use EL +41'
41	33	156	17	1.00	162	0	**162**	231	231	27	**258**	
40	34	163	17	1.00	172	0	**172**	245	245	27	**272**	
39	35	170	17	1.00	181	0	**181**	259	259	27	**286**	
38	36	177	21	1.00	191	0	**191**	273	273	33	**307**	
37	37	184	26	1.00	201	0	**201**	287	287	41	**329**	
36	38	191	28	1.00	211	0	**211**	302	302	45	**347**	
35	39	199	28	1.00	221	0	**221**	316	316	45	**361**	
34	40	202	28	1.00	226	0	**226**	323	323	45	**368**	
33	41	205	28	1.00	231	0	**231**	330	330	45	**375**	
32	42	209	28	1.00	236	0	**236**	337	337	45	**382**	
31	43	212	28	1.00	240	0	**240**	343	343	45	**389**	
30	44	216	28	1.00	245	0	**245**	350	350	45	**396**	
29	45	219	28	1.00	250	0	**250**	357	357	45	**402**	
28	46	223	28	1.00	255	0	**255**	364	364	45	**409**	
27	47	226	28	1.00	260	0	**260**	371	371	45	**416**	
26	48	230	28	1.00	265	0	**265**	378	378	45	**423**	
25	49	233	28	1.00	269	0	**269**	385	385	45	**430**	Strength (267k)
24	50	237	28	1.00	274	0	**274**	392	392	45	**437**	use EL+23'
23	51	240	28	1.00	279	0	**279**	399	399	45	**444**	
22	52	243	28	1.00	284	0	**284**	406	406	45	**451**	
21	53	247	28	1.00	289	0	**289**	413	413	45	**458**	
20	54	250	28	1.00	294	0	**294**	419	419	45	**465**	
19	55	254	28	1.00	298	0	**298**	426	426	45	**472**	
18	56	257	30	1.00	303	0	**303**	433	433	48	**482**	
17	57	261	32	1.00	308	0	**308**	440	440	52	**492**	
16	58	264	34	1.00	313	0	**313**	447	447	54	**501**	
15	59	268	34	1.00	318	0	**318**	454	454	54	**508**	
14	60	274	34	1.00	327	0	**327**	468	468	54	**521**	
13	61	281	34	1.00	337	0	**337**	481	481	54	**535**	
12	62	288	34	1.00	346	0	**346**	494	494	54	**548**	
11	63	295	34	1.00	355	0	**355**	508	508	54	**561**	
10	64	301	34	1.00	365	0	**365**	521	521	54	**575**	
9	65	308	34	1.00	374	0	**374**	534	534	54	**588**	
8	66	314	34	1.00	383	0	**383**	547	547	54	**601**	
7	67	321	34	1.00	392	0	**392**	560	560	54	**613**	
6	68	327	34	1.00	401	0	**401**	573	573	54	**626**	
5	69	333	34	1.00	410	0	**410**	585	585	54	**639**	
4	70	340	34	1.00	418	0	**418**	598	598	54	**651**	
3	71	346	34	1.00	427	0	**427**	610	610	54	**664**	
2	72	352	34	1.00	436	0	**436**	622	622	54	**676**	
1	73	358	34	1.00	444	0	**444**	635	635	54	**688**	
0	74	364	34	1.00	453	0	**453**	647	647	54	**700**	
-1	75	370	34	1.00	461	0	**461**	658	658	54	**712**	
-2	76	376	34	1.00	469	0	**469**	670	670	54	**724**	
-3	77	381	34	1.00	477	0	**477**	682	682	54	**735**	
-4	78	387	34	1.00	485	0	**485**	693	693	54	**747**	
-5	79	393	34	1.00	493	0	**493**	704	704	54	**758**	
-6	80	398	34	1.00	501	0	**501**	715	715	54	**769**	
-7	81	404	34	1.00	508	0	**508**	726	726	54	**780**	
-8	82	409	34	1.00	516	0	**516**	737	737	54	**790**	
-9	83	414	34	1.00	523	0	**523**	747	747	54	**801**	
-10	84	419	34	1.00	530	0	**530**	757	757	54	**811**	
-11	85	424	34	1.00	537	0	**537**	768	768	54	**821**	
-12	86	429	34	1.00	544	0	**544**	778	778	54	**831**	
-13	87	435	34	1.00	551	0	**551**	788	788	54	**841**	

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Abut 1
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

-14	88	440	34	1.00	559	0	**559**	798	798	54	**852**
-15	89	445	34	1.00	566	0	**566**	808	808	54	**862**
	90	450	34	1.00	573	0	**573**	819	819	54	**872**

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 2
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

Finish Grade Elevation = 18 ft
Cut Off Elevation = 13 ft

Pile type: 118'"-diameter CIDH

Pre-liquefaction Condition(only)

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.2	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	1	Clay	0.88
(2)	1	36	Sand	0.88
(3)	36	71	Clay	0.88
(4)	71	150	sand	0.88

(=>Pile Length)

Axial Group Reduction Factor (η) for Sandy Materials= 0.88
Axial Group Reduction Factor (η) for Clayey Materials= 0.88

Skin Resistance above neutral axis (refere (=>Pile Length)
minus @ Ele.= 18 ' for Liq. settlement=0.1"
0 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State				
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)	
18	0	0	0		0	0	**0**	0		0	**0**	
12	6	6	1215	0.88	7	428	**435**	10	10	1711	**1722**	
11	7	15	1215	0.88	18	428	**446**	26	26	1711	**1737**	
10	8	23	1215	0.88	29	428	**456**	41	41	1711	**1752**	
9	9	33	1215	0.88	40	428	**468**	58	58	1711	**1769**	
8	10	43	1215	0.88	53	428	**481**	76	76	1711	**1787**	
7	11	54	1215	0.88	67	428	**495**	96	96	1711	**1807**	Extreme (1503k)*
6	12	66	1215	0.88	82	428	**509**	117	117	1711	**1828**	Use El +2'
5	13	79	1215	0.88	97	428	**525**	139	139	1711	**1850**	
4	14	92	1215	0.88	114	428	**542**	163	163	1711	**1874**	
3	15	107	1215	0.88	131	428	**559**	188	188	1711	**1899**	
2	16	121	1215	0.88	150	428	**577**	214	214	1711	**1925**	
1	17	137	1215	0.88	169	428	**597**	241	241	1711	**1952**	
0	18	153	1195	0.88	189	420	**609**	270	270	1682	**1951**	
-1	19	170	1173	0.88	209	413	**622**	299	299	1651	**1950**	
-2	20	187	1150	0.88	231	405	**635**	330	330	1619	**1948**	
-3	21	205	1126	0.88	253	396	**649**	361	361	1585	**1946**	
-4	22	224	1101	0.88	275	388	**663**	393	393	1550	**1944**	
-5	23	243	1075	0.88	299	378	**677**	427	427	1513	**1940**	
-6	24	262	1048	0.88	323	369	**692**	461	461	1475	**1936**	
-7	25	282	1020	0.88	347	359	**706**	496	496	1436	**1932**	
-8	26	302	991	0.88	372	349	**721**	532	532	1395	**1927**	
-9	27	323	963	0.88	398	339	**737**	569	569	1355	**1924**	
-10	28	344	938	0.88	424	330	**754**	606	606	1320	**1926**	
-11	29	366	916	0.88	451	322	**773**	644	644	1289	**1934**	
-12	30	388	897	0.88	478	316	**794**	683	683	1263	**1946**	
-13	31	411	881	0.88	506	310	**816**	723	723	1241	**1964**	
-14	32	433	869	0.88	534	306	**840**	763	763	1223	**1986**	
-15	33	457	860	0.88	562	303	**865**	803	803	1210	**2014**	
-16	34	480	853	0.88	591	300	**892**	845	845	1201	**2046**	
-17	35	504	850	0.88	621	299	**920**	887	887	1197	**2084**	
-18	36	528	850	0.88	650	299	**949**	929	929	1197	**2126**	
-19	37	559	850	0.88	689	299	**988**	984	984	1197	**2181**	
-20	38	591	850	0.88	728	299	**1027**	1040	1040	1197	**2237**	
-21	39	622	850	0.88	767	299	**1066**	1096	1096	1197	**2293**	
-22	40	654	850	0.88	806	299	**1105**	1151	1151	1197	**2348**	
-23	41	686	850	0.88	845	299	**1144**	1207	1207	1197	**2404**	
-24	42	717	850	0.88	884	299	**1183**	1262	1262	1197	**2459**	
-25	43	749	850	0.88	922	299	**1222**	1318	1318	1197	**2515**	
-26	44	780	850	0.88	961	299	**1261**	1373	1373	1197	**2570**	
-27	45	812	850	0.88	1000	299	**1300**	1429	1429	1197	**2626**	
-28	46	844	850	0.88	1039	299	**1338**	1485	1485	1197	**2682**	
-29	47	875	850	0.88	1078	299	**1377**	1540	1540	1197	**2737**	
-30	48	907	850	0.88	1117	299	**1416**	1596	1596	1197	**2793**	
-31	49	938	850	0.88	1156	299	**1455**	1651	1651	1197	**2848**	
-32	50	970	850	0.88	1195	299	**1494**	1707	1707	1197	**2904**	
-33	51	1001	850	0.88	1234	299	**1533**	1762	1762	1197	**2959**	
-34	52	1033	850	0.88	1273	299	**1572**	1818	1818	1197	**3015**	
-35	53	1065	913	0.88	1312	321	**1633**	1874	1874	1285	**3158**	
-36	54	1096	978	0.88	1350	344	**1695**	1929	1929	1377	**3306**	
-37	55	1128	1047	0.88	1389	368	**1758**	1985	1985	1474	**3458**	
-38	56	1159	1118	0.88	1428	394	**1822**	2040	2040	1574	**3615**	
-39	57	1191	1193	0.88	1467	420	**1887**	2096	2096	1680	**3776**	
-40	58	1222	1271	0.88	1506	447	**1953**	2151	2151	1790	**3941**	
-41	59	1254	1352	0.88	1545	476	**2021**	2207	2207	1904	**4111**	
-42	60	1286	1436	0.88	1584	506	**2089**	2263	2263	2022	**4285**	
-43	61	1317	1523	0.88	1623	536	**2159**	2318	2318	2145	**4463**	
-44	62	1349	1608	0.88	1662	566	**2228**	2374	2374	2264	**4637**	
-45	63	1380	1682	0.88	1701	592	**2293**	2429	2429	2369	**4798**	
-46	64	1412	1748	0.88	1739	615	**2355**	2485	2485	2461	**4946**	
-47	65	1443	1804	0.88	1778	635	**2413**	2541	2541	2540	**5081**	
-48	66	1475	1851	0.88	1817	651	**2469**	2596	2596	2606	**5202**	
-49	67	1507	1888	0.88	1856	665	**2521**	2652	2652	2659	**5310**	
-50	68	1538	1916	0.88	1895	675	**2570**	2707	2707	2698	**5405**	
-51	69	1570	1935	0.88	1934	681	**2615**	2763	2763	2724	**5487**	
-52	70	1601	1944	0.88	1973	684	**2657**	2818	2818	2738	**5556**	
-53	71	1633	1944	0.88	2012	684	**2696**	2874	2874	2738	**5612**	
-54	72	1658	1944	0.88	2042	684	**2727**	2917	2917	2738	**5655**	
-55	73	1682	1944	0.88	2072	684	**2757**	2961	2961	2738	**5698**	
-56	74	1706	1944	0.88	2102	684	**2787**	3003	3003	2738	**5741**	
-57	75	1731	1944	0.88	2132	684	**2816**	3046	3046	2738	**5783**	
-58	76	1754	1944	0.88	2161	684	**2846**	3088	3088	2738	**5825**	
-59	77	1778	1944	0.88	2191	684	**2875**	3129	3129	2738	**5867**	
-60	78	1801	1944	0.88	2219	684	**2904**	3171	3171	2738	**5908**	
-61	79	1825	1944	0.88	2248	684	**2932**	3211	3211	2738	**5949**	
-62	80	1847	1944	0.88	2276	684	**2960**	3251	3251	2738	**5989**	
-63	81	1870	1944	0.88	2304	684	**2988**	3291	3291	2738	**6029**	
-64	82	1892	1944	0.88	2331	684	**3016**	3330	3330	2738	**6068**	
-65	83	1914	1944	0.88	2358	684	**3043**	3369	3369	2738	**6106**	
-66	84	1936	1944	0.88	2385	684	**3069**	3407	3407	2738	**6144**	
-67	85	1957	1944	0.88	2411	684	**3095**	3444	3444	2738	**6182**	
-68	86	1978	1944	0.88	2437	684	**3121**	3481	3481	2738	**6219**	
-69	87	1999	1944	0.88	2463	684	**3148**	3519	3519	2738	**6256**	
-70	88	2021	1944	0.88	2490	684	**3174**	3557	3557	2738	**6295**	
-71	89	2043	1944	0.88	2517	684	**3201**	3595	3595	2738	**6333**	
-72	90	2065	1944	0.88	2544	684	**3228**	3634	3634	2738	**6372**	

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 2
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

-73	91	2087	1944	0.88	2572	684	**3256**	3674	3674	2738	**6411**	
-74	92	2110	1944	0.88	2600	684	**3284**	3714	3714	2738	**6451**	
-75	93	2133	1944	0.88	2628	684	**3312**	3754	3754	2738	**6492**	
-76	94	2156	1944	0.88	2656	684	**3341**	3795	3795	2738	**6532**	
-77	95	2180	1944	0.88	2685	684	**3370**	3836	3836	2738	**6574**	
-78	96	2203	1944	0.88	2714	684	**3399**	3878	3878	2738	**6615**	
-79	97	2227	1944	0.88	2744	684	**3428**	3920	3920	2738	**6657**	
-80	98	2251	1944	0.88	2774	684	**3458**	3962	3962	2738	**6700**	
-81	99	2276	1944	0.88	2804	684	**3488**	4006	4006	2738	**6743**	
-82	100	2301	1944	0.88	2834	684	**3519**	4049	4049	2738	**6787**	
-83	101	2326	1944	0.88	2865	684	**3550**	4093	4093	2738	**6831**	
-84	102	2351	1944	0.88	2896	684	**3581**	4137	4137	2738	**6875**	
-85	103	2376	1944	0.88	2928	684	**3612**	4182	4182	2738	**6920**	
-86	104	2402	1944	0.88	2959	684	**3644**	4228	4228	2738	**6965**	
-87	105	2428	1944	0.88	2992	684	**3676**	4274	4274	2738	**7011**	
-88	106	2454	1944	0.88	3024	684	**3708**	4320	4320	2738	**7057**	
-89	107	2481	1944	0.88	3057	684	**3741**	4367	4367	2738	**7104**	
-90	108	2508	1944	0.88	3090	684	**3774**	4414	4414	2738	**7151**	
-91	109	2535	1944	0.88	3123	684	**3807**	4462	4462	2738	**7199**	
-92	110	2562	1944	0.88	3157	684	**3841**	4510	4510	2738	**7247**	
-93	111	2590	1944	0.88	3191	684	**3875**	4558	4558	2738	**7296**	
-94	112	2618	1944	0.88	3225	684	**3910**	4607	4607	2738	**7345**	
-95	113	2646	1944	0.88	3260	684	**3944**	4657	4657	2738	**7394**	
-96	114	2674	1944	0.88	3295	684	**3979**	4707	4707	2738	**7444**	
-97	115	2703	1944	0.88	3330	684	**4014**	4757	4757	2738	**7495**	
-98	116	2732	1944	0.88	3366	684	**4050**	4808	4808	2738	**7546**	
-99	117	2761	1944	0.88	3402	684	**4086**	4859	4859	2738	**7597**	
-100	118	2790	1944	0.88	3438	684	**4122**	4911	4911	2738	**7649**	Strength (4101k)
-101	119	2820	1944	0.88	3474	684	**4159**	4964	4964	2738	**7701**	use EL-102'
-102	120	2850	1944	0.88	3511	684	**4196**	5016	5016	2738	**7754**	
-103	121	2880	1944	0.88	3549	684	**4233**	5069	5069	2738	**7807**	
-104	122	2911	1944	0.88	3586	684	**4271**	5123	5123	2738	**7861**	
-105	123	2942	1944	0.88	3624	684	**4308**	5177	5177	2738	**7915**	
-106	124	2973	1944	0.88	3662	684	**4347**	5232	5232	2738	**7969**	
-107	125	3004	1944	0.88	3701	684	**4385**	5287	5287	2738	**8024**	
18												
18												
18												
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Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 3
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

Finish Grade Elevation = 18 ft
Cut Off Elevation = 13 ft
Pile type: 118'"-diameter CIDH
Pre-liquefaction Condition

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.2	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	13	Sand	0.88
(2)	13	28	Sand	0.88
(3)	28	68	Clay	0.88
(4)	68	150	Sand	0.88

(=>Pile Length)

Axial Group Reduction Factor (η) for Sandy Materials= 0.88
Axial Group Reduction Factor (η) for Clayey Materials= 0.88

Skin Resistance above neutral axis (reference only)
minus @ Ele.= 18 ' for Liq. settlement=0.1"
0 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State			
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)
18	0	0	0		0	0	**0**	0		0	**0**
12	6	4	672	0.88	5	236	**241**	7	7	946	**953**
11	7	10	706	0.88	12	249	**261**	17	17	995	**1012**
10	8	16	741	0.88	19	261	**280**	28	28	1043	**1071**
9	9	22	769	0.88	27	271	**298**	39	39	1082	**1121**
8	10	29	794	0.88	36	280	**316**	52	52	1118	**1170**
7	11	37	813	0.88	45	286	**332**	65	65	1145	**1210**
6	12	45	824	0.88	56	290	**346**	79	79	1161	**1240**
5	13	54	829	0.88	66	292	**358**	95	95	1167	**1262**
4	14	63	833	0.88	78	293	**371**	111	111	1173	**1284**
3	15	73	838	0.88	90	295	**385**	129	129	1179	**1308**
2	16	84	842	0.88	104	296	**400**	148	148	1185	**1333**
1	17	95	846	0.88	118	298	**415**	168	168	1191	**1359**
0	18	108	849	0.88	132	299	**431**	189	189	1196	**1385**
-1	19	120	853	0.88	148	300	**448**	211	211	1201	**1412**
-2	20	133	855	0.88	164	301	**465**	235	235	1204	**1439**
-3	21	147	857	0.88	181	302	**483**	259	259	1207	**1466**
-4	22	162	858	0.88	199	302	**501**	284	284	1208	**1493**
-5	23	176	859	0.88	217	302	**520**	311	311	1209	**1520**
-6	24	192	859	0.88	236	302	**539**	338	338	1209	**1547**
-7	25	208	858	0.88	256	302	**558**	366	366	1208	**1574**
-8	26	224	857	0.88	276	302	**578**	394	394	1207	**1601**
-9	27	241	856	0.88	297	301	**598**	424	424	1205	**1629**
-10	28	258	854	0.88	318	301	**619**	454	454	1203	**1657**
-11	29	290	853	0.88	357	300	**657**	510	510	1201	**1710**
-12	30	321	852	0.88	396	300	**696**	565	565	1199	**1765**
-13	31	353	851	0.88	435	300	**734**	621	621	1198	**1819**
-14	32	384	851	0.88	474	299	**773**	676	676	1198	**1874**
-15	33	416	850	0.88	512	299	**812**	732	732	1197	**1929**
-16	34	448	850	0.88	551	299	**851**	788	788	1197	**1985**
-17	35	479	850	0.88	590	299	**889**	843	843	1197	**2040**
-18	36	511	850	0.88	629	299	**928**	899	899	1197	**2096**
-19	37	542	850	0.88	668	299	**967**	954	954	1197	**2151**
-20	38	574	850	0.88	707	299	**1006**	1010	1010	1197	**2207**
-21	39	605	850	0.88	746	299	**1045**	1065	1065	1197	**2263**
-22	40	637	850	0.88	785	299	**1084**	1121	1121	1197	**2318**
-23	41	669	850	0.88	824	299	**1123**	1177	1177	1197	**2374**
-24	42	700	850	0.88	863	299	**1162**	1232	1232	1197	**2429**
-25	43	732	850	0.88	901	299	**1201**	1288	1288	1197	**2485**
-26	44	763	850	0.88	940	299	**1240**	1343	1343	1197	**2540**
-27	45	795	850	0.88	979	299	**1279**	1399	1399	1197	**2596**
-28	46	826	850	0.88	1018	299	**1317**	1455	1455	1197	**2652**
-29	47	858	850	0.88	1057	299	**1356**	1510	1510	1197	**2707**
-30	48	890	850	0.88	1096	299	**1395**	1566	1566	1197	**2763**
-31	49	921	850	0.88	1135	299	**1434**	1621	1621	1197	**2818**
-32	50	953	913	0.88	1174	321	**1495**	1677	1677	1285	**2962**
-33	51	984	978	0.88	1213	344	**1557**	1732	1732	1377	**3109**
-34	52	1016	1047	0.88	1252	368	**1620**	1788	1788	1474	**3262**
-35	53	1047	1118	0.88	1290	394	**1684**	1844	1844	1574	**3418**
-36	54	1079	1193	0.88	1329	420	**1749**	1899	1899	1680	**3579**
-37	55	1111	1271	0.88	1368	447	**1816**	1955	1955	1790	**3744**
-38	56	1142	1352	0.88	1407	476	**1883**	2010	2010	1904	**3914**
-39	57	1174	1436	0.88	1446	506	**1952**	2066	2066	2022	**4088**
-40	58	1205	1523	0.88	1485	536	**2021**	2121	2121	2145	**4266**
-41	59	1237	1608	0.88	1524	566	**2090**	2177	2177	2264	**4441**
-42	60	1269	1682	0.88	1563	592	**2155**	2233	2233	2369	**4601**
-43	61	1300	1748	0.88	1602	615	**2217**	2288	2288	2461	**4749**
-44	62	1332	1804	0.88	1641	635	**2276**	2344	2344	2540	**4884**
-45	63	1363	1851	0.88	1680	651	**2331**	2399	2399	2606	**5005**
-46	64	1395	1888	0.88	1718	665	**2383**	2455	2455	2659	**5113**
-47	65	1426	1916	0.88	1757	675	**2432**	2510	2510	2698	**5208**
-48	66	1458	1935	0.88	1796	681	**2477**	2566	2566	2724	**5290**
-49	67	1490	1944	0.88	1835	684	**2520**	2622	2622	2738	**5359**
-50	68	1521	1944	0.88	1874	684	**2558**	2677	2677	2738	**5415**
-51	69	1544	1944	0.88	1903	684	**2587**	2718	2718	2738	**5456**
-52	70	1568	1944	0.88	1931	684	**2616**	2759	2759	2738	**5497**
-53	71	1591	1944	0.88	1960	684	**2644**	2800	2800	2738	**5537**
-54	72	1614	1944	0.88	1988	684	**2673**	2840	2840	2738	**5578**
-55	73	1637	1944	0.88	2016	684	**2701**	2880	2880	2738	**5618**
-56	74	1659	1944	0.88	2044	684	**2728**	2920	2920	2738	**5658**
-57	75	1682	1944	0.88	2072	684	**2756**	2960	2960	2738	**5697**
-58	76	1704	1944	0.88	2099	684	**2784**	2999	2999	2738	**5736**
-59	77	1726	1944	0.88	2126	684	**2811**	3038	3038	2738	**5775**
-60	78	1748	1944	0.88	2153	684	**2838**	3076	3076	2738	**5814**
-61	79	1769	1944	0.88	2180	684	**2864**	3114	3114	2738	**5852**
-62	80	1791	1944	0.88	2206	684	**2891**	3152	3152	2738	**5889**
-63	81	1812	1944	0.88	2232	684	**2917**	3189	3189	2738	**5927**
-64	82	1833	1944	0.88	2258	684	**2942**	3226	3226	2738	**5963**
-65	83	1853	1944	0.88	2283	684	**2968**	3262	3262	2738	**6000**
-66	84	1874	1944	0.88	2308	684	**2993**	3298	3298	2738	**6035**
-67	85	1894	1944	0.88	2333	684	**3017**	3333	3333	2738	**6071**
-68	86	1914	1944	0.88	2358	684	**3042**	3368	3368	2738	**6105**
-69	87	1934	1944	0.88	2382	684	**3067**	3403	3403	2738	**6141**
-70	88	1954	1944	0.88	2407	684	**3092**	3439	3439	2738	**6177**
-71	89	1975	1944	0.88	2433	684	**3117**	3475	3475	2738	**6213**
-72	90	1996	1944	0.88	2459	684	**3143**	3512	3512	2738	**6250**

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 3
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

-73	91	2017	1944	0.88	2485	684	**3169**	3549	3549	2738	**6287**	
-74	92	2038	1944	0.88	2511	684	**3195**	3587	3587	2738	**6325**	
-75	93	2060	1944	0.88	2538	684	**3222**	3625	3625	2738	**6363**	
-76	94	2082	1944	0.88	2565	684	**3249**	3664	3664	2738	**6401**	
-77	95	2104	1944	0.88	2592	684	**3276**	3703	3703	2738	**6441**	
-78	96	2126	1944	0.88	2620	684	**3304**	3742	3742	2738	**6480**	
-79	97	2149	1944	0.88	2648	684	**3332**	3782	3782	2738	**6520**	
-80	98	2172	1944	0.88	2676	684	**3360**	3823	3823	2738	**6560**	
-81	99	2195	1944	0.88	2705	684	**3389**	3864	3864	2738	**6601**	
-82	100	2219	1944	0.88	2734	684	**3418**	3905	3905	2738	**6643**	
-83	101	2243	1944	0.88	2763	684	**3447**	3947	3947	2738	**6685**	
-84	102	2267	1944	0.88	2792	684	**3477**	3989	3989	2738	**6727**	
-85	103	2291	1944	0.88	2822	684	**3507**	4032	4032	2738	**6770**	
-86	104	2315	1944	0.88	2853	684	**3537**	4075	4075	2738	**6813**	
-87	105	2340	1944	0.88	2883	684	**3568**	4119	4119	2738	**6856**	
-88	106	2365	1944	0.88	2914	684	**3598**	4163	4163	2738	**6901**	
-89	107	2391	1944	0.88	2945	684	**3630**	4208	4208	2738	**6945**	
-90	108	2416	1944	0.88	2977	684	**3661**	4253	4253	2738	**6990**	
-91	109	2442	1944	0.88	3009	684	**3693**	4298	4298	2738	**7036**	
-92	110	2468	1944	0.88	3041	684	**3725**	4344	4344	2738	**7082**	
-93	111	2495	1944	0.88	3073	684	**3758**	4390	4390	2738	**7128**	
-94	112	2521	1944	0.88	3106	684	**3791**	4437	4437	2738	**7175**	
-95	113	2548	1944	0.88	3139	684	**3824**	4485	4485	2738	**7222**	
-96	114	2575	1944	0.88	3173	684	**3857**	4532	4532	2738	**7270**	
-97	115	2603	1944	0.88	3206	684	**3891**	4581	4581	2738	**7318**	
-98	116	2630	1944	0.88	3241	684	**3925**	4629	4629	2738	**7367**	
-99	117	2658	1944	0.88	3275	684	**3959**	4679	4679	2738	**7416**	
-100	118	2686	1944	0.88	3310	684	**3994**	4728	4728	2738	**7466**	
-101	119	2715	1944	0.88	3345	684	**4029**	4778	4778	2738	**7516**	
-102	120	2744	1944	0.88	3380	684	**4065**	4829	4829	2738	**7566**	
-103	121	2773	1944	0.88	3416	684	**4100**	4880	4880	2738	**7617**	
-104	122	2802	1944	0.88	3452	684	**4136**	4931	4931	2738	**7669**	
-105	123	2831	1944	0.88	3488	684	**4173**	4983	4983	2738	**7721**	
-106	124	2861	1944	0.88	3525	684	**4209**	5036	5036	2738	**7773**	Strength (4245k)
-107	125	2891	1944	0.88	3562	684	**4246**	5088	5088	2738	**7826**	use EL-108'

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 3
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

Finish Grade Elevation = 18 ft
Cut Off Elevation = 13 ft

Pile type: 118'"-diameter CIDH

Post-liquefaction Condition

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.2	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	13	Clay	0.88
(2)	13	28	Sand	0.88
(3)	28	68	Clay	0.88
(4)	68	150	Sand	0.88

Axial Group Reduction Factor (η) for Sandy Materials= 0.88
Axial Group Reduction Factor (η) for Clayey Materials= 0.88

Skin Resistance above neutral axis (=>Pile Length)
minus @ Ele.= 18 ' for Liq. settlement=0.1"
0 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State				
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)	
18	0	0	0		0	0	**0**	0		0	**0**	
12	6	3	691	0.88	4	243	**247**	6	6	973	**979**	
11	7	7	721	0.88	8	254	**262**	12	12	1015	**1027**	
10	8	10	751	0.88	13	264	**277**	18	18	1057	**1075**	
9	9	14	775	0.88	17	273	**289**	24	24	1091	**1114**	
8	10	17	797	0.88	21	281	**302**	30	30	1122	**1152**	
7	11	20	814	0.88	25	286	**312**	36	36	1146	**1182**	
6	12	24	824	0.88	29	290	**320**	42	42	1161	**1203**	
5	13	27	829	0.88	33	292	**325**	48	48	1167	**1215**	
4	14	37	833	0.88	45	293	**338**	64	64	1173	**1238**	
3	15	47	838	0.88	58	295	**352**	82	82	1179	**1261**	
2	16	57	842	0.88	71	296	**367**	101	101	1185	**1286**	
1	17	69	846	0.88	85	298	**383**	121	121	1191	**1312**	
0	18	81	849	0.88	100	299	**399**	142	142	1196	**1338**	
-1	19	94	853	0.88	115	300	**415**	165	165	1201	**1365**	
-2	20	107	855	0.88	132	301	**433**	188	188	1204	**1392**	
-3	21	121	857	0.88	149	302	**450**	212	212	1207	**1419**	
-4	22	135	858	0.88	166	302	**468**	238	238	1208	**1446**	
-5	23	150	859	0.88	185	302	**487**	264	264	1209	**1473**	
-6	24	165	859	0.88	204	302	**506**	291	291	1209	**1500**	
-7	25	181	858	0.88	223	302	**525**	319	319	1208	**1527**	
-8	26	197	857	0.88	243	302	**545**	348	348	1207	**1554**	
-9	27	214	856	0.88	264	301	**565**	377	377	1205	**1582**	
-10	28	231	854	0.88	285	301	**586**	407	407	1203	**1610**	Extreme (1599k)*
-11	29	263	853	0.88	324	300	**624**	463	463	1201	**1664**	Use El-15
-12	30	295	852	0.88	363	300	**663**	519	519	1199	**1718**	
-13	31	326	851	0.88	402	300	**701**	574	574	1198	**1772**	
-14	32	358	851	0.88	441	299	**740**	630	630	1198	**1827**	
-15	33	389	850	0.88	480	299	**779**	685	685	1197	**1883**	
-16	34	421	850	0.88	519	299	**818**	741	741	1197	**1938**	
-17	35	453	850	0.88	557	299	**857**	796	796	1197	**1993**	
-18	36	484	850	0.88	596	299	**896**	852	852	1197	**2049**	
-19	37	516	850	0.88	635	299	**935**	908	908	1197	**2105**	
-20	38	547	850	0.88	674	299	**973**	963	963	1197	**2160**	
-21	39	579	850	0.88	713	299	**1012**	1019	1019	1197	**2216**	
-22	40	610	850	0.88	752	299	**1051**	1074	1074	1197	**2271**	
-23	41	642	850	0.88	791	299	**1090**	1130	1130	1197	**2327**	
-24	42	674	850	0.88	830	299	**1129**	1185	1185	1197	**2383**	
-25	43	705	850	0.88	869	299	**1168**	1241	1241	1197	**2438**	
-26	44	737	850	0.88	908	299	**1207**	1297	1297	1197	**2494**	
-27	45	768	850	0.88	947	299	**1246**	1352	1352	1197	**2549**	
-28	46	800	850	0.88	985	299	**1285**	1408	1408	1197	**2605**	
-29	47	831	850	0.88	1024	299	**1324**	1463	1463	1197	**2660**	
-30	48	863	850	0.88	1063	299	**1363**	1519	1519	1197	**2716**	
-31	49	895	850	0.88	1102	299	**1401**	1574	1574	1197	**2772**	
-32	50	926	913	0.88	1141	321	**1462**	1630	1630	1285	**2915**	
-33	51	958	978	0.88	1180	344	**1524**	1686	1686	1377	**3063**	
-34	52	989	1047	0.88	1219	368	**1587**	1741	1741	1474	**3215**	
-35	53	1021	1118	0.88	1258	394	**1651**	1797	1797	1574	**3371**	
-36	54	1052	1193	0.88	1297	420	**1717**	1852	1852	1680	**3532**	
-37	55	1084	1271	0.88	1336	447	**1783**	1908	1908	1790	**3697**	
-38	56	1116	1352	0.88	1374	476	**1850**	1964	1964	1904	**3867**	
-39	57	1147	1436	0.88	1413	506	**1919**	2019	2019	2022	**4041**	
-40	58	1179	1523	0.88	1452	536	**1989**	2075	2075	2145	**4220**	
-41	59	1210	1608	0.88	1491	566	**2057**	2130	2130	2264	**4394**	
-42	60	1242	1682	0.88	1530	592	**2122**	2186	2186	2369	**4555**	
-43	61	1274	1748	0.88	1569	615	**2184**	2241	2241	2461	**4702**	
-44	62	1305	1804	0.88	1608	635	**2243**	2297	2297	2540	**4837**	
-45	63	1337	1851	0.88	1647	651	**2298**	2353	2353	2606	**4958**	
-46	64	1368	1888	0.88	1686	665	**2350**	2408	2408	2659	**5067**	
-47	65	1400	1916	0.88	1725	675	**2399**	2464	2464	2698	**5162**	
-48	66	1431	1935	0.88	1763	681	**2445**	2519	2519	2724	**5244**	
-49	67	1463	1944	0.88	1802	684	**2487**	2575	2575	2738	**5312**	
-50	68	1495	1944	0.88	1841	684	**2526**	2630	2630	2738	**5368**	
-51	69	1518	1944	0.88	1870	684	**2554**	2671	2671	2738	**5409**	
-52	70	1541	1944	0.88	1899	684	**2583**	2712	2712	2738	**5450**	
-53	71	1564	1944	0.88	1927	684	**2611**	2753	2753	2738	**5491**	
-54	72	1587	1944	0.88	1955	684	**2640**	2793	2793	2738	**5531**	
-55	73	1610	1944	0.88	1983	684	**2668**	2834	2834	2738	**5571**	
-56	74	1633	1944	0.88	2011	684	**2696**	2873	2873	2738	**5611**	
-57	75	1655	1944	0.88	2039	684	**2723**	2913	2913	2738	**5650**	
-58	76	1677	1944	0.88	2066	684	**2751**	2952	2952	2738	**5690**	
-59	77	1699	1944	0.88	2094	684	**2778**	2991	2991	2738	**5729**	
-60	78	1721	1944	0.88	2121	684	**2805**	3029	3029	2738	**5767**	
-61	79	1743	1944	0.88	2147	684	**2832**	3068	3068	2738	**5805**	
-62	80	1764	1944	0.88	2174	684	**2858**	3105	3105	2738	**5843**	
-63	81	1785	1944	0.88	2200	684	**2884**	3142	3142	2738	**5880**	
-64	82	1806	1944	0.88	2225	684	**2910**	3179	3179	2738	**5917**	
-65	83	1827	1944	0.88	2251	684	**2935**	3215	3215	2738	**5953**	
-66	84	1847	1944	0.88	2276	684	**2960**	3251	3251	2738	**5989**	
-67	85	1867	1944	0.88	2300	684	**2985**	3286	3286	2738	**6024**	
-68	86	1887	1944	0.88	2325	684	**3009**	3321	3321	2738	**6059**	
-69	87	1907	1944	0.88	2350	684	**3034**	3357	3357	2738	**6094**	
-70	88	1928	1944	0.88	2375	684	**3059**	3392	3392	2738	**6130**	
-71	89	1948	1944	0.88	2400	684	**3084**	3429	3429	2738	**6166**	
-72	90	1969	1944	0.88	2426	684	**3110**	3465	3465	2738	**6203**	

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 3
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

-73	91	1990	1944	0.88	2452	684	**3136**	3503	3503	2738	**6240**
-74	92	2012	1944	0.88	2478	684	**3163**	3540	3540	2738	**6278**
-75	93	2033	1944	0.88	2505	684	**3189**	3579	3579	2738	**6316**
-76	94	2055	1944	0.88	2532	684	**3216**	3617	3617	2738	**6355**
-77	95	2077	1944	0.88	2559	684	**3244**	3656	3656	2738	**6394**
-78	96	2100	1944	0.88	2587	684	**3271**	3696	3696	2738	**6433**
-79	97	2123	1944	0.88	2615	684	**3299**	3736	3736	2738	**6473**
-80	98	2146	1944	0.88	2643	684	**3328**	3776	3776	2738	**6514**
-81	99	2169	1944	0.88	2672	684	**3356**	3817	3817	2738	**6555**
-82	100	2192	1944	0.88	2701	684	**3385**	3858	3858	2738	**6596**
-83	101	2216	1944	0.88	2730	684	**3415**	3900	3900	2738	**6638**
-84	102	2240	1944	0.88	2760	684	**3444**	3943	3943	2738	**6680**
-85	103	2264	1944	0.88	2790	684	**3474**	3985	3985	2738	**6723**
-86	104	2289	1944	0.88	2820	684	**3504**	4028	4028	2738	**6766**
-87	105	2314	1944	0.88	2850	684	**3535**	4072	4072	2738	**6810**
-88	106	2339	1944	0.88	2881	684	**3566**	4116	4116	2738	**6854**
-89	107	2364	1944	0.88	2913	684	**3597**	4161	4161	2738	**6898**
-90	108	2390	1944	0.88	2944	684	**3628**	4206	4206	2738	**6943**
-91	109	2416	1944	0.88	2976	684	**3660**	4251	4251	2738	**6989**
-92	110	2442	1944	0.88	3008	684	**3692**	4297	4297	2738	**7035**
-93	111	2468	1944	0.88	3041	684	**3725**	4344	4344	2738	**7081**
-94	112	2495	1944	0.88	3073	684	**3758**	4391	4391	2738	**7128**
-95	113	2522	1944	0.88	3107	684	**3791**	4438	4438	2738	**7175**
-96	114	2549	1944	0.88	3140	684	**3824**	4486	4486	2738	**7223**
-97	115	2576	1944	0.88	3174	684	**3858**	4534	4534	2738	**7271**
-98	116	2604	1944	0.88	3208	684	**3892**	4583	4583	2738	**7320**
-99	117	2632	1944	0.88	3242	684	**3927**	4632	4632	2738	**7369**
-100	118	2660	1944	0.88	3277	684	**3961**	4681	4681	2738	**7419**
-101	119	2688	1944	0.88	3312	684	**3996**	4732	4732	2738	**7469**
-102	120	2717	1944	0.88	3347	684	**4032**	4782	4782	2738	**7520**
-103	121	2746	1944	0.88	3383	684	**4068**	4833	4833	2738	**7571**
-104	122	2775	1944	0.88	3419	684	**4104**	4885	4885	2738	**7622**
-105	123	2805	1944	0.88	3456	684	**4140**	4937	4937	2738	**7674**
-106	124	2835	1944	0.88	3492	684	**4177**	4989	4989	2738	**7726**
-107	125	2865	1944	0.88	3529	684	**4214**	5042	5042	2738	**7779**
18											
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Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 4
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

Finish Grade Elevation = 18 ft
Cut Off Elevation = 13 ft
Pile type: 118"-diameter CIDH
Pre-liquefaction Condition

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.2	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	13	Sand	0.88
(2)	13	28	Sand	0.88
(3)	28	68	Clay	0.88
(4)	68	150	Sand	0.88

(=>Pile Length)

Axial Group Reduction Factor (η) for Sandy Materials= 0.88
Axial Group Reduction Factor (η) for Clayey Materials= 0.88

Skin Resistance above neutral axis (reference only)
minus @ Ele.= 18 ' for Liq. settlement=0.1"
0 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State			
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)
18	0	0	0		0	0	**0**	0		0	**0**
12	6	4	672	0.88	5	236	**241**	7	7	946	**953**
11	7	10	706	0.88	12	249	**261**	17	17	995	**1012**
10	8	16	741	0.88	19	261	**280**	28	28	1043	**1071**
9	9	22	769	0.88	27	271	**298**	39	39	1082	**1121**
8	10	29	794	0.88	36	280	**316**	52	52	1118	**1170**
7	11	37	813	0.88	45	286	**332**	65	65	1145	**1210**
6	12	45	824	0.88	56	290	**346**	79	79	1161	**1240**
5	13	54	829	0.88	66	292	**358**	95	95	1167	**1262**
4	14	63	833	0.88	78	293	**371**	111	111	1173	**1284**
3	15	73	838	0.88	90	295	**385**	129	129	1179	**1308**
2	16	84	842	0.88	104	296	**400**	148	148	1185	**1333**
1	17	95	846	0.88	118	298	**415**	168	168	1191	**1359**
0	18	108	849	0.88	132	299	**431**	189	189	1196	**1385**
-1	19	120	853	0.88	148	300	**448**	211	211	1201	**1412**
-2	20	133	855	0.88	164	301	**465**	235	235	1204	**1439**
-3	21	147	857	0.88	181	302	**483**	259	259	1207	**1466**
-4	22	162	858	0.88	199	302	**501**	284	284	1208	**1493**
-5	23	176	859	0.88	217	302	**520**	311	311	1209	**1520**
-6	24	192	859	0.88	236	302	**539**	338	338	1209	**1547**
-7	25	208	858	0.88	256	302	**558**	366	366	1208	**1574**
-8	26	224	857	0.88	276	302	**578**	394	394	1207	**1601**
-9	27	241	856	0.88	297	301	**598**	424	424	1205	**1629**
-10	28	258	854	0.88	318	301	**619**	454	454	1203	**1657**
-11	29	290	853	0.88	357	300	**657**	510	510	1201	**1710**
-12	30	321	852	0.88	396	300	**696**	565	565	1199	**1765**
-13	31	353	851	0.88	435	300	**734**	621	621	1198	**1819**
-14	32	384	851	0.88	474	299	**773**	676	676	1198	**1874**
-15	33	416	850	0.88	512	299	**812**	732	732	1197	**1929**
-16	34	448	850	0.88	551	299	**851**	788	788	1197	**1985**
-17	35	479	850	0.88	590	299	**889**	843	843	1197	**2040**
-18	36	511	850	0.88	629	299	**928**	899	899	1197	**2096**
-19	37	542	850	0.88	668	299	**967**	954	954	1197	**2151**
-20	38	574	850	0.88	707	299	**1006**	1010	1010	1197	**2207**
-21	39	605	850	0.88	746	299	**1045**	1065	1065	1197	**2263**
-22	40	637	850	0.88	785	299	**1084**	1121	1121	1197	**2318**
-23	41	669	850	0.88	824	299	**1123**	1177	1177	1197	**2374**
-24	42	700	850	0.88	863	299	**1162**	1232	1232	1197	**2429**
-25	43	732	850	0.88	901	299	**1201**	1288	1288	1197	**2485**
-26	44	763	850	0.88	940	299	**1240**	1343	1343	1197	**2540**
-27	45	795	850	0.88	979	299	**1279**	1399	1399	1197	**2596**
-28	46	826	850	0.88	1018	299	**1317**	1455	1455	1197	**2652**
-29	47	858	850	0.88	1057	299	**1356**	1510	1510	1197	**2707**
-30	48	890	850	0.88	1096	299	**1395**	1566	1566	1197	**2763**
-31	49	921	850	0.88	1135	299	**1434**	1621	1621	1197	**2818**
-32	50	953	913	0.88	1174	321	**1495**	1677	1677	1285	**2962**
-33	51	984	978	0.88	1213	344	**1557**	1732	1732	1377	**3109**
-34	52	1016	1047	0.88	1252	368	**1620**	1788	1788	1474	**3262**
-35	53	1047	1118	0.88	1290	394	**1684**	1844	1844	1574	**3418**
-36	54	1079	1193	0.88	1329	420	**1749**	1899	1899	1680	**3579**
-37	55	1111	1271	0.88	1368	447	**1816**	1955	1955	1790	**3744**
-38	56	1142	1352	0.88	1407	476	**1883**	2010	2010	1904	**3914**
-39	57	1174	1436	0.88	1446	506	**1952**	2066	2066	2022	**4088**
-40	58	1205	1523	0.88	1485	536	**2021**	2121	2121	2145	**4266**
-41	59	1237	1608	0.88	1524	566	**2090**	2177	2177	2264	**4441**
-42	60	1269	1682	0.88	1563	592	**2155**	2233	2233	2369	**4601**
-43	61	1300	1748	0.88	1602	615	**2217**	2288	2288	2461	**4749**
-44	62	1332	1804	0.88	1641	635	**2276**	2344	2344	2540	**4884**
-45	63	1363	1851	0.88	1680	651	**2331**	2399	2399	2606	**5005**
-46	64	1395	1888	0.88	1718	665	**2383**	2455	2455	2659	**5113**
-47	65	1426	1916	0.88	1757	675	**2432**	2510	2510	2698	**5208**
-48	66	1458	1935	0.88	1796	681	**2477**	2566	2566	2724	**5290**
-49	67	1490	1944	0.88	1835	684	**2520**	2622	2622	2738	**5359**
-50	68	1521	1944	0.88	1874	684	**2558**	2677	2677	2738	**5415**
-51	69	1544	1944	0.88	1903	684	**2587**	2718	2718	2738	**5456**
-52	70	1568	1944	0.88	1931	684	**2616**	2759	2759	2738	**5497**
-53	71	1591	1944	0.88	1960	684	**2644**	2800	2800	2738	**5537**
-54	72	1614	1944	0.88	1988	684	**2673**	2840	2840	2738	**5578**
-55	73	1637	1944	0.88	2016	684	**2701**	2880	2880	2738	**5618**
-56	74	1659	1944	0.88	2044	684	**2728**	2920	2920	2738	**5658**
-57	75	1682	1944	0.88	2072	684	**2756**	2960	2960	2738	**5697**
-58	76	1704	1944	0.88	2099	684	**2784**	2999	2999	2738	**5736**
-59	77	1726	1944	0.88	2126	684	**2811**	3038	3038	2738	**5775**
-60	78	1748	1944	0.88	2153	684	**2838**	3076	3076	2738	**5814**
-61	79	1769	1944	0.88	2180	684	**2864**	3114	3114	2738	**5852**
-62	80	1791	1944	0.88	2206	684	**2891**	3152	3152	2738	**5889**
-63	81	1812	1944	0.88	2232	684	**2917**	3189	3189	2738	**5927**
-64	82	1833	1944	0.88	2258	684	**2942**	3226	3226	2738	**5963**
-65	83	1853	1944	0.88	2283	684	**2968**	3262	3262	2738	**6000**
-66	84	1874	1944	0.88	2308	684	**2993**	3298	3298	2738	**6035**
-67	85	1894	1944	0.88	2333	684	**3017**	3333	3333	2738	**6071**
-68	86	1914	1944	0.88	2358	684	**3042**	3368	3368	2738	**6105**
-69	87	1934	1944	0.88	2382	684	**3067**	3403	3403	2738	**6141**
-70	88	1954	1944	0.88	2407	684	**3092**	3439	3439	2738	**6177**
-71	89	1975	1944	0.88	2433	684	**3117**	3475	3475	2738	**6213**
-72	90	1996	1944	0.88	2459	684	**3143**	3512	3512	2738	**6250**

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 4
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

-73	91	2017	1944	0.88	2485	684	**3169**	3549	3549	2738	**6287**	
-74	92	2038	1944	0.88	2511	684	**3195**	3587	3587	2738	**6325**	
-75	93	2060	1944	0.88	2538	684	**3222**	3625	3625	2738	**6363**	
-76	94	2082	1944	0.88	2565	684	**3249**	3664	3664	2738	**6401**	
-77	95	2104	1944	0.88	2592	684	**3276**	3703	3703	2738	**6441**	
-78	96	2126	1944	0.88	2620	684	**3304**	3742	3742	2738	**6480**	
-79	97	2149	1944	0.88	2648	684	**3332**	3782	3782	2738	**6520**	
-80	98	2172	1944	0.88	2676	684	**3360**	3823	3823	2738	**6560**	
-81	99	2195	1944	0.88	2705	684	**3389**	3864	3864	2738	**6601**	
-82	100	2219	1944	0.88	2734	684	**3418**	3905	3905	2738	**6643**	
-83	101	2243	1944	0.88	2763	684	**3447**	3947	3947	2738	**6685**	
-84	102	2267	1944	0.88	2792	684	**3477**	3989	3989	2738	**6727**	
-85	103	2291	1944	0.88	2822	684	**3507**	4032	4032	2738	**6770**	
-86	104	2315	1944	0.88	2853	684	**3537**	4075	4075	2738	**6813**	
-87	105	2340	1944	0.88	2883	684	**3568**	4119	4119	2738	**6856**	
-88	106	2365	1944	0.88	2914	684	**3598**	4163	4163	2738	**6901**	
-89	107	2391	1944	0.88	2945	684	**3630**	4208	4208	2738	**6945**	
-90	108	2416	1944	0.88	2977	684	**3661**	4253	4253	2738	**6990**	
-91	109	2442	1944	0.88	3009	684	**3693**	4298	4298	2738	**7036**	
-92	110	2468	1944	0.88	3041	684	**3725**	4344	4344	2738	**7082**	
-93	111	2495	1944	0.88	3073	684	**3758**	4390	4390	2738	**7128**	
-94	112	2521	1944	0.88	3106	684	**3791**	4437	4437	2738	**7175**	
-95	113	2548	1944	0.88	3139	684	**3824**	4485	4485	2738	**7222**	
-96	114	2575	1944	0.88	3173	684	**3857**	4532	4532	2738	**7270**	
-97	115	2603	1944	0.88	3206	684	**3891**	4581	4581	2738	**7318**	
-98	116	2630	1944	0.88	3241	684	**3925**	4629	4629	2738	**7367**	
-99	117	2658	1944	0.88	3275	684	**3959**	4679	4679	2738	**7416**	
-100	118	2686	1944	0.88	3310	684	**3994**	4728	4728	2738	**7466**	
-101	119	2715	1944	0.88	3345	684	**4029**	4778	4778	2738	**7516**	
-102	120	2744	1944	0.88	3380	684	**4065**	4829	4829	2738	**7566**	
-103	121	2773	1944	0.88	3416	684	**4100**	4880	4880	2738	**7617**	
-104	122	2802	1944	0.88	3452	684	**4136**	4931	4931	2738	**7669**	
-105	123	2831	1944	0.88	3488	684	**4173**	4983	4983	2738	**7721**	
-106	124	2861	1944	0.88	3525	684	**4209**	5036	5036	2738	**7773**	
-107	125	2891	1944	0.88	3562	684	**4246**	5088	5088	2738	**7826**	
-108	126	2921	1944	0.88	3599	684	**4284**	5142	5142	2738	**7879**	
-109	127	2952	1944	0.88	3637	684	**4321**	5196	5196	2738	**7933**	
-110	128	2983	1944	0.88	3675	684	**4359**	5250	5250	2738	**7987**	
-111	129	3014	1944	0.88	3713	684	**4398**	5304	5304	2738	**8042**	
-112	130	3045	1944	0.88	3752	684	**4436**	5360	5360	2738	**8097**	
-113	131	3077	1944	0.88	3791	684	**4475**	5415	5415	2738	**8153**	
-114	132	3109	1944	0.88	3830	684	**4514**	5471	5471	2738	**8209**	Strength (4514k)
-115	133	3141	1944	0.88	3869	684	**4554**	5528	5528	2738	**8265**	use EL-116'
-116	134	3173	1944	0.88	3909	684	**4594**	5585	5585	2738	**8322**	
-117	135	3206	1944	0.88	3950	684	**4634**	5642	5642	2738	**8380**	

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 4
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

Finish Grade Elevation = 18 ft
Cut Off Elevation = 13 ft

Pile type: 118"-diameter CIDH

Post-liquefaction Condition

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.2	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	13	Clay	0.88
(2)	13	28	Sand	0.88
(3)	28	68	Clay	0.88
(4)	68	150	Sand	0.88

Axial Group Reduction Factor (η) for Sandy Materials= 0.88
Axial Group Reduction Factor (η) for Clayey Materials= 0.88

Skin Resistance above neutral axis (=>Pile Length)
minus @ Ele.= 18 ' for Liq. settlement=0.1"
0 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State				
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)	
18	0	0	0		0	0	**0**	0		0	**0**	
12	6	3	691	0.88	4	243	**247**	6	6	973	**979**	
11	7	7	721	0.88	8	254	**262**	12	12	1015	**1027**	
10	8	10	751	0.88	13	264	**277**	18	18	1057	**1075**	
9	9	14	775	0.88	17	273	**289**	24	24	1091	**1114**	
8	10	17	797	0.88	21	281	**302**	30	30	1122	**1152**	
7	11	20	814	0.88	25	286	**312**	36	36	1146	**1182**	
6	12	24	824	0.88	29	290	**320**	42	42	1161	**1203**	
5	13	27	829	0.88	33	292	**325**	48	48	1167	**1215**	
4	14	37	833	0.88	45	293	**338**	64	64	1173	**1238**	
3	15	47	838	0.88	58	295	**352**	82	82	1179	**1261**	
2	16	57	842	0.88	71	296	**367**	101	101	1185	**1286**	
1	17	69	846	0.88	85	298	**383**	121	121	1191	**1312**	
0	18	81	849	0.88	100	299	**399**	142	142	1196	**1338**	
-1	19	94	853	0.88	115	300	**415**	165	165	1201	**1365**	
-2	20	107	855	0.88	132	301	**433**	188	188	1204	**1392**	
-3	21	121	857	0.88	149	302	**450**	212	212	1207	**1419**	
-4	22	135	858	0.88	166	302	**468**	238	238	1208	**1446**	
-5	23	150	859	0.88	185	302	**487**	264	264	1209	**1473**	
-6	24	165	859	0.88	204	302	**506**	291	291	1209	**1500**	
-7	25	181	858	0.88	223	302	**525**	319	319	1208	**1527**	
-8	26	197	857	0.88	243	302	**545**	348	348	1207	**1554**	
-9	27	214	856	0.88	264	301	**565**	377	377	1205	**1582**	
-10	28	231	854	0.88	285	301	**586**	407	407	1203	**1610**	
-11	29	263	853	0.88	324	300	**624**	463	463	1201	**1664**	
-12	30	295	852	0.88	363	300	**663**	519	519	1199	**1718**	
-13	31	326	851	0.88	402	300	**701**	574	574	1198	**1772**	
-14	32	358	851	0.88	441	299	**740**	630	630	1198	**1827**	
-15	33	389	850	0.88	480	299	**779**	685	685	1197	**1883**	
-16	34	421	850	0.88	519	299	**818**	741	741	1197	**1938**	
-17	35	453	850	0.88	557	299	**857**	796	796	1197	**1993**	Extreme (1945k)*
-18	36	484	850	0.88	596	299	**896**	852	852	1197	**2049**	Use El-22
-19	37	516	850	0.88	635	299	**935**	908	908	1197	**2105**	
-20	38	547	850	0.88	674	299	**973**	963	963	1197	**2160**	
-21	39	579	850	0.88	713	299	**1012**	1019	1019	1197	**2216**	
-22	40	610	850	0.88	752	299	**1051**	1074	1074	1197	**2271**	
-23	41	642	850	0.88	791	299	**1090**	1130	1130	1197	**2327**	
-24	42	674	850	0.88	830	299	**1129**	1185	1185	1197	**2383**	
-25	43	705	850	0.88	869	299	**1168**	1241	1241	1197	**2438**	
-26	44	737	850	0.88	908	299	**1207**	1297	1297	1197	**2494**	
-27	45	768	850	0.88	947	299	**1246**	1352	1352	1197	**2549**	
-28	46	800	850	0.88	985	299	**1285**	1408	1408	1197	**2605**	
-29	47	831	850	0.88	1024	299	**1324**	1463	1463	1197	**2660**	
-30	48	863	850	0.88	1063	299	**1363**	1519	1519	1197	**2716**	
-31	49	895	850	0.88	1102	299	**1401**	1574	1574	1197	**2772**	
-32	50	926	913	0.88	1141	321	**1462**	1630	1630	1285	**2915**	
-33	51	958	978	0.88	1180	344	**1524**	1686	1686	1377	**3063**	
-34	52	989	1047	0.88	1219	368	**1587**	1741	1741	1474	**3215**	
-35	53	1021	1118	0.88	1258	394	**1651**	1797	1797	1574	**3371**	
-36	54	1052	1193	0.88	1297	420	**1717**	1852	1852	1680	**3532**	
-37	55	1084	1271	0.88	1336	447	**1783**	1908	1908	1790	**3697**	
-38	56	1116	1352	0.88	1374	476	**1850**	1964	1964	1904	**3867**	
-39	57	1147	1436	0.88	1413	506	**1919**	2019	2019	2022	**4041**	
-40	58	1179	1523	0.88	1452	536	**1989**	2075	2075	2145	**4220**	
-41	59	1210	1608	0.88	1491	566	**2057**	2130	2130	2264	**4394**	
-42	60	1242	1682	0.88	1530	592	**2122**	2186	2186	2369	**4555**	
-43	61	1274	1748	0.88	1569	615	**2184**	2241	2241	2461	**4702**	
-44	62	1305	1804	0.88	1608	635	**2243**	2297	2297	2540	**4837**	
-45	63	1337	1851	0.88	1647	651	**2298**	2353	2353	2606	**4958**	
-46	64	1368	1888	0.88	1686	665	**2350**	2408	2408	2659	**5067**	
-47	65	1400	1916	0.88	1725	675	**2399**	2464	2464	2698	**5162**	
-48	66	1431	1935	0.88	1763	681	**2445**	2519	2519	2724	**5244**	
-49	67	1463	1944	0.88	1802	684	**2487**	2575	2575	2738	**5312**	
-50	68	1495	1944	0.88	1841	684	**2526**	2630	2630	2738	**5368**	
-51	69	1518	1944	0.88	1870	684	**2554**	2671	2671	2738	**5409**	
-52	70	1541	1944	0.88	1899	684	**2583**	2712	2712	2738	**5450**	
-53	71	1564	1944	0.88	1927	684	**2611**	2753	2753	2738	**5491**	
-54	72	1587	1944	0.88	1955	684	**2640**	2793	2793	2738	**5531**	
-55	73	1610	1944	0.88	1983	684	**2668**	2834	2834	2738	**5571**	
-56	74	1633	1944	0.88	2011	684	**2696**	2873	2873	2738	**5611**	
-57	75	1655	1944	0.88	2039	684	**2723**	2913	2913	2738	**5650**	
-58	76	1677	1944	0.88	2066	684	**2751**	2952	2952	2738	**5690**	
-59	77	1699	1944	0.88	2094	684	**2778**	2991	2991	2738	**5729**	
-60	78	1721	1944	0.88	2121	684	**2805**	3029	3029	2738	**5767**	
-61	79	1743	1944	0.88	2147	684	**2832**	3068	3068	2738	**5805**	
-62	80	1764	1944	0.88	2174	684	**2858**	3105	3105	2738	**5843**	
-63	81	1785	1944	0.88	2200	684	**2884**	3142	3142	2738	**5880**	
-64	82	1806	1944	0.88	2225	684	**2910**	3179	3179	2738	**5917**	
-65	83	1827	1944	0.88	2251	684	**2935**	3215	3215	2738	**5953**	
-66	84	1847	1944	0.88	2276	684	**2960**	3251	3251	2738	**5989**	
-67	85	1867	1944	0.88	2300	684	**2985**	3286	3286	2738	**6024**	
-68	86	1887	1944	0.88	2325	684	**3009**	3321	3321	2738	**6059**	
-69	87	1907	1944	0.88	2350	684	**3034**	3357	3357	2738	**6094**	
-70	88	1928	1944	0.88	2375	684	**3059**	3392	3392	2738	**6130**	
-71	89	1948	1944	0.88	2400	684	**3084**	3429	3429	2738	**6166**	
-72	90	1969	1944	0.88	2426	684	**3110**	3465	3465	2738	**6203**	

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 4
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

-73	91	1990	1944	0.88	2452	684	**3136**	3503	3503	2738	**6240**
-74	92	2012	1944	0.88	2478	684	**3163**	3540	3540	2738	**6278**
-75	93	2033	1944	0.88	2505	684	**3189**	3579	3579	2738	**6316**
-76	94	2055	1944	0.88	2532	684	**3216**	3617	3617	2738	**6355**
-77	95	2077	1944	0.88	2559	684	**3244**	3656	3656	2738	**6394**
-78	96	2100	1944	0.88	2587	684	**3271**	3696	3696	2738	**6433**
-79	97	2123	1944	0.88	2615	684	**3299**	3736	3736	2738	**6473**
-80	98	2146	1944	0.88	2643	684	**3328**	3776	3776	2738	**6514**
-81	99	2169	1944	0.88	2672	684	**3356**	3817	3817	2738	**6555**
-82	100	2192	1944	0.88	2701	684	**3385**	3858	3858	2738	**6596**
-83	101	2216	1944	0.88	2730	684	**3415**	3900	3900	2738	**6638**
-84	102	2240	1944	0.88	2760	684	**3444**	3943	3943	2738	**6680**
-85	103	2264	1944	0.88	2790	684	**3474**	3985	3985	2738	**6723**
-86	104	2289	1944	0.88	2820	684	**3504**	4028	4028	2738	**6766**
-87	105	2314	1944	0.88	2850	684	**3535**	4072	4072	2738	**6810**
-88	106	2339	1944	0.88	2881	684	**3566**	4116	4116	2738	**6854**
-89	107	2364	1944	0.88	2913	684	**3597**	4161	4161	2738	**6898**
-90	108	2390	1944	0.88	2944	684	**3628**	4206	4206	2738	**6943**
-91	109	2416	1944	0.88	2976	684	**3660**	4251	4251	2738	**6989**
-92	110	2442	1944	0.88	3008	684	**3692**	4297	4297	2738	**7035**
-93	111	2468	1944	0.88	3041	684	**3725**	4344	4344	2738	**7081**
-94	112	2495	1944	0.88	3073	684	**3758**	4391	4391	2738	**7128**
-95	113	2522	1944	0.88	3107	684	**3791**	4438	4438	2738	**7175**
-96	114	2549	1944	0.88	3140	684	**3824**	4486	4486	2738	**7223**
-97	115	2576	1944	0.88	3174	684	**3858**	4534	4534	2738	**7271**
-98	116	2604	1944	0.88	3208	684	**3892**	4583	4583	2738	**7320**
-99	117	2632	1944	0.88	3242	684	**3927**	4632	4632	2738	**7369**
-100	118	2660	1944	0.88	3277	684	**3961**	4681	4681	2738	**7419**
-101	119	2688	1944	0.88	3312	684	**3996**	4732	4732	2738	**7469**
-102	120	2717	1944	0.88	3347	684	**4032**	4782	4782	2738	**7520**
-103	121	2746	1944	0.88	3383	684	**4068**	4833	4833	2738	**7571**
-104	122	2775	1944	0.88	3419	684	**4104**	4885	4885	2738	**7622**
-105	123	2805	1944	0.88	3456	684	**4140**	4937	4937	2738	**7674**
-106	124	2835	1944	0.88	3492	684	**4177**	4989	4989	2738	**7726**
-107	125	2865	1944	0.88	3529	684	**4214**	5042	5042	2738	**7779**
-108	126	2895	1944	0.88	3567	684	**4251**	5095	5095	2738	**7833**
-109	127	2925	1944	0.88	3604	684	**4289**	5149	5149	2738	**7886**
-110	128	2956	1944	0.88	3642	684	**4327**	5203	5203	2738	**7941**
-111	129	2987	1944	0.88	3680	684	**4365**	5258	5258	2738	**7995**
-112	130	3019	1944	0.88	3719	684	**4403**	5313	5313	2738	**8050**
-113	131	3050	1944	0.88	3758	684	**4442**	5368	5368	2738	**8106**
-114	132	3082	1944	0.88	3797	684	**4482**	5425	5425	2738	**8162**
-115	133	3114	1944	0.88	3837	684	**4521**	5481	5481	2738	**8219**
-116	134	3147	1944	0.88	3877	684	**4561**	5538	5538	2738	**8276**
-117	135	3179	1944	0.88	3917	684	**4601**	5595	5595	2738	**8333**

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 5
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

Finish Grade Elevation = 50 ft
Cut Off Elevation = 45 ft
Pile type: 118"'-diameter CIDH
Pre-liquefaction Condition

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.2	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	7	Sand	0.88
(2)	7	37	Sand	0.88
(3)	37	57	Sand	0.88
(4)	57	97	Clay	0.88
(5)	97	170	Sand	0.88

(=>Pile Length)

Axial Group Reduction Factor (η) for Sandy Materials= 0.88
Axial Group Reduction Factor (η) for Clayey Materials= 0.88

Skin Resistance above neutral axis (reference only)
minus @ Ele.= 30 ' for Liq. settlement=0.1"
222 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State			
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)
50	0	0	0		0	0	**0**	0		0	**0**
44	6	3	0	0.88	3	0	**3**	5	0	0	**0**
43	7	9	0	0.88	10	0	**10**	15	0	0	**0**
42	8	14	0	0.88	18	0	**18**	25	0	0	**0**
41	9	21	0	0.88	26	0	**26**	37	0	0	**0**
40	10	28	0	0.88	34	0	**34**	49	0	0	**0**
39	11	36	0	0.88	44	0	**44**	63	0	0	**0**
38	12	44	0	0.88	54	0	**54**	77	0	0	**0**
37	13	52	0	0.88	65	0	**65**	92	0	0	**0**
36	14	62	0	0.88	76	0	**76**	108	0	0	**0**
35	15	71	0	0.88	88	0	**88**	125	0	0	**0**
34	16	81	0	0.88	100	0	**100**	143	0	0	**0**
33	17	92	0	0.88	113	0	**113**	162	0	0	**0**
32	18	103	0	0.88	127	0	**127**	181	0	0	**0**
31	19	114	46	0.88	141	16	**157**	201	0	65	**65**
30	20	126	95	0.88	155	33	**189**	222	0	133	**133**
29	21	138	145	0.88	170	51	**221**	243	21	205	**226**
28	22	151	199	0.88	186	70	**256**	265	44	280	**323**
27	23	164	254	0.88	202	89	**291**	288	66	358	**424**
26	24	177	312	0.88	218	110	**328**	311	90	439	**528**
25	25	190	372	0.88	235	131	**365**	335	113	523	**637**
24	26	204	434	0.88	252	153	**405**	360	138	611	**749**
23	27	219	499	0.88	269	176	**445**	385	163	702	**865**
22	28	233	561	0.88	287	197	**485**	410	188	790	**978**
21	29	248	616	0.88	305	217	**522**	436	214	868	**1082**
20	30	263	665	0.88	324	234	**558**	463	241	936	**1177**
19	31	278	706	0.88	343	249	**591**	489	268	995	**1262**
18	32	294	741	0.88	362	261	**622**	517	295	1043	**1338**
17	33	309	769	0.88	381	271	**652**	544	323	1082	**1405**
16	34	325	789	0.88	401	278	**679**	572	351	1112	**1462**
15	35	341	803	0.88	421	283	**703**	601	379	1131	**1510**
14	36	358	810	0.88	441	285	**726**	630	408	1141	**1549**
13	37	374	810	0.88	461	285	**746**	659	437	1141	**1578**
12	38	391	810	0.88	482	285	**767**	688	467	1141	**1607**
11	39	408	812	0.88	503	286	**789**	719	497	1144	**1641**
10	40	426	815	0.88	525	287	**811**	749	528	1147	**1675**
9	41	443	817	0.88	546	288	**834**	781	559	1151	**1710**
8	42	461	820	0.88	569	289	**857**	812	590	1155	**1745**
7	43	480	823	0.88	591	290	**881**	844	623	1158	**1781**
6	44	498	826	0.88	614	291	**904**	877	655	1162	**1818**
5	45	517	829	0.88	637	292	**928**	910	688	1167	**1855**
4	46	536	832	0.88	660	293	**953**	943	721	1171	**1892**
3	47	555	835	0.88	684	294	**978**	977	755	1175	**1930**
2	48	574	838	0.88	707	295	**1002**	1011	789	1180	**1969**
1	49	594	841	0.88	731	296	**1027**	1045	823	1184	**2007**
0	50	613	843	0.88	756	297	**1052**	1079	858	1187	**2044**
-1	51	633	845	0.88	780	297	**1077**	1114	892	1190	**2082**
-2	52	653	847	0.88	804	298	**1102**	1149	927	1192	**2119**
-3	53	673	848	0.88	829	299	**1127**	1184	962	1194	**2156**
-4	54	693	849	0.88	854	299	**1152**	1219	998	1196	**2193**
-5	55	713	850	0.88	878	299	**1177**	1255	1033	1197	**2230**
-6	56	733	850	0.88	903	299	**1203**	1290	1069	1197	**2266**
-7	57	753	850	0.88	928	299	**1227**	1326	1104	1197	**2301**
-8	58	785	850	0.88	967	299	**1266**	1382	1160	1197	**2357**
-9	59	817	850	0.88	1006	299	**1305**	1437	1215	1197	**2412**
-10	60	848	850	0.88	1045	299	**1344**	1493	1271	1197	**2468**
-11	61	880	850	0.88	1084	299	**1383**	1548	1327	1197	**2524**
-12	62	911	850	0.88	1123	299	**1422**	1604	1382	1197	**2579**
-13	63	943	850	0.88	1162	299	**1461**	1659	1438	1197	**2635**
-14	64	974	850	0.88	1201	299	**1500**	1715	1493	1197	**2690**
-15	65	1006	850	0.88	1239	299	**1539**	1771	1549	1197	**2746**
-16	66	1038	850	0.88	1278	299	**1578**	1826	1604	1197	**2801**
-17	67	1069	850	0.88	1317	299	**1617**	1882	1660	1197	**2857**
-18	68	1101	850	0.88	1356	299	**1655**	1937	1716	1197	**2913**
-19	69	1132	850	0.88	1395	299	**1694**	1993	1771	1197	**2968**
-20	70	1164	850	0.88	1434	299	**1733**	2048	1827	1197	**3024**
-21	71	1195	850	0.88	1473	299	**1772**	2104	1882	1197	**3079**
-22	72	1227	850	0.88	1512	299	**1811**	2160	1938	1197	**3135**
-23	73	1259	850	0.88	1551	299	**1850**	2215	1993	1197	**3190**
-24	74	1290	850	0.88	1590	299	**1889**	2271	2049	1197	**3246**
-25	75	1322	850	0.88	1628	299	**1928**	2326	2105	1197	**3302**
-26	76	1353	850	0.88	1667	299	**1967**	2382	2160	1197	**3357**
-27	77	1385	850	0.88	1706	299	**2006**	2438	2216	1197	**3413**
-28	78	1417	850	0.88	1745	299	**2044**	2493	2271	1197	**3468**
-29	79	1448	913	0.88	1784	321	**2105**	2549	2327	1285	**3612**
-30	80	1480	978	0.88	1823	344	**2167**	2604	2382	1377	**3759**
-31	81	1511	1047	0.88	1862	368	**2230**	2660	2438	1474	**3912**
-32	82	1543	1118	0.88	1901	394	**2294**	2715	2494	1574	**4068**
-33	83	1574	1193	0.88	1940	420	**2360**	2771	2549	1680	**4229**
-34	84	1606	1271	0.88	1979	447	**2426**	2827	2605	1790	**4394**
-35	85	1638	1352	0.88	2017	476	**2493**	2882	2660	1904	**4564**
-36	86	1669	1436	0.88	2056	506	**2562**	2938	2716	2022	**4738**
-37	87	1701	1523	0.88	2095	536	**2632**	2993	2771	2145	**4917**
-38	88	1732	1608	0.88	2134	566	**2700**	3049	2827	2264	**5091**
-39	89	1764	1682	0.88	2173	592	**2765**	3104	2883	2369	**5252**
-40	90	1795	1748	0.88	2212	615	**2827**	3160	2938	2461	**5399**

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 5
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

-41	91	1827	1804	0.88	2251	635	**2886**	3216	2994	2540	**5534**	
-42	92	1859	1851	0.88	2290	651	**2941**	3271	3049	2606	**5655**	
-43	93	1890	1888	0.88	2329	665	**2993**	3327	3105	2659	**5763**	
-44	94	1922	1916	0.88	2368	675	**3042**	3382	3161	2698	**5859**	
-45	95	1953	1935	0.88	2407	681	**3088**	3438	3216	2724	**5940**	
-46	96	1985	1944	0.88	2445	684	**3130**	3493	3272	2738	**6009**	
-47	97	2017	1944	0.88	2484	684	**3169**	3549	3327	2738	**6065**	
-48	98	2037	1944	0.88	2510	684	**3194**	3585	3363	2738	**6101**	
-49	99	2058	1944	0.88	2535	684	**3219**	3622	3400	2738	**6137**	
-50	100	2079	1944	0.88	2561	684	**3245**	3658	3437	2738	**6174**	
-51	101	2100	1944	0.88	2587	684	**3272**	3696	3474	2738	**6212**	
-52	102	2121	1944	0.88	2614	684	**3298**	3734	3512	2738	**6250**	
-53	103	2143	1944	0.88	2640	684	**3325**	3772	3550	2738	**6288**	
-54	104	2165	1944	0.88	2668	684	**3352**	3811	3589	2738	**6327**	
-55	105	2188	1944	0.88	2695	684	**3379**	3850	3628	2738	**6366**	
-56	106	2210	1944	0.88	2723	684	**3407**	3890	3668	2738	**6406**	
-57	107	2233	1944	0.88	2751	684	**3435**	3930	3708	2738	**6446**	
-58	108	2256	1944	0.88	2779	684	**3464**	3971	3749	2738	**6486**	
-59	109	2279	1944	0.88	2808	684	**3493**	4012	3790	2738	**6527**	
-60	110	2303	1944	0.88	2837	684	**3522**	4053	3831	2738	**6569**	
-61	111	2327	1944	0.88	2867	684	**3551**	4095	3873	2738	**6611**	
-62	112	2351	1944	0.88	2896	684	**3581**	4138	3916	2738	**6653**	
-63	113	2375	1944	0.88	2926	684	**3611**	4181	3959	2738	**6696**	
-64	114	2400	1944	0.88	2957	684	**3641**	4224	4002	2738	**6740**	
-65	115	2425	1944	0.88	2987	684	**3672**	4268	4046	2738	**6784**	
-66	116	2450	1944	0.88	3018	684	**3703**	4312	4090	2738	**6828**	
-67	117	2475	1944	0.88	3050	684	**3734**	4357	4135	2738	**6873**	
-68	118	2501	1944	0.88	3081	684	**3766**	4402	4180	2738	**6918**	
-69	119	2527	1944	0.88	3113	684	**3798**	4448	4226	2738	**6963**	
-70	120	2553	1944	0.88	3146	684	**3830**	4494	4272	2738	**7010**	
-71	121	2580	1944	0.88	3178	684	**3863**	4540	4319	2738	**7056**	
-72	122	2607	1944	0.88	3211	684	**3896**	4587	4366	2738	**7103**	
-73	123	2634	1944	0.88	3244	684	**3929**	4635	4413	2738	**7151**	
-74	124	2661	1944	0.88	3278	684	**3962**	4683	4461	2738	**7199**	
-75	125	2688	1944	0.88	3312	684	**3996**	4731	4510	2738	**7247**	
-76	126	2716	1944	0.88	3346	684	**4031**	4780	4558	2738	**7296**	
-77	127	2744	1944	0.88	3381	684	**4065**	4830	4608	2738	**7345**	Strength (4059k)
-78	128	2772	1944	0.88	3416	684	**4100**	4879	4658	2738	**7395**	use EL-79'
-79	129	2801	1944	0.88	3451	684	**4135**	4930	4708	2738	**7445**	
-80	130	2830	1944	0.88	3486	684	**4171**	4980	4759	2738	**7496**	

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 5
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

Finish Grade Elevation = 50 ft
Cut Off Elevation = 45 ft
Pile type: 118'"-diameter CIDH
Post-liquefaction Condition

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.2	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	7	Sand	0.88
(2)	7	37	Clay	0.88
(3)	37	57	Sand	0.88
(4)	57	97	Clay	0.88
(5)	97	170	Sand	0.88

Axial Group Reduction Factor (η) for Sandy Materials= 0.88
Axial Group Reduction Factor (η) for Clayey Materials= 0.88

Skin Resistance above neutral axis (=>Pile Length)
minus @ Ele.= 30 ' for Liq. settlement=0.1"
93 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State				
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)	
50	0	0	0		0	0	**0**	0		0	**0**	
44	6	5	113	0.88	6	40	**46**	9	0	159	**159**	
43	7	9	113	0.88	10	40	**50**	15	0	159	**159**	
42	8	12	113	0.88	15	40	**55**	21	0	160	**160**	
41	9	15	114	0.88	19	40	**59**	27	0	160	**160**	
40	10	19	114	0.88	23	40	**63**	33	0	160	**160**	
39	11	22	114	0.88	27	40	**67**	39	0	160	**160**	
38	12	25	114	0.88	31	40	**71**	45	0	160	**160**	
37	13	29	114	0.88	36	40	**76**	51	0	160	**160**	
36	14	32	114	0.88	40	40	**80**	57	0	160	**160**	
35	15	36	114	0.88	44	40	**84**	63	0	160	**160**	
34	16	39	114	0.88	48	40	**88**	69	0	160	**160**	
33	17	42	114	0.88	52	40	**92**	75	0	160	**160**	
32	18	46	114	0.88	57	40	**96**	81	0	160	**160**	
31	19	49	153	0.88	61	54	**115**	87	0	216	**216**	
30	20	53	195	0.88	65	69	**133**	93	0	274	**274**	
29	21	56	238	0.88	69	84	**153**	99	6	336	**342**	
28	22	59	284	0.88	73	100	**173**	105	12	400	**412**	
27	23	63	332	0.88	77	117	**194**	111	18	467	**485**	
26	24	66	381	0.88	82	134	**216**	117	24	537	**561**	
25	25	70	433	0.88	86	152	**238**	123	30	610	**640**	
24	26	73	487	0.88	90	171	**261**	129	36	685	**721**	
23	27	76	542	0.88	94	191	**285**	135	42	763	**805**	
22	28	80	596	0.88	98	210	**308**	141	48	839	**887**	
21	29	83	643	0.88	103	226	**329**	147	54	906	**960**	
20	30	87	685	0.88	107	241	**348**	153	60	965	**1024**	
19	31	90	721	0.88	111	254	**365**	159	66	1015	**1081**	
18	32	93	751	0.88	115	264	**379**	164	72	1057	**1129**	
17	33	97	774	0.88	119	273	**392**	170	78	1090	**1168**	
16	34	100	792	0.88	124	279	**402**	176	84	1116	**1199**	
15	35	104	804	0.88	128	283	**411**	182	90	1132	**1222**	
14	36	107	810	0.88	132	285	**417**	188	96	1141	**1236**	
13	37	110	810	0.88	136	285	**421**	194	102	1141	**1242**	
12	38	127	810	0.88	157	285	**442**	224	131	1141	**1272**	
11	39	144	812	0.88	178	286	**464**	254	162	1144	**1306**	
10	40	162	815	0.88	199	287	**486**	285	192	1147	**1340**	
9	41	180	817	0.88	221	288	**509**	316	224	1151	**1374**	
8	42	198	820	0.88	244	289	**532**	348	255	1155	**1410**	
7	43	216	823	0.88	266	290	**556**	380	287	1158	**1446**	
6	44	234	826	0.88	289	291	**579**	413	320	1162	**1482**	
5	45	253	829	0.88	312	292	**603**	445	353	1167	**1519**	
4	46	272	832	0.88	335	293	**628**	479	386	1171	**1557**	Extreme (1551k)*
3	47	291	835	0.88	359	294	**653**	512	420	1175	**1595**	Use El-1'
2	48	310	838	0.88	382	295	**677**	546	454	1180	**1633**	
1	49	330	841	0.88	406	296	**702**	581	488	1184	**1671**	
0	50	349	843	0.88	430	297	**727**	615	522	1187	**1709**	
-1	51	369	845	0.88	455	297	**752**	650	557	1190	**1747**	
-2	52	389	847	0.88	479	298	**777**	685	592	1192	**1784**	
-3	53	409	848	0.88	504	299	**802**	720	627	1194	**1821**	
-4	54	429	849	0.88	529	299	**827**	755	662	1196	**1858**	
-5	55	449	850	0.88	553	299	**852**	790	698	1197	**1894**	
-6	56	469	850	0.88	578	299	**877**	826	733	1197	**1930**	
-7	57	490	850	0.88	603	299	**902**	862	769	1197	**1966**	
-8	58	521	850	0.88	642	299	**941**	917	825	1197	**2022**	
-9	59	553	850	0.88	681	299	**980**	973	880	1197	**2077**	
-10	60	584	850	0.88	720	299	**1019**	1028	936	1197	**2133**	
-11	61	616	850	0.88	759	299	**1058**	1084	991	1197	**2188**	
-12	62	647	850	0.88	798	299	**1097**	1140	1047	1197	**2244**	
-13	63	679	850	0.88	837	299	**1136**	1195	1102	1197	**2299**	
-14	64	711	850	0.88	876	299	**1175**	1251	1158	1197	**2355**	
-15	65	742	850	0.88	914	299	**1214**	1306	1214	1197	**2411**	
-16	66	774	850	0.88	953	299	**1253**	1362	1269	1197	**2466**	
-17	67	805	850	0.88	992	299	**1291**	1417	1325	1197	**2522**	
-18	68	837	850	0.88	1031	299	**1330**	1473	1380	1197	**2577**	
-19	69	869	850	0.88	1070	299	**1369**	1529	1436	1197	**2633**	
-20	70	900	850	0.88	1109	299	**1408**	1584	1491	1197	**2689**	
-21	71	932	850	0.88	1148	299	**1447**	1640	1547	1197	**2744**	
-22	72	963	850	0.88	1187	299	**1486**	1695	1603	1197	**2800**	
-23	73	995	850	0.88	1226	299	**1525**	1751	1658	1197	**2855**	
-24	74	1026	850	0.88	1265	299	**1564**	1806	1714	1197	**2911**	
-25	75	1058	850	0.88	1303	299	**1603**	1862	1769	1197	**2966**	
-26	76	1090	850	0.88	1342	299	**1642**	1918	1825	1197	**3022**	
-27	77	1121	850	0.88	1381	299	**1681**	1973	1880	1197	**3078**	
-28	78	1153	850	0.88	1420	299	**1719**	2029	1936	1197	**3133**	
-29	79	1184	913	0.88	1459	321	**1780**	2084	1992	1285	**3276**	
-30	80	1216	978	0.88	1498	344	**1842**	2140	2047	1377	**3424**	
-31	81	1247	1047	0.88	1537	368	**1905**	2196	2103	1474	**3576**	
-32	82	1279	1118	0.88	1576	394	**1969**	2251	2158	1574	**3733**	
-33	83	1311	1193	0.88	1615	420	**2035**	2307	2214	1680	**3894**	
-34	84	1342	1271	0.88	1654	447	**2101**	2362	2270	1790	**4059**	
-35	85	1374	1352	0.88	1692	476	**2168**	2418	2325	1904	**4229**	
-36	86	1405	1436	0.88	1731	506	**2237**	2473	2381	2022	**4403**	
-37	87	1437	1523	0.88	1770	536	**2307**	2529	2436	2145	**4581**	
-38	88	1468	1608	0.88	1809	566	**2375**	2585	2492	2264	**4755**	
-39	89	1500	1682	0.88	1848	592	**2440**	2640	2547	2369	**4916**	
-40	90	1532	1748	0.88	1887	615	**2502**	2696	2603	2461	**5064**	

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 5
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

-41	91	1563	1804	0.88	1926	635	**2561**	2751	2659	2540	**5199**	
-42	92	1595	1851	0.88	1965	651	**2616**	2807	2714	2606	**5320**	
-43	93	1626	1888	0.88	2004	665	**2668**	2862	2770	2659	**5428**	
-44	94	1658	1916	0.88	2043	675	**2717**	2918	2825	2698	**5523**	
-45	95	1690	1935	0.88	2082	681	**2763**	2974	2881	2724	**5605**	
-46	96	1721	1944	0.88	2120	684	**2805**	3029	2936	2738	**5674**	
-47	97	1753	1944	0.88	2159	684	**2844**	3085	2992	2738	**5730**	
-48	98	1773	1944	0.88	2185	684	**2869**	3121	3028	2738	**5766**	
-49	99	1794	1944	0.88	2210	684	**2894**	3157	3065	2738	**5802**	
-50	100	1815	1944	0.88	2236	684	**2920**	3194	3101	2738	**5839**	
-51	101	1836	1944	0.88	2262	684	**2946**	3232	3139	2738	**5876**	
-52	102	1858	1944	0.88	2289	684	**2973**	3269	3177	2738	**5914**	
-53	103	1879	1944	0.88	2315	684	**3000**	3308	3215	2738	**5953**	
-54	104	1901	1944	0.88	2343	684	**3027**	3347	3254	2738	**5991**	
-55	105	1924	1944	0.88	2370	684	**3054**	3386	3293	2738	**6031**	
-56	106	1946	1944	0.88	2398	684	**3082**	3425	3333	2738	**6070**	
-57	107	1969	1944	0.88	2426	684	**3110**	3466	3373	2738	**6110**	
-58	108	1992	1944	0.88	2454	684	**3139**	3506	3414	2738	**6151**	
-59	109	2016	1944	0.88	2483	684	**3168**	3547	3455	2738	**6192**	
-60	110	2039	1944	0.88	2512	684	**3197**	3589	3496	2738	**6234**	
-61	111	2063	1944	0.88	2542	684	**3226**	3631	3538	2738	**6276**	
-62	112	2087	1944	0.88	2571	684	**3256**	3673	3581	2738	**6318**	
-63	113	2111	1944	0.88	2601	684	**3286**	3716	3624	2738	**6361**	
-64	114	2136	1944	0.88	2632	684	**3316**	3760	3667	2738	**6404**	
-65	115	2161	1944	0.88	2662	684	**3347**	3803	3711	2738	**6448**	
-66	116	2186	1944	0.88	2693	684	**3378**	3848	3755	2738	**6493**	
-67	117	2212	1944	0.88	2725	684	**3409**	3892	3800	2738	**6537**	
-68	118	2237	1944	0.88	2756	684	**3441**	3938	3845	2738	**6583**	
-69	119	2263	1944	0.88	2788	684	**3473**	3983	3891	2738	**6628**	
-70	120	2289	1944	0.88	2821	684	**3505**	4029	3937	2738	**6674**	
-71	121	2316	1944	0.88	2853	684	**3538**	4076	3983	2738	**6721**	
-72	122	2343	1944	0.88	2886	684	**3571**	4123	4030	2738	**6768**	
-73	123	2370	1944	0.88	2919	684	**3604**	4171	4078	2738	**6815**	
-74	124	2397	1944	0.88	2953	684	**3637**	4219	4126	2738	**6863**	
-75	125	2424	1944	0.88	2987	684	**3671**	4267	4174	2738	**6912**	
-76	126	2452	1944									
-77	127	2480	1944									
-78	128	2509	1944									
-79	129	2537	1944									
-80	130	2566	1944									Strength (4716k)
50												use EL-81'
50												
50												
50												
50												

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 6
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

Finish Grade Elevation = 50 ft
Cut Off Elevation = 45 ft
Pile type: 118"'-diameter CIDH
Pre-liquefaction Condition

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.2	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	5	Clay	0.88
(2)	5	30	Sand	0.88
(3)	30	40	Sand	0.88
(4)	40	95	Clay	0.88
(5)	95	170	Sand	0.88

(=>Pile Length)

Axial Group Reduction Factor (η) for Sandy Materials= 0.88
Axial Group Reduction Factor (η) for Clayey Materials= 0.88

Skin Resistance above neutral axis (reference only)
minus @ Ele.= 30 ' for Liq. settlement=0.1"
224 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State			
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)
50	0	0	0		0	0	**0**	0		0	**0**
44	6	4	0	0.88	5	0	**5**	7	0	0	**0**
43	7	10	0	0.88	12	0	**12**	17	0	0	**0**
42	8	16	0	0.88	19	0	**19**	28	0	0	**0**
41	9	22	0	0.88	27	0	**27**	39	0	0	**0**
40	10	29	0	0.88	36	0	**36**	52	0	0	**0**
39	11	37	0	0.88	45	0	**45**	65	0	0	**0**
38	12	45	46	0.88	56	16	**72**	79	0	65	**65**
37	13	54	95	0.88	66	33	**100**	95	0	133	**133**
36	14	63	145	0.88	78	51	**129**	111	0	205	**205**
35	15	73	199	0.88	89	70	**159**	128	0	280	**280**
34	16	83	254	0.88	102	89	**191**	145	0	358	**358**
33	17	93	312	0.88	115	110	**225**	164	0	439	**439**
32	18	104	372	0.88	128	131	**259**	183	0	523	**523**
31	19	116	434	0.88	142	153	**295**	203	0	611	**611**
30	20	127	499	0.88	157	176	**332**	224	0	702	**702**
29	21	140	561	0.88	172	197	**369**	246	21	790	**811**
28	22	152	619	0.88	187	218	**405**	268	44	871	**915**
27	23	165	669	0.88	203	236	**439**	290	66	943	**1009**
26	24	178	714	0.88	220	251	**471**	314	90	1005	**1094**
25	25	192	751	0.88	236	264	**501**	338	113	1057	**1171**
24	26	206	781	0.88	253	275	**528**	362	138	1100	**1238**
23	27	220	805	0.88	271	283	**554**	387	163	1133	**1296**
22	28	234	822	0.88	289	289	**578**	413	188	1157	**1345**
21	29	249	832	0.88	307	293	**600**	439	214	1171	**1385**
20	30	264	835	0.88	325	294	**619**	465	241	1175	**1416**
19	31	280	838	0.88	344	295	**639**	492	268	1180	**1448**
18	32	295	841	0.88	364	296	**660**	520	296	1184	**1479**
17	33	312	843	0.88	384	297	**681**	549	324	1187	**1511**
16	34	328	845	0.88	404	297	**702**	578	354	1190	**1543**
15	35	345	847	0.88	425	298	**723**	608	383	1192	**1576**
14	36	363	848	0.88	447	299	**745**	638	414	1194	**1608**
13	37	380	849	0.88	468	299	**767**	669	445	1196	**1641**
12	38	398	850	0.88	491	299	**790**	701	477	1197	**1673**
11	39	416	850	0.88	513	299	**812**	733	509	1197	**1706**
10	40	435	850	0.88	536	299	**835**	765	541	1197	**1738**
9	41	466	850	0.88	575	299	**874**	821	597	1197	**1794**
8	42	498	850	0.88	614	299	**913**	877	652	1197	**1849**
7	43	530	850	0.88	652	299	**952**	932	708	1197	**1905**
6	44	561	850	0.88	691	299	**991**	988	763	1197	**1961**
5	45	593	850	0.88	730	299	**1030**	1043	819	1197	**2016**
4	46	624	850	0.88	769	299	**1068**	1099	875	1197	**2072**
3	47	656	850	0.88	808	299	**1107**	1154	930	1197	**2127**
2	48	688	850	0.88	847	299	**1146**	1210	986	1197	**2183**
1	49	719	850	0.88	886	299	**1185**	1266	1041	1197	**2238**
0	50	751	850	0.88	925	299	**1224**	1321	1097	1197	**2294**
-1	51	782	850	0.88	964	299	**1263**	1377	1153	1197	**2350**
-2	52	814	850	0.88	1003	299	**1302**	1432	1208	1197	**2405**
-3	53	845	850	0.88	1042	299	**1341**	1488	1264	1197	**2461**
-4	54	877	850	0.88	1080	299	**1380**	1543	1319	1197	**2516**
-5	55	909	850	0.88	1119	299	**1419**	1599	1375	1197	**2572**
-6	56	940	850	0.88	1158	299	**1457**	1655	1430	1197	**2627**
-7	57	972	850	0.88	1197	299	**1496**	1710	1486	1197	**2683**
-8	58	1003	850	0.88	1236	299	**1535**	1766	1542	1197	**2739**
-9	59	1035	850	0.88	1275	299	**1574**	1821	1597	1197	**2794**
-10	60	1066	850	0.88	1314	299	**1613**	1877	1653	1197	**2850**
-11	61	1098	850	0.88	1353	299	**1652**	1932	1708	1197	**2905**
-12	62	1130	850	0.88	1392	299	**1691**	1988	1764	1197	**2961**
-13	63	1161	850	0.88	1431	299	**1730**	2044	1819	1197	**3016**
-14	64	1193	850	0.88	1469	299	**1769**	2099	1875	1197	**3072**
-15	65	1224	850	0.88	1508	299	**1808**	2155	1931	1197	**3128**
-16	66	1256	850	0.88	1547	299	**1847**	2210	1986	1197	**3183**
-17	67	1287	850	0.88	1586	299	**1885**	2266	2042	1197	**3239**
-18	68	1319	850	0.88	1625	299	**1924**	2322	2097	1197	**3294**
-19	69	1351	850	0.88	1664	299	**1963**	2377	2153	1197	**3350**
-20	70	1382	850	0.88	1703	299	**2002**	2433	2208	1197	**3406**
-21	71	1414	850	0.88	1742	299	**2041**	2488	2264	1197	**3461**
-22	72	1445	850	0.88	1781	299	**2080**	2544	2320	1197	**3517**
-23	73	1477	850	0.88	1820	299	**2119**	2599	2375	1197	**3572**
-24	74	1509	850	0.88	1858	299	**2158**	2655	2431	1197	**3628**
-25	75	1540	850	0.88	1897	299	**2197**	2711	2486	1197	**3683**
-26	76	1572	850	0.88	1936	299	**2236**	2766	2542	1197	**3739**
-27	77	1603	913	0.88	1975	321	**2296**	2822	2597	1285	**3882**
-28	78	1635	978	0.88	2014	344	**2358**	2877	2653	1377	**4030**
-29	79	1666	1047	0.88	2053	368	**2421**	2933	2709	1474	**4182**
-30	80	1698	1118	0.88	2092	394	**2486**	2988	2764	1574	**4339**
-31	81	1730	1193	0.88	2131	420	**2551**	3044	2820	1680	**4500**
-32	82	1761	1271	0.88	2170	447	**2617**	3100	2875	1790	**4665**
-33	83	1793	1352	0.88	2209	476	**2685**	3155	2931	1904	**4835**
-34	84	1824	1436	0.88	2248	506	**2753**	3211	2987	2022	**5009**
-35	85	1856	1523	0.88	2286	536	**2823**	3266	3042	2145	**5187**
-36	86	1887	1608	0.88	2325	566	**2891**	3322	3098	2264	**5361**
-37	87	1919	1682	0.88	2364	592	**2956**	3377	3153	2369	**5522**
-38	88	1951	1748	0.88	2403	615	**3018**	3433	3209	2461	**5670**
-39	89	1982	1804	0.88	2442	635	**3077**	3489	3264	2540	**5804**
-40	90	2014	1851	0.88	2481	651	**3132**	3544	3320	2606	**5926**

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 6
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

-41	91	2045	1888	0.88	2520	665	**3184**	3600	3376	2659	**6034**	
-42	92	2077	1916	0.88	2559	675	**3233**	3655	3431	2698	**6129**	
-43	93	2108	1935	0.88	2598	681	**3279**	3711	3487	2724	**6211**	
-44	94	2140	1944	0.88	2637	684	**3321**	3766	3542	2738	**6280**	
-45	95	2172	1944	0.88	2675	684	**3360**	3822	3598	2738	**6335**	
-46	96	2192	1944	0.88	2701	684	**3385**	3859	3634	2738	**6372**	
-47	97	2213	1944	0.88	2727	684	**3411**	3895	3671	2738	**6409**	
-48	98	2235	1944	0.88	2753	684	**3437**	3933	3709	2738	**6446**	
-49	99	2256	1944	0.88	2779	684	**3464**	3971	3746	2738	**6484**	
-50	100	2278	1944	0.88	2806	684	**3491**	4009	3785	2738	**6522**	
-51	101	2300	1944	0.88	2833	684	**3518**	4048	3824	2738	**6561**	
-52	102	2322	1944	0.88	2861	684	**3545**	4087	3863	2738	**6600**	
-53	103	2345	1944	0.88	2889	684	**3573**	4127	3902	2738	**6640**	
-54	104	2367	1944	0.88	2917	684	**3601**	4167	3943	2738	**6680**	
-55	105	2391	1944	0.88	2945	684	**3630**	4207	3983	2738	**6721**	
-56	106	2414	1944	0.88	2974	684	**3658**	4248	4024	2738	**6762**	
-57	107	2437	1944	0.88	3003	684	**3687**	4290	4066	2738	**6803**	
-58	108	2461	1944	0.88	3032	684	**3717**	4332	4108	2738	**6845**	
-59	109	2485	1944	0.88	3062	684	**3746**	4374	4150	2738	**6888**	
-60	110	2510	1944	0.88	3092	684	**3776**	4417	4193	2738	**6931**	
-61	111	2534	1944	0.88	3122	684	**3807**	4461	4236	2738	**6974**	
-62	112	2559	1944	0.88	3153	684	**3837**	4504	4280	2738	**7018**	
-63	113	2584	1944	0.88	3184	684	**3868**	4549	4324	2738	**7062**	
-64	114	2610	1944	0.88	3215	684	**3900**	4593	4369	2738	**7107**	
-65	115	2636	1944	0.88	3247	684	**3931**	4639	4414	2738	**7152**	
-66	116	2662	1944	0.88	3279	684	**3963**	4684	4460	2738	**7198**	
-67	117	2688	1944	0.88	3311	684	**3996**	4730	4506	2738	**7244**	Strength (3997k)
-68	118	2714	1944	0.88	3344	684	**4028**	4777	4553	2738	**7290**	use EL-68'
-69	119	2741	1944	0.88	3377	684	**4061**	4824	4600	2738	**7337**	
-70	120	2768	1944	0.88	3410	684	**4094**	4871	4647	2738	**7385**	
-71	121	2795	1944	0.88	3444	684	**4128**	4919	4695	2738	**7433**	
-72	122	2823	1944	0.88	3477	684	**4162**	4968	4744	2738	**7481**	
-73	123	2850	1944	0.88	3512	684	**4196**	5017	4792	2738	**7530**	
-74	124	2878	1944	0.88	3546	684	**4231**	5066	4842	2738	**7579**	
-75	125	2907	1944	0.88	3581	684	**4265**	5116	4892	2738	**7629**	
50												
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Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 6
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

Finish Grade Elevation = 50 ft
Cut Off Elevation = 45 ft

Pile type: 118'"-diameter CIDH

Post-liquefaction Condition

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.2	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	5	Clay	0.88
(2)	5	30	Clay	0.88
(3)	30	40	Sand	0.88
(4)	40	95	Clay	0.88
(5)	95	170	Sand	0.88

Axial Group Reduction Factor (η) for Sandy Materials= 0.88
Axial Group Reduction Factor (η) for Clayey Materials= 0.88

Skin Resistance above neutral axis (=>Pile Length)
minus @ Ele.= 30 ' for Liq. settlement=0.1"
90 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State				
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)	
50	0	0	0		0	0	**0**	0		0	**0**	
44	6	3	116	0.88	4	41	**45**	6	0	163	**163**	
43	7	7	117	0.88	8	41	**49**	12	0	164	**164**	
42	8	10	117	0.88	13	41	**54**	18	0	165	**165**	
41	9	14	118	0.88	17	41	**58**	24	0	166	**166**	
40	10	17	118	0.88	21	42	**62**	30	0	166	**166**	
39	11	20	118	0.88	25	42	**67**	36	0	167	**167**	
38	12	24	158	0.88	29	56	**85**	42	0	222	**222**	
37	13	27	200	0.88	33	70	**104**	48	0	281	**281**	
36	14	31	243	0.88	38	86	**123**	54	0	342	**342**	
35	15	34	288	0.88	42	102	**143**	60	0	406	**406**	
34	16	37	336	0.88	46	118	**164**	66	0	473	**473**	
33	17	41	385	0.88	50	136	**186**	72	0	542	**542**	
32	18	44	436	0.88	54	154	**208**	78	0	614	**614**	
31	19	48	489	0.88	59	172	**231**	84	0	689	**689**	
30	20	51	545	0.88	63	192	**255**	90	0	767	**767**	
29	21	54	598	0.88	67	210	**277**	96	6	842	**848**	
28	22	58	647	0.88	71	228	**299**	102	12	911	**923**	
27	23	61	691	0.88	75	243	**319**	108	18	973	**991**	
26	24	65	729	0.88	80	257	**336**	114	24	1026	**1050**	
25	25	68	761	0.88	84	268	**352**	120	30	1072	**1101**	
24	26	71	787	0.88	88	277	**365**	126	36	1109	**1144**	
23	27	75	808	0.88	92	284	**376**	132	42	1138	**1179**	
22	28	78	823	0.88	96	290	**386**	138	48	1158	**1206**	
21	29	82	832	0.88	100	293	**393**	144	54	1171	**1225**	
20	30	85	835	0.88	105	294	**399**	150	60	1175	**1235**	
19	31	100	838	0.88	124	295	**419**	177	87	1180	**1267**	
18	32	116	841	0.88	143	296	**439**	205	115	1184	**1298**	
17	33	132	843	0.88	163	297	**460**	233	143	1187	**1330**	
16	34	149	845	0.88	184	297	**481**	262	173	1190	**1363**	
15	35	166	847	0.88	205	298	**503**	292	203	1192	**1395**	
14	36	183	848	0.88	226	299	**524**	323	233	1194	**1427**	
13	37	201	849	0.88	248	299	**547**	354	264	1196	**1460**	
12	38	219	850	0.88	270	299	**569**	385	296	1197	**1492**	
11	39	237	850	0.88	292	299	**591**	417	328	1197	**1525**	
10	40	256	850	0.88	315	299	**614**	450	360	1197	**1557**	
9	41	287	850	0.88	354	299	**653**	506	416	1197	**1613**	
8	42	319	850	0.88	393	299	**692**	561	471	1197	**1668**	Extreme (1638k)*
7	43	350	850	0.88	432	299	**731**	617	527	1197	**1724**	Use El+3'
6	44	382	850	0.88	471	299	**770**	672	583	1197	**1780**	
5	45	414	850	0.88	510	299	**809**	728	638	1197	**1835**	
4	46	445	850	0.88	548	299	**848**	783	694	1197	**1891**	
3	47	477	850	0.88	587	299	**887**	839	749	1197	**1946**	
2	48	508	850	0.88	626	299	**925**	895	805	1197	**2002**	
1	49	540	850	0.88	665	299	**964**	950	860	1197	**2057**	
0	50	571	850	0.88	704	299	**1003**	1006	916	1197	**2113**	
-1	51	603	850	0.88	743	299	**1042**	1061	972	1197	**2169**	
-2	52	635	850	0.88	782	299	**1081**	1117	1027	1197	**2224**	
-3	53	666	850	0.88	821	299	**1120**	1172	1083	1197	**2280**	
-4	54	698	850	0.88	860	299	**1159**	1228	1138	1197	**2335**	
-5	55	729	850	0.88	899	299	**1198**	1284	1194	1197	**2391**	
-6	56	761	850	0.88	937	299	**1237**	1339	1249	1197	**2447**	
-7	57	792	850	0.88	976	299	**1276**	1395	1305	1197	**2502**	
-8	58	824	850	0.88	1015	299	**1315**	1450	1361	1197	**2558**	
-9	59	856	850	0.88	1054	299	**1353**	1506	1416	1197	**2613**	
-10	60	887	850	0.88	1093	299	**1392**	1561	1472	1197	**2669**	
-11	61	919	850	0.88	1132	299	**1431**	1617	1527	1197	**2724**	
-12	62	950	850	0.88	1171	299	**1470**	1673	1583	1197	**2780**	
-13	63	982	850	0.88	1210	299	**1509**	1728	1639	1197	**2836**	
-14	64	1014	850	0.88	1249	299	**1548**	1784	1694	1197	**2891**	
-15	65	1045	850	0.88	1288	299	**1587**	1839	1750	1197	**2947**	
-16	66	1077	850	0.88	1326	299	**1626**	1895	1805	1197	**3002**	
-17	67	1108	850	0.88	1365	299	**1665**	1951	1861	1197	**3058**	
-18	68	1140	850	0.88	1404	299	**1704**	2006	1916	1197	**3113**	
-19	69	1171	850	0.88	1443	299	**1742**	2062	1972	1197	**3169**	
-20	70	1203	850	0.88	1482	299	**1781**	2117	2028	1197	**3225**	
-21	71	1235	850	0.88	1521	299	**1820**	2173	2083	1197	**3280**	
-22	72	1266	850	0.88	1560	299	**1859**	2228	2139	1197	**3336**	
-23	73	1298	850	0.88	1599	299	**1898**	2284	2194	1197	**3391**	
-24	74	1329	850	0.88	1638	299	**1937**	2340	2250	1197	**3447**	
-25	75	1361	850	0.88	1677	299	**1976**	2395	2305	1197	**3502**	
-26	76	1392	850	0.88	1715	299	**2015**	2451	2361	1197	**3558**	
-27	77	1424	913	0.88	1754	321	**2076**	2506	2417	1285	**3701**	
-28	78	1456	978	0.88	1793	344	**2138**	2562	2472	1377	**3849**	
-29	79	1487	1047	0.88	1832	368	**2201**	2617	2528	1474	**4001**	
-30	80	1519	1118	0.88	1871	394	**2265**	2673	2583	1574	**4158**	
-31	81	1550	1193	0.88	1910	420	**2330**	2729	2639	1680	**4319**	
-32	82	1582	1271	0.88	1949	447	**2396**	2784	2694	1790	**4484**	
-33	83	1613	1352	0.88	1988	476	**2464**	2840	2750	1904	**4654**	
-34	84	1645	1436	0.88	2027	506	**2532**	2895	2806	2022	**4828**	
-35	85	1677	1523	0.88	2066	536	**2602**	2951	2861	2145	**5006**	
-36	86	1708	1608	0.88	2105	566	**2670**	3006	2917	2264	**5180**	
-37	87	1740	1682	0.88	2143	592	**2736**	3062	2972	2369	**5341**	
-38	88	1771	1748	0.88	2182	615	**2798**	3118	3028	2461	**5489**	
-39	89	1803	1804	0.88	2221	635	**2856**	3173	3083	2540	**5624**	
-40	90	1835	1851	0.88	2260	651	**2912**	3229	3139	2606	**5745**	

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 6
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

-41	91	1866	1888	0.88	2299	665	**2964**	3284	3195	2659	**5853**	
-42	92	1898	1916	0.88	2338	675	**3012**	3340	3250	2698	**5948**	
-43	93	1929	1935	0.88	2377	681	**3058**	3395	3306	2724	**6030**	
-44	94	1961	1944	0.88	2416	684	**3100**	3451	3361	2738	**6099**	
-45	95	1992	1944	0.88	2455	684	**3139**	3507	3417	2738	**6154**	
-46	96	2013	1944	0.88	2480	684	**3165**	3543	3453	2738	**6191**	
-47	97	2034	1944	0.88	2506	684	**3190**	3580	3490	2738	**6228**	
-48	98	2055	1944	0.88	2532	684	**3217**	3617	3528	2738	**6265**	
-49	99	2077	1944	0.88	2559	684	**3243**	3655	3566	2738	**6303**	
-50	100	2099	1944	0.88	2585	684	**3270**	3694	3604	2738	**6341**	
-51	101	2121	1944	0.88	2613	684	**3297**	3732	3643	2738	**6380**	
-52	102	2143	1944	0.88	2640	684	**3324**	3772	3682	2738	**6419**	
-53	103	2165	1944	0.88	2668	684	**3352**	3811	3722	2738	**6459**	
-54	104	2188	1944	0.88	2696	684	**3380**	3851	3762	2738	**6499**	
-55	105	2211	1944	0.88	2724	684	**3409**	3892	3802	2738	**6540**	
-56	106	2235	1944	0.88	2753	684	**3438**	3933	3843	2738	**6581**	
-57	107	2258	1944	0.88	2782	684	**3467**	3975	3885	2738	**6622**	
-58	108	2282	1944	0.88	2812	684	**3496**	4017	3927	2738	**6664**	
-59	109	2306	1944	0.88	2841	684	**3526**	4059	3969	2738	**6707**	
-60	110	2331	1944	0.88	2871	684	**3556**	4102	4012	2738	**6750**	
-61	111	2355	1944	0.88	2902	684	**3586**	4145	4055	2738	**6793**	
-62	112	2380	1944	0.88	2932	684	**3617**	4189	4099	2738	**6837**	
-63	113	2405	1944	0.88	2963	684	**3648**	4233	4144	2738	**6881**	
-64	114	2431	1944	0.88	2995	684	**3679**	4278	4188	2738	**6926**	
-65	115	2456	1944	0.88	3026	684	**3711**	4323	4233	2738	**6971**	
-66	116	2482	1944	0.88	3058	684	**3743**	4369	4279	2738	**7017**	
-67	117	2509	1944	0.88	3090	684	**3775**	4415	4325	2738	**7063**	
-68	118	2535	1944	0.88	3123	684	**3807**	4462	4372	2738	**7109**	
-69	119	2562	1944	0.88	3156	684	**3840**	4509	4419	2738	**7156**	
-70	120	2589	1944	0.88	3189	684	**3874**	4556	4466	2738	**7204**	
-71	121	2616	1944	0.88	3223	684	**3907**	4604	4514	2738	**7252**	
-72	122	2643	1944	0.88	3257	684	**3941**	4652	4563	2738	**7300**	
-73	123	2671	1944	0.88	3291	684	**3975**	4701	4612	2738	**7349**	
-74	124	2699	1944	0.88	3325	684	**4010**	4751	4661	2738	**7398**	
-75	125	2728	1944	0.88	3360	684	**4045**	4800	4711	2738	**7448**	
50												
50												
50												
50												
50												Strength (4716k)
50												use EL-81'
50												
50												
50												
50												

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 7
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

Finish Grade Elevation = 50 ft
Cut Off Elevation = 45 ft
Pile type: 118"'-diameter CIDH
Pre-liquefaction Condition

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.2	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	5	Sand	0.88
(2)	5	40	Sand	0.88
(3)	40	45	Sand	0.88
(4)	45	95	Clay	0.88
(5)	95	170	Sand	0.88

(=>Pile Length)

Axial Group Reduction Factor (η) for Sandy Materials= 0.88
Axial Group Reduction Factor (η) for Clayey Materials= 0.88

Skin Resistance above neutral axis (reference only)
minus @ Ele.= 30 ' for Liq. settlement=0.1"
224 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State			
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)
50	0	0	0		0	0	**0**	0		0	**0**
44	6	4	0	0.88	5	0	**5**	7	0	0	**0**
43	7	10	0	0.88	12	0	**12**	17	0	0	**0**
42	8	16	0	0.88	19	0	**19**	28	0	0	**0**
41	9	22	0	0.88	27	0	**27**	39	0	0	**0**
40	10	29	0	0.88	36	0	**36**	52	0	0	**0**
39	11	37	0	0.88	45	0	**45**	65	0	0	**0**
38	12	45	0	0.88	56	0	**56**	79	0	0	**0**
37	13	54	0	0.88	66	0	**66**	95	0	0	**0**
36	14	63	0	0.88	78	0	**78**	111	0	0	**0**
35	15	73	0	0.88	89	0	**89**	128	0	0	**0**
34	16	83	0	0.88	102	0	**102**	145	0	0	**0**
33	17	93	0	0.88	115	0	**115**	164	0	0	**0**
32	18	104	0	0.88	128	0	**128**	183	0	0	**0**
31	19	116	0	0.88	142	0	**142**	203	0	0	**0**
30	20	127	0	0.88	157	0	**157**	224	0	0	**0**
29	21	140	0	0.88	172	0	**172**	246	21	0	**21**
28	22	152	69	0.88	187	24	**212**	268	44	98	**141**
27	23	165	142	0.88	203	50	**253**	290	66	200	**266**
26	24	178	218	0.88	220	77	**296**	314	90	307	**397**
25	25	192	298	0.88	236	105	**341**	338	113	419	**533**
24	26	206	381	0.88	253	134	**388**	362	138	536	**674**
23	27	220	447	0.88	271	157	**428**	387	163	629	**792**
22	28	234	515	0.88	289	181	**470**	413	188	725	**913**
21	29	249	585	0.88	307	206	**513**	439	214	824	**1039**
20	30	264	658	0.88	325	232	**557**	465	241	927	**1168**
19	31	279	727	0.88	344	256	**600**	492	268	1024	**1291**
18	32	295	784	0.88	363	276	**639**	519	295	1104	**1399**
17	33	311	830	0.88	383	292	**675**	547	323	1168	**1491**
16	34	327	864	0.88	402	304	**707**	575	351	1216	**1567**
15	35	343	887	0.88	422	312	**734**	603	379	1249	**1628**
14	36	359	900	0.88	442	317	**759**	632	408	1267	**1675**
13	37	376	906	0.88	463	319	**782**	661	437	1276	**1713**
12	38	392	905	0.88	483	319	**802**	691	466	1275	**1741**
11	39	409	897	0.88	504	316	**820**	720	496	1263	**1759**
10	40	426	881	0.88	525	310	**835**	750	526	1241	**1767**
9	41	444	869	0.88	546	306	**852**	781	556	1223	**1780**
8	42	461	860	0.88	568	303	**871**	812	588	1210	**1798**
7	43	479	853	0.88	590	300	**891**	843	619	1201	**1821**
6	44	497	850	0.88	613	299	**912**	876	651	1197	**1848**
5	45	516	850	0.88	636	299	**935**	908	684	1197	**1881**
4	46	548	850	0.88	675	299	**974**	964	739	1197	**1936**
3	47	579	850	0.88	713	299	**1013**	1019	795	1197	**1992**
2	48	611	850	0.88	752	299	**1052**	1075	851	1197	**2048**
1	49	642	850	0.88	791	299	**1091**	1130	906	1197	**2103**
0	50	674	850	0.88	830	299	**1129**	1186	962	1197	**2159**
-1	51	705	850	0.88	869	299	**1168**	1242	1017	1197	**2214**
-2	52	737	850	0.88	908	299	**1207**	1297	1073	1197	**2270**
-3	53	769	850	0.88	947	299	**1246**	1353	1128	1197	**2326**
-4	54	800	850	0.88	986	299	**1285**	1408	1184	1197	**2381**
-5	55	832	850	0.88	1025	299	**1324**	1464	1240	1197	**2437**
-6	56	863	850	0.88	1064	299	**1363**	1519	1295	1197	**2492**
-7	57	895	850	0.88	1103	299	**1402**	1575	1351	1197	**2548**
-8	58	926	850	0.88	1141	299	**1441**	1631	1406	1197	**2603**
-9	59	958	850	0.88	1180	299	**1480**	1686	1462	1197	**2659**
-10	60	990	850	0.88	1219	299	**1518**	1742	1518	1197	**2715**
-11	61	1021	850	0.88	1258	299	**1557**	1797	1573	1197	**2770**
-12	62	1053	850	0.88	1297	299	**1596**	1853	1629	1197	**2826**
-13	63	1084	850	0.88	1336	299	**1635**	1908	1684	1197	**2881**
-14	64	1116	850	0.88	1375	299	**1674**	1964	1740	1197	**2937**
-15	65	1148	850	0.88	1414	299	**1713**	2020	1795	1197	**2992**
-16	66	1179	850	0.88	1453	299	**1752**	2075	1851	1197	**3048**
-17	67	1211	850	0.88	1492	299	**1791**	2131	1907	1197	**3104**
-18	68	1242	850	0.88	1530	299	**1830**	2186	1962	1197	**3159**
-19	69	1274	850	0.88	1569	299	**1869**	2242	2018	1197	**3215**
-20	70	1305	850	0.88	1608	299	**1908**	2298	2073	1197	**3270**
-21	71	1337	850	0.88	1647	299	**1946**	2353	2129	1197	**3326**
-22	72	1369	850	0.88	1686	299	**1985**	2409	2184	1197	**3381**
-23	73	1400	850	0.88	1725	299	**2024**	2464	2240	1197	**3437**
-24	74	1432	850	0.88	1764	299	**2063**	2520	2296	1197	**3493**
-25	75	1463	850	0.88	1803	299	**2102**	2575	2351	1197	**3548**
-26	76	1495	850	0.88	1842	299	**2141**	2631	2407	1197	**3604**
-27	77	1526	913	0.88	1881	321	**2202**	2687	2462	1285	**3747**
-28	78	1558	978	0.88	1919	344	**2264**	2742	2518	1377	**3895**
-29	79	1590	1047	0.88	1958	368	**2327**	2798	2573	1474	**4047**
-30	80	1621	1118	0.88	1997	394	**2391**	2853	2629	1574	**4204**
-31	81	1653	1193	0.88	2036	420	**2456**	2909	2685	1680	**4364**
-32	82	1684	1271	0.88	2075	447	**2522**	2964	2740	1790	**4530**
-33	83	1716	1352	0.88	2114	476	**2590**	3020	2796	1904	**4699**
-34	84	1747	1436	0.88	2153	506	**2658**	3076	2851	2022	**4873**
-35	85	1779	1523	0.88	2192	536	**2728**	3131	2907	2145	**5052**
-36	86	1811	1608	0.88	2231	566	**2797**	3187	2962	2264	**5226**
-37	87	1842	1682	0.88	2270	592	**2862**	3242	3018	2369	**5387**
-38	88	1874	1748	0.88	2309	615	**2924**	3298	3074	2461	**5535**
-39	89	1905	1804	0.88	2347	635	**2982**	3353	3129	2540	**5669**
-40	90	1937	1851	0.88	2386	651	**3038**	3409	3185	2606	**5791**

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 7
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

-41	91	1969	1888	0.88	2425	665	**3090**	3465	3240	2659	**5899**	
-42	92	2000	1916	0.88	2464	675	**3139**	3520	3296	2698	**5994**	
-43	93	2032	1935	0.88	2503	681	**3184**	3576	3352	2724	**6076**	
-44	94	2063	1944	0.88	2542	684	**3226**	3631	3407	2738	**6145**	
-45	95	2095	1944	0.88	2581	684	**3265**	3687	3463	2738	**6200**	
-46	96	2115	1944	0.88	2606	684	**3290**	3722	3498	2738	**6236**	
-47	97	2135	1944	0.88	2631	684	**3315**	3758	3534	2738	**6272**	
-48	98	2156	1944	0.88	2656	684	**3341**	3795	3570	2738	**6308**	
-49	99	2177	1944	0.88	2682	684	**3366**	3831	3607	2738	**6345**	
-50	100	2198	1944	0.88	2708	684	**3392**	3869	3644	2738	**6382**	
-51	101	2220	1944	0.88	2735	684	**3419**	3906	3682	2738	**6420**	
-52	102	2241	1944	0.88	2761	684	**3446**	3945	3720	2738	**6458**	
-53	103	2263	1944	0.88	2788	684	**3473**	3983	3759	2738	**6497**	
-54	104	2285	1944	0.88	2816	684	**3500**	4022	3798	2738	**6536**	
-55	105	2308	1944	0.88	2843	684	**3528**	4062	3838	2738	**6575**	
-56	106	2331	1944	0.88	2871	684	**3556**	4102	3878	2738	**6615**	
-57	107	2354	1944	0.88	2900	684	**3584**	4143	3918	2738	**6656**	
-58	108	2377	1944	0.88	2928	684	**3613**	4184	3959	2738	**6697**	
-59	109	2401	1944	0.88	2957	684	**3642**	4225	4001	2738	**6738**	
-60	110	2424	1944	0.88	2987	684	**3671**	4267	4043	2738	**6780**	
-61	111	2448	1944	0.88	3016	684	**3701**	4309	4085	2738	**6822**	
-62	112	2473	1944	0.88	3046	684	**3731**	4352	4128	2738	**6865**	
-63	113	2497	1944	0.88	3077	684	**3761**	4395	4171	2738	**6908**	
-64	114	2522	1944	0.88	3107	684	**3792**	4439	4215	2738	**6952**	
-65	115	2547	1944	0.88	3138	684	**3823**	4483	4259	2738	**6996**	
-66	116	2573	1944	0.88	3169	684	**3854**	4528	4303	2738	**7041**	
-67	117	2598	1944	0.88	3201	684	**3885**	4573	4349	2738	**7086**	
-68	118	2624	1944	0.88	3233	684	**3917**	4618	4394	2738	**7132**	
-69	119	2650	1944	0.88	3265	684	**3949**	4664	4440	2738	**7178**	
-70	120	2677	1944	0.88	3298	684	**3982**	4711	4487	2738	**7224**	
-71	121	2703	1944	0.88	3330	684	**4015**	4758	4534	2738	**7271**	
-72	122	2730	1944	0.88	3364	684	**4048**	4805	4581	2738	**7318**	
-73	123	2757	1944	0.88	3397	684	**4081**	4853	4629	2738	**7366**	
-74	124	2785	1944	0.88	3431	684	**4115**	4901	4677	2738	**7415**	
-75	125	2813	1944	0.88	3465	684	**4149**	4950	4726	2738	**7463**	
-76	126	2841	1944	0.88	3500	684	**4184**	4999	4775	2738	**7513**	
-77	127	2869	1944	0.88	3534	684	**4219**	5049	4825	2738	**7562**	
-78	128	2897	1944	0.88	3569	684	**4254**	5099	4875	2738	**7612**	
-79	129	2926	1944	0.88	3605	684	**4289**	5150	4926	2738	**7663**	
-80	130	2955	1944	0.88	3641	684	**4325**	5201	4977	2738	**7714**	Strength (4314k)
-81	131	2984	1944	0.88	3677	684	**4361**	5252	5028	2738	**7766**	use EL-82'
-82	132	3014	1944	0.88	3713	684	**4397**	5304	5080	2738	**7818**	
-83	133	3044	1944	0.88	3750	684	**4434**	5357	5133	2738	**7870**	
-84	134	3074	1944	0.88	3787	684	**4471**	5410	5185	2738	**7923**	
-85	135	3104	1944	0.88	3824	684	**4509**	5463	5239	2738	**7976**	

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 7
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

Finish Grade Elevation = 50 ft
Cut Off Elevation = 45 ft
Pile type: 118'"-diameter CIDH
Post-liquefaction Condition

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.2	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	5	Sand	0.88
(2)	5	40	Clay	0.88
(3)	40	45	Sand	0.88
(4)	45	95	Clay	0.88
(5)	95	170	Sand	0.88

Axial Group Reduction Factor (η) for Sandy Materials= 0.88
Axial Group Reduction Factor (η) for Clayey Materials= 0.88

Skin Resistance above neutral axis (=>Pile Length)
minus @ Ele.= 30 ' for Liq. settlement=0.1"
90 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State				
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)	
50	0	0	0		0	0	**0**	0		0	**0**	
44	6	3	111	0.88	4	39	**43**	6	0	156	**156**	
43	7	7	111	0.88	8	39	**47**	12	0	156	**156**	
42	8	10	111	0.88	13	39	**52**	18	0	157	**157**	
41	9	14	111	0.88	17	39	**56**	24	0	157	**157**	
40	10	17	111	0.88	21	39	**60**	30	0	157	**157**	
39	11	20	112	0.88	25	39	**64**	36	0	157	**157**	
38	12	24	111	0.88	29	39	**69**	42	0	157	**157**	
37	13	27	111	0.88	33	39	**73**	48	0	157	**157**	
36	14	31	111	0.88	38	39	**77**	54	0	157	**157**	
35	15	34	111	0.88	42	39	**81**	60	0	157	**157**	
34	16	37	111	0.88	46	39	**85**	66	0	157	**157**	
33	17	41	111	0.88	50	39	**89**	72	0	157	**157**	
32	18	44	111	0.88	54	39	**94**	78	0	156	**156**	
31	19	48	111	0.88	59	39	**98**	84	0	156	**156**	
30	20	51	111	0.88	63	39	**102**	90	0	156	**156**	
29	21	54	111	0.88	67	39	**106**	96	6	157	**163**	
28	22	58	174	0.88	71	61	**132**	102	12	245	**257**	
27	23	61	240	0.88	75	85	**160**	108	18	338	**356**	
26	24	65	309	0.88	80	109	**188**	114	24	436	**460**	
25	25	68	382	0.88	84	134	**218**	120	30	538	**567**	
24	26	71	457	0.88	88	161	**249**	126	36	644	**680**	
23	27	75	515	0.88	92	181	**273**	132	42	725	**767**	
22	28	78	575	0.88	96	202	**299**	138	48	810	**858**	
21	29	82	637	0.88	100	224	**325**	144	54	897	**951**	
20	30	85	701	0.88	105	247	**352**	150	60	988	**1047**	
19	31	88	761	0.88	109	268	**377**	156	66	1072	**1138**	
18	32	92	811	0.88	113	285	**398**	161	72	1142	**1213**	
17	33	95	850	0.88	117	299	**416**	167	78	1197	**1274**	
16	34	99	878	0.88	121	309	**431**	173	84	1237	**1320**	
15	35	102	896	0.88	126	316	**441**	179	90	1262	**1352**	
14	36	105	906	0.88	130	319	**449**	185	96	1276	**1371**	
13	37	109	909	0.88	134	320	**454**	191	102	1280	**1382**	
12	38	112	906	0.88	138	319	**457**	197	108	1276	**1384**	
11	39	116	897	0.88	142	316	**458**	203	114	1263	**1377**	
10	40	119	881	0.88	147	310	**457**	209	120	1241	**1361**	
9	41	136	869	0.88	168	306	**474**	240	150	1223	**1374**	
8	42	154	860	0.88	190	303	**492**	271	181	1210	**1391**	
7	43	172	853	0.88	212	300	**512**	303	213	1201	**1414**	
6	44	190	850	0.88	234	299	**534**	335	245	1197	**1442**	
5	45	209	850	0.88	257	299	**556**	367	278	1197	**1475**	
4	46	240	850	0.88	296	299	**595**	423	333	1197	**1530**	
3	47	272	850	0.88	335	299	**634**	478	389	1197	**1586**	
2	48	303	850	0.88	374	299	**673**	534	444	1197	**1641**	
1	49	335	850	0.88	413	299	**712**	590	500	1197	**1697**	
0	50	367	850	0.88	452	299	**751**	645	555	1197	**1753**	Extreme (1723k)*
-1	51	398	850	0.88	491	299	**790**	701	611	1197	**1808**	Use El -5'
-2	52	430	850	0.88	529	299	**829**	756	667	1197	**1864**	
-3	53	461	850	0.88	568	299	**868**	812	722	1197	**1919**	
-4	54	493	850	0.88	607	299	**907**	867	778	1197	**1975**	
-5	55	524	850	0.88	646	299	**945**	923	833	1197	**2030**	
-6	56	556	850	0.88	685	299	**984**	979	889	1197	**2086**	
-7	57	588	850	0.88	724	299	**1023**	1034	944	1197	**2142**	
-8	58	619	850	0.88	763	299	**1062**	1090	1000	1197	**2197**	
-9	59	651	850	0.88	802	299	**1101**	1145	1056	1197	**2253**	
-10	60	682	850	0.88	841	299	**1140**	1201	1111	1197	**2308**	
-11	61	714	850	0.88	880	299	**1179**	1257	1167	1197	**2364**	
-12	62	746	850	0.88	918	299	**1218**	1312	1222	1197	**2419**	
-13	63	777	850	0.88	957	299	**1257**	1368	1278	1197	**2475**	
-14	64	809	850	0.88	996	299	**1296**	1423	1334	1197	**2531**	
-15	65	840	850	0.88	1035	299	**1334**	1479	1389	1197	**2586**	
-16	66	872	850	0.88	1074	299	**1373**	1534	1445	1197	**2642**	
-17	67	903	850	0.88	1113	299	**1412**	1590	1500	1197	**2697**	
-18	68	935	850	0.88	1152	299	**1451**	1646	1556	1197	**2753**	
-19	69	967	850	0.88	1191	299	**1490**	1701	1611	1197	**2808**	
-20	70	998	850	0.88	1230	299	**1529**	1757	1667	1197	**2864**	
-21	71	1030	850	0.88	1269	299	**1568**	1812	1723	1197	**2920**	
-22	72	1061	850	0.88	1307	299	**1607**	1868	1778	1197	**2975**	
-23	73	1093	850	0.88	1346	299	**1646**	1923	1834	1197	**3031**	
-24	74	1124	850	0.88	1385	299	**1685**	1979	1889	1197	**3086**	
-25	75	1156	850	0.88	1424	299	**1723**	2035	1945	1197	**3142**	
-26	76	1188	850	0.88	1463	299	**1762**	2090	2000	1197	**3197**	
-27	77	1219	913	0.88	1502	321	**1823**	2146	2056	1285	**3341**	
-28	78	1251	978	0.88	1541	344	**1885**	2201	2112	1377	**3489**	
-29	79	1282	1047	0.88	1580	368	**1948**	2257	2167	1474	**3641**	
-30	80	1314	1118	0.88	1619	394	**2012**	2312	2223	1574	**3797**	
-31	81	1345	1193	0.88	1658	420	**2078**	2368	2278	1680	**3958**	
-32	82	1377	1271	0.88	1697	447	**2144**	2424	2334	1790	**4123**	
-33	83	1409	1352	0.88	1735	476	**2211**	2479	2389	1904	**4293**	
-34	84	1440	1436	0.88	1774	506	**2280**	2535	2445	2022	**4467**	
-35	85	1472	1523	0.88	1813	536	**2349**	2590	2501	2145	**4646**	
-36	86	1503	1608	0.88	1852	566	**2418**	2646	2556	2264	**4820**	
-37	87	1535	1682	0.88	1891	592	**2483**	2701	2612	2369	**4981**	
-38	88	1567	1748	0.88	1930	615	**2545**	2757	2667	2461	**5128**	
-39	89	1598	1804	0.88	1969	635	**2604**	2813	2723	2540	**5263**	
-40	90	1630	1851	0.88	2008	651	**2659**	2868	2778	2606	**5384**	

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 7
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

-41	91	1661	1888	0.88	2047	665	**2711**	2924	2834	2659	**5493**	
-42	92	1693	1916	0.88	2086	675	**2760**	2979	2890	2698	**5588**	
-43	93	1724	1935	0.88	2124	681	**2806**	3035	2945	2724	**5670**	
-44	94	1756	1944	0.88	2163	684	**2848**	3091	3001	2738	**5738**	
-45	95	1788	1944	0.88	2202	684	**2887**	3146	3056	2738	**5794**	
-46	96	1808	1944	0.88	2227	684	**2911**	3182	3092	2738	**5829**	
-47	97	1828	1944	0.88	2252	684	**2937**	3217	3128	2738	**5865**	
-48	98	1849	1944	0.88	2278	684	**2962**	3254	3164	2738	**5902**	
-49	99	1870	1944	0.88	2303	684	**2988**	3291	3201	2738	**5938**	
-50	100	1891	1944	0.88	2330	684	**3014**	3328	3238	2738	**5976**	
-51	101	1912	1944	0.88	2356	684	**3040**	3366	3276	2738	**6013**	
-52	102	1934	1944	0.88	2383	684	**3067**	3404	3314	2738	**6052**	
-53	103	1956	1944	0.88	2410	684	**3094**	3443	3353	2738	**6090**	
-54	104	1978	1944	0.88	2437	684	**3122**	3482	3392	2738	**6129**	
-55	105	2001	1944	0.88	2465	684	**3149**	3521	3431	2738	**6169**	
-56	106	2023	1944	0.88	2493	684	**3177**	3561	3472	2738	**6209**	
-57	107	2046	1944	0.88	2521	684	**3206**	3602	3512	2738	**6250**	
-58	108	2070	1944	0.88	2550	684	**3234**	3643	3553	2738	**6291**	
-59	109	2093	1944	0.88	2579	684	**3263**	3684	3594	2738	**6332**	
-60	110	2117	1944	0.88	2608	684	**3293**	3726	3636	2738	**6374**	
-61	111	2141	1944	0.88	2638	684	**3322**	3768	3679	2738	**6416**	
-62	112	2165	1944	0.88	2668	684	**3352**	3811	3721	2738	**6459**	
-63	113	2190	1944	0.88	2698	684	**3382**	3854	3765	2738	**6502**	
-64	114	2215	1944	0.88	2729	684	**3413**	3898	3808	2738	**6546**	
-65	115	2240	1944	0.88	2760	684	**3444**	3942	3853	2738	**6590**	
-66	116	2265	1944	0.88	2791	684	**3475**	3987	3897	2738	**6635**	
-67	117	2291	1944	0.88	2822	684	**3507**	4032	3942	2738	**6680**	
-68	118	2317	1944	0.88	2854	684	**3539**	4078	3988	2738	**6725**	
-69	119	2343	1944	0.88	2886	684	**3571**	4124	4034	2738	**6771**	
-70	120	2369	1944	0.88	2919	684	**3603**	4170	4080	2738	**6818**	
-71	121	2396	1944	0.88	2952	684	**3636**	4217	4127	2738	**6865**	
-72	122	2423	1944	0.88	2985	684	**3669**	4264	4175	2738	**6912**	
-73	123	2450	1944	0.88	3019	684	**3703**	4312	4222	2738	**6960**	
-74	124	2478	1944	0.88	3052	684	**3737**	4360	4271	2738	**7008**	
-75	125	2505	1944	0.88	3086	684	**3771**	4409	4320	2738	**7057**	
-76	126	2533	1944									
-77	127	2561	1944									
-78	128	2590	1944									
-79	129	2619	1944									
-80	130	2648	1944									Strength (4716k)
-81	131	2677	1944									use EL-81'
-82	132	2707	1944									
-83	133	2736	1944									
-84	134	2766	1944									
-85	135	2797	1944									

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 8
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

Finish Grade Elevation = 50 ft
Cut Off Elevation = 45 ft
Pile type: 118"'-diameter CIDH
Pre-liquefaction Condition

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.2	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	2	Sand	0.88
(2)	2	37	Sand	0.88
(3)	37	42	Sand	0.88
(4)	42	82	Clay	0.88
(5)	82	170	Sand	0.88

(=>Pile Length)

Axial Group Reduction Factor (η) for Sandy Materials= 0.88
Axial Group Reduction Factor (η) for Clayey Materials= 0.88

Skin Resistance above neutral axis (reference only)
minus @ Ele.= 30 ' for Liq. settlement=0.1"
224 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State			
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)
50	0	0	0		0	0	**0**	0		0	**0**
44	6	4	0	0.88	5	0	**5**	7	0	0	**0**
43	7	10	0	0.88	12	0	**12**	17	0	0	**0**
42	8	16	0	0.88	19	0	**19**	28	0	0	**0**
41	9	22	0	0.88	27	0	**27**	39	0	0	**0**
40	10	29	0	0.88	36	0	**36**	52	0	0	**0**
39	11	37	0	0.88	45	0	**45**	65	0	0	**0**
38	12	45	0	0.88	56	0	**56**	79	0	0	**0**
37	13	54	0	0.88	66	0	**66**	95	0	0	**0**
36	14	63	0	0.88	78	0	**78**	111	0	0	**0**
35	15	73	0	0.88	89	0	**89**	128	0	0	**0**
34	16	83	0	0.88	102	0	**102**	145	0	0	**0**
33	17	93	0	0.88	115	0	**115**	164	0	0	**0**
32	18	104	0	0.88	128	0	**128**	183	0	0	**0**
31	19	116	69	0.88	142	24	**167**	203	0	98	**98**
30	20	127	142	0.88	157	50	**207**	224	0	200	**200**
29	21	140	218	0.88	172	77	**249**	246	21	307	**329**
28	22	152	298	0.88	187	105	**292**	268	44	419	**463**
27	23	165	381	0.88	203	134	**337**	290	66	536	**603**
26	24	178	447	0.88	220	157	**377**	314	90	629	**718**
25	25	192	515	0.88	236	181	**418**	338	113	725	**838**
24	26	206	585	0.88	253	206	**460**	362	138	824	**962**
23	27	220	658	0.88	271	232	**503**	387	163	927	**1090**
22	28	234	727	0.88	289	256	**545**	413	188	1024	**1212**
21	29	249	784	0.88	307	276	**583**	439	214	1104	**1318**
20	30	264	830	0.88	325	292	**618**	465	241	1168	**1409**
19	31	279	864	0.88	344	304	**648**	492	268	1216	**1484**
18	32	295	887	0.88	363	312	**676**	519	295	1249	**1543**
17	33	311	900	0.88	383	317	**700**	547	323	1267	**1590**
16	34	327	906	0.88	402	319	**721**	575	351	1276	**1627**
15	35	343	905	0.88	422	319	**741**	603	379	1275	**1654**
14	36	359	897	0.88	442	316	**758**	632	408	1263	**1671**
13	37	376	881	0.88	463	310	**773**	661	437	1241	**1678**
12	38	393	869	0.88	484	306	**789**	691	467	1223	**1690**
11	39	410	860	0.88	505	303	**807**	721	497	1210	**1707**
10	40	427	853	0.88	527	300	**827**	752	528	1201	**1729**
9	41	445	850	0.88	549	299	**848**	784	560	1197	**1757**
8	42	464	850	0.88	571	299	**870**	816	592	1197	**1789**
7	43	495	850	0.88	610	299	**909**	872	647	1197	**1844**
6	44	527	850	0.88	649	299	**948**	927	703	1197	**1900**
5	45	558	850	0.88	688	299	**987**	983	758	1197	**1956**
4	46	590	850	0.88	727	299	**1026**	1038	814	1197	**2011**
3	47	622	850	0.88	766	299	**1065**	1094	870	1197	**2067**
2	48	653	850	0.88	805	299	**1104**	1149	925	1197	**2122**
1	49	685	850	0.88	843	299	**1143**	1205	981	1197	**2178**
0	50	716	850	0.88	882	299	**1182**	1261	1036	1197	**2233**
-1	51	748	850	0.88	921	299	**1221**	1316	1092	1197	**2289**
-2	52	779	850	0.88	960	299	**1259**	1372	1147	1197	**2345**
-3	53	811	850	0.88	999	299	**1298**	1427	1203	1197	**2400**
-4	54	843	850	0.88	1038	299	**1337**	1483	1259	1197	**2456**
-5	55	874	850	0.88	1077	299	**1376**	1538	1314	1197	**2511**
-6	56	906	850	0.88	1116	299	**1415**	1594	1370	1197	**2567**
-7	57	937	850	0.88	1155	299	**1454**	1650	1425	1197	**2622**
-8	58	969	850	0.88	1194	299	**1493**	1705	1481	1197	**2678**
-9	59	1000	850	0.88	1233	299	**1532**	1761	1537	1197	**2734**
-10	60	1032	850	0.88	1271	299	**1571**	1816	1592	1197	**2789**
-11	61	1064	850	0.88	1310	299	**1610**	1872	1648	1197	**2845**
-12	62	1095	850	0.88	1349	299	**1648**	1927	1703	1197	**2900**
-13	63	1127	850	0.88	1388	299	**1687**	1983	1759	1197	**2956**
-14	64	1158	913	0.88	1427	321	**1748**	2039	1814	1285	**3099**
-15	65	1190	978	0.88	1466	344	**1810**	2094	1870	1377	**3247**
-16	66	1221	1047	0.88	1505	368	**1873**	2150	1926	1474	**3399**
-17	67	1253	1118	0.88	1544	394	**1937**	2205	1981	1574	**3556**
-18	68	1285	1193	0.88	1583	420	**2003**	2261	2037	1680	**3717**
-19	69	1316	1271	0.88	1622	447	**2069**	2316	2092	1790	**3882**
-20	70	1348	1352	0.88	1660	476	**2136**	2372	2148	1904	**4052**
-21	71	1379	1436	0.88	1699	506	**2205**	2428	2203	2022	**4226**
-22	72	1411	1523	0.88	1738	536	**2275**	2483	2259	2145	**4404**
-23	73	1443	1608	0.88	1777	566	**2343**	2539	2315	2264	**4578**
-24	74	1474	1682	0.88	1816	592	**2408**	2594	2370	2369	**4739**
-25	75	1506	1748	0.88	1855	615	**2470**	2650	2426	2461	**4887**
-26	76	1537	1804	0.88	1894	635	**2529**	2706	2481	2540	**5021**
-27	77	1569	1851	0.88	1933	651	**2584**	2761	2537	2606	**5143**
-28	78	1600	1888	0.88	1972	665	**2636**	2817	2592	2659	**5251**
-29	79	1632	1916	0.88	2011	675	**2685**	2872	2648	2698	**5346**
-30	80	1664	1935	0.88	2049	681	**2731**	2928	2704	2724	**5428**
-31	81	1695	1944	0.88	2088	684	**2773**	2983	2759	2738	**5497**
-32	82	1727	1944	0.88	2127	684	**2812**	3039	2815	2738	**5552**
-33	83	1745	1944	0.88	2150	684	**2835**	3072	2848	2738	**5585**
-34	84	1764	1944	0.88	2173	684	**2857**	3104	2880	2738	**5617**
-35	85	1782	1944	0.88	2195	684	**2880**	3136	2912	2738	**5649**
-36	86	1800	1944	0.88	2217	684	**2902**	3168	2943	2738	**5681**
-37	87	1818	1944	0.88	2240	684	**2924**	3200	2976	2738	**5713**
-38	88	1837	1944	0.88	2263	684	**2947**	3232	3008	2738	**5746**
-39	89	1855	1944	0.88	2286	684	**2970**	3266	3041	2738	**5779**
-40	90	1874	1944	0.88	2309	684	**2994**	3299	3075	2738	**5812**

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 8
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

-41	91	1894	1944	0.88	2333	684	**3018**	3333	3109	2738	**5846**	
-42	92	1913	1944	0.88	2357	684	**3042**	3368	3143	2738	**5881**	
-43	93	1933	1944	0.88	2382	684	**3066**	3402	3178	2738	**5916**	
-44	94	1953	1944	0.88	2406	684	**3091**	3438	3214	2738	**5951**	
-45	95	1974	1944	0.88	2432	684	**3116**	3474	3249	2738	**5987**	
-46	96	1994	1944	0.88	2457	684	**3141**	3510	3286	2738	**6023**	
-47	97	2015	1944	0.88	2483	684	**3167**	3547	3322	2738	**6060**	
-48	98	2036	1944	0.88	2509	684	**3193**	3584	3360	2738	**6097**	
-49	99	2058	1944	0.88	2535	684	**3219**	3622	3397	2738	**6135**	
-50	100	2079	1944	0.88	2562	684	**3246**	3660	3435	2738	**6173**	
-51	101	2101	1944	0.88	2589	684	**3273**	3698	3474	2738	**6212**	
-52	102	2124	1944	0.88	2616	684	**3301**	3737	3513	2738	**6251**	
-53	103	2146	1944	0.88	2644	684	**3328**	3777	3553	2738	**6290**	
-54	104	2169	1944	0.88	2672	684	**3356**	3817	3593	2738	**6330**	
-55	105	2192	1944	0.88	2700	684	**3384**	3857	3633	2738	**6371**	
-56	106	2215	1944	0.88	2729	684	**3413**	3898	3674	2738	**6411**	
-57	107	2238	1944	0.88	2758	684	**3442**	3939	3715	2738	**6453**	
-58	108	2262	1944	0.88	2787	684	**3471**	3981	3757	2738	**6495**	
-59	109	2286	1944	0.88	2816	684	**3501**	4024	3799	2738	**6537**	
-60	110	2310	1944	0.88	2846	684	**3531**	4066	3842	2738	**6580**	
-61	111	2335	1944	0.88	2877	684	**3561**	4109	3885	2738	**6623**	
-62	112	2360	1944	0.88	2907	684	**3592**	4153	3929	2738	**6666**	
-63	113	2385	1944	0.88	2938	684	**3622**	4197	3973	2738	**6711**	
-64	114	2410	1944	0.88	2969	684	**3654**	4242	4018	2738	**6755**	
-65	115	2436	1944	0.88	3001	684	**3685**	4287	4063	2738	**6800**	
-66	116	2462	1944	0.88	3033	684	**3717**	4332	4108	2738	**6846**	
-67	117	2488	1944	0.88	3065	684	**3749**	4378	4154	2738	**6892**	
-68	118	2514	1944	0.88	3097	684	**3782**	4425	4200	2738	**6938**	
-69	119	2541	1944	0.88	3130	684	**3814**	4472	4247	2738	**6985**	
-70	120	2568	1944	0.88	3163	684	**3848**	4519	4295	2738	**7032**	
-71	121	2595	1944	0.88	3197	684	**3881**	4567	4342	2738	**7080**	
-72	122	2622	1944	0.88	3230	684	**3915**	4615	4391	2738	**7128**	
-73	123	2650	1944	0.88	3264	684	**3949**	4664	4439	2738	**7177**	
-74	124	2678	1944	0.88	3299	684	**3983**	4713	4488	2738	**7226**	
-75	125	2706	1944	0.88	3334	684	**4018**	4762	4538	2738	**7276**	
-76	126	2734	1944	0.88	3369	684	**4053**	4812	4588	2738	**7326**	Strength (4051k)
-77	127	2763	1944	0.88	3404	684	**4088**	4863	4639	2738	**7376**	use EL-78'
-78	128	2792	1944	0.88	3440	684	**4124**	4914	4690	2738	**7427**	
-79	129	2821	1944	0.88	3476	684	**4160**	4965	4741	2738	**7479**	
-80	130	2851	1944	0.88	3512	684	**4196**	5017	4793	2738	**7531**	

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 8
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

Finish Grade Elevation = 50 ft
Cut Off Elevation = 45 ft
Pile type: 118'"-diameter CIDH
Post-liquefaction Condition

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.2	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	2	Sand	0.88
(2)	2	37	Clay	0.88
(3)	37	42	Sand	0.88
(4)	42	82	Clay	0.88
(5)	82	170	Sand	0.88

Axial Group Reduction Factor (η) for Sandy Materials= 0.88
Axial Group Reduction Factor (η) for Clayey Materials= 0.88

Skin Resistance above neutral axis (=>Pile Length)
minus @ Ele.= 30 ' for Liq. settlement=0.1"
90 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State				
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)	
50	0	0	0		0	0	**0**	0		0	**0**	
44	6	3	111	0.88	4	39	**43**	6	0	156	**156**	
43	7	7	111	0.88	8	39	**48**	12	0	157	**157**	
42	8	10	112	0.88	13	39	**52**	18	0	157	**157**	
41	9	14	112	0.88	17	39	**56**	24	0	158	**158**	
40	10	17	112	0.88	21	39	**60**	30	0	158	**158**	
39	11	20	112	0.88	25	40	**65**	36	0	158	**158**	
38	12	24	112	0.88	29	40	**69**	42	0	158	**158**	
37	13	27	113	0.88	33	40	**73**	48	0	158	**158**	
36	14	31	113	0.88	38	40	**77**	54	0	159	**159**	
35	15	34	113	0.88	42	40	**82**	60	0	159	**159**	
34	16	37	113	0.88	46	40	**86**	66	0	159	**159**	
33	17	41	113	0.88	50	40	**90**	72	0	159	**159**	
32	18	44	113	0.88	54	40	**94**	78	0	159	**159**	
31	19	48	176	0.88	59	62	**120**	84	0	247	**247**	
30	20	51	242	0.88	63	85	**148**	90	0	340	**340**	
29	21	54	311	0.88	67	109	**176**	96	6	438	**444**	
28	22	58	383	0.88	71	135	**206**	102	12	539	**551**	
27	23	61	458	0.88	75	161	**237**	108	18	645	**663**	
26	24	65	516	0.88	80	182	**261**	114	24	727	**751**	
25	25	68	576	0.88	84	203	**286**	120	30	811	**841**	
24	26	71	638	0.88	88	225	**312**	126	36	898	**934**	
23	27	75	702	0.88	92	247	**339**	132	42	988	**1030**	
22	28	78	762	0.88	96	268	**364**	138	48	1073	**1120**	
21	29	82	811	0.88	100	286	**386**	144	54	1142	**1196**	
20	30	85	850	0.88	105	299	**404**	150	60	1197	**1257**	
19	31	88	878	0.88	109	309	**418**	156	66	1237	**1303**	
18	32	92	896	0.88	113	316	**429**	161	72	1262	**1334**	
17	33	95	906	0.88	117	319	**436**	167	78	1276	**1353**	
16	34	99	909	0.88	121	320	**441**	173	84	1280	**1364**	
15	35	102	906	0.88	126	319	**445**	179	90	1276	**1366**	
14	36	105	897	0.88	130	316	**446**	185	96	1263	**1359**	
13	37	109	881	0.88	134	310	**444**	191	102	1241	**1343**	
12	38	126	869	0.88	155	306	**461**	221	131	1223	**1355**	
11	39	143	860	0.88	176	303	**479**	252	162	1210	**1372**	
10	40	161	853	0.88	198	300	**498**	283	193	1201	**1394**	
9	41	178	850	0.88	220	299	**519**	314	224	1197	**1421**	
8	42	197	850	0.88	242	299	**542**	346	256	1197	**1454**	
7	43	228	850	0.88	281	299	**581**	402	312	1197	**1509**	
6	44	260	850	0.88	320	299	**619**	457	368	1197	**1565**	Extreme (1550k)*
5	45	291	850	0.88	359	299	**658**	513	423	1197	**1620**	Use El +1'
4	46	323	850	0.88	398	299	**697**	569	479	1197	**1676**	
3	47	355	850	0.88	437	299	**736**	624	534	1197	**1731**	
2	48	386	850	0.88	476	299	**775**	680	590	1197	**1787**	
1	49	418	850	0.88	515	299	**814**	735	646	1197	**1843**	
0	50	449	850	0.88	554	299	**853**	791	701	1197	**1898**	
-1	51	481	850	0.88	592	299	**892**	846	757	1197	**1954**	
-2	52	512	850	0.88	631	299	**931**	902	812	1197	**2009**	
-3	53	544	850	0.88	670	299	**970**	958	868	1197	**2065**	
-4	54	576	850	0.88	709	299	**1008**	1013	923	1197	**2120**	
-5	55	607	850	0.88	748	299	**1047**	1069	979	1197	**2176**	
-6	56	639	850	0.88	787	299	**1086**	1124	1035	1197	**2232**	
-7	57	670	850	0.88	826	299	**1125**	1180	1090	1197	**2287**	
-8	58	702	850	0.88	865	299	**1164**	1235	1146	1197	**2343**	
-9	59	734	850	0.88	904	299	**1203**	1291	1201	1197	**2398**	
-10	60	765	850	0.88	943	299	**1242**	1347	1257	1197	**2454**	
-11	61	797	850	0.88	981	299	**1281**	1402	1312	1197	**2509**	
-12	62	828	850	0.88	1020	299	**1320**	1458	1368	1197	**2565**	
-13	63	860	850	0.88	1059	299	**1359**	1513	1424	1197	**2621**	
-14	64	891	913	0.88	1098	321	**1419**	1569	1479	1285	**2764**	
-15	65	923	978	0.88	1137	344	**1481**	1624	1535	1377	**2912**	
-16	66	955	1047	0.88	1176	368	**1544**	1680	1590	1474	**3064**	
-17	67	986	1118	0.88	1215	394	**1609**	1736	1646	1574	**3220**	
-18	68	1018	1193	0.88	1254	420	**1674**	1791	1701	1680	**3381**	
-19	69	1049	1271	0.88	1293	447	**1740**	1847	1757	1790	**3547**	
-20	70	1081	1352	0.88	1332	476	**1808**	1902	1813	1904	**3716**	
-21	71	1112	1436	0.88	1371	506	**1876**	1958	1868	2022	**3890**	
-22	72	1144	1523	0.88	1409	536	**1946**	2013	1924	2145	**4069**	
-23	73	1176	1608	0.88	1448	566	**2014**	2069	1979	2264	**4243**	
-24	74	1207	1682	0.88	1487	592	**2079**	2125	2035	2369	**4404**	
-25	75	1239	1748	0.88	1526	615	**2141**	2180	2090	2461	**4552**	
-26	76	1270	1804	0.88	1565	635	**2200**	2236	2146	2540	**4686**	
-27	77	1302	1851	0.88	1604	651	**2255**	2291	2202	2606	**4808**	
-28	78	1333	1888	0.88	1643	665	**2307**	2347	2257	2659	**4916**	
-29	79	1365	1916	0.88	1682	675	**2356**	2403	2313	2698	**5011**	
-30	80	1397	1935	0.88	1721	681	**2402**	2458	2368	2724	**5093**	
-31	81	1428	1944	0.88	1760	684	**2444**	2514	2424	2738	**5161**	
-32	82	1460	1944	0.88	1798	684	**2483**	2569	2480	2738	**5217**	
-33	83	1478	1944	0.88	1821	684	**2506**	2602	2512	2738	**5250**	
-34	84	1497	1944	0.88	1844	684	**2528**	2634	2545	2738	**5282**	
-35	85	1515	1944	0.88	1866	684	**2551**	2666	2577	2738	**5314**	
-36	86	1533	1944	0.88	1889	684	**2573**	2698	2608	2738	**5346**	
-37	87	1551	1944	0.88	1911	684	**2595**	2730	2640	2738	**5378**	
-38	88	1570	1944	0.88	1934	684	**2618**	2763	2673	2738	**5411**	
-39	89	1589	1944	0.88	1957	684	**2641**	2796	2706	2738	**5444**	
-40	90	1608	1944	0.88	1981	684	**2665**	2829	2740	2738	**5477**	

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 8
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

-41	91	1627	1944	0.88	2004	684	**2689**	2863	2774	2738	**5511**	
-42	92	1646	1944	0.88	2028	684	**2713**	2898	2808	2738	**5546**	
-43	93	1666	1944	0.88	2053	684	**2737**	2933	2843	2738	**5581**	
-44	94	1686	1944	0.88	2078	684	**2762**	2968	2878	2738	**5616**	
-45	95	1707	1944	0.88	2103	684	**2787**	3004	2914	2738	**5652**	
-46	96	1727	1944	0.88	2128	684	**2813**	3040	2950	2738	**5688**	
-47	97	1748	1944	0.88	2154	684	**2838**	3077	2987	2738	**5725**	
-48	98	1769	1944	0.88	2180	684	**2864**	3114	3024	2738	**5762**	
-49	99	1791	1944	0.88	2206	684	**2891**	3152	3062	2738	**5800**	
-50	100	1812	1944	0.88	2233	684	**2917**	3190	3100	2738	**5838**	
-51	101	1834	1944	0.88	2260	684	**2944**	3229	3139	2738	**5876**	
-52	102	1857	1944	0.88	2287	684	**2972**	3268	3178	2738	**5915**	
-53	103	1879	1944	0.88	2315	684	**2999**	3307	3217	2738	**5955**	
-54	104	1902	1944	0.88	2343	684	**3027**	3347	3257	2738	**5995**	
-55	105	1925	1944	0.88	2371	684	**3056**	3388	3298	2738	**6035**	
-56	106	1948	1944	0.88	2400	684	**3084**	3428	3339	2738	**6076**	
-57	107	1971	1944	0.88	2429	684	**3113**	3470	3380	2738	**6118**	
-58	108	1995	1944	0.88	2458	684	**3142**	3512	3422	2738	**6159**	
-59	109	2019	1944	0.88	2488	684	**3172**	3554	3464	2738	**6202**	
-60	110	2043	1944	0.88	2518	684	**3202**	3597	3507	2738	**6244**	
-61	111	2068	1944	0.88	2548	684	**3232**	3640	3550	2738	**6288**	
-62	112	2093	1944	0.88	2578	684	**3263**	3683	3594	2738	**6331**	
-63	113	2118	1944	0.88	2609	684	**3294**	3727	3638	2738	**6375**	
-64	114	2143	1944	0.88	2640	684	**3325**	3772	3682	2738	**6420**	
-65	115	2169	1944	0.88	2672	684	**3356**	3817	3727	2738	**6465**	
-66	116	2195	1944	0.88	2704	684	**3388**	3863	3773	2738	**6510**	
-67	117	2221	1944	0.88	2736	684	**3420**	3909	3819	2738	**6556**	
-68	118	2247	1944	0.88	2768	684	**3453**	3955	3865	2738	**6603**	
-69	119	2274	1944	0.88	2801	684	**3486**	4002	3912	2738	**6650**	
-70	120	2301	1944	0.88	2834	684	**3519**	4049	3959	2738	**6697**	
-71	121	2328	1944	0.88	2868	684	**3552**	4097	4007	2738	**6745**	
-72	122	2355	1944	0.88	2902	684	**3586**	4145	4055	2738	**6793**	
-73	123	2383	1944	0.88	2936	684	**3620**	4194	4104	2738	**6842**	
-74	124	2411	1944	0.88	2970	684	**3654**	4243	4153	2738	**6891**	
-75	125	2439	1944	0.88	3005	684	**3689**	4293	4203	2738	**6940**	
-76	126	2467	1944									
-77	127	2496	1944									
-78	128	2525	1944									
-79	129	2554	1944									
-80	130	2584	1944									Strength (4716k)
50												use EL-81'
50												
50												
50												
50												

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 9
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

Finish Grade Elevation = 50 ft
Cut Off Elevation = 45 ft

Pile type: 118"'-diameter CIDH

Pre-liquefaction Condition

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.2	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	1	Sand	0.88
(2)	1	26	Sand	0.88
(3)	26	36	Sand	0.88
(4)	36	96	Clay	0.88
(5)	96	170	Sand	0.88

(=>Pile Length)

Axial Group Reduction Factor (η) for Sandy Materials= 0.88
Axial Group Reduction Factor (η) for Clayey Materials= 0.88

Skin Resistance above neutral axis (reference only)
minus @ Ele.= 30 ' for Liq. settlement=0.1"
224 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State			
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)
50	0	0	0		0	0	**0**	0		0	**0**
44	6	4	-69	0.88	5	-24	**-19**	7	0	-98	**-98**
43	7	10	0	0.88	12	0	**12**	17	0	0	**0**
42	8	16	69	0.88	19	24	**44**	28	0	98	**98**
41	9	22	142	0.88	27	50	**77**	39	0	200	**200**
40	10	29	218	0.88	36	77	**113**	52	0	307	**307**
39	11	37	298	0.88	45	105	**150**	65	0	419	**419**
38	12	45	381	0.88	56	134	**190**	79	0	536	**536**
37	13	54	467	0.88	66	165	**231**	95	0	658	**658**
36	14	63	557	0.88	78	196	**274**	111	0	785	**785**
35	15	73	651	0.88	89	229	**319**	128	0	917	**917**
34	16	83	748	0.88	102	263	**365**	145	0	1053	**1053**
33	17	93	841	0.88	115	296	**411**	164	0	1185	**1185**
32	18	104	904	0.88	128	318	**446**	183	0	1272	**1272**
31	19	116	955	0.88	142	336	**478**	203	0	1344	**1344**
30	20	127	994	0.88	157	350	**507**	224	0	1400	**1400**
29	21	140	1022	0.88	172	360	**532**	246	21	1439	**1460**
28	22	152	1039	0.88	187	366	**553**	268	44	1462	**1506**
27	23	165	1044	0.88	203	367	**571**	290	66	1470	**1536**
26	24	178	1037	0.88	220	365	**585**	314	90	1461	**1550**
25	25	192	1020	0.88	236	359	**595**	338	113	1436	**1549**
24	26	206	991	0.88	253	349	**602**	362	138	1395	**1533**
23	27	220	963	0.88	271	339	**610**	387	163	1355	**1519**
22	28	235	938	0.88	290	330	**620**	414	190	1320	**1510**
21	29	251	916	0.88	309	322	**631**	441	217	1289	**1506**
20	30	267	897	0.88	328	316	**644**	469	245	1263	**1508**
19	31	283	881	0.88	349	310	**659**	498	274	1241	**1515**
18	32	300	869	0.88	369	306	**675**	528	304	1223	**1527**
17	33	317	860	0.88	391	303	**693**	558	334	1210	**1544**
16	34	335	853	0.88	413	300	**713**	589	365	1201	**1567**
15	35	353	850	0.88	435	299	**734**	621	397	1197	**1594**
14	36	371	850	0.88	458	299	**757**	654	430	1197	**1627**
13	37	403	850	0.88	497	299	**796**	709	485	1197	**1682**
12	38	435	850	0.88	535	299	**835**	765	541	1197	**1738**
11	39	466	850	0.88	574	299	**874**	820	596	1197	**1793**
10	40	498	850	0.88	613	299	**912**	876	652	1197	**1849**
9	41	529	850	0.88	652	299	**951**	932	707	1197	**1904**
8	42	561	850	0.88	691	299	**990**	987	763	1197	**1960**
7	43	592	850	0.88	730	299	**1029**	1043	819	1197	**2016**
6	44	624	850	0.88	769	299	**1068**	1098	874	1197	**2071**
5	45	656	850	0.88	808	299	**1107**	1154	930	1197	**2127**
4	46	687	850	0.88	847	299	**1146**	1210	985	1197	**2182**
3	47	719	850	0.88	886	299	**1185**	1265	1041	1197	**2238**
2	48	750	850	0.88	924	299	**1224**	1321	1096	1197	**2293**
1	49	782	850	0.88	963	299	**1263**	1376	1152	1197	**2349**
0	50	814	850	0.88	1002	299	**1302**	1432	1208	1197	**2405**
-1	51	845	850	0.88	1041	299	**1340**	1487	1263	1197	**2460**
-2	52	877	850	0.88	1080	299	**1379**	1543	1319	1197	**2516**
-3	53	908	850	0.88	1119	299	**1418**	1599	1374	1197	**2571**
-4	54	940	850	0.88	1158	299	**1457**	1654	1430	1197	**2627**
-5	55	971	850	0.88	1197	299	**1496**	1710	1485	1197	**2683**
-6	56	1003	850	0.88	1236	299	**1535**	1765	1541	1197	**2738**
-7	57	1035	850	0.88	1275	299	**1574**	1821	1597	1197	**2794**
-8	58	1066	850	0.88	1313	299	**1613**	1876	1652	1197	**2849**
-9	59	1098	850	0.88	1352	299	**1652**	1932	1708	1197	**2905**
-10	60	1129	850	0.88	1391	299	**1691**	1988	1763	1197	**2960**
-11	61	1161	850	0.88	1430	299	**1729**	2043	1819	1197	**3016**
-12	62	1192	850	0.88	1469	299	**1768**	2099	1874	1197	**3072**
-13	63	1224	850	0.88	1508	299	**1807**	2154	1930	1197	**3127**
-14	64	1256	850	0.88	1547	299	**1846**	2210	1986	1197	**3183**
-15	65	1287	850	0.88	1586	299	**1885**	2265	2041	1197	**3238**
-16	66	1319	850	0.88	1625	299	**1924**	2321	2097	1197	**3294**
-17	67	1350	850	0.88	1664	299	**1963**	2377	2152	1197	**3349**
-18	68	1382	850	0.88	1703	299	**2002**	2432	2208	1197	**3405**
-19	69	1413	850	0.88	1741	299	**2041**	2488	2264	1197	**3461**
-20	70	1445	850	0.88	1780	299	**2080**	2543	2319	1197	**3516**
-21	71	1477	850	0.88	1819	299	**2118**	2599	2375	1197	**3572**
-22	72	1508	850	0.88	1858	299	**2157**	2654	2430	1197	**3627**
-23	73	1540	850	0.88	1897	299	**2196**	2710	2486	1197	**3683**
-24	74	1571	850	0.88	1936	299	**2235**	2766	2541	1197	**3738**
-25	75	1603	850	0.88	1975	299	**2274**	2821	2597	1197	**3794**
-26	76	1635	850	0.88	2014	299	**2313**	2877	2653	1197	**3850**
-27	77	1666	850	0.88	2053	299	**2352**	2932	2708	1197	**3905**
-28	78	1698	913	0.88	2092	321	**2413**	2988	2764	1285	**4049**
-29	79	1729	978	0.88	2130	344	**2475**	3043	2819	1377	**4196**
-30	80	1761	1047	0.88	2169	368	**2538**	3099	2875	1474	**4348**
-31	81	1792	1118	0.88	2208	394	**2602**	3155	2930	1574	**4505**
-32	82	1824	1193	0.88	2247	420	**2667**	3210	2986	1680	**4666**
-33	83	1856	1271	0.88	2286	447	**2733**	3266	3042	1790	**4831**
-34	84	1887	1352	0.88	2325	476	**2801**	3321	3097	1904	**5001**
-35	85	1919	1436	0.88	2364	506	**2869**	3377	3153	2022	**5175**
-36	86	1950	1523	0.88	2403	536	**2939**	3433	3208	2145	**5353**
-37	87	1982	1608	0.88	2442	566	**3008**	3488	3264	2264	**5527**
-38	88	2013	1682	0.88	2481	592	**3073**	3544	3319	2369	**5688**
-39	89	2045	1748	0.88	2519	615	**3135**	3599	3375	2461	**5836**
-40	90	2077	1804	0.88	2558	635	**3193**	3655	3431	2540	**5971**

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 9
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

-41	91	2108	1851	0.88	2597	651	**3249**	3710	3486	2606	**6092**	
-42	92	2140	1888	0.88	2636	665	**3301**	3766	3542	2659	**6200**	
-43	93	2171	1916	0.88	2675	675	**3350**	3822	3597	2698	**6295**	
-44	94	2203	1935	0.88	2714	681	**3395**	3877	3653	2724	**6377**	
-45	95	2235	1944	0.88	2753	684	**3437**	3933	3708	2738	**6446**	
-46	96	2266	1944	0.88	2792	684	**3476**	3988	3764	2738	**6502**	
-47	97	2288	1944	0.88	2818	684	**3503**	4026	3802	2738	**6539**	
-48	98	2309	1944	0.88	2845	684	**3529**	4064	3840	2738	**6578**	
-49	99	2331	1944	0.88	2872	684	**3556**	4103	3879	2738	**6616**	
-50	100	2353	1944	0.88	2899	684	**3584**	4142	3918	2738	**6655**	
-51	101	2376	1944	0.88	2927	684	**3612**	4182	3958	2738	**6695**	
-52	102	2399	1944	0.88	2955	684	**3640**	4222	3998	2738	**6735**	
-53	103	2422	1944	0.88	2984	684	**3668**	4262	4038	2738	**6776**	
-54	104	2445	1944	0.88	3012	684	**3697**	4303	4079	2738	**6817**	
-55	105	2469	1944	0.88	3041	684	**3726**	4345	4121	2738	**6858**	
-56	106	2492	1944	0.88	3071	684	**3755**	4387	4162	2738	**6900**	
-57	107	2517	1944	0.88	3100	684	**3785**	4429	4205	2738	**6942**	
-58	108	2541	1944	0.88	3130	684	**3815**	4472	4248	2738	**6985**	
-59	109	2565	1944	0.88	3161	684	**3845**	4515	4291	2738	**7028**	
-60	110	2590	1944	0.88	3191	684	**3876**	4559	4335	2738	**7072**	
-61	111	2615	1944	0.88	3222	684	**3907**	4603	4379	2738	**7116**	
-62	112	2641	1944	0.88	3253	684	**3938**	4648	4424	2738	**7161**	
-63	113	2666	1944	0.88	3285	684	**3969**	4693	4469	2738	**7206**	
-64	114	2692	1944	0.88	3317	684	**4001**	4738	4514	2738	**7252**	
-65	115	2718	1944	0.88	3349	684	**4034**	4785	4560	2738	**7298**	Strength (4006k)
-66	116	2745	1944	0.88	3382	684	**4066**	4831	4607	2738	**7344**	use EL-67'
-67	117	2772	1944	0.88	3415	684	**4099**	4878	4654	2738	**7391**	
-68	118	2799	1944	0.88	3448	684	**4132**	4925	4701	2738	**7439**	
-69	119	2826	1944	0.88	3481	684	**4166**	4973	4749	2738	**7487**	
-70	120	2853	1944	0.88	3515	684	**4200**	5022	4797	2738	**7535**	
-71	121	2881	1944	0.88	3549	684	**4234**	5070	4846	2738	**7584**	
-72	122	2909	1944	0.88	3584	684	**4268**	5120	4895	2738	**7633**	
-73	123	2937	1944	0.88	3619	684	**4303**	5169	4945	2738	**7683**	
-74	124	2966	1944	0.88	3654	684	**4338**	5220	4995	2738	**7733**	
-75	125	2994	1944	0.88	3689	684	**4374**	5270	5046	2738	**7784**	

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 9
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

Finish Grade Elevation = 50 ft
Cut Off Elevation = 45 ft
Pile type: 118'"-diameter CIDH
Post-liquefaction Condition

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.2	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	1	Sand	0.88
(2)	1	26	Clay	0.88
(3)	26	36	Sand	0.88
(4)	36	96	Clay	0.88
(5)	96	170	Sand	0.88

Axial Group Reduction Factor (η) for Sandy Materials= 0.88
Axial Group Reduction Factor (η) for Clayey Materials= 0.88

Skin Resistance above neutral axis (=>Pile Length)
minus @ Ele.= 30 ' for Liq. settlement=0.1"
90 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State				
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)	
50	0	0	0		0	0	**0**	0		0	**0**	
44	6	3	57	0.88	4	20	**24**	6	0	80	**80**	
43	7	7	120	0.88	8	42	**51**	12	0	169	**169**	
42	8	10	183	0.88	13	64	**77**	18	0	258	**258**	
41	9	14	249	0.88	17	88	**104**	24	0	351	**351**	
40	10	17	318	0.88	21	112	**133**	30	0	448	**448**	
39	11	20	390	0.88	25	137	**162**	36	0	549	**549**	
38	12	24	465	0.88	29	164	**193**	42	0	655	**655**	
37	13	27	543	0.88	33	191	**225**	48	0	764	**764**	
36	14	31	624	0.88	38	220	**257**	54	0	879	**879**	
35	15	34	708	0.88	42	249	**291**	60	0	997	**997**	
34	16	37	795	0.88	46	280	**326**	66	0	1120	**1120**	
33	17	41	879	0.88	50	310	**360**	72	0	1238	**1238**	
32	18	44	933	0.88	54	329	**383**	78	0	1314	**1314**	
31	19	48	977	0.88	59	344	**402**	84	0	1375	**1375**	
30	20	51	1010	0.88	63	355	**418**	90	0	1422	**1422**	
29	21	54	1033	0.88	67	363	**430**	96	6	1454	**1460**	
28	22	58	1045	0.88	71	368	**439**	102	12	1471	**1483**	
27	23	61	1047	0.88	75	369	**444**	108	18	1474	**1492**	
26	24	65	1039	0.88	80	366	**445**	114	24	1462	**1486**	
25	25	68	1020	0.88	84	359	**443**	120	30	1436	**1466**	
24	26	71	991	0.88	88	349	**437**	126	36	1395	**1431**	
23	27	86	963	0.88	106	339	**445**	151	61	1355	**1417**	
22	28	101	938	0.88	124	330	**454**	177	88	1320	**1408**	
21	29	116	916	0.88	143	322	**466**	205	115	1289	**1404**	
20	30	132	897	0.88	163	316	**479**	233	143	1263	**1406**	
19	31	149	881	0.88	183	310	**493**	262	172	1241	**1413**	
18	32	165	869	0.88	204	306	**510**	291	202	1223	**1425**	
17	33	183	860	0.88	225	303	**528**	322	232	1210	**1442**	
16	34	200	853	0.88	247	300	**547**	353	263	1201	**1465**	
15	35	219	850	0.88	269	299	**569**	385	295	1197	**1492**	
14	36	237	850	0.88	292	299	**591**	417	328	1197	**1525**	
13	37	269	850	0.88	331	299	**630**	473	383	1197	**1580**	Extreme (1569k)*
12	38	300	850	0.88	370	299	**669**	528	439	1197	**1636**	Use El +8'
11	39	332	850	0.88	409	299	**708**	584	494	1197	**1691**	
10	40	363	850	0.88	448	299	**747**	640	550	1197	**1747**	
9	41	395	850	0.88	487	299	**786**	695	605	1197	**1802**	
8	42	427	850	0.88	525	299	**825**	751	661	1197	**1858**	
7	43	458	850	0.88	564	299	**864**	806	717	1197	**1914**	
6	44	490	850	0.88	603	299	**903**	862	772	1197	**1969**	
5	45	521	850	0.88	642	299	**941**	917	828	1197	**2025**	
4	46	553	850	0.88	681	299	**980**	973	883	1197	**2080**	
3	47	584	850	0.88	720	299	**1019**	1029	939	1197	**2136**	
2	48	616	850	0.88	759	299	**1058**	1084	994	1197	**2191**	
1	49	648	850	0.88	798	299	**1097**	1140	1050	1197	**2247**	
0	50	679	850	0.88	837	299	**1136**	1195	1106	1197	**2303**	
-1	51	711	850	0.88	876	299	**1175**	1251	1161	1197	**2358**	
-2	52	742	850	0.88	915	299	**1214**	1306	1217	1197	**2414**	
-3	53	774	850	0.88	953	299	**1253**	1362	1272	1197	**2469**	
-4	54	805	850	0.88	992	299	**1292**	1418	1328	1197	**2525**	
-5	55	837	850	0.88	1031	299	**1330**	1473	1383	1197	**2581**	
-6	56	869	850	0.88	1070	299	**1369**	1529	1439	1197	**2636**	
-7	57	900	850	0.88	1109	299	**1408**	1584	1495	1197	**2692**	
-8	58	932	850	0.88	1148	299	**1447**	1640	1550	1197	**2747**	
-9	59	963	850	0.88	1187	299	**1486**	1695	1606	1197	**2803**	
-10	60	995	850	0.88	1226	299	**1525**	1751	1661	1197	**2858**	
-11	61	1027	850	0.88	1265	299	**1564**	1807	1717	1197	**2914**	
-12	62	1058	850	0.88	1304	299	**1603**	1862	1772	1197	**2970**	
-13	63	1090	850	0.88	1342	299	**1642**	1918	1828	1197	**3025**	
-14	64	1121	850	0.88	1381	299	**1681**	1973	1884	1197	**3081**	
-15	65	1153	850	0.88	1420	299	**1720**	2029	1939	1197	**3136**	
-16	66	1184	850	0.88	1459	299	**1758**	2085	1995	1197	**3192**	
-17	67	1216	850	0.88	1498	299	**1797**	2140	2050	1197	**3247**	
-18	68	1248	850	0.88	1537	299	**1836**	2196	2106	1197	**3303**	
-19	69	1279	850	0.88	1576	299	**1875**	2251	2162	1197	**3359**	
-20	70	1311	850	0.88	1615	299	**1914**	2307	2217	1197	**3414**	
-21	71	1342	850	0.88	1654	299	**1953**	2362	2273	1197	**3470**	
-22	72	1374	850	0.88	1693	299	**1992**	2418	2328	1197	**3525**	
-23	73	1405	850	0.88	1731	299	**2031**	2474	2384	1197	**3581**	
-24	74	1437	850	0.88	1770	299	**2070**	2529	2439	1197	**3636**	
-25	75	1469	850	0.88	1809	299	**2109**	2585	2495	1197	**3692**	
-26	76	1500	850	0.88	1848	299	**2147**	2640	2551	1197	**3748**	
-27	77	1532	850	0.88	1887	299	**2186**	2696	2606	1197	**3803**	
-28	78	1563	913	0.88	1926	321	**2247**	2751	2662	1285	**3947**	
-29	79	1595	978	0.88	1965	344	**2309**	2807	2717	1377	**4094**	
-30	80	1626	1047	0.88	2004	368	**2372**	2863	2773	1474	**4246**	
-31	81	1658	1118	0.88	2043	394	**2436**	2918	2828	1574	**4403**	
-32	82	1690	1193	0.88	2082	420	**2502**	2974	2884	1680	**4564**	
-33	83	1721	1271	0.88	2121	447	**2568**	3029	2940	1790	**4729**	
-34	84	1753	1352	0.88	2159	476	**2635**	3085	2995	1904	**4899**	
-35	85	1784	1436	0.88	2198	506	**2704**	3140	3051	2022	**5073**	
-36	86	1816	1523	0.88	2237	536	**2773**	3196	3106	2145	**5251**	
-37	87	1848	1608	0.88	2276	566	**2842**	3252	3162	2264	**5425**	
-38	88	1879	1682	0.88	2315	592	**2907**	3307	3217	2369	**5586**	
-39	89	1911	1748	0.88	2354	615	**2969**	3363	3273	2461	**5734**	
-40	90	1942	1804	0.88	2393	635	**3028**	3418	3329	2540	**5869**	

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 9
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

-41	91	1974	1851	0.88	2432	651	**3083**	3474	3384	2606	**5990**	
-42	92	2005	1888	0.88	2471	665	**3135**	3530	3440	2659	**6098**	
-43	93	2037	1916	0.88	2510	675	**3184**	3585	3495	2698	**6193**	
-44	94	2069	1935	0.88	2548	681	**3230**	3641	3551	2724	**6275**	
-45	95	2100	1944	0.88	2587	684	**3272**	3696	3607	2738	**6344**	
-46	96	2132	1944	0.88	2626	684	**3311**	3752	3662	2738	**6400**	
-47	97	2153	1944	0.88	2653	684	**3337**	3790	3700	2738	**6437**	
-48	98	2175	1944	0.88	2679	684	**3364**	3828	3738	2738	**6476**	
-49	99	2197	1944	0.88	2707	684	**3391**	3866	3777	2738	**6514**	
-50	100	2219	1944	0.88	2734	684	**3418**	3906	3816	2738	**6553**	
-51	101	2242	1944	0.88	2762	684	**3446**	3945	3856	2738	**6593**	
-52	102	2264	1944	0.88	2790	684	**3474**	3985	3896	2738	**6633**	
-53	103	2287	1944	0.88	2818	684	**3502**	4026	3936	2738	**6674**	
-54	104	2311	1944	0.88	2847	684	**3531**	4067	3977	2738	**6715**	
-55	105	2334	1944	0.88	2876	684	**3560**	4108	4019	2738	**6756**	
-56	106	2358	1944	0.88	2905	684	**3590**	4150	4060	2738	**6798**	
-57	107	2382	1944	0.88	2935	684	**3619**	4193	4103	2738	**6840**	
-58	108	2406	1944	0.88	2965	684	**3649**	4235	4146	2738	**6883**	
-59	109	2431	1944	0.88	2995	684	**3679**	4279	4189	2738	**6927**	
-60	110	2456	1944	0.88	3026	684	**3710**	4322	4233	2738	**6970**	
-61	111	2481	1944	0.88	3057	684	**3741**	4367	4277	2738	**7014**	
-62	112	2506	1944	0.88	3088	684	**3772**	4411	4322	2738	**7059**	
-63	113	2532	1944	0.88	3119	684	**3804**	4456	4367	2738	**7104**	
-64	114	2558	1944	0.88	3151	684	**3836**	4502	4412	2738	**7150**	
-65	115	2584	1944	0.88	3184	684	**3868**	4548	4458	2738	**7196**	
-66	116	2611	1944	0.88	3216	684	**3901**	4595	4505	2738	**7242**	
-67	117	2637	1944	0.88	3249	684	**3933**	4642	4552	2738	**7289**	
-68	118	2664	1944	0.88	3282	684	**3967**	4689	4599	2738	**7337**	
-69	119	2691	1944	0.88	3316	684	**4000**	4737	4647	2738	**7385**	
-70	120	2719	1944	0.88	3350	684	**4034**	4785	4695	2738	**7433**	
-71	121	2747	1944	0.88	3384	684	**4068**	4834	4744	2738	**7482**	
-72	122	2775	1944	0.88	3418	684	**4103**	4883	4793	2738	**7531**	
-73	123	2803	1944	0.88	3453	684	**4137**	4933	4843	2738	**7581**	
-74	124	2831	1944	0.88	3488	684	**4173**	4983	4893	2738	**7631**	Strength (4600k)
-75	125	2860	1944	0.88	3524	684	**4208**	5034	4944	2738	**7682**	Use EL-76'
50												
50												
50												
50												
50												
50												
50												
50												
50												
50												

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 10
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

Finish Grade Elevation = 46 ft
Cut Off Elevation = 41 ft

Pile type: 118"-diameter CIDH

Pre-liquefaction Condition

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.2	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	16	Sand	0.88
(2)	16	26	Sand	0.88
(3)	26	96	Clay	0.88
(4)	96	166	Sand	0.88

(=>Pile Length)

Axial Group Reduction Factor (η) for Sandy Materials= 0.88
Axial Group Reduction Factor (η) for Clayey Materials= 0.88

Skin Resistance above neutral axis (reference only)
minus @ Ele.= 30 ' for Liq. settlement=0.1"
145 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State			
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)
46	0	0	0		0	0	**0**	0		0	**0**
40	6	4	224	0.88	5	79	**84**	7	0	316	**316**
39	7	10	280	0.88	12	99	**111**	17	0	395	**395**
38	8	16	337	0.88	19	119	**138**	28	0	474	**474**
37	9	22	391	0.88	27	138	**165**	39	0	550	**550**
36	10	29	442	0.88	36	156	**192**	52	0	623	**623**
35	11	37	491	0.88	45	173	**218**	65	0	692	**692**
34	12	45	538	0.88	56	189	**245**	79	0	758	**758**
33	13	54	582	0.88	66	205	**271**	95	0	820	**820**
32	14	63	624	0.88	78	220	**297**	111	0	879	**879**
31	15	73	664	0.88	89	234	**323**	128	0	934	**934**
30	16	83	701	0.88	102	247	**348**	145	0	986	**986**
29	17	93	736	0.88	115	259	**374**	164	19	1036	**1055**
28	18	105	766	0.88	129	270	**399**	185	39	1079	**1118**
27	19	117	792	0.88	144	279	**423**	206	60	1115	**1175**
26	20	130	814	0.88	160	286	**446**	228	82	1146	**1228**
25	21	143	831	0.88	176	293	**468**	251	106	1170	**1276**
24	22	156	845	0.88	193	297	**490**	275	130	1189	**1319**
23	23	171	854	0.88	210	301	**511**	301	155	1202	**1357**
22	24	186	859	0.88	229	302	**531**	327	181	1210	**1391**
21	25	201	861	0.88	247	303	**550**	353	208	1212	**1420**
20	26	217	858	0.88	267	302	**569**	381	236	1208	**1444**
19	27	248	856	0.88	306	301	**607**	437	291	1205	**1496**
18	28	280	854	0.88	345	301	**645**	492	347	1203	**1549**
17	29	311	853	0.88	384	300	**684**	548	402	1201	**1603**
16	30	343	852	0.88	422	300	**722**	604	458	1199	**1657**
15	31	375	851	0.88	461	300	**761**	659	514	1198	**1712**
14	32	406	851	0.88	500	299	**800**	715	569	1198	**1767**
13	33	438	850	0.88	539	299	**839**	770	625	1197	**1822**
12	34	469	850	0.88	578	299	**877**	826	680	1197	**1877**
11	35	501	850	0.88	617	299	**916**	881	736	1197	**1933**
10	36	532	850	0.88	656	299	**955**	937	792	1197	**1989**
9	37	564	850	0.88	695	299	**994**	993	847	1197	**2044**
8	38	596	850	0.88	734	299	**1033**	1048	903	1197	**2100**
7	39	627	850	0.88	773	299	**1072**	1104	958	1197	**2155**
6	40	659	850	0.88	812	299	**1111**	1159	1014	1197	**2211**
5	41	690	850	0.88	850	299	**1150**	1215	1069	1197	**2266**
4	42	722	850	0.88	889	299	**1189**	1270	1125	1197	**2322**
3	43	753	850	0.88	928	299	**1227**	1326	1181	1197	**2378**
2	44	785	850	0.88	967	299	**1266**	1382	1236	1197	**2433**
1	45	817	850	0.88	1006	299	**1305**	1437	1292	1197	**2489**
0	46	848	850	0.88	1045	299	**1344**	1493	1347	1197	**2544**
-1	47	880	850	0.88	1084	299	**1383**	1548	1403	1197	**2600**
-2	48	911	850	0.88	1123	299	**1422**	1604	1458	1197	**2655**
-3	49	943	850	0.88	1162	299	**1461**	1659	1514	1197	**2711**
-4	50	974	850	0.88	1201	299	**1500**	1715	1570	1197	**2767**
-5	51	1006	850	0.88	1239	299	**1539**	1771	1625	1197	**2822**
-6	52	1038	850	0.88	1278	299	**1578**	1826	1681	1197	**2878**
-7	53	1069	850	0.88	1317	299	**1617**	1882	1736	1197	**2933**
-8	54	1101	850	0.88	1356	299	**1655**	1937	1792	1197	**2989**
-9	55	1132	850	0.88	1395	299	**1694**	1993	1847	1197	**3045**
-10	56	1164	850	0.88	1434	299	**1733**	2049	1903	1197	**3100**
-11	57	1196	850	0.88	1473	299	**1772**	2104	1959	1197	**3156**
-12	58	1227	850	0.88	1512	299	**1811**	2160	2014	1197	**3211**
-13	59	1259	850	0.88	1551	299	**1850**	2215	2070	1197	**3267**
-14	60	1290	850	0.88	1590	299	**1889**	2271	2125	1197	**3322**
-15	61	1322	850	0.88	1628	299	**1928**	2326	2181	1197	**3378**
-16	62	1353	850	0.88	1667	299	**1967**	2382	2236	1197	**3434**
-17	63	1385	850	0.88	1706	299	**2006**	2438	2292	1197	**3489**
-18	64	1417	850	0.88	1745	299	**2044**	2493	2348	1197	**3545**
-19	65	1448	850	0.88	1784	299	**2083**	2549	2403	1197	**3600**
-20	66	1480	850	0.88	1823	299	**2122**	2604	2459	1197	**3656**
-21	67	1511	850	0.88	1862	299	**2161**	2660	2514	1197	**3711**
-22	68	1543	850	0.88	1901	299	**2200**	2715	2570	1197	**3767**
-23	69	1574	850	0.88	1940	299	**2239**	2771	2626	1197	**3823**
-24	70	1606	850	0.88	1979	299	**2278**	2827	2681	1197	**3878**
-25	71	1638	850	0.88	2018	299	**2317**	2882	2737	1197	**3934**
-26	72	1669	850	0.88	2056	299	**2356**	2938	2792	1197	**3989**
-27	73	1701	850	0.88	2095	299	**2395**	2993	2848	1197	**4045**
-28	74	1732	850	0.88	2134	299	**2433**	3049	2903	1197	**4100**
-29	75	1764	850	0.88	2173	299	**2472**	3104	2959	1197	**4156**
-30	76	1795	850	0.88	2212	299	**2511**	3160	3015	1197	**4212**
-31	77	1827	850	0.88	2251	299	**2550**	3216	3070	1197	**4267**
-32	78	1859	913	0.88	2290	321	**2611**	3271	3126	1285	**4411**
-33	79	1890	978	0.88	2329	344	**2673**	3327	3181	1377	**4558**
-34	80	1922	1047	0.88	2368	368	**2736**	3382	3237	1474	**4710**
-35	81	1953	1118	0.88	2407	394	**2800**	3438	3292	1574	**4867**
-36	82	1985	1193	0.88	2445	420	**2865**	3493	3348	1680	**5028**
-37	83	2017	1271	0.88	2484	447	**2932**	3549	3404	1790	**5193**
-38	84	2048	1352	0.88	2523	476	**2999**	3605	3459	1904	**5363**
-39	85	2080	1436	0.88	2562	506	**3068**	3660	3515	2022	**5537**
-40	86	2111	1523	0.88	2601	536	**3137**	3716	3570	2145	**5715**
-41	87	2143	1608	0.88	2640	566	**3206**	3771	3626	2264	**5889**
-42	88	2174	1682	0.88	2679	592	**3271**	3827	3681	2369	**6050**
-43	89	2206	1748	0.88	2718	615	**3333**	3883	3737	2461	**6198**
-44	90	2238	1804	0.88	2757	635	**3392**	3938	3793	2540	**6333**

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 10
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

-45	91	2269	1851	0.88	2796	651	**3447**	3994	3848	2606	**6454**	
-46	92	2301	1888	0.88	2834	665	**3499**	4049	3904	2659	**6562**	
-47	93	2332	1916	0.88	2873	675	**3548**	4105	3959	2698	**6657**	
-48	94	2364	1935	0.88	2912	681	**3593**	4160	4015	2724	**6739**	
-49	95	2395	1944	0.88	2951	684	**3636**	4216	4070	2738	**6808**	
-50	96	2427	1944	0.88	2990	684	**3674**	4272	4126	2738	**6864**	
-51	97	2449	1944	0.88	3017	684	**3702**	4310	4165	2738	**6902**	
-52	98	2471	1944	0.88	3045	684	**3729**	4350	4204	2738	**6942**	
-53	99	2494	1944	0.88	3073	684	**3757**	4389	4244	2738	**6981**	
-54	100	2517	1944	0.88	3101	684	**3785**	4429	4284	2738	**7022**	
-55	101	2540	1944	0.88	3129	684	**3813**	4470	4325	2738	**7062**	Strength (3807k)
-56	102	2563	1944	0.88	3158	684	**3842**	4511	4366	2738	**7103**	use EL-57'
-57	103	2587	1944	0.88	3187	684	**3871**	4553	4407	2738	**7145**	
-58	104	2611	1944	0.88	3216	684	**3901**	4595	4449	2738	**7187**	
-59	105	2635	1944	0.88	3246	684	**3930**	4637	4492	2738	**7229**	
-60	106	2659	1944	0.88	3276	684	**3960**	4680	4535	2738	**7272**	
-61	107	2684	1944	0.88	3306	684	**3991**	4724	4578	2738	**7316**	
-62	108	2709	1944	0.88	3337	684	**4022**	4767	4622	2738	**7359**	
-63	109	2734	1944	0.88	3368	684	**4053**	4812	4666	2738	**7404**	
-64	110	2759	1944	0.88	3400	684	**4084**	4856	4711	2738	**7449**	
-65	111	2785	1944	0.88	3431	684	**4116**	4902	4756	2738	**7494**	
-66	112	2811	1944	0.88	3463	684	**4148**	4947	4802	2738	**7539**	
-67	113	2837	1944	0.88	3495	684	**4180**	4994	4848	2738	**7586**	
-68	114	2864	1944	0.88	3528	684	**4212**	5040	4895	2738	**7632**	
-69	115	2890	1944	0.88	3561	684	**4245**	5087	4942	2738	**7679**	
-70	116	2917	1944	0.88	3594	684	**4279**	5135	4989	2738	**7727**	
-71	117	2945	1944	0.88	3628	684	**4312**	5183	5037	2738	**7775**	
-72	118	2972	1944	0.88	3662	684	**4346**	5231	5086	2738	**7823**	
-73	119	3000	1944	0.88	3696	684	**4380**	5280	5135	2738	**7872**	
-74	120	3028	1944	0.88	3731	684	**4415**	5329	5184	2738	**7921**	
-75	121	3056	1944	0.88	3765	684	**4450**	5379	5234	2738	**7971**	
-76	122	3085	1944	0.88	3801	684	**4485**	5429	5284	2738	**8022**	
-77	123	3114	1944	0.88	3836	684	**4521**	5480	5335	2738	**8072**	
-78	124	3143	1944	0.88	3872	684	**4556**	5531	5386	2738	**8123**	
-79	125	3172	1944	0.88	3908	684	**4593**	5583	5438	2738	**8175**	

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 10
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

Finish Grade Elevation = 46 ft
Cut Off Elevation = 41 ft

Pile type: 118"-diameter CIDH

Post-liquefaction Condition

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.2	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	16	Clay	0.88
(2)	16	26	Sand	0.88
(3)	26	96	Clay	0.88
(4)	96	166	Sand	0.88

Axial Group Reduction Factor (η) for Sandy Materials= 0.88
Axial Group Reduction Factor (η) for Clayey Materials= 0.88

Skin Resistance above neutral axis (=>Pile Length)
minus @ Ele.= 30 ' for Liq. settlement=0.1"
66 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State				
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)	
46	0	0	0		0	0	**0**	0		0	**0**	
40	6	3	268	0.88	4	94	**98**	6	0	377	**377**	
39	7	7	316	0.88	8	111	**120**	12	0	445	**445**	
38	8	10	365	0.88	13	128	**141**	18	0	514	**514**	
37	9	14	412	0.88	17	145	**162**	24	0	580	**580**	
36	10	17	457	0.88	21	161	**182**	30	0	644	**644**	
35	11	20	502	0.88	25	177	**202**	36	0	706	**706**	
34	12	24	544	0.88	29	192	**221**	42	0	766	**766**	
33	13	27	585	0.88	33	206	**240**	48	0	824	**824**	
32	14	31	625	0.88	38	220	**258**	54	0	880	**880**	
31	15	34	664	0.88	42	234	**275**	60	0	934	**934**	
30	16	37	701	0.88	46	247	**293**	66	0	986	**986**	
29	17	48	736	0.88	59	259	**318**	85	19	1036	**1055**	
28	18	60	766	0.88	73	270	**343**	105	39	1079	**1118**	
27	19	72	792	0.88	88	279	**367**	126	60	1115	**1175**	
26	20	84	814	0.88	104	286	**390**	148	82	1146	**1228**	
25	21	97	831	0.88	120	293	**413**	171	106	1170	**1276**	
24	22	111	845	0.88	137	297	**434**	196	130	1189	**1319**	
23	23	125	854	0.88	155	301	**455**	221	155	1202	**1357**	
22	24	140	859	0.88	173	302	**475**	247	181	1210	**1391**	
21	25	156	861	0.88	192	303	**495**	274	208	1212	**1420**	
20	26	171	858	0.88	211	302	**513**	302	236	1208	**1444**	
19	27	203	856	0.88	250	301	**551**	357	291	1205	**1496**	
18	28	234	854	0.88	289	301	**590**	413	347	1203	**1549**	
17	29	266	853	0.88	328	300	**628**	468	402	1201	**1603**	
16	30	298	852	0.88	367	300	**667**	524	458	1199	**1657**	
15	31	329	851	0.88	406	300	**705**	579	514	1198	**1712**	
14	32	361	851	0.88	444	299	**744**	635	569	1198	**1767**	
13	33	392	850	0.88	483	299	**783**	691	625	1197	**1822**	
12	34	424	850	0.88	522	299	**822**	746	680	1197	**1877**	Extreme (1843k)
11	35	456	850	0.88	561	299	**860**	802	736	1197	**1933**	Use El +7'
10	36	487	850	0.88	600	299	**899**	857	792	1197	**1989**	
9	37	519	850	0.88	639	299	**938**	913	847	1197	**2044**	
8	38	550	850	0.88	678	299	**977**	968	903	1197	**2100**	
7	39	582	850	0.88	717	299	**1016**	1024	958	1197	**2155**	
6	40	613	850	0.88	756	299	**1055**	1080	1014	1197	**2211**	
5	41	645	850	0.88	795	299	**1094**	1135	1069	1197	**2266**	
4	42	677	850	0.88	834	299	**1133**	1191	1125	1197	**2322**	
3	43	708	850	0.88	872	299	**1172**	1246	1181	1197	**2378**	
2	44	740	850	0.88	911	299	**1211**	1302	1236	1197	**2433**	
1	45	771	850	0.88	950	299	**1250**	1357	1292	1197	**2489**	
0	46	803	850	0.88	989	299	**1288**	1413	1347	1197	**2544**	
-1	47	834	850	0.88	1028	299	**1327**	1469	1403	1197	**2600**	
-2	48	866	850	0.88	1067	299	**1366**	1524	1458	1197	**2655**	
-3	49	898	850	0.88	1106	299	**1405**	1580	1514	1197	**2711**	
-4	50	929	850	0.88	1145	299	**1444**	1635	1570	1197	**2767**	
-5	51	961	850	0.88	1184	299	**1483**	1691	1625	1197	**2822**	
-6	52	992	850	0.88	1223	299	**1522**	1747	1681	1197	**2878**	
-7	53	1024	850	0.88	1261	299	**1561**	1802	1736	1197	**2933**	
-8	54	1055	850	0.88	1300	299	**1600**	1858	1792	1197	**2989**	
-9	55	1087	850	0.88	1339	299	**1639**	1913	1847	1197	**3045**	
-10	56	1119	850	0.88	1378	299	**1677**	1969	1903	1197	**3100**	
-11	57	1150	850	0.88	1417	299	**1716**	2024	1959	1197	**3156**	
-12	58	1182	850	0.88	1456	299	**1755**	2080	2014	1197	**3211**	
-13	59	1213	850	0.88	1495	299	**1794**	2136	2070	1197	**3267**	
-14	60	1245	850	0.88	1534	299	**1833**	2191	2125	1197	**3322**	
-15	61	1277	850	0.88	1573	299	**1872**	2247	2181	1197	**3378**	
-16	62	1308	850	0.88	1612	299	**1911**	2302	2236	1197	**3434**	
-17	63	1340	850	0.88	1650	299	**1950**	2358	2292	1197	**3489**	
-18	64	1371	850	0.88	1689	299	**1989**	2413	2348	1197	**3545**	
-19	65	1403	850	0.88	1728	299	**2028**	2469	2403	1197	**3600**	
-20	66	1434	850	0.88	1767	299	**2066**	2525	2459	1197	**3656**	
-21	67	1466	850	0.88	1806	299	**2105**	2580	2514	1197	**3711**	
-22	68	1498	850	0.88	1845	299	**2144**	2636	2570	1197	**3767**	
-23	69	1529	850	0.88	1884	299	**2183**	2691	2626	1197	**3823**	
-24	70	1561	850	0.88	1923	299	**2222**	2747	2681	1197	**3878**	
-25	71	1592	850	0.88	1962	299	**2261**	2802	2737	1197	**3934**	
-26	72	1624	850	0.88	2001	299	**2300**	2858	2792	1197	**3989**	
-27	73	1655	850	0.88	2040	299	**2339**	2914	2848	1197	**4045**	
-28	74	1687	850	0.88	2078	299	**2378**	2969	2903	1197	**4100**	
-29	75	1719	850	0.88	2117	299	**2417**	3025	2959	1197	**4156**	
-30	76	1750	850	0.88	2156	299	**2455**	3080	3015	1197	**4212**	
-31	77	1782	850	0.88	2195	299	**2494**	3136	3070	1197	**4267**	
-32	78	1813	913	0.88	2234	321	**2555**	3191	3126	1285	**4411**	
-33	79	1845	978	0.88	2273	344	**2617**	3247	3181	1377	**4558**	
-34	80	1877	1047	0.88	2312	368	**2680**	3303	3237	1474	**4710**	
-35	81	1908	1118	0.88	2351	394	**2744**	3358	3292	1574	**4867**	
-36	82	1940	1193	0.88	2390	420	**2810**	3414	3348	1680	**5028**	
-37	83	1971	1271	0.88	2429	447	**2876**	3469	3404	1790	**5193**	
-38	84	2003	1352	0.88	2467	476	**2943**	3525	3459	1904	**5363**	
-39	85	2034	1436	0.88	2506	506	**3012**	3581	3515	2022	**5537**	
-40	86	2066	1523	0.88	2545	536	**3082**	3636	3570	2145	**5715**	
-41	87	2098	1608	0.88	2584	566	**3150**	3692	3626	2264	**5889**	
-42	88	2129	1682	0.88	2623	592	**3215**	3747	3681	2369	**6050**	
-43	89	2161	1748	0.88	2662	615	**3277**	3803	3737	2461	**6198**	
-44	90	2192	1804	0.88	2701	635	**3336**	3858	3793	2540	**6333**	

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Bent 10
DONE BY: TK **DATE:** 09/27/16 **CHECKED BY:** AZ **DATE:** 09/27/16

-45	91	2224	1851	0.88	2740	651	**3391**	3914	3848	2606	**6454**
-46	92	2255	1888	0.88	2779	665	**3443**	3970	3904	2659	**6562**
-47	93	2287	1916	0.88	2818	675	**3492**	4025	3959	2698	**6657**
-48	94	2319	1935	0.88	2856	681	**3538**	4081	4015	2724	**6739**
-49	95	2350	1944	0.88	2895	684	**3580**	4136	4070	2738	**6808**
-50	96	2382	1944	0.88	2934	684	**3619**	4192	4126	2738	**6864**
-51	97	2404	1944	0.88	2961	684	**3646**	4231	4165	2738	**6902**
-52	98	2426	1944	0.88	2989	684	**3673**	4270	4204	2738	**6942**
-53	99	2449	1944	0.88	3017	684	**3701**	4310	4244	2738	**6981**
-54	100	2471	1944	0.88	3045	684	**3729**	4350	4284	2738	**7022**
-55	101	2495	1944	0.88	3073	684	**3758**	4390	4325	2738	**7062**
-56	102	2518	1944	0.88	3102	684	**3786**	4431	4366	2738	**7103**
-57	103	2542	1944	0.88	3131	684	**3816**	4473	4407	2738	**7145**
-58	104	2565	1944	0.88	3161	684	**3845**	4515	4449	2738	**7187**
-59	105	2590	1944	0.88	3190	684	**3875**	4558	4492	2738	**7229**
-60	106	2614	1944	0.88	3220	684	**3905**	4600	4535	2738	**7272**
-61	107	2639	1944	0.88	3251	684	**3935**	4644	4578	2738	**7316**
-62	108	2663	1944	0.88	3281	684	**3966**	4688	4622	2738	**7359**
-63	109	2689	1944	0.88	3312	684	**3997**	4732	4666	2738	**7404**
-64	110	2714	1944	0.88	3344	684	**4028**	4777	4711	2738	**7449**
-65	111	2740	1944	0.88	3375	684	**4060**	4822	4756	2738	**7494**
-66	112	2766	1944	0.88	3407	684	**4092**	4868	4802	2738	**7539**
-67	113	2792	1944	0.88	3440	684	**4124**	4914	4848	2738	**7586**
-68	114	2818	1944	0.88	3472	684	**4157**	4960	4895	2738	**7632**
-69	115	2845	1944	0.88	3505	684	**4190**	5007	4942	2738	**7679**
-70	116	2872	1944	0.88	3538	684	**4223**	5055	4989	2738	**7727**
-71	117	2899	1944	0.88	3572	684	**4256**	5103	5037	2738	**7775**
-72	118	2927	1944	0.88	3606	684	**4290**	5151	5086	2738	**7823**
-73	119	2955	1944	0.88	3640	684	**4325**	5200	5135	2738	**7872**
-74	120	2983	1944	0.88	3675	684	**4359**	5250	5184	2738	**7921**
-75	121	3011	1944	0.88	3710	684	**4394**	5299	5234	2738	**7971**
-76	122	3040	1944	0.88	3745	684	**4429**	5350	5284	2738	**8022**
-77	123	3068	1944	0.88	3780	684	**4465**	5400	5335	2738	**8072**
-78	124	3098	1944	0.88	3816	684	**4501**	5452	5386	2738	**8123**
-79	125	3127	1944	0.88	3852	684	**4537**	5503	5438	2738	**8175**

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Abut 11
DONE BY: TK **DATE:** 08/03/16 **CHECKED BY:** AZ **DATE:** 08/03/16

Finish Grade Elevation = 67 ft
Cut Off Elevation = 67 ft
Pile type: 24'"-diameter CIDH
Pre-liquefaction Condition(only)

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.0	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	10	Sand	1.00
(2)	10	15	Sand	1.00
(3)	15	17	Sand	1.00
(4)	17	35	Sand	1.00
(5)	35	45	Sand	1.00
(6)	45	115	Clay	1.00
(7)	115	167	Sand	1.00

(=>Pile Length)

Axial Group Reduction Factor (η) for Sandy Materials= 1.00
Axial Group Reduction Factor (η) for Clayey Materials= 1.00
Reduction for top 20 feet casing= 0.40

Skin Resistance above neutral axis (reference only)
minus @ Ele.= 30 ' for Liq. settlement=0.1"
251 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State				
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)	
67	0	0	0		0	0	**0**	0		0	**0**	
63	4	1	6	0.40	1	0	**1**	1	0	4	**4**	
62	5	4	7	0.40	2	0	**2**	3	0	4	**4**	
61	6	6	8	0.40	3	0	**3**	5	0	5	**5**	
60	7	9	5	0.40	5	0	**5**	7	0	3	**3**	
59	8	12	2	0.40	7	0	**7**	10	0	1	**1**	
58	9	15	0	0.40	9	0	**9**	12	0	0	**0**	
57	10	19	0	0.40	11	0	**11**	15	0	0	**0**	
56	11	23	0	0.40	13	0	**13**	19	0	0	**0**	
55	12	27	0	0.40	15	0	**15**	22	0	0	**0**	
54	13	32	0	0.40	18	0	**18**	26	0	0	**0**	
53	14	37	0	0.40	21	0	**21**	29	0	0	**0**	
52	15	42	0	0.40	23	0	**23**	33	0	0	**0**	
51	16	47	0	0.40	26	0	**26**	38	0	0	**0**	
50	17	53	0	0.40	29	0	**29**	42	0	0	**0**	
49	18	58	0	0.40	33	0	**33**	47	0	0	**0**	
48	19	64	0	0.40	36	0	**36**	51	0	0	**0**	
47	20	69	0	0.40	39	0	**39**	55	0	0	**0**	
46	21	75	0	1.00	47	0	**47**	67	0	0	**0**	
45	22	81	0	1.00	55	0	**55**	78	0	0	**0**	Strength T (52k)
44	23	86	0	1.00	63	0	**63**	89	0	0	**0**	use EL +40'
43	24	92	0	1.00	71	0	**71**	101	0	0	**0**	
42	25	98	0	1.00	79	0	**79**	112	0	0	**0**	
41	26	103	0	1.00	87	0	**87**	124	0	0	**0**	
40	27	109	0	1.00	95	0	**95**	135	0	0	**0**	
39	28	115	0	1.00	103	0	**103**	147	0	0	**0**	
38	29	121	0	1.00	111	0	**111**	158	0	0	**0**	
37	30	126	0	1.00	119	0	**119**	170	0	0	**0**	
36	31	132	0	1.00	127	0	**127**	181	0	0	**0**	
35	32	138	6	1.00	135	0	**135**	193	0	10	**10**	
34	33	144	13	1.00	143	0	**143**	204	0	21	**21**	Strength RW (140k)
33	34	150	17	1.00	151	0	**151**	216	0	27	**27**	use EL +20'
32	35	155	17	1.00	159	0	**159**	227	0	27	**27**	
31	36	161	17	1.00	167	0	**167**	239	0	27	**27**	
30	37	167	17	1.00	176	0	**176**	251	0	27	**27**	
29	38	173	17	1.00	184	0	**184**	263	12	27	**39**	
28	39	179	17	1.00	192	0	**192**	274	24	27	**50**	
27	40	185	17	1.00	200	0	**200**	286	35	27	**62**	
26	41	191	17	1.00	209	0	**209**	298	47	27	**74**	
25	42	197	31	1.00	217	0	**217**	310	59	50	**109**	
24	43	203	48	1.00	225	0	**225**	322	71	77	**148**	
23	44	209	57	1.00	234	0	**234**	334	83	90	**174**	
22	45	215	57	1.00	242	0	**242**	346	95	90	**185**	
21	46	221	57	1.00	251	0	**251**	359	108	90	**198**	
20	47	227	57	1.00	260	0	**260**	371	121	90	**211**	
19	48	234	57	1.00	269	0	**269**	384	134	90	**224**	
18	49	240	57	1.00	278	0	**278**	397	146	90	**237**	
17	50	247	57	1.00	287	0	**287**	410	159	90	**250**	
16	51	253	57	1.00	296	0	**296**	423	172	90	**263**	
15	52	259	57	1.00	305	0	**305**	436	185	90	**275**	
14	53	266	57	1.00	314	0	**314**	449	198	90	**288**	
13	54	272	57	1.00	323	0	**323**	461	211	90	**301**	
12	55	279	57	1.00	332	0	**332**	474	223	90	**314**	
11	56	285	57	1.00	341	0	**341**	487	236	90	**327**	
10	57	292	57	1.00	350	0	**350**	500	249	90	**340**	Strength (345k)
9	58	298	57	1.00	359	0	**359**	513	262	90	**352**	use EL +8'
8	59	304	57	1.00	368	0	**368**	526	275	90	**365**	
7	60	311	57	1.00	377	0	**377**	538	288	90	**378**	
6	61	317	57	1.00	386	0	**386**	551	301	90	**391**	
5	62	324	57	1.00	395	0	**395**	564	313	90	**404**	
4	63	330	57	1.00	404	0	**404**	577	326	90	**417**	
3	64	337	57	1.00	413	0	**413**	590	339	90	**430**	
2	65	343	57	1.00	422	0	**422**	603	352	90	**442**	
1	66	349	57	1.00	431	0	**431**	616	365	90	**455**	
0	67	356	57	1.00	440	0	**440**	628	378	90	**468**	
-1	68	362	57	1.00	449	0	**449**	641	390	90	**481**	
-2	69	369	57	1.00	458	0	**458**	654	403	90	**494**	
-3	70	375	57	1.00	467	0	**467**	667	416	90	**507**	
-4	71	381	57	1.00	476	0	**476**	680	429	90	**519**	
-5	72	388	57	1.00	485	0	**485**	693	442	90	**532**	
-6	73	394	57	1.00	494	0	**494**	705	455	90	**545**	
-7	74	401	57	1.00	503	0	**503**	718	468	90	**558**	
-8	75	407	57	1.00	512	0	**512**	731	480	90	**571**	
-9	76	414	57	1.00	521	0	**521**	744	493	90	**584**	
-10	77	420	57	1.00	530	0	**530**	757	506	90	**597**	
-11	78	426	57	1.00	539	0	**539**	770	519	90	**609**	
-12	79	433	57	1.00	548	0	**548**	783	532	90	**622**	
-13	80	439	57	1.00	557	0	**557**	795	545	90	**635**	
-14	81	446	57	1.00	566	0	**566**	808	557	90	**648**	
-15	82	452	57	1.00	575	0	**575**	821	570	90	**661**	
-16	83	459	57	1.00	584	0	**584**	834	583	90	**674**	
-17	84	465	57	1.00	593	0	**593**	847	596	90	**686**	
-18	85	471	57	1.00	602	0	**602**	860	609	90	**699**	

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Abut 11
DONE BY: TK **DATE:** 08/03/16 **CHECKED BY:** AZ **DATE:** 08/03/16

-19	86	478	57	1.00	611	0	**611**	872	622	90	**712**
-20	87	484	57	1.00	620	0	**620**	885	634	90	**725**
-21	88	491	57	1.00	629	0	**629**	898	647	90	**738**
-22	89	497	57	1.00	638	0	**638**	911	660	90	**751**
-23	90	504	57	1.00	647	0	**647**	924	673	90	**764**

Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Abut 11
DONE BY: TK **DATE:** 08/03/16 **CHECKED BY:** AZ **DATE:** 08/03/16

Finish Grade Elevation = 67 ft
Cut Off Elevation = 67 ft
Pile type: 24'"-diameter CIDH
Post-liquefaction Condition(only)

	Strength Limit State	Extreme Limit State
Resistance Factor for Skin Friction =	0.7	1.0
Resistance Factor for Base Bearing =	0.0	0.8

Soil Layer	Top (ft)	Bottom (ft)	Soil Type	η
(1)	0	10	Sand	1.00
(2)	10	15	Sand	1.00
(3)	15	17	Sand	1.00
(4)	17	35	Clay	1.00
(5)	35	45	Sand	1.00
(6)	45	115	Clay	1.00
(7)	115	167	Sand	1.00

(=>Pile Length)

Axial Group Reduction Factor (η) for Sandy Materials= 1.00
Axial Group Reduction Factor (η) for Clayey Materials= 1.00
Reduction for top 20 feet casing= 0.40

Skin Resistance above neutral axis (reference only)
minus @ Ele.= 30 ' for Liq. settlement=0.1"
88 kips

Depths and Elevations		Unfactored Pile Capacity From SHAFT Results		Group Reduction Factor	Factored Pile Capacity for Strength Limit State			Factored Pile Capacity for Extreme Limit State				
Elevation (ft)	Depth, z (ft)	Skin Friction (tons)	End Bearing (tons)	η	Q_s (kips)	Q_b (kips)	Q_{total} (kips)	$Q_{s,f}$ (kips)	$Q_{s,f**}$ (kips)	$Q_{b,f}$ (kips)	$Q_{total,f}$ (kips)	
67	0	0	0		0	0	**0**	0		0	**0**	
63	4	1	6	0.40	1	0	**1**	1	0	4	**4**	
62	5	4	7	0.40	2	0	**2**	3	0	4	**4**	
61	6	6	8	0.40	3	0	**3**	5	0	5	**5**	
60	7	9	5	0.40	5	0	**5**	7	0	3	**3**	
59	8	12	2	0.40	7	0	**7**	10	0	1	**1**	
58	9	15	0	0.40	9	0	**9**	12	0	0	**0**	
57	10	19	0	0.40	11	0	**11**	15	0	0	**0**	
56	11	23	0	0.40	13	0	**13**	19	0	0	**0**	
55	12	27	0	0.40	15	0	**15**	22	0	0	**0**	
54	13	32	0	0.40	18	0	**18**	26	0	0	**0**	
53	14	37	2	0.40	21	0	**21**	29	0	1	**1**	
52	15	42	4	0.40	23	0	**23**	33	0	3	**3**	
51	16	47	6	0.40	26	0	**26**	38	0	4	**4**	
50	17	53	6	0.40	29	0	**29**	42	0	4	**4**	
49	18	53	6	0.40	30	0	**30**	43	0	4	**4**	
48	19	54	6	0.40	30	0	**30**	43	0	4	**4**	
47	20	55	6	0.40	31	0	**31**	44	0	4	**4**	
46	21	55	6	1.00	32	0	**32**	45	0	9	**9**	
45	22	56	6	1.00	33	0	**33**	47	0	9	**9**	
44	23	57	6	1.00	34	0	**34**	48	0	9	**9**	
43	24	57	6	1.00	35	0	**35**	49	0	9	**9**	
42	25	58	6	1.00	35	0	**35**	51	0	9	**9**	
41	26	59	6	1.00	36	0	**36**	52	0	9	**9**	
40	27	60	6	1.00	37	0	**37**	53	0	9	**9**	
39	28	60	6	1.00	38	0	**38**	55	0	9	**9**	
38	29	61	6	1.00	39	0	**39**	56	0	9	**9**	
37	30	62	6	1.00	40	0	**40**	58	0	9	**9**	
36	31	62	6	1.00	41	0	**41**	59	0	9	**9**	
35	32	63	10	1.00	42	0	**42**	60	0	15	**15**	
34	33	64	14	1.00	43	0	**43**	62	0	23	**23**	
33	34	64	17	1.00	44	0	**44**	63	0	27	**27**	
32	35	65	17	1.00	45	0	**45**	65	0	27	**27**	
31	36	71	17	1.00	53	0	**53**	76	0	27	**27**	
30	37	77	17	1.00	61	0	**61**	88	0	27	**27**	
29	38	83	17	1.00	70	0	**70**	100	12	27	**39**	
28	39	89	17	1.00	78	0	**78**	111	24	27	**50**	
27	40	94	17	1.00	86	0	**86**	123	35	27	**62**	
26	41	100	17	1.00	95	0	**95**	135	47	27	**74**	
25	42	106	31	1.00	103	0	**103**	147	59	50	**109**	
24	43	112	48	1.00	111	0	**111**	159	71	77	**148**	
23	44	118	57	1.00	120	0	**120**	171	83	90	**174**	
22	45	124	57	1.00	128	0	**128**	183	95	90	**185**	
21	46	131	57	1.00	137	0	**137**	196	108	90	**198**	
20	47	137	57	1.00	146	0	**146**	209	121	90	**211**	
19	48	144	57	1.00	155	0	**155**	221	134	90	**224**	
18	49	150	57	1.00	164	0	**164**	234	146	90	**237**	
17	50	156	57	1.00	173	0	**173**	247	159	90	**250**	?Extreme (250k)?
16	51	163	57	1.00	182	0	**182**	260	172	90	**263**	use EL +15'
15	52	169	57	1.00	191	0	**191**	273	185	90	**275**	
14	53	176	57	1.00	200	0	**200**	286	198	90	**288**	
13	54	182	57	1.00	209	0	**209**	298	211	90	**301**	
12	55	188	57	1.00	218	0	**218**	311	223	90	**314**	
11	56	195	57	1.00	227	0	**227**	324	236	90	**327**	
10	57	201	57	1.00	236	0	**236**	337	249	90	**340**	
9	58	208	57	1.00	245	0	**245**	350	262	90	**352**	
8	59	214	57	1.00	254	0	**254**	363	275	90	**365**	
7	60	221	57	1.00	263	0	**263**	376	288	90	**378**	
6	61	227	57	1.00	272	0	**272**	388	301	90	**391**	
5	62	233	57	1.00	281	0	**281**	401	313	90	**404**	
4	63	240	57	1.00	290	0	**290**	414	326	90	**417**	
3	64	246	57	1.00	299	0	**299**	427	339	90	**430**	
2	65	253	57	1.00	308	0	**308**	440	352	90	**442**	
1	66	259	57	1.00	317	0	**317**	453	365	90	**455**	
0	67	266	57	1.00	326	0	**326**	465	378	90	**468**	
-1	68	272	57	1.00	335	0	**335**	478	390	90	**481**	
-2	69	278	57	1.00	344	0	**344**	491	403	90	**494**	
-3	70	285	57	1.00	353	0	**353**	504	416	90	**507**	
-4	71	291	57	1.00	362	0	**362**	517	429	90	**519**	
-5	72	298	57	1.00	371	0	**371**	530	442	90	**532**	
-6	73	304	57	1.00	380	0	**380**	543	455	90	**545**	
-7	74	311	57	1.00	389	0	**389**	555	468	90	**558**	
-8	75	317	57	1.00	398	0	**398**	568	480	90	**571**	
-9	76	323	57	1.00	407	0	**407**	581	493	90	**584**	
-10	77	330	57	1.00	416	0	**416**	594	506	90	**597**	
-11	78	336	57	1.00	425	0	**425**	607	519	90	**609**	
-12	79	343	57	1.00	434	0	**434**	620	532	90	**622**	
-13	80	349	57	1.00	443	0	**443**	632	545	90	**635**	
-14	81	355	57	1.00	452	0	**452**	645	557	90	**648**	
-15	82	362	57	1.00	461	0	**461**	658	570	90	**661**	
-16	83	368	57	1.00	470	0	**470**	671	583	90	**674**	
-17	84	375	57	1.00	479	0	**479**	684	596	90	**686**	
-18	85	381	57	1.00	488	0	**488**	697	609	90	**699**	

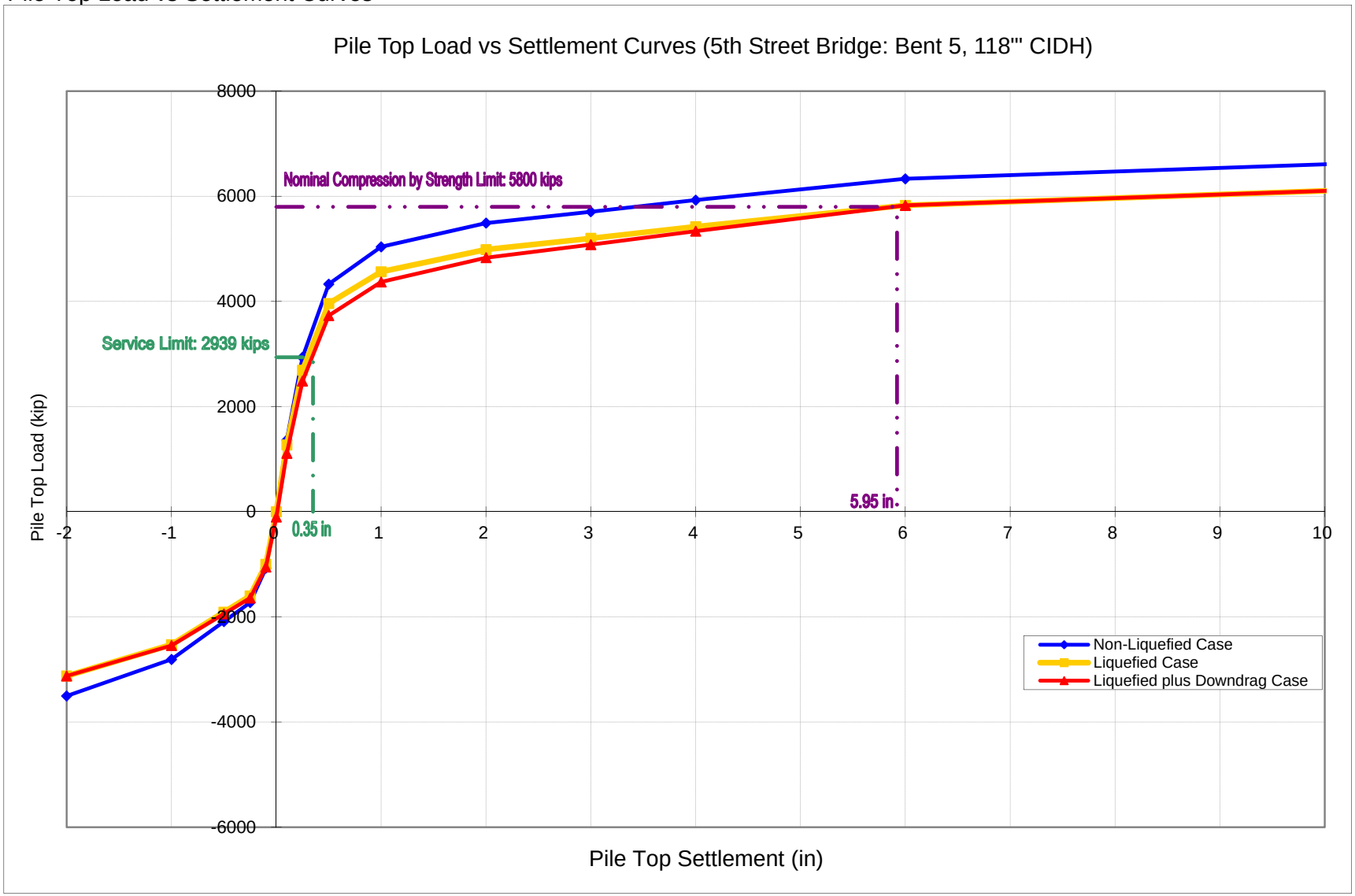
Drilled SHAFT Pile Capacity

PROJECT: 13-121 - Dokken, 5th Street Bridge PSR PR
PROJECT NO.: 13-121
Bridge Name: 5th Street Bridge (Replace) **Location:** Abut 11
DONE BY: TK **DATE:** 08/03/16 **CHECKED BY:** AZ **DATE:** 08/03/16

-19	86	388	57	1.00	497	0	**497**	709	622	90	**712**
-20	87	394	57	1.00	506	0	**506**	722	635	90	**725**
-21	88	400	57	1.00	515	0	**515**	735	647	90	**738**
-22	89	407	57	1.00	524	0	**524**	748	660	90	**751**
-23	90	413	57	1.00	533	0	**533**	761	673	90	**764**

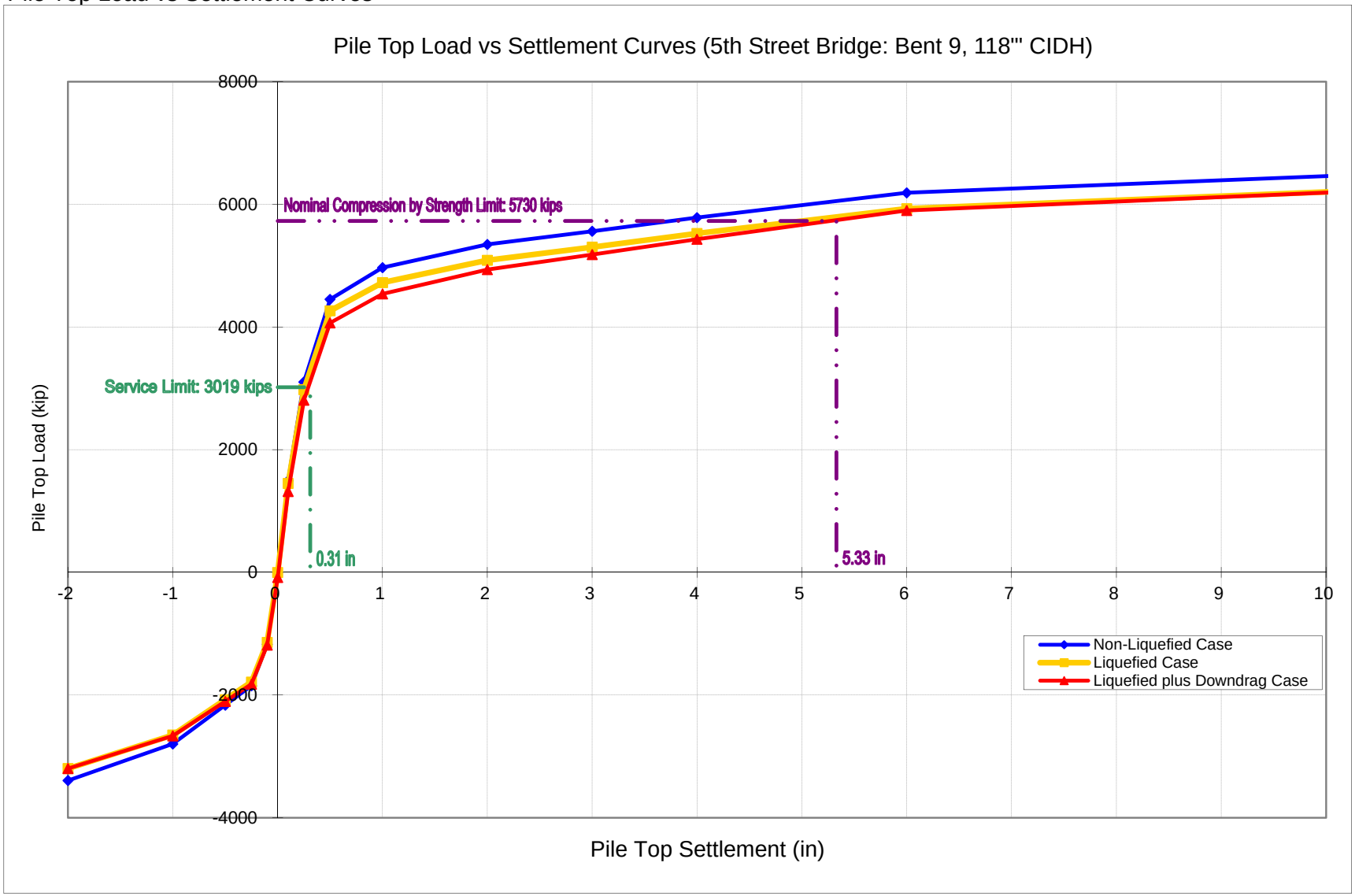
BMCOL 76 Displacement-based Downdrag Analysis
(Bent 5 and Bent 9)

Pile Top Load vs Settlement Curves



Note: The above curves were developed by the axial mode of BMCOL program using the tz-curves derived from SHAFT.

Pile Top Load vs Settlement Curves

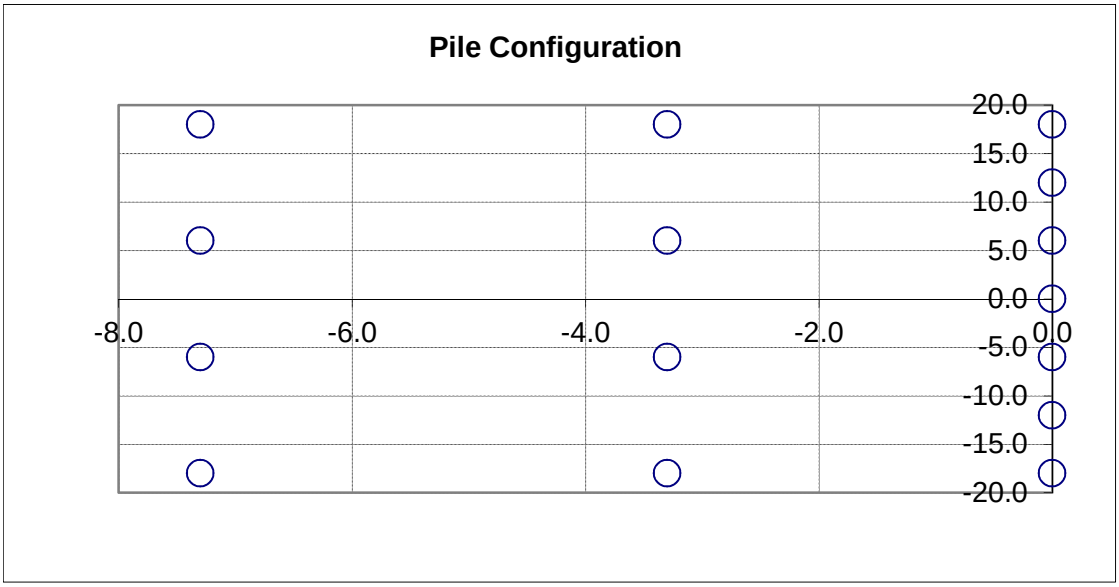


Note: The above curves were developed by the axial mode of BMCOL program using the tz-curves derived from SHAFT.

Pile Lateral Design

Project: 2nd Street OC, Abut 1M
By: TK

Calculation of Pile Group Efficiency (using formula in Group 7.0 Technical Manual)



Pile Dia.: 1.17
No. of Piles: 15

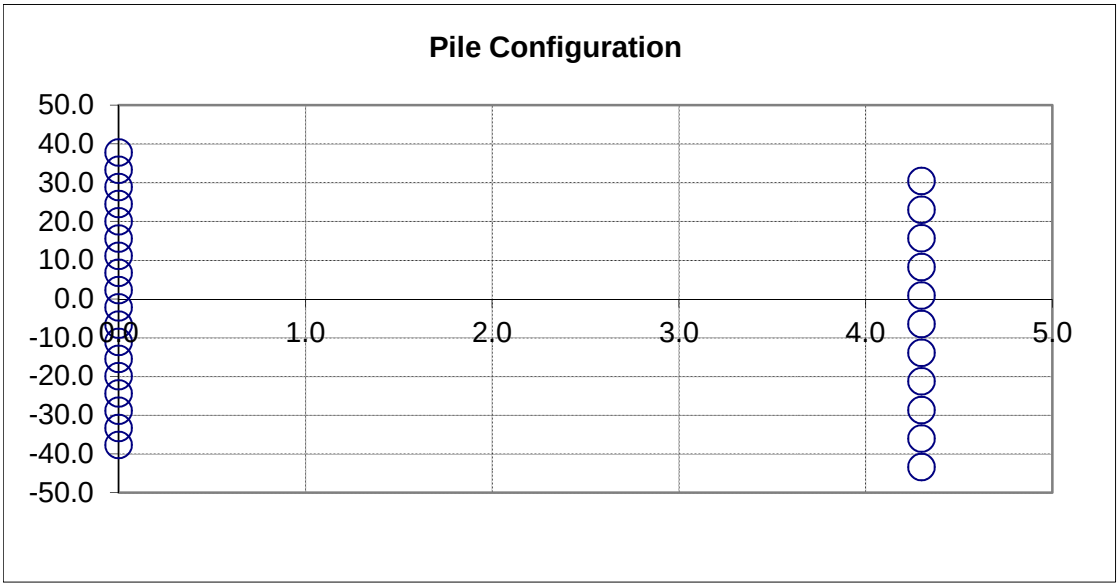
6 SP

	X-Dir	Y-Dir
Group Efficiency	0.821	0.882

Pile No.	X	Y	Reduction Factors in X-dir	Reduction Factors in Y-dir
1	0.000	-18.00	0.917	0.815
2	0.000	-12.00	1.000	0.854
3	0.000	-6.00	0.917	0.815
4	0.000	0.00	1.000	0.854
5	0.000	6.00	0.917	0.815
6	0.000	12.00	1.000	0.854
7	0.000	18.00	0.917	0.911
8	-3.300	-18.00	0.678	0.847
9	-3.300	-6.00	0.669	0.847
10	-3.300	6.00	0.669	0.847
11	-3.300	18.00	0.678	0.887
12	-7.300	-18.00	0.739	0.973
13	-7.300	-6.00	0.739	0.973
14	-7.300	6.00	0.739	0.973
15	-7.300	18.00	0.739	0.973

Project: 2nd Street OC, Abut 2R
By: TK

Calculation of Pile Group Efficiency (using formula in Group 7.0 Technical Manual)



Pile Dia.: 1.17 4.44 SP
No. of Piles: 29

	X-Dir	Y-Dir
Group Efficiency	0.899	0.838

Pile No.	X	Y	Reduction Factors in X-dir	Reduction Factors in Y-dir
1	0.000	-37.74	0.824	0.779
2	0.000	-33.30	0.855	0.754
3	0.000	-28.86	0.789	0.788
4	0.000	-24.42	0.861	0.753
5	0.000	-19.98	0.812	0.774
6	0.000	-15.54	0.822	0.773
7	0.000	-11.10	0.856	0.753
8	0.000	-6.66	0.788	0.788
9	0.000	-2.22	0.860	0.753
10	0.000	2.22	0.814	0.773
11	0.000	6.66	0.820	0.774
12	0.000	11.10	0.857	0.753
13	0.000	15.54	0.788	0.788
14	0.000	19.98	0.859	0.754
15	0.000	24.42	0.816	0.772
16	0.000	28.86	0.818	0.775
17	0.000	33.30	0.899	0.790
18	0.000	37.74	1.000	0.991
19	4.300	30.36	0.998	0.954
20	4.300	22.98	0.997	0.927
21	4.300	15.60	0.983	0.918
22	4.300	8.22	0.999	0.924
23	4.300	0.84	0.996	0.927
24	4.300	-6.54	0.983	0.918
25	4.300	-13.92	1.000	0.925
26	4.300	-21.30	0.995	0.927
27	4.300	-28.68	0.983	0.917
28	4.300	-36.06	1.000	0.925

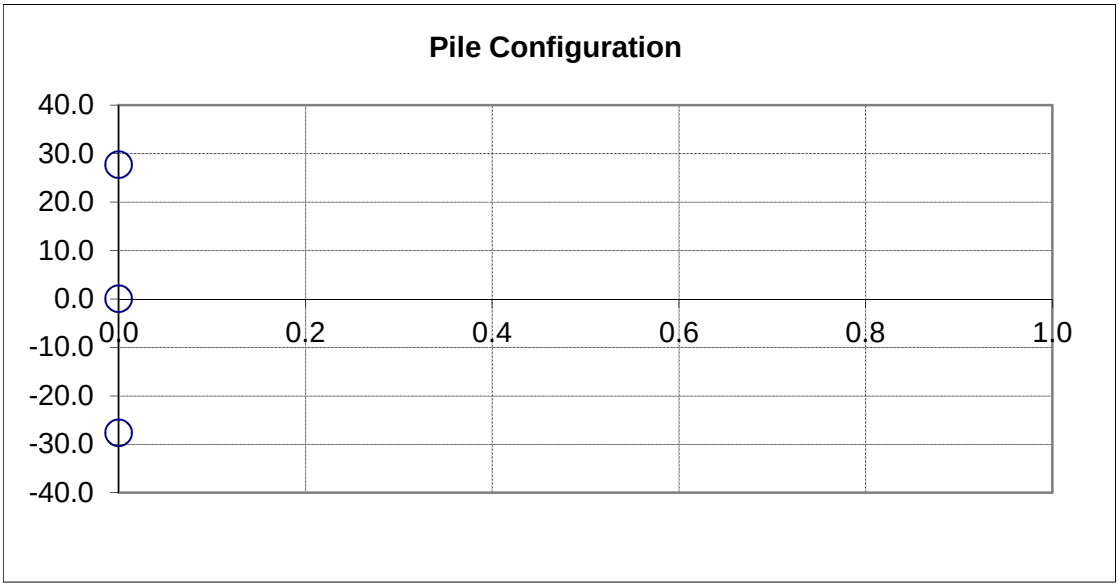
29	4.300	-43.44

1.000	0.940

Project: 5th Street Relacement Bridge, Bent 2

By: TC

Calculation of Pile Group Efficiency (using formula in Group 7.0 Technical Manual)



Pile Dia.: 9.83

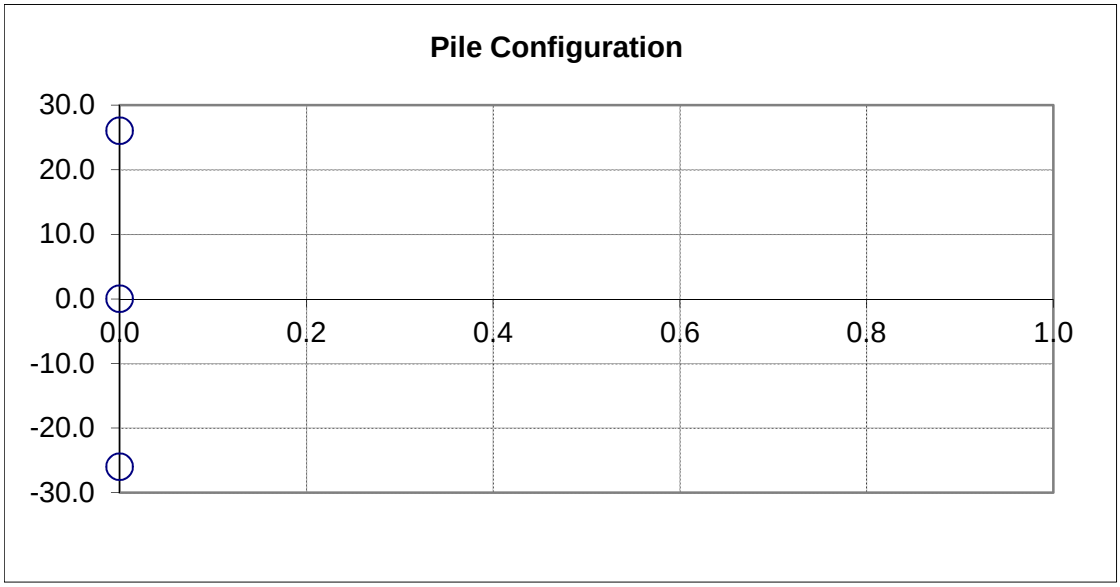
No. of Piles: 3

	X-Dir	Y-Dir
Group Efficiency	0.882	0.742

Pile No.	X	Y	Reduction Factors in X-dir	Reduction Factors in Y-dir
1	0.000	-27.670	0.910	0.658
2	0.000	0.000	0.828	0.651
3	0.000	27.670	0.910	0.916

Project: 5th Street Relacement Bridge, Bents 3 to 10
By: TC

Calculation of Pile Group Efficiency (using formula in Group 7.0 Technical Manual)



Pile Dia.: 9.83
No. of Piles: 3

	X-Dir	Y-Dir
Group Efficiency	0.858	0.718

Pile No.	X	Y	Reduction Factors in X-dir	Reduction Factors in Y-dir
1	0.000	-26.000	0.891	0.628
2	0.000	0.000	0.793	0.626
3	0.000	26.000	0.891	0.901

LPILE Lateral Analysis – 2nd Street OC, Abutments 1, Class 200

==========

LPILE Plus for Windows, Version 5.0 (5.0.47)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

(c) 1985-2010 by Ensoft, Inc.
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==========

This program is licensed to:

TC
EMI

Files Used for Analysis

Path to file locations: C:\Users\t.ke\Documents\13-121 - Dokken, 5th Street Bridge PSR PR\DFR\Analysis\20160923_2nd_LP\
Name of input data file: Ab1.lpd
Name of output file: Ab1.lpo
Name of plot output file: Ab1.lpp
Name of runtime file: Ab1.lpr

Time and Date of Analysis

Date: September 27, 2016 Time: 12:00:42

Problem Title

2th Street OC, Abut 1, Class 200 (pm_avg=0.85)

Program Options

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 300
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 20

Pile Structural Properties and Geometry

Pile Length = 840.00 in

Depth of ground surface below top of pile = -24.00 in

Slope angle of ground surface = 0.00 deg.

Structural properties of pile defined using 2 points

Point No.	Point Depth in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	14.00000000	1601.0000	196.0000	4770000.
2	840.0000	14.00000000	1601.0000	196.0000	4770000.

Soil and Rock Layering Information

The soil profile is modelled using 7 layers

Layer 1 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = -24.000 in
Distance from top of pile to bottom of layer = 120.000 in
p-y subgrade modulus k for top of soil layer = 15.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 15.000 lbs/in**3

Layer 2 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 120.000 in
Distance from top of pile to bottom of layer = 180.000 in
p-y subgrade modulus k for top of soil layer = 15.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 15.000 lbs/in**3

Layer 3 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 180.000 in
Distance from top of pile to bottom of layer = 300.000 in
p-y subgrade modulus k for top of soil layer = 60.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 60.000 lbs/in**3

Layer 4 is stiff clay without free water
Distance from top of pile to top of layer = 300.000 in
Distance from top of pile to bottom of layer = 600.000 in

Layer 5 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 600.000 in
Distance from top of pile to bottom of layer = 1020.000 in
p-y subgrade modulus k for top of soil layer = 70.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 70.000 lbs/in**3

Layer 6 is stiff clay without free water
Distance from top of pile to top of layer = 1020.000 in
Distance from top of pile to bottom of layer = 1500.000 in

Layer 7 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 1500.000 in
Distance from top of pile to bottom of layer = 1900.000 in
p-y subgrade modulus k for top of soil layer = 118.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 118.000 lbs/in**3

(Depth of lowest layer extends 1060.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 14 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-24.00	0.06366
2	120.00	0.06366
3	120.00	0.02755
4	180.00	0.02755
5	180.00	0.03333
6	300.00	0.03333
7	300.00	0.03623
8	600.00	0.03623
9	600.00	0.03623
10	1020.00	0.03623
11	1020.00	0.03623
12	1500.00	0.03623
13	1500.00	0.03912
14	1900.00	0.03912

Shear Strength of Soils

Shear strength parameters with depth defined using 14 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-24.000	0.00000	29.00	------	------
2	120.000	0.00000	29.00	------	------
3	120.000	0.00000	29.00	------	------
4	180.000	0.00000	29.00	------	------
5	180.000	0.00000	33.00	------	------
6	300.000	0.00000	33.00	------	------
7	300.000	17.36110	0.00	0.00800	0.0
8	600.000	17.36110	0.00	0.00800	0.0
9	600.000	0.00000	34.00	------	------
10	1020.000	0.00000	34.00	------	------
11	1020.000	27.77780	0.00	0.00500	0.0
12	1500.000	27.77780	0.00	0.00500	0.0
13	1500.000	0.00000	38.00	------	------
14	1900.000	0.00000	38.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

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p-y Modification Factors

Distribution of p-y multipliers with depth defined using 2 points

Point No.	Depth X in	p-mult	y-mult
1	0.000	0.8500	1.0000
2	840.000	0.8500	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 4

Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.250 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 400000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.500 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 400000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 1.000 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 400000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 2.000 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 400000.000 lbs

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition Type 4)
Specified deflection at pile head = 0.250000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 400000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	0.250000	0.0000	5427.0413	-0.0032990	2040.8163	-71.3864	399.7637
56.000	0.086248	225759.	143.8468	-0.0022702	3027.8965	-87.4906	2840.3291
112.000	0.004978	170103.	-2527.9854	-0.0007061	2784.5529	-8.6314	4855.1632
168.000	-0.008557	43198.0044	-1953.5600	6.4798E-05	2229.6896	18.3694	6010.8484
224.000	-0.002143	-15946.6771	-64.1052	9.1835E-05	2110.5395	20.5426	26836.4320
280.000	9.67E-05	-5258.0169	275.7663	2.6867E-06	2063.8058	-1.2024	34833.5157
336.000	-3.89E-06	214.7160	-34.3875	6.0862E-08	2041.7551	2.7035	1944992.
392.000	1.01E-07	0.5120627	0.4758733	-7.4138E-09	2040.8186	-0.0701976	1944992.
448.000	-1.48E-09	-0.1087297	-3.6911E-05	2.0562E-10	2040.8168	0.0010284	1944992.
504.000	2.67E-12	0.0031799	-0.0002043	-3.2305E-12	2040.8163	-1.8579E-06	1944992.
560.000	5.59E-13	-5.2572E-05	6.3883E-06	1.2417E-14	2040.8163	-3.8802E-07	1944992.
616.000	-1.19E-13	1.8678E-06	-9.1429E-08	-9.7344E-16	2040.8163	2.1289E-09	49949.2070
672.000	-3.00E-14	-3.1920E-07	-1.7673E-09	1.5902E-15	2040.8163	6.3420E-10	59278.8070
728.000	4.54E-15	-6.7917E-08	4.2476E-09	-1.6415E-18	2040.8163	-1.3096E-10	80715.7730
784.000	5.85E-16	1.3596E-08	-2.0747E-10	-4.7760E-17	2040.8163	-1.9155E-11	91691.7730
840.000	-4.17E-16	0.0000	0.0000	-6.6478E-18	2040.8163	1.5296E-11	51333.8865

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.25000000 in
Computed slope at pile head = -0.00329896
Maximum bending moment = 231577.82896 lbs-in
Maximum shear force = 5427.04131 lbs
Depth of maximum bending moment = 67.20000000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 5
Number of zero deflection points = 11

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition Type 4)
Specified deflection at pile head = 0.500000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 400000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	0.500000	0.0000	10067.2899	-0.0065275	2040.8163	-119.9940	335.9832

56.000	0.174773	443102.	480.2415	-0.0045373	3978.1773	-174.3321	2792.9409
112.000	0.011368	340256.	-4980.4762	-0.0014356	3528.5086	-19.7114	4855.0082
168.000	-0.016787	88406.5285	-3912.8472	0.0001166	2427.3533	36.0350	6010.4913
224.000	-0.004321	-31020.7619	-156.4093	0.0001823	2176.4474	41.4087	26835.5610
280.000	0.000176	-10591.2891	544.5850	6.1854E-06	2087.1243	-2.1911	34833.5142
336.000	-7.39E-06	427.0016	-66.6129	9.7014E-08	2042.6833	5.1328	1944992.
392.000	1.95E-07	0.6689272	0.9426365	-1.4034E-08	2040.8193	-0.1358004	1944992.
448.000	-2.92E-09	-0.2052995	-0.0007224	3.9709E-10	2040.8172	0.0020315	1944992.
504.000	7.06E-12	0.0061328	-0.0003844	-6.3610E-12	2040.8164	-4.9071E-06	1944992.
560.000	1.05E-12	-0.0001033	1.2301E-05	2.7804E-14	2040.8163	-7.2766E-07	1944992.
616.000	-2.29E-13	3.6331E-06	-1.7688E-07	-1.9820E-15	2040.8163	4.0868E-09	49949.2070
672.000	-5.85E-14	-6.1240E-07	-3.5909E-09	3.0730E-15	2040.8163	1.2376E-09	59278.8070
728.000	8.66E-15	-1.3292E-07	8.2065E-09	4.0794E-18	2040.8163	-2.4965E-10	80715.7730
784.000	1.15E-15	2.6016E-08	-3.8293E-10	-9.2514E-17	2040.8163	-3.7763E-11	91691.7730
840.000	-8.12E-16	0.0000	0.0000	-1.3380E-17	2040.8163	2.9757E-11	51333.8865

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.50000000 in
Computed slope at pile head = -0.00652746
Maximum bending moment = 456896.67568 lbs-in
Maximum shear force = 10067.28989 lbs
Depth of maximum bending moment = 67.20000000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 5
Number of zero deflection points = 11

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition Type 4)
Specified deflection at pile head = 1.000000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 400000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	1.000000	0.0000	16803.8955	-0.0126965	2040.8163	-156.2052	218.6873
56.000	0.361689	840143.	1912.1764	-0.0090489	5714.1449	-336.8241	2607.5097
112.000	0.030471	680060.	-9535.5112	-0.0029970	5014.2213	-52.8222	4853.8222
168.000	-0.031745	187678.	-7848.5341	0.0001614	2861.3944	68.1297	6009.2487
224.000	-0.008820	-57181.7316	-467.7147	0.0003567	2290.8301	84.5184	26831.9025
280.000	0.000257	-21577.3580	1049.9278	1.6829E-05	2135.1583	-3.2014	34833.5117
336.000	-1.26E-05	839.8415	-121.2027	5.7840E-08	2044.4883	8.7470	1944992.
392.000	3.54E-07	-0.6185043	1.8334	-2.3674E-08	2040.8190	-0.2460608	1944992.
448.000	-5.64E-09	-0.3432898	-0.0050136	7.1555E-10	2040.8178	0.0039198	1944992.
504.000	2.36E-11	0.0110050	-0.0006348	-1.2160E-11	2040.8164	-1.6363E-05	1944992.
560.000	1.71E-12	-0.0001962	2.1960E-05	7.1908E-14	2040.8163	-1.1876E-06	1944992.
616.000	-4.05E-13	6.6985E-06	-3.2040E-07	-4.1489E-15	2040.8163	7.2242E-09	49949.2070
672.000	-1.08E-13	-1.0805E-06	-7.8626E-09	5.5795E-15	2040.8163	2.2809E-09	59278.8070
728.000	1.67E-14	-2.5739E-07	1.4720E-08	3.9072E-17	2040.8163	-4.0854E-10	68608.4070
784.000	2.52E-15	5.0290E-08	-6.2008E-10	-1.8840E-16	2040.8163	-8.2446E-11	91691.7730
840.000	-1.68E-15	0.0000	0.0000	-3.1490E-17	2040.8163	6.1677E-11	51333.8865

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

Pile-head deflection = 1.00000000 in
Computed slope at pile head = -0.01269652
Maximum bending moment = 881598.15396 lbs-in
Maximum shear force = 16803.89552 lbs
Depth of maximum bending moment = 72.80000000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 6
Number of zero deflection points = 11

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition Type 4)
Specified deflection at pile head = 2.000000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 400000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	2.000	0.0000	25205.5680	-0.0241323	2040.8163	-163.6572	114.5601
56.000	0.769822	1498784.	6501.8302	-0.0179259	8593.9013	-558.6341	2031.8653
112.000	0.092357	1351549.	-17232.9373	-0.0064806	7950.1505	-159.7313	4842.5779
168.000	-0.055702	418146.	-15710.4236	2.6709E-05	3869.0641	119.4738	6005.6661
224.000	-0.018299	-93840.4670	-1569.2915	0.0006782	2451.1119	175.2475	26816.0103
280.000	0.000136	-44706.3540	1923.4825	5.1958E-05	2236.2845	-1.6906	34833.5151
336.000	-1.65E-05	1690.0834	-199.3062	-4.8790E-07	2048.2058	11.4749	1944992.
392.000	5.75E-07	-10.0347	3.5958	-2.9790E-08	2040.8602	-0.3995675	1944992.
448.000	-1.09E-08	-0.4158809	-0.0264171	1.1425E-09	2040.8181	0.0075435	1944992.
504.000	9.13E-11	0.0173415	-0.0007263	-2.2874E-11	2040.8164	-6.3429E-05	1944992.
560.000	1.85E-12	-0.0003630	3.4041E-05	2.2297E-13	2040.8163	-1.2832E-06	1944992.
616.000	-6.07E-13	1.1447E-05	-5.2009E-07	-9.4790E-15	2040.8163	1.0836E-08	49949.2070
672.000	-1.84E-13	-1.6299E-06	-1.9851E-08	9.0628E-15	2040.8163	3.9022E-09	59278.8070
728.000	2.58E-14	-4.4424E-07	2.4052E-08	1.7519E-16	2040.8163	-6.3232E-10	68608.4070
784.000	4.78E-15	7.7715E-08	-5.9005E-10	-3.2048E-16	2040.8163	-1.5637E-10	91691.7730
840.000	-2.95E-15	0.0000	0.0000	-6.5902E-17	2040.8163	1.0805E-10	51333.8865

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection = 2.00000000 in
Computed slope at pile head = -0.02413226
Maximum bending moment = 1643007. lbs-in
Maximum shear force = 25205.56803 lbs
Depth of maximum bending moment = 78.40000000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 7
Number of zero deflection points = 11

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= 0.250000	M= 0.000	400000.	0.2500000	231578.	5427.0413
4	y= 0.500000	M= 0.000	400000.	0.5000000	456897.	10067.2899
4	y= 1.000000	M= 0.000	400000.	1.0000000	881598.	16803.8955
4	y= 2.000	M= 0.000	400000.	2.0000	1643007.	25205.5680

Pile-head Deflection vs. Pile Length

Boundary Condition Type 4, Deflection and Moment

Deflection = 0.25000 in
Moment = 0. in-lbs
Axial Load = 400000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
840.000	0.25000000	231577.82896	5427.04131
798.000	0.25000000	231602.01487	5428.24394
756.000	0.25000000	231583.89215	5427.34743
714.000	0.25000000	231606.28474	5428.50245
672.000	0.25000000	231596.99345	5427.91030
630.000	0.25000000	231636.95091	5428.67126
588.000	0.25000000	231626.76403	5429.30911
546.000	0.25000000	231652.01894	5429.06256
504.000	0.25000000	231586.30185	5428.13460
462.000	0.25000000	231642.25197	5429.39954

The analysis ended normally.

LPILE Lateral Analysis – 2nd Street OC, Abutments 2, Class 200

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LPILE Plus for Windows, Version 5.0 (5.0.47)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

TC
EMI

Files Used for Analysis

Path to file locations: C:\Users\t.ke\Documents\13-121 - Dokken, 5th Street Bridge PSR PR\DFR\Analysis\20160923_2nd_LP\
Name of input data file: Ab2.lpd
Name of output file: Ab2.lpo
Name of plot output file: Ab2.lpp
Name of runtime file: Ab2.lpr

Time and Date of Analysis

Date: September 27, 2016 Time: 12:03:07

Problem Title

2th Street OC, Abut 2, Class 200 (pm_avg=0.87)

Program Options

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 300
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 20

Pile Structural Properties and Geometry

Pile Length = 840.00 in

Depth of ground surface below top of pile = -24.00 in

Slope angle of ground surface = 0.00 deg.

Structural properties of pile defined using 2 points

Point No.	Point Depth in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	14.00000000	1601.0000	196.0000	4770000.
2	840.0000	14.00000000	1601.0000	196.0000	4770000.

Soil and Rock Layering Information

The soil profile is modelled using 7 layers

Layer 1 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = -24.000 in
Distance from top of pile to bottom of layer = 120.000 in
p-y subgrade modulus k for top of soil layer = 15.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 15.000 lbs/in**3

Layer 2 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 120.000 in
Distance from top of pile to bottom of layer = 180.000 in
p-y subgrade modulus k for top of soil layer = 15.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 15.000 lbs/in**3

Layer 3 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 180.000 in
Distance from top of pile to bottom of layer = 300.000 in
p-y subgrade modulus k for top of soil layer = 60.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 60.000 lbs/in**3

Layer 4 is stiff clay without free water
Distance from top of pile to top of layer = 300.000 in
Distance from top of pile to bottom of layer = 600.000 in

Layer 5 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 600.000 in
Distance from top of pile to bottom of layer = 1020.000 in
p-y subgrade modulus k for top of soil layer = 70.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 70.000 lbs/in**3

Layer 6 is stiff clay without free water
Distance from top of pile to top of layer = 1020.000 in
Distance from top of pile to bottom of layer = 1500.000 in

Layer 7 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 1500.000 in
Distance from top of pile to bottom of layer = 1900.000 in
p-y subgrade modulus k for top of soil layer = 118.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 118.000 lbs/in**3

(Depth of lowest layer extends 1060.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 14 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-24.00	0.06366
2	120.00	0.06366
3	120.00	0.02755
4	180.00	0.02755
5	180.00	0.03333
6	300.00	0.03333
7	300.00	0.03623
8	600.00	0.03623
9	600.00	0.03623
10	1020.00	0.03623
11	1020.00	0.03623
12	1500.00	0.03623
13	1500.00	0.03912
14	1900.00	0.03912

Shear Strength of Soils

Shear strength parameters with depth defined using 14 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-24.000	0.00000	29.00	------	------
2	120.000	0.00000	29.00	------	------
3	120.000	0.00000	29.00	------	------
4	180.000	0.00000	29.00	------	------
5	180.000	0.00000	33.00	------	------
6	300.000	0.00000	33.00	------	------
7	300.000	17.36110	0.00	0.00800	0.0
8	600.000	17.36110	0.00	0.00800	0.0
9	600.000	0.00000	34.00	------	------
10	1020.000	0.00000	34.00	------	------
11	1020.000	27.77780	0.00	0.00500	0.0
12	1500.000	27.77780	0.00	0.00500	0.0
13	1500.000	0.00000	38.00	------	------
14	1900.000	0.00000	38.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

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p-y Modification Factors

Distribution of p-y multipliers with depth defined using 2 points

Point No.	Depth X in	p-mult	y-mult
1	0.000	0.8700	1.0000
2	840.000	0.8700	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 4

Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.250 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 400000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.500 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 400000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 1.000 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 400000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 2.000 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 400000.000 lbs

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition Type 4)
Specified deflection at pile head = 0.250000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 400000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	0.250000	0.0000	5521.0044	-0.0033147	2040.8163	-73.0661	409.1699
56.000	0.085643	228128.	128.4717	-0.0022732	3038.2519	-88.9271	2907.3834
112.000	0.004578	170439.	-2563.4646	-0.0006984	2786.0199	-8.1254	4969.4082
168.000	-0.008572	42315.4328	-1956.4500	6.9315E-05	2225.8307	18.8345	6152.2797
224.000	-0.002074	-16263.3144	-47.5152	9.1083E-05	2111.9239	20.3478	27467.8959
280.000	0.000108	-5091.9676	276.1437	1.9798E-06	2063.0798	-1.3810	35653.1277
336.000	-4.13E-06	212.1432	-35.4055	7.9509E-08	2041.7439	2.8675	1944992.
392.000	1.04E-07	0.7877809	0.4731751	-7.8973E-09	2040.8198	-0.0724219	1944992.
448.000	-1.48E-09	-0.1162431	0.0004871	2.1269E-10	2040.8168	0.0010271	1944992.
504.000	1.23E-12	0.0032959	-0.0002195	-3.2430E-12	2040.8163	-8.5762E-07	1944992.
560.000	6.03E-13	-5.2960E-05	6.6373E-06	9.7570E-15	2040.8163	-4.1885E-07	1944992.
616.000	-1.24E-13	1.9053E-06	-9.4920E-08	-8.9300E-16	2040.8163	2.2587E-09	51124.4825
672.000	-2.97E-14	-3.3451E-07	-1.3389E-09	1.6177E-15	2040.8163	6.4400E-10	60673.6025
728.000	4.74E-15	-6.6826E-08	4.3021E-09	-1.0013E-17	2040.8163	-1.3651E-10	80715.7730
784.000	5.66E-16	1.4059E-08	-2.3076E-10	-4.8096E-17	2040.8163	-1.8533E-11	91691.7730
840.000	-4.16E-16	0.0000	0.0000	-6.1151E-18	2040.8163	1.5256E-11	51333.8865

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.25000000 in
Computed slope at pile head = -0.00331471
Maximum bending moment = 233698.61454 lbs-in
Maximum shear force = 5521.00440 lbs
Depth of maximum bending moment = 67.20000000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 5
Number of zero deflection points = 11

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition Type 4)
Specified deflection at pile head = 0.500000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 400000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	0.500000	0.0000	10241.1308	-0.0065584	2040.8163	-122.8174	343.8886

56.000	0.173570	447780.	453.2341	-0.0045435	3998.6307	-177.2598	2859.5191
112.000	0.010562	340977.	-5051.3115	-0.0014204	3531.6607	-18.7448	4969.2705
168.000	-0.016824	86658.4747	-3919.5241	0.0001257	2419.7103	36.9650	6151.9124
224.000	-0.004183	-31670.9472	-123.2629	0.0001809	2179.2902	41.0363	27467.0599
280.000	0.000200	-10262.9437	545.6928	4.7599E-06	2085.6887	-2.5483	35653.1257
336.000	-7.87E-06	422.1255	-68.7232	1.3481E-07	2042.6620	5.4686	1944992.
392.000	2.02E-07	1.2271	0.9379024	-1.5023E-08	2040.8217	-0.1404038	1944992.
448.000	-2.92E-09	-0.2206543	0.0003369	4.1170E-10	2040.8173	0.0020305	1944992.
504.000	4.16E-12	0.0063721	-0.0004155	-6.3911E-12	2040.8164	-2.8877E-06	1944992.
560.000	1.14E-12	-0.0001042	1.2814E-05	2.2446E-14	2040.8163	-7.9057E-07	1944992.
616.000	-2.38E-13	3.7125E-06	-1.8402E-07	-1.8234E-15	2040.8163	4.3487E-09	51124.4825
672.000	-5.81E-14	-6.4389E-07	-2.7661E-09	3.1336E-15	2040.8163	1.2583E-09	60673.6025
728.000	9.07E-15	-1.3091E-07	8.3331E-09	-1.3129E-17	2040.8163	-2.6151E-10	80715.7730
784.000	1.12E-15	2.7015E-08	-4.3149E-10	-9.3368E-17	2040.8163	-3.6549E-11	91691.7730
840.000	-8.11E-16	0.0000	0.0000	-1.2309E-17	2040.8163	2.9728E-11	51333.8865

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.50000000 in
Computed slope at pile head = -0.00655837
Maximum bending moment = 461118.66229 lbs-in
Maximum shear force = 10241.13083 lbs
Depth of maximum bending moment = 67.20000000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 5
Number of zero deflection points = 11

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition Type 4)
Specified deflection at pile head = 1.000000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 400000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	1.000000	0.0000	17092.0797	-0.0127555	2040.8163	-159.8806	223.8329
56.000	0.359331	849162.	1878.3858	-0.0090628	5753.5777	-342.8826	2671.8277
112.000	0.028821	681770.	-9676.3784	-0.0029674	5021.6973	-51.1383	4968.1784
168.000	-0.031861	184276.	-7866.7438	0.0001803	2846.5201	69.9870	6150.6299
224.000	-0.008551	-58574.4223	-401.6382	0.0003543	2296.9194	83.8678	27463.5375
280.000	0.000308	-20941.6986	1054.0840	1.3915E-05	2132.3790	-3.9160	35653.1218
336.000	-1.36E-05	831.5774	-125.8292	1.3612E-07	2044.4522	9.4604	1944992.
392.000	3.69E-07	0.5344567	1.8276	-2.5771E-08	2040.8187	-0.2561130	1944992.
448.000	-5.65E-09	-0.3757856	-0.0028340	7.4732E-10	2040.8180	0.0039262	1944992.
504.000	1.76E-11	0.0115236	-0.0007005	-1.2248E-11	2040.8164	-1.2222E-05	1944992.
560.000	1.90E-12	-0.0001984	2.3069E-05	6.0984E-14	2040.8163	-1.3203E-06	1944992.
616.000	-4.25E-13	6.8804E-06	-3.3558E-07	-3.8453E-15	2040.8163	7.7609E-09	51124.4825
672.000	-1.08E-13	-1.1477E-06	-6.3444E-09	5.7299E-15	2040.8163	2.3298E-09	60673.6025
728.000	1.75E-14	-2.5402E-07	1.5127E-08	1.7190E-18	2040.8163	-4.3968E-10	70222.7225
784.000	2.42E-15	5.2382E-08	-7.3133E-10	-1.8943E-16	2040.8163	-7.9153E-11	91691.7730
840.000	-1.67E-15	0.0000	0.0000	-2.8798E-17	2040.8163	6.1286E-11	51333.8865

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

Pile-head deflection = 1.00000000 in
Computed slope at pile head = -0.01275546
Maximum bending moment = 889537.39498 lbs-in
Maximum shear force = 17092.07968 lbs
Depth of maximum bending moment = 70.00000000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 6
Number of zero deflection points = 11

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition Type 4)
Specified deflection at pile head = 2.000000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 400000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	2.000	0.0000	25637.0499	-0.0242410	2040.8163	-167.5080	117.2556
56.000	0.765274	1515346.	6507.5458	-0.0179584	8666.3134	-570.1940	2086.2363
112.000	0.088898	1356013.	-17510.1856	-0.0064251	7969.6688	-157.3959	4957.4679
168.000	-0.056103	411732.	-15766.0068	6.6931E-05	3841.0166	123.1635	6146.8975
224.000	-0.017784	-96995.3270	-1438.3089	0.0006751	2464.9058	174.3303	27448.1504
280.000	0.000247	-43540.2667	1938.8313	4.5900E-05	2231.1860	-3.1470	35653.1241
336.000	-1.89E-05	1691.0621	-211.3066	-3.2716E-07	2048.2101	13.1144	1944992.
392.000	6.12E-07	-7.6982	3.6229	-3.4565E-08	2040.8500	-0.4252744	1944992.
448.000	-1.10E-08	-0.4893896	-0.0220814	1.2224E-09	2040.8185	0.0076397	1944992.
504.000	7.97E-11	0.0186319	-0.0008736	-2.3312E-11	2040.8164	-5.5338E-05	1944992.
560.000	2.27E-12	-0.0003717	3.6766E-05	2.0224E-13	2040.8163	-1.5788E-06	1944992.
616.000	-6.58E-13	1.1969E-05	-5.5702E-07	-8.9950E-15	2040.8163	1.2019E-08	51124.4825
672.000	-1.87E-13	-1.7887E-06	-1.7258E-08	9.5176E-15	2040.8163	4.0628E-09	60673.6025
728.000	2.78E-14	-4.4662E-07	2.5225E-08	1.1023E-16	2040.8163	-6.9760E-10	70222.7225
784.000	4.64E-15	8.3100E-08	-8.2447E-10	-3.2727E-16	2040.8163	-1.5198E-10	91691.7730
840.000	-2.97E-15	0.0000	0.0000	-6.1406E-17	2040.8163	1.0884E-10	51333.8865

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection = 2.00000000 in
Computed slope at pile head = -0.02424105
Maximum bending moment = 1657121. lbs-in
Maximum shear force = 25637.04992 lbs
Depth of maximum bending moment = 78.40000000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 7
Number of zero deflection points = 11

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= 0.250000	M= 0.000	400000.	0.2500000	233699.	5521.0044
4	y= 0.500000	M= 0.000	400000.	0.5000000	461119.	10241.1308
4	y= 1.000000	M= 0.000	400000.	1.0000000	889537.	17092.0797
4	y= 2.000	M= 0.000	400000.	2.0000	1657121.	25637.0499

Pile-head Deflection vs. Pile Length

Boundary Condition Type 4, Deflection and Moment

Deflection = 0.25000 in
Moment = 0. in-lbs
Axial Load = 400000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
840.000	0.25000000	233698.61454	5521.00440
798.000	0.25000000	233743.93934	5522.23168
756.000	0.25000000	233680.28691	5521.31586
714.000	0.25000000	233744.23242	5522.49291
672.000	0.25000000	233718.17693	5521.89187
630.000	0.25000000	233758.97649	5522.66654
588.000	0.25000000	233765.22438	5523.31510
546.000	0.25000000	233770.74409	5523.06072
504.000	0.25000000	233707.17713	5522.12227
462.000	0.25000000	233748.44545	5523.40515

The analysis ended normally.

LPILE Lateral Analysis – 2nd Street OC, Abutments 2, North Wingwalls, Class 200

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LPILE Plus for Windows, Version 5.0 (5.0.47)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

TC
EMI

Files Used for Analysis

Path to file locations: C:\Users\t.ke\Documents\13-121 - Dokken, 5th Street Bridge PSR PR\DFR\Analysis\20160927Abut_wingwal_piles_LP\2nd_Abut2\
Name of input data file: Ab2.lpd
Name of output file: Ab2.lpo
Name of plot output file: Ab2.lpp
Name of runtime file: Ab2.lpr

Time and Date of Analysis

Date: September 27, 2016 Time: 16:56:46

Problem Title

2th Street OC, Abut 2N RW, Class 200 (pm_avg=0.6

Program Options

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 300
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 20

Pile Structural Properties and Geometry

Pile Length = 600.00 in

Depth of ground surface below top of pile = -24.00 in

Slope angle of ground surface = 0.00 deg.

Structural properties of pile defined using 2 points

Point No.	Point Depth in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	14.00000000	1601.0000	196.0000	4770000.
2	840.0000	14.00000000	1601.0000	196.0000	4770000.

Soil and Rock Layering Information

The soil profile is modelled using 7 layers

Layer 1 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = -24.000 in
Distance from top of pile to bottom of layer = 120.000 in
p-y subgrade modulus k for top of soil layer = 15.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 15.000 lbs/in**3

Layer 2 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 120.000 in
Distance from top of pile to bottom of layer = 180.000 in
p-y subgrade modulus k for top of soil layer = 15.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 15.000 lbs/in**3

Layer 3 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 180.000 in
Distance from top of pile to bottom of layer = 300.000 in
p-y subgrade modulus k for top of soil layer = 60.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 60.000 lbs/in**3

Layer 4 is stiff clay without free water
Distance from top of pile to top of layer = 300.000 in
Distance from top of pile to bottom of layer = 600.000 in

Layer 5 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 600.000 in
Distance from top of pile to bottom of layer = 1020.000 in
p-y subgrade modulus k for top of soil layer = 70.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 70.000 lbs/in**3

Layer 6 is stiff clay without free water
Distance from top of pile to top of layer = 1020.000 in
Distance from top of pile to bottom of layer = 1500.000 in

Layer 7 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 1500.000 in
Distance from top of pile to bottom of layer = 1900.000 in
p-y subgrade modulus k for top of soil layer = 118.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 118.000 lbs/in**3

(Depth of lowest layer extends 1300.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 14 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-24.00	0.06366
2	120.00	0.06366
3	120.00	0.02755
4	180.00	0.02755
5	180.00	0.03333
6	300.00	0.03333
7	300.00	0.03623
8	600.00	0.03623
9	600.00	0.03623
10	1020.00	0.03623
11	1020.00	0.03623
12	1500.00	0.03623
13	1500.00	0.03912
14	1900.00	0.03912

Shear Strength of Soils

Shear strength parameters with depth defined using 14 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-24.000	0.00000	29.00	------	------
2	120.000	0.00000	29.00	------	------
3	120.000	0.00000	29.00	------	------
4	180.000	0.00000	29.00	------	------
5	180.000	0.00000	33.00	------	------
6	300.000	0.00000	33.00	------	------
7	300.000	17.36110	0.00	0.00800	0.0
8	600.000	17.36110	0.00	0.00800	0.0
9	600.000	0.00000	34.00	------	------
10	1020.000	0.00000	34.00	------	------
11	1020.000	27.77780	0.00	0.00500	0.0
12	1500.000	27.77780	0.00	0.00500	0.0
13	1500.000	0.00000	38.00	------	------
14	1900.000	0.00000	38.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

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p-y Modification Factors

Distribution of p-y multipliers with depth defined using 2 points

Point No.	Depth X in	p-mult	y-mult
1	0.000	0.6000	1.0000
2	600.000	0.6000	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 4

Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.250 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 400000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.500 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 400000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 1.000 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 400000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 2.000 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 400000.000 lbs

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition Type 4)
Specified deflection at pile head = 0.250000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 400000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	0.250000	0.0000	4190.2972	-0.0030714	2040.8163	-50.3904	201.5615
40.000	0.133841	163168.	1470.0423	-0.0025926	2754.2294	-75.6731	1130.7873
80.000	0.049586	200601.	-1080.8834	-0.0015880	2917.8972	-46.3570	1869.7780
120.000	0.005785	148763.	-2122.2460	-0.0006485	2691.2496	-6.2710	2168.0038
160.000	-0.007286	69840.5053	-1972.4049	-7.4799E-05	2346.1777	10.5203	2887.9856
200.000	-0.005521	5427.8537	-957.4173	0.0001053	2064.5484	34.3282	12435.1540
240.000	-0.001711	-12498.8252	-8.3750	6.9978E-05	2095.4645	13.1019	15316.0201
280.000	-0.000127	-7122.6076	228.8595	1.4238E-05	2071.9583	1.1510	18196.1052
320.000	8.96E-06	82.0355	39.4583	-6.9502E-07	2041.1750	-6.2252	1389280.
360.000	-5.52E-07	10.4767	-3.5003	2.8010E-08	2040.8621	0.3835911	1389280.
400.000	2.90E-08	-1.5549	0.2531418	-5.1493E-10	2040.8231	-0.0201688	1389280.
440.000	-1.20E-09	0.1405415	-0.0157315	-5.1213E-11	2040.8169	0.0008363	1389280.
480.000	2.55E-11	-0.0102811	0.0008358	8.0546E-12	2040.8164	-1.7693E-05	1389280.
520.000	1.81E-12	0.0006454	-3.5306E-05	-7.4020E-13	2040.8163	-1.2571E-06	1389280.
560.000	-3.12E-13	-3.4631E-05	8.0855E-07	5.4829E-14	2040.8163	2.1705E-07	1389280.
600.000	1.82E-14	0.0000	0.0000	-5.6732E-15	2040.8163	-1.2623E-08	694640.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.25000000 in
Computed slope at pile head = -0.00307137
Maximum bending moment = 202263.43984 lbs-in
Maximum shear force = 4190.29715 lbs
Depth of maximum bending moment = 72.00000000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 5
Number of zero deflection points = 8

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition Type 4)
Specified deflection at pile head = 0.500000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 400000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	0.500000	0.0000	7777.0793	-0.0060805	2040.8163	-84.7016	169.4033

40.000	0.269573	316972.	3023.2749	-0.0051607	3426.7034	-144.4080	1071.3847
80.000	0.101221	397121.	-2031.2836	-0.0031877	3777.1357	-94.2765	1862.7824
120.000	0.012894	297513.	-4186.3968	-0.0013180	3341.6210	-13.9764	2167.8953
160.000	-0.014019	141301.	-3932.3210	-0.0001657	2658.6203	20.2432	2887.8623
200.000	-0.010949	12510.5782	-1936.7827	0.0002038	2095.5159	68.0625	12432.3634
240.000	-0.003460	-24316.1057	-40.2111	0.0001393	2147.1328	26.4948	15315.7554
280.000	-0.000273	-14266.1171	445.5909	2.9384E-05	2103.1916	2.4861	18196.1031
320.000	1.85E-05	68.7710	88.5174	-1.3407E-06	2041.1170	-12.8703	1389280.
360.000	-1.11E-06	27.5637	-7.4798	5.0047E-08	2040.9368	0.7705422	1389280.
400.000	5.62E-08	-3.5051	0.5242219	-5.2613E-10	2040.8317	-0.0390590	1389280.
440.000	-2.17E-09	0.3010864	-0.0316566	-1.3768E-10	2040.8176	0.0015093	1389280.
480.000	3.07E-11	-0.0213326	0.0016228	1.8236E-11	2040.8164	-2.1340E-05	1389280.
520.000	5.05E-12	0.0013014	-6.4126E-05	-1.5892E-12	2040.8163	-3.5105E-06	1389280.
560.000	-7.13E-13	-6.7435E-05	1.0551E-06	1.1390E-13	2040.8163	4.9546E-07	1389280.
600.000	5.25E-14	0.0000	0.0000	-1.0376E-14	2040.8163	-3.6434E-08	694640.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.50000000 in
Computed slope at pile head = -0.00608055
Maximum bending moment = 399521.87990 lbs-in
Maximum shear force = 7777.07934 lbs
Depth of maximum bending moment = 74.00000000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 5
Number of zero deflection points = 8

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition Type 4)
Specified deflection at pile head = 1.000000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 400000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	1.000000	0.0000	12997.7287	-0.0118432	2040.8163	-110.2625	110.2625
40.000	0.549112	585485.	6277.2750	-0.0101832	4600.7118	-243.5768	887.1666
80.000	0.213547	771083.	-3353.2050	-0.0064333	5412.1963	-195.5870	1831.7929
120.000	0.033061	594363.	-8044.2490	-0.0027499	4639.5290	-35.8235	2167.1381
160.000	-0.024973	291257.	-7787.9018	-0.0004197	3314.2710	36.0541	2887.4955
200.000	-0.021366	34128.2526	-3990.9664	0.0003697	2190.0342	132.7048	12421.8695
240.000	-0.007124	-44829.0393	-209.8371	0.0002749	2236.8209	54.5492	15314.6204
280.000	-0.000658	-28623.3113	823.4805	6.3725E-05	2165.9651	5.9836	18196.0900
320.000	4.04E-05	-388.5947	229.8768	-2.4070E-06	2042.5154	-28.0363	1389280.
360.000	-2.24E-06	91.5663	-17.5923	6.7042E-08	2041.2167	1.5583	1389280.
400.000	1.02E-07	-9.1859	1.1466	1.7291E-09	2040.8565	-0.0709938	1389280.
440.000	-3.04E-09	0.7120716	-0.0643285	-4.6974E-10	2040.8194	0.0021148	1389280.
480.000	-5.02E-11	-0.0468813	0.0029737	4.8178E-11	2040.8165	3.4886E-05	1389280.
520.000	1.80E-11	0.0026592	-9.2343E-05	-3.7765E-12	2040.8163	-1.2514E-05	1389280.
560.000	-1.91E-12	-0.0001247	-9.9368E-07	2.5100E-13	2040.8163	1.3287E-06	1389280.
600.000	1.94E-13	0.0000	0.0000	-1.5379E-14	2040.8163	-1.3456E-07	694640.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

Pile-head deflection = 1.00000000 in
Computed slope at pile head = -0.01184324
Maximum bending moment = 772285.25811 lbs-in
Maximum shear force = 12997.72874 lbs
Depth of maximum bending moment = 76.00000000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 6
Number of zero deflection points = 8

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition Type 4)
Specified deflection at pile head = 2.000000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 400000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	2.000	0.0000	19484.6116	-0.0225549	2040.8163	-115.5228	57.7614
40.000	1.136	1002809.	11998.3668	-0.0197836	6425.3655	-313.0650	551.4083
80.000	0.471081	1441568.	-3968.5258	-0.0130502	8343.7353	-399.0152	1694.0404
120.000	0.095880	1180578.	-14657.8891	-0.0059458	7202.6203	-103.5769	2160.5475
160.000	-0.037057	615680.	-15186.4331	-0.0012010	4732.7331	53.4895	2886.8519
200.000	-0.040358	105669.	-8431.9300	0.0005795	2502.8281	249.9254	12385.4924
240.000	-0.015038	-73536.2885	-954.3241	0.0005323	2362.3366	115.1084	15309.4896
280.000	-0.001771	-57396.6304	1359.7412	0.0001475	2291.7697	16.1131	18195.9915
320.000	9.41E-05	-2955.3302	676.9960	-3.6570E-06	2053.7378	-65.3668	1389280.
360.000	-4.57E-06	333.4711	-45.9590	-3.4785E-09	2042.2744	3.1757	1389280.
400.000	1.61E-07	-27.3188	2.6908	1.4975E-08	2040.9358	-0.1118884	1389280.
440.000	-6.71E-10	1.8741	-0.1323544	-1.7416E-09	2040.8245	0.0004660	1389280.
480.000	-5.63E-10	-0.1108685	0.0047967	1.4451E-10	2040.8168	0.0003911	1389280.
520.000	6.87E-11	0.0055312	-3.5083E-05	-1.0002E-11	2040.8164	-4.7700E-05	1389280.
560.000	-5.83E-12	-0.0002060	-1.4847E-05	5.9622E-13	2040.8163	4.0474E-06	1389280.
600.000	7.54E-13	0.0000	0.0000	-8.3577E-15	2040.8163	-5.2381E-07	694640.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection = 2.00000000 in
Computed slope at pile head = -0.02255493
Maximum bending moment = 1443122. lbs-in
Maximum shear force = 19484.61157 lbs
Depth of maximum bending moment = 82.00000000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 7
Number of zero deflection points = 8

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= 0.250000	M= 0.000	400000.	0.2500000	202263.	4190.2972
4	y= 0.500000	M= 0.000	400000.	0.5000000	399522.	7777.0793
4	y= 1.000000	M= 0.000	400000.	1.0000000	772285.	12997.7287
4	y= 2.000	M= 0.000	400000.	2.0000	1443122.	19484.6116

Pile-head Deflection vs. Pile Length

Boundary Condition Type 4, Deflection and Moment

Deflection = 0.25000 in
Moment = 0. in-lbs
Axial Load = 400000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
600.000	0.25000000	202263.43984	4190.29715
570.000	0.25000000	202164.39566	4188.11466
540.000	0.25000000	202109.70165	4186.93659
510.000	0.25000000	202164.99294	4188.37664
480.000	0.25000000	202133.80953	4187.70647
450.000	0.25000000	202260.28983	4190.39695
420.000	0.25000000	202154.49197	4187.99160
390.000	0.25000000	202154.66770	4187.99542
360.000	0.25000000	202158.43599	4188.52288
330.000	0.25000000	202163.71333	4188.28432

The analysis ended normally.

LPILE Lateral Analysis – 5th Street Bridge, Abutment 1, 24” CIDH

LPILE Lateral Analysis – 5th Street Bridge, Abutment 11, 24” CIDH

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LPILE Plus for Windows, Version 5.0 (5.0.47)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

TC
EMI

Files Used for Analysis

Path to file locations: C:\Users\t.ke\Documents\13-121 - Dokken, 5th Street Bridge PSR PR\DFR\Analysis\20160707LP_5th_Abut11_CIDH_SP_3D\24inCIDH_pm_85\
Name of input data file: P11.lpd
Name of output file: P11.lpo
Name of plot output file: P11.lpp
Name of runtime file: P11.lpr

Time and Date of Analysis

Date: September 28, 2016 Time: 12:20:23

Problem Title

5th Street Bridge, Abut 11, 24"CIDH (pm_avg=0.85), LQ, P.fixed

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Program Options

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 300
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 20

Pile Structural Properties and Geometry

Pile Length = 960.00 in

Depth of ground surface below top of pile = 0.00 in

Slope angle of ground surface = 0.00 deg.

Structural properties of pile defined using 6 points

Point No.	Point Depth in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	24.00000000	8143.0000	452.0000	3420000.
2	24.0000	24.00000000	8143.0000	452.0000	3420000.
3	24.0000	24.00000000	27179.0000	452.0000	3420000.
4	264.0000	24.00000000	27179.0000	452.0000	3420000.
5	264.0000	24.00000000	8143.0000	452.0000	3420000.
6	960.0000	24.00000000	8143.0000	452.0000	3420000.

Soil and Rock Layering Information

The soil profile is modelled using 7 layers

Layer 1 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 0.000 in
Distance from top of pile to bottom of layer = 108.000 in
p-y subgrade modulus k for top of soil layer = 70.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 70.000 lbs/in**3

Layer 2 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 108.000 in
Distance from top of pile to bottom of layer = 168.000 in
p-y subgrade modulus k for top of soil layer = 45.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 45.000 lbs/in**3

Layer 3 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 168.000 in
Distance from top of pile to bottom of layer = 192.000 in
p-y subgrade modulus k for top of soil layer = 10.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 10.000 lbs/in**3

Layer 4 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 192.000 in
Distance from top of pile to bottom of layer = 408.000 in

Layer 5 is sand, p-y criteria by API RP-2A, 1987

Distance from top of pile to top of layer = 408.000 in
Distance from top of pile to bottom of layer = 528.000 in
p-y subgrade modulus k for top of soil layer = 50.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 50.000 lbs/in**3

Layer 6 is stiff clay without free water
Distance from top of pile to top of layer = 528.000 in
Distance from top of pile to bottom of layer = 1368.000 in

Layer 7 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 1368.000 in
Distance from top of pile to bottom of layer = 1992.000 in
p-y subgrade modulus k for top of soil layer = 118.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 118.000 lbs/in**3

(Depth of lowest layer extends 1032.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 14 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	0.00	0.06366
2	108.00	0.06266
3	108.00	0.06366
4	168.00	0.06366
5	168.00	0.06076
6	192.00	0.06076
7	192.00	0.02466
8	408.00	0.02466
9	408.00	0.03333
10	528.00	0.03333
11	528.00	0.03623
12	1368.00	0.03623
13	1368.00	0.03912
14	1992.00	0.03912

Shear Strength of Soils

Shear strength parameters with depth defined using 14 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	0.000	0.00000	32.00	------	------
2	108.000	0.00000	32.00	------	------
3	108.000	0.00000	30.00	------	------
4	168.000	0.00000	30.00	------	------
5	168.000	0.00000	28.00	------	------
6	192.000	0.00000	28.00	------	------
7	192.000	2.77780	0.00	0.01500	0.0
8	408.000	2.77780	0.00	0.01500	0.0
9	408.000	0.00000	32.00	------	------
10	528.000	0.00000	32.00	------	------
11	528.000	27.77780	0.00	0.00500	0.0
12	1368.000	27.77780	0.00	0.00500	0.0

13	1368.000	0.00000	38.00	------	------
14	1992.000	0.00000	38.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

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p-y Modification Factors

Distribution of p-y multipliers with depth defined using 2 points

Point No.	Depth X in	p-mult	y-mult
1	0.000	0.8500	1.0000
2	960.000	0.8500	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 5

Load Case Number 1

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 0.250 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 500000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 0.400 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 500000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 0.500 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 500000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 1.000 in

Slope at pile head = 0.000 in/in
Axial load at pile head = 500000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 2.000 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 500000.000 lbs

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Slope (Pile-head Condition Type 5)
Specified deflection at pile head = 0.250000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 500000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	0.250000	-2465758.	48967.7644	0.0000	4739.8799	0.0000	0.0000
64.000	0.157245	271870.	29770.9228	-0.0018217	1226.2300	-478.5140	9737.9476
128.000	0.057100	1182158.	-45.0359	-0.0012051	1628.1380	-287.5365	16114.0651
192.000	0.004471	813274.	-8806.5033	-0.0004850	1465.2694	-43.4837	31122.5374
256.000	-0.012678	302243.	-6450.6410	-0.0001105	1239.6404	61.6099	15550.6491
320.000	-0.009402	15684.6285	-2521.8505	0.0001521	1129.3085	55.7772	18983.4963
384.000	-0.001285	-51321.8088	266.3878	7.6386E-05	1181.8255	28.7740	71627.2063
448.000	0.000648	-14463.2659	495.4551	-7.4433E-07	1127.5086	-7.3582	36338.1778
512.000	0.000143	4585.8079	154.7658	-7.8648E-06	1112.9526	-2.0073	45042.1963
576.000	-3.21E-06	-225.9837	-21.9639	2.5533E-07	1106.5277	4.0180	4000003.
640.000	5.11E-08	12.4075	-0.1567963	-6.8199E-09	1106.2130	-0.0638990	4000003.
704.000	-2.06E-10	-0.3804899	0.0196136	1.3093E-10	1106.1953	0.0002570	4000003.
768.000	-2.20E-11	0.0084008	-0.0007210	-1.3694E-12	1106.1947	2.7443E-05	4000003.
832.000	1.03E-12	-0.0001219	1.8245E-05	-2.1227E-14	1106.1947	-1.2930E-06	4000003.
896.000	-2.99E-14	5.4118E-08	-3.2750E-07	1.6989E-15	1106.1947	3.7333E-08	4000003.
960.000	5.01E-16	0.0000	0.0000	-8.6980E-17	1106.1947	-6.2632E-10	2000002.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.25000000 in
Computed slope at pile head = -0.00000901
Maximum bending moment = -2465758. lbs-in
Maximum shear force = 48967.76435 lbs
Depth of maximum bending moment = 0.00000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 14
Number of zero deflection points = 10

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (Pile-head Condition Type 5)
Specified deflection at pile head = 0.400000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 500000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	0.400000	-3735840.	69991.7279	0.0000	6611.5472	0.0000	0.0000
64.000	0.256412	261379.	45705.0777	-0.0028592	1221.5980	-602.5434	7519.7028
128.000	0.095923	1782803.	1665.2833	-0.0019826	1893.3333	-477.2384	15920.6922
192.000	0.006540	1276114.	-12998.9010	-0.0008738	1669.6211	-49.3703	24155.1727
256.000	-0.027114	530905.	-9728.2444	-0.0002645	1340.5984	79.3606	9366.1089
320.000	-0.024100	73708.8173	-4551.6338	0.0002705	1214.8163	76.3071	10131.8724
384.000	-0.006906	-85265.1775	-427.9825	0.0002062	1231.8464	50.3186	23317.0107
448.000	0.000270	-48718.6010	1018.2017	3.3859E-05	1177.9893	-3.0666	36338.1938
512.000	0.000286	2765.5585	593.2478	-1.3530E-05	1110.2702	-4.0294	45042.1938
576.000	-6.98E-06	-287.2156	-59.3673	4.9066E-07	1106.6179	8.7235	4000003.
640.000	1.25E-07	22.7106	0.0547138	-1.4288E-08	1106.2282	-0.1562555	4000003.
704.000	-1.03E-09	-0.7718587	0.0331410	3.0072E-10	1106.1958	0.0012857	4000003.
768.000	-3.18E-11	0.0185086	-0.0014090	-3.9658E-12	1106.1947	3.9812E-05	4000003.
832.000	1.94E-12	-0.0003083	3.8748E-05	-1.4677E-14	1106.1947	-2.4203E-06	4000003.
896.000	-6.14E-14	1.7631E-06	-7.6850E-07	2.9750E-15	1106.1947	7.6786E-08	4000003.
960.000	1.62E-15	0.0000	0.0000	-1.3651E-16	1106.1947	-2.0268E-09	2000002.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.40000000 in
Computed slope at pile head = -0.00001288
Maximum bending moment = -3735840. lbs-in
Maximum shear force = 69991.72792 lbs
Depth of maximum bending moment = 0.00000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 16
Number of zero deflection points = 10

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Slope (Pile-head Condition Type 5)
Specified deflection at pile head = 0.500000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 500000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	0.500000	-4501018.	81147.8797	0.0000	7739.1569	0.0000	0.0000
64.000	0.324643	192353.	55280.5777	-0.0035221	1191.1218	-639.2163	6300.7402
128.000	0.124265	2139700.	3634.9010	-0.0025161	2050.9092	-610.5877	15723.4764
192.000	0.008770	1577306.	-15408.9388	-0.0011641	1802.6025	-54.4496	19866.4711
256.000	-0.037887	691997.	-11772.9438	-0.0003968	1411.7234	88.7175	7493.3237
320.000	-0.036246	125488.	-5926.0555	0.0003451	1291.1210	87.4191	7717.8614

384.000	-0.012420	-101941.	-1092.0573	0.0003125	1256.4204	61.1781	15763.0765
448.000	-0.000451	-79094.8095	1350.3992	7.1884E-05	1222.7534	5.1233	36338.1878
512.000	0.000374	-1408.4541	996.5951	-1.5937E-05	1108.2703	-5.2711	45042.1914
576.000	-9.54E-06	-245.8321	-89.5846	6.2477E-07	1106.5570	11.9251	4000003.
640.000	1.81E-07	27.9948	0.3599315	-1.9158E-08	1106.2359	-0.2262469	4000003.
704.000	-1.83E-09	-1.0160	0.0384900	4.2295E-10	1106.1962	0.0022827	4000003.
768.000	-3.21E-11	0.0254959	-0.0018132	-6.1376E-12	1106.1947	4.0156E-05	4000003.
832.000	2.42E-12	-0.0004528	5.2344E-05	2.6024E-15	1106.1947	-3.0294E-06	4000003.
896.000	-8.15E-14	3.5976E-06	-1.0920E-06	3.5521E-15	1106.1947	1.0189E-07	4000003.
960.000	2.60E-15	0.0000	0.0000	-1.4884E-16	1106.1947	-3.2519E-09	2000002.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

Pile-head deflection = 0.50000000 in
Computed slope at pile head = -0.00001493
Maximum bending moment = -4501018. lbs-in
Maximum shear force = 81147.87970 lbs
Depth of maximum bending moment = 0.00000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 16
Number of zero deflection points = 10

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (Pile-head Condition Type 5)
Specified deflection at pile head = 1.000000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 500000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	1.000000	-7762857.	120724.	0.0000	12545.9932	0.0000	0.0000
64.000	0.682970	-498674.	93293.8620	-0.0065622	1326.3678	-671.8068	3147.6971
128.000	0.290441	3535949.	19956.0036	-0.0052338	2667.3774	-1259.8524	13880.6945
192.000	0.035370	2993925.	-24596.7587	-0.0028131	2428.0647	-86.6879	7842.8874
256.000	-0.089813	1531794.	-20843.7093	-0.0012690	1782.5082	118.2869	4214.4973
320.000	-0.104948	461425.	-12784.3206	0.0006420	1786.1770	124.5880	3798.8653
384.000	-0.047560	-146022.	-5613.5534	0.0009180	1321.3811	95.6984	6438.9004
448.000	-0.006218	-262004.	2866.2151	0.0003279	1492.2990	70.6065	36336.4164
512.000	0.000761	-35984.6879	3478.8917	-2.0780E-05	1159.2238	-10.7138	45042.1735
576.000	-2.21E-05	356.2941	-260.6530	1.1573E-06	1106.7197	27.6212	4000003.
640.000	4.83E-07	45.6039	2.6318	-4.2014E-08	1106.2619	-0.6037775	4000003.
704.000	-6.88E-09	-2.1065	0.0461824	1.0545E-09	1106.1978	0.0085989	4000003.
768.000	-2.43E-12	0.0602806	-0.0034879	-1.8733E-11	1106.1948	3.0420E-06	4000003.
832.000	4.20E-12	-0.0012469	0.0001173	1.4896E-13	1106.1947	-5.2557E-06	4000003.
896.000	-1.73E-13	1.5821E-05	-2.7907E-06	4.9808E-15	1106.1947	2.1656E-07	4000003.
960.000	8.45E-15	0.0000	0.0000	-1.0658E-16	1106.1947	-1.0567E-08	2000002.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection = 1.00000000 in
Computed slope at pile head = -0.00002222
Maximum bending moment = -7762857. lbs-in
Maximum shear force = 120723.74655 lbs
Depth of maximum bending moment = 0.00000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 15
Number of zero deflection points = 10

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (Pile-head Condition Type 5)
Specified deflection at pile head = 2.000000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 500000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	2.000	-1.2857E+07	170851.	0.0000	20053.2703	0.0000	0.0000
64.000	1.452	-2270386.	143379.	-0.0116425	2108.6094	-672.3942	1481.5533
128.000	0.720213	5019762.	59446.8146	-0.0103843	3322.5068	-1925.4561	8555.0554
192.000	0.181034	5285594.	-34371.2831	-0.0064558	3439.8761	-149.4071	2640.9565
256.000	-0.131331	3106001.	-34726.6557	-0.0035603	2477.5478	134.2572	3271.2963
320.000	-0.215632	1232874.	-24889.2701	0.0007327	2923.0294	158.3837	2350.4323
384.000	-0.114140	-101108.	-15539.2474	0.0019256	1255.1938	128.1205	3591.9450
448.000	-0.019303	-587815.	4568.4892	0.0008412	1972.4337	219.1004	36321.0399
512.000	0.001320	-120796.	7882.0333	-1.0882E-05	1284.2067	-18.5737	45042.1262
576.000	-4.45E-05	3298.7406	-672.6003	1.5197E-06	1111.0559	55.5635	4000003.
640.000	1.15E-06	38.0773	10.3096	-7.7933E-08	1106.2508	-1.4370	4000003.
704.000	-2.12E-08	-3.5491	-0.0269502	2.3301E-09	1106.1999	0.0265348	4000003.
768.000	1.96E-10	0.1246831	-0.0050305	-5.0282E-11	1106.1949	-0.0002448	4000003.
832.000	4.53E-12	-0.0030611	0.0002250	6.9833E-13	1106.1947	-5.6605E-06	4000003.
896.000	-3.05E-13	5.2713E-05	-6.3430E-06	9.6403E-16	1106.1947	3.8145E-07	4000003.
960.000	2.38E-14	0.0000	0.0000	4.4989E-16	1106.1947	-2.9723E-08	2000002.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 5:

Pile-head deflection = 2.00000000 in
Computed slope at pile head = -0.00003147
Maximum bending moment = -12857170. lbs-in
Maximum shear force = 170851.42448 lbs
Depth of maximum bending moment = 0.00000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 14
Number of zero deflection points = 10

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
5	y= 0.250000	S= 0.000	500000.	0.2500000	-2465758.	48967.7644
5	y= 0.400000	S= 0.000	500000.	0.4000000	-3735840.	69991.7279
5	y= 0.500000	S= 0.000	500000.	0.5000000	-4501018.	81147.8797
5	y= 1.000000	S= 0.000	500000.	1.0000000	-7762857.	120724.
5	y= 2.000	S= 0.000	500000.	2.0000	-1.2857E+07	170851.

Pile-head Deflection vs. Pile Length

Boundary Condition Type 5, Deflection and Slope

Deflection = 0.25000 in
Slope = 0.00000
Axial Load = 500000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
960.000	0.25000000	-2465758.	48967.76435
912.000	0.25000000	-2498840.	49221.19786
864.000	0.25000000	-2456644.	48930.10924
816.000	0.25000000	-2489037.	49136.33843
768.000	0.25000000	-2463098.	49009.23919
720.000	0.25000000	-2489025.	49025.04151
672.000	0.25000000	-2483487.	49129.09734
624.000	0.25000000	-2467726.	48955.89040
576.000	0.25000000	-2470659.	49033.92349
528.000	0.25000000	-2476145.	49067.06898

The analysis ended normally.

LPILE Lateral Analysis – 5th Street Bridge, Abutment 11, Wingwalls, 24” CIDH

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LPILE Plus for Windows, Version 5.0 (5.0.47)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

TC
EMI

Files Used for Analysis

Path to file locations: C:\Users\t.ke\Documents\13-121 - Dokken, 5th Street Bridge PSR PR\DFR\Analysis\20160927Abut_wingwal_piles_LP_pin\5th_Anut11\
Name of input data file: P11.lpd
Name of output file: P11.lpo
Name of plot output file: P11.lpp
Name of runtime file: P11.lpr

Time and Date of Analysis

Date: September 27, 2016 Time: 17:10:21

Problem Title

5th Street Bridge, Abut 11NS RW, 24"CIDH (pm_avg=0.60), LQ

Program Options

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 300
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 20

Pile Structural Properties and Geometry

Pile Length = 720.00 in

Depth of ground surface below top of pile = -24.00 in

Slope angle of ground surface = 0.00 deg.

Structural properties of pile defined using 2 points

Point No.	Point Depth in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	24.00000000	8143.0000	452.0000	3420000.
2	960.0000	24.00000000	8143.0000	452.0000	3420000.

Soil and Rock Layering Information

The soil profile is modelled using 7 layers

Layer 1 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = -24.000 in
Distance from top of pile to bottom of layer = 108.000 in
p-y subgrade modulus k for top of soil layer = 70.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 70.000 lbs/in**3

Layer 2 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 108.000 in
Distance from top of pile to bottom of layer = 168.000 in
p-y subgrade modulus k for top of soil layer = 45.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 45.000 lbs/in**3

Layer 3 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 168.000 in
Distance from top of pile to bottom of layer = 192.000 in
p-y subgrade modulus k for top of soil layer = 10.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 10.000 lbs/in**3

Layer 4 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 192.000 in
Distance from top of pile to bottom of layer = 408.000 in

Layer 5 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 408.000 in
Distance from top of pile to bottom of layer = 528.000 in
p-y subgrade modulus k for top of soil layer = 50.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 50.000 lbs/in**3

Layer 6 is stiff clay without free water
Distance from top of pile to top of layer = 528.000 in
Distance from top of pile to bottom of layer = 1368.000 in

Layer 7 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 1368.000 in
Distance from top of pile to bottom of layer = 1992.000 in
p-y subgrade modulus k for top of soil layer = 118.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 118.000 lbs/in**3

(Depth of lowest layer extends 1272.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 14 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-24.00	0.06366
2	108.00	0.06266
3	108.00	0.06366
4	168.00	0.06366
5	168.00	0.06076
6	192.00	0.06076
7	192.00	0.02466
8	408.00	0.02466
9	408.00	0.03333
10	528.00	0.03333
11	528.00	0.03623
12	1368.00	0.03623
13	1368.00	0.03912
14	1992.00	0.03912

Shear Strength of Soils

Shear strength parameters with depth defined using 14 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-24.000	0.00000	32.00	------	------
2	108.000	0.00000	32.00	------	------
3	108.000	0.00000	30.00	------	------
4	168.000	0.00000	30.00	------	------
5	168.000	0.00000	28.00	------	------
6	192.000	0.00000	28.00	------	------
7	192.000	2.77780	0.00	0.01500	0.0
8	408.000	2.77780	0.00	0.01500	0.0
9	408.000	0.00000	32.00	------	------
10	528.000	0.00000	32.00	------	------
11	528.000	27.77780	0.00	0.00500	0.0
12	1368.000	27.77780	0.00	0.00500	0.0
13	1368.000	0.00000	38.00	------	------
14	1992.000	0.00000	38.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

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p-y Modification Factors

Distribution of p-y multipliers with depth defined using 2 points

Point No.	Depth X in	p-mult	y-mult
1	0.000	0.6000	1.0000
2	720.000	0.6000	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 4

Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.250 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 400000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.500 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 400000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 1.000 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 400000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 2.000 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 400000.000 lbs

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition Type 4)
Specified deflection at pile head = 0.250000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 400000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	0.250000	0.0000	18966.3894	-0.0031124	884.9558	-192.1659	922.3962
48.000	0.112007	662190.	5529.0775	-0.0024450	1860.7981	-304.7328	6529.5598
96.000	0.023995	660077.	-5526.1713	-0.0012249	1857.6833	-120.6371	12066.4662
144.000	-0.011450	359754.	-6192.9190	-0.0003405	1415.1105	56.0692	11752.5726
192.000	-0.016422	132353.	-3896.2961	6.8709E-05	1079.9991	47.3975	6926.9557
240.000	-0.009883	-4784.9500	-1768.7906	0.0001642	892.0071	40.0274	9720.5974
288.000	-0.003107	-50795.7234	-138.4099	0.0001049	959.8113	27.2424	21040.5283
336.000	-9.37E-05	-33128.1593	787.4945	2.5912E-05	933.7753	4.7508	121645.
384.000	0.000265	-3763.1967	312.5079	-2.3161E-06	890.5014	-13.4337	121645.
432.000	0.000115	930.0629	14.5379	-2.8132E-06	886.3263	-0.9544159	19986.3271
480.000	2.21E-05	896.2106	-11.5125	-1.0582E-06	886.2765	-0.2161002	23442.3274
528.000	-1.35E-07	230.0142	-14.7168	-6.3962E-08	885.2947	0.1685886	3000002.
576.000	-1.96E-08	-13.8611	0.5868180	5.4506E-09	884.9762	0.0244604	3000002.
624.000	2.78E-09	0.7205418	-0.0113840	-3.8506E-10	884.9568	-0.0034779	3000002.
672.000	-2.47E-10	-0.0300603	-0.0009261	2.3621E-11	884.9558	0.0003091	3000002.
720.000	2.81E-11	0.0000	0.0000	-8.9161E-13	884.9558	-3.5093E-05	1500001.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.25000000 in
Computed slope at pile head = -0.00311236
Maximum bending moment = 732062.05084 lbs-in
Maximum shear force = 18966.38938 lbs
Depth of maximum bending moment = 69.60000000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 13
Number of zero deflection points = 6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition Type 4)
Specified deflection at pile head = 0.500000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 400000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	0.500000	0.0000	30901.9992	-0.0059674	884.9558	-243.5240	584.4575

48.000	0.232937	1174064.	11954.7951	-0.0048192	2615.1251	-485.6410	5003.6550
96.000	0.055243	1262684.	-9369.1430	-0.0025618	2745.7203	-274.8663	11941.4036
144.000	-0.022478	718196.	-11577.3459	-0.0008378	1943.3311	110.0196	11747.1517
192.000	-0.039395	311883.	-6704.7858	1.7701E-05	1344.5654	63.4401	3864.8774
240.000	-0.029605	57924.6192	-3760.8948	0.0003169	970.3169	57.6805	4675.9887
288.000	-0.014127	-66683.0067	-1274.7590	0.0002922	983.2237	45.0791	7658.4691
336.000	-0.003439	-86300.2437	499.7398	0.0001477	1012.1328	28.1588	19652.4280
384.000	0.000570	-41716.0977	1021.9213	3.2761E-05	946.4310	-15.4324	65006.1034
432.000	0.000957	-9770.2422	422.7666	-7.5798E-06	899.3538	-7.9720	19986.3071
480.000	0.000412	2745.6505	122.4775	-1.1561E-05	889.0019	-4.0266	23442.3239
528.000	2.97E-05	5829.1703	-14.2636	-3.5291E-06	893.5460	-37.1152	3000002.
576.000	-2.41E-06	-214.1011	-13.7954	2.0579E-07	885.2713	3.0154	3000002.
624.000	1.65E-07	2.3873	1.6510	-1.0260E-08	884.9593	-0.2063893	3000002.
672.000	-9.92E-09	0.5470432	-0.1371157	3.9244E-10	884.9566	0.0124037	3000002.
720.000	1.78E-09	0.0000	0.0000	8.9479E-11	884.9558	-0.0022236	1500001.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.50000000 in
Computed slope at pile head = -0.00596735
Maximum bending moment = 1358490. lbs-in
Maximum shear force = 30901.99921 lbs
Depth of maximum bending moment = 74.40000000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 15
Number of zero deflection points = 6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition Type 4)
Specified deflection at pile head = 1.000000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 400000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	1.000000	0.0000	44113.6136	-0.0110691	884.9558	-252.5432	303.0519
48.000	0.497950	1872191.	23499.4241	-0.0093064	3643.9254	-572.7848	2760.6832
96.000	0.141056	2313960.	-11986.4414	-0.0054351	4294.9417	-656.3008	11166.6506
144.000	-0.034418	1438100.	-20766.6526	-0.0021381	3004.2239	168.3251	11737.3233
192.000	-0.088942	724381.	-11550.3597	-0.0003363	1952.4455	83.2220	2245.6653
240.000	-0.082064	263473.	-7558.5237	0.0004898	1273.2246	81.0204	2369.4846
288.000	-0.052171	-21663.3864	-3915.6545	0.0006736	916.8802	69.6681	3204.9314
336.000	-0.022965	-147008.	-954.4372	0.0005073	1101.5948	53.0007	5538.9672
384.000	-0.005051	-146495.	1106.2388	0.0002395	1100.8394	32.0033	15206.3347
432.000	0.001269	-74050.7148	1610.0749	4.5412E-05	994.0812	-10.5648	19986.2917
480.000	0.001339	-12875.4951	924.0182	-2.4804E-05	903.9298	-13.0757	23442.2909
528.000	0.000147	21339.6741	359.6623	-1.5110E-05	916.4031	-183.3965	3000002.
576.000	-1.10E-05	-626.2784	-83.4200	8.3107E-07	885.8787	13.7896	3000002.
624.000	7.13E-07	-9.4868	8.2712	-3.8134E-08	884.9697	-0.8913415	3000002.
672.000	-4.05E-08	3.5055	-0.6324530	1.1999E-09	884.9609	0.0506551	3000002.
720.000	7.74E-09	0.0000	0.0000	4.5626E-10	884.9558	-0.0096722	1500001.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

Pile-head deflection = 1.00000000 in
Computed slope at pile head = -0.01106911
Maximum bending moment = 2378308. lbs-in
Maximum shear force = 44113.61358 lbs
Depth of maximum bending moment = 84.00000000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 17
Number of zero deflection points = 6

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (Pile-head Condition Type 4)
Specified deflection at pile head = 2.000000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 400000.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	2.000	0.0000	59131.6984	-0.0201001	884.9558	-252.7165	151.6299
48.000	1.077	2760494.	38448.4325	-0.0175694	4952.9811	-579.1232	1290.8404
96.000	0.371569	3945949.	-6450.9695	-0.0114623	6699.9364	-1225.5271	7915.8041
144.000	-0.025221	2842074.	-34371.7090	-0.0054056	5073.2018	123.4260	11745.2580
192.000	-0.186168	1636583.	-19838.8154	-0.0016449	3296.7203	106.4560	1372.3884
240.000	-0.209392	819684.	-14553.6641	0.0004412	2092.8898	110.7112	1268.9460
288.000	-0.163242	227715.	-9414.0731	0.0013108	1220.5294	101.8954	1498.0716
336.000	-0.096697	-139057.	-4890.4751	0.0013562	1089.8789	85.5767	2123.9998
384.000	-0.040272	-305623.	-1283.5992	0.0009470	1335.3389	63.9096	3808.6525
432.000	-0.007999	-290520.	2861.4582	0.0004011	1313.0833	66.6101	19984.9118
480.000	0.001381	-123526.	3615.9174	3.8845E-05	1066.9911	-13.4930	23442.2886
528.000	0.000406	34213.9737	2424.9276	-3.4059E-05	935.3755	-507.2992	3000002.
576.000	-2.76E-05	-297.2895	-281.4604	1.6811E-06	885.3939	34.4524	3000002.
624.000	1.63E-06	-96.9999	23.2549	-6.3723E-08	885.0987	-2.0384	3000002.
672.000	-8.38E-08	12.3646	-1.5996	8.6150E-10	884.9740	0.1047620	3000002.
720.000	1.79E-08	0.0000	0.0000	1.3090E-09	884.9558	-0.0223824	1500001.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection = 2.00000000 in
Computed slope at pile head = -0.02010012
Maximum bending moment = 3946735. lbs-in
Maximum shear force = 59131.69836 lbs
Depth of maximum bending moment = 93.60000000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 14
Number of zero deflection points = 6

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= 0.250000	M= 0.000	400000.	0.2500000	732062.	18966.3894
4	y= 0.500000	M= 0.000	400000.	0.5000000	1358490.	30901.9992
4	y= 1.000000	M= 0.000	400000.	1.0000000	2378308.	44113.6136
4	y= 2.000	M= 0.000	400000.	2.0000	3946735.	59131.6984

Pile-head Deflection vs. Pile Length

Boundary Condition Type 4, Deflection and Moment

Deflection = 0.25000 in
Moment = 0. in-lbs
Axial Load = 400000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
720.000	0.25000000	732062.05084	18966.38938
684.000	0.25000000	732607.74232	18974.64307
648.000	0.25000000	732742.21962	18978.13212
612.000	0.25000000	732575.19977	18977.38091
576.000	0.25000000	732933.44984	18982.15392
540.000	0.25000000	732596.01886	18976.48948
504.000	0.25000000	733076.60382	18984.40889
468.000	0.25000000	732703.41488	18977.74435
432.000	0.25000000	732609.71391	18977.64536
396.000	0.25000000	732785.13692	18981.08030

The analysis ended normally.

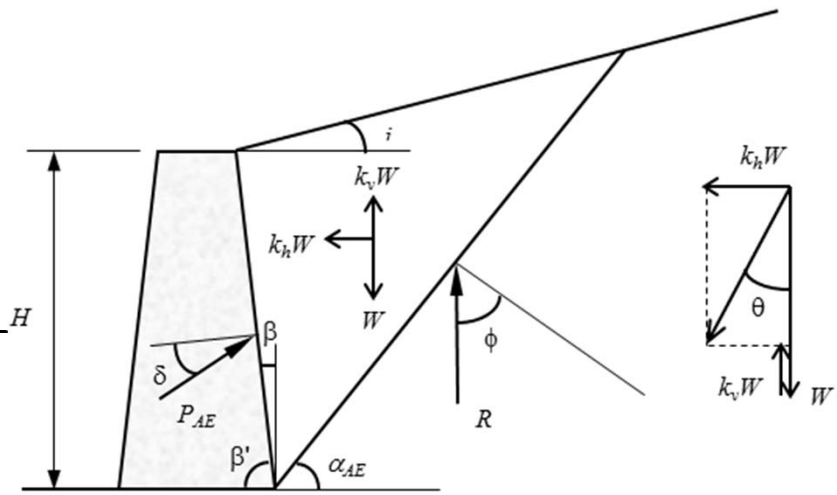
Lateral Earth Pressures and Slope Stability

Active Earth Pressure (Coulomb and Mononobe-Okabe Methods)

Project:	5th Street Bridge	Project Number:	13-121		
Location:	Yuba City	Calculations by:	AZ	Date:	9/12/2016
		Checked by:	TK	Date:	9/12/2016

(k_h = 1/2 PGA of 0.24 g)

ϕ =	34	deg
k_h =	0.120	
k_v =	0	
β =	0	deg
i =	0	deg
H =	25	ft
γ =	125	pcf
δ =	0	deg
β' =	90	deg
θ =	6.843	deg



Active Earth Pressure :

Static (Coulumb):

K_A =	0.283	
P_A =	11,044	lbs
K_{AH} =	0.283	
P_{AH} =	11,044	lbs
EFP =	35.3	pcf

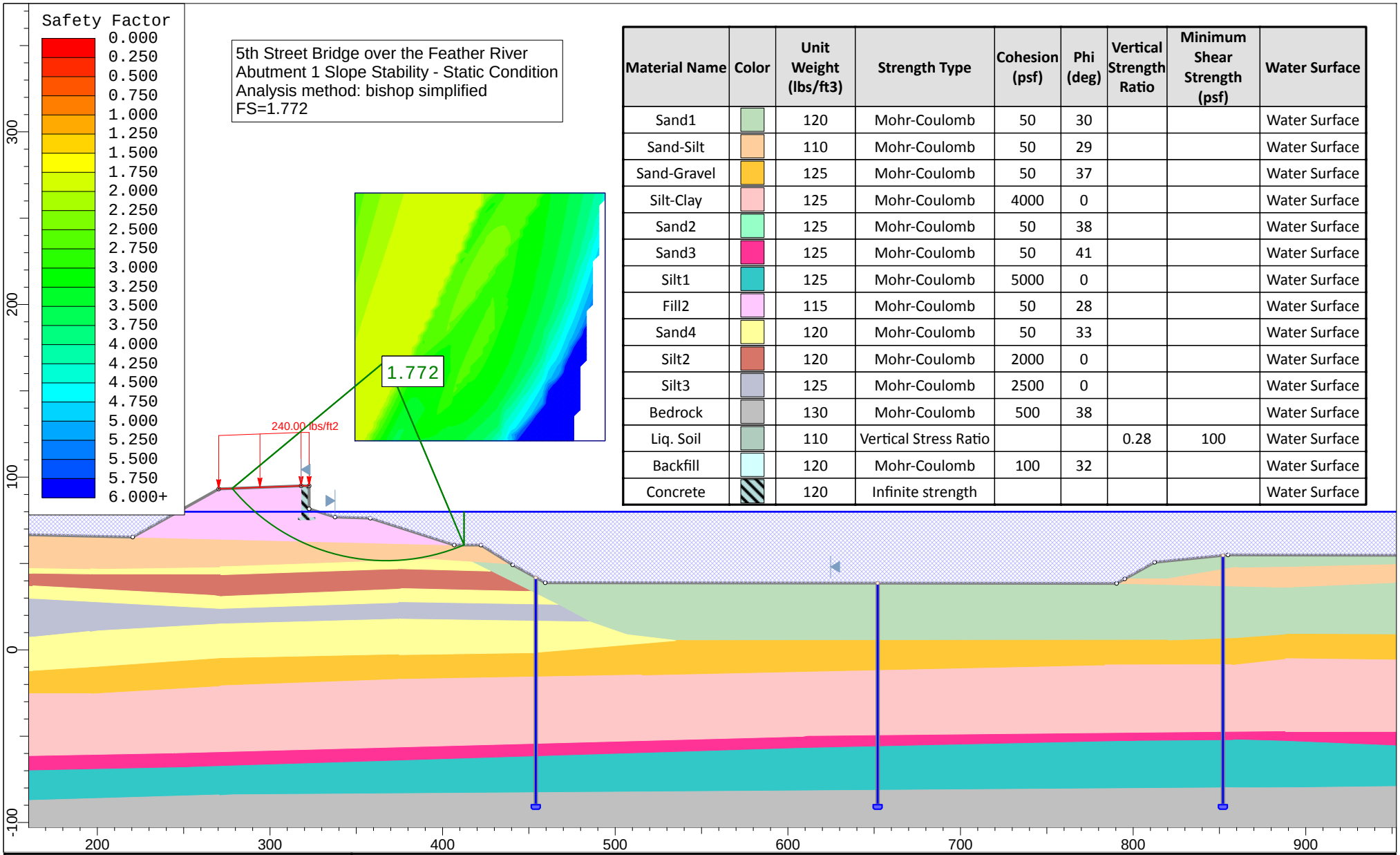
Seismic (Mononobe-Okabe):

K_{AE} =	0.354	
P_{AE} =	13,813	lbs
K_{AEH} =	0.354	
P_{AEH} =	13,813	lbs
EFP_E =	44.2	pcf
ΔEFP_E =	8.9	pcf

Approximate Failure Plane Angle:

Static: α_A = 62 degrees

Seismic: α_{AE} = 57 degrees

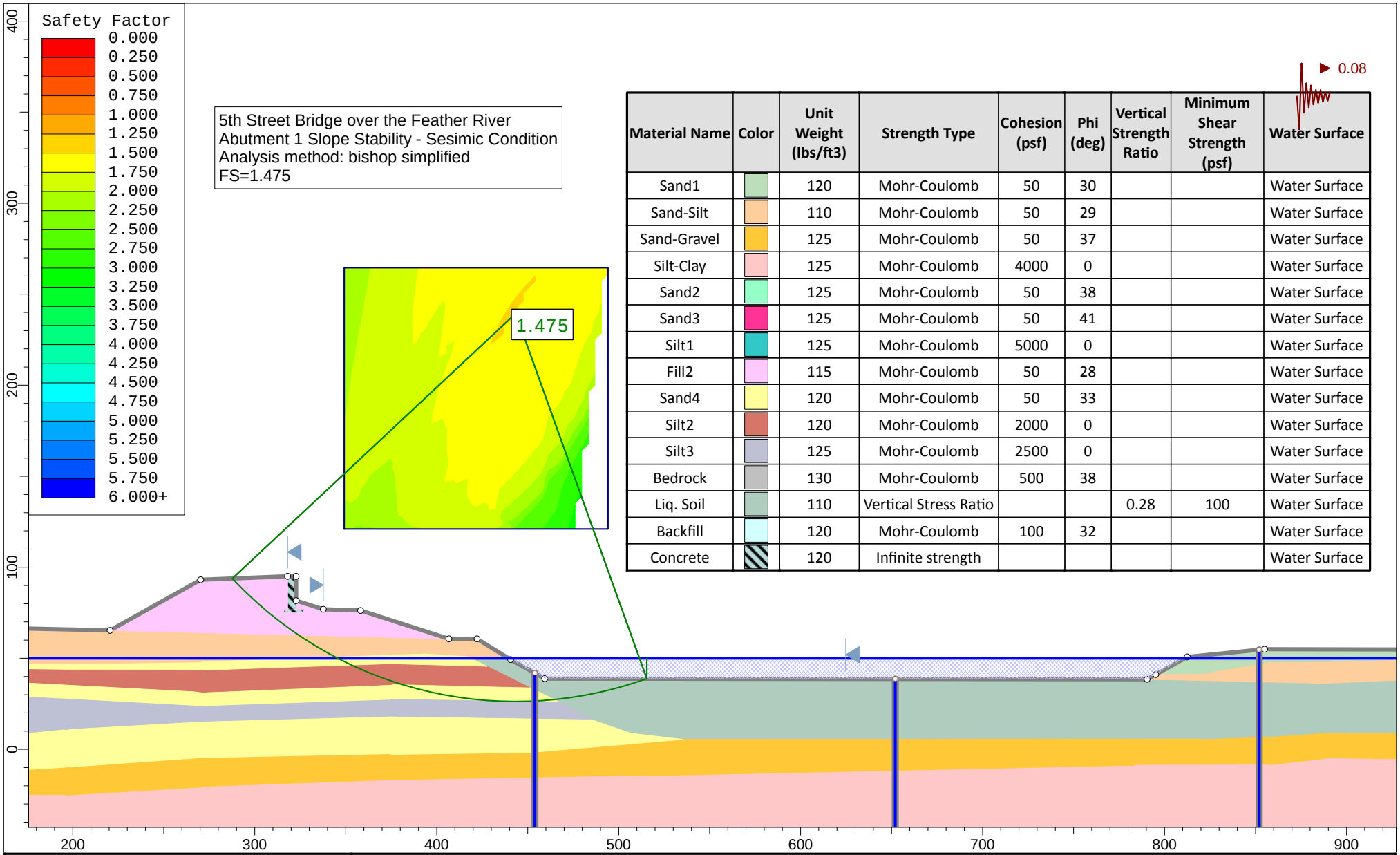


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)	Water Surface
Sand1		120	Mohr-Coulomb	50	30			Water Surface
Sand-Silt		110	Mohr-Coulomb	50	29			Water Surface
Sand-Gravel		125	Mohr-Coulomb	50	37			Water Surface
Silt-Clay		125	Mohr-Coulomb	4000	0			Water Surface
Sand2		125	Mohr-Coulomb	50	38			Water Surface
Sand3		125	Mohr-Coulomb	50	41			Water Surface
Silt1		125	Mohr-Coulomb	5000	0			Water Surface
Fill2		115	Mohr-Coulomb	50	28			Water Surface
Sand4		120	Mohr-Coulomb	50	33			Water Surface
Silt2		120	Mohr-Coulomb	2000	0			Water Surface
Silt3		125	Mohr-Coulomb	2500	0			Water Surface
Bedrock		130	Mohr-Coulomb	500	38			Water Surface
Liq. Soil		110	Vertical Stress Ratio			0.28	100	Water Surface
Backfill		120	Mohr-Coulomb	100	32			Water Surface
Concrete		120	Infinite strength					Water Surface

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

Project	5th Street Bridge over the Feather River
Analysis Description	Abutment 1 Slope Stability - Static Condition
Drawn By	AZ
Scale	1:922
Company	
Date	
File Name	Abut 1 circular.slim

SLIDEINTERPRET 7.017

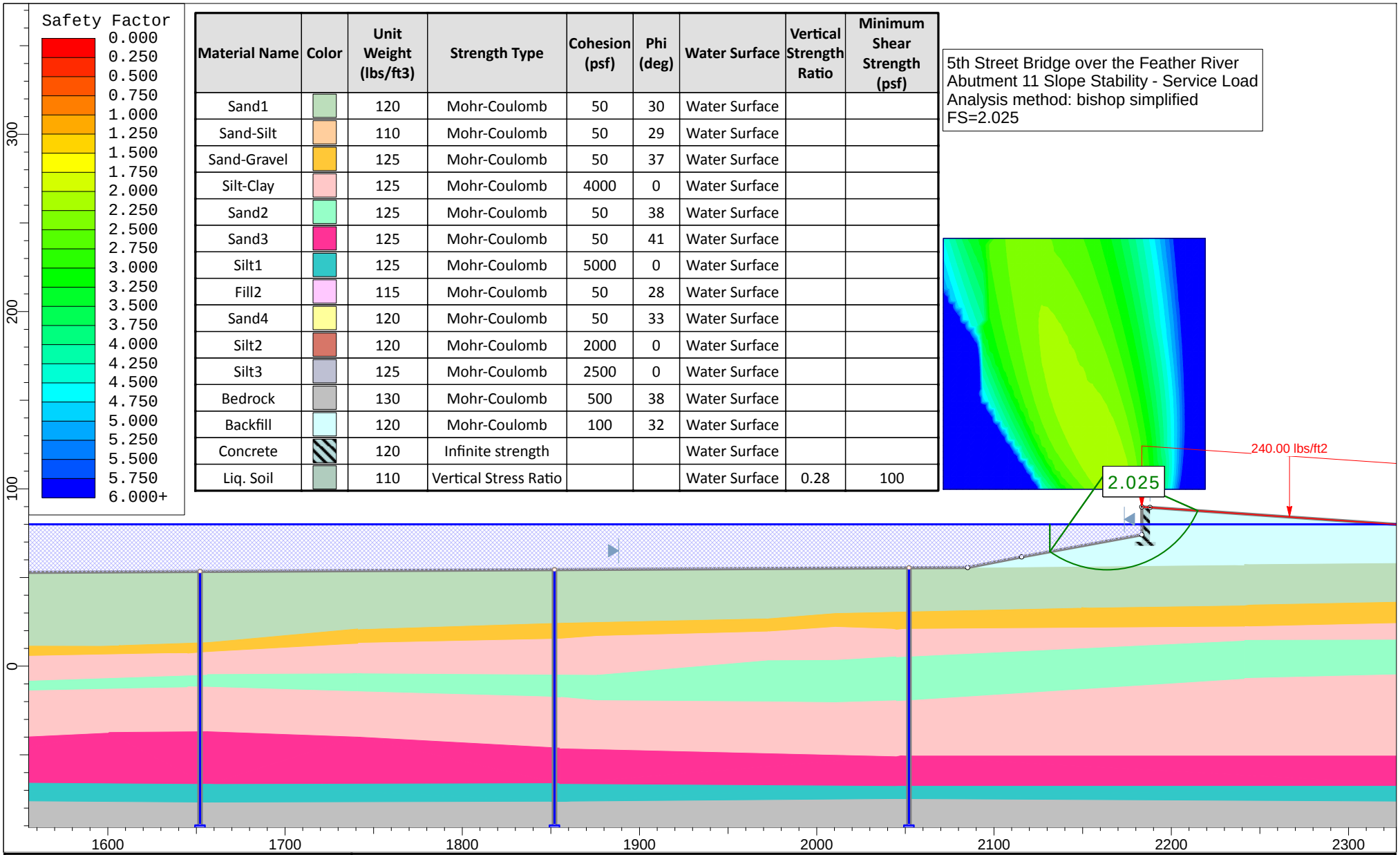


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)	Water Surface
Sand1		120	Mohr-Coulomb	50	30			Water Surface
Sand-Silt		110	Mohr-Coulomb	50	29			Water Surface
Sand-Gravel		125	Mohr-Coulomb	50	37			Water Surface
Silt-Clay		125	Mohr-Coulomb	4000	0			Water Surface
Sand2		125	Mohr-Coulomb	50	38			Water Surface
Sand3		125	Mohr-Coulomb	50	41			Water Surface
Silt1		125	Mohr-Coulomb	5000	0			Water Surface
Fill2		115	Mohr-Coulomb	50	28			Water Surface
Sand4		120	Mohr-Coulomb	50	33			Water Surface
Silt2		120	Mohr-Coulomb	2000	0			Water Surface
Silt3		125	Mohr-Coulomb	2500	0			Water Surface
Bedrock		130	Mohr-Coulomb	500	38			Water Surface
Liq. Soil		110	Vertical Stress Ratio			0.28	100	Water Surface
Backfill		120	Mohr-Coulomb	100	32			Water Surface
Concrete		120	Infinite strength					Water Surface

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

Project	5th Street Bridge over the Feather River		
Analysis Description	Abutment 1 Slope Stability - Sesimic Condition		
Drawn By	AZ	Scale 1:875	Company
Date			File Name Abut 1 EQ circular.slim

SLIDEINTERPRET 7.017



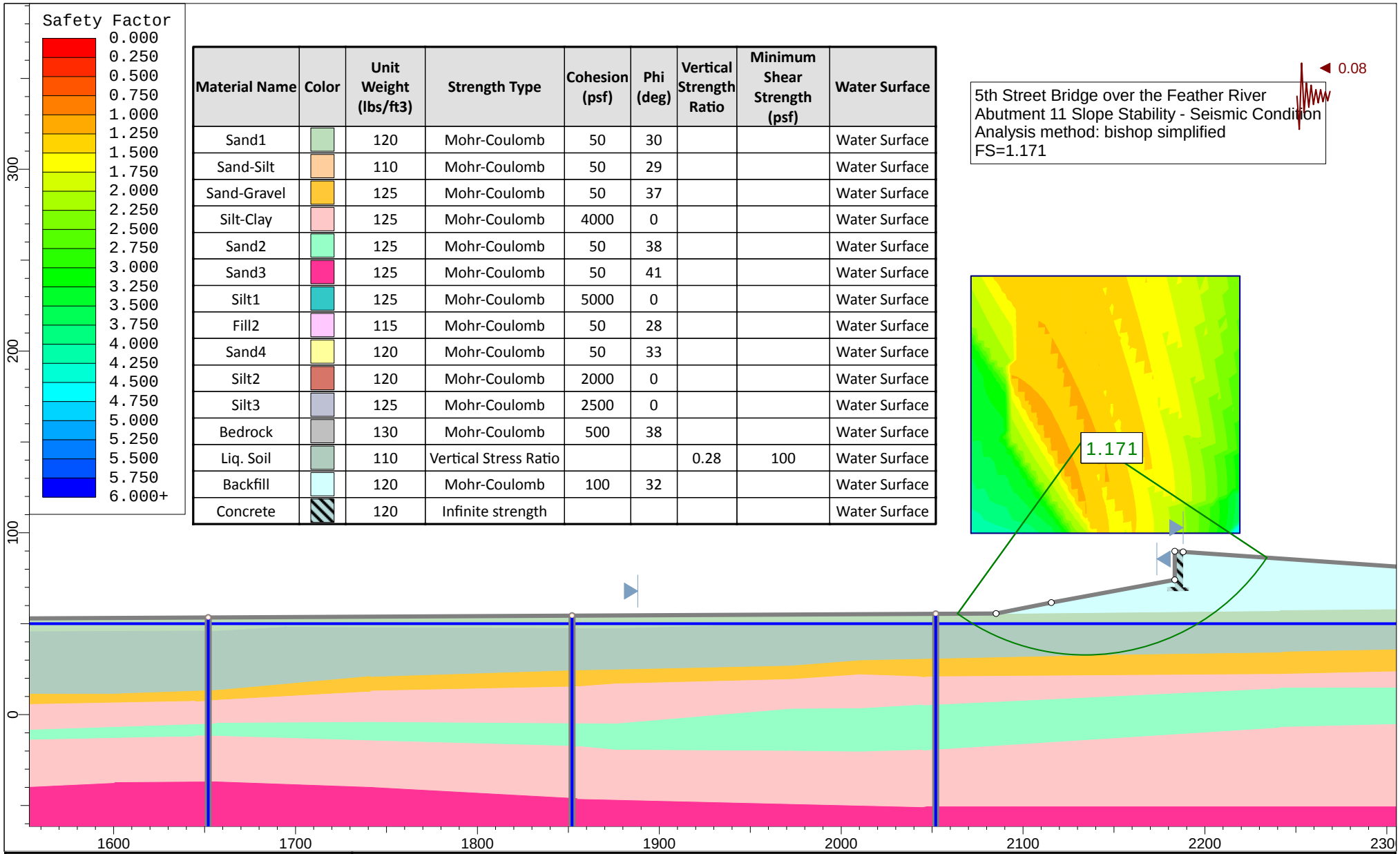
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Vertical Strength Ratio	Minimum Shear Strength (psf)
Sand1		120	Mohr-Coulomb	50	30	Water Surface		
Sand-Silt		110	Mohr-Coulomb	50	29	Water Surface		
Sand-Gravel		125	Mohr-Coulomb	50	37	Water Surface		
Silt-Clay		125	Mohr-Coulomb	4000	0	Water Surface		
Sand2		125	Mohr-Coulomb	50	38	Water Surface		
Sand3		125	Mohr-Coulomb	50	41	Water Surface		
Silt1		125	Mohr-Coulomb	5000	0	Water Surface		
Fill2		115	Mohr-Coulomb	50	28	Water Surface		
Sand4		120	Mohr-Coulomb	50	33	Water Surface		
Silt2		120	Mohr-Coulomb	2000	0	Water Surface		
Silt3		125	Mohr-Coulomb	2500	0	Water Surface		
Bedrock		130	Mohr-Coulomb	500	38	Water Surface		
Backfill		120	Mohr-Coulomb	100	32	Water Surface		
Concrete		120	Infinite strength			Water Surface		
Liq. Soil		110	Vertical Stress Ratio			Water Surface	0.28	100

5th Street Bridge over the Feather River
Abutment 11 Slope Stability - Service Load
Analysis method: bishop simplified
FS=2.025

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

Project	5th Street Bridge over the Feather River		
Analysis Description	Abutment 11 Slope Stability - Service Load		
Drawn By: AZ	Scale: 1:898	Company	
Date		File Name: Abut 11 static circular.slim	

SLIDEINTERPRET 7.017

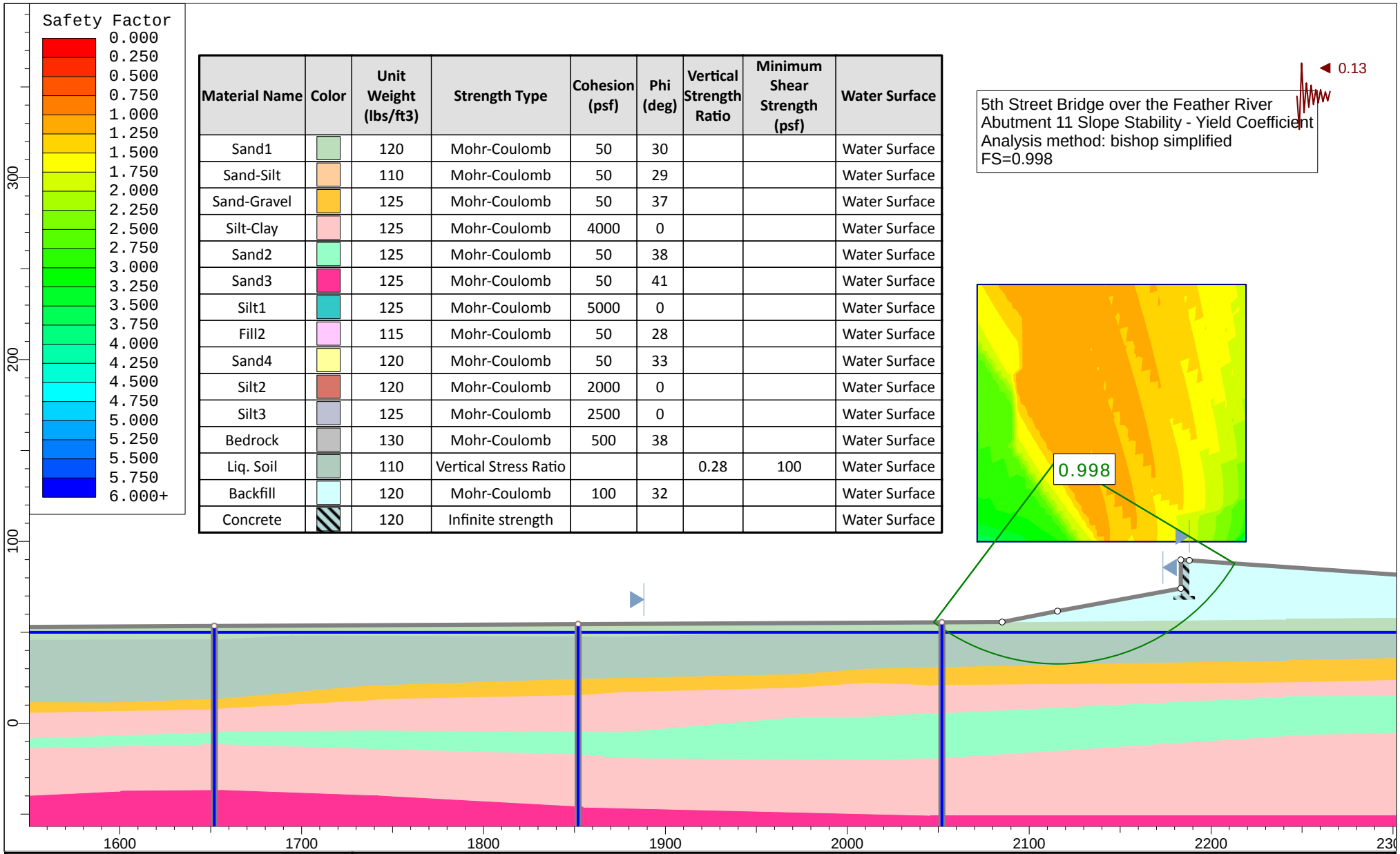


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)	Water Surface
Sand1		120	Mohr-Coulomb	50	30			Water Surface
Sand-Silt		110	Mohr-Coulomb	50	29			Water Surface
Sand-Gravel		125	Mohr-Coulomb	50	37			Water Surface
Silt-Clay		125	Mohr-Coulomb	4000	0			Water Surface
Sand2		125	Mohr-Coulomb	50	38			Water Surface
Sand3		125	Mohr-Coulomb	50	41			Water Surface
Silt1		125	Mohr-Coulomb	5000	0			Water Surface
Fill2		115	Mohr-Coulomb	50	28			Water Surface
Sand4		120	Mohr-Coulomb	50	33			Water Surface
Silt2		120	Mohr-Coulomb	2000	0			Water Surface
Silt3		125	Mohr-Coulomb	2500	0			Water Surface
Bedrock		130	Mohr-Coulomb	500	38			Water Surface
Liq. Soil		110	Vertical Stress Ratio			0.28	100	Water Surface
Backfill		120	Mohr-Coulomb	100	32			Water Surface
Concrete		120	Infinite strength					Water Surface

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

Project	5th Street Bridge over the Feather River		
Analysis Description	Abutment 11 Slope Stability - Seismic Condition		
Drawn By	AZ	Scale 1:875	Company
Date			File Name Abut 11 EQ circular.slim

SLIDEINTERPRET 7.017



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)	Water Surface
Sand1		120	Mohr-Coulomb	50	30			Water Surface
Sand-Silt		110	Mohr-Coulomb	50	29			Water Surface
Sand-Gravel		125	Mohr-Coulomb	50	37			Water Surface
Silt-Clay		125	Mohr-Coulomb	4000	0			Water Surface
Sand2		125	Mohr-Coulomb	50	38			Water Surface
Sand3		125	Mohr-Coulomb	50	41			Water Surface
Silt1		125	Mohr-Coulomb	5000	0			Water Surface
Fill2		115	Mohr-Coulomb	50	28			Water Surface
Sand4		120	Mohr-Coulomb	50	33			Water Surface
Silt2		120	Mohr-Coulomb	2000	0			Water Surface
Silt3		125	Mohr-Coulomb	2500	0			Water Surface
Bedrock		130	Mohr-Coulomb	500	38			Water Surface
Liq. Soil		110	Vertical Stress Ratio			0.28	100	Water Surface
Backfill		120	Mohr-Coulomb	100	32			Water Surface
Concrete		120	Infinite strength					Water Surface

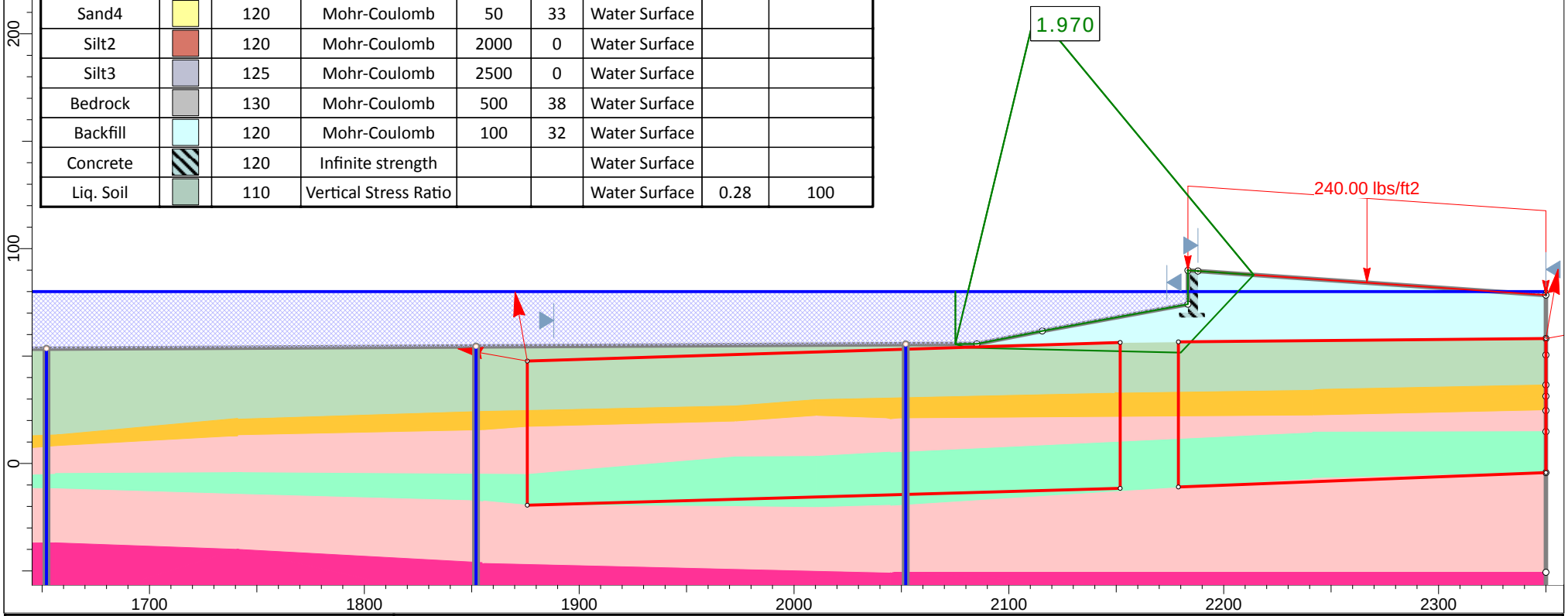
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

Project	5th Street Bridge over the Feather River		
Analysis Description	Abutment 11 Slope Stability - Yield Coefficient		
Drawn By	AZ	Scale 1:875	Company
Date			File Name Abut 11 Yield Coeff circular.slim

SLIDEINTERPRET 7.017

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Vertical Strength Ratio	Minimum Shear Strength (psf)
Sand1		120	Mohr-Coulomb	50	30	Water Surface		
Sand-Silt		110	Mohr-Coulomb	50	29	Water Surface		
Sand-Gravel		125	Mohr-Coulomb	50	37	Water Surface		
Silt-Clay		125	Mohr-Coulomb	4000	0	Water Surface		
Sand2		125	Mohr-Coulomb	50	38	Water Surface		
Sand3		125	Mohr-Coulomb	50	41	Water Surface		
Silt1		125	Mohr-Coulomb	5000	0	Water Surface		
Fill2		115	Mohr-Coulomb	50	28	Water Surface		
Sand4		120	Mohr-Coulomb	50	33	Water Surface		
Silt2		120	Mohr-Coulomb	2000	0	Water Surface		
Silt3		125	Mohr-Coulomb	2500	0	Water Surface		
Bedrock		130	Mohr-Coulomb	500	38	Water Surface		
Backfill		120	Mohr-Coulomb	100	32	Water Surface		
Concrete		120	Infinite strength			Water Surface		
Liq. Soil		110	Vertical Stress Ratio			Water Surface	0.28	100

5th Street Bridge over the Feather River
Abutment 11 Slope Stability - Service Load (Block Failure)
Analysis method: spencer
FS=1.970



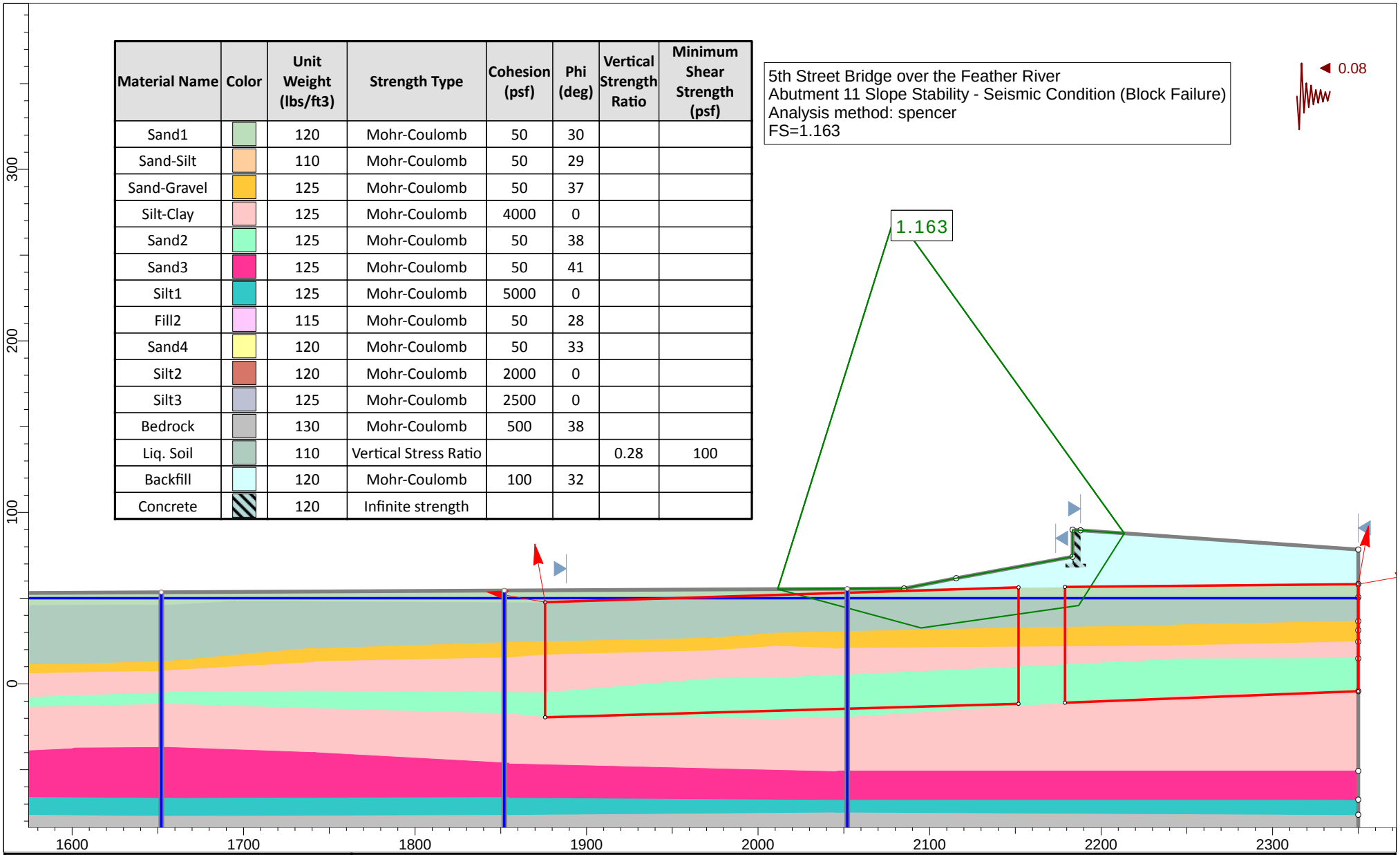
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

Project	5th Street Bridge over the Feather River
Analysis Description	Abutment 11 Slope Stability - Service Load (Block Failure)
Drawn By	AZ
Scale	1:830
Company	
Date	
File Name	Abut 11 static block.slim

SLIDEINTERPRET 7.017

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Sand1		120	Mohr-Coulomb	50	30		
Sand-Silt		110	Mohr-Coulomb	50	29		
Sand-Gravel		125	Mohr-Coulomb	50	37		
Silt-Clay		125	Mohr-Coulomb	4000	0		
Sand2		125	Mohr-Coulomb	50	38		
Sand3		125	Mohr-Coulomb	50	41		
Silt1		125	Mohr-Coulomb	5000	0		
Fill2		115	Mohr-Coulomb	50	28		
Sand4		120	Mohr-Coulomb	50	33		
Silt2		120	Mohr-Coulomb	2000	0		
Silt3		125	Mohr-Coulomb	2500	0		
Bedrock		130	Mohr-Coulomb	500	38		
Liq. Soil		110	Vertical Stress Ratio			0.28	100
Backfill		120	Mohr-Coulomb	100	32		
Concrete		120	Infinite strength				

5th Street Bridge over the Feather River
Abutment 11 Slope Stability - Seismic Condition (Block Failure)
Analysis method: spencer
FS=1.163



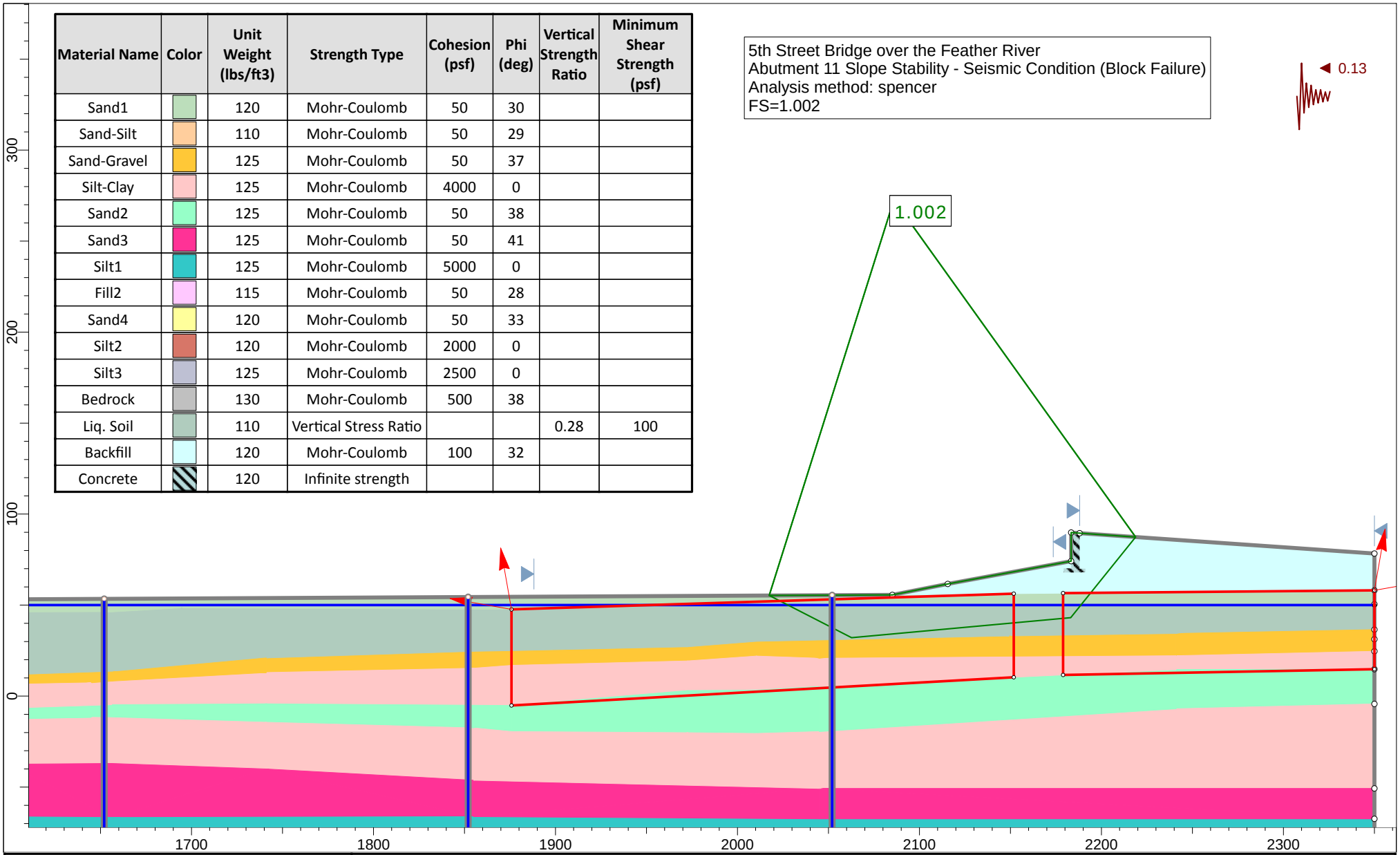
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

Project	5th Street Bridge over the Feather River
Analysis Description	Abutment 11 Slope Stability - Seismic Condition (Block Failure)
Drawn By	AZ
Scale	1:928
Company	
Date	
File Name	Abut 11 seismic block.slim

SLIDEINTERPRET 7.017

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Sand1		120	Mohr-Coulomb	50	30		
Sand-Silt		110	Mohr-Coulomb	50	29		
Sand-Gravel		125	Mohr-Coulomb	50	37		
Silt-Clay		125	Mohr-Coulomb	4000	0		
Sand2		125	Mohr-Coulomb	50	38		
Sand3		125	Mohr-Coulomb	50	41		
Silt1		125	Mohr-Coulomb	5000	0		
Fill2		115	Mohr-Coulomb	50	28		
Sand4		120	Mohr-Coulomb	50	33		
Silt2		120	Mohr-Coulomb	2000	0		
Silt3		125	Mohr-Coulomb	2500	0		
Bedrock		130	Mohr-Coulomb	500	38		
Liq. Soil		110	Vertical Stress Ratio			0.28	100
Backfill		120	Mohr-Coulomb	100	32		
Concrete		120	Infinite strength				

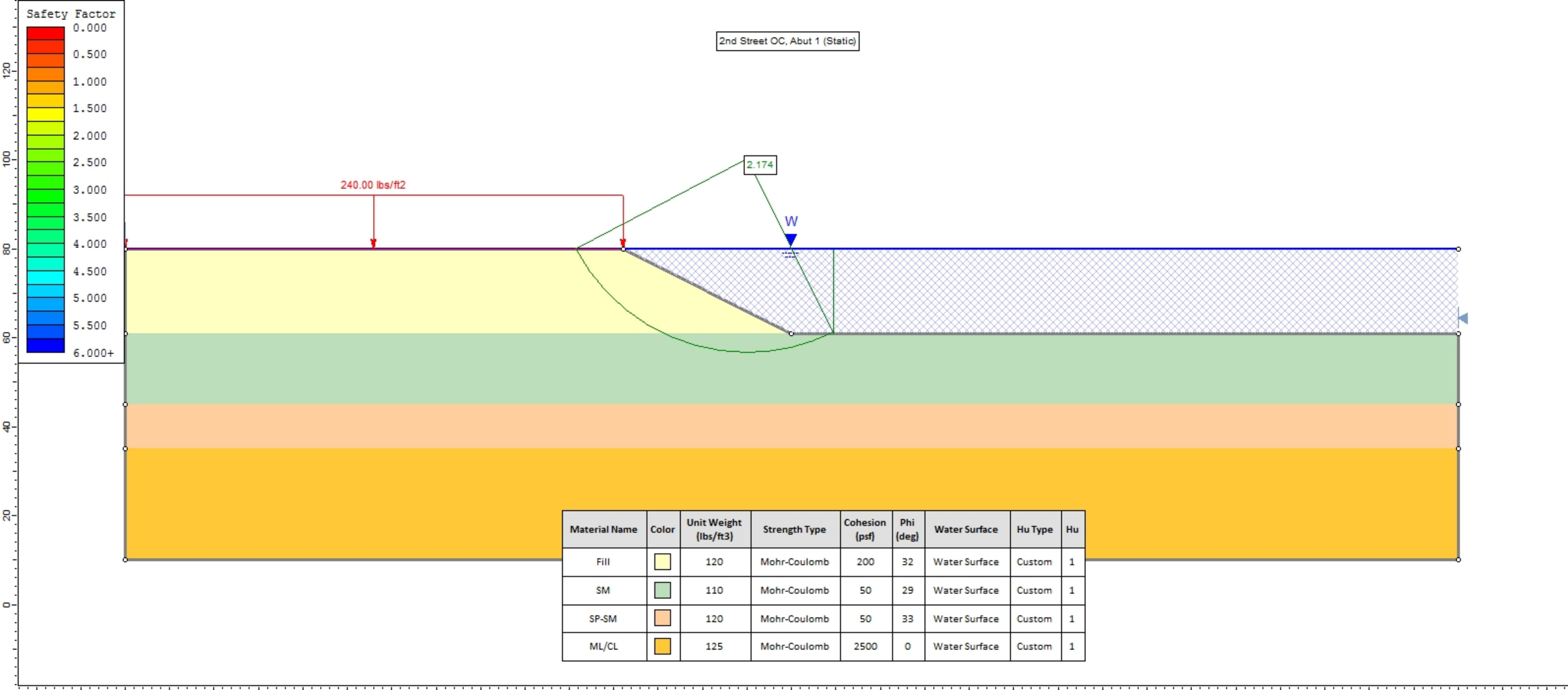
5th Street Bridge over the Feather River
Abutment 11 Slope Stability - Seismic Condition (Block Failure)
Analysis method: spencer
FS=1.002



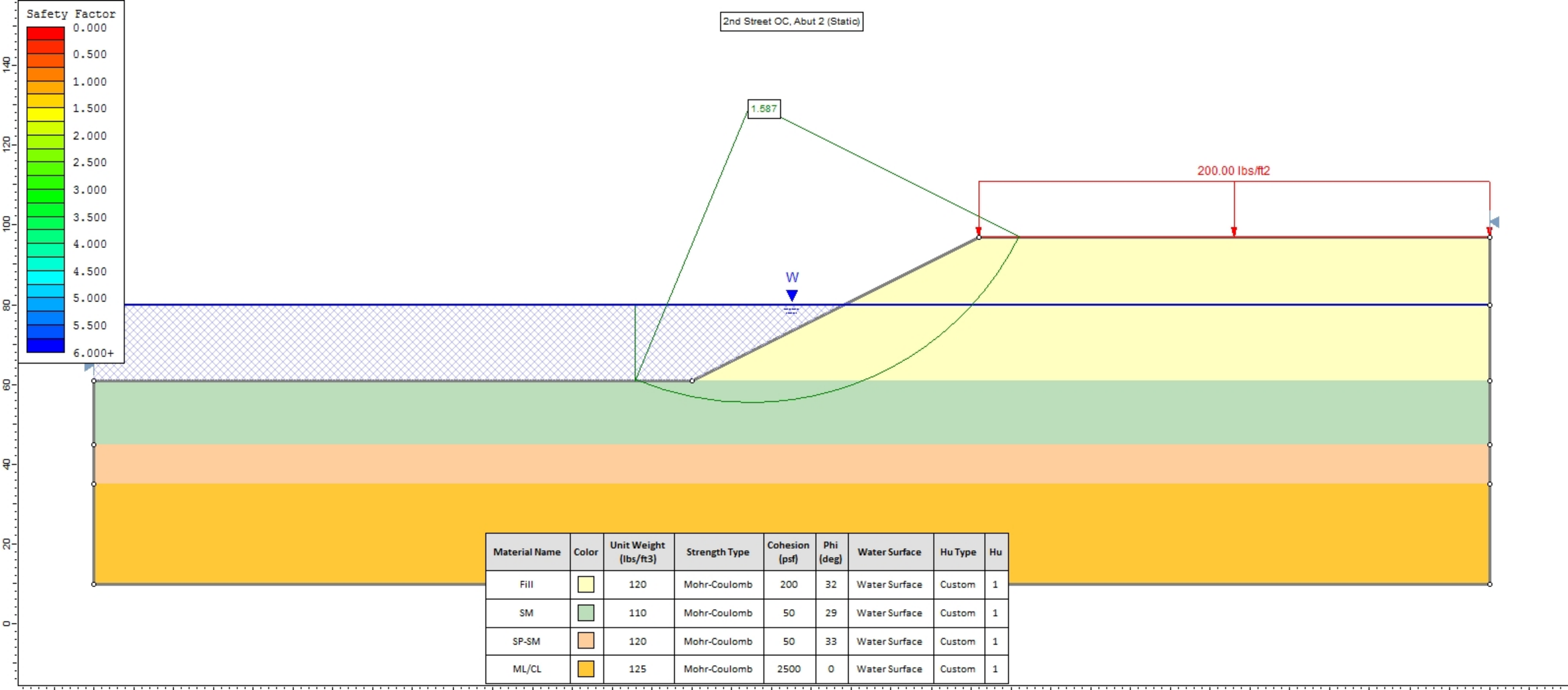
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

Project	5th Street Bridge over the Feather River
Analysis Description	Abutment 11 Slope Stability - Seismic Condition (Block Failure)
Drawn By	AZ
Scale	1:875
Company	
Date	
File Name	Abut 11 Yiled Acceleration Block.slim

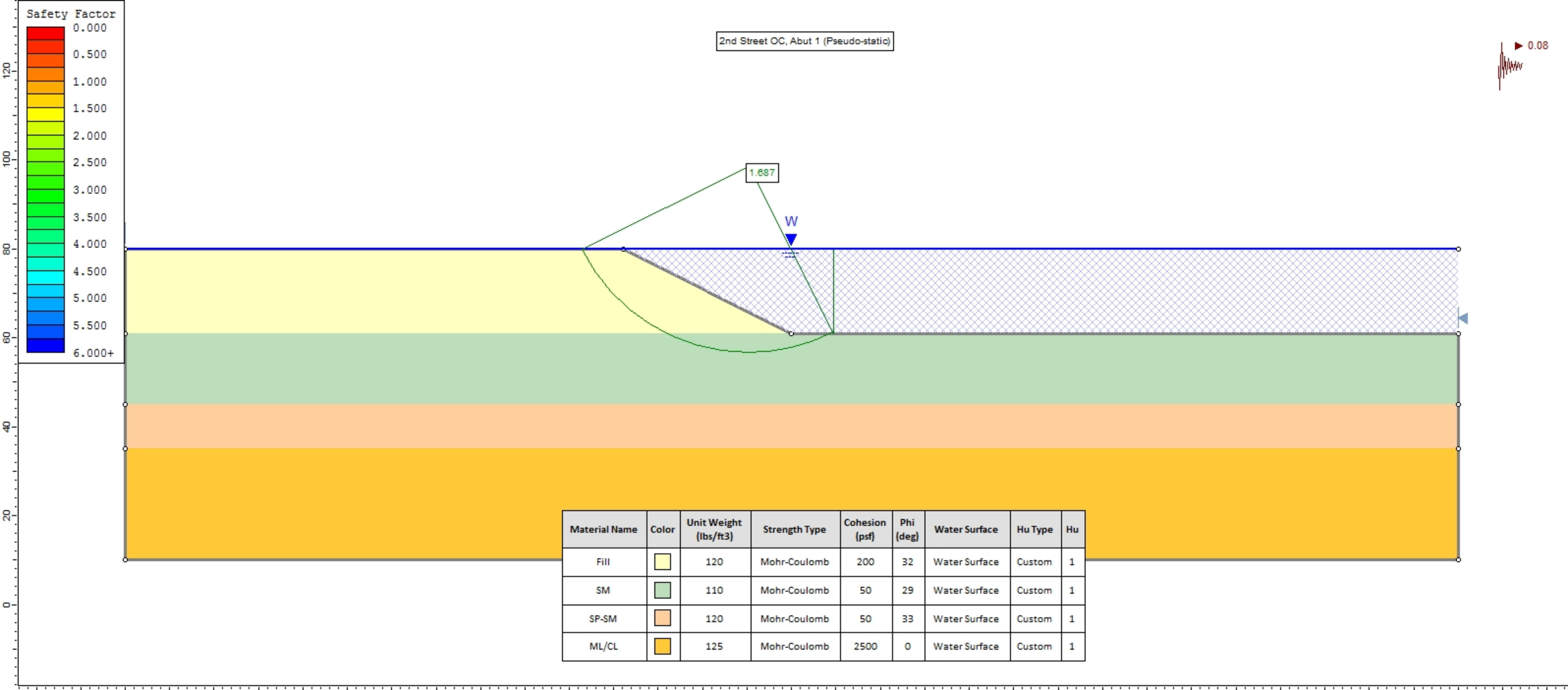
SLIDEINTERPRET 7.017



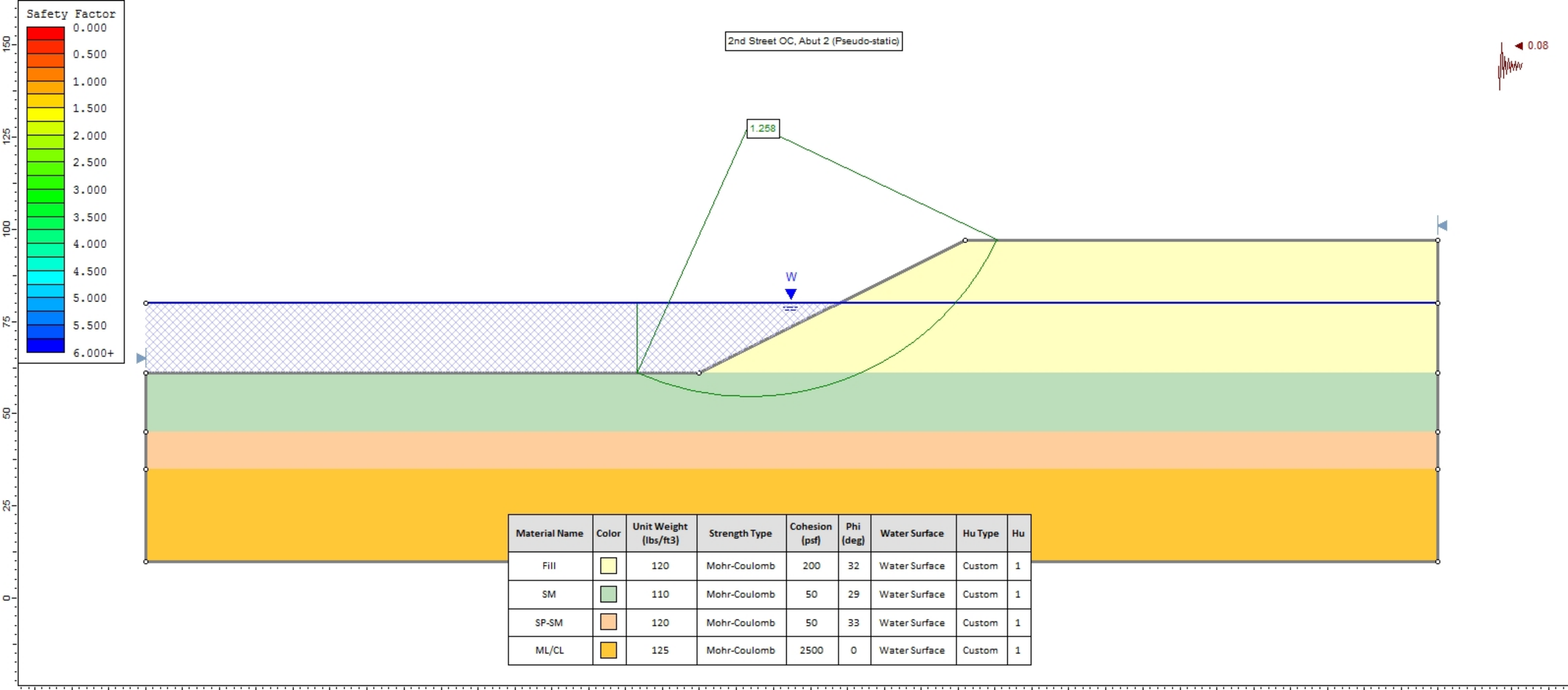
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Fill		120	Mohr-Coulomb	200	32	Water Surface	Custom	1
SM		110	Mohr-Coulomb	50	29	Water Surface	Custom	1
SP-SM		120	Mohr-Coulomb	50	33	Water Surface	Custom	1
ML/CL		125	Mohr-Coulomb	2500	0	Water Surface	Custom	1



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Fill		120	Mohr-Coulomb	200	32	Water Surface	Custom	1
SM		110	Mohr-Coulomb	50	29	Water Surface	Custom	1
SP-SM		120	Mohr-Coulomb	50	33	Water Surface	Custom	1
ML/CL		125	Mohr-Coulomb	2500	0	Water Surface	Custom	1



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Fill		120	Mohr-Coulomb	200	32	Water Surface	Custom	1
SM		110	Mohr-Coulomb	50	29	Water Surface	Custom	1
SP-SM		120	Mohr-Coulomb	50	33	Water Surface	Custom	1
ML/CL		125	Mohr-Coulomb	2500	0	Water Surface	Custom	1



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Fill		120	Mohr-Coulomb	200	32	Water Surface	Custom	1
SM		110	Mohr-Coulomb	50	29	Water Surface	Custom	1
SP-SM		120	Mohr-Coulomb	50	33	Water Surface	Custom	1
ML/CL		125	Mohr-Coulomb	2500	0	Water Surface	Custom	1