Received APR 1 8 2006

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
ENGINEERING SERVICES

Office of Geotechnical Design – West

GEOTECHNICAL DESIGN REPORT

HIGH STREET SEISMIC RETROFIT PROJECT

O4-ALA-KP 43.6/45.5

04247-165421

December, 2005

State of California | Business, Transportation and Housing Agency

Memorandum

Flex your power!
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To: MR JERRY MA
District Office Chief
Office of Design Alameda I

Date: November 1, 2005

Attention: A. R. Vito

File: 04-ALA-880 KP 43.6/45.5
(PM 27.2/28.4)
04247-165421
High Street Overhead
Seismic Retrofit

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Subject: Final Geotechnical Design Report (GDR)

This Final Geotechnical Design Report presents the results of our geotechnical study performed for the proposed Route 880 High Street Overhead Seismic Retrofit Project in the city of Oakland in Alameda County, California. This project proposes to replace the existing bridge structure at High Street with a more seismically stable structure. During this process, the mainline travel-way will be realigned and ramps will be reconfigured.

The purpose of this report is to document subsurface geotechnical conditions, provide analyses of anticipated site conditions as they pertain to the project described herein, and to recommend design and construction criteria for the roadway portion of the project. This report also establishes a geotechnical baseline to be used in assessing the existence and scope of changed site conditions.

This Geotechnical Design Report is intended for use by the project roadway design engineer, and structural engineer.

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TABLE OF CONTENTS

1. **INTRODUCTION** 1
2. **EXISTING FACILITY, AND PROPOSED IMPROVEMENTS** 1
   - 2.1 Existing Facility 1
   - 2.2 Proposed Improvements 2
3. **PERTINENT REPORTS AND INVESTIGATIONS** 2
4. **PHYSICAL SETTING** 3
   - 4.1 Climate 3
   - 4.2 Topography and Drainage 3
   - 4.3 Man-Made and Natural Features of Engineering and Construction Significance 3
     - 4.3.1 Existing Retaining Wall 3
     - 4.3.2 Utility 3
     - 4.3.3 Subsurface Drainage System 3
   - 4.4 Regional Geology 4
   - 4.5 Seismicity 4
     - 4.5.1 Ground Shaking 5
     - 4.5.2 Liquefaction 6
5. **FIELD INVESTIGATION AND LABOARATORY TESTING** 6
   - 5.1 Filed Investigation 6
   - 5.2 Laboratory Testing 6
6. **GEOTECHNICAL CONDITIONS** 6
   - 6.1 Site Geology 6
   - 6.2 Subsurface Soil Conditions 7
   - 6.3 Groundwater 7
7. **GEOTECHNICAL ANALYSIS AND DESIGN** 7
   - 7.1 Dynamic Analysis 7
     - 7.1.1 Selection of Design Parameters 7
     - 7.2.1 Liquefaction Analysis 7
   - 7.2 Static Analysis 8

7.2.1 Selection of Design Parameters 8
7.3 Cuts and Excavations 9
7.3.1 Rippability 9
7.4 Embankments 9
7.4.1 Subsurface conditions 10
7.4.2 Stability Analysis 10
7.4.3 Settlement Anaysis 10
7.4.4 Recommendations 11
7.5 Retaining Walls 12
Retaining Wall #1 12
Retaining Wall #2 14
Retaining Wall #3 14
Retaining Wall #4 16
Retaining Wall #5 17
8.0 CULVERT AND MINOR STRUCTURES 17
8.1 Culverts 17
8.2 Minor Structure Foundation 17
9. MATERIAL SOURCE AND DISPOSAL 18
9.1 Grading Factor 19
10. CORROSION INVESTIGATION 19
11. CONSTRUCTION CONSIDERATIONS 20
11.1 Construction Advisory 20
11.1.1 Saturated and Unstable Subgrade 20
11.1.2 Retaining Wall 20
11.1.3 Groundwater 20
11.1.4 Temporary Cuts and Shoring 21
11.1.5 Hazardous Waste Consideration 21
11.2 Construction Consideration that influence Specifications 21
11.2.1 Drilled holes for Soil Nail Wall 21
11.2.2 Soil Nail Wall Construction 21
11.2.3 Use of excavated on-site material as fill 22

11.3 Construction Monitoring and Instrumentation 22
11.3.1 Settlement Monitoring 22
12 **SUMMARY OF RECOMMENDATION AND SPECIFICATION** 22
12.1 Embankments 22
12.2 Cuts 22
12.3 Retaining Walls 22
12.4 Corrosion 23

LIST OF TABLES

Table 1	Maximum Credible Earthquake and Expected Bedrock Accelerations
Table 2	Engineering Properties of Pertinent Soils
Table 3	Imported Borrow Specification for Ground Improvement
Table 4	Soil Parameters Used in Soil Nail Wall Design
Table 5	Commercial Material Sources

LIST OF FIGURES

Figure 1	Location Map
Figure 2	Vicinity Map
Figure 2A	Project Layout
Figure 2B	Project Layout
Figure 2C	Project Layout
Figure 2D	Project Layout
Figure 2E	Project Layout
Figure 2F	Project Layout
Figure 3	Generalized Geology Map
Figure 4	Fault Map
Figure 5	Ground Shaking Intensity Map
Figure 6	Subsurface Drainage (Typical Section)
Figure 7	Sub-excavation for Foundation Improvement (Layout)
Figure 8	Sub-excavation for Foundation Improvement (Typical Cross Section)
Figure 9	Typical Section for Soil Nail Configuration
Figure 10	Sub-excavation for Foundation Improvement for Retaining Wall #5 (Typical Cross Section)
Figure 11	Load Combination for Sign "A"
Figure 12	Load Combination for Sign "F"
Figure 13	Load Combination for Sign "D"
Figure 14	Special Footing for Sign "D"
Figure 15	Special Pillar for Sign "D"
Figure 16	Sub-excavation for Foundation Improvement for Specially Designed Sign "D"

LIST OF APPENDIXES

Appendix – A	LOTB Sheets
Appendix – B	Laboratory Test Result Summary and Data
Appendix – C	References
Appendix – D	Backup Calculations
Appendix – E	Guide Specifications
Appendix – F	Correspondence

1. INTRODUCTION

This Geotechnical Design Report covers the roadway portion of the High Street Overhead Seismic Retrofit Project. Project limits start on Route 880 in Oakland from 0.8 km south of High Street (Kilo Post (KP) 43.9, Post Mile (PM) 27.3) to 0.2 km south of Fruitvale Avenue (KP 45.4, PM 28.2). See Figure 1 for project vicinity map and Figure 2 for a project location map.

This report covers roadway geotechnical portion of the project including fill embankments, cuts, four proposed retaining walls, and other geotechnical issues related to the project. A separate "Foundation Report" that covers the bridge structure replacement is prepared by Office of Geotechnical Design West, Branch F.

The purpose of this report is to document subsurface geotechnical conditions, provide analyses of anticipated site conditions as they pertain to the proposed work, and to recommend design and construction criteria for the roadway portions of the project. This report also establishes a geotechnical baseline to be used in assessing the existing and scope of changed site conditions.

To accomplish the above stated purpose, we have performed the following:

- Review of in-house and published data pertaining to the project site. This included review of as-built plans and reports, and review of published geologic literature.
- Site reconnaissance to visually observe and document the existing site conditions.
- Subsurface investigation consisting of power borings, to determine the subsurface and groundwater conditions at the site. Laboratory testing of selected soil samples for engineering classification of the soils and to determine in-situ moisture content, density, shear strength, consolidation and corrosivity characteristics of the prevailing soils encountered.
- Engineering analysis of findings, preparation of geotechnical recommendations, and preparation of this report.

This report is intended for use by the project roadway design engineers, construction personnel and contractors.

2. EXISTING FACILITY AND PROPOSED IMPROVEMENTS

2.1 Existing Facility

Within the project limits, the existing Route 880 is an eight-lane freeway with 1.5 m wide inside and outside shoulders. However, there is no outside shoulder in some areas. The roadway is divided by a concrete median barrier. The existing Route 880 roadway (mainline) is located on elevated embankment approximately 1 to 8 m in height with

approximately 1:1.5 (V:H) side slopes. In some areas, the embankment is retained by gravity retaining walls. Some of the existing ramps are in cut section with 1:1.5 (V:H) cut slopes. A major portion of the freeway within the project limits consists of a bridge structure (High Street Viaduct).

The project site is currently surrounded by industrial parcels and urban developments to the east and west. Within the limit of this project, a Southern Pacific Transit Railroad line runs parallel to the Route 880 and crosses Route 880 underneath the High Street viaduct. The ground elevation is generally higher to the east of the Route 880. The existing facility is shown in "dotted " font in Figures 2A-2F.

The performance of the cut and fill slopes within the project limits has been good with no known slope failures. The performance of the roadway pavement has also been satisfactory with no apparent signs of settlement related distress. Existing retaining walls and culverts have performed well and there are no visible signs of distress or premature wear out.

2.2 Proposed Improvements

It is proposed to replace this bridge structure with a more seismically stable one ("S" and "N" Lines Station 502+60± to 507+80±). During this process, the main travelled way will be realigned and ramps will be reconfigured. Fills (up to 5 m in height) and cuts (up to 6 m in depth) will be made to accommodate the new configuration.

The proposed travelled way will consist of four lanes and 5.1 m wide, inside and outside shoulders. Some of the existing ramps will be realigned and four new retaining walls are proposed. All of the proposed improvements are shown in Figures 2A-2F.

3. PERTINENT REPORTS AND DOCUMENTS

The following documents were used in preparing this report.

1. "Preliminary Geotechnical Design Report, High Street Viaduct Seismic Retrofit, prepared by Office of Geotechnical Design, Dated November 6, 2003.

2. As Built Plans for Highway Construction in Oakland, CA, Route 69 Contract No. 0-14TC53, dated April 5, 1968

3. As Built Plans for Highway Construction in Oakland, CA, Contract No. 62-14T13C19, dated February, 1961.

4. "Site Investigation Report, High Street Overhead Seismic Retrofit Project, Interstate 880, Oakland California, Caltrans Office of Environment Engineering, Prepared by IT Corporation, dated June 29, 2001.

4. PHYSICAL SETTING

4.1 Climate

Climate is moderate in the project area. Rain falls mainly in winter with little or no rain in summer. The mean annual temperature ranges from 10.7 C (51.3 F) to 18.2 C (64.7 F) (www.wrcc@dri.edu). Most precipitation falls between October and April. Localized showers are infrequent. Storms are moderate in duration and intensity, but, at times, precipitation is heavy enough to cause flooding. Snow and hail are rare. The strongest winds are usually associated with winter storms.

4.2 Topography and Drainage

The site is located on the nearly flat San Leandro Bay plain, with existing roadway and other development fills and Tidal Canal drainage providing the only topographic relief. Grades adjacent to High Street overhead range from 3m to 6m. Areas surrounding the project area are developed. Therefore, drainage is controlled by manmade features, including fill that was placed over the native low-lying older deposits. In general, the filled ground surface is lower southwest of the High Street interchange.

The general pattern of the drainage for the project area is in the Southwest direction towards the San Francisco Bay. The existing drainage system on Route 880 (mainline) includes median inlets and cross culverts. Portions of the existing ramps and the local street, within the project limits, are drained by network of surface drains and underdrains. Topography and the existing drainage features are shown in Figures 2A-2F.

4.3 Man Made and Natural Features of Engineering and Construction Significance

4.3.1 Existing Retaining Walls

An existing retaining wall (Caltrans standard, Type 1, wall on shallow footing) is located immediately in front of the proposed Retaining Wall #3 (soil nail wall). This existing retaining wall will have to be demolished in stages during construction of Retaining Wall #3 (soil nail wall).

4.3.2 Utility

Many overhead utility lines are situated over the project site. A myriad of utility lines are also present underground. These utilities are likely to affect by the construction.

4.3.3 Subsurface Drainage System

As built plans show that an extensive network of underdrains was installed along the ramps and local street. The proposed realignment of the ramps will require a combination of abandonment and realignment of the existing underdrains.

4.4 Regional Geology

The project area lies entirely within San Francisco Bay Block, west of the Hayward fault zone, which roughly corresponds with San Francisco Bay Assemblage as defined by R.W. Graymer in 2000. See Geology Map, Figure 3.

Information on the depth to bedrock immediately underlying the site is not available, none of the borings drilled in this and previous studies reached bedrock. However, based upon the available references, the depth to bedrock in the immediate vicinity of the site is controversial. Goldman, 1969 reported that the bedrock depth is at least 60m (200 ft) or more, below the ground surface, while Rogers D., 1991 indicated that the depth is around 275m (900ft).

Overlying the bedrock is the San Francisco Bay Assemblage Quaternary deposits which are in angular unconformity directly above the Franciscan Complex rocks (Graymer, 2000 – USGS Geologic map and map database of Oakland metropolitan area, Alameda, Contra Costa, and San Francisco counties, California).

San Francisco Bay Assemblage Quaternary deposits are represented by the following late Pleistocene sediments:

Alameda formation that is divided into a lower continental unit (mainly stiff clay, sand, and gravel) and an upper marine unit (blue-gray clay and silt). The Alameda formation at the project area is about 245m (800ft) thick. (Isopach Map of Alameda formation, Rogers, D., 1991). The end of Alameda formation appears to have been marked by a major period of erosion.

Yerba Buena (Old Bay) Mud on the top of the Alameda formation erosional surface. The Yerba Buena Mud thickness in the project area is between 0 and 15m (0-50ft)
(Isopach Map of the Old Bay Mud Formation, Rogers, D., 1991)

San Antonio Formation is the non-marine sediments (predominantly sands and silts) that were deposited adjacent to and on top of the Yerba Buena Mud (old Bay Mud). San Antonio formation thickness at the project site is about 8m (25 ft) (Isopach Map of the Posey/Merritt/San Antonio formation, Rogers, D., 1991).

Young Bay Mud: The stream valleys incised into the Merritt, Posey and San Antonio formation were soon filled with estuarine mud, known as the Young Bay Mud. The Young Bay Mud reaches a maximum thickness of about 120 feet.

4.5 Seismicity

The Project Area is within the seismically active San Francisco region with numerous faults capable of generating moderate to strong earthquakes. Regional seismic sources that are potentially significant to the project include Hayward Fault, The San Andreas Fault, Calaveras Fault, and Concord Fault (Figure 4). These faults have a trend northwesterly

direction and are designated as special studies zones by the California Division of Mines & Geology (Alquist-Priolo Special Studies Zones Act, 1973).

The Hayward Fault lies within close proximity to the project area and is considered the dominant fault in the project area. The Hayward Fault could cause damage due to severe ground shaking. The other three faults are not in the immediate vicinity; however, a maximum credible earthquake on any of these faults could affect the project area.

The approximate distances from the project area to the faults are shown in Table 1, together with estimated maximum credible event, and the maximum credible rock accelerations anticipated at the site from such an event.

Table 1. Maximum Credible Earthquake and Expected Bedrock Accelerations

Distance from the Project Site (Km)	Maximum Credible Earthquake (Mw)	Fault	Maximum Expected Bedrock Acceleration (g)
3.50	7.5	Hayward	0.63
25.50	8.0	San Andreas	0.37
19.50	7.5	Calaveras	0.31
25.75	6.5	Concord	0.15

The Hayward Fault is part of Hayward – Rogers Creek segment, which has a 32 percent probability of $M \geq 6.7$ Earthquake occurring on Hayward Fault before the year 2030.

The San Andreas Fault has a 21 percent probability of an $M \geq 6.7$ Earthquake occurring before the year 2030.

The Calaveras Fault has an 18 percent probability of an $M \geq 6.7$ Earthquake occurring before the year 2030.

The Concord Fault is part of Concord – Green Valley segment, which has a 6 percent probability of an $M \geq 6.7$ Earthquake occurring on Concord Fault before the year 2030 (USGS, 1999 – Earthquake Probability, Fault Classification Study, Working Group 99).

There are no mapped faults through the alluvial soil or artificial fill in the immediate vicinity of the site.

4.5.1 Ground Shaking

The project site is expected to undergo very strong intensity of ground shaking. See Ground Shaking Intensity Map, Figure 5. According to ABAG earthquake (Association of Bay Area Government), 2003, the shaking at this site is classified as Level " VIII – Very Strong" intensity of shaking. Site Specific dynamic analysis is discussed in Section 7.1.

4.5.2 Liquefaction

Borings show that the groundwater depth ranges from 1.25 m (4.1 ft) to 5.27 m (17.3 ft) below the ground surface. USGS Bay Area Liquefaction Map shows the site to have Moderate susceptibility for liquefaction. Site specific liquefaction analysis is discussed in Section 7.1.2.

5.0 FIELD INVESTIGATION AND LABORATORY TESTING

5.1 Field Investigation

Fifteen (15) power auger borings were drilled to a maximum depth of 18.5 m (60 ft.) or until drill refusal by Geocon Consultants from May 5, 2003 to May 27, 2003 and from June 6, 2003 to June 11, 2003. Standard penetration tests (SPT) were performed every 1.5 m depth to determine the consistency of the soils with depth. Relatively undisturbed samples were taken from selected depths for laboratory testing. The locations of these borings, boring logs, and the results of the SPT tests are shown on the Log of Test Borings (LOTB) sheets in Appendix A.

The drilling and sampling for this project was contracted out to an outside consultant, Geocon Consultants, due the presence of contaminated soils at the site.

5.2 Laboratory Testing

A program of laboratory testing was conducted to determine the engineering properties of the foundation soil by Geocon Consultants. Laboratory tests include: One-dimensional consolidation (ASTM D2435), moisture content and density (ASTM D2937), R-value (CTM 301), gradation (ASTM D422)and Atterberg limits (ASTM D4318). The locations of the test samples and selected test results are shown on the LOTB (Appendix A). Laboratory test results are summarized in Table A in Appendix B.

6.0 GEOTECHNICAL CONDITIONS

6.1 Site Geology

The following are the main surficial geologic units that have been mapped in the immediate vicinity of the site (Graymer, 2000), as shown in the attached Site Geologic Map, Figure 3:

- Artificial fill (Historic, af) – Manmade deposit of various materials and ages. Some are compacted and quite firm, but fills placed before 1965 are likely not compacted and consist of end-dumped materials.

Alluvial fan and deposits (Holocene, Qhaf) – Alluvial fan deposits consisting of medium dense to dense, gravely sand or sandy gravel that generally grades upward to sandy or silty clay.

6.2 Subsurface Soil Conditions

Subsurface soil conditions, as interpreted from borings, consist of artificial fill over alluvia material. The fill generally consists of moderately to well compacted mixture of moist, lean clay, sand, and gravel. The natural alluvia material consist of alternating layers of stiff to very stiff clays (lean and fat clays), medium dense to dense silty sands, and occasional lenses of poorly graded sand and gravel (see LOTB sheets for details). The thickness of the individual layers (strata) are highly variable and not all material types, mentioned above, are present at every location. There are two locations where we have identified potentially problem soils, and these areas will require special attention:

1. Borings P1, P'2, P2, P'2 and M1 drilled in the vicinity of Retaining Walls #1 and 4 (20 to 30 m left of "S" Line, Station ~ 502+00), show a 2 to 3 m thick layer of soft black plastic clay (CH) at 0 to 1.5 m below the ground surface.

2. Borings P2 and P'2 drilled in the vicinity of Retaining Walls #1 (20m left of "S" Line, Station ~ 502+00), show a 2 to 3 m thick layer of loose, poorly-graded sand (SP) with gravel, at approximately 8 m (26 ft.) below ground surface.

6.3 Groundwater

Groundwater was encountered in most of the borings drilled at the site. Groundwater was encountered from 1 to 3 m below the ground surface during drilling in May, 2002 (see LOTB sheets for details).

High ground water is expected. The design ground water elevation selected for this project is Elevation 2.0± m. The precise groundwater elevations used in the analyses are mentioned in the pertinent Sections of this report.

7.0. GEOTECHNICAL ANALYSIS AND DESIGN

7.1 Dynamic Analysis

7.1.1 Selection of Design Parameters

For this project, the design earthquake is a maximum credible earthquake of moment magnitude 7.5 along the Hayward fault located at a distance of 3.5 km from the project site. The maximum anticipated bedrock acceleration is 0.63g. In general, the site has a deep deposit of stiff lean clay intermixed with cohesionless soils. The maximum anticipated ground acceleration is 0.56g (Dickenson and Seed, 1994 & Caltrans Seismic Design Criteria, Version 1.3, ARS Curve Figure B.8).

7.1.2 Liquefaction Analysis

The basic cause of liquefaction is the build up of excess hydrostatic pressure in loose saturated cohesionless soils due to the application of sudden or cyclic shear stress. Borings P2 and P'2 located approximately 20 m left of "S" Line, Station. 502+00 (and in the vicinity of Retaining Walls #1 and 4), show a 2 to 3 m thick layer of loose poorly-graded sand (SP) with gravel, located approximately 8 m (26 ft.) below ground surface. The SPT blow counts in the loose poorly graded sand range from 8 to 9.

Our analysis shows that the loose sand will liquefy during a design earthquake. The calculated liquefaction safety factor of this material is 0.16. Potential settlement due to liquefaction is approximately 6.5 to 13 cm (2.5 to 5 inches) (Tokimatsu & Seed, '84).

This magnitude of settlement may cause serviceability problems, especially to critical underground utilities. Ground improvement measures may be required if critical utilities cannot tolerate the anticipated settlement.

Please note that ground improvement is very expensive and should only be considered if the utilities are critical. In most cases, it is cheaper to repair the utilities then to do ground improvement to mitigate settlement due to an earthquake.

We do not have utility plans at this time. We will address this issue in an addendum when we are provided with a complete set of utility plans.

7.2 Static Analysis

7.2.1 Selection of Soil Design Parameters

A range of engineering properties was selected for engineering analysis and design. These properties are based on laboratory test results and our engineering judgment. The selected properties are summarized in Table 2

Table 2. Engineering Properties of Pertinent Soils

Material	Wet Density γ_{wet} (Kg/m^3)	Consolidation Parameters					Shear Strength Parameters		
		C_c	C_r	C_v	e_o	OCR	Phi Φ (deg.)	C (kPa)	S_u (kPa)
Fill	2002.3	Assumed Incompressible					30	12.0	71.8
Soft Clay	1762.0	0.44	0.05	0.24	1.08	6.0			23.9
Stiff clay	2002.3	0.1 -0.15	0.05	0.33	0.74 - 56	2.5 - 3.0	30	22.5	71.8
Loose Sand	1922.2	N/A					28 - 30		
Dense Sand	2002.3	N/A					35	-	
Alluvium	2002.3	0.1	0.01	0.33 (4.0)	0.56	2.0	-	--	71.8

7.3 Cut and Excavation

Two significant cuts are proposed in this project. These cuts and the subsurface conditions at these cut locations are discussed below:

- A cut for a depressed ramp is proposed from Station Lt. "S" 506+66± to 509+30±. The maximum depth of this cut is 3± m and most of this cut will be retained by Retaining Wall #2. Borings P3, P4 and P7 drilled in the vicinity of this cut indicate that this cut will be mostly in fill or stiff lean clay and this cut will extend close to the groundwater level at some locations. Saturated unstable subgrade may be encountered at these locations. The unstable subgrade will require subgrade stabilization. Refer to Section 11.1.1 for subgrade stabilization recommendations. Also please note that this cut will be made in areas with existing subsurface drainage facilities. It is imperative that the existing subsurface drainage system in this area is mapped and its integrity is maintained.

  We recommend an underdrain at least 0.6 m deep in the cut area as shown in Figure 6. The temporary cut slope at this location for should adhere to CAL/OSHA requirements for soil Type "C."

- At 6 m deep cut is proposed in the east side of the existing embankment from Station "N" 507+81± to 508+66±. This permanent cut will be mostly in the fill material and may extend slightly into native material from Station. "N" 507+81± to 508+40±. The fill in this area generally consists of moderately to well compacted lean clay with sand and gravel. One of the borings drilled at this location show seepage of water within the fill.

In addition to the areas discussed above, several other smaller cuts are also proposed. We recommend that all permanent cut slopes be constructed at a maximum inclination ratio of 1:2 (V:H).

7.3.1 Rippability

The excavations proposed in this project can be made with standard grading equipment with one exception. The 6 m deep cut mentioned in Section 7.3 will require that an existing gravity retaining wall be demolished in stages. This cannot be done with standard grading equipment and special measure will be needed for this operation.

7.4 Embankment

Two new fill embankments are proposed in this project. These embankments will be located adjacent to and on top of the existing fill embankments. The locations of the new embankments that are significant from geotechnical engineering standpoint are listed below:

- Adjacent to and on top of southbound Route 880 from Station Lt. "S" 501+00± to 502+60±. Portions of this embankment will be retained by Retaining Walls #1 and 4.

- On top of the existing fill embankment on nouthbound Route 880 from Station Rt. "N" 507+81± to 507+90±. This fill embankment is located immediately above the proposed 6 m cut and Retaining Wall#3.

7.4.1 Subsurface Conditions

Embankment Fill, Station Lt. "S" 501+00± to 502+60±

The subsurface condition at this location, as described in borings P1, P'1, P2, and P'2, consists of 0 to 1 m of fill underlain by 2 to 3 m of black, soft clay (with SPT blow count of 3). The soft clay is underlain by 3 to 6.5 m thick layer of moderately overconsolidated, stiff clay. The stiff clay layer is underlain by 0.5 to 4 m thick layer of loose to dense, poorly graded sand. The sand layer is underlain by 1.5 to 4.5 m thick layer of stiff clay, which is underlain by 2 m thick layer of dense sand. The material below the sand layer is alluvia material consisting of alternations layer of lean clay and sand to a considerable depth. Groundwater was encountered in the borings from 2.4 to 4.2 m below the ground surface or between Elevation 0±_and -2.0± m. The engineering properties of these materials are summarized in Table 2.

Embankment Fill, Station Rt. "N" 507+80± to 507+90±

The subsurface condition at this location as, described in borings P5 and P6, consists of 6 m of fill (moderately to well compacted mixture of lean clay, sand, and gravel) over 6 to 12 m of stiff to very stiff, lean and fat clay. The clay is underlain by a 5 m thick layer of very dense poorly graded sand and gravel. The groundwater was encountered in the borings at a depth of 6 m±. below the ground surface or at Elevation 2.0 m±. The engineering properties of these materials are summarized in Table 2.

7.4.2 Stability Analysis

Embankment Fill, Station Lt. "S" 501+00± to 502+60±

A large portion of the fill embankment proposed in this location will be retained by Retaining Walls #1 and 4. Refer to Section 7.5 (Retaining Walls #1- Global Stability) for discussion.

Embankment Fill, Station Rt. "N" 507+80± to 507+90±

The fill embankment proposed at this location will be located on top of Retaining Wall #3. Refer to Section 7.5 (Retaining Walls #3- Global Stability) for discussion.

7.4.3 Settlement Analysis

The settlement analysis is based on Terzaghi's one-dimensional consolidation theory and was performed using FHWA computer program FoSSA. FoSSA was used because of it ability to model irregular embankment and subsurface configurations along a section. FoSSA can also accurately predict settlement time rate for multiple compressible soil layers with different consolidation rates.

The most critical fill cross-sections were modeled and the settlements were computed along the entire critical cross-sections. The results of the settlement analysis are discussed below.

Fill Embankment Station Lt. "S" 501+00± to 502+60±

A 5 m (maximum) high, irregularly shaped, fill is proposed at this location. A portion of this fill will be retained by Retaining Walls #1 and 4. The ultimate primary settlement, without ground improvement, due to this fill is expected to be over 195 mm (7.8 inches). However, with ground improvement (removal and replacement of the surficial soft with relatively incompressible material), the primary ultimate settlement is reduced to 84 mm (3.4 inches). Ninety percent of the anticipated primary settlement is expected to occur over a period of 400 days after the placement of the fill. However, our analysis also shows that a majority of this settlement (over 60 mm) will occur in the first 90 days. Refer to Appendix D for settlement analysis model and results.

Fill Section Station Rt. "N" 507+80± to 507+90±

A 2.6-m (maximum) high trapezoidal shaped fill is proposed at this location. Based on our analysis, the primary ultimate settlement due to this fill is expected to be less than 25 mm (1 inch). The time rate analysis show that this settlement will occur in 90 day after the fill is constructed. Refer to Appendix D for settlement analysis model and results.

7.4.4 Recommendations

Fill Embankment Station Lt. "S" 501+00± to 502+60±

Based on the results of the settlement analysis, we recommend that the surficial soft soil be removed and replaced with compacted imported borrow or treated soil. We also recommend that a waiting period of 90 days prior to the construction of the pavement structural section and other hardscape at this location. The limits and configuration of the removal and replacement are shown in Figures 7 and 8, respectively.

The removed soft soil cannot be used as fill material in this project. The contractor can either import material that meets the specification specified in Table 3 or use Standard Type E backfill or alternatively can perform lime treatment of the in-place soils in accordance with Standard Specification 24-1. The entire removed soil has to be treated. The fill slope of this embankment should be inclined at a maximum slope inclination ratio of 1:2 (V:H).

Table 3. Imported Borrow Specification for Ground Improvement

Sieve Size	Percent Passing
75 mm	100
4.75 mm	35 -100
Sand Equivalent: 30 (min.)	
Relative Compaction: 90% min. and 95% min below retaining wall footings	

Settlement monitoring is needed to ensure that the anticipated settlement is completed prior to construction of pavement structural section and hardscape over the fill. We recommend the installation of survey hubs, at locations shown in Figure 7, to monitor the settlement.

Fill Section Station Rt. "N" 507+80± to 507+90±

The anticipated settlement at this location is minimal and majority of the anticipated settlement will occur during the construction period of embankment. Special mitigation measures are not needed. The fill slope for this embankment should be inclined at a maximum slope inclination ratio of 1:2 (V:H).

Other Miscellaneous Fill Areas

In addition to the areas discussed above there are several other areas where small/sliver fill are proposed. We recommend that all fill slope be constructed at a maximum slope inclination ratio of 1:2 (V:H).

7.5 Retaining Walls

Five new retaining walls are proposed in this project. The wall types, maximum heights, and locations of these walls are summarized below:

1. Retaining Wall #1: Standard Caltrans retaining wall (type 1); fill Wall; maximum height=5 m; located from Station Lt. "S" 501+70± to 502+55±
2. Retaining Wall #2: Standard Caltrans retaining wall (Type 5); cut wall; maximum height=3 m; located from Station Lt. "S" 506+66± to 508+66± (SER Line)
3. Retaining Wall #3: Soil-nailed wall; cut wall; maximum height=6 m; located from Station Rt. "N" 507+81± to 508+40± (NER Line)
4. Retaining Wall #4: Standard Caltrans retaining wall (type 5); fill wall, maximum height=2 m; located from Station Lt. "S" 501+10± to 502+10±
5. Retaining Wall #5: Standard Caltrans retaining wall (type 6B); fill wall, maximum height=1.2 m, located from Station Lt. "O" 11+16 to 13+30

Retaining Wall #1:

Subsurface Conditions

The subsurface condition at this location are discussed in Section 7.4.1 (Fill Embankment Station Lt. "S"501+10± to 502+60±).

Bearing Capacity

Using a safety factor of 3, the allowable foundation soil bearing capacity is approximately 50 kPa (1041 psf), whereas according to Caltrans Standard Plans dated July, 1999, wall toe pressure for a 5.5-m high (18') wall is 190 kPa (3968 psf). However, if the surficial soft soil

is removed and replaced with properly compacted fill (ground improvement), the bearing capacity is increased to 195 kPa (4080 psf). The bearing capacity calculations are included in Appendix D.

Settlement

The primary ultimate settlement at the wall location without ground improvement is anticipated to be 147 mm. However, with ground improvement (removal of the surficial soft soil), the settlement can be reduced to 64 mm. Majority of this settlement will occur within 90 of the wall construction. See Section 7.4.3 for detailed discussion on settlement.

Global stability

The global stability of Retaining Wall #1 was analysed using computer program XSTABL. The analysis was performed for cases with and without ground improvement (removal of surficial soft soil). The model used in for the analysis and results of the slope stability analysis are included in Appendix D.

The global stability Safety Factor (SF) for Retaining Wall #1 was computed to be 1.0 without ground improvement and over 3.0 with ground improvement for static conditions. The SF in the event of a design earthquake (pseudo-static condition) with ground improvement was computed to be over 2.5.

The bearing capacity, settlement analysis and global stability results show that a Standard Caltrans wall (type 1) wall is adequate provided the top surficial soft soil is removed and replaced with compacted fill (ground improvement) as shown in Figure 8. A waiting period of 90 days is recommended prior to construction of pavement structural section and hardscape at the wall location.

Retaining Wall #2:

Subsurface Conditions

The subsurface conditions at Retaining Wall #2 location, as described in borings P3, P4 and P7, consist of 0 to 3 m of fill (moderately to well compacted mixture of lean clay , sand, and gravel) over 10 m of stiff to very stiff lean clay with sand and gravel. Groundwater was encountered in the borings at the depth of 2 to 4 m below the ground surface or between Elevation 0 and 1.0± m.

Bearing Capacity

Using a safety factor of 3, the allowable foundation soil bearing capacity is approximately 164 kPa (3427 psf), whereas according to Caltrans Standard Plans dated July, 1999, wall toe pressure for a 3.0 m high wall is 145 kPa (3028 psf).

Settlement

Retaining Wall #2 is a cut wall. We do not anticipate any significant settlement of this wall.

Global Stability

Based on the results of the global stability analysis of Retaining Wall #1, It is our opinion that global stability of Retaining Wall #2 is adequate.

Standard Caltrans retaining wall Type 5 is appropriate for this wall. The proposed wall footing will be located at a depth of 3.0 m (maximum) below the existing ground surface. At some location saturated and unstable subgrade conditions may be encountered and subgrade stabilization may be needed. Refer to Section 11.1.1 for subgrade stabilization recommendations.

Retaining Wall #3:

Since Retaining Wall #3 is a cut wall (with the entire cut in existing fill), a soil-nailed wall is a more viable option than a standard Caltrans cantilever type retaining wall. A soil nail wall will not require a temporary cut behind the proposed wall for construction.

Subsurface Conditions

The subsurface conditions at Retaining Wall #3 location as described in borings P5, and P6 consists of 6 m of fill (moderately to well compacted mixture of lean clay, sand, and gravel) over 5 m of stiff to very stiff lean clay. The lean clay is underlain by 8 m of stiff fat clay. Groundwater was encountered in the borings at a depth of 2. to 6. m below the ground surface or at Elevation 0±. m.

Soil Nail Wall Design

The soil nail wall design was performed using Caltrans computer program "SNAIL". The soil parameters were used in the design are summarized in Table 4.

Table 4 Soil Parameters Used in Soil Nail Wall Design

	Fill Material	**Natural Material (Lean Clay)**
Friction Angle	30 degrees	25 degrees
Cohesion	11.97 (250 psf)	22.50 (470 psf)
Band Strength	48.7 (7 psi)	48.7 kPa (7.0 psi)
Unit Weight	18.9 KN/m^3 (120 pcf)	20.0 KN/m^3 (125 pcf)

Other parameters used in the analysis are as follows:

- Diameter of reinforcement element: 2.54 cm (1.0 in)
- Yield stress of reinforcement: 248.2 MPa (36.0 ksi)
- Grout hole diameter: 15.2 cm (6.0 in)
- Punching shear: 155.7 kN (35.0 kip)
- Psuedostatic Seismic Coefficient = 0.31g (50% of PGA)

Our analysis shows that soil nails with spacing of 1.5 m (maximum) horizontally and vertically, inclined at 15 degrees from the horizontal, with reinforcement lengths ranging from 7.6 to 8.5 m will be adequate. The nail spacing will varies to accommodate the varying wall height. The top two levels nails should be 8.5 m in length and the bottom level(s) nails should be 7.6 m in length. We recommend a minimum of two levels at all locations (regardless of the wall height). A typical nail configuration and nail spacing criteria is shown in Figure 9.

The computed Safety Factors (SF) for the nail configuration shown in Figure 9 are 1.62 for static condition and 1.1 for the psuedostatic condition. The SNAIL outputs (for wall heights of 4.8 m and 6.1 m) are included in Appendix D. It is our understanding that the Nail Layout Plan for Retaining Wall #3 will be prepared by the project Structural Engineer.

The nails will be located entirely in the existing fill material. The source of the existing fill is unknown and sufficient tests were not conducted in this material to determine its corrosivity. Therefore, we recommend that the fill material is considered corrosive and epoxy-encapsulated nails are used for this wall.

As built plans show an existing 200 mm (8 inch) Perforated Metal Pipe (PMP) underdrain at the base of the existing retaining wall (located immediately in front of the proposed Retaining Wall #3). This underdrain will be removed by the proposed excavation and therefore a new underdrain is needed at the base of Retaining Wall #3 as shown in Figure 9.

We anticipate localized seepage in the fill during construction of this wall. This seepage may be significant during the rainy season and will have to be controlled to ensure stability of the temporary cut during construction.

Portions of the existing (Caltrans standard) retaining wall will have to be demolished in stages to make room for the benches needed for the soil nail wall construction. We anticipate the need for saw cutting of the existing retaining wall at select locations.

Global Stability

The global stability of this wall was also analyzed using computer program "SNAIL" by allowing the failure surface search limits to extend well beyond the nail lengths and below the toe of the wall. Our analysis shows that the critical failure surface passes through the toe of the wall in all instances. This implies that the critical failure mode is internal and global stability of this wall is not an issue.

Retaining Wall #4

Subsurface Conditions.

The subsurface conditions at this location are discussed in Section 7.4.1 (Fill Embankment Station Lt. "S" 501+10± to 502+60±).

Bearing Capacity

Using a safety factor of 3, the allowable foundation soil bearing capacity is approximately 50 kPa (1041 psf), whereas according to Caltrans Standard Plans dated July, 1999, wall toe pressure for a 2.0 m high wall is 120 kPa (2506 psf). However, if the surficial soft soil is removed and replaced with properly compacted fill (ground improvement), the bearing capacity is increased to 195 kPa (4080 psf). The bearing capacity calculations are included in Appendix D.

Settlement

The primary ultimate settlement at the wall location without mitigation is anticipated to be 73 mm. However, with ground improvement (removal of the surficial soft soil), the settlement can be reduced to 40 mm. Majority of this settlement will occur within 90 days of the wall construction. See Section 7.4.3 for detailed discussion on settlement rate.

Global Stability

Based on the results of the global stability of Retaining Wall #1, it is our opinion that with ground improvement (removal of surficial soft soil), global stability of this wall will be adequate.

The bearing capacity and settlement analysis results show that a Standard Caltrans wall (type 5) wall is adequate provided the top surficial soft soil is removed and replaced with engineered fill to Elev. 1.8 m as shown in Figures 7 and 8. A waiting period of 90 days is recommended prior to construction of pavement structural section and hardscape at the wall location.

Retaining Wall #5

Retaining Wall #5 is proposed as a Standard Caltrans retaining wall (Type 6B), fill wall, maximum height= 1.2 m, located from Station Lt. "O" 11+16 to 13+30.

Subsurface Conditions

Since Retaining Wall #5 was proposed after the geotechnical investigation was completed, no soil borings were specifically done for this wall. Subsurface conditions were inferred from the nearest borings, M1, P1, P'1, P2 and P'2, and are discussed in Section 7.4.1.

Bearing Capacity

Using a safety factor of 3,the allowable foundation bearing capacity is approximately 201 kPa (4198 psf), if the surficial soft clay layer is removed and replaced with properly compacted fill. This soft clay layer should be excavated to at least Elevation 1 m, and replaced with 90% compacted fill; the 1-m layer of fill directly beneath the foundation footing should consist of AB or Structural Backfill compacted to 95%. See Figure 10.

This allowable foundation bearing capacity is greater than that specified in the Caltrans Standard Plans (dated July 2004) of 95 kPa (1984 psf).

Settlement

Since no consolidation data was available, settlement analysis was not performed. However, based on nearby soil data, we do not expect settlement to be significant with ground improvement as discussed above.

Global Stability

Based on the results of the global stability of Retaining Wall #1, it is our opinion that with ground improvement (removal of surficial soft soil), global stability of this wall will be adequate.

8.0 CULVERT AND MONOR STRUCTURES

8.1 Culverts

A 355 mm (14-inch) diameter temporary water pipe is proposed running across, and 355 mm (14 inches) below Retaining Wall #4 at approximately "SOR" Sta. 11+80 (152 mm (six inches) below the key of the retaining wall.) In order to provide some protection against the load of the retaining wall, we recommend using a corrugated metal pipe and encapsulating the 355 mm (14") pipe with a 406 mm or 457 mm (16" or 18") steel pipe. This encapsulating pipe should span the width of the retaining wall footing plus an additional 0.6 m (2 ft) at both ends. The space between the two pipes should be filled with grout.

We do not have any other plans showing culverts at this time. We will address this issue when we are provided with plans showing proposed culvert types, locations and necessary details.

8.2 Minor Structure Foundation

8.2.1 Caltrans Standard Overhead Signs A & F

Caltrans Standard Overhead Signs A & F are proposed at Sta. 496+60 and Sta. 511+40 respectively. Foundation analysis was based on the loading combinations provided by Structural Design as shown in Figures 11 & 12.

The subsurface conditions at Sign A, as described in Boring S'1, consist of 2-1/2 m of very loose clayey sand with gravel over 2 m of very soft fat clay. A ½ m thick medium dense sand lens is then encountered. This is underlain by 12-1/2 m of stiff to very stiff lean clay; a soft spot (SPT 5) was encountered at Elevation –1 m. Medium dense silty sand is finally encountered at Elevation –12-1/2 m. Groundwater was encountered at 2 m below ground surface or Elevation 1.5 m.

The subsurface conditions at Sign F, as described in Boring S2, consist of stiff to very stiff lean clay. A 1 m-thick lens of dense poorly graded gravel was encountered at approximately Elevation 1m. Stiff lean clay is again encountered below this lens. Groundwater was encountered at Elevation –1.7 m.

CIDH pile dimensions should be built according to Caltrans Standard Plans (July 2004); however, the pile length for Sign A should be increased to 8.6m since the standard length of 5.8 m would sit on a layer of soft clay. Therefore:

For Sign A with Post Type 5, CIDH pile dimensions are 8.6 m x 1372 mm.
For Sign F with Post Type 7, CIDH pile dimensions are 7.0 m x 1524 mm.

For either pile, analyses show that pile head lateral deflections do not exceed the 12.7 mm (0.5 inch) acceptable criteria. LPILE analysis results that show the shear and bending moments induced in the pile have been forwarded to the Structural Engineer for structural analysis on February 23, 2005.

8.2.2 Overhead Sign D-Special Design

Overhead Sign D, post type 4, is proposed at Sta. 502+40, adjacent to Retaining Wall #1. Foundation analysis was based on the loading combinations provided by Structural Design as shown in Fig.13.

A special pillar base and spread footing, with dimensions shown in Fig.14 & 15, are required to support this sign. Such a design would induce a maximum bearing pressure (q_{max}) of 137 kPa (2862 psf), whereas the allowing bearing capacity (q_{allow}) of the foundation soil is approximately 181 kPa (3780 psf) using a safety factor of 3, if the top layer of soft foundation soil is treated as follows: Remove the top soft clay layer to at least Elevation 1.5 m and replace with 90 percent compacted fill; the 1 m of fill directly beneath the foundation footing compacted 95 percent. See Figure 16.

9.0 MATERIAL SOURCE AND DISPOSAL

Based on the project plans, the only significant cuts or excavations made on this project is along the proposed Retaining Walls #2 and 3. This quantity does not appear to be sufficient for use as fill in the proposed embankment sections. Therefore, imported borrow will likely

be required for embankment fills and for structural backfill of retaining walls. The nearby commercial sources for materials likely needed for this project are tabulated in Table 5.

Excavated material that is not suitable for use as engineered fill has to be disposed off site or used at select locations as directed by the Engineer.

9.1 Grading Factor

A portion of the excavated material can be used as engineered fill. For preliminary estimate, a Grading Factor of 0.9 may be assumed.

Table 5. Commercial Material Sources

Source	Haul Distance	Imported Borrow	AS	AB	CTB	ATPB	AC	Permeable Material
Dumbarton Quarry Assoc. 9600 Quarry Rd., Fremont, CA (510) 793-0195	34 km	X		X		X	X	
La Vista Quarry 28814 Mission Blvd., Hayward, CA (510) 793-8861	24 km	X		X			X	
RMC Pacific Materials, Inc., Sunol Plant 6527 Calavaras Rd., Sunol, CA (408) 487-3100	48 km		X	X	X			X
Graniterock 11711 Berryessa Rd., San Jose, CA (408) 487-31--	58 km	X	X	X	X	X	X	X
Hanson Aggregrates 3000 Busch Rd., Pleasonton, CA (925) 846-8800	42 km	X	X	X				
Curtner Quarry 2200 Scott Creek Rd., Milpitas, CA (408) 942-1230	50 km		X	X	X			
Gallagher & Burk, Inc., 344 High Street, Oakland, CA (510) 261-0466	2 km					X	X	
Steven Creek Quarry, Inc,. 12100 Stevens Canyon Rd., Cupertino, CA (408) 253-2512	70 km	X	X	X				X

The excavated material, with the exception of the surficial black, soft, fat clay may used as fill provided its meets the standard specifications requirements. The on-site materials used as fill should be approved by the engineer.

10.0 CORROSION INVESTIGATION

Corrosion samples were not taken during the subsurface investigations. However the corrosion sample taken during the subsurface investigation of the proposed bridge structures within the limits of the project, indicate that the soil at the project site is non corrosive. Standard corrosion measures are recommended.

The soil nail wall will be located within the existing fill embankment material. Since the source of the existing fill material is unknown, we recommended that the fill be considered corrosive for the purposes of the soil nail wall design. We recommend that epoxy - encapsulated nails be used for Retaining Wall #3.

11.0 CONSTRUCTION CONSIDERATIONS

11.1 Construction Advisory

11.1.1 Saturated and Unstable Soil Conditions

The near surface native soils at the site consists of moist lean and fat clays. These soils will require varying degrees of drying prior to compaction to meet the requirements for subgrade soils. Highly moist to wet subgrade soils may be encountered at the site especially in cut areas. These soils could be unstable under construction equipment. Where these condition occur, subgrade improvement may be required prior to the construction of the pavement section or other rigid structures. The recommended methods for subgrade stabilization include the following:

Over Excavation and Removal
Extend the excavation to additional depth of 200 mm (minimum) to allow the placement of a 100 mm-thick layer of Aggregate Base (AB). This AB layer should be encapsulated with Type B, Rock Slope Protection (RSP) fabric. The fabric and the AB will act as a bridging layer and provide a working platform.

Lime Treatment
The exposed wet and unstable soil should be treated with 2.5 percent quicklime to provide a workable subgrade. The lime treatment should extend to a depth of at least 450 mm. The treated subgrade should be compacted over its full depth to achieve at least 95 percent relative compaction in the top 200 mm below the grading plane.

11.1.2 Retaining Wall

The existing cantilever retaining wall will have to be demolished in stages as retaining wall #3 (soil nail wall) is constructed. The removal of the existing wall may require saw cutting.

11.1.3 Groundwater

High ground water is expected. Ground water level of up to 1 m below ground surface was encountered during drilling on May, 2002. Some temporary excavation may extend below the groundwater table. Contractor should take appropriate measures to control ground water during construction.

11.1.4 Temporary Cuts and Shoring

Temporary excavations extending close to or below groundwater table will be needed for "construction of the bridge footings, and retaining walls. Due to the space constraints and/or utility conflicts, vertical cuts in excess of 2.0 m may be necessary at some locations. These vertical cuts will require temporary shoring during construction. It is the responsibility of the contractor to select and design appropriate shoring system. However, the most appropriate temporary shoring system for this project includes:

- Sheet-Pile
- Soldier Pile and Lagging
- Soil Nail walls (above the ground water table)

The recommended "equivalent fluid pressures" for the design of a shoring system are 721 kg/m^3 for above groundwater table and 1362 kg/m^3 below groundwater table. Temporary Cut should conform to CAL/OSHA requirements for soil Type "C."

11.1.5 Hazardous Waste Considerations

This project site was assessed to contain contaminated soil. Please refer to hazardous waste assessment report by Caltrans Environmental Engineering Branch. Excavated soil in the project site must be handled and disposed of appropriately.

11.2 Construction Consideration that Influence Specifications

11.2.1 Drilled Holes for Soil Nail Wall

The drilled holes for the installation of soil nails for Retaining Wall #3 (soil nail wall) will be in fill material. Caving of the holes should be anticipated. Casing of the holes may be needed.

11.2.2 Soil Nail Wall Construction

Seepage of water at isolated location in the temporary vertical cuts (needed for the construction of the Retaining Wall #3) should be anticipated. This seepage can be significant during the rainy season and can cause instability of the cut. We recommend that Retaining Wall #3 be constructed in dry months of the year to avoid potential cut instability. If the cut is made in the wet season, the contractor will likely need special measures to stabilize the temporary cut during construction.

11.2.3 Use of on Site Material as Fill

Some of the surficial on-site material cannot be used as fill without treatment. All on site material to be used as fill has to be approved by the engineer in accordance with guidelines specified in this report and per standard specification.

11.3 Construction Monitoring and Instrumentation

11.3.1 Settlement Monitoring

As discussed in Section 7.4.4 of this report, it will be necessary to determine when 90 percent of the primary consolidation settlement due to the proposed fill occurs in the field. This can be achieved most effectively by installing settlement Survey Hubs. Survey Hubs should be installed at the site to monitor the settlement at location shown in Figure 7 and in accordance with the guide specification. The guide specification for the survey hub is included in Appendix E.

12. RECOMMENDATION SUMMARY

12.1 Embankments

The fill embankment located from Station Lt. "S" 501+00± to 502+60± (at the location of Retaining Walls #1 and 4) will require ground improvement (removal and replacement of the surficial soil as shown in Figures 7 and 8). The replaced material should be per guide specification provided in Table 3. This fill also has a recommended settlement waiting period of 90 days.

All fills slopes should be inclined at a maximum slope inclination ratio of 1:2 (V:H).

The recommended settlement monitoring is by survey hubs. The location and specification of the survey hubs are discussed in Sections 7.4.4 and 11.3, respectively. The locations of the survey hubs are shown in Figure 7.

12.2 Cuts

Underdrains are recommended in cut section from Station Lt. "S" 506+66± to 509+30± as shown in Figure 6 and next to the soil nail wall. Saturated and unstable soil may be encountered in the cut sections and subgrade stabilization may be needed. All cut slopes should be inclined at a maximum slope inclination ratio of 1:2 (V:H).

12.3 Retaining Walls

The proposed Retaining Walls #1 and 4 are fill walls. The recommended wall type for Retaining Walls #1 and 4 are Caltrans standard walls, type 1 and type 5, respectively. The foundation soils at these locations will require ground improvement as shown in Figure 8.

Retaining Wall #2 is a cut wall. The recommend wall type is Caltrans standard type 5. The subgrade below the wall footing may require subgrade stabilization. Refer to Section 11.1.1 for recommendations.

Retaining Wall #3 is cut wall. The recommended wall type at this location is a soil nail wall. The recommended nail spacing is shown in Figure 9. Since the nails will be installed in fill soil, caving of the drilled hole is a possibility. See Sections 7.5 and 11.2.1 for recommendations.

12.4 Corrosion

The soils at the project site are non-corrosive. Use standard corrosion protection measures.

Epoxy-encapsulated nails should be used for the soil-nailed wall (Retaining Wall #3) due to uncertainty regarding corrosivity of the existing fill material at this location.

FIGURES

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HIGH STREET VIADUCT

04-ALA-880 KP 43.5/45.5
4250-165421 APRIL 2005

LOCATION MAP | FIGURE 1

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DGN FILE => 416542g01.dgn

STATE OF CALIFORNIA

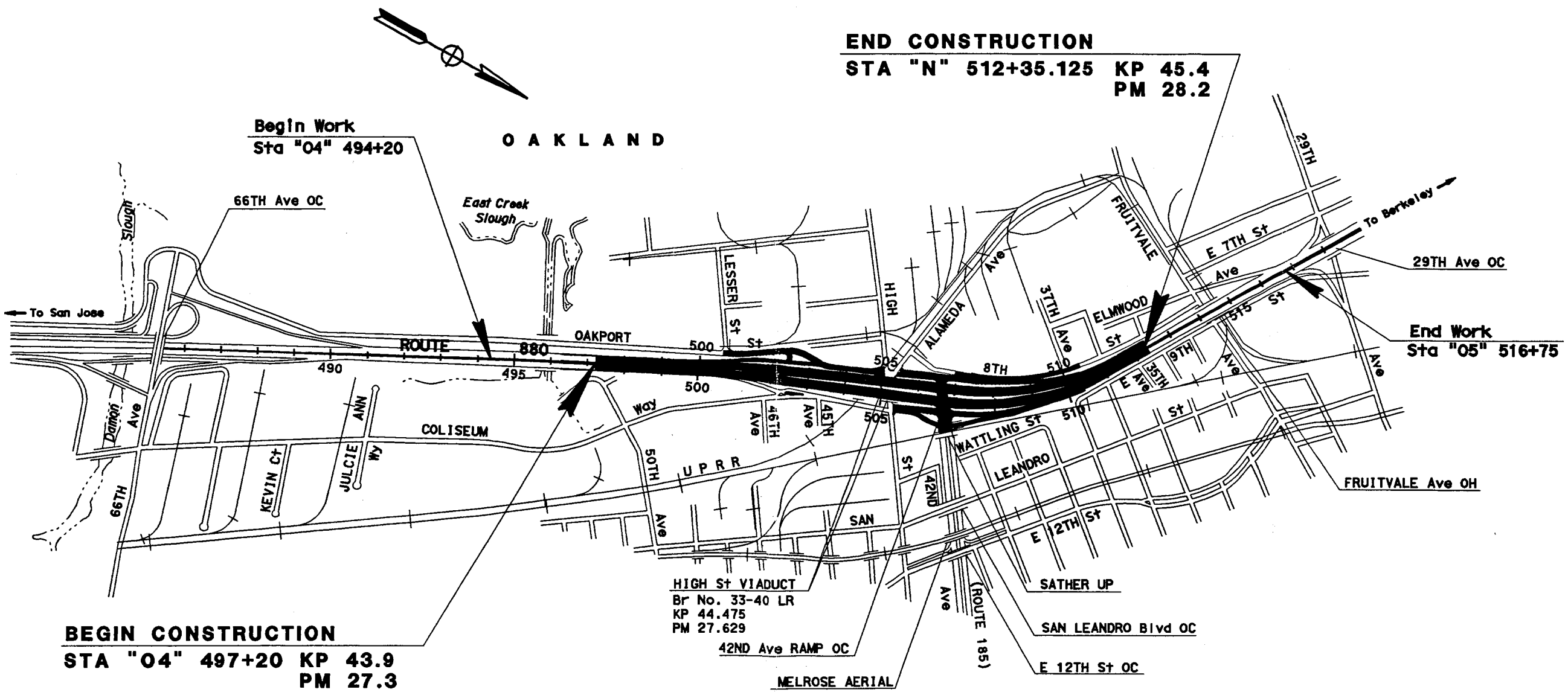
DEPARTMENT OF TRANSPORTATION

PROJECT PLANS FOR CONSTRUCTION ON

STATE HIGHWAY

IN ALAMEDA COUNTY
IN OAKLAND FROM 0.8 km SOUTH OF HIGH STREET TO 0.2 KM SOUTH OF FRUITVALE AVENUE

To be supplemented by Standard Plans dated July, 1999



NOT TO SCALE

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

DRAWN BY: M. REYNOLDS
CHECKED BY: B. LEE

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HIGH STREET VIADUCT	
04-ALA-880	KP 43.5/45.5
4250-165421	APRIL 2005
VICINITY MAP	FIGURE 2

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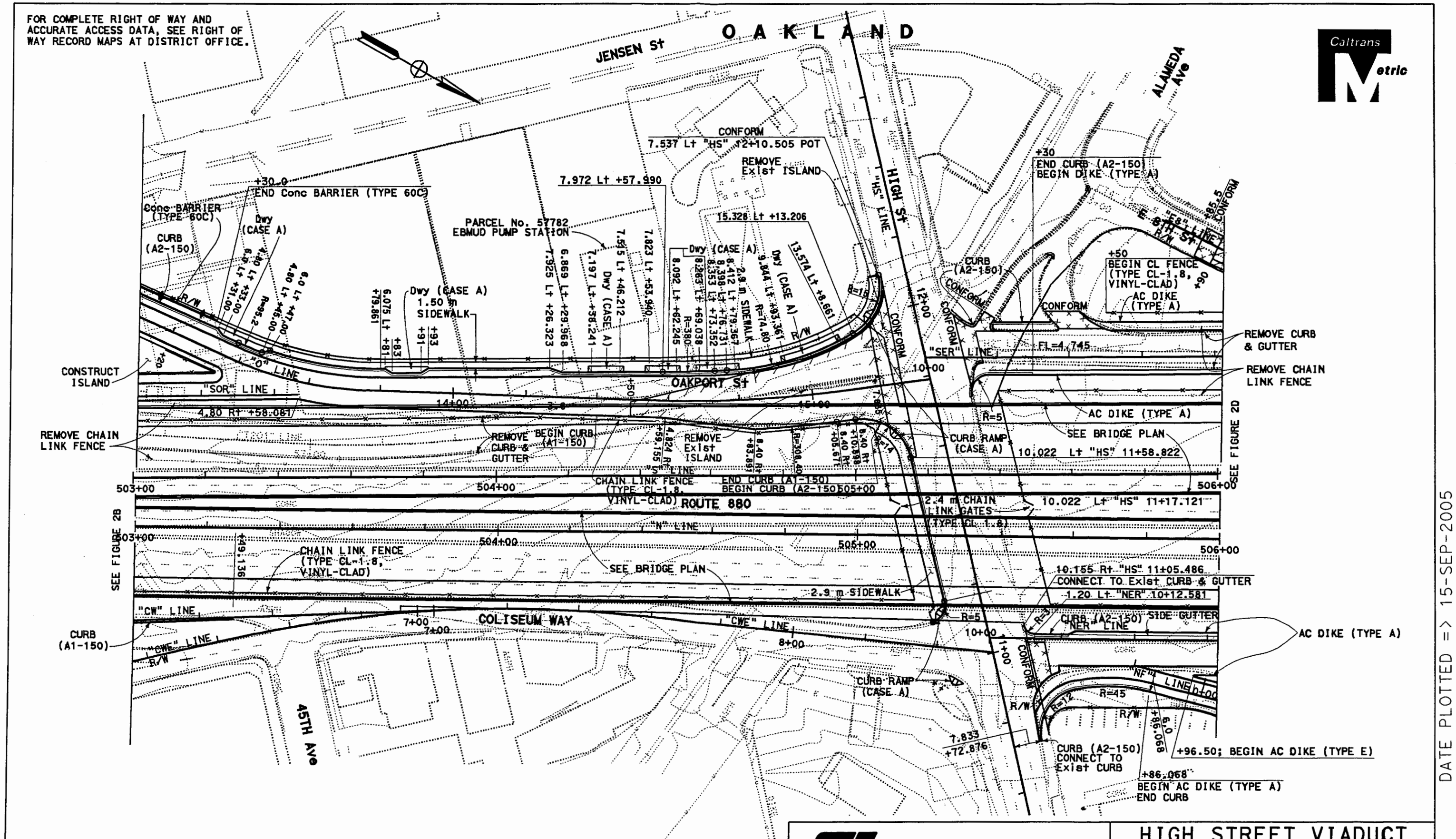
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.



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ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

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HIGH STREET VIADUCT

04-ALA-880 KP 43.5/45.5
4250-165421 APRIL 2005

PROJECT LAYOUT | FIGURE 2C

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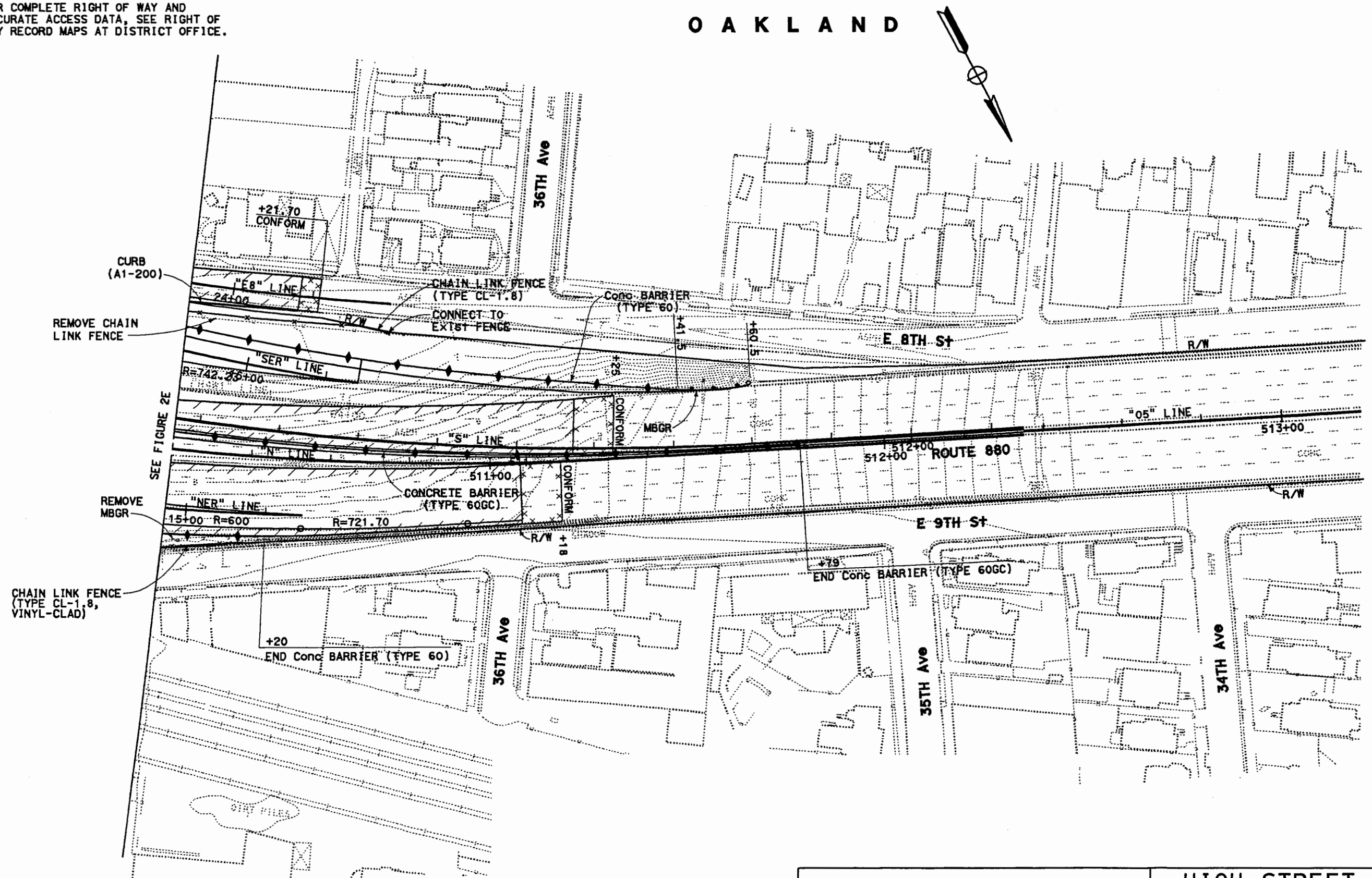
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

Caltrans Metric



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HIGH STREET VIADUCT	
04-ALA-880	KP 43.5/45.5
4250-165421	APRIL 2005
PROJECT LAYOUT	FIGURE 2F

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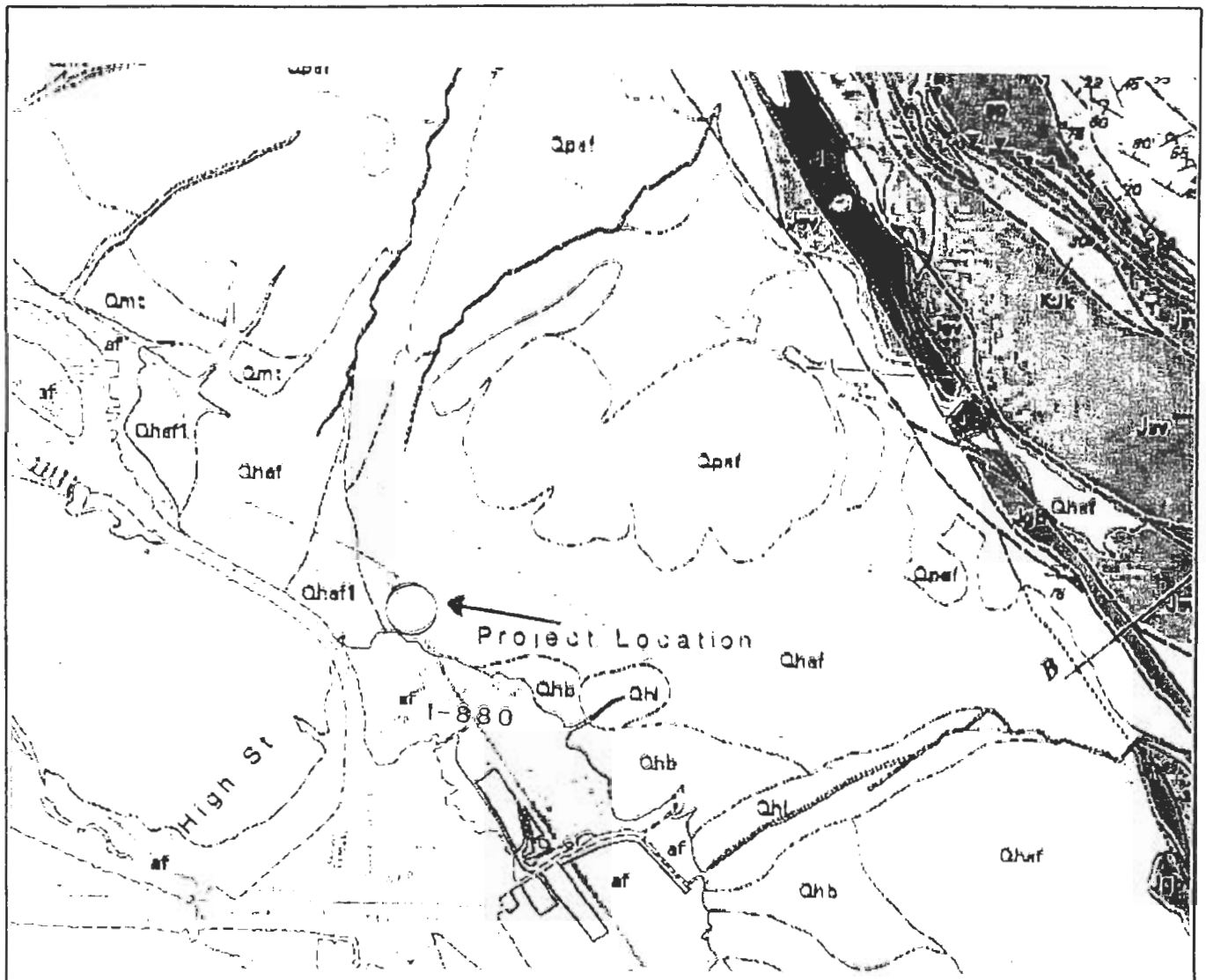

NOT TO SCALE

LIST OF MAP UNITS

af - Artificial fill (Historic)
Qhaf1 - Younger alluvial fan deposits (Holocene)
Qhaf - Alluvial fan and fluvial deposits (Holocene)
Qhb - Basin deposits (Holocene)
Qhl - Natural levee deposits (Holocene)
Qpaf - Alluvial fan and fluvial deposits (Pleistocene)
Qmt - Marine terrace deposits (Pleistocene)
KJK - Knoxville formation (early Cretaceous and late Jurassic)
Jsv - Keratophyre and quartz kertophyre (late Jurassic)
Jb - Massive basalt and diabse (Jurassic – Coast Range ophiolite)
Jgb - Gabbro (Jurassic - Coast Range ophiolite)
Sp - Serpentinite (Jurassic -Coast Range ophiolite)

REFERENCE:

U.S. Geological Survey
Geologic map and map database of the Oakland metropolitan area, Alameda, Contra Costa, and San Francisco Counties, California.

By: R. W. Graymer, 2000

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DATE PLOTTED => 31-AUG-2005
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HIGH STREET VIADUCT

04-ALA-880 KP 43.5/45.5
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GEOLOGY MAP | FIGURE 3

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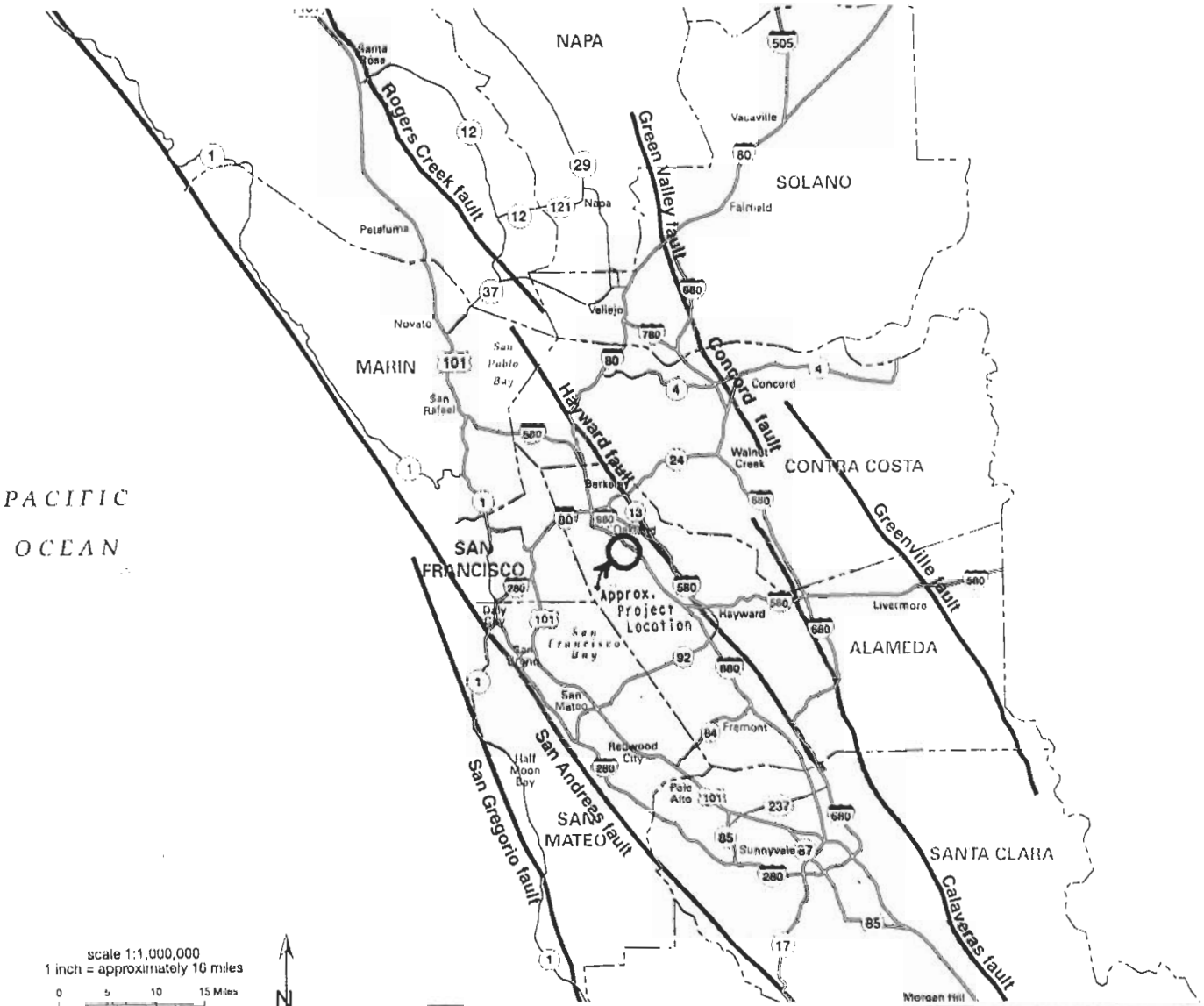

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Office of Geotechnical Design - West

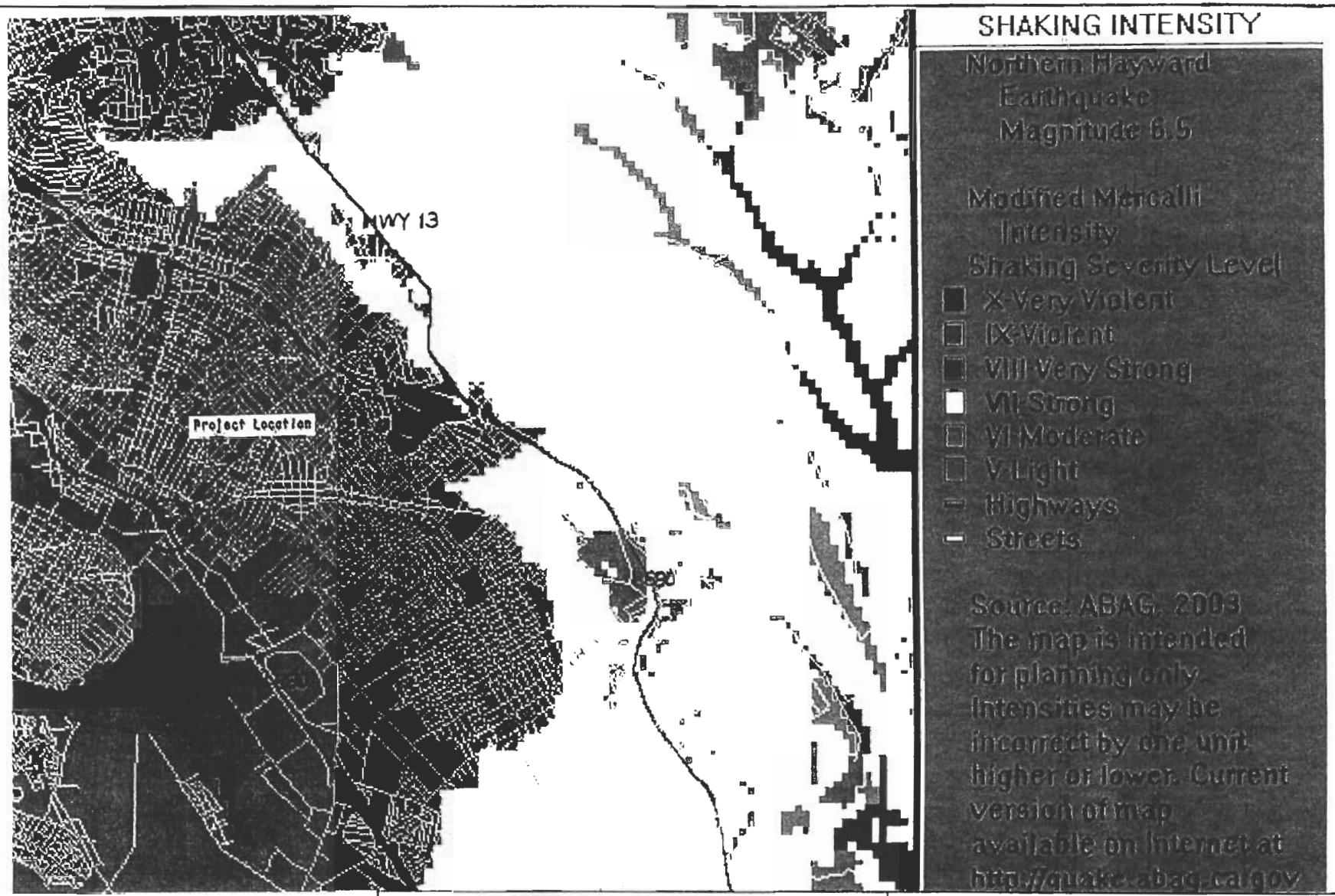
HIGH STREET VIADUCT

04-ALA-880 KP 43.5/45.5
4250-165421 APRIL 2005

FAULT MAP | FIGURE 4

DATE PLOTTED => 31-AUG-2005
TIME PLOTTED => 06:26

USERNAME => mreynold
DGN FILE => 416542g04.dgn



DRAWN BY: M. REYNOLDS
CHECKED BY: B. LEE

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HIGH STREET VIADUCT

04-ALA-880 KP 43.5/45.5
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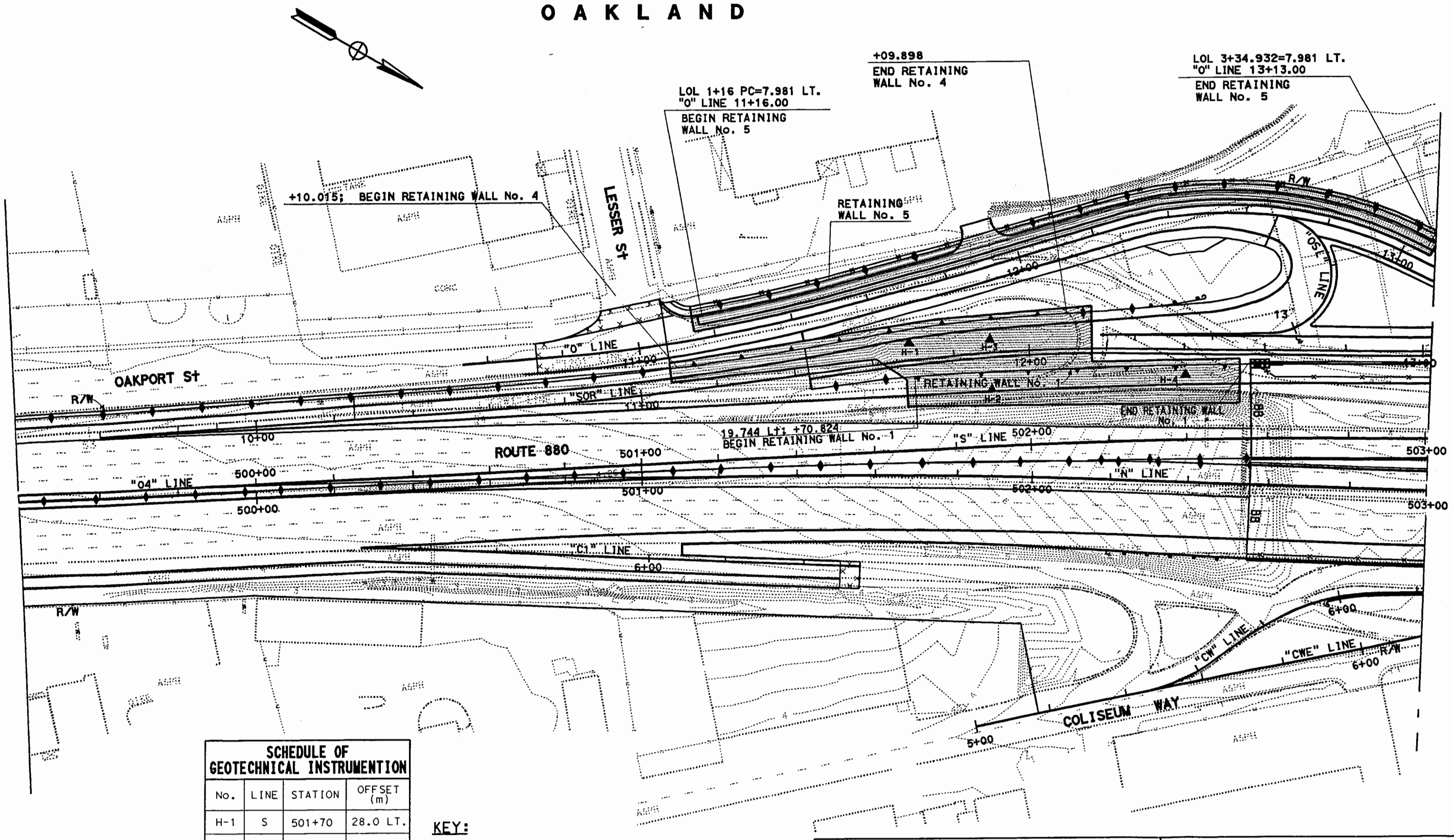
GROUND SHAKING INTENSITY MAP | FIGURE 5

DATE PLOTTED => 18-MAY-2005
TIME PLOTTED => 15:53

USERNAME => mreynold
DGN FILE => 416542g00.dgn

OAKLAND



SCHEDULE OF GEOTECHNICAL INSTRUMENTION			
No.	LINE	STATION	OFFSET (m)
H-1	S	501+70	28.0 LT.
H-2	S	501+90	15.0 LT.
H-3	S	501+90	28.0 LT.
H-4	S	502+40	17.0 LT.

KEY:

OVEREXCAVATE TO 1.8 m AND REPLACE WITH IMPORTED BORROW

SURVEY HUB

NOT TO SCALE

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HIGH STREET VIADUCT

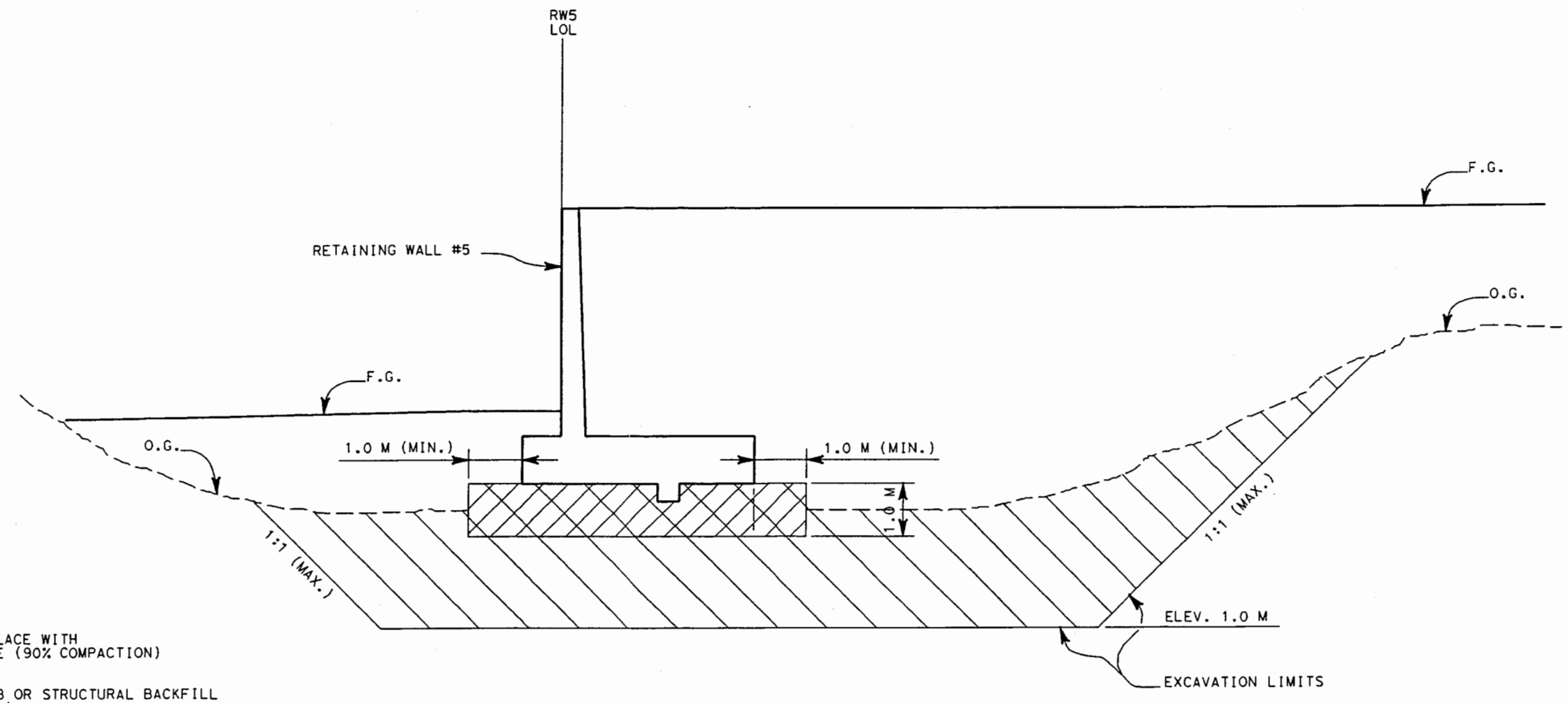
04-ALA-880 KP 43.5/45.5
4250-165421 APRIL 2005

GROUND IMPROVEMENT LAYOUT | FIGURE 7

DRAWN BY: M. REYNOLDS
CHECKED BY: B. LEE

USERNAME => mreynold
DGN FILE => 416542g07.dgn

DATE PLOTTED => 19-DEC-2005
TIME PLOTTED => 15:51



KEY:

- REMOVE AND REPLACE WITH BACKFILL TYPE E (90% COMPACTION)
- REPLACE WITH AB OR STRUCTURAL BACKFILL (95% COMPACTION)

GROUND IMPROVEMENT (TYPICAL SECTION) FOR RETAINING WALL #5

7.981 LT. "0" LINE, STA. 11+16 TO 13+30
NOT TO SCALE

DATE PLOTTED => 31-AUG-2005
TIME PLOTTED => 13:53

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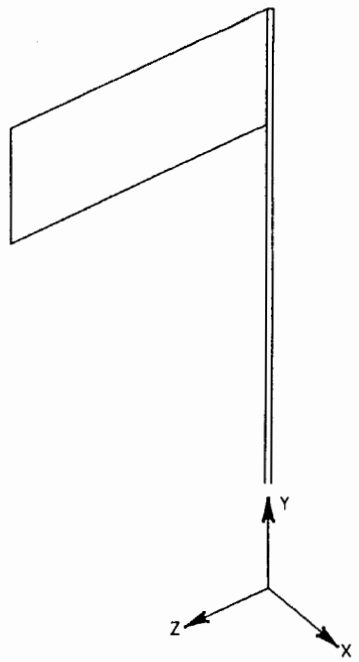
HIGH STREET VIADUCT	
04-ALA-880	KP 43.5/45.5
4250-165421	APRIL 2005
	FIGURE 10

DRAWN BY: M. REYNOLDS
CHECKED BY: B. LEE

USERNAME => mreynold
DGN FILE => 416542g10.dgn

High Street Viasuct, EA # 04-165421



Forces and moments at top of the base plate as shown on the submitted plan for Sign Structure (A), @ Sta. 496+60 (FNBT).

Combination (1)	Combination (2)
F_X =46649 N	F_X =27989 N
F_Y =55987 N	F_Y =55987 N
F_Z = 9330 N	F_Z =13995 N
M_X =205691 N-m	M_X =240324 N-m
M_Y =184963 N-m	M_Y =110978 N-m
M_Z =346322 N-m	M_Z =207793 N-m

NOTE: Design has to be based on Load Combination (1), AND Load Combination (2) separately. Do not mix the load combinations (1) and (2), do not take the maximum loads of the two.

DATE PLOTTED => 19-SEP-2005
TIME PLOTTED => 09:59

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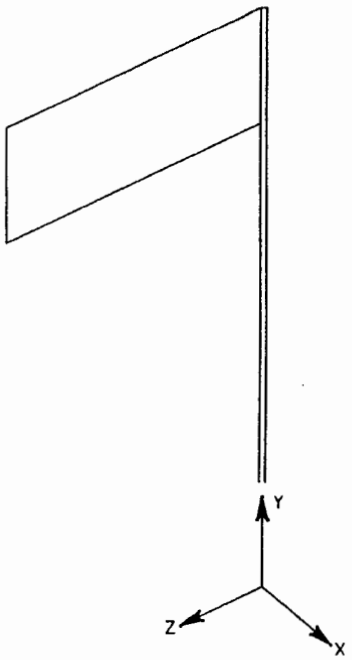
HIGH STREET VIADUCT	
04-ALA-880	KP 43.5/45.5
4250-165421	APRIL 2005
SIGN STRUCTURE (A)	FIGURE 11

USERNAME => mreynold
DGN FILE => 416542g11.dgn

High Street Viasuct, EA # 04-165421



Forces and moments at top of the base plate as shown on the submitted plan for Sign Structure (F), @ Sta. 511+40 (FNBT).

Combination (1)	Combination (2)
F_X =64591 N	F_X =38755 N
F_Y =59828 N	F_Y =59828 N
F_Z =12918 N	F_Z =19377 N
M_X =352760 N-m	M_X =401447 N-m
M_Y =354605 N-m	M_Y =212763 N-m
M_Z =486628 N-m	M_Z =291927 N-m

NOTE: Design has to be based on Load Combination (1), AND Load Combination (2) separately. Do not mix the load combinations (1) and (2), do not take the maximum loads of the two.

DATE PLOTTED => 19-SEP-2005
TIME PLOTTED => 09:08

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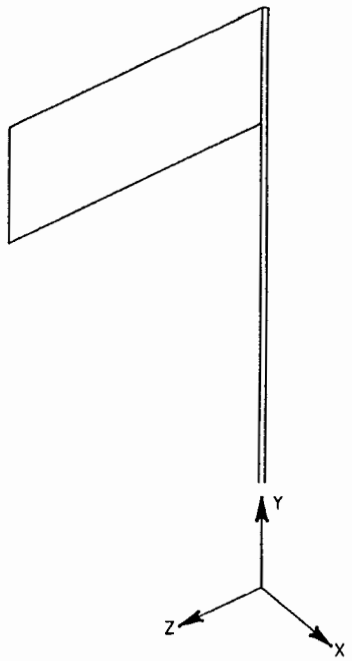
HIGH STREET VIADUCT

04-ALA-880 KP 43.5/45.5
4250-165421 APRIL 2005

SIGN STRUCTURE (F) | FIGURE 12

USERNAME => mreynold
DGN FILE => 416542g12.dgn

High Street Viasuct, EA # 04-165421



Forces and moments at top of the base plate as shown on the submitted plan for Sign Structure (D), @ Sta. 502+40 (FSBT).

Combination (1)	Combination (2)
F_X =24341 N	F_X =14605 N
F_Y =52283 N	F_Y =52283 N
F_Z = 4868 N	F_Z = 7302 N
M_X =148094 N-m	M_X =161883 N-m
M_Y = 77440 N-m	M_Y = 46464 N-m
M_Z =137889 N-m	M_Z = 82733 N-m

NOTE: Design has to be based on Load Combination (1), AND Load Combination (2) separately. Do not mix the load combinations (1) and (2), do not take the maximum loads of the two.

DATE PLOTTED => 19-SEP-2005
TIME PLOTTED => 09:58

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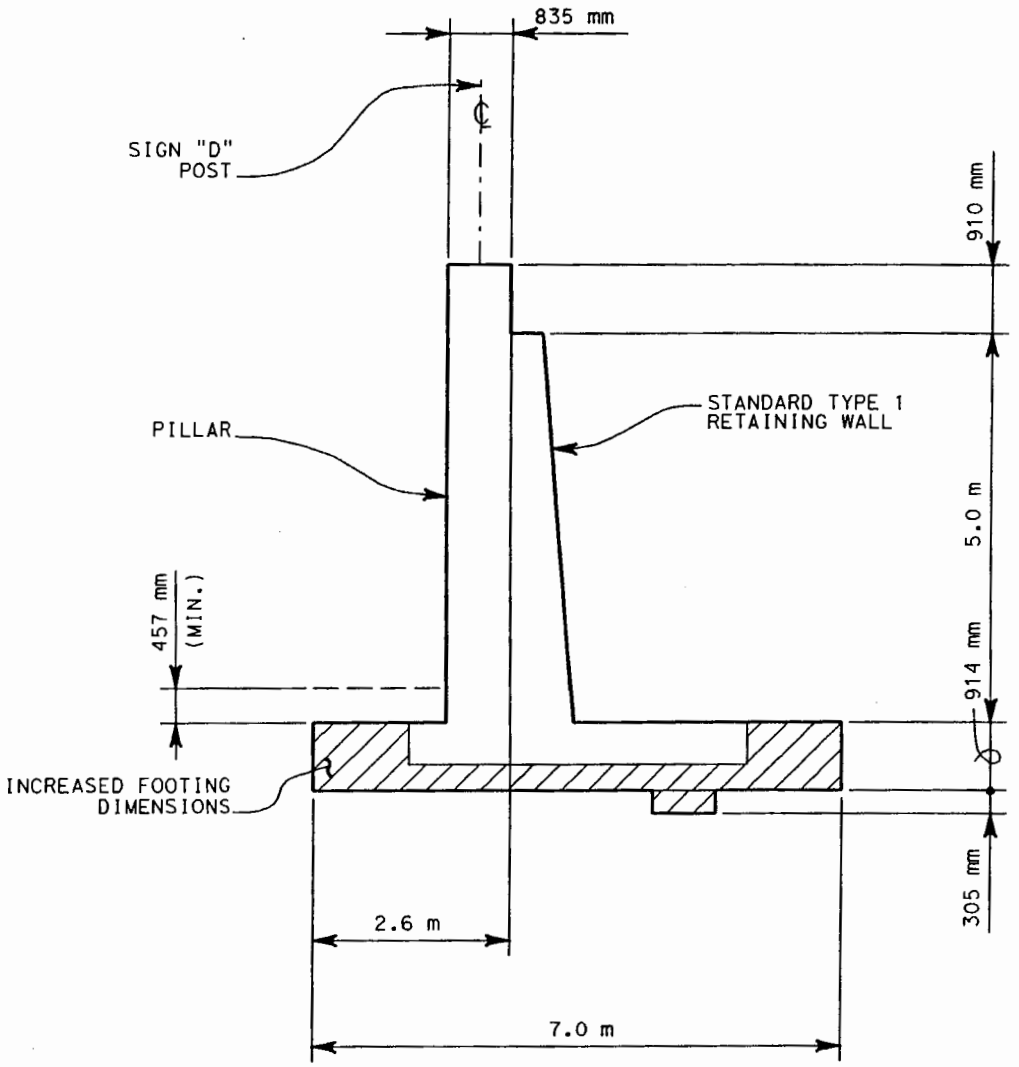
HIGH STREET VIADUCT

04-ALA-880 KP 43.5/45.5
4250-165421 APRIL 2005

SIGN STRUCTURE (D) | FIGURE 13

USERNAME => mreynold
DGN FILE => 416542g13.dgn



SPECIAL FOOTING FOR SIGN "D"
AT STATION 502+40
NOT TO SCALE

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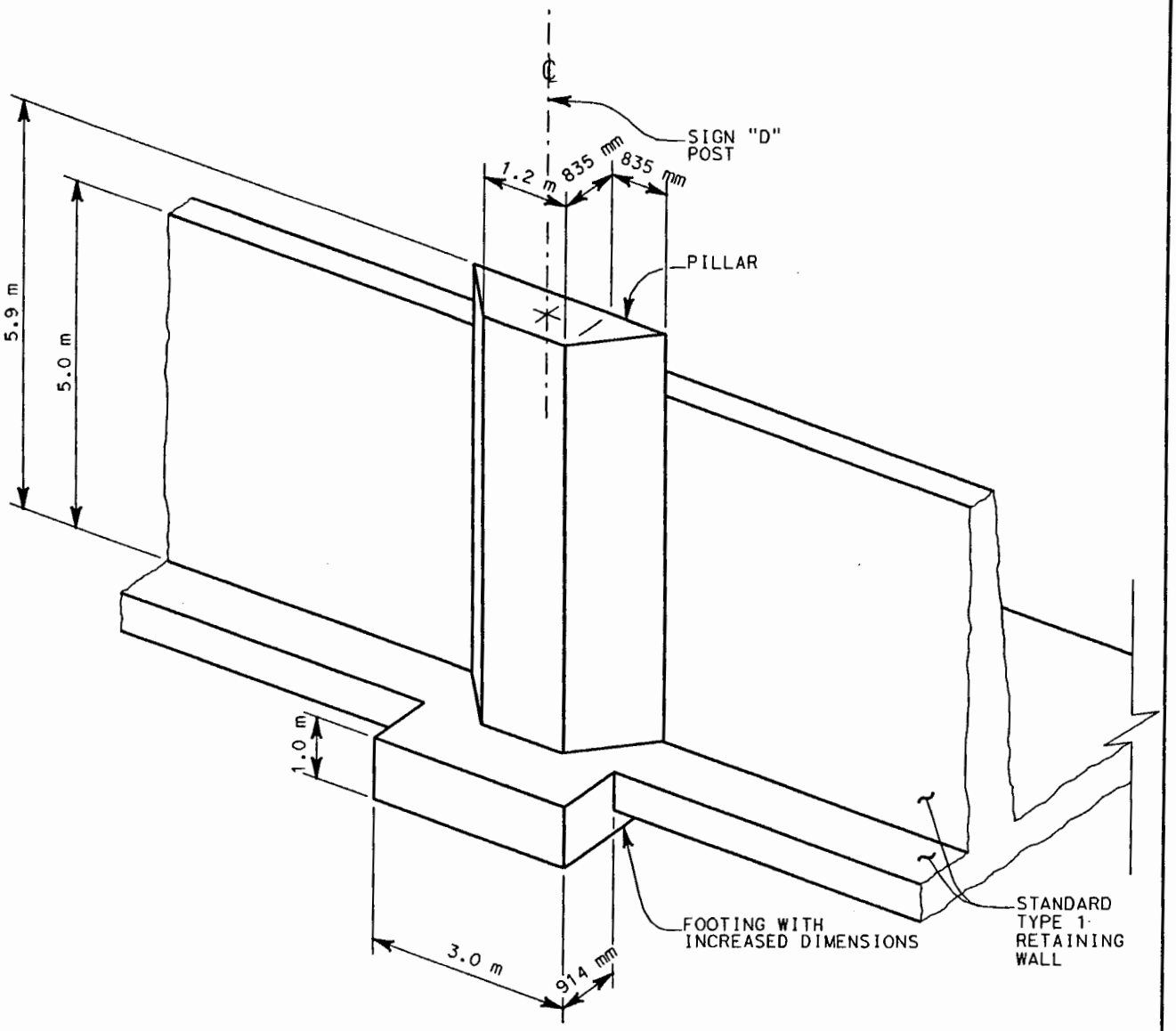
HIGH STREET VIADUCT	
04-ALA-880	KP 43.5/45.5
4250-165421	APRIL 2005
SIGN STRUCTURE (D)	FIGURE 14

DATE PLOTTED => 30-AUG-2005
TIME PLOTTED => 10:44

USERNAME => mreynold
DGN FILE => 416542g14.dgn



SPECIAL FOOTING FOR SIGN "D"

AT STATION 502+40
NOT TO SCALE

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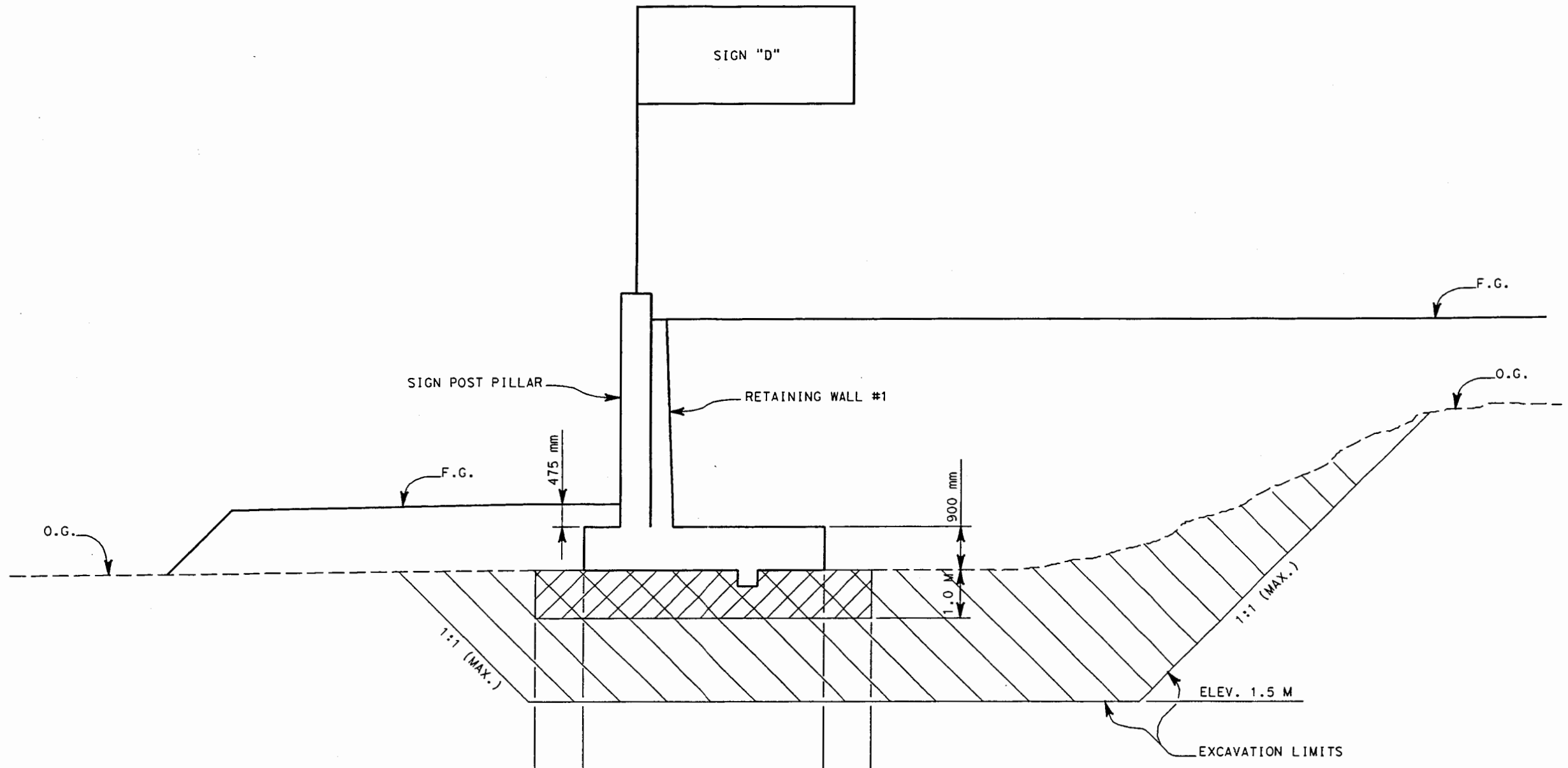
Geotechnical Design - West

HIGH STREET VIADUCT	
04-ALA-880	KP 43.5/45.5
4250-165421	APRIL 2005
SIGN STRUCTURE (D)	FIGURE 15

DATE PLOTTED => 30-AUG-2005
TIME PLOTTED => 10:52

USERNAME => mreynold
DGN FILE => 416542g15.dgn



KEY:

REMOVE AND REPLACE WITH BACKFILL TYPE E (90% COMPACTION)

REPLACE WITH AB OR STRUCTURAL BACKFILL (95% COMPACTION)

GROUND IMPROVEMENT STA 502+40 (FSBT)

NOT TO SCALE

DRAWN BY: M. REYNOLDS
CHECKED BY: B. LEE

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Geotechnical Services
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HIGH STREET VIADUCT

04-ALA-880 KP 43.5/45.5
4250-165421 APRIL 2005

FIGURE 16

DATE PLOTTED => 30-AUG-2005
TIME PLOTTED => 13:04

USERNAME => mreynold
DGN FILE => 416542g16.dgn

APPENDIX A

(Log of Test Borings (LOTB) Sheets)

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	ALA	880	43.6 - 45.5	1	10

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER JEREMY JACOB ZORNE No. C60936 Exp. 12/31/06 CIVIL STATE OF CALIFORNIA

GEOCON
CONSULTANTS, INCORPORATED
11375 SUNRISE PARK DRIVE, SUITE 100
RANCHO CORDOVA, CA. 95742-7207
PHONE 916 852-9118 - FAX 916 852-9132

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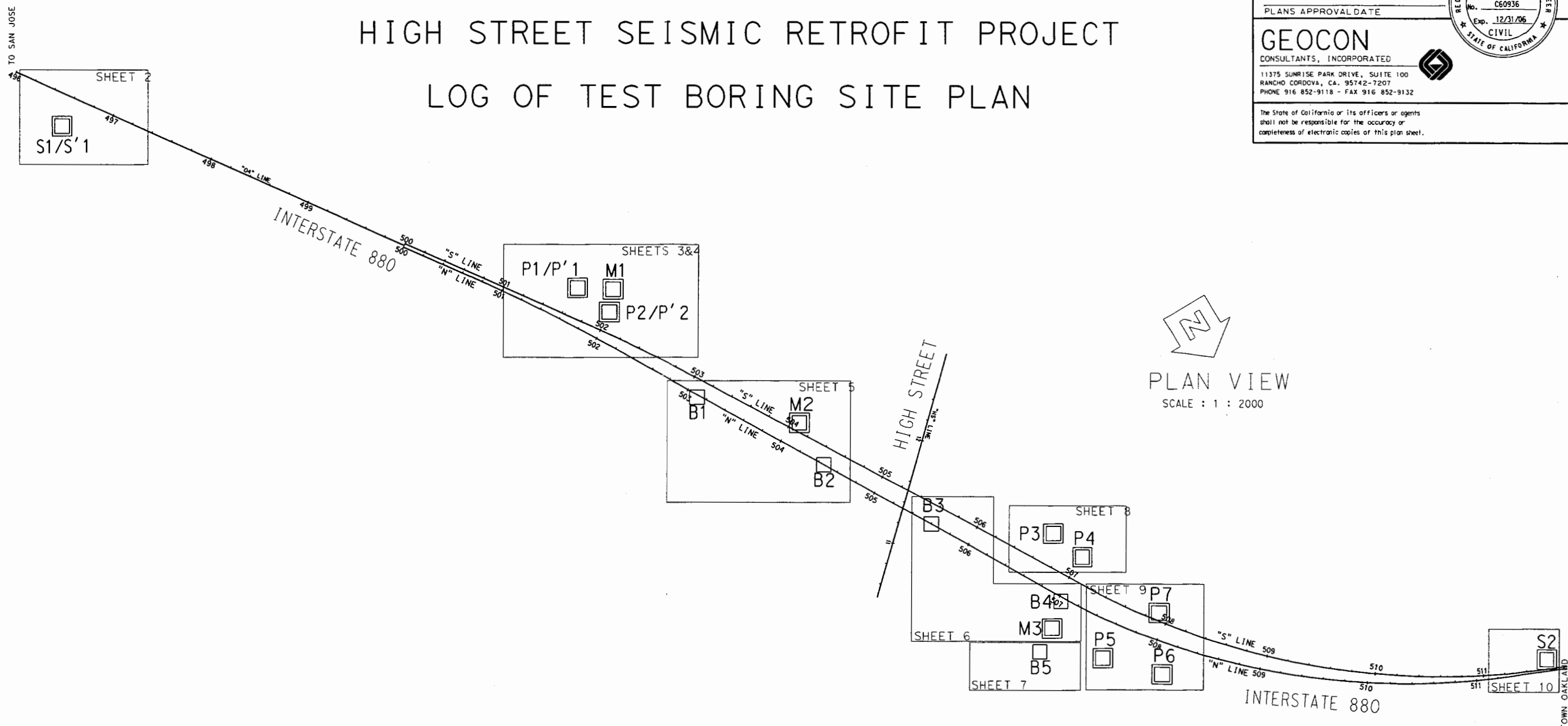
Caltrans Metric

HIGH STREET SEISMIC RETROFIT PROJECT

LOG OF TEST BORING SITE PLAN



PLAN VIEW
SCALE : 1 : 2000

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

LEGEND OF BORING OPERATIONS

Hollow-Stem Auger Boring (Diameter)
Rotary Boring, wet (Diameter)
Top Hole El.
Casing Drive
Size of Sampler (mm)
Blows per 300 mm or Penetration
Penetration - Blows per 300 mm or Penetration
Casing Depth
Depth of Water (Date)
Depth of Caving (Date)
Total Unit Weight (kN/m³)
Moisture
Laboratory Test (see key)
Unconfined Compressive Strength (kPa) based on Pocket Penetrometer (Py)
Shear Strength (kPa) based on Torvane (Sv)
Data Measures
Conformable material change
Inferred material change
Unconformable material change
Boring Termination Depth
Boring Termination Date
HOLLOW-STEM AUGER BORING (DRY) OR ROTARY BORING (WET)

SOIL TEST DESIGNATIONS

- (AL) ATTERBERG LIMITS
- (CH) CHLORIDE
- (CR) CORROSIVITY
- (DD) MAXIMUM DRY DENSITY
- (CD) CONSOLIDATED UNDRAINED TRIAXIAL
- (DS) DIRECT SHEAR
- (SS) SOLUBLE SULPHATES
- (R) R-VALUE
- (CN) CONSOLIDATION
- (GS) GRAIN SIZE ANALYSIS
- (UC) UNCONFINED COMPRESSION
- (UU) UNCONSOLIDATED UNDRAINED TRIAXIAL

TYPES OF BORING

- 51 mm CONE PENETRATION
- SAMPLE BORING (DRY)
- ROTARY SAMPLE BORING (WET)
- AUGER BORING (DRY)
- TEST PIT
- DIAMOND CORE BORING
- JET BORING
- ELECTRONIC CONE PENETROMETER

LEGEND OF EARTH MATERIALS

- GRAVEL
- SAND
- SILT
- CLAY
- SANDY CLAY or CLAYEY SAND
- SANDY SILT or SILTY SAND
- SILTY CLAY
- CLAYEY SILT
- PEAT and/or ORGANIC MATTER
- COBBLES and/or BOULDERS
- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC

CONSISTENCY CLASSIFICATION FOR SOILS

According to the Standard Penetration Test

SPT N-Value (Blows/ 0.3m)	Granular	SPT N-Value (Blows/ 0.3m)	Cohesive
0-4	Very Loose	0	Very Soft
5-10	Loose	2-4	Soft
11-30	Medium Dense	5-8	Firm
31-50	Dense	9-15	Stiff
>50	Very Dense	16-30	Very stiff
		>30	Hard

Note: Visual classification of earth materials based on field inspection is confirmed or revised with laboratory test results as necessary.

CALTRANS DESIGN OVERSIGHT	DRAWN BY: A. M. LADRILLONO	FIELD INVESTIGATION BY: LEANNE ROBERTS, MAY 2002; JEREMY ZORNE, APRIL 2003	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE	CHECKED BY: J. J. ZORNE		

B. LEE
PROJECT ENGINEER

BRIDGE NO. 33-0040 L/R 33-0068 S
KILOMETER POST 43.6 - 45.5

HIGH STREET SEISMIC RETROFIT PROJECT
LOG OF TEST BORINGS

CU 04247
EA 165421

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY): 01/18/03 05/25/03 01/29/04 03/01/04 05/18/04

SHEET 1 OF 10

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

OGS CIVIL LOG OF TEST BORINGS SHEET (METRIC) (REV. 3/01)

FILE => LOTB_SHEET01.dgn

USERNAME => dtoloso DATE PLOTTED => 13-JAN-2006 TIME PLOTTED => 08:46

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	ALA	880	43.6 - 45.5	4	10

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — JEREMY JACOB ZORNE — No. C60936 — Exp. 12/31/06 — CIVIL — STATE OF CALIFORNIA

GEOCON
CONSULTANTS, INCORPORATED
11375 SUNRISE PARK DRIVE, SUITE 100
RANCHO CORDOVA, CA. 95742-7207
PHONE 916 852-9118 - FAX 916 852-9132

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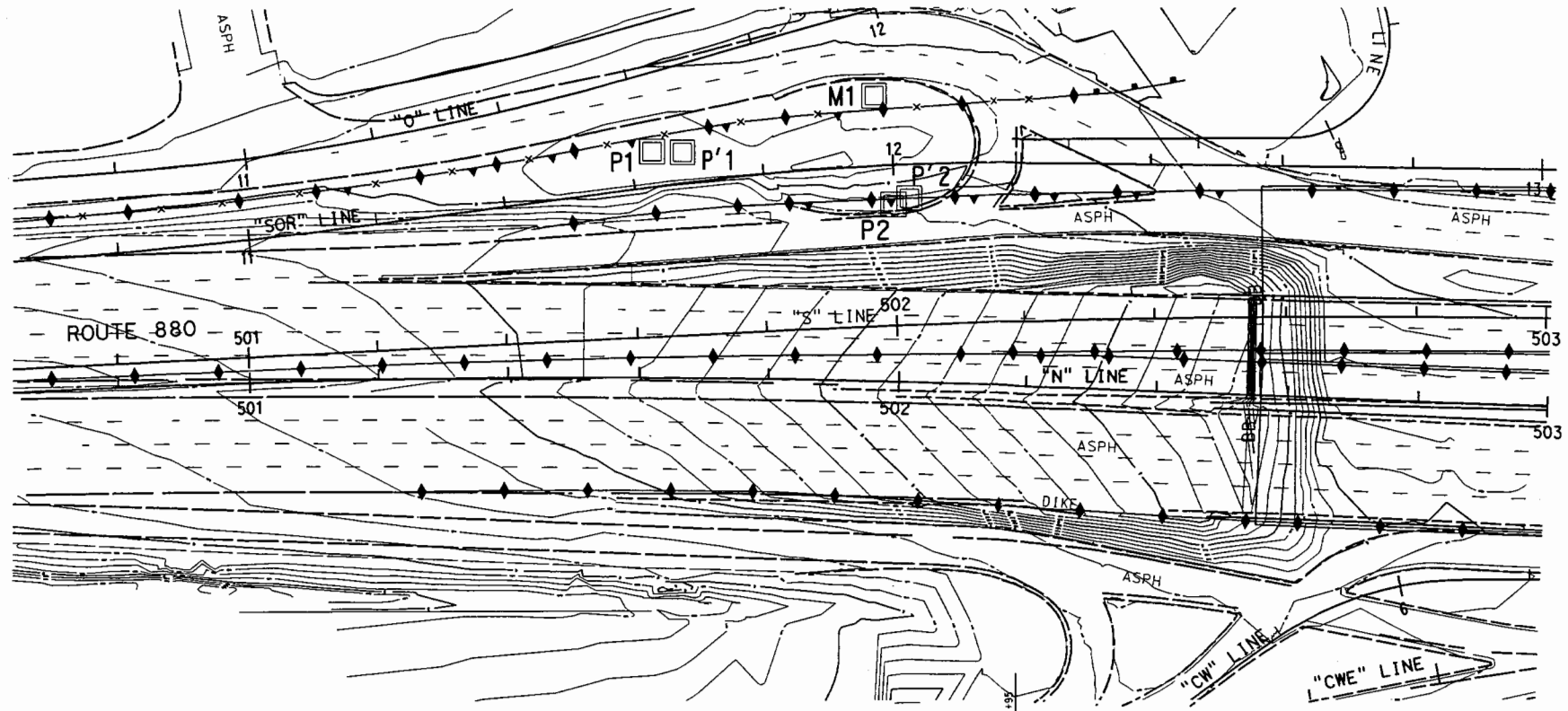

PLAN VIEW
SCALE : 1 : 500

NOTES:

1. 60 mm samples were taken using a modified California soil-barrel sampler with an inside diameter of 60 mm and outside diameter of 76 mm.
2. Standard Penetration Tests (SPT) were performed by driving a 51 mm outside diameter, 35 mm inside diameter split-spoon SPT sampler.
3. The boring logs and related information represent the opinion of the professional engineer as to the character of the material at the locations shown. Soil and groundwater conditions between adjacent test holes and at other locations may differ from those shown. Groundwater conditions may change with passage of time.
4. Test boring elevations are approximate and are based on portable GPS equipment readings and interpreted based on topographic base sheet mapping prepared for this project.
5. Test boring locations were determined in the field based on taping and pacing from mapped site features. The locations of the explorations should be considered accurate only to the degree implied by the measuring methods used.
6. A 64 kg automatic hammer falling 760 mm was used to drive the samplers.
7. Visual classification of earth materials was based on field inspection and was confirmed or revised with laboratory test results.

PROFILE
VERT. SCALE. 1:100

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

LEGEND OF BORING OPERATIONS

SOIL TEST DESIGNATIONS

LEGEND OF TYPES OF BORING

LEGEND OF EARTH MATERIALS

CONSISTENCY CLASSIFICATION FOR SOILS

According to the Standard Penetration Test			
SPT N-Value (Blows/ 0.3m)	Granular	SPT N-Value (Blows/ 0.3m)	Cohesive
0-4	Very Loose	0	Very Soft
5-10	Loose	2-4	Soft
11-30	Medium Dense	5-8	Firm
31-50	Dense	9-15	Stiff
>50	Very Dense	16-30	Very stiff
		>30	Hard

Note: Visual classification of earth materials based on field inspection is confirmed or revised with laboratory test results as necessary.

CALTRANS DESIGN OVERSIGHT	DRAWN BY	A. M. LADRILLONO	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	B. LEE
SIGN OFF DATE	CHECKED BY	J. J. ZORNE	LEANNE ROBERTS MAY 2002		PROJECT ENGINEER

BRIDGE NO. 33-0040 L/R 33-0068 S
KILOMETER POST 43.6 - 45.5

HIGH STREET SEISMIC RETROFIT PROJECT

LOG OF TEST BORINGS

CU 04247
EA 165421

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY): 01/07/03 01/17/03 06/24/03 07/18/03 01/29/04 03/04/04 05/18/04

SHEET 4 OF 10

OGS CIVIL LOG OF TEST BORINGS SHEET (METRIC) (REV. 3/01)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

FILE => LOTB_SHEET04.dgn

USERNAME => gtolosa DATE PLOTTED => 13-JAN-2006 TIME PLOTTED => 08:44

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	ALA	880	43.6 - 45.5	1	10

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER JEREMY JACOB ZORNE C60936 Exp. 12/31/06 CIVIL STATE OF CALIFORNIA

GEOCON
CONSULTANTS, INCORPORATED
11375 SUNRISE PARK DRIVE, SUITE 100
RANCHO CORDOVA, CA. 95742-7207
PHONE 916 852-9118 - FAX 916 852-9132

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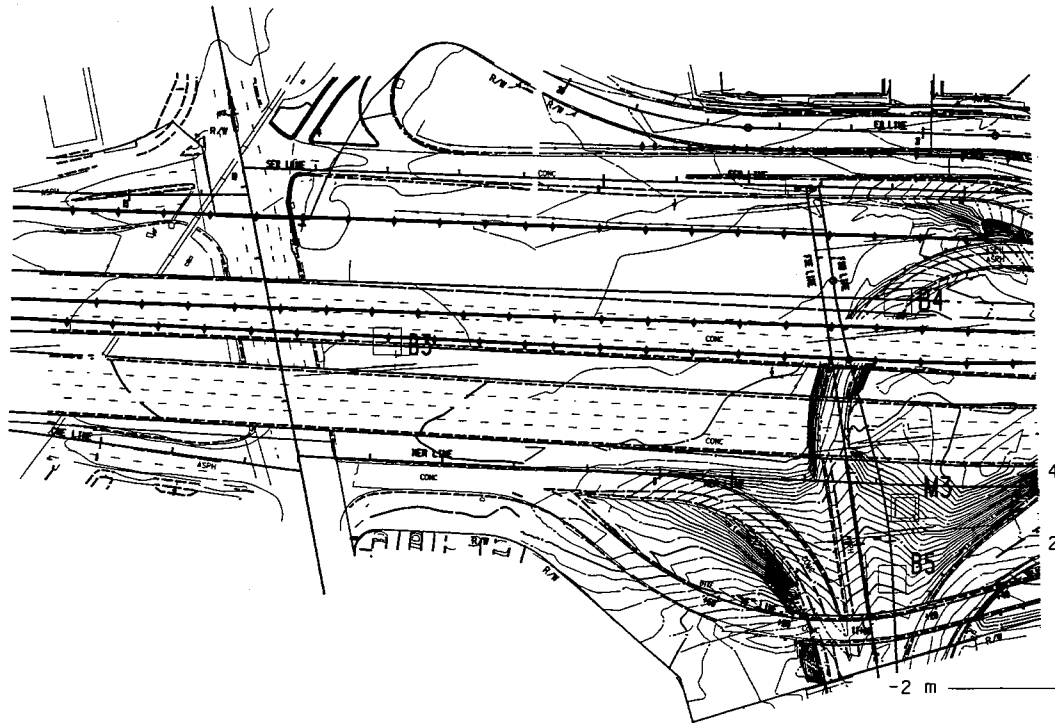
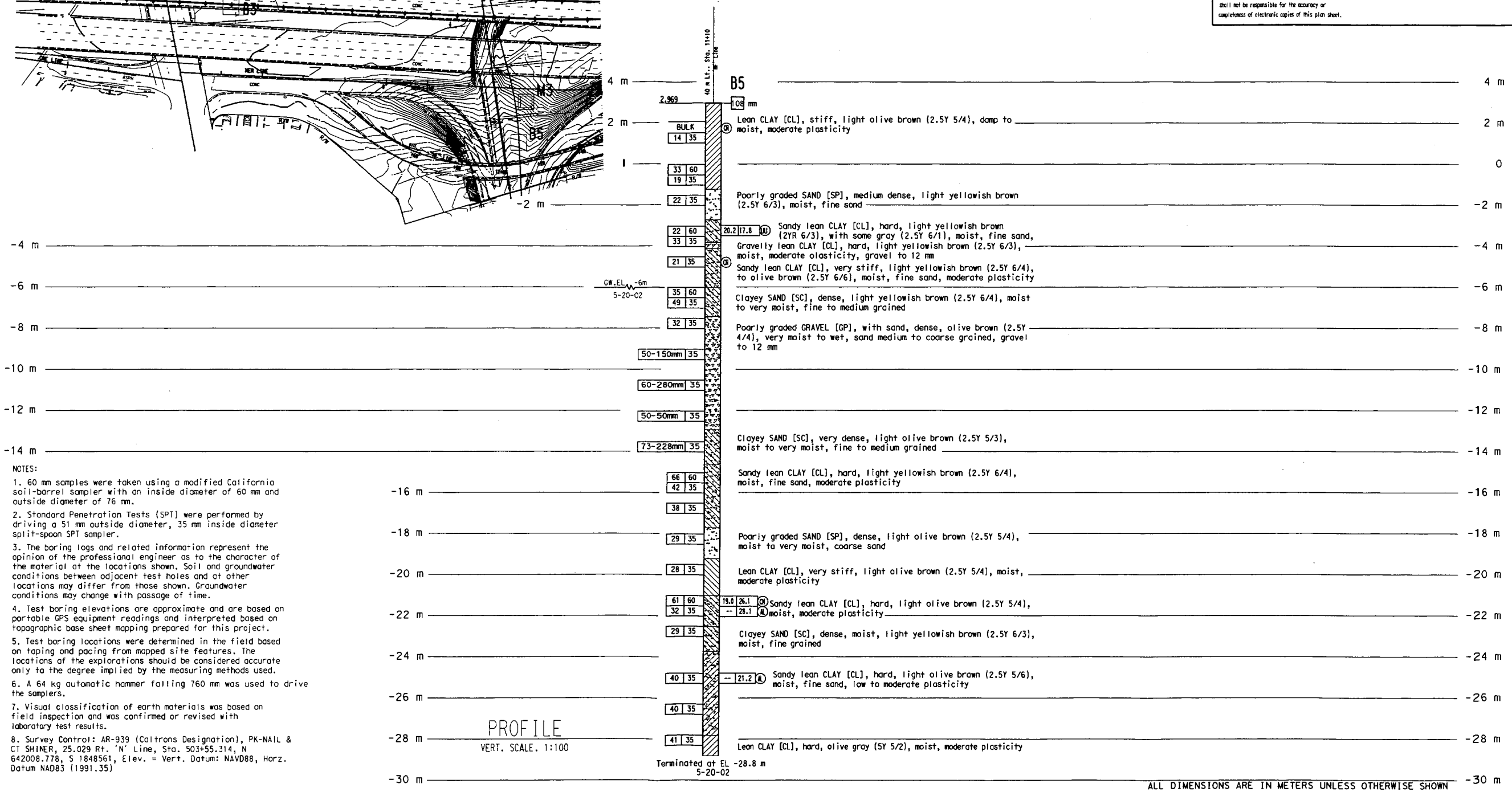
Caltrans Metric



PLAN VIEW

SCALE : 1 : 1500



PROFILE

VERT. SCALE. 1:100

NOTES:

1. 60 mm samples were taken using a modified California soil-barrel sampler with an inside diameter of 60 mm and outside diameter of 76 mm.
2. Standard Penetration Tests (SPT) were performed by driving a 51 mm outside diameter, 35 mm inside diameter split-spoon SPT sampler.
3. The boring logs and related information represent the opinion of the professional engineer as to the character of the material at the locations shown. Soil and groundwater conditions between adjacent test holes and at other locations may differ from those shown. Groundwater conditions may change with passage of time.
4. Test boring elevations are approximate and are based on portable GPS equipment readings and interpreted based on topographic base sheet mapping prepared for this project.
5. Test boring locations were determined in the field based on taping and pacing from mapped site features. The locations of the explorations should be considered accurate only to the degree implied by the measuring methods used.
6. A 64 kg automatic hammer falling 760 mm was used to drive the samplers.
7. Visual classification of earth materials was based on field inspection and was confirmed or revised with laboratory test results.
8. Survey Control: AR-939 (Caltrans Designation), PK-NAIL & CT SHINER, 25.029 Rt. 'N' Line, Sta. 503+55.314, N 642008.778, S 1848561, Elev. = Vert. Datum: NAVD88, Horz. Datum NAD83 (1991.35)

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

LEGEND OF BORING OPERATIONS

Hollow-Stem Auger Boring (Diameter) — Rotary Boring, wet (Diameter) — Penetration - Blows per 300 mm (Blows per foot) — Casing Blows — Size of Casing (mm) — Size of Bit (mm) — Depth of Casing — Depth of Water (Date) — Depth of Water (Date) — Unconfined Compressive Strength (ksf) Qpocket Penetrometer — Shear Strength (ksf) Qtorvane (Lab) — Qtorvane (Field) — Qvane (Laboratory test (see key)) — Soil Moisture — Soil Density — Boring Terminated Below Depth — Water Level Depth — Caving — California material change — Unconformable material change — HOLLOW-STEM AUGER BORING (DRY) OR ROTARY BORING (WET)

SOIL TEST DESIGNATIONS

AT ATTERBERG LIMITS — CH CHLORIDE — CR CORROSIVITY — MD MAXIMUM DRY DENSITY — CU CONSOLIDATED UNDRAINED TRIAXIAL — DS DIRECT SHEAR — SO SOLUBLE SULPHATES — R R-VALUE — CN CONSOLIDATION — GS GRAIN SIZE ANALYSIS — UC UNCONFINED COMPRESSION — UU UNCONSOLIDATED UNDRAINED TRIAXIAL

TYPES OF BORING

57 mm CONE PENETRATION — SAMPLE BORING (DM) — ROTARY SAMPLE BORING (WET) — AUGER BORING (DRY) — TEST PIT — DIAMOND CORE BORING — JET BORING — ELECTRONIC CONE PENETROMETER

LEGEND OF EARTH MATERIALS

GRAVEL — SAND — SILT — CLAY — SANDY CLAY or CLAYEY SAND — SANDY SILT or SILTY SAND — SILTY CLAY — CLAYEY SILT — PEAT and/or ORGANIC MATTER — COBBLES and/or BOULDERS — CONCRETE ROCK — SEDIMENTARY ROCK — METAMORPHIC

CONSISTENCY CLASSIFICATION FOR SOILS

According to the Standard Penetration Test

SPT N-Value (Blows/0.3m)	Granular	SPT N-Value (Blows/0.3m)	Cohesive
0-4	Very Loose	0	Very Soft
5-10	Loose	2-4	Soft
11-30	Medium Dense	5-8	Firm
31-50	Dense	9-15	Stiff
>50	Very Dense	16-30	Very stiff
		>30	Hard

Note: Visual classification of earth materials based on field inspection is confirmed or revised with laboratory test results as necessary.

CALTRANS DESIGN OVERSIGHT	DRAWN BY	A. W. LADRILLONO	FIELD INVESTIGATION BY: LEANNE ROBERTS MAY 2002
SIGN OFF DATE	CHECKED BY	J. J. ZORNE	

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

B. LEE
PROJECT ENGINEER

BRIDGE NO. 33-0040 L/R 33-0068 S
KILOMETER POST 43.6 - 45.5

HIGH STREET SEISMIC RETROFIT PROJECT

LOG OF TEST BORINGS

CU 04247
EA 165421

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 1 10 20 30 40 50 60 70 80 90 100

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY): 01/01/03 01/17/03 03/28/03 07/15/03 01/23/04 03/04/04 05/10/04

SHEET 7 OF 10

FILE => LOTB_SHEET07.dgn

OGS CIVIL LOG OF TEST BORINGS SHEET (METRIC) (REV. 3/01)

USERNAME => dtolasa DATE PLOTTED => 13-JAN-2006 TIME PLOTTED => 08:45

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	ALA	880	43.6 - 45.5	10	10

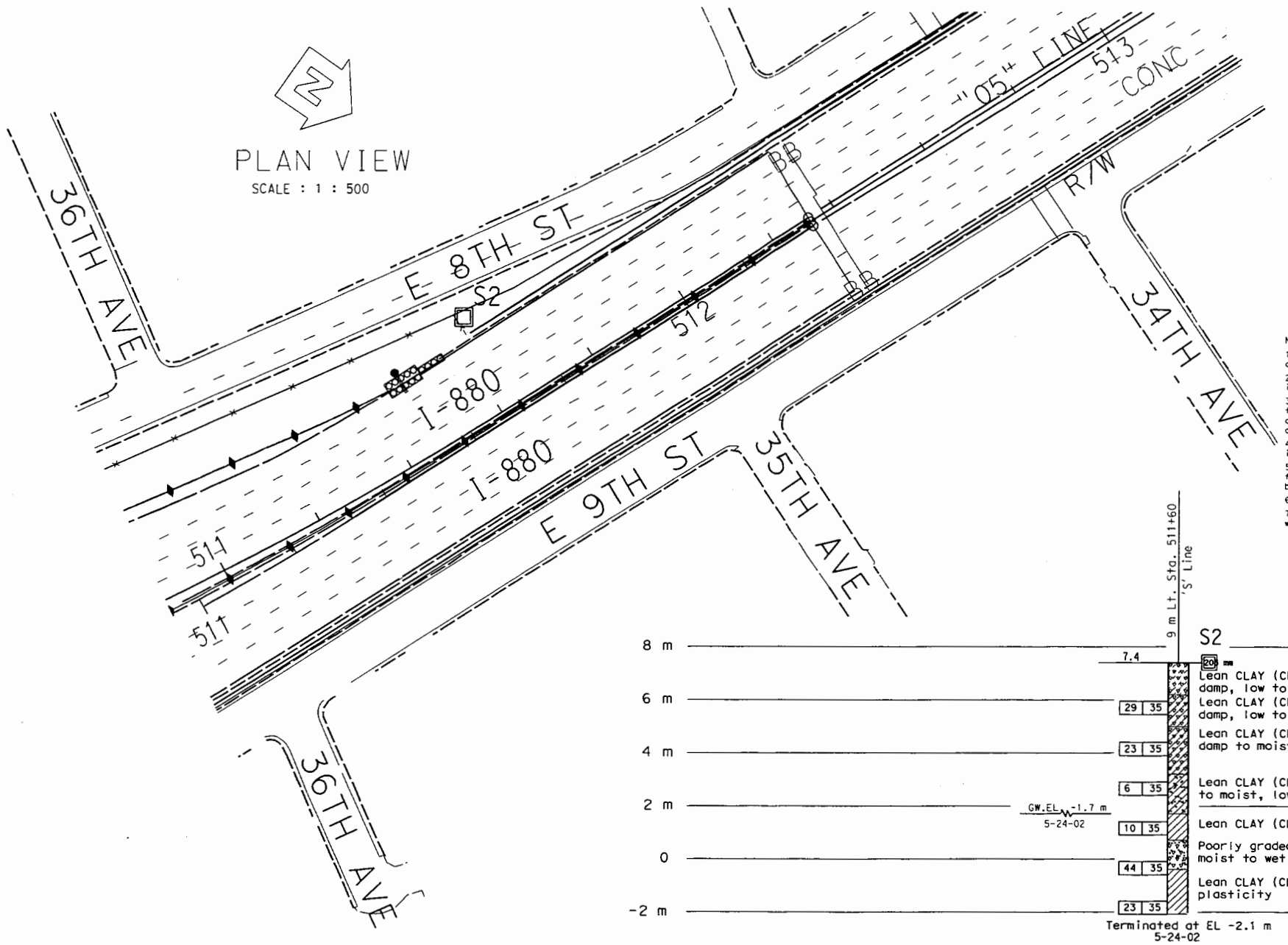
REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — JEREMY JACOB ZORNE — No. C60936 — Exp. 12/31/06 — CIVIL — STATE OF CALIFORNIA

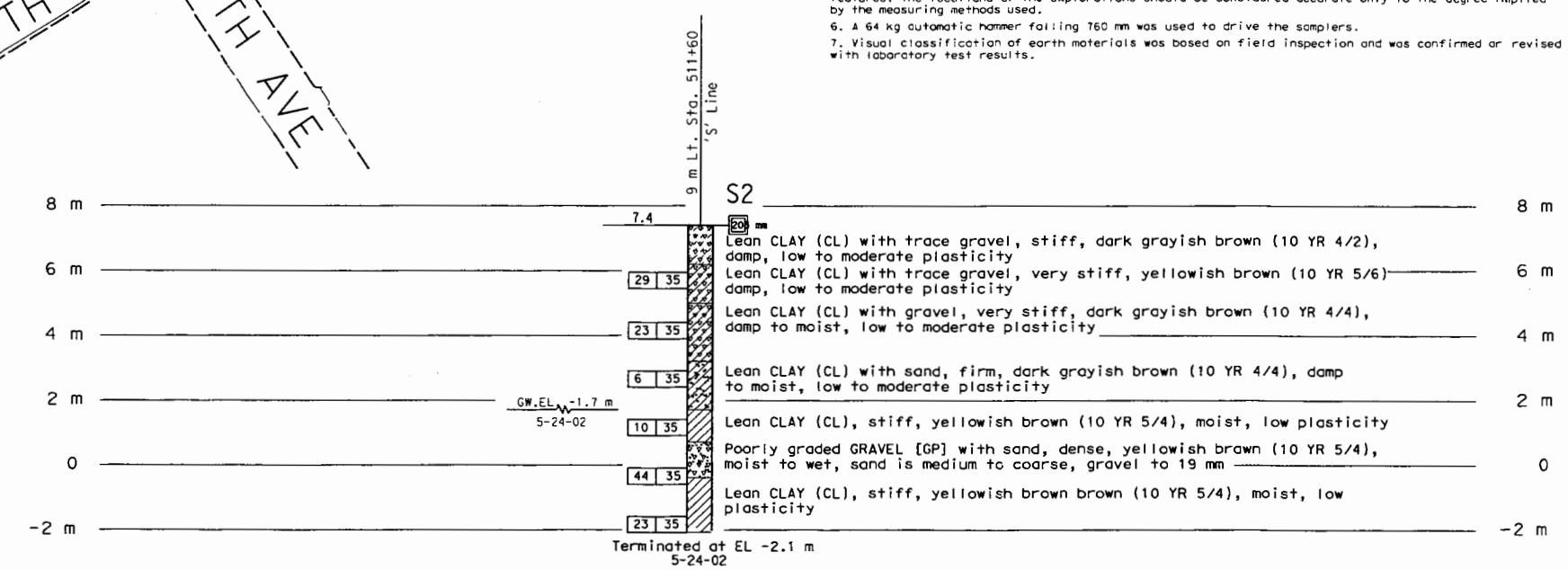
GEOCON
CONSULTANTS, INCORPORATED
11375 SUNRISE PARK DRIVE, SUITE 100
RANCHO CORDOVA, CA. 95742-7207
PHONE 916 852-9118 - FAX 916 852-9132

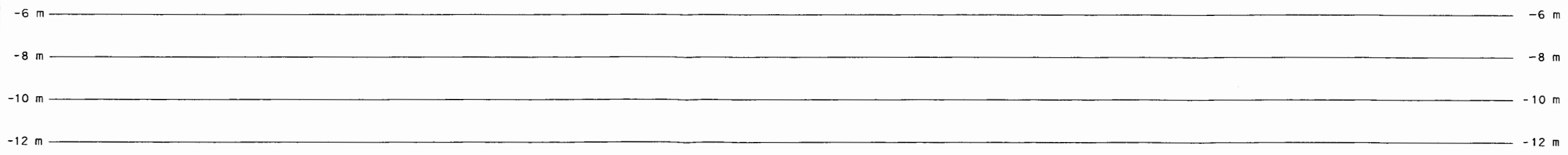
The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.



NOTES:

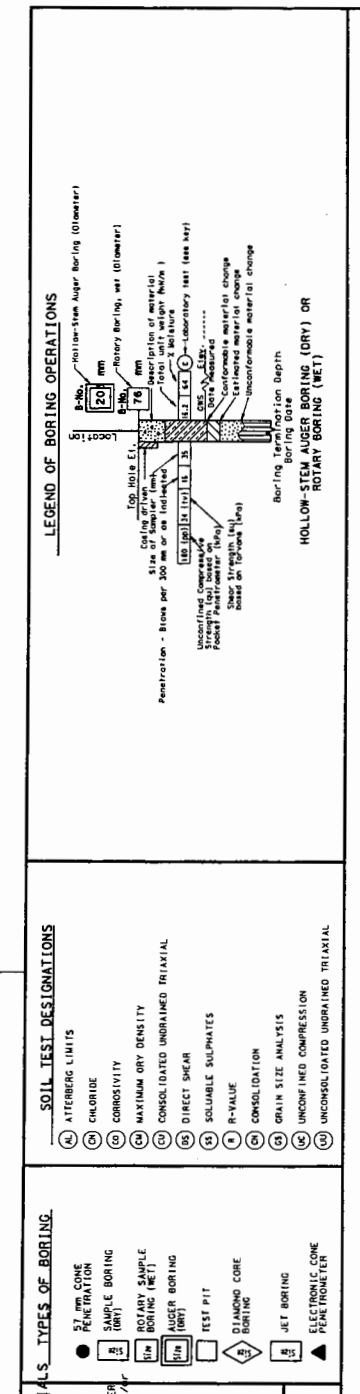
1. 60 mm samples were taken using a modified California soil-barrel sampler with an inside diameter of 60 mm and outside diameter of 76 mm.
2. Standard Penetration Tests (SPT) were performed by driving a 51 mm outside diameter, 35 mm inside diameter split-spoon SPT sampler.
3. The boring logs and related information represent the opinion of the professional engineer as to the character of the material at the locations shown. Soil and groundwater conditions between adjacent test holes and at other locations may differ from those shown. Groundwater conditions may change with passage of time.
4. Test boring elevations are approximate and are based on portable GPS equipment readings and interpreted based on topographic base sheet mapping prepared for this project.
5. Test boring locations were determined in the field based on taping and pacing from mapped site features. The locations of the explorations should be considered accurate only to the degree implied by the measuring methods used.
6. A 64 kg automatic hammer falling 760 mm was used to drive the samplers.
7. Visual classification of earth materials was based on field inspection and was confirmed or revised with laboratory test results.





PROFILE
VERT. SCALE. 1:100

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN



CALTRANS DESIGN OVERSIGHT	DRAWN BY	A. M. LADRILLONO	FIELD INVESTIGATION BY: LEANNE ROBERTS MAY 2002
SIGN OFF DATE	CHECKED BY	J. J. ZORNE	

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

B. LEE
PROJECT ENGINEER

BRIDGE NO. 33-0040 L/R 33-0068 S
KILOMETER POST 43.6 - 45.5

HIGH STREET SEISMIC RETROFIT PROJECT

LOG OF TEST BORINGS

OGS CIVIL LOG OF TEST BORINGS SHEET (METRIC) (REV. 3/01)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 04247
EA 165421

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY): 01/07/03 01/17/03 09/23/03 01/29/04 03/04/04 05/18/04

SHEET 10 OF 10

FILE => LOTB_SHEET10.dgn

USERNAME => dtoloso DATE PLOTTED => 13-JAN-2006 TIME PLOTTED => 08:47

APPENDIX B

(Laboratory Test Result Summary and Data)

TABLE A. SUMMARY OF LABORATORY TEST RESULTS HIGH STREET SEISMIC RETROFIT PROJECT

BORING	DEPTH (meters)	ELEVATION (m)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	CONSOL. TEST?
P-1	4.5	-1	16.5	36	21	
P-3	1.5	4	3.6	31	16	NA
P-3	6	0	20.3	51	31	NA
P-3	10.5	-4	18.8	46	30	NA
P-4	3	2	15.7	35	19	NA
P-4	7.5	-2	29.5	44	25	NA
P-4	9.6	-4	24.2	51	32	NA
P-7	3	5	13.3	31	17	NA
P-7	4.5	3	15.6	28	12	NA
P-7	7.5	0	23.2	51	35	NA
P-7	10	-3	~~NA~~ 26.4	59	36	DONE
P-7	15	-8	26.9	31	9	NA
P'-2	1.5	3	~~NA~~ 32	39	22	DONE
P'-2	4.5	-1	~~NA~~ 22.3	43	27	DONE
P'-2	12	-8	~~NA~~ 21.7	46	28	DONE

GEOCON CONSULTANTS, INC.

MOISTURE TESTS

PROJECT NAME: High Street OSRP PROJECT NUMBER: S8550-06-01A

DATE: 6/16/03 TESTED BY: PO LAB NUMBER: 1684 SHEET 1 OF 2

SAMPLE NO.	P1-4.5	P3-1.5	P3-6.0	P3-10.5	P4-3	P4-7.5	P4-9.6
DEPTH OF SAMPLE	4.5	1.5	6	10.5	3	7.5	9.6
TARE NO.	F1	I-4	O-1	CA	HH	999	G-1
WET WT.+TARE (gm.)	685.60	436.80	528.50	569.80	589.10	620.70	722.80
DRY WT.+TARE (gm.)	619.20	429.10	475.80	514.20	540.00	530.40	625.20
TARE WT. (gm.)	216.60	215.80	216.30	218.00	228.20	224.80	222.30
WT. OF WATER (gm.)	66.40	7.70	52.70	55.60	49.10	90.30	97.60
WT. OF DRY SOIL (gm.)	402.60	213.30	259.50	296.20	311.80	305.60	402.90
WATER CONTENT (%)	16.5	3.6	20.3	18.8	15.7	29.5	24.2
VISUAL SAMPLE DISCRIPTION	See Atterberg limits test data for descriptions						

GEOCON CONSULTANTS, INC.

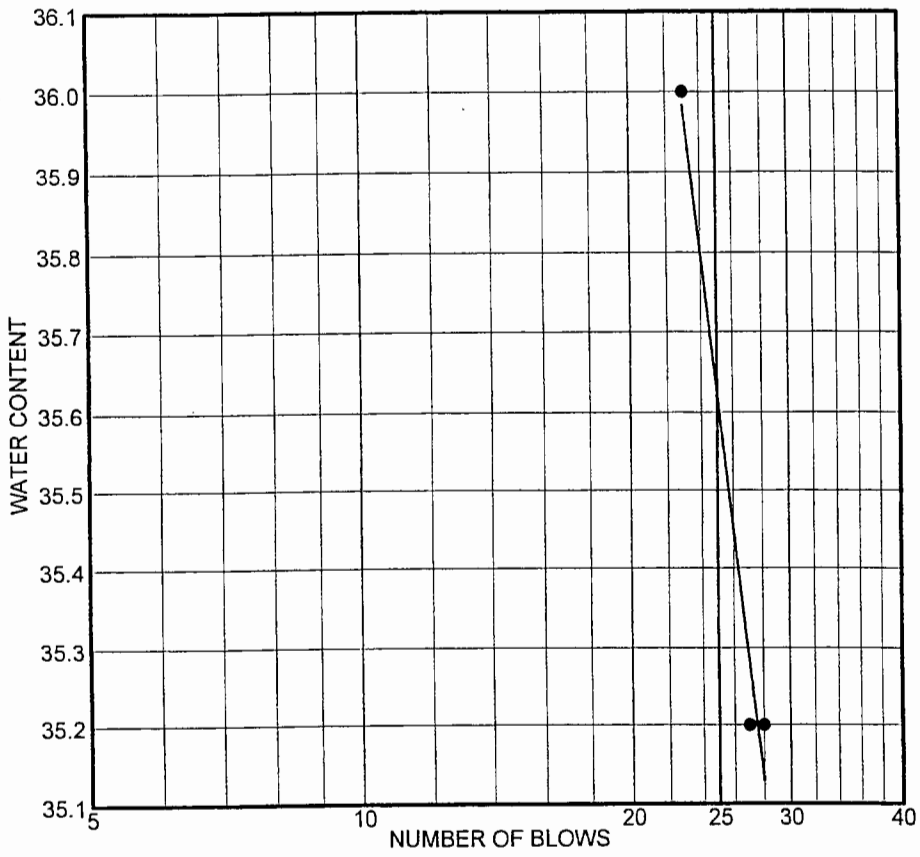
MOISTURE TESTS

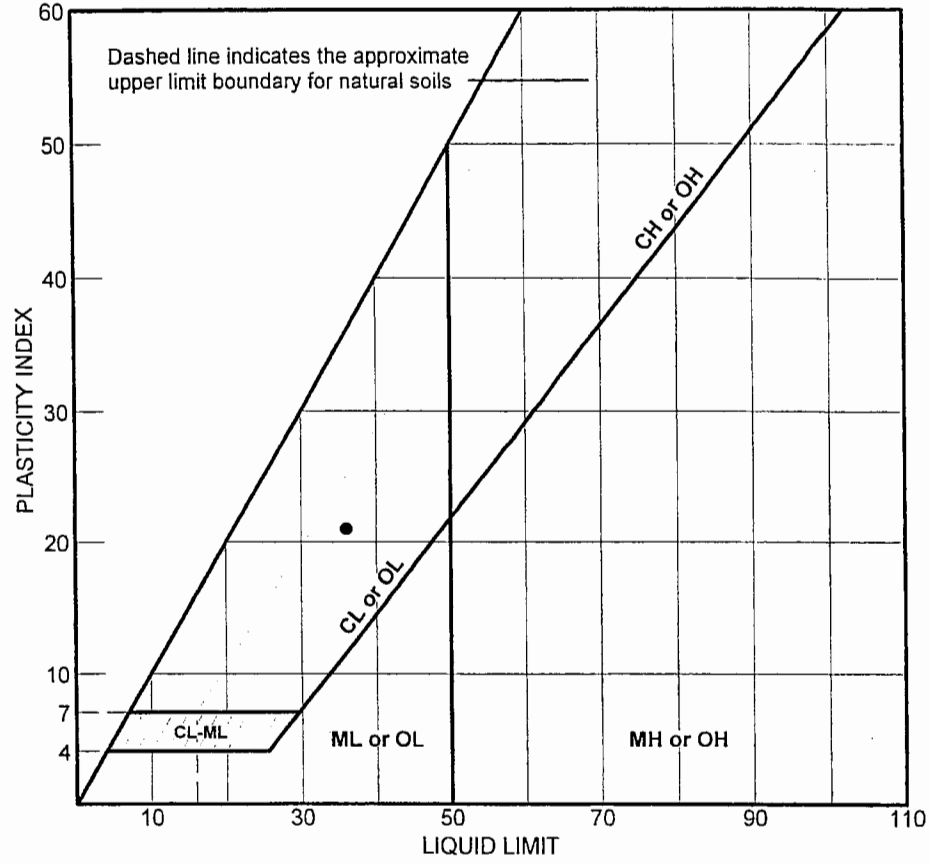
PROJECT NAME: High Street OSRP PROJECT NUMBER: S8550-06-01A

DATE: 6/16/03 TESTED BY: PO LAB NUMBER: 1684 SHEET 2 OF 2

SAMPLE NO.	P7-3 Elv. 5m	P7-4.5 Elv. 3.5	P7-7.5 Elv. 0	P7-15 Elv. 7.8m			
DEPTH OF SAMPLE	3	4.5	7.5	15			
TARE NO.	G-2	CB	BB-1	CA			
WET WT.+TARE (gm.)	543.80	677.20	743.40	494.90			
DRY WT.+TARE (gm.)	506.20	615.58	644.10	436.20			
TARE WT. (gm.)	222.80	220.20	215.90	217.90			
WT. OF WATER (gm.)	37.60	61.62	99.30	58.70			
WT. OF DRY SOIL (gm.)	283.40	395.38	428.20	218.30			
WATER CONTENT (%)	13.3	15.6	23.2	26.9			
VISUAL SAMPLE DISCRIPTION	See Atterberg limits test data for descriptions →						

LIQUID AND PLASTIC LIMITS TEST REPORT





	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
●	S8550-06-01A	P1-4.5	4.5 meters	6-2-03	CL	Yellowish brown lean CLAY with sand		36	21
			Elv. -1m						

Client Caltrans

Project High Street

Project No. S8550-06-01A | Plate

GEOCON CONSULTANTS, INC.

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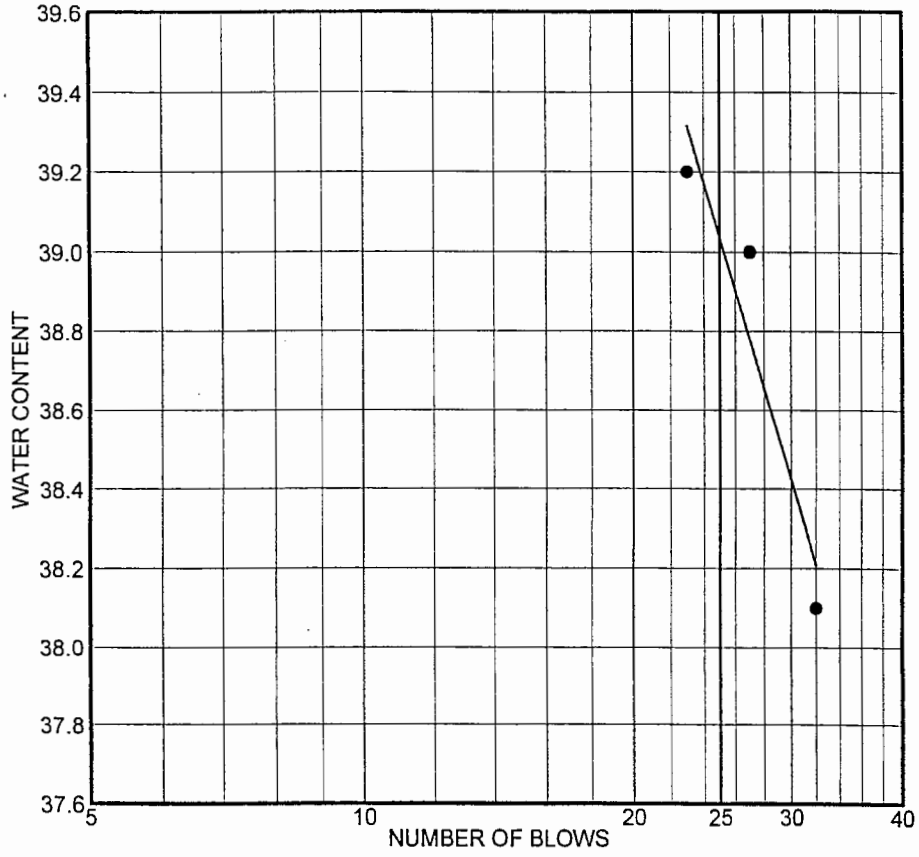
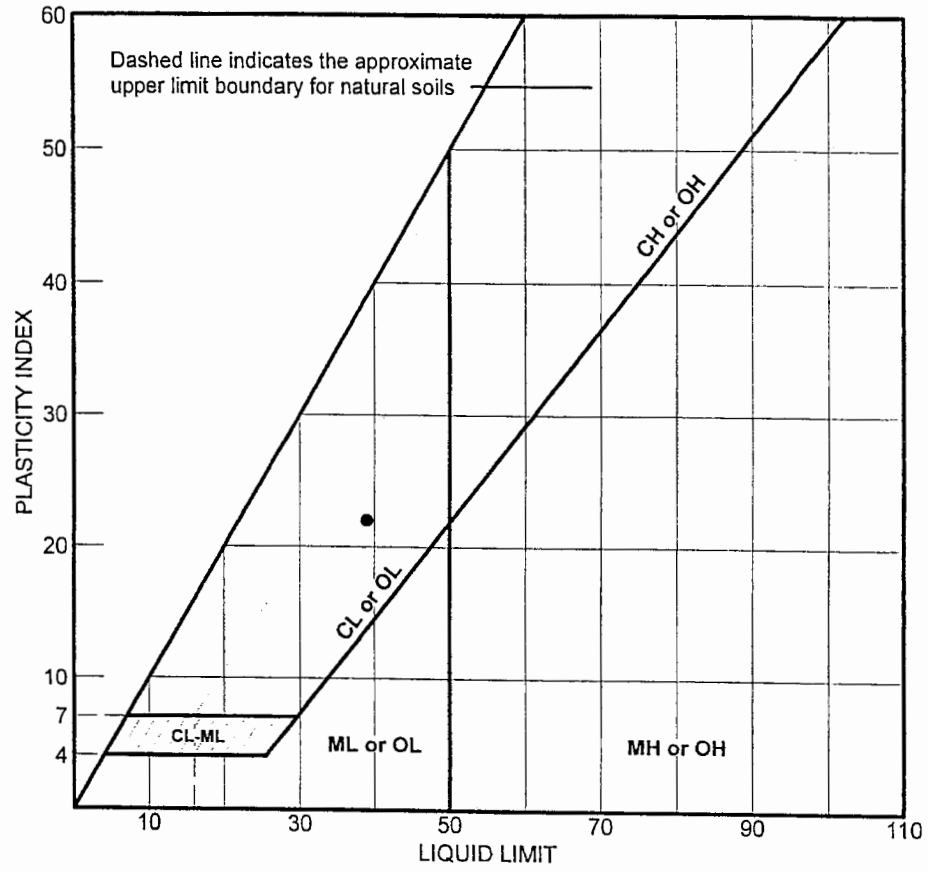
LIQUID AND PLASTIC LIMITS TEST REPORT





SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
S8550-06-01A	P'2-1.5	1.5 meters	6-5-03	CL	Vey dark grayish brown to black lean CLAY		39	22
		Elv. 3m						

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Project High Street

Project No. S8550-06-01A

Plate

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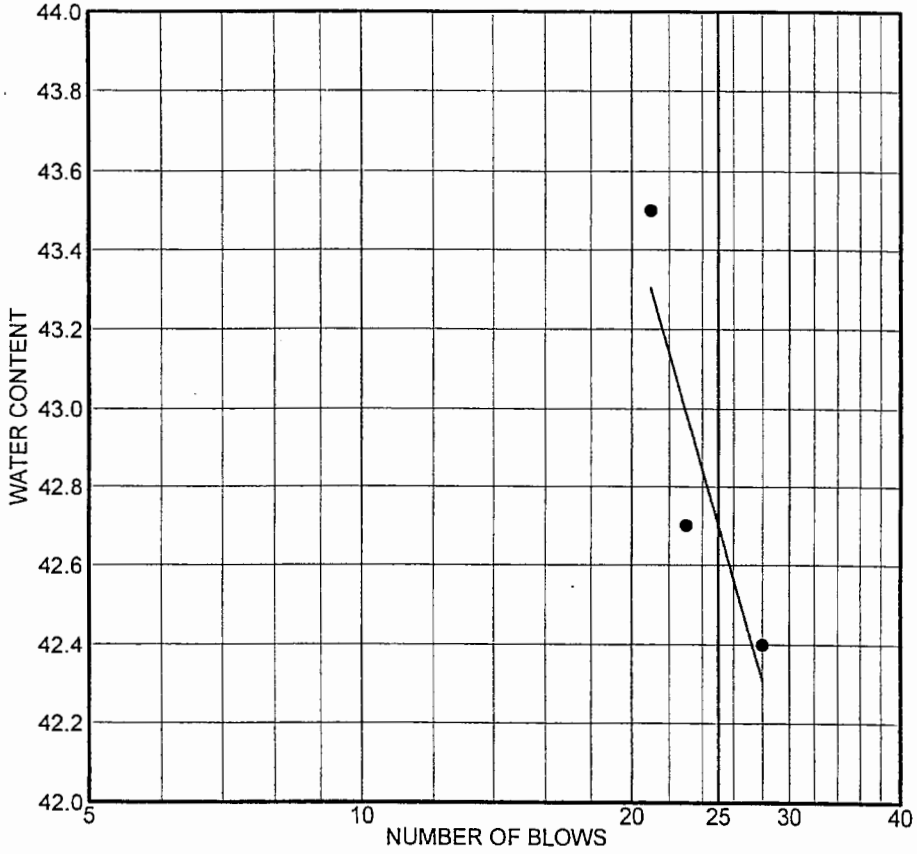
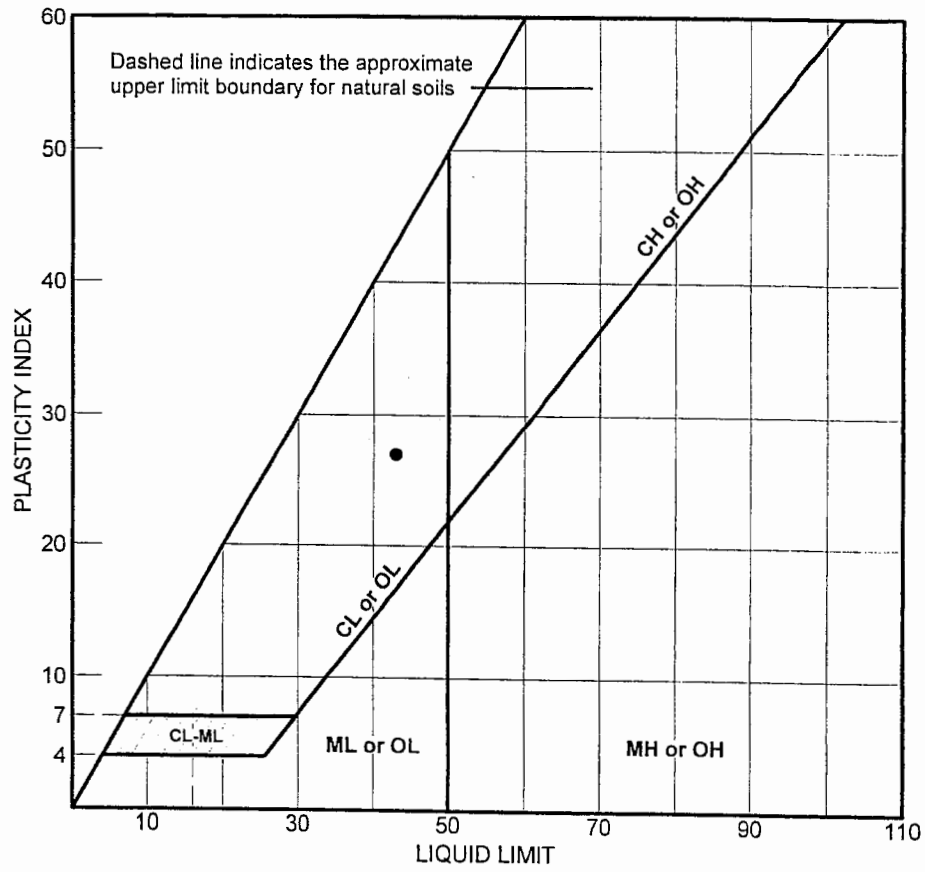
LIQUID AND PLASTIC LIMITS TEST REPORT





	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
●	S8550-06-01A	P'2-4.5	4.5 meters	6-5-03	CL	Yellowish brown lean CLAY with sand		43	27
			Elv. -1m						

Client Caltrans

Project High Street

Project No. S8550-06-01A | Plate

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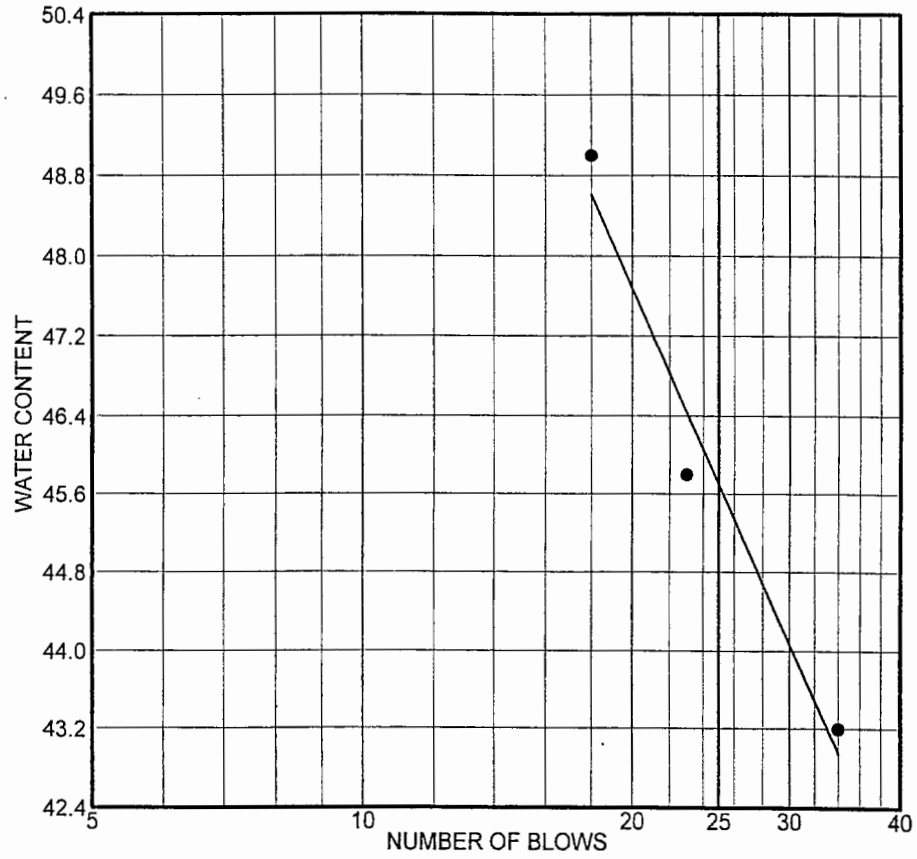
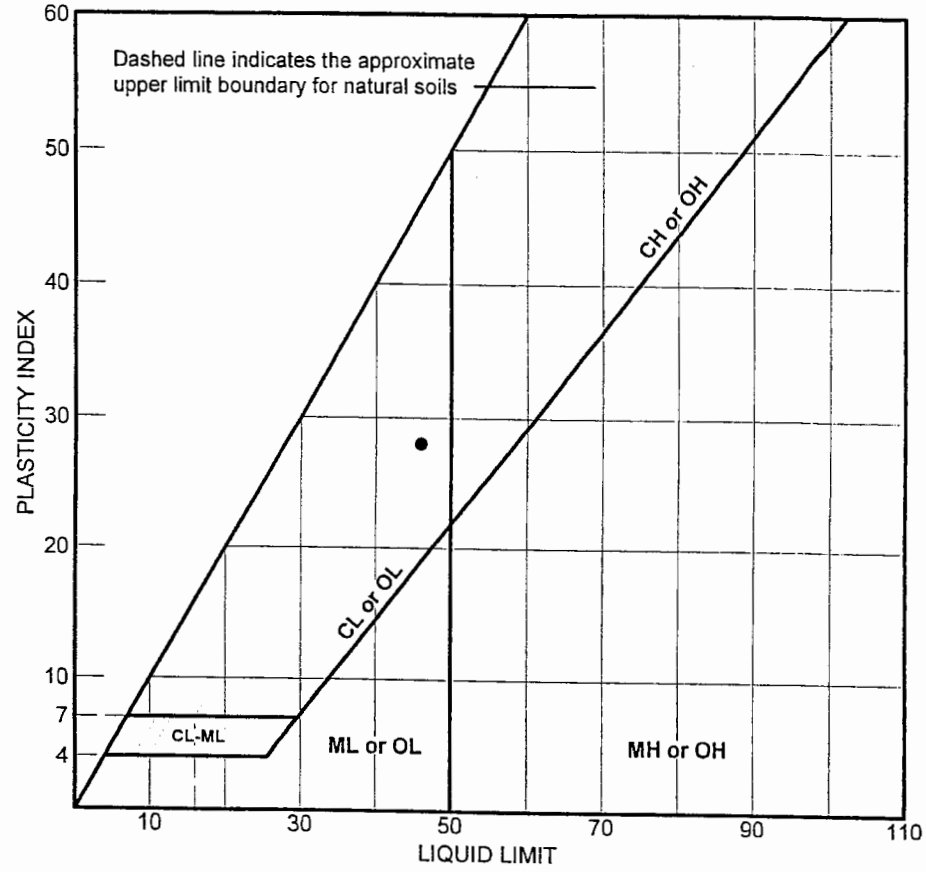
LIQUID AND PLASTIC LIMITS TEST REPORT





	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
●	S8550-06-01A	P'2-12	12 meters	6-19-0	CL	Yellowish brown lean CLAY		46	28
			ELV. -8m						

Client Caltrans

Project High Street

Project No. S8550-06-01A | Plate

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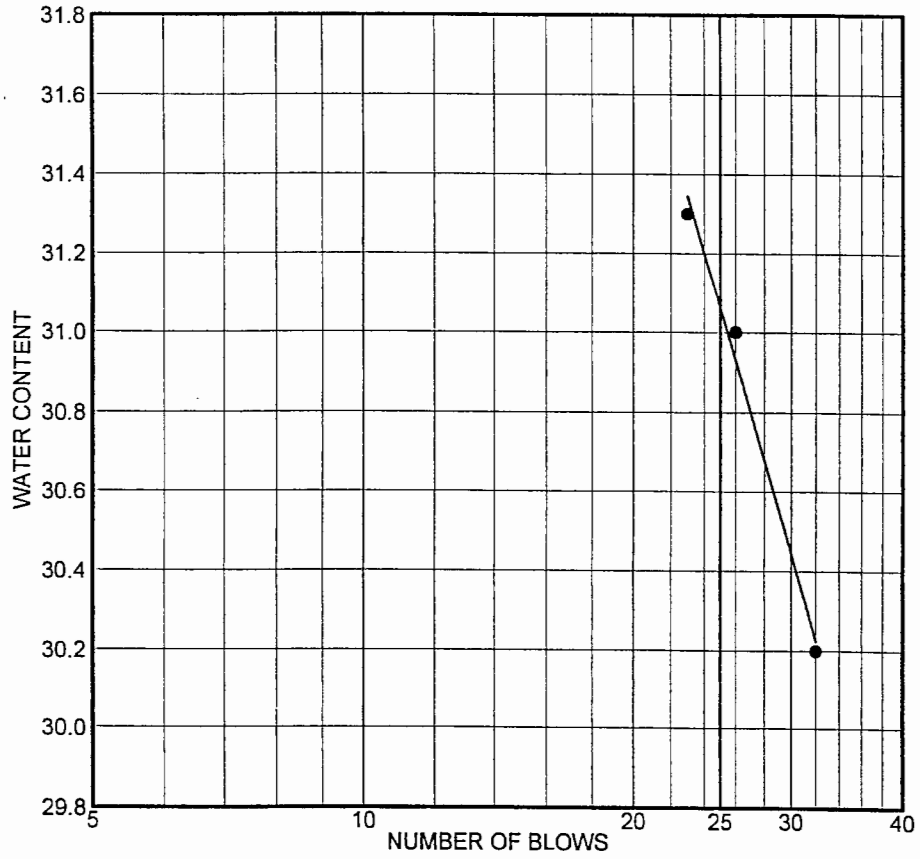
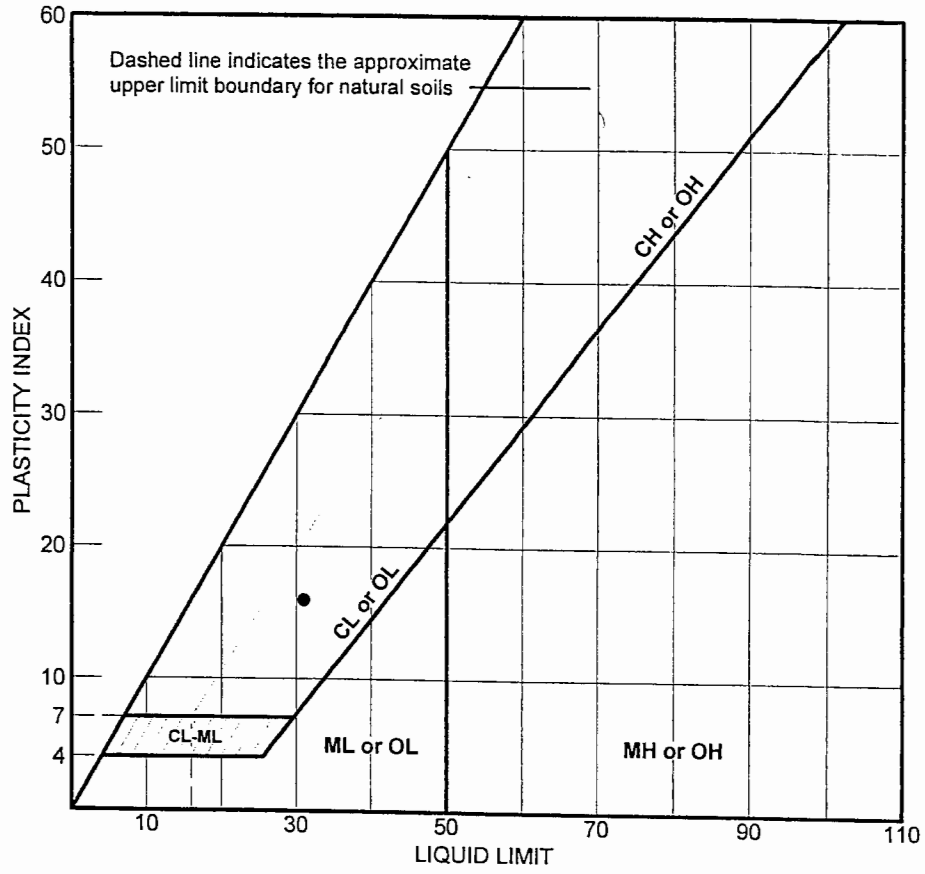
LIQUID AND PLASTIC LIMITS TEST REPORT





	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
●	S8550-06-01A	P3-1.5	1.5 meters	6-2-03	SC	Light olive brown clayey SAND		31	16
			Elv. 4 m						

Client Caltrans

Project High Street

Project No. S8550-06-01A | Plate

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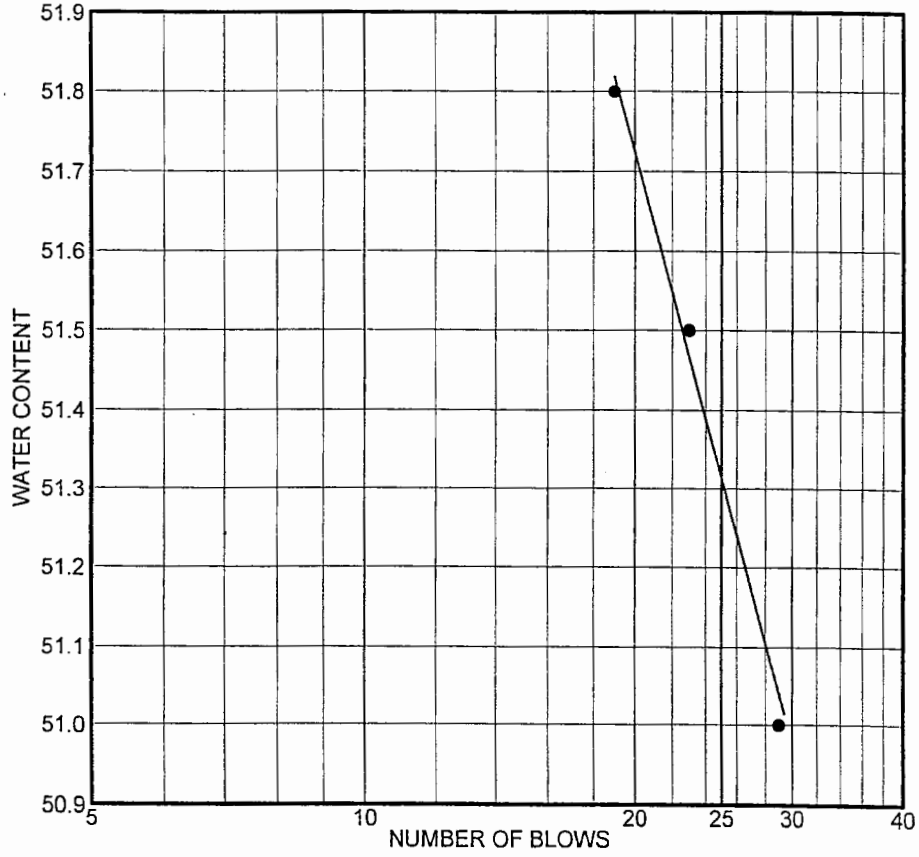
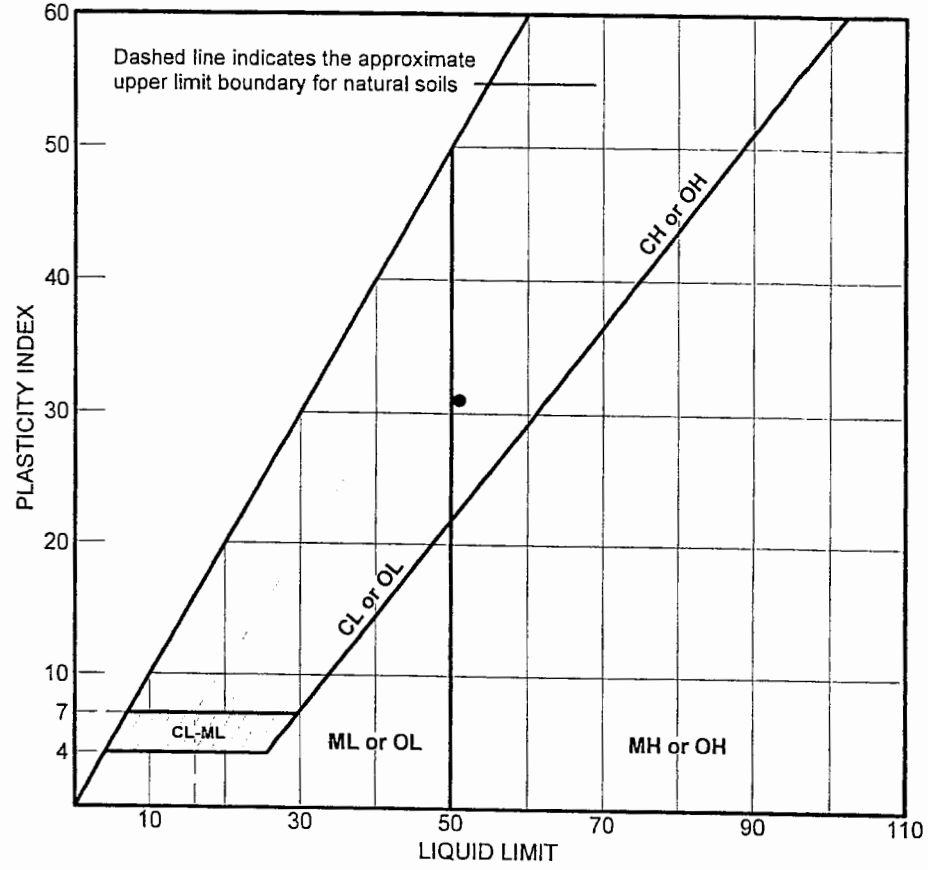
●

LIQUID AND PLASTIC LIMITS TEST REPORT





SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
S8550-06-01A	P3-6.0	6.0 meters	6-2-03	CH	Light yellowish brown fat CLAY		51	31
		Elv. 0 m						

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Project High Street

Project No. S8550-06-01A

Plate

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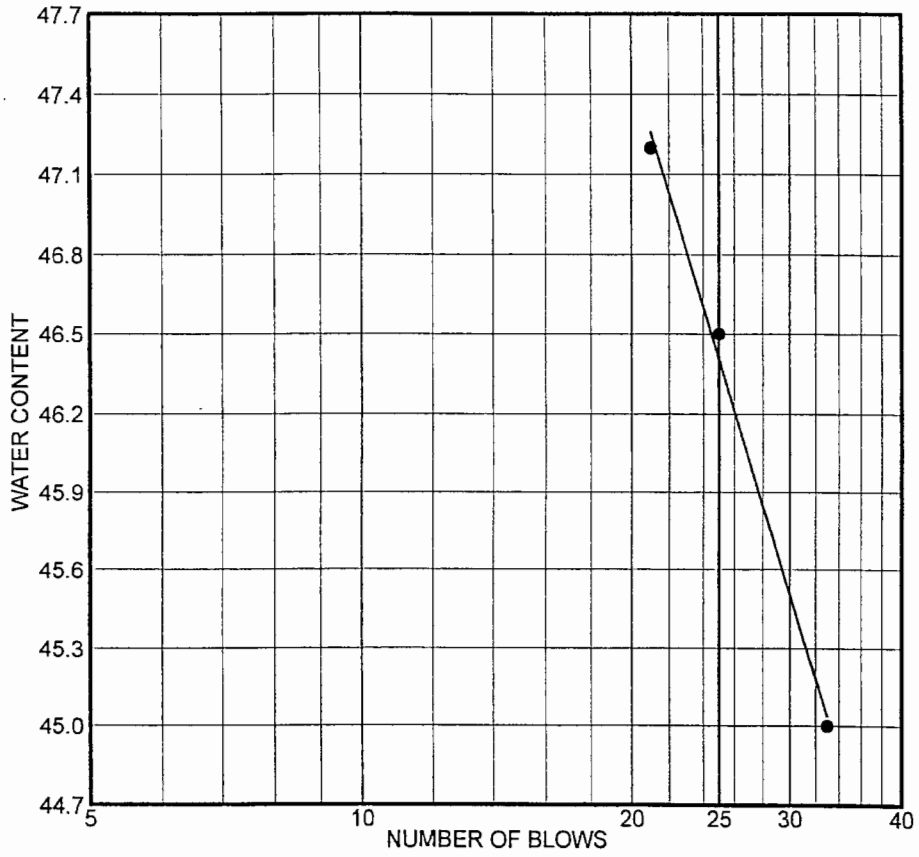
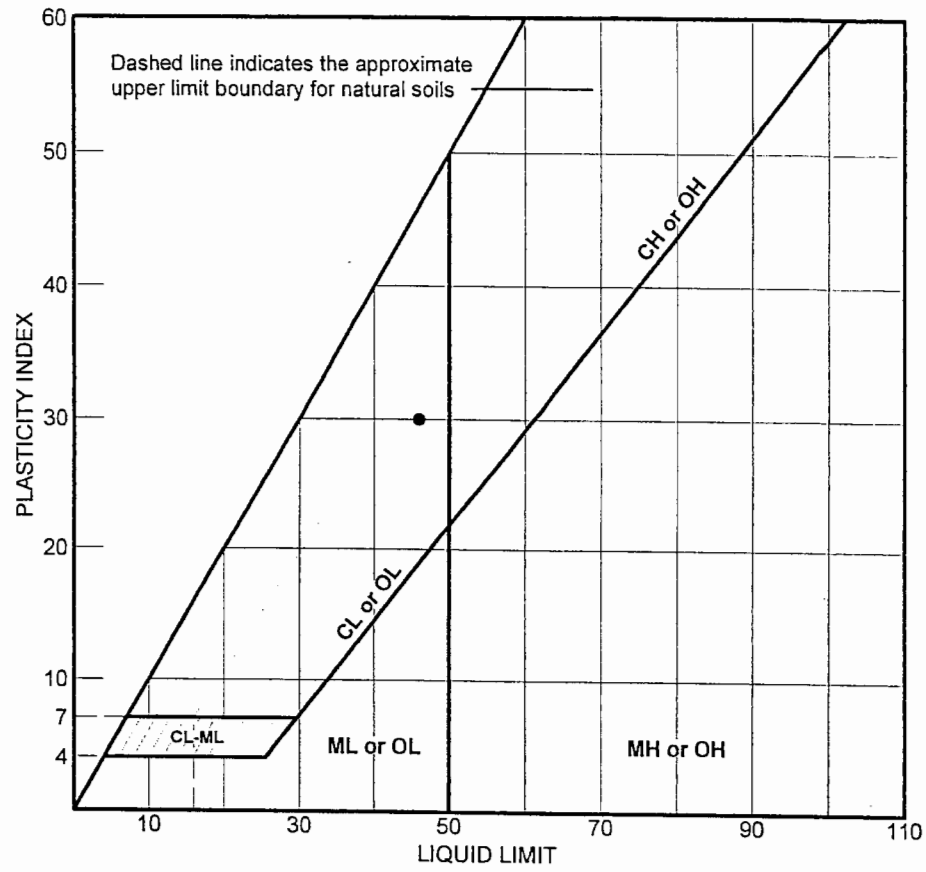
LIQUID AND PLASTIC LIMITS TEST REPORT





	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
●	S8550-06-01A	P3-10.5	10.5 meters	6-2-03	CL	Light yellowish brown lean CLAY		46	30
			Elv. -4m						

Client Caltrans

Project High Street

Project No. S8550-06-01A | Plate

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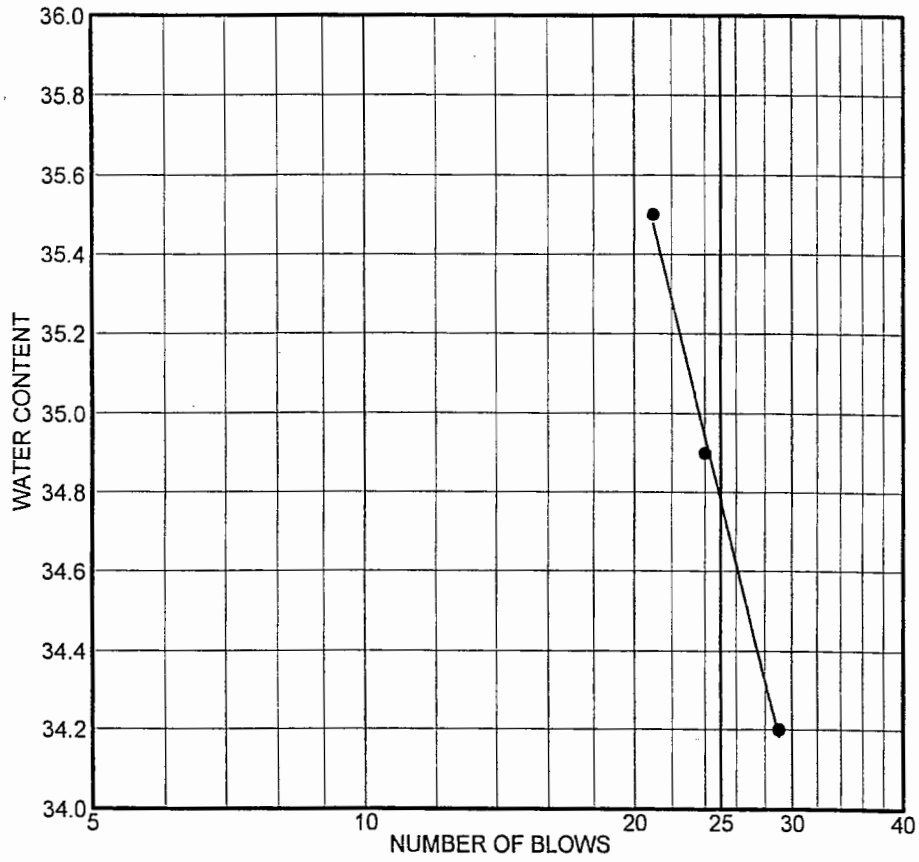
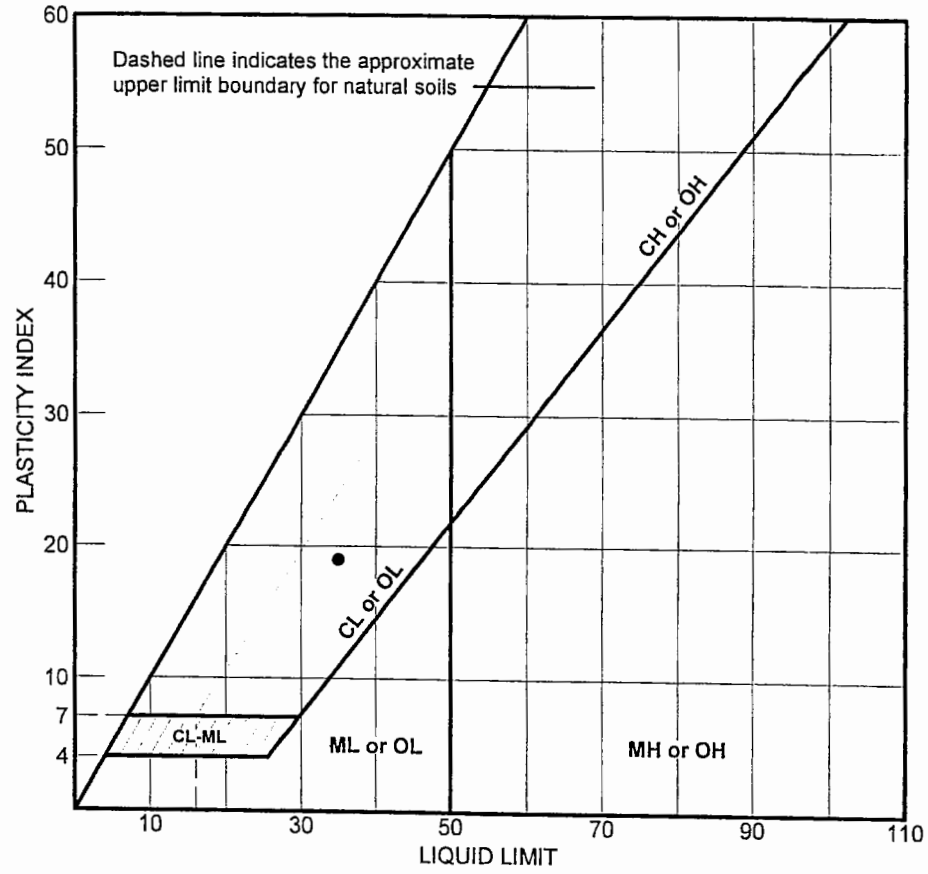
LIQUID AND PLASTIC LIMITS TEST REPORT





SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
S8550-06-01A	P4-3	3 meters	6-6-03	CL	Yellowish brown sandy lean CLAY		35	19
		Elv. 2m						

Client Caltrans

Project High Street

Project No. S8550-06-01A

Plate

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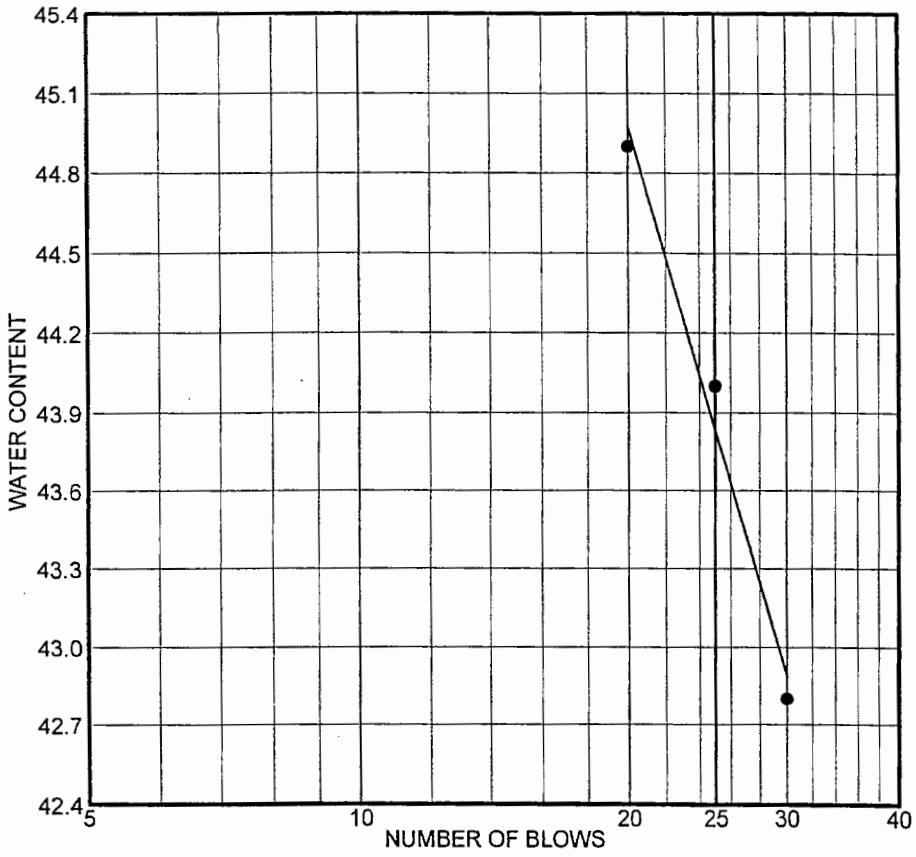
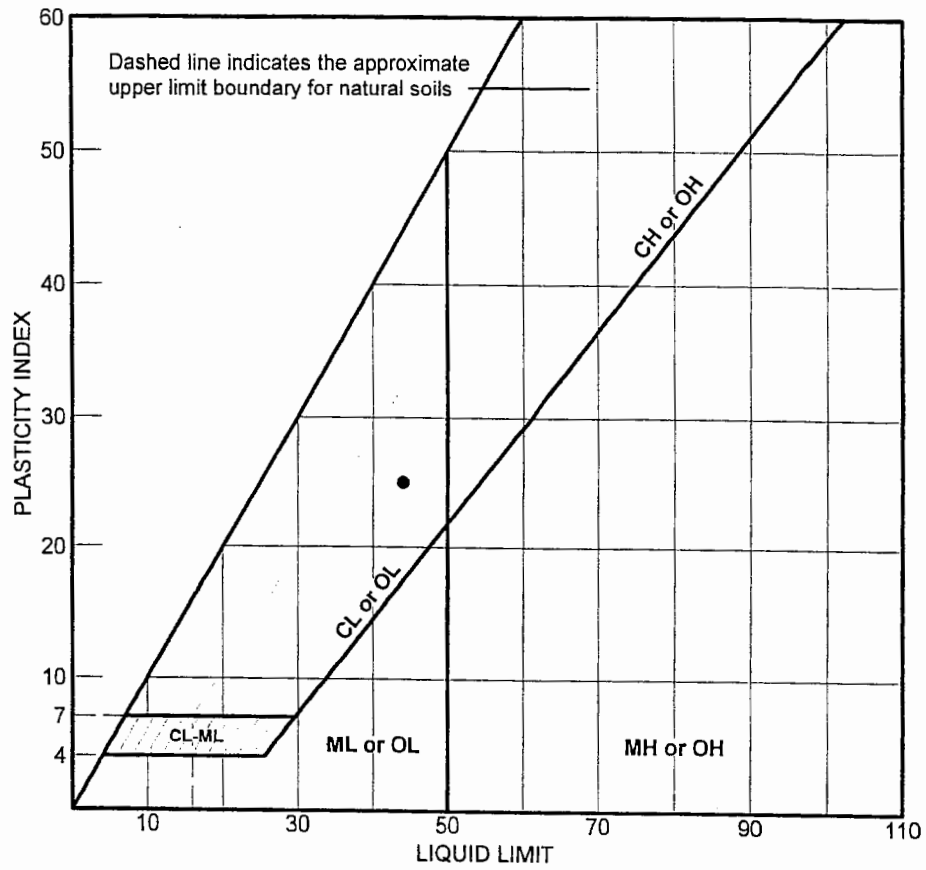
LIQUID AND PLASTIC LIMITS TEST REPORT





	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
●	S8550-06-01A	P4-7.5	7.5 meters	6-5-03	CL	Yellowish brown lean CLAY		44	25
			Elv. -2m						

Client Caltrans

Project High Street

Project No. S8550-06-01A | Plate

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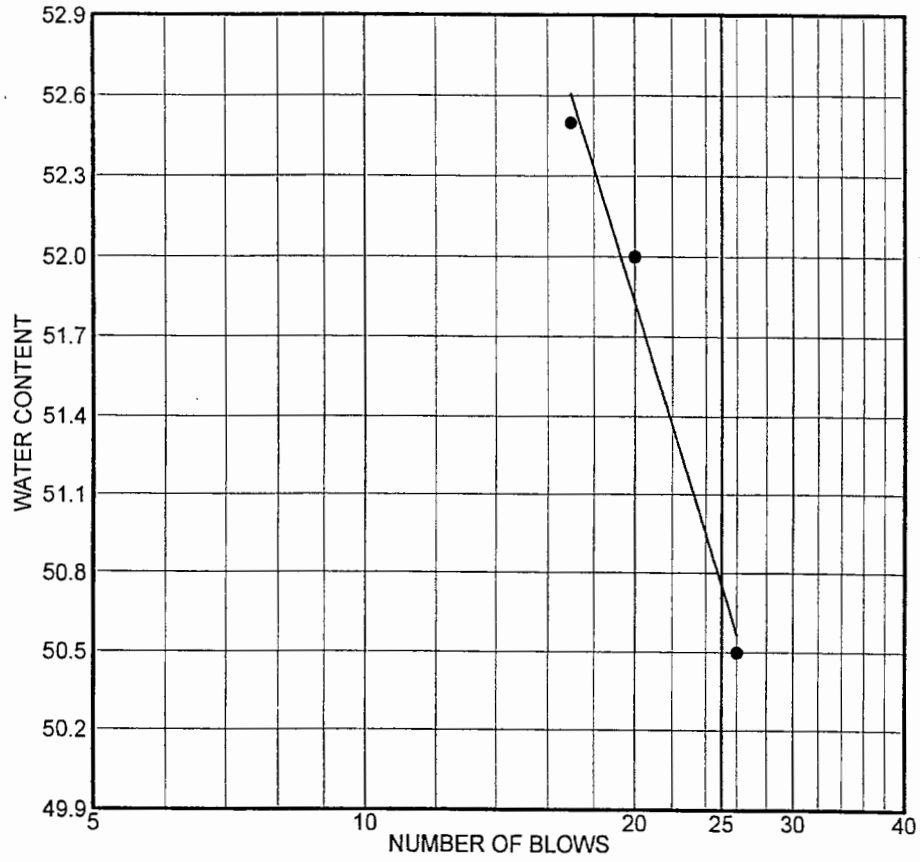
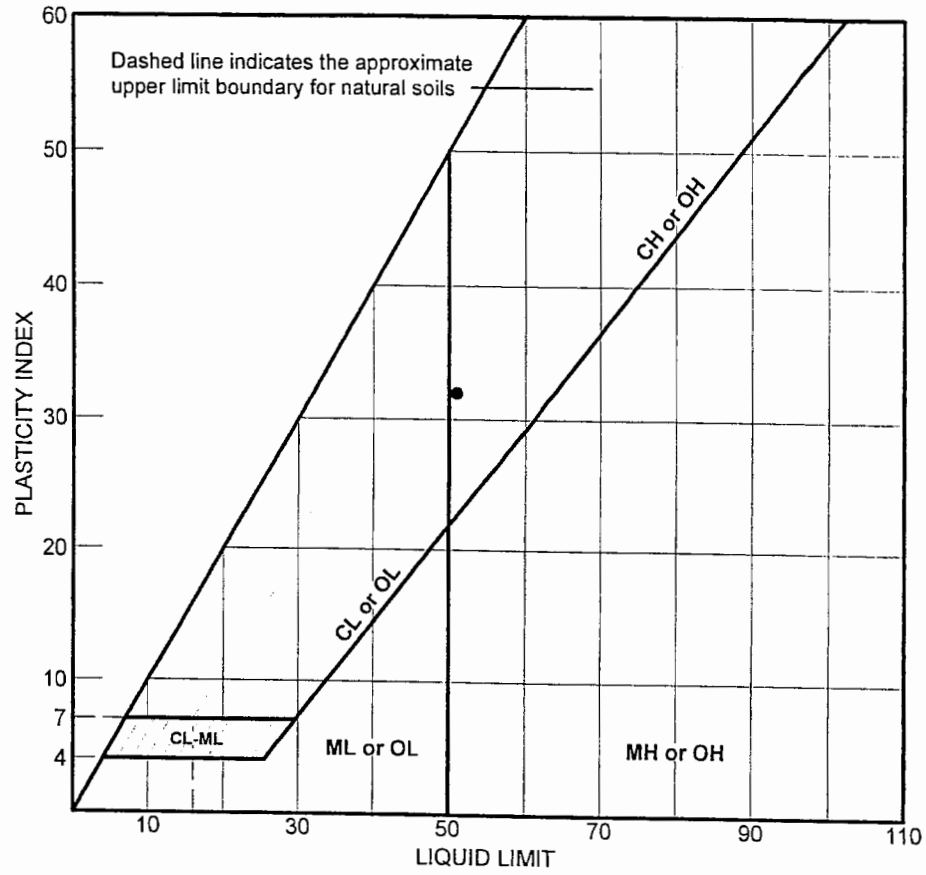
LIQUID AND PLASTIC LIMITS TEST REPORT





	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
●	S8550-06-01A	P4-9.6	9.6 meters	6-9-03	CH	Yellowish brown fat CLAY		51	32
			Elev -4 m						

Client Caltrans

Project High Street

Project No. S8550-06-01A | Plate

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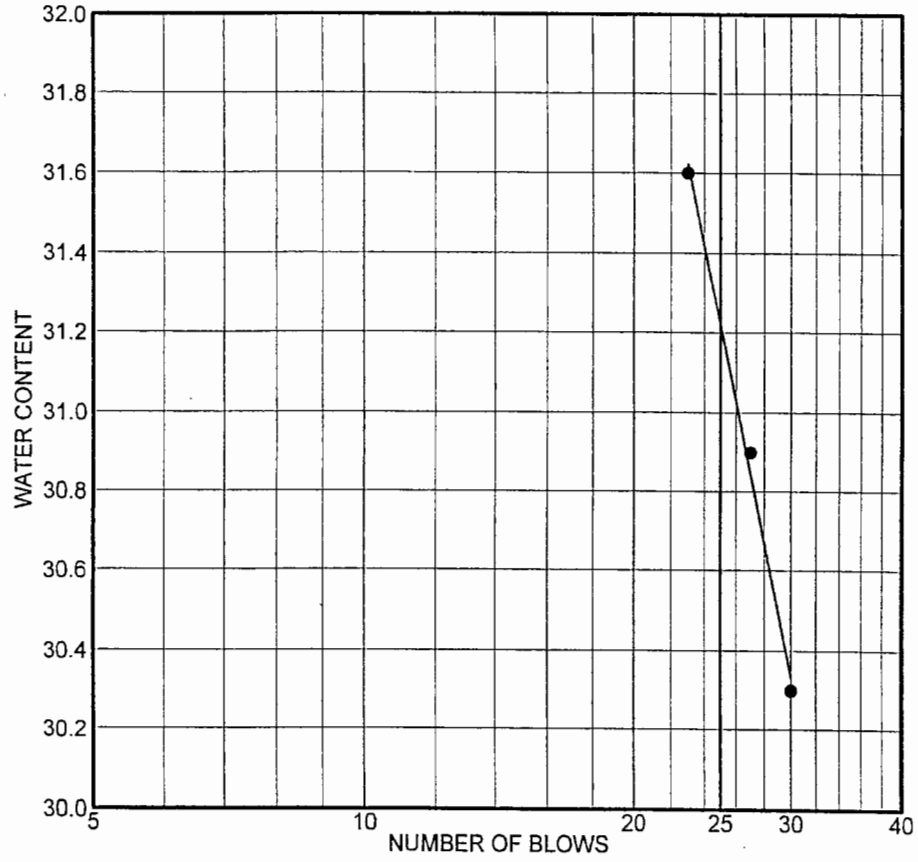
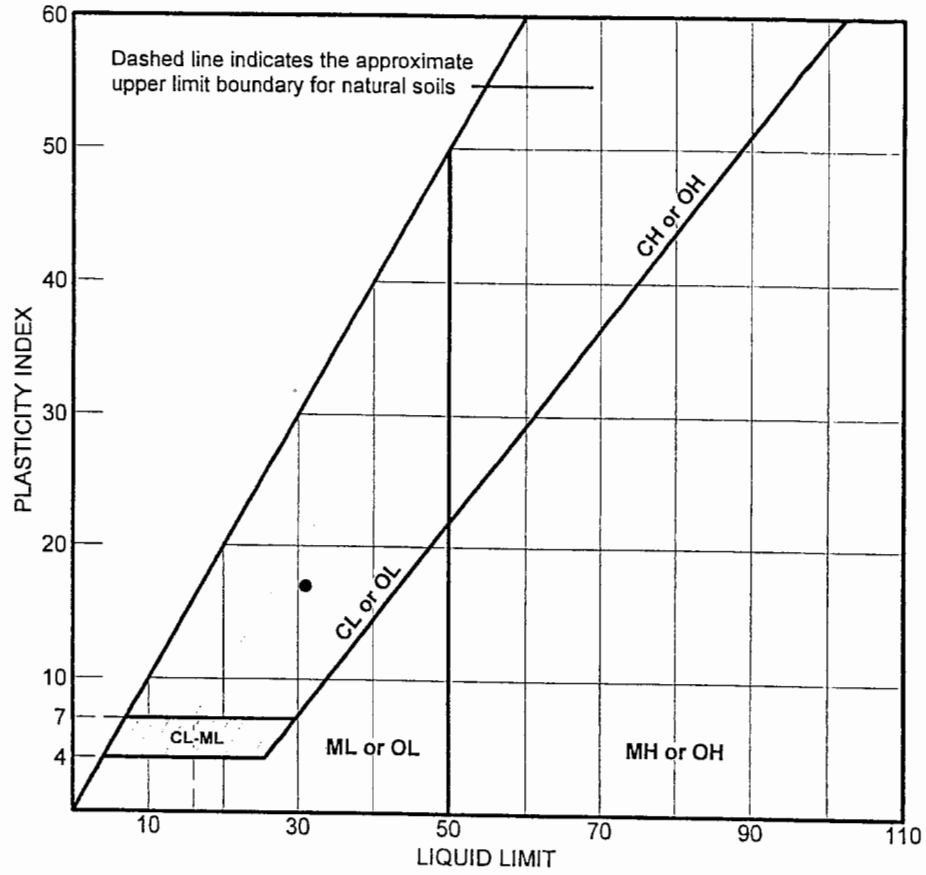
LIQUID AND PLASTIC LIMITS TEST REPORT





	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
●	S8550-06-01A	P7-3	3 meters	6-5-03	CL	dark yellowish brown sandy lean CLAY		31	17
			7.5 m						

Client Caltrans

Project High Street

Project No. S8550-06-01A | Plate

GEOCON CONSULTANTS, INC.

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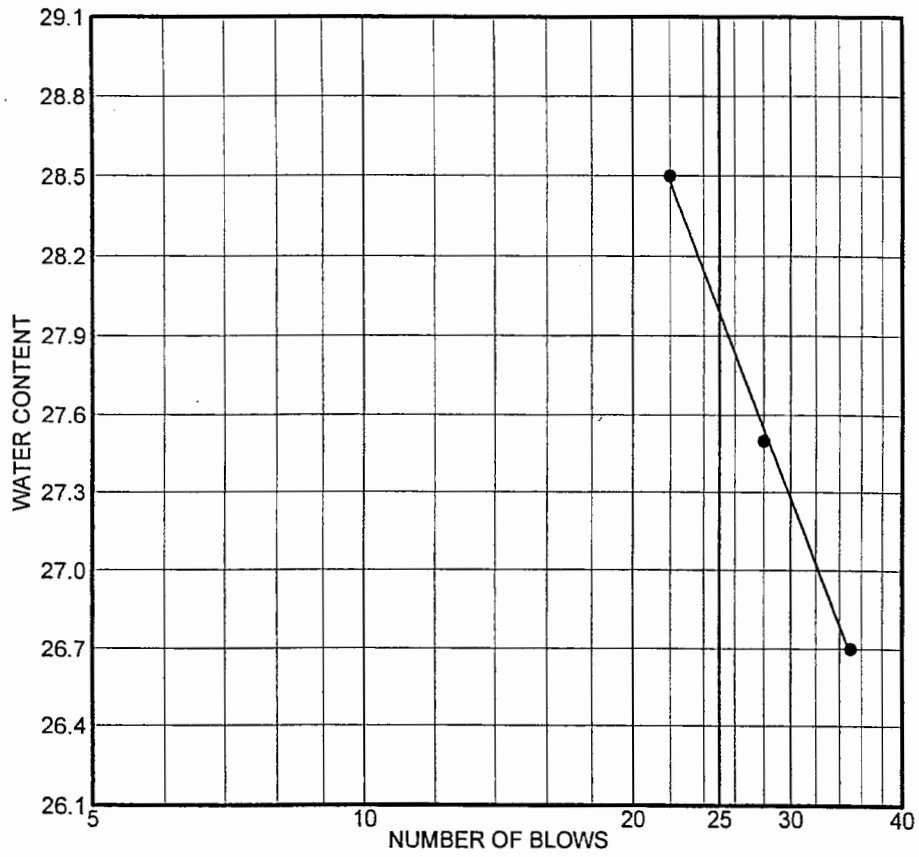
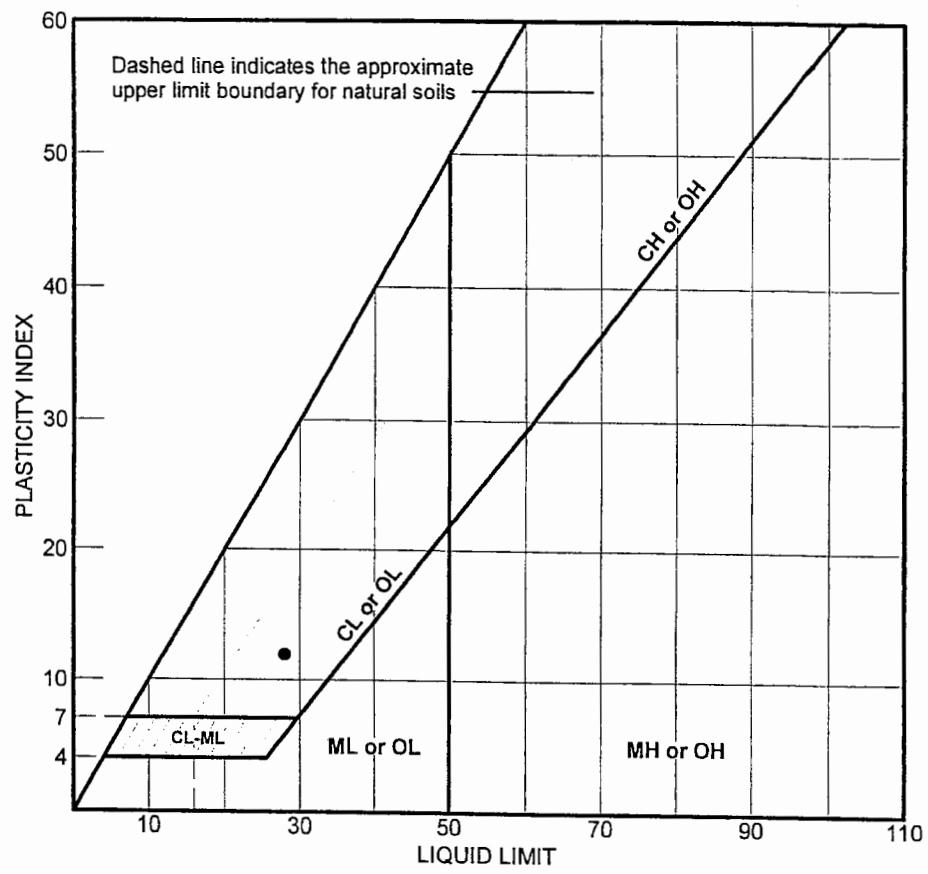
LIQUID AND PLASTIC LIMITS TEST REPORT





	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
●	S8550-06-01A	P7-4.5	4.5 meters	6-5-03	SC	Yellowish brown clayey SAND		28	12
			Elv 3m						

Client Caltrans

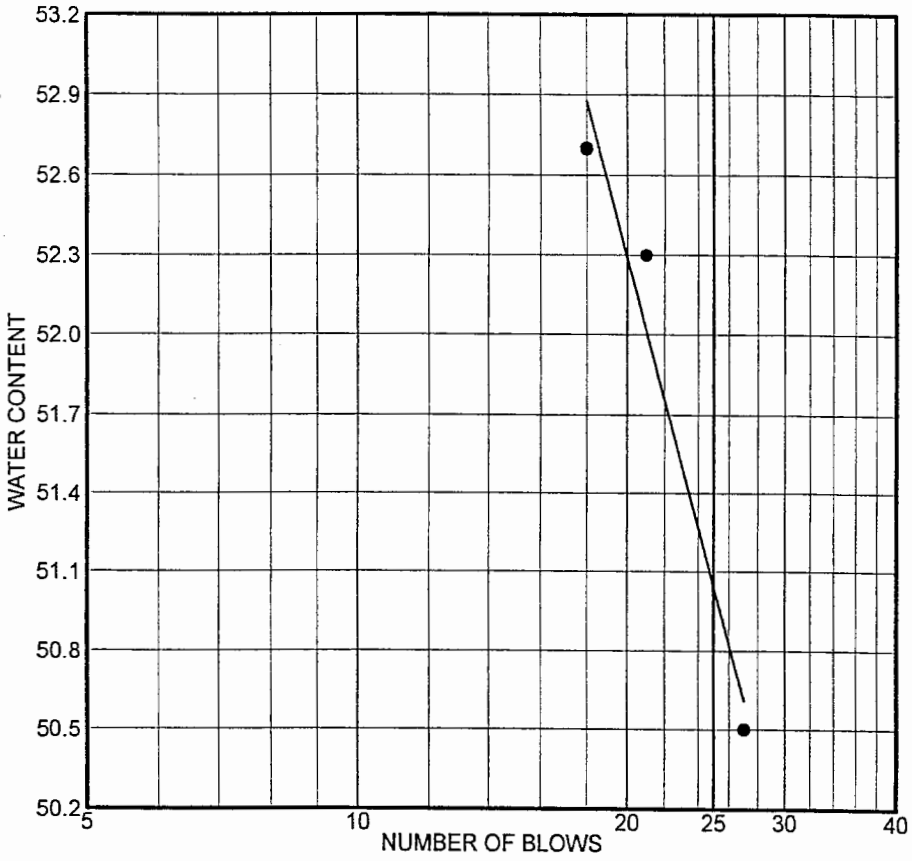
Project High Street

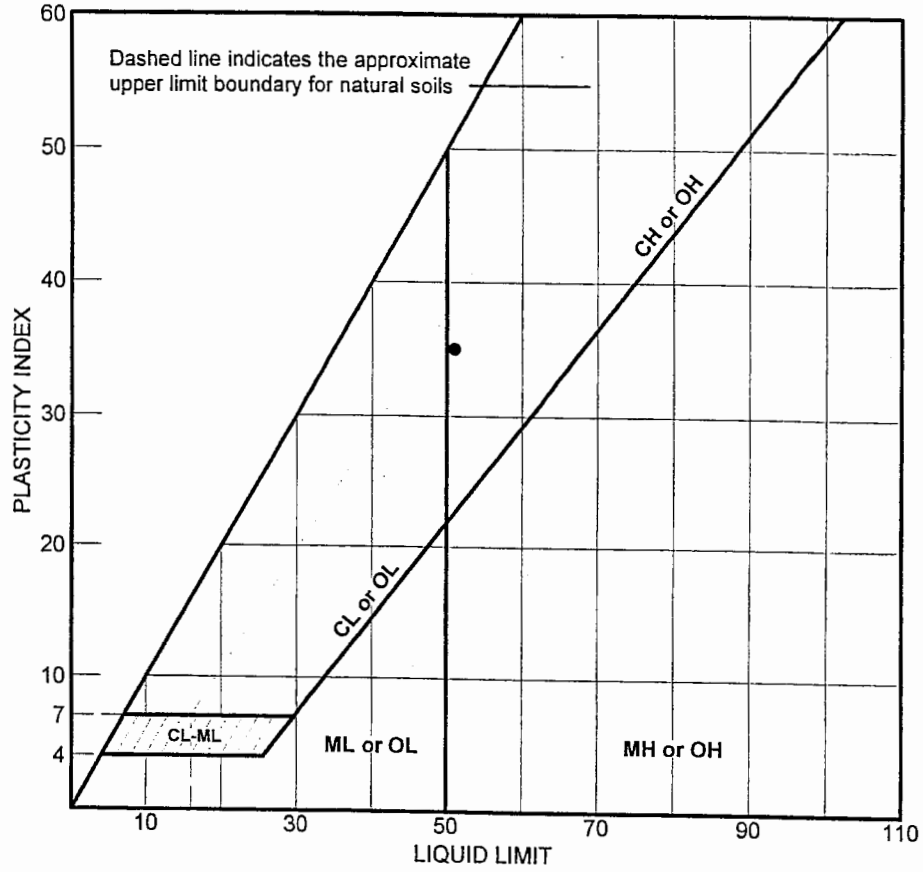
Project No. S8550-06-01A | Plate

GEOCON CONSULTANTS, INC.

●

LIQUID AND PLASTIC LIMITS TEST REPORT





	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
●	S8550-06-01A	P7-7.5	7.5 meters	6-5-03	CH	Brown fat CLAY		51	35
			Elv 0						

Client Caltrans

Project High Street

Project No. S8550-06-01A | Plate

GEOCON CONSULTANTS, INC.

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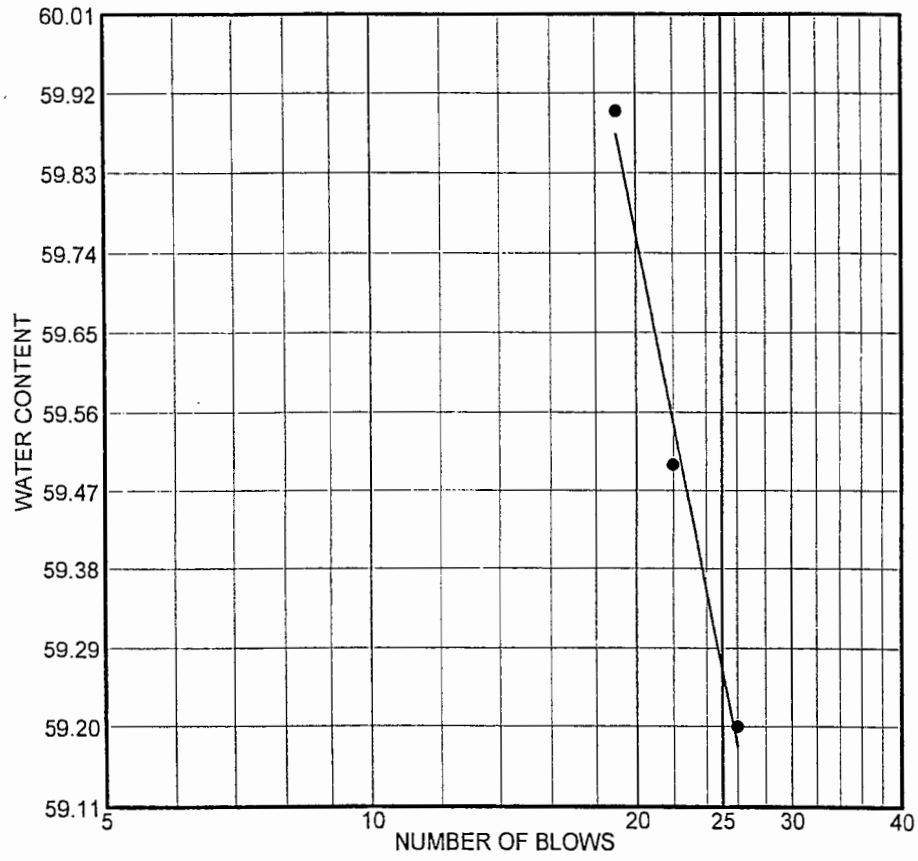
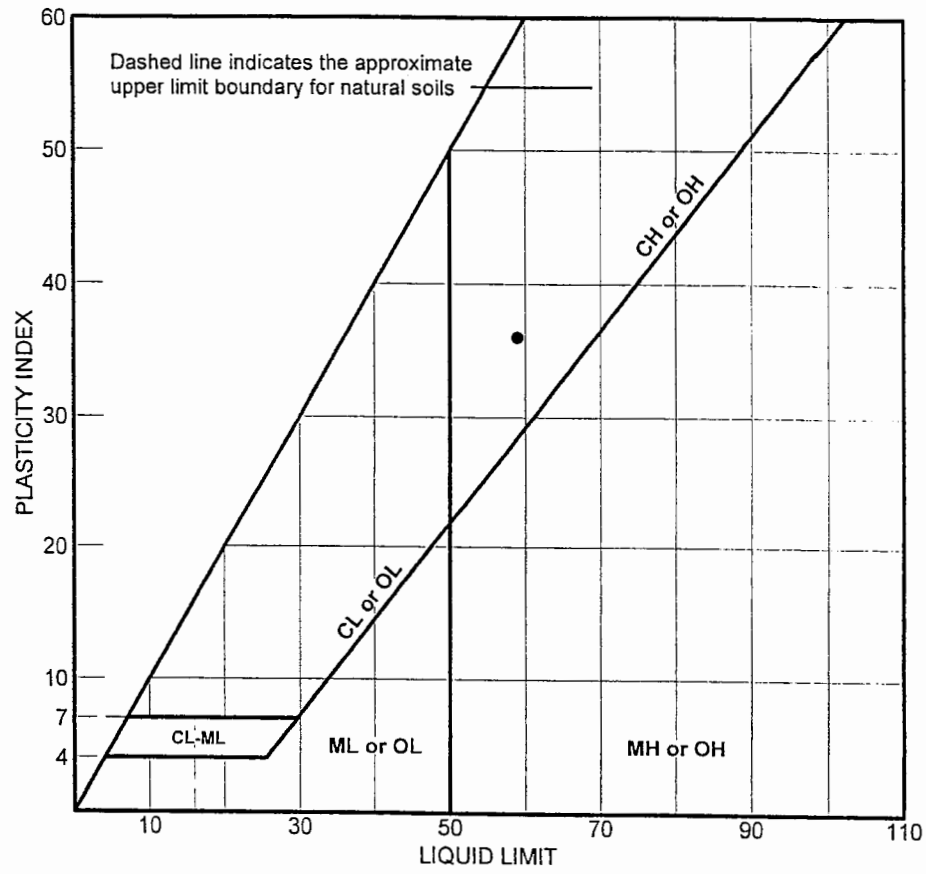
LIQUID AND PLASTIC LIMITS TEST REPORT





	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
●	S8550-06-01A	P7-10	10 meters	6-20-0	CH	Light yellowish brown fat CLAY		59	36
			Elv -3m						

Client Caltrans

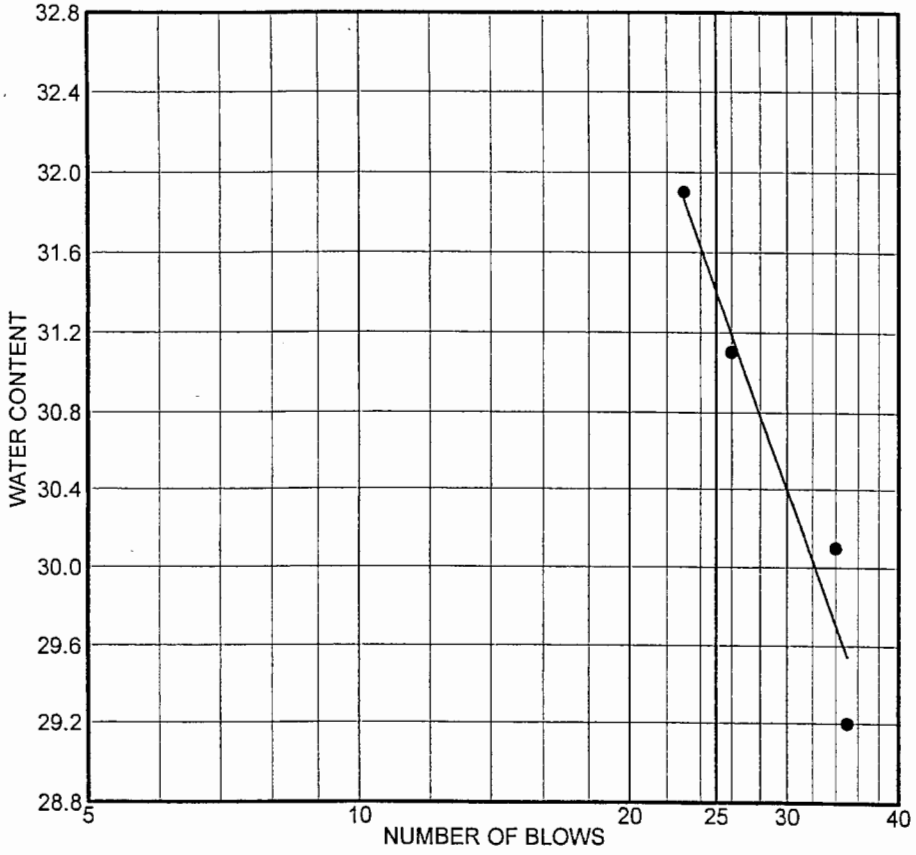
Project High Street

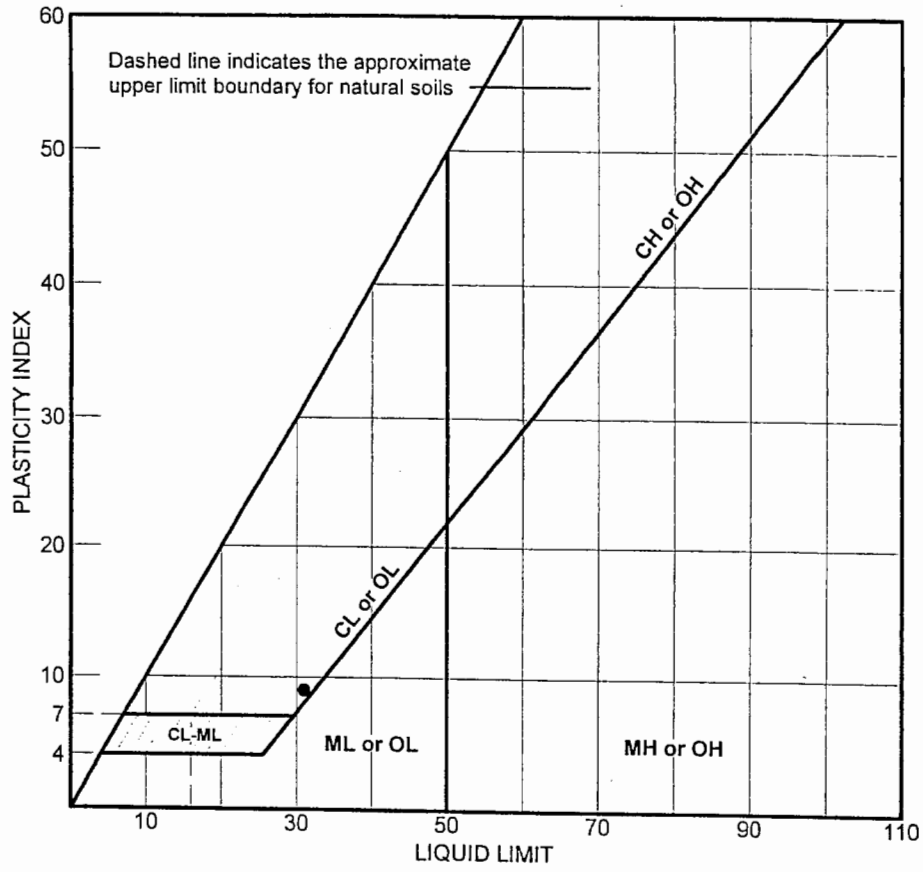
Project No. S8550-06-01A | Plate

GEOCON CONSULTANTS, INC.

●

LIQUID AND PLASTIC LIMITS TEST REPORT





	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
●	S8550-06-01A	P7-15	15 meters	6-9-03	CL	Yellowish brown sandy lean CLAY		31	9
			Elv. - (6.5..)						

Client Caltrans

Project High Street

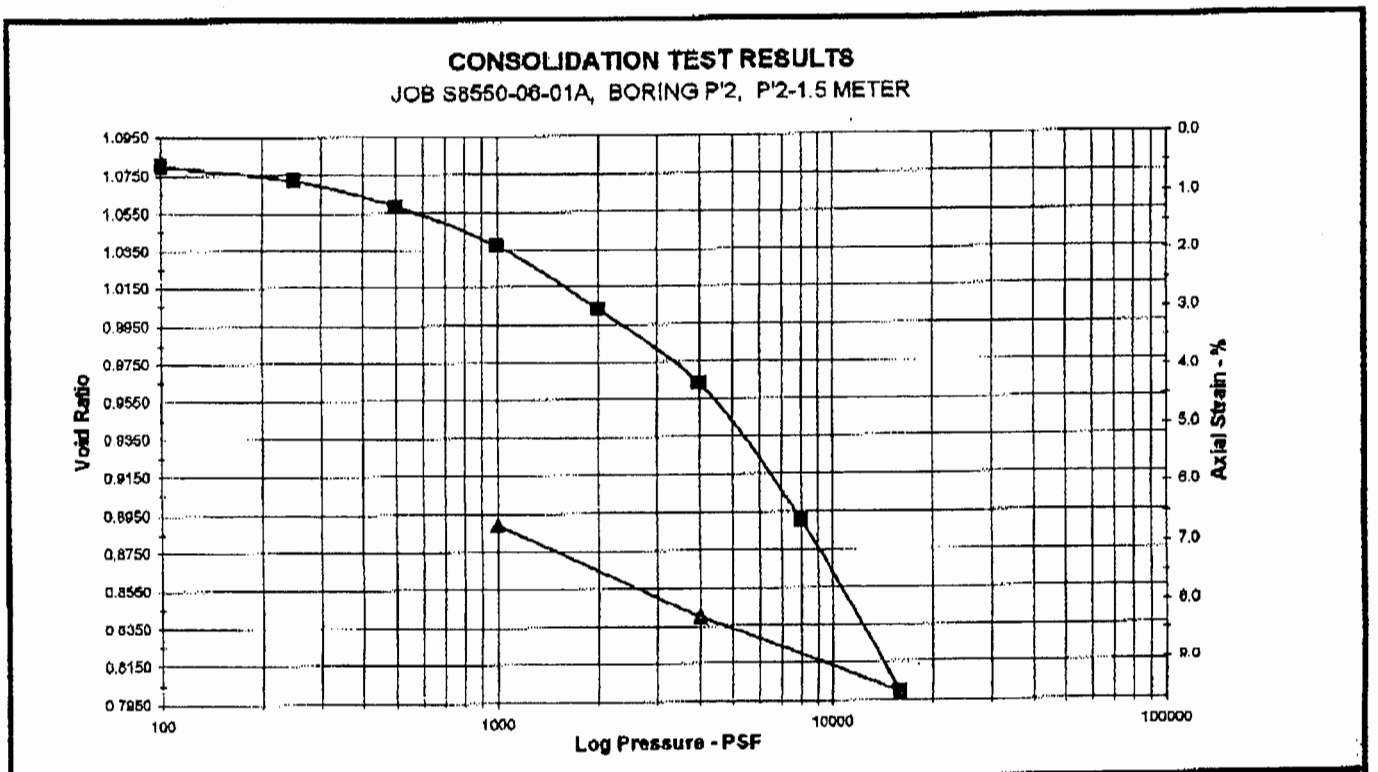
Project No. S8550-06-01A | Plate

GEOCON CONSULTANTS, INC.

●

CONSOLIDATION TEST

Project Name: High Street OSRP
Project Number: S8550-06-01A
Sample Number: P'2-1.5



Axial Load (psf)	Void Ratio	Axial Strain (%)	m_v, coef of vol Compres (in^2/lb)	c_c, Comp Index	50% Consolidation t_{50}, Time to Consol (min)	50% Consolidation C_v, Coeff of Consol (ft^2/yr)	90% Consolidation t_{90}, Time to Consol (min)	90% Consolidation C_v, Coeff of Consol (ft^2/yr)
250	1.0720	0.40	0.0036	0.020	0.64	157.51	1.32	327.93
500	1.0587	1.04	0.0037	0.044	1.77	56.46	3.65	117.54
1000	1.0370	2.08	0.0030	0.072	0.89	110.68	1.83	230.43
2000	1.0029	3.72	0.0024	0.113	0.97	98.78	2.00	205.65
4000	0.9633	5.63	0.0014	0.132	0.63	146.25	1.30	304.49
8000	0.8906	9.12	0.0013	0.241	1.31	66.15	2.71	137.72
16000	0.7993	13.51	0.0009	0.303	2.97	26.77	6.15	55.73

	COND AT START OF TEST	COND AT END OF TEST
HEIGHT (in.)	0.7500	0.6811
MOISTURE CONTENT (%)	32.1	30.7
DRY DENSITY (pcf):	87.0	95.8
SATURATION (%)	86.4	100.1
VOID RATIO	1.080	0.889

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CONSOLIDATION TEST RESULTS

File No.	Job Name	Procedure	Date
S8550-06-01A	High Street OSRP	ASTM D2435-90	6/9/2003

Boring	Sample	Sample Description
P'2	P'2-1.5	Very dark grayish brown to black lean CLAY

Sample (ring) Ht, H_i	Sample Diameter:	Dia-Height Ratio (min 2.5)	Sample Area, A:
0.75 inches	2.5 inches	3.33	4.91 sq inches

Wt Ring + Moist Soil:	326.8 gms
Wt of Ring:	215.67 gms
Initial Wet Density:	115.0 pcf
Cal'd Init Dry Dens, D_d:	87.0 pcf
Cal'd Init Dry Wt, W_S:	84.1 gms
Initial Saturation:	86.4 %
Cal'd Ht of Solids:	0.3605 inches

Specific Gravity, G_s (assumed or tested): 2.9

INIT MOIST CONTENT SAMP	
Gross Wet Wt	185.21 gm
Gross Dry Wt	152.58 gm
Tare	51.05 gm
% Water, w	32.1 %

Interpreted Preconsolidation Pressure, P_P - from chart: 2200 psf

Interpreted Compression Index, C_C - from chart:

FINAL - ENTIRE SAMPLE	
Wet+Ring	324.4 gm
Tare (ring)	215.67 gm
Cal'd Dry Wt	83.2 gm
FINAL MOISTURE SAMP	
Wet+Pan	158.88 gm
Dry+Pan	133.41 gm
Tare (pan)	50.35 gm
Dry Soil	83.1 gm
% Wat, w	30.7 %
Final Ht	0.6811 inches
Dry Density	95.8 pcf
Saturation	100.1 %

Ht of Solids, $H_0 = Ws/(Gs-A)$

Ht of Voids, $H_V = H - H_0$

Void Ratio, $e = H_V/H_0$

Initial Void Ration, e_0 = void ratio at start of test

Dry Density, $D_d = (2.205)(1728)(W_S)/[(A)(H_i)(1000)]$

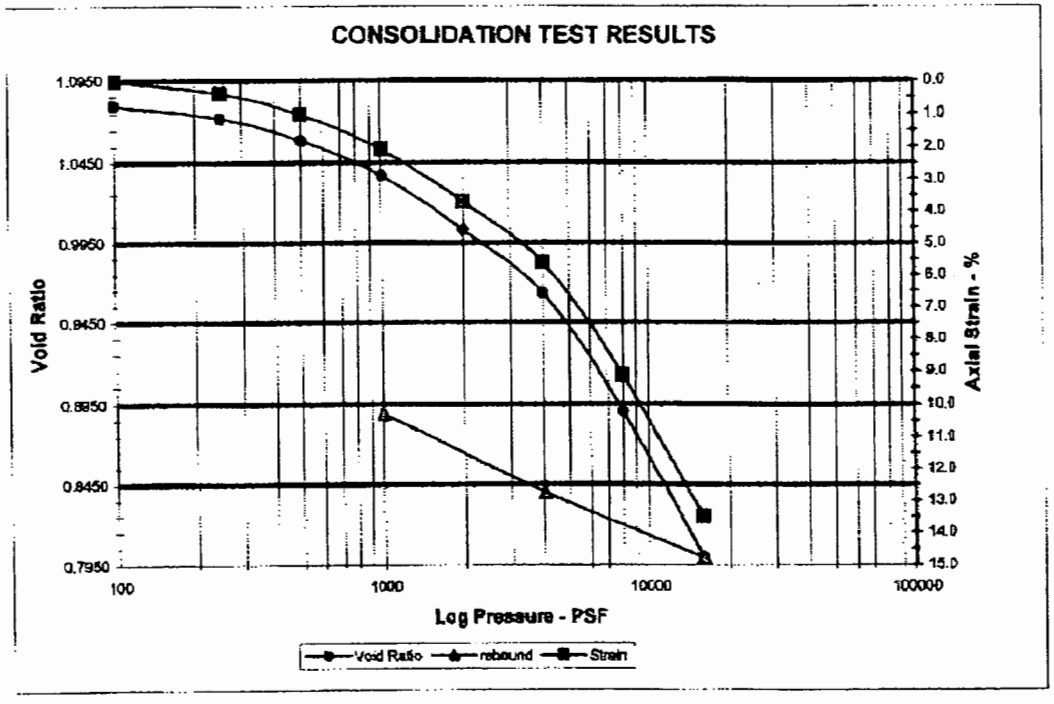
Saturation $= (w)(G_S)(D_d)/[(62.4)(G_S)-D_d]$

Coeff of Vol Compressibility, $m_v = a_v/(1+e_1) = (\text{del } e)/(\text{del } p)(1+e_1)$

Compression Index, $C_C = -(e_2-e_1)/\log(P_2/P_1)$

Coeff of Consolidation, $C_V = t_{50}(HN)^2/t_{50} = .197(H_2-H_1)/4(t_{50})$

P, Axial Load psf	Final Dial Read (in)	Total Change in Ht (in)	H, Final Sample Height (in)	Axial Strain (%)	H_V, Final Ht of Voids (in)	e, Final Void Ratio	m_V, Coeff of Vol Comp (in2/lb)	C_C, Comp Index	t_{50}, Time to 50% Consol (min)	C_{V-50}, Coeff of Consol (ft^2/yr)
0	0.6620	0.0000	0.7500	0.00	0.3895	1.0803				
100	0.6622	-0.0002	0.7498	0.03	0.3893	1.0798				
250	0.6650	-0.0030	0.7470	0.40	0.3865	1.0720	0.0036	0.01952	0.64	157.51
500	0.6698	-0.0078	0.7422	1.04	0.3817	1.0587	0.0037	0.04423	1.77	56.46
1000	0.6776	-0.0156	0.7344	2.08	0.3739	1.0370	0.0030	0.07187	0.89	110.68
2000	0.6899	-0.0279	0.7221	3.72	0.3616	1.0029	0.0024	0.11333	0.97	98.78
4000	0.7042	-0.0422	0.7078	5.63	0.3473	0.9633	0.0014	0.13176	0.63	146.25
8000	0.7304	-0.0684	0.6816	9.12	0.3211	0.8906	0.0013	0.24141	1.31	66.15
16000	0.7633	-0.1013	0.6487	13.51	0.2882	0.7993	0.0009	0.30315	2.97	26.77
4000	0.7486	-0.0866	0.6634	11.55	0.3029	0.8401				
1000	0.7309	-0.0689	0.6811	9.19	0.3206	0.8892				

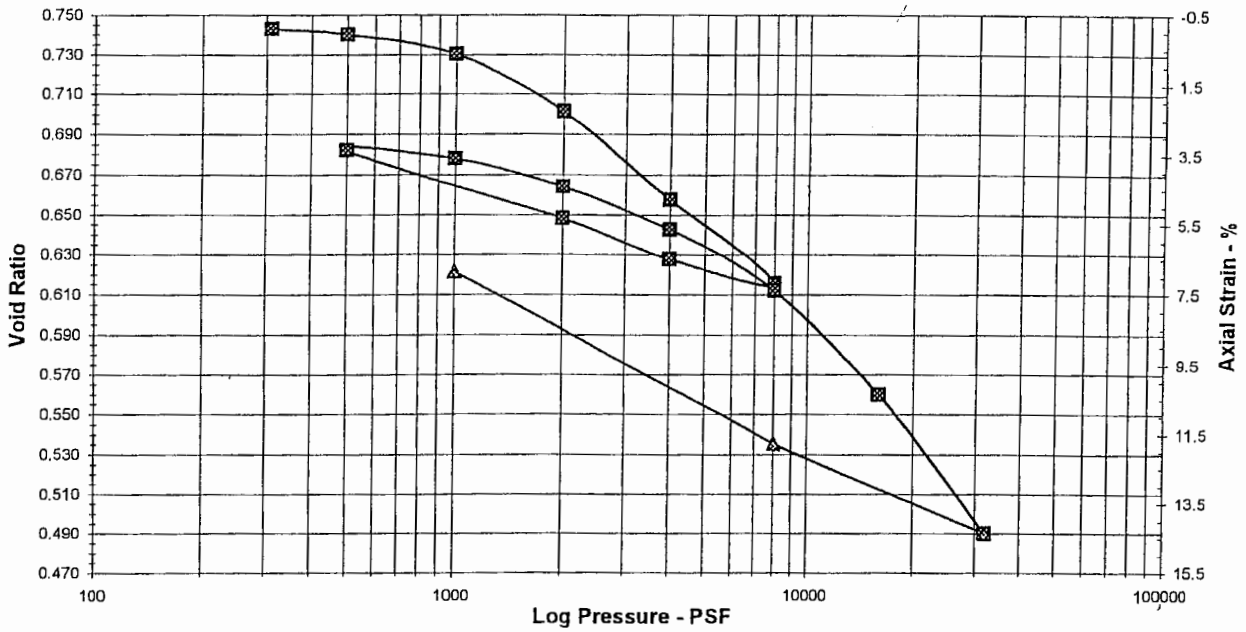


CONSOLIDATION TEST

Project Name: High Street OSRP
Project Number: S8550-06-01A
Sample Number: P'2-4.5 rerun

CONSOLIDATION TEST RESULTS

JOB S8550-06-01A, BORING P'2, P'2-4.5 rerun



Axial Load (psf)	Void Ratio	Axial Strain (%)	m_V, coef of vol Compres (in^2/lb)	c_C, Comp Index	50% Consolidation t_{50}, Time to Consol (min)	50% Consolidation C_V, Coeff of Consol (ft^2/yr)	90% Consolidation t_{90}, Time to Consol (min)	90% Consolidation C_V, Coeff of Consol (ft^2/yr)
0	0.743	0.00						
310	0.743	-0.01						
500	0.740	0.15	0.0012	0.013	0.23	431.44	1.00	433.93
1000	0.730	0.72	0.0017	0.033	15.27	6.56	65.44	6.60
2000	0.701	2.37	0.0024	0.096	36.18	2.71	155.02	2.72
4000	0.658	4.88	0.0018	0.145	37.51	2.50	160.74	2.52
8000	0.616	7.29	0.0009	0.140	43.10	2.07	184.66	2.08
4000	0.628	6.59	0.0003	0.041				
2000	0.648	5.43	0.0009	0.067				
500	0.682	3.47	0.0020	0.057				
1000	0.678	3.71	0.0007	0.014				
2000	0.664	4.52	0.0012	0.047				
4000	0.642	5.75	0.0009	0.071				
8000	0.612	7.51	0.0007	0.102				
16000	0.560	10.48	0.0006	0.172	27.26	3.07	116.81	3.09
32000	0.490	14.49	0.0004	0.232	34.38	2.25	147.33	2.27
8000	0.535	11.89	0.0002	0.075				
1000	0.621	6.96	0.0012	0.095				

G_s = 2.78 (assumed)	COND AT START OF TEST	COND AT END OF TEST
HEIGHT (in.)	0.7500	0.6978
MOISTURE CONTENT (%)	25.2	23.1
DRY DENSITY (pcf):	99.6	107.1
SATURATION (%)	94.3	103.4
VOID RATIO	0.743	0.621

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CONSOLIDATION TEST RESULTS

File No.	Job Name	Procedure	Date
S8550-06-01A	High Street OSRP	ASTM D2435-90	10/15/2003

Boring	Sample	Sample Description
P'2	P'2-4.5 rerun	Yellowish brown fat CLAY with sand

Sample (ring) Ht, H_i	Sample Diameter:	Dia-Height Ratio (min 2.5)	Sample Area, A:
0.75 inches	2.5 inches	3.33	4.91 sq inches

Wt Ring + Moist Soil:	336.14 gms
Wt of Ring:	215.68 gms
Initial Wet Density:	124.7 pcf
Cal'd Init Dry Dens, D_d:	99.6 pcf
Cal'd Init Dry Wt, W_S:	96.2 gms
Initial Saturation:	94.3 %
Cal'd Ht of Solids:	0.4304 inches

Specific Gravity, G_S (assumed or tested): 2.78

INIT MOIST CONTENT SAMP	
Gross Wet Wt	245.09 gm
Gross Dry Wt	205.91 gm
Tare	50.19 gm
% Water, w	25.2 %

Interpreted Preconsolidation Pressure, P_P - from chart: 1100 psf

Interpreted Compression Index, C_C - from chart:

FINAL - ENTIRE SAMPLE	
Wet+Ring	333.5 gm
Tare (ring)	215.68 gm
Cal'd Dry Wt	95.7 gm
FINAL MOISTURE SAMP	
Wet+Pan	168.26 gm
Dry+Pan	146.27 gm
Tare (pan)	50.92 gm
Dry Soil	95.4 gm
% Wat, w	23.1 %
Final Ht	0.6978 inches
Dry Density	107.1 pcf
Saturation	103.4 %

Ht of Solids, $H_0 = W_s/(G_s\text{-}A)$

Ht of Voids, $H_V = H - H_0$

Void Ratio, $e = H_V/H_0$

Initial Void Ratio, e_0 = void ratio at start of test

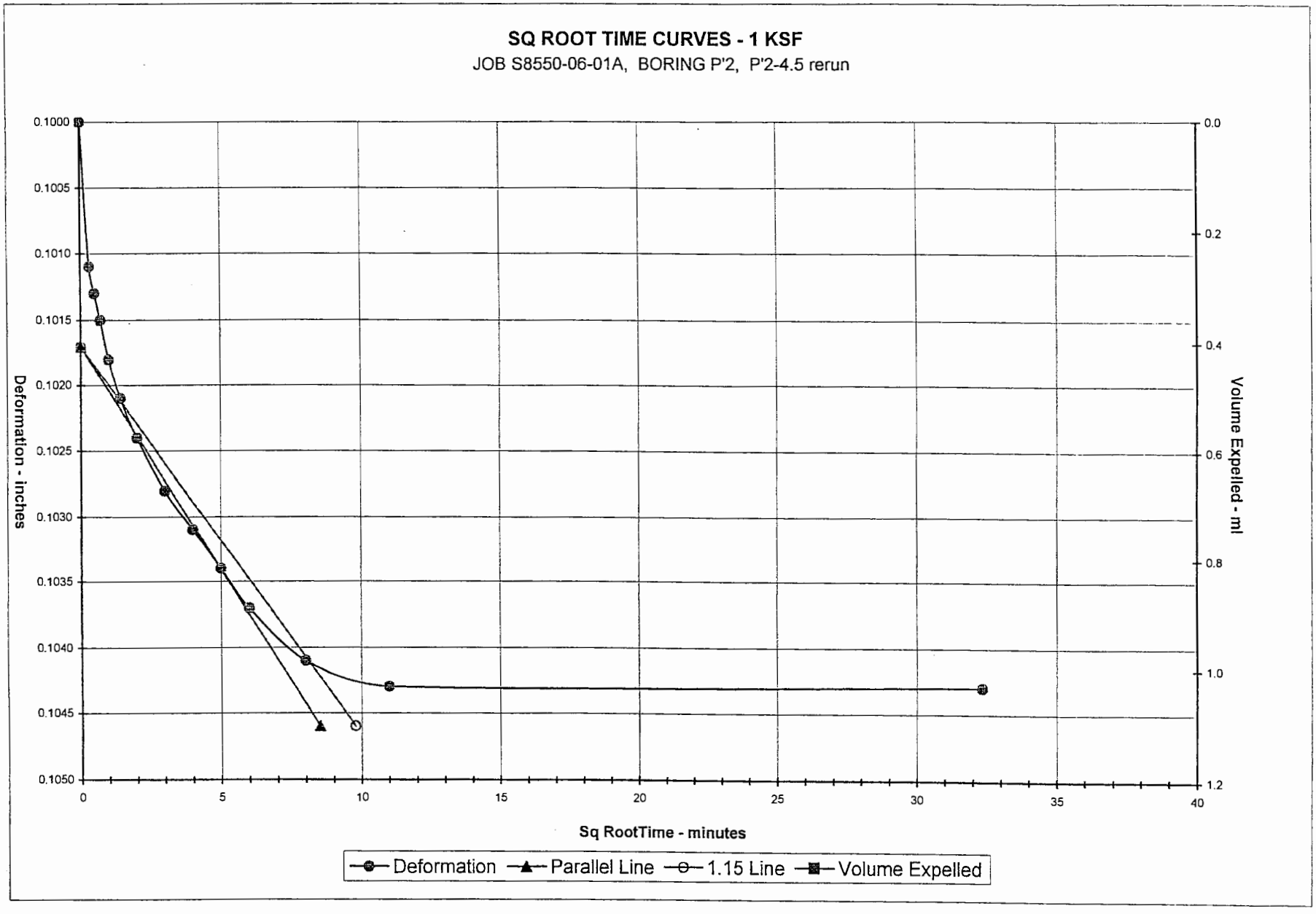
Dry Density, $D_d = (2.205)(1728)(W_S)/[(A)(H_i)(1000)]$

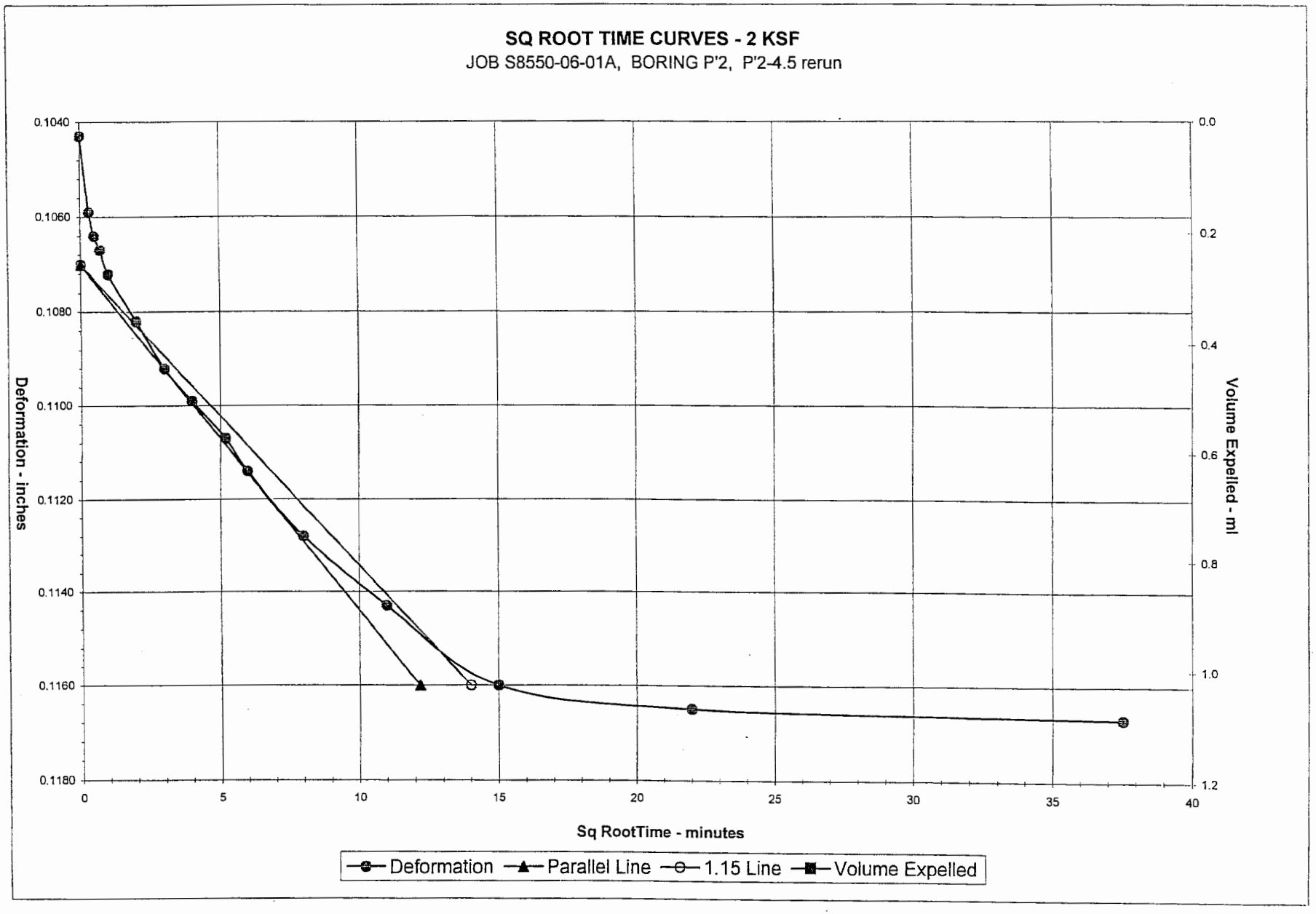
Saturation $= (w)(G_S)(D_d)/[(62.4)(G_S)\text{-}D_d]$

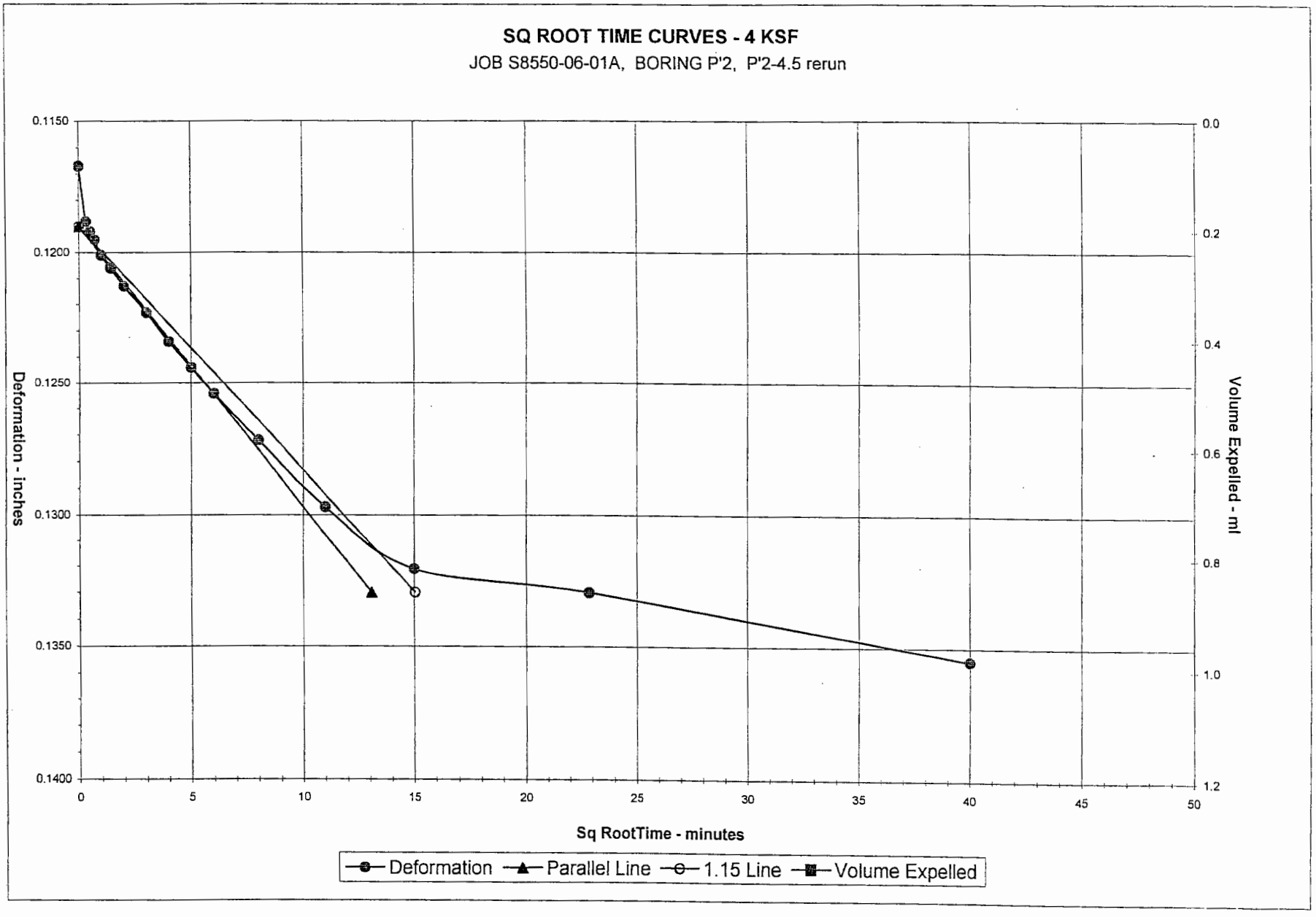
Coeff of Vol Compressibility, $m_V = a_V/(1+e_1) = (\text{del } e)/(\text{del } p)(1+e_1)$

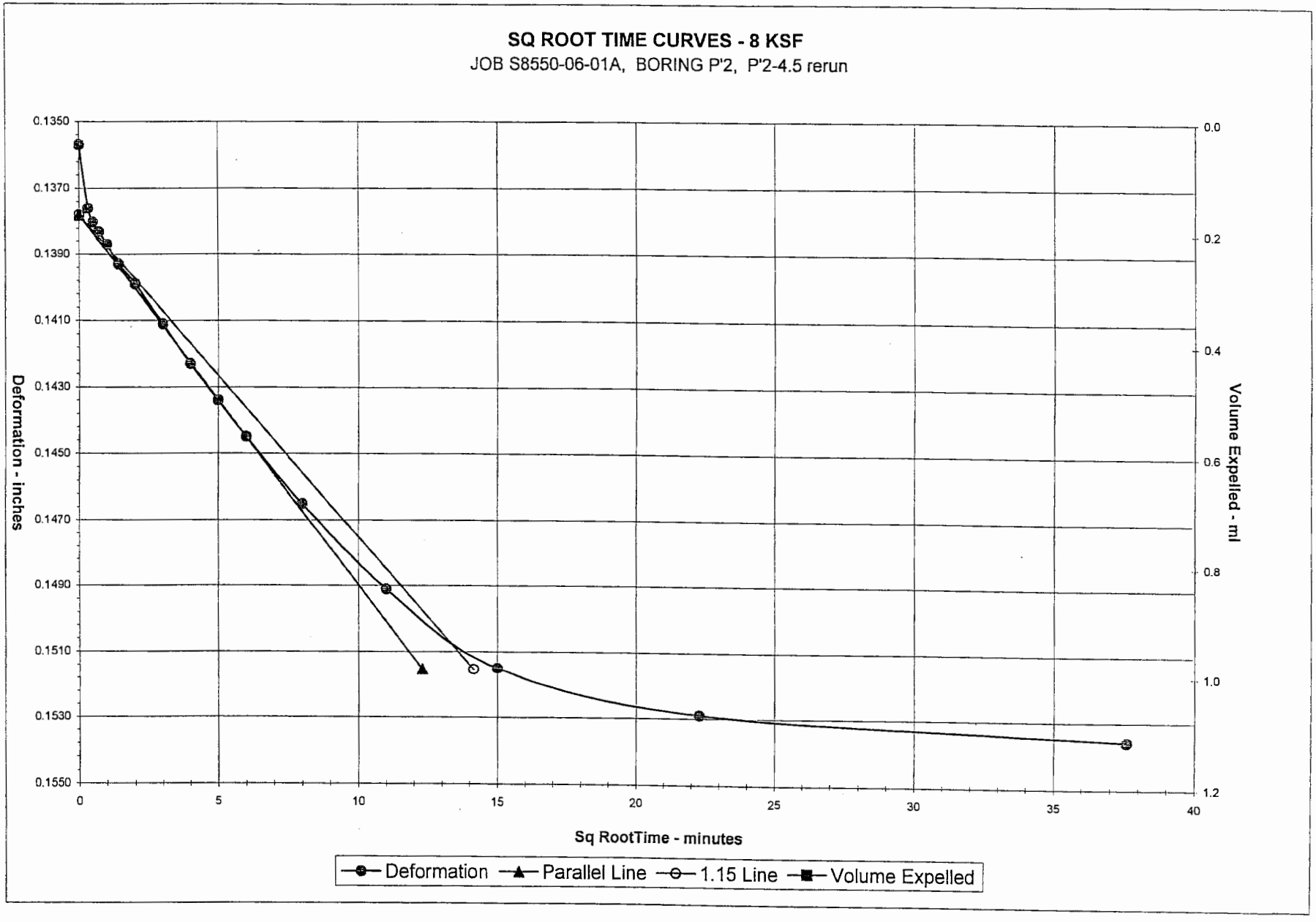
Compression Index, $C_C = -(e_2\text{-}e_1)/\log(P_2/P_1)$

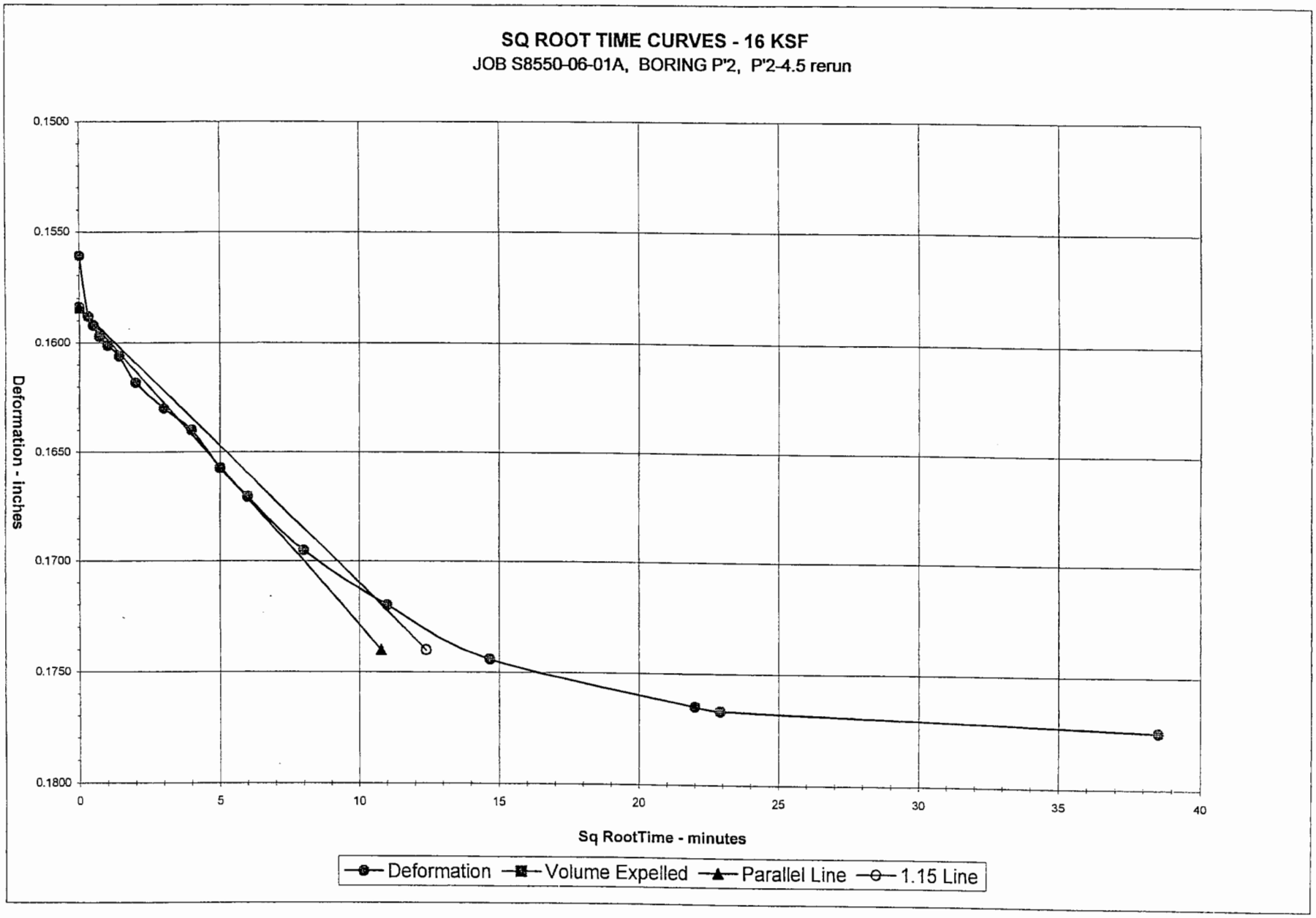
Coeff of Consolidation, $C_V = t_{50}(HN)^2/t_{50} = .197(H_2\text{-}H_1)/4(t_{50})$


SQ ROOT TIME CURVES - 1 KSF
JOB S8550-06-01A, BORING P'2, P'2-4.5 rerun
Deformation - inches
0.1000
0.1005
0.1010
0.1015
0.1020
0.1025
0.1030
0.1035
0.1040
0.1045
0.1050
Volume Expelled - ml
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
5
10
15
20
25
30
35
40
Sq RootTime - minutes
Deformation
Parallel Line
1.15 Line
Volume Expelled


SQ ROOT TIME CURVES - 2 KSF
JOB S8550-06-01A, BORING P'2, P'2-4.5 rerun
Deformation - inches
0.1040
0.1060
0.1080
0.1100
0.1120
0.1140
0.1160
0.1180
Volume Expelled - ml
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
5
10
15
20
25
30
35
40
Sq RootTime - minutes
Deformation
Parallel Line
1.15 Line
Volume Expelled

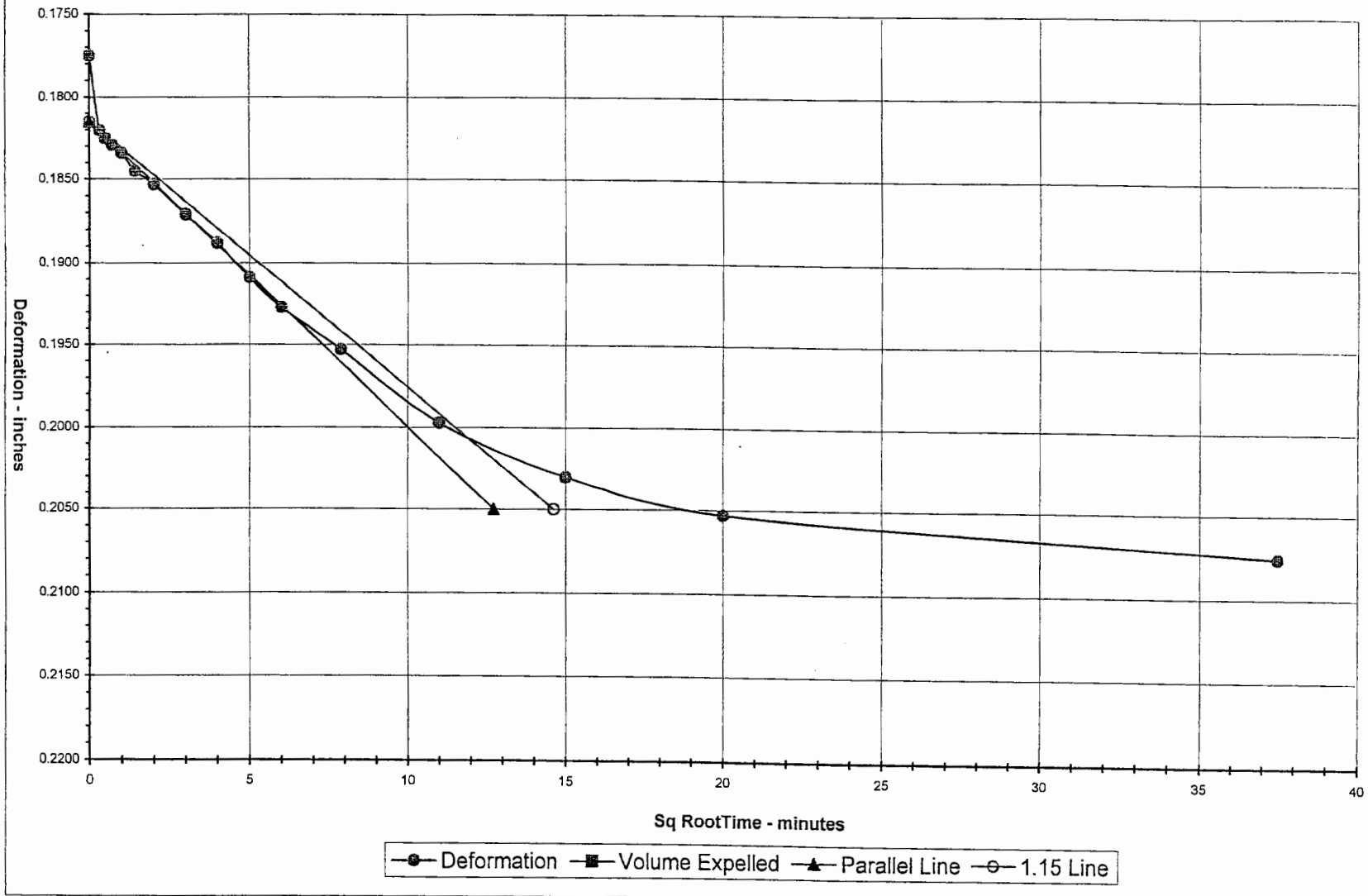

SQ ROOT TIME CURVES - 4 KSF
JOB S8550-06-01A, BORING P'2, P'2-4.5 rerun
Deformation - inches
0.1150
0.1200
0.1250
0.1300
0.1350
0.1400
Volume Expelled - ml
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
5
10
15
20
25
30
35
40
45
50
Sq RootTime - minutes
Deformation
Parallel Line
1.15 Line
Volume Expelled


SQ ROOT TIME CURVES - 8 KSF
JOB S8550-06-01A, BORING P'2, P'2-4.5 rerun
Deformation - inches
0.1350
0.1370
0.1390
0.1410
0.1430
0.1450
0.1470
0.1490
0.1510
0.1530
0.1550
Volume Expelled - ml
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
5
10
15
20
25
30
35
40
Sq RootTime - minutes
Deformation
Parallel Line
1.15 Line
Volume Expelled


SQ ROOT TIME CURVES - 16 KSF
JOB S8550-06-01A, BORING P'2, P'2-4.5 rerun
Deformation - inches
0.1500
0.1550
0.1600
0.1650
0.1700
0.1750
0.1800
0
5
10
15
20
25
30
35
40
Sq RootTime - minutes
Deformation
Volume Expelled
Parallel Line
1.15 Line

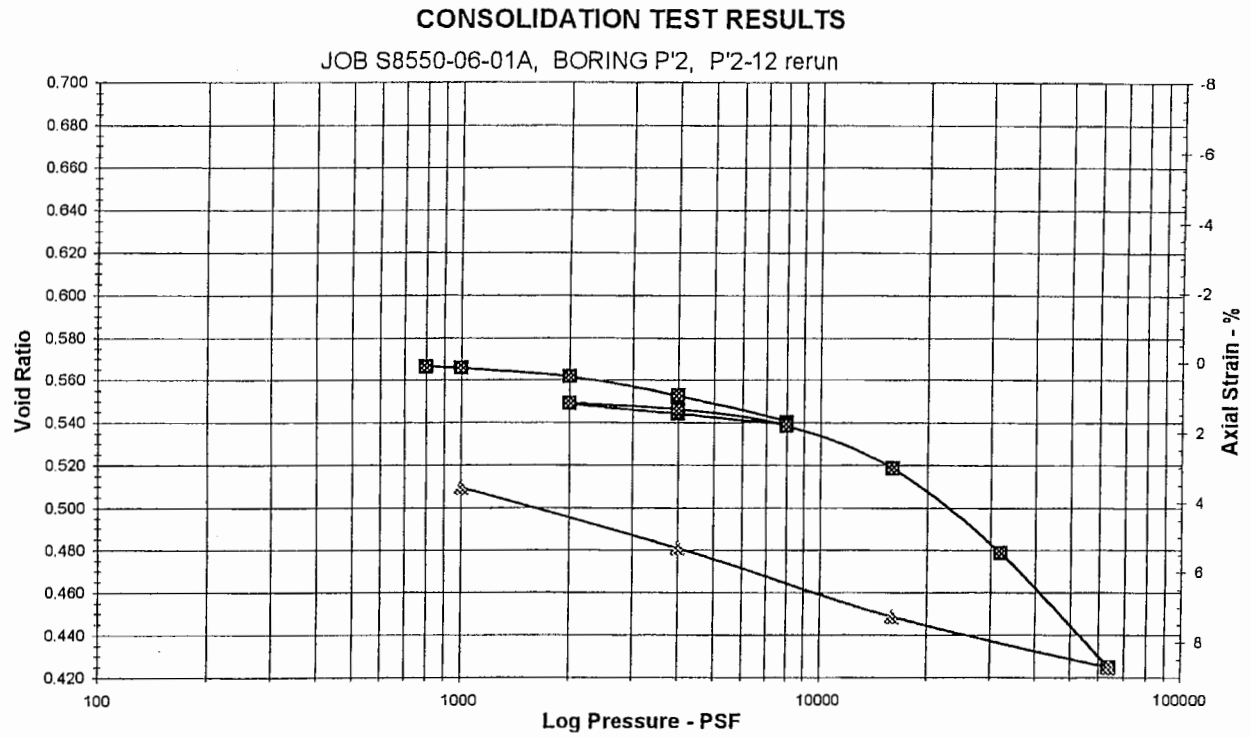
SQ ROOT TIME CURVES - 32 KSF

JOB S8550-06-01A, BORING P'2, P'2-4.5 rerun



CONSOLIDATION TEST

Project Name: High Street OSRP
Project Number: S8550-06-01A Sample Number: P'2-12 rerun



Axial Load (psf)	Void Ratio	Axial Strain (%)	m_V, coef of vol Compres (in^2/lb)	c_C, Comp Index	50% Consolidation t_{50}, Time to Consol (min)	50% Consolidation C_V, Coeff of Consol (ft^2/yr)	90% Consolidation t_{90}, Time to Consol (min)	90% Consolidation C_V, Coeff of Consol (ft^2/yr)
0	0.566	0.00						
800	0.566	-0.03						
1000	0.566	0.00	0.0002	0.004	0.55	183.87	2.36	184.94
2000	0.562	0.27	0.0004	0.014	0.46	220.68	1.96	221.96
4000	0.553	0.84	0.0004	0.030	0.60	167.38	2.56	168.35
8000	0.540	1.64	0.0003	0.042	1.16	85.30	4.95	85.79
4000	0.544	1.37	0.0001	0.014				
2000	0.549	1.07	0.0002	0.016				
4000	0.546	1.25	0.0001	0.010				
8000	0.539	1.73	0.0002	0.025				
16000	0.519	3.01	0.0002	0.067	2.07	46.60	8.86	46.87
32000	0.479	5.57	0.0002	0.133	2.37	39.09	10.15	39.31
64000	0.425	9.01	0.0002	0.179	8.34	10.43	35.72	10.49
16000	0.449	7.48	0.0001	0.040				
4000	0.481	5.41	0.0003	0.054				
1000	0.510	3.59	0.0009	0.048				

G_s = 2.72 (assumed)	COND AT START OF TEST	COND AT END OF TEST
HEIGHT (in.)	0.7500	0.7231
MOISTURE CONTENT (%)	19.4	18.7
DRY DENSITY (pcf):	108.5	112.5
SATURATION (%)	93.4	100.1
VOID RATIO	0.566	0.510

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CONSOLIDATION TEST RESULTS

File No.	Job Name	Procedure	Date
S8550-06-01A	High Street OSRP	ASTM D2435-90	10/14/2003

Boring	Sample	Sample Description
P'2	P'2-12 rerun	Yellowish brown fat CLAY

Sample (ring) Ht, H_i	Sample Diameter:	Dia-Height Ratio (min 2.5)	Sample Area, A:
0.75 inches	2.5 inches	3.33	4.91 sq inches

Wt Ring + Moist Soil:	199.23 gms
Wt of Ring:	74.10 gms
Initial Wet Density:	129.5 pcf
Cal'd Init Dry Dens, D_d:	108.5 pcf
Cal'd Init Dry Wt, W_S:	104.8 gms
Initial Saturation:	93.4 %
Cal'd Ht of Solids:	0.4790 inches

Specific Gravity, G_S (assumed or tested): 2.72

INIT MOIST CONTENT SAMP	
Gross Wet Wt	155.87 gm
Gross Dry Wt	138.83 gm
Tare	50.98 gm
% Water, w	19.4 %

Interpreted Preconsolidation Pressure, P_P - from chart: psf

Interpreted Compression Index, C_C - from chart:

FINAL - ENTIRE SAMPLE	
Wet+Ring	199.17 gm
Tare (ring)	74.10 gm
Cal'd Dry Wt	105.4 gm
FINAL MOISTURE SAMP	
Wet+Pan	175.29 gm
Dry+Pan	155.63 gm
Tare (pan)	50.57 gm
Dry Soil	105.1 gm
% Wat, w	18.7 %
Final Ht	0.7231 inches
Dry Density	112.5 pcf
Saturation	100.1 %

Ht of Solids, $H_0 = Ws/(Gs-A)$

Ht of Voids, $H_V = H - H_0$

Void Ratio, $e = H_V/H_0$

Initial Void Ratio, e_0 = void ratio at start of test

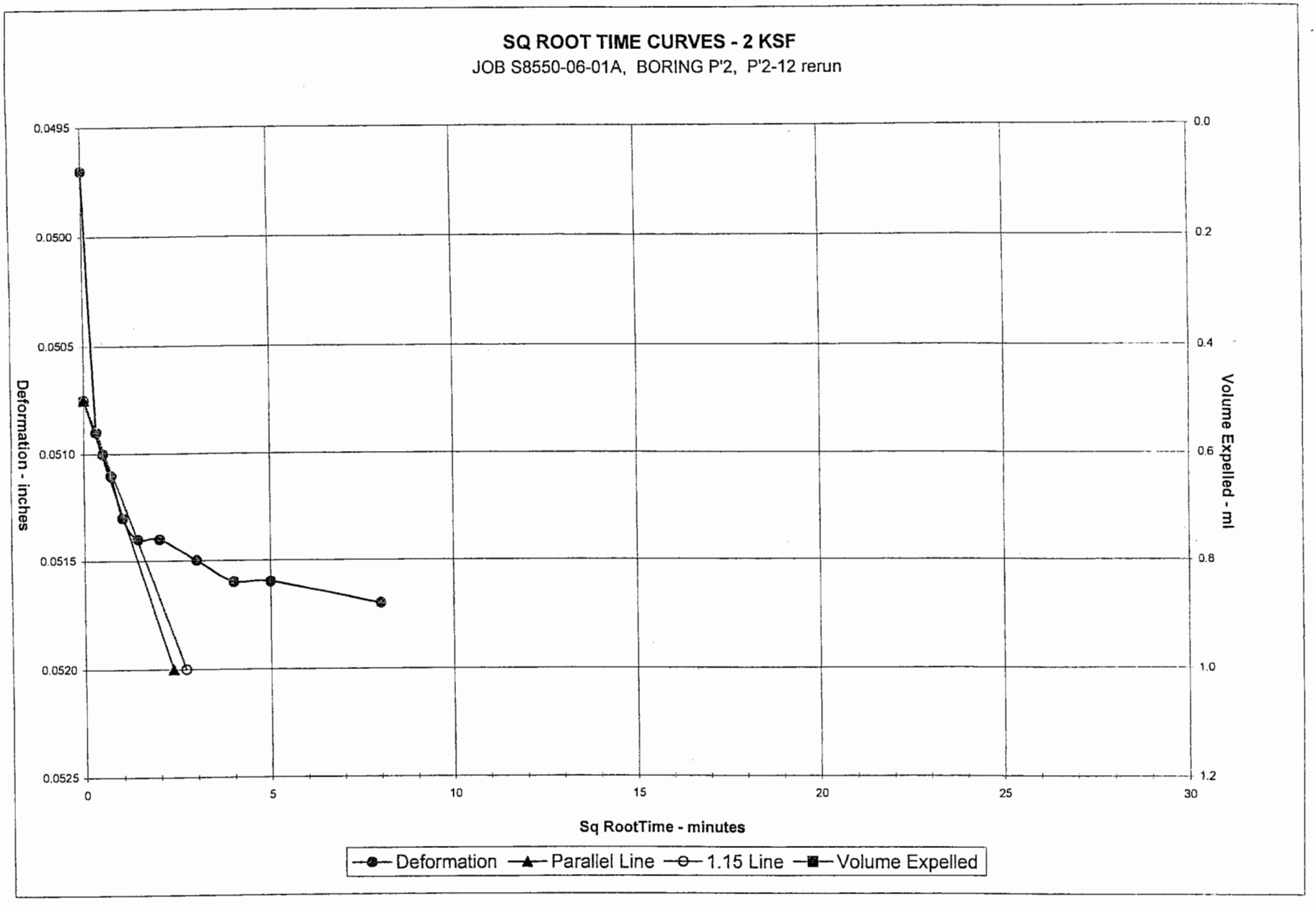
Dry Density, $D_d = (2.205)(1728)(W_S)/[(A)(H_i)(1000)]$

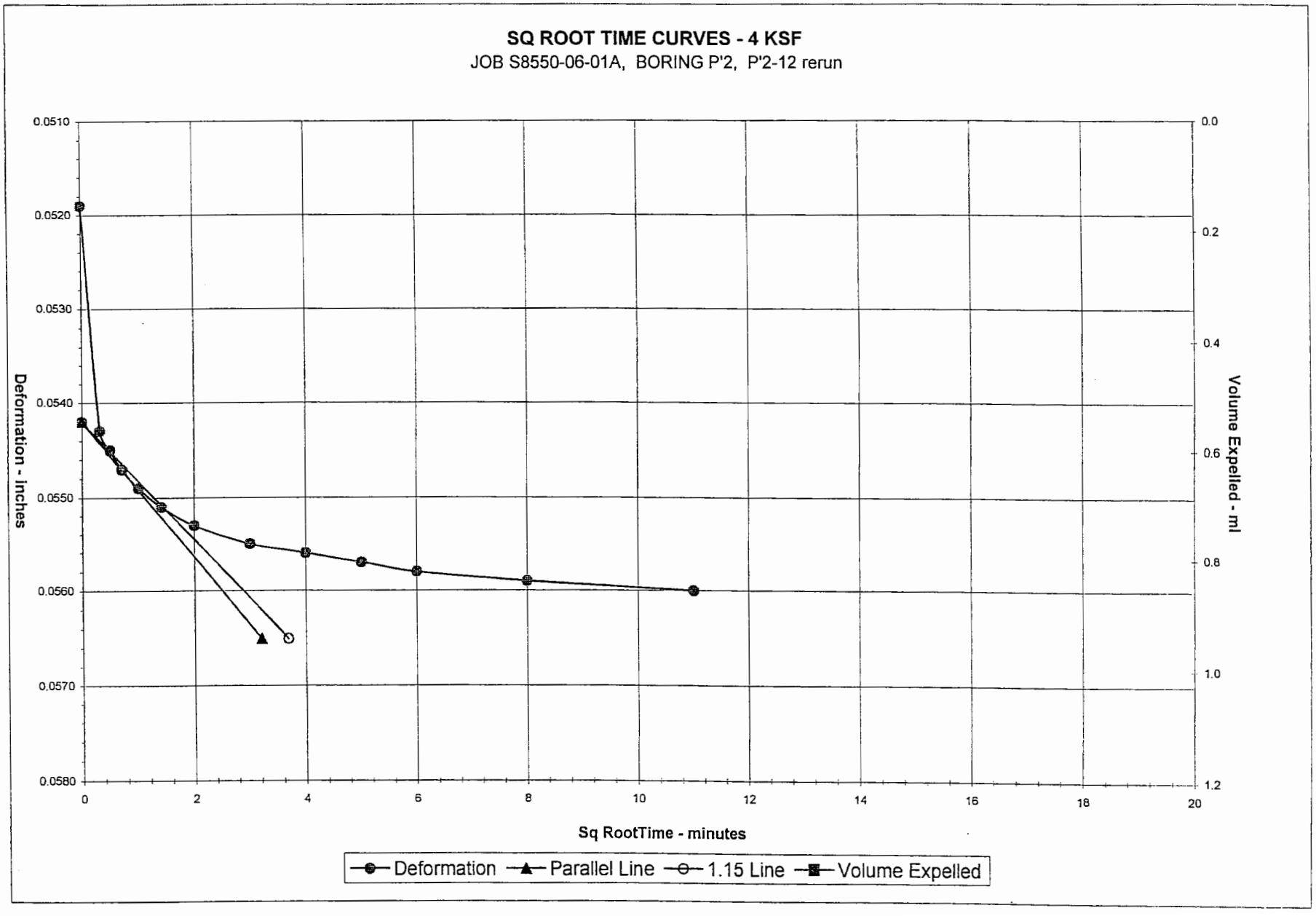
Saturation $= (w)(G_S)(D_d)/[(62.4)(G_S)-D_d]$

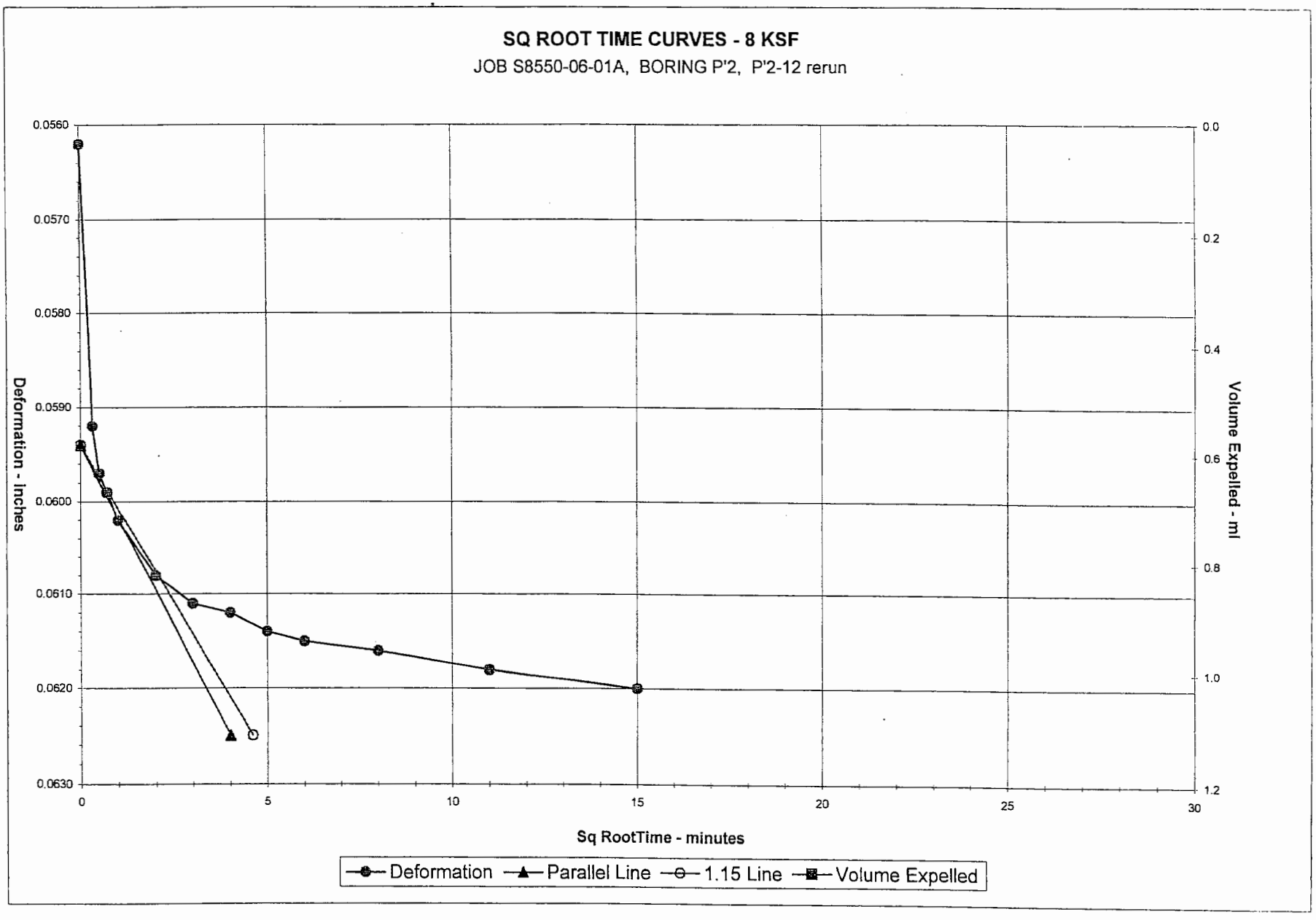
Coeff of Vol Compressibility, $m_V = a_V/(1+e_1) = (\text{del } e)/(\text{del } p)(1+e_1)$

Compression Index, $C_C = -(e_2-e_1)/\log(P_2/P_1)$

Coeff of Consolidation, $C_V = t_{50}(HN)^2/t_{50} = .197(H_2-H_1)/4(t_{50})$

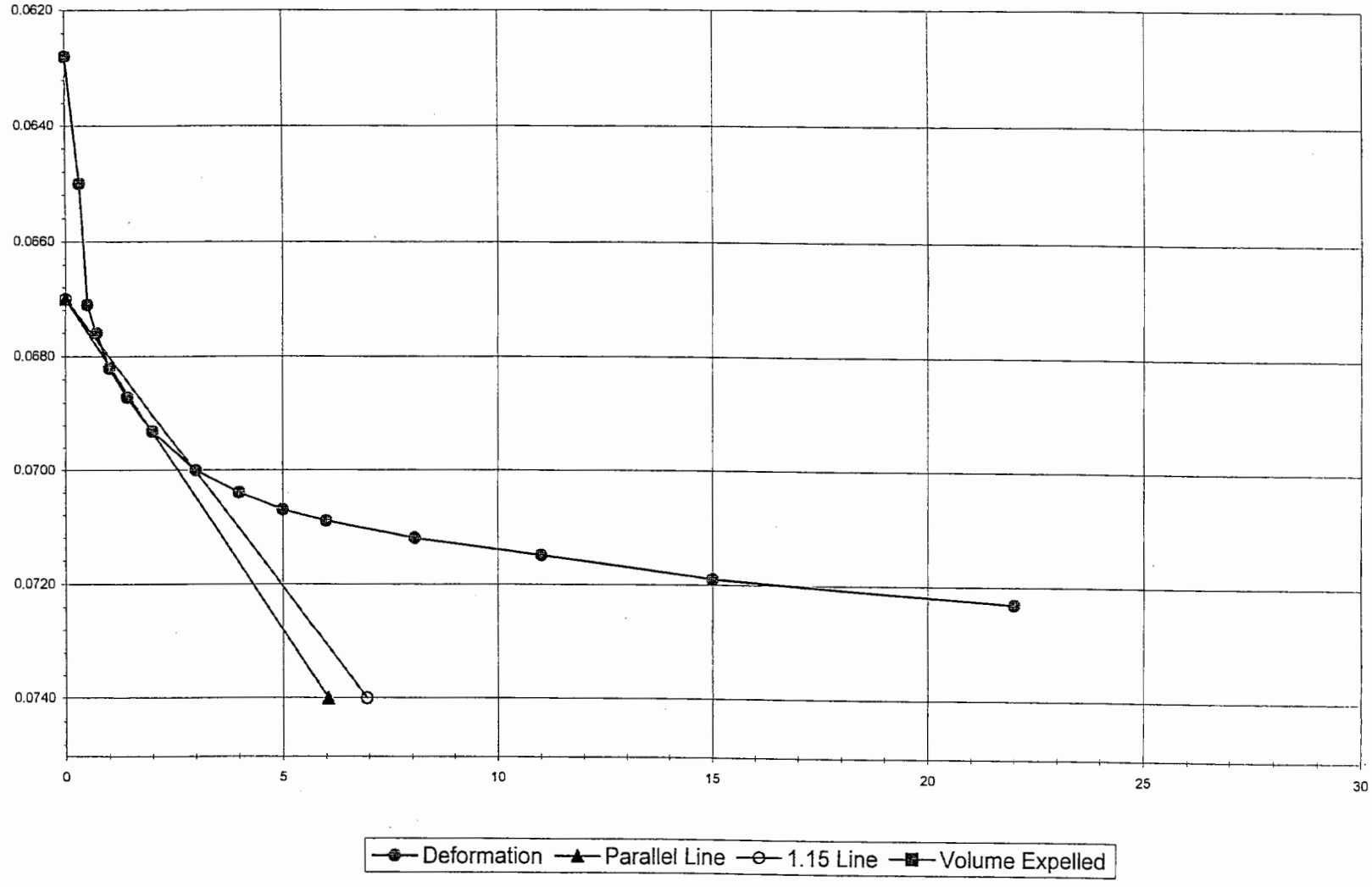

SQ ROOT TIME CURVES - 2 KSF
JOB S8550-06-01A, BORING P'2, P'2-12 rerun
Deformation - inches
0.0495
0.0500
0.0505
0.0510
0.0515
0.0520
0.0525
Volume Expelled - ml
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
5
10
15
20
25
30
Sq RootTime - minutes
Deformation
Parallel Line
1.15 Line
Volume Expelled


SQ ROOT TIME CURVES - 4 KSF
JOB S8550-06-01A, BORING P'2, P'2-12 rerun
Deformation - Inches
0.0510
0.0520
0.0530
0.0540
0.0550
0.0560
0.0570
0.0580
Volume Expelled - ml
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
2
4
6
8
10
12
14
16
18
20
Sq RootTime - minutes
Deformation
Parallel Line
1.15 Line
Volume Expelled


SQ ROOT TIME CURVES - 8 KSF
JOB S8550-06-01A, BORING P'2, P'2-12 rerun
Deformation - inches
0.0560
0.0570
0.0580
0.0590
0.0600
0.0610
0.0620
0.0630
Volume Expelled - ml
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
5
10
15
20
25
30
Sq RootTime - minutes
Deformation
Parallel Line
1.15 Line
Volume Expelled

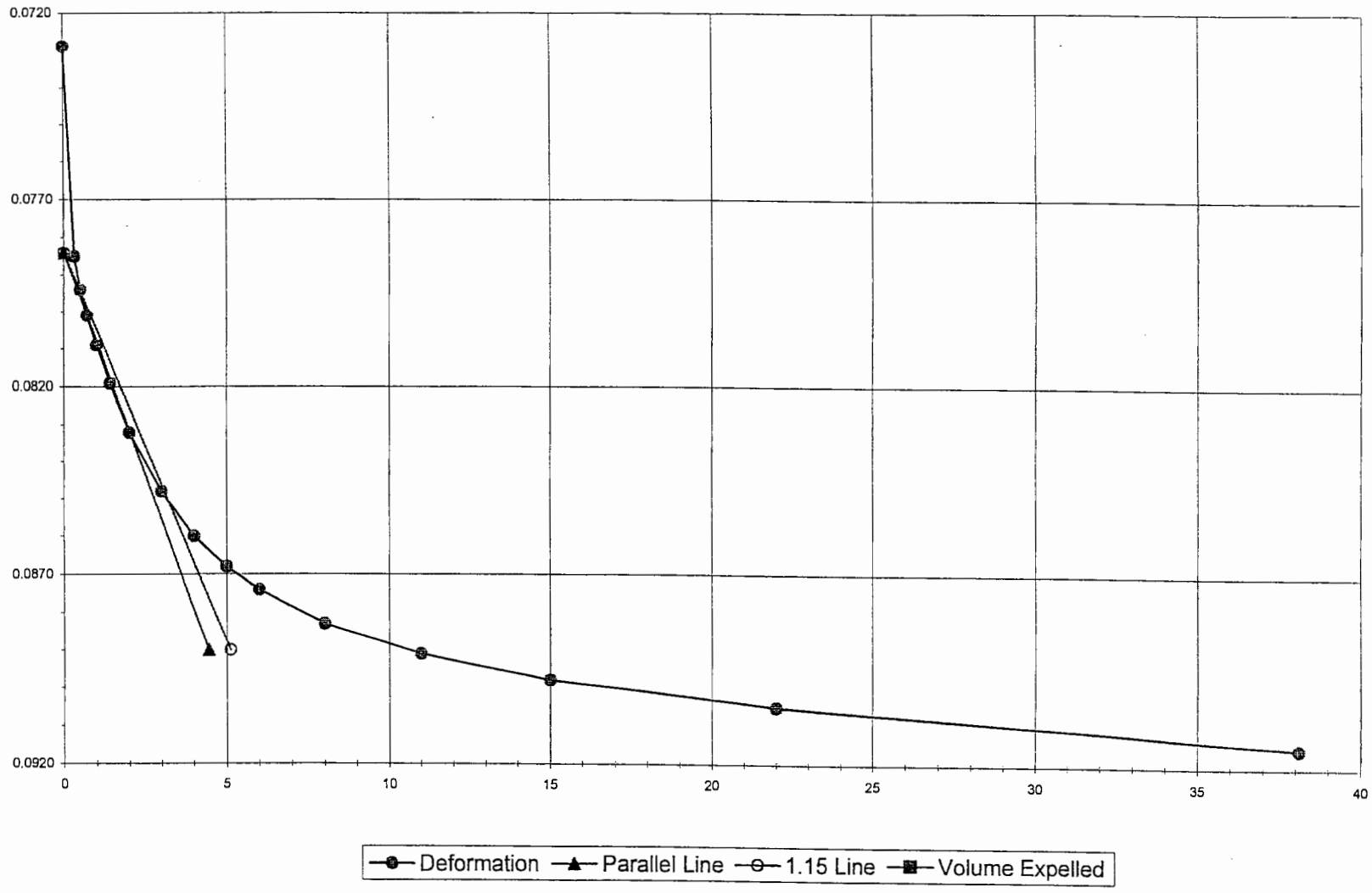
SQ ROOT TIME CURVES - 16 KSF

JOB S8550-06-01A, BORING P'2, P'2-12 rerun



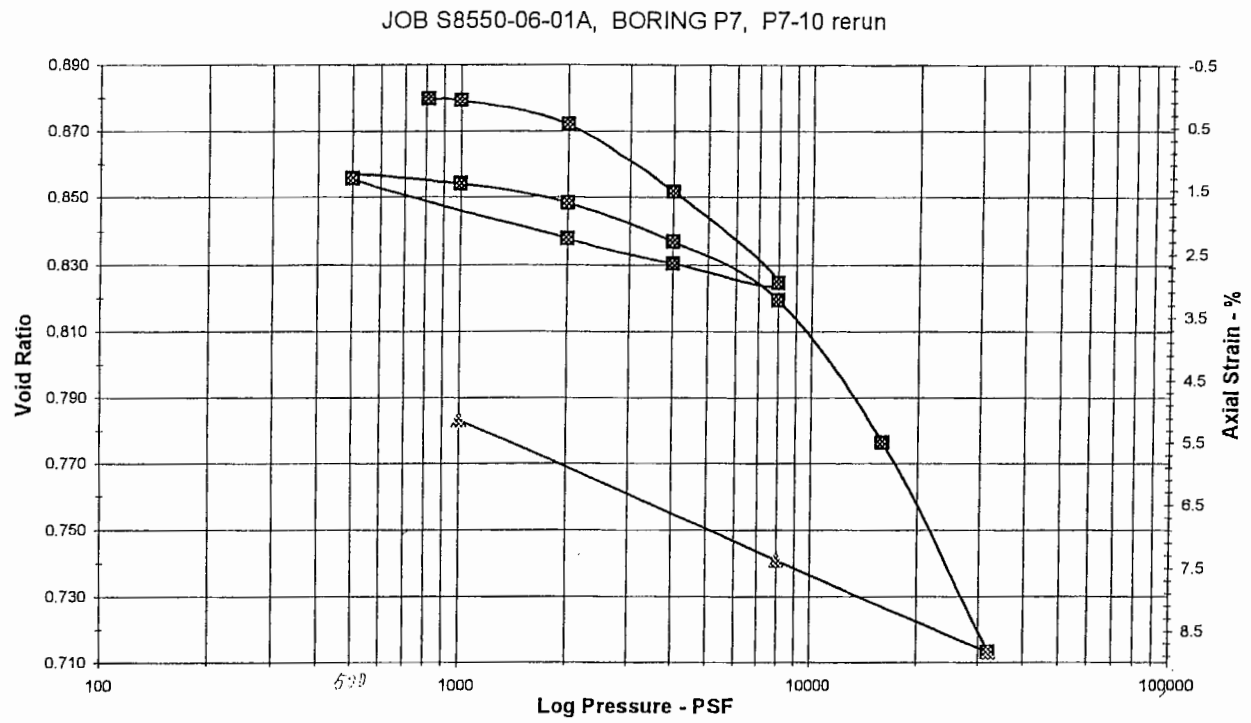
SQ ROOT TIME CURVES - 32 KSF

JOB S8550-06-01A, BORING P'2, P'2-12 rerun



CONSOLIDATION TEST

Project Name: High Street OSRP
Project Number: S8550-06-01A
Sample Number: P7-10 rerun



Axial Load (psf)	Void Ratio	Axial Strain (%)	m_v, coef of vol Compres (in^2/lb)	c_c, Comp Index	50% Consolidation t_{50}, Time to Consol (min)	50% Consolidation C_v, Coeff of Consol (ft^2/yr)	90% Consolidation t_{90}, Time to Consol (min)	90% Consolidation C_v, Coeff of Consol (ft^2/yr)
815	0.880	-0.03						
1000	0.879	0.00	0.0002	0.006	0.19	531.04	0.82	534.11
2000	0.872	0.39	0.0006	0.024	0.46	219.70	1.96	220.96
4000	0.852	1.47	0.0008	0.067	0.75	131.88	3.22	132.64
8000	0.825	2.91	0.0005	0.090	0.87	111.51	3.72	112.15
4000	0.830	2.60	0.0001	0.019				
2000	0.838	2.20	0.0003	0.025				
500	0.856	1.25	0.0009	0.030				
1000	0.854	1.33	0.0002	0.005				
2000	0.848	1.64	0.0004	0.019				
4000	0.837	2.25	0.0004	0.038				
8000	0.819	3.19	0.0003	0.058				
16000	0.776	5.47	0.0004	0.142	1.13	81.83	4.85	82.30
32000	0.713	8.84	0.0003	0.211	1.13	77.07	4.85	77.51
8000	0.741	7.36	0.0001	0.046				
1000	0.783	5.11	0.0005	0.047				

G_s = 2.88 (assumed)	COND AT START OF TEST	COND AT END OF TEST
HEIGHT (in.)	0.7500	0.7117
MOISTURE CONTENT (%)	26.4	24.4
DRY DENSITY (pcf):	95.7	100.8
SATURATION (%)	86.6	89.8
VOID RATIO	0.879	0.783

GEOCON
11375 Sunrise Park Drive, Suite 100
Rancho Cordova, CA 95742
tel. 916.852-9118 fax. 916.852.9132

Est. $G_s = 2.8$, $S e = G_s w$

$e_0 = \frac{(2.8)(.264)}{.84} = .854$

$.42 e_0 = (.42)(.879) = .369$

CONSOLIDATION TEST RESULTS

File No.	Job Name	Procedure	Date
S8550-06-01A	High Street OSRP	ASTM D2435-90	10/24/2003

Boring	Sample	Sample Description
P7	P7-10 rerun	Yellowish brown lean CLAY

Sample (ring) Ht, H_i	Sample Diameter:	Dia-Height Ratio (min 2.5)	Sample Area, A:
0.75 inches	2.5 inches	3.33	4.91 sq inches

Wt Ring + Moist Soil:	190.98 gms
Wt of Ring:	74.11 gms
Initial Wet Density:	121.0 pcf
Cal'd Init Dry Dens, D_d:	95.7 pcf
Cal'd Init Dry Wt, W_S:	92.5 gms
Initial Saturation:	86.6 %
Cal'd Ht of Solids:	0.3991 inches

Specific Gravity, G_S (assumed or tested): 2.88

INIT MOIST CONTENT SAMP	
Gross Wet Wt	214.89 gm
Gross Dry Wt	180.55 gm
Tare	50.48 gm
% Water, w	26.4 %

Interpreted Preconsolidation Pressure, P_P - from chart: psf

Interpreted Compression Index, C_C - from chart:

FINAL - ENTIRE SAMPLE	
Wet+Ring	189.5 gm
Tare (ring)	74.11 gm
Cal'd Dry Wt	92.8 gm
FINAL MOISTURE SAMP	
Wet+Pan	240.52 gm
Dry+Pan	217.89 gm
Tare (pan)	125.14 gm
Dry Soil	92.8 gm
% Wat, w	24.4 %
Final Ht	0.7117 inches
Dry Density	100.8 pcf
Saturation	89.8 %

Ht of Solids, $H_0 = Ws/(Gs-A)$

Ht of Voids, $H_V = H - H_0$

Void Ratio, $e = H_V/H_0$

Initial Void Ratio, e_0 = void ratio at start of test

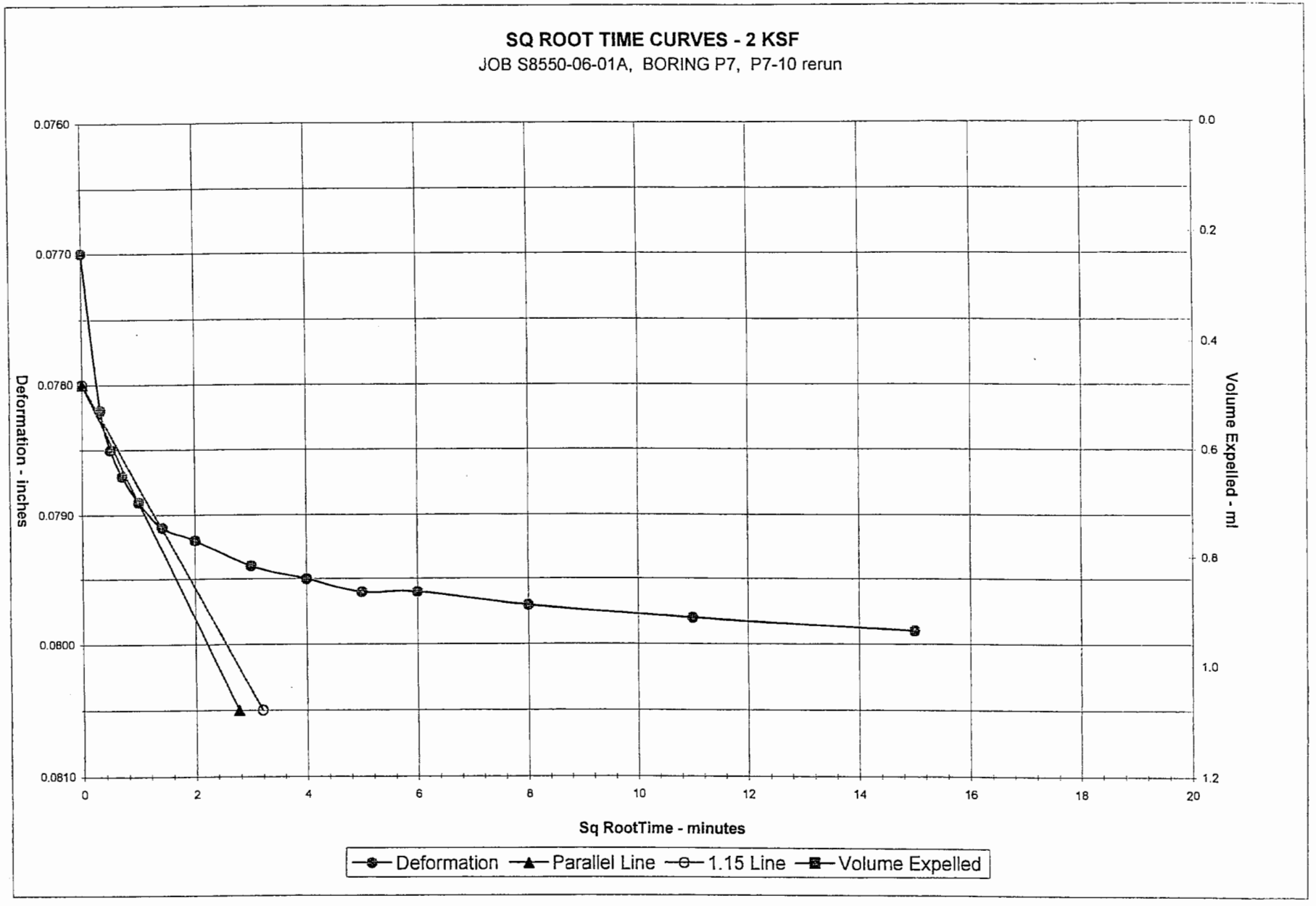
Dry Density, $D_d = (2.205)(1728)(W_S)/[(A)(H_i)(1000)]$

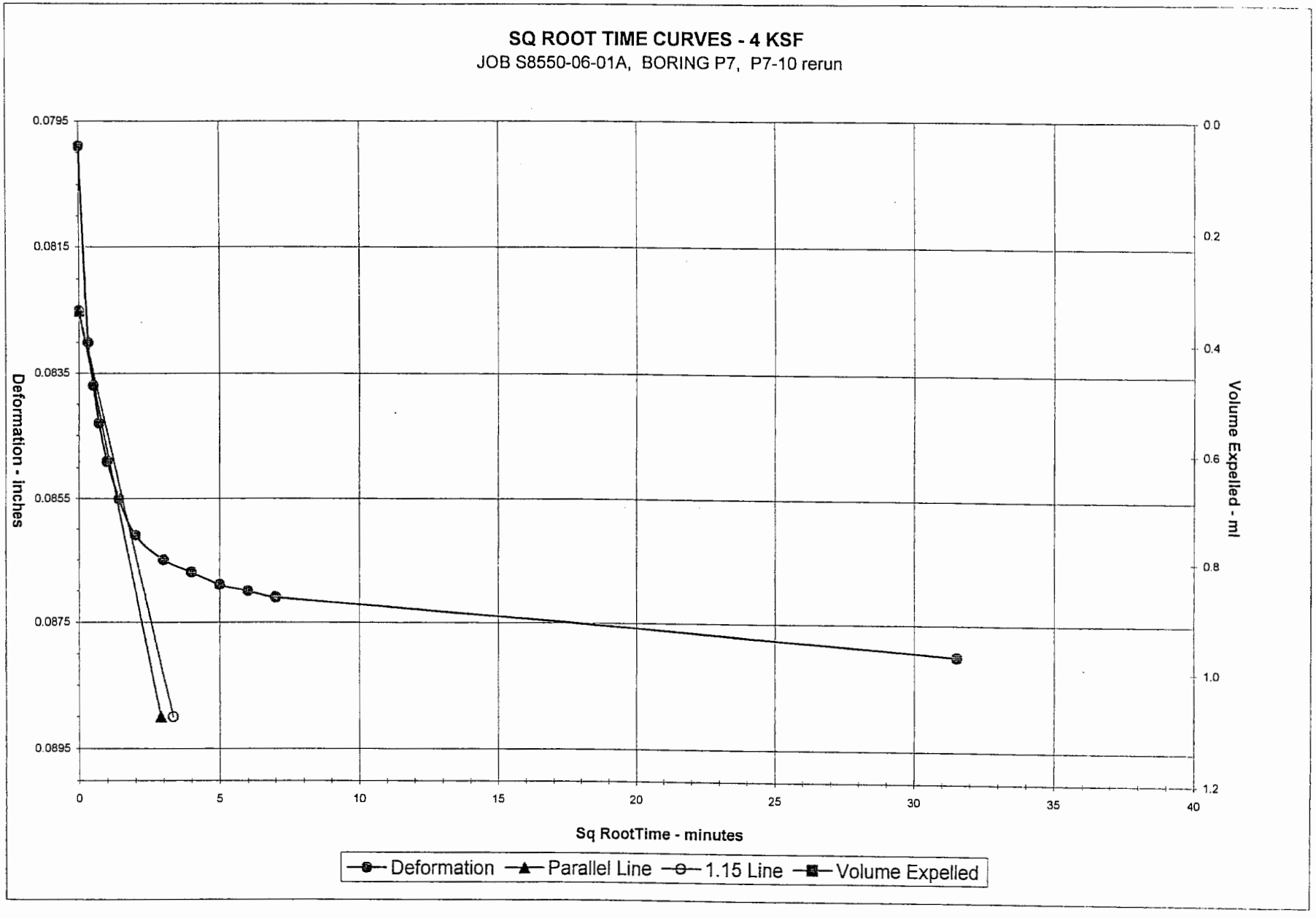
Saturation $= (w)(G_S)(D_d)/[(62.4)(G_S)-D_d]$

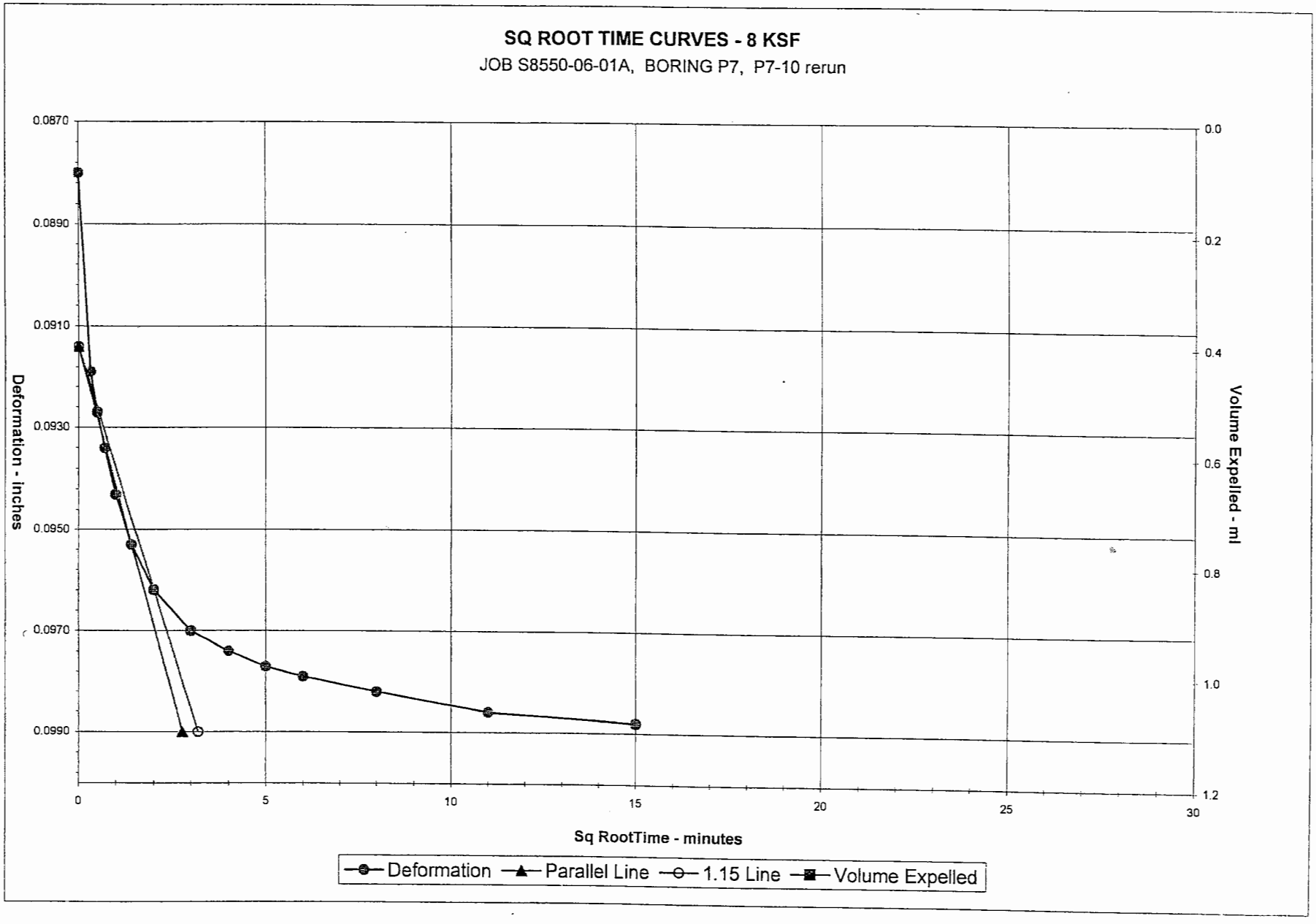
Coeff of Vol Compressibility, $m_V = a_V/(1+e_1) = (\text{del } e)/(\text{del } p)(1+e_1)$

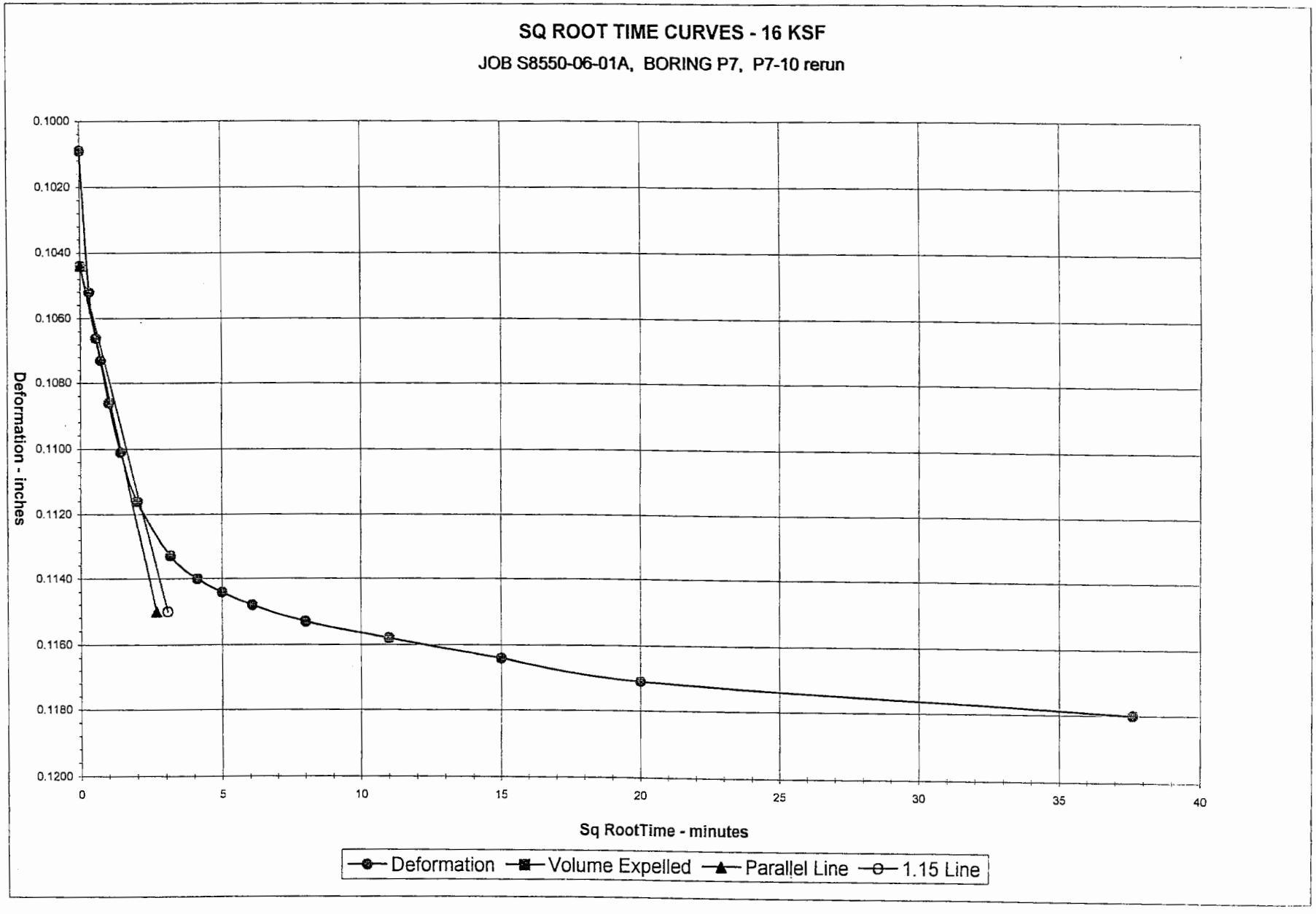
Compression Index, $C_C = -(e_2-e_1)/\log(P_2/P_1)$

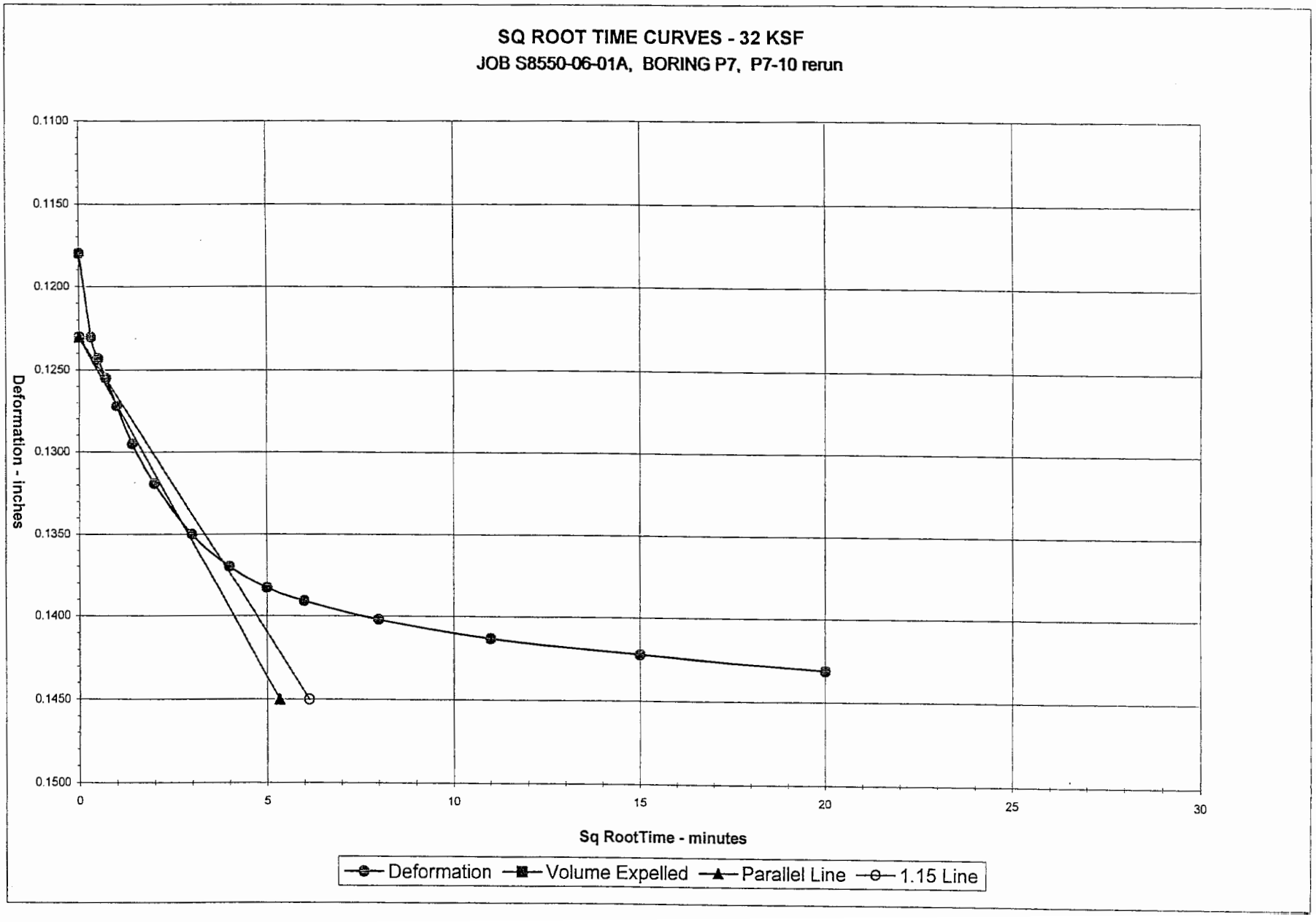
Coeff of Consolidation, $C_V = t_{50}(HN)^2/t_{50} = .197(H_2-H_1)/4(t_{50})$


SQ ROOT TIME CURVES - 2 KSF
JOB S8550-06-01A, BORING P7, P7-10 rerun
Deformation - inches
0.0760
0.0770
0.0780
0.0790
0.0800
0.0810
Volume Expelled - ml
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
2
4
6
8
10
12
14
16
18
20
Sq RootTime - minutes
Deformation
Parallel Line
1.15 Line
Volume Expelled


SQ ROOT TIME CURVES - 4 KSF
JOB S8550-06-01A, BORING P7, P7-10 rerun
Deformation - inches
0.0795
0.0815
0.0835
0.0855
0.0875
0.0895
Volume Expelled - ml
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
5
10
15
20
25
30
35
40
Sq RootTime - minutes
Deformation
Parallel Line
1.15 Line
Volume Expelled


SQ ROOT TIME CURVES - 8 KSF
JOB S8550-06-01A, BORING P7, P7-10 rerun
Deformation - inches
0.0870
0.0890
0.0910
0.0930
0.0950
0.0970
0.0990
Volume Expelled - ml
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
5
10
15
20
25
30
Sq RootTime - minutes
Deformation
Parallel Line
1.15 Line
Volume Expelled


SQ ROOT TIME CURVES - 16 KSF
JOB S8550-06-01A, BORING P7, P7-10 rerun
Deformation - inches
0.1000
0.1020
0.1040
0.1060
0.1080
0.1100
0.1120
0.1140
0.1160
0.1180
0.1200
0
5
10
15
20
25
30
35
40
Sq RootTime - minutes
Deformation
Volume Expelled
Parallel Line
1.15 Line


SQ ROOT TIME CURVES - 32 KSF
JOB S8550-06-01A, BORING P7, P7-10 rerun
Deformation - inches
0.1100
0.1150
0.1200
0.1250
0.1300
0.1350
0.1400
0.1450
0.1500
0
5
10
15
20
25
30
Sq RootTime - minutes
Deformation
Volume Expelled
Parallel Line
1.15 Line

APPENDIX C

(References)

References:

As Built Plans for Highway Construction in Oakland, California, Route 69, contract No. 0-14TC53, dated April 5, 1968.

As Built Plans for Highway Construction in Oakland, California, Contract No. 62-14T13C19, dated February 1961.

Bonilla, M.G., 1964, Bedrock Surface Map of San Francisco South Quadrangle, California: U.S. Geological Survey Map MF 334, 1:24,000.

Dickenson, Stephen E., 1994, Dynamic Response of Soft and Deep Cohesive Soils During the Loma Prieta Earthquake of October 17, 1989.

Goldman, H.B., 1969, Geology of San Francisco Bay, Geologic and Engineering Aspects of San Francisco Bay Fill, Special Report 97, San Francisco, California: Calilfornia Division of Mines and Geology, pp. 11-40.

Graymer, 2000, Geoleogic map and map database of the Oakland metropolitan area, Alameda, Contra Costa and San Francisco counties, California, USGS, Miscellaneous field studies, MF-2342.

Mualchin, L., July 1996, A Technical Report to Accompany the Caltrans California Seismic Hazard Map 1996 (Based on Maximum Credible Earthquakes), Caltrans.

Preliminary Geotechnical Design Report, High Street Viaduct Seismic Retrofit, prepared by Office of Geotechnical Design, dated November 6, 2003.

Rogers, J.D. and Figuers, S.H., 1991, Engineering Geologic Site Characterization of the Greater Oakland-Alameda Area, Alameda and San Francisco counties, California, Rogers/Pacific, Inc.

Site Investigation Report, High Street Overhead Seismic Retrofit Project, Interstate 880, Oakland, California, Caltrans Office of Environmental Engineering, Prepared by IT Corporation, dated June 29, 2001.

USDA, 1981, Soil Survey of Alameda County, California,West part.

Western Regional Climate Center, Web page www.wrcc@dri.edu.

APPENDIX D

(Backup Calculations)

STATE OF CALIFORNIA, DEPARTMENT OF TRANSPORTATION

QUANTITY CALCULATIONS

DC-CEM-4801 (OLD HC-52 REV. 11-92)

SHEET 1 OF 2

JOB STAMP: High street Seismic Retrofit	ITEM: Rw# 1 & 4	FILE NO
	LOCATION: Sta "S" 502+58 ±	SEGREGATION
	CALC. BY: WN	DATE
Bearing Capacity Calc Rw # 1 & Rw #4	CHK. BY	DATE 3/28/04

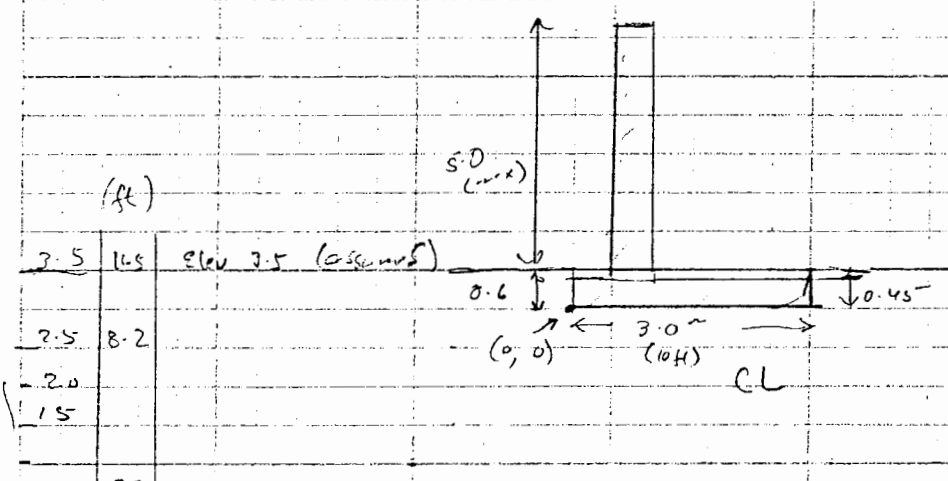
Type 1 wall

H = 5.0 m (max) Rw # 4

H = 2.5 m ± Rw # 1

Type 1 wall :

Design (H)	2.4	3.6	4.2	4.8	5.5
Footing width (W)	1.6	2.2	2.45	2.75	3.0
Toe Pressure (kpa)	105	135	160	170	190
(Toe Pressure (psf))	(2192)	(2819)	(3341)	(3550)	(3966)



Soft Black clay STP = 3
q_u = 1000 psf (max)
=> c = 500 psf

Stiff STP = 13.
q_u = 3.0 ksf
=> c = 1500 psf

CL

CL

CL

CL

STP = 10 ±

STP = 22 ±
q_u = 4.0 ~ 5.0 ksf
c = 2000 ~ 2500 psf

POSTED BY DATE POSTED TO

CEM-4801 (HC-52 REV. 11-92)

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

QUANTITY CALCULATIONS

DO-CEM-4601 (OLD HC-52 REV. 11-92)

SHEET 2 OF 2

JOB STAMP

ITEM: Ret wall # 1 & 4

FILE NO.

LOCATION

SEGREGATION: YES NO

CALC. BY

DATE

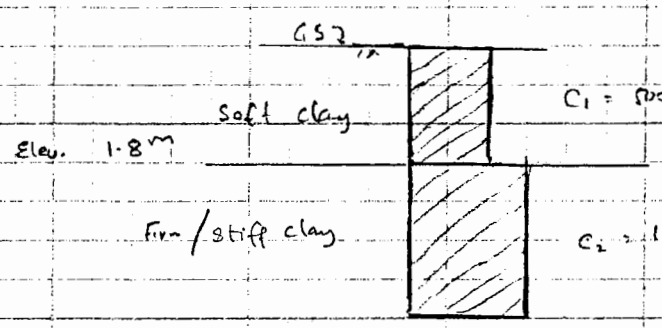
CHK. BY

DATE

(Bearing Capacity)

$$q_{ult} = cN_c + \gamma D$$

For two layered soil:



(2 layer soil)

DM 7.2-137

$C_2/C_1 = \frac{1500}{500} \approx 2.6$ (max) (failure tangent to 2nd layer)

$B = 10$ ft, $T = 5.0$ ft $\Rightarrow T/B = \frac{5.0}{10} = 0.50 \Rightarrow N_c = 5.53$ +

$\Rightarrow q_{ult} = 500 \times 5.53 + 120 \times 2$

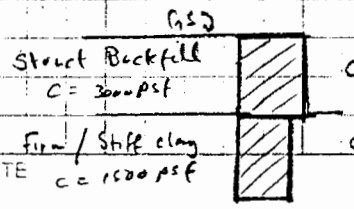
$= 3125$ psf

$q_{all} = \frac{3125}{3} = 1041$ psf << 3968 psf

No good

(need to remove soft soil!!)

Remove and Replace soft soil with Structural backfill 95% RC or AB 95% RC



$\frac{C_2}{C_1} = \frac{1300}{3000} =$

$T/B = 0.5$

$\Rightarrow N_c = 4.0$

POSTED BY DATE POSTED TO

$q_{all} = \frac{q_{ult}}{3} = \frac{4 \times 3000 + 120 \times 2}{3} = 4080 > 3968$ O.K

CEM-4601 (HC-52 REV. 11-92)

** REMOVE SOFT SOILS. LAYER !!! **

STATE OF CALIFORNIA, DEPARTMENT OF TRANSPORTATION

QUANTITY CALCULATIONS

DC-CEM-4601 (OLD HC-52 REV. 11/92) 7541-9503-0

SHEET ____ OF ____

JOB STAMP	ITEM	FILE NO
High St. Seismic Retrofit Bearing Capacity Calculation	RW # 2 Bearing Capacity	
	LOCATION depressed ramp E8 Line	SEGREGATION ☐ YES ☐ NO
	CALC. BY	DATE
RW # 2	CHK BY	DATE

Retaining wall # 2 H = 3.0 (max) cut wall.

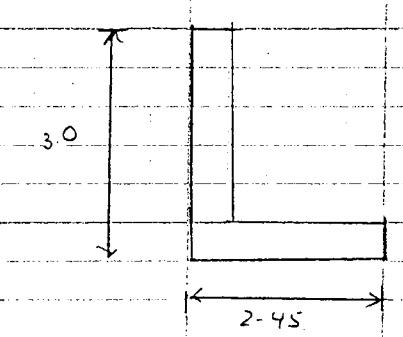
Depressed ramp E8 (Line) footing elev. 4m

Beg Sta. 42m Rt "S" 506+66

End Sta Rt "S" 508+66

Type 5 wall

H = 3.0 Toe Pressure = 145 kpa



Elev. 4

(CL) stiff c = C_{avg} = 2000 psf

SPT = 18-21

Elev. 0

CL/CH stiff

SPT = 11-15

q_{ult} = 5.14 x 2000 = 10280 psf

q_{all} = 10280/3 = 3426.6 psf or 164 kpa > 145 o.k.

POSTED BY DATE POSTED TO

STATE OF CALIFORNIA, DEPARTMENT OF TRANSPORTATION
QUANTITY CALCULATIONS
DC-CEM-801 (OLD HC-52 REV. 11) 32-7541-2330-C

JOB STAMP

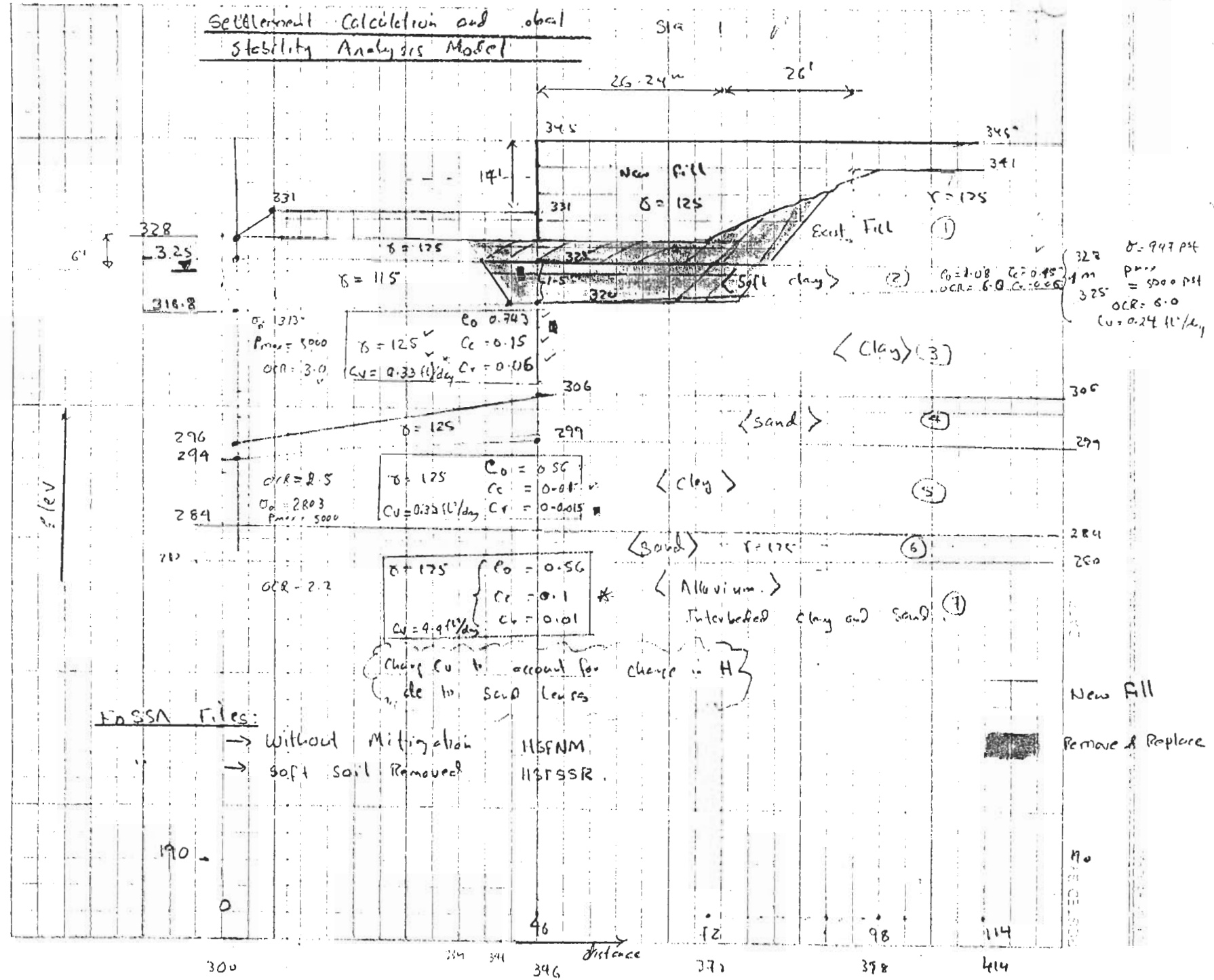
(High St. Seismic Retrofit)
EA 16S421

EA 16S421
Sta "S" 502+ 561
WN

4/1/04

SHEET 1 OF 1
FILE NO.
SEGREGATION ☐ YES ☐ NO

Settlement Calculation and Local Stability Analysis Model



EQSSA Files:
→ Without Mitigation 11SFNM
→ Soft Soil Removed 11STSSR.

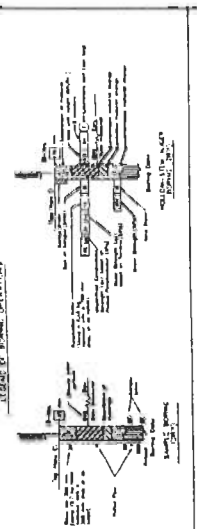
DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	ALA	880	43.6 – 45.5	3	10

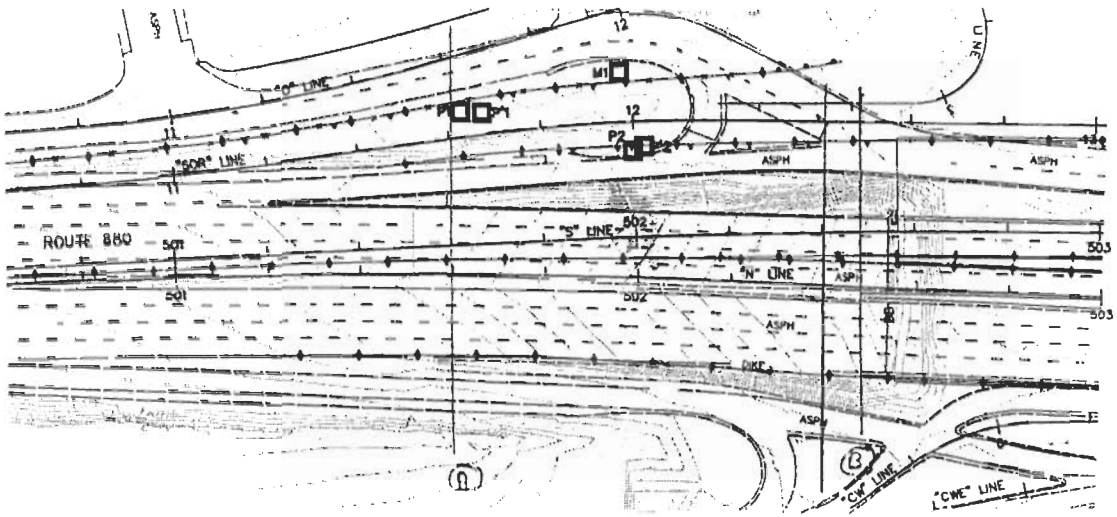
REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

GEOCON
CONSULTANTS, INCORPORATED
11325 SUNRISE PARK DRIVE, SUITE 110
RANCHO CORDOVA, CA. 95742-7202
PHONE 916 852-9118 – FAX 916 852-9132

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.

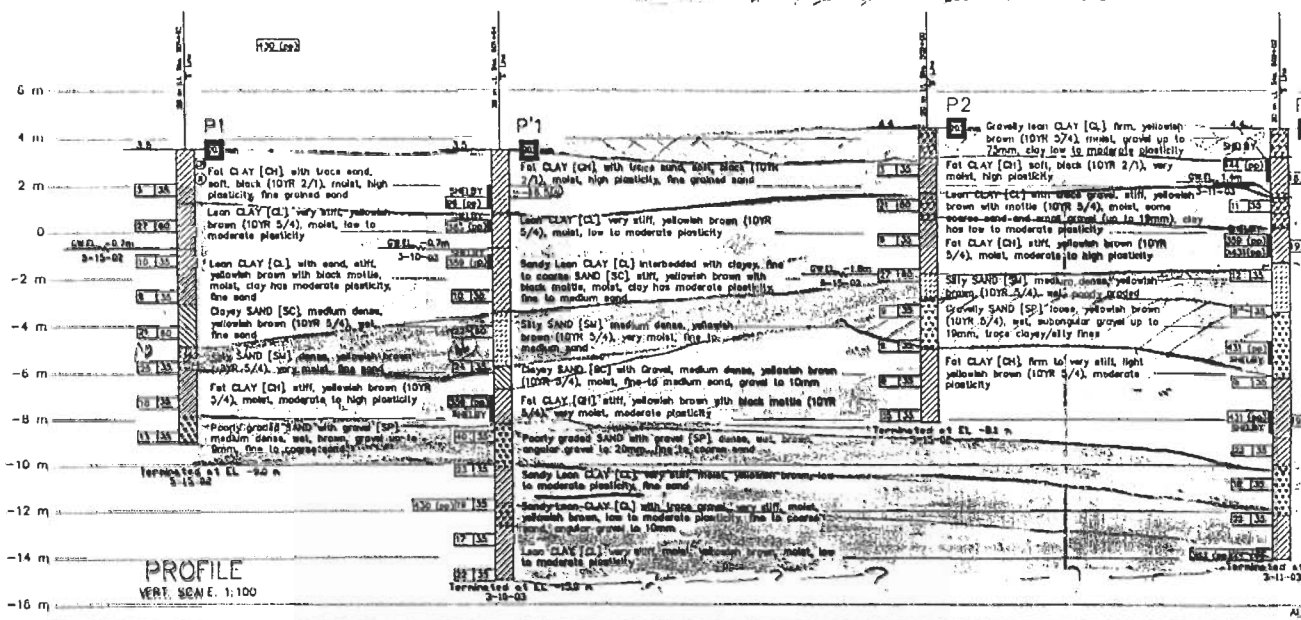




PLAN VIEW
SCALE : 1 : 500

NOTES:

1. 60 mm samples were taken using a modified California ring barrel sampler with an inside diameter of 60 mm and outside diameter of 75 mm.
2. Standard Penetration Tests (SPT) were performed by driving a 51 mm outside diameter, 33 mm inside diameter split-spoon SPT sampler.
3. The boring logs and related information represent the opinion of the professional engineer as to the character of the materials at the locations shown. Soil and groundwater conditions between adjacent test holes and at other locations may differ from those shown. Groundwater conditions may change with passage of time.
4. Test boring elevations are approximate and are based on portable GPS equipment readings and interpreted based on topographic base sheet mapping prepared for this project.
5. Test boring locations were determined in the field based on taping and pacing from mapped site features. The locations of the explorations should be considered accurate only to the degree implied by the measuring methods used.
6. A 64 kg automatic hammer falling 760 mm was used to drive the samplers.
7. Visual classification of earth materials was based on field inspection and was confirmed or revised with laboratory test results.



ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

CALTRANS DESIGN OVERSIGHT	DRAWN BY: A. M. LADRILLONO	FIELD INVESTIGATION BY: LEANNE ROBERTS MAY 2002	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	B. LEE, PROJECT ENGINEER
SIGN OFF DATE	CHECKED BY: J. J. ZORNE			CU 04247 EA 163421

BRIDGE NO. 33-0040 L/R 33-0040 R
KILOMETER POST 43.6 – 45.5

HIGH STREET SEISMIC RETROFIT PROJECT
LOG OF TEST BORINGS Pier #4 & 1

SHEET 3 OF 10

Pier #4, Pier #1 & Fill Embankment sta "S" LL ~502100
(Soil Profile)

I-880 Widening @ High Street

PROJECT IDENTIFICATION

Title: I-880 Widening @ High Street
Project Number: EA: 165421 -
Client: CT
Designer: WN
Station Number: Sta. ~ "S" 502−56

Description: Embankment Fill and Retaining Wall #1. Settlement Analysis Without Mit igation

Company's information:

Name: Caltrans - OGDW
Street:
Oakland, CA
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Program Files\ADAMA\FoSSA(1.0)\HSFNM.F2S
Original date and time of creating this file: Mon Apr 05 12:30:12 2004

GEOMETRY: Analysis of a 2D geometry

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License number FoSSA-FHWA-1000

INPUT DATA -- FOUNDATION LAYERS -- 8 layers

	Wet Unit Weight, γ [lb/ft³]	Poisson's Ratio μ	Description of Soil
1	125.00	0.30	
2	115.00	0.30	
3	125.00	0.30	
4	125.00	0.30	
5	125.00	0.30	
6	125.00	0.30	
7	125.00	0.30	
8	125.00	0.30	

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INPUT DATA -- EMBANKMENT LAYERS -- 1 layers

	Wet Unit Weight, γ [lb/ft³]	Description of Soil
1	125.00	

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INPUT DATA OF WATER

Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]
1	300.00	322.00
2	346.00	322.00
3	372.00	322.00
4	398.00	322.00
5	424.00	322.00

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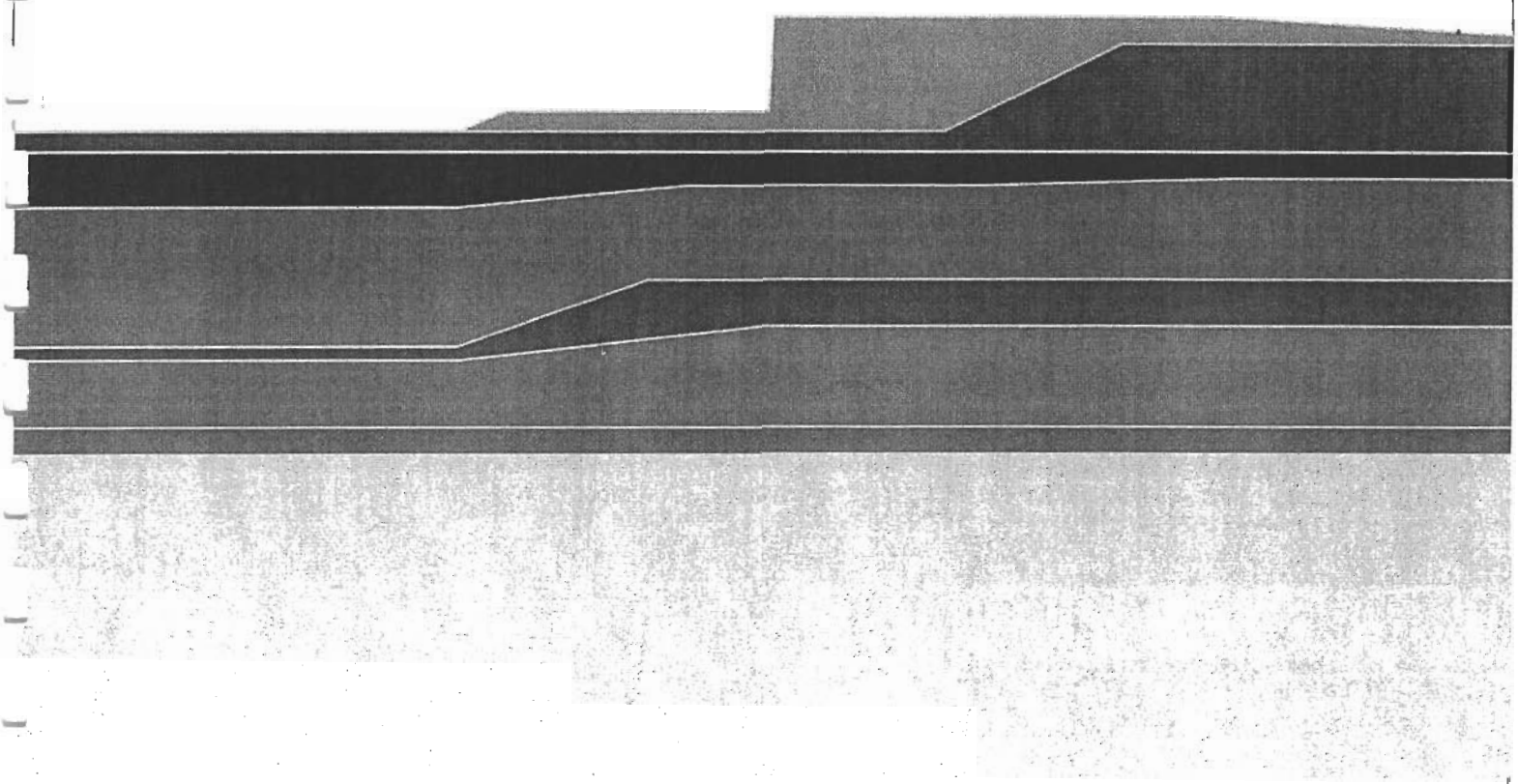
DRAWING OF SPECIFIED GEOMETRY



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INPUT DATA FOR CONSOLIDATION -- α 1/2

Layer #	Underging Consolidation [Yes/No]	OCR = Pc / Po	Cc	Cr	e0	Cv [ft ²/day]	Drains at :
1	No	N/A	N/A	N/A	N/A	N/A	N/A
2	Yes	6.00	0.44	0.06	1.08	0.6000	Top
3	Yes	3.00	0.15	0.06	0.74	0.3300	Bottom
4	No	N/A	N/A	N/A	N/A	N/A	N/A
5	Yes	2.50	0.10	0.05	0.56	0.3300	Top & Bot.
6	No	N/A	N/A	N/A	N/A	N/A	N/A
7	Yes	2.00	0.10	0.01	0.50	4.0000	Top & Bot.
8	No	N/A	N/A	N/A	N/A	N/A	N/A

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TABULTAED GEOMETRY INPUT OF FOUNDATION SOILS

Found. Soil #	Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]	DESCRIPTION
1	1	300.00	328.08	
	2	315.00	328.08	
	3	346.00	328.08	
	4	372.00	328.08	
	5	398.00	341.00	
	6	414.00	341.00	
2	1	289.29	325.00	
	2	300.00	325.00	
	3	334.00	325.00	
	4	341.00	325.00	
	5	372.00	325.00	
	6	378.00	325.00	
	7	414.00	325.00	
3	1	300.00	316.80	
	2	334.00	320.00	
	3	341.00	320.00	
	4	372.00	320.00	
	5	378.00	320.00	
	6	414.00	321.00	
4	1	300.00	296.00	
	2	328.08	306.00	
	3	346.00	306.00	
	4	372.00	306.00	
	5	414.00	306.00	
5	1	300.00	294.00	
	2	344.49	299.00	
	3	346.00	299.00	
	4	398.00	299.00	
	5	414.00	299.00	
6	1	300.00	284.00	
	2	328.08	284.00	
	3	346.00	284.00	
	4	372.00	284.00	
	5	414.00	284.00	
7	1	300.00	280.00	
	2	328.08	280.00	
	3	346.00	280.00	
	4	398.00	280.00	
	5	414.00	280.00	
8	1	300.00	190.00	
	2	346.00	190.00	
	3	372.00	190.00	
	4	398.00	190.00	
	5	414.00	190.00	

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TABULTAED GEOMETRY INPUT OF EMBANKMENT SOILS

Embank. Soil #	Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]	DESCRIPTION
1	1	346.00	331.00	
	2	346.50	345.00	
	3	398.00	345.00	
	4	414.00	345.00	
	5	3858.88	345.00	

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HISTORY OF SETTLEMENT ANALYSES

Case #	Location of 1D Section : (X) [ft.]	(Y) [ft.]	Ultimate Settlement, Sc [ft.]	Aftre... [days]	Actual Settlement, [ft.]	U-ave (min.for all consol.layers) [%]	USER'S DESCRIPTION
1	366.00	0.00	0.656	400.0	0.0	0.0	
2	346.00	0.00	0.491	400.0	0.0	0.0	
3	356.00	0.00	0.639	400.0	0.0	0.0	
4	---	---	---	---	---	---	
5	---	---	---	---	---	---	
6	---	---	---	---	---	---	
7	---	---	---	---	---	---	
8	---	---	---	---	---	---	
9	---	---	---	---	---	---	
10	---	---	---	---	---	---	
11	---	---	---	---	---	---	
12	---	---	---	---	---	---	
13	---	---	---	---	---	---	
14	---	---	---	---	---	---	
15	---	---	---	---	---	---	

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HISTORY OF STAGED CONSTRUCTION

Case #	Location of 1D Section : (X) [ft.]	(Y) [ft.]	Ultimate Settlement, Sc [ft.]	Aftre... [days]	Actual Settlement, [ft.]	U-ave (min.for all consol.layers) [%]	USER'S DESCRIPTION
1	---	---	---	---	---	---	
2	---	---	---	---	---	---	
3	---	---	---	---	---	---	
4	---	---	---	---	---	---	
5	---	---	---	---	---	---	
6	---	---	---	---	---	---	
7	---	---	---	---	---	---	
8	---	---	---	---	---	---	
9	---	---	---	---	---	---	
10	---	---	---	---	---	---	
11	---	---	---	---	---	---	
12	---	---	---	---	---	---	
13	---	---	---	---	---	---	
14	---	---	---	---	---	---	
15	---	---	---	---	---	---	

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I-880 Widening @ High Street

PROJECT IDENTIFICATION

Title: I-880 Widening @ High Street
Project Number: EA 165421 -
Client: CT
Designer: WN
Station Number: Sta "S" 502+56

Description: Embankment Fill and Retanining Wall #4 Settlement Analysis before Remo val of Soft Soil to Elev. 1.8 m

Company's information:

Name: Caltrans - OGDW
Street:
Oakland, CA
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Program Files\ADAMA\FoSSA(1.0)\HSFSSR1-4.F2S
Original date and time of creating this file: Mon Apr 05 13:04:40 2004

GEOMETRY: Analysis of a 2D geometry

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INPUT DATA -- FOUNDATION LAYERS -- 8 layers

	Wet Unit Weight, γ [lb/ft^3]	Poisson's Ratio μ	Description of Soil
1	125.00	0.30	
2	115.00	0.30	
3	125.00	0.30	
4	125.00	0.30	
5	125.00	0.30	
6	125.00	0.30	
7	125.00	0.30	
8	125.00	0.30	

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INPUT DATA -- EMBANKMENT LAYERS -- 1 layers

	Wet Unit Weight, γ [lb/ft³]	Description of Soil
1	125.00	

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INPUT DATA OF WATER

Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]
1	300.00	315.00
2	346.00	315.00
3	372.00	315.00
4	398.00	315.00
5	424.00	315.00

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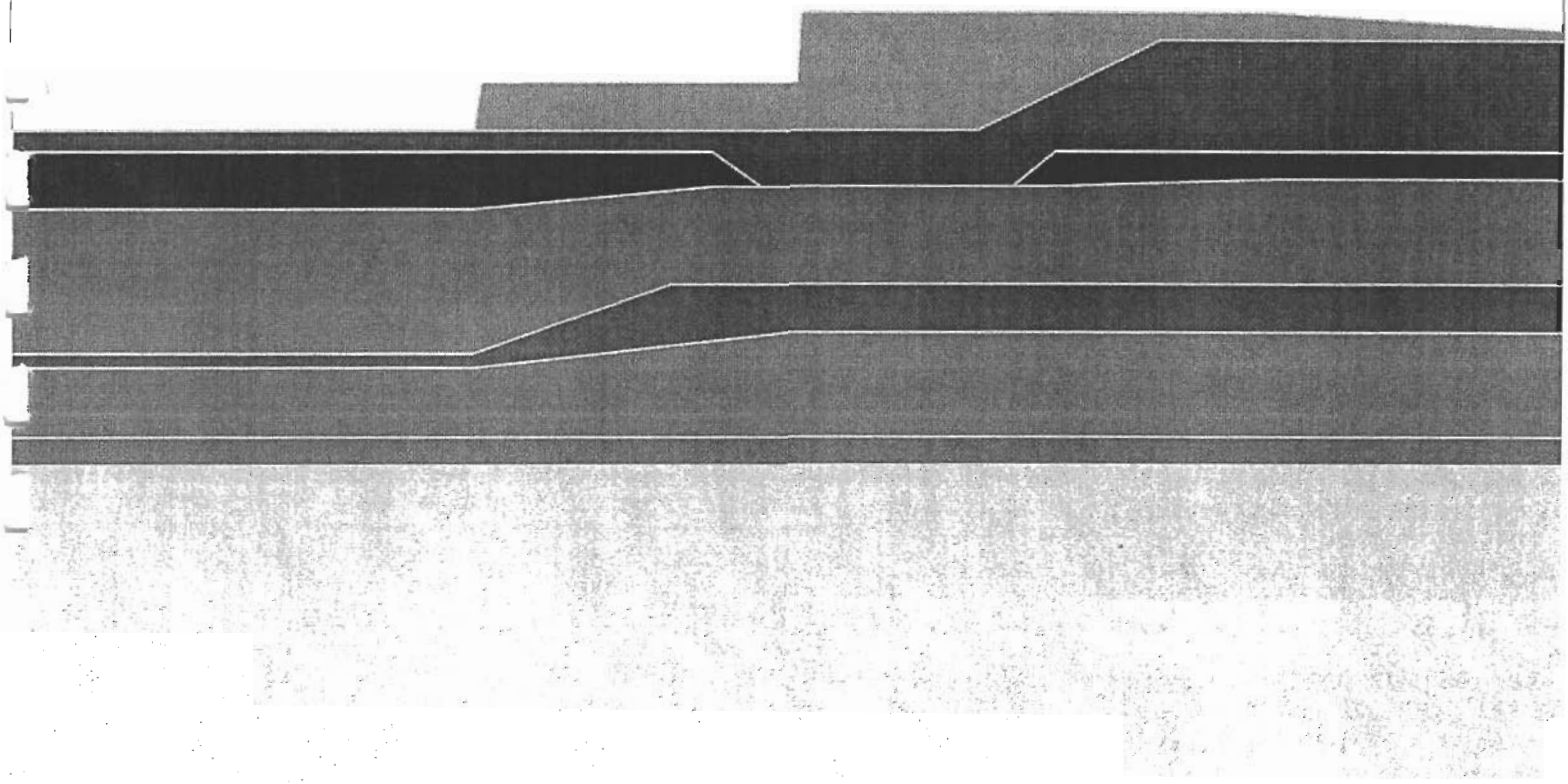
DRAWING OF SPECIFIED GEOMETRY



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INPUT DATA FOR CONSOLIDATION -- α 1/2

Layer #	Underging Consolidation [Yes/No]	OCR = Pc / Po	Cc	Cr	e0	Cv [ft ²/day]	Drains at :
1	No	N/A	N/A	N/A	N/A	N/A	N/A
2	Yes	6.00	0.44	0.06	1.08	0.2400	Bottom
3	Yes	3.00	0.15	0.06	0.74	0.3300	Bottom
4	No	N/A	N/A	N/A	N/A	N/A	N/A
5	Yes	2.50	0.10	0.05	0.56	0.3300	Top & Bot.
6	No	N/A	N/A	N/A	N/A	N/A	N/A
7	Yes	2.00	0.10	0.01	0.50	4.0000	Top & Bot.
8	No	N/A	N/A	N/A	N/A	N/A	N/A

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TABULTAED GEOMETRY INPUT OF FOUNDATION SOILS

Found. Soil #	Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]	DESCRIPTION
1	1	300.00	328.08	
	2	315.00	328.08	
	3	346.00	328.08	
	4	372.00	328.08	
	5	398.00	341.00	
	6	414.00	341.00	
2	1	289.29	325.00	
	2	300.00	325.00	
	3	334.00	325.00	
	4	341.00	320.00	
	5	377.00	320.00	
	6	383.00	325.00	
	7	414.00	325.00	
3	1	300.00	316.80	
	2	334.00	320.00	
	3	341.00	320.00	
	4	377.00	320.00	
	5	383.00	320.00	
	6	414.00	321.00	
4	1	300.00	296.00	
	2	328.08	306.00	
	3	346.00	306.00	
	4	372.00	306.00	
	5	414.00	306.00	
5	1	300.00	294.00	
	2	344.49	299.00	
	3	346.00	299.00	
	4	398.00	299.00	
	5	414.00	299.00	
6	1	300.00	284.00	
	2	328.08	284.00	
	3	346.00	284.00	
	4	372.00	284.00	
	5	414.00	284.00	
7	1	300.00	280.00	
	2	328.08	280.00	
	3	346.00	280.00	
	4	398.00	280.00	
	5	414.00	280.00	
8	1	300.00	190.00	
	2	346.00	190.00	
	3	372.00	190.00	
	4	398.00	190.00	
	5	414.00	190.00	

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TABULTAED GEOMETRY INPUT OF EMBANKMENT SOILS

Embank. Soil #	Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]	DESCRIPTION
1	1	346.00	335.00	
	2	346.50	345.00	
	3	398.00	345.00	
	4	414.00	345.00	
	5	3858.88	345.00	

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HISTORY OF SETTLEMENT ANALYSES

Case #	Location of 1D Section : (X) [ft.]	(Y) [ft.]	Ultimate Settlement, Sc [ft.]	Aftre... [days]	Actual Settlement, [ft.]	U-ave (min.for all consol.layers) [%]	USER'S DESCRIPTION
1	310.00	0.00	0.212	0.0	0.0	0.0	
2	305.00	0.00	0.190	0.0	0.0	0.0	
3	313.00	0.00	0.218	0.0	0.0	0.0	
4	---	---	---	---	---	---	
5	---	---	---	---	---	---	
6	---	---	---	---	---	---	
7	---	---	---	---	---	---	
8	---	---	---	---	---	---	
9	---	---	---	---	---	---	
10	---	---	---	---	---	---	
11	---	---	---	---	---	---	
12	---	---	---	---	---	---	
13	---	---	---	---	---	---	
14	---	---	---	---	---	---	
15	---	---	---	---	---	---	

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HISTORY OF STAGED CONSTRUCTION

Case #	Location of 1D Section : (X) [ft.]	(Y) [ft.]	Ultimate Settlement, Sc [ft.]	Aftre... [days]	Actual Settlement, [ft.]	U-ave (min.for all consol.layers) [%]	USER'S DESCRIPTION
1	---	---	---	---	---	---	
2	---	---	---	---	---	---	
3	---	---	---	---	---	---	
4	---	---	---	---	---	---	
5	---	---	---	---	---	---	
6	---	---	---	---	---	---	
7	---	---	---	---	---	---	
8	---	---	---	---	---	---	
9	---	---	---	---	---	---	
10	---	---	---	---	---	---	
11	---	---	---	---	---	---	
12	---	---	---	---	---	---	
13	---	---	---	---	---	---	
14	---	---	---	---	---	---	
15	---	---	---	---	---	---	

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I-880 Widening @ High Street

PROJECT IDENTIFICATION

Title:	I-880 Widening @ High Street
Project Number:	EA 165421 -
Client:	CT
Designer:	WN
Station Number:	Sta "S" 502+56
Description:	Embankment Fill and Retanining Wall #1 Settlement Analysis After Removal of Soft Soil to Elev. 1.8 m

Company's information:

Name:	Caltrans - OGDW
Street:	
	Oakland, CA
Telephone #:	
Fax #:	
E-Mail:	

Original file path and name: C:\Program Files\ADAMA\FoSSA(1.0)\HSFSSR1-4r.F2S
Original date and time of creating this file: Mon Apr 05 13:04:40 2004

GEOMETRY: Analysis of a 2D geometry

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INPUT DATA -- FOUNDATION LAYERS -- 8 layers

	Wet Unit Weight, γ [lb/ft³]	Poisson's Ratio μ	Description of Soil
1	125.00	0.30	
2	115.00	0.30	
3	125.00	0.30	
4	125.00	0.30	
5	125.00	0.30	
6	125.00	0.30	
7	125.00	0.30	
8	125.00	0.30	

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INPUT DATA -- EMBANKMENT LAYERS -- 1 layers

	Wet Unit Weight, γ [lb/ft³]	Description of Soil
1	125.00	

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INPUT DATA OF WATER

Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]
1	300.00	315.00
2	346.00	315.00
3	372.00	315.00
4	398.00	315.00
5	424.00	315.00

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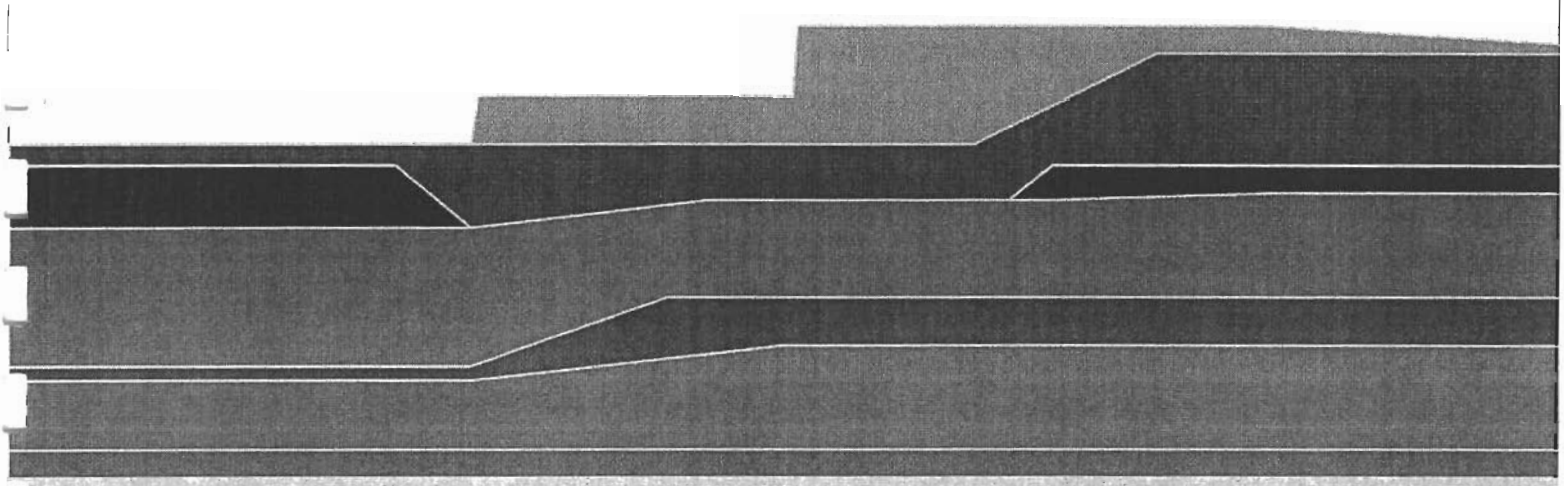
DRAWING OF SPECIFIED GEOMETRY



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INPUT DATA FOR CONSOLIDATION -- α 1/2

Layer #	Underging Consolidation [Yes/No]	OCR = Pc / Po	Cc	Cr	e0	Cv [ft ²/day]	Drains at :
1	No	N/A	N/A	N/A	N/A	N/A	N/A
2	Yes	6.00	0.44	0.06	1.08	0.2400	Bottom
3	Yes	3.00	0.15	0.06	0.74	0.3300	Bottom
4	No	N/A	N/A	N/A	N/A	N/A	N/A
5	Yes	2.50	0.10	0.05	0.56	0.3300	Top & Bot.
6	No	N/A	N/A	N/A	N/A	N/A	N/A
7	Yes	2.00	0.10	0.01	0.50	4.0000	Top & Bot.
8	No	N/A	N/A	N/A	N/A	N/A	N/A

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TABULTAED GEOMETRY INPUT OF FOUNDATION SOILS

Found. Soil #	Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]	DESCRIPTION
1	1	300.00	328.08	
	2	315.00	328.08	
	3	346.00	328.08	
	4	372.00	328.08	
	5	398.00	341.00	
	6	414.00	341.00	
2	1	289.29	325.00	
	2	300.00	316.00	
	3	334.00	320.00	
	4	341.00	320.00	
	5	377.00	320.00	
	6	383.00	325.00	
	7	414.00	325.00	
3	1	300.00	316.00	
	2	334.00	320.00	
	3	341.00	320.00	
	4	377.00	320.00	
	5	383.00	320.00	
	6	414.00	321.00	
4	1	300.00	296.00	
	2	328.08	306.00	
	3	346.00	306.00	
	4	372.00	306.00	
	5	414.00	306.00	
5	1	300.00	294.00	
	2	344.49	299.00	
	3	346.00	299.00	
	4	398.00	299.00	
	5	414.00	299.00	
6	1	300.00	284.00	
	2	328.08	284.00	
	3	346.00	284.00	
	4	372.00	284.00	
	5	414.00	284.00	
7	1	300.00	280.00	
	2	328.08	280.00	
	3	346.00	280.00	
	4	398.00	280.00	
	5	414.00	280.00	
8	1	300.00	190.00	
	2	346.00	190.00	
	3	372.00	190.00	
	4	398.00	190.00	
	5	414.00	190.00	

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TABULTAED GEOMETRY INPUT OF EMBANKMENT SOILS

Embank. Soil #	Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]	DESCRIPTION
1	1	346.00	335.00	
	2	346.50	345.00	
	3	398.00	345.00	
	4	414.00	345.00	
	5	3858.88	345.00	

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HISTORY OF SETTLEMENT ANALYSES

Case #	Location of 1D Section : (X) [ft.]	(Y) [ft.]	Ultimate Settlement, Sc [ft.]	Aftre... [days]	Actual Settlement, [ft.]	U-ave (min.for all consol.layers) [%]	USER'S DESCRIPTION
1	313.00	0.00	0.145	450.0	0.0	0.0	
2	310.00	0.00	0.136	450.0	0.0	0.0	
3	---	---	---	---	---	---	
4	---	---	---	---	---	---	
5	---	---	---	---	---	---	
6	---	---	---	---	---	---	
7	---	---	---	---	---	---	
8	---	---	---	---	---	---	
9	---	---	---	---	---	---	
10	---	---	---	---	---	---	
11	---	---	---	---	---	---	
12	---	---	---	---	---	---	
13	---	---	---	---	---	---	
14	---	---	---	---	---	---	
15	---	---	---	---	---	---	

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HISTORY OF STAGED CONSTRUCTION

Case #	Location of 1D Section : (X) [ft.]	(Y) [ft.]	Ultimate Settlement, Sc [ft.]	Aftre... [days]	Actual Settlement, [ft.]	U-ave (min.for all consol.layers) [%]	USER'S DESCRIPTION
1	---	---	---	---	---	---	
2	---	---	---	---	---	---	
3	---	---	---	---	---	---	
4	---	---	---	---	---	---	
5	---	---	---	---	---	---	
6	---	---	---	---	---	---	
7	---	---	---	---	---	---	
8	---	---	---	---	---	---	
9	---	---	---	---	---	---	
10	---	---	---	---	---	---	
11	---	---	---	---	---	---	
12	---	---	---	---	---	---	
13	---	---	---	---	---	---	
14	---	---	---	---	---	---	
15	---	---	---	---	---	---	

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I-880 Widening @ High Street

PROJECT IDENTIFICATION

Title: I-880 Widening @ High Street
Project Number: EA 165421 -
Client: CT
Designer: WN
Station Number: Sta "S" 502+56

Description: Embankment Fill and Retanining Wall #~~1~~4 Settlement Analysis After Removal of Soft Soil to Elev. 1.8 m

Company's information:

Name: Caltrans - OGDW
Street:
Oakland, CA
Telephone #:
Fax #:
E-Mail:

Original file path and name: C:\Program Files\ADAMA\FoSSA(1.0)\HSFSSR1-4r.F2S
Original date and time of creating this file: Mon Apr 05 13:04:40 2004

GEOMETRY: Analysis of a 2D geometry

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INPUT DATA -- FOUNDATION LAYERS -- 8 layers

	Wet Unit Weight, γ [lb/ft^3]	Poisson's Ratio μ	Description of Soil
1	125.00	0.30	
2	115.00	0.30	
3	125.00	0.30	
4	125.00	0.30	
5	125.00	0.30	
6	125.00	0.30	
7	125.00	0.30	
8	125.00	0.30	

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INPUT DATA -- EMBANKMENT LAYERS -- 1 layers

	Wet Unit Weight, γ [lb/ft³]	Description of Soil
1	125.00	

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INPUT DATA OF WATER

Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]
1	300.00	315.00
2	346.00	315.00
3	372.00	315.00
4	398.00	315.00
5	424.00	315.00

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INPUT DATA FOR CONSOLIDATION -- α 1/2

Layer #	Underging Consolidation [Yes/No]	OCR = Pc / Po	Cc	Cr	e0	Cv [ft ²/day]	Drains at :
1	No	N/A	N/A	N/A	N/A	N/A	N/A
2	Yes	6.00	0.44	0.06	1.08	0.2400	Bottom
3	Yes	3.00	0.15	0.06	0.74	0.3300	Bottom
4	No	N/A	N/A	N/A	N/A	N/A	N/A
5	Yes	2.50	0.10	0.05	0.56	0.3300	Top & Bot.
6	No	N/A	N/A	N/A	N/A	N/A	N/A
7	Yes	2.00	0.10	0.01	0.50	4.0000	Top & Bot.
8	No	N/A	N/A	N/A	N/A	N/A	N/A

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TABULTAED GEOMETRY INPUT OF FOUNDATION SOILS

Found. Soil #	Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]	DESCRIPTION
1	1	300.00	328.08	
	2	315.00	328.08	
	3	346.00	328.08	
	4	372.00	328.08	
	5	398.00	341.00	
	6	414.00	341.00	
2	1	289.29	325.00	
	2	300.00	316.00	
	3	334.00	320.00	
	4	341.00	320.00	
	5	377.00	320.00	
	6	383.00	325.00	
	7	414.00	325.00	
3	1	300.00	316.00	
	2	334.00	320.00	
	3	341.00	320.00	
	4	377.00	320.00	
	5	383.00	320.00	
	6	414.00	321.00	
4	1	300.00	296.00	
	2	328.08	306.00	
	3	346.00	306.00	
	4	372.00	306.00	
	5	414.00	306.00	
5	1	300.00	294.00	
	2	344.49	299.00	
	3	346.00	299.00	
	4	398.00	299.00	
	5	414.00	299.00	
6	1	300.00	284.00	
	2	328.08	284.00	
	3	346.00	284.00	
	4	372.00	284.00	
	5	414.00	284.00	
7	1	300.00	280.00	
	2	328.08	280.00	
	3	346.00	280.00	
	4	398.00	280.00	
	5	414.00	280.00	
8	1	300.00	190.00	
	2	346.00	190.00	
	3	372.00	190.00	
	4	398.00	190.00	
	5	414.00	190.00	

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TABULTAED GEOMETRY INPUT OF EMBANKMENT SOILS

Embank. Soil #	Point #	Coordinates (X, Z) : (X) [ft.]	(Z) [ft.]	DESCRIPTION
1	1	346.00	335.00	
	2	346.50	345.00	
	3	398.00	345.00	
	4	414.00	345.00	
	5	3858.88	345.00	

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HISTORY OF SETTLEMENT ANALYSES

Case #	Location of 1D Section : (X) [ft.]	(Y) [ft.]	Ultimate Settlement, Sc [ft.]	Aftre... [days]	Actual Settlement, [ft.]	U-ave (min.for all consol.layers) [%]	USER'S DESCRIPTION
1	313.00	0.00	0.145	450.0	0.0	0.0	
2	310.00	0.00	0.136	450.0	0.0	0.0	
3	---	---	---	---	---	---	
4	---	---	---	---	---	---	
5	---	---	---	---	---	---	
6	---	---	---	---	---	---	
7	---	---	---	---	---	---	
8	---	---	---	---	---	---	
9	---	---	---	---	---	---	
10	---	---	---	---	---	---	
11	---	---	---	---	---	---	
12	---	---	---	---	---	---	
13	---	---	---	---	---	---	
14	---	---	---	---	---	---	
15	---	---	---	---	---	---	

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HISTORY OF STAGED CONSTRUCTION

Case #	Location of 1D Section : (X) [ft.]	(Y) [ft.]	Ultimate Settlement, Sc [ft.]	Aftre... [days]	Actual Settlement, [ft.]	U-ave (min.for all consol.layers) [%]	USER'S DESCRIPTION
1	---	---	---	---	---	---	
2	---	---	---	---	---	---	
3	---	---	---	---	---	---	
4	---	---	---	---	---	---	
5	---	---	---	---	---	---	
6	---	---	---	---	---	---	
7	---	---	---	---	---	---	
8	---	---	---	---	---	---	
9	---	---	---	---	---	---	
10	---	---	---	---	---	---	
11	---	---	---	---	---	---	
12	---	---	---	---	---	---	
13	---	---	---	---	---	---	
14	---	---	---	---	---	---	
15	---	---	---	---	---	---	

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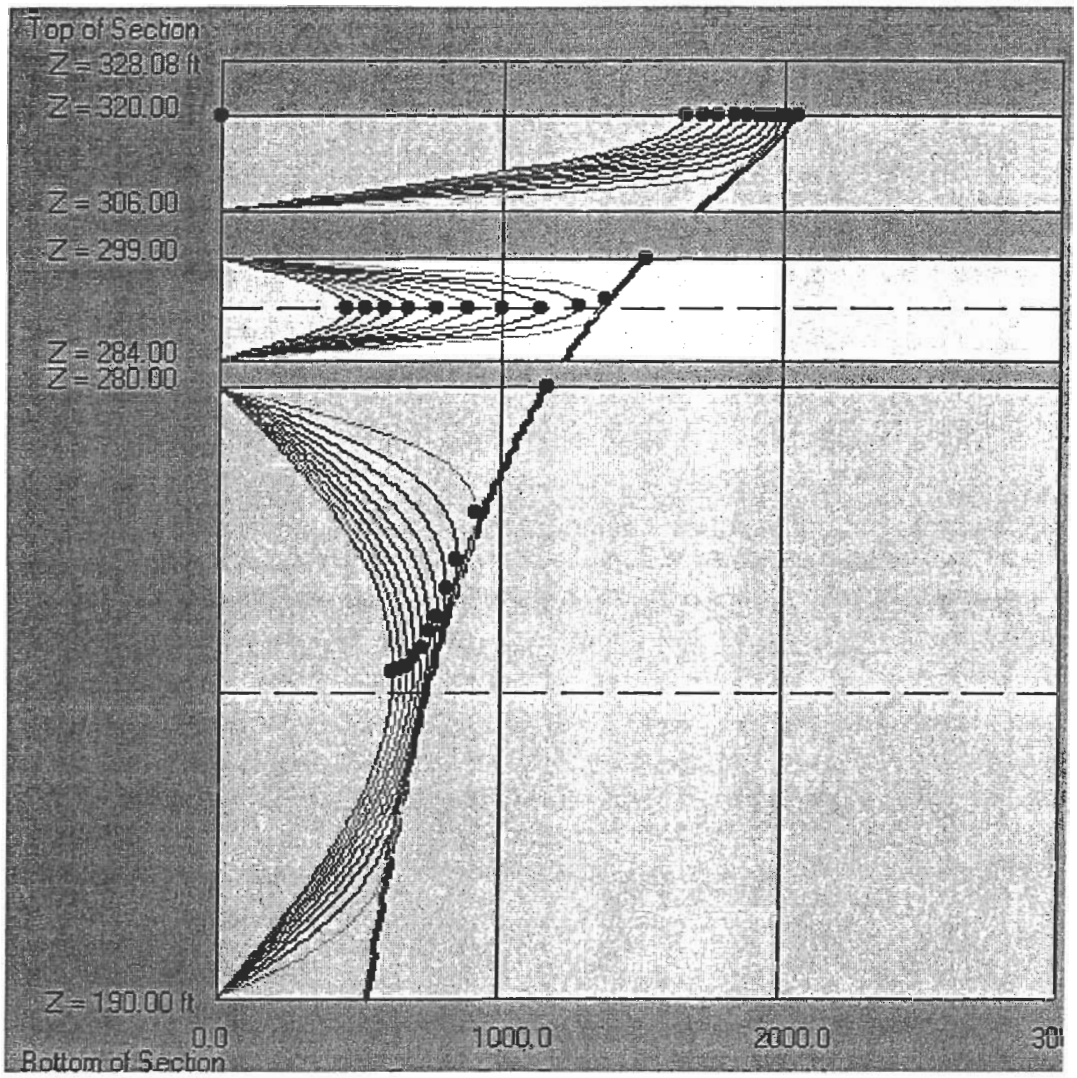
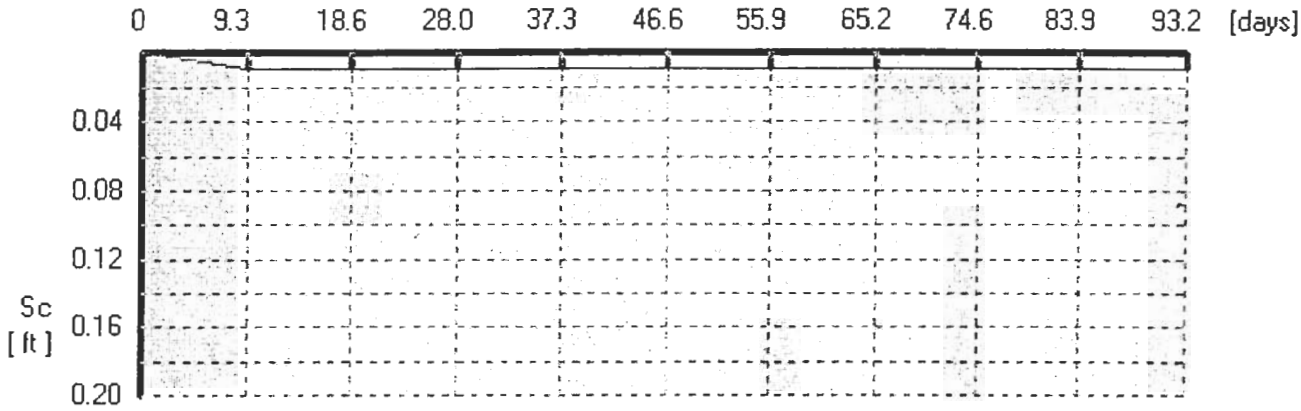
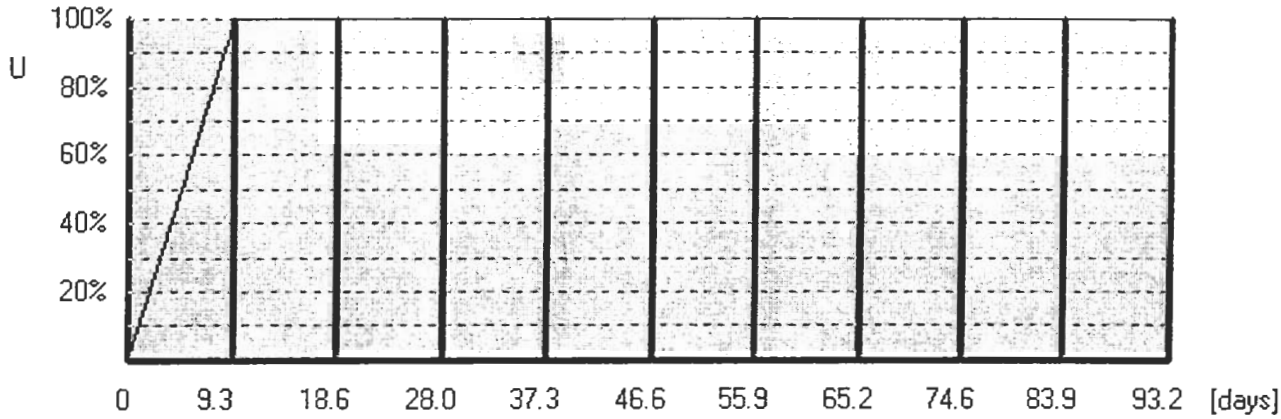
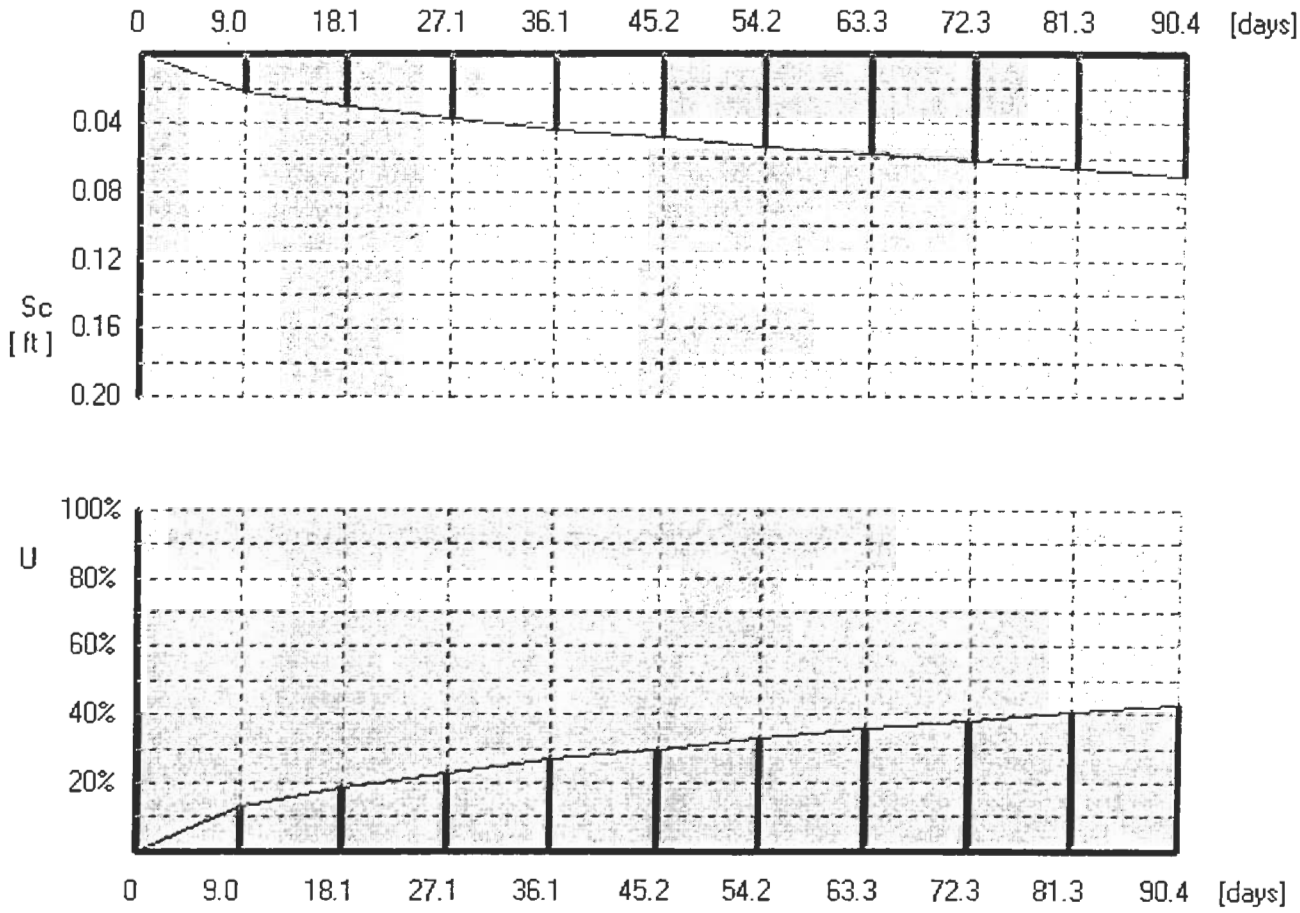
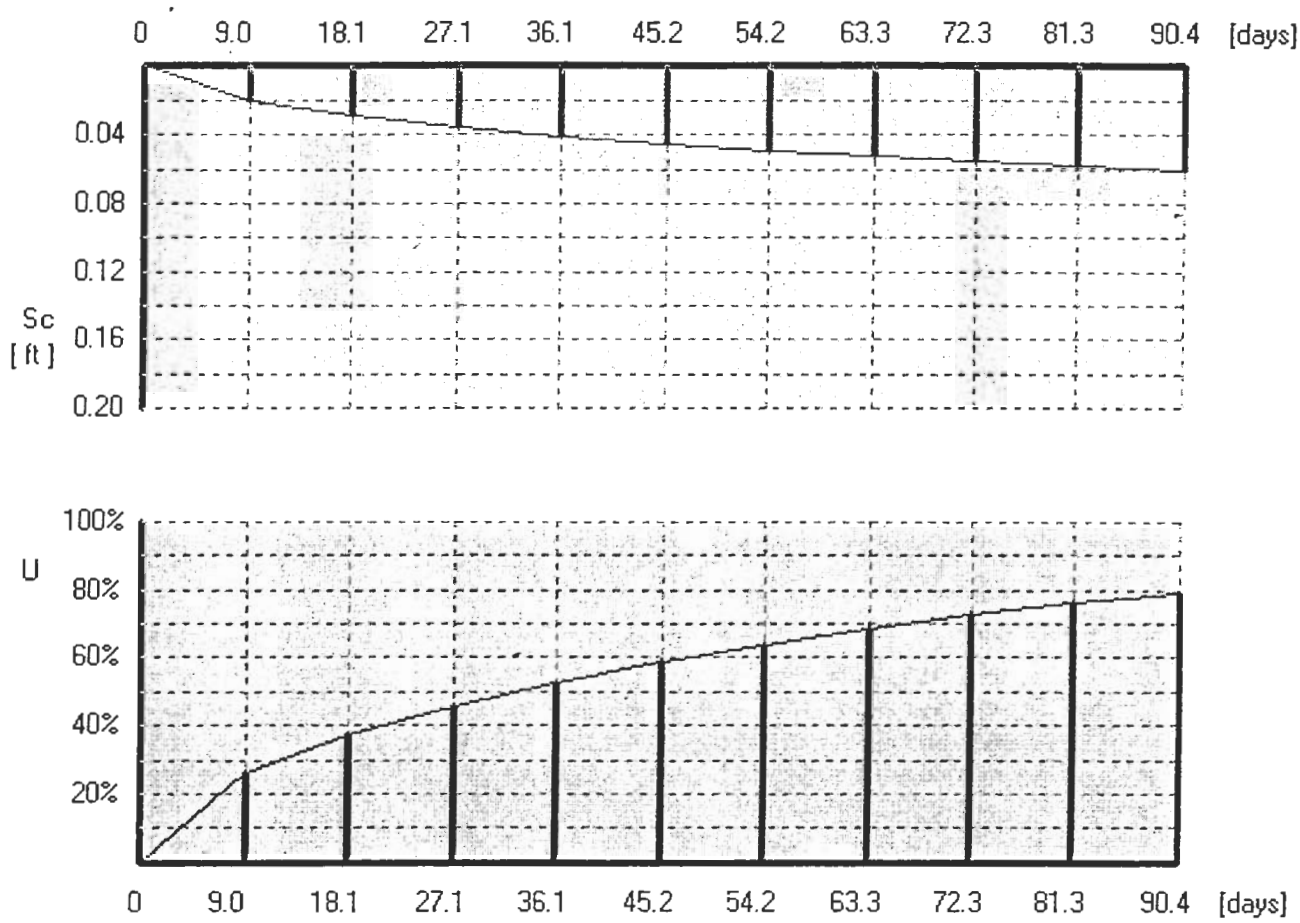

Top of Section
Z = 328.08 ft
Z = 320.00
Z = 306.00
Z = 299.00
Z = 284.00
Z = 280.00
Z = 190.00 ft
0.0
1000.0
2000.0
Bottom of Section


0
9.3
18.6
28.0
37.3
46.6
55.9
65.2
74.6
83.9
93.2
[days]
0.04
0.08
0.12
Sc
[ft]
0.16
0.20


100%
U
80%
60%
40%
20%
0
9.3
18.6
28.0
37.3
46.6
55.9
65.2
74.6
83.9
93.2
[days]


0
9.0
18.1
27.1
36.1
45.2
54.2
63.3
72.3
81.3
90.4
[days]
0.04
0.08
0.12
Sc
[ft]
0.16
0.20
100%
U
80%
60%
40%
20%
0
9.0
18.1
27.1
36.1
45.2
54.2
63.3
72.3
81.3
90.4
[days]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9.0
18.1
27.1
36.1
45.2
54.2
63.3
72.3
81.3
90.4
[days]
0.04
0.08
0.12
Sc
[ft]
0.16
0.20
100%
U
80%
60%
40%
20%
0
9.0
18.1
27.1
36.1
45.2
54.2
63.3
72.3
81.3
90.4
[days]

```
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*       San Francisco,  CA 94120        *
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*****************************************
```

Problem Description : High Street RW4 Stability EQ with soft soil removed

SEGMENT BOUNDARY COORDINATES

4 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	30.0	56.0	30.0	2
2	56.0	30.0	56.5	50.0	4
3	56.5	50.0	66.5	50.0	4
4	66.5	50.0	96.0	50.0	2

4 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	56.0	30.0	66.0	30.0	2
2	66.0	30.0	66.5	50.0	1
3	.0	30.0	96.0	30.0	2
4	.0	24.0	96.0	24.0	3

ISOTROPIC Soil Parameters

4 type(s) of soil

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	13.0	250.0	30.00	.000	.0	1
2	125.0	130.0	2000.0	.00	.000	.0	1

3	125.0	130.0	1500.0	.00	.000	.0	1
4	125.0	130.0	500.0	32.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	26.00
2	96.00	26.00

A horizontal earthquake loading coefficient of .200 has been assigned

A vertical earthquake loading coefficient of .000 has been assigned

BOUNDARY LOADS

1 load(s) specified

Load No.	x-left (ft)	x-right (ft)	Intensity (psf)	Direction (deg)
1	57.0	96.0	240.0	.0

NOTE - Intensity is specified as a uniformly distributed force acting on a HORIZONTALLY projected surface.

Trial failure surface specified by 7 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	48.00	30.00
2	56.65	27.53
3	65.52	29.07
4	73.49	33.26
5	80.85	38.43
6	88.52	43.15
7	92.23	50.00

****

HSFRW4SS

SUMMARY OF INDIVIDUAL SLICE INFORMATION :
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	52.00	28.86	1.142	8.000	-15.937	.000	1142.2
2	56.25	27.64	12.356	.500	-15.937	88.568	772.2
3	56.58	27.55	22.449	.150	-15.937	.000	420.9
4	56.83	27.56	22.440	.350	9.849	.000	981.7
5	61.26	28.33	21.670	8.520	9.849	.000	23078.1
6	65.76	29.20	20.804	.480	27.732	.000	1248.2
7	66.25	29.45	20.546	.500	27.732	.000	1284.1
8	66.89	29.79	20.207	.789	27.732	.000	1992.9
9	70.39	31.63	18.370	6.201	27.732	.000	14239.1
10	77.17	35.84	14.155	7.360	35.086	.000	13022.6
11	84.68	40.79	9.210	7.670	31.608	.000	8830.1
12	90.38	46.58	3.425	3.710	61.560	.000	1588.3

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	phi	c-value (psf)	U-base (lb)	U-top (lb)	P-top (lb)	Delta
1	357.2	.00	2000.0	.0	.0	.0	.00
2	1758.9	.00	2000.0	.0	.0	.0	.00
3	3020.5	.00	2000.0	.0	.0	.0	.00
4	2674.6	.00	2000.0	.0	.0	.0	.00
5	2818.3	.00	2000.0	.0	.0	2044.8	.00
6	2445.7	.00	2000.0	.0	.0	115.2	.00
7	2413.5	.00	2000.0	.0	.0	120.0	.00
8	2371.2	.00	2000.0	.0	.0	189.4	.00
9	2141.5	.00	2000.0	.0	.0	1488.2	.00
10	1481.9	.00	2000.0	.0	.0	1766.4	.00
11	929.2	.00	2000.0	.0	.0	1840.8	.00
12	-718.2	.00	2000.0	.0	.0	890.4	.00

For the single specified surface,
Corrected JANBU factor of safety = 2.899 (Fo factor =1.088)

Resisting Shear Strength = 105.59E+03 lb
Total Driving Shear Force = 396.27E+02 lb

```
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*                                       *
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*****************************************
```

Problem Description : High Street RW4 Stability without Mitigation

SEGMENT BOUNDARY COORDINATES

4 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	30.0	56.0	30.0	2
2	56.0	30.0	56.5	50.0	4
3	56.5	50.0	66.5	50.0	4
4	66.5	50.0	96.0	50.0	2

4 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	56.0	30.0	66.0	30.0	2
2	66.0	30.0	66.5	50.0	1
3	.0	30.0	96.0	30.0	2
4	.0	24.0	96.0	24.0	3

ISOTROPIC Soil Parameters

4 type(s) of soil

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	13.0	250.0	30.00	.000	.0	1
2	125.0	130.0	500.0	.00	.000	.0	1

3	125.0	130.0	1500.0	.00	.000	.0	1
4	125.0	130.0	500.0	32.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	26.00
2	96.00	26.00

BOUNDARY LOADS

1 load(s) specified

Load No.	x-left (ft)	x-right (ft)	Intensity (psf)	Direction (deg)
1	57.0	96.0	240.0	.0

NOTE - Intensity is specified as a uniformly distributed force acting on a HORIZONTALLY projected surface.

Trial failure surface specified by 7 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	48.00	30.00
2	56.65	27.53
3	65.52	29.07
4	73.49	33.26
5	80.85	38.43
6	88.52	43.15
7	92.23	50.00

****
SUMMARY OF INDIVIDUAL SLICE INFORMATION :
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	52.00	28.86	1.142	8.000	-15.937	.000	1142.2
2	56.25	27.64	12.356	.500	-15.937	88.568	772.2

3	56.58	27.55	22.449	.150	-15.937	.000	420.9
4	56.83	27.56	22.440	.350	9.849	.000	981.7
5	61.26	28.33	21.670	8.520	9.849	.000	23078.1
6	65.76	29.20	20.804	.480	27.732	.000	1248.2
7	66.25	29.45	20.546	.500	27.732	.000	1284.1
8	66.89	29.79	20.207	.789	27.732	.000	1992.9
9	70.39	31.63	18.370	6.201	27.732	.000	14239.1
10	77.17	35.84	14.155	7.360	35.086	.000	13022.6
11	84.68	40.79	9.210	7.670	31.608	.000	8830.1
12	90.38	46.58	3.425	3.710	61.560	.000	1588.3

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	phi	c-value (psf)	U-base (lb)	U-top (lb)	P-top (lb)	Delta
1	298.2	.00	500.0	.0	.0	.0	.00
2	1699.9	.00	500.0	.0	.0	.0	.00
3	2961.5	.00	500.0	.0	.0	.0	.00
4	2710.4	.00	500.0	.0	.0	.0	.00
5	2854.2	.00	500.0	.0	.0	2044.8	.00
6	2554.3	.00	500.0	.0	.0	115.2	.00
7	2522.1	.00	500.0	.0	.0	120.0	.00
8	2479.7	.00	500.0	.0	.0	189.4	.00
9	2250.0	.00	500.0	.0	.0	1488.2	.00
10	1627.0	.00	500.0	.0	.0	1766.4	.00
11	1056.2	.00	500.0	.0	.0	1840.8	.00
12	-337.1	.00	500.0	.0	.0	890.4	.00

For the single specified surface,
Corrected JANBU factor of safety = .999 (Fo factor =1.088)

Resisting Shear Strength = 263.97E+02 lb
Total Driving Shear Force = 287.60E+02 lb

XSTABL File: HSFRW4S 4-20-** 11:11

```
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*                                       *
*  Ver. 4.10                      1044  *
*****************************************
```

Problem Description : High Street RW4 Stability (soft Soil Removed)

SEGMENT BOUNDARY COORDINATES

4 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	30.0	56.0	30.0	2
2	56.0	30.0	56.5	50.0	4
3	56.5	50.0	66.5	50.0	4
4	66.5	50.0	96.0	50.0	2

4 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	56.0	30.0	66.0	30.0	2
2	66.0	30.0	66.5	50.0	1
3	.0	30.0	96.0	30.0	2
4	.0	24.0	96.0	24.0	3

ISOTROPIC Soil Parameters

4 type(s) of soil

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	13.0	250.0	30.00	.000	.0	1
2	125.0	130.0	2000.0	.00	.000	.0	1

3	125.0	130.0	1500.0	.00	.000	.0	1
4	125.0	130.0	500.0	32.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	26.00
2	96.00	26.00

BOUNDARY LOADS

1 load(s) specified

Load No.	x-left (ft)	x-right (ft)	Intensity (psf)	Direction (deg)
1	57.0	96.0	240.0	.0

NOTE - Intensity is specified as a uniformly distributed force acting on a HORIZONTALLY projected surface.

Trial failure surface specified by 7 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	48.00	30.00
2	56.65	27.53
3	65.52	29.07
4	73.49	33.26
5	80.85	38.43
6	88.52	43.15
7	92.23	50.00

****
SUMMARY OF INDIVIDUAL SLICE INFORMATION :
****

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	52.00	28.86	1.142	8.000	-15.937	.000	1142.2
2	56.25	27.64	12.356	.500	-15.937	88.568	772.2

3	56.58	27.55	22.449	.150	-15.937	.000	420.9
4	56.83	27.56	22.440	.350	9.849	.000	981.7
5	61.26	28.33	21.670	8.520	9.849	.000	23078.1
6	65.76	29.20	20.804	.480	27.732	.000	1248.2
7	66.25	29.45	20.546	.500	27.732	.000	1284.1
8	66.89	29.79	20.207	.789	27.732	.000	1992.9
9	70.39	31.63	18.370	6.201	27.732	.000	14239.1
10	77.17	35.84	14.155	7.360	35.086	.000	13022.6
11	84.68	40.79	9.210	7.670	31.608	.000	8830.1
12	90.38	46.58	3.425	3.710	61.560	.000	1588.3

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	phi	c-value (psf)	U-base (lb)	U-top (lb)	P-top (lb)	Delta
1	298.3	.00	2000.0	.0	.0	.0	.00
2	1700.0	.00	2000.0	.0	.0	.0	.00
3	2961.6	.00	2000.0	.0	.0	.0	.00
4	2710.4	.00	2000.0	.0	.0	.0	.00
5	2854.1	.00	2000.0	.0	.0	2044.8	.00
6	2554.1	.00	2000.0	.0	.0	115.2	.00
7	2521.9	.00	2000.0	.0	.0	120.0	.00
8	2479.6	.00	2000.0	.0	.0	189.4	.00
9	2249.9	.00	2000.0	.0	.0	1488.2	.00
10	1626.8	.00	2000.0	.0	.0	1766.4	.00
11	1056.0	.00	2000.0	.0	.0	1840.8	.00
12	-337.6	.00	2000.0	.0	.0	890.4	.00

For the single specified surface,
Corrected JANBU factor of safety = 3.995 (Fo factor =1.088)

Resisting Shear Strength = 105.59E+03 lb
Total Driving Shear Force = 287.52E+02 lb

PROJECT TITLE: Soil Nail Wall; I-880 @ High Street

Date: 04-13-2004

SnailWin 3.10

File: High Check tt16s

Minimum Factor of Safety = 1.11

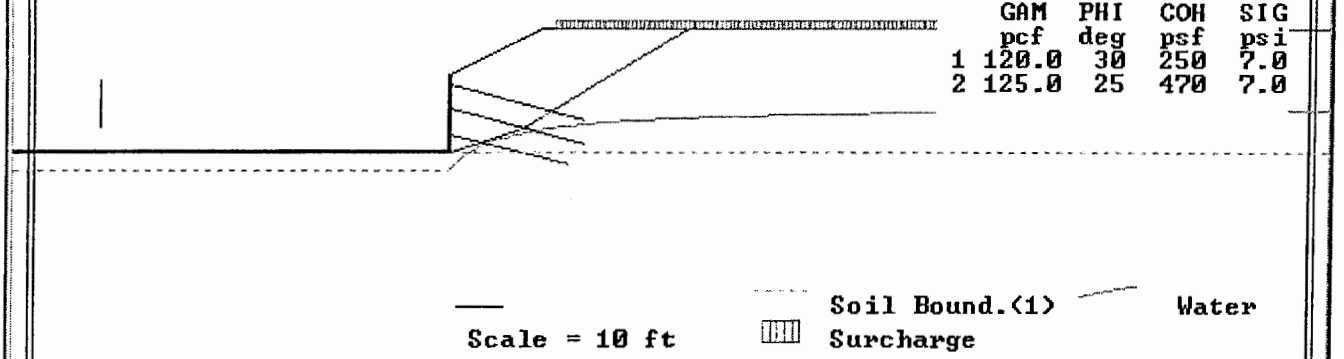
48.0 ft Behind Wall Crest
0.0 ft Below Wall Toe

LEGEND:
Crit.Ac= 0.36g
Hoz. KH= 0.31g
Vrt.PKH= 0.00g

PS= 35.0 Kips
FY= 35.0 Ksi
Sh= 5.0 ft
Sv= 5.0 ft

H= 16.0 ft

	GAM pcf	PHI deg	COH psf	SIG psi
1	120.0	30	250	7.0
2	125.0	25	470	7.0



Scale = 10 ft

Soil Bound.(1)

Surcharge

Water

```
*****************************************************
*    CALIFORNIA DEPARTMENT OF TRANSPORTATION        *
*          ENGINEERING SERVICE CENTER               *
*     DIVISION OF MATERIALS AND FOUNDATIONS         *
*   Office of Roadway Geotechnical Engineering      *
*    Date: 04-13-2004          Time: 11:56:44       *
*****************************************************
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Project Identification - Soil Nail Wall; I-880 @ High Street

--------- WALL GEOMETRY ---------

Vertical Wall Height	=	16.0 ft	
Wall Batter	=	0.0 degree	
		Angle (Deg)	Length (Feet)
First Slope from Wallcrest.	=	26.5	21.0
Second Slope from 1st slope.	=	0.0	50.0
Third Slope from 2nd slope.	=	0.0	0.0
Fourth Slope from 3rd slope.	=	0.0	0.0
Fifth Slope from 3rd slope.	=	0.0	0.0
Sixth Slope from 3rd slope.	=	0.0	0.0
Seventh Slope Angle.	=	0.0	

--------- SLOPE BELOW THE WALL ---------

First Slope Angle below Toe.	=	0.0 degrees
First Slope Distance from Toe.	=	30.0 ft
Second Slope Angle.	=	0.0 degrees
Second Slope Distance from Toe.	=	30.0 ft
Vertical Depth of Search.	=	5.0 ft
Number of Searches below wall Toe.	=	5

--------- SURCHARGE ---------

THE SURCHARGES IMPOSED ON THE SYSTEM ARE:

Begin Surcharge - Distance from toe	=	21.0 ft
End Surcharge - Distance from toe	=	100.0 ft
Loading Intensity - Begin	=	240.0 psf/ft
Loading Intensity - End	=	240.0 psf/ft

--------- OPTION #1 ---------

Ultimate Punching shear, Bond & Yield Stress are used.

--------- SOIL PARAMETERS ---------

Soil Layer	Unit Weight (Pcf)	Friction Angle (Degree)	Cohesion Intercept (Psf)	Bond* Stress (Psi)	Coordinates of Boundary XS1 (ft)	YS1 (ft)	XS2 (ft)	YS2 (ft)
1	120.0	30.0	250.0	7.0	0.0	0.0	0.0	0.0
2	125.0	25.0	470.0	7.0	0.0	0.0	80.0	0.0

* Ultimate bond Stress values also depend on BSF (Bond Stress Factor.)

--------- EARTHQUAKE ACCELERATION ---------

Horizontal Earthquake Coefficient = 0.31 (a/g)
Vertical Earthquake Coefficient = 0.00

--------- WATER SURFACE ---------

The Water Table is defined by three coordinate points.

X(1)-Coordinate = 0.00 ft Y(1)-Coordinate = -3.00 ft
X(2)-Coordinate = 20.00 ft Y(2)-Coordinate = 5.00 ft
X(3)-Coordinate = 80.00 ft Y(3)-Coordinate = 8.00 ft

--------- SEARCH LIMIT ---------

The Search Limit is from 0.0 to 240.0 ft

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

--------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels = 3
Horizontal Spacing = 5.0 ft
Yield Stress of Reinforcement = 35.0 ksi
Diameter of Grouted Hole = 6.0 in
Punching Shear = 35.0 kips

---------- (Varying Reinforcement Parameters) ---------

Level	Length (ft)	Inclination (degrees)	Vertical Spacing (ft)	Bar Diameter (in)	Bond Stress Factor
1	28.0	15.0	2.0	1.00	1.00
2	28.0	15.0	5.0	1.00	1.00
3	25.0	15.0	5.0	1.00	1.00

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
Toe	1.11	48.0	19.4	15.3	31.1	39.3

Reinf. Stress at Level 1 = 12.853 Ksi (Pullout controls...)
2 = 23.636 Ksi (Pullout controls...)
3 = 31.536 Ksi (Yield Stress controls.)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
1.00	1.13	48.0	22.4	20.8	32.7	34.2

Reinf. Stress at Level 1 = 10.534 Ksi (Pullout controls...)
2 = 22.779 Ksi (Pullout controls...)
3 = 30.956 Ksi (Yield Stress controls.)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
2.00	1.18	48.0	29.7	55.3	89.9	0.0

Reinf. Stress at Level 1 = 14.061 Ksi (Pullout controls...)
2 = 24.604 Ksi (Pullout controls...)
3 = 29.636 Ksi (Yield Stress controls.)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
3.00	1.13	48.0	21.5	15.5	34.0	40.5

Reinf. Stress at Level 1 = 8.734 Ksi (Pullout controls...)
2 = 18.520 Ksi (Pullout controls...)
3 = 25.062 Ksi (Pullout controls...)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
4.00	1.13	48.0	22.2	15.6	35.0	41.0

Reinf. Stress at Level 1 = 7.574 Ksi (Pullout controls...)
2 = 17.128 Ksi (Pullout controls...)
3 = 22.753 Ksi (Pullout controls...)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
5.00	1.13	48.0	22.9	15.6	35.9	41.5

Reinf. Stress at Level 1 = 6.457 Ksi (Pullout controls...)
2 = 15.774 Ksi (Pullout controls...)
3 = 20.499 Ksi (Pullout controls...)

****
* For Factor of Safety = 1.0 *

```
*          Maximum Average Reinforcement Working Force:          *
*                      15.410 Kips/level                         *
*****************************************************************
```

PROJECT TITLE: Soil Nail Wall; I-880 @ High Street

Date: 04-13-2004

SnailWin 3.10

File: High Check tt16

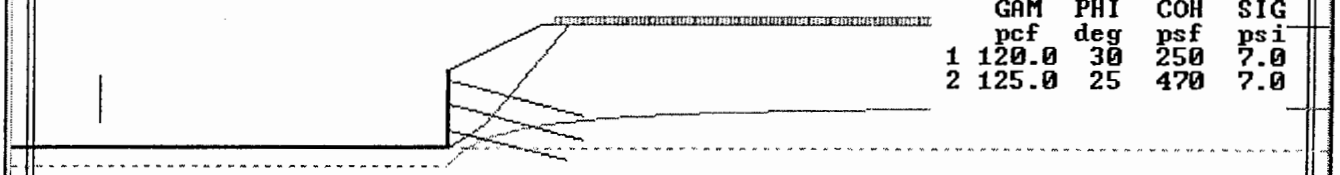
Minimum Factor of Safety = 1.62

24.0 ft Behind Wall Crest
0.0 ft Below Wall Toe

LEGEND:
PS= 35.0 Kips
FY= 35.0 Ksi
Sh= 5.0 ft
Sv= 5.0 ft

	GAM pcf	PHI deg	COH psf	SIG psi
1	120.0	30	250	7.0
2	125.0	25	470	7.0

H= 16.0 ft



Scale = 10 ft

Soil Bound.(1)

Surcharge

Water

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*****************************************************
*    CALIFORNIA DEPARTMENT OF TRANSPORTATION        *
*          ENGINEERING SERVICE CENTER               *
*     DIVISION OF MATERIALS AND FOUNDATIONS         *
*   Office of Roadway Geotechnical Engineering      *
*    Date: 04-13-2004          Time: 11:57:41       *
*****************************************************
```

Project Identification - Soil Nail Wall; I-880 @ High Street

--------- WALL GEOMETRY ---------

Vertical Wall Height	=	16.0 ft	
Wall Batter	=	0.0 degree	
		Angle (Deg)	Length (Feet)
First Slope from Wallcrest.	=	26.5	21.0
Second Slope from 1st slope.	=	0.0	50.0
Third Slope from 2nd slope.	=	0.0	0.0
Fourth Slope from 3rd slope.	=	0.0	0.0
Fifth Slope from 3rd slope.	=	0.0	0.0
Sixth Slope from 3rd slope.	=	0.0	0.0
Seventh Slope Angle.	=	0.0	

--------- SLOPE BELOW THE WALL ---------

First Slope Angle below Toe.	=	0.0 degrees
First Slope Distance from Toe.	=	30.0 ft
Second Slope Angle.	=	0.0 degrees
Second Slope Distance from Toe.	=	30.0 ft
Vertical Depth of Search.	=	5.0 ft
Number of Searches below wall Toe.	=	5

--------- SURCHARGE ---------

THE SURCHARGES IMPOSED ON THE SYSTEM ARE:

Begin Surcharge - Distance from toe	=	21.0 ft
End Surcharge - Distance from toe	=	100.0 ft
Loading Intensity - Begin	=	240.0 psf/ft
Loading Intensity - End	=	240.0 psf/ft

--------- OPTION #1 ---------

Ultimate Punching shear, Bond & Yield Stress are used.

--------- SOIL PARAMETERS ---------

Soil Layer	Unit Weight (Pcf)	Friction Angle (Degree)	Cohesion Intercept (Psf)	Bond* Stress (Psi)	Coordinates of Boundary XS1 (ft)	YS1 (ft)	XS2 (ft)	YS2 (ft)
1	120.0	30.0	250.0	7.0	0.0	0.0	0.0	0.0
2	125.0	25.0	470.0	7.0	0.0	0.0	80.0	0.0

* Ultimate bond Stress values also depend on BSF (Bond Stress Factor.)

--------- WATER SURFACE ---------

The Water Table is defined by three coordinate points.

X(1)-Coordinate = 0.00 ft Y(1)-Coordinate = -3.00 ft
X(2)-Coordinate = 20.00 ft Y(2)-Coordinate = 5.00 ft
X(3)-Coordinate = 80.00 ft Y(3)-Coordinate = 8.00 ft

--------- SEARCH LIMIT ---------

The Search Limit is from 0.0 to 240.0 ft

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

--------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels = 3
Horizontal Spacing = 5.0 ft
Yield Stress of Reinforcement = 35.0 ksi
Diameter of Grouted Hole = 6.0 in
Punching Shear = 35.0 kips

---------- (Varying Reinforcement Parameters) ---------

Level	Length (ft)	Inclination (degrees)	Vertical Spacing (ft)	Bar Diameter (in)	Bond Stress Factor
1	28.0	15.0	2.0	1.00	1.00
2	28.0	15.0	5.0	1.00	1.00
3	25.0	15.0	5.0	1.00	1.00

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
Toe	1.62	24.0	35.2	8.8	50.4	26.3

Reinf. Stress at Level 1 = 19.492 Ksi (Pullout controls...)
2 = 21.639 Ksi (Yield Stress controls.)
3 = 21.639 Ksi (Yield Stress controls.)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
1.00	1.67	24.0	47.7	35.7	89.9	0.0

Reinf. Stress at Level 1 = 20.088 Ksi (Pullout controls...)
2 = 20.962 Ksi (Yield Stress controls.)
3 = 20.962 Ksi (Yield Stress controls.)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
2.00	1.74	24.0	48.8	36.4	89.9	0.0

Reinf. Stress at Level 1 = 18.822 Ksi (Pullout controls...)
2 = 20.123 Ksi (Yield Stress controls.)
3 = 20.123 Ksi (Yield Stress controls.)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
3.00	1.78	24.0	49.8	37.2	89.9	0.0

Reinf. Stress at Level 1 = 17.999 Ksi (Pullout controls...)
2 = 19.699 Ksi (Yield Stress controls.)
3 = 19.699 Ksi (Yield Stress controls.)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
4.00	1.82	24.0	50.7	37.9	89.9	0.0

Reinf. Stress at Level 1 = 17.217 Ksi (Pullout controls...)
2 = 19.275 Ksi (Yield Stress controls.)
3 = 19.275 Ksi (Yield Stress controls.)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
5.00	1.85	24.0	51.7	38.7	89.9	0.0

Reinf. Stress at Level 1 = 16.491 Ksi (Pullout controls...)
2 = 18.870 Ksi (Yield Stress controls.)
3 = 18.870 Ksi (Yield Stress controls.)

****
* For Factor of Safety = 1.0 *

```
*          Maximum Average Reinforcement Working Force:          *
*                      0.000 Kips/level                          *
*****************************************************************
```

PROJECT TITLE: Soil Nail Wall; I-880 @ High Street

Date: 04-13-2004

SnailWin 3.10

File: High Check tt

Minimum Factor of Safety = 1.10

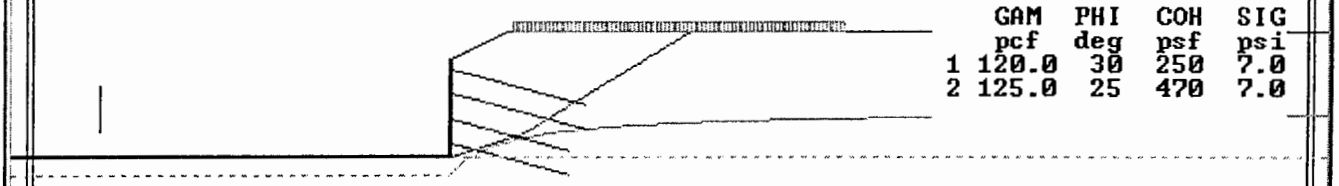
48.0 ft Behind Wall Crest
0.0 ft Below Wall Toe

LEGEND:
Crit.Ac= 0.35g
Hoz. KH= 0.31g
Vrt.PKH= 0.00g

PS= 35.0 Kips
FY= 35.0 Ksi
Sh= 5.0 ft
Sv= 5.0 ft

H= 20.0 ft

	GAM pcf	PHI deg	COH psf	SIG psi
1	120.0	30	250	7.0
2	125.0	25	470	7.0



Scale = 10 ft

Soil Bound.(1)

Surcharge

Water

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*************************************************
*    CALIFORNIA DEPARTMENT OF TRANSPORTATION    *
*          ENGINEERING SERVICE CENTER           *
*     DIVISION OF MATERIALS AND FOUNDATIONS     *
*   Office of Roadway Geotechnical Engineering  *
*    Date: 04-13-2004          Time: 11:42:25   *
*************************************************
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Project Identification - Soil Nail Wall; I-880 @ High Street

--------- WALL GEOMETRY ---------

Vertical Wall Height	=	20.0	ft
Wall Batter	=	0.0	degree
		Angle (Deg)	Length (Feet)
First Slope from Wallcrest.	=	26.5	12.8
Second Slope from 1st slope.	=	0.0	50.0
Third Slope from 2nd slope.	=	0.0	0.0
Fourth Slope from 3rd slope.	=	0.0	0.0
Fifth Slope from 3rd slope.	=	0.0	0.0
Sixth Slope from 3rd slope.	=	0.0	0.0
Seventh Slope Angle.	=	0.0	

--------- SLOPE BELOW THE WALL ---------

First Slope Angle below Toe.	=	0.0	degrees
First Slope Distance from Toe.	=	30.0	ft
Second Slope Angle.	=	0.0	degrees
Second Slope Distance from Toe.	=	30.0	ft
Vertical Depth of Search.	=	5.0	ft
Number of Searches below wall Toe.	=	5	

--------- SURCHARGE ---------

THE SURCHARGES IMPOSED ON THE SYSTEM ARE:

Begin Surcharge - Distance from toe	=	12.0	ft
End Surcharge - Distance from toe	=	80.0	ft
Loading Intensity - Begin	=	240.0	psf/ft
Loading Intensity - End	=	240.0	psf/ft

--------- OPTION #1 ---------

Ultimate Punching shear, Bond & Yield Stress are used.

--------- SOIL PARAMETERS ---------

Soil Layer	Unit Weight (Pcf)	Friction Angle (Degree)	Cohesion Intercept (Psf)	Bond* Stress (Psi)	Coordinates of Boundary XS1 (ft)	YS1 (ft)	XS2 (ft)	YS2 (ft)
1	120.0	30.0	250.0	7.0	0.0	0.0	0.0	0.0
2	125.0	25.0	470.0	7.0	0.0	0.0	80.0	0.0

* Ultimate bond Stress values also depend on BSF (Bond Stress Factor.)

--------- EARTHQUAKE ACCELERATION ---------

Horizontal Earthquake Coefficient = 0.31 (a/g)
Vertical Earthquake Coefficient = 0.00

--------- WATER SURFACE ---------

The Water Table is defined by three coordinate points.

X(1)-Coordinate = 0.00 ft Y(1)-Coordinate = -3.00 ft
X(2)-Coordinate = 20.00 ft Y(2)-Coordinate = 5.00 ft
X(3)-Coordinate = 80.00 ft Y(3)-Coordinate = 8.00 ft

--------- SEARCH LIMIT ---------

The Search Limit is from 0.0 to 240.0 ft

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

--------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels = 4
Horizontal Spacing = 5.0 ft
Yield Stress of Reinforcement = 35.0 ksi
Diameter of Grouted Hole = 6.0 in
Punching Shear = 35.0 kips

---------- (Varying Reinforcement Parameters) ---------

Level	Length (ft)	Inclination (degrees)	Vertical Spacing (ft)	Bar Diameter (in)	Bond Stress Factor
1	28.0	15.0	2.0	1.00	1.00
2	28.0	15.0	5.0	1.00	1.00
3	25.0	15.0	5.0	1.00	1.00
4	25.0	15.0	5.0	1.00	1.00

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
Toe	1.10	48.0	19.7	15.3	31.5	39.4

Reinf. Stress at Level 1 = 4.600 Ksi (Pullout controls...)
2 = 15.396 Ksi (Pullout controls...)
3 = 21.567 Ksi (Pullout controls...)
4 = 31.867 Ksi (Yield Stress controls.)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
1.00	1.09	48.0	22.7	20.8	33.0	34.3

Reinf. Stress at Level 1 = 2.832 Ksi (Pullout controls...)
2 = 13.287 Ksi (Pullout controls...)
3 = 21.126 Ksi (Pullout controls...)
4 = 32.162 Ksi (Yield Stress controls.)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
2.00	1.13	48.0	30.0	55.4	89.9	0.0

Reinf. Stress at Level 1 = 6.258 Ksi (Pullout controls...)
2 = 17.194 Ksi (Pullout controls...)
3 = 22.773 Ksi (Pullout controls...)
4 = 31.003 Ksi (Yield Stress controls.)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
3.00	1.10	48.0	21.7	15.5	34.4	40.7

Reinf. Stress at Level 1 = 1.265 Ksi (Pullout controls...)
2 = 11.238 Ksi (Pullout controls...)
3 = 15.712 Ksi (Pullout controls...)
4 = 28.754 Ksi (Pullout controls...)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
4.00	1.09	48.0	22.4	15.6	35.3	41.2

Reinf. Stress at Level 1 = 0.264 Ksi (Pullout controls...)
2 = 10.037 Ksi (Pullout controls...)
3 = 14.286 Ksi (Pullout controls...)
4 = 26.430 Ksi (Pullout controls...)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
5.00	1.09	48.0	23.1	15.7	36.2	41.6

Reinf. Stress at Level 1 = 0.000 Ksi
2 = 8.855 Ksi (Pullout controls...)

```
                    3 =  12.875 Ksi (Pullout controls...)
                    4 =  24.101 Ksi (Pullout controls...)

*****************************************************************
*                For Factor of Safety = 1.0                     *
*         Maximum Average Reinforcement Working Force:          *
*                    18.418 Kips/level                          *
*****************************************************************
```

PROJECT TITLE: Soil Nail Wall; I-880 @ High Street

Date: 04-13-2004

SnailWin 3.10

File: High Check tts

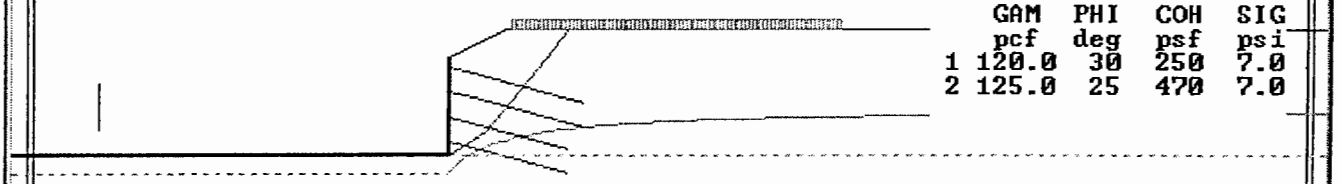
Minimum Factor of Safety = 1.54

24.0 ft Behind Wall Crest
0.0 ft Below Wall Toe

LEGEND:
PS= 35.0 Kips
FY= 35.0 Ksi
Sh= 5.0 ft
Sv= 5.0 ft

	GAM pcf	PHI deg	COH psf	SIG psi
1	120.0	30	250	7.0
2	125.0	25	470	7.0

H= 20.0 ft



Scale = 10 ft

Soil Bound.(1)

Surcharge

Water

```
*****************************************************
*    CALIFORNIA DEPARTMENT OF TRANSPORTATION        *
*          ENGINEERING SERVICE CENTER               *
*     DIVISION OF MATERIALS AND FOUNDATIONS         *
*   Office of Roadway Geotechnical Engineering      *
*    Date: 04-13-2004          Time: 11:40:14       *
*****************************************************
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Project Identification - Soil Nail Wall; I-880 @ High Street

--------- WALL GEOMETRY ---------

Vertical Wall Height	=	20.0	ft
Wall Batter	=	0.0	degree
		Angle (Deg)	Length (Feet)
First Slope from Wallcrest.	=	26.5	12.8
Second Slope from 1st slope.	=	0.0	50.0
Third Slope from 2nd slope.	=	0.0	0.0
Fourth Slope from 3rd slope.	=	0.0	0.0
Fifth Slope from 3rd slope.	=	0.0	0.0
Sixth Slope from 3rd slope.	=	0.0	0.0
Seventh Slope Angle.	=	0.0	

--------- SLOPE BELOW THE WALL ---------

First Slope Angle below Toe.	=	0.0	degrees
First Slope Distance from Toe.	=	30.0	ft
Second Slope Angle.	=	0.0	degrees
Second Slope Distance from Toe.	=	30.0	ft
Vertical Depth of Search.	=	5.0	ft
Number of Searches below wall Toe.	=	5	

--------- SURCHARGE ---------

THE SURCHARGES IMPOSED ON THE SYSTEM ARE:

Begin Surcharge - Distance from toe	=	12.0	ft
End Surcharge - Distance from toe	=	80.0	ft
Loading Intensity - Begin	=	240.0	psf/ft
Loading Intensity - End	=	240.0	psf/ft

--------- OPTION #1 ---------

Ultimate Punching shear, Bond & Yield Stress are used.

--------- SOIL PARAMETERS ---------

Soil Layer	Unit Weight (Pcf)	Friction Angle (Degree)	Cohesion Intercept (Psf)	Bond* Stress (Psi)	Coordinates of Boundary XS1 (ft)	YS1 (ft)	XS2 (ft)	YS2 (ft)
1	120.0	30.0	250.0	7.0	0.0	0.0	0.0	0.0
2	125.0	25.0	470.0	7.0	0.0	0.0	80.0	0.0

* Ultimate bond Stress values also depend on BSF (Bond Stress Factor.)

--------- WATER SURFACE ---------

The Water Table is defined by three coordinate points.

X(1)-Coordinate = 0.00 ft Y(1)-Coordinate = -3.00 ft
X(2)-Coordinate = 20.00 ft Y(2)-Coordinate = 5.00 ft
X(3)-Coordinate = 80.00 ft Y(3)-Coordinate = 8.00 ft

--------- SEARCH LIMIT ---------

The Search Limit is from 0.0 to 240.0 ft

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

--------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels	=	4
Horizontal Spacing	=	5.0 ft
Yield Stress of Reinforcement	=	35.0 ksi
Diameter of Grouted Hole	=	6.0 in
Punching Shear	=	35.0 kips

---------- (Varying Reinforcement Parameters) ---------

Level	Length (ft)	Inclination (degrees)	Vertical Spacing (ft)	Bar Diameter (in)	Bond Stress Factor
1	28.0	15.0	2.0	1.00	1.00
2	28.0	15.0	5.0	1.00	1.00
3	25.0	15.0	5.0	1.00	1.00
4	25.0	15.0	5.0	1.00	1.00

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
Toe	1.54	24.0	35.5	8.8	50.8	26.6

Reinf. Stress at Level 1 = 16.988 Ksi (Pullout controls...)
2 = 21.534 Ksi (Pullout controls...)
3 = 22.148 Ksi (Pullout controls...)
4 = 22.750 Ksi (Yield Stress controls.)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
1.00	1.54	24.0	36.6	9.0	51.8	27.2

Reinf. Stress at Level 1 = 16.533 Ksi (Pullout controls...)
2 = 20.923 Ksi (Pullout controls...)
3 = 21.395 Ksi (Pullout controls...)
4 = 22.671 Ksi (Yield Stress controls.)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
2.00	1.60	24.0	37.6	9.1	52.8	27.8

Reinf. Stress at Level 1 = 15.618 Ksi (Pullout controls...)
2 = 19.733 Ksi (Pullout controls...)
3 = 20.062 Ksi (Pullout controls...)
4 = 21.909 Ksi (Yield Stress controls.)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
3.00	1.60	24.0	43.7	16.6	55.1	21.0

Reinf. Stress at Level 1 = 14.810 Ksi (Pullout controls...)
2 = 18.640 Ksi (Pullout controls...)
3 = 19.796 Ksi (Pullout controls...)
4 = 21.886 Ksi (Yield Stress controls.)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
4.00	1.60	24.0	42.9	13.1	55.3	25.3

Reinf. Stress at Level 1 = 14.714 Ksi (Pullout controls...)
2 = 18.515 Ksi (Pullout controls...)
3 = 18.544 Ksi (Pullout controls...)
4 = 21.826 Ksi (Yield Stress controls.)

DEPTH BELOW WALL TOE (ft)	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
5.00	1.70	24.0	52.0	39.0	89.9	0.0

Reinf. Stress at Level 1 = 14.963 Ksi (Pullout controls...)
2 = 18.930 Ksi (Pullout controls...)

```
3 =  19.339 Ksi (Pullout controls...)
4 =  20.594 Ksi (Yield Stress controls.)

*****************************************************************
*                For Factor of Safety = 1.0                     *
*         Maximum Average Reinforcement Working Force:          *
*                     3.016 Kips/level                          *
*****************************************************************
```

Combo 1-long (S1)

S1-combo1-long.lpo

==========

LPILE Plus for Windows, Version 4.0

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:

Betty Lee
Caltrans

Path to file locations: C:\Program Files\Ensoft\LpileP4\
Name of input data file: S1-combo1-long.lpd
Name of output file: S1-combo1-long.lpo
Name of plot output file: S1-combo1-long.lpp
Name of runtime file: S1-combo1-long.lpr

Time and Date of Analysis

Date: February 17, 2005 Time: 15:19:36

Problem Title

High St. Sign-S1

Program Options

Units Used in Computations - SI Units, meters, kilopascals

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 does not use p-y multipliers (individual pile or shaft action only)
- 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
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100

- Deflection tolerance for convergence = 1.0000E-05 m
- Maximum allowable deflection = 3.7300E+00 m

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) = 1

Pile Structural Properties and Geometry

Pile Length = 8.60 m
Depth of ground surface below top of pile = .00 m
Slope angle of ground surface = .00 deg.

Structural properties of pile defined using 2 points

Point	Depth X m	Pile Diameter m	Moment of Inertia m**4	Pile Area Sq. m	Modulus of Elasticity kN/Sq. m
1	0.0000	1.37160000	.1737	1.4776	20684274.000
2	8.5978	1.37160000	.1737	1.4776	20684274.000

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = .000 m
Distance from top of pile to bottom of layer = 2.100 m
p-y subgrade modulus k for top of soil layer = 6786.179 kN/ m**3
p-y subgrade modulus k for bottom of layer = 6786.179 kN/ m**3

Layer 2 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 2.100 m
Distance from top of pile to bottom of layer = 4.000 m

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 4.000 m
Distance from top of pile to bottom of layer = 4.500 m
p-y subgrade modulus k for top of soil layer = 61075.611 kN/ m**3
p-y subgrade modulus k for bottom of layer = 61075.611 kN/ m**3

Layer 4 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 4.500 m
Distance from top of pile to bottom of layer = 6.600 m

Layer 5 is stiff clay without free water
Distance from top of pile to top of layer = 6.600 m
Distance from top of pile to bottom of layer = 8.600 m
p-y subgrade modulus k for top of soil layer = 81434.148 kN/ m**3
p-y subgrade modulus k for bottom of layer = 81434.148 kN/ m**3

(Depth of lowest layer extends .00 m below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 10 points

Point No.	Depth X m	Eff. Unit Weight kN/ m**3
1	.00	19.62563
2	2.10	19.62563
3	2.10	14.44099
4	4.00	14.44099
5	4.00	20.41283
6	4.50	20.41283
7	4.50	14.44099
8	6.60	14.44099
9	6.60	18.83843
10	8.60	18.83843

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 10 points

Point No.	Depth X m	Cohesion c kN/ m**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	.000	.00000	28.00	------	------
2	2.100	.00000	28.00	------	------
3	2.100	14.47899	.00	.02000	.0
4	4.000	14.47899	.00	.02000	.0
5	4.000	.00000	38.00	------	------
6	4.500	.00000	38.00	------	------
7	4.500	14.47899	.00	.02000	.0
8	6.600	14.47899	.00	.02000	.0
9	6.600	95.83714	.00	.00400	.0
10	8.600	95.83714	.00	.00400	.0

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.

Cyclic loading criteria was used for computation of p-y curves

Number of cycles of loading = 100.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 46.649 kN
Bending moment at pile head = 205.691 m- kN
Axial load at pile head = 55.987 kN

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment)condition.

Output of p-y Curves at Specified Depths

---

p-y curves are generated and printed for verification at 1 depths.

Depth No.	Depth Below Pile Head m	Depth Below Ground Surface m
1	5.000	5.000

p-y Curve Computed Using the Soft Clay Criteria for Cyclic Loading Conditions

Soil Layer Number = 4
Depth below ground surface = 5.000 m
Equivalent Depth = 8.871 m
Pile Diameter = 1.372 m
Cohesion, c = 14.479 kN/ m**2
Avg Eff Unit Weight = 17.21572 kN/ m**3
E50 parameter = .02000
Default J parameter = .500
Y50 = .06858 m
p-multiplier = 1.00000
y-multiplier = 1.00000
Number of cycles of loading = 100.
Xr = 3.862 m

y, m	p, kN/ m
.0000	.000
.0005	17.873
.0171	56.298
.0343	70.931
.0514	81.196
.0686	89.367
.0857	96.268
.1029	102.300
.1200	107.694
.1372	112.596
.1543	117.104
.1714	121.290
.1886	125.205
.2057	128.890
.5486	128.689
1.0287	128.689

1.3716 128.689

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Specified shear force at pile head = 46.649 kN
Specified bending moment at pile head = 205.691 m- kN
Specified axial load at pile head = 55.987 kN

Non-zero moment for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment)condition.

Depth X m	Deflect. y m	Moment M kN- m	Shear V kN	Slope S Rad.	Total Stress kN/ m**2	Soil Res p kN/ m
0.000	.002413	205.6910	46.6490	-5.985E-04	849.8485	0.0000
.08600	.002362	209.7057	46.5897	-5.935E-04	865.6963	-1.3785
.172	.002311	213.7101	46.4144	-5.884E-04	881.5037	-2.6977
.258	.002261	217.6946	46.1282	-5.833E-04	897.2323	-3.9584
.344	.002211	221.6498	45.7361	-5.780E-04	912.8453	-5.1612
.430	.002161	225.5668	45.2429	-5.727E-04	928.3074	-6.3072
.516	.002112	229.4371	44.6537	-5.672E-04	943.5853	-7.3970
.602	.002064	233.2527	43.9730	-5.617E-04	958.6472	-8.4315
.688	.002016	237.0059	43.2058	-5.560E-04	973.4627	-9.4116
.774	.001968	240.6895	42.3566	-5.503E-04	988.0034	-10.3381
.860	.001921	244.2965	41.4299	-5.445E-04	1002.2422	-11.2120
.946	.001875	247.8206	40.4303	-5.386E-04	1016.1535	-12.0342
1.032	.001828	251.2557	39.3622	-5.327E-04	1029.7134	-12.8056
1.118	.001783	254.5961	38.2299	-5.266E-04	1042.8992	-13.5271
1.204	.001738	257.8363	37.0376	-5.205E-04	1055.6901	-14.1998
1.290	.001693	260.9716	35.7896	-5.143E-04	1068.0662	-14.8245
1.376	.001649	263.9971	34.4898	-5.080E-04	1080.0094	-15.4023
1.462	.001606	266.9087	33.1424	-5.016E-04	1091.5029	-15.9342
1.548	.001563	269.7024	31.7511	-4.952E-04	1102.5309	-16.4212
1.634	.001521	272.3747	30.3198	-4.887E-04	1113.0795	-16.8644
1.720	.001479	274.9221	28.8523	-4.822E-04	1123.1356	-17.2646
1.806	.001438	277.3419	27.3521	-4.756E-04	1132.6874	-17.6231
1.892	.001397	279.6313	25.8228	-4.689E-04	1141.7247	-17.9408
1.978	.001357	281.7879	24.2680	-4.622E-04	1150.2380	-18.2189
2.064	.001318	283.8098	22.6908	-4.554E-04	1158.2193	-18.4583
2.150	.001279	285.6951	21.1386	-4.486E-04	1165.6616	-17.6397
2.236	.001241	287.4500	19.6160	-4.418E-04	1172.5887	-17.7696
2.322	.001203	289.0734	18.0826	-4.349E-04	1178.9969	-17.8925
2.408	.001166	290.5644	16.5388	-4.279E-04	1184.8826	-18.0083
2.494	.001129	291.9222	14.9854	-4.209E-04	1190.2424	-18.1170
2.580	.001093	293.1459	13.4230	-4.139E-04	1195.0732	-18.2185
2.666	.001058	294.2349	11.8522	-4.069E-04	1199.3719	-18.3128
2.752	.001023	295.1884	10.2735	-3.999E-04	1203.1358	-18.3999
2.838	9.89E-04	296.0058	8.6877	-3.928E-04	1206.3625	-18.4797
2.924	9.56E-04	296.6865	7.0953	-3.857E-04	1209.0494	-18.5522
3.010	9.23E-04	297.2299	5.4970	-3.786E-04	1211.1946	-18.6173
3.096	8.91E-04	297.6356	3.8935	-3.715E-04	1212.7961	-18.6750
3.182	8.59E-04	297.9032	2.2853	-3.643E-04	1213.8522	-18.7252
3.268	8.28E-04	298.0322	.6731	-3.572E-04	1214.3615	-18.7679
3.354	7.98E-04	298.0224	-.9425	-3.501E-04	1214.3228	-18.8030

3.440	7.68E-04	297.8734	-2.5607	-3.430E-04	1213.7349	-18.8306
3.526	7.39E-04	297.5852	-4.1810	-3.358E-04	1212.5972	-18.8504
3.612	7.10E-04	297.1575	-5.8027	-3.287E-04	1210.9089	-18.8626
3.698	6.82E-04	296.5903	-7.4250	-3.216E-04	1208.6699	-18.8670
3.784	6.55E-04	295.8835	-9.0475	-3.145E-04	1205.8798	-18.8635
3.870	6.28E-04	295.0372	-10.6672	-3.074E-04	1202.5389	-18.8050
3.956	6.02E-04	294.0517	-12.2733	-3.004E-04	1198.6489	-18.5450
4.042	5.76E-04	292.9291	-16.3949	-2.934E-04	1194.2173	-77.3082
4.128	5.51E-04	291.2346	-23.0242	-2.864E-04	1187.5285	-76.8616
4.214	5.27E-04	288.9717	-29.6076	-2.794E-04	1178.5956	-76.2397
4.300	5.03E-04	286.1448	-36.1303	-2.726E-04	1167.4366	-75.4514
4.386	4.80E-04	282.7599	-42.5785	-2.658E-04	1154.0748	-74.5052
4.472	4.58E-04	278.8239	-48.9388	-2.590E-04	1138.5375	-73.4091
4.558	4.36E-04	274.3449	-52.8130	-2.524E-04	1120.8570	-16.6885
4.644	4.14E-04	269.7425	-54.2365	-2.459E-04	1102.6891	-16.4172
4.730	3.93E-04	265.0186	-55.6366	-2.395E-04	1084.0418	-16.1440
4.816	3.73E-04	260.1753	-57.0132	-2.332E-04	1064.9230	-15.8687
4.902	3.53E-04	255.2146	-58.3660	-2.271E-04	1045.3408	-15.5912
4.988	3.34E-04	250.1385	-59.6948	-2.210E-04	1025.3033	-15.3111
5.074	3.15E-04	244.9492	-60.9994	-2.151E-04	1004.8186	-15.0284
5.160	2.97E-04	239.6487	-62.2795	-2.093E-04	983.8951	-14.7426
5.246	2.79E-04	234.2391	-63.5349	-2.036E-04	962.5411	-14.4534
5.332	2.62E-04	228.7227	-64.7653	-1.981E-04	940.7650	-14.1606
5.418	2.45E-04	223.1014	-65.9704	-1.927E-04	918.5754	-13.8635
5.504	2.29E-04	217.3776	-67.1497	-1.874E-04	895.9809	-13.5619
5.590	2.13E-04	211.5535	-68.3028	-1.823E-04	872.9904	-13.2550
5.676	1.98E-04	205.6313	-69.4293	-1.773E-04	849.6127	-12.9422
5.762	1.83E-04	199.6134	-70.5286	-1.724E-04	825.8572	-12.6227
5.848	1.68E-04	193.5020	-71.6000	-1.677E-04	801.7330	-12.2957
5.934	1.54E-04	187.2998	-72.6430	-1.632E-04	777.2498	-11.9599
6.020	1.40E-04	181.0090	-73.6567	-1.588E-04	752.4173	-11.6142
6.106	1.26E-04	174.6323	-74.6402	-1.545E-04	727.2456	-11.2570
6.192	1.13E-04	168.1724	-75.5923	-1.504E-04	701.7452	-10.8862
6.278	1.00E-04	161.6319	-76.5119	-1.464E-04	675.9269	-10.4995
6.364	8.81E-05	155.0137	-77.3975	-1.427E-04	649.8020	-10.0940
6.450	7.60E-05	148.3209	-78.2471	-1.390E-04	623.3823	-9.6659
6.536	6.42E-05	141.5566	-79.0588	-1.356E-04	596.6804	-9.2105
6.622	5.26E-05	134.7241	-82.0627	-1.323E-04	569.7095	-60.6466
6.708	4.14E-05	127.4431	-87.2034	-1.291E-04	540.9679	-58.9055
6.794	3.04E-05	119.7264	-92.1909	-1.262E-04	510.5065	-57.0828
6.880	1.97E-05	111.5874	-97.0476	-1.234E-04	478.3785	-55.8647
6.966	9.21E-06	103.0353	-102.2077	-1.208E-04	444.6194	-64.1373
7.052	-1.07E-06	94.0089	-104.6864	-1.185E-04	408.9878	6.4942
7.138	-1.12E-05	85.0304	-103.0433	-1.163E-04	373.5457	31.7178
7.224	-2.11E-05	76.2866	-99.8750	-1.144E-04	339.0296	41.9618
7.310	-3.08E-05	67.8530	-95.9760	-1.127E-04	305.7386	48.7129
7.396	-4.05E-05	59.7798	-91.5626	-1.111E-04	273.8698	53.9246
7.482	-5.00E-05	52.1053	-86.7380	-1.098E-04	243.5752	58.2753
7.568	-5.93E-05	44.8619	-81.5628	-1.086E-04	214.9820	62.0788
7.654	-6.86E-05	38.0776	-76.0767	-1.077E-04	188.2012	65.5056
7.740	-7.79E-05	31.7777	-70.3076	-1.068E-04	163.3329	68.6588
7.826	-8.70E-05	25.9857	-64.2762	-1.061E-04	140.4690	71.6052
7.912	-9.61E-05	20.7232	-57.9984	-1.056E-04	119.6957	74.3908
7.998	-1.05E-04	16.0110	-51.4865	-1.051E-04	101.0943	77.0485
8.084	-1.14E-04	11.8686	-44.7505	-1.048E-04	84.7423	79.6026
8.170	-1.23E-04	8.3149	-37.7985	-1.046E-04	70.7143	82.0715
8.256	-1.32E-04	5.3682	-30.6373	-1.044E-04	59.0824	84.4694
8.342	-1.41E-04	3.0463	-23.2724	-1.043E-04	49.9167	86.8076
8.428	-1.50E-04	1.3664	-15.7086	-1.042E-04	43.2853	89.0948
8.514	-1.59E-04	.3454	-7.9499	-1.042E-04	39.2551	91.3383
8.600	-1.68E-04	0.0000	0.0000	-1.042E-04	37.8916	93.5439

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.00241331	m
Computed slope at pile head	=	-.00059847	
Maximum bending moment	=	298.032	kN- m
Maximum shear force	=	-104.686	kN
Depth of maximum bending moment	=	3.26800000	m
Depth of maximum shear force	=	7.05200000	m
Number of iterations	=	8	
Number of zero deflection points	=	1	

Summary of Pile-head Response

Definition of symbols for pile-head boundary conditions:

y = pile-head displacment, m
M = pile-head moment, kN- m
V = pile-head shear force, kN
S = pile-head slope, radians
R = rotational stiffness of pile-head, m- kN/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load kN	Pile Head Deflection m	Maximum Moment m- kN	Maximum Shear kN
1	V= 46.649	M= 205.691	55.9870	.002413	298.0322	-104.6864

Pile-head Deflection vs. Pile Length

Boundary Condition Type 1, Shear and Moment

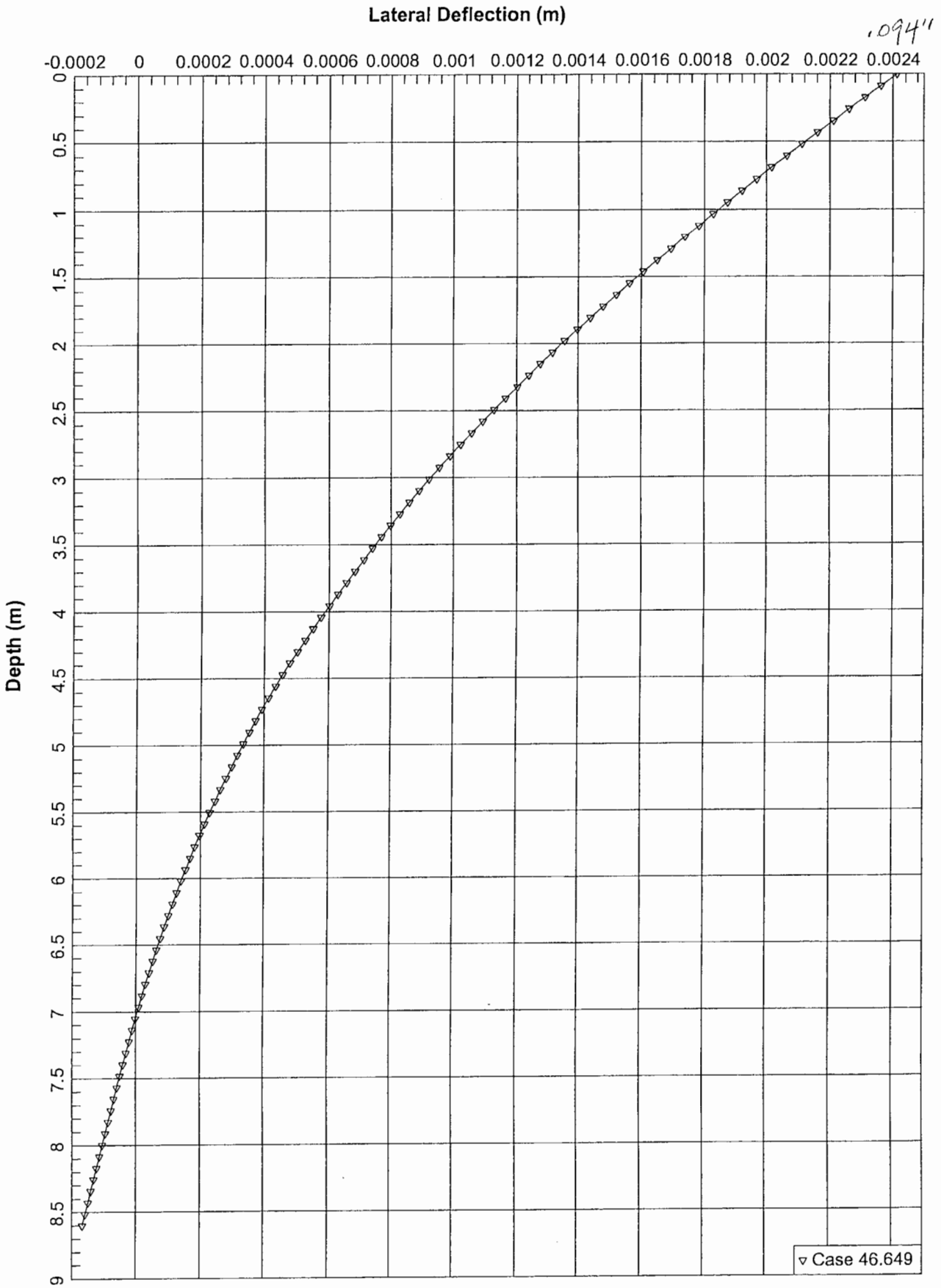
Shear	=	47.	kN
Moment	=	206.	m- kN
Axial Load	=	56.	kN

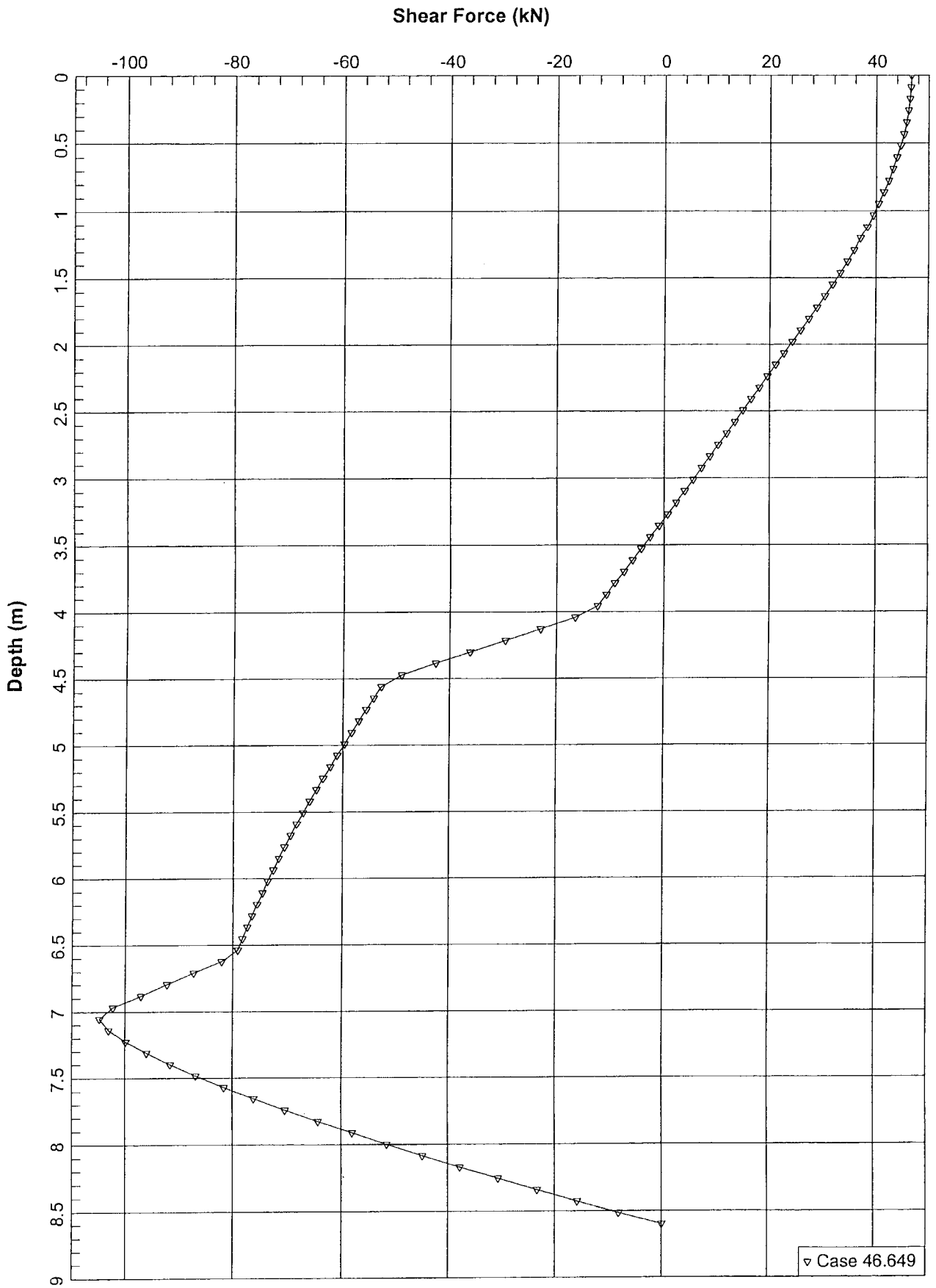
Pile Length m	Pile Head Deflection m	Maximum Moment m- kN	Maximum Shear kN
8.600	.00241331	298.032	-104.686
8.170	.00261736	293.211	-100.697
7.740	.00299527	285.680	-98.858
7.310	.00382296	274.448	-95.786
6.880	.00600419	259.770	-87.451
6.450	.00988761	250.701	-90.426
6.020	.01129376	249.399	-99.078
5.590	.01236019	248.774	-106.717
5.160	.01324830	248.383	-111.927

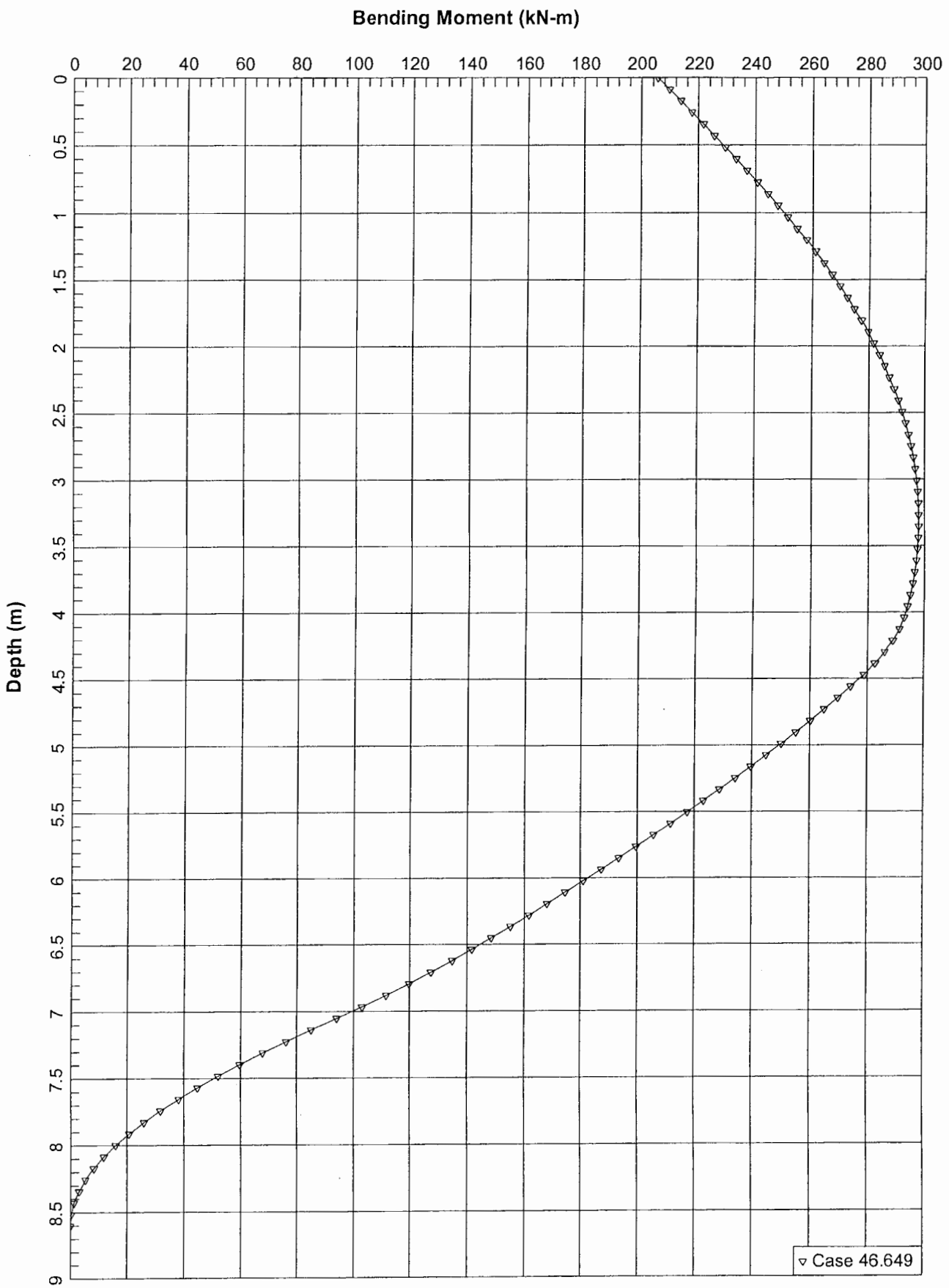
4.730	.01375721	248.196	-114.825

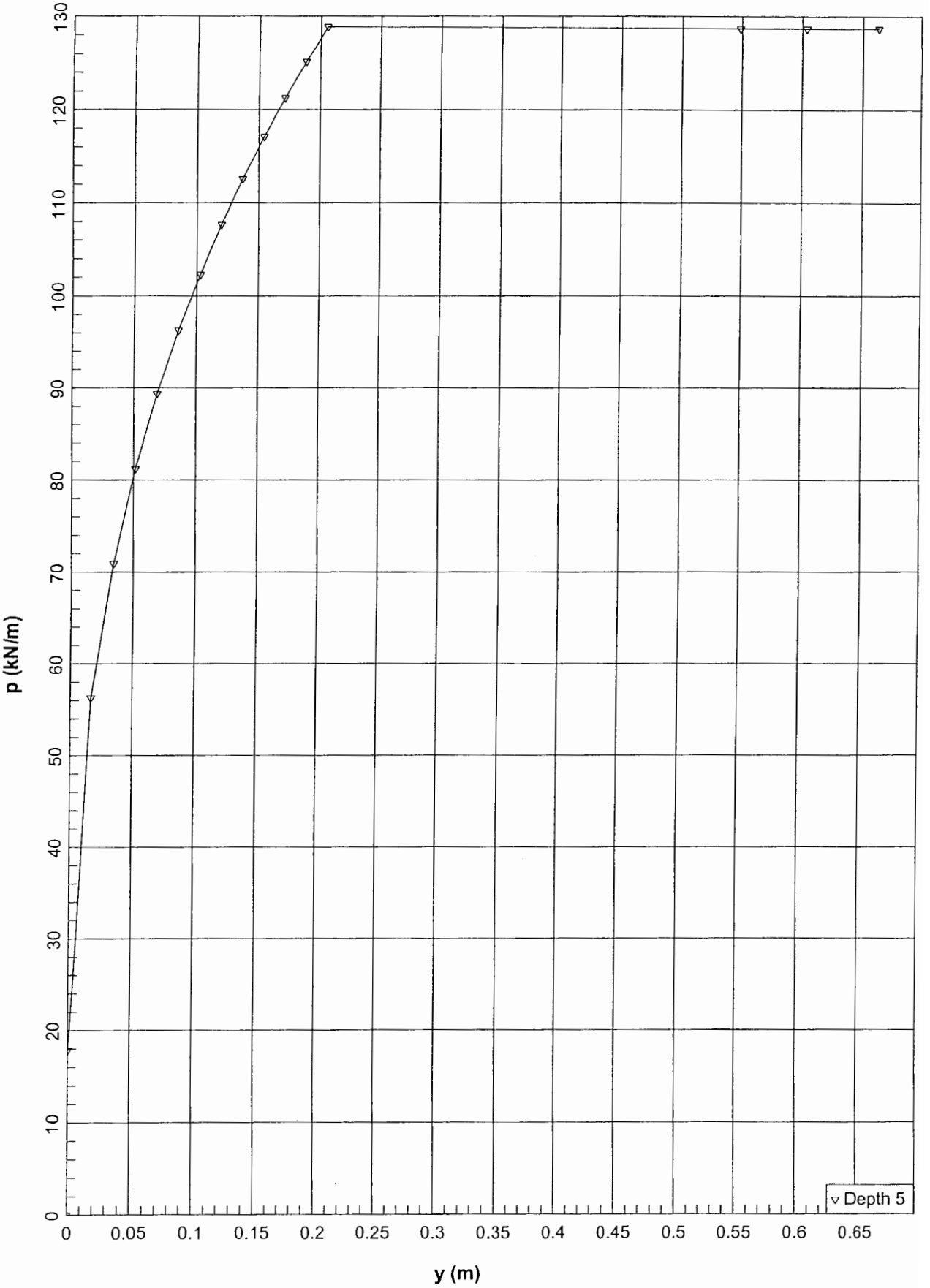
The analysis ended normally.

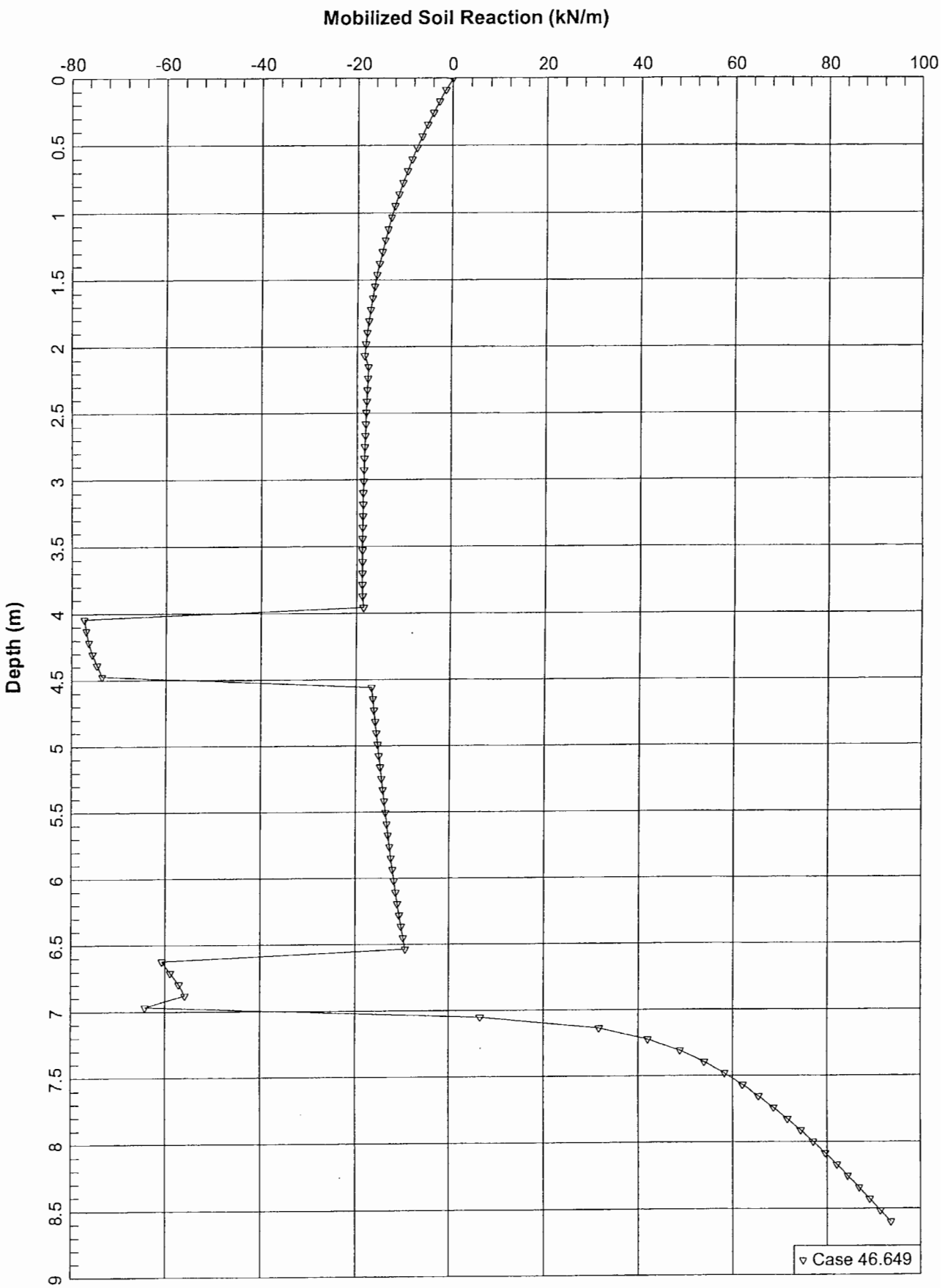
Combo 1 - long. (51)

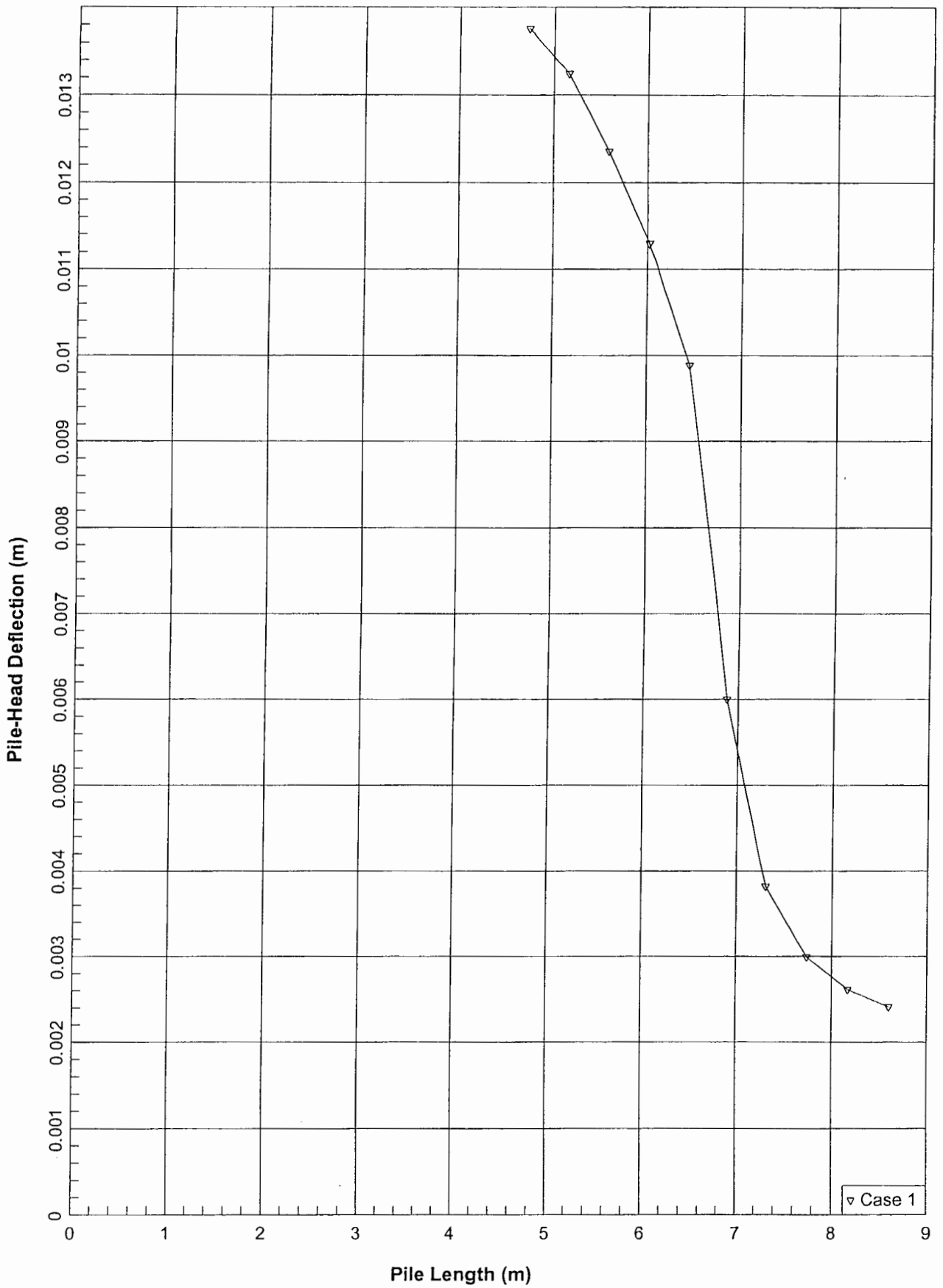



Shear Force (kN)
-100
-80
-60
-40
-20
0
20
40
Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
Case 46.649


Bending Moment (kN-m)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
Case 46.649


p (kN/m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
y (m)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
Depth 5


Mobilized Soil Reaction (kN/m)
-80
-60
-40
-20
0
20
40
60
80
100
Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
Case 46.649


Pile-Head Deflection (m)
0
0.001
0.002
0.003
0.004
0.005
0.006
0.007
0.008
0.009
0.01
0.011
0.012
0.013
0
1
2
3
4
5
6
7
8
9
Pile Length (m)
Case 1

Sign A. Combo-2-long (51)

S1-combo2-long.lpo

==========

LPILE Plus for Windows, Version 4.0

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:

Betty Lee
Caltrans

Path to file locations:	C:\Program Files\Ensoft\LpileP4\
Name of input data file:	S1-combo2-long.lpd
Name of output file:	S1-combo2-long.lpo
Name of plot output file:	S1-combo2-long.lpp
Name of runtime file:	S1-combo2-long.lpr

Time and Date of Analysis

Date: February 17, 2005 Time: 15:26: 9

Problem Title

High St. Sign-S1

Program Options

Units Used in Computations - SI Units, meters, kilopascals

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 does not use p-y multipliers (individual pile or shaft action only)
- 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
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100

- Deflection tolerance for convergence = 1.0000E-05 m
- Maximum allowable deflection = 3.7300E+00 m

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) = 1

Pile Structural Properties and Geometry

Pile Length = 8.60 m
Depth of ground surface below top of pile = .00 m
Slope angle of ground surface = .00 deg.

Structural properties of pile defined using 2 points

Point	Depth X m	Pile Diameter m	Moment of Inertia m**4	Pile Area Sq. m	Modulus of Elasticity kN/Sq. m
1	0.0000	1.37160000	.1737	1.4776	20684274.000
2	8.5978	1.37160000	.1737	1.4776	20684274.000

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = .000 m
Distance from top of pile to bottom of layer = 2.100 m
p-y subgrade modulus k for top of soil layer = 6786.179 kN/ m**3
p-y subgrade modulus k for bottom of layer = 6786.179 kN/ m**3

Layer 2 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 2.100 m
Distance from top of pile to bottom of layer = 4.000 m

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 4.000 m
Distance from top of pile to bottom of layer = 4.500 m
p-y subgrade modulus k for top of soil layer = 61075.611 kN/ m**3
p-y subgrade modulus k for bottom of layer = 61075.611 kN/ m**3

Layer 4 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 4.500 m
Distance from top of pile to bottom of layer = 6.600 m

Layer 5 is stiff clay without free water
Distance from top of pile to top of layer = 6.600 m
Distance from top of pile to bottom of layer = 8.600 m
p-y subgrade modulus k for top of soil layer = 81434.148 kN/ m**3
p-y subgrade modulus k for bottom of layer = 81434.148 kN/ m**3

(Depth of lowest layer extends .00 m below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 10 points

Point No.	Depth X m	Eff. Unit Weight kN/ m**3
1	.00	19.62563
2	2.10	19.62563
3	2.10	14.44099
4	4.00	14.44099
5	4.00	20.41283
6	4.50	20.41283
7	4.50	14.44099
8	6.60	14.44099
9	6.60	18.83843
10	8.60	18.83843

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 10 points

Point No.	Depth X m	Cohesion c kN/ m**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	.000	.00000	28.00	------	------
2	2.100	.00000	28.00	------	------
3	2.100	14.47899	.00	.02000	.0
4	4.000	14.47899	.00	.02000	.0
5	4.000	.00000	38.00	------	------
6	4.500	.00000	38.00	------	------
7	4.500	14.47899	.00	.02000	.0
8	6.600	14.47899	.00	.02000	.0
9	6.600	95.83714	.00	.00400	.0
10	8.600	95.83714	.00	.00400	.0

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.

Cyclic loading criteria was used for computation of p-y curves

Number of cycles of loading = 100.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 27.989 kN
Bending moment at pile head = 240.324 m- kN
Axial load at pile head = 55.987 kN

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment)condition.

Output of p-y Curves at Specified Depths

---

p-y curves are generated and printed for verification at 1 depths.

Depth No.	Depth Below Pile Head m	Depth Below Ground Surface m
1	5.000	5.000

p-y Curve Computed Using the Soft Clay Criteria for Cyclic Loading Conditions

Soil Layer Number = 4
Depth below ground surface = 5.000 m
Equivalent Depth = 8.871 m
Pile Diameter = 1.372 m
Cohesion, c = 14.479 kN/ m**2
Avg Eff Unit Weight = 17.21572 kN/ m**3
E50 parameter = .02000
Default J parameter = .500
Y50 = .06858 m
p-multiplier = 1.00000
y-multiplier = 1.00000
Number of cycles of loading = 100.
Xr = 3.862 m

y, m	p, kN/ m
.0000	.000
.0005	17.873
.0171	56.298
.0343	70.931
.0514	81.196
.0686	89.367
.0857	96.268
.1029	102.300
.1200	107.694
.1372	112.596
.1543	117.104
.1714	121.290
.1886	125.205
.2057	128.890
.5486	128.689
1.0287	128.689

1.3716 128.689

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Specified shear force at pile head = 27.989 kN
Specified bending moment at pile head = 240.324 m- kN
Specified axial load at pile head = 55.987 kN

Non-zero moment for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment)condition.

Depth X m	Deflect. y m	Moment M kN- m	Shear V kN	Slope S Rad.	Total Stress kN/ m**2	Soil Res p kN/ m
0.000	.001953	240.3240	27.9890	-5.346E-04	986.5608	0.0000
.08600	.001908	242.7336	27.9411	-5.288E-04	996.0727	-1.1133
.172	.001862	245.1350	27.7998	-5.230E-04	1005.5519	-2.1739
.258	.001818	247.5202	27.5695	-5.171E-04	1014.9676	-3.1825
.344	.001773	249.8819	27.2546	-5.111E-04	1024.2902	-4.1401
.430	.001730	252.2129	26.8595	-5.051E-04	1033.4919	-5.0476
.516	.001687	254.5066	26.3885	-4.990E-04	1042.5460	-5.9059
.602	.001644	256.7566	25.8458	-4.929E-04	1051.4277	-6.7160
.688	.001602	258.9568	25.2354	-4.868E-04	1060.1131	-7.4787
.774	.001560	261.1017	24.5614	-4.805E-04	1068.5801	-8.1951
.860	.001519	263.1860	23.8278	-4.743E-04	1076.8077	-8.8660
.946	.001479	265.2047	23.0384	-4.679E-04	1084.7763	-9.4926
1.032	.001439	267.1531	22.1969	-4.616E-04	1092.4677	-10.0756
1.118	.001399	269.0270	21.3072	-4.551E-04	1099.8647	-10.6162
1.204	.001360	270.8223	20.3728	-4.487E-04	1106.9518	-11.1152
1.290	.001322	272.5354	19.3971	-4.422E-04	1113.7141	-11.5738
1.376	.001284	274.1629	18.3838	-4.356E-04	1120.1385	-11.9929
1.462	.001247	275.7016	17.3360	-4.291E-04	1126.2126	-12.3736
1.548	.001211	277.1488	16.2571	-4.224E-04	1131.9253	-12.7168
1.634	.001175	278.5019	15.1503	-4.158E-04	1137.2666	-13.0236
1.720	.001139	279.7587	14.0186	-4.091E-04	1142.2276	-13.2950
1.806	.001104	280.9171	12.8650	-4.024E-04	1146.8003	-13.5321
1.892	.001070	281.9753	11.6925	-3.957E-04	1150.9777	-13.7358
1.978	.001036	282.9320	10.5038	-3.889E-04	1154.7541	-13.9073
2.064	.001003	283.7857	9.3018	-3.821E-04	1158.1242	-14.0476
2.150	9.70E-04	284.5356	8.0058	-3.753E-04	1161.0842	-16.0912
2.236	9.38E-04	285.1663	6.6176	-3.685E-04	1163.5742	-16.1926
2.322	9.07E-04	285.6773	5.2210	-3.617E-04	1165.5913	-16.2872
2.408	8.76E-04	286.0678	3.8165	-3.548E-04	1167.1328	-16.3747
2.494	8.46E-04	286.3372	2.4048	-3.480E-04	1168.1960	-16.4553
2.580	8.16E-04	286.4848	.9865	-3.411E-04	1168.7788	-16.5288
2.666	7.87E-04	286.5102	-.4378	-3.343E-04	1168.8788	-16.5952
2.752	7.59E-04	286.4127	-1.8676	-3.274E-04	1168.4942	-16.6546
2.838	7.31E-04	286.1921	-3.3021	-3.206E-04	1167.6233	-16.7068
2.924	7.04E-04	285.8479	-4.7408	-3.137E-04	1166.2644	-16.7519
3.010	6.77E-04	285.3797	-6.1831	-3.069E-04	1164.4163	-16.7897
3.096	6.51E-04	284.7873	-7.6283	-3.001E-04	1162.0780	-16.8204
3.182	6.25E-04	284.0705	-9.0759	-2.933E-04	1159.2484	-16.8438
3.268	6.00E-04	283.2291	-10.5252	-2.865E-04	1155.9269	-16.8599
3.354	5.76E-04	282.2629	-11.9755	-2.797E-04	1152.1131	-16.8687

3.440	5.52E-04	281.1720	-13.4263	-2.730E-04	1147.8066	-16.8701
3.526	5.29E-04	279.9562	-14.8768	-2.663E-04	1143.0075	-16.8642
3.612	5.07E-04	278.6157	-16.3266	-2.596E-04	1137.7159	-16.8508
3.698	4.84E-04	277.1506	-17.7749	-2.529E-04	1131.9322	-16.8300
3.784	4.63E-04	275.5609	-19.2210	-2.463E-04	1125.6571	-16.8017
3.870	4.42E-04	273.8469	-20.6626	-2.397E-04	1118.8912	-16.7239
3.956	4.22E-04	272.0092	-22.0898	-2.332E-04	1111.6370	-16.4669
4.042	4.02E-04	270.0497	-25.1164	-2.267E-04	1103.9019	-53.9177
4.128	3.83E-04	267.6914	-29.7289	-2.203E-04	1094.5925	-53.3507
4.214	3.64E-04	264.9385	-34.2874	-2.139E-04	1083.7254	-52.6615
4.300	3.46E-04	261.7960	-38.7818	-2.076E-04	1071.3208	-51.8578
4.386	3.28E-04	258.2700	-43.2024	-2.014E-04	1057.4020	-50.9474
4.472	3.11E-04	254.3671	-47.5404	-1.952E-04	1041.9956	-49.9375
4.558	2.95E-04	250.0949	-50.3173	-1.892E-04	1025.1312	-14.6410
4.644	2.79E-04	245.7144	-51.5651	-1.833E-04	1007.8392	-14.3759
4.730	2.63E-04	241.2275	-52.7899	-1.774E-04	990.1274	-14.1093
4.816	2.48E-04	236.6362	-53.9918	-1.717E-04	972.0035	-13.8413
4.902	2.34E-04	231.9426	-55.1706	-1.661E-04	953.4755	-13.5717
4.988	2.20E-04	227.1485	-56.3260	-1.606E-04	934.5511	-13.3002
5.074	2.06E-04	222.2560	-57.4581	-1.553E-04	915.2383	-13.0267
5.160	1.93E-04	217.2672	-58.5665	-1.500E-04	895.5451	-12.7510
5.246	1.80E-04	212.1840	-59.6512	-1.449E-04	875.4795	-12.4728
5.332	1.68E-04	207.0086	-60.7117	-1.398E-04	855.0496	-12.1918
5.418	1.56E-04	201.7430	-61.7480	-1.349E-04	834.2637	-11.9076
5.504	1.45E-04	196.3892	-62.7597	-1.302E-04	813.1301	-11.6198
5.590	1.34E-04	190.9495	-63.7464	-1.255E-04	791.6572	-11.3279
5.676	1.23E-04	185.4261	-64.7079	-1.210E-04	769.8534	-11.0313
5.762	1.13E-04	179.8210	-65.6436	-1.167E-04	747.7275	-10.7294
5.848	1.03E-04	174.1365	-66.5531	-1.124E-04	725.2883	-10.4212
5.934	9.37E-05	168.3749	-67.4357	-1.083E-04	702.5447	-10.1059
6.020	8.46E-05	162.5386	-68.2909	-1.044E-04	679.5060	-9.7822
6.106	7.58E-05	156.6299	-69.1178	-1.006E-04	656.1817	-9.4485
6.192	6.73E-05	150.6513	-69.9156	-9.689E-05	632.5814	-9.1030
6.278	5.91E-05	144.6053	-70.6830	-9.335E-05	608.7153	-8.7434
6.364	5.13E-05	138.4947	-71.4187	-8.996E-05	584.5938	-8.3665
6.450	4.37E-05	132.3222	-72.1211	-8.672E-05	560.2280	-7.9683
6.536	3.63E-05	126.0907	-72.7881	-8.363E-05	535.6295	-7.5432
6.622	2.93E-05	119.8034	-75.3332	-8.069E-05	510.8108	-51.6457
6.708	2.25E-05	113.1342	-79.6902	-7.790E-05	484.4842	-49.6808
6.794	1.59E-05	106.0975	-83.8671	-7.528E-05	456.7070	-47.4562
6.880	9.51E-06	98.7098	-87.8599	-7.283E-05	427.5443	-45.4000
6.966	3.35E-06	90.9863	-92.2528	-7.056E-05	397.0561	-56.7594
7.052	-2.63E-06	82.8430	-93.8856	-6.848E-05	364.9108	18.7880
7.138	-8.43E-06	74.8386	-91.6630	-6.659E-05	333.3139	32.9004
7.224	-1.41E-05	67.0776	-88.5256	-6.489E-05	302.6776	40.0622
7.310	-1.96E-05	59.6128	-84.8628	-6.338E-05	273.2108	45.1188
7.396	-2.50E-05	52.4818	-80.8089	-6.204E-05	245.0613	49.1571
7.482	-3.03E-05	45.7143	-76.4335	-6.086E-05	218.3469	52.5959
7.568	-3.55E-05	39.3358	-71.7793	-5.984E-05	193.1680	55.6415
7.654	-4.06E-05	33.3688	-66.8751	-5.897E-05	169.6136	58.4107
7.740	-4.56E-05	27.8338	-61.7415	-5.824E-05	147.7646	60.9762
7.826	-5.06E-05	22.7499	-56.3939	-5.764E-05	127.6957	63.3865
7.912	-5.55E-05	18.1347	-50.8442	-5.715E-05	109.4774	65.6755
7.998	-6.04E-05	14.0052	-45.1018	-5.676E-05	93.1765	67.8678
8.084	-6.53E-05	10.3777	-39.1743	-5.647E-05	78.8571	69.9819
8.170	-7.01E-05	7.2678	-33.0677	-5.626E-05	66.5808	72.0317
8.256	-7.49E-05	4.6906	-26.7871	-5.612E-05	56.4075	74.0283
8.342	-7.98E-05	2.6609	-20.3368	-5.603E-05	48.3955	75.9801
8.428	-8.46E-05	1.1932	-13.7202	-5.598E-05	42.6017	77.8940
8.514	-8.94E-05	.3016	-6.9404	-5.596E-05	39.0821	79.7755
8.600	-9.42E-05	0.0000	0.0000	-5.596E-05	37.8916	81.6288

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.00195337	m
Computed slope at pile head	=	-.00053458	
Maximum bending moment	=	286.510	kN- m
Maximum shear force	=	-93.886	kN
Depth of maximum bending moment	=	2.66600000	m
Depth of maximum shear force	=	7.05200000	m
Number of iterations	=	8	
Number of zero deflection points	=	1	

Summary of Pile-head Response

Definition of symbols for pile-head boundary conditions:

y = pile-head displacment, m
M = pile-head moment, kN- m
V = pile-head shear force, kN
S = pile-head slope, radians
R = rotational stiffness of pile-head, m- kN/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load kN	Pile Head Deflection m	Maximum Moment m- kN	Maximum Shear kN
1	V= 27.989	M= 240.324	55.9870	.001953	286.5102	-93.8856

Pile-head Deflection vs. Pile Length

Boundary Condition Type 1, Shear and Moment

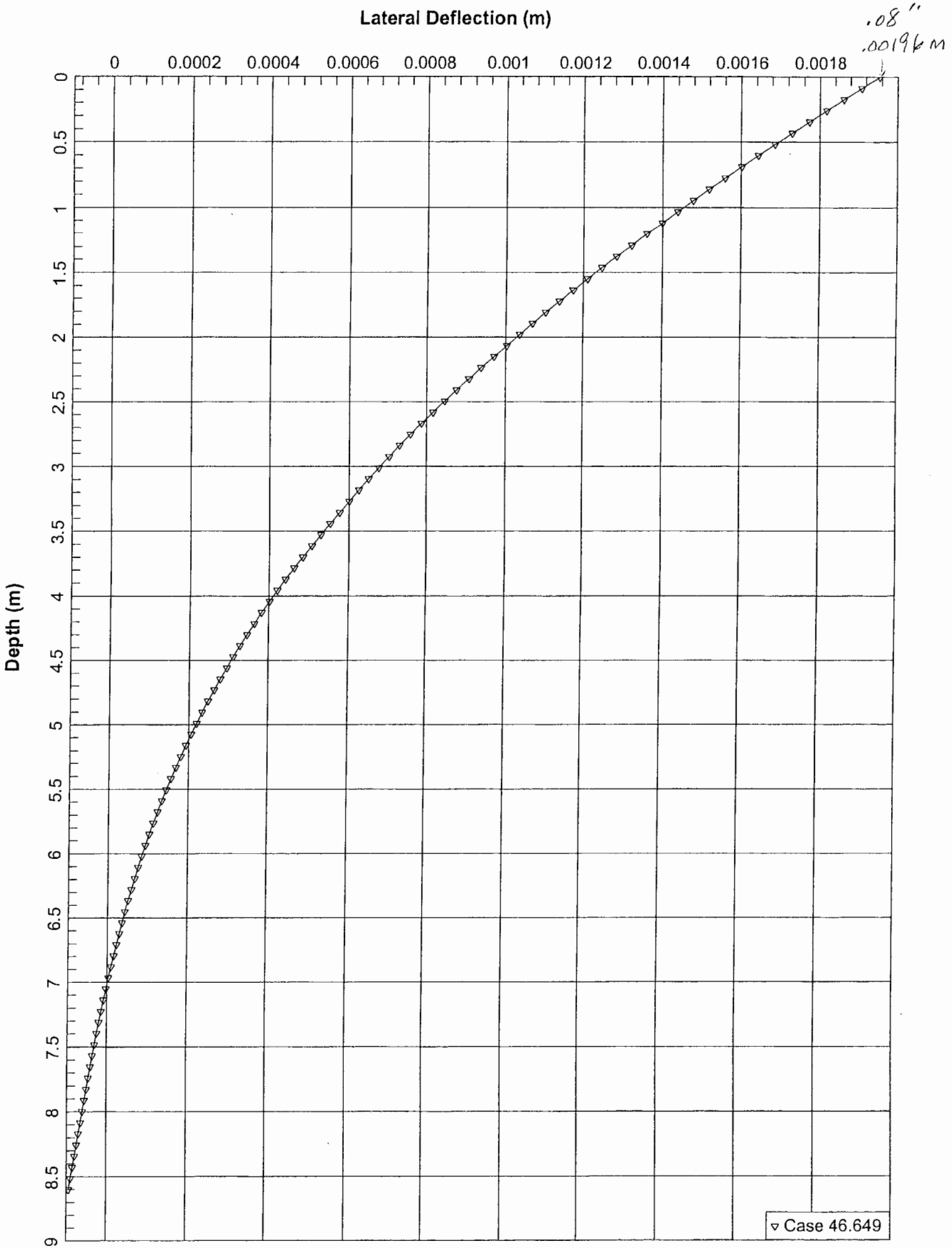
Shear	=	28.	kN
Moment	=	240.	m- kN
Axial Load	=	56.	kN

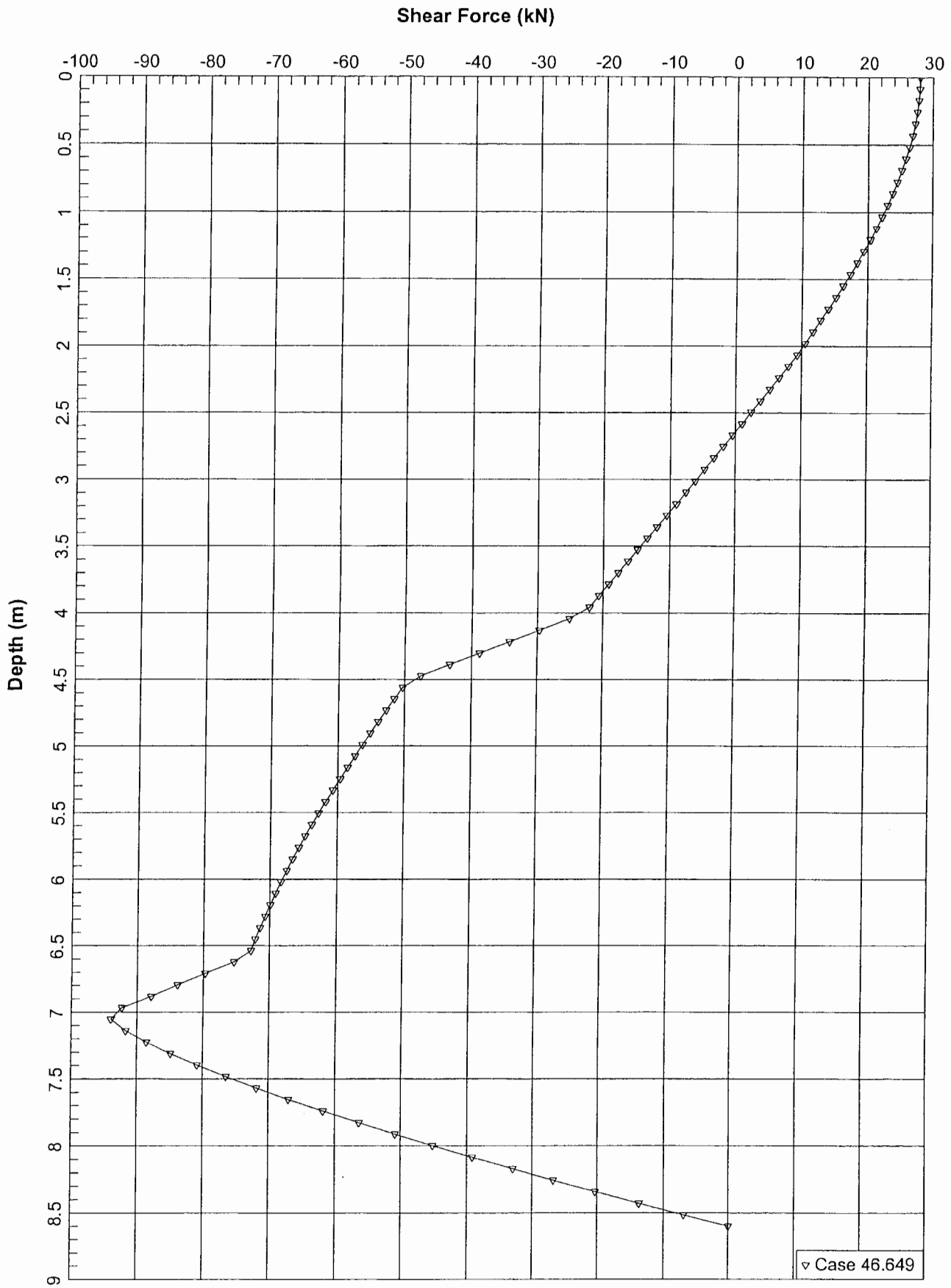
Pile Length m	Pile Head Deflection m	Maximum Moment m- kN	Maximum Shear kN
8.600	.00195337	286.510	-93.886
8.170	.00211490	284.091	-92.147
7.740	.00242039	280.418	-90.556
7.310	.00308148	275.071	-88.996
6.880	.00491990	267.438	-83.356
6.450	.00839121	262.536	-91.550
6.020	.00962129	261.870	-99.928
5.590	.01057131	261.564	-107.198
5.160	.01134731	261.384	-112.167

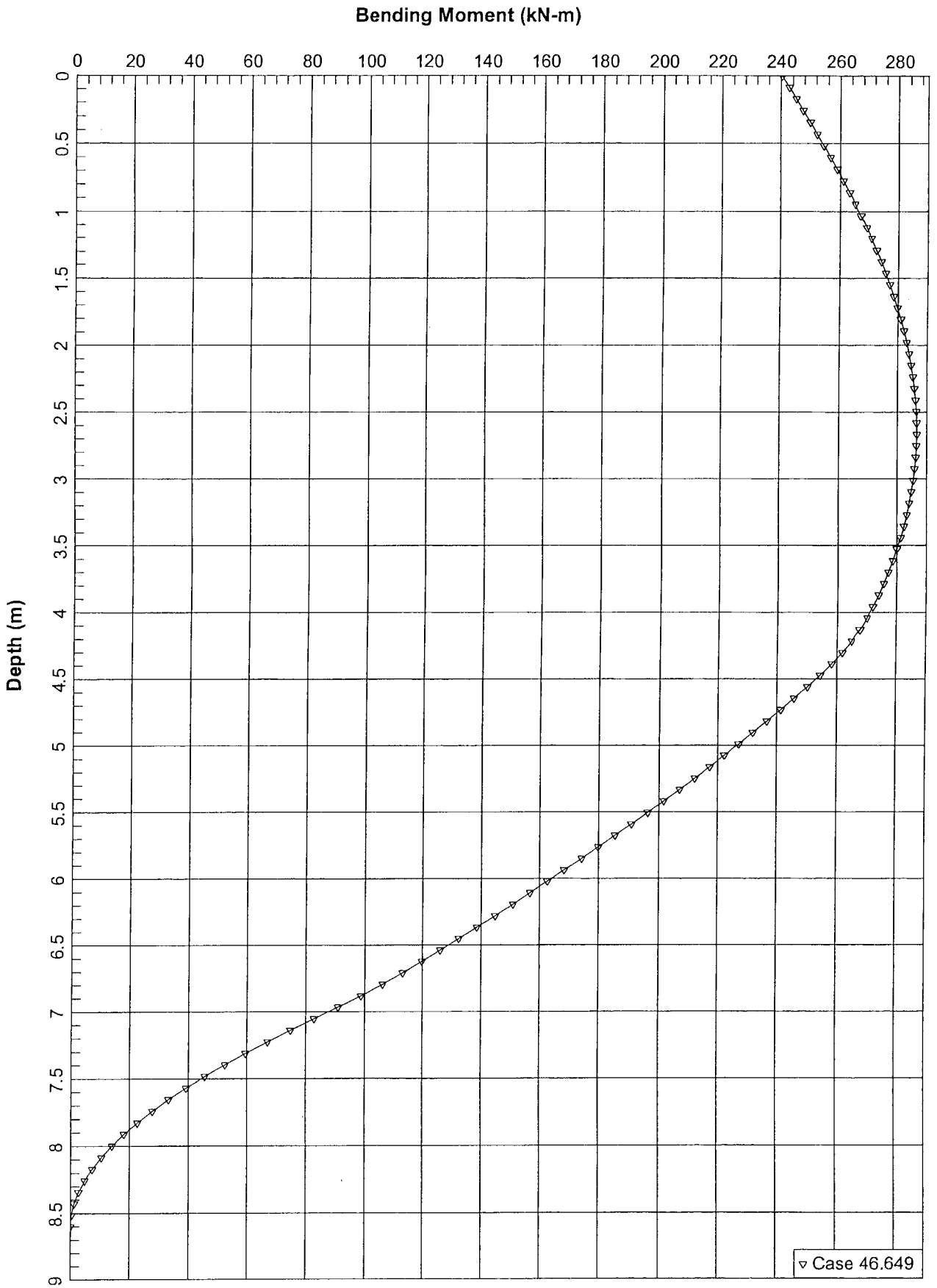
4.730	.01181650	261.292	-114.954

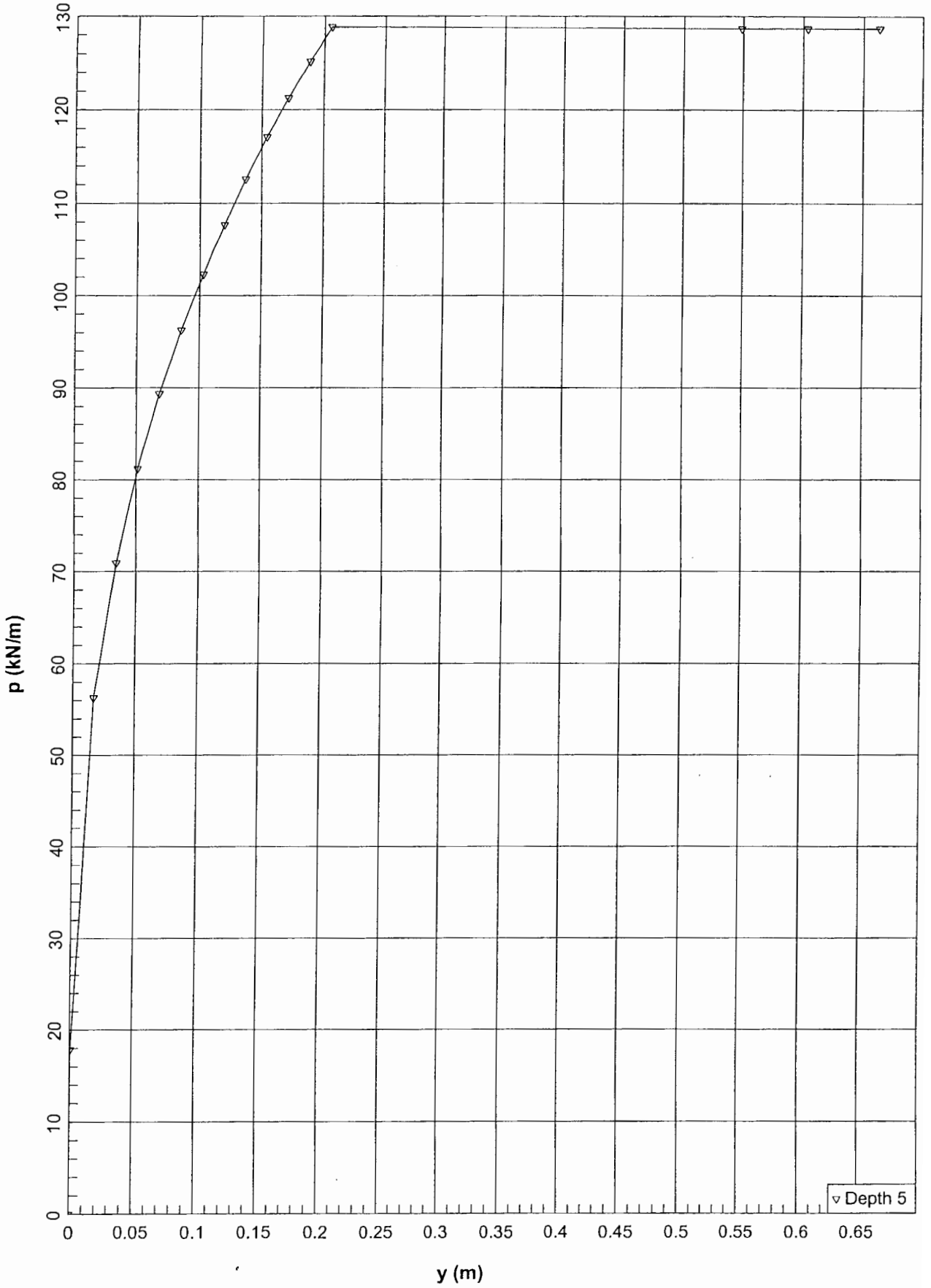
The analysis ended normally.

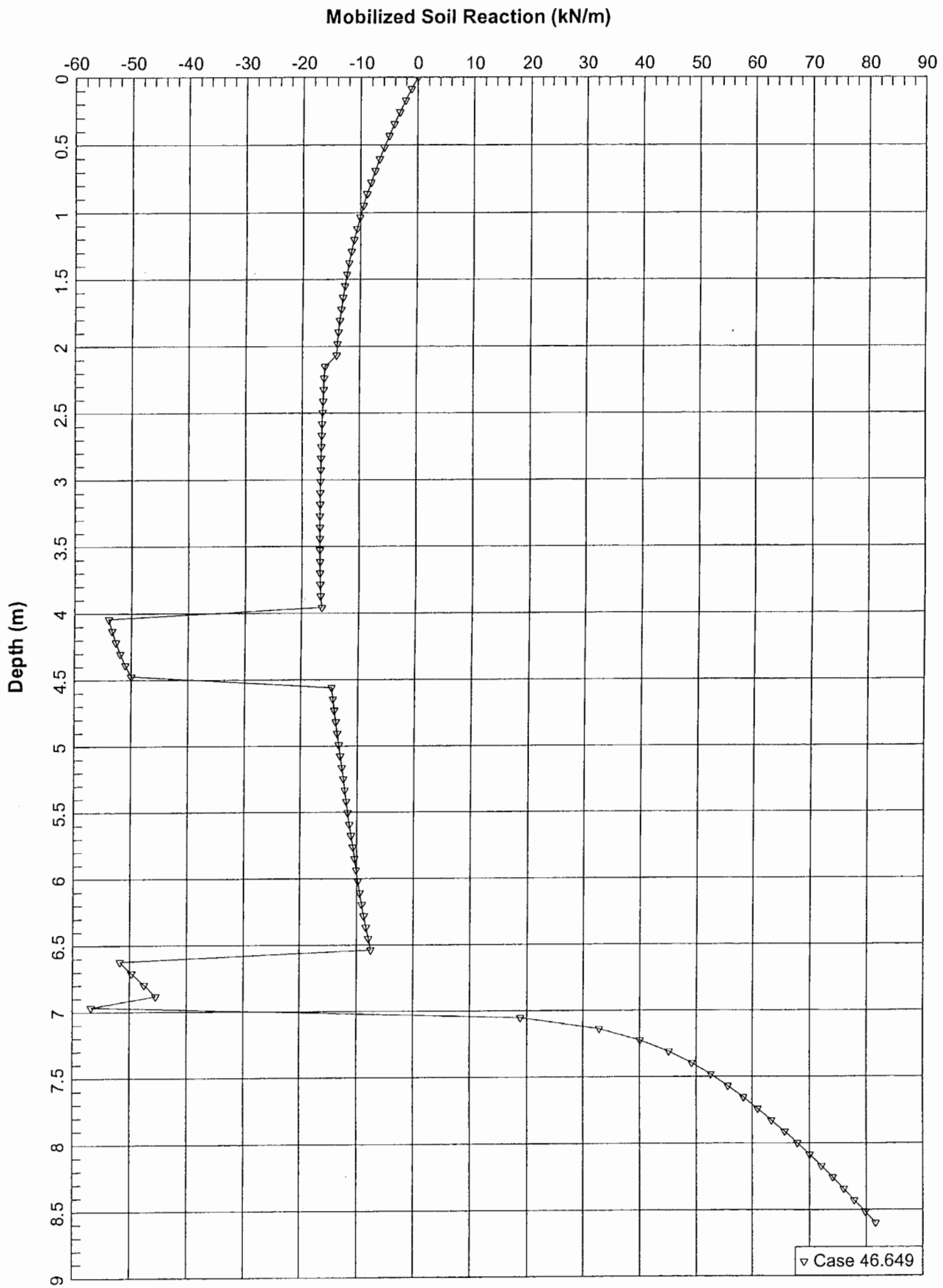
Sign A, Combo 2 - 2604 (1)

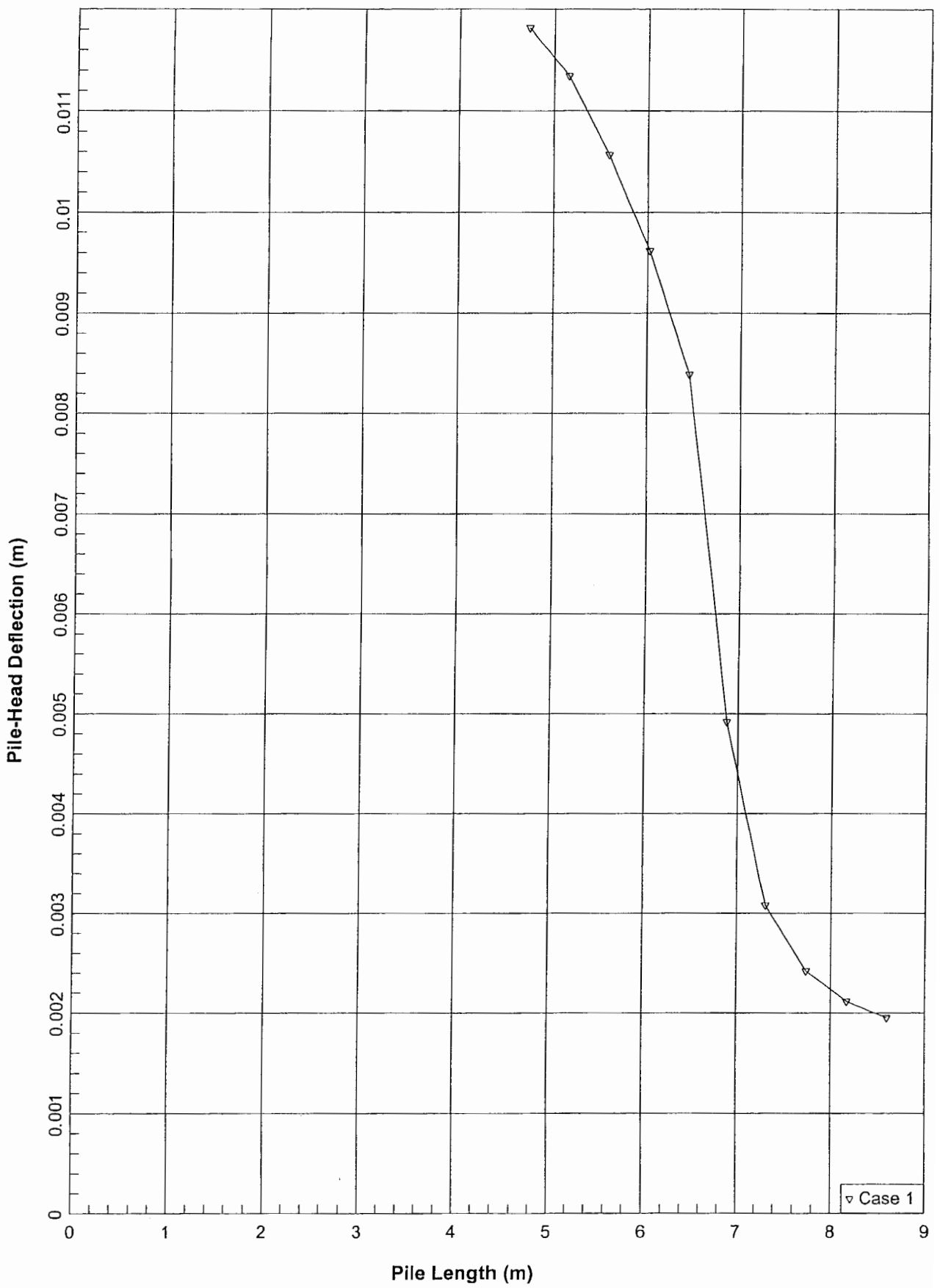



Shear Force (kN)
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
Case 46.649


Bending Moment (kN-m)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
Case 46.649


p (kN/m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
y (m)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
Depth 5


Mobilized Soil Reaction (kN/m)
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80
90
Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
Case 46.649


Pile-Head Deflection (m)
0
0.001
0.002
0.003
0.004
0.005
0.006
0.007
0.008
0.009
0.01
0.011
0
1
2
3
4
5
6
7
8
9
Pile Length (m)
Case 1

Combo-1 (S2)

S2-combo1.lpo

==========

LPILE Plus for Windows, Version 4.0

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:

Betty Lee
Caltrans

Path to file locations:	C:\Program Files\Ensoft\LpileP4\
Name of input data file:	S2-combo1.lpd
Name of output file:	S2-combo1.lpo
Name of plot output file:	S2-combo1.lpp
Name of runtime file:	S2-combo1.lpr

Time and Date of Analysis

Date: February 17, 2005 Time: 15:36:47

Problem Title

High St. Sign-S2

Program Options

Units Used in Computations - SI Units, meters, kilopascals

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 does not use p-y multipliers (individual pile or shaft action only)
- 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
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100

- Deflection tolerance for convergence = 1.0000E-05 m
- Maximum allowable deflection = 3.7300E+00 m

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) = 1

Pile Structural Properties and Geometry

Pile Length = 7.00 m
Depth of ground surface below top of pile = .00 m
Slope angle of ground surface = .00 deg.

Structural properties of pile defined using 2 points

Point	Depth X m	Pile Diameter m	Moment of Inertia m**4	Pile Area Sq. m	Modulus of Elasticity kN/Sq. m
1	0.0000	1.52400000	.2648	1.8240	20684274.000
2	7.0000	1.52400000	.2648	1.8240	20684274.000

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is stiff clay without free water
Distance from top of pile to top of layer = .000 m
Distance from top of pile to bottom of layer = 4.400 m
p-y subgrade modulus k for top of soil layer = 81434.148 kN/ m**3
p-y subgrade modulus k for bottom of layer = 81434.148 kN/ m**3

Layer 2 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 4.400 m
Distance from top of pile to bottom of layer = 7.000 m

(Depth of lowest layer extends .00 m below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth is defined using 4 points

Point No.	Depth X m	Eff. Unit Weight kN/ m**3
1	.00	18.85050
2	4.40	18.85050
3	4.40	15.39105
4	7.00	15.39105

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 4 points

Point No.	Depth X m	Cohesion c kN/ m**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	.000	96.50000	.00	.00400	.0
2	4.400	96.50000	.00	.00400	.0
3	4.400	28.95798	.00	.01500	.0
4	7.000	28.95798	.00	.01500	.0

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.

Cyclic loading criteria was used for computation of p-y curves

Number of cycles of loading = 100.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 64.591 kN
Bending moment at pile head = 354.605 m- kN
Axial load at pile head = 59.828 kN

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment)condition.

Output of p-y Curves at Specified Depths

p-y curves are generated and printed for verification at 1 depths.

Depth No.	Depth Below Pile Head m	Depth Below Ground Surface m
1	6.477	6.477

p-y Curve Computed Using the Soft Clay Criteria for Cyclic Loading Conditions

Soil Layer Number	=	2	
Depth below ground surface	=	6.477	m
Equivalent Depth	=	15.217	m
Pile Diameter	=	1.524	m
Cohesion, c	=	28.958	kN/ m**2
Avg Eff Unit Weight	=	17.74115	kN/ m**3
E50 parameter	=	.01500	
Default J parameter	=	.500	
Y50	=	.05715	m
p-multiplier	=	1.00000	
y-multiplier	=	1.00000	
Number of cycles of loading	=	100.	
Xr	=	6.378	m

y, m	p, kN/ m
.0000	.000
.0005	39.719
.0143	125.106
.0286	157.624
.0429	180.434
.0571	198.594
.0714	213.929
.0857	227.333
.1000	239.320
.1143	250.213
.1286	260.232
.1429	269.533
.1572	278.234
.1714	286.422
.4572	285.975
.8572	285.975
1.1430	285.975

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)

Specified shear force at pile head	=	64.591	kN
Specified bending moment at pile head	=	354.605	m- kN
Specified axial load at pile head	=	59.828	kN

Non-zero moment for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment)condition.

Depth X m	Deflect. y m	Moment M kN- m	Shear V kN	Slope S Rad.	Total Stress kN/ m**2	Soil Res p kN/ m
0.000	4.73E-04	354.6050	64.5910	-2.557E-04	1053.2658	-75.0272
.07000	4.56E-04	358.9436	59.3329	-2.511E-04	1065.7512	-75.2051
.140	4.38E-04	362.9137	54.0632	-2.465E-04	1077.1761	-75.3572
.210	4.21E-04	366.5145	48.7838	-2.419E-04	1087.5384	-75.4829
.280	4.04E-04	369.7455	43.4965	-2.372E-04	1096.8362	-75.5819

.350	3.88E-04	372.6060	38.2033	-2.324E-04	1105.0682	-75.6537
.420	3.72E-04	375.0959	32.9060	-2.276E-04	1112.2334	-75.6977
.490	3.56E-04	377.2148	27.6066	-2.228E-04	1118.3311	-75.7136
.560	3.41E-04	378.9627	22.3071	-2.180E-04	1123.3610	-75.7007
.630	3.26E-04	380.3396	17.0095	-2.131E-04	1127.3235	-75.6586
.700	3.11E-04	381.3458	11.7159	-2.083E-04	1130.2191	-75.5865
.770	2.96E-04	381.9816	6.4285	-2.034E-04	1132.0487	-75.4838
.840	2.82E-04	382.2475	1.1493	-1.985E-04	1132.8139	-75.3498
.910	2.69E-04	382.1441	-4.1194	-1.936E-04	1132.5165	-75.1838
.980	2.55E-04	381.6724	-9.3753	-1.888E-04	1131.1589	-74.9849
1.050	2.42E-04	380.8332	-14.6161	-1.839E-04	1128.7439	-74.7522
1.120	2.29E-04	379.6277	-19.8394	-1.790E-04	1125.2747	-74.4847
1.190	2.17E-04	378.0571	-25.0427	-1.742E-04	1120.7552	-74.1812
1.260	2.05E-04	376.1231	-30.2235	-1.694E-04	1115.1896	-73.8407
1.330	1.93E-04	373.8273	-35.3790	-1.646E-04	1108.5827	-73.4617
1.400	1.82E-04	371.1714	-40.5067	-1.598E-04	1100.9399	-73.0426
1.470	1.71E-04	368.1577	-45.6035	-1.551E-04	1092.2670	-72.5819
1.540	1.60E-04	364.7882	-50.6666	-1.504E-04	1082.5706	-72.0775
1.610	1.50E-04	361.0656	-55.6928	-1.458E-04	1071.8578	-71.5273
1.680	1.40E-04	356.9925	-60.6788	-1.412E-04	1060.1363	-70.9288
1.750	1.30E-04	352.5718	-65.6210	-1.366E-04	1047.4146	-70.2791
1.820	1.21E-04	347.8067	-70.5159	-1.322E-04	1033.7019	-69.5747
1.890	1.12E-04	342.7006	-75.3594	-1.277E-04	1019.0080	-68.8118
1.960	1.03E-04	337.2574	-80.1474	-1.234E-04	1003.3437	-67.9857
2.030	9.44E-05	331.4811	-84.8750	-1.191E-04	986.7208	-67.0908
2.100	8.62E-05	325.3759	-89.5374	-1.149E-04	969.1517	-66.1205
2.170	7.83E-05	318.9468	-94.1290	-1.108E-04	950.6502	-65.0666
2.240	7.07E-05	312.1988	-98.6435	-1.068E-04	931.2312	-63.9191
2.310	6.34E-05	305.1376	-103.0739	-1.028E-04	910.9108	-62.6652
2.380	5.63E-05	297.7693	-107.4123	-9.898E-05	889.7067	-61.2887
2.450	4.95E-05	290.1007	-111.6493	-9.523E-05	867.6383	-59.7683
2.520	4.30E-05	282.1392	-115.7738	-9.157E-05	844.7271	-58.0754
2.590	3.67E-05	273.8931	-119.7724	-8.802E-05	820.9969	-56.1701
2.660	3.07E-05	265.3718	-123.6282	-8.457E-05	796.4747	-53.9941
2.730	2.49E-05	256.5859	-127.3190	-8.124E-05	771.1910	-51.4579
2.800	1.93E-05	247.5478	-130.8144	-7.801E-05	745.1817	-48.4114
2.870	1.39E-05	238.2725	-134.0688	-7.491E-05	718.4897	-44.5717
2.940	8.79E-06	228.7788	-137.0039	-7.193E-05	691.1691	-39.2873
3.010	3.86E-06	219.0926	-139.4391	-6.906E-05	663.2945	-30.2908
3.080	-8.77E-07	209.2579	-138.3308	-6.633E-05	634.9928	61.9592
3.150	-5.43E-06	199.7268	-134.7203	-6.371E-05	607.5647	41.1978
3.220	-9.80E-06	190.3976	-131.6654	-6.122E-05	580.7175	46.0848
3.290	-1.40E-05	181.2942	-128.3031	-5.884E-05	554.5201	49.9799
3.360	-1.80E-05	172.4356	-124.6913	-5.658E-05	529.0275	53.2157
3.430	-2.19E-05	163.8379	-120.8684	-5.443E-05	504.2852	56.0090
3.500	-2.57E-05	155.5145	-116.8611	-5.239E-05	480.3327	58.4861
3.570	-2.93E-05	147.4778	-112.6886	-5.046E-05	457.2049	60.7260
3.640	-3.27E-05	139.7385	-108.3659	-4.862E-05	434.9333	62.7812
3.710	-3.61E-05	132.3069	-103.9045	-4.688E-05	413.5470	64.6884
3.780	-3.93E-05	125.1923	-99.3138	-4.524E-05	393.0729	66.4742
3.850	-4.24E-05	118.4034	-94.6016	-4.368E-05	373.5361	68.1590
3.920	-4.54E-05	111.9485	-89.7745	-4.221E-05	354.9603	69.7582
3.990	-4.83E-05	105.8353	-84.8380	-4.082E-05	337.3683	71.2840
4.060	-5.11E-05	100.0715	-79.7970	-3.950E-05	320.7813	72.7465
4.130	-5.38E-05	94.6641	-74.6554	-3.826E-05	305.2202	74.1537
4.200	-5.65E-05	89.6200	-69.4171	-3.708E-05	290.7047	75.5121
4.270	-5.90E-05	84.9460	-64.0853	-3.596E-05	277.2539	76.8274
4.340	-6.15E-05	80.6484	-58.6627	-3.491E-05	264.8865	78.1043
4.410	-6.39E-05	76.7335	-55.3567	-3.390E-05	253.6205	16.3525
4.480	-6.63E-05	72.8987	-54.2007	-3.294E-05	242.5850	16.6751
4.550	-6.85E-05	69.1457	-53.0224	-3.204E-05	231.7846	16.9909
4.620	-7.07E-05	65.4759	-51.8222	-3.118E-05	221.2238	17.3005
4.690	-7.29E-05	61.8908	-50.6005	-3.036E-05	210.9069	17.6044

4.760	-7.50E-05	58.3921	-49.3577	-2.959E-05	200.8383	17.9033
4.830	-7.70E-05	54.9810	-48.0942	-2.887E-05	191.0221	18.1974
4.900	-7.90E-05	51.6591	-46.8103	-2.819E-05	181.4626	18.4874
4.970	-8.10E-05	48.4278	-45.5061	-2.755E-05	172.1637	18.7735
5.040	-8.29E-05	45.2885	-44.1821	-2.695E-05	163.1295	19.0560
5.110	-8.48E-05	42.2425	-42.8384	-2.639E-05	154.3640	19.3355
5.180	-8.66E-05	39.2913	-41.4752	-2.587E-05	145.8712	19.6120
5.250	-8.84E-05	36.4362	-40.0928	-2.539E-05	137.6549	19.8860
5.320	-9.01E-05	33.6786	-38.6913	-2.494E-05	129.7190	20.1577
5.390	-9.19E-05	31.0197	-37.2708	-2.452E-05	122.0673	20.4273
5.460	-9.36E-05	28.4608	-35.8315	-2.414E-05	114.7037	20.6950
5.530	-9.52E-05	26.0034	-34.3736	-2.380E-05	107.6319	20.9612
5.600	-9.69E-05	23.6487	-32.8970	-2.348E-05	100.8557	21.2260
5.670	-9.85E-05	21.3981	-31.4020	-2.319E-05	94.3788	21.4895
5.740	-1.00E-04	19.2527	-29.8885	-2.293E-05	88.2048	21.7520
5.810	-1.02E-04	17.2139	-28.3567	-2.270E-05	82.3377	22.0136
5.880	-1.03E-04	15.2829	-26.8066	-2.249E-05	76.7809	22.2745
5.950	-1.05E-04	13.4611	-25.2383	-2.231E-05	71.5382	22.5348
6.020	-1.06E-04	11.7497	-23.6518	-2.215E-05	66.6133	22.7947
6.090	-1.08E-04	10.1501	-22.0471	-2.201E-05	62.0098	23.0543
6.160	-1.10E-04	8.6633	-20.4242	-2.188E-05	57.7314	23.3136
6.230	-1.11E-04	7.2909	-18.7832	-2.178E-05	53.7817	23.5729
6.300	-1.13E-04	6.0339	-17.1240	-2.170E-05	50.1644	23.8323
6.370	-1.14E-04	4.8937	-15.4467	-2.163E-05	46.8832	24.0886
6.440	-1.16E-04	3.8715	-13.7571	-2.157E-05	43.9417	24.1865
6.510	-1.17E-04	2.9679	-12.0607	-2.153E-05	41.3412	24.2833
6.580	-1.19E-04	2.1832	-10.3575	-2.150E-05	39.0831	24.3792
6.650	-1.20E-04	1.5180	-8.6476	-2.147E-05	37.1689	24.4742
6.720	-1.22E-04	.9727	-6.9311	-2.146E-05	35.5997	24.5684
6.790	-1.23E-04	.5478	-5.2081	-2.145E-05	34.3769	24.6618
6.860	-1.25E-04	.2438	-3.4785	-2.144E-05	33.5019	24.7545
6.930	-1.26E-04	.061008	-1.7425	-2.144E-05	32.9760	24.8465
7.000	-1.28E-04	0.0000	0.0000	-2.144E-05	32.8004	24.9379

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.00047338	m
Computed slope at pile head	=	-.00025570	
Maximum bending moment	=	382.247	kN- m
Maximum shear force	=	-139.439	kN
Depth of maximum bending moment	=	.84000000	m
Depth of maximum shear force	=	3.01000000	m
Number of iterations	=	10	
Number of zero deflection points	=	1	

Summary of Pile-head Response

Definition of symbols for pile-head boundary conditions:

y = pile-head displacment, m
M = pile-head moment, kN- m
V = pile-head shear force, kN

S = pile-head slope, radians
R = rotational stiffness of pile-head, m- kN/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load kN	Pile Head Deflection m	Maximum Moment m- kN	Maximum Shear kN
1	V= 64.591	M= 354.605	59.8280	4.734E-04	382.2475	-139.4391

Pile-head Deflection vs. Pile Length

Boundary Condition Type 1, Shear and Moment

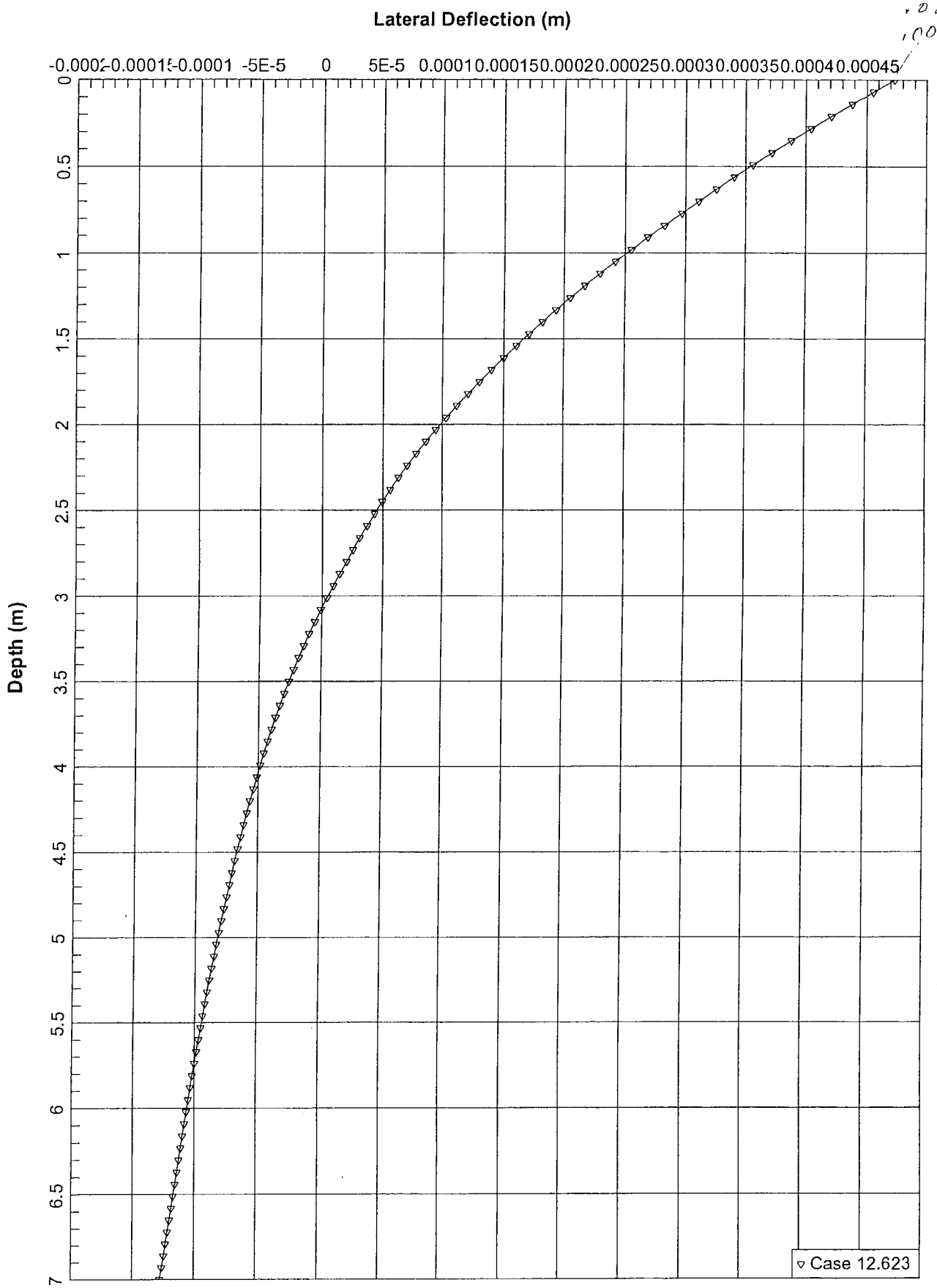
Shear = 65. kN
Moment = 355. m- kN
Axial Load = 60. kN

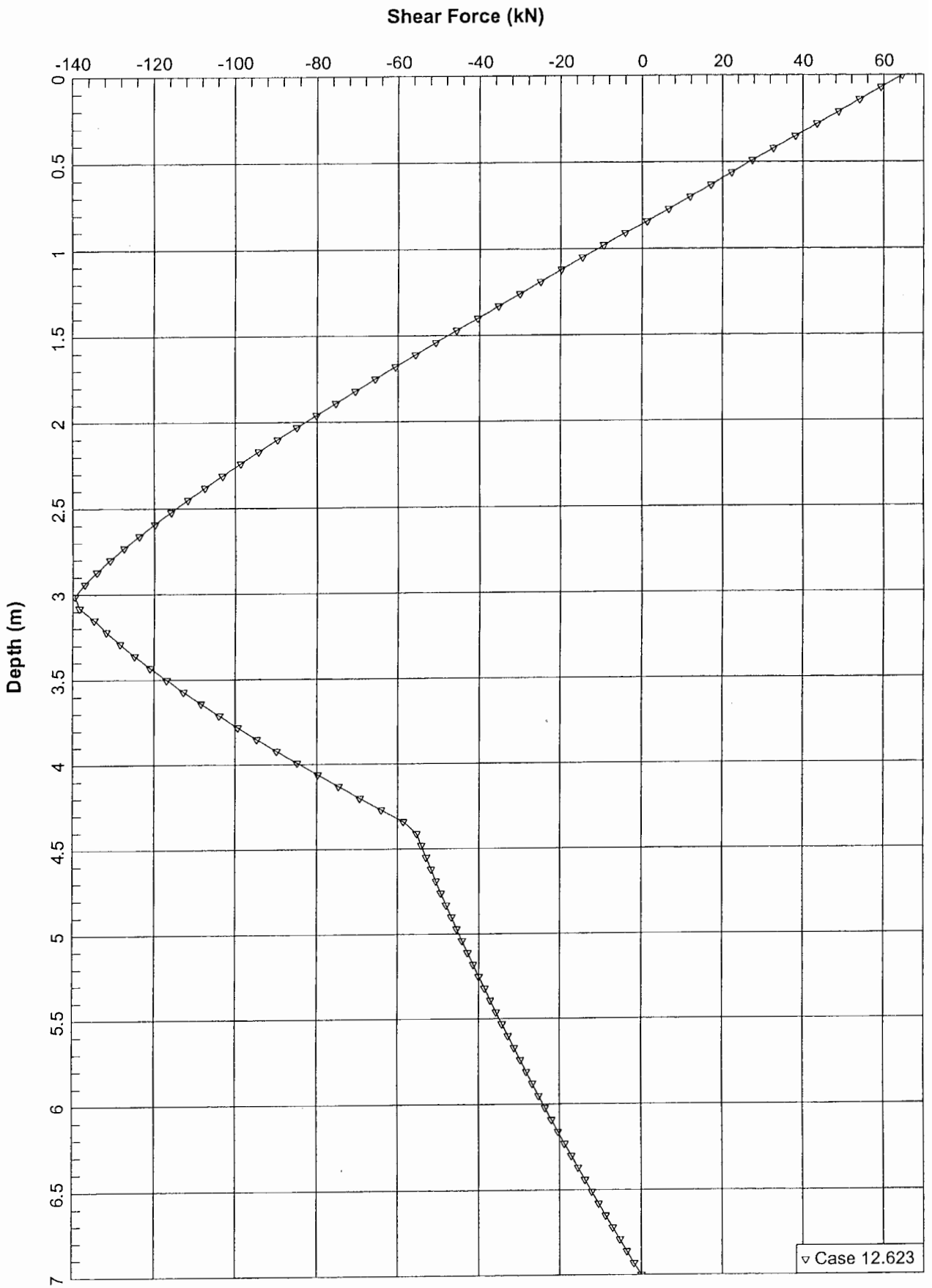
Pile Length m	Pile Head Deflection m	Maximum Moment m- kN	Maximum Shear kN
7.000	.00047338	382.247	-139.439
6.650	.00050573	381.673	-144.714
6.300	.00057535	380.837	-150.739
5.950	.00065766	379.877	-157.599
5.600	.00075468	378.923	-164.283
5.250	.00089497	377.906	-170.724
4.900	.00104281	377.002	-176.133
4.550	.00120411	376.202	-180.379
4.200	.00170625	374.371	-188.553
3.850	.00314209	371.602	-202.068

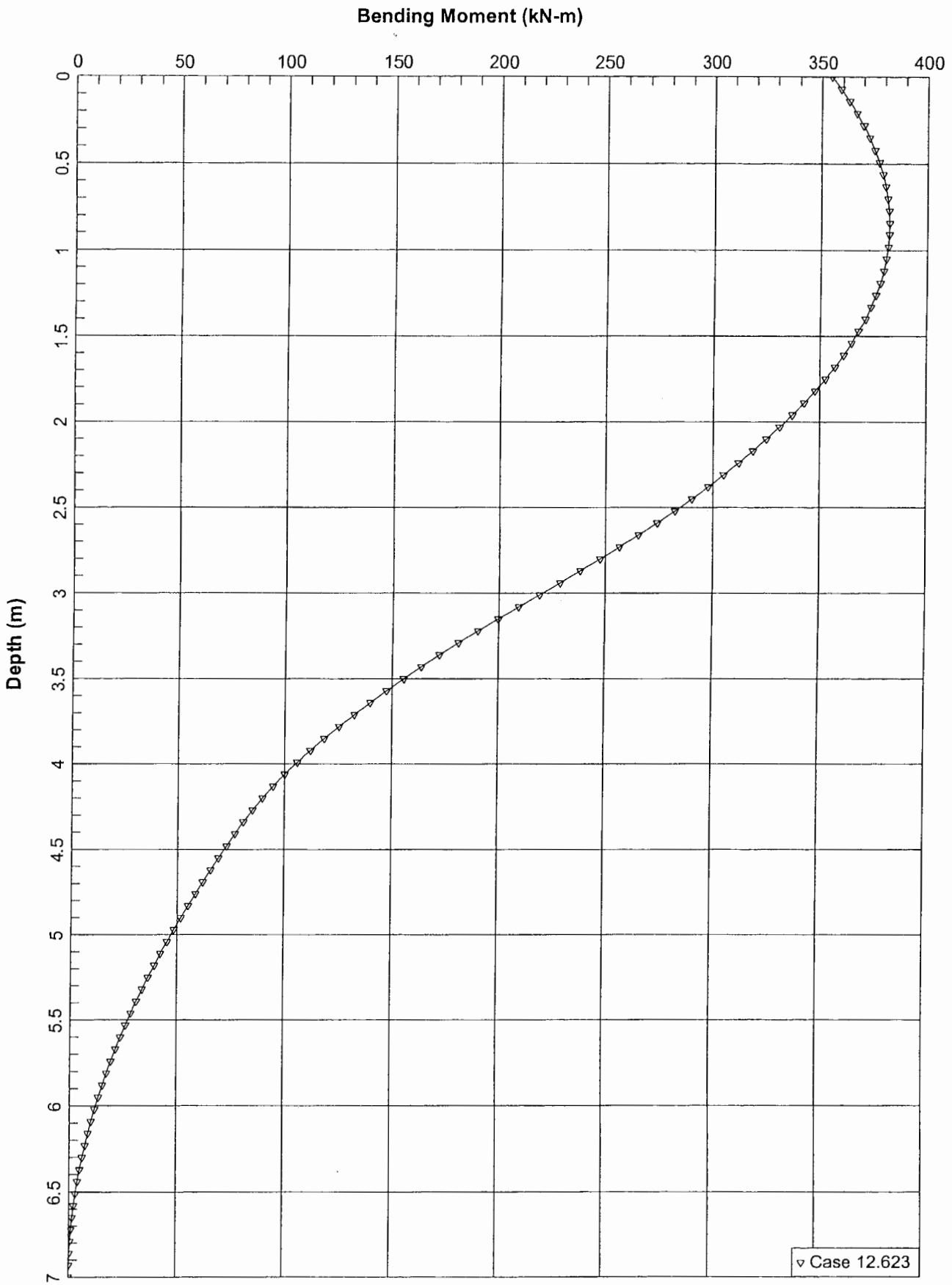
The analysis ended normally.

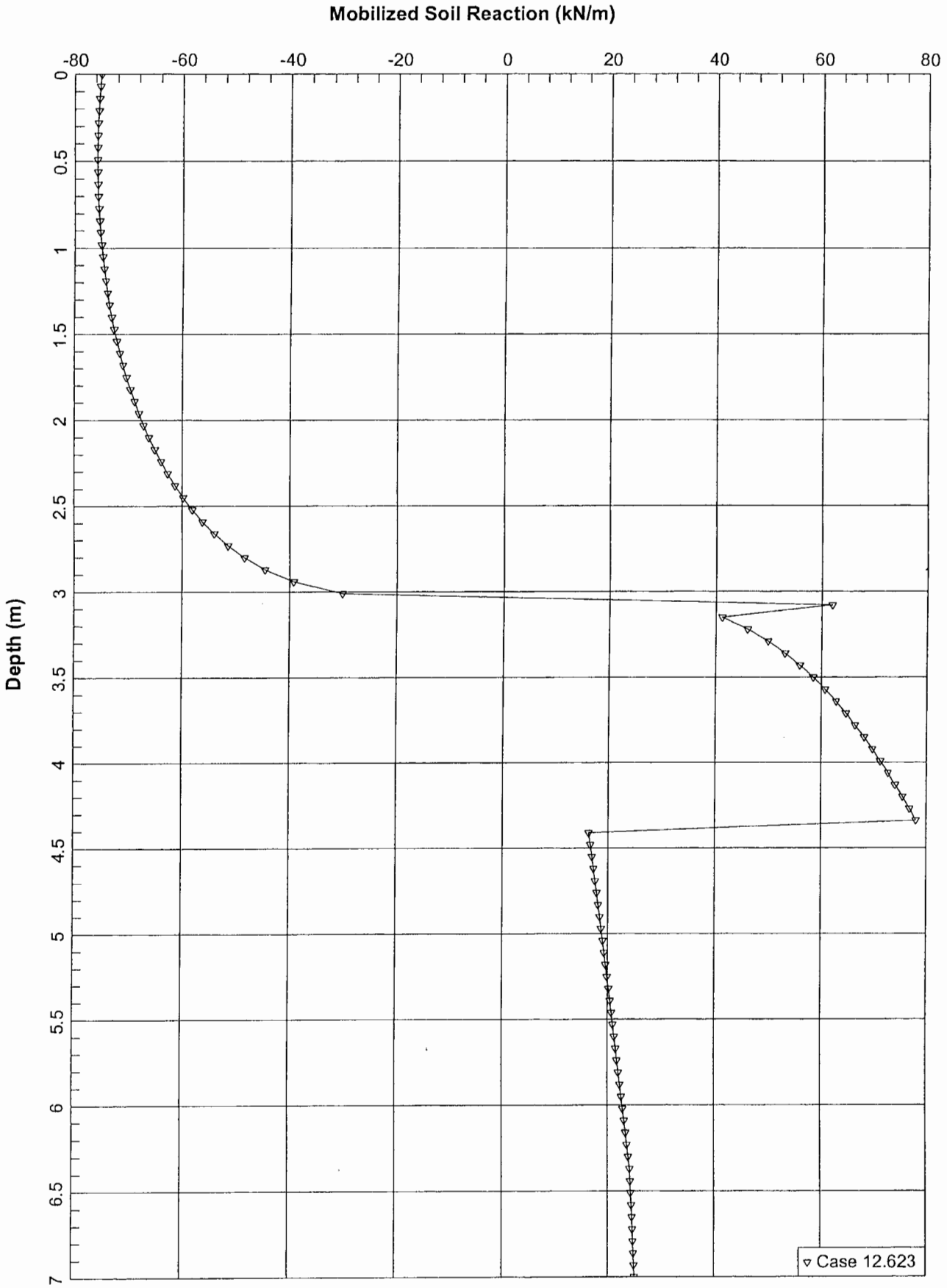
Conlo-1 SZ

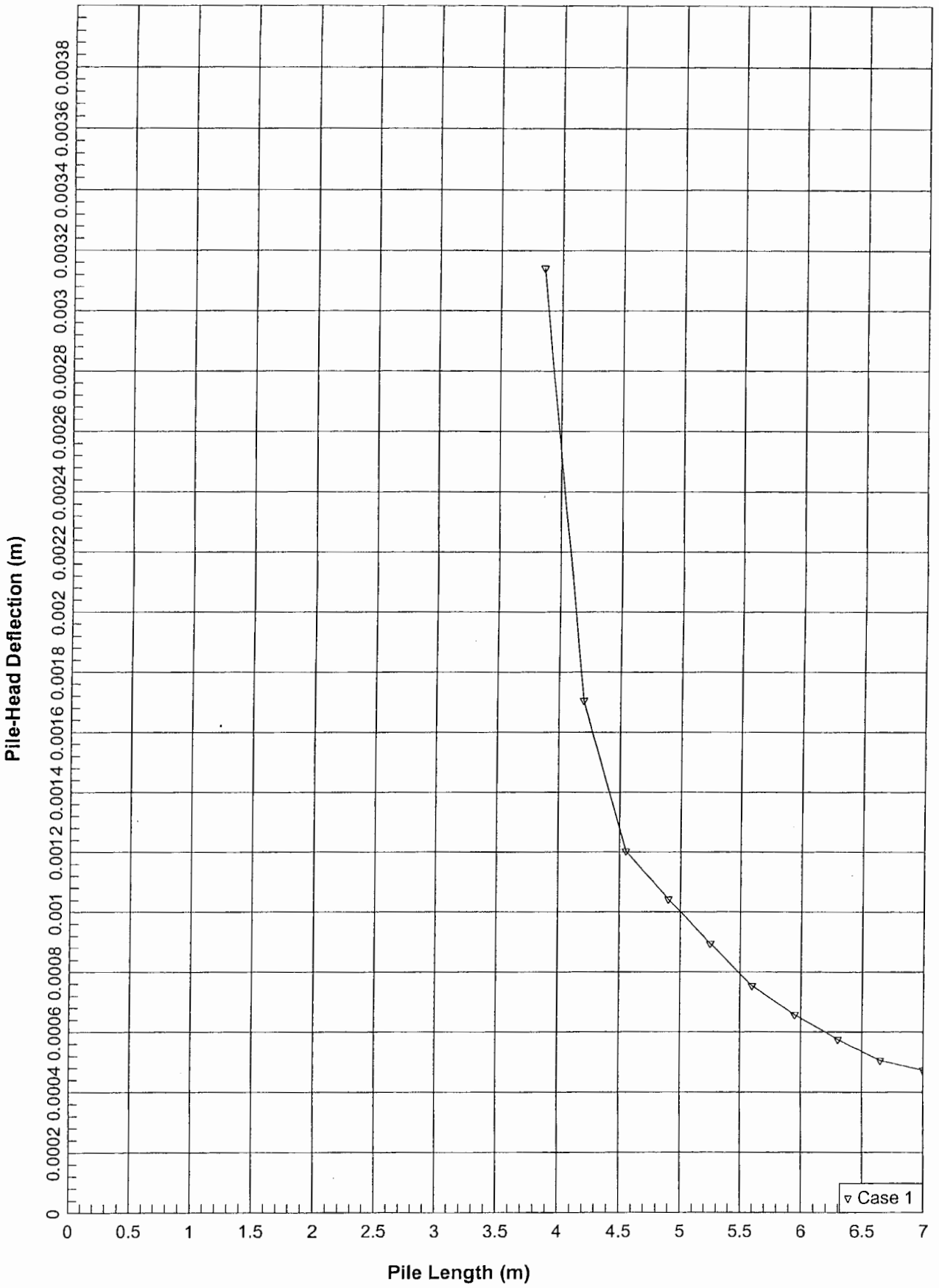
.02"
.00047m

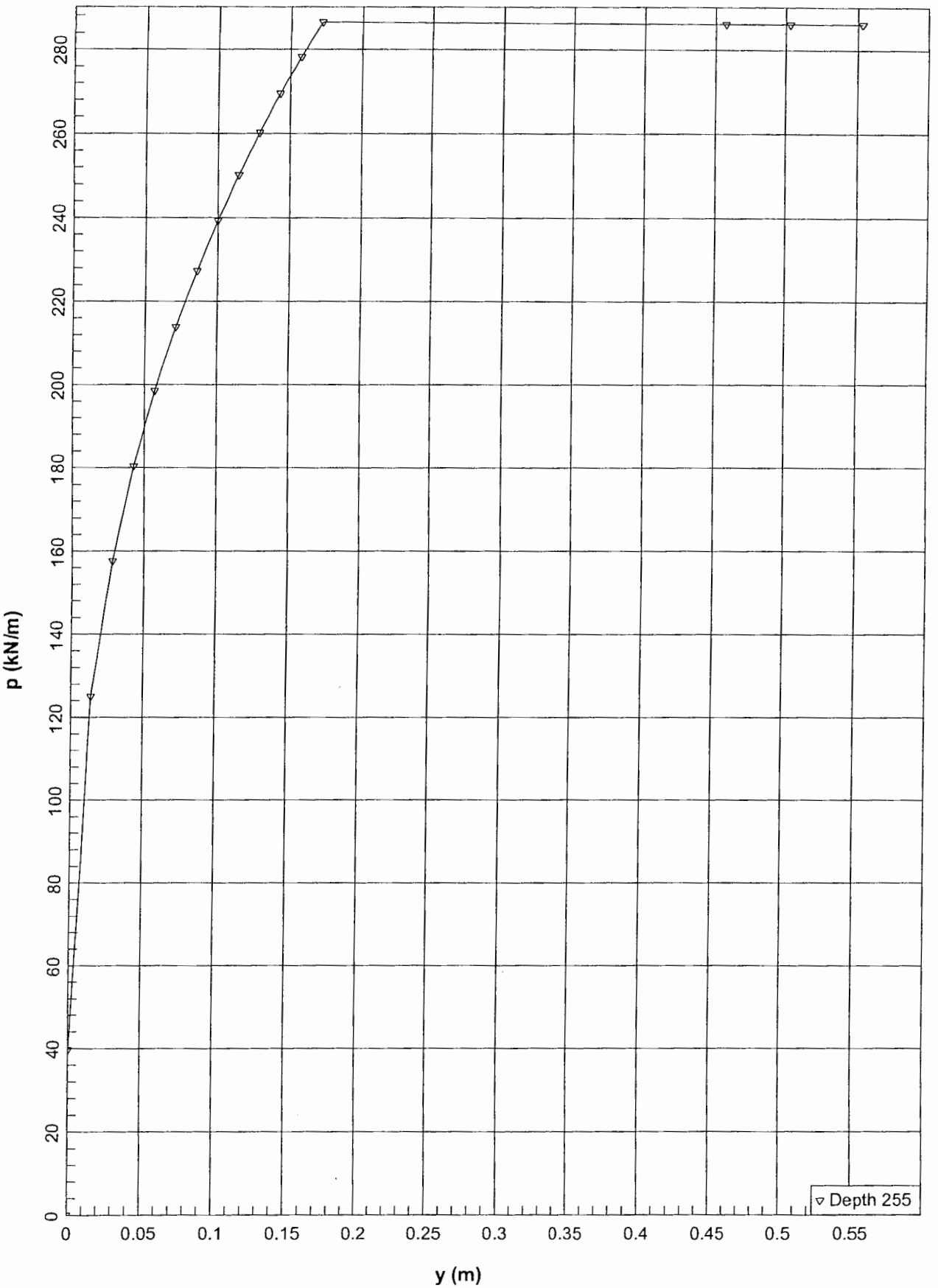



Shear Force (kN)
-140
-120
-100
-80
-60
-40
-20
0
20
40
60
Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
Case 12.623


Bending Moment (kN-m)
0
50
100
150
200
250
300
350
400
Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
Case 12.623


Mobilized Soil Reaction (kN/m)
-80
-60
-40
-20
0
20
40
60
80
Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
Case 12.623


Pile-Head Deflection (m)
0
0.0002
0.0004
0.0006
0.0008
0.001
0.0012
0.0014
0.0016
0.0018
0.002
0.0022
0.0024
0.0026
0.0028
0.003
0.0032
0.0034
0.0036
0.0038
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
Pile Length (m)
Case 1


p (kN/m)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
y (m)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
Depth 255

Combo-2 (S2)

S2-combo2.lpo

==========

LPILE Plus for Windows, Version 4.0

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:

Betty Lee
Caltrans

Path to file locations: C:\Program Files\Ensoft\LpileP4\
Name of input data file: S2-combo2.lpd
Name of output file: S2-combo2.lpo
Name of plot output file: S2-combo2.lpp
Name of runtime file: S2-combo2.lpr

Time and Date of Analysis

Date: February 23, 2005 Time: 16: 1:56

Problem Title

High St. Sign-S2

Program Options

Units Used in Computations - SI Units, meters, kilopascals

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 does not use p-y multipliers (individual pile or shaft action only)
- 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
- Analysis assumes no soil movements acting on pile
- Additional p-y curves computed at specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100

- Deflection tolerance for convergence = 1.0000E-05 m
- Maximum allowable deflection = 3.7300E+00 m

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) = 1

Pile Structural Properties and Geometry

Pile Length = 7.00 m
Depth of ground surface below top of pile = .00 m
Slope angle of ground surface = .00 deg.

Structural properties of pile defined using 2 points

Point	Depth X m	Pile Diameter m	Moment of Inertia m**4	Pile Area Sq. m	Modulus of Elasticity kN/Sq. m
1	0.0000	1.52400000	.2648	1.8240	20684274.000
2	7.0000	1.52400000	.2648	1.8240	20684274.000

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is stiff clay without free water
Distance from top of pile to top of layer = .000 m
Distance from top of pile to bottom of layer = 4.400 m
p-y subgrade modulus k for top of soil layer = 81434.148 kN/ m**3
p-y subgrade modulus k for bottom of layer = 81434.148 kN/ m**3

Layer 2 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 4.400 m
Distance from top of pile to bottom of layer = 7.000 m

(Depth of lowest layer extends .00 m below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth is defined using 4 points

Point No.	Depth X m	Eff. Unit Weight kN/ m**3
1	.00	18.85050
2	4.40	18.85050
3	4.40	15.39105
4	7.00	15.39105

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 4 points

Point No.	Depth X m	Cohesion c kN/ m**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	.000	96.50000	.00	.00400	.0
2	4.400	96.50000	.00	.00400	.0
3	4.400	28.95798	.00	.01500	.0
4	7.000	28.95798	.00	.01500	.0

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.

Cyclic loading criteria was used for computation of p-y curves

Number of cycles of loading = 100.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 38.755 kN
Bending moment at pile head = 401.447 m- kN
Axial load at pile head = 59.828 kN

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment)condition.

Output of p-y Curves at Specified Depths

p-y curves are generated and printed for verification at 1 depths.

Depth No.	Depth Below Pile Head m	Depth Below Ground Surface m
1	6.477	6.477

p-y Curve Computed Using the Soft Clay Criteria for Cyclic Loading Conditions

Soil Layer Number	=	2	
Depth below ground surface	=	6.477	m
Equivalent Depth	=	15.217	m
Pile Diameter	=	1.524	m
Cohesion, c	=	28.958	kN/ m**2
Avg Eff Unit Weight	=	17.74115	kN/ m**3
E50 parameter	=	.01500	
Default J parameter	=	.500	
Y50	=	.05715	m
p-multiplier	=	1.00000	
y-multiplier	=	1.00000	
Number of cycles of loading	=	100.	
Xr	=	6.378	m

y, m	p, kN/ m
.0000	.000
.0005	39.719
.0143	125.106
.0286	157.624
.0429	180.434
.0571	198.594
.0714	213.929
.0857	227.333
.1000	239.320
.1143	250.213
.1286	260.232
.1429	269.533
.1572	278.234
.1714	286.422
.4572	285.975
.8572	285.975
1.1430	285.975

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)

Specified shear force at pile head	=	38.755	kN
Specified bending moment at pile head	=	401.447	m- kN
Specified axial load at pile head	=	59.828	kN

Non-zero moment for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment)condition.

Depth X m	Deflect. y m	Moment M kN- m	Shear V kN	Slope S Rad.	Total Stress kN/ m**2	Soil Res p kN/ m
0.000	4.20E-04	401.4470	38.7550	-2.480E-04	1188.0654	-72.8678
.07000	4.03E-04	403.9824	33.6506	-2.428E-04	1195.3615	-72.9714
.140	3.86E-04	406.1601	28.5400	-2.376E-04	1201.6286	-73.0474
.210	3.69E-04	407.9799	23.4250	-2.324E-04	1206.8656	-73.0954
.280	3.53E-04	409.4416	18.3076	-2.272E-04	1211.0718	-73.1149

.350	3.38E-04	410.5449	13.1899	-2.220E-04	1214.2469	-73.1053
.420	3.22E-04	411.2900	8.0739	-2.167E-04	1216.3912	-73.0660
.490	3.07E-04	411.6771	2.9617	-2.115E-04	1217.5050	-72.9965
.560	2.93E-04	411.7064	-2.1445	-2.062E-04	1217.5895	-72.8960
.630	2.78E-04	411.3786	-7.2426	-2.009E-04	1216.6460	-72.7639
.700	2.64E-04	410.6941	-12.3303	-1.957E-04	1214.6764	-72.5994
.770	2.51E-04	409.6540	-17.4054	-1.905E-04	1211.6830	-72.4017
.840	2.38E-04	408.2590	-22.4654	-1.852E-04	1207.6686	-72.1698
.910	2.25E-04	406.5104	-27.5079	-1.800E-04	1202.6365	-71.9028
.980	2.13E-04	404.4094	-32.5305	-1.748E-04	1196.5904	-71.5996
1.050	2.01E-04	401.9576	-37.5305	-1.697E-04	1189.5347	-71.2589
1.120	1.89E-04	399.1565	-42.5054	-1.646E-04	1181.4740	-70.8795
1.190	1.77E-04	396.0082	-47.4523	-1.595E-04	1172.4138	-70.4599
1.260	1.66E-04	392.5146	-52.3683	-1.544E-04	1162.3600	-69.9983
1.330	1.56E-04	388.6779	-57.2505	-1.495E-04	1151.3191	-69.4930
1.400	1.46E-04	384.5007	-62.0957	-1.445E-04	1139.2983	-68.9418
1.470	1.36E-04	379.9857	-66.9007	-1.396E-04	1126.3052	-68.3422
1.540	1.26E-04	375.1358	-71.6618	-1.348E-04	1112.3483	-67.6915
1.610	1.17E-04	369.9542	-76.3756	-1.300E-04	1097.4369	-66.9863
1.680	1.08E-04	364.4443	-81.0379	-1.253E-04	1081.5809	-66.2229
1.750	9.92E-05	358.6099	-85.6446	-1.207E-04	1064.7910	-65.3968
1.820	9.09E-05	352.4551	-90.1910	-1.162E-04	1047.0789	-64.5027
1.890	8.29E-05	345.9842	-94.6723	-1.117E-04	1028.4571	-63.5340
1.960	7.53E-05	339.2019	-99.0829	-1.073E-04	1008.9395	-62.4831
2.030	6.79E-05	332.1135	-103.4168	-1.031E-04	988.5407	-61.3403
2.100	6.08E-05	324.7244	-107.6669	-9.885E-05	967.2769	-60.0933
2.170	5.41E-05	317.0409	-111.8256	-9.475E-05	945.1656	-58.7267
2.240	4.76E-05	309.0696	-115.8838	-9.075E-05	922.2262	-57.2203
2.310	4.14E-05	300.8179	-119.8306	-8.685E-05	898.4799	-55.5468
2.380	3.54E-05	292.2941	-123.6532	-8.306E-05	873.9503	-53.6684
2.450	2.97E-05	283.5072	-127.3351	-7.938E-05	848.6639	-51.5308
2.520	2.43E-05	274.4678	-130.8555	-7.582E-05	822.6508	-49.0505
2.590	1.91E-05	265.1881	-134.1854	-7.237E-05	795.9460	-46.0913
2.660	1.42E-05	255.6825	-137.2828	-6.904E-05	768.5912	-42.4044
2.730	9.44E-06	245.9691	-140.0779	-6.583E-05	740.6384	-37.4568
2.800	4.94E-06	236.0721	-142.4289	-6.275E-05	712.1575	-29.7138
2.870	6.57E-07	226.0295	-143.8028	-5.980E-05	683.2574	-9.5394
2.940	-3.43E-06	215.9402	-142.5081	-5.698E-05	654.2229	46.5290
3.010	-7.32E-06	206.0789	-139.2675	-5.428E-05	625.8444	46.0616
3.080	-1.10E-05	196.4432	-135.9468	-5.171E-05	598.1154	48.8142
3.150	-1.46E-05	187.0468	-132.4365	-4.926E-05	571.0747	51.4804
3.220	-1.79E-05	177.9025	-128.7486	-4.692E-05	544.7598	53.8891
3.290	-2.11E-05	169.0224	-124.9002	-4.471E-05	519.2049	56.0649
3.360	-2.42E-05	160.4169	-120.9062	-4.260E-05	494.4405	58.0479
3.430	-2.71E-05	152.0958	-116.7790	-4.061E-05	470.4946	59.8728
3.500	-2.99E-05	144.0682	-112.5286	-3.871E-05	447.3929	61.5666
3.570	-3.25E-05	136.3422	-108.1635	-3.692E-05	425.1594	63.1504
3.640	-3.50E-05	128.9256	-103.6908	-3.523E-05	403.8163	64.6410
3.710	-3.74E-05	121.8257	-99.1166	-3.362E-05	383.3847	66.0515
3.780	-3.97E-05	115.0495	-94.4460	-3.211E-05	363.8845	67.3925
3.850	-4.19E-05	108.6036	-89.6838	-3.068E-05	345.3346	68.6729
3.920	-4.40E-05	102.4941	-84.8337	-2.933E-05	327.7530	69.8999
3.990	-4.60E-05	96.7271	-79.8994	-2.806E-05	311.1570	71.0795
4.060	-4.80E-05	91.3084	-74.8841	-2.686E-05	295.5634	72.2169
4.130	-4.98E-05	86.2435	-69.7904	-2.572E-05	280.9880	73.3165
4.200	-5.16E-05	81.5380	-64.6209	-2.465E-05	267.4465	74.3820
4.270	-5.33E-05	77.1968	-59.3780	-2.364E-05	254.9538	75.4167
4.340	-5.49E-05	73.2252	-54.0636	-2.267E-05	243.5245	76.4232
4.410	-5.64E-05	69.6281	-50.8366	-2.176E-05	233.1729	15.7764
4.480	-5.79E-05	66.1083	-49.7234	-2.089E-05	223.0437	16.0292
4.550	-5.94E-05	62.6670	-48.5927	-2.007E-05	213.1406	16.2766
4.620	-6.07E-05	59.3055	-47.4449	-1.929E-05	203.4669	16.5189
4.690	-6.21E-05	56.0249	-46.2802	-1.855E-05	194.0262	16.7565

4.760	-6.33E-05	52.8264	-45.0991	-1.786E-05	184.8217	16.9898
4.830	-6.46E-05	49.7112	-43.9018	-1.720E-05	175.8569	17.2190
4.900	-6.57E-05	46.6803	-42.6886	-1.659E-05	167.1348	17.4446
4.970	-6.69E-05	43.7349	-41.4597	-1.601E-05	158.6587	17.6668
5.040	-6.80E-05	40.8761	-40.2153	-1.547E-05	150.4317	17.8859
5.110	-6.90E-05	38.1049	-38.9557	-1.496E-05	142.4569	18.1021
5.180	-7.01E-05	35.4224	-37.6811	-1.449E-05	134.7373	18.3157
5.250	-7.11E-05	32.8297	-36.3916	-1.406E-05	127.2761	18.5268
5.320	-7.20E-05	30.3277	-35.0874	-1.366E-05	120.0760	18.7358
5.390	-7.30E-05	27.9175	-33.7687	-1.328E-05	113.1402	18.9428
5.460	-7.39E-05	25.6002	-32.4355	-1.294E-05	106.4714	19.1481
5.530	-7.48E-05	23.3767	-31.0880	-1.263E-05	100.0727	19.3518
5.600	-7.57E-05	21.2480	-29.7263	-1.234E-05	93.9468	19.5540
5.670	-7.65E-05	19.2151	-28.3505	-1.208E-05	88.0967	19.7551
5.740	-7.74E-05	17.2790	-26.9606	-1.185E-05	82.5251	19.9550
5.810	-7.82E-05	15.4407	-25.5568	-1.164E-05	77.2350	20.1541
5.880	-7.90E-05	13.7012	-24.1391	-1.146E-05	72.2290	20.3523
5.950	-7.98E-05	12.0613	-22.7075	-1.129E-05	67.5100	20.5500
6.020	-8.06E-05	10.5222	-21.2621	-1.115E-05	63.0807	20.7471
6.090	-8.14E-05	9.0847	-19.8029	-1.102E-05	58.9440	20.9438
6.160	-8.21E-05	7.7499	-18.3300	-1.091E-05	55.1027	21.1403
6.230	-8.29E-05	6.5186	-16.8433	-1.082E-05	51.5594	21.3366
6.300	-8.36E-05	5.3919	-15.3429	-1.075E-05	48.3170	21.5329
6.370	-8.44E-05	4.3707	-13.8288	-1.068E-05	45.3783	21.7263
6.440	-8.51E-05	3.4560	-12.3062	-1.063E-05	42.7459	21.7771
6.510	-8.59E-05	2.6479	-10.7800	-1.060E-05	40.4205	21.8274
6.580	-8.66E-05	1.9469	-9.2503	-1.057E-05	38.4030	21.8773
6.650	-8.74E-05	1.3530	-7.7172	-1.054E-05	36.6940	21.9268
6.720	-8.81E-05	.8665	-6.1806	-1.053E-05	35.2941	21.9760
6.790	-8.88E-05	.4878	-4.6406	-1.052E-05	34.2042	22.0250
6.860	-8.96E-05	.2169	-3.0971	-1.052E-05	33.4248	22.0737
6.930	-9.03E-05	.054274	-1.5502	-1.052E-05	32.9566	22.1222
7.000	-9.10E-05	0.0000	0.0000	-1.052E-05	32.8004	22.1706

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.00041978	m
Computed slope at pile head	=	-.00024797	
Maximum bending moment	=	411.706	kN- m
Maximum shear force	=	-143.803	kN
Depth of maximum bending moment	=	.56000000	m
Depth of maximum shear force	=	2.87000000	m
Number of iterations	=	10	
Number of zero deflection points	=	1	

Summary of Pile-head Response

Definition of symbols for pile-head boundary conditions:

y = pile-head displacment, m
M = pile-head moment, kN- m
V = pile-head shear force, kN

S = pile-head slope, radians
R = rotational stiffness of pile-head, m- kN/rad

BC Type	Boundary Condition 1	Boundary Condition 2	Axial Load kN	Pile Head Deflection m	Maximum Moment m- kN	Maximum Shear kN
1	V= 38.755	M= 401.447	59.8280	4.198E-04	411.7064	-143.8028

Pile-head Deflection vs. Pile Length

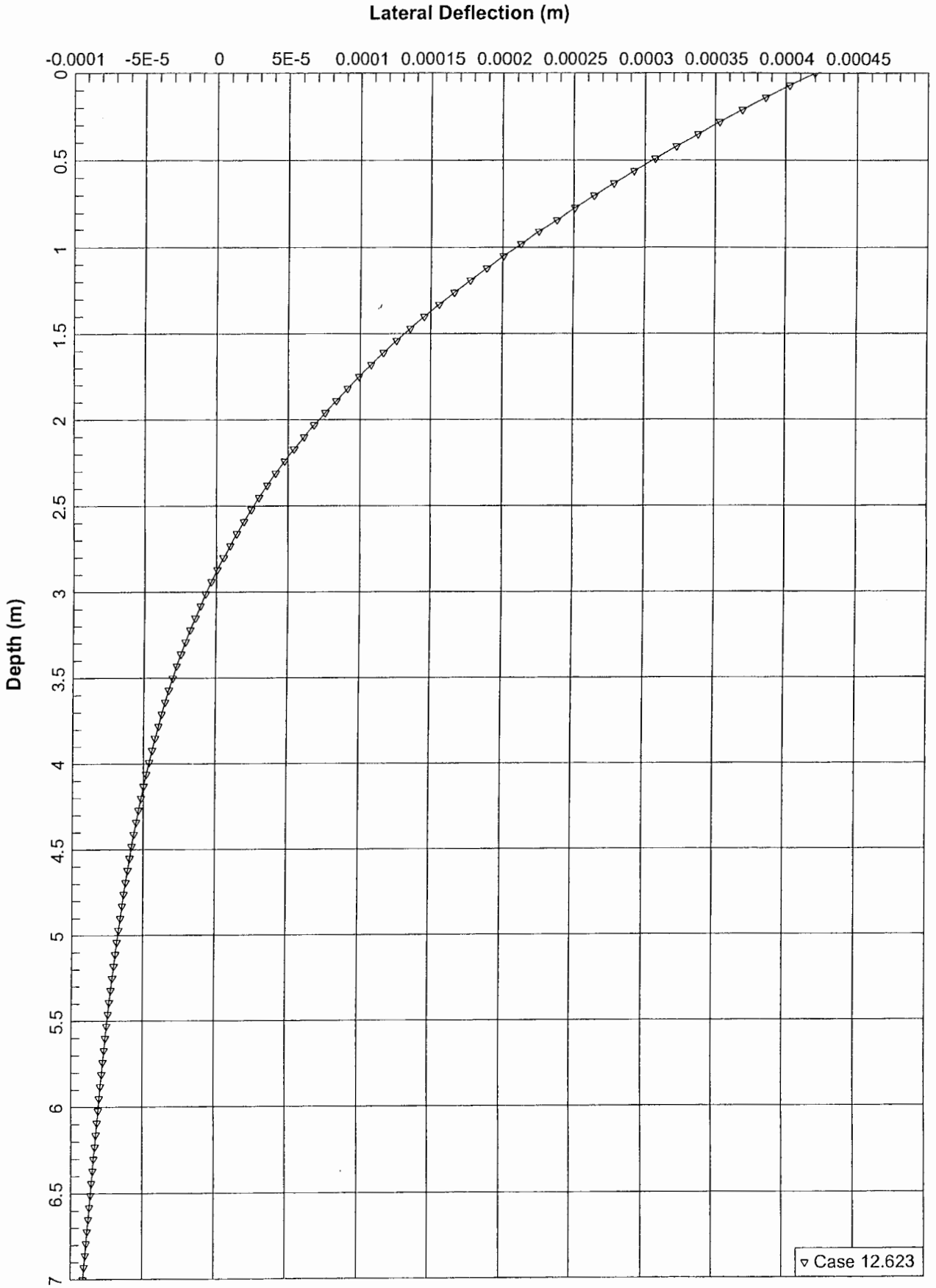
Boundary Condition Type 1, Shear and Moment

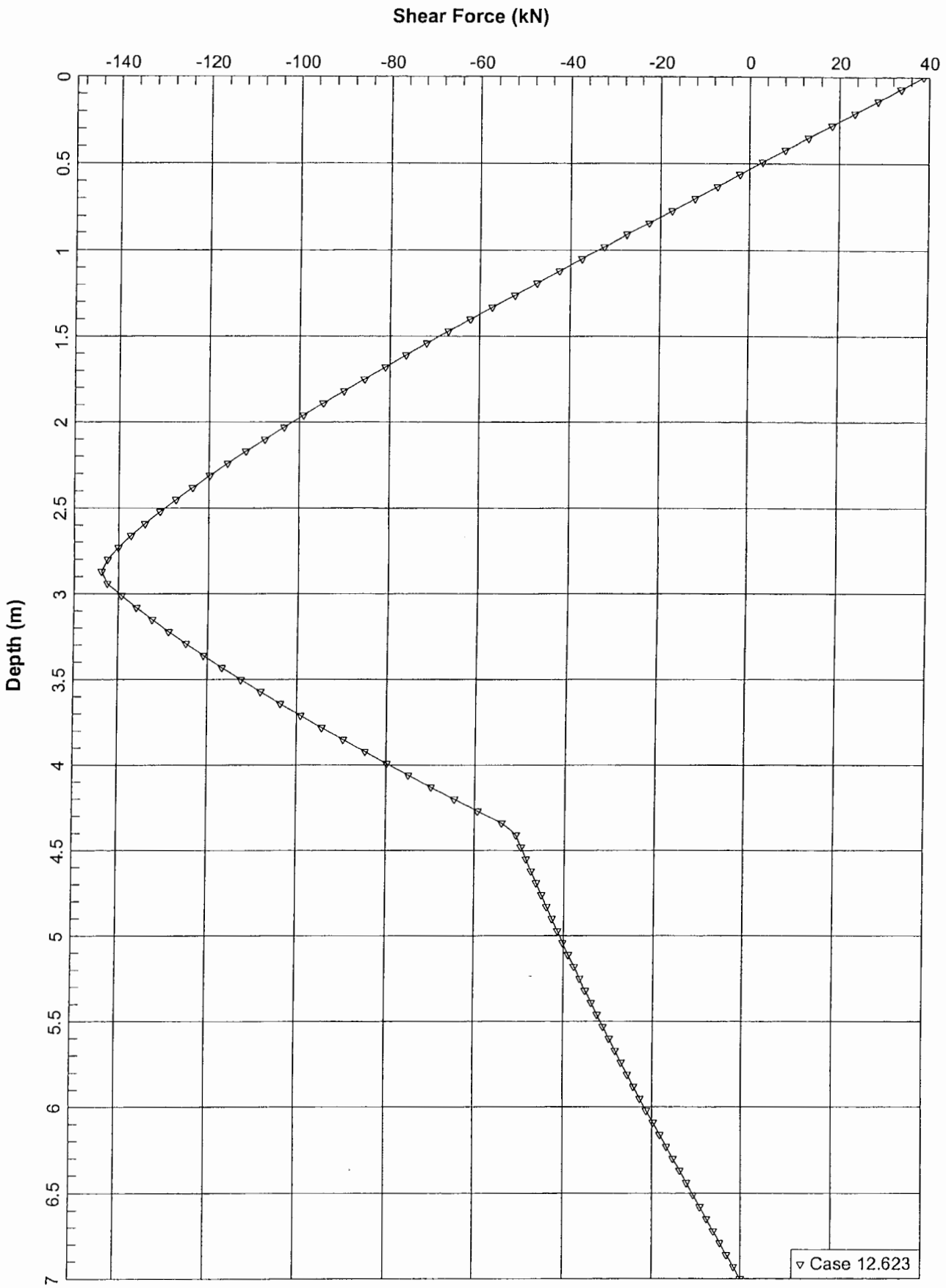
Shear = 39. kN
Moment = 401. m- kN
Axial Load = 60. kN

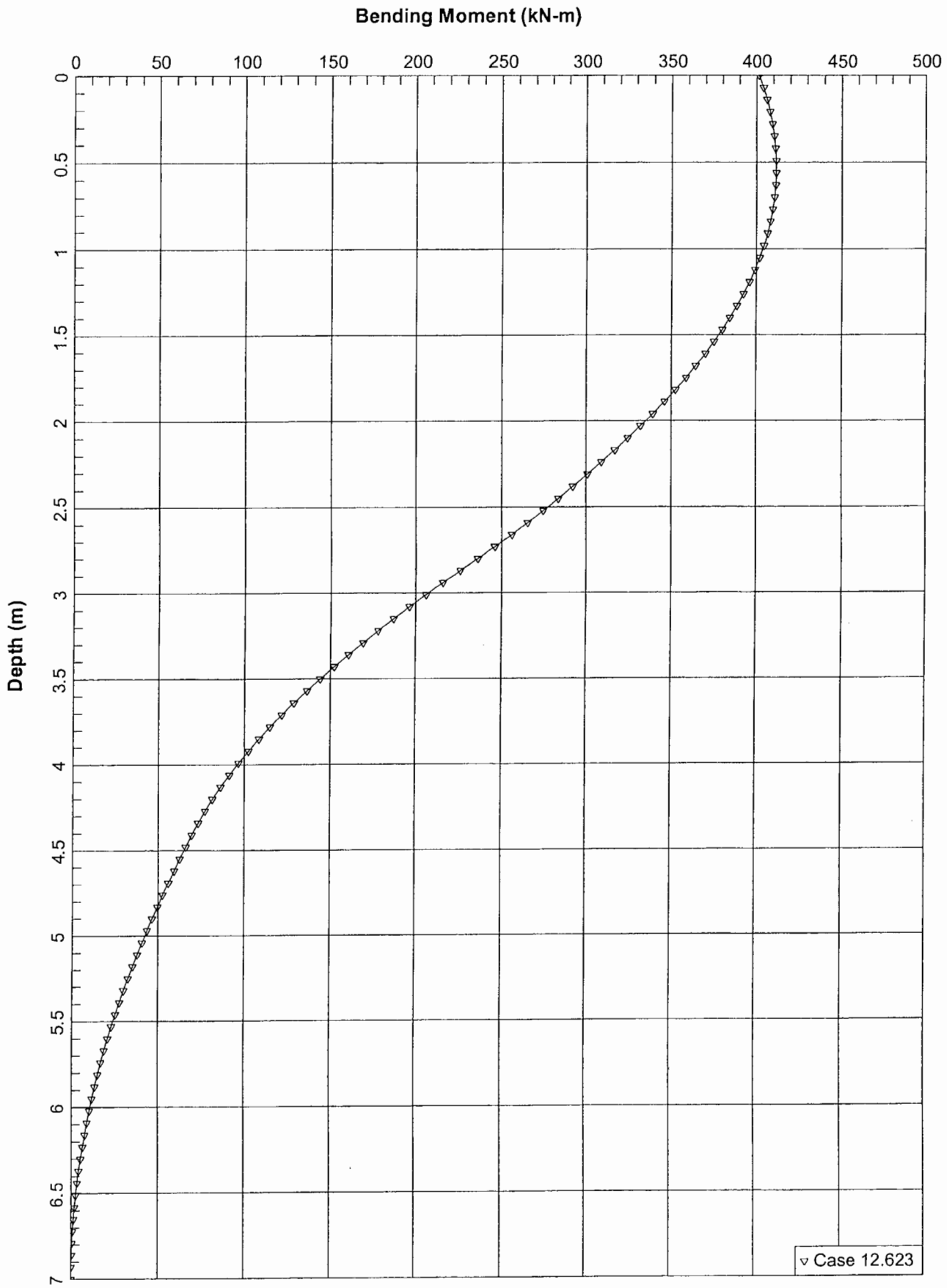
Pile Length m	Pile Head Deflection m	Maximum Moment m- kN	Maximum Shear kN
7.000	.00041978	411.706	-143.803
6.650	.00044847	411.581	-148.572
6.300	.00049587	411.297	-154.431
5.950	.00056018	410.960	-161.142
5.600	.00064437	410.615	-167.692
5.250	.00075495	410.242	-174.316
4.900	.00088421	409.916	-179.991
4.550	.00101509	409.610	-184.511
4.200	.00146965	408.889	-193.922
3.850	.00278654	407.773	-209.535

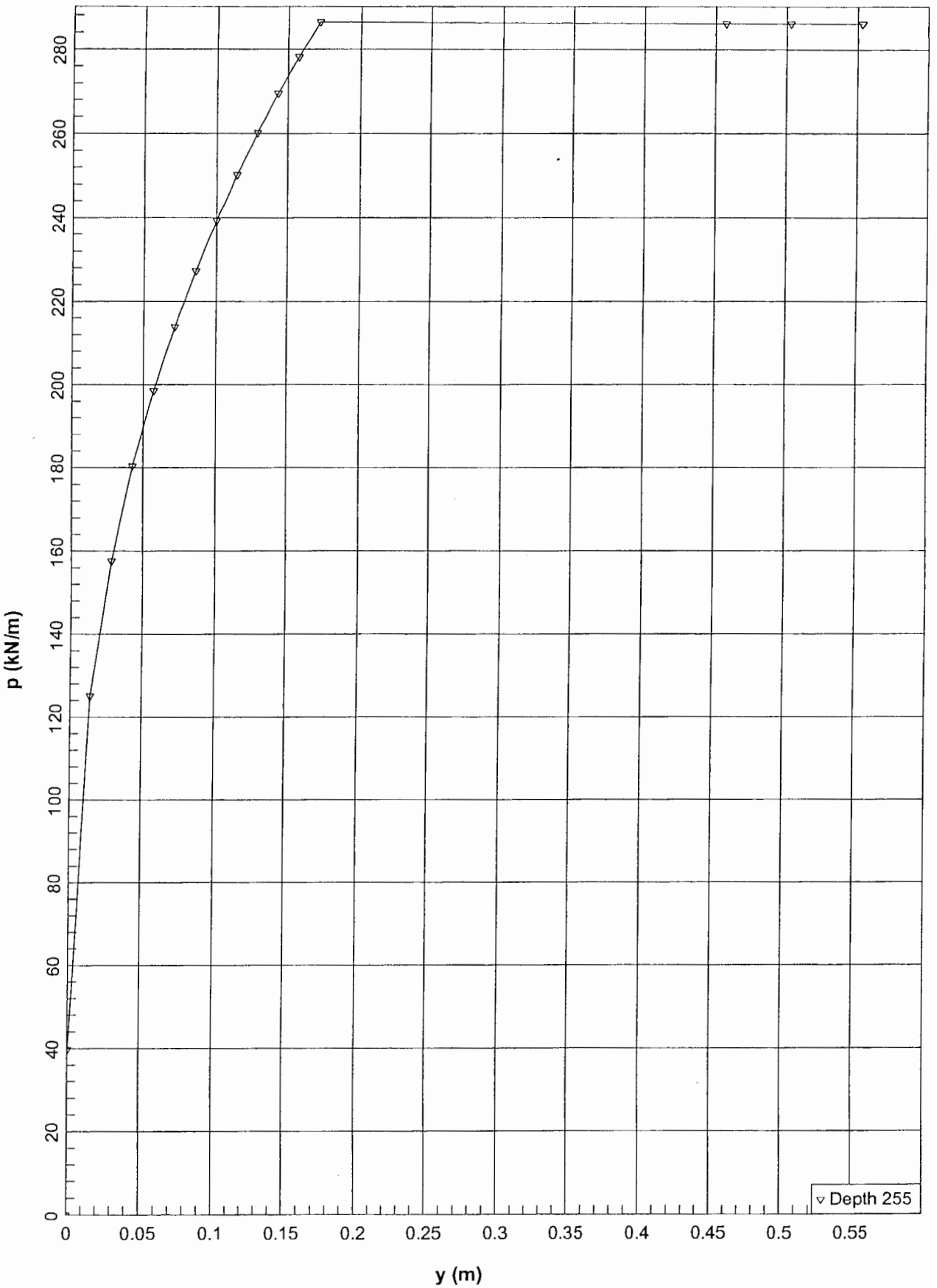
The analysis ended normally.

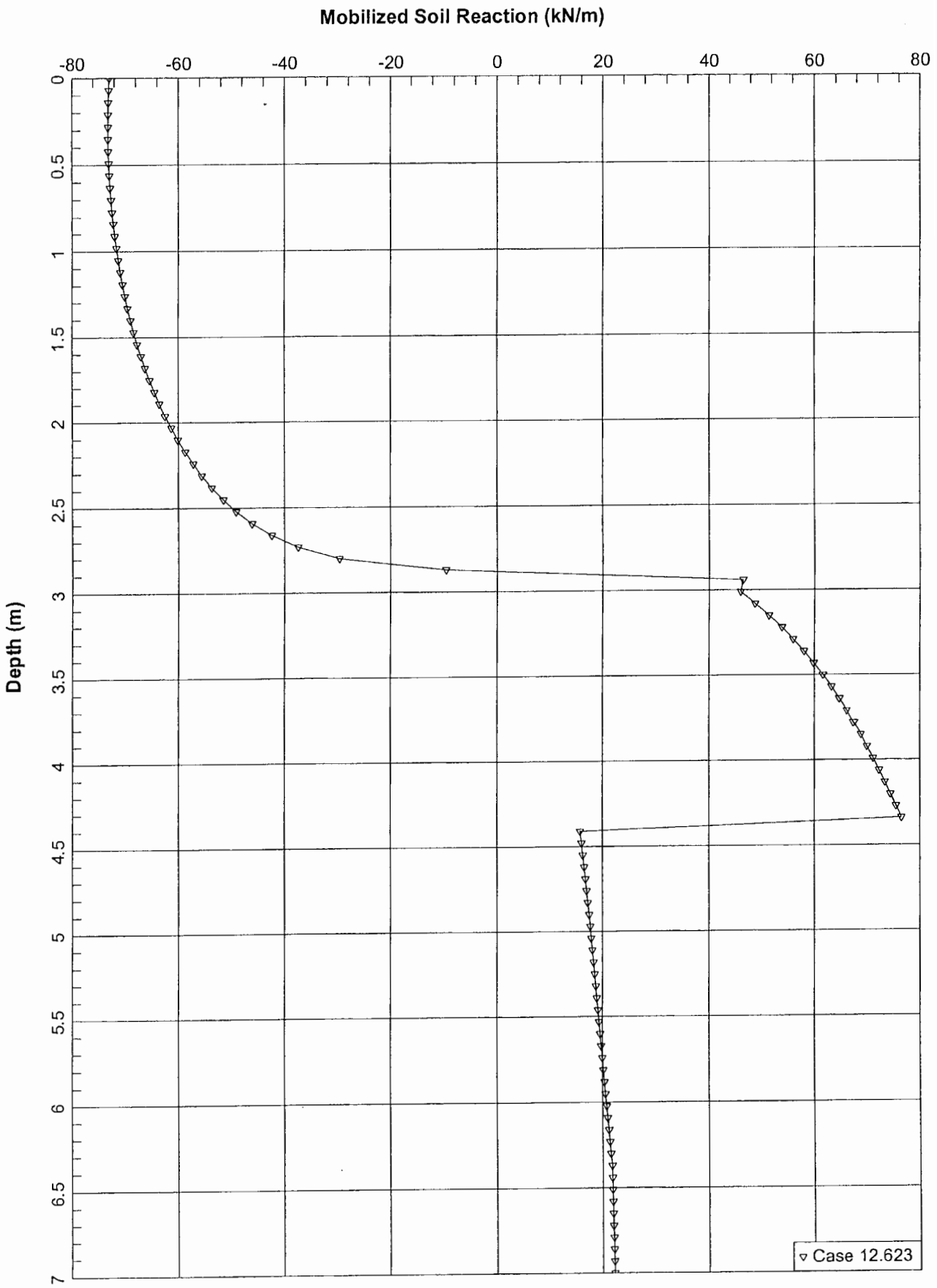
Combo - [illegible] (S2)

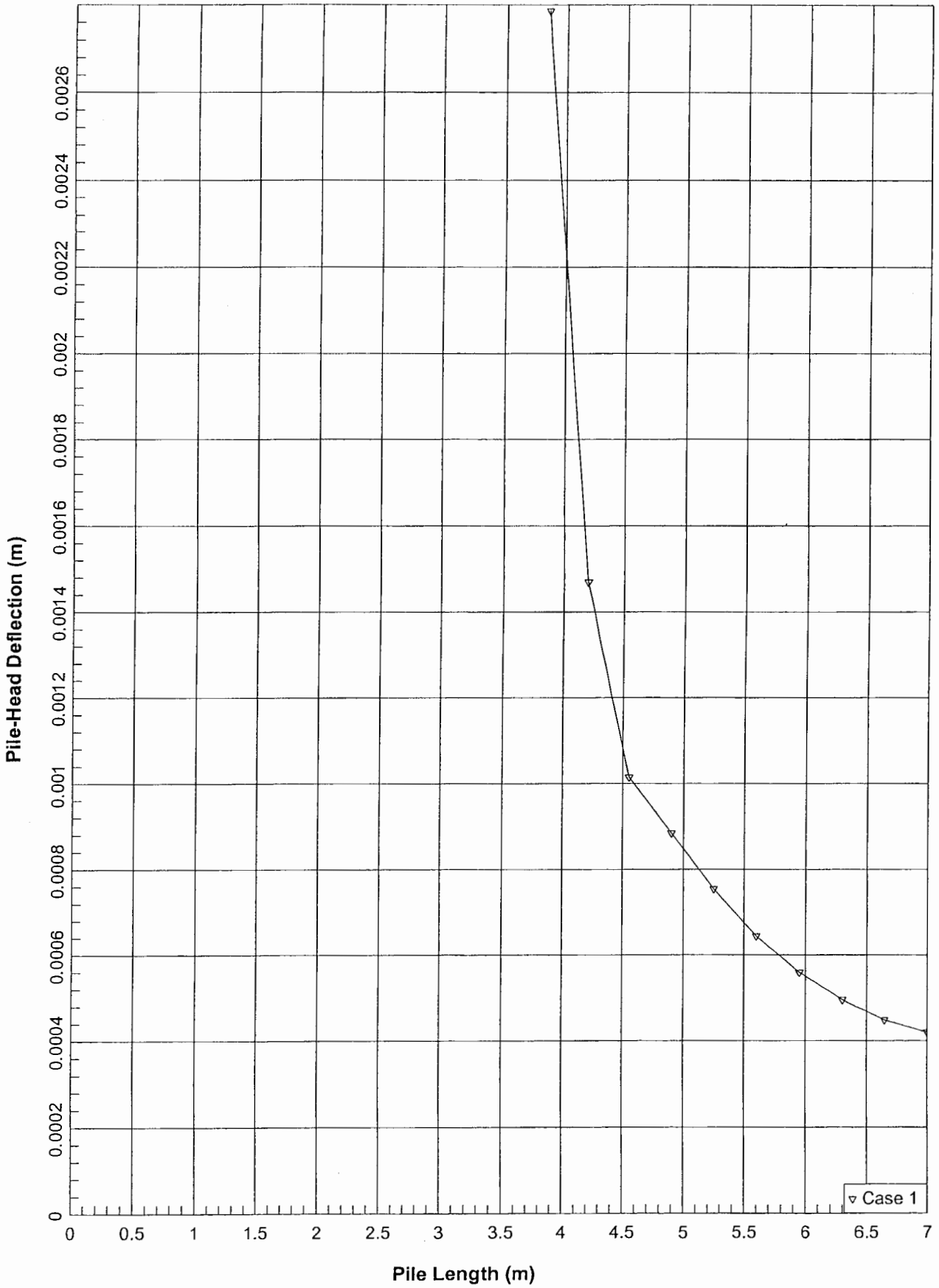

Lateral Deflection (m)
-0.0001
-5E-5
0
5E-5
0.0001
0.00015
0.0002
0.00025
0.0003
0.00035
0.0004
0.00045
Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
Case 12.623


Shear Force (kN)
-140
-120
-100
-80
-60
-40
-20
0
20
40
Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
Case 12.623


Bending Moment (kN-m)
0
50
100
150
200
250
300
350
400
450
500
Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
Case 12.623


p (kN/m)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
y (m)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
Depth 255


Mobilized Soil Reaction (kN/m)
-80
-60
-40
-20
0
20
40
60
80
Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
Case 12.623


Pile-Head Deflection (m)
0
0.0002
0.0004
0.0006
0.0008
0.001
0.0012
0.0014
0.0016
0.0018
0.002
0.0022
0.0024
0.0026
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
Pile Length (m)
Case 1

APPENDIX E

(Guide Specifications)

This SSP is edited by Wajahat Nyaz (510) 622-1777 of
Office of Geotechnical Design West, ES

SETTLEMENT_M.DOC

10-1.__SETTLEMENT INSTRUMENTATION

This work shall consist of installing survey hubs to monitor settlements as provided for in "Earthwork," elsewhere in these special provisions and as directed by the Engineer. The survey hubs and installed in accordance with the Contractor's proposed procedure that was reviewed and approved by the Engineer. A minimum of 48-hour notice shall be required before installation of these instruments.

The Contractor's instrumentation personnel shall monitor these instruments during the period of the contract as mentioned herein these special provisions or as directed by the Engineer. These instruments shall be left in place for the entire duration of the project unless otherwise directed by the Engineer. The survey hubs shall be left in place at the end of this contract unless otherwise directed by the Engineer.

Survey hubs, that are damaged from any cause during the progress of the work shall be repaired or replaced by the Contractor at the Contractor's expense.

SURVEY HUBS.-- The Contractor shall install hubs at a maximum of twenty (20) locations before fill placement as directed by the Engineer.

The survey hub shall consist of 50-mm square x 0.6-m long stake with nail on top.

The monitoring of survey hub shall consist of elevations, northings, and eastings of the top of the center of the nail. The Contractor shall survey and collect the data of the survey hubs weekly during the duration of the contract.

The survey data shall include locations on the plans and elevation of all survey hubs.

The collected data shall be furnished to the Engineer within the following working day after the readings are taken.

PAYMENT -- The contract lump sum price paid for settlement instrumentation (survey hubs) shall include full compensation for providing all labor, materials, tools, equipment, and incidentals required for furnishing, installing, maintaining, leaving in place and monitoring. This price includes collection and compilation of data and furnishing reports as specified in these special provisions; and as directed by the Engineer.

10-1.__ PERMEABLE MATERIAL

Permeable material shall conform with the details shown on the plans, and to the provisions in Section 68-1, "Underdrains," of the Standard Specifications, and these special provisions.Class 3 permeable material shall conform to the following grading requirements:

Grading Requirements

Sieve Sizes	Percentage Passing
37.5-mm	100
25-mm	90-100
19-mm	40-100
9.5-mm	0-50
4.75-mm	0-15
2.36-mm	0-5

Class 3 permeable material shall have a Durability Index of not less than 40.

At least 90 percent by mass of Class 3 permeable material shall be crushed particles as determined by California Test 205.

Filter fabric for use with permeable material shall conform to the provisions for filter fabric for underdrains in Section 88, "Engineering Fabrics," of the Standard Specifications and the following:

A. The subgrade and trench to receive the filter fabric, immediately prior to placing, shall conform to the compaction and elevation tolerance specified for the material involved.
B. Filter fabric shall be handled and placed in conformance with the manufacturer's recommendations.
C. The fabric shall be aligned and placed in a wrinkle-free manner.
D. Within 72 hours after the filter fabric has been placed, the fabric shall be covered with the planned thickness of overlying material as shown on the plans.

APPENDIX F

(Correspondence)

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

Geot.
B.Lee

To: MR. JERRY MA
District Office Chief
Office of Design Alameda I

Date: February 23, 2005

Attention: Amando Vito

File : 4-Ala 880 KP 43.6/45.5
04-165421
High St. Viaduct
Sign Structures

From: BETTY LEE
Associate M & R Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

WAJAHAT NYAZ
Senior Transportation Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

Subject: Geotechnical Design Recommendation-Overhead Signs A & F

We have completed the review of the proposed Caltrans Standard Overhead Signs A & F at Sta. 496+60 and Sta. 511+40 respectively, based on the loading combinations provided by Structural Engineer, Javad Massoomi.

Please note that the most recent Caltrans Standard Plans (July 2004) have different pile lengths and diameters than the ones you originally proposed. For Sign A with Post Type 5, the new CIDH pile dimensions are 5.8 m x 1372 mm. For Sign F with Post Type 7, the new CIDH pile dimensions are 7.0 m x 1524 mm. However, for Sign A, the originally proposed standard pile length of 5.8 m would sit on a layer of soft clay and result in pile settlement. We recommend increasing the pile length for Sign A to 8.6 m.

For either pile, our analyses show that the pile head lateral deflections do not exceed the 12.7 mm (0.5 inch) acceptable criteria. We are enclosing the results of the LPILE analysis that show the shear and bending moments induced in the piles. Please forward these to the Structural Engineer to check for the structural adequacy of the proposed piles.

If you have any questions, please call Betty Lee at (510) 286-4825 or Wajahat Nyaz at (510) 622-1777.

c: WNyaz, TPokrywka, , BLee, Daily File, Route File

BLee/mm

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

B. Lee
Geot.

Memorandum

Flex your power!
Be energy efficient!

To: MR. MAJID MADANI
Senior Bridge Engineer
Bridge Design Branch 14
Office of Bridge Design-South

Date: March 16, 2005

Attention: Javad Massoomi

File : 4-Ala 880 KP 43.6/45.5
04-165421
High St. Viaduct
Sign Structure
Br. No. 33-0040L/R

From: BETTY LEE BL
Associate M & R Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

WAJAHAT NYAZ WN
Senior Transportation Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

Subject: Geotechnical Design Recommendation-Special Design for Sign D

This is in response to your request of February 25, 2005, to re-analyze our footing design for Sign D (Sta. 502+40) based on a new geometrical configuration of the sign pillar support that you provided us.

Based on our analysis, the Geotechnical Design Recommendation for the original geometric configuration (dated January 12, 2005) is still sufficient for the new configuration and for both Load Combinations #1 & #2. The maximum bearing pressure (q_{max}) induced is approximately 137 kPa (2862 psf). As before, the allowable bearing capacity (q_{allow}) of the foundation soil is approximately 181 kPa (3780 psf) (using a Safety Factor of 3), if the top layer of soft foundation soil is treated as recommended in the Geotechnical Design Report.

If you have any questions, please call Betty Lee at (510) 286-4825 or Wajahat Nyaz at (510) 622-1777.

c: WNyaz, TPokrywka, , BLee, Daily File, Route File

BLee/mm

REGISTERED PROFESSIONAL ENGINEER
BETTY M. LEE
No. 44824
Exp. 3/31/06
CIVIL
STATE OF CALIFORNIA

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. MAJID MADANI
Senior Bridge Engineer
Bridge Design Branch 14
Office of Bridge Design-South

Date: January 25, 2005

Attention: Javad Massoomi

File : 4-Ala 880 KP 43.6/45.5
04-165421
High St. Viaduct
Sign Structure
Br. No. 33-0040L/R

From: BETTY LEE
Associate M & R Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

WAJAHAT NYAZ
Senior Transportation Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

Subject: Geotechnical Design Recommendation-Special Design Load Combination #2

This is in response to your email request of January 20, 2005, to re-analyze our footing design for Sign D (Sta. 502+40) based on a new Load Combination #2 that you provided us.

Based on our analysis, the Geotechnical Design Recommendation we provided to you based on Load Combination #1 (dated January 12, 2005) is still sufficient to handle Load Combination #2.

If you have any questions, please call Betty Lee at (510) 286-4825 or Wajahat Nyaz at (510) 622-1777.

c: WNyaz, TPokrywka, , BLee, Daily File, Route File

BLee/mm

REGISTERED PROFESSIONAL ENGINEER
BETTY M. LEE
No. 44824
Exp. 3/31/06
CIVIL
STATE OF CALIFORNIA

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. MAJID MADANI
Senior Bridge Engineer
Bridge Design Branch 14
Office of Bridge Design-South

Date: January 12, 2005

Attention: Javad Massoomi

File: 4-Ala 880 KP 43.6/45.5
165421
High St. Viaduct
Sign Structure
Br. No. 33-0040L/R

From: BETTY LEE
Associate M & R Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

WAJAHAT NYAZ
Senior Transportation Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

Subject: Geotechnical Design Recommendation-Special Design

In response to your Request for Foundation Recommendation (dated August 31, 2004) for Sign Structure "D" at Sta. 502+40, we have the following recommendation based on the loading forces you provided:

We recommend replacing the top 2-3 m of soft soil with AB or Structural Backfill, then constructing a spread footing with the dimensions as shown on the attached sketch: increase footing width and thickness dimensions as shown for a length of 3m (10 ft.). Such a footing would induce a maximum bearing pressure (q_{max}) of approximately 138.7 kPa (2897 psf). The allowable bearing capacity (q_{allow}) of the foundation soil (modified with AB or Structural Backfill as mentioned above) is approximately 181 kPa (3780 psf) (using a Safety Factor of 3). Such a design would also provide a Safety Factor for Sliding of 3.7.

If you have any questions, please call Betty Lee at (510) 286-4825 or Wajahat Nyaz at (510) 622-1777.

REGISTERED PROFESSIONAL ENGINEER
BETTY M. LEE
No. 44824
Exp. 3/31/06
CIVIL
STATE OF CALIFORNIA

c: WNyaz, TPokrywka, , BLee, Daily File, Route File

BLee/mm