APPENDIX

F Pile Dynamic Analysis, Static Pile Load Testing and Field Acceptance Criteria

Table of Contents

Fax to: *Office of Geotechnical Support*
Foundation Testing Branch
Attn: Doug Brittsan

Fax #: (916) 227-1083
Phone #: (916) 227-1079

Pile Load Test (PLT) Request Form

Project Name:	Request By:
Dist/Co/Rte/PM:	Office Phone #: ( )
EA No. & Activity Code:	Fax #: ( )
Bridge No:	Pager #: ( )
Date of Request:	Cell Phone #: ( )

Abutment or Bent Location	Pile Numbers	Pile Diameter	Max. Test Load	Date Ready for Testing	Status
					☐ Estimated Date ☐ Actual Date
					☐ Estimated Date ☐ Actual Date
					☐ Estimated Date ☐ Actual Date

Type of Pile Load Test to be Performed
(check all that apply)

☐ **Compression** ☐ **Tension** ☐ Lateral

Nature of Pile Load Test

☐ Required by Specifications
☐ Pile Load Test Indicator Program
☐ Emergency Construction Capacity Verification

Have the test pile and anchor pile load test connections already been installed? Yes ☐ / No ☐

Please submit forms to the above FAX number by 11:00 am Friday for testing to be scheduled during the following week. Please update all Estimated dates as dates can be confirmed or as piles become ready for testing.

For FTB Office Use Only

Tracking Number	FT&I Rep	Date Tested	Date of Report	Deadline
Comments:				

For individuals with sensory disabilities, this document can be made available in Braille, large print, audiocassette or computer disk upon request. To obtain one of these alternate formats, please call (916) 227-8185 or TTY 711 or write to the EEO Officer, Division of Engineering Services, P.O. Box 168041, Mail Stop 9 Room 509, Sacramento, CA 95816-8041.

Figure F-1. FTB Pile Load Test Request Form.

CALIFORNIA FTB Improving Mobility

Fax to: *Office of Geotechnical Support*
Foundation Testing Branch
Attn: Doug Brittsan

Fax #: (916) 227-1083
Phone #: (916) 227-1079

Pile Driving Analysis (PDA) Test Request Form

Project Name:	Request By:
Dist/Co/Rte/PM:	Office Phone #: ( )
EA No. & Activity Code:	Fax #: ( )
Bridge No:	Pager #: ( )
Date of Request:	Cell Phone #: ( )

Abutment or Bent Location	Pile Numbers	Pile Diameter	Pile Length	Date Ready for Testing	Status
					☐Estimated Date ☐Actual Date
					☐Estimated Date ☐Actual Date
					☐Estimated Date ☐Actual Date
					☐Estimated Date ☐Actual Date

This work to be performed for the Purpose of:

☐Dynamic Monitoring Only ☐Field Acceptance Criteria
☐Hammer Energy Verification ☐SPT Hammer Efficiency

Have the PDA bolt holes already been installed? Yes☐ / No☐

Comments:

Please submit forms to the above FAX number by 11:00 am Friday for testing to be scheduled during the following week.
Please update all Estimated dates as dates can be confirmed or as piles become ready for testing.

For FT&I Office Use Only

Tracking Number	FT&I Rep	Date Tested	Date of Report	Deadline
Comments:				

For individuals with sensory disabilities, this document can be made available in Braille, large print, audiocassette or computer disk upon request. To obtain one of these alternate formats, please call (916) 227-8185 or TTY 711 or write to the EEO Officer, Division of Engineering Services, P.O. Box 168041, Mail Stop 9 Room 509, Sacramento, CA 95816-8041.

Figure F-2. FTB Pile Driving Analysis Test Request Form.

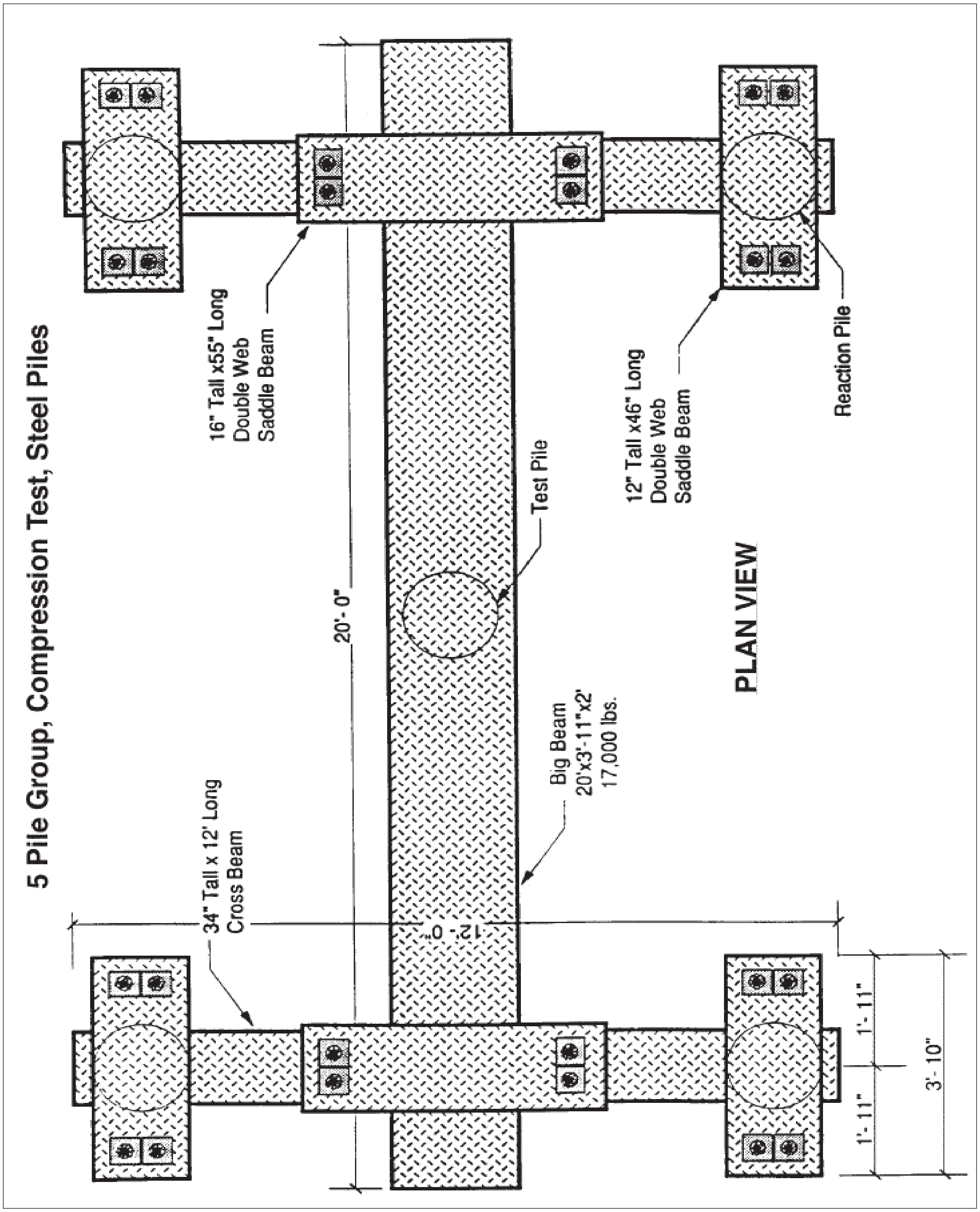

Figure F-3. Pile Load Test 5 Pile Group.

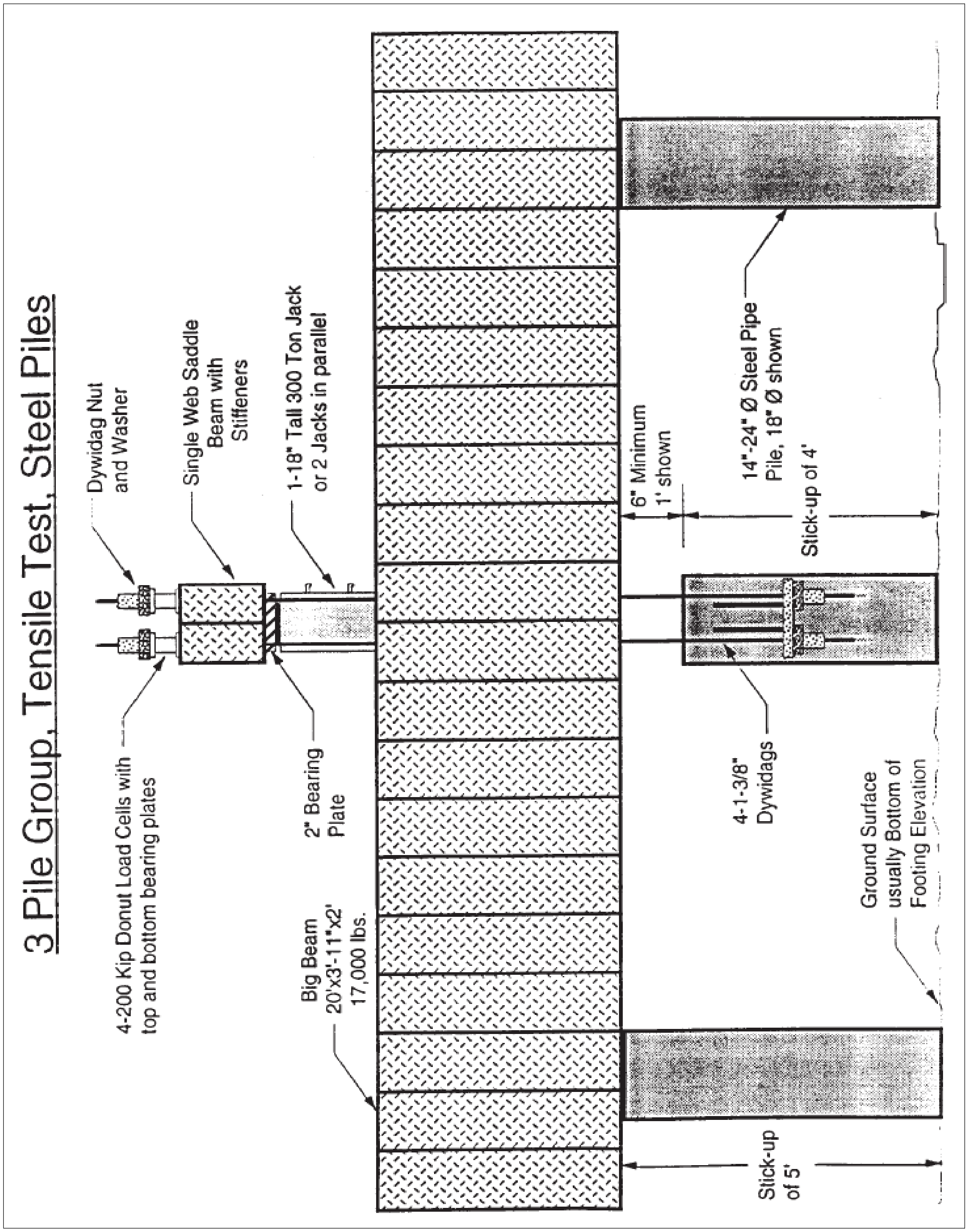

Figure F-4. Pile Load Test 3 Pile Group.

State of California
Department of Transportation

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: JOHN ZEHNDER
Structure Representative
405/22 Separation Project

Date: December 13, 2013

File: 12-ORA-22,405-PM20.66
12-071624 (1200000036)
405-22 HOV Connector Separation
Bridge No. 55-1103E

From:
DEPARTMENT OF TRANSPORTATION
Division of Engineering Services
Geotechnical Services - MS 5

Subject

Pile Dynamic Analysis (PDA) test results: Pile 19 at Bent 3L

Introduction

This report presents the results of Pile Dynamic Analysis (PDA) performed on the Pile 19 at Bent 3L of the above-referenced project. A site location map is provided for reference in Appendix A. The Pile 19 at Bent 3L was a production pile and would be incorporated into the structure. This driven pile at Bent 3L is in the control location of Bent 2 of Bridge number 55-1103E, so the same acceptance criteria needs to be used for this location. The PDA and PLT (Pile Load Test) test results along with Acceptance Criteria for the test piles at Bent 2 of Bridge number 55-1103E were provided in the report from this Office dated August 9, 2011. Pile 19 at Bent 3L was open-ended steel pipe pile of 48 inch diameter and 0.75 inch thickness spiral weld. The total length of the subject pile was 109.75 ft.

Pile Installation Summary

The subject pile was installed at Bent 3L by using vibratory hammer and then by Delmag 62-22 open ended diesel hammer. During driving by vibratory hammer top of pile at location of jaws was damaged, so contractor did remove the damaged part of pile and resurfaced top of pile.

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John Zehnder
EA 12-071624
EFIS 1200000036
December 13, 2013
Page 2

PDA Results
405-22 HOV Connector Separation
Pile 19 at Bent 3L
Br. No. 55-1103E

Because of this the approximate distance from top of pile to instruments remains 7.75 ft instead of 8.0 ft (2 x diameter of pile). According to Structure Construction, the elevation of the ground at the location of pile installation is about 15.5 ft and first 40 ft of the pile was driven using vibratory hammer. According to Contractor, the maximum fuel setting of the hammer was used during the PDA monitoring of the pile. PDA monitoring of the pile was conducted during initial drive on November 26, 2013; and during restrike on December 11, 2013 by Jason Wahleithner, Toua Vang, Wendy Tkacheff of the Foundation Testing Branch. By mistake the instruments F3 and F4 were swapped with each other, and A1 and A2 were left on in the machine, which was corrected during data analysis. The PDA instruments were attached approximately at 7.75 feet below the top of pile, and PDA test pile was longer than other production piles to attach the PDA instruments.

PDA Monitoring and Analysis

The Contractor utilized DELMAG 62-22 diesel hammer to drive the subject pile, and manufacturer's published specifications as available in the GRLWEAP Hammer Database File are shown in Table I.

Table I: Hammer Characteristics*

Hammer	Rated Energy	Ram Weight	Max. Stroke
DELMAG 62-22	164.6 (kip-ft)/kw	13.6 kips	12.05 ft

* Source: GRLWEAP Hammer Database File.

Pile Dynamic Analysis (PDA) monitoring was performed by utilizing a Pile Driving Analyzer® Model PAX 1, manufactured by Pile Dynamics Inc. and as per ASTM D4945-08. Elevation information is based on information provided by Structure Construction. Four strain sensors and two accelerometers were used to monitor the pile driving. The sensors used for the test pile are summarized in Table II.

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John Zehnder
EA 12-071624
EFIS 1200000036
December 13, 2013
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PDA Results
405-22 HOV Connector Separation
Pile 19 at Bent 3L
Br. No. 55-1103E

Table II: PDA Sensor Data

Sensor Type	ID No.	Calibration Date
Accelerometer A3	855	5/14/2013
Accelerometer A3**	855	
Accelerometer A4	837	5/14/2013
Accelerometer A4**	837	
Strain Gauge F1	7343	6/8/2012
Strain Gauge F1**	7343	
Strain Gauge F2	5152	6/8/2012
Strain Gauge F2**	5152	
Strain Gauge F3	7346	6/8/2012
Strain Gauge F3**	6197	6/8/2012
Strain Gauge F4	5156	5/13/2013
Strain Gauge F4**	6199	6/8/2012

* Calibration required per ASTM every two years.
** Instruments used during restrike.

Measured strains and accelerations induced in the pile as a result of driving were used to determine various engineering parameters of interest. Some of the more significant attributes derived for each hammer blow include the maximum energy transferred from the hammer, maximum compressive stresses, and the blow count. Plots depicting these parameters as a function of penetration depth are presented in Appendix B. The PDA-monitoring results of driving the subject pile are summarized in Table III.

Table III: PDA Monitoring Results; Pile 19 at Bent 3L

Approx Elevation of Pile Tip at Start of Monitoring (ft)*	
Initial Drive	-59.5
Restrike	-83.5
Transferred Energy (EMX)	
Near End of Initial Drive (k-ft)	68.5
Near Beginning of Restrike (k-ft)	74.6
Maximum Average Compressive Stress (CSX)	
During Initial Drive (ksi)	25.7
During Restrike (ksi)	23.0

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EA 12-071624
EFIS 1200000036
December 13, 2013
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PDA Results
405-22 HOV Connector Separation
Pile 19 at Bent 3L
Br. No. 55-1103E

Table III (continued): PDA Monitoring Results; Pile 19 at Bent 3L

Maximum Individual Compressive Stress (CSI)	
During Initial Drive (ksi)	29.7
During Restrike (ksi)	31.1
Approx Blow Counts During Driving	
Near End of Initial Drive	60 Blows/ft
During Restrike*	200 Blows/ft
Stroke Length (ft)	
Near End of Initial Drive	10.3
Near Beginning of Restrike	11.7

*Extrapolated from first 1/10th of foot driving during restrike.

Maximum CSX and CSI are within allowable limits (90% of 50 ksi) during initial and restrike PDA monitoring. According to the Acceptance Criteria (Pile 10 at Bent 2, Bridge number 55-1103E report dated August 9, 2011), Pile 19 at Bent 3L during initial driving near tip of pile with approximately 60 blows/ft and 10.3 ft stroke length have reached the required capacity of 1800 kips.

Recommendations

This Office recommends Structure Construction, Geotechnical and Structure designers to review the results of PDA testing in this report and use as needed. Any questions or comments regarding the change in design or tip elevations should be directed to Structure Construction personnel or designers.

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John Zehnder
EA 12-071624
EFIS 1200000036
December 13, 2013
Page 5

PDA Results
405-22 HOV Connector Separation
Pile 19 at Bent 3L
Br. No. 55-1103E

If you have any questions or comments regarding this memorandum please contact Tejinderjit Singh, P.E. at (916) 227-1052.

REGISTERED PROFESSIONAL ENGINEER
TEJINDERJIT SINGH
No. 75524
Exp. 6/2014
CIVIL
STATE OF CALIFORNIA

12/13/2013

TEJINDERJIT SINGH, P.E.
Transportation Engineer
Foundation Testing Branch
Office of Geotechnical Support

RONNIE GU, P.E.
Senior Transportation Engineer (Acting)
Foundation Testing Branch
Office of Geotechnical Support

Attachments

C: R. Stott - SC (Email)
B. Alsamman - SC (Email)
S. K. Amiri - OGDS1 (Email)
S. Kim - SC (Email)

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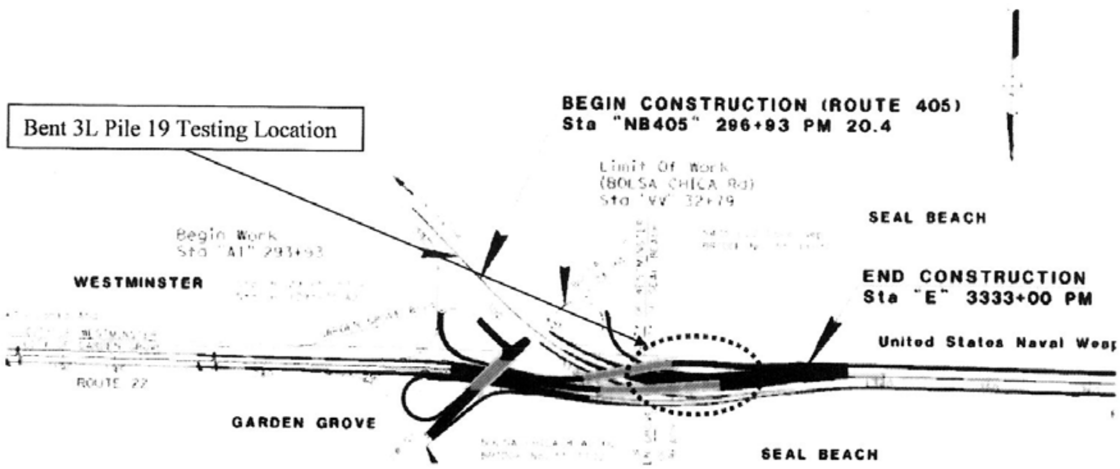
Foundation Testing Branch

APPENDIX A

Location Map

405/22 HOV Connector Separation
Bridge No. 55-1103E

Foundation Testing Branch



GENERAL SITE LOCATION MAP
405-22 HOV Connector Separation Bridge
Pile 19 at Bent 3L - PDA-Monitored Drive

Bridge No. 55-1103E
Contract No. 12-071624
12-ORA-22,405-PM20.75

CISS 48X0.75 inch Steel Pipe Piles
Installed: 11/26/2013

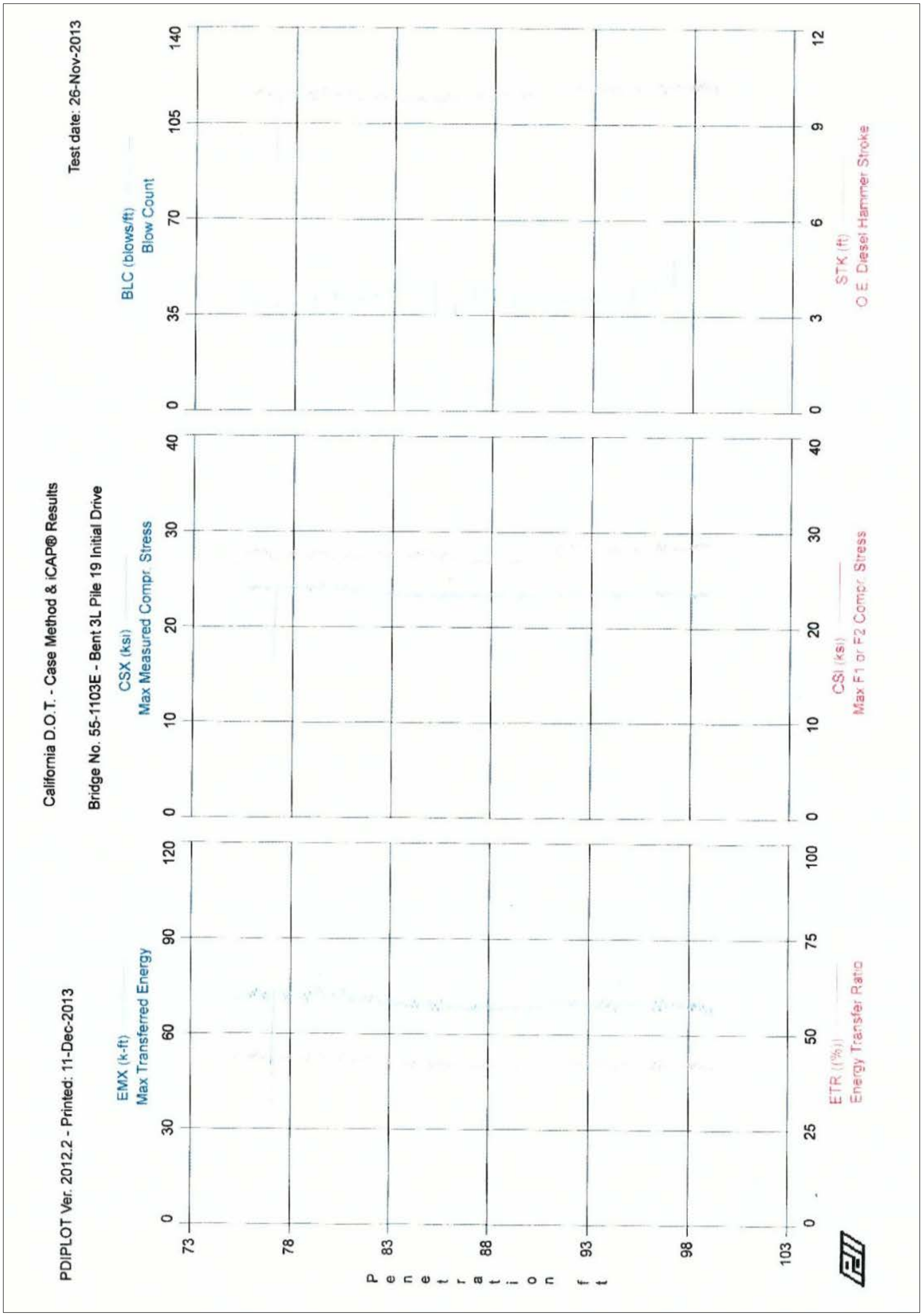
Caltrans

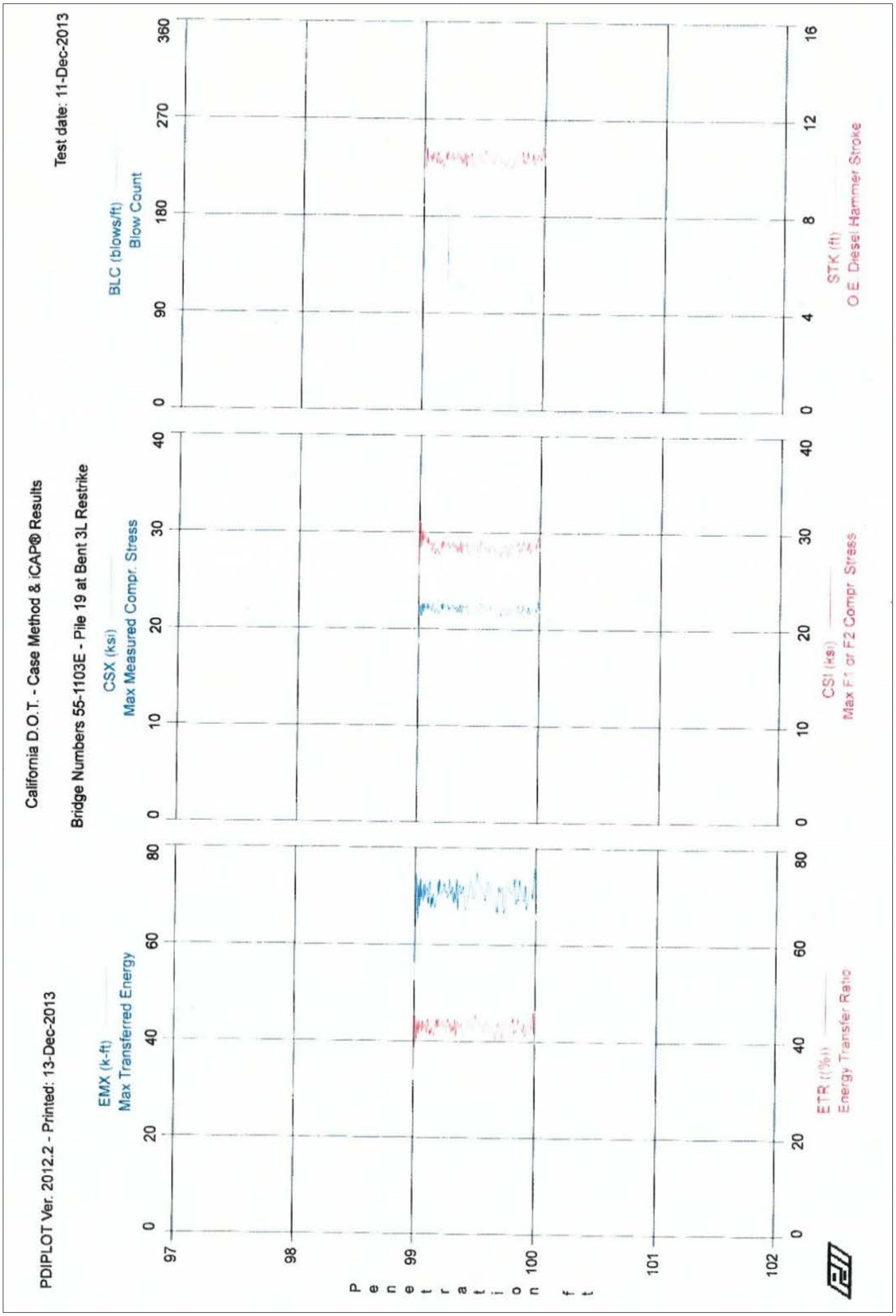
Foundation Testing Branch

APPENDIX B

PILE DYNAMIC ANALYSIS PLOT

405/22 HOV Connector Separation
Bridge No. 55-1103E


PDIPLOT Ver. 2012.2 - Printed: 11-Dec-2013
California D.O.T. - Case Method & iCAP® Results
Bridge No. 55-1103E - Bent 3L Pile 19 Initial Drive
Test date: 26-Nov-2013
EMX (k-ft)
Max Transferred Energy
ETR (%)
Energy Transfer Ratio
CSX (ksi)
Max Measured Compr. Stress
CSI (ksi)
Max F1 or F2 Compr. Stress
BLC (blows/ft)
Blow Count
STK (ft)
O.E. Diesel Hammer Stroke
Penetration ft


PDIPLOT Ver. 2012.2 - Printed: 13-Dec-2013
California D.O.T. - Case Method & iCAP® Results
Bridge Numbers 55-1103E - Pile 19 at Bent 3L Restrike
Test date: 11-Dec-2013
EMX (k-ft)
Max Transferred Energy
ETR (%)
Energy Transfer Ratio
CSX (ksi)
Max Measured Compr. Stress
CSI (ksi)
Max F1 or F2 Compr. Stress
BLC (blows/ft)
Blow Count
STK (ft)
O.E. Diesel Hammer Stroke
Penetration ft
97
98
99
100
101
102
0
20
40
60
80
0
10
20
30
40
0
90
180
270
360
0
4
8
12
16

APPENDIX C

Pile Information

405/22 HOV Connector Separation
Bridge No. 55-1103E

DEPARTMENT OF TRANSPORTATION

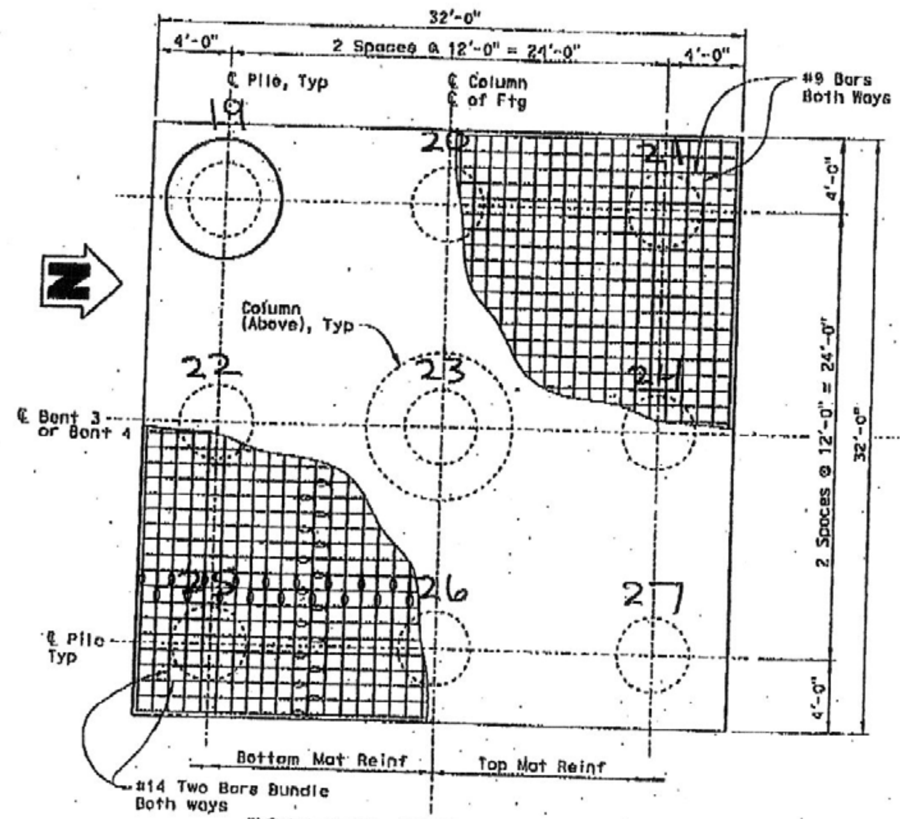
PILE LAYOUT SHEET

DH-OS C80 (REV. 08/08)

JOB STAMP
12-071624
12-Ora-22,405-R0.7/R2.9,20.4/22.3
Federal Aid Project
ARRAL-X059(061)N
CMLN-6212(013)

DRAWN BY JM
CHECKED BY
BRIDGE NO. 55-1103E
~~ABUTMENT OR~~ BENT NO 3 LEFT

DATE 01-20-2010 SHT NO
DATE
FTG
FTG TYPE spread
BOT FTG ELEV 15.50



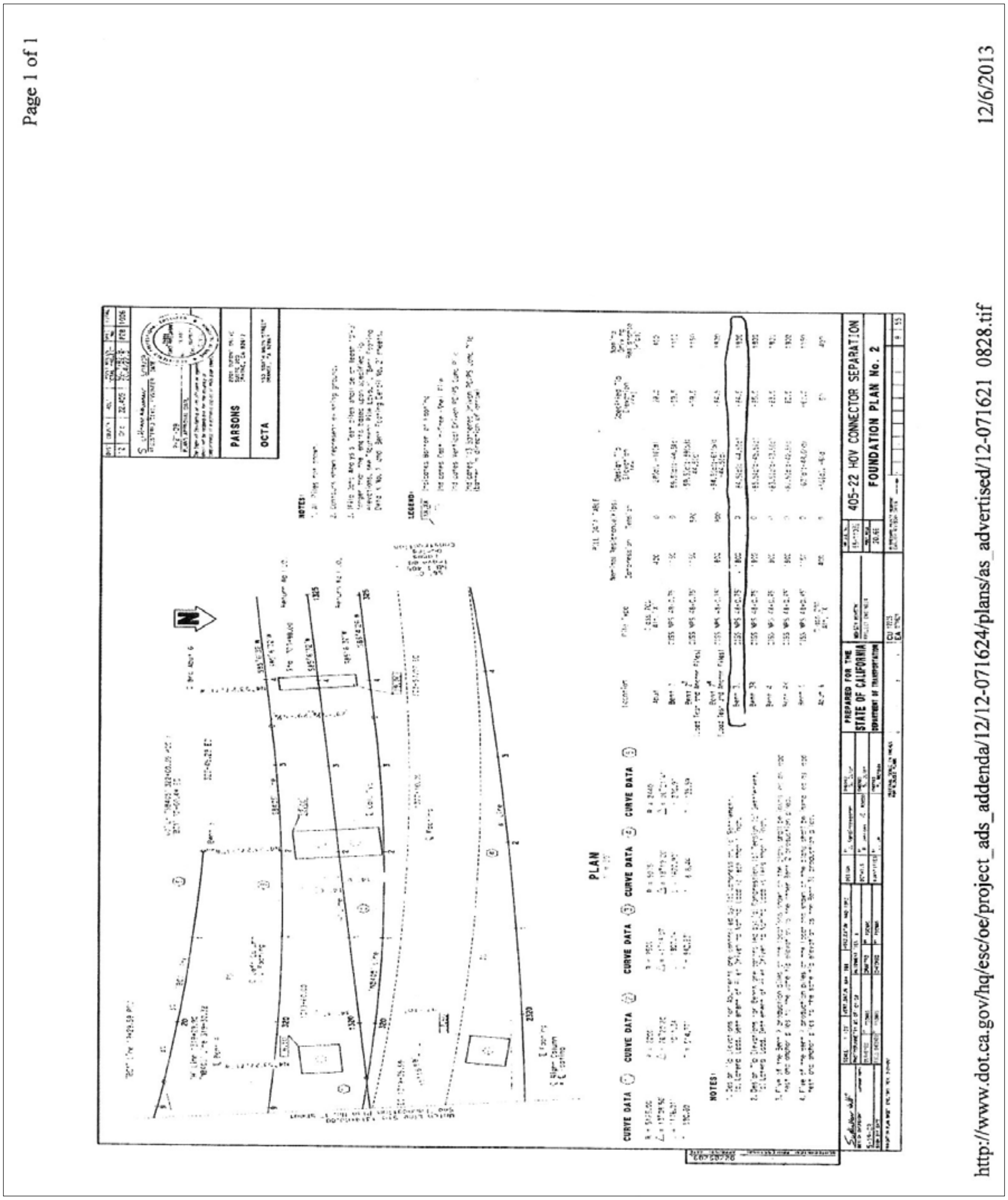
FOOTING PILE LAYOUT

1/4" = 1'-0"
(Bent 3, Bent 4)

LEGEND:

○ = Indicates Suggested PDA Test Pile Location

SCALE:


Page 1 of 1
PLAN
CURVE DATA
NOTES:
LEGEND:
PARSONS
OCTA
PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
405-22 HOV CONNECTOR SEPARATION
FOUNDATION PLAN No. 2
http://www.dot.ca.gov/hq/esc/oe/project_ads_addenda/12/12-071624/plans/as_advertised/12-071621 0828.tif
12/6/2013

State of California
DEPARTMENT OF TRANSPORTATION

California State Transportation Agency

Memorandum

Serious Drought!
Help Save Water!

To: BINH NGO
Oversight Structure Representative
405 / Wilmington Avenue
Interchange Improvements

Date: June 3, 2015

File: 07-LA-405-9.3/9.9
07-234004 (0700000394)
Dominguez Channel Bridge
Bridge No. 53-1166

From: **DEPARTMENT OF TRANSPORTATION**
Division of Engineering Services
Geotechnical Services - MS 5

Subject: Pile Dynamic Monitoring Results and Bearing Acceptance Criteria: Bents 4 and 6 Control Locations

Introduction

This memorandum presents the dynamic monitoring results and bearing acceptance criteria, prepared in accordance with Section 10-1.55 "PILING" of the Special Provisions, for the control locations identified in the Special Provisions (page 227) as Bents 4 and 6 of the Dominguez Channel Bridge (Widen), Bridge No. 53-1166.

Foundation Description

The Dominguez Channel Bridge (Widen) pile foundations include open-ended Cast-In-Steel-Shell Concrete Piling (CISS 24" x 0.5"). Specified tip elevations are controlled by compression demands. Pile data specified in the Contract Plans (Appendix C) for the control location is shown below in Table I.

Table I: Pile Data

Location	Pile Type (in.)	Nominal Resistance Compression (Kips)	Nominal Resistance Tension (Kips)	Cut-off Elevation(1) (ft)	Specified Tip Elevation (ft)	Pile Length (ft)
Bent 4	CISS 24 x 0.5	860	0	28.2	-87.0	115.2
Bent 6	CISS 24 x 0.5	720	0	27.5	-80.0	107.5

(1) Pile Cut-Off Elevations obtained from Log Pile Sheets.

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Subsurface Conditions

The subsurface conditions at the test pile locations are characterized by Geotechnical Log of Test Boring (LOTB) R-07-017 (October 2007), located between the two test piles. For a complete description of the subsurface conditions, please refer to the LOTB included in Appendix D.

Test Pile Installation

Bents 4 and 6 test piles were driven at the location of production piles. Exact location of the test piles within the bent layout is the outside pile, as marked on the Contract Plan sheet *Foundation Plan* included in Appendix C. Pile material consisted of A252 Grade 3 steel pipe based on field observation. The driving system consisted of an APE D46-32 single-acting diesel hammer based on field observation and discussions with field inspectors. The APE D46-32 has an approximate rated energy of 114 Kip-ft, a stroke of 11.25 feet at maximum rated energy, and a ram weight of 10.14 Kips. The driving system submitted to the project identified a Delmag D46-32 hammer. Both the APE and Delmag D46-32 hammers have an equivalent ram weight of 10.14 Kips.

Each test pile was driven in two pieces and included one field welded splice. The hammer was operated at the maximum fuel setting at the Bent 6 test pile. At Bent 4 the fuel setting was adjusted from fuel setting 3 to the maximum fuel setting during the initial drive. Pre-drilling occurred at both test pile locations prior to installation of the first pile piece. Approximately 16.7 feet of pre-drilling occurred at Bent 4 and approximately 21.4 feet of pre-drilling occurred at Bent 6 according to field inspectors. Center-relief drilling was not used during test pile installation. The depth to soil plug within the open-ended piles following driving to specified tip elevation was not measured due to the approximate 30 feet of pile extension above grade.

Table II: Test Pile Driving Information

Location	Date of Initial Drive[(1)]	Date of Restrike	Test Pile Length (ft)	Length of Pile Penetration (ft)	Approx. Depth to Soil Plug [(2)] (ft)
Bent 4	5-26-15	5-27-15	117.0	85.7	n/a
Bent 6	5-28-15	5-29-15	109.5	76.4	n/a

(1) Initial drive defined as continuous driving event to within one foot of specified tip after pile splicing.
(2) Not available due to over 30 feet of pile extension above grade following drive to tip elevation.

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Pile Dynamic Monitoring

Dynamic Monitoring was conducted utilizing a Pile Driving Analyzer manufactured by Pile Dynamics, Inc. Monitoring of the test piles was conducted by Engineers Jason Wahleithner and Jeremy Peterson-Self of the Caltrans Foundation Testing Branch (FTB). Calibration dates for strain gages and accelerometers used in monitoring are listed in Table III.

Table III. Dynamic Monitoring Sensor Information

	Sensor Type	ID No.	Date of Calibration[1]
Bent 4 and 6	Accelerometer A3	K1291	10-28-2014
	Accelerometer A4	K1298	10-28-2014
	Strain Gauge F3	7342	10-14-2014
	Strain Gauge F4	3664	10-14-2014

(1) Calibration recommended every two years by ASTM 4945.

Monitoring was performed during the final approximate 29 feet of initial driving at Bent 4 and the final approximate 23 feet of initial driving at Bent 6. Additional monitoring was also performed during a one foot restrike at each location. Results from dynamic monitoring are summarized in Table IV and included in Appendix B. Corresponding elevations, estimated to nearest tenth of a foot, were derived from temporary bench marks placed on existing columns and identified by field inspectors.

MR. BINH NGO
JUNE 3, 2015
PAGE 4

DYNAMIC MONITORING: BENTS 4 AND 6
DOMINGUEZ CHANNEL BRIDGE (WIDEN) (BR. 53-1166)
EA 07-234004 (EFIS 0700000394)
07-LA-405-9.3/9.9

Table IV Pile Dynamic Monitoring Results

		Bent 4		Bent 6	
		Initial Drive	Restrike	Initial Drive	Restrike
Pile Tip Elevation At Start of Monitoring	(ft)	-57.3	-86.0	-56.1	-79.0
Pile Tip Elevation At End of Monitoring	(ft)	-86.0	-87.0	-79.0	-80.0
Transferred Energy: End Initial Drive [EMX]	(Kip-ft)	41.2	--	52.4	--
Transferred Energy: Begin Restrike [EMX]	(Kip-ft)	--	63.4	--	74.1
Peak Max Average Compressive Stress [CSX]	(Ksi)	28.6	32.8	32.1	35.4
Peak Max Individual Compressive Stress [CSI]	(Ksi)	31.8	33.7	35.3	39.2
Stroke at End of Initial Drive [STK]	(ft)	8.5	--	8.1	--
Blow Count at End of Initial Drive [BLC]	(Blows/ft)	92	--	76	--
Stroke at Beginning of Restrike [STK]	(ft)	--	10.5	--	10.9
Blow Count at Beginning of Restrike [BLC] (1)	(Blows/ft)	--	460	--	290
Blow Count for Entire Restrike [BLC]	(Blows/ft)	--	290	--	157

(1) Extrapolated from blow count over first 0.1 foot of restrike.

Discussion of Dynamic Monitoring Results

The test piles appear to have been driven without damage while being monitored with a PDA. The pile driving stresses measured by the PDA during initial driving and restrike did not exceed the allowable driving stress of 40.5 ksi which represents 90% of the minimum yield stress for the A252 Grade 3 pipe material. Substantial difference between the average compressive stress of both strain gages and the peak compressive stress of any individual strain gage indicates that uneven stresses were induced in the pile. Pile and hammer alignment must be properly maintained to impart maximum energy to the pile and limit the potential for pile damage.

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Wave equation analysis was performed utilizing the pile driving analysis software CAPWAP Version 2006 in order to predict test pile capacity at the end of initial drive and the beginning of restrike. The CAPWAP derived pile capacities are presented in Table V.

Table V. CAPWAP Derived Pile Capacity

		Bent 4	Bent 6
Capacity at End of Initial Drive	(Kips)	775	827
Capacity at Beginning of Restrike	(Kips)	1,143	1,294

Pile Bearing Acceptance Criteria

Bearing acceptance criteria was developed by this Office based on the results of wave equation analysis correlated to pile dynamic measurements for the test piles driven at Bents 4 and 6. Wave equation analysis was performed utilizing the pile driving analysis software CAPWAP Version 2006 and GRL-WEAP Version 2010-4. According to the Special Provisions, the bearing acceptance criteria for the Bents 4 and 6 Control Locations shall be used for field acceptance of production pile driving. Bearing Acceptance Criteria Charts depicting estimated pile nominal compressive resistance (pile capacity) as a function of blow count and hammer stroke are presented in Appendix A. Estimated setup factors were calculated from initial drive and restrike monitoring and are also provided in Appendix A.

Bearing acceptance criteria presented in this report relate driving resistance to stroke and blow count. Bearing acceptance criteria are valid only for the APE D46-32, single-acting diesel hammer when operating properly for the installation of CISS (24" x 0.5") piling. The influence of uneven or eccentric blows is not addressed by these charts but should be considered. The values identified for stroke have been correlated to effective energy transferred to the pile for the driving event monitored. This field acceptance criteria will not be valid if the performance of the hammer is altered or if the construction practice is altered in a way that affects imparted energy.

MR. BINH NGO
JUNE 3, 2015
PAGE 6

DYNAMIC MONITORING: BENTS 4 AND 6
DOMINGUEZ CHANNEL BRIDGE (WIDEN) (BR. 53-1166)
EA 07-234004 (EFIS 0700000394)
07-LA-405-9.3/9.9

Recommendations

This Office recommends review of the attached dynamic monitoring results by the Dominguez Channel Bridge (Widen) geotechnical designer when considering release of production piles within the subject control zones.

The derived pile driving resistance relationship plot presented may be used to estimate pile driving resistance from observed blow count and stroke height for initial driving. The field acceptance criteria presented are pile type, site and hammer specific and should not be applied to piles outside the control zone. If the driving system is modified or if a new driving system is utilized, additional dynamic monitoring should be performed to verify dynamic characteristics and develop revised bearing acceptance criteria.

If you have any questions or comments regarding this report, please contact Jason Wahleithner at (916) 227-1059.

REGISTERED PROFESSIONAL ENGINEER
JASON DWIGHT WAHLEITHNER
No. C63572
Exp. 9/30/16
CIVIL
STATE OF CALIFORNIA

Jason D. Wahleithner
6/3/15

JASON D. WAHLEITHNER, P.E.
Transportation Engineer, Civil
Foundation Testing Branch
Office of Geotechnical Support

Benjamin Barnes

BENJAMIN BARNES, P.E.
Senior Transportation Engineer (Acting)
Foundation Testing Branch
Office of Geotechnical Support

c: V. Francis – OSC (Email)
T. Liu – OGDS1 (Email)
Z. Saleh – Hill International (Email)

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Foundation Testing Branch

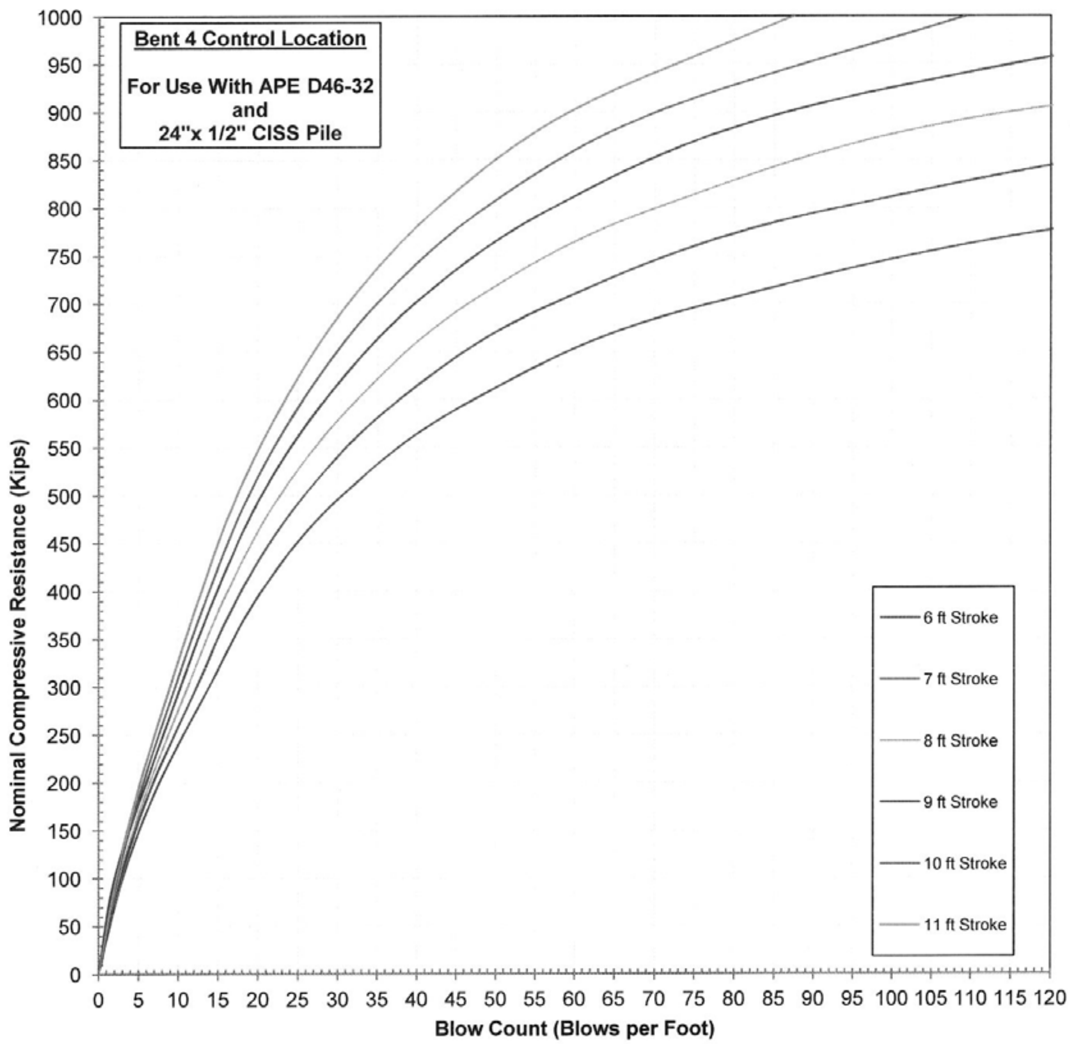
APPENDIX A

Bearing Curve and Setup Curve

Dominguez Channel Bridge (Widen)
Bridge No. 53-1166

Bents 4 and 6 Control Locations

Foundation Testing Branch



Bearing Acceptance Criteria Chart

Derived from Wave Equation Analysis Program (WEAP)

EA Number 07-234004

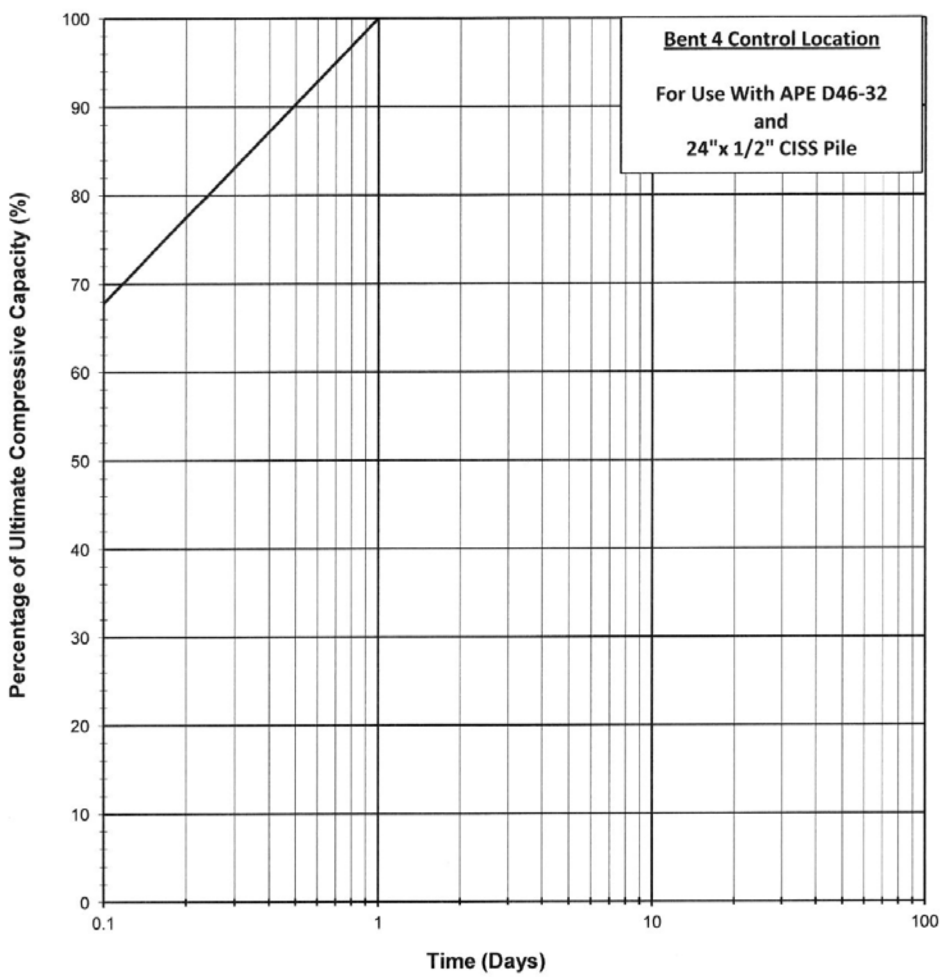
Bridge Number 53-1166

07-LA-405-9.3/9.9

Bent 4 Control Location

Dominguez Channel Bridge (Widen)

Foundation Testing Branch

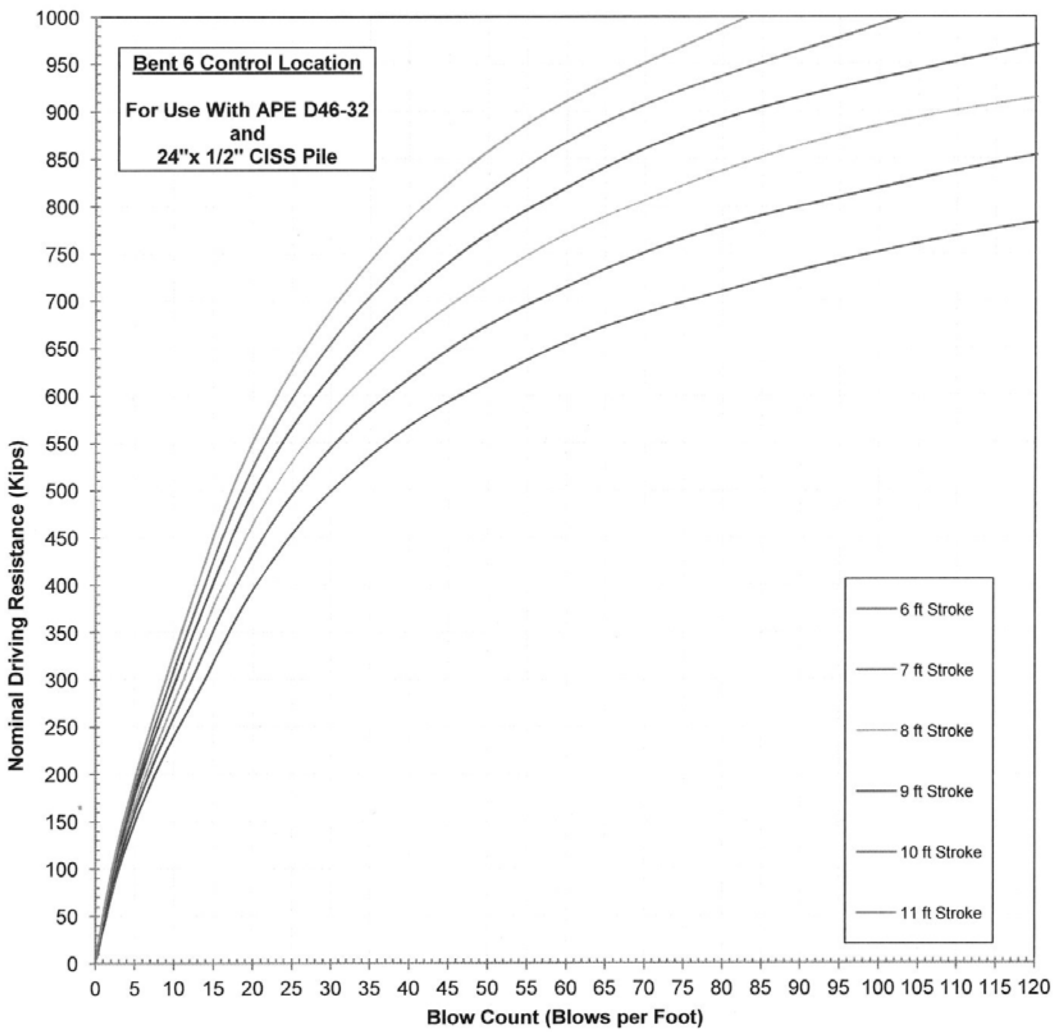


Bearing Acceptance Criteria: Setup Relationship
Derived from CapWap Capacities

EA Number 07-234004
Bridge Number 53-1166
07-LA-405-9.3/9.9

Bent 4 Control Location
Dominguez Channel Bridge (Widen)

Foundation Testing Branch



Bearing Acceptance Criteria Chart

Derived from Wave Equation Analysis Program (WEAP)

EA Number 07-234004

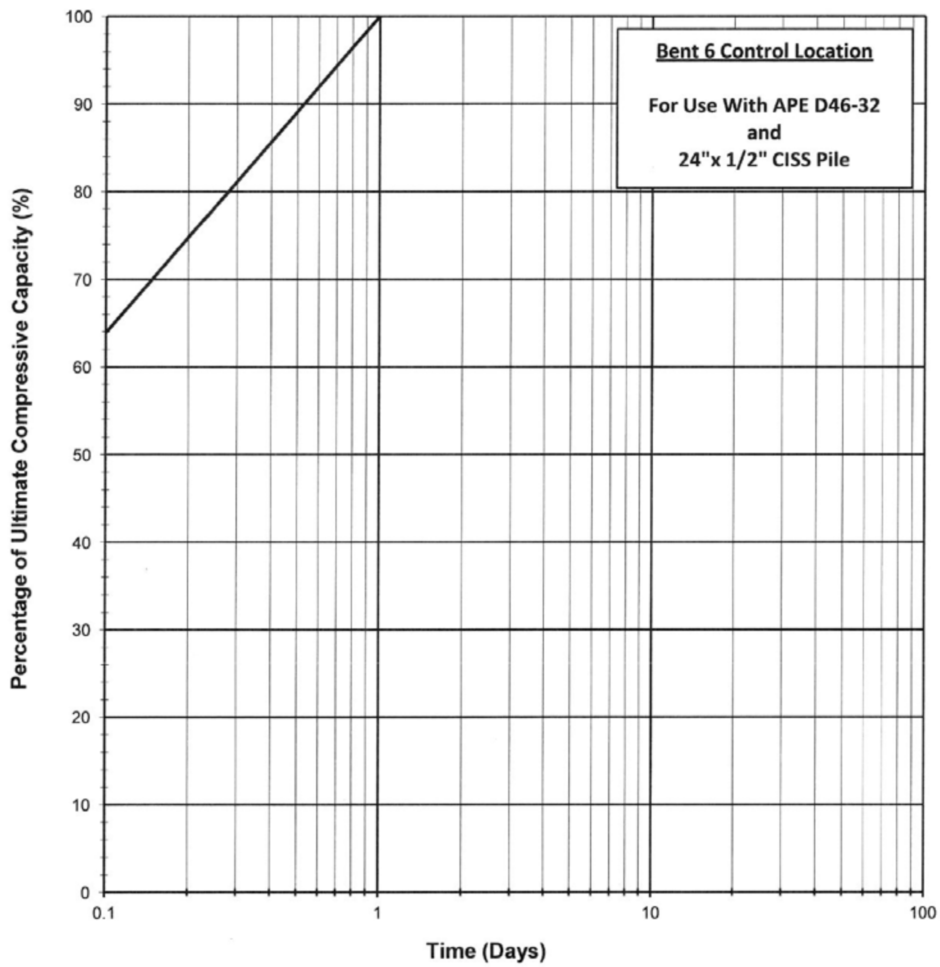
Bridge Number 53-1166

07-LA-405-9.3/9.9

Bent 6 Control Location

Dominguez Channel Bridge (Widen)

Foundation Testing Branch



Bearing Acceptance Criteria: Setup Relationship
Derived from CapWap Capacities

EA Number 07-234004
Bridge Number 53-1166
07-LA-405-9.3/9.9

Bent 6 Control Location
Dominguez Channel Bridge (Widen)

Foundation Testing Branch

The following presents an example of how to use the "Time-Setup Relationship" Curve at Bent 4. Use the same method for Bent 6 but with the setup factor from the Bent 6 time-setup relationship.

1) The production pile was driven to within 1 foot from the specified tip elevation.

2) 30 blows per foot were recorded with an 8.0 ft stroke at this depth. According to the Bearing Acceptance Criteria Chart (Bearing Graph), a Nominal Compressive Resistance of 585 kips is obtained (this is at 68% of the ultimate compressive capacity according to the time-setup relationship).

3) After a setup period of 1 day, the projected Nominal Compressive Resistance can be extrapolated as:
   585 kips x (1/0.68) = 860 kips

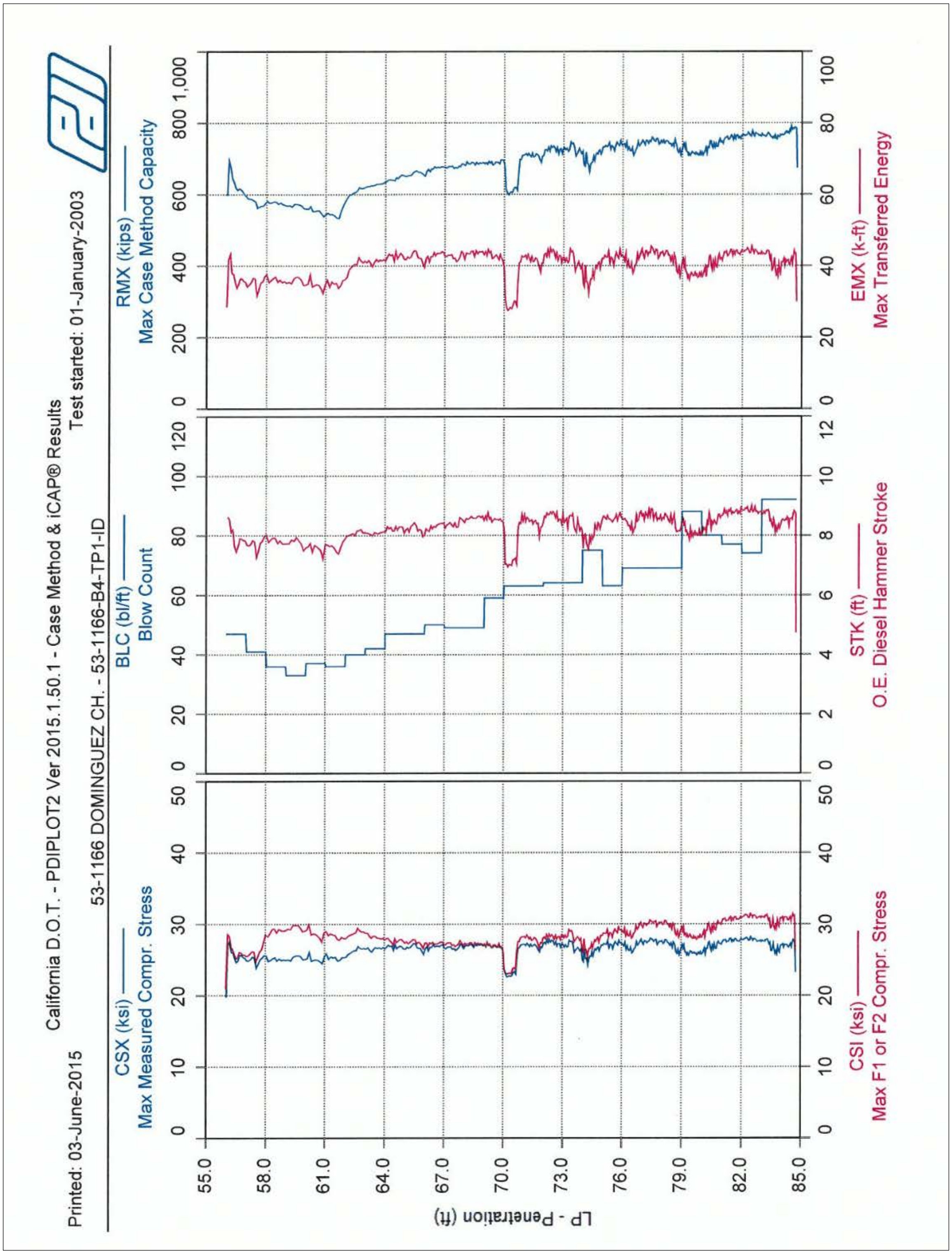
Foundation Testing Branch

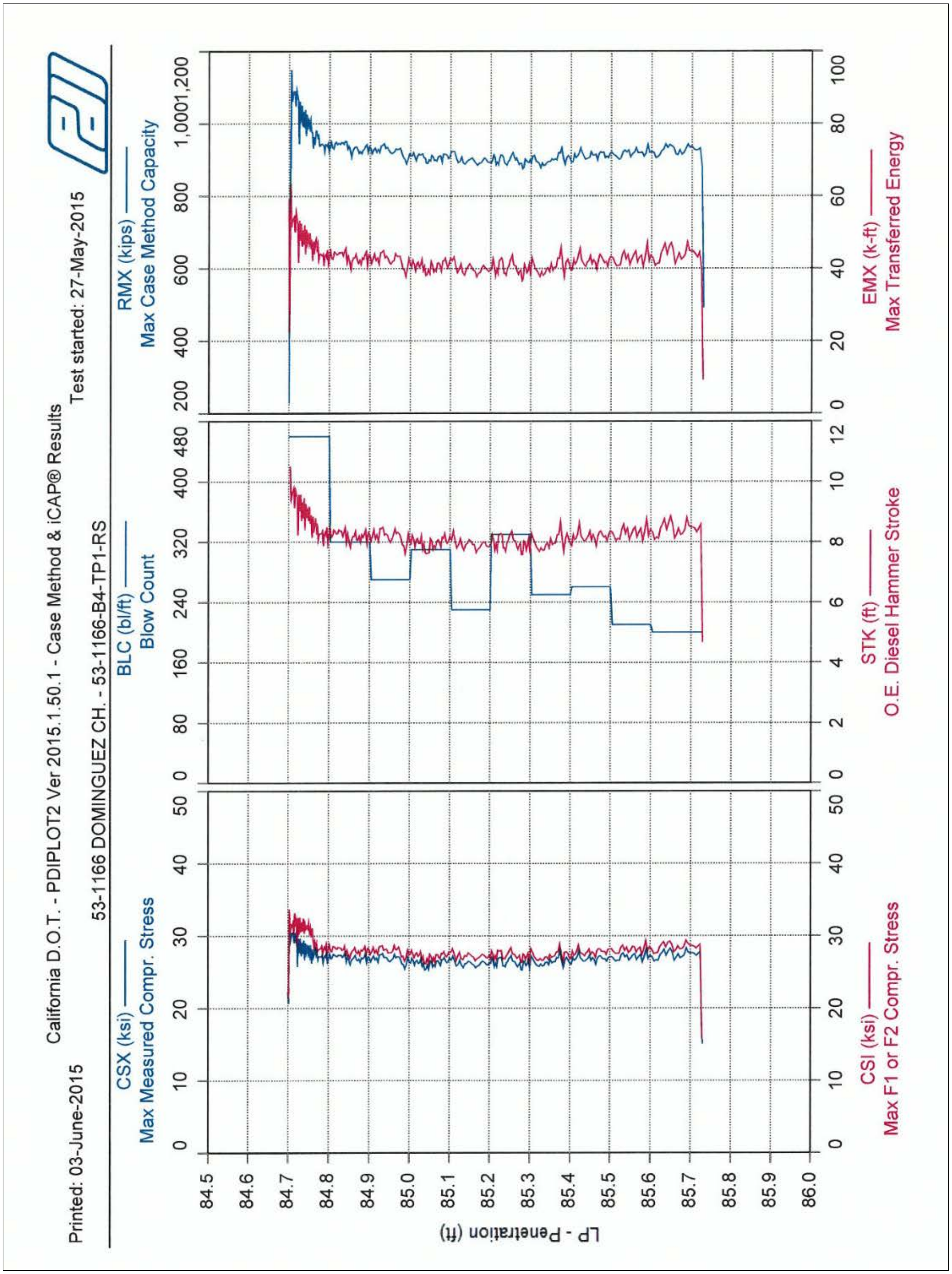
APPENDIX B

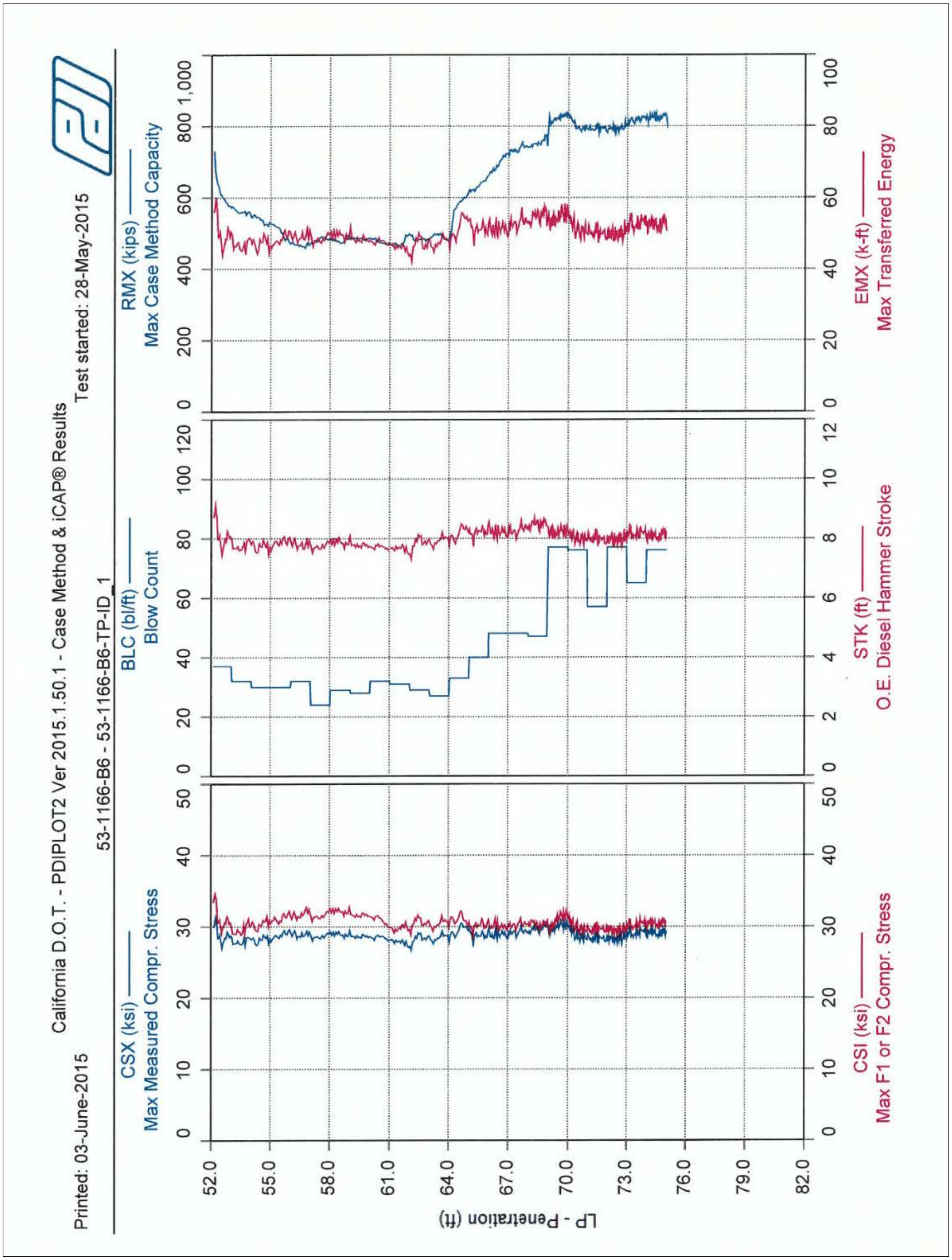
Pile Dynamic Monitoring Results

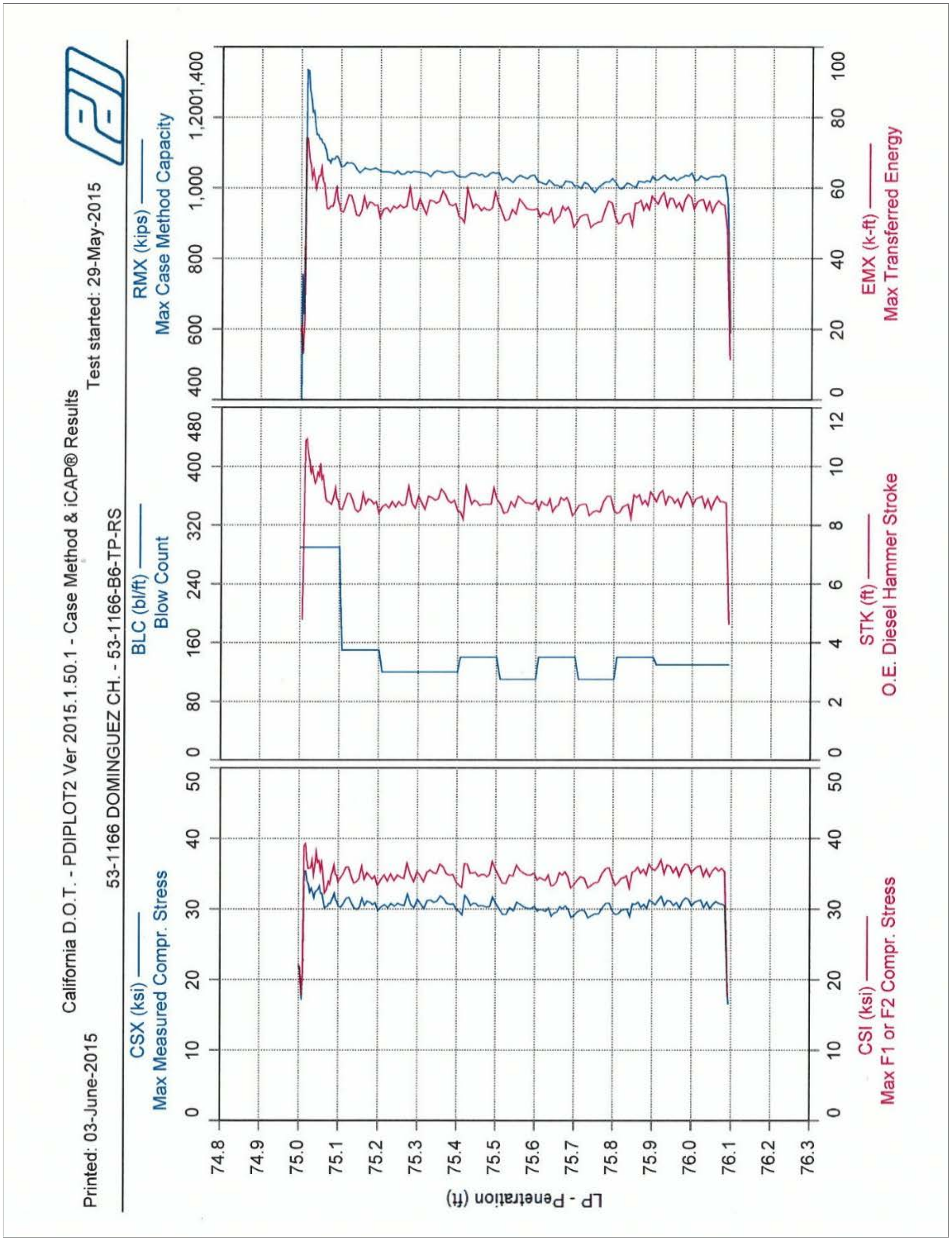
Dominguez Channel Bridge (Widen)
Bridge No. 53-1166

Bents 4 and 6 Control Locations


Printed: 03-June-2015
California D.O.T. - PDIPLOT2 Ver 2015.1.50.1 - Case Method & iCAP® Results
Test started: 01-January-2003
53-1166 DOMINGUEZ CH. - 53-1166-B4-TP1-ID
CSX (ksi)
Max Measured Compr. Stress
CSI (ksi)
Max F1 or F2 Compr. Stress
BLC (bl/ft)
Blow Count
STK (ft)
O.E. Diesel Hammer Stroke
RMX (kips)
Max Case Method Capacity
EMX (k-ft)
Max Transferred Energy
LP - Penetration (ft)


Printed: 03-June-2015
California D.O.T. - PDIPLOT2 Ver 2015.1.50.1 - Case Method & iCAP® Results
Test started: 27-May-2015
53-1166 DOMINGUEZ CH. - 53-1166-B4-TP1-RS
CSX (ksi)
Max Measured Compr. Stress
BLC (bl/ft)
Blow Count
RMX (kips)
Max Case Method Capacity
CSI (ksi)
Max F1 or F2 Compr. Stress
STK (ft)
O.E. Diesel Hammer Stroke
EMX (k-ft)
Max Transferred Energy
LP - Penetration (ft)


Printed: 03-June-2015
California D.O.T. - PDIPLOT2 Ver 2015.1.50.1 - Case Method & iCAP® Results
Test started: 28-May-2015
53-1166-B6 - 53-1166-B6-TP-ID_1
CSX (ksi)
Max Measured Compr. Stress
BLC (bl/ft)
Blow Count
RMX (kips)
Max Case Method Capacity
CSI (ksi)
Max F1 or F2 Compr. Stress
STK (ft)
O.E. Diesel Hammer Stroke
EMX (k-ft)
Max Transferred Energy
LP - Penetration (ft)


Printed: 03-June-2015
California D.O.T. - PDIPLOT2 Ver 2015.1.50.1 - Case Method & iCAP® Results
Test started: 29-May-2015
53-1166 DOMINGUEZ CH. - 53-1166-B6-TP-RS
CSX (ksi)
Max Measured Compr. Stress
BLC (bl/ft)
Blow Count
RMX (kips)
Max Case Method Capacity
CSI (ksi)
Max F1 or F2 Compr. Stress
STK (ft)
O.E. Diesel Hammer Stroke
EMX (k-ft)
Max Transferred Energy
LP - Penetration (ft)

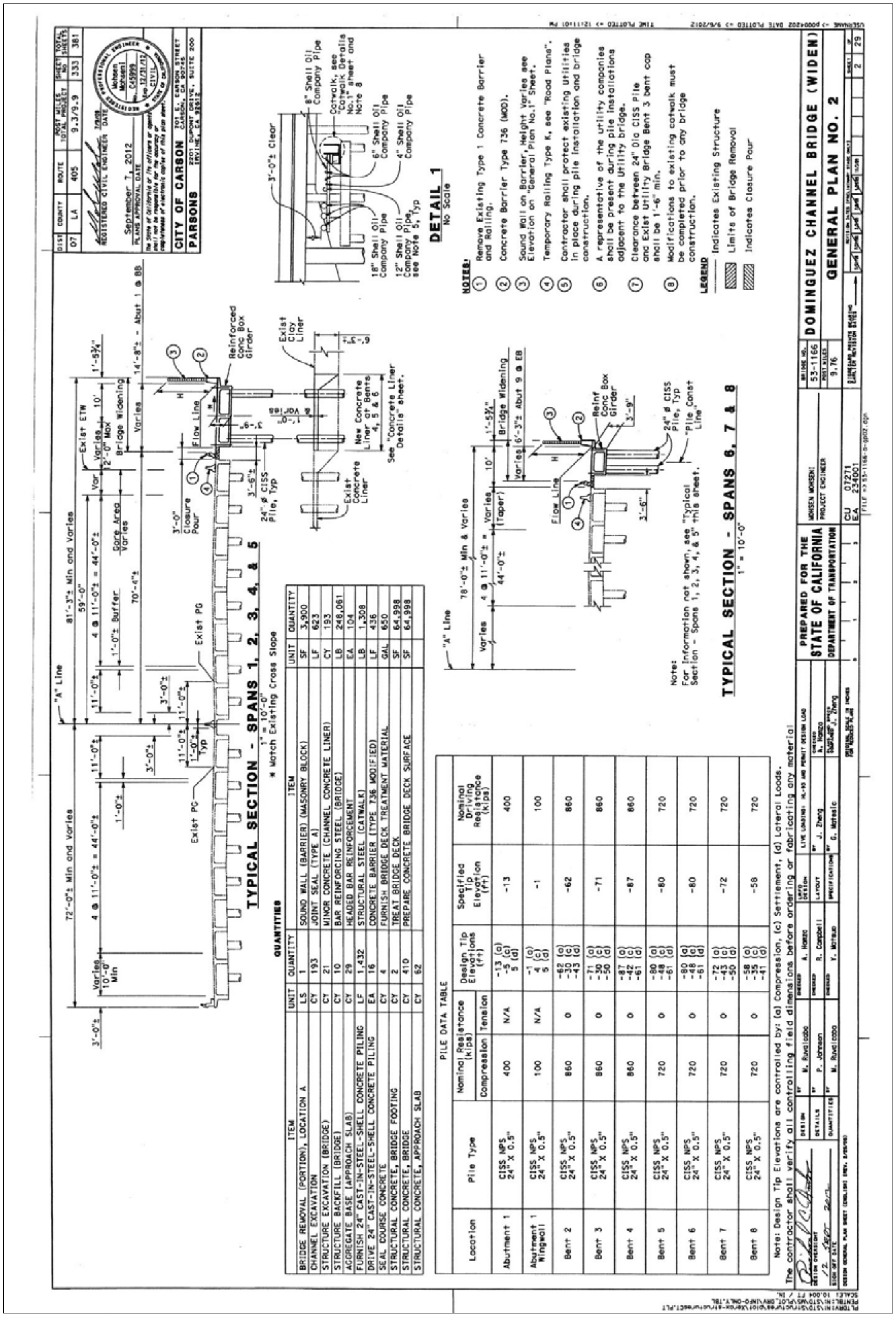
Foundation Testing Branch

APPENDIX C

Contract Plan Pile Data Table and Foundation Plan

Dominguez Channel Bridge (Widen)
Bridge No. 53-1166

Bents 4 and 6 Control Locations



QUANTITIES

ITEM	UNIT	QUANTITY	ITEM	UNIT	QUANTITY
BRIDGE REMOVAL (PORTION), LOCATION A	LS	1	SOUND WALL (BARRIER) (MASONRY BLOCK)	SF	3,900
CHANNEL EXCAVATION	CY	193	JOINT SEAL (TYPE A)	LF	623
STRUCTURE EXCAVATION (BRIDGE)	CY	21	MINOR CONCRETE (CHANNEL CONCRETE LINER)	CY	193
STRUCTURE BACKFILL (BRIDGE)	CY	10	BAR REINFORCING STEEL (BRIDGE)	LB	248,061
AGGREGATE BASE (APPROACH SLAB)	CY	29	HEADED BAR REINFORCEMENT	EA	104
FURNISH 24" CAST-IN-STEEL-SHELL CONCRETE PILING	LF	1,432	STRUCTURAL STEEL (CATWALK)	LB	1,308
DRIVE 24" CAST-IN-STEEL-SHELL CONCRETE PILING	EA	16	CONCRETE BARRIER (TYPE 736 MODIFIED)	LF	436
SEAL COURSE CONCRETE	CY	4	FURNISH BRIDGE DECK TREATMENT MATERIAL	GAL	650
STRUCTURAL CONCRETE, BRIDGE FOOTING	CY	2	TREAT BRIDGE DECK	SF	64,998
STRUCTURAL CONCRETE, BRIDGE	CY	410	PREPARE CONCRETE BRIDGE DECK SURFACE	SF	64,998
STRUCTURAL CONCRETE, APPROACH SLAB	CY	62			

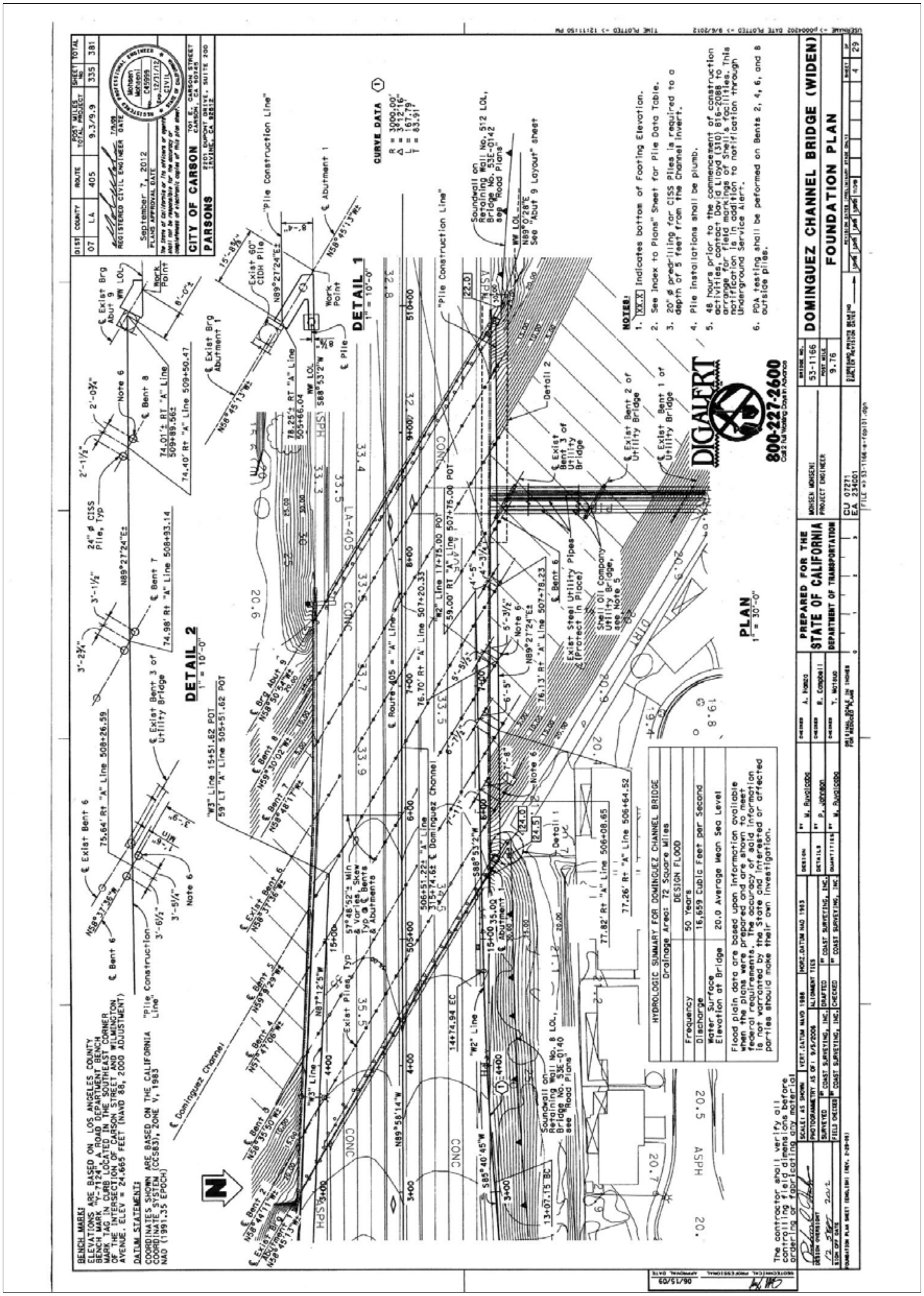
PILE DATA TABLE

Location	Pile Type	Nominal Resistance (kips) Compression	Nominal Resistance (kips) Tension	Design Tip Elevations (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance (kips)
Abutment 1	CISS NPS 24" X 0.5"	400	N/A	-13 (a) -5 (c) 5 (d)	-13	400
Abutment 1 Wingwall	CISS NPS 24" X 0.5"	100	N/A	-1 (a) 4 (c) 5 (d)	-1	100
Bent 2	CISS NPS 24" X 0.5"	860	0	-62 (a) -30 (c) -43 (d)	-62	860
Bent 3	CISS NPS 24" X 0.5"	860	0	-71 (a) -30 (c) -50 (d)	-71	860
Bent 4	CISS NPS 24" X 0.5"	860	0	-87 (a) -42 (c) -61 (d)	-87	860
Bent 5	CISS NPS 24" X 0.5"	720	0	-80 (a) -48 (c) -61 (d)	-80	720
Bent 6	CISS NPS 24" X 0.5"	720	0	-80 (a) -48 (c) -61 (d)	-80	720
Bent 7	CISS NPS 24" X 0.5"	720	0	-72 (a) -43 (c) -50 (d)	-72	720
Bent 8	CISS NPS 24" X 0.5"	720	0	-58 (a) -35 (c) -41 (d)	-58	720

Note: Design Tip Elevations are controlled by: (a) Compression, (c) Settlement, (d) Lateral Loads.
The contractor shall verify all controlling field dimensions before ordering or fabricating any material

NOTES:
1. Remove Existing Type 1 Concrete Barrier and Railing.
2. Concrete Barrier Type 736 (MOD).
3. Sound Wall on Barrier, Height Varies see Elevation on "General Plan No.1" Sheet.
4. Temporary Railing Type K, see "Road Plans".
5. Contractor shall protect existing Utilities in place during pile installation and bridge construction.
6. A representative of the utility companies shall be present during pile installations adjacent to the Utility bridge.
7. Clearance between 24" Dia CISS Pile and Exist Utility Bridge Bent 3 bent cap shall be 1'-6" min.
8. Modifications to existing catwalk must be completed prior to any bridge construction.

LEGEND
Indicates Existing Structure
Limits of Bridge Removal
Indicates Closure Pour


DOMINGUEZ CHANNEL BRIDGE (WIDEN)
FOUNDATION PLAN
PLAN
DETAIL 1
DETAIL 2
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
CITY OF CARSON
PARSONS

Foundation Testing Branch

APPENDIX D

Pile Log Sheet
Log of Test Borings

Dominguez Channel Bridge (Widen)
Bridge No. 53-1166

Bents 4 and 6 Control Locations

STATE OF CALIFORNIA.DEPARTMENT OF TRANSPORTATION
LOG PILE SHEET
SC-4805 (Formerly DH-OS C79) (REV. 12/17/13)

JOB STAMP
Wilmington Ave. Interchange
Modification at 405 Fwy
Federal Aid Project No. HPLUL-5403(017)
Contract No. 07-234004
Project I.D. 0700000394

PDA Testing

Bridge Name: Dominguez Channel Bridge (Widen) Sheet No. (1/2)
Bridge No. 53-1166 ~~Abut~~/Bent No. 4 Pile No. (0)
Hammer Make ~~Delmag~~ APE Model D46-32 Energy (ft-lbs) = 122,187 ft-Lbs @ 12.05' Stroke
Reference Descr Tip of Pile Bott. Half Reference Elev -57.34' Pile Type CISS
Pile Length 115.24 Pile Tip Elev -87 Pile Cutoff Elev 28.24
Date(s) Driven 5.26.15 & 5.27.15 Inspected by D. Martinez

Penetration (ft)	Tip Elev (ft)	Blows/ft	Blows/Min	Equiv Stroke	Time	Remarks
1	-58.34	48				Welded connection
2	-59	40		2.5'		Elev. -1.34'
3	-60	37				(Top of Pad)
4	-61	34			16.66'	Elev. -18.0'
5	-62	37		56'-6"	56'	
6	-63	38	(Bottom Half)			
7	-64	40			39.34'	
8	-65	43				
9	-66	47				Elev. -57.34'
10	-67	49				
11	-68	46				
12	-69	46			STE	
13	-70	49				
14	-71	49				changed to F4 fuel setting
15	-72	55				
16	-73	60				
17	-74	68				
18	-75	67				
19	-76	68				
20	-77	68				
21	-78	65				
22	-79	65				
23	-80	68				
24	-81	79				

STATE OF CALIFORNIA.DEPARTMENT OF TRANSPORTATION

LOG PILE SHEET

SC-4805 (Formerly DH-OS C79) (REV. 12/17/13)

PDA Testing

JOB STAMP
Wilmington Ave. Interchange
Modification at 405 Fwy
Federal Aid Project No. HPLUL-5403(017)
Contract No. 07-234004
Project I.D. 0700000394

Bridge Name: Dominguez Channel Bridge (Widen) Sheet No. (2/2)

Bridge No. 53-1166 ~~Abut~~/Bent No. 4 Pile No. (0)

Hammer Make ~~Delmag~~ APE Model D46-32 Energy (ft-lbs) = ~~122,187 ft-lbs @12.05' stroke~~

Reference Descr Tip of Pile Bott. Half Reference Elev -57.34 Pile Type CISS,

Pile Length 115.24 Pile Tip Elev -87 Pile Cutoff Elev 28.24

Date(s) Driven 5.26.15 & 5.27.15 Inspected by D. Martinez

	Penetration (ft)	Tip Elev (ft)	Blows/ft	Blows/Min	Equiv Stroke	Time	Remarks
	25	-82	80				
	26	-83	72				
	27	-84	80				
	28	-85	85				
5.26.15	29	-86	70		8.5±		Stopped at 28.7± Penetr.
5.27.15	30	-87	300		8.5±		Stopped at 29.7± Penetr.

STATE OF CALIFORNIA.DEPARTMENT OF TRANSPORTATION

LOG PILE SHEET

SC-4805 (Formerly DH-OS C79) (REV. 12/17/13)

JOB STAMP: Wilmington Ave. Interchange Modification at 405 Fwy Federal Aid Project No. HPLUL-5403(017) Contract No. 07-234004 Project I.D. 0700000394

PDA Testing

Bridge Name: Dominguez Channel Bridge (Widen) — Sheet No. (1/1)

Bridge No.: 53-1166 — ~~Abut~~/Bent No.: 6 — Pile No.: (10)

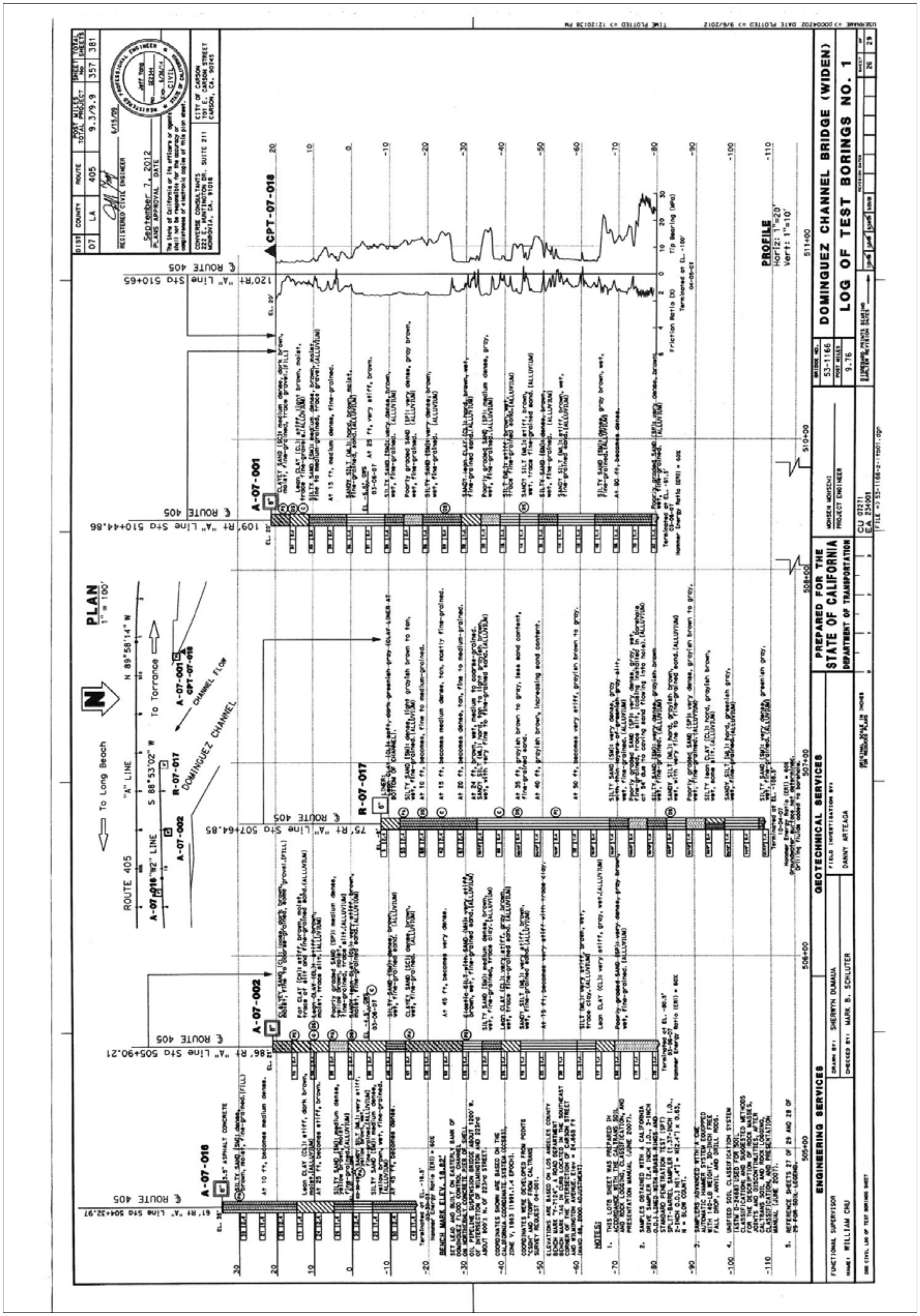
Hammer Make: ~~Delmag~~ APE — Model: D46-32 — Energy (ft-lbs) =

Reference Descr: Tip of Pile Bott. Half — Reference Elev: -56.06 — Pile Type: CISS

Pile Length: 107.45' — Pile Tip Elev: -80 — Pile Cutoff Elev: 27.45'

Date(s) Driven: 05.28.15 & 05.29.15 — Inspected by: D. Martinez

	Penetration (ft)	Tip Elev (ft)	Blows/ft	Blows/Min	Equiv Stroke	Time	Remarks
	1	-57.06	36				
	2	-58	32				
	3	-59	27				
	4	-60	32				Welded Connection
	5	-61	27			2.32'	Elev. -3.63'
	6	-62	29				(Top of Pad)
	7	-63	29			21.37'	Elev. - 25.0'
	8	-64	30	54'-9"			
	9	-65	30	(Bottom Half)	52.43'		
	10	-66	31			31.06'	
	11	-67	28				
	12	-68	29				Elev. -56.06'
	13	-69	33				
	14	-70	39				
	15	-71	48				
	16	-72	48				STE
	17	-73	51				
	18	-74	62				
	19	-75	69				
	20	-76	66				
	21	-77	75				
	22	-78	67				
05.28.15	23	-79	77		8.5±		
05.29.15	24	-80.00	145		8.6±		


DOMINGUEZ CHANNEL BRIDGE (WIDEN)
LOG OF TEST BORINGS NO. 1
PLAN
PROFILE
A-07-016
A-07-002
R-07-017
A-07-001
CPT-07-018
DOMINGUEZ CHANNEL
ROUTE 405
To Long Beach
To Torrance

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MANO MIRZAI
Structure Representative
Fresno Field Construction Office

Date: April 3, 2013

File: 06-Fre,Mad-99-26.7/R31.6,
R0.0/R1.6
06-442624 (06 0000 0972)
San Joaquin River Bridge (Replace)
Bridge No. 41-0090

From: **DEPARTMENT OF TRANSPORTATION**
Division of Engineering Services
Geotechnical Services - MS 5

Subject: Pile Dynamic Analysis, Pile Load Test Results, and Pile Field Acceptance Criteria: Test Pile at Pier 3

Attached is a report from this Office containing the Pile Dynamic Analysis, Pile Load Test results, and the Pile Field Acceptance Criteria for the Test Pile at Pier 3 of the above-referenced project.

If you have any questions or comments regarding this report, please contact James L. Ta, P.E. at (916) 227-1050.

Douglas E. Brittsan

DOUGLAS E. BRITTSAN, G.E.
Senior Transportation Engineer
Foundation Testing Branch

Attachments

c: R. Stott - SC (Email)
B. Alsamman - SC (Email)
K. Low - SC (Email)
N. Quiroz - SC (Email)
R. Simmons - SD (Email)
Q. Huang - OGDN (Email)
W. Bertucci - OGDN (Email)
T. Shantz - DRI (Email)
Geodog

"Caltrans improves mobility across California"

FOUNDATION TESTING BRANCH

April 3, 2013

06-Fre,Mad-99-26.7/R31.6,R0.0/R1.6
06-442624

San Joaquin River Bridge (Replace)
Bridge No. 41-0090

Pile Dynamic Analysis, Pile Load Test Results, and Pile Field Acceptance Criteria:

Test Pile at Pier 3

April 3, 2013

Project Information

06-Fre,Mad-99-26.7/R31.6,R0.0/R1.6
06-442624
San Joaquin River Bridge (Replace)
Bridge No. 41-0090

Subject

Pile Dynamic Analysis, Pile Load Test Results, and Pile Field Acceptance Criteria:
Test Pile at Pier 3

Introduction

This report presents the pile dynamic analysis (PDA), pile load test (PLT) results, and pile field acceptance criteria for the Test Pile at Pier 3 of the San Joaquin River Bridge replacement structure. Static axial load testing was conducted on the 74.5-inch diameter by 1.25-inch thick Cast-in-Steel-Shell (CISS) open ended steel pipe pile with respect to two different pile installation methods. The subject Test Pile is identified on the contract plans as Pile No. 1 at Pier 3. The compression load test used four reaction anchor piles each consist of a 48-inch diameter by 1.0-inch thick steel pipe piling. The Test Pile and four anchor piles were driven using the APE D180-42 and Pileco D225-22/32, open ended, single acting diesel impact hammers. A site location map of the Test Pile is provided in Appendix A.

The Test Pile at Pier 3 is a production pile that will be incorporated into the San Joaquin River Bridge foundations. Based on the contract plans, the four anchor piles used for PLT are non-production piles that will be cut below grade and leave in-placed.

The criteria detailed herein are designed to provide pile compressive acceptance criteria for the 74.5-inch diameter CISS piling based on wave equation analysis and PDA data with correlations to the static axial test results of the measured load-displacement behavior of the Test Pile. As such, the Test Pile at Pier 3 is intended to be representative of the CISS piling for the control locations of Piers 2 to 6 of the San Joaquin River Bridge replacement foundations.

Foundation Description

The replacement San Joaquin River Bridge is a six-span structure. Based on contract plans, Abutments 1 and 7 are designed to be supported by Class 140 Alt W piling. Piers 2 to 6 are designed to be supported by a five-column pier with CISS piling. A total of twenty-five (25) 74.5-inch diameter by 1.25-inch thick Cast-in-Steel-Shell (CISS) piles are planned to be installed at the proposed new bridge structure. The specified "designed" nominal resistance in compression for the production piles (Piers 2 to 6) at the San Joaquin River Bridge ranges from 4070 kips to 6230 kips with zero demand for tension. Nominal driving resistance ranges from 4230 kips to 6640 kips were shown on the plans (referred to Pile Data Table for specific support location).

Subsurface Conditions

Stratigraphy at the San Joaquin River Bridge load test site can be characterized by Geotechnical Boring RC-11-001 (boring dated 05-25-11). The site stratigraphy consists of granular materials of loose to medium dense to very dense silty sand, sand, silt, and sandy silt. Trace of gravel was encountered within the granular soil matrix. Very stiff to hard silty/lean clay, sandy clay, and silt were encountered and interbedded within the soil matrix. For complete description of the subsurface conditions at the test site, please refer to the Log of Test Boring provided in Appendix E.

Pile Installation Summary

The Test Pile at Pier 3 utilized for the compressive static axial load testing was a 74.5-inch diameter with 1.25-inch shell thickness, open ended steel pipe pile. Each of the four (4) anchor piles consist of a 48-inch diameter with 1.0-inch shell thickness, open ended steel pipe pile. All piling conformed to ASTM A252, Grade 3 and were manufactured by XKT Engineering, Inc. of Vallejo, CA. At Pier 3, the anchor pile (AKA Pile A, utilized for PDA monitoring) was driven with the APE D180-42 diesel hammer (max Fuel Setting during PDA monitoring) and the Test

Pile was driven with the Pileco D225-22/32 diesel hammer (Fuel Setting set from minimum to maximum during PDA monitoring) to approximate tip elevation of 52 feet (as reported). Original Grade (OG) elevation at the location of the Test Pile was estimated to be approximately elevation 237.5 feet.

Pile Dynamic Analysis - Test Pile & Anchor Pile

The contractor installed the isolation CMP casing. Clean out inside the CMP casing was provided to near casing tip. The first and second pipe sections (80 feet each) of the Test Pile were driven with the APE D180-42 hammer followed by field welding. Pile driving installations of the third-section of the steel pipe (76 feet) were utilized by both the APE D180-42 and Pileco D225-22/32 hammers. PDA monitoring (Pileco D225-22/32) was performed on March 8, 2013 for Test Pile and was driven to approximate tip elevation of 52 feet. The initial PDA monitoring of the Test Pile was referenced to penetration depths of 168.5 ft to 173.2 ft (elevation 56.7 ft to elevation 52 ft) with datum referenced to ground surface inside CMP casing (estimated at elevation 225.2 ft).

PDA monitoring was performed on February 22, 2013 for the Anchor Pile (Pile A) and was driven to approximate tip elevation of 106 feet. The initial PDA monitoring of the Anchor Pile was referenced to penetration depths of 104 ft to 130 ft (elevation 132 ft to elevation 106 ft) with datum reference at OG.

Characteristics of the Pileco D225-22/32 and APE D180-42 Diesel hammers are provided in Table I below that include the rated energy, Eq. max stroke, Eq. rate stroke, ram weight, and helmet/cap weight. Manufacturer's published specifications (additional information provided by the Contractor from other project with different hammer ID number) of the diesel hammers utilized to install the piles at the test site are shown in Table I. The below data were utilized for analysis purposes.

Table I: Hammer Characteristics

Hammer	Rated Energy* (kip-ft)	Ram Weight* (kips)	EQ. Rated Stroke* {EQ. Max Stroke}* (ft)	Helmet/Cap Weight** (kips)
Pileco D225-22/32***	555.34	49.584	11.2 {14.3}	45
APE D180-42	446.51	39.69	11.25 {16.75}	45

Source: *Hammer Database from GRLWEAP Version 2010.
**Contractor Submittal.
***Per Contractor submittal, Pileco D225-32 is the same as Pileco D225-22 from GRLWEAP hammer database.

Pile Dynamic Analysis (PDA) monitoring was performed on the Test Pile for 4.7 feet of driving, utilizing a Pile Driving Analyzer® Model PAX, Serial No. 3705L, manufactured by Pile Dynamics Inc. Four strain sensors and two accelerometers were used to monitor the Test Pile driving operations. All sensors were mounted on the outer surface of the pile at approximately 12.3 ft below top of pile. The sensor data for the Test Pile at Pier 3 are summarized in Table II.

Table II. PDA Sensor Data

Sensor Type	ID No.
Accelerometer A3	K1307
Accelerometer A4	K1300
Strain Gauge F1	C500
Strain Gauge F2	C501
Strain Gauge F3	C502
Strain Gauge F4	C494

Measured strains and accelerations induced in the pile as a result of driving were used to determine various engineering parameters of interest. Some of the more significant attributes derived for each hammer blow include the maximum energy transferred from the hammer to the pile, maximum pile compressive stresses, and the blow count. Plots depicting these parameters as a function of penetration depth are presented in Appendix B. PDA test results for the Anchor Pile (Pile A) and Test Pile at Pier 3 are summarized in Tables III(a) and III(b), respectively.

Table III(a). PDA Test Results of Anchor Pile (Pile A) at Pier 3

Approx. Elevation of Pile Tip for PDA Monitoring Start of Initial Drive End of Initial Drive	**English Units** 132 ft 106 ft
Max Transferred Energy (EMX) End of Initial Drive*	246.179 kip-ft*
Maximum Average Compressive Stress (CSX) Initial Drive*	26.246 ksi*
Maximum Individual Compressive Stress (CSI) Initial Drive*	33.739 ksi*
Actual Field Blow Counts End of Initial Drive	28 blows/ft

Note:
1) *Value based on full depth range of PDA data.

Table III(b). PDA Test Results of Test Pile at Pier 3

Approx. Elevation of Pile Tip for PDA Monitoring	English Units
Start of Initial Drive	56.7 ft
End of Initial Drive	52.0 ft
Max Transferred Energy (EMX)	
End of Initial Drive*	329.06 kip-ft*
End of Initial Drive**	286.9 kip-ft**
Maximum Average Compressive Stress (CSX)	
Initial Drive*	27.178 ksi*
Initial Drive**	26.09 ksi**
Maximum Individual Compressive Stress (CSI)	
Initial Drive*	29.872 ksi*
Initial Drive**	27.31 ksi**
Actual Field Blow Counts End of Drive	149 blows/ft

Notes:
1) *Value based on full depth range of PDA data.
2) **Value based on last ten blows only.

The Test Pile at the San Joaquin River replacement structure project appears to have been driven without observed damage while being monitored by Pile Dynamic Analyzer (PDA). The compressive pile driving stresses measured by PDA did not exceed the allowable stresses within the pile. The maximum compressive stress (CSI) recorded at any sensor was 29.872 ksi, during the initial drive. This represents about 66% of the minimum yield stress of 45 ksi, which is below the 90% allowable for pile installation. The maximum average compressive stress over the pile cross section was observed during initial drive at 27.178 ksi, which is about 60% of the minimum yield stress of 45 ksi.

In order to impart maximum energy to the pile and limit the potential for pile damage, pile and hammer alignment must be properly maintained. The pile experienced no observed bending during installation with the subject hammer system.

It should be noted that ultimate pile capacity has not been shown to be reliably predicted by PDA for large diameter, open ended pipe piles. Therefore, ultimate capacities computed from PDA using the CAPWAP® program are not deemed as a dependable evaluation of the actual CISS pipe pile capacity.

Pile driveability is highly dependent upon soil characteristics, hammer alignment, pile length, pile handling, and adherence to the specifications and industry-accepted driving practices, so engineering judgment should be exercised when applying this information to other piles driven within the control location.

Static Axial Compressive Load Testing

Static axial compressive load testing was conducted on March 15, 2013 for the first PLT test and on March 21, 2013 for the second PLT test by personnel (R. Medina, R. Cosato, J. Pattison, A. Valdez and J. Ta) from the Foundation Testing Branch of Geotechnical Services. Test procedures used were in general conformance with ASTM D 1143/D 1143M - 07, contract Special Provisions and specifications developed by this Office. The test frame consisted of a five-pile group, a Test Pile with four anchor piles. Applied load was monitored at the Test Pile utilizing four (4) load cells placed between the hydraulic loading rams and the main beam. Deflection was monitored utilizing four (4) displacement transducers placed (on mirror plate) below the top of the test pile and fastened to a pair of fixed beams. For test frame layout plan and photos, please refer to Appendix E.

Based on requirements from contract Special Provisions (with modifications by the Geotechnical Designers), total of two (2) compressive axial load tests were conducted for two different types of installation methods (first test with no clean out and second test with partial pile clean out). Each test consists of two (2) loading cycles. Cycle #1 was set to 2000 kips (at 30% the nominal resistance in compression) and Cycle #2 was set to 6640 kips (nominal resistance in compression) and increased to maximum test frame capacity of 8000 kips. Table IV summarizes the results of the static axial compressive load tests. Plot depicting load-displacement behavior for the Test Pile at Pier 3 can be found in Appendix C.

Table IV. Compression Test Results: Test Pile at Pier 3
74.5-inch diameter at 1.25-inch thick CISS Pile

Compression Test	PLT Test #1	PLT Test #2
Test Date	03/15/2013	03/21/2013
Measured Load at 1.0-inch deflection	4737.2 kips*	4630.7 kips*
Measured Demand Load	6640.4 kips*	6640.7 kips*
Displacement at Measured Demand Load	1.51 inches*	1.51 inches*
Measured Maximum Compressive Load	8011.7 kips*	8006.7 kips*
Max Displacement at Max Load	2.15 inches*	2.10 inches*
Required Nominal Compressive Resistance	6640 kips	6640 kips

*Data from Cycle #2.

Pile Field Acceptance Criteria

Field acceptance criteria were developed by this Office based on the results of wave equation analysis correlated to pile load test and pile dynamic measurements. Wave Equation Analysis was performed utilizing the pile driving analysis software GRLWEAP™ Version 2010. Plots depicting estimated pile nominal compressive resistance (pile capacity) as a function of blow count and hammer stroke are presented in Appendix D.

The pile field acceptance criteria are considered valid for only the specified pile type driven by the Pileco D225-22/32 hammer system (Field ID as D225-32), operating properly at up to maximum fuel setting. The influence of uneven or eccentric blows is not addressed by these charts and should be considered. If the performance of the hammer is altered, or if the construction practice is altered in a way that affects imparted energy, the pile field acceptance criteria will not be valid.

Results

This Office recommends the Structure Representative, Structural Designer, and Geotechnical Designers to review the submitted PLT report and to utilize the test results in accordance to the design requirements for the 74.5-inch diameter CISS piling at the control locations of Piers 2 to 6 of the San Joaquin River replacement structure, Bridge No. 41-0090.

If you have any questions or comments regarding this report, please contact James L. Ta, P.E. at (916) 227-1050.

JAMES L. TA, P.E.
Associate M & R Engineer
Foundation Testing Branch
Office of Geotechnical Support

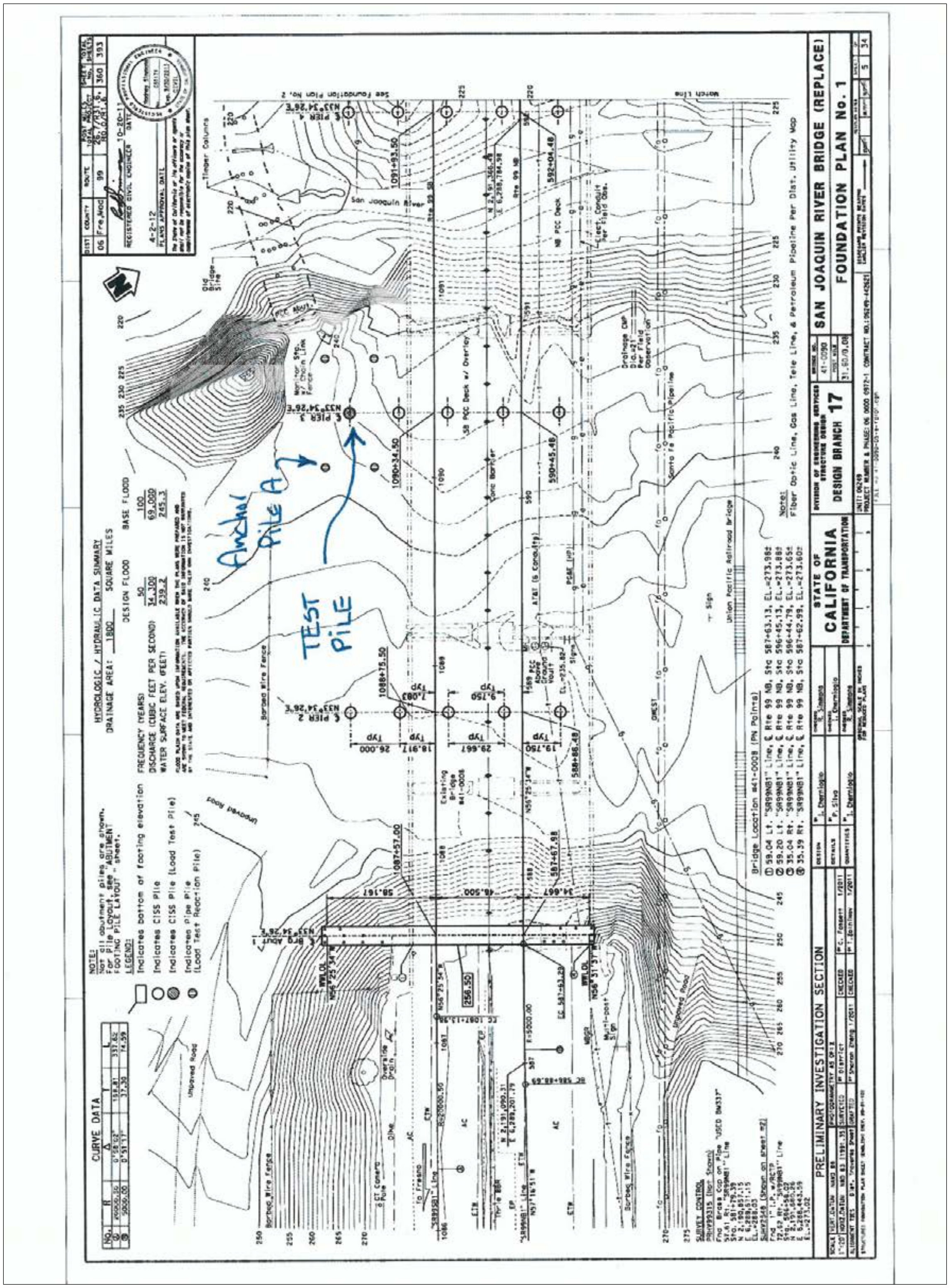
04/03/2013

APPENDIX A

LOCATION MAP OF SUBJECT PILING

San Joaquin River Bridge (Replace)
Bridge No. 41-0090

Test Pile at Pier 3

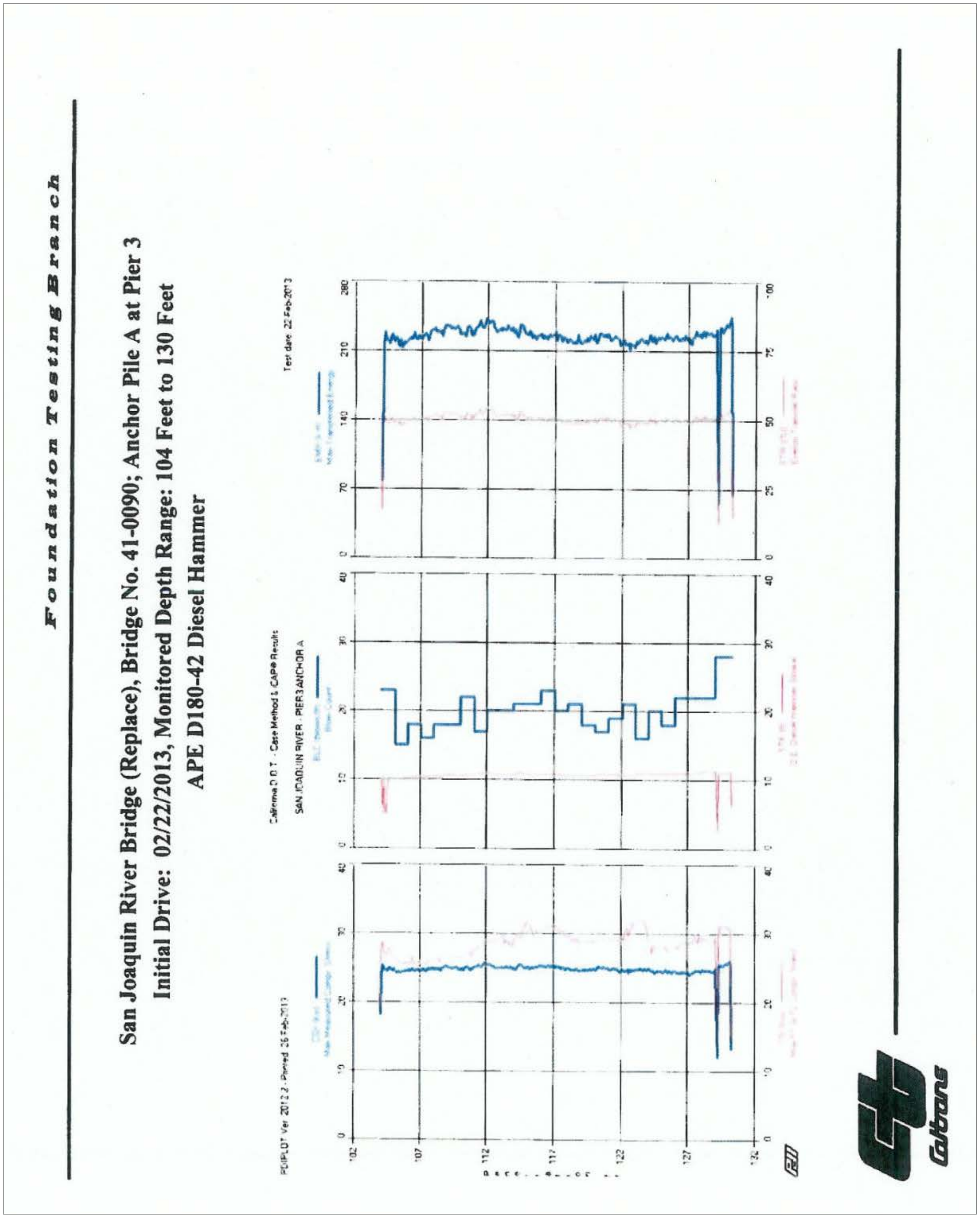

Anchor Pile A
TEST PILE
CURVE DATA
HYDROLOGIC / HYDRAULIC DATA SUMMARY
PRELIMINARY INVESTIGATION SECTION
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DESIGN BRANCH 17
SAN JOAQUIN RIVER BRIDGE (REPLACE)
FOUNDATION PLAN No. 1

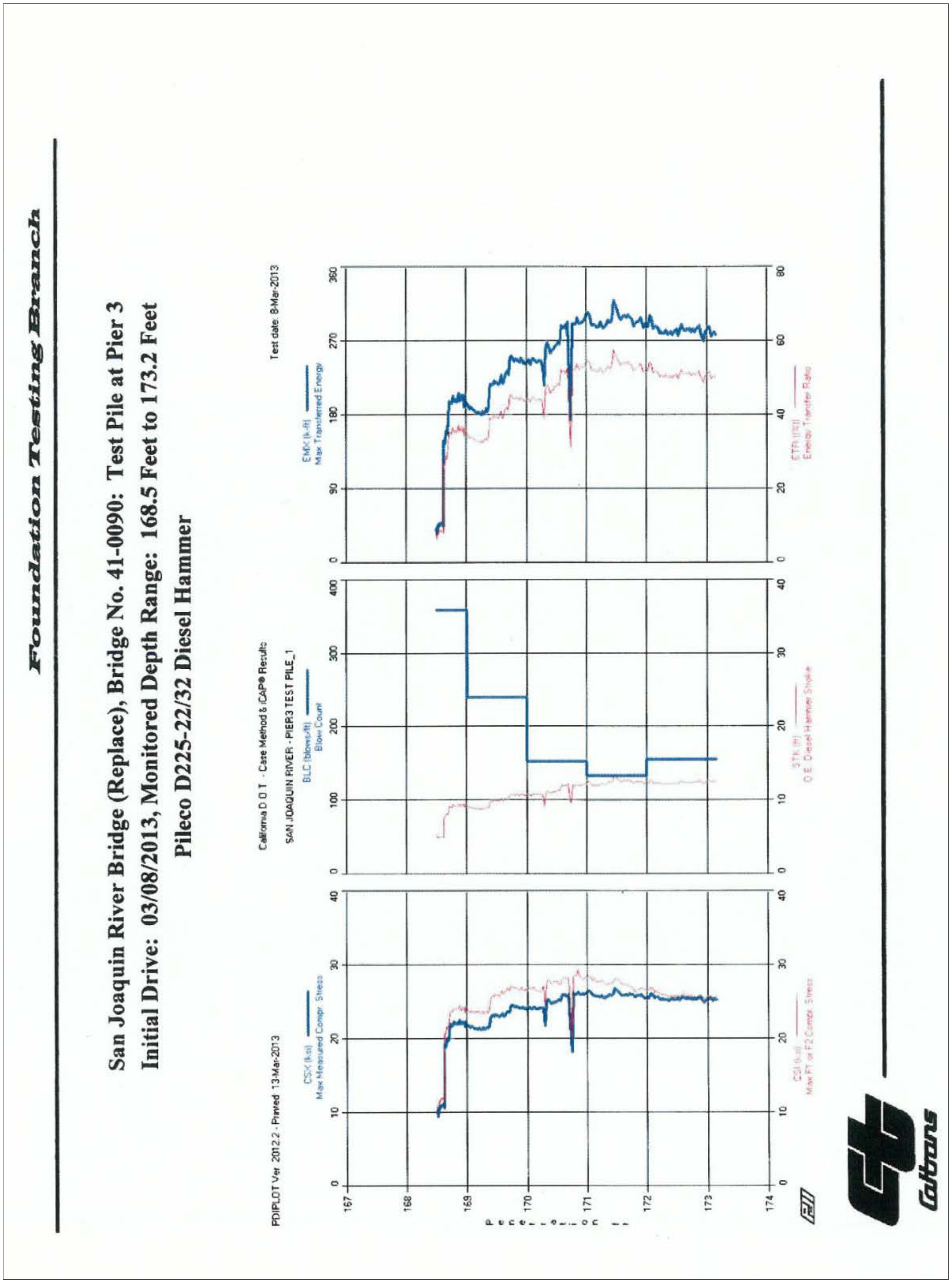
APPENDIX B

PILE DYNAMIC ANALYSIS

San Joaquin River Bridge (Replace)
Bridge No. 41-0090

Test Pile at Pier 3


Foundation Testing Branch
San Joaquin River Bridge (Replace), Bridge No. 41-0090; Anchor Pile A at Pier 3
Initial Drive: 02/22/2013, Monitored Depth Range: 104 Feet to 130 Feet
APE D180-42 Diesel Hammer
Caltrans


Foundation Testing Branch
San Joaquin River Bridge (Replace), Bridge No. 41-0090: Test Pile at Pier 3
Initial Drive: 03/08/2013, Monitored Depth Range: 168.5 Feet to 173.2 Feet
Pileco D225-22/32 Diesel Hammer
PDIPLOT Ver. 2012.2 - Printed: 13-Mar-2013
California D.O.T. - Case Method & iCAP® Results
SAN JOAQUIN RIVER - PIER3 TEST PILE_1
Test date: 8-Mar-2013
CSX (ksi) Max Measured Compr. Stress
CSI (ksi) Max F1 or F2 Compr. Stress
BLC (blows/ft) Blow Count
STK (ft) O.E. Diesel Hammer Stroke
EMX (k-ft) Max Transferred Energy
ETR (%) Energy Transfer Ratio
Caltrans

Foundation Testing Branch

APPENDIX C

STATIC AXIAL PILE LOAD TEST:

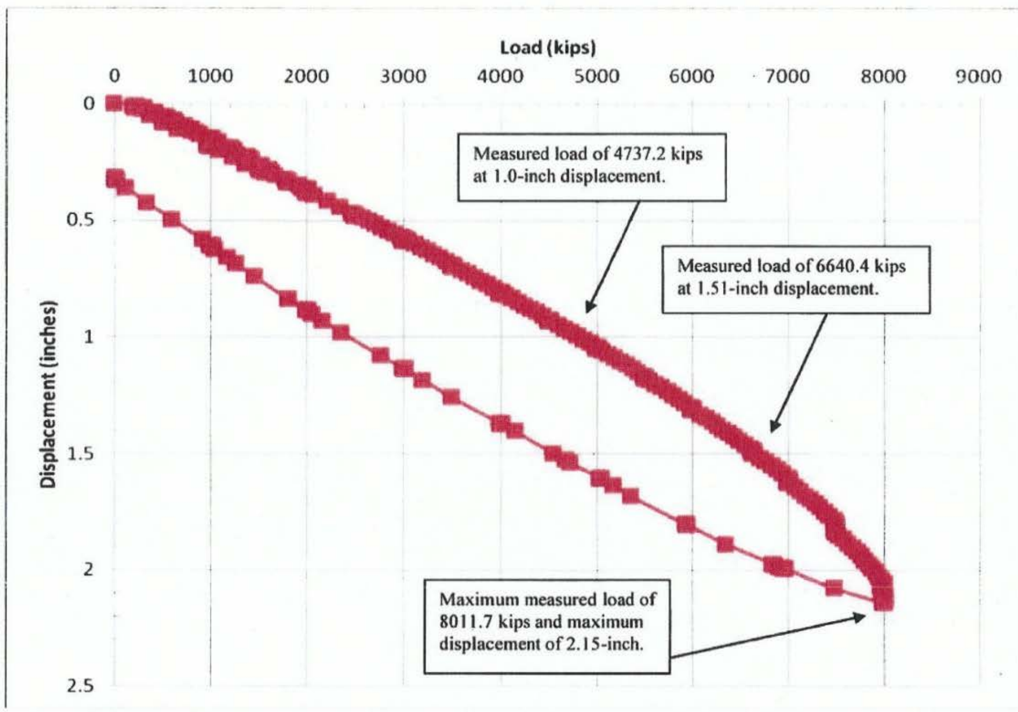
LOAD-DISPLACEMENT BEHAVIOR

San Joaquin River Bridge (Replace)
Bridge No. 41-0090

Test Pile at Pier 3

Caltrans

Foundation Testing Branch



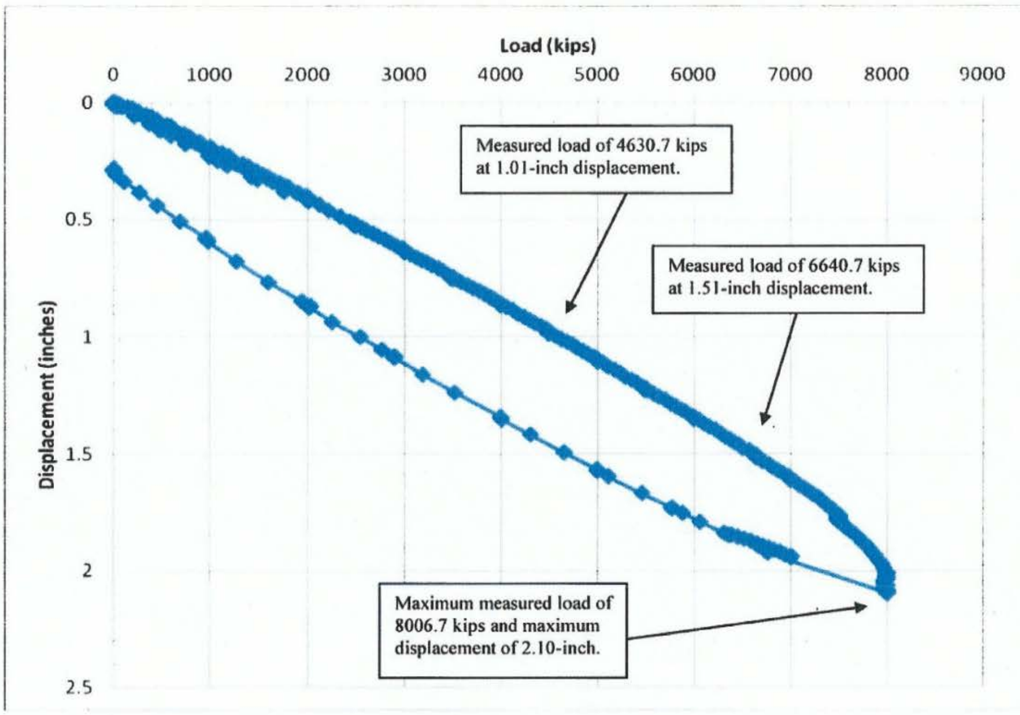
Load - Displacement Behavior
Pile Load Test

San Joaquin River Bridge (Replace)
(First PLT Test)
Test Pile at Pier 3

Bridge No. 41-0090
EA: 06-442624
06-Fre,Mad-99-26.7/R31.6,R0.0/R1.6
Compression Test Date: 03/15/2013

74.5-inch diameter by 1.25-inch thick
CISS Piling (prior to pile clean out)
Pile Tip Elev. = 52 ft (Reported)

Foundation Testing Branch



Load - Displacement Behavior
Pile Load Test

<u>San Joaquin River Bridge (Replace)</u>
(Second PLT Test)
Test Pile at Pier 3

Bridge No. 41-0090
EA: 06-442624
06-Fre,Mad-99-26.7/R31.6,R0.0/R1.6
Compression Test Date: 03/21/2013

74.5-inch diameter by 1.25-inch thick
CISS Piling (with partial pile clean out)
Pile Tip Elev. = 52 ft (Reported)

Foundation Testing Branch

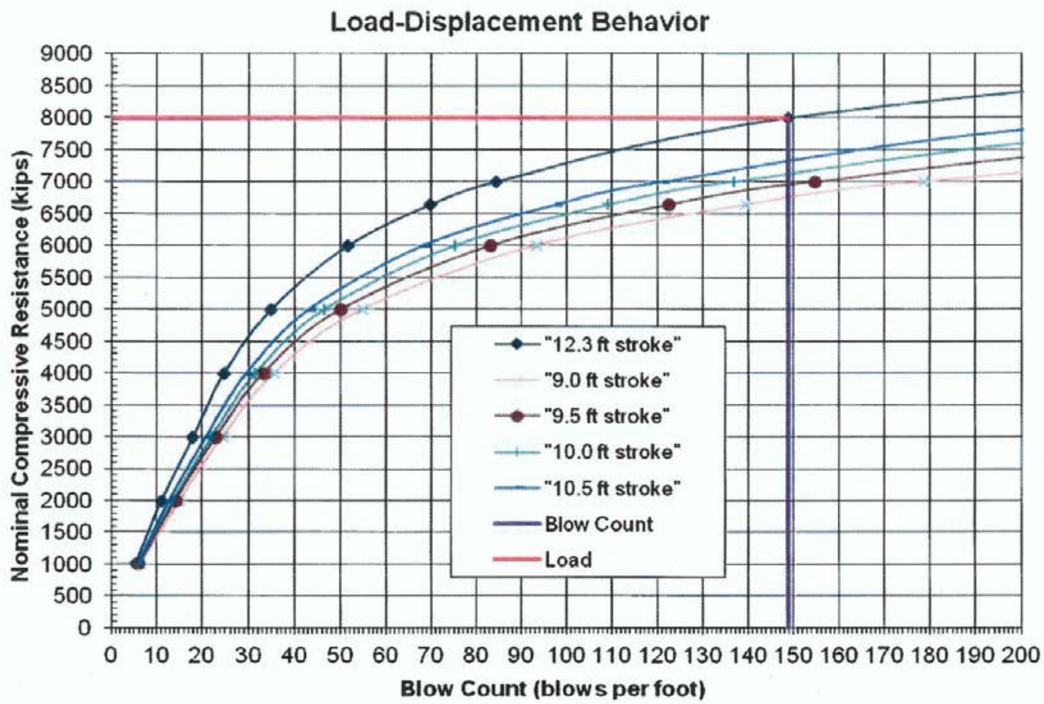
APPENDIX D

PILE FIELD ACCEPTANCE CRITERIA

San Joaquin River Bridge (Replace)
Bridge No. 41-0090

Test Pile at Pier 3

Foundation Testing Branch



Graph #1

Field Acceptance Chart: Capacity Relationship

Derived from Wave Equation Analysis Program (WEAP) and Load Test Results

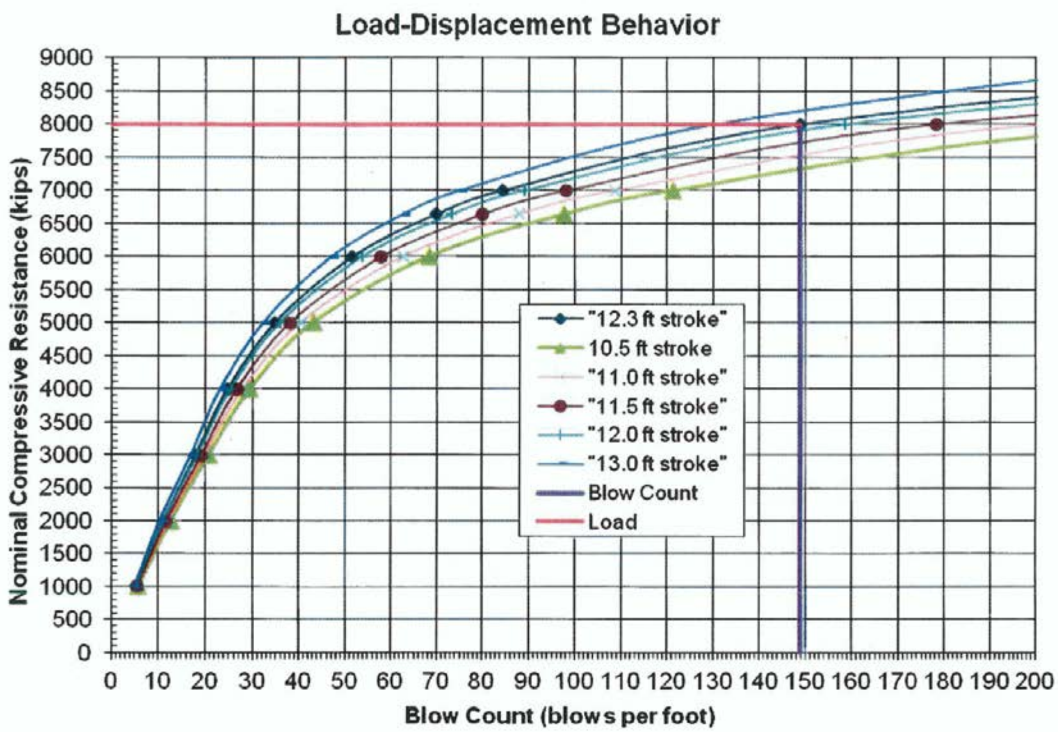
San Joaquin River Bridge (Replace)
Test Pile at Pier 3

(For Stroke Range: 9.0 feet to 10.5 feet)

Bridge No. 41-0090
06-Fre,Mad-99-26.7/R31.6,R0.0/R1.6
Compression Test Date: 03/15/2013

74.5-inch x 1.25-inch CISS Pile
OG Elev. = 237.5 ft (estimated)
Pile Tip Elev. = 52 ft (reported)

Foundation Testing Branch



Graph #2

Field Acceptance Chart: Capacity Relationship

Derived from Wave Equation Analysis Program (WEAP) and Load Test Results

San Joaquin River Bridge (Replace)
Test Pile at Pier 3

(For Stroke Range: 10.5 feet to 13.0 feet)

Bridge No. 41-0090
06-Fre,Mad-99-26.7/R31.6,R0.0/R1.6
Compression Test Date: 03/15/2013

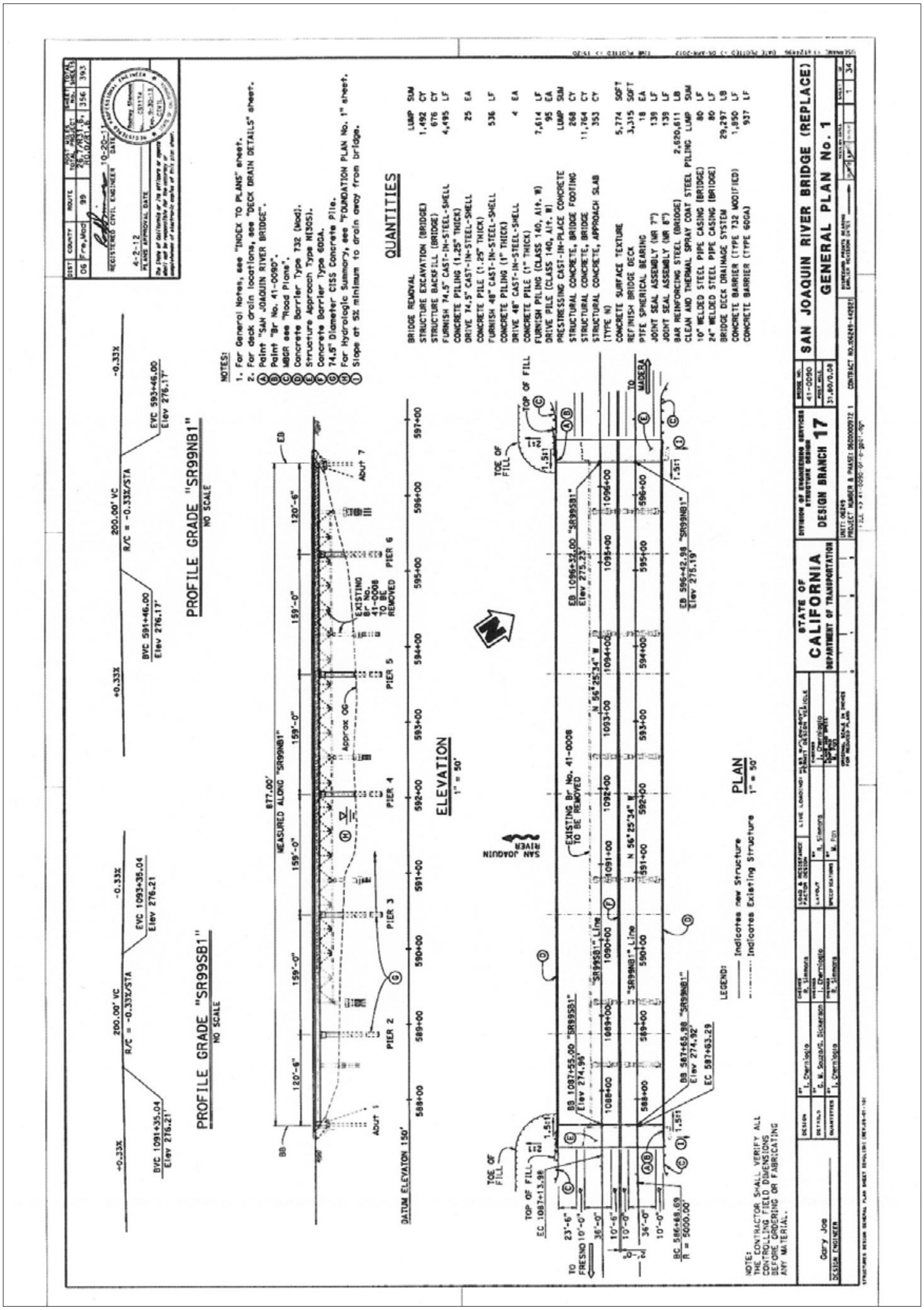
74.5-inch x 1.25-inch CISS Pile
OG Elev. = 237.5 ft (estimated)
Pile Tip Elev. = 52 ft (reported)

APPENDIX E

CONTRACT PLANS AND PHOTOS

San Joaquin River Bridge (Replace)
Bridge No. 41-0090

Test Pile at Pier 3


PROFILE GRADE "SR99SB1"
NO SCALE
PROFILE GRADE "SR99NB1"
NO SCALE
ELEVATION
1" = 50'
PLAN
1" = 50'
NOTES:
QUANTITIES
LEGEND:
Indicates new Structure
Indicates Existing Structure
SAN JOAQUIN RIVER BRIDGE (REPLACE)
GENERAL PLAN No. 1
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DESIGN BRANCH 17

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
06	Fre,Mad	99	26.7/R31.6, R0.0/R1.6	358	393

REGISTERED CIVIL ENGINEER 10-20-11 DATE

4-2-12
PLANS APPROVAL DATE

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.

INDEX TO PLANS

SHEET NO.	TITLE
1.	GENERAL PLAN No. 1
2.	GENERAL PLAN No. 2
3.	INDEX TO PLANS
4.	DECK CONTOURS
5.	FOUNDATION PLAN No. 1
6.	FOUNDATION PLAN No. 2
7.	ABUTMENT LAYOUT
8.	ABUTMENT FOOTING PILE LAYOUT
9.	ABUTMENT DETAILS No. 1
10.	ABUTMENT DETAILS No. 2
11.	ABUTMENT DETAILS No. 3
12.	PTFE/SPHERICAL EXPANSION BEARING DETAILS
13.	PIER LAYOUT No. 1
14.	PIER LAYOUT No. 2
15.	PIER DETAILS No. 1
16.	PIER DETAILS No. 2
17.	PIER DETAILS No. 3
18.	LOAD TEST PILE DETAILS
19.	TYPICAL SECTION No. 1
20.	TYPICAL SECTION No. 2
21.	GIRDER LAYOUT No. 1
22.	GIRDER LAYOUT No. 2
23.	GIRDER REINFORCEMENT
24.	GIRDER DETAILS No. 1
25.	GIRDER DETAILS No. 2
26.	GIRDER DETAILS No. 3
27.	DECK DRAIN DETAILS
28.	JOINT SEAL-ASSEMBLY
29.	STRUCTURE APPROACH DRAINAGE DETAILS
30.	STRUCTURE APPROACH TYPE N(30S)
31.	LOG OF TEST BORINGS 1
32.	LOG OF TEST BORINGS 2
33.	LOG OF TEST BORINGS 3
34.	LOG OF TEST BORINGS 4

STANDARD PLANS DATED MAY 2006

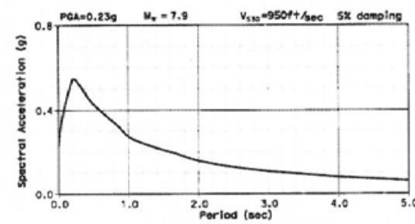
A10A	ACRONYMS AND ABBREVIATIONS (A-L)
A10B	ACRONYMS AND ABBREVIATIONS (M-Z)
A62C	LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL BRIDGE
A76D	CONCRETE BARRIER TYPE 60GA
B0-1	BRIDGE DETAILS
B0-5	BRIDGE DETAILS
B0-13	BRIDGE DETAILS
B2-5	PILE DETAILS CLASS 90 AND CLASS 140
B7-1	BOX GIRDER DETAILS
B7-7	DECK DRAIN TYPE D-3
B7-8	DECK DRAINAGE DETAILS
B7-10	UTILITY OPENING BOX GIRDER
B8-5	CAST-IN-PLACE PRESTRESSED GIRDER DETAILS
B11-55	CONCRETE BARRIER TYPE 732
B14-3	COMMUNICATION AND SPRINKLER CONTROL CONDUITS (CONDUIT LESS THAN 4")
B14-5	WATER SUPPLY LINE DETAILS (PIPE SIZE LESS THAN 4")

Standard Plan Sheet No.
Detail No.

Structural Concrete, Bridge
Structural Concrete, Bridge (4,000 psi at 28 days)
Structural Concrete, Bridge (5,000 psi at 28 days)
Structural Concrete, Bridge Footing
Cast-In-Steel-Shell (CISS) pile

CONCRETE STRENGTH AND TYPE LIMITS

No Scale



SITE SPECIFIC ARS

GENERAL NOTES

LOAD AND RESISTANCE FACTOR DESIGN

DESIGN:
AASHTO LRFD Bridge Design Specifications, 4th edition and the California Amendments, preface dated December 2008.

SEISMIC DESIGN:
Caltrans Seismic Design Criteria (SDC), Version 1.5 dated September 2009.

SEISMIC LOADING:
See SITE SPECIFIC ARS

DEAD LOAD:
Includes 35 psf for future wearing surface.

LIVE LOADING:
HL93 and permit design load.

CONCRETE:
fy = 60 ksi
f'c = 3.6 ksi (except as shown on Concrete Strength & Type Limits).
n = 8
See "Prestressing Notes" on "Girder Details No. 2" sheet.

STRUCTURAL STEEL:
CISS Piles: ASTM A252, Grade 3
fy = 45 ksi
fu = 66 ksi

PILE DATA TABLE

LOCATION	PILE TYPE	PILE No.	NOMINAL RESISTANCE (KIPS) COMPRESSION	NOMINAL RESISTANCE (KIPS) TENSION	CUT-OFF ELEVATION (ft)	DESIGN TIP ELEVATION (ft)	SPECIFIED TIP ELEVATION (ft)	NOMINAL DRIVING RESISTANCE (KIPS)
Abutment 1	Class 140 Alt W	-	280	0	*	186 (c)	186	398
Pier 2	CISS 74.5 x 1.25	1,3,5	5090	0	232.0	66 (a), 160 (b)	66	5290
		2	4070	0		94 (a), 160 (b)	94	4230
		4	5990	0		39 (a), 160 (b)	39	6230
Pier 3	CISS 74.5 x 1.25	1	5260	0	230.0	42 (a), 52 (b), 14 (c)	14	6640
		3,5	5260	0		42 (a), 152 (b)	42	5700
		2	4200	0		73 (a), 152 (b)	73	4645
		4	6190	0		14 (a), 152 (b)	14	6640
Pier 4	CISS 74.5 x 1.25	1,3,5	5290	0	230.0	43 (a), 152 (b)	43	5650
		2	4230	0		73 (a), 152 (b)	73	4630
		4	6200	0		14 (a), 152 (b)	14	6490
Pier 5	CISS 74.5 x 1.25	1,3,5	5290	0	230.0	45 (a), 152 (b)	45	5500
		2	4200	0		76 (a), 152 (b)	76	4460
		4	6230	0		15 (a), 152 (b)	15	6480
Pier 6	CISS 74.5 x 1.25	1,3,5	5100	0	230.0	66 (a), 146 (b)	66	5280
		2	4090	0		90 (a), 146 b)	90	4700
		4	6000	0		39 (a), 146 (b)	39	6200
Abutment 7	Class 140 Alt W	-	280	0	*	172 (a)	172	477

NOTES:
* See "FOUNDATION PLAN" and "ABUTMENT DETAILS NO. 1" sheets
1. Design tip elevation is controlled by the following demands: (a) Compression, (b) Lateral Load, (c) Test Pile Tip
2. For temporary cut-off elevation of Test Pile and for Anchor Pile data, see "LOAD TEST PILE DETAILS" sheet.

DESIGN: I. Cherniogio — CHECKED: R. Simmons
DETAILS: L. Wong / G. Dickerson — CHECKED: I. Cherniogio
QUANTITIES: I. Cherniogio — CHECKED: R. Simmons

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

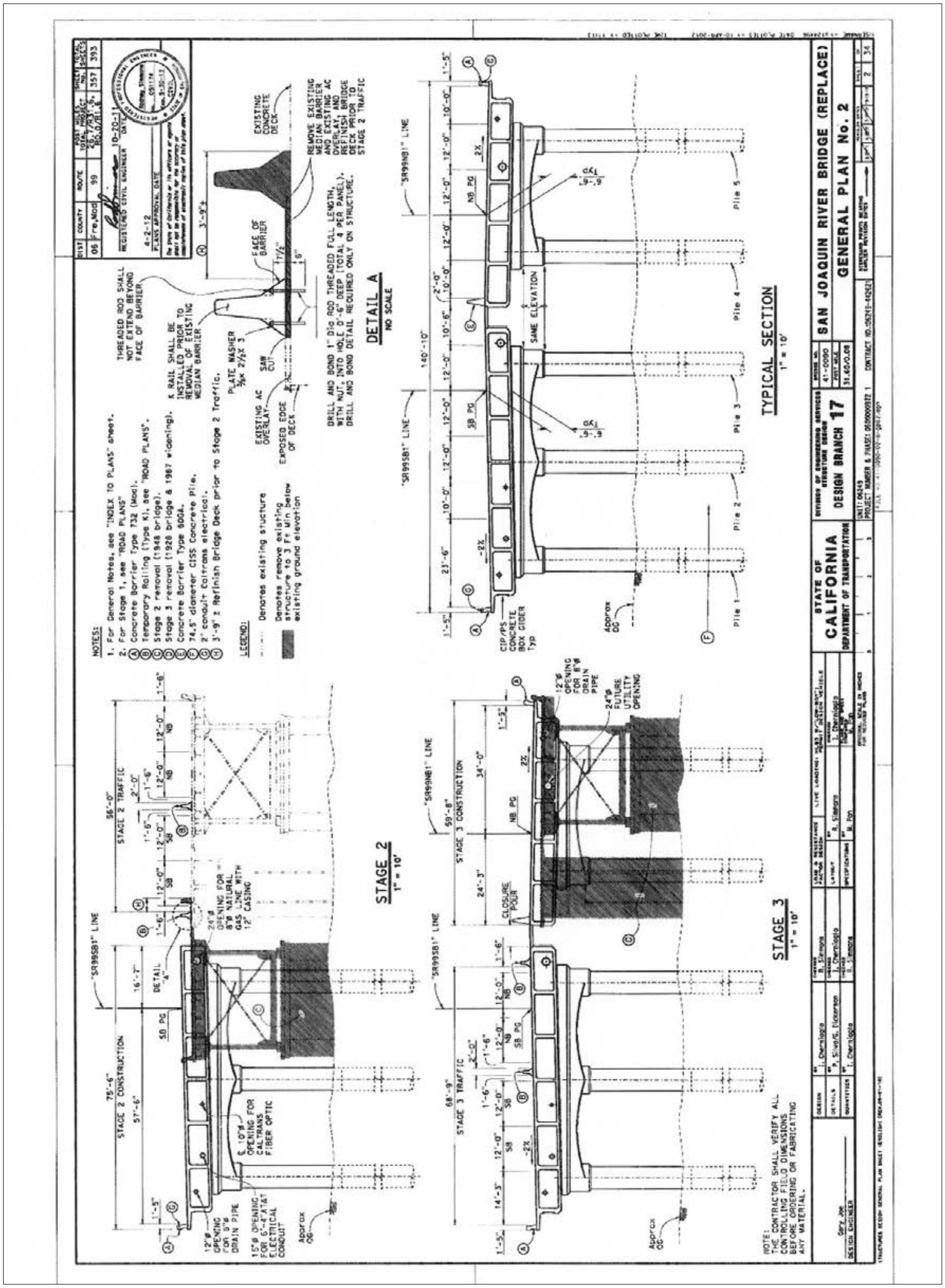
DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN
DESIGN BRANCH 17

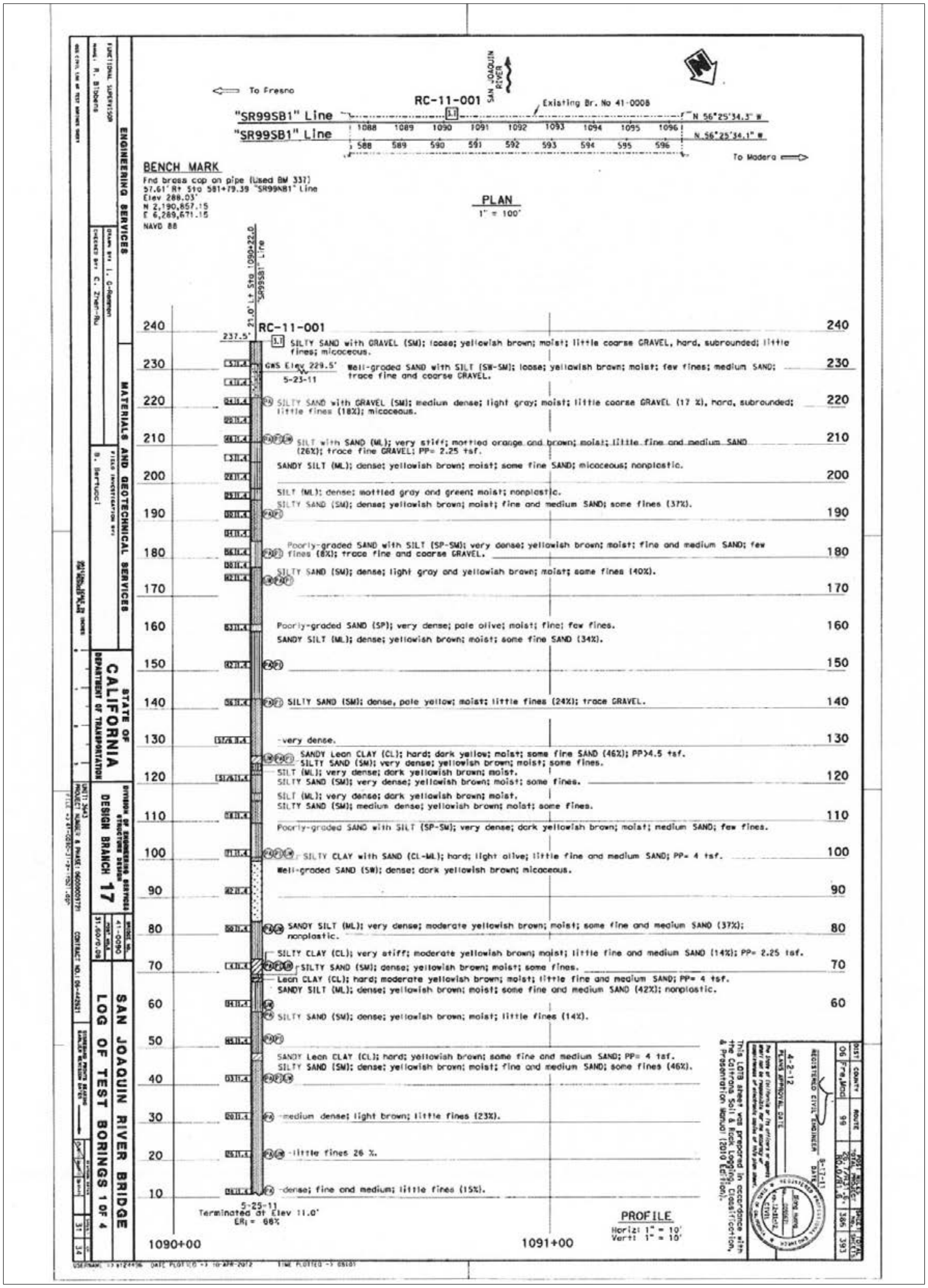
BRIDGE NO. 41-0090
POST MILE 31.60/0.08

SAN JOAQUIN RIVER BRIDGE (REPLACE)
INDEX TO PLANS

UNIT: 06249
PROJECT NUMBER & PHASE: 0600000972 1
CONTRACT NO.: 06249-44262

SHEET 3 OF 34


STAGE 2
STAGE 3
DETAIL A
TYPICAL SECTION
SAN JOAQUIN RIVER BRIDGE (REPLACE)
GENERAL PLAN No. 2


To Fresno
SAN JOAQUIN RIVER
RC-11-001
Existing Br. No 41-0008
"SR99SB1" Line
"SR99SB1" Line
N 56°25'34.3" W
N 56°25'34.1" W
To Madera
BENCH MARK
Fnd brass cap on pipe (Used BM 337)
57.61' Rt Sta 581+79.39 "SR99NB1" Line
Elev 288.03'
N 2,190,857.15
E 6,289,671.15
NAVD 88
PLAN
1" = 100'
21.0' Lt Sta 1090+22.0 "SR99SB1" Line
RC-11-001
237.5'
SILTY SAND with GRAVEL (SM); loose; yellowish brown; moist; little coarse GRAVEL, hard, subrounded; little fines; micaceous.
GWS Elev 229.5'
5-23-11
Well-graded SAND with SILT (SW-SM); loose; yellowish brown; moist; few fines; medium SAND; trace fine and coarse GRAVEL.
SILTY SAND with GRAVEL (SM); medium dense; light gray; moist; little coarse GRAVEL (17 %), hard, subrounded; little fines (18%); micaceous.
SILT with SAND (ML); very stiff; mottled orange and brown; moist; little fine and medium SAND (26%); trace fine GRAVEL; PP= 2.25 tsf.
SANDY SILT (ML); dense; yellowish brown; moist; some fine SAND; micaceous; nonplastic.
SILT (ML); dense; mottled gray and green; moist; nonplastic.
SILTY SAND (SM); dense; yellowish brown; moist; fine and medium SAND; some fines (37%).
Poorly-graded SAND with SILT (SP-SM); very dense; yellowish brown; moist; fine and medium SAND; few fines (8%); trace fine and coarse GRAVEL.
SILTY SAND (SM); dense; light gray and yellowish brown; moist; some fines (40%).
Poorly-graded SAND (SP); very dense; pale olive; moist; fine; few fines.
SANDY SILT (ML); dense; yellowish brown; moist; some fine SAND (34%).
SILTY SAND (SM); dense, pale yellow; moist; little fines (24%); trace GRAVEL.
-very dense.
SANDY Lean CLAY (CL); hard; dark yellow; moist; some fine SAND (46%); PP>4.5 tsf.
SILTY SAND (SM); very dense; yellowish brown; moist; some fines.
SILT (ML); very dense; dark yellowish brown; moist.
SILTY SAND (SM); very dense; yellowish brown; moist; some fines.
SILT (ML); very dense; dark yellowish brown; moist.
SILTY SAND (SM); medium dense; yellowish brown; moist; some fines.
Poorly-graded SAND with SILT (SP-SM); very dense; dark yellowish brown; moist; medium SAND; few fines.
SILTY CLAY with SAND (CL-ML); hard; light olive; little fine and medium SAND; PP= 4 tsf.
Well-graded SAND (SW); dense; dark yellowish brown; micaceous.
SANDY SILT (ML); very dense; moderate yellowish brown; moist; some fine and medium SAND (37%); nonplastic.
SILTY CLAY (CL); very stiff; moderate yellowish brown; moist; little fine and medium SAND (14%); PP= 2.25 tsf.
SILTY SAND (SM); dense; yellowish brown; moist; some fines.
Lean CLAY (CL); hard; moderate yellowish brown; moist; little fine and medium SAND; PP= 4 tsf.
SANDY SILT (ML); dense; yellowish brown; moist; some fine and medium SAND (42%); nonplastic.
SILTY SAND (SM); dense; yellowish brown; moist; little fines (14%).
SANDY Lean CLAY (CL); hard; yellowish brown; some fine and medium SAND; PP= 4 tsf.
SILTY SAND (SM); dense; yellowish brown; moist; fine and medium SAND; some fines (46%).
-medium dense; light brown; little fines (23%).
-little fines 26 %.
-dense; fine and medium; little fines (15%).
5-25-11
Terminated at Elev 11.0'
ERi = 66%
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
1090+00
1091+00
PROFILE
Horiz: 1" = 10'
Vert: 1" = 10'
This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, & Presentation Manual (2010 Edition).
REGISTERED CIVIL ENGINEER
PLANS APPROVAL DATE
4-2-12
DIST 06
COUNTY Fre,Mad
ROUTE 99
ENGINEERING SERVICES
MATERIALS AND GEOTECHNICAL SERVICES
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DESIGN BRANCH 17
SAN JOAQUIN RIVER BRIDGE
LOG OF TEST BORINGS 1 OF 4
41-0090


B1-3