Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

TECHNICAL MEMORANDUM

EMI PROJECT NO: 10-113

DATE: July 1, 2010

PREPARED FOR: Vinh Trinh / WKE, Inc.

PREPARED BY: S. "Raja" Pirathiviraj and Andrew Lee / Earth Mechanics, Inc. (EMI)

SUBJECT: **Grand Avenue Overcrossing (Replace), Bridge No. 53-1864**
Structure Preliminary Geotechnical Report (SPGR) for Advanced Planning Study
07-LA-60, PM R24.45
EA 07-279100

Introduction

This memorandum has been prepared to provide the necessary geotechnical information to assist the structural designers in the Advance Planning Study (APS) process for the replacement of Grand Avenue Overcrossing (OC) of the SR-57/SR-60 Confluence project. The content of this memorandum follows Caltrans Foundation Report Preparation for Bridge Foundations (Caltrans, 2009b). It includes preliminary geotechnical, seismic, and foundation recommendations for the subject structure. The recommendations provided in this memorandum are based on subsurface information contained on the as-built Log-of-Test-Boring (LOTB) sheets of the existing Grand Avenue OC and the associated wingwall repair. An additional site-specific geotechnical investigation will be performed for this structure during the PS&E phase; therefore, the following recommendations may change when additional site-specific information becomes available.

Project Description

The existing Grand Avenue OC is located within the State Route (SR) SR-57/SR-60 Confluence in the Cities of Industry and Diamond Bar. The SR-57/SR-60 Confluence is a section of freeway where the SR-57 and SR-60 mainlines meet and co-exist as one mainline. SR-57 is a major north-south freeway that originates in central Orange County and extends northerly to the boundaries of the Cities of Pomona and San Dimas in Los Angeles County. SR-60 serves as a major east-west freeway that originates in the Los Angeles metropolitan area and extends through Los Angeles County into Riverside County. A Site Location Map is presented in Figure 1.

17660 Newhope Street, Suite E, Fountain Valley, California 92708. Tel: (714) 751-3826, Fax: (714) 751-3928

Existing Structure. The existing Grand Avenue OC was constructed in August 1969 and is a two-span cast-in-place prestressed box girder structure with total length of 309 feet and width of 92 feet. The OC crosses SR-60 at a 38° 17' 06" skew. All foundations of the existing OC are supported on Class I 45-ton Concrete Piles. Retaining walls are located at both ends of Abutments 1 and 3 and they are Caltrans standard Type 1 Retaining Walls supported on spread footings.

Proposed Structure. The existing Grand Avenue OC will be replaced with a new OC to accommodate the widening of Grand Avenue and SR-60.

Site Geology

The site is located in the northern part of the Puente Hills, a northwesterly trending range of low-elevation, rounded hills at the northern edge of the Peninsular Ranges. The site is in valley of Diamond Bar Creek between the Los Angeles basin to the west and the Upper Santa Ana River Valley on the east, and the San Gabriel Valley and Mountains on the north. Diamond Bar Valley is a small narrow valley with a flat floor ranging from about 550 feet on the west to 700 feet in elevation in the northeast. The valley is bounded by a ridge on the north that rises to about 800 feet elevation, and hills on the south that rise to about 1000 feet before descending into Tonner Canyon on the south. The project facilities are basically on the valley floor and the creek bed along the north side of the valley.

The valley floor is underlain by late- to middle-Holocene-age stream channel, alluvial basin, and alluvial fan sediments (Division of Mines and Geology, 1998; Morton and Miller, 2003). These young deposits are about 45 to 50 feet thick and overlie Miocene-age (~15 million years old) rocks of the Puente Formation.

The Puente formation consists of siltstone, sandstone, and conglomerate. Depending largely on the relative amounts of these sedimentary rock types, the unit is divided into members called the Sycamore Canyon, Yorba, Soquel, and La Vida members. The slopes of the adjacent ridge just north of the site are predominantly Yorba and Soquel members and the slopes on the south are predominantly La Vida member. In the site area, these members are predominantly siltstone and sandstone that range from soft to very hard rocks where cemented by calcium carbonate.

Geologic Hazards

Landsliding. The Puente Formation typically has abundant landslides (Tan, 1998; Morton and Miller, 2003), generally a result of low-angle, out-of-slope bedding orientation. The seismic hazard map of the San Dimas quadrangle (Division of Mines and Geology, 1998) does not identify the site as having a potential for landsliding during an earthquake. However, the materials at the site underlain by late- to middle-Holocene-age stream channel, alluvial basin, and alluvial fan sediments which may be susceptible to running or caving in temporary excavations.

Flooding. There are three dams located in the surroundings of the project area; Puddingstone dam is located about 8.5 miles to the north, Santa Fe Basin is located about 11 miles to the northwest, and Whittier Narrows Dam is located about 15 miles to the west. However, the Los Angeles County General Plan (1990) indicates that the site is not located within a potential inundation area from an earthquake-induced failure; therefore, the potential for flooding due to earthquake-induced dam failure is very low.

Ground Rupture. The valley of Diamond Bar Creek may be controlled by a fault under the axis of the valley (Tan, 1998; Morton and Miller, 2003). The northeast-southwest linearity of the valley may be due to erosion along the fractured rocks along the fault. However, this fault is only inferred and not exposed. If there is a fault, it is not known to be active. No Alquist-Priolo Earthquake Fault Zones requiring special studies are designated by the California Geological Survey (formerly the Division of Mines and Geology). Therefore, the risk for ground surface rupture is low. Potential for lateral spreading at the bridge site is very low.

Other seismic hazards such as ground motion considerations, soil liquefaction, and seismically induced ground subsidence and slope stability will be addressed in later sections.

Subsurface Conditions

According to the attached As-Built LOTB sheets, three rotary-wash borings were drilled in April 1965 for construction of the existing Grand Avenue OC. The deepest boring was advanced to about elevation +606 feet. Existing grades at the borehole locations at the time of the investigation were between elevations +671 and +672 feet. The current surface elevation of the Grand Avenue OC is between +701.5 and +703 feet, and at the SR-60 mainline, it is between +676 and +679 feet.

One auger boring was also drilled in July 1986 for the wingwall repair near the western end of Abutment 3. The boring was performed at the bridge approach at elevation +698.2 feet down to elevation +651.7 feet.

The subsurface condition below the SR-60 mainline at this location is predominantly loose to medium dense granular materials underlain by interbedded shale and sandstone bedrock. The bedrock contact varies approximately from elevations +619 to +625 feet. Furthermore, the 1965 borings show a uniform layer of soft silt and very loose silty sand to sand between elevations +635 and +655 feet. However, the 1986 boring contradicts the soil type classification of the 1965 borings and classify this same soil layer as soft sandy silt and silty clay. In our opinion, the low Standard Penetration Test (SPT) blowcounts near and between elevations +635 and +655 feet appears to confirm that the soil type of the above weak soil layer is most likely silt and silty clay. All of the above will be confirmed using site-specific soil borings during PS&E phase.

Groundwater was encountered in the as-built borings between elevations +658 and +665.2 feet. Based on California Geological Survey (CGS, 1998), the recorded highest historical groundwater at the project site is between 15 and 20 feet below the ground surface. The average ground surface elevation at the SR-60 grade is about +678 feet. Therefore, the CGS historical highest groundwater elevation could be between +658 and +663 feet, which is consistent with the measured groundwater level. Based on the measured and historical highest groundwater elevations, a groundwater elevation of +665.2 feet can be used for liquefaction assessment.

Preliminary Seismic Recommendations

To develop preliminary ARS curves in accordance with the 2009 Seismic Design Criteria (SDC) (Caltrans, 2009b and 2009d) procedures, we considered the following response spectra:

- Deterministic Criteria based on late-Quaternary faults in 2007 fault database (Shantz and Merriam, 2009);
- Probabilistic Criteria based on 5% in 50 years probability of exceedance ground motion; and
- Minimum Deterministic Spectrum based on a Mw= 6.5 strike-slip event occurring at a distance of 7.5 miles (12 km) from the site.

We used the Caltrans Deterministic Response Spectrum Spreadsheet as recommended by the 2009 SDC to develop the deterministic ARS curves. The spreadsheet uses the arithmetic average of two Next Generation Attenuation (NGA) relationships developed by Chiou-Youngs (2008) and Campbell-Bozorgnia (2008) with user-provided input parameters, including fault characteristics, site-to-fault distances and site condition parameters as presented in table below.

Controlling Fault	Fault ID	Maximum Moment Magnitude M_{max}	Site to Fault Distance R_{RUP} (miles)	Style of Fault	Fault Dip /Direction
Puente Hills Blind Thrust	240	7.3	7.5	Reverse	25° / North
Elsinore Fault Zone (Whittier Section)	241	7.6	8.5	Reverse Lateral Strike Slip	75° / Northeast

The parameter of small-strain shear wave velocity (V_S^{30}) for the upper 100 feet of subsurface materials is correlated based on the SPT blowcounts presented in as-built LOTB sheets. The calculated V_S^{30} for this bridge site is 820 feet/sec. This will be updated during the PS&E phase after completion of our site-specific field investigation program.

Results obtained from the spreadsheet were then verified with the Caltrans online web tool (Caltrans, 2009a). The spreadsheet method is recommended because the online web tool, though more user-friendly, does not include updates since 2007 in its calculation database and presently is not approved to develop spectra for final design.

The probabilistic response spectrum is based on data from the 2008 United States Geological Survey (USGS, 2008a) National Seismic Hazard Map for the 5% in 50 years probability of exceedance (975-year return period) ground motion. To develop the probabilistic spectrum, the Caltrans Probabilistic Response Spectrum Spreadsheet and the USGS Interactive Deaggregation Tool (USGS, 2008b) were used. Results obtained from both the spreadsheet and deaggregation tool were then verified with the Caltrans online web tool. Again, the spreadsheet and deaggregation tool are recommended because the online web tool, though more user-friendly, does not include updates since 2007 in its calculation database.

The preliminary design ARS curve is the envelope of the above spectra. The resulting preliminary design ARS curve and the digitized coordinates are presented in Figure 2. A peak ground acceleration (PGA) of 0.61g is obtained from the preliminary design ARS curve. The design ARS curve will be updated during the PS&E phase.

Liquefaction Evaluation

The design groundwater table is at elevation +665.2 feet. Granular materials susceptible to liquefaction were encountered below the groundwater table. Therefore, the liquefaction potential at the bridge site is anticipated to be high. We will evaluate soil liquefaction once site-specific borings are drilled during the PS&E phase.

Seismic Settlement

Since the liquefaction potential is high at the bridge site, seismic settlement of onsite soils is anticipated. This seismic settlement will generate downdrag forces on the proposed pile foundations. Once the site-specific borings are drilled during PS&E phase, we will evaluate seismic settlement and the corresponding downdrag forces for pile capacity analysis.

Seismic Slope Stability

The project area is composed of hilly and flat terrains. Graded embankment consisting of retaining walls and fill slopes will be constructed at the approaches. These graded embankments, if properly constructed, should be stable at a gradient of 2:1 (H:V). We will evaluate slope stability during PS&E phase when layout and profile sheets are available.

Scour Evaluation

The existing structure does not cross a channel or basin that conveys water; therefore, scour potential should not be a design issue.

Corrosion Evaluation

There is no corrosion test result included with the as-built plans. Site-specific soil corrosivity must be investigated during PS&E phase in accordance with Caltrans requirements.

As-Built Foundation Data

The as-built foundation data of the existing Grand Avenue OC is summarized below.

Support Location	Foundation Type	Bottom of Footing Elevation (ft)	Specified Tip Elevation (ft)	Average As-Built Tip Elevation (ft)
Abutment 1	Class I, 45-ton Concrete Piles	+681	+620	+616.0
Bent 2		+670	+620	+616.0
Abutment 3		+681	+622	+615.5

Preliminary Foundation Recommendations

Cast-in-Drilled-Hole (CIDH) piles are not recommended due to the presence of shallow groundwater and potentially caving soils; driven piles are preferred. We recommend using driven precast concrete piles (Caltrans Standard Alt "X") to match the existing foundation type. However, if soil liquefaction controls foundation design, steel HP or pipe piles may be preferred because steel piles can undergo larger deformation.

Settlement Period. Fill will be placed at the approaches of the bridge. Fine grained materials were encountered within and below the approach embankments in previous field exploration. Therefore, long-term consolidation settlements are anticipated for construction of the approach embankments. Mitigation measures such as surcharge loading may be necessary to reduce the settlement period. The settlement magnitude and settlement period will need to be evaluated using site-specific soil borings and laboratory test results during the PS&E phase.

Additional Field Work and Laboratory Testing

Caltrans typically requires a geotechnical boring be advanced at each support for new structures. Due to the presence of shallow groundwater condition, we recommend using a mud-rotary drill rig for the proposed geotechnical borings. The maximum boring depth is expected to be near 80 feet.

Samples recovered during the field investigation will be transported to the laboratory for testing. All of the soil samples will be visually classified and moisture content/density tests will be performed. Additional samples will be selected for sieve analysis, #200 wash, Atterberg, corrosion, consolidation, and direct shear tests. Other laboratory tests may be required depending upon the nature of the soils and bedrock encountered during the investigation.

Reference

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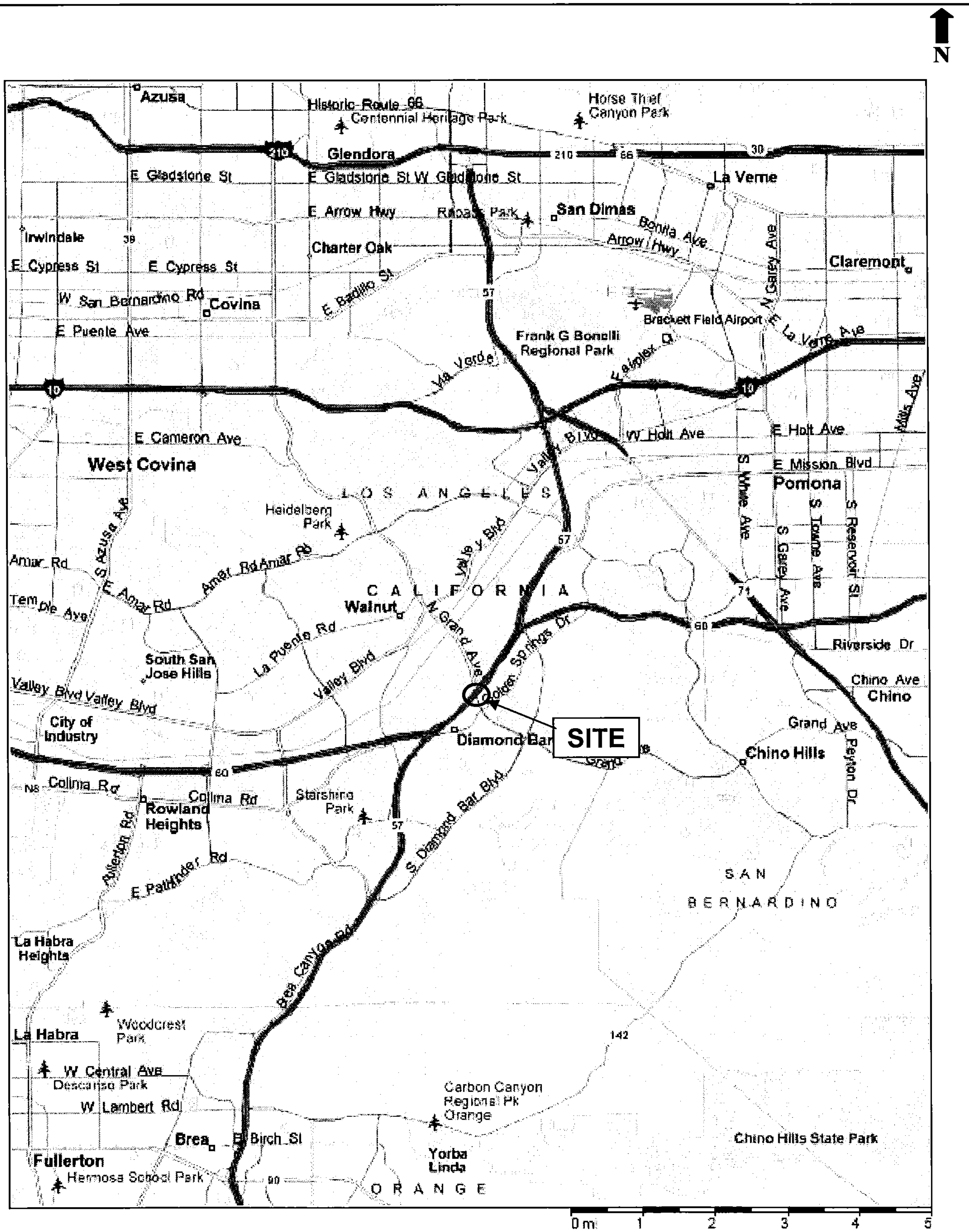
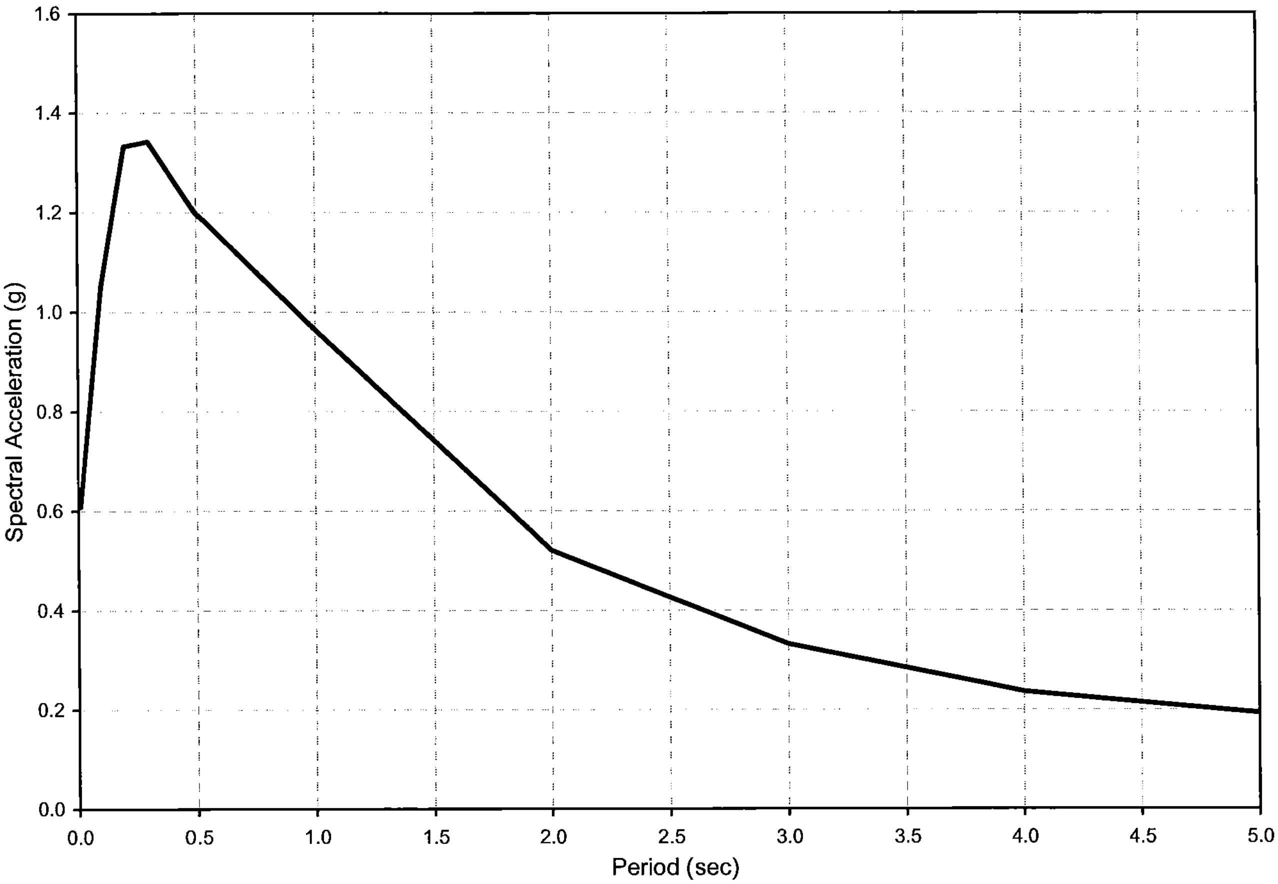
U.S. Geological Survey (USGS), 2008b, USGS Probabilistic Seismic Hazard Analysis, http://eqint.cr.usgs.gov/deaggint/2008/index.php.



Grand Avenue OC	**SITE LOCATION MAP**
Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	Figure 1
Project No. 10-113	Date: 06-01-10



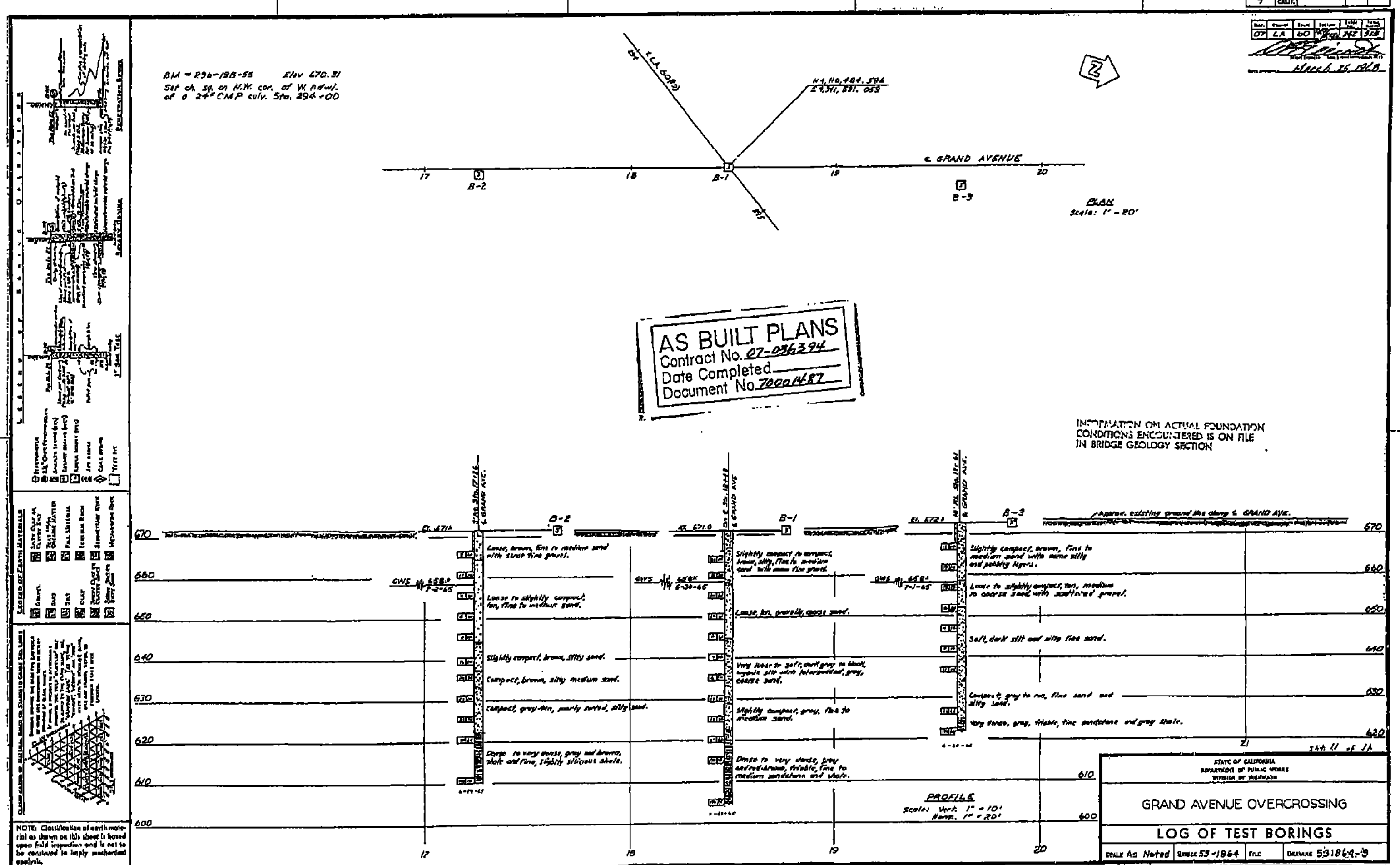
Latitude = 34.0104°
Longiture = -117.8236°
Small Strain Shear Wave Velocity V_{s30} = 820 ft/s

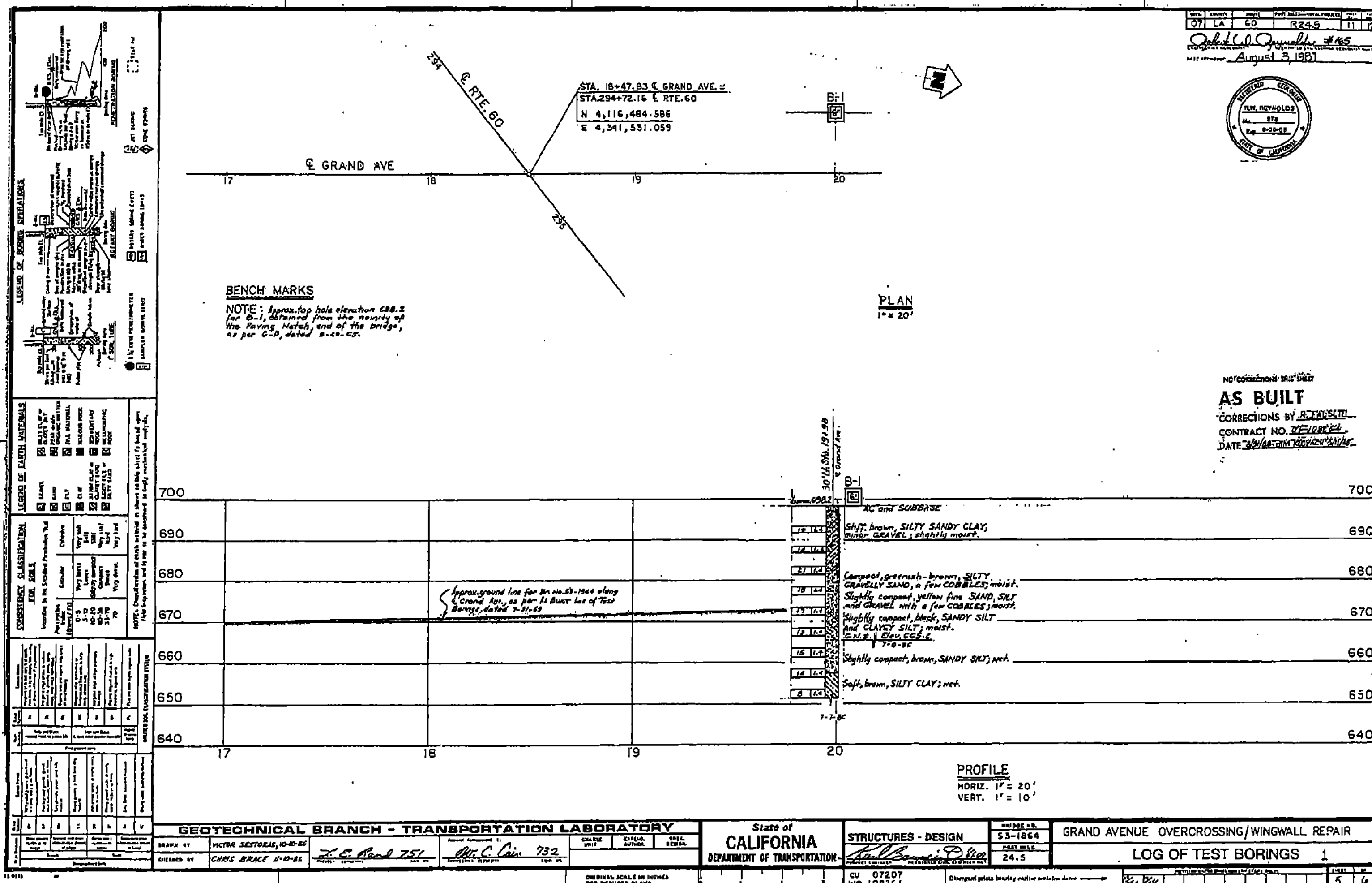
Spectral Coordinates	
Period (sec)	Acc. (g)
0.010	0.609
0.100	1.052
0.200	1.332
0.300	1.342
0.500	1.197
1.000	0.964
2.000	0.521
3.000	0.332
4.000	0.236
5.000	0.193

Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	Grand Ave Overcrossing		Preliminary Design ARS Curve
	Project: 10-113	Date: 06/09/10	Figure 2

ATTACHMENT 1

Log-Of-Test-Boring (LOTB) Sheets
Existing Grand Avenue OC, Bridge No. 53-1864


BM = 296-198-55 Elev. 670.31
Set ch. sq. on N.W. cor. of W. hdwl. of a 24" CMP culv. Sta. 294+00
C GRAND AVENUE
B-1
B-2
B-3
PLAN
Scale: 1" = 20'
AS BUILT PLANS
Contract No. 07-036394
Date Completed
Document No. 70001487
INFORMATION ON ACTUAL FOUNDATION CONDITIONS ENCOUNTERED IS ON FILE IN BRIDGE GEOLOGY SECTION
PROFILE
Scale: Vert. 1" = 10'
Horiz. 1" = 20'
LEGEND OF EARTH MATERIALS
NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.
BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
GRAND AVENUE OVERCROSSING
LOG OF TEST BORINGS
SCALE As Noted
BRIDGE 53-1864
DRAWING 531864-9
252



AS BUILT PLANS
Contract No. 07-108264
Date Completed: 3-31-88
Document No.

29X

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THE DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF TRANSPORTATION.
9-29-88