FOR CONTRACT NO.: 04-3S7404

INFORMATION HANDOUT

MATERIALS INFORMATION

SLIDE REPAIR RECOMMENDATIONS REPORT DATED JANUARY 21, 2010

ROUTE: 04-Son 1-27.2

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
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To: MS. OFELIA ALCANTARA
Supervising Bridge Engineer
Bridge Design West
Structures Design

Date: January 21, 2010

File: 4-SON-1-PM 27.13/27.25
04 – 3S7401
Storm Damage

Attention: Hamoud/Wang

From: A. KADDOURA/M. ZABOLZADEH
Associate Materials and Research Engineers
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

HOOSHMAND NIKOUI
Chief, Branch A
Office of Geotechnical Design - West
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Division of Engineering Services

Subject : Slide Repair Recommendations

This memorandum presents our geotechnical recommendations for the above referenced project. The recommendations contained in this report are based on the results from subsurface explorations at the site of the slide.

I. BACKGROUND

During January/February 2006 rainstorms, two separate slides have occurred on Route 01 below the roadway in southbound direction between PM 27.10 and PM 27.25, approximately 1 mile north of Meyers Grade Road, about 6 miles north of the Town of Jenner in Sonoma County. The head scarp of the slide runs along the southbound edge of the pavement and into the northbound lane. Maintenance crews have been placing AC overlay to keep the roadway open to traffic.

The total length of the slide areas is about 250 feet. The length of the slide is about 100 feet at PM 27.13 and about 150 feet at PM 27.2. See the attached Exhibit A for details.

Currently, 2-way traffic is being maintained.

We believe that the slide have been caused by the heavy 2006 rainfall, concentrated surface runoff that seeped through the cracks, and the groundwater from the adjacent hillside that is ponding on the ditch at the toe of the hillside along the northbound shoulder. This has saturated the soil and caused the loss of its shear strength.

It should be noted that we wrote two separate Foundation Reports (Nikoui to Alcantara dated April 27, 2006 for PM 27.13 and May 15, 2006 for PM 27.2 to 27.25) to address the above-mentioned slides. Since both walls will be constructed under one Contract (04-3S7404), this foundation report includes both walls.

II. SCOPE OF WORK

Work performed for this investigation includes field mapping, drilling a total of five power borings (boring P-1 was drilled in June 2006 for PM 27.2 and borings P-1 and P-2 drilled in April 2006 for PM 27.13). Also, borings A-09-001 and A-09-002 drilled in October 2009 for the wall gap closure.

III. REGIONAL/SITE GEOLOGY & SEISMICTY

Located within the Coast Range geomorphic province of California, the geology of the region consists of northwest-trending ridges, gently sloping hills, intermontane valleys, and large elongated depressions. The San Andreas Fault System, the most prominent geologic feature in the area, includes the San Andreas Fault as well as numerous splays, including the Hayward and Calaveras Faults, which together take up strain between the northward migrating Pacific plate and the southward (relatively) moving North American plate. The major faults within the system are predominantly right lateral, strike-slip faults with some compressional component.

Rocks of the Franciscan Group as well as locally derived alluvium and thin residual soils underlie the project site. Franciscan Group rocks at the site are argillitic shale and graywacke, the former being highly erodible. Graywacke is found as knockers, or blocks, within the shale matrix and can be found as prominent outcrops along Route 1.

The project area lies within the seismically active San Francisco Bay region and lies very close to the San Andreas Fault. Table 1 lists the active faults near the project area and the peak ground accelerations that could be expected from a maximum credible earthquake. The two major active faults in the region, the San Andreas and the Healdsburg/Rodgers Creek, both have the potential for magnitude 7.0 or greater earthquakes.

Table 1. Predicted Maximum Credible Earthquakes and Accelerations*

FAULT	Distance from project	Maximum Credible Earthquake	Peak Ground Acceleration
San Andreas	1.4 mi	8.0	0.70 g
Rodgers Creek/ Healdsburg	20.5 mi	7.0	0.15 g

*MCE's and accelerations from Mualchin (1996)

IV. SUBSURFACE SOIL CONDITIONS

Borings P-1 and P-2 were drilled (at PM 27.13) utilizing the rotary wash/hollow stem auger drilling methods with Standard Penetration Test (SPT) sampling in April 2006, on the northbound and southbound lanes within the slide area to the depths of 54.3feet and 30.5 feet, respectively. Boring P-1 describe the foundation soils/rocks as approximately 8 feet of medium dense clayey gravel with sand. This overlies approximately 5 feet of stiff to hard clay/sandy clay with sandstone fragments. The remainder of the boring as well as boring P-2 describes the foundation soils/rocks as very soft to hard, very intensely fresh weathered rock (sandstone/chert/shale). The unconfined compressive strength of the clayey soil (using a pocket penetrometer) was estimated to range between 1.5 and 3.5 tsf. The SPT blow counts range from 8 to more than 50 (refusal) blows per foot.

Groundwater was not encountered in boring P-1 and was not measured in P-2 due to the use of the rotary wash method.

Boring P-1 was drilled in June 2006 (PM 27.2) utilizing the hollow stem auger drilling method with Standard Penetration Test (SPT) sampling in the southbound lane within the slide area to a depth of 45.5. Boring P-1 describe the foundation soils/rocks as approximately 32 feet of medium stiff to hard clay/sandy clays with gravel with sand. The remainder of the boring describes the foundation soils/rocks as very soft to hard, intensely weathered to fresh rock (sandstone/shale). The unconfined compressive strength of the clayey soil (using a pocket penetrometer) was estimated to range between 1and 2 tsf. The SPT blow counts range from 11 to more than 50 (refusal) blows per foot. Log of Test Boring (LOTB) sheet should be included with the contract plans and will be forwarded to you upon completion.

Groundwater was not encountered in boring P-1 at the time of drilling. However, groundwater elevation fluctuates and may be encountered during drilling for the CIDH piles.

Borings A-09-001 and A-09-002 were drilled in October 2009 to the depths of 46.5 feet and 31.5 feet, respectively for the gap between the two initially proposed walls. The borings describe the foundation soils/rocks as approximately 20 to 30 feet of stiff to very stiff clay/sandy clays. The remainder of the boring describes the foundation soils/rocks as very soft, intensely weathered rock (sandstone/shale). The unconfined compressive strength of the clayey soil (using a pocket penetrometer) was estimated to range between 1.5 to 3.5 tsf. The SPT blow counts range from 9 to 80 blows per foot.

V. RECOMMENDATIONS

Tie-back Soldier Pile Wall

Based on the above, we recommend constructing two 18-foot high tieback/soldier pile walls (maximum) with wood lagging to hold against the slide.

The limits of Wall #1 are between Station 0+66± and station 2+80±
The limits of Wall #2 are between Station 3+59± and station 7+89±.
The approximate total lengths of the proposed walls are 214 feet for Wall #1 and 430 feet for Wall #2 with about 70 ft gap between the two walls.

We recommend the following requirements for the tieback wall:

- The proposed one row of tiebacks should be installed at least 6' below the roadway level. The anchors should be installed at an angle of 10 to 15 degrees below the horizontal plane.

- The unbounded length of the tieback anchors should be a minimum 50 ft long as shown on Exhibit A.

- The design of the anchor type and any anchor length in excess of the minimum length specified herein should be left up to the contractor. The contractor is responsible for providing tieback anchors that satisfy the contract specifications.

Earth Pressures

The wall should be designed for the following:

For *active pressure* against the wall, use the following:

- Between 0 and 16 feet depth (dredge line): Internal friction angle $\phi = 20°$, c = 500 psf & soil moist unit weight (γ) = 120 pcf.
- Earth pressure distribution shall be in accordance with "Memo to Designers 5-12" dated August 1990.
- For traffic surcharge, use a rectangular pressure diagram from top of the wall to a depth of 10 feet. This is equivalent to about 2 feet of fill (240 psf).
- The tieback wall shall be capable of resisting an additional seismic uniform earth pressure estimated to be equal to 60H psf

The above-recommended loadings are based on the assumption that an adequate drainage system will be provided to prevent the development of hydrostatic pressure behind the wall. If complete drainage of the wall cannot be achieved, add hydrostatic pressure assuming groundwater at 5 feet below top of wall.

For *passive pressure* against the soldier piles, use the following input:

a. $\phi = 38°$, C = 200 psf, and γ = 125 pcf.

b. Minimum of 5-foot wide berm at the base of the wall having 1V: 2H cut slope.

c. Friction Factor (δ) = 2/3 ϕ.

Vertical CIDH Pile Capacities and Penetration Depth

Soldier piles should be embedded a minimum of 35 feet below the roadway ground surface.

Pile spacing should be limited to not more than 8 ft.

The ultimate vertical compression and tension capacities of piles may be calculated using the following design parameters:

Use a unit pile shaft friction of 2.5 kips per unit surface area of the pile length below the dredge line of the wall.

Use 60 percent of the compression shaft resistance values mentioned above to calculate the ultimate tension (uplift) resistance of the pile.

Use an ultimate pile tip compression bearing pressure of 120 kips per unit tip area of the CIDH piles.

The above recommendations are based on parameters established by our field exploration, engineering judgment, and submitted wall cross-sections.

CONSTRUCTION CONSIDERATIONS AND REQUIREMENTS

The following construction considerations and requirements should be included in the design and construction specifications for the proposed walls and mitigation measures.

> The contractor may encounter difficulties during drilling for the soldier beam piles. This is due to the hard drilling condition experienced during drilling.

Although groundwater may not be encountered during drilling operation for the proposed CIDH piles, we still believe that minor caving of the drilled holes is possible. Thus, using of casing may be required. If groundwater is encountered, installation of solider piles may require drilling and placing concrete in wet conditions if de-watering is not desirable. For displacement of groundwater, the contractor may choose to use a closed system using a concrete pump or a tremie tube to place concrete at the bottom of the holes for soldier piles. A positive head should be maintained at all times to reduce potential for concrete segregation.

Piles

Installation of CIDH piles should be performed in accordance with Section 49-4 of the Standard Specifications.

- The drilling and concrete placement for CIDH pile construction shall be staggered. No open holes shall be adjacent.

- Use of casing may be required during drilling in unstable fill to keep the drilled hole walls from collapsing and reduce the amount of dewatering required (if encountered). The casing should be removed with the help of continuous vibration to reduce the potential for the concrete to "hang up" on casing.

VI. CORROSION

The Department considers the site to be corrosive to foundation elements if one or more of the following conditions exist for the representative soil and/or water samples taken at the site:

Chloride concentration is greater than or equal to 500 ppm, sulfate concentration is greater than or equal to 2000 ppm, or the pH is 5.5 or less.

The following table provides our corrosion test summary:

Boring	*SIC Number (TL-101)*	*Sample Depth*	*Resistivity (Ohm-Cm)*	*pH*	*Chloride Content (ppm)*	*Sulfate Content (ppm)*
P-1	C235818	15'-18'	680	7.8	18	865
P-2	C235824	15'-20'	880	7.5	20	499

The test results indicate that the site is not corrosive to foundation elements.

* * * * * *

If you have any questions or need additional information, please call us at (510) 286-4676/4831 or Hooshmand Nikoui, Branch Chief at (510) 286-4811.

Attachment

c: TPokrywka, HNikoui, MZabolzadeh, AKaddoura, Project File, Daily File

Kaddoura/Zabolzadeh/mm/SON-1-PM 27.13-27.25- 3S7401 Report

REGISTERED PROFESSIONAL ENGINEER
ALI K. KADDOURA
No. C55710
Exp. 12-31-10
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STATE OF CALIFORNIA

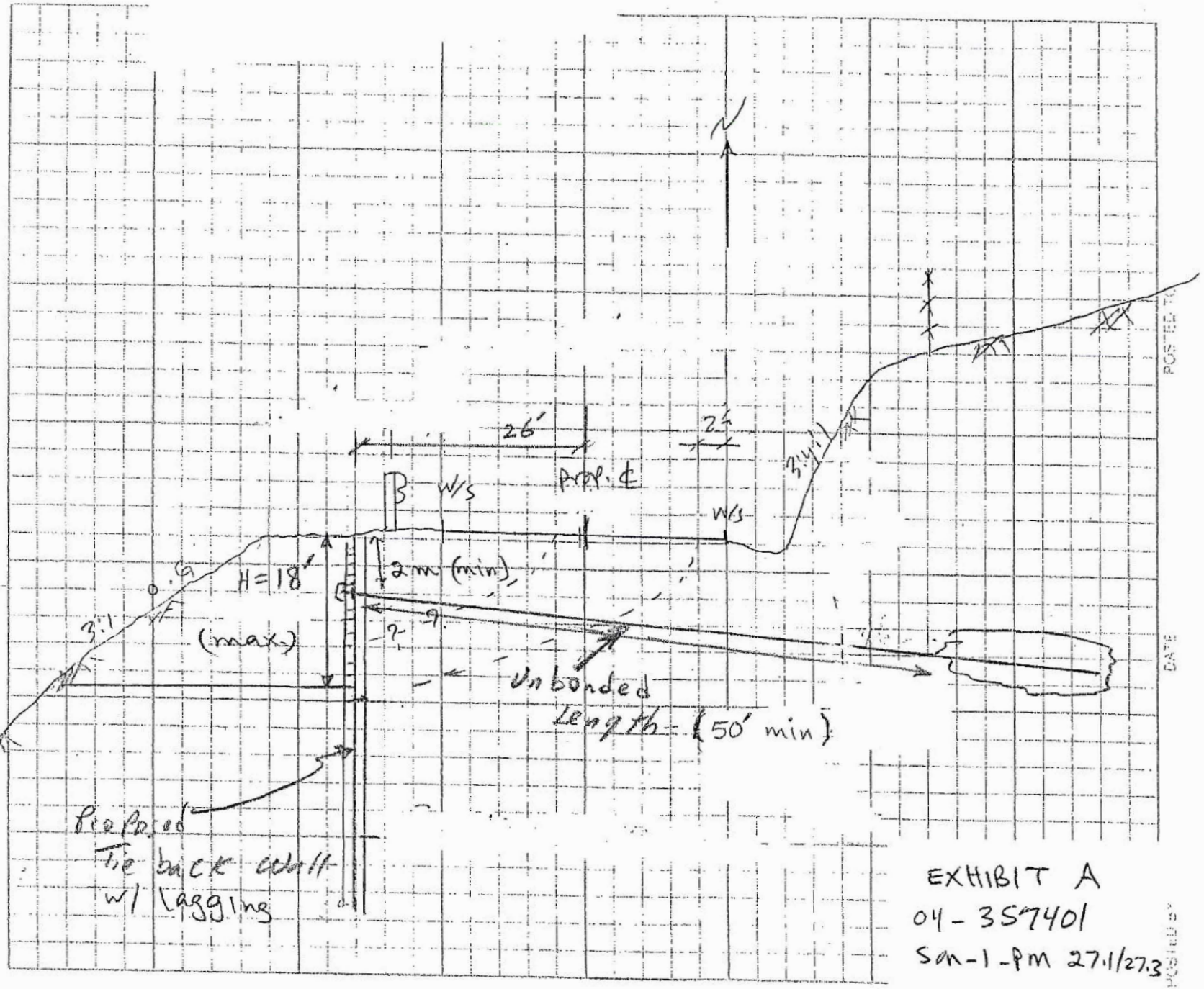

EXHIBIT A
04-357401
San-1-PM 27.1/27.3

QUANTITY CALCULATIONS