State of California

Business, Transportation and Housing Agency

Memorandum

MR. RAMIN RASHEDI
Division of Structure Design
Office of Bridge Design C

Attention: Mr. Gary Blakesley

Date: December 20, 2000

File: 11-SD-5-KP 49.2/49.3
11-0301U1

Retaining Wall Nos. 524 and 525

From: **DEPARTMENT OF TRANSPORTATION**
ENGINEERING SERVICE CENTER
Division of Structural Foundations - MS 5
Office of Structure Foundations

Subject: Revised Foundation Recommendations

An original Request for Foundation Recommendations (dated March 4, 1999) for the above retaining walls was submitted to the Office of Structure Foundations (OSF) by Mr. Earl Seaberg. An additional request for Revised Foundation Recommendations for Retaining Wall No. 525 was received November 13, 2000, from Mr. Gary Blakesley. Regarding revisions for Retaining Wall No. 525, the bottom of the stepped pile footings were subsequently lowered and finished grade was modified from previous plans. Also, at both Retaining Wall Nos. 524 and 525, HP305X110 (HP12X74) steel H-piles were substituted for thinner HP250X85 (HP10X57) piles. According to Mr. Michael Tolin of the Corrosion Technology Branch (August 18, 2000), in order to maintain a 75-year design life for the retaining walls, thicker steel pile sections are necessary due to corrosive soil and embankment conditions at the site. The author and Mr. Tolin agreed that the HP305X110 steel H-piles would be satisfactory. This completely revised report is being sent for clarity and convenience regarding foundation recommendations. This revision completely supersedes the previous Foundation Recommendations (Pratt, July 14, 2000) completed by the OSF.

A foundation investigation at the site of the proposed walls was completed in December 1999. Subsurface information was obtained by drilling and sampling five – 94 mm (3.7 in) diameter wet rotary borings. Results from the field study will be shown on the Logs of Test Borings (LOTBs).

Site Descriptions

Retaining Wall No. 524:

Underlying sediments beneath the proposed wall footprint at the site consist of embankment fill which ranges between approximately 8.87 to 7.25 m (29.1 to 23.8 ft) thick. Underlying native alluvium (Holocene and possible older Quaternary alluvium, undifferentiated) ranges from approximately 17.83 to 15.45 m (58.5 to 50.7 ft) thick. Underlying mudstones/claystones/siltstones and rare sandstones of the probable Ardath Shale (very soft to hard, generally intensely to slightly weathered, unfractured to slightly fractured) occur below elevations ranging from -7.32 to -8.14 m (-24.0 to -26.7 ft).

Embankment fill consists dominantly of stiff to very stiff/medium dense to minor loose, sandy clay with intermittent scattered gravel and cobbles [up to 150 mm (6 in) diameter, soft mudstone, siltstone, sandstone, and hard metavolcanic rock fragments] interlayered with silty sand, sandy silt, and clayey sand with intermittent scattered gravel. Native alluvium can be

divided into two units with the upper sediments consisting of dominantly soft to stiff/loose to medium dense, sandy clay and clay interbedded with silty sand, clayey sand, sandy silt with intermittent scattered gravel and rare cobbles [up to 150 mm (6 in) diameter, siltstone and metavolcanic rock fragments]. The upper alluvial unit ranges between approximately 17.25 to 14.23 m (56.6 to 46.7 ft) thick. The underlying native alluvial unit [from 0.58 to 1.22 m (1.9 to 4.0 ft) thick] found below elevations ranging from -6.10 to -7.38 m (-20.0 to -24.2 ft) consists of generally medium dense to very dense, gravel/cobble lenses with sand and clayey sand matrix intermittently interbedded with silty sand and silt. Generally the extremely hard, subrounded to subangular gravel/cobbles [up to an estimated 150 mm (6 in) diameter], composed dominantly of metavolcanic rock fragments, directly overlie bedrock or occur as minor (0 to 5% by volume) scattered rock fragments within the overlying alluvial unit. Some of the loose native material within the upper alluvial unit is considered potentially liquefiable and is being investigated by the Office of Geotechnical Earthquake Engineering (OGEE). The maximum boring depth penetrated 47.24 m (155.0 ft) below the surface, down to elevation -36.33 m (-119.2 ft).). The LOTB should be reviewed for more specific details.

Ground Water

Boring 99-5 (Bent 2 – Right Side Widen) for the nearby Rte. 5/805 Separation (Br. No. 57-0512) revealed static ground water at elevation +8.84 m (+29.0 ft) measured March 2, 2000 (shortly after rains). This site is very close to the End Wall station for Retaining Wall No. 524. Ground water measurements fluctuated almost 0.3 m (1 ft) during OSF investigation near Los Penasquitos Creek.

Retaining Wall No. 525:

Underlying sediments beneath the proposed wall at the site consist of embankment fill which ranges between approximately 7.0 to 5.2 m (23 to 17 ft) thick. Underlying native alluvium (Holocene and possible older Quaternary alluvium, undifferentiated) ranges from approximately 12.5 to 12.9 m (41 to 42.4 ft) thick. Intertongueing formational sands of the probable Eocene Torrey Sandstone (uncemented, soil-like, very dense sand) occur beneath approximate elevations -3.96 to -5.0 m (-13 to -16.4 ft). At this specific site, intertongueing formational mudstones of the probable Ardath Shale (very soft to moderately hard, generally slightly weathered, siltstone/claystone/mudstone) occur below elevations ranging from -7.53 to -12.0 m (-24.7 to -39.4 ft).

Embankment fill consists dominantly of very stiff to hard/medium dense, sandy clay with gravel and cobbles interlayered with silty sand, sandy silt, and clayey sand with intermittent scattered gravel and cobbles. Native alluvium can be divided into two units with the upper sediments consisting of dominantly loose to medium dense, sand interbedded with silty sand, clayey sand and minor stiff sandy clay lenses. The upper alluvial unit is approximately 9.14 m (30 ft) thick. The underlying native alluvial unit [from 3.29 to 3.78 m (10.8 to 12.4 ft) thick] found below elevations ranging from -0.67 to -1.22 m (-2.2 to -4 ft) consists of generally medium dense to very dense, gravel/cobble lenses with sand matrix intermittently interbedded with sand with silt. Generally the extremely hard, subrounded to subangular gravel/cobbles [up to 150 mm (6 in) diameter], composed dominantly of metavolcanic rock fragments, directly overlie bedrock or occur as sporadic lenses within the underlying alluvial unit. Much of the loose native material is considered potentially liquefiable and is being investigated by the OGEE. Remnants of probable Torrey Sandstone (uncemented, soil-like, very dense sand with gravel/cobble lenses) intertongue with probable Ardath Shale (very soft to moderately hard, generally more rock-like, generally slightly weathered, siltstone/claystone/mudstone). The

maximum boring depth penetrated 45.7 m (150.0 ft) below the surface, down to elevation -25.4 m (-83.4 ft). The LOTB should be reviewed for more specific details.

Ground Water

In the area of Boring 99-1 (near Bent 8, left side – left bridge widen) for the nearby Sorrento Viaduct (Br. No. 57-513L), static ground water was measured at elevation +7.77 m (+25.5 ft) on January 11, 2000. Boring 99-1 is immediately south of Retaining Wall No. 525 on the east side of Sorrento Valley Road.

Liquefaction

Liquefaction potential is considered moderate to high. Holocene and older Quaternary alluvium (undifferentiated) at the site is dominantly composed of loose to medium dense/stiff, sand interbedded with silty sand, clayey sand, and sandy clay lenses. Ground water is also rather shallow, ranging from 3.44 to 6.43 m (11.3 to 21.1 ft) depth in the vicinity. Final liquefaction potential will be determined by the OGEE.

Foundation Recommendations

The following recommendations are based on District 11 Layout Sheets with retaining walls (highlighted), General Plans for Retaining Wall No. 524 (received January 24, 2000) and revised General Plans and Structure Plans (Nos. 1, 2, and 3) for Retaining Wall No. 525 (received November 13, 2000), the Foundation Plans for Los Penasquitos Creek Widen (Br. No. 57-0511, 1 sheet, checked by S. Wang, October 14, 1998) and Rte. 5/805 Separation Widen (Br. No. 57-0512, sheet 1 of 2, checked by S. Wang, October 24, 1998) which show most of the existing topography, and sporadic discussions with Mr. Rashedi and Mr. Blakesley from March 1999 to December 2000.

Retaining Wall No. 524:

Retaining Wall No. 524 (a modified Type I retaining wall) is approximately 105.271 m (345.4 ft) in length and varies from 3.6 to 6.1 m (11.8 to 20 ft) in height with an additional Type 25 Barrier (concrete) to be placed on top of the wall.

Steel H-piles [HP305X110 (HP12X74)], 400 kN (45 ton) design load, are recommended for wall support as indicated below. Heavier steel sections are recommended here due to anticipated hard driving conditions through cobble/gravel zones and very dense sand. Corrosive soils tested at the site require that additional sacrificial steel be provided to protect the structural integrity of the piles. The above heavier steel section, which is commonly used for 625 kN (70 ton) design load piles, contains the additional sacrificial steel required at the site. Predrilling of the embankment is required down to elevation +7.92 m (+26 ft) before pile installation.

Retaining Wall No 524

Wall LOL Station*	Bottom of Pile Footing Elevation m (ft)	Approximate Begin Pile Bearing Elevation m (ft)	Design Pile Tip Elevation m (ft)	Specified Pile Tip Elevation m (ft)
10+00 (Beg. Wall)	+21.825 (+71.6)	+3.05 (+10.0)	-7.01(1) (-23.0)(1)	-7.01 (-23.0)
10+10	+21.825 (+71.6)	+3.35 (+11.0)	-7.32(1) (-24.0)(1)	-7.32 (-24.0)
10+10	+20.575 (+67.5)	+3.35 (+11.0)	-7.32(1) (-24.0)(1)	-7.32 (-24.0)
10+35	+20.575 (+67.5)	+3.66 (+12.0)	-7.62(1) (-25.0)(1)	-7.62 (-25.0)
10+35	+19.325 (+63.4)	+3.66 (+12.0)	-7.62(1) (-25.0)(1)	-7.62 (-25.0)
10+74	+19.325 (+63.4)	+4.27 (+14.0)	-8.23(1) (-27.0)(1)	-8.23 (-27.0)
10+96	+19.325 (+63.4)	+4.27 (+14.0)	-7.62(1) (-25.0)(1)	-7.62 (-25.0)
10+96	+20.725 (+68.0)	+4.27 (+14.0)	-7.62(1) (-25.0)(1)	-7.62 (-25.0)
11+05.271 (End Wall)	+20.725 (+68.0)	+4.27 (+14.0)	-7.62(1) (-25.0)(1)	-7.62 (-25.0)

Notes: *Interpolate between listed Wall LOL Stations to determine specified pile tip elevations for intermediate support locations.
Design tip elevation is controlled by the following demands:(1)Compression;(2)Lateral Loads

If pile tip elevation is controlled by lateral demands, the designer is responsible to present correct foundation data, governed by lateral control, on the foundation plans. OSF feels that alluvial soils may be potentially liquefiable above Approximate Begin Pile Bearing Elevation which is estimated to range from +3.05 to + 4.27 m (+10.0 to +14.0 ft). All elevations are based on the current metric NAVD 88 datum.

Retaining Wall No. 525:

Retaining Wall No. 525 (a modified Type I retaining wall) is approximately 59.526 m (195.3 ft) in length [which attaches to an additional 1.65 m (5.4 ft) stub wall for Los Penasquitos Creek Bridge, Br. No. 57-0511] and varies from 6.7 to 8.5 m (22.0 to 27.9 ft) in height with an additional Type 25 Barrier (concrete) to be placed on top of the wall.

Steel H-piles [HP305X110 (HP12X74)], 400 kN (45 ton) design load, are recommended for wall support as indicated below. Heavier steel sections are recommended here due to anticipated hard driving conditions through cobble/gravel zones and very dense sand. Corrosive soils tested at the site require that additional sacrificial steel be provided to protect the structural integrity of the piles. The above heavier steel section, which is commonly used for 625 kN (70 ton) design load piles, contains the additional sacrificial steel required at the site. Predrilling of the embankment is required down to elevation +7.92 m (+26 ft) before pile installation.

Retaining Wall No 525

Bottom of Pile Footing Elevation m (ft)	Approximate Begin Pile Bearing Elevation m (ft)	Design Pile Tip Elevation m (ft)	Specified Pile Tip Elevation m (ft)
+14.375 (+47.2)	+3.05 (+10.0)	-4.57(1) (-15.0)(1)	-4.57 (-15.0)
+13.800 (+45.3)	+3.05 (+10.0)	-5.18(1) (-17.0)(1)	-5.18 (-17.0)
+13.125 (+43.1)	+2.74 (+9.0)	-5.49(1) (-18.0)(1)	-5.49 (-18.0)
+12.550 (+41.2)	+2.44 (+8.0)	-5.49(1) (-18.0)(1)	-5.49 (-18.0)
+11.850 (+38.9)	+2.01 (+6.6)	-5.49(1) (-18.0)(1)	-5.49 (-18.0)
+11.200 (+36.7)	+2.01 (+6.6)	-5.79(1) (-19.0)(1)	-5.79 (-19.0)
+10.450 (+34.3)	+1.52 (+5.0)	-6.10(1) (-20.0)(1)	-6.10 (-20.0)

Design tip elevation is controlled by the following demands:(1)Compression;(2)Lateral Loads

If pile tip elevation is controlled by lateral demands, the designer is responsible to present correct foundation data, governed by lateral control, on the foundation plans. OSF feels that alluvial soils may be potentially liquefiable above Approximate Begin Pile Bearing Elevation which is estimated to range from +3.05 to + 1.52 m (+10.0 to +5.0 ft). All elevations are based on the current metric NAVD 88 datum.

Constructability

As mentioned above, predriliing through fill material is required and will help simplify pile installation. Hard driving is anticipated near specified tip elevation within dense gravel/cobbles zones, very dense sand (formational sand), and within soft mudstone/claystone/siltstone. Also, some cobble/gravel lenses and sporadic cobbles may be encountered at more shallow depths within alluvium. Ground water should be anticipated at shallow depths. Pile tips will be well below static ground water level.

With added embankment load [ranging from approximately 8.53 to 4.88 m (28 to 16 ft) in added height], at the proposed bridge and freeway widenings at each end of the proposed retaining walls, settlement was calculated ranging from 350 to 226 mm (13.8 to 8.9 in). A settlement period of up to 180 days was also estimated and is mentioned within the previously completed Foundation Recommendations for adjoining bridge widenings. This settlement magnitude and waiting period is substantial. The actual waiting period shall be determined by the Project Engineer on the basis of settlement data in the field. The purpose of the proposed retaining walls is to keep added embankment from encroaching on nearby businesses. OSF recommends that as much fill as possible be added to the embankment for the duration of the settlement period. At the completion of the settlement period, when settlement has essentially ceased to tolerable levels, the walls and bridge abutment widenings can then be constructed.

Corrosiveness

Laboratory tests of composite soil samples (taken within Boring 99-1 for Retaining Wall No. 524) indicate that fill and native material are corrosive. Corrosion tests on embankment fill show a pH of 7.48, minimum resistivity of 475 ohm-cm, sulfate and chloride content were measured at 5730 and 760 ppm, respectively. Corrosion tests on alluvial material show pH ranges from 7.48 to 7.98, minimum resistivity ranges from 475 to 746 ohm-cm, sulfate and chloride content were measured at 6000 to 360 ppm and 230 to 150 ppm, respectively. Laboratory tests of one soil sample taken from Boring 99-1 [depths 19.81 to 20.27 m (65.0 to 66.5 ft)], for Retaining Wall No. 525, show fill has a pH of 8.27.

Corrosion test results, which have been evaluated by Mr. Michael Tolin (August 18, 2000) of the Corrosion Technology Branch (CTB), require that an additional sacrificial steel thickness (corrosion allowance) be added to the exposed face of H-piles. In order to insure a design life of 75 years for the retaining walls, Mr. Mike Tolin (CTB, August 18, 2000) specifies that a 3.8 mm (0.150 in) sacrificial steel thickness is required on the H-piles exposed to soil/water. The above specified HP305X110 steel H-piles would provide an additional 4.8 mm (0.19 in) sacrificial steel thickness, above and beyond the pile structural steel thickness required, and are consistent with the above recommendations.

If you have any questions, please call Joe Pratt at (562) 864-5740 or Richard Fox at (916) 227-7085.

Report by:

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