State of California

Business, Transportation and Housing Agency

Memorandum

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

Attention: Mr. Gary Blakesley

Date: July 14, 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: Foundation Recommendations

A Request for Foundation Recommendations (dated March 4, 1999) for the retaining walls was submitted to the Office of Structure Foundations (OSF) by Mr. Earl Seaberg.

A subsequent foundation investigation at the site of the proposed walls was completed in December 1999. Subsurface information was obtained by 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's 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 Nos. 524 and 525 (received January 24, 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 May 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 [HP250X85 (HP10X57)], 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 normally used for 625 kN (70 ton) design load piles, should contain 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 61.176 m (200.7 ft) in length and varies from 5.5 to 6.1 m (18 to 20 ft) in height with an additional Type 25 Barrier (concrete) to be placed on top of the wall.

Steel H-piles [HP250X85 (HP10X57)], 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 normally used for 625 kN (70 ton) design load piles, should contain 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

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)	+15.175 (+49.8)	+3.05 (+10.0)	-4.57(1) (-15.0)(1)	-4.57 (-15.0)
10+11.5	+15.175 (+49.8)	+3.05 (+10.0)	-5.49(1) (-18.0)(1)	-5.49 (-18.0)
10+31.5	+15.175 (+49.8)	+2.13 (+7.0)	-6.10(1) (-20.0)(1)	-6.10 (-20.0)
10+31.5	+14.00 (+45.9)	+2.13 (+7.0)	-6.10(1) (-20.0)(1)	-6.10 (-20.0)
10+48.5	+14.00 (+45.9)	+1.52 (+5.0)	-6.71(1) (-22.0)(1)	-6.71 (-22.0)
10+61.176 (End Wall)	+14.00 (+45.9)	+1.52 (+5.0)	-6.71(1) (-22.0)(1)	-6.71 (-22.0)

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 + 1.52 m (+10.0 to +5.0 ft). All elevations are based on the current metric NAVD 88 datum.

Constructability

As mentioned above, predrilling 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 recently 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 that are being evaluated by the Corrosion Technology Branch (CTB) require that an additional sacrificial steel thickness (corrosion allowance) needs to be added to the exposed face of H-piles. In preliminary discussions with Mr. Mike Tolin (CTB) on May 16, 2000, it was felt that a 1.6 mm (0.0625 in) corrosion allowance would be required per steel face exposed to soil/water. The above specified H-piles would provide an additional 1.8 mm (0.072 in) sacrificial steel thickness, above and beyond the pile structural steel thickness required, and should be consistent with the above preliminary recommendations. However, OSF feels that the CTB should comment on corrosion test results and provide final recommendations regarding additional sacrificial steel thickness required for the above structures to achieve adequate design life.

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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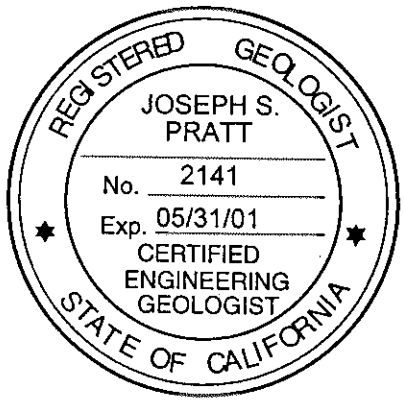

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