Development Services

From Concept to Construction

Phone: 503-823-7300 Email: bds@portlandoregon.gov 1900 SW 4th Ave, Portland, OR 97201
More Contact Info (http://www.portlandoregon.gov//bds/article/519984)

APPEAL SUMMARY

Status: Decision Rendered

Appeal ID: 20218	**Project Address:** 1477 NE Alberta Street
Hearing Date: 4/10/19	**Appellant Name:** Ben Anderson
Case No.: B-016	**Appellant Phone:** 5039697736
Appeal Type: Building	**Plans Examiner/Inspector:** Jed Stoken
Project Type: commercial	**Stories:** 4 **Occupancy:** R2 & M or A-3 **Construction Type:** V-A
Building/Business Name: Alberta/Bezel	**Fire Sprinklers:** Yes - Throughout
Appeal Involves: Erection of a new structure	**LUR or Permit Application No.:** 17-197095-CO
Plan Submitted Option: pdf [File 1] [File 2] [File 3] [File 4] [File 5] [File 6]	**Proposed use:** commercial cal

APPEAL INFORMATION SHEET

Appeal item 1

Code Section	OSSC 2014 Section 1810.3.10.4
Requires	Seismic reinforcement. A permanent steel casing shall be provided from the top of the micropile down to the point of zero curvature.
Proposed Design	The project proposes to utilize ten recently installed micropiles which have permanent steel casing installed down to the point where curvature (bending moments) are negligible but are not technically zero. The recently installed micropiles are located at approximately gridlines G.2-J.5/1 (see Exhibit 1). The micropiles consist of grouted micropiles with Titan 40/20 central bars, a grouted diameter of at least 6 inches, and permanent 4.5-inch diameter steel casing. The steel casing is in intended to resist bending moments in the upper section. Exhibit 2 shows the as-built detail of the ten micropiles. Verification and performance testing of the micropiles has been performed and was successful (see Exhibit 3). We provided recommendations for the construction of micropiles with permanent steel casing down to a depth of 4.5 feet below the footing. Our design report is submitted as Exhibit 4. The micropiles were installed with steel casing to a depth of 4.5 feet, as recommended in our report. Our original micropile design and recommendations assumed that the micropiles would not experience lateral loads or deflections. The structural design of the building assumes that lateral forces in the vicinity of the micropiles will be resisted by bearing friction under concrete footings adjacent to the micropiles.
Reason for alternative	

As part of the review process, the City of Portland BDS has asked us to evaluate the effect of a small amount of deflection of the concrete footing which could occur during a seismic event for the mobilization of sliding friction. Based on the results of our analyses, the point of zero curvature occurs at 10 feet below the concrete footing in which the micropile is embedded, while the steel casing extends to a depth of 4.5 feet. However, for the anticipated lateral deflection, at the bottom of the permanent steel casing, the bending moments in the micropile are 0.70 ft-kips or less. Our calculations show that the bending moments in the micropile below the steel casing do not exceed the cracking moment of the micropile and are therefore considered insignificant. Our evaluation of the moments induced in the micropile due to lateral displacement of the concrete footing during a seismic event and calculation of the cracking moment of the micropile are provided in Exhibit 5.

Based on this information, it is our professional opinion that the as-built micropiles will not be damaged in the event of the design earthquake and will retain their original axial support capacity. It is also our professional opinion that since the bending moments below the permanent steel casing are insignificant, the intent of OSSC 2014 Section 1810.3.10.4 is satisfied in this case by the micropiles in their as-built condition. We propose to retain and utilize the recently installed micropiles.

Since the as-built micropiles satisfy the intent of OSSC 2014 Section 1810.3.10.4, it is our professional opinion that the as-built micropiles provide equivalent life safety protection to what the code requires.

In the extremely unlikely event that the as-built micropiles were to fail due to excessive lateral displacement of the concrete footing at gridlines G.2-J.5/1, the concrete footing would remain supported by native medium dense sand and very dense gravel with a layer of compacted base rock at the ground surface. Even if the concrete footing were to no longer receive any support from the micropiles, we calculate that the vertical settlement of the concrete footing would be less than 1 inch, which would be compatible with the settlement of adjacent footings. The vertical settlement of the concrete footing would not cause significant damage to the building and would not pose a life-safety risk. Our calculation of vertical settlement for this hypothetical case is presented on Exhibit 6.

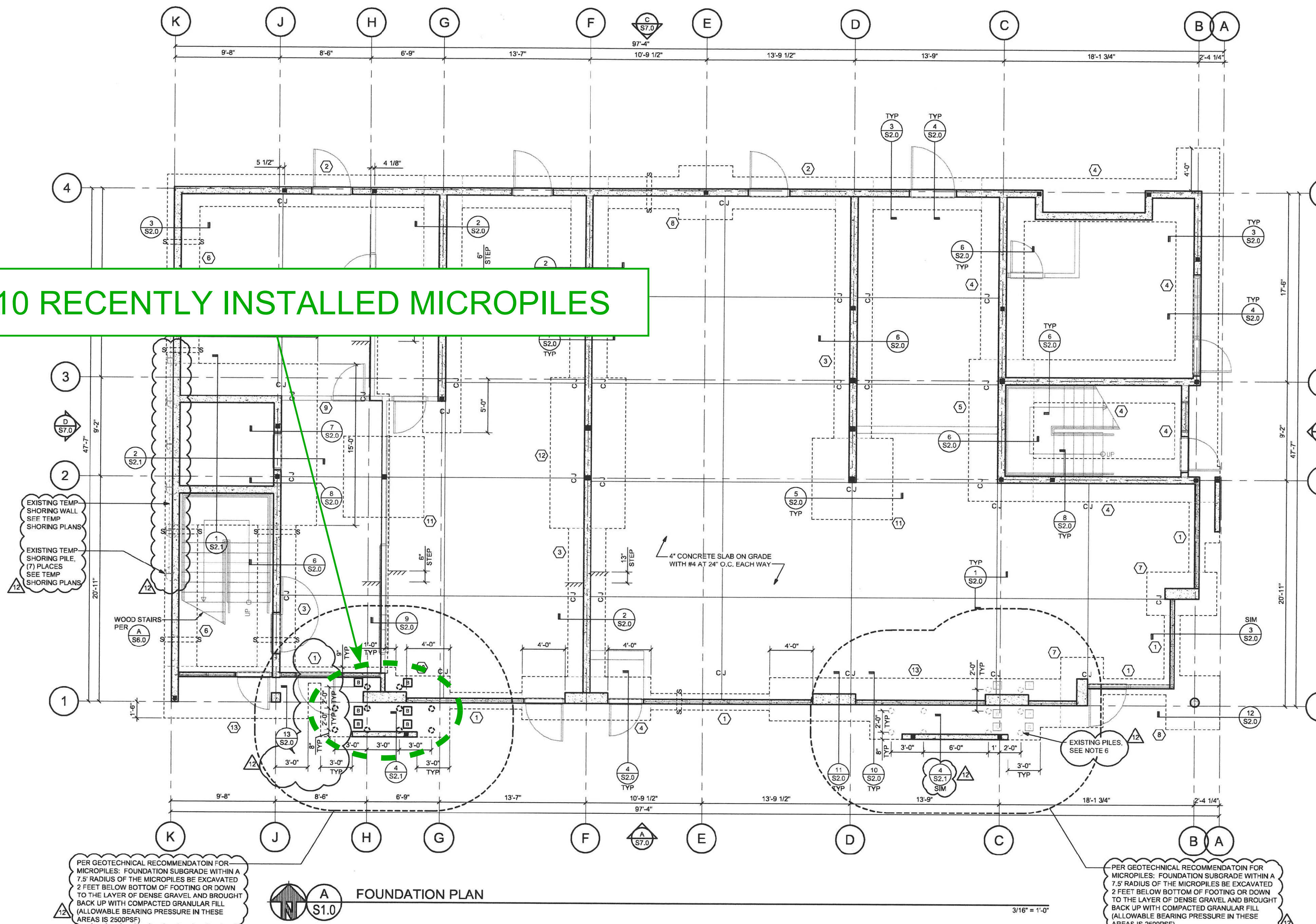
APPEAL DECISION

Use of existing micropiles: Granted as proposed.

The Administrative Appeal Board finds that the information submitted by the appellant demonstrates that the approved modifications or alternate methods are consistent with the intent of the code; do not lessen health, safety, accessibility, life, fire safety or structural requirements; and that special conditions unique to this project make strict application of those code sections impractical.

Pursuant to City Code Chapter 24.10, you may appeal this decision to the Building Code Board of Appeal within 180 calendar days of the date this decision is published. For information on the appeals process and costs, including forms, appeal fee, payment methods and fee waivers, go to www.portlandoregon.gov/bds/appealsinfo, call (503) 823-7300 or come in to the Development Services Center.

EXHIBIT 1 - FOUNDATION PLAN



A S1.0 FOUNDATION PLAN 3/16" = 1'-0"

FOUNDATION LEGEND:

- CONCRETE STEM WALL
- CONCRETE FOOTING PER SCHEDULE THIS SHEET
- CONCRETE FOOTING STEP PER DETAIL 3/S2.1
- STEEL COLUMN OR WOOD POST PER STRUCTURAL WALL PLAN
- FOOTING TYPE PER SCHEDULE THIS SHEET
- C J — CONCRETE SLAB CONTROL JOINT PER DETAIL 1/S2.0
- EXISTING MICROPILE LOCATION
- A — REQUIRED PILE CAPACITIES PER SCHEDULE THIS SHEET, TYPE A U.N.O.

FOUNDATION NOTES:

1. CONTRACTOR TO VERIFY ALL DIMENSIONS AND ELEVATIONS WITH ARCHITECTURAL DRAWINGS.
2. CONTRACTOR TO VERIFY ALL FOOTING ELEVATIONS WITH THE FOLLOWING CRITERIA: TOP OF FOOTING TO BE MINIMUM 12" BELOW FINISH GRADE AND FINISH FLOOR. BOTTOM OF FOOTING TO BE A MINIMUM OF 18" BELOW FINISH GRADE.
3. REFERENCE ARCHITECTURAL PLANS FOR SLAB AND STEM WALL ELEVATIONS.
4. SEE GEOTECHNICAL REPORT FOR SUBGRADE PREPARATION AND COMPACTION TO SUPPORT FOUNDATIONS AND CONCRETE SLAB ON GRADE.
5. PROVIDE AN UNDER SLAB VAPOR BARRIER IF REQUIRED BY THE ARCHITECT/OWNER. PLACE IN ACCORDANCE WITH GEOTECHNICAL ENGINEER'S RECOMMENDATIONS. USE CURING BLANKETS FOR SLABS PLACED OVER VAPOR BARRIERS. DO NOT WET CURE.
6. CUT OFF PILES (10 TOTAL) A MINIMUM OF 12" BELOW THE FINISHED BOTTOM OF FOUNDATION. RE-COMPACT DISTURBED SUBGRADE AS OUTLINED BY THE GEOTECHNICAL PILE 'TRANSITION ZONE' RECOMMENDATIONS.
7. FOUNDATIONS THAT INTERSECT ADJACENT FOUNDATIONS SHALL HAVE THEIR REINFORCING EXTEND NOT LESS THAN TWO FEET OR 40 BAR DIAMETERS, WHICHEVER IS LESS, INTO THE ADJACENT FOUNDATION.

REQUIRED PILE CAPACITIES

	VERTICAL	UPLIFT
A	12.0 KIPS	4.0 KIPS
B	24.0 KIPS	10.0 KIPS

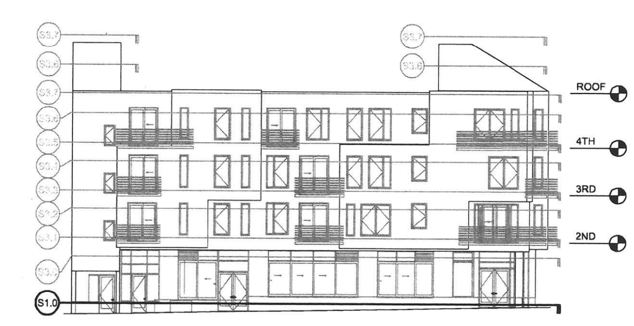
PILE NOTES:

1. ASSUMED PILE TYPE: TITAN 40/16 MICROPILE
2. SUBMIT STAMPED CALCULATIONS AND DETAILS FOR PILES BASED ON SERVICE LOADS INDICATED.
3. REFERENCE GEOTECHNICAL RECOMMENDATIONS PREPARED BY GEOPACIFIC ENGINEERING, INC. FOR ADDITIONAL INFORMATION AND REQUIREMENTS.
4. INDICATED LOADS ARE TO BE THE NET ALLOWABLE LOAD AFTER INCLUDING GROUP EFFICIENCY FACTORS BASED ON PILE SPACING.
5. LOCATION OF PILES AND NUMBER OF PILES ARE BASED ON PRELIMINARY PILE CAPACITIES BY GEOPACIFIC ENGINEERING, INC. REVISIONS MAY BE REQUIRED BASED ON PILE DESIGN REQUIREMENTS, PERFORMANCE TESTING, AND FIELD CONDITIONS.

FOOTING SCHEDULE

MARK	SIZE	REINFORCING
1	1'-6" WIDE x 12" DEEP x CONT	(3) #5 CONT TOP & BOTTOM
2	3'-0" WIDE x 16" DEEP x CONT	(4) #4 CONT TOP, (4) #6 CONT BOTTOM
3	3'-6" WIDE x 18" DEEP x CONT	(4) #4 CONT TOP, (4) #6 CONT BOTTOM
4	4'-0" WIDE x 20" DEEP x CONT	(5) #6 CONT TOP & BOTTOM, #6 AT 12" O.C. TRANSVERSE BOTTOM
5	6'-0" WIDE x 30" DEEP x CONT	(6) #4 CONT TOP, (6) #6 CONT BOTTOM
6	3'-0" WIDE x 16" DEEP x CONT	#6 AT 12" O.C. EACH WAY BOTTOM
7	4'-0" x 6'-6" x 20" DEEP	#5 AT 9" O.C. EACH WAY TOP & BOTTOM
8	5'-0" x 5'-0" x 16" DEEP	(6) #5 EACH WAY BOTTOM
9	15'-0" x 14'-0" x 30" DEEP	#4 TOP & #6 BOTTOM AT 12" O.C. E.W.
10	4'-0" x 5'-6" x 20" DEEP	#5 AT 12" O.C. EACH WAY BOTTOM
11	7'-6" x 7'-6" x 20" DEEP	(9) #6 EACH WAY BOTTOM
12	5'-0" x 10'-0" x 20" DEEP	#6 AT 8" O.C. EACH WAY BOTTOM
13	4'-0" WIDE x 24" DEEP x CONT	#6 AT 10" O.C. EACH WAY TOP & BOTTOM

DESIGN BEARING PRESSURE: 2,000 PSF DEAD PLUS LIVE LOAD
SEE SOILS INVESTIGATION BY: GEOPACIFIC ENGINEERING, INC DATED DECEMBER 11, 2015



FLOOR PLAN KEY PLAN NTS

03/06/2019
STRUCTURAL REGISTERED PROFESSIONAL ENGINEER PE OREGON JAN. 23, 2001 KEVIN M. KAPLAN
EXPIRES: 6-30-2019

FOSLER portland architecture
1930 NW LOVEJOY STREET
PORTLAND, OREGON 97209
503.241.9339

VLMK ENGINEERING + DESIGN
3933 SW Kelly Avenue
Portland, Oregon - 97239
503.222.4453
VLMK.COM

Project: 5015 NE 15th Avenue Alberta Apartments Portland, OR

Code: 20150322

Set: PERMIT SET

Date: 30 JUNE 2017

Revisions:
12 03.05.19 PLAN CHECK #4 SITE DEV PC #5

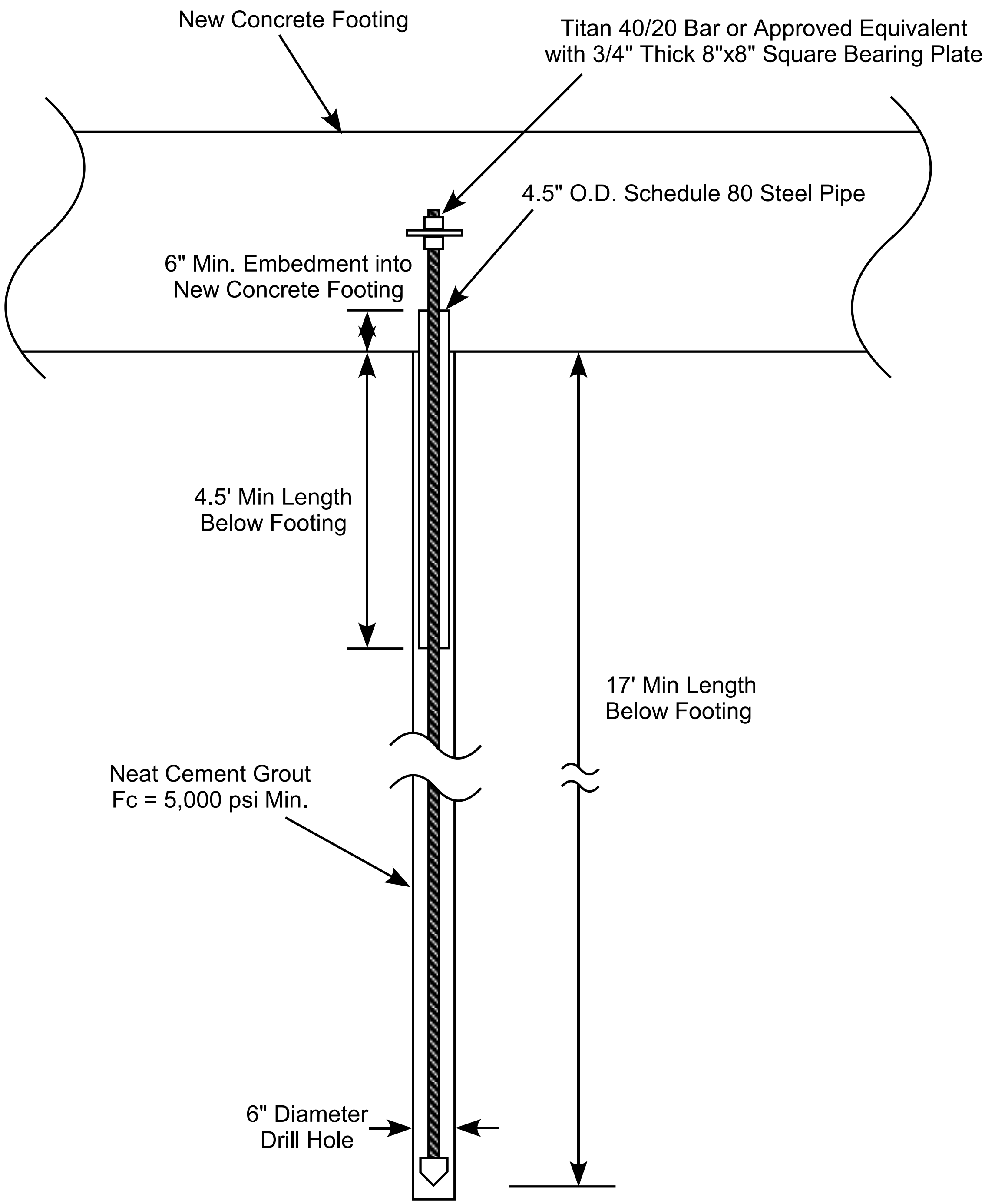
Sheet: S1.0

Title: FOUNDATION PLAN

GeoPacific Engineering, Inc.
14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

MICROPILE DETAIL

EXHIBIT 2 - MICROPILE DETAIL



Date: 03/21/19
Drawn by: BGA

Project: Alberta Apartments Portland, Oregon	Project No. 15-4044	FIGURE 1

EXHIBIT 3 - SUCCESSFUL MICROPILE TEST RESULTS

GeoPacific Engineering, Inc.
Real-World Geotechnical Solutions
Investigiation, Design, Construction Support

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Portland, Oregon 97224
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Fax (503) 941-9281

Pile Load Testing Results Summary

Project: 15th & Alberta
Project No. 15-4044

Pile ID: A4
Location: West Pile Group

Date: 12/17/18
Engineer: DPT

Bonded Length (ft):	17	Design Strength (kips):	24

Load Factor	Target Test Load (kips)
1.0	24
1.5	36
2.0	48

Proof / Verification Test Data

Pressure Gauge Reading (psi)	Conversion to Load (kips)	Displacement Gauge Reading (inches)
500	6.1	0.000
1000	12.2	0.026
1500	18.4	0.054
2000	24.5	0.090
2500	30.6	0.134
3000	36.7	0.179
3500	42.9	0.224
4000	49.0	0.251
3000	36.7	0.235
1000	12.2	0.205

Creep Test

Approximate Load (kips): 36.7

Minutes	Displacement Gauge 1 Reading (inches)
0	0.179
1	0.197
2	0.197
4	0.199
6	0.199
8	0.199
10	0.199
Total Displacement (in)	**0.002**

GeoPacific Engineering, Inc.
Real-World Geotechnical Solutions
Investigiation, Design, Construction Support

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Pile Load Testing Results Summary

Project: 15th & Alberta
Project No. 15-4044

Pile ID: B2
Location: East Pile Group

Date: 12/17/18
Engineer: DPT

Bonded Length (ft):	18	Design Strength (kips):	24

Load Factor	Target Test Load (kips)
1.0	24
1.5	36
2.0	48

Proof / Verification Test Data		
Pressure Gauge Reading (psi)	Conversion to Load (kips)	Displacement Gauge Reading (inches)
500	6.1	0.000
1000	12.2	0.016
1500	18.4	0.037
2000	24.5	0.061
2500	30.6	0.084
3000	36.7	0.113
2000	24.5	0.097
1000	12.2	0.065

Creep Test	
Approximate Load (kips): 36.7	
Minutes	Displacement Gauge 1 Reading (inches)
0	0.113
1	0.12
2	0.12
4	0.12
6	0.12
8	0.12
10	0.12
Total Displacement (in)	**0**

EXHIBIT 4 - MICROPILE DESIGN REPORT

Real-World Geotechnical Solutions
Investigation • Design • Construction Support

Revised May 21, 2018
GeoPacific Project No. 15-4044

Fosler Architecture
1930 NW Lovejoy Street
Portland, Oregon 97209
(503) 241-9339

Via email with hard copies mailed

SUBJECT: RECOMMENDATIONS FOR MICROPILES
ALBERTA APARTMENTS
1485 AND 5015 NE ALBERTA STREET
PORTLAND, OREGON 97211

References: GeoPacific Engineering, Inc., Geotechnical Engineering Report, Alberta Apartments, 1485 and 5015 NE Alberta Street, Portland, Oregon 97211, December 11, 2015.

As requested, this report provides recommendations for micropile foundation elements for the project. GeoPacific previously performed a geotechnical investigation of the site and provided recommendations for construction in the above-referenced report, dated May 18, 2018. It is our understanding that the current foundation plan shows some of the footings extending across the south and east property lines. The approximate locations of these footings are shown on the attached Site Plan (Figure 1).

The structural engineer plans to reduce the footprint of these footings so that they no longer cross the property line. The structural engineer has stated that since the footing sizes are to be reduced, vertical piles will be needed in order to adequately support the structural loads in these areas. Based on conversation with the architect, we understand that driven piles are not desired due to potential disturbance to adjacent structures. Potential alternatives, including, but not limited to, drilled shafts and grouted micropiles, were discussed. It is our understanding that grouted micropiles are desired for this site since they can get closer to the property line without significant load eccentricity issues.

Subsurface Conditions at Micropile Locations

Based on the results of our geotechnical investigation and our review of the foundation plan, we anticipate that very dense sand and gravel will be encountered at a maximum depth of 4 feet below the bottoms of footings. The dense sand and gravel encountered in our borings had SPT N-values ranging from 68 to 71. For design purposes, we neglected the upper 4 feet of medium dense sand, which had SPT N-values ranging from 15 to 16. Grout-to-ground bond strength values for the proposed Type A micropiles installed into very dense sand and gravel were selected from Table 5-2 of the FHWA-SA-97-070 manual.

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Transition Zone Around Micropiles

Special measures are needed in order to lower the risk of damage to the proposed structure due to differential settlement from having some foundation elements supported by micropiles and others supported by native medium dense sand. We recommend that foundation subgrade within a 7.5-foot radius of the micropiles be excavated 2 feet below bottom of footing or down to the layer of dense gravel, whichever is shallower, and brought back up with compacted granular fill. For planning purposes, the approximate extents of the areas to be overexcavated are shown on Figure 1. However, the actual extents will be determined after the structural engineer has finalized the micropile locations.

Construction Recommendations for Micropiles

Vertical micropiles should consist of Titan 40/16 bars, or approved equivalent, grouted in a 6-inch diameter hole. With hollow bar grout-injected installation methods, we anticipate that a 4-inch wide drill bit will be sufficient to achieve a 6-inch diameter drilled hole in sand and gravel. Grout should have a compressive strength of at least 5,000 psi and should be injected through the hollow bar. Centralizers may need to be installed on each bar prior to placing the bar in the drilled hole, depending on field conditions.

Micropiles should be installed within 5 degrees of vertical, and should not be assumed to resist any lateral loads. Lateral loads should be resisted by passive resistance on the embedded portions of the footings. Based on conversation with the project structural engineer, we assume that the micropiles will not be subjected to significant eccentric loads or bending moments. In some locations, we understand that the project structural engineer is planning to use micropile couples, where the pile nearest the property line will be loaded in compression and the couple pile, located slightly further from the property line, will be loaded in tension. For micropiles to be loaded in compression, a 4.5-inch outer diameter schedule 80 pipe should be installed in the upper 5 feet of the micropile, extending at least 6 inches into the footing or grade beam and 4.5 feet below the footing, as shown on Figure 2.

Vertical micropiles should be at least 8 feet long and embedded at least 4 feet into the layer of very dense sand and gravel. Design pile lengths should be determined by the structural engineer based on load capacity requirements in compression and uplift.

Actual pile depths will be determined by GeoPacific in the field based on conditions encountered in the field and the results of field load testing. The following table summarizes our design allowable compressive and uplift capacities for micropiles installed with a grout body diameter of at least 6 inches. The allowable micropile capacities presented on Table 1 incorporate a factor of safety of 2 in compression and 3 in uplift.

Table 1 – Allowable Compressive and Uplift Capacities for Micropiles

Total Pile Length Below Footing (ft)	Allowable Compressive Capacity (kips)	Allowable Uplift Capacity (kips)
8	11.8	7.9
10	17.7	11.8
12	23.6	15.7
14	29.5	19.6

Pile locations and spacing distances should be determined by the structural engineer. Micropiles should be spaced at least 2 feet apart, center to center, in order to avoid group effects. If micopiles need to be closer than 2 feet, GeoPacific should be consulted to provide specific recommendations. The properties of the bearing plate, which helps transfer loads from the footing to the micropile, should be approved by the structural engineer.

Vertical Micropiles - Verification Testing

Prior to installation of production micropiles, we recommend installation and performance testing of one sacrificial micropile to verify required capacities are being achieved. For this project, micropiles are not designed to incorporate end bearing; therefore tension tests may be performed. Performance tests should be held at 200 percent of the design load for at least 10 minutes to monitor the pile performance. After verification testing, the micropile may be loaded to failure at the discretion of the geotechnical engineer. Adjustments to the micropile lengths and/or installation methods may be necessary based on results of the performance testing. The locations of the tests should be approved by the geotechnical engineer.

The verification test micropiles should have a minimum bond length of 4 feet into the layer of dense sand and gravel as determined by the geotechnical engineer's representative in the field. The upper portion of the verification test micropile in the layer of medium dense sand and gravel should be unbonded. The unbonded zone can be formed by covering the upper 4 feet of the micropile with pvc pipe.

Verification test micropile bars should be sized such that the test load does not exceed 80 percent of the yield or ultimate strength of the steel.

Test locations proposed by the contractor should be reviewed by the geotechnical engineer during construction and modified as appropriate based on conditions encountered.

Verification micropiles should be tested as follows:

1. A small seating load should be applied to the micropile before starting the test. Gauges to measure displacement should be mounted on a tripod or similar independent reference point. Measurements of the micropile displacement should be taken to 0.001 inch, using the bar end as the point being measured.
2. The micropile should be loaded in increments of 30 percent of the design load to twice the design load. The load should be held for 2.5 minutes at each load increment, except for at 1.5 DL and 2.0 DL, when the load should be held for 10 minutes.
3. A creep test should be performed at 1.5 DL, when the load is held for 10 minutes. During the creep test, displacements should be recorded at 0, 1, 2, 3, 5, and 10 minutes. If the displacement between 1 and 10 minutes exceeds 0.04 in., the proof load should be maintained for an additional 50 minutes and the displacement recorded at 20, 30, 40, 50 and 60 minutes. For a 60 minute hold, the creep movement shall not exceed 0.08 in.
4. For a successful test, a plot of displacement versus log time for the 1.5 DL load should show a creep rate that does not exceed 0.08 inches per log cycle of time and should be linear or decreasing. In addition, the total displacement should not exceed 80 percent of the theoretical elastic elongation of the non-bonded length. If the above displacements are exceeded, the geotechnical engineering should be consulted to modify the design, the construction procedure, or both.

Vertical Micropiles - Proof Testing

At least two vertical micropiles shall be proof loaded, in tension, to 1.5 times the design load. The proof load shall be maintained at 1.5DL for a minimum of 10 minutes. Displacement (creep) should be recorded at 0,1,2,3,4,5,6, and 10 minutes and a plot made against the log of time. If the displacement between 1 and 10 minutes exceeds 0.04 in., the proof load should be maintained for an additional 50 minutes and the displacement recorded at 20, 30, 40, 50 and 60 minutes.

The micropile is considered acceptable if the measured displacement does not exceed 0.04 in. during the maximum load proof test for a 10 minute hold. For a 60 minute hold, the creep movement shall not exceed 0.08 in. during the maximum load. If the above displacements are exceeded, the geotechnical engineer should be consulted to design replacement micropile(s).

Gross settlement acceptance criteria is based on our understanding of the allowable settlements for the project. The piles shall sustain the appropriate design loads with no more than 1 inch of total vertical movement at the top of the pile.

GeoPacific should monitor micropile installation to verify that an appropriate bearing strata is reached and that the micropiles are properly constructed.

UNCERTAINTIES AND LIMITATIONS

We have prepared this report for the owner and their consultants for use in design of this project only. This report should be provided in its entirety to prospective contractors for bidding and estimating purposes; however, the conclusions and interpretations presented in this report should not be construed as a warranty of the subsurface conditions. Experience has shown that soil and groundwater conditions can vary significantly over small distances. Inconsistent conditions can occur between explorations that may not be detected by a geotechnical study. If, during future site operations, subsurface conditions are encountered which vary appreciably from those described herein, GeoPacific should be notified for review of the recommendations of this report, and revision of such if necessary.

Sufficient geotechnical monitoring, testing and consultation should be provided during construction to confirm that the conditions encountered are consistent with those indicated by explorations. The checklist attached to this report outlines recommended geotechnical observations and testing for the project. Recommendations for design changes will be provided should conditions revealed during construction differ from those anticipated, and to verify that the geotechnical aspects of construction comply with the contract plans and specifications.

Within the limitations of scope, schedule and budget, GeoPacific attempted to execute these services in accordance with generally accepted professional principles and practices in the fields of geotechnical engineering and engineering geology at the time the report was prepared. No warranty, expressed or implied, is made. The scope of our work did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous or toxic substances in the soil, surface water, or groundwater at this site.

We appreciate this opportunity to be of service.

Sincerely,

GEOPACIFIC ENGINEERING, INC.

For DPT

REGISTERED PROFESSIONAL ENGINEER
90013PE
OREGON
MAY 22, 2015
BENJAMIN G. ANDERSON

Expires: 12/31/19

Daniel P. Thabault, E.I.
Geotechncial Staff

Benjamin G. Anderson, P.E.
Senior Engineer

Attachments: Figure 1 - Site Plan
Figure 2 - Pile to Footing Connection Recommendation (Compression Piles)
Titan IBO Micropile Information Sheet
Micropile Design Calculations (2 Pages)

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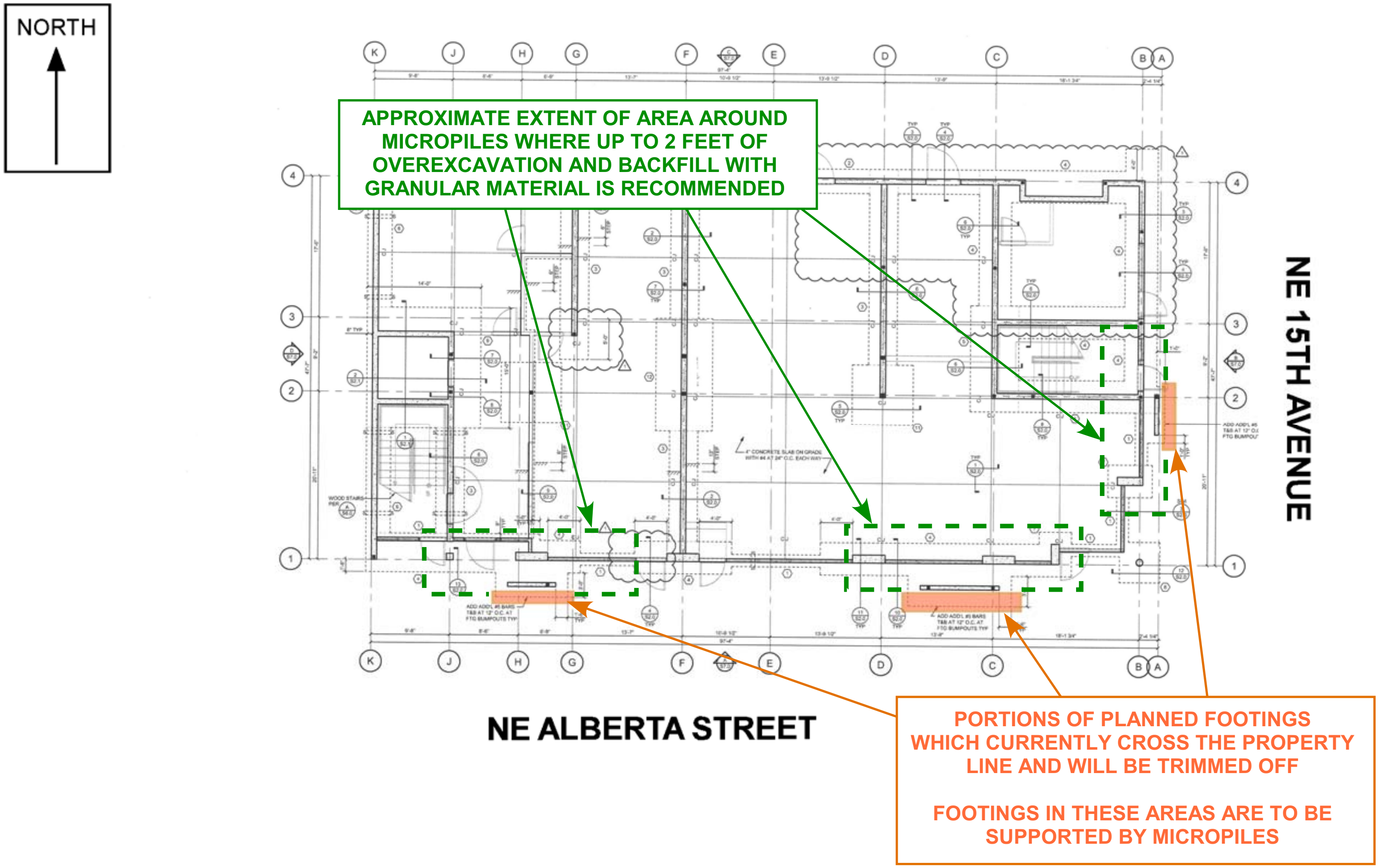
SITE PLAN



Base Map Provided by Client

Legend:

0 20'
APPROXIMATE SCALE 1"=20'

Date: 05/18/18
Drawn by: BGA

Project: Alberta Apartments
1485 NE Alberta Street, Portland, Oregon

Project No. 15-4044

FIGURE 1

GeoPacific Engineering, Inc.
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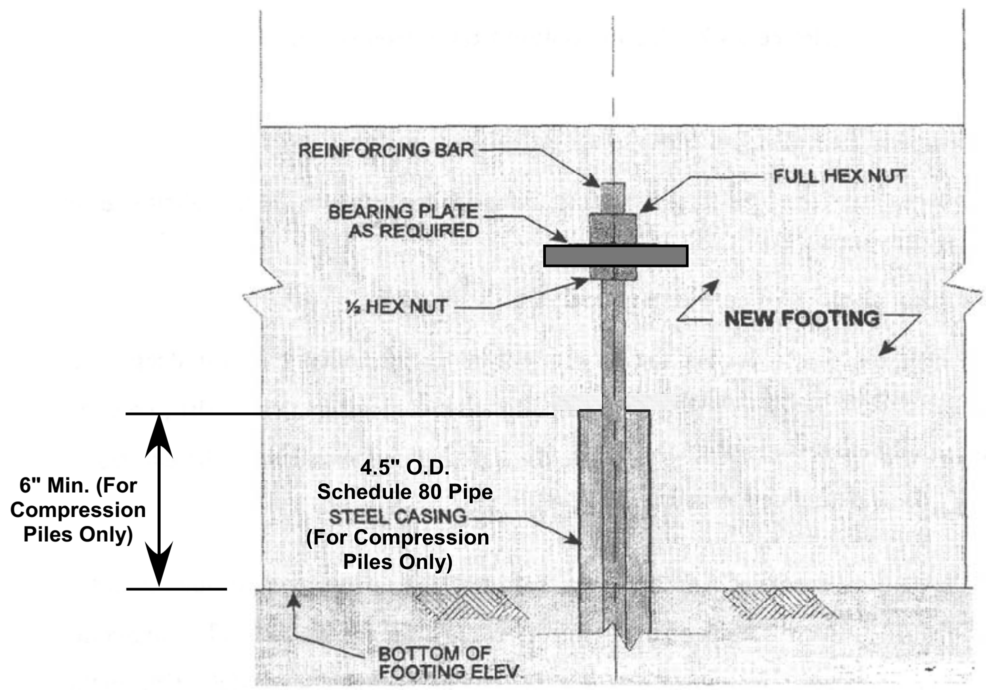
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

PILE TO FOOTING CONNECTION RECOMMENDATION

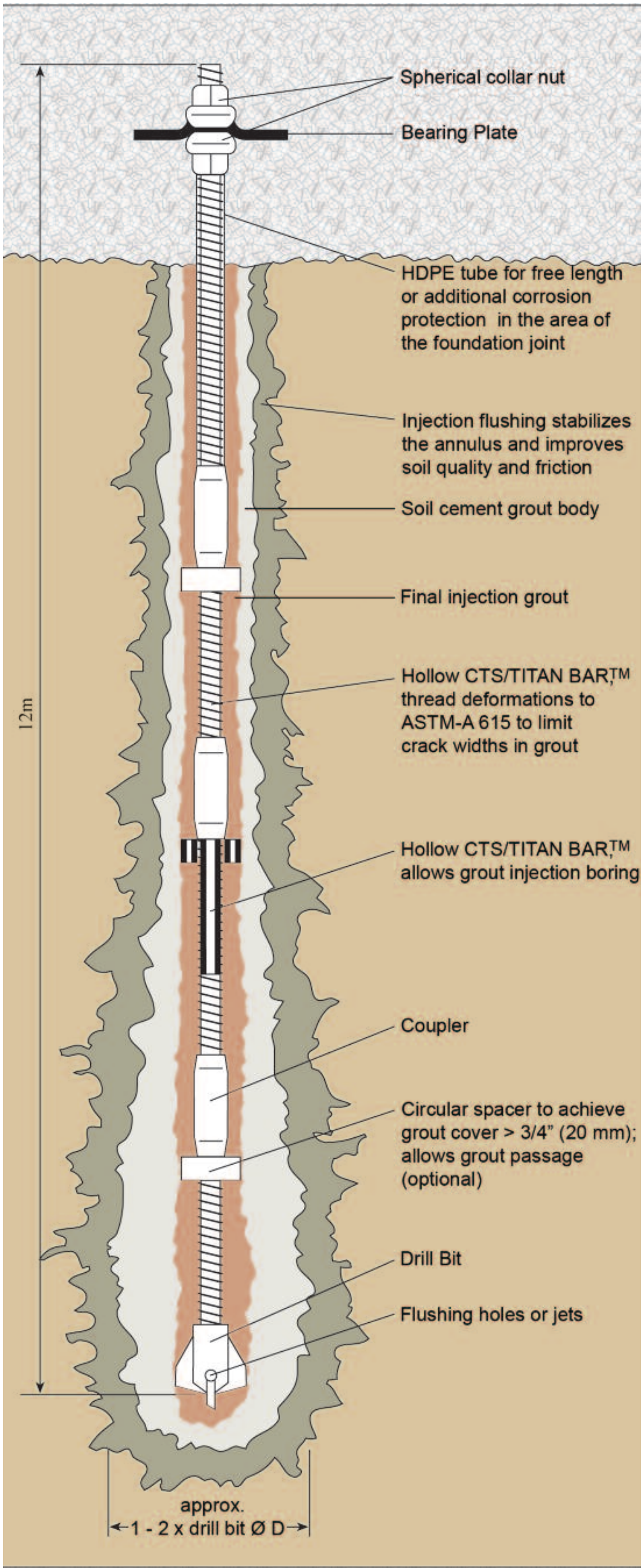


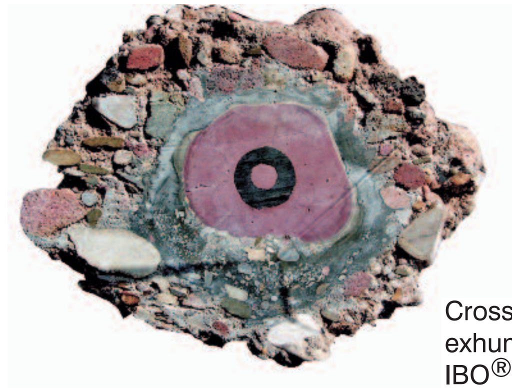
Pile to Footing Connection Typical Detail Modified from Figure 5-8 on the USDOT FHWA Micropile Design and Construction Guidelines (FHWA-SA-97-070)

Note: 4.5" O.D. Schedule 80 pipe with length of 5 feet (4.5 feet below bottom-of-footing) to be used for compression piles

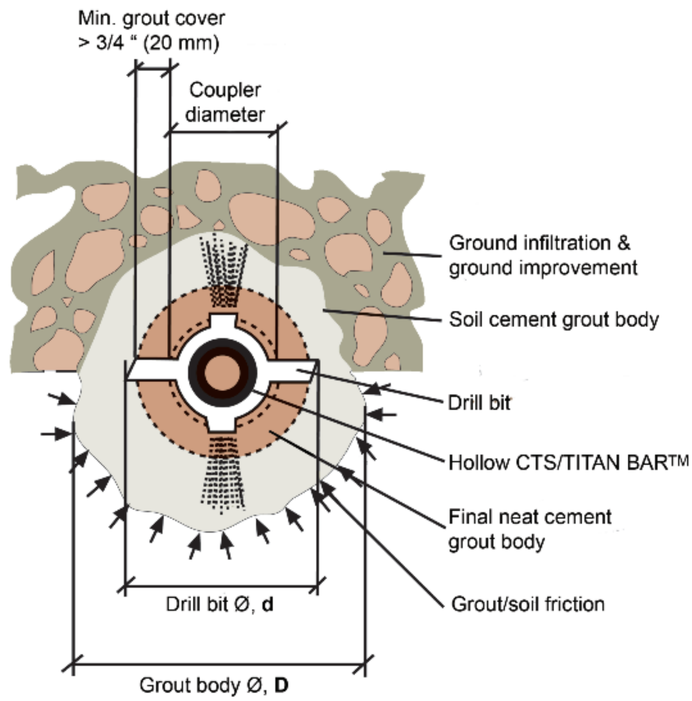
Date: 05/21/18
Drawn by: BGA

Project: Alberta Apartments Portland, Oregon	Project No. 15-4044	FIGURE 2





Cross section of exhumed CTS/TITAN IBO® micropile



Grout Body Diameter, D, in different Soils

D ≥	2.0 x d	for medium & coarse gravel
	1.5 x d	for sand & gravelly sand
	1.4 x d	for cohesive soil (clay, marl)
	1.0 x d	for weathered rock

d: Drill bit diameter

Please Note:
The above illustration is based on actual tests and experiences using the CTS/TITAN IBO® system installed with appropriate drilling and grouting equipment.

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Vertical Micropile Design per FHWA-SA-97-070

Titan 40-16 IBO bar
4" drill bit

Grout body diameter = 1.5 · D (D = drill bit diameter = 4")
for sand and gravelly sand

Grout body diameter = 6"

Grout to ground bond for Type A micropile, Table 5-2

$$\alpha_{\substack{bond\\grout}} = 180\ kPa\left(\frac{1\ ksf}{48\ kPa}\right) = 3.75\ ksf$$ for Sandy Gravel

Allowable geotechnical axial load, $P_{G\text{-}allowable}$

$$P_{G\text{-}allowable} = \frac{\alpha}{FS}(\pi)(\text{grout body diameter})(\text{bond length})$$

bond length = total pile length (L) − 4 to neglect upper 4 feet of silty sand

FS = 2.0 for compressive capacity
FS = 3.0 for uplift capacity

$$P_{\substack{G\text{-}allowable\\(compressive)}} = \frac{3.75\ ksf}{2.0}(\pi)\left(\frac{6}{12}\right)(L-4)$$

$$P_{\substack{G\text{-}allowable\\(uplift)}} = \frac{3.75\ ksf}{3.0}(\pi)\left(\frac{6}{12}\right)(L-4)$$

Project: 15th + Aberta	Job No. 15-4044	Drawn By: DPT	Date: 5/16/18

GEOPACIFIC ENGINEERING, INC.
14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

Values in Table 1 calculated by spread sheet

Table 1: Allowable Compressive and Uplift Capacities

Total Pile Length (ft)	Allowable Compressive Capacity (k)	Allowable Uplift Capacity (k)
8	11.8	7.9
10	17.7	11.8
12	23.6	15.7
14	29.5	19.6

Allowable compression load - structural

$$P_{s\text{-allowable}} = 0.40\, f'_{c\,grout}\, A_{grout} + 0.47\, F_{y\,bar}\, A_{bar}$$

where $f'_{c\,grout} = 5{,}000$ psi $= 5$ ksi

$A_{grout} = \frac{\pi d_g^2}{4} - \frac{\pi d_b^2}{4} = \frac{\pi (6)^2}{4} - 1.36 = 26.9\ in^2$

$F_{y\,bar} = 75$ ksi

$A_{bar} = 1.36\ in^2$

$P_{s\text{-allowable}} = 101.7$ Kips

Allowable uplift load - structural

$$P_{s\text{-allowable}_{uplift}} = 0.55\, F_{y\,bar}\, A_{bar}$$

$P_{s\text{-allowable}_{uplift}} = 56.1$ kips

Project: 15^{th} + Alberta	Job No. 15-4044	Drawn By: DPT	Date: 5/16/18

EXHIBIT 5 - EVALUATION OF BENDING MOMENTS

March 21, 2019
Project No. 15-4044

Folser Architecture
Steve Fosler
1930 NW Lovejoy Street
Portland, Oregon 97209
Phone: (503) 241-9339

CC: Ken Rust, VLMK Engineering, kenr@vlmk.com

Via email with hard copies mailed upon request

**SUBJECT: RESPONSE TO BDS CHECKSHEET DATED MARCH 19, 2019
ALBERTA APARTMENTS
1477 NE ALBERTA STREET
PORTLAND, OREGON 97211**

References: GeoPacific Engineering, Inc., *Geotechnical Engineering Report*, Alberta Apartments, 1485 and 5015 NE Alberta Street, Portland, Oregon 97211, dated December 11, 2015.

GeoPacific Engineering, Inc., *Recommendations for Micropiles*, 15th and Alberta Mixed Use, 1485 NE Alberta Street and 5011 NE 15th Avenue, Property ID: R674499, Tax Lots: 1481-1485, Portland, Oregon, Revised May 21, 2018.

At your request, GeoPacific Engineering, Inc. (GeoPacific) prepared the following response to the geotechnical issues noted in the Site Development Checksheet generated by the City of Portland Bureau of Development Services, dated March 19, 2019. GeoPacific previously performed a geotechnical investigation of the site and provided recommendations for site development in the above-referenced report, dated December 11, 2015. GeoPacific also provided recommendations for micropile foundation elements in the above-referenced report, revised May 21, 2018.

Checksheet Item #4 – Micropile Foundation

In response to Checksheet Item #4, we have provided a detail drawing to the design team, which is to be included in the drawing set. The detail drawing shows the center bar, casing, hole diameter, casing length, and overall length. A copy of the detail drawing is attached to this report.

Based on conversation with the project structural engineer, VLMK Engineering and Design, the micropiles that are to be utilized are located at approximate gridlines J.5-G/1. Lateral forces in this area are to be resisted by friction under the footings surrounding the micropiles. Therefore, it is our opinion that no significant lateral forces will be transferred to the micropiles.

However, the city has expressed concern that some movement of the footing may occur before sliding resistance is engaged and has asked us to show that the steel casing extends down to the point of zero curvature. In response to this item, we conservatively assumed a deflection of 0.10 inches of deflection at the top of the micropile and evaluated the induced moments due to this deflection. Theoretically, the deflection required to mobilize sliding friction is near zero, but we conservatively assume a deflection of 0.10 inches for analytical purposes.

The steel casing installed in the micropiles extends at least 4.5 feet below the bottom-of-footing. Since the steel casing is to be embedded only 6 inches into the concrete footing, we assumed a free head connection. With an assumed deflection of 0.10 inches at the top of the pile, the bending moment in the micropile at the bottom of the steel casing is 0.70 ft-kips, as shown on the figure below.

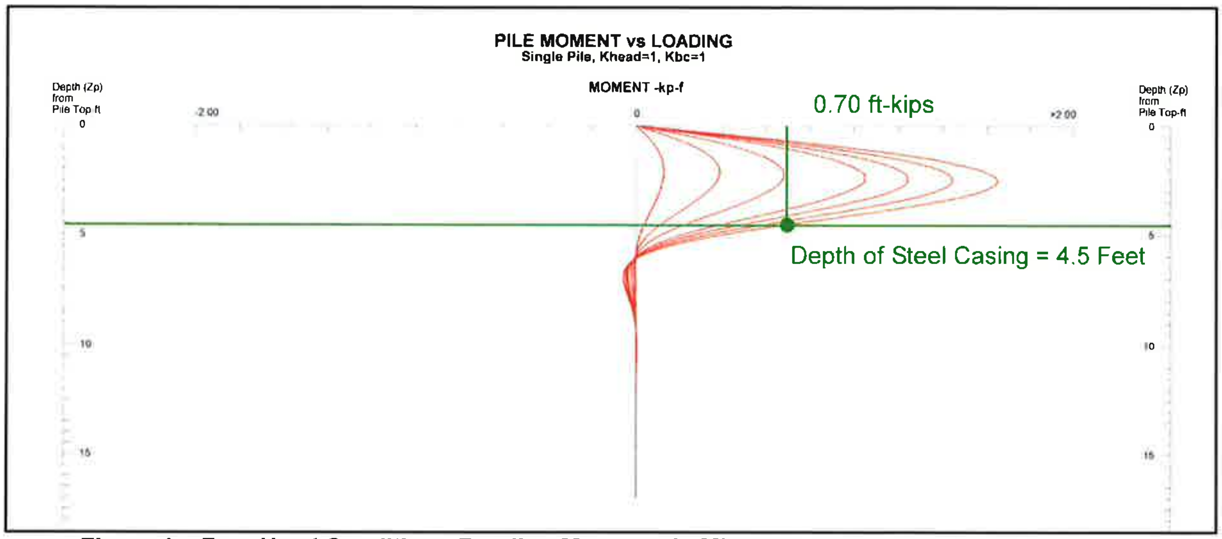


Figure 1 – Free-Head Condition - Bending Moments in Micropile Due to 0.10 Inches Deflection

Based on this analysis, the casing does not extend to the point of zero curvature, but the magnitude of the bending moment below the casing is very small. The calculated cracking moment of the micropile grout body is at least 0.84 ft-kips. Calculations for the cracking moment are attached to this report. Since the bending moment in the grout column below the steel casing is less than 0.84 ft-kips, the bending moments below the steel casing induced by 0.10 inches of deflection will not induce a crack the micropile. It is therefore our opinion that the micropile can withstand 0.10 inches of deflection and still perform as designed.

Checksheet Item #8 – Load Test Program

In response to Checksheet Item #8, we have provided a copy of the load test program to the design team, which is to be included in the drawing set. A copy of the load test program is attached to this report.

UNCERTAINTIES AND LIMITATIONS

Within the limitations of scope, schedule and budget, GeoPacific attempted to execute these services in accordance with generally accepted professional principles and practices in the fields of geotechnical engineering and engineering geology at the time the report was prepared. No warranty, expressed or implied, is made. The scope of our work did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous or toxic substances in the soil, surface water, or groundwater at this site.

We appreciate this opportunity to be of service.

Sincerely,

GEOPACIFIC ENGINEERING, INC.

Expires: 12/31/19

Benjamin G. Anderson, P.E.
Project Engineer

Attachment: Calculation of Cracking Moment
Micropile Detail
Load Test Program
Micropile Design Calculations

GeoPacific Engineering, Inc.
14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

Calculate Cracking Moment

Cracking moment, $M_{cr} = \frac{f_r I_g}{y_t}$

where f_r = modulus of rupture
I_g = moment of inertia
y_t = distance from center of gravity to extreme fiber on tension side

$f_r = 7.5\sqrt{f'_c} = 7.5\sqrt{4{,}000} = 474$ psi

conservatively assume $f'_c = 4{,}000$ psi (grout should have compressive strength greater than 5,000 psi as demonstrated by successful load tests in the field)

$I_g = 1/4\, \pi r^4 = 1/4\, \pi (3)^4 = 63.6$ in^4

y_t = 3 inches

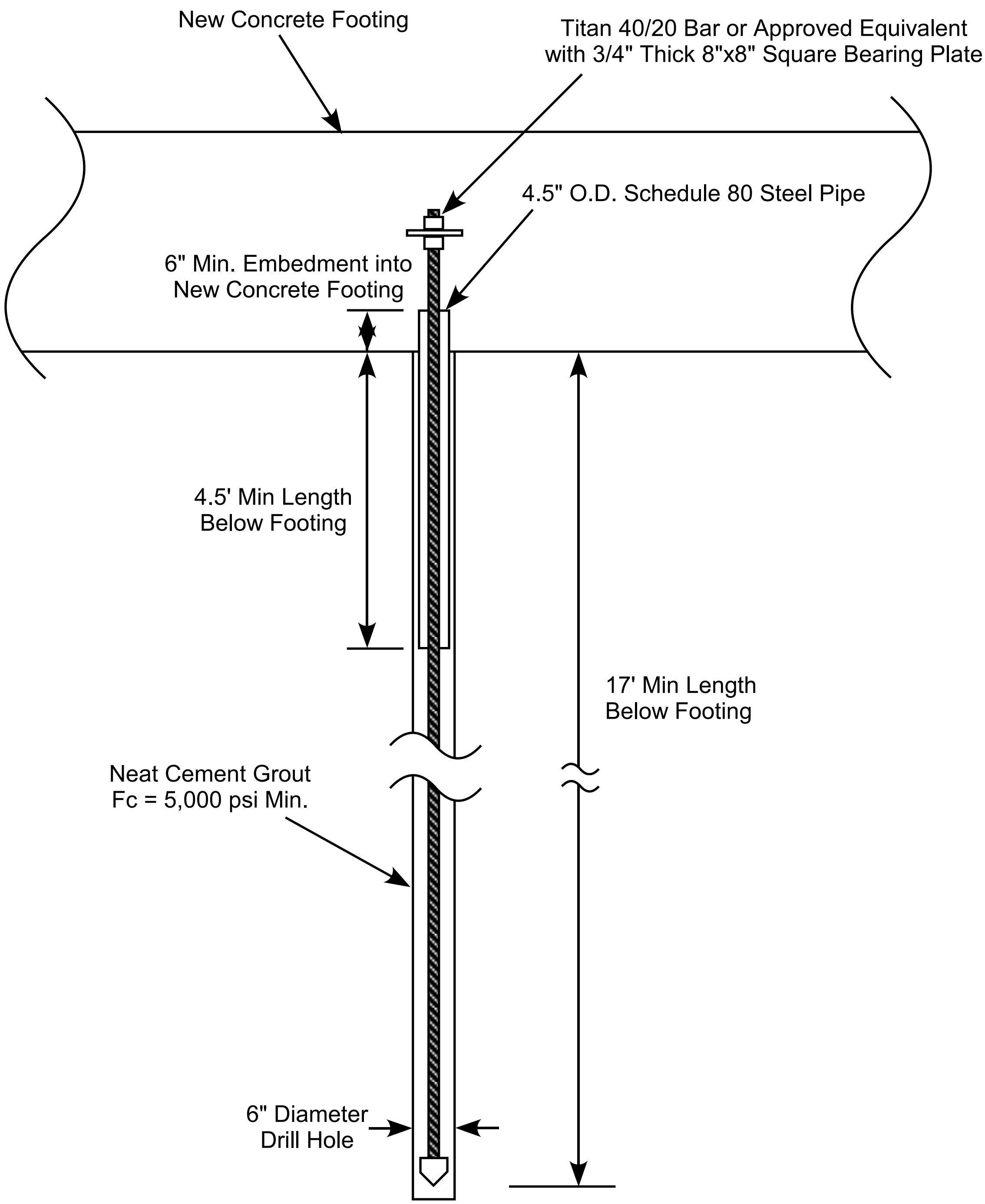
$M_{cr} = \frac{f_r I_g}{y_t} = \frac{474\,(63.6)}{3} = 10{,}050$ in·lbs $\left(\frac{1\,ft}{12\,in}\right)\left(\frac{1\,kip}{1{,}000\,lbs}\right) =$

$M_{cr} = 0.84$ ft·kips

Project: 15th + Alberta	Job No. 15-4044	Drawn By: BGA	Date: 3/21/19

GeoPacific Engineering, Inc.
14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

MICROPILE DETAIL



Date: 03/21/19
Drawn by: BGA

Project: Alberta Apartments Portland, Oregon	Project No. 15-4044	FIGURE 1

MICROPILE LOAD TESTING PROGRAM

Vertical Micropiles - Verification Testing

Prior to installation of production micropiles, we recommend installation and performance testing of one sacrificial micropile to verify required capacities are being achieved. For this project, micropiles are not designed to incorporate end bearing; therefore tension tests may be performed. Performance tests should be held at 200 percent of the design load for at least 10 minutes to monitor the pile performance. After verification testing, the micropile may be loaded to failure at the discretion of the geotechnical engineer. Adjustments to the micropile lengths and/or installation methods may be necessary based on results of the performance testing. The locations of the tests should be approved by the geotechnical engineer.

The verification test micropiles should have a minimum bond length of 4 feet into the layer of dense sand and gravel as determined by the geotechnical engineer's representative in the field. The upper portion of the verification test micropile in the layer of medium dense sand and gravel should be unbonded. The unbonded zone can be formed by covering the upper 4 feet of the micropile with pvc pipe.

Verification test micropile bars should be sized such that the test load does not exceed 80 percent of the yield or ultimate strength of the steel.

Test locations proposed by the contractor should be reviewed by the geotechnical engineer during construction and modified as appropriate based on conditions encountered.

Verification micropiles should be tested as follows:

1. A small seating load should be applied to the micropile before starting the test. Gauges to measure displacement should be mounted on a tripod or similar independent reference point. Measurements of the micropile displacement should be taken to 0.001 inch, using the bar end as the point being measured.
2. The micropile should be loaded in increments of 30 percent of the design load to twice the design load. The load should be held for 2.5 minutes at each load increment, except for at 1.5 DL and 2.0 DL, when the load should be held for 10 minutes.
3. A creep test should be performed at 1.5 DL, when the load is held for 10 minutes. During the creep test, displacements should be recorded at 0, 1, 2, 3, 5, and 10 minutes. If the displacement between 1 and 10 minutes exceeds 0.04 in., the proof load should be maintained for an additional 50 minutes and the displacement recorded at 20, 30, 40, 50 and 60 minutes. For a 60 minute hold, the creep movement shall not exceed 0.08 in.
4. For a successful test, a plot of displacement versus log time for the 1.5 DL load should show a creep rate that does not exceed 0.08 inches per log cycle of time and should be linear or decreasing. In addition, the total displacement should not exceed 80 percent of the theoretical elastic elongation of the non-bonded length. If the above displacements are exceeded, the geotechnical engineering should be consulted to modify the design, the construction procedure, or both.

Vertical Micropiles - Proof Testing

At least two vertical micropiles shall be proof loaded, in tension, to 1.5 times the design load. The proof load shall be maintained at 1.5DL for a minimum of 10 minutes. Displacement (creep) should be recorded at 0,1,2,3,4,5,6, and 10 minutes and a plot made against the log of time. If the displacement between 1 and 10 minutes exceeds 0.04 in., the proof load should be maintained for an additional 50 minutes and the displacement recorded at 20, 30, 40, 50 and 60 minutes.

The micropile is considered acceptable if the measured displacement does not exceed 0.04 in. during the maximum load proof test for a 10 minute hold. For a 60 minute hold, the creep movement shall not exceed 0.08 in. during the maximum load. If the above displacements are exceeded, the geotechnical engineer should be consulted to design replacement micropile(s).

Gross settlement acceptance criteria is based on our understanding of the allowable settlements for the project. The piles shall sustain the appropriate design loads with no more than 1 inch of total vertical movement at the top of the pile.

GeoPacific should monitor micropile installation to verify that an appropriate bearing strata is reached and that the micropiles are properly constructed.

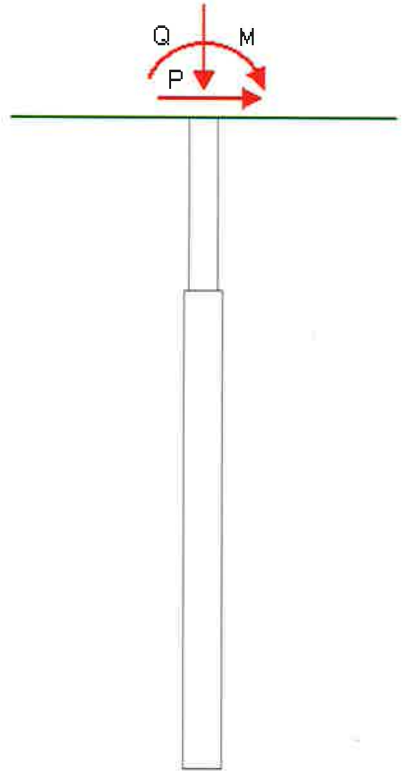
For uplift and compression, one no-friction steel casing section and one high pressure grouted section.

FOUNDATION PROFILE & SOIL CONDITIONS

FOUNDATION PROPERTIES

Depth from Ground-ft

Depth	Width-in	A'-in2	Per.-in	I'-in4	E -kp/i2	W -kp/f
0.0	4.5	5.6	14.1	10.8	29000	0.027
Steel (smooth)						
4.5	6	36.9	18.8	64.3	3000	0.032
Grouted						
17.0						



SOIL PROPERTIES

Depth from Ground-ft

Depth	γ -lb/f3	ϕ	C-kp/f2	k-lb/i3	e50 %	Nspt
0.0	125	36	0.00	120		18
Sand/Gravel Upper						
4.0	135	38	0.00	360		60
Sand/Gravel Lower						

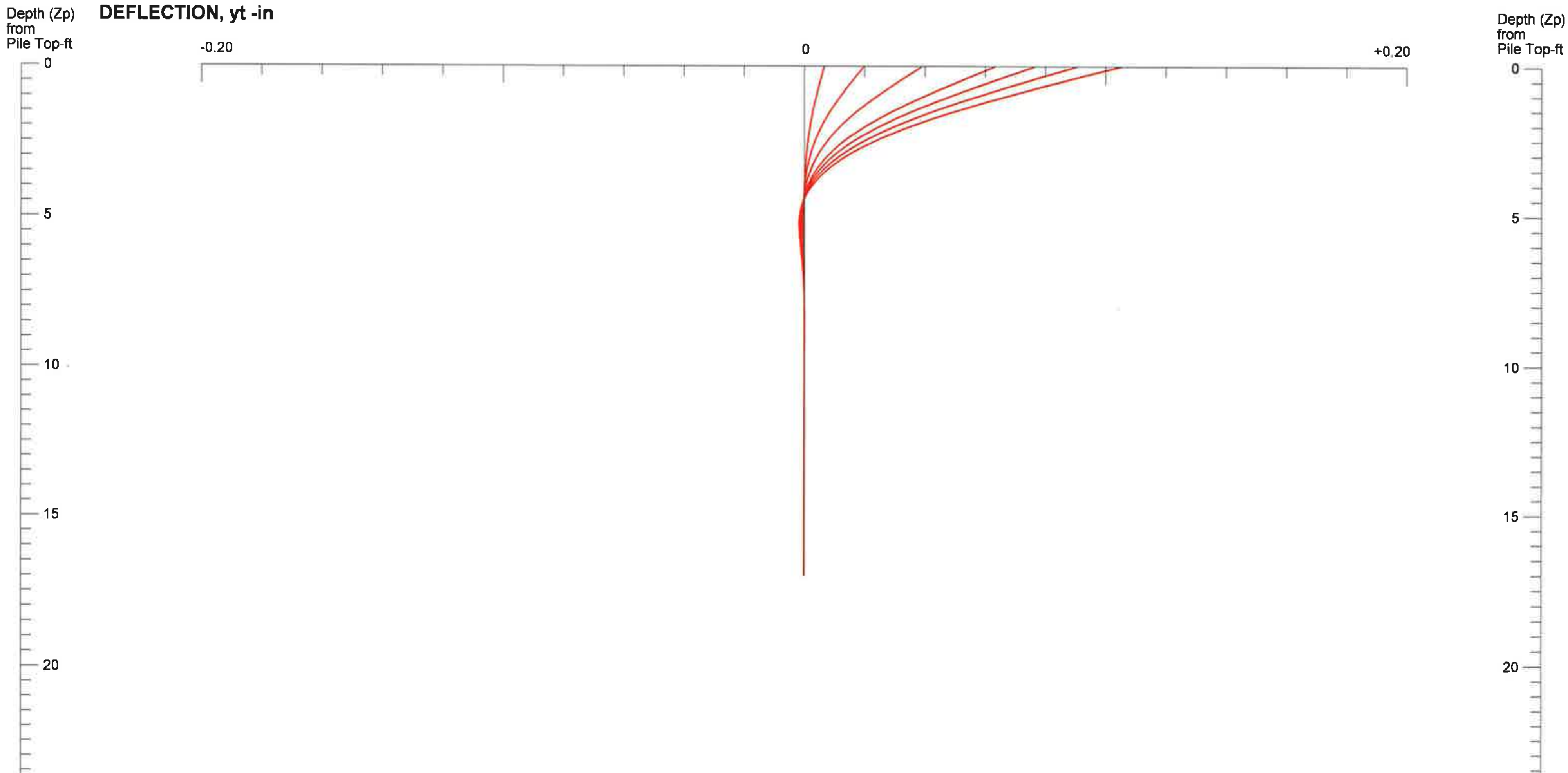
Batter Angle=0 (Pile diameter not to scale) Surface Angle=0

CivilTech Software

15-4044 - 15th and Alberta
Single Micropile - Free Head Condition **Figure 1**

PILE DEFLECTION vs LOADING

Single Pile, Khead=1, Kbc=1



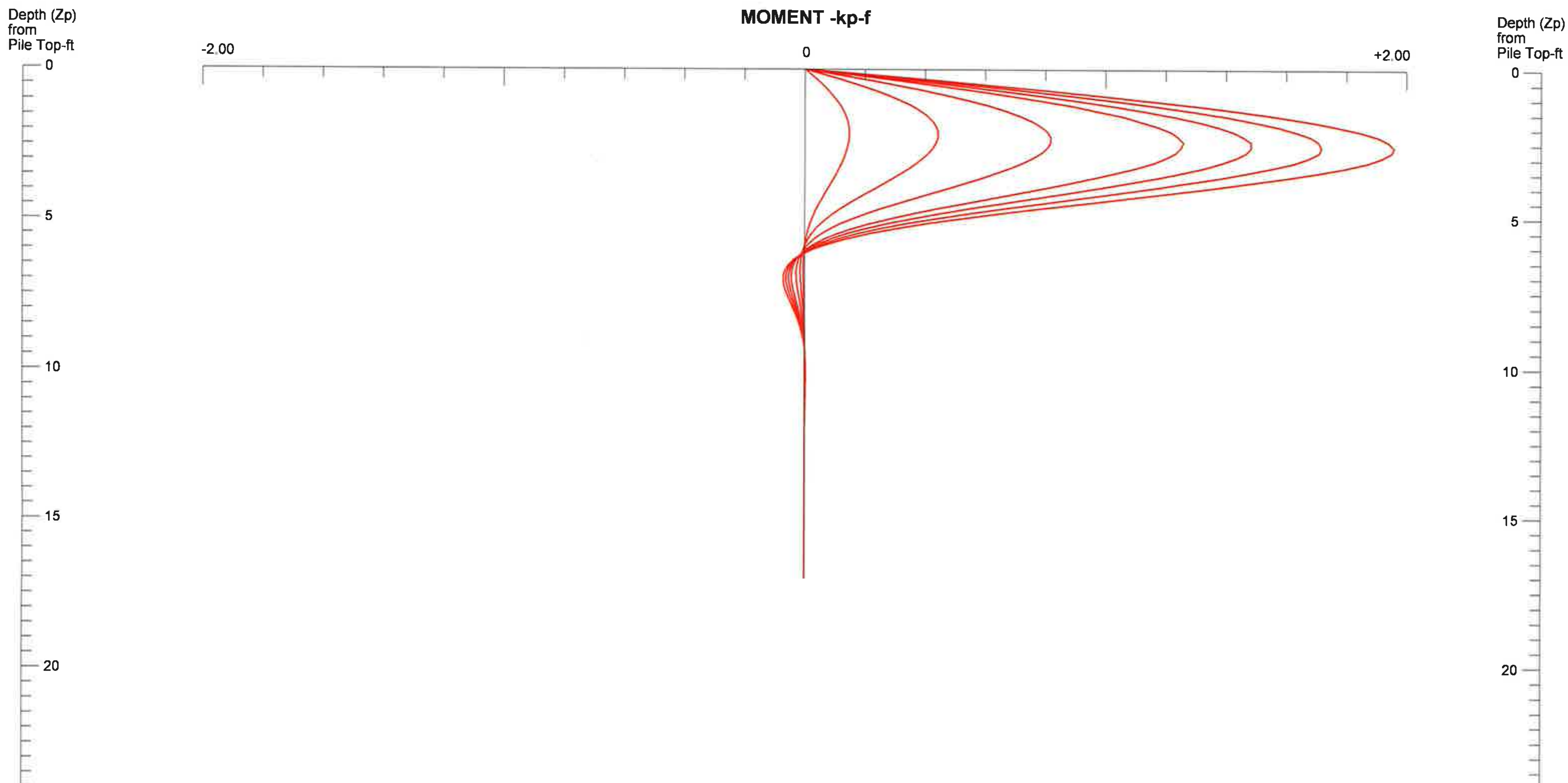
No.	Lateral Load (kip)	Moment Load (kip-ft)	Axial Load (kip)	yt at Top (in)	Slope at Top (in/in)	Max Moment (kip-ft)
1	0.1	0.0	18.0	0.0	0.00	0.1
2	0.3	0.0	18.0	0.0	0.00	0.4
3	0.6	0.0	18.0	0.0	0.00	0.8
4	0.8	0.0	18.0	0.1	0.00	1.3
5	0.9	0.0	18.0	0.1	0.00	1.5
6	1.0	0.0	18.0	0.1	0.00	1.7
7	1.1	0.0	18.0	0.1	0.00	2.0

CivilTech Software

15-4044 - 15th and Alberta
Single Micropile - Free Head Condition Figure 2

PILE MOMENT vs LOADING

Single Pile, Khead=1, Kbc=1



No.	Lateral Load (kip)	Moment Load (kip-ft)	Axial Load (kip)	yt at Top (in)	Slope at Top (in/in)	Max. Moment (kip-ft)
1	0.1	0.0	18.0	0.0	0.00	0.1
2	0.3	0.0	18.0	0.0	0.00	0.4
3	0.6	0.0	18.0	0.0	0.00	0.8
4	0.8	0.0	18.0	0.1	0.00	1.3
5	0.9	0.0	18.0	0.1	0.00	1.5
6	1.0	0.0	18.0	0.1	0.00	1.7
7	1.1	0.0	18.0	0.1	0.00	2.0

CivilTech Software

15-4044 - 15th and Alberta
Single Micropile - Free Head Condition Figure 2

****

ALLPILE 7
LATERAL ANALYSIS SUMMARY OUTPUT

www.civiltech.com

****

Licensed to
Date: 3/21/2019 File: Z:\Projects 2015 - 3654-4085\15-4044-15th and Alberta Mixed Use\Geotechnical\Micropiles\Single Pile Free Head.alp 1.0

Title 1: 15-4044 - 15th and Alberta
Title 2: Single Micropile - Free Head Condition

ALLPILE INPUT DATA:

---

* Pile Type Page *
Unit: English
For uplift and compression, one no-friction steel casing section and one high pressure grouted section.
Pile Type: Micropile (MiniPile)

* Pile Profile *
Foundation Depth: 17.0 -ft
Top Height: 0 -ft
Slope Angle: 0
Pile Angle: 0

* Pile Properties *

Zs Other -ft	Width Type -in	Area -in2	Perim. -in	I -in4	E -kp/i2	Weight -kp/f	Mix* %	Out Side	In Side	Par.
0.0	4.5	5.6	14.1	10.8	29000	0.027	72.0	2	2	
Steel (smooth)										
4.5	6	36.9	18.8	64.3	3000	0.032	4.0	5	5	0
Grouted										
17.0										
Pile Tip										

Note: Mix = % of Inside material/Outside material
Other Pra. = Crack deduction (%) for concrete pile

Group Type: 0
Top Type: 1

No Water Table
No Elevation Input

```
* Soil Properties *
Zs      Gamma    Phi     C        K        E50/Dr   Nspt     Type     Soil
-ft     -lb/f3   o       -kp/f2   -lb/i3    - %
0.0     125      36      0.00     120      51.54    18       4        Sand/Gravel Upper
4.0     135      38      0.00     360      95.94    60       4        Sand/Gravel Lower
```

ALLPILE ANALYSIS AND RESULTS:

FACTORS AND CONDITIONS:
    Load Factor for Vertical Loads: 1.0
    Load Factor for Lateral Loads: 1.0
    Loads Supported by Pile Cap: 0 %
    Shear Condition: Static

SINGLE PILE:
    (with Load Factor)
    Vertical Load= 18.00 -kp
    Shear= 1.15 -kp
    Moment= 0.00 -kp-f

Results:
    Top Deflection, yt= 0.10500-in
    Max. Moment, M= 1.96-kp-f
    Top Deflection Slope, St= -0.00321

    Top Deflection, 0.1050-in, OK with the Allowable Deflection= 1.00-in

Note: If the program cannot find a result or the result exceeds the upper limit.
The result will be displayed as 99999.

Notes:
Q - Vertical Load at pile top
P - Lateral Shear Load at pile top
M - Moment at pile top
Xtop - Pile top total settlement
yt - Pile top deflection
St - Pile top deflection slope (deflection/unit length)

The Max. Moment calculated by program is an internal moment of shaft due to the loading. Engineers
have to check whether the pile has enough moment capacity to resist the Max. Moment with adequate
factor of safety. If not, the pile may be damaged under the loading.

EXHIBIT 6 - EVALUATION OF HYPOTHETICAL VERTICAL SETTLEMENT

Real-World Geotechnical Solutions
Investigation • Design • Construction Support

April 5, 2019
Project No. 15-4044

Folser Architecture
Steve Fosler
1930 NW Lovejoy Street
Portland, Oregon 97209
Phone: (503) 241-9339

CC: Ken Rust, VLMK Engineering, kenr@vlmk.com

Via email with hard copies mailed upon request

SUBJECT: EVALUATION OF POTENTIAL VERTICAL SETTLEMENTS
ALBERTA APARTMENTS
1477 NE ALBERTA STREET
PORTLAND, OREGON 97211

References: 1) GeoPacific Engineering, Inc., *Geotechnical Engineering Report*, Alberta Apartments, 1485 and 5015 NE Alberta Street, Portland, Oregon 97211, dated December 11, 2015.

2) GeoPacific Engineering, Inc., *Recommendations for Micropiles*, 15th and Alberta Mixed Use, 1485 NE Alberta Street and 5011 NE 15th Avenue, Property ID: R674499, Tax Lots: 1481-1485, Portland, Oregon, Revised May 21, 2018.

3) GeoPacific Engineering, Inc., Response to BDS Checksheet Dated March 19, 2019, Alberta Apartments, 1477 NE Alberta Street, Portland, Oregon 97211, dated March 21, 2019.

At your request, GeoPacific Engineering, Inc. (GeoPacific) has performed an evaluation of vertical settlement at the site. GeoPacific previously performed a geotechnical investigation of the site and provided recommendations for site development in the above-referenced report, dated December 11, 2015 (Reference 1). GeoPacific also provided recommendations for micropile foundation elements in the above-referenced report, revised May 21, 2018 (Reference 2). GeoPacific evaluated bending moments in the micropile elements in the above referenced report, dated March 21, 2019 (Reference 3).

In our previous evaluation of bending moments we conservatively assumed that the concrete footing supported by the micropiles would deflect laterally 0.10 inches for mobilizing sliding friction in a seismic event. In our report we concluded that the permanent steel casing installed to a depth of 4.5 feet below the footing was deep enough to resist the bending moments. Further, we concluded that bending moments below the steel casing were less than the cracking moment of the micropile grout body and are therefore insignificant.

14835 SW 72nd Avenue
Portland, Oregon 97224

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The City of Portland BDS plan reviewer has since asked us to consider the hypothetical consequences if the ten micropiles to be utilized at gridlines G.2-J.5/1 were to fail due to excessive lateral deflection of the concrete footing. In this case, even if the micropiles were to completely fail, the concrete footing would remain supported by native medium dense sand and very dense gravel with a layer of compacted base rock at the ground surface. When GeoPacific visited the site on February 26, 2019, we observed that the base rock within about 12 inches of the ground surface around the micropiles at gridlines G.2-J.5/1 had been compacted to a very dense and unyielding state.

In order to satisfy the concerns of the City of Portland, we estimated the amount of vertical settlement which could occur in the hypothetical event of the micropiles failing due to excessive deflection of the concrete footing. Our analysis of vertical settlement was performed using the Skempton method and the subsurface data obtained during our exploration of the site and construction monitoring. We assumed a bearing pressure of 3,000 psf based on loading information provided by the project structural engineer. The results of our calculations are shown on Table 1.

Table 1 – Results of Vertical Settlement Analysis for the Footing at Gridlines G.2-J.5//1

Depth (ft)	SPT Blow Count	Cummulative Settlement (in)
1	60	0.08
2	15	0.37
3	15	0.64
4	15	0.85
5	60	0.90
6	60	0.92
7	60	0.94
8	60	0.94
9	60	0.94
10	60	0.94
15	60	0.94
20	60	0.94

As shown on Table 1, if the concrete footing at gridline G.2-J.5/1 were to hypothetically lose all support from the micropiles, we estimate that the vertical settlement of the footing would be 0.94 inches. Vertical settlement of 1 inch or less is compatible the amount of settlement anticipated for concrete footings adjacent to the pile-supported footing at gridline G.2-J.5/1, as presented in our initial geotechnical engineering report for the site (Reference 1) and accepted by the project structural engineer. Therefore, it is our opinion that the estimated vertical settlement of less than 1 inch would not cause significant damage to the building and would not pose a life-safety risk.

UNCERTAINTIES AND LIMITATIONS

Within the limitations of scope, schedule and budget, GeoPacific attempted to execute these services in accordance with generally accepted professional principles and practices in the fields of geotechnical engineering and engineering geology at the time the report was prepared. No warranty, expressed or implied, is made. The scope of our work did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous or toxic substances in the soil, surface water, or groundwater at this site.

We appreciate this opportunity to be of service.

Sincerely,

GEOPACIFIC ENGINEERING, INC.

REGISTERED PROFESSIONAL
ENGINEER
90013PE
OREGON
MAY 22, 2015
BENJAMIN G. ANDERSON
Expires: 12/31/19

Benjamin G. Anderson, P.E.
Project Engineer