

RAFTERY CRE, LLC

CONSTRUCTION AND REAL ESTATE CONSULTING SERVICES

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Revised May 4, 2018

Ken Barnes, MAI, CRE
McKee Appraisal
1200 Sixth Avenue, Suite 1805
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Subject: Alderwood South property foundation considerations based on geotechnical considerations as described by Geo Engineers in their report dated January 5, 2018

Dear Ken,

Thank you for asking me to assist you in evaluating the foundation improvements as proposed by Katerra in their letter to the Wolff Company and described in Geo Engineers report dated January 5, 2018. Katerra has proposed a pin pile and grade beam system to support a series of proposed buildings at the Alderwood South site located at 2927 Alderwood Mall Boulevard in Lynnwood, Washington.

The pin pile and grade beam system is one approach of four general solutions described in the geotechnical report to deal with and mitigate the consequences of building on site where liquefiable soils are present. Settlements of up to 5 inches could occur in a seismic event. Geo Engineers, in their report, identifies that approximately half the site is potentially subject to liquefaction.

RECOMMENDATIONS OF THE GEOTECHNICAL ENGINEER

The geotechnical engineer recommends four possible options for foundation construction in the areas subject to liquefaction.

1. Shallow foundations bearing on improved ground
2. Pin piles
3. Shallow foundations bearing on partial or full-depth removal and replacement of potentially liquefiable soils
4. Shallow foundations where permanent lowering of the perched ground water level has been lowered.

These options are listed on page 3 of the report. It goes on to rank the options as conservative, moderately conservative and less conservative.

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The Katerra quotation to Wolff addresses the use of a pin pile and grade beam system to provide foundation support to the buildings. This approach falls under the conservative approach, and certainly meet the recommendations of the engineer to mitigate the issues of soil liquefaction. The estimated cost is listed as **\$1,271,492**.

Other potentially workable options include fully excavating and replacing the liquefiable soils with competent fill, improving the ground using stone columns or rigid inclusions, both are conservative approaches, or soil improvement by soil mixing, a moderately conservative approach. Any of these options are potentially be less expensive than the pin pile solution, with the exception of full excavation, and still meet the requirements described in the Geotech report.

1. Excavate to full depth to glacial till. Approximately 31,000 cubic yards of material would need to be excavated and replaced with competent material. The estimated cost for this is option is **\$1,522,000**.
2. Excavate six feet below bottom of footing. Approximately 18,266 cubic yards of material would need to be excavated and replaced with competent material. The estimated cost is **\$915,000**.
3. Amend the soil across the building area to 6 feet depth. 68,500 sf * \$1.35/12" d per foot, or $68,500 * (\$1.35 * 6) = \$554,850$. Allowance for dewatering and erosion control \$100,000. Total = **\$654,840**
4. Install rigid inclusion piles in a 12' x 12' grid pattern at Buildings 2, 6, 7 & 9. Amend soil for conventional/shallow footings at other building pads. 30" diameter rigid inclusions per the KPFF drawing with 12" slab and thickened edge at four buildings. 86 piles/building to a depth of 18 feet at four buildings for a total of 6192 L.F. At \$69/foot = \$427,248. The structural slab with thickened edge over 12" capillary layer require 306 c.y. per building or 1224 cy overall * \$275/cy = \$336,600. Total for four buildings = \$736,248
Amending the soil for shallow foundations and conventional slabs at the other building pads requires soil amendment of 40,660 square feet of building pad. At \$1.35/foot of depth * 3 feet = \$4.05 per square foot or an additional \$164,673 to complete the site prep work for the structures. The total probable cost for this option is **\$900,921**.

Northwest Construction, Ground Up and Malcolm Drilling were consulted for feasibility and cost information for each of these options

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The probable costs associated with the rigid inclusion pile scenario is the lowest cost that fits within the conservative recommendations of the geotechnical engineer. While amending the soil to strengthen it is the lowest cost option, without further engineering work that may involve more geotechnical analysis it is a less conservative option, though it certainly is a potential solution. Some soil amendment, perhaps to a shallower depth, may have some advantages in minimizing settlements at sidewalk or promenade areas.

Thank you for the opportunity to review this material. If you have any questions please call me.

Very truly yours,
Raftery CRE, LLC



Chris Raftery
Managing Partner