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922 NW 11th AVE.
1N1E 34 BC 01200
2929/4

99485.71
June 19, 2002

Hoyt Street Properties, LLC
809 N.W. 11th Avenue
Portland, Oregon 97209

Attn: Mr. Jim Mitchell, Project Manager

Re: Observations of Driven Grout Pile Tests
Block 5, Hoyt Street Properties
Portland, Oregon

01-168323-CO

Dear Mr. Hardt:

This report presents a summary of our field observations and analysis in connection with the 16-inch diameter driven grout pile load tests on Block 5, Hoyt Street Properties in Portland, Oregon. A total of two pile load tests were conducted, one for compression, and the other for uplift. We understand that the current structural design plans show that the proposed building is supported by closed-end steel pipe piles. The significant portions of piles are required to be driven into the very dense lower sandy gravel layer to obtain 245 kips of compression and 80 kips of tension. The purpose of the pile load tests is to install 16-inch diameter driven grouted piles in to the upper dense to very dense sandy gravel layer to obtain the above required compression and tension. This letter presents our observations of the test pile installations and the load tests, and our engineering conclusions and recommendations based on the test results.

INSTALLATION OF TEST PILES

The test piles (TP) were installed on June 4 and 5, 2002. A total of five (5) test piles and four (4) reaction piles were installed. The locations of the test piles and reaction piles are shown on Figure 1, Test Pile Locations.

We understand that the top of the production piles will be about 15 feet below the existing ground surface. Also, the subsurface explorations suggested that a layer of potential liquefiable soil extends to about depths 20 to 38 feet from the existing ground surface. In order to model the future production piles and to reduce the skin friction on the upper section of the test pile, all test piles were installed with the top 21 feet of the piles cased in 16-inch diameter steel pipes. The details of the pile installations are described in the following paragraphs.

Driving: A single-acting air hammer, VULCAN-512, was used to install the piles. The rated maximum driving energy of the hammer is 60,000 ft-lbs. The piles were installed by driving a mandrel (steel casing) with a 2-foot long closed-end steel driving boot to the designated depths. The steel casing supports the soil while concrete is pumped into it under pressure and the mandrel is slowly withdrawn from the ground.

During pile installations, the mandrel penetration resistance (blows per foot) was observed and recorded for all piles. The pile driving records are enclosed as Attachment A. As shown in Attachment A, the test piles were driven to depths ranging between 45 and 54 feet from the existing ground surface, which is equivalent to the design depths of 30 to 39 feet below the production pile cap. Review of the pile driving records of test piles indicated that the test pile, TP-4, has the lowest last set of 20 blows/foot, equivalent to 5 blows per last 3 inches, as well as low driving resistance profile. As a consequence, the test pile, TP-4, was selected for both compression and tension load tests. In addition, four about reaction piles (RP) were installed to about 50 feet for conducting the pile compression load test.

Grouting: The installed concrete grout volume for test piles, TP-1 through TP-5, vary between 72 to 88 pump piston strokes. The piling contractor states that each stroke of the pump injects 1.1 cu.ft. of grout. Therefore, the measured grout volumes are about 125 to 132 percent of the theoretical pile volumes. This is above the stated industry standard, which specifies a minimum volume of 115 percent of the theoretical volume.

Steel Rebar and Steel Cage: A 30-foot long steel cage was installed into each of the test piles. Also, 1 3/8-inch diameter steel rebar was inserted into the bottom of each pile. In addition, a 1 3/8-inch diameter rebar was installed in each reaction pile.

OBSERVATION OF PILE LOAD TESTS

The pile tests were conducted on June 13 and 14, 2002, by Precision Measurements, Inc. A pile load test measurement report from Precision Measurements, Inc. is enclosed as Attachment B. An engineer from Squier Associates present during testing verified that the test equipment, set-up, and procedures were in general accordance with applicable standard practice. The following briefly describes the compression and tension load testing set-up and procedures.

Compression Load Testing: The static axial compressive load testing was set up and performed in general accordance with ASTM D1143-81, Standard Method for Piles Under Static Axial Compressive Load, and is described as follows:

Four hydraulic jacks acting against an anchored reaction frame were used to apply compression loading to the test pile. The jacks, supported on a steel plate affixed to the test pile, exerted loading in increments of about 15 percent of 150 tons. Load application was resisted by the test beam weight, as well as by four reaction piles. A load cell placed on top of the hydraulic jack was used to measure applied loads and was supported against a 2-inch-thick steel plate welded to the test beam.

The load reaction frame included a main steel beam supported by timber cribbing on either side, supporting shorter steel cross-beams, tied to reaction piles to either side of the test pile. Test beam set-up and anchoring were typical for both compression and tension load testing. Four dial gauges mounted at each corner of the top test plate of the test pile were used to monitor displacements of the test pile at intervals in general accordance with the Quick Load Test Method for Individual Piles (Section 5.6, ASTM D1143-81). Movement of about 0.842 inches was measured at 300 tons. About 57 percent of the deflection appears to have been due to elastic strains, since the measuring apparatus returned to about 0.362 inches at completion of the unloading cycle.

Tension Load Testing: Test pile TP-4 was loaded in tension to 200 percent of 50 tons in general accordance with the Standard Test Method for Individual Piles Under Static Axial Tensile Load, ASTM D3689-90.

One hydraulic jack was used in the tension load test. A 2-inch thick test plate was welded in position on the top side of the test beam for support of the hydraulic jacks. Two (2) displacement dial gauges were attached on either side of the test pile. Readings were taken in general accordance with ASTM D3689 standards under the Quick Load Test Method for Individual Piles (Section 7.7). The jack exerted loading in increments of about 15 percent of 50 tons. Movement of about 0.334 inches was measured at the maximum test load, 100 tons. About 43 percent of the deflection appears to have been due to elastic strains, since the measuring apparatus returned to about 0.189 inches at completion of the unloading cycle.

CONCLUSIONS AND RECOMMENDATIONS

The compression and uplift pile load test results are presented on Figures 2 and 3, respectively. As shown on Figure 2, Davisson Pile Failure Criteria indicated that the ultimate compression of the test pile is 290 tons. Figure 3 shows that the uplift test piles did not failed. However, the maximum uplift test load, 100 tons, in our opinion is close to the failure load. Based on our observations and analysis, we believe that the driven grout test piles were constructed in general conformance with current engineered construction practice. Measured grout volumes indicate grout volumes were in accordance with currently accepted industry practice. Based upon our engineering analyses and evaluations under considerations of the static pile load tests and the potential pile performance on seismic loading conditions, we recommend that the design compression capacity of 125 tons (250 kips) be assigned for the test pile TP-4, with factor of safety of 2.0. Under seismic loading conditions, the above allowable compressive capacity can be increased up to 33 percent with the lower factor of safety, 1.5. The design seismic uplift capacity of 40 tons (80 kips) is recommended for the test pile TP-4, with factor of safety of 1.5. In our current opinion, if all production piles are constructed following the same procedures and criteria as the test piles, the above seismic compression and uplift capacities can be used for the design of the proposed condominium buildings. In order to obtain the above seismic allowable uplift capacity of 40 tons, the minimum length of the production piles should be at least 32 feet. Recommendations for pile spacing and tolerance should follow our Block 5 foundation investigation report dated January 12, 2001. We should be retained to assist the Structural Engineer of Record to prepare the specification pile driving section based on the test pile driving and grout procedures and results.

If you have any questions regarding the above pile load tests and our engineering opinions, please do not hesitate to call.

Very truly yours,
Squier Associates, Inc.

by ______________________________
Risheng Piao, P.E.
Project Engineer

RP/AHR/SB/ph

Encl: Figures 1 through 3
Attachments A and B

cc: Gaafar Gaafar, Structural Engineer, KPFF

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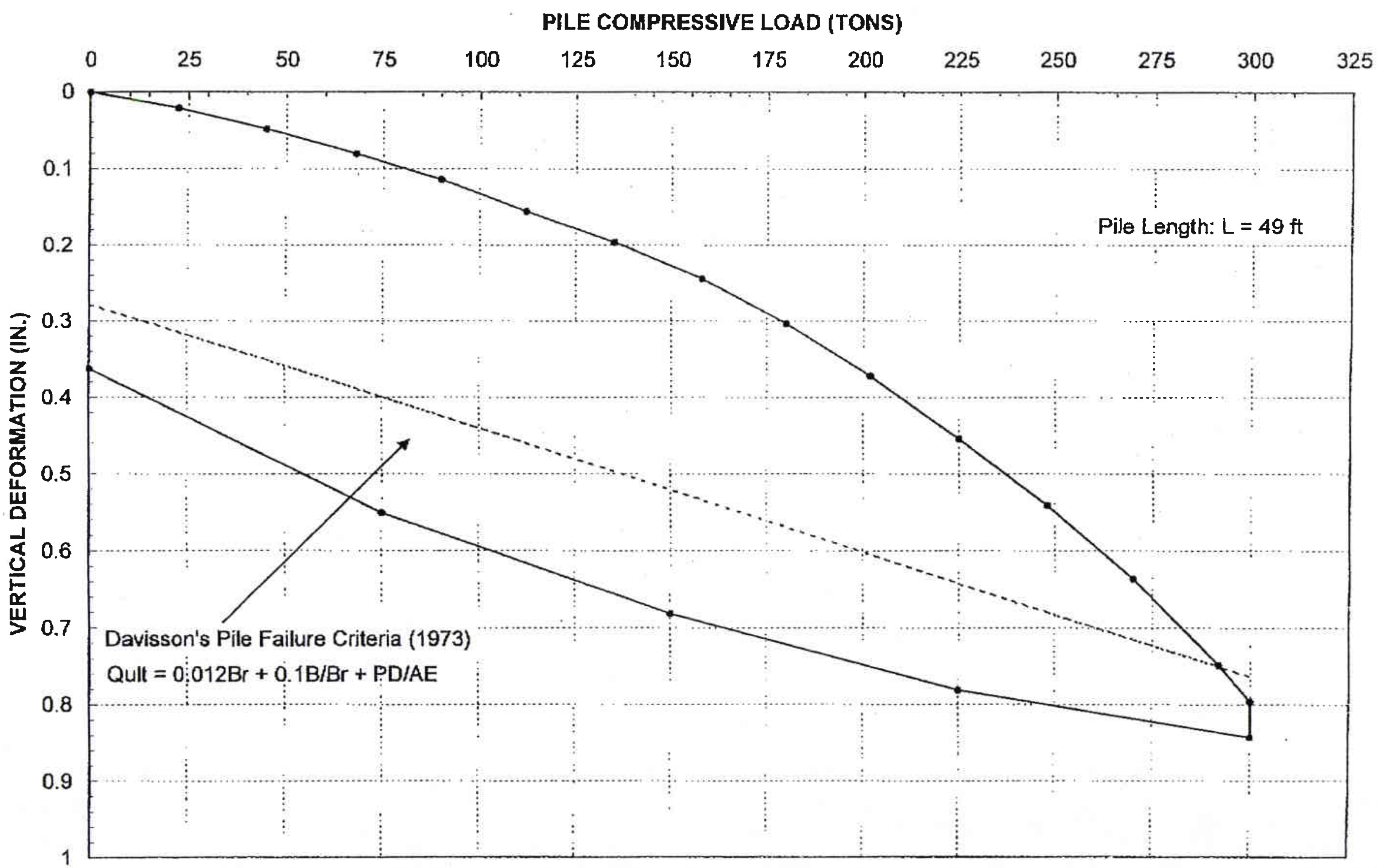
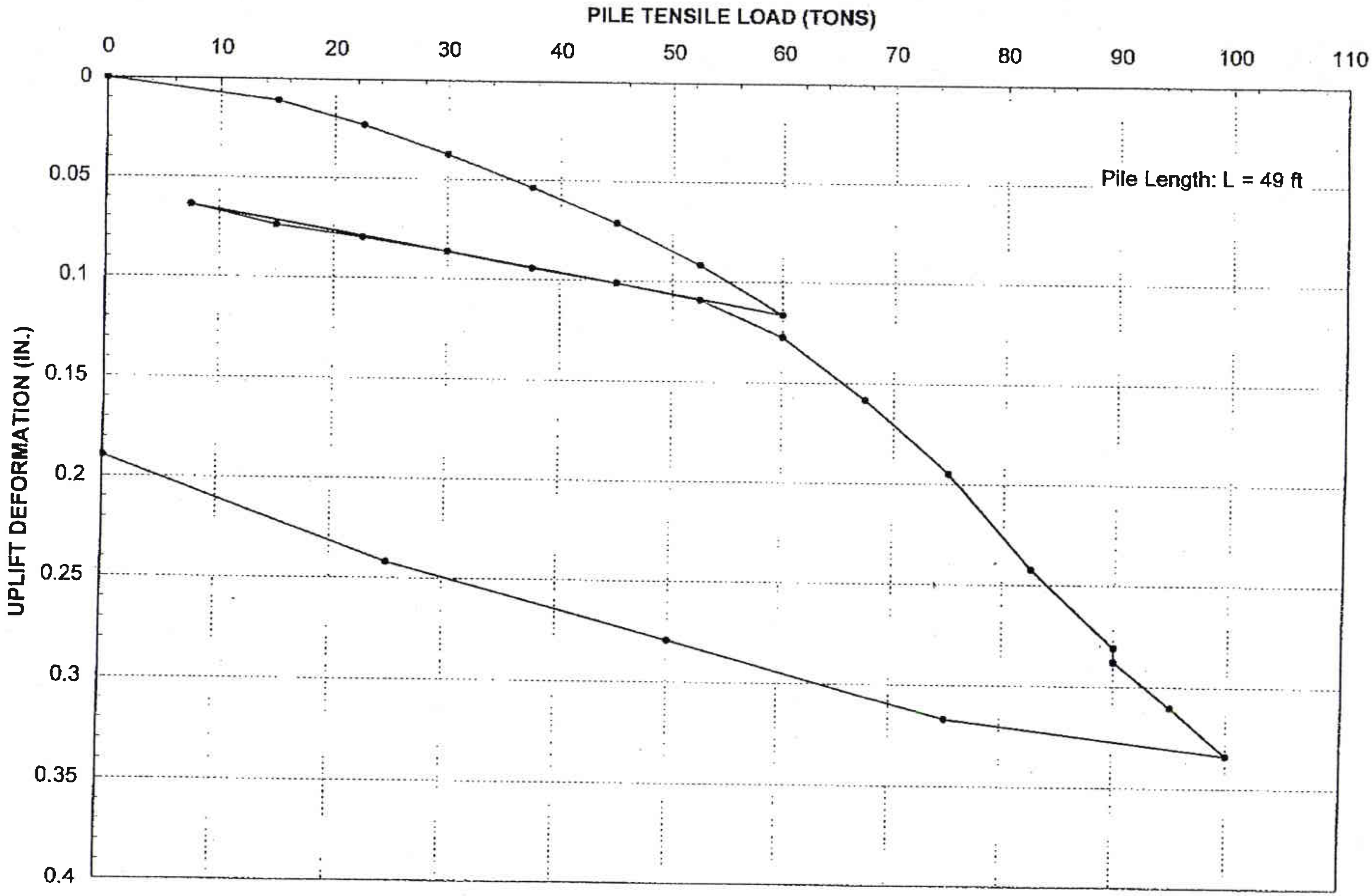
HOYT STREET BLOCK 5
16-INCH DIA. DRIVEN GROUT PILE COMPRESSIVE LOAD TEST



Compressive Load Test8/25/2005

FIGURE 2

HOYT STREET BLOCK 5
16-INCH DIA. DRIVEN GROUT PILE COMPRESSIVE LOAD TEST



Uplift Load Test8/25/2005

FIGURE 3