A Report for

Hobson Johnson & Associates

Geotechnical Evaluation
Proposed Simon Benson House
Portland State University
S.W. 9th Avenue and S.W. Montgomery Street
Portland, Oregon

Project No. EAXX-99-0133
Report No. 09-029-3031
February 12, 1999

BRAUN INTERTEC CORPORATION
February 12, 1999

Mr. Steve Ferrari
Hobson Johnson & Associates
610 S.W. Alder, Suite 910
Portland, Oregon 97205-3686

Dear Mr. Ferrari:

Re: Geotechnical Evaluation for the Proposed Simon Benson House, Portland State University, S.W. 9th Avenue and S.W. Montgomery Street, Portland, Oregon

The geotechnical evaluation you authorized on February 2, 1999, has been completed. The purpose of these services was to assist you, the architect and the engineer in designing foundations and preparing plans and specifications for construction of the new building. The evaluation was completed in general accordance with our Proposal No. EAAX-99-P171 and our Confirmation of Authorization for Services to you dated October 15, 1998.

Summary of Results

Two Standard Penetration Test (SPT) soil borings were completed in the proposed building area. The general soil profile was 12 inches of topsoil and fill underlain in turn by a medium stiff clayey silt extending to a depth of 8.5 feet. This clayey silt strata was in turn underlain by a medium dense silty fine grained sand extending to the maximum explored depth of 26.5 feet. The silty fine grained sand strata is known to extend to depths of several tens of feet. Groundwater was not observed in the explorations.

Summary of Recommendations

Based on the results of our soil test borings, it is our opinion that the proposed building can be supported on conventional shallow spread footings designed for a net maximum allowable bearing pressure up to 2,500 pounds per square foot when founded on the undisturbed clayey silt or silty fine grained sand stratum or on an engineered structural fill. After the proposed basement has been excavated to the planned subgrade, the concrete floor slab may be
placed over the clayey silt or silty fine grained sand stratum after the subgrade has been field verified to confirm its firmness.

General

Please refer to the attached report for a more detailed summary of our analyses and recommendations. If we can provide additional assistance, or observation and testing services during design and construction, please do not hesitate to contact us at (503) 289-1778 or 1(800) 783-6985.

Sincerely,

Joel W. Jeffery, RPG
Registered Geologist

Charles R. Lane, PE
Senior Engineer

Attachment: Geotechnical Evaluation Report
February 12, 1999

Geotechnical Evaluation
Proposed Simon Benson House
Portland State University
S.W. 9th Avenue and S.W. Montgomery Street
Portland, Oregon

1.0 Introduction

Braun Intertec Corporation (Braun Intertec) has conducted a geotechnical evaluation for the project site in general accordance with the scope of work as outlined in our proposal to Mr. Steve Ferrarini of Hobson Johnson & Associates dated October 15, 1998. Written authorization for our services was provided by Mr. Ferrarini dated February 2, 1999.

2.0 Project Description

We understand that present plans are to place an existing two-story residential-type structure upon the site. The building will be of wood frame construction with a finished concrete basement floor elevation some 6 to 8 feet below existing site grades.

3.0 Subsurface Investigation & Laboratory Examination

The purpose of our evaluation was to assess the subsurface soil conditions at the site in order to provide appropriate recommendations for site preparation and foundation design. In general, our evaluation included the following authorized scope of work items:
3.1 Subsurface Exploration

In order to ascertain soil conditions at the site, two Standard Penetration Test soil borings excavations were made using a truck-mounted hollow-stem power auger. Boring locations are shown in Figure 2 attached.

The Standard Penetration Test is performed by driving a 2-inch O.D. split-spoon sampler into the undisturbed formation at the bottom of the advanced auger with repeated blows of a 140-pound pin-guided mechanical hammer falling 30 inches. The number of blows required to drive the sampler one foot is a measure of the soil consistency. Samples were taken at 2.5 foot intervals in the first 15 feet and then at 5 foot intervals to the termination depths. Samples were identified in the field, placed in sealed containers and transported to the laboratory for further classification and testing.

State of Oregon Geotechnical Hole Reports were submitted to the Oregon Water Resources Department as required by OAR 690-240-035 for each geotechnical boring 18 feet or greater in depth. Copies of these reports are attached.

3.2 Laboratory Evaluation

Selected samples of the subsurface soils were returned to our laboratory for further evaluation to aid in classification of the materials and to help assess their strength and compressibility characteristics. The laboratory evaluation consisted of visual and textural examinations, moisture content determinations and gradation analysis. Results of the moisture content tests are shown on the attached Log of Borings. Other laboratory test results, including grain size distribution of the materials tested, are shown on Table A, attached.

3.3 Engineering Analysis

Engineering analysis and recommendations regarding general foundation design including allowable bearing pressures, minimum footing width and depth requirements and estimates of foundation settlement are included in this report. In addition, recommendations were developed addressing site preparation, placement and compaction of fill materials and site preparation of the floor slab areas.
4.0 Surface and Subsurface Features

Surface and subsurface features encountered at the time of our field services are described below.

4.1 Site Description

At the time of our field services, the project site comprised a grass-covered approximately 100 foot x 115 foot lot located adjacent to the southwest corner of the intersection of S.W. 9th Avenue and S.W. Montgomery Street on the Portland State University Campus. The site was bounded to the north by S.W. Montgomery Street, to the southward and west by multi-story apartment-type structures and to the east by south projection of S.W. 9th Avenue which serves as a campus walk-way. The surface grades within the north and east portion of the site stood near adjacent sidewalk grades but rose some 3 to 4 feet within the south and west portions.

4.2 Soils and Geology

Specific soil units encountered in the explorations are briefly discussed below.

**Topsoil** - Brown rootty clayey silt topsoil was encountered to a depth of 6 inches.

**Fill** - Brown clayey silt with crushed rock was encountered beneath the topsoil to a depth of 12 inches.

**Clayey Silt** - Brown with orange staining medium stiff to stiff, moist clayey silt was encountered to depths of 8.5 to 9 feet.

**Silty Sand** - Light brown, loose to medium dense silty fine grained sand was encountered to the maximum explored depth of 26.5 feet.

4.3 Groundwater

Groundwater was not encountered in our explorations.
4.4 Seismic Considerations

The site falls within seismic Zone 3 with a seismic zone factor of 0.3 as classified by the Uniform Building Code of 1997. Based on the local geology and the soil conditions encountered, the soil profile at the site is $S_0$ (Table 16-J of UBC). Our evaluation of the subsurface conditions at the site did not indicate a significant potential for soil liquefaction or landslide hazards associated with a seismic event at the site, or in the vicinity of the project site. However, it should be noted that a site specific seismic evaluation was beyond the present scope of services for this project. Such an evaluation could be performed at an additional fee with your written authorization.

4.5 Proposed Construction

We understand that present plans call for the placement of a two-story residential type structure on the site. The building will be of wood frame construction with a basement floor slab lying some 6 to 8 feet below existing site grades. Maximum continuous wall and columns loads are anticipated to be on the order of 3 to 4 kips per linear foot and 25 to 30 kips, respectively.

5.0 Conclusions and Recommendations

Based on the results of our field work, laboratory evaluation and engineering analysis, it is our opinion that the site is suitable for the proposed structure and associated improvements provided the following recommendations are incorporated into the design and construction of the project.

5.1 Site Preparation

In general, we recommend that all structural improvement areas be drained of surface water (pumping from a sump hole, if necessary), and stripped of surface vegetation, topsoil materials, highly saturated or disturbed soil, and any other deleterious materials encountered at the time of construction.

We envision that initial site preparation will consist of topsoil and fill soil stripping. We anticipate that topsoil and fill stripping and/or reworking of the surface soils to a depths of 6 to 12 inches may be required. Additional site preparation will depend upon the proposed site grades and the proposed building features.
All required structural fill materials placed in the building and pavement areas should be moistened or dried as necessary to near optimum moisture conditions and compacted by mechanical means to a minimum of 95 percent of the maximum dry density as determined in accordance with ASTM test method D-1557 (Modified Proctor). Fill materials should be placed in layers that, when compacted, do not exceed about 8 inches.

Placement of crushed rock should follow immediately after site grading to provide protection of the sensitive subgrade soils during construction activities. In traffic areas, the placement of a one-foot thick granular working base is generally recommended with thicker sections and/or geotextile fabrics recommended in heavily traveled areas. Generally, three to six inches of crushed rock is sufficient in foot traffic areas.

5.1.1 Site Preparation During Dry Weather Construction

During the dry season, prior to the placement of any fills, all exposed subgrade surfaces should be proofrolled with a loaded dump truck. Areas found to be soft or otherwise unsuitable for support of structural loads should be overexcavated and replaced with compacted fill as described below.

The on-site native soils could be considered for use as fill provided they are free from organic materials and debris and the work is performed during dry weather. However, it is anticipated these materials will have a moisture content in excess of optimum, except perhaps during the driest months of the year, and accordingly, will require drying to achieve compaction. Should wet weather grading be anticipated, the use of on-site soils as fill will be difficult. Selected samples of the material to be used for fill should be submitted to our laboratory in order to evaluate the maximum density, optimum moisture content, and the suitability of the soil for use as fill.

5.1.2 Site Preparation During Wet Weather Construction

The on-site native soils are highly moisture sensitive and thus will not be suitable as structural fill during wet weather construction. An all-weather, clean granular fill containing less than 5 percent material passing the No. 200 sieve, such as sand, crushed rock, or sand and gravel, is recommended in order to achieve compaction during wet weather grading operations. During wet weather grading operations, all excavations should be performed using a smooth bladed
tracked backhoe working from areas where material has yet to be removed or from the already placed structural fill. Subgrade areas should be cleanly cut to firm undisturbed soil.

Proofrolling of excavation bottoms is likely not appropriate during wet weather grading to avoid disturbance of moisture-sensitive soils. Should construction take place during wet weather, we recommend that a Braun Intertec representative be present to observe the subgrade to evaluate whether additional preparation is indicated.

5.2 Excavations

Excavation and construction operations may expose the on-site soils to inclement weather conditions. The stability of exposed soil may rapidly deteriorate due to precipitation or the action of heavy or repeated construction traffic. Accordingly, foundation and pavement area excavations should be adequately protected from the elements and from the action of repetitive or heavy construction loadings.

5.2.1 Construction Dewatering

Groundwater seepage in excavations should be anticipated during the wet season of the year. For most of the excavations for this project, pumping from sumps outside the limits of the excavation should control groundwater seepage and surface water ponding.

5.2.2 Excavations/Slopes

Temporary earth slopes may be cut near-vertical to heights of 4 feet. Excavations deeper than 4 feet should be performed in accordance with Department of Labor Occupational Safety and Health Administration (OSHA) guidelines for Type C soils. Job site safety is the responsibility of the project contractor.

5.3 Foundation Support

Based on the results of our geotechnical investigation, we recommend that in order to limit differential settlement, the structure should be supported on the undisturbed native clayey silt or silty fine grained sand or properly prepared structural fills placed on the clayey silt or silty fine strata using continuous and individual shallow spread footings. We recommend that continuous
and individual spread footings be designed for a net maximum allowable bearing pressure of 2,500 pounds per square foot (psf) with a minimum footing width of 16 inches and 2.5 feet square, respectively.

The allowable pressure of 2,500 psf is intended for dead loads and sustained live loads and can be increased by one-third for the total of all loads, including short-term wind or seismic loads. Continuous footings should extend to a minimum depth of 18 inches beneath the lowest adjacent exterior grade to provide frost protection.

If the footings are placed on structural fill, the compacted fill should extend laterally one foot away from the edges of the footings for each one foot of fill below the footings when placed adjacent to a downhill slope. They may be excavated near vertical where the surface soils extend out level some distance, therefore providing a confining soil pressure against the fill. This oversizing, where a downhill slope is adjacent to the footing, is important to provide sufficient lateral stability in the fill soils directly below the footings.

Allowable lateral frictional resistance between the base of footings and the subgrade can be expressed as the applied vertical load multiplied by a coefficient of friction of 0.30. In addition, lateral loads may be resisted by passive earth pressures based on an equivalent fluid density of 250 pounds per cubic foot (pcf) on footings poured "neat" against insitu soils or properly backfilled with structural fill. This recommended value includes a factor of safety of approximately 1.5, which is appropriate due to the amount of movement required to develop full passive resistance.

We estimate that foundations designed and constructed in accordance with the above recommendations will experience total settlements generally less than 1-inch and differential settlement between columns generally less than ¼-inch.

If the footings are constructed during wet weather, it may be necessary to protect the foundation excavation bottoms from disturbance during construction activities. In this regard, we recommend that a 3- to 4-inch thickness of crushed rock be placed at the bottom of the footing excavations immediately after the excavation is completed. If footings are constructed during the drier summer months, this crushed rock layer should not be required.
5.4 Floor Slab Support

The proposed concrete basement floor may be supported on structural fills placed over the undisturbed native silty subgrade after the planned excavations to subgrade have been conducted and the undisturbed silty subgrade has been field verified to confirm its firmness.

In order to provide uniform subgrade reaction beneath any proposed floor slab-on-grade, we recommend that floor slabs be underlain by a minimum of 6 inches of free-draining (a maximum size of 3/4 inch with less than 5 percent passing the No. 200 sieve) well-graded gravel or crushed rock base course. The base course material should be compacted to at least 95 percent of the maximum density obtainable by the ASTM D-1557 test procedure.

The crushed rock should provide a capillary break to limit migration of moisture through the slab. If additional protection against moisture vapor is desired, a vapor retarding membrane may also be incorporated into the design. Factors such as cost, special considerations for construction, and the floor coverings suggest that decisions on the use of vapor retarding membranes be made by the architect and owner.

5.5 Retaining Walls

Lateral earth pressures on walls which are not restrained at the top, such as retaining walls, etc., may be calculated on the basis of an equivalent fluid pressure of 35 psf for level backfill and 60 psf for steeply sloping backfill. Walls that are restrained from yielding at the top may be calculated on the basis of an equivalent fluid pressure of 55 psf for level backfill and 90 psf for steeply sloping backfill. Lateral loads may be resisted by passive pressures acting against footings and by frictional resistance between foundation elements and supporting soils. An equivalent fluid density of 250 pounds per cubic foot (pcf) and a friction factor of 0.30 may be used for design for foundations bearing on and resisted by native soils. The recommended equivalent fluid density includes a factor of safety of 1.5 which is appropriate due to the amount of movement required to develop full passive resistance.

All backfill for retaining walls, foundation walls, etc., should be select granular material (sand and/or sandy gravel). We anticipate that onsite material will not be suitable for this purpose and that it will be necessary to import material to the project for structure backfill.
All backfill behind walls should be placed in lifts not exceeding 6 inches in loose thickness and compacted to at least 90 percent of the maximum dry density obtainable by the ASTM D-1557 test procedure. Care in the placement of fill behind walls must be taken in order to insure that undue lateral loads are not placed on the wall.

5.6 Drainage Considerations

Any areas of the building which are to be developed below the exterior site grade must be provided with a well-designed drainage system in order to control hydrostatic pressures against walls, seepage of groundwater through basement walls, etc.

Under no circumstances should surface runoff water be led into foundation drains. Foundation drains should be placed at the base of the footings to prevent surface and shallow perched water from migrating beneath the footings.

Surface run-off from roofs, parking areas, etc., should be tied into the storm sewer or other approved disposal areas.

5.7 Pavement Recommendations

The following recommendations are presented as preliminary for your consideration. The civil engineer for the project may have more traffic and project design data available than is presently known and may wish to modify and refine these pavement sections. We will, upon request be pleased to provide a more detailed pavement design when definite traffic and building plans are available.

Prior to placing the base or leveling course the subgrade should be proof-rolled with a loaded dump truck to detect areas or pockets of unusually soft material. These should then be excavated and replaced with suitable compacted fill. A geotextile fabric (Manufacturer's and Brands: Mirafi 500X, Amoco CEF Style 2002, or an approved alternate) should be placed over all fine-grained soils (silts-clays) prior to the placement of base rock to prevent subgrade intrusion into the granular structural fill.
5.7.1 Asphalt Pavement

Based on our experience and using a design California Bearing Ratio (CBR) value of 4 to 10 for subgrade soils a designed life period of 20 years suggests the following pavement thicknesses. For entrance, truck and driveway areas, we assumed traffic would not exceed 25 equivalent 18-kip single axle loads (ESALs) per day. For car parking areas, we assumed 4 ESALs per day. If the anticipated traffic exceeds these values, we should be informed so that a specific pavement design is made for the project or the design can be modified by the site civil engineer.

A typical asphalt pavement section would be:

<table>
<thead>
<tr>
<th>Material</th>
<th>Entrance Service Roads</th>
<th>Car Parking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt Pavement (Ore. St. Class C)</td>
<td>4 inches</td>
<td>2 1/2 inches</td>
</tr>
<tr>
<td>Crushed Rock Base (Ore. St. Spec.)</td>
<td>12 inches</td>
<td>8 inches</td>
</tr>
</tbody>
</table>

Asphalt pavement base course materials should consist of well-graded 1 1/2-inch or 3/4-inch minus crushed rock, having less than 5 percent material passing the No. 200 sieve. The base course and asphaltic concrete materials should conform to the requirement set forth in the latest edition of the State of Oregon, Standard Specifications for Highway Construction. The base course material should be compacted to at least 95 percent of the maximum density as determined by the ASTM D-1557 test designation. The asphaltic concrete material should be compacted to at least 90 percent of the theoretical maximum density as determined by ASTM D-2041 (Rice Specific Gravity).

5.7.2 Concrete Pavement

We recommend that concrete pavement be designed for a modulus of subgrade reaction of 150 pci. A typical concrete pavement section would be:

<table>
<thead>
<tr>
<th>Material</th>
<th>Entrance Service Roads</th>
<th>Car Parking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Concrete (4,000 psi)  
Leveling Coarse  
(Sand or All-Weather Base)  

5.8 Construction Monitoring

We request that we examine and identify soil exposures created during project excavations in order to verify that soil conditions are as anticipated. We recommend that the structural fills be continuously observed and tested by our representative in order to evaluate the thoroughness and uniformity of their compaction. If possible, samples of fill materials should be submitted to our laboratory for evaluation prior to placement of fills on-site.

Costs for the recommended observations during construction are beyond the scope of this current consultation. Such future services would be at an additional charge.

6.0 General

Our conclusions and recommendations described in this report are subject to the following general conditions.

6.1 Use of Report

This report is for the exclusive use of the addressee and their representative to use to design the proposed structure described herein and prepare construction documents. The data, analyses and recommendations may not be appropriate for other structures or purposes. We recommend that parties contemplating other structures or purposes contact us. In the absence of our written approval, we make no representation and assume no responsibility to other parties regarding this report.

6.2 Level of Care

Services performed by the geologist and geotechnical engineer for this project have been conducted with that level of care and skill ordinarily exercised by members of the profession.
currently practicing in this area under similar budget and time restraints. No warranty, expressed or implied, is made.

We will be pleased to provide such additional assistance or information as you may require in the balance of the design phase of this project and to aid in construction control or solution of unforeseen conditions which may arise during the construction period.

Sincerely,

Joel W. Jeffery, RPG
Registered Geologist

Charles R. Lane, PE
Senior Engineer

Attachments: General Location Map
Site Map
Boring Logs
Laboratory Test Results, Table A
State of Oregon Geotechnical Hole Reports