GSH
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Geotechnical Consultants, Inc.

REPORT
GEOTECHNICAL STUDY
PROPOSED RETAIL BUILDING 'G' WITHIN DILLMAN SQUARE
EAST SIDE OF 700 EAST STREET AT APPROXIMATELY 12250 SOUTH
DRAPER, UTAH

Submitted To:

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Submitted By:

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November 20, 2006

Job No. 0109-002-06

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J.A. Swaney Corporation
P.O. Box 711226
Salt Lake City, Utah 84171-1226

Attention: Mr. John Swaney

Gentlemen:

Re: Report
Geotechnical Study
Proposed Retail Building 'G' within Dillman Square
East Side of 700 East Street at
Approximately 12250 South
Draper, Utah

1. INTROD UCTION

1.1 GENERAL

This report presents the results of our geotechnical study performed at the site of the proposed Retail Building 'G' within Dillman Square to be constructed on the east side of 700 East at approximately 12250 South in Draper, Utah. A layout of Dillman Square and Building 'G' with regard to adjoining streets is presented on Figure 1, Site Plan. The locations of the test pits excavated in conjunction with this study are also presented on Figure 1.

1.2 OBJECTIVES AND SCOPE

The objectives and scope of our study were planned in discussions between Mr. John Swaney of J.A. Swaney Corporation, and Mr. Bill Gordon of Gordon Spilker Huber Geotechnical Consultants, Inc. (GSH).

In general, the objectives of this study were to:

1. Accurately define and evaluate the subsurface soil and groundwater conditions across the site.

2. Provide appropriate foundation, earthwork, and pavement recommendations to be utilized in the design and construction of the proposed facility.

In accomplishing these objectives, our scope has included the following:

1. A field program consisting of the excavation and logging of two test pits.

2. An office program consisting of the correlation of available data, engineering analyses, and the preparation of this summary report.

It should be noted that approximately two years ago that this writer performed the geotechnical study for Building 'F,' which is located to the immediate north, for Mr. Swaney.

1.3 AUTHORIZATION

Authorization was provided by Mr. John Swaney of J.A. Swaney Corporation.

1.4 PROFESSIONAL STATEMENTS

Supporting data upon which our recommendations are based are presented in subsequent sections of this report. Recommendations presented herein are governed by the physical properties of the soils encountered in the exploration test pits, projected groundwater conditions, and the layout and design data discussed in Section 2., Proposed Construction, of this report. If subsurface conditions other than those described in this report are encountered and/or if design and layout changes are implemented, GSH must be informed so that our recommendations can be reviewed and amended, if necessary.

Our professional services have been performed, our findings developed, and our recommendations prepared in accordance with generally accepted engineering principles and practices in this area at this time.

2. PROPOSED CONSTRUCTION

The proposed retail building will be one level in height and have a footprint of approximately 9,600 feet. The long axis of the building will run north-south with the roof spanning the 60-foot width of the structure. Structural loads will be transmitted down from the roof to the east-west running perimeter bearing walls. At this time we project that the maximum wall loads will be on the 2.5 to 3.5 kips per lineal foot. As stated previously, no internal columns are anticipated. Subgrade floor slab loads will be typical with an average uniform loading projected to be on the order of 150 to 200 pounds per square. The structure will be primarily of masonry block construction.

Site development will require that a significant amount of structural site grading fill be placed across the area to achieve desired slab grade. In the center portion of the building it appears that approximately three to three and one-half feet of fill will be required.

3. FIELD PROGRAM

In order to define and evaluate the subsurface soil and groundwater conditions at the site, two test pits were excavated to depths of five and one-half and six feet with a rubber truck-mounted hydraulic backhoe provided by the general contractor. The approximately locations of the test pits are presented on Figure 1.

The field portion of our study was under the direct control and continual supervision of an experienced member of our geotechnical staff. During the course of the excavation operations, a continuous log of the subsurface conditions encountered was maintained. The soils were classified base upon visual and textural examination. Tabulated logs of the subsurface conditions encountered are presented in Section 4.2. The soils were classified in accordance with the nomenclature described on Figure 2, Unified Soil Classification System.

Following completion of excavating and logging, each test pit was backfilled. Although an effort was made to compact the backfill with the backhoe, backfill was not placed in uniform lifts and compacted to a specific density. Consequently, settlement of the backfill with time is likely to occur.

4. SITE CONDITIONS

4.1 SURFACE

The site at the time of our field study was essentially open and undeveloped. Curbs for the parking areas to the east and south had and were being installed. Roadways and parking areas will be in these areas. To the north are a sidewalk, a small landscaped area, and pavements associated with the Retail Building 'F'. To the west a very significant irrigation canal which flows in a south-to-north direction. The canal is about 15-feet wide and easily 5 to 8-feet deep. At the time of our field study about four to six inches of water was flowing.

Filling has taken place within the proposed building footprint areas. It appears that two episodes of filling occurred. The first appears to have consisted of the placement of a fairly uniform one to one and one-half-foot layer of silty clay/clayey silt with some sands, gravels, and occasional pieces of construction debris. More recently, additional fills to a thickness of one to one and one-half feet or so have been placed around the north, east, and south sides of the building footprint. These fills taper down in thickness towards the center were the first zone of fill is present at the surface. Relief across the present footprint due to the previous filling operations is projected to be three to possibly three and one-half feet. In the lower areas, about three and one-half or more feet of fill will be required to achieve desired grades.

It should be noted that the areas to the north, east, and west have been built up with structural fills. The terrain to the immediate west outside the building footprint consists of the natural soils leading to the eastern side of the canal. Vegetation is essentially non-existent. There is,

however, one fairly large tree just outside the building footprint at the northwest corner. In the areas adjacent to the canal vegetation consists of a short growth or grasses and weeds.

4.2 SUBSURFACE SOIL AND GROUNDWATER

Test Pit TP-1 was excavated in the lower northern end of the lower central portion of the site.

TEST PIT 1	
Depth (feet)	**Description**
0.0 to 1.5	Silty Clay/Clayey Silts with some gravels and occasional pieces of construction debris: grayish-brown, FILL – CL/ML – medium stiff – moist
1.5 to 6.0	Clayey Silts with some fine sands – medium stiff – moist grading to very moist
	Slight sidewall caving from 0.0 to 4.0 feet. Topsoil zone not observed between the natural soils and fills. Four-inch PVC pipe encountered at the base of the excavation. Backhoe operator stated that it looked to be a sewer line lateral.

Test Pit TP-2 was excavated in the southern portion of the lower portion central area of the site.

TEST PIT 2	
Depth (feet)	**Description**
0.0 to 3.0	Silty Clay/Clayey Silts with some construction debris – CL/ML – "very loose" – dry
3.0 to 5.5	Clayey Silts with some fine sands – ML – medium stiff – moist to very moist
	Also hit a four-inch diameter pipe in this excavation slight below natural grade. This could either be a drain line and/or another sewer lateral.

The more recently placed fills which were not encountered at the test pits are gray in color and consist of silty and clayey sands and gravels. These soils were end-dumped and spread without compactor effort. The older underlying fills are mostly silty clays and clayey silts and again do not exhibit characteristics of compacted material. In Test Pit TP-2, the soils to a depth of two feet are very dry and loose. All of the fills must be considered as non-engineered and will exhibit extremely variable and generally very poor engineering characteristics. The upper couple feet of the natural soils are medium stiff to stiff and moist and will exhibit moderate strength and compressibility characteristics. With greater depth, the soils grade very moist to near saturated and in this lower zone will exhibit lower strength and higher compressibility characteristics.

The static groundwater table was not determined in conjunction with this study, but appears to be approximately seven to eight feet below existing site grade.

5. DISCUSSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

By far, the most significant geotechnical aspect of the site is the non-engineered fill that appeared to range in thickness from approximately one and one-half feet in the lower central and central-western portion of the site to as much as three and one-half to four feet around the north, south, and east perimeters. These soils are variable in composition and are projected to exhibit extremely variable and in many cases very poor engineering characteristics. These soils are totally unsuitable for support of foundations. In proposed floor slab and outside perimeter flatwork area as much as two feet of non-engineered fill may remain provided that the surface is properly prepared and overlain by at least 18 inches of structural fill.

In the following sections, detailed discussions pertaining to earthwork, foundations, floor slabs, pavements, and the geoseismic setting of the site are provided.

5.2 EARTHWORK

5.2.1 Site Preparation

Preparation of the site must include the removal all except a maximum of two feet of non-engineered fill within an areas extending out a minimum of five feet beyond the perimeter of the structure. A maximum of two feet of existing fill may remain provided that it does not contain deleterious materials, is properly prepared, and ultimately overlain by at least 18 inches of structural fill. Preparation will consist of proofrolling by running moderate-weight rubber tire-mounted construction equipment uniformly over the surface continuously at least three times. If any suitable soils are encountered, they must be removed to a maximum depth of two feet and replaced with compacted granular structural fill. Subsequently the site may be brought to desired grade utilizing structural site grading fill properly placed and compacted. All non-engineered fills must be removed from beneath proposed footings.

During initial preparation, exact locations and functions of the plastic lines that were encountered in both of the test pits must be evaluated. If these are of active systems, they must be abandoned and/or appropriately relocated. If these systems are inactive, they may remain in place without further activity considering there depth below the proposed structure.

5.2.2 Excavations

Temporary construction excavations not exceeding four feet in depth above or below the water table in predominantly cohesive soils may be constructed with near-vertical sideslopes. Deeper excavations up to eight feet again in the cohesive soils above or below the water table may be

constructed with sideslopes generally not exceeding one-half horizontal to one vertical. If more granular soils are encountered, flatter sideslopes will be required.

All excavations must be inspected periodically by qualified personnel. If any signs of instability are noted, immediate remedial action must be initiated.

5.2.3 Structural Fill

Structural fill will be required as site grading fill, as backfill over foundations and utilities, and as replacement fill below footings. All structural fill must be free of sod, rubbish, construction debris, frozen soil, and other deleterious materials.

Structural fill placed below a below a level one foot above the water table at the time of construction and/or to stabilize soft subgrade should consist of a mixture of clean coarse gravels and cobbles and/or one and one-half to two-inch clean gap-graded crushed angular gravel.

The maximum particle size with structural site grading fill should generally not exceed four inches; although, occasional larger particles, up to six to eight inches may be incorporated provided that they do not result in "honeycombing" or preclude the obtainment of the desired degree of compaction. In confined areas, other than for the stabilizing materials, the maximum particle size should generally not exceed two and one-half inches.

Considering the time of year and the requirement of controlling moisture content within 1 to 2 percent of optimum, it is our recommendation that structural fill utilized in the upcoming construction period be granular soils. A significant portion of the non-engineered fills presently blanketing the site are fine-grained soils and in our opinion will be extremely difficult to maintain within a proper moisture range and to be utilized as structural fill at this time of year.

5.2.4 Fill Placement and Compaction

Coarse gravel and cobble mixtures and/or the coarser clean gap-graded gravel should be end-dumped, spread to a maximum loose lift thickness of 15 inches, and then compacted by dropping a backhoe bucket uniformly over the surface continuously at least three times. As an alternative, these coarse granular soils may be compacted by running vibratory compactors over the surface continuously at least three times.

All subsequent lifts of fill should be placed in loose lift thicknesses no greater than eight inches. The first lift should be properly "worked into" the underlying open graded gravels and cobbles so that long-term infiltration and subsidence does not occur. All structural site grading fill should be compacted to at least 95 percent of the maximum dry density as determined by the AASHTO[1] T-180 (ASTM[2] D-1557) compaction criteria.

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1 American Association of State Highway and Transportation Officials
2 American Society for Testing and Materials

Prior to the placement of structural site grading fill, the existing subgrade soils must be prepared as discussed in Section 5.2.1, Site Preparation, of this report. In confined areas, subgrade preparation should consist of the removal of all loose or disturbed soils.

5.2.5 Utility Trenches

All utility trench backfill material below structurally loaded facilities (flatwork, floor slabs, roads, etc.) should be placed at the same density requirements established for structural fill. If the surface of the backfill becomes disturbed during the course of construction, the backfill should be proofrolled and/or properly compacted prior to the construction of any exterior flatwork over a backfilled trench. Proofrolling may be performed by passing moderately loaded rubber tire-mounted construction equipment uniformly over the surface at least twice. If excessively loose or soft areas are encountered during proofrolling, they should be removed to a maximum depth of two feet below design finish grade and replaced with structural fill.

Most utility companies and City-County governments are now requiring that Type A-1 or A-1a (AASHTO Designation – basically granular soils with limited fines) soils be used as backfill over utilities. These organizations are also requiring that in public roadways the backfill over major utilities be compacted over the full depth of fill to at least 96 percent of the maximum dry density as determined by the AASHTO T-180 (ASTM D-1557) method of compaction. We recommend that as the major utilities continue onto the site that these compaction specifications are followed.

Fine-grained cohesive soils are not recommended for use as trench backfill.

5.3 SPREAD AND CONTINUOUS WALL FOUNDATIONS

5.3.1 Design Data

The proposed structure may be supported upon conventional spread and continuous wall foundations. Present grading plan and the existing non-engineered fills are such that all of the footings will be underlain by a minimum of 18 inches of granular structural fill extending to suitable natural soils. For this design condition, the following parameters are provided:

Minimum Recommended Depth of Embedment for Frost Protection	- 30 inches
Minimum Recommended Depth of Embedment for Non-frost Conditions	- 15 inches
Recommended Minimum Width for Continuous Wall Footings	- 18 inches

Minimum Recommended Width for Isolated Spread Footings	- 24 inches
Recommended Net Bearing Pressure for Real Load Conditions	- 2,000 pounds per square foot*
Bearing Pressure Increase for Seismic Loading	- 50 percent

* This assumes that all footings will be underlain by a minimum of 18 inches of granular structural fill.

The term "net bearing pressure" refers to the pressure imposed by the portion of the structure located above lowest adjacent final grade. Therefore, the weight of the footing and backfill to lowest adjacent final grade need not be considered. Real loads are defined as the total of all dead plus frequently applied live loads. Total load includes all dead and live loads, including seismic and wind.

5.3.2 Installation

Under no circumstances should the footings be underlain by loose or disturbed soils, sod, rubbish, construction debris, non-engineered fills, frozen soil, or other deleterious materials. When unsuitable soils are encountered, they must be removed and replaced with compacted granular structural fill. Granular soils that become loose or disturbed must be recompacted to the requirements for structural fill.

The width of structural replacement fill should be equal to the width of the footing plus one foot for each foot of fill thickness.

5.3.3 Settlements

Settlements of foundations designed and installed in accordance with the above recommendations and supporting loads as discussed in Section 2., Proposed Construction, should generally be in the range of three-eighths to one-half of an inch. Settlements will occur rapidly with approximately 50 to 60 percent of the quoted settlement occurring during construction.

5.4 AT-GRADE SLABS

At-grade slabs within the building area should be underlain by a minimum of four inches of "free-draining" granular material, such as one-half to three-quarter-inch minus clean gap-graded gravel. This will act as a capillary break and reduce the tendency of the at-grade slabs to become damp. The gravels may be placed upon structural fill extending to properly prepared existing fills or natural soils. Settlements of the at-grade floor slabs are not anticipated to exceed one-

quarter of an inch. For outside flatwork, the four inches of "free-draining" granular materials may be replaced with aggregate base.

As previously stated, no more than two feet of non-engineered fills may remain beneath the at-grade slabs. These fills must not contain deleterious materials and must be properly prepared prior to the placement of structural site grading fill. Settlements of at-grade slabs should generally not exceed one-quarter to three-eighths of an inch.

5.5 LATERAL RESISTANCE

Lateral loads imposed upon foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footings and the supporting soils. In determining frictional resistance, a coefficient of 0.42 should be utilized. Passive resistance provided by properly placed and compacted granular structural fill above the water table may be considered equivalent to a fluid with a density of 300 pounds per cubic foot. Below the water table, this granular soil should be considered equivalent to a fluid with a density of 150 pounds per cubic foot.

A combination of passive earth resistance and friction may be utilized provided that the friction component of the total is divided by 1.5.

5.6 PAVEMENTS

Pavements in the adjoining parking lots consist of:

2.5 inches	Asphalt concrete
6.0 inches	Aggregate base
Over	At least 18 inches of granular structural fill

Granular structural site grading fill may be placed on suitable natural soils or properly prepared existing non-engineered fill. Preparation should be as discussed in Section 5.2.1, Site Preparation.

5.7 GEOSEISMIC SETTING

5.7.1 General

Utah municipalities have adopted the International Building Code (IBC) 2003. The IBC 2003 code determines the seismic hazard for a site based upon regional mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class (formerly soil profile type). The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points). In