Soils Tests

SUBSOIL INVESTIGATION

PROPOSED MULTI-UNIT DEVELOPMENT

SNAKE RIVER VILLAGE

DALY/POLAND PROPERTY

A PORTION OF H.E.S. 110

BASE II

SUMMIT COUNTY, COLORADO

PREPARED FOR:

NORSE INC.

INTERNATIONAL MARKET SQUARE

275 MARKET

MINNEAPOLIS, MN 55405

ATTN: PETER STALLAND

PREPARED BY:

SUMMIT SOILS

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JOB NO. 95057

AUGUST 10,1995

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GENERAL

This report presents the results of a subsoil investigation conducted at the site of the proposed townhome development to be located on Daly/Poland Property, a Portion of H.E.S. 110, Base II, Summit County, Colorado, to be known as Snake River Village.

The investigation was made to determine the best types and depths of foundations, allowable soil bearing pressures, ground-water conditions, and any special precautions which should be taken in the design or construction of the buildings due to the soil and ground-water conditions.

The conclusions and recommendations presented are based on the data gathered during the site investigation, and on our experience with similar soil conditions.

PROPOSED CONSTRUCTION AND SITE CONDITIONS

The proposed buildings will be two story wood frame structures, consisting of eight buildings for a total of 49 units. Foundation construction is to be reinforced concrete, with concrete stem walls, slab on grade with no below grade habitable space. Attached garages are assumed.

The site is bounded on the north by open space and then Colo. Hwy. 6, Keystone property to the east and Frostfire development to the south and the Snake River Saloon and Cinnamon Ridge Townhomes to the west. The property is triangular in shape with the apex to the west. The east area is open grass and sage, with the northeast moderately treed with pines. Partial open space and residences occupy a pocket in the center of the eastern end at the base of the triangle.

SUBSOIL CONDITIONS

On August 2, 1995, seven test pits were excavated on the property, with each pit located in a proposed building site. The foundation soils encountered were consistent and were dense sandy gravels. No ground water was encountered in any of the pits.

The foundation soils encountered are non-expansive and are considered excellent foundation and slab support material.

FOUNDATIONS

The buildings should be founded on conventional spread footings that are

placed on the natural undisturbed sandy gravels and designed for a maximum soil bearing pressure of 4000 PSF, with a minimum width of sixteen inches for continuous footings and minimum pad width of eighteen inches. The estimated settlement or movement is one-half inch with a maximum differential of one-half of an inch. Local frost codes should be followed for depth below final grade.

INTERIOR FLOOR SLAB CONSTRUCTION

The natural lower soils that will support slabs are stable. However, the builder should realize that irregularities resulting in excavation may require backfill to provide a level subgrade. The backfill may consist of onsite excavated soils compacted to a minimum density of 90% ASTM D-698.

To minimize any possible damage that could be caused by movement, the slabs should have a positive separation from all bearing members and utility lines to allow their independent movements. Frequent joints should be scored in slabs to control the location of any cracking (maximum 200 square foot areas). In addition the soils are subject to disturbance and may require grading and compaction prior to concrete placement.

DRAIN SYSTEM

Free water was not encountered in any of the pits and no habitable space will extend below ground. Therefore, an exterior drain system is not required. However good surface drainage is required.

BACKFILL AND SURFACE DRAINAGE

The foundation soils should be prevented from being wetted after construction. Generally, this can be accomplished by insuring that the backfill placed around the foundation walls will not settle after completion of construction. The backfill material should be free of trash and it should be moistened and compacted to at least 90% ASTM D-698 Proctor density. Only enough water should be added to backfill material to allow proper compaction, do not puddle. The final grade of the backfill should have a positive slope away from the foundation walls on all sides. A minimum fall of 12 inches in the first 10 feet away from the foundation is recommended. Downspouts and sill cocks should discharge into splash blocks that extend beyond the limits of the backfill areas. Splash blocks should be sloped away from the foundation walls.

Particular care should be taken to compact disturbed natural soils and any fills placed to support sidewalks, garage and driveway slabs. Any fill placed for pavement support should be compacted to at least 95% ASTM D-698 Proctor density.

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LAWN IRRIGATION

A sprinkler system should not be installed next to foundation walls. Irrigation next to the foundation should be carefully controlled. All lawns, flowers, shrubs, etc., planted within 5 feet of foundation walls should be hand watered, and this watering should be minimized.

DESIGN CONSULTATION

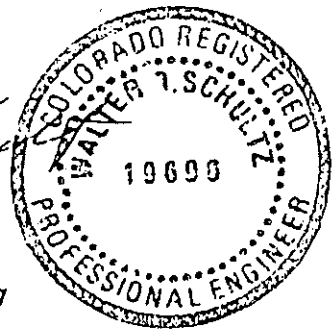
This report has been prepared for the exclusive use of providing geotechnical design criteria for the proposed project in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made. In the event that any changes in the nature or design of the project are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing.

It is recommended that the project geotechnical engineer be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications.

In any geotechnical investigation, it is necessary to assume that subsoil conditions do not vary from those encountered in the test pits. Our experience has shown that these variations exist and that they become apparent in the foundation excavation. For this reason, we should be called to inspect the foundation excavation prior to foundation construction.

Please contact us when further consultation or inspections are necessary. The fee for additional consultation or inspections is not included in the fee for this report.

Respectfully submitted,



Walter O. Schultz, P.E.
SUMMIT SOILS

CC: Pearson Engineering

TEST PIT LOCATION AND LOG

SNAKE RIVER VILLAGE

PIT NO. 1	(BUILDING 1)
0 - 10"	TOPSOIL AND VEGETATION
10" - 6'	SANDY GRAVEL WITH COBBLE, DENSE, MOIST, BROWN
	NO WATER ENCOUNTERED
	NO SAMPLE TAKEN
PIT NO. 2	(BUILDING 2)
0 - 6"	TOPSOIL AND VEGETATION
6" - 6'	SANDY GRAVEL WITH COBBLE, DENSE, MOIST, BROWN
	NO WATER ENCOUNTERED
	NO SAMPLE TAKEN
PIT NO. 3	(BUILDING 3)
0 - 6"	TOPSOIL AND VEGETATION
6" - 6'	SANDY GRAVEL WITH COBBLE, DENSE, MOIST, BROWN
	NO WATER ENCOUNTERED
	COMPOSITE SAMPLE TAKEN
PIT NO. 4	(BUILDING 4)
0 - 6"	TOPSOIL AND VEGETATION
6" - 6'	SANDY GRAVEL WITH COBBLE, DENSE, MOIST, BROWN
	NO WATER ENCOUNTERED
	COMPOSITE SAMPLE TAKEN

FIGURE 2

PIT NO. 5	(BUILDING 5)
0 - 2"	TOPSOIL AND VEGETATION
2" - 6'	SANDY GRAVEL WITH COBBLE, DENSE, MOIST, BROWN
	NO WATER ENCOUNTERED
	NO SAMPLE TAKEN
PIT NO. 6	(BUILDING 6)
0 - 6"	TOPSOIL AND VEGETATION
6" - 6'	SANDY GRAVEL WITH COBBLE, DENSE, MOIST, BROWN
	NO WATER ENCOUNTERED
	COMPOSITE SAMPLE TAKEN
PIT NO. 7	(BUILDING 7)
0 - 3"	TOPSOIL AND VEGETATION
3" - 6'	SANDY GRAVEL WITH COBBLE, DENSE, MOIST, BROWN
	NO WATER ENCOUNTERED
	COMPOSITE SAMPLE TAKEN

FIGURE 2

PAVEMENT DESIGN RECOMMENDATIONS

CONCLUSIONS

1. The predominate soils encountered in the test pits were natural sandy gravels. Free water was not encountered in the pits at the time of excavation.

2. We recommend the pavement sections should consist of the following:

   3" Asphalt over
   4" Base Course

3. All subgrade backfill will be from on site excavations or similar material placed in maximum loose lifts of 12" and compacted to at least 95% ASTM D-698 Proctor density, with moisture contents ranging from - 3% of optimum to + 1% optimum.

4. Dumpster pad areas (rear tire area of trucks included) should be a minimum of six inches of concrete or 7 inches full depth asphalt.

PURPOSE AND SCOPE OF STUDY

This report presents the results of a pavement design investigation and recommendations for the design of the proposed roadway system for the proposed project.

On August 2, 1995, a field investigation program consisting of excavating seven exploratory pits was conducted to obtain information on subsurface conditions. Material samples obtained during the field exploration were tested in the laboratory to determine classification and pavement support characteristics. The results of the field exploration and laboratory testing are presented herein.

This report has been prepared to summarize the data obtained during this study and to present our conclusions and recommendations based on the proposed construction and the subsurface conditions encountered. Design parameters and a discussion of geotechnical engineering considerations related to the project are included in the report.

PROPOSED ROADWAY

The roadway consists of two major sections which form a Y shaped system with the top of the Y facing east. The roadway services the eight buildings and appears to divide the traffic loading in half.

SUBSOIL CONDITIONS

The soil conditions encountered in the exploratory pits were consistent and consisted of natural sandy gravels with cobbles. Overall the soils encountered are considered excellent pavement subgrade support material. No ground water was encountered in the maximum depth explored of 6 feet.

CONSTRUCTION RECOMMENDATIONS

The proposed borrow areas soils should not pose any difficulty for typical road and utility excavation. However, the granular nature of the soil types are prone to caving. All backfill below roadways should be compacted to at least 95 ASTM D-698 Proctor density. The possibility of encountering ground water at depths of ten feet and greater should be anticipated.

PAVEMENT DESIGN RECOMMENDATIONS

A pavement section is a layered system designed to distribute concentrated traffic loads to the subgrade. Performance of the pavement structure is directly related to the physical properties and quality of the subgrade soils and traffic loading. Soils are represented for pavement design purposes by means of an CBR-value for flexible pavements which is empirically related to the strength of the soil. This value is then correlated to the design value Resilient Modulus.

Subgrade Materials

Samples of recommended subgrade materials taken during the investigation are classified as A-1-a with group indexes of O in accordance with the American Association of State Highway and Transportation Officials (AASHTO) classification. These soils are termed as excellent subgrade soils. Test results correlate to an CBR-values of 60 to 80. These values assume properly compacted fill or sound natural soil conditions. For design purposes, an CBR-value of 65 was used.

Design Traffic

Typical daily traffic on the roadways was converted to 18 KIP ESAL Values and the design life was twenty years. Heavy vehicle traffic was assumed to be limited to the main entries and designated delivery and/or trash routes. The remainder of the traffic is assumed to be residential vehicles.

The pavement sections presented below are based on laboratory test results, the traffic analysis, the Colorado Department of Highways pavement design procedures (1990), and past experience with similar conditions.

A Reliability of 95% and a design serviceability loss of 2.0 were used in the analysis. Structural coefficients of 0.40 for asphalt and 0.14 for base course were used in determining the pavement section.

The design nomographs, conversion charts and coefficients were obtained from the 1990 Colorado Department of Highways Roadway Design Manual.

Flexible Pavements

The asphalt pavement should consist of a bituminous plant mix composed of a mixture of aggregate and bituminous material which meets the requirements of a job-mix formula established by a qualified engineer. The bituminous material should be AC-10 grade and conform to the requirements of AASHTO M-226. Aggregates should meet Grade C specifications according to Sections 401 and 703 of the Colorado Standard Specifications for Road and Bridge Construction. The base course material should be Class 6 in accordance with Sections 304 and 703 of the standard specifications.

Subgrade Preparations

Prior to placing the pavement section, any unstable, upper silty sand soils and all organics must be removed, then the natural soil should be scarified to a depth of eight inches, adjusted to a moisture content near optimum and compacted to at least 95% of ASTM D-698 Proctor density. Then, any fill placed to bring the area to design subgrade should be compacted to at least 95% of ASTM D-698 Proctor density near optimum moisture content, placed in maximum 12" loose lifts, and consist of well mixed material from borrow area soils. The subgrade should consist of at least two feet of suitable soils Prior to placing of the base course, all subgrade must be proof-rolled with a heavily loaded pneumatic tired vehicle and any soft unstable areas removed and replaced with properly compacted backfill.

Additional Compaction Requirements

Asphaltic pavements should be compacted to at least 95% of Marshall Density (50 blow) and the base course should be compacted to at least 100% of ASTM D-698 Proctor density.

Drainage

The collection and diversion of surface drainage away from paved areas is extremely important to the satisfactory performance of the pavement. Drainage design should provide for the removal of water from paved areas and prevent the wetting of the subgrade soils, for a minimum depth of two feet below top of subgrade.

SECTION RECOMMENDATIONS

As stated, the performance of any pavement is directly related to the quality of the subgrade, particularly a flexible system. The recommended sections are as follows:

GENERAL ROADWAY

ASPHALT - 3"

BASE COURSE - 4"

FULL DEPTH ASPHALT - 5"

An alternative full depth concrete section was not provided. If desired concrete section recommendations can be provided.

Areas of dumpster site pads should be paved with at least six inches of concrete or seven inches of asphalt, placed on properly compacted subgrade.

PAVEMENT DESIGN CALCULATIONS

GENERAL ROADWAY

ADT < 750, DESIGN LIFE - 20 YR

DESIGN SERVICEABILITY LOSS - 2.0, MINIMUM ASPHALT THICKNESS - 3"

ASPHALT STRENGTH COEFFICIENT (a1) - 0.40

BASE COURSE STRENGTH COEFFICIENT (a2) - 0.14

R-VALUE - 65

MR = 30,000

18 KIP ESAL = 0.4 MILLION

STRUCTURAL NUMBER SN = (a1) (d1) + (a2) (d2) = 1.75

ASPHALT AND BASE - 1.75 = (0.40) (3) + 0.14 (d2)

d2 = 3,9" BASE COURSE 4"

FULL DEPTH ASPHALT - 5"

TEST PIT LOCATION
SNAKE RIVER TOWNHOMES
BASE II, KEYSTONE, CO

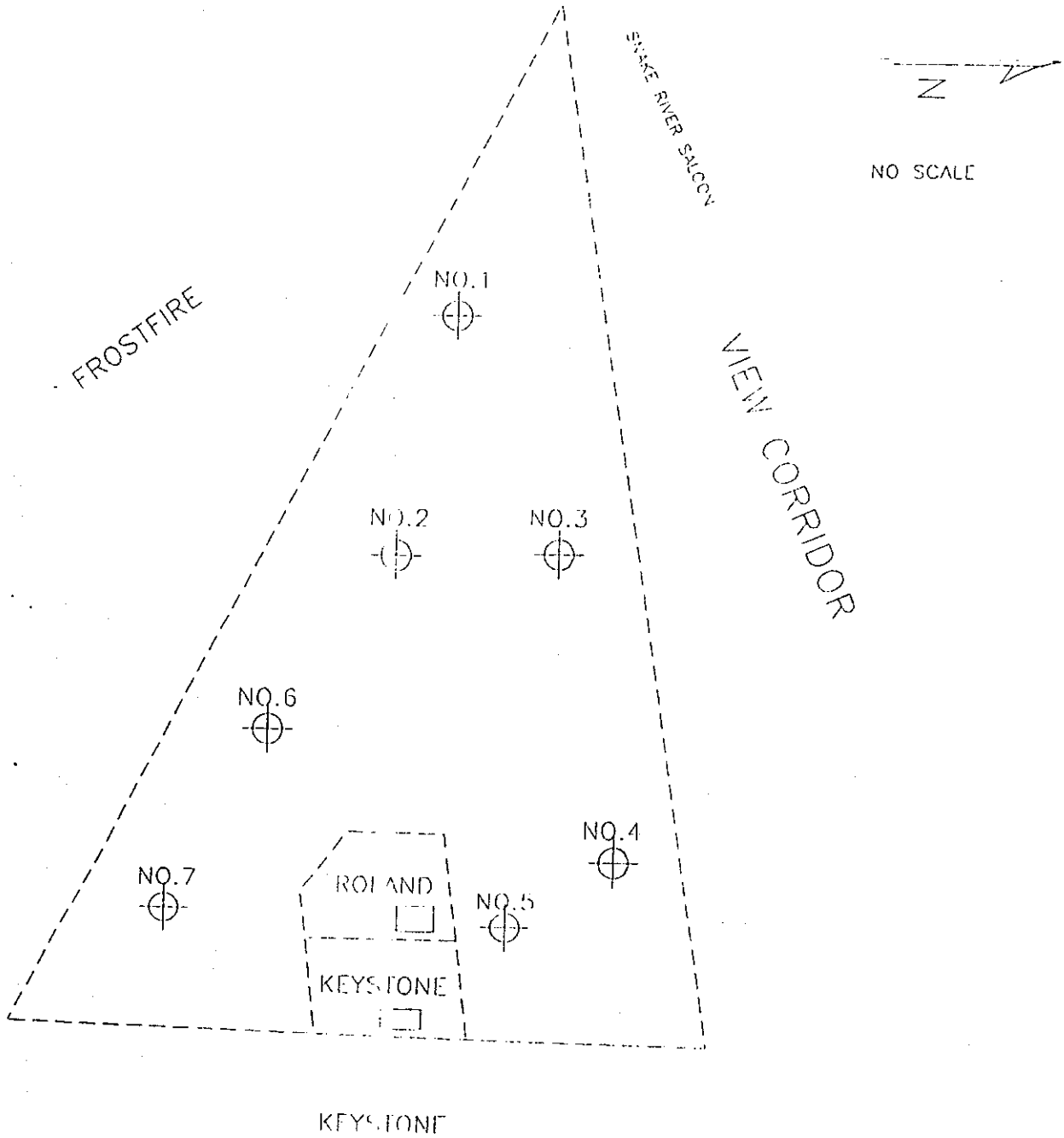


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FIGURE 1

SRTSITE