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May 27, 2020

Mr. Mike Autrey
Steamboat Springs
Colorado, 80487

Subject: Soil investigation for a residence proposed for Lot ~~#39~~ 236, in the Steamboat Lake, Filing #2 Subdivision in Routt County, Colorado.

Dear Ms. Autrey,

Per your request, we performed a soil investigation on the subject lot on May 21 of this year. This letter presents the results of that investigation, along with recommendations for design parameters for the foundation of the proposed residence. The recommendations contained herein assume that the proposed construction will be as described below.

The subject lot is located on the south side of Longfellow Way in the Steamboat Lake, Filing #2 subdivision in Routt County. The lot is covered with grass vegetation and aspen trees. It slopes downward toward the east at approximately a 5:1 slope. There is also a steep slope downward toward the street where a cut was made to construct the street, and a drainage ditch next to the south side of the street which drains to the east along the north side of the lot.

The proposed building is anticipated to be of single story, wood framed construction with a walkout lower level which will include a two car garage below the main floor. We anticipate that the driveway will access the house and garage from the northeast corner of the lot. The proposed foundation would consist of reinforced concrete walls bearing on reinforced concrete spread footers.

Two test pits were advanced on the lot. One was located near the west (uphill side) of the proposed house and the other was located to the east of the downhill side of it. We are familiar with subsoil conditions in the area via having designed foundations and observed the open excavations for residences in the area. Each of the two pits was advanced to a depth of approximately seven feet. Both pits revealed between eighteen and twenty-four inches of moist, dark brown clayey loam topsoil with some cobbles, which overlay a light brown, stiff, moderately moist, sandy clay subsoil which also contained some cobbles.

Our experience indicates that spread footers bearing on the stiff clay subsoil which was exposed at the anticipated depth of the footers of the proposed structure will provide acceptable structural performance. Spread footers should be designed to bear on the observed sandy clay subsoil with a maximum net bearing pressure of 3.4 KSF. Because future wetting of the subsoil might cause it to expand mildly, the foundation should also be designed to maintain a minimum dead load on the footers of 1.0 KSF. All retaining structures must be designed to withstand pressure equivalent to that which would be exerted by a fluid weighing 75 pcf. Careful attention must be paid to the drainage of moisture and surface drainage away from the proposed building.

It should be noted that we observed that the lower portion of the trunks of most of the older aspen trees showed some curvature. The observed curvature can be assumed to be an indication that there was some movement of the soil downhill toward the east at some point in the past. There was a significant slide at some point, likely about 35 to 40 years ago below a scarp which is located approximately 2/3 of a mile to the west of this lot. Our observations led us to from the opinion that most to all of the soil movement on this lot, as was indicated by the tree trunks, occurred when said (6 to 8 inch diameter) trees were much younger, and that the movement on this lot was likely limited to only the topsoil. Additionally, we observed that there is a significantly deep (8 to 10 foot) driveway cut for a lot situated about 100 yards to the west of this lot which has quite likely intercepted the flow of any water from uphill significant enough to cause any further soil movement on the subject lot. The above recommended, rather high equivalent fluid pressure of the native soils against retaining structures

reflects our observation of past soil movement on this lot.

The foundation's footers must be surrounded with a footer drain. This footer drain must be constructed using 4" diameter D-2729 perforated PVC pipe (placed with the perforations located at 4 and 8 'o'clock'), bedded and covered with ¾" screened rock, which in turn must be covered with a geo-fabric such as 'Mirafi' #140N. The invert of this drain should be located entirely below the grade for the bottom of the footers. The exterior of the foundation's stem walls and footers should be covered with an appropriate impervious membrane which comes across over the top of the footer, and then extends beneath and then upward to the outside of the drain. The footer drain should slope at a minimum grade of ½ %, without any dips, while running from a pair of clean-outs, around the foundation to a corner opposite the clean-outs and thence into a (non-perforated) 4 inch diameter D2729 drain line to daylight. The daylighted outfall of this gravity drain line must be protected from intrusion by critters by means of a screen and cobbles.

The subgrade for the lower floor must be constructed by placing compacted crusher fines, a minimum of 12 inches thick, and compacted to 95% standard Proctor in three lifts over a sheet of 'Mirafi' #140N placed over the native sandy clay subsoil. All of the existing topsoil must be stripped from the subgrade beneath this slab on grade .

In order to provide for proper curing of the slab on grade floor on the lower level, as well as for more economical heating of the building, a sheet of 6 mil thick visquene must be placed over the crusher fines fill prior to placing the slab concrete. If a hydronic radiant floor heating system is incorporated in the slab, we highly recommend using an insulating vapor barrier, such as 'the Barrier' in place of the above specified visquene, in combination with insulating panels designed to locate and retain the hydronic tubing above the vapor barrier.

Frost protection for the foundation must be provided by a minimum of forty-eight inches of earth coverage, measured in any direction, from the bottom of the footers. The finish grade should provide for a minimum of 2% slope away from the structure in all directions for a minimum of 10 feet, as well as for positive and continuous drainage away from the building without any ponding.

In order to protect the structure above from damage should the

slab on grade floor on the lower level ever heave upward due to an increase in the moisture content of the subsoil beneath it, all partitions located immediately above said slab on grade must be provided with a 1-½ " tall expansion joint, constructed per typical local practice with said joint located immediately above a treated wood sill plate on the slab on grade.

Native clay subsoil materials will provide appropriate backfill for the stem walls. This backfill may be capped with a maximum six inch thick layer of topsoil. The native backfill material must be placed in lifts a maximum of 10 inches thick, with each lift moistened and compacted to 93% of its Standard Proctor density. Any imported backfill material must be of an impervious nature, and be placed per the above specification.

Thank you for the opportunity to have been of professional service to you in this matter.

Sincerely,
Bear Valley Design, Ltd.

Gregory H. Hermann
Colorado P. E. #17422