Geotechnical Study Guidelines For Light Commercial and Residential Buildings in Colorado

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Colorado Association of Geotechnical Engineers

PREFACE

The enclosed "Geotechnical Study Guidelines for Light Commercial and Residential Buildings in Colorado" including commentary was developed by the Colorado Association of Geotechnical Engineers (CAGE). This document was adopted by the CAGE Board of Directors on May 9, 2007, and is being published in September, 2007. It represents a consensus of geotechnical practice as of that date. It should not be construed to represent practice prior to then. Geotechnical practice in Colorado will likely evolve with time, thus changes to this document may be merited from time to time.

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COMMENTARY

These Guidelines were developed by the Colorado Association of Geotechnical Engineers (CAGE) to assist Geotechnical Engineers in planning and conducting geotechnical investigations and design studies for light commercial and residential buildings in Colorado. It is emphasized that these Guidelines are not mandatory nor does each outlined procedure or recommendation apply to every project. Rather, the Guidelines are offered for consideration by the Geotechnical Engineer as suitable for particular sites and projects.

These Guidelines are intended to apply to geotechnical investigations in support of design of structures as described above. They are not intended as guidance for land use review or geologic hazard assessment. For more information regarding those activities, refer to Senate Bill 72-35, C.R.S. 30-28-101, et seq., House Bill 73-1574, C.R.S. 34-1-201 and to Policy Statement 50.2 of the State Board of Licensure for Professional Engineers and Professional Land Use Surveyors.

The Guidelines follow standard engineering problem-solving procedures: (A) Define the problem; (B) Explore conditions which pertain to problem solution(s); (C) Establish specific and reasonably implemented recommendations for problem solution(s); (D) Provide geotechnically-related construction recommendations pertaining to the solution(s); and (E) Identify potentially related issues pertaining to the solution(s), and express limitations of the study.

The experience and judgment of the Geotechnical Engineer should be applied when establishing the scope of study appropriate for a particular site and project. The scope should be developed by the Geotechnical Engineer based upon client input and in consideration of the Geotechnical Engineer's personal or company experience, the standard of practice in the area at the time of the study, the geologic and topographic site conditions, the proposed construction, and the local construction practices and limitations. If the client places limitations on the scope of the geotechnical studies, the Geotechnical Engineer is advised to document those limitations and to state the general risks created by such limitations.

The general methods outlined in these Guidelines do not address environmental conditions, natural hazards, or geologically complex sites. Therefore, it is emphasized that some issues or sites may not be adequately assessed by the methods outlined herein. When the Geotechnical Engineer recognizes that a project may benefit by multi-disciplinary assessments and solutions to mitigate particular problems, the client should be advised about the potential advantages.

GUIDELINES

These Guidelines are not intended to be a code nor are they intended to create specifications. Further, these Guidelines are not intended for adoption by local Building Agencies. They were developed for consideration by Professional Engineers practicing geotechnical engineering in Colorado. Some of the Guideline suggestions may not be merited by particular projects.

A. Define the Project and Identify the Geotechnical Issues

1. Communicate with the client regarding the proposed building(s) and the anticipated changes in land configuration, elevation and surface drainage conditions.

   Here, 'communicate' and 'client' are to be broadly interpreted, and the need to communicate may continue through completion of construction. The Geotechnical Engineer is particularly qualified to raise questions pertinent to geotechnical issues, but communication must be both ways. The client has responsibility to fully define the project and its requirements. The Geotechnical Engineer should also communicate with other design team members when these team members have been identified and the project is sufficiently complex to merit design team interaction. (Example: For a residential foundation study where the applicable foundation issues and solutions are generally known by members of the design team through common experience, special team interaction may not be required.)

2. Generally assess the site conditions including previous land use and both on-site and near-site drainage.

3. Generally assess the building requirements and the construction requirements and procedures for which geotechnical recommendations will be necessary.

4. Evaluate the general magnitude of earthwork activity which will be required for construction, including depth of excavation and/or fill and, in some cases, staging and the temporary and permanent storage of excavated materials.

5. Review readily available information from public studies, maps and reports related to general understanding of the regional geology and the surface and subsurface conditions at the site.

6. Evaluate whether local codes and land use restrictions may influence geotechnical study requirements and construction procedures.

7. Refer to previous geologic hazards evaluations and related information for the site in question, if available.

8. Recognize that there are often distinct differences in the applicable geotechnical conditions and issues for undeveloped sites, re-construction at previously occupied sites, and additions to existing structures. Also, recognize that geotechnical study of conditions influencing an existing building generally differs from geotechnical study for design and construction of new buildings.

B. Explore the Geotechnical Characteristics of the Site

1. Formulate a plan for field exploration and laboratory testing which will allow technical characterization of the site to a depth below the zone which will be meaningfully impacted by or will have an impact upon construction, post-construction loads and surcharge, and anticipated changed conditions such as wetting.

2. Implement the field program, allowing for modification of the program, as appropriate, based upon initial evaluation of conditions encountered.

3. Review the results of the field exploration to complete a general classification and evaluation of subsurface conditions and to develop a laboratory testing program.

4. As applicable, perform laboratory tests to identify the pertinent engineering properties of the subsurface materials which will provide support and stability for structures or which will impose load on structures. Possible tests and related assessments may include:

   a. unit weight, moisture content, grain-size and distribution, soil classification
   b. soil strength, including ϕ and c, if the project is influenced by slope stability
   c. swell-consolidation properties
   d. soil collapse potential
   e. bearing capacity, including consideration of foundation depth
   f. excavation and compaction characteristics
   g. site or imported material acceptability for use in fill
   h. lateral earth pressure conditions

i. slab and pavement support properties
j. erosion potential
k. permeability/percolation properties
l. freeze-thaw properties (site-specific considerations and/or code requirements)
m. corrosion/sulfate attack

5. Consider how these properties might change as a result of the construction process, development of adjacent properties, or time-dependent conditions.

C. Establish Design Criteria

1. Identify reasonable foundation alternatives. Where assessment of alternatives may require additional study, indicate the purpose and the potential benefit.

2. Recommend the type and depth of suitable foundations and the design criteria for each. Identify basic advantages/disadvantages of the recommended systems. Discuss potential movement. If drilled piers are recommended, also consider the CAGE commentary on "Drilled Pier Design Criteria for Lightly Loaded Structures in the Denver Metropolitan Area" and related updated materials by CAGE.

3. Discuss use of structural or slab-on-grade base floor and associated geotechnical criteria. Identify basic advantages/disadvantages of the alternative systems. If slab-on-grade floors are identified as an alternative, discuss potential movement, and consider the CAGE document "Guideline for Slab Performance Risk Evaluation and Residential Basement Floor System Recommendations" and related updated materials by CAGE.

4. Recommend design lateral loads and discuss backfill materials and procedures. Consider the construction sequence and the wall support conditions associated with the recommended design loads. Identify basic reasons for the recommendations and their associated limitations.

5. If applicable, recommend soil treatment materials and procedures.

6. For hillside sites, consider stabilizing requirements including drainage control measures.

7. Discuss and, where appropriate, recommend subsurface water controls which are directly associated with geotechnical conditions, such as perimeter drains and groundwater cut-off-walls. Differentiate recommendations pertaining to long-term components of the building and site from those pertaining to construction.

8. Identify geotechnically significant water controls requiring design by a civil engineer or hydrologist. If the construction sequence of such controls is critical to the geotechnical conditions and site stability, highlight this importance.

9. Discuss surface water controls and/or landscape requirements to limit potential changes in ground conditions affecting the structures, such as control of roof water and surface gradients.

D. Provide Geotechnically-Related Construction Recommendations

1. Provide recommendations for site observations, materials testing, instrumentation, and monitoring during and following the construction period, as merited.

2. Where applicable, identify anticipated special equipment requirements for excavating or drilling and potential need for blasting.

3. Identify portions of the construction process which require review by the Geotechnical Engineer for confirmation of site conditions and recommended design parameters.

4. Identify construction processes which require quality assurance observation and/or testing by the Geotechnical Engineer.

5. Provide recommendations for materials and compaction requirements for structural fill which will support foundations, floor systems, and pavements.

6. Describe procedures and limitations pertaining to foundation backfill.

7. Describe general considerations related to temporary excavation stability, as necessary.

E. Identify Potentially Related Issues and Express Limitations of the Study

There are a number of issues that are primarily the responsibility of the site owners, other members of the design team, and/or future building occupants/managers which may influence the geotechnical performance of the project and which are beyond the control of the Geotechnical Engineer. Such issues may not be specifically addressed in the Guidelines presented above, for they are not within the scope of a typical geotechnical study. The Geotechnical Engineer may make note of such issues in the report of geotechnical findings and recommendations. However, report wording should be avoided which might suggest the notation to be definitive or which may cause the Geotechnical Engineer to accept responsibility for these issues. Examples include:

1. The Engineer may provide reference to the "Guidelines for Design and Construction of New Homes with Below-Grade Under-Floor Spaces," developed by the Moisture Management Task Force (October 2003), for design and construction methods to help control moisture at buildings with basements.

2. The Engineer may discuss constructed elements which influence water management such as foundation elevations, grading away from foundations, surface grading and drainages, management of roof water and landscaping.

3. The Engineer may make note of site conditions and constructed elements which have a potential to change following construction and thus influence long-term building performance. Erosion control and backfill settlement are examples. If the Geotechnical Engineer's recommendations for surface gradients near foundations include an allowance for backfill settlement, it is suggested this purpose be stated in the report. The Geotechnical Engineer may also consider providing recommendations for the monitoring and maintenance of these constructed elements and indicate appropriate corrective measures.

In addition to the issues which must be addressed by other parties, the Geotechnical Engineer may discuss limitations of the scope of the particular study. If factors interrelated with geotechnical conditions were excluded from the scope, such exclusion may be noted in the report. Exclusion of environmental assessment is an example. If, during the course of the study, geotechnical conditions are discovered which merit expansion of the scope agreed upon for the study, and this scope expansion is not authorized, the potential limitations of the geotechnical study should be discussed in the report.