Are Geotechnical Investigations Required for Structural Design?

This white paper may shed some light on that question.

CASE STUDY

Engineer A designed a plan of repair for a post-tensioned concrete slab for a single family dwelling in Rowlett, Texas. The foundation was severely diselevated and after being monitored for over a year, the foundation was found to be continually shifting. The repair to supposedly level and stabilize the foundation consisted of a series of shallow drilled concrete underpinning piers to be installed throughout the interior and exterior of the foundation. After the completion of the repair, it was determined the foundation was still diselevated and was continuing to shift. Engineer B undertook the forensic investigation of the foundation and the analysis of the plan of repair prepared by Engineer A. A geotechnical investigation was performed and it was found the shallow drilled concrete underpinning piers had not been designed to penetrate the subsoil active zone and therefore they were ineffective. Engineer A noted on his/her plan of repair drawings that no geotechnical investigation was used in the preparation of the plan.

Engineer A and the foundation repair company by whom he/she was retained were then sued by the homeowner. In the Certificate of Merit prepared by Engineer B against Engineer A, he/she claimed negligence on the part of Engineer A in the design of the plan of repair. The Certificate of Merit cited Section 1001.056 (c) (2) of the Texas Engineering Practice Act:

> **§ 1001.056. Construction or Repair of and Plans for Certain Buildings**
> (a) A person, sole proprietorship, firm, partnership, joint stock association, or private corporation is exempt from the licensing requirements of this chapter if: …
>
> (c) The exemption provided by this section does not apply to a person or entity that is: …
>
> (2) providing engineering design relating to constructing, enlarging, altering, or repairing, or drawing plans or specifications for, a residential dwelling slab located on expansive soil that meets the expansive soil classification provisions of the International Residential Code as applied in the jurisdiction in which the residential dwelling is located, unless the construction, enlargement, alteration, repair, or drawing of plans or specifications meets the International Residential Code requirements as applied in the jurisdiction in which the residential dwelling is located.

The 2009 International Residential Code in Section R403.1.8 states:

R403.1.8 Foundations on expansive soils. Foundation and floor slabs for buildings located on expansive soils shall be designed in accordance with Section 1803.6 of the *International Building Code*.

Exception: Slab-on-ground and other foundation systems which have performed adequately in soil conditions similar to those encountered at the building site are permitted subject to the approval of the *building official*.

R403.1.8.1 Expansive soils classifications. Soils meeting all four of the following provisions shall be considered expansive, except that tests to show compliance with Items 1, 2 and 3 shall not be required if the test prescribed in Item 4 is conducted:

1. Plasticity Index (PI) of 15 or greater, determined in accordance with ASTM D 4318.
2. More than 10 percent of the soil particles pass a No. 200 sieve (75 μm), determined in accordance with ASTM D 422.
3. More than 10 percent of the soil particles are less than 5 micrometers in size, determined in accordance with ASTM D 422.
4. Expansion Index greater than 20, determined in accordance with ASTM D 4829.

Following then to Section 1803 of the 2009 International Building Code:

SECTION 1803
GEOTECHNICAL INVESTIGATIONS

1803.1 General. Geotechnical investigations shall be conducted in accordance with Section 1803.2 and reported in accordance with Section 1803.6. Where required by the *building official* or where geotechnical investigations involve in-situ testing, laboratory testing or engineering calculations, such investigations shall be conducted by a *registered design professional*.

1803.2 Investigations required. Geotechnical investigations shall be conducted in accordance with Sections 1803.3 through 1803.5.

Exception: The *building official* shall be permitted to waive the requirement for a geotechnical investigation where satisfactory data from adjacent areas is available that demonstrates an investigation is not necessary for any of the conditions in Sections 1803.5.1 through 1803.5.6 and Sections 1803.5.10 and 1803.5.11.

1803.3 Basis of investigation. Soil classification shall be based on observation and any necessary tests of the materials disclosed by borings, test pits or other subsurface exploration made in appropriate locations. Additional studies shall be made as necessary to evaluate slope stability, soil strength, position and adequacy of load-bearing soils, the effect of

moisture variation on soil-bearing capacity, compressibility, liquefaction and expansiveness.

1803.3.1 Scope of investigation. The scope of the geotechnical investigation including the number and types of borings or soundings, the equipment used to drill or sample, the in-situ testing equipment and the laboratory testing program shall be determined by a *registered design professional*.

Engineer A then filed a complaint against Engineer B with the Texas Board of Professional Engineers citing the fact that Engineer B *"mistakenly says the repair of a residential dwelling slab located on expansive soil must be designed with the benefit of a geotechnical investigation" and "none of the City Engineers in any DFW area cities have this requirement…".*

The Board, after deliberating the evidence for only 38 days issued the following decision to the attorney for Engineer B:

It has been concluded that the evidence obtained during this inquiry did not provide sufficient probable cause that your client was misleading when he authored the CoM and that his assertions were based on a valid interpretation of the applicable building codes.

Please consider this matter closed by this office, effective the date of this letter.

CONCLUSION

The code is clear and the Texas Board of Professional Engineers agree; the engineering design relating to constructing, enlarging, altering, or repairing, or drawing plans or specifications for a residential dwelling slab located on expansive soil must be designed with the benefit of a geotechnical investigation unless that requirement is specifically waived by the building official.

Jerald W. Kunkel, P.E., F.ASCE
Principal
Jerald W. Kunkel Consulting Engineers, Inc.