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Industrialized Housing and Buildings
Technical Bulletin

IHB TB 10-01 – Foundations on Expansive Soils – Residential
Applicable Code: 2015 IRC, 2015 IBC

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Foundations for buildings installed on expansive soils are required by the section 403.1.8 of the International Residential Code (IRC) to be designed in accordance with section 1808.6 of the International Building Code (IBC). Industrialized builders are responsible for ensuring that the foundation system ordered is designed for the existing soil conditions. As a minimum, USDA Natural Resources Conservation Service (NRCS) soil survey reports can help to determine the presence and location of expansive soils. Engineering data for specific counties may be downloaded from the NRCS web site at https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm.

Expansive soils, soils that shrink and swell due to changes in moisture content, are a very common cause of foundation problems. "According to many sources such as The American Society of Civil Engineers (ASCE), expansive soils continue to damage commercial and residential structures across the United States. ASCE and the USGS have estimated that that damage in the United States includes 25% of all structures, resulting in greater financial losses than earthquakes, floods, hurricanes, and tornadoes. The losses are anticipated in that 60 percent of new homes will experience minor damage and 10 percent experience significant damage (Holtz and Hart, 1978)."

The expansion ability of an individual soil is determined by the percentage of clay and the type of clay in the soil. Expansive soils, or shrink-swell soils, with high moisture levels will heave (swell), causing a building to be lifted. Low moisture levels will cause the soils to collapse (cave in or crumple) resulting in building settlement. Both can cause extensive damage to buildings. The amount and depth of possible swelling that can occur in a clay material are to some extent functions of regular changes in moisture content of the soil.

In their meeting of March 31, 2005, the Texas Industrialized Building Code Council directed the Department to add the requirement for soil tests to the site inspection residential checklist to determine the soil's characteristics (properties) in areas likely to have expansive, compressible, shifting or other unknown soil characteristics in accordance with section R401.4 of the IRC. Section R401.4.2 provides the following alternatives (also see sections 1808.6.3 and 1808.6.4 of the IBC) to a complete geotechnical evaluation when top or subsoils are compressible or shifting.

- Remove the top or subsoils to a depth and width sufficient to assure stable moisture content. The soils removed may not be used as fill
- Stabilize the soil by chemical dewatering (removal of moisture) or chemical presaturation (addition of moisture)

The IRC recognizes the potential for foundation problems linked to expansive soils and requires that certain steps be taken to assure that the foundation design lessens these problems by designing the foundation in accordance with section 1808.6 of the IBC. Section R403.1.8.1 of the IRC requires soils to be considered expansive soils if they meet the following four provisions.

1. Plasticity index (PI) of 15 or greater (determined per ASTM D 4318)
2. More than 10% of the soil particles pass a No. 200 sieve (determined per ASTM D 422)
3. More than 10% of the soil particles are less than 5 micrometers in size (determined per ASTM D 422)
4. Expansion index greater than 20 (determined per ASTM D 4829) – *Tests to show compliance with item #'s 1, 2, and 3 are not required if this test is performed*

The industrialized builder must ensure that water drains away from the house on all sides and that the subcontractors do nothing to hinder the drainage. The homeowners must be made aware of the potential for damage if changes in the drainage flow occur. Proper surface drainage, plant choices, sprinkling practices, and long-term maintenance are all important in minimizing fluctuations in the soil water content and can help to assure minimal foundation problems for properly designed foundation systems.