C19 Adaptations in Foundation Design: Have Improvements Occurred Through Science or Litigation?

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After attending the presentation, attendees will learn several important principles of geotechnical engineering and foundation design, including the history of foundation design changes in areas of expansive soil. Additional discussion will focus on common causes of foundation movement and historical data related to design changes and deep foundations. Special emphasis will be given to the Colorado experience and the potential effect of construction defect cases on current foundation design.

This presentation will impact the forensic science community by presenting a history of the progressive nature of foundation design. The presentation will document advances in engineering design methodology and trends in foundation design over time. This presentation will also summarize data and testimony that suggest that significant changes in foundation design may correlate with an increase in construction defect litigation.

Expansive soils cause more damage to residential structures (and pavements) than any other natural hazard. Available data suggests that the effects of expansive soil are more costly than damage caused by earthquakes, floods, tornadoes, and hurricanes combined. Expansive soils can damage foundations by uplift as they swell with increasing moisture. The American Society of Civil Engineers estimates that a quarter of all homes may suffer damage caused by these soils. Because of these problems, this presentation focuses on the importance of providing adequate engineering designs that can reduce the risk of damage from expansive soils.

Swelling soils can lift and crack lightly-loaded footings and cause distress to floor slabs and interior finishes. To combat the negative effects of expansive soil, engineers began to modify foundation designs to reduce the risk of differential movement. Beginning in the late 1950s, engineers began utilizing deep foundation designs (i.e. drilled pier foundations) to reduce the risk of soils-related damage. Some of the first states to implement these designs included California, Colorado, and Texas. For the next three decades, the science and practice of foundation design changed little. In the late 1980s and 1990s, methodologies for predicting slab heave, pier lengths, and pier heave were published. This guidance helped provide engineers with the design basis that is commonly used today.

As new methodologies were published, the depth of piers utilized in construction became deeper over time. In Colorado, relatively significant increases in pier depth occurred around 1990. Professional organizations, such as the Colorado Association of Geotechnical Engineers, documented increasingly conservative (i.e., deeper and/or longer piers) designs over time; however, the cause for these design changes was questionable. More recent publications suggest that the mechanics of soils movement and pier behavior are more complicated than initially contemplated in the 1950s. Although design improvements have occurred with advances in science, evidence suggests that it is likely that litigation has had a more significant impact on design than engineering research alone.

Over the past 25 years, the western United States has seen a relatively significant increase in the amount of construction defect litigation. The timing of such litigation correlates with increases in pier length used in the design of new construction. While practical experience and continuing research has affected the design of deep foundations, data and testimony suggest that significant changes in foundation design may correlate with an increase in construction defect litigation.

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Engineering Design, Construction Defect, Geotechnical