Cyclical Foundation Movements and Their Remediation

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1 INTRODUCTION

Climate and vegetation may alter the soil moisture profile underlying slab-on-grade foundations and cause movements. Shallow foundations constructed on expansive clay soils are particularly subject to damaging foundation movements. A statistical study of 453 residential foundations regarding cyclical movements in Southeast Texas is presented. A case history of a successful tree root/moisture barrier remediation will be discussed.

The greater Houston area is known for its hot summers and relatively mild winters. Droughts or wet periods may occur during the summer or winter. Many trees are deciduous and are expected to be more active during summer than winter. Interaction of these variables and how they produce trends in foundation movements are presented.

This talk will analyze residential foundation elevation surveys from 1998 through 2002, and focus on out-of-level trends versus time, considering the effects of climate and vegetation. The analysis was limited to slab-on-grade foundations that were constructed without piers and that had not been repaired or re-leveled. All of the survey data is from Southeast Texas (mostly Houston but also Beaumont/Port Arthur). Most houses investigated were 20 years in age or older and most had under floor sewer drain leaks (because most of these surveys were performed for insurance reasons).

2 CONCLUSIONS

Southeast Texas slab levelness is influenced by the seasons (spring, summer fall, winter), extraction of soil moisture by trees, rainfall variation, droughts (primarily during the growing season), and ground water availability (particularly during winter droughts when trees are not drawing from the same water source).

At the onset of the Southeast Texas growing season, the slabs were, on average, more level (the out-of-level moving average was about 2-1/4"). The data indicated that as the growing seasons progressed, temperatures rose, evaporation rates increased, and trees extracted soil moisture, these variables caused progressive slab-on-grade settlement (out-of-levelness was about 3-3/4"). Droughts during the growing season accelerated or worsen the settlement trend. More than normal rainfall slowed the progression of settlement. Slab levelness, on average, recovered during winters due to soil rehydration resulting from normal rainfall, reduced evaporation, and soil suction drawing moisture from relatively shallow ground water, combined with tree dormancy. During drought

winters, the rehydration recovery still occurred, although perhaps minimally suppressed. More than normal rainfall caused an earlier winter recovery in one season and another caused only a temporary, short-term recovery.

Remedial Case History

A successful repair to damaging cyclical foundation movements will be presented in a detailed case history format. Various parties recorded slab elevations over a ten-year period. A plan to address drainage, tree effects and future movement/damage was developed by each party's engineers and agreed to by both parties which were involved in a legal dispute. A tree root/moisture barrier and drainage improvements were installed and the structure was monitored for movements and distress for a two-year period. All parties involved in the problem solving resolution process have considered the cost effective repairs successful.