

# Reasons for Foundation Distress

## General

Foundations may experience distress as a result of one or a combination of many factors. It is frequently difficult to pin point the exact cause of foundation distress because more than one factor may be involved. The factors which may cause foundation distress are:

False Foundation Movement

Lack of Maintenance

Improper Construction

Inadequate Information and Design

## False Foundation Movement

False foundation movement is not really movement, although some acceptable variations in elevation may have occurred, but rather is some cosmetic conditions which develop. It generally occurs in the early years of the structure and the cosmetic indicators include some molding separations, some tile and sheetrock cracks, nail pops, and some brick cracks. These items are frequently covered in the one-year warranty because they may be caused by drying/shrinking of the wood structure, the veneers and the trim after completing construction and dehumidifying the residence. The brick cracks are frequently expansion/contraction cracks caused by temperature variations in excessively long walls or short intersecting walls.

## Lack of Proper Maintenance

Maintenance is the process of controlling the environment and condition of a structure so that it may perform its intended function properly. Since it is the responsibility of the owner, all owners/residents must understand the effect of moisture variation in expansive clays and the influence of water, landscaping, trees, drainage, sand, downspouts, gutters, sprinklers and remodels on the foundation. Improper controls of these items will influence the foundation and may cause differential movements which may become excessive, resulting in foundation distress.

## Improper Construction

Construction techniques vary from builder to builder and all builders generally desire to building a good product but they supervise many trades and people, all of whom will affect foundation performance. A partial list on construction problems is as follows:

- The failure to follow recommendations of the soils engineer with regard to compacted fill and the scraping of organic matter from the lot.

- The lack of attention of the site conditions related to good drainage and moisture maintenance. These include large trees, their root systems, and ditches or creeks with a close proximity to the foundation.
- The improper installation of drilled footings. These include, failure to follow the engineer's recommendation with regard to the depth, bell sizing, reinforcing and spacing.
- The grade beams are undersized or do not extend into the specified stratum of undisturbed soil.
- The slab section does not reach the specified thickness, or is placed over unstable fill or voids.
- Improper reinforcing steel placement, specifically ungraded reinforcing, lack of attention to "continuous" reinforcing, the lack of chairs under welded wire fabric, and the failure to place the fabric in the correct position in the slab.
- The lack of adequate post-tensioned reinforcing due to improper installation of tendons. This includes tendons unsecured during the concrete placement, resulting in tendons on the bottom of the slab or grade beams.
- The lack of attention to concrete placement procedures including adding too much water to the mix.
- Improper stressing of post-tensioning materials, the failure to have measured elongations reviewed by an engineer, and improper grouting procedures for post-tensioned slabs.
- The lack of attention to correct final grading of the lot and the installation of landscaping.

#### Inadequate Information and Design

Foundation distress can occur if the foundation, structure or veneers are poorly designed. The following factors which may cause inadequate design are as follows:

- A faulty geotechnical report which may consist of the following:
  - Inadequate site condition description
  - Incorrect bearing capacity
  - Footing depth
  - Inadequate PTI or BRAB parameters
  - Absence of recommendations of foundation maintenance
  - Inadequate testing of soil characteristics
  - Incorrectly estimated movement values
  - Inadequate information regarding perched water table
  - Borings drilled in the wrong locations
- Unfamiliarity with proper design methods in regards to Post-Tensioned slab design, Conventional slab design, and Structural slab design.
- Excessive pier spacing or undersized piers
- Foundation design without soils report.
- Continuity of grade beams/waffle slab for Post-Tensioned and Slab-on-Grade Systems or for slabs on fill with piers when the PIs are high.

- Misapplication of design to site conditions which includes sloped sites, sites on active faults and using the wrong type of foundation for soil conditions.
- Eccentric loading of slabs, specially post-tensioned slabs which includes support of concentrated loads.
- Drops and raises in foundation.
- Inadequate information with regards to drainage, slope, existing trees, future trees and vegetation prior to foundation design.

### Conclusions

In general, one or several of the items discussed may be responsible for foundation distress. In order to determine the cause of distress in any foundation the items as mentioned must be reviewed and evaluated to properly identify the problem areas.