METHODS OF FOUNDATION REPAIR

There are several methods of foundation repair currently on the market. This appendix covers the advantages and disadvantages of each method.

DRILLED AND UNDERREAMED PIERS
(Commonly Called Bell-Bottomed Piers)

This method has been used on numerous structures and is a standard geotechnically engineered foundation repair method. Most homes costing more than $250,000.00, multiple story buildings, bridges and petro-chemical facilities use the drilled pier method. This method has been thoroughly researched by instrumented load tests to failure by the University of Texas, Texas A & M and numerous other universities. The test by the University of Texas was performed in the Beaumont Clay Formation found in the greater Houston area. This load test data gives engineers the capability of predicting the capacity of a drilled pier with or without an underream (bell) in order to properly design a foundation or its repair.

ADVANTAGES:

- Years of thorough research. Instrumented load tests to failure in Beaumont Clay Formation of the greater Houston area.
- Soil information on the stratigraphy and strength of the soil available through the use of a fifteen feet test hole.
- Centerline of bell lines up with centerline of foundation beam.
- 70% of the capacity of the pier is end bearing across the base of the bell below the pleistocene interface.
- Tapered shape of the pier and the bell resist uplifting soils.
- Ability to inspect the hole and the size of the bell.
- Quality control of concrete obtained from batch plant at specified strength.
- Reinforced with #4 reinforcing rods which provides lateral strength.
- Reinforced pier cap to carry eccentric load.
- Capacity of load is significantly higher than the load imparted by the structure, thus providing a factor of safety for changes in load or changes in the moisture content of the soil.
- No stress on the structure during the installation of the piers.

DISADVANTAGES:

- Susceptible to poor construction technique by placing the piers at too shallow a depth and/or without bell.
- Difficulty in obtaining an adequate bell in areas immediately adjacent to water front property.

PERMA PILE ®

Perma Pile ® repair methods use cylinders six inches in diameter and one foot long made of concrete which are hydraulically pushed into the ground.

ADVANTAGES:

- Material costs less expensive for the contractor.
- Completion time is decreased.
- Not as sensitive to contractor technique or knowledge.

DISADVANTAGES:

- No published research on instrumented load tests to failure in order to determine capacity.
- No historical data to determine if a long term solution.
- Sections are not connected and can be deflected by roots, rocks or calcareous nodules.
- Axial load may not be transmitted if piles are not vertical.
- No capacity for lateral loads.
- No factor of safety. Piles are at incipient failure. That is, if load changes or moisture conten of the soil changes deflection of the slab can occur.
- Load capacity of pile, if driven to twelve feet, has 1/3 the capacity of a drilled pier wit underream. In order the achieve the same capacity of a twelve foot underreamed drilled pier using a 1,000 psf soil shear strength as found in the Houston area, pressed piles would need t be installed to 43 feet.
- No resistance to uplift.
- No knowledge of soil capacity or presence of underlying weak layers of soil.
- Transition block which handles eccentric load is unreinforced and susceptible to cracking.
- Unreinforced precast concrete cylinder susceptible to cracking during installation.
- Proper compaction of soil after tunnelling cannot be accomplished with methods currently used. The four inch slab is designed to be in contact with the soil. When a void exists the slab will deflect.
- High stress concentrations are placed on the slab and the brick veneer when lifting from one pile location.
- Cylinders do not extend to pleistocene interface (usually eight to ten feet deep) or to stable clay when used on lightly loaded structures such as frame houses.

CABLE LOCK ™

Cable Lock ™ is similar to Perma Pile ® in that it uses cylinders six inches in diameter by twelve inches long. It differs in that there is a central hole in the cylinder through which a cable is placed.

ADVANTAGES:

- Material costs less expensive for the contractor.
- Completion time is decreased.
- Not as sensitive to contractor technique.

DISADVANTAGES:

- No published research on instrumented load tests to failure in order to determine capacity.
- No historical data to determine if a long term solution.
- Sections are not connected and can be deflected by roots, rocks or calcareous nodules.
- Axial load may not be transmitted if piles are not vertical.
- No capacity for lateral loads.
- No factor of safety. Piles are at incipient failure. That is, if load changes or moisture content of the soil changes deflection of the slab can occur.
- Load capacity of pile, if driven to twelve feet, has 1/3 the capacity of a drilled pier with underream. In order the achieve the same capacity of a twelve foot underreamed drilled pier, using a 1,000 psf soil shear strength as found in the Houston area, pressed piles would need to be installed to 43 feet.

- No resistance to uplift.
- No knowledge of soil capacity or presence of underlying weak layers of soil.
- Transition block which handles eccentric load is unreinforced and susceptible to cracking.
- Unreinforced precast concrete cylinder susceptible to cracking during installation.
- Proper compaction of soil after tunnelling cannot be accomplished with methods currently used. The four inch slab is designed to be in contact with the soil. When a void exists the slab will deflect.
- High stress concentrations are placed on the slab and the brick veneer when lifting from one pile location.
- Cylinders do not extend to pleistocene interface (usually eight to ten feet deep) or to stable clay when used on lightly loaded structures such as frame houses.

ULTRA-PILE ™

Ultra-Pile ™ is similar to both Perma Pile ® and Cable Lock ™ in that it uses cylinders six inches in diameter by twelve inches long. It differs in that there is a central hole in the cylinder through which rebar is placed.

ADVANTAGES:

- Material costs less expensive for the contractor.
- Completion time is decreased.
- Not as sensitive to contractor technique.
- Can carry slight lateral load.

DISADVANTAGES:

- No published research on instrumented load tests to failure in order to determine capacity.
- No historical data to determine if a long term solution.
- Sections are not connected and can be deflected by roots, rocks or calcareous nodules.
- Axial load may not be transmitted if piles are not vertical.
- No capacity for lateral loads.
- No factor of safety. Piles are at incipient failure. That is, if load changes or moisture content of the soil changes deflection of the slab can occur.
- Load capacity of pile, if driven to twelve feet, has 1/3 the capacity of a drilled pier with underream. In order the achieve the same capacity of a twelve foot underreamed drilled pier, using a 1,000 psf soil shear strength as found in the Houston area, pressed piles would need to be installed to 43 feet.
- No resistance to uplift.
- No knowledge of soil capacity or presence of underlying weak layers of soil.
- Transition block which handles eccentric load is unreinforced and susceptible to cracking.
- Unreinforced precast concrete cylinder susceptible to cracking during installation.
- Proper compaction of soil after tunnelling cannot be accomplished with methods currently used. The four inch slab is designed to be in contact with the soil. When a void exists the slab will deflect.
- High stress concentrations are placed on the slab and the brick veneer when lifting from one pile location.
- Cylinders do not extend to pleistocene interface (usually eight to ten feet deep) or to stable clay when used on lightly loaded structures such as frame houses.