CASE STUDY

Project:	**Geotechnical Engineer:**	**Structural Engineer:**	**Contractor:**
Carrington Estates Richmond, B.C.	Levelton and Associates Richmond, B.C.	Bogdonov Pao & Associates. Vancouver, B.C.	Vickars Construction Burnaby, B.C.

Job Description:

After construction of these four townhouse double units, settling became apparent and had progressed to an astounding differential movement of 13 " across two of the units. The other two units were 11 and 8 inches differentially settled.

Soils:

Underlying soil conditions were found to consist of 15-25 ' of dense granular fills with pockets of till- like fill whose strength exceeded 40- 60 blows per foot in the fill layers. Beneath that was a further 30' - 40' of soft silts and sandy silts finally getting into densifying sands at 65'- 80 ' overall depth.

Underground obstructions included drainage piping, sewers, electrical services, natural gas high pressure lines and irrigation systems.

Repair:

As the underlying cause of this massive settlement was thought to be the dense layer of fills settling into the soft silts any remedial piling driven through this area would feel large down drag forces known as negative skin friction. That and the predictable shearing of services to the buildings at the piled foundations by the settling soil mass made such a repair option undesirable. Therefore Vickars proposed to the structural and geotechnical engineers the alternative of shallow pilings into the dense upper fills. After that was done we would elevate the buildings to level on the pilings and leave access to the leveling devices to readjust the building , if necessary, over the years. That plan had the added benefit of allowing global settlement of the fill layers along with all of the

contained services, in a uniform fashion with the buildings/foundations themselves. There was therefore no predictable increase in repair costs to the services to the structures over their reasonable lifetime.

HELICAL PULLDOWN™ Micropiles were selected as much piling was done between buildings only 5- 6 ‘ apart or on the interior of the buildings finished main floor. This allowed handheld piling equipment capable of reliably placing 40 kip (180kN) minipilings into the dense fill layers. The other advantage was the ease in constructing a small reusable leveling apparatus that could be accessed again should any portion of the structure undergo any further differential settlement. The jacking pits only, 4”x 6” square, were allowed by the central structural 1½ inch square shaft of the helical pile to transfer 40 kip (180kN) to the pile shaft embedded into the dense fill layers beneath the building. This allows safe leveling of structures with up to 13” of differential movement in the foundations and frame.

Pile configuration was 6-8-10 SS150 square shaft lead with a 4 inch fibre reinforced silica fume grout column approximately 8-10’ deep. All pilings were placed to torques in excess of 4000 ft lbs.

Load Testing:

Two piles were tested under the direction and auspices of Levelton and Associates of Richmond, B. C. office. Both were to be loaded to 200% of design load or 40 kips (180kn). One test pile were inserted with the same handheld units as were to be used in the buildings interior the other inserted with the drive head mounted on a small tracked excavator. Final average displacements at the pile head, at maximum loads, was 1.2 inches. Displacement at design load was .040 inch.

Production Piling Installation:

All production piling was installed using the same procedures as employed for the test piles. The grout mixture was a proprietary silica fume grout produced by Basilite Concrete Products Inc., known as Pulldown pile grout type A, reinforced with Polyfibre at a mix rate of a one pound bag for every cubic yard of grout.