Helical Piers & Polyurethane Foaming

A Logical Marriage

by G. L. Bowen, PE, LLC

A certain percentage of all foundation repairs involve reinforced concrete foundation slabs-on-grade that require lifting, replacement, or void filling. The use of closed cell polyurethane foam is an improvement over the use of piers and slab brackets, mud jacking, or slab replacement.

General

Repeatedly, circumstances arise where a helical pier contractor faces sunken slabs or slabs with voids under them in the course of repairing a structure. The usual circumstance for the contractor would be to set a manufacturer's slab bracket on a helical pier per an engineer's plan, raise or stabilize the slab by point supports and continue with the project. Unfortunately, a sunken slab is normally cracked from settling and is usually lightly constructed or certainly constructed to an unknown degree of quality. Furthermore there may be in-slab heating. The usual and most common response is to replace it completely because it is may be cheaper and better solution. There are circumstances, however, that require the slab be repaired with a minimum or with no disturbance in a place of business. It should also be noted that a foaming contractor also needs helical pier support at positions of concentrated loads. My first involvement with foaming was to take over a job where a foaming contractor was unable to lift a structure. The foam just kept pushing the ground downwards without lifting the structure. There was no slab involved. The purpose here is to suggest that the use of injected polyurethane expanding foam is a logical marriage to the use of helical piers to repair foundations. Some examples are given where the use of foam has been used concurrently with helical piers to achieve the desired result and even where piers were not required.

Permanence

The question logically arises as to the permanence of closed cell polyurethane foam lifting of a slab. A foaming contractor may offer a guarantee of the actual material but the client will ask if the slab will still settle. Most often we are seeing the results of decades of settlement. If we were to raise the slab to level under these circumstances, we might expect a long term return to possibly some settlement. In a situation where there was an expectation of rapid and large deflections in the new slab, the slab should not be a slab-on-grade but a structural slab supported upon helical piers or another type of deep foundation.

Where there is some expectation of some future settlement, a re-foaming might be required at a later date.

Examples

The Masonic Lodge in Sitka, Alaska, was foamed under the slab and helical piers were used at the perimeter. This Lodge was built in 1959 and the building settled immediately. The ground level of the building was rented to an automotive supply store. If they were forced to close or incur a business interruption during repair work, they stated they would vacate the premises permanently.

The Masonic Lodge in Sitka, Alaska, was lifted with piers and foam. The ground level floor houses an automotive supply business. Engineer: G. L. Bowen; Helical Pier Contractor: Martin Enterprises (A. B. Chance helical piers); Foaming Contractor: URETEK (Canada)
The roof trusses spanned the entire building and landed on reinforced concrete columns. Because the piers needed to support the columns and grade beam, there was concern the piers might collide with the column footers so the footers were exposed. No problem was found because the builders never constructed footers, the peat was too deep. The footer steel was simply bent back at a depth of 8 feet. The reinforced concrete slab-on-grade was dowelled into the perimeter grade beam. It required a coordinated foaming and perimeter pier lifting to raise the building most of the 6 inches required to attain level.

The Hadden House in Anchorage, Alaska, is built upon a base soil of peat. For a number of years in Anchorage the Municipality allowed a gravel pad placed upon peat. Certain neighborhoods in Anchorage are sinking because of this. The Hadden house had sunk about 8 inches. An aquarium business was conducted in the basement and the owner insisted upon no business interruption including any dust and odor.

This was a coordinated lift with helical piers and foam. The differential lift was about 7 inches and it went extremely well rising quickly and easily.

The Hadden House in Anchorage, Alaska, was lifted by piers and foam. Engineer: G. L. Bowen; Helical Pier Contractor: Grayhawk Enterprises (Dixie helical piers); Foaming Contractor: URETEK (Alaska)

The Martin Apartments in Sitka, Alaska, were built upon driven but untreated pilings. Pilings had been placed at locations of concentrated loads but not under the slab-on-grade. The result was that the ground had settled about 2 feet from beneath the slab. There was a fear that the slab could collapse. Some of the exposed pilings were also rotting. The perimeter had most of the rotted pilings and helical piers were set. The soft ground was approximately 50 feet deep. The interior pilings were encased with foam and beneath foaming forms were set in the middle of floor slabs (intersecting diagonals in each room). The apartments were occupied at the time of the repair. A full foaming would have been preferred but the volume required was simply too great to be economic. Even full support by piers was uneconomic because of the depth. There was also the consideration of tenant occupancy.

The Martin Apartments in Sitka, Alaska. It is supported by helical piers at the perimeter and by partial foaming in the interior. Engineer: G. L. Bowen; Pier Contractor: Martin Enterprises (A. B. Chance product); Foaming Contractor: Foundation Contractors of Alaska.

View beneath the Martin Apartments showing an exposed piling top as well as the degree of settling. The photograph is prior to repair.

Martin Enterprises has become a major rental business in the City of Sitka (with at least 70 rentals) by salvaging properties such as this one. Using helical piers and foaming (if required) they put them into a state where they can be financed. A good deal of repair work has been required because untreated pilings were installed during the initial construction of houses (the building codes still allow untreated piling immersed in fresh water). Unfortunately, through road construction and other developments, the water level has dropped exposing the piling to air and eventual decay.

The Petersburg City Offices in Petersburg, Alaska, were built in the 1950s. They also housed the Fire Station. The major perimeter structure was supported on pilings but the slab was deeply bowed. Subsequent repairs by the owner consisted of multiple pours of new concrete to attain level. This was unsatisfactory and the owner selected a recommended repair by foaming. This was successful and the owner has been looking at additional building repairs by foaming.
Offices of the City of Petersburg were raised by foam only. Engineer: G. L. Bowen; Contractor: Nana-Pacific Solid Earth Services

Results and Conclusions

Foaming as a supporting technique for repairs by helical piers has much to recommend itself. The cleanliness of foaming plus less intrusiveness and a lesser weight compared to mud jacking are all positives. In addition, the polyurethane gives some tensile properties to the base of the slabs. How much depends upon the amount of foam beneath the slab as well as the adherence to the slab base. In specifying the foam you will need to work with a foaming contractor in your area to be certain of the specified foam properties such as water absorption. I certainly regret not knowing about this technique until about 5 years ago. Now it is integrated into my repertoire of design tools.
This technique offers less risk and usually costs less than slab lifting by helical piers. It also expands the capability of a helical pier contractor by allowing void filling beneath slabs where vibrations from machinery can cause building problems or where slab settling might be imminent.

Reference:

URETEK USA, Engineering Manual, 72 pages, 2001. www.uretekusa.com

G. L. Bowen
4/6/2008