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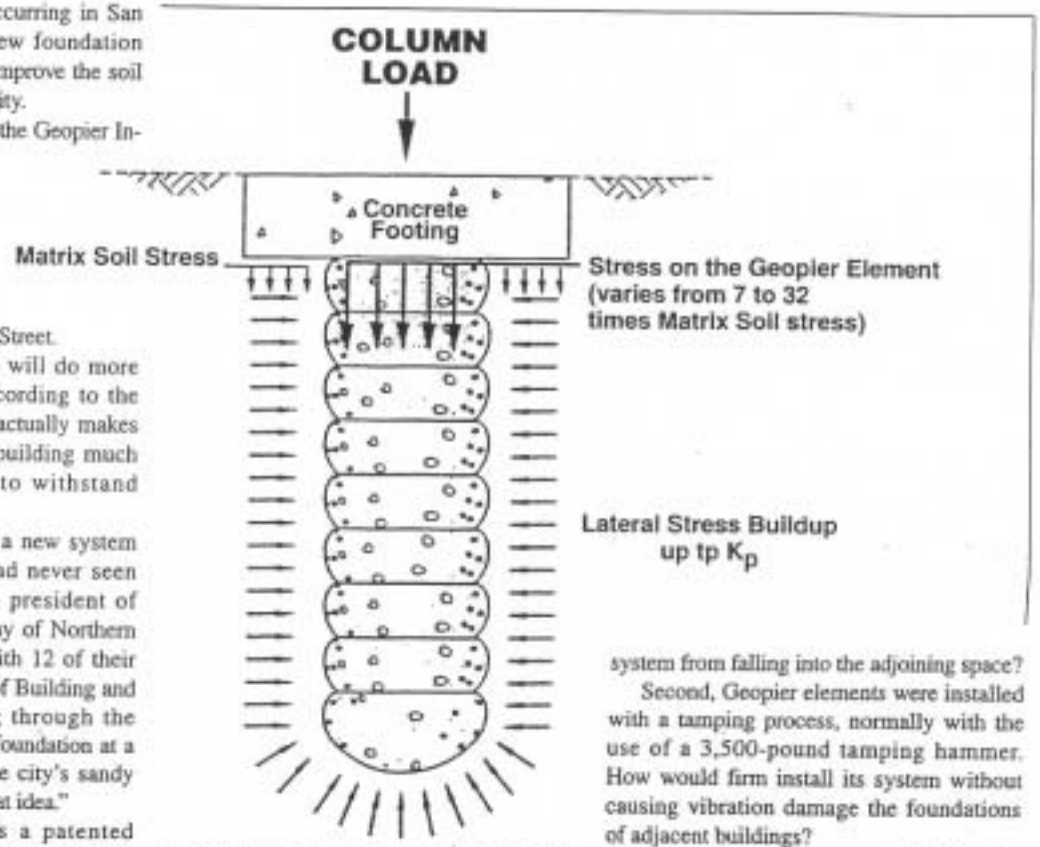
Geopier System Introduced in Seismically-Sensitive San Francisco

A construction first is occurring in San Francisco this month. A new foundation system, that is supposed to improve the soil around it, will appear in the city.

The new system is called the Geopier Intermediate Foundation System. Its first application in San Francisco is the foundation system for the Orchard Hotel, a building about to rise 10 stories at 665 Bush Street.



The Geopier foundation will do more than support the hotel. According to the engineer who invented it, it actually makes the sandy soil beneath the building much stronger and better able to withstand seismic activity.

"We came to town with a new system that the city's engineers had never seen before," says Tom Farrell, president of Geopier Foundation Company of Northern California. "We sat down with 12 of their engineers at the Department of Building and Inspection. After working through the challenges of constructing a foundation at a busy and cramped site in the city's sandy soil, they realized it was a great idea."

The Geopier system is a patented process developed by Dr. Nathaniel S. Fox, president of Geopier Foundation Company of Scottsdale, Arizona. Geopier foundations have been installed in 27 states and two countries since being patented in 1993. In all cases, they have strengthened the soils in which they have been constructed and provided positive settlement control.

Seismic Testing

In a recent test, a full-scale interstate highway bridge span was subjected to shaking forces equivalent to an earthquake measuring 7.5 on the Richter scale. The shaking caused equivalent reactive forces on the test frame, supported by 15-foot-long Geopier elements, and the bridge span, which was supported by 65-foot-long piles.

The result: Geopier elements moved with the rocking foundations, allowing them to finally rest only fractions of an inch from their original positions, and downward settlement of the footings was controlled to less than 1 inch.

It's a fact of life in construction even without any earthquake activity. All structures settle unless they are built on solid rock. The objective is to minimize settlement as much as possible while simultaneously keeping costs under control.

Geopier intermediate foundations and soil reinforcements have controlled settlements within stringent 1-inch maximum-settlement designs while controlling single-column loads as heavy as 1,100 tons and multiple-column loads of 3,000 tons. In many cases, settlements are less than 1/4 inch.

Tight Fit

They had to use casings in every hole it drilled at the Orchard Hotel site. First, a 36-inch (diameter) hole was drilled four feet deep, into which was put a casing—essentially a sleeve to hold back the loose sands. Once in place, a second hole of 30 inches was drilled for the Geopier element. The elements were constructed down to 10 feet below the bottom of the foundation footing.

Yet, the Orchard Hotel site posed two other challenges. First, the site had "zero lot lines," meaning there was no extra room between buildings. What if an adjacent building owner would decide in the future to rebuild next to the Orchard Hotel? How would company prevent its foundation system from falling into the adjoining space?

Second, Geopier elements were installed with a tamping process, normally with the use of a 3,500-pound tamping hammer. How would firm install its system without causing vibration damage the foundations of adjacent buildings?

Farrell says the company tackled the first challenge by installing 108 rammed cement Geopiers around the periphery of the site. These piers were alternated between 24- and 30-inch (diameter) elements, each installed to 10 feet below the bottom of the foundation's footing.

As for the challenge to limit vibrations during construction, a smaller 2,000-pound tamping hammer was used. A geotechnical consultant was on site, at the city's direction, to make sure that vibrations were within acceptable limits and monitor construction. Because of the high frequency involved in the process, soils are not sensitive to the impact ramming action and soil vibrations and limited.

Construction of the system was begun on June 2, and a load test was conducted on June 4. During construction of the load test, measured vibrations were about half of the maximum allowed by the city. A 53-ton load (106 kips) was tested on a single-column Geopier element at 100 percent of design load, producing a measurable settlement of 1/4 inch. Under application of 150 percent of design load, it produced a settlement of 1/2 inch.