UNDERPINNING ANCHORING REPORTS

HELICAL PIER® FOUNDATION SYSTEMS CASE HISTORIES

POWER SYSTEMS, INC.

210 North Allen Street
Centralia, MO 65240 USA

Phone: 573-682-8414
Fax: 573-682-8660
www.hubbell.com/abchance

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Cert. No. 001136
A. B. Chance Co.
Centralia, MO USA

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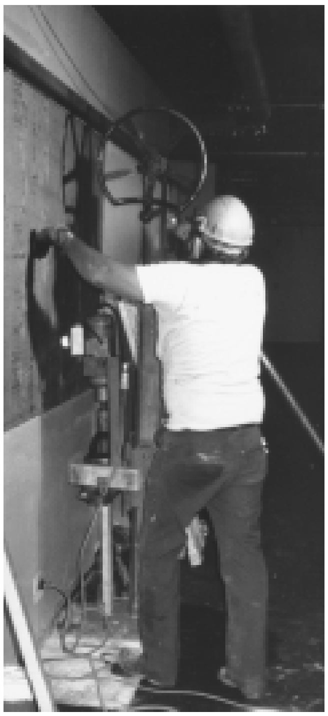
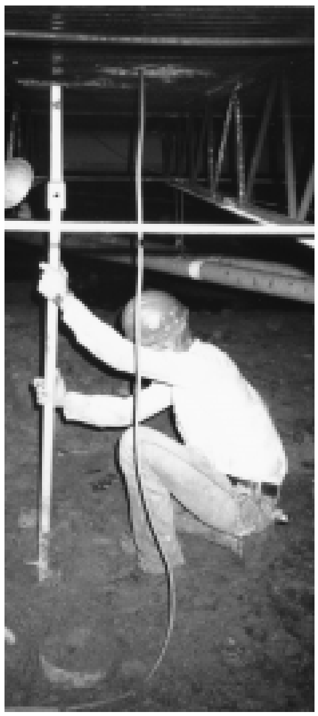
UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:	**Geotechnical Engineer:**	**Structural Engineer:**	**Underpinning Contractor:**
Fairview High School Underpinning Boulder, CO	Keith Ferguson G.E.I. Consultants Englewood, CO	Jim VanLier Sellards & Grigg Lakewood, CO	D & B Drilling Wheat Ridge, CO





Job Description:
The structural engineering firm determined that the roof at Fairview High School in Boulder needed to be upgraded for snow loading. Trusses were designed to handle the maximum snow loading anticipated. Consequently, 69 anchors were needed to support the columns holding the trusses in place. Because of the limited access inside the building, it was concluded that Chance HELICAL PIER® Foundation Systems anchors would cause the least amount of disturbance and be the most cost-effective alternate to cast-in-place or auger-cast concrete piles since no spoils would have to be removed. Chance SS5 anchors with either a single 6" or 8" helix were required to carry a load of 30 Kips. Each column required two or three Chance anchors. Special brackets were designed to allow attachment of the columns to the Chance anchors without the use of concrete.

A portable anchor installer developed by D & B Drilling with a maximum installation capacity of 5,000 ft.-lb. was used to install the Chance anchors. This unit incorporates a Sweeney torque multiplier powered by either a hydraulic motor or an electric core drill. Chance anchors were installed from 5' to 15' into the very competent rocky soils.

Mechanical connection of column to two Chance anchors required.

(Additional lateral bracing not shown in this photo.)

UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:
Rembrandt Terrace
Dallas, TX

Underpinning Contractor:
Hargrave & Hargrave
Wiley, TX

Structural Engineer:
R.M.I. Structures
Dallas, TX

Job Description:
This home is a three-story brick with approximate loads expected in excess of 3000 lb. per linear ft. This home was constructed on a creek bank in North Dallas. The lay of the land was such that water drained toward the creek and under and around the home. A French drain was installed to assist in water removal, but the home had experienced both settlement and upheaval causing extensive damage to the structure.

The Plan of Repair called for 50 anchors to be installed around the structure on the grade beam. Soil borings demonstrated tan calcareous w/limy pebbles at 5'; tan and gray shaly clay at 10'; gray shale from 20' to termination at 27'. Concrete piles 12" in diameter belled to twice the diameter extending a minimum of 20' were required around the perimeter of the home. Upon lift, the interior of the home began to "dish". Lift was terminated while the problem of the interior not moving was considered. An attempt to lift the interior using concrete blocks and hydraulic jacks proved ineffective.

Repair:
It was decided to use the Chance HELICAL PIER® Foundation Systems anchors on the interior grade beam. A 10" helix on a 7' shaft was installed using extension material to a depth of 20' to attain a bearing capacity of 25 Kips. The shaft of the anchor would then be encased by a sonotube with a foot-bracket encased in high strength concrete. This would provide the lift platform to use to raise the interior of the home in conjunction with the lift on the exterior grade beam. The lift was effected to 9" as indicated in the bottom photo.

A class "c" fly ash slurry was pressure injected to consolidate loose soil and to fill voids between the bottom of the slab and the soil beneath that was created by the lifting process.

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UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:
Two-story chimney falling
from side of house
Prince George's County
Laurel, MD

Contractor:
Levelift Systems Inc.
Rockville, MD

Job Description:
The two-story chimney had moved away from the side of the house 2¼ in. at the top. At about 4 ft. from ground level the chimney had moved away from the house ⅝ in. Two 10 in. HELICAL PIER® Foundation Systems anchors were installed to 19 ft. depths at the corners of the chimney. The anchors were installed to 2,500 ft.-lb. of torque and the Chance lifting brackets were attached to the foundation of the fireplace.

Using an Enerpac manifold jacking system, the lift was accomplished. The gap at the top of the chimney was closed from 2¼ in. to ½ in. and at the 4 ft. mark on the chimney, the gap was closed from ⅝ in. to 3⁄16 in.

Anchor Loads
During the time of jacking, a pressure gauge was being monitored to determine the amount of load that was being applied to the Chance brackets and anchors. When the lift was completed, the total load on the two anchors was 21,000 lb. Note that each anchor was installed to take a load of 25,000 lb.

Installing Equipment
A Chance hand-held 2,500 ft.-lb. hydraulic drive unit with power pack was used to install the anchors.

Summary
The project went extremely smoothly. The time required to complete this job was eight hours.

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UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:
Chimney Creek Condominiums
Genesee, CO

Structural Engineer:
Richard Weinhart Consultants
Lakewood, CO

Tieback Contractor:
D & B Drilling
Wheat Ridge, CO

Job Description:
One of the end units in this condominium complex built into the mountainside overlooking Denver was experiencing lateral movement. Fourteen 9"-diameter holes were cored through the interior walls facing the mountainside so that Chance SS5 anchors with single 8-in. helices could be turned into the soil.

Two rows of tiebacks were required.
On the lower wall, the anchors were installed to depths from 11 ft. to 23 ft.
The top row anchors were installed to depths from 25 ft. to 49 ft.

All anchors were load-tested from 5 Kips to 23 Kips.
The cored holes in the wall were filled with non-shrink grout and end adapter plates were installed on the threaded stud adapters terminating the SS anchor extension shafts.

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UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:
The Hunt at Louvier subdivision
Newark, DE

Home Builder:
Toll Brothers

Foundation Contractor:
Phoenix Construction

Foundation Engineer:
Tim Wentling

Job Description:

A large two-story house with basement was to be built at The Hunt of Louvier subdivision, outside Newark, DE.

Site and Methods Analysis:

The contractor excavated to the footing elevation and discovered soil unsuitable for the "standard" footer. Competent soil was found to be at least 10 feet deeper.

Excavation and replacement with compacted fill was determined not to be cost effective in this case. As an alternative, Chance SS-5 galvanized HELICAL PIER® Foundation Systems anchors were submitted to the City of Newark and approved.

Installation Procedure:

Phoenix Construction installed the underpinning anchors with a Chance torque head mounted on a Kubota backhoe. Each anchor had two helices (10" and 12" diameters) and was installed until 3,500 ft.-lb. of torque was reached. Torque was measured by a Chance shear-pin torque indicator. Average anchor depth was 22 feet.

A locally-fabricated load-transfer device was placed on each cut-off anchor shaft. The device consisted of square tubing welded to a 6" x 6" top plate. Plate elevation was 3" above the footing bottom.

UNDERPINNING ANCHORING REPORT

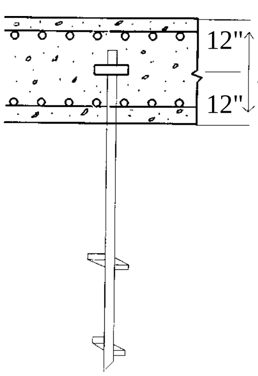
A CASE HISTORY

Project:
Lake Austin Resorts
Austin, Texas

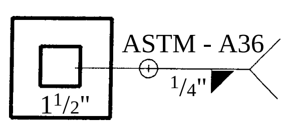
Engineer:
Walter Snowden
Snowden, Inc.
Austin, Texas

Contractor:
Hargrave & Hargrave, Inc.
Wylie, Texas

Job Description:
A new gymnasium was to be constructed by Hillman Constructors, Inc., Austin, Texas. The gymnasium is 63 x 65 ft. utilizing 16 pile caps, each with four HELICAL PIER® Foundation Systems anchor placements, installed to a capacity of 30 Kips per anchor (or 120 Kips per pile cap). Each anchor placement was positioned midway in the 24"-thick concrete slab (or 12" from the surface). The bearing plate was a 5" x 5" square plate, 1/2"-thick with a square hole in the center to allow the helix shaft to protrude. The plate was welded to the helix shaft. Seventy-two anchors, each with 8" and 10" helices on a 1 1/2"-square, 7-ft.-long shaft, were installed to depths ranging from 24 to 28 ft. Torque was monitored by a shear pin indicator attached to an Eskridge drive unit mounted on a 7438 Bobcat loader with bail and jib extender. All anchors were installed to a minimum of 30 Kips with many anchors installed, to 35 Kips to compensate for the placement of the shafts in the pile cap. Some shafts had to be cut off because of the hard limestone encountered at depth. All anchors were installed, the site was cleaned up and equipment removed in two days.



5" x 5" x 1/2" Plate



UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:
Pineland Baptist Church
Burlington, Ontario

Geotechnical Engineer:
V.A. Wood
Associates, Ltd.

Structural Engineer and Underpinning Contractor:
W.C. Pietz

Job Description:

The Pineland Baptist Church had a two-story addition built in 1981. A creek that would have flowed close to the addition was diverted. The geotechnical investigation indicated 12 feet of clayey silt fill containing some organics and wood fragments. Below the clayey silt was weathered shale atop a solid shale stratum.

A spread footing located in the clayey silt fill had not provided an adequate foundation for the addition. Significant cracking was evident in the brick facing on the southeast corner of the addition. Vertical cracks in the original structure were determined to be the result of the addition settling and rotating out, away from the rest of the structure.

Seven two-helix SS175 anchors were used to underpin the settling addition. The maximum design load per anchor was 30.25 kip. Installation torque of 9,000 to 10,000 ft.-lb. was enough to penetrate the shale. The anchors were loaded until a positive displacement ($^1/_8$" approx.) was seen with a transit-level. The building could have been lifted back to a level position had the brick facing not been repointed.

The proposal submitted by the underpinning contractor was roughly half the cost of alternate systems.

UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:
VGO Pump Station in Tye, Texas
Pride Refining, Inc.
Abilene, Texas

Engineer:
William Fowler, P.E.
Tippett & Gee
Abilene, Texas

Underpinning Contractor:
Hargrave & Hargrave, Inc.
Wylie, Texas

Job Description:

A steel fuel-storage tank (120-ft.-dia., 50 ft. high) on a reinforced-concrete ring-beam foundation had differential settlement of 1½" to 2½". This movement caused deflection in the tank side walls and deterioration of an interior seal which leaked volatile fumes.

Pride Refining wanted to stabilize the concrete ring by following Tippett & Gee's recommendations to use Chance Helical Pier® Foundation Systems anchors. The ring beam measures 4 ft. high, 1½ ft. wide and is 3 ft. below grade.

Live loads are applied cyclically on a daily basis.

Dead Load	1,000 psf
Live Load	1,300 psf
Total Load	**2,300 psf**

Average differential settlement was recorded at 2.1 inches.

Testing:
Geotechnical information was provided by Trinity Engineering Testing Corp., Dallas, Texas.

Soil Borings

Depth	Soil Description
1 ft.	Reddish Brown/Brown Fat Clay
2 ½ ft.	Reddish/Brown Fat Clay
5 ft.	Reddish-Brown Shaly Fat Clay

The plasticity of the Shaly Fat Clay is LL @ 57, PL @ 24 and PI @ 33 with (-) 200 sieve values @ 74%. The in situ moisture content varies from 17 to 25% with an average of 20%. The unconfined compressive strength of one test is 2.26 tsf.

A high water table of 1.0 ft. produced 0.1 gallon/minute which would fill a 5-in. hole 20-ft. deep to within 1 ft. of the surface in three hours, or approximately 1 ft. of water per nine minutes.

Blow Counts

Depth	N-Values
5 ft.	17
10 ft.	44
15 ft.	74
20 ft.	68

Anchors

To test on site, an anchor was installed to a torque of 4,000 ft.-lb. using an Eskridge 10,000 ft.-lb. installer head monitored by a shear-pin torque indicator with 500 ft.-lb. pins. Eight pins were sheared at 11½ ft. depth and nine pins were used to reach the 12-ft. test depth. A compression-test beam was erected over the test anchor using four reaction anchors. A calibrated 60-ton hollow-ram jack was used to apply load to the test anchor. The total deflection recorded was ½ inch.

Procedures:

Chance foundation anchors were specified for their ability to install quickly and produce the needed capacity in the high water table. Live-load capacity was used in the anchor calculations. Chance SS150 (1½"-square shaft), twin-helix (8"- and 10"-diameters) anchors were chosen for their high-torsional ratings. Chance Standard-Duty Bracket C150-0121 was specified for this stabilization project. Anode protection was added by attaching the 1/0 copper strand pigtail to the brackets by the Cadweld system.

The ring beam was excavated and surfaced on the side and bottom to fit the bracket. Each anchor was installed to a minimum torque of 4,000 ft.-lb. Many of the 47 anchors had to be installed to 6,000 ft.-lb. to reach the job depth specified by the engineer. An 18,000-lb. load was applied to seat each bracket.

Metal wedge shims between the concrete ring beam and the metal tank walls were used to bring the tank back to level. Including backfill and clean-up, work began at 7:30 a.m. and was completed at 3:00 p.m. the next day.

UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:	Geotechnical Engineer:	Underpinning Contractor:
Montrose High School	Buckhorn Geotechnical	D & B Drilling
Montrose, CO	Montrose, CO	Wheat Ridge, CO

Job Description:
This 50 year old high school was supported by piles embedded in a dense gravel layer on top of shale. A floating slab inside the building had been settling for many years due to a compressible silty clay layer about 30' thick. With a complete remodeling of the building, a new 7" structural slab on piles was designed. Three pile design alternatives were proposed: 1. Auger-cast piles. 2. Screw anchors. 3. Small dia. pipe piles. The costs for auger-cast piles and screw anchors were very close. The deciding factor that tipped the scales to screw anchors was the time factor. Also, the lack of spoils removal with Chance HELICAL PIER® Foundation Systems anchors was another plus in the confined working area. The general contractor was allowing only two weeks for the completion of the anchors while construction was going on in the building.

Screw anchors and extensions being moved into the Montrose High School

Repair:
The new structural slab was supported by 179 anchors on 10' grids installed to depths of 40' to 50'. Type SS5 anchors with a single 10" helix were used to develop the design load of 20 KIPS with a 2 to 1 safety factor. Two skid loaders with 6,000 ft.-lb hydraulic motors mounted on short booms were used to drive the **7800' of anchors in less than five days.** A locally fabricated mounting plate was slipped onto the top of the anchors to support the rebar mat. Around the inside perimeter of three walls was a utility vault that required the use of 60 Chance underpinning brackets. To allow for more bearing area for the structural slab, a 3" dia. pipe with a flange on top was welded onto the top of the underpinning bracket's T-pipe and coated with a bitumastic material.

5,000 ft.-lb. hydraulic drive attached to skid loader installs screw anchor along side a utility vault

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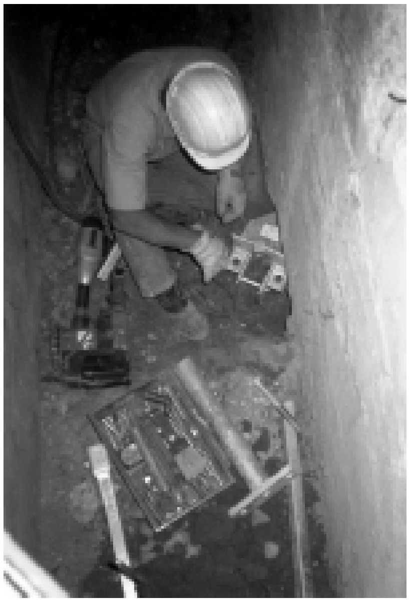
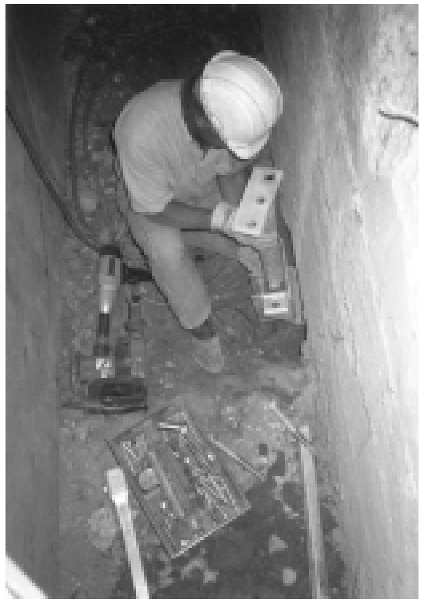
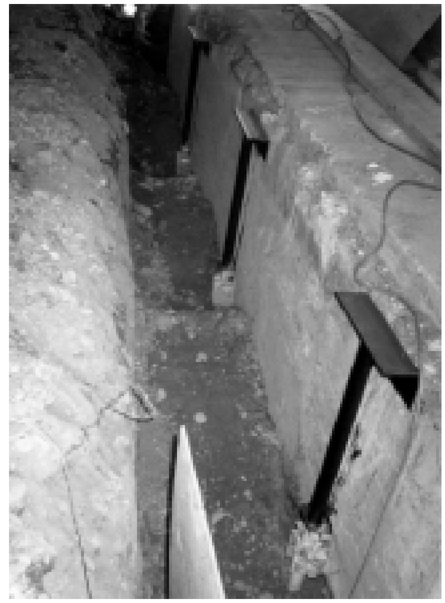




Underpinning bracket being assembled onto Chance Helical Pier® Foundation Systems anchor and under utility vault



Pipe and flange assembly was welded onto the underpinning bracket's T-pipe to give added bearing area for the new 7" structural slab

Chance anchor being installed in slab area on a 10' grid

Fabricated cap with bolt allowed for precise adjustment with a laser level providing a reference point

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UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:
Coastal Cities Imaging Center
Oxnard, CA

Engineer:
Medical Imaging Consultants
Beverly Hills, CA

Geotechnical Engineer:
Earth Systems Consultants
Ventura, CA

Structural Engineer:
Engel & Company Engineering
Bakersfield, CA

Foundation Contractor:
RJG Construction
Cyn. Country, CA

Job Description: A linear accelerator room was being added inside the existing Coastal Cities Imaging Center building. The walls, floor, and ceiling in the new 25' x 35' room would be 3' to 4' thick concrete to act as shielding. With compressible bay mud and sand layer 10' below, there was concern by the geotechnical engineer that the room could settle up to 1" if left unsupported. A compression load test was conducted at the site on a Chance SS5 HELICAL PIER® Foundation Systems screw anchor with 8" and 10" helices to determine the suitability of using them to support the concrete. The screw anchor was installed to 30' into a gravelly sand layer with a phi angle of 40° to 45°. Installation torque exceeded 5,000 ft.-lb. A test load of 68 KIPS was applied to the screw anchor. Design load for the piers was 34 KIPS. A total of 26 anchors were installed to depths of 31' to 34$^1/_2$' and 12 tiebacks for lateral loading considerations were installed to 42'.

Threaded stud adapter (on ground) will be attached to the screw anchors and lateral anchors. A square plate will be double-nutted onto the adapter and cast in concrete.

An existing room at CCIC was converted to a linear accelerator room.

CHANCE®

A CASE HISTORY

UNDERPINNING ANCHORING REPORT

Project:	Engineer:	Anchor Contractor:
U.P.S. Building Addition	James Williams, J.M. Williams & Associates	D & B Drilling
West Valley City, UT	Salt Lake City, UT	Wheat Ridge, CO

Job Description: United Parcel Service was planning to add onto their building in the Salt Lake City area. To meet seismic requirements, the footings were originally going to be oversized to handle the uplift loads. Instead, to lower the cost of the foundation, a conventional spread footing to handle the bearing load was used in conjunction with tension loaded, Chance screw anchors cast into the footing to provide 83 KIPS of uplift per anchor. Twelve SS175 anchors were installed from 25' to 35' into a dense sand layer lying under 15' to 20' of loose sand.

Type SS175 anchors were driven into the ground with a bed mounted digger truck.

Epoxy coated thread bar was connected to a thread bar adapter on the end of the screw anchor extension shaft. A square plate was double-nutted onto the thread bar and cast into the footing for uplift resistance.

CHANCE®

UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project: Zecca Plaza Gallup, New Mexico	**Foundation Repair Contractor:** Vic Peery Construction Albuquerque, NM

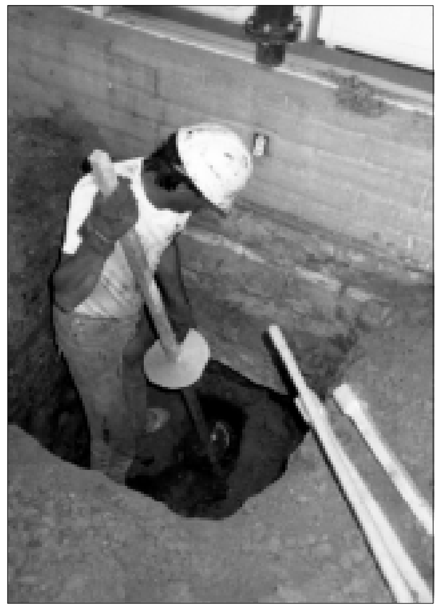
Job Description:
The foundation of the TG&Y store on the east end of this shopping plaza had settled 9" over the years.

Repair:
To prevent any further settlement, 40 Chance HELICAL PIER® Foundation Systems screw anchors and underpinning brackets were used on the east side and about half way across the north side of the building. The owner decided against trying to raise the foundation with the underpinning brackets because of the possibility of doing further damage to the building's roof.

Every 6' to 8' the foundation was exposed to 1' below the bottom of the footing to allow for the installation of the twin helix (8" & 10") anchors and the underpinning bracket. Using a 6,000 ft.-lb. hydraulic motor mounted on a skid loader, the anchors were installed to depths of 35' to 40' to reach the bedrock material lying below the soft alluvium material.

To provide a 2 to 1 safety factor on the anchors for the 15 KIP working capacity of the underpinning bracket, the anchors were installed to torques averaging 3,000 ft.-lb. After installing the underpinning bracket body under the foundation and the T-pipe onto the anchor's $1^1/_2$" solid steel square shaft, the 2 nuts on the vertical bolts were tightened down to preload the foundation onto the anchors. The job was completed in less than 2 weeks with no disruption to customer traffic into the store.

For larger loads Chance has an underpinning bracket with a working capacity of 40,000 lb. It is used with $1^3/_4$" square shaft SS175 anchors.



Anchor being spotted next to foundation

Skid loader driving screw anchor to 40'

UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:	**Structural Engineer:**	**General Contractor:**
Elerding Residence Sitka, AK	Straiger Engineering Sitka, AK	Alaska Foundation Technology Sitka, AK

Job Description: This single story residence was sitting on untreated wood piling that had been rotting and causing it to settle. The soil consisted of a 6' to 14' layer of organically filled sand and gravel mixture over a 3' to 6' layer of dense volcanic ash overlaying a dense clay. The typical repair method employed in the area was to hand dig out the foundation and replace it with concrete columns. Using Chance HELICAL PIER® Foundation Systems represents savings up to 50% over conventional methods.

Repair: Seventeen SS5 screw anchors with 8" and 10" helices were installed from 12' to 36' depths to reach load bearing soils. Five of the piers were installed inside the house through 12"-square holes cut through the wooden floor. Chance underpinning brackets were installed under the foundation and onto the anchors. Using hydraulic jacks inserted into the brackets, the foundation was leveled.

Twelve screw anchors were installed on the outside.

The owner was pleased and wrote: *"I would like to express my sincere thanks for the professional job your crew did on 'putting back together' our surroundings. They've made it like no construction job ever took place and I really appreciate it . . ."* Michal Beth Elerding

HELICAL PIER underpinning bracket

Portable hydraulic driver installing screw anchor through kitchen floor →

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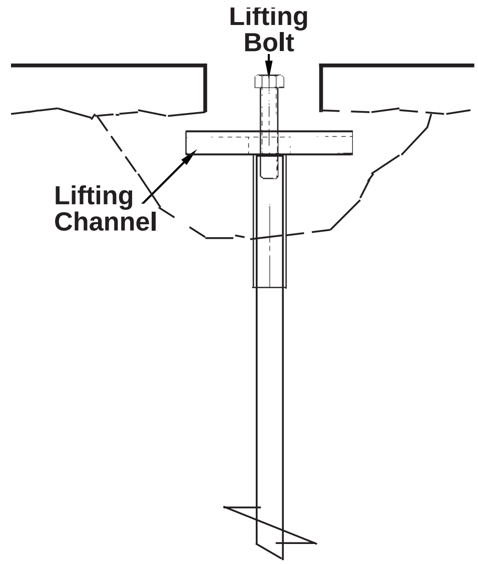
UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:	Structural Engineer:	Underpinning Contractor:
Balfour Residence	Structural Design Associates	Vic Peery Construction, Inc.
Gallup, NM	Albuquerque, NM	Albuquerque, NM

Job Description: Due to a non-uniform, lightly compacted, sand fill below the interior slab of this single story, wood frame with brick veneer home, the floor slab was experiencing differential settlement, primarily along a central interior corridor. The perimeter of the house was bearing on a competent clay and was stable. Geological investigation revealed that competent hard sandy clay at a depth of 8' was satisfactory to bear an underpinning anchor system.

Repair: Eighty-seven Chance HELICAL PIER® Foundation Systems screw anchors were installed through cored 6"-dia. holes in the slab on a 6' grid to allow the slab to be raised with a slab bracket on the top of the anchor. Average installation depth of the anchors was 10'. As the dead weight of the slab and the service live load totalled 40 PSF, the anchors were only required to support 1,500 lb. The 6"-dia. helices on the solid-steel 1½" square shaft were installed to a minimum torque of ____ ft.-lb. for a minimum load of 3000 lbs. per anchor using a portable 2,500 ft.-lb. hydraulic driver. Voids created by lifting the slab were grout filled.



Cross-sectional view of slab lifting bracket

1"+ gap can be seen between column and ceiling.

Gap is closed after lifting slab.

UNDERPINNING ANCHORING REPORT

CHANCE®

A CASE HISTORY

Project:
Two-story chimney,
Richmond, Virginia

Contractor:
Stable Foundations, Inc.
Ashland, Virginia

Job Description:

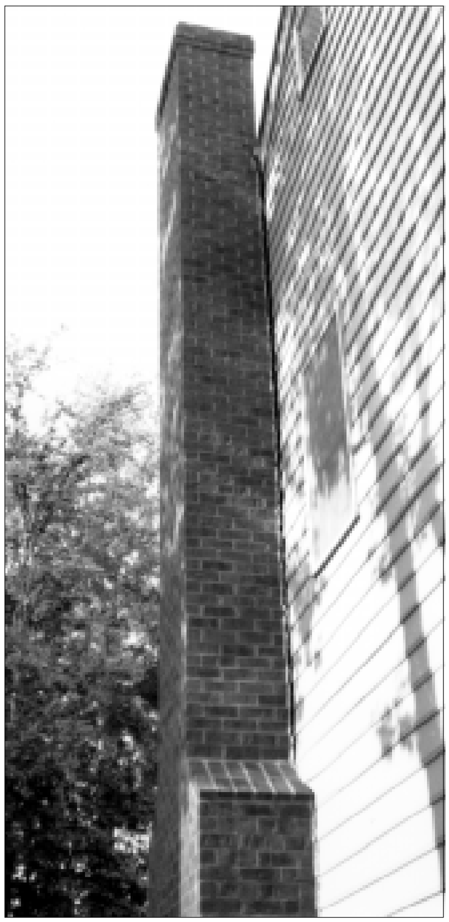
A two-story chimney (35 feet high) had pulled away from the side of the house. There was a 3-inch gap at the top of the chimney and a 3/16-inch gap 4-feet up from ground level.

Two 10"-diameter HELICAL PIER® Foundation Systems screw anchors were installed to a 12-ft. depth, 18 inches from the corner. A foundation bracket was connected to each anchor and the footer. Each anchor was installed to 2,500 ft.lb. of torque for a 25,000 lb. load capacity.

The jacking operation utilized two 10-ton Enerpac hydraulic jacks. Each anchor was loaded to 18,000 lb. to accomplish the lift. When the lift was completed, the chimney had rotated back to its original, like new, position.

This job required six hours.

BEFORE



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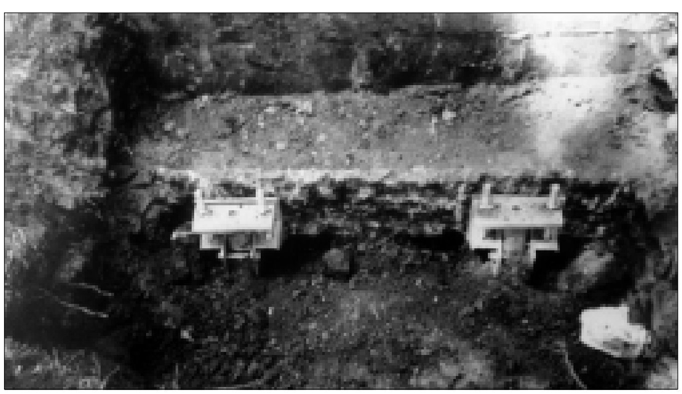


UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:	Contractor:
One-story brick house, Richmond, Virginia	Stable Foundations, Inc. Ashland, Virginia

Job Description:

A 17-year-old house had settled approximately $^{7}/_{8}$ inch at a front corner. This settlement resulted in a $^{5}/_{8}$ inch horizontal crack along a 4-ft. section of the front and a 3-ft. section of the side.

A 2x3-ft. hole was dug at three pier locations. Two 10-inch diameter Helical Pier® Foundation Systems screw anchors were installed on the front and one on the side. Each anchor was installed to an 18-ft. depth with 2,500 ft.-lb. of torque for a load capacity of 25,000 lb. A foundation bracket was connected to each anchor and the footer.

The three anchors were loaded gradually to 14,000 lb. by simultaneously using three 10-ton Enerpac hydraulic jacks. This closed the $^{5}/_{8}$ inch crack to only $^{1}/_{16}$ inch and new mortar was installed.

This job required nine hours.

BEFORE

AFTER

CHANCE®

UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project: Tohatchi High School Gym Tohatchi, New Mexico	**Geotechnical Engineering:** Western Technologies, Inc. Albuquerque, New Mexico	**General Contractor:** PC Construction Gallup, New Mexico
	Structural Engineering: TECH, Inc. Farmington, New Mexico	**Underpinning Contractor:** Vic Peery Construction Albuquerque, New Mexico

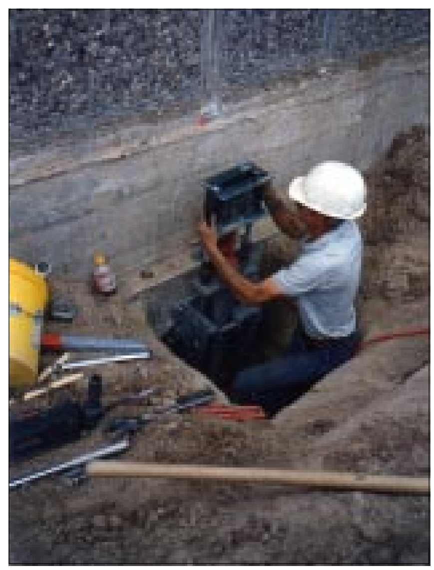
Job Description:

This 10-year-old school gymnasium was built on a hillside leveled with fill over shale bedrock. Settlement of up to 6 inches across the diagonal length of the gym floor with slight horizontal movement caused by an underground water source necessitated some type of repair. Chance HELICAL PIER® Foundation Systems screw anchors and brackets were selected as the most cost-effective method to correct the problem.

Repair:

The wood gym floor and concrete slab were removed. Around the interior of the gym and the exterior of the tilt-up building, 132 anchors (each with three helices of 8-, 10- and 12-inch diameters on a 1¾-inch-square shaft) were installed to depths of 13 to 24½ feet on intervals of 6 to 8 feet. The anchors were installed by a 10,000 ft.-lb. hydraulic motor mounted on a skid loader.

Design load capacities of these anchors varied from 21 to 40 Kips. All piers were installed with a 2:1 safety factor to provide ultimate capacities from 42 to 80 Kips.



Chance Heavy-Duty underpinning brackets (40,000-lb. working capacity) connected the anchors to the foundation footing. 30-ton jacks were mounted on the brackets to lift the foundation in intermediate steps back to level.

The adjoining locker rooms were supported by 120 Chance screw anchors (each with an 8-inch-diameter helix on a 1½-inch-square shaft) and slab brackets on 6-ft. grids. These slab anchors were installed through 8-inch holes cored through the slab to average depths of 20 feet for the 6 Kips design load. The anchors were installed by a custom-made 5,000 ft.-lb. portable drive rig bolted to the slab

CONTINUED, NEXT PAGE

at each location. To lift the slab back to level, approximately 150 ft.-lb. of torque was applied to the slab-brackets' lifting bolts.

To resist lateral forces, 12 Chance tieback anchors were installed on the uphill side of the gym to depths of 40 feet. A new grade beam was cast with sleeves in it to allow post-tensioning these anchors. The tiebacks were tested to 65 Kips and locked off at the design load of 40 Kips.

Heavy-Duty underpinning brackets installed outside and inside perimeter of foundation.

Slab-leveling anchor being installed and bracket bolt visible through core which was refilled after final adjustment.

UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:
Foundation settlement
Columbus, Ohio

Owner:
The Daimler Group

Structural Engineer:
Jezerinac, Geers & Associates, Inc.

Geotechnical Engineering:
CTL Engineering

Designed By:
Engineering Division of Hydro-Tech

Installed By:
Hydro-Tech

Description of Building:

200,000-square-foot warehouse under construction with exterior walls of 26-ft.-high concrete tilt-up panels. Design load for the footings was 4,000 pounds per lineal foot.

Site Preparation:

The entire site had been raised 2 to 12 feet with compacted clay during the winter.

Distress Observed:

After the erection of the tilt-up panels and the placement of the steel roof, the southwest and southeast corners of the building settled approximately 1 to 3 inches. Standard penetration tests were performed by CTL Engineering to determine the consistency of the soil near the corners of the building. Blow counts, as low as 1 were encountered 6 to 10 feet below the footing elevation. The engineers concluded that the weak soil was probably a result of frozen soil being stripped and placed within the building area.

Repair:

33 Helical Pier® Foundation Systems screw anchors were installed to an average depth of 20 feet. Lifting force of 15,000 to 20,000 pounds was applied. Amount of Lift: ¼" to 2³⁄₁₆".

CHANCE®

UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:	**Geotechnical Investigation:**	**General Contractor:**
Wentworth Condominiums Hamilton, Ontario	Peto MacCallum Ltd. Kitchener, Ontario **Consultant:** Kleinfeldt Consultants Ltd. Kitchener, Ontario	EBS Engineering & Construction Breslau, Ontario

Job Description:

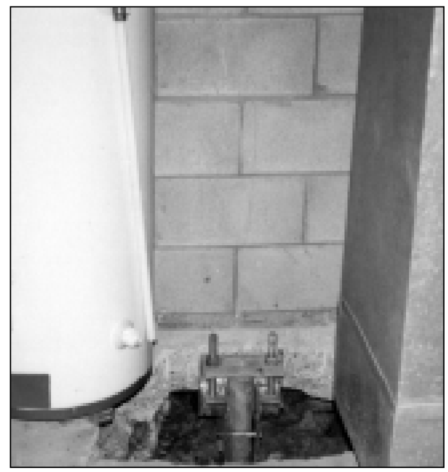
The Wentworth townhouse development was built in 1973 on a low-lying area that had been filled to facilitate the development. This fill, consisting of a mixture of clay, silt and sand with organics and topsoil inclusions, had been placed with little compaction effort. To further compound the problem, the original compressible topsoil layer was not stripped before the fill was placed. Underlying the surficial fill and original topsoil layer, the native soil comprised competent deposits of clay and clayey silt till.

The townhouse units were built with slab-on-grade construction (no basements) and footings 4 to 12 feet below grade. Many of the units were experiencing distress resulting from the long-term settlement of the fill layer. A total of 12½ units in four different buildings required underpinning to stabilize the townhouses against further anticipated settlement.

Repair:

With the water table at 5 feet, extensive shoring was required to expose the footing, located at depths up to 12 feet below grade. (Utility locations were unknown, requiring hand digging.) Water had to be pumped continuously from the deeper excavations.

The HELICAL PIER® Foundation Systems screw anchor size selected for underpinning was the two helix (8- and 10-inch diameters) Type SS5. All anchors were installed into the native soil layer with portable equipment. Installation torque was monitored to ensure anchor capacity. Anchor lengths varied up to a maximum of 25 feet below grade. Of the 220 anchors, approximately 25 per cent were installed in living areas. The remaining anchors were installed in garages or along the exterior of living areas. Substantial savings were realized over other methods.



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UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:
Central Secondary School
London, Ontario

Geotechnical Investigation:
Golder Associates
London, Ontario

Consultant:
M.D. Morham Engineering, Inc.
London, Ontario

General Contractor:
EBS Engineering & Construction
Breslau, Ontario

Job Description:

The London Secondary School, originally constructed in 1922, required additional space. The existing boiler house was to be extended along with another level added above the entire boiler house. The existing walls did not indicate any evidence of significant settlement, cracking or other foundation-related distress in the areas examined. Results from boreholes and test pits indicated the existing west wall was founded on loose sand that was not capable of supporting the proposed increase in bearing pressure.

Repair:

A Helical Pier® Foundation Systems anchor was designed to increase the capacity of the existing foundation for the boiler room wall as well as support interior columns. This system was considerably less disruptive than traditional underpinning panels.

Each Type SS5 anchor consisted of a two helix (8- and 10-inch diameters) lead section followed by 5-foot extensions and, finally, a foundation-repair bracket. Installation depth varied from 7 to 22 feet. Once installed, the anchors transferred the additional load placed on the walls down through the loose fill and into the native fine to medium sand below.

(Installation torque was monitored to ensure capacity.) All anchors were installed from inside the building using portable equipment. This required working around other column foundations as well as limited working space; however, the need for extensive shoring to expose the footing was no longer required. Anchors were preloaded to 75 per cent of the design load.

The proposed south building addition was to be founded on conventional spread or strip footings bearing on native, undisturbed sand. With the recently gained experience, it was decided that screw anchors with the new construction bracket would support the addition. This also eliminated any potential undermining of the existing building footing.

The cost of using this system was significantly less than other underpinning methods.

CHANCE®

UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project
Condominium project in
St. Tammany Parish, LA

Project Scope:
Rehabilitation of existing pile/beam foundation system

Contractor:
Hargrave & Associates

Geotechnical Engineering:
Gore Engineering, Inc.

Structural Engineering:
Smythe Engineering Co.

Details:

The condominium was an elevated structure with a wood joist framing system comprising the first floor. This wood framing system was supported by shallow concrete block pillars embedded 1 to 2 feet. These pillars had experienced both vertical and lateral movement as a result of a highly expansive clay layer ranging from 2½ to 6 feet in depth. "Crane space" available between the floor joists and ground ranged from 24 to 40 inches.

Remedial Repair:

Plan was to replace the existing concrete block pillars with HELICAL PIER® Foundation Systems anchors installed at least 10 feet deep. This depth would ensure that the helix bearing plates would be below the active soil zone. Special 2ft.-8in.-long lead sections and extensions would be used due to limited head room under the structure. In areas of minimal clearance, holes would be hand excavated for head room needed to start the lead sections.

Load Testing:

Load tests were performed on two different foundation anchor configurations. Test Anchor 1 was a lead section with 10- and 12-inch-diameter helices installed to a depth of 13ft.,6in. and a final torque of 1,700 ft.-lb.

Test Anchor 2 was a lead section with a single 12-inch-diameter helix installed to a depth of 10ft. and a final torque of 900 ft.-lb. At twice the working load (13,000 lb.), Test Anchor 1 experienced a ⅜-inch displacement and Test Anchor 2 experienced a ⅝-inch displacement.

Installation:

Twenty-four (24) foundation anchors, each with a single 12-inch-helix lead section, were installed to a minimum of 1,000 ft.-lb. of torque. This torque was achieved at the 10-ft. depth at most locations. Some required additional plain extensions to achieve this torque. A Chance 2,500-ft.-lb. portable hydraulic drive unit was used to installation all 24 anchors in 1½ days by a three-man crew. This two-anchor-per-hour rate was remarkable since the crew was always working in a horizontal or kneeling position.

CHANCE®

UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:
Talbot School
Billerica, MA

Engineer:
Veitas & Veitas
Braintree, MA

Contractor:
Jager Construction
Amherst, NH

Job Description:

To install an elevator, it was necessary to excavate beside a 2-foot-wide interior stone foundation wall. This would undermine the wall which was carrying a load of over 4,000 pounds per lineal foot.

Repair:

To prevent the wall from collapsing, HELICAL PIER® Foundation Systems anchors were used to support the interior wall during and after construction of the elevator. Five anchors also were used on an adjacent exterior wall to prevent lateral movement from soil pressure pushing in on the wall after the existing concrete slab and soil were removed.

Each anchor was installed to a minimum of 2,500 ft.-lb. for a bearing capacity of 25,000 pounds. 8" x 8" angles were fixed on top of the foundation repair brackets above each anchor and set under the wall, with high-strength grout filling the voids. This was done on both sides of the wall.

During construction of the elevator, the wall was totally undermined and all its weight was supported by the HELICAL PIER Foundation Systems anchors.

CHANCE®

UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:	Engineer:	Contractor:
Lafayette Center Kennebunk, ME	Indus Engineering Portland, ME	Jager Construction Amherst, NH

Job Description:

This four-story elevator and stairway tower had settled and rotated away from the original building. HELICAL PIER® Foundation Systems anchors were used to lift and stabilize the structure.

The portion of the building which is nearest to the river was constructed on organic soils. It had settled differentially so that it had created a 4-inch gap at the top between old and new portions of the building.

Repair:

Twelve SS175 foundation anchors were installed to a 15-foot depth. A Case 580E backhoe with a 10,000 ft.-lb. hydraulic drive head was used to screw the anchors into the soil. Heavy-duty foundation repair brackets were installed on top of the anchors and fastened to the bottom of the foundation. Five SS5 foundation anchors with standard foundation repair brackets were installed inside the elevator pit.

After all anchors were installed, a series of jacking tools and 50-ton hydraulic jacks were set on the anchors. Forces were applied simultaneously to the jacks to start lifting the building. By the end of that day, the elevator building had been lifted to near its original position.

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UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:	Anchor Contractor:	Anchor Design:	Project Engineer:
Mezzanine foundations, Harvard University, Cambridge, MA	Jager Construction Amherst, NH	Veitas & Veitas Braintree, MA	Haley & Aldrich Cambridge, MA

Job Description:

HELICAL PIER® Foundation Systems anchors were installed inside the Briggs Gymnasium to support columns for a new mezzanine.

Repair:

The concrete floor was removed in the areas where the anchors were to be installed. A Bobcat with a 20,000 ft.-lb. hydraulic drive head was used to install 25 anchors, each with 10"- and 12"-diameter anchor plates. Each helix was installed through an organic fill layer into dense sand, to a depth of 10 to 12 feet, for a minimum ultimate capacity of 45 kips. Some anchors achieved an ultimate capacity of up to 80 kips. Anchor pile caps were cast to complete the foundations in three days without major disruptions at a cost savings versus alternate methods considered.

CHANCE®

UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:	**Geotechnical Engineer:**	**Structural Engineer:**	**General Contractor:**
Ken Keyes, Jr. College Coos Bay, OR	Tom Ferrero Ferrero Geologic Ashland, OR	Robert Taylor Robert F. Taylor Engineering, Inc. Medford, OR	Phelps & Son Construction Eugene, OR

Problem:

When an addition was made to this building, part of the site consisted of fill. To prevent settlement of the building, wooden piles were driven through the fill to provide support for the foundation. Over time, these piles rotted, allowing the structure to settle at one end.

Repair Solution:

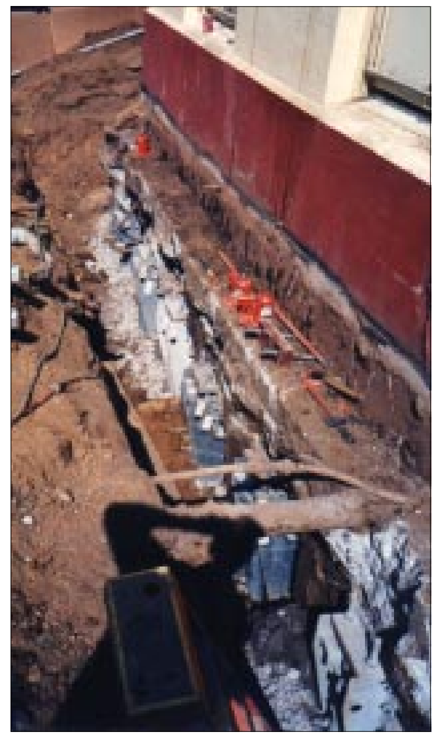
To remedy this situation, 68 remedial Helical Pier® Foundation Systems anchors were placed under the settling part of the structure. They now support the weight of the structure to help prevent further settlement.

Helical Pier Foundation Systems was developed by the Chance Co. This approach has three main components: Lead section, extensions and foundation bracket or new construction bracket. The lead section used on this job was a 1¾-inch-square steel shaft with three helices welded to it. A helix is one pitch of a screw which provides the anchor's bearing surface as well as its means of installation. The extensions also were 1¾-inch-square steel shaft. By adding extensions to the lead section, depths greater than 100 feet may be reached.

The foundation bracket is L-shaped to

fit under and bolt to the side of the foundation. The load of the structure is transferred from the foundation to the anchor via the bracket. For new construction, a T-shaped piece is fitted over the end of the anchor. Reinforcing steel is then tied or welded to the bracket before being cast into a concrete grade beam.

The anchors are installed by a hydraulic drive motor which screws them into the ground. Installation torque is constantly monitored and directly correlates to the bearing capacity of each individual anchor. On this job, each anchor was installed to 8,000 foot pounds of torque to



support the design load of 40,000 pounds per anchor with a safety factor of two.

Installation depths: 21 to 40 feet

Anchor spacing: 4 to 5 feet.

Anchors were preloaded to 20 kips, for stabilizing only. The four-story masonry building had settled as much as 9 inches. Trying to lift the foundation could have further damaged the building.

UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:
Charles Residence, McCormick Ranch, Scottsdale, AZ

Geotechnical Engineer:
Thomas Hartig & Associates, Chandler, AZ

Problem:

Jerry Hargrave told high-school friend Mr. Charles that any distressed property in Scottsdale could be fit with Chance HELICAL PIER® Foundation Systems anchors. Mr. Charles took the challenge and located a house in McCormick Ranch that had developed a "sunken" living room.

Two attempts to stop the movement had proved futile: Pressure grouting and pipe piles.

Pressure grouting, if done properly, can be effective but often proves costly. It is difficult to control just where grout will flow in the ground. For example, a weakened sewer line may break, providing a low resistance void where much wasted grout may go. If the pressure grout material is not founded on a good bearing stratum, the extra weight may cause further settlement of a foundation.

Because pipe piles are pushed into the ground using the foundation as a reaction, it's not always possible to get the piles into adequate bearing material. In such a case, a pipe pile's capacity is derived from its skin friction with the soil. Since the pipe can be pushed only as much as the foundation will react, there is no way to provide any safety factor.

Chance anchors are installed independently of the foundation. By measuring installation torque, the capacity of a screw anchor can be determined. A known safety factor can thus be established.

Repair solution:

Since geotechnical engineer Tom Thomas had not seen a screw anchor installed, he was skeptical.

A test anchor was installed to determine feasibility. It was driven about 24 feet into bearing stratum that could support 25 kips.

More than 40 production anchors were driven, from 20 to 40 feet deep. Because the existing footing was not reinforced, the anchors were spaced 5 feet apart on the exterior walls. Using Chance underpinning brackets, the foundation was lifted 3 inches. After leveling the structure, a new floor was poured.

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UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:	**Geotechnical Engineer:**	**General Contractor:**	**Anchor Contractor:**
Yoshi's Restaurant & Jazz Club at Jack London Square Oakland, CA	Harza Consulting Engineers & Scientists Oakland, CA	Rudolph & Sletten, Inc. Irvine, CA	Sunstone Construction Campbell, CA

Problem:

Part of the ground floor of the Jack London Square Garage had been allocated for retail shops. Deep foundations were needed due to higher loads for Yoshi's Japanese Restaurant & Jazz Club and a 10-foot layer of loose sand (2 blow counts SPT) located 10 feet below ground level.

Repair solution:

Chance Helical Pier® Foundation Systems anchors were specified because of the low overhead clearance (9 to 15 feet) and their lower installed cost compared to other foundation types. A total of 123 Type SS175 (1¾"-square steel shaft) anchors were used.

The design load was 45 kips. Three compression tests were conducted to 75 kips. Net deflection was less than ¼ inch. The three-helix (8-, 10-, 12-inch diameters) anchors were installed 31 to 36 feet into a very dense sand layer with blow counts to 60. Minimum installation torques of 8,000 ft.-lb. were achieved.

The anchors were cast into grade beams tied into the parking garage footings. The anchor end termination was an 8" x 12" x 1¼"-thick steel plate welded to a 3¼" steel pipe with a ⅜" wall. A hole through the pipe allowed a ⅞" bolt to pin the pile cap to the 1¾" anchor shaft.

The parking garage is located about a half mile from the double-deck section of I-880 that collapsed during the 1989 Loma Prieta earthquake. The original floor was a floating slab which could subject the restaurant's contents to considerable damage during an earthquake. A slab on grade beams supported by Chance anchors was chosen to mitigate potential seismic damage. Because the anchors were cast in grade beams, lateral restraint was supplied by the parking garage's foundation.

The site had a potential for liquefaction in the loose to medium-dense sand layers during an earthquake. Concern for buckling of the anchors in very loose sands was addressed by a buckling analysis using the computer program LPILE by Ensoft, Inc. of Austin, TX. The analysis showed that with axial loads up to 90 kips, the very loose sand layer from 10 to 20 feet depth did not adversely affect the buckling response of the anchor.

CHANCE®

UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:
Corestates Center Sports Complex
Philadelphia, PA

Structural Engineer:
Bernard Schwartz & Associates
Blue Bell, PA

General Contractor:
L.F. Driscoll Co.
Bala Cynwyd, PA

Foundation Contractor:
D'Angelo Bros., Inc.
Philadelphia, PA

Job Description:

Mechanical-equipment foundation installation with strict settlement tolerances posed unique challenges to the foundation designers. Since the underground piping systems had to be installed before the equipment, two problems came to light. One was that the structure itself limited access for a timber-pile rig. The other was that the proximity of the underground piping raised concerns against the excessive vibration and possible heaving associated with pile driving.

Site geology consisted of a dense sand and gravel layer under a 25-foot organic/clay layer covered by 5 feet of common fill.

Repair Solution:

Chance SS175 HELICAL PIER® Foundation Systems anchors were used to support the structural equipment pads which required a 10-kip working load per anchor.

Due to the close spacing of the 45 anchors, 4,000 ft.-lb. of installing torque was used to exceed standard factors of safety used for this working load. The installation was achieved using a 190 Dynahoe first to expose the existing piping and then to supply power to the 10,000 ft.-lb. drive head for anchor installation.

Chance streetlight foundations also were installed for site lighting around the arena perimeter.

CHANCE®

UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:
University of Pennsylvania
White Training Center basement reconstruction
Philadelphia, PA

Structural Engineer:
Joseph B. Callaghan, Inc.
Philadelphia, PA

General Contractor:
John S. McQuade Co.
Philadelphia, PA

Foundation Contractor:
D'Angelo Bros., Inc.
Philadelphia, PA

Job Description:

Replace existing bi-level basement slab and retaining walls with pile supported structural slab on grade and wall footings.

Unconsolidated and eroding soil were the major factors causing structural damage to the food-preparation and mechanical areas in the basement.

Specified Solution:

Install 30 piles with a 40-kip working load per pile. The Chance HELICAL PIER® Foundation Systems screw anchor was among four pile options listed in the Specifications.

Repair:

D'Angelo Bros., Inc. was selected as the pile contractor using Chance SS200 screw anchors. Each pile consisted of a lead section with three helices (6-, 8-, and 10-inch diameters) and 15 vertical feet of extension to reach the required decomposed mica schist bearing stratum. Torque ranging from 8,000 to 10,000 ft.-lb. was achieved during this installation using a 10,000 ft.-lb. drive head hung off a mini excavator that fit through the 44"-wide door opening and under the 7-foot ceiling. The drive head was powered by a hydraulic power unit stationed outside the building and engaged by hand-held remote.

Pile installation was completed in five working days, six days ahead of the general contractor's schedule.

UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:	**Structural Engineer:**	**General Contractor:**
Federal Express air structure	Consulting Structural Engineers, Inc.	Copestone Company
Colorado Springs, CO Airport	Colorado Springs, CO	Colorado Springs, CO
Geotechnical Engineer:		**Chance Anchor Installer:**
Commercial Testing Laboratories Inc.		SCHP, Inc.
Colorado Springs, CO		Colorado Springs, CO

Job Description: For a temporary air freight cargo facility, Federal Express chose a tent-like building called a Sprung Instant Structure. This type of structure required a temporary foundation to meet the designed pull out load of 4,880 lb. for each of 16 tiedown anchors required.

Commercial Testing Laboratories, a division of CTL-Thompson, Inc., performed tests on three tiedown methods. Testing was performed using a calibrated hydraulic system consisting of a pump, hollow ram jack and calibrated gauge. A 4-ft. length of ¾- dia., threaded rod was placed through a base plate connected to the tiedown anchors. Two 10-ft. lengths of W6 beams were placed adjacent to the base plates and supported on each end by CMUs (concrete masonary units) to act as a reaction assembly. The hollow-core ram jack was placed over the threaded rod and slid onto the top of the reaction beam assembly. A plate washer and nut were used to retain the top of the ram.

Chance screw anchors helped speed up the construction of this temporary storage building.

1. The initial anchor test was on two ⅝" x 3 ft. smooth-steel dowels driven in at 30° from vertical. An ultimate load capacity of 950 lb. was recorded.
2. The second test was performed on four, #5 x 3 ft. rebars driven at 30°. The ultimate load capacity for this system was 2,630 lb.
3. The third test was done on a Chance HELICAL PIER® Foundation Systems screw anchor (8"-dia. helix on a 5-ft. x 1½"-square shaft). It was installed to about 500 ft.-lb. and load tested to 5,000 lb.

Results: One Chance screw anchor per frame was installed on the inside of the fully constructed structure. An angled connection designed by CSE, Inc. allowed attachment from the structure frame to the screw anchor via a ⅜"-dia. steel cable. The 16 anchors and connections were installed in less than eight hours by a skid loader with a 5,000 ft.-lb. hydraulic drive head.

Update: Three years after the anchors were installed, the temporary facility was no longer required. Copestone Company requested SCHP, Inc. to remove the screw anchors. All material recovered was fully intact and completely reusable.

UNDERPINNING ANCHORING REPORT

A CASE HISTORY

Project:
Chandler Residence
Bahia Bay, TX

Engineer:
Ronald Voss, P.E.
Corpus Christi, TX

General Contractor:
Haristan Homes, Inc.
Rockport, TX

Foundation Contractor:
Torq Teq, Inc.
Montgomery, TX

Job Description:

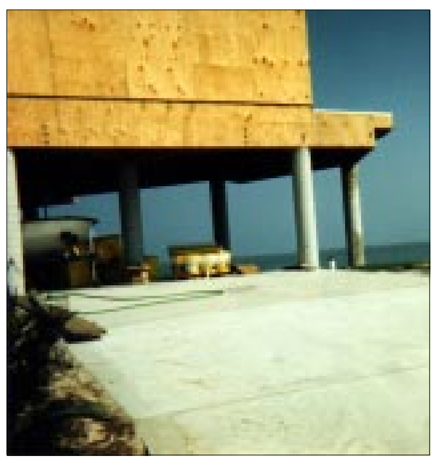
A two-story contemporary home was to be built on a lot overlooking the intercoastal waterway on the Gulf of Mexico. The Building Code required the structure be elevated 10 feet above ground level and be designed to withstand 115 mph winds.

Bulkheads bordered three sides of the lot. A soil test boring revealed a stratum of loose fine sand to a depth of 23 feet, then medium-dense to dense fine sand from 23 to 55 feet. "N" values within these sands ranged from 19 to 38 blows per foot. These soils were non-plastic with shell fragments throughout the 55-foot depth. Ground water was constant at a 6-foot depth.

Specified Solution:

To resist vertical-compression design loads ranging from 3,500 to 14,800 pounds, 27 square-steel-shaft Chance HELICAL PIER® Foundation Systems anchors were specified. Each was placed at a support column location on the grade beam. A vertical-compression design load was given for each column.

In one and a half workdays, the foundation anchors were installed to depths as much as 28 feet by an Eskridge 6,000-ft.-lb. drive head on a 960 Mustang skid loader. To ensure desired load capacities, installation torque was monitored at 1-foot intervals. Each anchor was terminated with a 5-inch-square plate welded to the shaft.



Superstructure:

To connect the support columns with reinforcing steel to the 24-inch-deep grade beam, an 18-inch-diameter fiber tube was placed around each anchor shaft from a depth 2 feet below grade to the 10-foot elevation required for the first-floor joists. Hence, a concrete column terminated and extended each anchor to the house.

Lateral loads are resisted in the design by the concrete slab-on-grade parking area below the house and the skin friction and passive-soil pressure on the grade beam. The overturning moment is resisted in bearing and side friction on the grade beam.