SlabTek Installation Procedure Manual

For: Commercial Post-Tension Slab

Dated: February 15, 2018

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Section 1. Overview

This Installation Procedure Manual reflects current industry best practices for installation of the Slab-Tek foundation system. Soil expansion and contraction, due to changes in moisture content, causes the vast majority of concrete slab failure in regions where highly expansive soils are found. Properly installed, the SlabTek foundation system effectively protects a concrete slab foundation from damage due to expansive soils by providing a void under the slab of greater height than the maximum soil expansion. This is accomplished using a patented system using lifting mechanism which sit atop each pier in a suitably sized array of piers beneath the slab. Piers may be either reinforced concrete or helical, and slab reinforcement may be either conventional rebar or post tension strands.

Reducing the incidence of foundation distress due to soil movement is only one of many advantages of the SlabTek system. Other advantages include:

- Significantly simplified site preparation compared to typical slab-on-grade construction.
- Labor and material savings due to the elimination of all internal beams

The SlabTek system and lifting mechanism can be incorporated in a concrete slab with rebar reinforcement, post tension cable reinforcement or a combination of both post tension cable and rebar. For purpose of this document, the example provided in this document illustrates a typical 30-40’ x 60-80’ two-way flat-plate suspended post tension foundation on piers, poured on the grade and lifted after installation to provide a void between the foundation and the soil. This void allows for seasonal movement of the soil without affecting the foundation

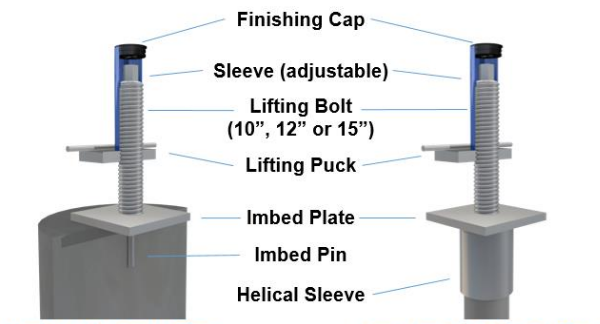
This document does not dictate one single, specific method for installation of the SlabTek system, but rather provides minimum requirements which must be met to ensure proper functioning of the system. Any specific installation procedure which meets or exceeds these minimum requirements is acceptable.

This document provides the minimum requirements for proper installation of the SlabTek System, in the context of a detailed step-by-step overview of an example SlabTek installation. The example given is solely as reference to engineers and contractors who may be unfamiliar with the system. Throughout this installation example, options and recommendations are discussed. These installation recommendations follow procedures that have gained wide acceptance by builders since the first installation in 2005.

Section 2. Layout and Installation of Forms, Beams, and Piers

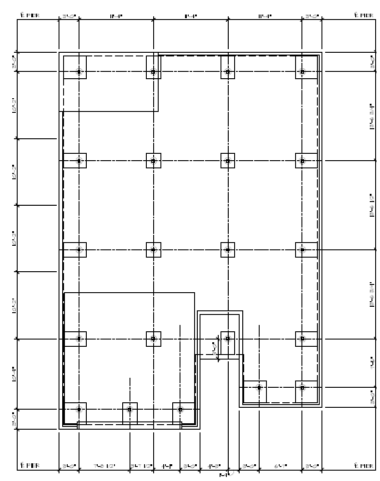
2.1 General Description

2.1.1 The SlabTek system consists of lifting mechanisms (MECH) installed atop an array of piers, which together support a (typically) 5”-6” thick reinforced concrete slab. Since the slab is only supported at pier locations, grade beams are not required. The number, location, and type of piers is specified in the structural drawing package. Piers can be traditional concrete piers or steel helical piers. Piers are typically arranged in a rectangular grid which enables each post tension (PT) cable to align with an entire row, or column of piers. In a (nominally) 22” square region, centered on each pier, the (nominally) 5” slab is thickened to (nominally) 10”. This “capital”, serves to distribute high structural loads present at each pier, evenly to the surrounding slab. A rectangular grid of rebar is centered over each capital. These rebar grids are aligned with, and tied to, the PT cable grid. SlabTek foundations do not require a perimeter beam for structural support, but most slabs include a perimeter beam to provide a barrier to protect the void produced under the slab after lifting from moisture, erosion, and animals. Perimeter (or ‘skirt’) beam reinforcement may be provided with rebar or PT cables.



Mech for Concrete Piers
Mech for Steel Helical Piers

The amount that a soil can be expected to expand and contract depends on the mineral composition of that soil. This change is characterized by a number, the Potential Vertical Rise (PVR) of the soil. Roughly speaking, PVR represents the change in ground level that can be expected as that soil’s moisture content changes from very dry to very wet. PVR is generally found in the geotechnical report obtained for the construction site, where it is calculated based on scientific analysis of soil samples taken from the site.


Typical Rectangular Grid Pier Array

2.1.2 SlabTek recommends that the slab be lifted an absolute minimum of 1 inch higher than the PVR of the soils, but preferably 1.5X the PVR of the soils.

2.1.3 Effectiveness of the SlabTek system is based on providing and maintaining a sufficient void beneath the slab so that subsequent natural soil movement does not disturb the foundation. Even with proper installation, slab distress can be caused by:

- Improperly designed or installed piers
- Soil movement in excess of the lift height

For this reason, SlabTek *highly recommends* that engineers and contractors utilizing the system pay close attention to pier design & construction, and ensure that an appropriate geotechnical report has been consulted.

2.1.4 In cases where the void has been exhausted either by pier settlement or excessive soil expansion, the SlabTek mechanism may still be used to further lift the slab to limit distress.

2.2 Site Preparation

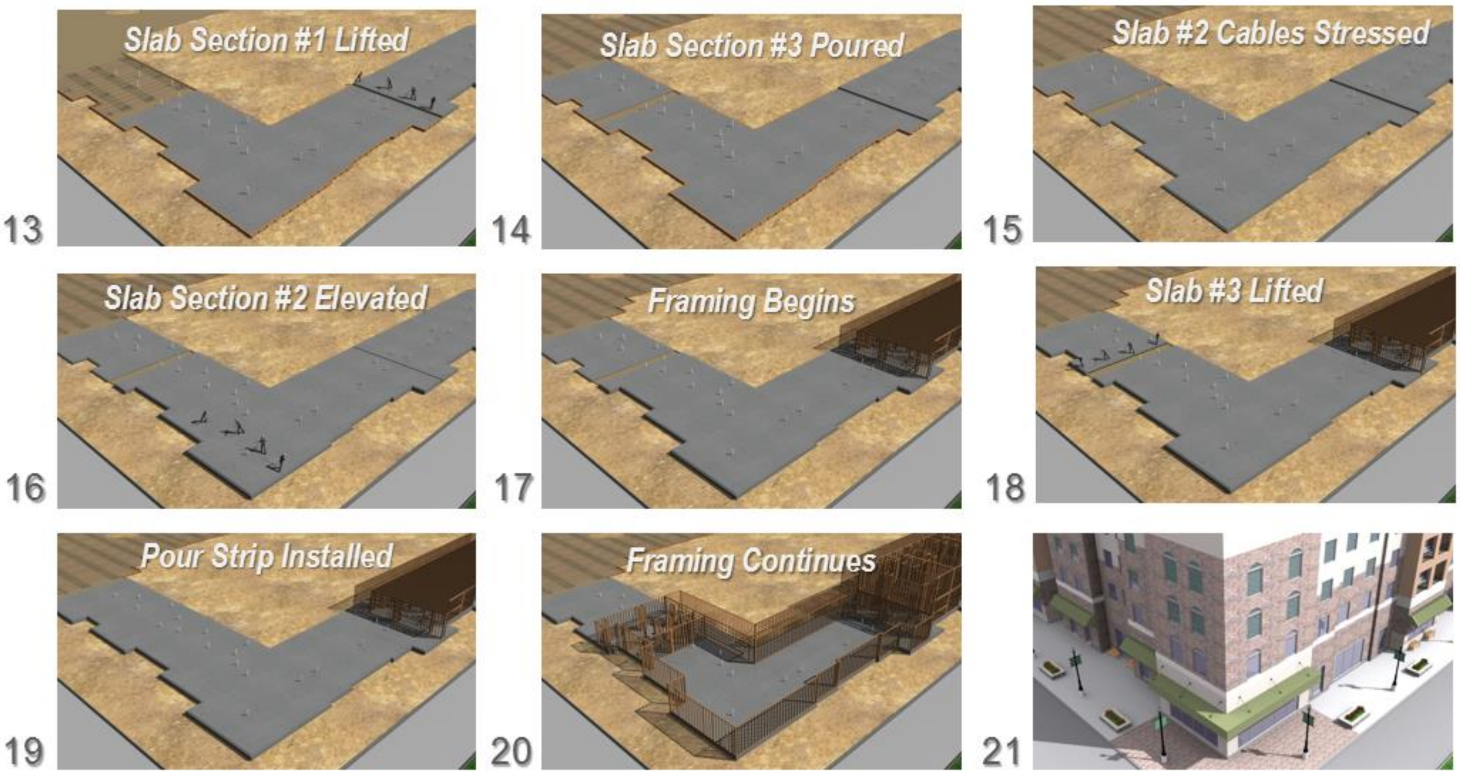
2.2.1 Care should be taken to insure finished floor height meets municipality guidelines on overall height of building.

2.2.2 Pad site to be excavated to the proper level to account for specified lift.

2.2.3 If it is determined lift is to be greater or lower than originally specified, overall building height can be compromised. Check with municipality or feasibility.

2.2.4 Notifications of specified lift changes must be made to engineer of record as soon as possible

The following graphic provides overall context for the typical sequence of SlabTek system installation steps, and may provide a useful reference when reading the subsequent sections, which give detailed descriptions of each construction step.



2.3 Layout of the Forms

2.3.1 Once the site is leveled appropriately, set perimeter form boards at grade level per the structural drawings. For the typical 5" slab thickness, SlabTek recommends 8" form boards to allow room to attach the PT cables.

- If 8" form boards are used, the spoils from the excavation of piers and capitals will typically be sufficient to make up the pads for the 5" foundation without the necessity for additional backfill. Form boards taller than 8" may be used, but more backfill will be required to make up the pad.
- It is <u>not required</u> to compact any backfill used to create the pad.

2.3.2 The top of the perimeter form boards should be set at the finished floor level minus the amount the foundation is to be raised. (example: if the finished floor elevation is to be 100'-0", and the foundation is to be raised 6", then set the top of the perimeter forms at 99'-6". When the foundation is elevated 6", the finished floor will be 100'-0").

2.3.3 After the perimeter form boards are placed, locate and mark the center of all piers per the structural drawings.

2.3.4

2.4 Creation of the Perimeter Beam

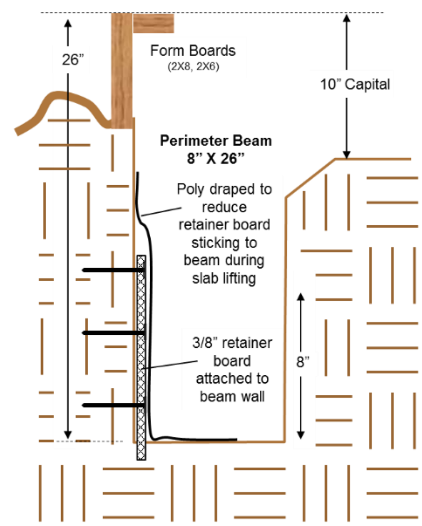
As previously mentioned, a perimeter beam on a SlabTek slab is optional and provides no structural support. The perimeter beam may be installed prior to, or after, the piers are installed. If the perimeter beam is to be installed after the piers, the steps in this section may be deferred.

2.4.1 Trench the perimeter beam width and depth as specified on the structural drawings. Beam requirements can be found in the structural drawings. Typical perimeter beam width is 8" with a tolerance of +2" and -0".

2.4.2 Since the slab will ultimately be lifted above grade by the SlabTek system, it is imperative that any concrete adhesion between the perimeter beam and the surrounding grade is avoided. Failure to prevent adhesion can lead to slab distress.

Soil Retainer Board Installation Option

Installation of a 3/8" High Density Polypropylene material (HDPP) such as Coroplast and draped with poly to reduce sticking to the beam.



- The sides of the perimeter beam trench must be smooth and have no large irregular surfaces.
- The beam should be of a consistent width vertically as well as horizontally. In no case shall the bottom of the beam be wider than the top of the beam.
- Historically, when the perimeter beam is embedded into compacted stiff materials, soils do not have a tendency to collapse within the void created under the beam after it is raised. However, if poor drainage exists, rough grade is not performed after the foundation is lifted, or the perimeter beam void is exposed during lifting, soils can collapse or be pushed into the cavity. It is for this reason that Slab-Tek recommends the use of soil retainer on the outside of the perimeter beam trench to prevent loose soils from collapsing into the trench prior to slab pour, or after slab lift. SlabTek recommends the use of soil retainer on either or both sides of the trench where sidewall collapse has been observed prior to slab pour.
- Where trenching of a perimeter beam has encountered rock or other object and the side-walls cannot be created in a smooth manner, SlabTek also recommends the use of soil retainer to eliminate the possibility of the concrete and rock effectively attaching the slab to the grade prior to lift. Objects can included, but not limited to tree roots, preexisting plumbing, concrete, electric, gas lines, and rock.
- The perimeter beam must be able to move freely upward during the lifting process.

2.5 Pier Installation

Engineered foundations using the SlabTek system may specify either reinforced concrete piers or helical piers. Refer to the structural drawings for the selected pier type and construction details. Concrete pier installation is described in section 2.5.1, and Helical pier installation is described in section 2.5.2.

2.5.1 Concrete Pier Installation

2.5.1.1 At each of the locations marked in 2.3.3, drill holes of the required diameter, depth, and verticality specified on the structural drawings.

2.5.1.2 Unless noted otherwise on structural drawings, SlabTek *requires* that all piers be located within a 3" maximum tolerance from the specified location

- *If pier cannot be located within tolerance due to conditions in the field, the engineer of record shall be notified prior to proceeding for potential design revisions.*

2.5.1.3 After drilling, pier holes shall be cleared of any loose debris and any water removed.

2.5.1.5 Unless noted otherwise on structural drawings, SlabTek *requires*:

2.5.1.4	SlabTek recommends that all pier holes be inspected by the engineer of record or a 3rd party to verify that the quantity, location and depth of piers is in compliance with the structural drawings. Pier depth and any variances from specifications should be recorded and retained.

- Concrete for piers shall have compressive strength of at least 3000 psi.
- Concrete for piers shall have a minimum of 5-inch slump. Higher slump ranges are recommended when the concrete will be placed by pumping.
- Pier holes shall not have more than 6” of water at bottom at time of pour. If necessary, water shall be pumped out and the concrete can then be poured immediately, once correct depth has been confirmed.

2.5.1.6 Construct and install reinforcing steel in each pier hole as specified in the structural drawings.

2.5.1.7 SlabTek recommends the use of pier forms to ensure the proper pier elevation and eventual placement of the SlabTek MECH. Cut the pier-forms to allow a minimum of 6" to remain inside the pier hole. The top of the pier form should be high enough to ensure proper pier top Elevation.

- *Inadequate containment of the wet concrete at the top of the pier can lead to “mushroom” pier tops, which can decrease the structural performance of the pier, and must be avoided.*
- Pier forms may not be necessary when 8” perimeter form boards are used, since the top of the concrete is typically below original grade level. *Regardless of the perimeter form boards utilized, if the sides of the pier hole at the level of the top of the pier concrete are sufficiently stable, pier forms may be omitted.*

2.5.1.8 Pier shafts shall be filled to a typical elevation of 10" to 10 ½" below the top of concrete per the engineering specification.

- For a typical 10" capital, the maximum tolerances allowed are minus (-) ¾"and plus (+) 1". minimum capital thickness is 9"
- Thicker capitals are possible but custom sleeves must be made to accommodate the deeper sections.

2.5.1.9 Concrete shall be placed in a manner to avoid shifting the reinforcing steel during placement

2.5.1.10 Lightly tamp the top of pier concrete to eliminate voids in the upper surface of the pier

2.5.1.11 Trowel the top of the pier concrete to provide a smooth finished surface.

2.5.1.12 SlabTek recommends taking concrete cylinders of the concrete mix at the time of pour to verify the concrete mix meets the design specifications of the structural drawings.

2.5.1.13 Care should be taken when pier is located close to a drop. Capital thickness is determined by the low side of the drop and the top of pier is to be poured accordingly.

2.5.2 Helical Pier Installation

2.5.2.1 At each of the locations marked in 2.3.3, insert helical piers of the specified size, and that meet or exceed all material and quality specifications contained in the structural drawing package. Installation to be completed by certified installer.

2.5.2.2 <u>Unless otherwise specified</u> on structural drawings, SlabTek *requires* that all piers be located within a 3" maximum tolerance from the specified location

- *If pier cannot be located within tolerance due to conditions in the field, the engineer of record shall be notified prior to proceeding for potential design revisions.*

2.5.2.3 <u>Unless otherwise specified</u> on structural drawings, Slab-Tek *requires* that helical piers be plumb to within 1 inch in 4 feet.

2.5.2.4 Helical piers shall be installed to the depth specified on the structural drawings.

2.5.2.5 Helical piers shall be torqued to the specified refusal pressure as specified on the structural drawings.

2.5.2.6 All helical piers shall have a lateral stabilizing device installed with each helical pier. The most common lateral stabilizing device recommended is a non-reinforced concrete helical cap. The cap is created by digging or augering a hole around the helical and placing concrete around the top of the helical steel shaft providing lateral stability for the top of the pier.

The Helical Pier is measured to assure it is center and cut to the proper height

The cap is typically cylindrical and is typically specified to be 3000 PSI concrete 1' in diameter and a minimum of 20" deep:

2.5.2.6.1. If the minimum distance between the inner wall of the closest perimeter beam to the outer diameter of the augered pile cap is ≤ Lift Height then the augered pile cap shall be 4' deep.

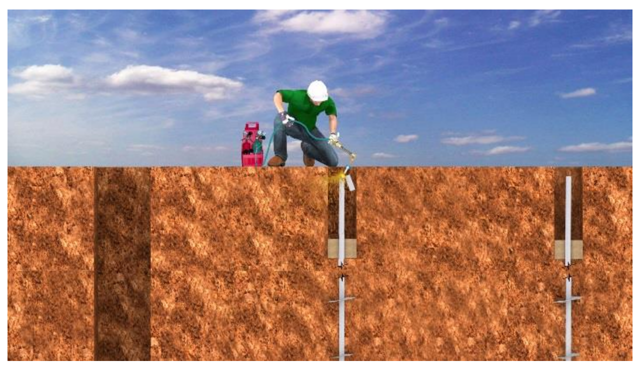
2.5.2.6.2. If the minimum distance between the inner wall of the closest plumbing trench to the outer diameter of the augered pile cap is ≤ depth of the plumbing trench then the augered pile cap shall be twice the depth of the plumbing trench.

Concrete Cap Poured around Helical Pier top

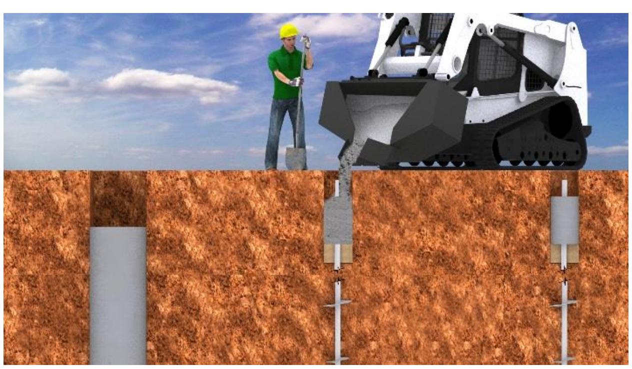
2.5.2.7 Helicals should be held in the center of the augered hole while cap is poured, and braced in place while the cap cures assuring that the helical piers be plumb to within 1 inch in 4 feet.

2.5.2.8 After all augered pile caps have been poured, trenches shall not be re-routed closer than their depth to the outer diameter of any augered pile cap without the permission of the engineer of record.

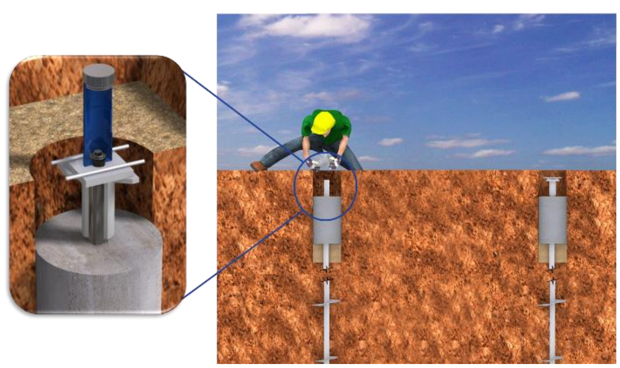
1. Helical Piers Installed



2. Helical Pier Cut to Proper Height



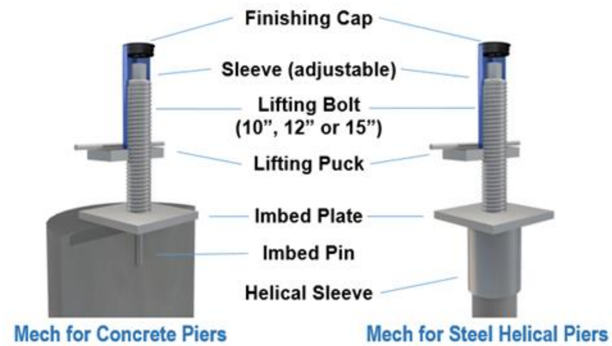
3. Helical Pier Caps Poured



4. Lifting Mechanism installed

2.6 Installation of the SlabTek Lifting Mechanism (MECH) Base

The SlabTek MECH is available in two version, MECH for Concrete Piers and MECH for Steel Helical Piers as shown.



In both cases, the base of the MECH is attached to the top of each pier. For concrete piers, this can be done while the concrete is still malleable, using the Wet MECH Installation Method described in 2.6.1, or after it has completely hardened using the Dry MECH Installation Method described in 2.6.2. Section 2.6.3 describes the MECH installation procedure for Helical piers.

2.6.1 Wet MECH Installation Method

2.6.1.1 Top of pier should be typically 10" below top of concrete or as specified in the foundation design plan.

2.6.1.2 The base of the SlabTek MECH is embedded in the concrete at the top of each pier before the concrete has hardened, but when it is hard enough to prevent the mechanism from "sinking" into the pier.

Pier top ready for MECH

2.6.1.3 The top surface of the pier should have a smooth, voidless surface as noted in sections 2.5.1.10 and 2.5.1.11.

2.6.1.4 The MECH should be placed in the center of the pier within a plus or minus (±) 1" tolerance.

- *If the top of the pier has 'mushroomed', the center of the pier shaft and the center of the mushroomed top may be different. Tolerance is measured from the center of the pier shaft.*

MECH Aligned & Set

2.6.1.5 The top of the MECH base plate should be embedded flush to the top of the pier.

2.6.1.6 At time of placement, ensure the protective plug is inserted inside the MECH nut well to protect the threads from dirt and debris.

2.6.1.7 Plumb and level each MECH assembly without disturbing the concrete under the assembly.

2.6.1.8 Smooth and relevel the top of the pier outside the embed/base plate.

2.6.2 Dry MECH Installation Method

2.6.2.1 Top of pier should be 10-1/2" below top of concrete.

2.6.2.2 The top of the pier should be level and smooth; if necessary, grind to achieve this.

2.6.2.3 Locate the center of the pier within a plus or minus (±) 1" tolerance.

- *If the top of the pier has 'mushroomed', the center of the pier shaft and the center of the mushroomed top may be different. Tolerance is measured from the center of the pier shaft.*

2.6.2.4 Drill a 1/2" to 5/8" diameter hole in the center of the pier vertically, to a depth of 5"

2.6.2.5 Blow out the dust from the drilled hole.

2.6.2.6 Dry-fit the MECH to the pier and verify that the MECH is plumb and level, and completely seated to the pier

2.6.2.7 Disassemble, and reassemble using a high-strength, non-shrink grout or equivalent epoxy patching compound on the imbed pin & underside of the MECH

2.6.2.8 At time of placement, ensure the protective plug is inserted inside the MECH nut well to protect the threads from dirt and debris.

2.6.2.9 The drilled hole is to be filled with epoxy, ARDEX can be used to level the MECH.

Hole for dry MECH Install

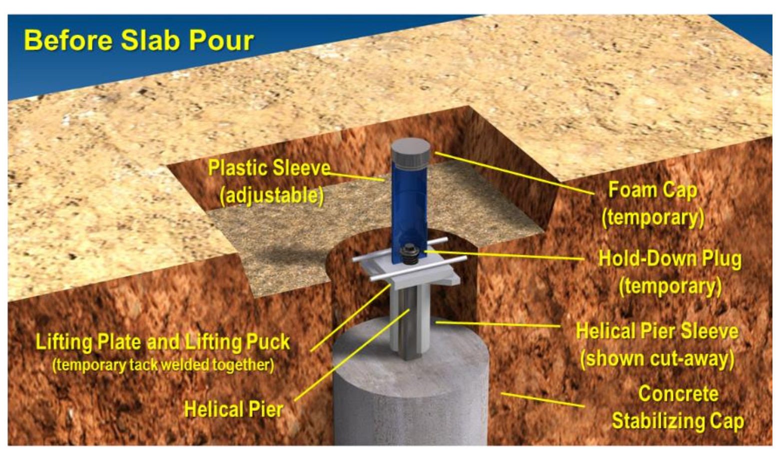
MECH installed using epoxy

2.6.3 Helical Pier MECH Installation Method

2.6.3.1 The shaft of each helical pier must be cut level at the elevation corresponding to the bottom of the capital per the structural drawings. Nominally this elevation is 10-1/2" below the top of concrete insuring contact between MECH and helical

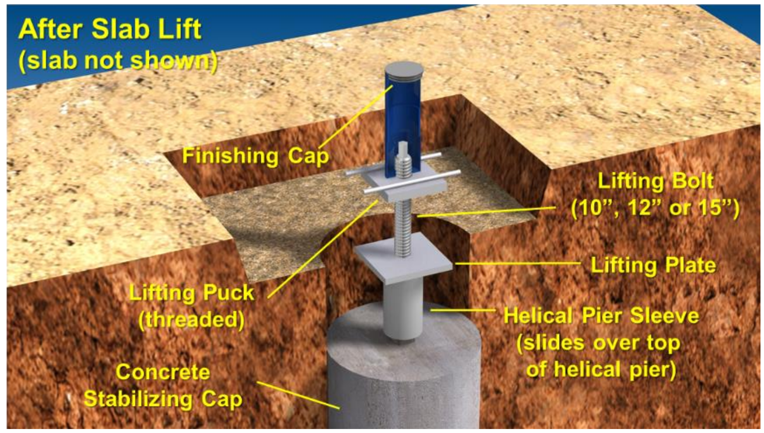
2.6.3.2 Slide the helical pier MECH sleeve onto the cut shaft

2.6.3.3 At time of placement, ensure the protective plug is inserted inside the MECH nut well to protect the threads from dirt and debris.



Show to the right is a graphic of the lifting mechanism during the slab elevation process.

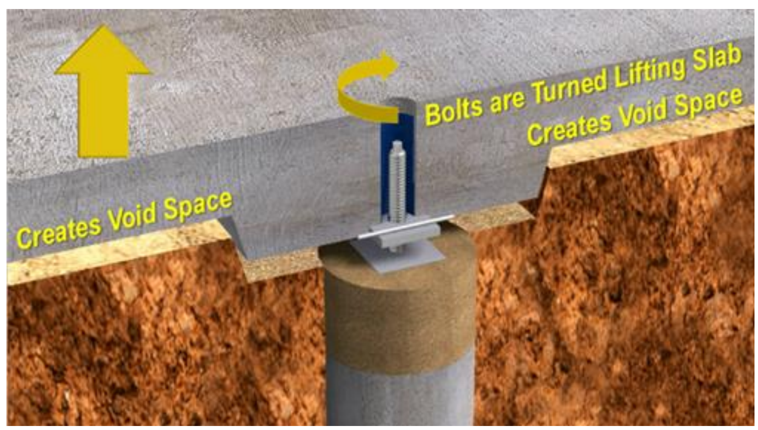
Note: the slab is not included in this graphic.



2.6.4 Inspection of Piers and Mechanisms

SlabTek recommends that all piers and mechanisms be inspected before beginning placement of the foundation so that any remediation required due to field conditions can be made without disrupting the foundation components. The inspection should include:

- proper level and plumb condition of the MECH
- proper location of the MECH in the center of the pier
- proper elevation of the pier and MECH
- proper number of piers per the structural drawings



Section 3. Plumbing Installation

SlabTek does not dictate any method for the installation of plumbing within the foundation system but provides general guidelines to methods commonly utilized for suspended foundations, as well as methods for elevating the plumbing with the foundation. The plumbing and its performance with this foundation system is not the responsibility of SlabTek and should be coordinated by the builder/contractor. It is not the intention of this guidance to detail or specify the process of plumbing installation. Instead, this section addresses some minimum requirements and recommendations for plumbing installation on elevated foundation systems.

There are two recommended methods for installing plumbing with the SlabTek system: *Conventional*, and *Suspended*. These are described in Sections 3.1 and 3.2 respectively.

- ***Note that plumbing cannot penetrate the perimeter beam when using the Conventional method, however it may do so when the Suspended method is utilized.***

3.1 Conventional Plumbing for Suspended Foundations

The most common method of installing plumbing in suspended foundations is to embed the plumbing lines in the sub-grade with sufficient cushioning to allow eventual soil movement to flow around the plumbing lines. Since the SlabTek slab is raised after curing, plumbing stacks must be sleeved to allow the foundation to be elevated without disturbing the plumbing; only the outer sleeves are raised with the slab.

3.1.1 Plumbing shall not be installed directly on compacted soils.

3.1.2 In accordance with IRC and IPC regulations, SlabTek *requires* routes for drain lines to be over-trenched (below the bottom of the drainage pipe) by not less than the height by which the slab will be lifted. As noted in section 2.1.2, this equates to a minimum over-trench of PVR + 1”. The trench shall then be filled with cushion sand to a depth of PVR +1” such that the top of the drainage pipe is nowhere less than 5” below the top of the perimeter form boards, except where stacks penetrate the slab.

Plumbing Installation using Cushion Sand

3.1.3 As an additional precaution, void boxes should be placed under the elbows of major plumbing stacks protruding through the slab.

3.1.4 Plumbing shall not be installed in or through the perimeter beams

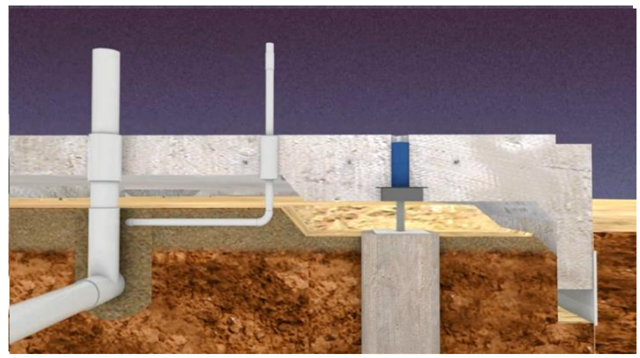
3.1.5 Plumbing shall not protrude vertically through capitals, but may be routed entirely beneath them.

3.1.6 Vertical stacks shall be sleeved, and sufficiently taped to ensure that no concrete penetrates into the void space between the sleeve and the enclosed stack during the pour.

3.1.6 SlabTek recommends that rough plumbing installed in over trenched runs be inspected prior to covering with sand. This inspection should include

- depth of over-trenching and quality of cushion material
- stacks and sleeves are plumb (to avoid binding when slab is lifted vertically)
- sufficient sealing of sleeves to stacks (to prevent concrete intrusion)

3.1.7 SlabTek recommends the plumbing sleeves be sealed (bonded) to the plumbing stacks after the foundation has been elevated. This will resist movement of the plumbing due to soil movement. This method will not stop potential movement of the plumbing below grade, but is equivalent to accepted practices commonly used on suspended foundations. Bonding the plumbing stacks to the sleeve can be done by several methods including:



Sleeved stacks for conventional in-ground plumbing

- High strength non-shrink grout or Epoxy with 3,000 psi compressive strength minimum at least 2” deep below top of concrete
- Use PVC glue to secure a modified PVC reducer to both the stack and its sleeve

Shown in the photos from right to left are the three steps in cutting the sleeves and securing the plumbing.

Post slab-lift with full sleeves, sleeve is cut flush with slab, void between sleeve and plumbing is grouted.

3.2 Suspended Plumbing

An acceptable alternate method of plumbing SlabTek foundations is to attach the plumbing lines to the slab with hangers and lift it above the subgrade along with the slab. This method has the advantage of minimizing differential movement between plumbing and slab, at the expense of more complicated installation.

SlabTek recommends lifting the plumbing systems when the foundation is being lifted. This can be done by several methods one of which is described below:

3.2.1 Set the plumbing lines on a sand bed a minimum of 6” in depth.

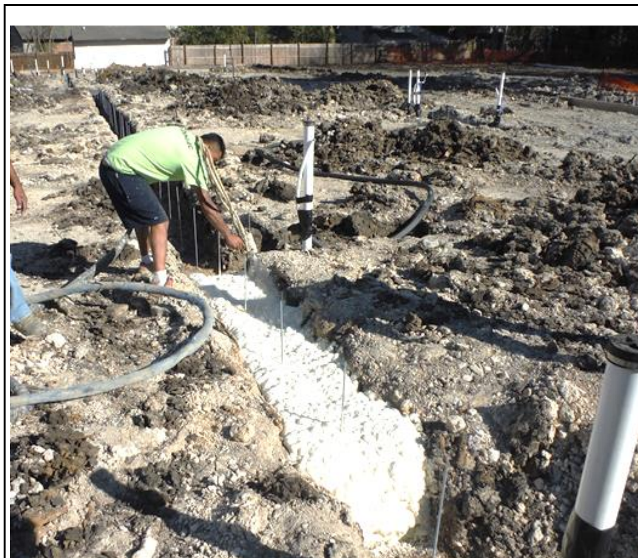
3.2.2 Install supports to the drain lines, at an appropriate spacing, to extend into the slab area

- Plumbing lines should bear on #3 rebar bent in a “U" shape spaced accordingly along the plumbing trench. Alternately, all-thread and clevis can be used instead.
- Other similar lifting systems may be used

Suspended Plumbing with Threaded Rod

3.2.3 It is desirable to minimize the weight resting on top of the suspended plumbing, in order to avoid any possible deformation or damage to the lines. This can be accomplished in several ways, among them:

- Plumbing trenches may be filled with a light material with sufficient structural integrity to support the concrete during the pour. Spray foam insulation is one such material. To minimize material costs, cardboard forms to restrict the spray foam to just the width of the drain line backfilled with dirt
- Plumbing trenches may be covered with an inverted metal pan with sufficient stiffness to support the concrete during the pour.
- Alternately, the top of the plumbing may be covered with a void box or other material. The space above the void box can be filled with local soil material or sand to 5” below the top of perimeter forms



Suspended Plumbing with light-weight material covering plumbing prior to the slab pour and slab lift

3.2.4 Since they will be lifted along with the slab, plumbing stacks extend up through the foundation without the use of a plumbing sleeve (except as required per code for protection against concrete).

3.2.5 Plumbing within the perimeter beams does not require void boxes as it will be lifted with the foundation, (but protective material may be required per code).

3.2.6 After the foundation is prepared, the #3 dowels (or equivalent lifting support) should be bent to reside within the near center of the slab. When the slab is lifted, these bars will suspend the plumbing through the void boxes, which are designed to deteriorate.

Section 4. <u>Foundation Installation</u>

4.1 Perimeter Beam

If the perimeter beam was not installed prior to pier installation, it must be installed at this point in the sequence. Refer to section 2.4 for the perimeter beam installation procedure.

4.2 Slab and Capitals

4.2.1 After the plumbing and perimeter beams have been installed, the pad (which will be the lower form for the slab concrete) needs to be formed to the engineering plans. For a typical 5” thick slab, it needs to be formed to an elevation of 5" below top of perimeter form boards. The use of local soils or cushioning sand is acceptable. The materials utilized for the pad do not require compaction. The slab should be installed with an overall average thickness of 5" with a tolerance of minus (-) 3/8” or plus (+) 1”. Polyethylene film may be used, but is not required since the slab will be elevated and no moisture barrier is needed.

4.2.2 Excavate the (typically 22” square) capitals around each pier as noted on the structural drawings. The tolerance of the capitals in depth is plus (+) 1” or minus (-) ¾”. The width tolerance is minus (-) 2” or plus (+) 6” measured at the bottom of the capital.

4.2.3 The capitals are depicted with vertical edges, however in practice it is acceptable for the edges to slope outward from bottom to top as long as dimensions are within tolerance.

4.2.4 For capitals located close to drops, the low side of the drop controls.

4.3 Cables and Steel

4.3.1 Typical perimeter beams utilize either a single #5 rebar, 6" above the bottom of the beam, or a post-tensioned cable located between 3” and 5” from the bottom of the beam. Refer to the structural drawings.

4.3.2 All cable anchors must be installed in a manner that allows for 4½” concrete coverage over the top of the anchor.

4.3.3 Pairs of cables designated as Distributed Cables (DC1) run the *long* direction of the foundation and straddle each pier in a given column of piers. There are as many DC pairs as there are columns of piers in the foundation. These are the first cables to be installed within the foundation. These cable pairs lay on the ground, one cable approximately 6” from each side of the MECH as noted on the structural drawings. These cables simply lay on the ground to be secured to the form boards later.

4.3.3.1 The DC1 are individually attached to the form boards at locations specified in the structural drawings.

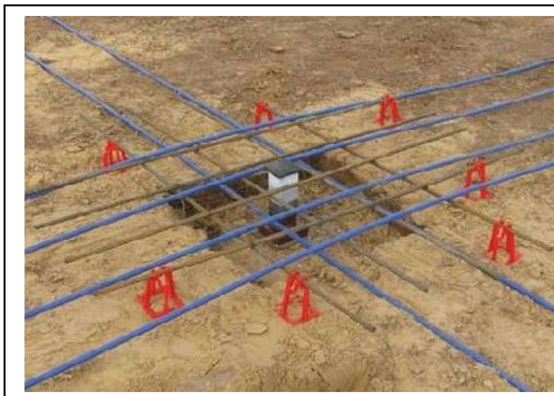
4.3.3.2 The DC1 may be deflected as necessary, in order to ensure that they maintain the proper straddle of all the MECH in their column

4.3.4 Using a jig created for the purpose, construct one rebar grid for each pier, from four (4) - #4 rebar 5 feet in length at 8" apart, on center, and a second set of four identical bars 90 degrees offset from, and above the first. Tie all intersections with wire. The intersections will occur at (nominally) 18”, 26”, 34”, and 42” from both ends of all bars.

Rebar grid being formed using jig

4.3.4.1 Install one rebar grid over each pier such that the bottom bars are parallel to the DC1. The grid will completely cover the capital excavation.

4.3.4.2 In order to provide 1” clear cover over the top of the rebar grid, support the bottom bars of each rebar grid with 4" chairs near the end of the bars where it rests on the pad (not the capital). Rebar stakes can also be used.



Detail of capital reinforcement

4.3.4.3 At each pier, raise the DC1 resting on the ground and tie to the bottom side of each of the upper four bars of the steel cage at a spacing of 6" to each side of the MECH (or 12” apart).

4.3.4.4 Allow cables to drape down between piers and support with 1½” chairs.

4.3.5 The sets of four (4) cables that typically span the *short* direction along each pier line are called Banded Cables (BC). Install these sets as noted on the structural drawings. There are as many sets of BC as there are rows of piers in the foundation.

4.3.5.1 Lay each set of four (4) cables on top of the #4 grid at each pier and tie to the lower bars of the steel cage and as well to the DC already in place running in the opposite direction. These cables within the band should be spaced at 12" apart on center with two cables each side of the MECH.

4.3.5.2 The BC cables are individually attached to the form boards at locations specified in the structural drawings.

4.3.5.3 The BC may be deflected as necessary, in order to ensure that they maintain the proper straddle of all the MECH in their row

4.3.5.4 Allow these cables to drape down between piers and support with 1½" chairs.

4.3.5.5 The BC must be secured at the midpoints between piers to maintain their spacing and be kept from moving. One method is to tie a 3'-6" section of #3 or #4 rebar across the four (4) cables at the approximate midpoint between each pier column and secure with rebar stake or 1-1/2" chair.

4.3.6 Install the individual PT cables that run parallel to, and between, the DC as noted on the structural drawings. These cables shall be "profiled" within the slab as described below.

4.3.6.1 Install cables to provide 1" of clear cover from top of cable to top of slab at the point where each cable crosses over the BC. Allow cables to drape down between piers and support with 1½" chairs.

4.3.6.2 These cables must also be secured at the high points where they cross over the BC, to maintain their spacing and to keep them from moving. One method to do this is to tie a #4 rebar across these cables and support the rebar with 4" chairs. Rebar stakes can be used also.

4.3.7 Install non-profiled shrinkage cables as noted on the structural drawings. These cables run parallel to, and between, the BC. The shrinkage cables remain at a constant height between each row of piers, and they are supported by simply tying them at all intersections to cables running perpendicular.

4.3.8 Install any steel "L" bars as noted per the structural drawings. Each perimeter pier, and beams without beam cables require the use of "L" bars.

4.3.8.1 The steel "L" bars at the pier locations are secured to the rebar grid when possible. Each perimeter pier must have "L" bars attached to the steel mat. Each pier will require 4 to 8 "L" bars.

4.3.8.2 When required, a #3 nose bar can be used to secure the steel "L" bars in place.

4.3.8.3 Secure the bottom of the steel "L" bars to the bottom reinforcing in the beam.

4.3.8.4 The bottom of the steel "L" bars should stop 2" short from the bottom of the beam.

4.3.8.5 When noted on the plans, steel "L" bars may be required within the perimeter beam away from the piers. To secure these bars, again a #3 nose bar may be used along with the bottom reinforcing in the beam for support. This is necessary when rebar is used instead of PT cable for reinforcement of the perimeter beam.

4.4 Attachment of SlabTek MECH Sleeves

After the foundation is prepared, and before the concrete is poured, sleeves must be fitted to each MECH Base installed in Section 2.6

Sleeve on MECH Base

4.4.1 Remove the temporary cap from the nut well of each lifting puck.

4.4.2 Apply a generous amount of thread lubricant to the nut well (Jet-Lube 550® Extreme or equivalent)

4.4.3 Set the lower plastic sleeve onto the lifting puck and secure using the base plug.

4.4.4 Screw the upper sleeve to the lower sleeve.

4.4.5 Insert the foam installation cap onto the upper sleeve

4.4.6 Screw the sleeve assembly up or down to adjust top of the sleeve plug to the desired top of the finished pour elevation. The maximum tolerance allowed is minus (-) ¾" or plus (+) 1". (Therefore, the minimum capital thickness is 9¼" and the maximum is 11".)

4.4.7 In the event that the capital thickness is smaller than the 9¼", the engineer of record should be notified for further evaluation. This is easily detectible in the field if the foam caps extend above the pour elevation with the sleeves tightened down to the smallest height.

4.4.8 When sleeves are fully extended while maintaining a minimum of ½" of bite remaining in the threads, this is the maximum capital thickness that the sleeve can accommodate. If conditions occur greater in depth than this, sleeve extensions must be utilized. This condition does not need to be evaluated by the engineer of record.

4.4.9 Verify that all cables and rebar are at least 1" away from the sleeve assemblies.

4.5 Inspection Prior to Pouring the Foundation

SlabTek recommends that the entire foundation be inspected by the engineer of record to ensure the installation has met the requirements of the structural drawings prior to placement of the concrete.

4.6 Pouring the Foundation

The foundation should be poured based upon accepted principles of concrete placement. There are no special requirements of the concrete pour unique to SlabTek.

Placing concrete on the prepared pad

SlabTek recommends:

- The concrete be poured away from MECH sleeves to prevent damage to the sleeves
- Extra sleeves be on hand at the time of pour to replace any broken or damaged sleeves immediately

4.6.1 The foam cap of the MECH may be used as a level screed for the placement of the concrete. The foam caps will not disturb the finish of the concrete.

4.6.2 Cold-joints and honeycombs must be avoided as they may have a detrimental effect to the structural performance of the foundation.

4.6.3 The concrete should be poured using a mix that meets or exceeds the required strength as noted on the structural drawings. Minimum cure strength values are required to be 1000 psi at 24 hours, 2500 psi at 7 days, and 3000 psi at 28-day.

4.6.4 SlabTek recommends having the engineer of record or a 3rd party witness the pour to verify placement of the concrete per the structural drawings.

4.6.5 SlabTek recommends taking concrete cylinders of the concrete mix at the time of pour to verify the concrete mix meets the design specifications of the structural drawings.

4.7 Stressing of Foundation

For slabs using PT reinforcement,

4.7.1 SlabTek recommends pre-stressing of the foundation at 24 hours by tensioning the cables to 30% of their ultimate capacity.

4.7.2 The foundation should receive full stressing at 7 to 10 days after the foundation is poured. The concrete must obtain minimum strengths of 2500 psi at time of full stressing.

Section 5. <u>Foundation Lift</u>

The following sections are provided as an overview of the lift process, and do not constitute training. Personnel should not attempt to execute these procedures unless and until they have been specifically trained to do so.

5.1 Preparation for Lifting the Foundation

5.1.1 The foundation cannot be lifted until all cables are stressed and the concrete has cured to a minimum of 2500 psi. This typically occurs within 7 days from the time of pour.

5.1.2 SlabTek recommends performing the lift prior to commencement of framing so that the framing can be installed in the most level conditions, and so that the lifting crew is least impeded by physical obstacles. Structurally, however, the foundation can be lifted during the framing stage.

5.1.3 Original Construction Elevations (OCE) of the slab near each lifting mechanism should be documented prior to the lift. A reference (or zero) point just off the foundation should be selected to validate the amount of lift accomplished.

5.1.4 Remove the foam cap from the adjustable sleeve, removing any concrete as necessary.

5.1.5 Remove the base plug from the nut well

5.1.6 Inspect the mechanism nut-well to ensure the threads are undamaged and void of debris.

5.1.7 If the threads have been damaged or if there is debris embedded in the nut-well, the nut-well must be cleaned and with a wire brush to remove any fine particles or rust. A thread chaser may be required to fix any thread damage. Thoroughly vacuum out any debris from the nut-well.

5.1.8 Check the lifting bolt for rust. Clean lifting bolt with wire brush.

5.2 Apply JetLube 550® Extreme (or equivalent) to portion of the threads that will engage during the lifting process. This is roughly equal to the Lift Height plus 2” measured from the bottom of the bolt.

5.2.1 Insert the lifting bolt into the nut and turn until resistance against the piers is encountered.

Lubricating lifting bolt threads

5.3 Lifting of the Foundation

The initial lift attempts only to raise each MECH by exactly the same amount. Therefore, if the foundation is out of level at OCE, it should be relatively the same out of level condition after the initial lift. If approved by the engineer of record, a secondary lift adjustment may be performed to repair any out-of-level condition.

SlabTek will not remove localized out of level conditions on the surface of the slab due to imperfections of the concrete pour.

Note: It is the concrete contractor’s responsibility to ensure that all pier locations have been located, and all MECH base plugs have been removed prior to arrival of the lifting contractor.

Two methods of raising a SlabTek foundation system are “*all at once*” and “*row by row*”.

Either method can use manual or pneumatic devices. Each full turn of a SlabTek bolt provides 1/3" of lift.

5.3.1 If a foundation to be lifted includes a dropped beam or stem wall, SlabTek recommends using the "row by row" lift method *only if it is possible to raise the structure parallel to the dropped beam or stem wall,* so as not to create bending forces within the noted sections. If this is not possible, SlabTek *does not recommend* using the "row by row" method on these types of foundations.

5.3.2 When raising the foundation *"all at once",* all mechanisms should be simultaneously turned at an equal rate to ensure the foundation is being raised evenly until the foundation is elevated to the height noted on the structural drawings.

5.3.3 When raising the foundation "row by row", simultaneously turn all the bolts in one row, one full turn. SlabTek recommends that a row be selected across the short dimension of the foundation, but the procedure can be performed in the long direction.

5.3.3.1 After the first row is raised, the crew proceeds to the next row & repeats the process. After all rows in the foundation have been raised one full turn (1/3"), the crew returns to the first row and starts another pass.

- Check the elevations of the slab every six (6) turns (2" of lift) or less to verify lift and to ensure the slab does not get out of sequence and bind the lifting mechanisms.

5.3.3.2 This process is repeated until the foundation has been raised to the height noted on the structural drawings. For reference, it takes 18 passes to raise the foundation 6".

Finish cap installed

5.3.4 *Only with approval of the engineer of record*, if small adjustments are needed to obtain a more level-like condition from OCE, they can be made by raising or lowering the appropriate bolts. Care must be taken to observe the slab during this process for any sign of cracking or distress. Deviation from OCE of ± 1/3" in any one location should not induce cracking or distress.

5.3.5 Install finish caps on the adjustable sleeve immediately after lift is completed.

Cap void filled flush

5.3.6 Fill in the void over the finish cap with ARDEX™ or similar concrete patch and smooth to flush with the top of the finished floor elevation.

5.3.7 Measure, record, and submit final elevation readings to the engineer of record.

5.4 Installation of Backfill Retainer

5.4.1 SlabTek recommends that a soil retainer or backfill retainer be installed prior to pouring the slab or immediately after slab is lifted

5.4.2 The backfill retainer is installed from the bottom of the concrete perimeter beam extending to the bottom of the beam soils.

5.4.3 The backfill retainer shall be the minimum grade and thickness as prescribed by the manufacturer's specifications to effectively withstand deterioration and lateral soil pressures, as well as to maintain a positive moisture/rodent barrier between the void space and the perimeter soils.

Section 6. Acronyms

BC	Banded cables
DC	Distributed cables
EOR	Engineer of Record
IPC	International Plumbing Code
IRC	International Residential Code
MECH	Lifting mechanism
OCE	Original construction elevation
PT	Post tension
PVR	Potential vertical rise
SC	Shrinkage cables

Section 7. Glossary

Banded cables (BC) - The set (or "band") of four post-tension cables that is placed over each row of piers in the short direction of the foundation. These cables are 'profiled' within the slab.

Beam cables - A single post-tension cable in all perimeter beams over 12'-0" in length

Capital - the (nominally) 26" square patch of extra slab thickness centered above each pier for purposes of strengthening the slab at the points of highest structural load concentration.

Cover – minimum distance between a reinforcing element and the surface of the encasing concrete. Cover requirements vary depending on whether the concrete is in contact with water, soil, or air, and are enforced to limit degradation of the reinforcing element due to water intrusion through the concrete.

Distributed cables (DC1 and DC2) – The pair of post-tension cables that are placed over each column of piers in the long direction of the foundation placed. These cables are 'profiled' within the slab.

Lifting mechanism (MECH) - The patented assembly placed atop each pier that allows the slab to be lifted. The MECH assembly consists of a steel bearing plate embedded in the top of the pier and an upper lifting device embedded in the slab.

Nose bar –

Profiled cables – Post-tension cables whose elevation varies along the length of the cable. Profiling is done for increasing strength in reinforced concrete.

Shrinkage cables (SC) - A post-tension cable used to provide additional compression within the slab, to minimize shrinkage cracking. The SC cables run in between each row of piers in the short direction of the slab. SC cables are not profiled.

Section 8. Work-Flow Steps and Responsibilities

Shown below is a listing of the steps of installation of a Tella Firma foundation using helical piers. The work-flow and responsibilities are similar with concrete piers with the exception that the Concrete Contractor is responsible for the installation of the concrete piers.

Step	Work-Flow Steps and Responsibilities	Tella Firma	Concrete Contractor
1	Surveys and marks all pier locations		X
2	Install concrete structural piers		X
3	Supply Steel Helical piers per loads specifications by the Engineer	X	
4	Install Steel Helical piers to proper depth and torque		X
5	Drill holes for Helical pier stablizing concrete caps		X
6	Cut off Helical piers to proper height (typically 10 1/2" below TOC)		X
7	Install 12" Diameter X 20" Deep (non-reinforced) concrete stabilizing caps around each Helical pier		X
8	Install plumbing and sleeves around each plumbing protrusion through slab	*PLUMBER*	
9	Supply Lifting Mechanism Assemblies (Lifting Mech, Bolt Protection Sleeve, Foam Cap)	X	
10a	Install steel Lifting Mechanism Assembly on top of each Helical pier		X
10b	Attach Plastic Bolt Protection Sleeve to Lifting Mech with Hold-Down Plug		X
10c	Insert Foam Plug into top of Plastic Sleeve and adjust Sleeve to TOC height		X
11	Provide on-site training and inspection of installation of Lifting Mechanism Assemblies	X	
12	Slab Make Up including all PT cables and rebar. Pour Slab		X
13	Pre-Stress post tension cables @ ~ 1-2 days after pour (optional)		X
14	Full Stress post tension cables @ ~ 7 days after pour		X
15	Find and remove all Lifting Mechanism Foam Caps prior to slab lift		X
16	Remove all temporary Hold-Down Plugs inside Plastic Sleeve prior to slab lift		X
17	Supply Lifting Bolts at time of Slab Lift		X
18	Lift slab to specified height (Comal County Jail = 10" lift)		X
19	Install Finishing Cap and Grout in all Lifting Mechanism access holes level to TOC		X
20	Cut off all plumbing sleeves level to TOC and grouts in gap around plumbing	*PLUMBER*	

Tella Firma – Commercial Construction
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