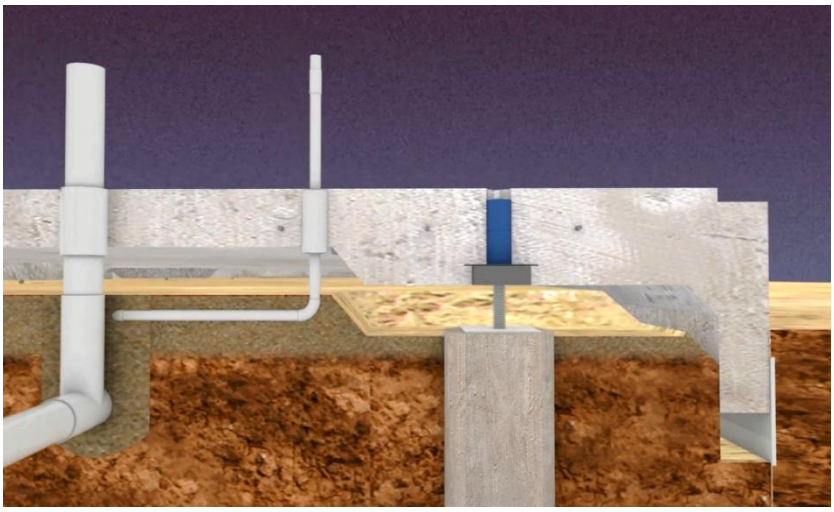
Introduction

Soil expansion and contraction, due to changes in moisture content, cause the vast majority of concrete slab failures 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 lifting mechanism system sitting atop each pier in a suitably sized array of piers beneath the slab. Sanitary drain lines that run beneath a SlabTek foundation system must be designed and installed with an understanding of the system.

The general contractor or homebuilder is responsible for the design, specification and implementation of the mechanical and plumbing systems. Although SlabTek is not responsible for or involved with the installation of the plumbing, we do provide some recommendation for plumbing installation. The plumbing under a SlabTek foundation may either be suspended from the bottom of the elevated slab, or left under grade after the slab is lifted. The latter method is referred to as conventional plumbing installation, and is covered in this paper.

Conventional Plumbing Installation Recommendations With the conventional plumbing installation method, sanitary drain lines are installed in trenches beneath the slab and are not lifted with the slab. During slab lifting process, these lines ride inside slip-joint 'sleeves' which are bonded to the slab. Once the foundation has been elevated, these plumbing stacks must be secured to the slab to minimize movement of the plumbing stack.



The ground beneath the slab may expand and contract due to changes in moisture content, therefore the drain lines may at times be compressed towards the slab. Improper construction technique can allow a situation where the compressive force causes damage to plumbing stacks or fixtures in the house. The purpose of this document is to describe construction techniques that minimize the magnitude of this compressive force, and provide sufficiently strong bonds which will enable satisfactory plumbing system performance.

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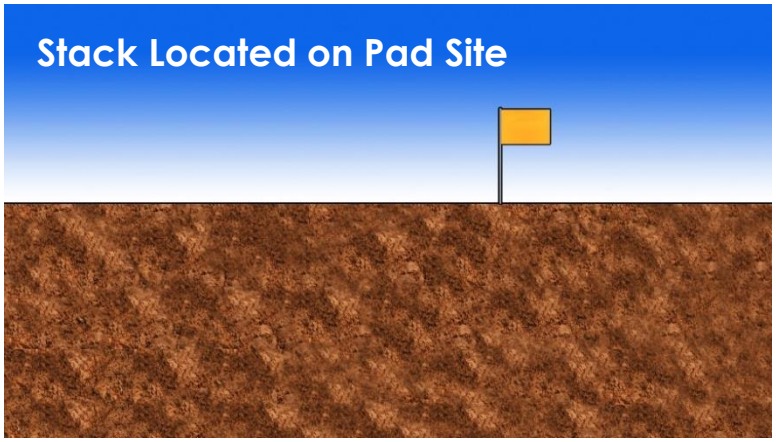
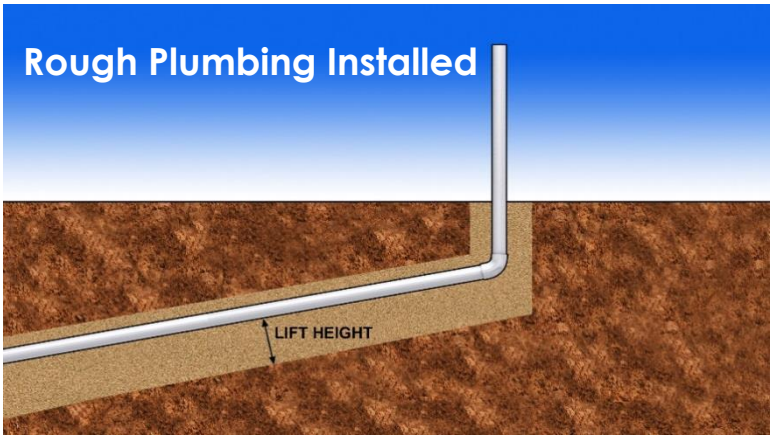
Shown here is an illustrated step-by-step recommended installation procedure starting with layout of the stack locations on the pad site.

Section P2604 of the IRC specifies that sanitary drain trenches shall be 'overtrenched' by two pipe diameters.

When the conventional plumbing method is employed with the Slab-Tek system, we recommend that the overtrenching must be at least equal to the slab lift height. The bottom of the trench is then filled with a low-cohesion granular material such as cushion sand, to a depth of at least the slab lift height. The drain line is placed on top of this cushion at the appropriate fall and is then covered with more cushion sand or other barrier to the level of the pad which will form the bottom of the slab.

In the event the soil beneath the drain line heaves, the sand may press against the drain line with significant force. If the drain line is sufficiently secured to the elevated slab when this heaving takes place, the force required to displace the pipe is anticipated to be greater than that required for the sand to flow around the drain line. This is the desired condition where the soil uplift forces are dissipated by the movement of the cushion sand, rather than destructively transmitted to the drain lines and/or their connections to the slab.





Rough Plumbing Installed in Trench with Sand

Cushion sand below and above plumbing lines

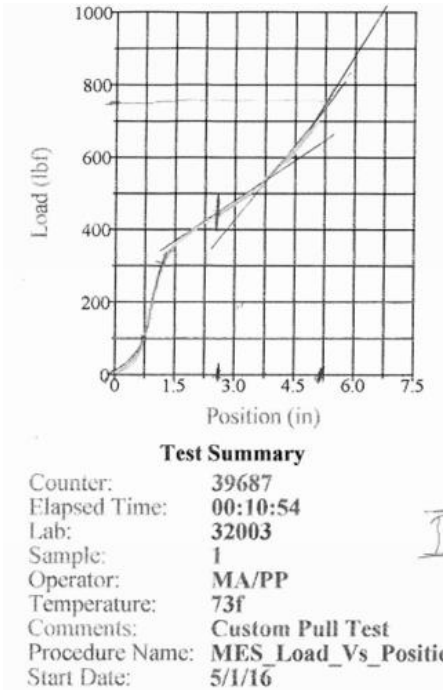
Important factors in the mitigation of plumbing line distress are:

- Ensure granular cushion material (depth ≥ lift height) beneath drain line in trench
- Ensure secure bonding of stack sleeve to slab
- Ensure secure bonding of stack to sleeve after slab is lifted.

Since the slab will be lifted vertically, if the stacks and/or sleeves are not plumb, an offset will be introduced after the lift which may complicate the bonding of the sleeve to the stack using the methods described below. Ideally, the sleeve and stack will both be perfectly plumb and concentric, but in practice a small misalignment may be tolerable. The maximum tilt of either stack or sleeve should be limited to 1" in 4'.

SlabTek has conducted experiments and analysis to quantify the force exhibited on a standard 4" ID Schedule 40 PVC drain line from an uplifting column of cushion sand, in a geometry that simulates a plumbing trench. The conclusions of this research indicates that roughly 800 lbs. of force is sufficient to enable standard uncompressed cushion sand to flow around the drain line during an uplift of 5". This now provides a lower limit for the strength of the sleeve-to-stack bonds noted above, in order to avoid damage to the plumbing lines.

Peak Position: 5.4516 in
Peak Load: 794.8600 lbf



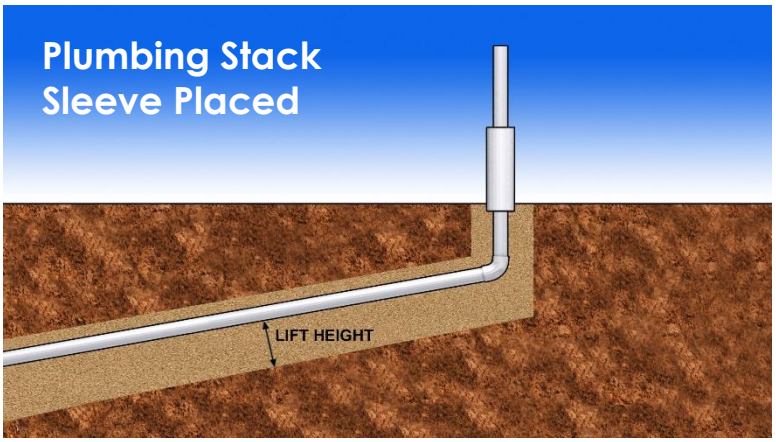
Test Summary

Counter:	39687
Elapsed Time:	00:10:54
Lab:	32003
Sample:	1
Operator:	MA/PP
Temperature:	73f
Comments:	Custom Pull Test
Procedure Name:	MES_Load_Vs_Positi
Start Date:	5/1/16

Stack Sleeves

Because the sanitary drain and vent lines are not lifted with the slab, they must be sleeved in order to provide a slip joint for elevating the slab without lifting the plumbing.

Typically this slip joint is provided by 'sleeving' the line with the next size larger schedule 40 PVC. As a substitute for the PVC sleeves, we also suggest the installation of 1/2" Armaflex or equivalent. After the rough plumbing is completed and



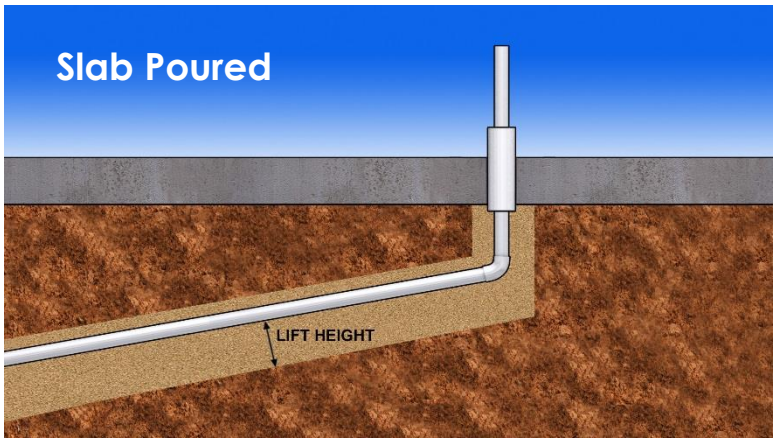
before the slab is poured, sleeves are placed around the stacks. When concrete is poured, it bonds to the sleeve, so that when the slab is lifted, the stack is not affected. Vertical stacks should be sleeved, and sufficiently taped to ensure that no concrete penetrates into the void space between the sleeve and the enclosed stack during the pour.

Void Box Option

As an additional precaution against expansion of soil against the underground plumbing, void boxes can be selectively placed under key sections of the plumbing (such as under the elbow of the plumbing stacks leading to the toilets or showers on the first floor.

Pouring the Slab

In order to ensure a good bond between the slab concrete and the sleeve, sleeves must be free of all oil and grease. It is advisable to clean them with a degreaser and lightly sand with fine grit sandpaper in order to maximize the bond to the concrete. SlabTek testing and evaluation indicates that properly executed, the strength of the sleeve-to-slab bond is sufficiently high to resist the expected uplift forces on the stack.

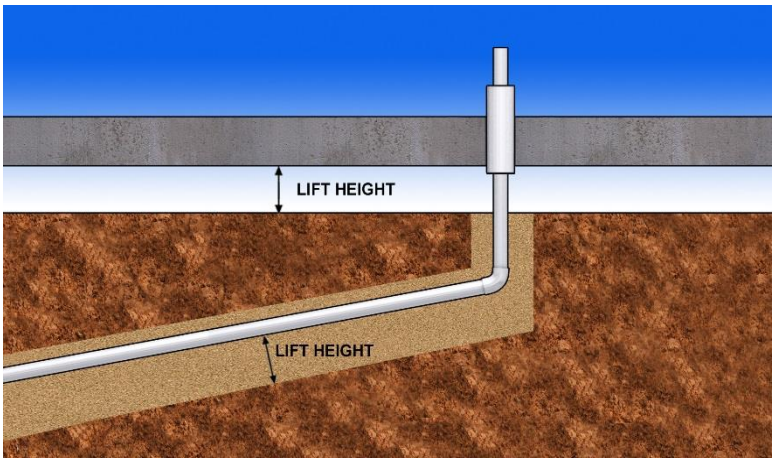


Example of PVC Sleeves

Example of Armaflex Sleeves

Cutting the Sleeves and Securing the Plumbing Stacks

Once the slab is lifted, the stacks must be secured to their sleeves by a method that provides significantly in excess of 800 lbs. shear strength in order to mitigate potential damage due to uplift forces on the drain lines beneath the slab. SlabTek suggests using a high-strength, non-shrink grout or epoxy (adhesive), with a compressive strength of 3,000 PSI minimum, to bond the gap between the sleeve and stack.



The PVC sleeve must be cut flush to the top of concrete in preparation for securing the plumbing stack. A backer rod must be inserted at the bottom of the gap to prevent the adhesive from leaking out. The gap between the sleeve and plumbing should be a minimum of ½" to a maximum of 1-1/4" width, and a minimum of 2" deep

Sleeve Cut and Prepared

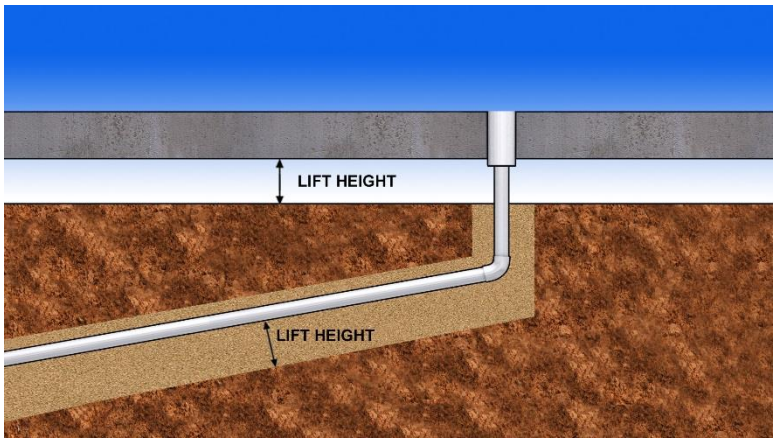
In the case where 1/2" Armaflex or equivalent is used, the top 2 inches of material between the plumbing and slab must be removed to create a gap that can be filled with non-shrink grout or epoxy to stabilize the plumbing.

Stack Grouted Flush with Slab

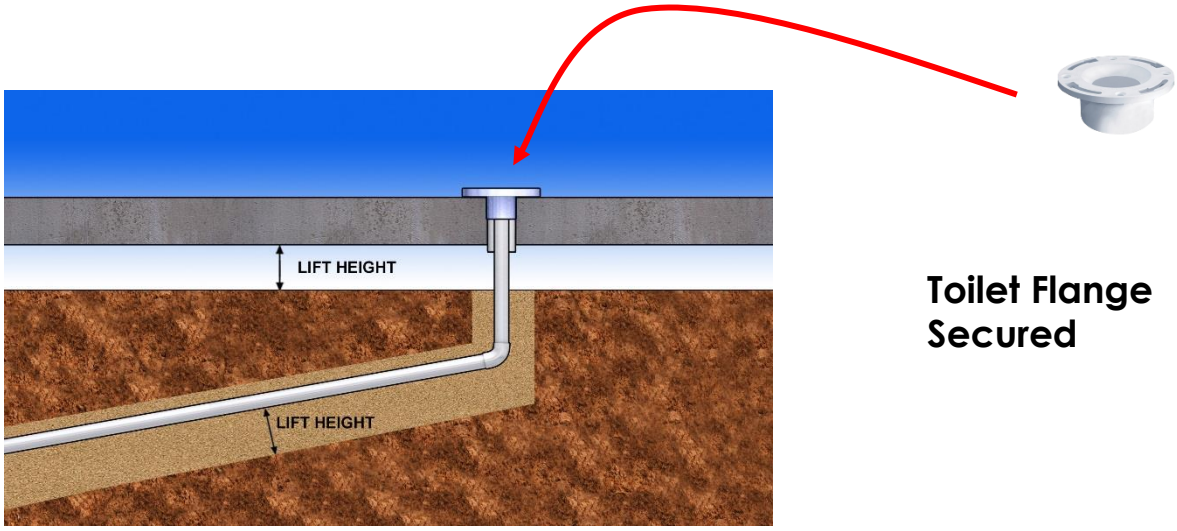
Two Methods of Securing Toilet Flanges

For toilet flanges, the 3" ID stack and 4" ID sleeve are both cut level with the top of the slab. Two methods of securing the stack to the sleeve are recommended:

Method 1 involves using a 'combination PVC toilet flange' which can be installed either inside a 4" line OR outside a 3" line. By applying standard PVC solvent primer and cement to both sides of the flange collar, the stack is effectively fused to the collar, which in turn is bonded to the slab – providing sufficient shear strength to resist the uplift forces on the stack. After the flange has been cemented, it must be secured to the slab using appropriate hardware.

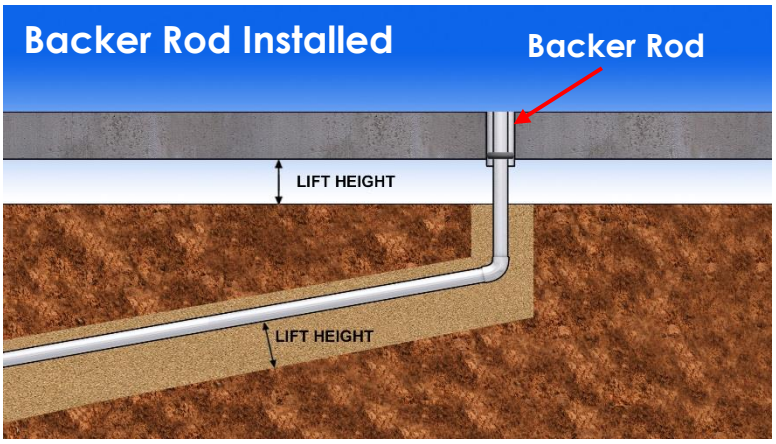


Toilet Sleeve and Stack Trimmed

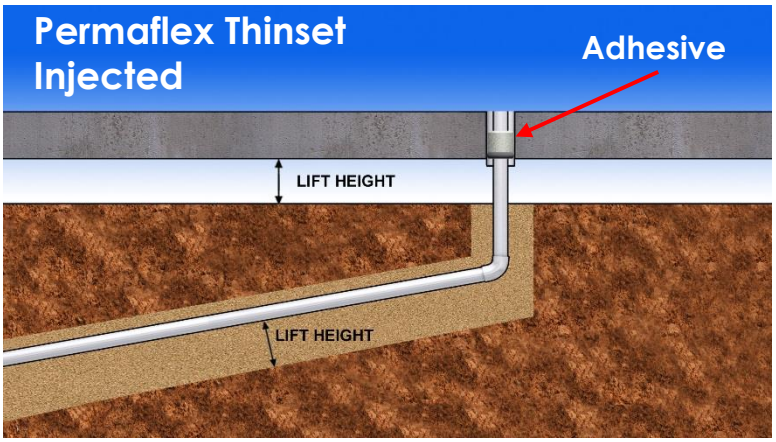


Toilet Flange Secured

Method 2 uses high-strength, non-shrink grout or epoxy (adhesive), with a compressive strength of 3,000 PSI minimum, to bond the gap between the sleeve and stack. Two considerations must be observed: a backer rod must be inserted at the bottom of the gap to prevent the adhesive from leaking out, and the adhesive must be cleaned away from surfaces that will ultimately bond the toilet flange to the stack.



Leaving a small air gap void in the backer rod seal at the bottom of the gap allows air to escape as the adhesive is introduced into the gap which prevents bubbles from reducing the strength of the resulting bond. A small amount of adhesive leakage through this air gap is of no consequence. The adhesive can be carefully injected with a syringe to a height not to exceed 2" below slab level. Any adhesive sticking to the outside of the toilet stack above this level will impede the toilet flange from bonding to the stack and must be thoroughly cleaned immediately. SlabTek testing indicates that properly executed, this method can provide in excess of 5,000 lbs of shear. Following curing of the adhesive, the toilet flange is glued to the stack using standard PVC solvent primer and cement, and the flange is subsequently secured to the slab using suitable hardware.



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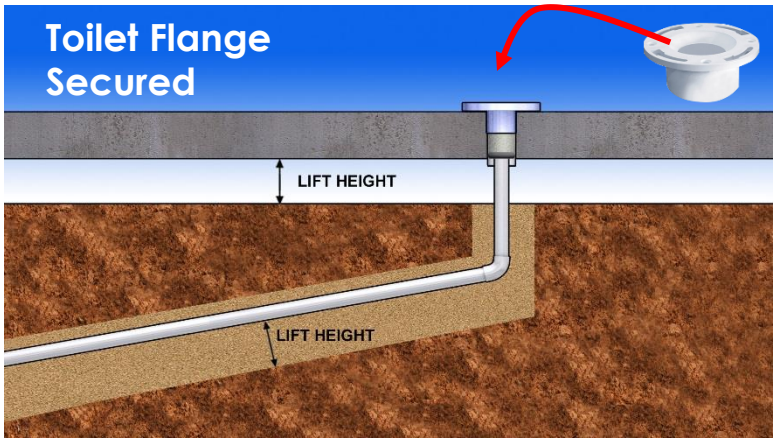
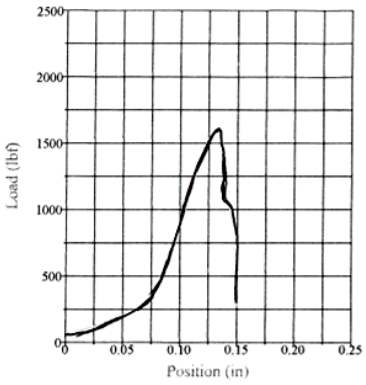
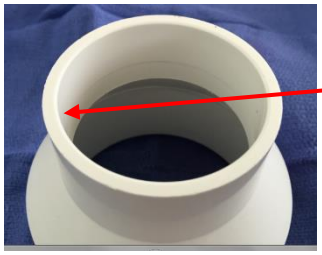


Method for securing Vent Stacks

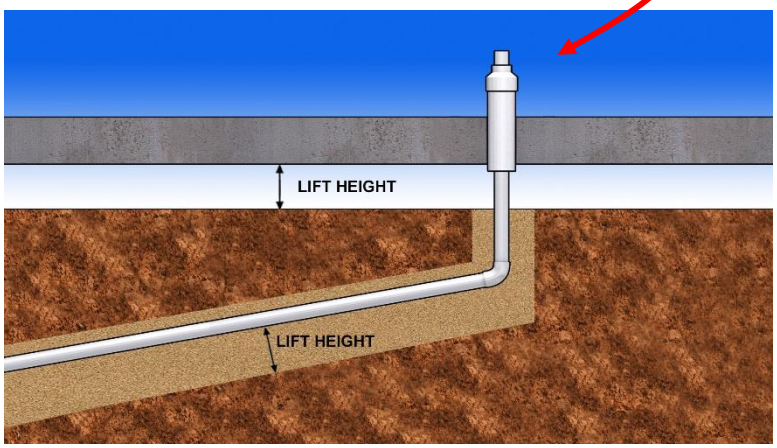


Test Summary	
Counter:	8084
Elapsed Time:	00:02:29
Lab:	32170
Sample:	1
Operator:	MA
Temperature:	74F
Material:	
Comments:	E 8
Procedure Name:	MES_Comp_LvrsP
Start Date:	6/7/2016
Start Time:	11:20:08 AM
End Date:	6/7/2016
End Time:	11:22:37 AM
Workstation:	HVL 120
Tested By:	Default

For vent stacks use Method 2, a modified Schedule 40 PVC reducer can be bonded to both the sleeve and stack using standard PVC solvent primer and cement. The required modification to the reducer involves shaving off the lip, which normally prevents the smaller line from sliding freely through the reducer. When removing the lip, care must be taken not to enlarge the ID of the reducer, which would affect the strength of the resulting bond. SlabTek experiments indicate that the shear strength achieved using this method can exceed 1400 lbs. for 2" pipe in a 3" sleeve.



Lip (which stops smaller diameter pipe from sliding freely through reducer) must be removed.



Modified Reducer Secured

Avoiding Plumbing in Perimeter Beam

Installation of plumbing through the perimeter beam should be avoided. Exterior wall drain plumbing for cabinetry sinks and other fixtures should be routed inside the perimeter beam and can be hidden underneath cabinetry.

Summary

The general contractor or homebuilder is responsible for the design, specification and implementation of the mechanical and plumbing systems. Although Tella Firma is not responsible for or involved with the installation of the plumbing, we believe that following these conventional plumbing installation recommendations will mitigate the majority of heave-related plumbing line distress in SlabTek foundation system installations.

APPENDIX

Photos of SUSPENDED Plumbing Installations

Rough Plumbing with hanging pipe brackets and threaded rod to penetrate the slab

Void between top of plumbing and bottom slab filled with lightweight foam to enable easy lifting of plumbing with slab lift

Rough Plumbing placed entirely on top of void boxes and suspended plumbing conduit stakes

Rough Plumbing with hanging pipe brackets / threaded rod. The void is formed with plywood forms.

SLABTEK COMPANY

This product and implementation of suspended slabs using this product are protected by the following:
US Patents: 8458984, 8671627, 8407898, 8678712, 7823341 B2, 8069620 B2.
Canadian Patent: 2628422

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