DiamondPier®
FOUNDATION SYSTEM

INSTALLATION MANUAL

Pin Foundations, Inc.
Gig Harbor, Washington
Phone (866) 255-9478 / *Fax* (253) 858-8607
www.pinfoundations.com or www.diamondpier.com

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Diamond Pier® Foundation Systems are covered by U.S. Patents 5,039,256; 6,910,832; 7,326,003; and patents pending.

Diamond Pier® is a U.S. registered trademark of Pin Foundations, Inc.

The latest version of this Installation Manual is available on our website, www.diamondpier.com, or by calling us at (866) 832-7835.

Other documents and publications referenced in this manual are listed below and available at www.diamondpier.com.

National Evaluations

"Diamond Pier DP-50 Precast Concrete Pier Foundation Assembly," ICC-ES Evaluation Report No. ESR-1895.

State Evaluations

"Diamond Pier DP-50 Precast Concrete Pier Foundation Assembly," Wisconsin Building Product Evaluation, Code Approval No. 201008-O, July 26, 2011.

Test Reports

"Precast Concrete Pier Foundation Assembly Test Report; In Accordance with ICC-ES AC336," Professional Service Industries, Inc., PSI Report No. 704-25035-1, November 28, 2006.

"Cross Pin Group Foundation Load Test Report," Earth Engineers, Inc., EEI Report No. 07-020-8, January 21, 2013.

Observational Evidence

"Diamond Pier Frost Performance Report, Zone II, Minnesota Soils," 2010.

"Diamond Pier National Performance Submittals," 2005.

"Diamond Pier Observational Evidence, Forest Lake, Minnesota," May 2011.

Building Code Compliance Documents

"Code Compliance Information for Diamond Pier Foundations in the State of Minnesota," Pin Foundations, Inc., September 2013.

CONTENTS

INTRODUCTION

Pin Foundations, Inc. (PFI)

Pin Foundations, Inc. (PFI) has been designing and manufacturing foundations for over 25 years. One thing has always driven our thinking—the soil is the true support and, in its natural state, it has plenty of strength and structure to do the job.

Pin Pile Technology

Foundations have two basic functions: to transfer loads properly into the soil structure and to provide support to the man-made structure above. There are two general types of foundations: deep vertical pilings (banged in) and shallow spread footings (dug in and buried). Pilings keep soil strength and structure intact and are easy to install if they do not need to go too deep. Footings spread loads more widely, but the digging breaks apart the soil, weakening it and blocking or exaggerating water flow.

Pin pile technology combines the best features of both types of foundations. By grouping short stiff piles (bearing pins), which can easily be driven in penetrable soils, and setting them at angles to work more like a shallow footing, an inexpensive foundation can be constructed that requires no excavation. The pin pile group resembles the roots of a tree, and some of the oldest man-made structures were supported over soft soils in this way. In recent decades, grouped pin piling has become a reliable technology for complex, heavy-duty commercial applications, performing a superior job of transferring loads to intact soils.

Diamond Pier Foundation System

PFI's innovation is to bring pin pile technology into common use with a superior connector—the Diamond Pier concrete head. This high-strength, precast component is a driving guide, a pin piling lock, and a structural connection all in one. As a driving guide, the pier maintains the pin angles so that their capacity is definable and consistent. As a lock, the pier is designed to increase its grip on the pin cluster when loaded up, down, or sideways—getting stronger and tighter as loads increase. And as a connection, an embedded anchor bolt and precast, post-matching shape make it a simple and proportional complement to its supported structure.

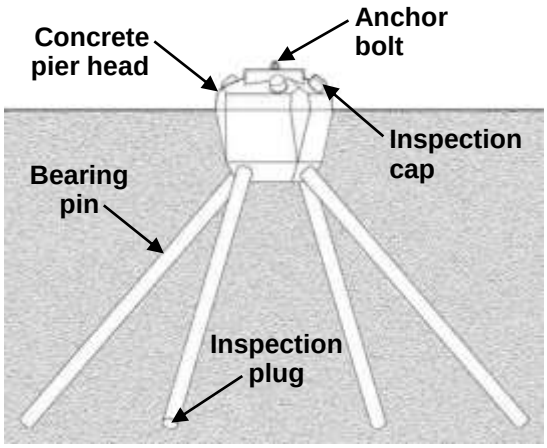

Figure 1. Diamond Pier Foundation Components

This composite pier combined with steel bearing pins forms the Diamond Pier system—a hybrid of familiar concrete and steel materials. It provides a solid, stable, economical foundation that both captures and preserves the supporting strength and natural functions of the soil it's engaged in and, in turn, solidly and simply connects to and protects the permanent structures above.

This manual provides installation instructions for Diamond Pier foundations in residential applications under normal construction conditions (see next section, "Conditions and Uses").

CONDITIONS AND USES

Normal Construction Conditions

Diamond Pier foundations sold through retail outlets can only be used for projects that have normal construction conditions. Normal construction conditions require sound soils, simple structures and safe sites, as defined in this section. If normal construction conditions do not exist, contact PFI for special construction conditions review (see “Special Construction Conditions” on page 7).

Sound Soils

For most residential applications there are two prescriptive penetrable soil types: 2000 psf sands and 1500 psf silts or clays. Soils that do not meet the prescriptive bearing strength in the local code will not provide expected foundation capacity. Ask your local code official for soil information regarding your site. (Information regarding soil type is available at the U.S. Geological Soil Survey Site managed by the Department of Agriculture: http://soils.usda.gov/.)

Diamond Pier foundations require sound soils, which include bearing strengths of at least 1500 psf in silts and clays or 2000 psf in sands, and clean foundation areas *without* unconsolidated backfill, soil contamination, buried debris or utilities, or improper drainage. Sound soils also include areas where traditional concrete piers, accepted by local codes, are able to provide adequate bearing to support the total load of the project or to protect the structure from the negative effects of frost heave.

Many soils are not considered to be sound. Some examples of unsound soils include soils that are weaker than 1500 psf, highly expansive or heave-susceptible soils that move vertically more than an inch, and soils with unknown characteristics. Soils can also be weakened when they retain standing water, and in certain types of soil this can cause severe heave problems. Weakened soils due to freeze/thaw cycling or excessive water can reduce the bearing capacity or uplift resistance of the Diamond Pier foundation. A site depression with standing water or the potential for water to pond, pool, or saturate the soil may be an indication that the soil is not sound. Downspouts that discharge at or near a foundation may also cause complications at a site and indicate unsound soils. Soils near home foundations may not be sound if they have been improperly or loosely backfilled, which may also facilitate the pooling of water. Drainage ditches, creeks, or nearby ponds may also indicate that nearby soils are not sound. Diamond Pier foundations should be set well away from these features. Where unsound soils exist, a special construction conditions review must be performed.

Simple Structures

Simple structures are structures that are accepted for review by the local building code official without the requirement for a registered design professional to be involved. Foundation designs for simple structures can be based on capacities and specifications shown in the “Normal Construction Conditions Load Chart” (see Table 1), with the local building code official reviewing and approving the design. If the local code official feels a registered design professional must be employed, indicating special construction conditions may exist, then PFI must also be contacted by the responsible design professional and provided sufficient project information to allow proper review of the Diamond Pier application for the specific project site. Ask your building official if your structure fits this definition of simple structures. If not, do not use Diamond Pier foundations to support the structure until it has been reviewed by PFI and the project design professional.

Safe Sites

Sites that have extreme conditions often require special foundation design, even if the project is a simple structure as defined above. Consult your local building official to determine if the site is mapped in the International Residential Code (IRC) or in local codes for extreme exposure to landslide, wind, or earthquake hazards; has historic evidence of conventional foundation failure; has steep slopes greater than 2:1 (27 degrees); or has potential problems with saturated soils or pooling water. Sites with these conditions must be reviewed by your design professional and PFI for special construction conditions.

> **WARNING:** You must check for underground utilities and follow the instructions described under the "Locate Buried Utilities" subsection (page 9) before Diamond Pier foundations can be installed.

Load Chart

Table 1. Normal Construction Conditions Load Chart

Load Bearing Capacity

US Patents: 5,039,256; 6,910,832; 7,326,003

	DP50 ESR-1895 Code Compliant				
Size >>>	DP50 36"	DP50 42"	DP50 50"	DP75 50"	DP75 63"
Bearing in 2000 psf Sands	3600#	3600#	3600#	5150#	5850#
Bearing in 1500 psf Silts/Clays	2700#	2700#	2700#	3870#	4400#
Eq Bearing Area in SF	1.8	1.8	1.8	2.58	2.93
Base Area Comparison	18" Cylinder	18" Cylinder	18" Cylinder	21" Cylinder	23" Cylinder
Uplift	670	920	1175	1215	1380
Lateral	575	820	1070	1150	1310
Frost Zone Rating	36"	42"	48"	48"	60"

This load chart is to be used for normal construction conditions only. DP-50 capacities used in conjunction with ESR-1895 per blue bordered box above shall be limited to residential decks, covered decks, stairways, and walkways.

No asymmetric, rotational, overturning, or dynamic loads should be supported by Diamond Pier foundations when employing the Normal Construction Conditions Load Chart. The project designer, builder, architect, or engineer will recognize these conditions, and, if they exist, recommend that the project follow the special construction conditions path.

Notes:

1. Values applicable in properly drained, sound soils with a minimum 1500 psf bearing capacity. See IRC Table R401.4.1 for complete soils listing.
2. For simple structures only. No asymmetrical, rotational, overturning, or dynamic loads.
3. For safe sites only. For steep slopes, seismic zones E, sites exposed to hurricanes, floods, or high water, or sites with historic evidence of conventional foundation failure, special construction conditions review is required. Wind design in designated areas per the 2012 IRC may also be required.
4. All capacities use four pins of the specified length per foundation. Length includes that portion embedded within the foundation head.
5. DP-50 uses defined in paragraph 2.0 of ESR-1895 are limited to residential decks, covered decks, stairways, and walkways. For DP-50 uses beyond these types of projects, refer to PFI Cross Pin Group Foundation Load Test Report (EEI Report No. 07-020-8).
6. Minimum 50" Pins are recommended for use of DP-50 where uplift and/or lateral loads govern.

For special construction conditions, larger Diamond Pier models are available, including the DP-100E and DP-200E. For these pier sizes, site-specific soils information, project application, and loads must be determined by a registered design professional and provided to PFI for calculated foundation capacities.

NOTE: The Diamond Pier system is a shallow bearing technology and does not require "refusal" or "friction" resistance, or the professional installation monitoring and oversight typically associated with conventional vertical or battered piling.

Special Construction Conditions

Special construction conditions exist when the requirements for sound soils, simple structures, or safe sites, as defined above under “Normal Construction Conditions,” are not met.

The Diamond Pier foundation system has been installed over the last 20 years throughout the U.S. and abroad supporting public and commercial structures, such as boardwalks, bridges, homes, and other complex structures. These applications have typically involved special construction conditions.

Special construction conditions require a site-specific/project-specific review with individual pier capacity calculations based on soils and loading information. These applications primarily use large Diamond Pier foundations: DP-100E or DP-200E. They also typically require individual registered engineer stamps for the foundations’ capacities and review by the project’s overseeing architect or engineer of record.

To determine whether the Diamond Pier system can be used for a specific job on a site with special construction conditions, the site-specific soils report or site investigation letter stamped by a registered engineer or geotechnical engineer must be provided to PFI along with the loading criteria for the foundations themselves. The report or letter must include a soils description, the height of the water table, and soil structural characteristics, such as blow counts or N values, Phi angle cohesive strength, and in-place unit weight. If in a frost zone, the local frost depth should also be included. Loading criteria for the foundations themselves should include the required bearing capacity and, where applicable, uplift and/or lateral load requirements.

With this information, PFI and its consulting engineers can provide a stamped capacity for the Diamond Pier model and pin length appropriate for the job. If the special construction conditions exceed the applicability or capacities of the Diamond Pier system, PFI can recommend alternative foundation solutions.

Please contact PFI if you have any questions regarding project conditions and/or the proper use of the Diamond Pier product.

Frost Heave Resistance

Frost is not a special construction condition unless the site has a history of conventional foundations—accepted by the local building code—failing due to frost heave. In frost zones, a properly drained sound soil will freeze like a fortress and hold its foundations tight. In heaving areas, water sources, the rate of temperature drop, and certain soil grain sizes can combine to cause pressures on foundations in all directions. Most traditional concrete foundations in frost zones rely on depth and gross weight as protections against frost heave. They use significant volumes of site-poured concrete, which has the potential for many field condition variables and inconsistent mix designs, and their installation requires considerable excavation, which weakens the existing soil structure, invites water problems, and leaves substantial amounts of soil to be removed from a site.

Rather than reaching a specific vertical depth or gross weight, Diamond Pier systems resist heave pressures with their wide-spreading pin pile groups. Embedded in intact soil structure, the pins are prevented from changing angle under load by the concrete head, creating a stable foundation for both bearing and uplift forces. Because of the unique design of the Diamond Pier head, the pins are also free to move along their axes without compromising the position of the pier or its lock on the pin cluster. This feature allows the Diamond Pier foundation to absorb soil strains caused by frost heave or expansive conditions without transferring these loads to the supported structure.

Diamond Pier foundations provide equal or better performance to traditional concrete foundations claimed as equivalent. In the capacity load chart (Table 1), PFI defines a “base area comparison” and “frost zone rating.” These two ratings define the size of the traditional concrete pier foundation that a given Diamond Pier foundation is equivalent to in bearing capacity and frost heave resistance. For example, a DP-50 shows a base area comparison of 18” and a frost zone rating of 48”. This compares with a traditional 18” round, 48” deep poured concrete foundation.

When assessing projects in extreme frost areas, be aware of sites where traditional concrete footings—48” to 60” deep—have failed or are likely to fail to resist frost heave, requiring larger, deeper concrete piers. Project sites that require concrete footings deeper than 60” to resist frost heave exceed the definition of normal construction conditions. Contact PFI to determine if a custom system can be designed for these special construction conditions.

INSTALLATION INSTRUCTIONS

These instructions cover the installation of Diamond Pier foundations in residential retail applications at sites where normal construction conditions exist. All other installations must be preapproved and may require a registered design professional to be involved.

Please also view the Installation Video provided on our website, www.diamondpier.com.

Preinstallation

Inspect Site for Normal Construction Conditions

Check your site to make sure normal construction conditions exist. Normal construction conditions require sound soils, simple structures, and safe sites, as defined under "Conditions and Uses" (page 5). If any special construction conditions exist at your project site (see "Special Construction Conditions", page 7), contact PFI for a Special Construction Conditions review.

Identify Underground Obstacles

The same obstacles that conventional foundation systems face, such as rocks, tree roots, underground utility lines, and other buried objects, also exist for the Diamond Pier system. Refer to the "Encountering Obstructions" subsection (page 13) for instructions on handling buried obstacles. If an obstacle is encountered that cannot be passed using the breaker hammer while driving the pins, the pins can be removed and the concrete head rotated, allowing the pins to penetrate the soil in a different location.

Locate Buried Utilities

WARNING: Do not install Diamond Pier foundations before all underground utilities have been located, marked, and de-energized.

All underground utility lines must be located and properly marked by your local official utility locating service, and all privately run lines must also be identified and located by the proper authority. If there are any electrical lines in the area, de-energize the power source prior to installing the Diamond Pier foundations. Never allow bodily contact with uninsulated portions of the automatic breaker hammer. Wear properly rated rubber-insulated gloves and boots. In, addition, if underground utilities are located on the site, check with your local utility locating service to confirm required safety zones. You must ensure that the horizontal pin distance for your foundation will have adequate horizontal clearance to be well outside all safety zones (see Figure 2 and Table 2 on next page).

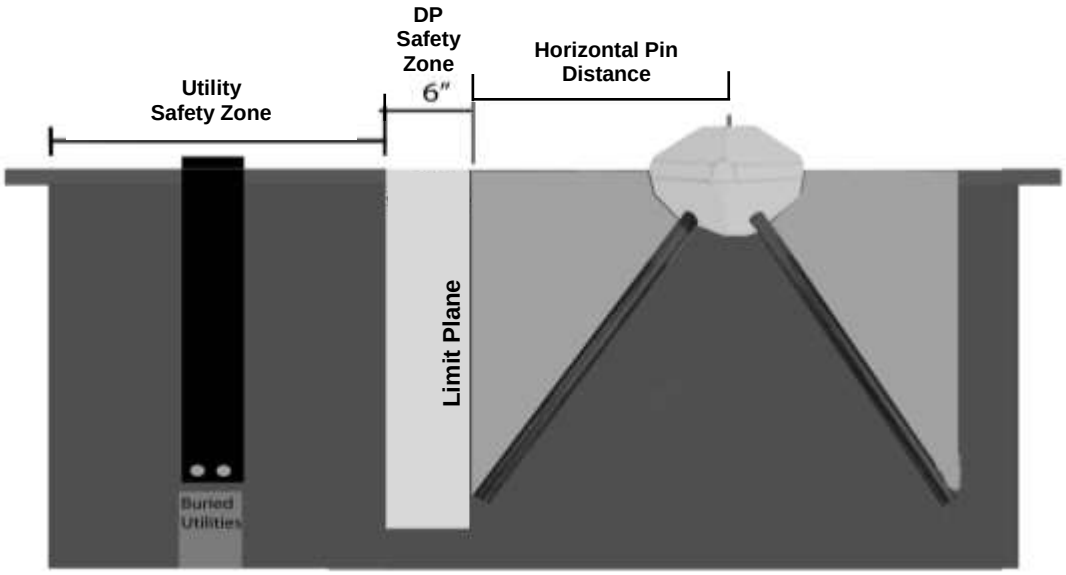

Figure 2. Horizontal Pin Distance
After installation, horizontal distance of all pins must be well outside all safety zones.

Table 2. Horizontal Pin Distance for All Diamond Pier Models
Measured from center of pier anchor bolt horizontally to vertical limit of pin end.

Pin Length (inches)	Horizontal Pin Distance (inches)	
	When Pin Is at 90 degrees (Perpendicular to Limit Plane)	***When Pin Is at 45 degrees (Shortest Distance to Limit Plane)***
36	20	15
42	24	17
50	29	21
63	38	27
84	51	36
126	78	56

Check Your Layout

To meet the load bearing capacities shown in the "Normal Construction Conditions Load Chart" (Table 1, page 6), Diamond Pier foundations must be spaced a minimum of 3 feet apart (from center of pier anchor bolt to center of pier anchor bolt). If they are spaced less than 3 feet apart, contact PFI for a revised capacity evaluation. They must also be set back the correct horizontal distance from existing foundations or other buried obstacles, as shown in Table 2. Tributary loads from the supported structure must be properly calculated, and the piers spaced accordingly, so that each pier is supporting only up to its designated allowable loads.

Assemble Tools and Supplies

Inspect your Diamond Pier assemblies to ensure that no parts are flawed or have been damaged in shipping. Do not install a concrete pier if it is cracked with a fissure running internally into the pier. Slight flaking or chipping is acceptable; a pier with surface flaking or chipping may be installed.

Verify that you have the correct number of concrete pier heads with the corresponding number of bearing pins (4 per pier), inspection caps (4 per pier), and inspection plugs (4 per pier), and that the anchor nuts thread properly on the pier anchor bolts.

You will need to assemble the following tools and gear:

- Automatic driving hammer with 1-1/8" hex shaft driving bit (see page 15)
- Square-edge shovel
- Sledgehammer
- Torpedo level
- Tape measure
- Pipe wrench
- Proper safety goggles, ear protection, insulated gloves, protective clothing, and boots

We recommend a minimum two-person crew for installation.

Installation

Identify Desired Location

1. Locate where you would like the center of the pier anchor bolt to be. Set a landscape spike at this location sticking up 3" above the ground.
2. Place the concrete pier head over the landscape spike. The bottom of the pier, which has a concave center point, will self-center over the landscape spike. This will align the anchor bolt vertically with the landscape spike, locating the anchor bolt where intended.

Set the Concrete Head

1. Dig a tapered square hole the same size and shape as the bottom half of the concrete head (see Figure 3). This creates a cradle to steady the pier for leveling. Soils directly below the pier should be left loose.
2. *Following safe lifting procedures,* carefully lift the concrete head and position it in the hole to its midpoint.* Ensure top is level and centered on your alignment.
3. Replace some of the removed soils back around the sides of the pier at grade, lightly tamping to maintain level and alignment during pin driving. (See Notes under "Drive in the Pins" on page 12.)

Figure 3. Tapered Hole for Concrete Head

*The pier may also be buried deeper for aesthetic considerations only. Access to the top of the pier needs to be maintained. Be sure to keep top half of pier clean until caps are glued on. The pier MAY NOT be buried for structural purposes.

Drive in the Pins

WARNING: Verify locations of any buried utilities before driving pins (see "Locate Buried Utilities," page 9).

1. Remove any dirt and debris from the pins and check that they will fit easily into the driving holes in the concrete heads. (If a cut or burr is restricting the fit, try the other end of the pin.)
2. Install the inspection plugs in the ends of the pins that will go into the pier first.
3. Slide the pins through opposing holes in the concrete head, making sure to support them so their weight doesn't roll the pier out of the hole or out of alignment.
4. Keeping the pin centered in the driving hole, carefully set pin 6" to 12" into the soil using the sledgehammer until the pier is locked into a level position (see Figure 4). To minimize flaking of the concrete surface or deformation of the end of the pin, impact the pin end squarely.

Figure 4. Setting Pins and Leveling Pier

5. With the pin driving bit installed on the automatic hammer, drive in opposing pins alternately in increments. Periodically check for level and alignment. Be sure to keep the weight of the auto-hammer from forcing the pin against the lower half of the driving hole and impacting the pier. Another crew member should hold the pin centered in the driving hole (see Figure 5). This will also reduce pin vibration and minimize concrete flaking.

   NOTE: Do not use the pin driving bit as a hammering tool or hammer against it with the sledgehammer. It is to be used with the automatic hammer only.

6. Temporarily drive all pins down to within 6" from the top of the pier; this allows easier removal if an obstruction is encountered.
7. Finish driving the pins with the automatic hammer (with pin driving bit), being careful not to damage the precast pier or the upper ends of the pins and leaving approximately 3/4" of the pin protruding from the top of the concrete.

Figure 5. Driving Pins with Auto-hammer and Pin Driving Bit

Note 1: Do not attempt to drive the pins all the way down with just a sledgehammer; this may damage the ends of the pins or crack the pier.

Note 2: Do not drive a pin all the way down at once if this causes the pier to be pulled to one side. Continue to rotate around the pier, driving the pins in increments, until the growing strength in the pile group is sufficient to allow final driving.

Note 3: Do not continue to hammer away at a pin that is bouncing, rattling, or scraping against an impassable object. This may cause the pier to ride up the pin, push the pier to one side, or risk eccentrically stressing the pier with a pin that is out of line. It could also cause the pier to crack, and a cracked pier must be removed and replaced. If encountering difficulties in the soil, see "Encountering Obstructions" on the next page.

Encountering Obstructions

If a pin stops moving when being driven in, STOP driving the pin. Be sure the other pins are at least half way in to stabilize the pier and ensure that the pier will remain in place before trying to drive the obstructed pin in any further. Attempt to drive the obstructed pin with the automatic hammer for approximately 20 to 30 seconds, or give it one or two firm square hits with the sledgehammer, which may drive it past the obstruction. Many small rocks will roll, potentially allowing the pin to move past. If the pin moves slightly, continue with the automatic hammer, but make sure that it is not being forced out of line. If its trajectory is off this can cause an eccentric stress on the pier and crack it.

If the trajectory is off or the pin will not go in at all, remove all the pins (see "Removing Pins"), rotate the pier around its center alignment, and reinstall to avoid the obstruction. The pier may also be relocated, within the parameters of your structural design, if necessary to avoid underground objects. If the obstruction is close enough to the surface, it may be dug up and removed. Once accomplished, recompact the soils with the sledgehammer, and then reset the pier.

NOTE: The edges of the top of the concrete pier do not have to align exactly with the sides of the post or post bracket as long as the bracket being used is supported by the concrete and providing proper weight distribution.

Removing Pins

The jacking method is the easiest way to remove pins. This method works best when the pin is approximately 6" extended out from the pier. A pipe wrench, a flat bar, and a pry bar are required. Follow the instructions below to turn the pin while corkscrewing it upward. See also the Pin Removal video on the website.

1. Using your right hand, place the pry bar flat against the concrete angle at the outer edge of the pier and perpendicular to the pin to be removed.
2. With your left hand, place the pipe wrench on the pin and slide it down tight to the pry bar. The pipe wrench handle should be pointing up slightly and perpendicular to the pry bar to allow the pipe wrench to turn the pin as it is pried (see Figure 6).
3. Pull up on the pipe wrench handle to lock.
4. Pull up on the pry bar with your right hand to move the pin out approximately 1" to 2".
5. Slide the pry bar back to be flush with the concrete angle on the pier.
6. Repeat lock and jack (steps 5–7) until the pin can be pulled by hand.

Figure 6. Jacking Method for Pin Removal

NOTE: For the first 4" of removal use the flat bar with the pipe wrench. After the pin is 4" removed you may use a pin as a pry bar.

Place Inspection Caps on Pins

1. Set the inspection caps loosely on the ends of the pins so they can be removed for pin length inspection (see “Field Inspection,” page 16).
2. Set brackets and posts or beams, and frame and complete the supported structure.
3. Once these framing material loads have been applied, pull the caps off and reverify the extent of the protruding pins, adjusting as necessary by tapping with the small sledgehammer.
4. After the field inspection has been completed, apply an adhesive caulk around the lips of the caps, and seal over the ends of the pins, tapping the caps down tight to the concrete with the small hammer (see Figure 7). We recommend using a 50-year adhesive caulk, or equivalent, and following the caulk manufacturer’s application guidelines.

Figure 7. Completed Installation with Inspection Caps

AUXILIARY PARTS AND EQUIPMENT

Post/Beam Brackets

The bracket needed to make the connection from the Diamond Pier foundation to the superstructure can be purchased separately from a local lumberyard. The DP-50 pier typically has a 1/2" galvanized bolt embedded in the top of the pier* (nut provided), and this bolt will connect to a Simpson Strong-Tie® bracket (Model ABW) or a similar approved post base. Check with your jurisdiction to verify which post bases are acceptable in your area, and make sure to match the post size and loads on the post with the appropriate bracket size and bracket load ratings. Typically these brackets come with a "standoff" design that separates the wood from contact with the base of the bracket and eliminates the need to drill into the bottom of the lumber to compensate for the raised anchor bolt. Most post-base brackets have a wide hole in the base that allows for horizontal adjustment of the final bracket location.

The DP-75 and DP-100E piers have 5/8" diameter bolts at the top of the pier; this corresponds to the Simpson Strong-Tie ABU bracket or similar code-approved post base. Horizontal beams may also be set directly in an appropriate bracket for direct connection to the Diamond Pier foundation when constructing low-profile structures. If you are using 6x6 posts with the DP-50 pier, make sure to ask your dealer for the DP-50 model that accommodates 6x6 posts. The DP-200E model has 3/4” anchor bolts and requires custom-fabricated brackets.

The proper bracket coating or finish should be chosen based on the lumber to be used and the treating specifications of the project superstructure. If stainless steel is chosen, the embedded galvanized bolt must be protected from contact with the stainless bracket with the addition of a plastic or rubber bushing (not supplied) or the piers must be special ordered with embedded stainless steel anchor bolts.

*In coastal zones, your local dealer may carry special DP-50 Diamond Pier foundations with 5/8” anchor bolts, for use with Simpson Strong-Tie ABU brackets or similar code-approved post bases..

Breaker Hammers and Driving Bits

Automatic breaker hammers used for installing the Diamond Pier pins are listed below. The bits for these automatic hammers all use 1-1/8" hex shafts and can be rented through a local rental yard, purchased through your lumber dealer, or purchased from PFI. Most of the rental yard bits are produced by Bruner & Lay of Chicago, (847) 678-3232, and distributed through various rental companies throughout the U.S.; we recommend bit Model #B 31-861 for DP-50, DP-75, and DP-100E piers and Model #B31-863 for DP-200E piers.

Only automatic breaker hammers should be used to install the Diamond Pier pins, and the special driving bits are meant to be used with these automatic hammers only. The bits are not to be used with, or as, a sledgehammer.

The electric hammers listed below have a range of impact energies from 20 to 44 ft-lb. Soft or loose soils will allow for the use of lighter lower-energy hammers. Stiff or dense soils will require electric hammers in the higher impact range or standard jackhammers driven by compressed air. In most cases, the DP-50 and DP-75 are installed with smaller electric hammers, and the DP-100E and DP-200E with larger electric or compressed-air hammers, regardless of soil strength. Roto-hammers are not adequate.

- MAKITA Model #HM1307CB 1-1/8” Hex 35-lb Demolition Hammer; Bit type: 1-1/8" Hex
- HITACHI Model #H65SD2 1-1/8" Hex 40-lb Demolition Hammer; Bit type: 1-1/8" Hex
- BOSCH Model #11335K Jack 15 Amp Breaker Hammer; Bit type: 1-1/8" Hex
- MILWAUKEE Model 5338 Breaker Hammer; Bit type: 1-1/8" Hex

FIELD INSPECTION

A Diamond Pier foundation code inspection may take place at any time after installation and may be combined with the structural framing inspection as each jurisdiction warrants. The top ends of all pins should be accessible for measuring pin lengths.

Pin Length

Diamond pier foundations are designed to be inspected from above grade after they have been installed. An inspection plug must be installed at the lower (driven) end of the pin to keep soils from moving up inside it and to allow a tape measure to be slid down from the top of the installed pin to verify its length (see “Inspection Plugs” on page 17).

NOTE: If framing members will be too close to the top of the pier to allow the tape measure to be inserted, then the inspection should be done before the framing is in place. Also, if inspection plugs have not been used, then the pins can be twisted or jacked out with a pipe wrench to verify their length (see “Removing Pins” on page 13). They can then be redriven into the same soil cavity. Pins are to be their full specified length (length tolerance is ±1/2”).

Pin Specifications

Bearing pins provided with the piers are schedule 40 galvanized pipe, Grade A electric resistance welded, with no threads. This also can be verified from above grade. With the rubber cap removed, the weld can be verified on the inside wall of the pin, and the wall thickness can be checked. If the wall thickness is thinner than specified, the pins have been substituted with a lower schedule pipe or conduit and must be replaced with the properly specified pipe—1” nominal schedule 40 pipe has a wall thickness of 0.133” (just over 1/8”), 1-1/4” nominal schedule 40 pipe has a wall thickness of 0.140”, 1-1/2” nominal schedule 40 pipe has a wall thickness of 0.145”, and 2” nominal schedule 40 pipe has a wall thickness of 0.154”. The wall thickness tolerance is ±12%.

Pier Integrity

If the Installation Instructions are properly followed, the piers should be level (within a 5-degree tolerance), and they should not have structural cracks as a result of improper handling or pin driving. (Surface spalls or chips may occur during driving or handling, but these are not structural and will not affect the pier.) A structural crack is perpendicular to the outer face of the pier and heads inward to the pier core. This can weaken the pier strength and/or allow water to penetrate and cause freeze/thaw problems in the concrete. If a pier is more than 5 degrees out of level, the symmetry of the pin pairs may be compromised, and the pier should be removed and correctly reinstalled. If a pier has a structural crack, it should NOT be patched. It should be removed and replaced.

Allowable Capacity

The piers should not be overloaded. The total load on any specific pier is based on the individual tributary loads of the structure supported by the corresponding post or beam connected to the pier. This weight is a combination of the live load (snow, people, furnishings) and the dead load (weight of structure itself). Therefore the total tributary load can be expressed in pounds per square foot (psf) as the *area* X *total load* (live load plus dead load). This value should not exceed the published capacity of the pier.

Inspection Plugs

Hard plastic plugs are inserted in the bottom of each bearing pin prior to installation to keep soil from moving up inside the pins as they are driven into the ground. This allows inspectors to slide a tape measure down a pin from above to verify its length. Align the slot in the plug with the interior weld bead and insert (see Figure 8). The allowable tolerance in pin wall thickness means that some plugs will fit high in the end of the pin, and some will fit down almost to the plug shoulder. In either case, tap the point of the plug with a hammer to seat it firmly enough in the end of the pin so that it will not drop out as you slide it through the driving holes in the pier. Don't worry that tapping the end of the plug with the hammer will blunt the point; it is not intended as a piercing or cutting tip, and this will happen anyway as the plug is driven into the soil.

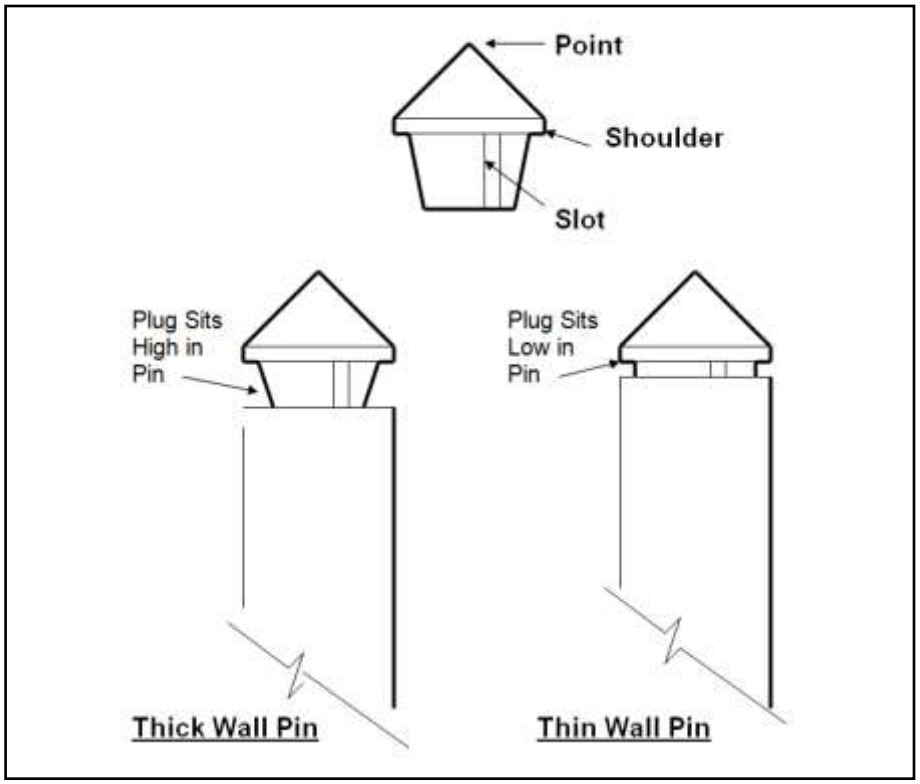

Figure 8. Inspection Plugs

SPECIFICATIONS

The information given in this section is provided for use in document/permit submittal, where applicable.

References/Standards

ASTM A 53 - Pipe, Steel, Black and Hot dipped, Zinc-coated
ASTM A153 - Zinc coating (hot-dip) on Steel Hardware
ASTM, ACI and CRSI standards for precast concrete products

Delivery/Storage and Handling

Contractor shall protect the materials from damage.

Pins

Four pins per pier. All pins to be galvanized steel pipe with butt cut ends, schedule 40, Grade A, Type E, electric resistance welded. Pins are to be capped with UV-resistant vinyl caps and sealed.

Connections/Posts/Beams

Diamond Pier foundation connection to be galvanized steel post base or beam bracket (by others) attached to embedded single galvanized anchor bolt in pier. See “Auxiliary Parts and Equipment” section, page 15.

Site

Alteration of site soils or vegetation to be kept to a minimum to avoid erosion, drainage issues, or the need for replanting.

Installation

Contractor shall verify superstructure layout, spans, and resulting loads for consistency with the manufacturer’s published capacities.

Pins to be full length as specified before driving. No coupled or welded pins are to be used.

Follow the complete Installation Instructions provided in this manual.

TROUBLESHOOTING

Cracked Pier – Always inspect materials when received from supplier. Do not install a pier that has a crack or fissure running internally into the pier. Slight flaking or chipping does not constitute a crack.

Concrete Flaking – During installation, pins rubbing against the pier may cause superficial flaking of concrete around the driving hole. This will not affect the structural strength. However, if a crack or fissure running internally into the pier develops during installation, the integrity of the pier has been compromised and the pier must be removed and replaced.

Hitting an Obstruction – If an obstruction is encountered, the pins may be removed and the pier repositioned. If the obstruction is dug out and removed, soil must be recompacted per the Installation Instructions. See “Encountering Obstructions” (page 13).

Pier Will Not Stay Level When Installing – One or more pins may be driving out of line due to obstructions in the soil (See “Encountering Obstructions,” page 13), or your hole for setting the pier may be too big. Only dig a hole the size of the pier being used, and be sure to put all pins in the pier before setting them. With all the pins sticking up from the pier, one person can also push or pull on the pins to manipulate the leveling process and guide or steer the pier to a level position, being careful not to wrench on the pier and cause a crack.

Pier Installed Out of Level – If a pier is more than 5 degrees out of level, this may compromise the symmetry of the bearing pins—it should be removed and repositioned. Reinstall the pins incrementally at first, checking level constantly, and if one pin is not going in straight and is causing the pier to tip, install the other pins first and then carefully finish driving this last pin.

Pins Have Risen Slightly Out of the Concrete Head – This may occur when extreme loads have been applied to the pier, but the system is designed to relieve pressure in this way. The pins may simply be tapped back to their original position with a small hammer. Remove the caps, tap the pin, and replace the caps.

Pins Will Not Fit into Pier – Make sure the pins fit into the pier before inserting the inspection plugs. Be sure pins and piers are free of dirt, and check both ends for fit. Always transport and store parts in a clean environment. Measure the pin diameter to be sure the proper pins have been supplied for your pier model. (The DP-50 model has a 1" nominal pin with a 1.315" actual outside diameter [OD]; DP-75 has a 1-1/4" nominal pin with a 1.67" actual OD; DP-100E has a 1-1/2" nominal pin with a 1.9" actual OD; and DP-200E has a 2" nominal pin with a 2.375" actual OD.) If the pins still do not fit, contact your supplier.

Inspection Caps Will Not Fit over Driven Pins – Check to be sure the proper cap size was supplied and that your caps are pliable and not frozen. Caps should be tapped on with a small hammer. If they still will not go on, check the pin ends for any extreme deformations that may have occurred while driving. File or grind off any damage to re-establish the original diameter, and apply the cap.