DiamondPier®

FOUNDATION SYSTEM

INSTALLATION MANUAL

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The latest version of this Installation Manual is available on our website, www.diamondpiers.com, or by calling us at 866-255-9478 (Toll Free) or 253-858-8809 (Main Office).

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

National Evaluations

"Diamond Pier DP-50 & DP-75 for Bearing Pin Piers," ICC-ES Evaluation Report No. ESR-1895, 2017.

State Evaluations

"Diamond Pier DP-50 & DP-75 Precast Concrete Pier Foundation Assembly," Wisconsin Building Product Evaluation, Code Approval No. 201612-O (Replaces No. 201008-O), November 22, 2016.

Observational Evidence

"Diamond Pier National Performance Submittals," 2005.

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

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

Building Code Compliance Documents

"Code Compliance Information for Diamond Pier Foundations in the State of Michigan," Pin Foundations, Inc., Revised January 2018.

"Code Compliance Information for Diamond Pier Foundations in the State of Minnesota," Pin Foundations, Inc., Revised January 2018.

CONTENTS

INTRODUCTION

Soils

Pin Foundations, Inc. (PFI) has been designing and manufacturing foundations for over 25 years. One thing has always driven our thinking—the Earth is the actual foundation, and soils, in their natural undisturbed state, have the strength and structure to do the job.

Man-made foundations have two basic functions: to transfer loads properly into the Earth's soil structure and to provide a connection to the built structure above. There are two general types of man-made foundations: deep vertical pilings (banged in) and shallow spread footings (dug in and buried). Pilings keep the Earth's existing 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

Pin pile technology combines the best features of both types of man-made foundations. By grouping short stiff piles (bearing pins), which can easily be driven into intact penetrable soils, and setting them at angles to work more like a shallow footing, a sound foundation can be constructed that requires no excavation. The pin pile group simulates nature's design, resembling the roots of a tree providing bearing, uplift, and lateral capacity. 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 undisturbed 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 head maintains the pin angles so that their capacity is definable and consistent. As a lock, the head 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.

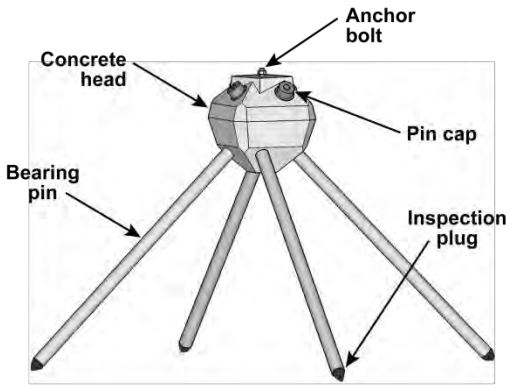

Figure 1. Diamond Pier Foundation Components

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

This manual provides information and instructions for installing Diamond Pier foundations in residential applications in Normal Soil Conditions (see next section).

CONDITIONS AND USES

Normal Soil Conditions

Diamond Pier foundations sold through retail outlets are designed for projects that are founded in normal sound soils. Normal soils are typical in most residential neighborhoods throughout the United States and are defined in the International Residential Code (IRC) Table R401.4.1. Presumptive Load-Bearing Values of Foundation Materials.

For residential applications, the two most common prescriptive bearing soil types relied upon in the IRC table, and in most local codes, are 2000 psf sands/gravels and 1500 psf silts/clays. Diamond Pier foundations sold through retail outlets must be founded in soils with a minimum 1500 psf bearing strength. Supporting soils that do not meet the presumptive bearing strength defined in the applicable code for your area will not provide expected foundation capacity, and their bearing capacity may need to be determined by a soils investigation. Ask your local code official for soil information regarding your site. Additional soils information may also be available at the U.S. Geological Soils Survey website managed by the U.S. Department of Agriculture—see http://websoilsurvey.sc.egov.usda.gov/.

Supporting Soils

Some soils may not be appropriate for supporting Diamond Pier foundations. Some examples include soils that are weaker than 1500 psf, soils that are highly expansive, shifting or sliding soils, soils on slopes greater than 2:1 (27 degrees), contaminated soils, or soils where traditional concrete piers, accepted by local codes, are unable to provide adequate bearing to support the loads of the project or to protect the structure from the negative effects of frost heave. Where unsound soils exist, a registered design professional may be required to review the project.

Soils can also be weakened when they retain standing water or are improperly drained, and in certain types of soil this can also cause heave problems. 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 soil problems, and setting a Diamond Pier foundation adjacent to any water body should be considered carefully. Depending on the variables involved, soils at the edge of or within lakes, ponds, rivers, streams, or tidal zones may be considerably weaker (as much as 40% or more) than dry or well-drained soils. Soils adjacent to existing foundations may also have been improperly or loosely backfilled, which may also cause poor drainage or poor soil conditions. Be sure to inform your project designer if any of these conditions exist.

Please contact PFI if you have any questions regarding your project or soil conditions, and/or the proper use of the Diamond Pier product or “Residential Diamond Pier Load Chart,” provided in Table 1.

WARNING: You must check for underground utilities and follow the instructions described under “Locate Buried Utilities” (page 8) before Diamond Pier foundations can be installed.

Residential Diamond Pier Load Chart

Table 1. Residential Diamond Pier Load Chart
IAS-Accredited Third-Party Bearing, Uplift, and Lateral Field Tests[2]

Minimum 1500 psf
Silts/Clays (CL, ML, MH, CH)[3]

Model No. / Pin Length	Bearing Load Capacity	☐ Equivalent Base Area	○ Cylinder Comparison	❄ Frost Zone	Uplift Load Capacity	Lateral Load Capacity
DP-50/36"	2700#	1.8 sf	18" dia	24"	600#	600#
DP-50/42"	* 3000#	2.0 sf	19" dia	36"	* 900#	* 600#
DP-50/50"	3300#	2.2 sf	20" dia	48"	1200#	600#
DP-75/50"	* 3750#	2.5 sf	21" dia	48"	* 1400#	* 600#
DP-75/63"	4200#	2.8 sf	22" dia	60"	1600#	600#
		Equivalency to Traditional Concrete Footings				

Minimum 2000 psf
Sands/Gravels (SW, SP, SM, SC, GM, GC)[3]

Model No. / Pin Length	Bearing Load Capacity	☐ Equivalent Base Area	○ Cylinder Comparison	❄ Frost Zone	Uplift Load Capacity	Lateral Load Capacity
DP-50/36"	3600#	1.8 sf	18" dia	24"	600#	600#
DP-50/42"	* 4000#	2.0 sf	19" dia	36"	* 900#	* 600#
DP-50/50"	4400#	2.2 sf	20" dia	48"	1200#	600#
DP-75/50"	* 5600#	2.8 sf	22" dia	48"	* 1400#	* 600#
DP-75/63"	6400#	3.2 sf	24" dia	60"	1600#	600#
		Equivalency to Traditional Concrete Footings				

*Interpolated from field test values.

Notes:

1. This load chart is intended for simple structures supported by columns, posts, and beams loaded up to, but not exceeding, the stated capacities. It is not intended for structures with asymmetrical, rotational, overturning, or dynamic forces. Intended uses are described in section 2.0 of ICC-ES prescriptive bearing evaluation report ESR-1895. For projects that exceed the capacities or limitations defined herein, or the intended uses described in ESR-1895, contact PFI for additional information or site-specific capacity evaluation. See also the Use and Applications download at www.diamondpiers.com.
2. Capacities shown are tested to a Factor of Safety of 2, and are applicable in properly drained, normal sound soils only, with minimum soil bearing capacities as indicated. Copies of the field test reports are available from PFI upon request.
3. See IRC Table R401.4.1, “Presumptive Load-Bearing Values of Foundation Materials,” for a full description of applicable 1500 psf and 2000 psf soil types. For soils below 1500 psf, or soils with unknown characteristics, additional site and design analysis is required. For soils above 2000 psf, the values in this chart shall apply.
4. All capacities use four pins of the specified length per foundation. Pin length includes that portion of the pin embedded within the concrete head. See “Check Your Layout” on page 9 for more information on pin/pier layout and spacing restrictions.
5. For professional engineers designing for short-term transient loads, contact PFI for further information.

Use and Applications

The intended use for Diamond Pier DP-50 and DP-75 foundations sold through retail stores is to support simple residential projects constructed with columns, posts, and beams. The scope of project is defined as decks, covered decks, walkways, stairways, and accessory structures or similar projects that meet this intent. Project loads are limited to the capacities defined in the “Residential Diamond Pier Load Chart” shown in Table 1. The load chart shows that Diamond Pier foundations provide equal or better performance when compared to traditional concrete foundations claimed as equivalent.

In the residential load chart, “cylinder comparison” and “frost zone” values are given. These two values 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 with 50" bearing pins shows a cylinder comparison of 20" and a frost zone rating of 48". This compares with a traditional 20" diameter, 48" deep poured concrete foundation. For more information, please refer to the Use and Applications document at www.diamondpiers.com.

Frost Heave

Frost is not an unusual or unsound soil condition unless the site has a history of locally accepted conventional foundations failing due to frost heave or freeze/thaw cycling. In frost zones, a properly drained, sound soil will freeze solid 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. The most important of these three factors is the presence of water in the soil, and this makes proper drainage a must—for all types of foundations.

Heave Resistance

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.

Diamond Pier foundations resist heave pressures and are often used in areas requiring frost protection.

Rather than reaching a specific vertical depth or gross weight, Diamond Pier foundations resist heave pressures with their wide-spreading pin pile groups. Embedded in the 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 head 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 losing alignment or transferring these strains to the supported structure.

When assessing projects in extreme frost areas, be aware of sites where traditional concrete footings—48" to 60" deep—have failed 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 soil conditions and the limits of the “Residential Diamond Pier Load Chart.”

INSTALLATION INSTRUCTIONS

These instructions only cover the installation of Diamond Pier foundations in residential applications where normal soil conditions exist and the “Residential Diamond Pier Load Chart” (Table 1) is referenced (see discussion of “Normal Soil Conditions” on page 5 and “Residential Diamond Pier Load Chart” on page 6).

Please also view the “Installation” video provided on our website, www.diamondpiers.com.

Prior to Installation

Inspect for Underground Obstacles

The same obstacles that conventional foundation systems encounter, such as rocks, tree roots, underground utility lines, and other buried objects, can also obstruct the Diamond Pier system. Refer to “Encountering Obstructions” (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 and not cracking the concrete pier head in the process, 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, including the 6" Diamond Pier (DP) safety zone (see Figure 2 and Table 2 on next page).

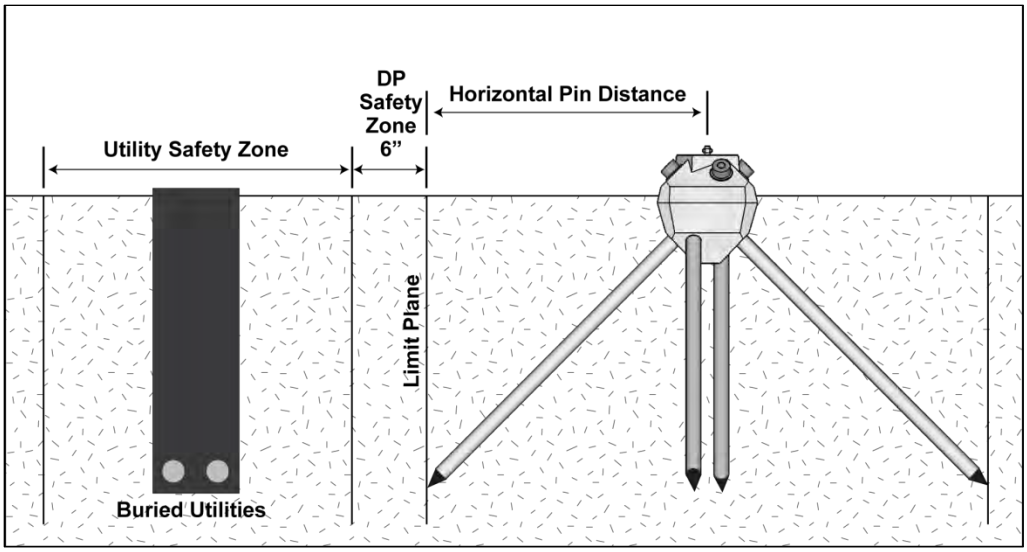

Figure 2. Horizontal Pin Distance
After installation, horizontal distance of all pins must be well outside all safety zones.

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 “Residential Diamond Pier 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, the bearing capacity must be reduced by 13% for each closer-spaced pier. The piers 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

You will need to assemble the following tools and gear:

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

We recommend a minimum two-person crew for installation.

Inspect and Prepare Diamond Pier Components

Inspect your Diamond Pier assemblies (see Figure 3) to ensure that no parts are flawed or have been damaged in shipping. Do not install a concrete pier if it has a structural crack with a fissure running internally into the head (see “Concrete Head Integrity” on page 16). Slight flaking or chipping is acceptable; a concrete head with surface flaking or chipping may be installed.

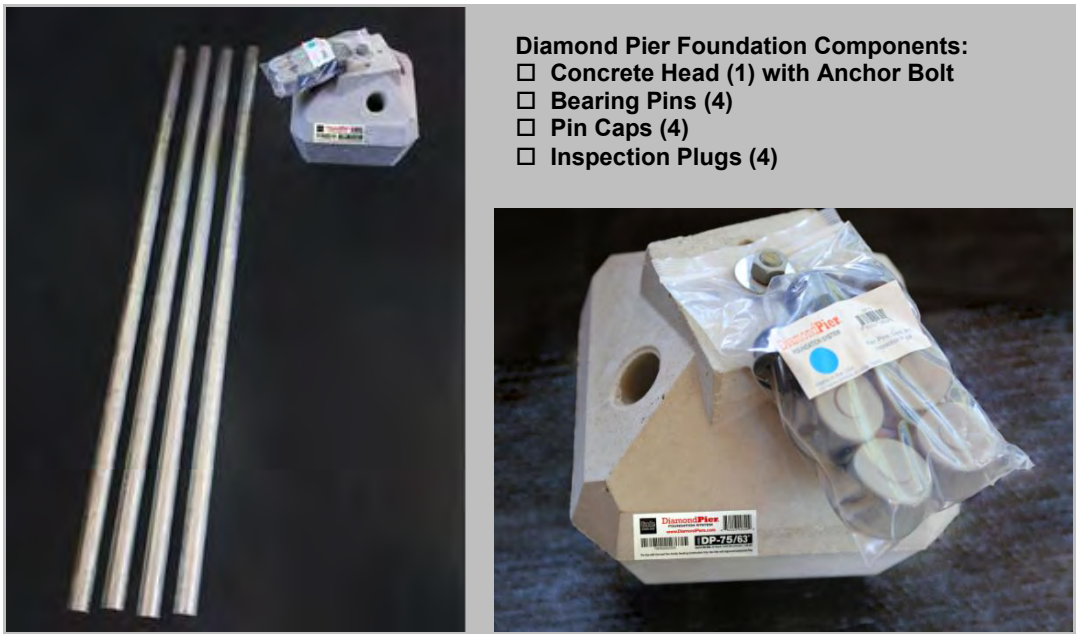

Figure 3. Diamond Pier Model DP-75/63" – Concrete Head with Bearing Pins and Package Containing Pin Caps and Inspection Plugs

Verify that you have the correct number of concrete heads with the corresponding number of bearing pins (4 per pier), pin caps (4 per pier), and inspection plugs (4 per pier), and that the anchor nuts thread properly on the pier anchor bolts. 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.) If the pins do not fit, contact your supplier. The inspection 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 as a method to verify its length.

Install Inspection Plugs in Pins

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.)

Install the inspection plugs in the ends of the pins that will go into the concrete head first. Align the slot in the plug with the interior weld bead and insert (see Figure 4). 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. (See "Encountering Obstructions," page 13, for plug use where buried obstructions may be encountered.)

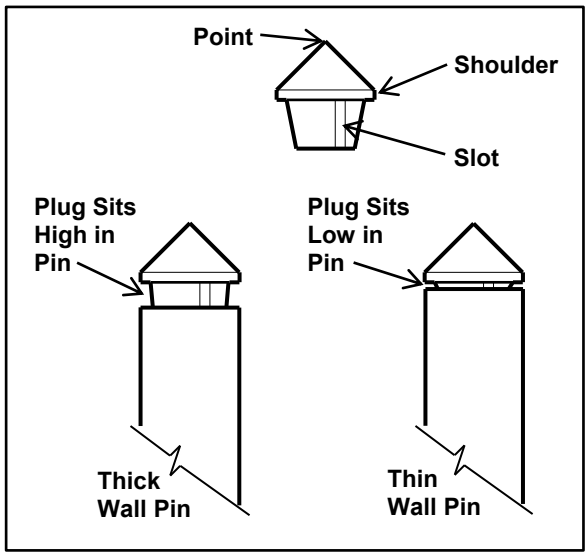

Figure 4. Inspection Plugs Must Be Installed in Pins

Installation

Identify and Mark Location

1. Identify where you would like the center of the pier anchor bolt to be located.
2. Mark the location by using reference points that will easily identify the center location of the pier even after top soil is removed. **Tip:** Set a string line centered on the anchor bolt approximately 12-14" above the ground for a quick reference point and to maintain alignment.

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 5). This creates a cradle to steady the head for leveling. Soils directly below the head 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 head at grade, lightly tamping to maintain level and alignment during pin driving. (See Notes under "Drive in the Pins" on page 12.) A few inches of small rounded pea gravel may be used if native soils are not available.

Figure 5. Tapered Hole for Concrete Head

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

*The concrete head may also be buried for aesthetic considerations, but access to the top of the head needs to be maintained. Concrete slabs, patios, and other products installed MUST NOT interfere with the Diamond Pier foundation and the attached post/beam assembly. Expansion joints may be used to protect the foundation. Proper drainage must also be maintained.

Drive in the Pins

WARNING: Verify locations of any buried utilities before driving pins (see "Locate Buried Utilities," page 8).

1. Slide the ends of the pins with the inspection plugs through opposing holes in the concrete head, making sure to support them so their weight does not roll the head out of the hole or out of alignment.
2. Keeping the pin centered in the driving hole, carefully set each pin 6" to 12" into the soil tapping with the sledgehammer (gripped just below the hammer head) until the concrete head is locked into a level position (see Figure 6). Impact the pin end squarely to minimize flaking of the concrete surface or deformation of the end of the pin (see **Note 1**).
3. With the pin driving bit installed on the automatic hammer, and another crew member holding the pin, drive in opposing pins alternately in increments (see **Note 2**). Periodically check for alignment and level (a 5-degree tolerance is allowed). 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 concrete head. The other crew member should hold the pin centered in the driving hole (see Figure 7). This will also reduce pin vibration and minimize concrete flaking.

Figure 6. Setting Pins and Leveling Concrete Head

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.

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

Figure 7. Driving Pins with Auto-hammer and Pin Driving Bit

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

Note 2: Do not drive a pin all the way down at once as this may cause the head to be pulled to one side. Continue to rotate around the head, 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 concrete head to ride up the pin, push the head to one side, or risk eccentrically stressing the head with a pin that is out of line. It could also cause the concrete head to have a structural crack, which would require removal and replacement (see "Concrete Head Integrity" on page 16). 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. 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 concrete head.

You can also try to drive the pin past or through the obstruction. Be sure the other pins are at least half way in to stabilize the concrete head and ensure that the head will remain in place before trying to drive the obstructed pin in any further. Put a pencil mark on the pin by the head to indicate if the pin moves. Attempt to drive the obstructed pin with the automatic hammer for approximately 10 to 20 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 directly past. If the pin begins to move, 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 concrete head and crack it.

If you can remove the pin, you can try removing the soil plug and redriving. Inspection plugs may only be omitted when approved by the building official. With the plug removed and less surface area at the lower end, the pin may drive easier, and not be forced by the angle of the plug past an obstruction, but off its trajectory.

If the trajectory is off or the pin will not go in at all, remove all the pins (see “Removing Pins”), rotate the concrete head around its center alignment, and reinstall to avoid the obstruction. The pier may also be relocated, within the parameters of your structure’s design, if necessary.

Removing Pins

The jacking method is used to spin and pry a pin out from the concrete head simultaneously by using a pipe wrench and a pry bar. This method works best when the pin is approximately 6" extended out from the concrete head. 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 head 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 8).
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 head.
6. Repeat lock and jack (steps 3–5) until the pin can be pulled out by hand.

Figure 8. Jacking Method for Pin Removal

Note 1: 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.

Note 2: For an alternate removal technique, an internal pipe locking tool with an electric impact wrench may be used to spin the pin and draw it from the concrete head.

Place Pin Caps on Pins

1. Set the pin caps loosely on the ends of the pins so they can be removed for pin length inspection (see “Pin Length 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, tap the caps down tight with the small hammer (see Figure 9) to seal them against the concrete.

Figure 9. Completed Installation with Pin Caps

NOTE: If the caps 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.

Register Your Product Warranty

1. Download the Limited Lifetime Warranty Application Form available at www.diamondpiers.com.
2. Submit application within 30 days of project completion.
3. Confirm receipt of your registered warranty by PFI.

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" diameter galvanized bolt embedded in the top of the concrete head (nut provided), and this bolt will connect to a code-approved post base. The DP-75 pier has a 5/8" diameter bolt at the top of the concrete head. Check your local building code or building official 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.

Horizontal beams may also be set directly in an appropriate bracket for direct connection to the Diamond Pier foundation when constructing low-profile structures. Larger piers not shown on the “Residential Diamond Pier Load Chart” (Table 1) have a variety of bolt diameters and configurations. Contact PFI for more information if your project requires piers larger than the DP-50 or DP-75.

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 concrete heads must be special ordered with embedded stainless steel anchor bolts to avoid the potential for corrosion of dissimilar metals in contact.

Breaker Hammers and Driving Bits

The Diamond Pier driving bit is recommended for use with a standard breaker/demolition hammer, see below. The driving bit has a 1-1/8" hex shaft, and can be rented or purchased through a local dealer or purchased directly from PFI. **NOTE:** ***The bits are NOT to be used with, or as, a sledgehammer.***

Only automatic breaker/demolition hammers should be used to install the Diamond Pier pins. Any standard automatic hammer that will handle a 1-1/8" hex shaft can be used, provided it can be properly and safely controlled by the operator and not risk injury or damage to the concrete head. 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 electric hammers. Roto-hammers are not adequate.

Below is a list of commonly available electric automatic breaker/demolition hammers.

- BOSCH Brute #BH2760VC 63-lb Breaker Hammer; Bit type: 1-1/8" Hex
- MAKITA Model #HM1307CB 35-lb Demolition Hammer; Bit type: 1-1/8" Hex
- HITACHI Model #H65SD2 40-lb Demolition Hammer; Bit type: 1-1/8" Hex
- BOSCH Model #11335K 35-lb Breaker Hammer; Bit type: 1-1/8" Hex
- MILWAUKEE Model #5338 71-lb Breaker Hammer; Bit type: 1-1/8" Hex

FIELD INSPECTION

A Diamond Pier foundation code inspection may take place at any time during or 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 Inspection

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 “Install Inspection Plugs in Pins” on page 11).

NOTE: The Diamond Pier foundation is a shallow bearing technology and does not require “refusal” or “friction” resistance, or the professional installation monitoring or special inspection typically associated with conventional vertical or battered piling.

NOTE: If framing members will be too close to the top of the concrete head 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 been unintentionally forgotten, 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. If a plug has been removed to facilitate driving in an obstructed condition (see “Encountering Obstructions,” page 13), be sure to note or mark the location of this pin for the inspector. Pins are to be their full specified length without joints or coupling (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 pin 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". The wall thickness tolerance is ±12%.

Concrete Head Integrity

If the “INSTALLATION INSTRUCTIONS” (page 8) are properly followed, the concrete heads should be level, 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 concrete head.) A structural crack is a fissure running internally into the head. It is perpendicular to the outer face of the head and runs inward to its core. This can weaken the strength of the pier head and/or allow water to penetrate and cause freeze/thaw problems in the concrete. If a concrete head has a structural crack, it should NOT be patched. It must be removed and replaced.

If a concrete head is more than 5 degrees out of level, the symmetry of the pin pairs may be compromised, and the head should be removed and correctly reinstalled.

Allowable Capacity

The piers must 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. If you are not capable of properly calculating allowable loads, have the loading and capacities verified by your local building department or an independent registered design professional.

The total load calculated for a post or beam connected to the pier (also known as the “support column”) is based on a combination of the live load (snow, people, furnishings, etc.) and the dead load (weight of structure itself). The live load and dead load requirements are provided by your local bulding department; loads are specified in pounds per square foot (psf). A determination must be made as to what portion of the floor area is supported by a single support column. A design professional should be able to make this determination. Once the proper area for the single support column is determined, multiply the area (A) supported by the required loads (in psf) to determine the total tributary load (in pounds) for the single pier:

(A) x (psf) = Total Tributary Load

This value should not exceed the published capacity of the Diamond Pier model and corresponding pin length intended for use.

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.

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 concrete head. See “Post/Beam Brackets” (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. Site must be properly drained.

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 Concrete Head	Always inspect materials when received from supplier. Do not install a head that has a structural crack or fissure running internally into it. Slight flaking or chipping does not constitute a crack.
Concrete Flaking	During installation, pins rubbing against the concrete head may cause superficial flaking of concrete around the driving hole. This will not affect the structural strength. However, if a structural crack or fissure running internally into the concrete head develops during installation, the integrity of the pier has been compromised and the concrete head must be removed and replaced.
Concrete Head 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 concrete head may be too big. Only dig a hole the size of the head being used, and be sure to put all pins in the head before setting them. With all the pins sticking up from the head, one person can also push or pull on the pins to manipulate the leveling process and guide or steer the concrete head to a level position, being careful not to wrench on it and cause a crack.
Concrete Head Installed Out of Level	If a concrete head is more than 5 degrees out of level, the symmetry of the bearing pins may be compromised—the head 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 head to tip, install the other pins first and then carefully finish driving this last pin.
Hitting an Obstruction When Installing	If an obstruction is encountered, the pins may be removed and the concrete head repositioned. If the obstruction is dug out and removed, soil must be recompacted per the Installation Instructions. See “Encountering Obstructions” (page 13).
Installing in Frozen Ground	Check with the local building code for criteria or limitations on installing foundations in frozen soil. See “Frost Heave” and “Heave Resistance” on page 7.
Pins Have Risen Slightly Out of the Concrete Head	This may occur when extreme loads have been applied to the pier, but the foundation 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 Concrete Head	Make sure the pins fit into the concrete head before inserting the inspection plugs. Be sure pins and concrete heads are free of dirt, and check both ends of pins 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.) If the pins still do not fit, contact your supplier.
Pin 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.

DiamondPier®
FOUNDATION SYSTEM

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