

# **DP-50**

# **DIAMOND PIER<sup>®</sup>**

## **FROST PERFORMANCE REPORT**

**Zone II, Minnesota Soils**

**2010**

Pin Foundations Inc.  
5114 Pt Fosdick Dr NW  
Bldg # E - 60  
Gig Harbor, WA, 98335

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## **Reference**

- ICC-ES Evaluation Report, ESR-1895 \*
- Diamond Pier Performance Affidavits – National, 2005 \*
- Manufacturers Installation Instructions \*
- Professional Service Industries Foundation Bearing Report -704-25035-1\*
- MN Adopted 2006 IRC Alternate Methods & Materials – R104.11
- MN Adopted 2006 IRC – MN 1309.0403, Section 403, Footings
- 2007 MN State Building Code – Rule 1303.1600
- MN Adopted 2006 IRC – Soils Section R401.4, and Table R401.4.1

\*Documents with an asterisk are available on the Pin Foundations website ,  
*www.diamondpiers.com.*

## Overview

We appreciate your taking the time in your schedule to review the Diamond Pier® DP-50 as an alternate foundation system for residential porches, decks, walkways and stairs, and we recognize the importance of your participation in evaluating this new technology. The enclosed performance report is specific to the capacity of the system to perform in frost conditions, and is intended to establish its equivalency with conventional footings.

## History and Advantages

The Diamond Pier was developed more than 26 years ago in an effort to reduce excavation and construction material volumes, and eliminate the site pouring of concrete. It has been used successfully for public works projects across the country since 1996, and was first introduced to the residential market in 2002.

The environmental advantages of minimizing excavation and reducing concrete volumes, are far reaching and significant. Cement manufacture has the third largest carbon footprint in US industry, and digging, whether for the mining of concrete constituents, or for the placing of deep monolithic concrete components, releases more carbon into the atmosphere, interrupts natural groundwater flows, and breaks down established soil strength and structure.

Though simple, conventional, large concrete foundations require considerable digging to embed, leaving substantial amounts of soil to remove from a site, and they rely on significant volumes of site poured concrete, with the potential for field variables and limitations to their consistency. These conventional systems rely on depth and gross weight as protections against frost heave.

## Function

The Diamond Pier is not a depth or gross volume system, but instead relies on small section, high strength manufactured components to create a foundation based on pressure resistance and capturing in-place soil strength. Short stiff galvanized steel Pins are engaged in a precast concrete head, which pushes the Pin cluster against the soil as one unit – up or down - gaining both bearing strength and uplift resistance from the surrounding intact material. Pin length then is based on providing sufficient bearing and resistance to heave pressures, rather than reaching a specific vertical depth. Because of its unique configuration, these 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 to absorb soil strains caused by frost or expansive conditions, without transferring these strains to the supported structure.

With these features, the Diamond Pier can be used for residential porches, decks, walkways or stairways attached to the primary dwelling, meeting or exceeding the intent of the Code to provide a solid, stable bearing component, which is protected from soil movement, and in turn protects, the permanent structures it supports. It can also be inspected at any time during construction to check for proper Pin length, and the installation of level, intact piers.

## Acceptance

To gain acceptance as a new technology, the Diamond Pier must meet the criteria for “Alternate Materials”. The following code compliance discussion, and enclosed performance report address this issue specifically.

If you have any questions about this report or ESR-1895, please feel free to contact me directly. I can be reached at (253) 858-3844 or by e-mail, [@pinfoundations.com](mailto:@pinfoundations.com).

Thank you,

**Richard J. Gagliano**  
**President, Pin Foundations, Inc**

## Colorado Code Consulting, L.L.C.



**Main Office**  
4610 S Ulster Street  
Suite 150  
Denver, CO 80237  
(303) 400-6564  
Fax: (303) 693-0630

**Northern Office**  
811 Fourth Street  
Berthoud, CO 80513  
(303) 895-9988  
Fax: (970) 532-2789

**Mountain Office**  
152 Larson Lane  
PO Box 1261  
Frisco, CO 80443  
(303) 591-9258  
Fax: (970) 668-0862

### Diamond Pier DP-50 – IRC R104.11 Alternate Methods Compliance for Frost Protection

The following report by Steven Schmidt, PE is intended to provide frost performance verification pursuant to Diamond Pier Evaluation Services Report ESR-1895, Section 5.3. The report, in conjunction with ESR-1895, is intended for Building Official review and approval of the 50" pin length Diamond Pier DP-50 foundation system.

In accordance with Minnesota adopted International Residential Code (IRC) Section R104.11 Alternate Materials, it is my professional opinion that the report demonstrates that Diamond Pier DP-50 foundations have been proven to protect attached, permanent secondary structures (such as decks and stairs) from frost heave. Therefore, the piers comply with the intent of the Minnesota Code Section 1309.0403 and its amended IRC section R403.1.4.1 for footing frost protection. **The intent of these provisions is to ensure footings and the permanent structures they support are protected from the negative effects of frost heave.** Diamond Pier's track record proves that it provides for the IRC's full frost protection intent.

#### Background

Diamond Pier has been evaluated by ICC Evaluation Services and was issued ESR-1895. This ESR provides clear guidance on bearing capabilities of the DP-50 pier assembly. It also contains an affirmative statement in Section 5.3, permitting the DP-50 piers to be used for attached decks, porches and stair structures, when such structures are exposed to frost. This statement was added at the behest of the ICC-ES Committee, of which I was a member during this hearing. During these public hearings on the product in 2005, the Committee recognized the successful field performance of the Diamond Pier product to date. The 5.3 statement intended that the building official may either approve the product consistent with the IRC Section R403.1.4.1 Exception for detached structures, OR approve it for attached structures based on submitted proven field performance. The Schmidt report provides additional local field performance for the latter purpose of permitting use for attached structures.

The current foundation frost protection methodologies contained in the IRC are also based on observed field performance. There is no national test standard available to test a foundation system for frost performance, including those historically accepted within the IRC. All foundations must be evaluated in the field before being accepted in the code. I base this assertion on the foundations testimony that I have witnessed as either a hearing attendee or committee member of the IRC Building and Energy Committee. I am currently the chairman of this committee.

Pin Foundations, Inc has monitored Diamond Pier installations across the country for the past 15 years and have had no reported failures to date. Affidavit letters from various Diamond Pier installations across the United States helped assure the ICC-ES committee code officials in 2005 that the product would achieve equivalent frost performance to that prescribed by the IRC. The enclosed Schmidt report has assessed performance in a variety of soils in the Zone II Minnesota region, and provides for a specific local analysis of field performance in frost. The success of the Diamond Pier product in these soils was affirmed by Mr. Schmidt as he finds NO movement or structural degradation in any of the Minnesota locations he investigated in the preparation of his report.

**Conclusion**

When used as a supplement to the ESR-1895 evaluation report (specifically Section 5.3), the Schmidt frost performance report provides the Minnesota code official with product performance assurance for Diamond Piers supporting attached structures in areas with frost heave potential. In my professional opinion, the combination of the ESR-1895 report and the performance verification provided within the Schmidt study more than satisfies the code official's assessment responsibilities under IRC Section R104.11 for code-equivalent foundation frost protection of attached porch, deck, and stair construction.

Respectfully,

A handwritten signature in black ink, appearing to read 'T. Meyers', written in a cursive style.

Thomas Meyers, CBO  
Vice President - Colorado Code Consulting, LLC

I have been requested by Pin Foundations, Inc. to review a series of deck installations using the Diamond Pier foundation system, its proprietary foundation product. The scope of this report is to assess each deck's performance and whether any significant movement has occurred as a result of the use of this foundation system. I have reviewed the ICC-ES Evaluation Report ESR-1895 covering the Diamond Pier, as well as product and test data provided by Pin Foundations. Of particular interest in this region is the equivalency of the Diamond Pier System to traditional frost protected foundations in a freeze/thaw environment, where the potential for heaving action can adversely affect the supported structure.

Briefly, frost action occurs when moisture moves into the freezing zone of a soil. Specific conditions must be present for frost heave to occur; the correct combination of soil characteristics including density, texture, and saturated hydraulic conductivity, the depth of water table and excess of available water, and temperature gradient. Silt and highly structured clays soils that have a high water table are the most susceptible to frost action. Well drained or very sandy soils are the least susceptible to frost action. Other factors like snow cover and vegetation add an insulating quality to the soil beneath, and can also be considered as affecting heaving action. The structures selected for inclusion in this report represent common site and soil conditions in number of jurisdictions. While each site is unique, and detailed soil testing not performed, the requisite conditions for heaving as referenced above can be present at these sites.

Damage caused by frost heave and the resulting low soil strength during thawing is most apparent in pavements and other rigid structures that have displaced. Signs that a deck has experienced frost heaving would be tilted piers, posts out of plumb, wrenched connections with bent connection hardware, and unlevel joists and decking. **As of the review date, all of the installations assessed are in good condition and show no significant distress that would indicate that the use of the Diamond Pier system has caused the structure to displace.** Based on these observations, one can conclude the Diamond Pier performance is satisfactory and equivalent to the conventional footings in this region.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINT NAME: STEVEN A. SCHMIDT

SIGNATURE: 

DATE: 06/14/10 LICENSE #: 40502

**Siebrasse, Paul & Lynette**

6796 Everest Lane North

Maple Grove, MN 55311

Builder: Archadeck (John Buenneke 612-232-8038)

Installed: May 2008, East Facing



I reviewed the deck installed at the aforementioned address on 5/4/10 for any indications of movement that may be attributable to the use of the Diamond Pier foundation system.



The main deck is roughly 11 feet by 33 feet and 10 feet in height. Three piers have been installed in a straight line along a common beam located approximately 11 feet from the house. Additional piers support a walkway from the structure to the driveway on the side of the house and a landing and stairway off the corner of the structure. A total of ten Diamond Piers are installed.



Observation of the soil and proximity to the Barras home described above indicates the soils are hard packed clay.

The Diamond Piers were reviewed for distress around the pin sleeves or if the pins have moved relative to the pier. No signs of distress or cracking were observed. All pins project consistently from the Diamond Piers. A sampling of the pins indicates none are loose and a measurement down the inside indicates the pins are 50 inches long. An 8-inch bullet level was used to measure the levelness of the Diamond Pier. All were level. The post connection brackets were secure and fully seated on all Diamond Piers.



A 4-foot level was used to check the levelness of the deck. All posts are plumb and the main supporting beam between the piers is level and tightly secured to the posts. There are no indications of differential movement between the piers.



The joists are level and the ledger board connecting to the house was reviewed. All of the joist brackets are secure and no sign of prying is apparent.

**There are no indications of any foundation movement or degrading of the structure.**





**Boie, Matt**

10467 6<sup>th</sup> Street NE

Hanover, MN 55341

Builder: DYI

Installed: May 2007, West Facing



I reviewed the deck installed at the aforementioned address on 5/4/10 for any indications of movement that may be attributable to the use of the Diamond Pier foundation system.

The deck in question is roughly 19 feet by 20 feet and 6 feet in height with a stairway. Two beams support the deck parallel to the back of the house; one eight feet from the house and the second at perimeter. Three piers support each beam. The deck has a trellis structure above. The soil on site is stiff clay.

The Diamond Piers were reviewed for distress around the pin sleeves or if the pins have moved relative to the pier. No signs of distress or cracking were observed. All caps covering the ends of the pins have been sealed to the concrete. The homeowner stated 48 inch pins were used on the project.

All Diamond Piers were level and the post connection brackets were secure and flat against the top of the pier. A 4- foot level was used to check the levelness of the joists and supporting beams. All posts are plumb and the supporting beams between the piers are level and tightly secured to the posts. I observed that the perimeter beam appears to have rolled slightly at the southeast end. The homeowner acknowledges that this occurred during construction because he had not joined the two plies of the beam together and the bracket at the top of the post bent. He has added a third ply to the beam and thru bolted all three members along the length of the beam. There is no indication of differential movement between the posts on either beam line.

The joists are level and the hangers at the ledger board attached to the home are tight. No prying was apparent.

**There are no indications of any foundation movement or degrading of the structure.**





**Barras, Ben & Jamie**

6788 Fountain Lane North

Maple Grove, MN 55311

Builder: Archadeck (John Buenneke 612-232-8038)

Installed: Summer 2008, East Facing



I reviewed the deck installed at the aforementioned address on 5/4/10 for any indications of movement that may be attributable to the use of the Diamond Pier foundation system.

The main deck is roughly 22 feet by 14 feet and 12 feet in height. Three piers have been installed in a straight line along a common beam located approximately 13 feet from the house. Three additional piers support a walkway from the structure to the driveway on the side of the house and six piers support an octagonal landing leading to a stairway off the corner of the structure.



The homeowner reported drainage problems at the side yard of the property where water draining from the driveway ponds at the corner of the deck near the stairway. The homeowner was in the process of re-grading the site and adding a drain tile to drain the area. A shallow hole was dug nearby and the soils appear to be hard packed clay.



The Diamond Piers were reviewed for distress around the pin sleeves or if the pins have moved relative to the pier. No signs of distress or cracking were observed. Two pins of forty-eight on the site projected approximately 3/4" to 1" above the concrete while the remaining pins projected consistently from the Diamond Pier. A sampling of the pins indicates none are loose and measurements down the inside indicate the pins are 50 inches long. I used an 8-inch bullet level to measure the levelness of the Diamond Pier. All were level. The post connection brackets were secure and fully seated on all Diamond Piers.



I used a 4-foot level to check the levelness of the deck. All posts are plumb and the main supporting beam between the piers is level and tightly secured to the posts. There are no indications of differential movement between the piers.



The joists are level and the ledger board connecting to the house was reviewed. All of the joist brackets are secure and no sign of prying is apparent.



**There are no indications of any foundation movement or degrading of the structure.**

**Bechel, Cheryl**

6486 Shadyview Lane North

Maple Grove, MN 55311

Builder: Precision Decks (Bob Januik 763-228-4429)

Installed: October 2008, South Facing

I reviewed the deck installed at the aforementioned address on 5/4/10 for any indications of movement that may be attributable to the use of the Diamond Pier foundation system.

The deck in question is 12 feet by 14 feet and 12 feet in height with a stairway on one side. Two piers support the main deck and additional piers support the stairway and landing. The yard is flat and slopes gently away from the house toward a pond.

Architectural elements obscured direct observation of the Diamond Piers and the supporting structure. I was able to observe one pin and its projection is consistent with other projects. It was not loose and a measurement down the inside of the pin indicates 50 inch pins were used on the project.

Observation of soil nearby indicates sandy silt.

A 4-foot level was used to check the levelness of the deck. The joists are level and the hangers at the ledger board attached to the home are tight. No prying was apparent.

**There are no indications of any foundation movement or degrading of the structure.**



**Larson, Randy**

10124 Kiersten Place

Eden Prairie, MN 55347

Builder: Precision Decks (Bob Januik)

Installed: July 2008, West Facing



I reviewed the deck installed at the aforementioned address on 5/6/10 for any indications of movement that may be attributable to the use of the Diamond Pier foundation system.

The deck in question is roughly 16 feet by 20 feet and 2 feet in height. Three piers support a common beam installed 14 feet from the house. The yard slopes towards the house and the homeowner reports that water saturates the soil around and under the deck as it drains from the hillside. The homeowner reports the site drains quickly and the soil is sandy and no water enters the basement of the house after heavy rains.



The piers were buried underground and the low deck made access difficult. I was able to observe one pier and its pins. The pier was not damaged and the pin projection is consistent with that found on other projects. None of the pins are loose and a measurement down the inside indicates 63 inch pins were used on the project.



A 4-foot level was used to check the levelness of the deck. The joists and decking are level, as is the crossbeam. The posts are tight to the pier and beam. I was able to observe the ledger beam from each end. The hangers at the ledger board attached to the home are tight. All hangers appeared to be tight to the ledger board.



**There are no indications of any foundation movement or degrading of the structure.**





**Loven, Ron**

8752 Knollwood Drive

Eden Prairie, MN 55347

Builder: Cade Moore

Installed: August 2008, South Facing



I reviewed the deck installed at the aforementioned address on 5/6/10 for any indications of movement that may be attributable to the use of the Diamond Pier foundation system.

The deck in question is roughly 11 feet by 22 feet and 10 feet in height. Three piers support a common beam installed 10 feet from the house. Two additional piers are installed at a stair landing along the front of the deck. The yard slopes steeply away from the home towards a ravine approximately 35 feet from the deck.

The piers were all installed level and the pins project consistently from each pier. One pier has a slight spall around one pin. No cracking was observed. None of the pins are loose and a measurement down the inside indicates 60 inch pins were used on the project.

The post base brackets are level against the pier and the posts are tightly secured. The posts to beam connections are tight and no gaps were observed.

A 4-foot level was used to check the levelness of the deck. The joists and decking are level, as is the supporting beam. The joists are connected to the ledger board using metal joist brackets. The joist brackets are secure and no sign of prying is apparent.

**There are no indications of any foundation movement or degrading of the structure.**



**Hlushko, Dean & Alley**

16527 75<sup>th</sup> Avenue North

Maple Grove, MN

Builder: O’Noonan Construction (Pat Noonan 612-243-3999)

Installed: September 2009, West Facing



I reviewed the deck installed at the aforementioned address on 5/4/10 for any indications of movement that may be attributable to the use of the Diamond Pier foundation system.

The deck in question is roughly 12 feet by 17 feet and 10 feet in height. Three piers have been installed in a straight line along a common beam located approximately 10 feet from the house. Four additional piers support a stairway from the structure. The site consists of a large engineered fill with a 15-foot tall rock retaining wall. No drainage issues are apparent.



The Diamond Piers were reviewed for distress around the pin sleeves or if the pins have moved relative to the pier. No signs of distress or cracking were observed and all the pins project consistently from the Diamond Pier. A sampling of the pins indicates none are loose and measurements down the inside indicate the pins are 50 inches long. An 8-inch bullet level was used to measure the levelness of the Diamond Pier. All were level. The post connection bracket was secure and fully seated on the Diamond Pier.



A 4-foot level was used to check the levelness of the deck. All posts are plumb and the supporting beam between the piers is level and tightly secured to the posts. There are no indications of differential movement between the piers.



The joists are level sloped slightly away from the house and the ledger board connecting to the house was reviewed. All of the joist brackets are secure and no sign of prying is apparent.



**There are no indications of any foundation movement or degrading of the structure.**





**Hanson, Laura**

3536 39<sup>th</sup> Ave South

Minneapolis, MN 55406

Builder: Archadeck (John Buenneke 612-232-8038)

Installed: July 2008, West Facing



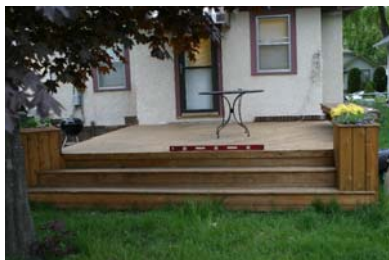
I reviewed the deck installed at the aforementioned address on 5/6/10 for any indications of movement that may be attributable to the use of the Diamond Pier foundation system.

The deck in question is 12 feet by 14 feet and 2 feet in height. The deck is freestanding and is not attached to the house. By code, footings extending to frost depth are not required for freestanding decks. The deck is supported by two beams with three Diamond Piers per beam. The first beam is located 2 feet from the house running parallel to the house. The second beam was located ten feet from and running parallel to the first beam.

All six piers observed, but access was restricted due to the height and finished sides of the deck. Two piers were reviewed: The first pier closest the house was level and two pin length measurements were taken: one pin length is 17 inches and the other is 29 inches. It appears a short pin was used in order to install the pier close to the house. The second pier was found to be approximately 1/2" out of level and the wood post does not bear fully on its connection bracket. But the post to beam connection was tight indicating that the pier was installed out of level and adjustments were made in the framing. One pin measurement was taken at this pier and the length is 33 inches.

A 4-foot level was used to check the levelness of the deck. The joists and decking are level, as are the supporting beams. No distress was observed in the framing joints, which would indicate that the second pier was installed out of level originally, and the framing compensated for the tilt of the pier.

**There are no indications of any foundation movement or degrading of the structure.**





**Remme, Mark**

10705 Cambridge Ct.

Burnsville, MN

Builder: College City Remodeling

Installed: May 2009, North & West Facing



I reviewed the deck installed at the aforementioned address on 5/18/10 for any indications of movement that may be attributable to the use of the Diamond Pier foundation system.

The structure supported by Diamond Piers is roughly 4 feet by 12 feet and 5 feet in height and is an addition to a deck set on conventional concrete piers. One diamond pier supports a beam which is framed into the existing structure. The two remaining piers support the landing of a stairway. The yard slopes steeply away from the home towards a ravine approximately 10 feet from the deck.

The piers were all installed level and the pins project consistently from each pier. None of the pins are loose and a measurement down the inside indicates 63 inch pins were used on the project. The post base brackets are level against the pier and the posts are tightly secured. The posts to beam connections are tight and no gaps were observed.

A 4-foot level was used to check the levelness of the deck. The joists and decking are level, as is the beam supported at one end by a diamond pier.

**In the portion of the structure supported on Diamond Piers, there are no indications of any foundation movement or degrading of the structure.**

