

# **DiamondPier<sup>®</sup>**

## **FOUNDATION SYSTEM**

### **Code Compliance Information for Diamond Pier<sup>®</sup> Foundations in the State of Minnesota**

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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 document is available on our website, [www.diamondpiers.com](http://www.diamondpiers.com), or by calling us at 708-406-5005. Other documents and publications referenced in this document and listed below are also available on the website.

“Diamond Pier DP-50 & DP-75 for Bearing Pin Piers,” ICC-ES Evaluation Report No. ESR-1895, Reissued December 2019.

“Diamond Pier National Performance Submittals,” 2005.

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

“Diamond Pier Frost Performance Review,” Nebraska Engineer’s Review, Certified letter from Paul C. Gilham, P.E., Western Wood Structures, Inc., January 29, 2013.

“Diamond Pier Observational Evidence,” Forest Lake, Minnesota, May 2011.

“Diamond Pier Installation Manual,” 2020.

**UPDATE TITLE / FROST STUDY** “Code Compliance for Diamond Pier Foundations, Models DP-50 and DP-75; Frost Performance Criteria,” 2020.

# ***Code Compliance Information for Diamond Pier® Foundations in the State of Minnesota***

## **Introduction**

The information in this document is intended to assist homeowners and builders in obtaining code approval to use Diamond Pier foundations for projects in the state of Minnesota. The Diamond Pier foundation system manufactured by Pin Foundations, Inc. (PFI) has proven to demonstrate performance equal to or better than the traditional prescriptive footing method in areas described as having severe frost susceptible soils, and it is compliant with the 2006, 2009, 2012, 2015, and 2018 International Residential Code (IRC) and the new 2020 Minnesota Residential Code (MRC) when properly installed. The procedure and submittal instructions below detail what to provide with your permit application to establish that the intent of the code is fully met with the use of Diamond Pier foundations for the specific project as described in the application.

PFI is the innovator of the proprietary Diamond Pier technology, which has been evolving since its development 30 years ago. With a deep understanding of the technological concept and the related soil science, PFI has developed the specialized engineering knowledge to evaluate bearing, uplift, and lateral loads and to understand dynamic loading such as asymmetrical and rotational forces. PFI worked directly with ICC-ES, to produce the AC336 document, "Acceptance Criteria for Bearing Pin Piers," which is used to establish code compliance for the Diamond Pier bearing pin piers. Our code compliance status also includes independent ICC audits of strength reports for each Diamond Pier batch that is cast and tracked with our unique G1S bar code.

## **Procedure**

The procedure when seeking code approval for any project involves the submittal of a code-compliant design to the local building code official, along with the building permit application and supporting documentation. The project then goes through a plan review process. If the building official finds the project meets the intent of the code, then the project will be approved and the building permit issued. This is true regardless of how common a product is; even a prescriptive concrete pier footing typically accepted by a code official for use in frost zones, as prescribed in Part 1300.1600 of the MRC, must be reviewed to ensure that site-specific conditions and the application meet the intent of the code. There may be cases where the prescriptive code is not satisfactory and additional means and measures are required. There is no product, design, or method of construction that is approved until a building official stamps the site plans for the project as approved.

For Diamond Pier foundations, the procedure is to submit the Diamond Pier product as an alternate method with the application for the building permit. This is accomplished by attaching a detail of the Diamond Pier product in the project drawings, along with the layout and spacing of the piers in accordance with the "Residential Diamond Pier Load Chart." Also, it is important to include a current copy of ICC-ES evaluation report ESR-1895 and, if requested, frost performance documents, which are available on the manufacturer's website, [www.diamondpiers.com](http://www.diamondpiers.com).

## **Submittal**

Each project submittal using the Diamond Pier foundations must be reviewed by the local building code official to ensure that site-specific conditions and product applications meet the requirements of the Diamond Pier Installation Manual, the Residential Load Chart, and ESR-1895. Note that Section 5.1 of ESR-1895 states, in part, that the Diamond Pier foundations must be installed in accordance with the PFI published installation instructions, the IRC, and ESR-1895. Testing results for uplift and lateral loads are available upon request.

During the review process, the building official considers the scope of the project and that it conforms to Section 2.0 of ESR-1895, the project structure, soils information, and site conditions to ensure that the Diamond Pier product is being installed in accordance with its published capacities and that the published capacities and evidence of system performance submitted comply with the intent of the MRC.

Once the building official determines that the proposed project is satisfactory and complies with the intent of the code, the use of the Diamond Pier product shall be approved.

## Code Compliance Information

The Diamond Pier foundation system is IRC code compliant, and it also complies with the 2020 MRC, as amended, when used in accordance with ESR-1895 and PFI's published Diamond Pier Installation Manual.

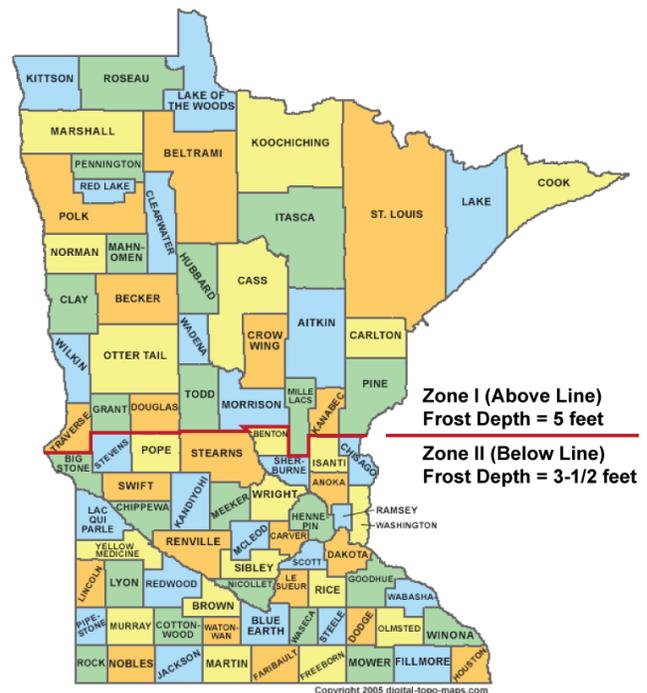
The path to approval is via Part 1300.0110, Subpart 13: Alternative materials, design, and methods of construction and equipment, in the MRC.

The prescriptive code governing traditional concrete pier footing depth for frost protection is described in R403.1.4.1 of the MRC and Part 1303.1600 in the Minnesota Administrative Rules, which specify the frost depth as 5 feet in Zone I and 3-1/2 feet in Zone II (as shown in Figure 1).

The intent of Part 1303.1600 is to ensure that **concrete pier footings provide adequate protection of the structure from the negative effects of frost heave**. Frost heave occurs when the frost heave force exceeds the uplift capacity of the foundation system.

**Diamond Pier footings are pre-engineered to provide equivalent performance to concrete footings:**

- The DP-50 model with 50" bearing pins equates to a 20" dia footing 40" deep.
- The DP-75 model with 63" bearing pins equates to a 22" dia footing 60" deep.



**Figure 1. Frost Depth in Minnesota Counties per Part 1303.1600, Subpart 1. Minimum Footing Depth.**

Section 5.1 of ESR-1895 states that the system must be installed in accordance with the published installation instructions. The Diamond Pier Installation Manual defines the frost depth equivalence shown above as 48" deep for the DP-50/50" model and 60" deep for the DP-75/63" model. This is shown in the Residential Diamond Pier Load Chart in the installation manual (also provided here on page 5), and is supported by the statement in Section 2.0 of ESR-1895 for use in all weathering classifications.

Section 5.3 of ESR-1895 states: *In areas requiring frost protection, exterior decks on bearing pin piers as described in Section 2.0 may be connected to and supported by a dwelling when approved by the code official.* The phrase "when approved by the code official" implies that such approval is not intended to be an arbitrary decision. This statement refers to the requirement for a plan review process to identify any violations to the specifications and limitations defined in the Diamond Pier Installation Manual. The plan review process renders a code-based reason for acceptance or denial on the use of a code-compliant product on a project-by-project basis. This process considers how the product is to be used and whether that use meets the intent of the code.

## Submittal Evidence

The Diamond Pier DP-50 and DP-75 foundations have proven to provide sufficient bearing capacity in Minnesota. The testing and performance evidence shows that the Diamond Pier product provides adequate bearing, lateral, and uplift support for the life of the project when used in accordance with the Diamond Pier published capacities as defined in the Residential Diamond Pier Load Chart.

### **Residential Diamond Pier Load Chart** **IAS-Accredited Third-Party Bearing, Uplift, and Lateral Field Tests<sup>2</sup>**

## Minimum 1500 psf Silts/Clays (CL, ML, MH, CH)<sup>3</sup>

Model / Pin No. / 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#
<b>Equivalency to Traditional Concrete Footings</b>						

## Minimum 2000 psf Sands/Gravels (SW, SP, SM, SC, GM, GC)<sup>3</sup>

Model / Pin No. / 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#
<b>Equivalency to Traditional Concrete Footings</b>					*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](http://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" in the Diamond Pier Installation Manual 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.

## **Load Bearing Testing**

IAS-Accredited Diamond Pier Compression Field Load Test Report, EEI Report No. 07-020-10, published October 5, 2016; submitted to the ICC-ES evaluation services for review and publication in December 2016. A copy of this test report is available upon request.

The current ESR-1895, reissued December 2019, in Section 4.1, provides evidence of bearing capacity using Diamond Pier foundations as equivalent to the published load capacity chart provided on page 5 per 2018 IRC Table R401.4.1. The Diamond Pier DP-50 with 50" pins provides 3300 lb of bearing capacity in 1500 psf minimum soils per 2018 IRC Table R401.4.1. The Diamond Pier DP-75 with 63" pins provides 4200 lb of bearing capacity in 1500 psf minimum soils.

## **Uplift and Lateral Load Testing**

IAS-Accredited Diamond Pier Uplift and Lateral Load Field Test Report, EEI Report No. 07-020-11, published January 2017.

The IAS-Accredited Diamond Pier Uplift and Lateral Load Field Test provides evidence of equivalent or better uplift loads when compared to a traditional concrete foundation assembly. The Diamond Pier DP-50 with 50" pins provides 1200 lb of uplift resistance in 1500 psf minimum soils per 2018 IRC Table R401.4.1. The Diamond Pier DP-75 with 63" pins provides 1600 lb of uplift resistance in 1500 psf minimum soils.

## **Uplift Comparison**

The Diamond Pier DP-50/50" provides 1200 lb of uplift load capacity per IAS-accredited third-party testing.

- A 12" diameter x 48" deep concrete cylinder footing provides an uplift resistance of 465 lb (dead load calculation).
- The Diamond Pier DP-50 foundation with 50" pins provides an uplift resistance of 1200 lb.
- The Diamond Pier DP-75 foundations with 63" pins provide an uplift resistance of 1600 lb.

## **Field Performance**

PFI also provides evidence of equivalency for frost heave resistance by providing equal or better uplift resistance and over 20 years of independently documented field performance. These documents are available on PFI's website.

- 2005 National Performance Affidavits: A series of testimonials and engineers' opinion letters attesting to the performance of the system in a wide variety of climates and conditions.
- 2010 Frost Performance Report: A Minnesota engineer's certified report of a series of monitored local deck installations, including a review from Colorado Code Consulting. Colorado Code Consulting provides educational seminars for building and residential code, including specific courses addressing the review of alternate building products. Colorado Code Consulting states:

*"In accordance with the Minnesota Building Code (MBC) Minnesota Rules Section 1300.0110, Subpart 13 Alternate Methods, it is my professional opinion that this 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 to be protected from the negative effects of frost heave. Diamond Pier foundation's track record proves that it provides for the IRC's full frost protection intent."*

Tom Meyers, Colorado Code Consulting

- 2013 Nebraska State Engineer's Letter: Review and evaluation of 2010 Frost Performance Report by a professional structural engineer for the state of Nebraska.

*"I have reviewed the DP-50 Diamond Pier Frost Performance Report, consisting of the preface, a letter from Thomas Meyers, CBO and a report by Steven A Schmidt, PE. Additionally, I have reviewed ICC-ES Evaluation Report, ESR-1895. These documents adequately certify that the DP-50 Diamond Piers perform acceptably for detached or attached deck structures subjected to frost heave conditions."*

Paul C. Gilham, P.E.S.E.

- 2011 Observational Report: A direct side-by-side comparison of the Diamond Pier foundation system to a conventional concrete footing in Forest Lake Minnesota.
- **UPDATE TITLE / FROST STUDY** 2019 Frost Study: Frost Heave Susceptible Soils, Diamond Pier Performance: A comprehensive study on the mechanics of frost heave based on "Casagrande's Criteria" of soil susceptibility to frost expansion. This study also includes field performance data for the Diamond Pier foundation system showing its substantial ability to resist frost heave forces in severe frost susceptible soils.

#### Additional Documentation

AC336, ICC-ES, "Acceptance Criteria for Bearing Pin Piers," Approved June 2016, Revised April 2019.

### **Conclusion**

The evidence submitted and described in this document clearly demonstrates equal or better performance of Diamond Pier foundations as specified in the 2020 Minnesota Residential Code, per Part 1300.0110, Subpart 13, Alternative materials, design, and methods of construction and equipment.

Over 100,000 Diamond Pier foundations have been installed in a random mix of mild, moderate, and severe frost heave susceptible soils, as defined by the USDA web soils survey, and have exhibited excellent field performance.

PFI does not advocate a blanket approval of the Diamond Pier product by any building code official. PFI is dependent on the review process to ensure that the Diamond Pier product is used in accordance with the application for which it is intended—in normal construction conditions—and within the limits of the system. This process protects the homeowner, the builder, and PFI as the manufacturer. The Diamond Pier product should not be used until the local code official approves its use as submitted in the permit application.

A proper review process defines for the builder or applicant any special conditions that may exist, and provides an explanation of whether the intent of the code has or has not been met. In the event that the code official denies the use of the Diamond Pier product as an alternate method, the building code official shall document the code-based reason for the denial per Part 1300.0120, Subpart 8, and provide a written copy to the permit applicant. The building code official should deny the use of the Diamond Pier system if the project is not installed in accordance with PFI's Diamond Pier Installation Manual and ESR-1895, but in all cases, a proper project review must be done without prejudice. . If you feel that you have been denied the use of the Diamond Pier product without a proper code-based reason for the denial, please email PFI at [info@diamondpiers.com](mailto:info@diamondpiers.com).

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