Bearing Pin Piers as an Alternative to Conventional Concrete Deck Footings

Code Officials Conference of Michigan
COCM Fall Conference
Shanty Creek Resort, Bellaire, MI
September 28, 2023

Roger Axel, CBO, Retired
raxelcodeguy@gmail.com
952-217-2307

MI CE Approved

This educational offering is recognized by the Michigan Department of Licensing and Regulatory Affairs as satisfying 3 hours toward licensure of Building Officials and Residential Building Inspectors.

Program Approval Number:	**CP-23-00056**
Class Title:	**Bearing Pin Piers as an Alternative to Conventional Concrete Footings**
Class Category:	**Administration, Technical & Plan Review**
Registration Category:	**BI or registrants with ONLY BO/PR, but no inspector registration**
Hours Approved:	**1 Administration, 1 Technical & 1 Plan Review**

Attendance Certificate

Code Officials Conference of Michigan

CONTINUING EDUCATION
COURSE COMPLETION CERTIFICATE

BUILDING OFFICIALS & RESIDENTIAL BUILDING INSPECTORS

This course has been approved for 3-hours continuing education by the MI Department of Licensing and Regulatory Affairs

SPONSOR: Furnish original completion certificate to attendee at conclusion of course.

ATTENDEE: Retain the original course completion certificate in your records.

STUDENT'S NAME	LICENSE NUMBER
STUDENT'S ADDRESS	Building Officials Residential Building Inspectors
CITY, STATE, ZIP CODE	SPONSOR AFFILIATION COCM

COURSE TITLE
Bearing Pin Piers as an Alternative to Conventional Concrete Footings

NO. OF HOURS	COURSE NUMBER	COURSE DATE
3	CP-23-00056	September 28th, 2023

SPONSOR'S SIGNATURE	SPONSOR'S NAME	Location
Roger Axel	Roger Axel	Shanty Creek Resort Bellaire, MI

DISCLAIMER

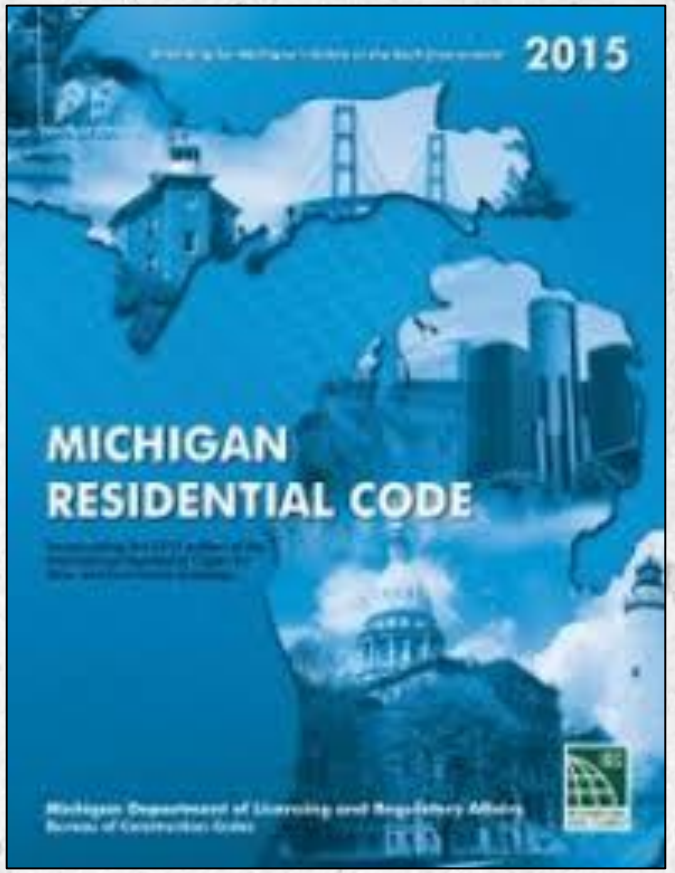
Photos, pictures and illustrations within this seminar are for example only and are not intended to impart knowledge or show favoritism of specific products or specific companies and are not intended to promote specific products, businesses or companies.

Code Reference

2015 MI Residential Code

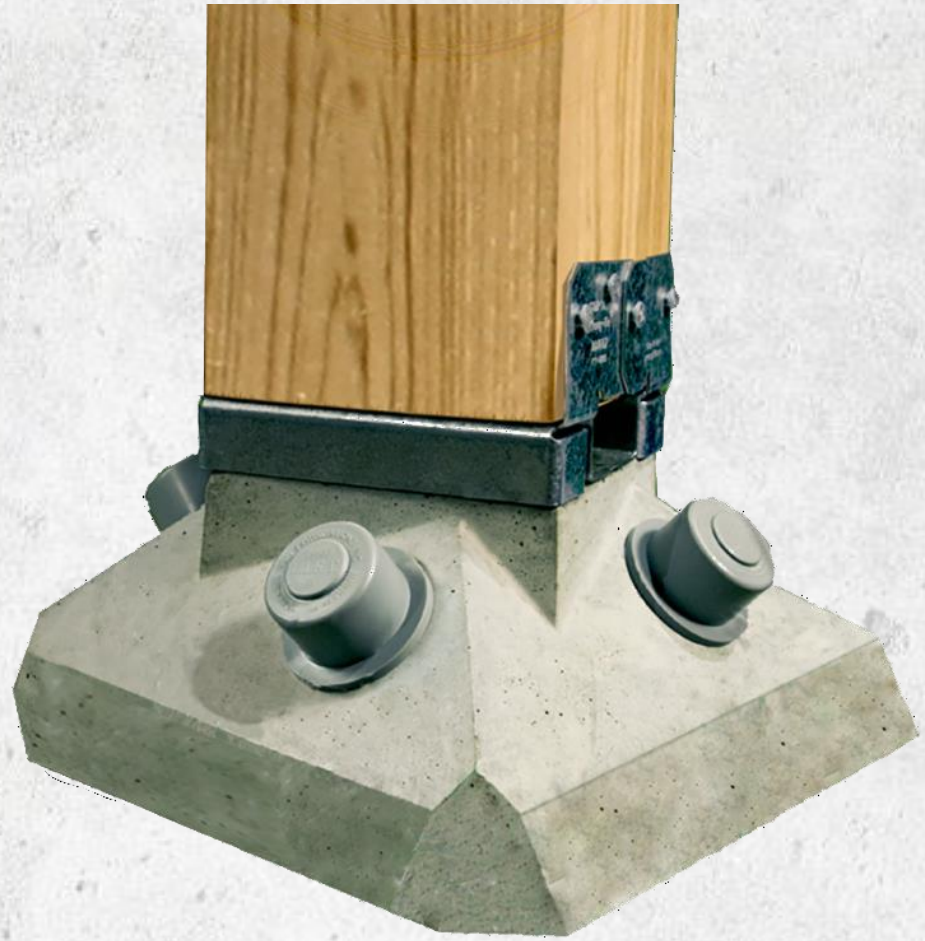
Section R104.11

Alternative materials, design, and methods of construction and equipment



Learning Objectives

- What is a Bearing Pin Pier?
- History of Bearing Pin Piers
- Benefits of Bearing Pin Piers
- Engineering
- Features of Bearing Pin Piers
- Path to Code Compliance
- Proper Installation Techniques



What is a Bearing Pin Pier?

Since their development, Bearing Pin Piers have combined the **ease** of installation of surface driven pins with the bearing **capacity** of spread footings.

What is a Bearing Pin Pier?

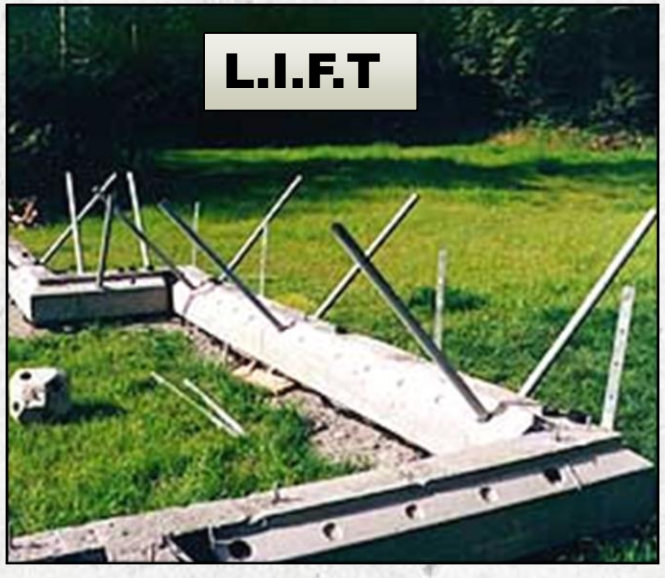
Various Types

Diamond Pier
- Manufactured by Pin Foundations, Inc. 1984
- Commercial and Residential Use

HANDI-Pier
- New in 2019
- Manufactured by Natural Concrete Products
- Residential Use

SureFoot
- Made in Australia
- Commercial Projects

L.I.F.T.
- Residential Homes



What is a Bearing Pin Pier?

A bearing pin pier consists of a factory-fabricated, pre-cast concrete head that has galvanized steel bearing pins which are jobsite installed through holes precast in the head and driven into the underlying soil.

History of Bearing Pin Piers

Bearing Pin Piers have been used in Wetlands
to support public works boardwalks.

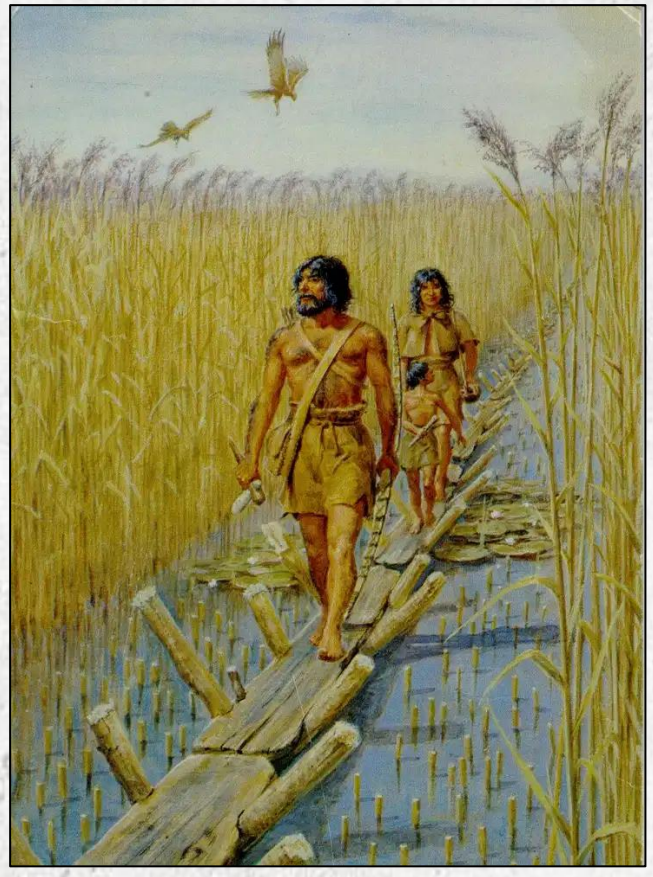
BPP's are lightweight, low impact, easily installed foundation in sensitive environmental areas.

History of Bearing Pin Piers

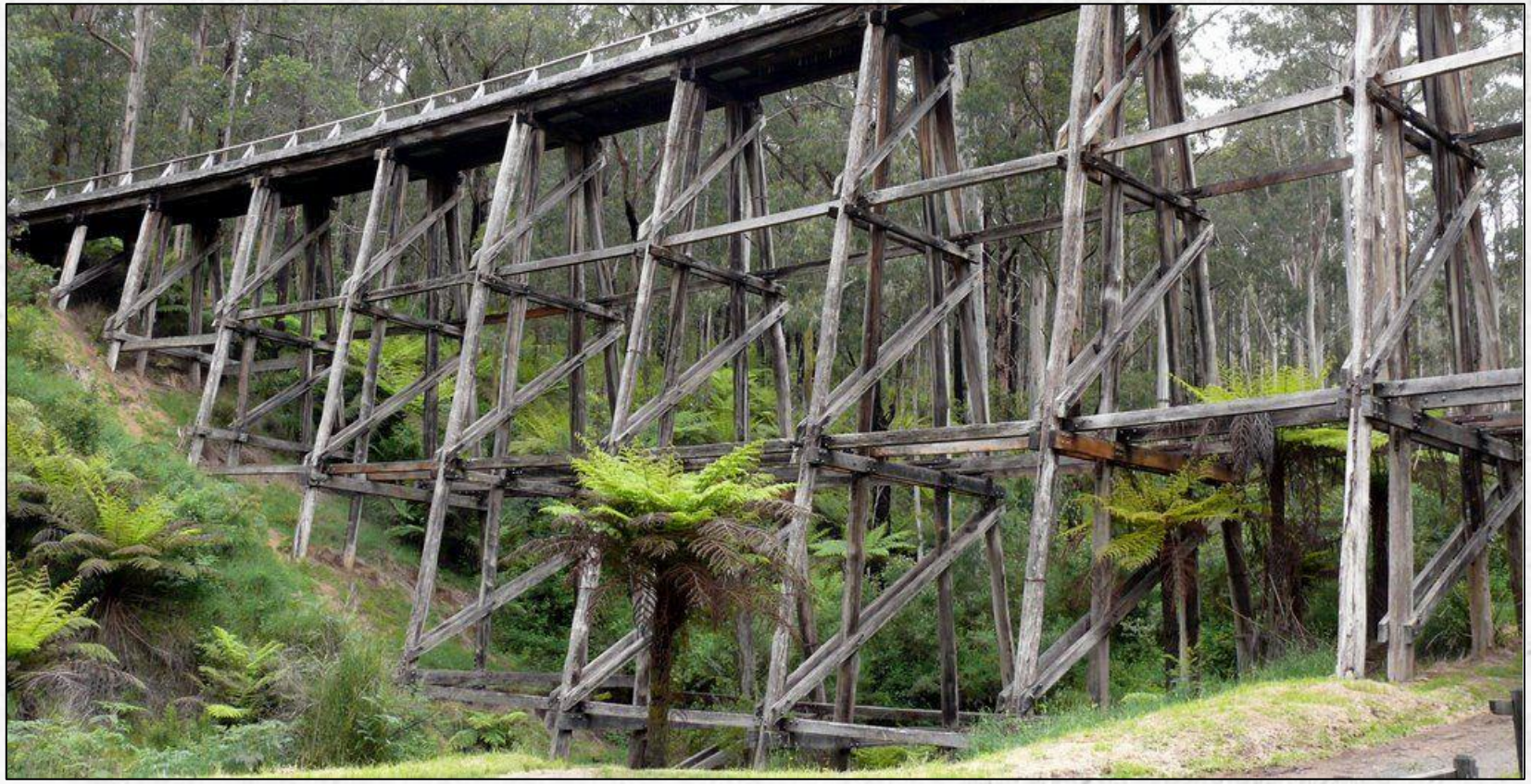
Intuitive Concept

In 3800 BC we see examples of angled piles supporting structures in weak soils.

The **Sweet Track** is an ancient trackway, or causeway, in the Somerset Levels area in England.



History of Bearing Pin Piers



Railroad trestles: Inclined piles are **locked** to prevent spread and increase lateral stability.

Benefits of Bearing Pin Piers

Speed

Systems can be installed in minutes and projects constructed immediately:

- Seven foundations were installed in **less than an hour** and this project was completed in one day.
- Footing inspections can be done **after** completion.
- Provides **consistent** structural values.
- Helps foster center **placement** of support columns.

Benefits of Bearing Pin Piers

Engineered Project

Can be used for larger commercial projects.

- Site-specific **engineered.**
- Based on soil borings, with **engineered** capacities.
- Projects should be **engineered** stamped plans
- Historically used in environmentally sensitive areas.

Benefits of Bearing Pin Piers

Environmentally Sensitive Areas

Low-Impact Foundation

- Increases the **accessibility** of constructing boardwalks in environmentally sensitive wetlands and critical dunes environments.

Benefits of Bearing Pin Piers

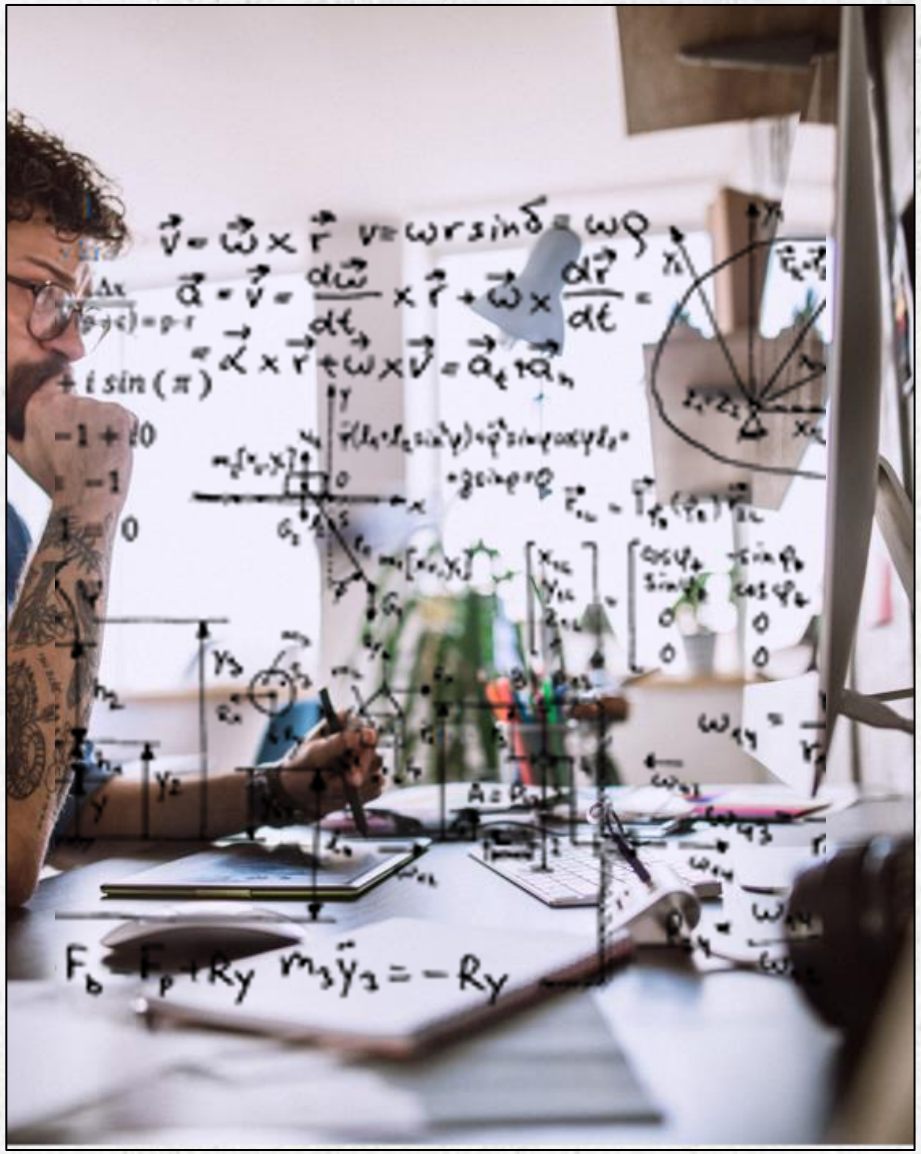
Environmentally Sensitive Areas

Water Impervious Site

Foundations can be constructed without excavation.

- This two-story townhome project is constructed over a watershed, **previously** designated as not buildable.

Engineering



Structurally Rated System

Overview:

- **Engineered** to Soil Strength
- Soil Particle **Interaction**
- **Distributes** Loads Over A Greater Area
- **Reduces** the Pounds Per Sq.Ft. on The Soil
- **Increases** Uplift Resistance Compared to Vertical Pier
- Bearing Pin **Lock**
- Loads Are **Transferred** into Natural Soils

Engineering – Structurally Rated System

Engineered to Soil Strength

Laboratory testing of the obtained soil samples was not included as part of our scope of services. A limited analysis of the observed onsite/subsurface soils was performed to estimate key soil parameters and therefore are approximate and represent our professional opinion based on previous experience with similar soil conditions. Recommended soil design parameters provided include unit weight, angle of friction, and cohesion. See Table 1 and 2 below for the observed subsurface soil conditions and the estimated soil parameters to be used for design of the Diamond Pier® Pin Foundation system.

Table 1: Borehole B-1

Depth (feet)	Description	Soil Parameters		
		Unit Weight, γ (PCF)	Friction Angle, φ	Cohesion, c (PSF)
0 - 1.5	**Highly Organic Topsoil,** black, saturated	90	15	150
1.5 - 3.5	**Silty Clay (CL),** whitish tan, saturated, stiff	105	22	300
3.5 - 5.5	**Poorly Graded Sand (SP),** brown, saturated, loose, with trace silt and gravel	110	33	0
5.5- 6.5*	**Clay (CL),** tan, saturated, very stiff	100	19	200

*Auger refusal at 6.5 ft / Groundwater encountered at surface at time of drilling

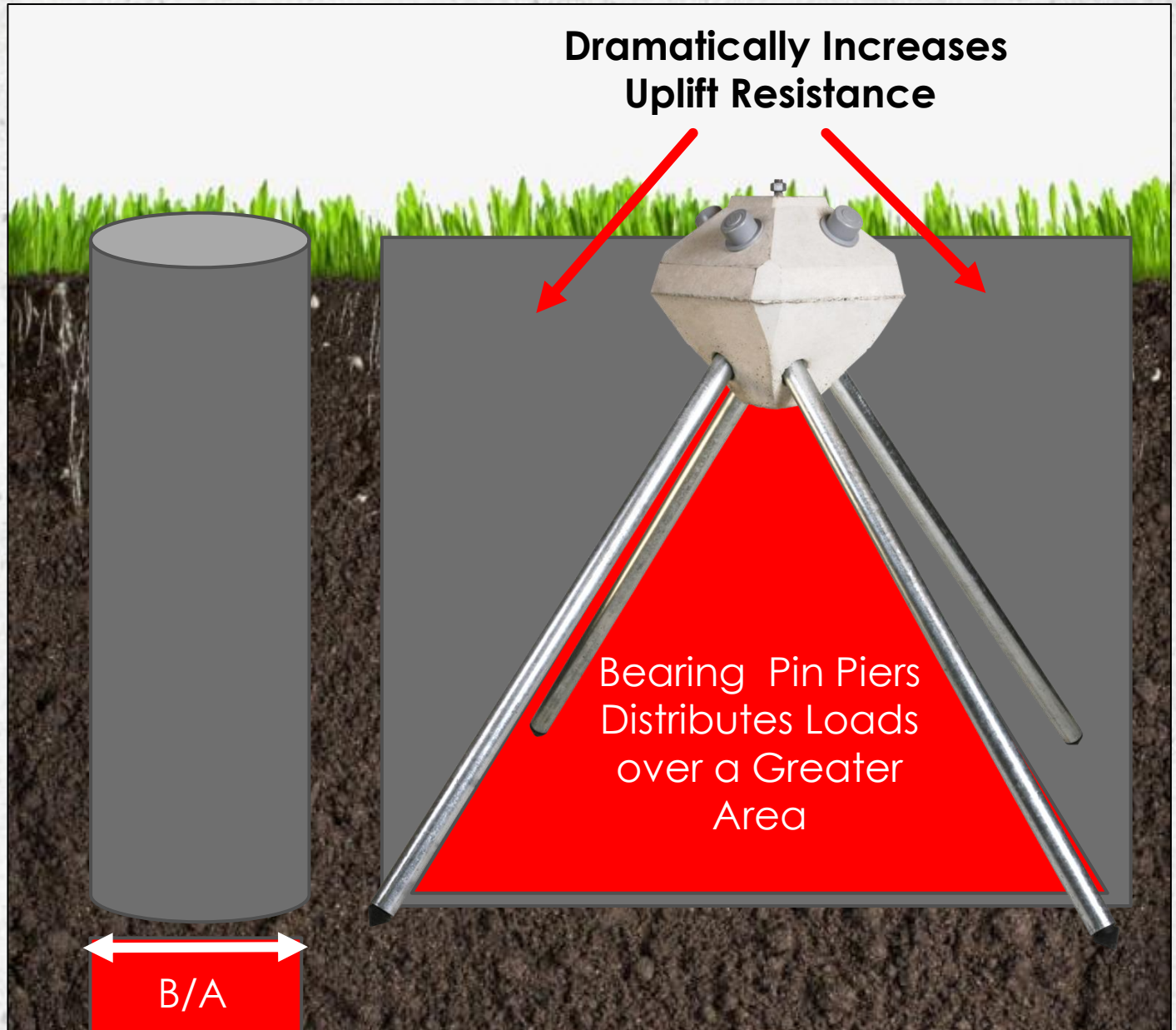
Example

Engineering – Structurally Rated System

Bearing Pin Lock

Transfers loads:

- Locked bearing pin piers transfer loads into the soils
- The stress placed on the soil moves out in a cone shape
- Pins provide dramatically increased uplift resistance

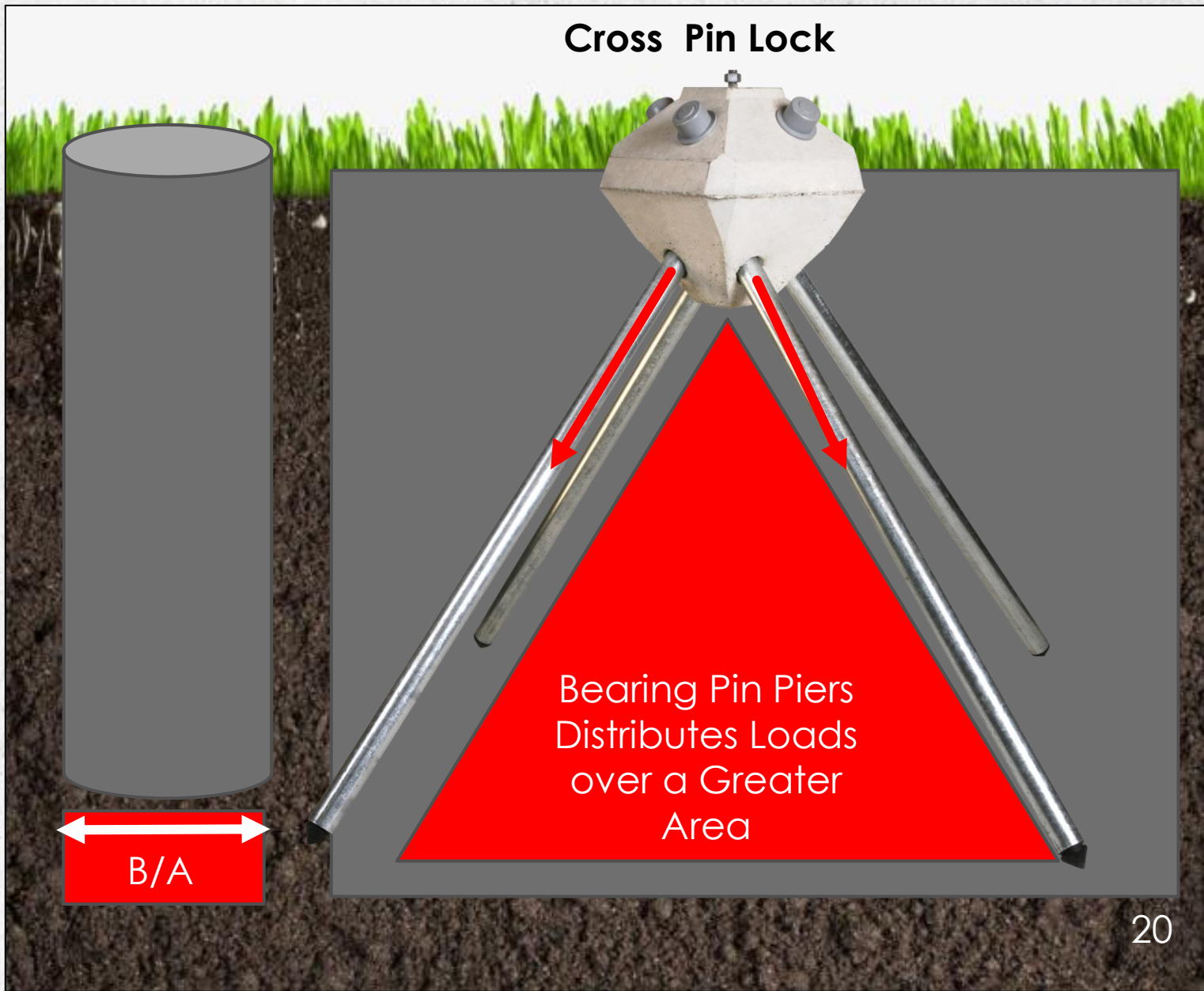


Engineering – Structurally Rated System

Bearing Pin Lock

Locked pins transfer loads Into undisturbed soils:

- If the pins **cannot** change angle, then the head **cannot** go up or down
- Uplift **resistance** and the diamond shape encourages frost heaved soils to **cleave** around the head
- Bearing forces **engage** the soil mass zone under the pier much like a spread footing
- Uplift is also greatly **enhanced** by the overburden stress and cohesion of the undisturbed soils above the pins

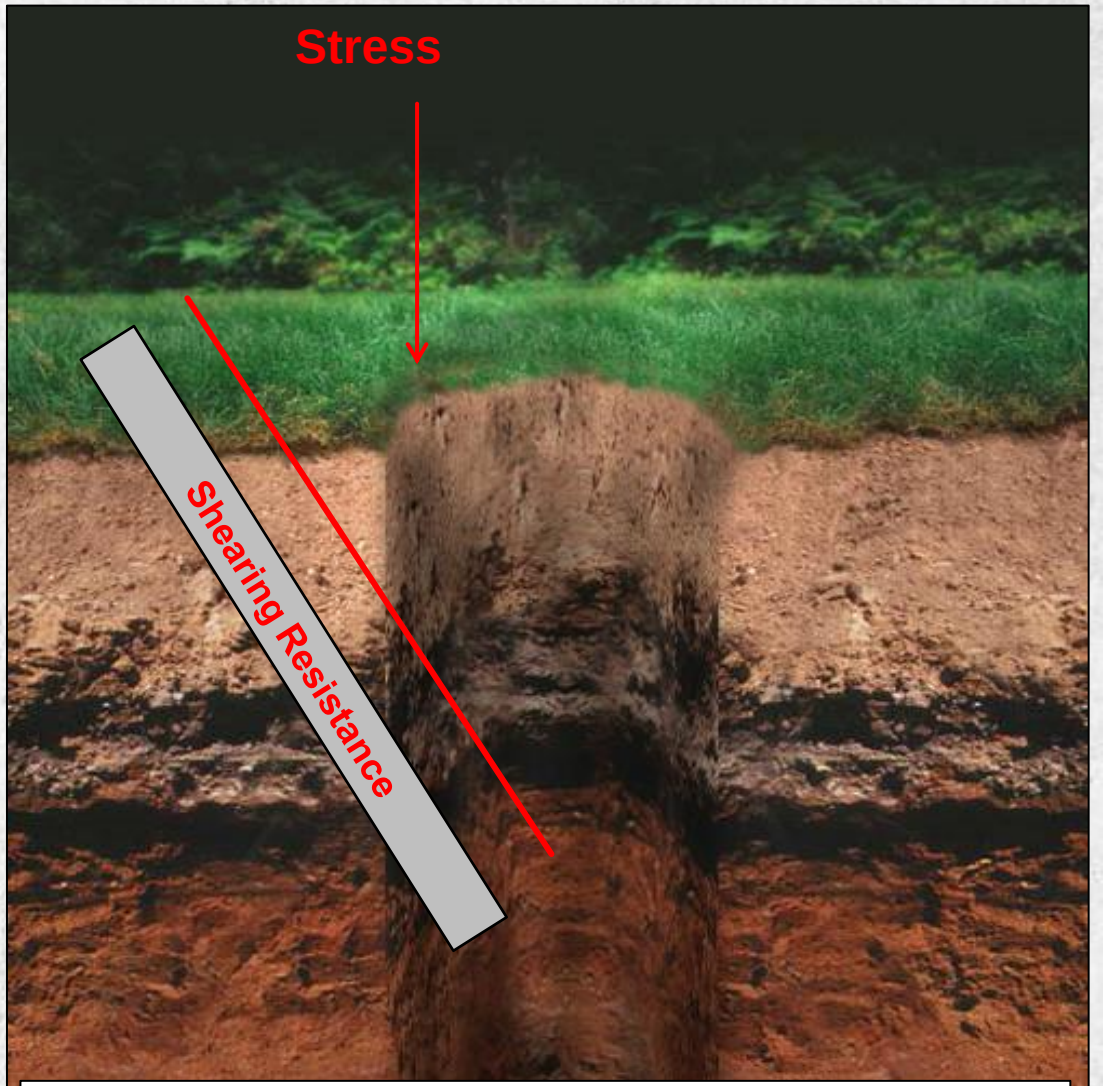


Engineering – Structurally Rated System

Soil Particle Interaction

Engineered to the soil strength/soil particle interaction:

- Based on soil Strength: i.e. **Friction Angle, Unit Weight and Cohesion** calculates capacities based on a rigid **A-frame**
- The soil wedge represents a spread footing **equivalent base area** which is represented in load capacity chart
- **Pre-engineering** systems sold through retail stores are 3rd party tested to 1500 psf soils and correlate to presumptive soil values shown in Table R401.4.1 and are **limited** to simple **residential** projects
- Larger **commercial** projects requires site specific **engineering** to include: geotechnical soil boring, site specific stamped capacities, and engineered **stamped plans** by a registered engineer

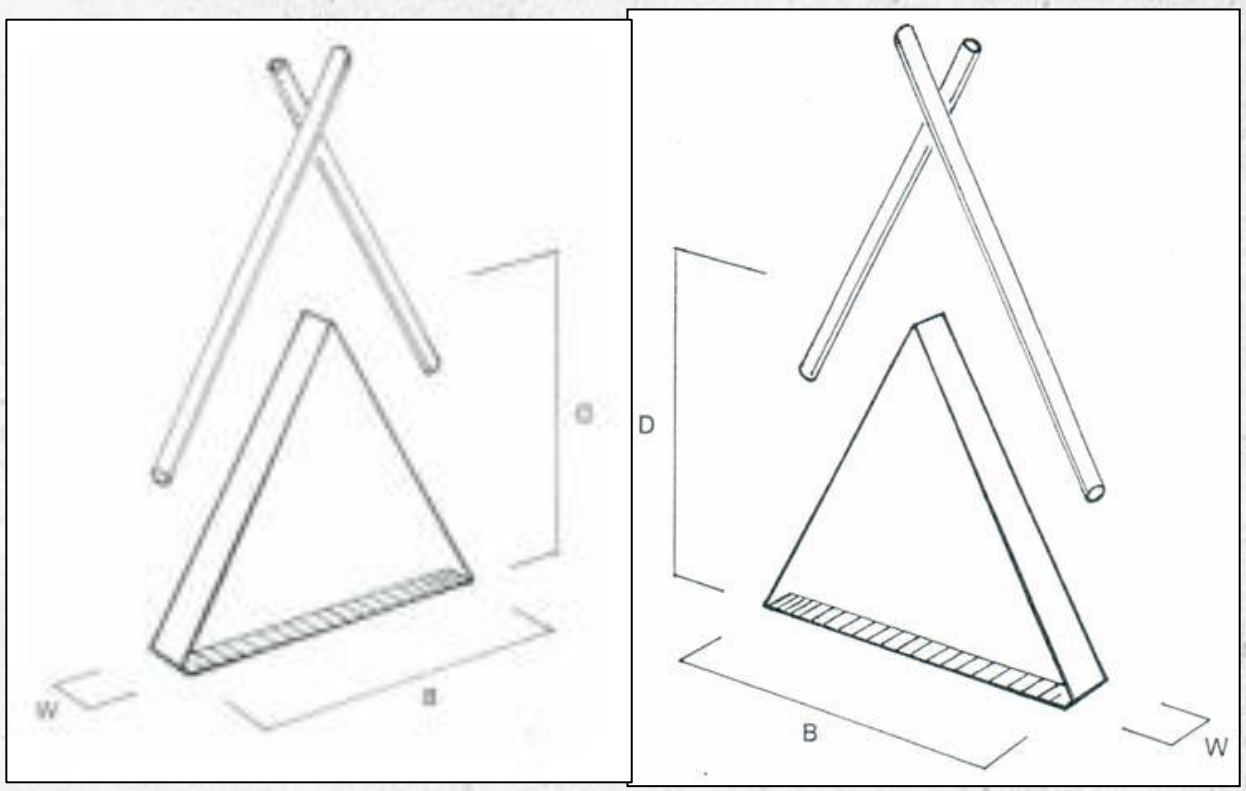


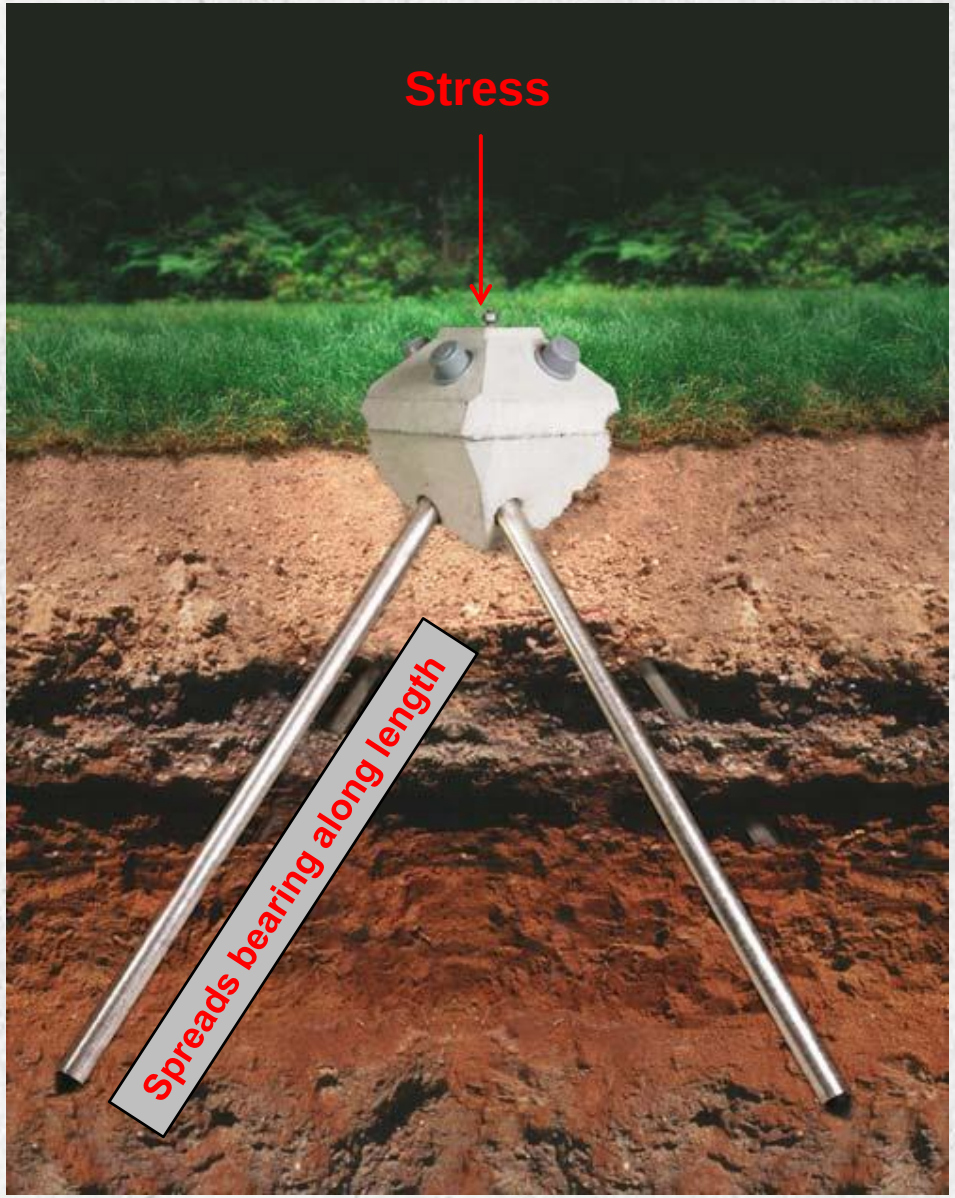
- **When a typical hole is drilled into undisturbed soils, the surrounding soils form a rigid cylinder that supports its shape**

Engineering – Structurally Rated System

Soil Particle Interaction

Distributing loads over wider area reduces the PSF load on the soil.





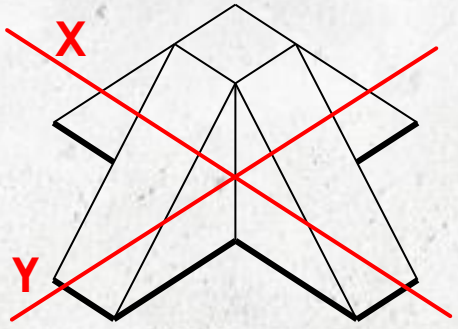
- The Bearing Pin pier foundation combines four pins into two rigid **A-frames** and provides a flexible **connection** system to the supported structure
- The depth, width and base area are used to calculate an **equivalent base area** comparison to a spread footing

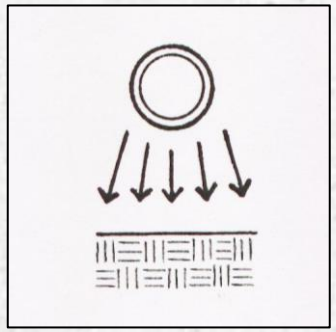
Engineering – Structurally Rated System

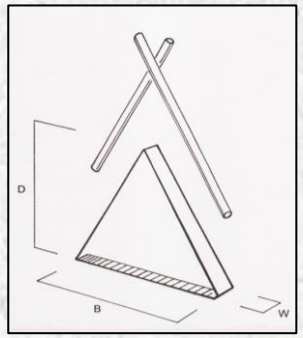
Soil Particle Interaction

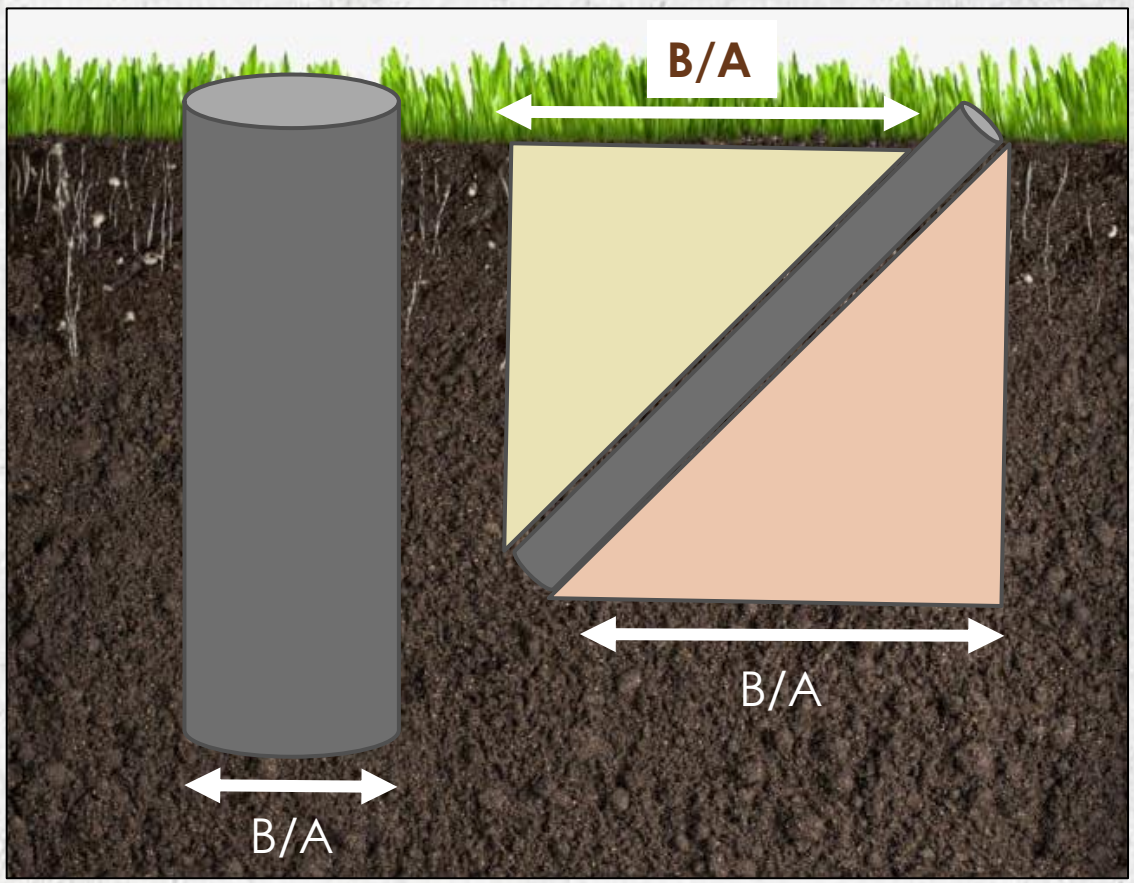
Distributing loads over greater area reduces the PSF load on the soil

- Inclined pins **disburse** loads over a greater area vs. vertical piles
- Inclining pins dramatically **increases** uplift resistance
- Use of inclined pins **reduces** the pounds per square inch of pressure to the surrounding soils
- Grouping the inclined pins in an X, Y orientation allows for greater **distribution** of loads









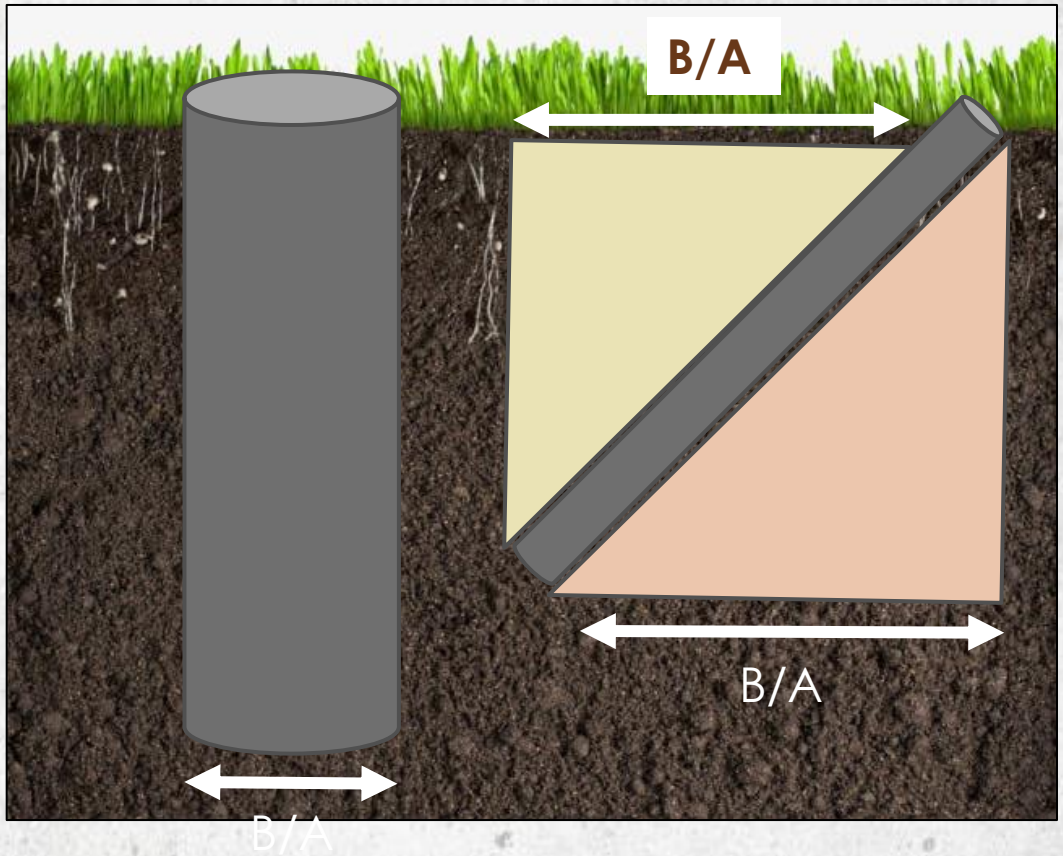
- Grouping the Pins in an X, Y dramatically **reduces** the effect of frost jacking
- Frost Jacking occurs with vertical cylinders that frost heave, but do not settle completely back to the original position whereas the overburdened soils above pins bring the system back to **original** position

Engineering – Structurally Rated System

Soil Particle Interaction

Increase uplift resistance:

- **Review Evaluation Service Reports as well as 3rd party testing for uplift and lateral loads**
- **For foundation assemblies, Evaluation Service Reports will only address bearing capacities**
- **Ask for 3rd party testing for uplift and lateral loads**



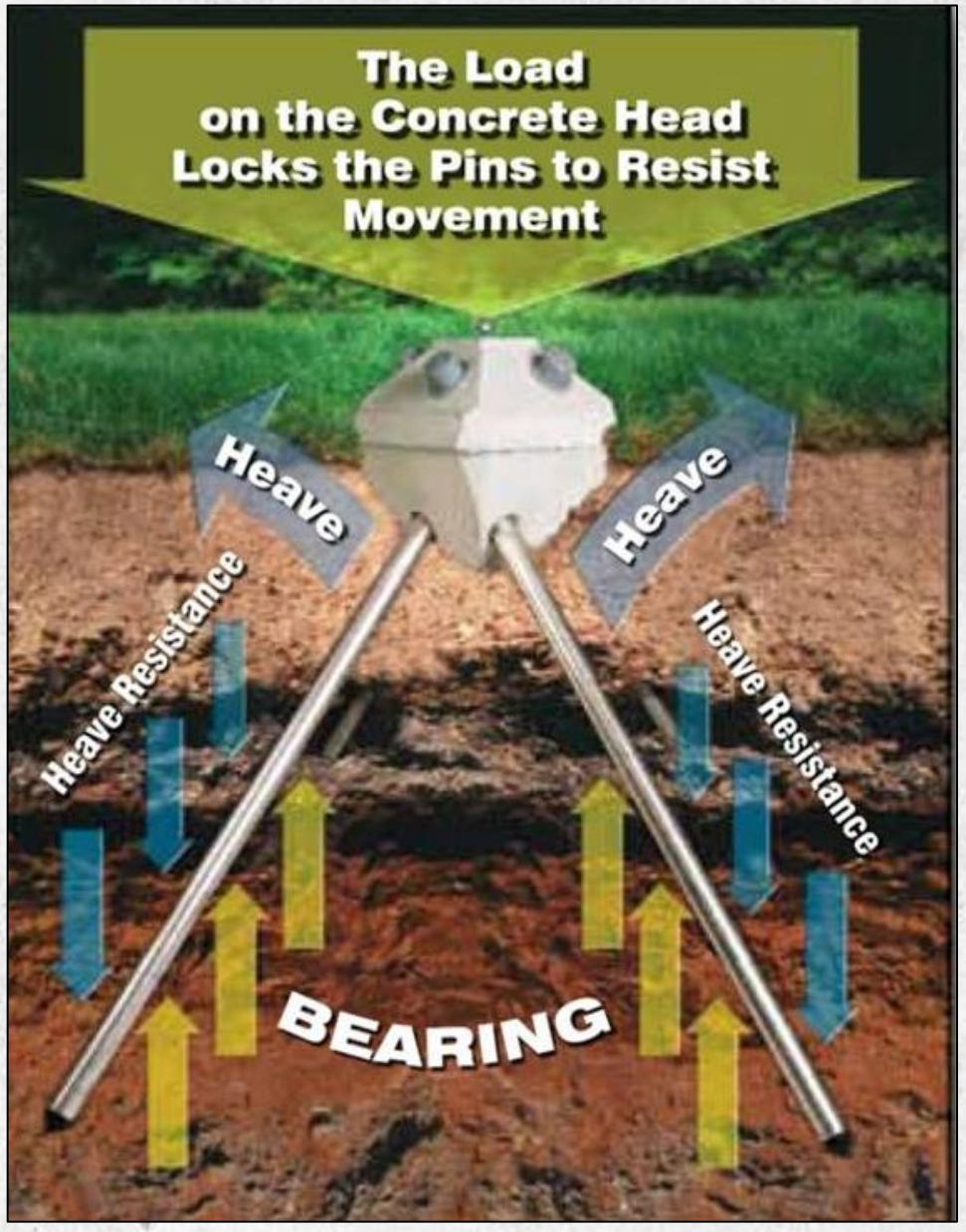
- The IRC has **no** uplift requirements for a "**Foundation Assembly**"
- IRC Section **R802.11.1** provides uplift resistance for roof assemblies to supporting wall assemblies
- Since there is no requirement for an uplift load on a foundation assembly, the ICC ES does not address uplift in the evaluation service report

Engineering – Structurally Rated System

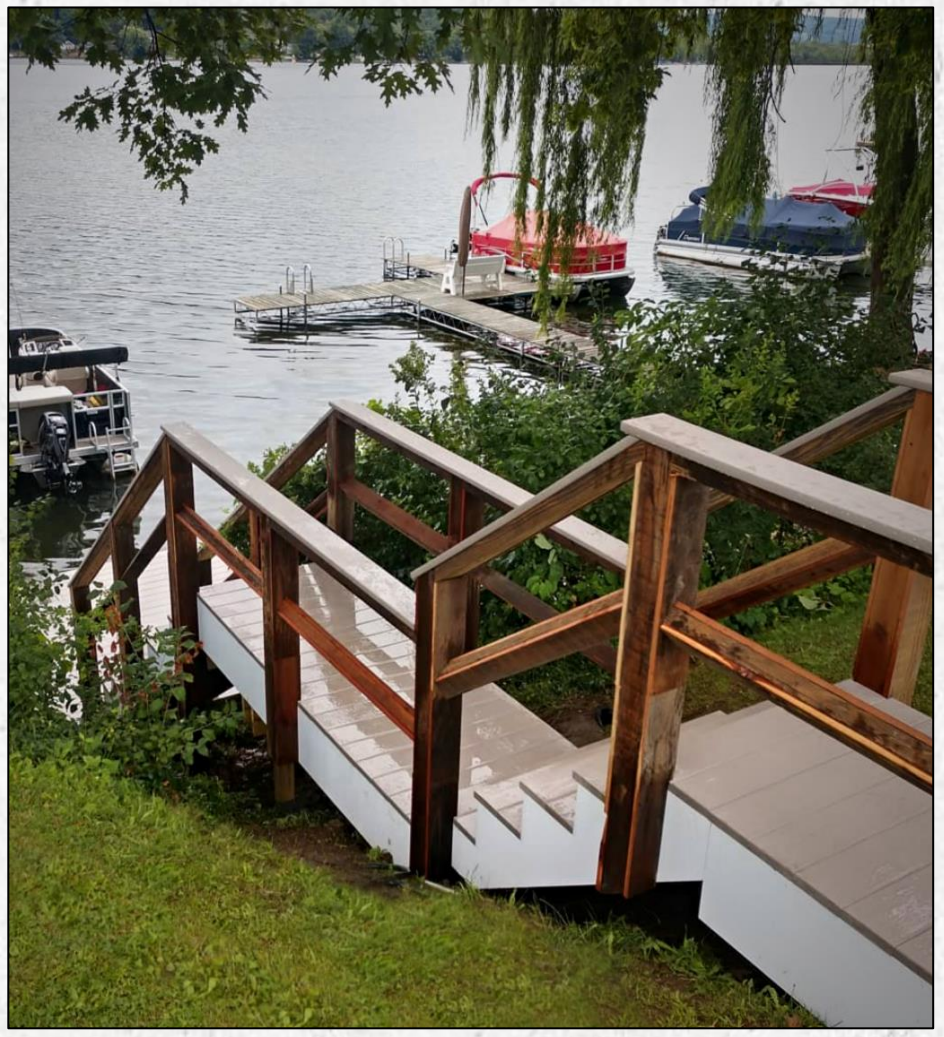
Bearing Pin Lock

In undisturbed soils, bearing pin systems:

- **Utilizes** the strength of the soil to determine its capacities
- **Maintains** inherent structural strength
- **Maintains** existing drainage pathways
- **Prevents** Water Ponding
- **Creates** Uplift Resistance
- Wide base **provides** better lateral and uplift capacity



Features of Bearing Pin Piers



Overview - Advantages

- **Eliminates Field Variables**
- Consistent Placement
- Always the Same Strength
- Reduces Property Damage
- Preserves Landscaping
- Eliminates Water Problems
- No Heavy Equipment
- Provides Cost Efficiencies
- Depth Inspection Can Be Done After Framing
- Eliminates Down Time for The Contractor

Features of Bearing Pin Piers

Eliminates Field Variables

What don't we know about a poured footing:

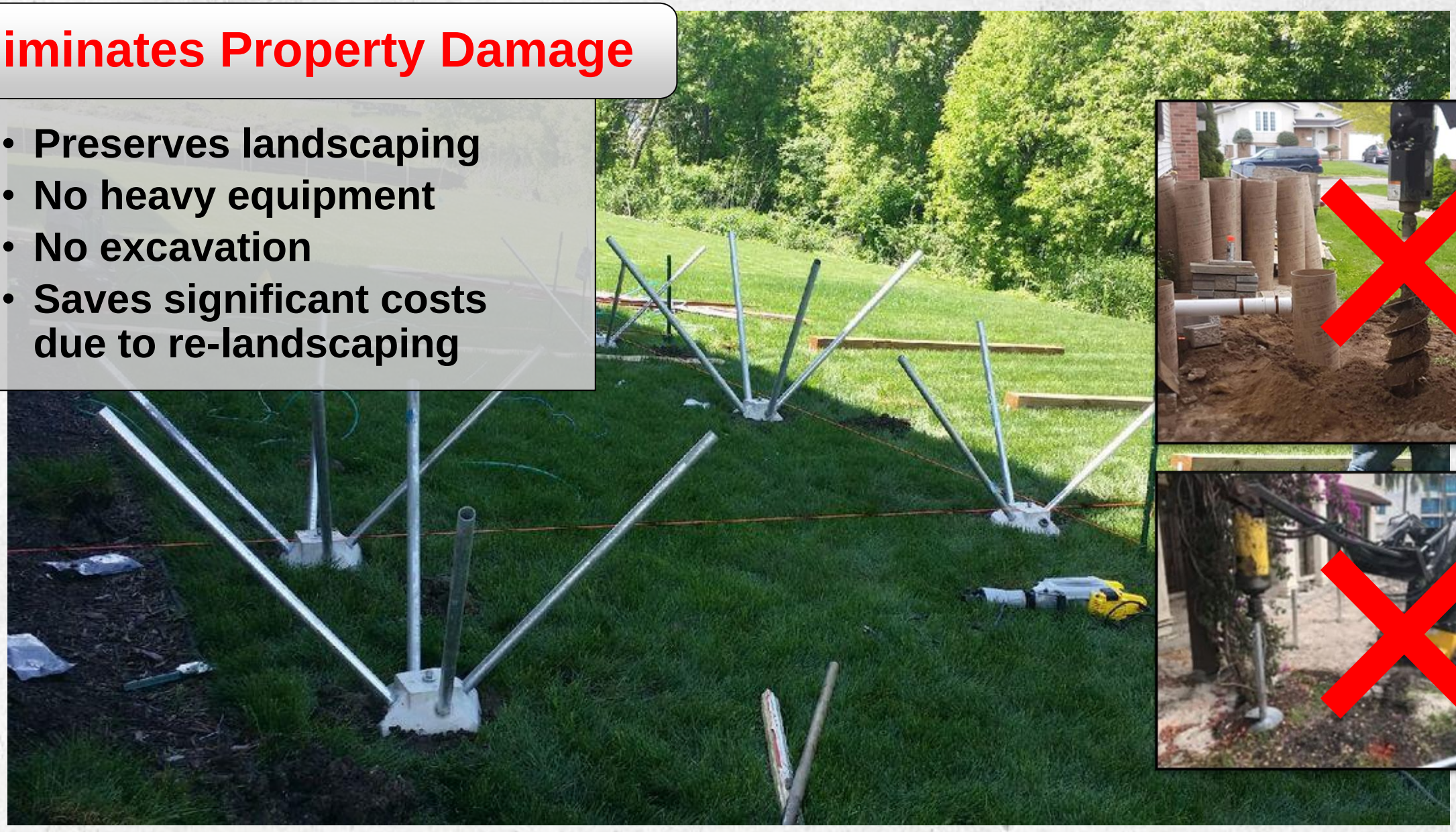
- What is the strength for compression and tension?
- Was it a ready-mix delivery?
- 5 bag mix or 6 bag mix?
- Was it mixed onsite in concrete bags?
- How much water was used?
- Was it mixed properly?
- Did they dry pour and spray water in the hole?

- **Unknown field variable can greatly affect the strength of the footing**
- **Excavated backfilled soils create a cavity for water-absorbing frost heave issues**
- **Bearing Pin piers are installed the same way every time, providing consistent structural capacities that are documentable**

Features of Bearing Pin Piers

Eliminates Property Damage

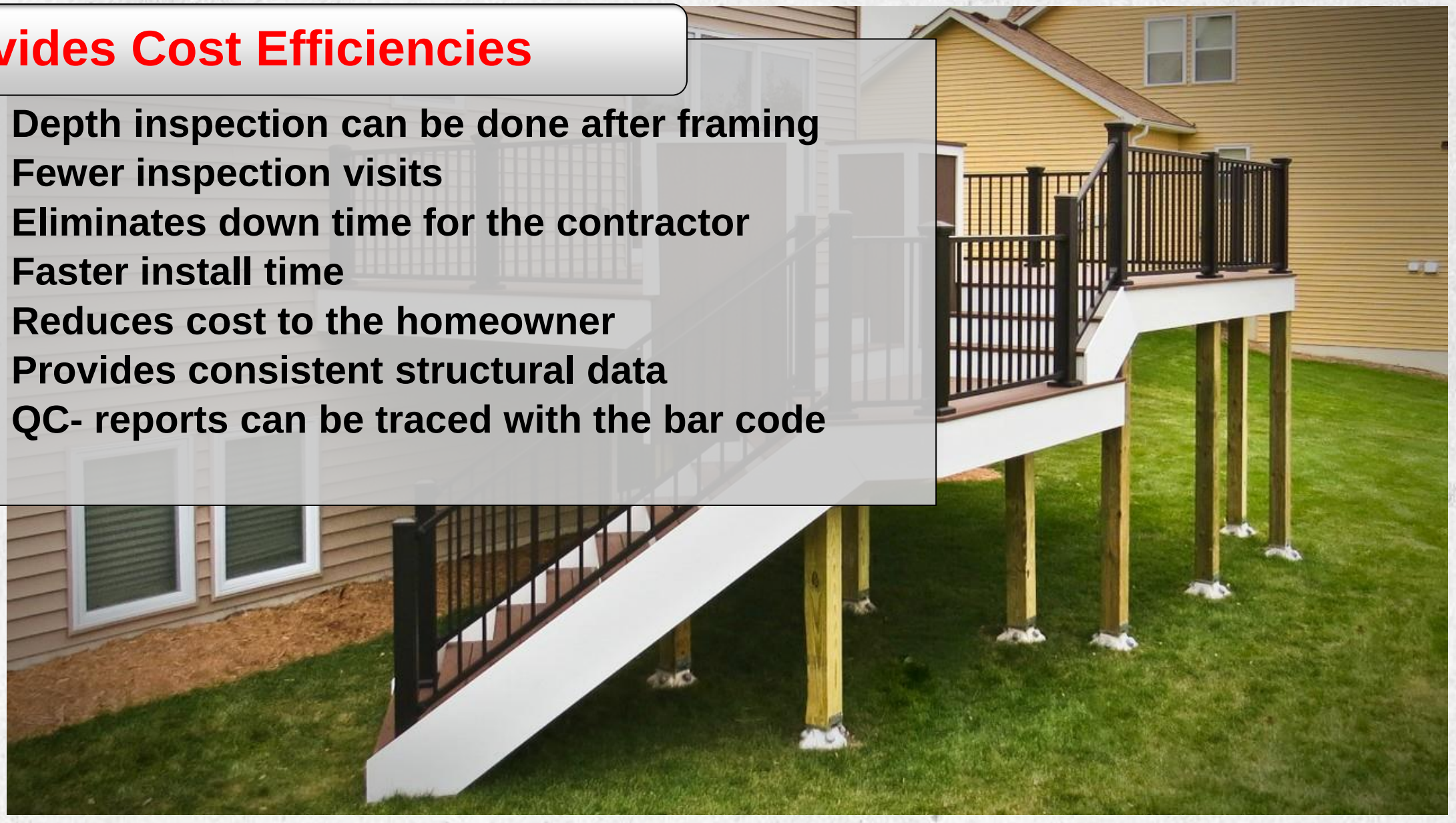
- **Preserves landscaping**
- **No heavy equipment**
- **No excavation**
- **Saves significant costs due to re-landscaping**



Features of Bearing Pin Piers

Provides Cost Efficiencies

- Depth inspection can be done after framing
- Fewer inspection visits
- Eliminates down time for the contractor
- Faster install time
- Reduces cost to the homeowner
- Provides consistent structural data
- QC- reports can be traced with the bar code



Features of Bearing Pin Piers

Possible Manufacturer Warranty:

- **Homeowner coverage**
- **Possible cover on parts and labor**
- **Manufacturer support**

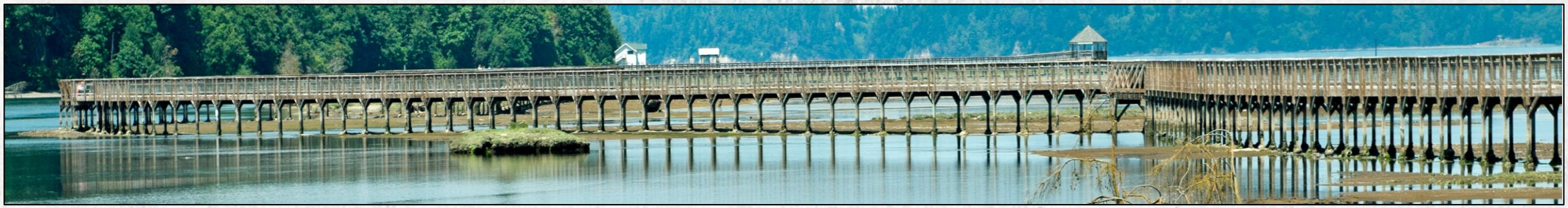
Features of Bearing Pin Piers

Site Specific Engineered Models

Some bearing pin piers can be used for:

- Low-impact construction in parks
- Nature preserves
- Public works projects
- Homes
- Solar panels

Site Specific Engineered Projects



Features of Bearing Pin Piers

Site Specific Engineered Models

- Systems can be used for larger public works projects
- The bearing pin piers can be engineered to support large structures supporting heavy equipment

Features of Bearing Pin Piers

Site Specific Engineered Models

- Systems can be used for larger commercial projects

Site Specific Engineered Project

- Bearing Pin Piers are an excellent solution for stairways on heavy sloped, sandy dune terrain
- The spread pin footing is more stable and can be easily reset in environments with shifting sands

Features of Bearing Pin Piers

Pre-engineered Models

Simple Residential Projects

- Model designation by manufacturer:
  - Published load charts by manufacturer
  - Review manufacturer's published limitations:
    - Tributary loads
    - Soils
    - Scope of project
    - Underground line
    - Water application
    - Burying the head

Path to Code Compliance

Two Paths to Code Compliance

Commercial Projects (IBC)

Site Specific Engineering:

- Site Specific Soils Evaluation by a Registered Geotechnical Engineer
- Site Specific Stamped Capacities
- Stamped Engineered Plans
- Project Submittal by a Registered Design Professional

Prescriptive vs. Performance (Alternate Materials & Methods)

Residential Projects (IRC)

R104.11 - Alternate Means & Methods

For Applications Defined as exterior decks, including covered decks, exterior porch decks, elevated walkways, stairway construction and accessory structures.

Documentation:

- Evaluation Service Reports
- 3rd party accredited testing
- Manufacturer Load Chart

Path to Code Compliance

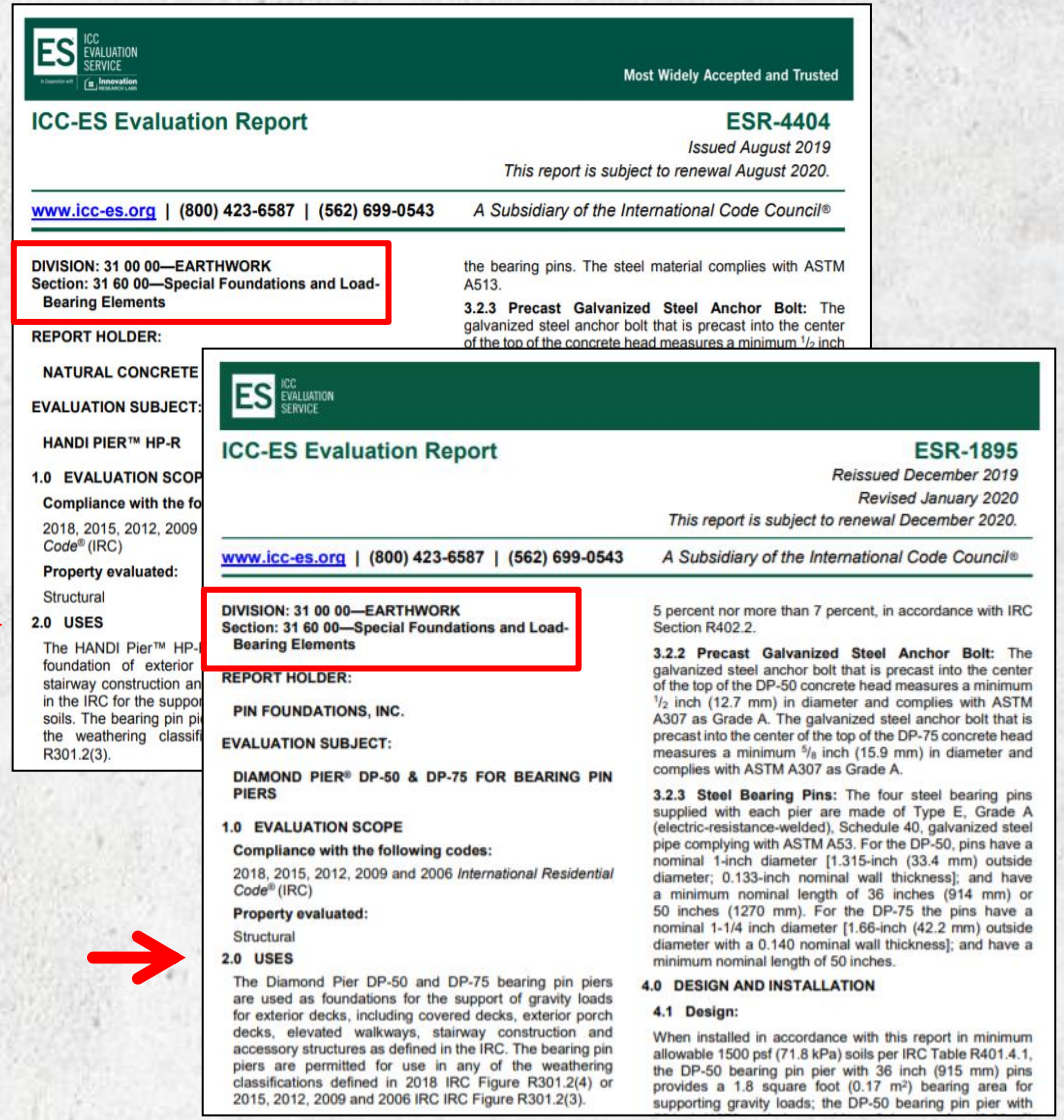
Residential Projects

USES

DIVISION: 31 00 00—EARTHWORK
Section: 31 60 00—Special Foundations and Load-Bearing Elements

Pre-engineered Models:

- For applications defined as exterior decks, including covered decks, exterior porch decks, elevated walkways, stairway construction and accessory structures
- Scope of project can be subjective; “Covered porches/Covered Decks"
- **Plan review should consider site specific conditions that may adversely affect the system**



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Issued August 2019
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DIVISION: 31 00 00—EARTHWORK
Section: 31 60 00—Special Foundations and Load-Bearing Elements

REPORT HOLDER:

NATURAL CONCRETE

EVALUATION SUBJECT:

HANDI PIER™ HP-R

1.0 EVALUATION SCOP

Compliance with the fo

2018, 2015, 2012, 2009 *Code®* (IRC)

Property evaluated:

Structural

2.0 USES

The HANDI Pier™ HP-R foundation of exterior stairway construction an in the IRC for the suppor soils. The bearing pin pi the weathering classifi R301.2(3).

the bearing pins. The steel material complies with ASTM A513.

3.2.3 Precast Galvanized Steel Anchor Bolt: The galvanized steel anchor bolt that is precast into the center of the top of the concrete head measures a minimum 1/2 inch

ICC EVALUATION SERVICE

ICC-ES Evaluation Report — ESR-1895
Reissued December 2019
Revised January 2020
This report is subject to renewal December 2020.
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DIVISION: 31 00 00—EARTHWORK
Section: 31 60 00—Special Foundations and Load-Bearing Elements

REPORT HOLDER:

PIN FOUNDATIONS, INC.

EVALUATION SUBJECT:

DIAMOND PIER® DP-50 & DP-75 FOR BEARING PIN PIERS

1.0 EVALUATION SCOPE

Compliance with the following codes:

2018, 2015, 2012, 2009 and 2006 *International Residential Code®* (IRC)

Property evaluated:

Structural

2.0 USES

The Diamond Pier DP-50 and DP-75 bearing pin piers are used as foundations for the support of gravity loads for exterior decks, including covered decks, exterior porch decks, elevated walkways, stairway construction and accessory structures as defined in the IRC. The bearing pin piers are permitted for use in any of the weathering classifications defined in 2018 IRC Figure R301.2(4) or 2015, 2012, 2009 and 2006 IRC IRC Figure R301.2(3).

5 percent nor more than 7 percent, in accordance with IRC Section R402.2.

3.2.2 Precast Galvanized Steel Anchor Bolt: The galvanized steel anchor bolt that is precast into the center of the top of the DP-50 concrete head measures a minimum 1/2 inch (12.7 mm) in diameter and complies with ASTM A307 as Grade A. The galvanized steel anchor bolt that is precast into the center of the top of the DP-75 concrete head measures a minimum 5/8 inch (15.9 mm) in diameter and complies with ASTM A307 as Grade A.

3.2.3 Steel Bearing Pins: The four steel bearing pins supplied with each pier are made of Type E, Grade A (electric-resistance-welded), Schedule 40, galvanized steel pipe complying with ASTM A53. For the DP-50, pins have a nominal 1-inch diameter [1.315-inch (33.4 mm) outside diameter; 0.133-inch nominal wall thickness]; and have a minimum nominal length of 36 inches (914 mm) or 50 inches (1270 mm). For the DP-75 the pins have a nominal 1-1/4 inch diameter [1.66-inch (42.2 mm) outside diameter with a 0.140 nominal wall thickness]; and have a minimum nominal length of 50 inches.

4.0 DESIGN AND INSTALLATION

4.1 Design:

When installed in accordance with this report in minimum allowable 1500 psf (71.8 kPa) soils per IRC Table R401.4.1, the DP-50 bearing pin pier with 36 inch (915 mm) pins provides a 1.8 square foot (0.17 m²) bearing area for supporting gravity loads; the DP-50 bearing pin pier with

Path to Code Compliance

Residential Projects

Handi Pier - ESR-4404

Paragraph **2.0 - USES**

The Handi Pier HP-R bearing pin pier use as the foundation of exterior porch deck, elevated walkway, stairway construction and accessory structures as defined in the IRC for the **support of gravity loads** when installed in soils. The bearing pin piers are **permitted** for use in any of the weathering classifications defined in 2018 IRC Figure R301.2(3).

Defining "Covered Decks"

Path to Code Compliance

Residential Projects

Diamond Pier - ESR-1895

Paragraph **2.0 - USES**

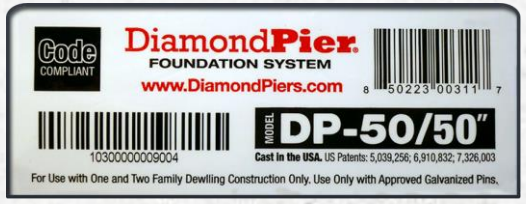
The Diamond Pier DP-50 and DP-75 bearing pin piers are used as foundations for the **support of gravity loads** for exterior decks, including covered decks, exterior porch decks, elevated walkways, stairway construction and accessory structures as defined in the IRC. The bearing pin piers are **permitted** for use in any of the weathering classifications defined in 2018 IRC Figure R301.2(4) or 2015, 2012, 2009 and 2006 IRC IRC Figure R301.2(3).

Defining "Covered Decks"

Path to Code Compliance

QC PROCESS

- **R402.2** references applicable standards listed in ACI 332
- Casting QC audited by ICC-ES per Para 3.2.1 of ESR-1895
- **Requirement of AC336**
- Manufacturers must provide traceability to assure compliance. For example, **Diamond Piers** uses identification labels that are scanned and can be tracked



- **R402.2** references applicable standards listed in ACI 332
- Casting QC audited by ICC-ES per Paragraph 3.2 of ESR-4404
- **Requirement of AC336**
- No similar tracking label on **Handi Piers**

AC336 – ICC Acceptance Criteria for Bearing Pin Piers

Path to Code Compliance

Frost Protection-Both DP & HP

Paragraph 5.3

5.3: 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.

Paragraph 5.4

5.4: Frost protection for **accessory structures** defined by the IRC is **beyond the scope** of this report, except free-standing accessory structures constructed in accordance with IRC Section R403.1.4.1 Exception 1 or 2, where frost protection is not required.

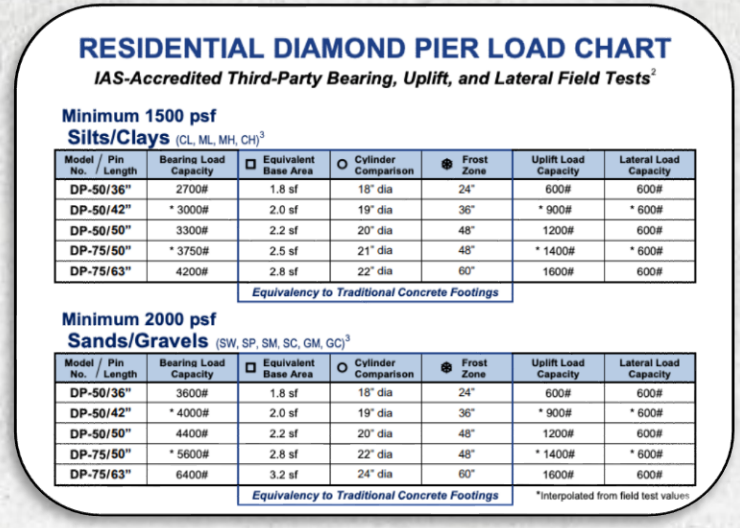
5.3: References decks attached to a dwelling in all Frost Zones may be approved with a proper plan review. Exception 3 refers to detached decks **"As Applicable".** If the deck is detached it does not require frost protection per Exception 3.

Path to Code Compliance

Manufacturer's Recommendations

Paragraph 5.1 – Both reports

- The bearing pin piers must be installed in accordance with the manufacturer's published installation instructions, the IRC and this report. In the event of a **conflict** between this report and the Pin Foundations, Inc. or HANDI Pier HP-R published installation instructions, this **(ESR) report governs**.



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 / 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#

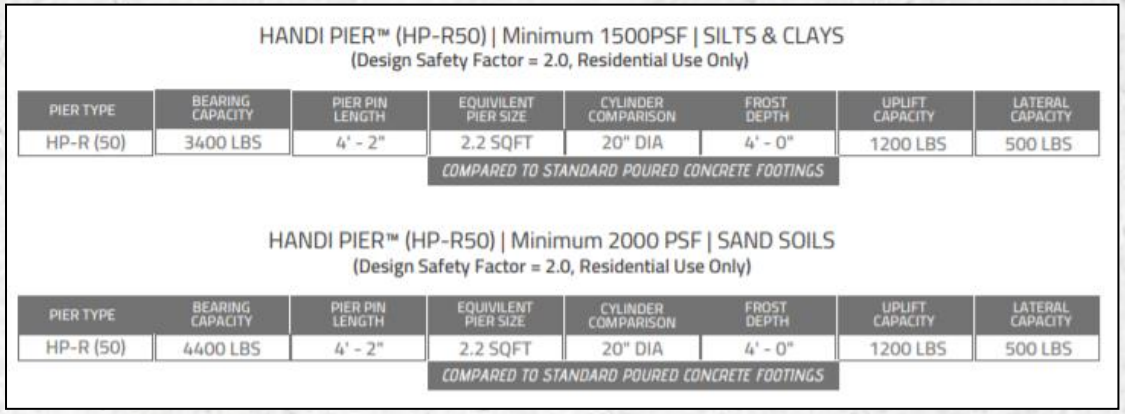
Equivalency to Traditional Concrete Footings

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

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#

Equivalency to Traditional Concrete Footings

*Interpolated from field test values



HANDI PIER™ (HP-R50) | Minimum 1500PSF | SILTS & CLAYS
(Design Safety Factor = 2.0, Residential Use Only)

PIER TYPE	BEARING CAPACITY	PIER PIN LENGTH	EQUIVILENT PIER SIZE	CYLINDER COMPARISON	FROST DEPTH	UPLIFT CAPACITY	LATERAL CAPACITY
HP-R (50)	3400 LBS	4' - 2"	2.2 SQFT	20" DIA	4' - 0"	1200 LBS	500 LBS

COMPARED TO STANDARD POURED CONCRETE FOOTINGS

HANDI PIER™ (HP-R50) | Minimum 2000 PSF | SAND SOILS
(Design Safety Factor = 2.0, Residential Use Only)

PIER TYPE	BEARING CAPACITY	PIER PIN LENGTH	EQUIVILENT PIER SIZE	CYLINDER COMPARISON	FROST DEPTH	UPLIFT CAPACITY	LATERAL CAPACITY
HP-R (50)	4400 LBS	4' - 2"	2.2 SQFT	20" DIA	4' - 0"	1200 LBS	500 LBS

COMPARED TO STANDARD POURED CONCRETE FOOTINGS

Path to Code Compliance

Uplift & Lateral: Paragraph 5.6- Both reports

- The capacity of the bearing pin piers to resist lateral and/or uplift loads was **not evaluated** for this report

Section R802.11 Roof tie-down

- **Paragraph R802.11.1** defines the minimum requirement for uplift resistance on a roof assembly per sections R802.11.1.1 and R802.11.1.3
- **Section R301.2.1** Wind design criteria. - In the last sentence states "..a continuous load path shall be provided to transmit the applicable uplift forces in Section R802.11.1 from the roof assembly to the foundation"

- The IRC has **no** specific uplift requirements for a foundation assembly
- Therefore, the ICC-ES does **not evaluate uplift and lateral loads in** ESR's
- However, in the plan review process, uplift and lateral loads are inferred and need to be known in order to satisfy paragraph R802 regarding uplift requirements from the roof to the foundation

Path to Code Compliance

Frost Testing

- Frost testing is not applicable
- There has never been a **correlated** frost heave resistant performance criteria implemented into the building code for any foundation system
- Historical depths are based on anecdotal observations of performance. The how or why was never considered
- Depth of footing is only a contributing factor, not a solution to frost heave
- **How does one determine equivalent protection regarding frost heave when compared to a prescriptive concrete footings?**

Path to Code Compliance

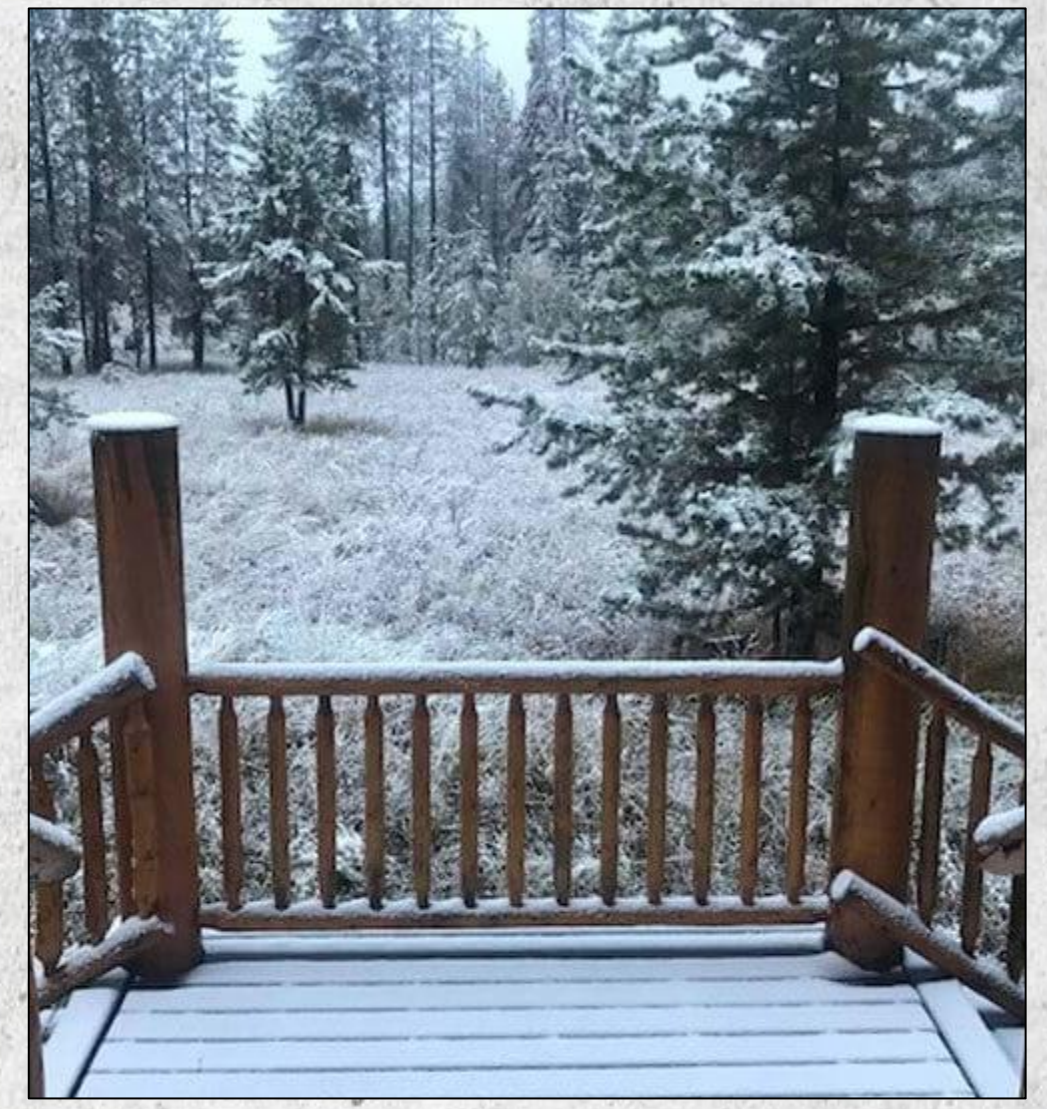
Frost Heave Resistance:

- Mathematically, it's uplift resistance. **Frost heave occurs when the frost force exceeds uplift resistance** (**FF>UR**). A deeper/heavier footing provides greater uplift resistance However, this is still not a requirement of any building code. Uplift in the building codes address roof wind loads only
- To date there is **no proven methodology** for determining the severity of heave in frost susceptible soils or for determining the force of frost on any given point load
- Therefore, **no engineering calculation exists** to determine "Frost Force"
- Reference Chamberlain 1981; Frost Susceptibility of Soil Review of Index Tests

Path to Code Compliance

Frost Heave Resistance

- If an engineered frost force cannot be determined...
  Then uplift resistance, supported by observed **historical performance** becomes the only remaining equivalent criteria to evaluate an alternate foundation method
- Is the system effectively withstanding the forces of frost heave to a reasonable standard? (**Yes** or **No**)
- What is a **code-based** reason for denial?
- The code requires new means & methods be judged on equivalent **performance** not prescriptive measurements



Path to Code Compliance

Frost Heave Resistance

Bearing Pin Pier Field Statistics

(Proprietary field performance)

- As the original maker, PFI, with 30 years experience, has **Diamond Pier** models DP50 & DP75 installed in the Minnesota market for the past 12 years exceeding 95,000 piers
- Over 12-yrs. PFI has been notified of some type of movement in 70 of 14,200 projects, or **0.493%**
- All the installations that required intervention violated manufacturer's installation manual. See their installation manual page 5, Supporting Soils, first paragraph
- **HANDI Pier** organized in 2016 and is a relatively new manufacturer of bearing pin piers. Performance data not available on their website
- **As the building official, can you consider long-term performance?**

Path to Code Compliance

Frost Heave Resistance

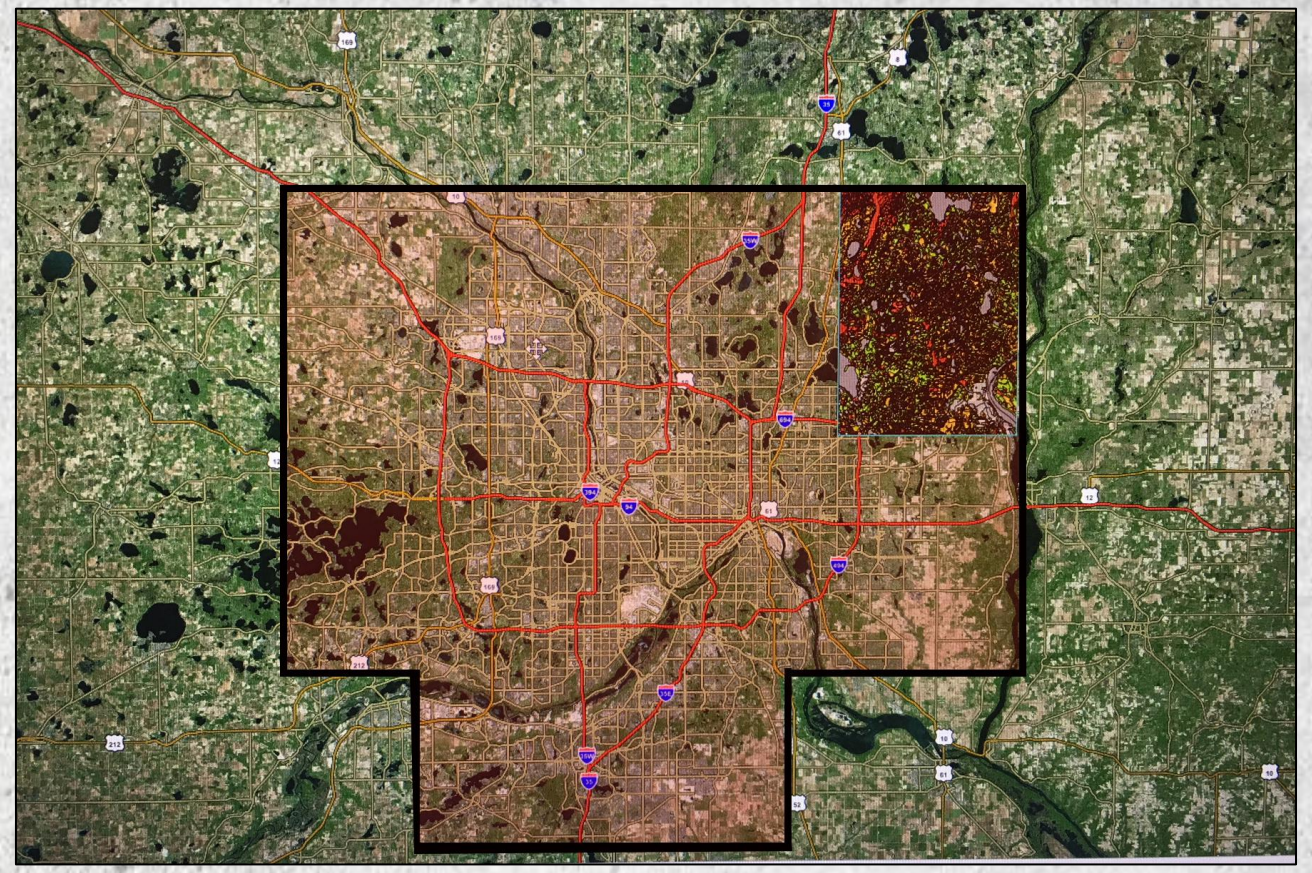
- The low incident rates statistically defines these sites as having some type of anomaly
- A scientific analysis would require an established procedure or methodology to determine cause. **No such procedure or methodology exists.**
- One can assume that extreme frost heave susceptible soils exist in less than **½ of 1%** of area sites. Otherwise, no known definitive attribute can be applied
- **As the building official, can you consider long-term performance?**

Path to Code Compliance

Frost Heave Resistance

- The US Department Agriculture has classified frost susceptible soils into (3) categories: **Mild**, **Moderate** and **Severe**

- The area shown in (Figure 1) outlines a representative area surveyed through the USDA web soil survey website, to determine the percentage of mild, moderate and severe frost that exists in the **Twin Cities area of Minnesota**



https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

Mild - 30.3% **Moderate - 40.3%** **Severe - 29.3%**

Path to Code Compliance

Denials

Some code-based reasons for denial of a bearing pin system:

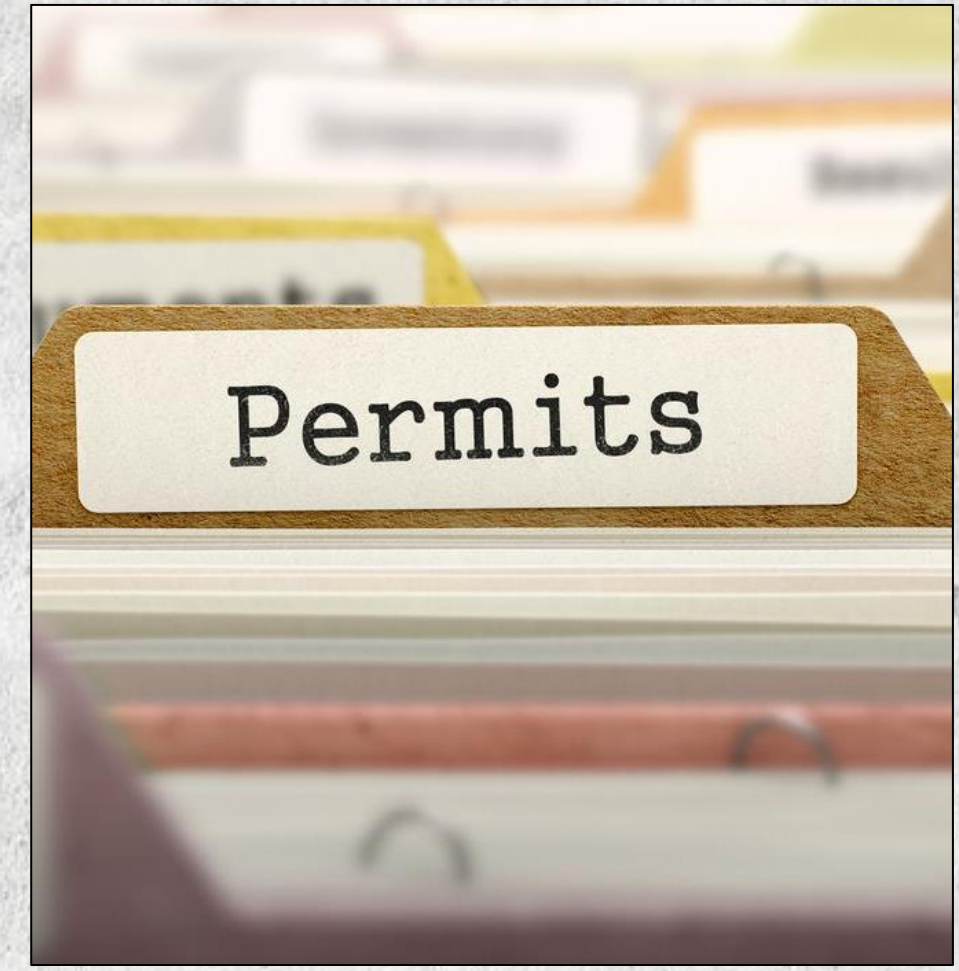
- Does not conform to manufacturer's instructions
- Soils below 1500 PSF minimum
- Slopes - Greater than 2:1 – 27 degrees
  - Option to consult manufacturer
- Existing code compliant footings heaved - Requiring a larger equivalent
- Uses and Applications are beyond ESR definitions
- Lack of QC on the casting
- Other site specific anomalies
- **Approval of intent of the code is by the building official**

Path to Code Compliance

Denials

Reasons to deny any foundation system:

- Tributary loads exceed capacities
- Soil strength degradation or soil strength is in question - Soils report
- Soils evaluation - Presumptive values per TableR401.4.1 or soils engineering
- R401.4 Soil tests - Where quantifiable data created by accepted soils science methodologies indicate **expansive** soils, **compressible** soils, **shifting** soils or other **questionable** soil characteristics are likely to be present, the building official shall determine whether to require a soil test to determine the soil's characteristics at a particular location. This test shall be done by an approved agency using an approved method **regardless** of the foundation type

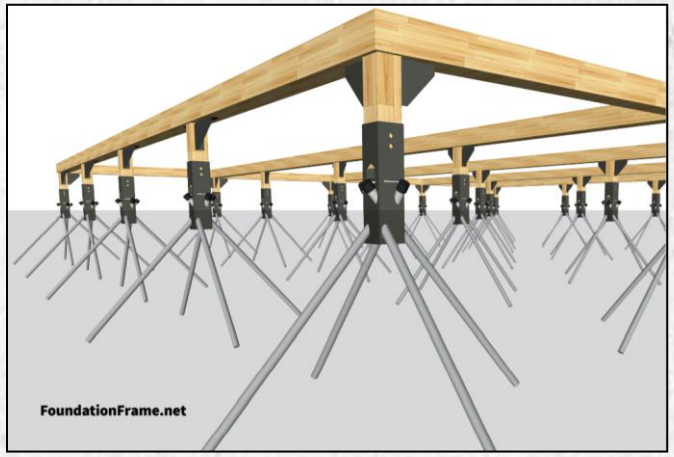


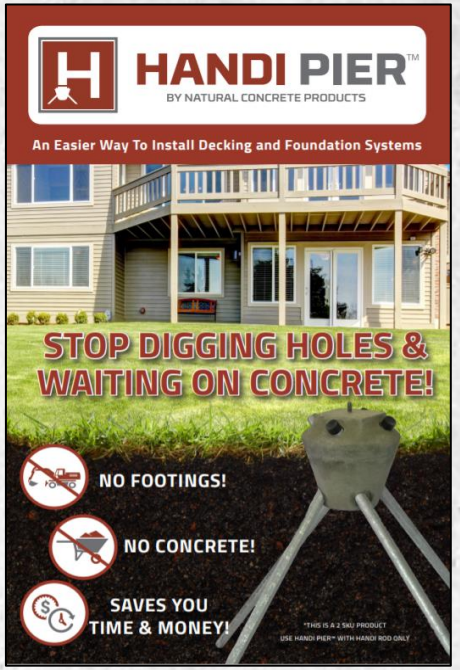
- Should an inspector be making a geotechnical assessment by looking into a hole?

Proper Installation Techniques

- **Follow manufacturer's instructions:**
  - Quick install guides
  - Manufacturer's websites for guidance:

    www.diamondpiers.com
    www.naturalconcreteproducts.com





Proper Installation Techniques

Site Inspection

A Bearing Pin 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 shall be accessible for measuring pin lengths. Minor mushrooming of pin end permitted as long as head is not damaged.

Pin Length Inspection:

- Measure for full depth check.
- May cut with review of resulting capacities
- Pin length less 1" to 1.5" less for tip placement

Pin Specifications:

- Schedule 40 ASTM A53 galvanized pipe
- Consult ESR Report for detail specifications

Concrete Head Integrity:

- Must be 5 degrees within level
- No structural cracks (surface spalls or chips are acceptable)

Proper Installation Techniques

Site Inspection

Allowable capacities

- Manufacturer's published load charts

LOAD CHA

The following load chart is intended for residential use only on decking and foundation projects such as decking, covered walkways, gazebos, platforms, columns and post supports for simple structures. Please follow all load chart requirements before using HANDI PIER™ support block systems on your desired project. The information provided is in comparison to standard poured concrete footings including load bearing capacity and frost heave resistance.

HANDI PIER™ (HP-R50) | Minimum 1500PSF | SILTS & CLAYS
(Design Safety Factor = 2.0, Residential Use Only)

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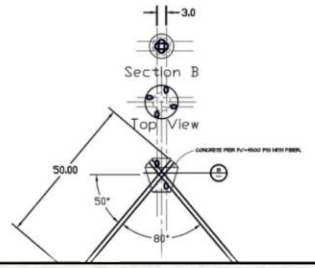

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		Equivalency to Traditional Concrete Footings			*Interpolated from field test values	

Path to Code Compliance

Response from Building Official

"I have replied on this product to you many times in writing and told you I have reviewed this product before. There is nothing new in the ESR – 1895 Document. The section referred to IRC R403.1.4.1 in the letter from the product salesperson is just the section on frost protection."

"I have put much time into responses on this specific product and will not be responding further on it. It could be used as a standalone support option as long as the deck was not attached to the home."

"I would be happy to talk to someone from ICC about this. Mark (Romano) just keeps saying the same thing- that I can approve it. If ICC can't categorically state in the report that it works with frost depth, then we will not go beyond and approve it."

Path to Code Compliance

Letter provided to Building Official

John,
Here is a summary of the information you can present to the [redacted] Building Official ([redacted] BO) to get approval for use of the Diamond Pier (DP) system for your deck project. This information is based on the provisions/requirements identified in the ICC Evaluation Service Report ESR-1895, issued December 2022. DPs are classified as a bearing pin pier system and not prescriptively identified in the residential Code so approval is by the alternate materials and methods provided for in Chapter 1 of the IRC. This, along with the ESR is the basis for approval.

To identify the accreditation of the DP system, I'll start with Section 6.0 of the ESR and move to the front of the ESR:

Path to Code Compliance

Letter provided to Building Official

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Bearing Pin Piers (AC336), dated June 2016 (editorially revised April 2019).

- Pin Foundations has submitted test data to the ICC to verify that the DP system meets the requirements of the AC 336 to be identified as a valid Bearing Pin Pier system.

Path to Code Compliance

Letter provided to Building Official

DIVISION: 31 00 00—EARTHWORK
Section: 31 60 00—Special Foundations and Load-Bearing Elements

- By satisfying the AC 336 criteria, DPs are now listed in the Construction Specifications Institute (CSI) in Section 31 60 00 as a “Special Foundations and Load-Bearing Element”.
- The word “**Special**” is important because that indicates that the system is not listed as a prescriptive method of providing a foundation in the building code. By default, that moves the approval process of DPs to **Section 104.11 Alternative materials, design and methods of construction and equipment** of the IRC.

Path to Code Compliance

Letter provided to Building Official

R104.11 Alternative materials, design and methods of construction and equipment. The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code. The building official shall have the authority to approve an alternative material, design, or method of construction upon application of the owner or the owner's authorized agent. The building official shall first find that the proposed design is satisfactory **and complies with the intent of the provisions of this code**, and that the material, method, or work offered is, for the purpose intended, **not less than the equivalent of that prescribed in this code** in quality, strength, effectiveness, fire resistance, durability, and safety. Compliance with the specific performance-based provisions of the International Codes shall be an alternative to the specific requirements of this code. Where the alternative material, design or method of construction is not approved, the building official **shall respond in writing,** stating the reasons why the alternative was not approved.

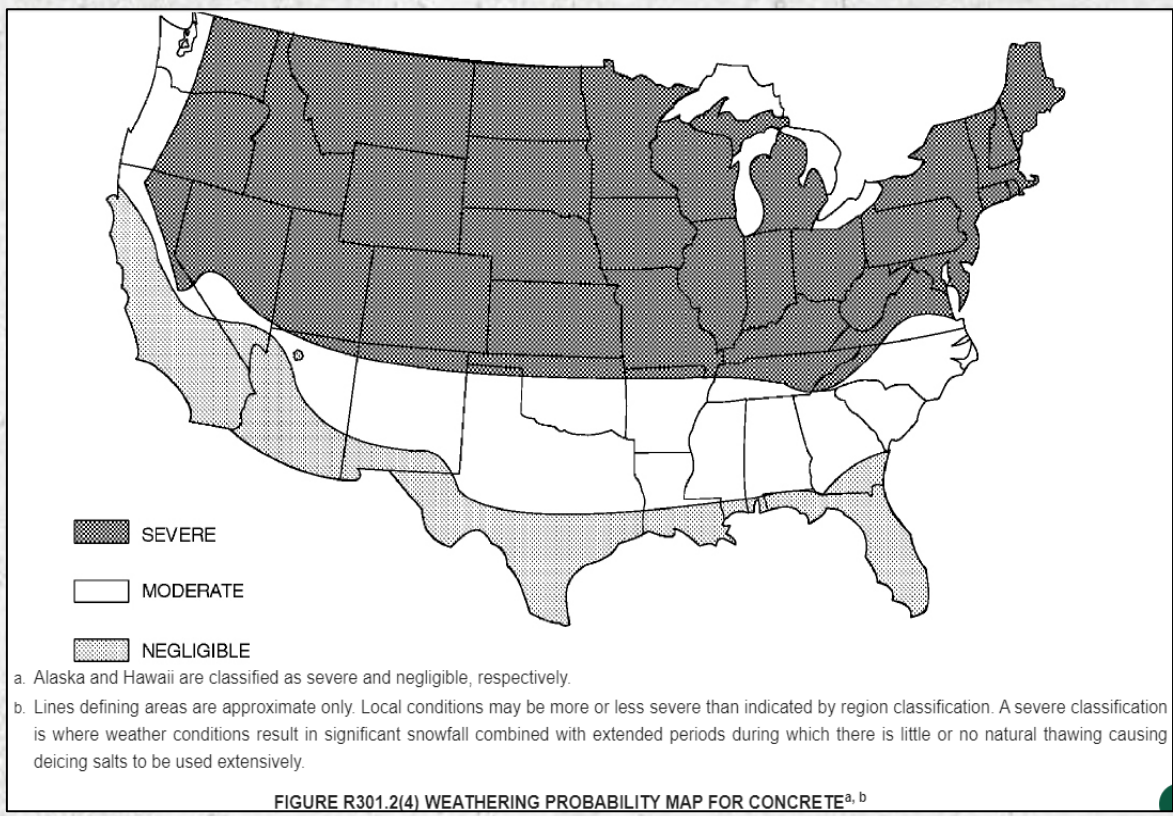
- The key words are "…complies with the **intent** of the provisions of the code, and …**performance-based** - provisions of the code…" In other words, "**Will it work?"**
- Lastly, the IRC requires that the [redacted] BO provide you with a written (**code-based**, my insert) reason for not approving the alternative. It appears that he has not done that.

Path to Code Compliance

Letter provided to Building Official

2.0 USES

The Diamond Pier DP-50 and DP-75 bearing pin piers are used as foundations for the support of gravity loads for exterior decks, including covered decks, exterior porch decks, elevated walkways, stairway construction and accessory structures as defined in the IRC. The bearing pin piers are permitted for use in any of the weathering classifications defined in 2018 IRC Figure R301.2(4) or 2015, 2012, 2009 and 2006 IRC Figure R301.2(3).



a. Alaska and Hawaii are classified as severe and negligible, respectively.

b. Lines defining areas are approximate only. Local conditions may be more or less severe than indicated by region classification. A severe classification is where weather conditions result in significant snowfall combined with extended periods during which there is little or no natural thawing causing deicing salts to be used extensively.

FIGURE R301.2(4) WEATHERING PROBABILITY MAP FOR CONCRETE[a, b]

- [redacted] is in the Severe Weathering Classification.
- The ESR clearly identifies that the proposed deck is an approved use in this weathering classification area.
- **So far so good!**

Path to Code Compliance

Letter provided to Building Official

4.1 Design:

When installed in accordance with this report in minimum allowable 1500 psf (71.8 kPa) soils per IRC Table R401.4.1, the DP-50 bearing pin pier with 36 inch (915 mm) pins provides a 1.8 square foot (0.17 m^2) bearing area for supporting gravity loads; the DP-50 bearing pin pier with 50 inch (1270 mm) pins provides a 2.4 square foot (0.23 m^2) bearing area for supporting gravity loads; and the DP-75 bearing pin pier with 50 inch (1270 mm) pins provides a 2.8 square foot (0.26 m^2) bearing area for supporting gravity loads.

- Section 4.1 identifies a minimum 1500 psf soil bearing capacity.
  I am assuming that is accurate for your site.

Path to Code Compliance

Letter provided to Building Official

4.2 Installation:

The site soil is prepared by digging a hole with a conical shape, approximately the shape of the base of the concrete head and slightly deeper than the pier itself, leaving loose soils directly below the head. The head is positioned in the hole to its midpoint, and braced as needed to plumb. The bearing pins must then be slid through the holes in the concrete head, and driven into the soil as recommended in the Pin Foundations published installation instructions, leaving $^{3}/_{4}$ inch (19.1 mm) of the pin protruding from the upper surface of the pier. Once the dead loads have been applied to the pier, the length of the protruding bearing pin must be verified and adjusted as necessary to $^{3}/_{4}$ inch (19.1 mm). The exposed end of the bearing pins must then be capped and sealed as recommended in the Pin Foundations published installation instructions. The minimum spacing of the installed bearing pin piers is 3 feet (0.91 m) on center.

- Section 4.2 provides the manufacturer's installation instructions that must be followed during the installation process. This information is not critical to the permit approval process. Installation can be verified via a progress inspection by the [redacted] BO.

Path to Code Compliance

Letter provided to Building Official

5.0 CONDITIONS OF USE

The Diamond Pier DP-50 and DP-75 bearing pin piers described in this report comply with, or are suitable alternatives to what is specified in the code indicated in Section 1.0 of this report, subject to the following conditions:

5.1 The bearing pin piers must be installed in accordance with the Pin Foundations, Inc. published installation instructions, the IRC and this report. In the event of a conflict between this report and the Pin Foundations, Inc. published installation instructions, this report governs.

- Sections 5.0 **CONDITIONS OF USE** and 5.1 **CLEARLY** states that the DP's "…comply with or are suitable alternatives to what is specified in the code… and must be installed in accordance with the Pin Foundations installation instructions."
- See **EER-1895 Conditions of Use Item 10** for tabular requirements on frost

Path to Code Compliance

Letter provided to Building Official

> **5.3** 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. See IRC Section R403.1.4.1, Exception 3, as applicable.

- Section 5.3 states that "…exterior decks on bearing pin piers…may be connected to and supported by a dwelling…". Exception 3 is not a factor and is not applicable in this case.

Path to Code Compliance

Letter provided to Building Official

> **5.6** The capacity of the bearing pin piers to resist lateral and/or uplift loads was not evaluated for this report.

- "Uplift" is not frost heave! Uplift refers to wind uplift on the structure (See IRC Sections R301.2.1 & 802.11). Therefore, uplift was not evaluated for his report. DP's were evaluated for their load-bearing capacities.

- Again, so far so good!

Path to Code Compliance

Letter provided to Building Official

In summary, if this project is a simple deck, the [redacted] BO has no real code-based basis for not approving the permit application. Pin Foundations has all the engineering data available on their website (www.pinfoundations.com) for review if necessary. Mark Romano and I are available for any discussions the [redacted] BO may want to participate in if he has continued questions about the alternative materials and materials approval process. Many code officials are reluctant to pull that trigger simply because they are uncertain about system performance and something possibly failing. My response to those concerns is that if the applicant has provided the necessary documentation that the building code requires, the application could be approved. If something does fail sometime in the future, then the paper trail would guide the investigation of "What happened?" and then proceed accordingly.

Hope this helps.
Feel free to contact me with any other questions.

Questions?

Thank you for your attendance.

Roger Axel, CBO
raxelcodeguy@gmail.com
952-217-2307