

DECK & PORCH FRAMING

Footing Requirements

Are the footings appropriate for the loads and codes?

Code Requirements: Deck Post Footing Requirements

- IRC® -'00-'15, DCA 6- '09/'12
R403.1.1 Minimum size
 - 12” square or equivalent
- IBC® -'00-'15
See 1809.4 – '09/'12/'15, 1805.4 – '00/'03/'06 and
Table 1809.7 – '09/'12/'15, 1805.4.2 – '00/'03/'06
- ACI 318-08 (referenced standard in the IRC/IBC)
15.7 Minimum footing depth
Depth of footing above bottom reinforcement shall not be less than 6”
for footings on soil, nor less than 12” for footings on piles.

Prescriptive Deck & Porch Footings

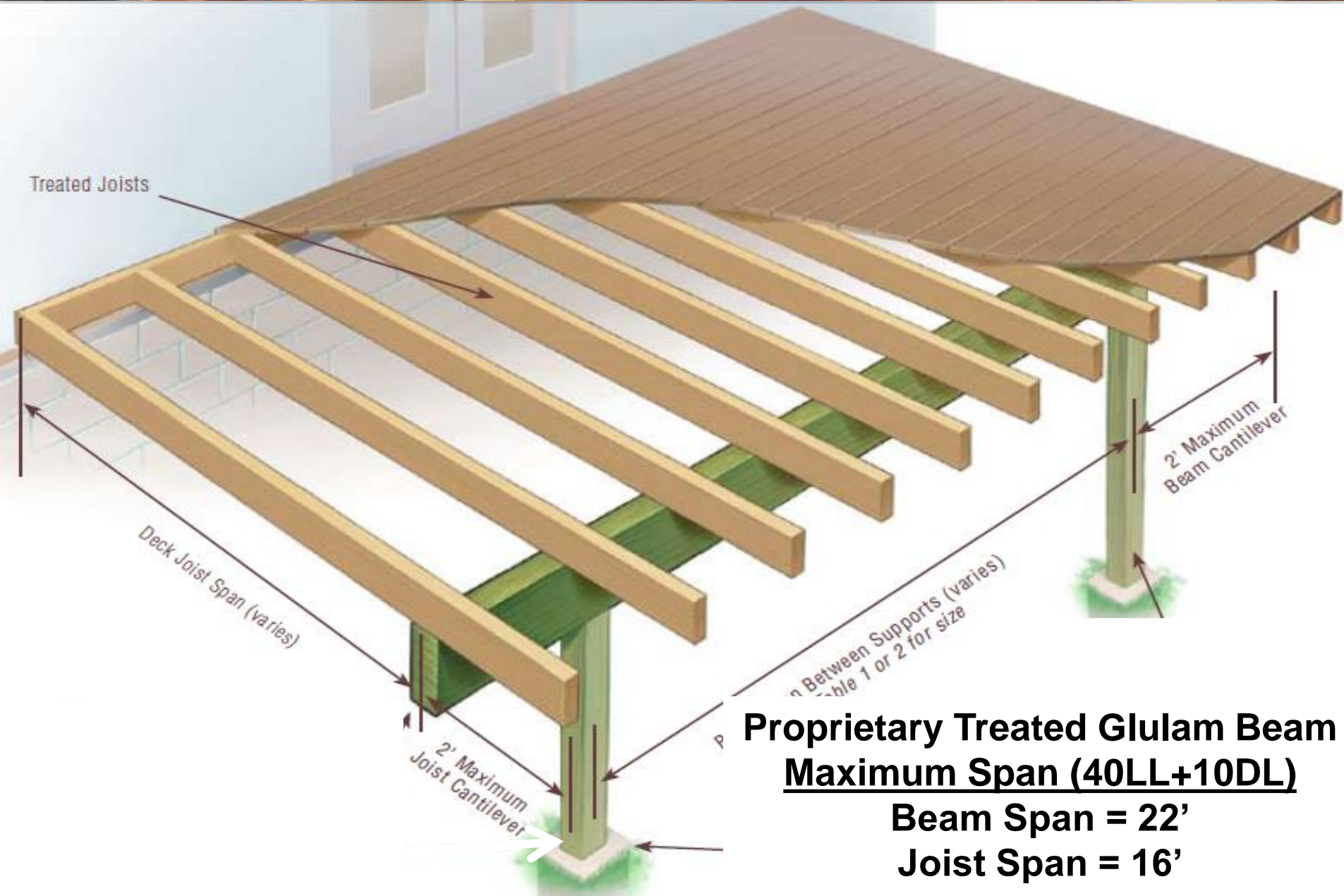
- **DCA 6-'12: Footings, pg. 12**
 - Footing closer than 5' to an exterior house wall must bear at the same elevation as the existing house foundation footing

Assumes 40 psf live load, 10 psf dead load, 1500 psf soil bearing capacity, and 2500 psi compressive strength of concrete.

Table 4. Post Height for 6x6⁵ and Footing Sizes for all Posts.

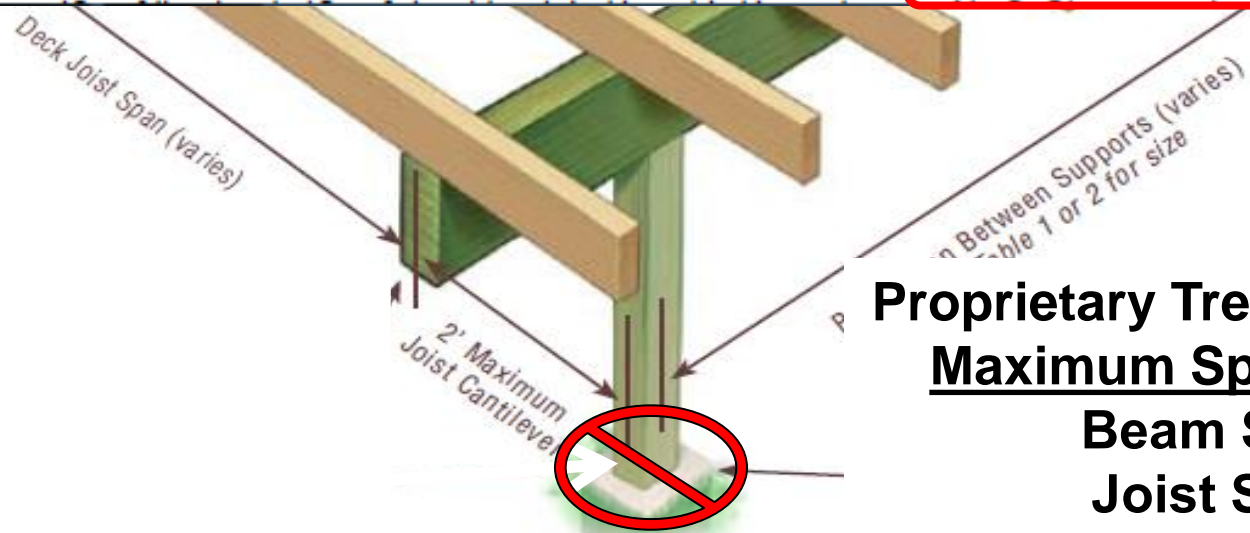
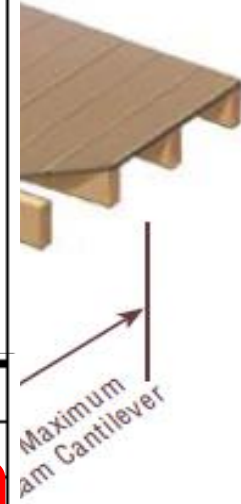
| Beam Span, L _B | Joist Span L _J | Post Heights ¹ | | | | | Footing Sizes ² | | |
|---------------------------|---------------------------|---------------------------|--------------------------------|---------------------------------------|---------|--|----------------------------|----------------|--------------------------------|
| | | Southern Pine | Douglas Fir-Larch ³ | Hem-Fir ³ , Western Cedars | Redwood | Ponderosa Pine, Red Pine, SPF ³ | Round Footing Diameter | Square Footing | Footing Thickness ⁴ |
| 6' | ≤10' | 14' | 14' | 14' | 14' | 14' | 18" | 16"x16" | 7" |
| | ≤14' | 14' | 14' | 14' | 14' | 14' | 21" | 18"x18" | 8" |
| | ≤18' | 14' | 14' | 12' | 14' | 11' | 24" | 21"x21" | 10" |
| 8' | ≤10' | 14' | 14' | 14' | 14' | 14' | 20" | 18"x18" | 8" |
| | ≤14' | 14' | 14' | 14' | 14' | 11' | 24" | 21"x21" | 10" |
| | ≤18' | 14' | 13' | 11' | 12' | 8' | 27" | 24"x24" | 11" |
| 10' | ≤10' | 14' | 14' | 14' | 14' | 12' | 23" | 20"x20" | 9" |
| | ≤14' | 14' | 13' | 11' | 13' | 8' | 27" | 24"x24" | 11" |
| | ≤18' | 12' | 11' | 8' | 11' | 2' | 31" | 27"x27" | 13" |
| 12' | ≤10' | 14' | 14' | 12' | 14' | 10' | 25" | 22"x22" | 10" |
| | ≤14' | 13' | 12' | 9' | 11' | 5' | 30" | 26"x26" | 13" |
| | ≤18' | 11' | 9' | 6' | 9' | 2' | 34" | 30"x30" | 15" |
| 14' | ≤10' | 14' | 13' | 11' | 13' | 8' | 27" | 24"x24" | 11" |
| | ≤14' | 11' | 10' | 7' | 10' | 2' | 32" | 29"x29" | 14" |
| | ≤18' | 9' | 8' | 2' | 8' | NP | 37" | 33"x33" | 16" |
| 16' | ≤10' | 13' | 12' | 10' | 12' | 6' | 29" | 26"x26" | 12" |
| | ≤14' | 10' | 9' | 5' | 9' | 2' | 35" | 31"x31" | 15" |
| | ≤18' | 7' | 5' | 2' | 7' | NP | 40" | 35"x35" | 18" |
| 18' | ≤10' | 12' | 11' | 8' | 11' | 2' | 31" | 27"x27" | 13" |
| | ≤14' | 9' | 8' | 2' | 8' | NP | 37" | 33"x33" | 16" |
| | ≤18' | 5' | 2' | 2' | 6' | NP | 42" | 37"x37" | 19" |

Large Spans Create Large Footings



Large Spans Create Large Footings

| Beam Span, L _B | Joist Span L _J | Post Heights ¹ | | | | | Footing Sizes ² | | |
|---------------------------|---------------------------|---------------------------|--------------------------------|---------------------------------------|---------|--|----------------------------|----------------|--------------------------------|
| | | Southern Pine | Douglas Fir-Larch ³ | Hem-Fir ³ , Western Cedars | Redwood | Ponderosa Pine, Red Pine, SPF ³ | Round Footing Diameter | Square Footing | Footing Thickness ⁴ |
| 18' | ≤10' | 12' | 11' | 8' | 11' | 2' | 31" | 27"x27" | 13" |
| | ≤14' | 9' | 8' | 2' | 8' | NP | 37" | 33"x33" | 16" |
| | ≤18' | 5' | 2' | 2' | 6' | NP | 42" | 37"x37" | 19" |



Proprietary Treated Glulam Beam
Maximum Span (40LL+10DL)
 Beam Span = 22'
 Joist Span = 16'

Code Requirements: Deck Post Footing Requirements

- IRC® -'00-'15, DCA 6-'09/'12

R403.1.4 Minimum depth. All exterior footings shall be placed at least 12 inches below undisturbed ground surface. ...

(Not 12 inches below the top of the final grade, below undisturbed ground)

- IBC® -'00-'15

1809.4-'09/'12/'15, 1805.2-all others, Depth of footings. (See above)

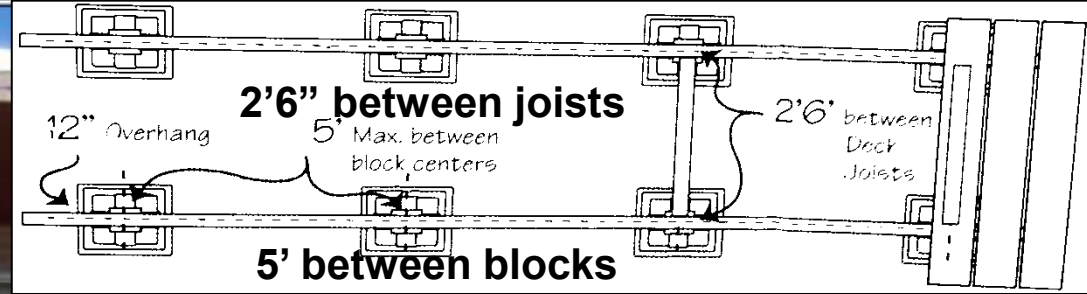
“Undisturbed ground” – any ground that is broken up or agitated is considered permanently disturbed. It must be subjected to so little disturbance that it is suitable to safely support the loads.

Screw-type anchors must be engineered to address proper soil compaction and density to address uplift and lateral loads.

A 5, 7 or 10 year settling period for suitability does NOT exist.

The backfill area within 3', 4' or 5' from a basement foundation is usually considered “disturbed”.

Is the Footing at Least 12" Below UNDISTURBED ground? Where's the Resistance to Uplift for the Post?



Photos courtesy of C. Johnson - Simpson Strong-Tie - MN 417707



**85 decks on this
apartment
complex.**

**Decks are attached
to the structure.**



Deck Post Footing – Frost Protection Is the Footing Deep Enough to Resist the Uplift Loads?

- IRC® -'00-'15, DCA 6-'09/'12
R403.1.4.1 Frost protection. ...Footings shall not bear on frozen soil unless the frozen condition is permanent.
- IBC® -'00-'15
1809.5-'09/'12/'15, 1805.2.1 -*all others*, Frost protection. (See above)

IRC '03-'15-R403.1.4. Minimum depth ...Where applicable, the depth of the footing shall also conform to R403.1.4.1-R403.1.4.2 (This means minimum depth is required, frost protection may not be.) Frost Protection Exceptions: 3. Decks not supported by a dwelling (freestanding) need not be provided with footings that extend below the frost line

IBC-'03/'06/'09-1805.2.1 1809.5-'12/'15 Frost Protection Exceptions:

Deck Post Footing – Frost Protection Is the Footing Deep Enough to Resist the Uplift Loads?

“This is a classic example of the footing not being deep enough and the footing heaved up”. Mel Zehm – Zehm Bros. Construction, Inc.



Deck Post Footing Where's the Footing?

In order for posts to properly resist the loads they must be supported on, and anchored to concrete footings. Patios and pre-cast piers do not qualify as proper footings for decks that are attached to a house.

Footing shall be:

- 1. Minimum 12"x12" or equivalent.**
- 2. 12" below undisturbed ground.**
- 3. Shall not bear on frozen soil unless the frozen condition is permanent.**

Requirements: Typical Footing Options

- IRC® -'15

R507.8.1 Deck post to deck footing. Posts shall bear on footings in accordance with Section R403 and Figure R507.8.1.

FIGURE R507.7.1
DECK BEAM TO DECK POST

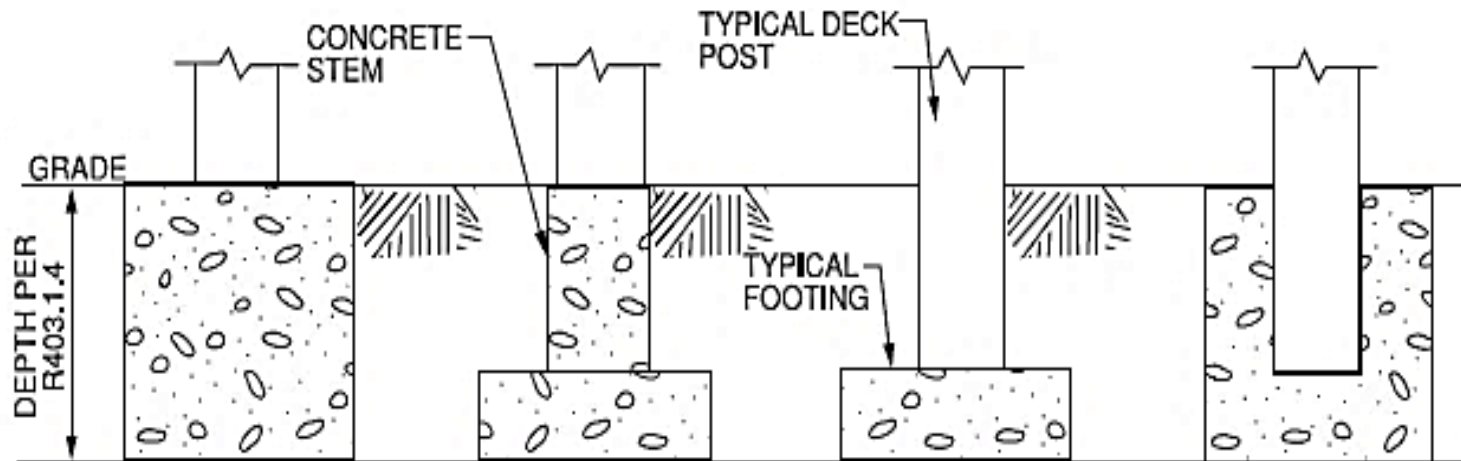
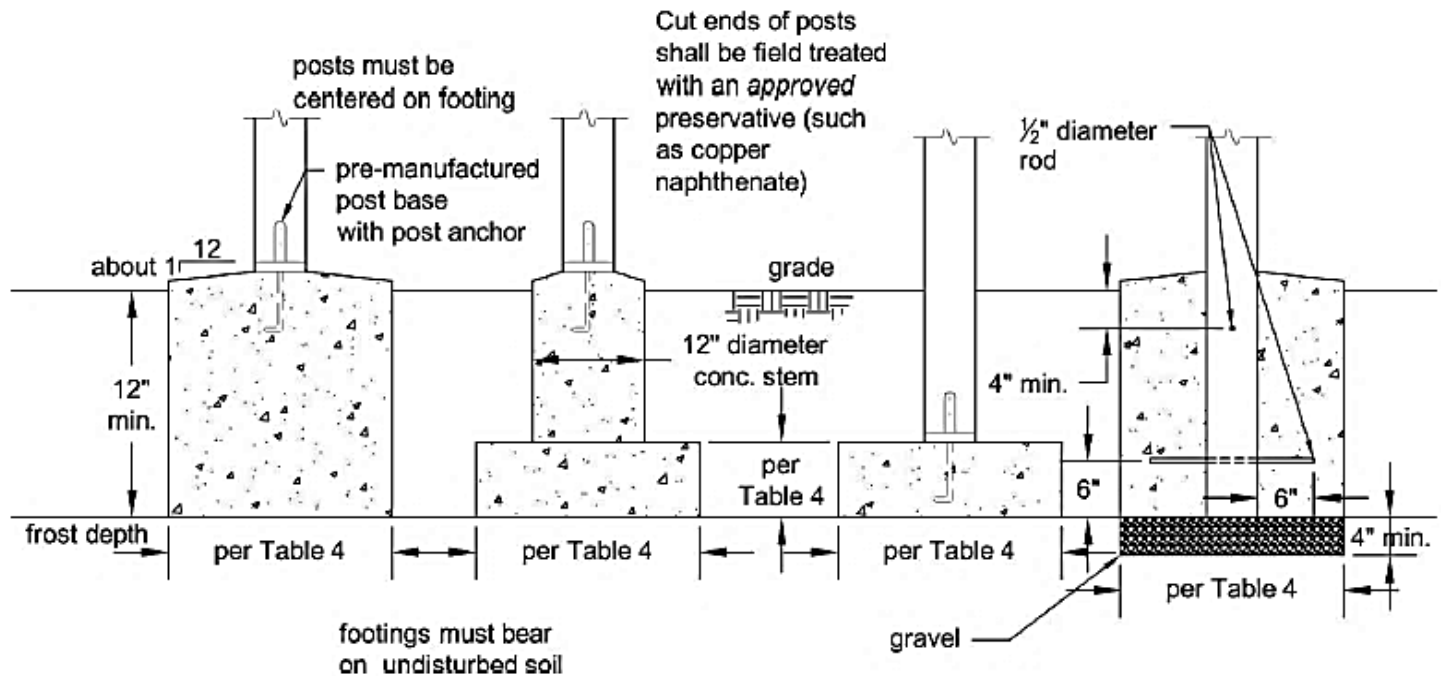


FIGURE R507.8.1
TYPICAL DECK POSTS TO DECK FOOTINGS

Requirements: Typical Footing Options

- DCA 6 – '12

Figure 12. Typical Footing Options.



Requirements: Typical Footing Options

• IRC® -'15

FIGURE R507.7.1
DECK BEAM TO DECK POST

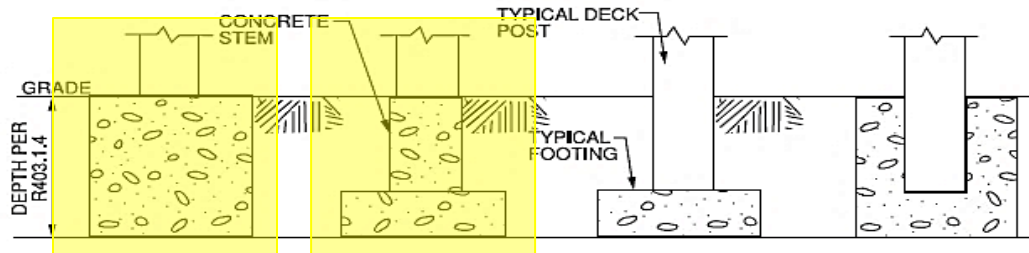
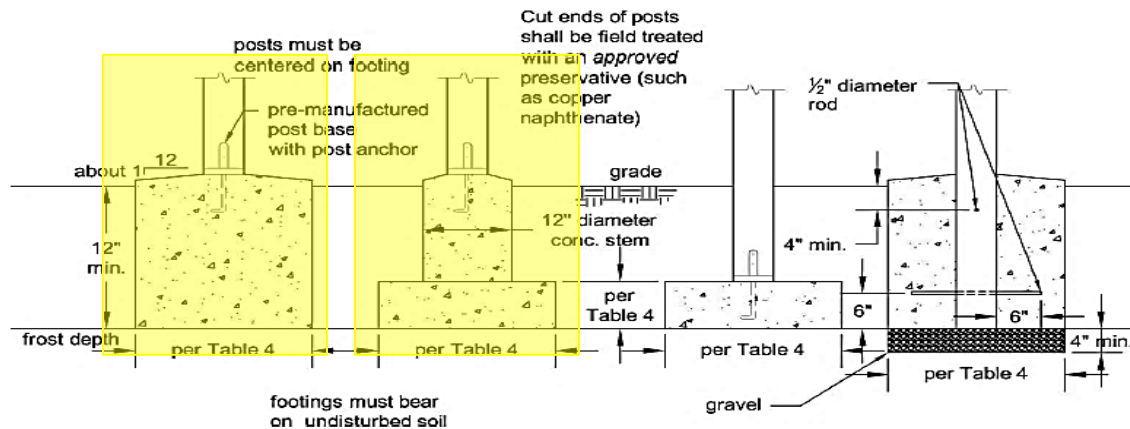


FIGURE R507.8.1
TYPICAL DECK POSTS TO DECK FOOTINGS

Very similar

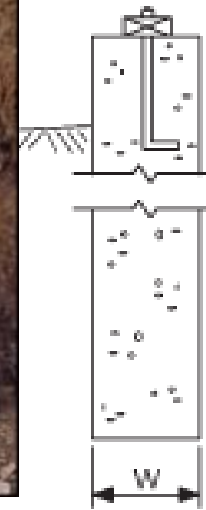
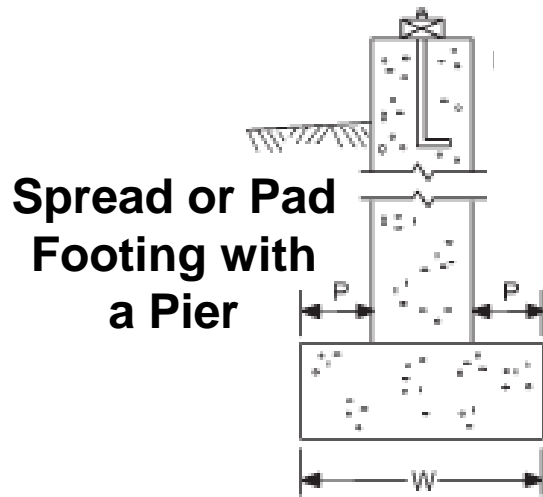
• DCA 6 – '12

Figure 12. Typical Footing Options.



Deck Post Footings

Is the Spread Footing Connected to the Pier?



Pier, only, must be at least 12" square or equivalent

Spread or Pad footing must be connected to the pier.

- **ACI 318-08**

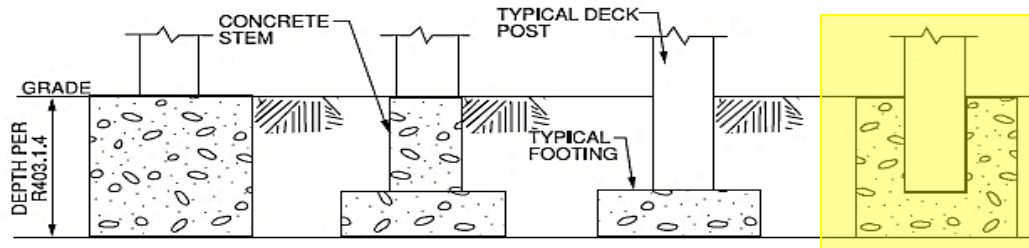
6.4.3 (Construction Joints) ...Provisions shall be made for the transfer of shear and other forces through construction joints.

15.8.1 (Footings) – Forces and moments at the base of the column...shall be transferred to supporting pedestal by bearing on concrete AND by reinforcement, dowels, and mechanical connectors.

Requirements: Typical Footing Options

- IRC® -'15**

FIGURE R507.7.1
DECK BEAM TO DECK POST

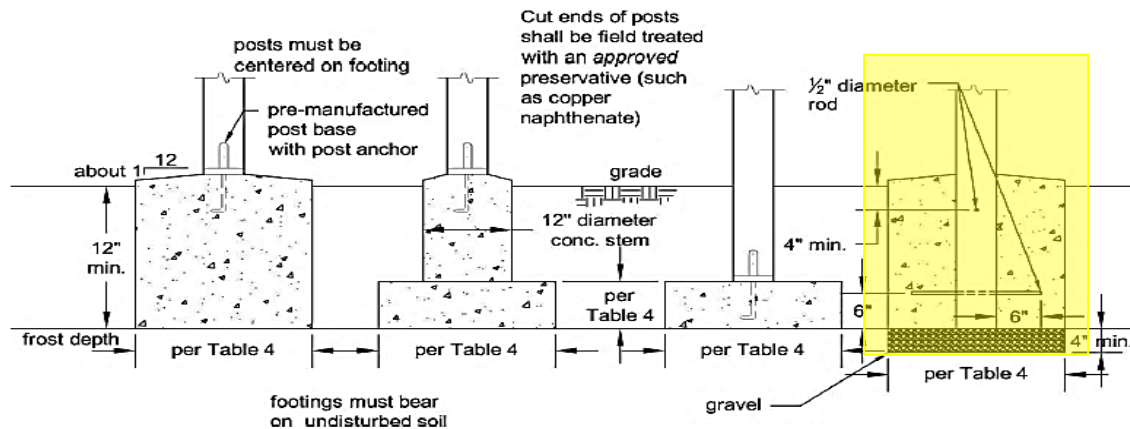


Where's the resistance to uplift?

- DCA 6 – '12**

FIGURE R507.8.1
TYPICAL DECK POSTS TO DECK FOOTINGS

Figure 12. Typical Footing Options.



Potential issues of embedding the post in concrete.

Embedded Posts and Poles – Issues

Wood posts will rot when they are embedded in concrete.

When the wood dries out, it shrinks and water (rain) gets into the opening and the post will rot.



Embedded Posts and Poles – Issues

Steel posts will corrode when they are embedded in concrete.

The concrete creates a pocket for the moisture to collect and the wood and steel will rot or corrode.



Photo courtesy of D. Paul 5/27/14

Requirements: Typical Footing Options

- IRC® -'15

FIGURE R507.7.1
DECK BEAM TO DECK POST

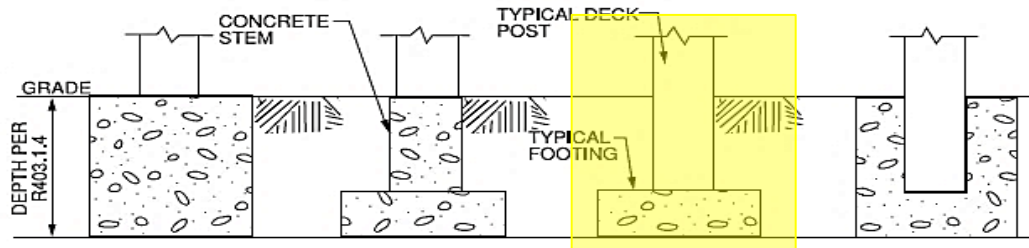
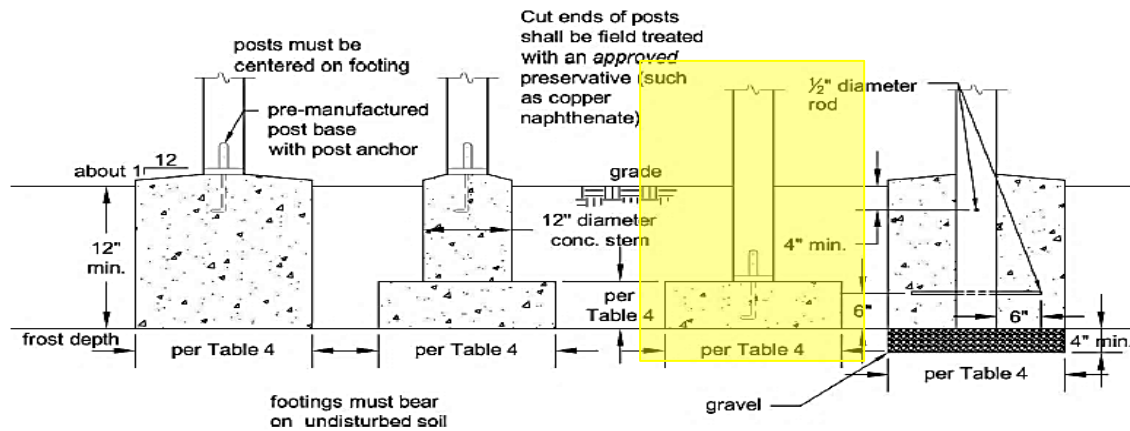


FIGURE R507.8.1
TYPICAL DECK POSTS TO DECK FOOTINGS

- DCA 6 – '12

Figure 12. Typical Footing Options.



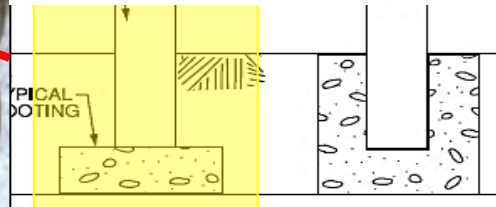
Requirements: Typical Footing Options

• IRC® -'15

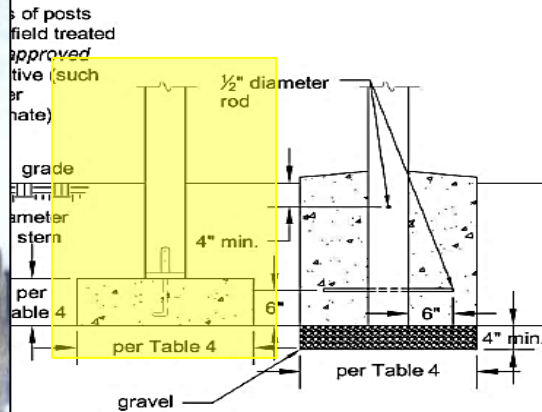
• DCA 6 – '15



Posts embedded in the ground may rot at the surface-to-ground interface, just below the surface.



507.8.1
FOOTINGS FOR DECK FOOTINGS

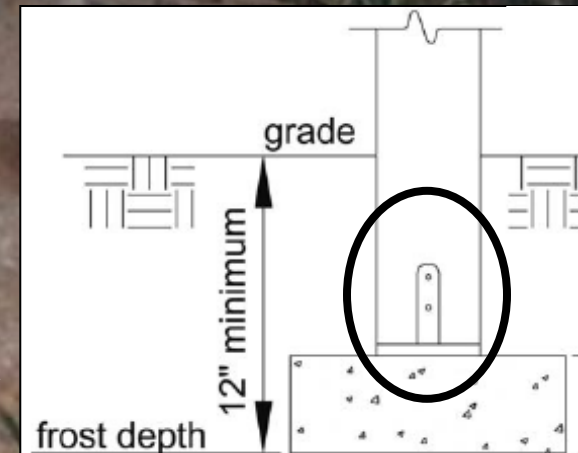


Embedded Post Resistance

Why worry about uplift when the post is buried in the ground?

Photo courtesy of K. Kelly – Simpson Strong-Tie -MD 3/31/08

Post is buried in the ground and has a footing, but no post base to resist uplift



Post are Embedded into the Ground



Nice Porch!

Nice Deck!

Nice Deck!

Photo courtesy of T. Wood Shelby Township 6-14-08

Post are Embedded into the Ground

The ground froze and heaved the deck and stairs up 8"-12"

So much force caused significant damage to the doors and windows



~~Nice Porch!~~

What other significant structural damage occurred? Ledger?

~~Nice Deck!~~

~~Nice Deck!~~



Code Requirements: Embedded Posts and Poles

- IRC® -'00-'15

Until 2015, the IRC provided no guidelines for embedding deck posts. **R507.8.1 Deck post to deck footing. ... Posts shall be restrained to prevent lateral displacement at the bottom support. Such lateral restraint shall be provided by manufactured connectors ...or a minimum post embedment of 12 inches in surrounding soils or concrete piers.**

- IBC® -'00-'15

1807.3/1805.7 Designs employing lateral bearing.

1807.3.1/1805.7.3.2/1805.7.1 Limitations. #2. **Posts embedded in the earth shall not be used to provide lateral support for structural and nonstructural materials... unless bracing is provided that develops the limited deflection required.**

Equation 18-1 provides a formula for minimum embedment depth for a non-constrained post.

(See handout for a definition of a non-constrained post)

Code Requirements: Embedded Posts and Poles

- **IBC® -'03-'15**

2306.1 The design and construction of wood elements in structures... shall be in accordance with the following;

- ✓ **ASABE EP 486.1-Shallow Post Foundation Design**

American Society of Agricultural and Biological Engineers (ASABE)

The IBC adopted ASABE EP 486.1 to give the designer the tools to use to determine the embedment depth based on the assumption that soil is an elastic material and its strength and stiffness increases with depth below grade.

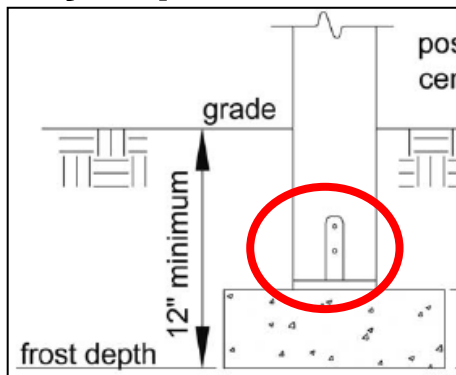
The following guidelines are from ASABE EP 486.1.

Code Requirements: Embedded Posts and Poles

- **ASABE Engineering Practice 486.1 – Shallow Post Foundation Design**
4.3 Backfill. Excavated soil...shall be compacted to at least pre-excitation density.

It's not sufficient to fill the hole around the post without significant compaction of soil that was removed to install the footing and post.

8.3.1 Post uplift design....Below grade, use mechanical fasteners with durability equal to the service life of the building.



Simpson Strong-Tie recommends stainless steel connectors and fasteners in contact with soil.

C-C-2015, pgs. 14-15 – Elevated Service

8.3.1.1 Friction. Do not include the frictional resistance between soil and post.

(In practice the uplift is usually limited to the strength of the connection.)

Code Requirements: Embedded Posts and Poles

- **IRC® -'00-'15**

Until 2015, the IRC provided no guidelines for embedding deck posts.

R507.8.1 Deck post to deck footing. ... Posts shall be restrained to prevent lateral displacement at the bottom support. Such lateral restraint shall be provided by manufactured connectors ...or a minimum post embedment of 12 inches in surrounding soils or concrete piers.

Questions/Comments about R507.8.1?

- 1. Does the soil have to be compacted?**
- 2. How much resistance to the lateral loads is resisted at 12" embedment?**
- 3. How much resistance to any uplift loads are resisted at 12" embedment?**

Embedded Posts in the Ground

**Is there a footing?
UNSEEN MAY BE UNSAFE**

Do you see anything wrong with this deck? 60 decks on this apartment complex and they all look the same.

The Fence Builder:

To install a fence post, you dig a hole, install the post and pour some concrete around the post. However, for a deck post something is missing, what's missing?



Embedded Posts and Poles

No concern for frost heave, use a plastic footing pad as your footing.

- **ICC-ES AC49 – Molded Plastic Footing Pads (11/1/09)**

6.2.4 The ...pads are used as isolated footings to resist bearing loads only and are not used to resist lateral or uplift loads.

6.2.6 Mechanical fasteners must not be used with the molded plastic footing pads.

6.2.8 Design calculations in accordance with Chapter 18 (IBC) and Chapter 4 (IRC) and ASABE ANSI EP 486.1 must be submitted to the code official documenting uplift and lateral load resistance.

- **How will the post resist lateral and uplift forces without attachment using mechanical fasteners?**
- **Every installation requires design.**



A photograph showing the wooden framing of a deck or porch, with various beams and joists visible. The wood is a light brown color.

Decks and Porches in Flood Hazard Areas

Footing Requirements in Flood Hazard Areas – A Zones

- **ASCE 24-05 Flood Resistant Design and Construction**
 - 9.1 Miscellaneous structures (*decks and porches*) and construction ...shall be designed to withstand all flood-related loads as defined in section 1.6...**
 - 1.6.1 ...*these include hydrodynamic loads, wave action, etc. AND ...wave induced and flood-related erosion and scour...***

Deck Collapse in a Flood Hazard Area

Footing Depth May Need to be Deeper to address Flood Related Erosion & Scour

T.S. Irene – La Plata, MD





Deck Footing Failure due to Flood Uplift

Inadequate Footing Depth

Post Base Held to the Footing Lifting up the Concrete



ABA uplift = 555 lbs. – 720 lbs.

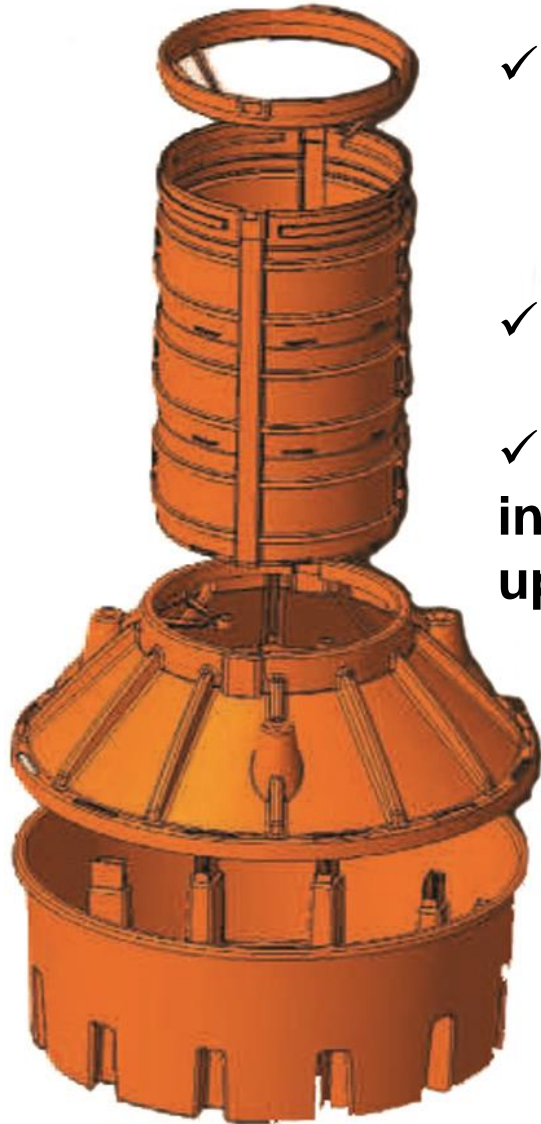
Solution-

wp Fail-Safe Form Footer™

wp Fail-Safe
FORM FOOTER™

www.wpfailsafe.com

- ✓ **Significant dead weight to add to load resistance;**
 - 18" system = 515 lbs. – 840 lbs.
 - 25" system = 752 lbs. – 1072 lbs.
- ✓ **Bell shaped footing adds structural stability.**
- ✓ **Rebar is precut and prebent to length to fit into integrated rebar holders to help resist the lateral and uplift forces.**



Solution-

wp Fail-Safe Form Footer™

wp Fail-Safe
FORM FOOTER™

www.wpfailsafe.com



1 tower – 36" tall



2 towers – 54" tall



3 towers – 72" tall

- ✓ **Stackable to meet varying frost depths and soil conditions.**
 - **Each tower is a 12" diameter, 18" tall.**
- ✓ **Snaps together in minutes - no tools needed. Quick & easy to install.**