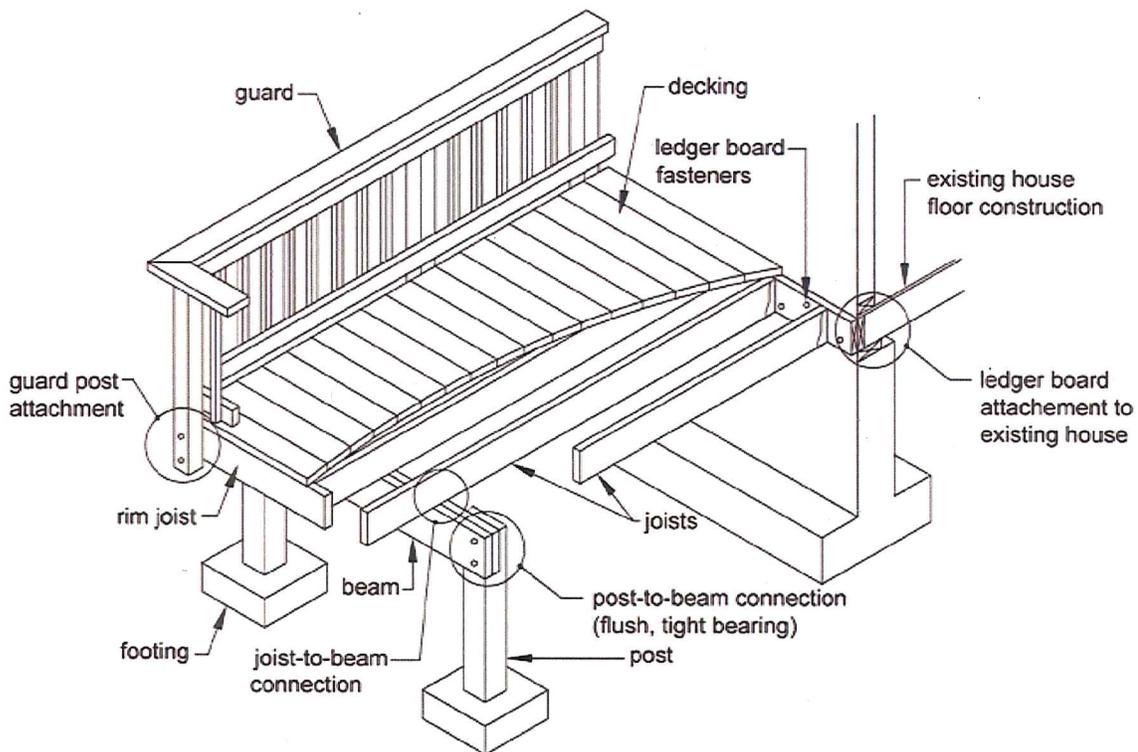




# RESIDENTIAL WOOD DECK CONSTRUCTION GUIDE



**Building Permits are required for all Uncovered Decks where the floor of the Deck is more than thirty (30") inches above grade. The thirty inch height is measured extending three (3') feet out from the Deck perimeter at all locations.**

Some of the drawings and information contained in this guide are borrowed from the Prescriptive Residential Wood Deck Construction Guide published by American Forest & Paper Association, Inc. Where applicable, provisions and other details contained in this guide are based on the *International Residential Code (IRC 2009)*. Any prescriptive construction methods recommended meet or exceed the minimum requirements of the IRC. Provisions found in this guide that are not in the IRC are recommended as good industry practice. Where there is a difference between the provisions of this guide and the IRC, the provisions IRC 2009 shall apply. This guide is not intended to ban the use of other construction methods or materials. If you are using this guide for deck construction in other jurisdictions, the authority having jurisdiction must approve all construction and material.

## **General Notes**

1. All lumber shall be a naturally durable species (i.e. Redwood or Natural Cedars) or be pressure treated in accordance with American Wood Preservers' Association standards, # 2 Southern Yellow Pine or better. All lumber in contact with the ground shall be approved preservative treated wood suitable for ground contact.
2. All screws and nails shall be hot-dipped galvanized or stainless steel. All hardware shall be galvanized with 1.85 oz/square foot of zinc (G-185 coating) or stainless steel type 304 or better.
3. All building permits for decks shall have drawings (2 sets) that comply with the information in this guide.
4. Decks constructed according to this guide are not to be used for hot tub support. Decks for hot tubs have heavy design loads that are outside the scope of this guide and generally require a structural engineer's sealed design.
5. Decks shall not be attached to house overhangs (cantilevers), cantilevered box or bay windows, brick veneers, or chimneys. These decks would require self supporting construction methods or a design stamped by a Pennsylvania licensed engineer. (See figures 19 and 20.\*)
6. Decking material may be 2"x 6" or 5/4" lumber, or plastic/composite products that have an approved evaluation report on file with the International Code Council. Composite and plastic materials must be installed per the manufacturer's instructions.
7. This Deck Construction Guide is intended for Residential single level decks only.

## **Required Inspections**

1. 1) Footing 2) Rough Framing and 3) Final Inspection are required on all decks. Footing inspections are required prior to pouring concrete.
2. Decks shall not be used until a final inspection has been approved the deck. Failure to call for and receive the required inspections may lead to the issuance of a STOP WORK ORDER and legal proceedings.

## **Joist Sizing**

The span of a joist is measured from the centerline of bearing at one end of the joist to the centerline of bearing at the other end of the joist and does not include the length of the overhangs. Use the table below to determine maximum joist span based on lumber size and spacing.

**Table 1 Maximum Joist Spans ( $L_j$ )**

Maximum Joist Spans ( $L_j$ )		Joist Spacing (o.c.)					
Species	Size	Without Overhangs <sup>1</sup>			With Overhangs up to $L_j/4$ <sup>4</sup>		
		12"	16"	24"	12"	16"	24"
Southern Pine	2x8	13'-8"	12'-5"	10'-2"	10'-9"	10'-9"	10'-2"
	2x10	17'-8"	15'-10"	13'-1"	15'-6"	15'-6"	13'-1"
	2x12	18'-0"	18'-0"	15'-5"	18'-0"	18'-0"	15'-5"
Douglas Fir-Larch, Hem-Fir, SPF <sup>2</sup>	2x8	12'-6"	11'-1"	9'-1"	9'-5"	9'-5"	9'-1"
	2x10	15'-8"	13'-7"	11'-1"	13'-7"	13'-7"	11'-1"
	2x12	18'-0"	15'-9"	12'-10"	18'-0"	15'-9"	12'-10"
Redwood, Western Cedars, Ponderosa Pine <sup>3</sup> , Red Pine <sup>4</sup>	2x8	11'-8"	10'-7"	8'-8"	8'-6"	8'-6"	8'-6"
	2x10	14'-11"	13'-0"	10'-7"	12'-3"	12'-3"	10'-7"
	2x12	17'-5"	15'-1"	12'-4"	16'-5"	15'-1"	12'-4"

1. Assumes 40 psf live load, 10 psf dead load, L/360 deflection, No. 2 grade, and wet service conditions. See Figure 1B.

2. Assumes 40 psf live load, 10 psf dead load, L/180 camber-deflection with 200 lb point load, No. 2 grade, and wet service conditions. See Figure 1A, and Figure 2.

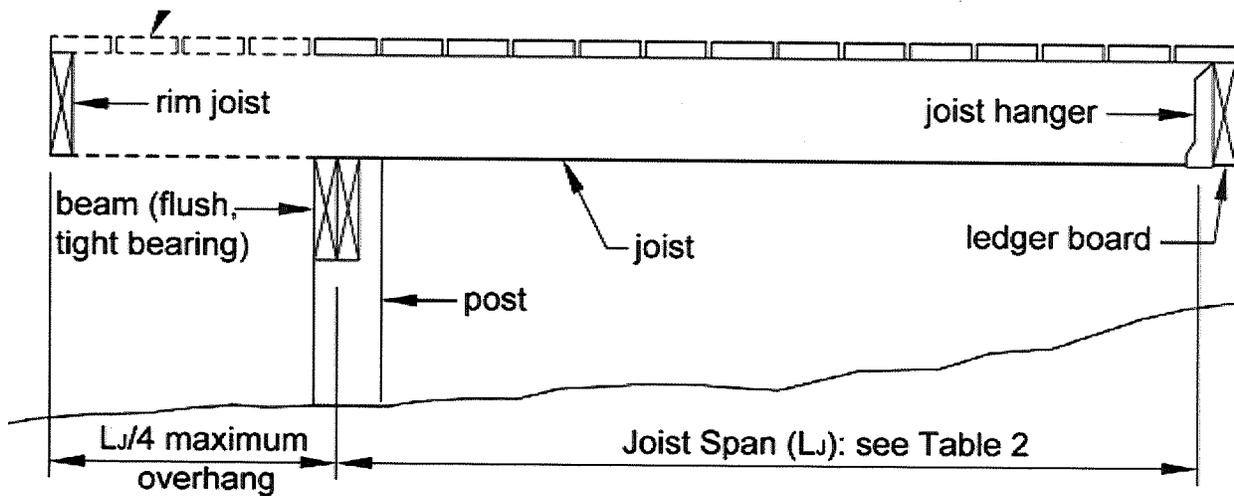
3. Trussing assumed for refractory species including Douglas fir-larch, hem-fir, and spruce-pine-fir.

4. Design values based on northern species with no trussing assumed.

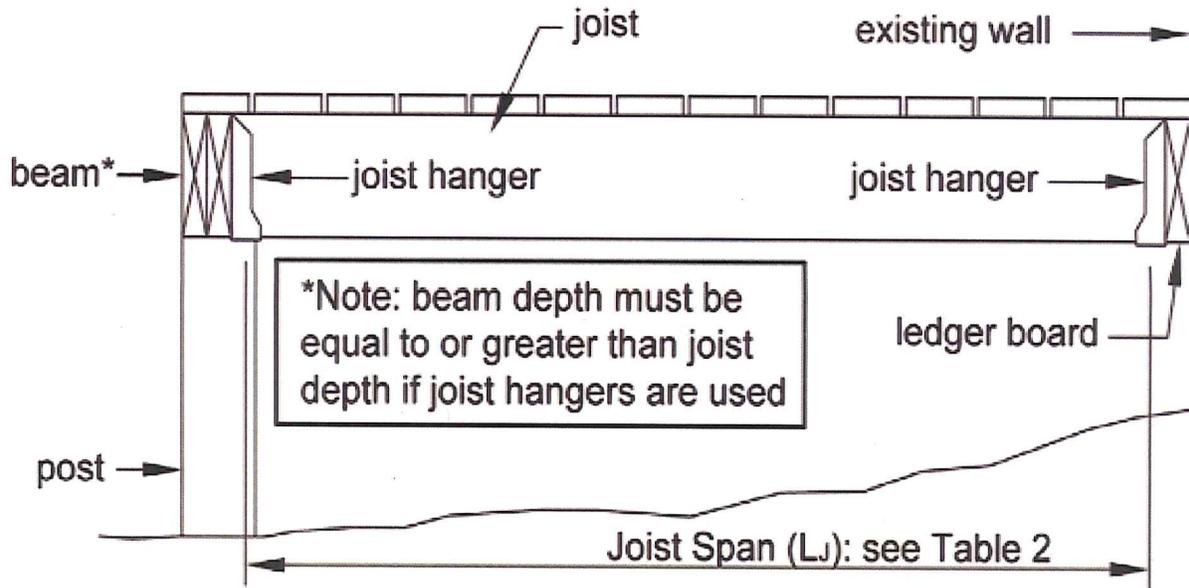
## Typical Deck Framing

### Side View

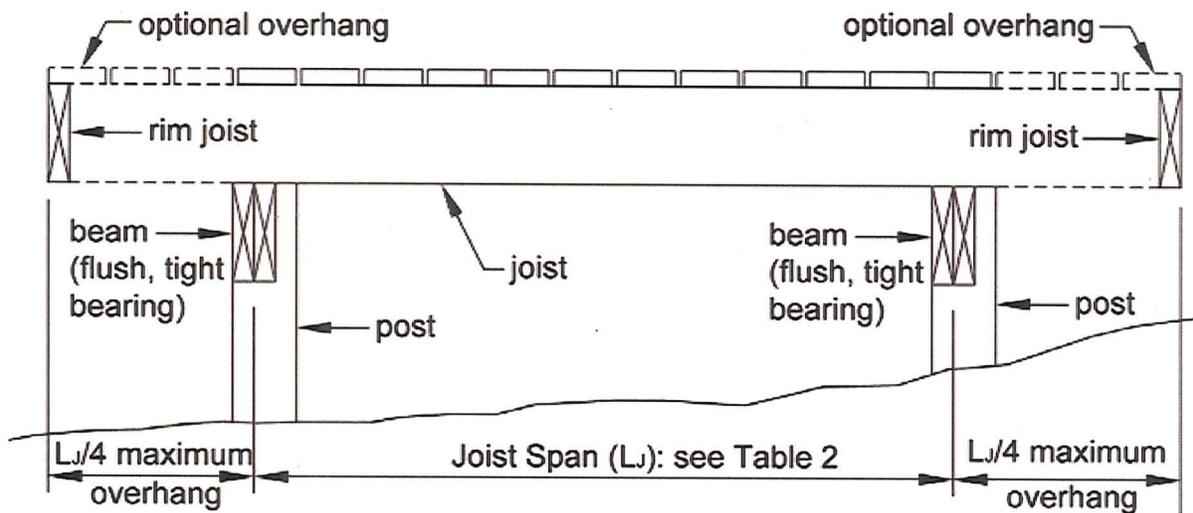
**Figure 1 Joist Span-Deck Attached at House and Bearing Over Beam**



**Figure 2 Joist Span-Joists Attached at House and to Side of Beam**



**Figure 3 Joist Span-Free Standing Deck**



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## Main Beam Sizing and Assembly

The main deck beam shall be sized according with Table 2 below. The main beam can extend past the post centerline up to  $L_B/4$  as shown in Figure 2. Joists may bear on the beam and extend past the beam centerline up to  $L_J/4$  as shown in Figures 1 and 3. The joists may attach to the side of the beam with joist hangers as shown in Figure 2.

**Table 2 Deck Beam Spans ( $L_B$ )<sup>1</sup> for Joist Framing from One Side Only.**  
 (Assumes 40 #/ft<sup>2</sup> live load and 10#/ft<sup>2</sup> dead load with a simple span beam deflection limit of  $L/360$  and an  $L/180$  cantilever deflection limit.)

<b>Deck Beam Spans (<math>L_B</math>)<sup>1</sup> for Joists Framing from One Side Only</b>		<b>Joist Spans (<math>L_J</math>) Less Than or Equal to:</b>						
<b>Species</b>	<b>Size<sup>4</sup></b>	<b>6'</b>	<b>8'</b>	<b>10'</b>	<b>12'</b>	<b>14'</b>	<b>16'</b>	<b>18'</b>
<b>Southern Pine</b>	<b>2-2x6</b>	7' - 1"	6' - 2"	5' - 6"	5' - 0"	4' - 8"	4' - 4"	4' - 1"
	<b>2-2x8</b>	9' - 2"	7' - 11"	7' - 1"	6' - 6"	6' - 0"	5' - 7"	5' - 3"
	<b>2-2x10</b>	11' - 10"	10' - 3"	9' - 2"	8' - 5"	7' - 9"	7' - 3"	6' - 10"
	<b>2-2x12</b>	13' - 11"	12' - 0"	10' - 9"	9' - 10"	9' - 1"	8' - 6"	8' - 0"
	<b>3-2x6</b>	8' - 7"	7' - 8"	6' - 11"	6' - 3"	5' - 10"	5' - 5"	5' - 2"
	<b>3-2x8</b>	11' - 4"	9' - 11"	8' - 11"	8' - 1"	7' - 6"	7' - 0"	6' - 7"
	<b>3-2x10</b>	14' - 5"	12' - 10"	11' - 6"	10' - 6"	9' - 9"	9' - 1"	8' - 7"
	<b>3-2x12</b>	17' - 5"	15' - 1"	13' - 6"	12' - 4"	11' - 5"	10' - 8"	10' - 1"
<b>Douglas Fir-Larch<sup>2</sup>, Hem-Fir<sup>2</sup>, SPF<sup>2</sup>, Redwood, Western Cedars, Ponderosa Pine<sup>3</sup>, Red Pine<sup>3</sup></b>	<b>3x6 or 2-2x6</b>	5' - 5"	4' - 8"	4' - 2"	3' - 10"	3' - 6"	3' - 1"	2' - 9"
	<b>3x8 or 2-2x8</b>	6' - 10"	5' - 11"	5' - 4"	4' - 10"	4' - 6"	4' - 1"	3' - 8"
	<b>3x10 or 2-2x10</b>	8' - 4"	7' - 3"	6' - 6"	5' - 11"	5' - 6"	5' - 1"	4' - 8"
	<b>3x12 or 2-2x12</b>	9' - 8"	8' - 5"	7' - 6"	6' - 10"	6' - 4"	5' - 11"	5' - 7"
	<b>4x6</b>	6' - 5"	5' - 6"	4' - 11"	4' - 6"	4' - 2"	3' - 11"	3' - 8"
	<b>4x8</b>	8' - 5"	7' - 3"	6' - 6"	5' - 11"	5' - 6"	5' - 2"	4' - 10"
	<b>4x10</b>	9' - 11"	8' - 7"	7' - 8"	7' - 0"	6' - 6"	6' - 1"	5' - 8"
	<b>4x12</b>	11' - 5"	9' - 11"	8' - 10"	8' - 1"	7' - 6"	7' - 0"	6' - 7"
<b>3-2x6</b>	7' - 4"	6' - 8"	6' - 0"	5' - 6"	5' - 1"	4' - 9"	4' - 6"	
<b>3-2x8</b>	9' - 8"	8' - 6"	7' - 7"	6' - 11"	6' - 5"	6' - 0"	5' - 8"	
<b>3-2x10</b>	12' - 0"	10' - 5"	9' - 4"	8' - 5"	7' - 10"	7' - 4"	6' - 11"	
<b>3-2x12</b>	13' - 11"	12' - 1"	10' - 9"	9' - 10"	9' - 1"	8' - 6"	8' - 1"	

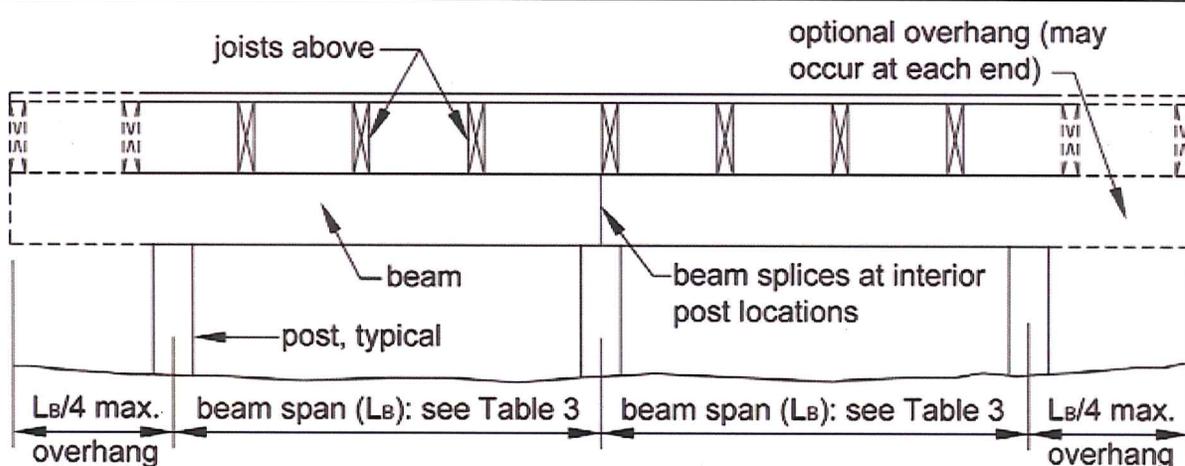
1 Assumes 40 psf live load, 10 psf dead load,  $L/360$  simple span beam deflection limit,  $L/180$  cantilever deflection limit, No. 2 grade, and wet service conditions.

2 Incising assumed for refractory species including Douglas fir-larch, hem-fir, and spruce-pine-fir.

3 Design values based on northern species with no incising assumed.

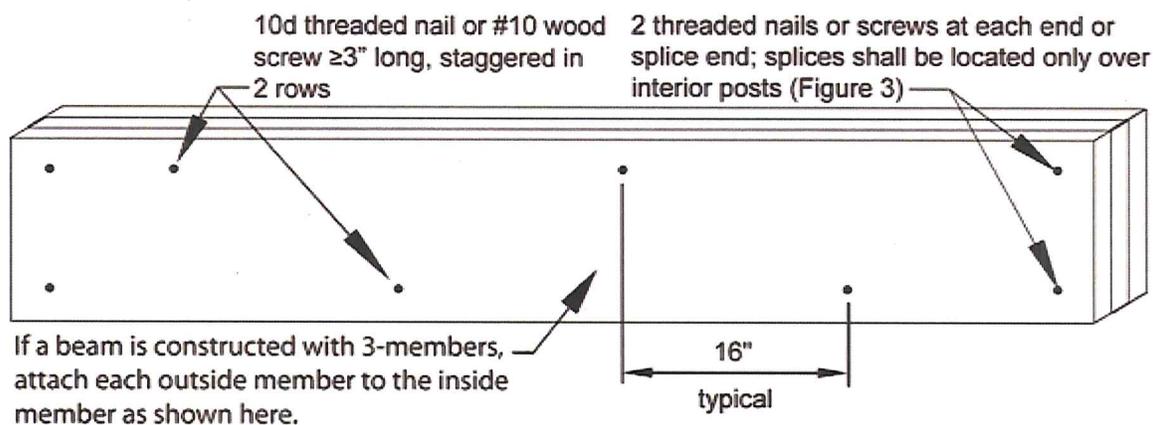
4 Beam depth must be equal to or greater than joist depth if joist hangers are used (see Figure 6, Option 3)

**Figure 4 Beam Span Types**



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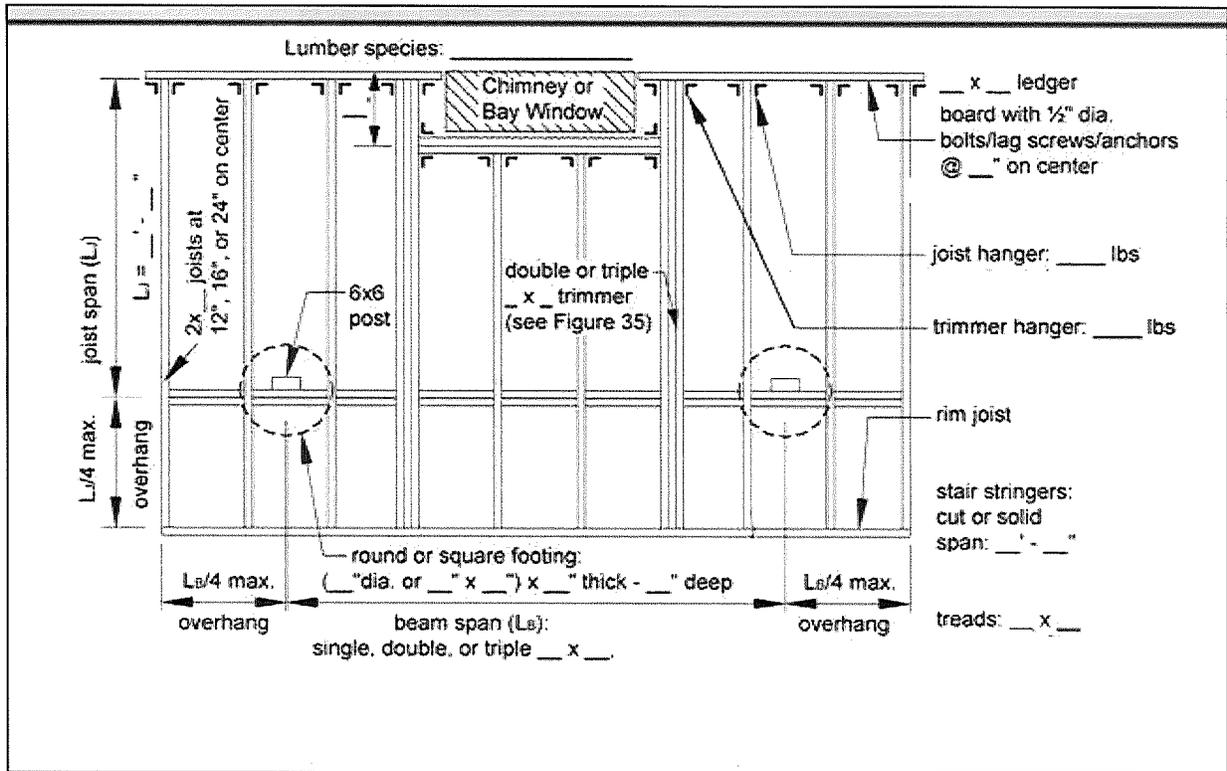
**Figure 5 Beam Assembly Details**



## Deck Framing Plan

Two copies of a deck framing plan are required for the building permit application. The plan shows the layout of the joists, beams, posts, ledger board, and footings. It also shows the type, size, and spacing of the ledger board fasteners. Figure 6 below is an example of a typical deck framing plan.

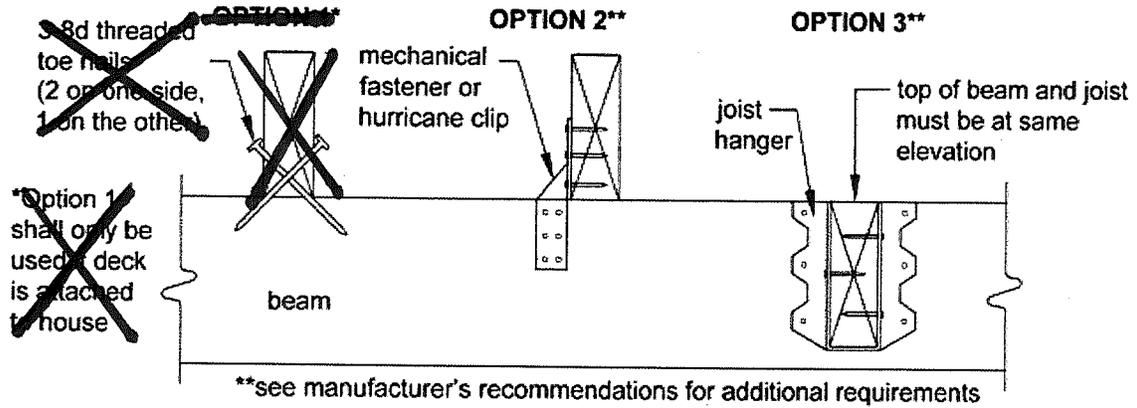
Figure 6



## Joist to Beam Connections

Each joist shall be attached to the beam as shown below in Figure 7. The joists may overhang past the beam a maximum of  $L_j/4$ . The mechanical fasteners in Option 2 must have a minimum capacity of 100 lbs in both uplift and lateral load directions. The joists may also attach to the side of the beam with joist hangers per Option 3. Joists shall not attach from opposite sides of the same beam without specific engineering.

**Figure 7 Joist to Beam Detail**

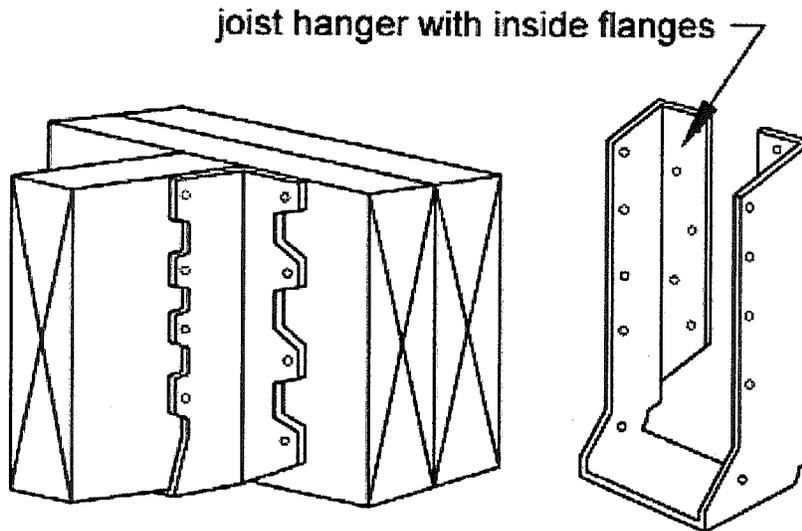


**Joist Hangers**

Joist hangers shown in Figure 8 shall have the download capacity as listed below. Joist hangers shall be galvanized or stainless steel. Use joist hangers with inside flanges when clearances to the edge of ledger board or beam dictate. Bending of joist hangers to accomplish this is not permitted. Clip angles or brackets are not allowed to support joists

Joist Hanger Size	Capacity
2" x 8"	600 lbs
2" x 10"	700 lbs
2" x 12"	800 lbs

**Figure 8 Typical Joist Hangers**



## Post-Beam Connections (typical)

### Post Requirements

All deck posts (for decks higher than 48" above the ground) shall be 6" x 6" nominal or larger. The maximum height above grade is limited to 14'-0" as measured to the under side of the main beam. The posts shall be centered on the footings (see Figure 13 for typical installations). Cut ends of post shall be field treated with an approved preservative per IRC 2009 [R402.1.2]. For 6" x 6" posts, the beam shall be attached to the post by notching the 6" x 6" post as shown in Figure 9 or by providing an approved post cap to connect the beam. And post as shown in Figure 11. Three ply beams shall be connected to posts with a post cap. **All through bolts shall have washers under the bolt head and nut.** Attachment of the beam to the side of the post without notching is prohibited (see Figure 10). For 4" x 4" posts, the beam shall be attached using an approved post cap.

Figure 9 Post to Beam Attachment.

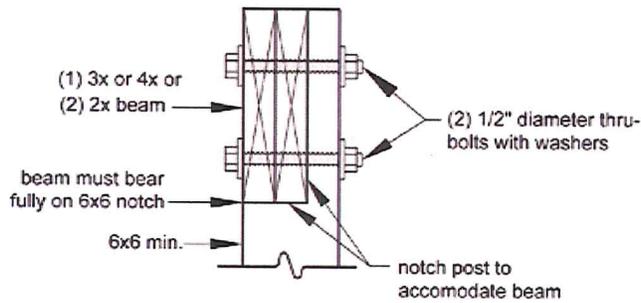


Figure 10 Prohibited Attachment.

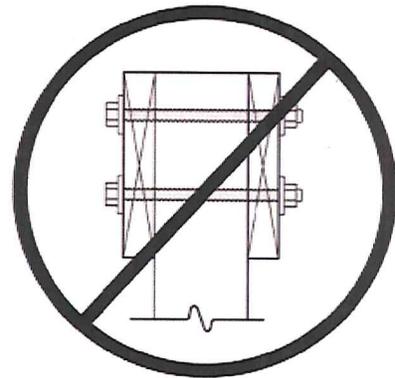
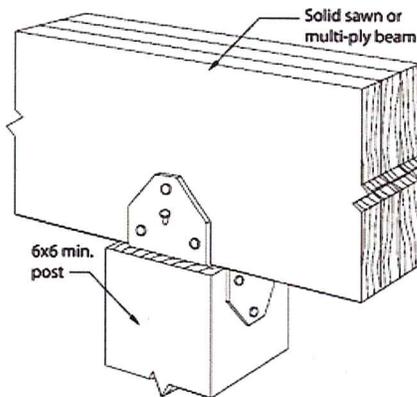
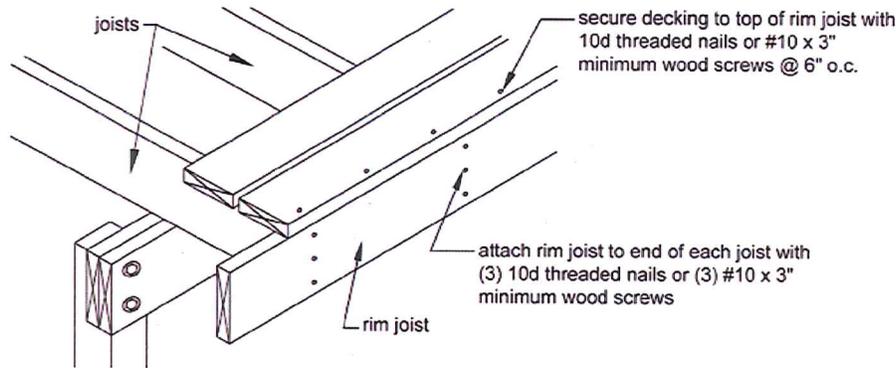


Figure 11 Alternate Post to Beam Connection with Approved Post Cap



## Rim Joist Requirements

A continuous rim joist must be attached to the ends of the deck floor joists as shown below in Figure 12.

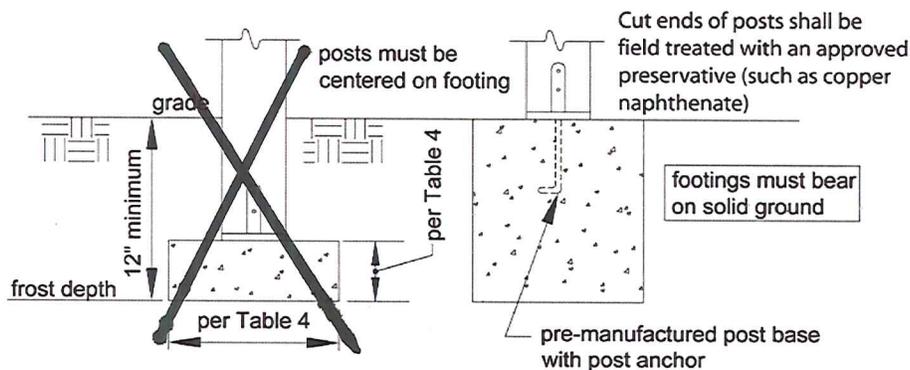


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## Footing Requirements

Decks that are attached to the house are required to have footings that extend below the frost line (36" below grade in City of Allentown). The footing shall bear on solid ground and be verified in the field by the building inspector prior to the placement of concrete. Concrete must have a minimum 2500 psi compressive strength. The size of the footings varies soil bearing capacity, the span of the deck, and the distances between the support posts. The minimum diameter for a deck footing is 12". There must be a minimum of 6" of concrete under the posts. The building inspector will approve the footing designs on a case by case basis as it is impossible to detail a prescriptive size for all cases. See Figure 13 for typical options. Sono tubes are an option but not required, wooden posts cannot be buried in the ground or concrete.

### Figure 13 Typical Footing Options



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## Ledger Attachment Requirements [R502.2.2]

**General Requirements:** Attach the ledger board to the residence in accordance with Figures 16, 17, and 18. The ledger board shall be equal to or greater in depth than the deck floor joists. The band joist of the existing residence must be capable of supporting the new deck. If this cannot be verified or construction of the house is different than Figures 16, 17, or 18, then either a free standing deck or an engineered deck design is required. For Manufactured Wood Truss Systems (open web floor trusses see Figure 15) refer to the WTCA Technical Note - *Attachment of Residential Decks to Wood Truss Floor Systems* for special blocking details and attachment requirements ([www.sbcindustry.com](http://www.sbcindustry.com)). Homes with Manufactured Wood I-Joists (see Figure 14) have band joists that may be 1" or thicker engineered wood products (EWP) such as oriented strand board (OSB) or structural composite lumber (SCL) including laminated veneer lumber (LVL). These rim boards must be 1" or thicker to support a new deck.

Figure 14. Wood I-Joist

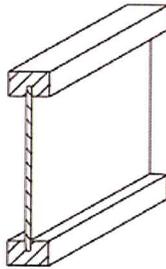
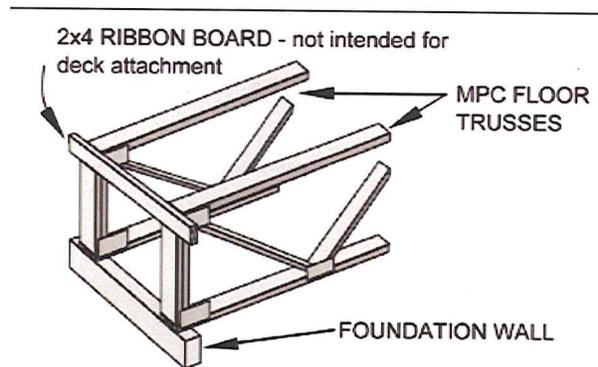
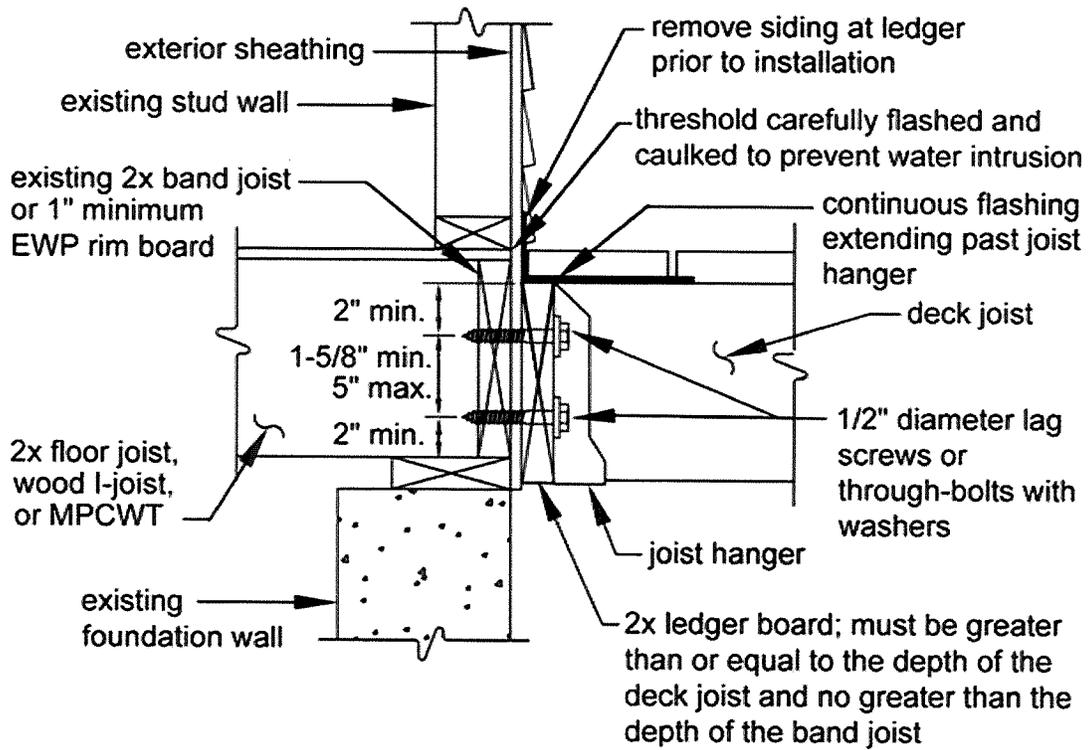


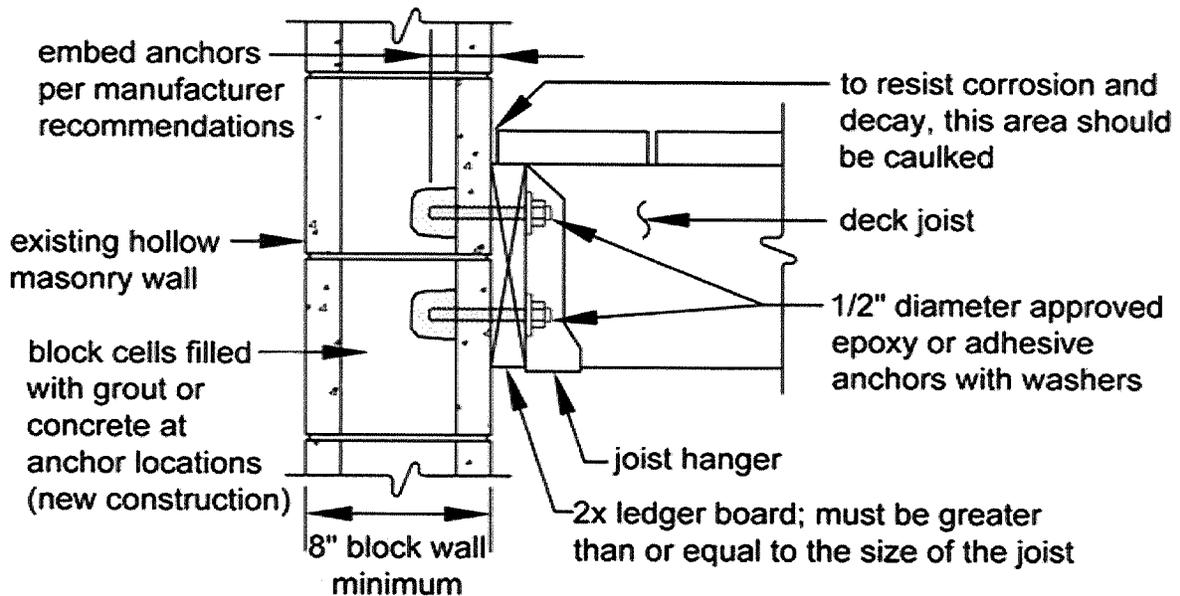
Figure 15 MPCWFT (Metal Plate Connected Wood Floor Truss)



**Figure 16 General Attachment of Ledger Board to Rim Board**

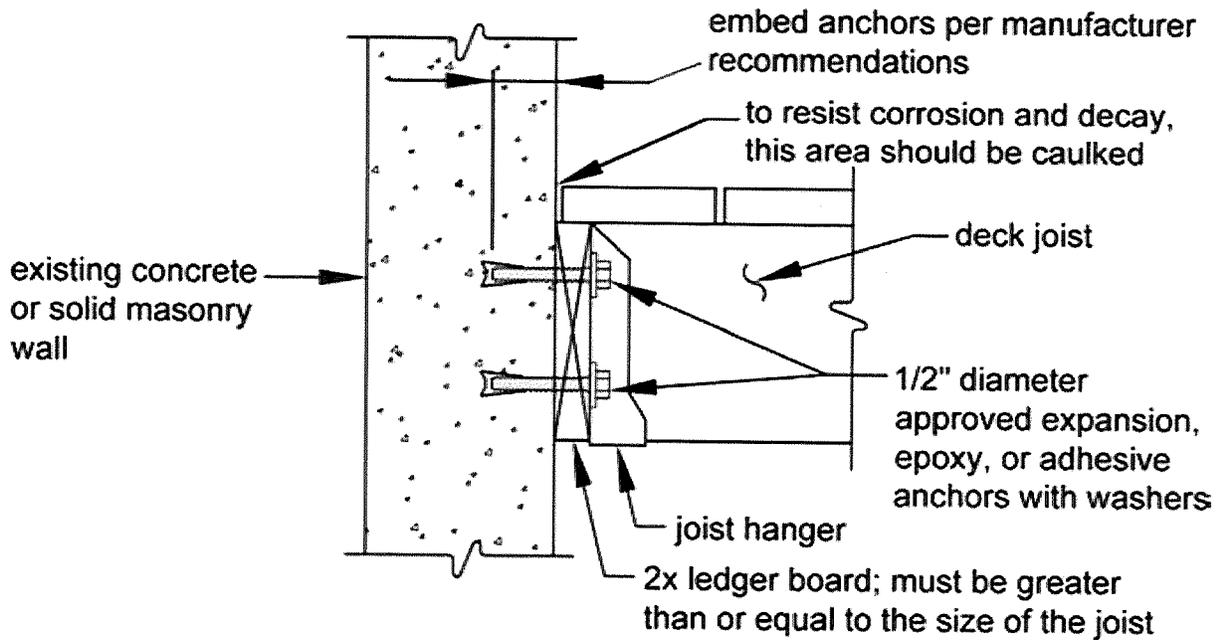


**Figure 17 Attachment of Ledger Board to Hollow Masonry Wall**



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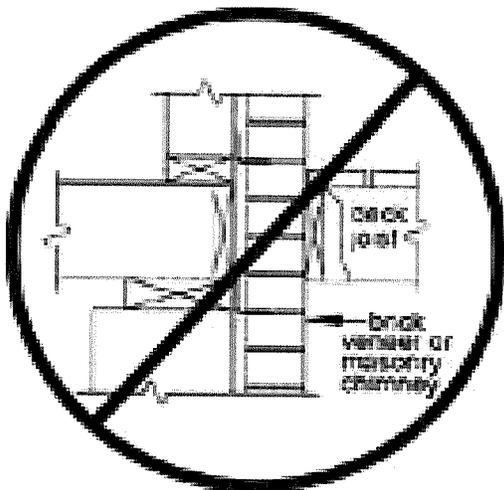
**Figure 18 Attachment of Ledger to Concrete or Solid Masonry Wall**



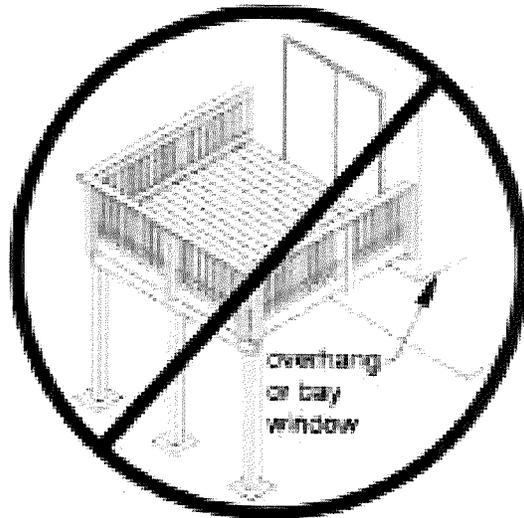
**Prohibited Ledger Attachments**

Attachments to exterior brick, masonry, or stone veneers and to cantilevered floor overhangs or bay windows are prohibited. See Figures 19 and 20. In such cases the deck shall be free standing.

**Figure 19 No Attachment to Veneers**



**Figure 20 No Attachment to Floor Overhang**



## Ledger Board Fasteners and Deck Ledger Connection to Band Joist

The connection between a deck ledger board and a 2” (1-1/2” actual) nominal solid sawn lumber band joist or EWP rim board bearing on a sill plate or a wall plate shall be made with 1/2” lag screws or bolts with washers per Table 4 and Figure 21. Only the fasteners listed below are acceptable. Lead anchors are not allowed.

**Table 4 Fastener Spacing for a Southern Pine, Douglas Fir-larch, or Hem-Fir Deck Ledger and a 2” Nominal Solid sawn Spruce-Pine-Fir<sup>7,9</sup> Band Joist or EWP Rim Board<sup>6</sup> (Deck Live Load = 40 psf, Deck Dead Load = 10 psf)<sup>3,6</sup>**

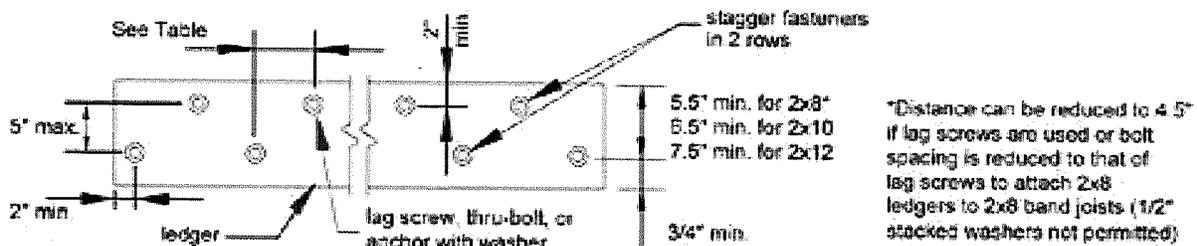
Joist Span	Rim Board or Band Joist	6'-0" and less	6'-1" to 8'-0"	8'-1" to 10'-0"	10'-1" to 12'-0"	12'-1" to 14'-0"	14'-1" to 16'-0"	16'-1" to 18'-0"
<b>Connection Details</b>		<b>On-Center Spacing of Fasteners<sup>1,2</sup></b>						
1/2" diameter lag screw with 1 1/2" maximum sheathing <sup>1</sup>	1" EWP <sup>6</sup>	24"	18"	14"	12"	10"	9"	8"
	1-1/8" EWP <sup>6</sup>	28"	21"	16"	14"	12"	10"	9"
	1-1/2" Lumber <sup>7,9</sup>	30"	23"	18"	15"	13"	11"	10"
1/2" diameter bolt with 1 1/2" maximum sheathing	1" EWP <sup>6</sup>	24"	18"	14"	12"	10"	9"	8"
	1-1/8" EWP <sup>6</sup>	28"	21"	16"	14"	12"	10"	9"
	1-1/2" Lumber <sup>7,9</sup>	36"	36"	34"	29"	24"	21"	19"
1/2" diameter bolt with 1 1/2" maximum sheathing and 1/2" stacked washers <sup>2,3</sup>	1" EWP <sup>6</sup>	24"	18"	14"	12"	10"	9"	8"
	1-1/8" EWP <sup>6</sup>	28"	21"	16"	14"	12"	10"	9"
	1-1/2" Lumber <sup>7,9</sup>	36"	36"	29"	24"	21"	18"	16"

- <sup>1</sup> The tip of the lag screw shall fully extend beyond the inside face of the band joist.
- <sup>2</sup> The maximum gap between the face of the ledger board and face of the wall sheathing shall be 1/2".
- <sup>3</sup> Ledgers shall be flashed or caulked to prevent water from contacting the house band joist (see Figures 14, 15, and 16).
- <sup>4</sup> Lag screws and bolts shall be staggered per Figure 19.
- <sup>5</sup> Deck ledgers shall be maximum 2x8 pressure-preservative-treated No.2 grade lumber, or other approved materials as established by standard engineering practice.
- <sup>6</sup> When solid-sawn pressure-preservative-treated deck ledgers are attached to engineered wood products (minimum 1" thick wood structural panel band joist or structural composite lumber including laminated veneer lumber), the ledger attachment shall be designed in accordance with accepted engineering practice. Tabulated values based on 300 lbs and 350 lbs for 1" and 1-1/8" EWP rim board, respectively.
- <sup>7</sup> A minimum 1"x9 1/2" Douglas fir-larch laminated veneer lumber rim board shall be permitted in lieu of the 2" nominal band joist.
- <sup>8</sup> Wood structural panel sheathing, gypsum board sheathing, or foam sheathing not exceeding one inch thickness shall be permitted. The maximum distance between the face of the ledger board and the face of the band joist shall be one inch.
- <sup>9</sup> Fastener spacing also applies to southern pine, Douglas fir-larch, and hem-fir band joists.

## Placement of Lag Screws or Through Bolts in Deck Ledger Boards

Lag screws or bolts shall be placed as shown in Figure 21. They shall be staggered from top to the bottom along the horizontal run of the deck ledger.

**Figure 21 Ledger Board Fastener Spacing and Clearances**



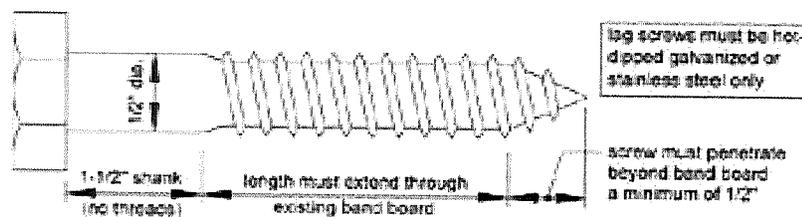
**Thru Bolts.** Thru bolts shall have a diameter of  $\frac{1}{2}$ " Pilot holes for thru bolts shall be  $\frac{17}{32}$ " to  $\frac{9}{16}$ " in diameter. Thru bolts require washers at the bolt head and nut.

**Expansion and Adhesive Anchors.** When attaching ledger boards to a concrete or solid masonry wall as shown in Figure 17 or a hollow masonry wall with fully grouted cell as shown in Figure 18, use approved expansion or adhesive anchors. These anchor bolts must have a diameter of  $\frac{1}{2}$ " and installed per the manufacturer's instructions. The anchors must have washers on the bolt head end.

**Lag Screws.** Lag screws shall have a diameter of  $\frac{1}{2}$ ". Lag screws may be used when the construction method is in accordance with Figure 16. All lag screws shall have washers at the bolt head end.

**Installation of Lag Screws:** Each lag screw shall have pilot holes drilled as follows. First drill a  $\frac{1}{2}$ " hole in the ledger board. Second drill a  $\frac{5}{16}$ " diameter hole into the house band joist. Do not drive lag screws with a hammer. The threaded portion of the lag screw shall be inserted by turning. Do not over tighten to the point of crushing the wood fibers.

### Figure 22 Lag Screw Requirement



**Lag screw installation requirements:** Each lag screw shall have pilot holes drilled as follows: 1) Drill a  $\frac{1}{2}$ " diameter hole in the ledger board. 2) Drill a  $\frac{5}{16}$ " diameter hole into the band board of the existing house. **DO NOT DRILL A  $\frac{1}{2}$ " DIAMETER HOLE INTO THE BAND BOARD.**

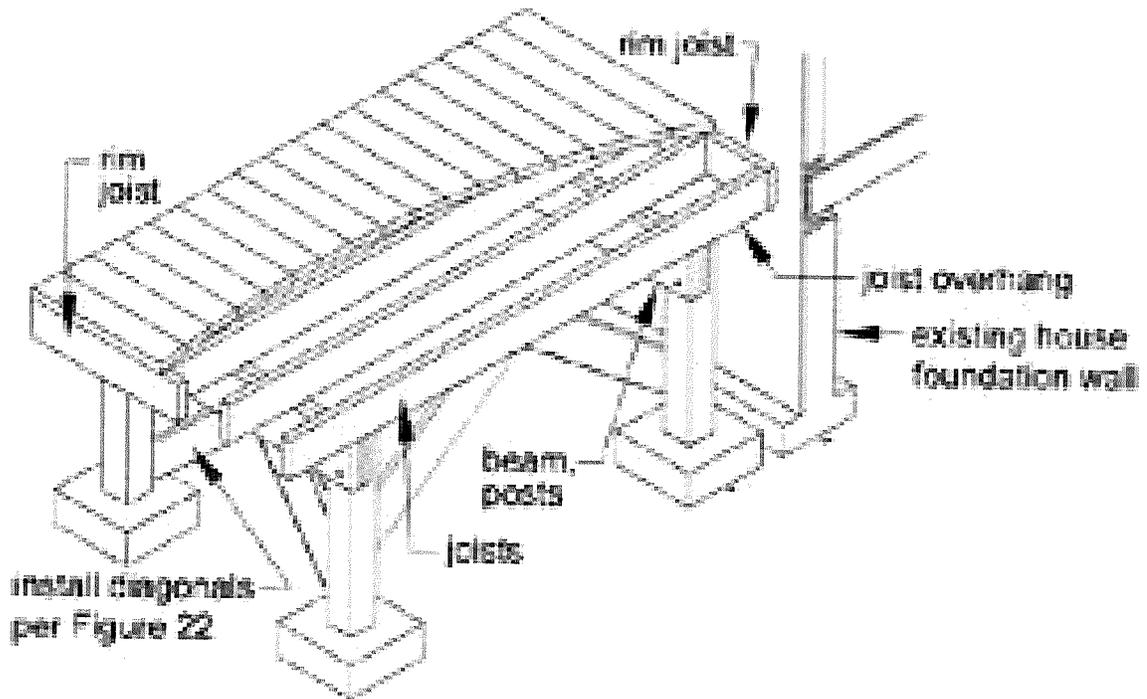
The threaded portion of the lag screw shall be inserted into the pilot hole by turning. **DO NOT DRIVE LAG SCREWS WITH A HAMMER.** Use soap or a wood-compatible lubricant as required to facilitate tightening. Each lag screw shall be thoroughly tightened (snug but not over-tightened to avoid wood damage).

### Free Standing Decks

When certain conditions exist, a free standing deck may be a viable solution. These conditions may be existing cantilevered floor systems, hollow block walls, or framing with rim joists less than 1' thick. Free standing decks do not utilize the exterior wall of the existing house to support vertical or lateral loads. An additional beam and post configuration is used within  $L/4$  of the existing house.

**Footing Requirements for Free Standing Decks not attached to house.** [R403.1.4] All exterior footings shall be placed at least 12" below the undisturbed ground surface. [R403.1.4.1 Exception 3] Decks not supported by a dwelling need not be provided with footings that extend below the frost line.

### **Figure 23 Free Standing Deck Example**

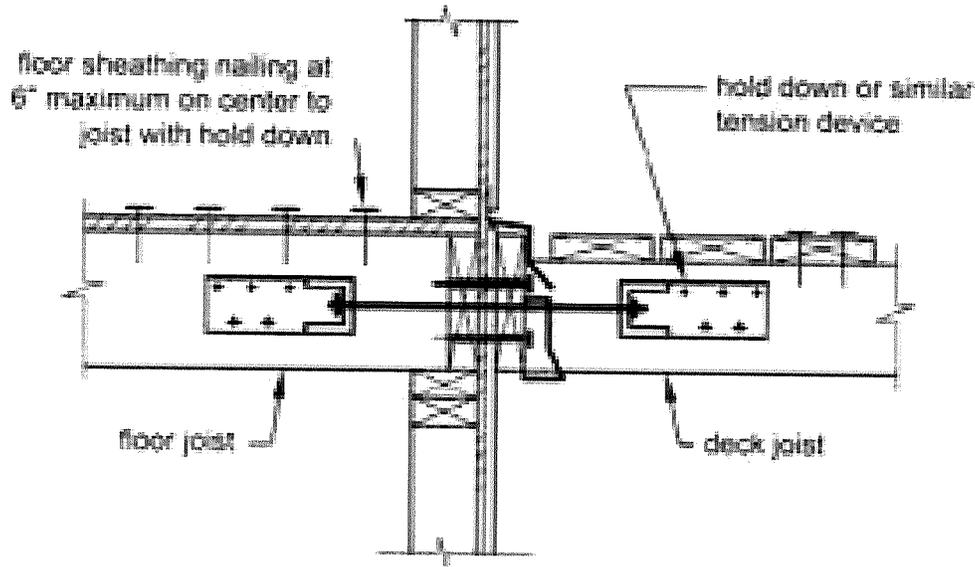


**Note: It is the responsibility of the deck builder to ensure the positive connection of the deck ledger to the existing building. It is the responsibility of the homeowner to maintain the deck in good condition. The homeowner should inspect the deck annually for the integrity of all fasteners and structural members.**

## Satisfying Lateral Load Requirements

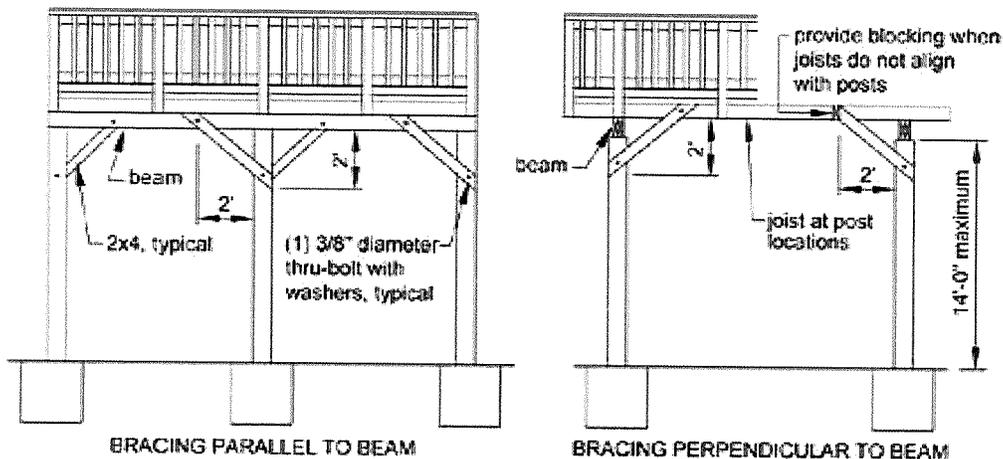
The lateral load connection in Figure R502.2.2.3 (IRC 2009) will satisfy the code requirement for any seismic or wind zone in the United States. There are acceptable alternatives for this area. For decks higher than 30 inches above grade, properly installed diagonal bracing will, in most cases, satisfy the lateral load support requirements. See the illustrations below for some examples that may be used.

**Figure 24** IRC 2009 Figure 502.2.2.3



\*This figure was taken directly from the FEMA Home Builder's Guide to Seismic Resistant Construction (FEMA 232). This guide refers to this device as an "above code recommendation".

**Figure 25** Examples of other ways of satisfying lateral loads.



## Applicable Deck Code Sections IRC 2009

**1. R502.2.2 Decks.** Where supported by attachment to an exterior wall, decks shall be positively anchored to the primary structure and designed for **both vertical and lateral loads** as applicable. Such attachments shall not be accomplished by the use of toenails or nails subject to withdrawal. Where positive connection to the primary building structure cannot be verified during inspection, decks **shall be self-supporting**. For decks with cantilevered framing members, connections to exterior walls or other framing members, shall be designed and constructed to resist uplift resulting from the full live load specified in Table R301.5 (40 lbs/square foot) acting on the cantilevered portion of the deck.

**2. R502.2.2.1 Deck ledger connection to band joist.** For decks supporting a total design (vertical) load of 50 pounds per square foot (40 pounds per square foot live load plus 10 pounds per square foot dead load), the connection between a deck ledger of pressure-treated Southern Pine, incised pressure-preservative-treated Hem Fir, or approved decay resistant species, and a 2 inch nominal lumber band joist bearing on a sill plate or a wall plate shall be constructed with 1/2-inch lag screws or bolts with washers in accordance with Table R502.2.2.1. Lag screws, bolts and washers shall be hot-dipped galvanized or stainless steel.

**3. R502.2.2.1.1 Placement of lag screws or bolts in deck ledgers.** The lag screws or bolts shall be placed 2 inches in from the bottom or top of the ledgers and between 2 and 5 inches in from the ends. The lag screws or bolts shall be staggered from the top to the bottom along the horizontal run of the deck ledger. (See Figure 21).

**4. R502.2.2.2 Alternate deck ledger connections.** Deck ledger connections not conforming to Table R502.2.2.1 shall be designed in accordance with accepted engineering practice. Girders supporting deck joists shall not be supported on ledgers or band joists. Deck ledgers shall not be supported on stone or masonry veneer.

**TABLE R502.2.2.1  
FASTENER SPACING FOR A SOUTHERN PINE OR HEM-FIR DECK LEDGER  
AND A 2-INCH NOMINAL SOLID-SAWN SPRUCE-PINE-FIR BAND JOIST<sup>a, b</sup>  
(Deck live load = 40 psf, deck dead load = 10 psf)**

JOIST SPAN	6' and less	6'1" to 8'	8'1" to 10'	10'1" to 12'	12'1" to 14'	14'1" to 16'	16'1" to 18'
<b>Connection details</b>	<b>On-center spacing of fasteners<sup>d, e</sup></b>						
1/2 inch diameter lag screw with 15/32 inch maximum sheathing <sup>a</sup>	30	23	18	15	13	11	10
1/2 inch diameter bolt with 15/32 inch maximum sheathing	36	36	34	29	24	21	19
1/2 inch diameter bolt with 15/32 inch maximum sheathing and 1/2 inch stacked washers <sup>b, h</sup>	36	36	29	24	21	18	16

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479kPa.

- a. The tip of the lag screw shall fully extend beyond the inside face of the band joist.
- b. The maximum gap between the face of the ledger board and face of the wall sheathing shall be 1/2".
- c. Ledgers shall be flashed to prevent water from contacting the house band joist.
- d. Lag screws and bolts shall be staggered in accordance with Section R502.2.2.1.1.
- e. Deck ledger shall be minimum 2 x 8 pressure-preservative-treated No.2 grade lumber, or other approved materials as established by standard engineering practice.
- f. When solid-sawn pressure-preservative-treated deck ledgers are attached to a minimum 1 inch thick engineered wood product (structural composite lumber, laminated veneer lumber or wood structural panel band joist), the ledger attachment shall be designed in accordance with accepted engineering practice.
- g. A minimum 1 x 9/2 Douglas Fir laminated veneer lumber rimboard shall be permitted in lieu of the 2-inch nominal band joist.
- h. Wood structural panel sheathing, gypsum board sheathing or foam sheathing not exceeding 1 inch in thickness shall be permitted. The maximum distance between the face of the ledger board and the face of the band joist shall be 1 inch.

**5. R502.2.2.3 Deck lateral load connection.** The lateral load connection required by Section R502.2.2 shall be permitted to be in accordance with Figure R502.2.2.3. Hold down tension devices shall be installed in not less than two locations per deck, and each device shall have an allowable stress design capacity of not less than 1500 pounds.

**6. R502.2.2.4 Exterior wood/plastic composite deck boards.** Wood/ plastic composite deck boards shall be installed in accordance with the manufacturer's instructions.

## Deck Railing and Guard Requirements and Miscellaneous Code References

### IRC 2009 Code Sections

- 1. R310.5 Emergency escape windows under decks and porches.** Emergency escape windows are allowed to be installed under decks and porches provided the location of the deck allows the emergency escape window to be fully opened and provides a path not less than 36" in height to a yard or court.
- 2. R311.7.1 Width (Stairways).** Stairways shall not be less than 36 inches in clear width at all points above the permitted handrail height and below the required headroom height. Handrails shall not project more than 4.5 inches on either side of the stairway and the minimum clear width of the stairway at and below the handrail height, including treads and landings, shall not be less than 31.5 inches where a handrail is installed on one side and 27 inches where handrails are installed on both sides.
- 3. ACT 13 Pennsylvania.** Stair riser maximum is 8-1/4 inches and the minimum tread width is 9 inches. (This act supersedes the IRC 2009).
- 4. R311.7.7 Handrails.** Handrails shall be provided on at least one side of each continuous run of treads or flight with four or more risers.
- 5. R311.7.7.1 Height.** Handrail height, measured vertically from the sloped plane adjoining the tread nosing, or finish surface of ramp slope, shall not be less than 34 inches and not more than 38 inches.
- 6. R312.1 Guards. Where Required.** Guards shall be located along open sided walking surfaces, including stairs, ramps, and landings that are located more than 30 inches measured vertically to the floor or grade below at any point within 36 inches horizontally to the edge of the open side. Insect screening shall not be considered a guard.
- 7. R312.2 Height.** Required guards at open sided walking surfaces, including stairs, porches, balconies, or landings shall be not less than 36 inches high measured vertically above the adjacent walking surface, adjacent fixed seating, or the line connecting the leading edges of the treads.

### **Exceptions:**

1. Guards on the open sides of stairs shall have a height not than 34 inches measured vertically from a line connecting the edges of the treads.

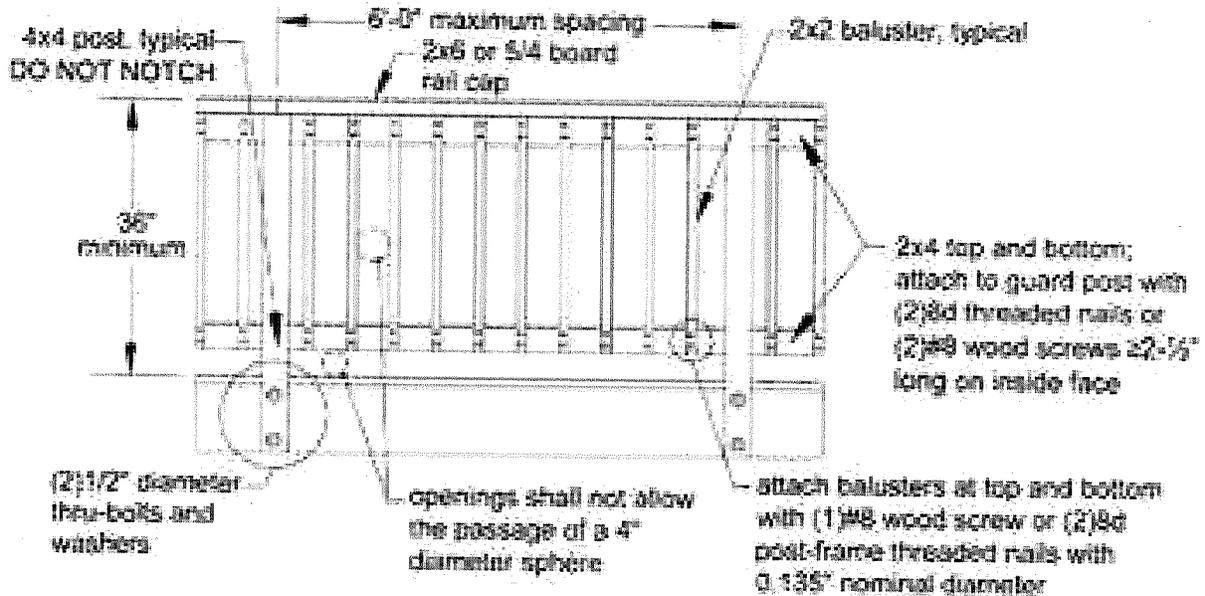
2. Where the top of the guard also serves as a handrail on the sides of stairs, the top of the guard shall not be less than 34 and not more than 38 inches measured vertically from a line connecting the leading edges of the treads.

**R312.3 Opening Limitations.** Required guards shall not have openings from the walking surface to the required guard height which allows passage of a sphere 4 inches in diameter.

**Exceptions:**

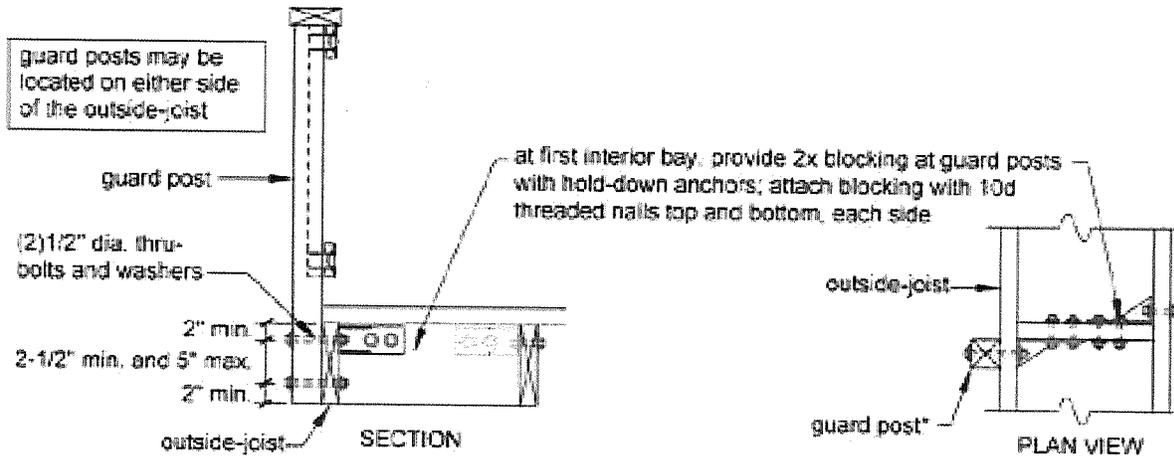
1. The triangular openings at the open side of a stair, formed by the riser, tread, and bottom rail of a guard shall not allow passage of a sphere 6 inches in diameter.
2. Guards on open sides of stairs shall not have openings which allow passage of a sphere 4-3/8 inches in diameter.

**Figure 26 Example of Deck Guard, mounting 4 x 4's to the outside of the deck rim joist and or the end joists**

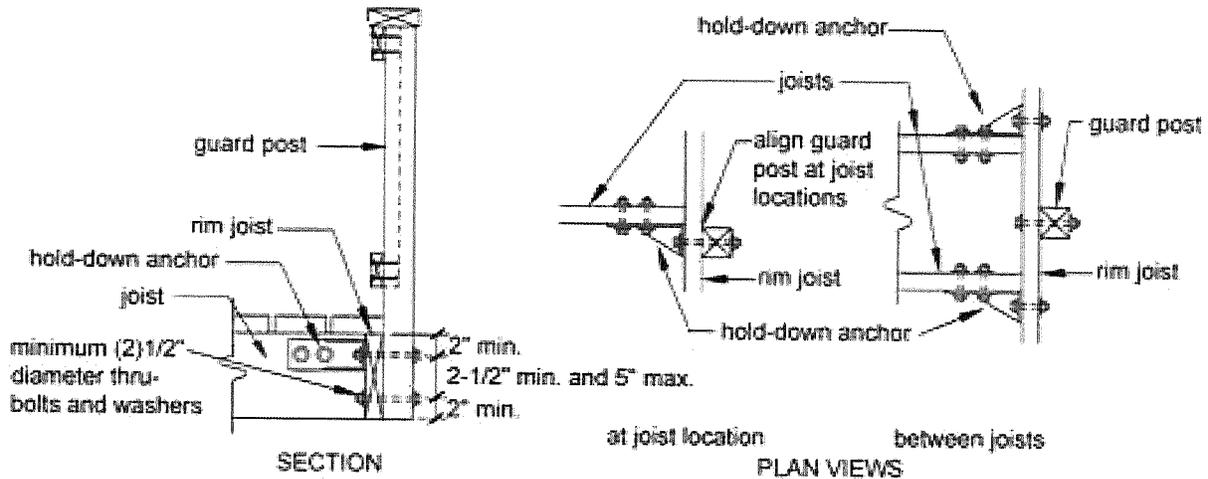


**Figure 27 Guard Post to Deck End Joist**

**DO NOT CUT OR NOTCH 4x4 POSTS USED FOR GUARD POSTS**



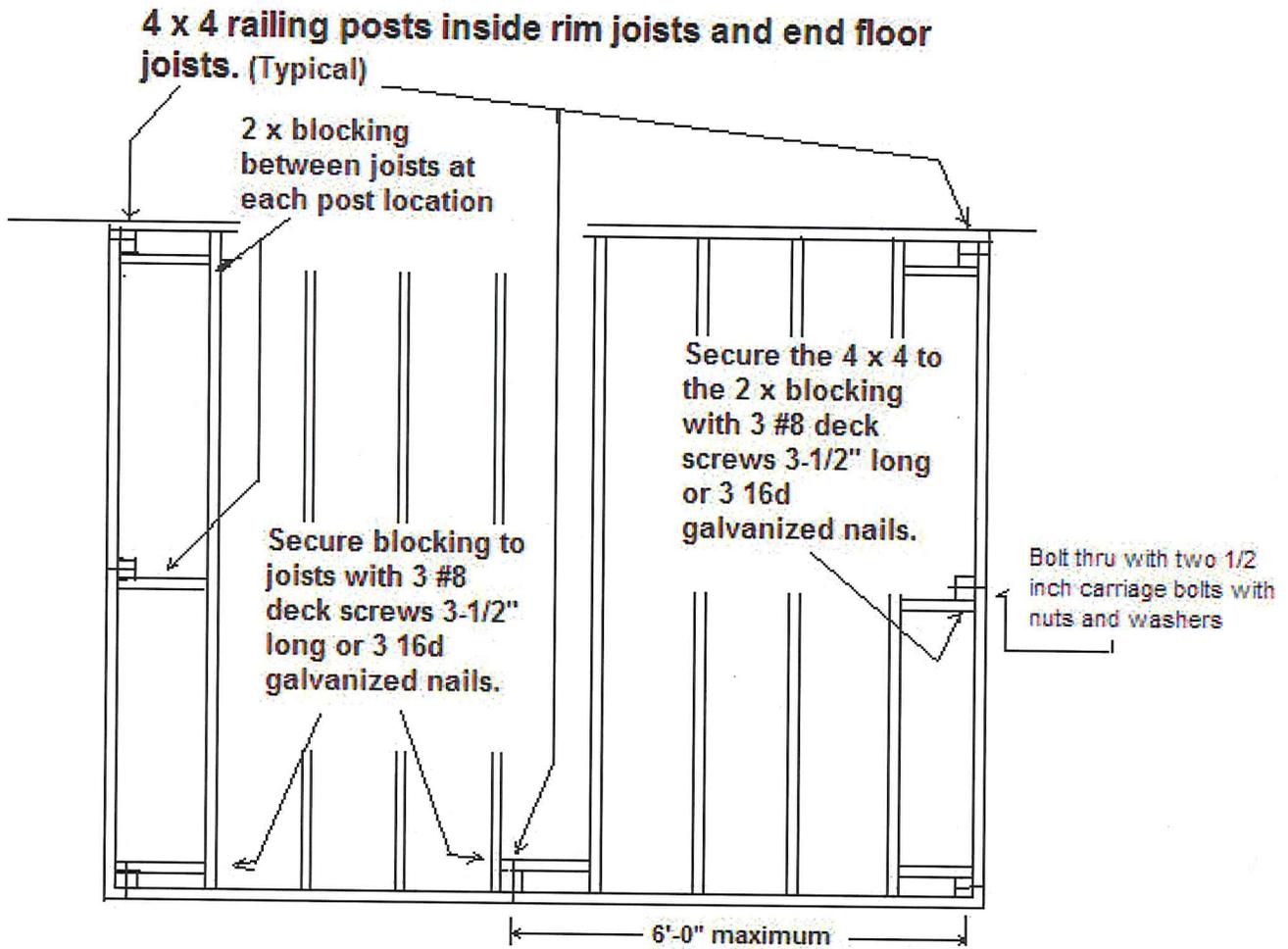
**Figure 28 Guard Post to Deck Rim Joist**



**Guard Post Attachment Comments Using the Methods In Figures 27 and 28**

All hold down anchors shall have a minimum allowable tension load of 1,800 pounds for a 36 inch maximum railing height and be installed per manufacturer’s instructions.

### Figure 29 Optional Railing Post Attachment Detail

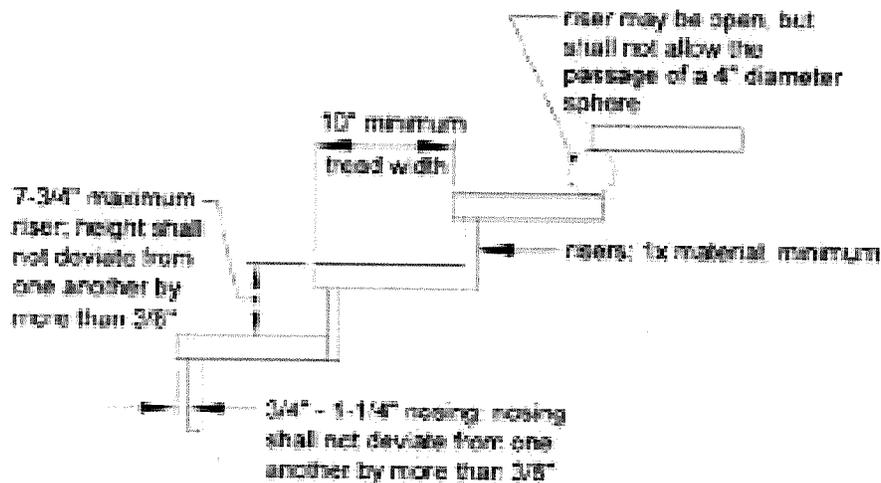


## IRC 2009 Design Loads for Railings and Guards.

**From Table R301.5.** Guard rails and handrails are required to withstand a 200 pound concentrated load applied in any direction at any point along the top. Guard rail fill in components are required to withstand a load of 50 pounds applied horizontally on an area equal to 1 square foot.

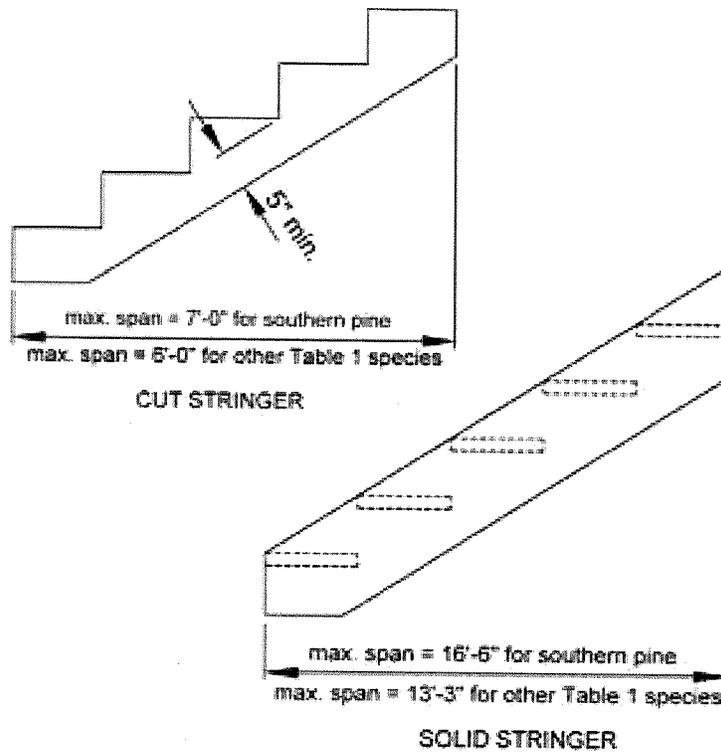
**Stairway Construction.** Stairs, stair stringers, and stair guards should meet the requirements shown in Figures 30, 31, 32, 33, 34, 35, and 36. All stringers shall be constructed from a minimum of 2 x 12 lumber. Stringers shall not span more than the dimensions shown in Figure 31. If the span limitations are exceeded, then additional support will be required to shorten the span length. This can be accomplished with 4 x 4 posts that are notched and bolted to the stringer per Figure 9. The posts should be centered on a 12 inch diameter or 10 inch square footer at least 6 inches thick and constructed as shown in Figure 36 and posts should be attached to the footing as shown in Figure 13. If the total vertical height of the stairway is more than 12'-0", then an intermediate landed must be constructed. The intermediate landing should be constructed as a free standing deck. Stairs shall be a minimum of 36 inches in width as shown in Figure 35. If only cut stringers are used, a minimum of three stringers is required. The width of landings shall not be less than the width of the stairway served. All landings shall be at least 36" in the direction of travel.

## Figure 30 Tread and Riser Requirements



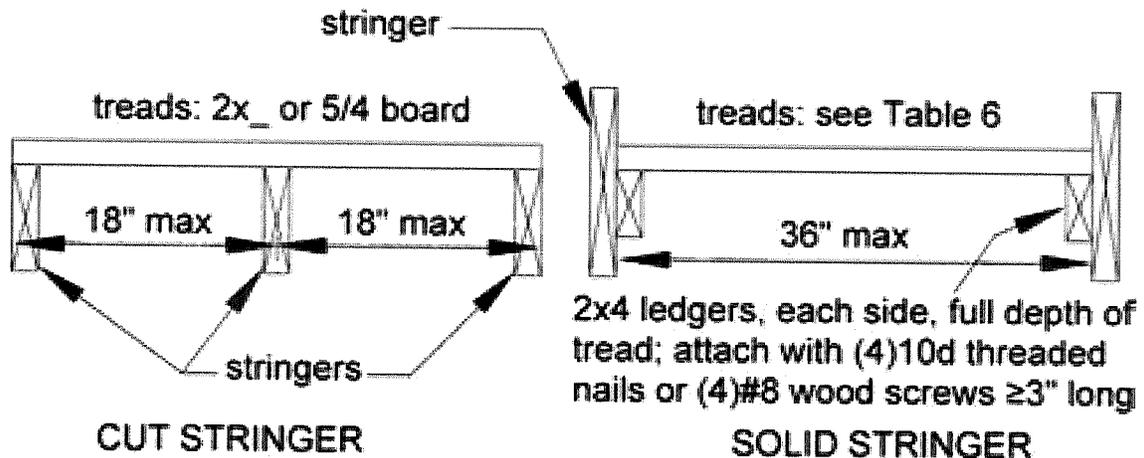
**Note: Pennsylvania's Act 13 allows the tread and riser dimensions to be 9" minimum tread width and 8-1/4" maximum riser height respectively.**

## Figure 31 Stair Stringer Requirements

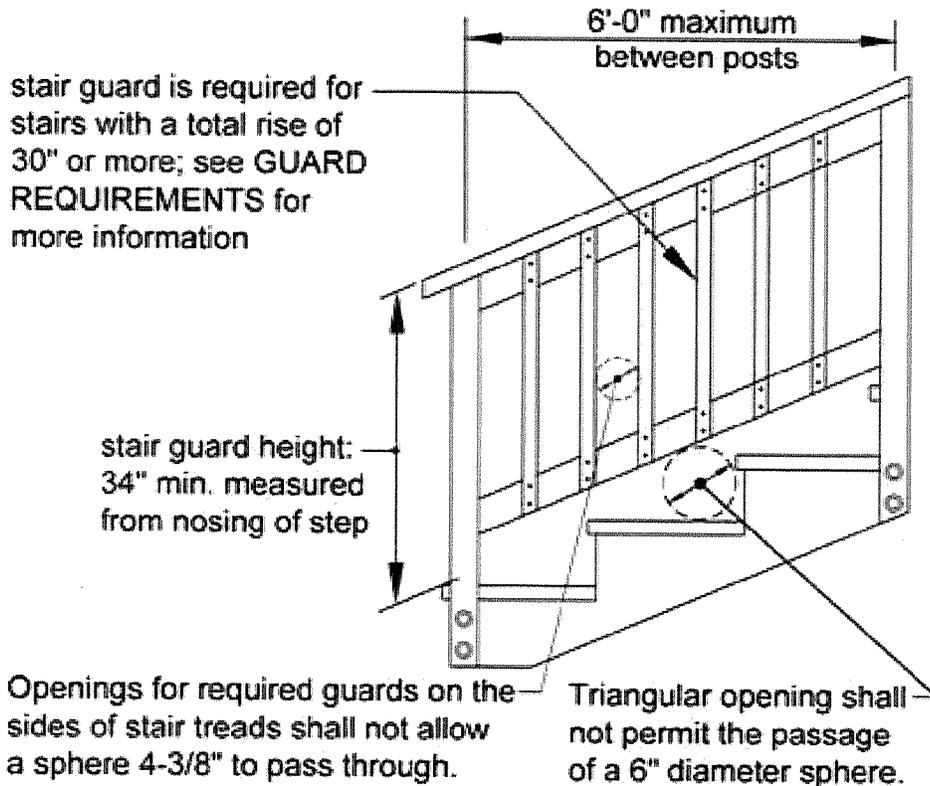


**Figure 32 Tread Connection Requirements**

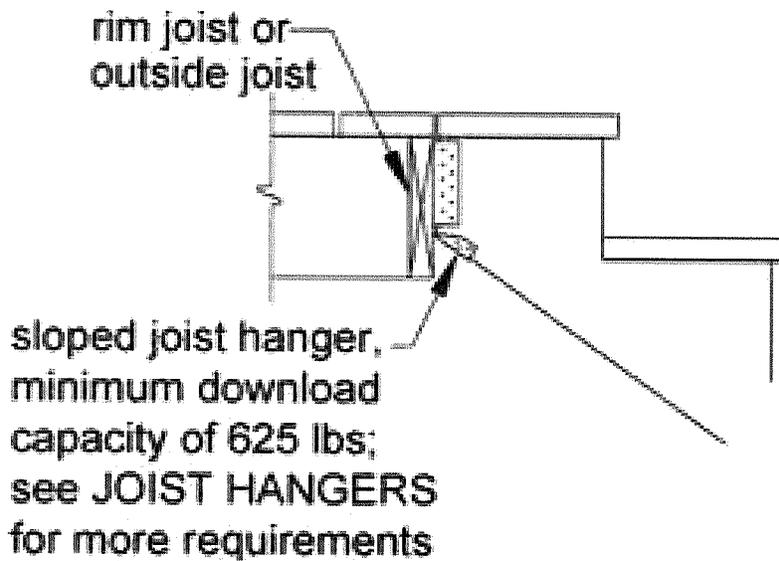
Attachment per tread at each stringer or ledger:  
 2x\_ or 5/4 treads - (2)#8d threaded nails or (2)#8 screws  $\geq 2\text{-}1/2"$  long  
 3x\_ treads - (2)#16d threaded nails or (2)#8 screws  $\geq 3\text{-}1/2"$  long



**Figure 33 Stair Guard Requirements**

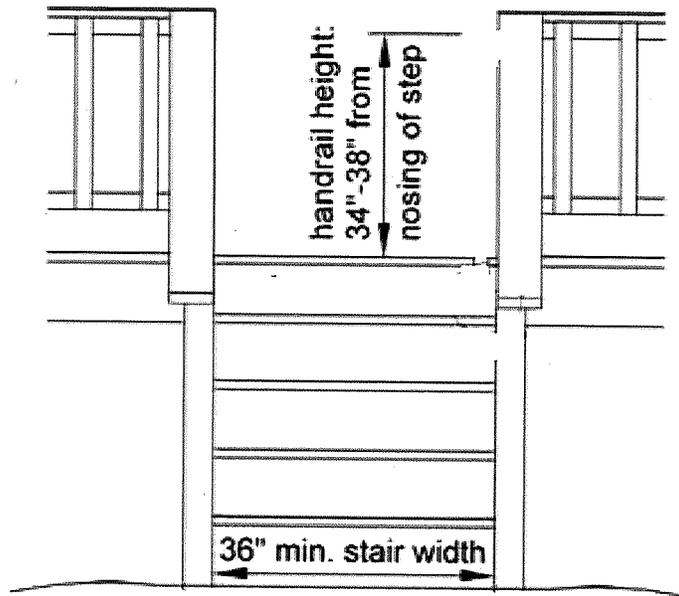


**Figure 34 Stair Stringer Attachment. (Recommended)**



**ATTACHMENT WITH HANGERS**

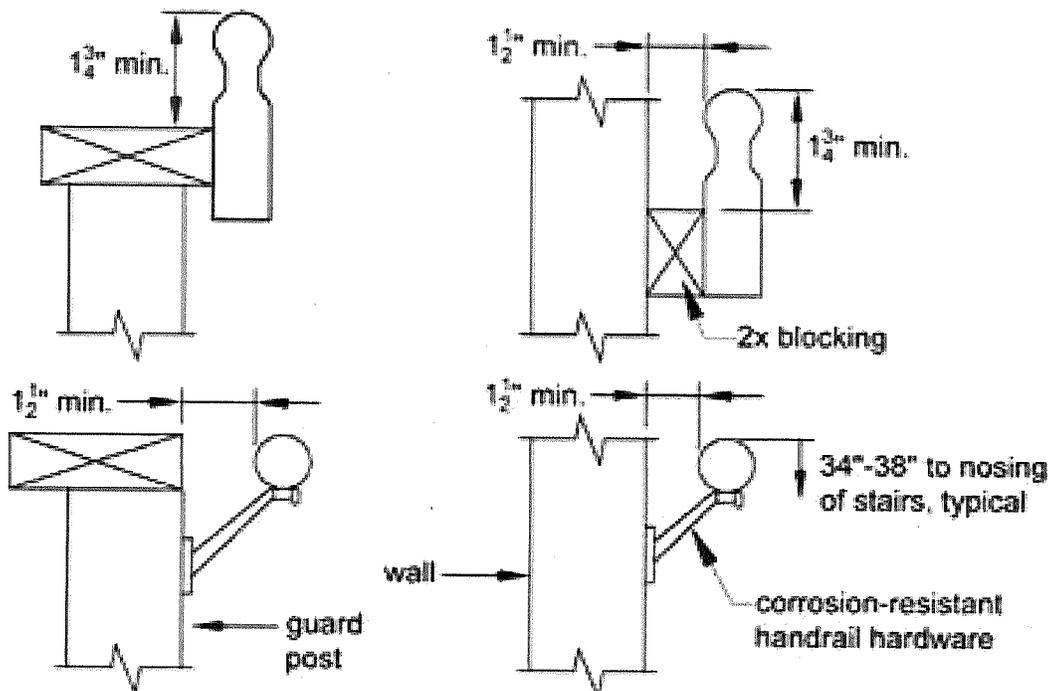
## Deck Figure 35 Miscellaneous Stair Requirements



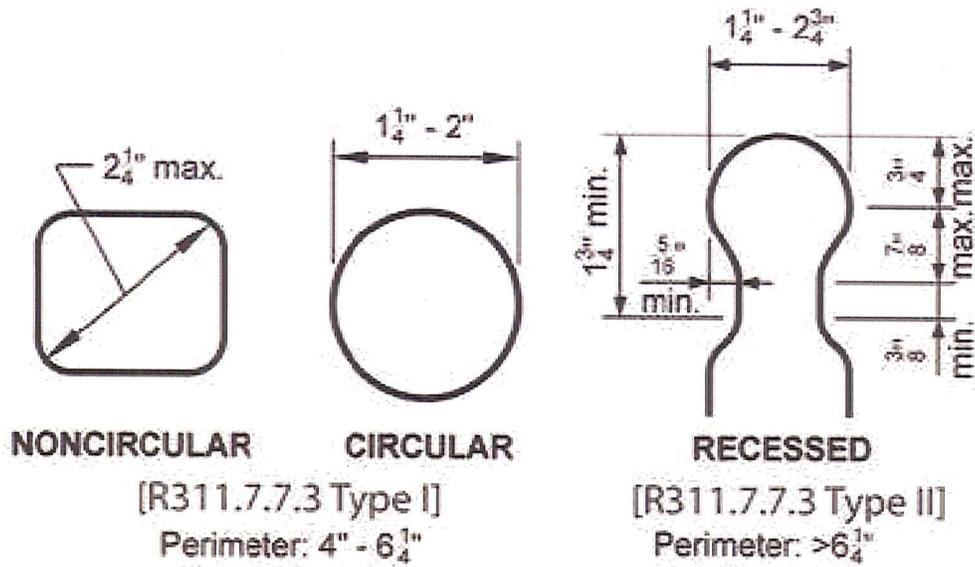
## Hand Rail Requirements

### DECK FIGURE 37

Install corrosion resistant fasteners per manufacturer's instructions.



## DECK FIGURE 38



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