

BASE ENGINEERING INC.
CONSULTING ENGINEERS & SURVEYORS
1010 N. QUEBEC STREET, ALLENTOWN, PA 18109-1607



(610) 437-0979

www.BaseEng.com

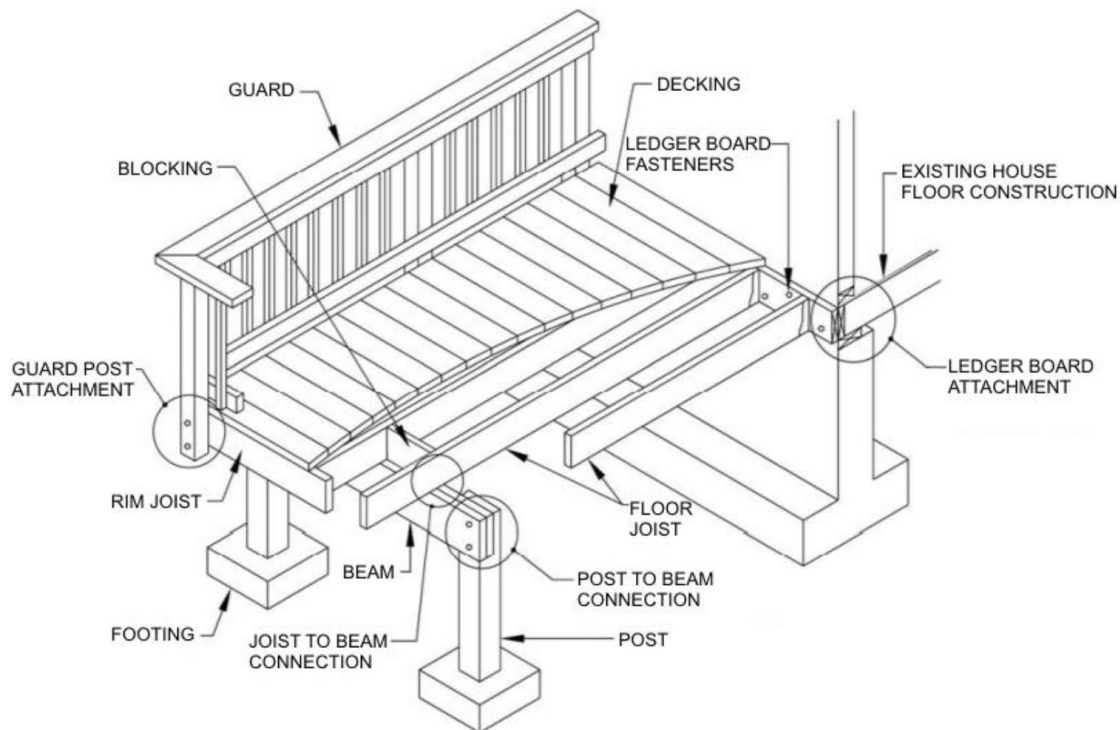
BaseEngineering@BaseEng.com

CIVIL • STRUCTURAL • MUNICIPAL • CONSTRUCTION INSPECTIONS • CODE ENFORCEMENT • SUPERVISION

Residential Deck Construction

This guide specifies the Pennsylvania Uniform Construction Code (PA UCC) requirements regarding the construction of a wood deck. The information provided is derived from the 2021 International Residential Code (IRC) as adopted by the PA UCC. The purpose of this document is to provide contractors and homeowners with guidelines and details for the construction of a typical residential deck. This document is limited to single level – single span deck designs using a uniform floor live load of 40 psf and dead load of 10 psf over the entire floor of the deck. Decks supporting uniform loads exceeding 50 psf or large concentrated loads such as hot tubs, spas, outdoor kitchens, roofs, and sunrooms must be evaluated and approved by a registered design professional. Decks designed and constructed in accordance with this guide are **not** approved for a future roof, hot tub installation and/or any enclosures. Tables and details provided are taken from the IRC. This guide is intended to provide pertinent and helpful excerpts from the noted sources and should not be considered as a complete list of code requirements. Contact the authority having jurisdiction for additional requirements or modifications to the following information. This document is not intended to preclude the use of other construction methods or materials not shown herein. Manufactured materials shall be installed in accordance with the manufacturer's installation instructions.

COMPONENTS OF A DECK



• Build your foundation on a solid BASE • 46 years of service with integrity •

GENERAL REQUIREMENTS

1. The permit holder shall keep a copy of the approved construction documents (including this guide) at the work site open to inspection by the construction code official. (PA UCC 403.63(c))
2. The permit holder shall submit a revised set of construction documents for approval for changes made during construction that are not in accordance with the approved construction documents. (PA UCC 403.63(j))
3. All construction shall comply with PA UCC requirements for new construction. Construction not depicted on the plans will be field verified. Manufactured materials, systems and equipment shall be installed in accordance with the manufacturer's installation instructions. The manufacturer's installation instructions shall be available on site for review.
4. Decks shall not be attached to house overhangs (cantilevers), cantilevered box or bay windows, brick or stone veneers, exterior finishes, or chimneys. These decks would require self-supporting construction methods or a design by a licensed design professional.
5. All wood materials shall be No. 2 grade or better lumber, preservative-treated or naturally resistant to decay. Lumber in contact with the ground shall be rated as ground-contact. Cuts, notches and drilled holes in preservative-treated wood members shall be field treated with an approved wood preservative.
6. Metal fasteners and connectors used for all decks shall be in accordance with Table R507.2.3. Specialty fasteners shall be approved for their use and installed in accordance with the manufacturer's instructions. Copies of material labels and installation instructions shall be available on site for review.
7. Plastic composite deck boards, stair treads, guards, and handrails shall comply with the requirements of ASTM D7032. The materials or their packaging shall bear a label that indicates compliance with ASTM D7032 and includes the allowable loads and the maximum allowable spans. Plastic composite deck boards, stair treads, guards, and handrails shall be installed in accordance with the manufacturer's instructions. Copies of material labels and installation instructions shall be available on site for review.
8. Stairways shall have a light source that illuminates all stairs and landings. Lights shall be operable from interior switches, motion detectors or timed switches. Low voltage lighting at each tread is permissible.
9. All decks that are accessible from the inside of the dwelling shall have at least one receptacle outlet accessible from the deck.
10. Decks constructed for a swimming pool or spa/hot tub shall also comply with the requirements for guards and any other applicable regulations.

**TABLE R507.2.3
FASTENER AND CONNECTOR SPECIFICATIONS FOR DECKS^{a, b}**

ITEM	MATERIAL	MINIMUM FINISH/COATING	ALTERNATE FINISH/COATING ^e
Nails and glulam rivets	In accordance with ASTM F1667	Hot-dipped galvanized per ASTM A153, Class D for $\frac{3}{8}$ -inch diameter and less	Stainless steel, silicon bronze or copper
Bolts ^c	In accordance with ASTM A307 (bolts), ASTM A563 (nuts), ASTM F844 (washers)	Hot-dipped galvanized per ASTM A153, Class C (Class D for $\frac{3}{8}$ -inch diameter and less) or mechanically galvanized per ASTM B695, Class 55 or 410 stainless steel	Stainless steel, silicon bronze or copper
Lag screws ^d (including nuts and washers)			
Metal connectors	Per manufacturer's specification	ASTM A653 type G185 zinc-coated galvanized steel or post hot-dipped galvanized per ASTM A123 providing a minimum average coating weight of 2.0 oz./ft ² (total both sides)	Stainless steel

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

a. Equivalent materials, coatings and finishes shall be permitted.

b. Fasteners and connectors exposed to salt water or located within 300 feet of a salt water shoreline shall be stainless steel.

c. Holes for bolts shall be drilled a minimum $\frac{1}{32}$ inch and a maximum $\frac{1}{16}$ inch larger than the bolt.

d. Lag screws $\frac{1}{2}$ inch and larger shall be predrilled to avoid wood splitting per the *National Design Specification (NDS) for Wood Construction*.

e. Stainless-steel-driven fasteners shall be in accordance with ASTM F1667.

DECK JOISTS (R507.6)

1. The end of each joist shall have not less than 1½" bearing on wood or metal and not less than 3" of bearing on concrete or masonry for the entire width of the joist.
2. Joists bearing on top of a multiple-ply beam or ledger shall be fastened in accordance with Table R602.3(1). Joists bearing on top of a single-ply beam or ledger shall be attached by a mechanical connector. Joists framing into the side of a beam or ledger board shall be supported by approved joist hangers.
3. Joist ends and bearing locations shall be provided with lateral resistance to prevent rotation. Where lateral restraint is provided by joist hangers or blocking between the joists, their depth shall equal not less than 60% of the joist depth. Where lateral restraint is provided by rim joists, they shall be secured to the end of each joist with three 10d nails or three No. 10 x 3-inch long wood screws.
4. Wood decking shall be attached to each supporting member with not less than two 8d threaded nails or two No. 8 wood screws. Other approved decking or fastener systems shall be installed in accordance with the manufacturer's installation requirements.

**TABLE R602.3(1)—continued
FASTENING SCHEDULE**

ITEM	DESCRIPTION OF BUILDING ELEMENTS	NUMBER AND TYPE OF FASTENER ^{a, b, c}	SPACING AND LOCATION
Floor			
22	Joist to sill, top plate or girder	4-8d box (2½" × 0.113"); or 3-8d common (2½" × 0.131"); or 3-10d box (3" × 0.128"); or 3-3" × 0.131" nails	Toe nail
23	Rim joist, band joist or blocking to sill or top plate (roof applications also)	8d box (2½" × 0.113")	4" o.c. toe nail
		8d common (2½" × 0.131"); or 10d box (3" × 0.128"); or 3" × 0.131" nails	6" o.c. toe nail
24	1" × 6" subfloor or less to each joist	3-8d box (2½" × 0.113"); or 2-8d common (2½" × 0.131"); or 3-10d box (3" × 0.128"); or 2 staples, 1" crown, 16 ga., 1¾" long	Face nail
25	2" subfloor to joist or girder	3-16d box (3½" × 0.135"); or 2-16d common (3½" × 0.162")	Blind and face nail
26	2" planks (plank & beam—floor & roof)	3-16d box (3½" × 0.135"); or 2-16d common (3½" × 0.162")	At each bearing, face nail
27	Band or rim joist to joist	3-16d common (3½" × 0.162"); or 4-10 box (3" × 0.128"); or 4-3" × 0.131" nails; or 4-3" × 14 ga. staples, 7/16" crown	End nail
28	Built-up girders and beams, 2-inch lumber layers	20d common (4" × 0.192"); or	Nail each layer as follows: 32" o.c. at top and bottom and staggered.
		10d box (3" × 0.128"); or 3" × 0.131" nails	24" o.c. face nail at top and bottom staggered on opposite sides
		And: 2-20d common (4" × 0.192"); or 3-10d box (3" × 0.128"); or 3-3" × 0.131" nails	Face nail at ends and at each splice
29	Ledger strip supporting joists or rafters	4-16d box (3½" × 0.135"); or 3-16d common (3½" × 0.162"); or 4-10d box (3" × 0.128"); or 4-3" × 0.131" nails	At each joist or rafter, face nail
30	Bridging or blocking to joist, rafter or truss	2-10d box (3" × 0.128"); or 2-8d common (2½" × 0.131"); or 3" × 0.131" nails	Each end, toe nail

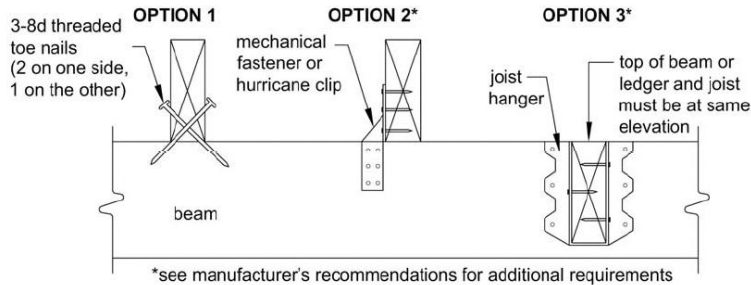
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 mile per hour = 0.447 m/s; 1 ksi = 6.895 MPa.

a. Nails are smooth-common, box or deformed shanks except where otherwise stated. Nails used for framing and sheathing connections are carbon steel and shall have minimum average bending yield strengths as shown: 80 ksi for shank diameter of 0.192 inch (20d common nail), 90 ksi for shank diameters larger than 0.142 inch but not larger than 0.177 inch, and 100 ksi for shank diameters of 0.142 inch or less. Connections using nails and staples of other materials, such as stainless steel, shall be designed by accepted engineering practice or approved under Section R104.11.

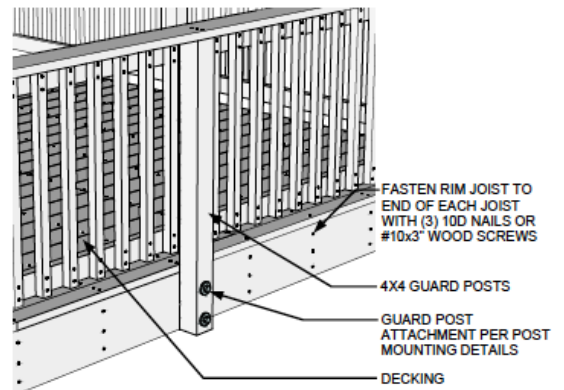
b. RSRS-01 is a Roof Sheathing Ring Shank nail meeting the specifications in ASTM F1667.

c. Nails shall be spaced at not more than 6 inches on center at all supports where spans are 48 inches or greater.

JOIST TO BEAM CONNECTION

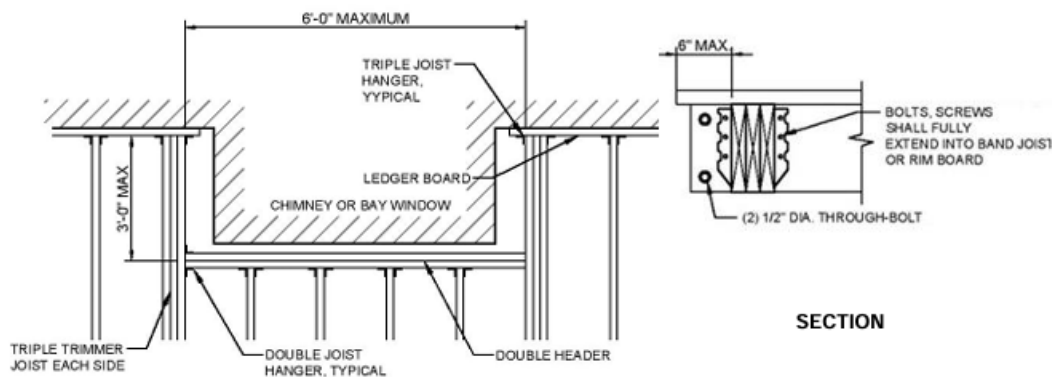


RIM JOIST CONNECTION



FRAMING AT CHIMNEY OR BAY WINDOW

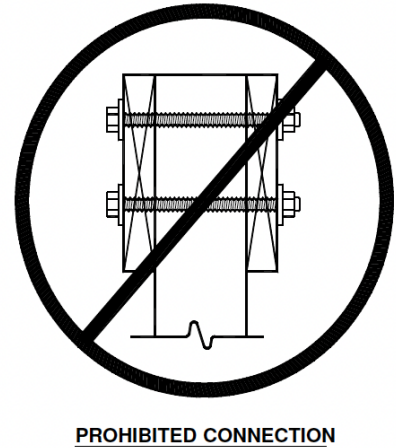
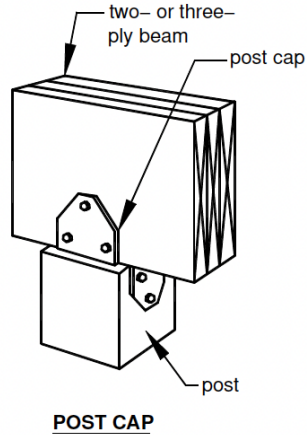
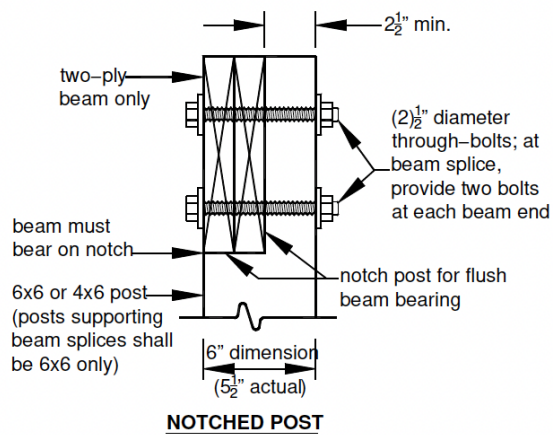
- Header sizes shall be the same as the floor joists.
- When the chimney or bay window is deeper than 3'-0", install 6x6 posts with footings below each triple joist at the location of the header connection.
- When the header is longer than 6'-0", install 6x6 posts with footings below the header to reduce the span to less than 6'-0".
- Joist hangers shall be specifically designed to accommodate the number of plies.



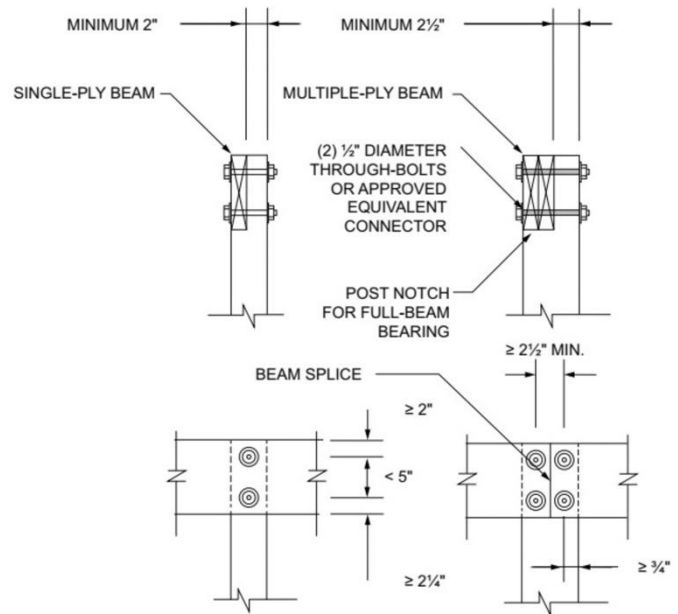
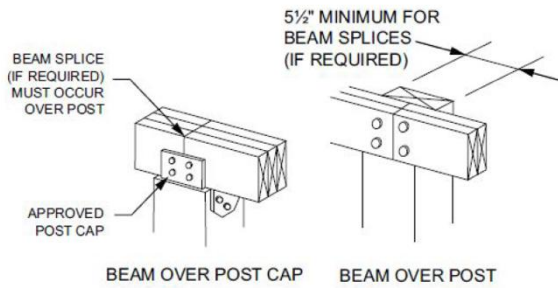
DECK BEAMS (R507.5)

- The ends of beams shall have not less than 1½" of bearing on wood or metal and not less than 3" of bearing on concrete or masonry for the entire width of the beam. Where multiple span beams bear on intermediate posts, each ply must have full bearing on the post (see details below).
- Deck beams shall be attached to the support posts in a manner capable of transferring vertical loads and resisting horizontal displacement (see details below). Manufactured post-to-beam connectors shall be sized for the post and beam sizes. Bolts shall have washers under the head and nut.
- Beam plies shall be fastened in accordance with the Beam Assembly detail below.
- Beams are permitted to cantilever at each end up to one-fourth of the actual beam span.
- Deck beams of other materials shall be permitted where designed in accordance with accepted engineering practices. Beam design specifications for engineered wood products (obtained from the manufacturer or lumber supplier) shall be provided.

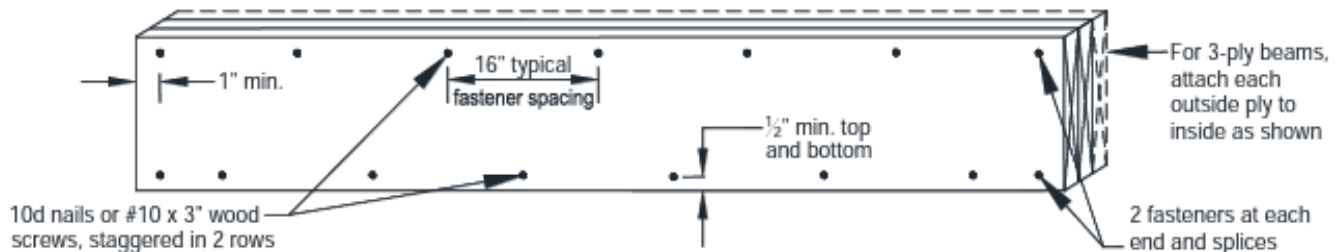
BEAM TO POST CONNECTIONS



SPLICED BEAM TO POST CONNECTIONS

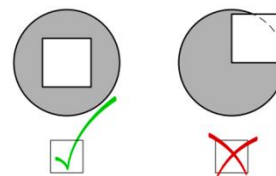


BEAM ASSEMBLY DETAIL



DECK POSTS (R507.4)

1. Posts must be centered on or in the footing and shall be restrained at the bottom to prevent lateral displacement by approved manufactured connectors.
2. Notched deck posts shall be sized to accommodate beam size in accordance with Section R507.5.2. Two-ply beams shall be attached to 4x4 posts with an approved post cap or by notching a 6x6 post. Three-ply beams shall be attached to 6x6 posts with an approved post cap. Manufactured post to beam connectors shall be sized for the post and beam and installed per manufacturer's installation instructions.
3. Attachment of the beam to the side of the post is not permitted.
4. Cut ends and notches of posts shall be field treated with an approved wood preservative.



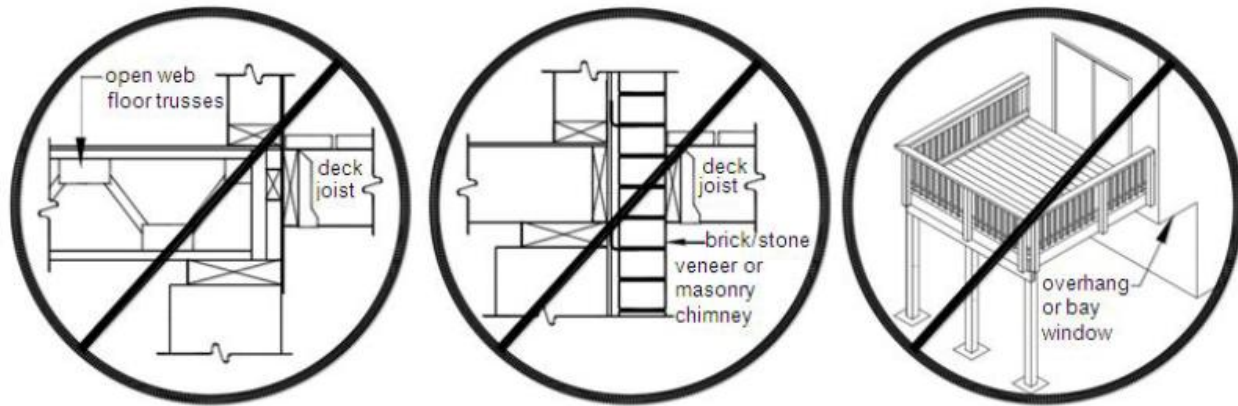
DECK FOOTINGS (R507.3)

1. All decks shall be supported on concrete footings or other approved structural systems that are designed to support all loads. The footings shall be sized to carry the imposed loads from the deck structure to the ground. Posts must be centered on or in the footing.
2. Concrete for footings shall have a minimum compressive strength of 3,000 psi (Table R402.2).
3. Footing depth below grade shall be in accordance with minimum local requirements for frost and bear on undisturbed or natural soil.
4. Footings closer than 5'-0" to an existing house foundation wall must bear on undisturbed soil at the same elevation as the house foundation.
5. Footings shall not be installed over utility lines or piping of any kind. Footings are to be arranged not to interfere with existing underground utilities and piping.
6. Footings are required where stairs are supported by posts (minimum 12" diameter).

LEDGER BOARDS (R507.9)

1. Deck ledgers shall be equal to or greater than the depth of the deck joists but not less than a 2x8.
2. Deck ledgers shall not support concentrated loads from beams or girders. Deck ledgers shall not be supported on stone or masonry veneer.
3. Band joists supporting a ledger shall be a minimum 2-inch-nominal solid-sawn, spruce-pine-fir or better lumber or a minimum 1-inch nominal engineered wood rim board. Band joists shall bear fully on the primary structure capable of supporting all required loads. If the band board is not structurally adequate to support the new deck, the deck shall be freestanding or designed by an engineer.
4. Remove exterior finishes prior to installing the ledger board. Install flashings where ledgers are secured to existing construction. Both back flashing (behind ledger) and cap flashing (shingle style flashing over ledger board) are to be provided at deck connections. Flashing shall be installed at a door threshold to prevent water infiltration.
5. Fasteners used to connect the ledger board to the band joist shall be hot-dipped galvanized or stainless steel. Type, spacing and placement of fasteners shall be in accordance with Tables R507.9.1.3(1) and R507.9.1.3(2) and Figure R507.9.1.3(1).
6. Approved expansion and adhesive anchors shall be used when attaching a ledger board to a concrete or solid masonry wall.

PROHIBITED LEDGER BOARD CONNECTIONS



FASTENER REQUIREMENTS

TABLE R507.9.1.3(1)
DECK LEDGER CONNECTION TO BAND JOIST

LOAD ^c (psf)	JOIST SPAN ^a (feet)	ON-CENTER SPACING OF FASTENERS ^b (inches)		
		1/2-inch diameter lag screw with 1/2-inch maximum sheathing ^{d, e}	1/2-inch diameter bolt with 1/2-inch maximum sheathing ^e	1/2-inch diameter bolt with 1-inch maximum sheathing ^f
40 live load	6	30	36	36
	8	23	36	36
	10	18	34	29
	12	15	29	24
	14	13	24	21
	16	11	21	18
	18	10	19	16

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

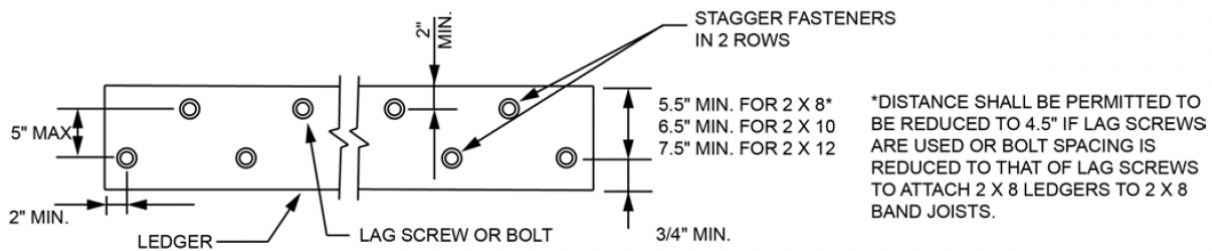
- a. Interpolation permitted. Extrapolation is not permitted.
- b. Ledgers shall be flashed in accordance with Section R703.4 to prevent water from contacting the house band joist.
- c. Dead Load = 10 psf. Snow load shall not be assumed to act concurrently with live load.
- d. The tip of the lag screw shall fully extend beyond the inside face of the band joist.
- e. Sheathing shall be wood structural panel or solid sawn lumber.
- f. Sheathing shall be permitted to be wood structural panel, gypsum board, fiberboard, lumber or foam sheathing. Up to 1/2-inch thickness of stacked washers shall be permitted to substitute for up to 1/2 inch of allowable sheathing thickness where combined with wood structural panel or lumber sheathing.

TABLE R507.9.1.3(2)
PLACEMENT OF LAG SCREWS AND BOLTS IN DECK LEDGERS AND BAND JOISTS

MINIMUM END AND EDGE DISTANCES AND SPACING BETWEEN ROWS				
	TOP EDGE	BOTTOM EDGE	ENDS	ROW SPACING
Ledger ^a	2 inches ^d	3/4 inch	2 inches ^b	1 5/8 inches ^b
Band Joist ^c	3/4 inch	2 inches	2 inches ^b	1 5/8 inches ^b

For SI: 1 inch = 25.4 mm.

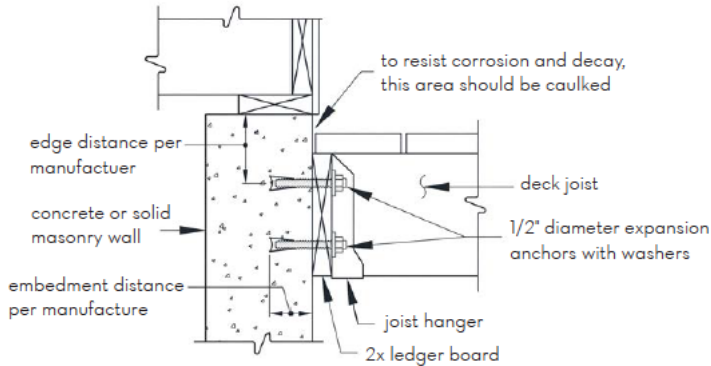
- a. Lag screws or bolts shall be staggered from the top to the bottom along the horizontal run of the deck ledger in accordance with Figure R507.9.1.3(1).
- b. Maximum 5 inches.
- c. For engineered rim joists, the manufacturer's recommendations shall govern.
- d. The minimum distance from bottom row of lag screws or bolts to the top edge of the ledger shall be in accordance with Figure R507.9.1.3(1).



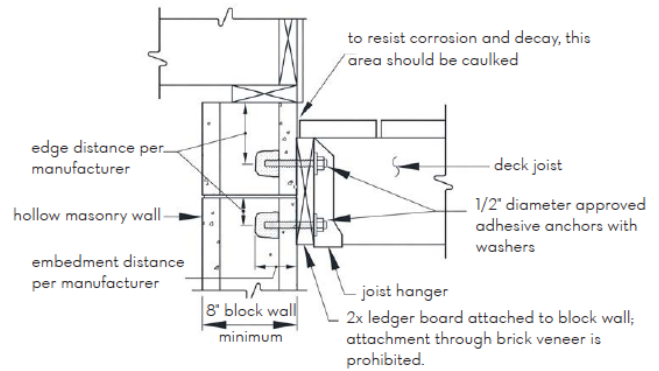
For SI: 1 inch = 25.4 mm.

FIGURE R507.9.1.3(1)
PLACEMENT OF LAG SCREWS AND BOLTS IN LEDGERS

LEDGER CONNECTION TO CONCRETE OR SOLID MASONRY

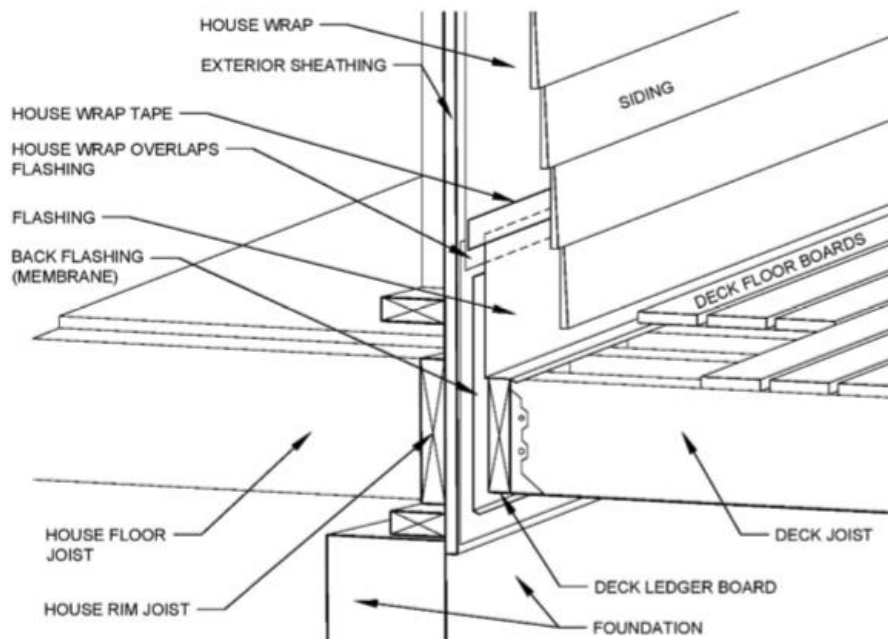


LEDGER CONNECTION TO HOLLOW MASONRY



FLASHING (R507.2.4)

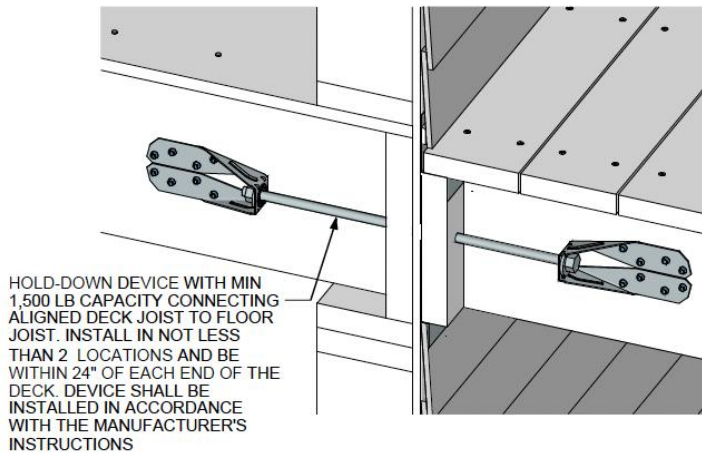
1. Flashing shall be installed where decks attach to a wall or floor assembly of wood-frame construction. Flashing shall be corrosion-resistant metal of nominal thickness not less than 0.019 inch or approved nonmetallic material that is compatible with the substrate of the structure and the decking materials.



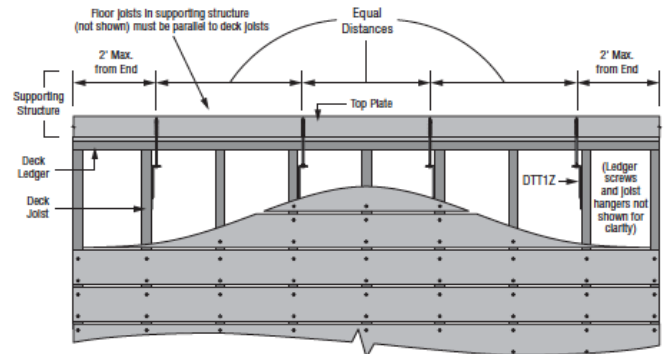
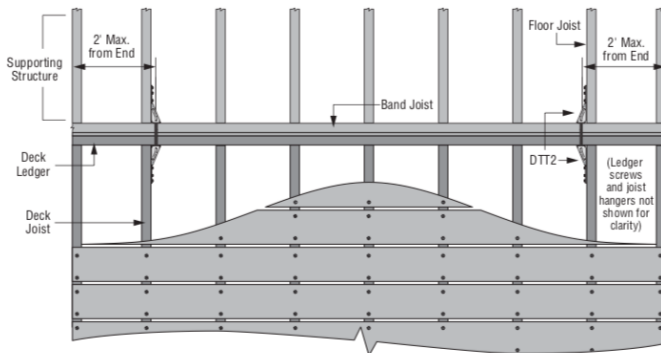
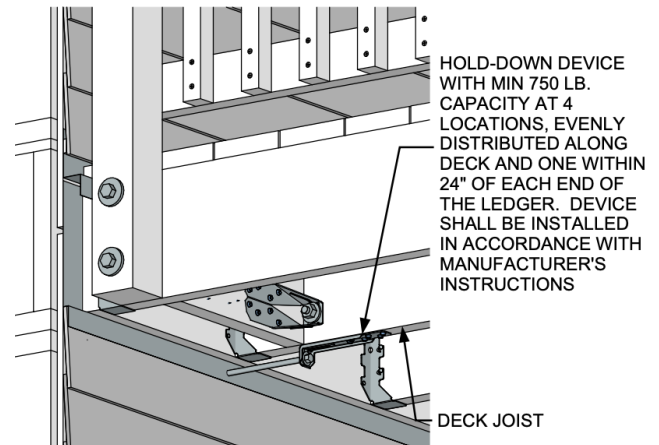
LATERAL LOAD REQUIREMENTS (R507.9.2)

1. Lateral loads shall be transferred to the ground or to a structure capable of transmitting them to the ground. Where supported by attachment to an exterior wall, hold-down tension devices shall be installed in accordance with one of the following methods:
 - a. Install in not less than two locations per deck, within 24" of each end of the deck. Each device shall have an allowable stress design capacity of not less than 1,500 pounds.
 - b. Install in not less than four locations per deck. Each device shall have an allowable stress design capacity of not less than 750 pounds.

1,500 POUND CONNECTOR INSTALLATION

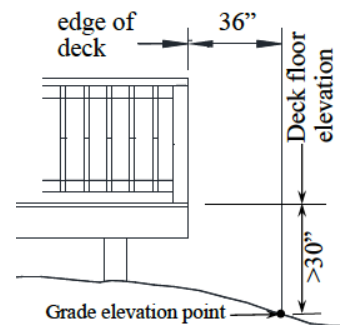


750 POUND CONNECTOR INSTALLATION

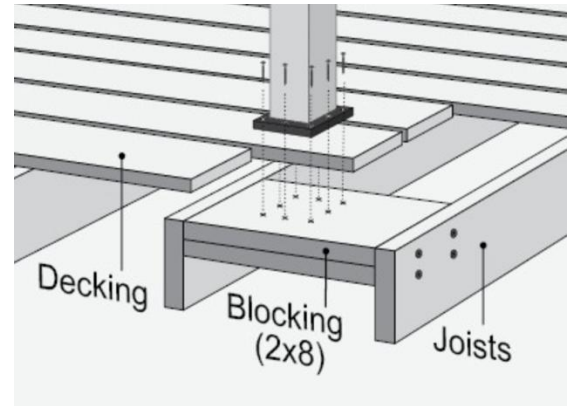


EXTERIOR GUARDS (R507.10)

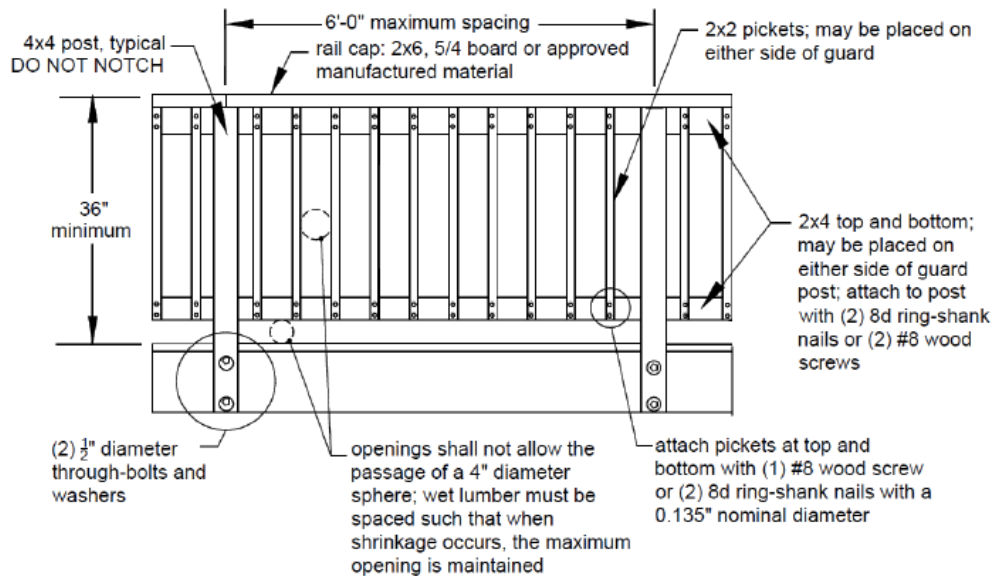
1. Guards are required along open sided walking surfaces; including stairs, ramps, and landings that are located 30" vertically above the adjoining floor or grade below at any point within 36" horizontally to the edge of the deck.
2. Wood-plastic or other composite/plastic/vinyl guard system shall be installed in accordance with the manufacturer's installation instructions and shall be accompanied by a valid evaluation report (ICC-ES or equal).
3. Guard posts shall be a minimum 4x4 and must be fastened to floor framing members to ensure the entire guard can resist a minimum 200-pound lateral load applied along the top of the guard assembly.
4. Where guards are connected to the interior or exterior side of a deck joist or beam, the joist or beam shall be connected to the adjacent joists to prevent rotation of the joist or beam. Connections relying only on fasteners in end grain withdrawal are not permitted.



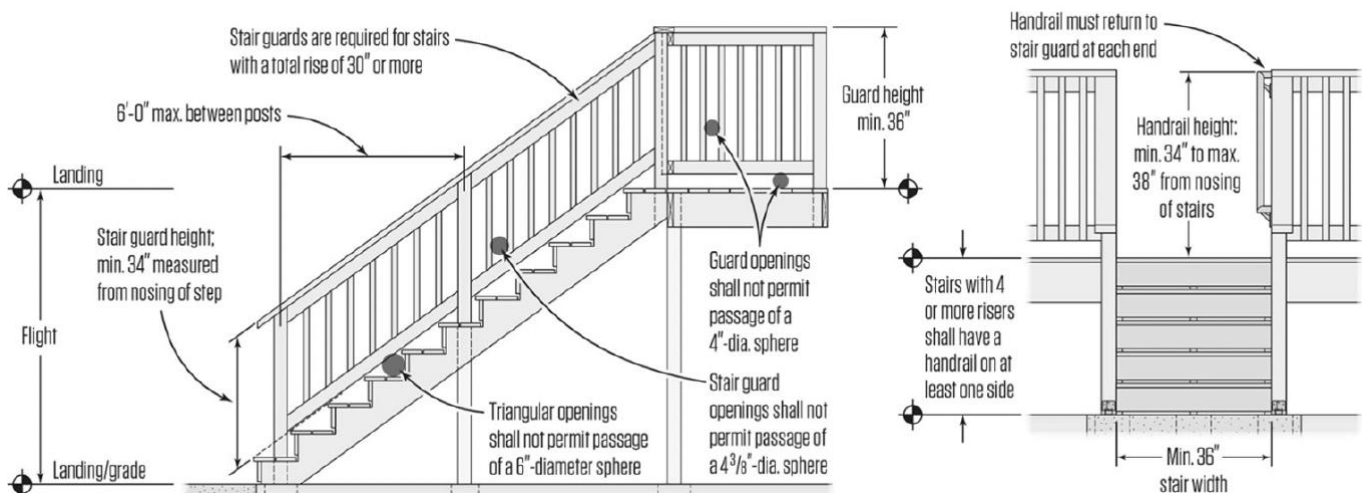
5. Where guards are mounted on top of the decking, the guards shall be connected to the deck framing or blocking and installed in accordance with manufacturer's instructions to transfer the guard loads to the adjacent joists.
6. Guard posts shall not be cut or notched at the connection to the supporting structure.
7. Guards shall not be less than 36" above the adjacent walking surface. Guards for stairs shall not be less than 34" above the nosing of each step.
8. Installed guards shall have opening limitations in accordance with the details below.



GENERAL

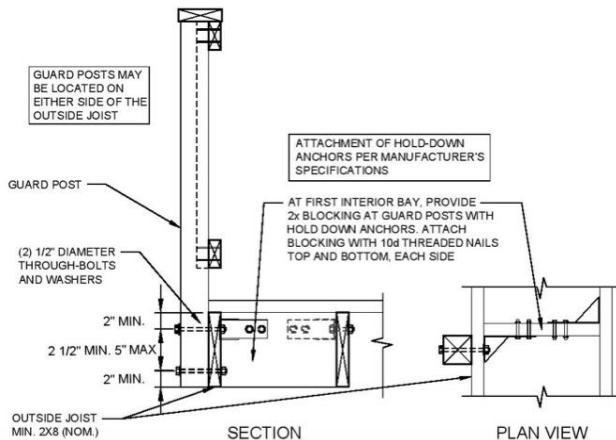


GUARD REQUIREMENTS FOR STAIRS

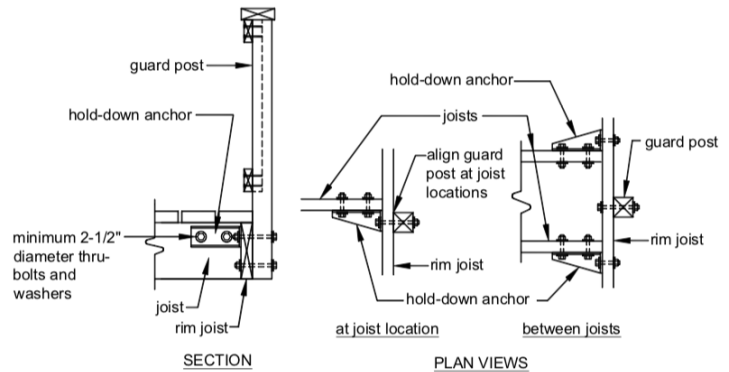


POST MOUNTING

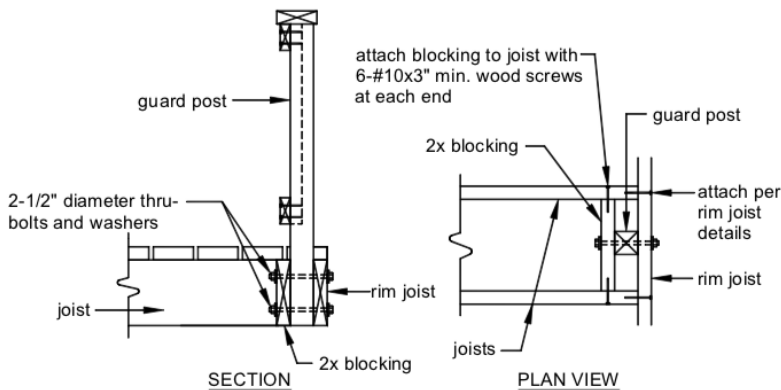
EXTERIOR SIDE OF JOIST



EXTERIOR SIDE OF RIM JOIST

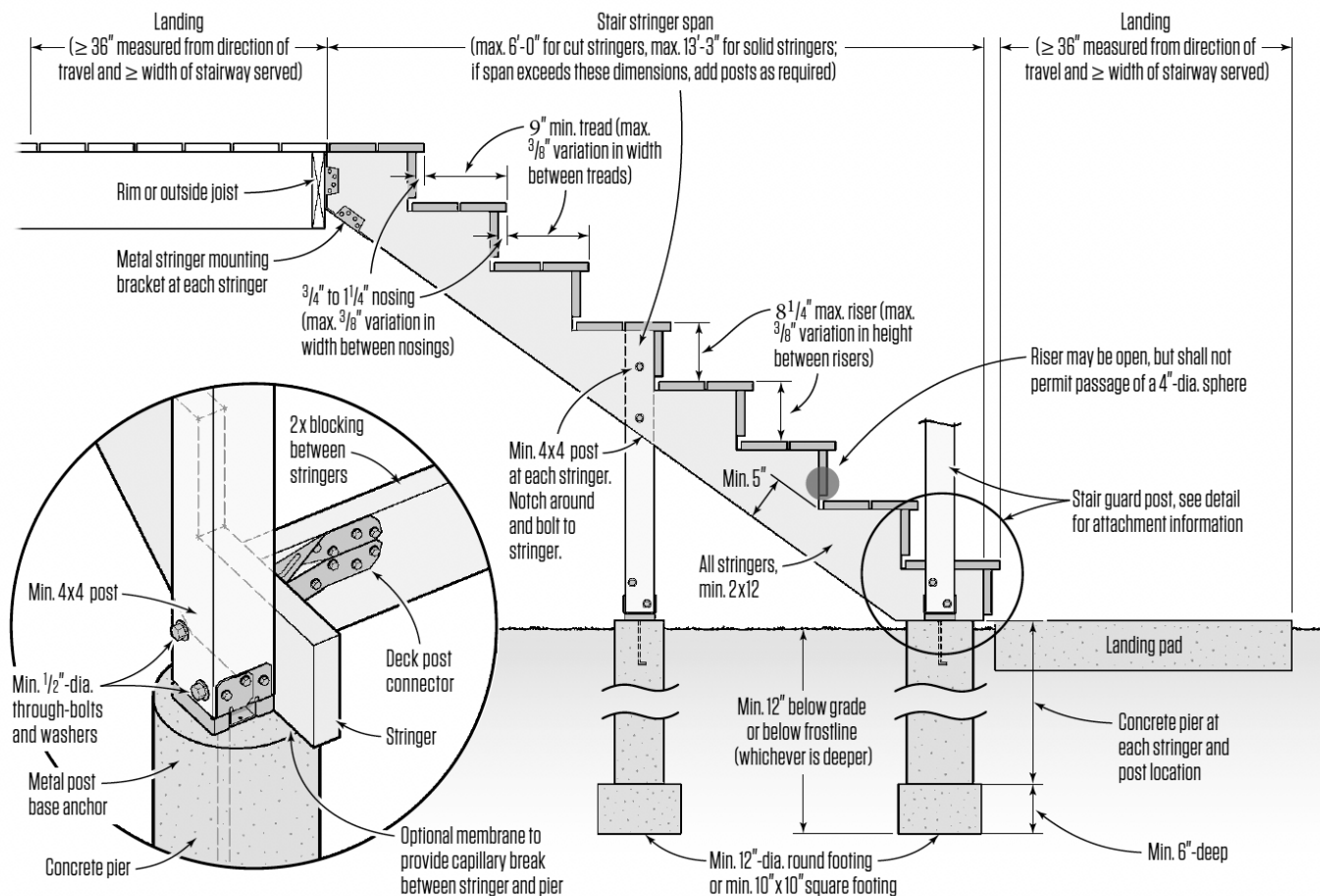


INTERIOR SIDE OF RIM JOIST

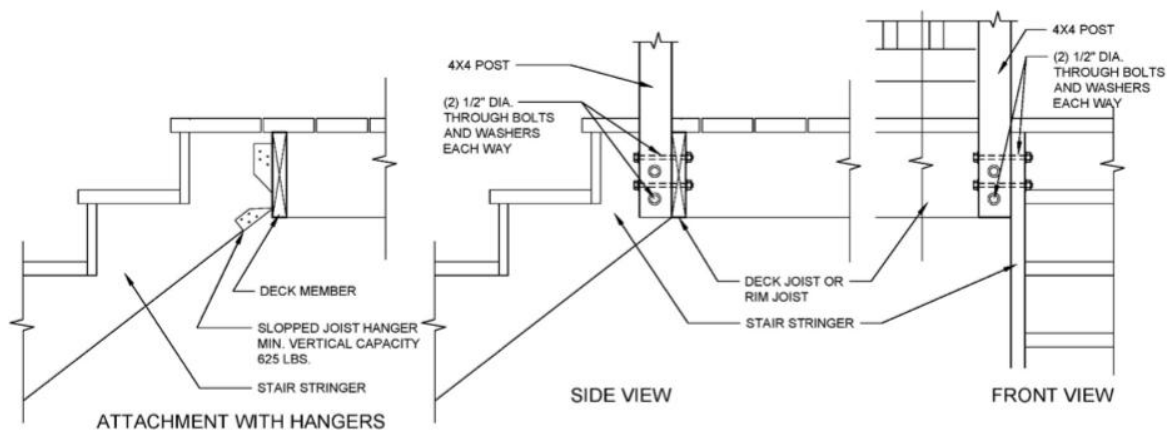


STAIR REQUIREMENTS (R311.7)

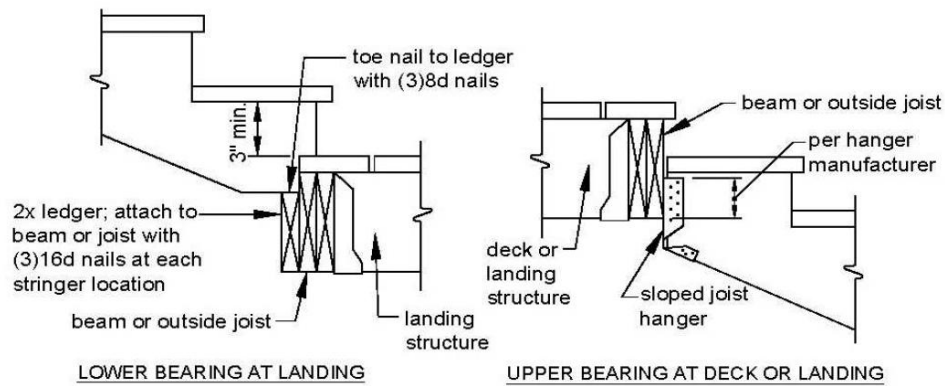
1. Stairs shall be constructed with the following dimensions: 36" minimum clear width, 8 $\frac{1}{4}$ " maximum riser height (UCC amended), and 9" minimum tread depth (UCC amended). Risers may be open but shall not allow the passage of a 4" diameter sphere.
2. A floor or landing is required at the top and bottom of each stairway. Landing widths shall be equal to the total width(s) of the stairway(s) served and extend in the direction of travel not less than 36".
3. Stairs with a vertical height exceeding 12'-7" are required to have an intermediate landing. Landings shall be constructed as a free-standing deck with 4x4 support posts.
4. All stringers shall be a minimum sawn or solid 2x12 spaced at a maximum of 18" on center. Stringers shall bear on footings and attach to the deck or landing with approved hangers installed in accordance with manufacturer's installation instructions.
5. Stairways shall be provided with an artificial light source located at the top landing (R303.8).



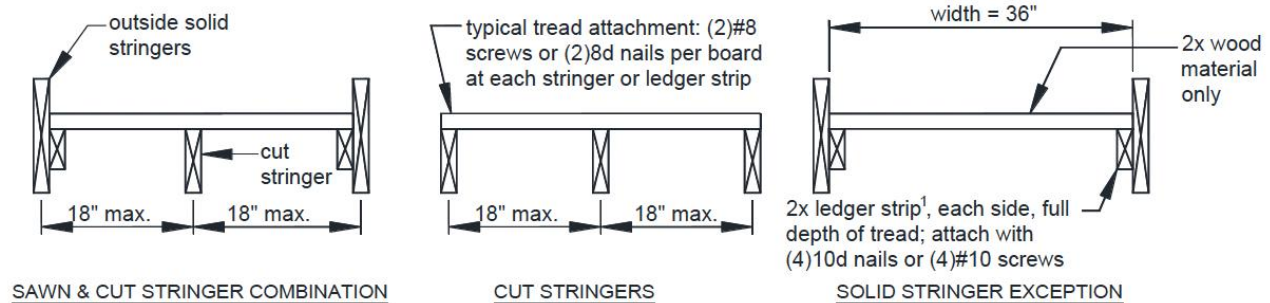
STAIR STRINGER CONNECTIONS



STAIR STRINGER CONNECTION - LANDINGS



TREAD CONNECTIONS

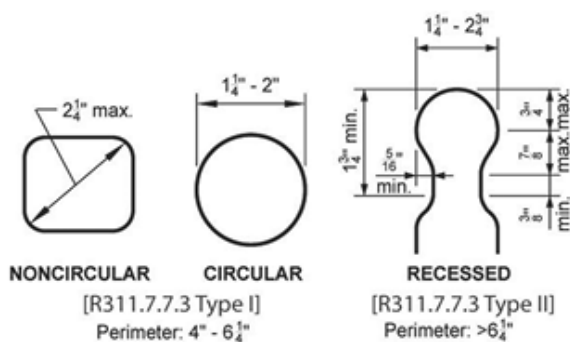


¹ A galvanized staircase clip angle, installed per manufacturer's instructions, is permitted to substitute for the 2x ledger strip.

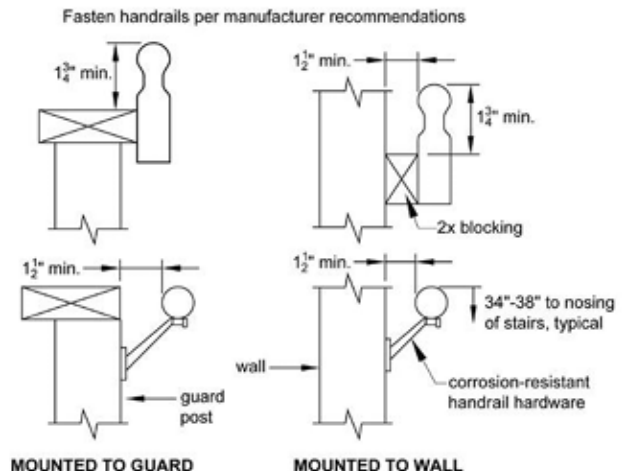
HANDRAIL REQUIREMENTS (R311.7.8)

1. Handrails shall be provided on not less than one side of each flight of stairs with four or more risers. The top of the handrail shall be at a height between 34" and 38" above the nosing of each step.
2. Handrails shall be continuous for the full length of the flight, from a point directly above the top riser to a point directly above the lowest riser. Handrail ends shall be returned toward a wall, guard walking surface continuous to itself, or terminate to a post.
3. Handrails shall be graspable, made of decay-resistant and/or corrosion resistant material and have a smooth surface with no sharp corners.
4. Handrails may be interrupted by a newel post at a turn in a flight, at a landing, or over the lowest tread.

HANDRAIL GRIP SIZE



HANDRAIL MOUNTING EXAMPLES



REQUIREMENTS FOR DECKS AT POOLS

1. Steps used to access the deck shall be capable of being secured to prevent access. A 48-inch high guard/gate is required at the base of the stairs that is self-closing and self-latching and equipped to accommodate a locking device.
2. The release mechanism for the latch shall be a minimum of 54-inches from the bottom of the gate or shall be located on the pool side, 3-inches below the top of the gate with no openings greater than 1/2-inch within 18-inches of the release latch.

