R506.2.1 Fill. Fill material shall be free of vegetation and foreign material. The fill shall be compacted to ensure uniform support of the slab, and except where *approved*, the fill depths shall not exceed 24 inches (610 mm) for clean sand or gravel and 8 inches (203 mm) for earth.

❖ To minimize differential settlement caused by consolidation of uncompacted fill and the problems associated with differential settlement, any fill beneath a concrete slab must be compacted. Properly compacted fill, besides minimizing settlement, increases the soil load-bearing characteristics and soil stability and reduces water penetration. The amount of compaction for fill is not specifically stipulated. Generally, fill soils should be compacted to 95-percent maximum density as determined by a Standard Proctor Test (ASTM D698). Compaction requirements for expansive soils should be determined from an engineering analysis.

Soil may be compacted using equipment appropriate to the type of material being compacted, with lifts not exceeding 8 inches (203 mm). In general, thinner layers produce better compaction of fill, regardless of the type of soil being compacted.

R506.2.2 Base. A 4-inch-thick (102 mm) base course consisting of clean graded sand, gravel, crushed stone, crushed concrete or crushed blast-furnace slag passing a 2-inch (51 mm) sieve shall be placed on the prepared subgrade where the slab is below *grade*.

Exception: A base course is not required where the concrete slab is installed on well-drained or sand-gravel mixture soils classified as Group I according to the United Soil Classification System in accordance with Table R405.1.

❖ Slabs need to be protected from the penetration of water and water vapor from below to prevent damage to interior finish material. Additionally, the effectiveness of thermal insulation at the slab may be adversely affected because of moisture. A 4-inch (102 mm) minimum granular base course is placed over the fill or undisturbed soil for slabs below grade to provide a capillary stop for water rising through the soil and into the slab. A base course is especially necessary where the site soil is other than gravel or clean sand. Both surface and groundwater problems must be addressed. Proper site preparation, selection of adequate fill and base course materials, and the installation of a vapor barrier minimize potential moisture problems associated with slab-on-grade construction

R506.2.3 Vapor retarder. A minimum 10-mil (0.010 inch; 0.254 mm) vapor retarder conforming to ASTM E1745 Class A requirements with joints lapped not less than 6 inches (152 mm) shall be placed between the concrete floor slab and the base course or the prepared subgrade where a base course does not exist.

Exception: The vapor retarder is not required for the following:

1. Garages, utility buildings and other unheated *accessory structures*.
2. For unheated storage rooms having an area of less than 70 square feet (6.5 m²) and carports.

3. Driveways, walks, patios and other flatwork not likely to be enclosed and heated at a later date.
4. Where *approved* by the *building official*, based on local site conditions.

❖ Although good quality, uncracked concrete is practically impermeable to the passage of water (unless the water is under a considerable pressure), concrete is not impervious to the passage of water vapors. If the surface of the slab is not sealed, water vapor will pass through the slab. If a floor finish such as linoleum, vinyl tile, wood flooring or any type of covering is placed on top of the slab, the moisture will be trapped in the slab. If the floor finish is adhered to the concrete, with time it may loosen, buckle or blister.

Many of the moisture problems associated with slabs-on-ground can be minimized by installing a vapor retarder. Where required, vapor retarders of either single- or multiple-layer membranes should be acceptable if the vapor retarder is properly installed with lapped joints and the barrier is not punctured during construction.

R506.2.4 Reinforcement support. Where provided in slabs-on-ground, reinforcement shall be supported to remain in place from the center to upper one-third of the slab for the duration of the concrete placement.

❖ The code does not require reinforcement for the concrete slab-on-ground floors. Where reinforcement is provided, common practice is to use welded wire fabric. The welded wire fabric frequently is left on the ground during the pour and not picked up. When lifted up by construction personnel, it is often not in a proper or consistent location, with some on the ground and some near the top of the slab. This section does not require installation of reinforcement; however, if reinforcement is installed, it must be properly located in the slab, or its benefit is lost.

SECTION R507
EXTERIOR DECKS

R507.1 Decks. Wood-framed decks shall be in accordance with this section. Decks shall be designed for the *live load* required in Section R301.5 or the ground snow load indicated in Table R301.2, whichever is greater. For decks using materials and conditions not prescribed in this section, refer to Section R301.

❖ Wood frame decks are often built after construction of a dwelling or townhouse is complete. Section R507 provides provisions for adding a deck to an existing building or building the deck at the same time as the dwelling. The provisions of this section are based on a minimum live load of 40 pounds per square foot (psf), as required in Table R301.5, and a dead load of 10 psf (to account for the deck structure). This loading is for typical residential decks covered by the IRC. In addition, tables for deck post footings, deck posts, beams and joists include provisions for ground snow loads up to 70 psf. However, decks that have an unusual amount of dead or live load (hot tubs, heavy floor covering, etc.) are beyond the scope of the tables in Section R507.

Snow loading is not considered to occur at the same time as the live load. While people can be on decks at the same time as snow, a full snow load and 40 psf live load are unlikely. For Section R507, the ground snow load of Table R301.2(1) is used. In high snowfall areas, shedding of snow from roofs, and drifts, may need to be considered and may require additional design.

R507.2 Materials. Materials used for the construction of decks shall comply with this section.

❖ Limitations for decking materials are contained in the provisions of Section R507.2.

R507.2.1 Wood materials. Wood materials shall be No. 2 grade or better lumber, preservative-treated in accordance with Section R317, or *approved*, naturally durable lumber, and termite protected where required in accordance with Section R318. Where design in accordance with Section R301 is provided, wood structural members shall be designed using the wet service factor defined in AWC NDS. Cuts, notches and drilled holes of preservative-treated wood members shall be treated in accordance with Section R317.1.1. All preservative-treated wood products in contact with the ground shall be *labeled* for such usage. -

❖ Wood and engineered wood products must be naturally durable or preservative treated. This section references the American Wood Council's (AWC) *National Design Specification (NDS) for Wood Construction* when calculating capacity of structural members.

R507.2.1.1 Engineered wood products. Engineered wood products shall be in accordance with Section R502.

❖ See the commentary to Section R507.2.1.

R507.2.2 Plastic composite deck boards, stair treads, guards or handrails. *Plastic composite* exterior deck boards, stair treads, *guards* and *handrails* shall comply with the requirements of ASTM D7032 and this section. .

❖ Plastic composite (PC) materials, commonly used in exterior deck boards, guards and handrails have a widespread acceptance for residential construction. The referenced standard, ASTM D7032, *Standard Specification for Establishing Performance Ratings for Wood-Plastic Composite and Plastic Lumber Deck Boards, Stair Treads, Guards, and Handrails* includes performance evaluations, such as flexural tests, ultraviolet-resistance tests, freeze-thaw-resistance tests, biodegradation tests, fire-performance tests, creep-recovery tests, mechanical fastener holding tests and slip-resistance tests. The standard also includes considerations of the effects of temperature and moisture, concentrated loads and fire propagation tests. Requiring plastic composite exterior deck boards, stair treads, guards and handrails to comply with ASTM D7032 helps ensure these products are designed and tested for the intended application.

R507.2.2.1 Labeling. *Plastic composite* deck boards and stair treads, or their packaging, shall bear a *label* that indicates compliance with ASTM D7032 and includes the allowable load and maximum allowable span determined in accordance with ASTM D7032. Plastic or composite *handrails* and *guards*, or their packaging, shall bear a *label* that indicates

compliance with ASTM D7032 and includes the maximum allowable span determined in accordance with ASTM D7032.

❖ Mandatory labeling requirements for exterior deck components manufactured of plastic composites are specifically identified in this section. Each deck board and stair tread, similar to pressure-preservative treated wood, is required to have a label. The required label would be applied on an end or on a face (side) of each board. Product labels will show verification of compliance with ASTM D7032 and provide the appropriate performance information.

For example, deck board labels would identify the allowable load and span [e.g., 40 psf load on a 16-inch (406 mm) span may be expressed as "16/40"]. Handrails and guardrail systems, which are more often supplied as "kits" in packages, require labels on the items or on the packaging. The maximum span (maximum vertical post spacing) is required to be on the label, as is verifying compliance with ASTM D7032.

R507.2.2.2 Flame spread index. *Plastic composite* deck boards, stair treads, *guards*, and *handrails* shall exhibit a flame spread index not exceeding 200 when tested in accordance with ASTM E84 or UL 723 with the test specimen remaining in place during the test. . -

Exception: *Plastic composites* determined to be noncombustible.

❖ The flame spread index of plastic composite materials is limited to 200 when tested in accordance with ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, or UL723, *Standard Test Method for Surface Burning Characteristics of Building Materials*, (Class C FSI). This is a measure of how rapid a fire may spread for the plastic composite (PC) materials using the common ASTM E84 or UL723 test method.

R507.2.2.3 Decay resistance. *Plastic composite* deck boards, stair treads, *guards* and *handrails* containing wood, cellulosic or other biodegradable materials shall be decay resistant in accordance with ASTM D7032.

❖ ASTM D7032 includes a requirement that plastic composite materials pass a fungal decay resistance test. See the commentary to Section R317.

R507.2.2.4 Termite resistance. Where required by Section 318, *plastic composite* deck boards, stair treads, *guards* and *handrails* containing wood, cellulosic or other biodegradable materials shall be termite resistant in accordance with ASTM D7032.

❖ ASTM D7032 includes a requirement for plastic composite materials pass a termite resistance test. See the commentary to Section R318.

R507.2.2.5 Installation of plastic composites. *Plastic composite* deck boards, stair treads, *guards* and *handrails* shall be installed in accordance with this code and the manufacturer's instructions.

❖ Requirements for the installation of plastic composite products are in accordance with the manufacturer's instructions, which is the best way to ensure that PCs perform to the required design loads. Installation instructions are an integral part of the manufacturer's labeling program.

R507.2.3 Fasteners and connectors. Metal fasteners and connectors used for all decks shall be in accordance with Section R317.3 and Table R507.2.3.

❖ Structural fasteners and connectors are vital to the integrity of a wood deck. Not only must fasteners and connectors tie wood members to one another—for example a ledger fastened to an exterior wall, or a beam to column—they must maintain connections while exposed to the elements. Fasteners and connectors must be corrosion resistant to be structurally sound throughout the life of the deck.

This section requires fasteners and connectors to comply with Section R317.3, which addresses the use of corrosion-resistant fasteners and connectors in contact with preservative-treated wood. Section R317.3 does not address fastener use with other materials such as naturally decay-resistant wood or plastic composites. Additionally, Section R317.3 does not look at exposure conditions such as rain, snow or heat.

Fasteners and connectors must comply with Table R507.2.3, which accounts for conditions such as openly exposed and partially sheltered connections. The table provides recommendations for fastener types and metal connectors as well as providing an alternative for corrosion-resistant connections.

TABLE R507.2.3. See below.

❖ Note b addresses proximity to saltwater by limiting fastener type to stainless steel. Note d intends to reduce splitting of wood members. For lag screws, Section 12.1.4, Lag Screws, of the *National Design Specification* (NDS) requires predrilling with drill bit(s) sized based on the wood species, the shank size of the lag screw, and the root diameter of the threaded section of the lag screws. The NDS is available online at www.awc.org. See also the commentary to Section R507.2.3.

R507.2.4 Flashing. Flashing shall be corrosion-resistant metal of nominal thickness not less than 0.019 inch (0.48 mm) or *approved* nonmetallic material that is compatible with the substrate of the structure and the decking materials.

❖ Approved materials for deck flashing are provided in this section. Required installation locations and performance criteria are provided in Section R703.4.

R507.2.5 Alternate materials. Alternative materials, including glass and metals, shall be permitted.

❖ See the commentary to Section R104.11.

R507.3 Footings. Decks shall be supported on concrete footings or other *approved* structural systems designed to accommodate all loads in accordance with Section R301. Deck footings shall be sized to carry the imposed loads from the deck structure to the ground as shown in Figure R507.3.

Exceptions:

1. Footings shall not be required for free-standing decks consisting of joists directly supported on grade over their entire length.

2. Footings shall not be required for free-standing decks that meet all of the following criteria:

    2.1. The joists bear directly on *precast concrete* pier blocks at grade without support by beams or posts.

    2.2. The area of the deck does not exceed 200 square feet (18.6 m²).

    2.3. The walking surface is not more than 20 inches (508 mm) above grade at any point within 36 inches (914 mm) measured horizontally from the edge.

❖ Settlement of soils below a deck footing pulls the deck away from the ledger attached to a building. It is important that a deck footing be sufficiently large to resist soil movement, with every effort made to place a deck's footings on undisturbed soils. Minimum widths and depths of deck footings are based on the deck tributary area, snow or deck live load and soil bearing pressure. Minimum dimensions are given for both square and round footings. Typical deck footings vary widely from one region to another. Figure 507.3 gives examples of typical footings.

Two exceptions are provided from the requirement that decks be supported on concrete footings or other traditional foundation systems. As an exception, a free-standing wood deck consisting entirely of joists laid directly on the ground, with decking over top of them, supported only by the ground is allowed. If such a deck or patio settles or moves due to frost heave or

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 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 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./ft² (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 ¹/₃₂ inch and a maximum ¹/₁₆ inch larger than the bolt.

d. Lag screws 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.

other ground movement, it will not create a safety concern for occupants or compromise the adjacent dwelling, since the entire structure is resting on the finished grade.

A second exception applies to a small deck low to the ground that may use concrete piers as footings directly supporting deck joists (no beams or posts). These precast concrete pier blocks are popular in many areas of the country where frost concerns are minimal, shifting or uplift of the deck and pier blocks due to high winds or earthquakes is not anticipated, and the deck is constructed close to the finished grade. Three conditions are required in this exception. First, the deck joists must sit directly on the pier blocks, typically passing through notches provided in the top of the block, without the need for a beam or post. This limits the height of the deck and avoids any concerns about lateral stability. The second condition limits the area of a deck supported on pier blocks. The third condition limits the height of the top of the decking above the grade below. This limits the possibility of serious injury if a deck fails due to settlement of the pier blocks or movement of the deck joists within the pier blocks.

R507.3.1 Minimum size. The minimum size of concrete footings shall be in accordance with Table R507.3.1, based on the tributary area and allowable soil-bearing pressure in accordance with Table R401.4.1.

❖ The 2021 IRC includes deck tributary area for determining minimum footing size in Section R507.3, and for selecting deck post species, size and maximum height in Section R507.4. Tributary area is the horizontal surface area of deck that the element being designed supports. The tributary area for a footing and its post will be the same.

To demonstrate the concept of tributary area, consider the following deck example and Commentary Figure R507.3.1:

- The tributary area for a post and the post's footing are based on the area of the deck attributed to that post. That's the area halfway from the post to the nearest structural element plus any cantilever (overhang).
- The beam across the top of the post is supported by three posts along the length of the deck. For the left post, (Post 1), the beam cantilever on the left and half the distance to the center post is tributary to Post 1. For this example, that's 1 foot of beam cantilever plus 4 feet of beam span, which is 5 feet. For the joists supported by the beam, half the length of the joist span plus the entire joist cantilever is attributed to the beam. For this deck, that would be 4 feet of joist span and 2 feet of joist cantilever, which is 6 feet.
- The tributary area of a post and its footing depend on their location under the deck.
  - o Post 1 supports Tributary Areas 1, 2, 3 and 4 for a total tributary area of 30 square feet: $(1 + 4) \times (4 + 2) = 30$ sq. ft.
  - o The center post (Post 2) supports Tributary Areas 5 and 6 for a total tributary area of 48 square feet; $(4 + 4) \times (4 + 2) = 48$ sq. ft.

TABLE R507.3.1. See page 5-49.
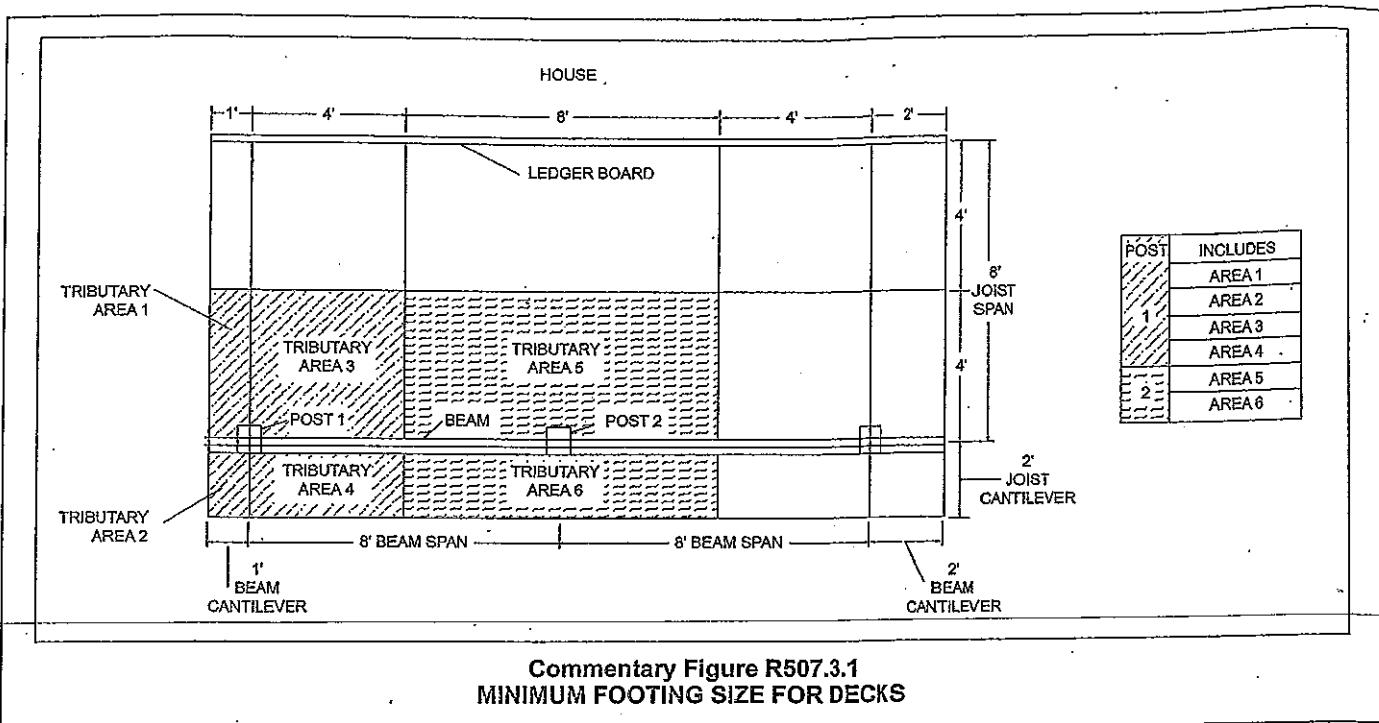
❖ See the commentary to Section R507.3.1.

R507.3.2 Minimum depth. Deck footings shall be placed not less than 12 inches (305 mm) below the undisturbed ground surface.

❖ See the commentary to Section R507.3.
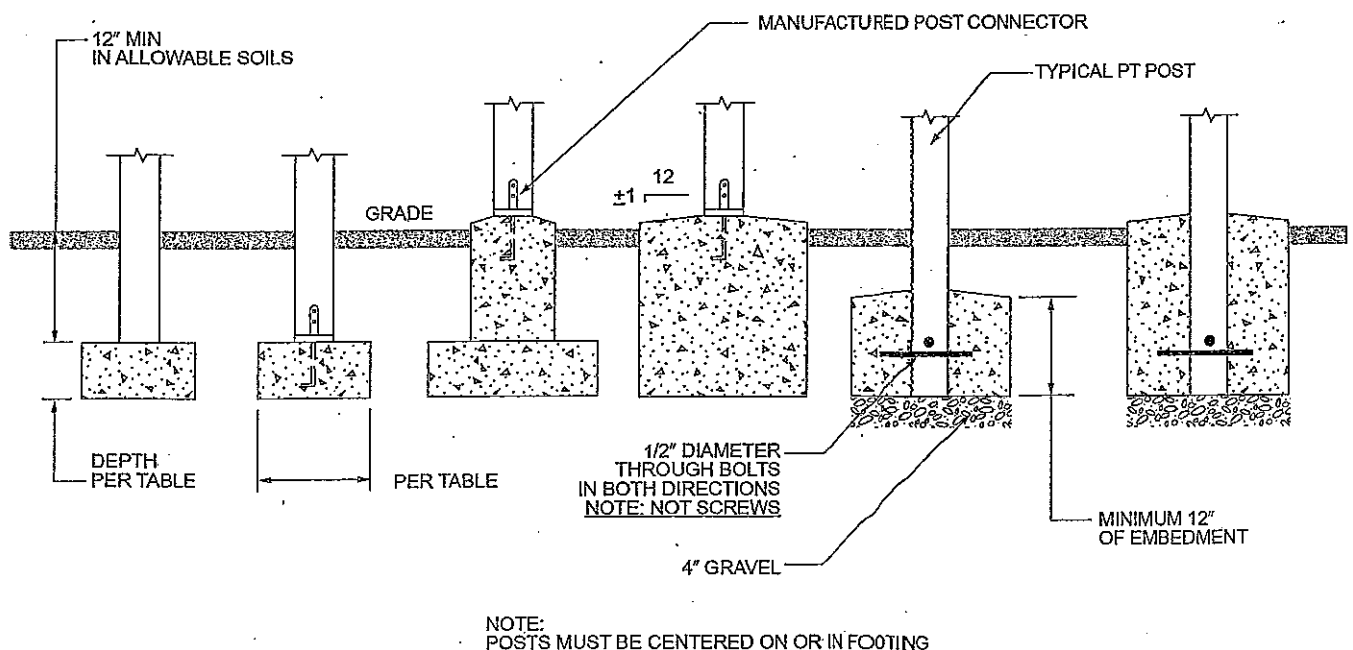
For SI: 1 inch = 25.4 mm.

FIGURE R507.3
DECK POSTS TO DECK FOOTING CONNECTION

Commentary Figure R507.3.1
MINIMUM FOOTING SIZE FOR DECKS

R507.3.3 Frost protection. Where decks are attached to a frost-protected structure, deck footings shall be protected from frost by one or more of the following methods:

1. Extending below the frost line specified in Table R301.2.

2. Erecting on solid rock.

3. Other *approved* methods of frost protection.

❖ Section R507.3.3 explicitly states that when attached to a frost-protected structure, the deck footing can extend below the frost line or use another approved method of frost protection. Foundations for decks that are not attached to a structure or are attached to a nonfrost-protected structure, such as a detached garage on a shallow monolithic foundation, do not require frost protection. Also see the commentary to Section R403.3 on frost-protected shallow foundations.

R507.4 Deck posts. For single-level decks, wood post size shall be in accordance with Table R507.4.

❖ Section R507.4 contains prescriptive provisions for sizing wood posts and connecting the post to the footing of a deck. The post-sizing provisions are presented in Table R507.4. Posts must be restrained at the bottom to prevent lateral displacement. The lateral restraint may be provided by a minimum post-to-footing connection based on the manufacturer's requirements for connections supplying lateral restraint or by embedding the post 12 inches or greater into the soil or concrete piers. See the commentary in Section R317.1.4 for decay resistance of wood columns and Section R507.3.1 for calculation of tributary area.

TABLE R507.4. See page 5-50.

❖ Table R507.4 assumes wet service, No. 2 grade lumber. Maximum post height depends on wood species,

ground snow load, tributary deck area and post size. Height is determined by measuring from the connection under the deck beam to the top of the footing. Note, when notching a support post, a 2-ply beam will require a 6-inch nominal post and a 3-ply beam will require an 8-inch nominal post to retain the 2$\frac{1}{2}$-inch minimum notched lateral support.

The calculations used in the creation of Table R507.4 assume pure compressive force and a pinned connection at the top and bottom of the post. The calculations assume the post connection prevents sideways movement but provides little rotation resistance. For some decks, these assumptions may be inappropriate. For example, a freestanding deck with inadequate bracing may lack lateral stiffness or sufficient lateral restraint. Thus, a pinned connection at the top of a post would be an inappropriate assumption and engineering calculations may be needed.

R507.4.1 Deck post to deck footing connection. Where posts bear on concrete footings in accordance with Section R403 and Figure R507.3, lateral restraint shall be provided by manufactured connectors or a minimum post embedment of 12 inches (305 mm) in surrounding soils or concrete piers. Other footing systems shall be permitted.

Exception: Where expansive, compressible, shifting or other questionable soils are present, surrounding soils shall not be relied on for lateral support.

❖ An exception limits the location of embedded deck posts used for lateral support to soils that are stable; in other words, soils of Site Class A, B, C or D. Where shifting or expansive soils are present, embedding posts only 12 inches in surrounding soils does not adequately prevent lateral displacement of the deck post.

TABLE R507.3.1
MINIMUM FOOTING SIZE FOR DECKS

LIVE OR GROUND SNOW LOAD[b] (psf)	TRIBUTARY AREA (ft²)	LOAD-BEARING VALUE OF SOILS[a, c, d] (psf)								
		1,500[e]			2,000[e]			≥ 3,000[e]		
		Side of a square footing (inches)	Diameter of a round footing (inches)	Thickness (inches)[f]	Side of a square footing (inches)	Diameter of a round footing (inches)	Thickness (inches)[f]	Side of a square footing (inches)	Diameter of a round footing (inches)	Thickness (inches)[f]
40	5	7	8	6	7	8	6	7	8	6
	20	10	12	6	9	9	6	7	8	6
	40	14	16	6	12	14	6	10	12	6
	60	17	19	6	15	17	6	12	14	6
	80	20	22	7	17	19	6	14	16	6
	100	22	25	8	19	21	6	15	17	6
	120	24	27	9	21	23	7	17	19	6
	140	26	29	10	22	25	8	18	21	6
	160	28	31	11	24	27	9	20	22	7
50	5	7	8	6	7	8	6	7	8	6
	20	11	13	6	10	11	6	8	9	6
	40	15	17	6	13	15	6	11	13	6
	60	19	21	6	16	18	6	13	15	6
	80	21	24	8	19	21	6	15	17	6
	100	24	27	9	21	23	7	17	19	6
	120	26	30	10	23	26	8	19	21	6
	140	28	32	11	25	28	9	20	23	7
	160	30	34	12	26	30	10	21	24	8
60	5	7	8	6	7	8	6	7	8	6
	20	12	14	6	11	12	6	9	10	6
	40	16	19	6	14	16	8	12	14	6
	60	20	23	7	17	20	6	14	16	6
	80	23	26	9	20	23	7	16	19	6
	100	26	29	10	22	25	8	18	21	6
	120	28	32	11	25	28	9	20	23	7
	140	31	35	12	27	30	10	22	24	8
	160	33	37	13	28	32	11	23	26	9
70	5	7	8	6	7	8	6	7	8	6
	20	12	14	6	11	13	6	9	10	6
	40	18	20	6	15	17	6	12	14	6
	60	21	24	8	19	21	6	15	17	6
	80	25	28	9	21	24	8	18	20	6
	100	28	31	11	24	27	9	20	22	7
	120	30	34	12	26	30	10	21	24	8
	140	33	37	13	28	32	11	23	26	9
	160	35	40	15	30	34	12	25	28	9

For SI: 1 inch = 25.4 mm, 1 square foot = 0.0929 m², 1 pound per square foot = 0.0479 kPa.

a. Interpolation permitted, extrapolation not permitted.
b. Based on highest load case: Dead + Live or Dead + Snow.
c. Footing dimensions shall allow complete bearing of the post.
d. If the support is a brick or CMU pier, the footing shall have a minimum 2-inch projection on all sides.
e. Area, in square feet, of deck surface supported by post and footings.
f. Minimum thickness shall only apply to plain concrete footings.

TABLE R507.4
DECK POST HEIGHT

LOADS (psf)[b]	POST SPECIES[c]	POST SIZE[d]	TRIBUTARY AREA (ft²)[g,h]							
			20	40	60	80	100	120	140	160
			MAXIMUM DECK POST HEIGHT[a] (feet-inches)							
40 live load	Southern pine	4 × 4	14-0	13-8	11-0	9-5	8-4	7-5	6-9	6-2
		4 × 6	14-0	14-0	13-11	12-0	10-8	9-8	8-10	8-2
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Douglas fir[e] Hem-fir[e] Spruce-pine-fir[e]	4 × 4	14-0	13-6	10-10	9-3	8-0	7-0	6-2	5-3
		4 × 6	14-0	14-0	13-10	11-10	10-6	9-5	8-7	7-10
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Redwood[f] Western cedars[f] Ponderosa pine[f] Red pine[f]	4 × 4	14-0	13-2	10-3	8-1	5-8	NP	NP	NP
		4 × 6	14-0	14-0	13-6	11-4	9-9	8-4	6-9	4-7
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	13-7	9-7
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
50 ground snow load	Southern pine	4 × 4	14-0	12-2	9-10	8-5	7-5	6-7	5-11	5-4
		4 × 6	14-0	14-0	12-6	10-9	9-6	8-7	7-10	7-3
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	14-0	13-4
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Douglas fir[e] Hem-fir[e] Spruce-pine-fir[e]	4 × 4	14-0	12-1	9-8	8-2	7-1	6-2	5-3	4-2
		4 × 6	14-0	14-0	12-4	10-7	9-4	8-4	7-7	6-11
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	14-0	12-10
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Redwood[f] Western cedars[f] Ponderosa pine[f] Red pine[f]	4 × 4	14-0	11-8	9-0	6-10	3-7	NP	NP	NP
		4 × 6	14-0	14-0	12-0	10-0	8-6	7-0	5-3	NP
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	10-8	2-4
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
60 ground snow load	Southern pine	4 × 4	14-0	11-1	8-11	7-7	6-7	5-10	5-2	4-6
		4 × 6	14-0	14-0	11-4	9-9	8-7	7-9	7-1	6-6
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	12-9	11-2
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Douglas fir[e] Hem-fir[e] Spruce-pine-fir[e]	4 × 4	14-0	10-11	8-8	7-3	6-2	5-0	3-7	NP
		4 × 6	14-0	13-11	11-2	9-7	8-4	7-5	6-8	5-11
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	12-2	10-2
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Redwood[f] Western cedars[f] Ponderosa pine[f] Red pine[f]	4 × 4	14-0	10-6	7-9	4-7	NP	NP	NP	NP
		4 × 6	14-0	13-7	10-9	8-9	7-0	4-9	NP	NP
		6 × 6	14-0	14-0	14-0	14-0	14-0	9-9	NP	NP
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0

(continued)

TABLE R507.4—continued
DECK POST HEIGHT

LOADS (psf)[b]	POST SPECIES[c]	POST SIZE[d]	TRIBUTARY AREA (ft²)[g,h]							
			20	40	60	80	100	120	140	160
			MAXIMUM DECK POST HEIGHT[a] (feet-inches)							
70 ground snow load	Southern pine	4 × 4	14-0	10-2	8-2	6-11	5-11	5-2	4-4	3-4
		4 × 6	14-0	12-11	10-5	8-11	7-10	7-1	6-5	5-10
		6 × 6	14-0	14-0	14-0	14-0	14-0	12-9	10-11	8-7
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Douglas fir[e] Hem-fir[e] Spruce-pine-fir[e]	4 × 4	14-0	10-1	7-11	6-6	5-3	3-7	NP	NP
		4 × 6	14-0	12-10	10-3	8-9	7-7	6-8	5-10	4-11
		6 × 6	14-0	14-0	14-0	14-0	14-0	12-2	9-9	5-9
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Redwood[f] Western cedars[f] Ponderosa pine[f] Red pine[f]	4 × 4	14-0	9-5	6-5	NP	NP	NP	NP	NP
		4 × 6	14-0	12-6	9-8	7-7	5-3	NP	NP	NP
		6 × 6	14-0	14-0	14-0	14-0	10-8	NP	NP	NP
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0

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

NP = Not Permitted.

a. Measured from the underside of the beam to the top of footing or pier.
b. 10 psf dead load. Snow load not assumed to be concurrent with live load.
c. No. 2 grade, wet service factor included.
d. Notched deck posts shall be sized to accommodate beam size in accordance with Section R507.5.2.
e. Includes incising factor.
f. Incising factor not included.
g. Area, in square feet, of deck surface supported by post and footings.
h. Interpolation permitted. Extrapolation not permitted.

R507.5 Deck beams. Maximum allowable spans for wood deck beams, as shown in Figure R507.5, shall be in accordance with Tables R507.5(1) through R507.5(4). Beam plies shall be fastened together with two rows of 10d (3-inch × 0.128-inch) nails minimum at 16 inches (406 mm) on center along each edge. Beams shall be 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.

❖ Section R507.5 is based on wet use and treated lumber. The span tables for wood floors in Section R502 are not appropriate for exterior wood-framed decks.

Additional wood species that are not in Section R502 are included in the deck beam and joist tables. The tables are based on wood capacity using the *National Design Specification for Wood Construction* (NDS). The deck joist and beam tables assume #2 grade wood, wet use and incising, where applicable. Incising is done to assist chemical additives to soak deeper into preservative treated lumber. Incising is only assumed in lumber species that are resistant to pressure treatment such as Douglas fir and Hem-fir. Southern pine more easily absorbs preservatives during the pressure treating process and does not require incising.

DROPPED BEAM

FLUSH BEAM
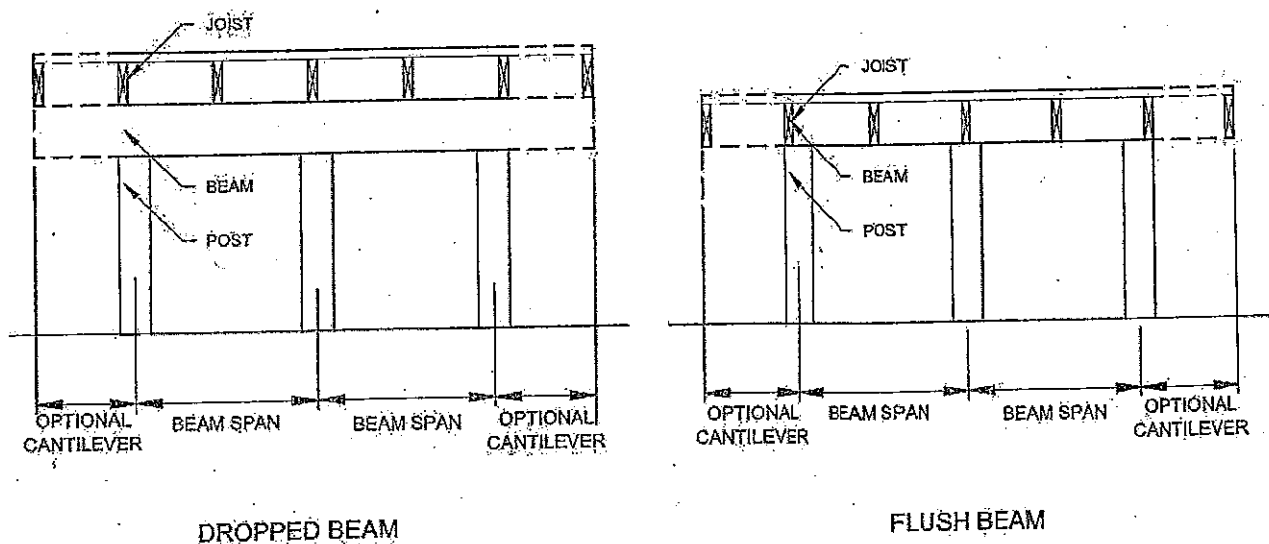
FIGURE R507.5
TYPICAL DECK JOIST SPANS

Maximum beam spans consider the load from tributary areas based on joist spans. The beams may be either flush with joists or dropped below to support the joists, as shown in Figure R507.5. The maximum beam span length is controlled by the effective deck joist span. The joist span is described as effective in order to take account of the potential for a deck joist to cantilever beyond the deck beam. In Tables R507.5(1)–(4), all deck joists are assumed to cantilever the allowed length of one-fourth of the joist backspan past the supporting beam. This assumption is included in the calculated tributary area of the beam. Table R507.5(5), added to the 2021 code, may be used to determine a shorter effective joist span where a beam supports a shorter cantilever. Where the joist cantilever is shorter than one-fourth of the backspan or there is no cantilever, the joist span may be decreased when determining the beam's maximum span. This allows the maximum beam span to increase due to the shorter effective joist span.

Maximum cantilever length is intended to be one-fourth of the total actual beam length. Where a beam supports joists cantilevered less than one-fourth of the main span length, or is not cantilevered at all, the beam would be supporting less load. Actual beam length is the length of the physical beam; cantilever maximum length should be calculated by dividing the actual beam length by four. The beam span is measured from the center of one post to the center of the following post. The beam span is the clear span plus the bearing length on each post. For example, if the span between beam supports is 8 feet, then the maximum cantilever length is 8 feet divided by four, or 2 feet. There may be a 2-foot cantilever of the beam on one or both sides of the deck.

Applying Note j: the "Effective Deck Joist Span Length" of Tables R507.5(1) through R507.5(4) allows an increase of the maximum beam length determined by Note j and Table R507.5(5). Calculate C/J of Table R507.5(5) by dividing the actual joist cantilever length (C) by actual (main) joist span length (J). Then, to get the "Effective Deck Joist Span Length" to be used in Tables R507.5(1) through R507.5(4), multiply the actual main joist span by the "joist span factor" of Table R507.5(5).

The deck illustrated in Commentary Figure R507.3.1 has joists cantilevered at 2 feet (C) and the adjacent joist main span is 8 feet (J). Thus C/J is 1/4, and the "joist span factor" from Table R507.5(5) is 1.0. Hence, the "Effective Deck Joist Span Length" to be used in Tables R507.5(1) through R507.5(4) equals the actual joist main span length—but only where the joist cantilever is one-fourth of the joist main span length.

Example 1:

A deck with a ground snow load of 50 psf has a beam using two plies of Southern pine 2 x 10.

Joist span is 12 feet and there is no cantilever.

- C = cantilever, J = joist
- C = 0 feet
- J = 12 feet

- Without Note j, Table R507.5(2) limits the beam to a maximum span of 7 feet 1 inch.

Applying the adjustment factor from Note j and Table R507.5(5):

- C/J = 0 and the joist span factor is 0.66.
- An effective joist span can be calculated as 0.66 × 12 feet = 8 feet.
- The maximum beam span is 8 feet 9 inches per Table R507.5(2) because there is no cantilever.

Note: The beam span is not reduced by 0.66, rather the joist span is reduced by 0.66 to determine an effective joist span.

Assume a deck has joists cantilevered at 1 foot (C) and the adjacent joist main span is 8 feet (J). Thus C/J is 1/8, and the "joist span factor" from Table R507.5(5) is 0.84. Hence, the "Effective Deck Joist Span Length" to be used in Tables R507.5(1) through R507.5(4) is the actual joist main span length (8 ft.) times 0.84, which equals 6.72 feet, which can be rounded up to 7 feet as the "Effective Deck Joist Span Length" to be used in Tables R507.5(1) through R507.5(4). Using a live load of 40 psf, Table R507.5(1) allows for a Southern Pine beam size of 1 – 2 x 10 to span 6 feet and 6 inches, by interpolation. The effect of Note j is to allow for an additional 6 inches of beam span length in this case where the joists cantilever one-eighth of joist main span length.

Example 2:

A deck with a ground snow load of 50 psf is designed using two plies of Southern pine 2 × 10.

Joist span is 12 feet and there is a 12-inch cantilever.

- C = cantilever, J = joist
- C = 1 foot
- J = 12 feet
- Without Note j, Table R507.5(2) limits the beam to a maximum span of 7 feet 1 inch.

Applying the adjustment factor from footnote j and Table R507.5(5):

- C /J = 1/12; therefore, the joist span factor is 0.72.
- An effective joist span can be calculated as 0.72 × 12 feet = 8 feet 8 inches.
- A maximum beam span can be determined from Table R507.5(2) for a 10-foot effective joist span = 7 feet 10 inches
- Or by interpolating per Note a, a beam span of 8 feet 5 inches is achieved as follows:

From Table R507.5(2) (converted to inches):

	A	B	C
Effective joist span	8 ft 96"	8 ft 8 in. 104"	10 ft 120"
Maximum beam span	105"	?	94"

To interpolate, subtract the number of inches between the 10-foot (Column C) and 8-foot (Column A) joist spans, which is 24 inches. The effective joist span in Column B is 8 inches longer than the smaller span in

Column A, which is 8/24 or one-third the difference in lengths. Subtract beam span C from beam span A to get 11 inches. Multiply 11 inches by one-third to get 3.67 inches. Then take beam span A which is 105 inches and subtract 4 inches (rounded up from 3.67 inches). This gives a maximum beam span of 101 inches, or 8 feet 5 inches.

	A	B	C
Effective joist span	96"	104"	120"
Maximum beam span	8 ft 9 in. 105"	8 ft 5 in. 101"	7 ft 10 in. 94"

The beam span table includes single-ply beams. For small decks, porches and landings, often a single member is capable of supporting the live load on the deck For larger beams, an equivalent alternative to two 2x beams is a 4x beam of the same material and depth. Thus, a 4 x 8 beam could use the same allowable span as two 2 x 8 beams.

TABLE R507.5(1). See page 5-54.

❖ Note a: Interpolation allows for more specific beam sizing when a joist span is between two of the tabular choices. For example: Designed with a live load of 40 psf, a Southern pine double 2 x 10 beam carrying joists spanning 9 feet can span 8 feet 6 inches. Though a 9-foot joist span is not an option in the table, it is halfway between the 8-foot and 10-foot joist span columns. Using interpolation, the maximum beam span is also halfway between the tabular 8 feet and 9 feet, resulting in a maximum beam span of 8 feet 6 inches.

Extrapolation is when data is estimated outside of the tabular entries of the table, as opposed to between two entries, and is not permitted. See also the commentary to Section 507.5.

TABLE R507.5(2). See page 5-55.

❖ See the commentary to Section 507.5.

TABLE R507.5(3). See page 5-56.

❖ See the commentary to Section 507.5.

TABLE R507.5(4). See page 5-57.

❖ See the commentary to Section 507.5.

TABLE R507.5(5). See page 5-58.

❖ Table R507.5(5) is used to determine an effective joist span. When the joist cantilever is shorter than one-fourth of the backspan or there is no cantilever, the effective joist span length may be decreased when

determining the beam's maximum span. This allows the maximum beam span length to increase due to the shorter effective joist span.

R507.5.1 Deck beam bearing. The ends of beams shall have not less than 1 1/2 inches (38 mm) of bearing on wood or metal and not less than 3 inches (76 mm) 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 in accordance with Figures R507.5.1(1) and R507.5.1(2).

❖ Beam connections must resist vertical and horizontal forces where attached to wood posts, where attached to concrete or masonry walls, and where the beam is supported on footings. Regardless of how the beam is supported, the beam must resist these forces.

The sizing of deck posts to support the beam is critical to ensure that full bearing on the post exists for each ply of a beam. Beam connection requirements emphasize the ability of the beam to transfer vertical loads to the posts below. Figure R507.5.1(1), illustrating deck beam to deck post connection, emphasizes the important aspects of beam splices connections. Splices must be located over a post.

Beam connections must also resist horizontal displacement, which may be due to wind or seismic events, and dynamic live loads such as people moving. Where manufactured structural components are used, they should be installed as required by the manufacturer's instructions.

FIGURE R507.5.1(1). See page 5-58.

❖ See the commentary to Section R507.5.1.

FIGURE R507.5.1(2). See page 5-59.

❖ See the commentary to Section R507.5.1.

R507.5.2 Deck beam connection to supports. Deck beams shall be attached to supports in a manner capable of transferring vertical loads and resisting horizontal displacement. Deck beam connections to wood posts shall be in accordance with Figures R507.5.1(1) and R507.5.1(2). Manufactured post-to-beam connectors shall be sized for the post and beam sizes. Bolts shall have washers under the head and nut.

❖ Figure R507.5.1(1) illustrates acceptable methods of connecting deck beams to a post. Figure R507.5.1(2), showing more details of notched post connections, depicts the full bearing requirement of Section R507.5.1 for single- and multiple-ply beams, illustrates the minimum post thickness required to support that beam, and shows fastening requirements for vertical and lateral support and restraint.

TABLE R507.5(1)
MAXIMUM DECK BEAM SPAN—40 PSF LIVE LOAD[c]

BEAM SPECIES[d]	BEAM SIZE[e]	EFFECTIVE DECK JOIST SPAN LENGTH[a, i] (feet)						
		6	8	10	12	14	16	18
		MAXIMUM DECK BEAM SPAN LENGTH (feet-inches)[a, b, f]						
Southern pine	1 – 2 × 6	4-7	4-0	3-7	3-3	3-0	2-10	2-8
	1 – 2 × 8	5-11	5-1	4-7	4-2	3-10	3-7	3-5
	1 – 2 × 10	7-0	6-0	5-5	4-11	4-7	4-3	4-0
	1 – 2 × 12	8-3	7-1	6-4	5-10	5-5	5-0	4-9
	2 – 2 × 6	6-11	5-11	5-4	4-10	4-6	4-3	4-0
	2 – 2 × 8	8-9	7-7	6-9	6-2	5-9	5-4	5-0
	2 – 2 × 10	10-4	9-0	8-0	7-4	6-9	6-4	6-0
	2 – 2 × 12	12-2	10-7	9-5	8-7	8-0	7-5	7-0
	3 – 2 × 6	8-6	7-5	6-8	6-1	5-8	5-3	4-11
	3 – 2 × 8	10-11	9-6	8-6	7-9	7-2	6-8	6-4
	3 – 2 × 10	13-0	11-2	10-0	9-2	8-6	7-11	7-6
	3 – 2 × 12	15-3	13-3	11-10	10-9	10-0	9-4	8-10
Douglas fir-larch[g] Hem-fir[g] Spruce-pine-fir	1 – 2 × 6	4-1	3-6	3-0	2-8	2-5	2-3	2-1
	1 – 2 × 8	5-6	4-8	4-0	3-6	3-2	2-11	2-9
	1 – 2 × 10	6-8	5-10	5-1	4-6	4-1	3-9	3-6
	1 – 2 × 12	7-9	6-9	6-0	5-6	5-0	3-9	3-6
	2 – 2 × 6	6-1	5-3	4-9	4-4	3-11	3-7	3-3
	2 – 2 × 8	8-2	7-1	6-4	5-9	5-2	4-8	4-4
	2 – 2 × 10	10-0	8-7	7-9	7-0	6-6	6-0	5-6
	2 – 2 × 12	11-7	10-0	8-11	8-2	7-7	7-1	6-8
	3 – 2 × 6	7-8	6-8	6-0	5-6	5-1	4-9	4-6
	3 – 2 × 8	10-3	8-10	7-11	7-3	6-8	6-3	5-11
	3 – 2 × 10	12-6	10-10	9-8	8-10	8-2	7-8	7-2
	3 – 2 × 12	14-6	12-7	11-3	10-3	9-6	8-11	8-5
Redwood[h] Western cedars[h] Ponderosa pine[h] Red pine[h]	1 – 2 × 6	4-2	3-7	3-1	2-9	2-6	2-3	2-2
	1 – 2 × 8	5-4	4-7	4-1	3-7	3-3	3-0	2-10
	1 – 2 × 10	6-6	5-7	5-0	4-7	4-2	3-10	3-7
	1 – 2 × 12	7-6	6-6	5-10	5-4	4-11	4-7	4-4
	2 – 2 × 6	6-2	5-4	4-10	4-5	4-0	3-8	3-4
	2 – 2 × 8	7-10	6-10	6-1	5-7	5-2	4-10	4-5
	2 – 2 × 10	9-7	8-4	7-5	6-9	6-3	5-10	5-6
	2 – 2 × 12	11-1	9-8	8-7	7-10	7-3	6-10	6-5
	3 – 2 × 6	7-8	6-9	6-0	5-6	5-1	4-9	4-6
	3 – 2 × 8	9-10	8-6	7-7	6-11	6-5	6-0	5-8
	3 – 2 × 10	12-0	10-5	9-4	8-6	7-10	7-4	6-11
	3 – 2 × 12	13-11	12-1	10-9	9-10	9-1	8-6	8-1

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa, 1 pound = 0.454 kg.

a. Interpolation permitted. Extrapolation not permitted.

b. Beams supporting a single span of joists with or without cantilever.

c. Dead load = 10 psf, L/Δ = 360 at main span, L/Δ = 180 at cantilever. Snow load is not assumed to be concurrent with live load.

d. No. 2 grade, wet service factor included.

e. Beam depth shall be equal to or greater than the depth of intersecting joist for a flush beam connection.

f. Beam cantilevers are limited to the adjacent beam's span divided by 4.

g. Includes incising factor.

h. Incising factor not included.

i. Deck joist span as shown in Figure R507.5.

j. For calculation of effective deck joist span, the actual joist span length shall be multiplied by the joist span factor in accordance with Table R507.5(5).

TABLE R507.5(2)
MAXIMUM DECK BEAM SPAN—50 PSF GROUND SNOW LOAD[c]

BEAM SPECIES[d]	BEAM SIZE[e]	EFFECTIVE DECK JOIST SPAN LENGTH (feet)[a, i]						
		6	8	10	12	14	16	18
		MAXIMUM DECK BEAM SPAN LENGTH (feet-inches)[a, b, f]						
Southern pine	1−2×6	4-6	3-11	3-6	3-2	2-11	2-9	2-7
	1−2×8	5-9	4-11	4-5	4-0	3-9	3-6	3-3
	1−2×10	6-9	5-10	5-3	4-9	4-5	4-2	3-11
	1−2×12	8-0	6-11	6-2	5-8	5-3	4-11	4-7
	2−2×6	6-8	5-9	5-2	4-9	4-4	4-1	3-10
	2−2×8	8-6	7-4	6-7	6-0	5-7	5-2	4-11
	2−2×10	10-1	8-9	7-10	7-1	6-7	6-2	5-10
	2−2×12	11-11	10-3	9-2	8-5	7-9	7-3	6-10
	3−2×6	7-11	7-2	6-6	5-11	5-6	5-1	4-10
	3−2×8	10-5	9-3	8-3	7-6	6-11	6-6	6-2
	3−2×10	12-8	10-11	9-9	8-11	8-3	7-9	7-3
	3−2×12	14-11	12-11	11-6	10-6	9-9	9-1	8-7
Douglas fir-larch[g] Hem-fir[g] Spruce-pine-fir[g]	1−2×6	4-0	3-5	2-11	2-7	2-4	2-2	2-0
	1−2×8	5-4	4-7	3-11	3-5	3-1	2-10	2-8
	1−2×10	6-7	5-8	4-11	4-5	4-0	3-8	3-5
	1−2×12	7-7	6-7	5-11	5-4	4-10	4-6	4-2
	2−2×6	6-0	5-2	4-7	4-2	3-10	3-5	3-2
	2−2×8	8-0	6-11	6-2	5-8	5-0	4-7	4-2
	2−2×10	9-9	8-5	7-7	6-11	6-4	5-10	5-4
	2−2×12	11-4	9-10	8-9	8-0	7-5	6-11	6-6
	3−2×6	7-6	6-6	5-9	5-3	4-11	4-7	4-4
	3−2×8	10-0	8-8	7-9	7-1	6-6	6-1	5-8
	3−2×10	12-3	10-7	9-6	8-8	8-0	7-6	7-0
	3−2×12	14-3	12-4	11-0	10-1	9-4	8-9	8-3
Redwood[h] Western cedars[h] Ponderosa pine[h] Red pine[h]	1−2×6	4-1	3-6	3-0	2-8	2-5	2-3	2-1
	1−2×8	5-2	4-6	4-0	3-6	3-2	2-11	2-9
	1−2×10	6-4	5-6	4-11	4-6	4-1	3-9	3-6
	1−2×12	7-4	6-4	5-8	5-2	4-10	4-6	4-3
	2−2×6	6-1	5-3	4-8	4-4	3-11	3-6	3-3
	2−2×8	7-8	6-8	5-11	5-5	5-0	4-8	4-3
	2−2×10	9-5	8-2	7-3	6-8	6-2	5-9	5-5
	2−2×12	10-11	9-5	8-5	7-8	7-2	6-8	6-3
	3−2×6	7-1	6-5	5-11	5-5	5-0	4-8	4-5
	3−2×8	9-4	8-4	7-5	6-10	604	5-11	5-7
	3−2×10	11-9	10-2	9-1	8-4	7-8	7-2	6-9
	3−2×12	13-8	11-10	10-7	9-8	8-11	8-4	7-10

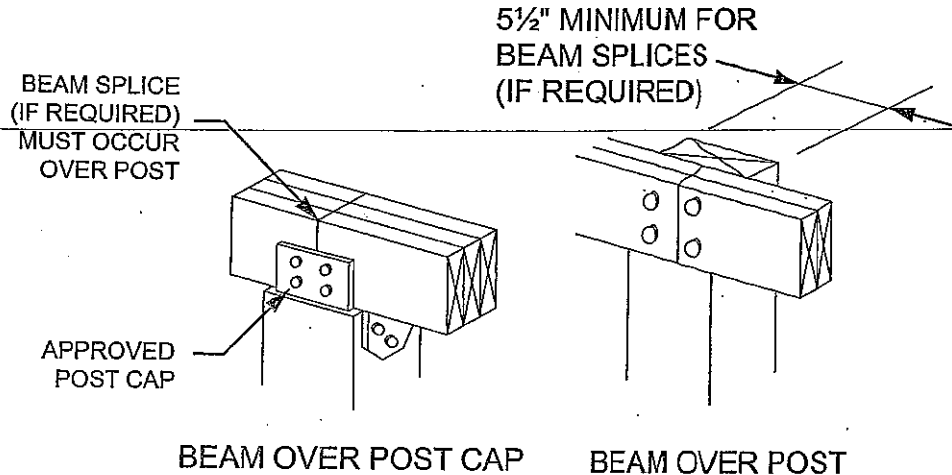For SI: 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa, 1 pound = 0.454 kg.

a. Interpolation allowed. Extrapolation is not allowed.
b. Beams supporting a single span of joists with or without cantilever.
c. Dead load = 10 psf, L/Δ = 360 at main span, L/Δ = 180 at cantilever. Snow load not assumed to be concurrent with live load.
d. No. 2 grade, wet service factor included.
e. Beam depth shall be equal to or greater than the depth of intersecting joist for a flush beam connection.
f. Beam cantilevers are limited to the adjacent beam's span divided by 4.
g. Includes incising factor.
h. Incising factor not included.
i. Deck joist span as shown in Figure R507.5.
j. For calculation of effective deck joist span, the actual joist span length shall be multiplied by the joist span factor in accordance with Table R507.5(5).

TABLE R507.5(5)
JOIST SPAN FACTORS FOR CALCULATING EFFECTIVE DECK JOIST SPAN
[for use with Note j in Tables R507.5(1), R507.5(2), R507.5(3) and R507.5(4)]

C/J[a]	JOIST SPAN FACTOR
0 (no cantilever)	0.66
1/12 (0.87)	0.72
1/10 (0.10)	0.80
1/8 (0.125)	0.84
1/6 (0.167)	0.90
1/4 (0.250)	1.00

For SI: 1 foot = 304.8 mm.

a. C = actual joist cantilever length (feet); J = actual joist span length (feet).

5½" MINIMUM FOR BEAM SPLICES (IF REQUIRED)

BEAM SPLICE (IF REQUIRED) MUST OCCUR OVER POST

APPROVED POST CAP

BEAM OVER POST CAP   **BEAM OVER POST**

For SI: 1 inch = 25.4 mm.

FIGURE R507.5.1(1)
DECK BEAM TO DECK POST

R507.6 Deck joists. Maximum allowable spans for wood deck joists, as shown in Figure R507.6, shall be in accordance with Table R507.6. The maximum joist spacing shall be limited by the decking materials in accordance with Table R507.7.

❖ Section R507.6 addresses deck joist requirements and includes maximum joist span length, maximum joist cantilever length, minimum length of bearing, and provisions for lateral restraint on the free ends of the joists and at locations of bearing.

Figure R507.6 illustrates common decks, including a deck connected to a structure and a free-standing deck. The allowable joist span, per Table R507.6, is based on the required minimum load (dead load, plus live load or ground snow load, whichever is higher), the joist species, the joist size (nominal size), and the on-center spacing of the joists. The maximum cantilever (overhang), per Table R507.6, is based on the allowable joist span criteria and the joist backspan of the cantilevered joist. Stated differently, the maximum cantilever of a joist is limited by the actual joist span of the noncantilevered segment of the joist. For the deck shown in Commentary Figure R507.3.1, with a live load of 40 psf, a Southern pine 2 x 8 joist at 16 inches o.c. has a maximum allowable joist span of 11 feet 10 inches. In this example, the (actual) joist backspan is 8 feet, which allows for a maximum cantilever of 2 feet.
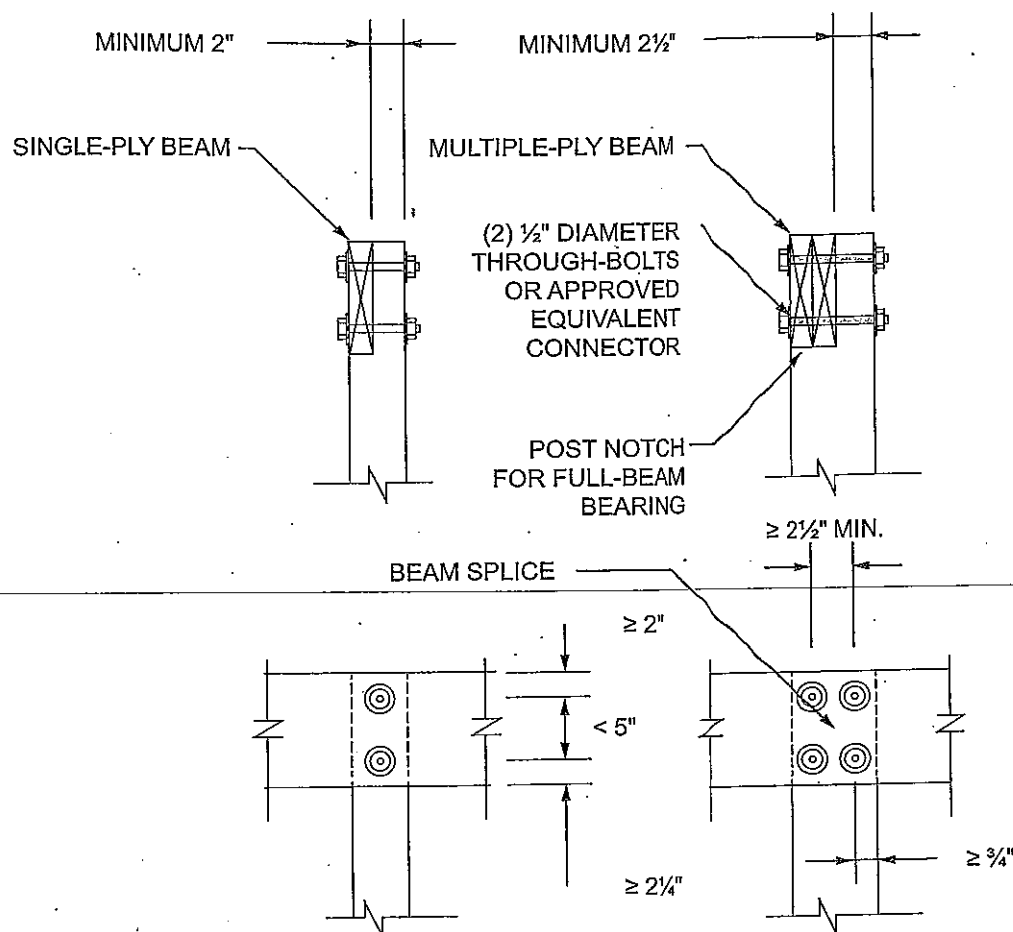
For wood joists, the maximum allowable cantilever is limited to not more than one-fourth of the actual joist backspan. Additionally, the maximum cantilever is based on the bending strength (deflection) of the joist evaluated with a 220-pound point load placed at the end of the cantilever. This point load is almost always more restrictive than the minimum required live load or ground snow load.

Note the NP (Not Permitted) entries in Table R507.6 for the maximum cantilever length are where the table's column for joist backspan (the actual joist span of the noncantilevered segment of the joist) exceeds the allowable joist span.

TABLE R507.6. See page 5-61.

❖ Table R507.6 contains the maximum allowable joist span length as well as the maximum allowable joist cantilever length. Allowable joist spans are based on the joist's on-center spacing.

Joist cantilevers are based on the actual backspan creating a more intuitive maximum cantilever length. The term "backspan" is used to differentiate the actual joist span from the maximum allowable joist span available in the table. Where Table R507.6 states a cantilever is not permitted, the backspan required is longer than the maximum allowable joist span. Cantilevers, in order to carry their loads, must have the joist extend

MINIMUM 2" ——→

MINIMUM 2½" ——→

SINGLE-PLY BEAM

MULTIPLE-PLY BEAM

(2) ½" DIAMETER
THROUGH-BOLTS
OR APPROVED
EQUIVALENT
CONNECTOR

POST NOTCH
FOR FULL-BEAM
BEARING

≥ 2½" MIN.

BEAM SPLICE

≥ 2"

< 5"

≥ 2¼"

≥ ¾"

For SI: 1 inch = 25.4 mm.

FIGURE R507.5.1(2)
NOTCHED POST-TO-BEAM CONNECTION

back along the deck a distance longer than the cantilever's length. Generally, a backspan needs to be at least four times as long as the cantilever. An example of this is a Southern pine 2 x 6 joist which has a maximum joist span of 9 feet 11 inches. The table has entries for backspans of 10 feet to 18 feet but the cantilever length for a 2 x 6 is shown as Not Permitted (NP) since a joist span of 10 feet is not permitted for 2 x 6 lumber.

Note a assumes a 10 psf dead load in addition to the live load or ground snow load. Note g allows interpolation between two entries in the table. For example: A deck with a live load of 40 psf, Southern pine 2 x 8 joists at 16 inches o.c (maximum allowable joist span of 11'-10") is designed with a joist backspan of 9 feet. Interpolation would result in a maximum cantilever of 2 feet 3 inches. See also the commentary to Section R507.6.

R507.6.1 Deck joist bearing. The ends of joists shall have not less than 1½ inches (38 mm) of bearing on wood or metal and not less than 3 inches (76 mm) of bearing on concrete or masonry over its entire width. 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. Joist framing into the side of a beam or ledger board shall be supported by *approved* joist hangers.

❖ Mechanical connectors are required where joists bear on a single-ply ledger or beam and where attached to the side of a beam or ledger.

R507.6.2 Deck joist lateral restraint. 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 joists, their depth shall equal not less than 60 percent of the joist depth. Where lateral restraint is provided by rim joists, they shall be secured to the end of each joist with not fewer than three 10d (3-inch by 0.128-inch) (76 mm by 3.3 mm) nails or three No. 10 x 3-inch-long (76 mm) wood screws.

❖ These requirements are intended to prevent rotation of the joists. See the commentary to Section R507.6.

R507.7 Decking. Maximum allowable spacing for joists supporting wood decking, excluding *stairways*, shall be in accordance with Table R507.7. Wood decking shall be attached to each supporting member with not less than two 8d threaded nails or two No. 8 wood screws. Maximum allowable spacing for joists supporting *plastic composite* decking shall be in accordance with Section R507.2. Other *approved* deck-

ing or fastener systems shall be installed in accordance with the manufacturer's installation requirements.

❖ Table R507.7 requires that the wood deck boards be either perpendicular or diagonal to the joist. The maximum angle of the diagonal deck board is 45 degrees from perpendicular. Wood decking shall be fastened by either threaded nails or wood screws. Other decking or fastener systems would be permitted where installed per the manufacturer's installation instructions.

The span rating of wood decking is based on the decking's ability to resist a 220-pound point load with three supports. While supporting decking over multiple supports will have better performance, many areas of a deck do not allow for this option. The allowable span of the decking for single spans is adjusted to produce an equivalent bending stress to the multiple-span condition. Similarly, the decking boards spanning diagonally are adjusted for equivalent strength.

Section R507.2, and specifically Section R507.2.2, include requirements for plastic composite decking and stair treads.

TABLE R507.7. See page 5-62.

❖ Table R507.7 considers whether wood decking is perpendicular to the joists or diagonal, whether the decking runs across multiple joists or only two, the spacing of the joists and the thickness of the decking. A multiple-span condition with decking allows an increase in the maximum joist spacing in some cases, particularly when decking is relatively thin and flexible. If a wider spacing of joists is desired for 1¼-inch-thick wood decking, Note b allows a lumber grading agency or third-party wood inspection agency to provide maximum spans for a specific species of 1¼-inch-thick decking.
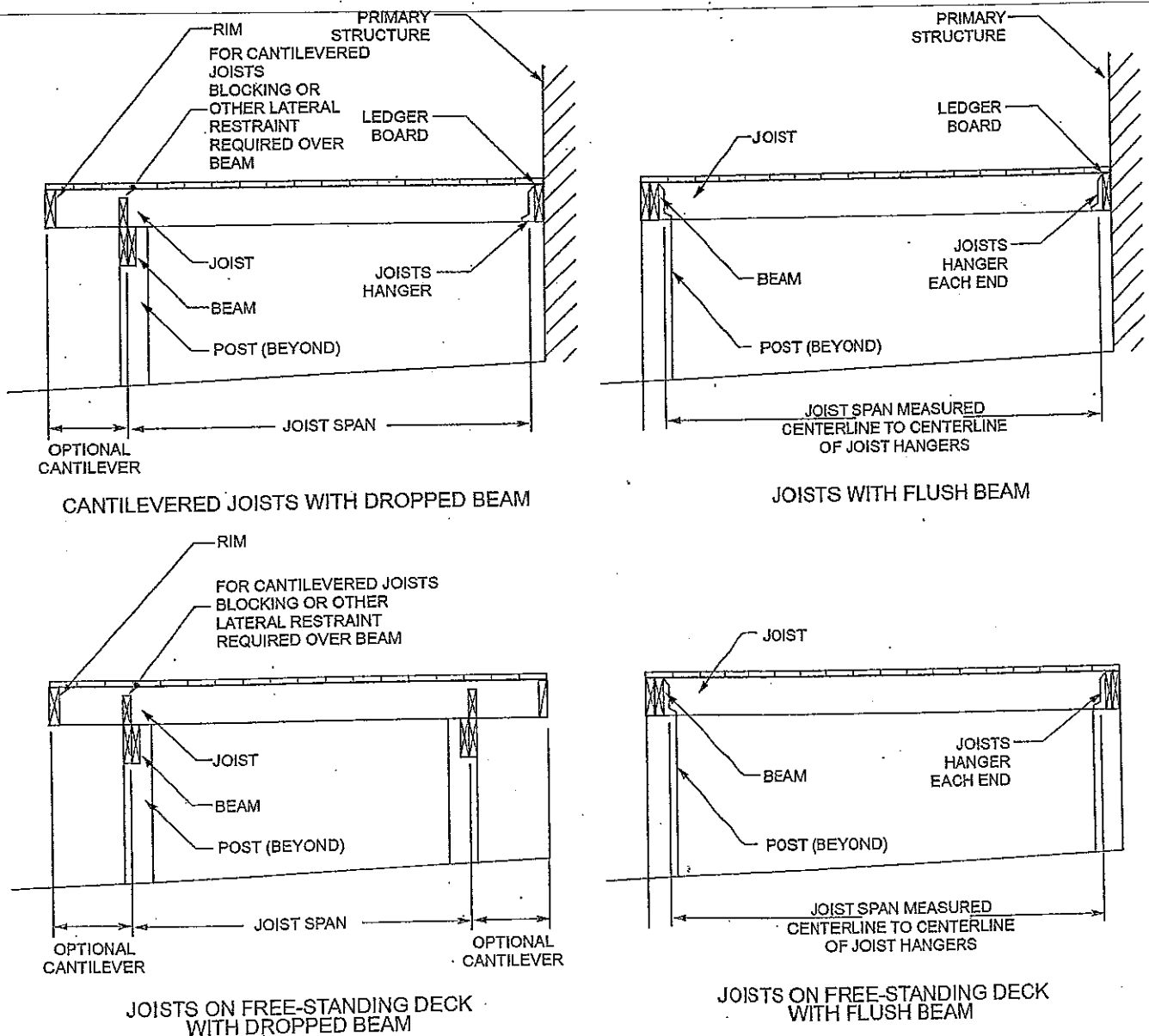

CANTILEVERED JOISTS WITH DROPPED BEAM

JOISTS WITH FLUSH BEAM

JOISTS ON FREE-STANDING DECK WITH DROPPED BEAM

JOISTS ON FREE-STANDING DECK WITH FLUSH BEAM

FIGURE R507.6
TYPICAL DECK JOIST SPANS

TABLE R507.6
MAXIMUM DECK JOIST SPANS

LOAD[a] (psf)	JOIST SPECIES[b]	JOIST SIZE	ALLOWABLE JOIST SPAN[b,c] (feet-inches) Joist spacing (inches)			MAXIMUM CANTILEVER[d,f] (feet-inches) Joist back span[g] (feet)							
			12	16	24	4	6	8	10	12	14	16	18
40 live load	Southern pine	2 × 6	9-11	9-0	7-7	1-0	1-6	1-5	NP	NP	NP	NP	NP
		2 × 8	13-1	11-10	9-8	1-0	1-6	2-0	2-6	2-3	NP	NP	NP
		2 × 10	16-2	14-0	11-5	1-0	1-6	2-0	2-6	3-0	3-4	3-4	NP
		2 × 12	18-0	16-6	13-6	1-0	1-6	2-0	2-6	3-0	3-6	4-0	4-1
	Douglas fir-larch[e] Hem-fir[e] Spruce-pine-fir[e]	2 × 6	9-6	8-4	6-10	1-0	1-6	1-4	NP	NP	NP	NP	NP
		2 × 8	12-6	11-1	9-1	1-0	1-6	2-0	2-3	2-0	NP	NP	NP
		2 × 10	15-8	13-7	11-1	1-0	1-6	2-0	2-6	3-0	3-3	NP	NP
		2 × 12	18-0	15-9	12-10	1-0	1-6	2-0	2-6	3-0	3-6	3-11	3-11
	Redwood[f] Western cedars[f] Ponderosa pine[f] Red pine[f]	2 × 6	8-10	8-0	6-10	1-0	1-4	1-1	NP	NP	NP	NP	NP
		2 × 8	11-8	10-7	8-8	1-0	1-6	2-0	1-11	NP	NP	NP	NP
		2 × 10	14-11	13-0	10-7	1-0	1-6	2-0	2-6	3-0	2-9	NP	NP
		2 × 12	17-5	15-1	12-4	1-0	1-6	2-0	2-6	3-0	3-6	3-8	NP
50 ground snow load	Southern pine	2 × 6	9-2	8-4	7-4	1-0	1-6	1-5	NP	NP	NP	NP	NP
		2 × 8	12-1	11-0	9-5	1-0	1-6	2-0	2-5	2-3	NP	NP	NP
		2 × 10	15-5	13-9	11-3	1-0	1-6	2-0	2-6	3-0	3-1	NP	NP
		2 × 12	18-0	16-2	13-2	1-0	1-6	2-0	2-6	3-0	3-6	3-10	3-10
	Douglas fir-larch[e] Hem-fir[e] Spruce-pine-fir[e]	2 × 6	8-10	8-0	6-8	1-0	1-6	1-4	NP	NP	NP	NP	NP
		2 × 8	11-7	10-7	8-11	1-0	1-6	2-0	2-3	NP	NP	NP	NP
		2 × 10	14-10	13-3	10-10	1-0	1-6	2-0	2-6	3-0	3-0	NP	NP
		2 × 12	17-9	15-5	12-7	1-0	1-6	2-0	2-6	3-0	3-6	3-8	NP
	Redwood[f] Western cedars[f] Ponderosa pine[f] Red pine[f]	2 × 6	8-3	7-6	6-6	1-0	1-4	1-1	NP	NP	NP	NP	NP
		2 × 8	10-10	9-10	8-6	1-0	1-6	2-0	1-11	NP	NP	NP	NP
		2 × 10	13-10	12-7	10-5	1-0	1-6	2-0	2-6	2-9	NP	NP	NP
		2 × 12	16-10	14-9	12-1	1-0	1-6	2-0	2-6	3-0	3-5	3-5	NP
60 ground snow load	Southern pine	2 × 6	8-8	7-10	6-10	1-0	1-6	1-5	NP	NP	NP	NP	NP
		2 × 8	11-5	10-4	8-9	1-0	1-6	2-0	2-4	NP	NP	NP	NP
		2 × 10	14-7	12-9	10-5	1-0	1-6	2-0	2-6	2-11	2-11	NP	NP
		2 × 12	17-3	15-0	12-3	1-0	1-6	2-0	2-6	3-0	3-6	3-7	NP
	Douglas fir-larch[e] Hem-fir[e] Spruce-pine-fir[e]	2 × 6	8-4	7-6	6-2	1-0	1-6	1-4	NP	NP	NP	NP	NP
		2 × 8	10-11	9-11	8-3	1-0	1-6	2-0	2-2	NP	NP	NP	NP
		2 × 10	13-11	12-4	10-0	1-0	1-6	2-0	2-6	2-10	NP	NP	NP
		2 × 12	16-6	14-3	11-8	1-0	1-6	2-0	2-6	3-0	3-5	3-5	NP
	Redwood[f] Western cedars[f] Ponderosa pine[f] Red pine[f]	2 × 6	7-9	7-0	6-2	1-0	1-4	NP	NP	NP	NP	NP	NP
		2 × 8	10-2	9-3	7-11	1-0	1-6	2-0	1-11	NP	NP	NP	NP
		2 × 10	13-0	11-9	9-7	1-0	1-6	2-0	2-6	2-7	NP	NP	NP
		2 × 12	15-9	13-8	11-2	1-0	1-6	2-0	2-6	3-0	3-2	NP	NP

(continued)

TABLE R507.6—continued
MAXIMUM DECK JOIST SPANS

LOAD[a] (psf)	JOIST SPECIES[b]	JOIST SIZE	ALLOWABLE JOIST SPAN [b, c] (feet-inches)			MAXIMUM CANTILEVER[d,f] (feet-inches)							
			Joist spacing (inches)			Joist back span[g] (feet)							
			12	16	24	4	6	8	10	12	14	16	18
70 ground snow load	Southern pine	2 × 6	8-3	7-6	6-5	1-0	1-6	1-5	NP	NP	NP	NP	NP
		2 × 8	10-10	9-10	8-2	1-0	1-6	2-0	2-2	NP	NP	NP	NP
		2 × 10	13-9	11-11	9-9	1-0	1-6	2-0	2-6	2-9	NP	NP	NP
		2 × 12	16-2	14-0	11-5	1-0	1-6	2-0	2-6	3-0	3-5	3-5	NP
	Douglas fir-larch[e] Hem-fir[e] Spruce-pine-fir[e]	2 × 6	7-11	7-1	5-9	1-0	1-6	NP	NP	NP	NP	NP	NP
		2 × 8	10-5	9-5	7-8	1-0	1-6	2-0	2-1	NP	NP	NP	NP
		2 × 10	13-3	11-6	9-5	1-0	1-6	2-0	2-6	2-8	NP	NP	NP
		2 × 12	15-5	13-4	10-11	1-0	1-6	2-0	2-6	3-0	3-3	NP	NP
	Redwood[f] Western cedars[f] Ponderosa pine[f] Red pine[f]	2 × 6	7-4	6-8	5-10	1-0	1-4	NP	NP	NP	NP	NP	NP
		2 × 8	9-8	8-10	7-4	1-0	1-6	1-11	NP	NP	NP	NP	NP
		2 × 10	12-4	11-0	9-0	1-0	1-6	2-0	2-6	2-6	NP	NP	NP
		2 × 12	14-9	12-9	10-5	1-0	1-6	2-0	2-6	3-0	3-0	NP	NP

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa, 1 pound = 0.454 kg.
NP = Not Permitted.
a. Dead load = 10 psf. Snow load not assumed to be concurrent with live load.
b. No. 2 grade, wet service factor included.
c. L/Δ = 360 at main span.
d. L/Δ = 180 at cantilever with a 220-pound point load applied to end.
e. Includes incising factor.
f. Incising factor not included.
g. Interpolation allowed. Extrapolation is not allowed.

TABLE R507.7
MAXIMUM JOIST SPACING FOR WOOD DECKING

DECKING MATERIAL TYPE AND NOMINAL SIZE	DECKING PERPENDICULAR TO JOIST		DECKING DIAGONAL TO JOIST[a]	
	Single span[c]	Multiple span[c]	Single span[c]	Multiple span[c]
	Maximum on-center joist spacing (inches)			
1¼-inch-thick wood[b]	12	16	8	12
2-inch-thick wood	24	24	18	24

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 degree = 0.01745 rad.
a. Maximum angle of 45 degrees from perpendicular for wood deck boards.
b. Other maximum span provided by an accredited lumber grading or inspection agency also allowed.
c. Individual wood deck boards supported by two joists shall be considered single span and three or more joists shall be considered multiple span.

R507.8 Vertical and lateral supports. 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. Such attachment shall not be accomplished by the use of toenails or nails subject to withdrawal. For decks with cantilevered framing members, connection 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 acting on the cantilevered portion of the deck. Where positive connection to the primary building structure cannot be verified during inspection, decks shall be self-supporting.

❖ If an exterior wall is used to support a deck, the deck framing must be positively attached to the building structure. This connection design must include a consideration of both vertical and lateral loads, and the connection must be available for inspection. If the deck to structure connection is not available for inspection, this method of support is not permitted and the deck must be self-supporting. The attachment of deck framing, including ledgers, cannot rely solely on nails subject to withdrawal, but must use lag screws, bolts or other connectors that provide resistance to withdrawal. Many deck failures occur at the deck ledger-to-band joist connection, and in many cases these failures can be attributed to deck ledgers attached solely with nails.

In addition to the loads addressed in the preceding paragraph, if a deck has cantilevered framing, the framing must have a connection to its support that is designed to resist uplift resulting from the various live loads acting solely on the cantilevered span (such as

deck occupants congregating on the cantilevered portion of the deck). This load condition will produce maximum uplift at the support opposite the cantilevered end.

However, beam cantilevers and joist cantilevers designed from the prescriptive design tables in Section 507 (Tables R507.5(1)–R507.5(4), and Table R507.6, respectively) do not require an evaluation of uplift at the joist connection to the ledger, or beam at the connection to a post. These prescriptive tables were designed such that live loads on the cantilever areas should not generate a large uplift force at the end of the beam or joist opposite the cantilever. But, when beams or joists are designed with greater cantilever lengths or shorter main span lengths, such designs must account for uplift that may occur due to unbalanced loading over the length of the beam or joist.

R507.9 Vertical and lateral supports at band joist. Vertical and lateral supports for decks shall comply with this section.

❖ This section contains prescriptive design requirements for positive anchorage of a deck to the primary structure. The ledger connection requirements tabulated in this section are designed for vertical loads on the deck ranging from 50 psf (2394 Pa) to 80 psf (3830 Pa). This total load includes a 10 psf (479 Pa) dead load allowance for the weight of decking materials and framing plus either the 40 psf (1915 Pa) live load mandated by Table R301.5 or ground snow loads ranging from 40 psf (1915 Pa) to 70 psf (3352 Pa).

R507.9.1 Vertical supports. Vertical loads shall be transferred to band joists with ledgers in accordance with this section.

❖ The prescriptive band joist and ledger requirements in this section are based on testing of deck-ledger-to-house-band-joist connections. A practical range of preservative-treated deck ledgers including incised hem-fir and Southern pine lumber were attached to a spruce-pine-fir sawn lumber or Douglas fir laminated veneer lumber (LVL) band joist by 1/2-inch (12.7 mm) lag screws or bolts with washers. The ledger connection tests did not include carriage bolts; therefore, an engineered design of the ledger connection is required if carriage bolts are used.

The strength of connections with carriage bolts has not been researched nor included in the NDS, and the connection capacity can be affected by the method of installation. Since these factors have yet to be quantified, the code does not include prescriptive provisions for the use of carriage bolts.

R507.9.1.1 Ledger details. Deck ledgers shall be a minimum 2-inch by 8-inch (51 mm by 203 mm) nominal, pressure-preservative-treated Southern pine, incised pressure-preservative-treated hem-fir, or *approved*, naturally durable, No. 2 grade or better lumber. Deck ledgers shall not support concentrated loads from beams or girders. Deck ledgers shall not be supported on stone or masonry veneer.

❖ This section specifies the material requirements for the deck ledger. Deck ledgers must support deck joists directly. The deck ledger is prohibited from being supported on stone or masonry veneer.

R507.9.1.2 Band joist details. Band joists supporting a ledger shall be a minimum 2-inch-nominal (51 mm), solid-sawn, spruce-pine-fir or better lumber or a minimum 1-inch (25 mm) nominal engineered wood rim boards in accordance with Section R502.1.7. Band joists shall bear fully on the primary structure capable of supporting all required loads.

❖ This section specifies the minimum material requirements for the band joist. A practical range of preservative-treated deck ledgers including incised hem-fir and Southern pine lumber were tested. Band joists of 2-inch (51 mm) nominal spruce-pine-fir and 1-inch by 9 1/2-inch Douglas fir (DF) laminated veneer lumber (LVL) were included. The LVL specification is replaced with a reference to engineered wood rim boards. These products, which are commonly used as an alternative to sawn lumber band joists, are manufactured under one of two industry consensus standards (ANSI/APA PRP 410 and ASTM D7672) and have five or more times the design capacity used to develop Table R507.9.1.3(1). Where other engineered wood products are used as the band joist, the ledger attachment must be designed in accordance with accepted engineering practice.

R507.9.1.3 Ledger to band joist details. Fasteners used in deck ledger connections in accordance with Table R507.9.1.3(1) shall be hot-dipped galvanized or stainless steel and shall be installed in accordance with Table R507.9.1.3(2) and Figures R507.9.1.3(1) and R507.9.1.3(2).

❖ Table R507.9.1.3(1) provides guidance regarding maximum on-center spacing of lag screws and bolts in the ledger-to-band joist connection based on the required minimum load, selected joist span, fastener and sheathing thickness. Table R507.9.1.3(2) provides guidance on minimum end distances, edge distances, and minimum spacing between rows of lag screws and bolts in ledgers attached to band joists. Figures R507.9.1.3(1) and R507.9.1.3(2) provide additional guidance with illustrations.

FIGURE R507.9.1.3(1). See page 5-64.

❖ See the commentary to Section R507.9.1.3.

FIGURE R507.9.1.3(2). See page 5-64.

❖ See the commentary to Section R507.9.1.3.

TABLE R507.9.1.3(1). See page 5-66.

❖ The on-center spacing of the fasteners as shown in Table R507.9.1.3(1) for a 40 psf live load and Figures R507.9.1.3(1) and R507.9.1.3(2) is the closest spacing for the two cases of deck ledger lumber tested. The tested lag screw and bolt capacities used to establish the original on-center spacing were used to expand Table R507.9.1.3(1) for the range of ground snow loads covered in the code. In deck construction, a joist hanger or angle connector is commonly installed at the end of the ledger board to support the deck rim joist. Often these members are double two-ply members [3-inch (76 mm) nominal width]. The spacing of 2 inches to 5 inches (51 mm to 127 mm) from the ledger ends allows the installer flexibility to locate the lag screw or bolt so that it does not interfere with the installation of the joist hanger or structural connector.

In one set of ledger/band joist samples tested, the deck ledger was separated from the structure's band joist by placing a piece of $^{15}/_{32}$-inch wall sheathing in the connection. Note e specifies that only wood structural panel or solid sawn lumber sheathing is permitted. The maximum ½-inch sheathing thickness is in reference to wood structural panels, as lumber sheathing is typically closer to ¾-inch thickness and would not create a structural deficiency in this connection.

In another set of tests of just bolts, a ½-inch (12.7 mm) stack of washers was inserted into the connection to provide a gap for drainage and ventilation. Note f permits either a ½-inch thickness of stacked washers or a ½-inch thickness of a set of approved sheathing materials where combined with wood structural panel or lumber sheathing. In any case, the total distance between the outside face of the band joist and the adjacent inside face of the ledger must not exceed 1 inch (25.4 mm).

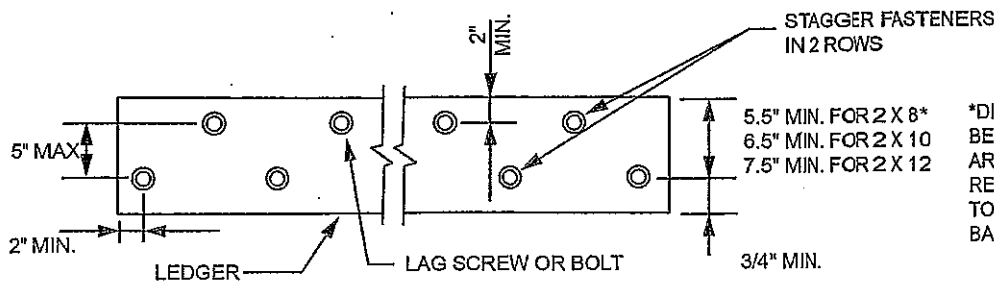TABLE R507.9.1.3(2). See page 5-67.

❖ See the commentary to Table R507.9.1.3(1).

R507.9.1.4 Alternate ledger details. Alternate framing configurations supporting a ledger constructed to meet the load requirements of Section R301.5 shall be permitted.

❖ See the commentary to Section R507.9.

R507.9.2 Lateral connection. Lateral loads shall be transferred to the ground or to a structure capable of transmitting them to the ground. Where the lateral load connection is provided in accordance with Figure R507.9.2(1), hold-down tension devices shall be installed in not less than two locations per deck, within 24 inches (610 mm) of each end of the deck. Each device shall have an allowable stress design capacity of not less than 1,500 pounds (6672 N). Where the lateral load connections are provided in accordance with Figure R507.9.2(2), the hold-down tension devices shall be installed in not less than four locations per deck, and each device shall have an allowable stress design capacity of not less than 750 pounds (3336 N).
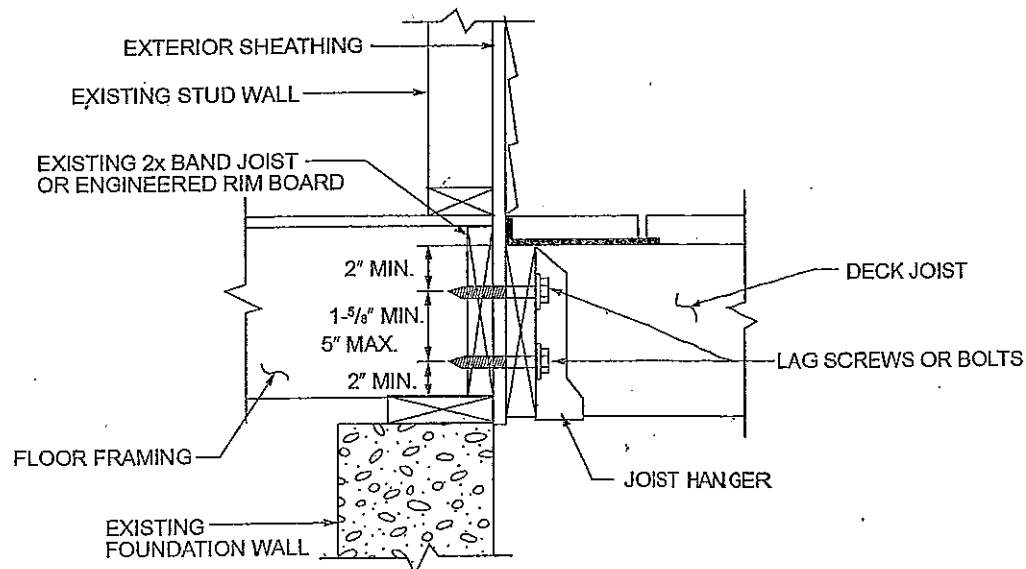
❖ The code requires decks supported by attachment to an exterior wall to be positively anchored to the primary structure and be designed for both vertical and lateral loads. The vertical and lateral loads referred to

5" MAX

2" MIN.

2" MIN.

5.5" MIN. FOR 2 X 8*
6.5" MIN. FOR 2 X 10
7.5" MIN. FOR 2 X 12

3/4" MIN.

STAGGER FASTENERS IN 2 ROWS

*DISTANCE SHALL BE PERMITTED TO BE REDUCED TO 4.5" IF LAG SCREWS ARE USED OR BOLT SPACING IS REDUCED TO THAT OF LAG SCREWS TO ATTACH 2 X 8 LEDGERS TO 2 X 8 BAND JOISTS.

LEDGER — LAG SCREW OR BOLT

For SI: 1 inch = 25.4 mm.

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

EXTERIOR SHEATHING
EXISTING STUD WALL
EXISTING 2x BAND JOIST OR ENGINEERED RIM BOARD
2" MIN.
1-5/8" MIN.
5" MAX.
2" MIN.
FLOOR FRAMING
EXISTING FOUNDATION WALL
DECK JOIST
LAG SCREWS OR BOLTS
JOIST HANGER

For SI: 1 inch = 25.4 mm.

FIGURE R507.9.1.3(2)
PLACEMENT OF LAG SCREWS AND BOLTS IN BAND JOISTS

are code-prescribed loads such as dead, live, wind and seismic loads. The magnitude of the lateral loads to be resisted is not specified and must be determined in accordance with accepted engineering practice.

Attachment only to the band joist may not be sufficient for the lateral loads. Positive anchorage of the deck joist to the floor framing addresses this potential failure. Figures R507.9.2(1) and R507.9.2(2) show typical hold-down devices that provide a positive connection to the floor framing in order to resist the lateral loads. Figure R507.9.2(1) is based on a similar figure from FEMA 232. Where Figure R507.9.2(1) is used, a minimum of two hold-down devices, located within 24 inches of each end of the deck, with a design capacity of 1,500 pounds (6672 N) each, are required.

Figure R507.9.2(2) provides an alternative prescriptive method to achieve an acceptable lateral load connection for residential decks. For new or replacement decks on existing homes, builders or homeowners must often remove interior sheet rock on ceilings in order to install hold-down tension devices as required by Figure R507.9.2(1). Figure R507.9.2(2) achieves an acceptable lateral load connection between the deck and primary structure by permitting the installation of surface mounted hold-down connection devices spread out along the length of the ledger and precludes the need to enter ceiling spaces. Where Figure R507.9.2(2) is used, a minimum of four hold-down devices having a design capacity of 750 pounds each, with one located within 24 inches of each end of the deck, are required.

Where Figure R507.9.2(1) or R507.9.2(2) is not used then the quantity and load capacity must comply with the engineered design.

FIGURE R507.9.2(1). See page 5-67.

❖ See the commentary to Section R507.9.2.

FIGURE R507.9.2(2). See page 5-67.

❖ See the commentary to Section R507.9.2.

R507.10 Exterior guards. *Guards* shall be constructed to meet the requirements of Sections R301.5 and R312, and this section.

❖ Exterior guards on decks, particularly guard system connections to the deck framing, are rarely engineered and even more rarely tested to verify adequacy to meet the 200-pound load requirements of Table R301.5. Exterior deck guards must meet Section R312 requirements and the loads listed in Table R301.5. Section R507.10 reinforces the need for a load path from the guard and rail into the deck joists, beams or blocking to which a guard is connected. End grain connections in withdrawal are prohibited.

In other words, guard fasteners may not be installed into the ends of deck joists or beams if loading will occur parallel to the length of the joist or beam and slowly pull the fasteners out of the lumber. When guards are connected to the side of beams or joists, the beam or joist shall be connected to adjacent joists—for example by blocking or straps—to resist rotation of the supporting beam or joist when load is applied to the guard.

Where a guard also functions as a handrail, the guard must comply with the live load requirements for a guard and for a handrail as required by Section R301.5.

R507.10.1 Support of guards. Where *guards* are supported on deck framing, *guard* loads shall be transferred to the deck framing with a continuous load path to the deck joists.

❖ Guard assemblies come in numerous geometries and materials. Regardless of the material or configuration of a guard assembly, the connection of the guard assembly to the supporting structure is critical. When that supporting structure is a deck, the ability of the guard assembly to adequately support the code-prescribed guard loads (see Section R507.10) relies heavily on the deck framing. In most cases involving decks of wood construction, the deck framing elements that best support the guard are the joists.

The intent of this section is to provide guidance for developing details that will resist the action of a guard on the deck framing when the guard loads are applied. While the code does not define a prescriptive detail for either guard construction or guard connection to deck framing, the intent of the language in this section is to create an understanding of the behavior of the guard and the structure supporting the guard. Applying the loads described in Section R301.5 to the top of a guard develops large forces at the base of the guard. There must be a load path for those forces to be delivered to the deck joists, as shown in Commentary Figures R507.10.1.1(1) and R507.10.1.1(2).

R507.10.1.1 Guards supported by side of deck framing. 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.

❖ When supporting a guard assembly on a band or rim joist, the band or rim joist must be connected to the adjacent joists in order to prevent rotation caused by the guard assembly. Fasteners in end grain provide relatively little withdrawal resistance. They are not permitted to resist the rotation of the members to which a guard assembly is attached as there is a high risk of failure due to deterioration of wood members or fasteners. In Commentary Figure R507.10.1.1(1), the joists supporting the decking would be attached into their end grain. Therefore, another solution is used for attachment that does not require the fasteners to be connected to the joist.

In Commentary Figure R507.10.1.1(2), a single joist alone is insufficient to resist loads from the guard, so blocking is added between joists to help transfer load from the guard assembly to multiple floor joists.

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
50 ground snow load	6	29	36	36
	8	22	36	35
	10	17	33	28
	12	14	27	23
	14	12	23	20
	16	11	20	17
	18	9	18	15
60 ground snow load	6	25	36	36
	8	18	35	30
	10	15	28	24
	12	12	23	20
	14	10	20	17
	16	9	17	15
	18	8	15	13
70 ground snow load	6	22	36	35
	8	16	31	26
	10	13	25	21
	12	11	20	17
	14	9	17	15
	16	8	15	13
	18	7	13	11

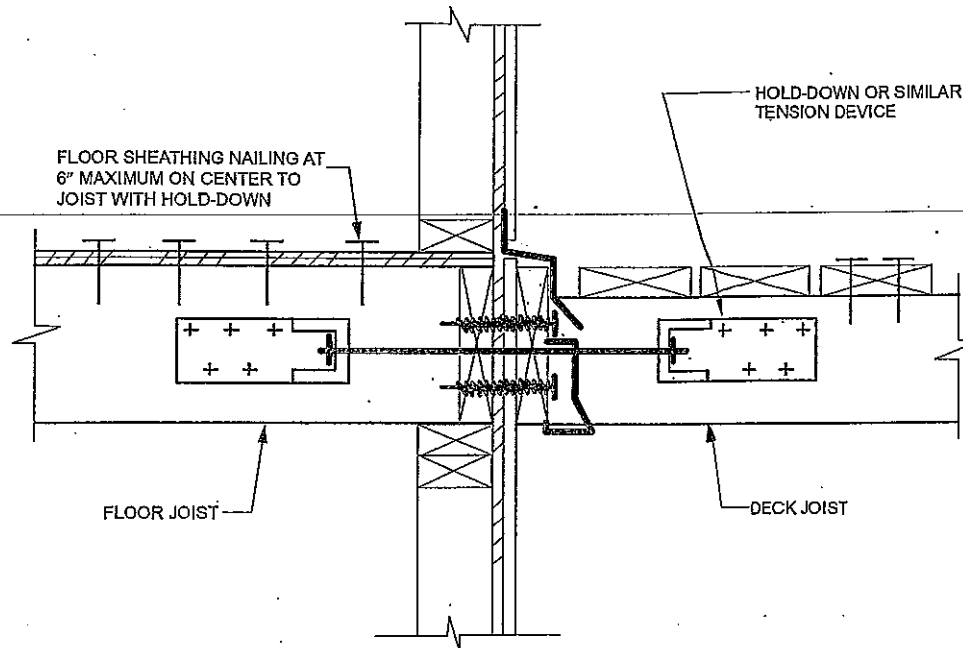For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa.

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

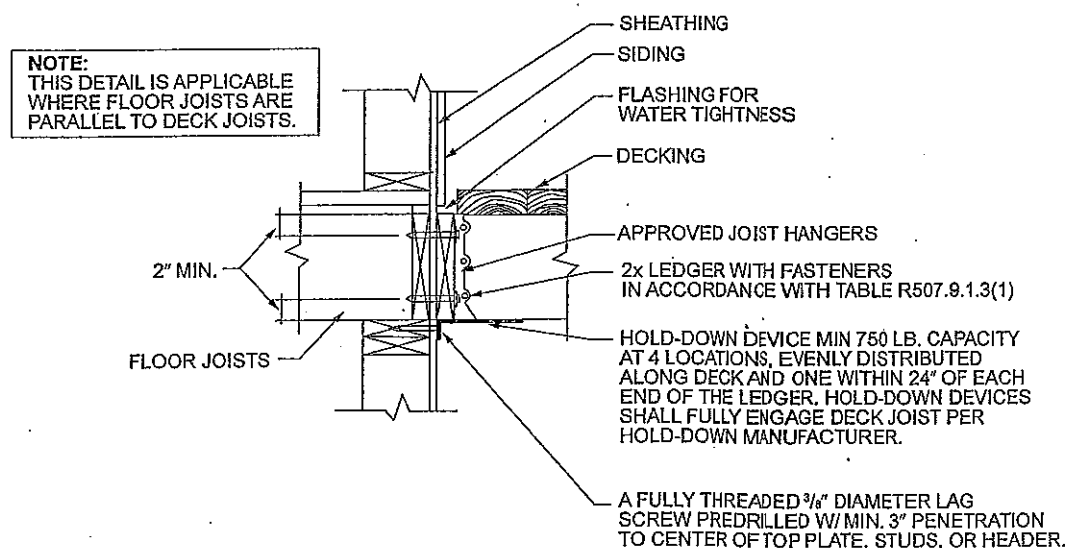|	MINIMUM END AND EDGE DISTANCES AND SPACING BETWEEN ROWS			
	TOP EDGE	BOTTOM EDGE	ENDS	ROW SPACING
Ledger[a]	2 inches[d]	$^3/_4$ inch	2 inches[b]	$1^5/_8$ inches[b]
Band Joist[c]	$^3/_4$ inch	2 inches	2 inches[b]	$1^5/_8$ inches[b]

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).
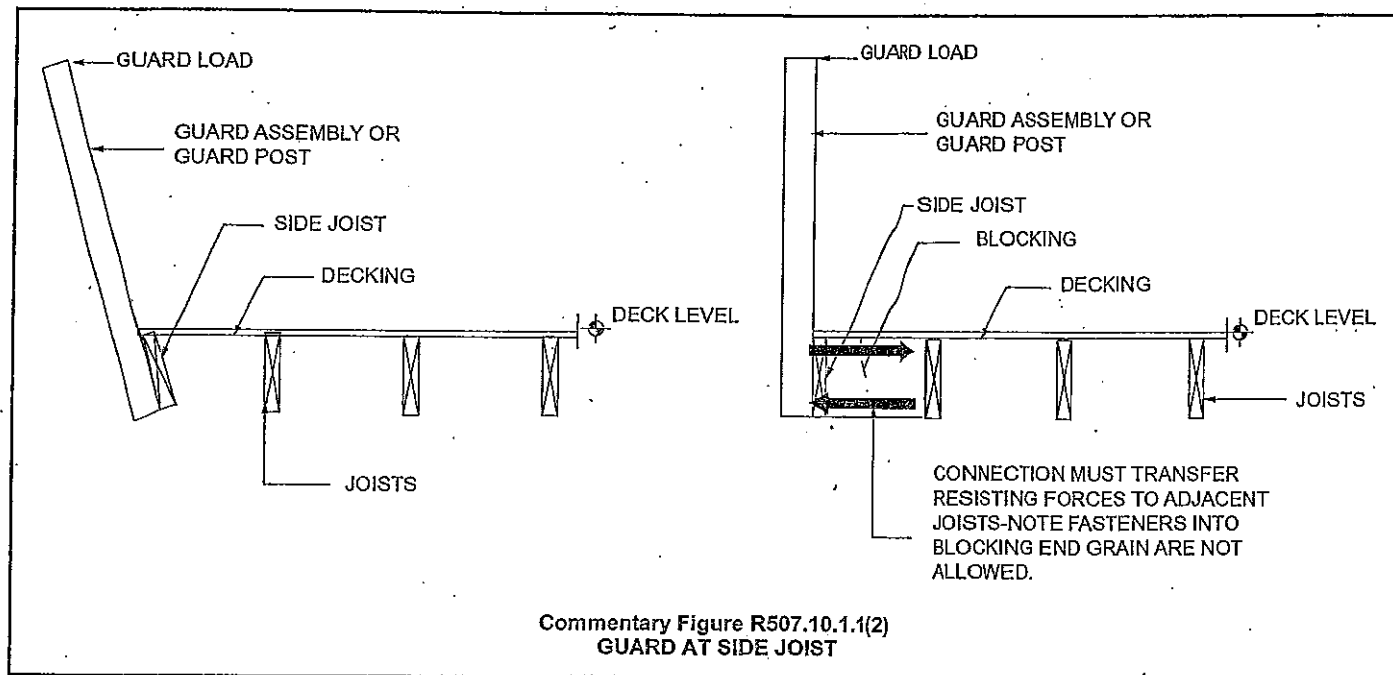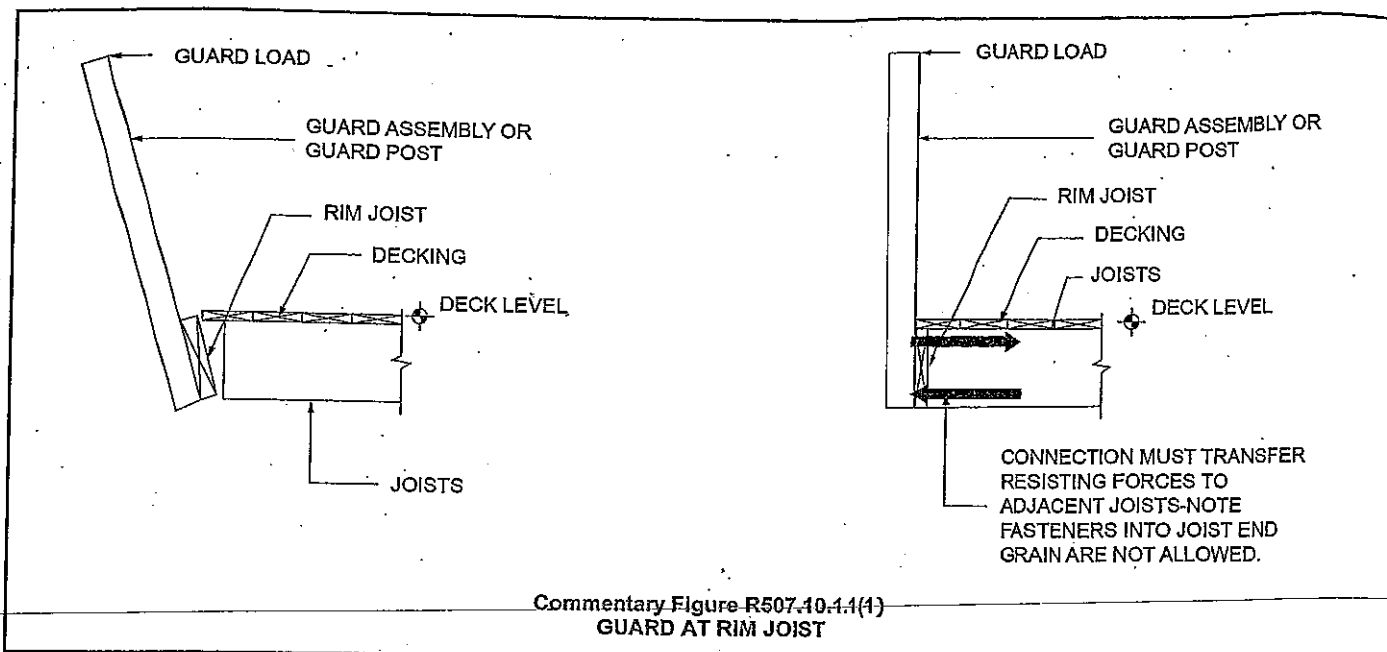

HOLD-DOWN OR SIMILAR TENSION DEVICE

FLOOR SHEATHING NAILING AT 6" MAXIMUM ON CENTER TO JOIST WITH HOLD-DOWN

FLOOR JOIST

DECK JOIST

For SI: 1 inch = 25.4 mm.

FIGURE R507.9.2(1)
DECK ATTACHMENT FOR LATERAL LOADS

NOTE:
THIS DETAIL IS APPLICABLE WHERE FLOOR JOISTS ARE PARALLEL TO DECK JOISTS.

SHEATHING

SIDING

FLASHING FOR WATER TIGHTNESS

DECKING

APPROVED JOIST HANGERS

2x LEDGER WITH FASTENERS IN ACCORDANCE WITH TABLE R507.9.1.3(1)

2" MIN.

FLOOR JOISTS

HOLD-DOWN DEVICE MIN 750 LB. CAPACITY AT 4 LOCATIONS, EVENLY DISTRIBUTED ALONG DECK AND ONE WITHIN 24" OF EACH END OF THE LEDGER. HOLD-DOWN DEVICES SHALL FULLY ENGAGE DECK JOIST PER HOLD-DOWN MANUFACTURER.

A FULLY THREADED $^3/_8$" DIAMETER LAG SCREW PREDRILLED W/ MIN. 3" PENETRATION TO CENTER OF TOP PLATE, STUDS, OR HEADER.

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

FIGURE R507.9.2(2)
DECK ATTACHMENT FOR LATERAL LOADS

Commentary Figure R507.10.1.1(1)
GUARD AT RIM JOIST

Commentary Figure R507.10.1.1(2)
GUARD AT SIDE JOIST

R507.10.1.2 Guards supported on top of deck framing. 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.

❖ Many manufactured guard assemblies mount to the top surface of a deck. While manufacturers provide detailed requirements for the base connections of their guard assemblies, it is critical that the connection and blocking details used in these instances be well connected to the deck joists adjacent to the guard base connections. This section requires that the guard assembly base connection follows the manufacturer's requirements and delivers the guard live load to the deck joists.

R507.10.2 Wood posts at deck guards. Where 4-inch by 4-inch (102 mm by 102 mm) wood posts support guard loads applied to the top of the guard, such posts shall not be notched at the connection to the supporting structure.

❖ The American Wood Council (AWC) *National Design Specification* (NDS) does not allow notching of members in bending. In many cases, the connection of a guard assembly to the supporting structure is a point of maximum bending in the post, and the notch reduces the strength capacity of the post. A notch at the base of a nominal 4 x 4 post reduces the strength of the 4 x 4 post such that it is inadequate to resist the guard loads described in Section R301.5.

R507.10.3 Plastic composite guards. *Plastic composite guards* shall comply with the provisions of Section R507.2.2.

❖ See the commentary to Section R507.2.2.

R507.10.4 Other guards. Other *guards* shall be in accordance with either manufacturer's instructions or accepted engineering principles.

❖ This section recognizes that guard systems on exterior decks are commonly different than guard designs included in the scope of Sections R507.10.1 through R507.10.3. Manufacturers typically design their guard systems to meet or exceed the requirements of the code, provided that the guard is assembled and installed in accordance with the manufacturer's instructions. Consistent with many other aspects of the code, accepted engineering practices may be the basis for designing and constructing guard systems that comply with code requirements.

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