



17-14 Prescriptive Residential Decks, Stairs, and Railings

Background

This handout is intended to serve as a reference for the design of elevated decks accessory to 1&2 family homes and townhouses constructed in accordance with the California Residential Code (CRC). More detailed information regarding the construction of decks can be found in the CRC. If you have questions regarding the construction or replacement of a deck, contact the City of Carmel, Community Planning and Building Department.

Citations

Carmel Municipal Code Title 15, Buildings and Construction
 2019 CA Building Code
 2019 CA Residential Code

Guidance

Planning Approval Required:

The City of Carmel has adopted standards affecting the construction of decks, patios, balconies, and similar outdoor accessory spaces. Planning Division approval of all similar construction is required prior to issuance of a building permit for the project. A Design Study and Planning Commission approval may be required. Contact the Planning Division for more information.

Permit Required:

A building permit is required for all decks that are attached to a building, and/or having a walking surface that is 30" or more above adjacent grade, and for all decks serving as a required landing at an exterior door. Decks in with walking surfaces 10 feet or more above adjacent grade require plans that are stamped by a State registered structural or civil engineer.

Design:

1. Deck Foundation Requirements

- a. All footings shall bear on solid ground and shall be placed at least 12 inches below the undisturbed ground surface (See Figure 1 and Table 1 for size and spacing). Pre-manufactured post bases shall be galvanized.

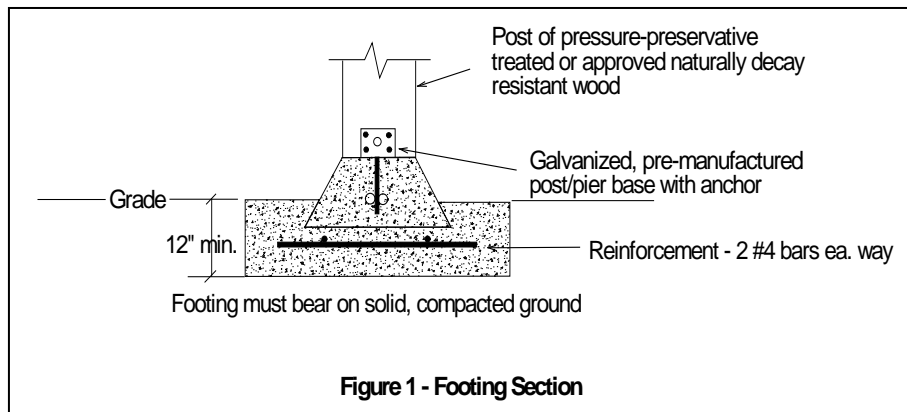


Table 1 – Concrete Footings				
Beam Span	Joist Span	Round Footing Diameter	Square Footing Dimension	Footing Thickness
6'	≤ 10'	15"	13"	6"
	≤ 14'	17"	15"	6"
	≤ 18'	20"	18"	7"
8'	≤ 10'	17"	15"	6"
	≤ 14'	20"	18"	8"
	≤ 18'	23"	21"	9"
10'	≤ 10'	19"	17"	7"
	≤ 14'	22"	20"	9"
	≤ 18'	25"	23"	10"
12'	≤ 10'	21"	19"	8"
	≤ 14'	22"	20"	9"
	≤ 18'	28"	26"	11"
14'	≤ 10'	22"	20"	9"
	≤ 14'	26"	24"	11"
	≤ 18'	30"	28"	12"
16'	≤ 10'	24"	22"	9"
	≤ 14'	28"	26"	12"
	≤ 18'	32"	30"	13"
18'	≤ 10'	25"	23"	10"
	≤ 14'	30"	28"	12"
	≤ 18'	34"	32"	14"
1. Assumes 1,500 psf soil bearing capacity 2. Assumes 2,500 psi compressive strength concrete				

2. Deck Framing Requirements

- a. Deck framing shall be positively anchored to the primary structure for both vertical and lateral loads. Such attachment *shall not* be accomplished by the use of toenails or nails subject to withdrawal. Where the positive connection to the primary structure cannot be provided, decks shall be self-supporting. Wood and wood based products exposed to weather must be protected from decay.
- b. The ledger shall be attached as set forth in CRC Table R507.9.1.3(1) with ½ inch minimum lag screws or bolts with washers, all hot-dipped galvanized or stainless steel. Lag screws shall be placed 2" in from the bottom and top and 2" – 5" from the ends of the deck ledger and shall be staggered. The tip of the lag screw shall fully extend beyond the inside face of the band joist (See figure 2 and Table 2).
- c. Deck framing shall have positive tension tie connections with floor framing. Hold-down tension devices shall be installed in not less than 2 locations per deck. Each device shall have an allowable design capacity of not less than 1500 pounds (See figure 3).
- d. Deck ledgers shall be flashed to prevent water from contacting the house band/rim joist.
- e. Deck ledger shall be a minimum 2x8 pressure treated No. 2 or better grade lumber (See Table 2, Footnote 5).
- f. The maximum distance between the face of the ledger and the face of the band/ rim joist shall not exceed 1 inch.
- g. Ledger connections not conforming to the above requirements shall be designed and sealed by a State registered engineer in accordance with accepted engineering practice.

- h. Deck framing (e.g. joists, beams, posts, decking, etc.) shall be of approved, naturally durable or pressure-preservative-treated wood.
- i. Joist Hangers, when used, shall each have a minimum load capacity in accordance with Table 5 – Joist Hanger Capacity. Joist hangers shall be from an approved manufacturer, and selected on the dimensions of the joist or girder it is carrying. Joist hangers shall be galvanized or stainless steel. Use joist hangers with inside flanges when clearances to the edge of the beam or ledger board dictate. **Do not use clip angles or brackets to support joists.**

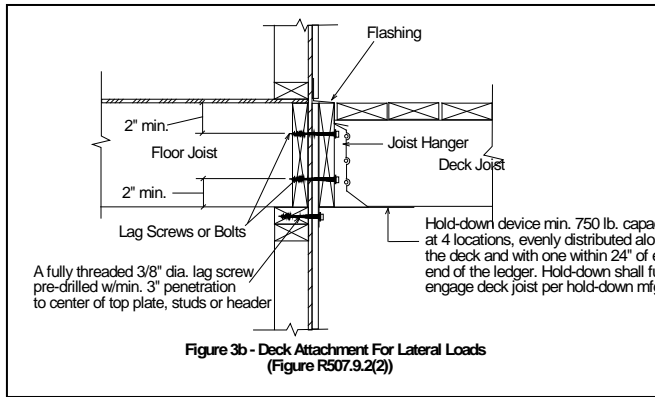
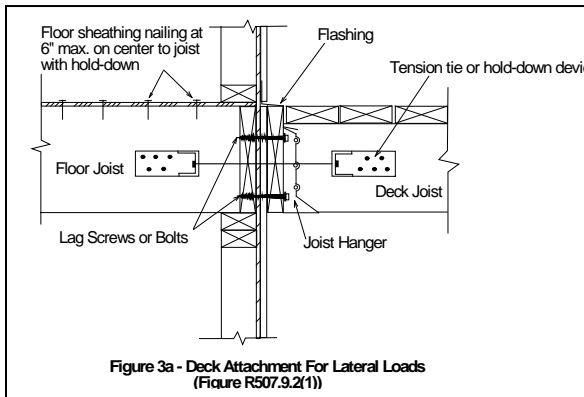
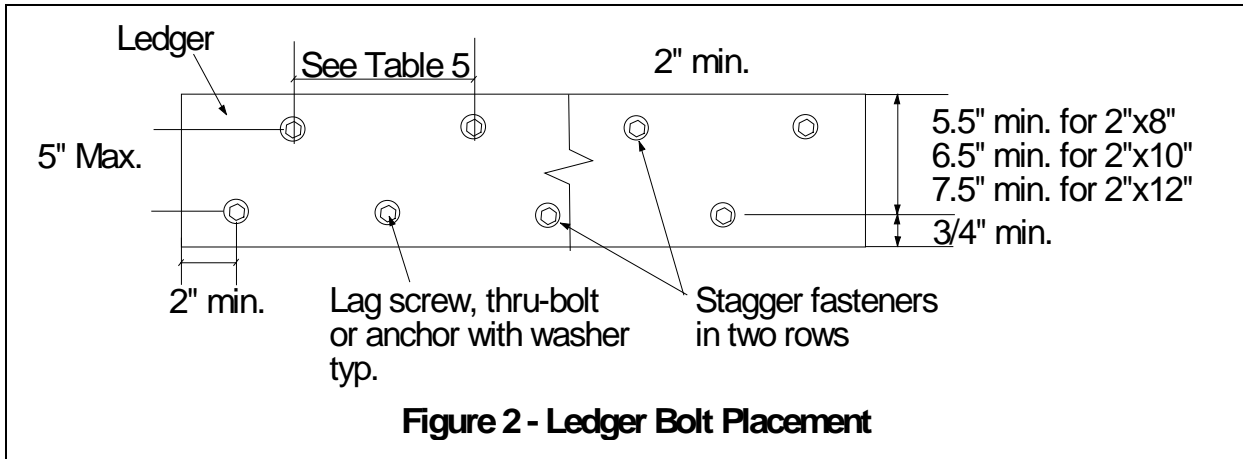


Table 5 – Joist Hanger Load Capacity Requirements	
Joist size	Minimum Capacity (Lbs.)
2x8	600
2x10	700
2x12	800

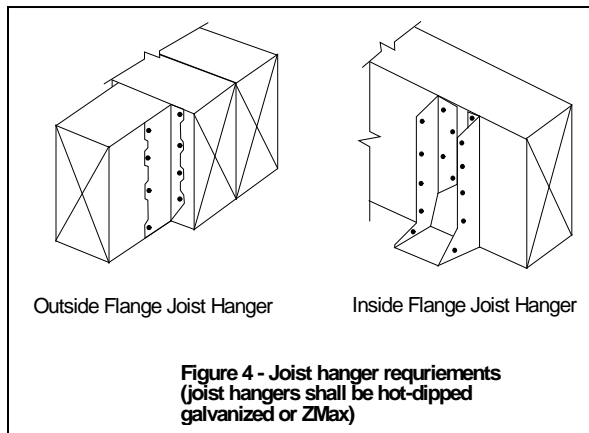


Table 2 – Fastener Spacing for Deck Ledgers (Deck Live Load = 40 psf, Deck Dead Load = 10 psf ^{3,6})								
Joist Span	Rim Board Or Band Joist	6'-0" And Less	6'- 1" To 8'- 0"	8'-1" To 10'- 0"	10'- 1" To 12'- 0"	12'- 1" To 14'- 0"	14'- 1" To 16'- 0"	16'- 1" To 18'- 0"
Connection Details	On-Center Spacing of Fasteners ^{4,5}							
½" dia. Lag screw with 15/32" max. sheathing	1" EWP ⁶	24"	18"	14"	12"	10"	9"	8"
	1-1/8" EWP ⁶	28"	21"	16"	14"	12"	10"	9"
	1-1/2" Lumber ^{7,9}	30"	23"	18"	15"	13"	11"	10"
½" dia. Thru-bolt with 15/32" max. sheathing	1" EWP ⁶	24"	18"	14"	12"	10"	9"	8"
	1-1/8" EWP ⁶	28"	21"	16"	14"	12"	10"	9"
	1-1/2" Lumber ^{7,9}	36"	36"	34"	29"	24"	21"	19"
½" dia. bolt with 15/32" max sheathing and ½" stacked washers ^{2,8}	1" EWP ⁶	24"	18"	14"	12"	10"	9"	8"
	1-1/8" EWP ⁶	28"	21"	16"	14"	12"	10"	9"
	1-1/2" Lumber ^{7,9}	36"	36"	29"	24"	21"	18"	16"
<ol style="list-style-type: none"> The tip of the lag screw shall fully extend beyond the inside face of the band joist The maximum gap between the face of the ledger board and face of the wall sheathing shall be ½" Ledgers shall be flashed or caulked to prevent water from contacting the band joist Lag screws and bolts shall be staggered per Figure 2 Deck ledgers shall be minimum 2x8 pressure-preservative-treated, No. 2 grade lumber, or other approved materials as established by standard engineering practice When solid-sawn, pressure-preservative-treated deck ledgers are attached to engineered wood products (EWP) (min. 1" thick wood structural panel band joist or structural composite lumber including laminated veneer lumber), the ledger attachment shall be designed in accordance with accepted engineering practice. Tabulated values based on 300 lbs and 350 lbs for 1" and 1-1/8" EWP rim board respectively A minimum 1" x 9-1/2" Douglas fir-larch laminated veneer lumber rim board shall be permitted in lieu of the 2" nominal band joist Wood structural panel sheathing, gypsum board sheathing, or foam sheathing not exceeding one inch thickness shall be permitted. The maximum distance between the face of the ledger board and the face of the band joist shall be 1" Fastener spacing also applies to southern pine, Douglas fir-larch, and hem-fir band joists Fasteners in contact with pressure-preservative-treated wood shall be hot-dipped galvanized, stainless steel, silicone bronze or copper. 								

Table 3 – Deck Joist Spans							
Joist Spacing (on center)							
Species	Size	Without Overhangs ¹			With Cantilevers ²		
		12"	16"	24"	12"	16"	24"
Southern Pine	2x8	13'-8"	12'-5"	10'-2"	10'-9"	10'-9"	10'-2"
	2x10	17'-5"	15'-10"	13'-1"	15'-6"	15'-6"	13'-1"
	2x12	18'-0"	18'-0"	15'-5"	18'-0"	18'-0"	15'-5"
Douglas Fir-Larch, Hem-Fir, SPF ³	2x8	12'-6"	11'-1"	9'-1"	9'-5"	9'-5"	9'-1"
	2x10	15'-8"	13'-7"	11'-1"	13'-7"	13'-7"	11'-1"
	2x12	18'-0"	15'-9"	12'-10"	18'-0"	15'-9"	12'-10"
Redwood, Western Cedars, Ponderosa Pine ⁴ , Red Pine ⁴	2x8	11'-8"	10'-7"	8'-8"	8'-6"	8'-6"	8'-6"
	2x10	14'-11"	13'-0"	10'-7"	12'-3"	12'-3"	10'-7"
	2x12	17'-5"	15'-1"	12'-4"	16'-5"	15'-1"	12'-4"
1. Assumes 40 psf live load, 10 psf dead load, L/360 deflection, No. 2 grade and wet service conditions.							

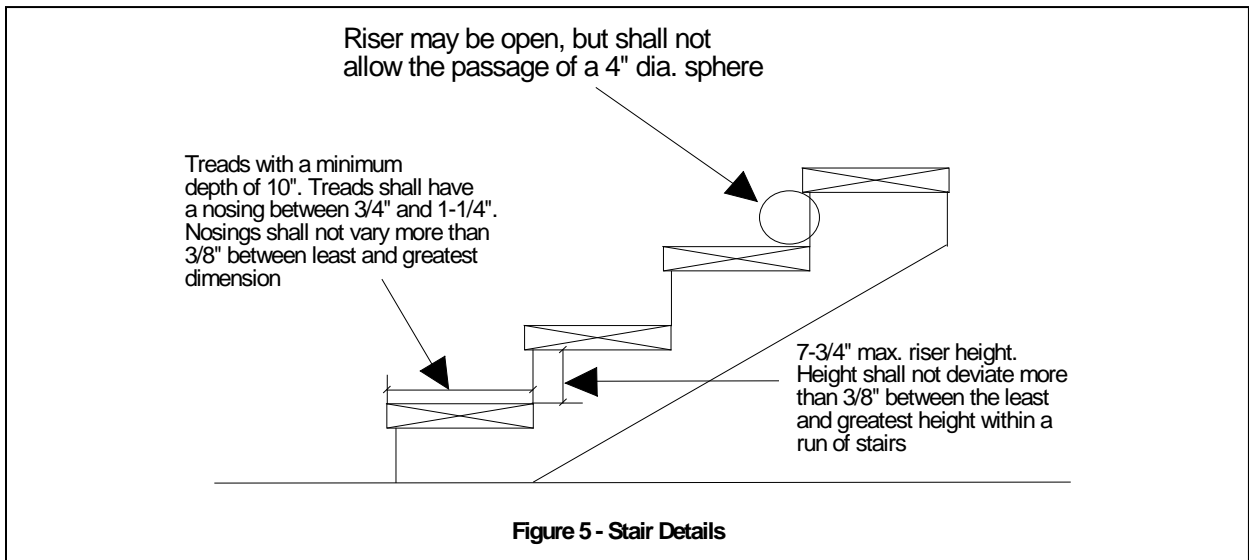
2. Assumes 40 psf live load, 10 psf dead load, L/180 cantilever deflection with 220 lb. point load. No. 2 grade and wet service conditions.
3. Incising assumed for refractory species including Douglas Fir-Larch, Hem-Fir, and spruce-pine-fir
4. Design values based on northern species with no incising assumed

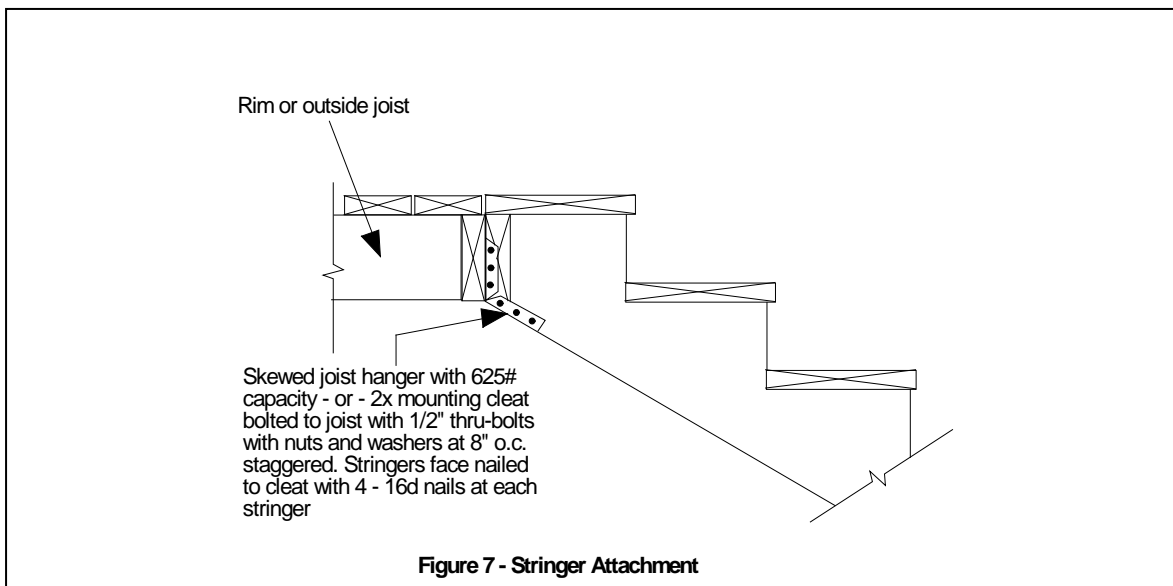
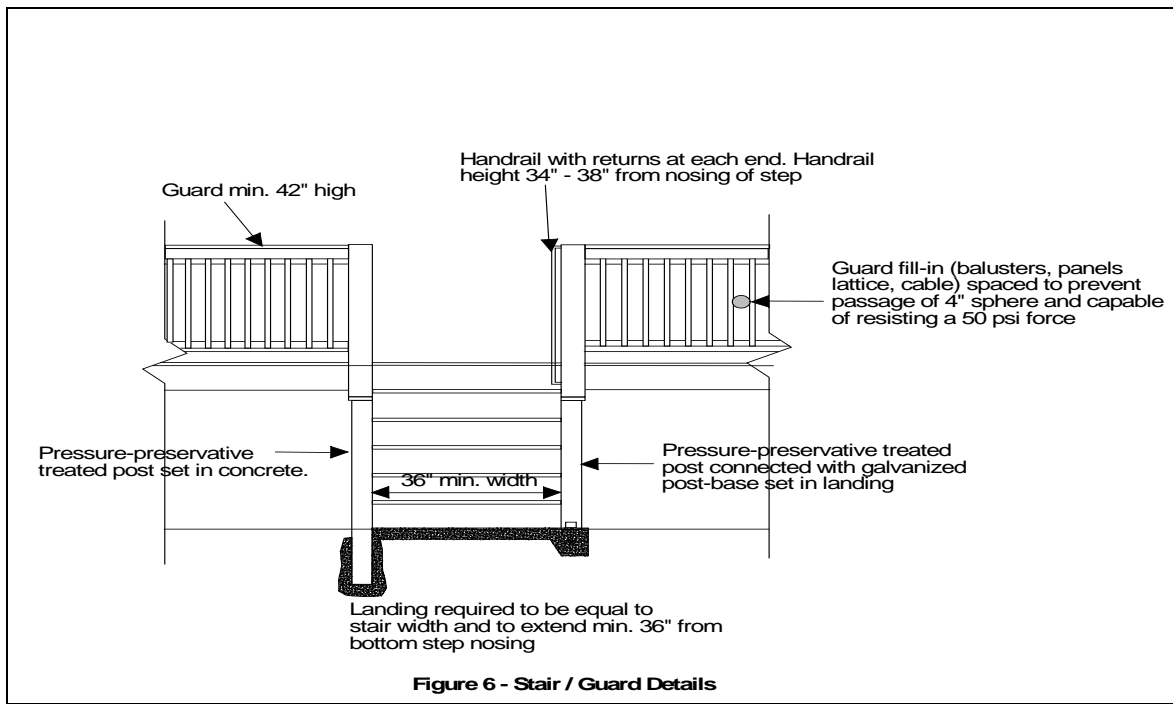
Table 4 – Beam/Girder Spans								
Joist Spans Less Than or Equal To:								
Species	Size ⁴	6'	8'	10'	12'	14'	16'	18'
Southern Pine	2-2x6	7'-1"	6'-2"	5'-6"	5'-0"	4'-8"	4'-4"	4'-1"
	2-2x8	9'-2"	7'-11"	7'-1"	6'-6"	6'-0"	5'-7"	5'-3"
	2-2x10	11'-10"	10'-3"	9'-2"	8'-5"	7'-9"	7'-3"	6'-10"
	2-2x12	13'-11"	12'-0"	10'-9"	9'-10"	9'-1"	8'-6"	8'-0"
	3-2x6	8'-7"	7'-8"	6'-11"	6'-3"	5'-10"	5'-5"	5'-2"
	3-2x8	11'-4"	9'-11"	8'-11"	8'-1"	7'-6"	7'-0"	6'-7"
	3-2x10	14'-5"	12'-10"	11'-6"	10'-6"	9'-9"	9'-1"	8'-7"
	3-2x12	17'-5"	15'-1"	13'-6"	12'-4"	11'-5"	10'-8"	10'-1"
Douglas Fir-Larch ² , Hem-Fir ² , SPF ² , Redwood, Western Cedars, Ponderosa Pine ³ , Red Pine ³	3x6 or 2-2x6	5'-5"	4'-8"	4'-2"	3'-10"	3'-6"	3'-1"	2'-9"
	3x8 or 2-2x8	6'-10"	5'-11"	5'-4"	4'-10"	4'-6"	4'-1"	3'-8"
	3x10 or 2-2x10	8'-4"	7'-3"	6'-6"	5'-11"	5'-6"	5'-1"	4'-8"
	3x12 or 2-2x12	9'-8"	8'-5"	7'-6"	6'-10"	6'-4"	5'-11"	5'-7"
	4x6	6'-5"	5'-6"	4'-11"	4'-6"	4'-2"	3'-11"	3'-8"
	4x8	8'-5"	7'-3"	6'-6"	5'-11"	5'-6"	5'-2"	4'-10"
	4x10	9'-11"	8'-7"	7'-8"	7'-0"	6'-6"	6'-1"	5'-8"
	4x12	11'-5"	9'-11"	8'-10"	8'-1"	7'-6"	7'-0"	6'-7"
	3-2x6	7'-4"	6'-8"	6'-0"	5'-6"	5'-1"	4'-9"	4'-6"
	3-2x8	9'-8"	8'-6"	7'-7"	6'-11"	6'-5"	6'-0"	5'-8"
	3-2x10	12'-0"	10'-5"	9'-4"	8'-6"	7'-10"	7'-4"	6'-11"
	3-2x12	13'-11"	12'-1"	10'-9"	9'-10"	9'-1"	8'-6"	8'-1"

1. Assumes 40 psf live load, 10 psf dead load, L/360 simple span beam deflection limit, L/180 cantilever deflection limit. No. 2 grade, wet service conditions.
2. Incising assumed for refractory species including Douglas Fir-Larch, Hem-Fir, and Spruce-Pine-Fir
3. Design values based on northern species with no incising assumed.
4. Girder depth must be equal to or greater than joist depth if joist hangers are used.

3. *Stairway Requirements*

- a. Stairways shall not be less than 36 inches in clear width above the handrails. Handrail projections are limited to not more than 4.5 inches on either side of the stairway (See figure 5).
- b. Headroom shall be not less than 6 feet 8 inches measured vertically from the tread nosing.
- c. Riser height shall not exceed 7³/₄ inches. The greatest riser height within any flight of stairs shall not exceed the smallest by more than 3⁸/₈" (See figure 4).
- d. Tread depth (measured from nosing to riser, or back of tread) shall be at least 10 inches. The largest tread depth within any flight of stairs shall not exceed the smallest by more than 3⁸/₈" (See figure 4)
- e. Nosing's not less than 0.75" but not more than 1.25" shall be provided on stairways with solid risers if the tread depth is less than 11". The radius of curvature at the nosing shall be no greater than 9/116 inch (See Figure 4).
- f. Open risers are permitted, provided that the opening between treads does not permit the passage of a 4-inch sphere. The opening between adjacent treads is not limited on stairs with a total rise of 30 inches or less. (CRC Sec. R311.7.5.1) (See figure 4).

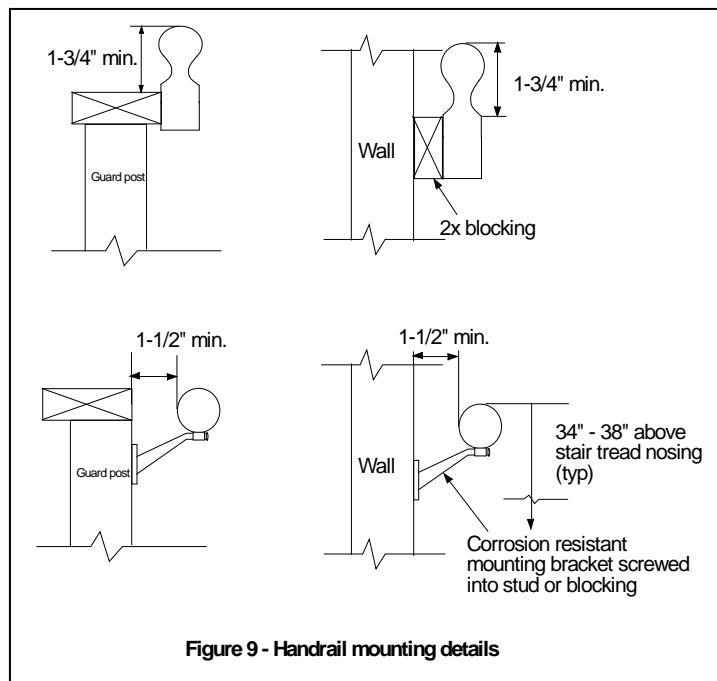
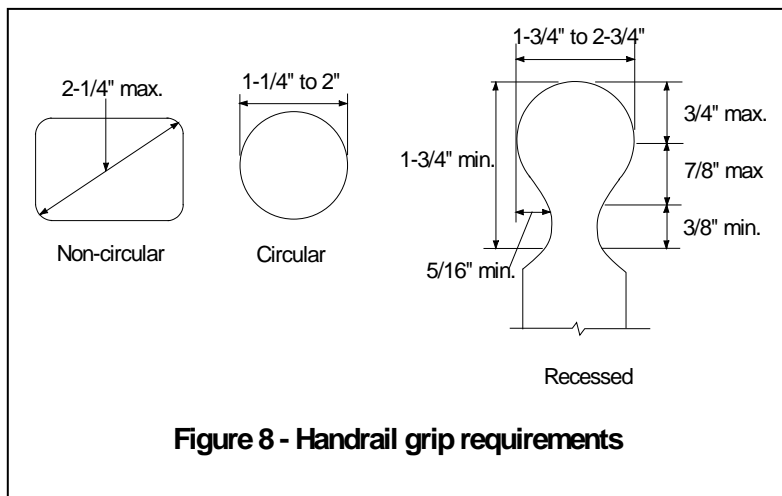




4. Handrail requirements

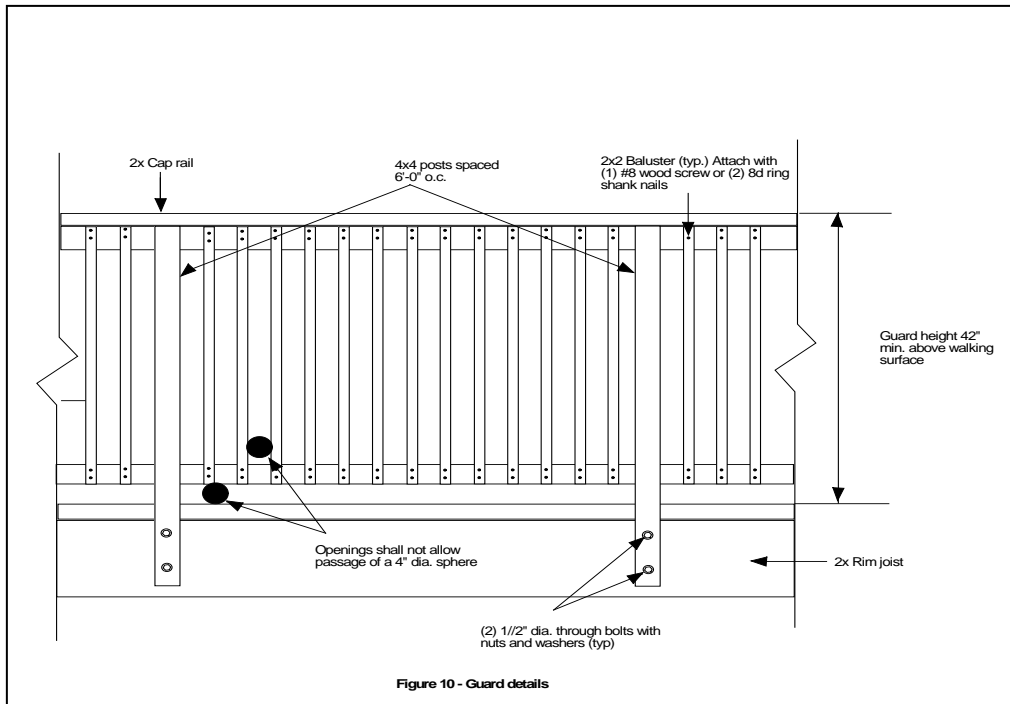
- a. Handrails shall be provided on at least one side of each continuous flight of stairs with 4 or more risers.
- b. The top of handrails shall be 34 to 38 inches above the tread nosing.
- c. Handrails shall be graspable and shall be of one of the following types:
 - i. Type I. Handrails with a circular cross-section of between 1-1/4" and 2" in diameter. If the handrail is not circular, it shall have a perimeter dimension of at least 4 inches and not greater than 6-1/4 inches with a maximum cross section dimension of 2-1/4" Edges shall have a minimum radius of 0.01 inch (See figure 6 & 7)

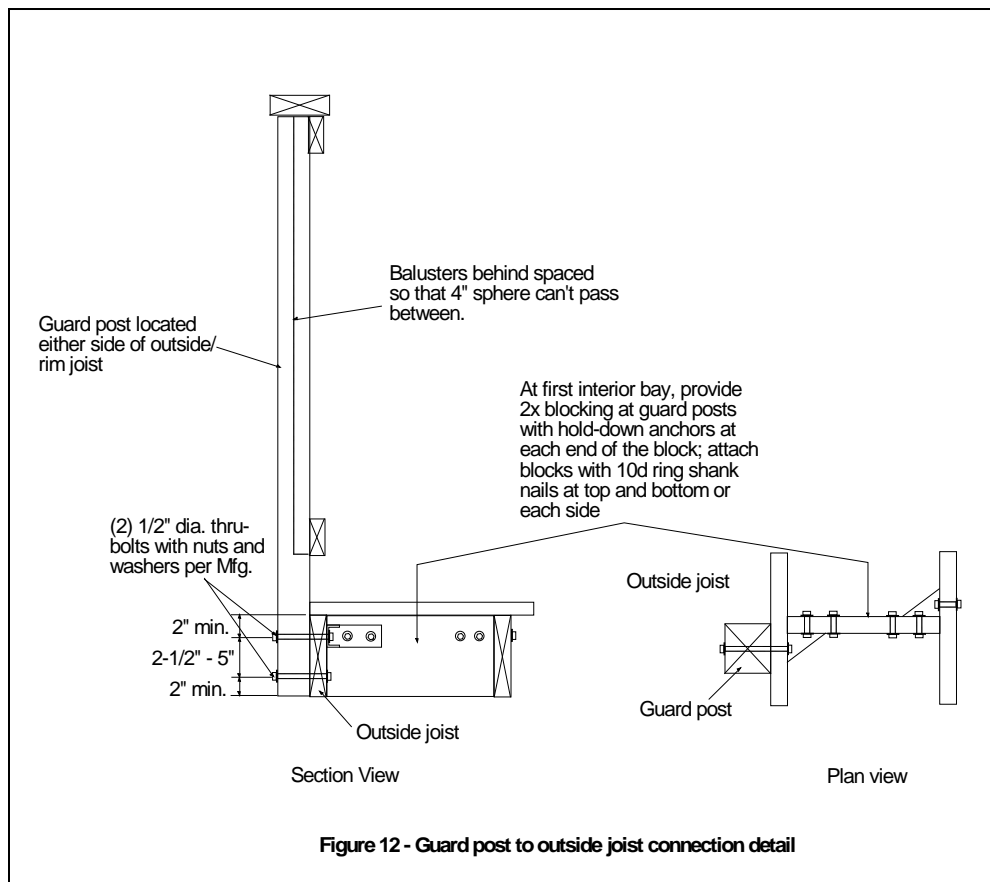
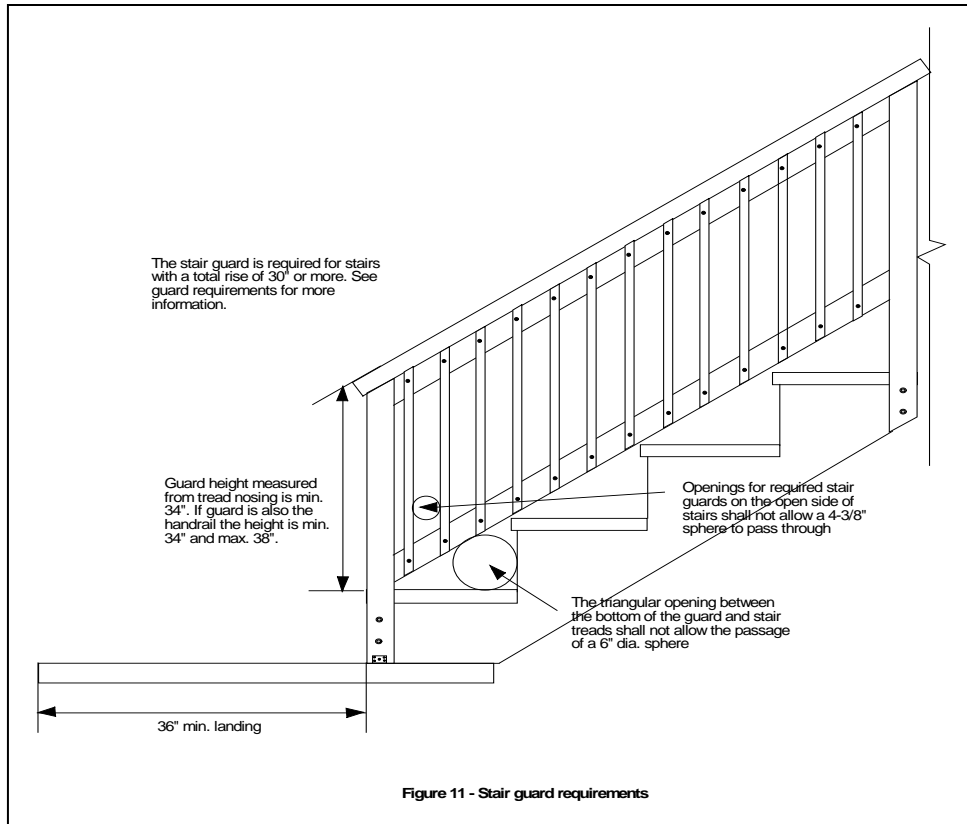
- ii. Type II. Handrails with a perimeter greater than 6-1/4" shall have a graspable finger recess area on both sides of the profile. The finger recess shall begin with a distance of 3/4 inch measured vertically from the tallest portion of the profile and achieve a depth of at least 5/16 inch within 7/8 inches below the widest portion of the profile. This required depth shall continue for at least 3/8 inch to a level that is not less than 1-3/4 inches below the tallest portion of the profile. The minimum width of the handrail above the recess shall be 1-1/4 inches to a maximum of 2-3/4 inches. Edges shall have a minimum radius of 0.01 inch. (See figure 6 & 7).
- d. Handrail ends shall be returned or shall terminate in a newel post or safety terminal. Handrails adjacent to a wall shall have a space of not less than 1-1/2 inch between the wall and the handrail.

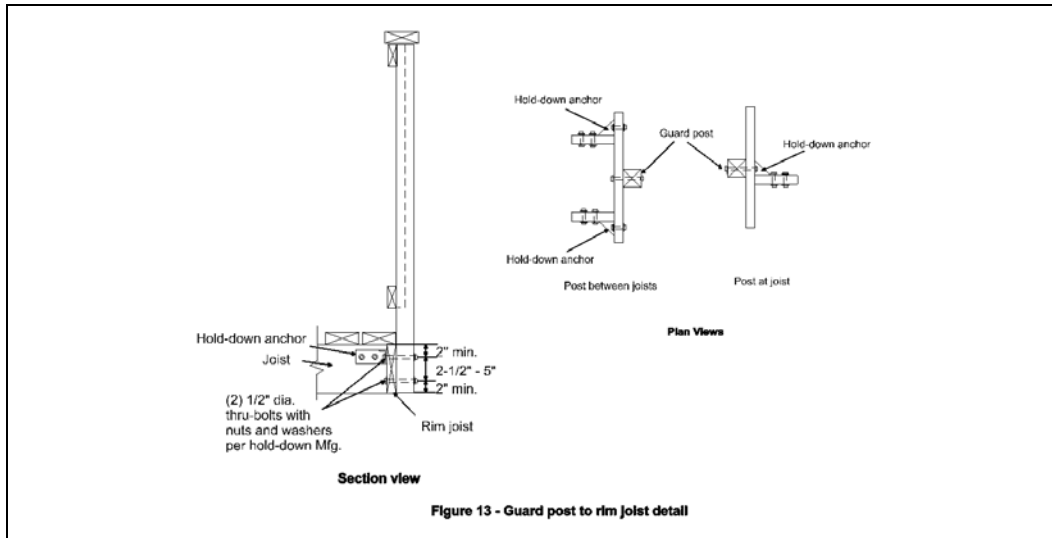


5. Guardrail Requirements

- a. Guards shall be located along open sides of decks, porches, landings, stairs that are located more than 30 inches (measured vertically to the floor or grade below at any point within 36 inches horizontally to the edge of the open side (See figure 6).
- b. Guards shall be not less than 42 inches high measured vertically above the walking surface, adjacent fixed seating, or the line connecting the leading edges of the treads (See figure 6).
 - i. Exceptions:
 - 1. Guards on the open sides of stairs shall have a height of not less than 34 inches measured vertically from a line connecting the leading edges of the treads.
 - 2. Where the top of the guard also serves as a handrail on the open sides of stairs, the top of the guard shall not be less than 34 inches and not more than 38 inches measured vertically from a line connecting the leading edges of the treads (See figure 5)
- c. Guardrails and handrails shall be capable of withstanding a single concentrated load of 200 lbs applied in any direction at any point along the top of the rail.
- d. Guardrail in-fill components, balusters, and panel fillers shall be capable of withstanding a horizontally applied normal load of 50 lbs on an area equal to 1 sq. ft. This load need not be assumed to act concurrently with any other live load requirement.

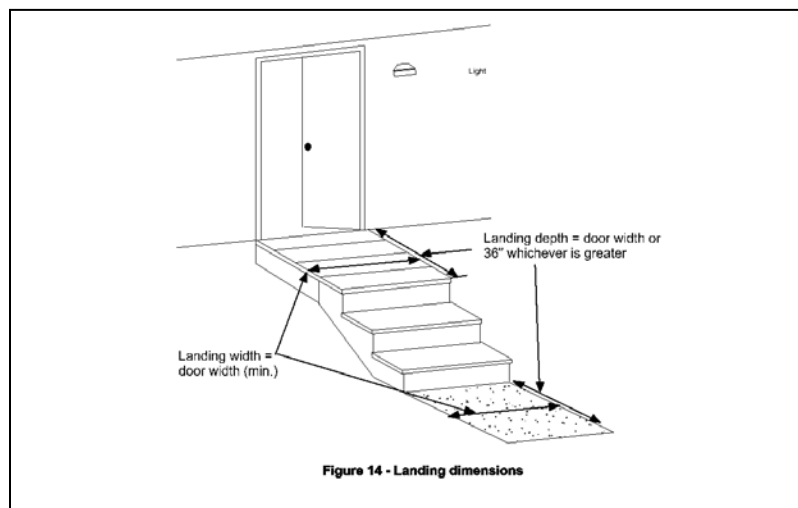






6. Landing Requirements:

- a. Exterior doors shall be provided with landings. The width of each landing shall be not less than the width of the door served. Every landing shall have a minimum dimension of 36 inches measured in the direction of travel. Exterior landings are permitted to have a slope not exceeding ¼ unit vertical in 12 units' horizontal (2%). (Figure 13)
- b. Exterior landings at the required egress door shall not be more than 1-1/2 inches lower than the top of the threshold for the out-swinging door and not more than 7-3/4 inches below the top of the threshold for an in-swinging door.
- c. Doors other than the required egress door shall be provided with landings not more than 7-3/4 inches below the top of the threshold.
 - i. Exception: A landing is not required where a stairway of two or fewer risers is located on the exterior side of the door, provided the door does not swing over the stairway.
- d. Exterior doors and stairways shall be provided with an artificial light source located in the immediate vicinity of the top landing of the stairway. Lighting shall be controlled from inside the dwelling unit, unless the lighting is continuously illuminated or automatically controlled.



7. *Smoke Alarms:*

- a. When a permit is required for alterations, repairs or additions, smoke detectors shall be installed:
 - i. In each sleeping room
 - ii. Outside each separate sleeping area in the immediate vicinity of the bedrooms
 - iii. On each story of the dwelling, including basements but not including crawl spaces and uninhabitable attics. (CRC Sec. R314)

8. *Carbon Monoxide Alarms:*

- a. When a permit is required for alterations, repairs or additions, to existing dwellings that have attached garages with a door between the garage and dwelling, or where fuel burning appliances are present in the dwelling, the dwelling shall be provided with a carbon monoxide alarm in the following locations:
 - i. Outside the dwelling unit sleeping area in the immediate vicinity of the bedroom(s)
 - ii. On every level of a dwelling unit including basements (CRC Sec. R315)

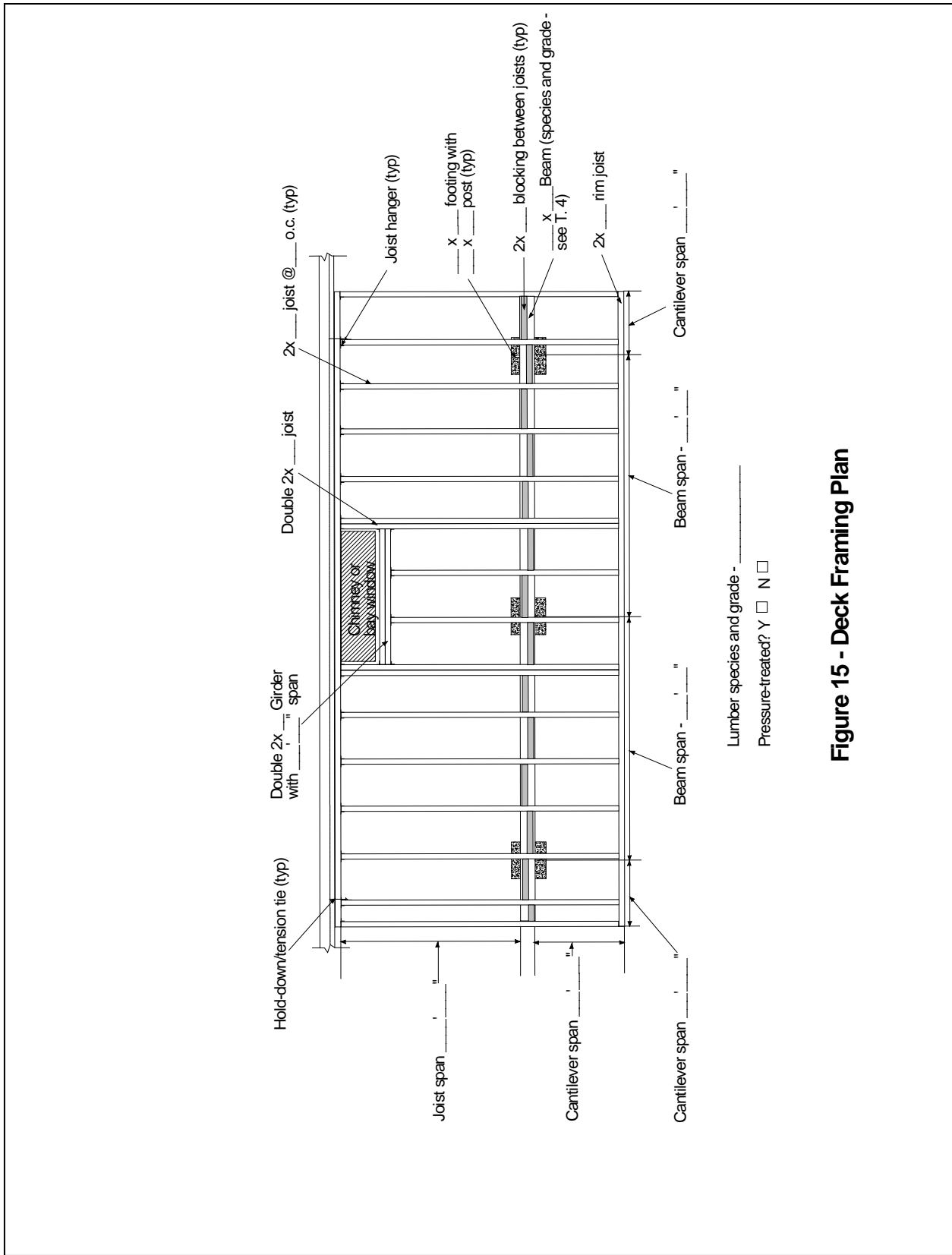


Figure 15 - Deck Framing Plan