1

Description

This half-day seminar introduces basic design and construction methods for single-story residential wood decks. The vertical and lateral load paths of conventional residential decks are now addressed in the *2015 International Residential Code*.

Specific design guidance includes convenient span tables for joists and beams and charts of post sizing limitations and connection methods. Figures for multiple lateral connections make connection to an existing dwelling simpler and require less removal of existing materials.

2

Objectives

Upon completion of this course, you will be better able to:

1. Identify vertical and lateral load paths of conventional residential decks
2. Apply requirements of the 2015 IRC to a deck plan
3. Identify minimum local footing size and material
4. Determine appropriate beams and joist span lengths from tables

3

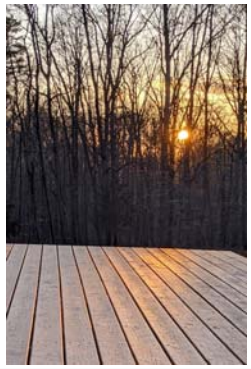
Objectives

5. Identify reasonable decking and joist materials
6. Determine best lateral connection for deck to existing dwelling
7. Apply requirements for stairway, railing and handrail size and materials
8. Determine potential hazards due to glass, water and electricity and apply code requirements for location

4

Outline

- General Requirements
- Load Paths
- Fire Protection
- Foundations
- Selecting Deck Materials
- Deck Design
- Posts and Columns
- Ledger
- Beams
- Joists
- Decking
- Free-standing Decks
- Deck Safety
- Deck Amenities



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Module 1

General Requirements

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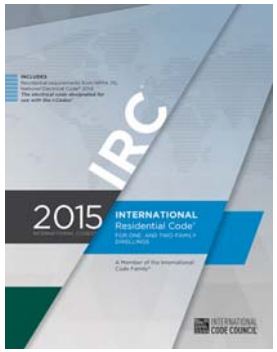
Code and Standards



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General Requirements

Existing Buildings – R102.7

Legal occupancy of any structure existing on the date of adoption of a code is permitted to continue without change.

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General Requirements

Existing Buildings – R102.7.1

Additions, alterations or repairs to a structure shall conform to requirements for a new structure.

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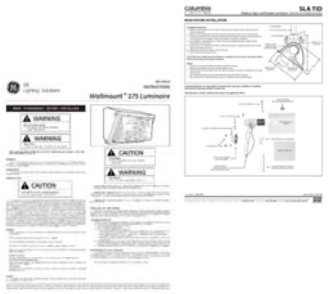
General Requirements

Manufacturer's Installation Instructions – R106.1.2

Manufacturer's installation instructions shall be at the jobsite during inspection.



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General Requirements

Permits – R105.2

Item 10 – A permit not required for a deck that meets ***ALL*** these requirements:

- Not exceeding 200 ft^2 in area
- Not more than 30 inches above grade at any point
- Not attached to a dwelling
- Not serving the egress door

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General Requirements

Used Materials – R104.9.1

Used materials, equipment and devices shall not be reused unless approved

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General Requirements

Alternative Materials and Methods – R104.11

An alternative material, design or method of construction shall be approved if the proposed design is satisfactory and complies with the intent of the code.

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Evaluation Reports

ESR-1461 Master Mark Rhino Composite Decking

ESR-1369 GEODECK™ Composite Decking and Guardrail Systems

ESR-1137 ITW Red Head EPCON G5 Adhesive Anchoring System

ESR-2138 Simpson Strong-Tie® Powder-Actuated Fasteners, Threaded Studs and Assembles

ESR-3269 GRS™ Glass Balustrade Guard System for Monolithic Tempered Glass Applications

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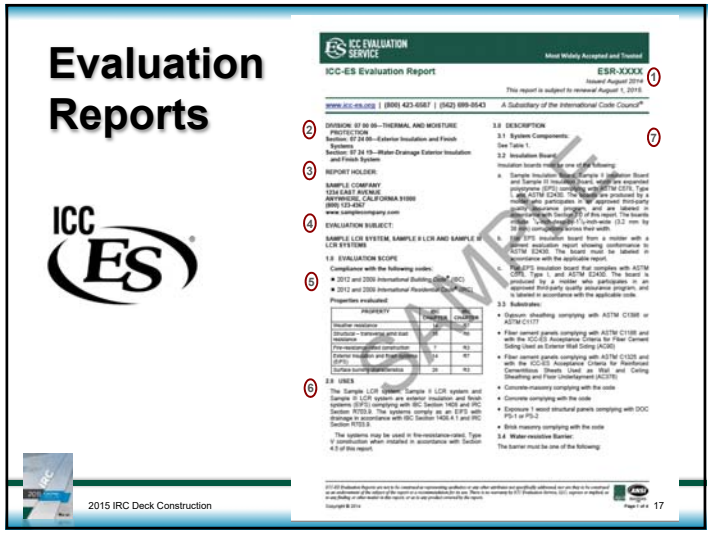

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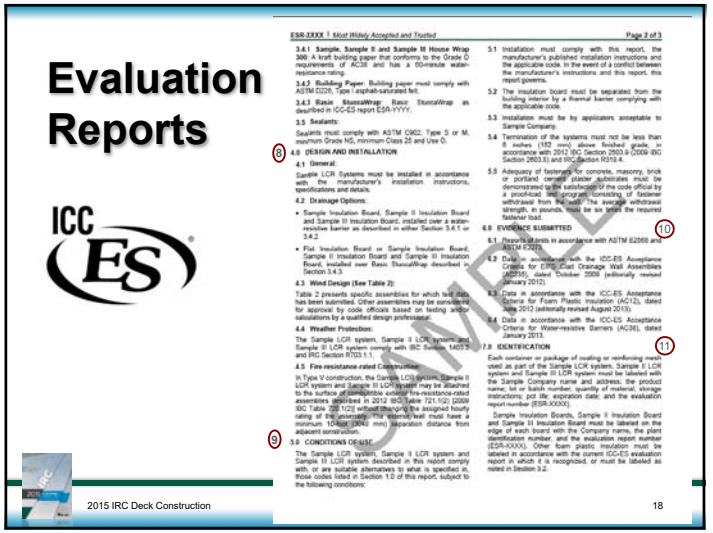

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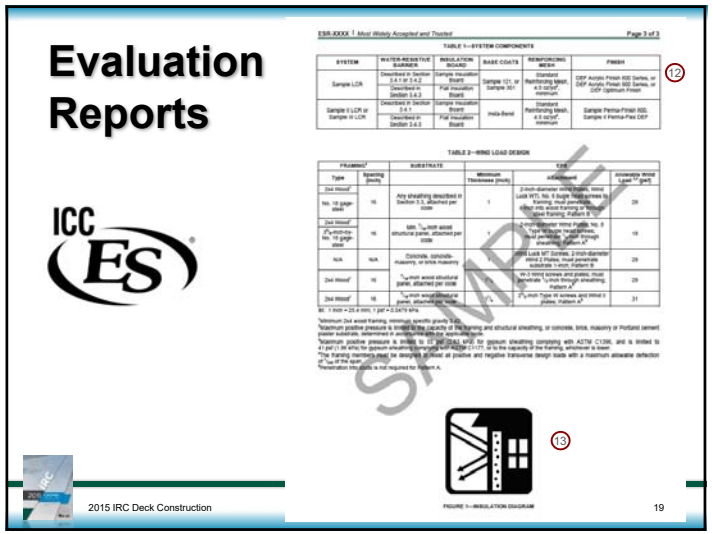

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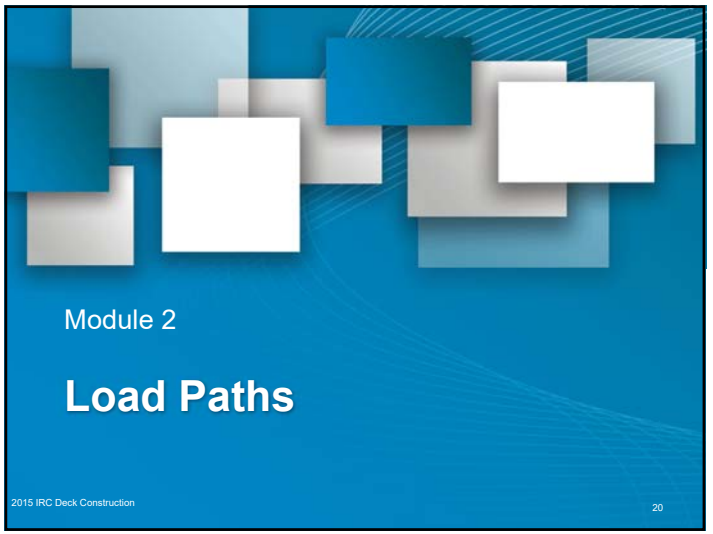

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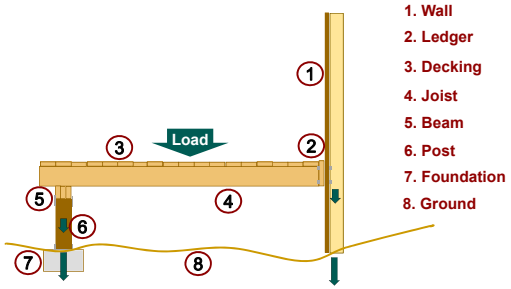
Load Path

Vertical (Gravity) Load Path



1. Wall
2. Ledger
3. Decking
4. Joist
5. Beam
6. Post
7. Foundation
8. Ground

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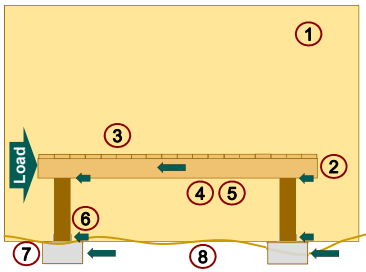
Load Path

Lateral Load Path



1. Wall
2. Ledger (hidden)
3. Decking
4. Joists/Rim (hidden)
5. Beams (hidden)
6. Post
7. Foundation
8. Ground

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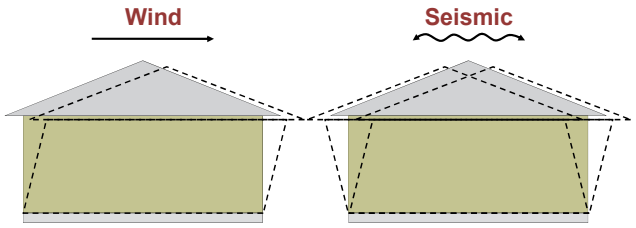
Lateral Forces



Force = Pressure x Area

Force = Mass x Acceleration

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Lateral Forces

- *Wood Design Focus* – Vol. 23, No. 2

Figure 2. Cyclic Loading Caused by Occupants Swaying Side to Side in Unison

http://wdf.forestprod.org/Archive/23_2.pdf

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Module 3

Fire Protection

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Projections and Fire Protection

Table R302.1(1) Exterior Walls

EXTERIOR WALL ELEMENT		MINIMUM FIRE-RESISTANCE RATING	MINIMUM FIRE SEPARATION DISTANCE
Walls	Fire-resistance rated	1 hour—tested in accordance with ASTM E 119 or UL 263 with exposure from both sides	< 5 feet
	Not fire-resistance rated	0 hours	≥ 5 feet
Projections	Not allowed	N/A	< 2 feet
	Fire-resistance rated	1 hour on the underside	≥ 2 feet to < 5 feet
	Not fire-resistance rated	0 hours	≥ 5 feet

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Projections and Fire Protection

Table R302.1(2) Exterior Walls – Dwellings with sprinklers

EXTERIOR WALL ELEMENT		MINIMUM FIRE-RESISTANCE RATING	MINIMUM FIRE SEPARATION DISTANCE
Walls	Fire-resistance rated	1 hour—tested in accordance with ASTM E 119 or UL 263 with exposure from both sides	0 feet
	Not fire-resistance rated	0 hours	3 feet
Projections	Not allowed	N/A	< 2 feet
	Fire-resistance rated	1 hour on the underside	2 feet
	Not fire-resistance rated	0 hours	3 feet

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International Wildland-Urban Interface Code (IWUIC)

R504.7, 505.7 – Appendages and projections

Unenclosed accessory structures attached to buildings with habitable spaces and projections, such as decks, shall be not less than 1-hour fire resistance-rated construction, heavy timber construction or other approved material

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International Wildland-Urban Interface Code (IWUIC)

One-hour fire-resistance-rated construction

Methods use steel, concrete or gypsum products, and need to be a water-tight assembly.

Photo courtesy of nathanvossconstruction.com

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International Wildland-Urban Interface Code (IWUIC)

Heavy timber construction (Type IV)

Good fire resistance

Minimum size:

- Columns/posts: 8 in. x 8 in.
- Beams: 6 in. x 10 in.
- Decking: 3 in. covered by 1 in. T&G

Typically framing (posts and beams)

30

International Wildland-Urban Interface Code (IWUIC)

Approved noncombustible materials

Referenced standard for noncombustibility exists (ASTM E 136), but accepting material as noncombustible can vary from region to region

Typically used for decking material.

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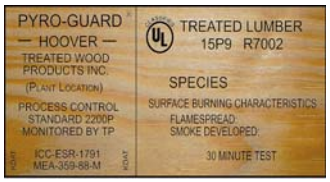
International Wildland-Urban Interface Code (IWUIC)

Fire-retardant-treated lumber (FRT)

Lumber specifically treated to be fire-resistant. Must meet IRC requirements in Chapter 3 for treatment.

Typically used for joists.



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Module 4

Foundation

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Foundation

Soil Bearing Capacity – R401.4

For expansive, compressible, shifting or other questionable soils, the building official will determine whether a soil test will be done.

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Foundation

Class of Material	Load-Bearing Pressure (psf)
Crystalline bedrock	12,000
Sedimentary and foliated rock	4,000
Sandy gravel and/or gravel (GW and GP)	3,000
Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2,000
Clay, sandy clay, silty clay, clayey silt, silt and sandy silt (CL, ML, MH and CH)	1,500

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Foundation

Minimum Depth – R403.1.4

Minimum footing depth is 12 inches or the frost depth if greater.

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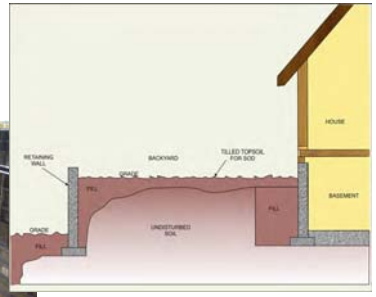
Foundation

Minimum depth is 12 inches below *undisturbed* soil depth.



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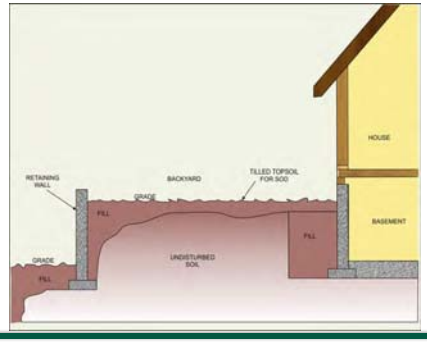
Foundation

Retaining Walls – R404.4

When a deck is on top of a retaining wall (supports load) – max. height is 24 inches without engineered design.



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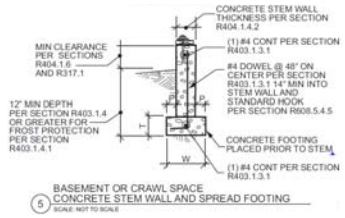
Foundation

Minimum footing size – R403.1

SDC D_0, D_1, D_2

- Minimum footing size is 12 inches by 6 inches.
- Minimum reinforcement per Figure R403.1.3.



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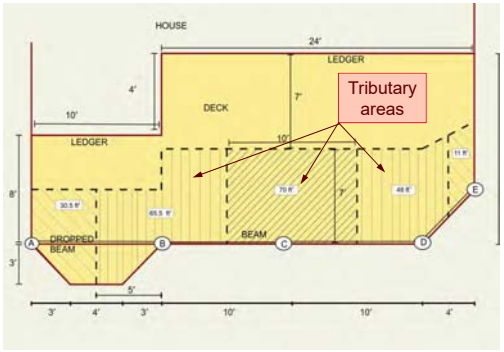
Foundation



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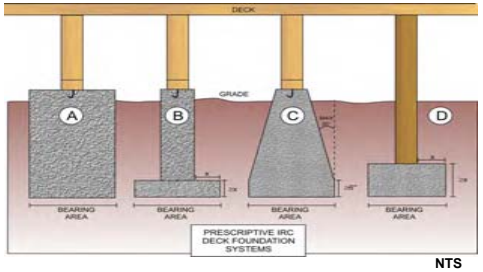
DISCUSSION

Foundation

How much of the concrete in the footing is really needed?



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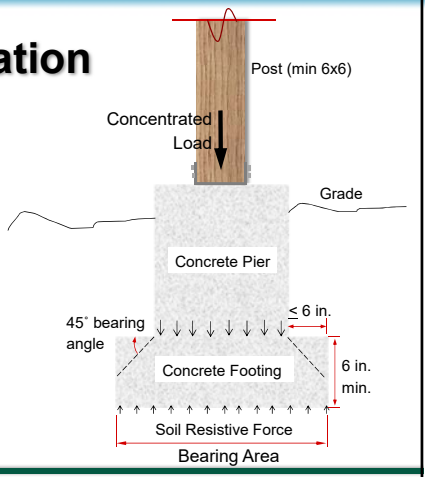
DISCUSSION

Foundation

Concrete pier and isolated footing



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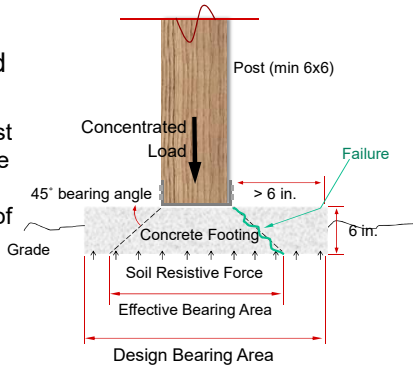
DISCUSSION

Foundation

Post on undersized concrete footing

- Footing depth must be greater than the length of footing beyond the edge of the post



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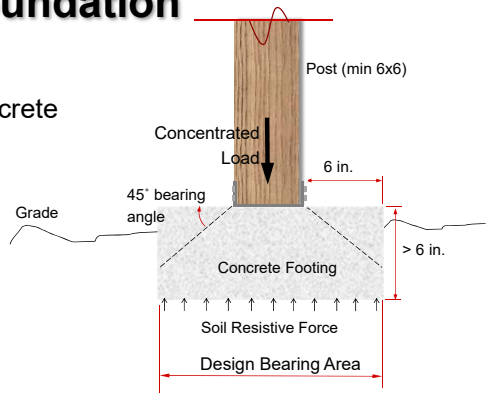
DISCUSSION

Foundation

Post on concrete footing



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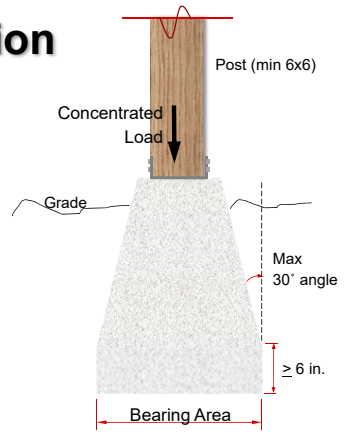
DISCUSSION

Foundation

Concrete belled pier foundation



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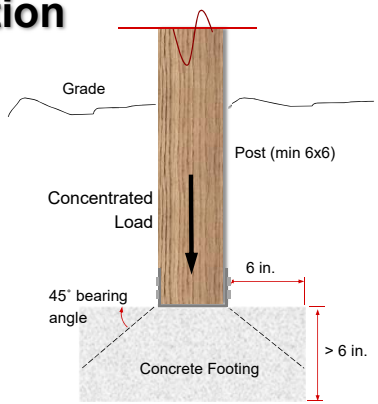
DISCUSSION

Foundation

Buried PT post on concrete footing



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QUESTION & ANSWER

Poll Question

2. A 12-inch dimension is required for which of the following deck footing provisions?

a. Minimum depth below undisturbed soil
b. Minimum distance from the lot line
c. Minimum thickness of footing
d. All of the above

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Module 5

Selecting Deck Materials

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Selecting deck materials

Sawn Lumber – R502.1.1

Sawn lumber shall be identified by a grade mark of an accredited lumber grading or inspection agency.

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Selecting deck materials

- Lumber – machine rated, visual rated or engineered - the stamps all vary
- Check the stamp to verify the correct selection of lumber

Lumber Grade Mark

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Selecting deck materials

End-jointed lumber – R502.1.1.2

Approved end-jointed lumber identified by grade mark is used interchangeably with solid-sawn members of the same species and grade.

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Selecting deck materials

Engineered lumber

Layered wood products including:

- Glulam
- Laminated veneer lumber(LVL)
- Parallel strand lumber (PSL)
- Laminated strand lumber (LSL)
- Oriented strand lumber (OSL)
- Plywood
- I-joists

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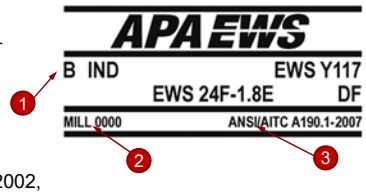
Selecting deck materials

Glulam Grade Stamp

1. Indicates structural use:
   - B-Simple span bending member
   - C-Compression member
   - T-Tension member
   - CB-Continuous or cantilevered span
2. Mill number.
3. ANSI Standard A190.1-2002, Structural Glued Laminated Timber.



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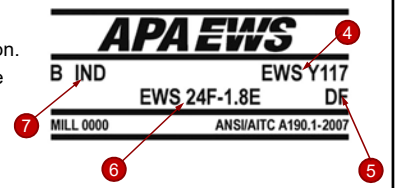
Selecting deck materials

Glulam Grade Stamp

4. Applicable laminating specification
5. Wood species.
6. Structural grade designation.
7. Designation of appearance grade.
   - INDUSTRIAL
   - ARCHITECTURAL
   - PREMIUM
   - FRAMING or FRAMING-L



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Selecting deck materials

Composite materials

Plastic composite = a generic designation referring to wood-plastic composites and plastic lumber.

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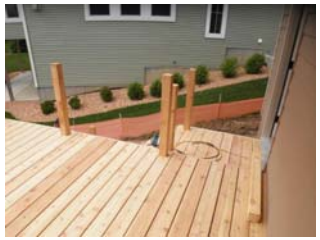
Selecting deck materials

Naturally durable solid-sawn lumber

- 90% or more of lumber stud, post or beam is heartwood
- Redwood, cedar, black locust or black walnut lumber (decay resistant)



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Selecting deck materials

Preservative-treated lumber

Protection of lumber from decay is provided by use of naturally durable wood or wood that is preservative-treated using AWPA U1.

Photo Courtesy of BB&S Treated Lumber of New England

57

Preservative-treated lumber

Quality mark – R317.2

Lumber and plywood required to be pressure-preservative treated shall bear the quality mark of an approved inspection agency.

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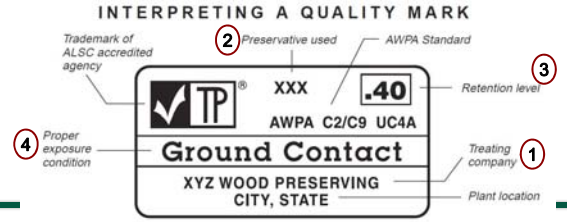
Preservative-treated lumber

Required information – R317.2.1

1. Identification of the treating plant.
2. Type of preservative.
3. The minimum preservative retention.
4. End use for which the product was treated.



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Preservative-treated lumber

Required information – R317.2.1

5. Standard to which the product was treated.
6. Identity of the *approved* inspection agency.
7. The designation “Dry,” if applicable.

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Preservative-treated lumber

Location required – R317.1

- Wood framing members resting on concrete walls less than 8 inches above ground.
- Wood structural members supporting moisture permeable floors exposed to weather.

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Preservative-treated lumber

Location required: ground contact – R317.1.2

Use approved pressure-preservative-treated wood suitable for ground contact use for wood

- in contact with the ground
- embedded in concrete in ground exposed to the weather

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Preservative-treated lumber

Wood Columns – R317.1.4

Deck posts supported by concrete piers less than 6 inches above exposed earth require decay resistant or pressure treated lumber.

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Preservative-treated lumber

Field Treatment – R317.1.1

Field-cut ends, notches and drilled holes of preservative-treated wood shall be treated in the field using the AWPA M4 standard.

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Porches and Decks

Location required: geographical areas – R317.1.3

When lumber is exposed to the weather without roof, eave or overhang naturally durable or pressure-preservative treated wood shall be used for the structural supports of balconies and porches.

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Selecting deck materials

Fire-retardant treated lumber

Pressure-treated lumber and plywood that exhibit reduced surface burning characteristics and resist propagation of fire.

At this time there is no FRTL available that allows ground contact as well.

66

Selecting deck materials

Termite control – R318.1

In areas subject to damage from termites as indicated by Table R301.2(1), methods of protection include:

1. Chemical termiticide treatment
2. Termite baiting system
3. Pressure-preservative-treated
4. Naturally durable termite-resistant
5. Physical barriers
6. Cold-formed steel framing

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Selecting deck materials

Fasteners and Hardware

Fasteners in preservative-treated and fire-retardant-treated wood shall meet the requirements of ASTM A153 (min. zinc coating weight) or ASTM F 1667 for stainless steel.

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Selecting deck materials

Fasteners for preservative-treated wood – R317.3.1

Fasteners, including nuts and washers, shall be either:

- Hot-dipped, zinc-coated galvanized steel (min. ASTM A 653 type G185)
- Stainless steel
- Silicon bronze
- Copper

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Selecting deck materials

Fasteners and Hardware in fire-retardant treated wood

Fasteners, including nuts and washers, used in the exterior, or in wet or damp locations may be:

- Hot-dipped, zinc-coated galvanized steel
- Stainless steel
- Silicon bronze
- Copper

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Selecting deck materials

Wood/plastic composites – R311.7.8.4, 312.1.4, 317.4

Plastic composite exterior treads, handrails, guards and deck boards may contain wood, cellulosic or other biodegradable materials meeting ASTM D 7032 requirements

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Selecting deck materials

Wood/plastic composites – R311.7.8.4, 312.1.4, 317.4

Requirements from ASTM D 7032 include minimum standards for:

- Flame spread ≤ 200
- Decay resistance
- Termite resistance
- Labeling – load and allowable span

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Selecting deck materials

Wood/plastic composites – R311.7.8.4, 312.1.4, 317.4

	TEST METHOD	VALUES
Flame Spread (a)	ASTM E84	60 (Transcend) / 85 (Enhance)
	Typical Trex® Values for Coefficient of Thermal Expansion/Contraction (36" (91.4 cm) long samples)	
Thermal	Width	35.2 x 10-6 to 42.7 x 10-6 (inch/inch/°F) 644 x 10-6 to 776 x 10-6 (length/length/°C)
	Length	16.1 x 10-6 to 19.2 x 10-6 (inch/inch/°F)
	Width -3%	-1%
Nail Withdrawal	ASTM D1761	163 lbs/in (1.12 Mpa)
Screw Withdrawal	ASTM D1761	558 lbs/in (3.85 Mpa)
Fungus Resistance (White & Brown Rot)	ASTM D1413	Rating = No Decay
Termite Resistance (c)	AWPAE1-72	Rating = 9.6
		ULTIMATE (TYPICAL) VALUES DESIGN VALUES

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Poll Question

3. Deck materials can be which of following?

a. No. 2 or better preservative-treated or naturally durable lumber
b. Engineered wood products
c. Plastic composites
d. All of the above

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Module 6

Deck Design

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Deck design

Alternative provisions – R301.1.1

Other standards can be used to design a deck. Although not specifically referenced in the IRC, DCA 6-2012, the deck design guideline from the American Wood Council can be used to design a deck.

Additional documents may be available in some regions.

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Deck design

Engineered design – R301.1.3

A deck may be designed by an engineer or architect. In that case, the requirements of Section R507 need not be followed.

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Deck design

Deck design and construction – R507

- Wood-framed decks follow the requirements of this section or be engineered for specific materials and conditions
- Decks shall be positively anchored to the primary structure and designed for both vertical and lateral loads

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Deck design

Deck design and construction – R507

Where positive connection to the primary building structure cannot be verified during inspection, decks shall be self-supporting.

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Deck design

Deck design and construction – R507

Decks with cantilevered framing members connected to exterior walls or other framing members *shall be designed* and constructed to resist uplift from loads acting on the cantilevered portion of the deck.

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Deck design

Design criteria – R301.2

- Ground snow
- Wind speed
- Seismic design category
- Weathering of concrete
- Frost line depth
- Termite prevalence

TABLE R301.2(1)
CLIMATIC AND GEOGRAPHIC DESIGN CRITERI

GROUND SNOW LOAD	WIND DESIGN				SEISMIC DESIGN CATEGORY[f]	SUBJECT TO DAMAGE FROM		
	Speed[d] (mph)	Topographic effects[k]	Special wind region[l]	Wind-borne debris zone[m]		Weathering[a]	Frost line depth[b]	Termite[c]

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Deck design

Live loads – R301.5

Use	Live Load
Balconies (exterior) and decks[e]	40
Fire escapes	40
Guards and handrails[d]	200[h]
Guard in-fill components[f]	50[h]
Stairs	40[c]

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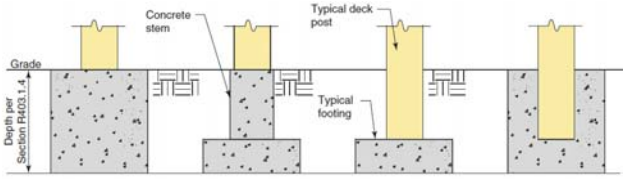
Module 7

Posts and Columns

83

Post to footing attachment



*Restrain posts against lateral displacement at base of post. Restraint may be by manufactured connector or minimum 12 inch embedment into soil or concrete.

84

Post to base connection

- **R507.8.1**
  - Use of the post base secures the base of a post against lateral forces
  - A pressure-treated post sunk into the earth at least 12 inches and bearing on a footing below will resist lateral forces

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Post height

Table R507.8 Deck Post Height

Deck Post Size	Maximum Height
4 x 4	8'
4 x 6	8'
6 x 6	14'

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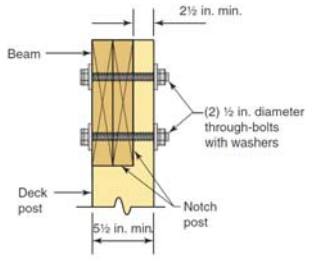
86

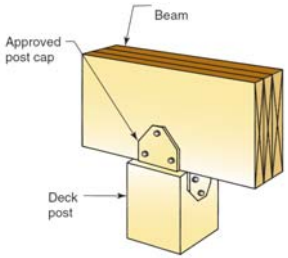
Post to beam connection

Notched post connection



Notched post

Post cap connection



Post cap

2015 IRC Deck Construction 87

87

Posts and Columns

Bearing Length – R507.7

- Bearing over wood or metal must be a minimum of 1.5 inches
- Bearing over concrete or masonry must be a minimum of 3 inches

2015 IRC Deck Construction 88

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Poll Question

4. Which of the following deck post sizes can be 14 feet in height?

a. 4x6
b. 6x6
c. 8x8
d. All of the above
e. b. and c. only

89

Module 8

Ledger

90

Ledger

Decks – R507 & R311.5.1

- Decks must be positively anchored to the primary structure when supported by attachment to an exterior wall
- Both lateral and gravity loads must be considered

91

Ledger

Minimum 2x8 nominal:

- Pressure-preservative treated southern pine
- Incised pressure-preservative-treated hem-fir
- No. 2 or better naturally durable lumber

92

Ledger

- May not support concentrated loads from beams or girders
- May not be supported on stone or masonry veneer

93

Ledger

Band joist details – R507.2.2

Minimum band joist =

- Minimum 2" nominal solid-sawn, SPF lumber
- Minimum 1" x 9.5" Douglas fir LVL
- Must be fully supported from below

94

Ledger

Band joist details – R507.2.2

Solid board must exist, in the case of open web joists, the ribbon strip is not sufficient connection

95

Ledger

Fasteners for ledger attachment – R507.2.3

- Fasteners shall be hot-dipped galvanized or stainless steel
- Installed following Tables R507.2 and R507.2.1 and Figures R507.2.1(1) and R507.2.1(2)

96

Ledger

Table R507.2 Deck Ledger Connection To Band Joist

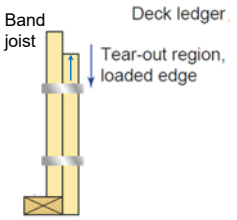
Connection Details	Joist Span						
	6' and less	6'1" to 8'	8'1" to 10'	10'1" to 12'	12'1' to 14'	14'1" to 16'	16'1" to 18'
	On-center spacing of fasteners (inches)						
1/2-inch diameter lag screw with 1/2-inch maximum sheathing	30	23	18	15	13	11	10
1/2-inch diameter bolt with 1/2-inch maximum sheathing	36	36	34	29	24	21	19
1/2-inch diameter bolt with 1-inch maximum sheathing	36	36	29	24	21	18	16

97

Ledger

Fastener placement in deck ledger – Table R507.2.1

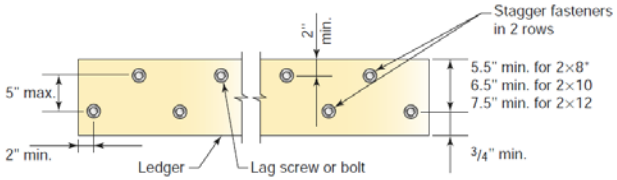
Minimum End and Edge Distances and Spacing Between Rows				
	Top Edge	Bottom Edge	Ends	Row Spacing
Ledger	2 inches	3/4 inch	2 inches	1-5/8 inches
Band Joist	3/4 inch	2 inches	2 inches	1-5/8 inches



98

Ledger

Placement of Lag Screws and Bolts in Ledgers – R507.2.1(1)

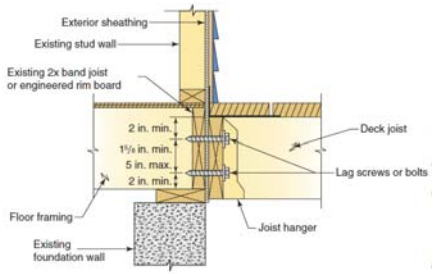


*Distance shall be permitted to be reduced to 4.5" if lag screws are used or bolt spacing is reduced to that of lag screws to attach 2x8 ledgers to 2x8 band joists.

99

Ledger

Placement of Lag Screws and Bolts in Band Joists – R507.2.1(2)



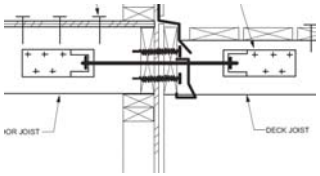
100

Ledger

Deck lateral load connection – R507.2.4

- Lateral load connection provided by hold-downs, angles or any other approved method
- Total resistance should be 3000 lbs (tension)

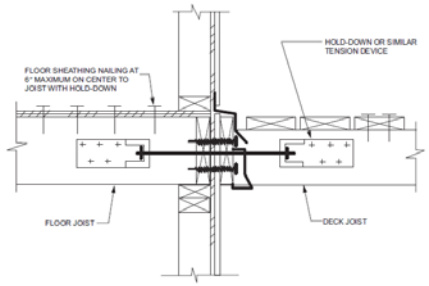
Is this required?



101

Ledger

Deck attachment for lateral loads – Figure R507.2.3(1)



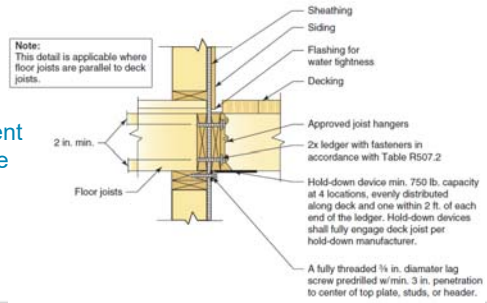
Option 1

102

Ledger

Deck attachment for lateral loads – Figure R507.2.3(2)

New attachment method in the 2015 IRC



Option 2

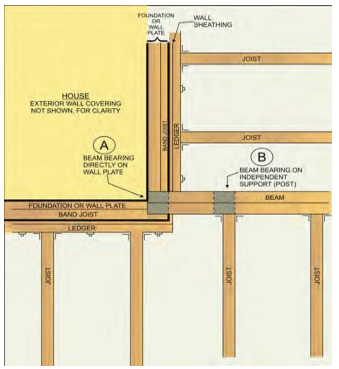
103

Ledger

Ledger at dwelling corners

A built-up beam used to carry joists cannot be attached to the ledger or band joist.

- Option "A" shows the beam extending into the existing structure and resting on the foundation below, while
- Option "B" depicts an independent support provided underneath the beam, such as a post or pier.



104

Ledger

Decks at dwelling cantilevers

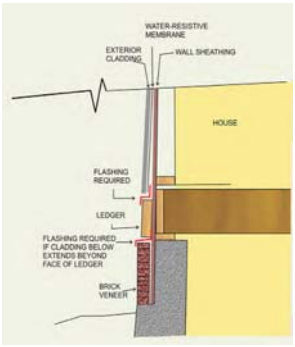
At the cantilevered face of the dwelling, a dropped beam can take the load of the deck joists.

105

Ledger

Flashing – R703.4 Item 5

- Approved corrosion-resistant flashing applied shingle-fashion
- Self-adhered membranes used as flashing complying with AAMA 711



106

Poll Question

5. Which of the following is true about deck ledgers?

a. Nails can be used to attach ledger to bandjoist
b. Can be supported on stone or masonry veneer
c. Can be attached with lag screws at 48” o.c.
d. Minimum 2x8 nominal No. 2 grade or better lumber

107

Module 9

Beams

108

Beams

Table R507.6 Deck Beam Span Length (ft-in)

Species	Size	Deck Joist Span Less Than or Equal to: (feet)						
		6	8	10	12	14	16	18
Southern pine	2 – 2 x 6	6-11	5-11	5-4	4-10	4-6	4-3	4-0
	2 – 2 x 8	8-9	7-7	6-9	6-2	5-9	5-4	5-0
	2 – 2 x 10	10-4	9-0	8-0	7-4	6-9	6-4	6-0
	2 – 2 x 12	12-2	10-7	9-5	8-7	8-0	7-6	7-0
	3 – 2 x 6	8-2	7-5	6-8	6-1	5-8	5-3	5-0
	3 – 2 x 8	10-10	9-6	8-6	7-9	7-2	6-8	6-4
	3 – 2 x 10	13-0	11-3	10-0	9-2	8-6	7-11	7-6
	3 – 2 x 12	15-3	13-3	11-10	10-9	10-0	9-4	8-10

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Beams

Table R507.6 Deck Beam Span Length (ft-in)

Species	Size	Deck Joist Span Less Than or Equal to: (feet)						
		6	8	10	12	14	16	18
Douglas Fir-larch, Hem-fir, Spruce-pine-fir, Redwood, Western Cedars, Ponderosa Pine, Red Pine	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

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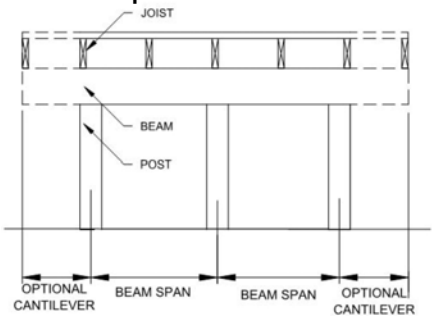
Beams

Figure R507.6 Deck Beam Spans

Dropped Beam



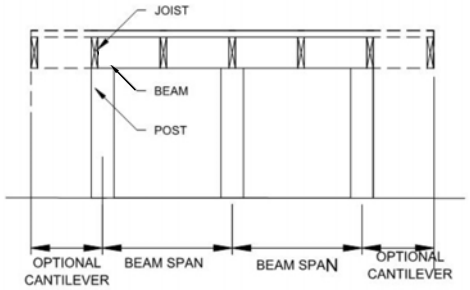
Cantilever up to ¼ beam span

111

Beams

Figure R507.6 Deck Beam Spans

Flush Beam



Cantilever up to ¼ beam span

112

Beams

Beam bearing – R507.7

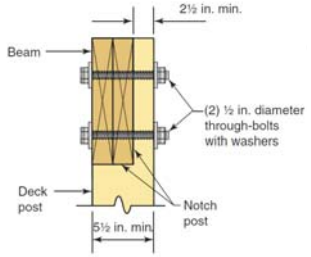
Beam bearing:

- 1-1/2 in. min. on wood or metal
- 3 inches min. on concrete or masonry

113

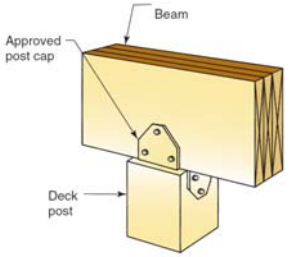
Post to beam connection

Notched post connection



Notched post

Post cap connection



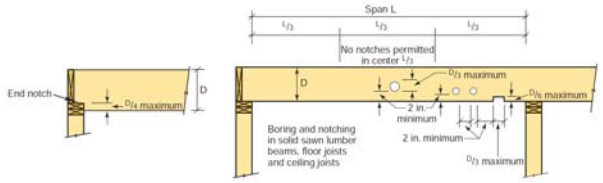
Post cap

114

Beams

Drilling and notching – R502.8

- Structural solid sawn members shall not be cut, bored or notched in excess of limitations in the Figure 502.8
- Engineered lumber may not be cut, bored or notched unless permitted by the manufacturer



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Module 10

Joists

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Joists

Joist material

Joists may be solid sawn naturally durable lumber, pressure treated lumber, or potentially engineered lumber that is also treated to resist decay.

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Joists

Maximum joist spacing – R507.4

Decking Material Type and Nominal Size	Maximum On-center Joist Spacing	
	Decking perpendicular to joist	Decking diagonal to joist
1¼-inch-thick wood	16 inches	12 inches
2-inch-thick wood	24 inches	16 inches
Plastic composite	In accordance with Section R507.3	In accordance with Section R507.3

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Joists

Maximum joist span – R507.5

Species	Size	Spacing of Deck Joists with No Cantilever (inches)			Spacing of Deck Joists with Cantilevers (inches)		
		12	16	24	12	16	24
Southern Pine	2 x 6	9-11	9-0	7-7	6-8	6-8	6-8
	2 x 8	13-1	11-10	9-8	10-1	10-1	9-8
	2 x 10	16-2	14-0	11-5	14-6	14-0	11-5
	2 x 12	18-0	16-6	13-6	18-0	16-6	13-6
Douglas Fir-larch, Hem-fir Spruce-pine-fir	2 x 6	9-6	8-8	7-2	6-3	6-3	6-3
	2 x 8	12-6	11-1	9-1	9-5	9-5	9-1
	2 x 10	15-8	13-7	11-1	13-7	13-7	11-1
	2 x 12	18-0	15-9	12-10	18-0	15-9	12-10
Redwood, Western Cedars, Ponderosa Pine, Red Pine	2 x 6	8-10	8-0	7-0	5-7	5-7	5-7
	2 x 8	11-8	10-7	8-8	8-6	8-6	8-6
	2 x 10	14-11	13-0	10-7	12-3	12-3	10-7
	2 x 12	17-5	15-1	12-4	16-5	15-1	12-4

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Joists

Joist bearing – R502.7

Joist bearing:

- 1-1/2 in. min. on wood or metal
- Joist framing supported by approved joist hangers at side of beam
- Joists bearing on a beam attached to resist lateral movement

120

Joists

Joist restraint at supports – R507.5.1

Joist ends and bearing locations shall be provided with lateral restraint to prevent rotation.

- joist hangers or blocking - depth ≥ 60 percent of the joist depth
- rim joists - nailed with (3) 10d (3-inch x 0.128-inch) nails or (3) #10 x 3-inch long wood screws

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Joists

Framing of openings – R502.10

- Openings in floor framing (for stairs) are framed with a header and trimmer joists.
- Double joists if header span is greater than 4 feet.

2015 IRC Deck Construction 122

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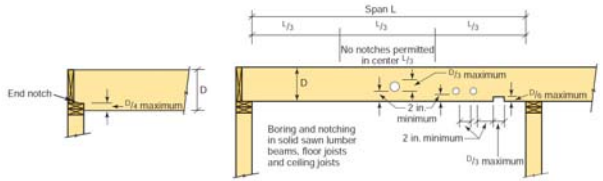
Joists

Drilling and notching – R502.8

The same requirements for beams apply to joists when cutting, drilling or notching



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Module 11

Decking

2015 IRC Deck Construction 124

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Decking material

Lumber deck boards

Fastening of lumber decking to supporting joists and beams is detailed in Table R602.3(1).

- #8 or greater wood screws are often used for exterior decking fastening, as the expansion/contraction of materials causes nails to rise out from the decking
- Hidden fastener systems and other types of fastening products must be tested as an alternative

125

Decking material

Plastic composite deck boards – R507.3

- Plastic composite exterior deck boards and stair treads comply with ASTM D 7032
- The label on the packaging will state that the decking complies and give the maximum span
- Flame spread < 200

126

Decking attachment

Joist spacing

This particular decking product, when installed on a 45-degree angle requires a maximum spacing of 12 inches o.c. Originally installed on joists spaced 16 inches o.c., additional joists were required.

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Decking attachment

Deck board spacing

These deck boards were installed with no gap during cold temperatures and expanded considerably when warm weather arrived, affecting the performance and stability of the installation.

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Module 12

Free-Standing Decks

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Free standing decks

Free standing decks are not attached by ledger to the dwelling, although they may be placed next to the dwelling

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Footing

Footing of freestanding decks need to be restrained similarly to decks fastened to the dwelling.

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Lateral bracing

2015 IRC Deck Construction 132

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Poll Question

6. Which of the following is <u>false</u> about deck beams?

a. Minimum bearing is 1-1/2 inches on wood
b. Cantilevers can be up to ¼ of the beam span
c. Beams are supported by bearing on posts
d. Can support joist spans up to 20 feet

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Module 13

Deck Safety

134

Landings

Landings – R311.3

- Landing or floor required on each side of an exterior door.
- Min. landing width = width of the door
- Min. landing length = 36 in. in direction of travel
- Slope of exterior landings ≤ 1/4:12 (2 percent)

135

Landings

Landings – R311.3

Exception:
Exterior balconies < 60 square feet and only accessible from a door may have a landing < 36 inches in direction of travel

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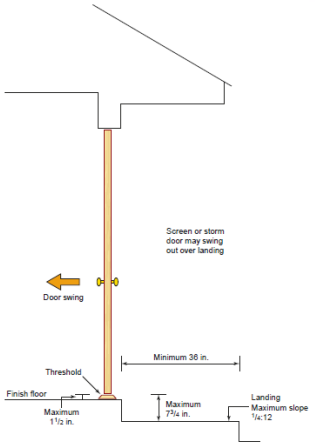
Landings

Landings – R311.3.1

- Egress door – landing ≤ 1.5 inches below threshold
- Exception allows 7-3/4 inches on exterior side when door swings inward



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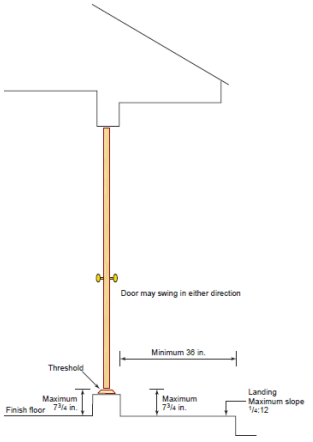
Landings

Landings – 311.3.2

Other exterior doors – landing < 7-3/4 inches below threshold



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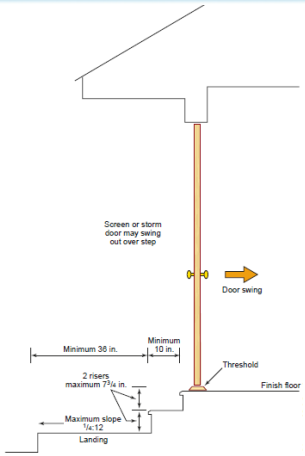
Landings

Landings – 311.3.2

Exception: Top landing not required where a two riser stairway is located on the exterior side of the door, provided that the door does not swing over the stairway



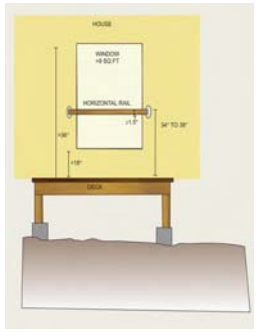
139

Safety Glazing

Glazing in windows – R308.4.3

Safety glazing is required when:

1. An individual pane is < 9 square feet
2. Bottom edge of glazing is <18 inches above the floor
3. Top edge of glazing is > 36 inches above the floor
4. Walking surface is < 36 inches from the glazing



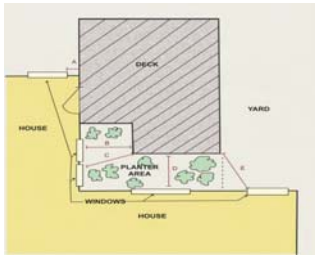
140

Safety Glazing

Glazing in windows – R308.4.3

Exceptions:

1. Decorative glazing
2. Rail installed in front of glazing



141

Safety Glazing

Glazing in guards and rails – R308.4.4

- Glazing in guards and railings, including structural baluster panels and nonstructural in-fill panels, is a hazardous location

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Safety Glazing

Table R301.5 Minimum Uniformly Distributed Live Loads (psf)

- Glazing used in handrail assemblies and guards shall be designed with a safety factor of 4.
- The safety factor shall be applied to each concentrated load at the top of the rail, and to the uniform load on the infill components.

Use	Live Load
Guards and handrails	200[h]
Guard in-fill components	50[h]

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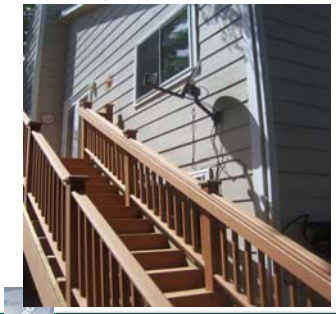
Safety Glazing

Glazing adjacent to stairs and ramps – R308.4.6



Glazing < 36 inches above the adjacent walking surface of stairways and ramps is a hazardous location

Exceptions:

1. Rail installed in front of glazing
2. Glazing > 36 in. away from walking surface

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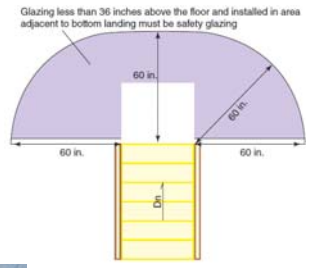
Safety Glazing

Glazing adjacent to the bottom stair landing – R308.4.7



Glazing adjacent to the bottom of a stairway if < 36 inches above the landing and within 60-inches horizontal from the bottom tread nosing is a hazardous location

145

Emergency Escape and Rescue Openings

EERO required – R310.2.4

Must open directly into a public way, yard or court.

EEROs may be installed under decks and porches if the location of the deck allows the EERO to be fully opened and provides a path ≥ 36 inches tall to a yard or court.

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Emergency Escape and Rescue Openings

Bars, grilles, covers and screens – R310.4

May be placed over EEROs, bulkhead enclosures, or window wells, if the minimum net clear opening size complies, and they can be moved from the inside without the use of a key, tool, or special knowledge or force greater than that required for the normal operation of the escape and rescue opening.

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Potential hazard areas

Stairways – R311.5.1 & R311.7

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Stairways

Design – live load - Table R301.5

Use	Live Load
Stairs	40

Footnote c: Individual stair treads shall be designed for the uniformly distributed live load or a 300-pound concentrated load acting over an area of 4 square inches, whichever produces the greater stresses.

149

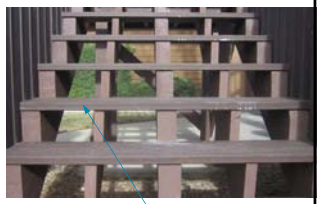
FOR EXAMPLE

Stringer spacing

A heavy-timber stairway had 4 by 12 treads replaced with composite decking.

Previous stringer spacing of 18 inches was insufficient to support the span of the new tread material.

Two 2 x 12 notched stringers were added.



What is wrong with these stairs?

150

Stairways

Risers – R311.7.5.1

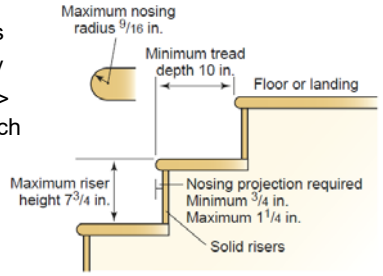
- Max. height < 7-3/4 in.
- The riser shall be measured vertically between adjacent treads.
- The greatest riser height > than the smallest < 3/8 inch
- Risers are vertical or sloped < 30 degrees from vertical
- Open risers are permitted if openings located more than 30 in. above floor or grade do not permit passage of a 4 in sphere

151

Stairways

Treads – R311.7.5.2

- Min. depth ≥10 inches
- Measured horizontally
- Greatest tread depth > than smallest ≤ 3/8 inch

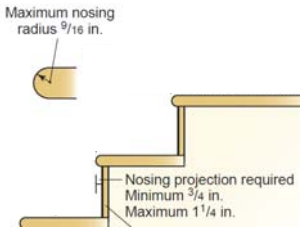


152

Stairways

Nosings – R311.7.5.3

- Radius of curvature ≤ 9/16 inch
- Projection between 3/4 inch and 1-1/4 inches
- Greatest nosing projection > than smallest ≤ 3/8 inch between stories
- Beveling of nosings ≤ 1/2 inch

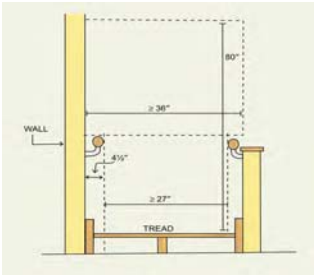


153

Stairways

Width – R311.7.1

- Stairways ≥ 36 inches in clear width above handrails
- Handrails project ≤ 4-1/2 inches on either side of the stairway
- Clear width ≥ 31-1/2 inches with handrail on one side and 27 inches with two handrails

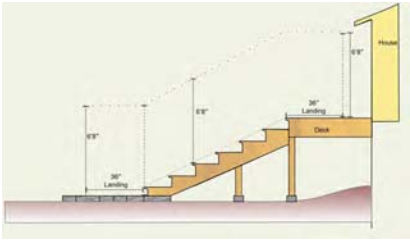


154

Stairways

Headroom – R311.7.2

≥ 6 feet 8 inches vertically from the tread nosing or floor surface



155

Stairways

Walkline – R311.7.4

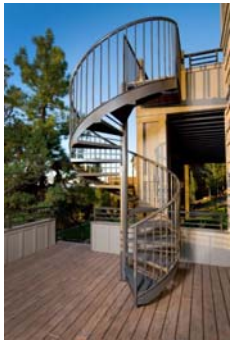
- Concentric to the direction of travel across winder treads
- Located 12 inches from narrowest side, measured from widest point of clear stair width

156

Spiral Stairways

Spiral stairways – R311.7.10.1

- Clear width at and below the handrail ≥ 26 inches
- Walkline radius ≤ 24-1/2 inches
- Tread depth ≥ 6-3/4 inches at walkline
- Treads identical
- Riser ≤ 9-1/2 inches
- Headroom ≥ 6 feet 6 inches



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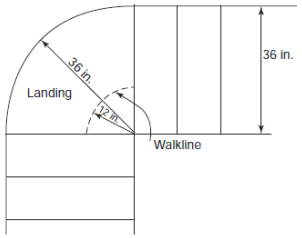
Stairways

Stairway landings – R311.7.6

- Floor or landing at the top and bottom of each stairway.
- Landing width ≥ width of the flight served.
- Landing depth ≥ 36 inches
- Non-rectangular landings permitted if depth at walk line and total area ≥ quarter circle with a radius ≥ stairway width



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Poll Question

7. Safety glazing is required for which of the following locations?

a. Deck guard and railing infill
b. <36” above adjacent walking surface of stairs/landings
c. <60” horizontally from bottom stair tread nosing
d. All of the above

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Ramps

Ramp slope – R311.8.1

- Egress door ramp max. slope of 1:12 (8.3 percent) See exception
- All other ramp max. slope of 1:8 (12.5 percent)

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Handrails

What is wrong?

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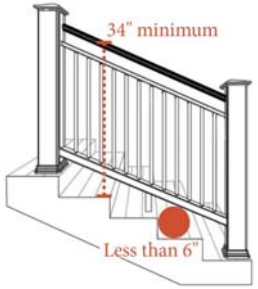
Handrails

Height – R311.7.8.1

Measured vertically from the tread nosing or ramp slope, height must be between 34 and 38 inches



162

Handrails

Table R301.5 Minimum Concentrated Live Load (lbs)

A single concentrated load of 200 lbs applied in any direction at any point along the top of the handrail.

Use	Live Load
Handrails[d]	200[h]

Reminder: Glazing used in handrail assemblies shall be designed with a safety factor of 4.

163

Handrails

Continuity – R311.7.8.2

- Handrails must be continuous
- Ends are returned or terminate in newel posts or safety terminals.
- When adjacent to a wall, handrails must have a gap ≥ 1-1/2 inches

164

Handrails

Grip Size – R311.7.8.3

Type I

- Outside diameter between 1-1/4 and 2 inches (circular cross section)
- Perimeter dimension between 4 and 6-1/4 inches and cross section ≤ 2-1/4 inches (noncircular cross section)
- Edges shall have a radius ≥ 0.01 inch

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Handrails

Grip Size – R311.7.8.3

Type II

- When perimeter > 6-1/4 inches - graspable finger recess area on both sides of profile
- Finger recess begins within 3/4 inch from tallest portion
- Recess depth ≥ 5/16 inch within 7/8 inch below the widest portion
- Required depth between 3/8 and 1-3/4 inches below the tallest portion

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Handrails

Grip Size – R311.7.8.3

Type II cont.

- Handrail width above the recess between 1-1/4 and 2-3/4 inches
- Edge radius ≥ 0.01 inch

Photo courtesy of Willamson Welding

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Guards

Guard location – R312.1

- Open-sided walking surfaces, including stairs, ramps and landings, located higher than 30 inches above grade within 36 inches horizontally of the deck edge must have guards.
- Insect screening is not a guard

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Guards

Table R301.5 Minimum Concentrated Live Load (lbs)

A single concentrated load of 200 lbs applied in any direction at any point along the top of the guard or handrail.

Use	Live Load
Guards[d]	200[h]

Reminder: Glazing used in guards shall be designed with a safety factor of 4.

169

Guards

Table R301.5 Minimum Uniformly Distributed Live Loads (psf)

Guard in-fill components, balusters and panel fillers shall be designed to withstand a horizontally applied load of 50 psf.

Use	Live Load
Guard in-fill components[f]	50[h]

Reminder: Glazing used in guards shall be designed with a safety factor of 4.

170

Guards

Height – R312.1.2

For required guards, height must be ≥ 36 inches measured above the adjacent walking surface or line connecting leading edges of treads

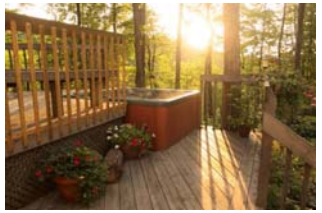
171

Guards

Height – R312.1.2

Exceptions:

1. Guards on the open sides of stairs ≥ 34 inches measured from leading edge of treads
2. Guard serving as handrail on open sides of stairs; top of guard between 34 and 38 inches line connecting the leading edge of treads



172

Guards

Opening limits – R312.3

Openings in required guards may not allow a 4-inch sphere to pass between required guards.

Exceptions:

- Triangular openings at the open side of stair may not allow a 6-inch sphere to pass
- Guards at stair may not allow a $4^{3}/_{8}$-inch sphere to pass

173

Poll Question

8. Required guards shall meet each of the following conditions except:

a. At least 36” height from adjacent walking surface
b. At least 34” height from nosing on stairs
c. Guard openings shall not allow 4” sphere to pass
d. Stair guard openings shall not allow 4” sphere to pass

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Module 14

Deck Amenities

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Deck Amenities

Deck seating – R312.1.2

- Guard height at permanent deck seating measured from the surface of the decking
- (Change from 2012 IRC)

176

Deck Amenities

Hot Tubs

177

Deck Amenities

Design – Dead Load R301.4

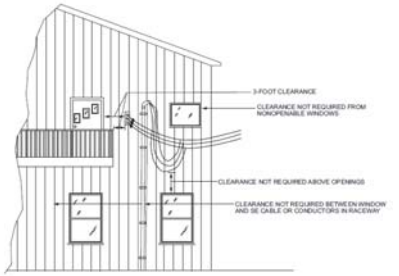
Actual weight of materials is used to determine the dead load of deck equipment.

178

Service Conductors

Vertical clearance from grade – E3604.2.2

All service conductors require a clearance of 10 feet.

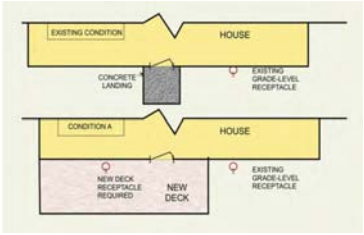


179

Electrical Outlets

Outdoor outlets – E3901.7

- At least one receptacle outlet accessible from grade at front and back of house (≤ 6.5 ft above grade)
- At least one receptacle outlet accessible above each deck (≤ 6.5 ft above deck surface)



180

Wet Areas

Glazing and wet surfaces – R308.4.5

Glazing in walls or fences facing hot tubs and outdoor swimming pools where bottom edge of glazing < 60 inches vertical above any walking surface is a hazardous location.

Except – when glazing is > 60 inches away horizontally

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Electrical Outlets

Receptacles in wet locations E4002.10

A receptacle shall have an enclosure that is weatherproof when the equipment is not attended while in use.

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Electrical Outlets

Location – E4203.1.1

Receptacles that provide power for water-pump motors:

- If located 6 to 10 feet from the inside walls of pools and hot tubs
- Receptacle is single and of the grounding type
- Protected by ground-fault circuit interrupters

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Electrical Outlets

Switching devices – E4203.2

Located ≥ 5 feet from walls of pools and hot tubs

Except –

1. Where separated by a solid fence or wall,
2. When switches are listed for use within 5 feet

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Electrical Outlets

Disconnecting means – E4203.3

- At least one method required to simultaneously disconnect all ungrounded conductors for equipment, other than lighting,
- Each method is readily accessible and within sight of equipment it serves
- Method located ≥ 5 feet from inside walls of pool or hot tub

185

Luminaires

Luminaires and lighting outlets in outdoor locations – E4203.4.1

Luminaires, lighting outlets, and canopy-suspended paddle fans are not installed over the pool or hot tub, or over the area extending 5 feet from the inside walls of a pool or hot tub unless the equipment is > 12 feet above the water surface

186

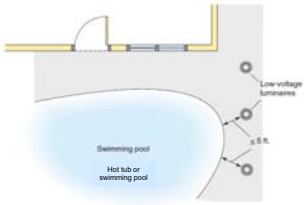
Luminaires

Low-voltage luminaires – E4203.4.3

Listed low-voltage luminaires

- not requiring grounding,
- not exceeding the low-voltage contact limit
- supplied by listed transformers or power supplies

are permitted to be < 5 ft from the inside walls of the pool



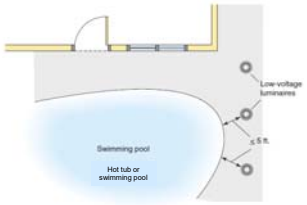
187

Luminaires

Existing lighting outlets and luminaires – E4203.4.4

Existing lighting outlets and luminaires within 5 feet of pools and hot tubs must be:

- At least 5 feet above the maximum water level
- Rigidly attached to the existing structure
- Protected by a ground-fault circuit-interrupter



188

Luminaires

GFCI protection in adjacent areas – E4203.4.6

Luminaires and outlets installed between 5 and 10 feet from pools and hot tubs shall be protected by ground-fault circuit-interrupters

Except - Where fixtures and outlets are installed ≥ 5 feet above maximum water level and rigidly attached to the structure

189

Luminaires

Overhead conductor clearances – E4203.6

Prohibited locations:

1. Pools
2. Diving structures
3. Observation stands, towers, and platforms
4. Area within 10 feet of the structures

190

Luminaires

Underground wiring – E4203.7

Prohibited below or within 5 feet of pools or hot tubs

Except – when the wiring method is a complete raceway system of corrosion resistant rigid metal conduit, intermediate metal conduit or a nonmetallic raceway system, and suitable for the location.

191

GFCI Protection

GFCI protection – E4203.1.3

Within 20 feet of pools and hot tubs all 15- and 20-ampere, single phase, 125-volt receptacles shall be protected by a ground-fault circuit interrupter

192

GFCI Protection

GFCI protection – E4203.1.3

Outlets supplying pool pump motors from branch circuits rated at 120 volts through 240 volts, single phase, whether by receptacle or direct connection, shall have ground-fault circuit-interrupter protection

193

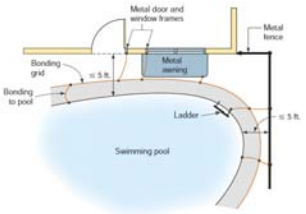
Electrical Bonding

Bonding – E4204.2

Parts of pools and hot tubs shall be bonded together using:

- insulated, covered or bare solid copper conductors not smaller than 8 AWG
- rigid metal conduit of brass or other identified corrosion-resistant metal

An 8 AWG or larger conductor shall not be required to be extended or attached to remote panelboards, service equipment, or electrodes.

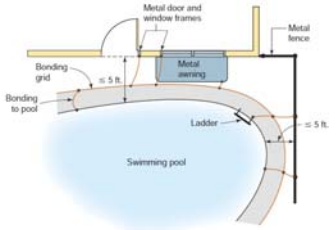


194

Electrical Bonding

Bonding of outdoor hot tubs and spas – E4204.4

- Outdoor hot tubs and spas shall comply with the bonding requirements of Sections E4204 through E4204.3.
- Bonding by metal-to-metal mounting on a common frame or base shall be permitted.
- The metal bands or hoops used secure wooden staves shall not required to be bonded as require in Section E4204.2



195

Grounding

Grounding – E4205.1

Equipment requiring grounding:

- Through-wall lighting assemblies
- Underwater luminaires
- Electrical equipment within 5 feet of pool or hot tub
- All electrical equipment associated with recirculating system

196

Grounding

Grounding – E4205.1

Equipment requiring grounding cont.:

- Junction boxes
- Transformer and power supply enclosures
- Ground-fault circuit-interrupters
- Panelboards not part of service equipment and supply electrical equipment associated with the pool or hot tub

197

Fuel Gas Requirements

Pool and spa heaters – G2441

Pool and spa heaters shall be:

- Tested in accordance with ANSI Z21.56/CSA 4.7
- Installed in accordance with the manufacturer's instructions

198

Fuel Gas Requirements

Connecting appliances – G2422

Appliances shall be connected to a piping system by:

Item 6: Listed and labeled outdoor appliance connectors in compliance with ANSI Z21.75/ CSA 6.27 and installed in accordance with the manufacturer's instructions.

199

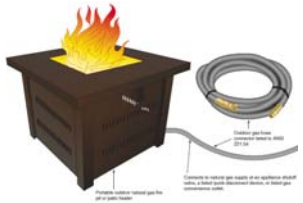
Fuel Gas Requirements

Connecting appliances – G2422

Appliances shall be connected to a piping system by:

Item 7: Listed outdoor gas hose conn (ANSI Z21.54) used to connect portable outdoor *appliances*.

The gas hose connection is ma outdoors and is to the gas *pipin* supply at an *appliance* shutoff v *listed* quick-disconnect device c gas convenience outlet.



200

Fuel Gas Requirements

Outdoor decorative appliances – G2454

Permanently fixed-in-place outdoor decorative appliances shall be tested in accordance with ANSI Z21.97 and shall be installed in accordance with the manufacturer's instructions.

201

Exhaust Terminations

Duct termination – M1502.3

- Dryer exhausts are commonly located at the rim joist of a home's floor; the same place decks are often attached.
- Check that the exhaust duct isn't covered by the deck nor below the decking.

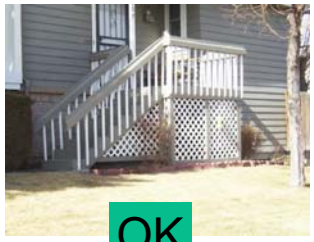
202

Combustion Air Duct

Combustion air duct – G2407.11 Item 2

Free movement of combustion air required

No Good



OK

203

Combustion Air Duct

Combustion air duct – G2407.11 Item 8

Combustion air intake openings shall be located not ≥ 12 inches above the adjoining grade level

204

Appliance Venting

Category IV appliance venting systems – G2425.14

- Category IV equipment = "high-efficiency," "90-percenter," "power-venter" or "condensing"
- Installation per manufacturer and listing
- Clearance is often 12 inches above grade
- Vertical clearance above of up to 36 inches

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Appliance Venting

Category IV appliance venting systems – G2425.14

The concentric vent termination serves a second Category IV appliance, whose clearances are regulated by the manufacturer.

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Appliance Venting

Category IV appliance venting systems – G2425.14

- Two styles Category IV appliance vents are shown. Each is configured in accordance with the manufacturer's requirements.
- The clearances around the vent terminations are also regulated by the appliance manufacturer.
- Due to their location, they are likely to the deck design.

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FOR EXAMPLE

Appliance Venting

1

2

3

4

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208

Appliance Venting

Direct-vent appliances – G2427.2.1

- Vent termination clearance air openings in accordance with manufacturer's instructions and input rating
- Minimum 12-inch clearance above grade for terminal and air intake

209

Useful References

Deck Expo deckexpo.com

American Wood Council (AWC) www.awc.org
DCA 6 – Prescriptive Residential Wood Deck Construction Guide
Wood Frame Construction Manual (WFCM)
Span Tables for Joists and Rafters (STJR)

Forest Products Society forestprod.org

Southern Pine Council southernpine.com

California Redwood Association (CRA)
calredwood.org

210

Useful References

Western Red Cedar Lumber Association (WRCLA)
www.realcedar.com

Western Wood Products Association (WWPA)
wwpa.org

North American Deck and Railing Association (NADRA)
nadra.org

Stair Manufacturers Association stairways.org

Professional Deck Builder Magazine
jlconline.com/deck-builder

211

Useful References

Structural Building Components Association,

Attachment of Residential Deck Ledger to Metal Plate Connected Wood Truss Floor Systems (Research Report #1408-01)

www.sbcindustry.com/deck-ledger-attachment

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