

CHAPTER 23

WOOD

SECTION 2301 GENERAL

2301.1 Scope. The provisions of this chapter shall govern the materials, design, construction, and quality of wood members and their fasteners.

2301.2 General design requirements. The design of structural elements or systems, constructed partially or wholly of wood or wood-based products, shall be based on one of the following methods.

2301.2.1 Allowable stress design. Design using allowable stress design methods shall resist the applicable load combinations of Chapter 16 in accordance with the provisions of Sections 2304, 2305 and 2306.

2301.2.2 Load and resistance factor design. Design using load and resistance factor design methods shall resist the applicable load combinations of Chapter 16 in accordance with the provisions of Sections 2304, 2305 and 2307.

2301.2.3 Conventional light-frame wood construction. The design and construction of conventional light-frame wood construction shall be in accordance with the provisions of Sections 2304 and 2308.

2301.3 Nominal sizes. For the purposes of this chapter, where dimensions of lumber are specified, they shall be deemed to be nominal dimensions unless specifically designated as actual dimensions. See Section 2304.2.

SECTION 2302 DEFINITIONS

2302.1 Definitions. The following words and terms shall, for the purposes of this chapter, have the meanings shown herein.

ACCREDITATION BODY. An approved, third-party organization that is independent of the grading and inspection agencies, and the lumber mills, and that initially accredits and subsequently monitors, on a continuing basis, the competency and performance of a grading or inspection agency related to carrying out specific tasks.

BOUNDARY ELEMENTS. Diaphragms and shear wall boundary members to which sheathing transfers forces. Boundary elements include chords and drag struts at diaphragm and shear wall perimeters, interior openings, discontinuities and re-entrant corners.

BRACED WALL LINE. A series of braced wall panels in a single story that meets the requirements of Section 2308.3 or 2308.12.4.

BRACED WALL PANEL. A section of wall braced in accordance with Section 2308.9.3 or 2308.12.4.

COLLECTOR. A horizontal diaphragm element parallel and in line with the applied force that collects and transfers diaphragm shear forces to the vertical elements of the lateral-

force-resisting system and/or distributes forces within the diaphragm.

CONVENTIONAL LIGHT-FRAME WOOD CONSTRUCTION. A type of construction whose primary structural elements are formed by a system of repetitive wood-framing members. See Section 2308 for conventional light-frame wood construction provisions.

CRIPPLE WALL. A framed stud wall extending from the top of the foundation to the underside of floor framing for the lowest occupied floor level.

DIAPHRAGM. A horizontal or nearly horizontal system acting to transmit lateral forces to the vertical-resisting elements. When the term "diaphragm" is used, it includes horizontal bracing systems.

DIAPHRAGM, BLOCKED. A diaphragm in which adjacent sheathing edges not occurring over framing are supported on and fastened to common blocking members.

DIAPHRAGM, BOUNDARY. A location where shear is transferred into or out of the diaphragm sheathing. Transfer is either to a boundary element or to another force-resisting element.

DIAPHRAGM, CHORD. A diaphragm boundary element perpendicular to the applied load that is assumed to take axial stresses due to the diaphragm moment.

DIAPHRAGM, RIGID. A diaphragm is rigid for the purpose of distribution of story shear and torsional moment when the lateral deformation of the diaphragm is less than two times the average story drift.

DIAPHRAGM, UNBLOCKED. A diaphragm that has edge nailing at supporting members only. Blocking between supporting structural members at panel edges is not included. Diaphragm panels are field nailed to supporting members.

DRAG STRUT. See "Collector."

FIBERBOARD. A fibrous, homogeneous panel made from lignocellulosic fibers (usually wood or cane) and having a density of less than 31 pounds per cubic foot (497 kg/m³) but more than 10 pounds per cubic foot (160 kg/m³).

GLUED BUILT-UP MEMBER. A structural element, the section of which is composed of built-up lumber, wood structural panels or wood structural panels in combination with lumber, all parts bonded together with structural adhesives.

GRADE (LUMBER). The classification of lumber in regard to strength and utility in accordance with DOC PS 20 and the grading rules of an approved lumber rules writing agency.

HARDBOARD. A fibrous-felted, homogeneous panel made from lignocellulosic fibers consolidated under heat and pressure in a hot press to a density not less than 31 pounds per cubic foot (497 kg/m³).

NAILING, BOUNDARY. A special nailing pattern required by design at the boundaries of diaphragms.

NAILING, EDGE. A special nailing pattern required by design at the edges of each panel within the assembly of a diaphragm or shear wall.

NAILING, FIELD. Nailing required between the sheathing panels and framing members at locations other than boundary nailing and edge nailing.

NATURALLY DURABLE WOOD. The heartwood of the following species with the exception that an occasional piece with corner sapwood is permitted if 90 percent or more of the width of each side on which it occurs is heartwood.

Decay resistant. Redwood, cedar, black locust and black walnut.

Termite resistant. Redwood and Eastern red cedar.

NOMINAL SIZE (LUMBER). The commercial size designation of width and depth, in standard sawn lumber and glued laminated lumber grades; somewhat larger than the standard net size of dressed lumber, in accordance with DOC PS 20 for sawn lumber and in accordance with the NDS for glued laminated lumber.

ORIENTED STRAND BOARD (OSB). A mat-formed wood structural panel product composed of thin rectangular wood strands or wafers arranged in oriented layers and bonded with waterproof adhesive.

PARTICLEBOARD. A generic term for a panel primarily composed of cellulosic materials (usually wood), generally in the form of discrete pieces or particles, as distinguished from fibers. The cellulosic material is combined with synthetic resin or other suitable bonding system by a process in which the interparticle bond is created by the bonding system under heat and pressure.

PLYWOOD. A wood structural panel comprised of plies of wood veneer arranged in cross-aligned layers. The plies are bonded with an adhesive that cures on application of heat and pressure.

PRESERVATIVE-TREATED WOOD. Wood (including plywood) pressure-treated with preservatives in accordance with Section 2303.1.8.

REFERENCE RESISTANCE (*D*). The resistance (force or moment as appropriate) of a member or connection computed at the reference end use conditions.

SHEAR WALL. A wall designed to resist lateral forces parallel to the plane of a wall.

STRUCTURAL GLUED LAMINATED TIMBER. Any member comprising an assembly of laminations of lumber in which the grain of all laminations is approximately parallel longitudinally, in which the laminations are bonded with adhesives.

SUBDIAPHRAGM. A portion of a larger wood diaphragm designed to anchor and transfer local forces to primary diaphragm struts and the main diaphragm.

TIE-DOWN (HOLD-DOWN). A device used to resist uplift of the chords of shear walls.

TREATED WOOD. Wood impregnated under pressure with compounds that reduce their susceptibility to flame spread or to deterioration caused by fungi, insects, or marine borers.

WOOD SHEAR PANEL. A wood floor, roof, or wall component sheathed to act as a shear wall or diaphragm.

WOOD STRUCTURAL PANEL. A panel manufactured from veneers; or wood strands or wafers; or a combination of veneer and wood strands or wafers; bonded together with waterproof synthetic resins or other suitable bonding systems. Examples of wood structural panels are plywood, oriented strand board (OSB) or composite panels.

SECTION 2303 MINIMUM STANDARDS AND QUALITY

2303.1 General. Structural lumber, end-jointed lumber, prefabricated I-joists, structural glued-laminated timber, wood structural panels, fiberboard sheathing (when used structurally), hardboard siding (when used structurally), particleboard, preservative treated wood, fire-retardant treated wood, hardwood plywood, trusses and joist hangers shall conform to the applicable provisions of this section.

2303.1.1 Lumber. Lumber used for load-supporting purposes, including end-jointed or edge-glued lumber, machine stress rated or machine evaluated lumber, shall be identified by the grade mark of a lumber grading or inspection agency that has been approved by an accreditation body that complies with DOC PS 20 or equivalent. Grading practices and identification shall comply with rules published by an agency approved in accordance with procedures of DOC PS 20 or equivalent procedures. In lieu of a grade mark on the material, a certificate of inspection as to species and grade issued by a lumber grading or inspection agency meeting the requirements of this section may be accepted for precut, remanufactured, or rough-sawn lumber, and for sizes larger than 3 inches (76 mm) nominal thickness.

Approved end-jointed lumber is permitted to be used interchangeably with solid-sawn members of the same species and grade.

2303.1.2 Prefabricated wood I-joists. Structural capacities and design provisions for prefabricated wood I-joists shall be established and monitored in accordance with ASTM D 5055.

2303.1.3 Structural glued laminated timber. Glued laminated timbers shall be manufactured and identified as required in AITC A190.1, and ASTM D 3737.

2303.1.4 Wood structural panels. Wood structural panels, when used structurally (including those used for siding, roof and wall sheathing, subflooring, diaphragms and built-up members), shall conform to the requirements for its type in DOC PS 1 or PS 2. Each panel or member shall be identified for grade and glue type by the trademarks of an approved testing and grading agency. Wood structural panel components shall be designed and fabricated in accordance with the applicable standards listed in Section 2306.1 and identified by the trademarks of an approved testing and inspection agency indicating conformance with the applicable stan-

ard. In addition, wood structural panels when permanently exposed in outdoor applications shall be of exterior type, except that wood structural panel roof sheathing exposed to the outdoors on the underside may be interior type bonded with exterior glue, Exposure 1.

2303.1.5 Fiberboard. Fiberboard for its various uses shall conform to AHA A194.1. Fiberboard sheathing, when used structurally, shall be so identified by an approved agency as conforming to AHA A194.1.

2303.1.5.1 Jointing. To ensure tightfitting assemblies, edges shall be manufactured with square, shiplapped, beveled, tongue-and-groove or U-shaped joints.

2303.1.5.2 Roof insulation. Where used as roof insulation in all types of construction, fiberboards shall be protected with an approved roof covering.

2303.1.5.3 Wall insulation. Where installed and fireblocked to comply with Chapter 7, fiberboards are permitted as wall insulation in all types of construction. In fire wall and fire separation wall constructions, unless treated to comply with Section 803.1 for Class I materials, the boards shall be cemented directly to the concrete, masonry or other noncombustible base and shall be protected with an approved noncombustible veneer anchored to the base without intervening air spaces.

2303.1.5.3.1 Protection. Fiberboard wall insulation applied on the exterior of foundation walls shall be protected below ground level with a bituminous coating.

2303.1.5.4 Insulating roof deck. Where used as roof decking in open beam construction, fiberboard insulation roof deck shall have a nominal thickness of not less than 1 inch (25 mm).

2303.1.6 Hardboard. Hardboard siding used structurally shall be identified by an approved agency conforming to AHA A135.6. Hardboard underlayment shall meet the strength requirements of $7/32$ -inch (5.6 mm) or $1/4$ -inch (6.4 mm) service class hardboard planed or sanded on one side to a uniform thickness of not less than 0.200 inch (5.1 mm). Prefinished hardboard paneling shall meet the requirements of AHA A135.5. Other basic hardboard products shall meet the requirements of AHA A135.4. Hardboard products shall be installed in accordance with manufacturer's recommendations.

2303.1.7 Particleboard. Particleboard shall conform to ANSI A208.1. Particleboard shall be identified by the grade mark or certificate of inspection issued by an approved agency. Particleboard shall not be utilized for applications other than indicated in this section unless the particleboard complies with the provisions of Section 2306.4.3.

2303.1.7.1 Floor underlayment. Particleboard floor underlayment shall conform to Type PBU of ANSI A208.1. Type PBU underlayment shall not be less than $1/4$ -inch (6.4 mm) thick and shall be installed in accordance with the installation instructions of the Composite Panel Association.

2303.1.8 Preservative-treated wood. Lumber, timber, plywood, piles and poles supporting permanent structures re-

quired by Section 2304.11 to be preservative-treated shall conform to the requirements of the applicable AWPA Standard C1, C2, C3, C4, C9, C14, C15, C16, C22, C23, C24, C28 and M4, for the species, product, preservative and end use. Preservatives shall conform to AWPA P1/P13, P2, P5, P8 and P9. Lumber and plywood used in wood foundation systems shall conform to Chapter 18.

2303.1.8.1 Identification. Wood required by Section 2304.11 to be preservative-treated shall bear the quality mark of an inspection agency that maintains continuing supervision, testing and inspection over the quality of the preservative-treated wood. Inspection agencies for preservative treated wood shall be listed by an accreditation body that complies with the requirements of the American Lumber Standards Treated Wood Program, or equivalent. The quality mark shall be on a stamp or label affixed to the preservative-treated wood. The quality mark shall include the following information:

1. Identification of treating manufacturer.
2. Type of preservative used.
3. Minimum preservative retention (pef).
4. End use for which the product is treated.
5. AWPA standard to which the product was treated.
6. Identity of the accredited inspection agency.

2303.1.8.2 Moisture content. Where preservative-treated wood is used in enclosed locations where drying in service cannot readily occur, such wood shall be at a moisture content of 19 percent or less before being covered with insulation, interior wall finish, floor covering or other materials.

2303.1.9 Structural composite lumber. Structural capacities for structural composite lumber shall be established and monitored in accordance with ASTM D 5456.

2303.2 Fire-retardant-treated wood. Fire-retardant-treated wood is any wood product which, when impregnated with chemical by a pressure process in accordance with AWPA C20 or AWPA C27, or other means during manufacture, shall have, when tested in accordance with ASTM E 84, a listed flame spread of 25 or less and show no evidence of significant progressive combustion when the test is continued for an additional 20-minute period. In addition, the flame front shall not progress more than 10.5 feet (3200 mm) beyond the centerline of the burners at any time during the test.

2303.2.1 Labeling. Fire-retardant-treated lumber and wood structural panels shall bear the identification mark of an approved agency in accordance with Section 1703.5. Such identification marks shall indicate conformance with appropriate standards in accordance with Sections 2303.2.2 through 2303.2.5.

2303.2.2 Strength adjustments. Design values for untreated lumber and wood structural panels, as specified in Section 2303.1, shall be adjusted for fire-retardant-treated wood. Adjustments to design values shall be based on an approved method of investigation that takes into consideration the effects of the anticipated temperature and humidity to

which the fire-retardant-treated wood will be subjected, the type of treatment and redrying procedures.

2303.2.3 Exposure to weather. Where fire-retardant-treated wood is exposed to weather, it shall be identified as “Exterior” to indicate there is no increase in the listed flame spread index as defined in Section 2303.2 when subjected to ASTM D 2898.

2303.2.4 Interior applications. Where fire-retardant-treated wood is exposed to humid interior conditions, it shall be identified as “Interior Type A” to indicate the treated wood has a moisture content of not over 28 percent when tested in accordance with ASTM D 3201 procedures at 92 percent relative humidity.

2303.2.5 Moisture content. Fire-retardant-treated wood shall be dried to a moisture content of 19 percent or less for lumber and 15 percent or less for wood structural panels before use.

2303.2.6 Type I and II construction applications. See Section 603.1 for limitations on the use of fire-retardant-treated wood in buildings of Type I or II construction.

2303.3 Hardwood plywood. Hardwood and decorative plywood shall be manufactured and identified as required in HPVA HP-1.

2303.4 Trusses. Metal-plate-connected wood trusses shall be manufactured as required by TPI 1. Each manufacturer of trusses using metal plate connectors shall retain an approved agency to make unscheduled inspections of truss manufacturing and delivery operations. The inspection shall cover all phases of truss operations, including lumber storage, handling, cutting fixtures, presses or rollers, manufacturing, bundling and banding.

2303.4.1 Deleted.

2303.5 Test standard for joist hangers and connectors. For the required test standards for joist hangers and connectors, see Section 1715.1.

2303.6 Nails and staples. Nails and staples shall conform to requirements of ASTM F 1667. Nails used for framing and sheathing connections shall have minimum average bending yield strengths as follows: 80 ksi (551 MPa) for shank diameters larger than 0.177 inch (4.50 mm) but not larger than 0.254 inch (6.45 mm), 90 ksi (620 MPa) for shank diameters larger than 0.142 inch (3.61 mm) but not larger than 0.177 inch (4.50 mm), and 100 ksi (689 MPa) for shank diameters of 0.142 inch (3.61 mm) or less.

SECTION 2304 GENERAL CONSTRUCTION REQUIREMENTS

2304.1 General. The provisions of this section apply to design methods specified in Section 2301.2.

2304.2 Size of structural members. Computations to determine the required sizes of members shall be based on the net dimensions (actual sizes) and not nominal sizes.

2304.3 Wall framing. The framing of exterior and interior walls shall be in accordance with the provisions specified in Section 2308 unless a specific design is furnished.

2304.3.1 Bottom plates. Studs shall have full bearing on a 2-by (actual 1½ inch, 38 mm) or larger plate or sill having a width at least equal to the width of the studs.

2304.3.2 Framing over openings. Headers, double joists, trusses or other approved assemblies that are of adequate size to transfer loads to the vertical members shall be provided over window and door openings in load-bearing walls and partitions.

2304.4 Floor and roof framing. The framing of wood-joisted floors and wood framed roofs shall be in accordance with the provisions specified in Section 2308 unless a specific design is furnished.

2304.5 Framing around flues and chimneys. Combustible framing shall be a minimum of 2 inches (51 mm), but shall not be less than the distance specified in Sections 2111 and 2113 and the *International Mechanical Code*, from flues, chimneys and fireplaces, and 6 inches (152 mm) away from flue openings.

2304.6 Wall sheathing.

2304.6.1 Wall sheathing. Except as provided for in Section 1405 for weather boarding or where stucco construction that complies with Section 2510 is installed, enclosed buildings shall be sheathed with one of the materials of the nominal thickness specified in Table 2304.6.1 or any other approved material of equivalent strength or durability.

2304.6.1.1 Wood structural panel sheathing. Where wood structural panel sheathing is used as the exposed finish on the exterior of outside walls, it shall have an exterior exposure durability classification. Where wood structural panel sheathing is used on the exterior of outside walls but not as the exposed finish, it shall be of a type manufactured with exterior glue (Exposure 1 or Exterior). Where wood structural panel sheathing is used elsewhere, it shall be of a type manufactured with intermediate or exterior glue.

2304.6.2 Interior paneling. Softwood wood structural panels used for interior paneling shall conform with the provisions of Chapter 8 and shall be installed in accordance with Table 2304.9.1. Panels shall comply with DOC PS 1 or PS 2. Prefinished hardboard paneling shall meet the requirements of AHA A135.5. Hardwood plywood shall conform to HPVA HP-1.

2304.7 Floor and roof sheathing.

2304.7.1 Structural floor sheathing. Structural floor sheathing shall be designed in accordance with the general provisions of this code and the special provisions in this section.

Floor sheathing conforming to the provisions of Table 2304.7(1), 2304.7(2), 2304.7(3), or 2304.7(4) shall be deemed to meet the requirements of this section.

2304.7.2 Structural roof sheathing. Structural roof sheathing shall be designed in accordance with the general provisions of this code and the special provisions in this section.

Roof sheathing conforming to the provisions of Table 2304.7(1), 2304.7(2), 2304.7(3), or 2304.7(5) shall be deemed to meet the requirements of this section. Wood structural panel roof sheathing shall be bonded by exterior glue.

2304.8 Mechanically laminated floors and decks.

2304.8.1 General. A laminated lumber floor or deck built up of wood members set on edge, when meeting the following requirements, is permitted to be designed as a solid floor or roof deck of the same thickness, and continuous spans are permitted to be designed on the basis of the full cross section using the simple span moment coefficient.

Nail lengths shall not be less than two and one-half times the net thickness of each lamination. Where deck supports are 4 feet (1219 mm) on center or less, side nails shall be

spaced not more than 30 inches (762 mm) on center alternately near top and bottom edges, and staggered one-third of the spacing in adjacent laminations. Where supports are spaced more than 4 feet (1219 mm) on center, side nails shall be spaced not more than 18 inches (457 mm) on center alternately near top and bottom edges, and staggered one-third of the spacing in adjacent laminations. Two side nails shall be used at each end of butt-jointed pieces.

Laminations shall be toenailed to supports with 20d or larger common nails. Where the supports are 4 feet (1219 mm) on center or less, alternate laminations shall be toenailed to alternate supports; where supports are spaced more than 4 feet (1219 mm) on center, alternate laminations shall be toenailed to every support. A single-span deck shall have all laminations full length. A continuous deck of two spans shall not have more than every fourth lamination spliced within quarter points adjoining supports. Joints shall be closely butted over supports or staggered across the deck but within the adjoining quarter spans. No lamination shall be spliced more than twice in any span.

**TABLE 2304.6.1
MINIMUM THICKNESS OF WALL SHEATHING**

SHEATHING TYPE	MINIMUM THICKNESS	MAXIMUM WALL STUD SPACING
Wood boards	5/8 inch	24 inches on center
Fiberboard	1 1/2 inch	16 inches on center
Wood structural panel	In accordance with Table 2308.9.3(2) and 2308.9.3(3)	—
M-S “Exterior Glue” and M-2 “Exterior Glue” Particleboard	In accordance with Table 2306.4.3 and 2308.9.3(5)	—
Gypsum sheathing	1/2 inch	16 inches on center
Gypsum wallboard	1/2 inch	24 inches on center
Reinforced cement mortar	1 inch	24 inches on center

For SI: 1 inch = 25.4 mm.

**TABLE 2304.7(1)
ALLOWABLE SPANS FOR LUMBER FLOOR AND ROOF SHEATHING^{a,b}**

SPAN (Inches)	MINIMUM NET THICKNESS (inches) OF LUMBER PLACED			
	Perpendicular to supports		Diagonally to supports	
	Surfaced dry ^c	Surfaced unseasoned	Surfaced dry ^c	Surfaced unseasoned
Floors				
24	3/4	25/32	3/4	25/32
16	5/8	11/16	5/8	11/16
Roofs				
24	5/8	11/16	3/4	25/32

For SI: 1 inch = 25.4 mm.

- a. Installation details shall conform to Sections 2304.6.1 and 2304.6.2 for floor and roof sheathing, respectively.
- b. Floor or roof sheathing conforming with this table shall be deemed to meet the design criteria of Section 2304.6.
- c. Maximum 19-percent moisture content.

**TABLE 2304.7(2)
SHEATHING LUMBER, MINIMUM GRADE REQUIREMENTS: BOARD GRADE**

SOLID FLOOR OR ROOF SHEATHING	SPACED ROOF SHEATHING	GRADING RULES
Utility	Standard	NLGA, WCLIB, WWPA
4 common or utility	3 common or standard	NLGA, WCLIB, WWPA, NSLB or NELMA
No. 3	No. 2	SPIB
Merchantable	Construction common	RIS

**TABLE 2304.7(3)
ALLOWABLE SPANS AND LOADS FOR WOOD STRUCTURAL PANEL SHEATHING AND
SINGLE-FLOOR GRADES CONTINUOUS OVER TWO OR MORE SPANS WITH
STRENGTH AXIS PERPENDICULAR TO SUPPORTS^{a,b}**

SHEATHING GRADES		ROOF ^c				FLOOR ^d
Panel span rating roof/floor span	Panel thickness (inches)	Maximum span (inches)		Load ^e (psf)		Maximum span (inches)
		With edge support ^f	Without edge support	Total load	Live load	
12/0	5/16	12	12	40	30	0
16/0	5/16, 3/8	16	16	40	30	0
20/0	5/16, 3/8	20	20	40	30	0
24/0	3/8, 7/16, 1/2	24	20 ^g	40	30	0
24/16	7/16, 1/2	24	24	50	40	16
32/16	15/32, 1/2, 5/8	32	28	40	30	16 ^h
40/20	19/32, 5/8, 3/4, 7/8	40	32	40	30	20 ^{h,i}
48/24	23/32, 3/4, 7/8	48	36	45	35	24
54/32	7/8, 1	54	40	45	35	32
60/32	7/8, 1 1/8	60	48	45	35	32
SINGLE FLOOR GRADES		ROOF ^c				FLOOR ^d
Panel span rating	Panel thickness (inches)	Maximum span (inches)		Load ^e (psf)		Maximum span (inches)
		With edge support ^f	Without edge support	Total load	Live load	
16 oc	1/2, 19/32, 5/8	24	24	50	40	16 ^h
20 oc	19/32, 5/8, 3/4	32	32	40	30	20 ^{h,i}
24 oc	23/32, 3/4	48	36	35	25	24
32 oc	7/8, 1	48	40	50	40	32
48 oc	1 3/32, 1 1/8	60	48	50	40	48

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

- a. Applies to panels 24 inches or wider.
- b. Floor and roof sheathing conforming with this table shall be deemed to meet the design criteria of Section 2304.7.
- c. Uniform load deflection limitations 1/180 of span under live load plus dead load, 1/240 under live load only.
- d. Panel edges shall have approved tongue-and-groove joints or shall be supported with blocking unless 1/4-inch minimum thickness underlayment or 1 1/2 inches of approved cellular or lightweight concrete is placed over the subfloor, or finish floor is 3/4-inch wood strip. Allowable uniform load based on deflection of 1/360 of span is 100 pounds per square foot (psf) except the span rating of 48 inches on center is based on a total load of 65 psf.
- e. Allowable load at maximum span.
- f. Tongue-and-groove edges, panel edge clips (one midway between each support, except two equally spaced between supports 48 inches on center), lumber blocking, or other. Only lumber blocking shall satisfy blocked diaphragm requirements.
- g. For 1/2-inch panel, maximum span shall be 24 inches.
- h. Is permitted to be 24 inches on center where 3/4-inch wood strip flooring is installed at right angles to joist.
- i. Is permitted to be 24 inches on center for floors where 1 1/2 inches of cellular or lightweight concrete is applied over the panels.

TABLE 2304.7(4)
ALLOWABLE SPAN FOR WOOD STRUCTURAL PANEL COMBINATION SUBFLOOR-UNDERLAYMENT (SINGLE FLOOR)^{a,b}
(Panels Continuous over Two or More Spans and Strength Axis Perpendicular to Supports)

IDENTIFICATION	MAXIMUM SPACING OF JOISTS (inches)				
	16	20	24	32	48
Species group ^c	Thickness (inches)				
1	1/2	5/8	3/4	—	—
2, 3	5/8	3/4	7/8	—	—
4	3/4	7/8	1	—	—
Single floor span rating ^d	16 o.c.	20 o.c.	24 o.c.	32 o.c.	48 o.c.

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

- a. Spans limited to value shown because of possible effects of concentrated loads. Allowable uniform loads based on deflection of 1/360 of span is 100 pounds per square foot (psf) except allowable total uniform load for 1 1/8-inch wood structural panels over joists spaced 48 inches on center is 65 psf. Panel edges shall have approved tongue-and-groove joints or shall be supported with blocking, unless 1/4-inch minimum thickness underlayment or 1 1/2 inches.
- b. Floor panels conforming with this table shall be deemed to meet the design criteria of Section 2304.7.
- c. Applicable to all grades of sanded exterior-type plywood. See DOC PS 1 for plywood species groups.
- d. Applicable to Underlayment grade, C-C (Plugged) plywood, and Single Floor grade wood structural panels.

TABLE 2304.7(5)
ALLOWABLE LOAD (PSF) FOR WOOD STRUCTURAL PANEL ROOF SHEATHING CONTINUOUS OVER
TWO OR MORE SPANS AND STRENGTH AXIS PARALLEL TO SUPPORTS
(Plywood structural panels are five-ply, five-layer unless otherwise noted)^{a,b}

PANEL GRADE	THICKNESS (inch)	MAXIMUM SPAN (inches)	LOAD AT MAXIMUM SPAN (psf)	
			Live	Total
Structural I sheathing	7/16	24	20	30
	15/32	24	35 ^c	45 ^c
	1/2	24	40 ^c	50 ^c
	19/32, 5/8	24	70	80
	23/32, 3/4	24	90	100
Sheathing, other grades covered in DOC PS 1 or DOC PS 2	7/16	16	40	50
	15/32	24	20	25
	1/2	24	25	30
	19/32	24	40 ^c	50 ^c
	5/8	24	45 ^c	55 ^c
	23/32, 3/4	24	60 ^c	65 ^c

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

- a. Roof sheathing conforming with this table shall be deemed to meet the design criteria of Section 2304.7.
- b. Uniform load deflection limitations 1/180 of span under live load plus dead load, 1/240 under live load only. Edges shall be blocked with lumber or other approved type of edge supports.
- c. For composite and four-ply plywood structural panel, load shall be reduced by 15 pounds per square foot.

2304.9 Connections and fasteners.

2304.9.1 Fastener requirements. Connections for wood members shall be designed in accordance with the appropriate methodology in Section 2301.2. The number and size of nails connecting wood members shall not be less than that set forth in Table 2304.9.1.

2304.9.2 Sheathing fasteners. Sheathing nails or other approved sheathing connectors shall be driven so that their head or crown is flush with the surface of the sheathing.

2304.9.3 Joist hangers and framing anchors. Connections depending on joist hangers or framing anchors, ties and other mechanical fastenings not otherwise covered are permitted where approved. The vertical load-bearing capacity, torsional moment capacity, and deflection characteristics of joist hangers shall be determined in accordance with Section 1715.1.

2304.9.4 Other fasteners. Clips, staples, glues and other approved methods of fastening are permitted where approved.

2304.9.5 Fasteners in preservative-treated and fire-retardant-treated wood. Fasteners for preservative-treated and fire-retardant-treated wood shall be of hot-dipped zinc coated galvanized steel, stainless steel, silicon bronze or copper. Fastenings for wood foundations shall be as required in AF&PA Technical Report No. 7.

2304.9.6 Load path. Where wall framing members are not continuous from foundation sill to roof, the members shall be secured to ensure a continuous load path. Where required, sheet metal clamps, ties or clips shall be formed of galvanized steel or other approved corrosion-resistant material not less than 0.040-inch (1.01 mm) nominal thickness.

**TABLE 2304.9.1
FASTENING SCHEDULE**

CONNECTION	FASTENING ^{a,m}	LOCATION
1. Joist to sill or girder	3-8d common 3-3" x 0.131" nail 3-3" 14 gage staple	toenail
2. Bridging to joist	2-8d common 2 - 3" x 0.131" nail 2 - 3" 14 gage staple	toenail each end
3. 1" x 6" subfloor or less to each joist	2-8d common	face nail
4. Wider than 1" x 6" subfloor to each joist	3-8d common	face nail
5. 2" subfloor to joist or girder	2-16d common	blind and face nail
6. Sole plate to joist or blocking	16d at 16" o.c. 3" x 0.131" nail at 8" o.c. 3" 14 gage staple at 12" o.c.	typical face nail
Sole plate to joist or blocking at braced wall panel	3-16d at 16" 3" x 0.131" nail at 16" 3" 14 gage staple per 16"	braced wall panels
7. Top plate to stud	2-16d common 3 - 3" x 0.131" nail 3 - 3" 14 gage staple	end nail
8. Stud to sole plate	4-8d common 4 - 3" x 0.131" nail 3 - 3" 14 gage staple 2-16d common 3 - 3" x 0.131" nail 3 - 3" 14 gage staple	toe nail end nail
9. Double studs	16d at 24" o.c. 3" x 0.131" nail at 8" o.c. 3" 14 gage staple at 8" o.c.	face nail
10. Double top plates	16d at 16" o.c. 3" x 0.131" nail at 12" o.c. 3" 14 gage staple at 12" o.c.	typical face nail
Double top plates	8-16d common 12 - 3" x 0.131" nail 12 - 3" 14 gage staple typical face nail	lap splice

(continued)

TABLE 2304.9.1—continued
FASTENING SCHEDULE

CONNECTION	FASTENING ^{a,m}	LOCATION
11. Blocking between joists or rafters to top plate	3-8d common 3 - 3" × 0.131" nail 3 - 3" 14 gage staple	toenail
12. Rim joist to top plate	8d at 6" (152 mm) o.c. 3" × 0.131" nail at 6" o.c. 3" 14 gage staple at 6" o.c.	toenail
13. Top plates, laps and intersections	2-16d common 3 - 3" × 0.131" nail 3 - 3" 14 gage staple	face nail
14. Continuous header, two pieces	16d common	16" o.c. along edge
15. Ceiling joists to plate	3-8d common 5 - 3" × 0.131" nail 5 - 3" 14 gage staple	toenail
16. Continuous header to stud	4-8d common	toenail
17. Ceiling joists, laps over partitions (See Section 2308.10.4.1, Table 2308.10.4.1)	3-16d common minimum, Table 2308.10.4.1 4 - 3" × 0.131" nail 4 - 3" 14 gage staple	face nail
18. Ceiling joists to parallel rafters (See Section 2308.10.4.1, Table 2308.10.4.1)	3-16d common minimum, Table 2308.10.4.1 4 - 3" × 0.131" nail 4 - 3" 14 gage staple	face nail
19. Rafter to plate (See Section 2308.10.1, Table 2308.10.1)	3-8d common 3 - 3" × 0.131" nail 3 - 3" 14 gage staple	toenail
20. 1" diagonal brace to each stud and plate	2-8d common 2 - 3" × 0.131" nail 2 - 3" 14 gage staple face nail	face nail
21. 1" × 8" sheathing to each bearing wall	2-8d common	face nail
22. Wider than 1" × 8" sheathing to each bearing	3-8d common	face nail
23. Build-up corner studs	16d common 3" × 0.131" nail 3" 14 gage staple	24" o.c. 16" o.c. 16" o.c.
24. Built-up girder and beams	20d common 32" o.c. 3" × 0.131" nail at 24" o.c. 3" 14 gage staple at 24" o.c. 2-20d common 3-3" × 0.131" nail 3-3" 14 gage staple	face nail at top and bottom staggered on opposite sides face nail at ends and at each splice
25. 2" planks	16d common	at each bearing
26. Collar tie to rafter	3-10d common 4 - 3" × 0.131" nail 4 - 3" 14 gage staple face nail	face nail
27. Jack rafter to hip	3-10d common 4-3" × 0.131" nail 4-3" 14 gage staple 2-16d common 3 - 3" × 0.131" nail 3 - 3" 14 gage staple	toenail face nail

(continued)

TABLE 2304.9.1—continued
FASTENING SCHEDULE

CONNECTION	FASTENING ^{a,m}		LOCATION	
28. Roof rafter to 2-by ridge beam	2-16d common 3 - 3" × 0.131" nail 3 - 3" 14 gage staple		toenail	
	2-16d common 3 - 3" × 0.131" nail 3 - 3" 14 gage staple		face nail	
29. Joist to band joist	3-16d common 5 - 3" × 0.131" nail 5 - 3" 14 gage staple		face nail	
30. Ledger strip	3-16d common 4 - 3" × 0.131" nail 4 - 3" 14 gage staple		face nail	
31. Wood structural panels and particleboard: ^b Subfloor, roof and wall sheathing (to framing):	1/2" and less	6d ^{e,1} 2 3/8" × 0.113" nail ⁿ 1 3/4" 16 gage ^o		
	19/32" to 3/4"	8d ^d or 6d ^e 2 3/8" × 0.113" nail ^p 2" 16 gage ^p		
	7/8" to 1"	8d ^e		
	Single Floor (combination subfloor-underlayment to framing):	1 1/8" to 1 1/4"		10d ^d or 8d ^e
	3/4" and less	6d ^e		
	7/8" to 1"	8d ^e		
1 1/8" to 1 1/4"	10d ^d or 8d ^e			
32. Panel siding (to framing)	1/2" or less	6d ^f		
	5/8"	8d ^f		
33. Fiberboard sheathing: ^g	1/2"	No. 11 gage roofing nail ^h 6d common nail No. 16 gage staple ^j		
	25/32"	No. 11 gage roofing nail ^h 8d common nail No. 16 gage staple ⁱ		
34. Interior paneling	1/4"		4d ^j	
	3/8"		6d ^k	

For SI: 1 inch = 25.4 mm.

- a. Common or box nails are permitted to be used except where otherwise stated.
- b. Nails spaced at 6 inches on center at edges, 12 inches at intermediate supports except 6 inches at supports where spans are 48 inches or more. For nailing of wood structural panel and particleboard diaphragms and shear walls, refer to Section 2305. Nails for wall sheathing are permitted to be common, box or casing.
- c. Common or deformed shank.
- d. Common.
- e. Deformed shank.
- f. Corrosion-resistant siding or casing nail.
- g. Fasteners spaced 3 inches on center at exterior edges and 6 inches on center at intermediate supports.
- h. Corrosion-resistant roofing nails with 7/16-inch diameter head and 1 1/2-inch length for 1/2-inch sheathing and 1 3/4-inch length for 25/32-inch sheathing.
- i. Corrosion-resistant staples with nominal 7/16-inch crown and 1 1/8-inch length for 1/2-inch sheathing and 1 1/2-inch length for 25/32-inch sheathing. Panel supports at 16 inches (20 inches if strength axis in the long direction of the panel, unless otherwise marked).
- j. Casing or finish nails spaced 6 inches on panel edges, 12 inches at intermediate supports.
- k. Panel supports at 24 inches. Casing or finish nails spaced 6 inches on panel edges, 12 inches at intermediate supports.
- l. For roof sheathing applications, 8d nails are the minimum required for wood structural panels.
- m. Staples shall have a minimum crown width of 7/16 inch.
- n. For roof sheathing applications, fasteners spaced 4 inches on center at edges, 8 inches at intermediate supports.
- o. Fasteners spaced 4 inches on center at edges, 8 inches at intermediate supports for subfloor and wall sheathing and 3 inches on center at edges, 6 inches at intermediate supports for roof sheathing.
- p. Fasteners spaced 4 inches on center at edges, 8 inches at intermediate.

2304.9.7 Framing requirements. Wood columns and posts shall be framed to provide full end bearing. Alternatively, column-and-post end connections shall be designed to resist the full compressive loads, neglecting end bearing capacity. Column and post end connections shall be fastened to resist lateral and net induced uplift forces.

2304.10 Heavy timber construction.

2304.10.1 Columns. Columns shall be continuous or superimposed throughout all stories by means of reinforced concrete or metal caps with brackets, or shall be connected by properly designed steel or iron caps, with pintles and base plates, or by timber splice plates affixed to the columns by means of metal connectors housed within the contact faces, or by other approved methods.

2304.10.1.1 Column connections. Girders and beams shall be closely fitted around columns and adjoining ends shall be cross tied to each other, or inter-tied by caps or ties, to transfer horizontal loads across joints. Wood bolsters shall not be placed on tops of columns unless the columns support roof loads only.

2304.10.2 Floor framing. Approved wall plate boxes or hangers shall be provided where wood beams, girders, or trusses rest on masonry or concrete walls. Where intermediate beams are used to support a floor, they shall rest on top of girders, or shall be supported by ledgers or blocks securely fastened to the sides of the girders, or they shall be supported by an approved metal hanger into which the ends of the beams shall be closely fitted.

2304.10.3 Roof framing. Every roof girder and at least every alternate roof beam shall be anchored to its supporting member; and every monitor and every sawtooth construction shall be anchored to the main roof construction. Such anchors shall consist of steel or iron bolts of sufficient strength to resist vertical uplift of the roof.

2304.10.4 Floor decks. Floor decks and covering shall not extend closer than $\frac{1}{2}$ inch (12.7 mm) to walls. Such $\frac{1}{2}$ inch (12.7 mm) spaces shall be covered by a molding fastened to the wall either above or below the floor and arranged such that the molding will not obstruct the expansion or contraction movements of the floor. Corbeling of masonry walls under floors is permitted in place of such molding.

2304.10.5 Roof decks. Where supported by a wall, roof decks shall be anchored to walls at intervals not exceeding 20 feet (6096 mm).

2304.11 Protection against decay and termites.

2304.11.1 General. Where required by this section, protection from decay and termites shall be provided by the use of naturally durable or preservative-treated wood.

2304.11.2 Wood used above ground. Wood installed above ground in the locations specified in Sections 2304.11.2.1 through 2304.11.2.6 shall be naturally durable wood or preservative-treated wood that uses water-borne preservatives, and shall be treated in accordance with

AWPA C2 or C9 or applicable AWPA standards for above-ground use.

2304.11.2.1 Joists, girders and subfloor. Where wood joists or the bottom of a wood structural floor without joists are closer than 18 inches (457 mm), or wood girders are closer than 12 inches (305 mm), to the exposed ground in crawl spaces or unexcavated areas located within the perimeter of the building foundation, the floor assembly (including posts, girders, joists and subfloor) shall be of naturally durable or preservative-treated wood.

2304.11.2.2 Framing. Wood framing members, including wood sheathing, which rest on exterior foundation walls and are less than 8 inches (203 mm) from exposed earth shall be of naturally durable or preservative-treated wood. Wood framing members and furring strips attached directly to the interior of exterior masonry or concrete walls below grade shall be of approved naturally durable or preservative-treated wood.

2304.11.2.3 Sleepers and sills. Sleepers and sills on a concrete or masonry slab that is in direct contact with earth shall be of naturally durable or preservative-treated wood.

2304.11.2.4 [Comm 62.2304] Girder ends. The ends of wood girders entering exterior masonry or concrete walls shall be provided with a $\frac{1}{2}$ -inch (12.7 mm) air space on top, sides and end, unless naturally durable or preservative-treated wood is used. A moisture barrier shall be provided between an untreated or nondurable wood girder and an exterior masonry or concrete bearing surface.

2304.11.2.5 Wood siding. Clearance between wood siding and earth on the exterior of a building shall not be less than 6 inches (152 mm) except where siding, sheathing and wall framing are of naturally durable or preservative-treated wood.

2304.11.2.6 Posts or columns. Posts or columns supporting permanent structures and supported by a concrete or masonry slab or footing that is in direct contact with the earth shall be of naturally durable or preservative-treated wood.

Exceptions:

1. Posts or columns that are either exposed to the weather or located in basements or cellars, supported by concrete piers or metal pedestals projected at least 1 inch (25 mm) above the slab or deck and 6 inches (152 mm) above exposed earth, and are separated therefrom by an impervious moisture barrier.
2. Posts or columns in enclosed crawl spaces or unexcavated areas located within the periphery of the building, supported by a concrete pier or metal pedestal at a height greater than 8 inches (203 mm) from exposed ground, and are separated therefrom by an impervious moisture barrier.

2304.11.3 Laminated timbers. The portions of glued laminated timbers that form the structural supports of a building or other structure and are exposed to weather and not properly protected by a roof, eave or similar covering shall be pressure treated with preservative, or be manufactured from naturally durable or preservative treated wood.

2304.11.4 Wood in contact with the ground or fresh water. Wood in contact with the ground (exposed earth) that supports permanent structures shall be of naturally durable (species for both decay and termite resistance) or preservative-treated wood using water-borne preservatives and shall be treated in accordance with AWPA C2, C9 or other applicable AWPA standard for soil or fresh water contact, where used in the locations specified in Sections 2304.11.4.1 and 2304.11.4.2.

Exception: Untreated wood is permitted where such wood is continuously and entirely below the ground water level or submerged in fresh water.

2304.11.4.1 Posts or columns. Posts and columns supporting permanent structures that are embedded in concrete in direct contact with the earth or embedded in concrete exposed to the weather, or in direct contact with the earth, shall be of preservative-treated wood.

2304.11.4.2 Wood structural members. Wood structural members that support moisture-permeable floors or roofs that are exposed to the weather, such as concrete or masonry slabs, shall be of naturally durable or preservative-treated wood unless separated from such floors or roofs by an impervious moisture barrier.

2304.11.5 Supporting member for permanent appurtenances. Naturally durable or preservative-treated wood shall be utilized for those portions of wood members that form the structural supports of buildings, balconies, porches or similar permanent building appurtenances where such members are exposed to the weather without adequate protection from a roof, eave, overhang or other covering to prevent moisture or water accumulation on the surface or at joints between members.

Exception: When a building is located in a geographical region where experience has demonstrated that climatic conditions preclude the need to use durable materials where the structure is exposed to the weather.

2304.11.6 Termite protection. In geographical areas where the hazard of termite damage is known to be very heavy, the floor framing shall be of naturally durable or preservative-treated wood, or provided with approved methods of termite protection.

2304.11.7 Wood used in retaining walls and cribs. Wood installed in retaining or crib walls shall be of preservative-treated wood treated in accordance with AWPA C2 or C9 for soil and fresh water contact.

2304.11.8 Attic ventilation. For attic ventilation, see Section 1202.2.

2304.11.9 Underfloor ventilation (crawl space). For underfloor ventilation (crawl space), see Section 1202.4.

2304.12 Wood supporting masonry or concrete. Wood members shall not be used to permanently support the dead load of any masonry or concrete.

Exceptions:

1. Masonry or concrete nonstructural floor or roof surfacing not more than 4 inches (102 mm) thick is permitted to be supported by wood members.
2. Any structure is permitted to rest upon wood piles constructed in accordance with the requirements of Chapter 18.
3. Veneer of brick, concrete or stone applied as specified in Section 1405.5 having an installed weight of 40 pounds per square foot (1.9 kN/m²) or less are permitted to be supported by an approved treated wood foundation when the maximum height of veneer does not exceed 30 feet (9144 mm) above the foundation. Such veneer used as an interior wall finish is permitted to be supported on wood floor construction. The wood floor construction shall be designed to support the additional weight of the veneer plus any other loads and designed to limit the deflection and shrinkage to $1/600$ of the span of the supporting members.
4. Glass unit masonry having an installed weight of 20 pounds per square foot (0.96 kN/m²) or less is permitted to be installed in accordance with the provisions of Section 2110. The wood construction supporting the glass unit masonry shall be designed for dead and live loads to limit deflection and shrinkage to $1/600$ of the span of the supporting members.

**SECTION 2305
GENERAL DESIGN REQUIREMENTS FOR
LATERAL-FORCE-RESISTING SYSTEMS**

2305.1 General. Structures using wood shear walls and diaphragms to resist wind, seismic and other lateral loads, shall be designed and constructed in accordance with the provisions of this section.

2305.1.1 Shear resistance based on principles of mechanics. Shear resistance of diaphragms and shear walls are permitted to be calculated by principles of mechanics using values of fastener strength and sheathing shear resistance.

2305.1.2 Framing. Boundary elements shall be provided to transmit tension and compression forces. Perimeter members at openings shall be provided and shall be detailed to distribute the shearing stresses. Diaphragm and shear wall sheathing shall not be used to splice boundary elements. Diaphragm chords and collectors shall be placed in, or tangent to, the plane of the diaphragm framing unless it can be demonstrated that the moments, shears, and deformations, considering eccentricities resulting from other configurations can be tolerated without exceeding the adjusted resistance and drift limits.

2305.1.2.1 Framing members. Framing members shall be at least 2-inch (51 mm) nominal width. In general, adjoining panel edges shall bear and be attached to the

framing members and butt along their center lines. Nails shall be placed not less than $\frac{3}{8}$ inch (9.5 mm) from the panel edge, not more than 12 inches (305 mm) apart along intermediate supports, and 6 inches (152 mm) along panel edge bearings, and shall be firmly driven into the framing members.

2305.1.3 Openings in shear panels. Openings in shear panels that materially affect their strength shall be fully detailed on the plans, and shall have their edges adequately reinforced to transfer all shearing stresses.

2305.1.4 Shear panel connections. Positive connections and anchorages, capable of resisting the design forces, shall be provided between the shear panel and the attached components. In Seismic Design Category D, E or F, toenails shall not be used to transfer lateral forces in excess of 150 pounds per foot (2189 N/m) from diaphragms to shear walls, drag struts (collectors) or other elements, or from shear walls to other elements.

2305.1.5 Wood members resisting horizontal seismic forces contributed by masonry and concrete. Wood shear walls, diaphragms, horizontal trusses and other members shall not be used to resist horizontal seismic forces contributed by masonry or concrete construction in structures over one story in height.

Exceptions:

1. Wood floor and roof members are permitted to be used in horizontal trusses and diaphragms to resist horizontal seismic forces contributed by masonry or concrete construction (including those due to masonry veneer, fireplaces, and chimneys) provided such forces do not result in torsional force distribution through the truss or diaphragm.
2. Wood structural panel sheathed shear walls are permitted to be used to provide resistance to seismic forces contributed by masonry or concrete construction in two-story structures of masonry or concrete construction, provided the following requirements are met:
 - 2.1. Story-to-story wall heights shall not exceed 12 feet (3658 mm).
 - 2.2. Diaphragms shall not be designed to transmit lateral forces by rotation. Diaphragms shall not cantilever past the outermost supporting shear wall.
 - 2.3. Combined deflections of diaphragms and shear walls shall not permit story drift of supported masonry or concrete walls to exceed the limit of Table 1617.3.
 - 2.4. Wood structural panel sheathing in diaphragms shall have unsupported edges blocked. Wood structural panel sheathing for both stories of shear walls shall have unsupported edges blocked and, for the lower story, shall have a minimum thickness of $\frac{15}{32}$ inch (11.9 mm).

- 2.5. There shall be no out-of-plane horizontal offsets between the first and second stories of wood structural panel shear walls.

2305.2 Design of wood diaphragms.

2305.2.1 General. Wood diaphragms are permitted to be used to resist horizontal forces provided the deflection in the plane of the diaphragm, as determined by calculations, tests, or analogies drawn therefrom, does not exceed the permissible deflection of attached distributing or resisting elements. Connections shall extend into the diaphragm a sufficient distance to develop the force transferred into the diaphragm.

2305.2.2 Deflection. Permissible deflection shall be that deflection up to which the diaphragm and any attached distributing or resisting element will maintain its structural integrity under design load conditions, such that the resisting element will continue to support design loads without danger to occupants of the structure.

Calculations for diaphragm deflection shall account for the usual bending and shear components as well as any other factors, such as nail deformation, which will contribute to deflection.

The deflection (Δ) of a blocked wood structural panel diaphragm uniformly nailed throughout is permitted to be calculated by the use of the following formula. If not uniformly nailed, the constant 0.188 (For SI: 1/1627) in the third term must be modified accordingly.

$$\Delta = \frac{5vL^3}{8EAb} + \frac{vL}{4Gt} + 0.188Le_n + \frac{\sum(\Delta_c X)}{2b} \quad (\text{Equation 23-1})$$

$$\text{For SI: } \Delta = \frac{0.052L^3}{EAb} + \frac{vL}{4Gt} + \frac{Le_n}{1627} + \frac{\sum(\Delta_c X)}{2b}$$

where:

- A = Area of chord cross section, in square inches (mm^2).
- b = Diaphragm width, in feet (mm).
- E = Elastic modulus of chords, in pounds per square inch (N/mm^2).
- e_n = Nail deformation, in inches (mm).
- G = Modulus of rigidity of wood structural panel, in pounds per square inch (N/mm^2).
- L = Diaphragm length, in feet (mm).
- t = Effective thickness of wood structural panel for shear, in inches (mm).
- v = Maximum shear due to design loads in the direction under consideration, in pounds perlineal foot (N/mm).
- Δ = The calculated deflection, in inches (mm).
- $\sum(\Delta_c X)$ = Sum of individual chord-splice values on both sides of the diaphragm, each multiplied by its distance to the nearest support.

2305.2.3 Diaphragm aspect ratios. Size and shape of diaphragms shall be limited as set forth in Table 2305.2.3.

TABLE 2305.2.3
MAXIMUM DIAPHRAGM DIMENSION RATIOS HORIZONTAL
AND SLOPED DIAPHRAGM

TYPE	MAXIMUM LENGTH - WIDTH RATIO
Wood structural panel, nailed all edges	4:1
Wood structural panel, blocking omitted at intermediate joints	3:1
Diagonal sheathing, single	3:1
Diagonal sheathing, double	4:1

2305.2.4 Construction. Shear panels shall be constructed of wood structural panels, manufactured with exterior glue, not less than 4 by 8 feet (1219 mm by 2438 mm), except at boundaries and changes in framing. Boundary elements shall be connected at corners. Wood structural panel thickness for horizontal diaphragms shall not be less than set forth in Tables 2304.7(3) and 2304.7(5) for corresponding joist spacing and loads, except that 1/4-inch (6.4 mm) is permitted to be used where perpendicular loads permit. Sheet-type sheathing shall be arranged so that the width of a sheet in a shear wall shall not be less than 2 feet (610 mm).

2305.2.4.1 Seismic Design Category F. Structures assigned to Seismic Design Category F shall conform to requirements in Section 1620.4 and to the additional requirements of this section.

Wood structural panel sheathing used for diaphragms and shear walls that are part of the seismic-force-resisting system shall be applied directly to the framing members.

Exception: Wood structural panel sheathing in a diaphragm is permitted to be fastened over solid lumber planking or laminated decking provided the panel joints and lumber planking or laminated decking joints do not coincide.

2305.2.5 Rigid diaphragms. Design of structures with rigid diaphragms shall conform to the structure configuration requirements of Section 1616.5 and the horizontal shear distribution requirements of Section 1617.4.4.

Open front structures with rigid wood diaphragms resulting in torsional force distribution are permitted provided the length, *l*, of the diaphragm normal to the open side does not exceed 25 feet (7620 mm), the diaphragm sheathing conforms to Section 2305.2.4, and the *l/w* ratio (as shown in Figure 2305.2.5(1)) is less than 1.0 for one-story structures or 0.67 for structures over one story in height.

Exception: Where calculations show that diaphragm deflections can be tolerated, the length, *l*, normal to the open end is permitted to be increased to a *l/w* ratio not greater than 1.5 where sheathed in compliance with Section 2305.2.4 or to 1.0 where sheathed in compliance with Section 2306.3.4 or 2306.3.5.

Rigid wood diaphragms are permitted to cantilever past the outermost supporting shear wall (or other vertical-resisting element) a length, *l*, of not more than 25 feet (7620 mm) or two-thirds of the diaphragm width, *w*, whichever is the smaller. Figure 2305.2.5(2) illustrates the dimensions of *l* and *w* for a cantilevered diaphragm.

Structures with rigid wood diaphragms having a torsional irregularity in accordance with Table 1616.5.1, Item 1, shall meet the following requirements: The *l/w* ratio shall not exceed 1.0 for one-story structures or 0.67 for structures over one story in height, where *l* is the dimension parallel to the load direction for which the irregularity exists.

Exception: Where calculations demonstrate that the diaphragm deflections can be tolerated, the width is permitted to be increased and the *l/w* ratio is permitted to be increased to 1.5 where sheathed in compliance with Section 2305.2.4 or 1.0 where sheathed in compliance with Section 2306.3.4 or 2306.3.5.

2305.3 Design of wood shear walls.

2305.3.1 General. Wood shear walls are permitted to resist horizontal forces in vertical distributing or resisting elements, provided the deflection in the plane of the shear wall, as determined by calculations, tests, or analogies drawn therefrom, does not exceed the more restrictive of the permissible deflection of attached distributing or resisting elements or the drift limits of Section 1617.3. Shear wall sheathing other than

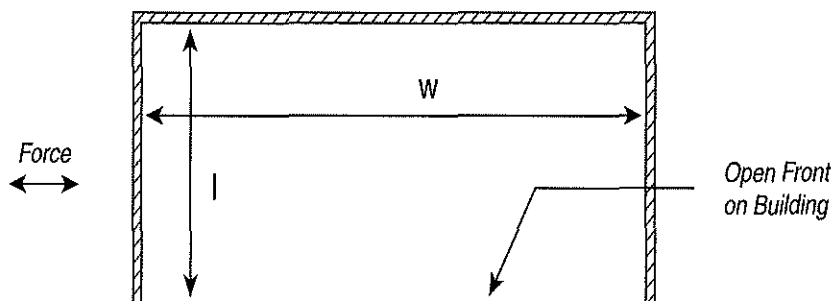


FIGURE 2305.2.5(1)
DIAPHRAGM LENGTH AND WIDTH FOR PLAN VIEW OF OPEN FRONT BUILDING

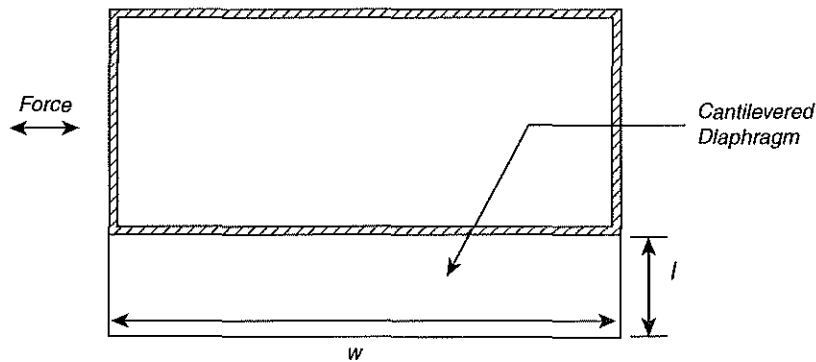


FIGURE 2305.2.5(2)
DIAPHRAGM LENGTH AND WIDTH FOR PLAN VIEW OF CANTILEVERED DIAPHRAGM

wood structural panels shall not be permitted in Seismic Design Category E or F. See Table 1617.6.

2305.3.2 Deflection. Permissible deflection shall be that deflection up to which the shear wall and any attached distributing or resisting element will maintain its structural integrity under design load conditions, i.e., continue to support design loads without danger to occupants of the structure.

The deflection (Δ) of a blocked wood structural panel shear wall uniformly fastened throughout is permitted to be calculated by the use of the following formula:

$$\Delta = \frac{8vh^3}{EAb} + \frac{vh}{Gt} + 0.75he_n + d_a \quad \text{(Equation 23-2)}$$

For SI: $\Delta = \frac{vh^3}{3EAb} + \frac{vh}{Gt} + \frac{he_n}{406.7} + d_a$

where:

- A = Area of boundary element cross section in square inches (mm²) (vertical member at shear wall boundary).
- b = Wall width, in feet (mm).
- d_a = Deflection due to anchorage details (rotation and slip at tie-down bolts).
- E = Elastic modulus of boundary element (vertical member at shear wall boundary), in pounds per square inch (N/mm²).
- e_n = Deformation of mechanically fastened connections, in inches (mm²).
- G = Modulus of rigidity of wood structural panel, in pounds per square inch (N/mm²).
- h = Wall height, in feet (mm).
- t = Effective thickness of wood structural panel for shear, in inches (mm).
- v = Maximum shear due to design loads at the top of the wall, in pounds per lineal foot (N/mm).
- Δ = The calculated deflection, in inches (mm).

2305.3.3 Shear wall aspect ratios. Size and shape of shear walls and shear wall segments within shear walls containing openings shall be limited as set forth in Table 2305.3.3.

TABLE 2305.3.3
MAXIMUM SHEAR WALL ASPECT RATIOS

TYPE	MAXIMUM HEIGHT WIDTH RATIO
Wood structural panels or particleboard, nailed edges	2:1 ^a
Diagonal sheathing, single	2:1
Fiberboard	1½:1

a. In Seismic Design Categories A through C, the height-to-width ratio is permitted to be 3½:1.

2305.3.4 Shear wall height definition. The height of a shear wall shall be defined as:

1. The maximum clear height from top of foundation to bottom of diaphragm framing above; or
2. The maximum clear height from top of diaphragm to bottom of diaphragm framing above. See Figure 2305.3.4(a).

2305.3.5 Shear wall width definition. The width of a shear wall shall be defined as the horizontal dimension of the shear wall sheathed between overturning restraint defined in Section 2305.3.6. See Figure 2305.3.4(a).

2305.3.5.1 Shear wall segment width definition. The width of full-height sheathing adjacent to unrestrained openings in a shear wall.

2305.3.6 Overturning restraint. Where the dead load stabilizing moment per Chapter 16 allowable stress design load combinations is not sufficient to prevent uplift due to overturning moments on the wall, an anchoring device shall be provided. Anchoring devices shall maintain a continuous load path to the foundation.

2305.3.7 Shear walls with openings. The provisions of this section shall apply to the design of shear walls with open-

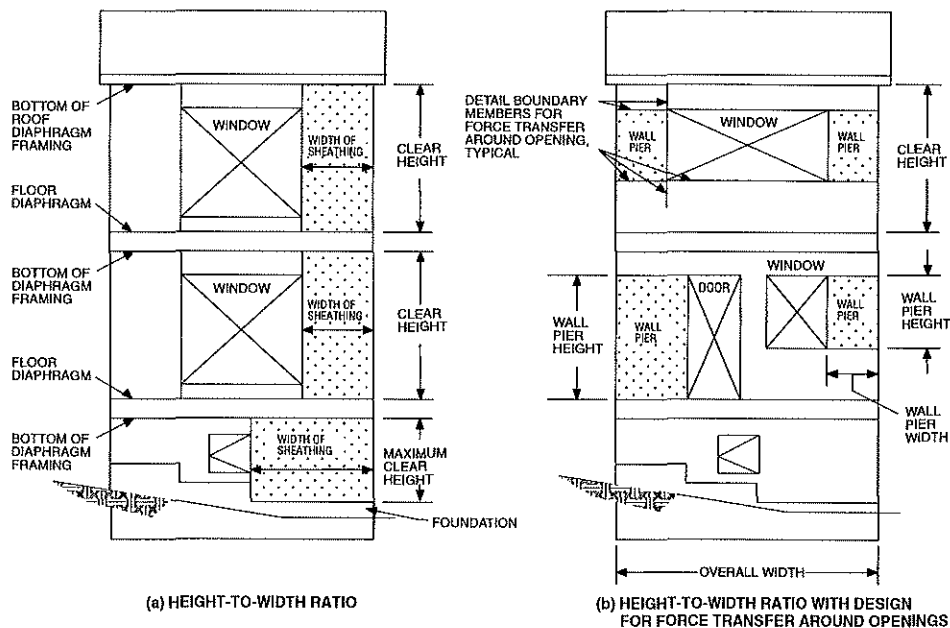


FIGURE 2305.3.4
GENERAL DEFINITION OF SHEAR WALL HEIGHT, WIDTH AND HEIGHT-TO-WIDTH RATIO

ings. Where framing and connections around the openings are designed for force transfer around the openings, the provisions of Section 2305.3.7.1 shall apply. Where framing and connections around the opening are not designed for force transfer around the openings, the provisions of Section 2305.3.7.2 shall apply.

2305.3.7.1 Force transfer around openings. Where shear walls with openings are designed for force transfer around the openings, the limitations of Table 2305.3.3 shall apply to the overall shear wall including openings and to each wall pier at the side of an opening. The height of a wall pier shall be defined as the clear height of the pier at the side of an opening. The width of a wall pier shall be defined as the sheathed width of the pier at the side of an opening. Design for force transfer shall be based on a rational analysis. Detailing of boundary elements around the opening shall be provided in accordance with the provisions of this section. See Figure 2305.3.4(b).

2305.3.7.2 No force transfer around openings. Where wood structural panel shear walls with openings are not designed for force transfer around the openings, the tabulated design shear capacity, plf (N/m), set forth in Table 2306.4.1 shall be adjusted in accordance with Table 2305.3.7.2 based on the maximum unrestrained opening height and the percentage of full-height sheathing.

The total shear capacity, pounds (N), shall be equal to the adjusted shear capacity, plf (N/m), times the sum of the widths of the shear wall segments meeting the aspect ratio requirements of Table 2305.3.3. Requirements for overturning restraint at the ends of the shear wall, uplift and shear connections at the base of each shear wall segment, drag struts and collectors shall be calculated using

the unadjusted allowable shear capacity from Table 2306.4.1 or calculated by rational analysis. Overturning restraint shall be located at each end of the shear wall adjacent to a shear wall segment meeting a height-to-width ratio set forth in Table 2305.3.3.

2305.3.7.2.1 Deflection of shear walls with openings. The controlling deflection of a blocked shear wall with openings uniformly nailed throughout shall be taken as the maximum individual deflection of the shear wall segments calculated in accordance with Section 2305.3.2, divided by the appropriate shear capacity adjustment factor calculated in accordance with Section 2305.3.7.2.

2305.3.8 Summing shear capacities. The shear values for shear panels of different materials applied to the same side of the wall are not cumulative except as allowed in Table 2306.4.1.

The shear values for the materials of the same thickness applied to both faces of the same wall are cumulative. Where the material thicknesses are not equal, the allowable shear shall be either two times the shear capacity of the thinner material or the capacity of the thicker material, whichever is greater.

Summing shear capacities of dissimilar materials applied to both faces or to the same wall line are not allowed.

Exception: For wind design, the shear values for dissimilar materials applied to both faces of the same wall are cumulative.

2305.3.9 Adhesives. Adhesive attachment of shear wall sheathing is not permitted as a substitute for mechanical fasteners, and shall not be used in shear wall strength calcula-

TABLE 2305.3.7.2
SHEAR CAPACITY ADJUSTMENT FACTORS

WALL HEIGHT, H	MAXIMUM OPENING HEIGHT ^a				
	H/3	H/2	2H/3	5H/6	H
8' Wall	2'-8"	4'-0"	5'-4"	6'-8"	8'-0"
10' Wall	3'-4"	5'-0"	6'-8"	8'-4"	10'-0"
Percent full-height sheathing ^b	Effective shear capacity ratio				
0%	1.00	0.67	0.50	0.40	0.33
10%	1.00	0.69	0.53	0.43	0.36
20%	1.00	0.71	0.56	0.45	0.38
30%	1.00	0.74	0.59	0.49	0.42
40%	1.00	0.77	0.63	0.53	0.45
50%	1.00	0.80	0.67	0.57	0.50
60%	1.00	0.83	0.71	0.63	0.56
70%	1.00	0.87	0.77	0.69	0.63
80%	1.00	0.91	0.83	0.77	0.71
90%	1.00	0.95	0.91	0.87	0.83
100%	1.00	1.00	1.00	1.00	1.00

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

- The vertical dimension of the tallest opening in the shear wall. Where areas above and below an opening remain unsheathed, the height of the opening shall be defined as the height of the wall.
- The sum of the lengths of the shear wall segments that are sheathed full height and meet the aspect ratio requirements of Table 2305.3.3 divided by the total length of the shear wall.

tions alone, or in combination with mechanical fasteners in Seismic Design Category D, E or F.

2305.3.10 Sill plate size and anchorage in Seismic Design Category D, E or F. Two inch (51 mm) nominal wood sill plates for shear walls shall include steel plate washers, a minimum of $\frac{3}{16}$ inch by 2 inches (4.76 mm by 51 mm by 51 mm) in size, between the sill plate and nut. Sill plates resisting a design load greater than 490 plf (LRFD) (7154 N/m) or 350 plf (ASD) (5110 N/m) shall not be less than a 3 inch (76 mm) nominal member. Where a single 3 inch (76 mm) nominal sill plate is used, 2-20d box end nails shall be substituted for 2-16d common end nails found in line 8 of Table 2304.9.1.

Exception: In shear walls where the design load is less than 840 plf (LRFD) (12 264 N/m) or 600 plf (ASD) (8760 N/m), the sill plate is permitted to be a 2-inch (51 mm) nominal member if the sill plate is anchored by two times the number of bolts required by design and $\frac{3}{16}$ inch by 2 inch by 2 inch (4.76 mm by 51 mm by 51 mm) plate washers are used.

SECTION 2306 ALLOWABLE STRESS DESIGN

2306.1 Allowable stress design. The structural analysis and construction of wood elements in structures using allowable design methods shall be in accordance with the following applicable standards:

American Forest & Paper Association.

NDS National Design Specification for Wood Construction

American Institute of Timber Construction.

- AITC 104 Typical Construction Details
- AITC 110 Standard Appearance Grades for Structural Glued Laminated Timber
- AITC 112 Standard for Tongue-and-Groove Heavy Timber Roof Decking
- AITC 113 Standard for Dimensions of Structural Glued Laminated Timber
- AITC 117 Standard Specifications for Structural Glued Laminated Timber of Softwood Species
- AITC 119 Structural Standard Specifications for Glued Laminated Timber of Hardwood Species
- AITC A190.1 Structural Glued Laminated Timber
- AITC 200 Inspection Manual
- AITC 500 Determination of Design Values for Structural Glued Laminated Timber

Truss Plate Institute, Inc.

TPI 1-1995 National Design Standard for Metal Plate Connected Wood Truss Construction

American Society of Agricultural Engineers.

- ASAE EP 484.2 Diaphragm Design of Metal-Clad, Post-Frame Rectangular Buildings
- ASAE 559 Design Requirements and Bending Properties for Mechanically Laminated Columns

APA—The Engineered Wood Association.

Plywood Design Specification

Plywood Design Specification Supplement 1 -
Design & Fabrication of Plywood Curved Panels.

Plywood Design Specification Supplement 2 -
Design & Fabrication of Glued Plywood-Lumber beams.

Plywood Design Specification Supplement 3 -
Design & Fabrication of Plywood Stressed-Skin Panels.

Plywood Design Specification Supplement 4 -
Design & Fabrication of Plywood Sandwich Panels.

Plywood Design Specification Supplement 5 -
Design & Fabrication of All-Plywood Beams.

EWS T300	Glulam Connection Details
EWS S560	Field Notching and Drilling of Glued Laminated Timber Beams
EWS S475	Glued Laminated Beam Design Tables
EWS X450	Glulam in Residential Construction
EWS X440	Product and Application Guide: Glulam.
EWS R540	Builders Tips: Proper Storage and Handling of Glulam Beams

2306.1.1 Joists and rafters. The design of rafter spans is permitted to be in accordance with the AF&PA Span Tables for Joists and Rafters.

2306.1.2 Plank and beam flooring. The design of plank and beam flooring is permitted to be in accordance with the AF&PA Wood Construction Data No. 4.

2306.1.3 Treated wood stress adjustments. The allowable unit stresses for preservative-treated wood need no adjustment for treatment, but are subject to other adjustments.

The allowable unit stresses for fire-retardant-treated wood, including fastener values, shall be developed from an approved method of investigation that considers the effects of anticipated temperature and humidity to which the fire-retardant-treated wood will be subjected, the type of treatment and the redrying process. Other adjustments are applicable except that the impact load duration shall not apply.

2306.2 Wind provisions for walls.

2306.2.1 Wall stud bending stress increase. The NDS fiber stress in bending (F_b) design values for wood studs resisting wind shall be increased by the factors in Table 2306.2.1, in lieu of the 1.15 repetitive member factor, to take into consideration the load sharing and composite actions provided by the wood structural panels as defined in Section 2302.1, where the studs are designed for bending in accordance with Section 1609.6.2.1 spaced no more than 16 inches (406 mm) on center, covered on the inside with a minimum of $1/2$ inch (12.7 mm) gypsum board fastened in accordance with Table 2306.4.5, and sheathed on the exterior with a minimum of $3/8$ inch (9.5 mm) wood structural panel sheathing that is attached to the studs using a minimum of 8d common nails spaced a maximum of 6 inches o.c. (152 mm) at panel edges and 12 inches o.c. (305 mm) in the field of the panels.

TABLE 2306.2.1
WALL STUD BENDING STRESS INCREASE FACTORS

STUD SIZE	SYSTEM FACTOR
2 × 4	1.5
2 × 6	1.4
2 × 8	1.3
2 × 10	1.2
2 × 12	1.15

2306.3 Wood diaphragms.

2306.3.1 Shear capacities modifications. The allowable shear capacities in Table 2306.3.1 for horizontal wood structural panel diaphragms shall be increased 40 percent for wind design.

2306.3.2 Wood structural panel diaphragms. Structural panel diaphragms with wood structural panels are permitted to be used to resist horizontal forces not exceeding those set forth in Table 2306.3.1 or calculated by principles of mechanics without limitations by using values for fastener strength in the NDS, structural design properties for wood structural panels based on DOC PS-1 and DOC PS-2 or plywood design properties given in the APA Plywood Design Specification.

2306.3.3 Diagonally sheathed lumber diaphragms. Diagonally sheathed lumber diaphragms shall be nailed in accordance with Table 2306.3.3.

2306.3.4 Single diagonally sheathed lumber diaphragms. Single diagonally sheathed lumber diaphragms shall be constructed of minimum 1-inch (25 mm) thick nominal sheathing boards laid at an angle of approximately 45 degrees (0.78 rad) to the supports. The shear capacity for single diagonally sheathed lumber diaphragms of southern pine or Douglas fir-larch shall not exceed 300 pounds per linear foot (4378 N/m) of width. The shear capacities shall be adjusted by reduction factors of 0.82 for framing members of species with a specific gravity equal to or greater than 0.42 but less than 0.49 and 0.65 for species with a specific gravity of less than 0.42, as contained in the NDS.

2306.3.4.1 End joints. End joints in adjacent boards shall be separated by at least one stud or joist space and there shall be at least two boards between joints on the same support.

2306.3.4.2 Single diagonally sheathed lumber diaphragms. Single diagonally sheathed lumber diaphragms made up of 2-inch (51 mm) nominal diagonal lumber sheathing fastened with 16d nails shall be designed with the same shear capacities as shear panels using 1-inch (25 mm) boards fastened with 8d nails, provided there are not splices in adjacent boards on the same support and the supports are not less than 4 inch (102 mm) nominal depth or 3 inch (76 mm) nominal thickness.

2306.3.5 Double diagonally sheathed lumber diaphragms. Double diagonally sheathed lumber diaphragms shall be constructed of two layers of diagonal sheathing boards at 90 degrees (1.57 rad) to each other on the same face of the supporting members. Each chord shall be considered as a beam with uniform load per foot equal to 50 percent of the unit shear due to diaphragm action. The load shall

TABLE 2306.3.1
 RECOMMENDED SHEAR (POUNDS PER FOOT) FOR WOOD STRUCTURAL PANEL DIAPHRAGMS WITH
 FRAMING OF DOUGLAS-FIR-LARCH, OR SOUTHERN PINE^a FOR WIND OR SEISMIC LOADING

PANEL GRADE	COMMON NAIL SIZE OR STAPLE ^f LENGTH AND GAGE	MINIMUM FASTENER PENETRATION IN FRAMING (inches)	MINIMUM NOMINAL PANEL THICKNESS (inch)	MINIMUM NOMINAL WIDTH OF FRAMING MEMBER (inches)	BLOCKED DIAPHRAGMS				UNBLOCKED DIAPHRAGMS		
					Fastener spacing (inches) at diaphragm boundaries (all cases) at continuous panel edges parallel to load (Cases 3, 4), and at all panel edges (Cases 5 and 6) ^b				Fasteners spaced 6" max. At supported edges ^b		
					6	4	2 1/2 ^c	2 ^c	Case 1 (No unblocked edges or continuous joints parallel to load)	All other configurations (Cases 2, 3, 4, 5 and 6)	
					Fastener spacing (inches) at other panel edges (Cases 1, 2, 3 and 4) ^b						
6	6	4	3								
Structural I Grades	6d ^e	1 1/4	5/16	2	185	250	375	420	165	125	
				3	210	280	420	475	185	140	
	1 1/2 16 Gage	1		2	155	205	310	350	135	105	
				3	175	230	345	390	155	115	
	8d	1 3/8	3/8	2	270	360	530	600	240	180	
				3	300	400	600	675	265	200	
	1 1/2 16 Gage	1		2	175	235	350	400	155	115	
				3	200	265	395	450	175	130	
	10d ^d	1 1/2	15/32	2	320	425	640	730	285	215	
				3	360	480	720	820	320	240	
		1 1/2 16 Gage		1	2	175	235	350	400	155	120
					3	200	265	395	450	175	130
Sheathing, single floor and other grades covered in DOC PS 1 and PS 2	6d ^e	1 1/4	5/16	2	170	225	335	380	150	110	
				3	190	250	380	430	170	125	
	1 1/2 16 Gage	1		2	140	185	275	315	125	90	
				3	155	205	310	350	140	105	
	6d ^e	1 1/4	3/8	2	185	250	375	420	165	125	
				3	210	280	420	475	185	140	
	8d	1 3/8		2	240	320	480	545	215	160	
				3	270	360	540	610	240	180	

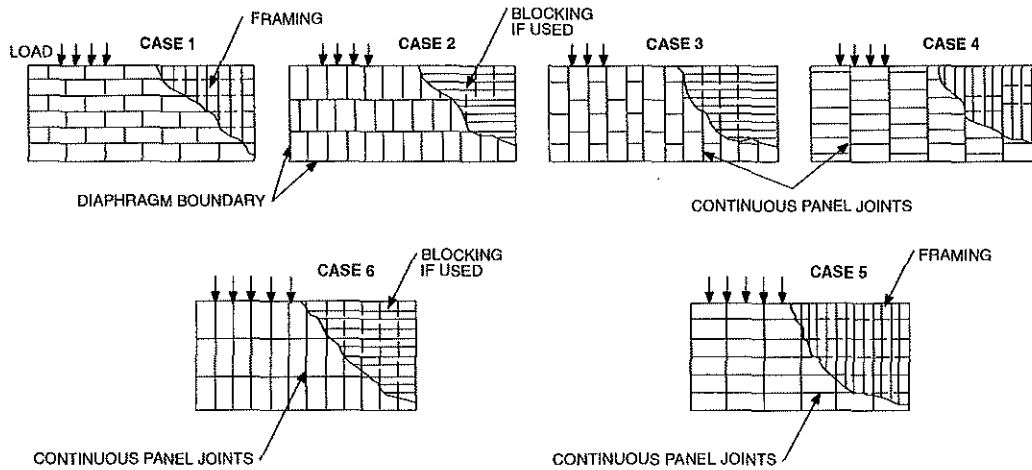
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TABLE 2306.3.1—continued
 RECOMMENDED SHEAR (POUNDS PER FOOT) FOR WOOD STRUCTURAL PANEL DIAPHRAGMS WITH
 FRAMING OF DOUGLAS-FIR-LARCH, OR SOUTHERN PINE^a FOR WIND OR SEISMIC LOADING

PANEL GRADE	COMMON NAIL SIZE OR STAPLE ^f LENGTH AND GAGE	MINIMUM FASTENER PENETRATION IN FRAMING (inches)	MINIMUM NOMINAL PANEL THICKNESS (inch)	MINIMUM NOMINAL WIDTH OF FRAMING MEMBER (inches)	BLOCKED DIAPHRAGMS				UNBLOCKED DIAPHRAGMS		
					Fastener spacing (inches) at diaphragm boundaries (all cases) at continuous panel edges parallel to load (Cases 3, 4), and at all panel edges (Cases 5 and 6) ^b				Fasteners spaced 6" max. at supported edges ^b		
					6	4	2 1/2 ^c	2 ^c	Case 1 (No unblocked edges or continuous joints parallel to load)	All other configurations (Cases 2, 3, 4, 5 and 6)	
					Fastener spacing (inches) at other panel edges (Cases 1, 2, 3 and 4) ^b						
6	6	4	3								
Sheathing, single floor and other grades covered in DOC PS 1 and PS 2 (continued)	1 1/2 16 Gage	1	3/8	2	160	210	315	360	140	105	
				3	180	235	355	400	160	120	
	8d	1 3/8	7/16	2	255	340	505	575	230	170	
				3	285	380	570	645	255	190	
	1 1/2 16 Gage	1		2	165	225	335	380	150	110	
				3	190	250	375	425	165	125	
	8d	1 3/8	15/32	2	270	360	530	600	240	180	
				3	300	400	600	675	265	200	
	10d ^d	1 1/2		2	290	385	575	655	255	190	
				3	325	430	650	735	290	215	
	1 1/2 16 Gage	1		2	160	210	315	360	140	105	
				3	180	235	355	405	160	120	
	10d ^d	1 1/2		19/32	2	320	425	640	730	285	215
					3	360	480	720	820	320	240
	1 3/4 16 Gage	1	2		175	235	350	400	155	115	
			3		200	265	395	450	175	130	

(continued)

TABLE 2306.3.1—continued
RECOMMENDED SHEAR (POUNDS PER FOOT) FOR WOOD STRUCTURAL PANEL DIAPHRAGMS WITH
FRAMING OF DOUGLAS-FIR-LARCH, OR SOUTHERN PINE^a FOR WIND OR SEISMIC LOADING



For SI: 1 inch = 25.4 mm, 1 pound per foot = 14.5939 N/m.

- a. For framing of other species: (1) Find specific gravity for species of lumber in AFPA National Design Specification. (2) For staples find shear value from table above for Structural I panels (regardless of actual grade) and multiply value by 0.82 for species with specific gravity of 0.42 or greater, or 0.65 for all other species. (3) For nails find shear value from table above for nail size for actual grade and multiply value by the following adjustment factor: Specific Gravity Adjustment Factor = $[1 - (0.5 - SG)]$, where SG = Specific Gravity of the framing lumber. This adjustment factor shall not be greater than 1.
- b. Space nails maximum 12 inches o.c. along intermediate framing members (6 inches o.c. where supports are spaced 48 inches o.c.).
- c. Framing at adjoining panel edges shall be 3 inches nominal or wider, and nails shall be staggered where nails are spaced 2 inches o.c. or 2 1/2 inches o.c.
- d. Framing at adjoining panel edges shall be 3 inches nominal or wider, and nails shall be staggered where both of the following conditions are met: (1) 10d nails having penetration into framing of more than 1 1/2 inches and (2) nails are spaced 3 inches o.c. or less.
- e. 8d is recommended minimum for roofs due to negative pressures of high winds.
- f. Staples shall have a minimum crown width of 7/16 inch.

TABLE 2306.3.3
DIAGONALLY SHEATHED LUMBER DIAPHRAGM NAILING SCHEDULE

SHEATHING NOMINAL DIMENSION	NAILING TO INTERMEDIATE AND END BEARING STUDS		NAILING AT THE SHEAR PANEL BOUNDARIES	
	Type, size and number of nails per board			
	Common nails	Box nails	Common nails	Box nails
1 x 6	two 8d	three 8d	three 8d	five 8d
1 x 8	three 8d	four 8d	four 8d	six 8d
2 x 6	two 16d.	three 16d	three 16d	five 16d
2 x 8	three 16d	four 16d	four 16d	six 16d

be assumed as acting normal to the chord in the plan of the diaphragm in either direction. The span of the chord or portion thereof shall be the distance between framing members of the diaphragm, such as the joists, studs, and blocking that serve to transfer the assumed load to the sheathing. The shear capacity of double diagonally sheathed diaphragms of southern pine or Douglas fir-larch shall not exceed 600 pounds per linear foot (8756 kN/m) of width. The shear capacity shall be adjusted by reduction factors of 0.82 for framing members of species with a specific gravity equal to or greater than 0.42 but less than 0.49 and 0.65 for species with a specific gravity of less than 0.42, as contained in the

NDS. Nailing of diagonally sheathed lumber diaphragms shall be in accordance with Table 2306.3.3.

2306.4 Shear walls. See Section 2305.3.1 for limitations on shear wall bracing materials. Panel sheathing joints in shear walls shall occur over studs or blocking. Adjacent panel sheathing joints shall occur over and be nailed to common framing members.

2306.4.1 Wood structural panel shear walls. The allowable shear capacities for wood structural panel shear walls shall be in accordance with Table 2306.4.1. These capacities are permitted to be increased 40 percent for wind design. Shear walls are permitted to be calculated by principles of

TABLE 2306.4.1
ALLOWABLE SHEAR (POUNDS PER FOOT) FOR WOOD STRUCTURAL PANEL SHEAR WALLS WITH
FRAMING OF DOUGLAS-FIR-LARCH, OR SOUTHERN PINE^a FOR WIND OR SEISMIC LOADING^{b, h, i, j}

PANEL GRADE	MINIMUM NOMINAL PANEL THICKNESS (inch)	MINIMUM FASTENER PENETRATION IN FRAMING (inches)	PANELS APPLIED DIRECT TO FRAMING				PANEL APPLIED OVER 1/2" OR 5/8" GYPSUM SHEATHING					
			NAIL (common or galvanized box) or staple size ^a	Fastener spacing at panel edges (inches)			NAIL (common or galvanized box) or staple size ^a	Fastener spacing at panel edges (inches)				
				6	4	3		2"	6	4	3	2"
Structural I Sheathing	5/16	1 1/4	6d	200	300	390	510	8d	200	300	390	510
		1	1 1/2 16 Gage	165	245	325	415	2 16 Gage	125	185	245	315
	3/8	1 3/8	8d	230 ^d	360 ^d	460 ^d	610 ^d	10d	280	430	550 ^f	730
		1	1 1/2 16 Gage	155	235	315	400	2 16 Gage	155	235	310	400
	7/16	1 3/8	8d	255 ^d	395 ^d	505 ^d	670 ^d	10d	280	430	550	730
		1	1 1/2 16 Gage	170	260	345	440	2 16 Gage	155	235	310	400
	15/32	1 3/8	8d	280	430	550 ^f	730	10d	280	430	550 ^f	730
			10d	340	510	665 ^f	870	—	—	—	—	
		1	1 1/2 16 Gage	185	280	375	475	2 16 Gage	155	235	300	400
		1 1/2	10d	340	510	665 ^f	870	10d	—	—	—	—
Sheathing, plywood siding ^e except Group 5 Species	5/16 or 1/4 ^c	1 1/4	6d	180	270	350	450	8d	180	270	350	450
		1	1 1/2 16 Gage	145	220	295	375	2 16 Gage	110	165	220	285
	3/8	1 1/4	6d	200	300	390	510	8d	200	300	390	510
		1 3/8	8d	220 ^d	320 ^d	410 ^d	530 ^d	10d	260	380	490 ^f	640
		1	1 1/2 16 Gage	140	210	280	360	2 16 Gage	140	210	280	360
	7/16	1 3/8	8d	240 ^d	350 ^d	450 ^d	585 ^d	10d	260	380	490 ^f	640
		1	1 1/2 16 Gage	155	230	310	395	2 16 Gage	140	210	280	360
	15/32	1 3/8	8d	260	380	490 ^f	640	10d	260	380	490 ^f	640
		1 1/2	10d	310	460	600 ^f	770	—	—	—	—	
		1	1 1/2 16 Gage	170	255	335	430	2 16 Gage	140	210	280	360
	19/32	1 1/2	10d	340	510	665 ^f	870	—	—	—	—	
		1	1 3/4 16 Gage	185	280	375	475	—	—	—	—	
				Nail Size (galvanized casing)					Nail Size (galvanized casing)			
		5/16 ^c	1 1/4	6d	140	210	275	360	8d	140	210	275
	3/8	1 3/8	8d	160	240	310 ^f	410	10d	160	240	310 ^f	410

For SI: 1 inch = 25.4 mm, 1 pound per foot = 14.5939 N/m.

- For framing of other species: (1) Find specific gravity for species of lumber in AFPA National Design Specification. (2) For staples find shear value from table above for Structural I panels (regardless of actual grade) and multiply value by 0.82 for species with specific gravity of 0.42 or greater, or 0.65 for all other species. (3) For nails find shear value from table above for nail size for actual grade and multiply value by the following adjustment factor: Specific Gravity Adjustment Factor = [1 - (0.5 - SG)]. where SG = Specific Gravity of the framing lumber. This adjustment factor shall not be greater than 1.
- Panel edges backed with 2-inch nominal or wider framing. Install panels either horizontally or vertically. Space nails maximum 6 inches o.c. along intermediate framing members for 1/4-inch and 7/16-inch panels installed on studs spaced 24 inches o.c. For other conditions and panel thickness, space nails maximum 12 inches o.c. on intermediate supports.
- 1/4-inch or siding 16 inches o.c. is minimum recommended where applied direct to framing as exterior siding.
- Shears are permitted to be increased to values shown for 15/32-inch sheathing with same nailing provided (a) studs are spaced a maximum of 16 inches o.c., or (b) if panels are applied with long dimension across studs.
- Framing at adjoining panel edges shall be 3 inches nominal or wider, and nails shall be staggered where nails are spaced 2 inches o.c.
- Framing at adjoining panel edges shall be 3 inches nominal or wider, and nails shall be staggered where both of the following conditions are met: (1) 10d nails having penetration into framing of more than 1 1/2 inches and (2) nails are spaced 3 inches o.c.
- Values apply to all-veneer plywood. Thickness at point of nailing on panel edges governs shear values.
- Where panels are applied on both faces of a wall and nail spacing is less than 6 inches o.c. on either side, panel joints shall be offset to fall on different framing members. Or framing shall be 3 inch nominal or thicker and nails on each side shall be staggered.
- In Seismic Design Category D, E or F, where shear design values exceed 490 plf (LRFD) or 350 plf (ASD) all framing members receiving edge nailing from abutting panels shall not be less than a single 3-inch nominal member. Plywood joint and sill plate nailing shall be staggered in all cases. See Section 2305.3.10 for sill plate side and anchorage requirements.
- Galvanized nails shall be hot-dipped or tumbled.
- Staples shall have a minimum crown width of 7/16 inch.

mechanics without limitations by using values for nail strength given in the NDS and wood structural panel design properties given in the APA/PDS.

2306.4.2 Lumber sheathed shear walls. Single and double diagonally sheathed lumber diaphragms are permitted using the construction and allowable load provisions of Sections 2306.3.4 and 2306.3.5.

2306.4.3 Particleboard shear walls. The design shear capacity of particleboard shear walls shall be in accordance with Table 2306.4.3. Shear panels shall be constructed with particleboard sheets not less than 4 by 8 feet (1219 by 2438 mm), except at boundaries and changes in framing. Particleboard panels shall be designed to resist shear only, and chords, collector members, and boundary elements shall be connected at all corners. Panel edges shall be backed with 2-inch (51 mm) nominal or wider framing. Sheets are permitted to be installed either horizontally or vertically. For 3/8-inch (9.5 mm) particleboard sheets installed with the long dimension parallel to the studs spaced 24 inches (610 mm) on center, nails shall be spaced at 6 inches (152 mm) on center along intermediate framing members. For all other conditions, nails of the same size shall be spaced at 12 inches (305 mm) on center along intermediate framing members. Particleboard panels less than 12 inches (305 mm) wide shall be blocked. Particleboard shall not be used to resist seismic forces in structures in Seismic Design Category D, E or F.

2306.4.4 Fiberboard shear walls. The design shear capacity of fiberboard shear walls shall be in accordance with Table 2308.9.3(4). The fiberboard sheathing shall be applied vertically to wood studs not less than 2-inch (51 mm) nominal thickness spaced 16 inches (406 mm) on center. Blocking not less than 2-inch (51 mm) nominal in thickness shall be provided at horizontal joints where wall height exceeds length of sheathing panel. Fiberboard shall not be used to resist seismic forces in structures in Seismic Design Category D, E or F.

2306.4.5 Shear walls sheathed with other materials. Shear capacities for walls sheathed with lath and plaster, and gypsum board shall be in accordance with Table 2306.4.5. Shear walls sheathed with lath, plaster, and gypsum board shall be constructed in accordance with Chapter 25 and Section 2306.4.5.1. The maximum allowable shear values set forth in

Table 2306.4.5 shall be reduced for seismic load resistance 50 percent in Seismic Design Category D. Lath, plaster, and gypsum board shall not be used to resist seismic forces in structures in Seismic Design Category E or F.

2306.4.5.1 Application of gypsum board or lath and plaster to wood framing.

2306.4.5.1.1 Joint staggering. End joints of adjacent courses of gypsum board shall not occur over the same stud.

2306.4.5.1.2 Blocking. Where required in Table 2306.4.5, wood blocking having the same cross-sectional dimensions as the studs shall be provided at joints that are perpendicular to the studs.

2306.4.5.1.3 Nailing. Studs, top and bottom plates and blocking shall be nailed in accordance with Table 2304.9.1.

2306.4.5.1.4 Fasteners. The size and spacing of nails shall be set forth in Table 2306.4.5. Nails shall be spaced not less than 3/8 inch (9.5 mm) from edges and ends of gypsum boards or sides of studs, blocking and top and bottom plates.

2306.4.5.1.5 Gypsum lath. Gypsum lath shall be applied perpendicular to the studs. Maximum allowable shear values shall be as set forth in Table 2306.4.5.

2306.4.5.1.6 Gypsum sheathing. Four-foot-wide (1219 mm) pieces of gypsum sheathing shall be applied parallel or perpendicular to studs. Two-foot-wide (610 mm) pieces of gypsum sheathing shall be applied perpendicular to the studs. Maximum allowable shear values shall be as set forth in Table 2306.4.5.

2306.4.5.1.7 Other gypsum boards. Gypsum board shall be applied parallel or perpendicular to studs. Maximum allowable shear values shall be as set forth in Table 2306.4.5.

**SECTION 2307
LOAD AND RESISTANCE FACTOR DESIGN**

2307.1 Load and resistance factor design. The structural analysis and construction of wood elements and structures using load and resistance factor design methods shall be in accordance with ASCE 16.

**TABLE 2306.4.3
ALLOWABLE SHEAR FOR PARTICLEBOARD SHEAR WALL SHEATHING**

PANEL GRADE	MINIMUM NOMINAL PANEL THICKNESS (inch)	MINIMUM NAIL PENETRATION IN FRAMING (inches)	PANELS APPLIED DIRECT TO FRAMING				
			Nail size (common or galvanized box)	Allowable shear (pounds per foot) nail spacing at panel edges (inches) ^a			
				6	4	3	2
M-S "Exterior Glue" and M-2 "Exterior Glue"	3/8	1 1/2	6d	120	180	230	300
	3/8	1 1/2	8d	130	190	240	315
	1/2			140	210	270	350
	1/2	1 5/8	10d	185	275	360	460
	5/8			200	305	395	520

For SI: 1 inch = 25.4 mm, 1 pound per foot = 14.5939 N/m.

a. Values are not permitted in Seismic Design Category D, E or F.

**TABLE 2306.4.5
ALLOWABLE SHEAR FOR WIND OR SEISMIC FORCES FOR SHEAR WALLS OF LATH
AND PLASTER OR GYPSUM BOARD WOOD-FRAMED WALL ASSEMBLIES**

TYPE OF MATERIAL	THICKNESS OF MATERIAL	WALL CONSTRUCTION	FASTENER SPACING ^b MAXIMUM (inches)	SHEAR VALUE ^{a,e} (plf)	MINIMUM FASTENER SIZE ^{c,d,h,k}
1. Expanded metal or woven wire lath and portland cement plaster	7/8"	Unblocked	6	180	No. 11 gage 1 1/2" long, 7/16" head 16 Ga. Galv. Staple, 7/8" legs
2. Gypsum lath, plain or perforated	3/8" lath and 1/2" plaster	Unblocked	5	100	No. 13 gage, 1 1/8" long, 19/64" head, plasterboard nail 16 Ga. Galv. Staple, 1 1/8" long 0.120" Nail, min. 3/8" head, 1 1/4" long
3. Gypsum sheathing	1/2" x 2' x 8'	Unblocked	4	75	No. 11 gage, 1 3/4" long, 7/16" head, diamond-point, galvanized 16 Ga. Galv. Staple, 1 3/4" long
	1/2" x 4'	Blocked ^f Unblocked	4 7	175 100	
	5/8" x 4'	Blocked	4" edge/ 7" field	200	6d galvanized 0.120" Nail, min. 3/8" head, 1 3/4" long
4. Gypsum board, gypsum veneer base, or water-resistant gypsum backing board	1/2"	Unblocked ^f	7	75	5d cooler or wallboard 0.120" Nail, min. 3/8" head, 1 1/2" long 16 Gage Staple, 1 1/2" long
		Unblocked ^f	4	110	
		Unblocked	7	100	
		Unblocked	4	125	
		Blocked ^g	7	125	
		Blocked ^g	4	150	
		Unblocked	8/12 ^h	60	
		Blocked ^g	4/16 ^h	160	
		Blocked ^g	4/12 ^h	155	
		Blocked ^{l, g}	8/12 ^h	70	
	Blocked ^g	6/12 ^h	90		
	5/8"	Unblocked ^f	7	115	6d cooler or wallboard 0.120" Nail, min. 3/8" head, 1 3/4" long 16 Gage Staple, 1 1/2" legs, 1 5/8" long
			4	145	
			7	145	
			4	175	
Blocked ^g Two-Ply		Base ply: 9 Face ply: 7	250	Base ply—6d cooler or wallboard 1 3/4" x 0.120" Nail, min. 3/8" head 1 5/8" 16 Ga. Galv. Staple Face ply—8d cooler or wallboard 0.120" Nail, min. 3/8" head, 2 3/8" long 15 Ga. Galv. Staple, 2 1/4" long	
Unblocked	8/12 ^h	70	No. 6-1 1/4" screws ⁱ		
Blocked ^g	8/12 ^h	90			

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per foot = 14.5939 N/m.

- a. These shear walls shall not be used to resist loads imposed by masonry or concrete construction. See Section 2305.1.5. Values shown are for short-term loading due to wind or due to seismic loading in Seismic Design Categories A, B and C. Values shall be reduced 50 percent in Seismic Design Category D. Values not permitted in Seismic Design Category E or F. Values shown shall be reduced 25 percent for normal loading.
- b. Applies to nailing at studs, top and bottom plates and blocking.
- c. Alternate nails are permitted to be used if their dimensions are not less than the specified dimensions. Drywall screws are permitted to be substituted for the 5d, 6d (cooler) nails listed above. 1 1/4 inches Type S or W, #6 for 6d (cooler) nails.
- d. For properties of cooler nails, see ASTM C 514.
- e. Except as noted, shear values are based on a maximum framing spacing of 16 inches o.c.
- f. Maximum framing spacing of 24 inches o.c.
- g. All edges are blocked, and edge nailing is provided at all supports and all panel edges.
- h. First number denotes fastener spacing at the edges; second number denotes fastener spacing in the field.
- i. Screws are Type W or S.
- j. Staples shall have a minimum crown width of 7/16-inch, measured outside the legs.
- k. Staples for the attachment of gypsum lath and woven-wire lath shall have a minimum crown width of 3/4-inch, measured outside the legs.

SECTION 2308 CONVENTIONAL LIGHT-FRAME CONSTRUCTION

2308.1 General. The requirements in this section are intended for conventional, light-frame construction. Other methods are permitted to be used provided a satisfactory design is submitted showing compliance with other provisions of this code. Interior nonload-bearing partitions, ceilings and curtain walls of conventional light-frame construction are not subject to the limitations of this section.

2308.2 Limitations. Buildings are permitted to be constructed in accordance with the provisions of conventional light-frame construction, subject to the following limitations, and subject to the further limitations of Sections 2308.11 and 2308.12.

1. Buildings shall be limited to a maximum of three stories above grade. For the purposes of this section, for buildings in Seismic Design Category D or E as determined in Section 1616, cripple stud walls shall be considered to be a story.

Exception: Solid blocked cripple walls not exceeding 14 inches (356 mm) in height need not be considered a story.

2. Bearing wall floor-to-floor heights shall not exceed 10 feet (3048 mm).
3. Loads as determined in Chapter 16 shall not exceed the following:
 - 3.1. Average dead loads shall not exceed 15 psf (718 N/m²) for roofs and exterior walls, floors and partitions.
 - 3.2. Live loads shall not exceed 40 psf (1916 N/m²) for floors.
 - 3.3. Ground snow loads shall not exceed 50 psf (2395 N/m²).
4. Wind speeds shall not exceed 100 mph (161 km/hr) (3-second gust).

Exception: Wind speeds shall not exceed 110 mph (177 km/hr) 3-second gust for buildings in Exposure Categories A or B.

5. Roof trusses and rafters shall not span more than 40 feet (12 192 mm) between points of vertical support.
6. The use of the provisions for conventional light-frame construction in this section shall not be permitted for buildings in Seismic Design Category F, as determined in Section 1616.
7. Conventional light-frame construction is limited in irregular structures in Seismic Design Category D or E, as specified in Section 2308.12.6.

2308.2.1 Basic wind speed greater than 100 mph (3-second gust). Where the basic wind speed exceeds 100 mph (3-second gust) the provisions of the AF&PA Wood Frame Construction Manual (WFCM), or the provisions of the SBCCI Standard for Hurricane Resistant Residential Construction SSTD-10, are permitted to be used.

2308.2.2 Buildings in Seismic Design Category B, C, D or E. Buildings of conventional light-frame construction in

Seismic Design Category B or C, as determined in Section 1616, shall comply with the additional requirements in Section 2308.11.

Exceptions:

1. Detached Group R-3 dwellings as applicable in Section 101.2 in Seismic Design Category B.
2. Detached Group R-3 dwellings as applicable in Section 101.2 in Seismic Design Category C where masonry veneer is limited to the first two stories above grade.

Buildings of conventional light-frame construction in Seismic Design Category D or E, as determined in Section 1616, shall comply with the additional requirements in Section 2308.12.

2308.3 Braced wall lines. Buildings shall be provided with exterior and interior braced wall lines as described in Section 2308.9.3 and installed in accordance with Sections 2308.3.1 through 2308.3.4.

2308.3.1 Spacing. Spacing of braced wall lines shall not exceed 35 feet (10 668 mm) on center in both the longitudinal and transverse directions in each story.

2308.3.2 Braced wall panel connections. Forces shall be transferred from the roofs and floors to braced wall panels and from the braced wall panels in upper stories to the braced wall panels in the story below by the following:

1. Braced wall panel top and bottom plates shall be fastened to joists, rafters or full depth blocking. Braced wall panels shall be extended and fastened to roof framing at intervals not to exceed 50 feet (15 240 mm) between parallel braced wall lines.

Exception: Where roof trusses are used, lateral forces shall be transferred from the roof diaphragm to the braced wall by blocking of the ends of the trusses or by other approved methods.

2. Bottom plate fastening to joist or blocking below shall be with not less than 3-16d nails at 16 inches (406 mm) on center.
3. Blocking shall be nailed to the top plate below with not less than 3-8d toenails per block.
4. Joists parallel to the top plates shall be nailed to the top plate with not less than 8d toenails at 6 inches (152 mm) on center.

In addition, top plate laps shall be nailed with not less than 8-16d face nails on each side of each break in the top plate.

2308.3.3 Sill anchorage. Where foundations are required by Section 2308.3.4, braced wall line sills shall be anchored to concrete or masonry foundations. Such anchorage shall conform to the requirements of Section 2308.6 except that such anchors shall be spaced at not more than 4 feet (1219 mm) on center for structures over two stories in height. The anchors shall be distributed along the length of the braced wall line. Other anchorage devices having equivalent capacity are permitted.

2308.3.3.1 Anchorage to all-wood foundations. Where all-wood foundations are used, the force transfer from the braced wall lines shall be determined based on calculation and shall have capacity greater than or equal to the connections required by Section 2308.3.3.

2308.3.4 Braced wall line support. Braced wall lines shall be supported by continuous foundations.

Exception: For structures with a maximum plan dimensions not over 50 feet (15 240 mm), continuous foundations are required at exterior walls only.

2308.4 Design of portions. Where a building of otherwise conventional construction contains nonconventional structural elements, those elements shall be designed to resist the forces specified in Chapter 16. The extent of such design need only demonstrate compliance of nonconventional elements with other applicable provisions of this code, and shall be compatible with the performance of the conventional framed system.

2308.5 Connections and fasteners. Connections and fasteners used in conventional construction shall comply with the requirements of Section 2304.9.

2308.6 Foundation plates or sills. Foundations and footings shall be as specified in Chapter 18. Foundation plates or sills resting on concrete or masonry foundations shall comply with Section 2304.3.1. Foundation plates or sills shall be bolted or anchored to the foundation with not less than 1/2-inch (12.7 mm) diameter steel bolts or approved anchors. Bolts shall be embedded at least 7 inches (178 mm) into concrete or masonry, and spaced not more than 6 feet (1829 mm) apart. There shall be a minimum of two bolts or anchor straps per piece with one bolt or anchor strap located not more than 12 inches (305 mm) or less than 4 inches (102 mm) from each end of each piece. A properly sized nut and washer shall be tightened on each bolt to the plate.

2308.7 Girders. Girders for single-story construction or girders supporting loads from a single floor shall not be less than 4 inches by 6 inches (102 mm by 152 mm) for spans 6 feet (1829 mm) or less, provided that girders are spaced not more than 8 feet (2438 mm) on center. Spans for built-up 2-inch (51 mm) girders shall be in accordance with Table 2308.9.5 or 2308.9.6. Other girders shall be designed to support the loads specified in this code. Girder end joints shall occur over supports.

Where a girder is spliced over a support, an adequate tie shall be provided. The ends of beams or girders supported on masonry or concrete shall not have less than 3 inches (76 mm) of bearing.

2308.8 Floor joists. Spans for floor joists shall be in accordance with Table 2308.8(1) or 2308.8(2). For other grades and or species, refer to the AF&PA Span Tables for Joists and Rafters.

2308.8.1 Bearing. Except where supported on a 1-inch by 4-inch (25.4 mm by 102 mm) ribbon strip and nailed to the adjoining stud, the ends of each joist shall not have less than 1 1/2 inches (38 mm) of bearing on wood or metal, or less than 3 inches (76 mm) on masonry.

2308.8.2 Framing details. Joists shall be supported laterally at the ends and at each support by solid blocking except where the ends of the joists are nailed to a header, band or rim joist or to an adjoining stud or by other means. Solid

blocking shall not be less than 2 inches (51 mm) in thickness and the full depth of the joist.

Notches on the ends of joists shall not exceed one-fourth the joist depth. Holes bored in joists shall not be within 2 inches (51 mm) of the top or bottom of the joist, and the diameter of any such hole shall not exceed one-third the depth of the joist. Notches in the top or bottom of joists shall not exceed one-sixth the depth and shall not be located in the middle third of the span.

Joist framing from opposite sides of a beam, girder or partition shall be lapped at least 3 inches (76 mm) or the opposing joists shall be tied together in an approved manner.

Joists framing into the side of a wood girder shall be supported by framing anchors or on ledger strips not less than 2 inches by 2 inches (51 mm by 51 mm).

2308.8.3 Framing around openings. Trimmer and header joists shall be doubled, or of lumber of equivalent cross section, where the span of the header exceeds 4 feet (1219 mm). The ends of header joists more than 6 feet (1829 mm) long shall be supported by framing anchors or joist hangers unless bearing on a beam, partition or wall. Tail joists over 12 feet (3658 mm) long shall be supported at header by framing anchors or on ledger strips not less than 2 inches by 2 inches (51 mm by 51 mm).

2308.8.4 Supporting bearing partitions. Bearing partitions parallel to joists shall be supported on beams, girders, doubled joists, walls or other bearing partitions. Bearing partitions perpendicular to joists shall not be offset from supporting girders, walls or partitions more than the joist depth unless such joists are of sufficient size to carry the additional load.

2308.8.5 Lateral support. Floor, attic and roof framing with a nominal depth-to-thickness ratio greater than or equal to 5:1, shall have one edge held in line for the entire span. Where the nominal depth-to-thickness ratio of the framing member exceeds 6:1, there shall be one line of bridging for each 8 feet (2438 mm) of span, unless both edges of the member are held in line. The bridging shall consist of not less than 1-inch by 3-inch (25 mm by 76 mm) lumber, double nailed at each end, of equivalent metal bracing of equal rigidity, full depth solid blocking, or other approved means. A line of bridging shall also be required at supports where equivalent lateral support is not otherwise provided.

2308.8.6 Structural floor sheathing. Structural floor sheathing shall comply with the provisions of 2304.7.1.

2308.8.7 Underfloor ventilation. For underfloor ventilation, see Section 1202.3.

2308.9 Wall framing.

2308.9.1 Size, height and spacing. The size, height and spacing of studs shall be in accordance with Table 2308.9.1 except that utility grade studs shall not be spaced more than 16 inches (406 mm) on center, or support more than a roof and ceiling, or exceed 8 feet (2438 mm) in height for exterior walls and load-bearing walls or 10 feet (3048 mm) for interior nonload-bearing walls.

TABLE 2308.8(1)
 FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES
 (Residential Sleeping Areas, Live Load = 30 psf, L/Δ = 360)

JOIST SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf				DEAD LOAD = 20 psf			
			2x6	2x8	2x10	2x12	2x6	2x8	2x10	2x12
			Maximum floor joist spans							
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	
12	Douglas Fir-Larch	SS	12-6	16-6	21-0	25-7	12-6	16-6	21-0	25-7
	Douglas Fir-Larch	#1	12-0	15-10	20-3	24-8	12-0	15-7	19-0	22-0
	Douglas Fir-Larch	#2	11-10	15-7	19-10	23-0	11-6	14-7	17-9	20-7
	Douglas Fir-Larch	#3	9-8	12-4	15-0	17-5	8-8	11-0	13-5	15-7
	Hem-Fir	SS	11-10	15-7	19-10	24-2	11-10	15-7	19-10	24-2
	Hem-Fir	#1	11-7	15-3	19-5	23-7	11-7	15-2	18-6	21-6
	Hem-Fir	#2	11-0	14-6	18-6	22-6	11-0	14-4	17-6	20-4
	Hem-Fir	#3	9-8	12-4	15-0	17-5	8-8	11-0	13-5	15-7
	Southern Pine	SS	12-3	16-2	20-8	25-1	12-3	16-2	20-8	25-1
	Southern Pine	#1	12-0	15-10	20-3	24-8	12-0	15-10	20-3	24-8
	Southern Pine	#2	11-10	15-7	19-10	18-8	11-10	15-7	18-7	21-9
	Southern Pine	#3	10-5	13-3	15-8	18-8	9-4	11-11	14-0	16-8
	Spruce-Pine-Fir	SS	11-7	15-3	19-5	23-7	11-7	15-3	19-5	23-7
	Spruce-Pine-Fir	#1	11-3	14-11	19-0	23-0	11-3	14-7	17-9	20-7
	Spruce-Pine-Fir	#2	11-3	14-11	19-0	23-0	11-3	14-7	17-9	20-7
	Spruce-Pine-Fir	#3	9-8	12-4	15-0	17-5	8-8	11-0	13-5	15-7
16	Douglas Fir-Larch	SS	11-4	15-0	19-1	23-3	11-4	15-0	19-1	23-0
	Douglas Fir-Larch	#1	10-11	14-5	18-5	21-4	10-8	13-6	16-5	19-1
	Douglas Fir-Larch	#2	10-9	14-1	17-2	19-11	9-11	12-7	15-5	17-10
	Douglas Fir-Larch	#3	8-5	10-8	13-0	15-1	7-6	9-6	11-8	13-6
	Hem-Fir	SS	10-9	14-2	18-0	21-11	10-9	14-2	18-0	21-11
	Hem-Fir	#1	10-6	13-10	17-8	20-9	10-4	13-1	16-0	18-7
	Hem-Fir	#2	10-0	13-2	16-10	19-8	9-10	12-5	15-2	17-7
	Hem-Fir	#3	8-5	10-8	13-0	15-1	7-6	9-6	11-8	13-6
	Southern Pine	SS	11-2	14-8	18-9	22-10	11-2	14-8	18-9	22-10
	Southern Pine	#1	10-11	14-5	18-5	22-5	10-11	14-5	17-11	21-4
	Southern Pine	#2	10-9	14-2	18-0	21-1	10-5	13-6	16-1	18-10
	Southern Pine	#3	9-0	11-6	13-7	16-2	8-1	10-3	12-2	14-6
	Spruce-Pine-Fir	SS	10-6	13-10	17-8	21-6	10-6	13-10	17-8	21-4
	Spruce-Pine-Fir	#1	10-3	13-6	17-2	19-11	9-11	12-7	15-5	17-10
	Spruce-Pine-Fir	#2	10-3	13-6	17-2	19-11	9-11	12-7	15-5	17-10
	Spruce-Pine-Fir	#3	8-5	10-8	13-0	15-1	7-6	9-6	11-8	13-6

(continued)

TABLE 2308.8(1)—continued
 FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES
 (Residential Sleeping Areas, Live Load = 30 psf, L/Δ = 360)

JOIST SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf				DEAD LOAD = 20 psf			
			2x6	2x8	2x10	2x12	2x6	2x8	2x10	2x12
			Maximum floor joist spans							
			(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
19.2	Douglas Fir-Larch	SS	10-8	14-1	18-0	21-10	10-8	14-1	18-0	21-0
	Douglas Fir-Larch	#1	10-4	13-7	16-9	19-6	9-8	12-4	15-0	17-5
	Douglas Fir-Larch	#2	10-1	12-10	15-8	18-3	9-1	11-6	14-1	16-3
	Douglas Fir-Larch	#3	7-8	9-9	11-10	13-9	6-10	8-8	10-7	12-4
	Hem-Fir	SS	10-1	13-4	17-0	20-8	10-1	13-4	17-0	20-7
	Hem-Fir	#1	9-10	13-0	16-4	19-0	9-6	12-0	14-8	17-0
	Hem-Fir	#2	9-5	12-5	15-6	17-1	8-11	11-4	13-10	16-1
	Hem-Fir	#3	7-8	9-9	11-10	13-9	6-10	8-8	10-7	12-4
	Southern Pine	SS	10-6	13-10	17-8	21-6	10-6	13-10	17-8	21-6
	Southern Pine	#1	10-4	13-7	17-4	21-1	10-4	13-7	16-4	19-6
	Southern Pine	#2	10-1	13-4	16-5	19-3	9-6	12-4	14-8	17-2
	Southern Pine	#3	8-3	10-6	12-5	14-9	7-4	9-5	11-1	13-2
	Spruce-Pine-Fir	SS	9-10	13-0	16-7	20-2	9-10	13-0	16-7	19-6
	Spruce-Pine-Fir	#1	9-8	12-9	15-8	18-3	9-1	11-6	14-1	16-3
	Spruce-Pine-Fir	#2	9-8	12-9	15-8	18-3	9-1	11-6	14-1	16-3
	Spruce-Pine-Fir	#3	7-8	9-9	11-10	13-9	6-10	8-8	10-7	12-4
24	Douglas Fir-Larch	SS	9-11	13-1	16-8	20-3	9-11	13-1	16-2	18-9
	Douglas Fir-Larch	#1	9-7	12-4	15-0	17-5	8-8	11-0	13-5	15-7
	Douglas Fir-Larch	#2	9-1	11-6	14-1	16-3	8-1	10-3	12-7	14-7
	Douglas Fir-Larch	#3	6-10	8-8	10-7	12-4	6-2	7-9	9-6	11-0
	Hem-Fir	SS	9-4	12-4	15-9	19-2	9-4	12-4	15-9	18-5
	Hem-Fir	#1	9-2	12-0	14-8	17-0	8-6	10-9	13-1	15-2
	Hem-Fir	#2	8-9	11-4	13-10	16-1	8-0	10-2	12-5	14-4
	Hem-Fir	#3	6-10	8-8	10-7	12-4	6-2	7-9	9-6	11-0
	Southern Pine	SS	9-9	12-10	16-5	19-11	9-9	12-10	16-5	19-11
	Southern Pine	#1	9-7	12-7	16-1	19-6	9-7	12-4	14-7	17-5
	Southern Pine	#2	9-4	12-4	14-8	17-2	8-6	11-0	13-1	15-5
	Southern Pine	#3	7-4	9-5	11-1	13-2	6-7	8-5	9-11	11-10
	Spruce-Pine-Fir	SS	9-2	12-1	15-5	18-9	9-2	12-1	15-0	17-5
	Spruce-Pine-Fir	#1	8-11	11-6	14-1	16-3	8-1	10-3	12-7	14-7
	Spruce-Pine-Fir	#2	8-11	11-6	14-1	16-3	8-1	10-3	12-7	14-7
	Spruce-Pine-Fir	#3	6-10	8-8	10-7	12-4	6-2	7-9	9-6	11-0

Check sources for availability of lumber in lengths greater than 20 feet.

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 47.8 N/m².

TABLE 2308.8(2)
FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES
 (Residential Living Areas, Live Load = 40 psf, L/Δ = 360)

JOIST SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf				DEAD LOAD = 20 psf			
			2x6	2x8	2x10	2x12	2x6	2x8	2x10	2x12
			Maximum floor joist spans							
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	
12	Douglas Fir-Larch	SS	11-4	15-0	19-1	23-3	11-4	15-0	19-1	23-3
	Douglas Fir-Larch	#1	10-11	14-5	18-5	22-0	10-11	14-2	17-4	20-1
	Douglas Fir-Larch	#2	10-9	14-2	17-9	20-7	10-6	13-3	16-3	18-10
	Douglas Fir-Larch	#3	8-8	11-0	13-5	15-7	7-11	10-0	12-3	14-3
	Hem-Fir	SS	10-9	14-2	18-0	21-11	10-9	14-2	18-0	21-11
	Hem-Fir	#1	10-6	13-10	17-8	21-6	10-6	13-10	16-11	19-7
	Hem-Fir	#2	10-0	13-2	16-10	20-4	10-0	13-1	16-0	18-6
	Hem-Fir	#3	8-8	11-0	13-5	15-7	7-11	10-0	12-3	14-3
	Southern Pine	SS	11-2	14-8	18-9	22-10	11-2	14-8	18-9	22-10
	Southern Pine	#1	10-11	14-5	18-5	22-5	10-11	14-5	18-5	22-5
	Southern Pine	#2	10-9	14-2	18-0	21-9	10-9	14-2	16-11	19-10
	Southern Pine	#3	9-4	11-11	14-0	16-8	8-6	10-10	12-10	15-3
	Spruce-Pine-Fir	SS	10-6	13-10	17-8	21-6	10-6	13-10	17-8	21-6
	Spruce-Pine-Fir	#1	10-3	13-6	17-3	20-7	10-3	13-3	16-3	18-10
	Spruce-Pine-Fir	#2	10-3	13-6	17-3	20-7	10-3	13-3	16-3	18-10
	Spruce-Pine-Fir	#3	8-8	11-0	13-5	15-7	7-11	10-0	12-3	14-3
16	Douglas Fir-Larch	SS	10-4	13-7	17-4	21-1	10-4	13-7	17-4	21-0
	Douglas Fir-Larch	#1	9-11	13-1	16-5	19-1	9-8	12-4	15-0	17-5
	Douglas Fir-Larch	#2	9-9	12-7	15-5	17-10	9-1	11-6	14-1	16-3
	Douglas Fir-Larch	#3	7-6	9-6	11-8	13-6	6-10	8-8	10-7	12-4
	Hem-Fir	SS	9-9	12-10	16-5	19-11	9-9	12-10	16-5	19-11
	Hem-Fir	#1	9-6	12-7	16-0	18-7	9-6	12-0	14-8	17-0
	Hem-Fir	#2	9-1	12-0	15-2	17-7	8-11	11-4	13-10	16-1
	Hem-Fir	#3	7-6	9-6	11-8	13-6	6-10	8-8	10-7	12-4
	Southern Pine	SS	10-2	13-4	17-0	20-9	10-2	13-4	17-0	20-9
	Southern Pine	#1	9-11	13-1	16-9	20-4	9-11	13-1	16-4	19-6
	Southern Pine	#2	9-9	12-10	16-1	18-10	9-6	12-4	14-8	17-2
	Southern Pine	#3	8-1	10-3	12-2	14-6	7-4	9-5	11-1	13-2
	Spruce-Pine-Fir	SS	9-6	12-7	16-0	19-6	9-6	12-7	16-0	19-6
	Spruce-Pine-Fir	#1	9-4	12-3	15-5	17-10	9-1	11-6	14-1	16-3
	Spruce-Pine-Fir	#2	9-4	12-3	15-5	17-10	9-1	11-6	14-1	16-3
	Spruce-Pine-Fir	#3	7-6	9-6	11-8	13-6	6-10	8-8	10-7	12-4

(continued)

TABLE 2308.8(2)—continued
 FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES
 (Residential Living Areas, Live Load = 40 psf, L/Δ = 360)

JOIST SPACING (inches)	SPECIES AND GRADE	DEAD LOAD = 10 psf				DEAD LOAD = 20 psf			
		2x6	2x8	2x10	2x12	2x6	2x8	2x10	2x12
		Maximum floor joist spans							
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
19.2	Douglas Fir-Larch SS	9-8	12-10	16-4	19-10	9-8	12-10	16-4	19-2
	Douglas Fir-Larch #1	9-4	12-4	15-0	17-5	8-10	11-3	13-8	15-11
	Douglas Fir-Larch #2	9-1	11-6	14-1	16-3	8-3	10-6	12-10	14-10
	Douglas Fir-Larch #3	6-10	8-8	10-7	12-4	6-3	7-11	9-8	11-3
	Hem-Fir SS	9-2	12-1	15-5	18-9	9-2	12-1	15-5	18-9
	Hem-Fir #1	9-0	11-10	14-8	17-0	8-8	10-11	13-4	15-6
	Hem-Fir #2	8-7	11-3	13-10	16-1	8-2	10-4	12-8	14-8
	Hem-Fir #3	6-10	8-8	10-7	12-4	6-3	7-11	9-8	11-3
	Southern Pine SS	9-6	12-7	16-0	19-6	9-6	12-7	16-0	19-6
	Southern Pine #1	9-4	12-4	15-9	19-2	9-4	12-4	14-11	17-9
	Southern Pine #2	9-2	12-1	14-8	17-2	8-8	11-3	13-5	15-8
	Southern Pine #3	7-4	9-5	11-1	13-2	6-9	8-7	10-1	12-1
	Spruce-Pine-Fir SS	9-0	11-10	15-1	18-4	9-0	11-10	15-1	17-9
	Spruce-Pine-Fir #1	8-9	11-6	14-1	16-3	8-3	10-6	12-10	14-10
	Spruce-Pine-Fir #2	8-9	11-6	14-1	16-3	8-3	10-6	12-10	14-10
	Spruce-Pine-Fir #3	6-10	8-8	10-7	12-4	6-3	7-11	9-8	11-3
24	Douglas Fir-Larch SS	9-0	11-11	15-2	18-5	9-0	11-11	14-9	17-1
	Douglas Fir-Larch #1	8-8	11-0	13-5	15-7	7-11	10-0	12-3	14-3
	Douglas Fir-Larch #2	8-1	10-3	12-7	14-7	7-5	9-5	11-6	13-4
	Douglas Fir-Larch #3	6-2	7-9	9-6	11-0	5-7	7-1	8-8	10-1
	Hem-Fir SS	8-6	11-3	14-4	17-5	8-6	11-3	14-4	16-10 ^a
	Hem-Fir #1	8-4	10-9	13-1	15-2	7-9	9-9	11-11	13-10
	Hem-Fir #2	7-11	10-2	12-5	14-4	7-4	9-3	11-4	13-1
	Hem-Fir #3	6-2	7-9	9-6	11-0	5-7	7-1	8-8	10-1
	Southern Pine SS	8-10	11-8	14-11	18-1	8-10	11-8	14-11	18-1
	Southern Pine #1	8-8	11-5	14-7	17-5	8-8	11-3	13-4	15-11
	Southern Pine #2	8-6	11-0	13-1	15-5	7-9	10-0	12-0	14-0
	Southern Pine #3	6-7	8-5	9-11	11-10	6-0	7-8	9-1	10-9
	Spruce-Pine-Fir SS	8-4	11-0	14-0	17-0	8-4	11-0	13-8	15-11
	Spruce-Pine-Fir #1	8-1	10-3	12-7	14-7	7-5	9-5	11-6	13-4
	Spruce-Pine-Fir #2	8-1	10-3	12-7	14-7	7-5	9-5	11-6	13-4
	Spruce-Pine-Fir #3	6-2	7-9	9-6	11-0	5-7	7-1	8-8	10-1

Check sources for availability of lumber in lengths greater than 20 feet.

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 47.8 N/m².

a. End bearing length shall be increased to 2 inches.

2308.9.2 Framing details. Studs shall be placed with their wide dimension perpendicular to the wall. Not less than three studs shall be installed at each corner of an exterior wall.

Exception: At corners, two studs are permitted, provided wood spacers or backup cleats of 3/8-inch-thick (9.5 mm) wood structural panel, 3/8-inch (9.5 mm) Type M “Exterior Glue” particleboard, 1-inch-thick (25 mm) lumber or other approved devices that will serve as an adequate backing for the attachment of facing materials are used. Where fire-resistance ratings or shear values are involved, wood spacers, backup cleats or other devices shall not be used unless specifically approved for such use.

2308.9.2.1 Top plates. Bearing and exterior wall studs shall be capped with double top plates installed to provide overlapping at corners and at intersections with other partitions. End joints in double top plates shall be offset at least 48 inches (1219 mm), and shall be nailed with not less than eight 16d face nails on each side of the joint.

Exception: A single top plate is permitted, provided the plate is adequately tied at joints, corners and intersecting walls by at least the equivalent of 3-inch by 6-inch (76 mm by 152 mm) by 0.036-inch-thick (0.914 mm) galvanized steel that is nailed to each wall or segment of wall by six 8d nails or equivalent, provided the rafters, joists or trusses are centered over the studs with a tolerance of no more than 1 inch (25 mm).

2308.9.2.2 Top plates for studs spaced at 24 inches (610 mm). Where bearing studs are spaced at 24-inch (610 mm) intervals and top plates are less than two 2-inch by 6-inch (51 mm by 152 mm) or two 3-inch by 4-inch (76 mm by 102 mm) members and where the floor joists, floor trusses or roof trusses that they support are spaced at more than 16-inch (406 mm) intervals, such joists or trusses shall bear within 5 inches (127 mm) of the studs beneath or a third plate shall be installed.

2308.9.2.3 Nonbearing walls and partitions. In nonbearing walls and partitions, studs shall be spaced not more than 28 inches (711 mm) on center and are permitted to be set with the long dimension parallel to the wall.

Interior nonbearing partitions shall be capped with no less than a single top plate installed to provide overlapping at corners and at intersections with other walls and partitions. The plate shall be continuously tied at joints by solid blocking at least 16 inches (406 mm) in length and equal in size to the plate or by 1/2 inch by 1 1/2-inch (12.7 mm by 38 mm) metal ties with spliced sections fastened with two 16d nails on each side of the joint.

2308.9.2.4 Plates or sills. Studs shall have full bearing on a plate or sill not less than 2 inches (51 mm) in thickness having a width not less than that of the wall studs.

2308.9.3 Bracing. Braced wall lines shall consist of braced wall panels that meet the requirements for location, type and amount of bracing specified in Table 2308.9.3(1), and are in line or offset from each other by not more than 4 feet (1219 mm). Braced wall panels shall start at not more than 8 feet (2438 mm) from each end of a braced wall line. A designed collector shall be provided if the bracing begins more than 12.5 feet (3810 mm) from an end of a braced wall line. Braced wall panels shall be clearly indicated on the plans. Construction of braced wall panels shall be by one of the following methods:

1. Nominal 1 by 4 (25.4 mm by 102 mm) continuous diagonal braces let into top and bottom plates and intervening studs, placed at an angle not more than 60 degrees (1.0 rad) or less than 45 degrees (0.79 rad) from the horizontal, and attached to the framing in conformance with Table 2304.9.1.
2. Wood boards of 5/8-inch (15.9 mm) net minimum thickness applied diagonally on studs spaced not over 24 inches (610 mm) on center.
3. Wood structural panel sheathing with a thickness not less than 5/16 inch (7.9 mm) for 16-inch (406 mm) stud spacing and not less than 3/8 inch (9.5 mm) for 24-inch (610 mm) stud spacing in accordance with Tables 2308.9.3(2) and 2308.9.3(3).
4. Fiberboard sheathing panels not less than 1/2 inch (12.7 mm) thick applied vertically on studs spaced not over 16 inches (406 mm) on center where installed

**TABLE 2308.9.1
SIZE, HEIGHT AND SPACING OF WOOD STUDS**

STUD SIZE (Inches)	BEARING WALLS				NONBEARING WALLS	
	Laterally unsupported stud height ^a (feet)	Supporting roof and ceiling only	Supporting one floor, roof and ceiling	Supporting two floors, roof and ceiling	Laterally unsupported stud height ^a (feet)	Spacing (inches)
2 x 3 ^b	—	—	—	—	10	16
2 x 4	10	24	16	—	14	24
3 x 4	10	24	24	16	14	24
2 x 5	10	24	24	—	16	24
2 x 6	10	24	24	16	20	24

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

a. Listed heights are distances between points of lateral support placed perpendicular to the plane of the wall. Increases in unsupported height are permitted where justified by an analysis.

b. Shall not be used in exterior walls.

with fasteners in accordance with Section 2306.4.3 and Table 2308.9.3(4).

5. Gypsum board [sheathing $\frac{1}{2}$ inch (12.7 mm) thick by 4 feet (1219 mm) wide, wallboard or veneer base] on studs spaced not over 24 inches (610 mm) on center and nailed at 7 inches (178 mm) on center with nails as required by Table 2306.4.5.
6. Particleboard wall sheathing panels where installed in accordance with Table 2308.9.3(5).
7. Portland cement plaster on studs spaced 16 inches (406 mm) on center installed in accordance with Section 2510.
8. Hardboard panel siding where installed in accordance with Section 2303.1.6 and Table 2308.9.3(6).

For cripple wall bracing, see Section 2308.9.4.1. For Methods 2, 3, 4, 6, 7 and 8, each panel must be at least 48 inches (1219 mm) in length, covering three stud spaces where studs are spaced 16 inches (406 mm) apart and covering two stud spaces where studs are spaced 24 inches (610 mm) apart.

For Method 5, each panel must be at least 96 inches (2438 mm) in length where applied to one face of a panel and 48 inches (1219 mm) where applied to both faces.

All vertical joints of panel sheathing shall occur over studs and adjacent panel joints shall be nailed to common framing members. Horizontal joints shall occur over blocking or other framing equal in size to the studding except where waived by the installation requirements for the specific sheathing materials.

Sole plates shall be nailed to the floor framing and top plates shall be connected to the framing above in accordance with Section 2308.3.2. Where joists are perpendicular to braced wall lines above, blocking shall be provided under and in line with the braced wall panels.

2308.9.3.1 Alternative bracing. Any bracing required by Section 2308.9.3 is permitted to be replaced by the following:

1. In one-story buildings, each panel shall have a length of not less than 2 feet 8 inches (813 mm) and a height of not more than 10 feet (3048 mm). Each panel shall be sheathed on one face with $\frac{3}{8}$ -inch-minimum-thickness (9.5 mm) plywood sheathing nailed with 8d common or galvanized box nails in accordance with Table 2304.9.1 and blocked at wood structural panel edges. Two anchor bolts installed in accordance with Section 2308.6 shall be provided in each panel. Anchor bolts shall be placed at each panel outside quarter points. Each panel end stud shall have a tie-down device fastened to the foundation, capable of providing an approved uplift capacity of not less than 1,800 pounds (8006 N). The tie-down device shall be installed in accordance with the manufacturer's recommendations. The panels shall be supported directly on a foundation or on floor framing supported directly on a foundation that is continuous across the entire length of the braced wall line. This foundation shall be reinforced with not less than one No. 4 bar top and bottom.

Where the continuous foundation is required to have a depth greater than 12 inches (305 mm), a minimum 12 inch by 12 inch (305 mm by 305 mm) continuous footing or turned down slab edge is permitted at door openings in the braced wall line. This continuous footing or turned down slab edge shall be reinforced with not less than one No. 4 bar top and bottom. This reinforcement shall be lapped 15 inches (381 mm) with the reinforcement required in the continuous foundation located directly under the braced wall line.

2. In the first story of two-story buildings, each wall panel shall be braced in accordance with Section 2308.9.3.1, Item 1, except that the wood structural panel sheathing shall be provided on both faces, three anchor bolts shall be placed at one-quarter points, and tie-down device uplift capacity shall not be less than 3,000 pounds (13 344 N).

2308.9.4 Cripple walls. Foundation cripple walls shall be framed of studs not less in size than the studding above with a minimum length of 14 inches (356 mm), or shall be framed of solid blocking. Where exceeding 4 feet (1219 mm) in height, such walls shall be framed of studs having the size required for an additional story.

2308.9.4.1 Bracing. For the purposes of this section, cripple walls having a stud height exceeding 14 inches (356 mm) shall be considered a story and shall be braced in accordance with Table 2308.9.3(1) for Seismic Design Category A, B or C. See Section 2308.12.4 for Seismic Design Category D or E.

2308.9.4.2 Nailing of bracing. Spacing of edge nailing for required wall bracing shall not exceed 6 inches (152 mm) on center along the foundation plate and the top plate of the cripple wall. Nail size, nail spacing for field nailing and more restrictive boundary nailing requirements shall be as required elsewhere in the code for the specific bracing material used.

2308.9.5 Openings in exterior walls.

2308.9.5.1 Headers. Headers shall be provided over each opening in exterior-bearing walls. The spans in Table 2308.9.5 are permitted to be used for one- and two-family dwellings. Headers for other buildings shall be designed in accordance with Section 2301.2.1 or 2301.2.2. Headers shall be of two pieces of nominal 2 inch (51 mm) framing lumber set on edge as permitted by Table 2308.9.5 and nailed together in accordance with Table 2304.9.1 or of solid lumber of equivalent size.

2308.9.5.2 Header support. Wall studs shall support the ends of the header in accordance with Table 2308.9.5. Each end of a lintel or header shall have a length of bearing of not less than $1\frac{1}{2}$ inches (38 mm) for the full width of the lintel.

2308.9.6 Openings in interior-bearing partitions. Headers shall be provided over each opening in interior-bearing partitions as required in Section 2308.9.5. The spans in Table 2308.9.6 are permitted to be used for one- and two-family dwellings. Wall studs shall support the ends of the header in accordance with Table 2308.9.5 or 2308.9.6 as appropriate.

**TABLE 2308.9.3(1)
BRACED WALL PANELS^a**

SEISMIC DESIGN CATEGORY	CONDITION	CONSTRUCTION METHODS ^{b,c}								BRACED PANEL LOCATION AND LENGTH ^d
		1	2	3	4	5	6	7	8	
A and B	One story, top of two or three story	X	X	X	X	X	X	X	X	Each end and not more than 25 feet on center
	First story of two story or second story of three story	X	X	X	X	X	X	X	X	
	First story of three story	—	X	X	X	X ^e	X	X	X	
C	One story, top of two or three story	—	X	X	X	X	X	X	X	Each end and not more than 25 feet on center
	First story of two story or second story of three story	—	X	X	X	X ^e	X	X	X	Each end and not more than 25 feet on center but total length shall not be less than 25% of building length ^f
	First story of three story	—	X	X ^g	X	X ^e	X	X	X	Each end and not more than 25 feet on center but total length shall not be less than 40% of building length ^f

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

- a. This table specifies minimum requirements for braced panels that form interior or exterior braced wall lines.
- b. See Section 2308.9.3 for full description.
- c. See Section 2308.9.3.1 for alternative braced panel requirement.
- d. Building length is the dimension parallel to the braced wall length.
- e. Gypsum wallboard applied to framing supports that are spaced at 16 inches on center.
- f. The required lengths shall be doubled for gypsum board applied to only one face of a braced wall panel.
- g. Perimeter nail spacing of panels shall not exceed 4 inches on center.

**TABLE 2308.9.3(2)
EXPOSED PLYWOOD PANEL SIDING**

MINIMUM THICKNESS ^a (inch)	MINIMUM NUMBER OF PLYS	STUD SPACING (inches) Plywood siding applied directly to studs or over sheathing
3/8	3	16 ^b
1/2	4	24

For SI: 1 inch = 25.4 mm.

- a. Thickness of grooved panels is measured at bottom of grooves.
- b. Are permitted to be 24 inches if plywood siding applied with face grain perpendicular to studs or over one of the following: (1) 1-inch board sheathing, (2) 7/16 inch wood structural panel sheathing or (3) 3/8 inch wood structural panel sheathing with strength axis (which is the long direction of the panel unless otherwise marked) of sheathing perpendicular to studs.

**TABLE 2308.9.3(3)
WOOD STRUCTURAL PANEL WALL SHEATHING
(Not exposed to the weather, strength axis parallel or perpendicular to studs except as indicated below)**

MINIMUM THICKNESS (inch)	PANEL SPAN RATING	STUD SPACING (inches)		
		Siding nailed to studs	Sheathing under coverings specified in Section 2308.9.3	
			Sheathing parallel to studs	Sheathing perpendicular to studs
5/16	12/0, 16/0, 20/0 Wall-16" o.c.	16	—	16
3/8, 15/32, 1/2	16/0, 20/0, 24/0, 32/16 Wall-24" o.c.	24	16	24
7/16, 15/32, 1/2	24/0, 24/16, 32/16 Wall-24" o.c.	24	24 ^a	24

For SI: 1 inch = 25.4 mm.

- a. Plywood shall consist of four or more plies.

TABLE 2308.9.3(4)
ALLOWABLE SHEAR VALUES (plf) FOR WIND OR SEISMIC LOADING ON
VERTICAL DIAPHRAGMS OF FIBERBOARD SHEATHING BOARD CONSTRUCTION
FOR TYPE V CONSTRUCTION ONLY^{a, b, c, d, e, f, g, h}

THICKNESS AND GRADE	FASTENER SIZE	SHEAR VALUE (pounds per linear foot) 3-INCH NAIL SPACING AROUND PERIMETER AND 6-INCH AT INTERMEDIATE POINTS
1/2" Structural	No. 11 gage galvanized roofing nail 1 1/2" long, 7/16" head	125 ^g
5/32" Structural	No. 11 gage galvanized roofing nail 1 3/4" long, 7/16" head	175 ^g

For SI: 1 inch = 25.4 mm, 1 pound per foot = 14.5939 N/m.

- a. Fiberboard sheathing diaphragms shall not be used to brace concrete or masonry walls.
- b. Panel edges shall be backed with 2 inch or wider framing of Douglas Fir-Larch or Southern Pine.
- c. Fiberboard sheathing on one side only.
- d. Fiberboard panels are installed with their long dimension parallel to studs and without horizontal joints.
- e. Fasteners shall be spaced 6 inches on center along intermediate framing members.
- f. For framing of other species: (1) Find specific gravity for species of lumber in AFPA National Design Specification, (2) Multiply the shear value from the above table by 0.82 for species with specific gravity of 0.42 or greater, or 0.65 for all other species.
- g. The same values can be applied when staples are used as described in Table 2304.9.1.
- h. Values are not permitted in Seismic Design Category D, E, or F.

TABLE 2308.9.3(5)
ALLOWABLE SPANS FOR PARTICLEBOARD WALL SHEATHING
(NOT EXPOSED TO THE WEATHER, LONG DIMENSION OF THE PANEL PARALLEL OR PERPENDICULAR TO STUDS)

GRADE	THICKNESS (inch)	STUD SPACING (Inches)	
		Siding nailed to studs	Sheathing under coverings specified in Section 2308.9.3 parallel or perpendicular to studs
M-S "Exterior Glue" and M-2 "Exterior Glue"	3/8	16	—
	1/2	16	16

For SI: 1 inch = 25.4 mm.

TABLE 2308.9.3(6)
HARDBOARD SIDING

SIDING	MINIMAL NOMINAL THICKNESS (inch)	2 x 4 FRAMING MAXIMUM SPACING	NAIL SIZE ^{a,b,d}	NAIL SPACING	
				General	Bracing panels ^c
1. Lap siding					
Direct to studs	3/8	16" o.c.	8d	16" o.c.	Not applicable
Over sheathing	3/8	16" o.c.	10d	16" o.c.	Not applicable
2. Square edge panel siding					
Direct to studs	3/8	24" o.c.	6d	6" o.c. edges; 12" o.c. at intermed. supports	4" o.c. edges; 8" o.c. intermed. supports
Over sheathing	3/8	24" o.c.	8d	6" o.c. edges; 12" o.c. at intermed. supports	4" o.c. edges; 8" o.c. intermed. supports
3. Shiplap edge panel siding					
Direct to studs	3/8	16" o.c.	6d	6" o.c. edges; 12" o.c. at intermed. supports	4" o.c. edges; 8" o.c. intermed. supports
Over sheathing	3/8	16" o.c.	8d	6" o.c. edges; 12" o.c. at intermed. supports	4" o.c. edges; 8" o.c. intermed. supports

For SI: 1 inch = 25.4 mm.

a. Nails shall be corrosion resistant.

b. Minimum acceptable nail dimensions:

	Panel Siding (inch)	Lap Siding (inch)
Shank diameter	0.092	0.099
Head diameter	0.225	0.240

c. Where used to comply with Section 2308.9.3.

d. Nail length must accommodate the sheathing and penetrate framing 1 1/2 inches.

**TABLE 2308.9.5
HEADER AND GIRDER SPANS^a FOR EXTERIOR BEARING WALLS**
(Maximum header spans for Douglas Fir-Larch, Hem-Fir, Southern Pine, and Spruce-Pine-Fir^b and required number of jack studs)

HEADERS SUPPORTING	SIZE	GROUND SNOW LOAD (psf) ^e											
		30						50					
		Building width ^c (feet)											
		20		28		36		20		28		36	
Span	NJ ^d	Span	NJ ^d	Span	NJ ^d	Span	NJ ^d	Span	NJ ^d	Span	NJ ^d		
Roof & Ceiling	2-2 x 4	3-6	1	3-2	1	2-10	1	3-2	1	2-9	1	2-6	1
	2-2 x 6	5-5	1	4-8	1	4-2	1	4-8	1	4-1	1	3-8	2
	2-2 x 8	6-10	1	5-11	2	5-4	2	5-11	2	5-2	2	4-7	2
	2-2 x 10	8-5	2	7-3	2	6-6	2	7-3	2	6-3	2	5-7	2
	2-2 x 12	9-9	2	8-5	2	7-6	2	8-5	2	7-3	2	6-6	2
	3-2 x 8	8-4	1	7-5	1	6-8	1	7-5	1	6-5	2	5-9	2
	3-2 x 10	10-6	1	9-1	2	8-2	2	9-1	2	7-10	2	7-0	2
	3-2 x 12	12-2	2	10-7	2	9-5	2	10-7	2	9-2	2	8-2	2
	4-2 x 8	7-0	1	6-1	2	5-5	2	6-1	2	5-3	2	4-8	2
	4-2 x 10	11-8	1	10-6	1	9-5	2	10-6	1	9-1	2	8-2	2
4-2 x 12	14-1	1	12-2	2	10-11	2	12-2	2	10-7	2	9-5	2	
Roof Ceiling & 1 Center-Bearing Floor	2-2 x 4	3-1	1	2-9	1	2-5	1	2-9	1	2-5	1	2-2	1
	2-2 x 6	4-6	1	4-0	1	3-7	2	4-1	1	3-7	2	3-3	2
	2-2 x 8	5-9	2	5-0	2	4-6	2	5-2	2	4-6	2	4-1	2
	2-2 x 10	7-0	2	6-2	2	5-6	2	6-4	2	5-6	2	5-0	2
	2-2 x 12	8-1	2	7-1	2	6-5	2	7-4	2	6-5	2	5-9	3
	3-2 x 8	7-2	1	6-3	2	5-8	2	6-5	2	5-8	2	5-1	2
	3-2 x 10	8-9	2	7-8	2	6-11	2	7-11	2	6-11	2	6-3	2
	3-2 x 12	10-2	2	8-11	2	8-0	2	9-2	2	8-0	2	7-3	2
	4-2 x 8	5-10	2	5-2	2	4-8	2	5-3	2	4-7	2	4-2	2
	4-2 x 10	10-1	1	8-10	2	8-0	2	9-1	2	8-0	2	7-2	2
4-2 x 12	11-9	2	10-3	2	9-3	2	10-7	2	9-3	2	8-4	2	
Roof Ceiling & 1 Clear Span Floor	2-2 x 4	2-8	1	2-4	1	2-1	1	2-7	1	2-3	1	2-0	1
	2-2 x 6	3-11	1	3-5	2	3-0	2	3-10	2	3-4	2	3-0	2
	2-2 x 8	5-0	2	4-4	2	3-10	2	4-10	2	4-2	2	3-9	2
	2-2 x 10	6-1	2	5-3	2	4-8	2	5-11	2	5-1	2	4-7	3
	2-2 x 12	7-1	2	6-1	3	5-5	3	6-10	2	5-11	3	5-4	3
	3-2 x 8	6-3	2	5-5	2	4-10	2	6-1	2	5-3	2	4-8	2
	3-2 x 10	7-7	2	6-7	2	5-11	2	7-5	2	6-5	2	5-9	2
	3-2 x 12	8-10	2	7-8	2	6-10	2	8-7	2	7-5	2	6-8	2
	4-2 x 8	5-1	2	4-5	2	3-11	2	4-11	2	4-3	2	3-10	2
	4-2 x 10	8-9	2	7-7	2	6-10	2	8-7	2	7-5	2	6-7	2
4-2 x 12	10-2	2	8-10	2	7-11	2	9-11	2	8-7	2	7-8	2	

(continued)

TABLE 2308.9.5—continued
HEADER AND GIRDER SPANS^a FOR EXTERIOR BEARING WALLS
 (Maximum header spans for Douglas Fir-Larch, Hem-Fir, Southern Pine, and Spruce-Pine-Fir^b and required number of jack studs)

HEADERS SUPPORTING	SIZE	GROUND SNOW LOAD (psf) ^e											
		30						50					
		Building width ^c (feet)											
		20		28		36		20		28		36	
Span	NJ ^d	Span	NJ ^d	Span	NJ ^d	Span	NJ ^d	Span	NJ ^d	Span	NJ ^d		
Roof Ceiling & 2 Center Bearing Floors	2-2 x 4	2-7	1	2-3	1	2-0	1	2-6	1	2-2	1	1-11	1
	2-2 x 6	3-9	2	3-3	2	2-11	2	3-8	2	3-2	2	2-10	2
	2-2 x 8	4-9	2	4-2	2	3-9	2	4-7	2	4-0	2	3-8	2
	2-2 x 10	5-9	2	5-1	2	4-7	3	5-8	2	4-11	2	4-5	3
	2-2 x 12	6-8	2	5-10	3	5-3	3	6-6	2	5-9	3	5-2	3
	3-2 x 8	5-11	2	5-2	2	4-8	2	5-9	2	5-1	2	4-7	2
	3-2 x 10	7-3	2	6-4	2	5-8	2	7-1	2	6-2	2	5-7	2
	3-2 x 12	8-5	2	7-4	2	6-7	2	8-2	2	7-2	2	6-5	3
	4-2 x 8	4-10	2	4-3	2	3-10	2	4-9	2	4-2	2	3-9	2
	4-2 x 10	8-4	2	7-4	2	6-7	2	8-2	2	7-2	2	6-5	2
4-2 x 12	9-8	2	8-6	2	7-8	2	9-5	2	8-3	2	7-5	2	
Roof, Ceiling & 2 Clear Span Floors	2-2 x 4	2-1	1	1-8	1	1-6	2	2-0	1	1-8	1	1-5	2
	2-2 x 6	3-1	2	2-8	2	2-4	2	3-0	2	2-7	2	2-3	2
	2-2 x 8	3-10	2	3-4	2	3-0	3	3-10	2	3-4	2	2-11	3
	2-2 x 10	4-9	2	4-1	3	3-8	3	4-8	2	4-0	3	3-7	3
	2-2 x 12	5-6	3	4-9	3	4-3	3	5-5	3	4-8	3	4-2	3
	3-2 x 8	4-10	2	4-2	2	3-9	2	4-9	2	4-1	2	3-8	2
	3-2 x 10	5-11	2	5-1	2	4-7	3	5-10	2	5-0	2	4-6	3
	3-2 x 12	6-10	2	5-11	3	5-4	3	6-9	2	5-10	3	5-3	3
	4-2 x 8	3-11	2	3-5	2	3-1	3	3-11	2	3-4	2	3-0	3
	4-2 x 10	6-10	2	5-11	2	5-3	2	6-9	2	5-10	2	5-2	2
4-2 x 12	7-11	2	6-10	2	6-2	3	7-9	2	6-9	2	6-0	3	

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 47.8 N/m².

- a. Spans are given in feet and inches (ft-in).
- b. Tabulated values are for #2 Grade lumber.
- c. Building width is measured perpendicular to the ridge. For widths between those shown, spans are permitted to be interpolated.
- d. NJ - Number of jack studs required to support each end. Where the number of required jack studs equals 1, the header is permitted to be supported by an approved framing anchor attached to the full-height wall stud and to the header.
- e. Use 30 psf ground snow load for cases in which ground snow load is less than 30 psf and the roof live load is equal to or less than 20 psf.

**TABLE 2308.9.6
HEADER AND GIRDER SPANS^a FOR INTERIOR-BEARING WALLS
(Maximum header spans for Douglas Fir-Larch, Hem-Fir, Southern Pine, and Spruce-Pine-Fir^b and required number of jack studs)**

HEADERS AND GIRDERS SUPPORTING	SIZE	BUILDING WIDTH ^c (feet)					
		20		28		36	
		Span	NJ ^d	Span	NJ ^d	Span	NJ ^d
One Floor Only	2-2 × 4	3-1	1	2-8	1	2-5	1
	2-2 × 6	4-6	1	3-11	1	3-6	1
	2-2 × 8	5-9	1	5-0	2	4-5	2
	2-2 × 10	7-0	2	6-1	2	5-5	2
	2-2 × 12	8-1	2	7-0	2	6-3	2
	3-2 × 8	7-2	1	6-3	1	5-7	2
	3-2 × 10	8-9	1	7-7	2	6-9	2
	3-2 × 12	10-2	2	8-10	2	7-10	2
	4-2 × 8	5-10	1	5-1	2	4-6	2
	4-2 × 10	10-1	1	8-9	1	7-10	2
	4-2 × 12	11-9	1	10-2	2	9-1	2
Two Floors	2-2 × 4	2-2	1	1-10	1	1-7	1
	2-2 × 6	3-2	2	2-9	2	2-5	2
	2-2 × 8	4-1	2	3-6	2	3-2	2
	2-2 × 10	4-11	2	4-3	2	3-10	3
	2-2 × 12	5-9	2	5-0	3	4-5	3
	3-2 × 8	5-1	2	4-5	2	3-11	2
	3-2 × 10	6-2	2	5-4	2	4-10	2
	3-2 × 12	7-2	2	6-3	2	5-7	3
	4-2 × 8	4-2	2	3-7	2	3-2	2
	4-2 × 10	7-2	2	6-2	2	5-6	2
	4-2 × 12	8-4	2	7-2	2	6-5	2

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

a. Spans are given in feet and inches (ft-in).

b. Tabulated values are for #2 Grade lumber.

c. Building width is measured perpendicular to the ridge. For widths between those shown, spans are permitted to be interpolated.

d. NJ - Number of jack studs required to support each end. Where the number of required jack studs equals 1, the headers are permitted to be supported by an approved framing anchor attached to the full-height wall stud and to the header.

2308.9.7 Openings in interior nonbearing partitions.

Openings in nonbearing partitions are permitted to be framed with single studs and headers. Each end of a lintel or header shall have a length of bearing of not less than 1½ inches (38 mm) for the full width of the lintel.

2308.9.8 Pipes in walls. Stud partitions containing plumbing, heating or other pipes shall be so framed and the joists underneath so spaced as to give proper clearance for the piping. Where a partition containing such piping runs parallel to the floor joists, the joists underneath such partitions shall be doubled and spaced to permit the passage of such pipes and shall be bridged. Where plumbing, heating or other pipes are placed in or partly in a partition, necessitating the cutting of the soles or plates, a metal tie not less than 0.058 inch (1.47 mm) (16 galvanized gage) and 1½ inches (38 mm) wide shall be fastened to each plate across and to each side of the opening with not less than six 16d nails.

2308.9.9 Bridging. Unless covered by interior or exterior wall coverings or sheathing meeting the minimum requirements of

this code, stud partitions or walls with studs having a height-to-least-thickness ratio exceeding 50 shall have bridging not less than 2 inches (51 mm) in thickness and of the same width as the studs fitted snugly and nailed thereto to provide adequate lateral support. Bridging shall be placed in every stud cavity and at a frequency such that no stud so braced shall have a height-to-least-thickness ratio exceeding 50 with the height of the stud measured between horizontal framing and bridging or between bridging, whichever is greater.

2308.9.10 Cutting and notching. In exterior walls and bearing partitions, any wood stud is permitted to be cut or notched to a depth not exceeding 25 percent of its width. Cutting or notching of studs to a depth not greater than 40 percent of the width of the stud is permitted in nonbearing partitions supporting no loads other than the weight of the partition.

2308.9.11 Bored holes. A hole not greater in diameter than 40 percent of the stud width is permitted to be bored in any wood stud. Bored holes not greater than 60 percent of the width of the stud are permitted in nonbearing partitions or in

any wall where each bored stud is doubled, provided not more than two such successive doubled studs are so bored.

In no case shall the edge of the bored hole be nearer than 5/8 inch (15.9 mm) to the edge of the stud.

Bored holes shall not be located at the same section of stud as a cut or notch.

2308.10 Roof and ceiling framing. The framing details required in this section apply to roofs having a minimum slope of three units vertical in 12 units horizontal (25-percent slope) or greater. Where the roof slope is less than three units vertical in 12 units horizontal (25-percent slope), members supporting rafters and ceiling joists such as ridge board, hips and valleys shall be designed as beams.

2308.10.1 Wind uplift. Roof assemblies shall have rafter and truss ties to the wall below. Resultant uplift loads shall be transferred to the foundation using a continuous load path. The rafter or truss to wall connection shall comply with Tables 2304.9.1 and 2308.10.1.

2308.10.2 Ceiling joist spans. Allowable spans for ceiling joists shall be in accordance with Table 2308.10.2(1) or 2308.10.2(2). For other grades and or species, refer to the AF&PA Span Tables for Joists and Rafters.

2308.10.3 Rafter spans. Allowable spans for rafters shall be in accordance with Table 2308.10.3(1), 2308.10.3(2), 2308.10.3(3), 2308.10.3(4), 2308.10.3(5), or 2308.10.3(6). For other grades and or species, refer to the AF&PA Span Tables for Joists and Rafters.

2308.10.4 Ceiling joist and rafter framing. Rafters shall be framed directly opposite each other at the ridge. There shall be a ridge board at least 1-inch (25 mm) nominal thickness at ridges and not less in depth than the cut end of the rafter. At valleys and hips, there shall be a single valley or hip rafter not less than 2-inch (51 mm) nominal thickness and not less in depth than the cut end of the rafter.

2308.10.4.1 Ceiling joist and rafter connections. Ceilings joists and rafters shall be nailed to each other and the assembly shall be nailed to the top wall plate in accordance with Tables 2304.9.1 and 2308.10.1. Ceiling joists shall be continuous or securely joined where they meet over interior partitions and fastened to adjacent rafters in accordance with Tables 2308.10.4.1 and 2304.9.1 to provide a continuous rafter tie across the building where such joists are parallel to the rafters. Ceiling joists shall have a bearing surface of not less than 1 1/2 inches (38 mm) on the top plate at each end.

Where ceiling joists are not parallel to rafters, an equivalent rafter tie shall be installed in a manner to provide a continuous tie across the building, at a spacing of not more than 4 feet (1219 mm) on center. The connections shall be in accordance with Tables 2308.10.4.1 and 2304.9.1, or connections of equivalent capacities shall be provided. Where ceiling joists or rafter ties are not provided at the top of the rafter support walls, the ridge formed by these rafters shall also be supported by a girder conforming to Section 2308.4.

Rafter ties shall be spaced not more than 4 feet (1219 mm) on center. Rafter tie connections shall be based on the equivalent rafter spacing in Table 2308.10.4.1. Where rafter ties are spaced at 32 inches (813 mm) on center, the number of 16d common nails shall be two times the number specified for rafters spaced 16 inches (406 mm) on center, with a minimum of 4-16d common nails where no snow loads are indicated. Where rafter ties are spaced at 48 inches (1219 mm) on center, the number of 16d common nails shall be two times the number specified for rafters spaced 24 inches (610 mm) on center, with a minimum of 6-16d common nails where no snow loads are indicated. Rafter/ceiling joist connections and rafter/tie connections shall be of sufficient size and number to prevent splitting from nailing.

TABLE 2308.10.1
REQUIRED RATING OF APPROVED UPLIFT CONNECTORS (pounds)^{a,b,c,e,f}

BASIC WIND SPEED (3-second gust)	ROOF SPAN (feet)							OVERHANGS (pounds/foot) ^d
	12	20	24	28	32	36	40	
85	-72	-120	-145	-169	-193	-217	-241	-38.55
90	-91	-151	-181	-212	-242	-272	-302	-43.22
100	-131	-281	-262	-305	-349	-393	-436	-53.36
110	-175	-292	-351	-409	-467	-526	-584	-64.56

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 mile per hour = 1.61 km/hr, 1 pound = 0.454 Kg, 1 pound/foot = 14.5939 N/m.

- a. The uplift connection requirements are based on a 30-foot mean roof height located in Exposure B. For Exposure C or D and for other mean roof heights, multiply the above loads by the Adjustment Coefficients in Table 1609.6.2.1(4).
- b. The uplift connection requirements are based on the framing being spaced 24 inches on center. Multiply by 0.67 for framing spaced 16 inches on center and multiply by 0.5 for framing spaced 12 inches on center.
- c. The uplift connection requirements include an allowance for 10 pounds of dead load.
- d. The uplift connection requirements do not account for the effects of overhangs. The magnitude of the above loads shall be increased by adding the overhang loads found in the table. The overhang loads are also based on framing spaced 24 inches on center. The overhang loads given shall be multiplied by the overhang projection and added to the roof uplift value in the table.
- e. The uplift connection requirements are based upon wind loading on end zones as defined in Section 1609.6.3. Connection loads for connections located a distance of 20 percent of the least horizontal dimension of the building from the corner of the building are permitted to be reduced by multiplying the table connection value by 0.7 and multiplying the overhang load by 0.8.
- f. For wall-to-wall and wall-to-foundation connections, the capacity of the uplift connector is permitted to be reduced by 100 pounds for each full wall above. (For example, if a 500-pound rated connector is used on the roof framing, a 400-pound rated connector is permitted at the next floor level down.)

TABLE 2308.10.2(1)
CEILING JOIST SPANS FOR COMMON LUMBER SPECIES
 (Uninhabitable Attics Without Storage, Live Load = 10 pounds psf, L/Δ = 240)

CEILING JOIST SPACING (inches)	SPECIES AND GRADE	DEAD LOAD = 5 pounds per square foot			
		2 x 4	2 x 6	2 x 8	2 x 10
		Maximum ceiling joist spans			
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
12	Douglas Fir-Larch SS	13-2	20-8	Note a	Note a
	Douglas Fir-Larch #1	12-8	19-11	Note a	Note a
	Douglas Fir-Larch #2	12-5	19-6	25-8	Note a
	Douglas Fir-Larch #3	10-10	15-10	20-1	24-6
	Hem-Fir SS	12-5	19-6	25-8	Note a
	Hem-Fir #1	12-2	19-1	25-2	Note a
	Hem-Fir #2	11-7	18-2	24-0	Note a
	Hem-Fir #3	10-10	15-10	20-1	24-6
	Southern Pine SS	12-11	20-3	Note a	Note a
	Southern Pine #1	12-8	19-11	Note a	Note a
	Southern Pine #2	12-5	19-6	25-8	Note a
	Southern Pine #3	11-6	17-0	21-8	25-7
	Spruce-Pine-Fir SS	12-2	19-1	25-2	Note a
	Spruce-Pine-Fir #1	11-10	18-8	24-7	Note a
	Spruce-Pine-Fir #2	11-10	18-8	24-7	Note a
	Spruce-Pine-Fir #3	10-10	15-10	20-1	24-6
16	Douglas Fir-Larch SS	11-11	18-9	24-8	Note a
	Douglas Fir-Larch #1	11-6	18-1	23-10	Note a
	Douglas Fir-Larch #2	11-3	17-8	23-0	Note a
	Douglas Fir-Larch #3	9-5	13-9	17-5	21-3
	Hem-Fir SS	11-3	17-8	23-4	Note a
	Hem-Fir #1	11-0	17-4	22-10	Note a
	Hem-Fir #2	10-6	16-6	21-9	Note a
	Hem-Fir #3	9-5	13-9	17-5	21-3
	Southern Pine SS	11-9	18-5	24-3	Note a
	Southern Pine #1	11-6	18-1	23-1	Note a
	Southern Pine #2	11-3	17-8	23-4	Note a
	Southern Pine #3	10-0	14-9	18-9	22-2
	Spruce-Pine-Fir SS	11-0	17-4	22-10	Note a
	Spruce-Pine-Fir #1	10-9	16-11	22-4	Note a
	Spruce-Pine-Fir #2	10-9	16-11	22-4	Note a
	Spruce-Pine-Fir #3	9-5	13-9	17-5	21-3

(continued)

TABLE 2308.10.2(1)—continued
CEILING JOIST SPANS FOR COMMON LUMBER SPECIES
 (Uninhabitable Attics Without Storage, Live Load = 10 pounds psf, L/Δ = 240)

CEILING JOIST SPACING (inches)	SPECIES AND GRADE	DEAD LOAD = 5 pounds per square foot			
		2 x 4	2 x 6	2 x 8	2 x 10
		Maximum ceiling joist spans			
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
19.2	Douglas Fir-Larch SS	11-3	17-8	23-3	Note a
	Douglas Fir-Larch #1	10-10	17-0	22-5	Note a
	Douglas Fir-Larch #2	10-7	16-7	21-0	25-8
	Douglas Fir-Larch #3	8-7	12-6	15-10	19-5
	Hem-Fir SS	10-7	16-8	21-11	Note a
	Hem-Fir #1	10-4	16-4	21-6	Note a
	Hem-Fir #2	9-11	15-7	20-6	25-3
	Hem-Fir #3	8-7	12-6	15-10	19-5
	Southern Pine SS	11-0	17-4	22-10	Note a
	Southern Pine #1	10-10	17-0	22-5	Note a
	Southern Pine #2	10-7	16-8	21-11	Note a
	Southern Pine #3	9-1	13-6	17-2	20-3
	Spruce-Pine-Fir SS	10-4	16-4	21-6	Note a
	Spruce-Pine-Fir #1	10-2	15-11	21-0	25-8
	Spruce-Pine-Fir #2	10-2	15-11	21-0	25-8
	Spruce-Pine-Fir #3	8-7	12-6	15-10	19-5
24	Douglas Fir-Larch SS	10-5	16-4	21-7	Note a
	Douglas Fir-Larch #1	10-0	15-9	20-1	24-6
	Douglas Fir-Larch #2	9-10	14-10	18-9	22-11
	Douglas Fir-Larch #3	7-8	11-2	14-2	17-4
	Hem-Fir SS	9-10	15-6	20-5	Note a
	Hem-Fir #1	9-8	15-2	19-7	23-11
	Hem-Fir #2	9-2	14-5	18-6	22-7
	Hem-Fir #3	7-8	11-2	14-2	17-4
	Southern Pine SS	10-3	16-1	21-2	Note a
	Southern Pine #1	10-0	15-9	20-10	Note a
	Southern Pine #2	9-10	15-6	20-1	23-11
	Southern Pine #3	8-2	12-0	15-4	18-1
	Spruce-Pine-Fir SS	9-8	15-2	19-11	25-5
	Spruce-Pine-Fir #1	9-5	14-9	18-9	22-11
	Spruce-Pine-Fir #2	9-5	14-9	18-9	22-11
	Spruce-Pine-Fir #3	7-8	11-2	14-2	17-4

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 47.8 N/m².
 a. Span exceeds 26 feet in length. Check sources for availability of lumber in lengths greater than 20 feet.

TABLE 2308.10.2(2)
CEILING JOIST SPANS FOR COMMON LUMBER SPECIES
 (Uninhabitable Attics With Limited Storage, Live Load = 20 pounds per square foot, $L/\Delta = 240$)

CEILING JOIST SPACING (inches)	SPECIES AND GRADE	DEAD LOAD = 10 pounds per square foot			
		2 x 4	2 x 6	2 x 8	2 x 10
		Maximum ceiling joist spans			
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
12	Douglas Fir-Larch SS	10-5	16-4	21-7	Note a
	Douglas Fir-Larch #1	10-0	15-9	20-1	24-6
	Douglas Fir-Larch #2	9-10	14-10	18-9	22-11
	Douglas Fir-Larch #3	7-8	11-2	14-2	17-4
	Hem-Fir SS	9-10	15-6	20-5	Note a
	Hem-Fir #1	9-8	15-2	19-7	23-11
	Hem-Fir #2	9-2	14-5	18-6	22-7
	Hem-Fir #3	7-8	11-2	14-2	17-4
	Southern Pine SS	10-3	16-1	21-2	Note a
	Southern Pine #1	10-0	15-9	20-10	Note a
	Southern Pine #2	9-10	15-6	20-1	23-11
	Southern Pine #3	8-2	12-0	15-4	18-1
	Spruce-Pine-Fir SS	9-8	15-2	19-11	25-5
	Spruce-Pine-Fir #1	9-5	14-9	18-9	22-11
	Spruce-Pine-Fir #2	9-5	14-9	18-9	22-11
	Spruce-Pine-Fir #3	7-8	11-2	14-2	17-4
16	Douglas Fir-Larch SS	9-6	14-11	19-7	25-0
	Douglas Fir-Larch #1	9-1	13-9	17-5	21-3
	Douglas Fir-Larch #2	8-9	12-10	16-3	19-10
	Douglas Fir-Larch #3	6-8	9-8	12-4	15-0
	Hem-Fir SS	8-11	14-1	18-6	23-8
	Hem-Fir #1	8-9	13-5	16-10	20-8
	Hem-Fir #2	8-4	12-8	16-0	19-7
	Hem-Fir #3	6-8	9-8	12-4	15-0
	Southern Pine SS	9-4	14-7	19-3	24-7
	Southern Pine #1	9-1	14-4	18-11	23-1
	Southern Pine #2	8-11	13-6	17-5	20-9
	Southern Pine #3	7-1	10-5	13-3	15-8
	Spruce-Pine-Fir SS	8-9	13-9	18-1	23-1
	Spruce-Pine-Fir #1	8-7	12-10	16-3	19-10
	Spruce-Pine-Fir #2	8-7	12-10	16-3	19-10
	Spruce-Pine-Fir #3	6-8	9-8	12-4	15-0

(continued)

TABLE 2308.10.2(2)—continued
 CEILING JOIST SPANS FOR COMMON LUMBER SPECIES
 (Uninhabitable Attics With Limited Storage, Live Load = 20 pounds per square foot, $L/\Delta = 240$)

CEILING JOIST SPACING (inches)	SPECIES AND GRADE	DEAD LOAD = 10 pounds per square foot			
		2 x 4	2 x 6	2 x 8	2 x 10
		Maximum ceiling joist spans			
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
19.2	Douglas Fir-Larch SS	8-11	14-0	18-5	23-4
	Douglas Fir-Larch #1	8-7	12-6	15-10	19-5
	Douglas Fir-Larch #2	8-0	11-9	14-10	18-2
	Douglas Fir-Larch #3	6-1	8-10	11-3	13-8
	Hem-Fir SS	8-5	13-3	17-5	22-3
	Hem-Fir #1	8-3	12-3	15-6	18-11
	Hem-Fir #2	7-10	11-7	14-8	17-10
	Hem-Fir #3	6-1	8-10	11-3	13-8
	Southern Pine SS	8-9	13-9	18-1	23-1
	Southern Pine #1	8-7	13-6	17-9	21-1
	Southern Pine #2	8-5	12-3	15-10	18-11
	Southern Pine #3	6-5	9-6	12-1	14-4
	Spruce-Pine-Fir SS	8-3	12-11	17-1	21-8
	Spruce-Pine-Fir #1	8-0	11-9	14-10	18-2
	Spruce-Pine-Fir #2	8-0	11-9	14-10	18-2
	Spruce-Pine-Fir #3	6-1	8-10	11-3	13-8
24	Douglas Fir-Larch SS	8-3	13-0	17-1	20-11
	Douglas Fir-Larch #1	7-8	11-2	14-2	17-4
	Douglas Fir-Larch #2	7-2	10-6	13-3	16-3
	Douglas Fir-Larch #3	5-5	7-11	10-0	12-3
	Hem-Fir SS	7-10	12-3	16-2	20-6
	Hem-Fir #1	7-6	10-11	13-10	16-11
	Hem-Fir #2	7-1	10-4	13-1	16-0
	Hem-Fir #3	5-5	7-11	10-0	12-3
	Southern Pine SS	8-1	12-9	16-10	21-6
	Southern Pine #1	8-0	12-6	15-10	18-10
	Southern Pine #2	7-8	11-0	14-2	16-11
	Southern Pine #3	5-9	8-6	10-10	12-10
	Spruce-Pine-Fir SS	7-8	12-0	15-10	19-5
	Spruce-Pine-Fir #1	7-2	10-6	13-3	16-3
	Spruce-Pine-Fir #2	7-2	10-6	13-3	16-3
	Spruce-Pine-Fir #3	5-5	7-11	10-0	12-3

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 47.8 N/m².
 a. Span exceeds 26 feet in length. Check sources for availability of lumber in lengths greater than 20 feet.

TABLE 2308.10.3(1)
RAFTER SPANS FOR COMMON LUMBER SPECIES
 (Roof Live Load = 20 pounds per square foot, Ceiling Not Attached to Rafters, $L/\Delta = 180$)

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 pounds per square foot					DEAD LOAD = 20 pounds per square foot				
			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum rafter spans									
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	
12	Douglas Fir-Larch	SS	11-6	18-0	23-9	Note a	Note a	11-6	18-0	23-5	Note a	Note a
	Douglas Fir-Larch	#1	11-1	17-4	22-5	Note a	Note a	10-6	15-4	19-5	23-9	Note a
	Douglas Fir-Larch	#2	10-10	16-7	21-0	25-8	Note a	9-10	14-4	18-2	22-3	25-9
	Douglas Fir-Larch	#3	8-7	12-6	15-10	19-5	22-6	7-5	10-10	13-9	16-9	19-6
	Hem-Fir	SS	10-10	17-0	22-5	Note a	Note a	10-10	17-0	22-5	Note a	Note a
	Hem-Fir	#1	10-7	16-8	21-10	Note a	Note a	10-3	14-11	18-11	23-2	Note a
	Hem-Fir	#2	10-1	15-11	20-8	25-3	Note a	9-8	14-2	17-11	21-11	25-5
	Hem-Fir	#3	8-7	12-6	15-10	19-5	22-6	7-5	10-10	13-9	16-9	19-6
	Southern Pine	SS	11-3	17-8	23-4	Note a	Note a	11-3	17-8	23-4	Note a	Note a
	Southern Pine	#1	11-1	17-4	22-11	Note a	Note a	11-1	17-3	21-9	25-10	Note a
	Southern Pine	#2	10-10	17-0	22-5	Note a	Note a	10-6	15-1	19-5	23-2	Note a
	Southern Pine	#3	9-1	13-6	17-2	20-3	24-1	7-11	11-8	14-10	17-6	20-11
	Spruce-Pine-Fir	SS	10-7	16-8	21-11	Note a	Note a	10-7	16-8	21-9	Note a	Note a
	Spruce-Pine-Fir	#1	10-4	16-3	21-0	25-8	Note a	9-10	14-4	18-2	22-3	25-9
	Spruce-Pine-Fir	#2	10-4	16-3	21-0	25-8	Note a	9-10	14-4	18-2	22-3	25-9
	Spruce-Pine-Fir	#3	8-7	12-6	15-10	19-5	22-6	7-5	10-10	13-9	16-9	19-6
16	Douglas Fir-Larch	SS	10-5	16-4	21-7	Note a	Note a	10-5	16-0	20-3	24-9	Note a
	Douglas Fir-Larch	#1	10-0	15-4	19-5	23-9	Note a	9-1	13-3	16-10	20-7	23-10
	Douglas Fir-Larch	#2	9-10	14-4	18-2	22-3	25-9	8-6	12-5	15-9	19-3	22-4
	Douglas Fir-Larch	#3	7-5	10-10	13-9	16-9	19-6	6-5	9-5	11-11	14-6	16-10
	Hem-Fir	SS	9-10	15-6	20-5	Note a	Note a	9-10	15-6	19-11	24-4	Note a
	Hem-Fir	#1	9-8	14-11	18-11	23-2	Note a	8-10	12-11	16-5	20-0	23-3
	Hem-Fir	#2	9-2	14-2	17-11	21-11	25-5	8-5	12-3	15-6	18-11	22-0
	Hem-Fir	#3	7-5	10-10	13-9	16-9	19-6	6-5	9-5	11-11	14-6	16-10
	Southern Pine	SS	10-3	16-1	21-2	Note a	Note a	10-3	16-1	21-2	Note a	Note a
	Southern Pine	#1	10-0	15-9	20-10	25-10	Note a	10-0	15-0	18-10	22-4	Note a
	Southern Pine	#2	9-10	15-1	19-5	23-2	Note a	9-1	13-0	16-10	20-1	23-7
	Southern Pine	#3	7-11	11-8	14-10	17-6	20-11	6-10	10-1	12-10	15-2	18-1
	Spruce-Pine-Fir	SS	9-8	15-2	19-11	25-5	Note a	9-8	14-10	18-10	23-0	Note a
	Spruce-Pine-Fir	#1	9-5	14-4	18-2	22-3	25-9	8-6	12-5	15-9	19-3	22-4
	Spruce-Pine-Fir	#2	9-5	14-4	18-2	22-3	25-9	8-6	12-5	15-9	19-3	22-4
	Spruce-Pine-Fir	#3	7-5	10-10	13-9	16-9	19-6	6-5	9-5	11-11	14-6	16-10

(continued)

TABLE 2308.10.3(1)—continued
RAFTER SPANS FOR COMMON LUMBER SPECIES
 (Roof Live Load = 20 pounds per square foot, Ceiling Not Attached to Rafters, $L/\Delta = 180$)

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 pounds per square foot					DEAD LOAD = 20 pounds per square foot				
			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum rafter spans									
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	
19.2	Douglas Fir-Larch	SS	9-10	15-5	20-4	25-11	Note a	9-10	14-7	18-6	22-7	Note a
	Douglas Fir-Larch	#1	9-5	14-0	17-9	21-8	25-2	8-4	12-2	15-4	18-9	21-9
	Douglas Fir-Larch	#2	8-11	13-1	16-7	20-3	23-6	7-9	11-4	14-4	17-7	20-4
	Douglas Fir-Larch	#3	6-9	9-11	12-7	15-4	17-9	5-10	8-7	10-10	13-3	15-5
	Hem-Fir	SS	9-3	14-7	19-2	24-6	Note a	9-3	14-4	18-2	22-3	25-9
	Hem-Fir	#1	9-1	13-8	17-4	21-1	24-6	8-1	11-10	15-0	18-4	21-3
	Hem-Fir	#2	8-8	12-11	16-4	20-0	23-2	7-8	11-2	14-2	17-4	20-1
	Hem-Fir	#3	6-9	9-11	12-7	15-4	17-9	5-10	8-7	10-10	13-3	15-5
	Southern Pine	SS	9-8	15-2	19-11	25-5	Note a	9-8	15-2	19-11	25-5	Note a
	Southern Pine	#1	9-5	14-10	19-7	23-7	Note a	9-3	13-8	17-2	20-5	24-4
	Southern Pine	#2	9-3	13-9	17-9	21-2	24-10	8-4	11-11	15-4	18-4	21-6
	Southern Pine	#3	7-3	10-8	13-7	16-0	19-1	6-3	9-3	11-9	13-10	16-6
	Spruce-Pine-Fir	SS	9-1	14-3	18-9	23-11	Note a	9-1	13-7	17-2	21-0	24-4
	Spruce-Pine-Fir	#1	8-10	13-1	16-7	20-3	23-6	7-9	11-4	14-4	17-7	20-4
Spruce-Pine-Fir	#2	8-10	13-1	16-7	20-3	23-6	7-9	11-4	14-4	17-7	20-4	
Spruce-Pine-Fir	#3	6-9	9-11	12-7	15-4	17-9	5-10	8-7	10-10	13-3	15-5	
24	Douglas Fir-Larch	SS	9-1	14-4	18-10	23-4	23-4	8-11	13-1	16-7	20-3	23-5
	Douglas Fir-Larch	#1	8-7	12-6	15-10	19-5	19-5	7-5	10-10	13-9	16-9	19-6
	Douglas Fir-Larch	#2	8-0	11-9	14-10	18-2	18-2	6-11	10-2	12-10	15-8	18-3
	Douglas Fir-Larch	#3	6-1	8-10	11-3	13-8	13-8	5-3	7-8	9-9	11-10	13-9
	Hem-Fir	SS	8-7	13-6	17-10	22-9	22-9	8-7	12-10	16-3	19-10	23-0
	Hem-Fir	#1	8-4	12-3	15-6	18-11	18-11	7-3	10-7	13-5	16-4	19-0
	Hem-Fir	#2	7-11	11-7	14-8	17-10	17-10	6-10	10-0	12-8	15-6	17-11
	Hem-Fir	#3	6-1	8-10	11-3	13-8	13-8	5-3	7-8	9-9	11-10	13-9
	Southern Pine	SS	8-11	14-1	18-6	23-8	23-8	8-11	14-1	18-6	22-11	Note a
	Southern Pine	#1	8-9	13-9	17-9	21-1	21-1	8-3	12-3	15-4	18-3	21-9
	Southern Pine	#2	8-7	12-3	15-10	18-11	18-11	7-5	10-8	13-9	16-5	19-3
	Southern Pine	#3	6-5	9-6	12-1	14-4	14-4	5-7	8-3	10-6	12-5	14-9
	Spruce-Pine-Fir	SS	8-5	13-3	17-5	21-8	21-8	8-4	12-2	15-4	18-9	21-9
	Spruce-Pine-Fir	#1	8-0	11-9	14-10	18-2	18-2	6-11	10-2	12-10	15-8	18-3
Spruce-Pine-Fir	#2	8-0	11-9	14-10	18-2	18-2	6-11	10-2	12-10	15-8	18-3	
Spruce-Pine-Fir	#3	6-1	8-10	11-3	13-8	13-8	5-3	7-8	9-9	11-10	13-9	

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 47.9 N/m².
 a. Span exceeds 26 feet in length. Check sources for availability of lumber in lengths greater than 20 feet.

TABLE 2308.10.3(2)
RAFTER SPANS FOR COMMON LUMBER SPECIES
 (Roof Live Load = 20 pounds per square foot, Ceiling Not Attached to Rafters, L/Δ = 240)

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 pounds per square foot					DEAD LOAD = 20 pounds per square foot				
			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum rafter spans									
			(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
12	Douglas Fir-Larch	SS	10-5	16-4	21-7	Note a	Note a	10-5	16-4	21-7	Note a	Note a
	Douglas Fir-Larch	#1	10-0	15-9	20-10	Note a	Note a	10-0	15-4	19-5	23-9	Note a
	Douglas Fir-Larch	#2	9-10	15-6	20-5	25-8	Note a	9-10	14-4	18-2	22-3	25-9
	Douglas Fir-Larch	#3	8-7	12-6	15-10	19-5	22-6	7-5	10-10	13-9	16-9	19-6
	Hem-Fir	SS	9-10	15-6	20-5	Note a	Note a	9-10	15-6	20-5	Note a	Note a
	Hem-Fir	#1	9-8	15-2	19-11	25-5	Note a	9-8	14-11	18-11	23-2	Note a
	Hem-Fir	#2	9-2	14-5	19-0	24-3	Note a	9-2	14-2	17-11	21-11	25-5
	Hem-Fir	#3	8-7	12-6	15-10	19-5	22-6	7-5	10-10	13-9	16-9	19-6
	Southern Pine	SS	10-3	16-1	21-2	Note a	Note a	10-3	16-1	21-2	Note a	Note a
	Southern Pine	#1	10-0	15-9	20-10	Note a	Note a	10-0	15-9	20-10	25-10	Note a
	Southern Pine	#2	9-10	15-6	20-5	Note a	Note a	9-10	15-1	19-5	23-2	Note a
	Southern Pine	#3	9-1	13-6	17-2	20-3	24-1	7-11	11-8	14-10	17-6	20-11
	Spruce-Pine-Fir	SS	9-8	15-2	19-11	25-5	Note a	9-8	15-2	19-11	25-5	Note a
	Spruce-Pine-Fir	#1	9-5	14-9	19-6	24-10	Note a	9-5	14-4	18-2	22-3	25-9
	Spruce-Pine-Fir	#2	9-5	14-9	19-6	24-10	Note a	9-5	14-4	18-2	22-3	25-9
	Spruce-Pine-Fir	#3	8-7	12-6	15-10	19-5	22-6	7-5	10-10	13-9	16-9	19-6
16	Douglas Fir-Larch	SS	9-6	14-11	19-7	25-0	Note a	9-6	14-11	19-7	24-9	Note a
	Douglas Fir-Larch	#1	9-1	14-4	18-11	23-9	Note a	9-1	13-3	16-10	20-7	23-10
	Douglas Fir-Larch	#2	8-11	14-1	18-2	22-3	25-9	8-6	12-5	15-9	19-3	22-4
	Douglas Fir-Larch	#3	7-5	10-10	13-9	16-9	19-6	6-5	9-5	11-11	14-6	16-10
	Hem-Fir	SS	8-11	14-1	18-6	23-8	Note a	8-11	14-1	18-6	23-8	Note a
	Hem-Fir	#1	8-9	13-9	18-1	23-1	Note a	8-9	12-11	16-5	20-0	23-3
	Hem-Fir	#2	8-4	13-1	17-3	21-11	25-5	8-4	12-3	15-6	18-11	22-0
	Hem-Fir	#3	7-5	10-10	13-9	16-9	19-6	6-5	9-5	11-11	14-6	16-10
	Southern Pine	SS	9-4	14-7	19-3	24-7	Note a	9-4	14-7	19-3	24-7	Note a
	Southern Pine	#1	9-1	14-4	18-11	24-1	Note a	9-1	14-4	18-10	22-4	Note a
	Southern Pine	#2	8-11	14-1	18-6	23-2	Note a	8-11	13-0	16-10	20-1	23-7
	Southern Pine	#3	7-11	11-8	14-10	17-6	20-11	6-10	10-1	12-10	15-2	18-1
	Spruce-Pine-Fir	SS	8-9	13-9	18-1	23-1	Note a	8-9	13-9	18-1	23-0	Note a
	Spruce-Pine-Fir	#1	8-7	13-5	17-9	22-3	25-9	8-6	12-5	15-9	19-3	22-4
	Spruce-Pine-Fir	#2	8-7	13-5	17-9	22-3	25-9	8-6	12-5	15-9	19-3	22-4
	Spruce-Pine-Fir	#3	7-5	10-10	13-9	16-9	19-6	6-5	9-5	11-11	14-6	16-10

(continued)

TABLE 2308.10.3(2)—continued
RAFTER SPANS FOR COMMON LUMBER SPECIES
 (Roof Live Load = 20 pounds per square foot, Ceiling Not Attached to Rafters, $L/\Delta = 240$)

RAFTER SPACING (inches)	SPECIES AND GRADE	DEAD LOAD = 10 pounds per square foot					DEAD LOAD = 20 pounds per square foot				
		2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
		Maximum rafter spans									
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
19.2	Douglas Fir-Larch SS	8-11	14-0	18-5	23-7	Note a	8-11	14-0	18-5	22-7	Note a
	Douglas Fir-Larch #1	8-7	13-6	17-9	21-8	25-2	8-4	12-2	15-4	18-9	21-9
	Douglas Fir-Larch #2	8-5	13-1	16-7	20-3	23-6	7-9	11-4	14-4	17-7	20-4
	Douglas Fir-Larch #3	6-9	9-11	12-7	15-4	17-9	5-10	8-7	10-10	13-3	15-5
	Hem-Fir SS	8-5	13-3	17-5	22-3	Note a	8-5	13-3	17-5	22-3	25-9
	Hem-Fir #1	8-3	12-11	17-1	21-1	24-6	8-1	11-10	15-0	18-4	21-3
	Hem-Fir #2	7-10	12-4	16-3	20-0	23-2	7-8	11-2	14-2	17-4	20-1
	Hem-Fir #3	6-9	9-11	12-7	15-4	17-9	5-10	8-7	10-10	13-3	15-5
	Southern Pine SS	8-9	13-9	18-1	23-1	Note a	8-9	13-9	18-1	23-1	Note a
	Southern Pine #1	8-7	13-6	17-9	22-8	Note a	8-7	13-6	17-2	20-5	24-4
	Southern Pine #2	8-5	13-3	17-5	21-2	24-10	8-4	11-11	15-4	18-4	21-6
	Southern Pine #3	7-3	10-8	13-7	16-0	19-1	6-3	9-3	11-9	13-10	16-6
	Spruce-Pine-Fir SS	8-3	12-11	17-1	21-9	Note a	8-3	12-11	17-1	21-0	24-4
	Spruce-Pine-Fir #1	8-1	12-8	16-7	20-3	23-6	7-9	11-4	14-4	17-7	20-4
Spruce-Pine-Fir #2	8-1	12-8	16-7	20-3	23-6	7-9	11-4	14-4	17-7	20-4	
Spruce-Pine-Fir #3	6-9	9-11	12-7	15-4	17-9	5-10	8-7	10-10	13-3	15-5	
24	Douglas Fir-Larch SS	8-3	13-0	17-2	21-10	Note a	8-3	13-0	16-7	20-3	23-5
	Douglas Fir-Larch #1	8-0	12-6	15-10	19-5	22-6	7-5	10-10	13-9	16-9	19-6
	Douglas Fir-Larch #2	7-10	11-9	14-10	18-2	21-0	6-11	10-2	12-10	15-8	18-3
	Douglas Fir-Larch #3	6-1	8-10	11-3	13-8	15-11	5-3	7-8	9-9	11-10	13-9
	Hem-Fir SS	7-10	12-3	16-2	20-8	25-1	7-10	12-3	16-2	19-10	23-0
	Hem-Fir #1	7-8	12-0	15-6	18-11	21-11	7-3	10-7	13-5	16-4	19-0
	Hem-Fir #2	7-3	11-5	14-8	17-10	20-9	6-10	10-0	12-8	15-6	17-11
	Hem-Fir #3	6-1	8-10	11-3	13-8	15-11	5-3	7-8	9-9	11-10	13-9
	Southern Pine SS	8-1	12-9	16-10	21-6	Note a	8-1	12-9	16-10	21-6	Note a
	Southern Pine #1	8-0	12-6	16-6	21-1	25-2	8-0	12-3	15-4	18-3	21-9
	Southern Pine #2	7-10	12-3	15-10	18-11	22-2	7-5	10-8	13-9	16-5	19-3
	Southern Pine #3	6-5	9-6	12-1	14-4	17-1	5-7	8-3	10-6	12-5	14-9
	Spruce-Pine-Fir SS	7-8	12-0	15-10	20-2	24-7	7-8	12-0	15-4	18-9	21-9
	Spruce-Pine-Fir #1	7-6	11-9	14-10	18-2	21-0	6-11	10-2	12-10	15-8	18-3
Spruce-Pine-Fir #2	7-6	11-9	14-10	18-2	21-0	6-11	10-2	12-10	15-8	18-3	
Spruce-Pine-Fir #3	6-1	8-10	11-3	13-8	15-11	5-3	7-8	9-9	11-10	13-9	

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 47.9 N/m².
 a. Span exceeds 26 feet in length. Check sources for availability of lumber in lengths greater than 20 feet.

TABLE 2308.10.3(3)
RAFTER SPANS FOR COMMON LUMBER SPECIES
 (Ground Snow Load = 30 pounds per square foot, Ceiling Not Attached to Rafters, L/Δ = 180)

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 pounds per square foot					DEAD LOAD = 20 pounds per square foot				
			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum rafter spans									
			(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
12	Douglas Fir-Larch	SS	10-0	15-9	20-9	Note a	Note a	10-0	15-9	20-1	24-6	Note a
	Douglas Fir-Larch	#1	9-8	14-9	18-8	22-9	Note a	9-0	13-2	16-8	20-4	23-7
	Douglas Fir-Larch	#2	9-5	13-9	17-5	21-4	24-8	8-5	12-4	15-7	19-1	22-1
	Douglas Fir-Larch	#3	7-1	10-5	13-2	16-1	18-8	6-4	9-4	11-9	14-5	16-8
	Hem-Fir	SS	9-6	14-10	19-7	25-0	Note a	9-6	14-10	19-7	24-1	Note a
	Hem-Fir	#1	9-3	14-4	18-2	22-2	25-9	8-9	12-10	16-3	19-10	23-0
	Hem-Fir	#2	8-10	13-7	17-2	21-0	24-4	8-4	12-2	15-4	18-9	21-9
	Hem-Fir	#3	7-1	10-5	13-2	16-1	18-8	6-4	9-4	11-9	14-5	16-8
	Southern Pine	SS	9-10	15-6	20-5	Note a	Note a	9-10	15-6	20-5	Note a	Note a
	Southern Pine	#1	9-8	15-2	20-0	24-9	Note a	9-8	14-10	18-8	22-2	Note a
	Southern Pine	#2	9-6	14-5	18-8	22-3	Note a	9-0	12-11	16-8	19-11	23-4
	Southern Pine	#3	7-7	11-2	14-3	16-10	20-0	6-9	10-0	12-9	15-1	17-11
	Spruce-Pine-Fir	SS	9-3	14-7	19-2	24-6	Note a	9-3	14-7	18-8	22-9	Note a
	Spruce-Pine-Fir	#1	9-1	13-9	17-5	21-4	24-8	8-5	12-4	15-7	19-1	22-1
	Spruce-Pine-Fir	#2	9-1	13-9	17-5	21-4	24-8	8-5	12-4	15-7	19-1	22-1
	Spruce-Pine-Fir	#3	7-1	10-5	13-2	16-1	18-8	6-4	9-4	11-9	14-5	16-8
16	Douglas Fir-Larch	SS	9-1	14-4	18-10	23-9	Note a	9-1	13-9	17-5	21-3	24-8
	Douglas Fir-Larch	#1	8-9	12-9	16-2	19-9	22-10	7-10	11-5	14-5	17-8	20-5
	Douglas Fir-Larch	#2	8-2	11-11	15-1	18-5	21-5	7-3	10-8	13-6	16-6	19-2
	Douglas Fir-Larch	#3	6-2	9-0	11-5	13-11	16-2	5-6	8-1	10-3	12-6	14-6
	Hem-Fir	SS	8-7	13-6	17-10	22-9	Note a	8-7	13-6	17-1	20-10	24-2
	Hem-Fir	#1	8-5	12-5	15-9	19-3	22-3	7-7	11-1	14-1	17-2	19-11
	Hem-Fir	#2	8-0	11-9	14-11	18-2	21-1	7-2	10-6	13-4	16-3	18-10
	Hem-Fir	#3	6-2	9-0	11-5	13-11	16-2	5-6	8-1	10-3	12-6	14-6
	Southern Pine	SS	8-11	14-1	18-6	23-8	Note a	8-11	14-1	18-6	23-8	Note a
	Southern Pine	#1	8-9	13-9	18-1	21-5	25-7	8-8	12-10	16-2	19-2	22-10
	Southern Pine	#2	8-7	12-6	16-2	19-3	22-7	7-10	11-2	14-5	17-3	20-2
	Southern Pine	#3	6-7	9-8	12-4	14-7	17-4	5-10	8-8	11-0	13-0	15-6
	Spruce-Pine-Fir	SS	8-5	13-3	17-5	22-1	25-7	8-5	12-9	16-2	19-9	22-10
	Spruce-Pine-Fir	#1	8-2	11-11	15-1	18-5	21-5	7-3	10-8	13-6	16-6	19-2
	Spruce-Pine-Fir	#2	8-2	11-11	15-1	18-5	21-5	7-3	10-8	13-6	16-6	19-2
	Spruce-Pine-Fir	#3	6-2	9-0	11-5	13-11	16-2	5-6	8-1	10-3	12-6	14-6

(continued)

TABLE 2308.10.3(3)—continued
RAFTER SPANS FOR COMMON LUMBER SPECIES
 (Ground Snow Load = 30 pounds per square foot, Ceiling Not Attached to Rafters, $L/\Delta = 180$)

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 pounds per square foot					DEAD LOAD = 20 pounds per square foot				
			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum rafter spans									
			(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
19.2	Douglas Fir-Larch	SS	8-7	13-6	17-9	21-8	25-2	8-7	12-6	15-10	19-5	22-6
	Douglas Fir-Larch	#1	7-11	11-8	14-9	18-0	20-11	7-1	10-5	13-2	16-1	18-8
	Douglas Fir-Larch	#2	7-5	10-11	13-9	16-10	19-6	6-8	9-9	12-4	15-1	17-6
	Douglas Fir-Larch	#3	5-7	8-3	10-5	12-9	14-9	5-0	7-4	9-4	11-5	13-2
	Hem-Fir	SS	8-1	12-9	16-9	21-4	24-8	8-1	12-4	15-7	19-1	22-1
	Hem-Fir	#1	7-9	11-4	14-4	17-7	20-4	6-11	10-2	12-10	15-8	18-2
	Hem-Fir	#2	7-4	10-9	13-7	16-7	19-3	6-7	9-7	12-2	14-10	17-3
	Hem-Fir	#3	5-7	8-3	10-5	12-9	14-9	5-0	7-4	9-4	11-5	13-2
	Southern Pine	SS	8-5	13-3	17-5	22-3	Note a	8-5	13-3	17-5	22-0	25-9
	Southern Pine	#1	8-3	13-0	16-6	19-7	23-4	7-11	11-9	14-9	17-6	20-11
	Southern Pine	#2	7-11	11-5	14-9	17-7	20-7	7-1	10-2	13-2	15-9	18-5
	Southern Pine	#3	6-0	8-10	11-3	13-4	15-10	5-4	7-11	10-1	11-11	14-2
	Spruce-Pine-Fir	SS	7-11	12-5	16-5	20-2	23-4	7-11	11-8	14-9	18-0	20-11
	Spruce-Pine-Fir	#1	7-5	10-11	13-9	16-10	19-6	6-8	9-9	12-4	15-1	17-6
	Spruce-Pine-Fir	#2	7-5	10-11	13-9	16-10	19-6	6-8	9-9	12-4	15-1	17-6
Spruce-Pine-Fir	#3	5-7	8-3	10-5	12-9	14-9	5-0	7-4	9-4	11-5	13-2	
24	Douglas Fir-Larch	SS	7-11	12-6	15-10	19-5	22-6	7-8	11-3	14-2	17-4	20-1
	Douglas Fir-Larch	#1	7-1	10-5	13-2	16-1	18-8	6-4	9-4	11-9	14-5	16-8
	Douglas Fir-Larch	#2	6-8	9-9	12-4	15-1	17-6	5-11	8-8	11-0	13-6	15-7
	Douglas Fir-Larch	#3	5-0	7-4	9-4	11-5	13-2	4-6	6-7	8-4	10-2	11-10
	Hem-Fir	SS	7-6	11-10	15-7	19-1	22-1	7-6	11-0	13-11	17-0	19-9
	Hem-Fir	#1	6-11	10-2	12-10	15-8	18-2	6-2	9-1	11-6	14-0	16-3
	Hem-Fir	#2	6-7	9-7	12-2	14-10	17-3	5-10	8-7	10-10	13-3	15-5
	Hem-Fir	#3	5-0	7-4	9-4	11-5	13-2	4-6	6-7	8-4	10-2	11-10
	Southern Pine	SS	7-10	12-3	16-2	20-8	25-1	7-10	12-3	16-2	19-8	23-0
	Southern Pine	#1	7-8	11-9	14-9	17-6	20-11	7-1	10-6	13-2	15-8	18-8
	Southern Pine	#2	7-1	10-2	13-2	15-9	18-5	6-4	9-2	11-9	14-1	16-6
	Southern Pine	#3	5-4	7-11	10-1	11-11	14-2	4-9	7-1	9-0	10-8	12-8
	Spruce-Pine-Fir	SS	7-4	11-7	14-9	18-0	20-11	7-1	10-5	13-2	16-1	18-8
	Spruce-Pine-Fir	#1	6-8	9-9	12-4	15-1	17-6	5-11	8-8	11-0	13-6	15-7
	Spruce-Pine-Fir	#2	6-8	9-9	12-4	15-1	17-6	5-11	8-8	11-0	13-6	15-7
Spruce-Pine-Fir	#3	5-0	7-4	9-4	11-5	13-2	4-6	6-7	8-4	10-2	11-10	

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 47.9 N/m².
 a. Span exceeds 26 feet in length. Check sources for availability of lumber in lengths greater than 20 feet.

TABLE 2308.10.3(4)
RAFTER SPANS FOR COMMON LUMBER SPECIES
 (Ground Snow Load = 50 pounds per square foot, Ceiling Not Attached to Rafters, $L/\Delta = 180$)

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 pounds per square foot					DEAD LOAD = 20 pounds per square foot				
			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum rafter spans									
			(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
12	Douglas Fir-Larch	SS	8-5	13-3	17-6	22-4	26-0	8-5	13-3	17-0	20-9	24-10
	Douglas Fir-Larch	#1	8-2	12-0	15-3	18-7	21-7	7-7	11-2	14-1	17-3	20-0
	Douglas Fir-Larch	#2	7-8	11-3	14-3	17-5	20-2	7-1	10-5	13-2	16-1	18-8
	Douglas Fir-Larch	#3	5-10	8-6	10-9	13-2	15-3	5-5	7-10	10-0	12-2	14-1
	Hem-Fir	SS	8-0	12-6	16-6	21-1	25-6	8-0	12-6	16-6	20-4	23-7
	Hem-Fir	#1	7-10	11-9	14-10	18-1	21-0	7-5	10-10	13-9	16-9	19-5
	Hem-Fir	#2	7-5	11-1	14-0	17-2	19-11	7-0	10-3	13-0	15-10	18-5
	Hem-Fir	#3	5-10	8-6	10-9	13-2	15-3	5-5	7-10	10-0	12-2	14-1
	Southern Pine	SS	8-4	13-0	17-2	21-11	Note a	8-4	13-0	17-2	21-11	Note a
	Southern Pine	#1	8-2	12-10	16-10	20-3	24-1	8-2	12-6	15-9	18-9	22-4
	Southern Pine	#2	8-0	11-9	15-3	18-2	21-3	7-7	10-11	14-1	16-10	19-9
	Southern Pine	#3	6-2	9-2	11-8	13-9	16-4	5-9	8-5	10-9	12-9	15-2
	Spruce-Pine-Fir	SS	7-10	12-3	16-2	20-8	24-1	7-10	12-3	15-9	19-3	22-4
	Spruce-Pine-Fir	#1	7-8	11-3	14-3	17-5	20-2	7-1	10-5	13-2	16-1	18-8
	Spruce-Pine-Fir	#2	7-8	11-3	14-3	17-5	20-2	7-1	10-5	13-2	16-1	18-8
	Spruce-Pine-Fir	#3	5-10	8-6	10-9	13-2	15-3	5-5	7-10	10-0	12-2	14-1
16	Douglas Fir-Larch	SS	7-8	12-1	15-10	19-5	22-6	7-8	11-7	14-8	17-11	20-10
	Douglas Fir-Larch	#1	7-1	10-5	13-2	16-1	18-8	6-7	9-8	12-2	14-11	17-3
	Douglas Fir-Larch	#2	6-8	9-9	12-4	15-1	17-6	6-2	9-0	11-5	13-11	16-2
	Douglas Fir-Larch	#3	5-0	7-4	9-4	11-5	13-2	4-8	6-10	8-8	10-6	12-3
	Hem-Fir	SS	7-3	11-5	15-0	19-1	22-1	7-3	11-5	14-5	17-8	20-5
	Hem-Fir	#1	6-11	10-2	12-10	15-8	18-2	6-5	9-5	11-11	14-6	16-10
	Hem-Fir	#2	6-7	9-7	12-2	14-10	17-3	6-1	8-11	11-3	13-9	15-11
	Hem-Fir	#3	5-0	7-4	9-4	11-5	13-2	4-8	6-10	8-8	10-6	12-3
	Southern Pine	SS	7-6	11-10	15-7	19-11	24-3	7-6	11-10	15-7	19-11	23-10
	Southern Pine	#1	7-5	11-7	14-9	17-6	20-11	7-4	10-10	13-8	16-2	19-4
	Southern Pine	#2	7-1	10-2	13-2	15-9	18-5	6-7	9-5	12-2	14-7	17-1
	Southern Pine	#3	5-4	7-11	10-1	11-11	14-2	4-11	7-4	9-4	11-0	13-1
	Spruce-Pine-Fir	SS	7-1	11-2	14-8	18-0	20-11	7-1	10-9	13-8	16-8	19-4
	Spruce-Pine-Fir	#1	6-8	9-9	12-4	15-1	17-6	6-2	9-0	11-5	13-11	16-2
	Spruce-Pine-Fir	#2	6-8	9-9	12-4	15-1	17-6	6-2	9-0	11-5	13-11	16-2
	Spruce-Pine-Fir	#3	5-0	7-4	9-4	11-5	13-2	4-8	6-10	8-8	10-6	12-3

(continued)

TABLE 2308.10.3(4)—continued
RAFTER SPANS FOR COMMON LUMBER SPECIES
 (Ground Snow Load = 50 pounds per square foot, Ceiling Not Attached to Rafters, $L/\Delta = 180$)

RAFTER SPACING (inches)	SPECIES AND GRADE	DEAD LOAD = 10 pounds per square foot					DEAD LOAD = 20 pounds per square foot				
		2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
		Maximum rafter spans									
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
19.2	Douglas Fir-Larch SS	7-3	11-4	14-6	17-8	20-6	7-3	10-7	13-5	16-5	19-0
	Douglas Fir-Larch #1	6-6	9-6	12-0	14-8	17-1	6-0	8-10	11-2	13-7	15-9
	Douglas Fir-Larch #2	6-1	8-11	11-3	13-9	15-11	5-7	8-3	10-5	12-9	14-9
	Douglas Fir-Larch #3	4-7	6-9	8-6	10-5	12-1	4-3	6-3	7-11	9-7	11-2
	Hem-Fir SS	6-10	10-9	14-2	17-5	20-2	6-10	10-5	13-2	16-1	18-8
	Hem-Fir #1	6-4	9-3	11-9	14-4	16-7	5-10	8-7	10-10	13-3	15-5
	Hem-Fir #2	6-0	8-9	11-1	13-7	15-9	5-7	8-1	10-3	12-7	14-7
	Hem-Fir #3	4-7	6-9	8-6	10-5	12-1	4-3	6-3	7-11	9-7	11-2
	Southern Pine SS	7-1	11-2	14-8	18-9	22-10	7-1	11-2	14-8	18-7	21-9
	Southern Pine #1	7-0	10-8	13-5	16-0	19-1	6-8	9-11	12-5	14-10	17-8
	Southern Pine #2	6-6	9-4	12-0	14-4	16-10	6-0	8-8	11-2	13-4	15-7
	Southern Pine #3	4-11	7-3	9-2	10-10	12-11	4-6	6-8	8-6	10-1	12-0
	Spruce-Pine-Fir SS	6-8	10-6	13-5	16-5	19-1	6-8	9-10	12-5	15-3	17-8
	Spruce-Pine-Fir #1	6-1	8-11	11-3	13-9	15-11	5-7	8-3	10-5	12-9	14-9
	Spruce-Pine-Fir #2	6-1	8-11	11-3	13-9	15-11	5-7	8-3	10-5	12-9	14-9
	Spruce-Pine-Fir #3	4-7	6-9	8-6	10-5	12-1	4-3	6-3	7-11	9-7	11-2
24	Douglas Fir-Larch SS	6-8	10-3	13-0	15-10	18-4	6-6	9-6	12-0	14-8	17-0
	Douglas Fir-Larch #1	5-10	8-6	10-9	13-2	15-3	5-5	7-10	10-0	12-2	14-1
	Douglas Fir-Larch #2	5-5	7-11	10-1	12-4	14-3	5-0	7-4	9-4	11-5	13-2
	Douglas Fir-Larch #3	4-1	6-0	7-7	9-4	10-9	3-10	5-7	7-1	8-7	10-0
	Hem-Fir SS	6-4	9-11	12-9	15-7	18-0	6-4	9-4	11-9	14-5	16-8
	Hem-Fir #1	5-8	8-3	10-6	12-10	14-10	5-3	7-8	9-9	11-10	13-9
	Hem-Fir #2	5-4	7-10	9-11	12-1	14-1	4-11	7-3	9-2	11-3	13-0
	Hem-Fir #3	4-1	6-0	7-7	9-4	10-9	3-10	5-7	7-1	8-7	10-0
	Southern Pine SS	6-7	10-4	13-8	17-5	21-0	6-7	10-4	13-8	16-7	19-5
	Southern Pine #1	6-5	9-7	12-0	14-4	17-1	6-0	8-10	11-2	13-3	15-9
	Southern Pine #2	5-10	8-4	10-9	12-10	15-1	5-5	7-9	10-0	11-11	13-11
	Southern Pine #3	4-4	6-5	8-3	9-9	11-7	4-1	6-0	7-7	9-0	10-8
	Spruce-Pine-Fir SS	6-2	9-6	12-0	14-8	17-1	6-0	8-10	11-2	13-7	15-9
	Spruce-Pine-Fir #1	5-5	7-11	10-1	12-4	14-3	5-0	7-4	9-4	11-5	13-2
	Spruce-Pine-Fir #2	5-5	7-11	10-1	12-4	14-3	5-0	7-4	9-4	11-5	13-2
	Spruce-Pine-Fir #3	4-1	6-0	7-7	9-4	10-9	3-10	5-7	7-1	8-7	10-0

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 47.9 N/m².
 a. Span exceeds 26 feet in length. Check sources for availability of lumber in lengths greater than 20 feet.

TABLE 2308.10.3(5)
RAFTER SPANS FOR COMMON LUMBER SPECIES
 (Ground Snow Load = 30 pounds per square foot, Ceiling Attached to Rafters, $L/\Delta = 240$)

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 pounds per square foot					DEAD LOAD = 20 pounds per square foot				
			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum rafter spans									
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	
12	Douglas Fir-Larch	SS	9-1	14-4	18-10	24-1	Note a	9-1	14-4	18-10	24-1	Note a
	Douglas Fir-Larch	#1	8-9	13-9	18-2	22-9	Note a	8-9	13-2	16-8	20-4	23-7
	Douglas Fir-Larch	#2	8-7	13-6	17-5	21-4	24-8	8-5	12-4	15-7	19-1	22-1
	Douglas Fir-Larch	#3	7-1	10-5	13-2	16-1	18-8	6-4	9-4	11-9	14-5	16-8
	Hem-Fir	SS	8-7	13-6	17-10	22-9	Note a	8-7	13-6	17-10	22-9	Note a
	Hem-Fir	#1	8-5	13-3	17-5	22-2	25-9	8-5	12-10	16-3	19-10	23-0
	Hem-Fir	#2	8-0	12-7	16-7	21-0	24-4	8-0	12-2	15-4	18-9	21-9
	Hem-Fir	#3	7-1	10-5	13-2	16-1	18-8	6-4	9-4	11-9	14-5	16-8
	Southern Pine	SS	8-11	14-1	18-6	23-8	Note a	8-11	14-1	18-6	23-8	Note a
	Southern Pine	#1	8-9	13-9	18-2	23-2	Note a	8-9	13-9	18-2	22-2	Note a
	Southern Pine	#2	8-7	13-6	17-10	22-3	Note a	8-7	12-11	16-8	19-11	23-4
	Southern Pine	#3	7-7	11-2	14-3	16-10	20-0	6-9	10-0	12-9	15-1	17-11
	Spruce-Pine-Fir	SS	8-5	13-3	17-5	22-3	Note a	8-5	13-3	17-5	22-3	Note a
	Spruce-Pine-Fir	#1	8-3	12-11	17-0	21-4	24-8	8-3	12-4	15-7	19-1	22-1
	Spruce-Pine-Fir	#2	8-3	12-11	17-0	21-4	24-8	8-3	12-4	15-7	19-1	22-1
	Spruce-Pine-Fir	#3	7-1	10-5	13-2	16-1	18-8	6-4	9-4	11-9	14-5	16-8
16	Douglas Fir-Larch	SS	8-3	13-0	17-2	21-10	Note a	8-3	13-0	17-2	21-3	24-8
	Douglas Fir-Larch	#1	8-0	12-6	16-2	19-9	22-10	7-10	11-5	14-5	17-8	20-5
	Douglas Fir-Larch	#2	7-10	11-11	15-1	18-5	21-5	7-3	10-8	13-6	16-6	19-2
	Douglas Fir-Larch	#3	6-2	9-0	11-5	13-11	16-2	5-6	8-1	10-3	12-6	14-6
	Hem-Fir	SS	7-10	12-3	16-2	20-8	25-1	7-10	12-3	16-2	20-8	24-2
	Hem-Fir	#1	7-8	12-0	15-9	19-3	22-3	7-7	11-1	14-1	17-2	19-11
	Hem-Fir	#2	7-3	11-5	14-11	18-2	21-1	7-2	10-6	13-4	16-3	18-10
	Hem-Fir	#3	6-2	9-0	11-5	13-11	16-2	5-6	8-1	10-3	12-6	14-6
	Southern Pine	SS	8-1	12-9	16-10	21-6	Note a	8-1	12-9	16-10	21-6	Note a
	Southern Pine	#1	8-0	12-6	16-6	21-1	25-7	8-0	12-6	16-2	19-2	22-10
	Southern Pine	#2	7-10	12-3	16-2	19-3	22-7	7-10	11-2	14-5	17-3	20-2
	Southern Pine	#3	6-7	9-8	12-4	14-7	17-4	5-10	8-8	11-0	13-0	15-6
	Spruce-Pine-Fir	SS	7-8	12-0	15-10	20-2	24-7	7-8	12-0	15-10	19-9	22-10
	Spruce-Pine-Fir	#1	7-6	11-9	15-1	18-5	21-5	7-3	10-8	13-6	16-6	19-2
	Spruce-Pine-Fir	#2	7-6	11-9	15-1	18-5	21-5	7-3	10-8	13-6	16-6	19-2
	Spruce-Pine-Fir	#3	6-2	9-0	11-5	13-11	16-2	5-6	8-1	10-3	12-6	14-6

(continued)

TABLE 2308.10.3(5)—continued
RAFTER SPANS FOR COMMON LUMBER SPECIES
 (Ground Snow Load = 30 pounds per square foot, Ceiling Attached to Rafters, $L/\Delta = 240$)

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 pounds per square foot				DEAD LOAD = 20 pounds per square foot					
			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum rafter spans									
			(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
19.2	Douglas Fir-Larch	SS	7-9	12-3	16-1	20-7	25-0	7-9	12-3	15-10	19-5	22-6
	Douglas Fir-Larch	#1	7-6	11-8	14-9	18-0	20-11	7-1	10-5	13-2	16-1	18-8
	Douglas Fir-Larch	#2	7-4	10-11	13-9	16-10	19-6	6-8	9-9	12-4	15-1	17-6
	Douglas Fir-Larch	#3	5-7	8-3	10-5	12-9	14-9	5-0	7-4	9-4	11-5	13-2
	Hem-Fir	SS	7-4	11-7	15-3	19-5	23-7	7-4	11-7	15-3	19-1	22-1
	Hem-Fir	#1	7-2	11-4	14-4	17-7	20-4	6-11	10-2	12-10	15-8	18-2
	Hem-Fir	#2	6-10	10-9	13-7	16-7	19-3	6-7	9-7	12-2	14-10	17-3
	Hem-Fir	#3	5-7	8-3	10-5	12-9	14-9	5-0	7-4	9-4	11-5	13-2
	Southern Pine	SS	7-8	12-0	15-10	20-2	24-7	7-8	12-0	15-10	20-2	24-7
	Southern Pine	#1	7-6	11-9	15-6	19-7	23-4	7-6	11-9	14-9	17-6	20-11
	Southern Pine	#2	7-4	11-5	14-9	17-7	20-7	7-1	10-2	13-2	15-9	18-5
	Southern Pine	#3	6-0	8-10	11-3	13-4	15-10	5-4	7-11	10-1	11-11	14-2
	Spruce-Pine-Fir	SS	7-2	11-4	14-11	19-0	23-1	7-2	11-4	14-9	18-0	20-11
	Spruce-Pine-Fir	#1	7-0	10-11	13-9	16-10	19-6	6-8	9-9	12-4	15-1	17-6
	Spruce-Pine-Fir	#2	7-0	10-11	13-9	16-10	19-6	6-8	9-9	12-4	15-1	17-6
	Spruce-Pine-Fir	#3	5-7	8-3	10-5	12-9	14-9	5-0	7-4	9-4	11-5	13-2
24	Douglas Fir-Larch	SS	7-3	11-4	15-0	19-1	22-6	7-3	11-3	14-2	17-4	20-1
	Douglas Fir-Larch	#1	7-0	10-5	13-2	16-1	18-8	6-4	9-4	11-9	14-5	16-8
	Douglas Fir-Larch	#2	6-8	9-9	12-4	15-1	17-6	5-11	8-8	11-0	13-6	15-7
	Douglas Fir-Larch	#3	5-0	7-4	9-4	11-5	13-2	4-6	6-7	8-4	10-2	11-10
	Hem-Fir	SS	6-10	10-9	14-2	18-0	21-11	6-10	10-9	13-11	17-0	19-9
	Hem-Fir	#1	6-8	10-2	12-10	15-8	18-2	6-2	9-1	11-6	14-0	16-3
	Hem-Fir	#2	6-4	9-7	12-2	14-10	17-3	5-10	8-7	10-10	13-3	15-5
	Hem-Fir	#3	5-0	7-4	9-4	11-5	13-2	4-6	6-7	8-4	10-2	11-10
	Southern Pine	SS	7-1	11-2	14-8	18-9	22-10	7-1	11-2	14-8	18-9	22-10
	Southern Pine	#1	7-0	10-11	14-5	17-6	20-11	7-0	10-6	13-2	15-8	18-8
	Southern Pine	#2	6-10	10-2	13-2	15-9	18-5	6-4	9-2	11-9	14-1	16-6
	Southern Pine	#3	5-4	7-11	10-1	11-11	14-2	4-9	7-1	9-0	10-8	12-8
	Spruce-Pine-Fir	SS	6-8	10-6	13-10	17-8	20-11	6-8	10-5	13-2	16-1	18-8
	Spruce-Pine-Fir	#1	6-6	9-9	12-4	15-1	17-6	5-11	8-8	11-0	13-6	15-7
	Spruce-Pine-Fir	#2	6-6	9-9	12-4	15-1	17-6	5-11	8-8	11-0	13-6	15-7
	Spruce-Pine-Fir	#3	5-0	7-4	9-4	11-5	13-2	4-6	6-7	8-4	10-2	11-10

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 47.9 N/m².
 a. Span exceeds 26 feet in length. Check sources for availability of lumber in lengths greater than 20 feet.

TABLE 2308.10.3(6)
RAFTER SPANS FOR COMMON LUMBER SPECIES
 (Ground Snow Load = 50 pounds per square foot, Ceiling Attached to Rafters, $L/\Delta = 240$)

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 pounds per square foot					DEAD LOAD = 20 pounds per square foot					
			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	
			Maximum rafter spans										
			(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	
12	Douglas Fir-Larch	SS	7-8	12-1	15-11	20-3	24-8	7-8	12-1	15-11	20-3	24-0	
	Douglas Fir-Larch	#1	7-5	11-7	15-3	18-7	21-7	7-5	11-2	14-1	17-3	20-0	
	Douglas Fir-Larch	#2	7-3	11-3	14-3	17-5	20-2	7-1	10-5	13-2	16-1	18-8	
	Douglas Fir-Larch	#3	5-10	8-6	10-9	13-2	15-3	5-5	7-10	10-0	12-2	14-1	
	Hem-Fir	SS	7-3	11-5	15-0	19-2	23-4	7-3	11-5	15-0	19-2	23-4	
	Hem-Fir	#1	7-1	11-2	14-8	18-1	21-0	7-1	10-10	13-9	16-9	19-5	
	Hem-Fir	#2	6-9	10-8	14-0	17-2	19-11	6-9	10-3	13-0	15-10	18-5	
	Hem-Fir	#3	5-10	8-6	10-9	13-2	15-3	5-5	7-10	10-0	12-2	14-1	
	Southern Pine	SS	7-6	11-0	15-7	19-11	24-3	7-6	11-10	15-7	19-11	24-3	
	Southern Pine	#1	7-5	11-7	15-4	19-7	23-9	7-5	11-7	15-4	18-9	22-4	
	Southern Pine	#2	7-3	11-5	15-0	18-2	21-3	7-3	10-11	14-1	16-10	19-9	
	Southern Pine	#3	6-2	9-2	11-8	13-9	16-4	5-9	8-5	10-9	12-9	15-2	
	Spruce-Pine-Fir	SS	7-1	11-2	14-8	18-9	22-10	7-1	11-2	14-8	18-9	22-4	
	Spruce-Pine-Fir	#1	6-11	10-11	14-3	17-5	20-2	6-11	10-5	13-2	16-1	18-8	
	Spruce-Pine-Fir	#2	6-11	10-11	14-3	17-5	20-2	6-11	10-5	13-2	16-1	18-8	
	Spruce-Pine-Fir	#3	5-10	8-6	10-9	13-2	15-3	5-5	7-10	10-0	12-2	14-1	
	16	Douglas Fir-Larch	SS	7-0	11-0	14-5	18-5	22-5	7-0	11-0	14-5	17-11	20-10
		Douglas Fir-Larch	#1	6-9	10-5	13-2	16-1	18-8	6-7	9-8	12-2	14-11	17-3
Douglas Fir-Larch		#2	6-7	9-9	12-4	15-1	17-6	6-2	9-0	11-5	13-11	16-2	
Douglas Fir-Larch		#3	5-0	7-4	9-4	11-5	13-2	4-8	6-10	8-8	10-6	12-3	
Hem-Fir		SS	6-7	10-4	13-8	17-5	21-2	6-7	10-4	13-8	17-5	20-5	
Hem-Fir		#1	6-5	10-2	12-10	15-8	18-2	6-5	9-5	11-11	14-6	16-10	
Hem-Fir		#2	6-2	9-7	12-2	14-10	17-3	6-1	8-11	11-3	13-9	15-11	
Hem-Fir		#3	5-0	7-4	9-4	11-5	13-2	4-8	6-10	8-8	10-6	12-3	
Southern Pine		SS	6-10	10-9	14-2	18-1	22-0	6-10	10-9	14-2	18-1	22-0	
Southern Pine		#1	6-9	10-7	13-11	17-6	20-11	6-9	10-7	13-8	16-2	19-4	
Southern Pine		#2	6-7	10-2	13-2	15-9	18-5	6-7	9-5	12-2	14-7	17-1	
Southern Pine		#3	5-4	7-11	10-1	11-11	14-2	4-11	7-4	9-4	11-0	13-1	
Spruce-Pine-Fir		SS	6-5	10-2	13-4	17-0	20-9	6-5	10-2	13-4	16-8	19-4	
Spruce-Pine-Fir		#1	6-4	9-9	12-4	15-1	17-6	6-2	9-0	11-5	13-11	16-2	
Spruce-Pine-Fir		#2	6-4	9-9	12-4	15-1	17-6	6-2	9-0	11-5	13-11	16-2	
Spruce-Pine-Fir		#3	5-0	7-4	9-4	11-5	13-2	4-8	6-10	8-8	10-6	12-3	

(continued)

TABLE 2308.10.3(6)—continued
RAFTER SPANS FOR COMMON LUMBER SPECIES
 (Ground Snow Load = 50 pounds per square foot, Ceiling Attached to Rafters, $L/\Delta = 240$)

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 pounds per square foot					DEAD LOAD = 20 pounds per square foot				
			2 x 4	2 x 6	2 x 8	2 x 10	2 x 12	2 x 4	2 x 6	2 x 8	2 x 10	2 x 12
			Maximum rafter spans									
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)
19.2	Douglas Fir-Larch	SS	6-7	10-4	13-7	17-4	20-6	6-7	10-4	13-5	16-5	19-0
	Douglas Fir-Larch	#1	6-4	9-6	12-0	14-8	17-1	6-0	8-10	11-2	13-7	15-9
	Douglas Fir-Larch	#2	6-1	8-11	11-3	13-9	15-11	5-7	8-3	10-5	12-9	14-9
	Douglas Fir-Larch	#3	4-7	6-9	8-6	10-5	12-1	4-3	6-3	7-11	9-7	11-2
	Hem-Fir	SS	6-2	9-9	12-10	16-5	19-11	6-2	9-9	12-10	16-1	18-8
	Hem-Fir	#1	6-1	9-3	11-9	14-4	16-7	5-10	8-7	10-10	13-3	15-5
	Hem-Fir	#2	5-9	8-9	11-1	13-7	15-9	5-7	8-1	10-3	12-7	14-7
	Hem-Fir	#3	4-7	6-9	8-6	10-5	12-1	4-3	6-3	7-11	9-7	11-2
	Southern Pine	SS	6-5	10-2	13-4	17-0	20-9	6-5	10-2	13-4	17-0	20-9
	Southern Pine	#1	6-4	9-11	13-1	16-0	19-1	6-4	9-11	12-5	14-10	17-8
	Southern Pine	#2	6-2	9-4	12-0	14-4	16-10	6-0	8-8	11-2	13-4	15-7
	Southern Pine	#3	4-11	7-3	9-2	10-10	12-11	4-6	6-8	8-6	10-1	12-0
	Spruce-Pine-Fir	SS	6-1	9-6	12-7	16-0	19-1	6-1	9-6	12-5	15-3	17-8
	Spruce-Pine-Fir	#1	5-11	8-11	11-3	13-9	15-11	5-7	8-3	10-5	12-9	14-9
	Spruce-Pine-Fir	#2	5-11	8-11	11-3	13-9	15-11	5-7	8-3	10-5	12-9	14-9
Spruce-Pine-Fir	#3	4-7	6-9	8-6	10-5	12-1	4-3	6-3	7-11	9-7	11-2	
24	Douglas Fir-Larch	SS	6-1	9-7	12-7	15-10	18-4	6-1	9-6	12-0	14-8	17-0
	Douglas Fir-Larch	#1	5-10	8-6	10-9	13-2	15-3	5-5	7-10	10-0	12-2	14-1
	Douglas Fir-Larch	#2	5-5	7-11	10-1	12-4	14-3	5-0	7-4	9-4	11-5	13-2
	Douglas Fir-Larch	#3	4-1	6-0	7-7	9-4	10-9	3-10	5-7	7-1	8-7	10-0
	Hem-Fir	SS	5-9	9-1	11-11	15-12	18-0	5-9	9-1	11-9	14-5	16-8
	Hem-Fir	#1	5-8	8-3	10-6	12-10	14-10	5-3	7-8	9-9	11-10	13-9
	Hem-Fir	#2	5-4	7-10	9-11	12-1	14-1	4-11	7-3	9-2	11-3	13-0
	Hem-Fir	#3	4-1	6-0	7-7	9-4	10-9	3-10	5-7	7-1	8-7	10-0
	Southern Pine	SS	6-0	9-5	12-5	15-10	19-3	6-0	9-5	12-5	15-10	19-3
	Southern Pine	#1	5-10	9-3	12-0	14-4	17-1	5-10	8-10	11-2	13-3	15-9
	Southern Pine	#2	5-9	8-4	10-9	12-10	15-1	5-5	7-9	10-0	11-11	13-11
	Southern Pine	#3	4-4	6-5	8-3	9-9	11-7	4-1	6-0	7-7	9-0	10-8
	Spruce-Pine-Fir	SS	5-8	8-10	11-8	14-8	17-1	5-8	8-10	11-2	13-7	15-9
	Spruce-Pine-Fir	#1	5-5	7-11	10-1	12-4	14-3	5-0	7-4	9-4	11-5	13-2
	Spruce-Pine-Fir	#2	5-5	7-11	10-1	12-4	14-3	5-0	7-4	9-4	11-5	13-2
Spruce-Pine-Fir	#3	4-1	6-0	7-7	9-4	10-9	3-10	5-7	7-1	8-7	10-0	

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 47.9 N/m².

TABLE 2308.10.4.1
RAFTER TIE CONNECTIONS^g

RAFTER SLOPE	TIE SPACING (inches)	GROUND SNOW LOAD (pound per square foot)											
		NO SNOW LOAD				30 pounds per square foot				50 pounds per square foot			
		Roof span (feet)											
		12	20	28	36	12	20	28	36	12	20	28	36
Required number of 16d common nails ^{a,b} per connection ^{c,d,e,f}													
3:12	12	4	6	8	10	4	6	8	11	5	8	12	15
	16	5	7	10	13	5	8	11	14	6	11	15	20
	24	7	11	15	19	7	11	16	21	9	16	23	30
	32	10	14	19	25	10	16	22	28	12	27	30	40
	48	14	21	29	37	14	32	36	42	18	32	46	60
4:12	12	3	4	5	6	3	5	6	8	4	6	9	11
	16	3	5	7	8	4	6	8	11	5	8	12	15
	24	4	7	10	12	5	9	12	16	7	12	17	22
	32	6	9	13	16	8	12	16	22	10	16	24	30
	48	8	14	19	24	10	18	24	32	14	24	34	44
5:12	12	3	3	4	5	3	4	5	7	3	5	7	9
	16	3	4	5	7	3	5	7	9	4	7	9	12
	24	4	6	8	10	4	7	10	13	6	10	14	18
	32	5	8	10	13	6	10	14	18	8	14	18	24
	48	7	11	15	20	8	14	20	26	12	20	28	36
7:12	12	3	3	3	4	3	3	4	5	3	4	5	7
	16	3	3	4	5	3	4	5	6	3	5	7	9
	24	3	4	6	7	3	5	7	9	4	7	10	13
	32	4	6	8	10	4	8	10	12	6	10	14	18
	48	5	8	11	14	6	10	14	18	9	14	20	26
9:12	12	3	3	3	3	3	3	3	4	3	3	4	5
	16	3	3	3	4	3	3	4	5	3	4	5	7
	24	3	3	5	6	3	4	6	7	3	6	8	10
	32	3	4	6	8	4	6	8	10	5	8	10	14
	48	4	6	9	11	5	8	12	14	7	12	16	20
12:12	12	3	3	3	3	3	3	3	3	3	3	3	4
	16	3	3	3	3	3	3	3	4	3	3	4	5
	24	3	3	3	4	3	3	4	6	3	4	6	8
	32	3	3	4	5	3	5	6	8	4	6	8	10
	48	3	4	6	7	4	7	8	12	6	8	12	16

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 47.8 N/m².

- a. 40d box or 16d sinker box nails are permitted to be substituted for 16d common nails.
- b. Nailing requirements are permitted to be reduced 25 percent if nails are clinched.
- c. Rafter tie heel joint connections are not required where the ridge is supported by a load-bearing wall, header or ridge beam.
- d. When intermediate support of the rafter is provided by vertical struts or purlins to a load-bearing wall, the tabulated heel joint connection requirements are permitted to be reduced proportionally to the reduction in span.
- e. Equivalent nailing patterns are required for ceiling joist to ceiling joist lap splices.
- f. Connected members shall be of sufficient size to prevent splitting due to nailing.
- g. For snow loads less than 30 psf, the required number of nails is permitted to be reduced by multiplying by the ratio of actual snow load plus 10 divided by 40, but not less than the number required for no snow load.

2308.10.4.2 Notches and holes. Notching at the ends of rafters or ceiling joists shall not exceed one-fourth the depth. Notches in the top or bottom of the rafter or ceiling joist shall not exceed one-sixth the depth and shall not be located in the middle one-third of the span, except that a notch not exceeding one-third of the depth is permitted in the top of the rafter or ceiling joist not further from the face of the support than the depth of the member.

Holes bored in rafters or ceiling joists shall not be within 2 inches (51 mm) of the top and bottom and their diameter shall not exceed one-third the depth of the member.

2308.10.4.3 Framing around openings. Trimmer and header rafters shall be doubled, or of lumber of equivalent cross-section, where the span of the header exceeds 4 feet (1219 mm). The ends of header rafters more than 6 feet (1829 mm) long shall be supported by framing anchors or rafter hangers unless bearing on a beam, partition or wall.

2308.10.5 Purlins. Purlins to support roof loads are permitted to be installed to reduce the span of rafters within allowable limits and shall be supported by struts to bearing walls. The maximum span of 2-inch by 4-inch (51 mm by 102 mm) purlins shall be 4 feet (1219 mm). The maximum span of the 2-inch by 6-inch (51 mm by 152 mm) purlin shall be 6 feet (1829 mm) but in no case shall the purlin be smaller than the supported rafter. Struts shall not be smaller than 2-inch by 4-inch (51 mm by 102 mm) members. The unbraced length of struts shall not exceed 8 feet (2438 mm) and the minimum slope of the struts shall not be less than 45 degrees (0.79 rad) from the horizontal.

2308.10.6 Blocking. Roof rafters and ceiling joists shall be supported laterally to prevent rotation and lateral displacement in accordance with the provisions of Section 2308.8.5.

2308.10.7 Wood trusses.

2308.10.7.1 Design. Wood trusses shall be designed in accordance with the requirements of Chapter 23 and accepted engineering practice. Members are permitted to be joined by nails, glue, bolts, timber connectors, metal connector plates, or other approved framing devices.

2308.10.7.2 Bracing. The bracing of wood trusses shall comply to their appropriate engineered design.

2308.10.7.3 Alterations to trusses. Truss members and components shall not be cut, notched, drilled, spliced or otherwise altered in any way without written concurrence and approval of a registered design professional. Alterations resulting in the addition of loads to any member (e.g., HVAC equipment, water heater) shall not be permitted without verification that the truss is capable of supporting such additional loading.

2308.10.8 Roof sheathing. Roof sheathing shall be in accordance with Tables 2304.7(3) and 2304.7(5) for wood

structural panels, and Tables 2304.7(1) and 2304.7(2) for lumber and shall comply with Section 2304.7.2.

2308.10.8.1 Joints. Joints in lumber sheathing shall occur over supports unless approved end-matched lumber is used, in which case each piece shall bear on at least two supports.

2308.10.9 Roof planking. Planking shall be designed in accordance with the general provisions of this code.

In lieu of such design, 2-inch (51 mm) tongue-and-groove planking is permitted in accordance with Table 2308.10.9. Joints in such planking are permitted to be randomly spaced, provided the system is applied to not less than three continuous spans, planks are center-matched and end-matched or splined, each plank bears on at least one support, and joints are separated by at least 24 inches (610 mm) in adjacent pieces.

2308.10.10 Attic ventilation. For attic ventilation, see Section 1202.2.

2308.11 Additional requirements for conventional construction in Seismic Design Category B or C. Structures of conventional light-frame construction in Seismic Design Category B or C, as determined in Section 1616 shall comply with Sections 2308.11.1 through 2308.11.3, in addition to the provisions of Sections 2308.1 through 2308.10.

2308.11.1 Number of stories. Structures of conventional light-frame construction shall not exceed two stories in height in Seismic Design Category C.

Exception: Detached one- and two-family dwellings are permitted to be three stories in height in Seismic Design Category C.

2308.11.2 Concrete or masonry. Concrete or masonry walls, or masonry veneer shall not extend above the basement.

Exceptions:

1. Masonry veneer is permitted to be used in the first two stories above grade or the first three stories above grade where the lowest story has concrete or masonry walls in Seismic Design Category B, provided that structural use panel wall bracing is used, and the length of bracing provided is 1.5 times the required length as determined in Table 2308.9.3(1).
2. Masonry veneer is permitted to be used in the first story above grade or the first two stories above grade where the lowest story has concrete or masonry walls in Seismic Design Category B or C.

2308.11.3 Framing and connection details. Framing and connection details shall conform to Sections 2308.11.3.1 through 2308.11.3.3.

2308.11.3.1 Anchorage. Braced wall lines shall be anchored in accordance with Section 2308.6 at foundations.

TABLE 2308.10.9
ALLOWABLE SPANS FOR 2-INCH TONGUE AND GROOVE DECKING

SPAN ^a (feet)	LIVE LOAD (pound per square foot)	DEFLECTION LIMIT	BENDING STRESS (f) (pound per square inch)	MODULUS OF ELASTICITY (E) (pound per square inch)
Roofs				
4	20	1/240 1/360	160	170,000 256,000
	30	1/240 1/360	210	256,000 384,000
	40	1/240 1/360	270	340,000 512,000
4.5	20	1/240 1/360	200	242,000 305,000
	30	1/240 1/360	270	363,000 405,000
	40	1/240 1/360	350	484,000 725,000
5.0	20	1/240 1/360	250	332,000 500,000
	30	1/240 1/360	330	495,000 742,000
	40	1/240 1/360	420	660,000 1,000,000
5.5	20	1/240 1/360	300	442,000 660,000
	30	1/240 1/360	400	662,000 998,000
	40	1/240 1/360	500	884,000 1,330,000
6.0	20	1/240 1/360	360	575,000 862,000
	30	1/240 1/360	480	862,000 1,295,000
	40	1/240 1/360	600	1,150,000 1,730,000
6.5	20	1/240 1/360	420	595,000 892,000
	30	1/240 1/360	560	892,000 1,340,000
	40	1/240 1/360	700	1,190,000 1,730,000
7.0	20	1/240 1/360	490	910,000 1,360,000
	30	1/240 1/360	650	1,370,000 2,000,000
	40	1/240 1/360	810	1,820,000 2,725,000

(continued)

TABLE 2308.10.9—continued
ALLOWABLE SPANS FOR 2-INCH TONGUE AND GROOVE DECKING

SPAN ^a (feet)	LIVE LOAD (pound per square foot)	DEFLECTION LIMIT	BENDING STRESS (<i>f</i>) (pound per square inch)	MODULUS OF ELASTICITY (<i>E</i>) (pound per square inch)
Roofs				
7.5	20	1/240	560	1,125,000
		1/360		1,685,000
	30	1/240	750	1,685,000
		1/360		2,530,000
8.0	20	1/240	640	1,360,000
		1/360		2,040,000
	30	1/240	850	2,040,000
		1/360		3,060,000
Floors				
4	40	1/360	840	1,000,000
4.5			950	1,300,000
5.0			1,060	1,600,000

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kN/m², 1 pound per square inch = 0.00689 N/mm².

a. Spans are based on simple beam action with 10 pounds per square foot dead load and provisions for a 300-pound concentrated load on a 12-inch width of decking. Random lay up is permitted in accordance with the provisions of Section 2308.10.9. Lumber thickness is 1½ inches net.

2308.11.3.2 Stepped footings. Where the height of a required braced wall panel extending from foundation to floor above varies more than 4 feet (1219 mm), the following construction shall be used:

1. Where the bottom of the footing is stepped and the lowest floor framing rests directly on a sill bolted to the footings, the sill shall be anchored as required in Section 2308.3.3.
2. Where the lowest floor framing rests directly on a sill bolted to a footing not less than 8 feet (2438 mm) in length along a line of bracing, the line shall be considered to be braced. The double plate of the cripple stud wall beyond the segment of footing extending to the lowest framed floor shall be spliced to the sill plate with metal ties, one on each side of the sill and plate. The metal ties shall not be less than 0.058 inch (1.47 mm [16 galvanized gage]) by 1.5 inches (38 mm) wide by 48 inches (1219 mm) with eight 16d common nails on each side of the splice location. See Figure 2308.11.3.2. The metal tie shall have a minimum yield of 33,000 psi (227 MPa).
3. Where cripple walls occur between the top of the footing and the lowest floor framing, the bracing requirements for a story shall apply.

2308.11.3.3 Openings in horizontal diaphragms. Openings in horizontal diaphragms with a dimension perpendicular to the joist is greater than 4 feet (1.2 m) shall be constructed in accordance with the following:

1. Blocking shall be provided beyond headers.
2. Metal ties not less than 0.058 inch (1.47 mm [16 galvanized gage]) by 1.5 inches (38 mm) wide with eight 16d common nails on each side of the header-

joist intersection shall be provided. See Figure 2308.11.3.3. The metal ties shall have a minimum yield of 33,000 psi (227 MPa).

2308.12 Additional requirements for conventional construction in Seismic Design Category D or E. Structures of conventional light-frame construction in Seismic Design Category D or E, as determined in Section 1616, shall conform to Sections 2308.12.1 through 2308.12.9, in addition to the requirements for Seismic Design Category B or C in Section 2308.11.

2308.12.1 Number of stories. Structures of conventional light-frame construction shall not exceed one story in height in Seismic Design Category D or E.

Exception: Detached one- and two-family dwellings are permitted to be two stories high in Seismic Design Category D or E.

2308.12.2 Concrete or masonry. Concrete or masonry walls or masonry veneer shall not extend above the basement.

2308.12.3 Braced wall line spacing. Spacing between interior and exterior braced wall lines shall not exceed 25 feet (7620 mm).

2308.12.4 Braced wall line sheathing. Braced wall lines shall be braced by one of the types of sheathing prescribed in Table 2308.12.4. The sum of lengths of braced wall panels at each braced wall line shall conform to Table 2308.12.4. Braced wall panels shall be distributed along the length of the braced wall line and start at not more than 8 feet (2438 mm) from each end of the braced wall line. A designed collector shall be provided where the bracing begins more than 8 feet (2438 mm) from an end of a braced wall line. Panel sheathing joints shall occur over studs or blocking.

Sheathing shall be fastened to studs and top and bottom plates and at panel edges occurring over blocking. Wall framing to which sheathing used for bracing is applied shall be nominal 2-inch wide (actual 1½ inch, 38 mm) or larger members.

Cripple walls having a stud height exceeding 14 inches (356 mm) shall be considered a story for the purpose of this section and shall be braced as required for braced wall lines in accordance with Table 2308.12.4. Where interior braced wall lines occur without a continuous foundation below, the length of parallel exterior cripple wall bracing shall be one and one-half times the lengths required by Table 2308.12.4. Where the cripple wall sheathing type used is Type S-W, and this additional length of bracing cannot be provided, the capacity of Type S-W sheathing shall be increased by reducing the spacing of fasteners along the perimeter of each piece of sheathing to 4 inches (102 mm) on center.

2308.12.5 Attachment of sheathing. Fastening of braced wall panel sheathing shall not be less than that prescribed in Table 2308.12.4 or 2304.9.1. Wall sheathing shall not be attached to framing members by adhesives.

2308.12.6 Irregular structures. Conventional light-frame construction shall not be used in irregular portions of structures in Seismic Design Category D or E. Such irregular portions of structures shall be designed to resist the forces specified in Chapter 16 to the extent such irregular features affect the performance of the conventional framing system. A portion of a structure shall be considered to be irregular where one or more of the conditions described in Items 1 through 6 below are present.

1. Where exterior braced wall panels are not in one plane vertically from the foundation to the uppermost story in which they are required, the structure shall be considered to be irregular. See Figure 2308.12.6(1).

Exception: Floors with cantilevers or setbacks not exceeding four times the nominal depth of the floor joists (see Figure 2308.12.6(2)) are permitted to support braced wall panels provided:

1. Floor joists are 2 inches by 10 inches (51 mm by 254 mm) or larger and spaced not more than 16 inches (406 mm) on center.
2. The ratio of the back span to the cantilever is at least 2 to 1.
3. Floor joists at ends of braced wall panels are doubled.
4. A continuous rim joist is connected to the ends of cantilevered joists. The rim joist is permitted to be spliced using a metal tie not less than 0.058 inch (1.47 mm) (16 galvanized gage) and 1½ inches (38 mm) wide fastened with six 16d common nails on each side. The metal tie shall have a minimum yield of 33,000 psi (227 MPa).
5. Joists at setbacks or the end of cantilevered joists shall not carry gravity loads from more

than a single story having uniform wall and roof loads, nor carry the reactions from headers having a span of 8 feet (2438 mm) or more.

2. Where a section of floor or roof is not laterally supported by braced wall lines on all edges, the structure shall be considered to be irregular. See Figure 2308.12.6(3).

Exception: Portions of roofs or floors that do not support braced wall panels above are permitted to extend up to 6 feet (1829 mm) beyond a braced wall line. See Figure 2308.12.6(4).

3. Where the end of a required braced wall panel extends more than 1 foot (305 mm) over an opening in the wall below, the structure shall be considered to be irregular. This requirement is applicable to braced wall panels offset in plane and to braced wall panels offset out of plane as permitted by the exception to Item 1 above in this section. See Figure 2308.12.6(5).

Exception: Braced wall panels are permitted to extend over an opening not more than 8 feet (2438 mm) in width where the header is a 4-inch by 12-inch (102 mm by 305 mm) or larger member.

4. Where portions of a floor level are vertically offset such that the framing members on either side of the offset cannot be lapped or tied together in an approved manner, the structure shall be considered to be irregular. See Figure 2308.12.6(6).

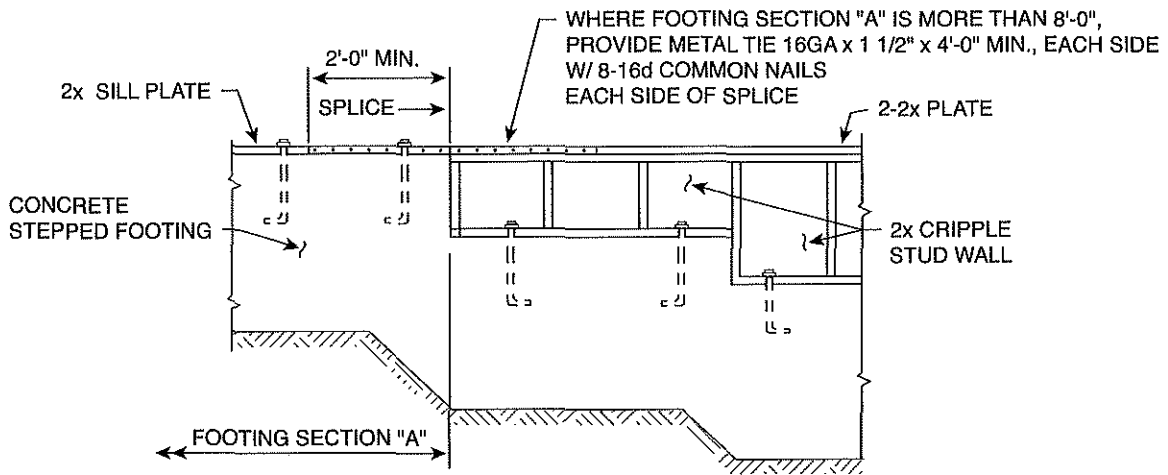
Exception: Framing supported directly by foundations need not be lapped or tied directly together.

5. Where braced wall lines are not perpendicular to each other, the structure shall be considered to be irregular. See Figure 2308.12.6(7).
6. Where openings in floor and roof diaphragms having a maximum dimension greater than 50 percent of the distance between lines of bracing or an area greater than 25 percent of the area between orthogonal pairs of braced wall lines are present, the structure shall be considered to be irregular. See Figure 2308.12.6(8).

2308.12.7 Exit facilities. Exterior exit balconies, stairs and similar exit facilities shall be positively anchored to the primary structure at not over 8 feet (2438 mm) on center or shall be designed for lateral forces. Such attachment shall not be accomplished by use of toenails or nails subject to withdrawal.

2308.12.8 Steel plate washers. Steel plate washers shall be placed between the foundation sill plate and the nut. Such washers shall be a minimum of ⅜ inch by 2 inches by 2 inches (4.76 mm by 51 mm by 51 mm) in size.

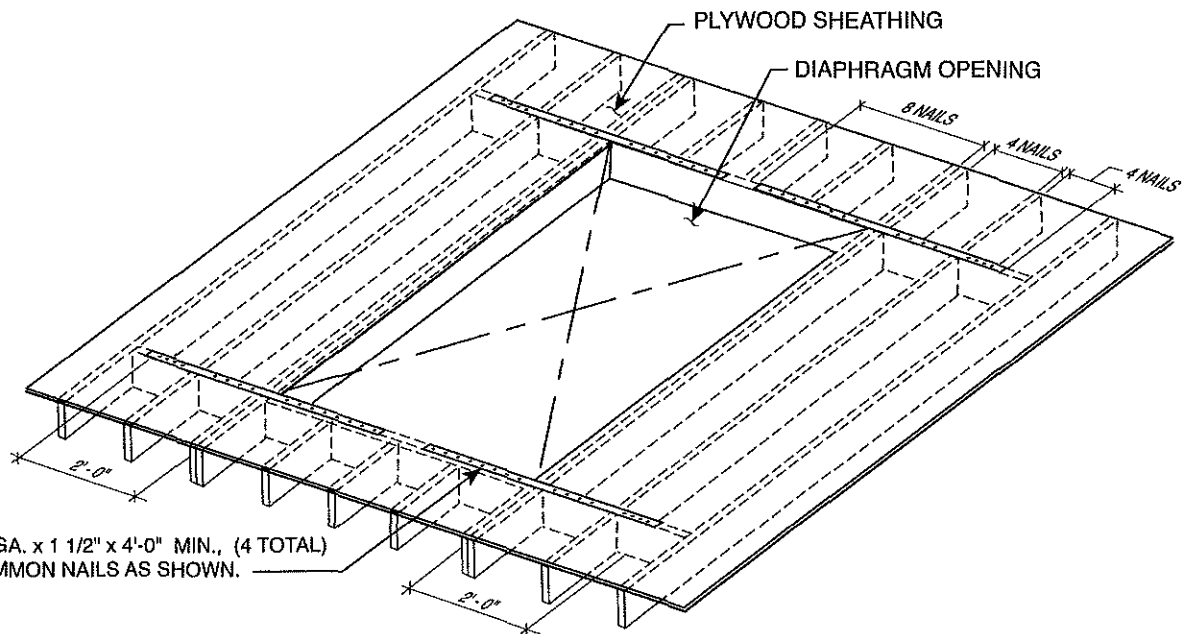
2308.12.9 Anchorage in Seismic Design Category E. Steel bolts with a minimum nominal diameter of ⅜ inch (15.9 mm) shall be used in Seismic Design Category E.



NOTE: WHERE FOOTING SECTION "A" IS LESS THAN 8'-0" LONG IN A 25'-0" TOTAL LENGTH WALL, PROVIDE BRACING AT CRIPPLE STUD WALL

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

FIGURE 2308.11.3.2
STEPPED FOOTING CONNECTION DETAILS



METAL TIE 16GA. x 1 1/2" x 4'-0" MIN., (4 TOTAL)
W/ 16-16d COMMON NAILS AS SHOWN.

-OR-

METAL TIE 16GA. x 1 1/2" x (OPENING WIDTH + 4'-0") MIN.,
(2 TOTAL) W/ 24-16d COMMON NAILS.

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

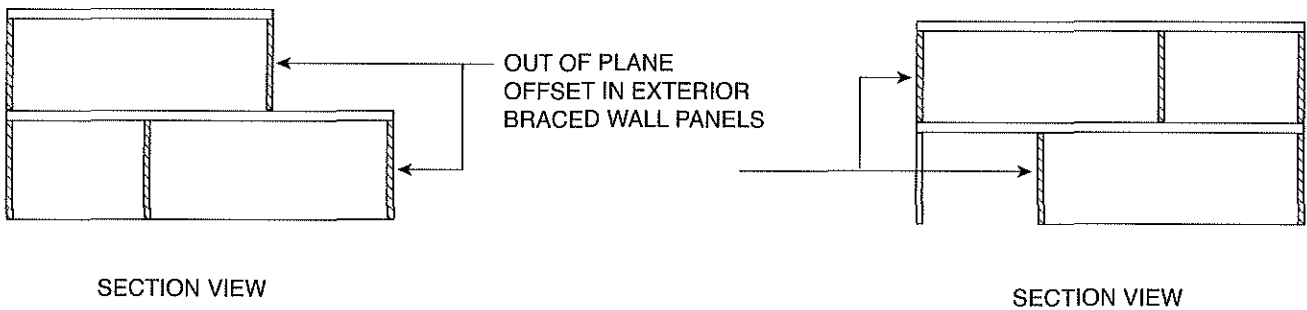
FIGURE 2308.11.3.3
OPENINGS IN HORIZONTAL DIAPHRAGMS

**TABLE 2308.12.4
WALL BRACING IN SEISMIC DESIGN CATEGORIES D OR E
(Minimum Length of Wall Bracing per Each 25 Linear Feet of Braced Wall Line^a)**

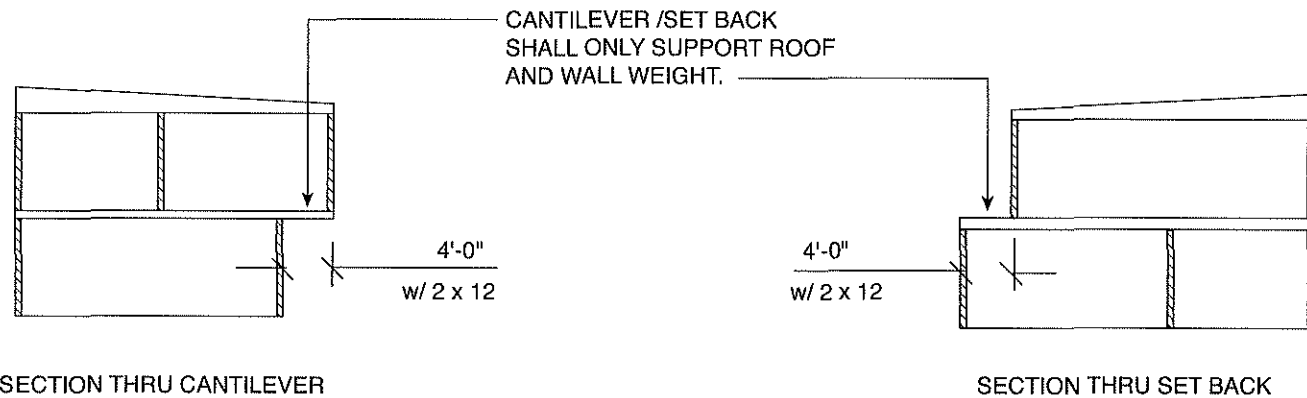
STORY LOCATION	SHEATHING TYPE ^b	$0.50 \leq S_{DS} < 0.75$	$0.75 \leq S_{DS} \leq 1.00$	$1.00 \leq S_{DS}$
Top or only story	G-P ^d	14 feet 8 inches ^c	18 feet 8 inches ^c	25 feet 0 inches ^c
	S-W	8 feet 0 inches ^c	9 feet 4 inches ^c	12 feet 0 inches ^c
Story below top story	G-P ^d	NP	NP	NP
	S-W	13 feet 4 inches ^c	17 feet 4 inches ^c	21 feet 4 inches ^c
Bottom story of three stories	G-P ^d	Conventional construction not permitted; conformance with Section 2301.2.1 or 2301.2.2 is required.		
	S-W			

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

- a. Minimum length of panel bracing of one face of wall for S-W sheathing or both faces of wall for G-P sheathing; h/v ratio shall not exceed 2/1. For S-W panel bracing of the same material on two faces of the wall, the minimum length is permitted to be one-half the tabulated value but the h/v ratio shall not exceed 2/1 and design for uplift is required.
- b. G-P = gypsum board, fiberboard, particleboard, lath and plaster, or gypsum sheathing boards; S-W = wood structural panels and diagonal wood sheathing. NP = not permitted.
- c. Applies to one- and two-family detached dwellings only.
- d. Nailing as specified below shall occur at all panel edges at studs, at top and bottom plates, and, where occurring, at blocking:
 - For 1/2-inch gypsum board, 5d (0.113 inch diameter) cooler nails at 7 inches centers;
 - For 3/4-inch gypsum board, No. 11 gage (0.120 inch diameter) at 7 inches centers;
 - For gypsum sheathing board, 1 3/4 inches long by 7/16-inch head, diamond point galvanized nails at 4 inches centers;
 - For gypsum lath, No. 13 gage (0.092 inch) by 1 1/8 inches long, 19/64-inch head, plasterboard at 5 inches centers;
 - For portland cement plaster, No. 11 gage (0.120 inch) by 1 1/2 inches long, 7/16-inch head at 6 inches centers;
 - For fiberboard and particleboard, No. 11 gage (0.120 inch) by 1 1/2 inches long, 7/16-inch head, galvanized nails at 3 inches centers.

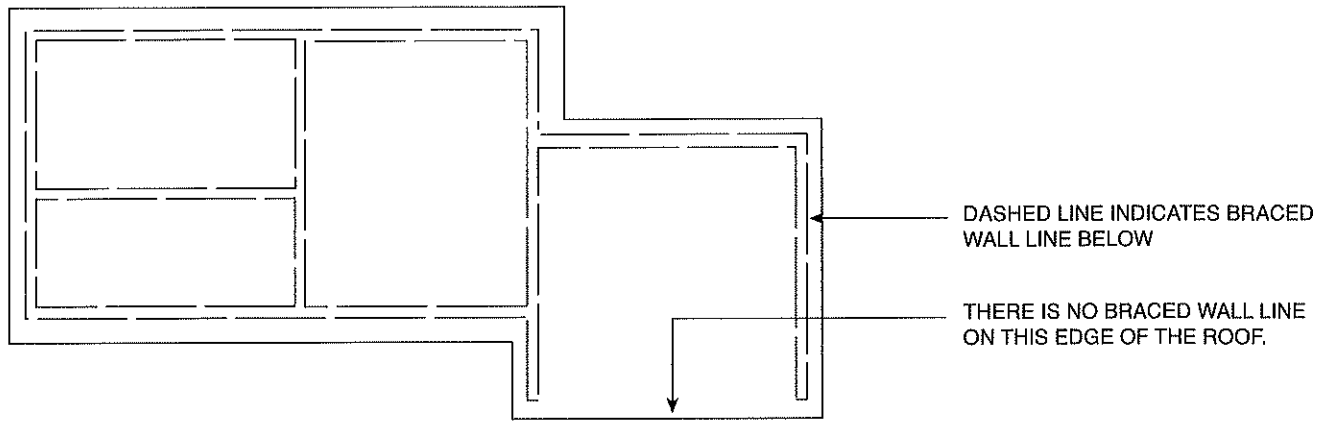


**FIGURE 2308.12.6(1)
BRACED WALL PANELS OUT OF PLANE**



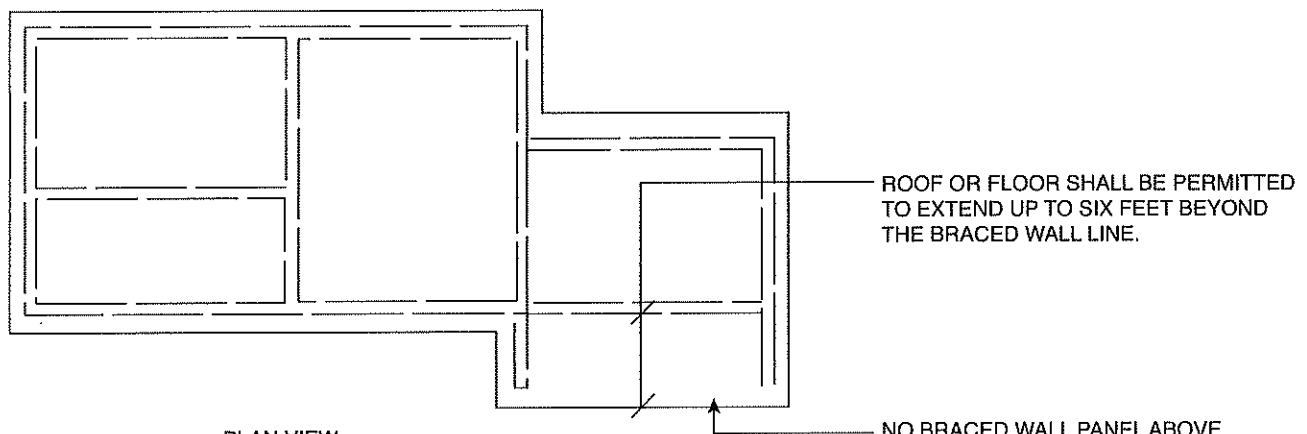
**FIGURE 2308.12.6(2)
BRACED WALL PANELS SUPPORTED BY CANTILEVER OR SET BACK**

For SI: 1 foot = 304.8 mm.



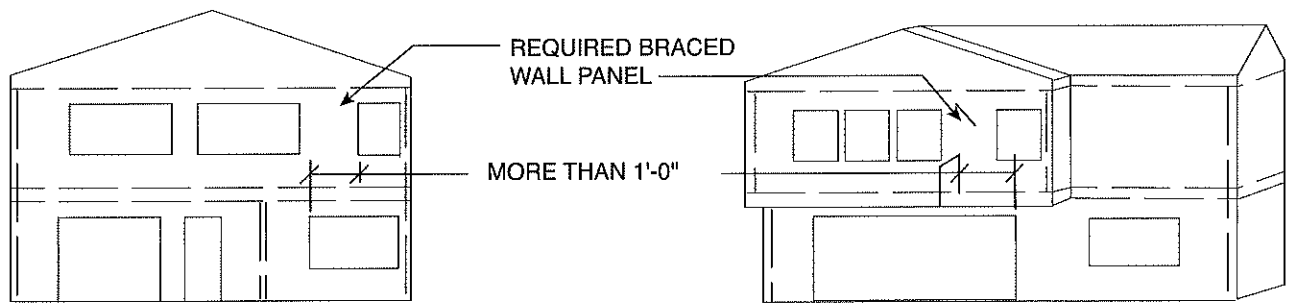
PLAN VIEW

FIGURE 2308.12.6(3)
FLOOR OR ROOF NOT SUPPORTED ALL EDGES



PLAN VIEW

FIGURE 2308.12.6(4)
ROOF OR FLOOR EXTENSION BEYOND BRACED WALL LINE

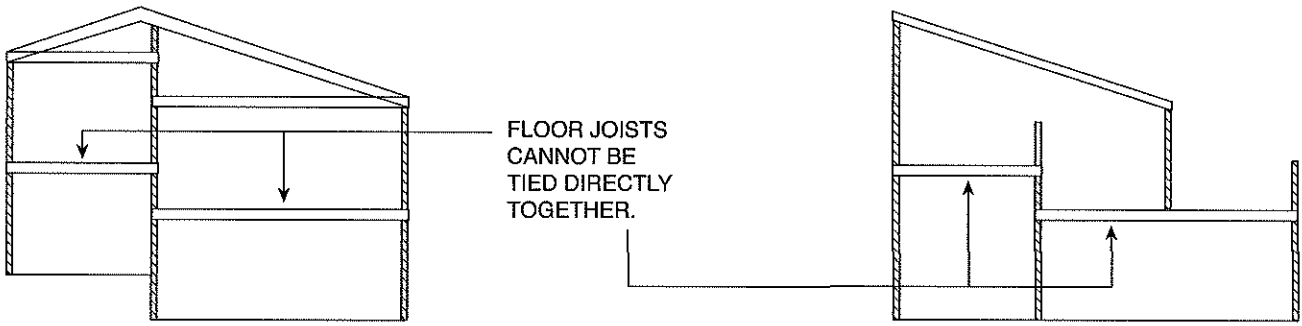


EXTERIOR ELEVATION

EXTERIOR ISOMETRIC

For SI: 1 foot = 304.8 mm.

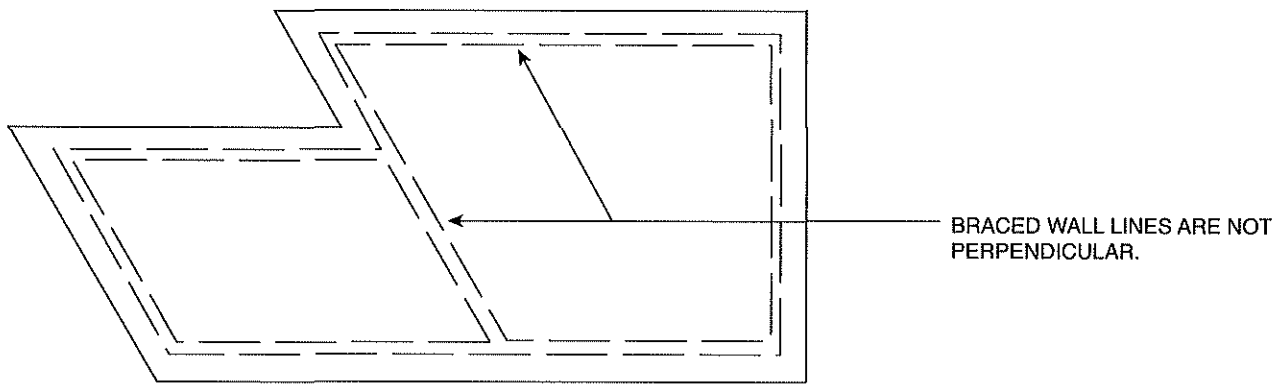
FIGURE 2308.12.6(5)
BRACED WALL PANEL EXTENSION OVER OPENING



SECTION VIEW

SECTION VIEW

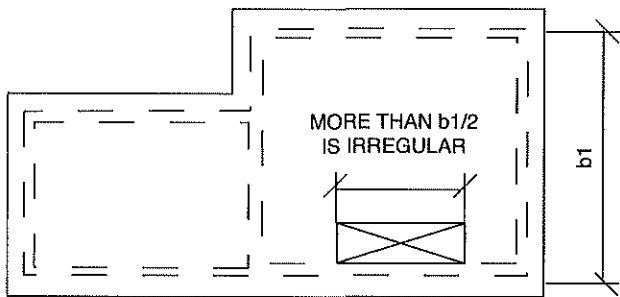
FIGURE 2308.12.6(6)
PORTIONS OF FLOOR LEVEL OFFSET VERTICALLY



BRACED WALL LINES ARE NOT PERPENDICULAR.

PLAN VIEW

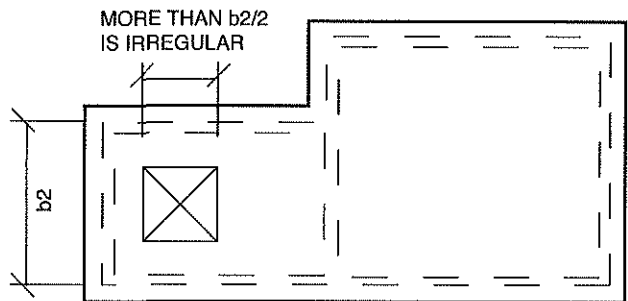
FIGURE 2308.12.6(7)
BRACED WALL LINES NOT PERPENDICULAR



MORE THAN $b_1/2$ IS IRREGULAR

b_1

PLAN VIEW



MORE THAN $b_2/2$ IS IRREGULAR

b_2

PLAN VIEW

FIGURE 2308.12.6(8)
OPENING LIMITATIONS FOR FLOOR AND ROOF DIAPHRAGMS

CHAPTER 24

GLASS AND GLAZING

SECTION 2401 GENERAL

2401.1 Scope. The provisions of this chapter shall govern the materials, design, construction, and quality of glass, light-transmitting ceramic and light-transmitting plastic panels for exterior and interior use in both vertical and sloped applications in buildings and structures.

2401.2 Glazing replacement. The installation of replacement glass shall be as required for new installations.

SECTION 2402 DEFINITIONS

2402.1 Definitions. The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

DALLE GLASS. A decorative composite glazing material made of individual pieces of glass that are embedded in a cast matrix of concrete or epoxy.

DECORATIVE GLASS. A carved, leaded or Dalle glass or glazing material whose purpose is decorative or artistic, not functional; whose coloring, texture or other design qualities or components cannot be removed without destroying the glazing material; and whose surface, or assembly into which it is incorporated, is divided into segments.

SECTION 2403 GENERAL REQUIREMENTS FOR GLASS

2403.1 Identification. Each pane shall bear the manufacturer's label designating the type and thickness of the glass or glazing material. The identification shall not be omitted unless approved and an affidavit is furnished by the glazing contractor certifying that each light is glazed in accordance with approved construction documents in accordance with the provisions of this chapter. Safety glazing shall be identified in accordance with Section 2406.1.1.

Each pane of tempered glass, except tempered spandrel glass, shall be permanently identified by the manufacturer. The identification label shall be acid etched, sand blasted, ceramic fired, embossed or shall be of a type that once applied cannot be removed without being destroyed.

Tempered spandrel glass shall be provided with a removable paper marking by the manufacturer.

2403.2 Glass supports. Where one or more sides of any pane of glass is not firmly supported, or is subjected to unusual load conditions, detailed construction documents, detailed shop drawings and analysis or test data assuring safe performance for the specific installation shall be prepared by a registered design professional.

2403.3 Framing. To be considered firmly supported, the framing members for each individual pane of glass shall be designed

so the deflection of the edge of the glass perpendicular to the glass pane shall not exceed $1/175$ of the glass edge length or $3/4$ inch (19.1 mm), whichever is less, when subjected to the larger of the positive or negative load where loads are combined as specified in Section 1605.

2403.4 Interior glazed areas. Where interior glazing is installed adjacent to a walking surface, the differential deflection of two adjacent unsupported edges shall not be greater than the thickness of the panels when a force of 50 pounds per linear foot (730 N/m) is applied horizontally to one panel at any point up to 42 inches (1067 mm) above the walking surface.

2403.5 Louvered windows or jalousies. Float, wired and patterned glass in louvered windows and jalousies shall be no thinner than nominal $3/16$ inch (4.8 mm) and no longer than 48 inches (1219 mm). Exposed glass edges shall be smooth.

Wired glass with wire exposed on longitudinal edges shall not be used in louvered windows or jalousies.

Where other glass types are used, the design shall be submitted to the building official for approval.

SECTION 2404 WIND, SNOW AND DEAD LOADS ON GLASS

2404.1 Vertical glass. Glass sloped 15 degrees (0.26 rad) or less from vertical in windows, curtain and window walls, doors and other exterior applications shall be designed to resist the wind loads in Section 1609 for components and cladding. Glazing firmly supported on all four edges is permitted to be designed by the following provisions. Where the glass is not firmly supported on all four edges, analysis or test data ensuring safe performance for the specific installation shall be prepared by a registered design professional.

The design of vertical glazing shall be based on the following equation:

$$F_{gw} \leq F_{ga} \quad \text{(Equation 24-1)}$$

where:

F_{gw} is the wind load on the glass computed per Section 1609 and F_{ga} is the maximum allowable load on the glass computed by the following formula:

$$F_{ga} = c_1 F_{ge} \quad \text{(Equation 24-2)}$$

where:

F_{ge} = Maximum allowable equivalent load, psf (kN/m²) determined from Figures 2404(1) through 2404(12) for the applicable glass dimensions and thickness.

c_1 = Factor determined from Table 2404.1 based on glass type.

TABLE 2404.1
 c_1 FACTORS FOR VERTICAL AND SLOPED GLASS^a
[For use with Figures 2404(1) through 2404(12)]

GLASS TYPE	FACTOR
Single Glass	
Regular (annealed)	1.0
Heat strengthened	2.0
Fully tempered	4.0
Wired	0.50
Patterned ^c	1.0
Sandblasted ^d	0.50
Laminated — regular plies ^e	0.7/0.90 ^f
Laminated — heat-strengthened plies ^e	1.5/1.8 ^f
Laminated — fully tempered plies ^e	3.0/3.6 ^f
Insulating Glass^b	
Regular (annealed)	1.8
Heat strengthened	3.6
Fully tempered	7.2
Laminated — regular plies ^e	1.4/1.6 ^f
Laminated — heat-strengthened plies ^e	2.7/3.2 ^f
Laminated — fully tempered plies ^e	5.4/6.5 ^f

- a. Either Table 2404.1 or 2404.2 shall be appropriate for sloped glass depending on whether the snow or wind load is dominant. See Section 2404.2. For glass types (vertical or sloped) not included in the tables, refer to ASTM E 1300 for guidance.
- b. Values apply for insulating glass with identical panes.
- c. The value for patterned glass is based on the thinnest part of the pattern; interpolation between graphs is permitted.
- d. The value for sandblasted glass is for moderate levels of sandblasting.
- e. Values for laminated glass are based on the total thickness of the glass and apply for glass with two equal glass ply thicknesses.
- f. The lower value applies if, for any laminated glass pane, either the ratio of the long to short dimension is greater than 2.0 or the lesser dimension divided by the thickness of the pane is 150 or less; the higher value applies in all other cases.

2404.2 Sloped glass. Glass sloped more than 15 degrees (0.26 rad) from vertical in skylights, sunspaces, sloped roofs and other exterior applications shall be designed to resist the most critical of the following combinations of loads.

$$1. F_g = W_o - D \quad \text{(Equation 24-3)}$$

$$2. F_g = W_i + D + 0.5 S \quad \text{(Equation 24-4)}$$

$$3. F_g = 0.5 W_i + D + S \quad \text{(Equation 24-5)}$$

where:

- D = Glass dead load (psf)
For glass sloped 30 degrees (0.52 rad) or less from horizontal,
 $D = 13 t_g$ (For SI: $0.0245 t_g$)
For glass sloped more than 30 degrees (0.52 rad) from horizontal,
 $D = 13 t_g \cos \theta$ (For SI: $0.0245 t_g \cos \theta$).

- F_g = Total load, psf (kN/m²) on glass.
- S = Snow load, psf (kN/m²) as determined in Section 1608.
- t_g = Total glass thickness, inches (mm) of glass panes and plies.
- W_i = Inward wind force, psf (kN/m²) as calculated in Section 1609.
- W_o = Outward wind force, psf (kN/m²) as calculated in Section 1609.
- θ = Angle of slope from horizontal.

The design of sloped glazing shall be based on the following equation:

$$F_g \leq F_{ga} \quad \text{(Equation 24-6)}$$

where F_g is the maximum load on the glass determined from the load combinations above, and F_{ga} is the maximum allowable load on the glass.

If F_g is determined by load combinations 1 or 2 above, F_{ga} shall be computed as for vertical glazing in Section 2404.1. If F_g is determined by load combination 3 above, F_{ga} shall be computed by the following equation:

$$F_{ga} = c_2 F_{ge} \quad \text{(Equation 24-7)}$$

where:

- F_{ge} = Maximum allowable equivalent load (psf) determined from Figures 2404(1) through 2404(12) for the applicable glass dimensions and thickness.
- c_2 = Factor determined from Table 2404.2 based on glass type.

SECTION 2405 SLOPED GLAZING AND SKYLIGHTS

2405.1 Scope. This section applies to the installation of glass and other transparent, translucent or opaque glazing material installed at a slope more than 15 degrees (0.26 rad) from the vertical plane, including glazing materials in skylights, roofs and sloped walls.

2405.2 Allowable glazing materials and limitations. Sloped glazing shall be any of the following materials, subject to the listed limitations.

1. For monolithic glazing systems the glazing material of the single light or layer shall be laminated glass with a minimum 30-mil (0.76 mm) polyvinyl butyral (or equivalent) interlayer, wired glass, light-transmitting plastic materials meeting the requirements of Section 2607, heat-strengthened glass or fully tempered glass.
2. For multiple-layer glazing systems, each light or layer shall consist of any of the glazing materials specified in Item 1 above.

Annealed glass is permitted to be used as specified within Exceptions 2 and 3 of Section 2405.3.

For additional requirements for plastic skylights, see Section 2610. Glass-block construction shall conform to the requirements of Section 2101.2.4.

TABLE 2404.2
 c_2 FACTORS FOR SLOPED GLASS^a
 [For use with Figures 2404(1) through 2404(12)]

GLASS TYPE	FACTOR
Single Glass	
Regular (annealed)	0.6
Heat strengthened	1.6
Fully tempered	3.6
Wired	0.3
Patterned ^c	0.6
Laminated — regular plies ^d	0.3/0.45 ^e
Laminated — heat-strengthened plies ^d	0.8/1.2 ^e
Laminated — fully tempered plies ^d	1.8/2.7 ^e
Insulating Glass^b	
Regular (annealed)	1.1
Heat strengthened	2.9
Fully tempered	6.5
Laminated — regular plies ^d	0.54/0.81 ^e
Laminated — heat-strengthened plies ^d	1.4/2.2 ^e
Laminated — fully tempered plies ^d	3.3/4.9 ^e

- a. Either Table 2404.1 or 2404.2 shall be appropriate for sloped glass depending on whether the snow or wind load is dominant. See Section 2404.2. For glass types (vertical or sloped) not included in the tables, refer to ASTM E 1300 for guidance.
- b. Values apply for insulating glass with identical panes.
- c. The value for patterned glass is based on the thinnest part of the pattern; interpolation between graphs is permitted.
- d. Values for laminated glass are based on the total thickness of the glass and apply for glass with two equal glass ply thicknesses.
- e. The lower value applies where, for any laminated glass pane, either the ratio of the long to short dimension is greater than 2.0 or the lesser dimension divided by the thickness of the pane is 150 or less. The higher value applies in all other cases.

2405.3 Screening. Where used in monolithic glazing systems, heat-strengthened glass and fully tempered glass shall have screens installed below the glazing material. The screens and their fastenings shall: (1) be capable of supporting twice the weight of the glazing; (2) be firmly and substantially fastened to the framing members; and (3) be installed within 4 inches (102 mm) of the glass. The screens shall be constructed of a noncombustible material not thinner than No. 12 B&S gage (0.0808 inch) with mesh not larger than 1 inch by 1 inch (25 mm by 25 mm). In a corrosive atmosphere, structurally equivalent noncorrosive screen materials shall be used. Heat-strengthened glass, fully tempered glass and wired glass, when used in multiple-layer glazing systems as the bottom glass layer over the walking surface, shall be equipped with screening that conforms to the requirements for monolithic glazing systems.

Exception: In monolithic and multiple-layer sloped glazing systems, the following applies:

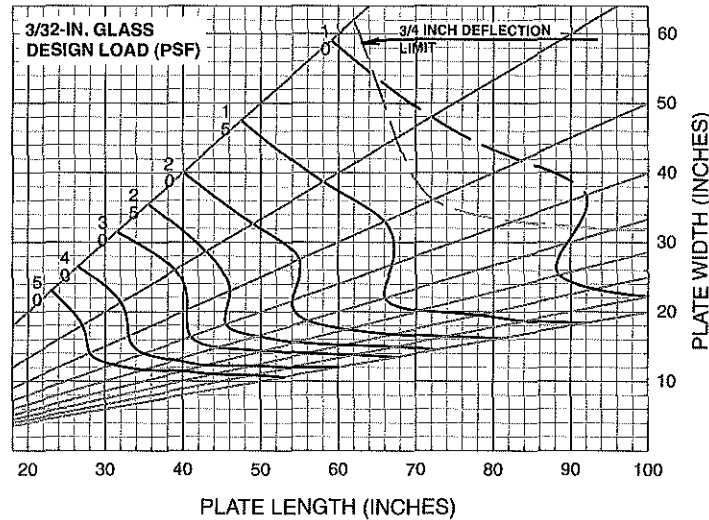
1. Fully tempered glass installed without protective screens where glazed between intervening floors at a

slope of 30 degrees (0.52 rad) or less from the vertical plane shall have the highest point of the glass 10 feet (3048 mm) or less above the walking surface.

2. Screens are not required below any glazing material, including annealed glass, where the walking surface below the glazing material is permanently protected from the risk of falling glass or the area below the glazing material is not a walking surface.
3. Any glazing material, including annealed glass, is permitted to be installed without screens in the sloped glazing systems of commercial or detached noncombustible greenhouses used exclusively for growing plants and not open to the public, provided that the height of the greenhouse at the ridge does not exceed 30 feet (9144 mm) above grade.
4. Screens shall not be required within individual dwelling units in Groups R-2, R-3 and R-4 as applicable in Section 101.2 where fully tempered glass is used as single glazing or as both panes in an insulating glass unit, and the following conditions are met:
 - 4.1. Each pane of the glass is 16 square feet (1.5 m²) or less in area.
 - 4.2. The highest point of the glass is 12 feet (3658 mm) or less above any walking surface or other accessible area.
 - 4.3. The glass thickness is $\frac{3}{16}$ inch (4.8 mm) or less.
5. Screens shall not be required for laminated glass with a 15-mil (0.38 mm) polyvinyl butyral (or equivalent) interlayer used within individual dwelling units in Groups R-2, R-3 and R-4 as applicable in Section 101.2 within the following limits:
 - 5.1. Each pane of glass is 16 square feet (1.5 m²) or less in area.
 - 5.2. The highest point of the glass is 12 feet (3658 mm) or less above a walking surface or other accessible area.

2405.4 Framing. In Types 1 and 2 construction, sloped glazing and skylight frames shall be constructed of noncombustible materials. In structures where acid fumes deleterious to metal are incidental to the use of the buildings, approved pressure-treated wood or other approved noncorrosive materials are permitted to be used for sash and frames. Sloped glazing and skylights shall be designed for tributary roof loads in Chapter 16. Skylights set at an angle of less than 45 degrees (0.79 rad) from the horizontal plane shall be mounted at least 4 inches (102 mm) above the plane of the roof on a curb construction as required for the frame. Skylights shall not be installed in the plane of the roof where the roof pitch is less than 45 degrees (0.79 rad) from the horizontal.

Exception: Curbs for skylights are not required on roofs with a minimum slope of three units vertical in 12 units horizontal (25-percent slope) in occupancies in Group R-3 as applicable in Section 101.2.

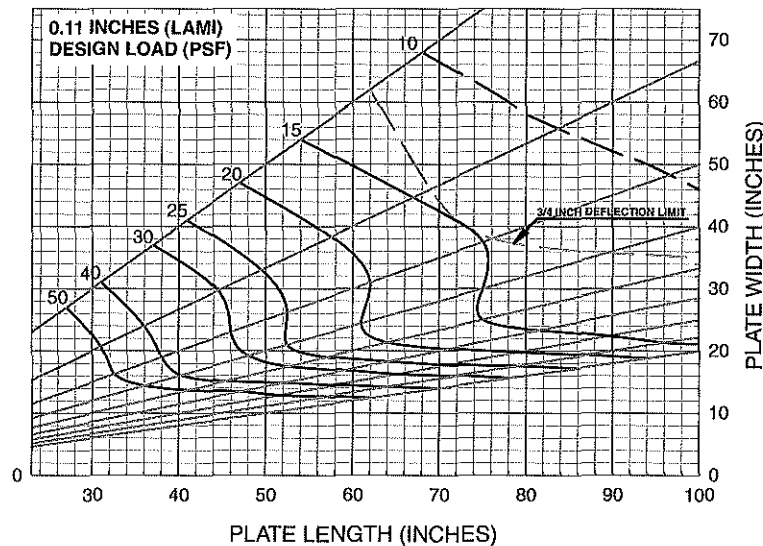


For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa.

FIGURE 2404(1)^{a, b, c, d, e, f}
MAXIMUM ALLOWABLE LOAD FOR VERTICAL AND SLOPED
RECTANGULAR GLASS SUPPORTED ON ALL EDGES

NOTES:

- a. In each graph, the vertical axis is the lesser dimension; the horizontal axis is the greater dimension.
- b. The diagonal number on each graph shows the equivalent design load in psf.
- c. The dashed lines indicate glass that has deflection in excess of $3/4$ inch.
- d. Interpolation between lines is permitted. Extrapolation is not allowed.
- e. For laminated glass, the applicable glass thickness is the total glass thickness.
- f. For insulating glass panes, the applicable glass thickness is the thickness of one pane.

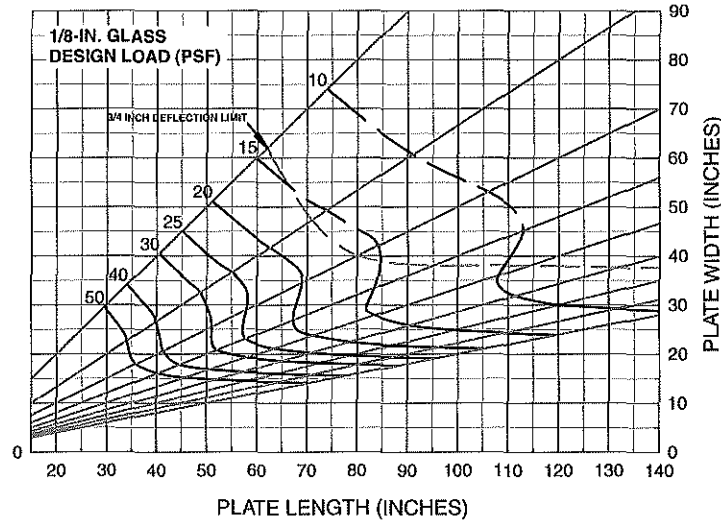


For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa.

FIGURE 2404(2)^{a, b, c, d, e, f}
MAXIMUM ALLOWABLE LOAD FOR VERTICAL AND SLOPED
RECTANGULAR GLASS SUPPORTED ON ALL EDGES

NOTES:

- a. In each graph, the vertical axis is the lesser dimension; the horizontal axis is the greater dimension.
- b. The diagonal number on each graph shows the equivalent design load in psf.
- c. The dashed lines indicate glass that has deflection in excess of $3/4$ inch.
- d. Interpolation between lines is permitted. Extrapolation is not allowed.
- e. For laminated glass, the applicable glass thickness is the total glass thickness.
- f. For insulating glass panes, the applicable glass thickness is the thickness of one pane.

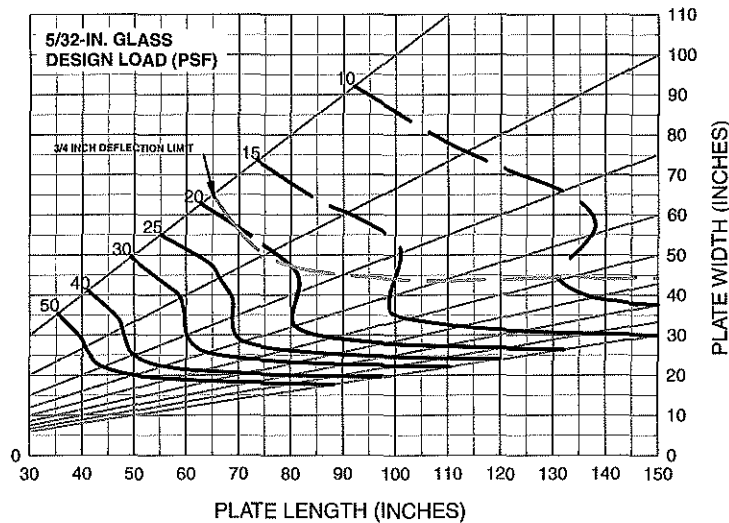


For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa.

**FIGURE 2404(3)^{a, b, c, d, e, f}
MAXIMUM ALLOWABLE LOAD FOR VERTICAL AND SLOPED
RECTANGULAR GLASS SUPPORTED ON ALL EDGES**

NOTES:

- a. In each graph, the vertical axis is the lesser dimension; the horizontal axis is the greater dimension.
- b. The diagonal number on each graph shows the equivalent design load in psf.
- c. The dashed lines indicate glass that has deflection in excess of 3/4 inch.
- d. Interpolation between lines is permitted. Extrapolation is not allowed.
- e. For laminated glass, the applicable glass thickness is the total glass thickness.
- f. For insulating glass panes, the applicable glass thickness is the thickness of one pane.

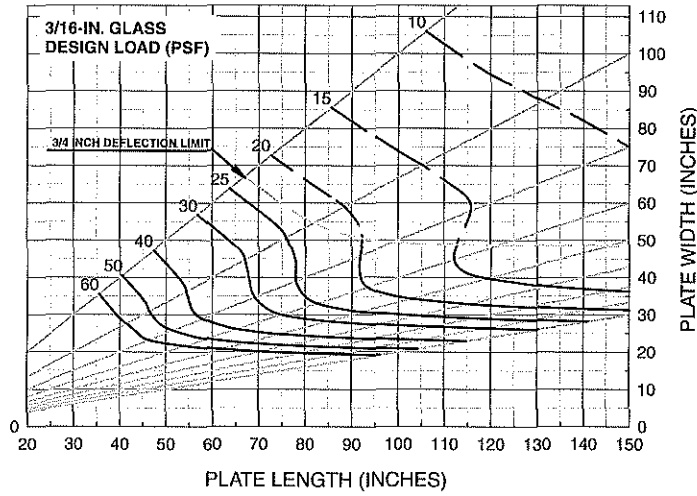


For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa.

**FIGURE 2404(4)^{a, b, c, d, e, f}
MAXIMUM ALLOWABLE LOAD FOR VERTICAL AND SLOPED
RECTANGULAR GLASS SUPPORTED ON ALL EDGES**

NOTES:

- a. In each graph, the vertical axis is the lesser dimension; the horizontal axis is the greater dimension.
- b. The diagonal number on each graph shows the equivalent design load in psf.
- c. The dashed lines indicate glass that has deflection in excess of 3/4 inch.
- d. Interpolation between lines is permitted. Extrapolation is not allowed.
- e. For laminated glass, the applicable glass thickness is the total glass thickness.
- f. For insulating glass panes, the applicable glass thickness is the thickness of one pane.

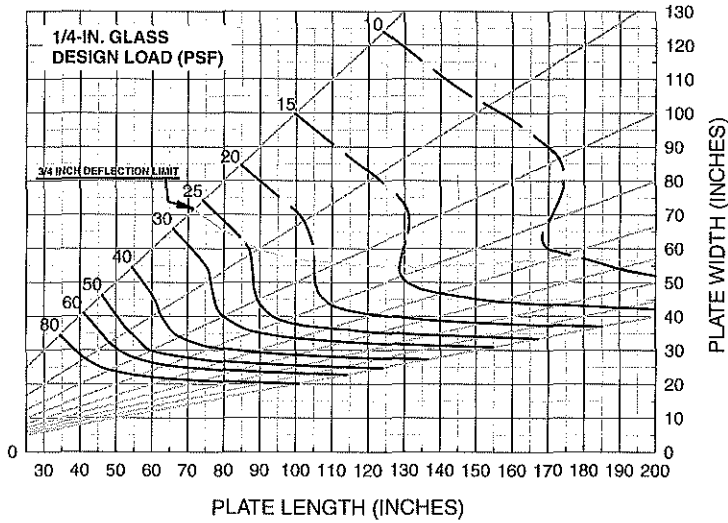


For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa.

**FIGURE 2404(5)^{a, b, c, d, e, f}
MAXIMUM ALLOWABLE LOAD FOR VERTICAL AND SLOPED
RECTANGULAR GLASS SUPPORTED ON ALL EDGES**

NOTES:

- a. In each graph, the vertical axis is the lesser dimension; the horizontal axis is the greater dimension.
- b. The diagonal number on each graph shows the equivalent design load in psf.
- c. The dashed lines indicate glass that has deflection in excess of $\frac{3}{4}$ inch.
- d. Interpolation between lines is permitted. Extrapolation is not allowed.
- e. For laminated glass, the applicable glass thickness is the total glass thickness.
- f. For insulating glass panes, the applicable glass thickness is the thickness of one pane.

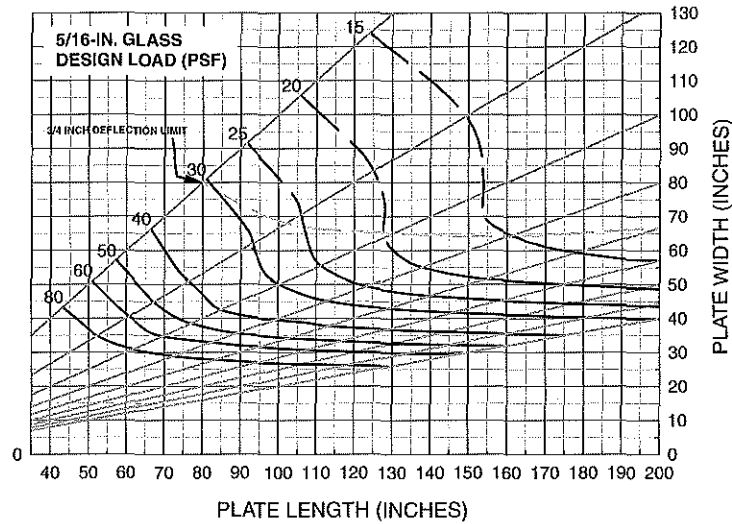


For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa.

**FIGURE 2404(6)^{a, b, c, d, e, f}
MAXIMUM ALLOWABLE LOAD FOR VERTICAL AND SLOPED
RECTANGULAR GLASS SUPPORTED ON ALL EDGES**

NOTES:

- a. In each graph, the vertical axis is the lesser dimension; the horizontal axis is the greater dimension.
- b. The diagonal number on each graph shows the equivalent design load in psf.
- c. The dashed lines indicate glass that has deflection in excess of $\frac{3}{4}$ inch.
- d. Interpolation between lines is permitted. Extrapolation is not allowed.
- e. For laminated glass, the applicable glass thickness is the total glass thickness.
- f. For insulating glass panes, the applicable glass thickness is the thickness of one pane.

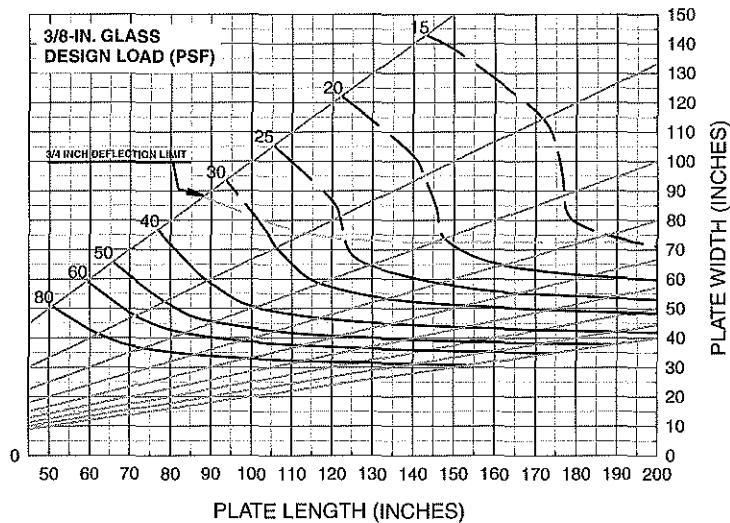


For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa.

FIGURE 2404(7)^{a, b, c, d, e, f}
MAXIMUM ALLOWABLE LOAD FOR VERTICAL AND SLOPED
RECTANGULAR GLASS SUPPORTED ON ALL EDGES

NOTES:

- a. In each graph, the vertical axis is the lesser dimension; the horizontal axis is the greater dimension.
- b. The diagonal number on each graph shows the equivalent design load in psf.
- c. The dashed lines indicate glass that has deflection in excess of $3/4$ inch.
- d. Interpolation between lines is permitted. Extrapolation is not allowed.
- e. For laminated glass, the applicable glass thickness is the total glass thickness.
- f. For insulating glass panes, the applicable glass thickness is the thickness of one pane.

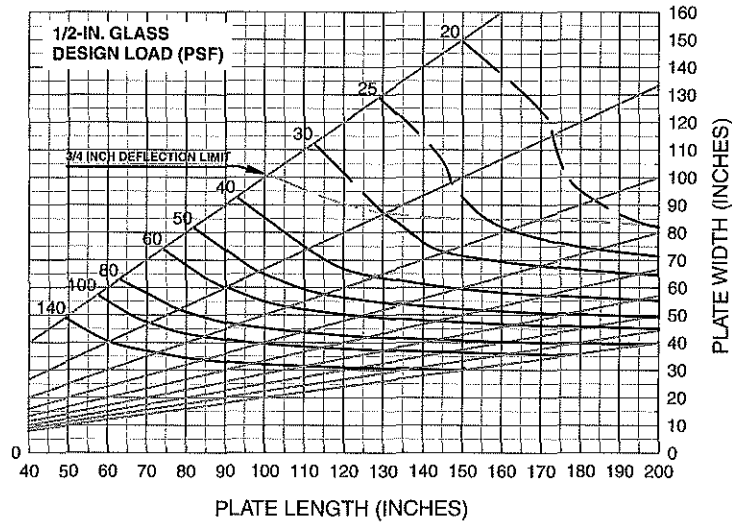


For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa.

FIGURE 2404(8)^{a, b, c, d, e, f}
MAXIMUM ALLOWABLE LOAD FOR VERTICAL AND SLOPED
RECTANGULAR GLASS SUPPORTED ON ALL EDGES

NOTES:

- a. In each graph, the vertical axis is the lesser dimension; the horizontal axis is the greater dimension.
- b. The diagonal number on each graph shows the equivalent design load in psf.
- c. The dashed lines indicate glass that has deflection in excess of $3/4$ inch.
- d. Interpolation between lines is permitted. Extrapolation is not allowed.
- e. For laminated glass, the applicable glass thickness is the total glass thickness.
- f. For insulating glass panes, the applicable glass thickness is the thickness of one pane.

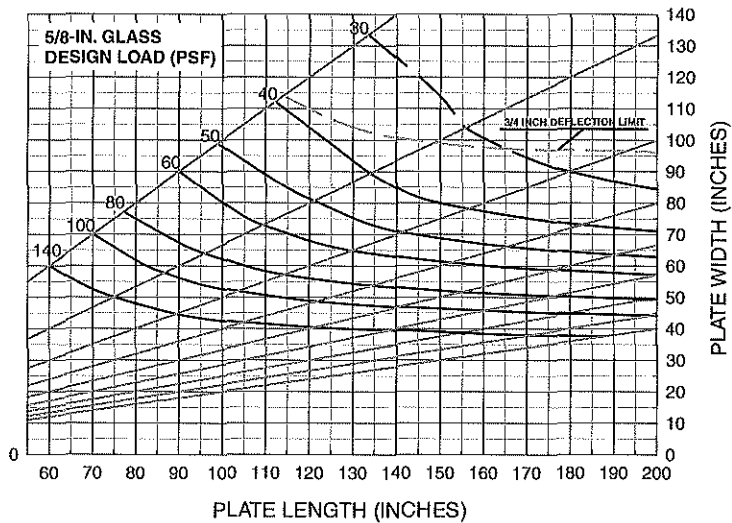


For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa.

**FIGURE 2404(9)^{a, b, c, d, e, f}
MAXIMUM ALLOWABLE LOAD FOR VERTICAL AND SLOPED
RECTANGULAR GLASS SUPPORTED ON ALL EDGES**

NOTES:

- a. In each graph, the vertical axis is the lesser dimension; the horizontal axis is the greater dimension.
- b. The diagonal number on each graph shows the equivalent design load in psf.
- c. The dashed lines indicate glass that has deflection in excess of $3/4$ inch.
- d. Interpolation between lines is permitted. Extrapolation is not allowed.
- e. For laminated glass, the applicable glass thickness is the total glass thickness.
- f. For insulating glass panes, the applicable glass thickness is the thickness of one pane.

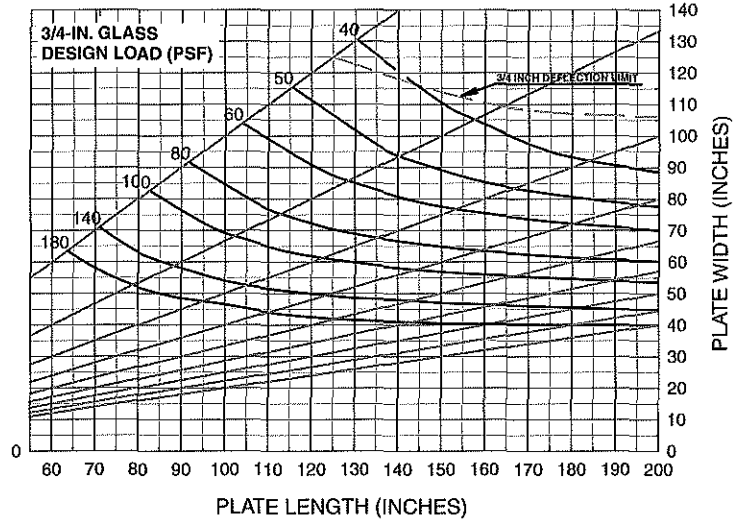


For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa.

**FIGURE 2404(10)^{a, b, c, d, e, f}
MAXIMUM ALLOWABLE LOAD FOR VERTICAL AND SLOPED
RECTANGULAR GLASS SUPPORTED ON ALL EDGES**

NOTES:

- a. In each graph, the vertical axis is the lesser dimension; the horizontal axis is the greater dimension.
- b. The diagonal number on each graph shows the equivalent design load in psf.
- c. The dashed lines indicate glass that has deflection in excess of $3/4$ inch.
- d. Interpolation between lines is permitted. Extrapolation is not allowed.
- e. For laminated glass, the applicable glass thickness is the total glass thickness.
- f. For insulating glass panes, the applicable glass thickness is the thickness of one pane.

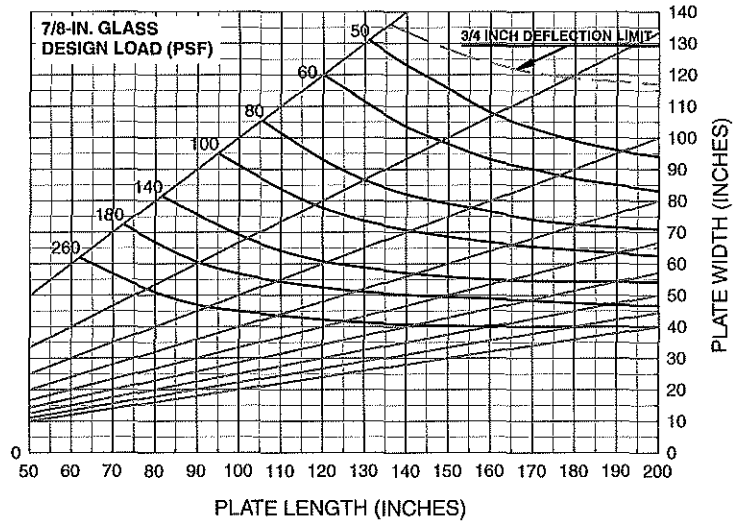


For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa.

FIGURE 2404(11)^{a, b, c, d, e, f}
MAXIMUM ALLOWABLE LOAD FOR VERTICAL AND SLOPED
RECTANGULAR GLASS SUPPORTED ON ALL EDGES

NOTES:

- a. In each graph, the vertical axis is the lesser dimension; the horizontal axis is the greater dimension.
- b. The diagonal number on each graph shows the equivalent design load in psf.
- c. The dashed lines indicate glass that has deflection in excess of 3/4 inch.
- d. Interpolation between lines is permitted. Extrapolation is not allowed.
- e. For laminated glass, the applicable glass thickness is the total glass thickness.
- f. For insulating glass panes, the applicable glass thickness is the thickness of one pane.



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

FIGURE 2404(12)^{a, b, c, d, e, f}
MAXIMUM ALLOWABLE LOAD FOR VERTICAL AND SLOPED
RECTANGULAR GLASS SUPPORTED ON ALL EDGES

NOTES:

- a. In each graph, the vertical axis is the lesser dimension; the horizontal axis is the greater dimension.
- b. The diagonal number on each graph shows the equivalent design load in psf.
- c. The dashed lines indicate glass that has deflection in excess of 3/4 inch.
- d. Interpolation between lines is permitted. Extrapolation is not allowed.
- e. For laminated glass, the applicable glass thickness is the total glass thickness.
- f. For insulating glass panes, the applicable glass thickness is the thickness of one pane.

**SECTION 2406
SAFETY GLAZING**

2406.1 Human impact loads. Individual glazed areas, including glass mirrors, in hazardous locations as defined in Section 2406.2 shall pass the test requirements of CPSC 16 CFR 1201, listed in Chapter 35. Glazing shall comply with the CPSC 16 CFR, Part 1201 criteria for Category I or Category II as indicated in Table 2406.1.

Exceptions:

1. Polished wire glass installed in fire doors, fire windows and view panels in fire-resistant walls shall comply with ANSI Z97.1 listed in Chapter 35.
2. Plastic glazing shall meet the weathering requirements of ANSI Z97.1 listed in Chapter 35.
3. Glass-block walls shall comply with Section 2101.2.4.
4. Louvered windows and jalousies shall comply with Section 2403.5.

2406.1.1 Identification of safety glazing. Except as indicated in Section 2406.1.2, each pane of safety glazing installed in hazardous locations shall be identified by a label specifying the labeler, whether the manufacturer or installer, and the safety glazing standard with which it complies, as well as the information specified in Section 2403.1. The label shall be acid etched, sand blasted, ceramic fired, or an embossed mark, or shall be of a type that once applied cannot be removed without being destroyed.

Exceptions:

1. For other than tempered glass, labels are not required, provided the building official approves the use of a certificate, affidavit or other evidence confirming compliance with this code.
2. Tempered spandrel glass is permitted to be identified by the manufacturer with a removable paper label.

2406.1.2 Multi-light assemblies. Multi-light glazed assemblies having individual lights not exceeding 1 square foot (0.09 square meter) in exposed area shall have at least one light in the assembly marked as indicated in Section 2406.1.1. Other lights in the assembly shall be marked “CPSC 16 CFR 1201” or “ANSI Z97.1” as appropriate.

2406.2 Hazardous locations. The following shall be considered specific hazardous locations requiring safety glazing materials:

1. Glazing in swinging doors except jalousies (see Section 2406.2.1).
2. Glazing in fixed and sliding panels of sliding door assemblies and panels in sliding and bifold closet door assemblies.
3. Glazing in storm doors.
4. Glazing in unframed swinging doors.
5. Glazing in doors and enclosures for hot tubs, whirlpools, saunas, steam rooms, bathtubs and showers. Glazing in any portion of a building wall enclosing these compartments where the bottom exposed edge of the glazing is less than 60 inches (1524 mm) above a standing surface.
6. Glazing in an individual fixed or operable panel adjacent to a door where the nearest exposed edge of the glazing is within a 24-inch (610 mm) arc of either vertical edge of the door in a closed position and where the bottom exposed edge of the glazing is less than 60 inches (1524 mm) above the walking surface.

Exceptions:

1. Panels where there is an intervening wall or other permanent barrier between the door and glazing.
2. Glazing in walls perpendicular to the plane of the door in a closed position in one- and two-family dwellings or within dwelling units in Group R-2.
7. Glazing in an individual fixed or operable panel, other than in those locations described in preceding Items 5 and 6, which meets all of the following conditions:
 - 7.1. Exposed area of an individual pane greater than 9 square feet (0.84 m²);
 - 7.2. Exposed bottom edge less than 18 inches (457 mm) above the floor;
 - 7.3. Exposed top edge greater than 36 inches (914 mm) above the floor; and
 - 7.4. One or more walking surface(s) within 36 inches (914 mm) horizontally of the plane of the glazing.

Exception: Safety glazing for condition number 7 is not required for the following installations:

1. A protective bar 1½ inches (38 mm) or more in height, capable of withstanding a horizontal load of 50 pounds per linear foot (730 N/m) without contacting the glass, is installed on the accessible sides of the glazing 34 inches to 38 inches (864 mm to 965 mm) above the floor.

**TABLE 2406.1
MINIMUM CATEGORY CLASSIFICATION OF GLAZING**

EXPOSED SURFACE AREA OF ONE SIDE OF ONE LITE	GLAZING IN STORM OR COMBINATION DOORS (Category class)	GLAZING IN DOORS (Category class)	GLAZED PANELS REGULATED BY ITEM 7 OF SECTION 2406.2 (Category class)	GLAZED PANELS REGULATED BY ITEM 6 OF SECTION 2406.2 (Category class)	DOORS AND ENCLOSURES REGULATED BY ITEM 5 OF SECTION 2406.2 (Category class)	SLIDING GLASS DOORS PATIO TYPE (Category class)
9 square feet or less	I	I	No requirement	I	II	II
More than 9 square feet	II	II	II	II	II	II

For SI: 1 square foot = 0.0929m².

2. The outboard pane in insulating glass units or multiple glazing where the bottom exposed edge of the glass is 25 feet (7620 mm) or more above any grade, roof, walking surface or other horizontal or sloped (within 45 degrees of horizontal) (0.78 rad) surface adjacent to the glass exterior.
8. Glazing in guards and railings, including structural baluster panels and nonstructural in-fill panels, regardless of area or height above a walking surface.
9. Glazing in walls and fences enclosing indoor and outdoor swimming pools, hot tubs and spas where all of the following conditions are present:
 - 9.1. The bottom edge of the glazing on the pool or spa side is less than 60 inches (1524 mm) above a walking surface on the pool or spa side of the glazing; and
 - 9.2. The glazing is within 60 inches (1524 mm) horizontally of the water's edge of a swimming pool or spa.
10. Glazing adjacent to stairways, landings and ramps where the following conditions are present:
 - 10.1. Within 36 inches (914 mm) horizontally of a walking surface;
 - 10.2. Within 60 inches (1524 mm) horizontally of the bottom tread of a stairway in any direction; and
 - 10.3. Bottom edge less than 60 inches (1524 mm) above the plane of the adjacent walking surface (or stairways, measured from the nose of the tread).

Exception: Safety glazing for condition number 10 is not required for the following installations where:

1. The side of a stairway, landing or ramp has a guard or handrail, including balusters or in-fill panels, complying with the provisions of Sections 1003.2.12 and 1607.7; and
2. The plane of the glass is 18 inches (457 mm) from the railing.

2406.2.1 Exceptions. The following products, materials and uses shall not be considered specific hazardous locations:

1. Openings in doors through which a 3-inch (76 mm) sphere is unable to pass.
2. Decorative glass in Section 2406.2, Item 1, 6 or 7.
3. Glazing materials used as curved glazed panels in revolving doors.
4. Commercial refrigerated cabinet glazed doors.
5. Glass block panels complying with Section 2101.2.4.
6. Louvered windows and jalousies complying with the requirements of Section 2403.5.
7. Mirrors and other glass panels mounted or hung on a surface that provides a continuous backing support.

2406.3 Fire department access panels. Fire department glass access panels shall be of tempered glass. For insulating glass units, all panes shall be tempered glass.

SECTION 2407

GLASS IN HANDRAILS AND GUARDS

2407.1 Materials. Glass used as structural balustrade panels in railings shall be constructed of either single fully tempered glass, laminated fully tempered glass or laminated heat-strengthened glass. Glazing in railing in-fill panels shall conform to ANSI Z97.1 listed in Chapter 35 or shall be of an approved safety glazing material that conforms to the provisions of Section 2406.1. For all glazing types, the minimum nominal thickness shall be 1/4 inch (6.4 mm). Fully tempered glass and laminated glass shall comply with Category II of CPSC 16 CFR 1201, listed in Chapter 35. Wired glass shall comply with ANSI Z97.1 listed in Chapter 35.

2407.1.1 Loads. The panels and their support system shall be designed to withstand the loads specified in Section 1607.7. A safety factor of 4 shall be used.

2407.1.2 Support. Each handrail or guard section shall be supported by a minimum of three glass balusters or shall be otherwise supported to remain in place should one baluster panel fail. Glass balusters shall not be installed without an attached handrail or guard.

2407.1.3 Parking garages. Glazing materials shall not be installed in railings in parking garages except for pedestrian areas not exposed to impact from vehicles.

SECTION 2408

GLAZING IN ATHLETIC FACILITIES

2408.1 General. Glazing in racquetball and squash courts, and similar uses subject to impact loads, which forms whole or partial wall sections or which is used as a door or part of a door, shall comply with Section 2408.2.

2408.2 Testing. Test methods and loads for individual glazed areas including those described in Section 2408.1 shall conform to those of CPSC 16 CFR, Part 1201, listed in Chapter 35, with impacts being applied at a height of 59 inches (1499 mm) above the playing surface to an actual or simulated glass wall installation with fixtures, fittings and methods of assembly identical to those used in practice.

Glass walls shall comply with the following conditions:

1. A glass wall in a racquetball or squash court, or similar use subject to impact loads, shall remain intact following a test impact.
2. The deflection of such walls shall not be greater than 1 1/2 inches (38 mm) at the point of impact.

Glass doors shall comply with the following conditions:

1. Glass doors shall remain intact following a test impact at the prescribed height in the center of the door.

2. The relative deflection between the edge of a glass door and the adjacent wall shall not exceed the following values for the impact test bag-drop heights:
 - 2.1. The thickness of the wall plus $\frac{1}{8}$ inch (3.2 mm) for a drop height of 24 inches (610 mm).
 - 2.2. The thickness of the wall plus $\frac{1}{4}$ inch (6.4 mm) for a drop height of 36 inches (914 mm).
 - 2.3. The thickness of the wall plus $\frac{1}{2}$ inch (12.7 mm) for a drop height of 48 inches (1219 mm).

The factor c_2 , for laminated glass found in Table 2404.2, applies to two-ply laminates only. The value of F_a shall be doubled for dynamic applications.

SECTION 2409 GLASS IN FLOORS AND SIDEWALKS

2409.1 General. Glass installed in the walking surface of floors, landings, stairwells and similar locations shall comply with Sections 2409.2 through 2409.4.

2409.2 Design load. The design for glass used in floors, landings, stair treads, and similar locations shall be determined as indicated in Section 2409.4 based on the load that produces the greater stresses from the following:

1. The uniformly distributed unit load (F_u), from Section 1605; or
2. The concentrated load (F_c) from Table 1607.1; or
3. The actual load (F_a) produced by the intended use.

The dead load (D) for glass in psf (kN/m²) shall be taken as the total thickness of the glass plies in inches by 13 (For SI: glass plies in mm by 0.0245). Load reductions allowed by Section 1607.9 are not permitted.

2409.3 Laminated glass. Laminated glass having a minimum of two plies shall be used. The glass shall be capable of supporting the total design load, as indicated in Section 2409.4, with any one ply broken.

2409.4 Design formula. The design of the glass shall be determined in accordance with the following:

$$2 F_u + D \leq 0.67 c_2 F_{ge}, \text{ and} \quad (\text{Equation 24-8})$$

$$(8 F_c / A) + D \leq 0.67 c_2 F_{ge}, \text{ and} \quad (\text{Equation 24-9})$$

$$F_a + D \leq 0.67 c_2 F_{ge} \quad (\text{Equation 24-10})$$

where:

- F_a = Actual intended use load, psf (kN/m²).
- F_u = Uniformly distributed load, psf (kN/m²).
- D = Glass dead load (psf) = $13 t_g$ (For SI: $D = (0.0245)(t_g)$, kN/m²).
- t_g = Total glass thickness (inches) (mm).
- F_c = Concentrated load pounds, kN.
- c_2 = Factor determined from Table 2404.2 based on glass type.
- F_{ge} = Maximum allowable load on glass, determined from Figures 2404(1) through 2404(12) for the applicable glass dimensions and thickness psf (kN/m²).
- A = Area of rectangular glass, square feet (m²).

CHAPTER 25

GYPSUM BOARD AND PLASTER

SECTION 2501 GENERAL

2501.1 Scope.

2501.1.1 General. Provisions of this chapter shall govern the materials, design, construction and quality of gypsum board, lath, gypsum plaster and cement plaster.

2501.1.2 Performance. Lathing, plastering and gypsum board construction shall be done in the manner and with the materials specified in this chapter, and when required for fire protection, shall also comply with the provisions of Chapter 7.

2501.1.3 Other materials. Other approved wall or ceiling coverings shall be permitted to be installed in accordance with the recommendations of the manufacturer and the conditions of approval.

SECTION 2502 DEFINITIONS

2502.1 Definitions. The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

CEMENT PLASTER. A mixture of portland or blended cement, portland cement or blended cement and hydrated lime, masonry cement, or plastic cement and aggregate and other approved materials as specified in this code.

EXTERIOR SURFACES. Weather-exposed surfaces.

GYPSUM BOARD. Gypsum wallboard, gypsum sheathing, gypsum base for gypsum veneer plaster, exterior gypsum soffit board, predecorated gypsum board, or water-resistant gypsum backing board complying with the standards listed in Tables 2506.2, 2507.2 and Chapter 35.

GYPSUM PLASTER. A mixture of calcined gypsum or calcined gypsum and lime and aggregate and other approved materials as specified in this code.

GYPSUM VENEER PLASTER. Gypsum plaster applied to an approved base in one or more coats normally not exceeding $\frac{1}{4}$ inch (6.4 mm) in total thickness.

INTERIOR SURFACES. Surfaces other than weather-exposed surfaces.

WEATHER-EXPOSED SURFACES. Surfaces of walls, ceilings, floors, roofs, soffits and similar surfaces exposed to the weather except the following:

1. Ceilings and roof soffits enclosed by walls, fascia, bulkheads, or beams that extend a minimum of 12 inches (305 mm) below such ceiling or roof soffits.
2. Walls or portions of walls beneath an unenclosed roof area, where located a horizontal distance from an open exterior opening equal to a least twice the height of the opening.

3. Ceiling and roof soffits located a minimum horizontal distance of 10 feet (3048 mm) from the outer edges of the ceiling or roof soffits.

WIRE BACKING. Horizontal strands of tautened wire attached to surfaces of vertical supports which, when covered with the building paper, provide a backing for cement plaster.

SECTION 2503 INSPECTION

2503.1 Deleted.

SECTION 2504 VERTICAL AND HORIZONTAL ASSEMBLIES

2504.1 Scope. The following construction requirements shall be met where construction involves gypsum board, lath and plaster in vertical and horizontal assemblies.

2504.1.1 Wood framing. Wood supports for lath or gypsum board shall not be less than 2 inches (51 mm) nominal thickness in the least dimension. Wood stripping or furring shall not be less than 2 inches (51 mm) nominal thickness in the least dimension.

Exception: The minimum nominal dimension of wood furring strips installed over solid backing shall not be less than 1 inch by 2 inches (25 mm by 51 mm).

2504.1.2 Studless partitions. The minimum thickness of vertically erected studless solid plaster partitions of $\frac{3}{8}$ -inch (9.5 mm) and $\frac{3}{4}$ -inch (19.1 mm) rib metal lath or $\frac{1}{2}$ -inch-thick (12.7 mm) long-length gypsum lath and gypsum board partitions shall be 2 inches (51 mm).

SECTION 2505 SHEAR WALL CONSTRUCTION

2505.1 Resistance to shear (wood framing). Wood-framed shear walls sheathed with gypsum board, lath and plaster shall be designed and constructed in accordance with Section 2306.4 and permitted to resist wind and seismic loads.

2505.2 Resistance to shear (steel framing). Steel-framed shear walls sheathed with gypsum board and constructed in accordance with the materials and provisions of Sections 2211.1, 2211.2, 2211.4, and 2211.6 are permitted to resist wind loads.

SECTION 2506 GYPSUM BOARD MATERIALS

2506.1 General. Gypsum board materials and accessories shall be identified by the manufacturer's designation to indicate compliance with the appropriate standards referenced in this section and stored to protect such materials from the weather.

2506.2 Standards. Gypsum board materials shall conform to the appropriate standards listed in Table 2506.2 and Chapter 35 and, where required for fire protection, shall conform to the provisions of Chapter 7.

**TABLE 2506.2
GYPSUM BOARD MATERIALS AND ACCESSORIES**

MATERIAL	STANDARD
Accessories for gypsum board	ASTM C 1047
Gypsum sheathing	ASTM C 79
Gypsum wallboard	ASTM C 36
Joint reinforcing tape and compound	ASTM C 474; C 475
Nails for gypsum boards	ASTM C 514, F 547, F 1667
Steel screws	ASTM C 954; C 1002
Steel studs, nonload bearing	ASTM C 645
Steel studs, load bearing	ASTM C 955
Water-resistant gypsum backing board	ASTM C 630
Exterior soffit board	ASTM C 931
Fiber-reinforced gypsum panels	ASTM C 1278
Gypsum backing board	ASTM C 442
Gypsum ceiling board	ASTM C 1395
Predecorated gypsum board	ASTM C 960
Adhesives for fastening gypsum wallboard	ASTM C 557
Testing gypsum and gypsum products	ASTM C 22; C 472; C 473
Glass mat gypsum substrate	ASTM C 1177
Glass mat gypsum backing panel	ASTM C 1178

2506.2.1 Other materials. Metal suspension systems for acoustical and lay-in panel ceilings shall conform with ASTM C 635 listed in Chapter 35 and Section 1621.2.5 for installation in high seismic areas.

SECTION 2507 LATHING AND PLASTERING

2507.1 General. Lathing and plastering materials and accessories shall be marked by the manufacturer's designation to indicate compliance with the appropriate standards referenced in this section and stored in such a manner to protect them from the weather.

2507.2 Standards. Lathing and plastering materials shall conform to the standards listed in Table 2507.2 and Chapter 35 and, where required for fire protection, shall also conform to the provisions of Chapter 7.

**TABLE 2507.2
LATH, PLASTERING MATERIALS AND ACCESSORIES**

MATERIAL	STANDARD
Accessories for gypsum veneer base	ASTM C 1047
Exterior plaster bonding compounds	ASTM C 932
Gypsum base for veneer plasters	ASTM C 588
Gypsum casting and molding plaster	ASTM C 59
Gypsum Keene's cement	ASTM C 61
Gypsum lath	ASTM C 37
Gypsum plaster	ASTM C 28
Gypsum veneer plaster	ASTM C 587
Interior bonding compounds, gypsum	ASTM C 631
Lime plasters	ASTM C 5; C 206
Masonry cement	ASTM C 91
Metal lath	ASTM C 847
Plaster aggregates	
Sand	ASTM C 35; C 897
Perlite	ASTM C 35
Vermiculite	ASTM C 35
Plastic cement	ASTM C 1328
Blended cement	ASTM C 595
Portland cement	ASTM C 150
Steel studs and track	ASTM C 645; C 955
Steel screws	ASTM C 1002; C 954
Welded wire lath	ASTM C 933
Woven wire plaster base	ASTM C 1032

SECTION 2508 GYPSUM CONSTRUCTION

2508.1 General. Gypsum board and gypsum plaster construction shall be of the materials listed in Tables 2506.2 and 2507.2. These materials shall be assembled and installed in compliance with the appropriate standards listed in Tables 2508.1 and 2511.1, and Chapter 35.

**TABLE 2508.1
INSTALLATION OF GYPSUM CONSTRUCTION**

MATERIAL	STANDARD
Gypsum sheathing	ASTM C 1280
Gypsum veneer base	ASTM C 844
Gypsum board	GA-216; ASTM C 840
Interior lathing and furring	ASTM C 841
Steel framing for gypsum boards	ASTM C 754; C 1007

2508.2 Limitations. Gypsum wallboard or gypsum plaster shall not be used in any exterior surface where such gypsum construction will be exposed directly to the weather. Gypsum sheathing shall be installed on exterior surfaces in accordance with ASTM C 1280.

2508.2.1 Weather protection. Gypsum wallboard, gypsum lath or gypsum plaster shall not be installed until weather protection for the installation is provided.

2508.3 Single-ply application. Edges and ends of gypsum board shall occur on the framing members, except those edges and ends that are perpendicular to the framing members. Edges and ends of gypsum board shall be in moderate contact except in concealed spaces where fire-resistance-rated construction, shear resistance, or diaphragm action is not required.

2508.3.1 Floating angles. Fasteners at the top and bottom plates of vertical assemblies, or the edges and ends of horizontal assemblies perpendicular to supports, and at the wall line are permitted to be omitted except on shear resisting elements or fire-resistance-rated assemblies. Fasteners shall be applied in such a manner as not to fracture the face paper with the fastener head.

2508.4 Joint treatment. Gypsum board fire-resistance-rated assemblies shall have joints and fasteners treated.

Exception: Joint and fastener treatment need not be provided where any of the following conditions occur:

1. Where the gypsum board is to receive a decorative finish such as wood paneling, battens, acoustical finishes or any similar application that would be equivalent to joint treatment.
2. On single layer systems where joints occur over wood framing members.
3. Square edge or tongue-and-groove edge gypsum board (V-edge) gypsum backing board or gypsum sheathing.
4. On multilayer systems where the joints of adjacent layers are offset from one to another.
5. Assemblies tested without joint treatment.

SECTION 2509 GYPSUM BOARD IN SHOWERS AND WATER CLOSETS

2509.1 Wet areas. Showers and public toilet walls shall conform to Sections 1209.2 and 1209.3.

2509.2 Base for tile. When gypsum board is used as a base for tile or wall panels for tubs, shower or water closet compartment walls, water-resistant gypsum backing board shall be used as a substrate. Regular gypsum wallboard is permitted under tile or wall panels in other wall and ceiling areas when installed in accordance with GA-216 or ASTM C 840.

2509.3 Limitations. Water-resistant gypsum backing board shall not be used in the following locations:

1. Over a vapor retarder in shower or bathtub compartments.

2. In areas subject to continuous high humidity, such as saunas, steam rooms, gang shower rooms, or indoor pools.
3. On ceilings where frame spacing exceeds 12 inches (305 mm) on center for 1/2-inch-thick (12.7 mm) water-resistant gypsum backing board and more than 16 inches (406 mm) on center for 5/8-inch-thick (15.9 mm) water-resistant gypsum backing board.

SECTION 2510 LATHING AND FURRING FOR CEMENT PLASTER (STUCCO)

2510.1 General. Exterior and interior cement plaster and lathing shall be done with the appropriate materials listed in Table 2507.2 and Chapter 35.

2510.2 Weather protection. Materials shall be stored in such a manner as to protect such materials from the weather.

2510.3 Installation. Installation of these materials shall be in compliance with ASTM C 926 and ASTM C 1063.

2510.4 Corrosion resistance. Metal lath and lath attachments shall be of corrosion-resistant material.

2510.5 Backing. Backing or a lath shall provide sufficient rigidity to permit plaster applications.

2510.5.1 Support of lath. Where lath on vertical surfaces extends between rafters or other similar projecting members, solid backing shall be installed to provide support for lath and attachments.

2510.5.2 Use of gypsum backing board.

2510.5.2.1 Use of gypsum board as a backing board. Gypsum lath or gypsum wallboard shall not be used as a backing for cement plaster.

Exception: Gypsum lath or gypsum wallboard is permitted, with a weather-resistive barrier, as a backing for self-furred metal lath or self-furred wire fabric lath and cement plaster where either of the following conditions occur:

1. On horizontal supports of ceilings or roof soffits.
2. On interior walls.

2510.5.2.2 Use of gypsum sheathing backing. Gypsum sheathing is permitted as a backing for metal or wire fabric lath and cement plaster on walls. A weather-resistive barrier shall be provided in accordance with Section 2510.6.

2510.5.3 Backing not required. Wire backing is not required under expanded metal lath or paperbacked wire fabric lath.

2510.6 Weather-resistant barriers. Weather-resistant barriers shall be installed as required in Section 1404.2 and, where applied over wood-based sheathing, shall include a weather-resistive vapor permeable barrier with a performance at least equivalent to two layers of Grade D paper.

2510.7 Preparation of masonry and concrete. Surfaces shall be clean, free from efflorescence, sufficiently damp and rough to ensure proper bond. If the surface is insufficiently rough, ap-

proved bonding agents or a portland cement dash bond coat mixed in proportions of not more than 2 parts volume of sand to 1 part volume of portland cement or plastic cement shall be applied. The dash bond coat shall be left undisturbed and shall be moist cured not less than 24 hours.

SECTION 2511 INTERIOR PLASTER

2511.1 General. Plastering gypsum plaster or cement plaster shall not be less than three coats where applied over metal lath or wire fabric lath and shall not be less than two coats where applied over other bases permitted by this chapter.

Exception: Gypsum veneer plaster and cement plaster specifically designed and approved for one-coat applications.

TABLE 2511.1
INSTALLATION OF PLASTER CONSTRUCTION

MATERIAL	STANDARD
Gypsum plaster	ASTM C 842
Gypsum veneer plaster	ASTM C 843
Interior lathing and furring (gypsum plaster)	ASTM C 841
Lathing and furring (cement plaster)	ASTM C 1063
Portland cement plaster	ASTM C 926
Steel framing	ASTM C 754; C 1007

2511.1.1 Installation. Installation of lathing and plaster materials shall conform with Table 2511.1 and Section 2507.

2511.2 Limitations. Plaster shall not be applied directly to fiber insulation board. Cement plaster shall not be applied directly to gypsum lath or gypsum plaster except as specified in Sections 2510.5.1 and 2510.5.2.

2511.3 Grounds. Where installed, grounds shall ensure the minimum thickness of plaster as set forth in ASTM C 842 and C 926. Plaster thickness shall be measured from the face of lath and other bases.

2511.4 Interior masonry or concrete. Condition of surfaces shall be as specified in Section 2510.7. Approved specially prepared gypsum plaster designed for application to concrete surfaces or approved acoustical plaster is permitted. The total thickness of base coat plaster applied to concrete ceilings shall be as set forth in ASTM C 842 or C 926. Should ceiling surfaces require more than the maximum thickness permitted in ASTM C 842 or C 926, metal lath or wire fabric lath shall be installed on such surfaces before plastering.

2511.5 Environmental conditions. When plastering work is in progress, the building or structure shall be enclosed and conditioned to provide proper ventilation. When gypsum plasters are applied, temperatures in the building or structure shall be maintained at not less than 40°F (4°C) nor more than 80°F (27°C) from one week prior to the plastering operation and until one week following or until the plaster is dry.

2511.5.1 Wet areas. Showers and public toilet walls shall conform to Sections 1209.2 and 1209.3. When wood-frame walls and partitions are covered on the interior with cement

plaster or tile of similar material and are subject to water splash, the framing shall be protected with an approved moisture barrier.

SECTION 2512 EXTERIOR PLASTER

2512.1 General. Plastering with cement plaster shall not be less than three coats where applied over metal lath or wire fabric lath and shall not be less than two coats where applied over masonry, concrete or gypsum board backing as specified in Section 2510.5. If the plaster surface is to be completely covered by veneer or other facing material, or is completely concealed by another wall, plaster application need be only two coats, provided the total thickness is as set forth in ASTM C 926.

2512.1.1 On-grade floor slab. On wood-framed or steel stud construction with an on-grade concrete floor slab system, exterior plaster shall be applied in such a manner as to cover, but not to extend below, the lath and paper. The application of lath, paper, and flashing or drip screeds shall comply with ASTM C 1063.

2512.1.2 Weep screeds. A minimum 0.019-inch (0.48 mm) (No. 26 galvanized sheet gage), corrosion-resistant weep screed with a minimum vertical attachment flange of 3¹/₂ inches (89 mm) shall be provided at or below the foundation plate line on exterior stud walls in accordance with ASTM C 926. The weep screed shall be placed a minimum of 4 inches (102 mm) above the earth or 2 inches (51 mm) above paved areas and shall be of a type that will allow trapped water to drain to the exterior of the building. The weather-resistant barrier shall lap the attachment flange. The exterior lath shall cover and terminate on the attachment flange of the weep screed.

2512.2 Plasticity agents. Only approved plasticity agents and approved amounts thereof shall be added to portland cement. When plastic cement or masonry cement is used, no additional lime or plasticizers shall be added. Hydrated lime or the equivalent amount of lime putty used as a plasticizer is permitted to be added to cement plaster or cement and lime plaster in an amount not to exceed that set forth in ASTM C 926.

2512.3 Limitations. Gypsum plaster shall not be used on exterior surfaces.

2512.4 Cement plaster. Plaster coats shall be protected from freezing for a period of not less than 24 hours after set has occurred. Plaster shall be applied when the ambient temperature is higher than 40°F (4°C), unless provisions are made to keep cement plaster work above 40°F (4°C) during application and 48 hours thereafter.

2512.5 Second coat application. The second coat shall be brought out to proper thickness, rodded and floated sufficiently rough to provide adequate bond for the finish coat. The second coat shall have no variation greater than 1/4 inch (6.4 mm) in any direction under a 5-foot (1524 mm) straight edge.

2512.6 Curing and interval. First and second coats of cement plaster shall be applied and moist cured as set forth in ASTM C 926 and Table 2512.6.

**TABLE 2512.6
CEMENT PLASTERS^a**

COAT	MINIMUM PERIOD MOIST CURING	MINIMUM INTERVAL BETWEEN COATS
First	48 hours ^a	48 hours ^b
Second	48 hours	7 days ^c
Finish	—	7 days

- a. The first two coats shall be as required for the first coats of exterior plaster, except that the moist-curing time period between the first and second coats shall not be less than 24 hours. Moist curing shall not be required where job and weather conditions are favorable to the retention of moisture in the cement plaster for the required time period.
- b. Twenty-four-hour minimum interval between coats of interior cement plaster. For alternate method of application, see Section 2512.8.
- c. Finish coat plaster is permitted to be applied to interior portland cement base coats after a 48-hour period.

2512.7 Application to solid backings. Where applied over gypsum backing as specified in Section 2510.5 or directly to unit masonry surfaces, the second coat is permitted to be applied as soon as the first coat has attained sufficient hardness.

2512.8 Alternate method of application. The second coat is permitted to be applied as soon as the first coat has attained sufficiently rigidity to receive the second coat.

2512.8.1 Admixtures. When using this method of application, calcium aluminate cement up to 15 percent of the weight of the portland cement is permitted to be added to the mix.

2512.8.2 Curing. Curing of the first coat is permitted to be omitted and the second coat shall be cured as set forth in ASTM C 926 and Table 2512.6.

2512.9 Finish coats. Cement plaster finish coats shall be applied over base coats that have been in place for the time periods set forth in ASTM C 926. The third or finish coat shall be applied with sufficient material and pressure to bond and to cover the brown coat and shall be of sufficient thickness to conceal the brown coat.

**SECTION 2513
EXPOSED AGGREGATE PLASTER**

2513.1 General. Exposed natural or integrally colored aggregate is permitted to be partially embedded in a natural or colored bedding coat of cement plaster or gypsum plaster, subject to the provisions of this section.

2513.2 Aggregate. The aggregate shall be applied manually or mechanically and shall consist of marble chips, pebbles or similar durable, moderately hard (three or more on the Mohs hardness scale), nonreactive materials.

2513.3 Bedding coat proportions. The bedding coat for interior or exterior surfaces shall be composed of one part portland cement, one part Type S lime and a maximum of three parts of graded white or natural sand by volume. The bedding coat for interior surfaces shall be composed of 100 pounds (45.4 kg) neat gypsum plaster and a maximum of 200 pounds (90.8 kg) of

graded white sand. A factory-prepared bedding coat for interior or exterior use is permitted. The bedding coat for exterior surfaces shall have a minimum compressive strength of 1,000 pounds per square inch (6895 kPa).

2513.4 Application. The bedding coat is permitted to be applied directly over the first (scratch) coat of plaster, provided the ultimate overall thickness is a minimum of 7/8 inch (22 mm), including lath. Over concrete or masonry surfaces the overall thickness shall be a minimum of 1/2 inch (12.7 mm).

2513.5 Bases. Exposed aggregate plaster is permitted to be applied over concrete, masonry, cement plaster basecoats or gypsum plaster basecoats installed in accordance with Section 2511 or 2512.

2513.6 Preparation of masonry and concrete. Masonry and concrete surfaces shall be prepared in accordance with the provisions of Section 2510.7.

2513.7 Curing of base coats. Cement plaster base coats shall be cured in accordance with ASTM C 926. Cement plaster bedding coats shall retain sufficient moisture for hydration (hardening) for 24 hours minimum or, where necessary, shall be kept damp for 24 hours by light water spraying.

CHAPTER 26 PLASTIC

SECTION 2601 GENERAL

2601.1 Scope. These provisions shall govern the materials, design, application, construction and installation of foam plastic, foam plastic insulation, plastic veneer, interior plastic finish and trim, and light-transmitting plastics. See Chapter 14 for requirements for exterior wall finish and trim.

SECTION 2602 DEFINITIONS

2602.1 General. The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

FOAM PLASTIC INSULATION. A plastic that is intentionally expanded by the use of a foaming agent to produce a reduced-density plastic containing voids consisting of open or closed cells distributed throughout the plastic for thermal insulating or acoustical purposes and that has a density less than 20 pounds per cubic foot (320 kg/m³).

LIGHT-DIFFUSING SYSTEM. Construction consisting in whole or in part of lenses, panels, grids or baffles made with light-transmitting plastics positioned below independently mounted electrical light sources, skylights or light-transmitting plastic roof panels. Lenses, panels, grids and baffles that are part of an electrical fixture shall not be considered as a light-diffusing system.

LIGHT-TRANSMITTING PLASTIC ROOF PANELS. Structural plastic panels other than skylights that are fastened to structural members, or panels or sheathing and that are used as light-transmitting media in the plane of the roof.

LIGHT-TRANSMITTING PLASTIC WALL PANELS. Plastic materials that are fastened to structural members, or to structural panels or sheathing, and that are used as light-transmitting media in exterior walls.

PLASTIC, APPROVED. Any thermoplastic, thermosetting or reinforced thermosetting plastic material that conforms to combustibility classifications specified in the section applicable to the application and plastic type.

PLASTIC GLAZING. Plastic materials that are glazed or set in frame or sash and not held by mechanical fasteners that pass through the glazing material.

REINFORCED PLASTIC, GLASS FIBER. Plastic reinforced with glass fiber having not less than 20 percent of glass fibers by weight.

THERMOPLASTIC MATERIAL. A plastic material that is capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature.

THERMOSETTING MATERIAL. A plastic material that is capable of being changed into a substantially nonreformable product when cured.

SECTION 2603 FOAM PLASTIC INSULATION

2603.1 General. The provisions of this section shall govern the requirements and uses of foam plastic insulation in buildings and structures.

2603.2 Labeling and identification. Packages and containers of foam plastic insulation and foam plastic insulation components delivered to the job site shall bear the label of an approved agency showing the manufacturer's name, the product listing, product identification and information sufficient to determine that the end use will comply with the code requirements.

2603.3 Surface-burning characteristics. Unless otherwise indicated in this section, foam plastic insulation and foam plastic cores of manufactured assemblies shall have a flame spread index of not more than 75 and a smoke-developed index of not more than 450 where tested in the maximum thickness intended for use in accordance with ASTM E 84. Loose-fill-type foam plastic insulation shall be tested as board stock for the flame spread index and smoke-developed index.

Exceptions:

1. Smoke-developed index for interior trim as provided for in Section 2604.2.
2. In cold storage buildings, ice plants, food plants, food processing rooms and similar areas, foam plastic insulation where tested in a thickness of 4 inches (102 mm) shall be permitted in a thickness up to 10 inches (254 mm) where the building is equipped throughout with an automatic fire sprinkler system in accordance with Section 903.3.1.1. The approved automatic sprinkler system shall be provided in both the room and that part of the building in which the room is located.
3. Foam plastic insulation that is a part of a Class A, B or C roof-covering assembly provided the assembly with the foam plastic insulation satisfactorily passes FM 4450 or UL 1256. The smoke-developed index shall not be limited for roof applications.
4. Foam plastic insulation greater than 4 inches in thickness shall have a maximum flame spread index of 75 and a smoke-developed index of 450 where tested at a minimum thickness of 4 inches, provided the end use is approved in accordance with Section 2603.7 using the thickness and density intended for use.

2603.4 Thermal barrier. Except as provided for in Sections 2603.4.1 and 2603.7, foam plastic shall be separated from the interior of a building by an approved thermal barrier of 0.5-inch (12.7 mm) gypsum wallboard or equivalent thermal barrier material that will limit the average temperature rise of the unexposed surface to not more than 250°F (120°C) after 15 minutes of fire exposure, complying with the standard time-temperature curve of ASTM E 119. The thermal barrier shall be installed in such a manner that it will remain in place for 15

minutes based on FM 4880, UL 1040 or UL 1715. Combustible concealed spaces shall comply with Section 716.

2603.4.1 Thermal barrier not required. The thermal barrier specified in Section 2603.4 is not required under the conditions set forth in Sections 2603.4.1.1 through 2603.4.1.12.

2603.4.1.1 Masonry or concrete construction. In a masonry or concrete wall, floor or roof system where the foam plastic insulation is covered on each face by a minimum of 1-inch (25.4 mm) thickness of masonry or concrete.

2603.4.1.2 Cooler and freezer walls. Foam plastic installed in a maximum thickness of 10 inches (254 mm) in cooler and freezer walls shall:

1. Have a flame spread index of 25 or less and a smoke-developed index of not more than 450, where tested in a minimum 4-inch (102 mm) thickness.
2. Have flash ignition and self-ignition temperatures of not less than 600°F and 800°F (316°C and 427°C), respectively.
3. Have a covering of not less than 0.032-inch (0.8 mm) aluminum or corrosion-resistant steel having a base metal thickness not less than 0.0160 inch (0.4 mm) at any point.
4. Be protected by an automatic sprinkler system. Where the cooler or freezer is within a building, both the cooler or freezer and that part of the building in which it is located shall be sprinklered.

2603.4.1.3 Walk-in coolers. In unsprinklered buildings, foam plastic having a thickness that does not exceed 4 inches (102 mm) and a maximum flame spread of 75 is permitted in walk-in coolers or freezer units where the aggregate floor area does not exceed 400 square feet (37 m²) and the foam plastic is covered by a metal facing not less than 0.032-inch-thick (0.81 mm) aluminum or corrosion-resistant steel having a minimum base metal thickness of 0.016 inch (0.41 mm). A thickness of up to 10 inches (254 mm) is permitted where protected by a thermal barrier.

2603.4.1.4 Exterior walls—one story buildings. For one-story buildings, foam plastic having a flame spread index of 25 or less, and a smoke-developed index of not more than 450, shall be permitted without thermal barriers in or on exterior walls in a thickness not more than 4 inches (102 mm) where the foam plastic is covered by a thickness of not less than 0.032-inch-thick (0.81 mm), aluminum or corrosion-resistant steel having a base metal thickness of 0.0160 inch (0.41 mm) and the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.

2603.4.1.5 Roofing. Foam plastic insulation under a roof assembly or roof covering that is installed in accordance with the code and the manufacturer's installation instructions shall be separated from the interior of the building by wood structural panel sheathing not less than 0.47 inch (11.9 mm) in thickness bonded with exterior glue,

with edges supported by blocking, tongue-and-groove joints or other approved type of edge support, or an equivalent material. A thermal barrier is not required for foam plastic insulation that is a part of a Class A, B or C roof-covering assembly, provided the assembly with the foam plastic insulation satisfactorily passes FM 4450 or UL 1256.

2603.4.1.6 Attics and crawl spaces. Within an attic or crawl space where entry is made only for service of utilities, foam plastic insulation shall be protected against ignition by 1.5-inch-thick (38 mm) mineral fiber insulation, 0.25-inch-thick (6.4 mm) wood structural panel, particleboard or hardboard, 0.375-inch (9.5 mm) gypsum wallboard, corrosion-resistant steel having a base metal thickness of 0.016 inch (0.4 mm), or other approved material installed in such a manner that the foam plastic insulation is not exposed. The protective covering shall be consistent with the requirements for the type of construction.

2603.4.1.7 Doors not required to have a fire protection rating. Where pivoted or side-hinged doors are permitted without a fire protection rating, foam plastic insulation, having a flame spread index of 75 or less and a smoke-developed index of not more than 450, shall be permitted as a core material where the door facing is of metal having a minimum thickness of 0.032-inch (0.8 mm) aluminum or steel having a base metal thickness of not less than 0.016 inch (0.4 mm) at any point.

2603.4.1.8 Exterior doors in buildings of Groups R-2 or R-3. In occupancies classified as Groups R-2 or R-3 as applicable in Section 101.2, foam-filled exterior entrance doors to individual dwelling units that do not require a fire-resistance rating shall be faced with wood or other approved materials.

2603.4.1.9 Garage doors. Where garage doors are permitted without a fire resistance rating and foam plastic is used as a core material, the door facing shall be metal having a minimum thickness of 0.032-inch (0.8 mm) aluminum or 0.010-inch (0.25 mm) steel or the facing shall be minimum 0.125-inch-thick (3.2 mm) wood. Garage doors having facings other than those described above shall be tested in accordance with, and meet the acceptance criteria of, ANSI/DASMA 107.

Exception: Garage doors using foam plastic insulation complying with Section 2603.3 in detached and attached garages associated with one- and two-family dwellings need not be provided with a thermal barrier.

2603.4.1.10 Siding backer board. Foam plastic insulation of not more than 2,000 Btu/sq ft (22.7 MJ/m²) as determined by NFPA 259 shall be permitted as a siding backer board with a maximum thickness of 0.5 inch (12.7 mm), provided it is separated from the interior of the building by not less than 2 inches (51 mm) of mineral fiber insulation or equivalent or where applied as insulation with residing over existing wall construction.

2603.4.1.11 Interior trim. Foam plastic used as interior trim in accordance with Section 2604 shall be permitted without a thermal barrier.

2603.4.1.12 Interior signs. Foam plastic used for interior signs in covered mall buildings in accordance with Section 402.14 shall be permitted without a thermal barrier.

2603.5 Exterior walls of buildings of any height. Exterior walls of buildings of Types I, II, III and IV construction of any height shall comply with Sections 2603.5.1 through 2603.5.7. Exterior walls of cold storage buildings required to be constructed of noncombustible materials, where the building is more than one story in height, shall also comply with the provisions of Sections 2603.5.1 through 2603.5.7. Exterior walls of buildings of Type V construction shall comply with Sections 2603.2, 2603.3, and 2603.4.

2603.5.1 Fire-resistance-rated walls. Where the wall is required to have a fire-resistance rating, data based on tests conducted in accordance with ASTM E 119 shall be provided to substantiate that the fire-resistance rating is maintained.

2603.5.2 Thermal barrier. Any foam plastic insulation shall be separated from the building interior by a thermal barrier meeting the provisions of Section 2603.4 unless a special approval is obtained on the basis of Section 2603.7.

Exception: One-story buildings complying with Section 2603.4.1.4.

2603.5.3 Potential heat. The potential heat of foam plastic insulation in any portion of the wall or panel shall not exceed the potential heat expressed in British thermal unit/square feet (mJ/m²) of the foam plastic insulation contained in the wall assembly tested in accordance with Section 2603.5.5. The potential heat of the foam plastic insulation shall be determined by tests conducted in accordance with NFPA 259 and the results shall be expressed in British thermal unit/square feet (mJ/m²).

Exception: One-story buildings complying with Section 2603.4.1.4.

2603.5.4 Flame spread and smoke-developed index. Foam plastic insulation, exterior coatings and facings shall be tested separately in the thickness intended for use and shall each have a flame spread index of 25 or less and a smoke-developed index of 450 or less as determined in accordance with ASTM E 84.

Exception: Prefabricated or factory-manufactured panels having minimum 0.020 inch (0.51 mm) aluminum facings and a total thickness of 0.25 inch (6.4 mm) or less are permitted to be tested as an assembly where the foam plastic core is not exposed in the course of construction.

2603.5.5 Test standard. The wall assembly shall be tested in accordance with and comply with the acceptance criteria of NFPA 285 or UBC Standard 26-4.

Exception: One-story buildings complying with Section 2603.4.1.4

2603.5.6 Label required. The edge or face of each piece of foam plastic insulation shall bear the label of an approved agency. The label shall contain the manufacturer's or dis-

tributor's identification, model number, serial number or definitive information describing the product or materials' performance characteristics and approved agency's identification.

2603.5.7 Ignition. Exterior walls shall not exhibit sustained flaming where tested in accordance with NFPA 268. Where a material is intended to be installed in more than one thickness, tests of the minimum and maximum thickness intended for use shall be performed.

Exception: Assemblies protected on the outside with one of the following:

1. A thermal barrier complying with Section 2603.4.
2. A minimum 1-inch (25.4 mm) thickness of concrete or masonry.
3. Glass-fiber-reinforced concrete panels of a minimum thickness of 0.375 inch (9.5 mm).
4. Metal-faced panels having minimum 0.019-inch-thick (0.48 mm) aluminum or 0.016-inch-thick (0.41 mm) corrosion-resistant steel outer facings.
5. A minimum 0.875-inch (22.2 mm) thickness of stucco complying with Section 2510.

2603.6 Roofing. Foam plastic insulation meeting the requirements of Sections 2603.2, 2603.3 and 2603.4 shall be permitted as part of a roof-covering assembly, provided the assembly with the foam plastic insulation is a Class A, B or C roofing assembly where tested in accordance with ASTM E 108 or UL 790.

2603.7 Special approval. Foam plastic shall not be required to comply with the requirements of Sections 2603.4 through 2603.6, where specifically approved based on large-scale tests such as, but not limited to, FM 4880, UL 1040 or UL 1715. Such testing shall be related to the actual end-use configuration and be performed on the finished manufactured foam plastic assembly in the maximum thickness intended for use. Foam plastics that are used as interior finish on the basis of special tests shall also conform to the flame spread requirements of Chapter 8. Assemblies tested shall include seams, joints and other typical details used in the installation of the assembly and shall be tested in the manner intended for use.

SECTION 2604 INTERIOR FINISH AND TRIM

2604.1 General. Plastic materials installed as interior finish or trim shall comply with Chapter 8. Foam plastics shall only be installed as interior finish where approved in accordance with the special provisions of Section 2603.7. Foam plastics that are used as interior finish shall also meet the flame spread index requirements for interior finish in accordance with Chapter 8. Foam plastics installed as interior trim shall comply with Section 2604.2.

[F] 2604.2 Interior trim. Foam plastic used as interior trim shall comply with Sections 2604.2.1 through 2604.2.4.

[F] 2604.2.1 Density. The minimum density of the interior trim shall be 20 pounds per cubic foot (320 kg/m³).

[F] 2604.2.2 Thickness. The maximum thickness of the interior trim shall be 0.5 inch (12.7 mm) and the maximum width shall be 8 inches (204 mm).

[F] 2604.2.3 Area limitation. The interior trim shall not constitute more than 10 percent of the aggregate wall and ceiling area of any room or space.

[F] 2604.2.4 Flame spread. The flame spread index shall not exceed 75 where tested in accordance with ASTM E 84. The smoke-developed index shall not be limited.

SECTION 2605 PLASTIC VENEER

2605.1 Interior use. Where used within a building, plastic veneer shall comply with the interior finish requirements of Chapter 8.

2605.2 Exterior use. Exterior plastic veneer shall be permitted to be installed on the exterior walls of buildings of any type of construction in accordance with all of the following requirements:

1. Plastic veneer shall be approved plastic as defined in Section 2602.
2. Plastic veneer shall not be attached to any exterior wall to a height greater than 50 feet (15 240 mm) above grade.
3. Sections of plastic veneer shall not exceed 300 square feet (27.9 m²) in area and shall be separated by a minimum of 4 feet (1219 mm) vertically.

Exception: The area and separation requirements and the smoke-density limitation are not applicable to plastic veneer applied to buildings constructed of Type VB construction, provided the walls are not required to have a fire-resistance rating.

SECTION 2606 LIGHT-TRANSMITTING PLASTICS

2606.1 General. The provisions of this section and Sections 2607 through 2611 shall govern the quality and methods of application of light-transmitting plastics for use as light-transmitting materials in buildings and structures. Foam plastics shall comply with Section 2603. Light-transmitting plastic materials that meet the other code requirements for walls and roofs shall be permitted to be used in accordance with the other applicable chapters of the code.

2606.2 Approval for use. Sufficient technical data shall be submitted to substantiate the proposed use of any light-transmitting material, as approved by the building official and subject to the requirements of this section.

2606.3 Identification. Each unit or package of light-transmitting plastic shall be identified with a mark or decal satisfactory to the building official, which includes identification as to the material classification.

2606.4 Specifications. Light-transmitting plastics, including thermoplastic, thermosetting or reinforced thermosetting plastic material, shall have a self-ignition temperature of 650°F (343°C) or greater where tested in accordance with ASTM D 1929; a smoke-developed index not greater than 450 where tested in the manner intended for use in accordance with

ASTM E 84, or not greater than 75 where tested in the thickness intended for use in accordance with ASTM D 2843; and shall conform to one of the following combustibility classifications:

Class CC1: Plastic materials that have a burning extent of 1 inch (25.4 mm) or less where tested at a nominal thickness of 0.060 inch (1.5 mm), or in the thickness intended for use, in accordance with ASTM D 635,

Class CC2: Plastic materials that have a burning rate of 2.5 inches per minute (1.06 mm/s) or less where tested at a nominal thickness of 0.060 inch (1.5 mm), or in the thickness intended for use, in accordance with ASTM D 635.

2606.5 Structural requirements. Light-transmitting plastic materials in their assembly shall be of adequate strength and durability to withstand the loads indicated in Chapter 16. Technical data shall be submitted to establish stresses, maximum unsupported spans and such other information for the various thicknesses and forms used as deemed necessary by the building official.

2606.6 Fastening. Fastening shall be adequate to withstand the loads in Chapter 16. Proper allowance shall be made for expansion and contraction of light-transmitting plastic materials in accordance with accepted data on coefficient of expansion of the material and other material in conjunction with which it is employed.

2606.7 Light-diffusing systems. Unless the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, light-diffusing systems shall not be installed in the following occupancies and locations:

1. Group A with an occupant load of 1,000 or more.
2. Theaters with a stage and proscenium opening and an occupant load of 700 or more.
3. Group I-2.
4. Group I-3.
5. Exit stairways and exit passageways.

2606.7.1 Support. Light-transmitting plastic diffusers shall be supported directly or indirectly from ceiling or roof construction by use of noncombustible hangers. Hangers shall be at least No. 12 steel-wire gage (0.106 inch) galvanized wire or equivalent.

2606.7.2 Installation. Light-transmitting plastic diffusers shall comply with Chapter 8 unless the light-transmitting will fall from the mountings before igniting, at an ambient temperature of at least 200°F (93°C) below the ignition temperature of the panels. The panels shall remain in place at an ambient room temperature of 175°F (79°C) for a period of not less than 15 minutes.

2606.7.3 Size limitations. Individual panels or units shall not exceed 10 feet (3048 mm) in length nor 30 square feet (2.79 m²) in area.

2606.7.4 Fire suppression system. In buildings that are equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, plastic light-diffusing systems shall be protected both above and below unless the sprinkler system has been specifically approved for installation only above the light-diffusing system. Areas of

light-diffusing systems that are protected in accordance with this section shall not be limited.

2606.7.5 Electrical lighting fixtures. Light-transmitting plastic panels and light-diffuser panels that are installed in approved electrical lighting fixtures shall comply with the requirements of Chapter 8 unless the light-transmitting plastic panels conform to the requirements of Section 2606.7.2. The area of approved light-transmitting plastic materials that are used in required exits or corridors shall not exceed 30 percent of the aggregate area of the ceiling in which such panels are installed, unless the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.

2606.8 Partitions. Light-transmitting plastics used in or as partitions shall comply with the requirements of Chapters 6 and 8.

2606.9 Bathroom accessories. Light-transmitting plastics shall be permitted as glazing in shower stalls, shower doors, bathtub enclosures and similar accessory units. Safety glazing shall be provided in accordance with Chapter 24.

2606.10 Awnings, patio covers and similar structures. Awnings constructed of light-transmitting plastics shall be constructed in accordance with provisions specified in Sections 3105 and Chapter 32 for projections and appendages. Patio covers constructed of light-transmitting plastics shall comply with Section 2606. Light-transmitting plastics used in canopies at motor vehicle fuel stations shall comply with Section 2606 except as modified by Section 406.5.2.

2606.11 Greenhouses. Light-transmitting plastics shall be permitted in lieu of plain glass in greenhouses.

2606.12 Solar collectors. Light-transmitting plastic covers on solar collectors having noncombustible sides and bottoms shall be permitted on buildings not over three stories in height or 9,000 square feet (836.1 m²) in total floor area, provided the light-transmitting plastic cover does not exceed 33.33 percent of the roof area for CC1 materials or 25 percent of the roof area for CC2 materials.

Exception: Plastic covers having a thickness of 0.010 inch (0.3 mm) or less or shall be permitted to be of any plastic material provided the area of the collectors does not exceed 33.33 percent of the roof area.

SECTION 2607 LIGHT-TRANSMITTING PLASTIC WALL PANELS

2607.1 General. Light-transmitting plastics shall not be used as wall panels in exterior walls in occupancies in Groups A-1, A-2, H, I-2 and I-3. In other groups, light-transmitting plastics shall be permitted to be used as wall panels in exterior walls, provided that the walls are not required to have a fire-resistance rating and the installation conforms to the requirements of this section. Such panels shall be erected and anchored on a foundation, waterproofed or otherwise protected from moisture absorption and sealed with a coat of mastic or other approved waterproof coating. Light-transmitting plastic wall panels shall also comply with Section 2606.

2607.2 Installation. Exterior wall panels installed as provided for herein shall not alter the type of construction classification of the building.

2607.3 Height limitation. Light-transmitting plastics shall not be installed more than 75 feet (22 860 mm) above grade plane, except as allowed by Section 2607.5.

2607.4 Area limitation and separation. The maximum area of a single wall panel and minimum vertical and horizontal separation requirements for exterior light-transmitting plastic wall panels shall be as provided for in Table 2607.4. The maximum percentage of wall area of any story in light-transmitting plastic wall panels shall not exceed that indicated in Table 2607.4 or the percentage of unprotected openings permitted by Section 704.8, whichever is smaller.

Exceptions:

1. In structures provided with approved flame barriers extending 30 inches (760 mm) beyond the exterior wall in the plane of the floor, a vertical separation is not required at the floor except that provided by the vertical thickness of the flame barrier projection.
2. Veneers of approved weather-resistant light-transmitting plastics used as exterior siding in buildings of Type V construction in compliance with Section 1406.
3. The area of light-transmitting plastic wall panels in exterior walls of greenhouses shall be exempt from the area limitations of Table 2607.4 but shall be limited as required for unprotected openings in accordance with Section 704.8.

2607.5 Automatic sprinkler system. Where the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, the maximum percentage area of exterior wall in any story in light-transmitting plastic wall panels and the maximum square footage of a single area given in Table 2607.4 shall be increased 100 percent, but the area of light-transmitting plastic wall panels shall not exceed 50 percent of the wall area in any story, or the area permitted by Section 704.8 for unprotected openings, whichever is smaller. These installations shall be exempt from height limitations.

2607.6 Combinations of glazing and wall panels. Combinations of light-transmitting plastic glazing and light-transmitting plastic wall panels shall be subject to the area, height and percentage limitations and the separation requirements applicable to the class of light-transmitting plastic as prescribed for light-transmitting plastic wall panel installations.

SECTION 2608 LIGHT-TRANSMITTING PLASTIC GLAZING

2608.1 Buildings of Type VB construction. Openings in the exterior walls of buildings of Type VB construction, where not required to be protected by Section 704, shall be permitted to be glazed or equipped with light-transmitting plastic. Light-transmitting plastic glazing shall also comply with Section 2606.

2608.2 Buildings of other types of construction. Openings in the exterior walls of buildings of types of construction other than Type VB, where not required to be protected by Section 704, shall be permitted to be glazed or equipped with

**TABLE 2607.4
AREA LIMITATION AND SEPARATION REQUIREMENTS FOR
LIGHT-TRANSMITTING PLASTIC WALL PANELS^a**

FIRE SEPARATION DISTANCE (feet)	CLASS OF PLASTIC	MAXIMUM PERCENTAGE AREA OF EXTERIOR WALL IN PLASTIC WALL PANELS	MAXIMUM SINGLE AREA OF PLASTIC WALL PANELS (square feet)	MINIMUM SEPARATION OF PLASTIC WALL PANELS (feet)	
				Vertical	Horizontal
Less than 6	—	Not Permitted	Not Permitted	—	—
6 or more but less than 11	CC1	10	50	8	4
	CC2	Not Permitted	Not Permitted	—	—
11 or more but less than or equal to 30	CC1	25	90	6	4
	CC2	15	70	8	4
Over 30	CC1	50	Not Limited	3 ^b	0
	CC2	50	100	6 ^b	3

For SI: 1 foot = 304.8 mm, 1 square foot = 0.093 m².

a. For combinations of plastic glazing and plastic wall panel areas permitted, see Section 2607.6.

b. For reductions in vertical separation allowed, see Section 2607.4.

light-transmitting plastic in accordance with Section 2606 and all of the following:

1. The aggregate area of light-transmitting plastic glazing shall not exceed 25 percent of the area of any wall face of the story in which it is installed. The area of a single pane of glazing installed above the first story shall not exceed 16 square feet (1.5 m²) and the vertical dimension of a single pane shall not exceed 4 feet (1219 mm).

Exception: Where an automatic sprinkler system is provided throughout in accordance with Section 903.3.1.1, the area of allowable glazing shall be increased to a maximum of 50 percent of the wall face of the story in which it is installed with no limit on the maximum dimension or area of a single pane of glazing.

2. Approved flame barriers extending 30 inches (762 mm) beyond the exterior wall in the plane of the floor, or vertical panels not less than 4 feet (1219 mm) in height, shall be installed between glazed units located in adjacent stories.

Exception: Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.

3. Light-transmitting plastics shall not be installed more than 75 feet (22 860 mm) above grade level.

Exception: Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.

SECTION 2609

LIGHT-TRANSMITTING PLASTIC ROOF PANELS

2609.1 General. Light-transmitting plastic roof panels shall comply with this section and Section 2606. Light-transmitting plastic roof panels shall not be installed in Groups H, I-2 and I-3. In all other groups, light-transmitting plastic roof panels shall comply with any one of the following conditions:

1. The building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.
2. The roof construction is not required to have a fire-resistance rating by Table 601.
3. The roof panels meet the requirements for roof coverings in accordance with Chapter 15.

2609.2 Separation. Individual roof panels shall be separated from each other by a distance of not less than 4 feet (1219 mm) measured in a horizontal plane.

Exceptions:

1. The separation between roof panels is not required in a building equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.
2. The separation between roof panels is not required in low-hazard occupancy buildings complying with the conditions of Section 2609.4, Exception 2 or 3.

2609.3 Location. Where exterior wall openings are required to be protected by Section 704.8, a roof panel shall not be installed within 6 feet (1829 mm) of such exterior wall.

2609.4 Area limitations. Roof panels shall be limited in area and the aggregate area of panels shall be limited by a percentage of the floor area of the room or space sheltered in accordance with Table 2609.4.

Exceptions:

1. The area limitations of Table 2609.4 shall be permitted to be increased by 100 percent in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.
2. Low-hazard occupancy buildings, such as swimming pool shelters, shall be exempt from the area limitations of Table 2609.4, provided that the buildings do not exceed 5,000 square feet (465 m²) in area and have a minimum fire separation distance of 10 feet (3048 mm).

3. Greenhouses that are occupied for growing plants on a production or research basis, without public access, shall be exempt from the area limitations of Table 2609.4 provided they have a minimum fire separation distance of 4 feet (1220 mm).
4. Roof coverings over terraces and patios in occupancies in Group R-3 as applicable in Section 101.2 shall be exempt from the area limitations of Table 2609.4 and shall be permitted with light-transmitting plastics.

**TABLE 2609.4
AREA LIMITATIONS FOR LIGHT-TRANSMITTING
PLASTIC ROOF PANELS**

CLASS OF PLASTIC	MAXIMUM AREA OF INDIVIDUAL ROOF PANELS (square feet)	MAXIMUM AGGREGATE AREA OF ROOF PANELS (percent of floor area)
CC1	300	30
CC2	100	25

For SI: 1 square foot = 0.093 m².

**SECTION 2610
LIGHT-TRANSMITTING PLASTIC
SKYLIGHT GLAZING**

2610.1 Light-transmitting plastic glazing of skylight assemblies. Skylight assemblies glazed with light-transmitting plastic shall conform to the provisions of this section and Section 2606.

Exception: Skylights in which the light-transmitting plastic conforms to the required roof-covering class in accordance with Section 1505.

2610.2 Mounting. The light-transmitting plastic shall be mounted above the plane of the roof on a curb constructed in accordance with the requirements for the type of construction classification, but at least 4 inches (102 mm) above the plane of the roof. Edges of light-transmitting plastic skylights or domes shall be protected by metal or other approved non-combustible material, or the light-transmitting plastic dome or skylight shall be shown to be able to resist ignition where exposed at the edge to a flame from a Class B brand as described in ASTM E 108 or UL 790.

Exceptions:

1. Curbs shall not be required for skylights used on roofs having a minimum slope of three units vertical in 12 units horizontal (25-percent slope) in occupancies in Group R-3 as applicable in Section 101.2 and on buildings with a nonclassified roof covering.
2. The metal or noncombustible edge material is not required where nonclassified roof coverings are permitted.

2610.3 Slope. Flat or corrugated light-transmitting plastic skylights shall slope at least four units vertical in 12 units horizontal (4:12). Dome-shaped skylights shall rise above the mounting flange a minimum distance equal to 10 percent of the maximum span of the dome but not less than 3 inches (76 mm).

Exception: Skylights that pass the Class B Burning Brand Test specified in ASTM E 108 or UL 790.

2610.4 Maximum area of skylights. Each skylight shall have a maximum area within the curb of 100 square feet (9.30 m²).

Exception: The area limitation shall not apply where the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or the building is equipped with smoke and heat vents in accordance with Section 910.

2610.5 Aggregate area of skylights. The aggregate area of skylights shall not exceed 33¹/₃ percent of the floor area of the room or space sheltered by the roof in which such skylights are installed where Class CC1 materials are utilized, and 25 percent where Class CC2 materials are utilized.

Exception: The aggregate area limitations of light-transmitting plastic skylights shall be increased 100 percent beyond the limitations set forth in this section where the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or the building is equipped with smoke and heat vents in accordance with Section 910.

2610.6 Separation. Skylights shall be separated from each other by a distance of not less than 4 feet (1219 mm) measured in a horizontal plane.

Exceptions:

1. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.
2. In Group R-3 as applicable in Section 101.2, multiple skylights located above the same room or space with a combined area not exceeding the limits set forth in Section 2610.4.

2610.7 Location. Where exterior wall openings are required to be protected in accordance with Section 704, a skylight shall not be installed within 6 feet (1829 mm) of such exterior wall.

2610.8 Combinations of roof panels and skylights. Combinations of light-transmitting plastic roof panels and skylights shall be subject to the area and percentage limitations and separation requirements applicable to roof panel installations.

**SECTION 2611
LIGHT-TRANSMITTING PLASTIC INTERIOR SIGNS**

2611.1 General. Light-transmitting plastic interior wall signs shall be limited as specified in Sections 2611.2 through 2611.4. Light-transmitting plastic interior wall signs in covered mall buildings shall comply with Section 402.14. Light-transmitting plastic interior signs shall also comply with Section 2606.

2611.2 Aggregate area. The sign shall not exceed 20 percent of the wall area.

2611.3 Maximum area. The sign shall not exceed 24 square feet (2.23 m²).

2611.4 Encasement. Edges and backs of the sign shall be fully encased in metal.

CHAPTER 27

ELECTRICAL

SECTION 2701 GENERAL

2701.1 Scope. This chapter governs the electrical components, equipment and systems used in buildings and structures covered by this code. Electrical components, equipment and systems shall be designed and constructed in accordance with the provisions of the ICC *Electrical Code*.

Note: As defined in s. Comm 62.0202 (1) (c), "ICC Electrical Code" means ch. Comm 16.

[F] SECTION 2702 EMERGENCY AND STANDBY POWER SYSTEMS

2702.1 Installation. Emergency and standby power systems shall be installed in accordance with the ICC *Electrical Code*, NFPA 110 and NFPA 111.

2702.2 Where required. Emergency and standby power systems shall be provided where required by Sections 2702.2.1 through 2702.2.19.

2702.2.1 Group A occupancies. Emergency power shall be provided for voice communication systems in Group A occupancies in accordance with Section 907.2.1.2.

2702.2.2 Smoke control systems. Standby power shall be provided for smoke control systems in accordance with Section 909.11.

2702.2.3 Exit signs. Emergency power shall be provided for exit signs in accordance with Section 1003.2.10.5.

2702.2.4 Means of egress illumination. Emergency power shall be provided for means of egress illumination in accordance with Section 1003.2.11.2.

2702.2.5 Accessible means of egress elevators. Standby power shall be provided for elevators that are part of an accessible means of egress in accordance with Section 1003.2.13.3.

2702.2.6 Horizontal sliding doors. Standby power shall be provided for horizontal sliding doors in accordance with Section 1003.3.1.3.3.

2702.2.7 Semiconductor fabrication facilities. Emergency power shall be provided for semiconductor fabrication facilities in accordance with Section 415.9.10.

2702.2.8 Membrane structures. Standby power shall be provided for auxiliary inflation systems in accordance with Section 3102.8.2. Emergency power shall be provided for exit signs in temporary tents and membrane structures in accordance with the *International Fire Code*.

2702.2.9 Hazardous materials. Emergency or standby power shall be provided in occupancies with hazardous materials in accordance with Section 414.5.4.

2702.2.10 Highly toxic and toxic materials. Emergency power shall be provided for occupancies with highly toxic or

toxic materials in accordance with the *International Fire Code*.

2702.2.11 Organic peroxides. Standby power shall be provided for occupancies with silane gas in accordance with the *International Fire Code*.

2702.2.12 Pyrophoric materials. Emergency power shall be provided for occupancies with silane gas in accordance with the *International Fire Code*.

2702.2.13 Covered mall buildings. Covered mall buildings exceeding 50,000 square feet (4645 m²) shall be provided with standby power systems which are capable of operating the emergency voice/alarm communication.

2702.2.14 High-rise buildings. Emergency and standby power shall be provided in high-rise buildings in accordance with Chapter 27 and for the items listed below:

1. Fire command center.
2. Fire pumps.
3. Emergency voice/alarm communication systems.
4. Lighting for mechanical equipment rooms.
5. Elevators.

2702.2.15 Underground buildings. Emergency and standby power shall be provided in underground buildings in accordance with Sections 405.9 and 405.10.

2702.2.16 Group I-3 occupancies. Emergency power shall be provided for doors in Group I-3 occupancies in accordance with Section 408.4.2.

2702.2.17 Airport traffic control towers. Standby power shall be provided in airport traffic control towers in accordance with Section 412.1.5.

2702.2.18 Elevators. Standby power for elevators shall be provided as set forth in Section 3003.1.

2702.2.19 Smokeproof enclosures. Standby power shall be provided for smokeproof enclosures as required by Section 909.20.

2702.3 Maintenance. Emergency and standby power systems shall be maintained and tested in accordance with the *International Fire Code*.

CHAPTER 28

MECHANICAL SYSTEMS

SECTION 2801 GENERAL

2801.1 Scope. Mechanical appliances, equipment and systems shall be constructed, installed and maintained in accordance with the *International Mechanical Code* and the *International Fuel Gas Code*. Masonry chimneys, fireplaces and barbecues shall comply with the *International Mechanical Code* and Chapter 21 of this code.

CHAPTER 29

PLUMBING SYSTEMS

SECTION 2901 GENERAL

2901.1 Scope. The provisions of this chapter and the *International Plumbing Code* shall govern the erection, installation, alteration, repairs, relocation, replacement addition to, use or maintenance of plumbing equipment and systems. Plumbing systems and equipment shall be constructed, installed and maintained in accordance with the *International Plumbing Code*. Private sewage disposal systems shall conform to the *International Private Sewage Disposal Code*.

Note: As defined in s. Comm 62.0202 (1) (h) and (i), "IPC and International Plumbing Code" and "IPSDC and International Private Sewage Disposal Code" mean chs. Comm 81 to 87.

Comm 62.2900 Additional criteria for toilets.

- (1) **Maintenance.** Every toilet room and every part thereof shall be kept clean and in good repair.
- (2) **Service sink.** In every building where a service sink is required by IBC Table 2902.1, the service sink shall be located in a service closet or room that is provided with the supplies necessary for the sanitary upkeep of the toilet rooms.
- (3) **Permanent and portable outdoor toilets.**
 - (a) **General.** Where local conditions or situations make it impractical to install a private onsite wastewater treatment system, permanent or portable outdoor toilets, or other sanitation systems or devices as described in ch. Comm 91, may be used, except as specified in par. (b).

Note: See ch. Comm 83 for detailed requirements for private onsite wastewater treatment systems.

- (b) **Exception:** For places of employment for more than 10 persons, schools larger than two rooms, and apartment houses, water-flush toilets shall be provided, unless outdoor toilets or other sanitation systems or devices are permitted in writing by the department.
- (c) **Permanent outdoor toilets.** Permanent outdoor toilets, consisting of composting toilet systems, incinerating toilets, or privies shall comply with ch. Comm 91, s. Comm 62.1209, and this section.
 1. A permanent outdoor toilet shall be provided with a suitable approach, such as a concrete, gravel, or cinder walk.
 2. All windows, ventilators, and other openings for permanent outdoor toilets shall be screened to prevent the entrance of flies, and all doors shall be self-closing.
- (d) **Portable outdoor toilets.**
 1. No portable outdoor toilet may be erected or maintained within 50 feet (15 240 mm) of any well; within 10 feet (3048 mm) of the line of any street or public thoroughfare, un-

less vehicular traffic has been detoured while the portable toilet is in use; within 5 feet (1524 mm) of the property line between premises; or within 25 feet (7620 mm) of a door, window, or other outdoor opening of any building.

2. A portable outdoor toilet shall be stabilized to prevent it from tipping over.
3. A portable outdoor toilet shall be located with an approach such that access is unobstructed and free of brush, debris, and standing water.

Note: Chapter Comm 91 contains requirements for storage chambers of portable toilets.

Note: Chapters NR 113 and NR 114 contain requirements for servicing portable toilets.

(4) Enclosure of fixtures.

- (a) Water closets and urinals within a toilet room shall be arranged to ensure privacy. Except as provided in par. (b), each water closet shall occupy a separate compartment, with walls or partitions and a door enclosing the fixtures to ensure privacy. Urinals shall be placed against walls at least 6 feet 8 inches (2032 mm) high and arranged individually with or without partitions.
- (b)
 1. Water closet compartments may be omitted in a single-occupant toilet room having a door with a privacy lock.
 2. Toilet rooms located in day-care and child-care facilities and containing two or more water closets may have one water closet without an enclosing compartment.

[P] SECTION 2902 MINIMUM PLUMBING FACILITIES

2902.1 Minimum number of fixtures. Plumbing fixtures shall be provided for the type of occupancy and in the minimum number shown in Table 2902.1 Types of occupancies not shown in Table 2902.1 shall be considered individually by the building official. The number of occupants shall be determined by this code. Occupancy classification shall be determined in accordance with Chapter 3.

Comm 62.2902 (1) Exception: Where more than one water closet is required for males, urinals may be substituted for up to 50 percent of the required number of water closets.

Note: Additional plumbing fixtures may be required for employees by the U.S. Department of Labor, occupational safety and health act (OSHA) regulations.

Note: Additional plumbing fixtures may be required by the Wisconsin Department of Health and Family Services for restaurants, mobile home parks, camping grounds, camping resorts, recreational camps and educational camps.

Note: Chapter Comm 90 also has requirements for minimum numbers of sanitary fixtures for a public swimming pool, as based on the pool area. For some buildings, the minimum number of sanitary fixtures determined in that manner may be larger than the minimum number determined in accordance with this section. Compliance with this section does not relieve an owner from complying with ch. Comm 90.

Comm 62.2902 (2) Lavatories for toilet rooms. At least one lavatory shall be provided in each toilet room or in a gender-designated lounge adjacent to the toilet room. If a multiple-use lavatory is provided, 24 lineal inches (610 mm) of wash sink, or 20 inches (508 mm) measured along the edge of a circular basin will be considered equivalent to one lavatory.

2902.2 [Comm 62.2902 (3)] Separate facilities. Where plumbing fixtures are required, separate facilities shall be provided for each sex. Toilet rooms shall be designated by legible signs.

Exceptions:

1. Separate facilities shall not be required for private facilities.
2. Separate employee facilities shall not be required in occupancies in which 15 or fewer people are employed.
3. Separate facilities shall not be required in structures or tenant spaces with a total occupant load, including both employees and customers, of 15 or less.

Note: Additional plumbing fixtures may be required by the Wisconsin Department of Health and Family Services for restaurants, mobile home parks, camping grounds, camping resorts, recreational camps and educational camps. [Comm 62.2902 (1) (b)]

Note: Chapter Comm 90 also has requirements for minimum numbers of sanitary fixtures for a public swimming pool, as based on the pool area. For some buildings, the minimum number of sanitary fixtures determined in that manner may be larger than the minimum number determined in accordance with this section. Compliance with this section does not relieve an owner from complying with ch. Comm 90. [Comm 62.2902 (1) (b)]

2902.3 Number of occupants of each sex. The required water closets, lavatories, and showers or bathtubs shall be distributed equally between the sexes based on the percentage of each sex anticipated in the occupant load. The occupant load shall be composed of 50 percent of each sex, unless statistical data approved by the code official indicate a different distribution of the sexes.

2902.4 Location of employee toilet facilities in occupancies other than assembly or mercantile. Access to toilet facilities in occupancies other than mercantile and assembly occupancies shall be from within the employees' working area. Employee facilities shall be either separate facilities or combined employee and public facilities.

Exception: Facilities that are required for employees in storage structures or kiosks, and are located in adjacent structures under the same ownership, lease or control, shall be a maximum travel distance of 500 feet (152 m) from the employees' regular working area.

2902.4.1 Travel distance. The required toilet facilities in occupancies other than assembly or mercantile shall be located not more than one story above or below the employee's working area and the path of travel to such facilities shall not exceed a distance of 500 feet (152 m).

Exception: The location and maximum travel distances to the required employee toilet facilities in factory and industrial occupancies are permitted to exceed that required in Section 2902.4.1, provided the location and maximum travel distances are approved by the code official.

2902.5 Location of employee toilet facilities in mercantile and assembly occupancies. Employees shall be provided with toilet facilities in buildings and tenant spaces utilized as restaurants, nightclubs, places of public assembly and mercantile occupancies. The employee facilities shall be either separate facilities or combined employee and public customer facilities. The required toilet facilities shall be located not more than one story above or below the employee's regular work area and the path of travel to such facilities, in other than covered malls, shall not exceed a distance of 500 feet (152 m). The path of travel to required facilities in covered malls shall not exceed a distance of 300 feet (91 440 mm).

Exception: Employee toilet facilities shall not be required in tenant spaces where the travel distance from the main entrance of the tenant space to a central toilet area does not exceed 300 feet (91 440 mm) and such central toilet facilities are located not more than one story above or below the tenant space.

2902.6 Public facilities. Customers, patrons and visitors shall be provided with public toilet facilities in structures and tenant spaces intended for public utilization. Public toilet facilities shall be located not more than one story above or below the space required to be provided with public toilet facilities and the path of travel to such facilities shall not exceed a distance of 500 feet (152 m).

Comm 62.2902 (4) Alternative public facilities. Toilet rooms may be omitted in a small retail or mercantile building where all of the following requirements are met:

- (a) No more than 25 occupants are accommodated.
- (b) Other restrooms are conveniently located and available to the patrons and employees during all hours of operation.
- (c) The omission is approved in writing by the local unit of government.
- (d) A copy of the written approval from the local unit of government is provided to the department or its authorized representative upon request.

Comm 62.2902 (5) Note: Additional location requirements for restaurant toilet rooms may be applied by the Wisconsin Department of Health and Family Services.

Comm 62.2902 (6) Mercantile toilet rooms. Toilet rooms for customers in business and mercantile occupancies shall be directly accessible to the customers, rather than accessible through employee work areas.

2902.6.1 Covered malls. In covered mall buildings, the path of travel to required toilet facilities shall not exceed a distance of 300 feet (91 440 mm). The required facilities shall be based on total square footage, and facilities shall be installed in each individual store or in a central toilet area located in accordance with this section. The maximum travel distance to the central toilet facilities in covered mall buildings shall be measured from the main entrance of any store or tenant space.

2902.6.2 [Comm 62.2902 (7)] Pay facilities. All toilet facilities shall be free of charge.

Comm 62.2902(7) Note: Section 146.085, Wisconsin Stats., prohibits charging a fee for the use of toilet facilities and imposes a fine of \$10 to \$50 for violations.

TABLE 2902.1
MINIMUM NUMBER OF PLUMBING FACILITIES^a

OCCUPANCY	WATER CLOSETS [see s. Comm 62.2902 (1) for urinals]		LAVATORIES	BATHTUBS/ SHOWERS	DRINKING FOUNTAINS (see the <i>International Plumbing Code</i>)	OTHERS	
	Male	Female					
Nightclubs	1 per 40	1 per 40	1 per 75	—	1 per 500	1 service sink	
Restaurants	1 per 75	1 per 75	1 per 200	—	1 per 500	1 service sink	
Theaters, halls, museums, etc.	1 per 125	1 per 65	1 per 200	—	1 per 500	1 service sink	
Coliseums, arenas (less than 3,000 seats)	1 per 75	1 per 40	1 per 150	—	1 per 1,000	1 service sink	
A S S E M B L Y	Coliseums, arenas (3,000 seats or greater)	1 per 120	Male 1 per 200 Female 1 per 150	—	1 per 1,000	1 service sink	
	Churches ^b	1 per 150	1 per 75	1 per 200	—	1 per 1,000	1 service sink
	Stadiums (less than 3,000 seats), pools, etc.	1 per 100	1 per 50	1 per 150	—	1 per 1,000	1 service sink
	Stadiums (3,000 seats or greater)	1 per 150	1 per 75	Male 1 per 200 Female 1 per 150	—	1 per 1,000	1 service sink
	Mercantile (see Sections 2902.2, 2902.5, 2902.6)	1 per 500		1 per 750	—	1 per 1,000	1 service sink
	Business (see Sections 2902.2, 2902.4, 2902.4.1)	1 per 50		1 per 80	—	1 per 100	1 service sink
	Educational	1 per 50		1 per 50	—	1 per 100	1 service sink
Factory and industrial	1 per 100		1 per 100	See the <i>International Plumbing Code</i>	1 per 400	1 service sink	
Passenger terminals and transportation facilities	1 per 500		1 per 750	—	1 per 1,000	1 service sink	

(continued)

TABLE 2902.1—continued
MINIMUM NUMBER OF PLUMBING FACILITIES^a

OCCUPANCY		WATER CLOSETS [see s. Comm 62.2902 (1) for urinals]		LAVATORIES	BATHTUBS/ SHOWERS	DRINKING FOUNTAINS (see the <i>International Plumbing Code</i>)	OTHERS
		Male	Female				
I N S T I T U T I O N A L	Residential care	1 per 10		1 per 10	1 per 8	1 per 100	1 service sink
	Hospitals, ambulatory nursing patients ^c	1 per room ^d		1 per room ^d	1 per 15	1 per 100	1 service sink per floor
	Day nurseries, sanitariums, non-ambulatory nursing home patients, etc. ^c	1 per 15		1 per 15	1 per 15 ^e	1 per 100	1 service sink
	Employees, other than residential care ^c	1 per 25		1 per 35	—	1 per 100	—
	Visitors, other than residential care	1 per 75		1 per 100	—	1 per 500	—
	Prisons ^c	1 per cell		1 per cell	1 per 15	1 per 100	1 service sink
	Asylums, reformatories, etc. ^c	1 per 15		1 per 15	1 per 15	1 per 100	1 service sink
R E S I D E N T I A L	Hotels, motels	1 per guestroom		1 per guestroom	1 per guestroom	—	1 service sink
	Lodges	1 per 10		1 per 10	1 per 8	1 per 100	1 service sink
	Multiple Family	1 per dwelling unit		1 per dwelling unit	1 per dwelling unit	—	1 kitchen sink per dwelling unit; 1 automatic clothes washer connection per 20 dwelling units
	Dormitories	1 per 10		1 per 10	1 per 8	1 per 100	1 service sink
	One- and two-family dwellings	1 per dwelling unit		1 per dwelling unit	1 per dwelling unit	—	1 kitchen sink per dwelling unit; 1 automatic clothes washer connection per dwelling unit ^f
Storage (See Sections 2902.2 and 2902.4)		1 per 100		1 per 100	See the <i>International Plumbing Code</i>	1 per 1,000	1 service sink

- a. The fixtures shown are based on one fixture being the minimum required for the number of persons indicated or any fraction of the number of persons indicated. The number of occupants shall be determined by this code.
- b. Fixtures located in adjacent buildings under the ownership or control of the church shall be made available during periods the church is occupied.
- c. Toilet facilities for employees shall be separate from facilities for inmates or patients.
- d. A single-occupant toilet room with one water closet and one lavatory serving not more than two adjacent patient rooms shall be permitted where such room is provided with direct access from each patient room and with provisions for privacy.
- e. For day nurseries, a maximum of one bathtub shall be required.
- f. For attached one- and two-family dwellings, one automatic clothes washer connection shall be required per 20 dwelling units.